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Introduction

This manual is only valid for sensor embedded firmware v6.x types ("N" series, e.g. QG65N, QG76N)

DIS inclination/acceleration sensor family overview:

- Three housing types: 60x50mm plastic or aluminium (QG65), 70x60 stainless steel (QG76)
- Three inclination types: Inclination 1-axis (vertical plane): ±180°
  Inclination 2-axis (horizontal plane): 2x ±30°
  Inclination 2-axis (horizontal plane): 2x ±90°
- Various acceleration types: Acceleration 2-axis (horizontal plane): up to 2x ±8G
- Various CAN settings can be configured conform CANopen standard
- Various Sensor-settings can be configured via CANopen
- EDS files available

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Quick Reference Guide:

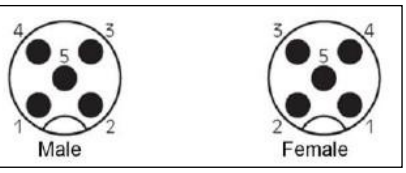
- CAN hardware interface: CAN2.0 A and B (complies with ISO11898-1&2)
- CANopen application layer and communication profile: CANopen protocol: EN50325-4 (CiA301 v4.0 and 4.2.0)
- Hexadecimal figures will have suffix "h" in this manual
- Negative values: two's complement
- Byte-sequence on CAN-bus: little-endian (least significant byte first)
- CAN bus bit rate: 50 kbit/s, 125 kbit/s (default), 250 kbit/s, 500 kbit/s, 1 Mbit/s
- Heartbeat: default on, 2s
- Node-ID: default 01h (possible range 01h – 7Fh, so max. 127 nodes)
- Two modes of PDO transmission:
  - Event mode: default on, event timer 50ms as default (range 5ms – 32767ms)
  - Sync mode: default off
- Sensor output:
  - TPDO1(CANID: 180h + node-ID) and TPDO2 (CANID: 280h + node-ID, default off)
  - TPDO mapping available to select sensor-output values
- Vendor ID DIS: 000001BDh (index 1018h sub-index 01h)
- Firmware version available via CAN Object Dictionary (index 1018h sub-index 03h)
- Serial number available via CAN Object Dictionary (index 1018h sub-index 04h)
- Center/zero adjustment available via CAN Object Dictionary (index 300Fh sub-id 00h)
- Sample rate g-sensor-chip inclination: 3200Hz. Averaging during event-time TPDO1
- Sample rate g-sensor-chip acceleration: 3200Hz. RMS or peak-detection during event-time TPDO1
- Input filter Inclination: fixed 32-tap FIR filter(cut off freq. 120Hz).
- Output filter: adjustable 1st order LPF/HPF. 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')

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



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).

Save limitations

Due to EEPROM limitations the maximum amount of 'save' actions is 4 million times

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Signal processing: see Appendix 1 and 2 for schematic overview

Sample rate:
Each axis of the internal G-sensor chip(MEMS) is sampled every 0,31ms (3200Hz). The sample rate is fixed.

Input filter(Inclination only):
Inclination: The raw values of the g-sensor-chip are filtered by a 32-tap FIR filter with a cut-off frequency of 120Hz. This will give a more stable and accurate output value. Samples are available from the input filter at 100Hz, this means the chip sample rate of 3200Hz is reduced to 100Hz by the input filter

Averaging:
Inclination: The filtered values are averaged during the TPDO1 cycle time. A longer TPDO cycle time results is a smaller bandwidth and therefore a more stable output signal (less noise), but also more phase delay. This cycle time is configured by TPDO1 event timer in Object Dictionary Index 1800h, Sub-index 05h.
E.g. if event time TPDO1 is 10 ms, an average value of 8 samples is calculated.(sample rate = 100Hz)

Acceleration: Sensor outputs are available with RMS, signed or unsigned peak within TPDO1 event time. By TPDO-mapping this can be selected, see sensor-specific part.

Calculation:
Inclination: Every TPDO1 cycle time a new angle value is calculated according to a smart algorithm including calibration settings.
Acceleration: The g-sensor delivers raw value at 3200Hz, all those raw values are corrected with gain and offset, zero calibration. Finally a RMS or peak value is determined during the TPDO1 event time.

