Sensors and Actuators

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1 Summary

Listed in this report is a set of sensors, actuators, and thrusters that could potentially be used on Cubesats from 1U to 3U. There is a wide range of sensors and actuators available for use depending on size, weight, and performance constraints. While thrusters currently on the market are generally of a lower technology readiness level than the available sensors on the market, there are still a range of options among available thrusters to choose based on size, weight, and performance constraints as well.

Additionally, there are several integrated attitude determination and attitude control products available on the market. These systems usually are quite compact and contain star trackers, sun sensors, and reaction wheels among other sensors and actuators. Finally, the end of this report presents a short list of general suppliers that can be considered in the future for sensor and actuator parts as well as parts for other systems on the cubesat.

2 Inertial Measurement Unit(IMU)

Most Inertial Measurement Unit(IMU) or Inertial Navigation System(INS) include sensors for both position estimation and attitude estimation.

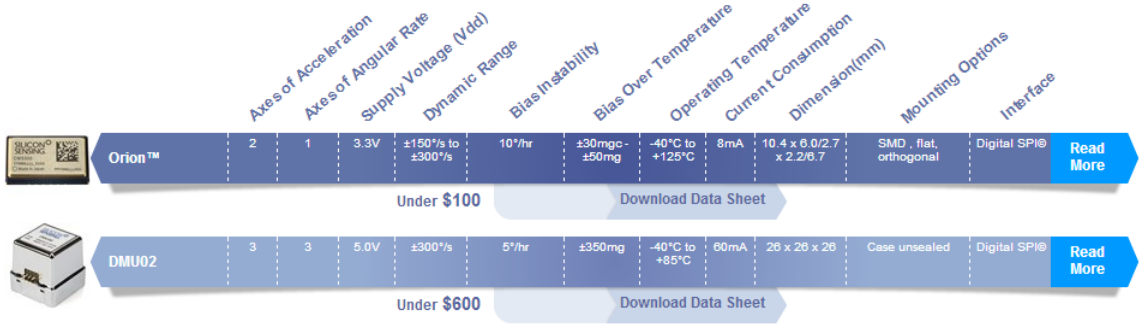

Figure 1: IMU's from Silicon Sensing [?]

