ELECTRONICS & DEFENSE

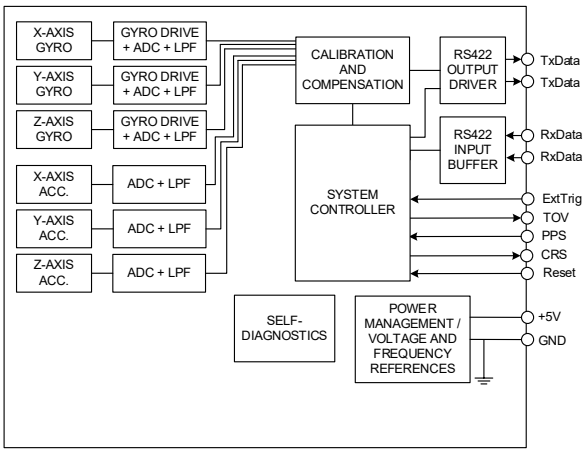
STIM320

Inertial Measurement Unit

FEATURES:

- Miniature package
- Low noise
- Low bias instability
- Excellent performance in vibration and shock environments
- 6 axes offered in same package
  - Electronically calibrated axis alignment
- Gyros based on Safran ButterflyGyro™
  - Single-crystal silicon technology
  - No intrinsic wear-out effects
- High stability accelerometers
- PPS output
- Output-signal with programmable timing (CRS)
- Multi-module transmission
- Insensitive to magnetic fields
- Full EMI compliance
- Digital interface, RS422
- Fully configurable
- Continuous self-diagnostics
- RoHS compatible

BLOCK DIAGRAM:



1 GENERAL DESCRIPTION

STIM320 is an IMU consisting of 3 high accuracy MEMS-based gyros and 3 high stability accelerometers in a miniature package. Each axis is factory-calibrated for bias, scale-factor and compensated for temperature effects to provide high-accuracy measurements in the temperature range -40°C to +85°C. The unit runs off a single +5V supply.

The STIM communicates via a standard high-level RS422 interface. The use of a 32-bit RISC ARM microcontroller provides flexibility in the configuration, like choice of output unit, sample rate, low pass filter –3dB frequency and RS422 bit-rate and protocol parameters. All configurable parameters can be defined when ordering or set by customer.

When the STIM is powered up, it will perform an internal system check and synchronize the sensor channels. As an acknowledgement of the complete power-up sequence, it will provide special datagrams containing part number, serial number, configuration and bias trim offset data. The STIM will then automatically proceed to provide measurement data.

The measurement data is transmitted as packages of data on a fixed format (datagram) at intervals given by the sample rate together with a synchronization signal (TOV). Means for synchronization is further enhanced by a PPS input and the provision of a digital output signal with programmable timing. The datagram is in binary coded format in order to have an efficient transfer of data. In addition to the measurement data itself, the datagram contains an identifier, status bytes, sample-counter and a 32-bit CRC (Cyclic Redundancy Check) to provide high degree of fault detection in the transmissions. The status bytes will flag any detected errors in the system. The STIM can also be configured to transmit data only when triggered by a separate digital input signal (ExtTrig).

For more advanced users, the IMU may be put in Service Mode. In this mode all the configuration parameters can be intermediately or permanently changed by overwriting the current settings in the flash memory. In Service Mode the commands and responses are in a human readable format (ASCII); to enable the use of terminal-type software during typical product integration. Service Mode also provides the ability to perform single measurements, perform diagnostics and obtain a higher detail level of detected errors reported in the status bytes.

Finally, the STIM may be put in Utility Mode. This mode is similar to Service Mode, but made for machine-machine communication.

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3 DEFINITIONS AND ABBREVIATIONS USED IN DOCUMENT

3.1 Definitions

g_0= 9.80665m/s^2 (standard gravity)

3.2 Abbreviations

Table 3-1: Abbreviations

ABBREVIATION	FULL NAME
ASCII	American Standard Code for Information Interchange
BCD	Binary Coded Decimal
BSL	Best Straight Line
BTO	Bias Trim Offset
CIC-filter	Cascaded Integrator-Comb filter
CR	Carriage Return
CRC	Cyclic Redundancy Check
CRS	Counter Restart Signal
ESD	Electro-Static Discharge
ExtTrig	External Trigger
GND	Ground
IMU	Inertial Measurement Unit
LF	Line Feed
LP filter	Low-Pass filter
MEMS	Micro Electro Mechanical Structure
NRST	Negative (active) Reset
PPS	Pulse Per Second
rms	root mean square
RxD	Receive Data
STIM	The product specified in this datasheet
TOV	Time of Validity
TxD	Transmit Data
VRC	Vibration Rectification Coefficient
VSUP	Voltage supply

4 ABSOLUTE MAXIMUM RATINGS

Stresses beyond those listed in Table 4-1 may cause permanent damage to the device.

Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Table 4-1: Absolute maximum ratings

Parameter	Rating	Comment
Mechanical shock	1500g/0.5ms half-sine	Any direction. Ref: MIL STD-883G
ESD human body model	±2kV	Ref: JEDEC/ESDA JS-001
Storage temperature	-55°C to +90°C	Up to 1000 hours
VSUP to GND	-7V to +7V	Reverse polarity protection implemented
RxD+ or RxD- to GND	-0.3V to +7V	
RxD+ to RxD-	±6V	with 120Ω Line Termination = ON
ExtTrig to GND	-0.3V to +7V	
PPS to GND	-0.3V to +7V	
NRST to GND	-0.3V to +7V	
Chassis to GND	500VDC	
Helium sensitivity		Not to be exposed to helium concentrations higher than those normally found in the atmosphere

5 SPECIFICATIONS

5.1 Operating conditions

Table 5-1: Operating conditions

Parameter	Conditions	Min	Nom	Max	Unit	Note
INPUT RANGE, ANGULAR RATE			±400		°/s	
INPUT RANGE, ACCELERATION			±10		g	1
POWER SUPPLY, VSUP		4.5	5.0	5.5	V	2,3
OPERATING TEMPERATURE		-40		+85	°C	

Note 1: Other ranges possible: 5g, 30g and 80g

Note 2: At supply voltages above 5.85V (nominal value) an internal voltage protection circuit will cut power and the unit will go into reset until the voltage is back within operating conditions.

Note 3: At supply voltages below 4.05V (nominal value) the unit will go into reset until the voltage is back within operating conditions. Due to power consumption being much lower in reset compared to normal operation, the series resistance between power source and the STIM could give rise to an oscillating behavior of the input voltage to the unit.

5.2 Functional specifications

5.2.1 General

Table 5-2: Functional specifications, general

Parameter	Conditions	Min	Nom	Max	Unit	Note
POWER CONSUMPTION						
Power consumption			1.8	2.5	W	
TIMING						
Start-Up time after Power-On				0.3	s	1
Time to transmit after Reset				0.2	s	2
Time to valid data			5		s	3
	T=+25°C			7	s	3
RS422 Bit-Rate			ref. Table 5-7			
RS422 Bit-Rate Accuracy				±1	%	4
Output Sample Rate				2000	samples/s	5
RS422 PROTOCOL						
Start Bit			1		bit	
Data Length			8		bits	
Parity			None			6
Stop Bits			1		bit	6
RS422 LINE TERMINATION						
Input resistance	Line termination = ON		120		Ω	
Input resistance	Line termination = OFF	48	125		kΩ	
RESET (NRST PIN)						
Logic levels	"high"	2.3			V	
	"low"			0.5	V	
Minimum hold time for reset		1			µs	
Pull-Up Resistor		80	100		kΩ	
EXTERNAL TRIGGER (ExtTrig PIN)						
Logic levels	"high"	2.3			V	
	"low"			0.6	V	
Trigger			Negative transition			
Time between triggers	Measurement unit:					
	angular rate	0.5		127	ms	7,8
	incremental angle	0.5		127	ms	7,9
	average rate	0.5		65	ms	7,10
	integrated angle	0.5		8	ms	7,11
Minimum "high" time before trigger, t_{ext_hi}		250			ns	12
Minimum "low" time after trigger, t_{ext_lo}		250			ns	12
Delay from external trigger to start of transmission, t_{ext_dl}				86	µs	12
Pull-Up Resistor		40	50		kΩ	

Parameter	Conditions	Min	Nom	Max	Unit	Note
Latency				1000	µs	
PULSE PER SECOND (PPS PIN)						
Logic levels	"high" "low"	2.3		 0.6	V V	
Pull-Up Resistor		40	50		kΩ	
TIME OF VALIDITY (TOV PIN)						
Output configuration			Open drain with internal pull up			
V_{OH}	I_{OH} = -10µA I_{OH} = -100µA	0.9 VSUP 0.7 VSUP			V V	
V_{OL}	I_{OL} = 10mA			0.1V		
TOV active level			Active "low"			
Minimum time of TOV, t_{tov_min}		50			µs	13
Delay from internal time-tick to TOV active, t_{tov_dl}			1.2	6	µs	13
Delay from TOV active to start of transmission, t_{tx_dl}				80	µs	13
COUNTER RESTART SIGNAL (CRS PIN)						
Output configuration			Open drain			
V_{OH}	I_{OH} = -10µA I_{OH} = -100µA	0.9 VSUP 0.7 VSUP				
V_{OL}	I_{OL} = 10mA			0.1V		
CRS active level			Active "low"			
Minimum time of CRS, t_{crs_min}		50			µs	14
Delay from internal time-tick to CRS active, t_{crs_dl}			1.2	6	µs	14
MULTI-MODULE TRANSMISSION						
Minimum time between datagrams, t_{mm_min}		45			µs	15
CHASSIS						
Isolation resistance chassis to GND (pin 15)	500VDC	100			MΩ	

Note 1: Time from Power-On to start of datagram transmissions (starting with part-number datagram)
Note 2: Time from Reset release to start of datagram transmissions (starting with part-number datagram)
Note 3: Time from Power-On or Reset to stable operation of the gyros. During this period the output data should be regarded as non-valid.
Note 4: If a user-defined bit-rate larger than 1.5Mbit/s is used, the deviation may exceed the specification due to the resolution of the bit-rate generator, ref. section 9.12.1
Note 5: Internal sample rate is 2000 samples/s for gyro + gyro temperature and 32000 samples/s for accelerometers and PPS filtered. Output sample rate can be configured, ref. Table 5-7. Output sample rate will be same for gyros, accelerometers, PPS and temperature
Note 6: Other values can be configured, ref. Table 5-7
Note 7: If time between triggers is longer than 127ms, the sample counter will over-run
Note 8: Time between triggers should be carefully evaluated as long time between triggers in combination with high bandwidths could lead to issues related to folding. Similar for accelerometer outputs
Note 9: If time between triggers is longer than 8ms, an overload may occur in the incremental angle. An overload will be flagged in the status byte, ref. Table 5-19. Similar for accelerometer output
Note 10: If time between triggers is longer, the accuracy of average rate may also be reduced. Similar for accelerometer output
Note 11: If time between triggers is longer, the integrated angle may have wrapped several times and hence the change in angle from last sample will not be possible to calculate. Similar for accelerometer output
Note 12: For definition, ref. Figure 7-3
Note 13: For definition, ref. Figure 7-5 and Figure 7-6
Note 14: For definition, ref Figure 7-8
Note 15: For definition, ref Equation 1

5.2.2 Gyros

Table 5-3: Functional specifications, gyros

Parameter	Conditions	Min	Nom	Max	Unit	Note
GYRO						
Full Scale (FS)			±400		°/s	1
Resolution			24		bits	
			0.22		°/h	
Scale Factor Accuracy			±500		ppm	
Non-Linearity	±400°/s		20		ppm	2
Bandwidth (-3dB)	LP-filter -3dB = 262Hz		262		Hz	3
Group Delay	LP-filter -3dB = 262Hz		2.2		ms	5
	LP-filter -3dB = 131Hz		3.7		ms	5
	LP-filter -3dB = 66Hz		6.7		ms	5
	LP-filter -3dB = 33Hz		12.7		ms	5
	LP-filter -3dB = 16Hz		24.7		ms	5
Bias Range		-250	0	+250	°/h	
Bias Trim offset range			±1		°/s	
Bias Run-Run			4		°/h	
Drift Rate Stability			1		°/h	
Bias error over temperature	ΔT ≤ ±1°C/min		10		°/h rms	
Bias Instability	Allan Variance @25°C					
Minimum			0.4		°/h	
600s integration time			0.5		°/h	
Angular Random Walk	Allan Variance @25°C		0.10		°/√h	
Linear Acceleration Effect						
Bias	With g-compensation		1		°/h/g	6
	No g-compensation		7		°/h/g	6
Scale Factor	With g-compensation		50		ppm/g	6
	No g-compensation		400		ppm/g	6
Vibration Rectification Coefficient			Ref. Figure 5-1		$°/h/g_{rms}^2$	
Misalignment			1		mrad	7
Non-Orthogonality			0.2		mrad	8

Note 1: Output is monotonous and will saturate at ±480°/s
Note 2: Largest deviation from BSL (Best Straight Line) over the range specified
Note 3: Low-pass filter -3dB frequency can be configured, ref. Table 5-7 and section 5.3.1.4
Note 4: Other values can be configured, ref. Table 5-7. Sample rate will be same for gyros, accelerometers, PPS and temperature
Note 5: Total delay to start of datagram transmission = group delay + 0.5ms + t_{tov_dl} + t_{tx_dl}. For output units with delayed output, the group delay will be 1.0ms longer, ref. section 7.6.2.2.1. For more details, see TS1631 Application Note "Timing details between sampling and datagram transmission"
Note 6: Section 6.2 gives advice on sensitive directions
Note 7: Ref. Figure 6-5 for definition of reference points used in axis alignment
Note 8: Gyros and accelerometers are calibrated in the same test-insertion to ensure minimum misalignment between the three sensor-axis systems

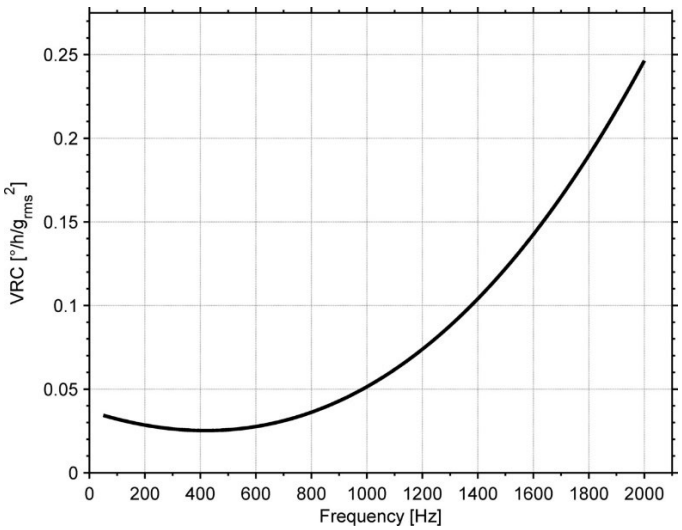

Figure 5-1: Nominal VRC at 20g rms for gyros (ref. section 6.2 for sensitive directions to acceleration-forces)

5.2.3 10g accelerometers

Table 5-4: Functional specifications, 10g accelerometers

Parameter	Conditions	Min	Nom	Max	Unit	Note
ACCELEROMETER						
Full Scale (FS)			±10		g	1
Resolution			24		bits	
			1.9		µg	
Scale Factor Accuracy			±200		ppm	
Scale Factor 1 year stability			600		ppm	
Non-Linearity	±10g		100		ppm	2
Bandwidth (-3dB)	LP-filter -3dB = 262Hz		225		Hz	3
Group Delay	LP-filter -3dB = 262Hz		3.0		ms	4
	LP-filter -3dB = 131Hz		4.5		ms	4
	LP-filter -3dB = 66Hz		7.5		ms	4
	LP-filter -3dB = 33Hz		13		ms	4
	LP-filter -3dB = 16Hz		25		ms	4
Bias 1 year stability			1.2		mg	
Bias Trim offset range			±0.1		g	
Bias error over temperature	ΔT ≤ ±1°C/min		±0.7		mg rms	
Bias Instability	Allan Variance @25°C					
Minimum			0.003		mg	
600s integration time			0.004		mg	
Velocity Random Walk	Allan Variance @25°C		0.015		m/s/√h	
Vibration Rectification Coefficient			Ref. Figure 5-2		mg/g_{rms}^2	
Misalignment			1		mrad	5
Non-Orthogonality			0.2		mrad	6

Note 1: Overload-bit in STATUS-byte (ref. section 5.6) will be set at 11g (+10% of range)
Note 2: Largest deviation from BSL (Best Straight Line) over the range specified
Note 3: Other values can be configured, ref. Table 5-7 and section 5.3.2.3
Note 4: Total delay to start of datagram transmission = group delay + 0.5ms + t_{tov_dl} + t_{tx_dl}. For more details, see TS1631 Application Note “Timing details between sampling and datagram transmission”
Note 5: Ref. Figure 6-5 for definition of reference points used in axis alignment
Note 6: Gyros and accelerometers are calibrated in the same test-insertion to ensure minimum misalignment between the three sensor-axis systems

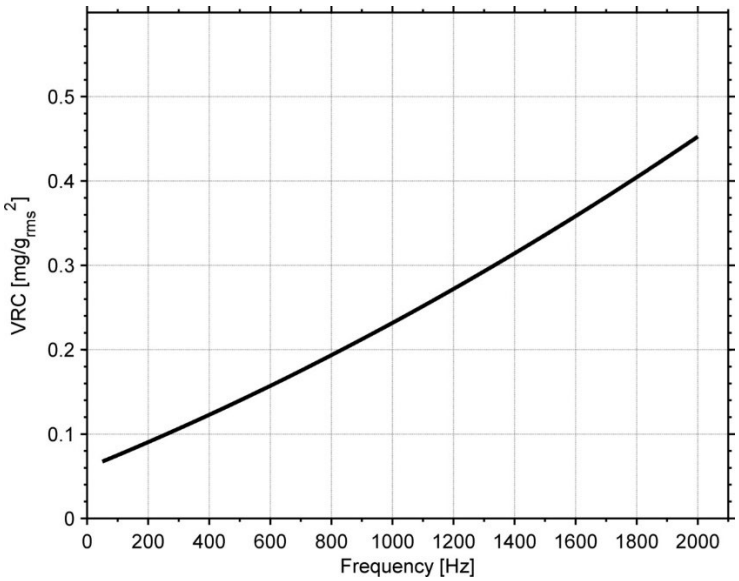

Figure 5-2: Nominal VRC at 10g rms for 10g accelerometers

5.2.4 PPS input

Table 5-5: Functional specifications, PPS input

Parameter	Conditions	Min	Nom	Max	Unit	Note
Time since detection, resolution			1		µs	
Time since detection				8388	ms	
PPS filtered, bandwidth (-3dB)	LP filter -3dB = 262Hz		262		Hz	1
PPS filtered, Group Delay	LP filter -3dB = 262Hz		1.4		ms	2
	LP filter -3dB = 131Hz		2.9		ms	2
	LP filter -3dB = 66Hz		5.9		ms	2
	LP filter -3dB = 33Hz		12		ms	2
	LP filter -3dB = 16Hz		24		ms	2

Note 1: Other values can be configured, ref. Table 5-7 and section 5.3.3.1
Note 2: Total delay to start of datagram transmission = group delay + 0.5ms + t_{tov_dl} + t_{tx_dl}

5.2.5 Temperature

Table 5-6: Functional specifications, temperature

Parameter	Conditions	Min	Nom	Max	Unit	Note
Resolution			0.0039		°C	
Temperature accuracy			±5		°C	

5.3 Typical performance characteristics

5.3.1 Gyro characteristics

5.3.1.1 Root Allan Variance of gyro

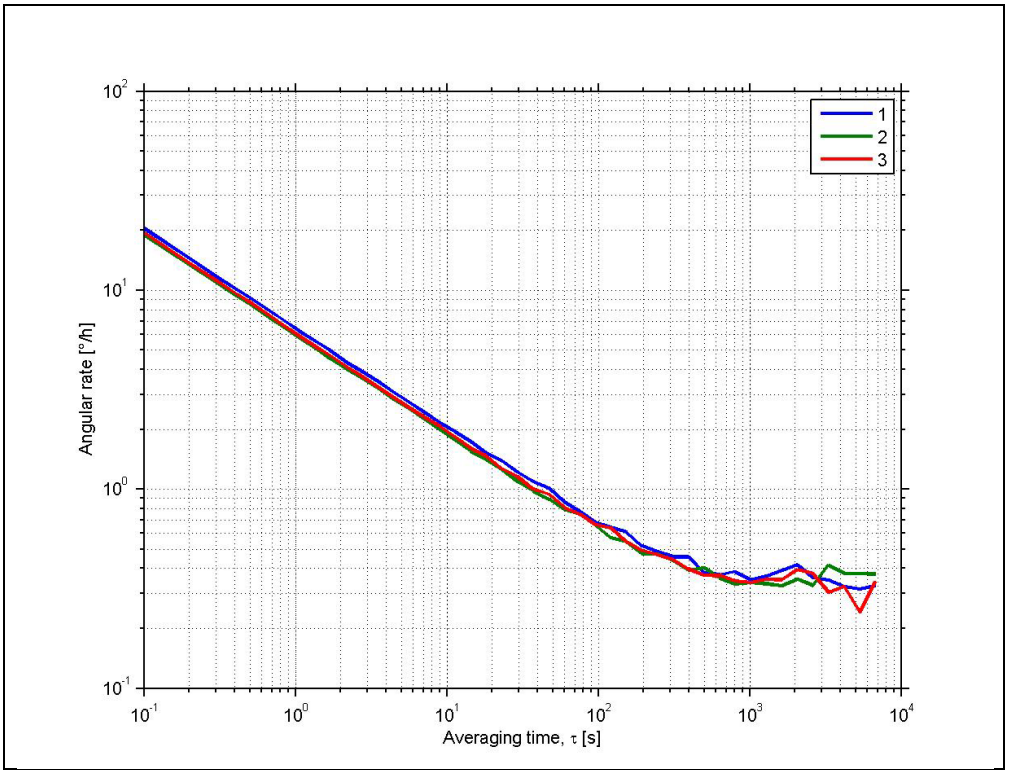

Figure 5-3: Typical Root Allan-Variance of gyro (400°/s gyro)

5.3.1.2 Initial bias drift of gyro

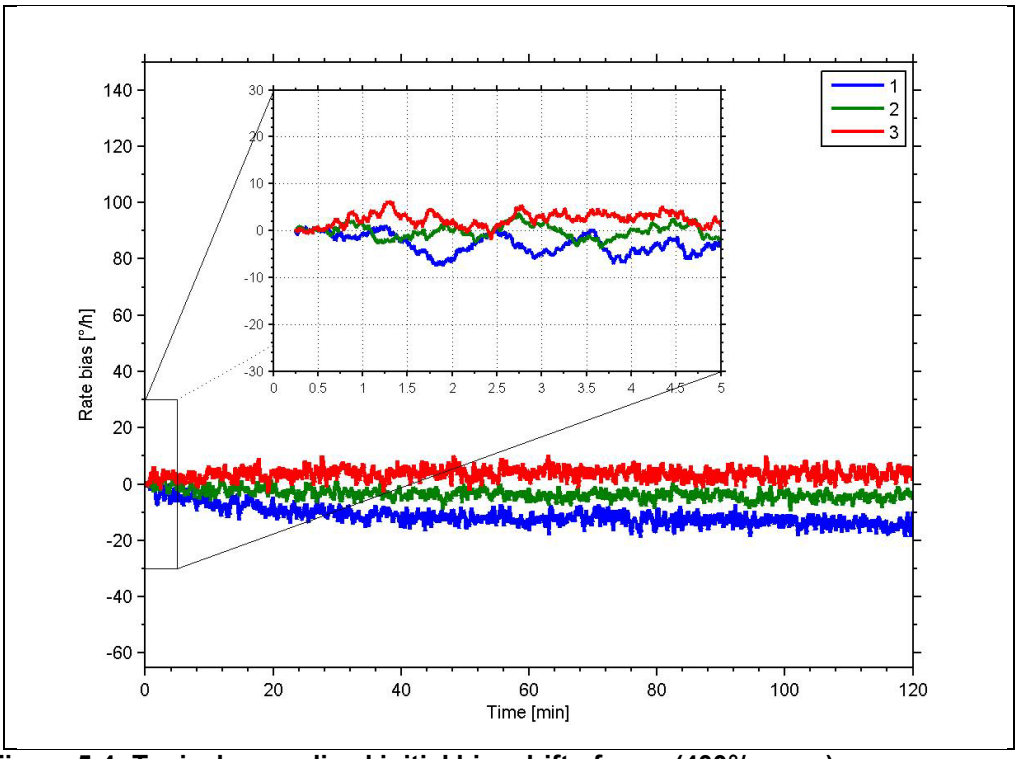

Figure 5-4: Typical normalized initial bias drift of gyro (400°/s gyro)

5.3.1.3 Bias drift over temperature

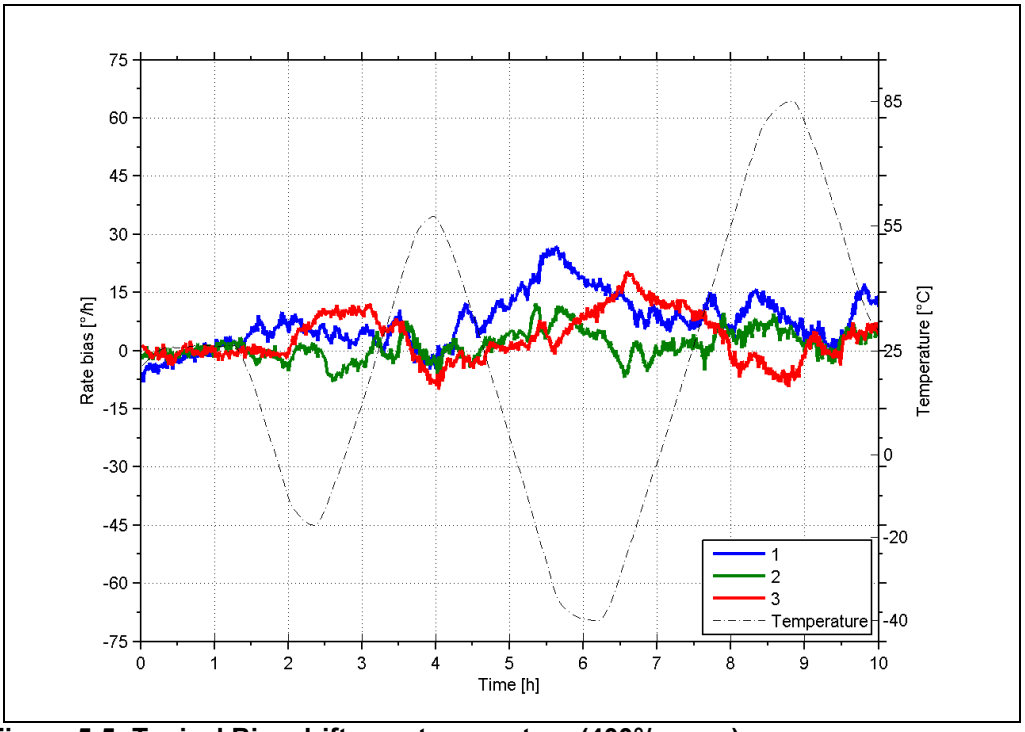

Figure 5-5: Typical Bias drift over temperature (400°/s gyro)

5.3.1.4 Frequency characteristics of gyros

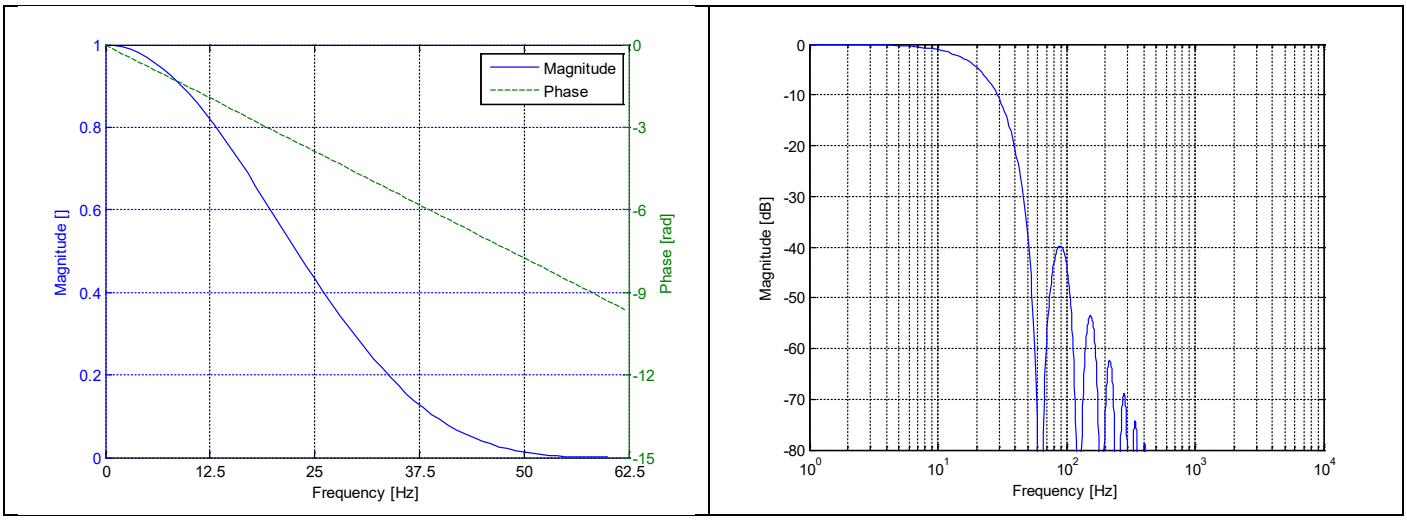

Figure 5-6: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 16Hz

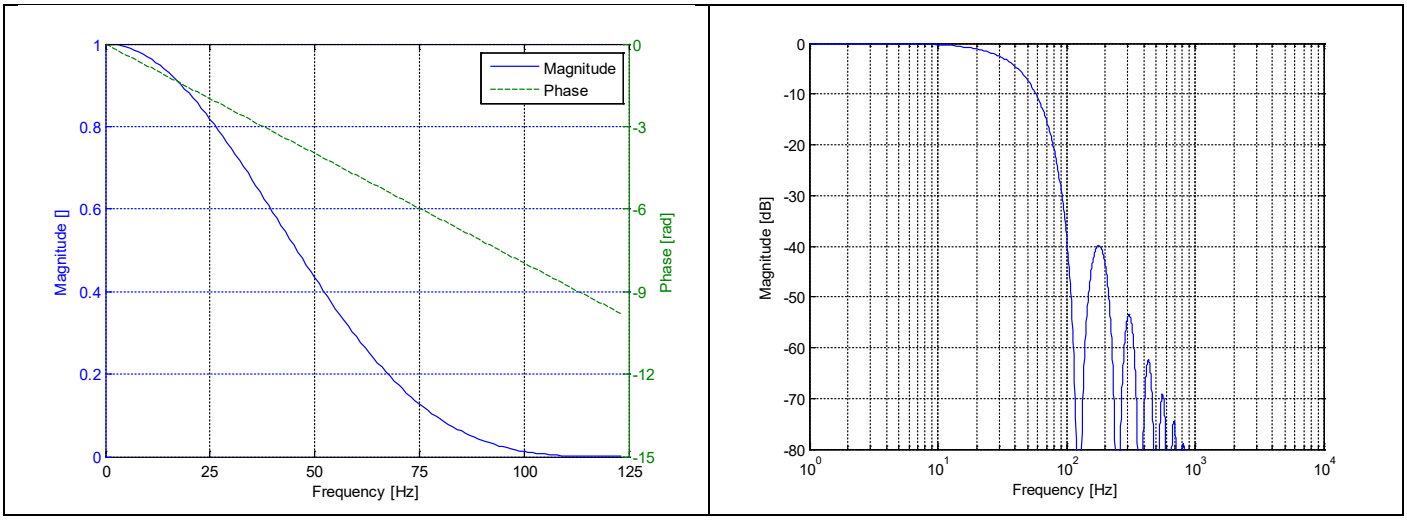

Figure 5-7: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 33Hz

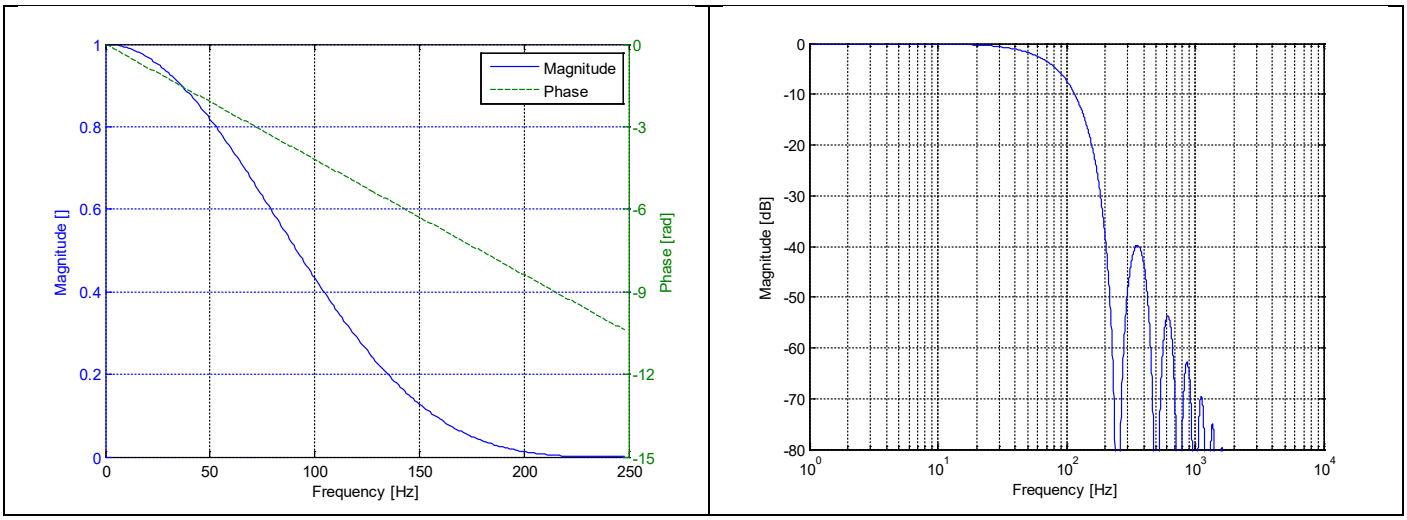

Figure 5-8: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 66Hz

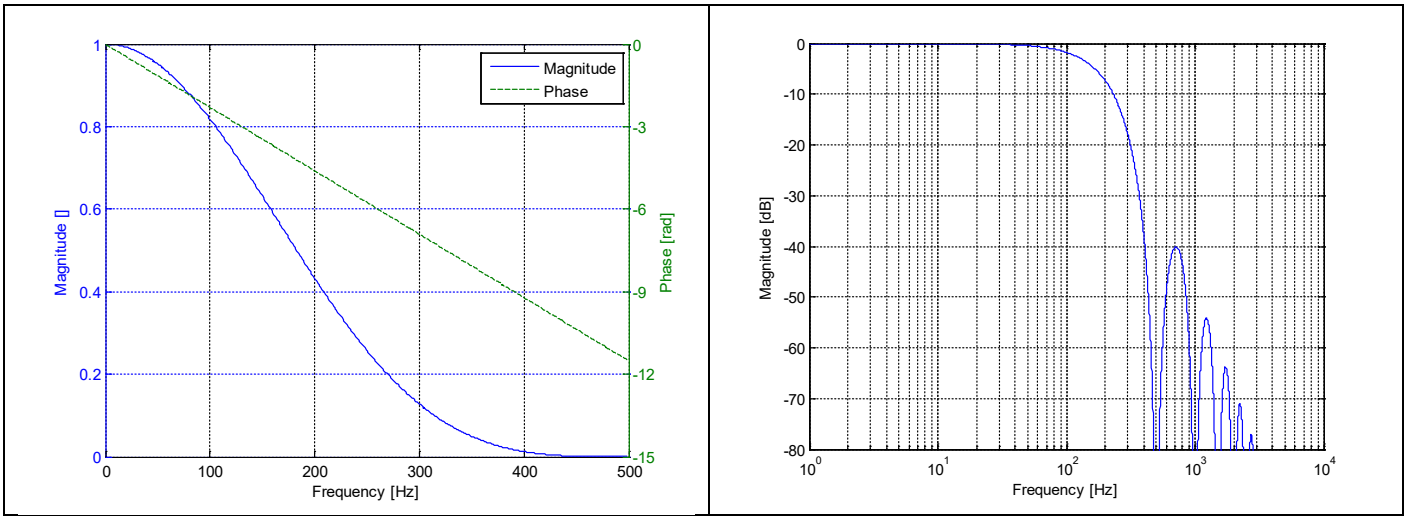

Figure 5-9: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 131Hz

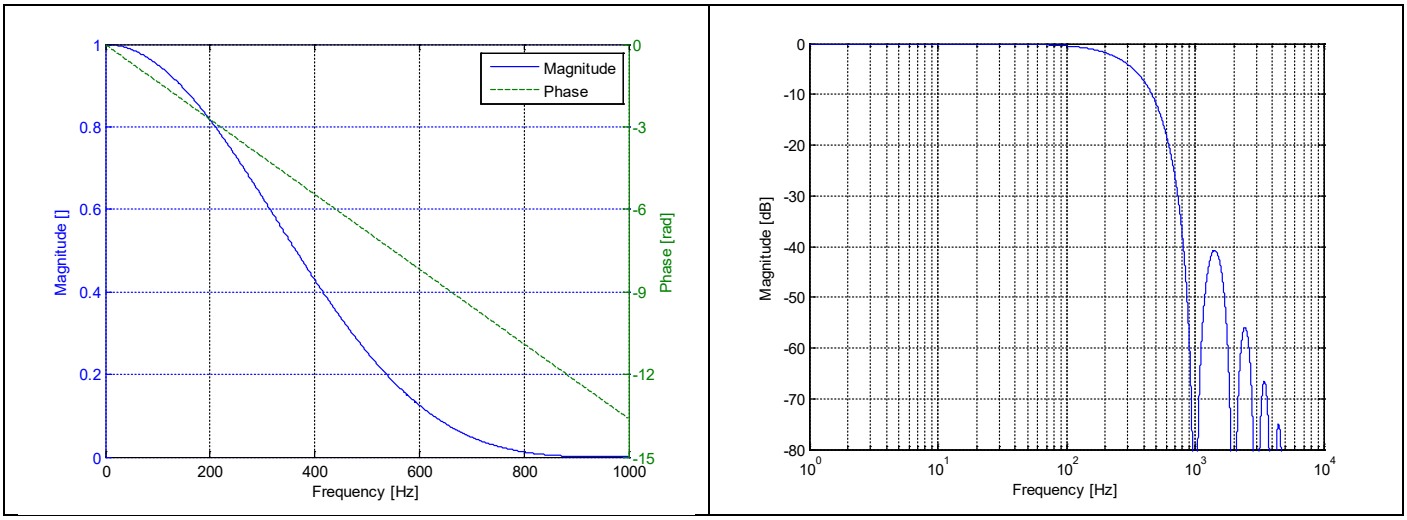

Figure 5-10: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 262Hz

5.3.2 Accelerometer characteristics

5.3.2.1 Root Allan Variance of accelerometer

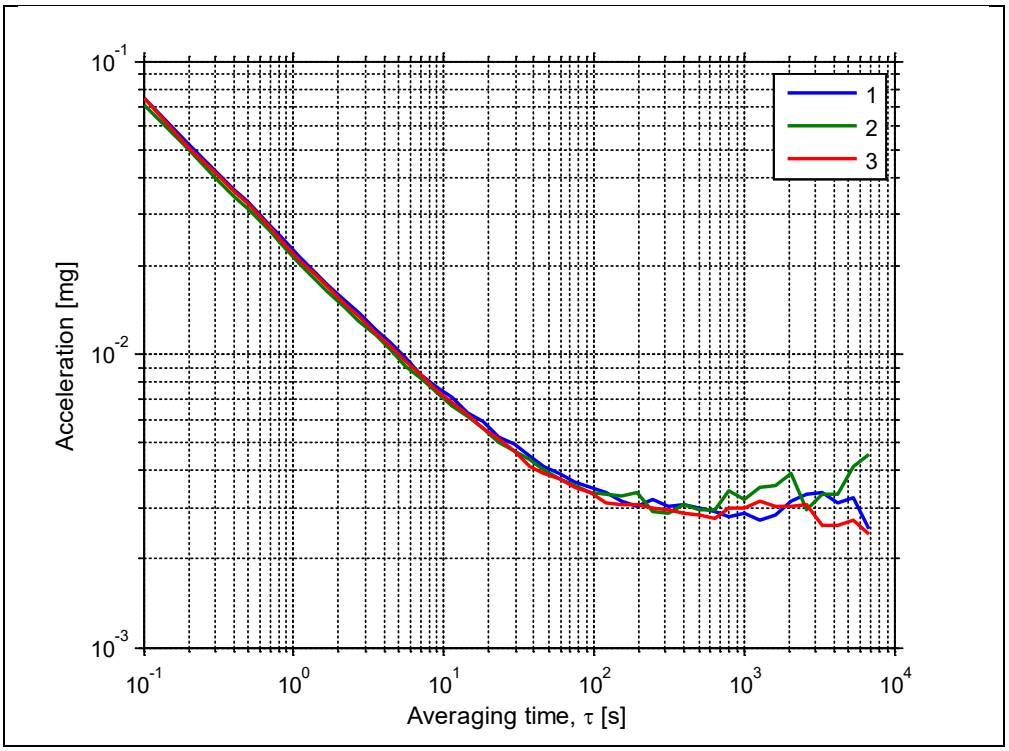

Figure 5-11: Typical Allan-Variance of accelerometer (10g accelerometer)

