DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

CAN User Manual Acceleration Safety Sensor (Type D) V2.2

Original instructions

ISO 9001 BUREAU VERITAS Certification
Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

Table of Contents

1 Introduction....3
2 Quick Reference Guide....3
3 Safety, Installation, use & maintenance....4
4 Certification....5
5 Acceleration sensor explained....5
6 Safety function....5
7 Hardware setup....5
8 Signal processing....6
8.1 Sample rate:....6
8.2 Averaging:....6
8.3 Output filter:....6
8.4 Peak Suppression Filter:....7
8.5 Pre-set/zero adjustment:....7
8.6 Acceleration element tolerance....8
8.7 Writing objects....8
8.8 Changing SRDO1 settings....8
9 Internal diagnostic tests....9
10 CAN Predefined Connection Object ID's....10
11 CAN Object Dictionary Entries (Communication Profile section)....11
12 CAN Object Dictionary Entries acceleration device (Application Specific section)....13
13 EDS files....15
14 Document revision control....15
A. Appendixes1 Schematic overview acceleration measurement....16
B. Appendixes2 Code list for EMCY message byte 05 Unique Identifier....17

List of Figures

Figure 1: Layout CAN bus connector....5
Figure 2: Schematic overview acceleration measurement.....16

List of Tables

Table 1 Object fields for zero value (pre-set) CRC calculation....7
Table 2: Emergency code....9
Table 3: COB id's....10
Table 4: Communication profile section....11
Table 5 Application specific profile section for an acceleration device....13

ISO 9001 BUREAU VERITAS Certification
Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

1 Introduction

This manual is only valid for sensor embedded firmware D-type (D-series acceleration sensors)

DIS CANopen safety acceleration sensor (D-type) family overview:

- Three housing types: 60x50mm plastic or aluminium (QG65), 70x60 stainless steel (QG76)
- One device: Acceleration 3-axis 3x 8000mg
- Three measurement methods: Unsigned PEAK mode
  Signed PEAK mode (default)
  RMS mode
- Various CANopen and sensor-settings can be configured conform CANopen standard
- EDS files available
- CRC calculation tool available

2 Quick Reference Guide

- Hexadecimal figures will have suffix “h” in this manual
- CAN hardware interface: CAN2.0 A and B (complies to ISO11898-1&2)
- CAN communication profile: CANopen (complies to CiA301 version 4.2.0 & EN50325-4)
- Baud-rate: default 125 kbit/s (can be set to 10, 20, 50, 125, 250, 500, 1000 kbit/s)
- Node-ID: default 01h (possible range 01h – 7Fh, so max. 127 nodes)
- Event time: default 50ms for TPDO1 and TPDO2 (range 10ms – 32767ms)
- TPDO1 output: 180h + node-ID (181h for node-ID 1). Default ‘off’
- TPDO2 output: 280h + node-ID (281h for node-ID 1). Default ‘off’
- SRDO1 normal: 0FFh + 2*node-ID (101h for node-ID 1).
- SRDO1 inverse: 100h + 2*node-ID (102h for node-ID 1).
- Byte-sequence on CAN-bus: little-endian (least significant byte first)
- Negative values: two’s complement
- Two modes of operation: Event-mode (periodically autonomous messages) & Sync-mode
- Sync-mode: default disabled for TPDO1 and TPDO2
- Heartbeat: default off
- Vendor-ID DIS: 000001BDh (index 1018h sub index 01h)
- Firmware-version available via CAN Object index 1018h sub index 03h
- Serial number available via CAN Object index 1018h sub index 04h
- Pre-set/zero adjustment available via CAN Object index 300Fh sub index 01h
- Sample rate g-sensor-chip: 3200Hz.
- PEAK or RMS measurement during event-time TPDO1
- No input filter
- Output filter: adjustable high-pass filter 1st order. Controlled by CAN object 300Eh.
- Document data-types definition:
  - U8 Unsigned 8-bits number (0 - 255)
  - U16 Unsigned 16-bit number (0 - 65535)
  - U32 Unsigned 32-bit number (0 - 4294967295)
  - S8 Signed 8-bits number (-128 - +127) (also known as ‘Integer 8’)
  - S16 Signed 16-bits number (-32768 - +32767) (also known as ‘Integer 16’)
  - S32 Signed 32-bits number (-2147483648 - +2147483647) (also known as ‘Integer 32’)

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

3 Safety, Installation, use & maintenance

- By ignoring the safety instructions, the manufacturer cannot be hold responsible for any damage or hazard.
- If any damage is noticed (M12 connector(s) and/or the enclosure) the device must be replaced by a new one to avoid hazard.
- Never move the sensor by pulling the cable.
- The device should only be used in situations covered by the datasheet.
- Only a SELV power supply should be used.
- Only the CANopen Safety interface according to EN50325-5 should be used.
- The family of sensors involved will have a variety of types due to different outputs, measuring ranges, enclosures, and connection options. Datasheets are available for each specific type. Customer must select and read the datasheet for the product he is using.
- The Safety Related Fault Response Time (SRFRT) of this device is defined as the maximum time the sensor will report a non-safe situation to the outside world, after detecting an internal safety error. Actual value is specified in the datasheet
- Configuration of the device like changing Node-ID, COB-ID's, and centring (sensor-offset) can only be done after a new CRC-code is generated separately and written to the device.
- The sensor should be mounted on a stable flat surface with all screws tightened.
- Use only double twisted double shielded CAN cables.
- The proof test interval for this sensor is 20 years. After this interval the sensor should be replaced or checked by comparing the output to a reference sensor or checked / recalibrated by the manufacturer. This is to check for any non-detectable faults and/or degradation. This check / recalibration is not included in the price.
- The calculated MTTFd of the sensor is specified in the datasheet.
- This sensor does not require any maintenance between proof-test intervals.

