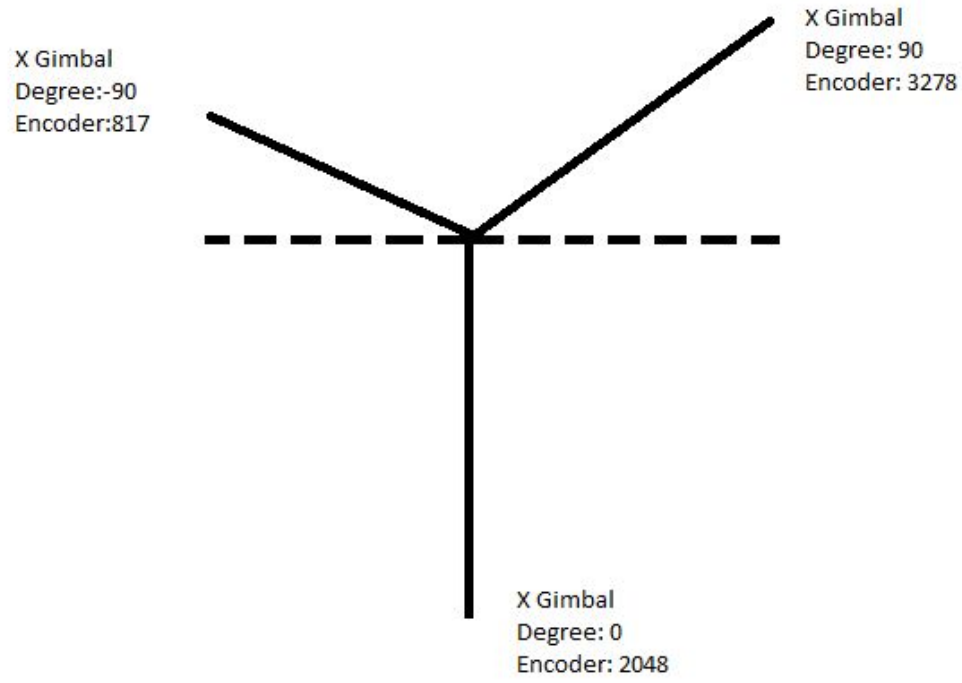
GEOMAGIC TOUCH Calibration Error

The following data is obtained by using the Geomagic Touch device with serial no: 16039002751
The same behaviour was also observed in other devices with serial no: 15049001931,150490001938

We were hoping that these errors were coming from our inaccurate measurements, the magnitude of the error is, however, quite high to be coming from inaccurate measurements(20 for this device, while 28 for some others).