Output filter:
The outputs of the sensor can be filtered in order to have a better response.

- inclination: 1st order low-pass filter
- acceleration: 1st order high pass filter

This output filter is disabled in default. 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 t 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 =$1/2\,\pi t$. This -3dB frequency is independent of a change in TPDO1 event time. But when the output filter time-constant is set < TPDO1 event time the output filter is disabled.

Center/zero adjustment:
To eliminate mechanical offsets, the sensor can be centered/zero-ed by the center/zero adjustment method, which results in a permanent offset on the output of the sensor. The current position will be regarded as the new center/zero position. This can be done repeatedly within the adjustment range limit.

- Inclination sensor can be centered (center point = middle of measuring range).
- Acceleration sensors can be zero-ed (0G point).

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 result of the zero operation is available from object 300Fh. This action will update objects 3010h, where the offset value can be read and written.(sub-index 01h for X axis, 02h for Y axis, 03h for Z axis)

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Self-test

During sensor start-up the two-axis g-element-chips and the EEPROM in the sensor are submitted to a self-test. The self-test will verify if both axis of the g-element-chip are functional and the main functions are working properly. Additionally the EEPROM for data storage is checked. When an error is detected during the self-test, this is reported on the CAN bus by an emergency message.

When the self-test is passed, an emergency message is sent with all zeroes.
When the self-test fails, an emergency message is sent according to the table below.

The receiving application should ignore the sensor-output when an error is reported.

CAN Connection Object ID: 080h+NODE_ID (emergency message)		
Data-index	Type	Description
00h to 01h	U16	Error-code: 0000h: No error (selftest OK) 5000h: Device hardware error (selftest FAIL) Error simulation (when switched ON via CAN object 3007h): 6200h: Device software error - user
02h	U8	Error-register: 00h: No error (selftest OK) 81h: Manufacturer specific error (selftest FAIL)
03h to 07h	5*U8	Manufacturer specific data: 00h, 00h, 00h, 00h, 00h: No error 00h, 00h, 00h, 00h, 01h: selftest initialization error 00h, 00h, 00h, 00h, 02h: selftest error X-axis 00h, 00h, 00h, 00h, 04h: selftest error Y-axis 00h, 00h, 00h, 00h, 08h: EEPROM error Multiple errors can be indicated (bitwise ORed) simultaneously.

Predefined CAN-IDs for most used objects

Predefined CAN-IDs for most used objects		
CAN-ID	Data(Hex)	Description (client = CANmaster, server = sensor)
000h		NMT Network Management
080h		Sync command to sensor
080h + node-ID		Emergency message from sensor
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, bootup-mode Heartbeat from sensor, stopped mode Heartbeat from sensor, operational mode Heartbeat from sensor, pre-operational mode

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CAN Object Dictionary Entries (Communication Profile section)

