	Contractor >> Spacecraft Name >>		Ball Aerospace	Ball Aerospace	Lockheed Martin	Lockheed Martin	MAXAR	Northrop Grumman	Northrop Grumman	QinetiQ Space	Space Flight Laboratory (SFL)	Space Flight Laboratory (SFL)	Southwest Research Institute	Southwest Research Institute	Thales Alenia Italy	Thales Alenia France	Tyvak	Tyvak
	Parameter	Units	Small	Large	LM4XX	LM2100	1300	ESPASat-Ex	LEOStar-3	P200	DEFIANT	DAUNTLESS	SwSP-35	SwSP-100	SwSP-100 (Baseline Config)	ELiTeBUS 1000	Trestles-6U	Trestles-12U
Compatibility	Orbit Average Payload Power (EOL)	W (EOL)	90	600	409	1,400 to 16,000 W	4000 - 16,000	100	580	70	20 to 50	30 to 173	22	50	2200	955	35	60
	Maximum Payload Mass	kg	170	600	75	300 to 1,275+	500 , up to 1200	50	850	100	7 to 30	30 to 300	11	30	<1200	350	7.31	15.5
	Bus Dry mass (w/o Payload)	kg	170	1270	186	900 to 2,645	939, up to 3000	88	1718	163	11 to 41	60 to 180	24	56.93	945	342	7.69	9.5
	Science Data Downlink	kbps	2,000	300,000	mission-specific	120,000	up to 2,000,000	4000 S-Band	384000 X-Band	100000	up to 2Mbps (or 50 to 400 Mbps with Option 2)	up to 2Mbps (or 50 to 400 Mbps with Option 2)	4,000	7530	16 / 128 / 512 / 2048	option	2,048	2,048
	Science Data Storage (Capacity)	Mbit	48,000	343,000	mission-specific	32MB	400 MB	16000	4000000	512	up to 2 GB (or 32 to 256 GB with Option 1)	up to 2 GB (or 32 to 256 GB with Option 1)	16,000	16000	1530 Gbits (EOL)	option	49,152	49,152
	Pointing Knowledge	arcsec	25	18	413 (3σ)	<60	32 arc sec	29	5	2	5.5	5.5	116 (3sigma)	1.5 (pitch/roll/ yaw)	< 0.015°, < 5 arcsec or better using additional, Star Tracker	90	25	25
	Pointing Control	arcsec	25	28.8	462 (3σ)	<40	10.8 to 36 arc sec	63 pitch 39 roll/yaw	21	6	10	10	264 (3sigma)	35 (pitch/roll/		432	50	50
	Pointing Stability (Jitter)	arcsec/sec	3	5.8	5 (3σ)	<46	0.001 deg 3 sigma	12	1.2 arc sec 3 sigma below 500 Hz	1.5	< 1	< 1	20	20	0.0025°(peak-peak) in 2 s	43	10	10
	Slew rate	deg / min	5	16	44	36	None	90	19	60	1 to 5	1 to 5	3 (pitch and yaw), 1.5 (roll)	3 (pitch and yaw)	< 1°/sec	n/a	180	120
	Mission Design Life	years	1, 0.9 Ps	5, 0.93 Ps	1-3	15	15, 0.85 Ps	2	5	5	1 to 3	1 to 3	2	3	7	12.5	2	2+
	Compatible LVs	(names)	Delta II, Pegsus, Falcon 9, Atlas V, ESPA-G	Delta II, Falcon 9, Atlas V, Falcon Heavy	Pegasus XL, Minotaur I, Minotaur IV, Minotaur-C, Antares, Falcon 9, Electron, Launcher One, Alpha, RS-1, Alpha, Epsilon, Vega	Falcon 9 / Ariane / Atlas V / Vulcan	Falcon 9, Atlas V, Delta V, H2A, Ariane 5, New Glenn, Vulcan	All EELV ESPA Compatible Launch Vehicles	Altlas V, Falcon 9	Falcon-9, Soyuz, PSLV, Ariane 5 & 6, Firefly Alpha.	Any	Any	GEVS, ESPA, NG-Pegasus, NG-Minotaur, RL-Electron, VO-L1, FF-Alpha	GSFC-STD-7000A (GEVS), ESPA, RocketLab, and Virgin Orbit LauncherOne	Falcon9, Soyuz, Vega-C	Falcon 9, Soyuz	All Major Rockets (Vega, PSLV, RocketLab, Virgin, Falcon 9, Soyuz, VOX, etc.)	All Major Rockets (Vega, PSLV, RocketLab, Virgin, Falcon 9, Soyuz, VOX, etc.)