MEMS Inertial Sensors

Accelerometers

	Part Number	Range (*g*)	Output Type	Sensing Axes	BW Typ (kHz)	Sensitivity	Noise (mg/√Hz)	Voltage Supply (V)	Supply Current (mA)	Temperature Range (°C)	Package	Additional Features
MEMS Accelerometers	ADXL103	±1.7, ±18	Analog	1	2.5	100 mV/*g* to 1000 mV/*g*	0.11	3.0 to 6.0	0.7	–40 to +125	5 mm × 5 mm × 2 mm LCC	Low noise, low tempco
	ADXL78	±35, ±50, ±70	Analog	1	0.4	27 mV/*g* to 55 mV/*g*	1.1	4.75 to 5.25	2.2	–40 to +105	5 mm × 5 mm × 2 mm LCC	
	ADXL001	±70, ±250, ±500	Analog	1	22	2.2 mV/*g* to 16 mV/*g*	3.3	3.135 to 6	2.5	–40 to +125	5 mm × 5 mm × 2 mm LCC	Ultrawide bandwidth
	ADXL203	±1.7, ±5, ±18	Analog	2	2.5	100 mV/*g* to 1000 mV/*g*	0.11	3.0 to 6.0	0.7	–40 to +125	5 mm × 5 mm × 2 mm LCC	Low noise, low tempco
	ADXL206	±5	Analog	2	2.5	312 mV/*g*	0.11	4.75 to 5.25	0.7	–40 to +175	13 mm × 8 mm × 2 mm SBDIP	Ultrahigh temperature
	ADXL278	±35, ±50, ±70	Analog	2	0.4	27 mV/*g* to 55 mV/*g*	1.1	4.75 to 5.25	2.2	–40 to +105	5 mm × 5 mm × 2 mm LCC	
	ADXL335	±3	Analog	3	1.6	300 mV/*g*	0.15	1.8 to 3.6	0.35	–40 to +85	4 mm × 4 mm × 1.45 mm LFCSP	
	ADXL326	±16	Analog	3	1.6	57 mV/*g*	0.3	1.8 to 3.6	0.35	–40 to +85	4 mm × 4 mm × 1.45 mm LFCSP	
	ADXL337	±3	Analog	3	1.6	300 mV/*g*	0.175	1.8 to 3.6	0.3	–40 to +85	3 mm × 3 mm × 1.45 mm LFCSP	
	ADXL325	±5	Analog	3	1.6	174 mV/*g*	0.25	1.8 to 3.6	0.35	–40 to +85	4 mm × 4 mm × 1.45 mm LFCSP	
	ADXL327	±2	Analog	3	1.6	440 mV/*g*	0.25	1.8 to 3.6	0.35	–40 to +85	4 mm × 4 mm × 1.45 mm LFCSP	
	ADXL377 ***New***	±200	Analog	3	1.6	6.5 mV/*g*	2.4	1.8 to 3.6	0.3	–40 to +85	3 mm × 3 mm × 1.45 mm LFCSP	3-axis, high-*g*
	ADXL350 ***New***	±1, ±2, ±4, ±8	Digital	3	1.6	2 mg/LSB	0.25	2.0 to 3.6	0.45 to 0.166	–40 to +85	3 mm × 4 mm × 1.2 mm LGA	Min/max tempco, low power, FIFO
	ADXL312	±1.5, ±3, ±6, ±12	Digital	3	1.6	2.9 mg/LSB	0.34	2.0 to 3.6	0.17	–40 to +105	5 mm × 5 mm × 1.45 mm LFCSP	
	ADXL345	±2, ±4, ±8, ±16	Digital	3	1.6	3.9 mg/LSB	0.52	2.0 to 3.6	0.03 to 0.14	–40 to +85	3 mm × 5 mm × 1 mm LGA	Low power, FIFO
	ADXL362 ***New***	±2, ±4, ±8	Digital	3	0.2	1 mg/LSB	0.18	1.6 to 3.5	0.002	–40 to +85	3 mm × 3.25 mm × 1.06 mm LGA	Ultralow power, deep FIFO, built in multiple sample activity/inactivity detection, external sync
	ADXL346	±2, ±4, ±8, ±16	Digital	3	1.6	3.9 mg/LSB	0.34	1.7 to 2.75	0.03 to 0.14	–40 to +85	3 mm × 3 mm × 1 mm LGA	Low power, FIFO
	ADXL213	±1.2	PWM	2	2.5	30%/*g*	0.16	3.0 to 6.0	0.7	–40 to +85	5 mm × 5 mm × 2 mm LCC	Low noise, low offset tempco, PWM output
	ADXL212	±2	PWM	2	0.5	12.5 %/*g*	0.5	3.0 to 5.25	0.7	–40 to +85	5 mm × 5 mm × 2 mm LCC	Low noise, low offset tempco, PWM output
iSensor® MEMS Accelerometer Subsystems	*Digital Accelerometers*											
	ADIS16003	1.7	SPI	2	5.5	—	0.11	5	1.5	–40 to +125	7 mm × 7 mm LGA	Internal temperature sensor
	ADIS16006	5	SPI	2	2.2	—	0.2	5	1.5	–40 to +125	7 mm × 7 mm LGA	Internal temperature sensor
	Inclinometers											
	ADIS16203	±1.7; ±180°	Digital	1	2.25	0.025°/LSB	—	3.3	11 (normal); 0.5 (sleep)	–40 to +125	9 mm × 9 mm LGA	Vertical mount, tilt and acceleration outputs, programmable alarms, digital filtering
	ADIS16209	±1.7; ±180°	Digital	2	0.05	0.025°/LSB	0.19	3.3	11 (normal); 0.14 (sleep)	–40 to +125	9 mm × 9 mm LGA	Dual-mode, high accuracy (0.1°) tilt and acceleration outputs, programmable alarms, digital filtering
	ADIS16201	±1.7; ±90°	Digital	2	2.25	0.1°/LSB	—	3.3	11 (normal); 0.5 (sleep)	–40 to +125	9 mm × 9 mm LGA	Tilt and acceleration outputs, programmable alarms, digital filtering
	ADIS16210	±1.7; ±180°	Digital	3	0.05	—	—	3.3	18 (normal); 0.23 (sleep)	–40 to +125	15 mm × 24 mm × 15 mm module	Tri-axis, single command frame alignment, programmable alarms, serial number and device ID
	Impact Sensors											
	ADIS16204	±70	Digital	2	0.4	8.407 mg/LSB	1.8	3.3	12 (normal); 0.15 (sleep)	–40 to +105	9 mm × 9 mm LGA	Programmable event recorder, peak sample/hold
	ADIS16240	±19	Digital	3	1.6	51.4 mg/LSB	0.48	3	1 (normal); 0.1 (sleep)	–40 to +85	12 mm × 12 mm BGA	Programmable event recorder, peak sample/hold
	Vibration Sensors											
	ADIS16228 ***New***	±18	Digital	3	5	0.3052 mg/LSB	0.248	3.3	40 (normal); 0.23 (sleep)	–40 to +125	15 mm × 24 mm × 15 mm module	Embedded FFT analysis, low noise, multiple capture modes, programmable windowing/filtering, serial number and device ID
	ADIS16223	±70	Digital	3	22	4.768 mg/LSB	3.3	3.3	43 (normal); 0.23 (sleep)	–40 to +125	15 mm × 15 mm × 15 mm module	
	ADIS16227	±70	Digital	3	22	1.192 mg/LSB	3.3	3.3	43 (normal); 0.23 (sleep)	–40 to +125	15 mm × 15 mm × 15 mm module	Embedded FFT analysis