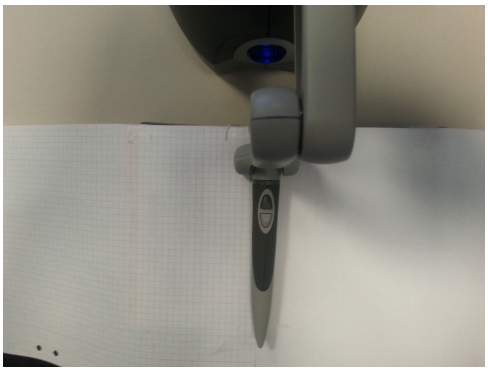
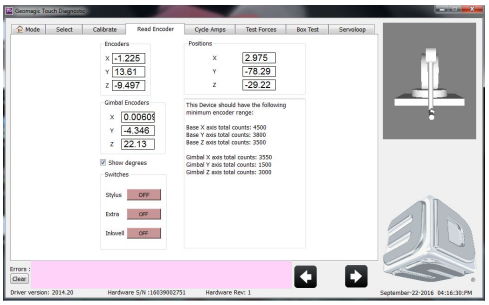
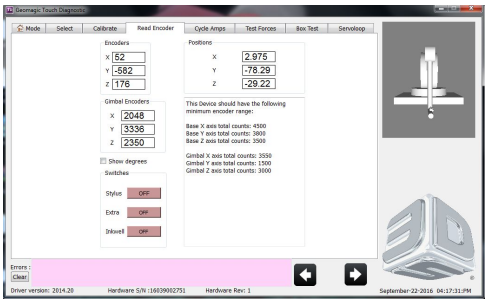
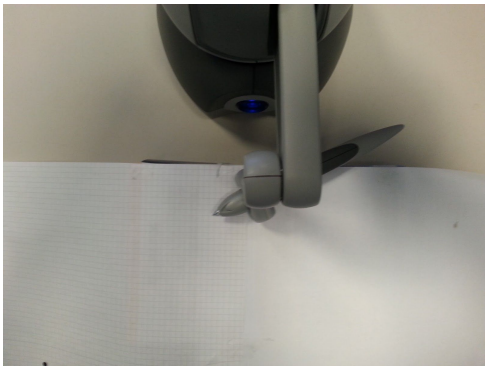
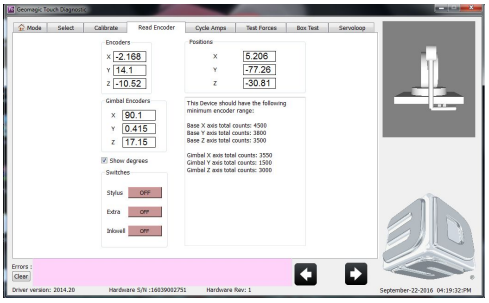
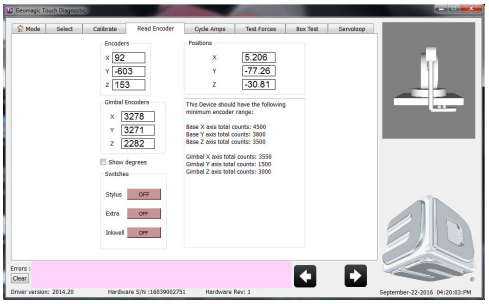
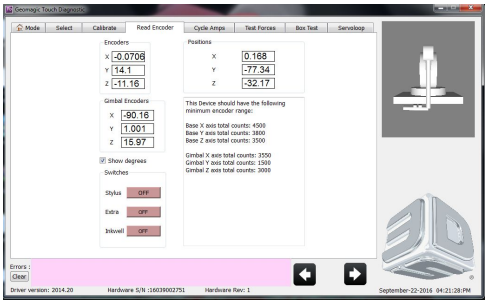
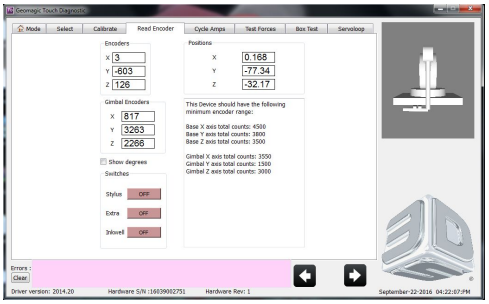
The figure below illustrates the problem that we are observing. We read 90 and -90 degrees from the encoders when we set the orientation of the haptic device handle in real life to orientations which is obviously larger than 90 and smaller than -90. Please also observe the asymmetry of the error, which was observed in all devices mentioned above.

