sensonor

1 FEATURES

- o Miniature package
- o Low noise
- o Low bias instability
- o Excellent performance in vibration and shock environments
- o 6 axes offered in same package
  - o Electronically calibrated axis alignment
- o Gyros based on Sensonor ButterflyGyro™
  - o Single-crystal silicon technology
  - o No intrinsic wear-out effects
- o High stability accelerometers and inclinometers
- o Separate "AUX" input for 24 bit ADC
- o Insensitive to magnetic fields
- o Full EMI compliance
- o Digital interface, RS422
- o Fully configurable
- o Continuous self-diagnostics

(38.6mm x 44.8mm x 21.5mm)

2 GENERAL DESCRIPTION

STIM300 is an IMU consisting of 3 high accuracy MEMS-based gyros, 3 high stability accelerometers and 3 high stability inclinometers in a miniature package. Each axis is factory-calibrated for bias, sensitivity 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.

STIM300 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 STIM300 is powered up, it will perform an internal system check and synchronise the sensor channels. As an acknowledgement of the complete power-up sequence, it will provide special datagrams containing part number, serial number and configuration data. STIM300 will then automatically proceed to provide measurement data. Connect power and STIM300 will provide accurate measurements over the RS422 interface.

Figure 2-1: STIM300 FUNCTION BLOCK DIAGRAM

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). 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 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. STIM300 can also be configured to transmit data only when triggered by a separate digital input signal (ExtTrig).

For more advanced users, the gyro 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.
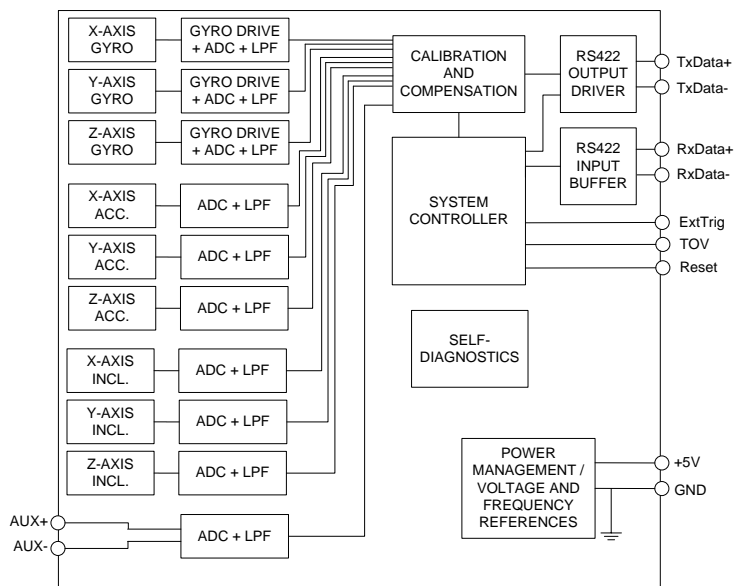
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4 DEFINITIONS AND ABBREVIATIONS USED IN DOCUMENT

4.1 Definitions

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

4.2 Abbreviations

Table 4-1: Abbreviations

ABBREVIATION	FULL NAME
BCD	Binary Coded Decimal
BSL	Best Straight Line
CIC-filter	Cascaded Integrator-Comb filter
CR	Carriage Return
FS	Full-Scale
LF	Line Feed
LP filter	Low-Pass filter
tbd	to be defined
LSB	Least Significant Byte
MSB	Most Significant Byte
lsb	Least significant bit
TOV	Time of Validity

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	
TOV to GND	-0.3V to +7V	
NRST to GND	-0.3V to +7V	
AUX+ to AUX-	±6.5V	
AUX+ or AUX- to GND	±6.5V	
Chassis to GND	500V	
Helium sensitivity		Not to be exposed to helium concentrations higher than those normally found in the atmosphere

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
INPUT RANGE, INCLINATION			±1.7		g	
POWER SUPPLY		4.5	5.0	5.5	V	2,3
OPERATING TEMPERATURE		-40		+85	°C	

Note 1: Other ranges available, ref. note 1 in Table 6-4
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 STIM300 could give rise for an oscillating behaviour of the input voltage to the unit.

Table 6-2: Functional specifications, general

Parameter	Conditions	Min	Nom	Max	Unit	Note
POWER CONSUMPTION						
Power consumption			1.5	2	W	
TIMING						
Start-Up time after Power-On				1	s	1
Time to transmit after Reset				1	s	2
Time to valid data				5	s	3
RS422 Bit-Rate			ref. Table 6-8			
RS422 Bit-Rate Accuracy				±1	%	4
RS422 PROTOCOL						
Start Bit			1		bit	
Data Length			8		bits	
Parity			None			5
Stop Bits			1		bit	5
RS422 LINE TERMINATION						
Input resistance	Line termination = ON		120		Ω	
Input resistance	Line termination = OFF	48	125		kΩ	
RESET (NRST PIN)						
Logic levels	"high"	2.3			V	
	"low"			0.6	V	
Minimum hold time for reset		1			µs	
Pull-Up Resistor		80	100		kΩ	
EXTERNAL TRIGGER (ExtTrig PIN)						
Logic levels	"high"	2.3			V	
	"low"			0.6	V	
Trigger			Negative transition			
Time between triggers	Measurement.unit:					
	angular rate	0.5		65	ms	6
	incremental angle	0.5		65	ms	6
	average rate	0.5		65	ms	6,7
	integrated angle	0.5		8	ms	6,8
Minimum "high" time before trigger, t_{ext_hi}		250			ns	9
Minimum "low" time after trigger, t_{ext_lo}		250			ns	9
Delay from external trigger to start of transmission, t_{ext_dl}				86	µs	9
Pull-Up Resistor		40	50		kΩ	
Latency				1000	µs	

TIME OF VALIDITY (TOV PIN)						
Output configuration			Open drain			
Internal Pull-Up Resistor to Vsup			10		kΩ	
Sink capability				50	mA	
TOV active level			Active "low"			
Minimum time of TOV, t_{tov_min}		50			µs	10
Delay from internal time-tick to TOV active, t_{tov_dl}			0.5	6	µs	10
Delay from TOV active (to start of transmission, t_{tx_dl}				80	µs	10
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 6-16). 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: Other values can be configured, ref. Table 6-8
Note 6: If time between triggers is longer, the latency will over-run. The sample counter will over-run after 127ms.
Note 7: If time between triggers is longer, the accuracy of average rate may also be reduced. Similar for accelerometer and inclinometer outputs
Note 8: 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 and inclinometer outputs
Note 9: For definition, ref. Figure 8-3
Note 10: For definition, ref. Figure 8-4 and Figure 8-5

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		25		ppm	2
	±400°/s		50		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 Run-Run			4		°/h	
Bias error over temperature	Static temperatures		9		°/h	6
Bias error over temperature gradients	$\Delta T \le \pm 1°C/min$		10		°/h	7
Bias Instability	Allan Variance @25°C		0.5		°/h	
Angular Random Walk	Allan Variance @25°C		0.15		°/√hr	
Linear Acceleration Effect						
Bias	With g-compensation		1		°/h /g	8
	No g-compensation			15	°/h /g	8
Scale Factor	With g-compensation		30		ppm/g	8
	No g-compensation		400		ppm/g	8
Vibration Rectification Coefficient			Ref. Figure 6-1		°/h /g²$_{rms}$	
Misalignment			1		mrad	9

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 6-8 and section 6.1.1.4

Note 4: Other values can be configured, ref. Table 6-8. Sample rate will be same for gyros, accelerometers, inclinometers, AUX and temperature

Note 5: Total delay to start of datagram transmission = group delay + 0.5ms + t_{tov_dl} + t_{tx_dl}. For output units with delayed output, the group delay will be 5ms longer, ref. section 8.5.2.2.1.

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 6-7

Note 8: Minimized when linear acceleration is applied in X-direction, ref.Figure 7-3

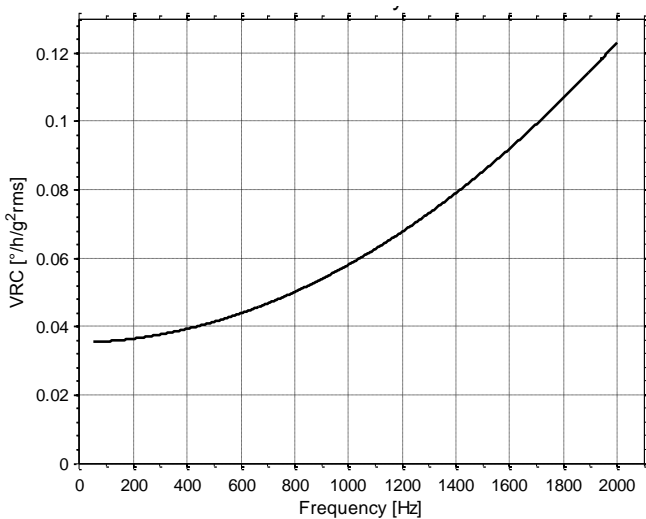Note 9: Ref. Figure 6-2 for definition of reference points used in axes alignment

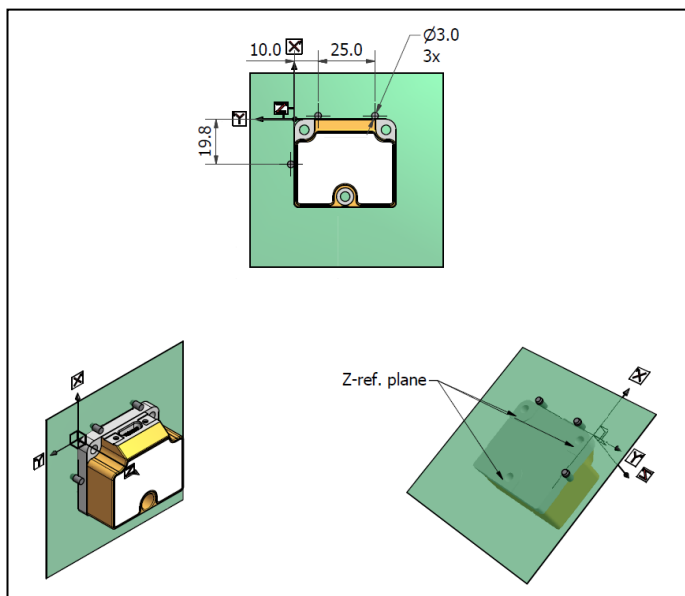**Figure 6-1: Nominal VRC at 5g rms for gyros**

Figure 6-2: Reference points for alignment of axes

Table 6-4: Functional specifications, accelerometers

Parameter	Conditions	Min	Nom	Max	Unit	Note
ACCELEROMETER						
Full Scale (FS)			±10		g	1
Resolution			24		bits	
			1.9		μg	2
Scale Factor Accuracy			±300		ppm	
Scale Factor 1 year stability			300	1000	ppm	
Non-Linearity	±10g		100		ppm	3
Bandwidth (-3dB)	LP-filter -3dB = 262Hz	90	214		Hz	4
Sample Rate				2000	samples/s	5
Group Delay	LP-filter -3dB = 262Hz		6.5		ms	6
	LP-filter -3dB = 131Hz		8.0		ms	6
	LP-filter -3dB = 66Hz		11		ms	6
	LP-filter -3dB = 33Hz		17		ms	6
	LP-filter -3dB = 16Hz		29		ms	6
Bias switch on/off repeatability		-0.75	0	+0.75	mg	7
Bias 1 year stability			1.5	7.5	mg	7
Bias error over temperature	ΔT $\leq$ ±1°C/min		±2		mg rms	7
Bias Instability	Allan Variance @25°C		0.05		mg	7
Velocity Random Walk	Allan Variance @25°C		0.07		m/s/√hr	7
Vibration Rectification Coefficient			Ref.Figure 6-3		mg/g$^2_{rms}$	
Misalignment			1		mrad	8

Note 1: Other ranges possible (±2g (date of introduction not yet defined), ±5g, ±30g, ±80g). Output of ±80g range will saturate at ±96g

Note 2: For resolution in [g] for other ranges, refer to Equation 5 and Equation 6

Note 3: Largest deviation from BSL (Best Straight Line) over the range specified

Note 4: Other values can be configured, ref. Table 6-8 and section 6.1.2.3

Note 5: Other values can be configured, ref. Table 6-8. Sample rate will be same for gyros, accelerometers, inclinometers, AUX and temperature

Note 6: Total delay to start of datagram transmission = group delay + 0.5ms + t_{tov_dl} + t_{tx_dl}

Note 7: Valid for ±10g range. Specification scale with resolution for other ranges

Note 8: Ref. Figure 6-2 for definition of reference points used in axes alignment
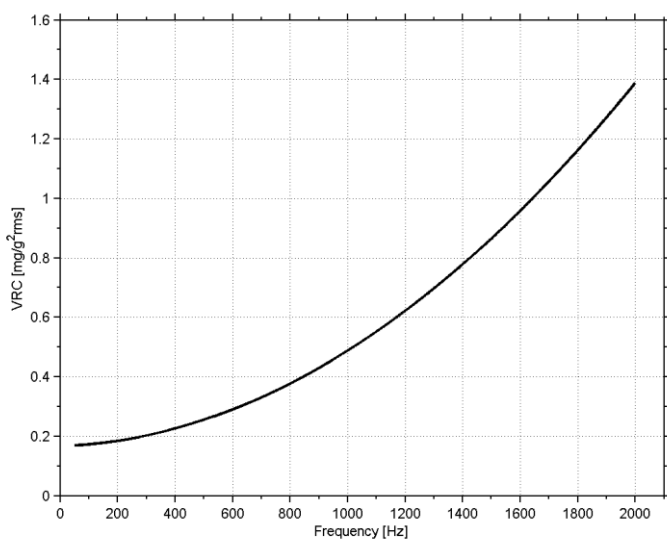

Figure 6-3: Nominal VRC at 10g rms for 10g accelerometers

Table 6-5: Functional specifications, inclinometers

Parameter	Conditions	Min	Nom	Max	Unit	Note
INCLINOMETER						
Full Scale (FS)			±1.7		g	
Resolution			24		bits	
			0.2		µg	
Scale Factor Accuracy	±1g		±500		ppm	
Non-Linearity	±1g		500		ppm	1
Bandwidth (-3dB)			17		Hz	2
Sample Rate				2000	samples/s	3
Group Delay	LP-filter -3dB = 262Hz		15		ms	4
	LP-filter -3dB = 131Hz		17		ms	4
	LP-filter -3dB = 66Hz		20		ms	4
	LP-filter -3dB = 33Hz		26		ms	4
	LP-filter -3dB = 16Hz		38		ms	4
Bias switch on/off repeatability		-0.75	0	+0.75	mg	
Bias error over temperature	ΔT $\leq$ ±1°C/min		±2		mg rms	
Bias Instability	Allan Variance @25°C		0.05		mg	5
Velocity Random Walk	Allan Variance @25°C		0.08		m/s/√hr	5
Misalignment			1		mrad	6

Note 1: Largest deviation from BSL (Best Straight Line) over the range specified
Note 2: Other values can be configured, ref. Table 6-8 and section 6.1.3.3
Note 3: Other values can be configured, ref. Table 6-8. Sample rate will be same for gyros, accelerometers, inclinometers, AUX and temperature
Note 4: Total delay to start of datagram transmission = group delay + 0.5ms + t_{tov_dl} + t_{tx_dl}
Note 5: At 0g. Bias Instability and Velocity Random Walk increases by typically 35% at ±1g given by the chosen technology for the inclinometers
Note 6: Ref. Figure 6-2 for definition of reference points used in axes alignment

Table 6-6: Functional specifications, AUXiliary input

Parameter	Conditions	Min	Nom	Max	Unit	Note
Full Scale (FS)			±2.5		V	1
Resolution			24		bits	
			0.30		µV	
Gain error	@25°C		±0.1		%	2
Gain drift			1.3		ppm/°C	
Non-Linearity			300		ppm	3
Bandwidth (-3dB)			262		Hz	4
Sample Rate				2000	samples/s	5
Group Delay	LP-filter -3dB = 262Hz		6.1		ms	6
	LP-filter -3dB = 131Hz		7.6		ms	6
	LP-filter -3dB = 66Hz		11		ms	6
	LP-filter -3dB = 33Hz		17		ms	6
	LP-filter -3dB = 16Hz		29		ms	6
Offset error	@25°C		±0.75		mV	2
Offset drift			±2.8		µV/°C	
Noise			8		µV rms	
Input impedance			Ref. Figure 6-4			

Note 1: Full-scale input voltage (FS): V$_{IN}$ = (AUX+) – (AUX-)
Note 2: Gain and offset error can be calibrated by changing the calibration coefficients, ref. 8.4 and 10.10
Note 3: Largest deviation from BSL (Best Straight Line) over the range specified
Note 4: Other values can be configured, ref. Table 6-8 and section 6.1.4.1
Note 5: Other values can be configured, ref. Table 6-8. Sample rate will be same for gyros, accelerometers, inclinometers, AUX and temperature
Note 6: Total delay to start of datagram transmission = group delay + 0.5ms + t_{tov_dl} + t_{tx_dl}
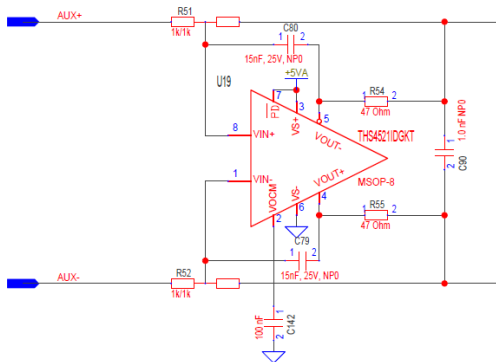
Figure 6-4: AUX input circuitry

Table 6-7: 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		%	
Sample Rate				2000	samples/s	2

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

Note 2: Other values can be configured, ref. Table 6-8. Sample rate will be same for gyros, accelerometers, inclinometers, AUX and temperature

6.1   TYPICAL PERFORMANCE CHARACTERISTICS

6.1.1   GYRO CHARACTERISTICS

6.1.1.1   Root Allan Variance of gyro
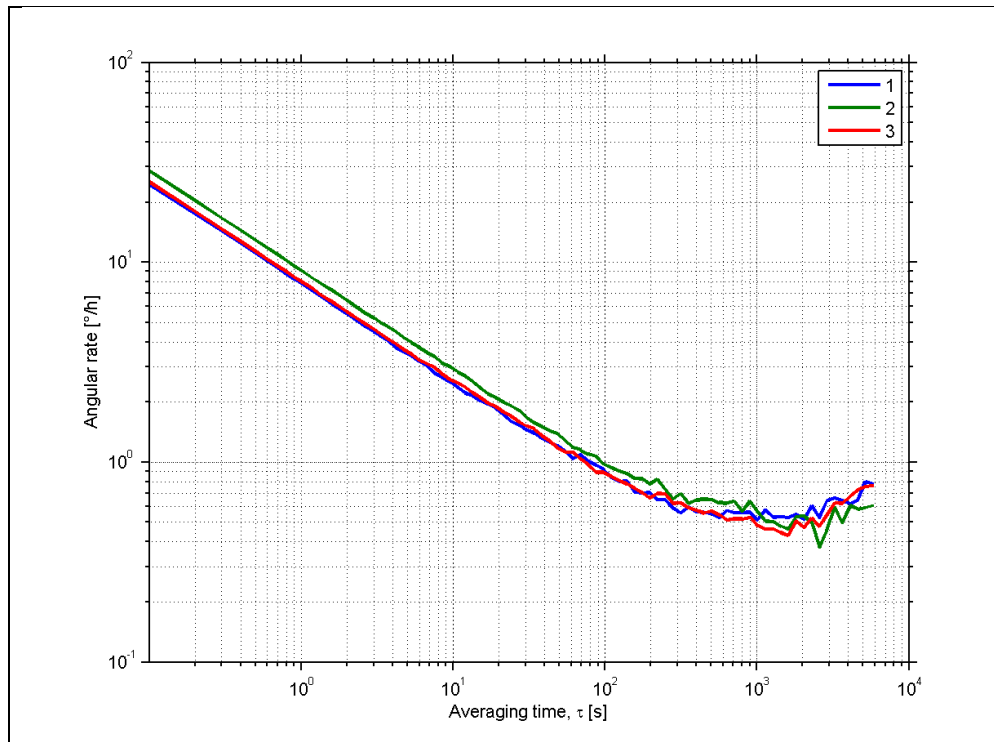
Figure 6-5: Typical Allan-Variance of gyro (400°/s gyro)

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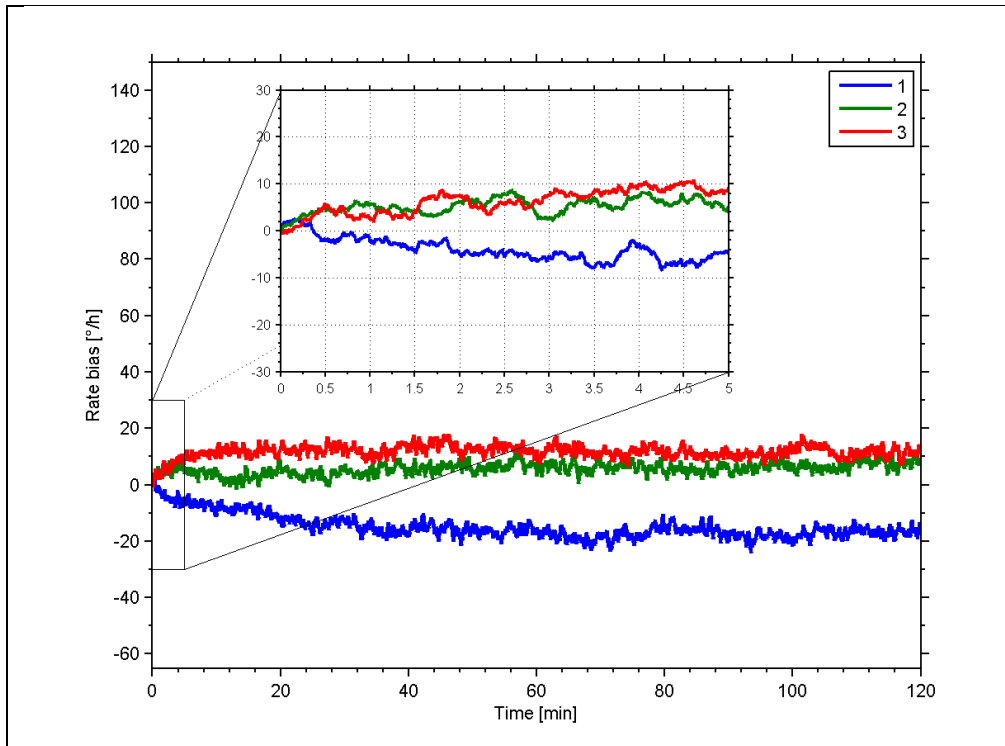
Figure 6-6: Typical normalized initial bias drift of gyro (400°/s gyro)

