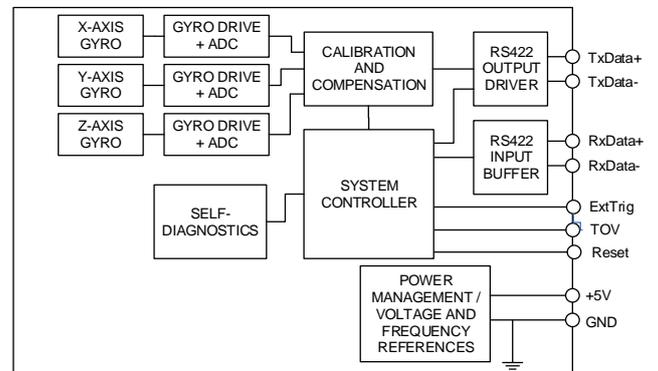# STIM277H

**Multi-axis
Gyro
Module**

FEATURES:

- o Miniature laser welded hermetic package
- o Tested to 20 years life expectancy
- o Aluminum casing, 6082-T6 alloy - SurTec 650 surface treated
- o ITAR-free
- o Low noise and bias instability
- o Calibrated and verified over operating range
- o Excellent performance in vibration and shock environments
- o 3 axes offered in same package
  - o Electronically calibrated axis alignment
- o Single-crystal silicon technology
  - o No intrinsic wear-out effects
- o Insensitive to magnetic fields
- o Full EMI compliance
- o Digital interface, RS422
- o Fully configurable
- o External Trigger input and Time Of Validity output to enable synchronization
- o Continuous self-diagnostics
- o Delivered in dust free clean-room packaging

BLOCK DIAGRAM:

1 GENERAL DESCRIPTION

STIM277H is a cluster of 3 high accuracy MEMS-based gyros 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.

STIM277H 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, LP filter -3dB frequency and RS422 bit-rate and protocol parameters. All configurable parameters can be defined when ordering or set by customer.

When STIM277H is powered up, it will perform an internal system check and synchronize the gyros. As an acknowledgement of the complete power-up sequence, it will provide special datagrams containing data, like part number, serial number and configuration parameters as mentioned above. STIM277H will then automatically proceed to provide measurement data.

The measurement data is transmitted as packages of data on a fixed format (datagram) at intervals given by the sample rate. 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, a status byte and a CRC (Cyclic Redundancy Check) byte to provide high degree of fault detection in the transmissions. The status byte will flag any detected errors in the system.

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; 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 byte.

Finally, STIM277H may be put in Utility Mode. This mode is similar to Service Mode, but made for machine-machine communication.

2   TABLE OF CONTENTS

3 DEFINITIONS AND ABBREVIATIONS USED IN DOCUMENT

3.1 Definitions

1g = 9.80665m/s^2

3.2 Abbreviations

Table 3-1: Abbreviations

ABBREVIATION	FULL NAME
ASCII	American Standard Code for Information Interchange
CIC-filter	Cascaded Integrator Comb filter
CR	Carriage Return
ESD	Electro-Static Discharge
ExtTrig	External Trigger
GND	Ground
LF	Line Feed
LP filter	Low-Pass filter
NRST	Negative (active) Reset
rms	Root mean square
RxD	Receive Data
TOV	Time Of Validity
TxD	Transmit Data
VSUP	Voltage supply

4 ABSOLUTE MAXIMUM RATINGS

Stresses beyond those listed in Table 4-1 may cause permanent damage to the device.
Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Table 4-1: Absolute maximum ratings

Parameter	Rating	Comment
Mechanical shock	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	
Chassis to GND	500VDC	
Helium sensitivity		Exposure to high concentrations of helium over several days may affect the overall performance

5 SPECIFICATIONS

Table 5-1: Operating conditions

Parameter	Conditions	Min	Nom	Max	Unit	Note
INPUT RANGE			±400		°/s	
POWER SUPPLY		4.5	5.0	5.5	V	
OPERATING TEMPERATURE		-40		+85	°C	

Table 5-2: Functional specifications, general

Parameter	Conditions	Min	Nom	Max	Unit	Note
POWER CONSUMPTION						
Power consumption			1.2	1.5	W	
TIMING						
Start-Up time after Power-On				0.3	s	1
Time to transmit after Reset				0.2	s	2
Time to valid data			0.7		s	3
	T=+25°C			1	s	3
RS422 Bit-Rate			ref. Table 5-5			
RS422 Bit-Rate Accuracy				±1	%	
RS422 PROTOCOL						
Start Bit			1		bit	
Data Length			8		bits	
Parity			None			4
Stop-bits			1		bit	4
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						
Logic levels	"high"	2.3			V	
	"low"			0.6	V	
Trigger			Negative transition			
Minimum "high" time before trigger, t_{ext_hi}		250			ns	5
Minimum "low" time after trigger, t_{ext_lo}		250			ns	5
Delay from external trigger to start of transmission, t_{ext_dl}				86	µs	5
Time between triggers	Measurement.unit:					
	angular rate	0.5		127	ms	6,7
	incremental angle	0.5		127	ms	6,8
	average rate	0.5		65	ms	6,9
	integrated angle	0.5		8	ms	6,10
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	11
Delay from internal time-tick to TOV active, t_{tov_dl}			0.5	6	µs	11
Delay from TOV "low" to start of transmission, t_{tx_dl}				80	µs	11
CHASSIS						
Isolation resistance chassis to GND (pin 15)	500VDC	100			MΩ	

Note 1: Time from Power-On to start of datagram transmissions (starting with part-number datagram)
Note 2: Time from Reset release to start of datagram transmissions (starting with part-number datagram)
Note 3: Time from Power-On or Reset to the reset of the Start-Up bit (Bit 6 in the STATUS byte ref. Table 5-14).
    During this period the output data should be regarded as non-valid
Note 4: Other values can be configured, ref. Table 5-5
Note 5: For definition, ref. Figure 7-3
Note 6: If time between triggers is longer than 127ms, the sample counter will over-run
Note 7: Time between triggers should be carefully evaluated as long time between triggers in combination with high
    bandwidths could lead to issues related to folding

Note 8: If time between triggers is longer than 8ms, an overload may occur in the incremental angle. An overload will be flagged in the status byte, ref. Table 5-14
Note 9: If time between triggers is longer than specified, the accuracy of average rate may be reduced
Note 10: If time between triggers is longer than specified, the integrated angle may have wrapped several times and hence the change in angle from last sample will not be possible to calculate
Note 11: For definition, ref. Figure 7-4 and Figure 7-5

Table 5-3: Functional specifications, gyros

Parameter	Conditions	Min	Nom	Max	Unit	Note
Full Scale (FS)			±400		°/s	1
Resolution			24		bits	
			0.22		°/h	
Scale Factor Accuracy			±500		ppm	
Non-Linearity	±200°/s		15		ppm	2
	±400°/s		25		ppm	2
Bandwidth (-3dB)			262		Hz	3
Sample Rate				2000	samples/s	4
Group Delay			2.2		ms	5
Bias Range		-250	0	+250	°/h	
Bias Trim Offset Range			±1		°/s	
Bias Run-Run	Static temperatures		4		°/h	
Bias error over temperature	$\Delta T \leq \pm 1°C/min$		9		°/h	6
Bias error over temperature gradients			10		°/h	7
Bias Instability	Allan Variance @25°C		0.3		°/h	
Angular Random Walk	Allan Variance @25°C		0.15		°/√hr	
Linear Acceleration Effect			7		°/h /g	8
Vibration Rectification Coefficient			Ref. Figure 5-1		°/h /g$_{rms}^2$	
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 5-5 and section 5.1.4
Note 4: Other values can be configured, ref. Table 5-5
Note 5: Specified group delay is valid for a filter setting = 262Hz. See Table 5-5 to find group delay for other filter-settings. Total delay to start of datagram transmission = group delay + 0.5ms + t_{tov_dl} + t_{tx_dl}
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 5-4
Note 8: Section 6.2 gives advice on sensitive directions
Note 9: Ref. Figure 6-5 for definition of reference points used in axis alignment
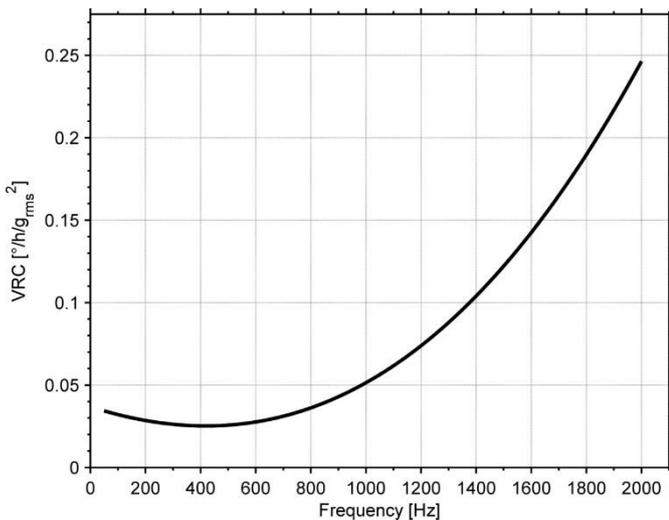
Figure 5-1: Nominal VRC at 20g rms for gyros (ref. section 6.2 for sensitive directions to acceleration-forces)

Table 5-4: Functional specifications, temperature

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

Note 1: Temperature is calibrated to reflect ambient temperature and not the internal temperature.

5.1 TYPICAL PERFORMANCE CHARACTERISTICS

5.1.1 Root Allan Variance
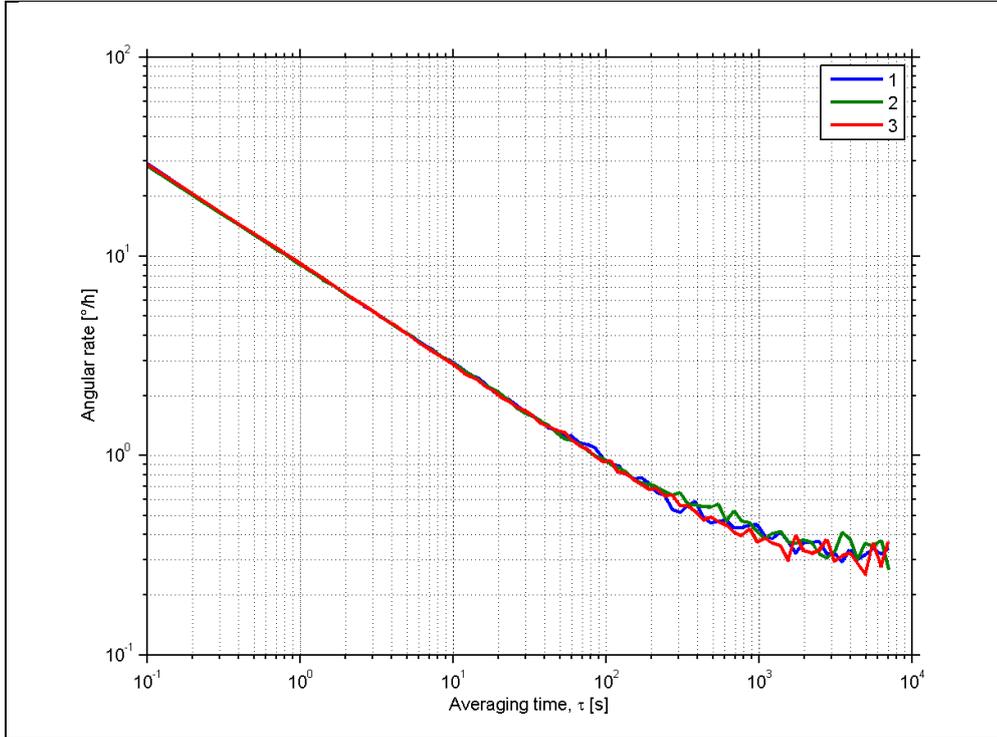
Figure 5-2: Typical Root Allan-Variance

5.1.2   Initial bias drift
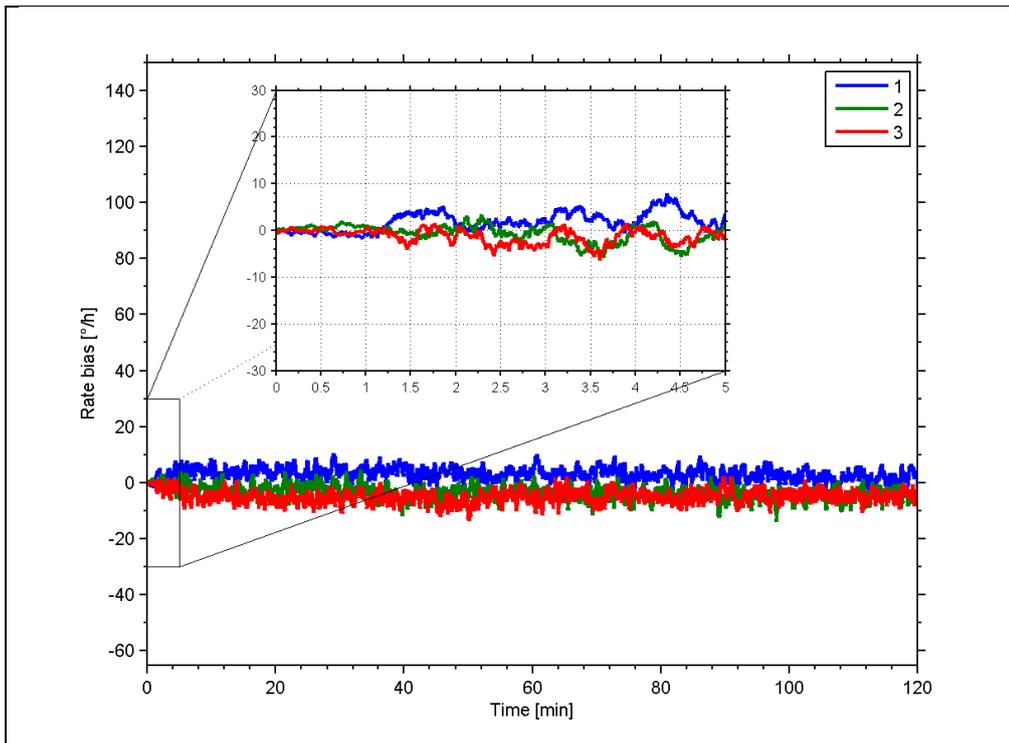
Figure 5-3: Typical normalized initial bias drift

5.1.3   Bias drift over temperature
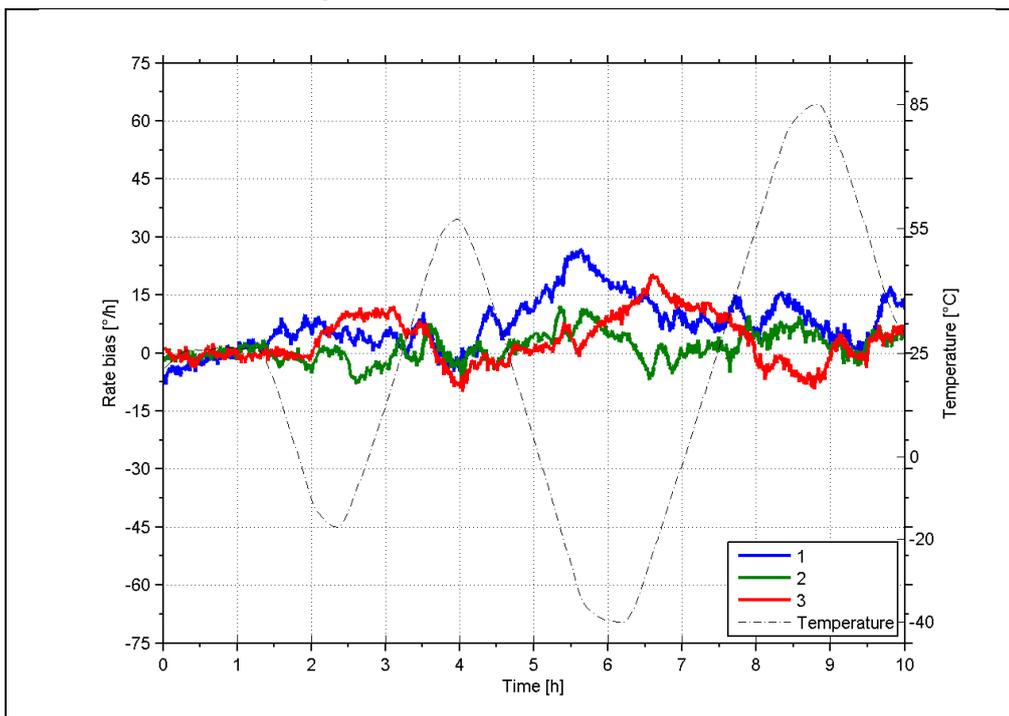
Figure 5-4: Typical Bias drift over temperature

