

1 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 Sensoror ButterflyGyro™
 - Single-crystal silicon technology
 - No intrinsic wear-out effects
- High stability accelerometers
- PPS input
- Output-signal with programmable timing (CRS)
- Insensitive to magnetic fields
- Full EMI compliance
- Digital interface, RS422
- Fully configurable
- Continuous self-diagnostics
- RoHS compatible



(38.6mm x 44.8mm x 21.5mm)

2 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.

STIM320 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 STIM320 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. STIM320 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. STIM320 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, STIM320 may be put in Utility Mode. This mode is similar to Service Mode, but made for machine-machine communication.

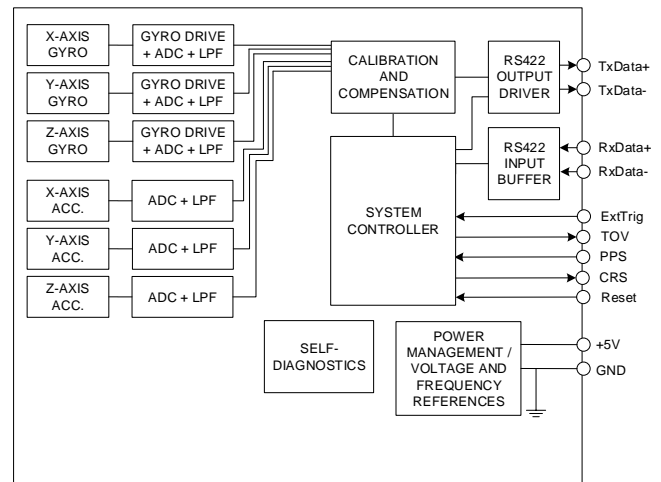


Figure 2-1: STIM320 FUNCTION BLOCK DIAGRAM

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4 DEFINITIONS AND ABBREVIATIONS USED IN DOCUMENT

4.1 Definitions

$g_0 = 9.80665 \text{m/s}^2$ (standard gravity)

4.2 Abbreviations

Table 4-1: Abbreviations

ABBREVIATION	FULL NAME
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
TOV	Time of Validity
TxD	Transmit Data
VRC	Vibration Rectification Coefficient
VSUP	Voltage supply

5 ABSOLUTE MAXIMUM RATINGS

Stresses beyond those listed in Table 5-1 may cause permanent damage to the device.

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

Table 5-1: Absolute maximum ratings

Parameter	Rating	Comment
Mechanical shock	1 500g/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	-0.5 to +7V	
RxD+ or RxD- to GND	-0.3V to +7V	
RxD+ to RxD-	±6V	with 120Ω Line Termination = ON
TxD+ or TxD- to GND	-8V to +8V	
ExtTrig to GND	-0.3V to +7V	
PPS to GND	-0.3V to +7V	
TOV to GND	-0.3V to +7V	
CRS to GND	-0.3V to +7V	
NRST to GND	-0.3V to +7V	
Chassis to GND	500V	
Helium sensitivity		Not to be exposed to helium concentrations higher than those normally found in the atmosphere at Earth's surface (~5ppm)

6 SPECIFICATIONS
Table 6-1: 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 STIM320 could give rise to an oscillating behavior of the input voltage to the unit.

Table 6-2: 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 Time to transmit after Reset Time to valid data	T=+25°C			0.3 0.2	s s	1 2	
RS422 Bit-Rate			3.5	5	s	3	
RS422 Bit-Rate Accuracy				ref. Table 6-7	±1	%	4
Output Sample Rate			125		2000	samples/s	5
RS422 PROTOCOL Start Bit Data Length Parity Stop Bits				1 8 None 1		bit bits bit	 6 6
RS422 LINE TERMINATION Input resistance Input resistance	Line termination = ON Line termination = OFF		120 125		Ω kΩ		
RESET (NRST PIN) Logic levels Minimum hold time for reset Pull-Up Resistor	“high” “low”	2.3 1 80		0.6 100	V V kΩ		
EXTERNAL TRIGGER (ExtTrig PIN) Logic levels Trigger Time between triggers	“high” “low” Measurement unit: angular rate incremental angle average rate integrated angle	2.3		0.6	V V		
				Negative transition			
			0.5		127	ms	7,8
			0.5		127	ms	7,9
			0.5		65	ms	7,10
		0.5		8	ms	7,11	
Minimum “high” time before trigger, t_{ext_hi} Minimum “low” time after trigger, t_{ext_lo} Delay from external trigger to start of transmission, t_{ext_dl} Pull-Up Resistor Latency		250 250 40		86 50	ns ns kΩ	12 12	
				1000	μs		

Parameter	Conditions	Min	Nom	Max	Unit	Note
PULSE PER SECOND (PPS PIN) Logic levels Pull-Up Resistor	“high” “low”	2.3		0.6	V V kΩ	
TIME OF VALIDITY (TOV PIN) Output configuration V_{OH} V_{OL} TOV active level Minimum time of TOV, t_{tov_min} Delay from internal time-tick to TOV active, t_{tov_dl} Delay from TOV active (to start of transmission, t_{tx_dl}	$I_{OH} = -10 \mu A$ $I_{OH} = -100 \mu A$ $I_{OL} = 10 mA$	Open drain with internal pull up 0.9 VSUP 0.7 VSUP		0.1V		
		50	Active “low”		μs	13
			1.2	6	μs	13
				80	μs	13
COUNTER RESTART SIGNAL (CRS PIN) Output configuration V_{OH} V_{OL} CRS active level Minimum time of CRS, t_{crs_min} Delay from internal time-tick to CRS active, t_{crs_dl}	$I_{OH} = -10 \mu A$ $I_{OH} = -100 \mu A$ $I_{OL} = 10 mA$	Open drain 0.9 VSUP 0.7 VSUP		0.1V		
		50	Active “low”		μs	14
			1.2	6	μs	14
CHASSIS Isolation resistance chassis to GND (pin 15)	500V	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 the reset of the Start-Up bit (Bit 6 in the STATUS byte ref. Table 6-18).

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 10.5.1

Note 5: Internal sample rate is 2000 samples/s for gyro + gyro temperature and 32 samples/s for accelerometers and PPS filtered. Output sample rate can be configured, ref. Table 6-7. Output sample rate will be same for gyros, accelerometers, PPS and temperature

Note 6: Other values can be configured, ref. Table 6-7

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 6-18. 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 8-3

Note 13: For definition, ref. Figure 8-4 and Figure 8-5

Note 14: For definition, ref Figure 8-7

Table 6-3: 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	±200°/s		15		ppm	2
	±400°/s		20		ppm	2
Bandwidth (-3dB)			262		Hz	3
Sample Rate				2000	samples/s	4
Group Delay	LP-filter -3dB = 262Hz		1.5		ms	5
	LP-filter -3dB = 131Hz		3.0		ms	5
	LP-filter -3dB = 66Hz		6.0		ms	5
	LP-filter -3dB = 33Hz		12		ms	5
	LP-filter -3dB = 16Hz		24		ms	5
Bias Range		-250	0	+250	°/h	
Bias Trim offset range			±1		°/s	
Bias Run-Run			4		°/h	
Drift Rate Stability			3		°/h	
Bias error over temperature	Static temperatures		9		°/h	6
Bias error over temperature gradients	$\Delta T \leq \pm 1^\circ\text{C}/\text{min}$		10		°/h	7
Bias Instability	Allan Variance @25°C		0.3		°/h	
Angular Random Walk	Allan Variance @25°C		0.10		°/√h	
Linear Acceleration Effect						
Bias	With g-compensation		1		°/h /g	8
	No g-compensation		7		°/h /g	8
Scale Factor	With g-compensation		50		ppm/g	8
	No g-compensation		400		ppm/g	8
Vibration Rectification Coefficient			Ref. Figure 6-1		°/h /g _{rms} ²	
Misalignment			1		mrad	9
Orthogonality			0.2		mrad	10

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 6-7 and section 6.1.1.4

Note 4: Other values can be configured, ref. Table 6-7. Sample rate will be same for gyros, accelerometers, PPS and temperature

Note 5: Total delay to start of datagram transmission = group delay + 0.5ms + $t_{\text{tov,dl}}$ + $t_{\text{bx,dl}}$. For output units with delayed output, the group delay will be 1.5ms longer, ref. section 8.6.2.2.1. For more details, see TS1631 Application Note "Timing details between sampling and datagram transmission"

Note 6: rms-value calculated on the residuals at static temperatures over the temperature range

Note 7: rms-value calculated on the residual over two temperature-cycles, ref. Figure 6-6

Note 8: Section 7.2 gives advice on sensitive directions

Note 9: Ref. Figure 6-2 for definition of reference points used in axes alignment

Note 10: Gyros and accelerometers are calibrated in the same test-insertion to ensure minimum misalignment between the three sensor-axis systems

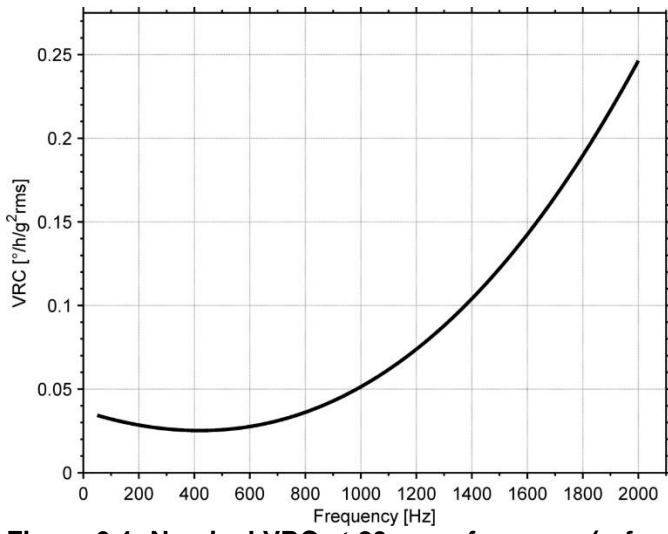


Figure 6-1: Nominal VRC at 20g rms for gyros (ref. section 7.2 for sensitive directions to acceleration-forces)

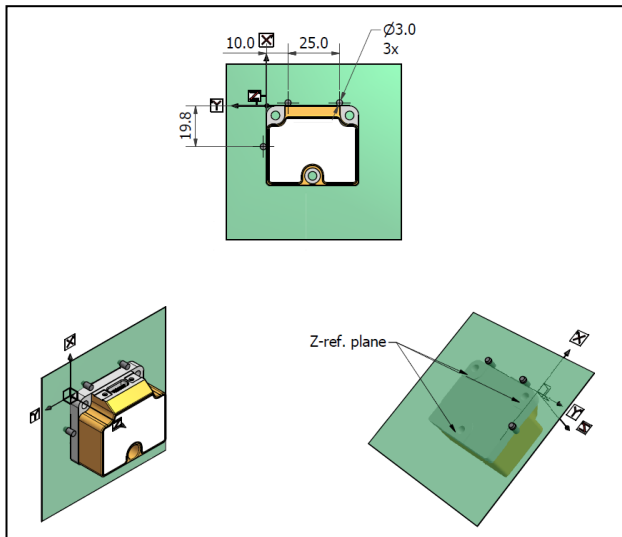


Figure 6-2: Reference points for alignment of axes

Table 6-4: Functional specifications, 10g accelerometers

Parameter	Conditions	Min	Nom	Max	Unit	Note
ACCELEROMETER						
Full Scale (FS)			±10		g	1
Resolution			24		bits	
Scale Factor Accuracy			1.9		µg	
Scale Factor 1 year stability			±200		ppm	
Non-Linearity	±10g		600		ppm	2
Bandwidth (-3dB)	LP-filter -3dB = 262Hz		100		ppm	2
Group Delay	LP-filter -3dB = 262Hz		225		Hz	3
	LP-filter -3dB = 131Hz		3.0		ms	4
	LP-filter -3dB = 66Hz		4.5		ms	4
	LP-filter -3dB = 33Hz		7.5		ms	4
	LP-filter -3dB = 16Hz		13		ms	4
			25		ms	4
			1.25	1.5		mg
Bias 1 year stability			±100		mg	
Bias Trim offset range			±0.7		mg rms	
Bias error over temperature	ΔT ≤ ±1°C/min					
Bias Instability	Allan Variance @25°C		0.003		mg	
Velocity Random Walk	Allan Variance @25°C		0.015		m/s/√h	
Vibration Rectification Coefficient			Ref. Figure 6-3		mg/g _{rms} ²	
Misalignment			1		mrad	5
Orthogonality			0.2		mrad	6

Note 1: Overload-bit in STATUS-byte (ref. section 6.4) 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 6-7 and section 6.1.2.3

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 6-2 for definition of reference points used in axes alignment

Note 6: Gyros and accelerometers are calibrated in the same test-insertion to ensure minimum misalignment between the three sensor-axis systems

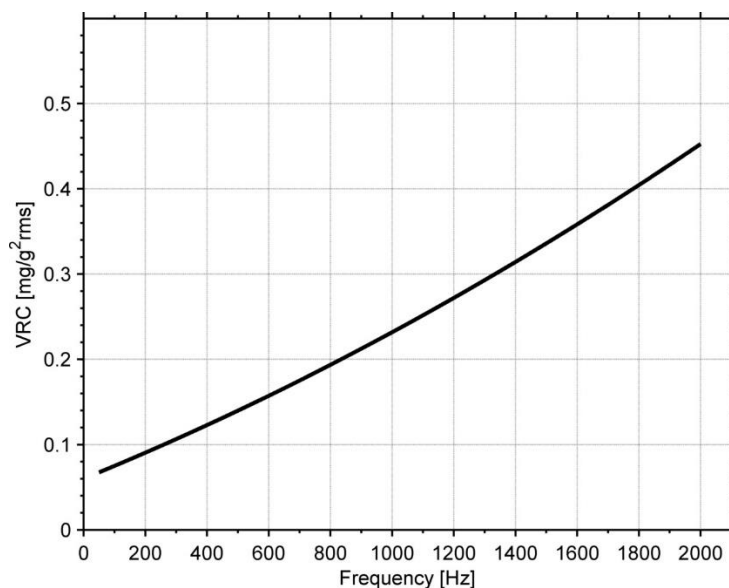


Figure 6-3: Nominal VRC at 10g rms for 10g accelerometers

Table 6-5: 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)			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 6-7 and section 6.1.3.1

Note 2: Total delay to start of datagram transmission = group delay + 0.5ms + t_{tov_dl} + t_{tx_dl}

Table 6-6: Functional specifications, temperature

Parameter	Conditions	Min	Nom	Max	Unit	Note
Resolution			0.0039		°C	
Bias Accuracy	@25°C		±5		°C	1
Scale factor accuracy			±5		%	

Note 1: Temperature measured at gyros. Temperature calibrated at static condition and referred to ambient temperature

6.1 TYPICAL PERFORMANCE CHARACTERISTICS

6.1.1 GYRO CHARACTERISTICS

6.1.1.1 Root Allan Variance of gyro

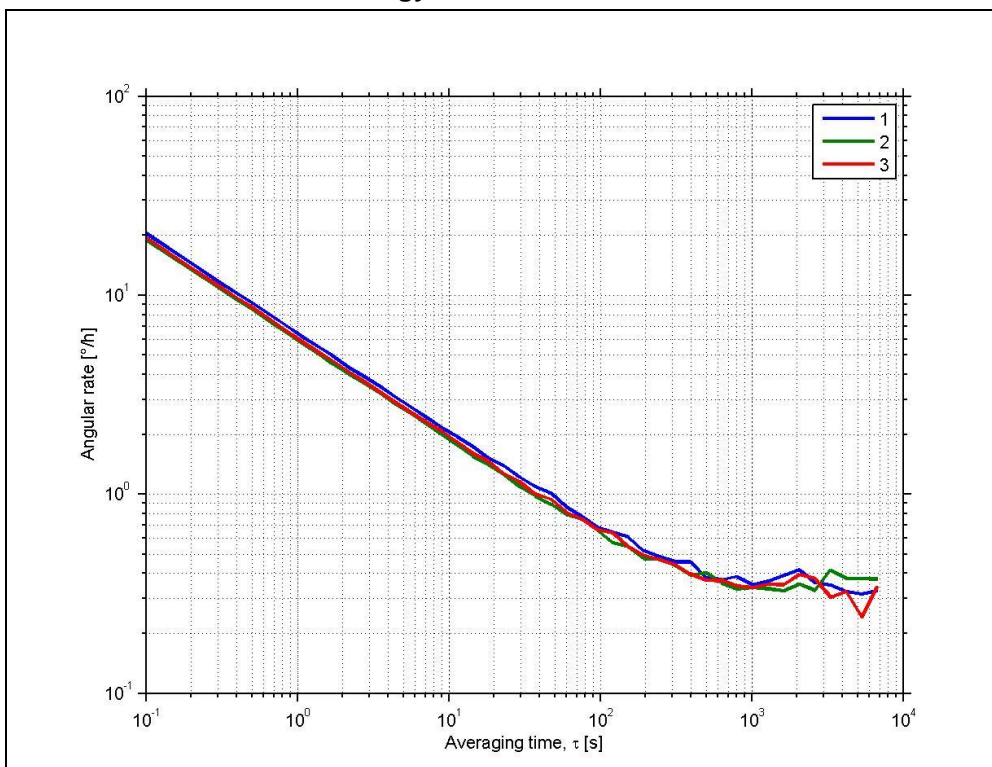


Figure 6-4: Typical Root Allan-Variance of gyro (400°/s gyro)

6.1.1.2 Initial bias drift of gyro

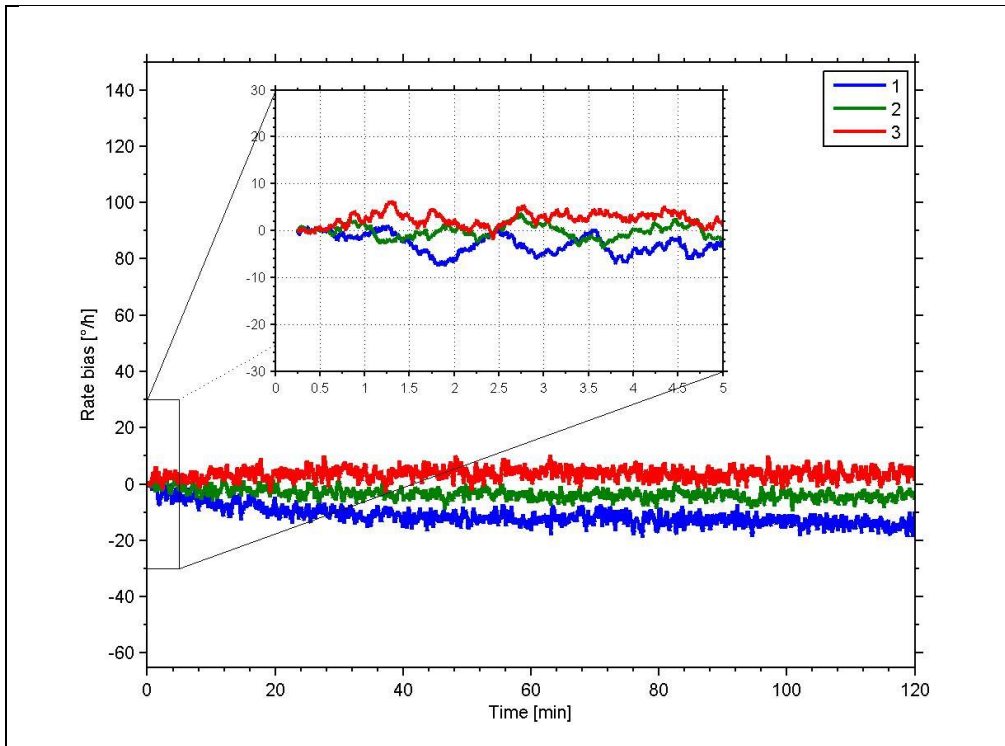


Figure 6-5: Typical normalized initial bias drift of gyro (400°/s gyro)

6.1.1.3 Bias drift over temperature

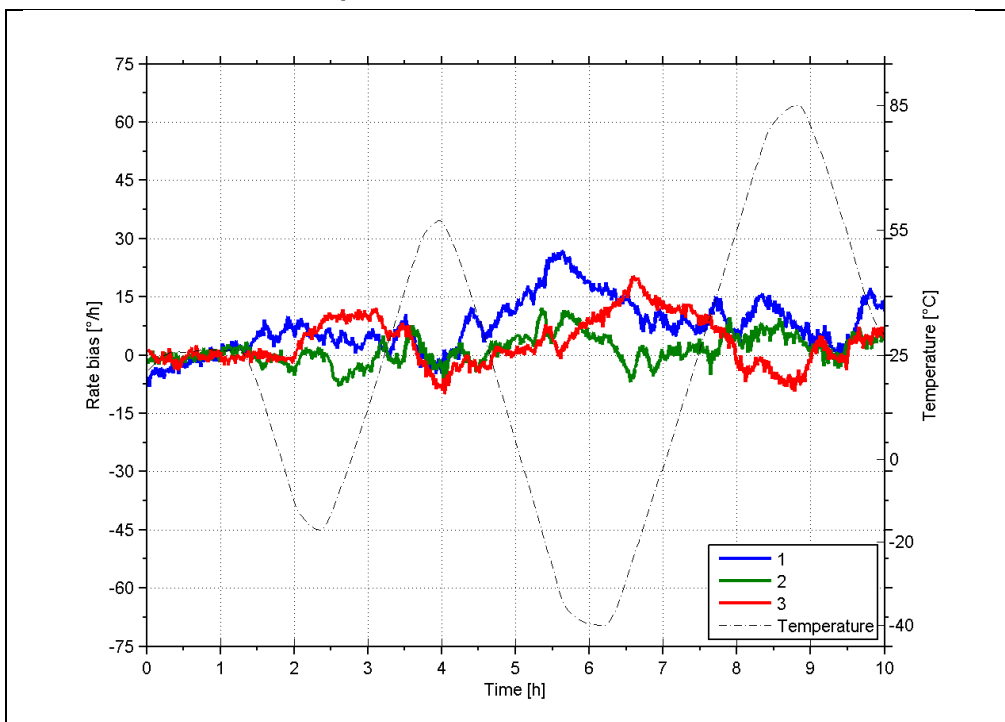


Figure 6-6: Typical Bias drift over temperature (400°/s gyro)