6.1.1.3   Bias drift over temperature
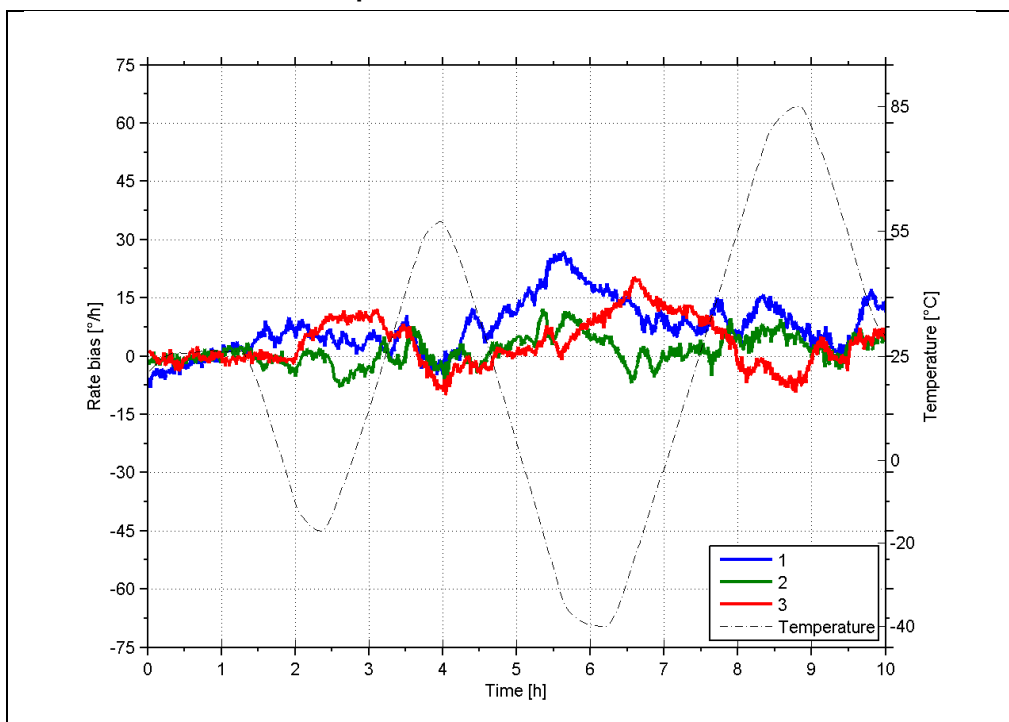
Figure 6-7: Typical Bias drift over temperature (400°/s gyro)

6.1.1.4 Frequency characteristics of gyros

Figure 6-8: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 16Hz

Figure 6-9: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 33Hz

Figure 6-10: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 66Hz

Figure 6-11: Frequency characteristics of gyros with low-pass filter -3dB frequency set to 131Hz

Figure 6-12: 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
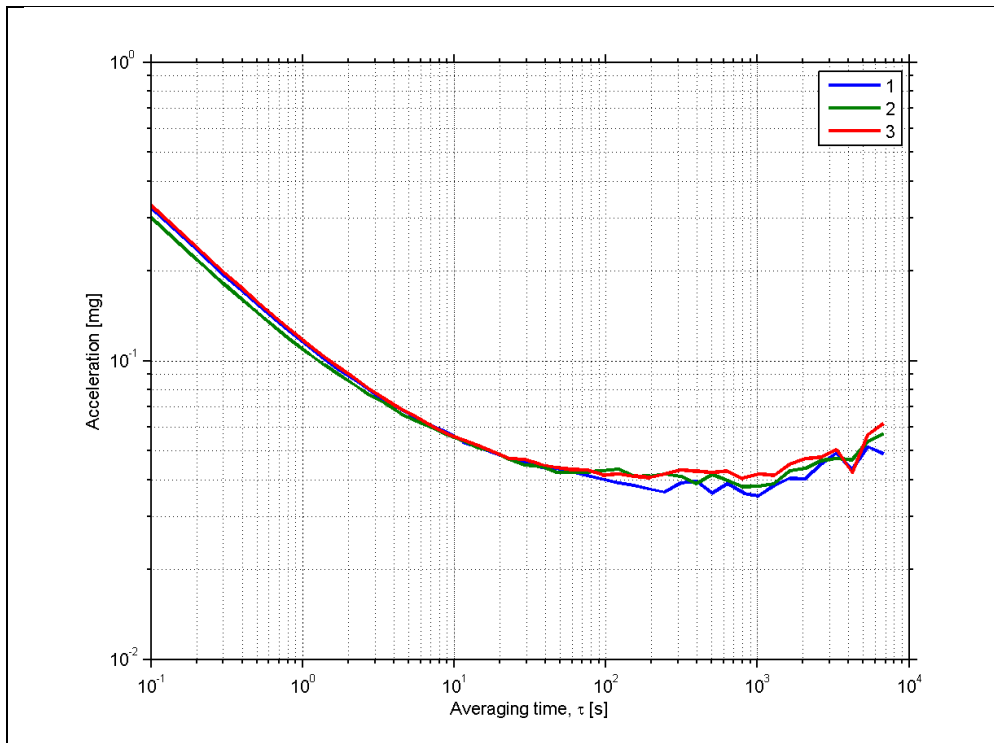
Figure 6-13: Typical Allan-Variance of accelerometer (10g accelerometer)

6.1.2.2 Initial bias drift of accelerometer
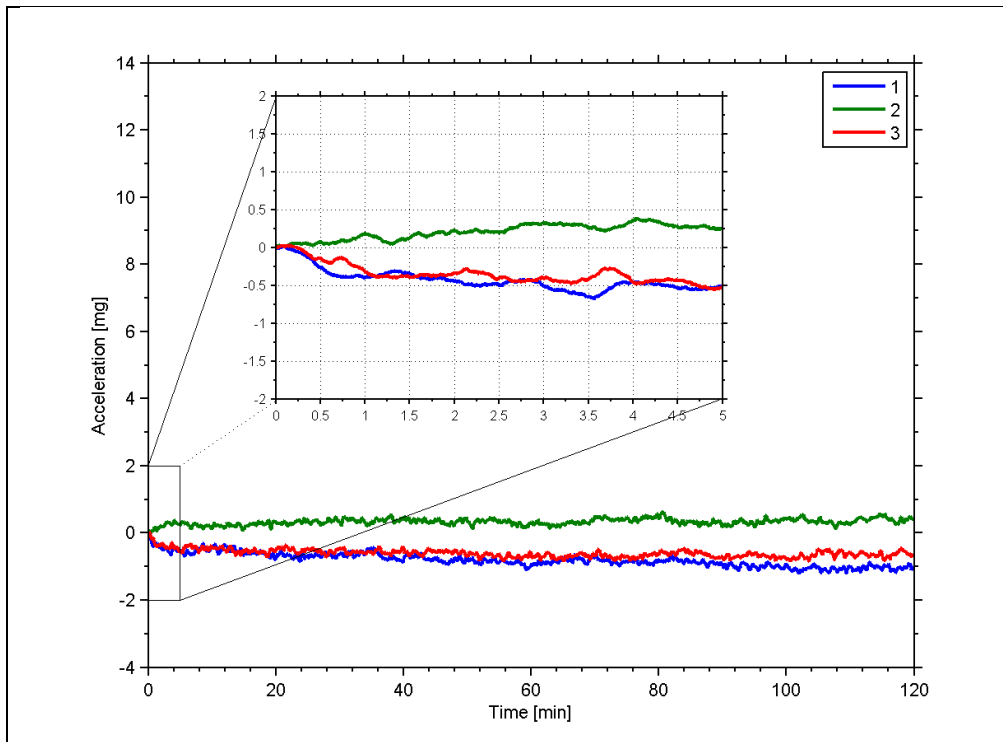
Figure 6-14: Typical normalized initial bias drift of accelerometer (10g accelerometer)

6.1.2.3   Frequency characteristics of accelerometers
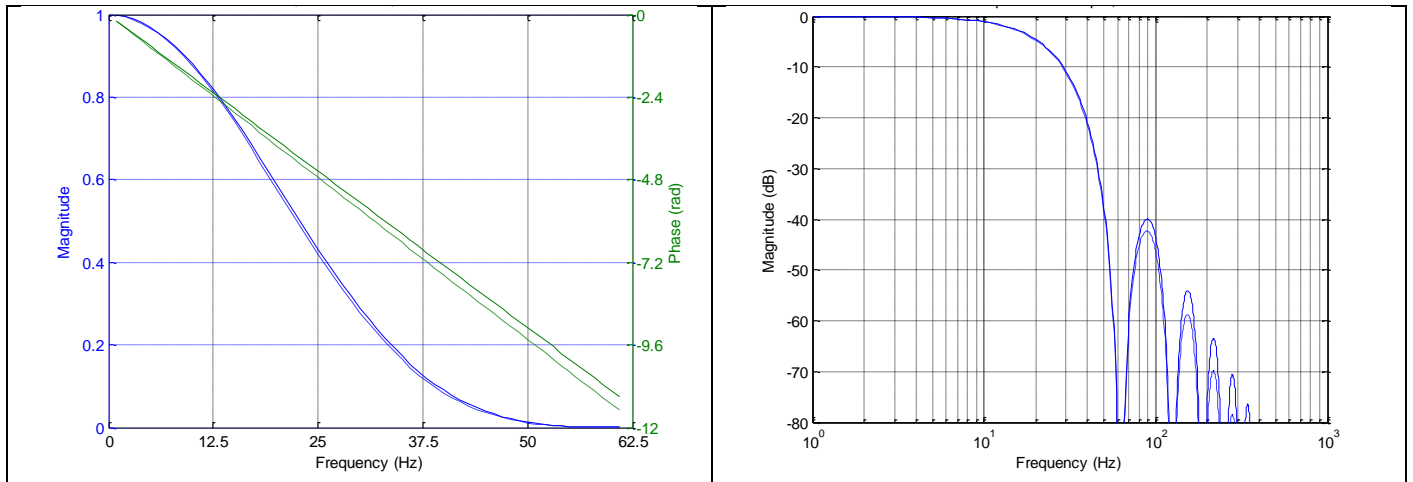
Figure 6-15: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 16Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)
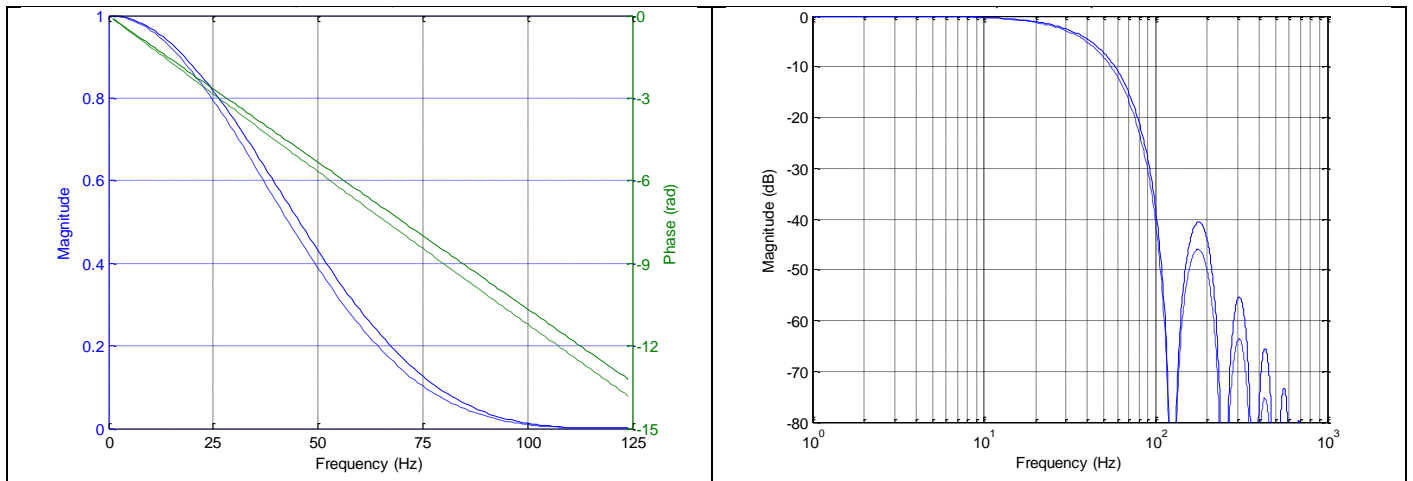
Figure 6-16: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 33Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)
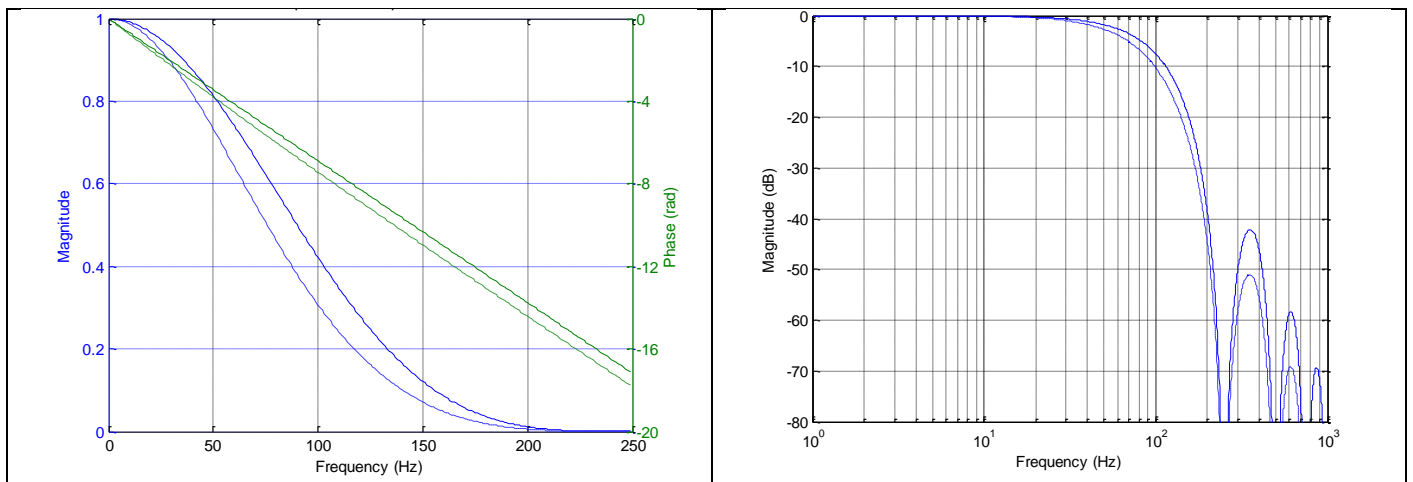
Figure 6-17: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 66Hz (solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)
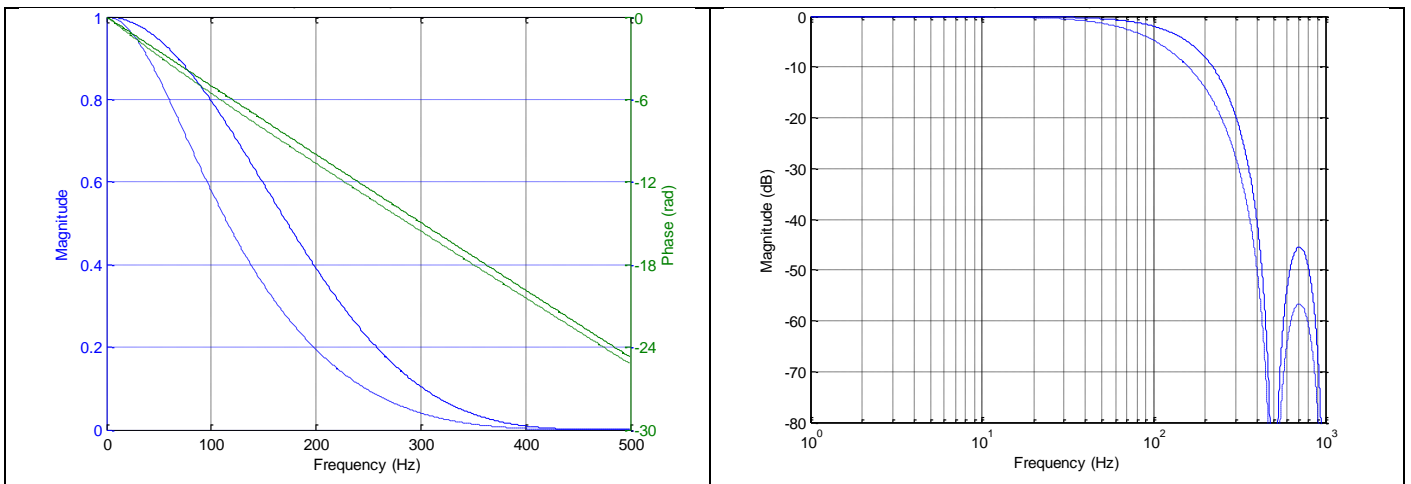
**Figure 6-18: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 131Hz
(solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)**
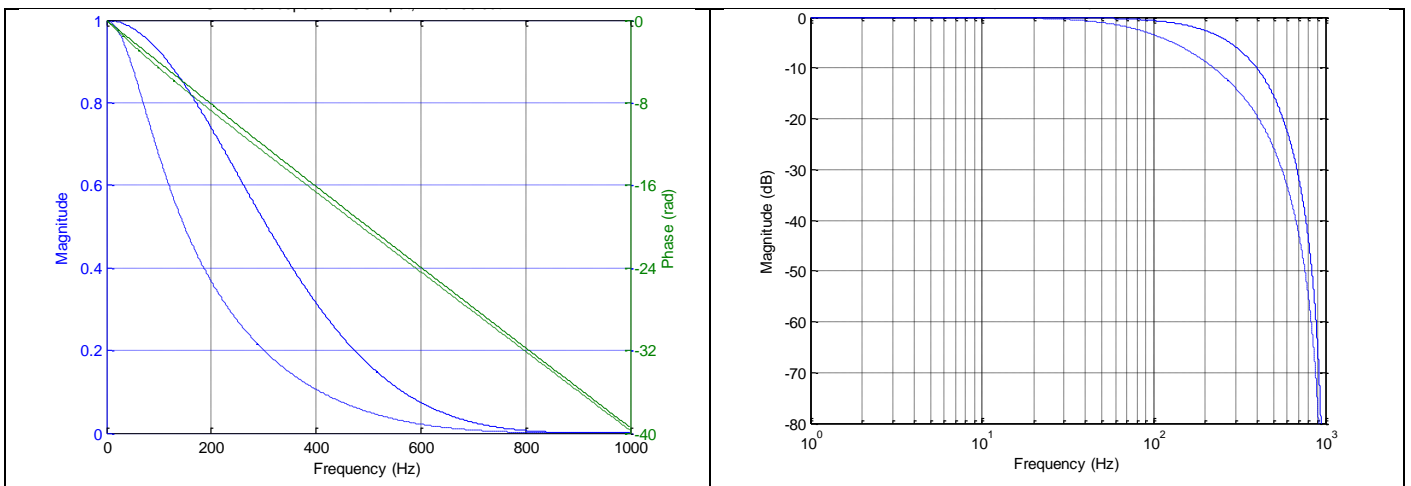
**Figure 6-19: Frequency characteristics of accelerometers with low-pass filter -3dB frequency set to 262Hz
(solid line: nominal, dashed line: minimum bandwidth, limited by accelerometer)**

6.1.3 INCLINOMETER CHARACTERISTICS

6.1.3.1 Root Allan Variance of inclinometer
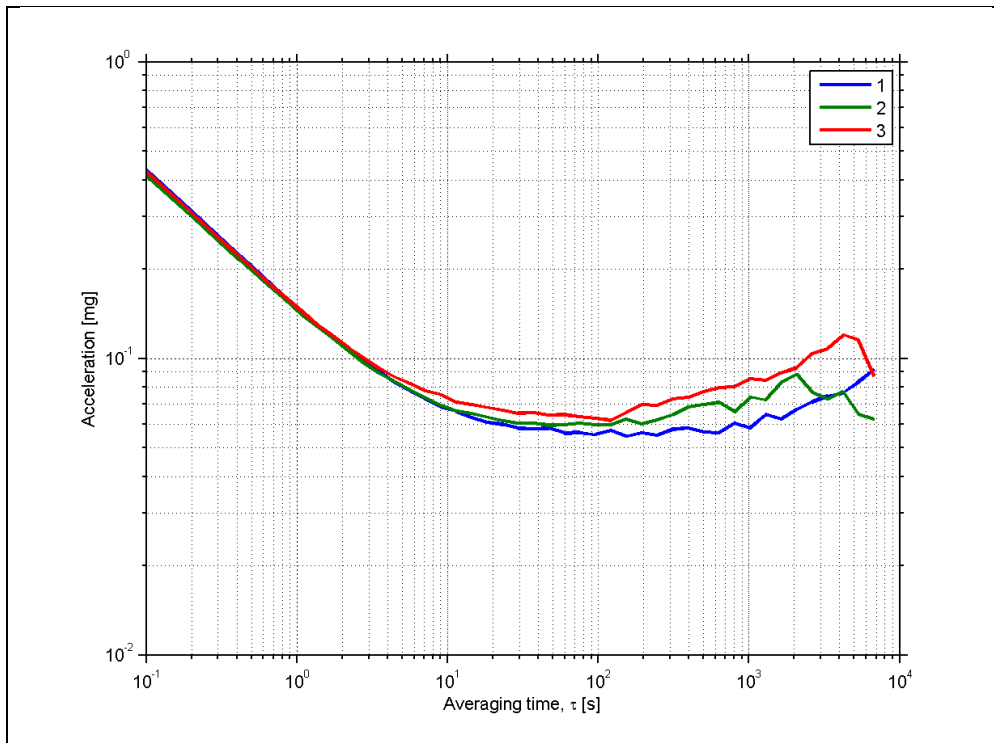
Figure 6-20: Typical Allan-Variance of inclinometer