<u>The user of this safety device shall only use this device when:</u>

- he is educated to design in / use functional safety sensors.
- he has taken knowledge of both the datasheet and the user manual.
- the zeroing / centering function is only performed in the right position by an authorized person.
- the redundancy compare parameters (both Redundancy Compare Time and Redundancy Compare Acceleration) are set by the customer according to the application demands. The actual values used by the customer should fit the application involved. Before using this sensor and with the chosen settings the customer should evaluate risks in order to check whether the chosen settings satisfy his safety requirements. Manufacturer is not responsible for any damage caused by these customer-settings, even when the manufacturer defaults are used.
- the bandwidth settings are according to the application demand
- the device is used inside the specified environmental situation

<u>The user of this safety device shall consider its output as 'defective' in the following situations:</u>

- the device is not responding
- the device is not running in operational state
- the device is not running in the desired mode of operation. To be checked at installation/start-up.
- the device is sending an emergency message
- the device switches to NMT stop state
- the safeguard cycle time (SCT) exceeds the limit
- the safety related validation time (SRVT) exceeds the limit

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

4 Certification

EC Type examination by:
Name: DEKRA testing and Certification GmbH
Adress: Handwerkstraße 15, D-70565, Stuttgart, Germany
Identification Nr.: 0158
EC Type-Examination Certificate no. 4821024.21001
Certificate valid until June 14th, 2026
Certified level: SIL CL2 (claim limit 2 according to IEC 62061) & PLd (according to EN ISO 13849)
Architecture: HFT=1 (according to IEC 62061) & CAT3 (according to EN ISO 13849)

5 Acceleration sensor explained

An accelerometer measures acceleration up to 3-axis. The device takes both the static component (100%) and the dynamic component (partial, depending on frequency and bandwidth-setting) into account. Optional the static component can be compensated for earth gravity. The device will periodically send a CAN message on the CAN-bus containing the acceleration value(s) in g.

6 Safety function

The safety function of the accelerometer sensor is to generate acceleration information based on values measured by a MEMS acceleration sensor chip. Based on this acceleration information the safety controller of the application can switch the machine to safe mode in order to prevent for a dangerous situation.

Example: a windmill having a maximum vibration level. If the vibration level exceeds a certain critical value, the windmill can get damaged and/or the blades can break. To prevent for this an accelerometer can be mounted onto the windmill, measuring accelerations in the X, Y and/or Z-axis. The safety controller of the application should calculate vibration information out of these acceleration values, should monitor these vibration values and should switch the windmill to safe mode as soon as the vibration level exceeds the limits for the application. This will significantly reduce the risk of a dangerous situation to happen.

7 Hardware setup

Connection:

Default: 2x 5-pins M12 connector (A-coding), female & male, loop-through.
According to CiA303 V1.8.0

Pin 1:	Shield
Pin 2:	Vcc
Pin 3:	Gnd & CAN_GND
Pin 4:	CAN_H
Pin 5:	CAN_L

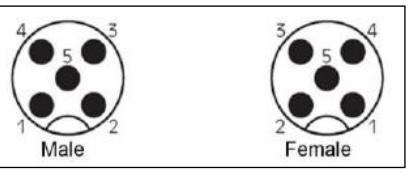


Figure 1: Layout CAN bus connector

Optional: 1x 5-pins M12 connector (A-coding) male only
CAN-Cable with 5-pins M12 connector (A-coding) male
CAN-Cable 5-wire

CAN-bus termination 120Ω

Default: no CAN-bus termination inside
Optional: CAN-bus termination inside

Tip: the last CAN-device in the chain should be terminated. For this purpose you can use the M12 male 5-pin termination resistor' (DIS article number 10217) or the M12 female 5-pin termination resistor' (DIS article number 10194).

ISO 9001 BUREAU VERITAS Certification
Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

8 Signal processing

The Safety sensor transmits SRDO messages. These messages must be used to check the data and timing. In this SRDO message the acceleration information is available in normal and in inverse format. Customer should compare these messages in order to check the sensor output is safe. It is also possible to send the data via the TPDO message according to CiA410 but in this case the sensor should be treated as a non-safety sensor. An output filter is available for removing the DC-component (static g-force). To compensate for mounting tolerances a pre-set/zero adjustment option is available. When pre-set/zero values are changed a CRC must be calculated off-line (CRC calculate tool available) and written to the sensor. The settings of the SRDO messages are also protected with a CRC code. When these are changed also new CRC code must be determined. When the sensor detects a failure an emergency message is generated, and a safe state is activated. In the safe state no communication is possible (No SRDO, TPDO and Heartbeat).

8.1 Sample rate:

The internal G-sensor chip is sampled every 5ms. Each sample consist of 16 acceleration values for each axis. Resulting in sample rate of 3200 Hz. Each sample is used to calculate the PEAK or RMS value. After every 10ms new data is available for the CAN bus. The PEAK or RMS value is determined during the event time of TPD01.
e.g. if Event time TPDO1 is 10 ms à a PEAK or RMS value over 32 samples is available.

8.2 Averaging:

The PEAK or RMS values are calculated during the TPDO1 cycle time. A longer TPDO cycle time results in a more stable output RMS signal (less noise). For PEAK applies that the highest value during this time is sent.

8.3 Output filter:

The output of the sensor can be extra filtered by a 1st order high-pass filter. This filter removes the DC-component (static g-force). Default this output filter is disabled.
Via the CAN object dictionary (index 300Eh) this filter can be controlled, by setting the time-constant in ms, with a maximum of FFFFh = 65536ms.
The time constant is defined as the time in which the output changes to 70% of the step after a step response.
The -3dB frequency can be calculated by the formula f = 1 / (2*pi*time-constant). This -3dB frequency is independent of a change in TPDO1 event time and SRDO refresh time. But when the output filter time-constant is set < min[TPDO1 event time, the SRDO refresh time] the output filter is disabled.