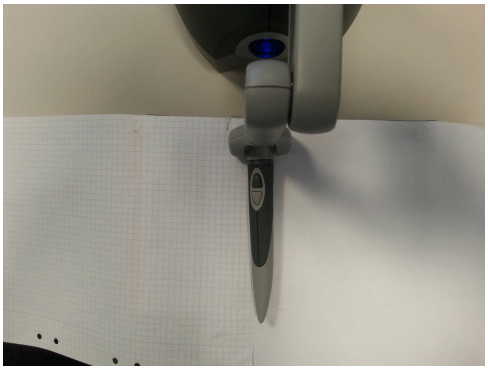
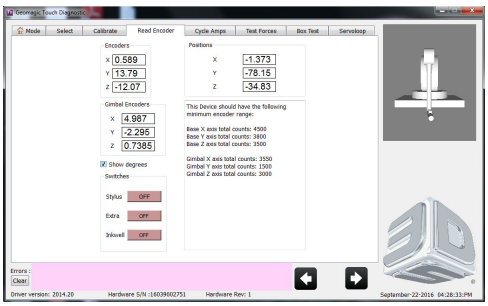
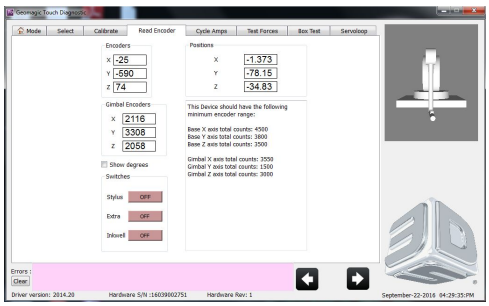
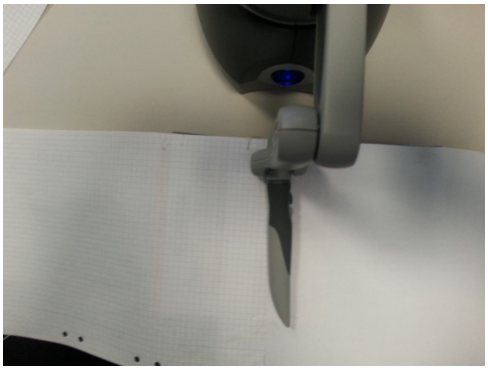
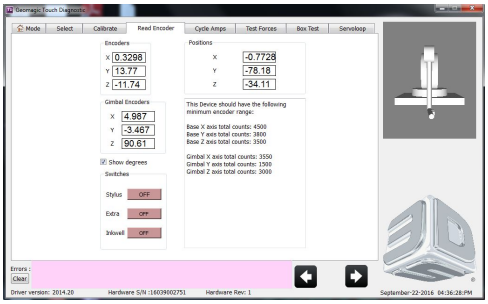
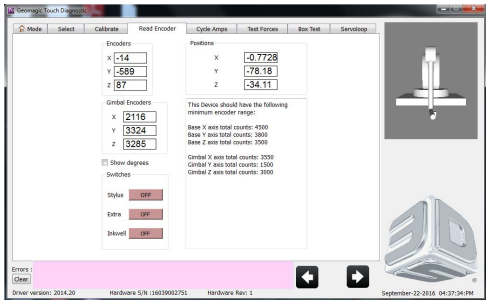
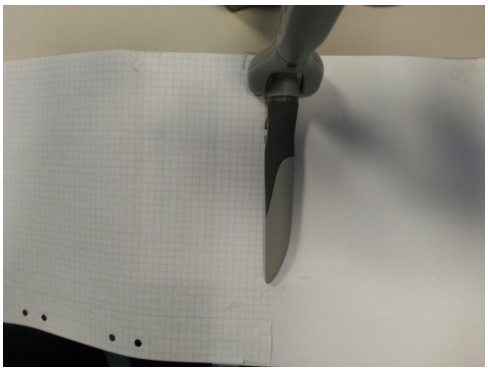
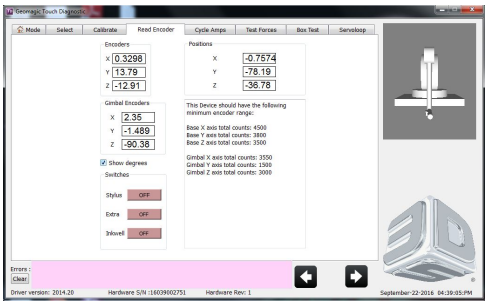
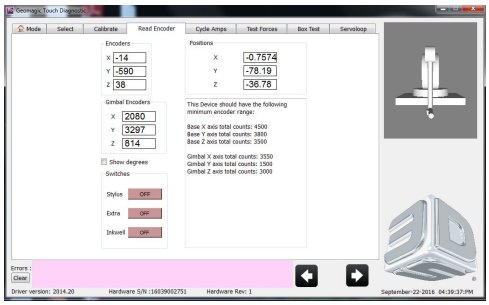


In order to check the mapping between the encoder values and degrees in the Diagnostics Tool, we also compared the difference between the angles and encoder values in different orientations. Moving the handle from 0 to 90 increases the encoder value 1230 ticks(from 2048 to 3278) while moving it from 0 to -90 decreases the encoder value 1231 ticks(from 2048 to 817).
Observing the same magnitude of change in the encoder values with the same magnitude of angles, hinting a correct mapping, suggests a higher chance of hardware failure than a software issue.

