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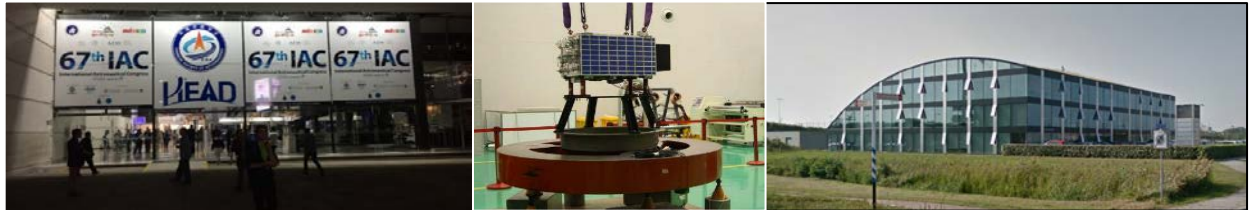
Chinese Space Products Catalog



Aerospace International Trade Center
CHINA HEAD AEROSPACE TECHNOLOGY CO.

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- A Group of international (private) space companies, headquartered in Beijing
 - Main entity: China HEAD Aerospace Technology Co. established in 2007
 - Offices and Subsidiaries in China (Hong Kong) and Europe (The Netherlands, France)
- Main focus
 - Space product trading to/from China
 - Downstream Applications & Services
 - Smallsat constellation-Skywalker



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I. Propulsion

1. 60 MPa micro pressure transducer

The pressure transducer provides a highly accurate, linear voltage output and stability over a wide temperature range. It is suitable for many applications such as aerospace, medical diagnostics, motor controllers and general industry. This product has been applied to Extra High Pressure Propulsion Platform.

1.1. Product introduction

60MPa micro pressure transducer			
Type	Application specification	Flight heritage and plan	Application
GPSS-60-0.5-1	Accuracy $\leq \pm 0.5\%$	First Flight in 2020	Micro satellites

1.2. Key features

- Pressure Range: 0 to 60MPa (0 to 600 Bar)
- $\pm 0.5\%$ FS Accuracy
- Operating Temperature Range: -20°C to $+50^{\circ}\text{C}$
- Low Cost and Compact Package
- Miniature sumption: $\leq 0.2\text{W}$
- External leakage: $\leq 1 \times 10^{-4} \text{ Pa} \cdot \text{L/s}$

1.3. Technical specifications

Size(cm)	30×30×63
Weight(g)	≤ 60
Interface material	1Cr18Ni9Ti
Thermal requirement	$-20^{\circ}\text{C} \sim +50^{\circ}\text{C}$
Storage requirement	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$
Electrical interface	Y4-4ZJLM

2. 2.5MPa micro pressure transducer

The pressure transducer is a small designed low pressure transducer which provides a highly accurate, linear voltage output and stability over a wide temperature range. It is suitable for many applications such as aerospace, medical diagnostics, motor controllers and general industry. Custom OEM designs are available including various ports and output options.

2.1. Product introduction

2.5MPa micro pressure transducer			
Type	Application specification	Flight heritage and plan	Application
GPSS-2.5-0.5-3	Accuracy $\leq \pm 0.5\%$	On orbit in 2015	Micro satellites

2.2. Key features

- Pressure Range: 0 to 2.5MPa (0 to 25Bar)
- $\pm 0.5\%$ FS Accuracy
- Operating Temperature Range: -20°C $+50^{\circ}\text{C}$
- Low Cost and Compact Package
- Miniature Design and Light Weight
- Power Consumption: $\leq 0.2\text{W}$
- External leakage : $\leq 1 \times 10^{-4} \text{ Pa} \cdot \text{L/s}$

2.3. Technical specifications

Size(cm)	26×26×62
Weight(g)	60±10
Interface material	1Cr18Ni9Ti
Thermal requirement	$-20^{\circ}\text{C} \sim +50^{\circ}\text{C}$
Storage requirement	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$
Electrical interface	Y4-4ZJLM

3. M2 low-power microwave ion thruster for micro-satellites

For 20kg satellites, M2-type low-power microwave ion thruster has the advantages of low power consumption, light weight, high specific impulse, reliable operation and easy use. The maximum thrust is 0.5mN; the specific impulse is better than 1000s; the total system weight is less than 3.2kg; the total impulse is more than 4400s; and the total system power consumption is less than 45W (when thrust is 0.5mN). At present, the M2 low-power microwave ion thruster is a leading high-performance ion propulsion system designed for satellites with power consumption less than 50W.



3.1. Product introduction

The effective beam diameter of M2 ion thruster is 2cm. It adopts microwave ionization principle and dual-gate ion optical system. It has the advantages of simple structure, reliable operation, convenient operation, and wide range of adjustment of working state.

The maximum thrust is 0.5mN; the power is less than 45W; the specific impulse exceeds 1100 s; Rated thrust 0.3mN with power less than 35W; When the thrust requirement is less than 0.3mN, the total power consumption of the propulsion system is less than 30W. The thruster has high reliability, 6000h life test has been completed and its performance is stable. Its integrated performance index is in the first class among the small power ion thrusters at home and abroad.

The thruster uses a double-surplus, cold backup heater-cathode neutralizer, with a heating power consumption of only 6W and a service life exceeding 5000h. Two heater-cathodes backup can ensure the reliability of the thruster.

3.2. Technical specifications

Thrust: $\geq 0.5\text{mN}$
 Specific impulse: $\geq 1100\text{s}$
 Total impulse: $\geq 4000\text{Ns}$
 Max power: $\leq 45\text{W}$ (0.5mN)
 Rated power: $\leq 35\text{W}$ (0.3mN)
 On-orbit life: ≥ 3 years
 Weight: $\leq 3.2\text{kg}$ (in which Xenon propellant weighs 0.4kg)
 Volume: 2.3U detachable; 1.3U compact
 Starting mode: Instant-Start
 Restart times: ≥ 5000
 Restart time interval: Unlimited
 Working time: 24h non-stop
 Control mode: Satellite computer analog control

4. 0.1MPa micro pressure transducer

The pressure transducer provides a highly accurate, linear voltage output and stability over a wide temperature range. It is suitable for many applications such as aerospace, medical diagnostics, motor controllers and general industry. Custom OEM designs are available including various ports and output options.



4.1. Product introduction

0.1MPa micro pressure transducer			
Type	Application specification	Flight heritage and plan	Application
GPSS-0.1-0.5-1	Accuracy $\leq \pm 0.5\%$	First fly in 2020	Micro satellites

4.2. Key features

- Pressure Range: 0 to 0.1MPa (0 to 1Bar)
- $\pm 0.5\%$ FS Accuracy
- Operating Temperature Range: -20°C to $+50^{\circ}\text{C}$
- Low Cost and Compact Package
- Miniature Design and Light Weight
- Power Consumption : $\leq 0.2\text{W}$
- External leakage : $\leq 1 \times 10^{-4} \text{ Pa} \cdot \text{L/s}$

4.3. Technical specifications

Size(cm)	22×22×56
Weight(g)	≤ 60
Interface material	1Cr18Ni9Ti
Thermal requirement	$-20^{\circ}\text{C} \sim +50^{\circ}\text{C}$
Storage requirement	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$
Electrical interface	Y4-4ZJLM

5. 1 N mono-propellant thruster

The thruster is the important actuator for small satellite attitude control. The 1N mono-propellant thruster can be used for satellite's application requirements, with the key technologies of full helix capillary and long-life valve breakthrough.

5.1. Product introduction

Solid cool gas generator micro propulsion module			
Type	Application Specification	Flight heritage and plan	Application
C-GTHR-1N	Specific impulse: 200s	On orbit over a thousand times	Micro satellites

5.2. Key features

- High reliability and low cost
- High space environment adaptability
- Over a thousand Flight heritage
- Operation Pressure: 0.5MPa-2.0MPa
- Specific impulse: 200s
- The preheating ignition: ≥ 2000
- Pulse cycles: $> 100,000$
- Standard vacuum thrust : 1N
- The minimum impulse time: 30 ms
- The longest total time of steady operation at one time: ≥ 1200 s

5.3. Technical specifications

Size(cm)	$\Phi 58 \times 128$
Weight(g)	300 ± 20
Propellant	N ₂ H ₄
Life	15 years
Working voltage	28 ± 3 V DC

6. 0.2N mono-propellant thruster

The thruster is the important actuator for small satellite attitude control. The thruster is based on no friction structure, which life is greatly improved. The 0.2N mono-propellant thruster can be used for satellite's application requirements, with the key technologies of full helix capillary and long-life valve breakthrough.