6.1.1.4 Frequency characteristics of gyros

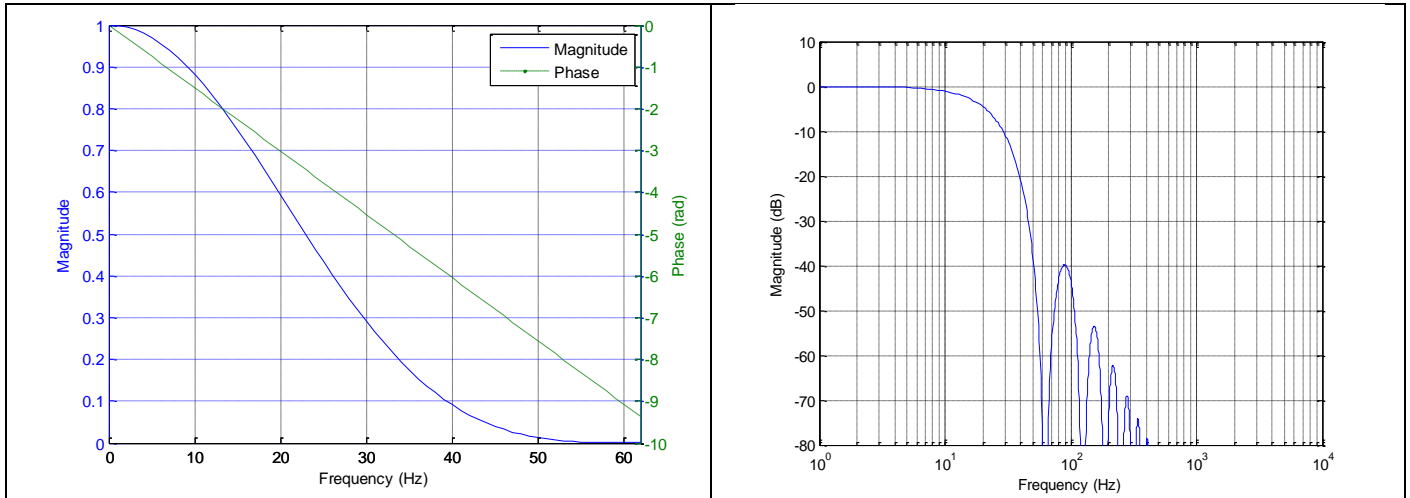


Figure 6-7: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 16Hz

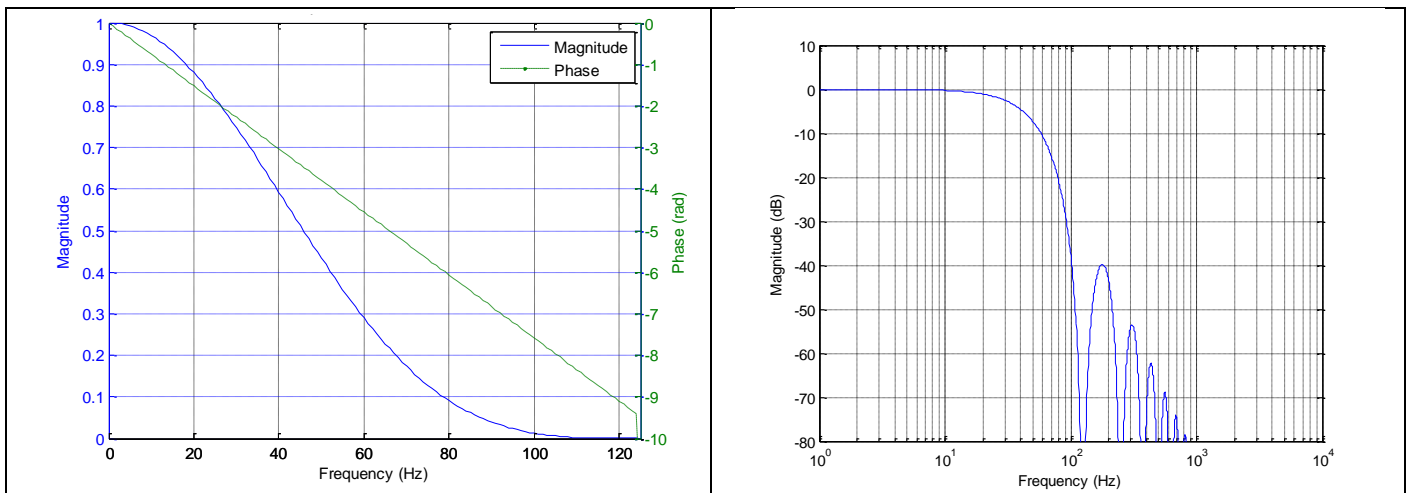


Figure 6-8: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 33Hz

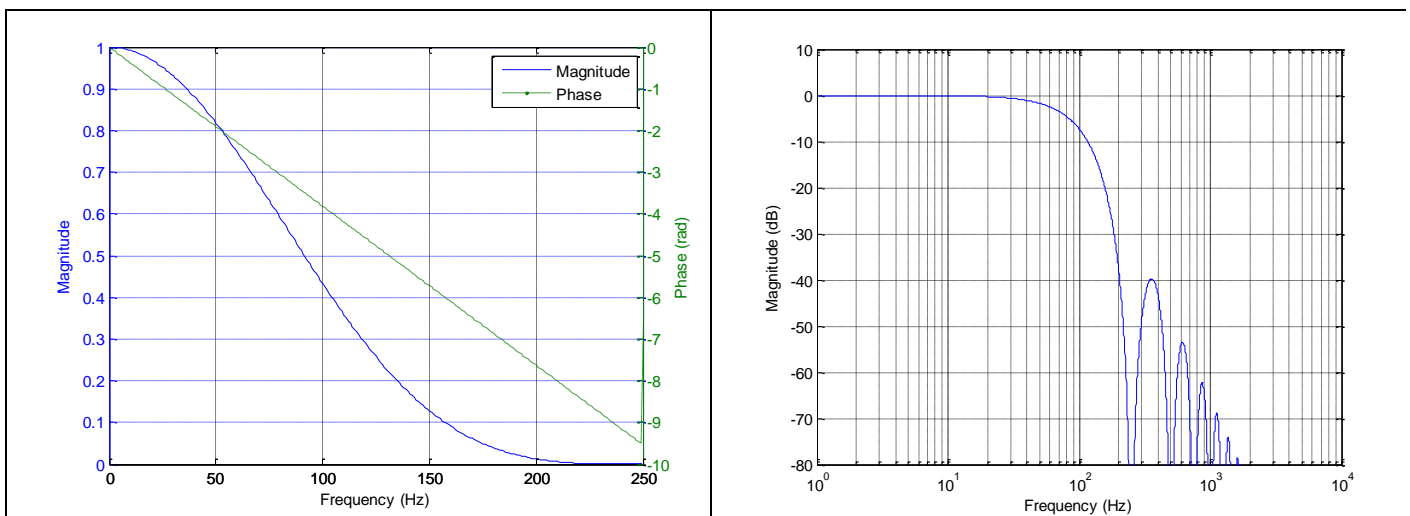


Figure 6-9: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 66Hz

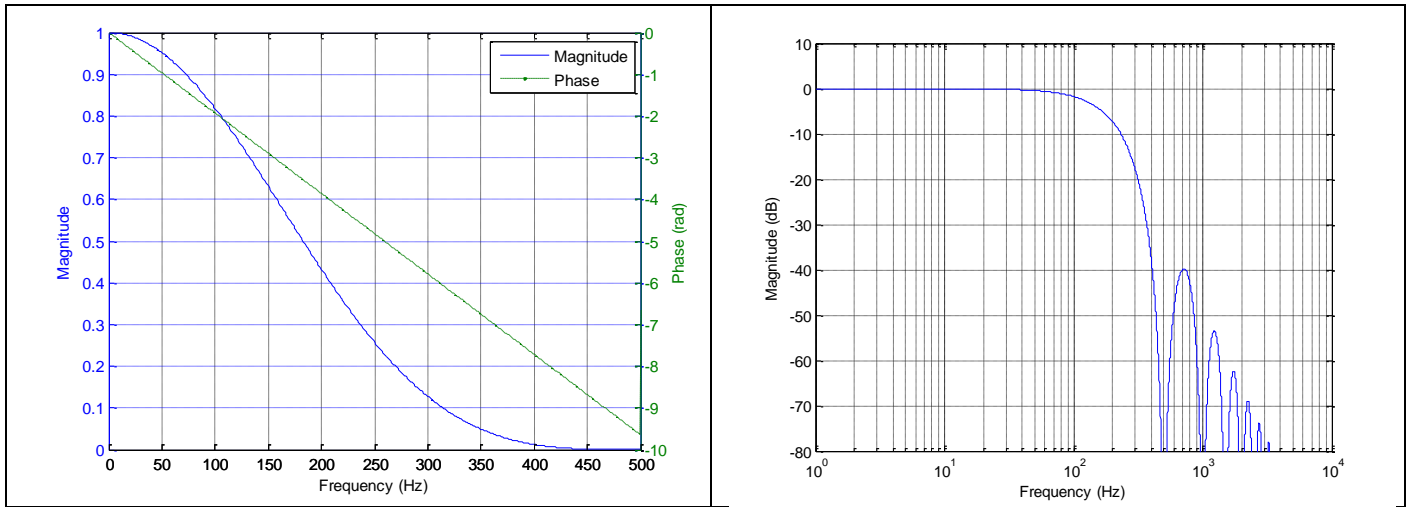


Figure 6-10: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 131Hz

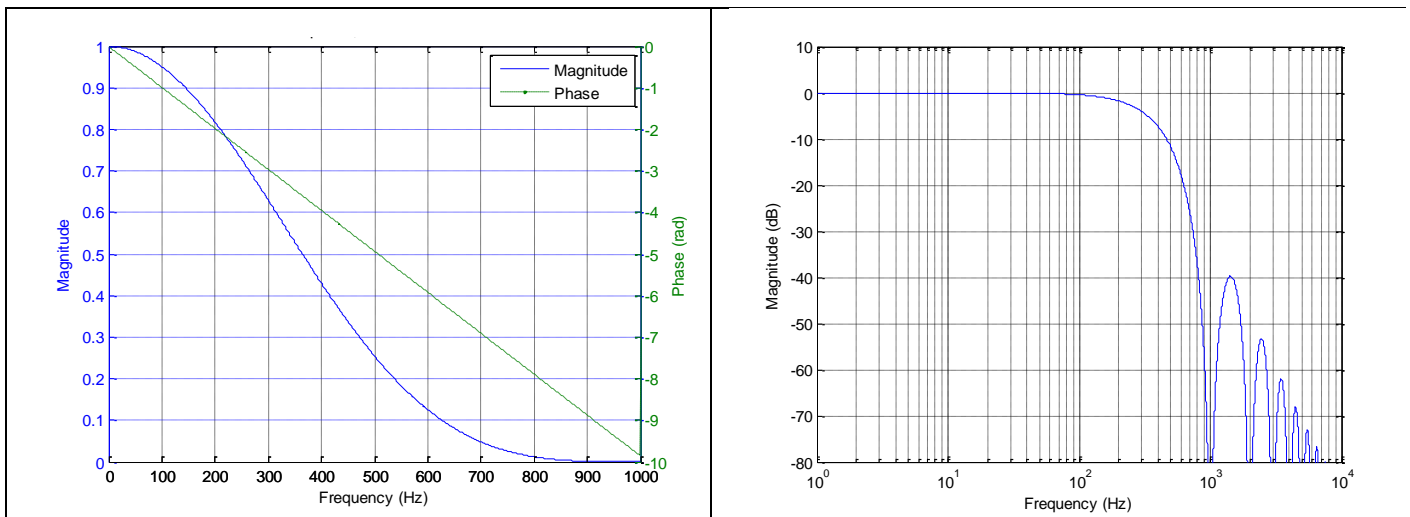


Figure 6-11: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 262Hz

6.1.2 ACCELEROMETER CHARACTERISTICS

6.1.2.1 Root Allan Variance of accelerometer

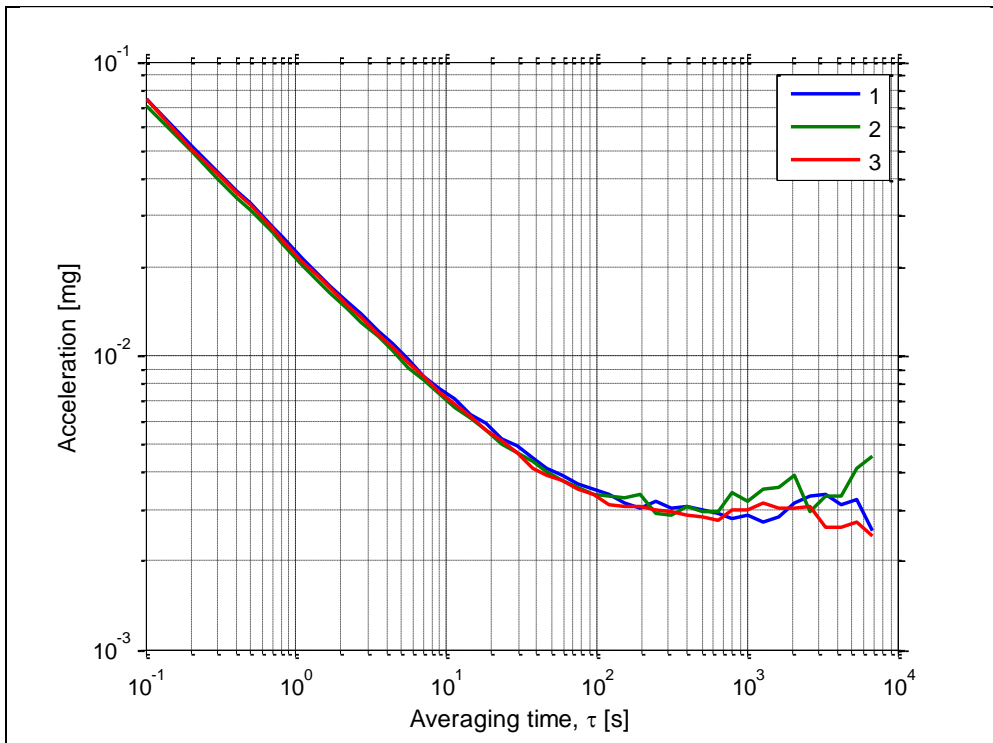


Figure 6-12: Typical Allan-Variance of accelerometer (10g accelerometer)

6.1.2.2 Initial bias drift of accelerometer

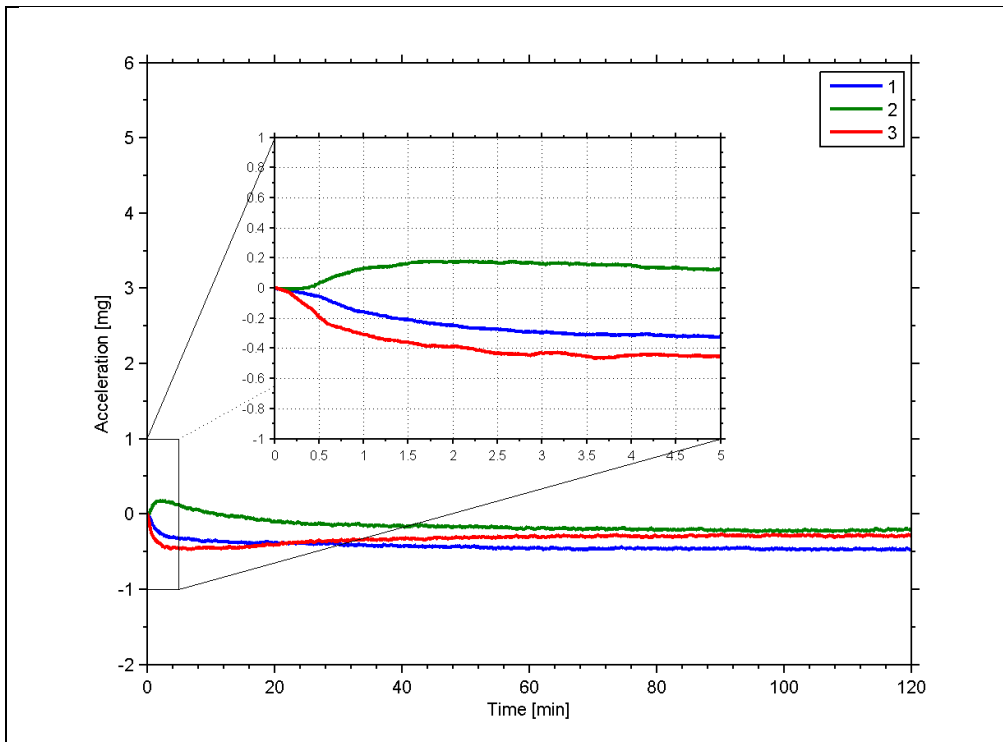


Figure 6-13: Typical normalized initial bias drift of accelerometer (10g accelerometer)

6.1.2.3 Frequency characteristics of accelerometers

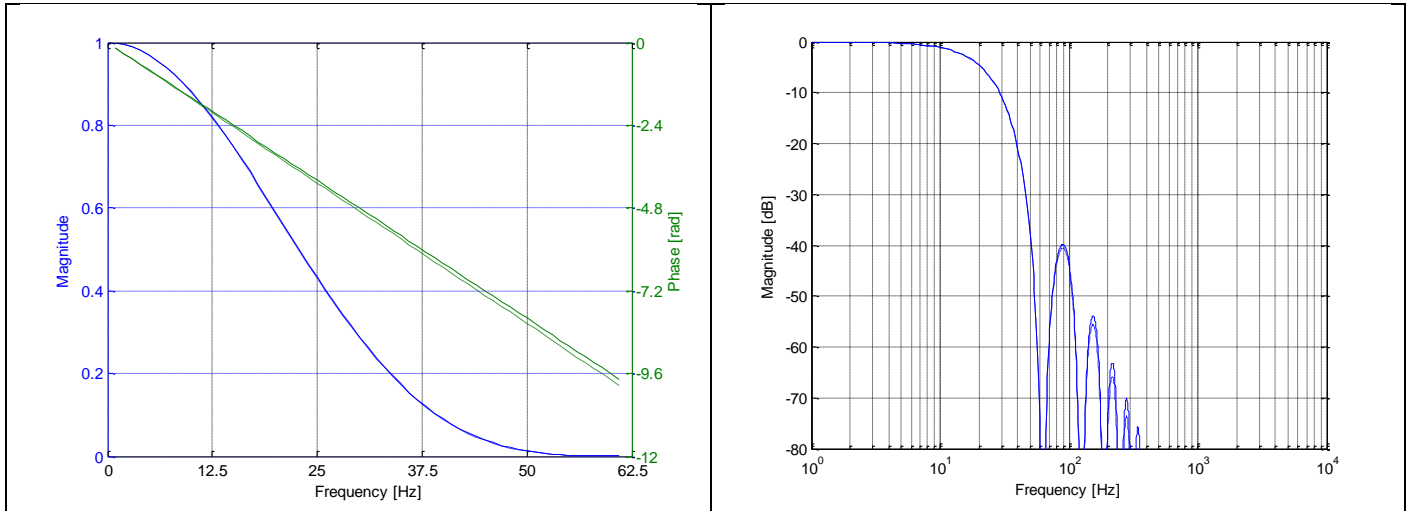


Figure 6-14: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 16Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)

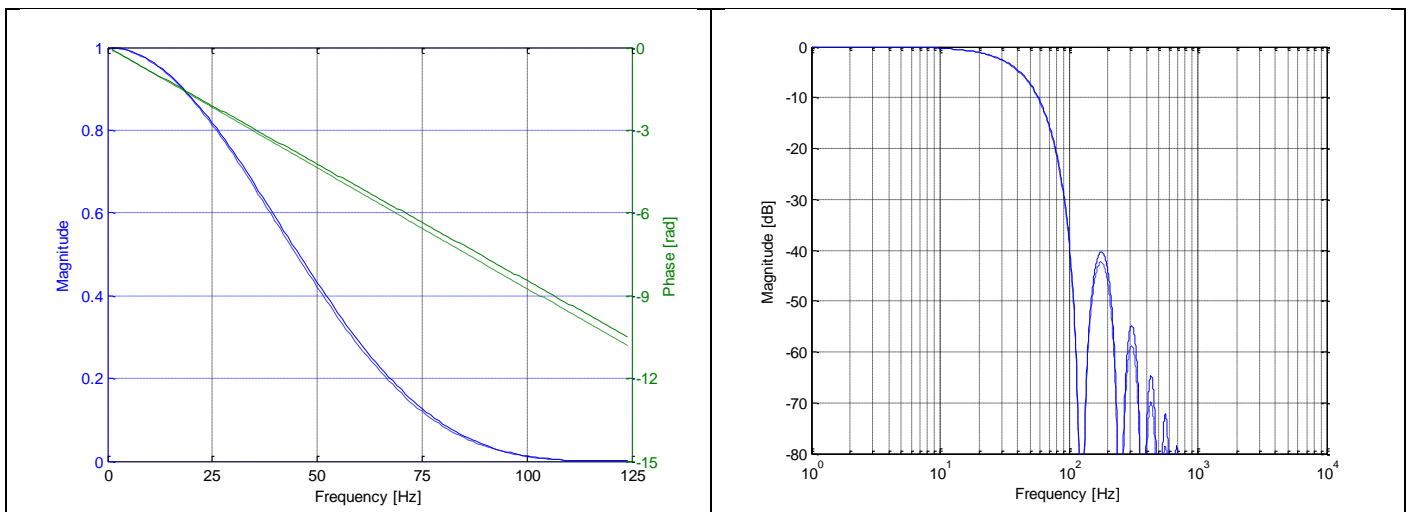


Figure 6-15: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 33Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)