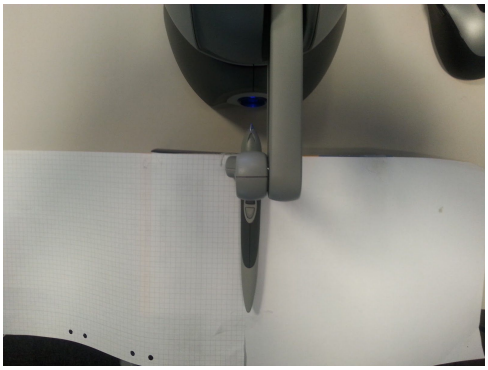
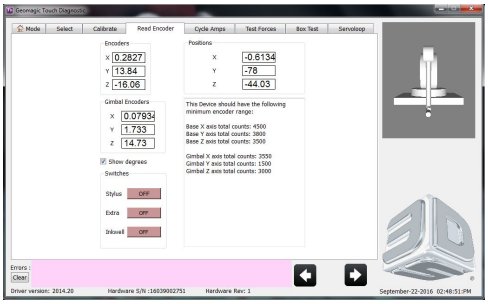
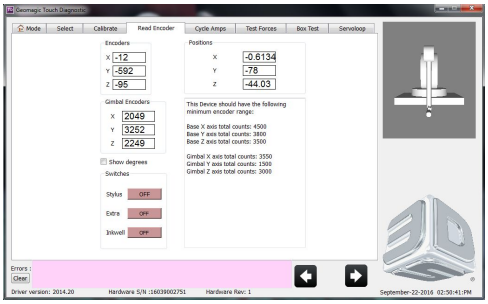
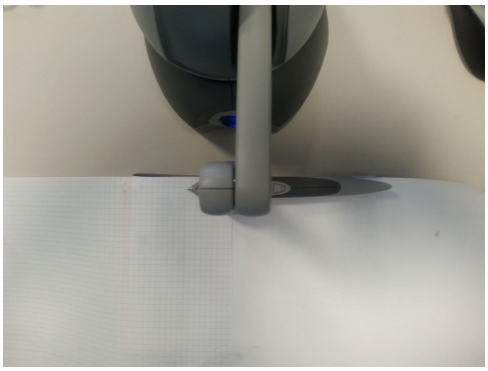
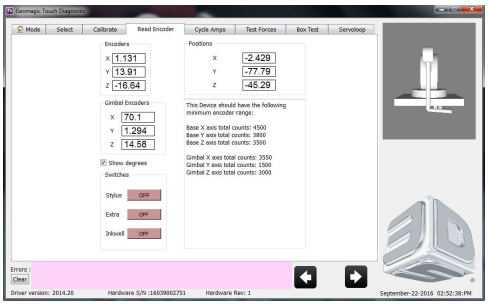
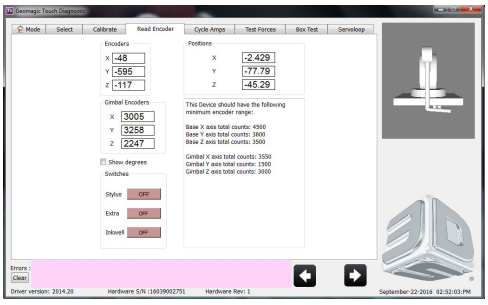
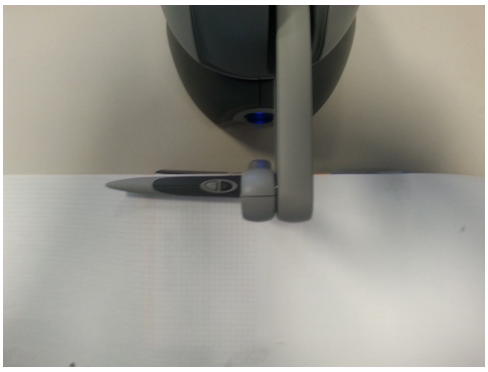
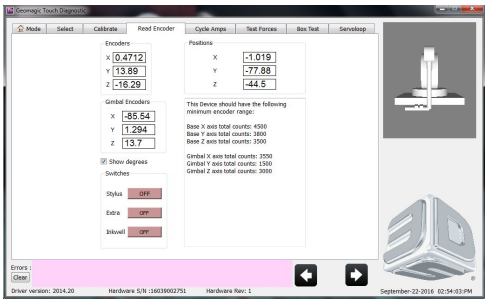
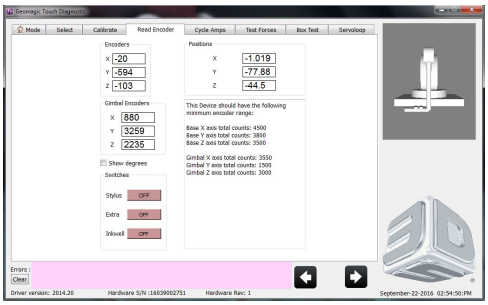
While our main issue has been the error on the X Gimbal values, we also observed some offsets on the Z Gimbal values. More samples are presented below showing the encoder values for different handle orientations in both X and Z axis.