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

8.4 Peak Suppression Filter:

Two Peak Suppression Filters (PSF) are implemented to reduce unwanted disturbances in the acceleration measurement caused by acceleration peaks.

Filter principle: An extreme sudden peak in the acceleration signal might indicate an unrealistic non-real peak. In this case the filter can make the sensor ignore this peak for a certain time

PSF in the redundancy compare chain (object 4007h):
The redundancy compare chain checks the difference between the two redundant MEMS chips. The filter helps to prevent for false safety alarms.

PSF in the acceleration output chain (object 4008h):

The filter in the output chain makes the acceleration output more stable and more realistic

PSF can be adjusted with 2 parameters:

- Acceleration (mg): This parameter sets the threshold for the peak. Only peaks above this threshold will be filtered. Setting this angle parameter to 0mg will disable the PSF
- Time (ms): After the peak suppression filter becomes active, it will hold the acceleration signal for a certain period, set by this parameter.

8.5 Pre-set/zero adjustment:

To eliminate mechanical offsets a pre-set/ zero value can be added. This can be done with the pre-set/zero adjustment method, so introducing a permanent offset on the output of the sensor (center point = middle of measuring range). The current position will be regarded as the new pre-set/zero position. This can be done limited to 100.000x. (The value is written in EEPROM. The write actions for EEPROM is limited to 100.000x)
Via CAN object 300Fh (see sensor specific part) the centering/zeroing can be done for each axis separate or for both axis at the same time. Status information of the result is available from the same object 300Fh
Since the offset has direct influence on the acceleration output, the pre-set/zero value is protected with a CRC code. This CRC code must be set via object 63FFh. When the CRC code is written it must be validated with object 63FE sub id 0 writing data A5h. The polynomial of the CRC code is:

$$g(x) = x^{16} + x^{12} + x^5 + 1$$

Table 1 Object fields for zero value (pre-set) CRC calculation

Order	Index	Sub index	Value	Size	Data
1	6200h	00h	Highest sub index supported	1 octet	a_7 *to* a_0
2		01h	Sub index number	1 octet	b_7^1 *to* b_0^1
3			Safety acceleration X axis offset (pre-set) value	2 octets	c_{15} *to* c_0
4		02h	Sub index number	1 octet	b_7^2 *to* b_0^2
5			Safety acceleration Y axis offset(pre-set) value	2 octets	d_{15} *to* d_0
		03h	Sub index number	1 octet	b_7^3 *to* b_0^3
			Safety acceleration Y axis offset(pre-set) value	2 octets	e_{15} *to* e_0

For CRC determination a PC tool is developed and can be found on the DIS web site www.dis-sensors.com
A CRC code is also mandatory for SRDO1 message for detailed information about generating see EN 50325-5. This CRC code can also be calculated with the same PC tool.

ISO 9001 BUREAU VERITAS Certification
Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

8.6 Acceleration element tolerance

The sensor consists of two accelerator elements. The acceleration values are compared, and a safe state is set when the elements differ too much. To prevent false alarms, Redundancy Compare Acceleration and Redundancy Compare Time tolerance can be configured. The tolerance consists of allowing a g-force deviation during a certain time.
These values are adjustable via object 4006h sub- index 01h and 02h. The default values are 300d and 200d (580mg during 2000 ms). The actual values used by the customer should fit the application involved. Before using this sensor and with the chosen settings the customer should evaluate risks in order to check whether the chosen settings satisfy his safety requirements. Manufacturer is not responsible for any damage caused by these customer-settings, even when the manufacturer defaults are used.
Definitions for the Redundancy error:
'Redundancy Compare time' (user programmable, default 2000ms)
'Redundancy Compare acceleration' (user programmable, default 580mg)

8.7 Writing objects

When writing an object, it can have a major influence on the output. To prevent unauthorized changes, most write action can only be executed when the device is in pre-operational state. According to EN 50325-5

8.8 Changing SRDO1 settings

When changing an SRDO1 setting the sensor must be in pre-operating state.
The direction 1301h sub id 01h must be disabled by writing 00h to object 1301h sub id 01h. When the SRDO setting is changed the CRC code must also be changed and activated. Finally, the data must be stored in EEPROM.

Example to change SRDO refresh time

Load object:	1301h sub id 01h with:	00h	disable SRDO1 communication.
Load object:	1301h sub id 02h with:	0064h	new SRDO refresh time.
Load object:	1301h sub id 01h with:	01h	enable transmit SRDO1 communication.
Load object:	13FFh sub id 01h with:	xxxxh	code from CRC calculation tool.
Load object:	13Feh sub id 00h with:	A5h	validate new CRC.
Load object:	1010h sub id 01h with:	"save" or 65766173h	write new SRDO1 refresh time, CRC and validation to EEPROM.

After a power reset and when the device is set to operational, the transmission time is equal to the desired time.

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

9 Internal diagnostic tests

To ensure safety the hard- and software of the safety sensor is continuouly checked. When a failure is detected, an emergency message is sent. After sending this message, the device goes to a safe state, in which no communication is possible (No SRDO, TPDO and Heartbeat). In this state, a NMT reset will not restart the sensor. Failure should be analyzed by reading out the emergency message. If the error can be fixed, giving the sensor a new power cycle will restart communication. If it is a 'sensor element error (redundancy error), you might consider updating 'redundancy compare time' and/or 'redundancy compare angle. If the error cannot be fixed, please contact your distributor.

The receiving application should detect that no communication is possible and shall set the system to a safe state.

