PST20 Protocol

CAN Interface

Former Version Record:
Version Number: 1.2
Author: LZ
Date: 2014-07-03

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Version Number: 1.3
Author: LZ
Date: 2014-07-17

PST20 CAN Protocol

In a CAN network, other devices can read and configure PST20 CAN interface inclinometer. PST20 supports CAN2.0A (standard frame format) and CAN2.0B (extended frame format), it can self-adjustable to standard or extended frame format.

The user can set the inclinometer to different working modes: angle continuous output mode, angle request output mode, and parameters setting mode. In angle continuous output mode, the sensor outputs X and Y axis angle data automatically after power on. In angle request output mode, the sensor will not output angle data unless an user request. In parameters setting mode, the user can set configuration parameters. The user can set configuration parameters in angle continuous output mode and angle request output mode.

PST20 default communication parameters:

Form 1. PST20 default communication parameters

Items	Default value
CAN baudrate	125Kbps
Frame type	Self-adjustable to Standard or Extended Frame Type
Request frame ID	0x300 (CAN2.0A/B)
Response frame ID	0x301 (CAN2.0A/B)
Synchronous frame ID	0x100 (CAN2.0A/B)
DLC	8 Bytes

1 CAN Communication Frame Format

When PST20 communicate with other devices on a CAN bus, all the Request Frame & Response Frame & Synchronous Frame are 8 bytes, and all the frames contain Function Chose Code (FSC, 1byte) and message data (7 bytes). Each FSC defines an action of the sensor.

PST20 general frame format is as below:

Form 2. General Frame Format

Each Frame							
FSC	Status/ Ms0	Ms1	Ms2	Ms3	Ms4	Ms5	Ms6
7 Byte0 0	15 Byte1 8	23 Byte2 16	31 Byte3 24	39 Byte4 32	47 Byte5 40	55 Byte6 48	63 Byte7 56

When another device is sending a request, the request frame should include: FSC, Ms0, Ms1, Ms2, Ms3, Ms4, Ms5, Ms6.

When PST20 is responding, the response frame will include: FSC, Status, Ms1, Ms2, Ms3, Ms4, Ms5, Ms6.

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1.1 Status Definition

Form 3. Status Structure

Status							
xAngle	yAngle	EEPROM	CMD	Default	Mode	Reserved	Reserved
bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0

xAngle: bit 7=1, X axis angle exceeds measurement range.

bit 7=0, X axis angle in measurement range.

yAngle: bit 6=1, Y axis angle exceeds measurement range.

bit 6=0, Y axis angle in measurement range.

EEPROM: bit 5=1, Parameter read or write error.

bit 5=0, Parameters read or write succeed.

CMD: bit 4=1, Command format invalid.

bit 4=0, Command format valid.

Default: bit 3=1, Default configuration parameters have been modified.

bit 3=0, Sensor with default configuration parameters.

Note: Sensor default configuration parameters include Request frame ID, Response frame ID, Synchronous frame ID, Filtering parameter, Update rate, Offset, CAN baudrate.

Mode: bit 2=1, Sensor in continuous working mode.

bit 2=0, Sensor in request & response working mode.

Reserve: bit 1=0, Reserved.

Reserve: bit 0=0, Reserved.

1.2 Boot-Up Frame

When PST20 power on or reset, it will output two boot-up frame: one standard frame (CAN 2.0A) and one extended frame (CAN 2.0B). The boot-up frame include: FSC, Status, Request frame ID, Software version.

Boot-Up frame format (Frame ID: 0x301):

Form 4. Boot-up Frame Structure

Boot-up Frame							
7 FSC 0	15 Status 8	23 RID0 16	31 RID1 24	39 RID2 32	47 RID3 40	55 SW0 48	63 SW1 56
0xFF	1 Byte	4 Byte				2 Byte	

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FSC: Function Chose Code, Boot-up frame FSC is 0xFF.

Status: Sensor status, 1byte.

RID0～RID3: Request frame ID, low byte first.

SW0～SW1: Software version.

Note: User can get sensor's Request Frame ID in Boot-up Frame.