6.1. Product introduction

Solid cool gas generator micro propulsion module			
Type	Application Specification	Flight heritage and plan	Application
GTHR-0.2N	Thrust 0.2N	On orbit Flight in 2011	Micro satellites

6.2. Key features

- Accurate thrust
- Friction-free and high reliability
- Low power and low mass
- High space environment adaptability
- Operation Pressure: 0.5MPa-2.0MPa
- Specific impulse: 190s
- The preheating ignition: ≥ 2000
- Pulse cycles: > 33000
- Standard vacuum thrust : 0.2N
- The minimum impulse time: 30 ms
- The longest total time of steady operation at one time: ≥ 1200 s
- The longest total time of steady operation at one time: ≥ 1200 s



6.3. Technical specifications

Size(cm)	$\Phi 48 \times 92$
Weight(g)	175 ± 10
Propellant	N2H4
Life	5 years
Working voltage	28 ± 3 V DC

7. The ADN Thruster Family

We have developed a family of ADN-based liquid thruster with different thrust levels, which includes 0.2N, 1N, 5N and 20N. And two types of ADN-based liquid propellants with different theoretical specific impulse are also developed: the medium energy formula propellant with theoretical specific impulse of 220s and the high energy formula propellant with theoretical specific impulse of 245s.

Two thrusters were installed on the satellite and a series of firings were arranged. The satellite was launched in November 2016 and 5 groups of tests were processed in two days and fulfilled the design performance parameters.

7.1. The on-orbit flight validation

The on-orbit flight validation			
No.	Operation mode	Total firing duration for two thrusters	Total propellant consumption
1	The pulsed operation mode on/off=0.1s/2s	1260s	30g
2	The 10s steady operation mode	60s	30g
3	The 100s steady operation mode	600s	300g
4	The 1000s steady operation mode	2000s	1000g
5	The 100s steady operation mode	600s	300g
Total		4520s	1660g

7.2. Key features

- Non-toxic liquid propellant
- High performance
- Two series of products with high or medium energy propellant
- Flexible and modular storage system

7.3. Products introduction

No.	Thrust level	Propellant type	Specific impulse
1	0.2N	Medium energy formula	196s
2	1N	Medium energy formula	210s
3	1N	High energy formula	226s
4	5N	Medium energy formula	214s
5	5N	High energy formula	235s
6	20N	Medium energy formula	218s
7	20N	High energy formula	241s

8. 1 to 15mN Solenoid proportional cold gas thruster

1-15mN Solenoid Proportional Cold Gas Thruster utilizes the clap type, friction-free solenoid drive method, which could regulate the seat area so that the thruster level is defined.

8.1. Product introduction

1-15mN solenoid proportional cold gas thruster			
Type	Specification	Flight plan	Application
MGTHR-GG1-15mN-1	1-15mN	First Flight in 2020	Micro satellites

8.2. Key features

- Long life and High Reliability
- Clap type and Friction-free proportion technology
- Light Mass, Small Volume and Low Power
- Good Compatibility to the Space Environment
- Thrust level continuously adjustable
- Medium: N₂
- Pressure: 0~0.1MPa
- Temperature: -20°C~+50°C
- Burst pressure: ≥ 0.2 MPa
- Outer leakage: $\leq 1 \times 10^{-4}$ Pa·L/s (@0.1MPa)
- Thrust force range: 1~15mN

8.3. Technical specifications

Features	
Size	Φ21mm x Φ21mm x 48mm
Weight (g)	≤ 40
Interface material	1Cr18Ni9Ti
Thermal requirement	-5~65°C
Storage requirement	-5~70°C
Electrical interface	2 FY1-2 wires

9. Micro Newton Level Thrust Force Adjustable Module

Micro Newton level thrust force adjustable module is mainly composed of proportion thruster and mass flow sensor. The flow path area of proportion thruster is adjustable, which is utilized to control the thrust level and the mass flow. The mass flow sensor is used to detect the mass of the propellant on time and under the control of the algorithm, close-loop control is utilized to get the high accuracy thrust.

9.1. Product introduction

Micro-Newton level thrust force adjustable module			
Type	Technical specification	Flight heritage and plan	Application
MGS-0.1/1~50 μ N-1	Mass: <0.4Kg Power: <1W Thrust Level Range: 1~50 μ N Thruster Resolution Ratio: 0.5 μ N Thrust Noise: <1.0 μ N/Hz ^{1/2}	First Flight in 2018	Spacecraft with drag-free control

9.2. Key features

- Micro Newton Level, Adjustable
- Low thrust Force Noise
- High Resolution Ratio
- Piezo-electric Driver
- Thermal Mass Flow Sensor
- Propellant: N₂
- Thrust range: 0.5~50 μ N
- Thrust resolution: 0.5 μ N
- Is: >50s ($\geq 10\mu$ N)
- Thrust noise: <1 μ N/Hz^{1/2} (1mHz-1Hz)
- Power Consumption: ≤ 1 W
- Mass Flow Output: 0-5VD.C
- Mass Flow Sensor Accuracy: $\leq 0.5\%$ FSO
- Pressure: 0.1 \pm 0.01MPa
- Mass Flow: 0.5-100 μ g/s

9.3. Technical Specifications

Size(cm)	180mm x 70 mm x 60mm
Weight(g)	≤ 0.4
Interface material	TC4
Thermal requirement	25~35°C
Storage requirement	0~50°C
Electrical interface	2 JAK17/CAN

10. Solid cool gas generator micro propulsion module

Solid cool gas generator micro propulsion module is an innovative propulsion method, which is composed of chamber, cool gas generators, pressure sensors, thrusters, control circuit. When activated, a gas generator yields nitrogen gas at ambient temperature in a chamber that is provided to an integrated thruster.



10.1. Product introduction

Solid cool gas generator micro propulsion module			
Type	Specification	Flight heritage / plan	Application
MPM-GS100mN-1/2	Total impulse 80Ns	First Flight in 2018	Micro satellites

10.2. Key features

- NO gas leakage during storage
- Long storage time
- Low power
- Flexible and modular storage system
- Standard interface
- Vacuum thrust : -100mN
- Total impulse : >80Ns
- Specific impulse : >650Ns/kg
- Working Power: <2W
- Minimum impulse operation time: 30ms
- Working voltage: 5V

10.3. Technical Specifications

Size(cm)	100 x 100 x100
Weight(g)	1200
Interface material	TC4
Thermal requirement	-15~55°C
Storage requirement	-40~95°C
Electrical interface	RS-422/CAN

11. Cold gas micro propulsion module based on butane propellant

The micro propulsion module uses liquid butane as the propellant, which pressurized by self-saturated vapor pressure. The module integrates control circuit, could plug and play. The thrust accuracy of the micro propulsion module is high, which can be used for orbit maneuver, orbit maintenance of the micro-nano satellite.



11.1. Product introduction

Cold gas micro propulsion module based on Butane propellant			
Type	Application Specification	Flight heritage and plan	Application
MPM-GB5mN-1	Total impulse 200Ns	First Flight in 2019	Micro satellites

11.2. Key features

- Simple and reliable
- Low cost and non-toxic
- Self-pressurization
- Low power and low mass
- Standard vacuum thrust: -5mN
- Total impulse : >200Ns
- Specific impulse: >600Ns/kg
- Working power: <3W
- Minimum impulse operation time: 10ms
- Working voltage: 5V

11.3. Technical specifications

Size(mm)	100 x 100 x100
Weight(g)	900
Interface material	TC4
Thermal requirement	10~30°C
Storage requirement	0~60°C
Electrical interface	RS-422/CAN

12. Micro extra-high pressure cold gas propulsion

The micro extra-high-pressure cold gas propulsion system can realize the very fine control of the satellite attitude, positioning and pointing to enable precision formation Flight, which is suitable for the satellite with the micro thrust and lower power requirements.



12.1. Production introduction

Micro extra-high pressure cold gas propulsion system			
Type	Specification	Flight heritage/plan	Application
MGS-60/10~200mN-1	Weight : <2Kg Power: <1W Total impulse: >700Ns	First Flight in 2019	Micro satellites

12.2. Key features

- High Total Impulse and High Reliability
- Extra-high Pressure Storage
- Fine control
- Pulsed or continuous mode
- Low power
- Medium: N₂
- Pressure: $\geq 60\text{MPa}$
- Total impulse: $\geq 700\text{Ns}$
- Weight: $\leq 2\text{kg}$
- Power : $\leq 1\text{W}$
- Thrust: 10mN/200mN
- Minimum Impulse: $\leq 100\mu\text{Ns}$
- Pulse Cycles : $\geq 1 \times 10^6$

12.3. Technical specifications

Size(mm)	190 x 430 x190
Weight(g)	≤ 2
Interface material	1Cr18Ni9Ti
Thermal requirement	-5~65°C
Storage requirement	-5~70°C
Electrical interface	2FY1-2wires

13. ADN based mono-propellant micro propulsion module

The module with AON green monopropellant contains propellant tank, pressure sensor, filters and so on, which is pressured by solid cool gas generator. The micro monopropellant propulsion module can provide higher velocity increment, and enable the micro satellite platform to access the wider range of missions.