Table 2: Emergency code

CAN Connection Object ID: 080h+NODE_ID (emergency message)		
Byte number	Type	Description
01h and 00h	U16	Error-code: 0000h: no error FF00h: CAN Open device specific error code
02h	U8	Error-register: 00h: no error 01h: error register object 1001h
04h and 03h	U8	Diagnose error CAN stack: 0000h: No error 0001h: Reset state 0002h: Can driver has to be reset 0004h: Safety cycle is ready 0008h: reserved 0010h: Timeout by watchdog diagnose 0020h: Overvoltage 0040h: Unknown interrupt occurs 0080h: CSC stack has entered safety stop 0100h: Initialization error 0200h: Can error 0400h: CAN NMT state error 0800h: Diagnose error 1000h: Safety cycle error 2000h: SRDO error 4001h: RAM error 8000h: Unknown error - Multiple errors can be indicated (bitwise OR-ed) simultaneously. - When an overvoltage occurs, the device stays permanent in safe state
05h		Unique Identifier: 3Eh: Voltage error - either overvoltage or undervoltage detected. -Full code list see appendix C
06h	U8	Diagnose error CAN stack: C00h: Start CRC calculation ROM 01h: Check register 02h: Check stack 03h: Check addressing part unit 1 04h: Check addressing part unit 2 05h: Check conditional jumps 06h: Check opcode 07h: Check CRC for SRDO's 09h: Check time stamp 0Ah: Wait for end of CRC calculation for CSC main 0Bh: Start CRC calculation ROM for application 0Ch: Wait for end of CRC calculation for application 0Dh: Start CRC calculation ROM for start-up monitor 0Eh: Wait for end of CRC calculation for start-up monitor 0Fh: Check RAM with GALPAT algorithm 10h: Check software interrupt 11h: Check software interrupt was ok 12h: Check undefined instruction interrupt

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

CAN Connection Object ID: 080h+NODE_ID (emergency message)		
Byte number	Type	Description
		19h: Check undefined instruction interrupt was ok 7Fh: Idle state
07h	U8	Application error 00h: No application error 01h: Unknown interrupt occurs 02h: Safety RAM error 04h: SRDO error 08h: 3V3 monitor error 10h: Sensor element error (Redundancy Error) 20h: RAM CRC error 40h: EEPROM error 80h: Watchdog Multiple errors can be indicated (bitwise OR-ed) simultaneously.
Sensor goes to safe state (stop state) when an error is reported. Sensor must be power cycled to restart.		

Example 1:
Receive COB-id 81h with data 00h FFh 01h 80h 00h 00h 0Eh 08h
81 emergency messages of node id 01h
00h FFh-> FF00h CAN Open device specific error code
01h-> error register object 1001h
80h 00h ->0080h CSC stack has entered safety stop
00h reserved
0Eh Wait for end of CRC calculation for start-up monitor
08h. 3V3 monitor error

Example 2:
Receive COB-id 81h with data 00h FFh 01h A0h 00h 3Eh 00h 00h
81 emergency messages of node id 01h
00h FFh-> FF00h CAN Open device specific error code
01h-> error register object 1001h
A0h 00h ->00A0h Overvoltage and CSC stack has entered safety stop
3Eh Voltage error
00h Start CRC calculation ROM
00h. No application error

10 CAN Predefined Connection Object ID's

Table 3: COB id's

Standard CAN Connection Object ID's (Most used)		
CAN-ID	Data	Description (client = CAN master, server = sensor)
000h		NMT Network Management
080h		Sync command to sensor
080h + node-ID		Emergency message from sensor
0FFh + 2 * node-ID		SRDO1
100h + 2 * node-ID		SRDO1 inverse
180h + node-ID		TPDO1 message from sensor
280h + node-ID		TPDO2 message from sensor
580h + node-ID		SDO Download Request: Feedback from sensor (server to client)
600h + node-ID		SDO Upload Request: Write to sensor (client to server)
700h + node-ID	00h 04h 05h 7Fh	heartbeat from sensor, boot-up mode heartbeat from sensor, stopped mode heartbeat from sensor, operational mode heartbeat from sensor, pre-operational mode

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

11 CAN Object Dictionary Entries (Communication Profile section)

Table 4: Communication profile section

Index	Sub index	Type	Read/ Write	Data	Description	Pre-operational
1000h	00h	U32	R	30000000h	Device type (No profile)	No
1001h	00h	U8	R	e.g. 00h e.g. 81h	Error Register = Normal operation = Device error	No
1003h	00h	U32	R		Predefined error field	No
1005h	00h	U32	R+W		COB-ID SYNC	No
100Ch	00h	U16	R		Guard time	No
100Dh	00h	U8	R		Life time factor	No
1010h	00h	U8	R	3	Number of entrees	No
	01h	U32	R+W	"save" in ASCII Or 65766173h	Save all parameters in EEPROM	Yes
	02h	U32	R+W	"save" in ASCII Or 65766173h	Save communication parameters in EEPROM	Yes
	03h	U32	R+W	"save" in ASCII Or 65766173h	Save application parameters in EEPROM	Yes
1011h	00h	U8	R	3	Number of entrees	No
	01h	U32	R+W	"load" in ASCII Or 64616F6Ch	Restore all parameters in EEPROM	Yes
	02h	U32	R+W	"load" in ASCII Or 64616F6Ch	Restore communication parameters in EEPROM	Yes
	03h	U32	R+W	"load" in ASCII Or 64616F6Ch	Restore application parameters in EEPROM	Yes
1017h	00h	U16	R+W	e.g. 07D0h/2000d e.g. 0000h	Heartbeat time (ms) = 2000 ms = 0 ms (heartbeat switched off, default)	No
1018h	01h	U32	R	4	Vendor ID (000001BDh)	No
	02h	U32	R	e.g. 04000412h e.g. 04000414h e.g. 04000418h	Product Code = 3-axis acceleration ±2G = 3-axis acceleration ±4G = 3-axis acceleration ±8G	No
	03h	U32	R	e.g. 00020001h	Firmware version sensor (000x000yh) = v2.1	No
	04h	U32	R	e.g. 00000000h up to FFFFFFFFh	Serial number sensor (32 bit, unique)	No
1300h	00h	U8	R+W	e.g. 00h e.g. 01h	GFC parameter = Invalid = Valid	No
1301h	00h	U8	R	6	Number of entrees	No
	01h	U8	R+W	e.g. 00h e.g. 01h e.g. 02h	SRDO1 direction = Disabled = TX/SRDO producer (default) = RX/SRDO consumer	Yes
	02h	U16	R+W	e.g. 0050h/80d	SRDO1 refresh time/SCT = 80 ms (default) (Tolerance: -10ms...+30ms)	Yes
	03h	U8	R+W	e.g. 14h/20d	safety-relevant validation time (SRVT) = 20 ms (default)	Yes
	04h	U8	R+W	e.g. FEh/254d	Transmission type = Asynchronous (default)	Yes
	05h	U32	R+W	e.g. 00000101h	COB ID1 = 0xFFh + Node ID *2 (default)	Yes
	06h	U32	R+W	e.g. 00000102h	COB_ID2 = 0x100h + Node ID *2 (default)	Yes
1381h	00h	U8	R	12	Number of entrees	No
	01h	U32	R	62100108h	SRDO1 mapping object 1 (normal) = Normal X acceleration bit 0-7	No
	02h	U32	R	62110108h	SRDO1 mapping object 1 (inverse) = Inverse X acceleration bit 0-7	No