1.3 Angle Request Output Mode

If PST20 works in angle request output mode, it won't output any data automatic except the boot-up frame data unless other device requests.

1) Request X axis real time angle data: (Default Request Frame ID 300h)

Form 5. Request Frame — X axis real time angle data request

Request Frame							
FSC (7 0)	Ms0 (15 8)	Ms1 (23 16)	Ms2 (31 24)	Ms3 (39 32)	Ms4 (47 40)	Ms5 (55 48)	Ms6 (63 56)
0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00

2) Request Y axis real time angle data: (Default Request Frame ID 300h)

Form 6. Request Frame — Y axis real time angle data request

Request Frame							
FSC (7 0)	Ms0 (15 8)	Ms1 (23 16)	Ms2 (31 24)	Ms3 (39 32)	Ms4 (47 40)	Ms5 (55 48)	Ms6 (63 56)
0x01	0x00	0x00	0x00	0x00	0x00	0x00	0x00

3) Response frame of the X axis real time angle data request: (Default Response Frame ID 301h)

Form 7. Response Frame — X axis real time angle data request

Response Frame							
FSC	Status	X axis angle data				Reserved	
(7 0) 0x00	(15 8) 1 Byte	(23 16) Byte0	(31 24) Byte1	(39 32) Byte2	(47 40) Byte3	(55 48) 0x00	(63 56) 0x00

Note: When request X axis real time angle data, the FSC of the response frame is equals to FSC of request frame, 0x00. The X axis angle data in the response frame is 32 bits float, low byte first, unit is degree.

4) Response frame of the Y axis real time angle data request: (Default Response Frame ID 301h)

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Form 8. Response Frame — Y axis real time angle data request

Response Frame							
FSC	Status	Y axis angle data				Reserved	
0x01	1 Byte	Byte0	Byte1	Byte2	Byte3	0x00	0x00
7 0	15 8	23 16	31 24	39 32	47 40	55 48	63 56

Note: When request Y axis real time angle data, the FSC of the response frame is equals to FSC of request frame, 0x01. The Y axis angle data in the response frame is 32 bits float, low byte first, unit is degree.

1.4 Angle Continuous Output Mode

If PST20 works in Angle Continuous Output Mode, it will output two frames of boot-up frames when power on or reset, and after the boot-up frames, sensor will output angle data automatic.

Note: For dual axis sensor, it outputs angle data of two axis in the cycle of "X→ Y → X → Y …",and the transmit period is from X axis angle data start to transmit to Y axis angle data finish transmit. For single axis sensor, it outputs angle data only with X axis.

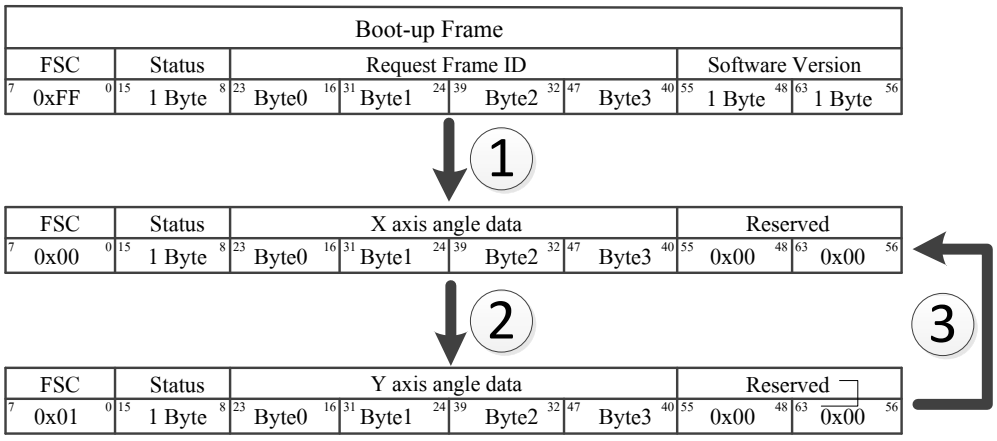

Figure 1. Output cycle in Angle Continuous Output Mode

1.5 Parameters Setting Mode

The Parameters Setting Mode is not a real working mode. In fact, this mode means that user can set or read configuration parameters freely. Every setting or reading function has a unique FSC, and the FSC in response frame is equals to FSC in request frame.