5.3.2.2 Initial bias drift of accelerometer

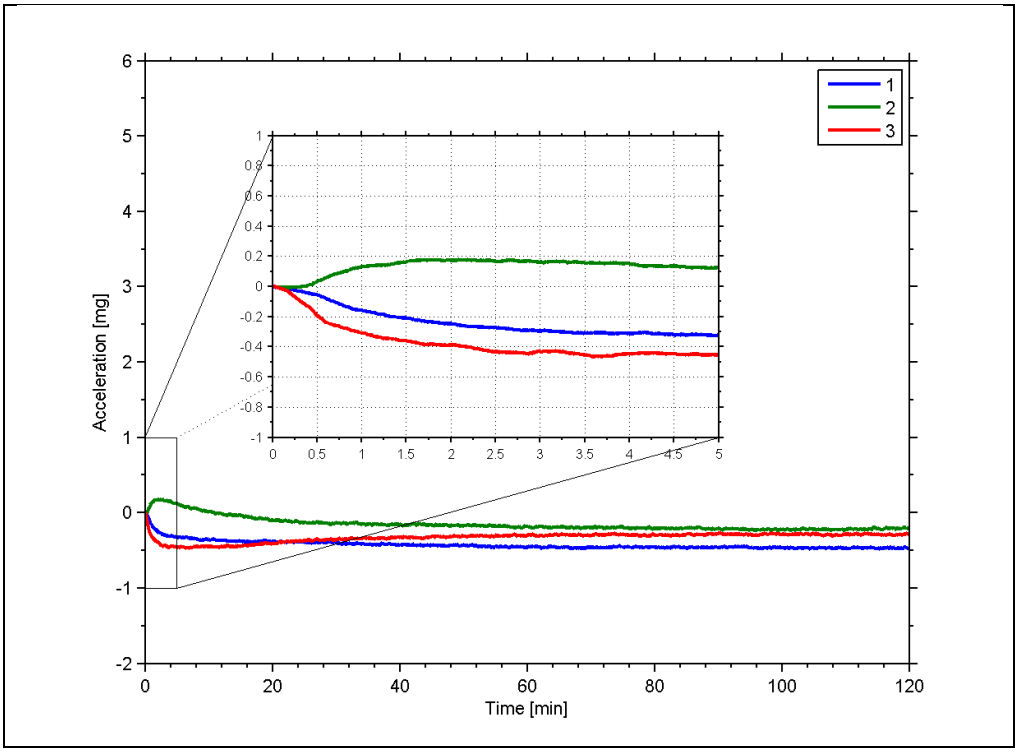

Figure 5-12: Typical normalized initial bias drift of accelerometer (10g accelerometer)

5.3.2.3 Frequency characteristics of accelerometers

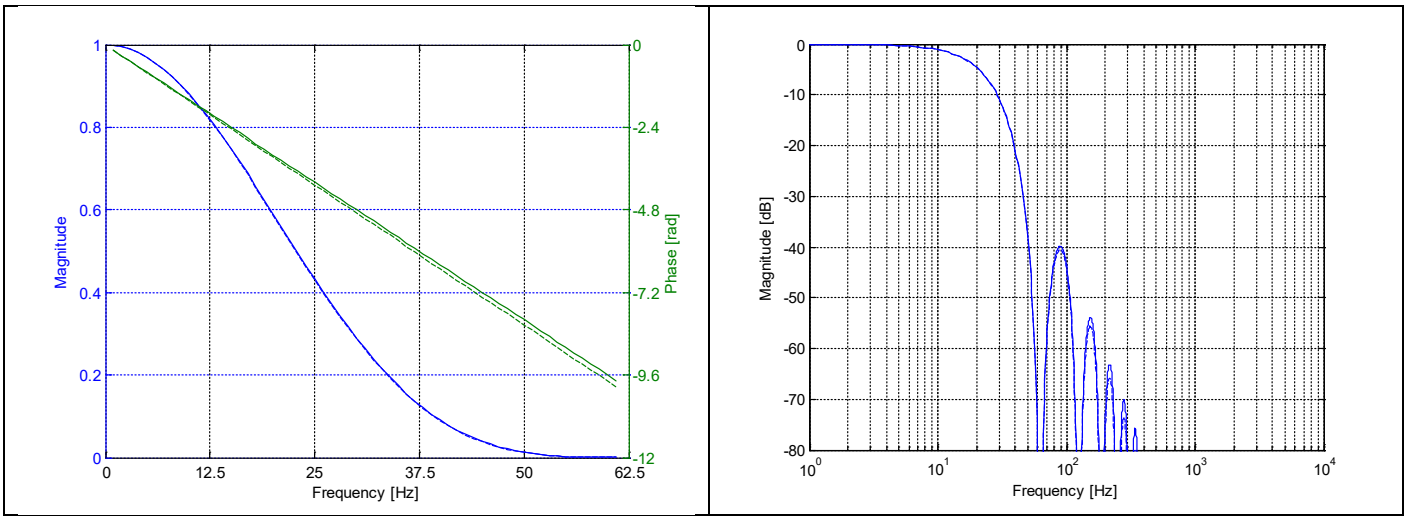

Figure 5-13: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 16Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)

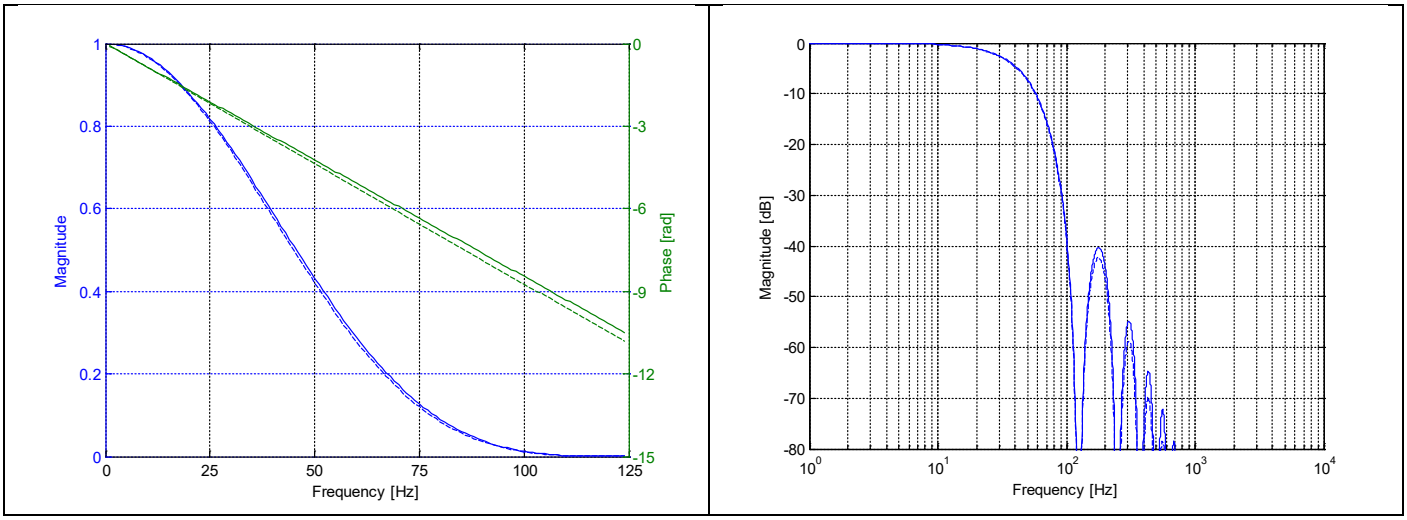

Figure 5-14: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 33Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)

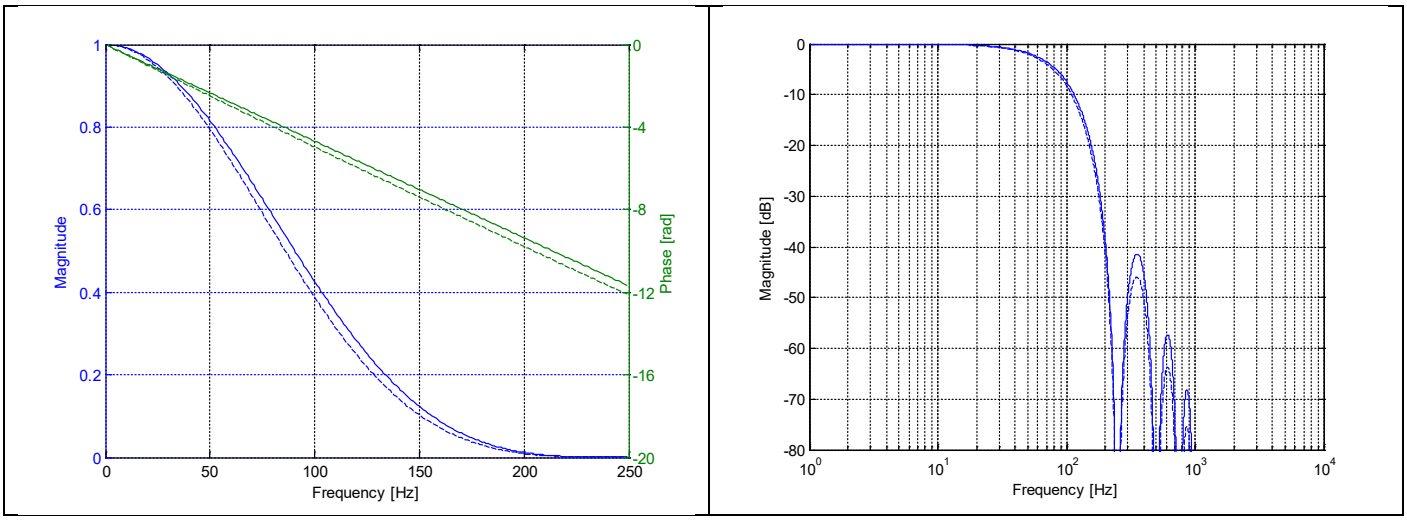

Figure 5-15: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 66Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)

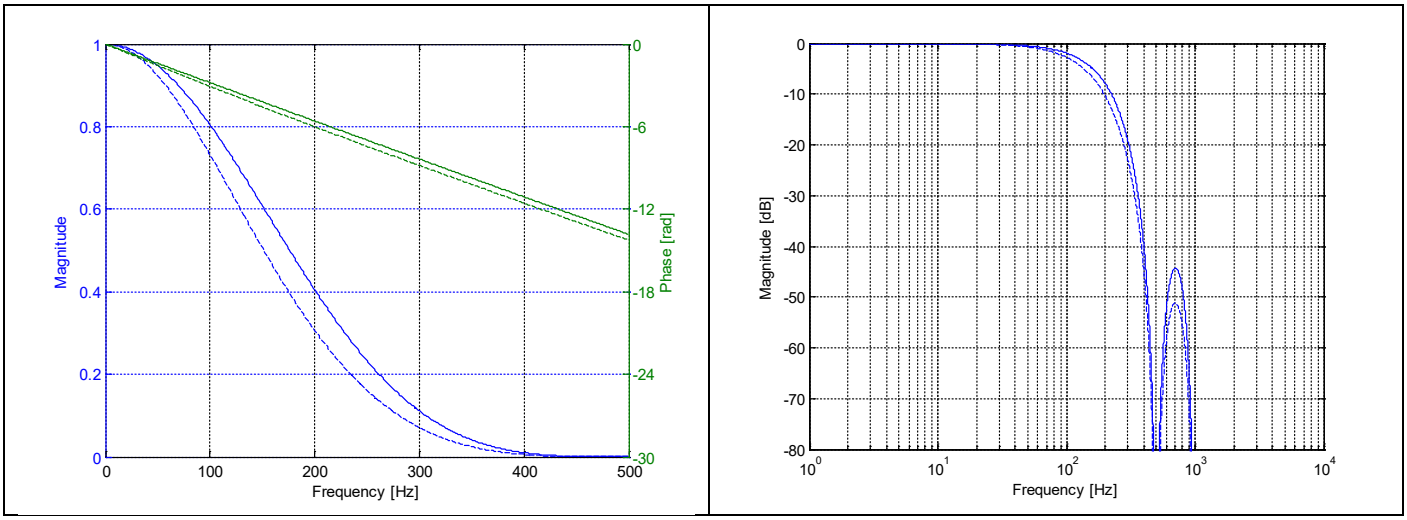

Figure 5-16: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 131Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)

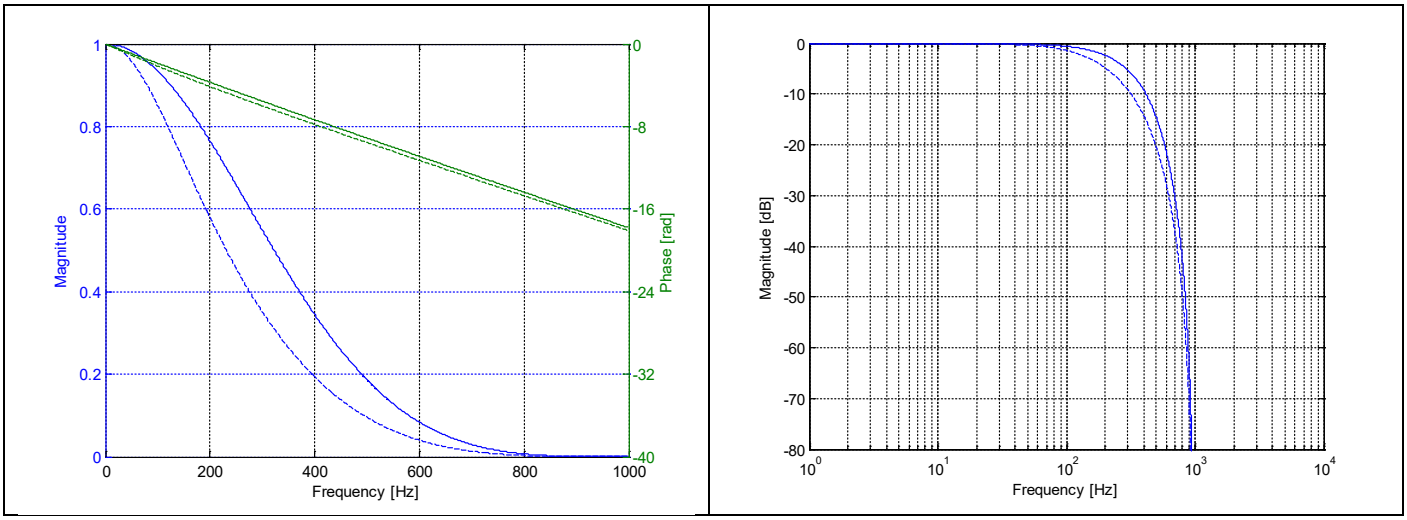

Figure 5-17: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 262Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)

5.3.3 PPS filtered characteristics

5.3.3.1 Frequency characteristics of PPS filtered

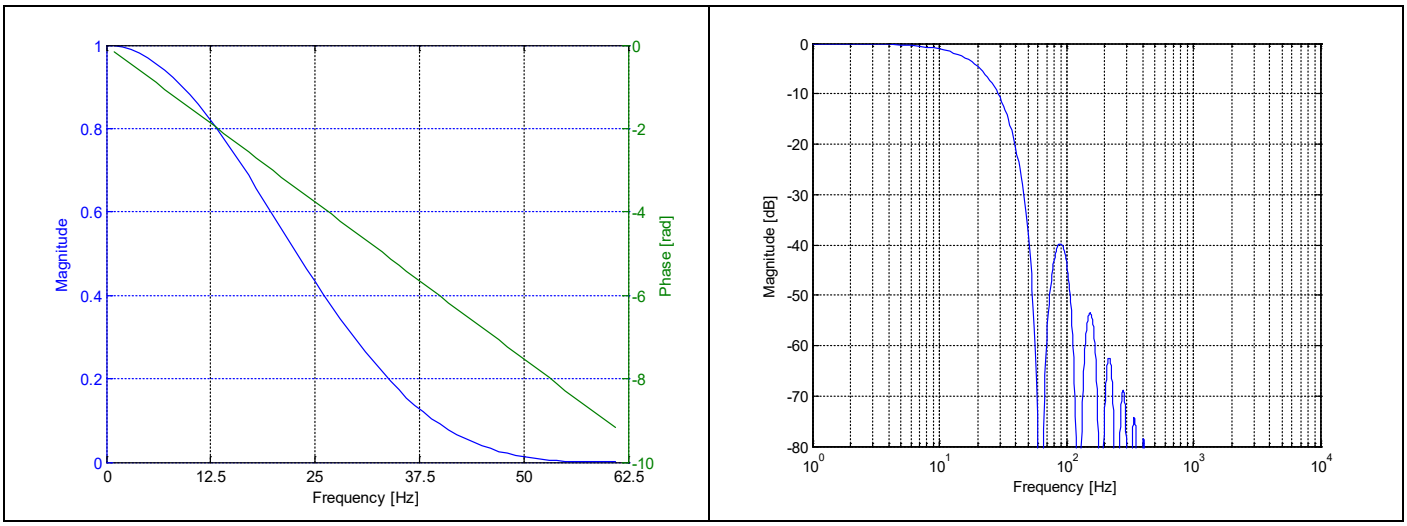

Figure 5-18: Frequency characteristics of PPS filtered with low-pass filter -3dB frequency set to 16Hz

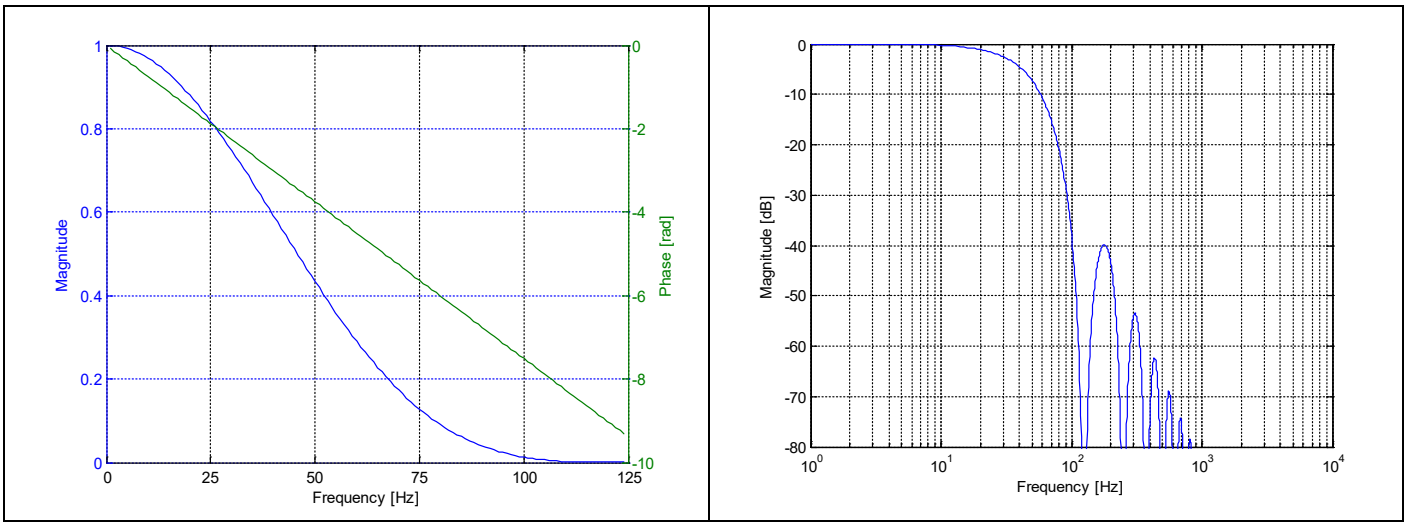

Figure 5-19: Frequency characteristics of PPS filtered with low-pass filter -3dB frequency set to 33Hz

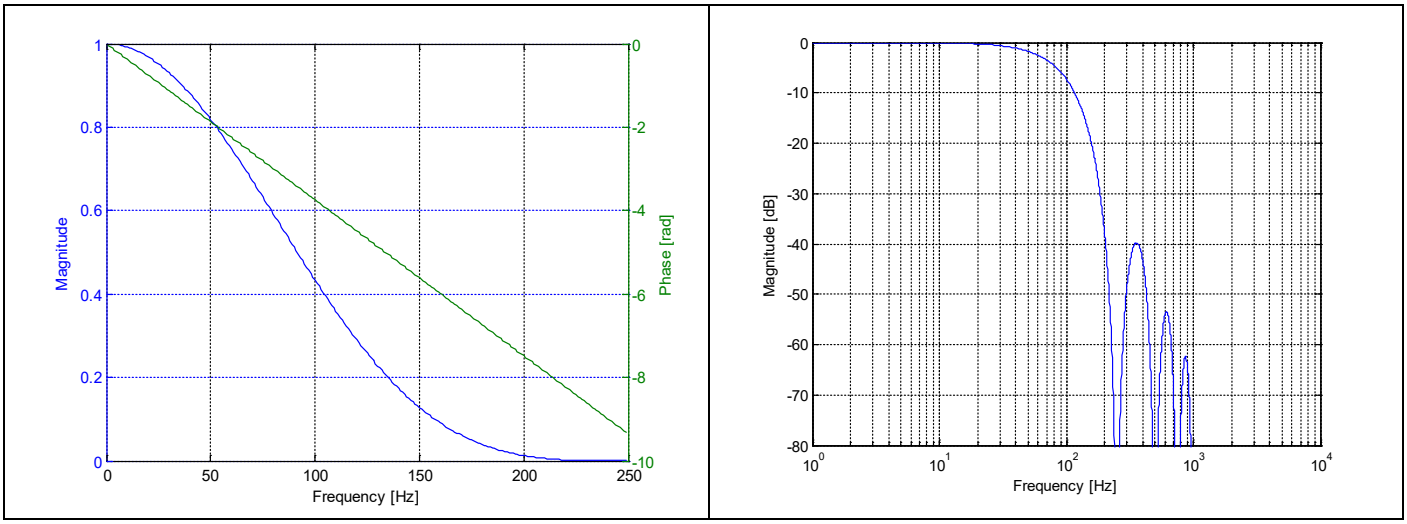

Figure 5-20: Frequency characteristics of PPS filtered with low-pass filter -3dB frequency set to 66Hz

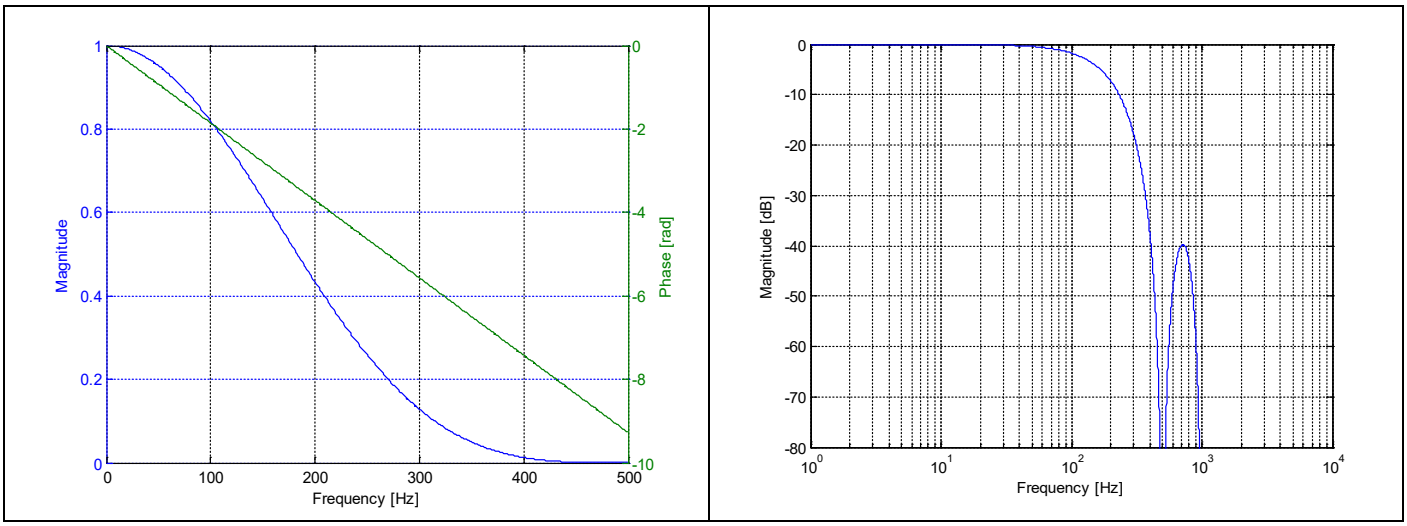

Figure 5-21: Frequency characteristics of PPS filtered with low-pass filter -3dB frequency set to 131Hz

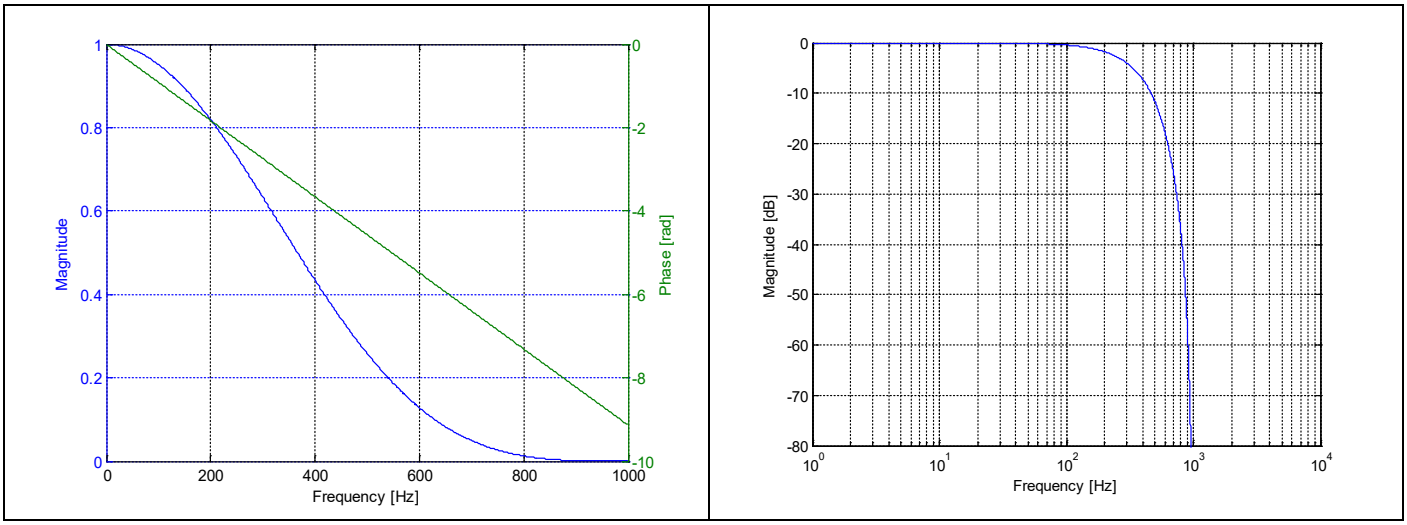

Figure 5-22: Frequency characteristics of PPS filtered with low-pass filter -3dB frequency set to 262Hz

5.4 Configurable parameters

Table 5-7: Configurable parameters

Parameter	Configurations	Comments
SAMPLE RATE	125 samples/s 250 samples/s 500 samples/s 1000 samples/s 2000 samples/s External trigger External trigger with Multi-Mode transmission	Some limitations apply to the use of higher sample rates (>500 samples/s), depending on selected bit-rate and datagram content, ref. Table 5-8
MULTI-MODE TRANSMISSION	Minimum delay between datagrams [0, 1000000]µs Minimum delay between start of datagrams [0, 1000000]µs Special datagrams to be transmitted at start-up [OFF/ON]	
LOW-PASS FILTER -3dB FREQUENCY	16Hz 33Hz 66Hz 131Hz 262Hz	Filter settings are independent of sample rate. Low-pass filters are CIC type filters with linear phase response. Filter settings can be set individually for each axis.
MEASUREMENT UNIT GYRO	Angular rate [°/s] Incremental angle [°/sample] Average angular rate [°/s] Integrated angle [°]	
GYRO G-COMPENSATION	OFF ON: Bias and/or scale factor g-compensation using accelerometer-signal	
MEASUREMENT UNIT ACCELEROMETER	Acceleration [g] Incremental velocity [m/s/sample] Average acceleration [g] Integrated velocity [gs] Integrated velocity [m/s]	
MEASUREMENT UNIT PPS	Time since detection of 0 [µs] Time since detection of 1 [µs] Filtered PPS [ ] Filtered PPS [ ] - delayed	
BIAS TRIM OFFSET	Bias Trim offset for gyro Bias Trim offset for accelerometers Reference information for bias trim offset	
COUNTER RESET SIGNAL INTERVAL	[0.5, 32768]ms	
IMU-ID	[0, 255]	
DATAGRAM	Rate together with any combination of acceleration, temperature, PPS and IMU-ID	
DATAGRAM TERMINATION	NONE <CR><LF>	
RS422 BIT-RATE	374400 bits/s 460800 bits/s 921600 bits/s 1843200 bits/s User-defined	Some limitations apply to the use of lower bit-rates (< 1843200 bits/s) depending on sample rate and datagram content, ref. Table 5-8. For user-defined bit-rates, see section 9.5
RS422 PARITY	None Odd Even	
RS422 STOP BITS	1 stop bit 2 stop bits	
RS422 120Ω LINE TERMINATION	OFF ON	
RS422 OUTPUT ACTIVE BETWEEN DATAGRAMS	Active Not active	

Refer to section 12 for information on how to configure the STIM when ordering and to sections 9 and 10 for information on how to reconfigure the unit in Service Mode and Utility Mode respectively.

Some datagrams are longer than the time between each sample at lower bit-rates. Table 5-8 shows the maximum sample rates.

Table 5-8: Maximum sample rate

Datagram content	Counter	Number of transmitted bytes[Note 1]	374400 bits/s[Note 2]	460800 bits/s[Note 2]	921600 bits/s[Note 2]	1843200 bits/s[Note 2]
Rate	1 byte	18	1000	2000	2000	2000
Rate and acceleration	1 byte	28	1000	1000	2000	2000
Rate and temperature	1 byte	25	1000	1000	2000	2000
Rate, acceleration and temperature	1 byte	42	500	500	1000	2000
Rate	2 bytes	19	1000	2000	2000	2000
Rate and acceleration	2 bytes	29	1000	1000	2000	2000
Rate and temperature	2 bytes	26	1000	1000	2000	2000
Rate, acceleration and temperature	2 bytes	43	500	500	1000	2000
Rate and PPS	2 bytes	23	1000	1000	2000	2000
Rate, acceleration and PPS	2 bytes	33	1000	1000	2000	2000
Rate, temperature and PPS	2 bytes	30	1000	1000	2000	2000
Rate, acceleration, temperature and PPS	2 bytes	47	500	500	1000	2000
IMU-ID, Rate	1 byte	19	1000	2000	2000	2000
IMU-ID, Rate and acceleration	1 byte	29	1000	1000	2000	2000
IMU-ID, Rate and temperature	1 byte	26	1000	1000	2000	2000
IMU-ID, Rate, acceleration and temperature	1 byte	43	500	500	1000	2000
IMU-ID, Rate	2 bytes	20	1000	2000	2000	2000
IMU-ID, Rate and acceleration	2 bytes	30	1000	1000	2000	2000
IMU-ID, Rate and temperature	2 bytes	27	1000	1000	2000	2000
IMU-ID, Rate, acceleration and temperature	2 bytes	44	500	500	1000	2000
IMU-ID, Rate and PPS	2 bytes	24	1000	1000	2000	2000
IMU-ID, Rate, acceleration and PPS	2 bytes	34	1000	1000	2000	2000
IMU-ID, Rate, temperature and PPS	2 bytes	31	1000	1000	2000	2000
IMU-ID, Rate, acceleration, temperature and PPS	2 bytes	48	500	500	1000	2000

Note 1: excluding <CR><LF> termination
Note 2: 10 bits/byte (=1 start bit, 8 data bits, no parity bit, 1 stop bit)

5.5 Datagram specifications

5.5.1 Part Number datagram

Table 5-9: Specification of the Part Number datagram

Byte#	Bit# 7	6	5	4	3	2	1	0	Specification
0	1 1 1 1	0 0 0 0	1 1 1 1	1 1 0 0	0 0 1 1	0 0 0 0	0 1 0 1	1 1 1 0	**Part Number datagram identifier:** 0xB1 for datagrams without IMU-ID and without CR+LF termination 0xB3 for datagrams without IMU-ID and with CR+LF termination 0xA9 for datagrams with IMU-ID and without CR+LF termination 0xAA for datagrams with IMU-ID and with CR+LF termination
1	ID_7	ID_6	ID_5	ID_4	ID_3	ID_2	ID_1	ID_0	Identification number of IMU. Will only be transmitted if a Normal Mode datagram with IMU-ID has been selected
2	0	0	0	0	$P1_3$	$P1_2$	$P1_1$	$P1_0$	Low nibble: 1. digit of part number
3	$P2_3$	$P2_2$	$P2_1$	$P2_0$	$P3_3$	$P3_2$	$P3_1$	$P3_0$	High nibble: 2. digit of part number Low nibble: 3. digit of part number
4	$P4_3$	$P4_2$	$P4_1$	$P4_0$	$P5_3$	$P5_2$	$P5_1$	$P5_0$	High nibble: 4. digit of part number Low nibble: 5. digit of part number
5	0	0	1	0	1	1	0	1	ASCII character "-" (0x2D)
6	$P6_3$	$P6_2$	$P6_1$	$P6_0$	$P7_3$	$P7_2$	$P7_1$	$P7_0$	High nibble: 6. digit of part number Low nibble: 7. digit of part number
7	$P8_3$	$P8_2$	$P8_1$	$P8_0$	$P9_3$	$P9_2$	$P9_1$	$P9_0$	High nibble: 8. digit of part number Low nibble: 9. digit of part number
8	$P10_3$	$P10_2$	$P10_1$	$P10_0$	$P11_3$	$P11_2$	$P11_1$	$P11_0$	High nibble: 10. digit of part number Low nibble: 11. digit of part number
9	0	0	1	0	1	1	0	1	ASCII character "-" (0x2D)
10	$P12_3$	$P12_2$	$P12_1$	$P12_0$	$P13_3$	$P13_2$	$P13_1$	$P13_0$	High nibble: 12. digit of part number (least significant nibble) Low nibble: 13. digit of part number
11	$P14_3$	$P14_2$	$P14_1$	$P14_0$	$P15_3$	$P15_2$	$P15_1$	$P15_0$	High nibble: 14. digit of part number Low nibble: 12. digit of part number (most significant nibble)
12	x	x	x	x	x	x	x	x	For future use
13	x	x	x	x	x	x	x	x	For future use
14	x	x	x	x	x	x	x	x	For future use
15	x	x	x	x	x	x	x	x	For future use
16	r_7	r_6	r_5	r_4	r_3	r_2	r_1	r_0	Part number revision. Content of byte represents the ASCII-character of the revision. Numbering sequence: "-", "A", "B", …., "Z"
17	c_{31}	c_{30}	c_{29}	c_{28}	c_{27}	c_{26}	c_{25}	c_{24}	Cyclic Redundancy Check is performed on all preceding bytes, ref. section 5.5.7
18	c_{23}	c_{22}	c_{21}	c_{20}	c_{19}	c_{18}	c_{17}	c_{16}	
19	c_{15}	c_{14}	c_{13}	c_{12}	c_{11}	c_{10}	c_9	c_8	
(20)	c_7	c_6	c_5	c_4	c_3	c_2	c_1	c_0	
(21)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(22)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

Table 5-9 shows the full content of the Part Number datagram. If a Normal Mode datagram without the IMU-ID field has been selected, byte 1 will not be transmitted.

Table 5-10: Converting information in the Part Number datagram to ASCII

Digit in part number	Value for conversion	ASCII-code if value < 10	ASCII-code if value ≥ 10
1. digit of part number	P1	P1 + 48	P1 + 55
2. digit of part number	P2	P2 + 48	P2 + 55
3. digit of part number	P3	P3 + 48	P3 + 55
4. digit of part number	P4	P4 + 48	P4 + 55
5. digit of part number	P5	P5 + 48	P5 + 55
-		45	45
6. digit of part number	P6	P6 + 48	P6 + 55
7. digit of part number	P7	P7 + 48	P7 + 55
8. digit of part number	P8	P8 + 48	P8 + 55
9. digit of part number	P9	P9+ 48	P9+ 55
10. digit of part number	P10	P10+ 48	P10+ 55
11. digit of part number	P11	P11 + 48	P11 + 55
-		45	45
12. digit of part number	$P12 + P15*2^4$	$(P12 + P15*2^{4)} + 48$	$(P12 + P15*2^{4)} + 55$
13. digit of part number	P13	P13 + 48	P13 + 55
14. digit of part number	P14	P14 + 48	P14 + 55

5.5.2 Serial Number datagram

Table 5-11: Specification of the Serial Number datagram

Byte#	Bit# 7	6	5	4	3	2	1	0	Specification
0	1 1 1 1	0 0 0 0	1 1 1 1	1 1 0 0	0 0 1 1	1 1 0 1	0 1 1 0	1 1 1 0	**Serial Number datagram identifier:** 0xB5 for datagrams without IMU-ID and without CR+LF termination 0xB7 for datagrams without IMU-ID and with CR+LF termination 0xAB for datagrams with IMU-ID and without CR+LF termination 0xAC for datagrams with IMU-ID and with CR+LF termination
1	ID_7	ID_6	ID_5	ID_4	ID_3	ID_2	ID_1	ID_0	Identification number of IMU. Will only be transmitted if a Normal Mode datagram with IMU-ID has been selected
2	0	1	0	0	1	1	1	0	ASCII-character for letter “N”
3	$S1_3$	$S1_2$	$S1_1$	$S1_0$	$S2_3$	$S2_2$	$S2_1$	$S2_0$	High nibble: 1. digit (BCD) of serial number Low nibble: 2. digit (BCD) of serial number
4	$S3_3$	$S3_2$	$S3_1$	$S3_0$	$S4_3$	$S4_2$	$S4_1$	$S4_0$	High nibble: 3. digit (BCD) of serial number Low nibble: 4. digit (BCD) of serial number
5	$S5_3$	$S5_2$	$S5_1$	$S5_0$	$S6_3$	$S6_2$	$S6_1$	$S6_0$	High nibble: 5. digit (BCD) of serial number Low nibble: 6. digit (BCD) of serial number
6	$S7_3$	$S7_2$	$S7_1$	$S7_0$	$S8_3$	$S8_2$	$S8_1$	$S8_0$	High nibble: 7. digit (BCD) of serial number Low nibble: 8. digit (BCD) of serial number
7	$S9_3$	$S9_2$	$S9_1$	$S9_0$	$S10_3$	$S10_2$	$S10_1$	$S10_0$	High nibble: 9. digit (BCD) of serial number Low nibble: 10. digit (BCD) of serial number
8	$S11_3$	$S11_2$	$S11_1$	$S11_0$	$S11_3$	$S11_2$	$S11_1$	$S11_0$	High nibble: 11. digit (BCD) of serial number Low nibble: 12. digit (BCD) of serial number
9	$S13_3$	$S13_2$	$S13_1$	$S13_0$	$S14_3$	$S14_2$	$S14_1$	$S14_0$	High nibble: 13. digit (BCD) of serial number Low nibble: 14. digit (BCD) of serial number
10	x	x	x	x	x	x	x	x	For future use
11	x	x	x	x	x	x	x	x	For future use
12	x	x	x	x	x	x	x	x	For future use
13	x	x	x	x	x	x	x	x	For future use
14	x	x	x	x	x	x	x	x	For future use
15	x	x	x	x	x	x	x	x	For future use
16	x	x	x	x	x	x	x	x	For future use
17	c_{31}	c_{30}	c_{29}	c_{28}	c_{27}	c_{26}	c_{25}	c_{24}	Cyclic Redundancy Check is performed on all preceding bytes, ref. section 5.5.7
18	c_{23}	c_{22}	c_{21}	c_{20}	c_{19}	c_{18}	c_{17}	c_{16}	
19	c_{15}	c_{14}	c_{13}	c_{12}	c_{11}	c_{10}	c_9	c_8	
(20)	c_7	c_6	c_5	c_4	c_3	c_2	c_1	c_0	
(21)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(22)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

Table 5-11 shows the full content of the Serial Number datagram. If a Normal Mode datagram without the IMU-ID field has been selected, byte 1 will not be transmitted.