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

Index	Sub index	Type	Read/ Write	Data	Description	Pre-operational
	03h	U32	R	62100208h	SRDO1 mapping object 2 (normal) = Normal X acceleration bit 8-15	No
	04h	U32	R	62110208h	SRDO1 mapping object 2 (inverse) = Inverse X acceleration bit 8-15	No
	05h	U32	R	62200108h	SRDO1 mapping object 3 (normal) = Normal Y acceleration bit 0-7	No
	06h	U32	R	62210108h	SRDO1 mapping object 3 (inverse) = Inverse Y acceleration bit 0-7	No
	07h	U32	R	62200208h	SRDO1 mapping object 4 (normal) = Normal Y acceleration bit 8-15	No
	08h	U32	R	62210208h	SRDO1 mapping object 4 (inverse) = Inverse Y acceleration bit 8-15	No
	09h	U32	R	62300108h	SRDO1 mapping object 5 (normal) = Normal Z acceleration bit 0-7	No
	0Ah	U32	R	62310108h	SRDO1 mapping object 5 (inverse) = Inverse Z acceleration bit 0-7	No
	0Bh	U32	R	62300208h	SRDO1 mapping object 6 (normal) = Normal Z acceleration bit 8-15	No
	0Ch	U32	R	62310208h	SRDO1 mapping object 6 (inverse) = Inverse Z acceleration bit 8-15	No
13FEh	00h	U8	R+W	e.g. A5h Other value	SRDO configuration = SRDO configuration signature valid = SRDO configuration signature not valid	Yes
13FFh	00h	U8	R	4	Number of entrees	No
	01h	U16	R+W		CRC of SRDO1	Yes
1400h	00h	U8	R	2	Number of entrees Receive PDO 1	No
	01h	U32	R+W		COB_ID used by PDO 0xC0000201 (default)	No
	02h	U8	R+W		Transmission type = FFh (default)	No
1401h	00h	U8	R	2	Number of entrees Receive PDO 2	No
	01h	U32	R+W		COB_ID used by PDO 0xC0000201 (default)	No
	02h	U8	R+W		Transmission type = FFh (default)	No
1600h	00h	U8	R	8	Number of entrees Receive PDO mapping	No
	01h-08h	U32	R	e.g. 00000000h	=Disabled	No
1601h	00h	U8	R	8	Number of entrees Receive PDO mapping	No
	01h-08h	U32	R	e.g. 00000000h	= Disabled	No
1800h	00h	U8	R	5	Number of entrees	No
	01h	U32	R+W	e.g. 40000181h e.g. C0000181h	TPDO1 event-mode _= Enable _= Disable (default)	No
	02h	U8	R+W	e.g. 01h e.g. FFh	TPDO1 sync-mode _= Enable _= Disable (default)	No
	05h	U16	R+W	e.g. 0032h e.g. 0000h	TPDO1 event-time in ms _= 50 ms (default) _= 0 ms (disable TPDO1)	No
1801h	00h		U8	5	Number of entrees	No
	01h	U32	R+W	e.g. 40000281h e.g. C0000281h	TPDO2 event-mode _= enable _= disable (default)	No
	02h	U8	R+W	e.g. 01h e.g. FFh	TPDO2 sync-mode _= enable _= disable (default)	No
	05h	U16	R+W	e.g. 0032h e.g. 0000h	TPDO2 event-time in ms _= 50 ms (default) _= 0 ms (disable TPDO2)	No
To store application specific parameters permanently into the EEPROM of the sensor CAN Object 1010h should be used, otherwise the changes will be lost after a power cycle.						
All not-specified indices and/or sub-indices are reserved for factory use only.						