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(1) Read X axis offset

Request Frame							
FSC 7 0	Ms0 15 8	Ms1 23 16	Ms2 31 24	Ms3 39 32	Ms4 47 40	Ms5 55 48	Ms6 63 56
0x04	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Response Frame							
FSC	Status	X axis offset				Reserved	
7 0x04 0	15 1 Byte 8	23 Byte0 16	31 Byte1 24	39 Byte2 32	47 Byte3 40	55 0x00 48	63 0x00 56

Note: X axis offset data is 32 bits float, low byte first, unit is degree.

(2) Read Y axis offset

Request Frame							
FSC 7 0	Ms0 15 8	Ms1 23 16	Ms2 31 24	Ms3 39 32	Ms4 47 40	Ms5 55 48	Ms6 63 56
0x05	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Response Frame							
FSC	Status	Y axis offset				Reserved	
7 0x05 0	15 1 Byte 8	23 Byte0 16	31 Byte1 24	39 Byte2 32	47 Byte3 40	55 0x00 48	63 0x00 56

Note: Y axis offset data is 32 bits float, low byte first, unit is degree.

(3) Read request frame ID

Request Frame							
FSC 7 0	Ms0 15 8	Ms1 23 16	Ms2 31 24	Ms3 39 32	Ms4 47 40	Ms5 55 48	Ms6 63 56
0x06	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Response Frame							
FSC	Status	Request frame ID				Reserved	
7 0x06 0	15 1 Byte 8	23 ID0 16	31 ID1 24	39 ID2 32	47 ID3 40	55 0x00 48	63 0x00 56

Note: Request frame ID is 4 bytes, low byte first. PST20 can self-adjust to standard frame type or extended frame type, so the following 3 things should be cared,

a) When setting request frame in standard frame type, the ID can't exceed 0x7FF.

b) When setting request frame in extended frame type, the ID can't exceed 0x1FFFFFFF.

c) After modified the request frame ID in a pointed type, request frame and response frame should be in the correct frame format.

If sensor's response frame ID is not the ID that user set, please check the communication frame type.

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(4) Read response frame ID

Request Frame							
7 FSC 0	15 Ms0 8	23 Ms1 16	31 Ms2 24	39 Ms3 32	47 Ms4 40	55 Ms5 48	63 Ms6 56
0x07	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Response Frame							
FSC	Status	Response frame ID				Reserved	
7 0x07 0	15 1 Byte 8	23 ID0 16	31 ID1 24	39 ID2 32	47 ID3 40	55 0x00 48	63 0x00 56

Note: Response frame ID is 4 bytes, low byte first. PST20 can self-adjust to standard frame type or extended frame type, so the following 3 things should be cared,

a) When setting request frame in standard frame type, the ID can't exceed 0x7FF.

b) When setting request frame in extended frame type, the ID can't exceed 0x1FFFFFFF.

c) After modified the response frame ID in a pointed type, request frame and response frame should be in the correct frame format.

(5) Read Synchronous frame ID

Request Frame							
7 FSC 0	15 Ms0 8	23 Ms1 16	31 Ms2 24	39 Ms3 32	47 Ms4 40	55 Ms5 48	63 Ms6 56
0x08	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Response Frame							
FSC	Status	Synchronous frame ID				Reserved	
7 0x08 0	15 1 Byte 8	23 ID0 16	31 ID1 24	39 ID2 32	47 ID3 40	55 0x00 48	63 0x00 56

Note: Synchronous frame ID is 4 bytes, low byte first. If a CAN bus with more than one sensor on it, user can use synchronous frame to request all the sensors, CAN master can send broadcast message via synchronous frame.