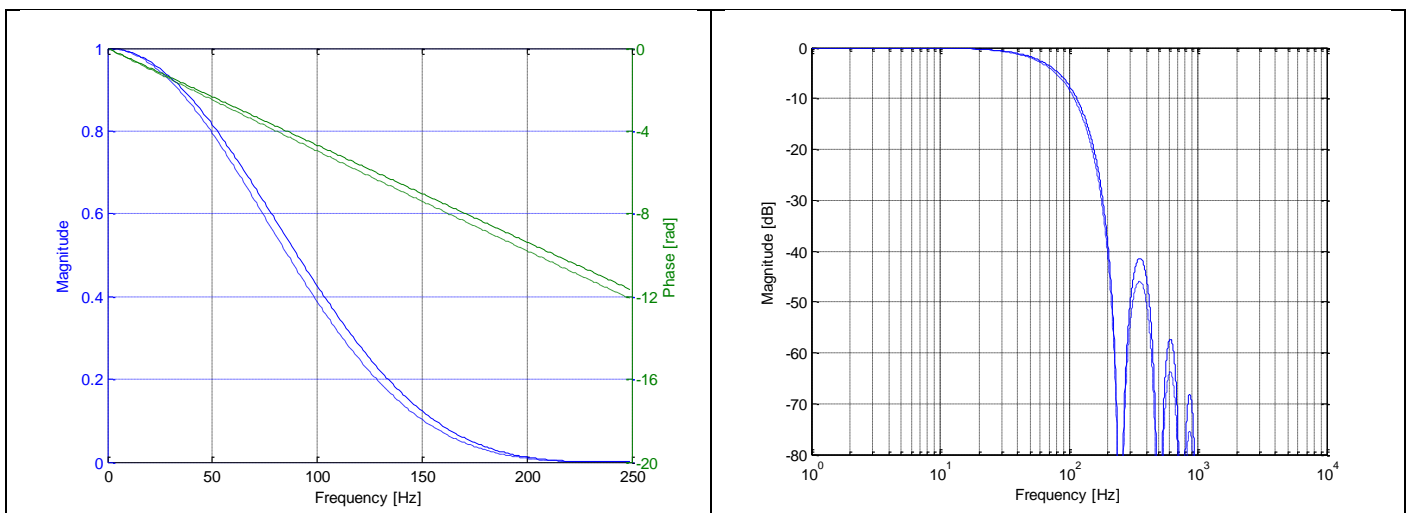


Figure 6-16: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 66Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)

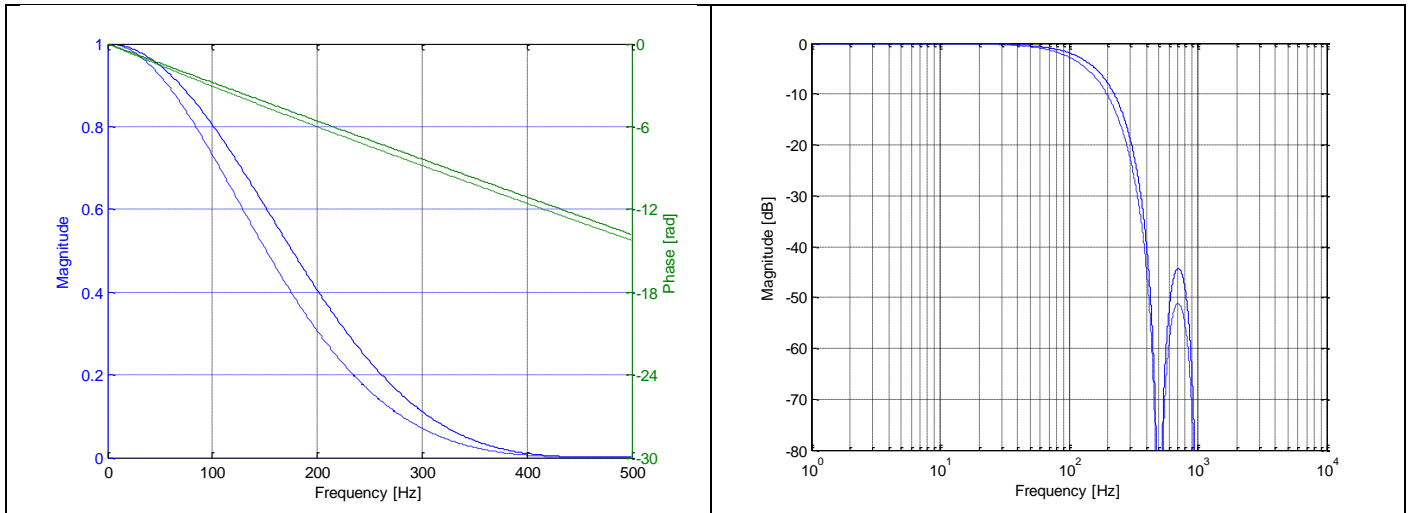


Figure 6-17: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 131Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)

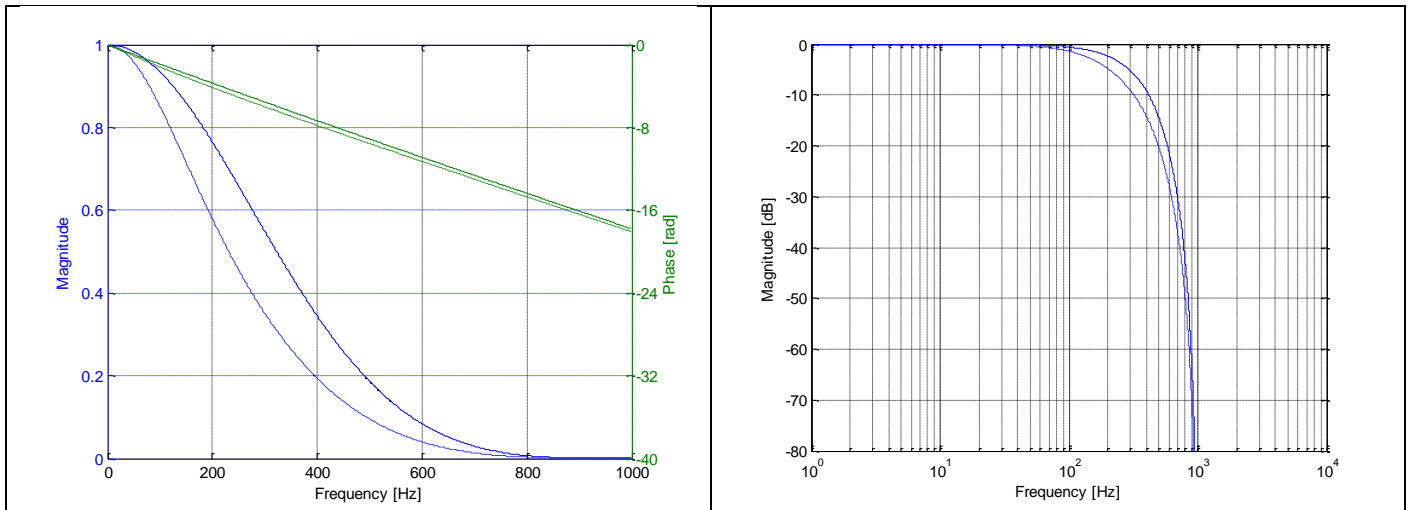


Figure 6-18: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 262Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)

6.1.3 PPS FILTERED CHARACTERISTICS

6.1.3.1 Frequency characteristics of PPS filtered

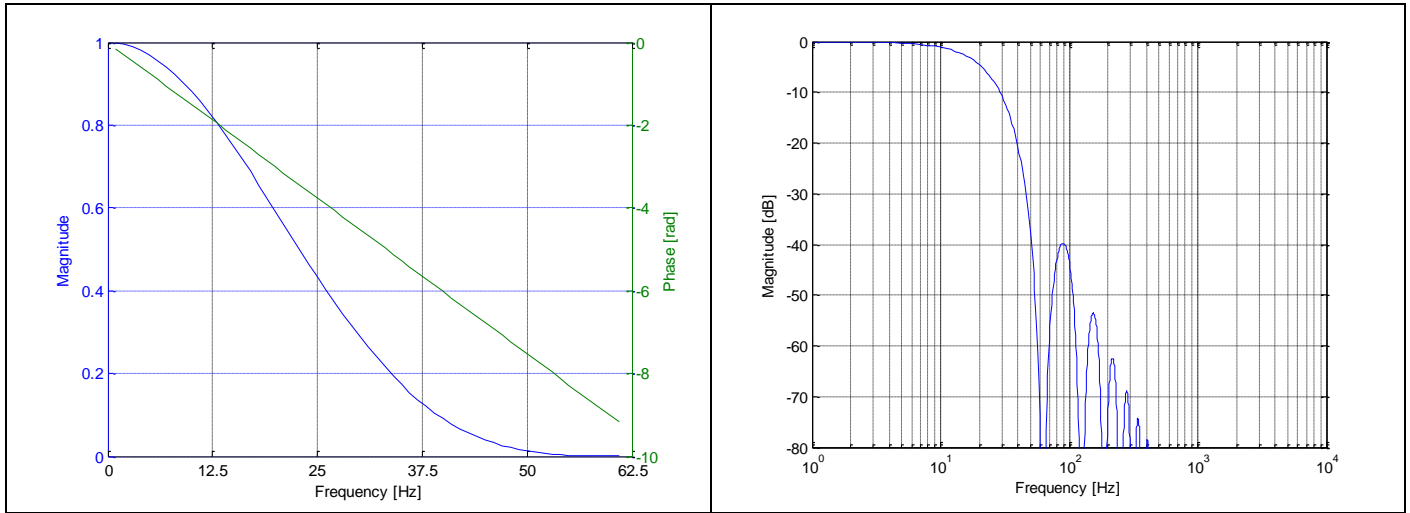


Figure 6-19: Frequency characteristics of PPS filtered with low-pass filter -3dB frequency set to 16Hz

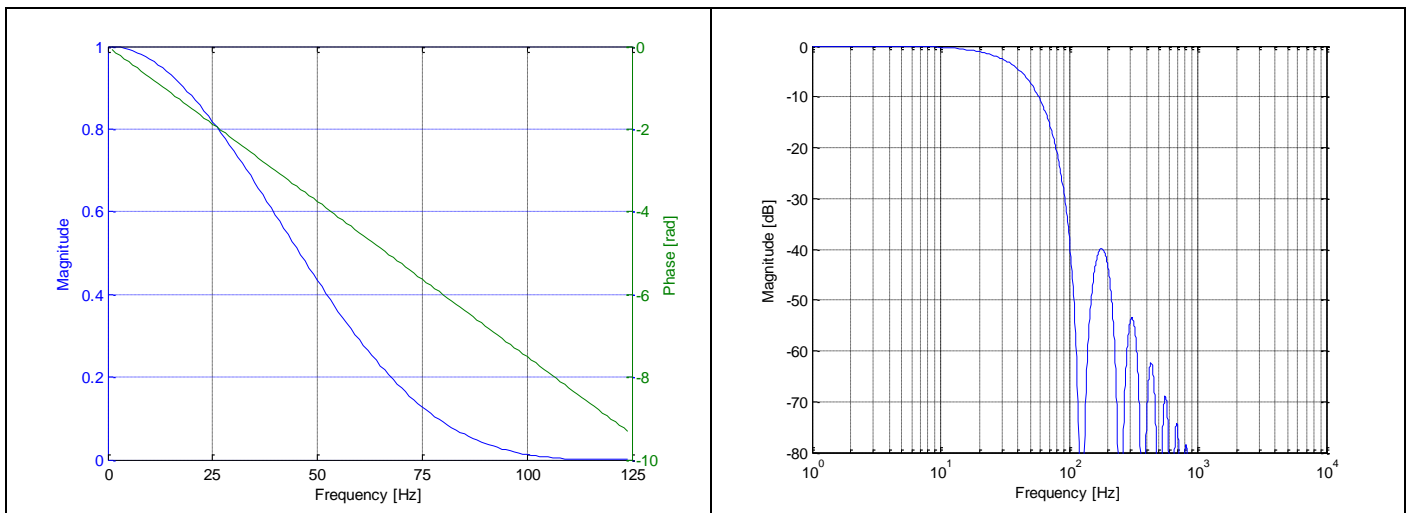


Figure 6-20: Frequency characteristics of PPS filtered with low-pass filter -3dB frequency set to 33Hz

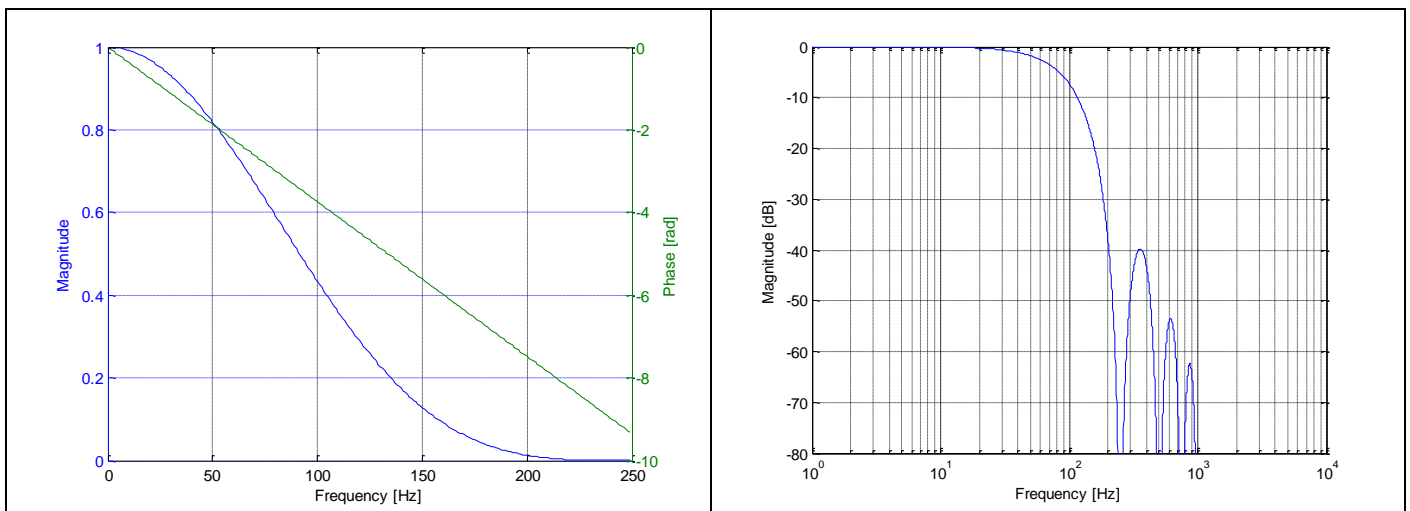


Figure 6-21: Frequency characteristics of PPS filtered with low-pass filter -3dB frequency set to 66Hz

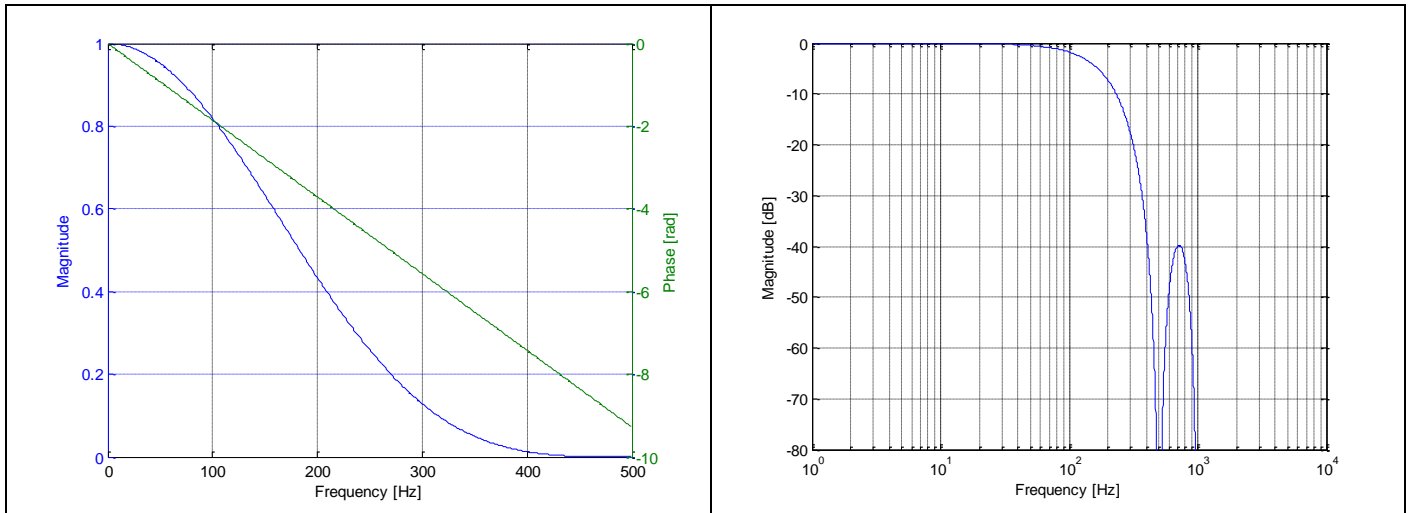


Figure 6-22: Frequency characteristics of PPS filtered with low-pass filter -3dB frequency set to 131Hz

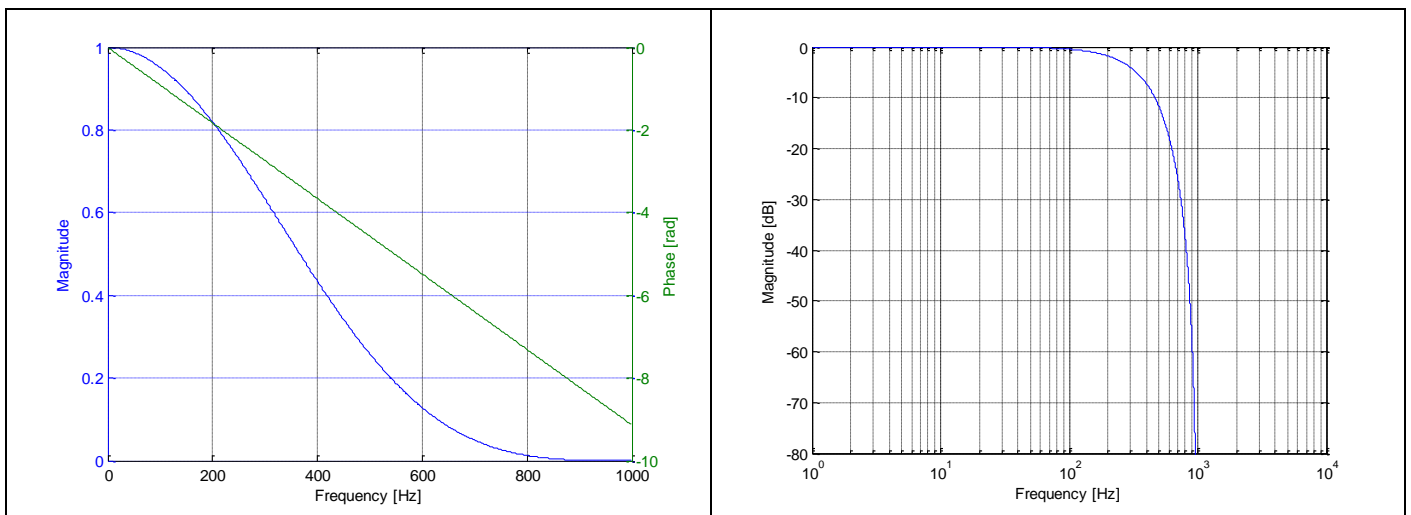


Figure 6-23: Frequency characteristics of PPS filtered with low-pass filter -3dB frequency set to 262Hz

6.2 Configurable parameters
Table 6-7: Configurable parameters

Parameter	Configurations	Comments
SAMPLE RATE	125 samples/s 250 samples/s 500 samples/s 1000 samples/s 2000 samples/s External trigger	Some limitations apply to the use of higher sample rates (>500 samples/s), dependent on selected bit-rate and datagram content, ref. Table 6-8
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 [°]	
MEASUREMENT UNIT ACCELEROMETER	Acceleration [g] Incremental velocity [m/s/sample] Average acceleration [g] Integrated velocity [m/s]	
DATAGRAM	Rate together with any combination of acceleration and temperature	
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) dependent on sample rate and datagram content, ref. Table 6-8. For user-defined bit-rates, see section 10.5
RS422 PARITY	None Odd Even	
RS422 STOP BITS	1 stop bit 2 stop bits	
RS422 120Ω LINE TERMINATION	OFF ON	

Refer to section 13 for information on how to configure STIM320 when ordering and to section 10 for information on how to reconfigure the unit in Service Mode.

Some datagrams are longer than the time between each sample at the lower bit-rate. Table 6-8 shows the maximum sample rates.