13.1. Product introduction

ADN based mono-propellant micro propulsion module			
Type	Specification	Flight heritage/plan	Application
MPM-MA200mN-1	Total impulse 800Ns	First Flight in 2019	Micro satellites

13.2. Key features

- High total impulse
- Flexible total impulse
- Simple mechanical electric interface
- Standardized parts
- High reliability, high safety
- Vacuum thrust :200mN
- Total impulse :>800Ns
- Specific impulse :>2000Ns/kg
- Working Power :<1W/single thruster
- Number of actuations: ≥ 300
- Cycle Life: ≥ 50000
- Minimum impulse operation time :100ms
- Working voltage: 5V

13.3. Technical specifications

Size(mm)	100 x 100 x100
Weight(g)	1400
Interface material	TC4
Thermal requirement	-15~55°C
Storage requirement	-20~85°C
Electrical interface	RS-422/CAN

14. MEMS solid propellant micro-thruster array module

Solid propellant micro-thruster array can provide micro impulses and impulse moments for precise orbit correction and attitude adjustment. When the module receives the signal from satellite computer, the control circuit addresses power to the specific micro-thruster, and a predefined amount of impulse is generated.



14.1. Product introduction

MEMS solid propellant micro-thruster array module			
Type	Specification	Flight heritage/ plan	Application
MPM-SA 100-1	Single impulse 10-5~10-3Ns	First fly in 2020	Nano satellites

14.2. Key features

- Light, Small volume
- No channels or valves
- Digital propulsion
- Long storage time
- Simple mechanical electric interface
- Integration scale: 10x10 thrusters/in²
- Single impulse : 10-5~10-3Ns
- Working voltage : 12V
- Ignition energy: ≤10mJ
- Thruster response time : <5ms

14.3. Technical specifications

Size(mm)	70 x 70 x30
Weight(g)	200
Interface material	2A2-H112
Thermal requirement	-15~55°C
Storage requirement	-30~55°C
Electrical interface	CAN/RS-422

15. Micro-Cathode Arc Thruster Module

The micro-cathode arc thruster module contains the power control unit and the thruster head. The thruster is based on the vacuum arc process where an arc flows through a medium between the cathode and anode. The cathode spot, which is created by the vacuum arc, produces quasi-neutral plasma at high velocities normal to cathode surface.

15.1. Product introduction

ADN-based non-toxic thruster module			
Type	Specification	Flight heritage / plan	Application
MPM-EC100 μ N-1	Specific impulse 1900s	First Flight in 2019	Micro satellites

15.2. Key features



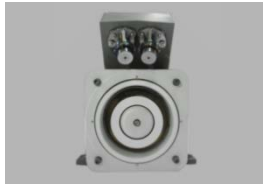
- Solid propellant and long storage time
- High specific impulse
- Low Power
- Flexible and modular storage system
- Standard interface
- Power: 1W-10W
- Isp: >1900s
- Single Impulse: 1 μ Ns
- Max Thrust: 0.1mN
- Working voltage: 5V
- Total impulse: >1000Ns

15.3. Technical specifications

Size(mm)	100 x 100 x30
Weight(g)	300
Interface material	Ti, Ni
Thermal requirement	-15~55°C
Storage requirement	-30~55°C
Electrical interface	RS-422/CAN

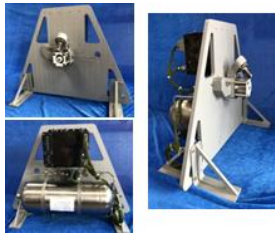
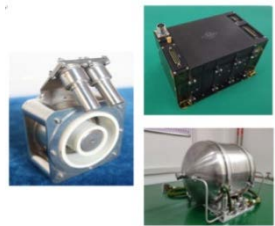
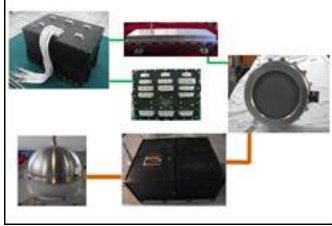
16. Electric propulsion

We have been developing electric propulsion since 1974 and have become the most famous corporation in electric propulsion field of China. The electric propulsion segment covers two major electric propulsion areas – Ion and Hall. The ion electric propulsion such as LIPS-200 and LIPS-300 and the Hall electric propulsion such as LHT-40, LHT-100 were used or are planned to fulfil different space missions.

Type	Photograph	Product	Description	Maturity
Electric Thruster		LIPS-200 Thruster	Performances: Propellant: Xenon Thrust: 40mN/60mN Specific Impulse: 3000s/3500s Power: 1kW/1.6kW Beam Diameter: 200mm Mass: 6.5kg Application: GEO satellite station keeping, Near-Earth Asteroid (NEA) mission.(SJ-9)	F
		LIPS-300 Thruster	Performances: Propellant: Xenon Thrust: 40mN/60mN Specific Impulse: 3000s/3500s Power: 1kW/1.6kW Beam Diameter: 200mm Mass: 6.5kg Application: NSSK, EWSK, orbit transfer for GEO satellite,	D
		LHT-100 Thruster	Performances: Propellant: Xenon Thrust: 83mN Specific Impulse: 1600s Power: 1.35kW Beam Diameter: 100mm Mass: 5.8kg Application: NSSK, EWSK, partial orbit transfer for GEO satellite, orbital maintenance for LEO & MEO spacecraft. (SJ-17)	F

Type	Photograph	Product	Description	Maturity
		LHT-40 Thruster	Performances: Propellant: Xenon Thrust: 12mN Specific Impulse: up to 1300s Power: 300W Beam Diameter: 40mm Mass: 1.1kg Application: Orbit transfer, Phase keeping and deorbiting for LEO satellite constellation of global telecommunication systems	U
		LHT-60 Thruster	Performances: Propellant: Xenon Thrust: 25mN Specific Impulse: up to 1400s Power: 530W Beam Diameter: 60mm Mass: 1.5kg Application: orbit transfer, Phase keeping and deorbiting for LEO satellite constellation of global telecommunication systems LEO & MEO spacecraft.	U
Hollow Cathode		LHC-5 Cathode	Emission Current: 1-5A Ignition Time: $\leq 330s$ Ignition Power: $\leq 90W$ Keeper Voltage: $\leq 35V$ Anode Voltage: $\leq 26V$ Lifetime: 16000h Size: $\Phi 45mm \times 64mm$	F
		LHC-20 Cathode	Emission Current: $\leq 20A$ Ignition Time: $\leq 300s$ Ignition Power: $\leq 120W$ Keeper Voltage: $\leq 8V$ Anode Voltage: $\leq 26V$ Lifetime: 30000h Size: $\Phi 47mm \times 78mm$	F
PPU		LIPS-200 PPU	Maximum dimensions(L×W×H, mm): $(340 \times 162 \times 276) \pm 1$; Mass: $11.4kg \pm 0.2kg$; Input Voltage: $100V \pm 5V$ Output Power: 1.2 kW ; Screen grid power supply(V/I): $1000V/0.6-0.9A$; Anode power supply(V/I): $20V-50V/2.5-5.2A$ Power Efficiency: $\geq 86\%$.	F

Type	Photograph	Product	Description	Maturity
		LIPS-300 PPU	Maximum dimensions(L×W×H, mm): 395(max)×314(±0.3)×220(max); Mass: 19kg±0.2kg; Input Voltage: 100V±5V Output Power: 3 kW /4 kW /5Kw; Screen grid power supply(V/I): 1100V-1450V/1A-4A; Anode power supply(V/I): 20V-50V/5A-30A; Power Efficiency: ≥94%。	D
		LHT-40 PPU	Input Power:up to 450W Input Voltage:42V Anode Voltage:up to 310V Efficiency:up to 94% Mass:2.5Kg Maximum dimensions: 182×164×145 m ³	U
		LHT-60 PPU	Input Power:up to 650W Input Voltage:42V Anode Voltage:up to 310V Efficiency:up to 94% Mass:3.0Kg Maximum dimensions: 232×164×145 m ³	U
Xenon Flow Controller		LHT-40 XSFU	Maximum Operating Pressure: ≤8.5MPa Anode Flow rate: (1.0±0.1) mg/s Cathode Flow rate: (0.1±0.02) mg/s Steady state Power: ≤2W Propellant capacity: ≤7.0Kg Maximum dimensions: 285×260×250 m ³ Mass: ≤2.9kg(including tank)	D
		LHT-60 XSFU	Maximum Operating Pressure: ≤15.0MPa Anode Flow rate: (1.0±0.1) mg/s Cathode Flow rate: (0.1±0.03) mg/s Steady state Power: ≤2W Propellant capacity: ≤16.0Kg Maximum dimensions: 320×270×270 m ³ Mass: ≤4.0kg(including tank)	D

Type	Photograph	Product	Description	Maturity
System		LHT-40 EPS	Performances: Thrust: 12mN Specific Impulse: up to 1300s Input Power: $\leq 350W$ System mass: 6.9kg Propellant capacity: $\leq 7Kg$ Application: Orbit transfer, Phase keeping and deorbiting for LEO satellite constellation of global telecommunication systems	U
		LHT-60 EPS	Performances: Thrust: 25mN Specific Impulse: up to 1400s Input Power: $\leq 600W$ System mass: 8.5kg Propellant capacity: $\leq 16.0Kg$ Application: Orbit transfer, Phase keeping and deorbiting for LEO satellite constellation of global telecommunication systems	U
		LHT-100 EPS	Performances: Thrust: 88mN Specific Impulse: up to 1650s Input Power: $\leq 1650W$ System mass: 8.5kg Propellant capacity: $\leq 16.0Kg$ Application: Orbit transfer, Phase keeping and deorbiting for LEO satellite constellation of global telecommunication systems	F
		LIPS-200 EPS	Performances: Thrust: 40mN Specific Impulse: up to 3300s Input Power: $\leq 1300W$ System mass: 37kg Life: $\geq 8000h$ Application: GEO satellite station keeping, Near-Earth Asteroid (NEA) mission.(SJ-9)	F

Note: F(Flight-proven), D(Developed), U(Under development)


II. Payloads

1. Space-Based Monitoring Camera

Space-based Monitoring Camera features compactness, low power dissipation, multi-function and flexible usage. Breakthroughs have been made in key technologies, including large FOV lens with low distortion, video image compression, identification and tracking of targets and measurement of relative attitude, as well various on-board intelligent image processing technologies.