6.1.3.2 Initial bias drift of inclinometer
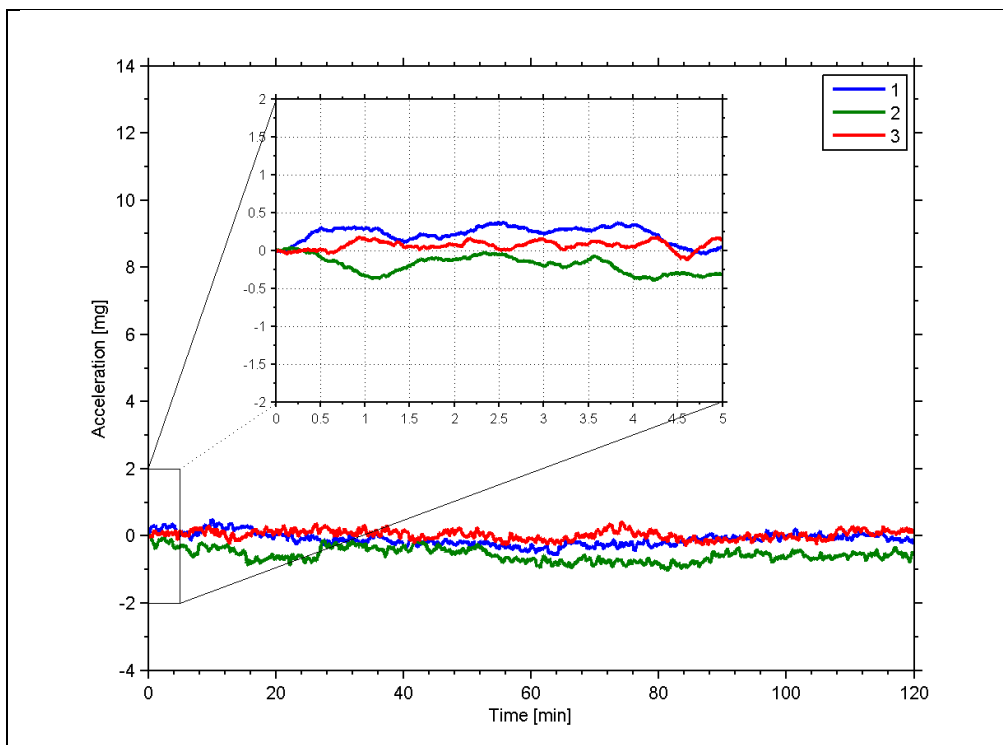
Figure 6-21: Typical normalized initial bias drift of inclinometer

6.1.3.3 Frequency characteristics of inclinometers
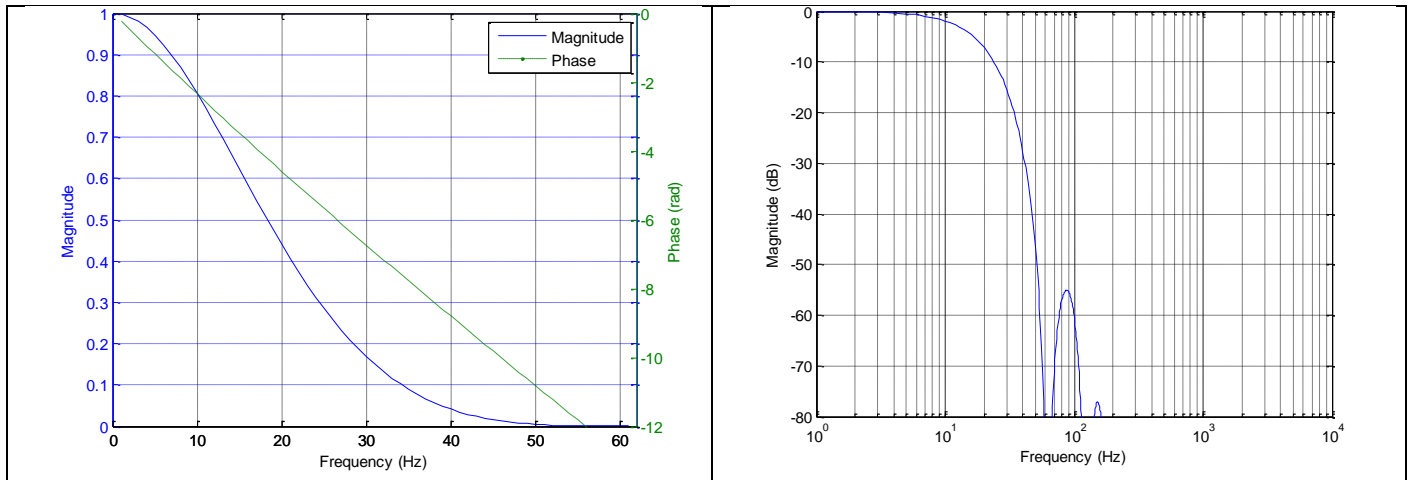
Figure 6-22: Frequency characteristics of inclinometers with low-pass filter -3dB frequency set to 16Hz
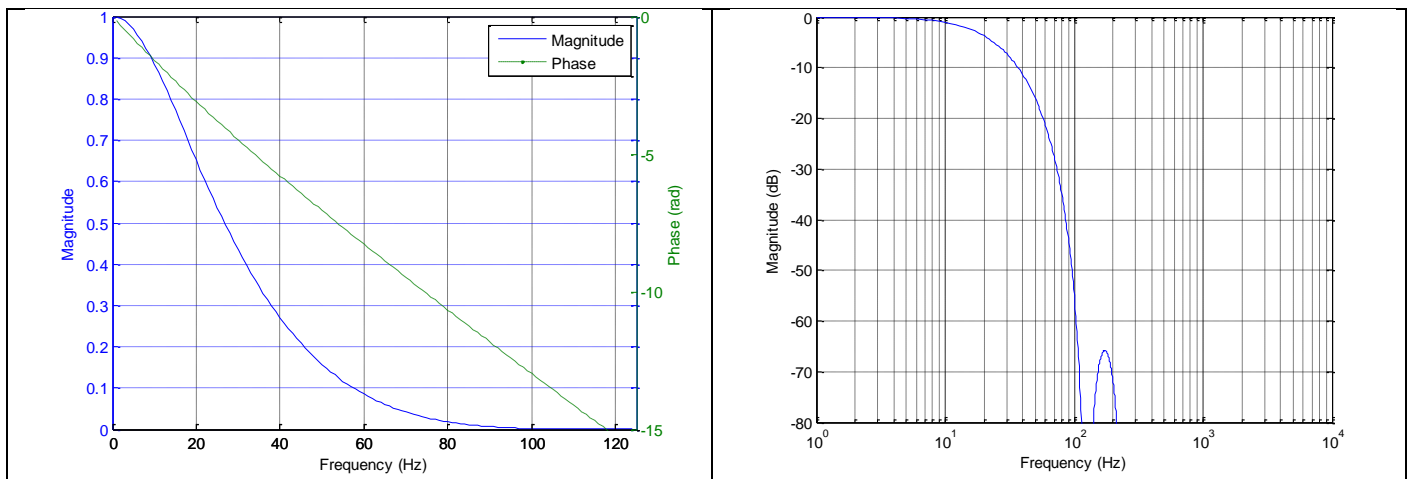
Figure 6-23: Frequency characteristics of inclinometers with low-pass filter -3dB frequency set to 33Hz
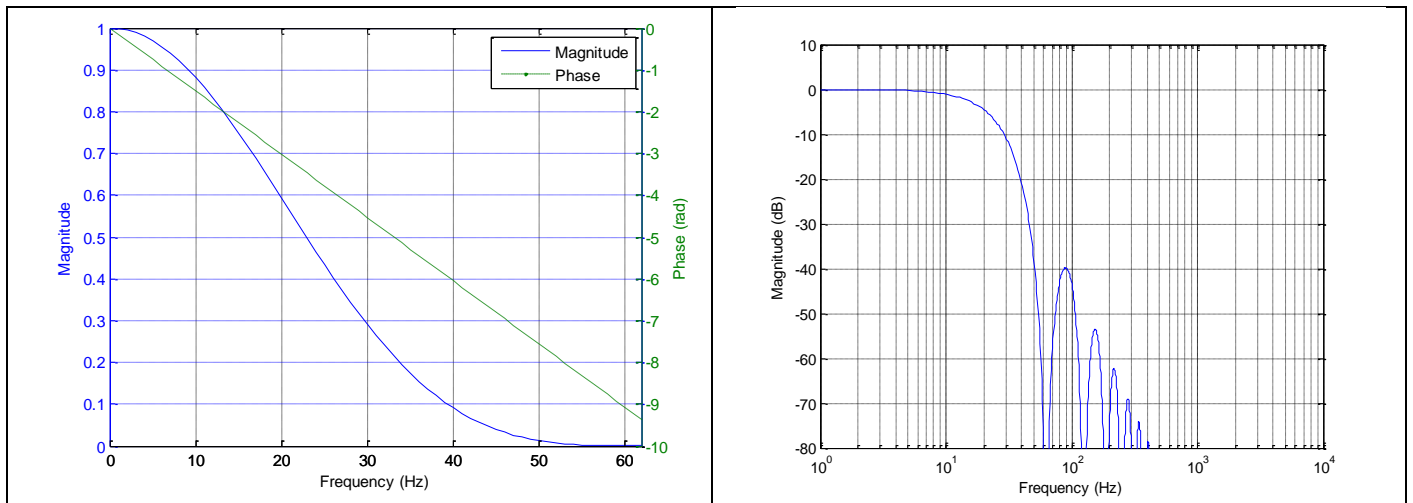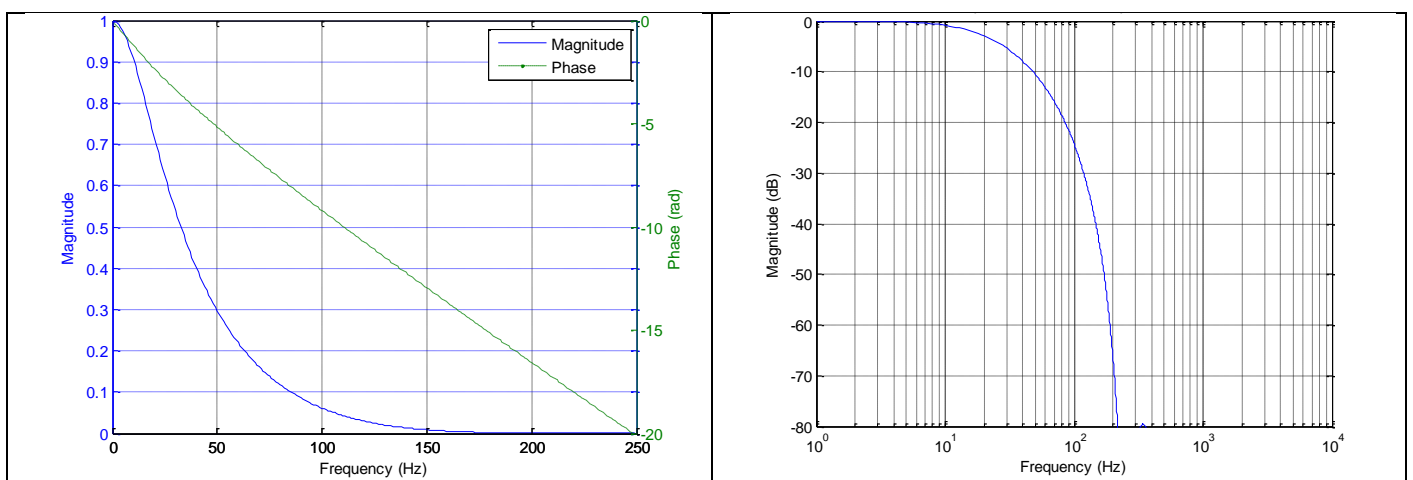

Figure 6-24: Frequency characteristics of inclinometers with low-pass filter -3dB frequency set to 66Hz
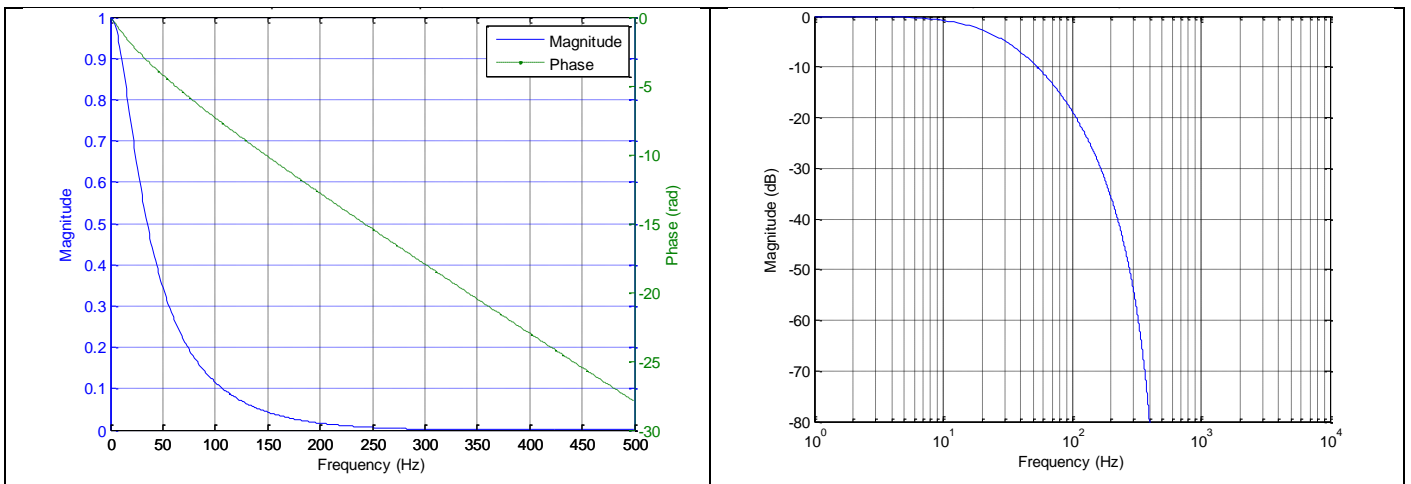
Figure 6-25: Frequency characteristics of inclinometers with low-pass filter -3dB frequency set to 131Hz
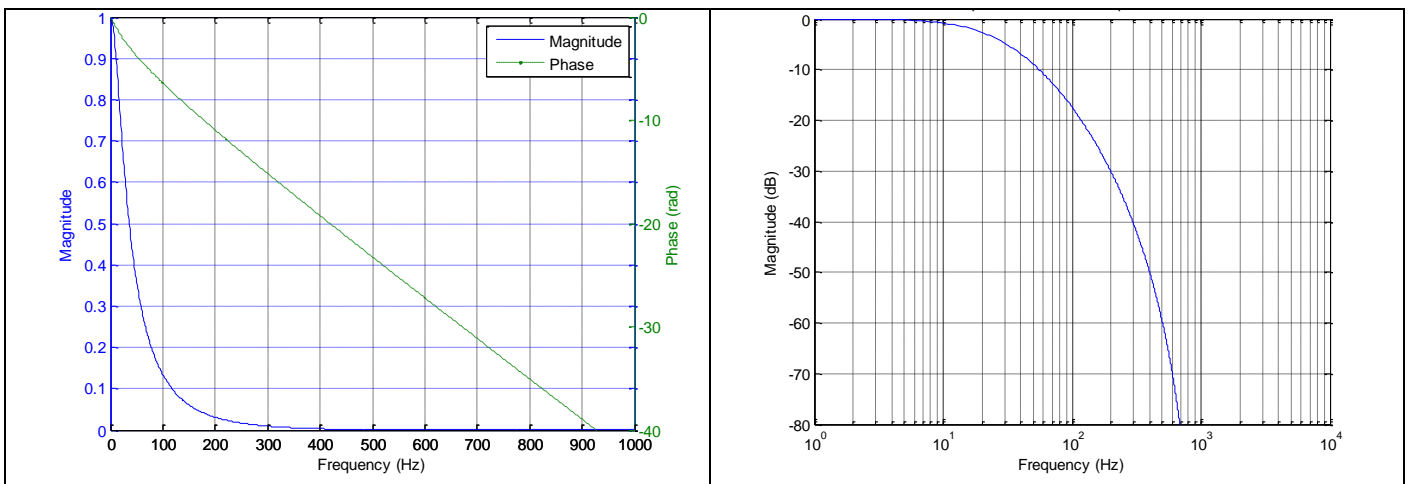
Figure 6-26: Frequency characteristics of inclinometers with low-pass filter -3dB frequency set to 262Hz

6.1.4 AUX CHARACTERISTICS

6.1.4.1 Frequency characteristics of AUX
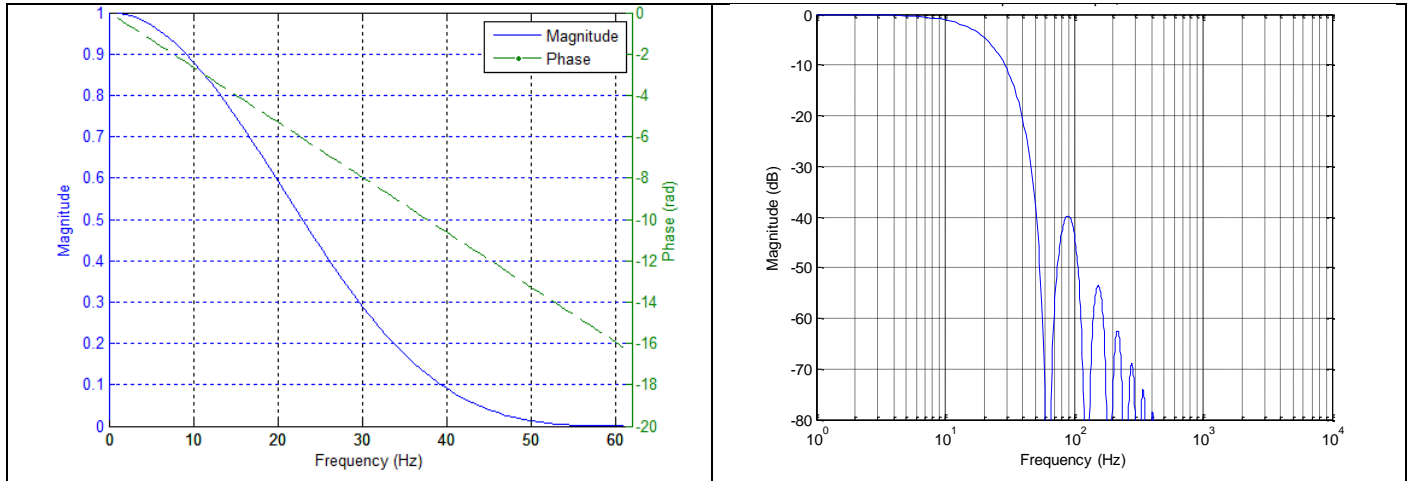
Figure 6-27: Frequency characteristics of AUX with low-pass filter -3dB frequency set to 16Hz
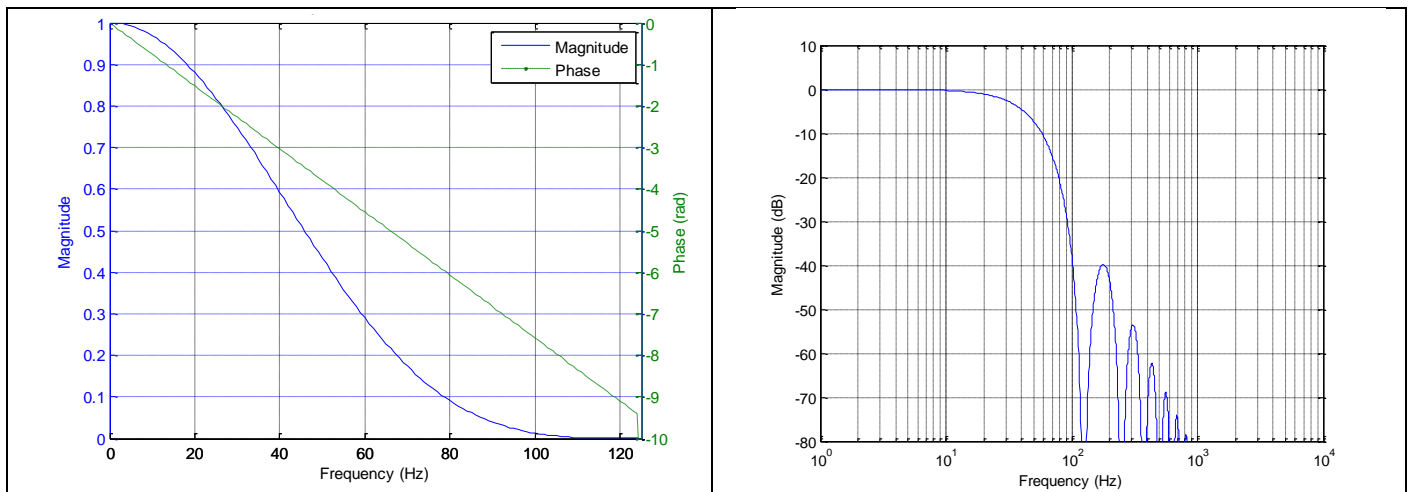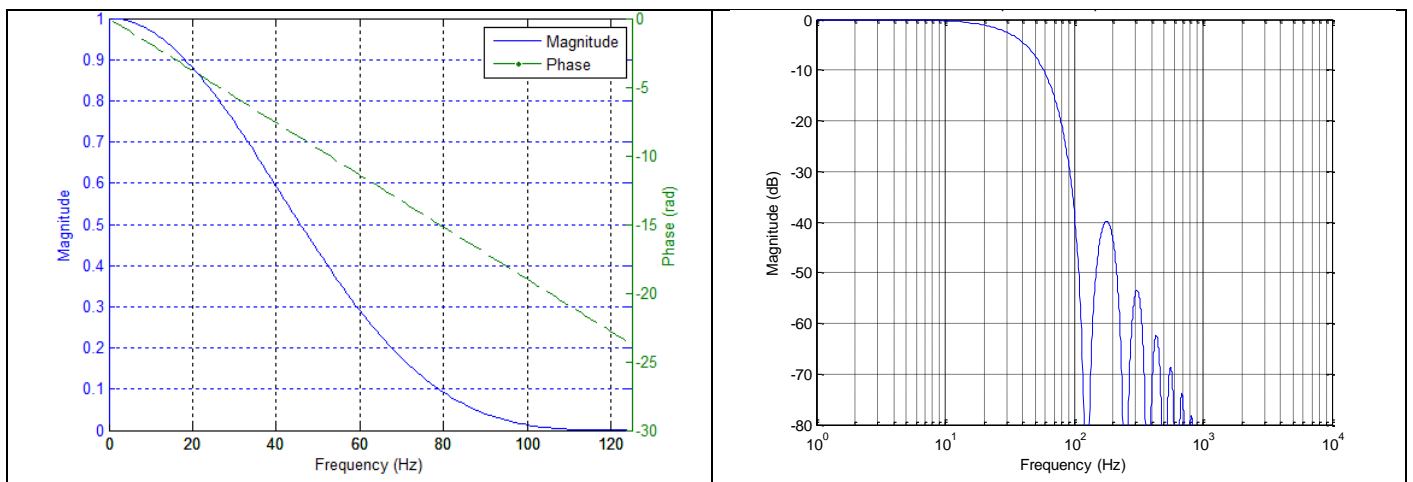