Table 6-8: 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

Note 1: excluding <CR><LF> termination

Note 2: 10 bits/byte (=1 start bit, 8 data bits, no parity bit, 1 stop bit)

6.3 Datagram specifications

6.3.1 Part Number datagram

Table 6-9: Specification of the Part Number datagram

Byte#	Bit#								Specification
	7	6	5	4	3	2	1	0	
0	1 1	0 0	1 1	1 1	0 0	0 0	0 1	1 1	Part Number datagram identifier: 0xB1 for datagrams without CR+LF termination 0xB3 for datagrams with CR+LF termination
1	0	0	0	0	P ₁₃	P ₁₂	P ₁₁	P ₁₀	Low nibble: 1.digit of part number High nibble: 2.digit of part number
2	P ₂₃	P ₂₂	P ₂₁	P ₂₀	P ₃₃	P ₃₂	P ₃₁	P ₃₀	Low nibble: 3.digit of part number High nibble: 4.digit of part number
3	P ₄₃	P ₄₂	P ₄₁	P ₄₀	P ₅₃	P ₅₂	P ₅₁	P ₅₀	Low nibble: 5.digit of part number High nibble: 6.digit of part number
4	0	0	1	0	1	1	0	1	ASCII character "-" (0x2D)
5	P ₆₃	P ₆₂	P ₆₁	P ₆₀	P ₇₃	P ₇₂	P ₇₁	P ₇₀	Low nibble: 7.digit of part number High nibble: 8.digit of part number
6	P ₈₃	P ₈₂	P ₈₁	P ₈₀	P ₉₃	P ₉₂	P ₉₁	P ₉₀	Low nibble: 9.digit of part number High nibble: 10.digit of part number
7	P ₁₀₃	P ₁₀₂	P ₁₀₁	P ₁₀₀	P ₁₁₃	P ₁₁₂	P ₁₁₁	P ₁₁₀	Low nibble: 11.digit of part number High nibble: 12.digit of part number
8	0	0	1	0	1	1	0	1	ASCII character "-" (0x2D)
9	P ₁₂₃	P ₁₂₂	P ₁₂₁	P ₁₂₀	P ₁₃₃	P ₁₃₂	P ₁₃₁	P ₁₃₀	Low nibble: 13.digit of part number High nibble: 14.digit of part number
10	P ₁₄₃	P ₁₄₂	P ₁₄₁	P ₁₄₀	x	x	x	x	High nibble: 14.digit of part number
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	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"
16	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 6.3.7
17	C ₂₃	C ₂₂	C ₂₁	C ₂₀	C ₁₉	C ₁₈	C ₁₇	C ₁₆	
18	C ₁₅	C ₁₄	C ₁₃	C ₁₂	C ₁₁	C ₁₀	C ₉	C ₈	
19	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀	
(20)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(21)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

6.3.2 Serial Number datagram

Table 6-10: Specification of the Serial Number datagram

Byte#	Bit#								Specification	
	7	6	5	4	3	2	1	0		
0	1	0	1	1	0	1	0	1	1	Serial Number datagram identifier: 0xB5 for datagrams without CR+LF termination 0xB7 for datagrams with CR+LF termination
1	0	1	0	0	1	1	1	1	0	ASCII-character for letter "N"
2	S ₃	S ₂	S ₁	S ₀	S ₃	S ₂	S ₁	S ₀		High nibble: 1.digit (BCD) of serial number Low nibble: 2.digit (BCD) of serial number
3	S ₃	S ₂	S ₁	S ₀	S ₃	S ₂	S ₁	S ₀		High nibble: 3.digit (BCD) of serial number Low nibble: 4.digit (BCD) of serial number
4	S ₅	S ₂	S ₁	S ₀	S ₆	S ₂	S ₁	S ₀		High nibble: 5.digit (BCD) of serial number Low nibble: 6.digit (BCD) of serial number
5	S ₇	S ₂	S ₁	S ₀	S ₈	S ₂	S ₁	S ₀		High nibble: 7.digit (BCD) of serial number Low nibble: 8.digit (BCD) of serial number
6	S ₉	S ₂	S ₁	S ₀	S ₁₀	S ₂	S ₁	S ₀		High nibble: 9.digit (BCD) of serial number Low nibble: 10.digit (BCD) of serial number
7	S ₁₁	S ₂	S ₁	S ₀	S ₁₁	S ₂	S ₁	S ₀		High nibble: 11.digit (BCD) of serial number Low nibble: 12.digit (BCD) of serial number
8	S ₁₃	S ₂	S ₁	S ₀	S ₁₄	S ₂	S ₁	S ₀		High nibble: 13.digit (BCD) of serial number Low nibble: 14.digit (BCD) of serial number
9	x	x	x	x	x	x	x	x	x	For future use
10	x	x	x	x	x	x	x	x	x	For future use
11	x	x	x	x	x	x	x	x	x	For future use
12	x	x	x	x	x	x	x	x	x	For future use
13	x	x	x	x	x	x	x	x	x	For future use
14	x	x	x	x	x	x	x	x	x	For future use
15	x	x	x	x	x	x	x	x	x	For future use
16	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 6.3.7
17	C ₂₃	C ₂₂	C ₂₁	C ₂₀	C ₁₉	C ₁₈	C ₁₇	C ₁₆		
18	C ₁₅	C ₁₄	C ₁₃	C ₁₂	C ₁₁	C ₁₀	C ₉	C ₈		
19	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		
(20)	0	0	0	0	1	1	0	1		<CR> If datagram termination has been selected
(21)	0	0	0	0	1	0	1	0		<LF> If datagram termination has been selected

6.3.3 Configuration datagram

Table 6-11: Specification of the Configuration datagram

Byte#	Bit#								Specification
	7	6	5	4	3	2	1	0	
0	1 1	1 1	1 1	0 0	1 1	1 1	0 0	0 1	Configuration datagram identifier: 0xEC for datagrams without CR+LF termination 0xED for datagrams with CR+LF termination
1	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”
2	f ₇	f ₆	f ₅	f ₄	f ₃	f ₂	f ₁	f ₀	Firmware revision. Numbering sequence: 0, 1, ..., 255
3	0	0	0	x	x	x	x	x	System configuration, Byte 1: 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	
4	0	0	0	0	x	x	x	x	System configuration, Byte 2: 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 10.5
	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	
5	x	0	x	x	x	x	x	x	System configuration, Byte 3: 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 = 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 = 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 = 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 = AVERAGE ANGULAR RATE – DELAYED	
x	x	x	x	1	0	1	1	Gyro output unit = INTEGRATED ANGLE – DELAYED	
6	x	0	0	0	x	x	x	x	System configuration, Byte 4: 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

7	x	0	0	0	x	x	x	x	System configuration, Byte 5: 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
8	x	0	x	x	x	x	x	x	System configuration, Byte 6: 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 = ACCELERATION
	x	x	x	x	0	0	0	1	Accelerometer output unit = INCREMENTAL VELOCITY
	x	x	x	x	0	0	1	0	Accelerometer output unit = AVERAGE ACCELERATION
	x	x	x	x	0	0	1	1	Accelerometer output unit = INTEGRATED VELOCITY
9	x	0	0	0	x	x	x	x	System configuration, Byte 7: 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	
10	x	0	0	0	x	x	x	x	System configuration, Byte 8: 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
11	x	x	x	x	0	0	0	0	System configuration, Byte 9: PPS output unit = TIME SINCE DETECTION OF 0
	x	x	x	x	0	0	0	1	PPS output unit = 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
12	x	0	0	0	x	x	x	x	System configuration, Byte 10: 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
13	x	x	x	x	x	x	x	System configuration, Byte 11: For future use	
14	x	x	x	x	x	x	x	System configuration, Byte 12: For future use	
15	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
16	0	0	0	0	x	x	x	x	High nibble: Gyro range, z-axis - 400°/s
17	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
18	0	0	0	0	x	x	x	x	High nibble: Accelerometer range, z-axis - 10g
19	x	x	x	x	x	x	x	x	For future use
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	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 6.3.7
23	C ₂₃	C ₂₂	C ₂₁	C ₂₀	C ₁₉	C ₁₈	C ₁₇	C ₁₆	
24	C ₁₅	C ₁₄	C ₁₃	C ₁₂	C ₁₁	C ₁₀	C ₉	C ₈	

25	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀	
(26)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(27)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

6.3.4 Bias Trim Offset datagram

Table 6-12: Specification of the Bias Trim Offset datagram

Byte#	Bit#								Specification
	7	6	5	4	3	2	1	0	
0	1	1	0	1	0	0	0	1	Bias Trim Offset datagram identifier: 0xD1 for datagrams without CR+LF termination 0xD2 for datagrams with CR+LF termination
1	Gx ₂₃	Gx ₂₂	Gx ₂₁	Gx ₂₀	Gx ₁₉	Gx ₁₈	Gx ₁₇	Gx ₁₆	X-axis gyro bias trim offset, ref. section 8.6.2.2.2 for conversion to [°/s]. NB: unit is [°/s] regardless of chosen output unit in Normal Mode datagram
2	Gx ₁₅	Gx ₁₄	Gx ₁₃	Gx ₁₂	Gx ₁₁	Gx ₁₀	Gx ₉	Gx ₈	
3	Gx ₇	Gx ₆	Gx ₅	Gx ₄	Gx ₃	Gx ₂	Gx ₁	Gx ₀	
4	Gy ₂₃	Gy ₂₂	Gy ₂₁	Gy ₂₀	Gy ₁₉	Gy ₁₈	Gy ₁₇	Gy ₁₆	Y-axis gyro bias trim offset, ref. section 8.6.2.2.2 for conversion to [°/s]. NB: unit is [°/s] regardless of chosen output unit in Normal Mode datagram
5	Gy ₁₅	Gy ₁₄	Gy ₁₃	Gy ₁₂	Gy ₁₁	Gy ₁₀	Gy ₉	Gy ₈	
6	Gy ₇	Gy ₆	Gy ₅	Gy ₄	Gy ₃	Gy ₂	Gy ₁	Gy ₀	
7	Gz ₂₃	Gz ₂₂	Gz ₂₁	Gz ₂₀	Gz ₁₉	Gz ₁₈	Gz ₁₇	Gz ₁₆	Z-axis gyro bias trim offset, ref. section 8.6.2.2.2 for conversion to [°/s]. NB: unit is [°/s] regardless of chosen output unit in Normal Mode datagram
8	Gz ₁₅	Gz ₁₄	Gz ₁₃	Gz ₁₂	Gz ₁₁	Gz ₁₀	Gz ₉	Gz ₈	
9	Gz ₇	Gz ₆	Gz ₅	Gz ₄	Gz ₃	Gz ₂	Gz ₁	Gz ₀	
10	Ax ₂₃	Ax ₂₂	Ax ₂₁	Ax ₂₀	Ax ₁₉	Ax ₁₈	Ax ₁₇	Ax ₁₆	X-axis accelerometer bias trim offset, ref. section 8.6.2.2.7 for conversion to [g]. NB: unit is [g] regardless of chosen output unit in Normal Mode datagram
11	Ax ₁₅	Ax ₁₄	Ax ₁₃	Ax ₁₂	Ax ₁₁	Ax ₁₀	Ax ₉	Ax ₈	
12	Ax ₇	Ax ₆	Ax ₅	Ax ₄	Ax ₃	Ax ₂	Ax ₁	Ax ₀	
13	Ay ₂₃	Ay ₂₂	Ay ₂₁	Ay ₂₀	Ay ₁₉	Ay ₁₈	Ay ₁₇	Ay ₁₆	Y-axis accelerometer bias trim offset, ref. section 8.6.2.2.7 for conversion to [g]. NB: unit is [g] regardless of chosen output unit in Normal Mode datagram
14	Ay ₁₅	Ay ₁₄	Ay ₁₃	Ay ₁₂	Ay ₁₁	Ay ₁₀	Ay ₉	Ay ₈	
15	Ay ₇	Ay ₆	Ay ₅	Ay ₄	Ay ₃	Ay ₂	Ay ₁	Ay ₀	
16	Az ₂₃	Az ₂₂	Az ₂₁	Az ₂₀	Az ₁₉	Az ₁₈	Az ₁₇	Az ₁₆	Z-axis accelerometer bias trim offset, ref. section 8.6.2.2.7 for conversion to [g]. NB: unit is [g] regardless of chosen output unit in Normal Mode datagram
17	Az ₁₅	Az ₁₄	Az ₁₃	Az ₁₂	Az ₁₁	Az ₁₀	Az ₉	Az ₈	
18	Az ₇	Az ₆	Az ₅	Az ₄	Az ₃	Az ₂	Az ₁	Az ₀	
19	x	x	x	x	x	x	x	x	
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	Rf ₃₁	Rf ₃₀	Rf ₂₉	Rf ₂₈	Rf ₂₇	Rf ₂₆	Rf ₂₅	Rf ₂₄	Reference info to last adjustment
29	Rf ₂₃	Rf ₂₂	Rf ₂₁	Rf ₂₀	Rf ₁₉	Rf ₁₈	Rf ₁₇	Rf ₁₆	
30	Rf ₁₅	Rf ₁₄	Rf ₁₃	Rf ₁₂	Rf ₁₁	Rf ₁₀	Rf ₉	Rf ₈	
31	Rf ₇	Rf ₆	Rf ₅	Rf ₄	Rf ₃	Rf ₂	Rf ₁	Rf ₀	
32	Sav ₁₅	Sav ₁₄	Sav ₁₃	Sav ₁₂	Sav ₁₁	Sav ₁₀	Sav ₉	Sav ₈	Remaining number of saves
33	Sav ₇	Sav ₆	Sav ₅	Sav ₄	Sav ₃	Sav ₂	Sav ₁	Sav ₀	
34	x	x	x	x	x	x	x	x	For future use
35	x	x	x	x	x	x	x	x	For future use
36	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 6.3.7
37	C ₂₃	C ₂₂	C ₂₁	C ₂₀	C ₁₉	C ₁₈	C ₁₇	C ₁₆	
38	C ₁₅	C ₁₄	C ₁₃	C ₁₂	C ₁₁	C ₁₀	C ₉	C ₈	
39	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀	
(40)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(41)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

6.3.5 Extended Error Information datagram

Table 6-13: Specification of the Extended Error Information datagram

Byte#	Bit#								Specification
	7	6	5	4	3	2	1	0	
0	1 1	0 0	1 1	1 1	1 1	1 1	1 1	0 1	Extended Error Information datagram identifier: 0xBE for datagrams without CR+LF termination 0xBF for datagrams with CR+LF termination
1	E ₁₂₇	E ₁₂₆	E ₁₂₅	E ₁₂₄	E ₁₂₃	E ₁₂₂	E ₁₂₁	E ₁₂₀	Ref. Table 6-14
2	E ₁₁₉	E ₁₁₈	E ₁₁₇	E ₁₁₆	E ₁₁₅	E ₁₁₄	E ₁₁₃	E ₁₁₂	Ref. Table 6-14
3	E ₁₁₁	E ₁₁₀	E ₁₀₉	E ₁₀₈	E ₁₀₇	E ₁₀₆	E ₁₀₅	E ₁₀₄	Ref. Table 6-14
4	E ₁₀₃	E ₁₀₂	E ₁₀₁	E ₁₀₀	E ₉₉	E ₉₈	E ₉₇	E ₉₆	Ref. Table 6-14
5	E ₉₅	E ₉₄	E ₉₃	E ₉₂	E ₉₁	E ₉₀	E ₈₉	E ₈₈	Ref. Table 6-14
6	E ₈₇	E ₈₆	E ₈₅	E ₈₄	E ₈₃	E ₈₂	E ₈₁	E ₈₀	Ref. Table 6-14
7	E ₇₉	E ₇₈	E ₇₇	E ₇₆	E ₇₅	E ₇₄	E ₇₃	E ₇₂	Ref. Table 6-14
8	E ₇₁	E ₇₀	E ₆₉	E ₆₈	E ₆₇	E ₆₆	E ₆₅	E ₆₄	Ref. Table 6-14
9	E ₆₃	E ₆₂	E ₆₁	E ₆₀	E ₅₉	E ₅₈	E ₅₇	E ₅₆	Ref. Table 6-14
10	E ₅₅	E ₅₄	E ₅₃	E ₅₂	E ₅₁	E ₅₀	E ₄₉	E ₄₈	Ref. Table 6-14
11	E ₄₇	E ₄₆	E ₄₅	E ₄₄	E ₄₃	E ₄₂	E ₄₁	E ₄₀	Ref. Table 6-14
12	E ₃₉	E ₃₈	E ₃₇	E ₃₆	E ₃₅	E ₃₄	E ₃₃	E ₃₂	Ref. Table 6-14
13	E ₃₁	E ₃₀	E ₂₉	E ₂₈	E ₂₇	E ₂₆	E ₂₅	E ₂₄	Ref. Table 6-14
14	E ₂₃	E ₂₂	E ₂₁	E ₂₀	E ₁₉	E ₁₈	E ₁₇	E ₁₆	Ref. Table 6-14
15	E ₁₅	E ₁₄	E ₁₃	E ₁₂	E ₁₁	E ₁₀	E ₉	E ₈	Ref. Table 6-14
16	E ₇	E ₆	E ₅	E ₄	E ₃	E ₂	E ₁	E ₀	Ref. Table 6-14
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 6.3.7
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 6-14: Specification of the Extended Error Information

Bit#	Specification	Bit#	Specification	Bit#	Specification	Bit#	Specification
E ₁₂₇	For future use (=0)	E ₁₂₆	For future use (=0)	E ₁₂₅	For future use (=0)	E ₁₂₄	For future use (=0)
E ₁₂₃	For future use (=0)	E ₁₂₂	For future use (=0)	E ₁₂₁	For future use (=0)	E ₁₂₀	For future use (=0)
E ₁₁₉	For future use (=0)	E ₁₁₈	For future use (=0)	E ₁₁₇	For future use (=0)	E ₁₁₆	For future use (=0)
E ₁₁₅	For future use (=0)	E ₁₁₄	For future use (=0)	E ₁₁₃	For future use (=0)	E ₁₁₂	PPS time overflow
E ₁₁₁	Reference voltage#4 error	E ₁₁₀	For future use (=0)	E ₁₀₉	For future use (=0)	E ₁₀₈	For future use (=0)
E ₁₀₇	For future use (=0)	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 (=0)	E ₉₂	For future use (=0)
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 (=0)
E ₈₃	For future use (=0)	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 (=0)
E ₇₅	For future use (=0)	E ₇₄	For future use (=0)	E ₇₃	For future use (=0)	E ₇₂	ACC Z: ADC error
E ₇₁	ACC Y: ADC error	E ₇₀	ACC X: ADC error	E ₆₉	For future use (=0)	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 (=0)	E ₅₄	For future use (=0)	E ₅₃	For future use (=0)	E ₅₂	For future use (=0)
E ₅₁	For future use (=0)	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	For future use (=0)	E ₄₀	For future use (=0)
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	For future use (=0)	E ₃₃	For future use (=0)	E ₃₂	GYRO Z: 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	For future use (=0)	E ₂₆	For future use (=0)	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

6.3.6 Normal Mode datagram

Table 6-15: 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 6-16	
1	Gx ₂₃	Gx ₂₂	Gx ₂₁	Gx ₂₀	Gx ₁₉	Gx ₁₈	Gx ₁₇	Gx ₁₆	X-axis gyro output, ref. sections 8.6.2.2.2 to 8.6.2.2.5 for conversion to units	
2	Gx ₁₅	Gx ₁₄	Gx ₁₃	Gx ₁₂	G ₁₁	Gx ₁₀	Gx ₉	Gx ₈		
3	Gx ₇	Gx ₆	Gx ₅	Gx ₄	Gx ₃	Gx ₂	Gx ₁	Gx ₀		
4	Gy ₂₃	Gy ₂₂	Gy ₂₁	Gy ₂₀	Gy ₁₉	Gy ₁₈	Gy ₁₇	Gy ₁₆		
5	Gy ₁₅	Gy ₁₄	Gy ₁₃	Gy ₁₂	Gy ₁₁	Gy ₁₀	Gy ₉	Gy ₈	Y-axis gyro output, ref. sections 8.6.2.2.2 to 8.6.2.2.5 for conversion to units	
6	Gy ₇	Gy ₆	Gy ₅	Gy ₄	Gy ₃	Gy ₂	Gy ₁	Gy ₀		
7	Gz ₂₃	Gz ₂₂	Gz ₂₁	Gz ₂₀	Gz ₁₉	Gz ₁₈	Gz ₁₇	Gz ₁₆		
8	Gz ₁₅	Gz ₁₄	Gz ₁₃	Gz ₁₂	Gz ₁₁	Gz ₁₀	Gz ₉	Gz ₈		
9	Gz ₇	Gz ₆	Gz ₅	Gz ₄	Gz ₃	Gz ₂	Gz ₁	Gz ₀	Z-axis gyro output, ref. sections 8.6.2.2.2 to 8.6.2.2.5 for conversion to units	
10	Gs ₇	Gs ₆	Gs ₅	Gs ₄	Gs ₃	Gs ₂	Gs ₁	Gs ₀		
11	Ax ₂₃	Ax ₂₂	Ax ₂₁	Ax ₂₀	Ax ₁₉	Ax ₁₈	Ax ₁₇	Ax ₁₆		X-axis accelerometer output, ref. sections 8.6.2.2.7 to 8.6.2.2.10 for conversion to units
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		
15	Ay ₁₅	Ay ₁₄	Ay ₁₃	Ay ₁₂	Ay ₁₁	Ay ₁₀	Ay ₉	Ay ₈	Y-axis accelerometer output, ref. sections 8.6.2.2.7 to 8.6.2.2.10 for conversion to units	
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		
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	Z-axis accelerometer output, ref. sections 8.6.2.2.7 to 8.6.2.2.10 for conversion to units	
20	As ₇	As ₆	As ₅	As ₄	As ₃	As ₂	As ₁	As ₀		
21	GTX ₁₅	GTX ₁₄	GTX ₁₃	GTX ₁₂	GTX ₁₁	GTX ₁₀	GTX ₉	GTX ₈		X-axis gyro temperature data, ref. section 8.6.2.2.13 for conversion to units
22	GTX ₇	GTX ₆	GTX ₅	GTX ₄	GTX ₃	GTX ₂	GTX ₁	GTX ₀		
23	Gty ₁₅	Gty ₁₄	Gty ₁₃	Gty ₁₂	Gty ₁₁	Gty ₁₀	Gty ₉	Gty ₈		
24	Gty ₇	Gty ₆	Gty ₅	Gty ₄	Gty ₃	Gty ₂	Gty ₁	Gty ₀		
25	GTZ ₁₅	GTZ ₁₄	GTZ ₁₃	GTZ ₁₂	GTZ ₁₁	GTZ ₁₀	GTZ ₉	GTZ ₈	Z-axis gyro temperature data, ref. section 8.6.2.2.13 for conversion to units	
26	GTZ ₇	GTZ ₆	GTZ ₅	GTZ ₄	GTZ ₃	GTZ ₂	GTZ ₁	GTZ ₀		
27	GTS ₇	GTS ₆	GTS ₅	GTS ₄	GTS ₃	GTS ₂	GTS ₁	GTS ₀		
28	Atx ₁₅	Atx ₁₄	Atx ₁₃	Atx ₁₂	Atx ₁₁	Atx ₁₀	Atx ₉	Atx ₈		
29	Atx ₇	Atx ₆	Atx ₅	Atx ₄	Atx ₃	Atx ₂	Atx ₁	Atx ₀	X-axis accelerometer temperature data, ref. section 8.6.2.2.13 for conversion to units	
30	Aty ₁₅	Aty ₁₄	Aty ₁₃	Aty ₁₂	Aty ₁₁	Aty ₁₀	Aty ₉	Aty ₈		
31	Aty ₇	Aty ₆	Aty ₅	Aty ₄	Aty ₃	Aty ₂	Aty ₁	Aty ₀		
32	Atz ₁₅	Atz ₁₄	Atz ₁₃	Atz ₁₂	Atz ₁₁	Atz ₁₀	Atz ₉	Atz ₈		
33	Atz ₇	Atz ₆	Atz ₅	Atz ₄	Atz ₃	Atz ₂	Atz ₁	Atz ₀	Z-axis accelerometer temperature data, ref. section 8.6.2.2.13 for conversion to units	
34	Ats ₇	Ats ₆	Ats ₅	Ats ₄	Ats ₃	Ats ₂	Ats ₁	Ats ₀		
35	P ₂₃	P ₂₂	P ₂₁	P ₂₀	P ₁₉	P ₁₈	P ₁₇	P ₁₆		STATUS byte for accelerometer temperature measurements, ref. Table 6-18
36	P ₁₅	P ₁₄	P ₁₃	P ₁₂	P ₁₁	P ₁₀	P ₉	P ₈		
37	P ₇	P ₆	P ₅	P ₄	P ₃	P ₂	P ₁	P ₀		
38	Ps ₇	Ps ₆	Ps ₅	Ps ₄	Ps ₃	Ps ₂	Ps ₁	Ps ₀		
39	n ₁₅	n ₁₄	n ₁₃	n ₁₂	n ₁₁	n ₁₀	n ₉	n ₈	Counter, ref. section 8.6.2.2.14.	
40	n ₇	n ₆	n ₅	n ₄	n ₃	n ₂	n ₁	n ₀	Note that transmission of high-byte is dependent on chosen datagram	
41	t ₁₅	t ₁₄	t ₁₃	t ₁₂	t ₁₁	t ₁₀	t ₉	t ₈	Latency, ref. section 8.6.2.2.15 for conversion to units.	
42	t ₇	t ₆	t ₅	t ₄	t ₃	t ₂	t ₁	t ₀		
43	C ₃₁	C ₃₀	C ₂₉	C ₂₈	C ₂₇	C ₂₆	C ₂₅	C ₂₄		
44	C ₂₃	C ₂₂	C ₂₁	C ₂₀	C ₁₉	C ₁₈	C ₁₇	C ₁₆		
45	C ₁₅	C ₁₄	C ₁₃	C ₁₂	C ₁₁	C ₁₀	C ₉	C ₈	Cyclic Redundancy Check is performed on all preceding bytes, ref. section 6.3.7	
46	C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	C ₀		
(47)	0	0	0	0	1	1	0	1		
(48)	0	0	0	0	1	0	1	0		

Normal Mode datagrams with reduced content can be chosen at order or configured in Service Mode. Overview of available datagrams can be found in Table 6-16 and in section 13. 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 6-15. When selecting temperature in the datagram, only temperatures for the selected measurement-clusters will be transmitted, e.g. if gyro data only has been chosen together with temperature, only temperatures for the gyros will be transmitted.