Widely used in such missions as satellites and spacecrafts monitoring, targets measuring and deep space exploration to provide in-orbit images of key mechanisms and payloads, get geometric and dynamic information of key processes and play an important role in ensuring the safety of spacecrafts and in-orbit services and maintenance.

1.1. Compact COTS Reinforced Monitoring Camera


Introduction	<p>Compact, intelligent, quick response, independent IPR</p> 
Features	Global test points and automatic exposure
	Manual exposure setting
	JPEG data compression
	Mono and RGB available
	Up to 4 million pixels
	Command Interface: Synchronous RS422
	Data output interface: LVDS
	Power supply: 5.2-12V
Application	Status monitoring and action display of various spacecraft and instrument targets, for example, solar array deployment, antenna deployment and moving process of other mechanisms. Monitoring close-range targets from various spacecrafts.

Technical Specifications

Product name	CMOS-C/4M/RS422-1
FOV	96° \ 130°
Bands	Mono/RGB
Compression mode	JPEG
Frame rate	Up to 10fps
Maximum Pixel number	2048×2048

Weight	350g
Measurement and control interface	Synchronous RS422
DT interface	3-wire LVDS
Power supply	5.2V-12V
Power dissipation	$\leq 6\text{w}$
Size	58*58*100
Designed months	3 months
Future product plan	Resolution: 20 million pixels JPEG static compression + dynamic compression


1.2. Extended COTS Reinforced Monitoring Camera

Introduction	Compact, intelligent, quick response, higher adaptability to space environment, various interfaces, independent IPR	
Features	Global test points and automatic exposure	
	Manual exposure setting	
	JPEG data compression	
	Mono and RGB available	
	Up to 4 million pixels	
	Synchronous RS422 command, 1553B CAN, CAN measurement and control interface	
	Power supply: 28-42V	
	Regular software refreshment (reserved)	
	In-orbit reprogramming (reserved)	
Application	Status monitoring and action display of various spacecraft and instrument targets, for example, solar array deployment, antenna deployment and moving process of other mechanisms. Monitoring close-range targets from various spacecrafts.	

Technical Specifications

Product name	CMOS-C/4 M/M-28A	CMOS-C/4 M/M-28B	CMOS-C/4 M/M-28C	CMOS-C/4 M/M-28D	CMOS-C/4 M/M-28F	CMOS-C/4 M/M-28G
FOV	96° \130°	96° \130°	96° \130°	96° \130°	96° \130°	96° \130°
Bands	PAN/RGB	PAN/RGB	PAN/RGB	PAN/RGB	PAN/RGB	PAN/RGB
Compression mode	JPEG	JPEG	JPEG	JPEG	JPEG	JPEG
Frame rate	Up to 10fps	Up to 10fps	Up to 10fps	Up to 10fps	Up to 10fps	Up to 10fps
Maximum Pixel number	2048×2048	2048×2048	2048×2048	2048×2048	2048×2048	2048×2048
Measurement and control interface	Synchronous RS422	Synchronous RS422	Synchronous RS422	Synchronous RS422	Synchronous RS422	1553B
DT interface	4-wire RS422	3-wire RS422	3-wire LVDS	6-wire LVDS	10-wire LVDS	3-wire LVDS
Power supply	28V-42V	28V-42V	28V-42V	28V-42V	28V-42V	28V-42V
Power dissipation	≤ 8w	≤ 8w	≤ 8w	≤ 8w	≤ 8w	≤ 8w
Weight	Around 850g	Around 850g	Around 850g	Around 850g	Around 850g	Around 850g
Size	83*83*122	83*83*122	83*83*122	83*83*122	83*83*122	83*83*122
Designed months	3 months	3 months	3 months	3 months	3 months	3 months

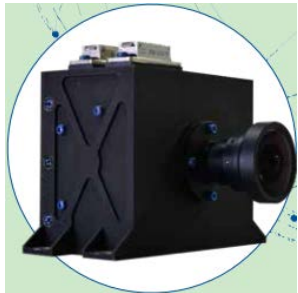
1.3. Compact Space-level Monitoring Camera

Introduction	<p>Compact, intelligent, quick response, highly adaptable to space environment, independent IPR</p> 
Features	Aerospace standard design and development
	Manual exposure setting
	High reliability and long life
	Global test points and automobile exposure
	Wavelet data compression
	Up to 1.3 million pixels
	Command Interface: Synchronous RS422
	Data output interface: RS422
	Power supply: 5.2V
Application	Status monitoring and action display of various spacecraft and instrument targets, for example, solar array deployment, antenna deployment and moving process of other mechanisms.

Technical specifications

Product name	CMOS-S/1.3M/RS-422-1
FOV	80×97.6°
Bands	Panchromatic
Compression mode	Wavelet
Frame rate	Up to 10fps
Maximum Pixel number	1280×1024
Measurement and control interface	RS422
DT interface	LVDS
Power supply	5.2V
Power dissipation	≤ 3.5w
Weight	Around 400g
Size	120*110*62.5
Designed months	1 year
Future product plan	Resolution: 20 million pixels JPEG static compression + dynamic compression

1.4. Extended Space-level Monitoring Camera

Introduction	<p>Compact, intelligent, quick response, highly adaptable to space environment, independent IPR multi-type interfaces</p> 
Features	Aerospace standard design and development
	Manual exposure setting
	High reliability and long life
	Global test points and automobile exposure
	PAN and chromatic available
	JPEG data compression
	Up to 4 million pixels
	Command Interface: Synchronous RS422, bus 1553B and CAN bus measure and control interface
	Data output interface: Three-wire LVDS, six- wire LVDS, four-wire RS422 and three-wire RS422 data output interfaces
	Power supply: 5V-42V

1.5. Successful cases

Chang'e 2 mission:

Chang'e-2 was equipped with 1 landing camera and 3 monitoring cameras. Each of them is less than 400g. It was the first successful application of China's traditional CMOS imaging technology in deep space detection.

Chang'e 3 mission:

Chang'e-3 is equipped with 1 landing camera and 3 monitoring cameras, recording the historical moment of descending, landing and separation.

The payload subsystem of Chang'e-3 is equipped with a landing camera, used for optical image acquisition at the landing area of powered descending phase of the lander and finishing the research on landform and geological conditions of lunar surface of landing area.

Engineering parameter measurement equipment has 3 monitoring cameras, finishing the whole monitoring for inspector releasing and separating and improving the lunar surface movement display of probe system.

Chang'e-5 Flight Tester:

Engineering parameter measurement subsystem of Chang'e-5 Flight Tester is equipped with 2 separated monitoring cameras and 1 solar panel monitoring camera.

To verify the technologies of the monitoring camera, such as lightweight design and double-resolution optical imaging, the engineering parameter measurement subsystem conducts a carrying test, including 1 technical test camera, 1 double-resolution camera and 1 camera

controller.

Obtain the lunar landform feature images at different altitudes of landing area during landing process of the lander.

Abilities of automatic exposure adjustment and image compression.

In-orbit verification of high-performance lightweight camera, double-resolution imaging technology and COTS strengthening technology.

High requirements for image quality, improving the image quality of products

2. Micro-Nano Remote Sensing Camera

The micro-nano remote sensing payload has the functions of scan imaging and video imaging. It has the features of highly lightweight & miniaturization, flexible working mode, high intelligence and good extensibility. In addition, it is easily to operate and is user friendly. The payload can be classified into visible, infrared and high-spectral products. The visible one covers a resolution of 0.5m, 1m, 2m, 3m and 5m, suitable for platforms from hundreds of km level to cubesat.

The micro- nano remote sensing payload is widely used in commercial sensing, traffic monitoring, urban planning, resource investigation, environmental protection monitoring and emergency disaster reduction. This payload is especially suitable for constellation network. It can realize global coverage with low cost and high time-frequency, and solve the problem of low time effect of data.