5.5.3 Configuration datagram

Table 5-12: Specification of the Configuration datagram

Byte#	Bit# 7	6	5	4	3	2	1	0	Specification
0	1	1	1	0	1	1	0	0	**Configuration datagram identifier:** 0xEC for datagrams without IMU-ID and without CR+LF termination
	1	1	1	0	1	1	0	1	0xED for datagrams without IMU-ID and with CR+LF termination
	1	0	1	1	1	0	0	0	0xB8 for datagrams with IMU-ID and without CR+LF termination
	1	0	1	1	1	0	1	0	0xBA for datagrams with IMU-ID and with CR+LF termination
1	ID_7	ID_6	ID_5	ID_4	ID_3	ID_2	ID_1	ID_0	Identification number of IMU. Will only be transmitted if a Normal Mode datagram with IMU-ID has been selected
2	r_7	r_6	r_5	r_4	r_3	r_2	r_1	r_0	Part number revision. Content of byte represents the ASCII-character of the revision. Numbering sequence: "-", "A", "B", …., "Z"
3	f_7	f_6	f_5	f_4	f_3	f_2	f_1	f_0	Firmware revision. Numbering sequence: 0, 1, …, 255
4	0	0	0	x	x	x	x	x	Sample frequency = 125 samples/s
	0	0	1	x	x	x	x	x	Sample frequency = 250 samples/s
	0	1	0	x	x	x	x	x	Sample frequency = 500 samples/s
	0	1	1	x	x	x	x	x	Sample frequency = 1000 samples/s
	1	0	0	x	x	x	x	x	Sample frequency = 2000 samples/s
	1	0	1	x	x	x	x	x	Sample frequency = External trigger
	x	x	x	x	0	x	x	x	Temperature not included in Normal Mode datagram
	x	x	x	x	1	x	x	x	Temperature included in Normal Mode datagram
	x	x	x	x	x	0	x	x	PPS not included in Normal Mode datagram
	x	x	x	x	x	1	x	x	PPS included in Normal Mode datagram
	x	x	x	x	x	x	0	x	Acceleration not included in Normal Mode datagram
	x	x	x	x	x	x	1	x	Acceleration included in Normal Mode datagram
	x	x	x	x	x	x	x	0	No <CR><LF> termination of Normal Mode datagram
	x	x	x	x	x	x	x	1	<CR><LF> termination of Normal Mode datagram
5	0	0	0	0	x	x	x	x	Bit-rate = 374400 bits/s
	0	0	0	1	x	x	x	x	Bit-rate = 460800 bits/s
	0	0	1	0	x	x	x	x	Bit-rate = 921600 bits/s
	0	0	1	1	x	x	x	x	Bit-rate = 1843200 bits/s
	1	1	1	1	x	x	x	x	Bit-rate = User-defined, ref. section 9.5
	x	x	x	x	0	x	x	x	Stop bit = 1
	x	x	x	x	1	x	x	x	Stop bits = 2
	x	x	x	x	x	0	0	x	Parity = none
	x	x	x	x	x	0	1	x	Parity = even
	x	x	x	x	x	1	0	x	Parity = odd
	x	x	x	x	x	x	x	0	Line termination = OFF
	x	x	x	x	x	x	x	1	Line termination = ON
6	x	0	x	x	x	x	x	x	Gyro X-axis is inactive
	x	1	x	x	x	x	x	x	Gyro X-axis is active
	x	x	0	x	x	x	x	x	Gyro Y-axis is inactive
	x	x	1	x	x	x	x	x	Gyro Y-axis is active
	x	x	x	0	x	x	x	x	Gyro Z-axis is inactive
	x	x	x	1	x	x	x	x	Gyro Z-axis is active
	x	x	x	x	0	0	0	0	Gyro output unit = [°/s] - ANGULAR RATE
	x	x	x	x	0	0	0	1	Gyro output unit = [°] - INCREMENTAL ANGLE
	x	x	x	x	0	0	1	0	Gyro output unit = [°/s] - AVERAGE ANGULAR RATE
	x	x	x	x	0	0	1	1	Gyro output unit = [°] - INTEGRATED ANGLE
	x	x	x	x	1	0	0	0	Gyro output unit = [°/s] - ANGULAR RATE – DELAYED
	x	x	x	x	1	0	0	1	Gyro output unit = [°] - INCREMENTAL ANGLE – DELAYED
	x	x	x	x	1	0	1	0	Gyro output unit = [°/s] - AVERAGE ANGULAR RATE – DELAYED
	x	x	x	x	1	0	1	1	Gyro output unit = [°] - INTEGRATED ANGLE – DELAYED
7	x	0	0	0	x	x	x	x	Gyro LP filter -3dB frequency for X-axis = 16Hz
	x	0	0	1	x	x	x	x	Gyro LP filter -3dB frequency for X-axis = 33Hz
	x	0	1	0	x	x	x	x	Gyro LP filter -3dB frequency for X-axis = 66Hz
	x	0	1	1	x	x	x	x	Gyro LP filter -3dB frequency for X-axis = 131Hz
	x	1	0	0	x	x	x	x	Gyro LP filter -3dB frequency for X-axis = 262Hz
	x	x	x	x	x	0	0	0	Gyro LP filter -3dB frequency for Y-axis = 16Hz
	x	x	x	x	x	0	0	1	Gyro LP filter -3dB frequency for Y-axis = 33Hz
	x	x	x	x	x	0	1	0	Gyro LP filter -3dB frequency for Y-axis = 66Hz
	x	x	x	x	x	0	1	1	Gyro LP filter -3dB frequency for Y-axis = 131Hz
	x	x	x	x	x	1	0	0	Gyro LP filter -3dB frequency for Y-axis = 262Hz

8	x	0	0	0	x	x	x	x	Gyro LP filter -3dB frequency for Z-axis = 16Hz
	x	0	0	1	x	x	x	x	Gyro LP filter -3dB frequency for Z-axis = 33Hz
	x	0	1	0	x	x	x	x	Gyro LP filter -3dB frequency for Z-axis = 66Hz
	x	0	1	1	x	x	x	x	Gyro LP filter -3dB frequency for Z-axis = 131Hz
	x	1	0	0	x	x	x	x	Gyro LP filter -3dB frequency for Z-axis = 262Hz
	x	x	x	x	0	0	0	0	Gyro g-comp: OFF
	x	x	x	x	0	0	0	1	Gyro g-comp: bias = OFF , scale = ACC
	x	x	x	x	0	0	1	0	Gyro g-comp: bias = OFF , scale = ACC+0.01Hz-filter
	x	x	x	x	0	0	1	1	Gyro g-comp: bias = ACC , scale = OFF
	x	x	x	x	0	1	0	0	Gyro g-comp: bias = ACC+0.01Hz-filter , scale = OFF
	x	x	x	x	0	1	1	1	Gyro g-comp: bias = ACC, scale = ACC
	x	x	x	x	1	0	0	0	Gyro g-comp: bias = ACC+0.01Hz-filter , scale = ACC
	x	x	x	x	1	0	1	1	Gyro g-comp: bias = ACC+0.01Hz-filter, scale = ACC+0.01Hz-filter
	x	x	x	x	1	1	1	1	Gyro g-comp: user-defined
9	x	0	x	x	x	x	x	x	Accelerometer X-axis is inactive
	x	1	x	x	x	x	x	x	Accelerometer X-axis is active
	x	x	0	x	x	x	x	x	Accelerometer Y-axis is inactive
	x	x	1	x	x	x	x	x	Accelerometer Y-axis is active
	x	x	x	0	x	x	x	x	Accelerometer Z-axis is inactive
	x	x	x	1	x	x	x	x	Accelerometer Z-axis is active
	x	x	x	x	0	0	0	0	Accelerometer output unit = [g] - ACCELERATION
	x	x	x	x	0	0	0	1	Accelerometer output unit = [m/s] - INCREMENTAL VELOCITY
	x	x	x	x	0	0	1	0	Accelerometer output unit = [g] - AVERAGE ACCELERATION
	x	x	x	x	0	0	1	1	Accelerometer output unit = [gs] - INTEGRATED VELOCITY
	x	x	x	x	0	1	0	0	Accelerometer output unit = [m/s] - INTEGRATED VELOCITY
10	x	0	0	0	x	x	x	x	Accelerometer LP filter -3dB frequency for X-axis = 16Hz
	x	0	0	1	x	x	x	x	Accelerometer LP filter -3dB frequency for X-axis = 33Hz
	x	0	1	0	x	x	x	x	Accelerometer LP filter -3dB frequency for X-axis = 66Hz
	x	0	1	1	x	x	x	x	Accelerometer LP filter -3dB frequency for X-axis = 131Hz
	x	1	0	0	x	x	x	x	Accelerometer LP filter -3dB frequency for X-axis = 262Hz
	x	x	x	x	x	0	0	0	Accelerometer LP filter -3dB frequency for Y-axis = 16Hz
	x	x	x	x	x	0	0	1	Accelerometer LP filter -3dB frequency for Y-axis = 33Hz
	x	x	x	x	x	0	1	0	Accelerometer LP filter -3dB frequency for Y-axis = 66Hz
	x	x	x	x	x	0	1	1	Accelerometer LP filter -3dB frequency for Y-axis = 131Hz
	x	x	x	x	x	1	0	0	Accelerometer LP filter -3dB frequency for Y-axis = 262Hz
11	x	0	0	0	x	x	x	x	Accelerometer LP filter -3dB frequency for Z-axis = 16Hz
	x	0	0	1	x	x	x	x	Accelerometer LP filter -3dB frequency for Z-axis = 33Hz
	x	0	1	0	x	x	x	x	Accelerometer LP filter -3dB frequency for Z-axis = 66Hz
	x	0	1	1	x	x	x	x	Accelerometer LP filter -3dB frequency for Z-axis = 131Hz
	x	1	0	0	x	x	x	x	Accelerometer LP filter -3dB frequency for Z-axis = 262Hz
12	x	x	x	x	0	0	0	0	PPS output unit = [µs] - TIME SINCE DETECTION OF 0
	x	x	x	x	0	0	0	1	PPS output unit = [µs] - TIME SINCE DETECTION OF 1
	x	x	x	x	0	0	1	0	PPS output unit = [ ] - FILTERED PPS
	x	x	x	x	0	0	1	1	PPS output unit = [ ] - FILTERED PPS - DELAYED
13	x	0	0	0	x	x	x	x	PPS LP filter -3dB frequency for X-axis = 16Hz
	x	0	0	1	x	x	x	x	PPS LP filter -3dB frequency for X-axis = 33Hz
	x	0	1	0	x	x	x	x	PPS LP filter -3dB frequency for X-axis = 66Hz
	x	0	1	1	x	x	x	x	PPS LP filter -3dB frequency for X-axis = 131Hz
	x	1	0	0	x	x	x	x	PPS LP filter -3dB frequency for X-axis = 262Hz
14	x	x	x	x	x	x	x	x	For future use
15	x	x	x	x	x	x	x	x	For future use
16	0	0	0	0	x	x	x	x	High nibble: Gyro range, x-axis - 400°/s
	x	x	x	x	0	0	0	0	Low nibble: Gyro range, y-axis - 400°/s
17	0	0	0	0	x	x	x	x	High nibble: Gyro range, z-axis - 400°/s
18	0	0	0	0	x	x	x	x	High nibble: Accelerometer range, x-axis - 10g
	x	x	x	x	0	0	0	0	Low nibble: Accelerometer range, y-axis - 10g
19	0	0	0	0	x	x	x	x	High nibble: Accelerometer range, z-axis - 10g
20	x	x	x	x	x	x	x	x	For future use
21	x	x	x	x	x	x	x	x	For future use
22	x	x	x	x	x	x	x	x	For future use
23	c_{31}	c_{30}	c_{29}	c_{28}	c_{27}	c_{26}	c_{25}	c_{24}	Cyclic Redundancy Check is performed on all preceding bytes, ref. section 5.5.7
24	c_{23}	c_{22}	c_{21}	c_{20}	c_{19}	c_{18}	c_{17}	c_{16}	
25	c_{15}	c_{14}	c_{13}	c_{12}	c_{11}	c_{10}	c_9	c_8	
(26)	c_7	c_6	c_5	c_4	c_3	c_2	c_1	c_0	
(27)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(28)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

Table 5-12 shows the full content of the Configuration datagram. If a Normal Mode datagram without the IMU-ID field has been selected, byte 1 will not be transmitted.

Note: The configuration of datagram, sample rate and transmission parameters can lead to a situation where the STIM is not able to transmit at the configured sample rate (ref. Table 5-8). If the transmission of the previous datagram is not completed at the time when the next datagram is to be transmitted, the datagram will not be transmitted, and the data will be lost. In such a situation, the sample rate reported by the configuration datagram will not reflect the actual sample rate.

5.5.4 Bias Trim Offset datagram

Table 5-13: Specification of the Bias Trim Offset datagram

Byte#	Bit# 7	6	5	4	3	2	1	0	Specification
0	1 1 1 1	1 1 1 1	0 0 0 0	1 1 0 1	0 0 0 0	0 0 0 0	0 1 0 0	1 0 0 0	**Bias Trim Offset datagram identifier:** 0xD1 for datagrams without IMU-ID and without CR+LF termination 0xD2 for datagrams without IMU-ID and with CR+LF termination 0xC0 for datagrams with IMU-ID and without CR+LF termination 0xD0 for datagrams with IMU-ID and with CR+LF termination
1	ID_7	ID_6	ID_5	ID_4	ID_3	ID_2	ID_1	ID_0	Identification number of IMU. Will only be transmitted if a Normal Mode datagram with IMU-ID has been selected
2	Gx_{23}	Gx_{22}	Gx_{21}	Gx_{20}	Gx_{19}	Gx_{18}	Gx_{17}	Gx_{16}	X-axis gyro bias trim offset, ref. section 7.6.2.2.3 for conversion to [°/s]. NB: unit is [°/s] regardless of selected output unit in Normal Mode datagram
3	Gx_{15}	Gx_{14}	Gx_{13}	Gx_{12}	G_{11}	Gx_{10}	Gx_9	Gx_8	
4	Gx_7	Gx_6	Gx_5	Gx_4	Gx_3	Gx_2	Gx_1	Gx_0	
5	Gy_{23}	Gy_{22}	Gy_{21}	Gy_{20}	Gy_{19}	Gy_{18}	Gy_{17}	Gy_{16}	Y-axis gyro bias trim offset, ref. section 7.6.2.2.3 for conversion to [°/s]. NB: unit is [°/s] regardless of selected output unit in Normal Mode datagram
6	Gy_{15}	Gy_{14}	Gy_{13}	Gy_{12}	Gy_{11}	Gy_{10}	Gy_9	Gy_8	
7	Gy_7	Gy_6	Gy_5	Gy_4	Gy_3	Gy_2	Gy_1	Gy_0	
8	Gz_{23}	Gz_{22}	Gz_{21}	Gz_{20}	Gz_{19}	Gz_{18}	Gz_{17}	Gz_{16}	Z-axis gyro bias trim offset, ref. section 7.6.2.2.3 for conversion to [°/s]. NB: unit is [°/s] regardless of selected output unit in Normal Mode datagram
9	Gz_{15}	Gz_{14}	Gz_{13}	Gz_{12}	Gz_{11}	Gz_{10}	Gz_9	Gz_8	
10	Gz_7	Gz_6	Gz_5	Gz_4	Gz_3	Gz_2	Gz_1	Gz_0	
11	Ax_{23}	Ax_{22}	Ax_{21}	Ax_{20}	Ax_{19}	Ax_{18}	Ax_{17}	Ax_{16}	X-axis accelerometer bias trim offset, ref. section 7.6.2.2.8 for conversion to [g]. NB: unit is [g] regardless of selected output unit in Normal Mode datagram
12	Ax_{15}	Ax_{14}	Ax_{13}	Ax_{12}	Ax_{11}	Ax_{10}	Ax_9	Ax_8	
13	Ax_7	Ax_6	Ax_5	Ax_4	Ax_3	Ax_2	Ax_1	Ax_0	
14	Ay_{23}	Ay_{22}	Ay_{21}	Ay_{20}	Ay_{19}	Ay_{18}	Ay_{17}	Ay_{16}	Y-axis accelerometer bias trim offset, ref. section 7.6.2.2.8 for conversion to [g]. NB: unit is [g] regardless of selected output unit in Normal Mode datagram
15	Ay_{15}	Ay_{14}	Ay_{13}	Ay_{12}	Ay_{11}	Ay_{10}	Ay_9	Ay_8	
16	Ay_7	Ay_6	Ay_5	Ay_4	Ay_3	Ay_2	Ay_1	Ay_0	
17	Az_{23}	Az_{22}	Az_{21}	Az_{20}	Az_{19}	Az_{18}	Az_{17}	Az_{16}	Z-axis accelerometer bias trim offset, ref. section 7.6.2.2.8 for conversion to [g]. NB: unit is [g] regardless of selected output unit in Normal Mode datagram
18	Az_{15}	Az_{14}	Az_{13}	Az_{12}	Az_{11}	Az_{10}	Az_9	Az_8	
19	Az_7	Az_6	Az_5	Az_4	Az_3	Az_2	Az_1	Az_0	
20	x	x	x	x	x	x	x	x	For future use
21	x	x	x	x	x	x	x	x	
22	x	x	x	x	x	x	x	x	
23	x	x	x	x	x	x	x	x	For future use
24	x	x	x	x	x	x	x	x	
25	x	x	x	x	x	x	x	x	
26	x	x	x	x	x	x	x	x	For future use
27	x	x	x	x	x	x	x	x	
28	x	x	x	x	x	x	x	x	
29	Rf_{31}	Rf_{30}	Rf_{29}	Rf_{28}	Rf_{27}	Rf_{26}	Rf_{25}	Rf_{24}	Reference info to last adjustment
30	Rf_{23}	Rf_{22}	Rf_{21}	Rf_{20}	Rf_{19}	Rf_{18}	Rf_{17}	Rf_{16}	
31	Rf_{15}	Rf_{14}	Rf_{13}	Rf_{12}	Rf_{11}	Rf_{10}	Rf_9	Rf_8	
32	Rf_7	Rf_6	Rf_5	Rf_4	Rf_3	Rf_2	Rf_1	Rf_0	
33	Sav_{15}	Sav_{14}	Sav_{13}	Sav_{12}	Sav_{11}	Sav_{10}	Sav_9	Sav_8	Remaining number of saves
34	Sav_7	Sav_6	Sav_5	Sav_4	Sav_3	Sav_2	Sav_1	Sav_0	
35	x	x	x	x	x	x	x	x	For future use
36	x	x	x	x	x	x	x	x	For future use
37	c_{31}	c_{30}	c_{29}	c_{28}	c_{27}	c_{26}	c_{25}	c_{24}	Cyclic Redundancy Check is performed on all preceding bytes, ref. section 5.5.7
38	c_{23}	c_{22}	c_{21}	c_{20}	c_{19}	c_{18}	c_{17}	c_{16}	
39	c_{15}	c_{14}	c_{13}	c_{12}	c_{11}	c_{10}	c_9	c_8	
(40)	c_7	c_6	c_5	c_4	c_3	c_2	c_1	c_0	
(41)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(42)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

Table 5-13 shows the full content of the Bias Trim Offset datagram. If a Normal Mode datagram without the IMU-ID field has been selected, byte 1 will not be transmitted.

5.5.5 Extended Error Information datagram

Table 5-14: Specification of the Extended Error Information datagram

Byte#	Bit# 7	6	5	4	3	2	1	0	Specification
0	1	0	1	1	1	1	1	0	**Extended Error Information datagram identifier:**
	1	0	1	1	1	1	1	1	0xBE for datagrams without IMU-ID and without CR+LF termination
	1	1	1	0	1	0	0	1	0xBF for datagrams without IMU-ID and with CR+LF termination
	1	1	1	0	1	0	1	0	0xE9 for datagrams with IMU-ID and without CR+LF termination
									0xEA for datagrams with IMU-ID and with CR+LF termination
1	ID_7	ID_6	ID_5	ID_4	ID_3	ID_2	ID_1	ID_0	Identification number of IMU. Will only be transmitted if a Normal Mode datagram with IMU-ID has been selected
2	E_{127}	E_{126}	E_{125}	E_{124}	E_{123}	E_{122}	E_{121}	E_{120}	Ref. Table 5-15
3	E_{119}	E_{118}	E_{117}	E_{116}	E_{115}	E_{114}	E_{113}	E_{112}	Ref. Table 5-15
4	E_{111}	E_{110}	E_{109}	E_{108}	E_{107}	E_{106}	E_{105}	E_{104}	Ref. Table 5-15
5	E_{103}	E_{102}	E_{101}	E_{100}	E_{99}	E_{98}	E_{97}	E_{96}	Ref. Table 5-15
6	E_{95}	E_{94}	E_{93}	E_{92}	E_{91}	E_{90}	E_{89}	E_{88}	Ref. Table 5-15
7	E_{87}	E_{86}	E_{85}	E_{84}	E_{83}	E_{82}	E_{81}	E_{80}	Ref. Table 5-15
8	E_{79}	E_{78}	E_{77}	E_{76}	E_{75}	E_{74}	E_{73}	E_{72}	Ref. Table 5-15
9	E_{71}	E_{70}	E_{69}	E_{68}	E_{67}	E_{66}	E_{65}	E_{64}	Ref. Table 5-15
10	E_{63}	E_{62}	E_{61}	E_{60}	E_{59}	E_{58}	E_{57}	E_{56}	Ref. Table 5-15
11	E_{55}	E_{54}	E_{53}	E_{52}	E_{51}	E_{50}	E_{49}	E_{48}	Ref. Table 5-15
12	E_{47}	E_{46}	E_{45}	E_{44}	E_{43}	E_{42}	E_{41}	E_{40}	Ref. Table 5-15
13	E_{39}	E_{38}	E_{37}	E_{36}	E_{35}	E_{34}	E_{33}	E_{32}	Ref. Table 5-15
14	E_{31}	E_{30}	E_{29}	E_{28}	E_{27}	E_{26}	E_{25}	E_{24}	Ref. Table 5-15
15	E_{23}	E_{22}	E_{21}	E_{20}	E_{19}	E_{18}	E_{17}	E_{16}	Ref. Table 5-15
16	E_{15}	E_{14}	E_{13}	E_{12}	E_{11}	E_{10}	E_9	E_8	Ref. Table 5-15
17	E_7	E_6	E_5	E_4	E_3	E_2	E_1	E_0	Ref. Table 5-15
18	c_{31}	c_{30}	c_{29}	c_{28}	c_{27}	c_{26}	c_{25}	c_{24}	Cyclic Redundancy Check is performed on all preceding bytes, ref. section 5.5.7
19	c_{23}	c_{22}	c_{21}	c_{20}	c_{19}	c_{18}	c_{17}	c_{16}	
20	c_{15}	c_{14}	c_{13}	c_{12}	c_{11}	c_{10}	c_9	c_8	
(21)	c_7	c_6	c_5	c_4	c_3	c_2	c_1	c_0	
(22)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(23)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

Table 5-14 shows the full content of the Extended Error information datagram. If a Normal Mode datagram without the IMU-ID field has been selected, byte 1 will not be transmitted.

Table 5-15: Specification of the Extended Error Information

Bit#	Specification	Bit#	Specification	Bit#	Specification	Bit#	Specification
E_{127}	For future use	E_{126}	For future use	E_{125}	For future use	E_{124}	For future use
E_{123}	For future use	E_{122}	For future use	E_{121}	For future use	E_{120}	For future use
E_{119}	For future use	E_{118}	For future use	E_{117}	For future use	E_{116}	For future use
E_{115}	For future use	E_{114}	For future use	E_{113}	For future use	E_{112}	PPS time overflow
E_{111}	Reference voltage#4 error	E_{110}	For future use	E_{109}	For future use	E_{108}	For future use
E_{107}	For future use	E_{106}	ACC Z: Overload	E_{105}	ACC Y: Overload	E_{104}	ACC X: Overload
E_{103}	GYRO Z: Overload	E_{102}	GYRO Y: Overload	E_{101}	GYRO X: Overload	E_{100}	GYRO Z: Config,error
E_{99}	GYRO Y: Config,error	E_{98}	GYRO X: Config.error	E_{97}	µC temperature failure	E_{96}	GYRO Z: ASIC temp.dev.
E_{95}	GYRO Y: ASIC temp.dev	E_{94}	GYRO X: ASIC temp.dev	E_{93}	For future use	E_{92}	For future use
E_{91}	ACC Z: Temp.deviation	E_{90}	ACC Y: Temp.deviation	E_{89}	ACC X: Temp.deviation	E_{88}	GYRO Z: Temp.deviation
E_{87}	GYRO Y: Temp.deviation	E_{86}	GYRO X: Temp.deviation	E_{85}	Self-test not running	E_{84}	For future use
E_{83}	For future use	E_{82}	TEMP ACC Z: ADC error	E_{81}	TEMP ACC Y: ADC error	E_{80}	TEMP ACC X: ADC error
E_{79}	TEMP GYRO Z: Clipped	E_{78}	TEMP GYRO Y: Clipped	E_{77}	TEMP GYRO X: Clipped	E_{76}	For future use
E_{75}	For future use	E_{74}	For future use	E_{73}	For future use	E_{72}	ACC Z: ADC error
E_{71}	ACC Y: ADC error	E_{70}	ACC X: ADC error	E_{69}	For future use	E_{68}	UART unable to transmit
E_{67}	GYRO Z: data missing	E_{66}	GYRO Y: Data missing	E_{65}	GYRO X: Data missing	E_{64}	Transmit stack warning
E_{63}	Flash stack warning	E_{62}	Sample stack warning	E_{61}	Command stack warning	E_{60}	Monitor stack warning
E_{59}	Supply overvoltage	E_{58}	Internal DAC error	E_{57}	Flash check error	E_{56}	RAM check error
E_{55}	For future use	E_{54}	For future use	E_{53}	For future use	E_{52}	For future use
E_{51}	For future use	E_{50}	TEMP ACC Z: Error	E_{49}	TEMP ACC Y: Error	E_{48}	TEMP ACC X: Error
E_{47}	ACC Z: Clipped	E_{46}	ACC Y: Clipped	E_{45}	ACC X: Clipped	E_{44}	GYRO Z: Data lost
E_{43}	GYRO Z: Exc.ampl.error	E_{42}	GYRO Z: Int.comm.error	E_{41}	GYRO Z: Excitation DC	E_{40}	GYRO Z: Detection DC
E_{39}	GYRO Z: ASIC overflow, I	E_{38}	GYRO Z: ASIC overflow, Q	E_{37}	GYRO Y: Data lost	E_{36}	GYRO Y: Exc.ampl.error
E_{35}	GYRO Y: Int.comm.error	E_{34}	GYRO Y: Excitation DC	E_{33}	GYRO Y: Detection DC	E_{32}	GYRO Y: ASIC overflow, I
E_{31}	GYRO Y: ASIC overflow, Q	E_{30}	GYRO X: Data lost	E_{29}	GYRO X: Exc.ampl.error	E_{28}	GYRO X: Int.comm.error
E_{27}	GYRO X: Excitation DC	E_{26}	GYRO X: Detection DC	E_{25}	GYRO X: ASIC overflow, I	E_{24}	GYRO X: ASIC overflow, Q
E_{23}	Regulated voltage#3 error	E_{22}	Regulated voltage#2 error	E_{21}	Regulated voltage#1 error	E_{20}	Supply voltage error
E_{19}	Reference voltage#3 error	E_{18}	Reference voltage#2 error	E_{17}	Reference voltage#1 error	E_{16}	Start-up phase active
E_{15}	GYRO Z: Int.comm.error	E_{14}	GYRO Y: Int.comm.error	E_{13}	GYRO X: Int.comm.error	E_{12}	GYRO Z: Clipped
E_{11}	GYRO Y: Clipped	E_{10}	GYRO X: Clipped	E_9	TEMP GYRO Z: Error	E_8	TEMP GYRO Y: Error
E_7	TEMP GYRO X: Error	E_6	GYRO Z: ASIC temp.error	E_5	GYRO Y: ASIC temp.error	E_4	GYRO X: ASIC temp.error
E_3	µC temperature error	E_2	GYRO Z: Exc.freq.error	E_1	GYRO Y: Exc.freq.error	E_0	GYRO X: Exc.freq.error

5.5.6 Normal Mode datagram

Table 5-16: Specification of the Normal Mode datagram (full data content in datagram)

Byte#	Bit#								Specification
	7	6	5	4	3	2	1	0	
0	1	0	1	0	1	1	1	1	Normal Mode datagram identifier for Normal Mode datagram with full content. Identifier for reduced content datagrams can be found in Table 5-17
1	ID_7	ID_6	ID_5	ID_4	ID_3	ID_2	ID_1	ID_0	Identification number of IMU
2	Gx_{23}	Gx_{22}	Gx_{21}	Gx_{20}	Gx_{19}	Gx_{18}	Gx_{17}	Gx_{16}	X-axis gyro output, ref. sections 7.6.2.2.3 to 7.6.2.2.6 for conversion to units
3	Gx_{15}	Gx_{14}	Gx_{13}	Gx_{12}	G_{11}	Gx_{10}	Gx_9	Gx_8	
4	Gx_7	Gx_6	Gx_5	Gx_4	Gx_3	Gx_2	Gx_1	Gx_0	
5	Gy_{23}	Gy_{22}	Gy_{21}	Gy_{20}	Gy_{19}	Gy_{18}	Gy_{17}	Gy_{16}	Y-axis gyro output, ref. sections 7.6.2.2.3 to 7.6.2.2.6 for conversion to units
6	Gy_{15}	Gy_{14}	Gy_{13}	Gy_{12}	Gy_{11}	Gy_{10}	Gy_9	Gy_8	
7	Gy_7	Gy_6	Gy_5	Gy_4	Gy_3	Gy_2	Gy_1	Gy_0	
8	Gz_{23}	Gz_{22}	Gz_{21}	Gz_{20}	Gz_{19}	Gz_{18}	Gz_{17}	Gz_{16}	Z-axis gyro output, ref. sections 7.6.2.2.3 to 7.6.2.2.6 for conversion to units
9	Gz_{15}	Gz_{14}	Gz_{13}	Gz_{12}	Gz_{11}	Gz_{10}	Gz_9	Gz_8	
10	Gz_7	Gz_6	Gz_5	Gz_4	Gz_3	Gz_2	Gz_1	Gz_0	
11	Gs_7	Gs_6	Gs_5	Gs_4	Gs_3	Gs_2	Gs_1	Gs_0	STATUS byte for gyro measurements, ref. Table 5-19
12	Ax_{23}	Ax_{22}	Ax_{21}	Ax_{20}	Ax_{19}	Ax_{18}	Ax_{17}	Ax_{16}	X-axis accelerometer output, ref. sections 7.6.2.2.8 to 7.6.2.2.11 for conversion to units
13	Ax_{15}	Ax_{14}	Ax_{13}	Ax_{12}	Ax_{11}	Ax_{10}	Ax_9	Ax_8	
14	Ax_7	Ax_6	Ax_5	Ax_4	Ax_3	Ax_2	Ax_1	Ax_0	
15	Ay_{23}	Ay_{22}	Ay_{21}	Ay_{20}	Ay_{19}	Ay_{18}	Ay_{17}	Ay_{16}	Y-axis accelerometer output, ref. sections 7.6.2.2.8 to 7.6.2.2.11 for conversion to units
16	Ay_{15}	Ay_{14}	Ay_{13}	Ay_{12}	Ay_{11}	Ay_{10}	Ay_9	Ay_8	
17	Ay_7	Ay_6	Ay_5	Ay_4	Ay_3	Ay_2	Ay_1	Ay_0	
18	Az_{23}	Az_{22}	Az_{21}	Az_{20}	Az_{19}	Az_{18}	Az_{17}	Az_{16}	Z-axis accelerometer output, ref. sections 7.6.2.2.8 to 7.6.2.2.11 for conversion to units
19	Az_{15}	Az_{14}	Az_{13}	Az_{12}	Az_{11}	Az_{10}	Az_9	Az_8	
20	Az_7	Az_6	Az_5	Az_4	Az_3	Az_2	Az_1	Az_0	
21	As_7	As_6	As_5	As_4	As_3	As_2	As_1	As_0	STATUS byte for accelerometer measurements, ref. Table 5-19
22	GTx_{15}	GTx_{14}	GTx_{13}	GTx_{12}	GTx_{11}	GTx_{10}	GTx_9	GTx_8	X-axis gyro temperature data, ref. section 7.6.2.2.14 for conversion to units
23	GTx_7	GTx_6	GTx_5	GTx_4	GTx_3	GTx_2	GTx_1	GTx_0	
24	GTy_{15}	GTy_{14}	GTy_{13}	GTy_{12}	GTy_{11}	GTy_{10}	GTy_9	GTy_8	Y-axis gyro temperature data, ref. section 7.6.2.2.14 for conversion to units
25	GTy_7	GTy_6	GTy_5	GTy_4	GTy_3	GTy_2	GTy_1	GTy_0	
26	GTz_{15}	GTz_{14}	GTz_{13}	GTz_{12}	GTz_{11}	GTz_{10}	GTz_9	GTz_8	Z-axis gyro temperature data, ref. section 7.6.2.2.14 for conversion to units
27	GTz_7	GTz_6	GTz_5	GTz_4	GTz_3	GTz_2	GTz_1	GTz_0	
28	GTs_7	GTs_6	GTs_5	GTs_4	GTs_3	GTs_2	GTs_1	GTs_0	STATUS byte for gyro temperature measurements, ref. Table 5-19
29	ATx_{15}	ATx_{14}	ATx_{13}	ATx_{12}	ATx_{11}	ATx_{10}	ATx_9	ATx_8	X-axis accelerometer temperature data, ref. section 7.6.2.2.14 for conversion to units
30	ATx_7	ATx_6	ATx_5	ATx_4	ATx_3	ATx_2	ATx_1	ATx_0	
31	ATy_{15}	ATy_{14}	ATy_{13}	ATy_{12}	ATy_{11}	ATy_{10}	ATy_9	ATy_8	Y-axis accelerometer temperature data, ref. section 7.6.2.2.14 for conversion to units
32	ATy_7	ATy_6	ATy_5	ATy_4	ATy_3	ATy_2	ATy_1	ATy_0	
33	ATz_{15}	ATz_{14}	ATz_{13}	ATz_{12}	ATz_{11}	ATz_{10}	ATz_9	ATz_8	Z-axis accelerometer temperature data, ref. section 7.6.2.2.14 for conversion to units
34	ATz_7	ATz_6	ATz_5	ATz_4	ATz_3	ATz_2	ATz_1	ATz_0	
35	ATs_7	ATs_6	ATs_5	ATs_4	ATs_3	ATs_2	ATs_1	ATs_0	STATUS byte for accelerometer temperature measurements, ref. Table 5-19
36	P_{23}	P_{22}	P_{21}	P_{20}	P_{19}	P_{18}	P_{17}	P_{16}	PPS, ref. sections 7.6.2.2.12 to 7.6.2.2.13 for conversion to units
37	P_{15}	P_{14}	P_{13}	P_{12}	P_{11}	P_{10}	P_9	P_8	
38	P_7	P_6	P_5	P_4	P_3	P_2	P_1	P_0	
39	Ps_7	Ps_6	Ps_5	Ps_4	Ps_3	Ps_2	Ps_1	Ps_0	STATUS byte for PPS, ref. Table 5-19
40	n_{15}	n_{14}	n_{13}	n_{12}	n_{11}	n_{10}	n_9	n_8	Counter, ref. section 7.6.2.2.15.
41	n_7	n_6	n_5	n_4	n_3	n_2	n_1	n_0	Note that transmission of high byte depends on selected datagram
42	t_{15}	t_{14}	t_{13}	t_{12}	t_{11}	t_{10}	t_9	t_8	Latency, ref. section 7.6.2.2.16 for conversion to units.
43	t_7	t_6	t_5	t_4	t_3	t_2	t_1	t_0	
44	c_{31}	c_{30}	c_{29}	c_{28}	c_{27}	c_{26}	c_{25}	c_{24}	Cyclic Redundancy Check is performed on all preceding bytes, ref. section 5.5.7
45	c_{23}	c_{22}	c_{21}	c_{20}	c_{19}	c_{18}	c_{17}	c_{16}	
46	c_{15}	c_{14}	c_{13}	c_{12}	c_{11}	c_{10}	c_9	c_8	
(47)	c_7	c_6	c_5	c_4	c_3	c_2	c_1	c_0	
(48)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(49)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

Normal Mode datagrams with reduced content can be selected at order or configured in Service Mode. Overview of available datagrams can be found in Table 5-17 and in section 12. When choosing a Normal mode datagram with reduced content, the Normal Mode datagram will be shorter. However, the order of requested data will be transmitted as shown in Table 5-16. When selecting temperature in the datagram, only temperatures for the selected measurement-clusters will be transmitted, e.g. if gyro data only has been selected together with temperature, only temperatures for the gyros will be transmitted.

Table 5-17: Normal Mode datagram identifiers

Datagram content	Counter	Identifier
Rate	1 byte	0x90
Rate and acceleration	1 byte	0x91
Rate and temperature	1 byte	0x94
Rate, acceleration and temperature	1 byte	0xA5
Rate	2 bytes	0xE0
Rate and acceleration	2 bytes	0xE1
Rate and temperature	2 bytes	0xE2
Rate, acceleration and temperature	2 bytes	0xE3
Rate and PPS	2 bytes	0xE4
Rate, acceleration and PPS	2 bytes	0xE5
Rate, temperature and PPS	2 bytes	0xE6
Rate, acceleration, temperature and PPS	2 bytes	0xE7
IMU-ID, Rate	1 byte	0xD5
IMU-ID, Rate and acceleration	1 byte	0xD6
IMU-ID, Rate and temperature	1 byte	0xD7
IMU-ID, Rate, acceleration and temperature	1 byte	0xD8
IMU-ID, Rate	2 bytes	0xD9
IMU-ID, Rate and acceleration	2 bytes	0xDA
IMU-ID, Rate and temperature	2 bytes	0xDB
IMU-ID, Rate, acceleration and temperature	2 bytes	0xDC
IMU-ID, Rate and PPS	2 bytes	0xDD
IMU-ID, Rate, acceleration and PPS	2 bytes	0xDE
IMU-ID, Rate, temperature and PPS	2 bytes	0xDF
IMU-ID, Rate, acceleration, temperature and PPS	2 bytes	0xE8

5.5.7 Cyclic Redundancy Check (CRC)

At the end of all datagrams is a 32-bit Cyclic Redundancy Checksum. The CRC checksum enables the user to detect errors in the transfer of data from the STIM. The CRC is calculated using the following polynomial:

$x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$
seed = 0xFFFFFFFF

All preceding data, including the datagram identifier, is included in the CRC.

The CRC-algorithm requires full sets of 32-bits (4 bytes). Several of the defined datagrams from the STIM have a length which is not an integer number of 4 bytes. In order to have an efficient transmission of data and thereby avoid transmitting bytes with no meaningful content, dummy-byte(s) with content = 0x00 are added when the CRC of the last byte(s) is calculated.

Example: Datagram with ID=0xA5 (rate, acceleration and temperature) has been selected. This datagram consists of 38 bytes prior to the CRC checksum. Hence this datagram consists of 9 sets of 32 bits + 2 bytes. In order to include the last 2 bytes in the CRC checksum, 2 bytes = 0x00 are added, making the last data bytes the least significant bytes.

Table 5-18 lists the number of dummy-bytes needed to calculate the final CRC-checksum for the different datagrams in Normal Mode.

Table 5-18: Number of dummy-bytes to be added for CRC-calculation

Datagram content	Counter	Identifier	# dummy-bytes
Part Number datagram	-	0xB1, 0xB3	0
Part Number datagram with IMU-ID	-	0xA9, 0xAA	3
Serial Number datagram	-	0xB5, 0xB7	0
Serial Number datagram with IMU-ID	-	0xAB, 0xAC	3
Configuration datagram	-	0xEC, 0xED	2
Configuration datagram with IMU-ID	-	0xB8, 0xBA	1
Extended Error Information datagram	-	0xBE, 0xBF	3
Extended Error Information datagram with IMU-ID	-	0xC0, 0xD0	2
Bias Trim offset datagram	-	0xD1, 0xD2	0
Bias Trim offset datagram with IMU-ID	-	0xE9, 0xEA	3
Rate	1 byte	0x90	2
Rate and acceleration	1 byte	0x91	0
Rate and temperature	1 byte	0x94	3
Rate, acceleration and temperature	1 byte	0xA5	2
Rate	2 bytes	0xE0	1
Rate and acceleration	2 bytes	0xE1	3
Rate and temperature	2 bytes	0xE2	2
Rate, acceleration and temperature	2 bytes	0xE3	1
Rate and PPS	2 bytes	0xE4	1
Rate, acceleration and PPS	2 bytes	0xE5	3
Rate, temperature and PPS	2 bytes	0xE6	2
Rate, acceleration, temperature and PPS	2 bytes	0xE7	1
IMU-ID, Rate	1 byte	0xD5	1
IMU-ID, Rate and acceleration	1 byte	0xD6	3
IMU-ID, Rate and temperature	1 byte	0xD7	2
IMU-ID, Rate, acceleration and temperature	1 byte	0xD8	1
IMU-ID, Rate	2 bytes	0xD9	0
IMU-ID, Rate and acceleration	2 bytes	0xDA	2
IMU-ID, Rate and temperature	2 bytes	0xDB	1
IMU-ID, Rate, acceleration and temperature	2 bytes	0xDC	0
IMU-ID, Rate and PPS	2 bytes	0xDD	0
IMU-ID, Rate, acceleration and PPS	2 bytes	0xDE	2
IMU-ID, Rate, temperature and PPS	2 bytes	0xDF	1
IMU-ID, Rate, acceleration, temperature and PPS	2 bytes	0xE8	0

5.6 Status byte

Table 5-19: Interpretation of bits in STATUS byte

Bit	STATUS bit information	Comment
7	0=OK, 1=System integrity error	
6	0=OK, 1=Start-Up	
5	0=OK, 1=Outside operating conditions	
4	0=OK, 1=Overload	Bits 0-2 will flag the overload channel(s)
3	0=OK, 1=Error in measurement-channel	Bits 0-2 will flag the error channel(s)
2	0=OK, 1=Z-channel	Gyro and accelerometer only
1	0=OK, 1=Y-channel	Gyro and accelerometer only
0	0=OK, 1=X-channel	Gyro and accelerometer only

Refer to section 7.7 for more information related to the self-diagnostics of the STIM.

6 MECHANICAL

Table 6-1: Mechanical specifications

Parameter	Conditions	Min Nom Max	Unit	Note
HOUSING MATERIAL		Aluminium, Alloy 6082-T6, DIN EN 754-2		
SURFACE TREATMENT Passivation		 Surtec 650		 1
WEIGHT		55	grams	
VOLUME		32.6 1.99	cm^3 in^3	
DUST AND HUMIDITY CLASSIFICATION		IP67		
CONNECTOR Type Number of pins Contact type		 Micro-D 15 female		
PLUG Proposed plug to fit connector Proposed cover to fit plug	 For best EMI performance	 Axon MDA 2 15 P Axon micro-D EMI back shell		
FIXATION BOLTS Recommended torque	 Steel base Aluminium base	M4 ISO 4762 / DIN 912 3.5 3.0	 Nm Nm	

Note 1: Hexavalent chromium free

6.1 Mechanical dimensions

All dimensions are in mm.