(6) Read CAN baudrate

Request Frame							
7 FSC 0	15 Ms0 8	23 Ms1 16	31 Ms2 24	39 Ms3 32	47 Ms4 40	55 Ms5 48	63 Ms6 56
0x09	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Response Frame							
FSC	Status	Baudrate	Reserved				
7 0x09 0	15 1 Byte 8	23 BR 16	31 0x00 24	39 0x00 32	47 0x00 40	55 0x00 48	63 0x00 56

Note: PST20 CAN interface inclinometer has a default CAN baudrate 125kbps, and the 125kbps

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baudrate matchup a BR code 0x04. Each available baudrate has a matchup BR code:

BR	→	Baudrate
0x01	→	40Kbps
0x02	→	50Kbps
0x03	→	100Kbps
0x04	→	125Kbps
0x05	→	250Kbps
0x06	→	500Kbps
0x07	→	1000Kbps

(7) Read filtering parameter

Request Frame							
FSC (7–0)	Ms0 (15–8)	Ms1 (23–16)	Ms2 (31–24)	Ms3 (39–32)	Ms4 (47–40)	Ms5 (55–48)	Ms6 (63–56)
0x0A	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Response Frame							
FSC	Status	Filtering parameter		Reserved			
7 0x0A 0	15 1 Byte 8	23 FIL0 16	31 FIL1 24	39 0x00 32	47 0x00 40	55 0x00 48	63 0x00 56

Note: The filtering parameter is a 2 bytes unsigned integer, low byte first. Default filtering parameter is 0x00C8. The filtering parameter has relationship with the output angle ripple and the response time of the sensor. Bigger filtering parameter, more quick response and bigger ripple. Smaller filtering parameter, slower response and smaller ripple.

(8) Read angle update rate and output mode

Request Frame							
FSC (7–0)	Ms0 (15–8)	Ms1 (23–16)	Ms2 (31–24)	Ms3 (39–32)	Ms4 (47–40)	Ms5 (55–48)	Ms6 (63–56)
0x0B	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Response Frame							
FSC	Status	Output mode	Update rate	Reserved			
7 0x0B 0	15 1 Byte 8	23 CYM 16	31 CYT 24	39 0x00 32	47 0x00 40	55 0x00 48	63 0x00 56

Note: CYM represents working mode, CYT represents update rate. If CYM equals to 0x01, it represents that the sensor works in angle continuous output mode; if CYM equals to 0x00, it represents that the sensor works in angle request output mode. CYT is the update rate in HEX. When modify the working mode(CYM), the right update rate is required(CYT).

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(9) Set current X axis angle as zero point

Request Frame							
FSC	Ms0	Ms1	Ms2	Ms3	Ms4	Ms5	Ms6
0x0C	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Response Frame							
FSC	Status	X axis offset				Reserved	
0x0C	1 Byte	ZER0	ZER1	ZER2	ZER3	0x00	0x00

Note: When use this command to set current X axis angle as zero point, the X axis current angle will add to the offset, and sensor response to output X axis offset.

(10) Set current Y axis angle as zero point

Request Frame							
FSC	Ms0	Ms1	Ms2	Ms3	Ms4	Ms5	Ms6
0x0D	0x00	0x00	0x00	0x00	0x00	0x00	0x00

Response Frame							
FSC	Status	Y axis offset				Reserved	
0x0D	1 Byte	ZER0	ZER1	ZER2	ZER3	0x00	0x00

Note: When use this command to set current Y axis angle as zero point, the Y axis current angle will add to the offset, and sensor response to output Y axis offset.

(11) Set request frame ID

Request Frame							
FSC	Request frame ID				Ms4	Ms5	Ms6
0x0F	ID0	ID1	ID2	ID3	0x00	0x00	0x00

Response Frame							
FSC	Status	Request Frame ID				Reserved	
0x0F	1 Byte	ID0	ID1	ID2	ID3	0x00	0x00

Note: Request frame ID is 4 bytes, low byte first. PST20 can self-adjust to standard frame type or extended frame type, so the following 3 things should be cared,

a) When setting request frame in standard frame type, the ID can't exceed 0x7FF.

b) When setting request frame in extended frame type, the ID can't exceed 0x1FFFFFFF.

c) After modified the request frame ID in a pointed type, request frame and response frame should be in the correct frame format.

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Once the request frame ID has been modified, sensor need to be re-power on or reset by command, new request communication should to use new request frame ID.