2.1. 0.5m micro-nano remote sensing camera

Introduction	high resolution, high performance, multi-mode, high- quality images; it can acquire super-sharp video images, long-stripe images and stripe images
Features	multi-modes of working, multi-use; integrated compression, storage, cloud judgment, target recognition; extensible integrated resolution, the swath of 5m&5km MWIR channel; high image resolution, vivid color; integrated compression, storage, cloud judgment, target recognition;
Application	commercial remote sensing, national defense security, traffic monitoring; urban planning, national defense security

Technical specifications

0.5m micro-nano remote sensing camera	Visible video camera	Visible push-broom multi-spectral camera
Working mode	Push-broom image	Push-broom image
Band	RGB or(PAN+ MS)	RGB or(PAN+ MS)
Pixel resolution	0.5m@500km	0.5m@500km
Swath	11km	11km

2.2. 1m micro-nano remote sensing camera

Introduction	high resolution, high performance, multi-mode, high- quality images;
	it can acquire super-sharp video images, long-stripe images and stripe images.
	It's a camera with high integration and large swath at sub-meter level; and can acquire clear long-stripe images, especially suitable for 70Kg platform.
Features	small size, lightweight, flexible, good imaging view, and multi modes of working; extensible integrated resolution, the swath of 13m&8km MWIR channel; the camera has the functions of integrated compression, storage and cloud judgment ; the bands are all 0.9m of RGB, and the images are clearer than traditional PAN&MS images finally acquired.
Application	commercial remote sensing, traffic monitoring and urban planning

Technical specifications

1m micro-nano remote sensing camera	Lightweight & small video camera	Visible video camera	Visible push-broom multi-spectral camera
Working mode	staring video, stripe imaging, push broom	Staring video, stripe imaging, push broom	Push-broom imaging
Band	Bayer RGB or PAN	Bayer RGB or PAN	RGB or (PAN+MS)
Pixel resolution	1 m@500km	1 m@500km	0.9m@500km
Swath	Video: 8km*6km Stripe/push broom: 8km	Video: 15km*6km Stripe/push broom: 15km	20km

2.3. 2m micro-nano remote sensing camera

Introduction	medium and high resolution, multi-modes; it can acquire clear video images and stripe images; especially suitable for 30Kg platform
Features	it's a high-performance and high integration payload, featuring wide applicability, lightweight and flexible working mode; it has the functions of integrated compression, storage and cloud judgment.
Application	commercial remote sensing, traffic monitoring and urban planning

Technical specifications

2m micro-nano remote sensing camera	video camera	push-broom camera
Work mode	Staring video, stripe imaging, push broom	Push-broom imaging
Band	Bayer RGB or PAN	RGB or (PAN+MS)
Pixel resolution	2m@500km	2m@500km
Swath	Video:15km*12km Stripe/push broom:15km	24km

2.4. 3m/5m cubesat camera

Introduction	an ultra-light and small camera, medium-low resolution, multi modes; it can acquire video images and stripe images; first choice for 6m cubesat platform
Features	a compact payload for cubesat, volume <3U, used for high time resolution satellite network
Application	commercial remote sensing and big data applications

Technical specifications

Product name	3m area-array video camera	5m area-array video camera
Work mode	Staring video, stripe imaging, push broom	Staring video, Push-broom imaging
Band	Bayer RGB or PAN	Bayer RGB or PAN
Pixel resolution	3m@500km	5 m@500km
Swath	Video:24km*18km broom:24km	Video:40km*18km Stripe/push broom: 40 km

2.5. 5m wide-swath push-broom camera

Introduction	medium-low resolution, general survey with large swath, compact; it can acquire clear long-stripe images
Features	it is a push broom camera with large swath for general survey, and can be used for resources survey; for detecting vessels, aircrafts and other medium and large size targets; first choice for cubesat platforms
Application	commercial remote sensing and ocean monitoring

Technical specifications

Introduction	5m push-broom camera with wide swath
Work mode	Push broom imaging
Band	RGB or (PAN+MS)
Pixel resolution	5m@500km
Swath	115km

2.6. Successful cases

Case 1

It was first launched on June 15, 2017 and it is operating well in orbit; video imaging/stripe imaging; 2 products have been finished within five and a half months; reinforcement of COTs

Resolution: 2m@550km

Swath: 8×6km

Mode: video,stripe



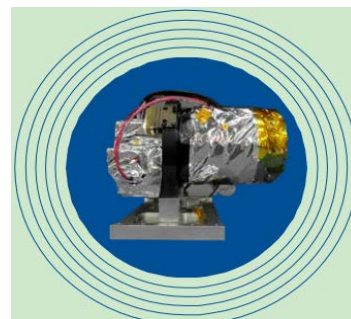
Case 2:

Launched on April 10, 2018, it's working well in orbit; video/push-broom imaging, digital TDI technology, push-broom imaging; automatic exposure control and other advanced algorithms; 5 months of lead time

Resolution: 2.5m@550km

Swath: 12.8km

Mode: video, push-broom imaging



III.Structures and mechanisms

1. Structures

1.1. Satellite Main Structures

Design, development and qualification of high performance spacecraft structures in fiber reinforced composites, metallic and hybrid technology.



Central Tubes

Central Tubes for DFH-3/ DFH-3A Satellites Bus

Configuration	Inner diameter Φ 1088, height2203	
Mass	49kg	51kg
Carrying Capacity (Mass of Satellite)	2350kg (Can be extended to2480kg)	3100kg (Can be extended to 3500kg)

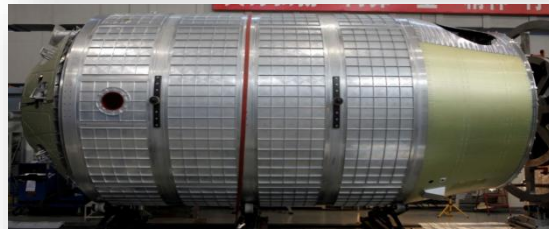
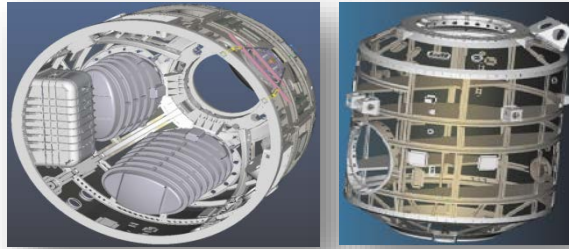
Global Stiffness Constrains		First lateral frequency $\geq 15\text{Hz}$ First longitudinal frequency $\geq 30\text{Hz}$	First lateral frequency $\geq 15\text{Hz}$ First longitudinal frequency $\geq 35\text{Hz}$
Quasi-static Loads	Longitudinal	6.5g	6.1g
	Lateral	1.2g	1.5g
Interface with Launch Vehicle		A standard 1194 interface The 1194A and 1194B are applicable	
Mechanical Interfaces with Propellant Tanks		4 quadrants $\Phi 1088(+0.1 \sim +0.2)$	
The Designed Lifetime		Storage on ground for 5 years, Working on the track for 15 years	

Central Tubes for DFH-4/ DFH-3B Bus

Configuration		Inner diameter $\Phi 1270$, height 3674.2	
Mass		89kg	73kg
Carrying Capacity (Mass of Satellite)		5320kg (Can be extended to 5600kg)	3800kg (Can be extended to 4600kg)
Global Stiffness Constrains		First lateral frequency $\geq 12\text{Hz}$ First longitudinal frequency $\geq 35\text{Hz}$	
Quasi-static Loads	Longitudinal	6.1g	
	Lateral	1.5g	
Interface with Launch Vehicle		A standard 1194A interface The 1194 and 1194B are applicable	
Mechanical Interfaces with Propellant Tanks		4 quadrants $\Phi 1255(0 \sim +0.1)$	
The Designed Lifetime		Storage on ground for 5 years, Working on the track for 15 years	

1.2. Sealed Structure

- Damage tolerance design, nondestructive testing technology of residual stress, optimal design of protective structure and so on, were breakthrough, in the process of sealed structure development of Recoverable satellite, Shenzhou spaceship and Tiangong space laboratory.
- At present, the main structures' development of cargo vehicles and space station will provide the technical support for building permanent space station and space transportation system in the third step of manned space program.



1.3. Thermal Protection Structure

- Be successfully used in 9 Shenzhou spaceships and their following product. Ablative thermal protection structures, which were made of cured silicone rubber based low density ablative material, reduce the mass per unit area by 35%, according to Soyuz spaceship.
- At present, the new generation of thermal protection structure is developing to meet the demand of high enthalpy, high heat flux and long heat time, and to meet $-100^{\circ}\text{C}\sim 100^{\circ}\text{C}$ alternating temperature environment.



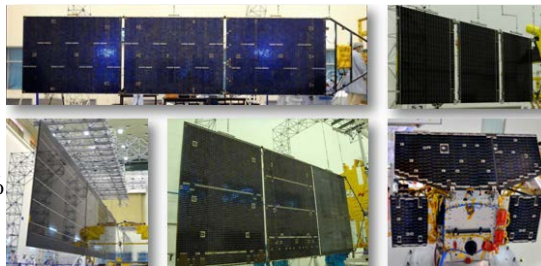
1.4. High Stability Structure

- Load matching structure, which was made of high modulus low thermal expansion coefficient composites, has high thermal stability by configuration design and lay-out design.
- The equivalent thermal expansion coefficient in plane is less than $5\text{E-}7/^{\circ}\text{C}$. The deformation of camera mounting surface flatness is less than 0.025mm.