Gyroscopes (continues on next page)

	Part Number	Range (°/sec)	Output Type	BW Typ (Hz)	In-Run Bias Stability (°/Hr)	Angle Random Walk (°/√Hr)	Linear Acceleration Effect(°/sec/*g*)	Sensitivity	Bias Tempco (°/sec/°C)	Sensitivity Tempco (ppm/°C)	Non-Linearity (% FS)	Voltage Supply (V)	Supply Current (mA)	Start-Up Time (ms)	Temperature Range (°C)	Package	Additional Features
MEMS Gyroscopes (All Single Axis)	ADXRS644	300	Analog	1000	9	0.6	0.015	9 mV/°/sec	—	—	0.1	6	3.5	50	–40 to +105	7 mm × 7 mm × 3 mm BGA	Vibration immune, min/max specs across temperature range, ultralow noise
	ADXRS646	300	Analog	1000	12	0.6	0.015	9 mV/°/sec	—	—	0.1	6	3.5	50	–40 to +105	7 mm × 7 mm × 3 mm BGA	Ultrahigh stability, vibration immune, min/max specs across temperature range, ultralow noise
	ADXRS642	250	Analog	2000	20	1.2	0.03	7 mV/°/sec	0.02	308	0.01	4.75 to 5.25	3.5	50	–40 to +105	7 mm × 7 mm × 3 mm BGA	High vibration immunity, industrial grade typ specs
	ADXRS624	50	Analog	1000	60	2	0.1	25 mV/°/sec	0.07	462	0.1	4.75 to 5.25	3.5	50	–40 to +105	7 mm × 7 mm × 3 mm BGA	Min/max specs across temperature range
	ADXRS623	150	Analog	3000	60	2	0.1	12.5 mV/°/sec	0.14	462	0.1	4.75 to 5.25	3.5	50	–40 to +105	7 mm × 7 mm × 3 mm BGA	Min/max specs across temperature range
	ADXRS622	250	Analog	2500	60	2	0.1	7 mV/°/sec	0.10	308	0.1	4.75 to 5.25	3.5	50	–40 to +105	7 mm × 7 mm × 3 mm BGA	Min/max specs across temperature range
	ADXRS652	250	Analog	2500	60	2	0.1	7 mV/°/sec	0.10	308	0.1	4.75 to 5.25	3.5	50	–40 to +105	7 mm × 7 mm × 3 mm BGA	Industrial grade typ specs
	ADXRS620	300	Analog	2500	60	2	0.1	6 mV/°/sec	0.11	308	0.1	4.75 to 5.25	3.5	50	–40 to +105	7 mm × 7 mm × 3 mm BGA	Min/max specs across temperature range
	ADXRS649	20,000+	Analog	2000	200	15	0.03	0.01 mV/°/sec	—	—	0.1	5	3.5	3	–40 to +105	7 mm × 7 mm × 3 mm BGA	High rotation rate up to 50,000°/sec, industrial grade typ specs
	ADXRS453	300	Digital	77.5	16	0.9	0.01	0.0125°/LSB	0.0034	207	0.05	3.15 to 5.25	6	100	–40 to +105	9 mm × 9 mm × 4 mm LCC VMP, 10 mm × 10 mm × 3.5 mm SOIC	Calibrated over temperature, vibration immune, in-plane and out-of-plane sensing
	ADXRS450	300	Digital	80	25	0.9	0.03	0.0125°/LSB	0.02	462	0.05	3.15 to 5.25	6	100	–40 to +105	9 mm × 9 mm × 4 mm LCC VMP, 10 mm × 10 mm × 3.5 mm SOIC	High vibration immunity, industrial grade typ specs, in-plane and out-of-plane sensing

