

MakerSat-0: 1U FastBus

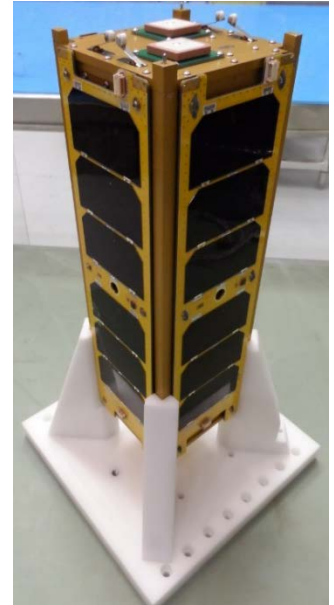
## FastBus CubeSat Platform

### All-In-One CubeSat: 1U to 6U

Low Cost, 100% On-Orbit Success, Real-Time Global Data, Fast Delivery, TRL 9, Customizable, Compliant with new FCC requirements

Includes: Unibody Structure, Advanced EPS, Simplex Comm, Solar Arrays, Sensors, ADCS, Online Ground Station, & Processor

*Spacecraft Bus ready for experiments and flight!*



GEARRS2: Shows 3U FastBus structure with GaAs solar cells, inhibit switches, Simplex & Duplex NSL Globalstar radios

#### Flight Ready

- Technical Readiness Level (TRL) 9
- 4 LEO Flights: TSAT, GEARRS 1 & 2, SHARC
- ~ 90-day final delivery from kickoff
- Orbit tested from 110 to 700 km
- PPOD and NANORACKS approved
- Critical piece for Mission Success
- Fully supported product

#### Unibody, Aluminum Structure

- Efficient assembly & integration flow with custom modifications
- Strong, stiff, precise, & aligned structure
- Fits Pumpkin/PC104 PCB boards
- Optical bench plate for mounting subsystems and assembly ease
- Many access plates for work flow
- Fully enclosed EMI satellite with rad-dose shielding
- Unibody excellent thermal short
- Includes 1U to 6U and 2x3U
- Very flexible, functional, agile, & suited for custom modification
- Includes gold anodized endplates & access panels, inhibit switches, holder, EyeStar antenna mounts

#### Advanced EPS

- All-in-one Power Distribution
- Certified Li-Poly batteries with protection and cell diagnostics
- MPPT for various Solar Arrays
- 3-Fault Inhibits & solar inhibit
- Charge meter with diagnostics
- Distribution 4 to 32 connectors
- Current monitors and protection
- Four 1-Wire Temp Bus
- Dual processors w/diagnostics

#### EPS Specifications

##### EPS Mechanical and Batteries

5U: Thermal radiator shield or open Li-Poly Batteries, Safety Report available  
UL, Nanoracks, ISS, Atlas, SpaceX

##### EPS Data I/O

Data input: 38,400 bits/s full duplex  
Effective data rates: 32 bits/s  
Handshaking and validated data

##### Dual Microcontrollers

One-wire Temp and Bus Voltage  
Custom Software

##### 9-axis IMU for acc/mag/gyro data

#### Comm Features

##### EyeStar-S3 Simplex

End to end communication system  
Globalstar connected Simplex modem  
24/7 real-time, global data coverage  
9 Bytes/s, 600 KBytes/day  
Sends health, safety, and sensor beacon  
Simple, serial interface protocol for Tx

##### Online Ground Station

No hardware needed  
Receive data on NSL Online Console

##### Built-in receiver

Now meets new FCC requirement of immediate shut-down capability

#### Notes and References

- 1) 100% on-orbit success
- 2) ICD and STEP files available
- 3) AIAA Small Sat Paper: SSC14-WK-6, 2014 First results TSAT/Globalstar, Voss et al.
- 4) AIAA Small Sat Paper: (SSC16-WK-11), Globalstar link results, Voss et al.
- 5) Custom work available



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#### Environmental/Flight Testing

##### Temperature:

Passive heat sink/radiator  
EPS: -40 to +60 C  
Non-Operational: -60 to +100 C  
Surface emissivity/reflectivity

##### Vibration:

PPOD: Delta/Atlas/SpaceX: 30/28/20g  
Nanoracks: Orbital: 20g

##### Dose Radiation:

Spot Shielding  
5 months in 350 by 700 km orbit  
No dose problems or upsets in SAMA

##### QA Radio Testing:

Vibration, Vacuum, Thermal testing  
Multi-day Burn-in  
Final system & server radio testing  
Certification

##### In-Orbit Reliability

4 of 4 EPS units worked on 4 satellites

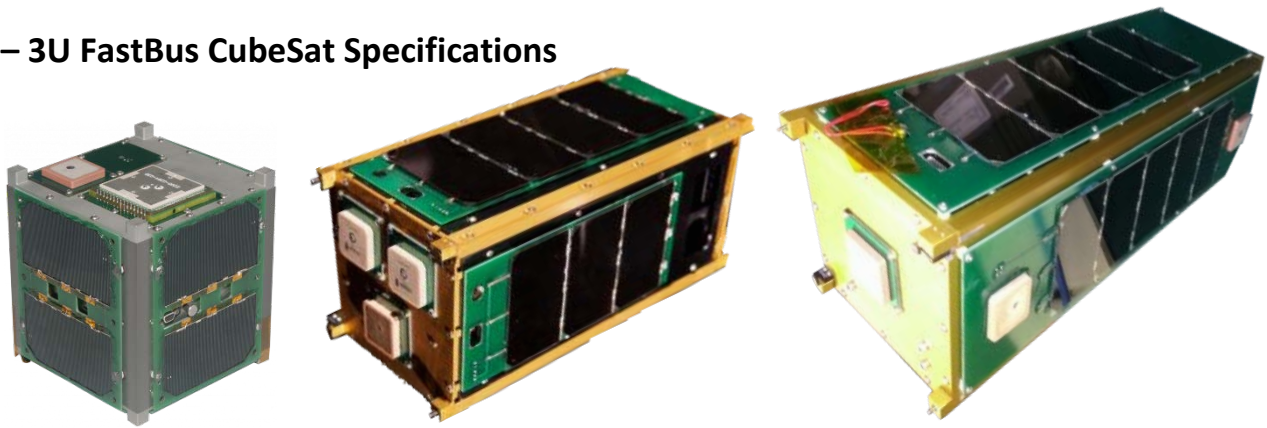
Customers: AFRL, NanoRacks, several universities, ...