Table 6-16: 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

6.3.7 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 STIM320. The CRC is calculated using the following equation:

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

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 STIM320 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 chosen. 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 6-17 lists the number of dummy-bytes needed to calculate the final CRC-checksum for the different datagrams in Normal Mode.

Table 6-17: Number of dummy-bytes to be added for CRC-calculation

Datagram content	Counter	Identifier	# dummy-bytes
Part Number datagram	-	0xB1, 0xB3	0
Serial Number datagram	-	0xB5, 0xB7	0
Configuration datagram	-	0xEC, 0xED	2
Extended Error Information datagram	-	0xBE, 0xBF	3
Bias Trim offset datagram	-	0xD1, 0xD2	0
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

6.4 Status byte

Table 6-18: 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 8.7 for more information related to the self-diagnostics of STIM320.

7 MECHANICAL

Table 7-1: 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		57			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

7.1 Mechanical dimensions

All dimensions are in mm.

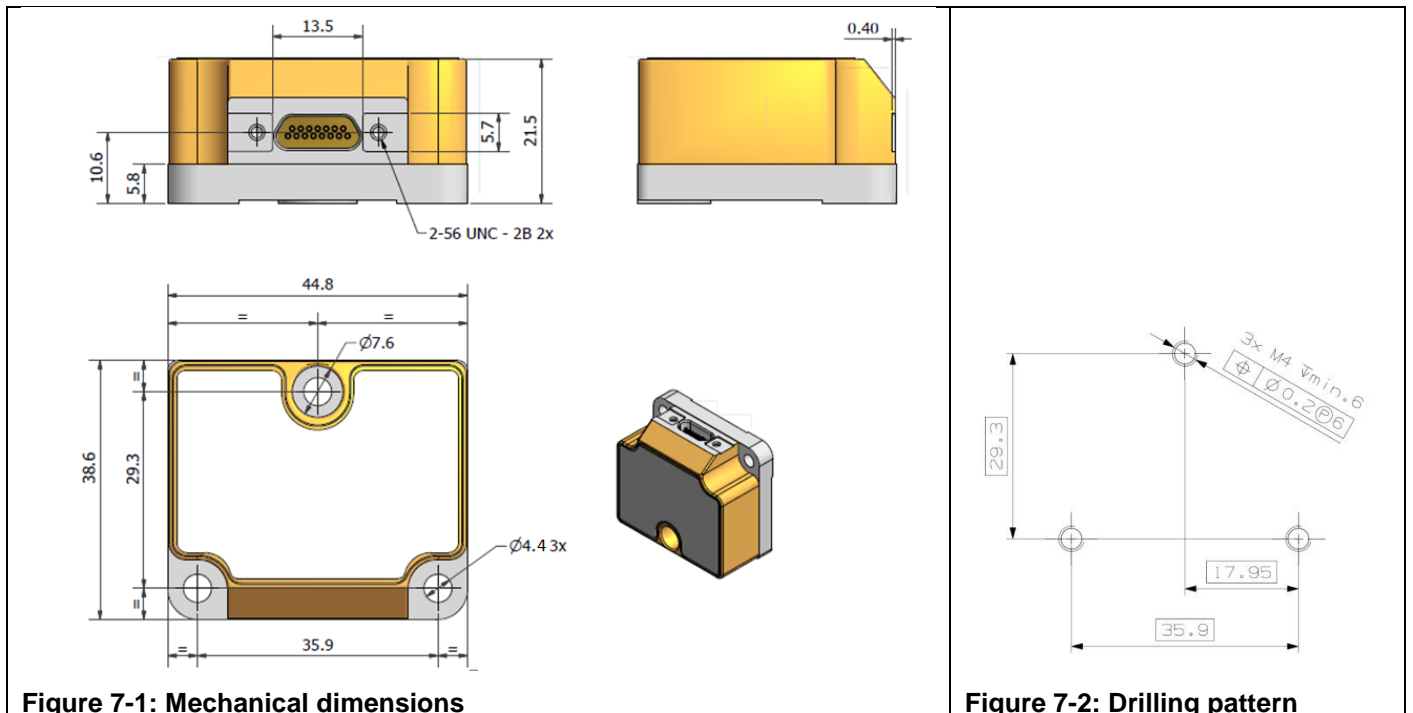


Figure 7-1: Mechanical dimensions

Figure 7-2: Drilling pattern

Table 7-2: Nominal position of accelerometer mass-centers (ref. Figure 6-2 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

7.2 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

7.3 Pin configuration

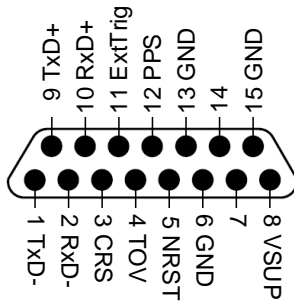


Figure 7-3: Pin configuration as seen from front of STIM320

Table 7-3: 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)

7.4 Definition of axes

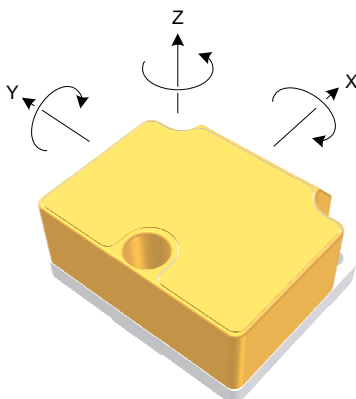


Figure 7-4: Definition of axes

8 BASIC OPERATION

STIM320 is very simple to use. Unless having been configured with external trigger, the unit will start performing measurements and transmit the results over the RS422 interface without any need for additional signalling or set-up after power-on. Figure 8-1 shows the simplest connection set-up for STIM320.

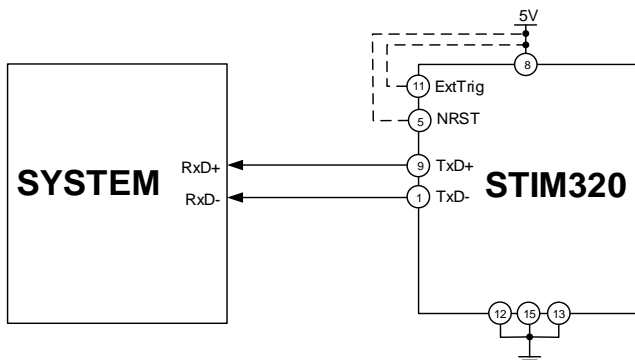


Figure 8-1: Transmit-Only Electrical Connection Diagram

In order to take full advantage of all features of STIM320, the unit needs to be connected as shown in Figure 8-2. 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.

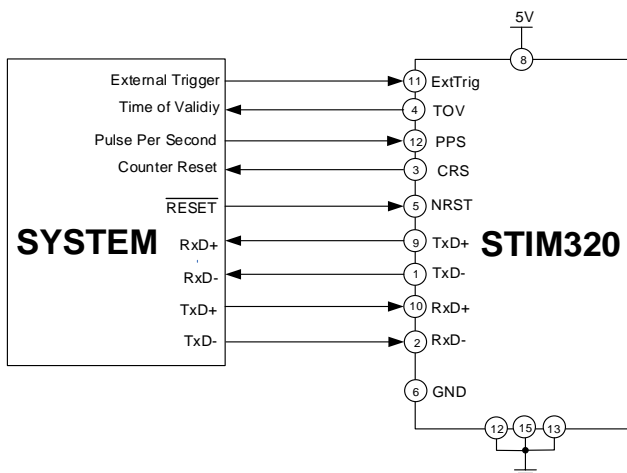


Figure 8-2: Full Function Electrical Connection Diagram

8.1 Reset

STIM320 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 STIM320 into Init Mode (ref. Figure 8-8 and section 8.6.1).

8.2 External Trigger

STIM320 has a separate digital input pin to be used when the unit has been configured to transmit only upon external trigger. The measurements themselves will be continuously running at the highest sample rate (2000 samples/s) in order to ensure shortest possible latency when a transmission is requested. The input is set to trigger on the falling edge of the input signal and will then transmit one datagram containing the result of the latest measurement.

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 9, 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 STIM320 is in Init Mode (after Power on or Reset), it will transmit the special datagrams as described in section 8.6.1 regardless of external trigger input.

The timing diagram is shown in Figure 8-3. Latency is the time between the moment at which the sample has been digitized + low pass-filtered and the receipt of the external trigger.

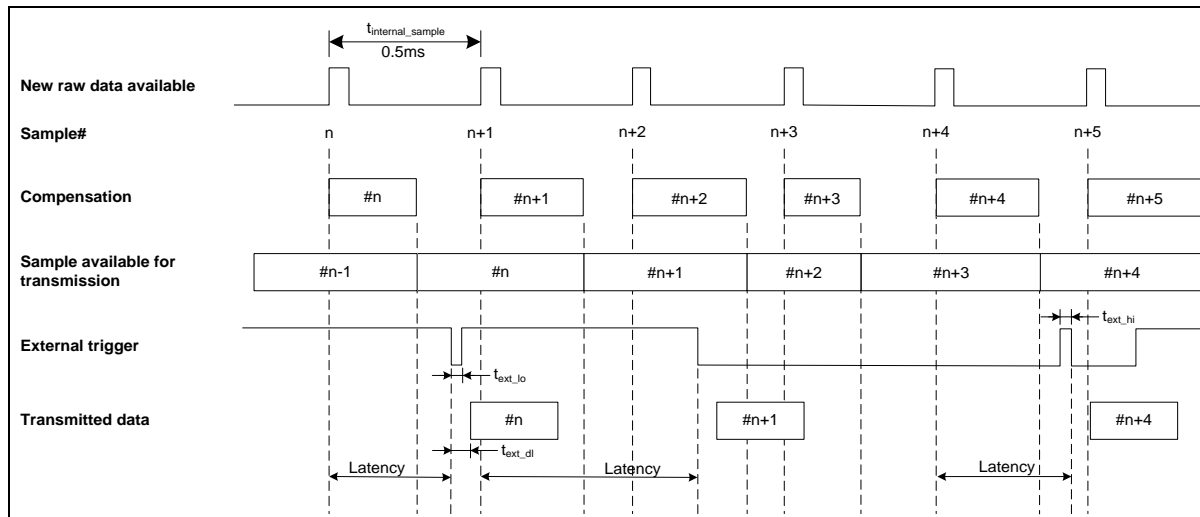


Figure 8-3: Timing of external trigger

8.3 Time of Validity (TOV)

The TOV-output serves 2 purposes:

- Provide a synchronization-signal derived from the internal clock of STIM320
- 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 8-4 and Figure 8-5 show the timing diagram of the TOV-output.

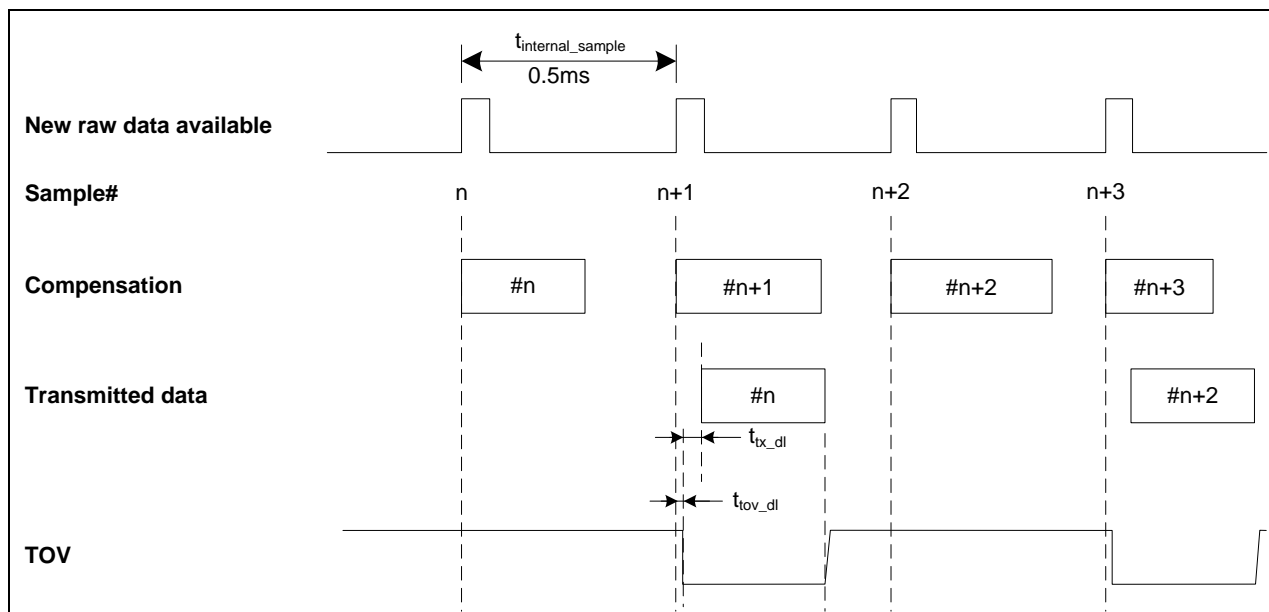


Figure 8-4: Timing of TOV (example: sample rate = 1000samples/s)

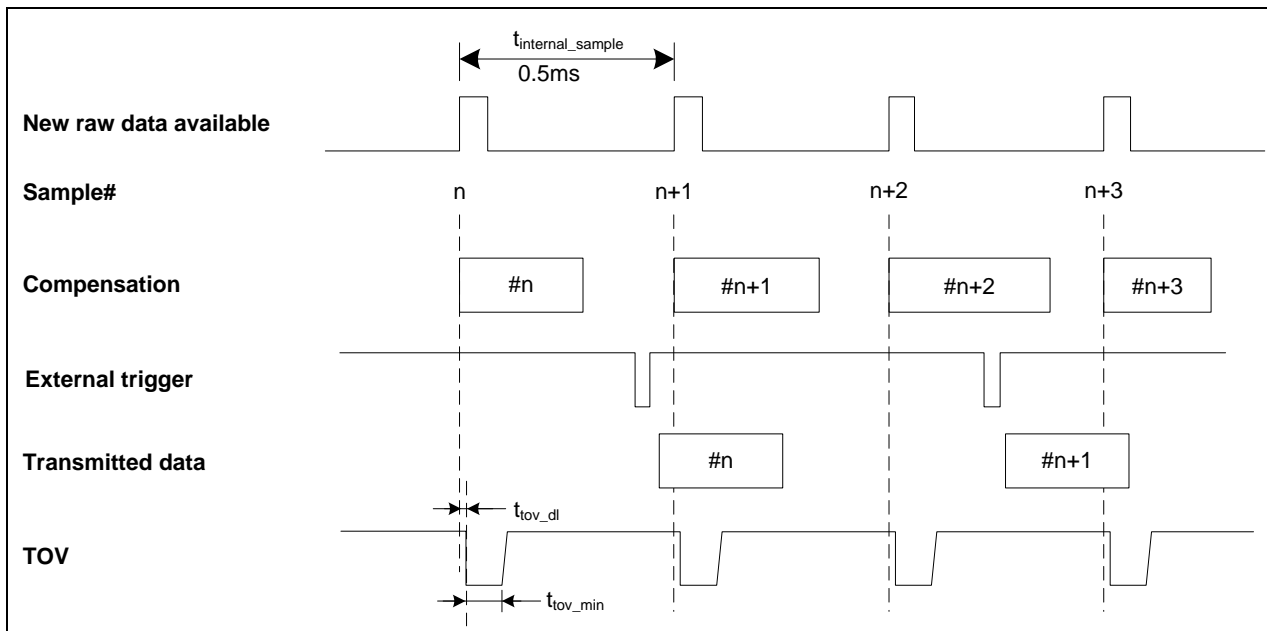


Figure 8-5: Timing of TOV with external trigger

8.4 PPS

The STIM320 provides functionality to detect a transition of or sample a PPS signal. The PPS part of the Normal Mode datagram (ref. section 6.3.6) can be activated by choosing a datagram containing PPS data (ref. sections 10.4, 11.4.5 and 13).

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

8.4.1 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 10.4, 11.4.5 and 13), the STIM320 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 8-6 for definition of “Time since detection”.

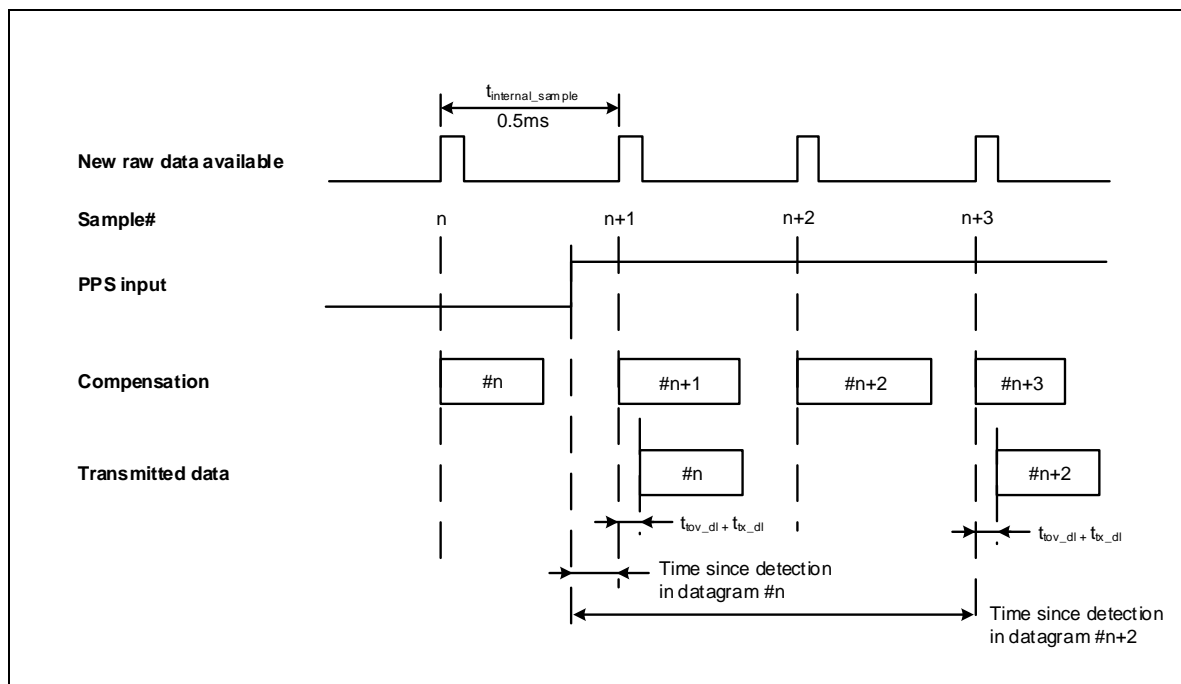


Figure 8-6: PPS sampling when output unit “Time since detection of 1”

If the time since detection becomes longer than what can be transmitted ($2^{23}-1\mu\text{s}$ 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 6.3.6 and 6.4.

The conversion of PPS data to $[\mu\text{s}]$ can be found in section 8.6.2.2.11.

8.4.2 Filtered PPS

If the output unit of PPS has been set to “Filtered PPS” (ref. sections 10.4 and 13), 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 10.8.

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 8.6.2.2.1.

The conversion of PPS data to [0, 1] can be found in section 8.6.2.2.12.

8.5 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 10.15 and 11.4.10.

Depending on the datagram chosen (ref. sections 10.4 and 13), 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 chosen, the counter will naturally wrap at $n \times 256$ (n is a positive integer) and then restart when the 16 bits counter reaches the defined interval.