Figure 6-28: Frequency characteristics of AUX with low-pass filter -3dB frequency set to 33Hz
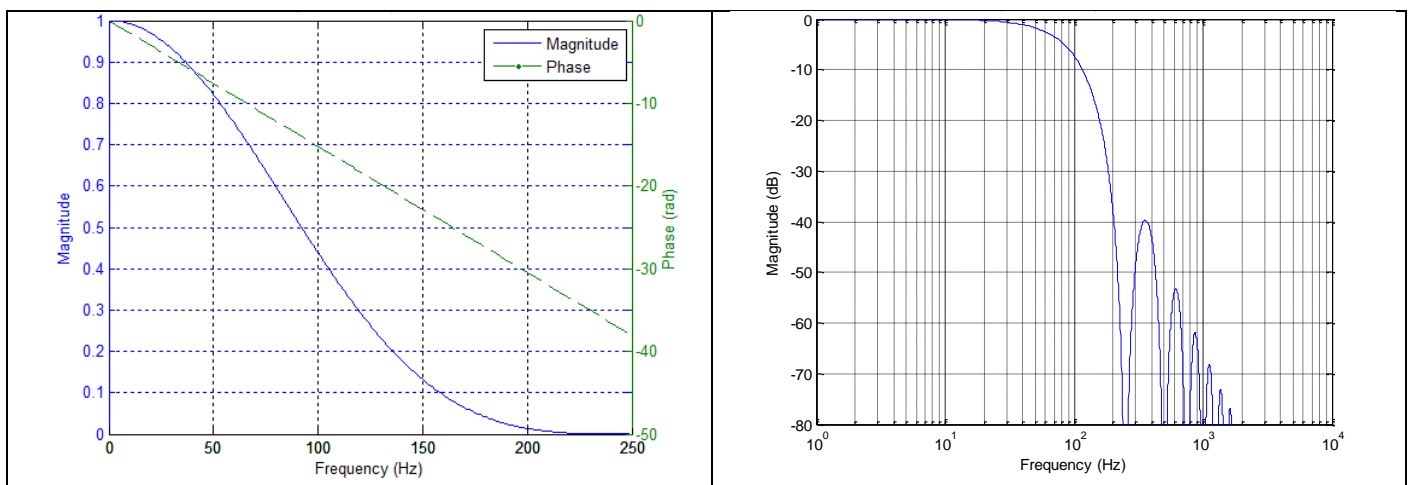
Figure 6-29: Frequency characteristics of AUX with low-pass filter -3dB frequency set to 66Hz
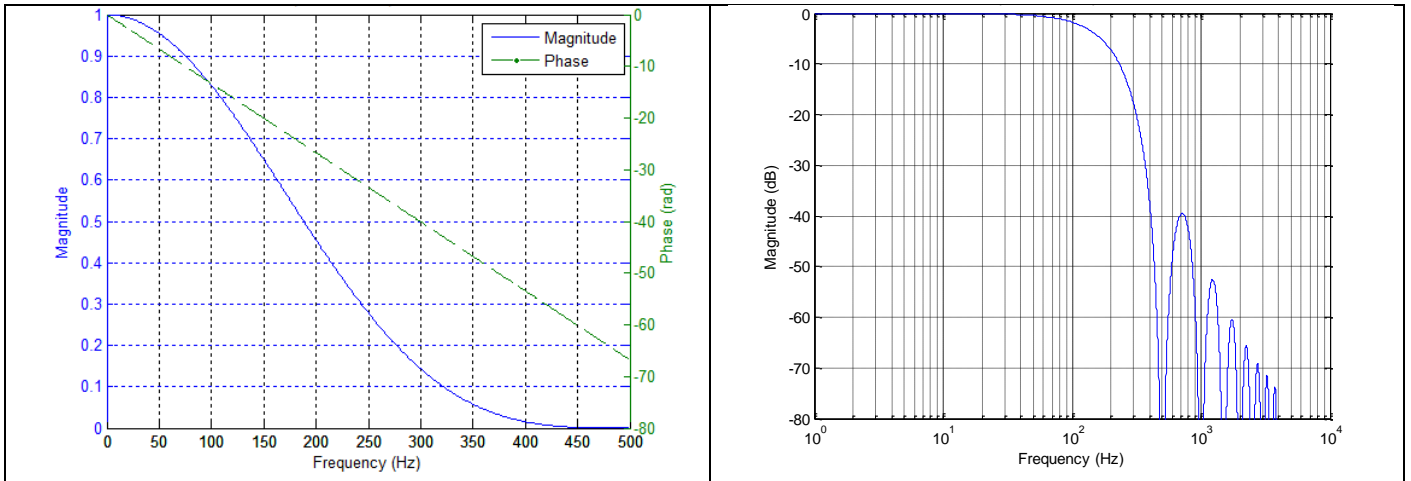
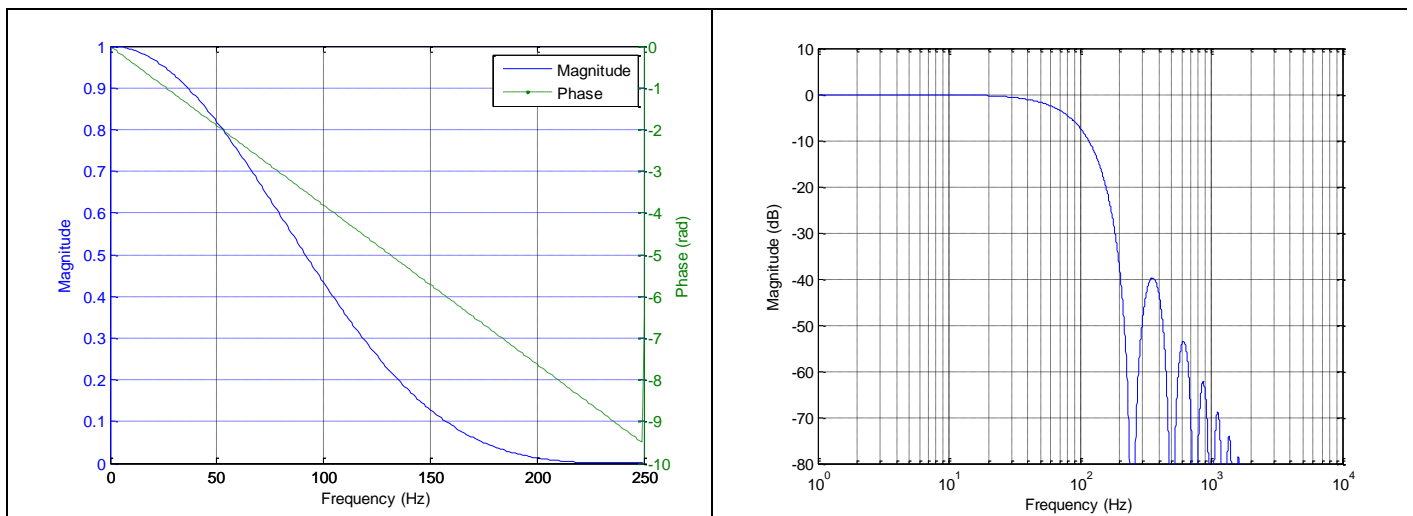**Figure 6-30: Frequency characteristics of AUX with low-pass filter -3dB frequency set to 131Hz**

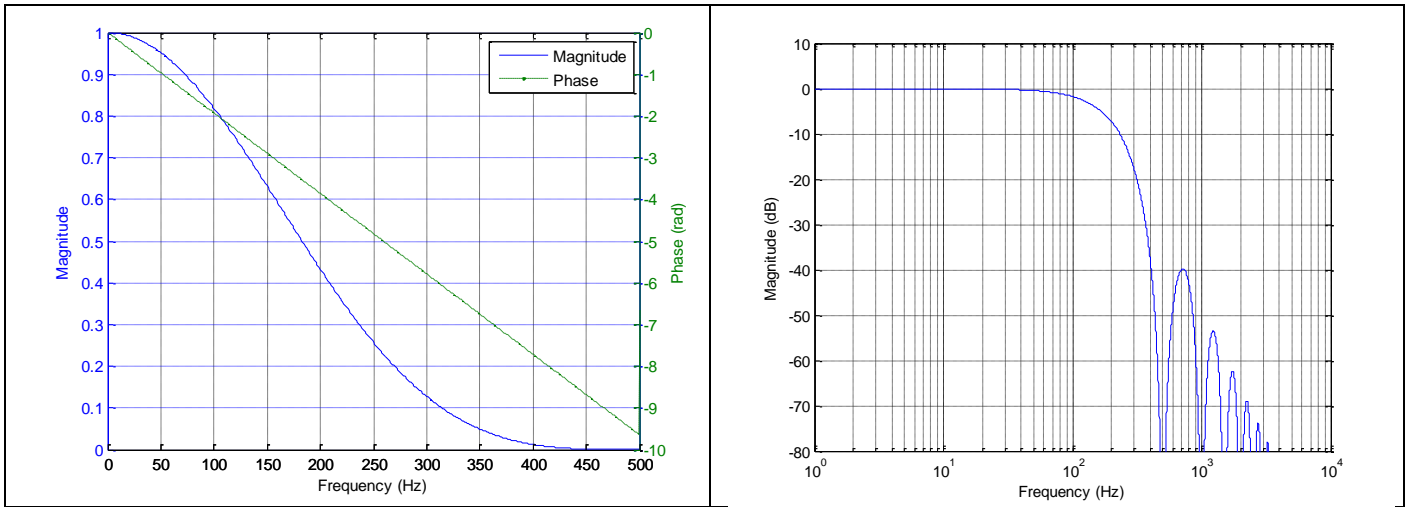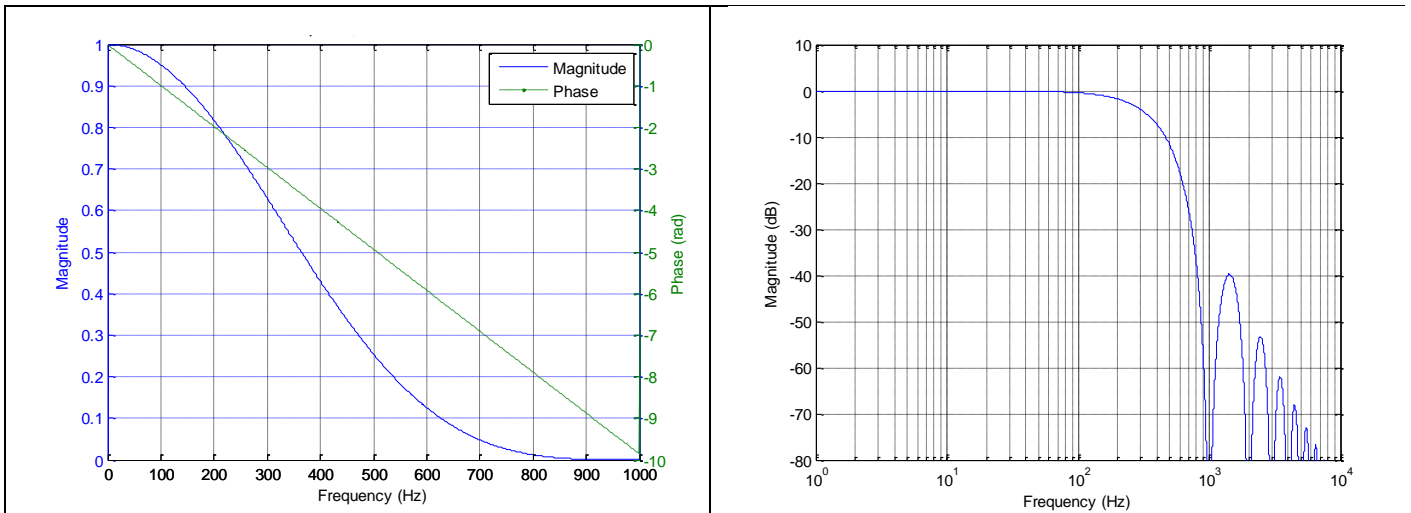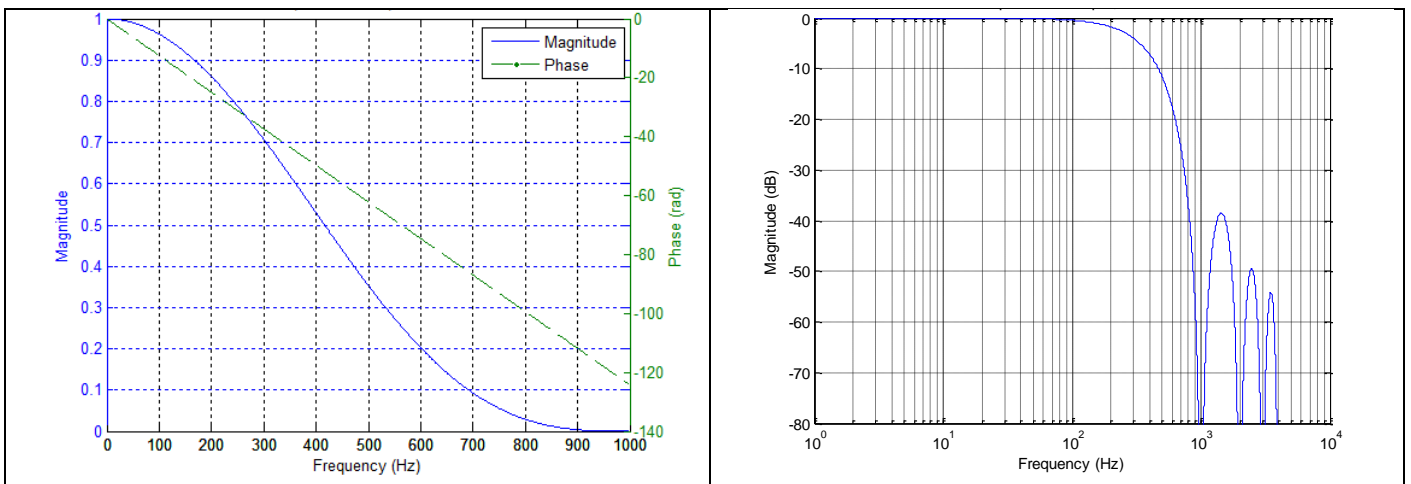**Figure 6-31: Frequency characteristics of AUX with low-pass filter -3dB frequency set to 262Hz**

6.2 Configurable parameters

Table 6-8: 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 6-9
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]	
MEASUREMENT UNIT INCLINOMETER	Acceleration [g] Incremental velocity [m/s/sample] Average acceleration [g]	
DATAGRAM	Rate together with any combination of acceleration, inclination, temperature and AUX	
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 6-9. 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 12 for information on how to configure STIM300 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 6-9 show the maximum bit-rates.

Table 6-9: Maximum sample rate

Datagram content	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	18	1000	2000	2000	2000
Rate and acceleration	28	1000	1000	2000	2000
Rate and inclincation	28	1000	1000	2000	2000
Rate, acceleration and inclination	38	500	1000	2000	2000
Rate and temperature	25	1000	1000	2000	2000
Rate, acceleration and temperature	42	500	500	1000	2000
Rate, inclination and temperature	42	500	500	1000	2000
Rate, acceleration, inclination and temperature	59	500	500	1000	2000
Rate and AUX	22	1000	1000	2000	2000
Rate, acceleration and AUX	32	1000	1000	2000	2000
Rate, inclination and AUX	32	1000	1000	2000	2000
Rate, acceleration, inclination and AUX	42	500	500	1000	2000
Rate, temperature and AUX	29	1000	1000	2000	2000
Rate, acceleration, temperature and AUX	46	500	500	1000	2000
Rate, inclination, temperature and AUX	46	500	500	1000	2000
Rate, acceleration, inclination, temperature and AUX	63	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 6-10: Specification of the Part Number datagram

Byte#	7	6	5	4	3	2	1	0	Specification

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	$P1_3$	$P1_2$	$P1_1$	$P1_0$	Low nibble: 1.digit (BCD) of part number
2	$P2_3$	$P2_2$	$P2_1$	$P2_0$	$P3_3$	$P3_2$	$P3_1$	$P3_0$	High nibble: 2.digit (BCD) of part number Low nibble: 3.digit (BCD) of part number
3	$P4_3$	$P4_2$	$P4_1$	$P4_0$	$P5_3$	$P5_2$	$P5_1$	$P5_0$	High nibble: 4.digit (BCD) of part number Low nibble: 5.digit (BCD) of part number
4	0	0	1	0	1	1	0	1	ASCII character "-" (0x2D)
5	$P6_3$	$P6_2$	$P6_1$	$P6_0$	$P7_3$	$P7_2$	$P7_1$	$P7_0$	High nibble: 6.digit (BCD) of part number Low nibble: 7.digit (BCD) of part number
6	$P8_3$	$P8_2$	$P8_1$	$P8_0$	$P9_3$	$P9_2$	$P9_1$	$P9_0$	High nibble: 8.digit (BCD) of part number Low nibble: 9.digit (BCD) of part number
7	$P10_3$	$P10_2$	$P10_1$	$P10_0$	$P11_3$	$P11_2$	$P11_1$	$P11_0$	High nibble: 10.digit (BCD) of part number Low nibble: 11.digit (BCD) of part number
8	0	0	1	0	1	1	0	1	ASCII character "-" (0x2D)
9	$P12_3$	$P12_2$	$P12_1$	$P12_0$	$P13_3$	$P13_2$	$P13_1$	$P13_0$	High nibble: 12.digit (BCD) of part number Low nibble: 13.digit (BCD) of part number
10	$P14_3$	$P14_2$	$P14_1$	$P14_0$	x	x	x	x	High nibble: 14.digit (BCD) 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}	
17	c_{23}	c_{22}	c_{21}	c_{20}	c_{19}	c_{18}	c_{17}	c_{16}	Cyclic Redundancy Check is performed on all preceding bytes, ref: 6.3.5
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 6-11: Specification of the Serial Number datagram