5.1.4 Frequency characteristics
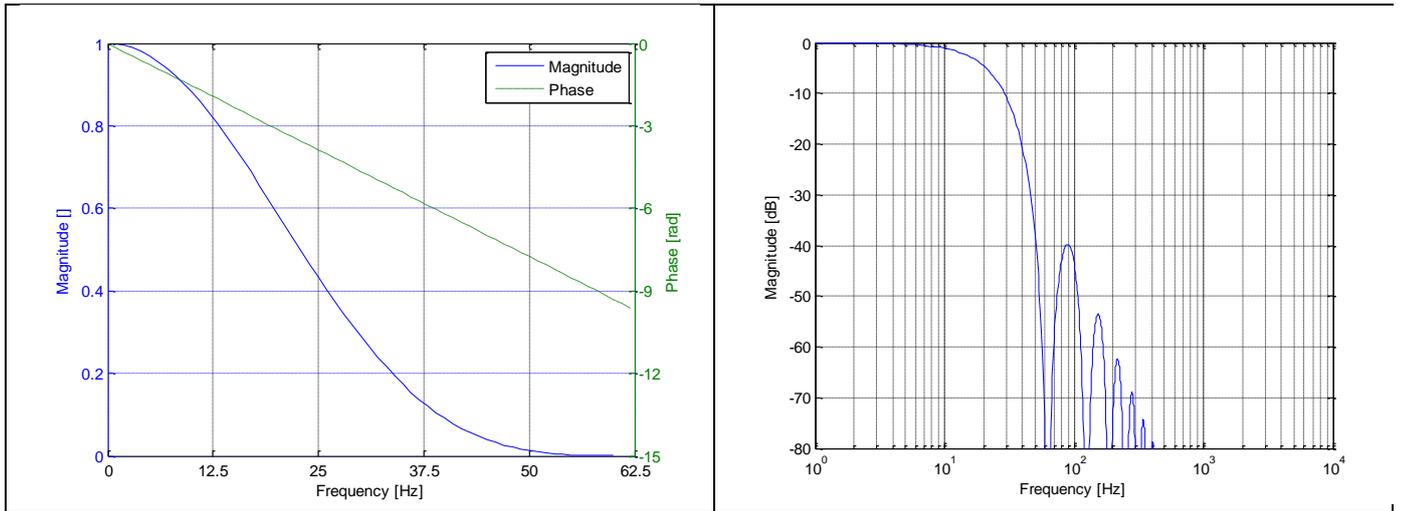
Figure 5-5: Frequency characteristics with low-pass filter -3dB frequency set to 16Hz
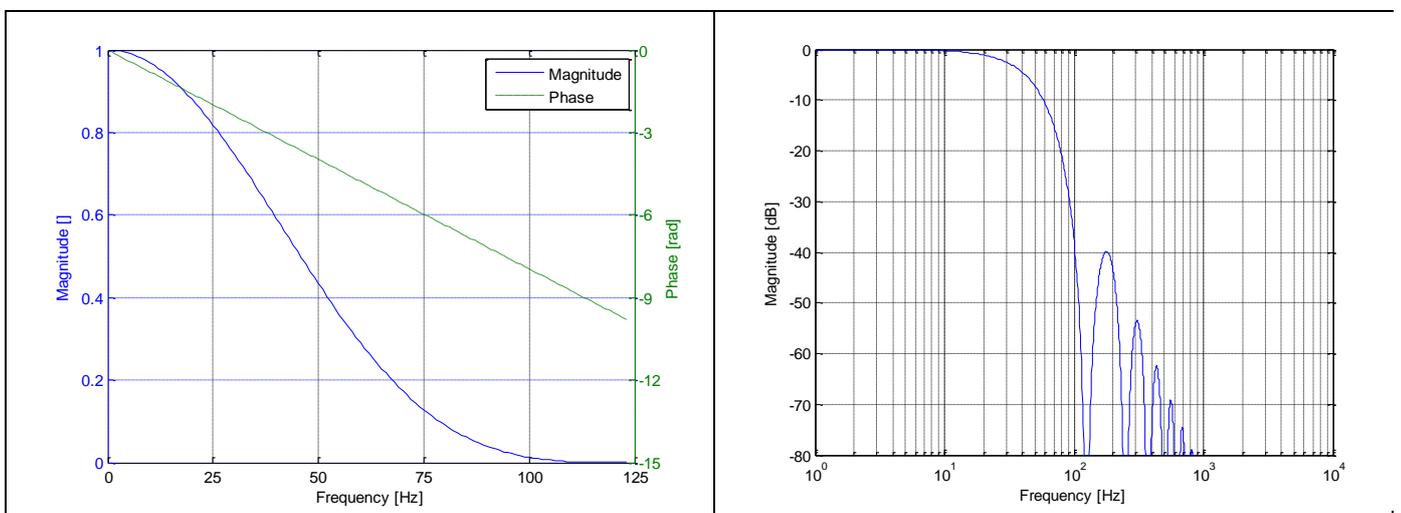
Figure 5-6: Frequency characteristics with low-pass filter -3dB frequency set to 33Hz
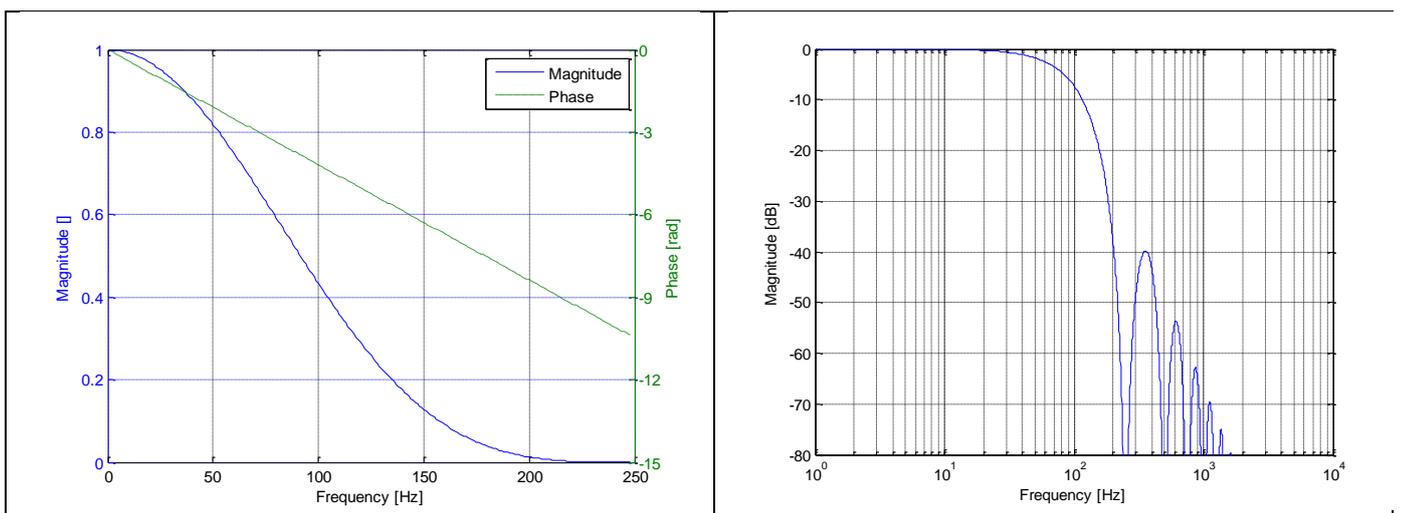
Figure 5-7: Frequency characteristics with low-pass filter -3dB frequency set to 66Hz
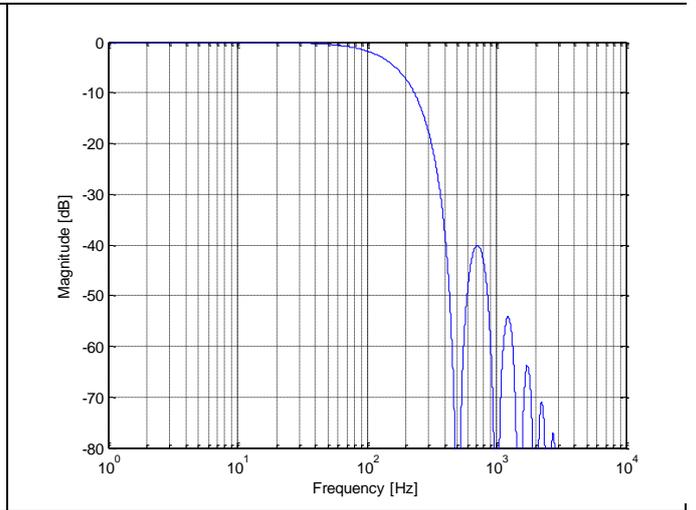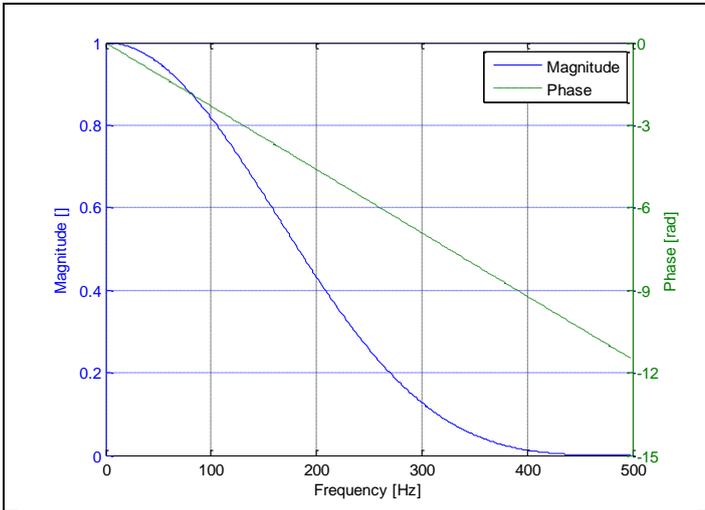
Figure 5-8: Frequency characteristics with low-pass filter -3dB frequency set to 131Hz
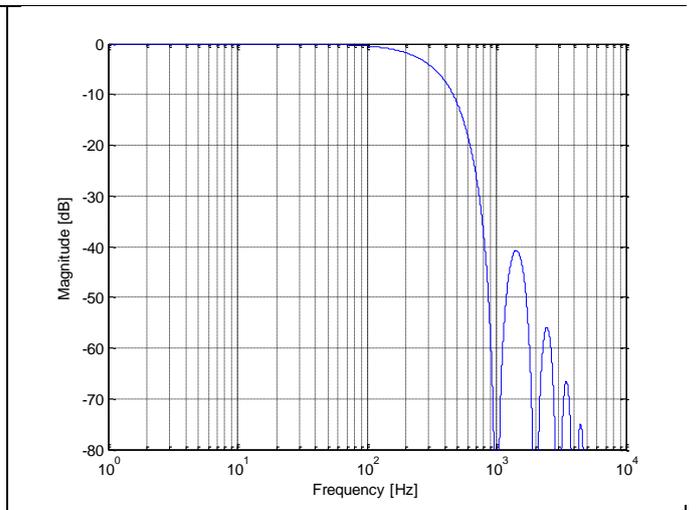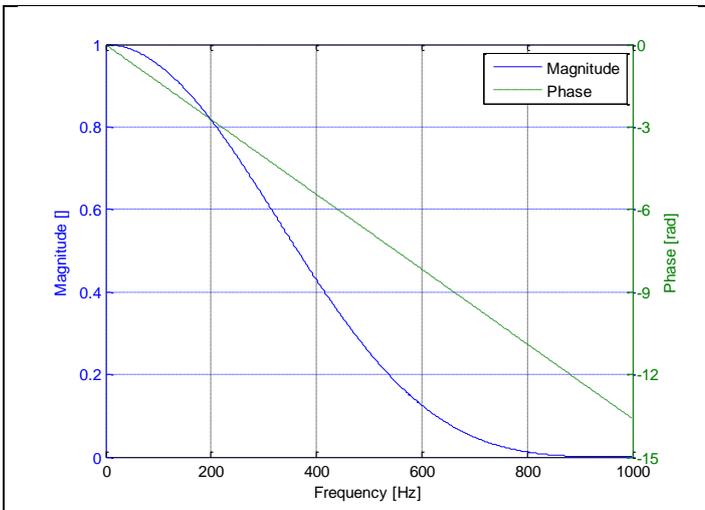
Figure 5-9: Frequency characteristics with low-pass filter -3dB frequency set to 262Hz

5.2   Configurable parameters

Table 5-5: Configurable parameters

Parameter	Configurations		Comments
DATAGRAM FORMAT	Standard Rate and temperature Rate and counter Rate and latency Rate, counter and latency Rate, temperature and counter Rate, temperature and latency Rate, temperature, counter and latency		Contains measurements and status byte
DATAGRAM TERMINATION	NONE <CR><LF>		
MEASUREMENT UNIT	Angular rate [°/s] Incremental angle [°/sample] Average angular rate [°/s] Integrated angle [°]		
SAMPLE RATE	125 samples/s 250 samples/s 500 samples/s 1000 samples/s 2000 samples/s External trigger		
LOW-PASS FILTER -3dB FREQUENCY	**-3dB freq.:** 16Hz 33Hz 66Hz 131Hz 262Hz	**Filter group delay:** 24.7ms 12.7ms 6.7ms 3.7ms 2.2ms	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. Total delay to the start of datagram transmission = group delay + 0.5ms + t_{tov_dl} + t_{tx_dl}
RS422 BIT-RATE	374400 bits/s 460800 bits/s 921600 bits/s 1843200 bits/s User-defined		Some limitations apply to the use of 374400 and 460800 bits/s, dependent on chosen sample rate and datagram format, ref Table 5-13. For user-defined bit-rates, see section 9.11
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 STIM277H when ordering.

5.3 Datagram specifications

5.3.1 Part Number datagram

Table 5-6: Specification of the Part Number datagram

Byte#	7	6	5	4	3	2	1	0	Specification
	Bit#								
0	0 0	1 1	0 0	1 1	0 0	1 1	0 1	0 0	**Part Number datagram identifier:** 0x54 for datagrams without CR+LF termination 0x56 for standard datagrams w.CR+LF
1	0	0	0	0	$P1_3$	$P1_2$	$P1_1$	$P1_0$	Low nibble: 1.digit of part number
2	$P2_3$	$P2_2$	$P2_1$	$P2_0$	$P3_3$	$P3_2$	$P3_1$	$P3_0$	High nibble: 2.digit of part number Low nibble: 3.digit of part number
3	$P4_3$	$P4_2$	$P4_1$	$P4_0$	$P5_3$	$P5_2$	$P5_1$	$P5_0$	High nibble: 4.digit of part number Low nibble: 5.digit of part number
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 of part number Low nibble: 7.digit of part number
6	$P8_3$	$P8_2$	$P8_1$	$P8_0$	$P9_3$	$P9_2$	$P9_1$	$P9_0$	High nibble: 8.digit of part number Low nibble: 9.digit of part number
7	0	0	1	0	1	1	0	1	ASCII character "-"(0x2D)
8	$P10_3$	$P10_2$	$P10_1$	$P10_0$	$P11_3$	$P11_2$	$P11_1$	$P11_0$	High nibble: 10.digit of part number Low nibble: 11.digit of part number
9	$P11_3$	$P11_2$	$P11_1$	$P11_0$	$P13_3$	$P13_2$	$P13_1$	$P13_0$	High nibble: 12.digit of part number Low nibble: 13.digit of part number
10	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"
11	c_7	c_6	c_5	c_4	c_3	c_2	c_1	c_0	Cyclic Redundancy Check is performed on all preceding bytes and is generated from the polynomial: $x^8 + x^2 + x + 1$, seed = 0xFF
(12)	0	0	0	0	1	1	0	1	<CR> only when <CR><LF> datagram termination have been chosen
(13)	0	0	0	0	1	0	1	0	<LF> only when <CR><LF> datagram termination have been chosen

5.3.2 Serial Number datagram

Table 5-7: Specification of the Serial Number datagram

Byte#	7	6	5	4	3	2	1	0	Specification
	Bit#								
0	0 0	1 1	0 0	1 1	1 1	0 0	1 0	0 0	**Serial Number datagram identifier:** 0x5A for datagrams without CR+LF termination 0x5C for standard datagrams w.CR+LF
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 of serial number Low nibble: 2.digit of serial number
3	$S3_3$	$S3_2$	$S3_1$	$S3_0$	$S4_3$	$S4_2$	$S4_1$	$S4_0$	High nibble: 3.digit of serial number Low nibble: 4.digit of serial number
4	$S5_3$	$S5_2$	$S5_1$	$S5_0$	$S6_3$	$S6_2$	$S6_1$	$S6_0$	High nibble: 5.digit of serial number Low nibble: 6.digit of serial number
5	$S7_3$	$S7_2$	$S7_1$	$S7_0$	$S8_3$	$S8_2$	$S8_1$	$S8_0$	High nibble: 7.digit of serial number Low nibble: 8.digit of serial number
6	$S9_3$	$S9_2$	$S9_1$	$S9_0$	$S10_3$	$S10_2$	$S10_1$	$S10_0$	High nibble: 9.digit of serial number Low nibble: 10.digit of serial number
7	$S11_3$	$S11_2$	$S11_1$	$S11_0$	$S11_3$	$S11_2$	$S11_1$	$S11_0$	High nibble: 11.digit of serial number Low nibble: 12.digit of serial number
8	$S13_3$	$S13_2$	$S13_1$	$S13_0$	$S14_3$	$S14_2$	$S14_1$	$S14_0$	High nibble: 13.digit of serial number Low nibble: 14.digit 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	c_7	c_6	c_5	c_4	c_3	c_2	c_1	c_0	Cyclic Redundancy Check is performed on all preceding bytes and is generated from the polynomial: $x^8 + x^2 + x + 1$, seed = 0xFF
(12)	0	0	0	0	1	1	0	1	<CR> only when <CR><LF> datagram termination have been chosen
(13)	0	0	0	0	1	0	1	0	<LF> only when <CR><LF> datagram termination have been chosen

5.3.3 Configuration datagram

Table 5-8: Specification of the Configuration datagram

Byte#	Bit#								Specification
	7	6	5	4	3	2	1	0	
0	0	0	1	0	1	0	0	0	**Configuration datagram identifier:** 0x28 for datagrams without CR+LF termination
	0	0	1	0	1	0	1	1	0x2B for standard datagrams w.CR+LF
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	h_7	h_6	h_5	h_4	h_3	h_2	h_1	h_0	Hardware revision. Numbering sequence: 0, 1, …, 255
4									**System configuration, Byte 1:**
	0	x	x	x	x	x	x	x	Z axis is inactive
	1	x	x	x	x	x	x	x	Z axis is active
	x	1	0	0	x	x	x	x	LP filter -3dB frequency for Z axis = 262Hz
	x	0	1	1	x	x	x	x	LP filter -3dB frequency for Z axis = 131Hz
	x	0	1	0	x	x	x	x	LP filter -3dB frequency for Z axis = 66Hz
	x	0	0	1	x	x	x	x	LP filter -3dB frequency for Z axis = 33Hz
	x	0	0	0	x	x	x	x	LP filter -3dB frequency for Z axis = 16Hz
	x	x	x	x	0	x	x	x	Y-axis is inactive
	x	x	x	x	1	x	x	x	Y-axis is active
	x	x	x	x	x	1	0	0	LP filter -3dB frequency for Y axis = 262Hz
	x	x	x	x	x	0	1	1	LP filter -3dB frequency for Y axis = 131Hz
	x	x	x	x	x	0	1	0	LP filter -3dB frequency for Y axis = 66Hz
	x	x	x	x	x	0	0	1	LP filter -3dB frequency for Y axis = 33Hz
	x	x	x	x	x	0	0	0	LP filter -3dB frequency for Y axis = 16Hz
5									**System configuration, Byte 2:**
	0	x	x	x	x	x	x	x	X-axis is inactive
	1	x	x	x	x	x	x	x	X-axis is active
	x	1	0	0	x	x	x	x	LP filter -3dB frequency for X axis = 262Hz
	x	0	1	1	x	x	x	x	LP filter -3dB frequency for X axis = 131Hz
	x	0	1	0	x	x	x	x	LP filter -3dB frequency for X axis = 66Hz
	x	0	0	1	x	x	x	x	LP filter -3dB frequency for X axis = 33Hz
	x	0	0	0	x	x	x	x	LP filter -3dB frequency for X axis = 16Hz
	x	x	x	x	1	0	1	x	Sample rate = External trigger
	x	x	x	x	1	0	0	x	Sample rate = 2000 samples/s
	x	x	x	x	0	1	1	x	Sample rate = 1000 samples/s
	x	x	x	x	0	1	0	x	Sample rate = 500 samples/s
	x	x	x	x	0	0	1	x	Sample rate = 250 samples/s
	x	x	x	x	0	0	0	x	Sample rate = 125 samples/s
	x	x	x	x	x	x	x	0	Output unit = ANGULAR RATE
	x	x	x	x	x	x	x	1	Output unit = other than ANGULAR RATE (ref. byte#8)
6									**System configuration, Byte 3:**
	0	x	x	x	x	x	x	x	Datagram format = STANDARD
	1	x	x	x	x	x	x	x	Datagram format = other than STANDARD (ref. byte#8)
	x	0	1	1	x	x	x	x	Bit-rate = 1843200 bits/s
	x	0	1	0	x	x	x	x	Bit-rate = 921600 bits/s
	x	0	0	1	x	x	x	x	Bit-rate = 460800 bits/s
	x	0	0	0	x	x	x	x	Bit-rate = 374400 bits/s
	x	1	1	1	x	x	x	x	Bit-rate = User-defined, ref.section 9.5
	x	x	x	x	0	x	x	x	Stop-bit = 1
	x	x	x	x	1	x	x	x	Stop-bits = 2
	x	x	x	x	x	0	0	x	Parity = none
	x	x	x	x	x	0	1	x	Parity = even
	x	x	x	x	x	1	0	x	Parity = odd
	x	x	x	x	x	x	x	0	Line termination = OFF
	x	x	x	x	x	x	x	1	Line termination = ON
7	s_7	s_6	s_5	s_4	s_3	s_2	s_1	s_0	STATUS byte. Ref. Table 5-14 for specification of the STATUS byte.
8									**System configuration, Byte 4:**
	0	0	0	0	x	x	x	x	Output unit = ANGULAR RATE
	0	0	0	1	x	x	x	x	Output unit = INCREMENTAL ANGLE
	0	0	1	0	x	x	x	x	Output unit = AVERAGE ANGULAR RATE
	0	0	1	1	x	x	x	x	Output unit = INTEGRATED ANGLE
	x	x	x	x	0	0	0	0	Datagram format = Standard
	x	x	x	x	0	0	0	1	Datagram format = Rate and temperature,
	x	x	x	x	0	1	0	0	Datagram format = Rate and counter,
	x	x	x	x	0	1	0	1	Datagram format = Rate and latency
	x	x	x	x	0	1	1	0	Datagram format = Rate, counter and latency
	x	x	x	x	0	1	1	1	Datagram format = Rate, temperature and counter
	x	x	x	x	1	0	0	0	Datagram format = Rate, temperature and latency
	x	x	x	x	1	0	0	1	Datagram format = Rate, temperature, counter and latency