Object Dictionary Communication Profile (Most used)					
Index	Sub-index	Data(hex)	Type	Read/ Write	Description
1000h	00h		U32	R	Device Type
1001h	00h		U8	R	Error Register
1005h	00		U32		COB-ID SYNC
1010h	00h	4	U8	R	Number of entrees
	01h	"save" in ASCII	U32	W	Save All parameters in EEPROM
	02h	Or "65766173h"			Save Communication parameters in EEPROM
	03h				Save Application Parameters in EEPROM (all indexes from 3000h)
1011h	00h	4	U8	R	Number of entrees
	01h	"load" in ASCII	U32	W	Load All parameters from EEPROM
	02h	Or			Load Communication parameters from EEPROM
	03h	"64616F6Chh"			Load Application Parameters from EEPROM
1014h	00		U32	R	COB-ID EMCY
1017h	00h	Time in ms e.g. 07D0h e.g. 0000h	U16	R+W	Cycle time of the heartbeat e.g. 2s (default) e.g. 0s (heartbeat off)
1018h	01h		U32	R	Vendor ID (000001BDh)
	02h	06000001h 06000002h 06000003h 06000402h 06000403h 06000406h 06000408h 0600040Ah 06000412h 06000414h 06000418h	U32	R	Product Code(xx------h) xx = 06 Type F (CAN version V6.x) Inclination 1-axis (vertical plane): ±180° Inclination 2-axis (horizontal plane): 2x ±90° Inclination 2-axis (horizontal plane): 2x ±30° Acceleration 2-axis (horizontal plane): 2x ±0.5g Acceleration 2-axis (horizontal plane): 2x ±1g Acceleration 2-axis (horizontal plane): 2x ±2g Acceleration 2-axis (horizontal plane): 2x ±4g Acceleration 2-axis (horizontal plane): 2x ±8g Acceleration 3-axis (horizontal plane): 3x ±2g Acceleration 3-axis (horizontal plane): 3x ±4g Acceleration 3-axis (horizontal plane): 3x ±8g
	03h	e.g. 00060001h	U32	R	Firmware Version from sensor (000x000yh = Vx.y) e.g. v6.1
	04h	00000000h ~ FFFFFFFFh	U32	R	Serial Number of the sensor in 32 bit, unique.
1800h	01h	C0000180h+Node-ID 40000180h+Node-ID	U32	R+W	COB-ID used by TPDO1 Disable TPDO1 Enable TPDO1 (default)
	02h	01h FFh	U8	R+W	Transmission type Sync mode Event mode(default)
	05h	Time in ms e.g. 0032h e.g. 0000h	U16	R+W	Event timer for TPDO1(range 5ms -32767ms) e.g. 50ms (default) e.g. 0ms (disable TPDO1)
1801h	01h	C0000280h+Node-ID 40000280h+Node-ID	U32	R+W	COB-ID used by TPDO2 Disable TPDO2 (default) Enable TPDO2
	02h	01h FFh	U8	R+W	Transmission type Sync mode Event mode(default)
	05h	Time in ms e.g. 0032h e.g. 0000h	U16	R+W	Event timer for TPDO2(range 5ms -32767ms) e.g. 50ms (default) e.g. 0ms (disable TPDO2)
1F80h	00h	00000000h 00000004h	U32	R+W	NMT start-up: Boot-up in Operational state (default) (= self-starting device) Boot-up in Pre-operational state, waiting . . . .

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CAN Object Dictionary Entries (Manufacturer Specific Profile section)

Manufacturer specific parameters					
Index	Sub-index	Data(hex)	Type	Read/Write	Description
3000h	00h	01h ~ 7Fh	U8	R+W	Set node-ID 01h (default) ~ 7Fh *(changes are being affected after a power cycle only)*
3001h	00h	06h 04h 03h 02h 00h	U8	R+W	Set CAN Bus bit rate 50 kbit/s 125 kbit/s (default) 250 kbit/s 500 kbit/s 1 Mbit/s *(changes are being affected after a power cycle only)*
3002h	00h	1	U8	R	Number of entrees
	01	00h 01h 02h	U8	R+W	Set measurement type for acceleration sensors only RMS measurement [mg] Signed peak measurement [mg] Unsigned peak measurement [mg]
300Eh	00h	Time in ms (hex) e.g. 0000h e.g. 0064h e.g. 03E8h	U16	R+W	Output Filter: disabled (default) time constant 100ms time constant 1000ms

To store manufacturer specific parameters permanent 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.

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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 have to store the settings into EEPROM by index1010h sub-id 01h to store permanently, see "CAN Object Dictionary Entries".

The EDS-files available for sensors with embedded firmware version v6.x described in this document should have a version number v6.x also.

The EDS-files below are available at www.dis-sensors.com under 'downloads':

- QG_Ftype_1_axis_360v_v6.x
- QG_Ftype_2_axis_90h_v6.x
- QG_Ftype_2_axis_30h_v6.x
- QG_Ftype_3_axis_8g_v6.x

Document revision control

V1.0		New document based on Rev. v5.05 , For "N" series only (e.g. QG65N, QG76N)
V1.1		Removed old non CAN open object 2300.
V1.2		Add instruction to change node-ID
V1.3		Change instruction of changing node id
V6.4	20190605	Correct sample rate MEMS, add examples of changing sensor settings.
V6.5	20190805	Minor text changes, TPDO2 default disabled, TPDO-mapping procedure changed to CANopen standard, this procedure added in the manual,

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')
LPF Low Pass Filter
FIR Finite Impulse Response
EDS Electronic Data Sheet
CiA CAN in Automation
EMCY Emergency