Byte#	Bit# 7	6	5	4	3	2	1	0	Specification
0	1	0	1	1	0	1	0	1	**Serial Number datagram identifier:** 0xB5 for datagrams without CR+LF termination
	1	0	1	1	0	1	1	1	0xB7 for datagrams with CR+LF termination
1	0	1	0	0	1	1	1	0	ASCII-character for letter "N"
2	$S1_3$	$S1_2$	$S1_1$	$S1_0$	$S2_3$	$S2_2$	$S2_1$	$S2_0$	High nibble: 1.digit (BCD) of serial number Low nibble: 2.digit (BCD) of serial number
3	$S3_3$	$S3_2$	$S3_1$	$S3_0$	$S4_3$	$S4_2$	$S4_1$	$S4_0$	High nibble: 3.digit (BCD) of serial number Low nibble: 4.digit (BCD) of serial number
4	$S5_3$	$S5_2$	$S5_1$	$S5_0$	$S6_3$	$S6_2$	$S6_1$	$S6_0$	High nibble: 5.digit (BCD) of serial number Low nibble: 6.digit (BCD) of serial number
5	$S7_3$	$S7_2$	$S7_1$	$S7_0$	$S8_3$	$S8_2$	$S8_1$	$S8_0$	High nibble: 7.digit (BCD) of serial number Low nibble: 8.digit (BCD) of serial number
6	$S9_3$	$S9_2$	$S9_1$	$S9_0$	$S10_3$	$S10_2$	$S10_1$	$S10_0$	High nibble: 9.digit (BCD) of serial number Low nibble: 10.digit (BCD) of serial number
7	$S11_3$	$S11_2$	$S11_1$	$S11_0$	$S11_3$	$S11_2$	$S11_1$	$S11_0$	High nibble: 11.digit (BCD) of serial number Low nibble: 12.digit (BCD) of serial number
8	$S13_3$	$S13_2$	$S13_1$	$S13_0$	$S14_3$	$S14_2$	$S14_1$	$S14_0$	High nibble: 13.digit (BCD) of serial number Low nibble: 14.digit (BCD) of serial number
9	x	x	x	x	x	x	x	x	For future use
10	x	x	x	x	x	x	x	x	For future use
11	x	x	x	x	x	x	x	x	For future use
12	x	x	x	x	x	x	x	x	For future use
13	x	x	x	x	x	x	x	x	For future use
14	x	x	x	x	x	x	x	x	For future use
15	x	x	x	x	x	x	x	x	For future use
16	c_{31}	c_{30}	c_{29}	c_{28}	c_{27}	c_{26}	c_{25}	c_{24}	
17	c_{23}	c_{22}	c_{21}	c_{20}	c_{19}	c_{18}	c_{17}	c_{16}	Cyclic Redundancy Check is performed on all preceding bytes, ref: 6.3.5
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 6-12: Specification of the Configuration datagram

Byte#	Bit# 7	6	5	4	3	2	1	0	Specification
0	1	0	1	1	1	0	0	1	**Configuration datagram identifier:** 0xBC for datagrams without CR+LF termination
	1	0	1	1	1	0	1	1	0xBD 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	0	x	x	x	x	AUX not included in Datagram
	x	x	x	1	x	x	x	x	AUX included in Datagram
	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	Inclination not included in Normal Mode datagram
	x	x	x	x	x	1	x	x	Inclination 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 = 121Hz
	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 = 121Hz
	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 = 121Hz
	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	0	1	Gyro g-comp: bias = INC , scale = OFF,
	x	x	x	x	0	1	1	0	Gyro g-comp: bias = INC+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	0	1	Gyro g-comp: bias = INC, scale = ACC
	x	x	x	x	1	0	1	0	Gyro g-comp: bias = INC+DC-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	0	0	Gyro g-comp: bias = INC+0.01Hz-filter, scale = INC+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
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	0	x	x	x	x	x	x	**System configuration, Byte 9:** Inclinometer X-axis is inactive
	x	1	x	x	x	x	x	x	Inclinometer X-axis is active
	x	x	0	x	x	x	x	x	Inclinometer Y-axis is inactive
	x	x	1	x	x	x	x	x	Inclinometer Y-axis is active
	x	x	x	0	x	x	x	x	Inclinometer Z-axis is inactive
	x	x	x	1	x	x	x	x	Inclinometer Z-axis is active
	x	x	x	x	0	0	0	0	Inclinometer output unit = ACCELERATION
	x	x	x	x	0	0	0	1	Inclinometer output unit = INCREMENTAL VELOCITY
	x	x	x	x	0	0	1	0	Inclinometer output unit = AVERAGE ACCELERATION
12	x	0	0	0	x	x	x	x	**System configuration, Byte 10:** Inclinometer LP filter -3dB frequency for X-axis = 16Hz
	x	0	0	1	x	x	x	x	Inclinometer LP filter -3dB frequency for X-axis = 33Hz
	x	0	1	0	x	x	x	x	Inclinometer LP filter -3dB frequency for X-axis = 66Hz
	x	0	1	1	x	x	x	x	Inclinometer LP filter -3dB frequency for X-axis = 121Hz
	x	1	0	0	x	x	x	x	Inclinometer LP filter -3dB frequency for X-axis = 262Hz
	x	x	x	x	x	0	0	0	Inclinometer LP filter -3dB frequency for Y-axis = 16Hz
	x	x	x	x	x	0	0	1	Inclinometer LP filter -3dB frequency for Y-axis = 33Hz
	x	x	x	x	x	0	1	0	Inclinometer LP filter -3dB frequency for Y-axis = 66Hz
	x	x	x	x	x	0	1	1	Inclinometer LP filter -3dB frequency for Y-axis = 121Hz
	x	x	x	x	x	1	0	0	Inclinometer LP filter -3dB frequency for Y-axis = 262Hz
13	x	0	0	0	x	x	x	x	**System configuration, Byte 11:** Inclinometer LP filter -3dB frequency for Z-axis = 16Hz
	x	0	0	1	x	x	x	x	Inclinometer LP filter -3dB frequency for Z-axis = 33Hz
	x	0	1	0	x	x	x	x	Inclinometer LP filter -3dB frequency for Z-axis = 66Hz
	x	0	1	1	x	x	x	x	Inclinometer LP filter -3dB frequency for Z-axis = 121Hz
	x	1	0	0	x	x	x	x	Inclinometer LP filter -3dB frequency for Z-axis = 262Hz

Byte	b7	b6	b5	b4	b3	b2	b1	b0	Description
14	x	0	0	0	x	x	x	x	**System configuration, Byte 12:** AUX LP filter -3dB frequency = 16Hz
	x	0	0	1	x	x	x	x	AUX LP filter -3dB frequency = 33Hz
	x	0	1	0	x	x	x	x	AUX LP filter -3dB frequency = 66Hz
	x	0	1	1	x	x	x	x	AUX LP filter -3dB frequency = 121Hz
	x	1	0	0	x	x	x	x	AUX LP filter -3dB frequency = 262Hz
15	0	0	0	0	x	x	x	x	High nibble: Gyro range, x-axis - 400°/s Low nibble: Gyro range, y-axis
	x	x	x	x	0	0	0	0	- 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
	0	0	1	0	x	x	x	x	- 2g
	0	0	1	1	x	x	x	x	- 5g
	0	1	0	0	x	x	x	x	- 30g
	0	1	1	0	x	x	x	x	- 80g
	x	x	x	x	0	0	0	0	Low nibble: Accelerometer range, y-axis - 10g
	x	x	x	x	0	0	1	0	- 2g
	x	x	x	x	0	0	1	1	- 5g
	x	x	x	x	0	1	0	0	- 30g
	x	x	x	x	0	1	1	0	- 80g
18	0	0	0	0	x	x	x	x	High nibble: Accelerometer range, z-axis - 10g
	0	0	1	0	x	x	x	x	- 2g
	0	0	1	1	x	x	x	x	- 5g
	0	1	0	0	x	x	x	x	- 30g
	0	1	1	0	x	x	x	x	- 80g
19	0	0	0	0	x	x	x	x	High nibble: Inclinometer range, x-axis - 1.7g Low nibble: Inclinometer range, y-axis
	x	x	x	x	0	0	0	0	- 1.7g
20	0	0	0	0	x	x	x	x	High nibble: Inclinometer range, z-axis - 1.7g
21	0	0	0	0	x	x	x	x	High nibble: AUX range - ±2.5V
22	c_{31}	c_{30}	c_{29}	c_{28}	c_{27}	c_{26}	c_{25}	c_{24}	
23	c_{23}	c_{22}	c_{21}	c_{20}	c_{19}	c_{18}	c_{17}	c_{16}	Cyclic Redundancy Check is performed on all preceding bytes, ref:
24	c_{15}	c_{14}	c_{13}	c_{12}	c_{11}	c_{10}	c_9	c_8	6.3.5
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 Normal Mode datagram

Table 6-13: Specification of the Normal Mode datagram (full data content in datagram)

Byte#	Bit# 7	6	5	4	3	2	1	0	Specification
0	0	0	0	1	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 6-14
1	Gx_{23}	Gx_{22}	Gx_{21}	Gx_{20}	Gx_{19}	Gx_{18}	Gx_{17}	Gx_{16}	
2	Gx_{15}	Gx_{14}	Gx_{13}	Gx_{12}	G_{11}	Gx_{10}	Gx_9	Gx_8	X-axis gyro output, ref. section 8.5.2.2.1 to 8.5.2.2.5 for conversion to units
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. section 8.5.2.2.1 to 8.5.2.2.5 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	Z-axis gyro output, ref. section 8.5.2.2.1 to 8.5.2.2.5 for conversion to units
9	Gz_7	Gz_6	Gz_5	Gz_4	Gz_3	Gz_2	Gz_1	Gz_0	
10	Gs_7	Gs_6	Gs_5	Gs_4	Gs_3	Gs_2	Gs_1	Gs_0	STATUS byte for gyro measurements, ref.Table 6-16
11	Ax_{23}	Ax_{22}	Ax_{21}	Ax_{20}	Ax_{19}	Ax_{18}	Ax_{17}	Ax_{16}	
12	Ax_{15}	Ax_{14}	Ax_{13}	Ax_{12}	Ax_{11}	Ax_{10}	Ax_9	Ax_8	X-axis accelerometer output, ref. section 8.5.2.2.7 to 8.5.2.2.9 for conversion to units
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. section 8.5.2.2.7 to 8.5.2.2.9 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	Z-axis accelerometer output, ref. section 8.5.2.2.7 to 8.5.2.2.9 for conversion to units
19	Az_7	Az_6	Az_5	Az_4	Az_3	Az_2	Az_1	Az_0	
20	As_7	As_6	As_5	As_4	As_3	As_2	As_1	As_0	STATUS byte for accelerometer measurements, ref.Table 6-16
21	Ix_{23}	Ix_{22}	Ix_{21}	Ix_{20}	Ix_{19}	Ix_{18}	Ix_{17}	Ix_{16}	
22	Ix_{15}	Ix_{14}	Ix_{13}	Ix_{12}	Ix_{11}	Ix_{10}	Ix_9	Ix_8	X-axis Inclinometer output, ref. section 8.5.2.2.10 to 8.5.2.2.12 for conversion to units
23	Ix_7	Ix_6	Ix_5	Ix_4	Ix_3	Ix_2	Ix_1	Ix_0	
24	Iy_{23}	Iy_{22}	Iy_{21}	Iy_{20}	Iy_{19}	Iy_{18}	Iy_{17}	Iy_{16}	
25	Iy_{15}	Iy_{14}	Iy_{13}	Iy_{12}	Iy_{11}	Iy_{10}	Iy_9	Iy_8	Y-axis Inclinometer output, ref. section 8.5.2.2.10 to 8.5.2.2.12 for conversion to units
26	Iy_7	Iy_6	Iy_5	Iy_4	Iy_3	Iy_2	Iy_1	Iy_0	
27	Iz_{23}	Iz_{22}	Iz_{21}	Iz_{20}	Iz_{19}	Iz_{18}	Iz_{17}	Iz_{16}	
28	Iz_{15}	Iz_{14}	Iz_{13}	Iz_{12}	Iz_{11}	Iz_{10}	Iz_9	Iz_8	Z-axis Inclinometer output, ref. section 8.5.2.2.10 to 8.5.2.2.12 for conversion to units
29	Iz_7	Iz_6	Iz_5	Iz_4	Iz_3	Iz_2	Iz_1	Iz_0	
30	Is_7	Is_6	Is_5	Is_4	Is_3	Is_2	Is_1	Is_0	STATUS byte for inclinometer measurements, ref.Table 6-16
31	GTx_{15}	GTx_{14}	GTx_{13}	GTx_{12}	GTx_{11}	GTx_{10}	GTx_9	GTx_8	X-axis gyro temperature data, ref. chapter 0 for conversion to units
32	GTx_7	GTx_6	GTx_5	GTx_4	GTx_3	GTx_2	GTx_1	GTx_0	
33	GTy_{15}	GTy_{14}	GTy_{13}	GTy_{12}	GTy_{11}	GTy_{10}	GTy_9	GTy_8	Y-axis gyro temperature data, ref. chapter 0 for conversion to units
34	GTy_7	GTy_6	GTy_5	GTy_4	GTy_3	GTy_2	GTy_1	GTy_0	
35	GTz_{15}	GTz_{14}	GTz_{13}	GTz_{12}	GTz_{11}	GTz_{10}	GTz_9	GTz_8	Z-axis gyro temperature data, ref. chapter 0 for conversion to units
36	GTz_7	GTz_6	GTz_5	GTz_4	GTz_3	GTz_2	GTz_1	GTz_0	
37	GTs_7	GTs_6	GTs_5	GTs_4	GTs_3	GTs_2	GTs_1	GTs_0	STATUS byte for gyro temperature measurements, ref.Table 6-16
38	ATx_{15}	ATx_{14}	ATx_{13}	ATx_{12}	ATx_{11}	ATx_{10}	ATx_9	ATx_8	X-axis accelerometer temperature data, ref. chapter 0 for conversion to units
39	ATx_7	ATx_6	ATx_5	ATx_4	ATx_3	ATx_2	ATx_1	ATx_0	
40	ATy_{15}	ATy_{14}	ATy_{13}	ATy_{12}	ATy_{11}	ATy_{10}	ATy_9	ATy_8	Y-axis accelerometer temperature data, ref. chapter 0 for conversion to units
41	ATy_7	ATy_6	ATy_5	ATy_4	ATy_3	ATy_2	ATy_1	ATy_0	
42	ATz_{15}	ATz_{14}	ATz_{13}	ATz_{12}	ATz_{11}	ATz_{10}	ATz_9	ATz_8	Z-axis accelerometer temperature data, ref. chapter 0 for conversion to units
43	ATz_7	ATz_6	ATz_5	ATz_4	ATz_3	ATz_2	ATz_1	ATz_0	
44	ATs_7	ATs_6	ATs_5	ATs_4	ATs_3	ATs_2	ATs_1	ATs_0	STATUS byte for accelerometer temperature measurements, ref.Table 6-16
45	ITx_{15}	ITx_{14}	ITx_{13}	ITx_{12}	ITx_{11}	ITx_{10}	ITx_9	ITx_8	X-axis inclinometer temperature data, ref. chapter 0 for conversion to units
46	ITx_7	ITx_6	ITx_5	ITx_4	ITx_3	ITx_2	ITx_1	ITx_0	
47	ITy_{15}	ITy_{14}	ITy_{13}	ITy_{12}	ITy_{11}	ITy_{10}	ITy_9	ITy_8	Y-axis inclinometer temperature data, ref. chapter 0 for conversion to units
48	ITy_7	ITy_6	ITy_5	ITy_4	ITy_3	ITy_2	ITy_1	ITy_0	
49	ITz_{15}	ITz_{14}	ITz_{13}	ITz_{12}	ITz_{11}	ITz_{10}	ITz_9	ITz_8	Z-axis inclinometer temperature data, ref. chapter 0 for conversion to units
50	ITz_7	ITz_6	ITz_5	ITz_4	ITz_3	ITz_2	ITz_1	ITz_0	
51	ITs_7	ITs_6	ITs_5	ITs_4	ITs_3	ITs_2	ITs_1	ITs_0	STATUS byte for temperature measurements, ref.Table 6-16
52	Au_{23}	Au_{22}	Au_{21}	Au_{20}	Au_{19}	Au_{18}	Au_{17}	Au_{16}	
53	Au_{15}	Au_{14}	Au_{13}	Au_{12}	Au_{11}	Au_{10}	Au_9	Au_8	AUX output
54	Au_7	Au_6	Au_5	Au_4	Au_3	Au_2	Au_1	Au_0	
55	Aus_7	Aus_6	Aus_5	Aus_4	Aus_3	Aus_2	Aus_1	Aus_0	STATUS byte for AUX measurement, ref.Table 6-16
56	n_7	n_6	n_5	n_4	n_3	n_2	n_1	n_0	Counter, ref.section 8.5.2.2.15
57	t_{15}	t_{14}	t_{13}	t_{12}	t_{11}	t_{10}	t_9	t_8	Latency, ref. Section 8.5.2.2.16 for conversion to units.
58	t_7	t_6	t_5	t_4	t_3	t_2	t_1	t_0	
59	c_{31}	c_{30}	c_{29}	c_{28}	c_{27}	c_{26}	c_{25}	c_{24}	
60	c_{23}	c_{22}	c_{21}	c_{20}	c_{19}	c_{18}	c_{17}	c_{16}	Cyclic Redundancy Check is performed on all preceding bytes, ref:section 6.3.5
61	c_{15}	c_{14}	c_{13}	c_{12}	c_{11}	c_{10}	c_9	c_8	
62	c_7	c_6	c_5	c_4	c_3	c_2	c_1	c_0	
(63)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(64)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

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 6-14 and in section 12. When choosing a Normal mode datagram with reduced content, the Normal Mode datagram will be shorter. However the order of requested data will be transmitted as shown in Table 6-13. When selecting temperature in the datagram, only temperatures for the selected measurement-clusters will be transmitted, e.g. if gyro and inclinometer data have been chosen together with temperature, only temperatures for the gyros and inclinometers will be transmitted.

Table 6-14: Normal Mode datagram identifiers

Datagram content	Identifier
Rate	0x90
Rate and acceleration	0x91
Rate and inclincation	0x92
Rate, acceleration and inclination	0x93
Rate and temperature	0x94
Rate, acceleration and temperature	0xA5
Rate, inclination and temperature	0xA6
Rate, acceleration, inclination and temperature	0xA7
Rate and AUX	0x98
Rate, acceleration and AUX	0x99
Rate, inclincation and AUX	0x9A
Rate, acceleration, inclination and AUX	0x9B
Rate, temperature and AUX	0x9C
Rate, acceleration, temperature and AUX	0xAD
Rate, inclination, temperature and AUX	0xAE
Rate, acceleration, inclination, temperature and AUX	0xAF

6.3.5 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 STIM300. 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 STIM300 have a length which is not an integer 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=0xA7 (rate, acceleration, inclination and temperature) has been chosen. This datagram consists of 55 bytes prior to the CRC checksum. Hence this datagram consists of 13 sets of 32 bits + 3 bytes. In order to include the last 3 bytes in the CRC checksum, 1 byte = 0x00 is added, making the last data byte the most significant byte.

Table 6-15 lists the number of dummy-bytes needed to calculate the final CRC-checksum for the different datagrams in Normal Mode.

Table 6-15: Number of dummy-bytes to be added for CRC-calculation

Datagram content	Identifier	# dummy-bytes
Part Number datagram	0xB1, 0xB3	1
Serial Number datagram	0xB5, 0xB7	1
Configuration datagram	0xB9, 0xBB	1
Rate	0x90	2
Rate and acceleration	0x91	0
Rate and inclincation	0x92	0
Rate, acceleration and inclination	0x93	2
Rate and temperature	0x94	3
Rate, acceleration and temperature	0xA5	2
Rate, inclination and temperature	0xA6	2
Rate, acceleration, inclination and temperature	0xA7	1
Rate and AUX	0x98	2
Rate, acceleration and AUX	0x99	0
Rate, inclincation and AUX	0x9A	0
Rate, acceleration, inclination and AUX	0x9B	2
Rate, temperature and AUX	0x9C	3
Rate, acceleration, temperature and AUX	0xAD	2
Rate, inclination, temperature and AUX	0xAE	2
Rate, acceleration, inclination, temperature and AUX	0xAF	1

6.4 Status byte

Table 6-16: 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	
1	0=OK, 1=Y-channel	
0	0=OK, 1=X-channel (or AUX)	

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			55		grams	
VOLUME			32.6 1.99		ccm cu in	
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.
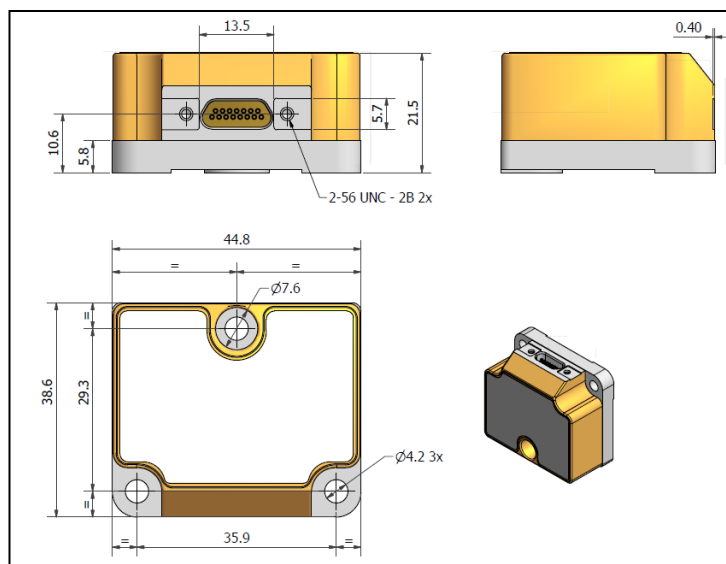
Figure 7-1: Mechanical dimensions

Table 7-2: Nominal position of accelerometer mass-centres (ref. Figure 6-2 for reference definition)

Axis	X-offset	Y-offset	Z-offset
X	-33.47mm	-8.67mm	12.92mm
Y	-24.90mm	-5.14mm	16.03mm
Z	-27.50mm	-11.78mm	6.81mm

7.2 Pin configuration
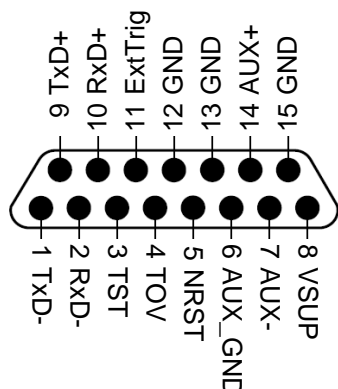
Figure 7-2: Pin configuration as seen from front of STIM300
Table 7-3: Pin descriptions