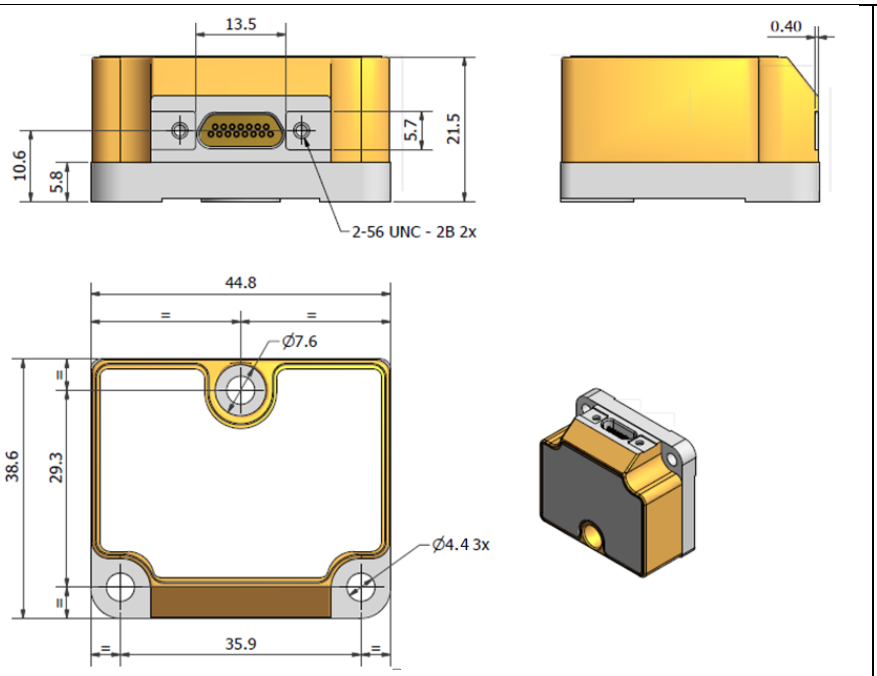

Figure 6-1: Mechanical dimensions

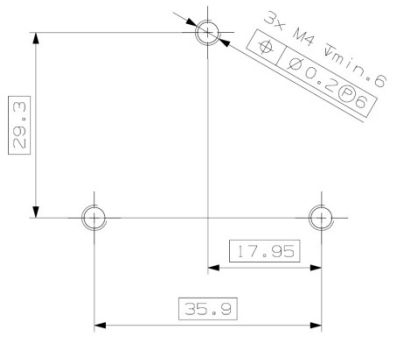

Figure 6-2: Drilling pattern

Table 6-2: Nominal position of accelerometer mass-centers (ref. Figure 6-5 for reference definition)

Axis	X-offset	Y-offset	Z-offset
X	-32.3	-10.2	12.0
Y	-26.5	-6.3	13.1
Z	-27.1	-10.7	6.8

6.2 Advice on mounting orientation

The gyros are sensitive to acceleration-forces in certain directions:

- X- and Y-gyros have their highest sensitivity to acceleration-forces in Z-direction
- Z-gyro has its highest sensitivity to acceleration-forces in Y-direction
- X-gyro has its lowest sensitivity to acceleration-forces in X-direction
- Y-gyro has its lowest sensitivity to acceleration-forces in Y-direction
- Z-gyro has its lowest sensitivity to acceleration-forces in Z-direction

6.3 Pin configuration

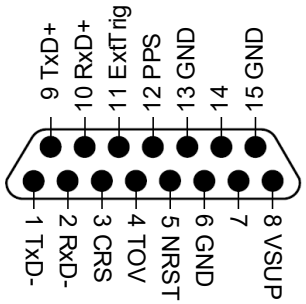

Figure 6-3: Pin configuration as seen from front of the STIM

Table 6-3: Pin descriptions

Pin#	Label	Type	Description
1	TxD-	OUTPUT	RS422 negative output
2	RxD-	INPUT	RS422 negative input
3	CRS	OUTPUT	Counter Restart Signal (if not in use, leave floating)
4	TOV	OUTPUT	Time of Validity (if not in use, leave floating)
5	NRST	INPUT	Reset (if not in use, connect to VSUP or leave floating)
6	GND	SUPPLY	Internally connected to Power ground (0V)
7			Not connected
8	VSUP	SUPPLY	Power supply (+5V)
9	TxD+	OUTPUT	RS422 positive output
10	RxD+	INPUT	RS422 positive input
11	ExtTrig	INPUT	External trigger (if not in use, connect to VSUP or leave floating)
12	PPS	INPUT	Pulse Per Second input
13	GND	INPUT	Test pin: Connect to ground (0V)
14			Not connected
15	GND	SUPPLY	Power ground (0V)

6.4 Definition of axes

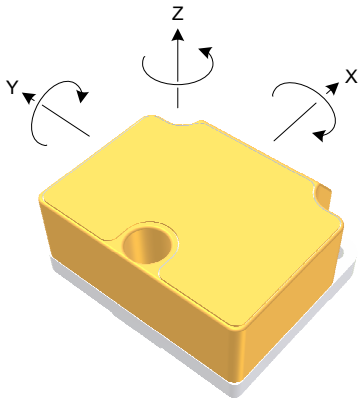

Figure 6-4: Definition of axes

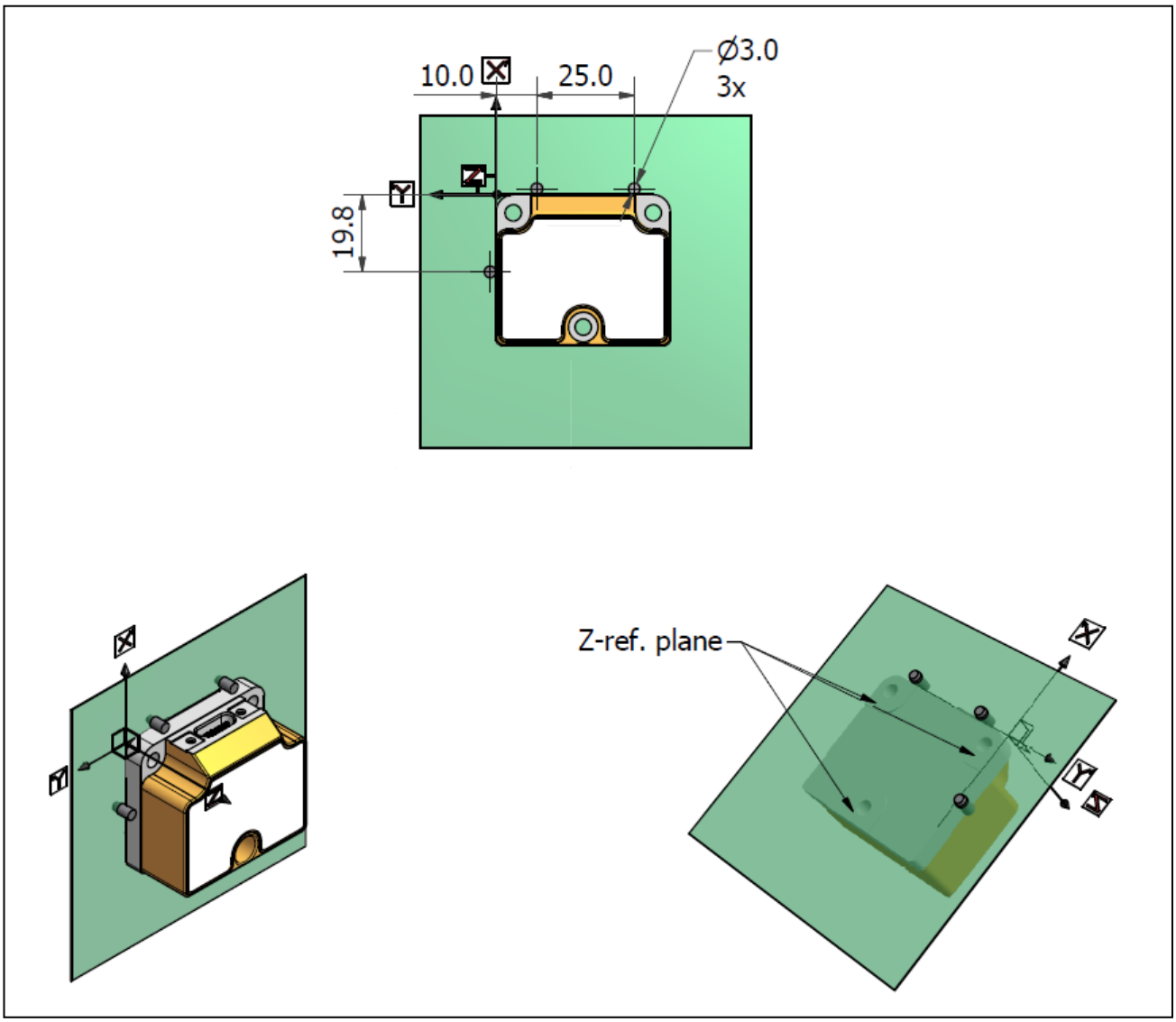

Figure 6-5: Reference points for alignment of axes

7 BASIC OPERATION

The STIM is designed for ease of use. Unless configured for external triggering, the unit automatically initiates measurements and transmits the results via the RS422 interface immediately upon power-up without any additional signaling or setup required. Figure 7-1 illustrates the simplest connection configuration for the STIM.

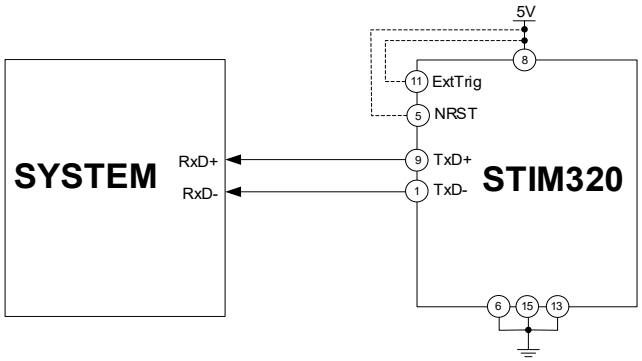

Figure 7-1: Transmit-Only Electrical Connection Diagram

In order to take full advantage of all features of the STIM, the unit needs to be connected as shown in Figure 7-2. In this set-up the system can reset the unit without having to toggle power, the external trigger function can be utilized, configuration parameters can be changed and extended information like diagnostic information can be read from the device.

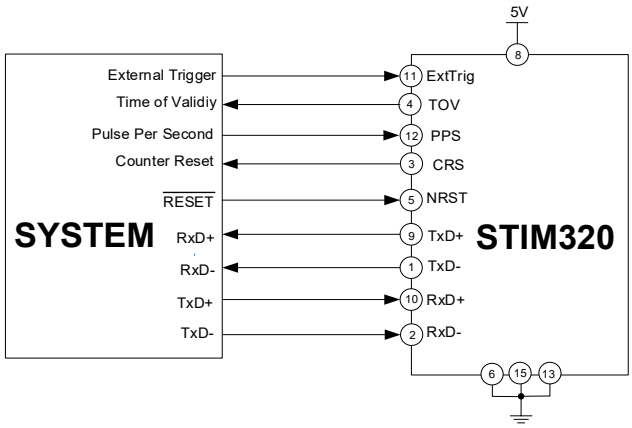

Figure 7-2: Full Function Electrical Connection Diagram

7.1 Reset

The STIM has a separate reset pin (NRST) in order for the application to reset the unit without having to toggle power.

The reset is active low and has an internal pull-up. Hence the input could be left floating if not in use.

The reset signal is routed to the reset of the microcontroller and effectively forces the STIM into Init Mode (ref. Figure 7-9 and section 7.6.1).

7.2 External Trigger

When configured for externally triggered transmission, the STIM utilizes a dedicated digital input pin to receive trigger signals. Internally, measurements are continuously performed at the maximum sample rate of 2000 samples per second to minimize latency upon trigger activation. The input is edge-sensitive and initiates transmission on the falling edge of the signal, resulting in a single datagram containing the most recent measurement data.

The input has an internal pull-up. Hence the input could be left floating if not in use.

Note that when requesting one of the special Normal Mode datagrams, ref. section 8, the datagram will be transmitted at the next external trigger input, replacing the datagram containing sensor data. If several requests for special datagrams are issued prior to an external trigger, it will be the last requested special datagram that will be transmitted.

When the STIM is in Init Mode (after Power on or Reset), it will transmit the special datagrams as described in section 7.6.1 regardless of external trigger input.

The timing diagram is shown in Figure 7-3. Latency is the time between the moment at which the sample has been digitized + low pass-filtered and the receipt of the external trigger.

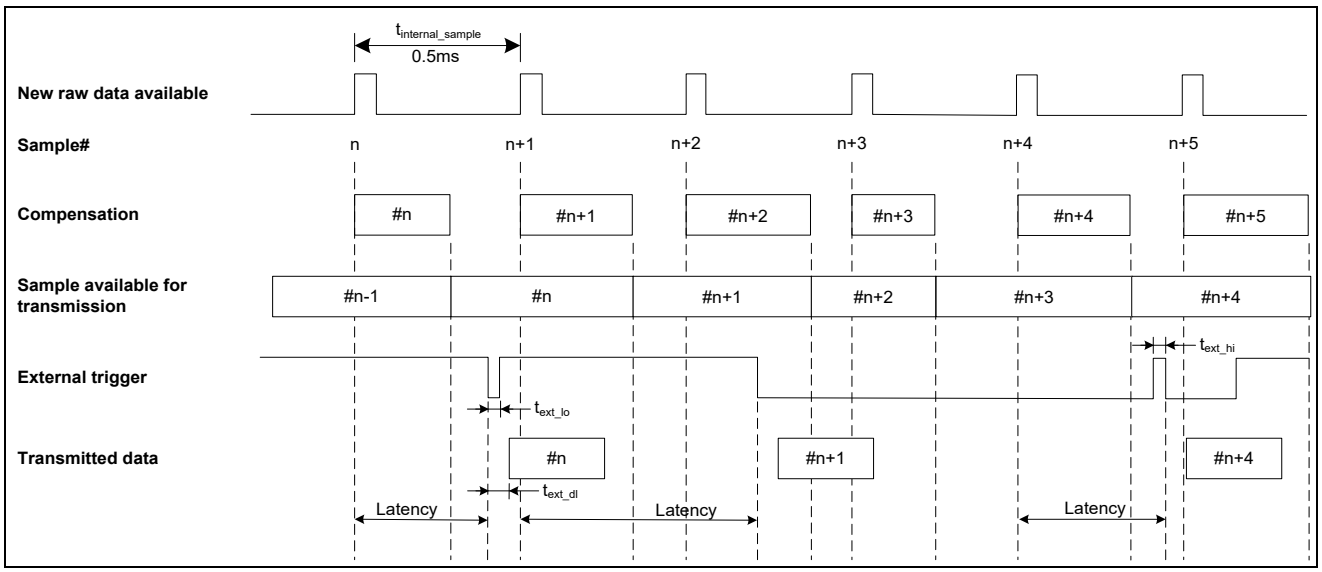

Figure 7-3: Timing of external trigger

7.2.1 Multi-module transmission

The STIM can be configured to support multi-module transmission when sample rate is set to External Trigger. This means that several STIMs can be connected to the same RS422-line and transmit the datagrams in sequential order.

The multi-module transmission is configured when selecting External Trigger as sample rate, either in Service Mode (ref. section 9.9) or in Utility Mode (ref. section 10.4.9). Choosing multi-module transmission will lead to the following:

- RS422 output will be disabled between transmissions
- The transmission will be delayed depending on the IMU-ID

If deselecting multi-module transmission later, the RS422 output will remain configured as disabled between transmissions and must be reconfigured in Service Mode or Utility Mode if required otherwise.

The timing of multi-module transmission is shown in Figure 7-4. The minimum datagram transmission delay is described in Equation 1:

Equation 1: Calculating minimum datagram transmission delay for a given IMU-ID

$$Min(t_{trans_{dl}}) = t_{ext_dl} + IMU_ID \cdot (BitRate \cdot CharLength \cdot DatagramLength + t_{tmm_min})$$

where:

t_{ext_dl}, is the delay due to final preparation of datagram, ref. Table 5-2
IMU_ID is the IMU-ID
BitRate is the bit-rate [bits/s]
CharLength is the character length [bits/byte]. This is 1 start bit + 8 data bits + number of stop-bits + parity bit (if configured)
DatagramLength is the length of the transmitted datagram [characters], ref. section 5.5 and Table 5-8
t_{mm_min} is the minimum time between datagrams, ref. Table 5-2

The timing of the sequential datagram transmissions can be modified when configuring multi-module transmission:

- Datagram delay: this parameter specifies a minimum time between the end of transmission from previous IMU and start of datagram transmission of the next. If this parameter is set lower than t_{mm_min} in Equation 1, the time between datagrams will be t_{mm_min}. Datagram delay should be set to 0, if shortest data transfer is required
- Transmission delay: this parameter specifies the time between start of datagram transmission from one IMU to the next. Note that this parameter will only be effective if it is longer than the time given by Min(t_{trans_dl}) as defined in Equation 1 AND taking into account the datagram delay parameter

As part of start-up after power-on or release of reset, the four special datagrams containing part-number, serial-number, configuration and bias trim offsets are transmitted without requiring an External Trigger to transmit. When choosing multi-module transmission, there will be an option to prevent the special datagrams from being transmitted during start-up. The special datagrams can still be requested through the Normal Mode commands, ref. section 8. If special datagrams are to be transmitted as part of start-up, all datagrams will be transmitted from one IMU before the next IMU starts transmitting its special datagrams.

The following points should be noted when operating in multi-module transmission configuration:

- All IMUs must have a unique IMU-ID
- The order and timing of start of datagram transmissions is given by the IMU-ID
- All IMUs must have the same configuration when it comes to datagram content and transmission parameters
- External Trigger should not be issued before all IMUs have completed their transmission. There is no communication between the IMUs that will ensure that the IMUs do not start transmission before the previous chain of transmissions has been completed
- Service Mode should be entered by specifying an IMU-ID, ref. section 8.7. This will enable communication with one specific IMU. The other IMUs will stop transmitting and not respond to Service Mode commands or external triggers until Service Mode is exited. If exiting Service Mode using commands “x n” or “x i", Service Mode will be exited without requesting a confirmation even if there are unsaved changes in the system configuration
- Utility Mode should be entered by specifying an IMU-ID, ref. section 8.8. This will enable communication with one specific IMU. The other IMUs will stop transmitting and not respond to external triggers until Utility Mode is exited
- If special datagrams are to be transmitted as part of start-up, the reset-line should preferably be used after power-on to ensure non-overlapping datagrams
- TOV output will still be active and should not be connected to TOVs of other IMUs

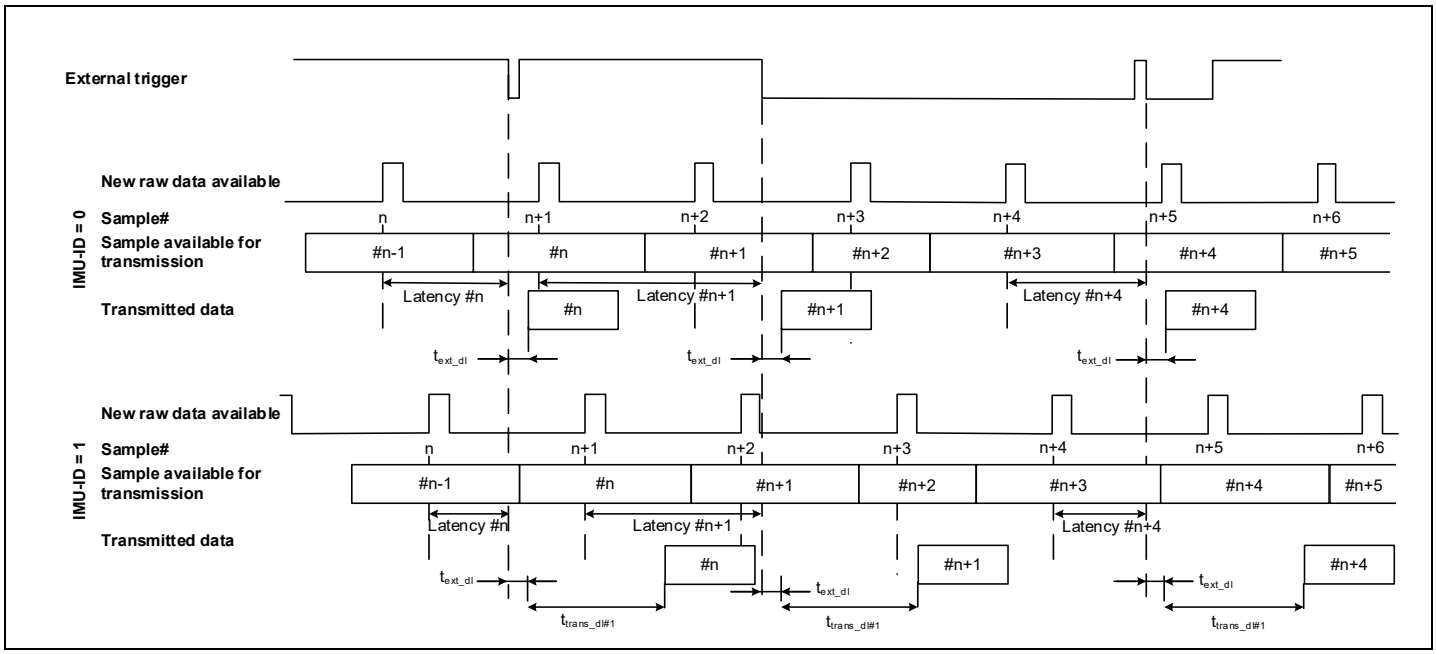

Figure 7-4: Timing of external trigger and multi-module transmission

7.3 Time of Validity (TOV)

The TOV-output serves 2 purposes:

- Provide a synchronization-signal derived from the internal clock of the STIM
- Provide means to signal when a datagram is being transmitted (NB: not when configured to external trigger)

The TOV falling edge occurs synchronous to the sample rate. The raising edge occurs after the last bit of the datagram has been transmitted.

Figure 7-5 and Figure 7-6 show the timing diagram of the TOV-output.

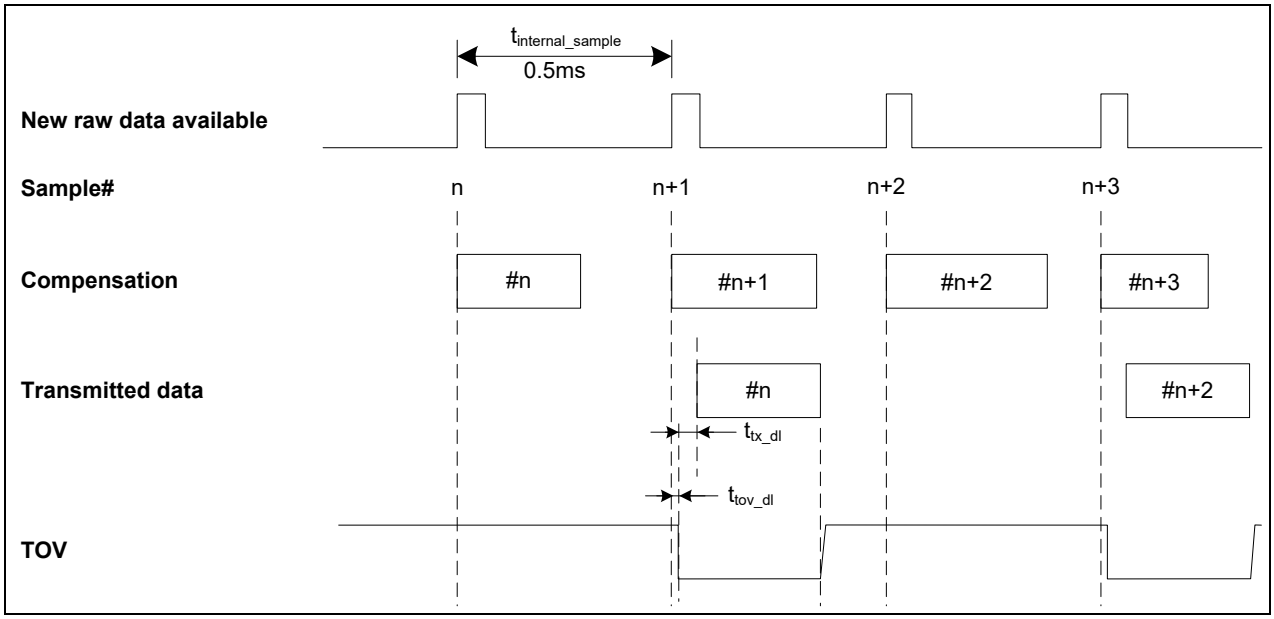

Figure 7-5: Timing of TOV (example: sample rate = 1000samples/s)

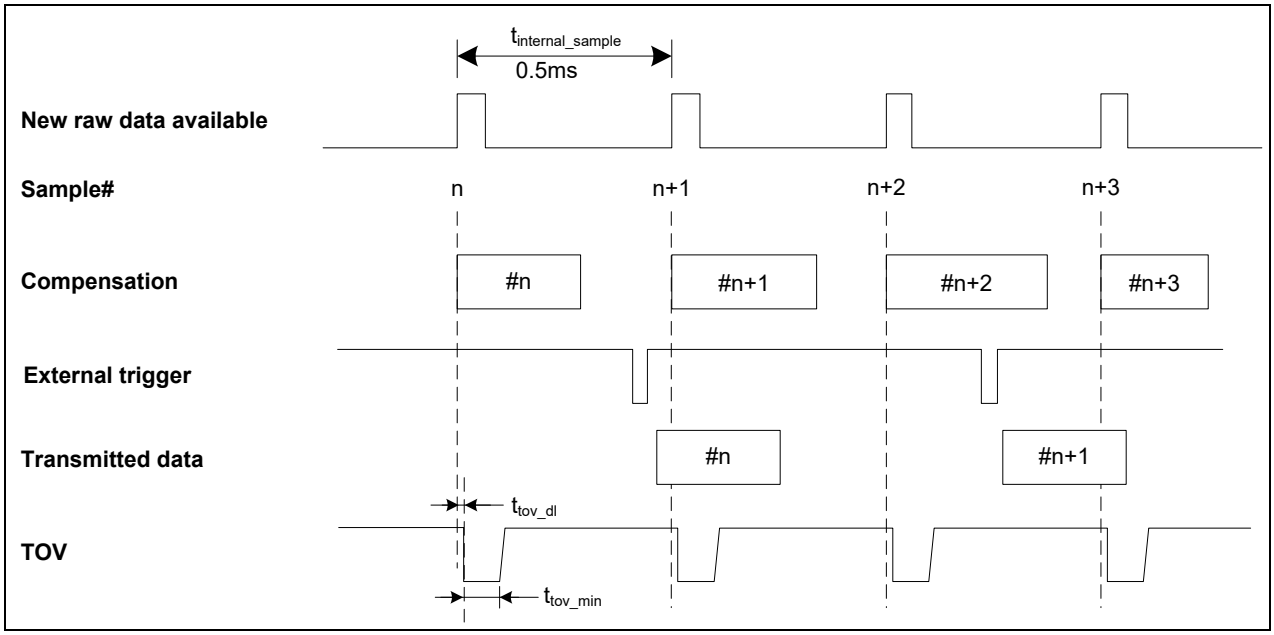

Figure 7-6: Timing of TOV with external trigger

7.4 PPS

The STIM provides functionality to detect a transition of or sample a PPS signal. The PPS part of the Normal Mode datagram (ref. section 5.5.6) can be activated by choosing a datagram containing PPS data (ref. sections 9.4, 10.4.3 and 12).

The PPS data can be represented either as “Time since detection” or as “PPS filtered”.

7.4.1 Time since detection

If the output unit of PPS has been set to “Time since detection of 0” or “Time since detection of 1” (ref. sections 9.4, 10.4.3 and 12), the STIM will be configured to give an internal interrupt when a transition (1 -> 0 or 0 -> 1) is detected in order to record the time at which the transition occurred.

“Time since detection of 0” will detect a transition from 1 -> 0. “Time since detection of 1” will detect a transition from 0 -> 1.

Every time a datagram is transmitted, the time since detection of the transition will be calculated and transmitted, ref: Figure 7-7 for definition of “Time since detection”.

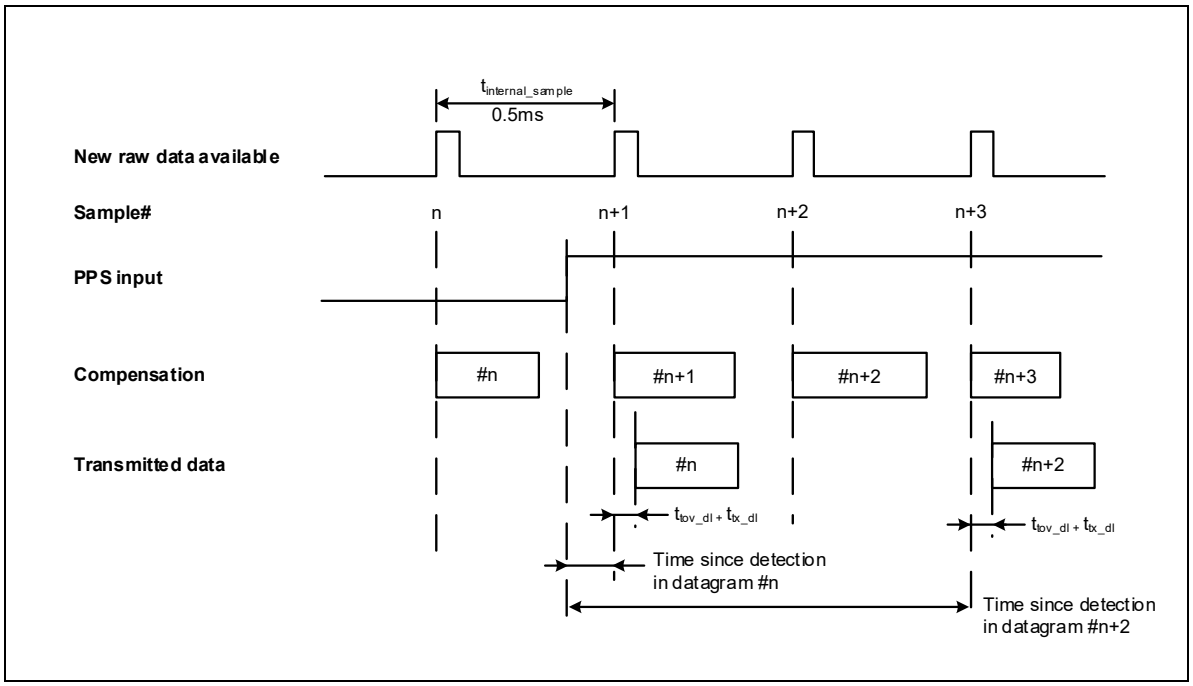

Figure 7-7: PPS sampling when output unit “Time since detection of 1”

If the time since detection becomes longer than what can be transmitted (2^{23}-1µs or approximately 8.4s), the time since detection will remain at the maximum value but with the overload bit (bit 4) set in the PPS status byte, ref. sections 5.5.6 and 5.6.

The conversion of PPS data to [µs] can be found in section 7.6.2.2.12.

7.4.2 Filtered PPS

If the output unit of PPS has been set to “Filtered PPS” (ref. sections 9.4 and 12), the PPS input will be sampled at 32kHz and sent through the same type of CIC-filter as for the gyros and accelerometers. The LP filter -3dB frequency can be changed in SERVICEMODE, ref. section 9.5.

As the group delay of digitizing the PPS-signal is different from the gyros and accelerometers, a “Filtered PPS – delayed” option is available, see section 7.6.2.2.1.

The conversion of PPS data to [0, 1] can be found in section 7.6.2.2.13.

7.5 Counter and Counter Restart Signal (CRS)

An internal counter is implemented which continuously counts the internal samples (2000 samples/s). The counter is 16 bits and takes values in the interval [0, 65535]. The counter will naturally wrap-around with no error-message indication in the Status-byte. The counter can also be set to restart at lower values than 65535 in SERVICEMODE, ref. section 9.7 and 10.4.3.

Depending on the selected datagram (ref. sections 9.4 and 12), the counter is transmitted as 8 bits (the least significant bits of the counter) or full 16 bits. If the counter interval is higher than 256 and a datagram with an 8-bit counter-value has been selected, the counter will naturally wrap at n x 256 (n is a positive integer) and then restart when the 16-bit counter reaches the defined interval.

The CRS outputs a pulse every time the counter restarts from 0. A timing diagram is shown in Figure 7-8. When the counter interval is set to maximum (counter restart-value = 0), there is no toggling of the CRS.

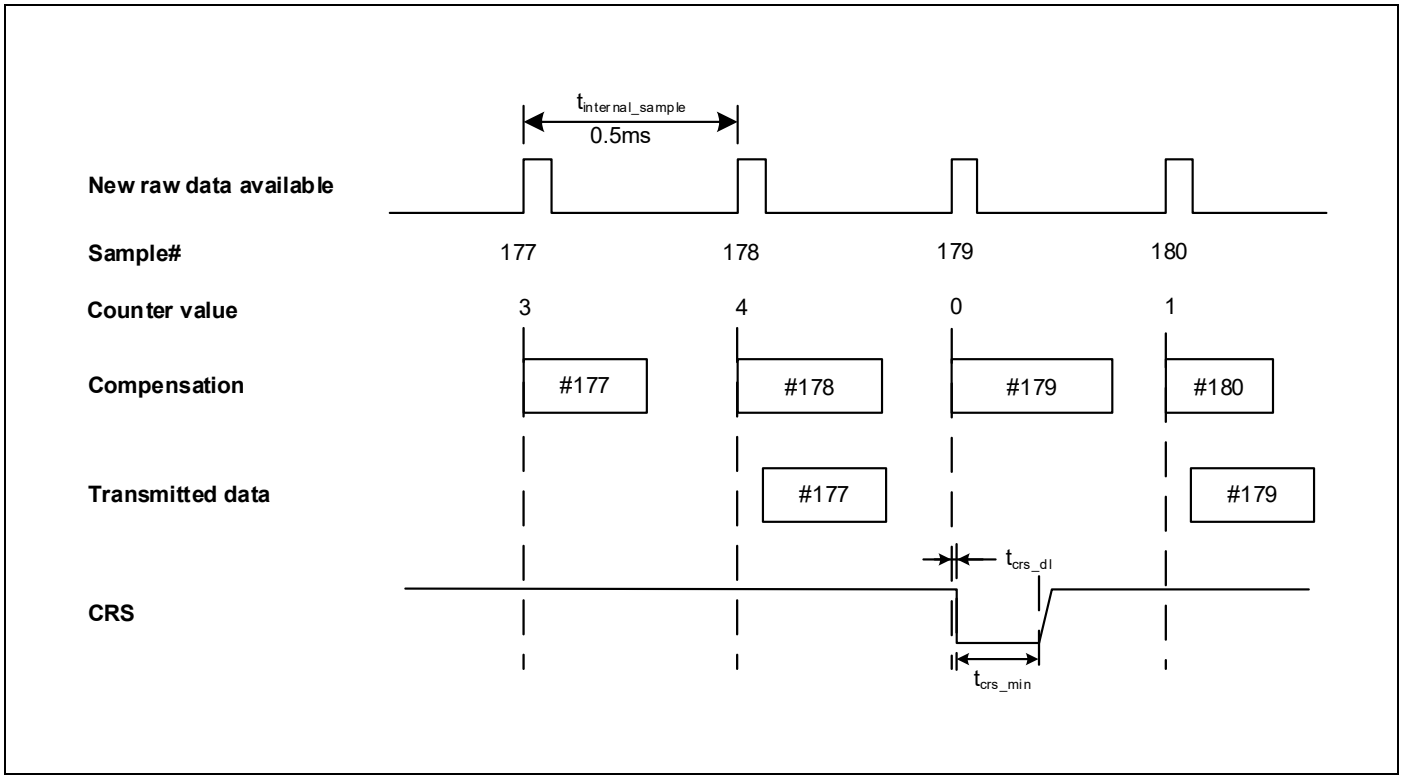

Figure 7-8: Timing of CRS (example: sample rate = 1000 samples/s, counter interval = 5)

7.6 Operating modes

The operating modes of the STIM are shown in Figure 7-9:

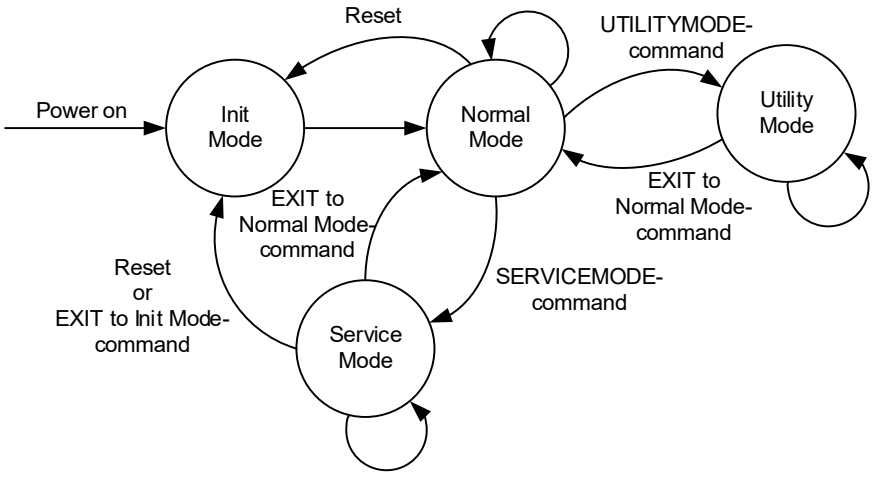

Figure 7-9: Operating modes

7.6.1 Init Mode

Init Mode is entered after the following conditions:

- power on
- after an external reset
- when receiving a reset command in Normal Mode
- when exiting to Init Mode from Service Mode.

In Init Mode the system waits for internal references to settle, resets and synchronizes the sensor channels and transmits four special datagrams containing part number, serial number, configuration data and bias trim offsets. Note that length and format of the special datagrams are different to the datagrams in Normal Mode.

The content and format of the Part Number datagram is specified in Table 5-9.
The content and format of the Serial Number datagram is specified in Table 5-11.
The content and format of the Configuration datagram is specified in Table 5-12.
The content and format of the Bias Trim Offset datagram is specified in Table 5-13.
After having transmitted the special Part Number, Serial Number, Configuration and Bias Trim Offset datagrams, the STIM enters Normal Mode.

All these special datagrams can also be requested by commands in Normal Mode, ref. section: 8.

7.6.2 Normal Mode

In Normal Mode the STIM will constantly transmit sensor data at the configured sample rate. The internal sample rate will always be at the maximum regardless of the transmitted sample rate.

The STIM will continue to transmit data regardless of any errors reported in the STATUS bytes (ref. Table 5-19). Hence the content of the STATUS byte should continuously be examined.

The content of the Normal Mode datagram is specified in Table 5-16.

7.6.2.1 Start-Up

When the STIM enters Normal Mode from Init Mode, there will be a start-up period where the STIM is stabilizing the gyros. During this period bit 6 is set in the STATUS-byte (ref. Table 5-19) to communicate its condition. Once stabilized, bit 6 will be cleared. During this period the output data should be regarded as non-valid.

There will not be any start-up period when the STIM is exiting from Service Mode directly to Normal Mode.

7.6.2.2 Data output options and interpretation

The gyros in the STIM measure angular rate [°/s] and the accelerometers measure acceleration [g]. However, in order to make the STIM more versatile, a few simple functions are offered, ref. Table 7-1 and Table 7-2:

Table 7-1: Implemented functions for gyro output units

Function	Description of function	Equation	Output unit
Incremental	Adds all internal samples between two transmissions multiplied by the time between internal samples	$Incremental = \sum_{i=1}^{n} AngularRate_i \cdot \frac{1}{2000} s$ n = 2000 / sample rate	[°]
Average	Calculates the average of the internal samples between two transmissions	$Average = \frac{1}{n} \cdot \sum_{i=1}^{n} AngularRate_i$ n = 2000 / sample rate	[°/s]
Integrated	Adds all internal samples multiplied by the time between internal samples since start-up / last reset. Note that the result takes values in the interval [-4°, 4°> and will naturally wrap-around with no error-message indication in the Status-byte	$Integrated = \sum_{i=1}^{n} AngularRate_i \cdot \frac{1}{2000} s$ n = internal samples (at a rate of 2000 samples/s) since start-up or last reset)	[°]

Table 7-2: Implemented functions for accelerometer output units

Function	Description of function	Equation	Output unit
Incremental	Adds all internal samples between two transmissions multiplied by the time between internal samples and converted to [m/s]	$Incremental = k_0 \cdot \sum_{i=1}^{n} Acceleration_i \cdot \frac{1}{2000} s$ k_0 = 9.80665 m/s²/g n = 2000 / sample rate	[m/s]
Average	Calculates the average of the internal samples between two transmissions	$Average = \frac{1}{n} \cdot \sum_{i=1}^{n} Acceleration_i$ n = 2000 / sample rate	[g]
Integrated	Adds all internal samples multiplied by the time between internal samples since start-up / last reset. Note that the result takes values in a specific interval as described in 7.6.2.2.11 and will naturally wrap-around with no error-message indication in the Status-byte	$Integrated = \sum_{i=1}^{n} Acceleration_i \cdot \frac{1}{2000} s$ n = internal samples (at a rate of 2000 samples/s) since start-up or last reset	[gs]
Integrated	Adds all internal samples multiplied by the time between internal samples since start-up / last reset. Note that the result takes values in a specific interval as described in 7.6.2.2.11 and will naturally wrap-around with no error-message indication in the Status-byte	$Integrated = k_0 \cdot \sum_{i=1}^{n} Acceleration_i \cdot \frac{1}{2000} s$ k_0 = 9.80665 m/s²/g n = internal samples (at a rate of 2000 samples/s) since start-up or last reset	[m/s]

7.6.2.2.1 IMU-ID

The STIM can be configured to include an IMU-ID in each datagram. This is a 1-byte identification, taking values between 0 and 255. When a Normal Mode-datagram with IMU-ID has been selected, the IMU-ID will also appear in the special datagrams transmitted during start-up and when requested using Normal Mode commands, ref. section 8.
The IMU-ID is a useful feature to identify from which IMU the data originates, e.g. in systems with different IMUs.