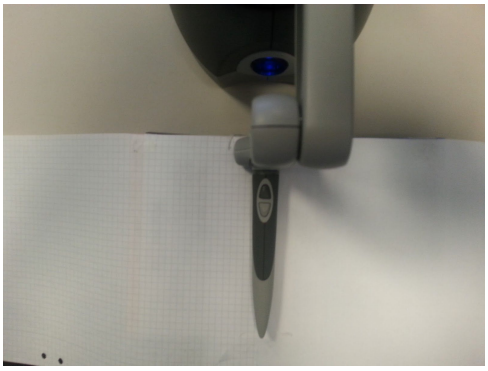
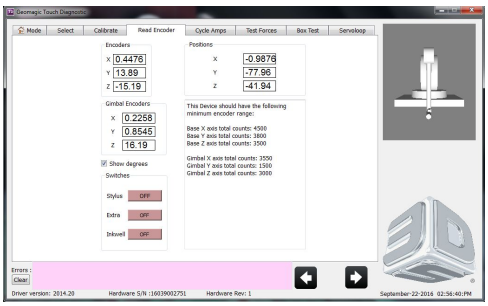
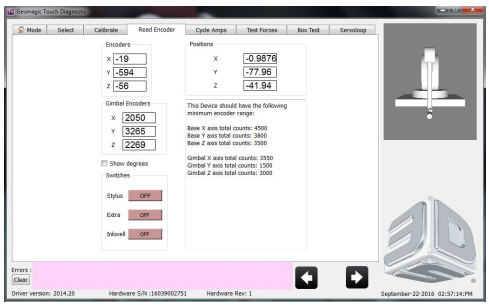
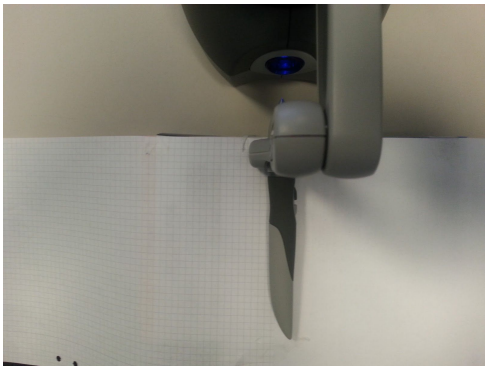
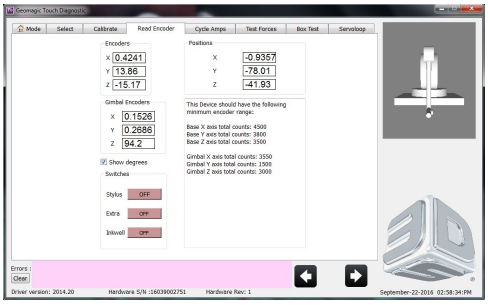
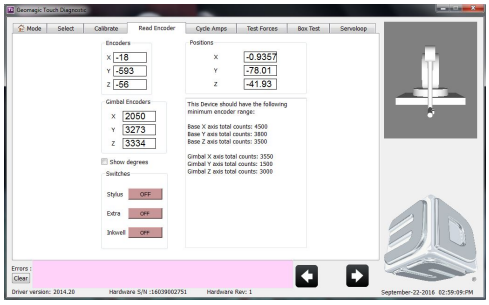
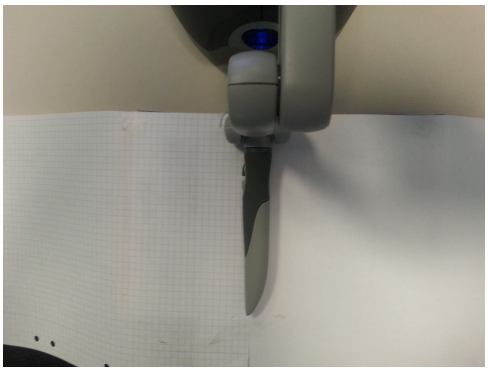
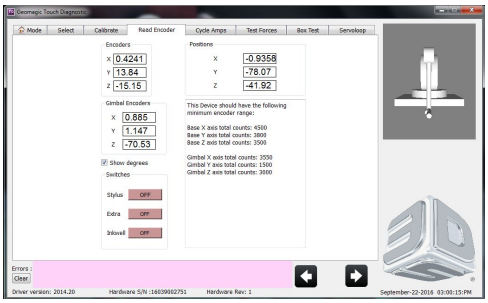
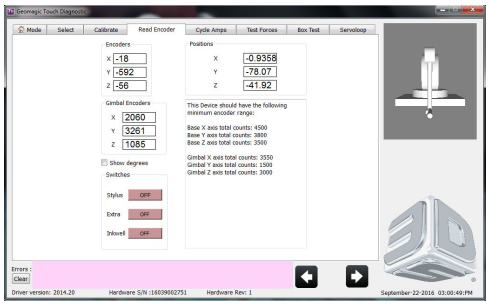
The data below data is obtained by adjusting the haptic device handle to get orthogonal gimbal encoder values in the Diagnostics Tool(Degrees Column).
First 3 rows refer to the (0º, 90º, -90º) rotations around the y-axis(changes X component of Gimbal Encoders in the GUI)
The latter 3 rows refer to the (0º, 90º, -90º) rotations around the z-axis(changes Z component of Gimbal Encoders in the GUI)