	Nominal Orbit	Altitude, Inclination, Type, Other	540 km 0 deg, equatorial	824 km, 98.7 deg, sun sync	LEO 400-1000 km, 0° to Sun Synch, Lunar	35,786, 0.0, GEO	GEO at 35,786 km, 0 deg	600 km, 98 deg, Sun Synch 12 pm LTAN	705 km, 98 deg, Sun Synch	650 km, 98 deg, sun-synchronous	400-1000 km, 0-98 deg inclination (any LEO)	400-1000 km, 0-98 deg inclination (any LEO)	Alt: 510 km Inclination: 35deg	Alt: 600km Inclination: 35deg	Apogee altitude: 450-1500, Perigee altitude: 450-1500 km km, Orbit plane type: Dawn-dusk, Orbit type: Inclined or Sun-synchronous	780 km, 86.4°	500 km, 98 deg, Sun Synch	500 km, 98 deg, Sun Synch
	Types of Orbits Available	as needed	LEO from 0 - 98 deg, up to 1,200 km	LEO from 0 - 98 deg, up tp 1200 km	LEO 400-1000 km 0° to Sun Synch, Lunar	GEO, MEO	HEO(GEO), MEO, LEO	All Low Earth Orbits, Earth-Trailing, Geosynchronous, Cis-Lunar, Libration Points	All Low Earth Orbits, Earth-Trailing , Geosynchronous, Cis-Lunar , Libration Points	Leo form 28.5 to 98 deg, up to 1000km	400-1000 km, 0-98 deg inclination (any LEO)	400-1000 km, 0-98 deg inclination (any LEO)	Alt: 450-750 km Inclination: 28-98deg SSO	Alt: 450-750km Inclination: 0-98deg SSO	Inclined or Sun-synchronous	LEO from 40 to 98 deg, up to 800km	Compatible with a vast range of orbits (LEO, GEO, Interplanetary). Any inclination for Earth orbits is supported	Compatible with a vast range of orbits (LEO, GEO, Interplanetary).
	External Payload Volume	meters	1 m hex x 1 m height	1.7 m x 1.4 m x 1.5 m height	0.6 x 0.66 x 0.3 h 0.38 x 0.7 x 0.4 h	Earth deck: ~3.7 m2	2 m x 2 m x 4 m	.56 m x .56 x 21 h	3.55 m dia x 1.78 m h	650 mm x 770 mm (footprint) x490 - 1872 mm (height)	up to 0.48 x 0.48 x 0.20	up to 1.1 x 1.2 x 0.71	Optional	0.46 x 0.48 x 0.86 (x/y/z)	3.6 m (max value)	Depends on launcher. Payload	N/A	N/A
	Internal Payload Volume	meters	None	None	0.07 m^3	Multiple areas each approx 10 sq meters; height varies	4 sections, each approx. 3.0 x 1.2 x 0.3 m	None	None	180 mm x 290 mm (footprint) x 160 mm (height)	up to 80% of external	up to 80% of external	465 x 190 x 122	Optional	ranges	Same panel, max height = 380mm	3.33E-3 m^3	14.40E-3 m^3
Description	ACS	type	3-axis	3-axis	Zero momentum, 3-axis stabilized	3-axis	3 axis stabilized	3-axis	3-axis	3-axis stabilized	tracking, sun pointing, limb pointing, all possible)	tracking, sun pointing, limb pointing, all possible)	3-axis	3-axis	3 axis stabilized	3-axis	3-axis	3-axis
	Star Trackers	# of STs	2	2	1	2	2	1	2	3	1 or 2	1 or 2	2	2	2	3	2	2
	GPS	# recievers	1	2	mission-specific	2	2	1	1 (internally redundant)	2	1 or 2	1 or 2	1	1	2	Option	1	1
	Batteries	cell type/capacity (Ah)	Li-ion / 24 Ah	Li-ion / 80 Ah (x2)	Li-ion, 30 Ah	Li-Ion, up to 280 Ahr	Li-Ion, 144 Ahr	Li ion/24 Ah	Two, Li ion/268 Ah	P20/18	Li-ion / 13-19 Ah	Li-ion / 20-91 Ah	Li-ion/8.4 Ahr	Li-ion/12.5Ahr	Li-ion /< 340	Li-ion / 252 cells 4.5 Ah@4.1V	Li-ion, 12.5 Ah	Li-ion, 12.5 Ah
	Solar Arrays	cell type/Area (m2)	Triple Junction GaAs, 3.2 m^2	Triple Junction GaAs, 11 m^2	Triple Junction GaAs, 3.87 m^2	Triple junction GaAs 24 - 60	Triple Junction GaAs 22.4 m^2	Triple Junction GaAs, 2.13 m^2	Triple Junction GaAs, 15.65 m^2	Four Deployable panels with 640 GaAs cells 30%	Triple Junction / 0.23-1.73 (customizable), wings only, not including body mounted cells for safe hold power	Triple-Junction / 1-3.2 (customizable), wings only, not including body mounted cells for safe hold power	Triple Junction GaAs with ARC/3.5 m^2	Triple Junction GaAs with ARC/0.7m2	GaAs/Ge Triple Junction Cells/ 18,3	Triple junction GaAs, 9m^2	Two-terminal triple junction GaInP2/GaAs/Ge, 0.319 m^2	Two-terminal triple junction GaInP2/GaAs/Ge, 0.319 m^2