The IMU-ID is used when the IMU is configured in multi-module transmission, ref. section 7.2.1, to define the time at which the IMU will transmit.

The IMU-D can be programmed in Service Mode, ref. section 9.7, or in Utility Mode, ref. section 10.4.3.

7.6.2.2.2 Delayed gyro and PPS outputs

The inherent group delay of the gyro-, accelerometer and PPS-signals are different, ref. Table 5-3 and Table 5-4 for gyro and accelerometers respectively.

As the group delay for the accelerometers is the longest, options are available to delay the gyro signals by 1.0ms and/or PPS signal by 1.5ms in order for the group delay of signals to be similar. To enable this feature, select one of the " – delayed" output-units for gyro and/or PPS, ref. section 9.13 and 12.

7.6.2.2.3 Gyro output unit = Angular Rate

In the case of the STIM being configured to output angular rate, the equations for conversion to [°/s] can be found in Equation 2 and Figure 7-10. Note that the output data is represented as two's complement.

Equation 2: Converting output to [°/s]:

$$Output[^\circ/s] = \frac{(AR_1)\cdot 2^{16} + (AR_2)\cdot 2^{8} + (AR_3) - (AR_{b23})\cdot 2^{24}}{2^{14}}$$

where AR_1 is the most significant byte of the 24bit output
AR_2 is the middle byte of the 24bit output
AR_3 is the least significant byte of the 24bit output
AR_{b23} is the most significant bit of AR_1

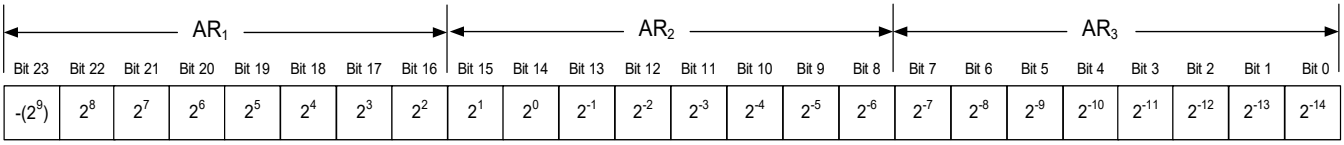

Figure 7-10: Converting output bytes to [°/s]

7.6.2.2.4 Gyro output unit = Incremental Angle

In the case of the STIM being configured to output incremental angle per sample, the equations for conversion to [°/sample] can be found in Equation 3 and Figure 7-11. Note that the output data is represented as two's complement.

Equation 3: Converting output to [°/sample]

$$Output[^\circ/sample] = \frac{(IA_1)\cdot 2^{16} + (IA_2)\cdot 2^{8} + (IA_3) - (IA_{b23})\cdot 2^{24}}{2^{21}}$$

where IA_1 is the most significant byte of the 24bit output
IA_2 is the middle byte of the 24bit output
IA_3 is the least significant byte of the 24bit output
IA_{b23} is the most significant bit of IA_1

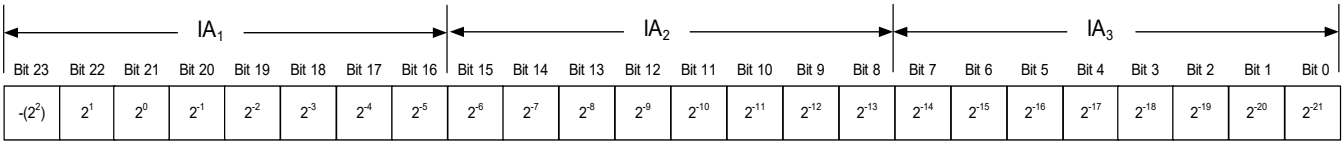

Figure 7-11: Converting output bytes to [°/sample]

7.6.2.2.5 Gyro output unit = Average Angular Rate

In the case of the STIM being configured to output average angular rate, the transmitted data will be the average of the samples since last transmission. E.g. in the case of continuous transmission of datagrams and a sample rate of 500Hz, each transmission will contain the average of the four previous internal samples.

Note that the configured low-pass filtering is performed prior to calculating the average.

Conversion to [°/s] is the same as for angular rate and is described in Equation 2.

7.6.2.2.6 Gyro output unit = Integrated Angle

In the case of the STIM being configured to output integrated angle, the transmitted data will be the continuously integrated angle since power-on or reset. The integrated angle will be in the interval [-4°, 4°> and will naturally wrap-around with no error-message indication in the Status-byte.

Conversion to [°] is the same as for incremental angle and is described in Equation 3.

7.6.2.2.7 Gyro g-compensation

As the STIM also contains accelerometers, functionality has been implemented to provide means to compensate for the g-sensitivity for gyro scale-factor and/or bias.

In addition, a simple 1-pole low-pass filter can be switched in to apply additional filtering of the accelerometer-signal prior to use in the compensation, ref: Figure 7-13. A simplified compensation-scheme can be found in Figure 7-12.

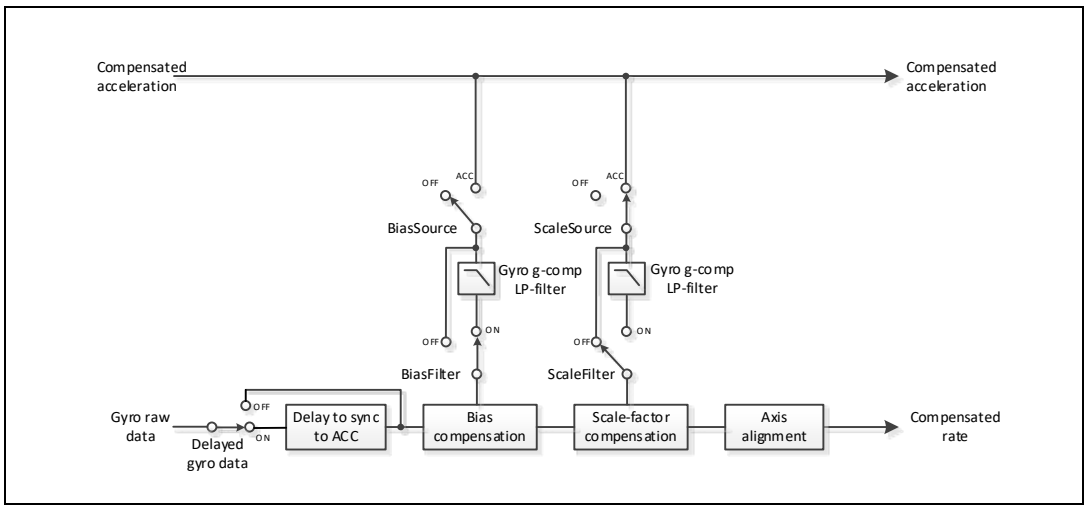

Figure 7-12: Simplified compensation-scheme for gyro g-compensation

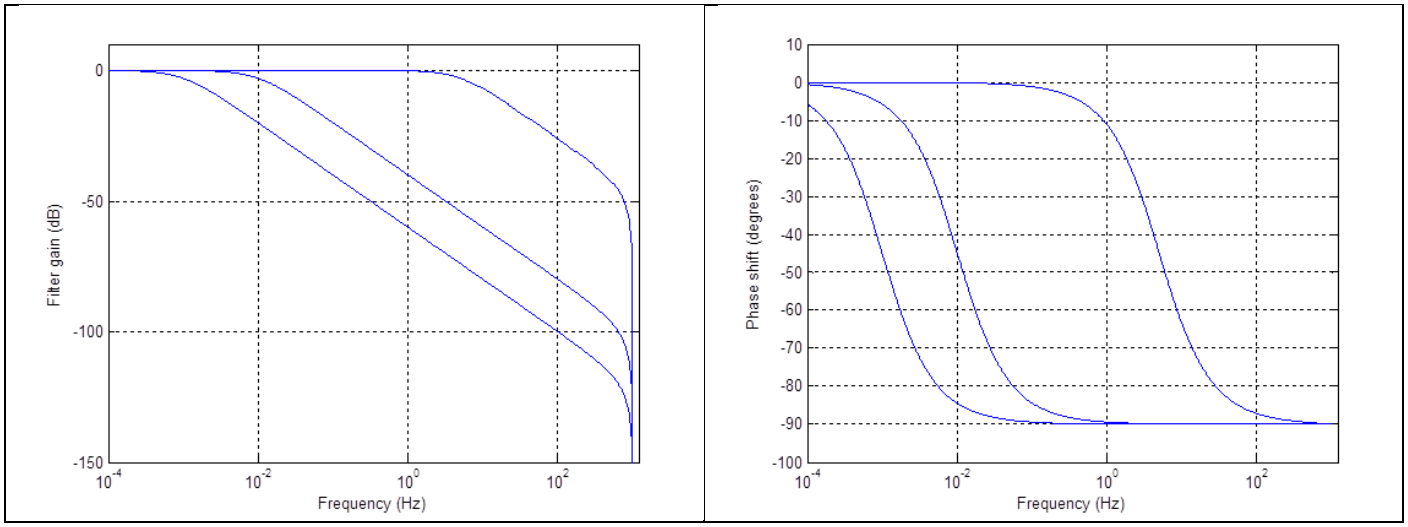

Figure 7-13: Frequency characteristics of g-compensation low-pass filter for 0.001Hz, 0.01Hz and 5Hz settings

7.6.2.2.8 Accelerometer output unit = Acceleration

In the case of the STIM being configured to output acceleration, the equations for conversion to [g] can be found in Equation 4 and Figure 7-14. Note that the output data is represented as two's complement.

Equation 4: Converting output to [g]:

Range	Conversion:
10g	$Output[g] = \frac{(ACC_1)\cdot 2^{16} + (ACC_2)\cdot 2^{8} + (ACC_3) - (ACC_{b23})\cdot 2^{24}}{2^{19}}$

where ACC_1 is the most significant byte of the 24bit output
ACC_2 is the middle byte of the 24bit output
ACC_3 is the least significant byte of the 24bit output
ACC_{b23} is the most significant bit of ACC_1

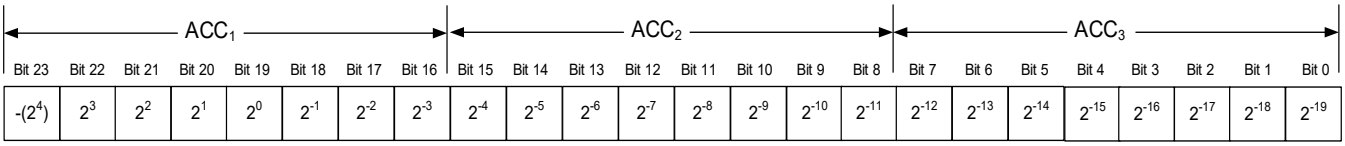

Figure 7-14: Converting output bytes to [g] (example is valid for 10g range)

7.6.2.2.9 Accelerometer output unit = Incremental Velocity

In the case of the STIM being configured to output incremental velocity per sample, the equations for conversion to [m/s/sample] can be found in Equation 5 and Figure 7-15. Note that the output data is represented as two's complement.

Equation 5: Converting output to [m/s/sample]

Range	Conversion:
10g	$Output[m/s/sample] = \frac{(IV_1)\cdot 2^{16} + (IV_2)\cdot 2^{8} + (IV_3) - (IV_{b23})\cdot 2^{24}}{2^{22}}$

where IV_1 is the most significant byte of the 24bit output
IV_2 is the middle byte of the 24bit output
IV_3 is the least significant byte of the 24bit output
IV_{b23} is the most significant bit of IV_1

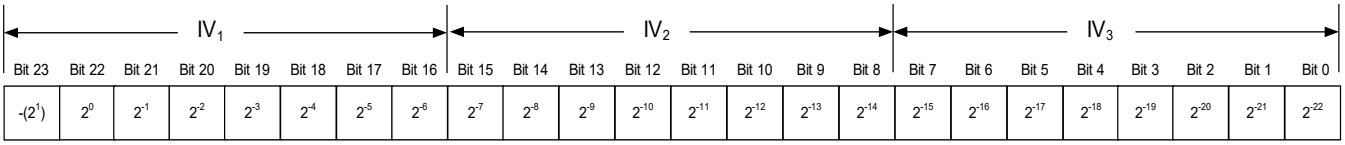

Figure 7-15: Converting output bytes to [m/s/sample] (example is valid for 10g range)

7.6.2.2.10 Accelerometer output unit = Average Acceleration

In the case of the STIM being configured to output average acceleration, the transmitted data will be the average of the samples since last transmission. E.g. in the case of continuous transmission of datagrams and a sample rate of 500Hz, each transmission will contain the average of the four internal samples.

Conversion to [g] is the same as for acceleration and is described in Equation 4.

7.6.2.2.11 Accelerometer output unit = Integrated Velocity

In the case of the STIM being configured to output integrated velocity, the transmitted data will be the continuously integrated velocity since power-on or reset. The integrated velocity will be in the interval as shown in Table 7-3 and will naturally wrap-around with no error-message indication in the Status-byte.

Table 7-3: Interval for integrated velocity

Range	Interval:
10g	[-2, 2>

Conversion to [gs] or [m/s] is the same as for incremental velocity and is described in Equation 5.

7.6.2.2.12 PPS output unit = Time since detection

In the case of the STIM being configured to “Time since detection of 0” or “Time since detection of 1”, the equation for conversion to [µs] can be found in Equation 6 and Figure 7-16. Note that the output data is represented as two’s complement.

Equation 6: Converting output to [µs]:

$$Output[\mu s] = (PPS_1) \cdot 2^{16} + (PPS_2) \cdot 2^8 + (PPS_3) - (PPS_{b23}) \cdot 2^{24}$$

where PPS_1 is the most significant byte of the 24bit output
PPS_2 is the middle byte of the 24bit output
PPS_3 is the least significant byte of the 24bit output
PPS_{b23} is the most significant bit of PPS_1

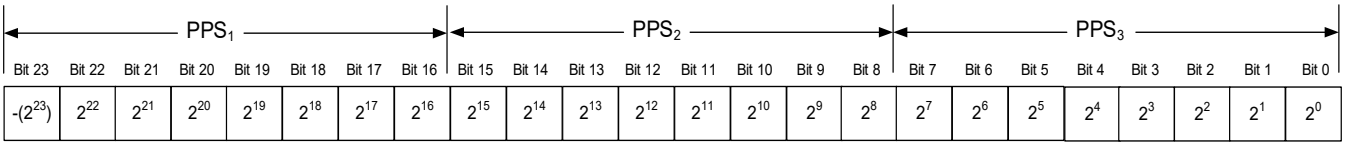

Figure 7-16: Converting output bytes to [µs]

7.6.2.2.13 PPS output unit = Filtered PPS

In the case of the STIM being configured to “Filtered PPS”, the equation for conversion can be found in Equation 7 and Figure 7-17. The output will take values in the range [0, 1].

Equation 7: Converting output to [ ]:

$$Output[\ ] = \frac{(PPS_1) \cdot 2^{16} + (PPS_2) \cdot 2^8 + (PPS_3)}{2^{22}}$$

where PPS_1 is the most significant byte of the 24bit output
PPS_2 is the middle byte of the 24bit output
PPS_3 is the least significant byte of the 24bit output

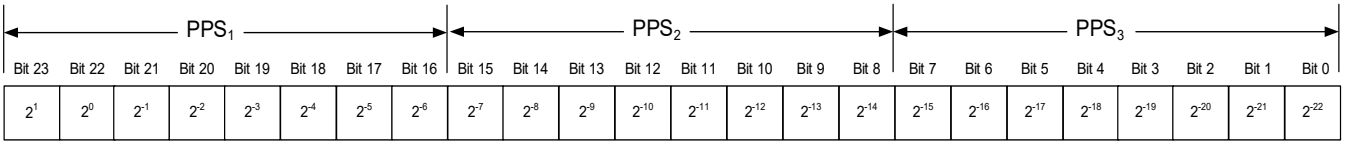

Figure 7-17: Converting output bytes to [ ]

7.6.2.2.14 Temperature

Temperature data for each axis is available in certain datagrams (ref. section 12).

Equation 8 and Figure 7-18 show how to convert to [°C]. Note that the output data is represented as two's complement.

Equation 8: Converting temperature data to [°C]

$$Output[°C] = \frac{(T_1)\cdot 2^8 + (T_2) - (T_{b15})\cdot 2^{16}}{2^8}$$

where T_1 is the most significant byte of the 16bit output
T_2 is the least significant byte of the 16bit output
T_{b15} is the most significant byte of T_1

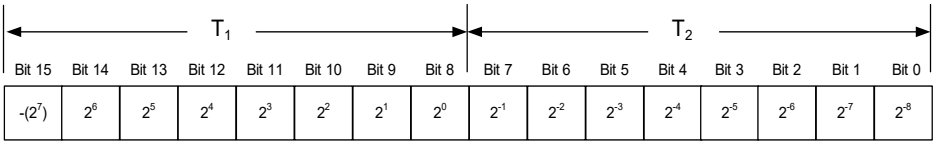

Figure 7-18: Converting temperature data to [°C]

7.6.2.2.15 Counter

Counter is un-signed and consists of 1 or 2 bytes depending of the selected datagram.

If counter is 2 bytes, the counter can be calculated as shown in Equation 9 and Figure 7-19:

Equation 9: Converting counter to an integer number:

$$Output = (Counter_1)\cdot 2^8 + (Counter_2)$$

where $Counter_1$ is the most significant byte of the counter
$Counter_2$ is the least significant byte of the counter

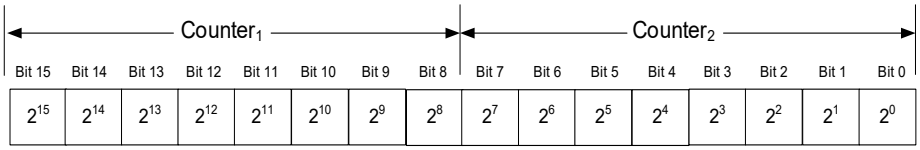

Figure 7-19: Converting counter to an integer number

7.6.2.2.16 Latency

To calculate the latency in [µs], refer to Equation 10 and Figure 7-20. Note that latency is an unsigned word.

Equation 10: Converting output to [µs]:

$$Output[\mu s] = (LT_1)\cdot 2^8 + (LT_2)$$

where LT_1 is the most significant byte of the 16bit output
LT_2 is the least significant byte of the 16bit output

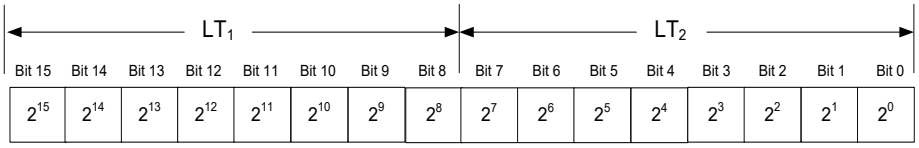

Figure 7-20: Converting output bytes to [µs]

7.6.2.3 Bias Trim Offset

The STIM offers the possibility to trim the biases by adding or subtracting user-defined offsets to the individual sensor signals. Adjusting the bias trim offsets can be done by entering Bias Trim Offset Mode (ref. section 7.6.4) or Service Mode (ref. section 9).

The bias trim offsets are applied to the sensor-signals after the compensation-algorithms with the sign-convention as shown in Equation 11:

Equation 11: Applying bias trim offsets:

$$Sensor_{adjusted} = Sensor_{compensated} + \text{BiasTrimOffset}$$

where $Sensor_{adjusted}$ is the sensor-data to be transmitted
$Sensor_{compensated}$ is the sensor-data after compensation
BiasTrimOffset is the current bias trim offset for the particular sensor axis

Note that the bias trim offset is in [°/s] for the gyros and [g] for the accelerometers. This is also the case if the selected output unit is incremental or integrated.

7.6.3 Service Mode

In Service Mode the communication interface is human readable and hence the communication format (ASCII) supports the use of terminal-based software during the development phase, when the configuration of a device needs to be changed or during investigations into an observed problem.

When Service Mode is entered, the STIM will respond with its configuration information (same as the response to the i (INFORMATION) command, ref: Figure 9-21).

A set of commands are available, ref. Section 9, enabling the user to change intermediately or permanently the configuration parameters, display latest measurement results, display higher details on error information and perform a full diagnostic of the unit.

In Service Mode the gyro measurements will still be running in the background, enabling to switch directly back to Normal Mode without the need for any stabilization time of filters, etc. However the measurement data itself, when the STIM is in Service Mode, is not transmitted and therefore lost. By using the a (SINGLE-SHOT MEASUREMENT) command (ref. Section 9.1) it is possible to display single measurement results.

Exiting Service Mode can be done in several ways:

1. Using the external reset. This will force the STIM into Init Mode. Be advised that during Init Mode, all the configuration parameters are loaded from flash. If any of the configuration parameters have been changed during the Service Mode session but not saved to flash, these changes will be overwritten by the content already stored in flash.
2. Using the x (EXIT) command. When using this command a parameter is required to decide whether the device should go to Init Mode or to Normal Mode. When exiting to Normal Mode, any of the changes made to the configuration parameters will still be valid. However, if not saved, the configuration parameters will be overwritten by the content already stored in flash at the next power-up or reset.

7.6.4 Utility Mode

The Utility Mode is similar to Service Mode (ref. section 7.6.3) but made for machine-machine communication. All commands and responses include CRC-8 to detect any errors in the communication.

After having received the “UTILITYMODE”-command (ref. section 8.8), the STIM will stop transmitting Normal Mode datagrams and send an acknowledgement that it is now in Utility Mode (ref. section 10.1). Even though the Normal Mode datagrams are not transmitted, the measurements will continue in the background.

Several commands are available to obtain information or change configuration parameters, ref. section 10.

When the Utility Mode is exited, the STIM will return to Normal Mode and resume transmission of Normal Mode datagrams.

7.7 Self-diagnostics

The STIM is continuously checking its internal status. The checks include:

- Check of internal references
- Check of sensors (error and overload)
- Check of internal temperatures
- Check of RAM and flash
- Check of supply voltage

A full diagnostic can be run to see the result of the individual checks by using the c (DIAGNOSTIC) command, ref. Section 9.2 in SERVICEMODE.

When an error situation is detected, the corresponding bit in the STATUS byte (ref. Table 5-19) will be set. If the sample-rate is set lower than 2000 samples/s, the STATUS byte will reflect the accumulated status of all the sub-samples between two data transmissions. The bits in the STATUS bytes are valid for the data in a single transmission and hence not latched.

Access to extended error registers containing accumulated error-information can be achieved either by using the Normal Mode-command "E" (EXTENDED ERROR INFORMATION DATAGRAM, ref. section 8.5 and Table 5-15) or the SERVICEMODE-command i e (INFORMATION on ACCUMULATED LAST ERRORS, ref. section 9.5).

The extended error registers are cleared at the following events:

- After the start-up phase, triggered by power-on or reset
- After transmission of Extended Error Information Datagram (ref. section 8.5)
- After use of SERVICEMODE-command "i e" (INFORMATION on ACCUMULATED LAST ERRORS, ref. section 9.5)

8 COMMANDS IN NORMAL MODE

Several commands are available in Normal Mode, as listed in Table 8-1. Note that all commands in Normal Mode must be transmitted in upper case letters.

Table 8-1 Available commands in Normal Mode

Command	Short description
N	Transmits one Part Number datagram
I	Transmits one Serial Number datagram
C	Transmits one Configuration datagram
T	Transmits one Bias Trim Offset datagram
E	Transmits one Extended Error Information datagram
R	Resets the unit
SERVICEMODE	Enters Service Mode
UTILITYMODE	Enters Utility Mode

Table 8-2 List of special ASCII characters used in Normal Mode

Char	Hex	Dec	Short description
<CR>	0x0D	13	“Carriage Return”: used as execution character for commands
<SP>	0x20	32	“Space”: used to separate command and first parameter

No echo of received command characters or error messages will appear for these commands. Only at the receipt of the complete correct command, will the STIM execute accordingly.

NB: if OUTPUT-UNIT is set to INCREMENTAL (ref. Section 9.13), the transmitted incremented value in the datagram following any of the requested special datagrams will NOT contain the incremental value since the last transmitted measurement. Hence the incremented value(s) occurring during the transmission of a special requested datagram will be lost.

8.1 N (PART NUMBER DATAGRAM) command

General description: Requests transmission of a Part Number datagram (ref. Table 5-9).

Table 8-3 : Available N (PART NUMBER DATAGRAM) command

Syntax	Response
N<CR>	Transmits one Part Number datagram

The Part Number datagram will replace the next transmitted Normal Mode datagram. If the Part Number datagram is longer than the selected Normal Mode datagram, the Part Number datagram may replace more than one Normal Mode datagram transmission (depending on sampling-rate and bit-rate).

If sample rate is set to external trigger, the Part Number datagram will be transmitted at the next external trigger input, replacing the datagram containing sensor data.

8.2 I (SERIAL NUMBER DATAGRAM) command

General description: Requests transmission of a Serial number datagram (ref. Table 5-11).

Table 8-4 : Available I (SERIAL NUMBER DATAGRAM) command

Syntax	Response
I<CR>	Transmits one Serial Number datagram

The Serial Number datagram will replace the next transmitted Normal Mode datagram. If the Serial Number datagram is longer than the selected Normal Mode datagram, the Serial Number datagram may replace more than one Normal Mode datagram transmission (depending on sampling-rate and bit-rate).

If sample rate is set to external trigger, the Serial Number datagram will be transmitted at the next external trigger input, replacing the datagram containing sensor data.

8.3 C (CONFIGURATION DATAGRAM) command

General description: Requests transmission of a Configuration datagram (ref. Table 5-12).

Table 8-5: Available C (CONFIGURATION DATAGRAM) command

Syntax	Response
C<CR>	Transmits one Configuration datagram

The Configuration datagram will replace the next transmitted Normal Mode datagram. If the Configuration datagram is longer than the selected Normal Mode datagram, the Configuration datagram may replace more than one Normal Mode datagram transmission (depending on sampling-rate and bit-rate).

If sample rate is set to external trigger, the Configuration datagram will be transmitted at the next external trigger input, replacing the datagram containing sensor data.

8.4 T (BIAS TRIM OFFSET DATAGRAM) command

General description: Requests transmission of a Bias Trim Offset datagram (ref. Table 5-13).

Table 8-6: Available T (BIAS TRIM OFFSET DATAGRAM) command

Syntax	Response
T<CR>	Transmits one Bias Trim Offset datagram

The Bias Trim Offset datagram will replace the next transmitted Normal Mode datagram. If the Bias Trim Offset datagram is longer than the selected Normal Mode datagram, the Bias Trim Offset datagram may replace more than one Normal Mode datagram transmission (depending on sampling-rate and bit-rate).

If sample rate is set to external trigger, the Bias Trim Offset datagram will be transmitted at the next external trigger input, replacing the datagram containing sensor data.

8.5 E (EXTENDED ERROR INFORMATION DATAGRAM) command

General description: Requests transmission of an Extended Error Information datagram (ref. Table 5-14). This datagram contains the accumulated detected errors (ref. section 7.7).

Once the Extended Error Information datagram has been transmitted, the error-registers are cleared.

Table 8-7: Available E (EXTENDED ERROR INFORMATION) command

Syntax	Response
E<CR>	Transmits one Extended Error Information datagram

The Extended Error Information datagram will replace the next transmitted Normal Mode datagram. If the Extended Error Information datagram is longer than the selected Normal Mode datagram, the Extended Error Information datagram may replace more than one Normal Mode datagram transmission (depending on sampling-rate and bit-rate).

If sample rate is set to external trigger, the Extended Error Information datagram will be transmitted at the next external trigger input, replacing the datagram containing sensor data.

8.6 R (RESET) command

General description: Force a Reset

Table 8-8: Available R (RESET) command

Syntax	Response
R<CR>	Resets the unit

8.7 SERVICEMODE command

General description: Enters Service Mode (ref. section 7.6.2.3).

Table 8-9: Available SERVICEMODE command

Syntax	Response
SERVICEMODE<CR>	Enters Service Mode
SERVICEMODE<SP><IMU-ID><CR>	Enters Service Mode for a specific IMU-ID. This is useful when the IMU has been configured to multi-module transmission, ref. section 7.2.1. The IMU-ID takes values between 0 and 255. If IMU-ID is outside specified range, the SERVICEMODE-command will be ignored without any error-messages

If the command is received during the transmission of a datagram, it will complete the transmission before entering Service Mode.

The following should be noted when the entering Service Mode for a specific IMU:

- The response to the SERVICEMODE-command will be delayed by the transmission of one datagram. This is to ensure that other IMUs have completed their transmission when operating with multi-module transmissions. After having entered Service Mode, the response will be without delays
- For IMUs with other IMU-IDs than the one specified, the IMU will stop transmitting datagrams and not respond to any commands. When Service Mode is exited, ref. section 9.14, the IMU will resume Normal Mode operation, but without any response to the exit-command

Note that the SERVICEMODE-command without specified IMU-ID will still work when the IMU has been configured to multi-module transmission. However, this command should not be used if more than one IMU are connected to the same RS422-line.

When entering Service Mode, the configuration and identification data of the device will be listed, as shown in Figure 8-1:

```
SERIAL NUMBER = N25582626002002
PRODUCT = STIM320
PART NUMBER = 85042-440010-D30 REV E
FW CONFIG = SWD12682 REV 0
GYRO OUTPUT UNIT = [°/s] – ANGULAR RATE DELAYED
ACCELEROMETER OUTPUT UNIT = [g] – ACCELERATION
PPS OUTPUT UNIT = [us] TIME SINCE DETECTION OF 1
SAMPLE RATE [samples/s] = 2000
GYRO CONFIG = XYZ
ACCELEROMETER CONFIG = XYZ
GYRO RANGE:
  X-AXIS: ± 400°/s
  Y-AXIS: ± 400°/s
  Z-AXIS: ± 400°/s
ACCELEROMETER RANGE:
  X-AXIS: ± 10g
  Y-AXIS: ± 10g
  Z-AXIS: ± 10g
GYRO LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
GYRO LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 262
GYRO LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 262
ACCELEROMETER LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
ACCELEROMETER LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 262
ACCELEROMETER LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 262
PPS LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
GYRO G-COMPENSATION:
  BIAS SOURCE, X-AXIS = OFF
  BIAS G-COMP LP-FILTER, X-AXIS = NA
  SCALE SOURCE, X-AXIS = ACC
  SCALE G-COMP LP-FILTER, X-AXIS = OFF
  BIAS SOURCE, Y-AXIS = OFF
  BIAS G-COMP LP-FILTER, Y-AXIS = NA
  SCALE SOURCE, Y-AXIS = ACC
  SCALE G-COMP LP-FILTER, Y-AXIS = OFF
  BIAS SOURCE, Z-AXIS = OFF
  BIAS G-COMP LP-FILTER, Z-AXIS = NA
  SCALE SOURCE, Z-AXIS = ACC
  SCALE G-COMP LP-FILTER, Z-AXIS = OFF
  G-COMP LP-FILTER CUTOFF [Hz] = 0.010
BIAS TRIM OFFSET:
  GYRO X-AXIS [°/s] = 0.02343
  GYRO Y-AXIS [°/s] = -0.01222
  GYRO Z-AXIS [°/s] = 0.00111
  ACCELEROMETER X-AXIS [g] = -0.004256
  ACCELEROMETER Y-AXIS [g] = -0.013777
  ACCELEROMETER Z-AXIS [g] = 0.000111
  REFERENCE INFO = 43639
DATAGRAM = RATE, ACCELERATION, PPS, 16 BITS COUNTER
DATAGRAM TERMINATION = NONE
BIT-RATE [bits/s] = 921600
DATA LENGTH = 8
STOP BITS = 1
PARITY = NONE
RS422 OUTPUT ACTIVE BETWEEN DATAGRAMS: YES
LINE TERMINATION = ON
SYSTEM CONFIGURATIONS:
  COUNTER INTERVAL: [0, 65535]
  IMU-ID: 0

>
```

Figure 8-1: Example of response from SERVICEMODE command

8.8 UTILITYMODE command

General description: Enters Utility Mode allowing the user to obtain information or change configuration parameters (ref. section 7.6.4).

Table 8-10: Available UTILITYMODE command

Syntax	Response
UTILITYMODE<CR>	Enters Utility Mode
UTILITYMODE<SP><IMU-ID><CR>	Enters Utility Mode for a specific IMU-ID. This is useful when the IMU has been configured to multi-module transmission, ref. section 7.2.1. The IMU-ID takes values between 0 and 255. If IMU-ID is outside specified range, the UTILITYMODE-command will be ignored without any error-messages

If the command is received during the transmission of a datagram, it will complete the transmission before entering Utility Mode.

The following should be noted when the entering Utility Mode for a specific IMU:

- The response to the UTILITYMODE-command will be delayed by the transmission of one datagram. This is to ensure that other IMUs have completed their transmission when operating with multi-module transmissions. After having entered Utility Mode, the response will be without delays
- For IMUs with other IMU-IDs than the one specified, the IMU will stop transmitting datagrams and not respond to any commands. When Utility Mode is exited, ref. section 10.3.22, the IMU will resume Normal Mode operation, but without any response to the exit-command

Note that the UTILITYMODE-command without specified IMU-ID will still work when the IMU has been configured to multi-module transmission. However, this command should not be used if more than one IMU are connected to the same RS422-line.

For response to the UTILITYMODE command and other commands in Utility Mode, see section 10.

9 COMMANDS IN SERVICE MODE

Several commands are available in Service Mode, as listed in Table 9-1. Note that all commands in Service Mode are case-sensitive (commands are lower case letters, whilst some parameters may be capital case letters).

Note that backward compatibility in Service Mode responses is not guaranteed.

Table 9-1 Available commands in Service Mode

Command	Short description	Ref.section
a	Performs a single-shot measurement	9.1
b	Changes bias trim offsets	9.2
c	Performs a diagnostic of the unit	9.3
d	Changes datagram format	9.4
f	Changes LP filter -3dB frequency	9.5
g	Changes the gyro g-compensation configuration for bias and scale factor	9.6
h	Changes defined system configurations	9.7
i	Lists specific information (e.g. serial number, configuration, error information)	9.8
m	Changes sample rate	9.9
r	Turns line termination ON or OFF	9.10
s	Saves configuration data	9.11
t	Changes transmission parameters (e.g. bit-rate, data-length, stop-bits)	9.12
u	Changes measurement output unit	9.13
x	Exits Service Mode and returns to Normal Mode or Init Mode	9.14
z	Restore to factory settings	9.15
?	Help function on the available commands in Service Mode	9.16

Table 9-2 List of special ASCII characters used in Service Mode

Char	Hex	Dec	Short description
<BS>	0x08	8	“Back Space”: deletes last received character (received since last <CR>)
<CR>	0x0D	13	“Carriage Return”: typically used as execution character for commands
<SP>	0x20	32	“Space”: used to separate command and first parameter
‘,’	0x2C	44	“Comma”: used to separate parameters in a command
‘>’	0x3E	62	Used together with <CR> as: “Ready to receive new command”-prompt

When the STIM is in Service Mode and ready to receive a new command, it will issue the special ASCII character <CR> followed by ‘>’. As some commands (e.g. SINGLE-SHOT MEASUREMENT-command) may respond with a varying number of lines, automated set-ups should look for the special prompt-sequence (<CR>+’>’) before issuing a new command.

Received characters will be echoed. A command is decoded and executed when receiving the special ASCII character <CR>. <BS> (“back-space”) is also recognized and will delete the last received character in the input buffer. The size of the input buffer is 80 characters. <BS> is valid for the characters received since last <CR>.

The command-character and first parameter (when applicable) are separated by a space (character 0x20). When there are more than one parameter to a command (e.g. TRANSMISSION PARAMETER-command), these must be separated by a comma (character 0x2C).

In the event of an unknown command, inconsistent syntax or incorrect value of parameter(s), the STIM will respond with an error message. Error messages are on the format:

E<nnn><SP><Error description><CR>

where nnn is an error number.

9.1 a (SINGLE-SHOT MEASUREMENT) command

General description: Displays the result of latest measurement (measurement process running constantly in the background).

NB: SINGLE-SHOT MEASUREMENT-command is not available if SAMPLE RATE is set to External Trigger.

Table 9-3: Available a (SINGLE-SHOT MEASUREMENT) command

Syntax	Response
a<CR>	Displays the result of the latest measurement sample

Table 9-4: Error messages for a (SINGLE-SHOT MEASUREMENT) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Any characters between command and <CR>

```
>a
GYRO X-AXIS = 1.43253 °/s
GYRO Y-AXIS = 2.34525 °/s
GYRO Z-AXIS = 243.33628 °/s
GYRO STATUS = 00000000 = OK

ACCELEROMETER X-AXIS = 0.042113 g
ACCELEROMETER Y-AXIS = 0.000342 g
ACCELEROMETER Z-AXIS = 0.929376 g
ACCELEROMETER STATUS = 00000000 = OK

TEMPERATURE GYRO X-AXIS = 32.326 °C
TEMPERATURE GYRO Y-AXIS = 32.467 °C
TEMPERATURE GYRO Z-AXIS = 32.265 °C
TEMPERATURE STATUS = 00000000 = OK

TEMPERATURE ACC X-AXIS = 32.846 °C
TEMPERATURE ACC Y-AXIS = 32.477 °C
TEMPERATURE ACC Z-AXIS = 32.965 °C
TEMPERATURE STATUS = 00000000 = OK

PPS = 612 us
PPS STATUS = 00000000 = OK

COUNTER = 10
LATENCY = 516 us

>
```

Figure 9-1: Example of response from a (SINGLE-SHOT MEASUREMENT) command

```
>a
GYRO X-AXIS = 0.00071 °/s
GYRO Y-AXIS = 0.12324 °/s
GYRO Z-AXIS = 480.00000 °/s
GYRO STATUS = 00010100 = NOT OK
  BIT 4: OVERLOAD
  BIT 2: ERROR IN Z-CHANNEL

ACCELEROMETER X-AXIS = 0.042113 g
ACCELEROMETER Y-AXIS = 0.000342 g
ACCELEROMETER Z-AXIS = 0.929376 g
ACCELEROMETER STATUS = 00000000 = OK

TEMPERATURE GYRO X-AXIS = 32.326 °C
TEMPERATURE GYRO Y-AXIS = 32.467 °C
TEMPERATURE GYRO Z-AXIS = 32.265 °C
TEMPERATURE STATUS = 00000000 = OK

TEMPERATURE ACC X-AXIS = 32.846 °C
TEMPERATURE ACC Y-AXIS = 32.477 °C
TEMPERATURE ACC Z-AXIS = 32.965 °C
TEMPERATURE STATUS = 00000000 = OK

PPS = 612 us
PPS STATUS = 00000000 = OK

COUNTER = 10
LATENCY = 516 us

>
```

Figure 9-2: Example of response from a (SINGLE-SHOT MEASUREMENT) command with error flagging

9.2 b (BIAS TRIM OFFSET) command

General description: Changes bias trim offsets.

Refer to section 7.6.2.3 for a description of this functionality.

Table 9-5: Available b (BIAS TRIM OFFSET) commands

Syntax	Response
b<SP><BiasTrimOffset><CR>	Sets the bias trim offsets for all sensors and axes. Command is useful when clearing all bias trim offsets
b<SP><BiasTrimOffset>','<sens><CR>	Sets the bias trim offsets for a specific sensor, all axes. Command is useful when clearing all bias trim offsets for a given sensor
b<SP><DeltaBiasTrimOffset>','<sens>','<axis><CR>	Adjusts the bias trim offsets for a specific sensor and axis. <DeltaBiasTrimOffset> is added to the current bias trim offset
b<SP><RefInfo>',r'<CR>	Sets the Reference Information. <RefInfo> is a 32-bit unsigned integer that can be used to define a reference to the bias trim offsets, e.g. a date code

If the bias trim offsets are programmed outside the specified min or max limits, ref. Table 5-3 and Table 5-4, the relevant bias trim offsets will be set to min or max, whichever is the closest to the requested value and flagged by error message E008, ref. Table 9-9.