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

12 CAN Object Dictionary Entries acceleration device (Application Specific section)

Table 5 Application specific profile section for an acceleration device

Application specific parameters						
Index	Sub index	Type	Read/ Write	Data	Description	Pre-operational
3000h	00h	U8	R	1	Number of entrees	No
	01h	U8	R+W	01h up to 7Fh	Node-ID (When Node Id >3Fh non-standard COB-ID of SRDO1 must be used) *(Changes are being affected after a power cycle only)*	Yes
3001h	00h	U8	R	1	Number of entrees	No
	01h	U8	R+W	e.g. 06h e.g. 05h e.g. 04h e.g. 03h e.g. 02h e.g. 01h e.g. 00h	Baud rate (kbit/s) = 50 = 100 = 125 (default) = 250 = 500 = 800 = 1000 *(Changes are being affected after a power cycle only)*	Yes
3002h	00	U8	R	1	Number of entrees	No
	01	U8	R/W	e.g. 00h e.g. 01h e.g. 02h	Acceleration type = RMS mode = Signed PEAK mode (default) = Unsigned PEAK mode	Yes
300Eh	00h	U8	R	1	Number of entrees	No
	01h	U16	R+W	Time in ms e.g. 0000h e.g. 0064h	Output filter (1st order high pass): = Disabled (default) = Enabled, 100 ms (f = 1.59 Hz)	Yes
300Fh	00h	U8	R	1	Number of entrees	No
	01h	S8	R+W	e.g. Write 01h e.g. Write 02h e.g. Write 04h e.g. Write 07h e.g. Read 00h e.g. Read FEh e.g. Read FCh	Pre-set adjustment acceleration. = Start zero X acceleration = Start zero Y acceleration = Start zero Z acceleration = Start zero XYZ acceleration = Zero successful, = Zero X unsuccessful = Zero X and Y unsuccessful	Yes
4006h	00h	U8	R	2	Number of entrees	No
	01h	U16	R+W	e.g. 012Ch/300d e.g. 0320h/800d	Redundancy Compare Acceleration (Maximal acceleration deviation between two elements) = 300 mg (default) (Max. = 800 mg)	Yes
	02h	U16	R+W	e.g. 00C8h/200d e.g. 03E8h/1000d	Redundancy Compare Time [x10 ms]. (Time within maximal deviation is allowed.) = 2000 ms (default) (Max. = 10 s)	Yes
4007h	00h	U8	R	1	Number of entrees	No
	01h	U16	R+W	e.g. 0000h e.g. 012Ch	Peak suppression redundancy acceleration [mg]. = Disabled = 300 mg (default) (Min. = 300 mg)	Yes
	02h	U16	R+W	e.g.0004h e.g. 03E8h/1000d	Name=Peak suppression redundancy time [x10 ms]. = 40 ms (default) (Max. = 10 s)	Yes
4008h	00h	U8	R	1	Number of entrees	
	01h	U16	R+W	e.g. 0000h	Peak suppression output acceleration = Disabled (default)	

ISO 9001 BUREAU VERITAS Certification
Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

Application specific parameters						
Index	Sub index	Type	Read/ Write	Data	Description	Pre-operational
				e.g. 012C/300d	(Min. = 300 mg)	
	02h	U16	R+W	e.g. 0005h e.g. 03E8h/1000d	Peak suppression output time [x10 ms]. = 50 ms (default) (Max. = 10 s)	
6000h	00h	U16	R	e.g. 0001h	Resolution = 0,001 g	No
6010h	00h	S16	R		X acceleration	No
6011h	00h	U8	R+W	e.g. Bit0 = 0 e.g. Bit0 = 1 e.g. Bit1 = 0 e.g. Bit1 = 1 Other bits	Operating parameter X acceleration = Acceleration normal = Acceleration inverse = Pre-set disable = Pre-set enable = No function	Yes
6020h	00h	S16	R		Y acceleration	No
6021h	00h	U8	R+W	e.g. Bit0 = 0 e.g. Bit0 = 1 e.g. Bit1 = 0 e.g. Bit1 = 1 Other bits	Operating parameter Y acceleration = Acceleration normal = Acceleration inverse = Pre-set disable = Pre-set enable = No function	Yes
6030h	00h	S16	R		Z acceleration	No
6031h	00h	U8	R+W	e.g. Bit0 = 0 e.g. Bit0 = 1 e.g. Bit1 = 0 e.g. Bit1 = 1 Other bits	Operating parameter Z acceleration = Acceleration normal = Acceleration inverse = Pre-set disable = Pre-set enable = No function	Yes
6200h	00h	U8	R	2	Number of entrees	No
	01h	S16	R+W		Pre-set value X Acceleration	Yes
	02h	S16	R+W		Pre-set value Y Acceleration	Yes
	03h	S16	R+W		Pre-set value Z Acceleration	
6210h	00h	U8	R	2	Number of entrees	No
	01h	U8	R		Bit 0-7 of normal SRDO X Acceleration	No
	02h	U8	R		Bit 8-15 of normal SRDO X Acceleration	No
6211h	00h	U8	R	2	Number of entrees	No
	01h	U8	R		Bit 0-7 of inverse SRDO X Acceleration	No
	02h	U8	R		Bit 8-15 of inverse SRDO X Acceleration	No
6220h	00h	U8	R	2	Number of entrees	No
	01h	U8	R		Bit 0-7 of normal SRDO Y Acceleration	No
	02h	U8	R		Bit 8-15 of normal SRDO Y Acceleration	No
6221h	00h	U8	R	2	Number of entrees	No
	01h	U8	R		Bit 0-7 of inverse SRDO Y Acceleration	No
	02h	U8	R		Bit 8-15 of inverse SRDO Y Acceleration	No
6230h	00h	U8	R	2	Number of entrees	No
	01h	U8	R		Bit 0-7 of normal SRDO Z Acceleration	No
	02h	U8	R		Bit 8-15 of normal SRDO Z Acceleration	No
6231h	00h	U8	R	2	Number of entrees	No
	01h	U8	R		Bit 0-7 of inverse SRDO Z Acceleration	No
	02h	U8	R		Bit 8-15 of inverse SRDO Z Acceleration	No
63FEh	00h	U8	R+W	e.g. A5h e.g. 00h	Pre-set configuration field = Signature valid = Signature not valid	Yes
63FFh	00h	U8	R	1	Number of entrees	No
	01h	U16	R+W		Pre-set value signature	Yes
To store application specific parameters permanently into the EEPROM of the sensor CAN Object 1010h should be used, otherwise the changes will be lost after a power cycle.						
All not-specified indices and/or sub-indices are reserved for factory use only.						