Pin#	Label	Type	Description
1	TxD-	OUTPUT	RS422 negative output
2	RxD-	INPUT	RS422 negative input
3	TST	OUTPUT	Test pin: Do not connect
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	AUX_GND	INPUT	AUX signal ground (internally connected to Power ground)
7	AUX-	INPUT	AUX negative signal input
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	GND	INPUT	Test pin: Connect to ground (0V)
13	GND	INPUT	Test pin: Connect to ground (0V)
14	AUX+	INPUT	AUX positive signal input
15	GND	SUPPLY	Power ground (0V)

7.3 Definition of axes
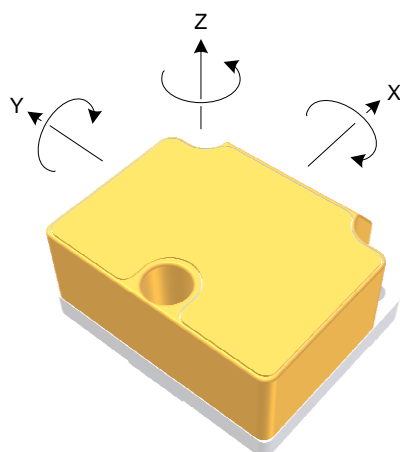
Figure 7-3: Definition of axes

8   BASIC OPERATION

STIM300 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 STIM300.
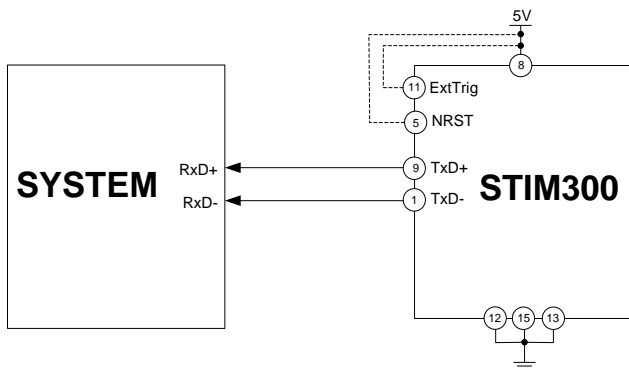
Figure 8-1: Transmit-Only Electrical Connection Diagram

In order to take full advantage of all features of STIM300, 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.
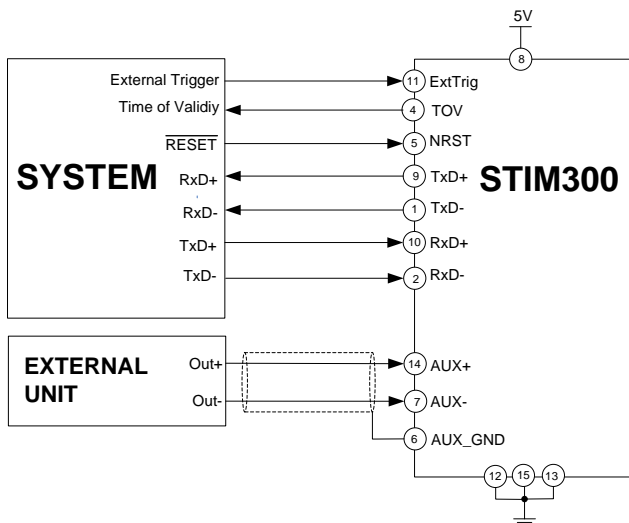
Figure 8-2: Full Function Electrical Connection Diagram

8.1   Reset

STIM300 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 STIM300 into Init Mode (ref. Figure 8-6 and section 8.5.1).

8.2   External Trigger

STIM300 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.

Please note that the commands in Normal Mode are active even if the datagram transmission has been configured to transmit only upon external trigger. This means that e.g. if the Normal Mode command "C" is issued over the RS-422

interface, the STIM300 will transmit a Configuration Datagram independent on the external trigger input. Also when STIM300 is in Init Mode (after Power on or Reset), it will transmit the 3 datagrams as described in section 8.5.1.

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 external trigger.
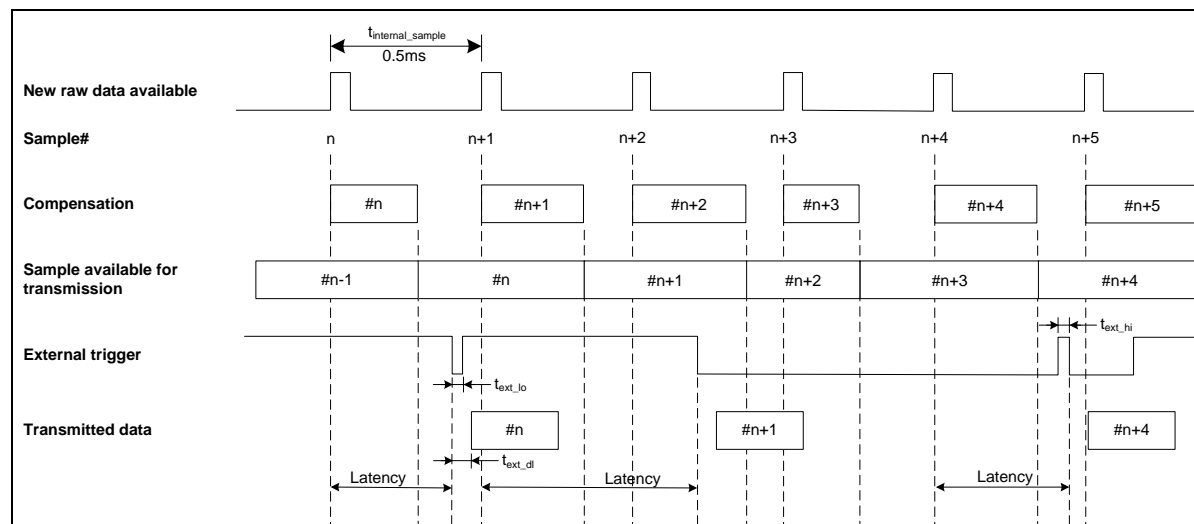

Figure 8-3: Timing of external trigger

8.3   Time of Validity (TOV)

The TOV-output serves 2 purposes:

- Provide a synchronisation-signal derived from the internal clock of STIM300
- Provide means to signal when a datagram is being transmitted (NB: not when configured to external trigger)

The TOV raising edge occurs synchronous to the sample rate. The falling 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.
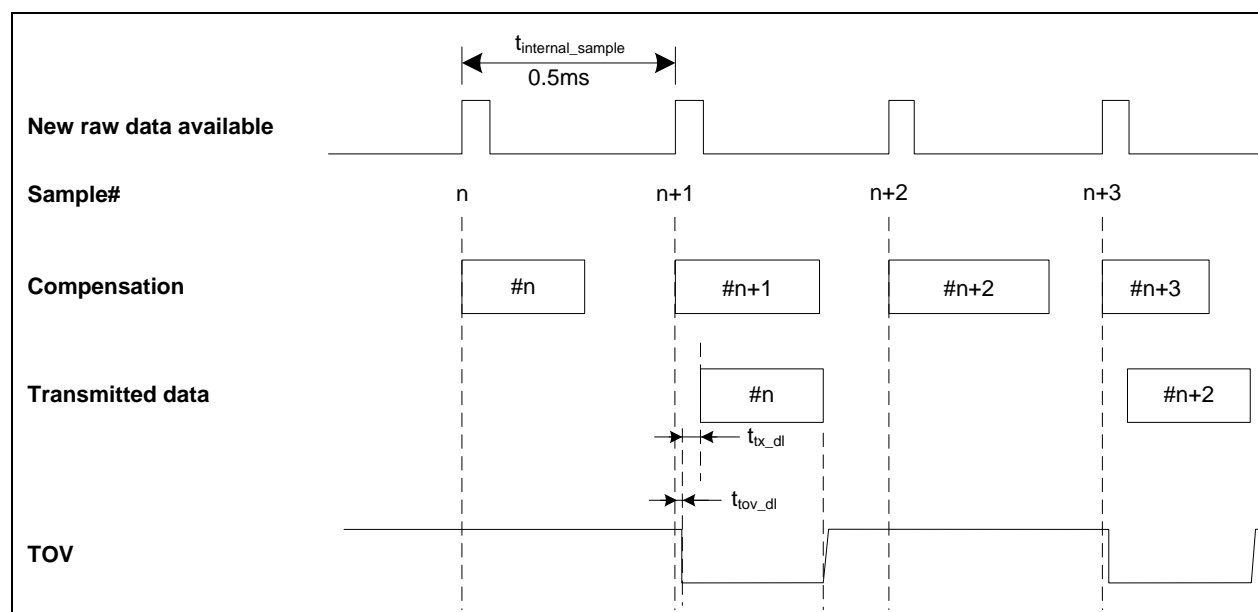
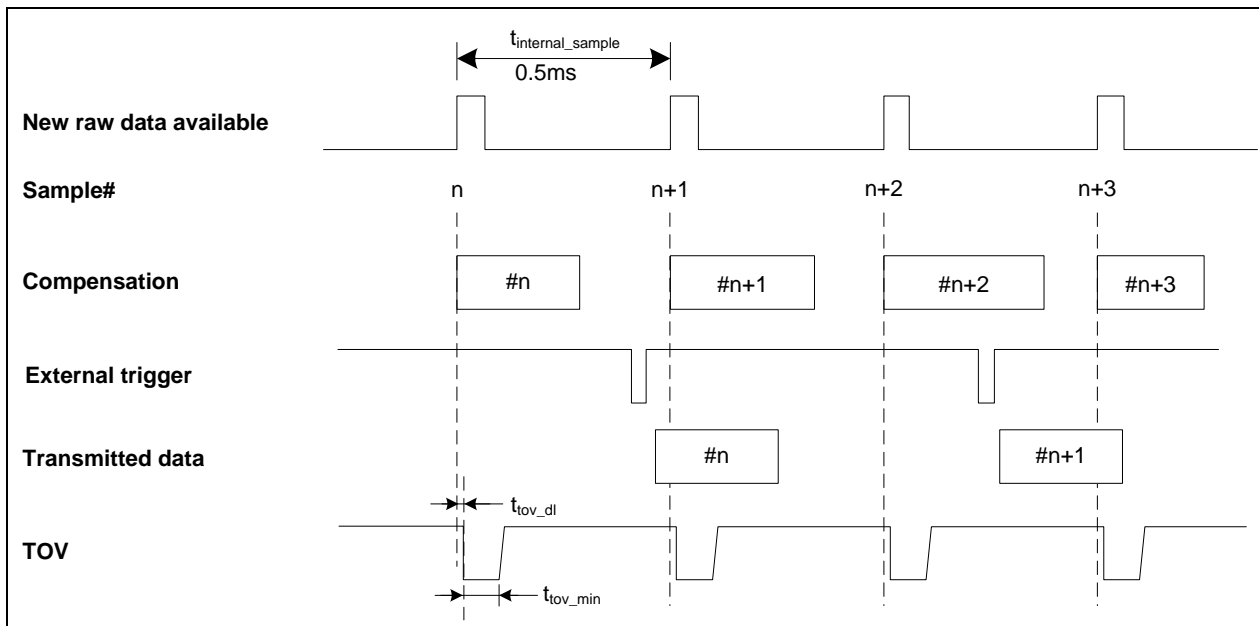**Figure 8-4: Timing of TOV (example: sample rate = 1000samples/s)**

Figure 8-5: Timing of TOV with external trigger

8.4 Auxiliary input

STIM300 provides input in order to digitize an external signal. The digitizer is a 24 bit sigma-delta ADC. The AUX data (24 bits + status byte) can be included in the datagrams, ref. sections 12 and 10.4. A simple compensation of the AUX data is performed as shown in Equation 1. The AUX data will be low-pass filtered. The bandwidth can be changed in Service Mode, ref. section 10.8.

Equation 1: AUX compensation algorithm:

$$AUX\_Output = A * AUX\_Input + B$$

where A and B are coefficients that can be programmed by the user in SERVICEMODE (k (AUX COMP)-command)

8.5 Operating modes

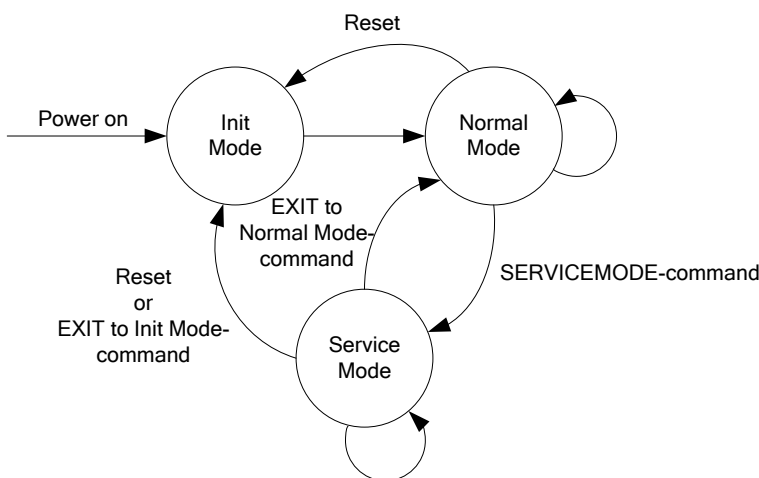The operating modes of STIM300 are shown in Figure 8-6:

Figure 8-6: Operating modes

8.5.1   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 three special datagrams containing part number, serial number and configuration data. Please 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 6-10.
The content and format of the Serial Number datagram is specified in Table 6-11.
The content and format of the Configuration datagram is specified in Table 6-12.
After having transmitted the special Part Number, Serial Number and Configuration datagrams, STIM300 enters Normal Mode.

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

8.5.2   Normal Mode

In Normal Mode STIM300 will constantly measure the available sensor channels at the configured sample rate. Note that if external trigger has been chosen, the internal sample rate will be set to maximum in order to minimize latency.

STIM300 will continue to transmit data regardless of any errors reported in the STATUS-bytes (ref. Table 6-16). Hence the content of the STATUS-byte should continuously be examined.

The content of the part number datagram is specified in Table 6-13.

8.5.2.1   Start-Up

When STIM300 enters Normal Mode from Init Mode, there will be a start-up period where STIM300 is stabilizing the gyros. During this period bit 6 is set in the STATUS-byte (ref. Table 6-16) 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 STIM300 is exiting from Service Mode directly to Normal Mode.

8.5.2.2   Data output options and interpretation

8.5.2.2.1 Delayed gyro output

The inherent group delay of the gyro-, accelerometer- , inclinometer- and AUX-signals are different, ref. Table 6-3, Table 6-4, Table 6-5 and Table 6-6 respectively. An option is available to delay the gyro signals by 5ms in order for the group delay of gyros, accelerometers and AUX to be similar. To enable this feature, select the gyro output-unit ≥ 8, ref. section 10.7 and 12.

8.5.2.2.2 Gyro output unit = Angular Rate

In the case of STIM300 being configured to output angular rate, Equation 2 and Figure 8-7 show how to convert to [°/s]. Please note that the output data is represented as two's complement.

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

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

where AR_1 is the most significant byte of the 24bit output
        AR_2 is the middle byte of the 24bit output
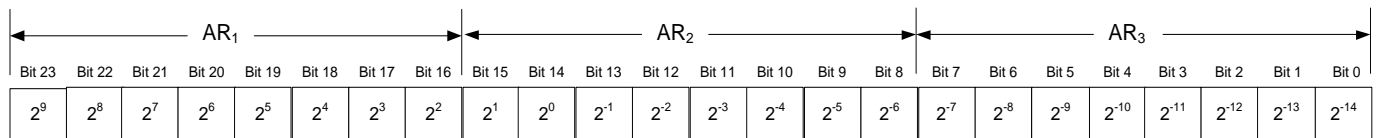 AR_3 is the least significant byte of the 24bit output

AR₁								AR₂								AR₃							
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}

Figure 8-7: Converting output bytes to [°/s]

8.5.2.2.3 Gyro output unit = Incremental Angle

In the case of STIM300 being configured to output incremental angle per sample, the equations for conversion to [°/sample] can be found in Equation 3 and Figure 8-8. Please note that the output data is represented as two's complement.

Equation 3: Converting output to [°/sample]

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

where IA_1 is the most significant byte of the 24bit output
        IA_2 is the middle byte of the 24bit output
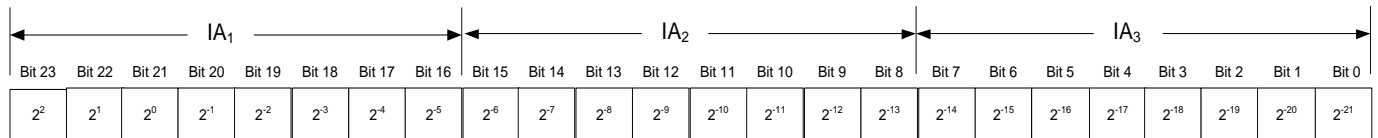 IA_3 is the least significant byte of the 24bit output

IA₁								IA₂								IA₃							
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}	2^{-15}	2^{-16}	2^{-17}	2^{-18}	2^{-19}	2^{-20}	2^{-21}

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

8.5.2.2.4 Gyro output unit = Average Angular Rate

In the case of STIM300 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.

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

The average is calculated on the samples using the conventional equation for average calculation:

Equation 4: Calculating average:

$$Average\_Angular\_Rate[°/s] = \frac{\sum_{m=1..n} Angular\_Rate_m}{n}$$

where   Angular_Rate$_m$ is one angular rate data sampled at 2000 samples/s

n is number of samples since last transmission

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

8.5.2.2.5 Gyro output unit = Integrated Angle

In the case of STIM300 being configured to output integrated angle, the transmitted data will be the continuously integrated angle since power-on or reset. The integrated angle takes values in the interval [-4°, 4°> and will naturally wrap-around with no error-message indication in the Status-byte.

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

8.5.2.2.6 Gyro g-compensation

The gyros are sensitive to acceleration-forces in certain directions:
- X- and Y-gyros are sensitive to acceleration-forces in Z-direction
- Z-gyro is sensitive to acceleration-forces in Y-direction
- The gyros are insensitive to acceleration-forces in X-direction

As the STIM300 also contains accelerometers and inclinometers, 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-/inclinometer-signal prior to use in the compensation, ref: Figure 8-10. A simplified compensation-scheme can be found in Figure 8-9.
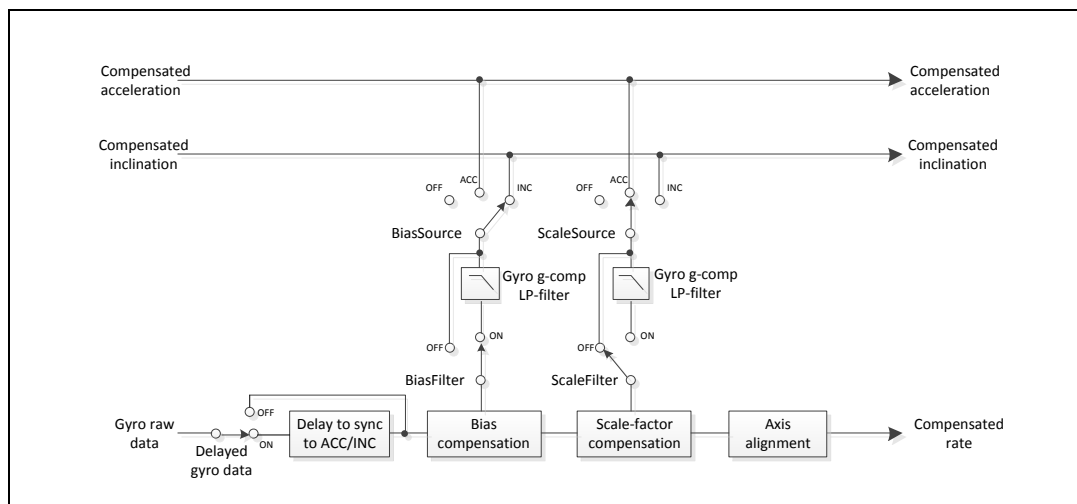

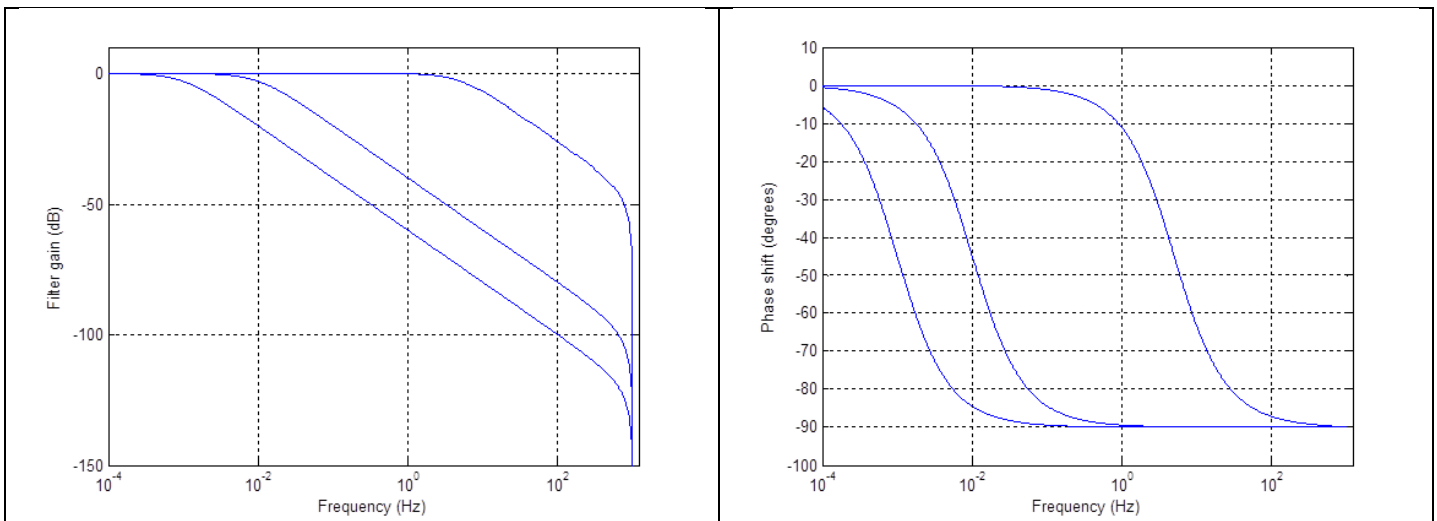**Figure 8-9: Simplified compensation-scheme for gyro g-compensation**

Figure 8-10: Frequency characteristics of g-compensation low-pass filter for 0.001Hz, 0.01Hz and 5Hz settings

8.5.2.2.7 Accelerometer output unit = Acceleration

In the case of STIM300 being configured to output acceleration, Equation 5 and Figure 8-11 show how to do this. Please note that the output data is represented as two's complement.