For more information on ADI MEMS inertial sensors, visit our website at *www.analog.com/MEMS*.

ANALOG DEVICES

Gyroscopes (continued)

	Part Number	Range (°/sec)	Output Type	BW Typ (Hz)	In-Run Bias Stability (°/Hr)	Angle Random Walk (°/√Hr)	Linear Acceleration Effect (°/sec/g)	Sensitivity	Bias Tempco (°/sec/°C)	Sensitivity Tempco (ppm/°C)	Non-Linearity (% FS)	Voltage Supply (V)	Supply Current (mA)	Start-Up Time (ms)	Temperature Range (°C)	Package	Additional Features
*i*Sensor MEMS Gyroscope Subsystems (All Single Axis)	ADIS16060	80	Digital	1000	—	—	0.1	0.0122°/LSB	0.11	—	0.1	5	4.3	10	–40 to +105	8 mm × 8 mm × 5 mm LGA	
	ADIS16080	80	Digital	40	—	—	0.2	0.0976°/LSB	—	—	0.15	5	7	35	–40 to +85	8 mm × 8 mm × 5 mm LGA	
	ADIS16136† ***New***	480	Digital	380	3.5	0.167	0.017	0.00007°/LSB	0.00125	35	0.05	5	120	180	–40 to +85	36 mm × 44 mm × 14 mm module	External clock option
	ADIS16133†	1200	Digital	335	6	0.75	0.03	0.05°/LSB	—	16	0.008	5	88	181	–40 to +85	36 mm × 44 mm × 14 mm module	Wide dynamic range
	ADIS16135†	350	Digital	335	6	0.75	0.03	0.0125°/LSB	—	16	0.008	5	88	181	–40 to +105	36 mm × 44 mm × 14 mm module	
	ADIS16265†	320	Digital	330	25	2	0.2	0.0183°/LSB	0.005	25	0.1	5	41	165	–40 to +105	11 mm × 11 mm × 5 mm LGA	Range scaling

†Includes part specific factory calibration, programmable filtering, and digital self-test.
For multiaxis solutions, see the MEMS Inertial Measurement Unit (IMU) selection table.