Byte#	7	6	5	4	3	2	1	0	Specification
9	0	0	0	0	x	x	x	x	High nibble: Gyro range, x-axis - $400°/s$
	x	x	x	x	0	0	0	0	Low nibble: Gyro range, y-axis - $400°/s$
10	0	0	0	0	x	x	x	x	High nibble: Gyro range, z-axis - $400°/s$
	x	x	x	x	x	0	x	x	Toggling of TOV during transmission of special datagrams at start-up: - No toggling
	x	x	x	x	x	1	x	x	- Toggling
	x	x	x	x	x	x	0	x	Transmission of Bias Trim Offset datagram at start-up: - No transmission
	x	x	x	x	x	x	1	x	- Transmission
11	c_7	c_6	c_5	c_4	c_3	c_2	c_1	c_0	Cyclic Redundancy Check is performed on all preceding bytes and is generated from the polynomial: $x^8 + x^2 + x + 1$, seed = 0xFF
(12)	0	0	0	0	1	1	0	1	<CR> only when <CR><LF> datagram termination have been chosen
(13)	0	0	0	0	1	0	1	0	<LF> only when <CR><LF> datagram termination have been chosen

5.3.4   Bias Trim Offset datagram

Table 5-9: Specification of the Bias Trim Offset datagram

Byte#	7	6	5	4	3	2	1	0	Specification
0	0	0	1	0	1	1	0	0	**Bias Trim Offset datagram identifier:** 0x2C for datagrams without CR+LF termination
	0	0	1	0	1	1	0	1	0x2D for datagrams with CR+LF termination
1	Gx_{23}	Gx_{22}	Gx_{21}	Gx_{20}	Gx_{19}	Gx_{18}	Gx_{17}	Gx_{16}	X-axis gyro bias trim offset, ref. section 7.4.2.2.1 for conversion to [°/s]. NB: unit is [°/s] regardless of chosen output unit in Normal Mode datagram
2	Gx_{15}	Gx_{14}	Gx_{13}	Gx_{12}	G_{11}	Gx_{10}	Gx_9	Gx_8	
3	Gx_7	Gx_6	Gx_5	Gx_4	Gx_3	Gx_2	Gx_1	Gx_0	
4	Gy_{23}	Gy_{22}	Gy_{21}	Gy_{20}	Gy_{19}	Gy_{18}	Gy_{17}	Gy_{16}	Y-axis gyro bias trim offset, ref. section 7.4.2.2.1 for conversion to [°/s]. NB: unit is [°/s] regardless of chosen output unit in Normal Mode datagram
5	Gy_{15}	Gy_{14}	Gy_{13}	Gy_{12}	Gy_{11}	Gy_{10}	Gy_9	Gy_8	
6	Gy_7	Gy_6	Gy_5	Gy_4	Gy_3	Gy_2	Gy_1	Gy_0	
7	Gz_{23}	Gz_{22}	Gz_{21}	Gz_{20}	Gz_{19}	Gz_{18}	Gz_{17}	Gz_{16}	Z-axis gyro bias trim offset, ref. section 7.4.2.2.1 for conversion to [°/s]. NB: unit is [°/s] regardless of chosen output unit in Normal Mode datagram
8	Gz_{15}	Gz_{14}	Gz_{13}	Gz_{12}	Gz_{11}	Gz_{10}	Gz_9	Gz_8	
9	Gz_7	Gz_6	Gz_5	Gz_4	Gz_3	Gz_2	Gz_1	Gz_0	
10	Rf_{31}	Rf_{30}	Rf_{29}	Rf_{28}	Rf_{27}	Rf_{26}	Rf_{25}	Rf_{24}	Reference info to last adjustment
11	Rf_{23}	Rf_{22}	Rf_{21}	Rf_{20}	Rf_{19}	Rf_{18}	Rf_{17}	Rf_{16}	
12	Rf_{15}	Rf_{14}	Rf_{13}	Rf_{12}	Rf_{11}	Rf_{10}	Rf_9	Rf_8	
13	Rf_7	Rf_6	Rf_5	Rf_4	Rf_3	Rf_2	Rf_1	Rf_0	
14	Sav_{15}	Sav_{14}	Sav_{13}	Sav_{12}	Sav_{11}	Sav_{10}	Sav_9	Sav_8	Remaining number of saves
15	Sav_7	Sav_6	Sav_5	Sav_4	Sav_3	Sav_2	Sav_1	Sav_0	
16	C_7	C_6	C_5	C_4	C_3	C_2	C_1	C_0	Cyclic Redundancy Check is performed on all preceding bytes and is generated from the polynomial: $x^8 + x^2 + x + 1$, seed = 0xFF
(17)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(18)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

5.3.5   Extended Error Information datagram

Table 5-10: Specification of the Extended Error Information datagram

Byte#	7	6	5	4	3	2	1	0	Specification
0	0	0	1	0	1	1	1	0	**Extended Error Information datagram identifier:** 0x2E for datagrams without CR+LF termination
	0	0	1	0	1	1	1	1	0x2F for datagrams with CR+LF termination
1	E_{79}	E_{78}	E_{77}	E_{76}	E_{75}	E_{74}	E_{73}	E_{72}	Ref. Table 5-11
2	E_{71}	E_{70}	E_{69}	E_{68}	E_{67}	E_{66}	E_{65}	E_{64}	Ref. Table 5-11
3	E_{63}	E_{62}	E_{61}	E_{60}	E_{59}	E_{58}	E_{57}	E_{56}	Ref. Table 5-11
4	E_{55}	E_{54}	E_{53}	E_{52}	E_{51}	E_{50}	E_{49}	E_{48}	Ref. Table 5-11
5	E_{47}	E_{46}	E_{45}	E_{44}	E_{43}	E_{42}	E_{41}	E_{40}	Ref. Table 5-11
6	E_{39}	E_{38}	E_{37}	E_{36}	E_{35}	E_{34}	E_{33}	E_{32}	Ref. Table 5-11
7	E_{31}	E_{30}	E_{29}	E_{28}	E_{27}	E_{26}	E_{25}	E_{24}	Ref. Table 5-11
8	E_{23}	E_{22}	E_{21}	E_{20}	E_{19}	E_{18}	E_{17}	E_{16}	Ref. Table 5-11
9	E_{15}	E_{14}	E_{13}	E_{12}	E_{11}	E_{10}	E_9	E_8	Ref. Table 5-11
10	E_7	E_6	E_5	E_4	E_3	E_2	E_1	E_0	Ref. Table 5-11
11	C_7	C_6	C_5	C_4	C_3	C_2	C_1	C_0	Cyclic Redundancy Check is performed on all preceding bytes and is generated from the polynomial: $x^8 + x^2 + x + 1$, seed = 0xFF
(12)	0	0	0	0	1	1	0	1	<CR> If datagram termination has been selected
(13)	0	0	0	0	1	0	1	0	<LF> If datagram termination has been selected

Table 5-11: Specification of the Extended Error Information

Bit#	Specification	Bit#	Specification	Bit#	Specification	Bit#	Specification
E_{79}	For future use (=0)	E_{78}	For future use (=0)	E_{77}	For future use (=0)	E_{76}	For future use (=0)
E_{75}	For future use (=0)	E_{74}	For future use (=0)	E_{73}	For future use (=0)	E_{72}	For future use (=0)
E_{71}	For future use (=0)	E_{70}	For future use (=0)	E_{69}	For future use (=0)	E_{68}	GYRO Z: Config,error
E_{67}	GYRO Y: Config,error	E_{66}	GYRO X: Config.error	E_{65}	µC temperature failure	E_{64}	GYRO Z: ASIC temp.dev.
E_{63}	GYRO Y: ASIC temp.dev	E_{62}	GYRO X: ASIC temp.dev	E_{61}	GYRO Z: Temp.deviation	E_{60}	GYRO Y: Temp.deviation
E_{59}	GYRO X: Temp.deviation	E_{58}	Self-test not running	E_{57}	UART unable to transmit	E_{56}	GYRO Z: data missing
E_{55}	GYRO Y: Data missing	E_{54}	GYRO X: Data missing	E_{53}	Transmit stack warning	E_{52}	Flash stack warning
E_{51}	Sample stack warning	E_{50}	Command stack warning	E_{49}	Monitor stack warning	E_{48}	Internal DAC error
E_{47}	Supply overvoltage	E_{46}	Flash check error	E_{45}	RAM check error	E_{44}	GYRO Z: Data lost
E_{43}	GYRO Z: Exc.ampl.error	E_{42}	GYRO Z: Int.comm.error	E_{41}	For future use (=0)	E_{40}	For future use (=0)
E_{39}	GYRO Z: ASIC overflow, I	E_{38}	GYRO Z: ASIC overflow, Q	E_{37}	GYRO Y: Data lost	E_{36}	GYRO Y: Exc.ampl.error
E_{35}	GYRO Y: Int.comm.error	E_{34}	For future use (=0)	E_{33}	For future use (=0)	E_{32}	GYRO Y: ASIC overflow, I
E_{31}	GYRO Y: ASIC overflow, Q	E_{30}	GYRO X: Data lost	E_{29}	GYRO X: Exc.ampl.error	E_{28}	GYRO X: Int.comm.error
E_{27}	For future use (=0)	E_{26}	For future use (=0)	E_{25}	GYRO X: ASIC overflow, I	E_{24}	GYRO X: ASIC overflow, Q
E_{23}	Regulated voltage#3 error	E_{22}	Regulated voltage#2 error	E_{21}	Regulated voltage#1 error	E_{20}	Supply voltage error
E_{19}	Reference voltage#3 error	E_{18}	Reference voltage#2 error	E_{17}	Reference voltage#1 error	E_{16}	Start-up phase active
E_{15}	GYRO Z: Int.comm.error	E_{14}	GYRO Y: Int.comm.error	E_{13}	GYRO X: Int.comm.error	E_{12}	GYRO Z: Clipped
E_{11}	GYRO Y: Clipped	E_{10}	GYRO X: Clipped	E_9	TEMP GYRO Z: Error	E_8	TEMP GYRO Y: Error
E_7	TEMP GYRO X: Error	E_6	GYRO Z: ASIC temp.error	E_5	GYRO Y: ASIC temp.error	E_4	GYRO X: ASIC temp.error
E_3	µC temperature error	E_2	GYRO Z: Exc.freq.error	E_1	GYRO Y: Exc.freq.error	E_0	GYRO X: Exc.freq.error

5.3.6 Normal Mode datagram

Table 5-12: Specification of the Normal Mode datagram

Standard datagram	Rate and temperature	Rate and counter	Rate and latency	Rate, counter and latency	Rate, temperature and counter	Rate, temperature and latency	Rate, temperature, counter and latency	7	6	5	4	3	2	1	0	Specification
0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	**Normal Mode datagram identifier:** 0x90 standard datagram
								1	0	1	0	0	0	0	0	0xA0 datagram with rate and temperature
								1	0	1	0	0	0	1	0	0xA2 datagram with rate and counter
								1	0	1	0	0	1	0	0	0xA4 datagram with rate and latency
								1	0	1	0	0	1	0	1	0xA5 datagram with rate, counter and latency
								1	0	0	1	1	0	0	1	0x99 datagram with rate, temperature and counter
								1	0	1	0	0	1	1	0	0xA6 datagram with rate, temperature and latency
								1	0	1	0	1	0	0	0	0xA8 datagram with rate, temperature, counter and latency
1	1	1	1	1	1	1	1	x_{23}	x_{22}	x_{21}	x_{20}	x_{19}	x_{18}	x_{17}	x_{16}	X axis gyro output. Ref. section 7.4.2.2 for conversion to units
2	2	2	2	2	2	2	2	x_{15}	x_{14}	x_{13}	x_{12}	x_{11}	x_{10}	x_9	x_8	
3	3	3	3	3	3	3	3	x_7	x_6	x_5	x_4	x_3	x_2	x_1	x_0	
4	4	4	4	4	4	4	4	y_{23}	y_{22}	y_{21}	y_{20}	y_{19}	y_{18}	y_{17}	y_{16}	Y axis gyro output. Ref. section 7.4.2.2 for conversion to units
5	5	5	5	5	5	5	5	y_{15}	y_{14}	y_{13}	y_{12}	y_{11}	y_{10}	y_9	y_8	
6	6	6	6	6	6	6	6	y_7	y_6	y_5	y_4	y_3	y_2	y_1	y_0	
7	7	7	7	7	7	7	7	z_{23}	z_{22}	z_{21}	z_{20}	z_{19}	z_{18}	z_{17}	z_{16}	Z axis gyro output. Ref. section 7.4.2.2 for conversion to units
8	8	8	8	8	8	8	8	z_{15}	z_{14}	z_{13}	z_{12}	z_{11}	z_{10}	z_9	z_8	
9	9	9	9	9	9	9	9	z_7	z_6	z_5	z_4	z_3	z_2	z_1	z_0	
10	10	10	10	10	10	10	10	s_7	s_6	s_5	s_4	s_3	s_2	s_1	s_0	STATUS byte. Ref. Table 5-14 for specification of this byte.
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	x	x	x	x	x	x	x	x	For future use.
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	x	x	x	x	x	x	x	x	For future use.
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	x	x	x	x	x	x	x	x	For future use.
N/A	11	N/A	N/A	N/A	11	11	11	Tx_{15}	Tx_{14}	Tx_{13}	Tx_{12}	Tx_{11}	Tx_{10}	Tx_9	Tx_8	X axis temperature data. Ref. section 7.4.2.2.5 for conversion to units
N/A	12	N/A	N/A	N/A	12	12	12	Tx_7	Tx_6	Tx_5	Tx_4	Tx_3	Tx_2	Tx_1	Tx_0	
N/A	13	N/A	N/A	N/A	13	13	13	Ty_{15}	Ty_{14}	Ty_{13}	Ty_{12}	Ty_{11}	Ty_{10}	Ty_9	Ty_8	Y axis temperature data. Ref. section 7.4.2.2.5 for conversion to units
N/A	14	N/A	N/A	N/A	14	14	14	Ty_7	Ty_6	Ty_5	Ty_4	Ty_3	Ty_2	Ty_1	Ty_0	
N/A	15	N/A	N/A	N/A	15	15	15	Tz_{15}	Tz_{14}	Tz_{13}	Tz_{12}	Tz_{11}	Tz_{10}	Tz_9	Tz_8	Z axis temperature data. Ref. section 7.4.2.2.5 for conversion to units
N/A	16	N/A	N/A	N/A	16	16	16	Tz_7	Tz_6	Tz_5	Tz_4	Tz_3	Tz_2	Tz_1	Tz_0	
N/A	N/A	11	N/A	11	17	N/A	17	n_7	n_6	n_5	n_4	n_3	n_2	n_1	n_0	Counter. Ref. section 7.4.2.2.6
N/A	N/A	N/A	11	12	N/A	17	18	l_{15}	l_{14}	l_{13}	l_{12}	l_{11}	l_{10}	l_9	l_8	Latency. Ref. section 7.4.2.2.7 for conversion to units.
N/A	N/A	N/A	12	13	N/A	18	19	l_7	l_6	l_5	l_4	l_3	l_2	l_1	l_0	
11	17	12	13	14	18	19	20	c_7	c_6	c_5	c_4	c_3	c_2	c_1	c_0	Cyclic Redundancy Check is performed on all preceding bytes and is generated from the polynomial: $x^8 + x^2 + x + 1$, seed = 0xFF
(12)	(18)	(13)	(14)	(15)	(19)	(20)	(21)	0	0	0	0	1	1	0	1	<CR> only when <CR><LF> datagram termination have been chosen
(13)	(19)	(14)	(15)	(16)	(20)	(21)	(22)	0	0	0	0	1	0	1	0	<LF> only when <CR><LF> datagram termination have been chosen

Table 5-13: Maximum sample rate

	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]
Standard datagram	12	2000	2000	2000	2000
Rate and temperature	18	1000	1000	2000	2000
Rate and counter	13	2000	2000	2000	2000
Rate and latency	14	1000	2000	2000	2000
Rate, counter and latency	15	1000	2000	2000	2000
Rate, temperature and counter	19	1000	1000	2000	2000
Rate, temperature and latency	20	1000	1000	2000	2000
Rate, temperature, counter and latency	21	1000	1000	2000	2000

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

5.3.6.1 Status byte

Table 5-14: 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 gyro 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	

Refer to section 7.5 for more information related to the self-diagnostics of STIM277H.