2. Mechanisms

2.1. Solar Arrays

- Over 89 satellites equipped with our solar wings
- More than 172 solar wings on-orbit , 100% successful deployment



Solar Arrays Technical Capabilities

- Deployable and body-mounted flat panel solar arrays
- Power range: 0.5 kW– 14 kW
- Damper available
- Partial deployment
- Multi-directional deployment
- Various configuration according to customers' requirements
- Silicon and Gallium Arsenide cell panels
- Based on the development and the heritage obtained, we can offer a variety of solutions for mechanisms
- Based on the development and the heritage obtained we can offer a variety of solutions for mechanism components/units for hold-down & release, deployment, damping



2.2. Solar panel for microsats

10mm thickness panel

Dimension	340×700×10 mm
Panel thick	10mm
Deployed frequency	0.5 (Hz)
Stowed frequency	40 (Hz)
Weight	1.9 kg
Designed lifetime	LEO: 10 GEO:10
Ground-based deployment time (s)	2~6

5mm panels

Dimension	340×700×5 mm
Panel thick	5mm
Deployed frequency	0.15 (Hz)
Stowed frequency	30 (Hz)
Weight	0.75 kg
Designed lifetime	LEO: 10 GEO:10
Ground-based deployment time (s)	3~6

5mm Ultrathin and Lightweight Rigid Solar Array consists of 5mm ultrathin composite material panels, Micro-type hinges and SMA hold-down and release mechanisms.

Rigid middle-sized solar array

Dimension	2000×1530×10 mm
Panel thick	23 mm
Deployed frequency	0.16 (Hz)
Stowed frequency	50 (Hz)
Weight	33.4 kg
Designed lifetime	LEO: 10; GEO:10
Ground-based deployment time (s)	12~16

Successful cases:

Jilin-1 satellite was successful launched in 2015, the solar array is developed by ASES.

Dimension: 1200 mm × 1100 mm

Newsat satellite was successful launched in Feb 2018, the solar array is developed by ASES.

Dimension: 500 mm × 500mm

Panel thickness: 5mm

2.3. SADA

We developed first SADA product since 1993 and the SADA went into orbit at 1999. There are more than 72 SADA products successfully operated in orbit till now. The total operation lifetime is 109a and the longest lifetime is 111 months.

The catalog covers applications in high, medium or low orbits, and in high, medium or low transmission power requirements.

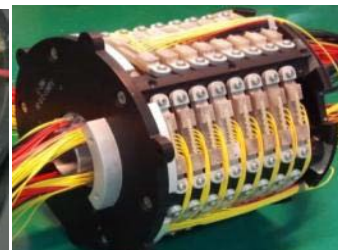
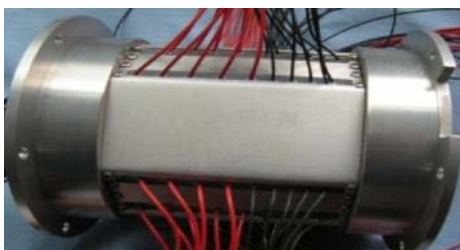
Classification by power: small, middle, large, extra large



Classification by signal DOF, Two DOFs



Classification by PDTD: slip ring, roll ring, cable-wrap



SADM-1-3-2-2A

Dimension	Φ240×362mm
Total current	132A
Power ring	8×9A、32×6A
Number of signal ring	24
Transmission Voltage	100V
Output Torque	12Nm
Designed lifetime	8a(LEO), 15a(GEO)
Mass	12.8kg

SADM-2-3-2-2A

Dimension	480×330×300mm
Total current	102A
Power ring	34×6A
Number of signal ring	26
Transmission Voltage	80V
Output Torque	7Nm,
Designed lifetime	5a(LEO)
Mass	18kg

2.4. Pointing Mechanism

- Smoothly deployment and reliably locked in orbit
- Large rotational range in two axes
- High pointing accuracy with long life span

2.5. Joining -Separating Device

More than thirty kinds of Joining -Separating devices such as Separating-Sealing Plank, Releasable Spring Lock, Pyrotechnical Driving Pole, serial Pyrotechnical Separators, Clamp Band Release Device, Explosive bolts, Pyrotechnical Nut Release Device have been used in orbit successfully.



Pyrotechnical Nut Release Device

- The feature of serial pyrotechnical nut release devices: compact structure, small weight, large load.
- Be able to adjust the release resistance to the best state in the assembly stage.



Dimension	61mm×81mm×39/47mm
Max load	12000N/30000N
Reliability	≥0.99995 (r=0.95)
Temperature Range	-45°C~+80°C
Weight	200g/290g
Life	6 years

2.6. Vibration and Impact Isolation Device

- A new type of seat-buffer landing system has been used in Shenzhou spaceships.
- Soft-landing system for CE-3 Lunar Lander worked well in the mission.
- Various type of isolators such as eddy-current damper, viscoelastic damper, viscous isolator has been developed for on-orbit vibration isolation.

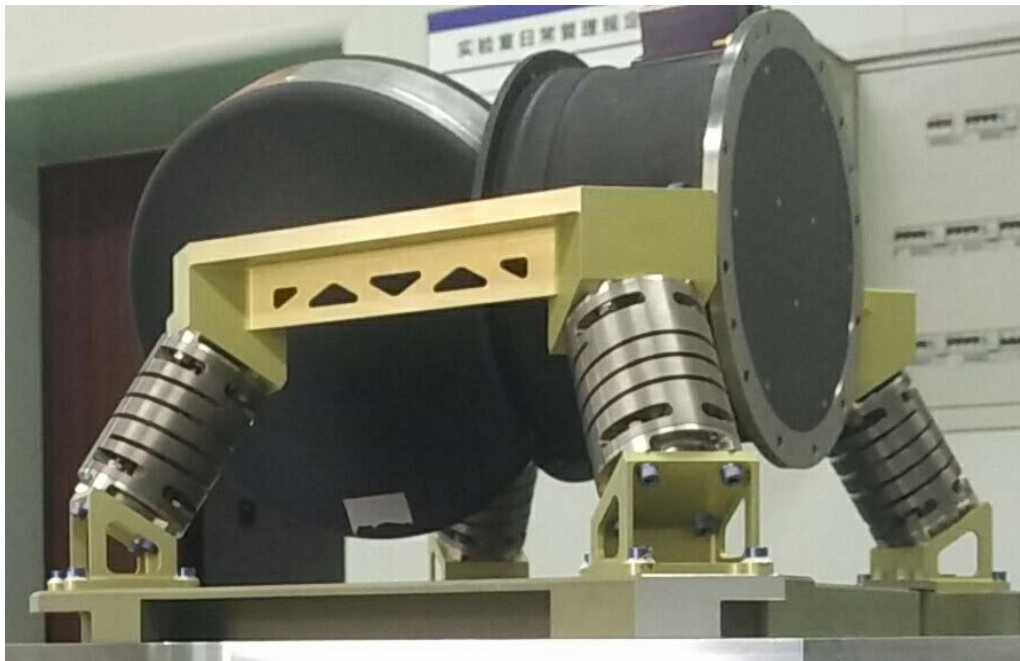


Fig. Single-machine load-bearing vibration isolation device

Product introduction:

The single-machine load-bearing vibration isolation device is composed of multiple sets of single-machine vibration isolators and structural connectors, and adopts an integrated design of vibration isolation and load-bearing. Compared with the large-loaded vibration isolation system, this device generally adopts a low-load single machine, and is suitable for all kinds of small single machines (such as CMG) with high requirements of vibration isolation, attitude and connection stiffness. This device can meet the service life requirements of more than 10 years in orbit.

Technical Specifications

- 1) Weight: $\leq 10\text{kg}$;
- 2) Load capacity: $10\text{kg} \sim 100\text{kg}$;
- 3) Vibration isolation performance (in-orbit insertion loss): $\geq 90\%$ ($5 \sim 500\text{Hz RMS}$);
- 4) Vibration isolation performance (emission amplification factor): ≤ 4 ;
- 5) Service life: ≥ 10 years;
- 6) Operating temperature: $-30^\circ\text{C} \sim +60^\circ\text{C}$

Application

It has been applied to GF-7 satellite, ZY-1 (02E) satellite, etc.

2.7. Passive driver

Product Introduction

A passive driver is a purely mechanical drive source that includes a spring, a booster train, and a time-controlled train. The passive driver uses a spring as a power source, and connects the spring and the wheel train through a bar. The spring simultaneously drives the booster train and the time-controlled train. The booster train transmits the amplified torque to the output shaft. The torque output is completed; the time-controlled wheel train controls the output speed of the booster train to ensure a smooth and uniform output torque of the mechanism. The passive driver does not require a controller, has low cost, and has a small locking impact. The currently developed products can meet the requirements of 180° expansion.