*i*Sensor MEMS Inertial Measurement Units (IMUs)

		Range				Gyroscope								Accelerometer					
Part Number	Output Type	Gyro (°/sec)	Acceler-ation (*g*)	Magnetometer (gauss)	Barometer (mbar)	In-Run Bias Stability (°/hr)	Angle Random Walk (°/√Hr)	Bias Tempco (°/sec/°C)	Linear Acceleration Effect (°/sec/*g*)	Sensitivity (°/sec/LSB)	Sensitivity Tempco (ppm/°C)	Non-Linearity (% FS)	Alignment (°)	BW Typ (Hz)	In-Run Bias Stability (*mg*)	Start-Up Time (ms)	Voltage Supply (V)	Temperature Range (°C)	Package	Additional Features
4 Degrees of Freedom																				
ADIS16305	Digital	300	3	N/A	N/A	22	1.85	0.006	0.02	0.0125	20	0.1	0.1	330	0.037	180	5	–40 to +85	23 mm × 31 mm × 8 mm module	Low profile
6 Degrees of Freedom																				
ADIS16445 ***New***	Digital	250	5	N/A	N/A	12	0.6	0.005	0.015	0.0025	40	0.1	0.05	330	0.075	—	3.3	–40 to +85	24 mm × 37 mm × 10 mm module	Programmable operation and control, wide dynamic range, external clock option, single command self-test
ADIS16385	Digital	300	5	N/A	N/A	6 (z); 21 (x, y)	0.75 (z); 1.9 (x, y)	0.001 (z); 0.004 (x, y)	0.03 (z); 0.05 (x, y)	0.0031	40	0.1	0.05	330	0.05	210	5	–40 to +105	36 mm × 47 mm × 39 mm module	High precision on yaw axis
ADIS16375	Digital	300	18	N/A	N/A	12	1	0.005	0.013	0.013	40	0.025	0.05	330	0.13	500	3.3	–40 to +85	44 mm × 47 mm × 14 mm module	Continuous bias estimator, single command self-test, delta angle/velocity, continuous bias estimator, programmable FIR filtering
ADIS16362	Digital	300	1.7	N/A	N/A	25	2	0.01	0.05	0.0125	50	0.1	0.05	330	0.041	180	5	–40 to +105	23 mm × 23 mm × 23 mm module	High sensitivity accelerometer, external clocking option, burst mode reads
ADIS16364	Digital	300	5	N/A	N/A	25	2	0.01	0.05	0.0125	50	0.1	0.05	330	0.1	180	5	–40 to +105	23 mm × 23 mm × 23 mm module	Narrowed temperature calibration range, external clocking option, burst mode reads
ADIS16365	Digital	300	18	N/A	N/A	25	2	0.01	0.05	0.0125	50	0.1	0.05	330	0.2	180	5	–40 to +105	23 mm × 23 mm × 23 mm module	Wide temperature calibration range, external clocking option, burst mode reads
ADIS16334	Digital	300	5	N/A	N/A	25	2	0.005	0.05	0.0125	40	0.1	0.05	330	0.1	180	5	–40 to +105	22 mm × 33 mm × 11 mm module	Small footprint/height, single command self-test
ADIS16485 ***New***	Digital	450	18	N/A	N/A	6	0.3	0.0025	0.009	3.052×10^{-7}	35	0.01	0.05	330	0.032	500	3.3	–40 to +85	44 mm × 47 mm × 14 mm module	Programmable FIR filtering, 2.46 kHz sample rate, single command self-test, delta angle/velocity, continuous bias estimator, linear-*g* compensation
ADIS16367	Digital	1200	18	N/A	N/A	47	2	0.01	0.075	0.05	40	0.1	0.05	330	0.2	180	5	–40 to +105	23 mm × 23 mm × 23 mm module	Wide dynamic range, external clocking option, burst mode reads
9 Degrees of Freedom																				
ADIS16405	Digital	300	18	2.5	N/A	25	2	0.01	0.05	0.0125	40	0.1	0.05	330	0.2	220	5	–40 to +105	23 mm × 23 mm × 23 mm module	Magnetometer
10 Degrees of Freedom																				
ADIS16407	Digital	300	18	2.5	10 to 1200	25	1.9	0.01	0.05	0.0125	40	0.1	0.05	330	0.2	220	5	–40 to +105	23 mm × 23 mm × 23 mm module	Barometer
ADIS16488 ***New***	Digital	450	18	2.5	10 to 1200	6	0.3	0.0025	0.009	3.052×10^{-7}	35	0.01	0.05	330	0.1	500	3.3	–40 to +85	47 mm × 44 mm × 14 mm module	Programmable FIR filtering, 2.46 kHz sample rate, programmable soft-iron correction matrix, programmable hard-iron correction, single command self-test, delta angle/velocity, continuous bias estimator, linear-*g* compensation
ADIS16480 ***New***	Digital	450	18	2.5	10 to 1200	6	0.3	0.0025	0.009	3.052×10^{-7}	35	0.01	0.05	330	0.1	500	3.3	–40 to +85	47 mm × 44 mm × 14 mm module	Extended Kalman filter, ±0.1° static angle accuracy, ±0.3° dynamic angle accuracy, programmable FIR filtering, 2.46 kHz sample rate, programmable soft-iron correction matrix, programmable hard-iron correction, single command self-test, delta angle/velocity, continuous bias estimator, linear-*g* compensation
ADIS16448 ***New***	Digital	1000	18	1.9	10 to 1200	14	0.6	0.005	0.015	0.01	40	0.1	0.05	330	0.12	205	3.3	–40 to +85	24 mm × 37 mm × 10 mm module	Programmable operation and control, wide dynamic range, external clock option, single command self-test