（12）Set response frame ID

Request Frame															
FSC		Response Frame ID						Ms4		Ms5		Ms6			
7 0x10 0	15 ID0 8	23 ID1 16	31 ID2 24	39 ID3 32	47 0x00 40	55 0x00 48	63 0x00 56

Response Frame															
FSC		Status		Response Frame ID						Reserved					
7 0x10 0	15 1 Byte 8	23 ID0 16	31 ID1 24	39 ID2 32	47 ID3 40	55 0x00 48	63 0x00 56

Note: Response frame ID is 4 bytes, low byte first. PST20 can self-adjust to standard frame type or extended frame type, so the following 3 things should be cared,

a) When setting request frame in standard frame type, the ID can't exceed 0x7FF.

b) When setting request frame in extended frame type, the ID can't exceed 0x1FFFFFFF.

c) After modified the response frame ID in a pointed type, request frame and response frame should be in the correct frame format.

（13）Set synchronous frame ID

Request Frame															
FSC		Synchronous Frame ID						Ms4		Ms5		Ms6			
7 0x11 0	15 ID0 8	23 ID1 16	31 ID2 24	39 ID3 32	47 0x00 40	55 0x00 48	63 0x00 56

Response Frame															
FSC		Status		Synchronous Frame ID						Reserved					
7 0x11 0	15 1 Byte 8	23 ID0 16	31 ID1 24	39 ID2 32	47 ID3 40	55 0x00 48	63 0x00 56

Note: Synchronous frame ID is 4 bytes, low byte first. Once the synchronous frame ID has been modified, sensor need to be re-power on or reset by command.

（14）Set CAN baudrate

Request Frame															
FSC		Ms1		Ms2		Ms3		Ms4		Ms5		Ms6			
7 0x12 0	15 BR 8	23 0x00 16	31 0x00 24	39 0x00 32	47 0x00 40	55 0x00 48	63 0x00 56

Response Frame															
FSC		Status		Baudrate		Reserved									
7 0x12 0	15 1 Byte 8	23 BR 16	31 0x00 24	39 0x00 32	47 0x00 40	55 0x00 48	63 0x00 56

Note: PST20 CAN interface inclinometer has a default CAN baudrate 125kbps, and the 125kbps

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baudrate matchup a BR code 0x04. Each available baudrate has a matchup BR code:

BR	→	Baudrate
0x01	→	40Kbps
0x02	→	50Kbps
0x03	→	100Kbps
0x04	→	125Kbps
0x05	→	250Kbps
0x06	→	500Kbps
0x07	→	1000Kbps

Once the CAN baudrate has been modified, sensor need to be re-power on or reset by command.

(15) Set update rate and angle output mode

Request Frame							
FSC	Output mode	Update rate	Ms2	Ms3	Ms4	Ms5	Ms6
7 0x13 0	15 CYM 8	23 CYT 16	31 0x00 24	39 0x00 32	47 0x00 40	55 0x00 48	63 0x00 56

Response Frame							
FSC	Status	Output mode	Update rate	Reserve			
7 0x13 0	15 1 Byte 8	23 1 Byte 16	31 1 Byte 24	39 0x00 32	47 0x00 40	55 0x00 48	63 0x00 56

Note: CYM represents working mode, CYT represents update rate. If CYM equals to 0x01, it represents that the sensor works in angle continuous output mode; if CYM equals to 0x00, it represents that the sensor works in angle request output mode. CYT is the update rate in HEX. When modify the working mode(CYM), the right update rate is required(CYT).

The available update rates are: 1Hz (0x01 in HEX), 3Hz (0x03 in HEX), 5Hz (0x05 in HEX), 10Hz (0x0A in HEX), 20Hz (0x14 in HEX) and 50Hz (0x32 in HEX).