6   MECHANICAL

Table 6-1: Mechanical specifications

Parameter	Conditions	Min Nom Max	Unit	Note
HOUSING MATERIAL		Aluminum, Alloy 6082-T6, DIN EN 754-2		
SURFACE TREATMENT Passivation		RoHS-compliant		
WEIGHT		52	grams	
VOLUME		32.6	ccm	
		1.99	cu in	
HERMETIC PACKAGE		Leak rate according to MIL-STD-883K 1014.15 Class H (military) as L Equivalent Leak rate (atm cm^3/s) air		
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 backshell		
FIXATION BOLTS Recommended torque	Steel base Aluminum base	M4 ISO 4762 / DIN 912 3.5 3.0	Nm Nm	

6.1   Mechanical dimensions

All dimensions are in mm.
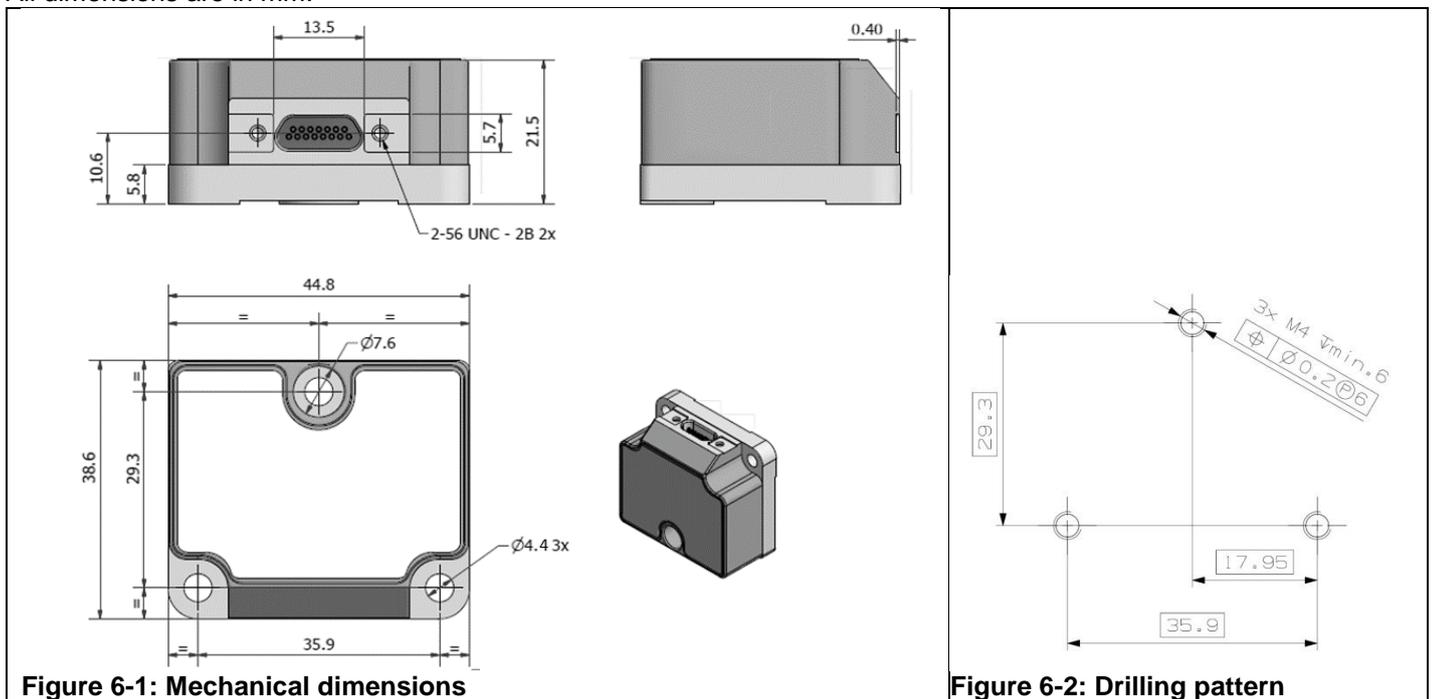
Figure 6-1: Mechanical dimensions   **Figure 6-2: Drilling pattern**

6.2   Advice on mounting orientation
The gyros are sensitive to acceleration-forces in certain directions:
- X- and Y-gyros have their highest sensitivity to acceleration-forces in Z-direction
- Z-gyro has its highest sensitivity to acceleration-forces in Y-direction
- X-gyro has its lowest sensitivity to acceleration-forces in X-direction
- Y-gyro has its lowest sensitivity to acceleration-forces in Y-direction
- Z-gyro has its lowest sensitivity to acceleration-forces in Z-direction

6.3 Pin configuration
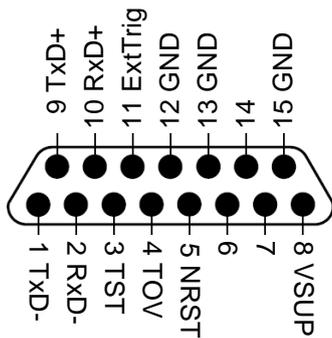
Figure 6-3: Pin configuration as seen from front of STIM277H

Table 6-2: 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			Not connected
7			Not connected
8	VSUP	SUPPLY	Power supply (+5V)
9	TxD+	OUTPUT	RS422 positive output
10	RxD+	INPUT	RS422 positive input
11	ExtTrig	INPUT	External trigger (if not in use, connect to VSUP or leave floating)
12	GND	INPUT	Test pin: Connect to ground (0V)
13	GND	INPUT	Test pin: Connect to ground (0V)
14			Not connected
15	GND	SUPPLY	Power ground (0V)

6.4 Definition of axes
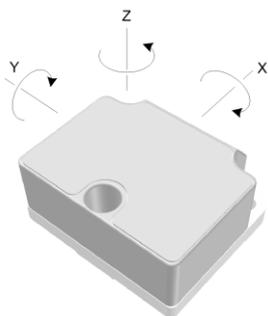
Figure 6-4: Definition of axes
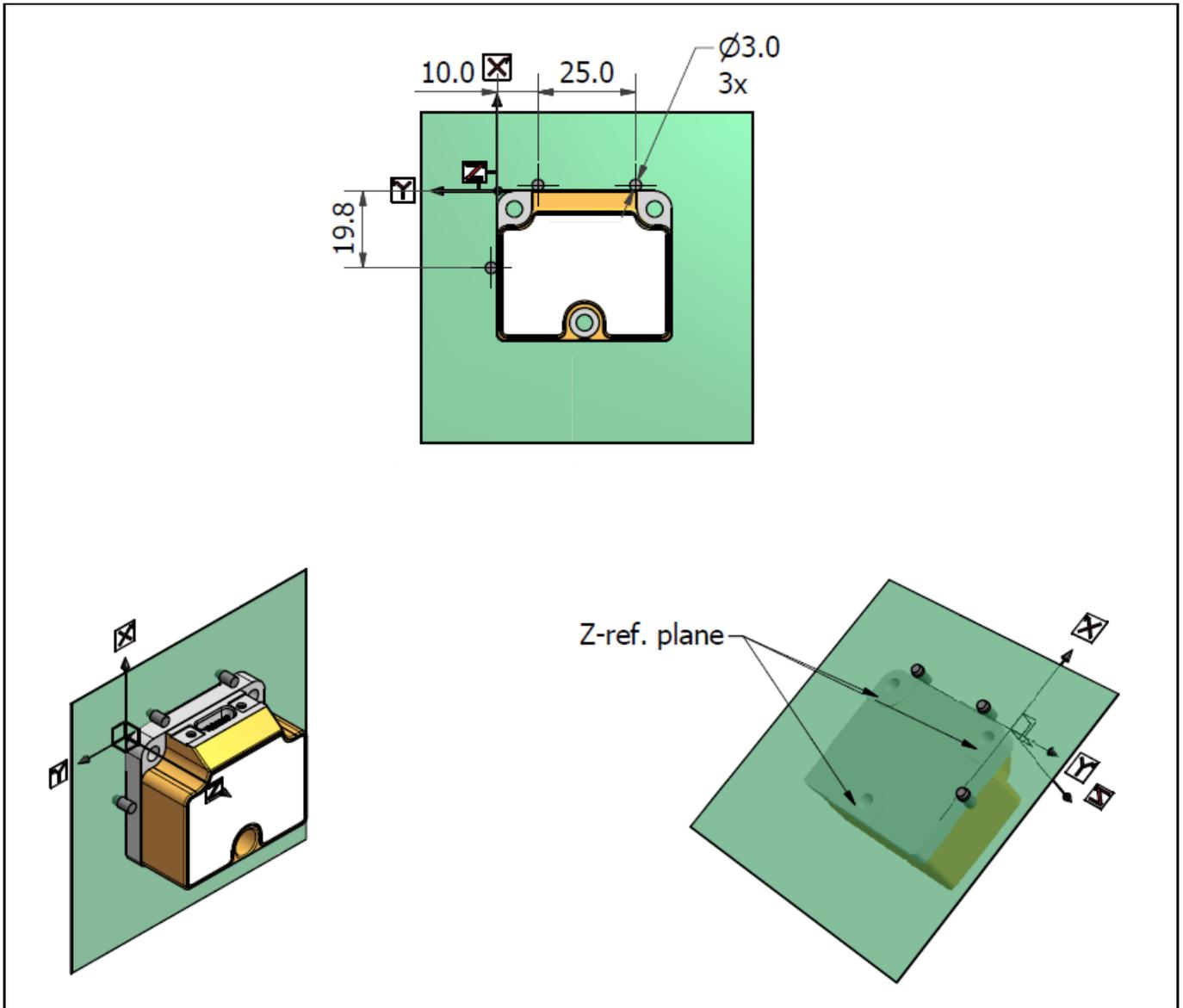
Figure 6-5: Reference points for alignment of axes

7   BASIC OPERATION

STIM277H is very simple to use. Unless having been configured to 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 7-1 shows the simplest connection set-up for STIM277H.
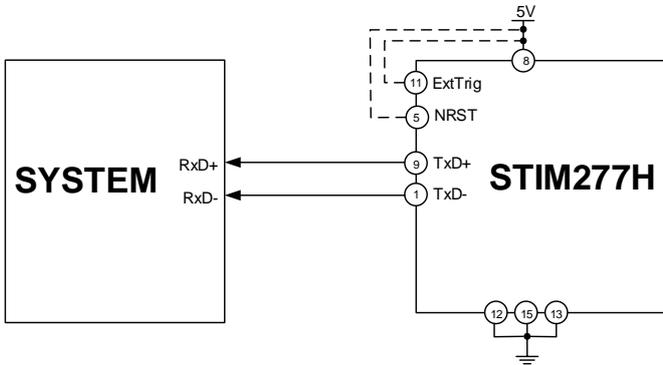

Figure 7-1: Transmit-Only Electrical Connection Diagram

In order to take full advantage of all features of STIM277H, the unit needs to be connected as shown in Figure 7-2. In this set-up the system can reset the unit without having to toggle power, the external trigger function can be utilized, configuration parameters can be changed and extended information like diagnostic information can be read from the device.
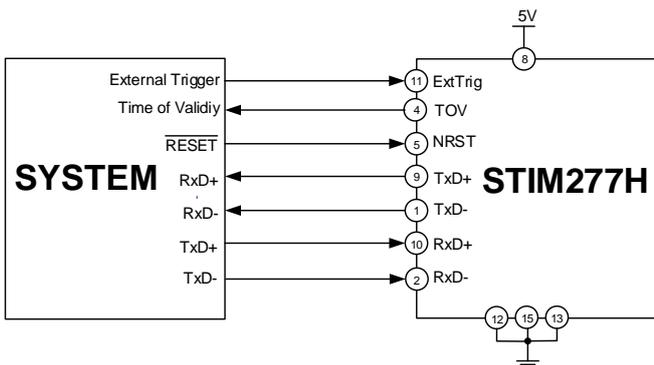
Figure 7-2: Full Function Electrical Connection Diagram

7.1   Reset

STIM277H 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 STIM277H into Init Mode (ref. Figure 7-6 and section 7.4.1).

7.2   External Trigger

STIM277H has a separate digital input pin to be used when the unit has been configured to transmit only upon external trigger. The measurements themselves will be continuously running at the highest sample rate (2000

samples/s) in order to ensure shortest possible latency when a transmission is requested. The input is set to trigger on the falling edge of the input signal and will then transmit one datagram containing the result of the latest measurement.

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

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

When STIM277H is in Init Mode (after Power on or Reset), it will transmit the 3 special datagrams as described in section 7.4.1 regardless of external input.

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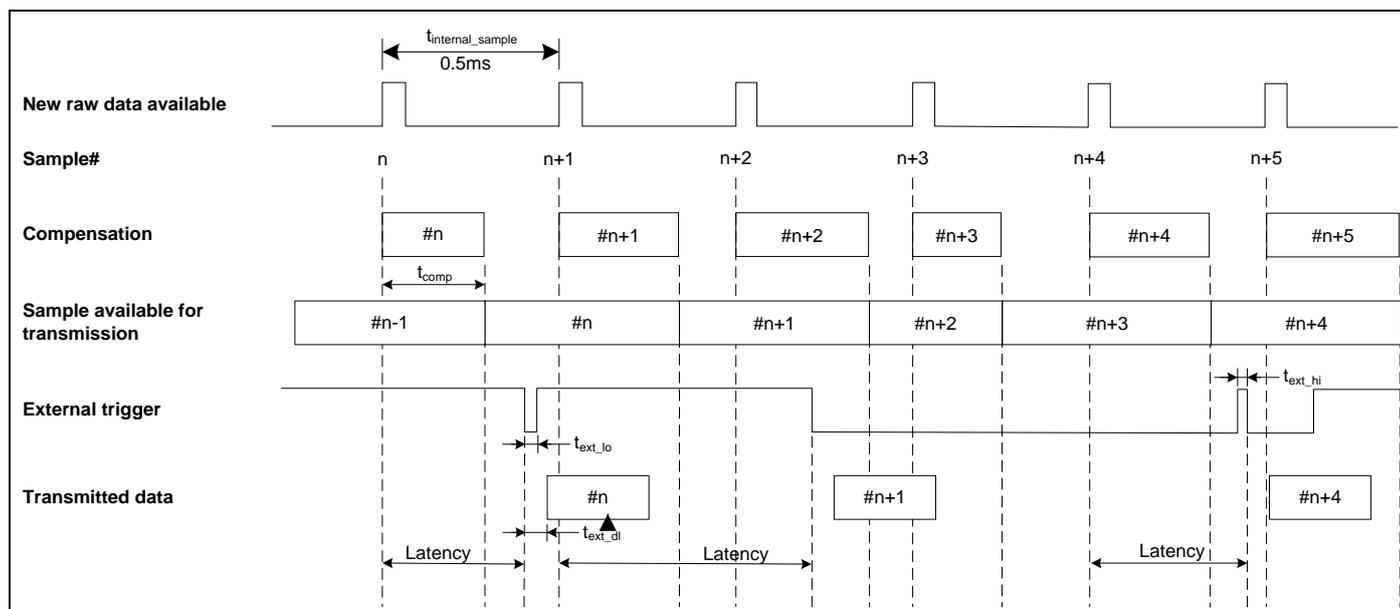

Figure 7-3: Timing of external trigger

7.3 Time of Validity (TOV)

The TOV-output serves 2 purposes:

- Provide a synchronization-signal derived from the internal clock of STIM277H
- Provide means to signal when a datagram is being transmitted (NB: not when configured to external trigger)

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

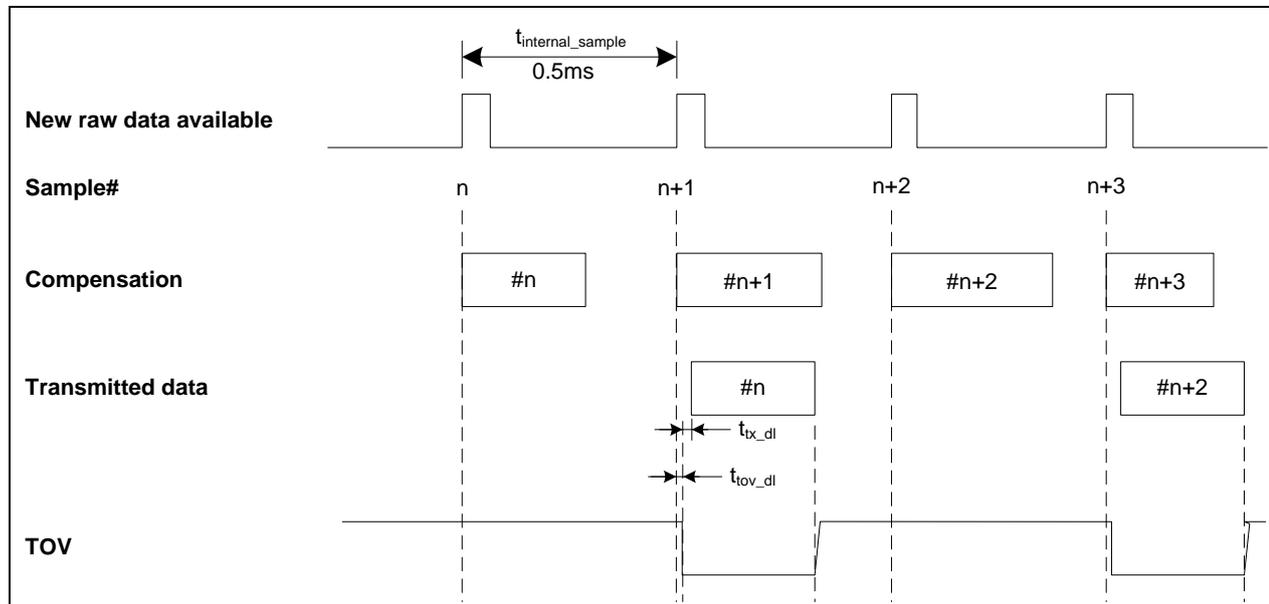Figure 7-4 and Figure 7-5 show the timing diagram of the TOV-output.

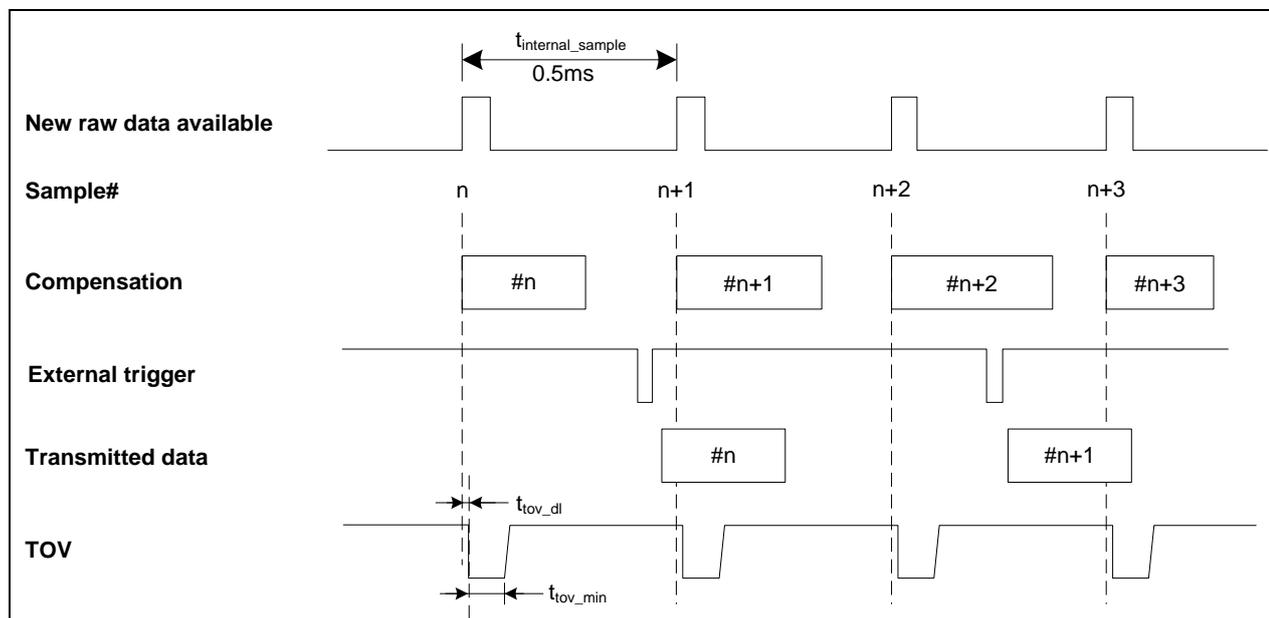**Figure 7-4: Timing of TOV (example: sample rate = 1000samples/s)**

Figure 7-5: Timing of TOV with external trigger

7.4 Operating modes

The operating modes of STIM277H are shown in Figure 7-6:
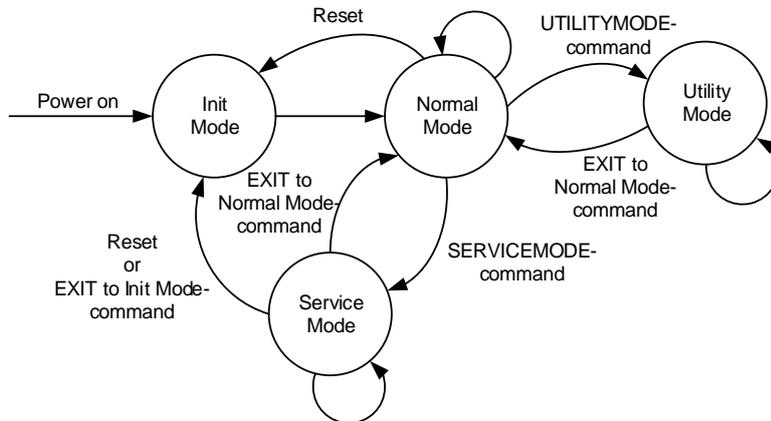

Figure 7-6: Operating modes

7.4.1 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.