Technical Specifications

WQ20 passive driver

- 1) Working torque ($0^\circ \sim 180^\circ$): $\geq 10\text{Nm}$;
- 2) Rotation range: $\geq 180^\circ$;
- 3) 180° rotation time with 5Nm load: $\leq 5\text{min}$ ($0^\circ\text{C} \sim +80^\circ\text{C}$), $\leq 9\text{min}$ ($-50^\circ\text{C} \sim 0^\circ\text{C}$);
- 4) weight: $\leq 1.05\text{kg}$;
- 5) Operating temperature: $-50^\circ\text{C} \sim +80^\circ\text{C}$.



Fig. WQ20 passive driver

2.8. Mechanical speed limiter

Product Description

The centrifugal mechanical speed limiter is a purely mechanical structure with a high-strength wear-resistant housing and high-performance friction brake components. It can be widely used in the speed control of the deployment mechanism, to achieve a smooth deployment, emergency speed limit protection and other occasions. The product has compact structure, light weight, high temperature resistance, strong mechanical impact and high reliability.

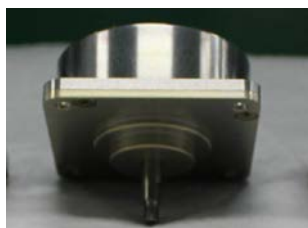


Fig. Centrifugal mechanical speed limiter

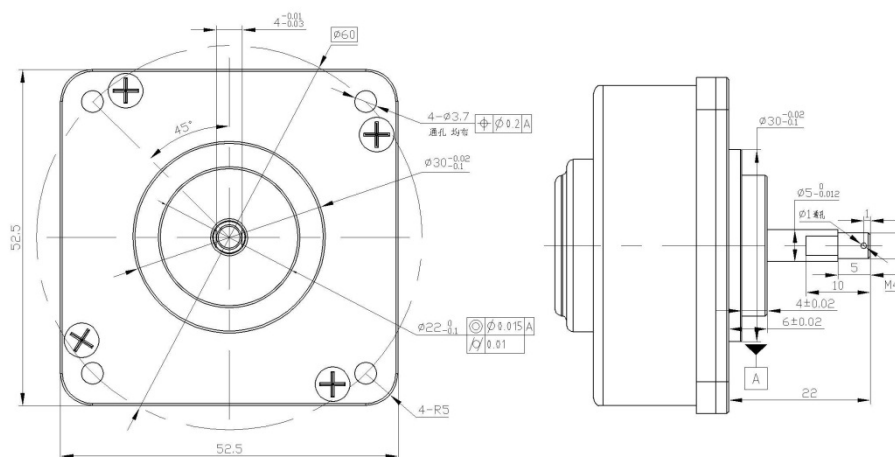


Fig. Centrifugal mechanical speed limiter interface diagram

Technical Specifications

No.	Item	Performance parameter
1	Balance speed under 0.05Nm traction torque	110±20rad/s
2	Balance speed at 0.075Nm traction torque	130±20rad/s
3	Balanced speed at 0.4Nm traction torque	300±50rad/s
4	Starting resistance torque below 3 rad/s	≤0.02Nm

5	Weight	≤ 135 g
6	service life	Vacuum storage: 7 years (normal temperature vacuum) Non-vacuum storage: 2 years (normal temperature and pressure)

Application

It has been applied to the Mars probe to achieve speed control of the deployment mechanism.

2.9. Ultrasonic motor

Product Description

The high-precision long-life driving mechanism is mainly composed of an AC permanent magnet synchronous motor, a harmonic reducer and a photoelectric encoder. Through precision matching shafting design, high-precision measurement and control design, etc., the arc second-level control accuracy is achieved, which is equivalent to the foreign high-precision drive mechanism. At the same time, through the solid-liquid composite lubrication basic research, the transmission sub-precision assembly design and other methods, the device can meet the service life requirements of 15 years in orbit.

Technical Specifications

No.	Item	Technical Specifications
1	driving voltage	400±50V (peak-to-peak)
2	total drive power	≤30W (in parallel drive mode)
3	Maximum torque	≥0.25N.m
4	Working torque	≥0.15N.m (at 80 rpm)
5	Power-off self-locking torque	≥0.5N.m (test after running)
6	Working speed	≥80 rpm (at a load of 0.15 N.m)
7	weight	≤210g
8	Environmental adaptability	Operating temperature -10 °C ~ +30°C; storage temperature -50 °C ~ +70 °C; working environment pressure ≤6.65×10 ⁻³ Pa.

Application

This product has been used in the first electromagnetic monitoring star Zhang Heng No. 1 reel in China, and works well in orbit.

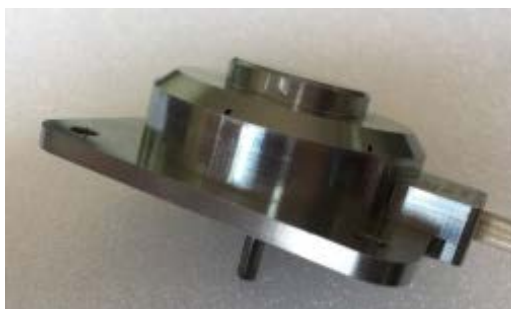


Fig. Ultrasonic motor

2.10. Hinged expansion rod mechanism



Fig. collapsed state of the hinged expansion rod mechanism



Fig. expansion state of the hinged expansion rod mechanism

Product Description

The hinge type expansion rod mechanism is a one-dimensional expansion mechanism composed of three hinges and three rods. The spring provides deployment power, and the deployment process is synchronous, and the deployment track is controllable. It can be used for space environment detection load and has the characteristics of non-magnetic and equipotential.

Technical Specifications

- Expansion length: 4.5m;
- Expansion fundamental frequency: $\geq 0.55\text{Hz}$ (with end load 1kg)
- Extend the repeatability: better than 0.1°
- Magnetic characteristics: The magnetic field on the top of the rod (3.6m from the root) is better than 0.062nT.

Application

This product has been applied on the ZH-1 satellite (launched in 2017) and successfully deployed in orbit.

2.11. Device of Clamp-Band Separation for Satellite and Rocket

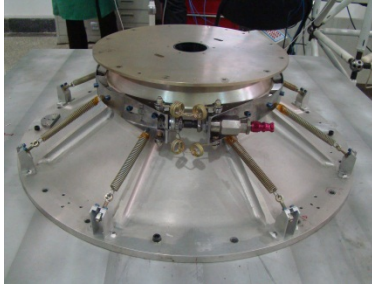


Fig. 1 Φ300-strap

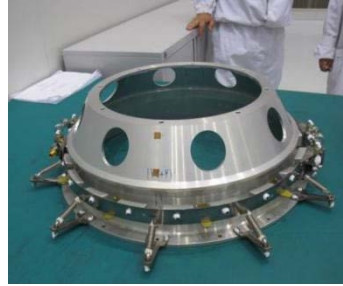


Fig. 2 Φ500-strap

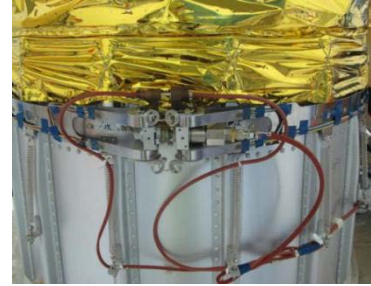


Fig. 3 Φ937-strap

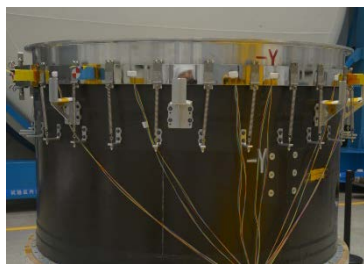


Fig. 4 Φ1194A-strap

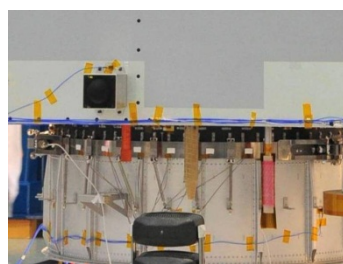


Fig. 5 Φ1194B-strap

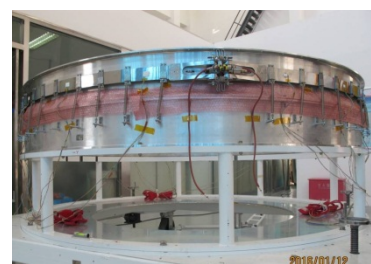


Fig. 6 Φ2334-strap

Product description

The strap is the lock and unlock device for connection between the satellite and the rocket or the satellite and some large components with separation requirements. Adopting the international standard V-clamp design, the straps are connected in series by two or three explosion bolts to realize the reliable connection between the connecting body and the connected body. When unlocking or separating is required, as long as one of the explosive bolts works, the connection can be released. The strap has the advantages of large connection rigidity and high reliability.