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Sensor-Specific: Inclination 1-axis (vertical plane): ±180°

Sensor output data available for TPDO-mapping:

Index 6401h		**Sensor output data Inclination 1-axis (vertical plane) ±180° (or ±360°)**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (9)
01h	U16	Angle normal (0 to +35999)
02h	U16	Angle reversed (+35999 to 0)
03h	S16	Angle normal (-17999 to +18000)
04h	S16	Angle reversed (+17999 to -18000)
05h	U16	Raw counts X-sensor (-512 to +512) (*)
06h	U16	Raw counts Y-sensor (-512 to +512) (*)
07h	S16	0h (reserved for future use)
08h	S16	0h (reserved for future use)
09h	U16	Reserved for future use

TPDO1-mapping:

Index 1A00h		**Default TPDO1-mapping**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (2)
01h	U32	64010310h (Index: 6401h, Sub-index: 03h, length in bits:10h) e.g. default = Angle normal (-17999 to +18000)

TPDO2-mapping:

Index 1A01h		**Default TPDO2-mapping**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (2)
01h	U32	64010510h (Index: 6401h, Sub-index: 05h, length in bits:10h) e.g. default = Raw counts X-sensor (-512 to +512)
02h	U32	64010610h (Index: 6401h, Sub-index: 06h, length in bits:10h) e.g. default = Raw counts Y-sensor (-512 to +512)

TPDO mapping procedure: e.g. for TPDO1, Node-ID 1 with COB-ID 181h

- Disable the TPDO — 1800h.01h = C0000181h
- Set the nr. of entries to 0 — 1A00h.00h = 00h
- Set the required TPDO-mapping — 1A00h.01h = required mapping
- Set the nr. of entries to the correct value again — 1A00h.00h = 01h
- Enable the TPDO — 1800h.01h = 40000181h

To store TPDO-mapping permanent into the EEPROM of the sensor CAN-object 1010h should be used. Otherwise the changes will be lost after a power cycle.

(*) Raw counts are uncalibrated sensor-chip values direct proportional to the g-force (no offset/gain compensation, no temperature compensation and no non-linearity calibration).

CAN Object Dictionary Entries (Manufacturer Specific Profile section):

Manufacturer specific parameters Inclination 1-axis (vertical plane) 360° (or ±180°)					
Index	Sub-index	Data	Type	Read/Write	Description
300Fh	00h	01h 00h FFh	U8	W R R	Start center adjustment, allow 1 second before read Center adjustment successful. Center adjustment failed
3010h	00h	1	U8	R	Number of entries
	01h	 e.g. 0063h	U16	R+W	Offset after center adjustment (1LSB=0.01°) e.g. offset = 0.99°

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Sensor-Specific: Inclination 2-axis (horizontal plane): 2x ±30°

Sensor output data available for TPDO-mapping:

Index 6401h		**Sensor output data Inclination 2-axis (horizontal plane) ±30°**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (6)
01h	S16	X-angle normal (-3000 to +3000)
02h	S16	Y-angle normal (-3000 to +3000)
03h	S16	X-angle reversed (+3000 to -3000)
04h	S16	Y-angle reversed (+3000 to -3000)
05h	U16	Raw counts X-sensor (-512 to +512) (*)
06h	U16	Raw counts Y-sensor (-512 to +512) (*)

TPDO1-mapping:

Index 1A00h		**Default TPDO1-mapping**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (2)
01h	U32	64010110h (Index: 6401h, Sub-index: 01h, length in bits:10h) e.g. default = X-angle normal (-3000 to +3000)
02h	U32	64010210h (Index: 6401h, Sub-index: 02h, length in bits:10h) e.g. default = Y-angle normal (-3000 to +3000)

TPDO2-mapping:

Index 1A01h		**Default TPDO2-mapping**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (2)
01h	U32	64010510h (Index: 6401h, Sub-index: 05h, length in bits:10h) e.g. default = Raw counts X-sensor (-512 to +512)
02h	U32	64010610h (Index: 6401h, Sub-index: 06h, length in bits:10h) e.g. default = Raw counts Y-sensor (-512 to +512)

TPDO mapping procedure:	e.g. for TPDO1, Node-ID 1 with COB-ID 181h
• Disable the TPDO	1800h.01h = C0000181h
• Set the nr. of entries to 0	1A00h.00h = 00h
• Set the required TPDO-mapping	1A00h.01h = required mapping
• Set the nr. of entries the the correct value again	1A00h.00h = 01h
• Enable the TPDO	1800h.01h = 40000181h

To store TPDO-mapping permanent into the EEPROM of the sensor CAN-object 1010h should be used. Otherwise the changes will be lost after a power cycle.