Equation 5: Converting output to [g]:

Range	Conversion:
2g	$Output[g] = \dfrac{(ACC_1) \cdot 2^{16} + (ACC_2) \cdot 2^8 + (ACC_3)}{2^{21}}$
5g	$Output[g] = \dfrac{(ACC_1) \cdot 2^{16} + (ACC_2) \cdot 2^8 + (ACC_3)}{2^{20}}$
10g	$Output[g] = \dfrac{(ACC_1) \cdot 2^{16} + (ACC_2) \cdot 2^8 + (ACC_3)}{2^{19}}$
30g	$Output[g] = \dfrac{(ACC_1) \cdot 2^{16} + (ACC_2) \cdot 2^8 + (ACC_3)}{2^{18}}$
80g	$Output[g] = \dfrac{(ACC_1) \cdot 2^{16} + (ACC_2) \cdot 2^8 + (ACC_3)}{2^{16}}$

where ACC_1 is the most significant byte of the 24bit output
          ACC_2 is the middle byte of the 24bit output
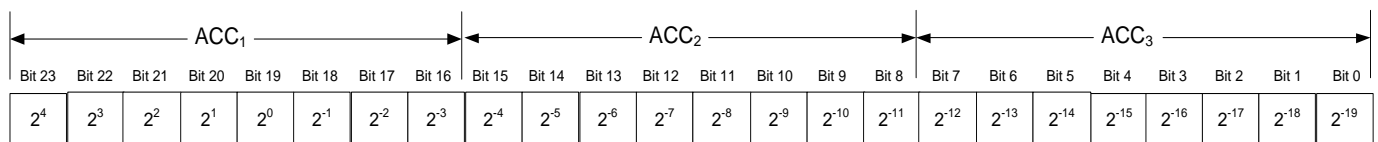 ACC_3 is the least significant byte of the 24bit output

Figure 8-11: Converting output bytes to [g] (example is valid for 10g range)

8.5.2.2.8 Accelerometer output unit = Incremental Velocity

In the case of STIM300 being configured to output incremental velocity per sample, the equations for conversion to [m/s/sample] can be found in Equation 6 and Figure 8-12. Please note that the output data is represented as two's complement.

Equation 6: Converting output to [m/s/sample]

Range	Conversion:
2g	$Output[m/s/sample] = \dfrac{(IV_1) \cdot 2^{16} + (IV_2) \cdot 2^8 + (IV_3)}{2^{24}}$
5g	$Output[m/s/sample] = \dfrac{(IV_1) \cdot 2^{16} + (IV_2) \cdot 2^8 + (IV_3)}{2^{23}}$
10g	$Output[m/s/sample] = \dfrac{(IV_1) \cdot 2^{16} + (IV_2) \cdot 2^8 + (IV_3)}{2^{22}}$
30g	$Output[m/s/sample] = \dfrac{(IV_1) \cdot 2^{16} + (IV_2) \cdot 2^8 + (IV_3)}{2^{21}}$
80g	$Output[m/s/sample] = \dfrac{(IV_1) \cdot 2^{16} + (IV_2) \cdot 2^8 + (IV_3)}{2^{19}}$

where IV_1 is the most significant byte of the 24bit output
IV_2 is the middle byte of the 24bit output
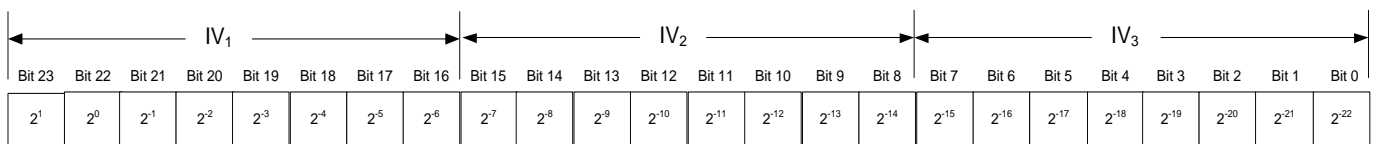IV_3 is the least significant byte of the 24bit output

Figure 8-12: Converting output bytes to [m/s/sample] (example is valid for 10g range)

8.5.2.2.9 Accelerometer output unit = Average Acceleration

In the case of STIM300 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.

The average is calculated on the samples using the conventional equation for average calculation:

Equation 7: Calculating average:

$$Output[g] = \frac{\sum_{m=1..n} Acceleration_m}{n}$$

where $Acceleration_m$ is one acceleration data sampled at 2000 samples/s
n is number of samples since last transmission

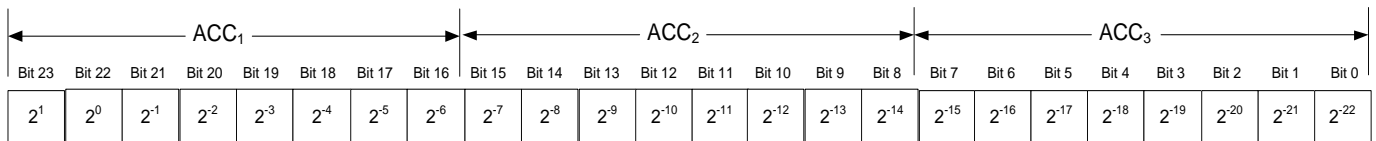Conversion to g] is the same as for angular rate and is described in Equation 5.

8.5.2.2.10 Inclinometer output unit = Acceleration

In the case of STIM300 being configured to output acceleration, Equation 8 and Figure 8-13 show how to do this. Please note that the output data is represented as two's complement.

Equation 8: Converting output to [g]:

$$Output[g] = \frac{(ACC_1) \cdot 2^{16} + (ACC_2) \cdot 2^8 + (ACC_3)}{2^{22}}$$

where ACC$_1$ is the most significant byte of the 24bit output
ACC$_2$ is the middle byte of the 24bit output
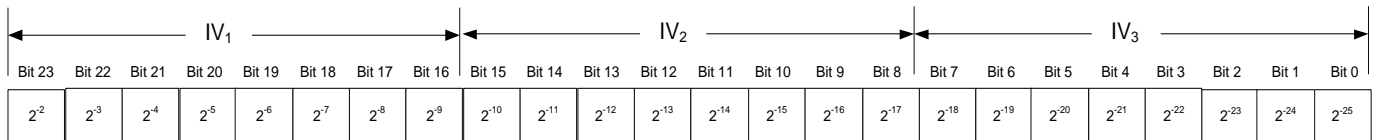ACC$_3$ is the least significant byte of the 24bit output

				ACC$_1$								ACC$_2$								ACC$_3$			
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}	2^{-15}	2^{-16}	2^{-17}	2^{-18}	2^{-19}	2^{-20}	2^{-21}	2^{-22}

Figure 8-13: Converting output bytes to [g]

8.5.2.2.11 Inclinometer output unit = Incremental Velocity

In the case of STIM300 being configured to output incremental velocity per sample, the equations for conversion to [m/s/sample] can be found in Equation 9 and Figure 8-14. Please note that the output data is represented as two's complement.

Equation 9: Converting output to [m/s/sample]

$$Output[m/s/sample] = \frac{(IV_1) \cdot 2^{16} + (IV_2) \cdot 2^8 + (IV_3)}{2^{25}}$$

where IV$_1$ is the most significant byte of the 24bit output
IV$_2$ is the middle byte of the 24bit output
IV$_3$ is the least significant byte of the 24bit output

				IV$_1$								IV$_2$								IV$_3$			
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}	2^{-15}	2^{-16}	2^{-17}	2^{-18}	2^{-19}	2^{-20}	2^{-21}	2^{-22}	2^{-23}	2^{-24}	2^{-25}

Figure 8-14: Converting output bytes to [m/s/sample]

8.5.2.2.12 Inclinometer output unit = Average Acceleration

In the case of STIM300 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.

The average is calculated on the samples using the conventional equation for average calculation:

Equation 10: Calculating average:

$$Output[g] = \frac{\sum_{m=1..n} Inclination_m}{n}$$

where Inclination$_m$ is one inclination data sampled at 2000 samples/s

Conversion to [g] is the same as for angular rate and is described in Equation 8.

8.5.2.2.13 Temperature

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

Equation 11 and Figure 8-15 show how to convert to [°C]. Please note that the output data is represented as two's complement.

Equation 11: Converting temperature data to [°C]

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

where T_1 is the most significant byte of the 16bit output
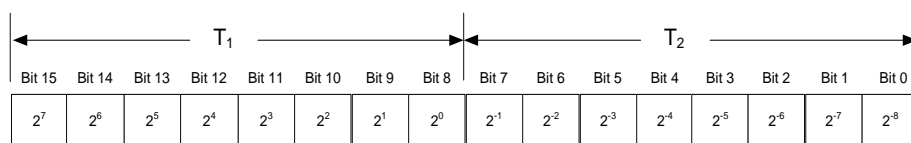 T_2 is the least significant byte of the 16bit output

				T$_1$									T$_2$			
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}

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

8.5.2.2.14   AUX

In the case of STIM300 being configured to AUX-data, Equation 12 and Figure 8-11 show how to do this. Please note that the output data is represented as two's complement.

Equation 12: Converting output to [V]:

$$Output[V] = \frac{(AUX_1) \cdot 2^{16} + (AUX_2) \cdot 2^8 + (AUX_3)}{2^{24}} \cdot 5V$$

where AUX_1 is the most significant byte of the 24bit output
        AUX_2 is the middle byte of the 24bit output
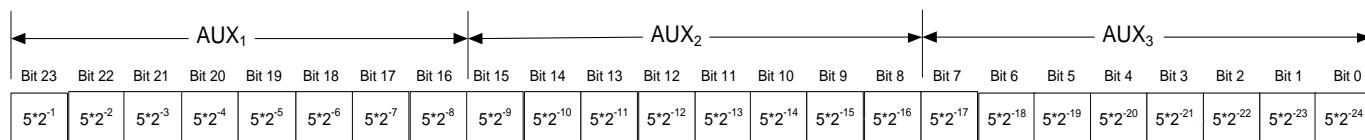 AUX_3 is the least significant byte of the 24bit output

				AUX$_1$								AUX$_2$								AUX$_3$			
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
5*2^{-1}	5*2^{-2}	5*2^{-3}	5*2^{-4}	5*2^{-5}	5*2^{-6}	5*2^{-7}	5*2^{-8}	5*2^{-9}	5*2^{-10}	5*2^{-11}	5*2^{-12}	5*2^{-13}	5*2^{-14}	5*2^{-15}	5*2^{-16}	5*2^{-17}	5*2^{-18}	5*2^{-19}	5*2^{-20}	5*2^{-21}	5*2^{-22}	5*2^{-23}	5*2^{-24}

Figure 8-16: Converting output bytes to [V]

8.5.2.2.15   Counter

Counter is continuously counting the internal samples (2000 samples/s). Counter is an un-signed single byte taking values in the interval [0 , 255]. The counter will naturally wrap-around with no error-message indication in the Status-byte.

8.5.2.2.16 Latency

To calculate the latency in [µs], refer to Equation 13 and Figure 8-17. Please note that latency is an unsigned word.

Equation 13: Converting output to [µs]:

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

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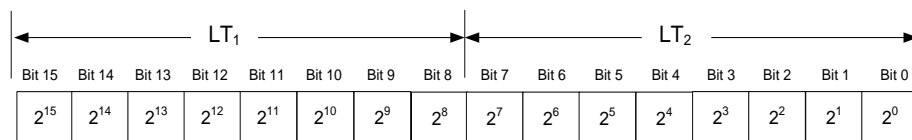LT_2 is the least significant byte of the 16bit output

LT₁								LT₂							
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

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

8.5.3 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, STIM300 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 stabilisation time of filters, etc. However the measurement data itself, when STIM300 is in Service Mode are not transmitted and therefore lost. By using the a (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 STIM300 into Init Mode. Please 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 Self diagnostics

STIM300 is constantly checking its internal status. The checks include:

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

When an error situation is detected, the corresponding bit in the STATUS byte (ref. Table 6-16) will be set.

The bits in the STATUS are valid for the data in a single transmission. Hence any error condition is not latched.

In Service Mode it is possible to see the last detected error by using the i e (INFORMATION on LAST ERROR IN NORMAL MODE) command, ref. Section 10.1 or run a full diagnostic and see the result of the individual checks by using the c (DIAGNOSTIC) command, ref. Section 10.3.

9   COMMANDS IN NORMAL MODE

Several commands are available in Normal Mode, as listed in Table 9-1. Please 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
R	Resets the unit
SERVICEMODE	Enters Service 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 nor error messages will appear for these commands. Only at the receipt of the complete correct command, STIM300 executes accordingly.

NB: if OUTPUT-UNIT of the gyros is set to INCREMENTAL ANGLE (ref. Section 10.7), the transmitted incremented angle in the datagram following any of the requested special datagrams will NOT contain the incremental angle since the last transmitted measurement. Hence the incremented angle 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 6-10).

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 datagram transmission is set to trigger on external trigger, the Part Number datagram will be transmitted without waiting for an external trigger signal.

9.2   I (SERIAL NUMBER DATAGRAM) command

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

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 datagram transmission is set to trigger on external trigger, the Serial Number datagram will be transmitted without waiting for an external trigger signal.

9.3   C (CONFIGURATION DATAGRAM) command

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

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 datagram transmission is set to trigger on external trigger, the Configuration datagram will be transmitted without waiting for an external trigger signal.

9.4   R (RESET) command

General description: Force a Reset

Table 9-6: Available R (RESET) command

Syntax	Response
R<CR>	Resets the unit

9.5   SERVICEMODE command

General description : Enters Service Mode (ref. section 8.5.3).

Table 9-7: 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 = N25580846002002
PRODUCT = STIM300
PART NUMBER = 84167-44000-331 REV C
FW CONFIG = SWD12046 REV 2
GYRO OUTPUT UNIT = [°/s] – ANGULAR RATE DELAYED
ACCELEROMETER OUTPUT UNIT = [g] – ACCELERATION
INCLINOMETER OUTPUT UNIT = [g] - ACCELERATION
SAMPLE RATE [samples/s] = 2000
GYRO CONFIG = XYZ
ACCELEROMETER CONFIG = XYZ
INCLINOMETER 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
INCLINOMETER RANGE:
  X-AXIS: ± 1.7g
  Y-AXIS: ± 1.7g
  Z-AXIS: ± 1.7g
AUX RANGE: ± 2.5V
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
INCLINOMETER LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
INCLINOMETER LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 262
INCLINOMETER LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 262
AUX LP FILTER -3dB FREQUENCY [Hz] = 262
AUX COMP COEFF: A = 1.0000000e+00, B = 0.0000000e+00
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
DATAGRAM = RATE, ACCELERATION, INCLINATION
DATAGRAM TERMINATION = NONE
BIT-RATE [bits/s] = 1843200
DATA LENGTH = 8
STOP BITS = 1
PARITY = NONE
LINE TERMINATION = ON
>
```

Figure 9-1: Example of response from SERVICEMODE command

10 COMMANDS IN SERVICE MODE

Several commands are available in Service Mode, as listed in Table 10-1. Please 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
k	Changes coefficients of the AUX compensation algorithm
g	Changes the gyro g-compensation configuration for bias and scale factor
s	Saves configuration data
x	Exits Service Mode and returns to Normal Mode or Init Mode
z	Restore to factory settings
?	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 STIM300 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), STIM300 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
k	Returns the compensation coefficients for AUX input
e	Prints the extended error information from the last detected error in Normal Mode

Table 10-5: Error messages for i (INFORMATION) commands

Error	Message	Possible reason
E001	UNKOWN 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 = N25580846002002
PRODUCT = STIM300
PART NUMBER = 84167-44000-331 REV C
FW CONFIG = SWD12046 REV 2
GYRO OUTPUT UNIT = [°/s] – ANGULAR RATE DELAYED
ACCELEROMETER OUTPUT UNIT = [g] – ACCELERATION
INCLINOMETER OUTPUT UNIT = [g] - ACCELERATION
SAMPLE RATE [samples/s] = 2000
GYRO CONFIG = XYZ
ACCELEROMETER CONFIG = XYZ
INCLINOMETER 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
INCLINOMETER RANGE:
  X-AXIS: ± 1.7g
  Y-AXIS: ± 1.7g
  Z-AXIS: ± 1.7g
AUX RANGE: ± 2.5V
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
INCLINOMETER LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
INCLINOMETER LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 262
INCLINOMETER LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 262
AUX LP FILTER -3dB FREQUENCY [Hz] = 262
AUX COMP COEFF: A = 1.0000000e+00, B = 0.0000000e+00
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
DATAGRAM = RATE, ACCELERATION, INCLINATION
DATAGRAM TERMINATION = NONE
BIT-RATE [bits/s] = 1843200
DATA LENGTH = 8
STOP BITS = 1
PARITY = NONE
LINE TERMINATION = ON

>
```

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

```
>i s
SERIAL NUMBER = N25580846002002

>
```

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

```
>i n
PRODUCT = STIM300

>
```

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

```
>i x
PART NUMBER = 84167-44000-331 REV C

>
```

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

```
>i a
GYRO CONFIG = XYZ
ACCELEROMETER CONFIG = XYZ
INCLINOMETER 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
INCLINOMETER RANGE:
  X-AXIS: ± 1.7g
  Y-AXIS: ± 1.7g
  Z-AXIS: ± 1.7g
AUX RANGE: ± 2.5V

>
```

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

```
>i p
FW CONFIG = SWD12046 REV 2

>
```

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
INCLINOMETER LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
INCLINOMETER LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 262
INCLINOMETER LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 262
AUX 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, INCLINATION
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] = 1843200
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
INCLINOMETER OUTPUT UNIT = [g] – ACCELERATION

>
```

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 k
AUX COMP COEFF: A = 1.0200000e+00, B = 3.4000000e-02

>
```

Figure 10-14: Example of response from i k (INFORMATION on AUX COMP) command

```
>i e
GYRO X-AXIS I-CH OVERFLOW = FAILED

>
```

Figure 10-15: Example of response from i e (INFORMATION on LAST ERROR IN NORMAL MODE) 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	UNKOWN 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

INCLINOMETER X-AXIS = 0.0426473 g
INCLINOMETER Y-AXIS = 0.0003832 g
INCLINOMETER Z-AXIS = 0.9246325 g
INCLINOMETER 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

TEMPERATURE INC X-AXIS = 32.326 °C
TEMPERATURE INC Y-AXIS = 32.123 °C
TEMPERATURE INC Z-AXIS = 32.326 °C
TEMPERATURE STATUS = 00000000 = OK

AUX = -0.8356746 V
AUX STATUS = 00000000 = OK

COUNTER = 10
LATENCY = 516 us

>
```

Figure 10-16: 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


INCLINOMETER X-AXIS = 0.0426473 g
INCLINOMETER Y-AXIS = 0.0003832 g
INCLINOMETER Z-AXIS = 0.9246325 g
INCLINOMETER 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


TEMPERATURE INC X-AXIS = 32.326 °C
TEMPERATURE INC Y-AXIS = 32.123 °C
TEMPERATURE INC Z-AXIS = 32.326 °C
TEMPERATURE STATUS = 00000000 = OK


AUX = -0.8356746 V
AUX STATUS = 00000000 = OK


COUNTER = 10
LATENCY = 516 us


>
```