Table 5-6 specifies the sequence and contents of the Part Number datagram.
Table 5-7 specifies the sequence and contents of the Serial Number datagram.
Table 5-8 specifies the sequence and contents of the Configuration datagram.

After having transmitted the special Part Number, Serial Number and Configuration datagrams, STIM277H enters Normal Mode. All these special datagrams can also be requested by commands in Normal Mode, ref. section 8.

7.4.2 Normal Mode

In Normal Mode STIM277H will constantly measure the gyro channels at an internal sample rate of 2000 samples/s and transmit at the chosen sample rate, alternatively when receiving an external trigger. STIM277H will transmit data regardless of any errors reported in the STATUS byte (ref. Table 5-14). Hence the content of the STATUS byte should continuously be examined.

Table 5-12 specifies the sequence and contents of the datagrams transmitted in Normal Mode.

7.4.2.1 Start-Up

When STIM277H enters Normal Mode from Init Mode, there will be a start-up period where STIM277H is stabilizing the gyros. This is a fixed period as specified in Table 5-2 and bit 6 is set in the STATUS byte (ref. Table 5-14) to communicate this condition. During the start-up period STIM277H will continuously sample, compensate and output data. However the data should not be regarded valid until bit 6 in STATUS byte is cleared.

There will not be any start-up period when STIM277H is exiting from Service Mode directly to Normal Mode.

7.4.2.2 Data output options and interpretation

The gyros in STIM277H measure angular rate [°/s]. However, in order to make the STIM277H more versatile, a few simple functions are offered, ref. Table 7-1:

Table 7-1: Implemented functions for gyro output units

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

7.4.2.2.1 Angular Rate

Angular Rate is available in all datagrams when STIM277H has been configured to output angular rate. The transmitted data will be the last internal sample. E.g. in the case of continuous transmission of datagrams and a sample rate of 250 samples/s, every 8th internally sample will be transmitted.

Equation 1 and Figure 7-7 show how to convert to [°/s]. Note that the output data is represented as two's complement.

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

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

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

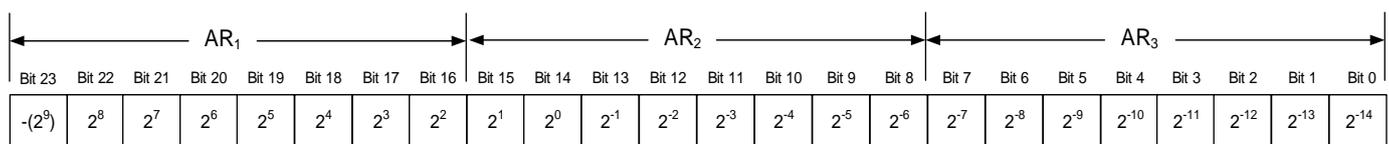|	AR₁								AR₂								AR₃							
Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
$-(2^9)$	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}	2^{-9}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

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

7.4.2.2.2 Incremental angle

Incremental angle is available in all datagrams when STIM277H has been configured to output incremental angle. The transmitted data will be the integrated angle since last transmitted sample. E.g. in the case of continuous transmission of datagrams and a sample rate of 250 samples/s, each transmission will contain the integrated angle of eight internal samples.

Equation 2 and Figure 7-8 show how to convert to [°/sample]. Note that the output data is represented as two's complement:

Equation 2: Converting output to [°/sample]

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

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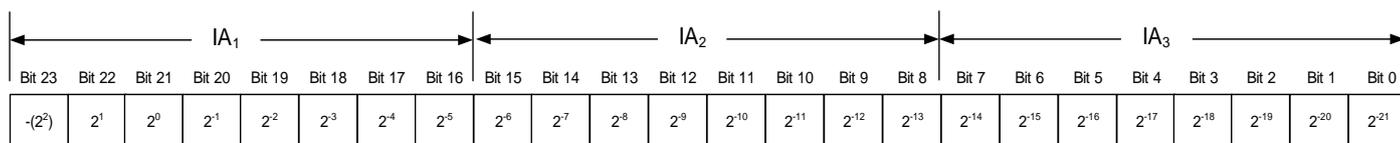IA_{b23} is the most significant bit of IA_1

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

7.4.2.2.3 Average angular rate

Average angular rate is available in all datagrams when STIM277H has been 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 250 samples/s, each transmission will contain the average of the eight internal samples.

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

Conversion to [°/s] is the same as for angular rate and is described in Equation 1.

7.4.2.2.4 Integrated angle

Integrated angle is available in all datagrams when STIM277H has been configured to output integrated angle. The transmitted data will be 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 2.

7.4.2.2.5 Temperature

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

Equation 3 and Figure 7-9 show how to convert to [°C]. Note that the output data is represented as two's complement:

Equation 3: Converting temperature data to [°C]

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

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

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}
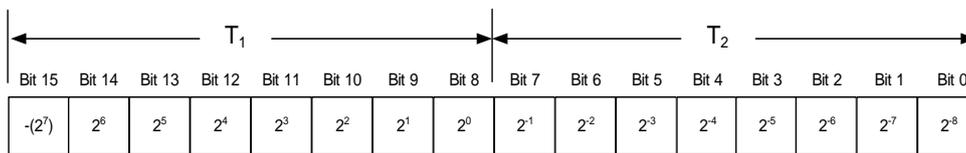
Figure 7-9: Converting temperature data to [°C]

7.4.2.2.6 Counter

A counter is available in certain datagrams (ref. section 12). 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.

7.4.2.2.7 Latency

Latency is available in certain datagrams (ref. section 12) with external trigger. Latency is an unsigned word taking values in the interval [0 , 65535] µs.

Equation 4 and Figure 7-10 show how to convert to [seconds]:

Equation 4: Converting latency data to [seconds]

$$Output[seconds] = ((t_1) \cdot 2^8 + (t_2)) \cdot 10^{-6}$$

where t_1 is the most significant byte of the 16bit output
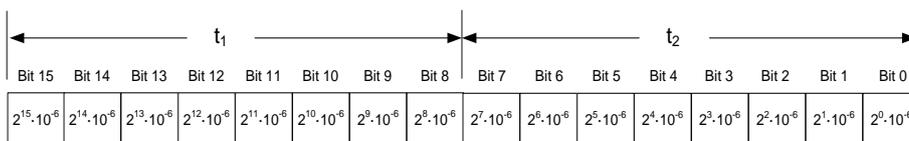 t_2 is the least significant byte of the 16bit output

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
$2^{15} \cdot 10^{-6}$	$2^{14} \cdot 10^{-6}$	$2^{13} \cdot 10^{-6}$	$2^{12} \cdot 10^{-6}$	$2^{11} \cdot 10^{-6}$	$2^{10} \cdot 10^{-6}$	$2^9 \cdot 10^{-6}$	$2^8 \cdot 10^{-6}$	$2^7 \cdot 10^{-6}$	$2^6 \cdot 10^{-6}$	$2^5 \cdot 10^{-6}$	$2^4 \cdot 10^{-6}$	$2^3 \cdot 10^{-6}$	$2^2 \cdot 10^{-6}$	$2^1 \cdot 10^{-6}$	$2^0 \cdot 10^{-6}$

Figure 7-10: Converting latency data to [seconds]

7.4.2.3 Bias Trim Offset

The STIM277H offers the possibility to trim the gyro biases by adding user-defined offsets. Adjusting the bias trim offsets can be done by entering Utility Mode (ref. section **7.4.4**) or Service Mode (ref. section 9.2).

The bias trim offsets are applied to the sensor-signals after the compensation-algorithms with the sign-convention as shown in Equation 5:

Equation 5: Applying bias trim offsets:

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

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

Note that the bias trim offset is in [°/s]. This is also the case if the chosen output unit is incremental or integrated.

7.4.3   Service Mode

The communication interface has been designed to be human-readable in Service Mode. This can for example be of great help in the development phase when the device needs to be re-configured during investigations into an observed problem, for example in combination with terminal based software.

When Service Mode is entered, STIM277H will respond with its configuration information (same as the response to the i (INFORMATION) command, ref: Figure 9-12).

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

In Service Mode the gyro measurements will still be running in the background, enabling to switch directly back to Normal Mode without the need for any stabilization time of filters, etc. However the measurement data itself, when STIM277H is in Service Mode are not transmitted and therefore lost. By using the a (SINGLE-SHOT MEASUREMENT) command (ref. section 9.1) it is possible to display single measurement results.

Exiting Service Mode can be done in several ways:
1. Using the external reset. This will force STIM277H into Init Mode. Be advised that during Init Mode, all the configuration parameters are loaded from flash. If any of the configuration parameters have been changed during the Service Mode session but not saved to flash, these changes will be overwritten by the content already stored in flash.
2. Using the x (EXIT) command. When using this command a parameter is required to decide whether the device should go to Init Mode or to Normal Mode. When exiting to Normal Mode, any of the changes made to the configuration parameters will still be valid. However, if not saved, the configuration parameters will be overwritten by the content already stored in flash at the next power-up or reset.

7.4.4   Utility Mode

The Utility Mode is similar to Service Mode (ref. section 7.4.3) but made for machine-machine communication. All commands and responses includes CRC-8 to detect any errors in the communication.

After having received the "UTILITYMODE"-command (ref. section 8.8), STIM277H will stop transmitting Normal Mode datagrams and send an acknowledgement that it is now in Utility Mode (ref. section 0). Even though the Normal Mode datagrams are not transmitted, the measurements will continue in the background.

Several commands are available to obtain information or change configuration parameters, ref. section 0.

When the Utility Mode is exited, the STIM277H will return to Normal Mode and resume transmission of Normal Mode datagrams

7.5   Self diagnostics

STIM277H is constantly checking its internal status. The checks include:
o   Check of internal references
o   Check of gyros (error and overload)
o   Check of internal temperatures
o   Check of RAM and flash
o   Check of supply voltage

A full diagnostic can be run to see the result of the individual checks by using the c (DIAGNOSTIC) command, ref. section 9.3 in SERVICEMODE.

When an error situation is detected, the corresponding bit in the STATUS byte (ref. Table 5-14) will be set. If the sample-rate is set lower than 2000 samples/s, the STATUS byte will reflect the accumulated status of all the sub-samples between two data transmissions. The bits in the STATUS bytes are valid for the data in a single transmission and hence not latched.

Access to extended error registers containing accumulated error-information can be achieved either by using the Normal Mode-command "E" (EXTENDED ERROR INFORMATION DATAGRAM, ref. Table 5-10 and Table 5-11) or the SERVICEMODE-command i e (INFORMATION on ACCUMULATED LAST ERRORS, ref. section 9.5).

The extended error registers are cleared at the following events:

- After the start-up phase, triggered by power-on or reset

- After transmission of Extended Error Information Datagram (ref. section 8.5)

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

8 COMMANDS IN NORMAL MODE

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

Table 8-1 Available commands in Normal Mode

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

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

Char	Hex	Dec	Short description
<CR>	0x0D	13	"Carriage Return": used as execution character for commands

No echo of received command characters nor error messages will appear for these commands. Only at the receipt of the complete correct command, STIM277H executes accordingly.

NB: if OUTPUT UNIT is set to INCREMENTAL ANGLE (ref. section 9.12), 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.

8.1   N (PART NUMBER DATAGRAM) command
General description: Requests transmission of a Part Number datagram (ref. Table 5-6).

Table 8-3 : 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 sample rate is set to external trigger, the Part Number datagram will be transmitted at the next external trigger input, replacing the datagram containing sensor data.

8.2   I (SERIAL NUMBER DATAGRAM) command
General description: Requests transmission of a Serial number datagram (ref. Table 5-7).

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

Syntax	Response
I<CR>	Transmits one Serial Number datagram

The Serial Number datagram will replace the next transmitted Normal Mode datagram.

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

8.3 C (CONFIGURATION DATAGRAM) command

General description: Requests transmission of a configuration datagram (ref. Table 5-8).

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

Syntax	Response
C<CR>	Transmits one Configuration datagram

The Configuration datagram will replace the next transmitted Normal Mode datagram.

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

8.4 T (BIAS TRIM OFFSET DATAGRAM) command

General description: Requests transmission of a Bias Trim Offset datagram (ref. Table 5-9).

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

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

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

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

8.5 E (EXTENDED ERROR INFORMATION DATAGRAM) command

General description: Requests transmission of an Extended Error Information datagram (ref. Table 5-10). This datagram contains the accumulated detected errors (ref. section 7.5).

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

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

Syntax	Response
E<CR>	Resets the unit

The Extended Error Information datagram will replace the next transmitted Normal Mode datagram.

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

8.6 R (RESET) command

General description: Force a Reset (ref. Figure 7-6).

Table 8-8: Available R (RESET) command

Syntax	Response
R<CR>	Resets the unit

8.7 SERVICEMODE command

General description: Enters Service Mode (ref. section 7.4.3).

Table 8-9: Available SERVICEMODE command

Syntax	Response
SERVICEMODE<CR>	Enters Service Mode

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

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

```
SERIAL NUMBER = N25582120002002
PRODUCT = STIM277H
PART NUMBER = 85032-0034-2101 REV A
HW CONFIG = M5750 REV 0
FW CONFIG = SWD12425 REV 0
OUTPUT UNIT = [°/sample] – INCREMENTAL ANGLE
SAMPLE RATE [samples/s] = 1000
GYRO CONFIG = XZ
GYRO RANGE:
  X-AXIS: ± 400°/s
  Y-AXIS: ± 400°/s
  Z-AXIS: ± 400°/s
LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 262
LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 262
BIT-RATE [bits/s] = 374400
DATA LENGTH = 8
STOP-BITS = 1
PARITY = EVEN
LINE TERMINATION = ON
DATAGRAM FORMAT = STANDARD
DATAGRAM TERMINATION = NONE
BIAS TRIM OFFSET:
  GYRO X-AXIS [°/s] = 0.02343
  GYRO Y-AXIS [°/s] = -0.01222
  GYRO Z-AXIS [°/s] = 0.00111
  REFERENCE INFO = 43639
SYSTEM CONFIGURATIONS:
  TOV ACTIVE FOR SPECIAL DATAGRAMS AFTER POWER-ON/RESET: OFF
  BTO-DATAGRAM TRANSMISSION AFTER POWER-ON/RESET: OFF


>
```

Figure 8-1: Example of response from SERVICEMODE command

8.8 UTILITYMODE command

General description: Enters Utility Mode allowing the user to obtain information or change configuration parameters (ref. section 7.4.4).

Table 8-10: Available UTILITYMODE command

Syntax	Response
UTILITYMODE<CR>	Enters Utility Mode

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

For response to the UTILITYMODE command and other commands in Utility Mode, see section 0.

9 COMMANDS IN SERVICE MODE

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

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

Table 9-1 Available commands in Service Mode

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

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

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

When STIM277H 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> is also recognized and will delete the last received character in the input buffer. The size of the input buffer is 80 characters. <BS> is valid for the characters received since last <CR>.

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

In the event of an unknown command, inconsistent syntax or incorrect value of parameter(s), STIM277H will respond with an error message. Error messages are on the format:

E<nnn><SP><Error description><CR>
where nnn is an error number

9.1 a (SINGLE-SHOT MEASUREMENT) command

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

If sample rate has been set to external trigger, the SINGLE-SHOT MEASUREMENT will respond to the measurement result at the latest trigger. Hence if no trigger is received, the command will respond with the same data if sent multiple times.

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

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

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

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

```
>a
X-AXIS = 1.43255°/s
Y-AXIS = -2.88426°/s
Z-AXIS = 243.33667°/s
STATUS = 00000000 = OK

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

```
>a
X-AXIS = 0.000716275°
Y-AXIS = -0.022958462°
Z-AXIS = 0.121668335°
STATUS = 00100101 = NOT OK
BIT 5: OUTSIDE OPERATING CONDITIONS
BIT 2: ERROR IN Z-CHANNEL
BIT 0: ERROR IN X-CHANNEL

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

9.2 b (BIAS TRIM OFFSET) command

General description: Changes bias trim offsets.

Refer to section 7.4.2.3 for a description of this functionality.

Note that this change will only be effective until STIM277H is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.10). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.13).

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

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

The gyro bias trim offsets must be entered in [°/s], regardless of the chosen output unit.

If the bias trim offsets are programmed outside the specified min or max limits, ref. Table 5-3, the relevant bias trim offsets will be set to min or max, whichever is the closest to the requested value and flagged by error message E008, ref. Table 9-7.

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

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

Table 9-7: Error messages for b (BIAS TRIM OFFSET) command

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

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

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

```
>b 0.001,x
BIAS TRIM OFFSET:
 GYRO X-AXIS [°/s] = 0.00100

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

```
>b 2.3
BIAS TRIM OFFSET:
  GYRO X-AXIS [°/s] = 1.0000
  GYRO Y-AXIS [°/s] = 1.0000
  GYRO Z-AXIS [°/s] = 1.0000

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

>
```

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

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

>
```

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

9.3 c (DIAGNOSTIC) command

General description: Performs a diagnostic of the unit.