(*) Raw counts are uncalibrated sensor-chip values direct proportional to the g-force (no offset/gain compensation, no temperature compensation and no non-linearity calibration).

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CAN Object Dictionary Entries (Manufacturer Specific Profile section):

Manufacturer specific parameters Inclination 2-axis (horizontal plane) ±30°					
Index	Sub-index	Data	Type	Read/Write	Description
300Fh	00h		S8		Center adjustment:
		01h		W	Start center adjustment X-axis
		02h		W	Start center adjustment Y-axis
		03h		W	Start center adjustment X- AND Y-axis
					Center adjustment response: *(allow 1 second before read)*
		00h		R	Center adjustment successful.
		FFh		R	Center adjustment X-axis failed
		FEh		R	Center adjustment Y-axis failed
		FDh		R	Center adjustment X- AND Y-axis failed
3010h	00h	2		R	Number of entries
	01h	e.g. 0063h	S16	R+W	Offset X-axis after center adjustment (1LSB=0.01°) e.g. offset = 0.99°
	02h	e.g. FF9Dh	S16	R+W	Offset Y-axis after center adjustment (1LSB=0.01°) e.g. offset = -0.99°

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Sensor-Specific: Inclination 2-axis (horizontal plane): 2x ±90°

Sensor output data available for TPDO-mapping:

Index 6401h		**Sensor output data Inclination 2-axis (horizontal plane) ±90°**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (6)
01h	S16	X-angle normal (-9000 to +9000)
02h	S16	Y-angle normal (-9000 to +9000)
03h	S16	X-angle reversed (+9000 to -9000)
04h	S16	Y-angle reversed (+9000 to -9000)
05h	U16	Raw counts X-sensor (-512 to +512) (*)
06h	U16	Raw counts Y-sensor (-512 to +512) (*)

TPDO1-mapping:

Index 1A00h		**Default TPDO1-mapping**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (2)
01h	U32	64010110h (Index: 6401h, Sub-index: 01h, length in bits:10h) e.g. default = X-angle normal (-9000 to +9000)
02h	U32	64010210h (Index: 6401h, Sub-index: 02h, length in bits:10h) e.g. default = Y-angle normal (-9000 to +9000)

TPDO2-mapping:

Index 1A01h		**Default TPDO2-mapping**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (2)
01h	U32	64010510h (Index: 6401h, Sub-index: 05h, length in bits:10h) e.g. default = Raw counts X-sensor (-512 to +512)
02h	U32	64010610h (Index: 6401h, Sub-index: 06h, length in bits:10h) e.g. default = Raw counts Y-sensor (-512 to +512)

TPDO mapping procedure:	e.g. for TPDO1, Node-ID 1 with COB-ID 181h
• Disable the TPDO	1800h.01h = C0000181h
• Set the nr. of entries to 0	1A00h.00h = 00h
• Set the required TPDO-mapping	1A00h.01h = required mapping
• Set the nr. of entries the the correct value again	1A00h.00h = 01h
• Enable the TPDO	1800h.01h = 40000181h

To store TPDO-mapping permanent into the EEPROM of the sensor CAN-object 1010h should be used. Otherwise the changes will be lost after a power cycle.

(*) Raw counts are uncalibrated sensor-chip values direct proportional to the g-force (no offset/gain compensation, no temperature compensation and no non-linearity calibration).