	Main Bus Voltage Range	volts	22 - 34	22 - 34	23-33 (28V nominal)	70V +/- 1.0V	31-100	28-33	25-34	24 - 33.6	10 to 13	24 to 32	26-32	26-32	Regulated 28 V to the Bus, Unregulated 47 – 65 V to feed the Payload	28-38	9.0–12.6	9.0–12.6
	C&DH Bus Architecture	description	1553	1553	Centralized processor control, Discrete I/O, 1553B and RS-422 connections	Bus, 1553	1553, RS-485, Compact PCI serial data bus	Single Master Avionics Unit for all spacecraft C&DH and power control functions, .	Fully redundant. IEM for spacecraft interfaces and instrument SOH.. Separate Payload Interface	1553	BASELINE: Dual AMM7 computers with synchronous and asynchronous serial, I2C, SPI, CAN, GPIO, discrete I/O,	BASELINE: Dual AMM7 computers with synchronous and asynchronous serial, I2C, SPI, CAN, GPIO, discrete I/O,	RS-422/SpW	RS-422/SpW	1553	1553	RS-422/485, Ethernet, USB 2.0	RS-422/485, Ethernet, USB 2.0
	Downlink Formats	CCSDS, STDN, etc	CCSDS, STDN	CCSDS, STDN	CCSDS or JPL type, STDN, DSN, SGLS, TDRSS	LM2100 BPSK; Optional: CCSDS, QPSK, SGLS, USB, TDRSS, User	Al Honeycomb/Graphite Epoxy composite	CCSDS, NEN (STDN), SN (TDRSS) and DSN	CCSDS, NEN (STDN), SN (TDRSS) and DSN	CCSDS compatible	NSP, commercial networks (KSAT-Lite, AWS, Leaf Space, others -	NSP, commercial networks (KSAT-Lite, AWS, Leaf Space, others -	CCSDS, STDN, SGLS	CCSDS, STDN, SGLS	CCSDS standard	CCSDS	AX.25, CCSDS	AX.25, CCSDS
	Comm Up\Downlink Band	S, X, UHF, Ka, Ku, etc.	S-band	S-band Uplink / S-band & X-band Downlinks	Cmd/Tlm: S-band Data: Mission-specific	Ku, Ka, C or S-band	S, X, C, Ku, Ka	S-band	S-band	S-band	S (X, Ku, Ka possible with converters)	S (X, Ku, Ka possible with converters)	S-band	S-band	X-band	Ka	UHF-band, S-band	UHF-band, S-band
	Structure	description	Honeycomb & Machined Al Hexagon	Al Honeycomb Hexagon	6 panel rect. box, CFRP facesheets w/ Al honeycomb core	Composite core cylinder; cruciform + earth and mid-deck panels for component mounting; Al panels with honeycomb core	Al Honeycomb/Graphite Epoxy composite	Al Honeycomb cuboid	Al Honeycomb Octagonal cuboid	Al honecomb panels	Aluminum	Aluminum, honeycomb	Al	Al, Al Honeycomb	Al alloys Honeycomb	Al honeycomb (lateral panels) and Al (bottom frame and chassis)	Al 7075 6U	Al 7075 12U
	Propulsion	type, fuel	None	Mono-prop (N2H4)	Blowdown, Mono-prop (N2H4)	Chemical (Hydrazine), Electric (Xenon)	Bi Prop (MMH/N2O4) Electric available	Mono-prop (N2H4)	Mono-prop (N2H4)	Monoprop (N2H4)	FEEP or Resistojet or Monopropulsion	FEEP, Resistojet, Monopropellant, Bipropellant, or Hall Thruster	Optional	Optional	Monopropellant system, Hydrazine	Mono-prop (N2H4)	N/A	N/A
	Propellant Capacity	kg	None	360	(LM400 baseline propellant load 49 kg)	Up to 2100kg of Hydrazine and 1500kg of Oxidizer	2272,2820, 3140 & 3800	21	458	12.5	5	5 to 36	Optional	Optional	154	164	N/A	N/A
	Max delta V	m/s	None	330	350	1500 +	>200	175	322	84	up to 300 m/s	up to 1000 m/s	Optional	Optional	155 m/s (ref. CSG)	340	N/A	N/A
Programmatic	heritage mission(s)	name(s)	GPIM, STPSat-2, STPSat-3	JPSS, NPP	GRAIL, XSS-11	Arabsat-6A, HellasSat-4, JCSAT-17, SBIRS	MTSAT-1/1R	ICON, TESS, ANGELS, Mycroft	Landsat 8, Fermi, GeoEye-1	PROBA1, PROBA2, PROBA V	HawkEye 360 Constellation, NorSat-4, NorSat-TD, Gray Jay, LEO 3, Aspera	LEO 2, StarBurst, NEMO-HD	CYGNSS	SensorSat	RADARSAT-2, S1, CSK, CSG	Iridium Next	Tyvak-0129	Tyvak-0129
	nominal schedule	months (ATP to ready for payload I&T)	22	23	18	36	24	33	37	20	12 to 24 (repetitive builds faster than this range)	18 to 30 (repetitive builds faster than this range)	16	16	ATP+26 (It depends on the mission)	20	14	14
	nominal schedule	months (ATP to launch)	29	35	31	54	28 - 36	44	50	32	18 to 30 (repetitive builds faster than this range)	24 to 36 (repetitive builds faster than this range)	26	26 (with NASA GSFC CDR	ATP+36	30	18	18