Table 9-8: Available c (DIAGNOSTIC) command

Syntax	Response
c<CR>	Performs a diagnostic check

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

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

```
>c
SERIAL NUMBER = N25582020002002
PRODUCT = STIM277H
PART NUMBER = 85032-0034-2101 REV A
HW CONFIG = M5750 REV 0
FW CONFIG = SWD12425 REV 0
SYSTEM STATUS:
  RAM CHECK = OK
  FLASH CHECK = OK
  STACK STATUS MONITOR  = OK
  STACK COMMAND HANDLER  = OK
  STACK SAMPLE  = OK
  STACK FLASH  = OK
  STACK TRANSMIT  = OK
  MICRO CONTROLLER TEMPERATURE  = OK
  START-UP PHASE = NOT ACTIVE
  SELF-TEST RUNNING = OK
  UART = OK
VOLTAGES AND REFERENCES:
  REFERENCE VOLTAGE_1 = OK
  REFERENCE VOLTAGE_2 = OK
  REFERENCE VOLTAGE_3 = OK
  REGULATED VOLTAGE_1 = OK
  REGULATED VOLTAGE_2  = OK
  REGULATED VOLTAGE_3  = OK
  SUPPLY VOLTAGE 5.0V = OK
  INTERNAL DAC = OK
GYRO X-AXIS:
  GYRO X-AXIS DATA RECEIVED = OK
  GYRO X-AXIS EXCITATION FREQUENCY = OK
  GYRO X-AXIS ASIC TEMPERATURE = OK
  GYRO X-AXIS TEMPERATURE = OK
  GYRO X-AXIS NO CLIPPING DETECTED = OK
  GYRO X-AXIS INTERNAL COMMUNICATION = OK
  GYRO X-AXIS NO ASIC OVERFLOW DETECTED = OK
  GYRO X-AXIS EXCITATION AMPLITUDE = OK
  GYRO X-AXIS CONFIGURATION  = OK
GYRO Y-AXIS:
  GYRO Y-AXIS DATA RECEIVED = OK
  GYRO Y-AXIS EXCITATION FREQUENCY = OK
  GYRO Y-AXIS ASIC TEMPERATURE = OK
  GYRO Y-AXIS TEMPERATURE = OK
  GYRO Y-AXIS NO CLIPPING DETECTED = OK
  GYRO Y-AXIS INTERNAL COMMUNICATION = OK
  GYRO Y-AXIS NO ASIC OVERFLOW DETECTED = OK
  GYRO Y-AXIS EXCITATION AMPLITUDE = OK
  GYRO Y-AXIS CONFIGURATION  = OK
GYRO Z-AXIS:
  GYRO Z-AXIS DATA RECEIVED = OK
  GYRO Z-AXIS EXCITATION FREQUENCY = OK
  GYRO Z-AXIS ASIC TEMPERATURE = OK
  GYRO Z-AXIS TEMPERATURE = OK
  GYRO Z-AXIS NO CLIPPING DETECTED = OK
  GYRO Z-AXIS INTERNAL COMMUNICATION = OK
  GYRO Z-AXIS NO ASIC OVERFLOW DETECTED = OK
  GYRO Z-AXIS EXCITATION AMPLITUDE = OK
  GYRO Z-AXIS CONFIGURATION  = OK


>
```

Figure 9-7: Example of response from c (DIAGNOSTIC) command

9.4 d (DATAGRAM FORMAT) command

General description: Changes the datagram format in Normal Mode (ref.Table 5-12).

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 chosen sample rate and bit rate (ref. Table 5-13 and error message E007 in Table 9-12).

Note that this change will only be effective until STIM277H is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.10). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.13).

Table 9-10 : Available d (DATAGRAM FORMAT) command

Syntax	Response
d<SP><d_format><CR>	Changes the datagram format in Normal Mode

Table 9-11 : Allowed values for d (DATAGRAM FORMAT) command

<d_format>	Result
s	Changes the datagram format in Normal Mode to standard format
j	Changes the datagram format in Normal Mode to rate and temperature
k	Changes the datagram format in Normal Mode to rate and counter
l	Changes the datagram format in Normal Mode to rate and latency
m	Changes the datagram format in Normal Mode to rate, counter and latency
n	Changes the datagram format in Normal Mode to rate, temperature and counter
o	Changes the datagram format in Normal Mode to rate, temperature and latency
p	Changes the datagram format in Normal Mode to rate, temperature, counter and latency

Table 9-12: Error messages for d (DATAGRAM FORMAT) command

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

```
>d s
DATAGRAM FORMAT = STANDARD

>
```
Figure 9-8: Example of response from d s (DATAGRAM FORMAT) command

```
>d m
DATAGRAM FORMAT = RATE, COUNTER AND LATENCY

>
```
Figure 9-9: Example of response from d m (DATATGRAM FORMAT) command

9.5   f (LP FILTER -3dB FREQUENCY) command

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

Note that filter settings should be considered together with the sample rate in order to avoid issues with folding due to under-sampling. No warnings will be issued by STIM277H if e.g. a high filter bandwidth and a low sample rate have been chosen. Also note that change in filter setting will change the group delay, ref.Table 5-5.

Note that this change will only be effective until STIM277H is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.10). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.13).

Table 9-13: Available f (LP FILTER -3dB FREQUENCY) commands

Syntax	Response
f<SP><-3dBfreq><CR>	Changes the LP filter -3dB frequency for all axes
f<SP><-3dBfreq>','<axis><CR>	Changes the LP filter -3dB frequency for a specified axis

Table 9-14: Allowed values for <-3dBfreq> parameter for f (LP FILTER -3dB FREQUENCY) commands

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

Table 9-15: Allowed values for <axis> parameter for f (LP FILTER -3dB FREQUENCY) commands

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

Table 9-16: Error messages for f (LP FILTER -3dB FREQUENCY) commands

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

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


>
```
Figure 9-10: Example of response from f (LP FILTER -3dB FREQUENCY) command

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


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

9.6 i (INFORMATION) command

General description: Lists various requested information about the device

Table 9-17 : Available i (INFORMATION) commands

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

Table 9-18 : Allowed values for <cmd> parameter for i (INFORMATION) commands

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

Table 9-19: Error messages for i (INFORMATION) commands

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command or parameter is not recognized
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 = N25582120002002
PRODUCT = STIM277H
PART NUMBER = 85032-0034-2101 REV A
HW CONFIG = M5750 REV 0
FW CONFIG = SWD12425 REV 0
OUTPUT UNIT = [°/sample] – INCREMENTAL ANGLE
SAMPLE RATE [samples/s] = 1000
GYRO CONFIG = XZ
GYRO RANGE:
  X-AXIS: ± 400°/s
  Y-AXIS: ± 400°/s
  Z-AXIS: ± 400°/s
LP FILTER -3dB FREQUENCY, X-AXIS [Hz] = 262
LP FILTER -3dB FREQUENCY, Y-AXIS [Hz] = 262
LP FILTER -3dB FREQUENCY, Z-AXIS [Hz] = 262
BIT-RATE [bits/s] = 374400
DATA LENGTH = 8
STOP-BITS = 1
PARITY = EVEN
LINE TERMINATION = ON
DATAGRAM TERMINATION = NONE
DATAGRAM FORMAT = STANDARD
BIAS TRIM OFFSET:
  GYRO X-AXIS [°/s] = 0.02343
  GYRO Y-AXIS [°/s] = -0.01222
  GYRO Z-AXIS [°/s] = 0.00111
  REFERENCE INFO = 43639
SYSTEM CONFIGURATIONS:
  TOV ACTIVE FOR SPECIAL DATAGRAMS AFTER POWER-ON/RESET: OFF
  BTO-DATAGRAM TRANSMISSION AFTER POWER-ON/RESET: OFF

>
```

Figure 9-12: Example of response from i (INFORMATION) command

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

>
```

Figure 9-13: Example of response from i a (INFORMATION on AXIS CONFIGURATION) command

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

>
```

Figure 9-14: Example of response from i b (INFORMATION on BIAS TRIM OFFSET) command

```
>i d
DATAGRAM FORMAT = STANDARD

>
```

Figure 9-15: Example of response from i d (INFORMATION on DATAGRAM CONTENT) command

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

LAST ERROR HISTORY IS NOW CLEARED

>
```

Figure 9-16: Example of response from i e (INFORMATION on LAST ERROR IN NORMAL MODE) command

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

>
```

Figure 9-17: Example of response from i f (INFORMATION on LP FILTER -3dB FREQUENCY) command

```
>i h
HW CONFIG = M5750 REV 0

>
```

Figure 9-18: Example of response from i h (INFORMATION on HW CONFIGURATION) command

```
>i j
SYSTEM CONFIGURATIONS:
  TOV ACTIVE FOR SPECIAL DATAGRAMS AFTER POWER-ON/RESET: OFF
  BTO-DATAGRAM TRANSMISSION AFTER POWER-ON/RESET: OFF

>
```

Figure 9-19: Example of response from i j (INFORMATION on SYSTEM CONFIGURATION) command

```
>i m
SAMPLE RATE [samples/s] = 1000

>
```

Figure 9-20: Example of response from i m (INFORMATION on SAMPLE RATE) command

```
>i n
PRODUCT = STIM277H

>
```

Figure 9-21: Example of response from i n (INFORMATION on PRODUCT NAME) command

```
>i p
FW CONFIG = SWD12425 REV 0

>
```

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

```
>i r
LINE TERMINATION = ON
DATAGRAM TERMINATION = NONE

>
```

Figure 9-23: Example of response from i r (INFORMATION) command

```
>i s
SERIAL NUMBER = N25582120002002

>
```

Figure 9-24: Example of response from i s (INFORMATION on SERIAL NUMBER) command

```
>i t
BIT-RATE [bits/s] = 374400
DATA LENGTH = 8
STOP-BITS = 1
PARITY = EVEN

>
```

Figure 9-25: Example of response from i t (INFORMATION on TRANSMISSION PARAMETERS) command

```
>i u
OUTPUT UNIT = [°/sample] – INCREMENTAL ANGLE

>
```

Figure 9-26: Example of response from i u (INFORMATION on OUTPUT UNIT) command

```
>i x
PART NUMBER = 85032-1034-0121 REV -

>
```

Figure 9-27: Example of response from i x (INFORMATION on PART NUMBER) command

9.7 j (SYSTEM CONFIGURATIONS) command

General description: Sets defined system configurations.

Note that this change will only be effective until STIM277H is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.10). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.13).

Table 9-20: Available j (SYSTEM CONFIGURATIONS) command

Syntax	Response
j<SP><SystemConfig>','<setting><CR>	Sets defined system configurations

Table 9-21: Allowed values for <SystemConfig> parameter for j (SYSTEM CONFIGURATIONS) command

<SystemConfig>	Function
t	Turns active toggling of TOV for special datagrams after power-on/reset on or off. With this feature set to "off", the behavior is backward compatible to previous revisions
b	Turns transmission of Bias Trim Offset datagram after power-on/reset on or off. With this feature set to "off", the behavior is backward compatible to previous revisions

Table 9-22: Allowed values for <setting> parameter for active toggling of TOV for special datagrams after power-on/reset

< SystemConfig >	<setting>	Result
t	0	No active toggling of TOV for special datagrams after power-on/reset
t	1	Active toggling of TOV for special datagrams after power-on/reset

Table 9-23: Allowed values for <setting> parameter for Bias Trim Offset datagram after power-on/reset

< SystemConfig >	<setting>	Result
b	0	No transmission of Bias Trim Offset datagram after power-on/reset
b	1	Transmission of Bias Trim Offset datagram after power-on/reset

Table 9-24: Error messages for j (SYSTEM CONFIGURATIONS) command

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

```
>j t,0
TOV ACTIVE FOR SPECIAL DATAGRAMS AFTER POWER-ON/RESET: OFF

>
```
Figure 9-28: Example of response from j (SYSTEM CONFIGURATION) command

```
>j b,1
BTO-DATAGRAM TRANSMISSION AFTER POWER-ON/RESET: ON

>
```
Figure 9-29: Example of response from j (SYSTEM CONFIGURATION) command

9.8   m (SAMPLE RATE) command

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

Note that the sample rate could be considered invalid, even if it has been entered correctly. This is because a valid sample rate also depends on the bit rate and chosen datagram content (ref. Table 5-13 and error message E007 in Table 9-27).

Note that sample rate should be considered together with filter settings in order to avoid issues with folding due to under-sampling. No warnings will be issued by STIM277H if e.g. a high filter bandwidth and a low sample rate have been chosen.

Note that this change will only be effective until STIM277H is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.10). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.13).

Table 9-25: Available m (SAMPLE RATE) command

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

Table 9-26: Allowed values for <sampl.freq> parameter for m (SAMPLE RATE) command

<sampl.freq>	Result
125	Will set sample rate to 125 samples /second
250	Will set sample rate to 250 samples /second
500	Will set sample rate to 500 samples /second
1000	Will set sample rate to 1000 samples /second
2000	Will set sample rate to 2000 samples /second
0	Enables External Trigger

Table 9-27: Error messages for m (SAMPLE RATE) command

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

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

>
```
Figure 9-30: Example of response from m (SAMPLE RATE) command

```
>m 0
SAMPLE RATE = EXTERNAL TRIGGER

>
```
Figure 9-31: Example of response from m (SAMPLE RATE) command

9.9 r (TERMINATION) command

General description: Changes the line termination and datagram termination. Line termination should be ON when communicating point-to-point (single master – single slave).

Note that this change will only be effective until STIM277H is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.10). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.13).

Table 9-28: Available r (TERMINATION) command

Syntax	Response
r<SP><term><CR>	Changes the line termination and datagram termination

Table 9-29: Allowed values for r (TERMINATION) command

<term>	Result
0	Turns line termination = OFF, datagram termination = none
1	Turns line termination = ON, datagram termination = none
2	Turns line termination = OFF, datagram termination = <CR><LF>
3	Turns line termination = ON, datagram termination = <CR><LF>

Table 9-30: Error messages for r (TERMINATION) command

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

```
>r 0
LINE TERMINATION = OFF
DATAGRAM TERMINATION = NONE


>
```
Figure 9-32: Example of response from r 0 (TERMINATION) command

```
>r 3
LINE TERMINATION = ON
DATAGRAM TERMINATION = <CR><LF>


>
```
Figure 9-33: Example of response from r 3 (TERMINATION) command

9.10 s (SAVE) command

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

The flash used in STIM277H 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. STIM277H will always attempt to save the configuration when receiving the s (SAVE) command regardless of the content of the save-counter.

Table 9-31: Available s (SAVE) command

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

Table 9-32: Error messages for s (SAVE) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Any characters between command and \<CR\>
E003	INVALID PARAMETER	Value of parameter outside valid range
E004	EXCEEDED MAXIMUM NUMBER OF SAVES	Warning appears when maximum number of saves has been exceeded (1000 saves). STIM277H will always attempt to save the configuration when receiving the s (SAVE) command.
E005	ERROR DURING SAVE	System parameters not successfully transferred to flash

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

>
```
Figure 9-34: Example of response from s (SAVE) command when confirming save

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

>
```
Figure 9-35: Example of response from s (SAVE) command when not confirming save

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

E003 INVALID PARAMETER

>
```
Figure 9-36: Example of response from s (SAVE) command when not correctly responding to confirmation

9.11 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 5-13 and error message E007 in Table 9-36).

Note that this change will only be effective until STIM277H is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.10). If confirmation to the SAVE-command is not "Y", the transmission parameters will be reset to the previously stored settings. In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.13).

Table 9-33 : Available t (TRANSMISSION PARAMETERS) commands

Syntax	Response
t<SP><bit-rate><CR>	Changes the transmission bit-rate and leaves number of stop-bits and parity unchanged
t<SP><bit-rate>','<stop-bits>','<parity><CR>	Changes the transmission bit-rate, number of stop-bits and parity

Table 9-34: Allowed values for <stop-bits> parameter for t (TRANSMISSION PARAMETERS) commands

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

Table 9-35: Allowed values for <parity> parameter for t (TRANSMISSION PARAMETERS) commands

<stop-bits>	Result
n	Will set no parity
e	Will set even parity
o	Will set odd parity

The STIM277H hardware is capable of setting bit-rates in the range between 1500 and 3 750 000 bits/s. However, the sample rate and the datagram length decide the minimum bit-rate possible, ref. Equation 6:

Equation 6: 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 including <CR><LF>, ref. Table 5-12 and Table 5-13 (NB: number of bytes in Table 5-13 excludes <CR><LF>)
          sample_rate is the chosen sample rate [samples/s]

If a bit-rate, lower than the allowed bit-rate defined by Equation 6, is entered, the command will respond with error message E007, ref. Table 9-36.

There are a finite number of bit-rates possible to set. This is defined in Equation 7:

Equation 7: Set bit-rate

$$Bit-rate_{SET} = \frac{59904000}{n} bits/s$$

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 1.2Mbit/s, the deviation between the requested bit-rate and set bit-rate could be larger than 1% and may be in conflict with the RS422 specification. No warnings are issued related to this issue. As a safety precaution, the new bit-rate can only be permanently set by the s (SAVE)-command later using the new bit-rate.

Table 9-36: Error messages for t (TRANSMISSION PARAMETERS) commands

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

```
>t 460800,2,e
TRANSMISSION PROTOCOL = 460800 bits/s, 2 STOP-BIT(S), EVEN PARITY

>
```

Figure 9-37: Example of response from t (TRANSMISSION PARAMETERS) command

```
>t 500000
TRANSMISSION PROTOCOL = 499200 bits/s, 2 STOP-BIT(S), EVEN PARITY

>
```

Figure 9-38: Example of response from t (TRANSMISSION PARAMETERS) command

Transmission parameters will change after the response as shown in Figure 9-37 or Figure 9-38 has been given.

9.12 u (OUTPUT UNIT) command

General description: Sets the unit of the transmission in Normal Mode to angular rate or incremental angle.

Note that this change will only be effective until STIM277H is initialized, reset or powered off, unless the new setting has been stored in flash using the SAVE-command (ref. section 9.10). In order to use or test a new setting in Normal Mode without permanently storing it, this can be achieved by using the EXIT n-command (ref. section 9.13).

Table 9-37: Available u (OUTPUT UNIT) command

Syntax	Response
u<SP><outunit><CR>	Changes the unit of the transmission in Normal Mode

Table 9-38: Allowed values for <outunit> for u (OUTPUT UNIT) command

<outunit>	Result
a	Changes the unit of the transmission in Normal Mode to angular rate [°/s]
i	Changes the unit of the transmission in Normal Mode to incremental angle [°/sample]
m	Changes the unit of the transmission in Normal Mode to average angular rate [°/s]
s	Changes the unit of the transmission in Normal Mode to integrated angle [°]

Table 9-39: Error messages for u (OUTPUT UNIT) command

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

```
>u a
OUTPUT UNIT = [°/s] – ANGULAR RATE

>
```
Figure 9-39: Example of response from u a (OUTPUT UNIT) command

```
>u i
OUTPUT UNIT = [°/sample] – INCREMENTAL ANGLE

>
```
Figure 9-40: Example of response from u i (OUTPUT UNIT) command

```
>u m
OUTPUT UNIT = [°/s] – AVERAGE ANGULAR RATE

>
```
Figure 9-41: Example of response from u m (OUTPUT UNIT) command

```
>u s
OUTPUT UNIT = [°] – INTEGRATED ANGLE

>
```
Figure 9-42: Example of response from u s (OUTPUT UNIT) command

9.13   x (EXIT) command

General description: Terminates Service Mode and returns to Normal Mode directly or via Init Mode (ref. Figure 7-6).

Table 9-40 : Available x (EXIT) command

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

Table 9-41 : 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 9-42: Error messages for x (EXIT) command

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

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

Figure 9-43: Example of response from x n (EXIT) command when system parameters match contents of flash

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

Figure 9-44: Example of response from x i (EXIT) command when system parameters match contents of flash

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

Figure 9-45: Example of response from x n (EXIT) command after system parameters have been changed but not saved with confirmed EXIT.

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

>
```

Figure 9-46: Example of response from x i (EXIT) command after system parameters have been changed but not saved with confirmed not to EXIT.

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

E003 INVALID PARAMETER

>
```

Figure 9-47: Example of response from x n (EXIT) command after system parameters have been changed but not saved with incorrect response to confirmation.