The CRS outputs a pulse every time the counter restarts from 0. A timing diagram is shown in Figure 8-7:

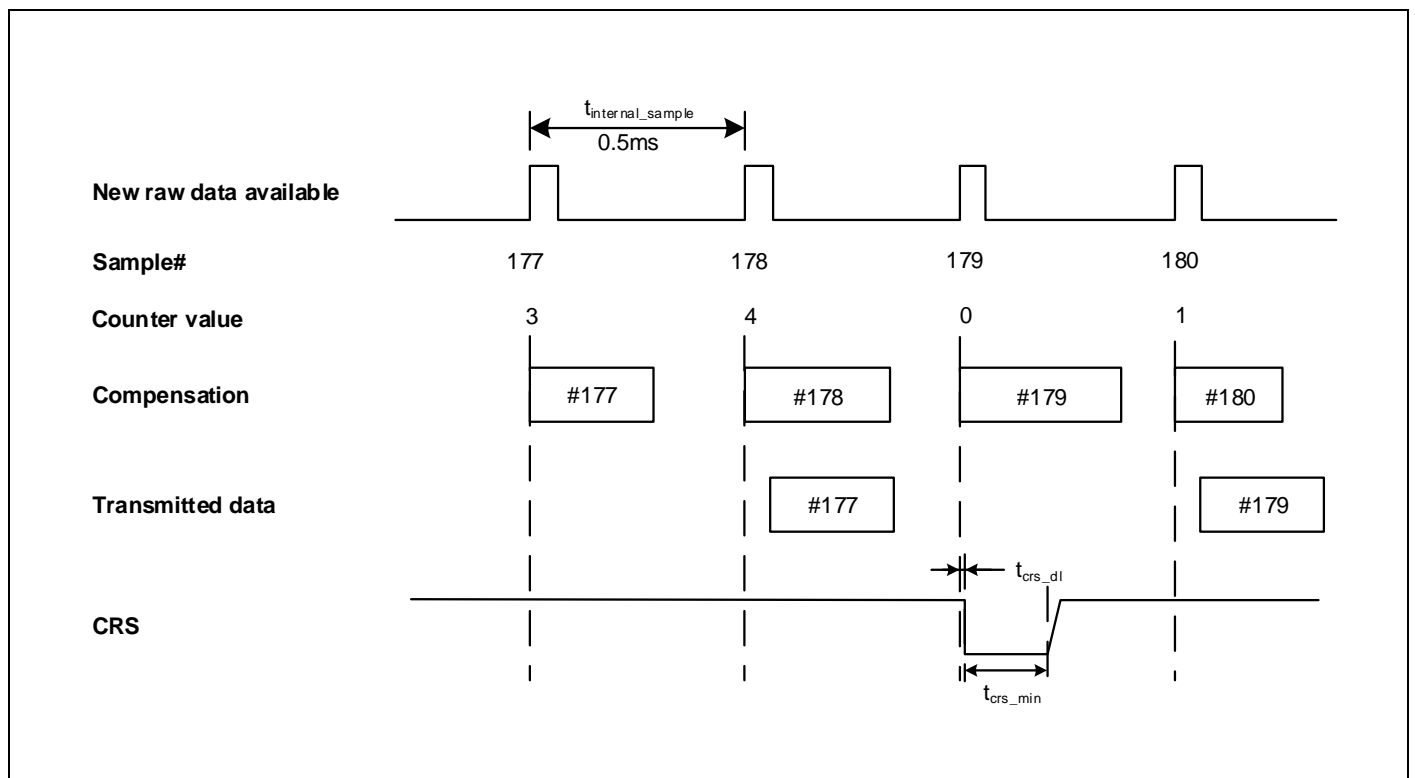


Figure 8-7: Timing of CRS (example: sample rate = 1000 samples/s, counter interval = 5)

8.6 Operating modes

The operating modes of STIM320 are shown in Figure 8-8:

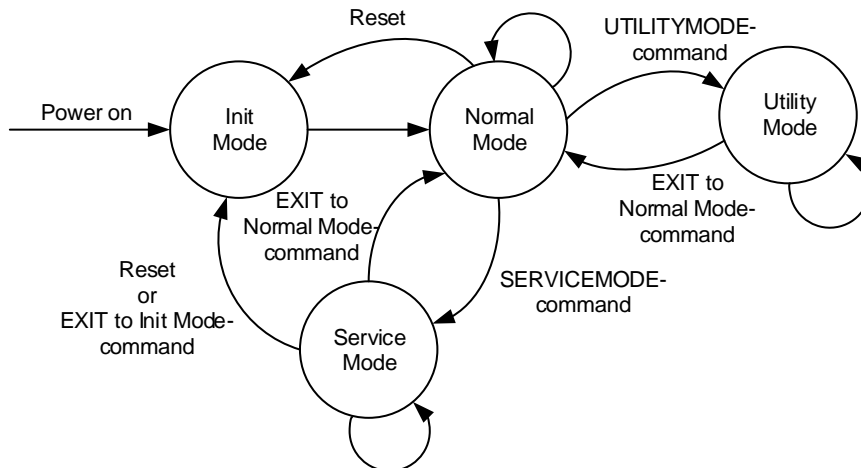


Figure 8-8: Operating modes

8.6.1 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 6-9.

The content and format of the Serial Number datagram is specified in Table 6-10.

The content and format of the Configuration datagram is specified in Table 6-11.

The content and format of the Bias Trim Offset datagram is specified in Table 6-12.

After having transmitted the special Part Number, Serial Number, Configuration and Bias Trim Offset datagrams, STIM320 enters Normal Mode.

All these special datagrams can also be requested by commands in Normal Mode, ref. section: 9.

8.6.2 Normal Mode

In Normal Mode STIM320 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.

STIM320 will continue to transmit data regardless of any errors reported in the STATUS-bytes (ref. Table 6-18). Hence the content of the STATUS-byte should continuously be examined.

The content of the Normal Mode datagram is specified in Table 6-15.

8.6.2.1 Start-Up

When STIM320 enters Normal Mode from Init Mode, there will be a start-up period where STIM320 is stabilizing the gyros. During this period bit 6 is set in the STATUS-byte (ref. Table 6-18) 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 STIM320 is exiting from Service Mode directly to Normal Mode.

8.6.2.2 Data output options and interpretation

The gyros in STIM320 measure angular rate [°/s] and the accelerometers measure acceleration [g]. However, in order to make the STIM320 more versatile, a few simple functions are offered, ref. Table 8-1 and Table 8-2:

Table 8-1: 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	$Incremental = \sum_{i=1}^n AngularRate_i \cdot \frac{1}{2000} s$ $n = 2000 / \text{sample rate}$	[°]
Average	Calculates the average of the internal samples between two transmissions	$Average = \frac{1}{n} \cdot \sum_{i=1}^n AngularRate_i$ $n = 2000 / \text{sample rate}$	[° / 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	$Integrated = \sum_{i=1}^n AngularRate_i \cdot \frac{1}{2000} s$ $n = \text{internal samples (at a rate of 2000 samples/s) since start-up or last reset}$	[°]

Table 8-2: 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]	$Incremental = k_0 \cdot \sum_{i=1}^n Acceleration_i \cdot \frac{1}{2000} s$ $k_0 = 9.80665 \text{ m/s}^2/\text{g}$ $n = 2000 / \text{sample rate}$	[m/s]
Average	Calculates the average of the internal samples between two transmissions	$Average = \frac{1}{n} \cdot \sum_{i=1}^n Acceleration_i$ $n = 2000 / \text{sample rate}$	[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 8.6.2.2.10 and will naturally wrap-around with no error-message indication in the Status-byte	$Integrated = k_0 \cdot \sum_{i=1}^n Acceleration_i \cdot \frac{1}{2000} s$ $k_0 = 9.80665 \text{ m/s}^2/\text{g}$ $n = \text{internal samples (at a rate of 2000 samples/s) since start-up or last reset}$	[m/s]

8.6.2.2.1 Delayed gyro output

The inherent group delay of the gyro-, accelerometer and PPS-signals are different, ref. Table 6-3 and Table 6-4 for gyro and accelerometers respectively.

As the group delay for the accelerometers is the longest, options are available to delay the gyro signals 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 10.7 and 13.

8.6.2.2.2 Gyro output unit = Angular Rate

In the case of STIM320 being configured to output angular rate, the equations for conversion to [°/s] can be found in Equation 1 and Figure 8-9. Note that the output data is represented as two's complement.

Equation 1: Converting output to [°/s]:

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

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

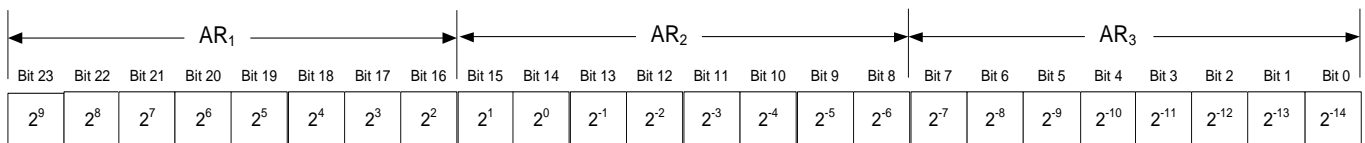


Figure 8-9: Converting output bytes to [°/s]

8.6.2.2.3 Gyro output unit = Incremental Angle

In the case of STIM320 being configured to output incremental angle per sample, the equations for conversion to [°/sample] can be found in Equation 2 and Figure 8-10. Note that the output data is represented as two's complement.

Equation 2: Converting output to [°/sample]

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

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

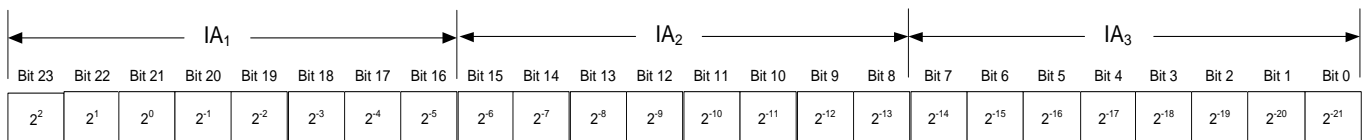


Figure 8-10: Converting output bytes to [°/sample]

8.6.2.2.4 Gyro output unit = Average Angular Rate

In the case of STIM320 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 1.

8.6.2.2.5 Gyro output unit = Integrated Angle

In the case of STIM320 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 2.

8.6.2.2.6 Gyro g-compensation

As the STIM320 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 8-12. A simplified compensation-scheme can be found in Figure 8-11.

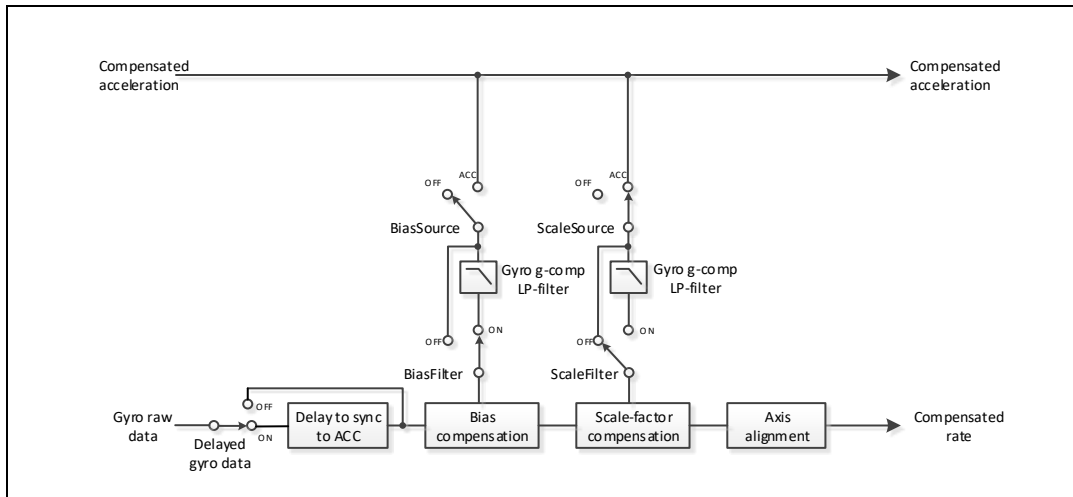


Figure 8-11: Simplified compensation-scheme for gyro g-compensation

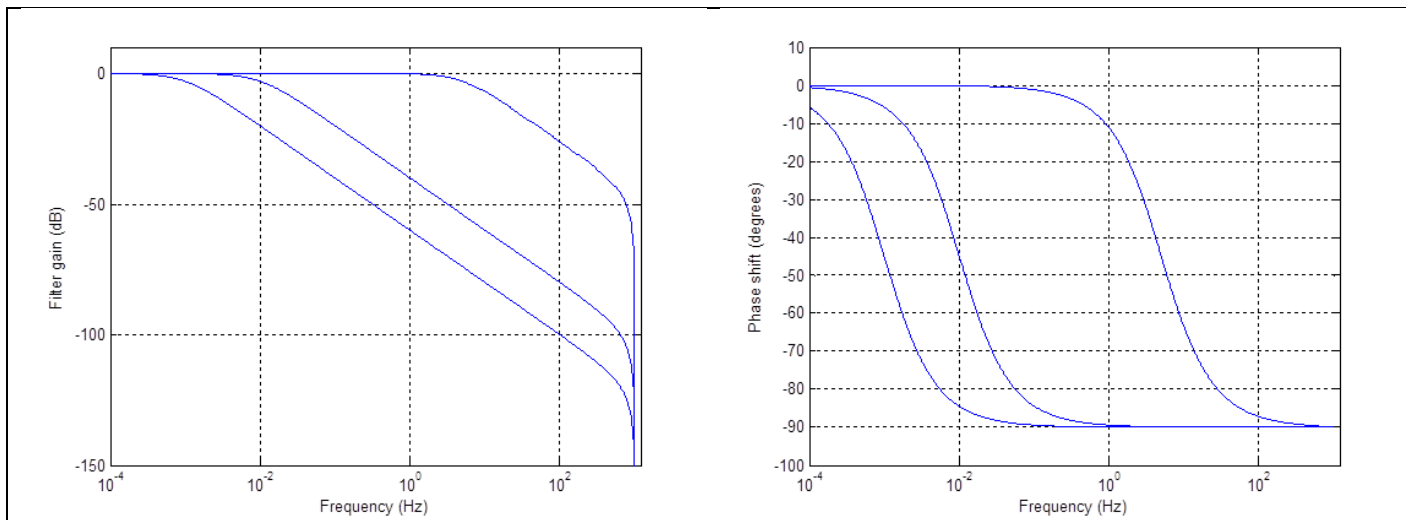


Figure 8-12: Frequency characteristics of g-compensation low-pass filter for 0.001Hz, 0.01Hz and 5Hz settings

8.6.2.2.7 Accelerometer output unit = Acceleration

In the case of STIM320 being configured to output acceleration, the equations for conversion to [g] can be found in Equation 3 and Figure 8-13. Note that the output data is represented as two's complement.

Equation 3: Converting output to [g]:

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

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

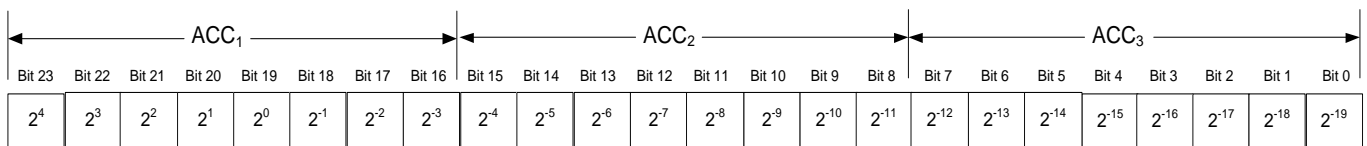


Figure 8-13: Converting output bytes to [g] (example is valid for 10g range)

8.6.2.2.8 Accelerometer output unit = Incremental Velocity

In the case of STIM320 being configured to output incremental velocity per sample, the equations for conversion to [m/s/sample] can be found in Equation 4 and Figure 8-14. Note that the output data is represented as two's complement.

Equation 4: Converting output to [m/s/sample]

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

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

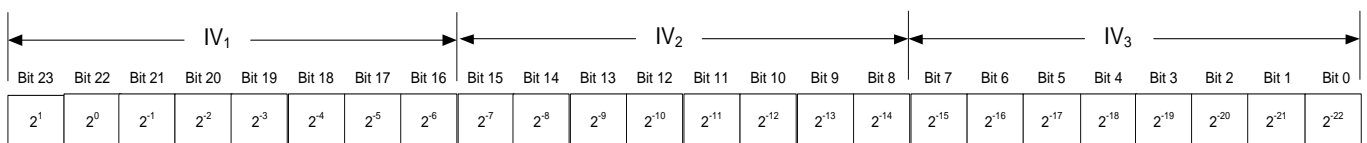


Figure 8-14: Converting output bytes to [m/s/sample] (example is valid for 10g range)

8.6.2.2.9 Accelerometer output unit = Average Acceleration

In the case of STIM320 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 3.

8.6.2.2.10 Accelerometer output unit = Integrated Velocity

In the case of STIM320 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 8-3 and will naturally wrap-around with no error-message indication in the Status-byte.

Table 8-3: Interval for integrated velocity

Range	Interval:
10g	[-2m/s, 2m/s>

Conversion to [m/s] is the same as for incremental velocity and is described in Equation 4.

8.6.2.2.11 PPS output unit = Time since detection

In the case of STIM320 being configured to “Time since detection of 0” or “Time since detection of 1”, the equation for conversion to [μ s] can be found in Equation 5. Note that the output data is represented as two’s complement.

Equation 5: Converting output to [μ s]:

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

where PPS₁ is the most significant byte of the 24bit output
 PPS₂ is the middle byte of the 24bit output
 PPS₃ is the least significant byte of the 24bit output

8.6.2.2.12 PPS output unit = Filtered PPS

In the case of STIM320 being configured to “Filtered PPS”, the equation for conversion can be found in Equation 6. The output will take values in the range [0, 1]. Note that the output data is represented as two’s complement.

Equation 6: Converting output to []:

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

where PPS₁ is the most significant byte of the 24bit output
 PPS₂ is the middle byte of the 24bit output
 PPS₃ is the least significant byte of the 24bit output

8.6.2.2.13 Temperature

Temperature data for each axis is available in certain datagrams (ref. section 13).

Equation 7 and Figure 8-15 show how to convert to [°C]. Note that the output data is represented as two’s complement.

Equation 7: Converting temperature data to [°C]

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

where T₁ is the most significant byte of the 16bit output
 T₂ is the least significant byte of the 16bit output

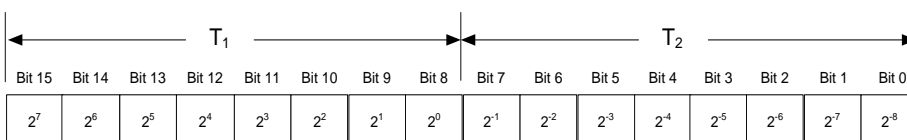


Figure 8-15: Converting temperature data to [°C]

8.6.2.2.14 Counter

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

If counter is 2 bytes, the counter can be calculated as shown in Equation 8 and Figure 8-16:

Equation 8: Converting counter to an integer number:

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

where Counter₁ is the most significant byte of the counter

Counter₂ is the least significant byte of the counter

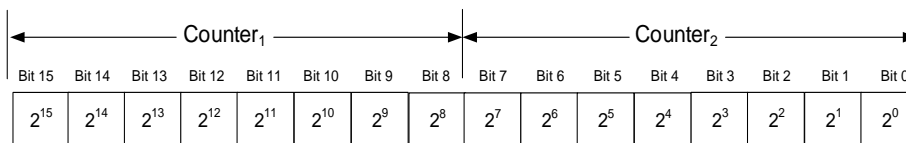


Figure 8-16: Converting counter to an integer number

8.6.2.2.15 Latency

To calculate the latency in [μs], refer to Equation 9 and Figure 8-17. Note that latency is an unsigned word.

Equation 9: Converting output to [μs]:

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

where LT₁ is the most significant byte of the 16bit output

LT₂ is the least significant byte of the 16bit output

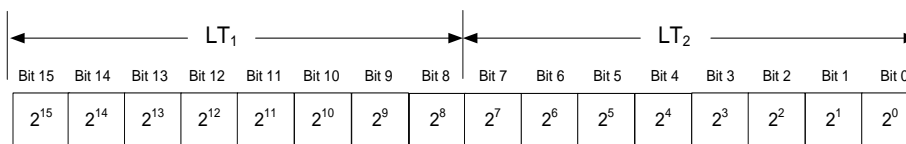


Figure 8-17: Converting output bytes to [μs]

8.6.2.3 Bias Trim Offset

The STIM320 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 8.6.4) or Service Mode (ref. section 10).

The bias trim offsets are applied to the sensor-signals after the compensation-algorithms with the sign-convention as shown in Equation 10:

Equation 10: Applying bias trim offsets:

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

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 chosen output unit is incremental or integrated.

8.6.3 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, STIM320 will respond with its configuration information (same as the response to the `i` (INFORMATION) command, ref: Figure 10-1).

A set of commands are available, ref. Section 10, 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 STIM320 is in Service Mode are not transmitted and therefore lost. By using the `s` (SINGLE-SHOT MEASUREMENT) command (ref. Section 10.2) 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 STIM320 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.

8.6.4 Utility Mode

The Utility Mode is similar to Service Mode (ref. section 8.6.3) but made for machine-machine communication. All commands and responses includes CRC-8 to detect any errors in the communication.

After having received the "UTILITYMODE"-command (ref. section 9.8), STIM320 will stop transmitting Normal Mode datagrams and send an acknowledgement that it is now in Utility Mode (ref. section 11.1). 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 11.

When the Utility Mode is exited, the STIM320 will return to Normal Mode and resume transmission of Normal Mode datagrams.

8.7 Self-diagnostics

STIM320 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 10.3 in SERVICEMODE.

When an error situation is detected, the corresponding bit in the STATUS byte (ref. Table 6-18) 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 9.5 and Table 6-14) or the SERVICEMODE-command `ie` (INFORMATION on ACCUMULATED LAST ERRORS, ref. section 10.1).

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 9.5)
- After use of SERVICEMODE-command "i e" (INFORMATION on ACCUMULATED LAST ERRORS, ref. section 10.1)

9 COMMANDS IN NORMAL MODE

Several commands are available in Normal Mode, as listed in Table 9-1. Note that all commands in Normal Mode must be transmitted in upper case letters.

Table 9-1 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 9-2 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

No echo of received command characters or error messages will appear for these commands. Only at the receipt of the complete correct command, will STIM320 execute accordingly.

NB: if OUTPUT-UNIT is set to INCREMENTAL (ref. Section 10.7), 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.

9.1 N (PART NUMBER DATAGRAM) command

General description: Requests transmission of a Part Number datagram (ref. Table 6-9).

Table 9-3 : Available I (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 chosen Normal Mode datagram, the Part Number datagram may replace more than one Normal Mode datagram transmission (dependent 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.

9.2 I (SERIAL NUMBER DATAGRAM) command

General description: Requests transmission of a Serial number datagram (ref. Table 6-10).

Table 9-4 : 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 chosen Normal Mode datagram, the Serial Number datagram may replace more than one Normal Mode datagram transmission (dependent 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.

9.3 C (CONFIGURATION DATAGRAM) command

General description: Requests transmission of a Configuration datagram (ref. Table 6-11).

Table 9-5: 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 chosen Normal Mode datagram, the Configuration datagram may replace more than one Normal Mode datagram transmission (dependent 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.

9.4 T (BIAS TRIM OFFSET DATAGRAM) command

General description: Requests transmission of a Bias Trim Offset datagram (ref. Table 6-12).

Table 9-6: Available B (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 chosen Normal Mode datagram, the Configuration datagram may replace more than one Normal Mode datagram transmission (dependent 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.

9.5 E (EXTENDED ERROR INFORMATION DATAGRAM) command

General description: Requests transmission of an Extended Error Information datagram (ref. Table 6-13). This datagram contains the accumulated detected errors (ref. section 8.7).

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

Table 9-7: 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 chosen Normal Mode datagram, the Extended Error Information datagram may replace more than one Normal Mode datagram transmission (dependent 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.

9.6 R (RESET) command

General description: Force a Reset

Table 9-8: Available R (RESET) command

Syntax	Response
R<CR>	Resets the unit

9.7 SERVICEMODE command

General description: Enters Service Mode (ref. section 8.6.2.3).