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CAN Object Dictionary Entries (Manufacturer Specific Profile section):

Manufacturer specific parameters Inclination 2-axis (horizontal plane) ±90°					
Index	Sub-index	Data	Type	Read/Write	Description
300Fh	00h		S8		Start center adjustment:
		01h		W	X-axis
		02h		W	Y-axis
		03h		W	X- AND Y-axis
					Center adjustment response:*(allow 1 second before read)*
		00h		R	Center adjustment successful.
		FFh		R	X-axis failed
		FEh		R	Y-axis failed
		FDh		R	X- AND Y-axis failed
3010h	00h	2	U8	R	Number of entries
	01h	e.g. 0063h	S16	R+W	Offset X-axis after center adjustment (1LSB=0.01°) e.g. offset = 0.99°
	02h	e.g. FF9Dh	S16	R+W	Offset Y-axis after center adjustment (1LSB=0.01°) e.g. offset = -0.99°

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Sensor-Specific: Acceleration 3-axis (horizontal plane): up to 3x ±8G

Sensor output data available for TPDO-mapping:

Index 6401h		**Sensor output data Acceleration 3-axis (horizontal plane) ± 8 G**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (09h)
01h	S16	X-acceleration within interval* (-8000 to +8000)
02h	S16	Y-acceleration within interval* (-8000 to +8000)
03h	S16	Z-acceleration within interval* (-8000 to +8000)
04h	S16	X-acceleration invers within interval* (+8000 to -8000)
05h	S16	Y-acceleration invers within interval* (+8000 to -8000)
06h	S16	Z-acceleration invers within interval* (+8000 to -8000)
07h	S16	X-acceleration raw counts(-512 to +512)
08h	S16	Y-acceleration raw counts(-512 to +512)
09h	S16	Z-acceleration raw counts(-512 to +512)

* note: interval is TPDO1 event-time
** note: RMS means Root Mean Square, also known as the quadratic mean.

TPDO1-mapping:

Index 1A00h		**Default TPDO1-mapping**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (3)
01h	U32	64010110h (Index: 6401h, Sub-index: 01h, length in bits:10h) e.g. default = X-acceleration average within interval (-8000 to +8000)
02h	U32	64010210h (Index: 6401h, Sub-index: 02h, length in bits:10h) e.g. default = Y-acceleration average within interval (-8000 to +8000)
03h	U32	64010310h (Index: 6401h, Sub-index: 03h, length in bits:10h) e.g. default = Z-acceleration average within interval (-8000 to +8000)

TPDO2-mapping:

Index 1A01h		**Default TPDO2-mapping**
Sub-index	Type	Description
00h	U8	Number of parameters in this object (3)
01h	U32	64010710h (Index: 6401h, Sub-index: 07h, length in bits:10h) e.g. default = X-acceleration raw counts(-512 to +512)
02h	U32	64010810h (Index: 6401h, Sub-index: 08h, length in bits:10h) e.g. default = Y- acceleration raw counts(-512 to +512)
03h	U32	64010910h (Index: 6401h, Sub-index: 09h, length in bits:10h) e.g. default = Z- acceleration raw counts(-512 to +512)

TPDO mapping procedure:	e.g. for TPDO1, Node-ID 1 with COB-ID 181h
• Disable the TPDO	1800h.01h = C0000181h
• Set the nr. of entries to 0	1A00h.00h = 00h
• Set the required TPDO-mapping	1A00h.01h = required mapping
• Set the nr. of entries the the correct value again	1A00h.00h = 01h
• Enable the TPDO	1800h.01h = 40000181h

To store TPDO-mapping permanent into the EEPROM of the sensor CAN-object 1010h should be used. Otherwise the changes will be lost after a power cycle.

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CAN Object Dictionary Entries (Manufacturer Specific Profile section):

Manufacturer specific parameters Acceleration 2-axis (horizontal plane) ± 8 G					
Index	Sub-index	Data	Type	Read/Write	Description
300Fh	00h		S8	W	Start zero adjustment:
		01h		W	X-axis
		02h		W	Y-axis
		03h			X- AND Y-axis
					Zero adjustment Response: *(allow 1 second before read)*
		00h		R	Zero adjustment successful.
		FFh		R	X-axis failed
		FEh		R	Y-axis failed
		FCh		R	Z- axis failed
3010h	00	3	U8	R	Number of entries
	01h	e.g. 0063h	S16	R+W	Zero offset X-axis after zero adjustment (1 LSB=1 mg) e.g. offset = 99 mg
	02h	e.g. FF9Dh	S16	R+W	Zero offset Y-axis after zero adjustment (1 LSB=1 mg) e.g. offset = -99 mg
	03h	e.g. FF9Dh	S16	R+W	Zero offset Z-axis after zero adjustment (1 LSB=1 mg) e.g. offset = -99 mg
3020h	00	3	U8	R	Number of entrees
	01	e.g. 3E8	S16	R+W	Gravity compensation X axis (1 LSB= 1mg) e.g. compensation =1g
	02	e.g. 3E8	S16	R+W	Gravity compensation Y axis (1 LSB= 1mg) e.g. compensation =1g
	03	e.g. 3E8	S16	R+W	Gravity compensation Z axis (1 LSB= 1mg) e.g. compensation =1g