9.14 z (RESTORE TO FACTORY SETTINGS) command

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

Table 9-43: Available z (RESTORE TO FACTORY SETTINGS) commands

Syntax	Response
z<CR>	Restores the configuration of the unit to its factory settings. **NB: The restored configuration will not be permanent unless it is SAVEd to flash before EXITing Service Mode, resetting the unit or turning off power.**
z<SP>,'s',<CR>	Restores the configuration of the unit to its factory settings and saves the configuration to flash.

Table 9-44: Error messages for z (RESTOR TO FACTORY SETTINGS) command

Error	Message	Possible reason
E001	UNKNOWN COMMAND	Command is incorrectly entered
E002	INCORRECT NUMBER OF PARAMETERS	Any characters between command and <CR>
E003	INVALID PARAMETER	Value of parameter outside valid range
E004	EXCEEDED MAXIMUM NUMBER OF SAVES	Warning appears when maximum number of saves has been exceeded (1000 saves). STIM277H will always attempt to save the configuration when receiving the s (SAVE)-command.
E005	ERROR DURING SAVE	System parameters not successfully transferred to flash

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

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

>
```

Figure 9-48: 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 9-49: Example of response from z (RESTORE TO FACTORY SETTINGS) command with change in transmission parameters.

```
>z s
RESTORE TO FACTORY SETTINGS.
CONFIRM CHANGE TO FACTORY SETTINGS(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 AND SAVED.
NUMBER OF SAVES = 26


>
```

Figure 9-50: Example of response from z s (RESTORE TO FACTORY SETTINGS with save of configuration) command with change in transmission parameters.

9.15 ? (HELP) command

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

Table 9-45: Available ? (HELP) commands

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

Table 9-46: Allowed values for \<hlp> for ? (HELP) command

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

Table 9-47: Error messages for ? (HELP) commands

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

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

>
```

Figure 9-51: Example of response from ? (HELP) command

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

>
```

Figure 9-52: Example of response from ? a (HELP ON SINGLE-SHOT MEASUREMENT) command

```
>? b
b <BiasTrimOffset>: CHANGES BIAS TRIM OFFSET FOR ALL AXES TO <BiasTrimOffset>
b <DeltaBiasTrimOffset >,<Axis>: ADJUSTS BIAS TRIM OFFSET FOR SPECIFIED AXIS BY <DeltaBiasTrimOffset >
b <RefInfo>,r: DEFINES REFERENCE INFO FOR BIAS TRIM OFFSET. <RefInfo> IS A 32-BIT UNSIGNED INTEGER
   ALLOWED VALUES FOR <axis>:
      x = X-AXIS
      y = Y-AXIS
      z = Z-AXIS
   ALLOWED RANGE FOR <BiasTrimOffset>:
      GYROS [°/s]: -1.00000 TO 1.00000


>
```

Figure 9-53: Example of response from ? b (HELP on BIAS TRIM OFFSET) command

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

>
```

Figure 9-54: Example of response from ? c (HELP on DIAGNOSTIC) command

```
>? d
d s: CHANGES THE CONTENT OF THE DATAGRAMS IN NORMAL MODE TO STANDARD CONTENT
d j: CHANGES THE CONTENT OF THE DATAGRAMS IN NORMAL MODE TO RATE AND TEMPERATURE
d k: CHANGES THE CONTENT OF THE DATAGRAMS IN NORMAL MODE TO RATE AND COUNTER
d l: CHANGES THE CONTENT OF THE DATAGRAMS IN NORMAL MODE TO RATE AND LATENCY
d m: CHANGES THE CONTENT OF THE DATAGRAMS IN NORMAL MODE TO RATE, COUNTER AND LATENCY
d n: CHANGES THE CONTENT OF THE DATAGRAMS IN NORMAL MODE TO RATE, TEMPERATURE AND COUNTER
d o: CHANGES THE CONTENT OF THE DATAGRAMS IN NORMAL MODE TO RATE, TEMPERATURE AND LATENCY
d p: CHANGES THE CONTENT OF THE DATAGRAMS IN NORMAL MODE TO RATE, TEMPERATURE, COUNTER AND LATENCY

>
```

Figure 9-55: Example of response from ? d (HELP on DATAGRAM FORMAT) command

```
>? f
f <-3dBfreq>: CHANGES THE LP FILTER -3dB FREQUENCY [Hz] FOR ALL AXES
f <-3dBfreq>,<axis>: CHANGES THE LP FILTER -3dB FREQUENCY [Hz] FOR A SPECIFIC AXIS
   ALLOWED VALUES FOR <-3dBfreq> = 16, 33, 66, 131 AND 262
   ALLOWED VALUES FOR <axis> = x, y AND z

>
```

Figure 9-56: Example of response from ? f (HELP on LP FILTER -3dB FREQUENCY) command

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

>
```

Figure 9-57: Example of response from ? i (HELP on INFORMATION) command

```
>? j
j <systemconfig>','<setting>: CHANGE DEFINED SYSTEM CONFIGURATIONS
  ALLOWED VALUES FOR <systemconfig>:
    t = ACTIVE TOGGLING OF TOV FOR SPECIAL DATAGRAMS AFTER POWER-ON/RESET
    b = TRANSMISSION OF BIAS TRIM OFFSET DATAGRAM AFTER POWER-ON/RESET
  ALLOWED VALUES FOR <setting> PARAMETER WHEN <systemconfig> = t
    0 = TOV ACTIVE FOR SPECIAL DATAGRAMS AFTER POWER-ON/RESET: OFF
    1 = TOV ACTIVE FOR SPECIAL DATAGRAMS AFTER POWER-ON/RESET: ON
  ALLOWED VALUES FOR <setting> PARAMETER WHEN <systemconfig> = b
    0 = BTO-DATAGRAM TRANSMISSION AFTER POWER-ON/RESET: OFF
    1 = BTO-DATAGRAM TRANSMISSION AFTER POWER-ON/RESET: ON

>
```

Figure 9-58: Example of response from ? j (HELP on SYSTEM CONFIGURATIONS) command

```
>? m
m <sampl.freq>: CHANGES THE SAMPLE RATE [samples/s]
    ALLOWED VALUES FOR <sampl.freq> = 125, 250, 500, 1000, 2000 AND 0 (EXTERNAL TRIGGER)

>
```

Figure 9-59: Example of response from ? m (HELP on SAMPLE RATE) command

```
>? r
r 0: TURNS LINE TERMINATION = OFF AND DATAGRAM TERMINATION = NONE
r 1: TURNS LINE TERMINATION = ON AND DATAGRAM TERMINATION = NONE
r 2: TURNS LINE TERMINATION = OFF AND DATAGRAM TERMINATION = <CR><LF>
r 3: TURNS LINE TERMINATION = ON AND DATAGRAM TERMINATION = <CR><LF>

>
```

Figure 9-60: Example of response from ? r (HELP on TERMINATION) command

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

>
```

Figure 9-61: Example of response from ? s (HELP on SAVE) command

```
? t
t <bit-rate>: CHANGES THE BIT-RATE [bits/s]
t <bit-rate>,<stop-bits>,<parity>: CHANGES THE BIT-RATE [bits/s], NUMBER OF STOP-BITS AND PARITY
   ALLOWED VALUES FOR <bit-rate>: 1500 TO 7500000
<bit-rate> MUST ONLY BE INCLUDED WHEN <bit-rate code> = f
   ALLOWED VALUES FOR <stop-bits>: 1 AND 2
   ALLOWED VALUES FOR <parity>: n (=NONE), e (=EVEN) AND o (=ODD)


>
```

Figure 9-62: Example of response from ? t (HELP on TRANSMISSION PARAMETERS) command

```
>? u
u a: CHANGES OUTPUT UNIT TO ANGULAR RATE [°/s]
u i: CHANGES OUTPUT UNIT TO INCREMENTAL ANGLE [°/sample]
u m: CHANGES OUTPUT UNIT TO AVERAGE ANGULAR RATE [°/s]
u s: CHANGES OUTPUT UNIT TO INTEGRATED ANGLE [°]
>
```