Figure 10-17: 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	UNKOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Any characters between command and <CR>

```
SERIAL NUMBER = N25581142431021
PRODUCT = STIM300
PART NUMBER = 84167-44000-331 REV C
HW CONFIG = M5728 REV 2
FW CONFIG = SWD12008 REV 2
SYSTEM STATUS:
  RAM CHECK = OK
  FLASH CHECK = OK
  STACK STATUS MONITOR  = OK
  STACK COMMAND HANDLER  = OK
  STACK SAMPLE  = OK
  STACK FLASH  = OK
  MICRO CONTROLLER TEMPERATURE  = OK
VOLTAGE SUPPLIES:
  REFERENCE VOLTAGE 5.0V = OK
  REFERENCE VOLTAGE 2.5V = OK
  REFERENCE VOLTAGE 2.048V = OK
  REGULATED VOLTAGE 5.0V  = OK
  REGULATED VOLTAGE 1.8V  = OK
  INPUT VOLTAGE 5.0V = OK
  VOLTAGE BOOST = OK
  VOLTAGE DAC = OK
 GYRO X-AXIS:
  GYRO X-AXIS Data Ready = OK
  GYRO X-AXIS EXC.FREQ = OK
  GYRO X-AXIS ASIC TEMP = OK
 GYRO X-AXIS SENSOR TEMP = OK
  GYRO X-AXIS COMPENSATED RATE SIGNAL = OK
  GYRO X-AXIS DASIC COMMUNICATION = OK
  GYRO X-AXIS Q-CH RANGE = OK
  GYRO X-AXIS I-CH RANGE = OK
  GYRO X-AXIS DET. DC = OK
  GYRO X-AXIS EXC. DC = OK
  GYRO X-AXIS SPI = OK
  GYRO X-AXIS EXC.AMPL = OK
  GYRO X-AXIS OVERRUN = OK
 GYRO Y-AXIS:
  GYRO Y-AXIS Data Ready = OK
  GYRO Y-AXIS EXC.FREQ = OK
  GYRO Y-AXIS ASIC TEMP = OK
  GYRO Y-AXIS SENSOR TEMP = OK
  GYRO Y-AXIS COMPENSATED RATE SIGNAL = OK
  GYRO Y-AXIS DASIC COMMUNICATION = OK
  GYRO Y-AXIS Q-CH RANGE = OK
  GYRO Y-AXIS I-CH RANGE = OK
  GYRO Y-AXIS DET. DC = OK
```

```
  GYRO Y-AXIS EXC. DC = OK
  GYRO Y-AXIS SPI = OK
  GYRO Y-AXIS EXC.AMPL = OK
  GYRO Y-AXIS OVERRUN = OK
 GYRO Z-AXIS:
  GYRO Z-AXIS Data Ready = OK
  GYRO Z-AXIS EXC.FREQ = OK
  GYRO Z-AXIS ASIC TEMP = OK
  GYRO Z-AXIS SENSOR TEMP = OK
  GYRO Z-AXIS COMPENSATED RATE SIGNAL = OK
  GYRO Z-AXIS DASIC COMMUNICATION = OK
  GYRO Z-AXIS Q-CH RANGE = OK
  GYRO Z-AXIS I-CH RANGE = OK
  GYRO Z-AXIS DET. DC = OK
  GYRO Z-AXIS EXC. DC = OK
  GYRO Z-AXIS SPI = OK
  GYRO Z-AXIS EXC.AMPL = OK
  GYRO Z-AXIS OVERRUN = OK
 ACCELEROMETER X-AXIS:
  ACCELEROMETER X-AXIS COMPENSATED SIGNAL = OK
  ACCELEROMETER X-AXIS TEMPERATURE = OK
  EXTERNAL ADC COMMUNICATION = OK
 ACCELEROMETER Y-AXIS:
  ACCELEROMETER Y-AXIS COMPENSATED SIGNAL = OK
  ACCELEROMETER Y-AXIS TEMPERATURE = OK
  EXTERNAL ADC COMMUNICATION = OK
 ACCELEROMETER Z-AXIS:
  ACCELEROMETER Z-AXIS COMPENSATED SIGNAL = OK
  ACCELEROMETER Z-AXIS TEMPERATURE = OK
  EXTERNAL ADC COMMUNICATION = OK
 INCLINOMETER X-AXIS:
  INCLINOMETER X-AXIS COMPENSATED SIGNAL = OK
  INCLINOMETER X-AXIS TEMPERATURE = OK
  EXTERNAL ADC COMMUNICATION = OK
 INCLINOMETER Y-AXIS:
  INCLINOMETER Y-AXIS COMPENSATED SIGNAL = OK
  INCLINOMETER Y-AXIS TEMPERATURE = OK
  EXTERNAL ADC COMMUNICATION = OK
 INCLINOMETER Z-AXIS:
  INCLINOMETER Z-AXIS COMPENSATED SIGNAL = OK
  INCLINOMETER Z-AXIS TEMPERATURE = OK
  EXTERNAL ADC COMMUNICATION = OK
 AUX:
  AUX = OK
  EXTERNAL ADC COMMUNICATION = OK

>
```

Figure 10-18: Example of response from c (DIAGNOSTIC) command

10.4 d (DATAGRAM FORMAT) command

General description: Sets the datagram transmission mode and termination (ref.Table 6-8 and section 12).

Note that the datagram format could be considered invalid, even if it has been entered correctly. This is because a valid datagram format also depends on the sample rate and chosen datagram content (ref. Table 6-9 and error message E007 in Table 10-13).

Note that this change will only be effective until STIM300 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. chapter 10.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. chapter 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 <trans> parameter of d (DATAGRAM TRANSMISSION MODE AND TERMINATION) command

<type>	Datagram content
0	ID, rate, counter, latency, CRC
1	ID, rate, acceleration, counter, latency, CRC
2	ID, rate, inclincation, counter, latency, CRC
3	ID, rate, acceleration, inclination, counter, latency, CRC
4	ID, rate, temperature, counter, latency, CRC
5	ID, rate, acceleration, temperature, counter, latency, CRC
6	ID, rate, inclination, temperature, counter, latency, CRC
7	ID, rate, acceleration, inclination, temperature, counter, latency, CRC
8	ID, rate, AUX, counter, latency, CRC
9	ID, rate, acceleration, AUX, counter, latency, CRC
a	ID, rate, inclincation, AUX, counter, latency, CRC
b	ID, rate, acceleration, inclination, AUX, counter, latency, CRC
c	ID, rate, temperature, AUX, counter, latency, CRC
d	ID, rate, acceleration, temperature, AUX, counter, latency, CRC
e	ID, rate, inclination, temperature, AUX, counter, latency, CRC
f	ID, rate, acceleration, inclination, temperature, AUX, counter, latency, CRC

Table 10-12 : Allowed values for <term> parameter of d (DATAGRAM TRANSMISSION MODE AND TERMINATION) command

<trans>	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	UNKOWN 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 8,0
DATAGRAM = RATE, AUX
DATAGRAM TERMINATION = NONE


>
```

Figure 10-19: Example of response from d (DATAGRAM MODE AND TERMINATION) command

```
>d 3,1
DATAGRAM = RATE, ACCELERATION, INCLINATION
DATAGRAM TERMINATION = <CR><LF>


>
```

Figure 10-20: 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 6-9 and error message E007 in Table 10-18).

Note that this change will only be effective until STIM300 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. chapter 10.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. chapter 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 STIM300 hardware is capable of setting bit-rates in the range between 1500 and 5 344 000 bits/s. However, the sample rate and the datagram length decide the minimum bit-rate possible, ref. Equation 14:

Equation 14: 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 6-13 and Table 6-9 (NB: number of bytes in Table 6-9 includes <CR><LF>)
        sample_rate is the chosen sample rate [samples/s]

If a bit-rate, lower than the allowed bit-rate defined by Equation 14, 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 15:

Equation 15: Set bit-rate

$$Bit-rate_{SET} = \frac{85504000}{n} bits/s$$

where   n is an integer

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

Table 10-18: Error messages for t (TRANSMISSION PARAMETERS) commands

Error	Message	Possible reason
E001	UNKOWN 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 10-21: 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 10-22: 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 STIM300 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. chapter 10.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. chapter 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	UNKOWN 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 10-23: Example of response from r 0 (LINE TERMINATION) command

```
>r 1
LINE TERMINATION = ON

>
```
Figure 10-24: 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 STIM300 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. chapter 10.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. chapter 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]
i	0	Changes the inclinometer output unit to acceleration [g]
i	1	Changes the inclinometer output unit to incremental velocity [m/s/sample]
i	2	Changes the inclinometer output unit to average acceleration [g]

Table 10-24: Error messages for u (OUTPUT UNIT) command

Error	Message	Possible reason
E001	UNKOWN 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 10-25: Example of response from u (OUTPUT UNIT) command

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


>
```
Figure 10-26: 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 STIM300 if e.g. a high filter bandwidth and a low sample rate have been chosen.

Note that change in filter setting will change the group delay, ref. Table 6-8.

Note that this change will only be effective until STIM300 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. chapter 10.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. chapter 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)
i	Will change LP filter -3dB frequency for the inclinometer(s)
u	Will change LP filter -3dB frequency for AUX

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	UNKOWN 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 10-27: 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
INCLINOMETER LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 131
INCLINOMETER LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 131
INCLINOMETER LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 131
AUX LP FILTER -3dB FREQUENCY [Hz] = 131


>
```

Figure 10-28: 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 10-29: Example of response from f (LP FILTER -3dB FREQUENCY) command

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

>
```

Figure 10-30: 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 sample rate and chosen datagram content (ref. Table 6-9 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 STIM300 if e.g. a high filter bandwidth and a low sample rate have been chosen.

Note that this change will only be effective until STIM300 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. chapter 10.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. chapter 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	UNKOWN 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 10-31: Example of response from m (SAMPLE RATE) command


```
>m 5
SAMPLE RATE = EXTERNAL TRIGGER


>
```
Figure 10-32: Example of response from m (SAMPLE RATE) command

10.10 k (AUX COMP) command

General description: Changes the compensation coefficients of the AUX input.

Note that this change will only be effective until STIM300 is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. chapter 10.11). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. chapter 10.13).

Table 10-33: Available k (AUX COMP) command

Syntax	Response
k<SP><A>','<B><CR>	Changes the compensation coefficients, A and B, of the AUX input

<A> and <B> are numbers. Decimal point = '.'. Format can be integer, scientific or decimal.

Table 10-34: Error messages for k (AUX COMP) command

Error	Message	Possible reason
E001	UNKOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Too many or too few parameters, use of comma between command and first parameter

```
>k 1.02,3.4e-2
AUX COMP COEFF: A = 1.0200000e+00, B = 3.4000000e-02


>
```

Figure 10-33: Example of response from e (AUX COMP) command

10.11 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 8.5.2.2.6 for a description of this functionality.

Table 10-35: 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 10-36 : Allowed values for <StdComp> for g (GYRO G-COMP) command

| <StdComp> | Bias | | ScaleSource | ScaleFilter |
	BiasSource	BiasFilter		
0	OFF	-	OFF	-
1[1]	OFF	-	ACC	OFF
2	OFF	-	ACC	ON
3[1]	ACC	OFF	OFF	-
4	ACC	ON	OFF	-
5[1]	INC	OFF	OFF	-
6	INC	ON	OFF	-
7[1]	ACC	OFF	ACC	OFF
8[1]	ACC	ON	ACC	OFF
9[1]	INC	OFF	ACC	OFF
a[1]	INC	ON	ACC	OFF
b	ACC	ON	ACC	ON
c	INC	ON	INC	ON

[1] A warning will be issued if gyro output unit has not been chosen as delayed (ref. section 8.5.2.2.1 and 10.7)

Table 10-37 : Allowed range for <FilterCutoff> for g (GYRO G-COMP) command

	Unit	Minimum	Standard	Maximum
<FilterCutoff>	Hz	0.001	0.01	5.00

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

Table 10-38 : 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
2	Gyro g-compensation uses data from inclinometers

Table 10-39 : 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 10-40 : 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 (ACC or INC)

Table 10-41: Error messages for g (GYRO G-COMP) command

Error	Message	Possible reason
E001	UNKOWN 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 10-34: 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 10-35: Example of response from g (GYRO G-COMP) command with warning

```
>g 2,1,1,0,0.5
GYRO G-COMPENSATION:
  BIAS SOURCE, X-AXIS = INC
  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 = INC
  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 = INC
  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 10-36: Example of response from g (GYRO G-COMP) command

```
>g 0,0,1,2,1,1,0
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 = INC
  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 10-37: Example of response from g (GYRO G-COMP) 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 initialisation or power-off.

The flash used in STIM300 is specified to be capable of minimum 1000 saves. A save-counter has been implemented and when the number of saves exceeds 1000, there will be issued a warning. STIM300 will always attempt to save the configuration when receiving the s (SAVE) command regardless of the content of the save-counter.

Table 10-42: 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.

Table 10-43: Error messages for s (SAVE) command

Error	Message	Possible reason
E001	UNKOWN 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 (1000 saves). STIM300 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 10-38: 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 10-39: 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 10-40: 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 8-6).

Table 10-44 : Available x (EXIT) command

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

Table 10-45 : 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 10-46: Error messages for x (EXIT) command

Error	Message	Possible reason
E001	UNKOWN 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 10-41: Example of response from x n (EXIT) command when system parameters match contents of flash

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

```

Figure 10-42: 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 10-43: 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 10-44: 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 10-45: 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.

Table 10-47: 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.**

Table 10-48: Error messages for z (RESTOR TO FACTORY SETTINGS) command

Error	Message	Possible reason
E001	UNKOWN 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

```
>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 COMMAND.

>
```

Figure 10-46: 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

TRANSMISSION PARAMETERS WILL BE CHANGED. PLEASE CONFIRM (Y/N): Y
THE TRANSMISSION CONFIGURATION WILL BE CHANGED TO:
TRANSMISSION PROTOCOL = 460800 BITS/S, 2 STOP BIT(S), EVEN PARITY

APPLYING FACTORY SETTINGS
FACTORY SETTINGS APPLIED. TO PERMANENTLY STORE THE SETTINGS, USE THE SAVE COMMAND.

>
```

Figure 10-47: Example of response from z (RESTORE TO FACTORY SETTINGS) command with change in transmission parameters.

10.15 ? (HELP) command

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

Table 10-49: Available ? (HELP) commands

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

Table 10-50: 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
k	Responds with information on the AUX COMP-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

Table 10-51: Error messages for ? (HELP) commands

Error	Message	Possible reason
E001	UNKOWN 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
k: CHANGES COMPENSATION COEFFICIENTS FOR AUX INPUT
s: SAVES CONFIGURATION DATA
x: EXITS SERVICE MODE
z: RESTORES FACTORY SETTINGS


>
```

Figure 10-48: 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 k: RETURNS THE COMPENSATION COEFFICIENTS OF AUX INPUT
i e: PRINTS THE EXTENDED ERROR INFORMATION FROM THE LAST DETECTED ERROR IN NORMAL MODE

>
```

Figure 10-49: Example of response from ? i (HELP on INFORMATION) command

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

>
```

Figure 10-50: Example of response from ? a (HELP ON SINGLE-SHOT MEASUREMENT) command

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

>
```

Figure 10-51: Example of response from ? c (HELP on DIAGNOSTIC) command

```
>? d
d <type>','<term>: CHANGES THE DATAGRAM FORMAT
  ALLOWED VALUES FOR <type>:
    0 = ID, RATE, COUNTER, LATENCY, CRC
    1 = ID, RATE, ACCELERATION, COUNTER, LATENCY, CRC
    2 = ID, RATE, INCLINATION, COUNTER, LATENCY, CRC
    3 = ID, RATE, ACCELERATION, INCLINATION, COUNTER, LATENCY, CRC
    4 = ID, RATE, TEMPERATURE, COUNTER, LATENCY, CRC
    5 = ID, RATE, ACCELERATION, TEMPERATURE, COUNTER, LATENCY, CRC
    6 = ID, RATE, INCLINATION, TEMPERATURE, COUNTER, LATENCY, CRC
    7 = ID, RATE, ACCELERATION, INCLINATIONS, TEMPERATURE, COUNTER, LATENCY, CRC
    8 = ID, RATE, AUX, COUNTER, LATENCY, CRC
    9 = ID, RATE, ACCELERATION, AUX, COUNTER, LATENCY, CRC
    A = ID, RATE, INCLINATION, AUX, COUNTER, LATENCY, CRC
    B = ID, RATE, ACCELERATION, INCLINATION, AUX, COUNTER, LATENCY, CRC
    C = ID, RATE, TEMPERATURE, COUNTER, AUX, LATENCY, CRC
    D = ID, RATE, ACCELERATION, AUX, TEMPERATURE, COUNTER, LATENCY, CRC
    E = ID, RATE, INCLINATION, AUX, TEMPERATURE, COUNTER, LATENCY, CRC
    F = ID, RATE, ACCELERATION, INCLINATIONS, TEMPERATURE, AUX, COUNTER, LATENCY, CRC
  ALLOWED VALUES FOR <term>:
    0 = NONE
    1 = <CR><LF>

>
```

Figure 10-52: 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 STIM300 DATASHEET FOR LIMITATIONS
   ALLOWED VALUES FOR <stop bits>:
      1 = 1
      2 = 2
   ALLOWED VALUES FOR <parity>:
      0 = NONE
      1 = ODD
      2 = EVEN

>
```

Figure 10-53: 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 10-54: 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
      i = INCLINOMETER
   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
   ALLOWED VALUES FOR u,i,<unit>:
      0 = ACCELERATION
      1 = INCREMENTAL VELOCITY
      2 = AVERAGE ACCELERATION

>
```

Figure 10-55: 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)
      i = INCLINOMETER(S)
      u = AUX
   ALLOWED VALUES FOR <axis>:
      x = X-AXIS
      y = Y-AXIS
      z = Z-AXIS

>
```

Figure 10-56: 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 10-57: 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
      5 = <BiasSource> = 2, <BiasFilter> = 0, <ScaleSource> = 0, <ScaleFilter> = 0
      6 = <BiasSource> = 2, <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
      9 = <BiasSource> = 2, <BiasFilter> = 0, <ScaleSource> = 1, <ScaleFilter> = 0
      a = <BiasSource> = 2, <BiasFilter> = 1, <ScaleSource> = 1, <ScaleFilter> = 0, <FilterCutoff> = 0.01
      b = <BiasSource> = 1, <BiasFilter> = 1, <ScaleSource> = 1, <ScaleFilter> = 1, <FilterCutoff> = 0.01
      c = <BiasSource> = 2, <BiasFilter> = 1, <ScaleSource> = 2, <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
      2 = INCLINOMETER
    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 10-58: Example of response from ? m (HELP on GYRO G-COMP) command

```
? k
k <coeff1>','<coeff2>: CHANGES THE AUX COMPENSATE COEFFICIENTS

>
```
Figure 10-59: Example of response from ? k (HELP on AUX COMP) command

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

>
```
Figure 10-60: 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-SAVED SYSTEM PARAMETERS WILL BE OVERWRITTEN BY STORED CONTENT IN FLASH
WHEN EXITING TO INIT MODE

>
```
Figure 10-61: Example of response from ? x (HELP on EXIT) command

```
? z
z: RESTORES FACTORY SETTINGS

>
```

Figure 10-62: Example of response from ? z (HELP on RESTORE TO FACTORY SETTINGS) command
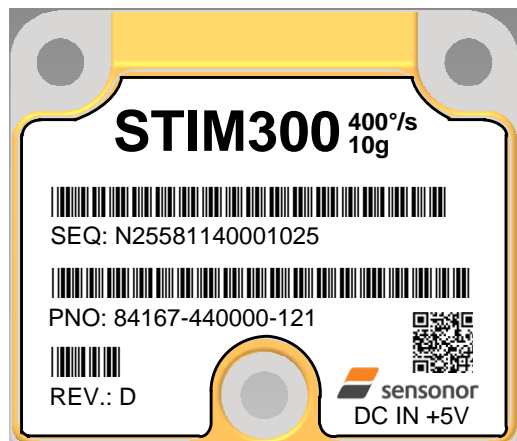
11   MARKING

Figure 11-1: Example of marking of STIM300

12 CONFIGURATION / ORDERING INFORMATION

The STIM300 will be delivered according to the configuration code as shown below. All configuration parameters can be changed later in Service Mode, ref. section 8.5.3. A full list of configurable parameters can be found in Table 6-8.

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

Range		Measurement							Output/RS422		
Prod_ID	-	**Sample rate**	**Filter band-width**	**Gyro output unit**	**Acc. output unit**	**Incl. output unit**	**Gyro g-comp**	-	**Datagram**	**Bit-rate**	**Termination**

Range

Prod_ID	Gyro	Acc
84455	400°/s	2g⁴⁾
84458	400°/s	5g
84167	**400°/s**	**10g**
84461	400°/s	30g
84615	400°/s	80g

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]

Incl. output unit:

0 = Acceleration [g]
1 = Incremental Velocity [m/s/sample]
2 = Average Acceleration [g]

Gyro g-comp

	Bias		Scale-factor	
	Source	0.01Hz-filter	Source	0.01Hz-filter
0	**OFF**	**-**	**OFF**	**-**
1¹⁾	OFF	-	ACC	OFF
2	OFF	-	ACC	ON
3¹⁾	ACC	OFF	OFF	-
4	ACC	ON	OFF	-
5¹⁾	INC	OFF	OFF	-
6	INC	ON	OFF	-
7¹⁾	ACC	OFF	ACC	OFF
8¹⁾	ACC	ON	ACC	OFF
9¹⁾	INC	OFF	ACC	OFF
a¹⁾	INC	ON	ACC	OFF
b	ACC	ON	ACC	ON
c	INC	ON	INC	ON

Datagram

		Included data				
		Rate	Acceleration	Inclination	Temperature	AUX
0		YES	NO	NO	NO	NO
1		YES	YES	NO	NO	NO
2		YES	NO	YES	NO	NO
3		**YES**	**YES**	**YES**	**NO**	**NO**
4		YES	NO	NO	YES	NO
5		YES	YES	NO	YES	NO
6		YES	NO	YES	YES	NO
7		YES	YES	YES	YES	NO
8		YES	NO	NO	NO	YES
9		YES	YES	NO	NO	YES
a		YES	NO	YES	NO	YES
b		YES	YES	YES	NO	YES
c		YES	NO	NO	YES	YES
d		YES	YES	NO	YES	YES
e		YES	NO	YES	YES	YES
f		YES	YES	YES	YES	YES

Bit-rate:

0 = 374400 bits/s
1 = 460800 bits/s
2 = 921600 bits/s
3 = 1843200 bits/s
f = User-defined ²⁾

Termination

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

RS422 data configuration

#Start bit	1
#Data bits	8
#Stop bits	1³⁾
Parity	None³⁾

¹⁾ Delayed gyro output unit should be selected with this option
²⁾ Bit-rate must be specified. See section 10.5 for limitations
³⁾ Configuration can be changed in SERVICEMODE. See section 10.5
⁴⁾ Date of introduction not yet defined

Example: 84167-413020-330 has the following configuration:
- o Gyro range = 400°/s, accelerometer range = 10g
- o Sample rate = 2000 samples/s
- o Low-pass filter bandwidth = 33Hz
- o Gyro output unit = Integrated Angle [°]
- o Accelerometer output unit = Acceleration [g]
- o Inclinometer output unit = Average Acceleration [g]
- o No g-/acc-compensation of bias and scale-factor
- o Datagram containing Rate, Acceleration and Inclination
- o Bit-rate = 1843200 bits/s
- o Datagram Termination = None
- o Line termination OFF

NOTES

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