

# 3DM-GX1®

## Orientation Sensor



### Timer Ticks, Calculation Cycle and Data Output Rates

#### Overview

MicroStrain's 3DM-GX1® orientation sensor allows the user to optimize the data output rate of finished data quantities to suit varying applications. Within certain limits, the user may speed up or slow down the number of data quantities delivered per second over the 3DM-GX1®'s default data delivery setting.

- This technical note assumes that the user has a working knowledge of the 3DM-GX1® and has read the *Calculation Cycle and Data Output Rate* section of the 3DM-GX1® Data Communication Protocol manual at: <http://www.microstrain.com/manuals/3DM-GX1%20Data%20Communication%20Protocol%203101.pdf>.
- **Table 1** describes all of the data quantity commands available for the 3DM-GX1®. The command name and the command byte are given.

**Table 1: Commands for Data Quantities**

Cmd	Hex
Send Raw Sensor Bits	0x01
Send Gyro-Stabilized Vectors	0x02
Send Instantaneous Vectors	0x03
Send Instantaneous Quaternion	0x04
Send Gyro-Stabilized Quaternion	0x05
Send Instantaneous Orientation Matrix	0x0A
Send Gyro-Stabilized Orientation Matrix	0x0B
Send Gyro-Stabilized Quaternion & Vectors	0x0C
Send Instantaneous Euler Angles	0x0D
Send Gyro-Stabilized Euler Angles	0x0E
Send Gyro-Stabilized Quaternion & Instantaneous Vectors	0x12
Send Gyro-Stabilized Euler Angles & Accel & Rate Vector	0x31

## Timer Ticks, Calculation Cycle and Data Output Rates

### Method

- A series of tests were conducted to determine the effect of differing timer tick intervals on the data output rate. Even timer tick intervals between 1 and 10 milliseconds were tested along with the default factory setting of 6.5536 milliseconds. The baud rate was set to the factory default 38,400. The 3DM-GX1® was operated in continuous mode. The results are shown in **Table 2**.
- As an example, the blue cell in the table shows that if the timer tick interval is set to 7 and the data quantity *Gyro-Stabilized Orientation Matrix* (command 0x0B) is requested, the 3DM-GX1® requires 2 timer ticks to output a finished data quantity.
- As another example, the red cell in the table shows that if the timer tick interval is set to 10 and the data quantity *Gyro-Stabilized Quaternion & Instantaneous Vectors* (command 0x12) is requested, the 3DM-GX1® requires 1 timer tick to output a finished data quantity.
- The number of timer ticks required for any given timer tick interval will not change, no matter the length of the data acquisition session, except with those settings where we have indicated the letter T, T for transitioning. In these configurations, the number of timer ticks to output a data quantity will vary throughout the session. If the user is counting on a constant output of data, these configurations should be avoided.

**Table 2: Timer Ticks required to complete Calculation Cycle**

mSecs	6.5536	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0
<b>Cmd</b>											
0x01	T	1	1	1	1	2	2	2	3	4	7
0x02	2	1	1	1	T	2	2	2	3	4	T
0x03	2	1	1	1	T	2	2	2	3	4	T
0x04	2	1	T	2	2	2	2	3	T	5	T
0x05	2	1	T	2	2	2	2	3	T	5	T
0x0A	2	1	1	2	2	2	2	3	3	5	9
0x0B	2	1	1	2	2	2	2	3	3	5	9
0x0C	2	1	2	2	2	2	2	3	4	5	10
0x0D	2	1	2	2	2	2	2	3	4	5	10
0x0E	2	1	2	2	2	2	2	3	4	5	10
0x12	2	1	2	2	2	2	2	3	4	5	10
0x31	2	1	2	2	2	2	2	3	4	5	10

## Timer Ticks, Calculation Cycle and Data Output Rates

- **Table 3** shows us the actual time (in milliseconds) with differing timer tick intervals to produce a finished data output. This is arrived at by multiplying the timer tick interval by the number of ticks required for any given data quantity request.
- As an example, the blue cell in the table shows that if the timer tick interval is set to 5 and the data quantity *Instantaneous Orientation Matrix* (command 0x0A) is requested, the 3DM-GX1<sup>®</sup> takes 10 milliseconds to output a finished data quantity.
- As another example, the red cell in the table shows that if the timer tick interval is set to 2 and the data quantity *Gyro-Stabilized Euler Angles & Accel & Rate Vector* (command 0x31) is requested, the 3DM-GX1<sup>®</sup> takes 10 milliseconds to output a finished data quantity.
- The green cells indicate the timer tick intervals which produce the fastest output.

**Table 3: Timer Ticks x Timer Tick Interval = Total Time to Complete Calculation Cycle**

mSecs	6.5536	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0
<b>Cmd</b>											
0x01	T	10	9	8	7	12	10	8	9	8	7
0x02	13.107	10	9	8	T	12	10	8	9	8	T
0x03	13.107	10	9	8	T	12	10	8	9	8	T
0x04	13.107	10	T	16	14	12	10	12	T	10	T
0x05	13.107	10	T	16	14	12	10	12	T	10	T
0x0A	13.107	10	9	16	14	12	10	12	9	10	9
0x0B	13.107	10	9	16	14	12	10	12	9	10	9
0x0C	13.107	10	18	16	14	12	10	12	12	10	10
0x0D	13.107	10	18	16	14	12	10	12	12	10	10
0x0E	13.107	10	18	16	14	12	10	12	12	10	10
0x12	13.107	10	18	16	14	12	10	12	12	10	10
0x31	13.107	10	18	16	14	12	10	12	12	10	10

## Timer Ticks, Calculation Cycle and Data Output Rates

- **Table 4** shows us the computed sampling rate per second (in Hz).
- As an example, the blue cell in the table shows that if the timer tick interval is set to 10 and the data quantity *Gyro-Stabilized Orientation Matrix* (command 0x0B) is requested, the 3DM-GX1<sup>®</sup> will produce 100 finished data quantities per second (100 Hz).

**Table 4: Samples per second (Hz)**

mSecs	6.5536	10.0	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0
<b>Cmd</b>											
0x01	T	100	111	125	143	83	100	125	111	125	143
0x02	76	100	111	125	T	83	100	125	111	125	T
0x03	76	100	111	125	T	83	100	125	111	125	T
0x04	76	100	T	63	71	83	100	83	T	100	T
0x05	76	100	T	63	71	83	100	83	T	100	T
0x0A	76	100	111	63	71	83	100	83	111	100	111
0x0B	76	100	111	63	71	83	100	83	111	100	111
0x0C	76	100	56	63	71	83	100	83	83	100	100
0x0D	76	100	56	63	71	83	100	83	83	100	100
0x0E	76	100	56	63	71	83	100	83	83	100	100
0x12	76	100	56	63	71	83	100	83	83	100	100
0x31	76	100	56	63	71	83	100	83	83	100	100

- **Note:** In a second series of tests, the baud rate was adjusted to 115,200 and 19,200. 19,200 was found to be problematic in many cases because it would not support the data output rate of the processor. 115,200 presented no problems and performed as did 38,400.