All ADI MEMS IMUs include part-specific factory calibration and programmable filtering, unless noted.

ANALOG DEVICES

Information from [?].

3 Position Estimation Sensors

Name	Mass	Size	Accuracy	Type	TRL	Comment
Aerocube-4 GPS [?]	NA	NA	±20	GPS receiver	NA	Orbit determination once per day or as power system permits
Nano Star Tracker on Chip (STC) [?]	65 g	73.5x 57.0x 57.8 mm	10" 50"	Star Tracker	NA	19.5 deg field of view, update rate 10 Hz, mean power (without Peltier cooler 250mW), peak power 1 W

4 Attitude Estimation Sensors

Name	Mass	Size	Accuracy	Type	TRL	Comment
Blue Canyon Technologies Nano Star Camera 1 [?]	<0.5 Kg	< 5x5x10cm	7-24 arc-sec	Star Tracker	NA	<0.5W power consumption
SD085-23-21-021 [?]	NA	3.76x 1.5x 3.3 mm	NA	Sun Sensor	9	
Melexis MLX90615 [?]	NA	4.7x 4.7x 2.7 mm	0.5 deg over 0 to 50 deg C	Earth Nadir Sensor	9	
Honeywell HMC6042 [?]	NA	5 x 3.6 x 1.0mm	0.15 milliGauss	2-Axis Magnet	9	
Honeywell HMC1041Z [?]	NA	1.15x4x1.25 mm	0.15 milliGauss	1-Axis Magnet	9	
Space Micro Coarse Sun Sensor [?]	10 g	1.27 cm diameter x0.90 cm height	5 deg of 1 axis knowledge	Sun Sensor	9	
Space Micro Medium Sun Sensor [?]	36 g	2.43 cm diameter x 3.49cm height	1 deg of 2 axis knowledge	Sun Sensor	9	
Berlin Space Technologies ST-200 [?]	50 g	30 mm x 30 mm x 38.1 mm	30 arc-sec (pitch/yaw), 200 arc-sec (roll)	Star Tracker	7	
Digital Fine Sun Sensor CubeSat-Shop [?]	35 g	34 mm x 32 mm x 21 mm	0.1 deg	Sun Sensor	7	
Magnetometer [?]	15 g sensor, 150 g electronics	Sensor: 10x10x5 mm, Electronics: 90x30x11 mm	Sensitivity: 10 nT	Magnetometer	9	
CubeSat Sun Sensor [?]	< 5 g	33 mm x 11 mm x 6 mm	< 0.5 deg	Sun Sensor	7	