Table 9-9: Available SERVICEMODE command

Syntax	Response
SERVICEMODE<CR>	Enters Service Mode

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

When entering Service Mode, the configuration and identification data of the device will be listed, as shown in Figure 9-1:

```

SERIAL NUMBER = N25582026002002
PRODUCT = STIM320
PART NUMBER = 85042-440010-D30 REV -
FW CONFIG = SWD12409 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 = 0.010 HZ
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
LINE TERMINATION = ON
SYSTEM CONFIGURATIONS:
  COUNTER INTERVAL: [0, 65535]
  >

```

Figure 9-1: Example of response from SERVICEMODE command

9.8 UTILITYMODE command

General description: Enters Utility Mode allowing the user to obtain information or change configuration parameters (ref. section 8.6.4).

Table 9-10: Available UTILITYMODE command

Syntax	Response
UTILITYMODE<CR>	Enters Utility Mode

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

For response to the UTILITYMODE command and other commands in Utility Mode, see section 11.

10 COMMANDS IN SERVICE MODE

Several commands are available in Service Mode, as listed in Table 10-1. Note that all commands in Service Mode are case-sensitive (commands are lower case letters, whilst some parameters may be capital case letters).

Table 10-1 Available commands in Service Mode

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

Table 10-2 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 STIM320 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 recognised 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), STIM320 will respond with an error message. Error messages are on the format:

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

where nnn is an error number.

10.1 i (INFORMATION) command

General description: Lists various requested information about the device

Table 10-3 : 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 10-4 : Allowed values for <cmd> parameter for i (INFORMATION) commands

<cmd>	Result
s	Returns the serial number of the device
n	Returns the product name of the device
x	Returns the part number of the device
a	Returns the axis configuration of the device
p	Returns the FW configuration and revision of the device
m	Returns the sample rate of the device
f	Returns the LP filter -3dB frequency for each axis
d	Returns the datagram format
t	Returns the transmission parameters of the device
r	Returns the line termination (ON or OFF)
u	Returns the output units of the device
g	Returns the configuration of the gyro g-compensation
b	Returns the bias trim offsets
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 9.5)
h	Returns the settings of the defined system configurations

Table 10-5: 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 = N25582026002002
PRODUCT = STIM320
PART NUMBER = 85042-440010-D30 REV -
FW CONFIG = SWD12409 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 = 0.010 HZ
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
LINE TERMINATION = ON
SYSTEM CONFIGURATIONS:
  COUNTER INTERVAL: [0, 65535]
>

```

Figure 10-1: Example of response from i (INFORMATION) command

```
>i s
SERIAL NUMBER = N25582026002002
>
```

Figure 10-2: Example of response from i s (INFORMATION on SERIAL NUMBER) command

```
>i n
PRODUCT = STIM320
>
```

Figure 10-3: Example of response from i n (INFORMATION on PRODUCT NAME) command

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

Figure 10-4: Example of response from i x (INFORMATION on PART NUMBER) 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 10-5: Example of response from i a (INFORMATION on AXIS CONFIGURATION) command

```
>i p
FW CONFIG = SWD12409 REV 0
>
```

Figure 10-6: Example of response from i p (INFORMATION on FW CONFIGURATION) command

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

Figure 10-7: Example of response from i m (INFORMATION on SAMPLE RATE) 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 10-8: Example of response from i f (INFORMATION on LP FILTER -3dB FREQUENCY) command

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

Figure 10-9: Example of response from i d (INFORMATION on DATAGRAM TRANSMISSION MODE AND TERMINATION) command

```
>i t
BIT-RATE [bits/s] = 921600
DATA LENGTH = 8
STOP BITS = 1
PARITY = NONE
>
```

Figure 10-10: Example of response from i t (INFORMATION on TRANSMISSION PARAMETERS) command

```
>i r
LINE TERMINATION = ON
>
```

Figure 10-11: Example of response from i r (INFORMATION on LINE TERMINATION) command

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

Figure 10-12: Example of response from i u (INFORMATION on OUTPUT UNIT) 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 = 0.010 HZ
>
```

Figure 10-13: Example of response from i g (INFORMATION on GYRO G-COMP) 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 10-14: Example of response from i b (INFORMATION on BIAS TRIM OFFSET) command

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

LAST ERROR HISTORY IS NOW CLEARED
>
```

Figure 10-15: Example of response from i e (INFORMATION on ACCUMULATED LAST ERRORS) command

```
>i e
NO ERRORS DETECTED
>
```

Figure 10-16: Example of response from i e (INFORMATION on ACCUMULATED LAST ERRORS) command

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

Figure 10-17: Example of response from i h (INFORMATION on SYSTEM CONFIGURATIONS) command

10.2 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 10-6: Available a (SINGLE-SHOT MEASUREMENT) command

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

Table 10-7: 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 10-18: 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 10-19: Example of response from a (SINGLE-SHOT MEASUREMENT) command with error flagging

10.3 c (DIAGNOSTIC) command

General description: Performs a diagnostic of the unit.

Table 10-8: Available c (DIAGNOSTIC) command

Syntax	Response
c<CR>	Performs a diagnostic check

Table 10-9: 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 = N25582026002002
PRODUCT = STIM320
PART NUMBER = 85042-440010-D30 REV -
HW CONFIG = M5728 REV 9
FW CONFIG = SWD12409 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 10-20: Example of response from c (DIAGNOSTIC) command

10.4 d (DATAGRAM FORMAT) command

General description: Sets the datagram transmission mode and termination (ref. Table 6-7 and section 13).

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 chosen sample rate and bit rate (ref. Table 6-8 and error message E007 in Table 10-13).

Note that this change will only be effective until STIM320 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 10.10). 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 10.13).

Table 10-10 : Available d (DATAGRAM FORMAT) command

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

Table 10-11 : Allowed values for <type> parameter of d (DATAGRAM TRANSMISSION MODE AND TERMINATION) command

<type>	Datagram content
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, CRC
e	ID, rate, temperature, PPS, 16-bits counter, latency, CRC
f	ID, rate, acceleration, temperature, PPS, 16-bits counter, latency, CRC

Table 10-12 : 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 10-13: 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 10-21: Example of response from d (DATAGRAM MODE AND TERMINATION) command

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

Figure 10-22: Example of response from d (DATATGRAM MODE AND TERMINATION) command

10.5 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 chosen datagram content (ref. Table 6-8 and error message E007 in Table 10-18).

Note that this change will only be effective until STIM320 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 10.10). 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 10.13).

Table 10-14 : 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>'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 10.5.1
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 10.5.1

Table 10-15: Allowed values for <bit-rate code> parameter for t (TRANSMISSION PARAMETERS) commands

<bit-rate code>	Result
0	Will set the bit-rate to 377400 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 10-16: 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 10-17: 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

10.5.1 User-defined bit-rate

The STIM320 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 11:

Equation 11: 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 chosen datagram, ref. Table 6-15 and Table 6-8 (NB: number of bytes in Table 6-8 excludes <CR><LF>. If <CR><LF> termination has been chosen, ref. section 10.4 DATAGRAM FORMAT-command, the 2 additional bytes must be added)
 sample_rate is the chosen sample rate [samples/s]

If a bit-rate, lower than the allowed bit-rate defined by Equation 11, is entered, the command will respond with error message E007, ref. Table 10-18.

There are a finite number of bit-rates possible to set. This is defined in Equation 12:

Equation 12: Set bit-rate

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

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 10-18: 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 10-23: 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 10-24: Example of response from `t` (TRANSMISSION PARAMETERS) command to set user-defined bit-rate

10.6 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 STIM320 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 10.10). 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 10.13).

Table 10-19: Available r (LINE TERMINATION) command

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

Table 10-20: Allowed values for r (LINE TERMINATION) command

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

Table 10-21: 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 10-25: Example of response from r 0 (LINE TERMINATION) command

```
>r 1
LINE TERMINATION = ON
>
```

Figure 10-26: Example of response from r 1 (LINE TERMINATION) command

10.7 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 STIM320 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 10.10). 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 10.13).

Table 10-22: Available u (OUTPUT UNIT) command

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

Table 10-23: 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 [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 10-24: 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 10-27: Example of response from u (OUTPUT UNIT) command

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

Figure 10-28: Example of response from u (OUTPUT UNIT) command

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

Figure 10-29: Example of response from u (OUTPUT UNIT) command

10.8 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 STIM320 if e.g. a high filter bandwidth and a low sample rate have been chosen. 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 6-7.

Note that this change will only be effective until STIM320 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 10.10). 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 10.13).

Table 10-25: 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 10-26: 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 10-27: 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 10-28: 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 10-29: 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 10-30: 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 10-31: 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 10-32: Example of response from f (LP FILTER -3dB FREQUENCY) command

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

```
>
```

Figure 10-33: Example of response from f (LP FILTER -3dB FREQUENCY) command

10.9 m (SAMPLE RATE) command

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

Note that the sample rate could be considered invalid, even if it has been entered correctly. This is because a valid sample rate also depends on the bit rate and chosen datagram content (ref. Table 6-8 and error message E007 in Table 10-32).

Note that sample rate should be considered together with filter settings in order to avoid issues with folding due to undersampling. No warnings will be issued by STIM320 if e.g. a high filter bandwidth and a low sample rate have been chosen. For more details, see Application Note TS1670: “Considerations related to sampling rate and filter settings”.

Note that this change will only be effective until STIM320 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 10.10). 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 10.13).

Table 10-30: Available m (SAMPLE RATE) command

Syntax	Response
m<SP><sampl.rate><CR>	Changes the sample rate in Normal Mode

Table 10-31: 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 10-32: 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 10-34: Example of response from m (SAMPLE RATE) command

```
>m 5
SAMPLE RATE = EXTERNAL TRIGGER
>
```

Figure 10-35: Example of response from m (SAMPLE RATE) command

10.10 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 8.6.2.2.6 for a description of this functionality.

Table 10-33: 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 10-34 : 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 chosen as delayed (ref. section 8.6.2.2.1 and 10.7)

Table 10-35 : Allowed range for <FilterCutoff> for g (GYRO G-COMP) command

<FilterCutoff>	Unit	Minimum	Standard	Maximum
<FilterCutoff>	Hz	0.001	0.01	5.00

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

Table 10-36 : 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 10-37 : 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 10-38 : 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 10-39: 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 = 0.010 HZ
>
```

Figure 10-36: 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 = 0.300 HZ
>
```

Figure 10-37: Example of response from g (GYRO G-COMP) command with warning

```
>g 0,0,1,1,1,1,0
GYRO G-COMPENSATION:
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 = 0.500 HZ
>
```

Figure 10-38: Example of response from g (GYRO G-COMP) command

10.11 b (BIAS TRIM OFFSET) command

General description: Changes bias trim offsets.

Refer to section 8.6.2.3 for a description of this functionality.

Table 10-40: 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 6-3 and Table 6-4, 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 10-44.

Table 10-41: 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 10-42: 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 10-43: 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 10-44: 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 10-39: 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 10-40: Example of response from b (BIAS TRIM OFFSET) command

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

Figure 10-41: 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 10-42: Example of response from b (BIAS TRIM OFFSET) command

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

Figure 10-43: Example of response from b (BIAS TRIM OFFSET) command

10.12 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 STIM320 is specified to be capable of minimum 10,000 saves. A save-counter has been implemented and when the number of saves exceeds 10,000, there will be issued a warning. STIM320 will always attempt to save the configuration when receiving the s (SAVE) command regardless of the content of the save-counter.

Table 10-45: 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 10.5) 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 10-46: 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 (10,000 saves). STIM320 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 10-44: 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 10-45: 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 10-46: Example of response from s (SAVE) command when not correctly responding to confirmation

10.13 x (EXIT) command

General description: Terminates Service Mode and returns to Normal Mode directly or via Init Mode (ref. Figure 8-8).

Table 10-47 : Available x (EXIT) command

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

Table 10-48 : 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). 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). 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 10-49: 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 10-47: Example of response from x n (EXIT) command when system parameters match contents of flash

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

Figure 10-48: 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 10-49: 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 10-50: 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 10-51: Example of response from x n (EXIT) command after system parameters have been changed but not saved with incorrect response to confirmation.

10.14 z (RESTORE TO FACTORY SETTINGS) command

General description: Restores the configuration of the unit to its factory settings. Note: Bias Trim Offset-parameters are not reset

Table 10-50: 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 10-51: 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 (10,000 saves). STIM320 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 10-52: 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 10-53: 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 10-54: Example of response from z s (RESTORE TO FACTORY SETTINGS with save of configuration) command with change in transmission parameters.

10.15 h (SYSTEMS CONFIGURATIONS) command

General description: Sets defined system configurations.

Note that this change will only be effective until STIM320 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 10.12). 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 10.13).

Table 10-52: Available h (SYSTEM CONFIGURATIONS) command

Syntax	Response
<code>h<SP><SystemConfig>','<setting><CR></code>	Sets defined system configurations

Table 10-53: Allowed values for <SystemConfig> parameter for h (SYSTEM CONFIGURATIONS) command

<SystemConfig>	Function
<code>c</code>	Sets counter restart-value and interval for CRS (ref. section 8.5)

Table 10-54: Allowed values for <setting> parameter for counter interval

< SystemConfig >	<setting>	Result
<code>c</code>	1..65535	Sets counter interval for CRS. As the counter is incrementing at every 0.5ms, the time-interval for CRS is: counter restart-value x 0.5ms. Remember counter starts at 0. Hence the counter will take values in the interval [0, counter interval – 1]
<code>c</code>	0	Sets counter interval to maximum [0, 65535]

Table 10-55: 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 10-55: Example of response from h (SYSTEM CONFIGURATION) command

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

Figure 10-56: Example of response from h (SYSTEM CONFIGURATION) command

10.16 ? (HELP) command

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

Table 10-56: Available ? (HELP) commands

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

Table 10-57: Allowed values for <hlp> for ? (HELP) command

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

Table 10-58: 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:
i: LISTS SPECIFIC INFORMATION
a: PERFORMS A SINGLE-SHOT MEASUREMENT
c: PERFORMS A DIAGNOSTIC OF THE UNIT
d: CHANGES DATAGRAM FORMAT
t: CHANGES TRANSMISSION PARAMETERS
r: CHANGES THE LINE TERMINATION
u: CHANGES OUTPUT UNIT
f: CHANGES LP FILTER -3DB FREQUENCY
m: CHANGES SAMPLE RATE
g: CHANGES CONFIGURATION OF GYRO G-COMPENSATION
b: CHANGES BIAS TRIM OFFSETS
s: SAVES CONFIGURATION DATA
x: EXITS SERVICE MODE
z: RESTORES FACTORY SETTINGS
h: CHANGES SYSTEM CONFIGURATIONS

>

```

Figure 10-57: Example of response from ? (HELP) command

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

>
```

Figure 10-58: Example of response from ? i (HELP on INFORMATION) command

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

>
```

Figure 10-59: Example of response from ? a (HELP ON SINGLE-SHOT MEASUREMENT) command

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

>
```

Figure 10-60: 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, CRC
    e = ID, RATE, TEMPERATURE, PPS, 16-BITS COUNTER, LATENCY, CRC
    f = ID, RATE, ACCELERATION, TEMPERATURE, PPS, 16-BITS COUNTER, LATENCY, CRC
  ALLOWED VALUES FOR <term>:
    0 = NONE
    1 = <CR><LF>

>
```

Figure 10-61: Example of response from ? d (DATAGRAM TRANSMISSION MODE AND TERMINATION) 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
  ALLOWED VALUES FOR <bit-rate code>:
    0 = 377400
    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 – 5023000 (INTEGER VALUE). SEE STIM320 DATASHEET FOR LIMITATIONS
  ALLOWED VALUES FOR <stop bits>:
    1 = 1
    2 = 2
  ALLOWED VALUES FOR <parity>:
    0 = NONE
    1 = ODD
    2 = EVEN
>
  
```

Figure 10-62: Example of response from ? t (HELP on TRANSMISSION PARAMETERS) command

```

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

Figure 10-63: Example of response from ? r (HELP on LINE TERMINATION) 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 = ANGULAR RATE
    1 = INCREMENTAL ANGLE
    2 = AVERAGE ANGULAR RATE
    3 = INTEGRATED ANGLE
    8 = ANGULAR RATE - DELAYED
    9 = INCREMENTAL ANGLE - DELAYED
    a = AVERAGE ANGULAR RATE - DELAYED
    b = INTEGRATED ANGLE - DELAYED
  ALLOWED VALUES FOR u,a,<unit>:
    0 = ACCELERATION
    1 = INCREMENTAL VELOCITY
    2 = AVERAGE ACCELERATION
    3 = INTEGRATED VELOCITY
  ALLOWED VALUES FOR u,p,<unit>:
    0 = TIME SINCE DETECTION OF 0
    1 = TIME SINCE DETECTION OF 1
    3 = FILTERED PPS
    4 = FILTERED PPS - DELAYED
>
  
```

Figure 10-64: Example of response from ? u (HELP on OUTPUT UNIT) 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 10-65: Example of response from ? f (HELP on LP FILTER -3dB FREQUENCY) command

```

>? m
m <sampl.rate>: CHANGES THE SAMPLE RATE [samples/s]
  ALLOWED VALUES FOR <sampl.rate>
    0 = 125
    1 = 250
    2 = 500
    3 = 1000
    4 = 2000
    5 = EXTERNAL TRIGGER
>

```

Figure 10-66: Example of response from ? m (HELP on SAMPLE RATE) 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 10-67: Example of response from ? g (HELP on GYRO G-COMP) 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 10-68: Example of response from ? b (HELP on BIAS TRIM OFFSET) command

```

>? s
s: SAVES SYSTEM PARAMETERS TO FLASH
>

```

Figure 10-69: Example of response from ? s (HELP on SAVE) 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-MAVED SYSTEM PARAMETERS WILL BE OVERWRITTEN BY STORED CONTENT IN FLASH
WHEN EXITING TO INIT MODE

>
```

Figure 10-70: Example of response from ? x (HELP on EXIT) command

```
? z
z: RESTORES FACTORY SETTINGS

>
```

Figure 10-71: Example of response from ? z (HELP on RESTORE TO FACTORY SETTINGS) command

```
? h
h <systemconfig>,'<setting>: CHANGE DEFINED SYSTEM CONFIGURATIONS
  ALLOWED VALUES FOR <systemconfig>:
  c = SETS COUNTER RESTART-VALUE AND INTERVAL FOR CRS
  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

>
```

Figure 10-72: Example of response from ? h (HELP on SYSTEM CONFIGURATIONS) command

11 COMMANDS IN UTILITY MODE

Several commands are available in Utility Mode, ref. Table 11-1:

Table 11-1: Available commands in Utility Mode

Command group	Command	Description	Ref. section
General	\$isn	Returns the product serial number	11.3.1
General	\$in	Returns the product name	11.3.2
General	\$ix	Returns the part number	11.3.3
General	\$ihw	Returns the HW configuration	11.3.4
General	\$ifw	Returns the FW configuration	11.3.5
General	\$iax	Returns the axis configuration	11.3.6
General	\$irng	Returns the measurement ranges	11.3.7
General	\$im	Returns the sampling rate	11.3.8
General	\$igf	Returns the LP filter -3dB frequency of the gyros	11.3.9
General	\$iaf	Returns the LP filter -3dB frequency of the accelerometers	11.3.10
General	\$ipf	Returns LP filter -3dB frequency of PPS	11.3.11
General	\$id	Returns the datagram format	11.3.12
General	\$it	Returns the RS422 transmission parameters	11.3.13
General	\$igu	Returns the output unit of the gyros	11.3.14
General	\$iau	Returns the output unit of the accelerometers	11.3.15
General	\$ipu	Returns output unit of PPS	11.3.16
General	\$ig	Returns the configuration of the gyro g-compensation	11.3.17
General	\$iconf	Returns setting of system configuration	11.3.18
General	\$ie	Returns the accumulated extended error information and resets the accumulated error register	11.3.19
General	\$save	Saves all configuration and system parameters to flash memory	11.3.20
General	\$isv	Returns the number of remaining saves	11.3.21
General	\$xn	Terminates Utility Mode and returns to Normal Mode	11.3.22
Reconfig	\$sm	Sets the output sampling rate	11.4.1
Reconfig	\$sgf	Sets the LP filter -3dB frequency of the gyros	11.4.2
Reconfig	\$saf	Sets the LP filter -3dB frequency of the accelerometers	11.4.3
Reconfig	\$spf	Sets the LP filter -3dB frequency of PPS	11.4.4
Reconfig	\$sd	Sets the datagram format	11.4.5
Reconfig	\$sgu	Sets the output unit of the gyros	11.4.6
Reconfig	\$sau	Sets the output unit of the accelerometers	11.4.7
Reconfig	\$spu	Sets the output unit of PPS	11.4.8
Reconfig	\$sg	Sets the configuration of the gyro g-compensation	11.4.9
Reconfig	\$sconf	Sets system configuration	11.4.10
BTO	\$ibto	Returns the bias trim offsets	11.5.1
BTO	\$sdbto	Adjusts the bias trim offsets	11.5.2
BTO	\$sbto	Programs the bias trim offset(s)	11.5.3
BTO	\$irf	Returns the last programmed reference information for bias trim offset	11.5.4
BTO	\$srf	Programs the reference information for bias trim offset	11.5.5

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 11.3.20) must be used after having updated the required parameters.

11.1 Acknowledgement for entering Utility Mode

After the "UTILITYMODE"-command has been received, the response as shown in Figure 11-1 is transmitted to acknowledge having entered Utility Mode:

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

Figure 11-1: Acknowledgement for entering Utility Mode

The number 234 in Figure 11-1 is the CRC of the response, ref. section 11.2.3.

11.2 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.

11.2.1 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 11.2.3)
- g) All commands are terminated by ASCII character carriage return (<CR>)
- h) Maximum number of characters in command string (including <CR>) is 100

11.2.2 Response string

- a) All responses from the STIM320 starts 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 11.2.4)
- 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 11.2.3)
- g) All command responses are terminated by ASCII character carriage return (<CR>)

11.2.3 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 preceding 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 11-2: Example of response string with CRC checksum

11.2.4 Command status codes

The status parameter is reporting the result of decoding and processing of the given command. Figure 11-2 lists the possible status codes. When status = 0 then there are no errors.

Table 11-2: 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 11-2)
- 3: CRC-8 calculation

Figure 11-3: 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 11-2)
- 3: CRC-8 calculation

Figure 11-4: 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 11-2)
- 3: CRC-8 calculation

Figure 11-5: 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 11-2)
- 3: CRC-8 calculation

Figure 11-6: 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 11-2)
- 3: CRC-8 calculation

Figure 11-7: 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 11-2. 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 11-8: 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 11-2)
- 3: Remaining number of saves = 8848
- 4: CRC-8 calculation

Figure 11-9: 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 11-2
- 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 11-10: 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)

11.3 General commands

General description: Various general commands.