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APPENDIX 1: Schematic overview inclination measurement

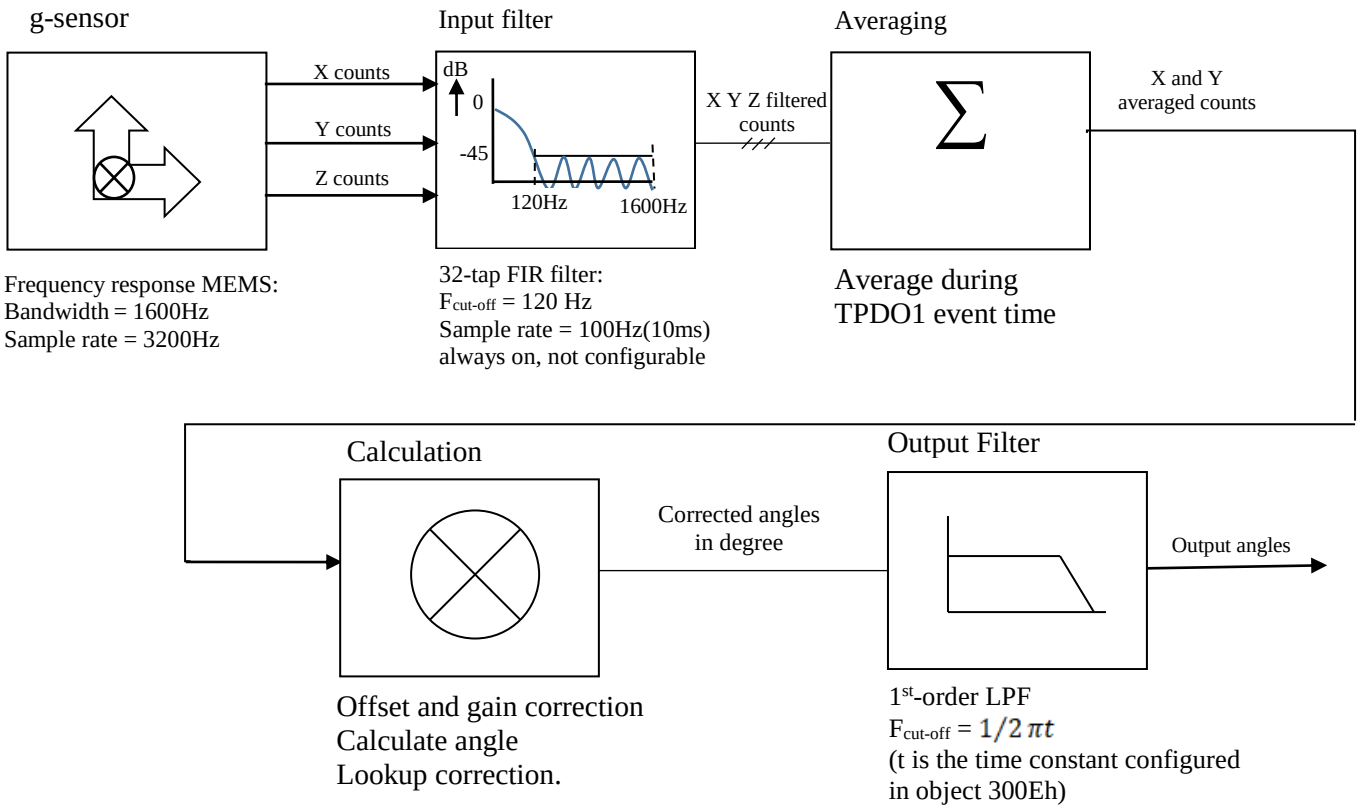


Figure 1: Schematic overview inclination measurement.