Table 9-6: Allowed values for <sens> parameter for b (BIAS TRIM OFFSET) commands

<sens>	Result
g	Will change bias trim offset for the gyro(s)
a	Will change bias trim offset for the accelerometer(s)

Table 9-7: Unit of <BiasTrimOffset> and <DeltaBiasTrimOffset> for the different values of <sens> for the b (BIAS TRIM OFFSET) commands

<sens>	Unit of <BiasTrimOffset> and <DeltaBiasTrimOffset>
g	[°/s]
a	[g]

Table 9-8: Allowed values for <axis> parameter for b (BIAS TRIM OFFSET) command

<axis>	Result
x	Will change bias trim offset for X-axis only
y	Will change bias trim offset for Y-axis only
z	Will change bias trim offset for Z-axis only

Table 9-9: Error messages for b (BIAS TRIM OFFSET) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range
E008	BIAS TRIM OFFSET(S) SET TO MIN OR MAX	Requested change(s) reduced due to violation of min/max limits for bias trim offset(s)

```
>b 0
BIAS TRIM OFFSET:
  GYRO X-AXIS [°/s] = 0.00000
  GYRO Y-AXIS [°/s] = 0.00000
  GYRO Z-AXIS [°/s] = 0.00000
  ACCELEROMETER X-AXIS [g] = 0.000000
  ACCELEROMETER Y-AXIS [g] = 0.000000
  ACCELEROMETER Z-AXIS [g] = 0.000000

>
```

Figure 9-3: Example of response from b (BIAS TRIM OFFSET) command

```
>b 0,a
BIAS TRIM OFFSET:
  ACCELEROMETER X-AXIS [g] = 0.000000
  ACCELEROMETER Y-AXIS [g] = 0.000000
  ACCELEROMETER Z-AXIS [g] = 0.000000

>
```

Figure 9-4: Example of response from b (BIAS TRIM OFFSET) command

```
>b 0.001,g,x
BIAS TRIM OFFSET:
  GYRO X-AXIS [°/s] = 0.02443

>
```

Figure 9-5: Example of response from b (BIAS TRIM OFFSET) command

```
>b 2.3,a
BIAS TRIM OFFSET:
  ACCELEROMETER X-AXIS [g] = 0.1000000
  ACCELEROMETER Y-AXIS [g] = 0.1000000
  ACCELEROMETER Z-AXIS [g] = 0.1000000

E008 BIAS TRIM OFFSET(S) SET TO MIN OR MAX

>
```

Figure 9-6: Example of response from b (BIAS TRIM OFFSET) command

```
>b 43639,r
BIAS TRIM OFFSET:
  REFERENCE INFO = 43639

>
```

Figure 9-7: Example of response from b (BIAS TRIM OFFSET) command

9.3 c (DIAGNOSTIC) command

General description: Performs a diagnostic of the unit.

Table 9-10: Available c (DIAGNOSTIC) command

Syntax	Response
c<CR>	Performs a diagnostic check

Table 9-11: Error messages for c (DIAGNOSTIC) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Any characters between command and <CR>

```
SERIAL NUMBER = N25582626002002
PRODUCT = STIM320
PART NUMBER = 85042-440010-D30 REV E
HW CONFIG = M5769 REV 2
FW CONFIG = SWD12682 REV 0
SYSTEM STATUS:
  RAM CHECK = OK
  FLASH CHECK = OK
  STACK STATUS MONITOR = OK
  STACK COMMAND HANDLER = OK
  STACK SAMPLE = OK
  STACK FLASH = OK
  STACK TRANSMIT = OK
  MICRO CONTROLLER TEMPERATURE = OK
  START-UP PHASE = NOT ACTIVE
  SELF-TEST RUNNING = OK
  UART = OK
VOLTAGES AND REFERENCES:
    REFERENCE VOLTAGE_1 = FAIL
  REFERENCE VOLTAGE_2 = OK
  REFERENCE VOLTAGE_3 = OK
  REFERENCE VOLTAGE_4 = OK
  REGULATED VOLTAGE_1 = OK
  REGULATED VOLTAGE_2 = OK
  REGULATED VOLTAGE_3 = OK
  SUPPLY VOLTAGE 5.0V = OK
  INTERNAL DAC = OK
GYRO X-AXIS:
  GYRO X-AXIS DATA RECEIVED = OK
  GYRO X-AXIS EXCITATION FREQUENCY = OK
  GYRO X-AXIS ASIC TEMPERATURE = OK
  GYRO X-AXIS TEMPERATURE = OK
  GYRO X-AXIS NO CLIPPING DETECTED = OK
  GYRO X-AXIS NO OVERLOAD DETECTED = OK
  GYRO X-AXIS INTERNAL COMMUNICATION = OK
  GYRO X-AXIS NO ASIC OVERFLOW DETECTED = OK
  GYRO X-AXIS EXCITATION AMPLITUDE = OK
  GYRO X-AXIS CONFIGURATION = OK
GYRO Y-AXIS:
  GYRO Y-AXIS DATA RECEIVED = OK
  GYRO Y-AXIS EXCITATION FREQUENCY = OK
  GYRO Y-AXIS ASIC TEMPERATURE = OK
  GYRO Y-AXIS TEMPERATURE = OK
  GYRO Y-AXIS NO CLIPPING DETECTED = OK
  GYRO Y-AXIS NO OVERLOAD DETECTED = OK
  GYRO Y-AXIS INTERNAL COMMUNICATION = OK
  GYRO Y-AXIS NO ASIC OVERFLOW DETECTED = OK
  GYRO Y-AXIS EXCITATION AMPLITUDE = OK
  GYRO Y-AXIS CONFIGURATION = OK
GYRO Z-AXIS:
  GYRO Z-AXIS DATA RECEIVED = OK
  GYRO Z-AXIS EXCITATION FREQUENCY = OK
  GYRO Z-AXIS ASIC TEMPERATURE = OK
  GYRO Z-AXIS TEMPERATURE = OK
  GYRO Z-AXIS NO CLIPPING DETECTED = OK
  GYRO Z-AXIS NO OVERLOAD DETECTED = OK
  GYRO Z-AXIS INTERNAL COMMUNICATION = OK
  GYRO Z-AXIS NO ASIC OVERFLOW DETECTED = OK
  GYRO Z-AXIS EXCITATION AMPLITUDE = OK
  GYRO Z-AXIS CONFIGURATION = OK
ACCELEROMETER X-AXIS:
  ACCELEROMETER X-AXIS NO CLIPPING DETECTED = OK
```

```
  ACCELEROMETER X-AXIS NO OVERLOAD DETECTED = OK
  ACCELEROMETER X-AXIS TEMPERATURE = OK
  ACCELEROMETER X-AXIS ADC = OK
ACCELEROMETER Y-AXIS:
  ACCELEROMETER Y-AXIS NO CLIPPING DETECTED = OK
  ACCELEROMETER Y-AXIS NO OVERLOAD DETECTED = OK
  ACCELEROMETER Y-AXIS TEMPERATURE = OK
  ACCELEROMETER Y-AXIS ADC = OK
ACCELEROMETER Z-AXIS:
  ACCELEROMETER Z-AXIS NO CLIPPING DETECTED = OK
  ACCELEROMETER Z-AXIS NO OVERLOAD DETECTED = OK
  ACCELEROMETER Z-AXIS TEMPERATURE = OK
  ACCELEROMETER Z-AXIS ADC = OK
PPS:
  PPS TIME OVERFLOW = OK

>
```

Figure 9-8: Example of response from c (DIAGNOSTIC) command

9.4 d (DATAGRAM FORMAT) command

General description: Sets the datagram transmission mode and termination (ref. Table 5-7 and section 12).

Note that the datagram format could be considered invalid, even if it has been entered correctly. This is because a valid datagram format also depends on the selected sample rate and bit-rate (ref. Table 5-8 and error message E007 in Table 9-15).

Note that this change will only be effective until the STIM is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.14).

Note that when choosing datagrams containing IMU ID, this will also affect and be valid for the special datagrams.

Table 9-12 : Available d (DATAGRAM FORMAT) command

Syntax	Response
d<SP><type>',''<term><CR>	Changes the datagram transmission mode and termination in Normal Mode

Table 9-13 : Allowed values for <type> parameter of d (DATAGRAM TRANSMISSION MODE AND TERMINATION) command

<type>	Datagram content
0	Datagram ID, rate, 8-bits counter, latency, CRC
1	Datagram ID, rate, acceleration, 8-bits counter, latency, CRC
4	Datagram ID, rate, temperature, 8-bits counter, latency, CRC
5	Datagram ID, rate, acceleration, temperature, 8-bits counter, latency, CRC
8	Datagram ID, rate, 16-bits counter, latency, CRC
9	Datagram ID, rate, acceleration, 16-bits counter, latency, CRC
a	Datagram ID, rate, temperature, 16-bits counter, latency, CRC
b	Datagram ID, rate, acceleration, temperature, 16-bits counter, latency, CRC
c	Datagram ID, rate, PPS, 16-bits counter, latency, CRC
d	Datagram ID, rate, acceleration, PPS, 16-bits counter, latency, CRC
e	Datagram ID, rate, temperature, PPS, 16-bits counter, latency, CRC
f	Datagram ID, rate, acceleration, temperature, PPS, 16-bits counter, latency, CRC
l	Datagram ID, IMU ID, rate, 8-bits counter, latency, CRC
m	Datagram ID, IMU ID, rate, acceleration, 8-bits counter, latency, CRC
n	Datagram ID, IMU ID, rate, temperature, 8-bits counter, latency, CRC
p	Datagram ID, IMU ID, rate, acceleration, temperature, 8-bits counter, latency, CRC
q	Datagram ID, IMU ID, rate, 16-bits counter, latency, CRC
r	Datagram ID, IMU ID, rate, acceleration, 16-bits counter, latency, CRC
s	Datagram ID, IMU ID, rate, temperature, 16-bits counter, latency, CRC
t	Datagram ID, IMU ID, rate, acceleration, temperature, 16-bits counter, latency, CRC
v	Datagram ID, IMU ID, rate, PPS, 16-bits counter, latency, CRC
w	Datagram ID, IMU ID, rate, acceleration, PPS, 16-bits counter, latency, CRC
x	Datagram ID, IMU ID, rate, temperature, PPS, 16-bits counter, latency, CRC
y	Datagram ID, IMU ID, rate, acceleration, temperature, PPS, 16-bits counter, latency, CRC

Table 9-14 : Allowed values for <term> parameter of d (DATAGRAM TRANSMISSION MODE AND TERMINATION) command

<term>	Result
0	Changes the datagram termination to no termination
1	Changes the datagram termination to <CR><LF>

Table 9-15: Error messages for d (DATAGRAM TRANSMISSION MODE AND TERMINATION) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range
E007	DATAGRAM WILL BE TOO LONG TO TRANSMIT	Combination of bit-rate, sample rate and datagram content results in a datagram that cannot be transmitted

```
>d 4,0
```

```
DATAGRAM = RATE, TEMPERATURE, 8-BITS COUNTER
DATAGRAM TERMINATION = NONE

>
```

Figure 9-9: Example of response from d (DATAGRAM MODE AND TERMINATION) command

```
>d c,1
DATAGRAM = RATE, PPS, 16-BITS COUNTER
DATAGRAM TERMINATION = <CR><LF>

>
```

Figure 9-10: Example of response from d (DATATGRAM MODE AND TERMINATION) command

9.5 f (LP FILTER -3dB FREQUENCY) command

General description: Changes the low-pass filter -3dB frequency for one or all axes.

Note that low pass filter settings should be considered together with sample rate in order to avoid issues with folding due to undersampling. No warnings will be issued by the STIM if e.g. a high filter bandwidth and a low sample rate have been selected. For more details, see Application Note TS1670: “Considerations related to sampling rate and filter settings“.

Note that change in filter setting will change the group delay, ref. Table 5-7.

Note that this change will only be effective until the STIM is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.14).

Table 9-16: Available f (LP FILTER -3dB FREQUENCY) commands

Syntax	Response
f<SP><-3dBfreq><CR>	Changes the LP filter -3dB frequency for all sensors and axes
f<SP><-3dBfreq>’,’<sens><CR>	Changes the LP filter -3dB frequency for all axes of a specific sensor
f<SP><-3dBfreq>’,’ <sens>’,’<axis><CR>	Changes the LP filter -3dB frequency for a specified sensor and axis

Table 9-17: Allowed values for <-3dBfreq> parameter for f (LP FILTER -3dB FREQUENCY) commands

<-3dBfreq>	Result
0	Will change LP filter -3dB frequency to 16Hz
1	Will change LP filter -3dB frequency to 33Hz
2	Will change LP filter -3dB frequency to 66Hz
3	Will change LP filter -3dB frequency to 131Hz
4	Will change LP filter -3dB frequency to 262Hz

Table 9-18: Allowed values for <sens> parameter for f (LP FILTER -3dB FREQUENCY) commands

<sens>	Result
g	Will change LP filter -3dB frequency for the gyro(s)
a	Will change LP filter -3dB frequency for the accelerometer(s)
p	Will change LP filter -3dB frequency for the PPS

Table 9-19: Allowed values for <axis> parameter for f (LP FILTER -3dB FREQUENCY) commands

<axis>	Result
x	Will change LP filter -3dB frequency for X-axis only
y	Will change LP filter -3dB frequency for Y-axis only
z	Will change LP filter -3dB frequency for Z-axis only

Table 9-20: Error messages for f (LP FILTER -3dB FREQUENCY) commands

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range

```
>f 2,a,x
ACCELEROMETER LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 66

>
```

Figure 9-11: Example of response from f (LP FILTER -3dB FREQUENCY) command

```
>f 3
GYRO LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 131
GYRO LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 131
GYRO LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 131
ACCELEROMETER LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 131
ACCELEROMETER LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 131
ACCELEROMETER LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 131
PPS LP FILTER -3dB FREQUENCY [Hz] = 131

>
```

Figure 9-12: Example of response from f (LP FILTER -3dB FREQUENCY) command

```
>f 1,g
GYRO LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 33
GYRO LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 33
GYRO LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 33

>
```

Figure 9-13: Example of response from f (LP FILTER -3dB FREQUENCY) command

```
>f 0,p
PPS LP FILTER -3dB FREQUENCY [Hz] = 16

>
```

Figure 9-14: Example of response from f (LP FILTER -3dB FREQUENCY) command

9.6 g (GYRO G-COMP) command

General description: Changes the compensation parameters for the gyro g-compensation of bias and/or scale-factor.

Refer to section 7.6.2.2.7 for a description of this functionality.

Table 9-21: Available g (GYRO G-COMP) commands

Syntax	Response
g<SP><StdComp><CR>	Changes the gyro g-compensation to one of the defined standard configurations. The cut-off frequency of the g-compensation LP-filter will be set to 0.01Hz. Gyro g-compensation will be applied to all axes.
g<SP><StdComp>','<FilterCutoff><CR>	Changes the gyro g-compensation to one of the defined standard configurations, but sets the g-compensation LP-filter to a non-standard cut-off frequency. Gyro g-compensation will be applied to all axes.
g<SP><BiasSource>','<BiasFilter>',' <ScaleSource>','<ScaleFilter><CR>	Changes the gyro g-compensation to a user-defined gyro g-compensation configuration, but leaves the g-compensation LP-filter unchanged. Gyro g-compensation will be applied to all axes.
g<SP><BiasSource>','<BiasFilter>',' <ScaleSource>','<ScaleFilter>',' <FilterCutoff><CR>	Changes the gyro g-compensation to a user-defined gyro g-compensation configuration, including the g-compensation LP-filter. Gyro g-compensation will be applied to all axes.
g<SP><Xonoff>','<Yonoff>','<Zonoff>',' <BiasSource>','<BiasFilter>',' <ScaleSource>','<ScaleFilter><CR>	Changes the gyro g-compensation to a user-defined gyro g-compensation configuration, but leaves the g-compensation LP-filter unchanged. Gyro g-compensation will be applied to specific axes.
g<SP><Xonoff>','<Yonoff>','<Zonoff>',' <BiasSource>','<BiasFilter>',' <ScaleSource>','<ScaleFilter>',' <FilterCutoff><CR>	Changes the gyro g-compensation to a user-defined gyro g-compensation configuration, including the g-compensation LP-filter. Gyro g-compensation will be applied to specific axes.

Table 9-22 : Allowed values for <StdComp> for g (GYRO G-COMP) command

<StdComp>	Bias		Scale-factor	
	BiasSource	BiasFilter	ScaleSource	ScaleFilter
0	OFF	-	OFF	-
1[1)]	OFF	-	ACC	OFF
2	OFF	-	ACC	ON
3[1)]	ACC	OFF	OFF	-
4	ACC	ON	OFF	-
7[1)]	ACC	OFF	ACC	OFF
8[1)]	ACC	ON	ACC	OFF
b	ACC	ON	ACC	ON

[1)] A warning will be issued if gyro output unit has not been selected as delayed (ref. section 7.6.2.2.1 and 9.13)

Table 9-23 : Allowed range for <FilterCutoff> for g (GYRO G-COMP) command

	Unit	Minimum	Standard	Maximum
<FilterCutoff>	Hz	0.001	0.01	5.00

Decimal point = '.'. Format can be integer, scientific or decimal.

Table 9-24 : Allowed values for <ScaleSource> and <BiasSource> for g (GYRO G-COMP) command

<BiasSource> <ScaleSource>	Result
0	Gyro g-compensation turned OFF
1	Gyro g-compensation uses data from accelerometers

Table 9-25 : Allowed values for <ScaleFilter> and <BiasFilter> for g (GYRO G-COMP) command

<BiasFilter> <ScaleFilter>	Result
0	Gyro g-compensation LP-filter not applied (OFF)
1	Gyro g-compensation LP-filter applied (ON)

Table 9-26 : Allowed values for <Xonoff>, <Yonoff> and <Zonoff> for g (GYRO G-COMP) command

<Xonoff> <Yonoff> <Zonoff>	Result
0	Gyro g-compensation is not applied to specific axis (OFF)
1	Gyro g-compensation is applied to specific axis

Table 9-27: Error messages for g (GYRO G-COMP) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range

```
>g 1
GYRO G-COMPENSATION:
  BIAS SOURCE, X-AXIS = OFF
  BIAS G-COMP LP-FILTER, X-AXIS = NA
  SCALE SOURCE, X-AXIS = ACC
  SCALE G-COMP LP-FILTER, X-AXIS = OFF
  BIAS SOURCE, Y-AXIS = OFF
  BIAS G-COMP LP-FILTER, Y-AXIS = NA
  SCALE SOURCE, Y-AXIS = ACC
  SCALE G-COMP LP-FILTER, Y-AXIS = OFF
  BIAS SOURCE, Z-AXIS = OFF
  BIAS G-COMP LP-FILTER, Z-AXIS = NA
  SCALE SOURCE, Z-AXIS = ACC
  SCALE G-COMP LP-FILTER, Z-AXIS = OFF
  G-COMP LP-FILTER CUTOFF [Hz] = 0.010

>
```

Figure 9-15: Example of response from g (GYRO G-COMP) command

```
>g 8,0.3
GYRO G-COMPENSATION: WARNING: DELAYED GYRO OUTPUT UNIT IS RECOMMENDED
  BIAS SOURCE, X-AXIS = ACC
  BIAS G-COMP LP-FILTER, X-AXIS = ON
  SCALE SOURCE, X-AXIS = ACC
  SCALE G-COMP LP-FILTER, X-AXIS = OFF
  BIAS SOURCE, Y-AXIS = ACC
  BIAS G-COMP LP-FILTER, Y-AXIS = ON
  SCALE SOURCE, Y-AXIS = ACC
  SCALE G-COMP LP-FILTER, Y-AXIS = OFF
  BIAS SOURCE, Z-AXIS = ACC
  BIAS G-COMP LP-FILTER, Z-AXIS = ON
  SCALE SOURCE, Z-AXIS = ACC
  SCALE G-COMP LP-FILTER, Z-AXIS = OFF
  G-COMP LP-FILTER CUTOFF [Hz] = 0.300

>
```

Figure 9-16: Example of response from g (GYRO G-COMP) command with warning

```
>g 0,0,1,1,1,1,0
GYRO G-COMPENSATION: WARNING: DELAYED GYRO OUTPUT UNIT IS RECOMMENDED
  BIAS SOURCE, X-AXIS = OFF
  BIAS G-COMP LP-FILTER, X-AXIS = NA
  SCALE SOURCE, X-AXIS = OFF
  SCALE G-COMP LP-FILTER, X-AXIS = NA
  BIAS SOURCE, Y-AXIS = OFF
  BIAS G-COMP LP-FILTER, Y-AXIS = NA
  SCALE SOURCE, Y-AXIS = OFF
  SCALE G-COMP LP-FILTER, Y-AXIS = NA
  BIAS SOURCE, Z-AXIS = ACC
  BIAS G-COMP LP-FILTER, Z-AXIS = ON
  SCALE SOURCE, Z-AXIS = ACC
  SCALE G-COMP LP-FILTER, Z-AXIS = OFF
  G-COMP LP-FILTER CUTOFF [Hz] = 0.500

>
```

Figure 9-17: Example of response from g (GYRO G-COMP) command

9.7 h (SYSTEMS CONFIGURATIONS) command

General description: Sets defined system configurations.

Note that this change will only be effective until the STIM is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.14).

Table 9-28: Available h (SYSTEM CONFIGURATIONS) command

Syntax	Response
h<SP><SystemConfig>’,’<setting><CR>	Sets defined system configurations

Table 9-29: Allowed values for <SystemConfig> parameter for h (SYSTEM CONFIGURATIONS) command

<SystemConfig>	Function
c	Sets counter restart-value and interval for CRS (ref. section 7.5)
i	Sets IMU-ID (ref. section 7.6.2.2.1)

Table 9-30: Allowed values for <setting> parameter for counter interval

<SystemConfig>	<setting>	Result
c	1..65535	Sets counter interval for CRS. As the counter is incrementing at every 0.5ms, the time-interval for CRS is: <setting> x 0.5ms. Remember: the counter starts at 0. Hence the counter will take values in the interval [0, <setting> – 1]
c	0	Counter interval [0, 65535], no toggling of CRS

Table 9-31: Allowed values for <setting> parameter for IMU-ID

<SystemConfig>	<setting>	Result
i	0..255	Sets IMU-ID

Table 9-32: Error messages for h (SYSTEM CONFIGURATIONS) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range

```
>h c,0
COUNTER INTERVAL: [0, 65535]

>
```

Figure 9-18: Example of response from h c (SYSTEM CONFIGURATION – COUNTER) command

```
>h c,100
COUNTER INTERVAL: [0, 99]

>
```

Figure 9-19: Example of response from h c (SYSTEM CONFIGURATION – COUNTER) command

```
>h i,3
IMU-ID: 3

>
```

Figure 9-20: Example of response from h i (SYSTEM CONFIGURATION – IMU-ID) command

9.8 i (INFORMATION) command

General description: Lists various requested information about the device

Table 9-33 : Available i (INFORMATION) commands

Syntax	Response
i<CR>	Lists the product configuration and identification data
i<SP><cmd><CR>	Gives information about the specific parameter

Table 9-34 : Allowed values for <cmd> parameter for i (INFORMATION) commands

<cmd>	Result
a	Returns the axis configuration of the device
b	Returns the bias trim offsets
d	Returns the datagram format
e	Prints the extended error information from the accumulated detected error(s) since last error read-out in Service Mode or by the E-command in Normal Mode (ref. section 8.5)
f	Returns the LP filter -3dB frequency for each axis
g	Returns the configuration of the gyro g-compensation
h	Returns the settings of the defined system configurations
m	Returns the sample rate of the device
n	Returns the product name of the device
p	Returns the FW configuration and revision of the device
r	Returns the line termination (ON or OFF)
s	Returns the serial number of the device
t	Returns the transmission parameters of the device
u	Returns the output units of the device
x	Returns the part number of the device

Table 9-35: Error messages for i (INFORMATION) commands

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command or parameter is not recognised
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range

```
>i
SERIAL NUMBER = N25582626002002
PRODUCT = STIM320
PART NUMBER = 85042-440010-D30 REV E
FW CONFIG = SWD12682 REV 0
GYRO OUTPUT UNIT = [°/s] – ANGULAR RATE DELAYED
ACCELEROMETER OUTPUT UNIT = [g] – ACCELERATION
PPS OUTPUT UNIT = [us] TIME SINCE DETECTION OF 1
SAMPLE RATE [samples/s] = 2000
GYRO CONFIG = XYZ
ACCELEROMETER CONFIG = XYZ
GYRO RANGE:
  X-AXIS: ± 400°/s
  Y-AXIS: ± 400°/s
  Z-AXIS: ± 400°/s
ACCELEROMETER RANGE:
  X-AXIS: ± 10g
  Y-AXIS: ± 10g
  Z-AXIS: ± 10g
GYRO LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
GYRO LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 262
GYRO LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 262
ACCELEROMETER LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
ACCELEROMETER LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 262
ACCELEROMETER LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 262
PPS LP FILTER -3dB FREQUENCY [Hz] = 262
GYRO G-COMPENSATION:
  BIAS SOURCE, X-AXIS = OFF
  BIAS G-COMP LP-FILTER, X-AXIS = NA
  SCALE SOURCE, X-AXIS = ACC
  SCALE G-COMP LP-FILTER, X-AXIS = OFF
  BIAS SOURCE, Y-AXIS = OFF
  BIAS G-COMP LP-FILTER, Y-AXIS = NA
  SCALE SOURCE, Y-AXIS = ACC
  SCALE G-COMP LP-FILTER, Y-AXIS = OFF
  BIAS SOURCE, Z-AXIS = OFF
  BIAS G-COMP LP-FILTER, Z-AXIS = NA
  SCALE SOURCE, Z-AXIS = ACC
  SCALE G-COMP LP-FILTER, Z-AXIS = OFF
  G-COMP LP-FILTER CUTOFF [Hz] = 0.010
BIAS TRIM OFFSET:
  GYRO X-AXIS [°/s] = 0.02343
  GYRO Y-AXIS [°/s] = -0.01222
  GYRO Z-AXIS [°/s] = 0.00111
  ACCELEROMETER X-AXIS [g] = -0.004256
  ACCELEROMETER Y-AXIS [g] = -0.013777
  ACCELEROMETER Z-AXIS [g] = 0.000111
  REFERENCE INFO = 43639
DATAGRAM = RATE, ACCELERATION, PPS, 16 BITS COUNTER
DATAGRAM TERMINATION = NONE
BIT-RATE [bits/s] = 921600
DATA LENGTH = 8
STOP BITS = 1
PARITY = NONE
RS422 OUTPUT ACTIVE BETWEEN DATAGRAMS: YES
LINE TERMINATION = ON
SYSTEM CONFIGURATIONS:
  COUNTER INTERVAL: [0, 65535]
  IMU-ID: 0

>
```

Figure 9-21: Example of response from i (INFORMATION) command

```
>i a
GYRO CONFIG = XYZ
ACCELEROMETER CONFIG = XYZ
GYRO RANGE:
  X-AXIS: ± 400°/s
  Y-AXIS: ± 400°/s
  Z-AXIS: ± 400°/s
ACCELEROMETER RANGE:
  X-AXIS: ± 10g
  Y-AXIS: ± 10g
  Z-AXIS: ± 10g

>
```

Figure 9-22: Example of response from i a (INFORMATION on AXIS CONFIGURATION) command

```
>i b
BIAS TRIM OFFSET:
  GYRO X-AXIS [°/s] = 0.02343
  GYRO Y-AXIS [°/s] = -0.01222
  GYRO Z-AXIS [°/s] = 0.00111
  ACCELEROMETER X-AXIS [g] = -0.004256
  ACCELEROMETER Y-AXIS [g] = -0.013777
  ACCELEROMETER Z-AXIS [g] = 0.000111
  REFERENCE INFO = 43639

>
```

Figure 9-23: Example of response from i b (INFORMATION on BIAS TRIM OFFSET) command

```
>i d
DATAGRAM = RATE, ACCELERATION, PPS, 16-BITS COUNTER
DATAGRAM TERMINATION = NONE

>
```

Figure 9-24: Example of response from i d (INFORMATION on DATAGRAM TRANSMISSION MODE AND TERMINATION) command

```
>i e
GYRO Z-AXIS NO CLIPPING DETECTED = FAIL

LAST ERROR HISTORY IS NOW CLEARED

>
```

Figure 9-25: Example of response from i e (INFORMATION on ACCUMULATED LAST ERRORS) command

```
>i e
NO ERRORS DETECTED

>
```

Figure 9-26: Example of response from i e (INFORMATION on ACCUMULATED LAST ERRORS) command

```
>i f
GYRO LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
GYRO LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 262
GYRO LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 262
ACCELEROMETER LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
ACCELEROMETER LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 262
ACCELEROMETER LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 262
PPS LP FILTER -3dB FREQUENCY [Hz] = 262

>
```

Figure 9-27: Example of response from i f (INFORMATION on LP FILTER -3dB FREQUENCY) command

```
>i g
GYRO G-COMPENSATION:
  BIAS SOURCE, X-AXIS = OFF
  BIAS G-COMP LP-FILTER, X-AXIS = NA
  SCALE SOURCE, X-AXIS = ACC
  SCALE G-COMP LP-FILTER, X-AXIS = OFF
  BIAS SOURCE, Y-AXIS = OFF
  BIAS G-COMP LP-FILTER, Y-AXIS = NA
  SCALE SOURCE, Y-AXIS = ACC
  SCALE G-COMP LP-FILTER, Y-AXIS = OFF
  BIAS SOURCE, Z-AXIS = OFF
  BIAS G-COMP LP-FILTER, Z-AXIS = NA
  SCALE SOURCE, Z-AXIS = ACC
  SCALE G-COMP LP-FILTER, Z-AXIS = OFF
  G-COMP LP-FILTER CUTOFF [Hz] = 0.010 HZ

>
```

Figure 9-28: Example of response from i g (INFORMATION on GYRO G-COMP) command

```
>i h
SYSTEM CONFIGURATIONS:
  COUNTER INTERVAL: [0, 65535]
  IMU-ID: 0

>
```

Figure 9-29: Example of response from i h (INFORMATION on SYSTEM CONFIGURATIONS) command

```
>i m
SAMPLE RATE [samples/s] = 2000

>
```

Figure 9-30: Example of response from i m (INFORMATION on SAMPLE RATE) command

```
>i n
PRODUCT = STIM320

>
```

Figure 9-31: Example of response from i n (INFORMATION on PRODUCT NAME) command

```
>i p
FW CONFIG = SWD12682 REV 0

>
```

Figure 9-32: Example of response from i p (INFORMATION on FW CONFIGURATION) command

```
>i r
LINE TERMINATION = ON

>
```

Figure 9-33: Example of response from i r (INFORMATION on LINE TERMINATION) command

```
>i s
SERIAL NUMBER = N25582626002002

>
```

Figure 9-34: Example of response from i s (INFORMATION on SERIAL NUMBER) command

```
>i t
BIT-RATE [bits/s] = 921600
DATA LENGTH = 8
STOP BITS = 1
PARITY = NONE
RS422 OUTPUT ACTIVE BETWEEN DATAGRAMS: YES

>
```

Figure 9-35: Example of response from i t (INFORMATION on TRANSMISSION PARAMETERS) command

```
>i x
PART NUMBER = 85042-440010-D30 REV E

>
```

Figure 9-36: Example of response from i x (INFORMATION on PART NUMBER) command

```
>i u
GYRO OUTPUT UNIT = [°/s] – ANGULAR RATE DELAYED
ACCELEROMETER OUTPUT UNIT = [g] – ACCELERATION
PPS OUTPUT UNIT = [us] – TIME SINCE DETECTION OF 1

>
```

Figure 9-37: Example of response from i u (INFORMATION on OUTPUT UNIT) command

9.9 m (SAMPLE RATE) command

General description: Changes the sample rate in Normal Mode. The sample rate is the same for all channels.

Note that changing the sample rate could lead to a situation where the STIM is not able to transmit at the configured sample rate depending on the configured length of the datagram and the transmission parameters (ref. Table 5-8). If the transmission of the previous datagram is not completed at the time when the next datagram is to be transmitted, the datagram will not be transmitted, and the data will be lost. Despite the timing violation, the requested sample rate will be redefined, and the response of the m (SAMPLE RATE) command will include error message E007 (ref. Table 9-41) to give the user a warning about the situation.

Note that sample rate should be considered together with filter settings to avoid issues with folding. No warnings will be issued by the STIM if e.g. a high filter bandwidth and a low sample rate have been selected. For more details, see Application Note TS1670: “Considerations related to sampling rate and filter settings”.

Note that this change will only be effective until the STIM is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.11). To use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.14).

Table 9-36: Available m (SAMPLE RATE) command

Syntax	Response
m<SP><sampl.rate><CR>	Changes the sample rate in Normal Mode
m<SP>’5,’<datagram.delay>’,’<trans.delay>’,’<special.dgrm><CR>	Sets configuration for multi-module transmission (only available for External Trigger (<sampl.rate> = 5)

Table 9-37: Allowed values for <sampl.rate> parameter for m (SAMPLE RATE) command

<sampl.rate>	Result
0	Will set sample rate to 125 samples /second
1	Will set sample rate to 250 samples /second
2	Will set sample rate to 500 samples /second
3	Will set sample rate to 1000 samples /second
4	Will set sample rate to 2000 samples /second
5	Will set sample to External Trigger

Table 9-38: Allowed values for <datagram.delay> parameter for m (SAMPLE RATE) command

<datagram.delay>	Result
0..1000000	Defines minimum delay between datagrams [µs], ref. section 7.2.1

Table 9-39: Allowed values for <trans.delay> parameter for m (SAMPLE RATE) command

<trans.delay>	Result
0..1000000	Defines minimum time between start of datagram transmissions in [µs], ref. section 7.2.1

Table 9-40: Allowed values for <special.dgrm> parameter for m (SAMPLE RATE) command

<special.dgrm>	Result
0	Special datagrams will not be transmitted during start-up
1	Special datagrams will be transmitted during start-up

Table 9-41: Error messages for m (SAMPLE RATE) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range
E007	DATAGRAM WILL BE TOO LONG TO TRANSMIT	Combination of bit-rate, sample rate and datagram content results in a datagram that cannot be transmitted

```
>m 2
SAMPLE RATE [samples/s] = 500

>
```

Figure 9-38: Example of response from m (SAMPLE RATE) command

```
>m 5
SAMPLE RATE = EXTERNAL TRIGGER

>
```

Figure 9-39: Example of response from m (SAMPLE RATE) command

```
>m 5,100,1034,0
SAMPLE RATE = EXTERNAL TRIGGER, MULTI-MODULE TRANSMISSION WITH:
  100µs DELAY BETWEEN DATAGRAMS
  1034µs DELAY BETWEEN START OF DATAGRAM TRANSMISSIONS
  NO SPECIAL DATAGRAMS TRANSMITTED DURING START-UP

>
```

Figure 9-40: Example of response from m (SAMPLE RATE) command

9.10 r (LINE TERMINATION) command

General description: Turns the line termination ON or OFF. Line termination should be ON when communicating point-point (single master – single slave).

Note that this change will only be effective until the STIM is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.14).

Table 9-42: Available r (LINE TERMINATION) command

Syntax	Response
r<SP><lineterm><CR>	Changes the line termination

Table 9-43: Allowed values for r (LINE TERMINATION) command

<lineterm>	Result
0	Turns line termination OFF
1	Turns line termination ON

Table 9-44: Error messages for r (LINE TERMINATION) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range

```
>r 0
LINE TERMINATION = OFF

>
```

Figure 9-41: Example of response from r 0 (LINE TERMINATION) command

```
>r 1
LINE TERMINATION = ON

>
```

Figure 9-42: Example of response from r 1 (LINE TERMINATION) command

9.11 s (SAVE) command

General description: Saves configuration parameters to flash. This will permanently change the configuration parameters and hence be valid after an initialization or power-off.

The flash used in the STIM is specified to be capable of minimum 10000 saves. A save-counter has been implemented and when the number of saves exceeds 10000, there will be issued a warning. The STIM will always attempt to save the configuration when receiving the s (SAVE) command regardless of the content of the save-counter.

Table 9-45: Available s (SAVE) command

Syntax	Response
s<CR>	Saves system parameters to flash. This command will require an additional confirmation prior to execution. Confirmation (“Y”) to be responded in upper case letter. If transmission parameters have been changed (ref. TRANSMISSION PARAMETERS command, section 9.5) AND confirmation to the save-command is not "Y", then the transmission parameters, including bit-rate, will be reset to the previously saved settings **NB: Do not turn off power until the ready-prompt (">") has been received**

Table 9-46: Error messages for s (SAVE) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Any characters between command and <CR>
E003	INVALID PARAMETER	Value of parameter outside valid range
E004	EXCEEDED MAXIMUM NUMBER OF SAVES	Warning appears when maximum number of saves has been exceeded (10000 saves). The STIM will always attempt to save the configuration when receiving the s (SAVE)-command.
E005	ERROR DURING SAVE	System parameters not successfully transferred to flash

```
>s
SYSTEM PARAMETERS WILL BE PERMANENTLY CHANGED. CONFIRM SAVE(Y/N): Y
SYSTEM PARAMETERS SUCCESSFULLY STORED IN FLASH.
NUMBER OF SAVES = 26

>
```

Figure 9-43: Example of response from s (SAVE) command when confirming save

```
>s
SYSTEM PARAMETERS WILL BE PERMANENTLY CHANGED. CONFIRM SAVE(Y/N): N
SAVE COMMAND ABORTED.

>
```

Figure 9-44: Example of response from s (SAVE) command when not confirming save

```
>s
SYSTEM PARAMETERS WILL BE PERMANENTLY CHANGED. CONFIRM SAVE(Y/N): y
SAVE COMMAND ABORTED.

E003 INVALID PARAMETER

>
```

Figure 9-45: Example of response from s (SAVE) command when not correctly responding to confirmation

9.12 t (TRANSMISSION PARAMETERS) command

General description: Changes the transmission parameters for the RS422 interface.

Note that the bit-rate could be considered invalid, even if it has been entered correctly. This is because a valid bit-rate also depends on the sample rate and selected datagram content (ref. Table 5-8 and error message E007 in Table 9-52).

Note that this change will only be effective until the STIM is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.11). If confirmation to the SAVE-command is not "Y", the transmission parameters will be reset to the previously stored settings. In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.14).

Table 9-47 : Available t (TRANSMISSION PARAMETERS) commands

Syntax	Response
t<SP><bit-rate code><CR>	Changes the transmission bit-rate and leaves number of stop-bits and parity unchanged
t<SP><bit-rate code>’,’<stop-bits>’,’<parity><CR>	Changes the transmission bit-rate, number of stop-bits and parity
t<SP><bit-rate code>’,’ <stop-bits>’,’<parity>’,’<trans-disabled><CR>	Changes the transmission bit-rate, number of stop-bits, parity and disable/enable RS422-transmitter between datagrams
t<SP>’f,’<bit-rate><CR>	Changes the transmission bit-rate to a user-defined bit-rate and leaves number of stop-bits and parity unchanged, ref. section 9.12.1
t<SP>’f,’<bit-rate>’,’<stop-bits>’,’<parity><CR>	Changes the transmission bit-rate to a user-defined bit-rate, number of stop-bits and parity, ref. section 9.12.1
t<SP>’f,’<bit-rate>’,’<stop-bits>’,’<parity>’,’ <trans-disabled><CR>	Changes the transmission bit-rate to a user-defined bit-rate (ref. section 9.12.1), number of stop-bits, parity and disable/enable RS422-transmitter between datagrams

Table 9-48: Allowed values for <bit-rate code> parameter for t (TRANSMISSION PARAMETERS) commands

<bit-rate code>	Result
0	Will set the bit-rate to 374400 bits/s
1	Will set the bit-rate to 460800 bits/s
2	Will set the bit-rate to 921600 bits/s
3	Will set the bit-rate to 1843200 bits/s

Table 9-49: Allowed values for <stop-bits> parameter for t (TRANSMISSION PARAMETERS) commands

<stop-bits>	Result
1	Will set number of stop bits to 1
2	Will set number of stop bits to 2

Table 9-50: Allowed values for <parity> parameter for t (TRANSMISSION PARAMETERS) commands

<parity>	Result
0	Will set no parity
1	Will set odd parity
2	Will set even parity

Table 9-51: Allowed values for <trans-disabled> parameter for t (TRANSMISSION PARAMETERS) commands

<parity>	Result
0	Transmitter is enabled between transmission of datagrams
1	Transmitter is disabled between transmission of datagrams

9.12.1 User-defined bit-rate

The STIM hardware is capable of setting bit-rates in the range between 1500 and 5184000 bits/s. However, the sample rate and the datagram length decide the minimum bit-rate possible, ref. Equation 12:

Equation 12: Minimum bit-rate

$$Bit-rate_{MIN} = 1.1 \cdot bits \cdot bytes \cdot sample_rate$$

where bits = start-bit (1) + data-bits (8) + stop-bits (1 or 2) + parity-bit (0 or 1)
bytes = number of bytes in the selected datagram, ref. Table 5-16 and Table 5-8 (NB: number of bytes in Table 5-8 excludes <CR><LF>. If <CR><LF> termination has been selected, ref. section 9.4 DATAGRAM FORMAT-command, the 2 additional bytes must be added)
sample_rate is the selected sample rate [samples/s]

If a bit-rate, lower than the allowed bit-rate defined by Equation 12, is entered, the command will respond with error message E007, ref. Table 9-52.

There are a finite number of bit-rates possible to set. This is defined in Equation 13:

Equation 13: Set bit-rate

$$Bit-rate_{SET} = \frac{82944000}{n} bits/s$$

where n is an integer

The actually set bit-rate will hence be the closest to requested bit-rate. The response of the t (TRANSMISSION PARAMETERS)-command will be the set bit-rate. Be aware that for certain bit-rates above 1.5Mbit/s, the deviation between the requested bit-rate and set bit-rate could be larger than 1% and may be in conflict with the RS422 specification. No warnings are issued related to this issue. As a safety precaution, the new bit-rate can only be permanently set by using the s (SAVE)-command (using the new bit-rate).

Table 9-52: Error messages for t (TRANSMISSION PARAMETERS) commands

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range
E007	DATAGRAM WILL BE TOO LONG TO TRANSMIT	Combination of bit-rate, sample rate and datagram content results in a datagram that cannot be transmitted

```
>t 2,1,2
BIT-RATE [bits/s] = 921600
DATA LENGTH = 8
STOP BITS = 1
PARITY = EVEN

>
```

Figure 9-46: Example of response from t (TRANSMISSION PARAMETERS) command to set standard bit-rate

```
>t f,500000
BIT-RATE [bits/s] = 500023
DATA LENGTH = 8
STOP BITS = 1
PARITY = EVEN

>
```

Figure 9-47: Example of response from t (TRANSMISSION PARAMETERS) command to set user-defined bit-rate

9.13 u (OUTPUT UNIT) command

General description: Sets the output unit of the transmission in Normal Mode.