Table 11-3: Available info commands

Command	Description	Ref. section
\$isn	Returns product serial number	11.3.1
\$in	Returns product name	11.3.2
\$ix	Returns part number	11.3.3
\$ihw	Returns HW configuration	11.3.4
\$ifw	Returns FW configuration	11.3.5
\$iax	Returns axis configuration	11.3.6
\$irng	Returns measurement ranges	11.3.7
\$im	Returns sampling rate	11.3.8
\$igf	Returns LP filter -3dB frequency of the gyros	11.3.9
\$iaf	Returns LP filter -3dB frequency of the accelerometers	11.3.10
\$ipf	Returns LP filter -3dB frequency of PPS	11.3.11
\$id	Returns datagram format	11.3.12
\$it	Returns RS422 transmission parameters	11.3.13
\$igu	Returns output unit of the gyros	11.3.14
\$iau	Returns output unit of the accelerometers	11.3.15
\$ipu	Returns output unit of PPS	11.3.16
\$ig	Returns configuration of the gyro g-compensation	11.3.17
\$iconf	Returns setting of system configuration	11.3.18
\$ie	Returns the accumulated extended error information and resets the accumulated error register	11.3.19
\$save	Saves all configuration and system parameters to flash memory	11.3.20
\$isv	Returns the number of remaining saves	11.3.21
\$xn	Terminates Utility Mode and returns to Normal Mode	11.3.22

11.3.1 \$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 11-2
- 3: SERIAL NUMBER = N2558184602002
- 4: CRC-8 calculation

Figure 11-11: Specification and example of \$isn command

11.3.2 \$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 11-2
- 3: PRODUCT = STIM320
- 4: CRC-8 calculation

Figure 11-12: Specification and example of \$in command

11.3.3 \$ix

Purpose: Provide information about part number and revision

Format: \$ix,<CRC><CR>

Example of command: \$ix,118<CR>

Example of response: #ix,0,84792,-,133<CR>

Explanation of response:

- 1: ix = command
- 2: Status of command execution: ref. Table 11-2
- 3: PART NUMBER = 84972
- 4: REVISION = -
- 5: CRC-8 calculation

Figure 11-13: Specification and example of \$ix command

11.3.4 \$ihw

Purpose: Provide information about hardware configuration

Format: \$ihw,<CRC><CR>

Example of command: \$ihw,184<CR>

Example of response: #ihw,0,M5728 REV 11,215<CR>

Explanation of response:

- 1: ihw = command
- 2: Status of command execution: ref. Table 11-2
- 3: HW CONFIG = M5728 REV 11
- 4: CRC-8 calculation

Figure 11-14: Specification and example of \$ihw command

11.3.5 \$ifw

Purpose: Provide information about firmware configuration

Format: \$ifw,<CRC><CR>

Example of command: \$ifw,148<CR>

Example of response: #ifw,0,SWD12409 REV 0,23<CR>

Explanation of response:

- 1: ifw = command
- 2: Status of command execution: ref. Table 11-2
- 3: FW CONFIG = SWD12409 REV 0
- 4: CRC-8 calculation

Figure 11-15: Specification and example of \$ifw command

11.3.6 \$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 11-2
- 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 11-16: Specification and example of \$iax command

11.3.7 \$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 11-2
- 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 11-17: Specification and example of \$irng command

11.3.8 \$im

Purpose: Provide information about output sampling rate

Format: \$im,<CRC><CR>

Example of command: \$im,96<CR>

Example of response: #im,0,4,85<CR>

Explanation of response:

- 1 : im = command
- 2: Status of command execution: ref. Table 11-2
- 3: SAMPLING FREQUENCY = 4 (2000 samples/s, ref. input parameters in Figure 11-33)
- 4: CRC-8 calculation

Figure 11-18: Specification and example of \$im command

11.3.9 \$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 11-2
- 3: GYRO LP FILTER -3dB FREQUENCY, X-AXIS = 4 (256Hz, ref. input parameters in Figure 11-34. If axis is not configured, response will be NA)
- 4: GYRO LP FILTER -3dB FREQUENCY, Y-AXIS = 4 (256Hz, ref. input parameters in Figure 11-34. If axis is not configured, response will be NA)
- 5: GYRO LP FILTER -3dB FREQUENCY, Z-AXIS = 4 (256Hz, ref. input parameters in Figure 11-34. If axis is not configured, response will be NA)
- 6: CRC-8 calculation

Figure 11-19: Specification and example of \$igf command

11.3.10 \$iaf

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

<p>Format: \$iaf,<CRC><CR></p> <p>Example of command: \$iaf,192<CR></p> <p>Example of response: #iaf,0,4,4,4,51<CR></p> <p>Explanation of response:</p> <ol style="list-style-type: none"> 1 : iaf = command 2: Status of command execution: ref. Table 11-2 3: ACCELEROMETER LP FILTER -3dB FREQUENCY, X-AXIS = 4 (256Hz, ref. input parameters in Figure 11-35. If axis is not configured, response will be NA) 4: ACCELEROMETER LP FILTER -3dB FREQUENCY, Y-AXIS = 4 (256Hz, ref. input parameters in Figure 11-35. If axis is not configured, response will be NA) 5: ACCELEROMETER LP FILTER -3dB FREQUENCY, Z-AXIS = 4 (256Hz, ref. input parameters in Figure 11-35. If axis is not configured, response will be NA) 6: CRC-8 calculation
--

Figure 11-20: Specification and example of \$iaf command

11.3.11 \$ipf

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

<p>Format: \$ipf,<CRC><CR></p> <p>Example of command: \$ipf,9<CR></p> <p>Example of response: #ipf,0,4,183<CR></p> <p>Explanation of response:</p> <ol style="list-style-type: none"> 1 : ipf = command 2: Status of command execution: ref. Table 11-2 3: PPS LP FILTER -3dB FREQUENCY = 4 (256Hz, ref. input parameters in Figure 11-36. 4: CRC-8 calculation

Figure 11-21: Specification and example of \$ipf command

11.3.12 \$id

Purpose: Provide information about the datagram format

<p>Format: \$id,<CRC><CR></p> <p>Example of command: \$id,221<CR></p> <p>Example of response: #id,0,0,103<CR></p> <p>Explanation of response:</p> <ol style="list-style-type: none"> 1 : id = command 2: Status of command execution: ref. Table 11-2 3: DATAGRAM FORMAT = 0 (ID,RATE,8-BITS COUNTER,LATENCY: ref. input parameters in Figure 11-37) 4: CRC-8 calculation

Figure 11-22: Specification and example of \$id command

11.3.13 \$it

Purpose: Provide information about the RS422 transmission parameters

<p>Format: \$it,<CRC><CR></p> <p>Example of command: \$it,138<CR></p> <p>Example of response: #it,0,374400,8,1,2,1,1,87<CR></p> <p>Explanation of response:</p> <ol style="list-style-type: none"> 1 : it = command 2: Status of command execution: ref. Table 11-2 3: BIT RATE [bps] = 374400 4: DATALENGTH = 8 5: STOP BITS = 1 6: PARITY = 2 (EVEN, ref. Table 10-17) 7: LINE TERMINATION = 1 (ON, ref. Table 10-20) 8: DATAGRAM TERMINATION = 1 (<CR><LF>, ref. Table 10-12) 9: CRC-8 calculation
--

Figure 11-23: Specification and example of \$it command

11.3.14 \$igu

Purpose: Provide information about the gyro output unit

<p>Format: \$igu,<CRC><CR></p> <p>Example of command: \$igu,213<CR></p> <p>Example of response: #igu,0,1,211<CR></p> <p>Explanation of response:</p> <ol style="list-style-type: none"> 1 : igu = command 2: Status of command execution: ref. Table 11-2 3: GYRO OUTPUT UNIT = 1 ([°/sample] – INCREMENTAL ANGLE, ref. input parameters in Figure 11-38) 4: CRC-8 calculation
--

Figure 11-24: Specification and example of \$igu command

11.3.15 \$iau

Purpose: Provide information about the accelerometer output unit

<p>Format: \$iau,<CRC><CR></p> <p>Example of command: \$iau,168<CR></p> <p>Example of response: #iau,0,1,31<CR></p> <p>Explanation of response:</p> <ol style="list-style-type: none"> 1 : iau = command 2: Status of command execution: ref. Table 11-2 3: ACCELEROMETER OUTPUT UNIT = 1 ([m/s/sample] – INCREMENTAL VELOCITY, ref. input parameters in Figure 11-39) 4: CRC-8 calculation

Figure 11-25: Specification and example of \$iau command

11.3.16 \$ipu

Purpose: Provide information about the PPS output unit

<p>Format: \$ipu,<CRC><CR></p> <p>Example of command: \$ipu,97<CR></p> <p>Example of response: #ipu,0,1,19<CR></p> <p>Explanation of response:</p> <ol style="list-style-type: none"> 1 : ipu = command 2: Status of command execution: ref. Table 11-2 3: PPS OUTPUT UNIT = 1 ([μs] – Time since detection of 1, ref. input parameters in Figure 11-40) 4: CRC-8 calculation

Figure 11-26: Specification and example of \$ipu command

11.3.17 \$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,1,1,0,0.5,65<CR>

Explanation of response:

- 1 : ig = command
- 2: Status of command execution: ref. Table 11-2
- 3: Axis = X
- 4: GYRO G-COMPENSATION SCALE SOURCE = 1 (ACCELEROMETER, ref. input parameters in Figure 11-41)
- 5: GYRO G-COMPENSATION SCALE LP FILTER = 1 (ON, ref. input parameters in Figure 11-41)
- 6: GYRO G-COMPENSATION BIAS SOURCE = 0 (OFF, ref. input parameters in Figure 11-41)
- 7: GYRO G-COMPENSATION BIAS LP FILTER = 0 (OFF, ref. input parameters in Figure 11-41)
- 8: LP FILTER -3dB FREQUENCY [Hz] = 0.5 (ref. input parameters in Figure 11-41)
- 9: CRC-8 calculation

Figure 11-27: Specification and example of \$ig command

11.3.18 \$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 8.5)

Example of command: \$iconf,c,239<CR>

Example of response: #iconf,C,100,11<CR>

Explanation of response:

- 1: iconf = command
- 2: Status of command execution: ref. Table 11-2
- 3: SYSTEM PARAMETER = C (Counter restart-value and interval for CRS, ref. input parameters in Figure 11-42)
- 4: CONFIGURATION = 100 (Counter interval [0, 99], ref. input parameters in Figure 11-42)
- 5: CRC-8 calculation

Figure 11-28: Specification and example of \$iconf command

11.3.19 \$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,0,0,0,16,0,0,0,0,0,0,0,0,0,0,0,0,221<CR>

Explanation of response:

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

Figure 11-29: Specification and example of \$ie command

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

11.3.20 \$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 11-2
3. REMAINING NUMBER OF SAVES = 9958
- 4: CRC-8 calculation

Figure 11-30: 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

11.3.21 \$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 11-2
- 3: NUMBER OF REMAINING SAVES = 9958
- 4: CRC-8 calculation

Figure 11-31: Specification and example of \$isv command

11.3.22 \$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 11-2
- 3: CRC-8 calculation

Figure 11-32: Specification and example of \$xn command

11.4 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 11.3.20) must be used after having updated the required parameters.

Table 11-4: Available commands for reconfiguration

Command	Description	Ref. section
\$sm	Sets the output sampling rate	11.4.1
\$sgf	Sets the LP filter -3dB frequency of the gyros	11.4.2
\$saf	Sets the LP filter -3dB frequency of the accelerometers	11.4.3
\$spf	Sets the LP filter -3dB frequency of PPS	11.4.4
\$sd	Sets the datagram format	11.4.5
\$sgu	Sets the output unit of the gyros	11.4.6
\$sau	Sets the output unit of the accelerometers	11.4.7
\$spu	Sets the output unit of PPS	11.4.8
\$sg	Sets the configuration of the gyro g-compensation	11.4.9
\$sconf	Sets system configuration	11.4.10

11.4.1 \$sm

Purpose: Change the output sampling rate

Format: \$sm,<SamplingRate>,<CRC><CR>

Explanation of input parameters:

<SamplingRate>: Output sampling rate. Valid entries are:

- 0 : 125 samples/s
- 1 : 250 samples/s
- 2 : 500 samples/s
- 3 : 1000 samples/s
- 4 : 2000 samples/s
- 5 : External Trigger

Example of command: \$sm,4,115<CR>

Example of response: #sm,0,4,213<CR>

Explanation of response:

- 1: sm = command
- 2: Status of command execution: ref. Table 11-2
3. SAMPLING FREQUENCY = 4 (2000 samples/)
- 4: CRC-8 calculation

Figure 11-33: Specification and example of \$sm command

11.4.2 \$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 11-2
- 3: GYRO LP FILTER -3dB FREQUENCY, X-AXIS = 3 (131Hz)
- 4: CRC-8 calculation

Figure 11-34: Specification and example of \$sgf command

11.4.3 \$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,4,138<CR>

Example of response: #saf,0,Z,4,43<CR>

Explanation of response:

- 1: saf = command
- 2: Status of command execution: ref. Table 11-2
- 3: ACCELEROMETER LP FILTER -3dB FREQUENCY, Z-AXIS = 4 (256Hz)
- 4: CRC-8 calculation

Figure 11-35: Specification and example of \$saf command

11.4.4 \$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 11-2
- 3: PPS LP FILTER -3dB FREQUENCY = 4 (256Hz)
- 4: CRC-8 calculation

Figure 11-36: Specification and example of \$spf command

11.4.5 \$sd

Purpose: Change the datagram format

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

Explanation of input parameters:

<DatagramFormat>: Datagram format. Valid entries: ref. Table 10-11

- 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, CRC
- e : ID, rate, temperature, PPS, 16-bits counter, latency, CRC
- f : 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 11-2
- 3: DATAGRAM FORMAT = 1 (ID,RATE,ACCELERATION,8-BITS COUNTER,LATENCY)
- 4: CRC-8 calculation

Figure 11-37: Specification and example of \$sd command

11.4.6 \$sgu
Purpose: Change the output unit for gyros

<p>Format: \$sgu,<OutputUnit>,<CRC><CR></p> <p>Explanation of input parameters: <OutputUnit>: Output unit. Valid entries:</p> <ul style="list-style-type: none"> • 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 [°]
<p>Example of command: \$sgu,2,111<CR></p> <p>Example of response: #sgu,0,2,101<CR></p> <p>Explanation of response: 1: sgu = command 2: Status of command execution: ref. Table 11-2 3: GYRO OUTPUT UNIT = [°/s] – AVERAGE ANGULAR ANGLE 4: CRC-8 calculation</p>

Figure 11-38: Specification and example of \$sgu command
11.4.7 \$sau
Purpose: Change the output unit for accelerometers

<p>Format: \$sau,<OutputUnit>,<CRC><CR></p> <p>Explanation of input parameters: <OutputUnit>: Output unit. Valid entries:</p> <ul style="list-style-type: none"> • 0 : Acceleration [g] • 1 : Incremental velocity [m/s/sample] • 2 : Average acceleration [g] • 3 : Integrated velocity [m/s]
<p>Example of command: \$sau,1,27<CR></p> <p>Example of response: #sau,0,1,150<CR></p> <p>Explanation of response: 1: sau = command 2: Status of command execution: ref. Table 11-2 3: ACCELEROMETER OUTPUT UNIT = [m/s/sample] – INCREMENTAL VELOCITY 4: CRC-8 calculation</p>

Figure 11-39: Specification and example of \$sau command

11.4.8 \$spu

Purpose: Change the output unit for PPS

<p>Format: \$spu,<OutputUnit>,<CRC><CR></p> <p>Explanation of input parameters: <OutputUnit>: Output unit. Valid entries:</p> <ul style="list-style-type: none"> • 0 : Time since detection of 0 • 1 : Time since detection of 1 • 2 : Filtered PPS • 3 : Filtered PPS – delayed
<p>Example of command: \$spu,1,75<CR></p> <p>Example of response: #spu,0,1,154<CR></p> <p>Explanation of response: 1: sau = command 2: Status of command execution: ref. Table 11-2 3: PPS OUTPUT UNIT = [µs] – Time since detection of 1 4: CRC-8 calculation</p>

Figure 11-40: Specification and example of \$spu command

11.4.9 \$sg

Purpose: Change the configuration of the gyro g-compensation (ref. section 8.6.2.2.6)

<p>Format: \$sg,<Axis>,<ScaleSource>,<ScaleFilter>,<BiasSource>,<BiasFilter>,<LPFilter-3dB>,<CRC><CR></p> <p>Explanation of input parameters: <Axis>: Specified axis. Valid entries are:</p> <ul style="list-style-type: none"> • x : X-axis • y : Y-axis • z : Z-axis <p><ScaleSource>: Source of the gyro scale-factor g-compensation. Valid entries:</p> <ul style="list-style-type: none"> • 0 : None (=OFF) • 1 : Accelerometer <p><ScaleFilter>: LP filtering of source for gyro scale-factor g-compensation. Valid entries:</p> <ul style="list-style-type: none"> • 0 : OFF • 1 : ON <p><BiasSource>: Source of the gyro bias g-compensation. Valid entries:</p> <ul style="list-style-type: none"> • 0 : None (=OFF) • 1 : Accelerometer <p><BiasFilter>: LP filtering of source for gyro bias-factor g-compensation. Valid entries:</p> <ul style="list-style-type: none"> • 0 : OFF • 1 : ON <p><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</p>
<p>Example of command: \$sg,x,1,1,0,0,0.5,213<CR></p> <p>Example of response: #sg,0,X,1,1,0,0,0.5,36<CR></p> <p>Explanation of response: 1: sg = command 2: Status of command execution: ref. Table 11-2 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</p>

Figure 11-41: Specification and example of \$sg command

11.4.10 \$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 8.5)

<Config>: Related configuration to specific system parameter. Valid entries are:

For <SystPar> = c:

- 0 : Sets counter restart-value to maximum interval [0, 65535]
- 1..65535: Sets counter restart-value and interval for CRS, ref. Table 10-54

Example of command: \$sconf,c,100,102<CR>

Example of response: #sconf,C,100,156<CR>

Explanation of response:

- 1: sconf = command
- 2: Status of command execution: ref. Table 11-2
- 3: SYSTEM PARAMETER = c (Counter restart-value and interval for CRS)
- 4: CONFIGURATION = 100 (Counter interval [0, 99])
- 5: CRC-8 calculation

Figure 11-42: Specification and example of \$sconf command

11.5 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 11.3.20) must be used after having updated the required parameters.

Table 11-5: Available programming commands

Command	Description	Ref. section
\$ibto	Returns the bias trim offsets	11.5.1
\$sdbto	Adjusts the bias trim offsets	11.5.2
\$sbto	Programs the bias trim offset(s)	11.5.3
\$irf	Returns the last programmed reference information for bias trim offset	11.5.4
\$srf	Programs the reference information for bias trim offset	11.5.5

11.5.1 \$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 11-2
- 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: ACCELEMETER X-AXIS BIAS TRIM OFFSET [g] = -0.036230 (number format: decimal number with 6 decimals)
- 7: ACCELEMETER Y-AXIS BIAS TRIM OFFSET [g] = 0.002872 (number format: decimal number with 6 decimals)
- 8: ACCELEMETER 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 11-43: Specification and example of \$ibto command

11.5.2 \$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,-0.053422,0.0000000,0.0000000,0.0000000,67<CR>

Explanation of response:

1: sdbto = command

2: Status of command execution: ref. Table 11-2

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 11-44: Specification and example of \$sdbto command

11.5.3 \$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,0,0.00000,0.00000,0.00000,0.000000,0.000000,0.000000,0.000000,0.000000,0.000000,177<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,0,0.02311,0.00934,0.54432,0.000000,0.000000,0.000000,0.000000,0.000000,0.000000,181<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,0,0.02311,0.00340,0.54432,0.089453,0.002666,0.053422,0.0000000,0.0000000,0.0000000,209<CR>

Explanation of response:

1: sbto = command

2: Status of command execution: ref. Table 11-2

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 11-45: Specification and example of \$sbto command

11.5.4 \$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,43638,44<CR>

Explanation of response:

- 1: irf = command
- 2: Status of command execution: ref. Table 11-2
- 3: REFERENCE INFORMATION = 43638 (number format: unsigned integer)
- 4: CRC-8 calculation

Figure 11-46: Specification and example of \$irf command

11.5.5 \$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 11-2
3. NEW REFERENCE INFORMATION = 43638
- 4: CRC-8 calculation

Figure 11-47: Specification and example of \$srf command

12 MARKING

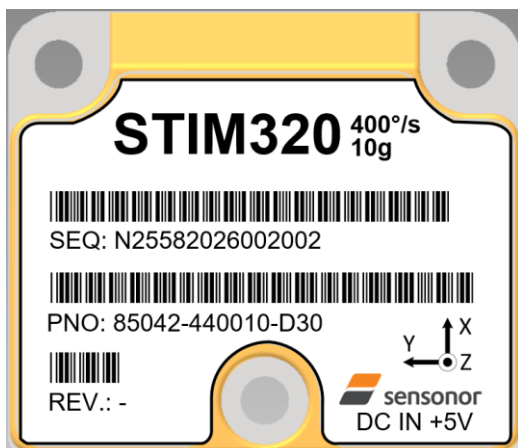


Figure 12-1: Example of marking of STIM320

13 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, ref. section 8.6.2.3. A full list of configurable parameters can be found in Table 6-7.

Configuration parameters in **bold** letters show the standard option.

Range		Measurement						Output/RS422			
Prod_ID	-	Sample rate	Filter bandwidth	Gyro output unit	Acc. output unit	PPS output unit	Gyro g-comp	-	Datagram	Bit-rate	Termination

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

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 [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				
	Rate	Acceleration	Temperature	PPS	Counter (bits)
0	YES	NO	NO	NO	8
1	YES	YES	NO	NO	8
4	YES	NO	YES	NO	8
5	YES	YES	YES	NO	8
8	YES	NO	NO	NO	16
9	YES	YES	NO	NO	16
A	YES	NO	YES	NO	16
B	YES	YES	YES	NO	16
C	YES	NO	NO	YES	16
D	YES	YES	NO	YES	16
E	YES	NO	YES	YES	16
F	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⁾

Termination		
	Line	Datagram
0	OFF	None
1	ON	None
2	OFF	<CR><LF>
3	ON	<CR><LF>

- 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 10.5 for limitations
- 4) Configuration can be changed in SERVICEMODE. See section 10.5

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
- Line termination OFF

RS422 data configuration	
#Start bit	1
#Data bits	8
#Stop bits	1 ⁴⁾
Parity	None ⁴⁾

NOTES

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