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APPENDIX 2: Schematic overview acceleration measurement

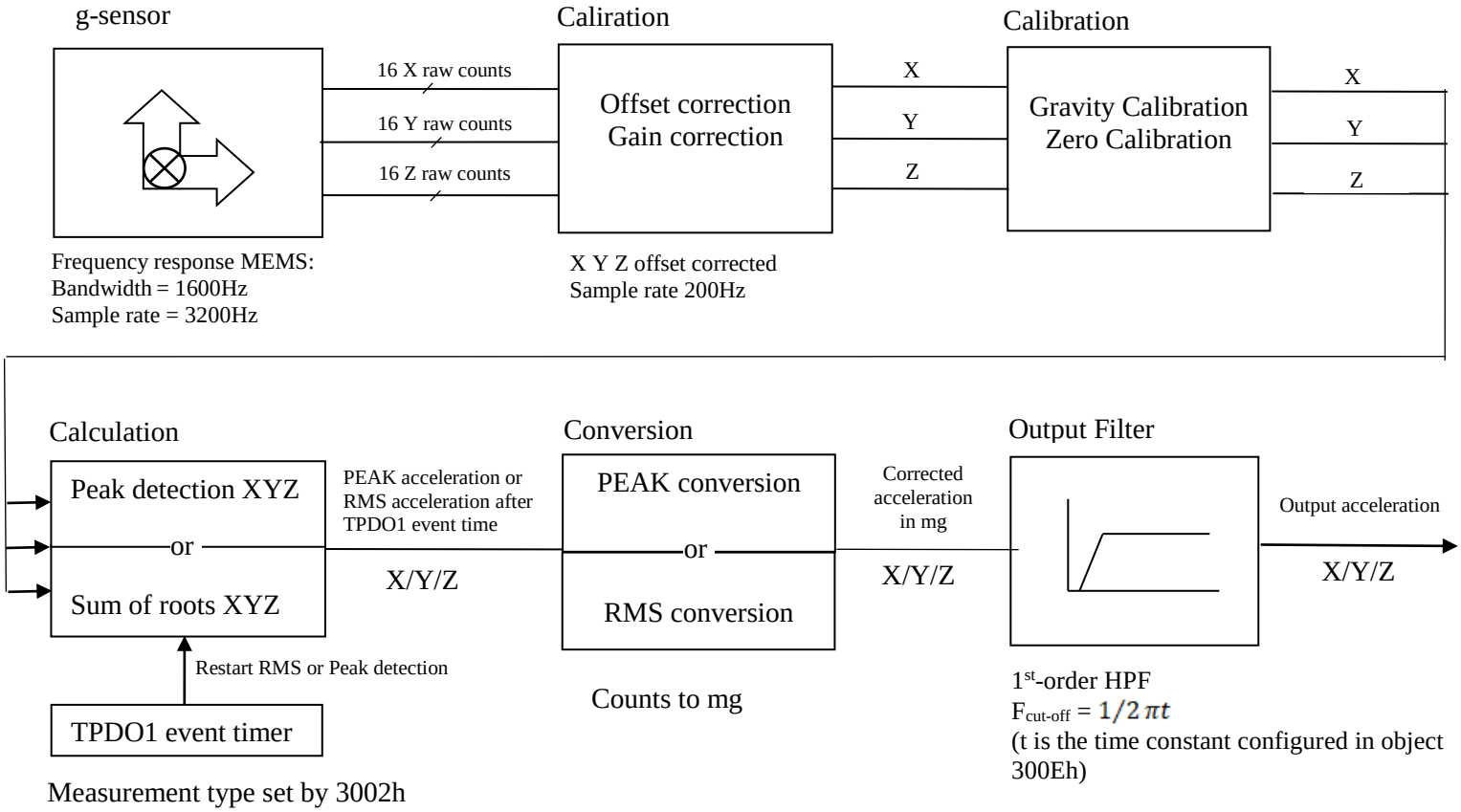


Figure 2: Schematic overview acceleration measurement.

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