Contractor-Provided Options	Option #1	description	Enhanced Data Storage	Enhanced Data Storage		Enhanced Data Storage	Enhanced Data Storage	Mission Operations	Mission Operations	Option for up to 768 Gbit of storage	Above science downlink and storage are based on this payload computer.	Above science downlink and storage are based on this payload computer.	External Payload	Internal Payload	Protoflight, based on Sentinel-1 program			Fully Redundant Avionics
	Option #2	description	Enhanced Attitude Control: Co-locate primary attitude sensors with payload	Enhanced Attitude Control: Co-locate primary attitude sensors with payload		Power Upgrade Package	Mission Data Link	Higher Payload Power	Higher Payload Power	Option for up to 200Mbps Downlink	X-band transmitter can be added. Different options available: 50Mbps to 400Mbps (above science downlink based on this	X-band transmitter can be added. Different options available: 50Mbps to 400Mbps (above science downlink based on this	S/C Structure Size Expansion	S/C Structure Size Expansion	Protoflight, based on Cosmo Second Generation program			High-data rate (340 Mbps) X-band radio and antennas
	Option #3	description	High Agility: Uses CMGs as primary actuators	High Agility: Uses CMGs as primary actuators		High accuracy pointing and stability	Hosted Payload Capability	X- or Ka-band communications	Ka-band communications	Change of baseline propellant to HPGP-LMP-103S as option.	Custom station retront or commercial ground network (Ksat-Lite, AWS, Leaf Space, others)	Custom station retront or commercial ground network (Ksat-Lite, AWS, Leaf Space, others)	Solar Array Capability Increase	Solar Array Capability Increase	Protoflight, based on Sentinel-1 program	Electrical propulsion		Electric Propulsion (0.22 kg, up to 500 m/s)
	Option #4	description	Higher Power: Resize and/or articulate solar array, change battery size	Higher Power: Resize solar array, Change battery size		Hybrid propulsion subsystem		Instrument in the loop pointing	Instrument in the loop pointing		AES-256 Commercial Encryption	AES-256 Commercial Encryption	Battery Capacity Increase	Battery Capacity Increase	Battery Capacity Increase	Power upgrade	Custom Payload Interface Board	Custom Payload Interface Board
	Option #5	description	Downlink: Add higher-rate X-band link	Downlink: Add higher rate and pointed Ka band link to playback recorded data				Larger payload volume and higher payload mass (launch vehicle dependent)	Larger payload volume and higher payload mass (launch vehicle dependent)				Payload Data Processing	Payload Data Processing	Payload Data Processing	Science data downlink	Mission Operations	Mission Operations
	Option #6	description	Propulsion: Add propulsion subsystem	Propulsion: Higher capacity propulsion for high delta-V									Data Storage Increase	Data Storage Increase	Data Storage Increase	Ground Services	Ground Services	Ground Services
	Option #7	description											Downlink Capacity Increase; X-band or Ka-band	Downlink Capacity Increase; X-band or Ka-band	Downlink Capacity Increase; X-band or Ka-band			
	Option #8	description											Encrypted Communications	High Performance Pointing	High Performance Pointing			
	Option #9	description											High Performance Pointing	Pointing Agility Increase	Pointing Agility Increase			
	Option #10	description											Pointing Agility Increase	Propulsion Package	Propulsion Package			
	Option #11	description											Propulsion Package	Access to space; Rideshare or Primary payload	Access to space; Rideshare or Primary payload			
	Option #12	description											Access to space; Rideshare or Primary payload	Mission Operations	Mission Operations			
	Option #13	description											Mission Operations					