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

13 EDS files

The “Electronic Data Sheet” (EDS file) is a file format that describes the communication behavior and the object dictionary entries of a device. In fact, it’s a template. This allows tools such as CAN configuration tools to handle the device properly. The file format is described in CiA306 V1.3.0

The EDS-file contains all possible settings and functions for the device by describing the CAN object dictionary for the device to be set by CAN commands.

The EDS-file does not contain a customer specific configuration description (the values of the object dictionary, like i.e. the chosen baud rate, TPDO1 event time, Node ID etc.). For this purpose, the customer can generate a so-called DCF-file (Device Configuration File) with all customer-specific settings out of the EDS-file. The DCF file is in fact the incarnation of the EDS-file.
After loading the DCF-file into the device you must store the settings into EEPROM by index 1010h sub index 01h to store permanently, see “CAN Object Dictionary Entries”.

The EDS-files available for sensors with embedded firmware version D-type described in this document should have a version D-type also.

The next EDS-file is available at www.dis-sensors.com under ‘downloads’:

- QG_Dtype_3_axis_2g_v*.*
- QG_Dtype_3_axis_4g_v*.*
- QG_Dtype_3_axis_8g_v*.*

14 Document revision control

V1.0 first release
V1.1 Add commend after review JK
V1.2 Safety information added (MvA) Schematic overview adjusted (RMo)
V1.3 EDS name split for different g type
V1.4 Add text original instructions in document
V1.5 Change mapping object 1381h for 1 axis and 2 axis according to profile (RMo)
Change description of object 1011
V1.6 20200831 Insert Peak suppression filter for MEMS elements and for acceleration output (MvA)
V1.7 20200823 correct proof test period and pre-set disable/enable. (SX)
V1.8 20210917 Re-certification / EC type examination by DEKRA successful. New certificate nr.
V1.9 20220328 Max./Min. value of Peak suppression filter added. Resolution data type corrected (SX)
V2.0 20220801 corrected value definition of object 3002 (SX)
V2.1 20251202 correct EMCY code, add tolerance time to SRDO refresh time (SX)
V2.2 20260519 Update EMCY code with unique identifier. small textual updates (SX)

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

A. Appendixes1 Schematic overview acceleration measurement

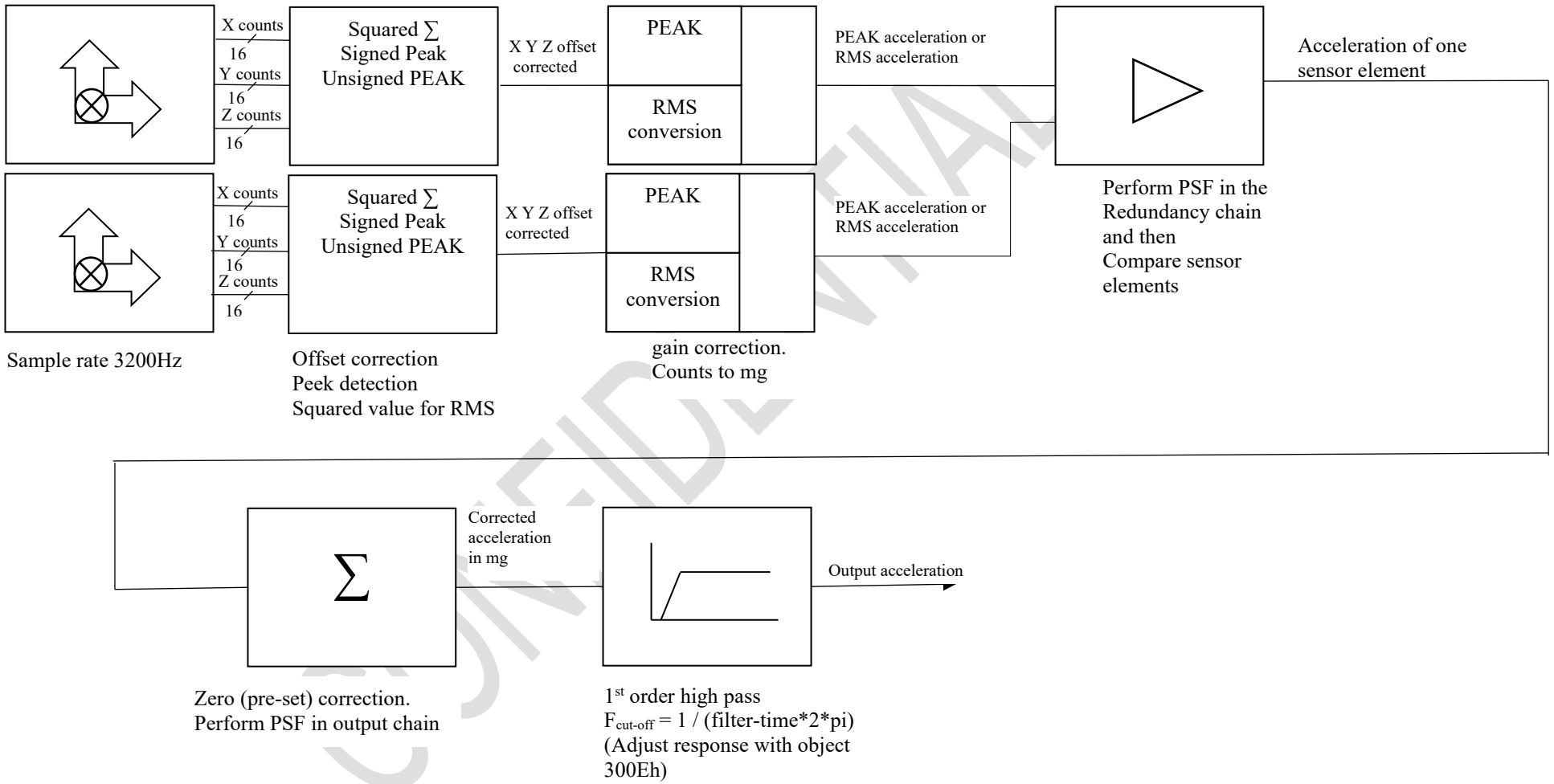


Figure 2: Schematic overview acceleration measurement.