Note that this change will only be effective until the STIM is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.14).

Table 9-53: Available u (OUTPUT UNIT) command

Syntax	Response
u<SP>'<sens>','<unit><CR>	Changes the unit of the transmission in Normal Mode

Table 9-54: Allowed values for <sens> and <unit> for u (OUTPUT UNIT) command

<sens>	<unit>	Result
g	0	Changes the gyro output unit to angular rate [°/s]
g	1	Changes the gyro output unit to incremental angle [°/sample]
g	2	Changes the gyro output unit to average angular rate [°/s]
g	3	Changes the gyro output unit to integrated angle [°]
g	8	Changes the gyro output unit to angular rate – delayed [°/s]
g	9	Changes the gyro output unit to incremental angle – delayed [°/sample]
g	a	Changes the gyro output unit to average angular rate – delayed [°/s]
g	b	Changes the gyro output unit to integrated angle – delayed [°]
a	0	Changes the accelerometer output unit to acceleration [g]
a	1	Changes the accelerometer output unit to incremental velocity [m/s/sample]
a	2	Changes the accelerometer output unit to average acceleration [g]
a	3	Changes the accelerometer output unit to integrated velocity [gs]
a	4	Changes the accelerometer output unit to integrated velocity [m/s]
p	0	Changes the PPS output unit to time since detection of 0
p	1	Changes the PPS output unit to time since detection of 1
p	2	Changes the PPS output unit to filtered PPS
p	3	Changes the PPS output unit to filtered PPS – delayed

Table 9-55: Error messages for u (OUTPUT UNIT) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range

```
>u g,0
GYRO OUTPUT UNIT = [°/s] – ANGULAR RATE

>
```

Figure 9-48: Example of response from u (OUTPUT UNIT) command

```
>u a,2
ACCELEROMETER OUTPUT UNIT = [g] – AVERAGE ACCELERATION

>
```

Figure 9-49: Example of response from u (OUTPUT UNIT) command

```
>u p,2
PPS OUTPUT UNIT = [ ] – FILTERED PPS

>
```

Figure 9-50: Example of response from u (OUTPUT UNIT) command

9.14 x (EXIT) command

General description: Terminates Service Mode and returns to Normal Mode directly or via Init Mode (ref. Figure 7-9).

Table 9-56 : Available x (EXIT) command

Syntax	Response
x<SP><exit_to><CR>	Terminates Service Mode

Table 9-57 : Allowed values for <exit_to> for x (EXIT) command

<exit_to>	Result
n	Terminates Service Mode and return to Normal Mode. If system parameters have been changed compared to flash content, a confirmation is requested before exiting to Normal Mode ("Y" in upper case letter) **unless the part has been configured to multi-module transmission where no confirmation will be requested**. There will be a 3 seconds hold-time between the transmitted command response and execution of the EXIT-command.
i	Terminates Service Mode and return to Init Mode. If system parameters have been changed compared to flash content, a confirmation is requested before exiting to Normal Mode ("Y" in upper case letter) **unless the part has been configured to multi-module transmission where no confirmation will be requested**. There will be a 3 seconds hold-time between the transmitted command response and execution of the EXIT-command. **NB: Changes made to system parameters, but not saved, will be overwritten by the data already stored in flash when entering Init Mode.**
N	Terminates Service Mode and return immediately to Normal Mode (without confirmation if system parameters have been changed compared to flash and without any hold-time)
I	Terminates Service Mode and return immediately to Init Mode (without confirmation if system parameters have been changed compared to flash and without any hold-time). **NB: Changes made to system parameters, but not saved, will be overwritten by the data already stored in flash when entering Init Mode.**

Table 9-58: Error messages for x (EXIT) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range

```
>x n
SYSTEM RETURNING TO NORMAL MODE.
```

Figure 9-51: Example of response from x n (EXIT) command when system parameters match contents of flash

```
>x i
SYSTEM RETURNING TO INIT MODE.
```

Figure 9-52: Example of response from x i (EXIT) command when system parameters match contents of flash

```
>x n
CURRENT SYSTEM PARAMETERS DO NOT MATCH FLASH CONTENT. CONFIRM EXIT(Y/N): Y
SYSTEM RETURNING TO NORMAL MODE.
```

Figure 9-53: Example of response from x n (EXIT) command after system parameters have been changed but not saved with confirmed EXIT

```
>x i
CURRENT SYSTEM PARAMETERS DO NOT MATCH FLASH CONTENT. CONFIRM EXIT(Y/N): N

>
```

Figure 9-54: Example of response from x i (EXIT) command after system parameters have been changed but not saved with confirmed not to EXIT

```
>x n
CURRENT SYSTEM PARAMETERS DOES NOT MATCH FLASH CONTENT. CONFIRM EXIT(Y/N): n

E003 INVALID PARAMETER

>
```

Figure 9-55: Example of response from x n (EXIT) command after system parameters have been changed but not saved with incorrect response to confirmation.

9.15 z (RESTORE TO FACTORY SETTINGS) command

General description: Restores the configuration of the unit to its factory settings

Table 9-59: Available z (RESTORE TO FACTORY SETTINGS) commands

Syntax	Response
z<CR>	Restores the configuration of the unit to its factory settings. **NB: The restored configuration will not be permanent unless it is SAVEd to flash before EXITing Service Mode, resetting the unit or turning off power.**
z<SP>,'s',<CR>	Restores the configuration of the unit to its factory settings and saves the configuration to flash. **NB: Do not turn off power until the ready-prompt (">") has been received**

Table 9-60: Error messages for z (RESTORE TO FACTORY SETTINGS) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Any characters between command and <CR>
E003	INVALID PARAMETER	Value of parameter outside valid range
E004	EXCEEDED MAXIMUM NUMBER OF SAVES	Warning appears when maximum number of saves has been exceeded (10000 saves). The STIM will always attempt to save the configuration when receiving the s (SAVE)-command.
E005	ERROR DURING SAVE	System parameters not successfully transferred to flash

```
>z
RESTORE TO FACTORY SETTINGS.
CONFIRM CHANGE TO FACTORY SETTINGS (Y/N): Y

APPLYING FACTORY SETTINGS
FACTORY SETTINGS APPLIED. TO PERMANENTLY STORE THE SETTINGS, USE THE SAVE OR 'z s' COMMAND.

>
```

Figure 9-56: Example of response from z (RESTORE TO FACTORY SETTINGS) command with no change in transmission parameters.

```
>z
RESTORE TO FACTORY SETTINGS.
CONFIRM CHANGE TO FACTORY SETTINGS(Y/N): Y

THE TRANSMISSION CONFIGURATION WILL BE CHANGED TO:
BIT-RATE [bits/s] = 921600
DATA LENGTH = 8
STOP BITS = 1
PARITY = EVEN
PLEASE CONFIRM (Y/N): Y

APPLYING FACTORY SETTINGS
FACTORY SETTINGS APPLIED. TO PERMANENTLY STORE THE SETTINGS, USE THE SAVE OR 'z s' COMMAND.

>
```

Figure 9-57: Example of response from z (RESTORE TO FACTORY SETTINGS) command with change in transmission parameters.

```
>z s
RESTORE TO FACTORY SETTINGS.
CONFIRM CHANGE TO FACTORY SETTINGS AND SAVING(Y/N): Y

THE TRANSMISSION CONFIGURATION WILL BE CHANGED TO:
BIT-RATE [bits/s] = 921600
DATA LENGTH = 8
STOP BITS = 1
PARITY = EVEN
PLEASE CONFIRM (Y/N): Y

APPLYING FACTORY SETTINGS
FACTORY SETTINGS APPLIED AND SAVED.
NUMBER OF SAVES = 26

>
```

Figure 9-58: Example of response from z s (RESTORE TO FACTORY SETTINGS with save of configuration) command with change in transmission parameters.

9.16 ? (HELP) command

General description: Help function on the available commands in Service Mode.

Table 9-61: Available ? (HELP) commands

Syntax	Response
?<CR>	Lists the available parameters for this command
?<SP><hlp><CR>	Responds with information on the specified command

Table 9-62: Allowed values for <hlp> for ? (HELP) command

<hlp>	Result
a	Responds with information on the SINGLE-SHOT MEASUREMENT-command
c	Responds with information on the DIAGNOSTIC-command
b	Responds with information on the BIAS TRIM OFFSET-command
d	Responds with information on the DATAGRAM FORMAT-command
f	Responds with information on the LP FILTER -3dB FREQUENCY-command
g	Responds with information on the GYRO G-COMP-command
h	Responds with information on the SYSTEM CONFIGURATIONS-command
i	Responds with information on the INFORMATION-command
m	Responds with information on the SAMPLE RATE-command
r	Responds with information on the LINE TERMINATION-command
s	Responds with information on the SAVE-command
t	Responds with information on the TRANSMISSION PARAMETERS-command
u	Responds with information on the OUTPUT UNIT-command
x	Responds with information on the EXIT-command
z	Responds with information on the RESTORE TO FACTORY SETTINGS-command

Table 9-63: Error messages for ? (HELP) commands

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter
E003	INVALID PARAMETER	Value of parameter outside valid range

```
>?
AVAILABLE PARAMETERS:
a: PERFORMS A SINGLE-SHOT MEASUREMENT
b: CHANGES BIAS TRIM OFFSETS
c: PERFORMS A DIAGNOSTIC OF THE UNIT
d: CHANGES DATAGRAM FORMAT
f: CHANGES LP FILTER -3dB FREQUENCY
g: CHANGES CONFIGURATION OF GYRO G-COMPENSATION
h: CHANGES SYSTEM CONFIGURATIONS
i: LISTS SPECIFIC INFORMATION
m: CHANGES SAMPLE RATE
r: CHANGES THE LINE TERMINATION
s: SAVES CONFIGURATION DATA
t: CHANGES TRANSMISSION PARAMETERS
u: CHANGES OUTPUT UNIT
x: EXITS SERVICE MODE
z: RESTORES FACTORY SETTINGS

>
```

Figure 9-59: Example of response from ? (HELP) command

```
>? i
i: LISTS THE PRODUCT CONFIGURATION DATA
i a: RETURNS THE AXIS CONFIGURATION
i b: RETURNS THE BIAS TRIM OFFSETS
i d: RETURNS THE DATAGRAM FORMAT
i e: RETURNS THE EXTENDED ERROR INFORMATION FROM THE LAST DETECTED ERROR IN NORMAL MODE
i f: RETURNS THE LP FILTER -3dB FREQUENCY
i g: RETURNS THE CONFIGURATION OF GYRO G-COMPENSATION
i h: RETURNS THE SYSTEM CONFIGURATIONS
i m: RETURNS THE SAMPLE RATE
i n: RETURNS THE PRODUCT NAME
i p: RETURNS THE FW CONFIGURATION AND REVISION
i r: RETURNS THE LINE TERMINATION SETTING
i s: RETURNS THE SERIAL NUMBER
i t: RETURNS THE TRANSMISSION PARAMETERS
i u: RETURNS THE OUTPUT UNIT
i x: RETURNS THE PART NUMBER

>
```

Figure 9-60: Example of response from ? i (HELP on INFORMATION) command

```
>? a
a: PERFORMS A SINGLE-SHOT MEASUREMENT

>
```

Figure 9-61: Example of response from ? a (HELP ON SINGLE-SHOT MEASUREMENT) command

```
>? b
b <BiasTrimOffset>: CHANGES BIAS TRIM OFFSET FOR ALL SENSORS AND ALL AXES TO <BiasTrimOffset>
b <BiasTrimOffset>,<Sensor>: CHANGES BIAS TRIM OFFSET FOR ALL AXES OF SPECIFIED SENSOR TO <BiasTrimOffset>
b <DeltaBiasTrimOffset >,<Sensor>, <Axis>: ADJUSTS BIAS TRIM OFFSET FOR SPECIFIED SENSOR AND AXIS BY
<DeltaBiasTrimOffset >
b <RefInfo>,r: DEFINES REFERENCE INFO FOR BIAS TRIM OFFSET. <RefInfo> IS A 32-BIT UNSIGNED INTEGER
   ALLOWED VALUES FOR <Sensor>:
      g = GYRO(S)
      a = ACCELEROMETER(S)
   ALLOWED VALUES FOR <axis>:
      x = X-AXIS
      y = Y-AXIS
      z = Z-AXIS
   ALLOWED RANGE FOR <BiasTrimOffset>:
      GYROS [°/s]: -1.00000 TO 1.00000
      ACCELEROMETERS [g]: -0.100000 TO 0.100000

>
```

Figure 9-62: Example of response from ? b (HELP on BIAS TRIM OFFSET) command

```
>? c
c: PERFORMS A DIAGNOSTIC OF THE UNIT

>
```

Figure 9-63: Example of response from ? c (HELP on DIAGNOSTIC) command

```
? d
d <type>','<term>: CHANGES THE DATAGRAM FORMAT
  ALLOWED VALUES FOR <type>:
    0 = ID, RATE, 8-BITS COUNTER, LATENCY, CRC
    1 = ID, RATE, ACCELERATION, 8-BITS COUNTER, LATENCY, CRC
    4 = ID, RATE, TEMPERATURE, 8-BITS COUNTER, LATENCY, CRC
    5 = ID, RATE, ACCELERATION, TEMPERATURE, 8-BITS COUNTER, LATENCY, CRC
    8 = ID, RATE, 16-BITS COUNTER, LATENCY, CRC
    9 = ID, RATE, ACCELERATION, 16-BITS COUNTER, LATENCY, CRC
    a = ID, RATE, TEMPERATURE, 16-BITS COUNTER, LATENCY, CRC
    b = ID, RATE, ACCELERATION, TEMPERATURE, 16-BITS COUNTER, LATENCY, CRC
    c = ID, RATE, PPS, 16-BITS COUNTER, LATENCY, CRC
    d = ID, RATE, ACCELERATION, PPS, 16-BITS COUNTER, LATENCY, CRCC
    e = ID, RATE, TEMPERATURE, PPS, 16-BITS COUNTER, LATENCY, CRC
    f = ID, RATE, ACCELERATION, TEMPERATURE, PPS, 16-BITS COUNTER, LATENCY, CRC
    l = ID, IMU ID, RATE, 8-BITS COUNTER, LATENCY, CRC
    m = ID, IMU ID, RATE, ACCELERATION, 8-BITS COUNTER, LATENCY, CRC
    n = ID, IMU ID, RATE, TEMPERATURE, 8-BITS COUNTER, LATENCY, CRC
    p = ID, IMU ID, RATE, ACCELERATION, TEMPERATURE, 8-BITS COUNTER, LATENCY, CRC
    q = ID, IMU ID, RATE, 16-BITS COUNTER, LATENCY, CRC
    r = ID, IMU ID, RATE, ACCELERATION, 16-BITS COUNTER, LATENCY, CRC
    s = ID, IMU ID, RATE, TEMPERATURE, 16-BITS COUNTER, LATENCY, CRC
    t = ID, IMU ID, RATE, ACCELERATION, TEMPERATURE, 16-BITS COUNTER, LATENCY, CRC
    v = ID, IMU ID, RATE, PPS, 16-BITS COUNTER, LATENCY, CRC
    w = ID, IMU ID, RATE, ACCELERATION, PPS, 16-BITS COUNTER, LATENCY, CRCC
    x = ID, IMU ID, RATE, TEMPERATURE, PPS, 16-BITS COUNTER, LATENCY, CRC
    y = ID, IMU ID, RATE, ACCELERATION, TEMPERATURE, PPS, 16-BITS COUNTER, LATENCY, CRC
  ALLOWED VALUES FOR <term>:
    0 = NONE
    1 = <CR><LF>

>
```

Figure 9-64: Example of response from ? d (DATAGRAM TRANSMISSION MODE AND TERMINATION) command

```
>? f
f <-3dBfreq>: CHANGES THE LP FILTER -3dB FREQUENCY [Hz] FOR ALL SENSORS AND AXES
f <-3dBfreq>','<sens>: CHANGES THE LP FILTER -3dB FREQUENCY [Hz] FOR ALL AXES OF SPECIFIED SENSOR
f <-3dBfreq>','<sens>','<axis>: CHANGES THE LP FILTER -3dB FREQUENCY [Hz] FOR A SPECIFIC SENSOR AND AXIS
   ALLOWED VALUES FOR <-3dBfreq>:
      0 = 16
      1 = 33
      2 = 66
      3 = 131
      4 = 262
   ALLOWED VALUES FOR <sens>:
      g = GYRO(S)
      a = ACCELEROMETER(S)
      p = PPS
   ALLOWED VALUES FOR <axis>:
      x = X-AXIS
      y = Y-AXIS
      z = Z-AXIS

>
```

Figure 9-65: Example of response from ? f (HELP on LP FILTER -3dB FREQUENCY) command

```
>? g
g <StdComp>: CHANGES GYRO G-COMP TO A PRE-DEFINED CONFIGURATION
g <StdComp>,<FilterCutoff>: CHANGES GYRO G-COMP TO A PRE-DEFINED CONFIG., BUT SPECIAL LP-FILTER CUTOFF
g <BiasSource>, <BiasFilter>,<ScaleSource>,<ScaleFilter>[,<FilterCutoff>]: CHANGES CONFIGURATION OF GYRO-G-COMP
g <Xonoff><Yonoff><Zonoff><BiasSource>, <BiasFilter>,<ScaleSource>,<ScaleFilter>[,<FilterCutoff>]: CHANGES
CONFIGURATION OF GYRO-G-COMP ON SPECIFIED AXES
   ALLOWED VALUES FOR <StdComp>:
      0 = <BiasSource> = 0, <BiasFilter> = 0, <ScaleSource> = 0, <ScaleFilter> = 0 (NO GYRO G-COMP)
      1 = <BiasSource> = 0, <BiasFilter> = 0, <ScaleSource> = 1, <ScaleFilter> = 0
      2 = <BiasSource> = 0, <BiasFilter> = 0, <ScaleSource> = 1, <ScaleFilter> = 1, <FilterCutoff> = 0.01
      3 = <BiasSource> = 1, <BiasFilter> = 0, <ScaleSource> = 0, <ScaleFilter> = 0
      4 = <BiasSource> = 1, <BiasFilter> = 1, <ScaleSource> = 0, <ScaleFilter> = 0, <FilterCutoff> = 0.01
      7 = <BiasSource> = 1, <BiasFilter> = 0, <ScaleSource> = 1, <ScaleFilter> = 0
      8 = <BiasSource> = 1, <BiasFilter> = 1, <ScaleSource> = 1, <ScaleFilter> = 0, <FilterCutoff> = 0.01
      b = <BiasSource> = 1, <BiasFilter> = 1, <ScaleSource> = 1, <ScaleFilter> = 1, <FilterCutoff> = 0.01
   ALLOWED RANGE FOR <FilterCutoff>
      0.010 – 5.000 (ENTERED VALUE IS IN [Hz])
   ALLOWED VALUES FOR <BiasSource> and <ScaleSource>:
      0 = OFF (NO G-COMP)
      1 = ACCELEROMETER
   ALLOWED VALUES FOR <BiasFilter> and <ScaleFilter>:
      0 = GYRO G-COMP LP-FILTER NOT IN USE (OFF)
      1 = GYRO G-COMP LP-FILTER IN USE (ON)
   ALLOWED VALUES FOR <Xonoff>, <Yonoff> and <Zonoff>:
      0 = NO GYRO G-COMP FOR SPECIFIC AXIS (OFF)
      1 = GYRO G-COMP FOR SPECIFIC AXIS (ON)

>
```

Figure 9-66: Example of response from ? g (HELP on GYRO G-COMP) command

```
? h
h <systemconfig>','<setting>: CHANGE DEFINED SYSTEM CONFIGURATIONS
  ALLOWED VALUES FOR <systemconfig>:
    c = SETS COUNTER RESTART-VALUE AND INTERVAL FOR CRS
    i = SETS IMU-ID
  ALLOWED VALUES FOR <setting> PARAMETER WHEN <systemconfig> = c
    1..65535 = COUNTER RESTART-VALUE AND INTERVAL FOR CRS IN INCREMENTS OF 0.5ms
    0 = NO RESTART-VALUE AND MAXIMUM INTERVAL FOR CRS
  ALLOWED VALUES FOR <setting> PARAMETER WHEN <systemconfig> = i
    0-255

>
```

Figure 9-67: Example of response from ? h (HELP on SYSTEM CONFIGURATIONS) command

```
>? m
m <sampl.rate>: CHANGES THE SAMPLE RATE [samples/s]
m<SP>'5,'<datagram.delay>','<trans.delay>','<special.dgrm>: CONFIGURES MULTI-MODULE TRANSMISSION (EXTERNAL
TRIGGER ONLY)
   ALLOWED VALUES FOR <sampl.rate>
      0 = 125
      1 = 250
      2 = 500
      3 = 1000
      4 = 2000
      5 = EXTERNAL TRIGGER
   ALLOWED VALUES FOR <datagram.delay>
      0 – 1000000 (ENTERED VALUE IS IN [µs])
   ALLOWED VALUES FOR <trans.delay>
      0 – 1000000 (ENTERED VALUE IS IN [µs])
   ALLOWED VALUES FOR <special.dgrm>
      0 = NO TRANSMISSION OF SPECIAL DATAGRAMS DURING START-UP
      1 = TRANSMISSION OF SPECIAL DATAGRAMS DURING START-UP

>
```

Figure 9-68: Example of response from ? m (HELP on SAMPLE RATE) command

```
>? r
r <on/off>: TURNS LINE TERMINATION ON OR OFF
   ALLOWED VALUES FOR <on/off>:
      0 = OFF
      1 = ON

>
```

Figure 9-69: Example of response from ? r (HELP on LINE TERMINATION) command

```
>? s
s: SAVES SYSTEM PARAMETERS TO FLASH

>
```

Figure 9-70: Example of response from ? s (HELP on SAVE) command

```
>? t
t <bit-rate code>[','<bit-rate>]: CHANGES THE BIT-RATE [bits/s]
t <bit-rate code>[','<bit-rate>]','<stop-bits>','<parity>: CHANGES THE BIT-RATE [bits/s], NUMBER OF STOP-BITS AND PARITY
t <bit-rate code>[','<bit-rate>]','<stop-bits>','<parity>','<trans-disabled>: CHANGES THE BIT-RATE [bits/s], NUMBER OF STOP-
BITS, PARITY AND
RS422 OUTPUT DISABLE BETWEEN DATAGRAMS
  ALLOWED VALUES FOR <bit-rate code>:
    0 = 374400
    1 = 460800
    2 = 921600
    3 = 1843200
    f = USER-DEFINED
<bit-rate> MUST ONLY BE INCLUDED WHEN <bit-rate code> = f
ALLOWED RANGE FOR <bit-rate>:
    1500 - 5184000 (INTEGER VALUE). SEE DATASHEET FOR LIMITATIONS
  ALLOWED VALUES FOR <stop-bits>:
    1 = 1
    2 = 2
  ALLOWED VALUES FOR <parity>:
    0 = NONE
    1 = ODD
    2 = EVEN
  ALLOWED VALUES FOR <trans-disabled>:
    0 = RS422 OUTPUT ACTIVE BETWEEN DATAGRAMS
    1 = RS422 OUTPUT NOT ACTIVE BETWEEN DATAGRAMS

>
```

Figure 9-71: Example of response from ? t (HELP on TRANSMISSION PARAMETERS) command

```
>? u
u <sens>','<unit>: CHANGES OUTPUT UNIT
   ALLOWED VALUES FOR <sens>:
      g = GYRO
      a = ACCELEROMETER
      p = PPS
   ALLOWED VALUES FOR u,g,<unit>:
      0 = [°/s] - ANGULAR RATE
      1 = [°] - INCREMENTAL ANGLE
      2 = [°/s] - AVERAGE ANGULAR RATE
      3 = [°] - INTEGRATED ANGLE
      8 = [°/s] - ANGULAR RATE - DELAYED
      9 = [°] - INCREMENTAL ANGLE - DELAYED
      a = [°/s] - AVERAGE ANGULAR RATE - DELAYED
      b = [°] - INTEGRATED ANGLE - DELAYED
   ALLOWED VALUES FOR u,a,<unit>:
      0 = [g] - ACCELERATION
      1 = [m/s] - INCREMENTAL VELOCITY
      2 = [g] - AVERAGE ACCELERATION
      3 = [gs] - INTEGRATED VELOCITY
      4 = [m/s] - INTEGRATED VELOCITY
   ALLOWED VALUES FOR u,p,<unit>:
      0 = [us] - TIME SINCE DETECTION OF 0
      1 = [us] - TIME SINCE DETECTION OF 1
      3 = [ ] - FILTERED PPS
      4 = [ ] - FILTERED PPS - DELAYED

>
```

Figure 9-72: Example of response from ? u (HELP on OUTPUT UNIT) command

```
>? x
x n: EXITS SERVICE MODE AND RETURNS TO NORMAL MODE
x i: EXITS SERVICE MODE AND RETURNS TO INIT MODE
x N: EXITS SERVICE MODE AND RETURNS IMMEDIATELY TO NORMAL MODE
x I: EXITS SERVICE MODE AND RETURNS IMMEDIATELY TO INIT MODE
NB: NON-SAVED SYSTEM PARAMETERS WILL BE OVERWRITTEN BY STORED CONTENT IN FLASH
WHEN EXITING TO INIT MODE

>
```

Figure 9-73: Example of response from ? x (HELP on EXIT) command

```
? z
z: RESTORES FACTORY SETTINGS

>
```

Figure 9-74: Example of response from ? z (HELP on RESTORE TO FACTORY SETTINGS) command

10 COMMANDS IN UTILITY MODE

Several commands are available in Utility Mode, ref. Table 10-1:

Table 10-1: Available commands in Utillity Mode

Command group	Command	Description	Ref. section
General	**$iaf**	Returns the LP filter -3dB frequency of the accelerometers	10.3.1
General	**$iau**	Returns the output unit of the accelerometers	10.3.2
General	**$iax**	Returns the axis configuration	10.3.3
General	**$iconf**	Returns setting of system configuration	10.3.4
General	**$id**	Returns the datagram format	10.3.5
General	**$ie**	Returns the accumulated extended error information and resets the accumulated error register	10.3.6
General	**$ifw**	Returns the FW configuration	10.3.7
General	**$ig**	Returns the configuration of the gyro g-compensation	10.3.8
General	**$igf**	Returns the LP filter -3dB frequency of the gyros	10.3.9
General	**$igu**	Returns the output unit of the gyros	10.3.10
General	**$ihw**	Returns the HW configuration	10.3.11
General	**$im**	Returns the sampling rate	10.3.12
General	**$in**	Returns the product name	10.3.13
General	**$ipf**	Returns LP filter -3dB frequency of PPS	10.3.14
General	**$ipu**	Returns output unit of PPS	10.3.15
General	**$irng**	Returns the measurement ranges	10.3.16
General	**$isn**	Returns the product serial number	10.3.17
General	**$isv**	Returns the number of remaining saves	10.3.18
General	**$it**	Returns the RS422 transmission parameters	10.3.19
General	**$ix**	Returns the part number	10.3.20
General	**$save**	Saves all configuration and system parameters to flash memory	10.3.21
General	**$xn**	Terminates Utility Mode and returns to Normal Mode	10.3.22
Reconfig	**$saf**	Sets the LP filter -3dB frequency of the accelerometers	10.4.1
Reconfig	**$sau**	Sets the output unit of the accelerometers	10.4.2
Reconfig	**$sconf**	Sets system configuration	10.4.3
Reconfig	**$sd**	Sets the datagram format	10.4.4
Reconfig	**$sfs**	Sets factory settings	10.4.5
Reconfig	**$sg**	Sets the configuration of the gyro g-compensation	10.4.6
Reconfig	**$sgf**	Sets the LP filter -3dB frequency of the gyros	10.4.7
Reconfig	**$sgu**	Sets the output unit of the gyros	10.4.8
Reconfig	**$sm**	Sets the output sampling rate	10.4.9
Reconfig	**$spf**	Sets the LP filter -3dB frequency of PPS	10.4.10
Reconfig	**$spu**	Sets the output unit of PPS	10.4.11
Reconfig	**$st**	Change the RS422 transmission parameters	10.4.12
BTO	**$ibto**	Returns the bias trim offsets	10.5.1
BTO	**$irf**	Returns the last programmed reference information for bias trim offset	10.5.2
BTO	**$sbto**	Programs the bias trim offset(s)	**10.5.3**
BTO	**$sdbto**	Adjusts the bias trim offsets	10.5.4
BTO	**$srf**	Programs the reference information for bias trim offset	10.5.5

Note: Use of commands that changes parameters do not permanently store the new values. The updated values will be in effect until the part is powered off or reset. To permanently store the new values, the $save-command (ref. section 10.3.21) must be used after having updated the required parameters.

10.1 Acknowledgement for entering Utility Mode

After the "UTILITYMODE"-command has been received, the response as shown in Figure 10-1 is transmitted to acknowledge having entered Utility Mode:

```
#UTILITYMODE,234<CR>
```

Figure 10-1:Acknowledgement for entering Utility Mode

The number 234 in Figure 10-1 is the CRC of the response, ref. section 10.2.3.

10.2 Command protocol for Utility Mode

The protocol is optimized for machine – machine communication. All communication is however in readable ASCII format and all numbers are in decimal format.

10.2.1 Command string

a) All commands start with a message start character, '$'
b) All characters must be in lower case letters
c) All parameters are delimited by character: ',' (comma)
d) Leading white space characters <SP> and <HT> are allowed in front of all parameters
e) Decimal separator is ".", scientific notation is allowed.
f) To ensure correct reception, last parameter is always an 8-bit CRC checksum (ref. section 10.2.3)
g) All commands are terminated by ASCII character carriage return (<CR>)
h) Maximum number of characters in command string (including <CR>) is 100

10.2.2 Response string

a) All responses from the STIM start with a start character '#'
b) The first return value is the command
c) All data are delimited by character: ',' (comma)
d) Second value is status of the executed command (0= OK, other = error), (ref. section 10.2.4)
e) Number of extra return values are defined for each command
f) Last value is always an 8-bit CRC checksum to ensure correct transmission (ref. section 10.2.3)
g) All command responses are terminated by ASCII character carriage return (<CR>)

10.2.3 Checksum

Both the command string and the response string contain a checksum as the last parameter to ensure that the string content is transmitted correctly.
The Checksum is calculated as a Cyclic Redundancy Checksum (CRC) with polynomial $X^8 + X^2 + X + 1$, seed = 0x0FF.
The checksum is calculated from ASCII values of all the characters in the proceeding string, including the start character ('$' or '#') and the last comma in front of the checksum.
The checksum value is presented as an ASCII string with a decimal value "0" through "255"

```
$isn,28<CR>
#isn,0,N2558184602002,32<CR>
```

Figure 10-2:Example of response string with CRC checksum

10.2.4 Command status codes

The status parameter is reporting the result of decoding and processing of the given command. Figure 10-2 lists the possible status codes. When status = 0 then there are no errors.

Table 10-2: List of possible status codes for commands

Status code	Reason
0	Command execution OK
1	Invalid command ($ missing in start of command-string or command used on a non-configured axis)
2	Incorrect CRC
3	Unknown command
4	Incorrect number of parameters
5	Invalid parameter(s)
6	Exceeded maximum number of saves
7	Error during save
8	Requested change(s) reduced due to violation of min/max limits for bias trim offset(s)

If more than one error occurs, the lowest status code will be in the command-response.

Example of invalid command: ibto,160<CR>
Response to command: #,1,180<CR>

Explanation of response:
1: # = no/invalid command
2: Status of command execution = 1 (Invalid command, ref. Table 10-2)
3: CRC-8 calculation

Figure 10-3: Example of response in case of invalid command (status code = 1)

Example of command with incorrect CRC: $sbto,0.00123,12<CR>
Response to command: #,2,139<CR>

Explanation of response:
1: # = no/invalid command
2: Status of command execution = 2 (Incorrect CRC, ref. Table 10-2)
3: CRC-8 calculation

Figure 10-4: Example of response in case of incorrect CRC (status code = 2)

Example of command with unknown command: $dbto,0.00123,0<CR>
Response to command: #,3,158<CR>

Explanation of response:
1: # = no/invalid command
2: Status of command execution = 3 (Unknown command, ref. Table 10-2)
3: CRC-8 calculation

Figure 10-5: Example of response in case of unknown command (status code = 3)

Example of command with incorrect number of parameters: $sbto,0.0123,g,y,0,2<CR>
Response to command: #sbto,4,136<CR>

Explanation of response:
1: sbto = command
2: Status of command execution = 4 (Incorrect number of parameters, ref. Table 10-2)
3: CRC-8 calculation

Figure 10-6: Example of response in case of incorrect number of parameters (status code = 4)

Example of command with invalid parameter(s): $sbto,0.0123,s,y,60<CR>
Response to command: #sbto,5,157<CR>

Explanation of response:
1: sbto = command
2: Status of command execution = 5 (Invalid parameter(s), ref. Table 10-2)
3: CRC-8 calculation

Figure 10-7: Example of response in case of invalid parameter(s) (status code = 5)

Example of command when exceeded maximum number of saves occurs: $save,33<CR>
Response to command: #save,6,0,158<CR>

Explanation of response:
1: save = command
2: Status of command execution = 6 (Exceeded maximum number of saves, ref. Table 10-2. Note: the parameters will be saved even if remaining number of saves was 0 prior to saving. However, this could eventually lead to quality issues related to the flash memory)
3. Remaining number of saves = 0 (No remaining saves)
4: CRC-8 calculation

Figure 10-8: Example of response in case of exceeded maximum number of saves (status code = 6)

Example of command when error during save occurs: $save,33<CR>
Response to command: #save,7,8848,163<CR>

Explanation of response:
1: save = command
2: Status of command execution = 7 (Error during save, ref. Table 10-2)
3. Remaining number of saves = 8848
4: CRC-8 calculation

Figure 10-9: Example of response in case of error during save (status code = 7)

Example of command with requested change(s) reduced due to violation of min/max limits for bias trim offset(s):
$sdbto,0.01388,-0.02425,0.01724,-1,1,1,0,0,0,237<CR>
Response to command: #sdbto,8,0.02311,0.00934,-0.54432,-0.100000,0.100000,0.100000,0.0000000,0.0000000,0.0000000,45<CR>

Explanation of response:
1: sdbto = command
2: Status of command execution: ref. Table 10-2
3: NEW GYRO X-AXIS BIAS TRIM OFFSET [°/s] = 0.02311
4: NEW GYRO Y-AXIS BIAS TRIM OFFSET [°/s] = 0.00934
5: NEW GYRO Z-AXIS BIAS TRIM OFFSET [°/s] = -0.54432
6: NEW ACCELEROMETER X-AXIS BIAS TRIM OFFSET [g] = -0.100000 (offset set to minimum limit)
7: NEW ACCELEROMETER Y-AXIS BIAS TRIM OFFSET [g] = 0.100000 (offset set to maximum limit)
8: NEW ACCELEROMETER Z-AXIS BIAS TRIM OFFSET [g] = 0.100000 (offset set to maximum limit)
9: FOR FUTURE USE = 0.0000000
10: FOR FUTURE USE = 0.0000000
11: FOR FUTURE USE = 0.0000000
12: CRC-8 calculation

Figure 10-10: Example of response in case of requested change(s) reduced due to violation of min/max limits for bias trim offset(s) (status code = 8)

10.3 General commands

General description: Various general commands.

Table 10-3: Available info commands

Command	Description	Ref. section
$iaf	Returns LP filter -3dB frequency of the accelerometers	10.3.1
$iau	Returns output unit of the accelerometers	10.3.2
$iax	Returns axis configuration	10.3.3
$iconf	Returns setting of system configuration	10.3.4
$id	Returns datagram format	10.3.5
$ie	Returns the accumulated extended error information and resets the accumulated error register	10.3.6
$ifw	Returns FW configuration	10.3.7
$ig	Returns configuration of the gyro g-compensation	10.3.8
$igf	Returns LP filter -3dB frequency of the gyros	10.3.9
$igu	Returns output unit of the gyros	10.3.10
$ihw	Returns HW configuration	10.3.11
$im	Returns sampling rate	10.3.12
$in	Returns product name	10.3.13
$ipf	Returns LP filter -3dB frequency of PPS	10.3.14
$ipu	Returns output unit of PPS	10.3.15
$irng	Returns measurement ranges	10.3.16
$isn	Returns product serial number	10.3.17
$isv	Returns the number of remaining saves	10.3.18
$it	Returns RS422 transmission parameters	10.3.19
$ix	Returns part number	10.3.20
$save	Saves all configuration and system parameters to flash memory	10.3.21
$xn	Terminates Utility Mode and returns to Normal Mode	10.3.22

10.3.1 $iaf

Purpose: Provide information about the accelerometer LP FILTER -3dB frequencies

Format: $iaf,<CRC><CR>

Example of command: $iaf,192<CR>
Example of response: #iaf,0,4,4,4,51<CR>

Explanation of response:
1 : iaf = command
2: Status of command execution: ref. Table 10-2
3: ACCELEROMETER LP FILTER -3dB FREQUENCY, X-AXIS = 4 (262Hz, ref. input parameters in Figure 10-33. If axis is not configured, response will be NA)
4: ACCELEROMETER LP FILTER -3dB FREQUENCY, Y-AXIS = 4 (262Hz, ref. input parameters in Figure 10-33. If axis is not configured, response will be NA)
5: ACCELEROMETER LP FILTER -3dB FREQUENCY, Z-AXIS = 4 (262Hz, ref. input parameters in Figure 10-33. If axis is not configured, response will be NA)
6: CRC-8 calculation

Figure 10-11: Specification and example of $iaf command

10.3.2 $iau

Purpose: Provide information about the accelerometer output unit

Format: $iau,<CRC><CR>
Example of command: $iau,168<CR> Example of response: #iau,0,1,31<CR> Explanation of response: 1 : iau = command 2: Status of command execution: ref. Table 10-2 3: ACCELEROMETER OUTPUT UNIT = 1 ([m/s/sample] – INCREMENTAL VELOCITY, ref. input parameters in Figure 10-34) 4: CRC-8 calculation

Figure 10-12: Specification and example of $iau command

10.3.3 $iax

Purpose: Provide information about axis configuration

Format: $iax,<CRC><CR>
Example of command: $iax,65<CR> Example of response: #iax,0,XYZ,XYZ,NA,214<CR> Explanation of response: 1 : iax = command 2: Status of command execution: ref. Table 10-2 3: GYRO AXIS CONFIGURATION = XYZ (if no axis configured, the response will be NA) 4: ACCELEROMETER AXIS CONFIGURATION = XYZ (if no axis configured, the response will be NA) 5: RESERVED FOR FUTURE USE = NA (if no axis configured, the response will be NA) 6: CRC-8 calculation

Figure 10-13: Specification and example of $iax command

10.3.4 $iconf

Purpose: Provide information about system configuration

Format: $iconf,<SystPar>,<Config><CRC><CR> Explanation of input parameters: <SystPar>: System parameter. Valid entry is: • c : Counter restart-value and interval for CRS (ref. section 7.5) • i : IMU-ID
Example of command: $iconf,c,239<CR> Example of response: #iconf,0,C,100,113<CR> Explanation of response: 1: iconf = command 2: Status of command execution: ref. Table 10-2 3: SYSTEM PARAMETER = C (Counter restart-value and interval for CRS, ref. input parameters in Figure 10-35) 4: CONFIGURATION = 100 (Counter interval [0, 99], ref. input parameters in Figure 10-35) 5: CRC-8 calculation Note: CONFIGURATION = 65536 will be returned if the counter restart-value has been set to 0. Example of command: $iconf,i,109<CR> Example of response: #iconf,0,I,3,70<CR> Explanation of response: 1: iconf = command 2: Status of command execution: ref. Table 10-2 3: SYSTEM PARAMETER = I (IMU-ID, ref. input parameters in Figure 10-35) 4: CONFIGURATION = 3 (IMU-ID) 5: CRC-8 calculation

Figure 10-14: Specification and example of $iconf command

10.3.5 $id

Purpose: Provide information about the datagram format

Format: $id,<CRC><CR>
Example of command: $id,221<CR> Example of response: #id,0,0,103<CR> Explanation of response: 1 : id = command 2: Status of command execution: ref. Table 10-2 3: DATAGRAM FORMAT = 0 (DATAGRAM ID,RATE,8-BITS COUNTER,LATENCY: ref. input parameters in Figure 10-36) 4: CRC-8 calculation

Figure 10-15: Specification and example of $id command

10.3.6 $ie

Purpose: Provide the accumulated extended error information and reset the accumulated error register

Format: $ie,<CRC><CR>
Example of command: $ie,200<CR> Example of response: #ie,0,0,0,16,0,0,0,0,0,0,0,0,0,0,0,0,0,221<CR> Explanation of response: 1 : ie = command 2: Status of command execution: ref. Table 10-2 3: EXTENDED ERROR REGISTER, BYTE#1 (MSB) in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 4: EXTENDED ERROR REGISTER, BYTE#2 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 5: EXTENDED ERROR REGISTER, BYTE#3 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 6: EXTENDED ERROR REGISTER, BYTE#4 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 7: EXTENDED ERROR REGISTER, BYTE#5 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 8: EXTENDED ERROR REGISTER, BYTE#6 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 9: EXTENDED ERROR REGISTER, BYTE#7 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 10: EXTENDED ERROR REGISTER, BYTE#8 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 11: EXTENDED ERROR REGISTER, BYTE#9 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 12: EXTENDED ERROR REGISTER, BYTE#10 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 13: EXTENDED ERROR REGISTER, BYTE#11 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 14: EXTENDED ERROR REGISTER, BYTE#12 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 15: EXTENDED ERROR REGISTER, BYTE#13 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 16: EXTENDED ERROR REGISTER, BYTE#14 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 17: EXTENDED ERROR REGISTER, BYTE#15 in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 18: EXTENDED ERROR REGISTER, BYTE#16 (LSB) in EXTENDED ERROR INFORMATION DATAGRAM: ref. Table 5-14 and Table 5-15 19: CRC-8 calculation

Figure 10-16: Specification and example of $ie command

Note: Reading the extended error information will reset the accumulated error register.