Photos	Degrees	Encoder Values
		
		
		

	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X 0.588 Y 13.79 Z -12.07 Positions X -1.373 Y -78.15 Z -34.83 Gimbal Encoders X 4.987 Y -2.295 Z 0.7385 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 04:28:33:PM	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X -25 Y -590 Z 74 Positions X -1.373 Y -78.15 Z -34.83 Gimbal Encoders X 2116 Y 3308 Z 2058 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 04:28:35:PM
	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X 0.3298 Y 13.77 Z -11.74 Positions X -0.7728 Y -78.18 Z -34.11 Gimbal Encoders X 4.987 Y -3.467 Z 90.61 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 04:36:28:PM	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X -14 Y -589 Z 87 Positions X -0.7728 Y -78.18 Z -34.11 Gimbal Encoders X 2116 Y 3324 Z 3285 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 04:37:34:PM
	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X 0.3298 Y 13.79 Z -12.91 Positions X -0.7574 Y -78.19 Z -36.78 Gimbal Encoders X 2.35 Y -1.489 Z -90.38 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 04:39:05:PM	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X -14 Y -590 Z 38 Positions X -0.7574 Y -78.19 Z -36.78 Gimbal Encoders X 2080 Y 3297 Z 814 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 04:39:37:PM

The data below data is obtained by adjusting the haptic device handle to orthogonal orientations(approximately) in the real world(Photos Column)
First 3 rows refer to the (0º, 90º, -90º) rotations around the y-axis(changes X component of Gimbal Encoders in the GUI)
The latter 3 rows refer to the (0º, 90º, -90º) rotations around the z-axis(changes Z component of Gimbal Encoders in the GUI)

Photos	Degrees	Encoder Values
		
		
		

	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X 0.4476 Y 13.89 Z -15.19 Positions X -0.9876 Y -77.96 Z -41.94 Gimbal Encoders X 0.2258 Y 0.8545 Z 16.19 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 02:56:40:PM	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X -19 Y -594 Z -56 Positions X -0.9876 Y -77.96 Z -41.94 Gimbal Encoders X 2050 Y 3265 Z 2269 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 02:57:14:PM
	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X 0.4241 Y 13.86 Z -15.17 Positions X -0.9357 Y -78.01 Z -41.93 Gimbal Encoders X 0.1526 Y 0.2686 Z 94.2 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 02:58:34:PM	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X -18 Y -593 Z -56 Positions X -0.9357 Y -78.01 Z -41.93 Gimbal Encoders X 2050 Y 3273 Z 3334 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 02:59:09:PM
	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X 0.4241 Y 13.84 Z -15.15 Positions X -0.9358 Y -78.07 Z -41.92 Gimbal Encoders X 0.885 Y 1.147 Z -70.53 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 03:00:15:PM	 Geomagic Touch Diagnostic Mode Select Calibrate Read Encoder Cycle Amps Test Forces Box Test Servoloop Encoders X -18 Y -592 Z -56 Positions X -0.9358 Y -78.07 Z -41.92 Gimbal Encoders X 2060 Y 3261 Z 1085 Show degrees Switches Stylus OFF Extra OFF Inkwell OFF This Device should have the following minimum encoder range: Base X axis total counts: 4500 Base Y axis total counts: 3800 Base Z axis total counts: 3500 Gimbal X axis total counts: 3550 Gimbal Y axis total counts: 1500 Gimbal Z axis total counts: 3000 Errors : Clear Driver version: 2014.20 Hardware S/N :16039002751 Hardware Rev: 1 September-22-2016 03:00:49:PM