Figure 9-63: Example of response from ? u (HELP on OUTPUT UNIT) command

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


>
```

Figure 9-64: Example of response from ? x (HELP on EXIT) command

```
>? z
z: RESTORES FACTORY SETTINGS


>
```

Figure 9-65: Example of response from ? z (HELP on RESTORES TO FACTORY SETTINGS) command

10 COMMANDS IN UTILITY MODE

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

Table 10-1: Available commands in Utility Mode

Command group	Command	Description	Ref. section
General	**$iax**	Returns the axis configuration	10.3.1
General	**$iconf**	Returns setting of system configuration	10.3.2
General	**$id**	Returns the datagram format	10.3.3
General	**$ie**	Returns the accumulated extended error information and resets the accumulated error register	10.3.4
General	**$ifw**	Returns the FW configuration	10.3.5
General	**$igf**	Returns the LP filter -3dB frequency of the gyros	10.3.6
General	**$igu**	Returns the output unit of the gyros	10.3.7
General	**$ihw**	Returns the HW configuration	10.3.8
General	**$im**	Returns the sampling rate	10.3.9
General	**$in**	Returns the product name	10.3.10
General	**$irng**	Returns the measurement ranges	10.3.11
General	**$isn**	Returns the product serial number	10.3.12
General	**$isv**	Returns the number of remaining saves	10.3.13
General	**$it**	Returns the RS422 transmission parameters	10.3.14
General	**$ix**	Returns the part number	10.3.15
General	**$save**	Saves all configuration and system parameters to flash memory	10.3.16
General	**$xn**	Terminates Utility Mode and returns to Normal Mode	10.3.17
Reconfig	**$sconf**	Sets system configuration	10.4.1
Reconfig	**$sd**	Sets the datagram format	10.4.2
Reconfig	**$sfs**	Sets factory settings	10.4.3
Reconfig	**$sgf**	Sets the LP filter -3dB frequency of the gyros	10.4.4
Reconfig	**$sgu**	Sets the output unit of the gyros	10.4.5
Reconfig	**$sm**	Sets the output sampling rate	10.4.6
Reconfig	**$st**	Sets the RS422 transmission parameters	10.4.7
BTO	**$ibto**	Returns the bias trim offsets	10.5.1
BTO	**$irf**	Returns the last programmed reference information for bias trim offset	10.5.2
BTO	**$sdbto**	Adjusts the bias trim offsets	10.5.3
BTO	**$sbto**	Programs the bias trim offset(s)	10.5.4
BTO	**$srf**	Programs the reference information for bias trim offset	10.5.5
Special	**$iead**	Returns relative drift in excitation amplitude of the gyros	10.6.1
Special	**$itemp**	Returns internal temperatures	10.6.2
Special	**$ivolt**	Returns internal voltages	10.6.3
Special	**$igdc**	Returns DC-value of gyro ADCs	10.6.4

Note: Use of commands that changes parameters do not permanently store the new values. The updated values will be in effect until the part is powered off or reset. To permanently store the new values, the $save-command (ref. section 10.3.16) must be used after having updated the required parameters.

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

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

Figure 10-1: Acknowledgement for entering Utility Mode

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

10.2 Command protocol for Utility Mode

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

10.2.1 Command string

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

10.2.2 Response string

a) All responses from the STIM277H starts with a start character '#'
b) The first return value is the command
c) All data are delimited by character: ',' (comma)
d) Second value is status of the executed command (0= OK, other = error), (ref. section 10.2.4)
e) Number of extra return values are defined for each command
f) Last value is always an 8 bit CRC checksum to ensure correct transmission (ref. section 10.2.3)
g) All command responses are terminated by ASCII character carriage return (<CR>)

10.2.3 Checksum

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

$isn,28<CR>
#isn,0,N25582120002002,158<CR>

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

10.2.4 Command status codes

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

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

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

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

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


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

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

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


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

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

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


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

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

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


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

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

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


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

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

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


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

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

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


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

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

Example of command with requested change(s) reduced due to violation of min/max limits for bias trim offset(s):

$sdbto,3.4,-8.6,0.01724,0,0,0,0,0,0,179<CR>

Response to command: #sdbto,8,1.0000,-1.00000,0.01724,0.000000,0.000000,0.000000,0.0000000,0.0000000,0.0000000,116,<CR>

Explanation of response:

1: sdbto = command

2: Status of command execution: ref. Table 10-2

3: Actual programmed bias trim offset for gyro X-axis [°/s] = 1.0000 (offset set to maximum limit)

4: Actual programmed bias trim offset for gyro Y-axis [°/s] = -1.0000 (offset set to minimum limit)

5: Actual programmed bias trim offset for gyro Z-axis [°/s] = -0.54432

6: FOR FUTURE USE = 0.000000

7: FOR FUTURE USE = 0.000000

8: FOR FUTURE USE = 0.000000

9: FOR FUTURE USE = 0.000000

10: FOR FUTURE USE = 0.000000

11: FOR FUTURE USE = 0.000000

12: CRC-8 calculation

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

10.3   General commands

General description: Various general commands.

Table 10-3: Available info commands

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

10.3.1 $iax

Purpose: Provide information about axis configuration

Format: $iax,<CRC><CR>

Example of command: $iax,65<CR>

Example of response: #iax,0,XYZ,NA,NA,215<CR>

Explanation of response:

1 : iax = command

2: Status of command execution: ref. Table 10-2

3: GYRO AXIS CONFIGURATION = XYZ (if no axis configured, the response will be NA)

4: RESERVED FOR FUTURE USE = NA

5: RESERVED FOR FUTURE USE = NA

6: CRC-8 calculation

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

10.3.2 $iconf

Purpose: Provide information about system configuration

Format: $iconf,<SystPar>,<CRC><CR>

Explanation of input parameters:
\<SystPar\>: System parameter. Valid entries are:
   • t : Toggling of TOV for special datagrams after power-on/reset
   • b : Transmission of Bias Trim Offset datagram after power-on/reset

Example of command: $iconf,t,211<CR> Example of response: #iconf,0,T,0,224<CR> Explanation of response: 1: iconf = command 2: Status of command execution: ref. Table 10-2 3: SYSTEM PARAMETER = T (Toggling of TOV for special datagrams after power-on/reset, ref. input parameters in Figure 10-28) 4: CONFIGURATION = 0 (No active toggling of TOV for special datagrams after power-on/reset, ref. input parameters in Figure 10-28) 5: CRC-8 calculation

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

10.3.3 $id

Purpose: Provide information about the datagram format

Format: $id,<CRC><CR>
Example of command: $id,221<CR> Example of response: #id,0,S,173<CR> Explanation of response: 1 : id = command 2: Status of command execution: ref. Table 10-2 3: DATAGRAM FORMAT = S (ID,RATE,CRC: ref. input parameters in Figure 10-29) 4: CRC-8 calculation

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

10.3.4 $ie

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

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

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

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

10.3.5 $ifw

Purpose: Provide information about firmware configuration

Format: $ifw,<CRC><CR>
Example of command: $ifw,148<CR> Example of response: #ifw,0,SWD12425 REV 0,49<CR> Explanation of response: 1 : ifw = command 2: Status of command execution: ref. Table 10-2 3: FW CONFIG = SWD12425 REV 0 4: CRC-8 calculation

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

10.3.6 $igf

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

Format: $igf,<CRC><CR>
Example of command: $igf,189<CR> Example of response: #igf,0,4,4,4,113<CR> Explanation of response: 1 : igf = command 2: Status of command execution: ref. Table 10-2 3: GYRO LP FILTER -3dB FREQUENCY, X-AXIS = 4 (262Hz, ref. input parameters in Figure 10-31. If axis is not configured, response will be NA) 4: GYRO LP FILTER -3dB FREQUENCY, Y-AXIS = 4 (262Hz, ref. input parameters in Figure 10-31. If axis is not configured, response will be NA) 5: GYRO LP FILTER -3dB FREQUENCY, Z-AXIS = 4 (262Hz, ref. input parameters in Figure 10-31. If axis is not configured, response will be NA) 6: CRC-8 calculation

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

10.3.7 $igu

Purpose: Provide information about the gyro output unit

Format: $igu,<CRC><CR>
Example of command: $igu,213<CR> Example of response: #igu,0,A,113<CR> Explanation of response: 1 : igu = command 2: Status of command execution: ref. Table 10-2 3: GYRO OUTPUT UNIT = A (Angular rate [°/s], ref. input parameters in Figure 10-32) 4: CRC-8 calculation

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

10.3.8 $ihw

Purpose: Provide information about hardware configuration

Format: $ihw,<CRC><CR>
Example of command: $ihw,184<CR> Example of response: #ihw,0,M5750 REV 0,105<CR> Explanation of response: 1 : ihw = command 2: Status of command execution: ref. Table 10-2 3: HW CONFIG = M5750 REV 0 4: CRC-8 calculation

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

10.3.9 $im

Purpose: Provide information about output sampling rate

Format: $im,<CRC><CR>
Example of command: $im,96<CR> Example of response: #im,0,2000,252<CR> Explanation of response: 1 : im = command 2: Status of command execution: ref. Table 10-2 3: SAMPLING FREQUENCY = 2000 samples/s (if External Trigger is chosen, response will be: 0) 4: CRC-8 calculation

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

10.3.10 $in

Purpose: Provide information about product name

Format: $in,<CRC><CR>
Example of command: $in,95<CR> Example of response: #in,0,STIM277H,184<CR> Explanation of response: 1: in = command 2: Status of command execution: ref. Table 10-2 3: PRODUCT = STIM277H 4: CRC-8 calculation

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

10.3.11 $irng

Purpose: Provide information about measurement range

Format: $irng,<CRC><CR>
Example of command: $irng,74<CR> Example of response: #irng,0,400,400,400,NA,NA,NA,NA,NA,NA,NA,160<CR> Explanation of response: 1 : irng = command 2: Status of command execution: ref. Table 10-2 3: GYRO RANGE, X-AXIS [°/s] = 400 (if axis is not configured, response will be NA) 4: GYRO RANGE, Y-AXIS [°/s] = 400 (if axis is not configured, response will be NA) 5: GYRO RANGE, Z-AXIS [°/s] = 400 (if axis is not configured, response will be NA) 6: FOR FUTURE USE = NA 7: FOR FUTURE USE = NA 8: FOR FUTURE USE = NA 9: FOR FUTURE USE = NA 10: FOR FUTURE USE = NA 11: FOR FUTURE USE = NA 12: FOR FUTURE USE = NA 13: CRC-8 calculation

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

10.3.12 $isn

Purpose: Provide information about product serial number

Format: $isn,<CRC><CR>
Example of command: $isn,28<CR> Example of response: #isn,0,N25582120002002,158<CR> Explanation of response: 1: isn = command 2: Status of command execution: ref. Table 10-2 3: SERIAL NUMBER = N25582120002002 4: CRC-8 calculation

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

10.3.13 $isv

Purpose: Provide information about the number of remaining saves

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

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

10.3.14 $it

Purpose: Provide information about the RS422 transmission parameters

Format: $it,<CRC><CR>
Example of command: $it,138<CR> Example of response: #it,0,374400,1,E,1,1,0,209<CR> Explanation of response: 1 : it = command 2: Status of command execution: ref. Table 10-2 3: BIT RATE [bps] = 374400 4: STOP BITS = 1 5: PARITY = E (EVEN, ref. Figure 10-34) 6: LINE TERMINATION = 1 (ON, ref. Figure 10-34) 7: DATAGRAM TERMINATION = 1 (<CR><LF>, ref. Figure 10-34) 8: FOR FUTURE USE = 0 (number format: integer) 9: CRC-8 calculation

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

10.3.15 $ix

Purpose: Provide information about part number and revision

Format: $ix,<CRC><CR>
Example of command: $ix,118<CR> Example of response: #ix,0,85032-0044-2101,-,253<CR> Explanation of response: 1: ix = command 2: Status of command execution: ref. Table 10-2 3: PART NUMBER = 85032-0044-2101 4: REVISION = - 5: CRC-8 calculation

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

10.3.16 $save

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

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

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

Note: the parameters will be saved even if remaining number of saves was 0 prior to saving. However, this could eventually lead to quality issues related to the flash memory.
Note: Do not turn off power until the command response has been received

10.3.17 $xn

Purpose: Terminate Utility Mode and return to Normal Mode

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

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

10.4   Commands for reconfiguration

General description: Various commands to reconfigure the part.

Note: Use of commands that changes parameters do not permanently store the new values. The updated values will be in effect until the part is powered off or reset. To permanently store the new values, the $save-command (ref. section 10.3.16) must be used after having updated the required parameters.

Table 10-4: Available commands for reconfiguration

Command	Description	Ref. section
$sconf	Sets system configuration	10.4.1
$sd	Sets the datagram format	10.4.2
$sfs	Sets factory settings	10.4.3
$sgf	Sets the LP filter -3dB frequency of the gyros	10.4.4
$sgu	Sets the output unit of the gyros	10.4.5
$sm	Sets the output sampling rate	10.4.6
$st	Sets the RS422 transmission parameters	10.4.7

10.4.1 $sconf

Purpose: Change system configuration parameters

Format: $sconf,<SystPar>,<Config>,<CRC><CR>
Explanation of input parameters:
<SystPar>: System parameter to be configured. Valid entries are:
• t : Toggling of TOV for special datagrams after power-on/reset
• b : Transmission of Bias Trim Offset datagram after power-on/reset
<Config>: Related configuration to specific system parameter. Valid entries are:
For <SystPar> = t:
• 0 : No active toggling of TOV for special datagrams after power-on/reset
• 1 : Active toggling of TOV for special datagrams after power-on/reset
For <SystPar> = b:
• 0 : No transmission of Bias Trim Offset datagram after power-on/reset
• 1 : Transmission of Bias Trim Offset datagram after power-on/reset
Example of command: $sconf,t,1,166<CR>
Example of response: #sconf,0,T,1,98<CR>
Explanation of response:
1: sconf = command
2: Status of command execution: ref. Table 10-2
3: SYSTEM PARAMETER = T (Toggling of TOV for special datagrams after power-on/reset)
4: CONFIGURATION = 1 (Toggling of tov active)
5: CRC-8 calculation

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

10.4.2 $sd

Purpose: Change the datagram format

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

Explanation of input parameters:
<DatagramFormat>: Datagram format. Valid entries: ref. Table 9-11
- s : ID, rate, CRC
- j : ID, rate, temperature, CRC
- k : ID, rate, counter, CRC
- l : ID, rate, latency, CRC
- m : ID, rate, counter, latency, CRC
- n : ID, rate, temperature, counter, CRC
    - o : ID, rate, temperature, latency, CRC
- p : ID, rate, temperature, counter, latency, CRC

Example of command: $sd,s,229<CR>
Example of response: #sd,0,S,45<CR>

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

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

10.4.3 $sfs

Purpose: Restore configuration to factory settings.

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

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

Explanation of input parameters:
<SaveConfiguration>: Save restored configuration
- 0 : Configuration not saved. The configuration can be saved later, by using the $save, ref. section 10.3.16
- 1 : Configuration saved

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

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

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

10.4.4 $sgf

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

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

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

<LP Filter>: LP filter -3dB frequency. Valid entries are:
- 0 :16Hz
- 1 : 33Hz
- 2 : 66Hz
- 3 : 131Hz
- 4 : 262Hz

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

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

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

10.4.5 $sgu

Purpose: Change the output unit for gyros

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

Explanation of input parameters:
<OutputUnit>: Output unit. Valid entries:
- a : Angular rate [°/s]
- i : Incremental angle [°/sample]
- m : Average angular rate [°/s]
- s : Integrated angle [°]

Example of command: $sgu,m,160<CR>
Example of response: #sgu,0,M,4<CR>

Explanation of response:
1: sgu = command
2: Status of command execution: ref. Table 10-2
3: GYRO OUTPUT UNIT = M (Average angular rate [°/s])
4: CRC-8 calculation

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

10.4.6 $sm

Purpose: Change the output sampling rate

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

Explanation of input parameters:
<SamplingRate>: Output sampling rate. Valid entries are:
- 0 : 125 samples/s
- 1 : 250 samples/s
- 2 : 500 samples/s
- 3 : 1000 samples/s
- 4 : 2000 samples/s
- 5 : External Trigger

Example of command: $sm,4,115<CR>
Example of response: #sm,0,4,213<CR>

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

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

10.4.7 $st

Purpose: Change the RS422 transmission parameters

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

Format: $st,<BitRate>,<StopBits>,<Parity>,<LineTermination>,<DatagramTermination>,0,<CRC><CR>

Explanation of input parameters:
<BitRate>: Bit rate [bps]. Some limitations apply, ref. section 9.11
<StopBits>: Number of stop-bits. Valid entries are:
- 1 : 1 stop bit
- 2 : 2 stop bits
<Parity>: Parity. Valid entries are:
- n: No parity
- o : Odd parity
- e : Even parity
<LineTermination>: Turn on/off 120 Ohm line termination on the RS422 Rx+ and Rx- inputs. Valid entries are:
- 0 : Line termination turned OFF
- 1 : Line termination turned ON
<DatagramTermination>: Turn on/off <CR><LF>-termination of datagrams. Valid entries are:
- 0 : No datagram termination
- 1 : Datagram termination = <CR><LF>

Example of command with specified bit rate: $st,921600,2,n,1,0,0,168<CR>
Example of response: #st,0,921699,2,N,1,0,0,132<CR>

Explanation of response:
1: st = command
2: Status of command execution: ref. Table 10-2
3: BIT RATE [bps] = 921600
4: STOP BITS = 2
5: PARITY = N (NO PARITY)
6: LINE TERMINATION = 1 (ON)
7: DATAGRAM TERMINATION = 0 (NONE)
8: FOR FUTURE USE = 0 (number format: integer)
9: CRC-8 calculation

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

10.5 Commands for bias trim offset

General description: Various commands related to bias trim offset.

Note: Use of commands that changes parameters do not permanently store the new values. The updated values will be in effect until the part is powered off or reset. To permanently store the new values, the $save-command (ref. section 10.3.16) must be used after having updated the required parameters.

Table 10-5: Available bias trim offset commands

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

10.5.1 $ibto

Purpose: Provide information about the current bias trim offsets

Format: $ibto,<CRC><CR>
Example of command: $ibto,160<CR> Example of response: #ibto,0.01388,-0.02425,0.01724,0.000000,0.000000,0.000000,0.0000000,0.0000000,0.0000000,225<CR> Explanation of response: 1: ibto = command 2: Status of command execution: ref. Table 10-2 3: GYRO X-AXIS BIAS TRIM OFFSET [°/s] = 0.01388 (number format: decimal number with 5 decimals. If axis is not configured, response will be NA) 4: GYRO Y-AXIS BIAS TRIM OFFSET [°/s] = -0.02425 (number format: decimal number with 5 decimals. If axis is not configured, response will be NA) 5: GYRO Z-AXIS BIAS TRIM OFFSET [°/s] = 0.01724 (number format: decimal number with 5 decimals. If axis is not configured, response will be NA) 6: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 7: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 8: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 9: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 10: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 11: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 12: CRC-8 calculation

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

10.5.2 $irf

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

Format: $irf,223<CR>
Example of command: $irf,223<CR> Example of response: #irf,43638,44<CR> Explanation of response: 1: irf = command 2: Status of command execution: ref. Table 10-2 3: REFERENCE INFORMATION = 43638 (number format: unsigned integer) 4: CRC-8 calculation

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

10.5.3 $sdbto

Purpose: Adjust the bias trim offsets

Format: $sdbto,<Gyro dX>,<Gyro dY>,<Gyro dZ>,0,0,0,0,0,0,<CRC><CR>
Explanation of input parameters: <Gyro dX>: Required adjustment in bias trim offset for gyro X-axis [°/s] <Gyro dY>: Required adjustment in bias trim offset for gyro Y-axis [°/s] <Gyro dZ>: Required adjustment in bias trim offset for gyro Z-axis [°/s]
Example of command: $sdbto,0.01388,-0.02425,0.01724,0,0,0,0,0,0,38<CR> Example of response: #sdbto,0,0.01388,-0.02425,0.01724,0.000000,0.000000,0.000000,0.0000000,0.0000000,0.0000000,244,<CR> Explanation of response: 1: sdbto = command 2: Status of command execution: ref. Table 10-2 3: NEW GYRO X-AXIS BIAS TRIM OFFSET [°/s] = 0.01388 (number format: decimal number with 5 decimals) 4: NEW GYRO Y-AXIS BIAS TRIM OFFSET [°/s] = -0.02425(number format: decimal number with 5 decimals) 5: NEW GYRO Z-AXIS BIAS TRIM OFFSET [°/s] = 0.01724(number format: decimal number with 5 decimals) 6: FOR FUTURE USE = 0.000000 (number format: decimal number with 6 decimals) 7: FOR FUTURE USE = 0.000000 (number format: decimal number with 6 decimals) 8: FOR FUTURE USE = 0.000000 (number format: decimal number with 6 decimals) 9: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 10: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 11: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals) 12: CRC-8 calculation

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

10.5.4 $sbto

Purpose: Program the bias trim offset(s)

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

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

- g : gyro

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

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

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

Example of command using format2: $sbto,0.01,g,70<CR> (example sets bias trim offset to 0.01°/s for all gyro axes)
Example of response using format2:
#sbto,0,0.01000,0.01000,0.01000,0.000000,0.000000,0.000000,0.0000000,0.0000000,0.0000000,104<CR>

Example of command using format3: $sbto,3.4e-03,g,y,128<CR> (example sets bias trim offset for gyro Y-axis to 0.0034°/s)
Example of response using format3:
#sbto,0,0.01000,0.00340,0.01000,0.000000,0.000000,0.000000,0.0000000,0.0000000,0.0000000,59<CR>

Explanation of response (ref. response to example using format 3):
1: sbto = command
2: Status of command execution: ref. Table 10-2
3: NEW GYRO X-AXIS BIAS TRIM OFFSET [°/s] = 0.01000 (number format: decimal number with 5 decimals)
4: NEW GYRO Y-AXIS BIAS TRIM OFFSET [°/s] = 0.00340 (number format: decimal number with 5 decimals)
5: NEW GYRO Z-AXIS BIAS TRIM OFFSET [°/s] = 0.01000 (number format: decimal number with 5 decimals)
6: FOR FUTURE USE = 0.000000 (number format: decimal number with 6 decimals)
7: FOR FUTURE USE = 0.000000 (number format: decimal number with 6 decimals)
8: FOR FUTURE USE = 0.000000 (number format: decimal number with 6 decimals)
9: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals)
10: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals)
11: FOR FUTURE USE = 0.0000000 (number format: decimal number with 7 decimals)
12: CRC-8 calculation

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

10.5.5 $srf

Purpose: Program the reference info for bias trim offset

Format: $srf,<RefInfo>,<CRC><CR>

Explanation of input parameters:
<RefInfo>: Reference information (format: 32-bit unsigned integer), e.g. a date code

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Example of command: $srf,43638,122<CR> (example shows programming of datecode for "June 22, 2019" (=43638))
Example of response: #srf,0,43638,69<CR>

Explanation of response:
1: srf = command
2: Status of command execution: ref. Table 10-2
3. NEW REFERENCE INFORMATION = 43638
4: CRC-8 calculation

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

10.6 Special commands

General description: Special commands to read out selected internal parameters

Table 10-6: Available special commands

Command	Description	Ref. section
$iead	Returns relative drift in excitation amplitude of the gyros	10.6.1
$itemp	Returns internal temperatures	10.6.2
$ivolt	Returns internal voltages	10.6.3
$igdc	Returns DC-value of gyro ADCs	10.6.4

10.6.1 $iead

Purpose: Provide information about relative drift in excitation amplitude of the gyros

Format: $iead,<CRC><CR>
Example of command: $iead,55<CR>
Example of response: #iead,0,1.000045,1.000008,0.999945,213<CR>
Explanation of response:
1: iead = command
2: Status of command execution: ref. Table 10-2
3: RELATIVE DRIFT IN GYRO EXCITATION AMPLITUDE, X-AXIS [ ] = 1.000045
4: RELATIVE DRIFT IN GYRO EXCITATION AMPLITUDE, Y-AXIS [ ] = 1.000008
5: RELATIVE DRIFT IN GYRO EXCITATION AMPLITUDE, Z-AXIS [ ] = 0.999945
6: CRC-8 calculation

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

10.6.2 $itemp

Purpose: Provide information about internal temperatures

Format: $itemp,<CRC><CR>
Example of command: $itemp,131<CR>
Example of response: #itemp,0,25.4,25.3,25.2,NA,NA,NA,NA,NA,NA,25.5,25.4,25.5,25.8,88<CR>
Explanation of response:
1: itemp = command
2: Status of command execution: ref. Table 10-2
3: GYRO TEMPERATURE, X-AXIS [°C] = 25.4
4: GYRO TEMPERATURE, Y-AXIS [°C] = 25.3
5: GYRO TEMPERATURE, Z-AXIS [°C] = 25.2
6: RESERVED FOR FUTURE USE = NA
7: RESERVED FOR FUTURE USE = NA
8: RESERVED FOR FUTURE USE = NA
9: RESERVED FOR FUTURE USE = NA
10: RESERVED FOR FUTURE USE = NA
11: RESERVED FOR FUTURE USE = NA
11: uC TEMPERATURE [°C] = 25.5
12: GYRO ANALOG ASIC TEMPERATURE, X-AXIS [°C] = 25.4
13: GYRO ANALOG ASIC TEMPERATURE, Y-AXIS [°C] = 25.5
14: GYRO ANALOG ASIC TEMPERATURE, Z-AXIS [°C] = 25.8
15: CRC-8 calculation

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

10.6.3 $ivolt

Purpose: Provide information about internal voltages

Format: $ivolt,<CRC><CR>
Example of command: $ivolt,131<CR> Example of response: #ivolt,0,5.2034,5.0111,NA,1.8033,5.0002,NA,2.5001,2.0478,5.4983,3.35234,12<CR> Explanation of response: 1: ivolt = command 2: Status of command execution: ref. Table 10-2 3: SUPPLY VOLTAGE [V] = 5.2034 4. REGULATED VOLTAGE#2 [V] = 5.0111 5: RESERVED FOR FUTURE USE = NA (Not Available) 6: REGULATED VOLTAGE#3 [V] = 1.8033 7: REFERENCE VOLTAGE#1 [V] = 5.0002 8: RESERVED FOR FUTURE USE = NA (Not Available) 9: REFERENCE VOLTAGE#2 [V] = 2.5001 10: REFERENCE VOLTAGE#3 [V] = 2.0478 11: REGULATED VOLTAGE#1 [V] = 5.4983 12: DAC VOLTAGE [V] = 3.5234 13: CRC-8 calculation

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

10.6.4 $igdc

Purpose: Provide information about DC-value of gyro ADCs

Format: $igdc,<CRC><CR>
Example of command: $igdc,176<CR> Example of response: #igdc,0,0.001023,- 0.000823,0.001008,-0.008333,-0.004566,0.010422,189<CR> Explanation of response: 1: igdc = command 2: Status of command execution: ref. Table 10-2 3: GYRO DC-VALUE OF DETECTION ADC, X-AXIS [ ] = 0.001023 4: GYRO DC-VALUE OF DETECTION ADC, Y-AXIS [ ] = - 0.000823 5: GYRO DC-VALUE OF DETECTION ADC, Z-AXIS [ ] = 0.001008 6: GYRO DC-VALUE OF EXCITATION ADC, X-AXIS [ ] = -0.008333 7: GYRO DC-VALUE OF EXCITATION ADC, Y-AXIS [ ] = -0.004566 8: GYRO DC-VALUE OF EXCITATION ADC, Z-AXIS [ ] = 0.010422 9: CRC-8 calculation

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

11 PACKAGING AND MARKING

11.1 Product marking

Figure 11-1: Example of marking of STIM277H

The label will not be attached to the product but delivered in a separate pocket in the packaging bag, ref. section 11.2.

11.2 Packaging

The STIM277H is packaged in accordance with ECSS-Q-ST-20-08C.

The product is cleaned and placed in a sealed bag in a contamination-controlled environment. The product-label is placed in a separate pocket as shown in Figure 11-2:

Figure 11-2: Sealed bag with product-label in separate pocket

The sealed bag is then placed in a sealed transportation bag in a contamination-controlled environment as shown in Figure 11-3:

Figure 11-3: Sealed transportation bag

12 PART NUMBER / ORDERING INFORMATION

Configuration options in **bold** letters are the standard option.

Main configuration	-	Output unit	Data-gram	Sample rate	Band-width	-	Bit-rate	Stop-bits	Parity	System Configuration

Main Configuration:

85032 = full 3-axis

Output unit:

0 = Angular Rate
1 = Incremental Angle
2 = Average Angular Rate
3 = Integrated Angle

Datagram:

0 = Standard
3 = Rate and temperature
4 = Rate and counter
5 = Rate and latency
6 = Rate, counter and latency
7 = Rate, temperature and counter
8 = Rate, temperature and latency
9 = Rate, temperature, counter and latency

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

Bandwidth:

0 = 16Hz
1 = 33Hz
2 = 66Hz
3 = 131Hz
4 = 262Hz

Bit-rate:

0 = 374400 bits/s
1 = 460800 bits/s
2 = 921600 bits/s
3 = 1843200 bits/s
7 = User-defined*

*) Bit-rate must be specified. See section 9.11 for limitations

Stop-bits:

1 = 1 stop-bit
2 = 2 stop-bits

Parity:

0 = no parity
1 = odd parity
2 = even parity

Example: part number 85032-0032-1211 has the following configuration:

- o X, Y and Z axis
- o Angular Rate Output [°/s]
- o Standard Datagram
- o 1000 samples/s
- o -3dB bandwidth = 66Hz
- o Bit-rate = 460800 bits/s
- o 2 stop-bits
- o Odd parity
- o Line termination ON
- o No datagram termination
- o TOV is not active for special datagrams at start-up
- o No transmission of BTO datagram at start-up

System configuration

	RS422 Rx 120 Ohms Line termination	Datagram termination <CR><LF>	Active toggling of TOV for special datagrams at start-up	Transmission of Bias Trim Offset datagram at start-up
0	OFF	OFF	OFF	OFF
1	**ON**	**OFF**	**OFF**	**OFF**
2	OFF	ON	OFF	OFF
3	ON	ON	OFF	OFF
4	OFF	OFF	ON	OFF
5	ON	OFF	ON	OFF
6	OFF	ON	ON	OFF
7	ON	ON	ON	OFF
8	OFF	OFF	OFF	ON
9	ON	OFF	OFF	ON
A	OFF	ON	OFF	ON
B	ON	ON	OFF	ON
C	OFF	OFF	ON	ON
D	ON	OFF	ON	ON
E	OFF	ON	ON	ON
F	ON	ON	ON	ON

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