(16) Sensor reset

Request Frame							
FSC	"R"	"E"	"S"	"E"	"T"	Ms5	Ms6
7 0x14 0	15 0x52 8	23 0x45 16	31 0x53 24	39 0x45 32	47 0x54 40	55 0x00 48	63 0x00 56

(17) Set filtering parameter

Request Frame						
FSC	Filtering parameter		Ms2	Ms3	Ms4	Ms5	Ms6
7 0x15 0	15 FIL0 8	23 FIL1 16	31 0x00 24	39 0x00 32	47 0x00 40	55 0x00 48	63 0x00 56

Response Frame							
FSC	Status	Filtering parameter		Reserved			
7 0x15 0	15 1 Byte 8	23 FIL0 16	31 FIL1 24	39 0x00 32	47 0x00 40	55 0x00 48	63 0x00 56

Note: The filtering parameter is a 2 bytes unsigned integer, low byte first. Default filtering parameter is 0x00C8. The filtering parameter has relationship with the output angle ripple and the response time of

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the sensor. Bigger filtering parameter, more quick response and bigger ripple. Smaller filtering parameter, slower response and smaller ripple.

The available filtering parameter setting range is from 0x0000 to 0xFFFF. Once the filtering parameter has been modified, sensor need to be re-power on or reset.

(18) Set X axis offset

Request Frame							
FSC	X axis offset				Ms4	Ms5	Ms6
0x16	ZER0	ZER1	ZER2	ZER3	0x00	0x00	0x00
7 0	15 8	23 16	31 24	39 32	47 40	55 48	63 56

Response Frame							
FSC	Status	X axis offset				Reserved	
0x16	1 Byte	ZER0	ZER1	ZER2	ZER3	0x00	0x00
7 0	15 8	23 16	31 24	39 32	47 40	55 48	63 56

Note: The offset value is 32 bits float, low byte first, unit is degree.

(19) Set Y axis offset

Request Frame							
FSC	Y axis offset				Ms4	Ms5	Ms6
0x17	ZER0	ZER1	ZER2	ZER3	0x00	0x00	0x00
7 0	15 8	23 16	31 24	39 32	47 40	55 48	63 56

Response Frame							
FSC	Status	Y axis offset				Reserved	
0x17	1 Byte	ZER0	ZER1	ZER2	ZER3	0x00	0x00
7 0	15 8	23 16	31 24	39 32	47 40	55 48	63 56

Note: The offset value is 32 bits float, low byte first, unit is degree.

(20) Restore parameters

Request Frame							
FSC	BW_Flag	UPT_Flag	ZERX_Flag	ZERY_Flag	FIL_Flag	Ms5	Ms6
0x0E	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	0x00	0x00
7 0	15 8	23 16	31 24	39 32	47 40	55 48	63 56

Response Frame							
FSC	Status	BW_Flag	UPT_Flag	ZERX_Flag	ZERY_Flag	FIL_Flag	Reserved
0x0E	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	0x00
7 0	15 8	23 16	31 24	39 32	47 40	55 48	63 56

Note: Restore parameters command can restore such parameters: Bandwidth (BW), Update rate (UPT), X axis offset (ZERX), Y axis offset (ZERY) and Filtering parameter (FIL).

- ***If the Bandwidth flag (BW_Flag) is not equals to 0x00, sensor's bandwidth will restore to default value 3Hz.***

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If the Bandwidth flag (BW_Flag) is equals to 0x00, sensor's bandwidth will keep the current value.

- *If the Update rate flag (UPT_Flag) is not equals to 0x00, sensor's update rate will restore to default value 5Hz.*

  If the Update rate flag (UPT_Flag) is equals to 0x00, sensor's update rate will keep the current value.

- *If the X axis offset flag (ZERX_Flag) is not equals to 0x00, sensor's X axis offset will restore to default value.*

  If the X axis offset flag (ZERX_Flag) is equals to 0x00, sensor's X axis offset will keep the current value.

- *If the Y axis offset flag (ZERY_Flag) is not equals to 0x00, sensor's Y axis offset will restore to default value.*

  If the Y axis offset flag (ZERY_Flag) is equals to 0x00, sensor's Y axis offset will keep the current value.

- *If Filtering parameter flag (FIL_Flag) is not equals to 0x00, sensor's filtering parameter will restore to default value.*

  If Filtering parameter flag (FIL_Flag) is equals to 0x00, sensor's filtering parameter will keep current value.

Once the Filtering parameter has been modified, sensor needed to be re-power on or reset by command.

We are here for you. Addresses and Contacts.

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