CONFIDENTIAL

ISO 9001 BUREAU VERITAS Certification
LRI Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

B. Appendixes2 Code list for EMCY message byte 05 Unique Identifier

Unique ID	Description	Unique ID	Description
0x00	Angle calculation between 2 MEMS differs too much	**0x3D**	Updating of EEPROM fails (related Manufacturer Data block)
0x01	Updating CRC on zero values fails	**0x3E**	Under- or overvoltage occured on the 5.0V voltage
0x02	Updating zero values in EEPROM fails	**0x3F**	Error occured during handling of SRDO message
0x03	Updating of RAM CRC value fails (related to Application Data block)	**0x40**	Error occured during handling of SRDO message
0x0A	Updating of RAM CRC value fails (related to EEPROM)	**0x41**	Error occured during handling of SRDO message
0x0B	Updating of RAM CRC value fails (related to EEPROM)	**0x42**	Error occured during handling of SRDO message
0x0C	Updating of RAM CRC value fails (related to EEPROM)	**0x43**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x14	Device ID of MEMS_A is incorrect	**0x44**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x15	Device ID of MEMS_B is incorrect	**0x45**	Updating of RAM CRC value fails (related to EEPROM Communication Data block)
0x16	Selftest error in X-axis of MEMS_A	**0x46**	Updating of RAM CRC value fails (related to EEPROM Communication Data block)
0x17	Selftest error in Y-axis of MEMS_A	**0x47**	Updating of Communication Data block in EEPROM fails
0x18	Selftest error in Z-axis of MEMS_A	**0x48**	Updating of Application Data block in EEPROM fails
0x19	Selftest error in X-axis of MEMS_B	**0x49**	Updating of Communication Data block in EEPROM fails
0x1A	Selftest error in Y-axis of MEMS_B	**0x4A**	Updating of Application Data block in EEPROM fails
0x1B	Selftest error in Z-axis of MEMS_B	**0x4B**	Updating of RAM CRC value fails (related to EEPROM Manufacturer Data block)
0x1C	SPI communication error MEMS_B	**0x4C**	Updating of RAM CRC value fails (related to EEPROM Manufacturer Data block)
0x1D	SPI communication error MEMS_A and MEMS_B	**0x4D**	Updating of RAM CRC value fails (related to EEPROM Manufacturer Data block)
0x1E	SPI communication error MEMS_A	**0x4E**	Updating of RAM CRC value fails (related to EEPROM Manufacturer Data block)
0x1F	SPI communication verify error MEMS_A (acceleration range register)	**0x4F**	Updating of RAM CRC value fails (related to EEPROM Manufacturer Data block)
0x20	SPI communication verify error MEMS_B (acceleration range register)	**0x50**	Updating of RAM CRC value fails (related to EEPROM Manufacturer Data block)

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000

DIS Sensors bv
Oostergracht 40
3763 LZ Soest | The Netherlands
T +31 (0)35 - 603 81 81
M info@dis-sensors.com
W www.dis-sensors.com

0x21	SPI communication verify error MEMS_A (configuration register)	**0x51**	Updating of RAM CRC value fails (related to EEPROM Manufacturer Data block)
0x22	SPI communication verify error MEMS_B (configuration register)	**0x52**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x23	SPI communication verify error MEMS_A (watermark level register)	**0x53**	Updating of RAM CRC value fails (related to EEPROM Communication Data block)
0x24	SPI communication verify error MEMS_B (watermark level register)	**0x54**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x25	SPI communication verify error MEMS_A (power control register)	**0x55**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x26	SPI communication verify error MEMS_B (power control register)	**0x56**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x27	SPI communication verify error MEMS_A (power configuration register)	**0x57**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x28	SPI communication verify error MEMS_B (power configuration register)	**0x58**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x29	MEMS interrupt are not coming at a regular interval	**0x59**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x32	RAM check error in AppSaveRam block	**0x5A**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x33	CRC error in CAN Communication Data block	**0x5B**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x34	CRC error in CAN Application Data block	**0x5C**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x35	CRC error in CAN Manufacturer2 Data block	**0x5D**	Updating of RAM CRC value fails (related to EEPROM Application Data block)
0x36	CRC error in CAN Manufacturer Data block	**0x5E**	Unused interrupt was triggered
0x37	Voltage error occurred on the 3.3V voltage	**0x5F**	Voltage error occured on the 3.3V voltage
0x38	Updating of RAM CRC value fails (related to voltage error)	**0x60**	Updating of RAM CRC value fails (related to EEPROM Manufacturer2 Data block)
0x39	Updating of RAM CRC value fails (related to voltage error)	**0x61**	Updating of RAM CRC value fails (related to EEPROM Manufacturer2 Data block)
0x3A	Updating of RAM CRC value fails (related to EEPROM Manufacturer Data block)	**0x62**	Updating of Manufacturer2 Data block in EEPROM fails
0x3B	Updating of RAM CRC value fails (related to EEPROM Manufacturer2 Data block)	**0x64**	Watchdog expired
0x3C	Updating of RAM CRC value fails (related to EEPROM Manufacturer Data block)	**0x65**	Watchdog expired
		0x6E	Error occured in bessel-filter

Distribuída no Brasil pela LRI | vendas@lri.com.br | 51 2129-3000