5 Inter-satellite Distance Sensors

Name	Mass	Size	Accuracy	Type	TRL	Comment
Nexus S [?]	129g	123.9x 63x 11	1.53m , 3 deg @30 m	Vision	-	
IBIS4-1300 [?]	Mass	Size	$<$ 100 arc-s	Vision	TRL	Vision based Star Tracker and Topology (for formation flying). Does not talk about satellite detection methods

6 Actuators

Reaction Wheels, Extending Wings, and Integrated Packages

Name	Mass	Size	Accuracy
Aerocube-4 Retractable wings [?]	NA	2 wings, each 9x10cm	N/A
Blue Canyon Technologies Micro Reaction Wheel [?]	150 g	43x43x18 mm	NA
BCT Integrated Attitude Control for Cubesats [?]	$<$ 0.7 Kg	$<$ 10x10x5 cm (0.5U)	Spacecraft Pointing Accuracy: 0.003 deg (1-sig) for 2 axes, 0.007 deg (1-sig) for 3rd axis
Sinclair Interplanetary RW-0.007-4 [?]	90 g	50 mm x 40 mm x 27 mm	NA
Sinclair Interplanetary RW-0.01-4 [?]	120 g	50 mm x 50 mm x 30 mm	NA
Sinclair Interplanetary RW-0.03-4 [?]	185 g	50 mm x 50 mm x 40 mm	NA
Berlin Space Technologies iACDS-100 [?]	250 g	95 mm x90mm x 32mm	«1 deg pointing , (30 arc-sec in Pitch/Yaw, and 200 arcsec in Roll for att. Determinatio

Magnetorquers

Name	Mass	Size	Accuracy	Type	TRL	Comment
Clyde Z-Axis Magnetorquer	50 g	100 x 100 x 4.3 mm	NA	Torquer	NA	magnetic moment of 0.19Am2
SSBV magnetorquer rod	<30 g	L7 x D9	NA	Torquer	NA	Magnetic moment: >0.2Am2
CubeSat Magnetorquer Rod [?]	30 g	Length 7 cm, Diameter < 9 mm	NA	Torquer	NA	Magnetic moment: 0.2 Am^2
CubeTorquer [?]	22.25 g	Length 60 mm, Diameter 10 mm	NA	Torquer	NA	Magnetic moment: 0.2 Am^2

7 Thrusters

COTS

Name	Mass	Size	Isp	ΔV	Thrust	System Power	Comment
Spence Pressure-fed electrospray [?]	<1.15 Kg	0.56 U	800	151 m/s	0.7 mN	< 9W	
Micro-pulsed plasma thruster [?]	<0.55 Kg	0.5 U	700	63 m/s		2W @ 2hz fire	Impulse: 0.5 mN-s primary, 0.13 mN-s ACS
Unpressurized (wicking feed) electrospray [?]	<0.4 Kg	0.4 U	750	76 m/s	0.1 mN	1W	
Microresistojet (MRJ) [?]	< 1.25 Kg	1.0 U	150	60m/s	2-10mN	3-15W	
RF Ion [?]	<1.25 Kg	1.25 U	1800	244m/s	0.067 mN	10W	
Green monopropellant [?]	< 1 Kg	0.5 U	240	130m/s	0.5N	15W	
Nanosatellite Micropropulsion System [?]	300 g	NA	50s-100s	NA	nominal: 100 uN to 10 mN	< 2 W	Pointing Res: 0.1 arcsec

Not COTS

Name	Mass	Size	Isp	δV	Thrust	System Power	Comment
Ion electrospray [?]		1/3 U	2500	200m/s	0.1 mN		
μVAT	150g	40x 40x 40mm	1000		5.4μN		turn 90 degrees in 10 minutes. .
YUsend-1 SPT [?]	94 g				0.15 mN		

8 Potential Suppliers

Blue Canyon Technologies
Melexis
Analog Devices
Silicon Sensing
Sinclair Interplanetary
Berlin Space Technologies

References