10.3.7 $ifw

Purpose: Provide information about firmware configuration

Format: $ifw,<CRC><CR>
Example of command: $ifw,148<CR> Example of response: #ifw,0,SWD12682 REV 0,171<CR> Explanation of response: 1 : ifw = command 2: Status of command execution: ref. Table 10-2 3: FW CONFIG = SWD12682 REV 0 4: CRC-8 calculation

Figure 10-17: Specification and example of $ifw command

10.3.8 $ig

Purpose: Provide information about the configuration of gyro g-compensation for a specified axis

Format: $ig,<Axis><CRC><CR> Explanation of input parameters: <Axis>: Specified axis. Valid entries are: • x : X-axis • y : Y-axis • z : Z-axis
Example of command: $ig,x,167<CR> Example of response: #ig,0,X,1,1,0,0.500,43<CR> Explanation of response: 1 : ig = command 2: Status of command execution: ref. Table 10-2 3: Axis = X 4: GYRO G-COMPENSATION SCALE SOURCE = 1 (ACCELEROMETER, ref. input parameters in Figure 10-38) 5: GYRO G-COMPENSATION SCALE LP FILTER = 1 (ON, ref. input parameters in Figure 10-38) 6: GYRO G-COMPENSATION BIAS SOURCE = 0 (OFF, ref. input parameters in Figure 10-38) 7: GYRO G-COMPENSATION BIAS LP FILTER = 0 (OFF, ref. input parameters in Figure 10-38) 8: LP FILTER -3dB FREQUENCY [Hz] = 0.500 (ref. input parameters in Figure 10-38) 9: CRC-8 calculation

Figure 10-18: Specification and example of $ig command

10.3.9 $igf

Purpose: Provide information about the gyro LP FILTER -3dB frequencies

Format: $igf,<CRC><CR>
Example of command: $igf,189<CR> Example of response: #igf,0,4,4,4,113<CR> Explanation of response: 1 : igf = command 2: Status of command execution: ref. Table 10-2 3: GYRO LP FILTER -3dB FREQUENCY, X-AXIS = 4 (262Hz, ref. input parameters in Figure 10-39. If axis is not configured, response will be NA) 4: GYRO LP FILTER -3dB FREQUENCY, Y-AXIS = 4 (262Hz, ref. input parameters in Figure 10-39. If axis is not configured, response will be NA) 5: GYRO LP FILTER -3dB FREQUENCY, Z-AXIS = 4 (262Hz, ref. input parameters in Figure 10-39. If axis is not configured, response will be NA) 6: CRC-8 calculation

Figure 10-19: Specification and example of $igf command

10.3.10 $igu

Purpose: Provide information about the gyro output unit

Format: $igu,<CRC><CR>
Example of command: $igu,213<CR> Example of response: #igu,0,1,211<CR> Explanation of response: 1 : igu = command 2: Status of command execution: ref. Table 10-2 3: GYRO OUTPUT UNIT = 1 ([°/sample] – INCREMENTAL ANGLE, ref. input parameters in Figure 10-40) 4: CRC-8 calculation

Figure 10-20: Specification and example of $igu command

10.3.11 $ihw

Purpose: Provide information about hardware configuration

Format: $ihw,<CRC><CR>
Example of command: $ihw,184<CR> Example of response: #ihw,0, M5769 REV 2,75<CR> Explanation of response: 1 : ihw = command 2: Status of command execution: ref. Table 10-2 3: HW CONFIG = M5769 REV 2 4: CRC-8 calculation

Figure 10-21: Specification and example of $ihw command

10.3.12 $im

Purpose: Provide information about output sampling rate

Format: $im,<CRC><CR>
Example of command: $im,96<CR> Example of response when IMU is not configured to multi-module transmission, ref. section 7.2.1: #im,0,2000,252<CR> Explanation of response: 1 : im = command 2: Status of command execution: ref. Table 10-2 3: SAMPLING FREQUENCY = 2000 samples/s (ref. input parameters in Figure 10-41) 4: CRC-8 calculation   Example of response when IMU is configured to multi-module transmission, ref. section 7.2.1: #im,0,0,50,1034,0,169<CR> Explanation of response: 1 : im = command 2: Status of command execution: ref. Table 10-2 3. SAMPLING FREQUENCY = External Trigger 4. DATAGRAM DELAY = 50µs 5: TRANSMISSION DELAY = 1034µs 6: SPECIAL DATAGRAMS DURING START-UP: 0 (= No transmission of special datagrams) 7: CRC-8 calculation

Figure 10-22: Specification and example of $im command

10.3.13 $in

Purpose: Provide information about product name

Format: $in,<CRC><CR>
Example of command: $in,95<CR> Example of response: #in,0,STIM320,33<CR> Explanation of response: 1: in = command 2: Status of command execution: ref. Table 10-2 3: PRODUCT = STIM320 4: CRC-8 calculation

Figure 10-23: Specification and example of $in command

10.3.14 $ipf

Purpose: Provide information about the PPS LP FILTER -3dB frequency

Format: $ipf,<CRC><CR>
Example of command: $ipf,9<CR> Example of response: #ipf,0,4,183<CR> Explanation of response: 1 : ipf = command 2: Status of command execution: ref. Table 10-2 3: PPS LP FILTER -3dB FREQUENCY = 4 (262Hz, ref. input parameters in Figure 10-42) 4: CRC-8 calculation

Figure 10-24: Specification and example of $ipf command

10.3.15 $ipu

Purpose: Provide information about the PPS output unit

Format: $ipu,<CRC><CR>
Example of command: $ipu,97<CR> Example of response: #ipu,0,1,19<CR> Explanation of response: 1 : ipu = command 2: Status of command execution: ref. Table 10-2 3: PPS OUTPUT UNIT = 1 ([µs] – Time since detection of 1, ref. input parameters in Figure 10-43) 4: CRC-8 calculation

Figure 10-25: Specification and example of $ipu command

10.3.16 $irng

Purpose: Provide information about measurement range

Format: $irng,<CRC><CR>
Example of command: $irng,74<CR> Example of response: #irng,0,400,400,400,10,10,10,NA,NA,NA,NA,196<CR> Explanation of response: 1 : irng = command 2: Status of command execution: ref. Table 10-2 3: GYRO RANGE, X-AXIS [°/s] = 400 (if axis is not configured, response will be NA) 4: GYRO RANGE, Y-AXIS [°/s] = 400 (if axis is not configured, response will be NA) 5: GYRO RANGE, Z-AXIS [°/s] = 400 (if axis is not configured, response will be NA) 6: ACCELEROMETER RANGE, X-AXIS [g] = 10 (if axis is not configured, response will be NA) 7: ACCELEROMETER RANGE, Y-AXIS [g] = 10 (if axis is not configured, response will be NA) 8: ACCELEROMETER RANGE, Z-AXIS [g] = 10 (if axis is not configured, response will be NA) 9: FOR FUTURE USE = NA (if axis is not configured, response will be NA) 10: FOR FUTURE USE = NA (if axis is not configured, response will be NA) 11: FOR FUTURE USE = NA (if axis is not configured, response will be NA) 12: FOR FUTURE USE = NA (if axis is not configured, response will be NA) 13: CRC-8 calculation

Figure 10-26: Specification and example of $irng command

10.3.17 $isn

Purpose: Provide information about product serial number

Format: $isn,<CRC><CR>
Example of command: $isn,28<CR> Example of response: #isn,0,N2558184602002,32<CR> Explanation of response: 1: isn = command 2: Status of command execution: ref. Table 10-2 3: SERIAL NUMBER = N2558184602002 4: CRC-8 calculation

Figure 10-27: Specification and example of $isn command

10.3.18 $isv

Purpose: Provide information about the number of remaining saves

Format: $isv,<CRC><CR>
Example of command: $isv,227<CR> Example of response: #isv,0,9958,168<CR> Explanation of response: 1: isv = command 2: Status of command execution: ref. Table 10-2 3: NUMBER OF REMAINING SAVES = 9958 4: CRC-8 calculation

Figure 10-28: Specification and example of $isv command

10.3.19 $it

Purpose: Provide information about the RS422 transmission parameters

Format: $it,<CRC><CR>
Example of command: $it,138<CR> Example of response: #it,0,374400,1,E,1,1,0,209<CR> Explanation of response: 1: it = command 2: Status of command execution: ref. Table 10-2 3: BIT-RATE [bps] = 374400 4: STOP BITS = 1 5: PARITY = E (EVEN, ref. Figure 10-44) 6: LINE TERMINATION = 1 (ON, ref. Figure 10-44) 7: DATAGRAM TERMINATION = 1 (<CR><LF>, ref. Figure 10-44) 8: RS422 TRANSMITTER DISABLED WHEN NOT TRANSMITTING = 0 (ALWAYS ON, ref. Figure 10-44) 9: CRC-8 calculation

Figure 10-29: Specification and example of $it command

10.3.20 $ix

Purpose: Provide information about part number and revision

Format: $ix,<CRC><CR>
Example of command: $ix,118<CR> Example of response: #ix,0,85042-440010-D30,B,42<CR> Explanation of response: 1: ix = command 2: Status of command execution: ref. Table 10-2 3: PART NUMBER = 85042-440010-D30 4: REVISION = B 5: CRC-8 calculation

Figure 10-30: Specification and example of $ix command

10.3.21 $save

Purpose: Permanently store all configuration and system parameters to flash memory

Format: $save,<CRC><CR>
Example of command: $save,33<CR> Example of response: #save,0,9958,175<CR> Explanation of response: 1: save = command 2: Status of command execution: ref. Table 10-2 3. REMAINING NUMBER OF SAVES = 9958 4: CRC-8 calculation

Figure 10-31: Specification and example of $save command

Note: the parameters will be saved even if remaining number of saves was 0 prior to saving. However, this could eventually lead to quality issues related to the flash memory.

Note: Do not turn off power until the command response has been received

10.3.22 $xn

Purpose: Terminate Utility Mode and return to Normal Mode

Format: $xn,<CRC><CR>
Example of command: $xn,150<CR> Example of response: #xn,0,125<CR> Explanation of response (format): 1: xn = command 2: Status of command execution: ref. Table 10-2 3: CRC-8 calculation

Figure 10-32: Specification and example of $xn command

10.4 Commands for reconfiguration

General description: Various commands to reconfigure the part.

Note: Use of commands that changes parameters do not permanently store the new values. The updated values will be in effect until the part is powered off or reset. To permanently store the new values, the $save-command (ref. section 10.3.21) must be used after having updated the required parameters.

Table 10-4: Available commands for reconfiguration

Command	Description	Ref. section
$saf	Sets the LP filter -3dB frequency of the accelerometers	10.4.1
$sau	Sets the output unit of the accelerometers	10.4.2
$sconf	Sets system configuration	10.4.3
$sd	Sets the datagram format	10.4.4
$sfs	Sets factory settings	10.4.5
$sg	Sets the configuration of the gyro g-compensation	10.4.6
$sgf	Sets the LP filter -3dB frequency of the gyros	10.4.7
$sgu	Sets the output unit of the gyros	10.4.8
$sm	Sets the output sampling rate	10.4.9
$spf	Sets the LP filter -3dB frequency of PPS	10.4.10
$spu	Sets the output unit of PPS	10.4.11
$st	Sets RS422 transmission parameters	10.4.12

10.4.1 $saf

Purpose: Change the LP filter -3dB frequency of the accelerometers

Format: $saf,<Axis>,<LP Filter>,<CRC><CR>

Explanation of input parameters:
<Axis>: Specified axis. Valid entries are:

- x : X-axis
- y : Y-axis
- z : Z-axis

<LP Filter>: LP filter -3dB frequency. Valid entries are:

- 0 :16Hz
- 1 : 33Hz
- 2 : 66Hz
- 3 : 131Hz
- 4 : 262Hz

Example of command: $saf,z,4,93<CR>
Example of response: #saf,0,Z,4,43<CR>

Explanation of response:
1: saf = command
2: Status of command execution: ref. Table 10-2
3: ACCELEROMETER LP FILTER -3dB FREQUENCY, Z-AXIS = 4 (262Hz)
4: CRC-8 calculation

Figure 10-33: Specification and example of $saf command

10.4.2 $sau

Purpose: Change the output unit for accelerometers

Format: $sau,<OutputUnit>,<CRC><CR>

Explanation of input parameters:
<OutputUnit>: Output unit. Valid entries:

- 0 : Acceleration [g]
- 1 : Incremental velocity [m/s/sample]
- 2 : Average acceleration [g]
- 3 : Integrated velocity [gs]
- 4 : Integrated velocity [m/s]

Example of command: $sau,1,27<CR>
Example of response: #sau,0,1,150<CR>

Explanation of response:
1: sau = command
2: Status of command execution: ref. Table 10-2
3: ACCELEROMETER OUTPUT UNIT = [m/s/sample] – INCREMENTAL VELOCITY
4: CRC-8 calculation

Figure 10-34: Specification and example of $sau command

10.4.3 $sconf

Purpose: Change system configuration parameters

Format: $sconf,<SystPar>,<Config>,<CRC><CR>

Explanation of input parameters:
<SystPar>: System parameter. Valid entry is:

- c : Sets counter restart-value and interval for CRS (ref. section 7.5)
- i : Sets IMU-ID (ref. section 7.6.2.2.1)

<Config>: Related configuration to specific system parameter. Valid entries are:
For <SystPar> = c:

- 0 : Sets counter interval to [0, 65535] and no toggling of CRS
- 1..65535 : Sets counter restart-value and interval for CRS, ref. Table 9-30

For <SystPar> = i:

- 0..255 : Sets IMU-ID

Example of command: $sconf,c,100,66<CR>
Example of response: #sconf,0,C,100,251<CR>

Explanation of response:
1: sconf = command
2: Status of command execution: ref. Table 10-2
3: SYSTEM PARAMETER = C (Counter restart-value and interval for CRS)
4: CONFIGURATION = 100 (Counter interval [0, 99])
5: CRC-8 calculation

Example of command: $sconf,i,3,21<CR>
Example of response: #sconf,0,I,3,209<CR>

Explanation of response:
1: sconf = command
2: Status of command execution: ref. Table 10-2
3: SYSTEM PARAMETER = I (IMU-ID)
4: CONFIGURATION = 3 (IMU-ID)
5: CRC-8 calculation

Figure 10-35: Specification and example of $sconf command

10.4.4 $sd

Purpose: Change the datagram format

Note: Depending on the configured sample rate and transmission parameter settings, a too large length of the datagram could lead to a situation where the STIM is not able to transmit at the configured sample rate (ref. Table 5-8). If the transmission of the previous datagram is not completed at the time when the next datagram is to be transmitted, the datagram will not be transmitted, and the data will be lost. There is no warning or error message given if this situation occurs.

Format: $sd,<DatagramFormat>,<CRC><CR>

Explanation of input parameters:
<DatagramFormat>: Datagram format. Valid entries: ref. Table 9-13

- 0 : Datagram ID, rate, 8-bits counter, latency, CRC
- 1 : Datagram ID, rate, acceleration, 8-bits counter, latency, CRC
- 4 : Datagram ID, rate, temperature, 8-bits counter, latency, CRC
- 5 : Datagram ID, rate, acceleration, temperature, 8-bits counter, latency, CRC
- 8 : Datagram ID, rate, 16-bits counter, latency, CRC
- 9 : Datagram ID, rate, acceleration, 16-bits counter, latency, CRC
- a : Datagram ID, rate, temperature, 16-bits counter, latency, CRC
- b : Datagram ID, rate, acceleration, temperature, 16-bits counter, latency, CRC
- c : Datagram ID, rate, PPS, 16-bits counter, latency, CRC
- d : Datagram ID, rate, acceleration, PPS, 16-bits counter, latency, CRC
- e : Datagram ID, rate, temperature, PPS, 16-bits counter, latency, CRC
- f : Datagram ID, rate, acceleration, temperature, PPS, 16-bits counter, latency, CRC
- l : Datagram ID, IMU ID, rate, 8-bits counter, latency, CRC
- m : Datagram ID, IMU ID, rate, acceleration, 8-bits counter, latency, CRC
- n : Datagram ID, IMU ID, rate, temperature, 8-bits counter, latency, CRC
- p : Datagram ID, IMU ID, rate, acceleration, temperature, 8-bits counter, latency, CRC
- q : Datagram ID, IMU ID, rate, 16-bits counter, latency, CRC
- r : Datagram ID, IMU ID, rate, acceleration, 16-bits counter, latency, CRC
- s : Datagram ID, IMU ID, rate, temperature, 16-bits counter, latency, CRC
- t : Datagram ID, IMU ID, rate, acceleration, temperature, 16-bits counter, latency, CRC
- v : Datagram ID, IMU ID, rate, PPS, 16-bits counter, latency, CRC
- w : Datagram ID, IMU ID, rate, acceleration, PPS, 16-bits counter, latency, CRC
- x : Datagram ID, IMU ID, rate, temperature, PPS, 16-bits counter, latency, CRC
- y : Datagram ID, IMU ID, rate, acceleration, temperature, PPS, 16-bits counter, latency, CRC

Example of command: $sd,1,148<CR>
Example of response: #sd,0,1,242<CR>

Explanation of response:
1: sd = command
2: Status of command execution: ref. Table 10-2
3: DATAGRAM FORMAT = 1 (DATAGRAM ID,RATE,ACCELERATION,8-BITS COUNTER,LATENCY)
4: CRC-8 calculation

Figure 10-36: Specification and example of $sd command

10.4.5 $sfs

Purpose: Restore configuration to factory settings.

Note that this command will be effective after the response of the command has been transmitted. If the RS422 configuration has been changed since the part has been delivered, the next command must be entered with the original RS422 configuration.

Format: $sfs,<SaveConfiguration>,<CRC><CR>

Explanation of input parameters:
<SaveConfiguration>: Save restored configuration
- 0 : Configuration not saved. The configuration can be saved later, by using the $save, ref. section 10.3.21
- 1 : Configuration saved

Example of command: $sfs,1,70<CR>
Example of response: #sfs,0,1,115<CR>

Explanation of response:
1: sfs = command
2: Status of command execution: ref. Table 10-2
3: SAVE CONFIGURATION = 1 (configuration saved)
4: CRC-8 calculation

Figure 10-37: Specification and example of $sfs command

10.4.6 $sg

Purpose: Change the configuration of the gyro g-compensation (ref. section 7.6.2.2.7)

Format: $sg,<Axis>,<ScaleSource>, <ScaleFilter>,<BiasSource>,<BiasFilter>,<LPFilter-3dB>,<CRC><CR>

Explanation of input parameters:
<Axis>: Specified axis. Valid entries are:
- x : X-axis
- y : Y-axis
- z : Z-axis

<ScaleSource>: Source of the gyro scale-factor g-compensation. Valid entries:
- 0 : None (=OFF)
- 1 : Accelerometer

<ScaleFilter>: LP filtering of source for gyro scale-factor g-compensation. Valid entries:
- 0 : OFF
- 1 : ON

<BiasSource>: Source of the gyro bias g-compensation. Valid entries:
- 0 : None (=OFF)
- 1 : Accelerometer

<BiasFilter>: LP filtering of source for gyro bias-factor g-compensation. Valid entries:
- 0 : OFF
- 1 : ON

<LPFilter-3dB >: LP Filter -3dB frequency for filtering of sources for gyro g-compensation. Valid range: [0.001, 5]Hz. NB: This field must have a number in the valid range, even if both <ScaleFilter> and <BiasFilter> are both turned OFF

Example of command: $sg,x,1,1,0,0,0.5,213<CR>
Example of response: #sg,0,X,1,1,0,0,0.5,36<CR>

Explanation of response:
1: sg = command
2: Status of command execution: ref. Table 10-2
3: AXIS = X
4: GYRO G-COMPENSATION SCALE SOURCE = 1 (ACCELEROMETER)
5: GYRO G-COMPENSATION SCALE LP FILTER = 1 (ON)
6: GYRO G-COMPENSATION BIAS SOURCE = 0 (OFF)
7: GYRO G-COMPENSATION BIAS LP FILTER = 0 (OFF)
8: LP FILTER -3dB FREQUENCY [Hz] = 0.5
9: CRC-8 calculation

Figure 10-38: Specification and example of $sg command

10.4.7 $sgf

Purpose: Change the LP filter -3dB frequency of the gyros

Format: $sgf,<Axis>,<LP Filter>,<CRC><CR>

Explanation of input parameters:
<Axis>: Specified axis. Valid entries are:

- x : X-axis
- y : Y-axis
- z : Z-axis

<LP Filter>: LP filter -3dB frequency. Valid entries are:

- 0 :16Hz
- 1 : 33Hz
- 2 : 66Hz
- 3 : 131Hz
- 4 : 262Hz

Example of command: $sgf,x,3,214<CR>
Example of response: #sgf,0,X,3,125<CR>

Explanation of response:
1: sgf = command
2: Status of command execution: ref. Table 10-2
3: GYRO LP FILTER -3dB FREQUENCY, X-AXIS = 3 (131Hz)
4: CRC-8 calculation

Figure 10-39: Specification and example of $sgf command

10.4.8 $sgu

Purpose: Change the output unit for gyros

Format: $sgu,<OutputUnit>,<CRC><CR>

Explanation of input parameters:
<OutputUnit>: Output unit. Valid entries:

- 0 : Angular rate [°/s]
- 1 : Incremental angle [°/sample]
- 2 : Average angular rate [°/s]
- 3 : Integrated angle [°]
- 8 : Angular rate – delayed [°/s]
- 9 : Incremental angle – delayed [°/sample]
- a : Average angular rate – delayed [°/s]
- b : Integrated angle – delayed [°]

Example of command: $sgu,2,111<CR>
Example of response: #sgu,0,2,101<CR>

Explanation of response:
1: sgu = command
2: Status of command execution: ref. Table 10-2
3: GYRO OUTPUT UNIT = [°/s] – AVERAGE ANGULAR ANGLE
4: CRC-8 calculation

Figure 10-40: Specification and example of $sgu command

10.4.9 $sm

Purpose: Change the output sampling rate

Note: Depending on the configured sample rate and transmission parameter settings, a too large length of the datagram could lead to a situation where the STIM is not able to transmit at the configured sample rate (ref. Table 5-8). If the transmission of the previous datagram is not completed at the time when the next datagram is to be transmitted, the datagram will not be transmitted, and the data will be lost. There is no warning or error message given if this situation occurs.

Format1: $sm,<SamplingRate>,<CRC><CR>
Format2: $sm,<SamplingRate>,<DatagramDelay>,<TransmissionDelay>,<SpecialDatagrams><CRC><CR> (only valid for External Trigger (<SamplingRate> = 0) when requiring multi-module transmission)

Explanation of input parameters:
<SamplingRate>: Output sampling rate. Valid entries are:

- 125 [samples/s]
- 250 [samples/s]
- 500 [samples/s]
- 1000 [samples/s]
- 2000 [samples/s]
- 0 : External Trigger (will turn off multi-module transmission if previously configured)

<DatagramDelay>: Minimum delay between datagrams (ref. section 7.2.1):

- [0, 1000000]: [µs]

<TransmissionDelay>: Minimum time between start of datagram transmissions in multi-module configuration (ref. section 7.2.1):

- [0, 1000000]: [µs]

<SpecialDatagrams>: Transmission of special datagrams during start-up (ref. section 7.2.1):

- 0: no special datagrams during start-up
- 1: special datagrams transmitted during start-up

Example of command using format 1: $sm,2000,194<CR>
Example of response using format 1: #sm,0,2000,247<CR>

Explanation of response:
1: sm = command
2: Status of command execution: ref. Table 10-2
3. SAMPLING FREQUENCY = 2000 samples/s
4: CRC-8 calculation

Example of command using format 2: $sm,0,50,1034,0,253<CR>
Example of response using format 2: #sm,0,0,50,1034,0,37<CR>

Explanation of response:
1: sm = command
2: Status of command execution: ref. Table 10-2
3. SAMPLING FREQUENCY = External Trigger
4. DATAGRAM DELAY = 50µs
5: TRANSMISSION DELAY = 1034µs
6: SPECIAL DATAGRAMS DURING START-UP: 0 (= No transmission of special datagrams)
7: CRC-8 calculation

Figure 10-41: Specification and example of $sm command

10.4.10 $spf

Purpose: Change the LP filter -3dB frequency of PPS

Format: $spf,<LP Filter>,<CRC><CR> Explanation of input parameters: <LP Filter>: LP filter -3dB frequency. Valid entries are: • 0 :16Hz • 1 : 33Hz • 2 : 66Hz • 3 : 131Hz • 4 : 262Hz
Example of command: $spf,4,87<CR> Example of response: #spf,0,4,62<CR> Explanation of response: 1: spf = command 2: Status of command execution: ref. Table 10-2 3: PPS LP FILTER -3dB FREQUENCY = 4 (262Hz) 4: CRC-8 calculation

Figure 10-42: Specification and example of $spf command

10.4.11 $spu

Purpose: Change the output unit for PPS

Format: $spu,<OutputUnit>,<CRC><CR> Explanation of input parameters: <OutputUnit>: Output unit. Valid entries: • 0 : Time since detection of 0 • 1 : Time since detection of 1 • 2 : Filtered PPS • 3 : Filtered PPS – delayed
Example of command: $spu,1,75<CR> Example of response: #spu,0,1,154<CR> Explanation of response: 1: spu = command 2: Status of command execution: ref. Table 10-2 3: PPS OUTPUT UNIT = [µs] – Time since detection of 1 4: CRC-8 calculation

Figure 10-43: Specification and example of $spu command

10.4.12 $st

Purpose: Change the RS422 transmission parameters

Note that this command will be effective after the response of the command has been transmitted. The next command must be entered with the new RS422 configuration.

Note: Depending on the configured sample rate and transmission parameter settings, a too large length of the datagram could lead to a situation where the STIM is not able to transmit at the configured sample rate (ref. Table 5-8). If the transmission of the previous datagram is not completed at the time when the next datagram is to be transmitted, the datagram will not be transmitted, and the data will be lost. There is no warning or error message given if this situation occurs.

Format: $st,<BitRate>,<StopBits>,<Parity>,<LineTermination>,<DatagramTermination>,<TransmitDisabled>,<CRC><CR>

Explanation of input parameters:
<BitRate>: Bit-rate [bps]. Some limitations apply, ref. section 9.5
<StopBits>: Number of stop-bits. Valid entries are:

- 1 : 1 stop bit
- 2 : 2 stop bits

<Parity>: Parity. Valid entries are:

- n: No parity
- o : Odd parity
- e : Even parity

<LineTermination>: Turn on/off 120 Ohm line termination on the RS422 Rx+ and Rx- inputs. Valid entries are:

- 0 : Line termination turned OFF
- 1 : Line termination turned ON

<DatagramTermination>: Turn on/off <CR><LF>-termination of datagrams. Valid entries are:

- 0 : No datagram termination
- 1 : Datagram termination = <CR><LF>

<TransmitDisabled>: Turn off/on RS422 transmitter between transmissions. Valid entries are:

- 0 : RS422 transmitter on always
- 1 : RS422 transmitter disabled when not transmitting

Example of command with specified bit-rate: $st,921600,2,n,1,0,1,189<CR>
Example of response: #st,0,921600,2,N,1,0,1,2<CR>

Explanation of response:
1: st = command
2: Status of command execution: ref. Table 10-2
3: BIT-RATE [bps] = 921600
4: STOP BITS = 2
5: PARITY = N (NO PARITY)
6: LINE TERMINATION = 1 (ON)
7: DATAGRAM TERMINATION = 0 (NONE)
8: RS422 TRANSMITTER DISABLED WHEN NOT TRANSMITTING = 1 (DISABLED WHEN NOT TRANSMITTING)
9: CRC-8 calculation

Figure 10-44: Specification and example of $st command

10.5 Commands for bias trim offset

General description: Various commands related to bias trim offset.

Note: Use of commands that changes parameters do not permanently store the new values. The updated values will be in effect until the part is powered off or reset. To permanently store the new values, the $save-command (ref. section 10.3.21) must be used after having updated the required parameters.

Table 10-5: Available bias trim offset commands

Command	Description	Ref. section
$ibto	Returns the bias trim offsets	10.5.1
$irf	Returns the last programmed reference information for bias trim offset	10.5.2
$sbto	Programs the bias trim offset(s)	10.5.3
$sdbto	Adjusts the bias trim offsets	10.5.4
$srf	Programs the reference information for bias trim offset	10.5.5

10.5.1 $ibto

Purpose: Provide information about the current bias trim offsets

Format: $ibto,<CRC><CR>

Example of command: $ibto,160<CR>
Example of response: #ibto,0.01388,-0.02425,0.01724,-0.036230,0.002872,0.015903,0.0000000,0.0000000,0.0000000,34<CR>

Explanation of response:
1: ibto = command
2: Status of command execution: ref. Table 10-2
3: GYRO X-AXIS BIAS TRIM OFFSET [°/s] = 0.01388 (number format: decimal number with 5 decimals)
4: GYRO Y-AXIS BIAS TRIM OFFSET [°/s] = -0.02425 (number format: decimal number with 5 decimals)
5: GYRO Z-AXIS BIAS TRIM OFFSET [°/s] = 0.01724 (number format: decimal number with 5 decimals)
6: ACCELEROMETER X-AXIS BIAS TRIM OFFSET [g] = -0.036230 (number format: decimal number with 6 decimals)
7: ACCELEROMETER Y-AXIS BIAS TRIM OFFSET [g] = 0.002872 (number format: decimal number with 6 decimals)
8: ACCELEROMETER Z-AXIS BIAS TRIM OFFSET [g] = 0.015903 (number format: decimal number with 6 decimals)
9: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals)
10: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals)
11: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals)
12: CRC-8 calculation

Figure 10-45: Specification and example of $ibto command

10.5.2 $irf

Purpose: Provide information about last programmed reference information for bias trim offset

Format: $irf,223<CR>

Example of command: $irf,223<CR>
Example of response: #irf,0,43638,210<CR>

Explanation of response:
1: irf = command
2: Status of command execution: ref. Table 10-2
3: REFERENCE INFORMATION = 43638 (number format: unsigned integer)
4: CRC-8 calculation

Figure 10-46: Specification and example of $irf command

10.5.3 $sbto

Purpose: Program the bias trim offset(s)

Format1: $sbto,<BiasTrimOffset>,<CRC><CR>
Format2: $sbto,<BiasTrimOffset>,<SensorCluster>,<CRC><CR>
Format3: $sbto, <BiasTrimOffset>,<SensorCluster>,<Axis> ,<CRC><CR>

Explanation of input parameters:
<BiasTrimOffset>: New value of bias trim offset [°/s] or [g]
<SensorCluster>: Sensor cluster to be programmed. Valid entries are:

- g : gyro
- a : accelerometer

<Axis>: Specific axis to be programmed. Valid entries are:

- x : X-axis
- y : Y-axis
- z : Z-axis

Example of command using format1: $sbto,0,165<CR> (example clears bias trim offset for all axes)
Example of response using format1:
#sbto,0,0.00000,0.00000,0.00000,0.000000,0.000000,0.000000,0.0000000,0.0000000,0.0000000,177<CR>

Example of command using format2: $sbto,0,a,125<CR> (example clears bias trim offset for all accelerometers)
Example of response using format2:
#sbto,0,0.02311,0.00934,0.54432,0.000000,0.000000,0.000000,0.0000000,0.0000000,0.0000000,211<CR>

Example of command using format3: $sbto,3.4e-03,g,y,128<CR> (example sets bias trim offset for gyro Y-axis to 0.0034°/s)
Example of response using format3:
#sbto,0,0.02311,0.00340,0.54432,0.089453,0.002666,0.053422,0.0000000,0.0000000,0.0000000,196<CR>

Explanation of response:
1: sbto = command
2: Status of command execution: ref. Table 10-2
3: NEW GYRO X-AXIS BIAS TRIM OFFSET [°/s] = 0.02311 (number format: decimal number with 5 decimals)
4: NEW GYRO Y-AXIS BIAS TRIM OFFSET [°/s] = 0.00340 (number format: decimal number with 5 decimals)
5: NEW GYRO Z-AXIS BIAS TRIM OFFSET [°/s] = 0.54432 (number format: decimal number with 5 decimals)
6: NEW ACCELEROMETER X-AXIS BIAS TRIM OFFSET [g] = 0.089453 (number format: decimal number with 6 decimals)
7: NEW ACCELEROMETER Y-AXIS BIAS TRIM OFFSET [g] = 0.002666 (number format: decimal number with 6 decimals)
8: NEW ACCELEROMETER Z-AXIS BIAS TRIM OFFSET [g] = 0.053422 (number format: decimal number with 6 decimals)
9: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals)
10: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals)
11: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals)
12: CRC-8 calculation

Figure 10-47: Specification and example of $sbto command

10.5.4 $sdbto

Purpose: Adjust the bias trim offsets

Format: $sdbto,<Gyro dX>,<Gyro dY>,<Gyro dZ>,<Acc dX>,<Acc dY>,<Acc dZ>,0,0,0,<CRC><CR> Explanation of input parameters: <Gyro dX>: Required adjustment in bias trim offset for gyro X-axis [°/s] <Gyro dY>: Required adjustment in bias trim offset for gyro Y-axis [°/s] <Gyro dZ>: Required adjustment in bias trim offset for gyro Z-axis [°/s] <Acc dX>: Required adjustment in bias trim offset for accelerometer X-axis [g] <Acc dY>: Required adjustment in bias trim offset for accelerometer Y-axis [g] <Acc dZ>: Required adjustment in bias trim offset for accelerometer Z-axis [g]
Example of command: $sdbto,0.01388,-0.02425,0.01724,-0.036230,0.002872,0.015903,0,0,0,67<CR> Example of response: #sdbto,0,0.02311,0.00934,-0.54432,0.089453,0.002666,-0.053422,0.0000000,0.0000000,0.0000000,226<CR> Explanation of response: 1: sdbto = command 2: Status of command execution: ref. Table 10-2 3: NEW GYRO X-AXIS BIAS TRIM OFFSET [°/s] = 0.02311 (number format: decimal number with 5 decimals) 4: NEW GYRO Y-AXIS BIAS TRIM OFFSET [°/s] = 0.00934 (number format: decimal number with 5 decimals) 5: NEW GYRO Z-AXIS BIAS TRIM OFFSET [°/s] = -0.54432 (number format: decimal number with 5 decimals) 6: NEW ACCELEROMETER X-AXIS BIAS TRIM OFFSET [g] = 0.089453 (number format: decimal number with 6 decimals) 7: NEW ACCELEROMETER Y-AXIS BIAS TRIM OFFSET [g] = 0.002666 (number format: decimal number with 6 decimals) 8: NEW ACCELEROMETER Z-AXIS BIAS TRIM OFFSET [g] = -0.053422 (number format: decimal number with 6 decimals) 9: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 10: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 11: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 12: CRC-8 calculation

Figure 10-48: Specification and example of $sdbto command

10.5.5 $srf

Purpose: Program the reference info for bias trim offset

Format: $srf,<RefInfo>,<CRC><CR> Explanation of input parameters: <RefInfo>: Reference information (format: 32-bit unsigned integer), e.g. a date code
Example of command: $srf,43638,122<CR> (example shows programming of datecode for "June 22, 2019" (=43638)) Example of response: #srf,0,43638,69<CR> Explanation of response: 1: srf = command 2: Status of command execution: ref. Table 10-2 3. NEW REFERENCE INFORMATION = 43638 4: CRC-8 calculation

Figure 10-49: Specification and example of $srf command

11 MARKING

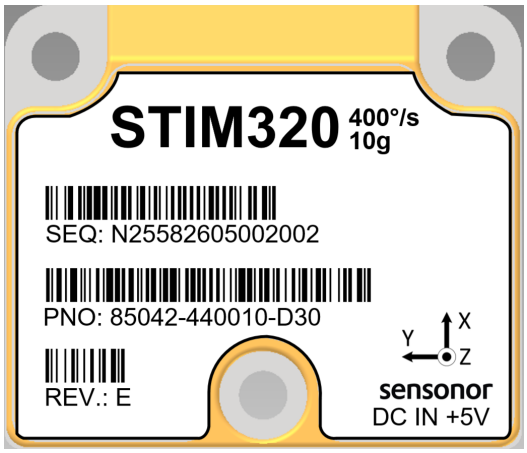

Figure 11-1: Example of marking of STIM320

12 CONFIGURATION / ORDERING INFORMATION

The STIM320 will be delivered according to the configuration code as shown below. All configuration parameters can be changed later in Service Mode or Utility Mode, ref. section 7.6.3 or 7.6.4 respectively. A full list of configurable parameters can be found in Table 5-7.

Configuration parameters in **bold** letters show the standard option.

Range		Measurement							Output/RS422		
Prod_ID	-	Sample rate	Filter band-width	Gyro output unit	Acc. output unit	PPS output unit	Gyro g-comp	-	Datagram	Bit-rate	Configuration

Range STIM320		
Prod_ID	Gyro	Acc
85042	400°/s	10g

Sample rate:
0 = 125 samples/s
1 = 250 samples/s
2 = 500 samples/s
3 = 1000 samples/s
4 = 2000 samples/s
5 = External Trigger

Filter bandwidth:
0 = 16Hz
1 = 33Hz
2 = 66Hz
3 = 131Hz
4 = 262Hz

RS422 data configuration	
#Start bit	1
#Data bits	8
#Stop bits	1[4)]
Parity	None[4)]

Gyro output unit:
0 = Angular Rate [°/s]
1 = Incremental Angle [°/sample]
2 = Average Angular Rate [°/s]
3 = Integrated Angle [°]
8 = Angular Rate [°/s] – delayed
9 = Incremental Angle [°/sample] – delayed
A = Average Angular Rate [°/s] – delayed
B = Integrated Angle [°] – delayed

Acc. output unit:
0 = Acceleration [g]
1 = Incremental Velocity [m/s/sample]
2 = Average Acceleration [g]
3 = Integrated Velocity [gs]
4 = Integrated Velocity [m/s]

PPS output unit:
0 = Time since detection of 0 [µs]
1 = Time since detection of 1 [µs]
2 = Filtered PPS [ ]
3 = Filtered PPS [ ] - delayed

Gyro g-comp	Bias		Scale-factor	
	Source	0.01Hz-filter	Source	0.01Hz-filter
0	**OFF**	**-**	**OFF**	**-**
1[1)]	OFF	-	ACC	OFF
2	OFF	-	ACC	ON
3[1)]	ACC	OFF	OFF	-
4	ACC	ON	OFF	-
7[1)]	ACC	OFF	ACC	OFF
8[1)]	ACC	ON	ACC	OFF
B	ACC	ON	ACC	ON

Datagram	Included data					
	ID	Rate	Acceleration	Temperature	PPS	Counter (bits)
0	NO	YES	NO	NO	NO	8
1	NO	YES	YES	NO	NO	8
4	NO	YES	NO	YES	NO	8
5	NO	YES	YES	YES	NO	8
8	NO	YES	NO	NO	NO	16
9	NO	YES	YES	NO	NO	16
A	NO	YES	NO	YES	NO	16
B	NO	YES	YES	YES	NO	16
C	NO	YES	NO	NO	YES	16
D	**NO**	**YES**	**YES**	**NO**	**YES**	**16**
E	NO	YES	NO	YES	YES	16
F	NO	YES	YES	YES	YES	16
L	YES	YES	NO	NO	NO	8
M	YES	YES	YES	NO	NO	8
N	YES	YES	NO	YES	NO	8
P	YES	YES	YES	YES	NO	8
Q	YES	YES	NO	NO	NO	16
R	YES	YES	YES	NO	NO	16
S	YES	YES	NO	YES	NO	16
T	YES	YES	YES	YES	NO	16
V	YES	YES	NO	NO	YES	16
W	YES	YES	YES	NO	YES	16
X	YES	YES	NO	YES	YES	16
Y	YES	YES	YES	YES	YES	16

Bit-rate:
0 = 374400 bits/s
1 = 460800 bits/s
2 = 921600 bits/s
3 = 1843200 bits/s [2)]
F = User-defined [2,3)]

1) Delayed gyro output unit should be selected with this option
2) USB-based evaluation kit works at bit-rates ≤ 1.5Mbit/s + 2Mbit/s and 3Mbits/s
3) Bit-rate must be specified. See section 9.5 for limitations
4) Configuration can be changed in SERVICEMODE. See section 9.5

Example: 85042-413020-E30 has the following configuration:

- Gyro range = 400°/s, accelerometer range = 10g
- Sample rate = 2000 samples/s
- Low-pass filter bandwidth = 33Hz
- Gyro output unit = Integrated Angle [°]
- Accelerometer output unit = Acceleration [g]
- PPS output unit = Filtered PPS
- No g-/acc-compensation of bias and scale-factor
- Datagram containing Rate, Temperature and PPS
- Bit-rate = 1843200 bits/s
- Datagram Termination = None
- RS422 input line termination OFF
- RS422 output is active between datagrams

Configuration			
	Input line termination	Datagram termination	Output active between datagrams
0	OFF	None	YES
1	**ON**	**None**	**YES**
2	OFF	<CR><LF>	YES
3	ON	<CR><LF>	YES
4	OFF	None	NO
5	ON	None	NO
6	OFF	<CR><LF>	NO
7	ON	<CR><LF>	NO

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