Manifested on 6 more flights currently

#### Options

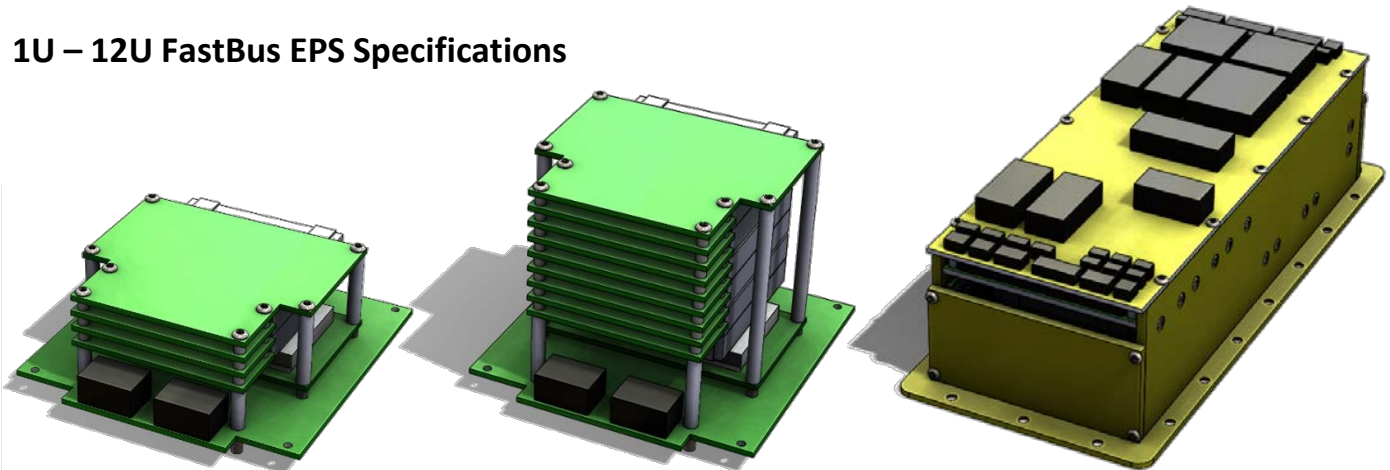
- 1U to 6U & 2x3U FastBus options
- Fast Delivery: Structure or EPS
- Duplex/Receiver Comm System
- Extra Batteries
- Deployable Solar Arrays
- Sensors – Particle, Plasma, IR, ...
- Frame only – full mechanical structure
- Custom modification and testing
- Academic rate available

## 1U – 3U FastBus CubeSat Specifications



FastBus Specifications	1U	2U	3U
Size (LxWxH)	10 x 10 x 11.35 cm	10 x 10 x 22.7 cm	10 x 10 x 34.05 cm
Mass	0.7 kg	1.1 kg	1.6 kg
Payload Volume	491.7 cm <sup>3</sup>	1299.4 cm <sup>3</sup>	2134.9 cm <sup>3</sup>
Solar Arrays	4x 1 W in Sun (Min)	3x 3 W in Sun (Min)	3x 6 W in Sun (Min)
Battery Capacity	16.3 Whrs	48.8 Whrs	48.8 Whrs
Comm System	Simplex + Receive	Simplex + Receive	Simplex + Receive
Ground Station	Online Console	Online Console	Online Console
Optional Comms	900 MHz, 2.4 GHz	900 MHz, 2.4 GHz, Full Duplex	900 MHz, 2.4 GHz, Full Duplex
Optional Power	Extra Solar	Deployable Solar + Battery	Deployable Solar + Battery

## 1U – 12U FastBus EPS Specifications



EPS Specifications	1U	2U - 4U	5U - 12U
Capacity	16.3 Whrs	48.8 Whrs	146.5 Whrs
Output Voltage	5 V, 3.3 V, BUSS+	5 V, 3.3 V, BUSS+	10 V Nominal
# Switched Outputs	5 - 15	5 - 15	15 (isolated)
Output Power	Up to 40 W	Up to 40 W	> 100 W
A/D Inputs	6 Analogs, 2 Digitals	6 Analogs, 2 Digitals	36 Analogs
Size (LxWxH)	8.7 x 9.0 x 3.3 cm	8.7 x 9.0 x 6.5 cm	20.0 x 8.8 x 5.5 cm
I/O Interface	6 x DF13	6 x DF13	< 32 x DF13
Input Voltage	7 – 16 V	7 – 16 V	7 – 35 V
# of MPPTs	6	12-16	6
1-Wire Temp	6	6	7

- NSL Inc. is a certified **Value Added Reseller (VAR)** of Globalstar Satellite radios with its approved FCC, EMI, and Globalstar EyeStar products (<http://www.globalstar.com/en/index.php?cid=2560>).
- For full, all-in-one CubeSat pricing, contact NSL
- Specifications subject to change without notice (please check with us for updated information)