Technical Specifications

- Interface diameter: Φ300mm、Φ500mm、Φ937mm、Φ1194mm、Φ2334mm
- Preload
 - Maximum 1200kN (Φ300mm、Φ500mm);
 - Maximum 2300kN (Φ937mm);
 - Maximum 5200kN (Φ1194mm、Φ2334mm)
- Weight:
 - 2.5kg (Φ300mm);
 - 3.0kg (Φ500mm);
 - 8.5kg (Φ937mm);
 - 11~12.5kg (Φ1194mm);
 - 21.5kg (Φ2334mm) .
- Operating temperature: -40°C~+60°C

Application

Φ300-strap has been applied to some satellite flight tests, such as CX-1 satellite, SZ-7 spacecraft companion star, XW-1 satellite, and TX-1 satellite.

Φ500-strap has been applied to XX-7 satellite flight tests.

Φ937-strap has been applied to some satellite flight tests, such as FY-1, FY-2.

Φ1194A-strap has been applied to DFH-4SP satellite initial sample identification test.

Φ1194B-strap has been applied to some satellite flight tests, such as ZY-1, ZY-3, GF-2, GF-3.

Φ2334-strap has been applied to XX-16 satellite flight tests.

2.12. Solid-Lubrication rolling bearing Capability and Products

We have accumulated abundant database on bearings operating performance under various complex space service conditions. The solid-lubrication roll bearings adopt the lubrication system of unbalanced magnetron sputtering MoS₂ film on the bearing raceway and self-lubricating cage, featured by wide temperature operation range, low running torque and long life.

Through numerous programs, we have become the most competitive supplier of solid-lubrication rolling bearings for all kinds of spacecrafts in China and has built up powerful capabilities of bearings design, manufacture, assembly and test. We have a professional R&D team consisting of scientists, engineers and skilled technicians to provide high quality and reliability products at best cost and short delivery period to worldwide customers.

Products	Description	Maturity
Angular contact ball bearings	Bearing Dimensions: Bore diameter (3mm~130mm) Outside diameter (10mm~180mm) Bearing Materials: AISI 440C stainless steel Bearing Precision: P2, P4, P5 Lubrication: Solid Lubricants Revolution Speed: $DN \leq 2 \times 10^4$ (D: pitch diameter/mm N: speed/rpm) Operating mode: small angle swing, one-way continuous operation Application: high stiffness and precision, Support both axial and radial load Temperature Range: -100°C~+100°C	F
Deep groove ball bearings	Bearing Dimensions: Bore diameter (3mm~260mm), Outside diameter (8mm~320mm) Bearing Materials: AISI 440C stainless steel Bearing Precision: P2, P4, P5 Lubrication: Solid Lubricants Revolution Speed: $DN \leq 2 \times 10^4$ (D: pitch diameter/mm N: speed/rpm) Operating mode: small angle swing, one-way continuous operation Application: high radial stiffness, little or no axial load capacity Temperature Range: -100°C~+100°C	F
Flexible bearings	Bearing Dimensions: Bore diameter (30mm~60mm), Outside diameter (40mm~80mm) Bearing Materials: SAE 52100 bearing steel AISI 440C stainless steel Bearing Precision: P5 Lubrication: Solid Lubrication Revolution Speed: 2×10^4 (D: pitch diameter/mm	F

	N:speed/rpm) Operating mode: small angle swing, one-way continuous operation Temperature Range:-60°C~+150°C Application: harmonic drive wave-generator bearings	
Thin-Section bearings	Bearing Dimensions: Bore diameter (63.5mm~406.4mm) Outside diameter (76.2mm~431.8mm) Bearing Materials: AISI 440C stainless steel Bearing Precision: P2, P4, P5 Lubrication: Solid Lubrication Revolution Speed: 2×104(D:pitch diameter/mm N:speed/rpm) Operating mode: small angle swing, one-way continuous operation Temperature Range:-80°C~+150°C Application: mainly used in spacecraft robotic arm joint	F
Spherical plain bearing	Bearing Dimensions: Bore diameter (5mm~15mm), Outside diameter (14mm~26mm) Bearing Materials: AISI 440C stainless steel Bearing Precision: P6 Lubrication: Solid Lubrication Revolution Speed: ≤50rpm Operating mode: small angle swing Temperature Range:-150°C~+150°C Application: Mainly used in satellite solar array deployment mechanism	F

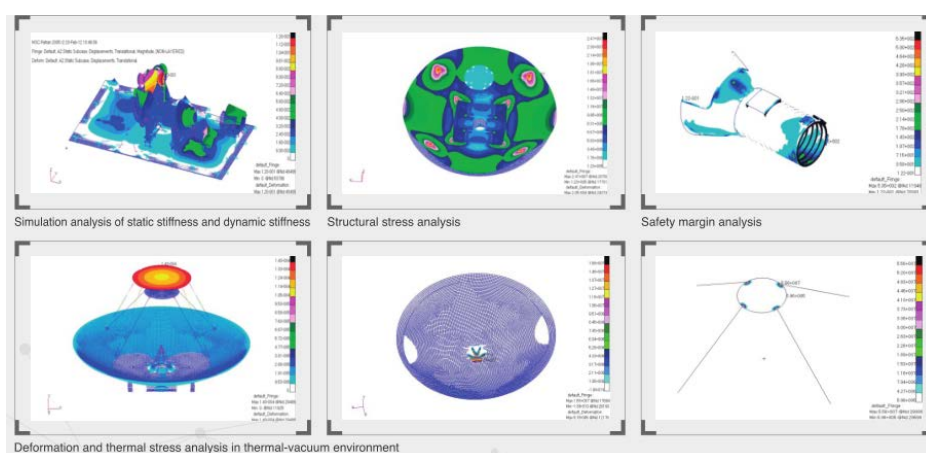
Notes: F(Flight-proven), D(Developed), U (Under development)

This product shall meet specified values for a minimum of 24 months after the date of shipment provided that the material is stored in its original unopened container at normal interior temperatures(15°C~30°C) and humidity(≤33%).

IV. Composite materials

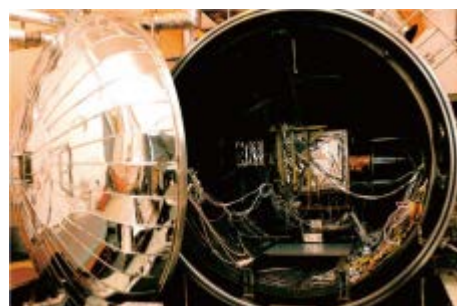
Having over 60 years' experience in designing, manufacturing and delivering composite materials products and services for spacecraft, we have obtained 24 patents obtained in the field of polymer matrix composites and honeycomb sandwich structures.

1. Structure design and simulation analysis of composites



2. Molding technologies of composites

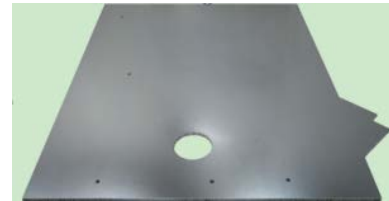
Autoclave molding technology;
 Vacuum bag molding technology;
 Expansion molding technology;
 Filament winding molding technology;
 Compression molding technology;
 RTM molding technology;
 Vacuum infusion molding technology;
 Cementing assembly technology.



3. On-board composite products

3.1. Aluminum deck/ aluminum honeycomb sandwich structure

- Large-size, multi-insert, high-precision honeycomb sandwich structure is formed through adhesive bonding- autoclave by aluminum panel, aluminum honeycomb, metal parts, heat pipes, etc.
- At present, the maximum dimension of the developed product is 3818mm×2780.8mm, which is currently the largest satellite cabin construction in China. The flatness of the whole plate is no more than 3.5mm, and the position of the hole is no more than $\phi 0.3\text{mm}$.
- Mainly used in satellite cabin wallboard.



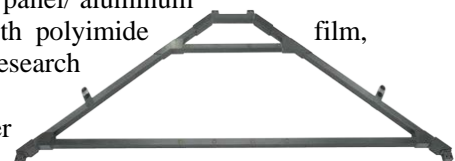
3.2. Carbon panel/ aluminum honeycomb sandwich structure panel

- Carbon panel/ aluminum honeycomb sandwich structure is assembled into a whole structure by the adhesive bonding by carbon panel/ aluminum honeycomb embedded parts, etc.
- The maximum external dimension of the developed satellite platform structural panels is 2686mm×2036mm, the flatness of the whole plate is no more than 3.0mm, the position of the hole is no more than $\phi 0.3\text{mm}$.
- Mainly used in satellite cabin wallboard.



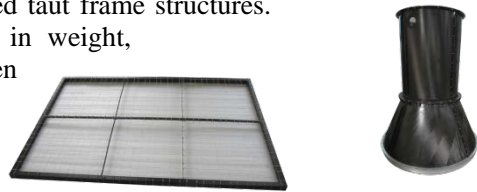
3.3. Rigid solar cell substrate panels and connecting brackets

- The rigid solar cell substrate panels is a carbon fiber mesh panel/ aluminum honeycomb sandwich structure, the surface is pasted with polyimide film, at present, the maximum external dimension of the research product is 6960mm×1800mm.
- The connecting bracket is a truss structure of carbon fiber composites.



3.4. The semi-rigid solar cell substrate panels

The semi-rigid solar cell substrate panels are single-sided taut frame structures. The semi-rigid solar cell substrate panels are lighter in weight, smaller in size, and better in heat dissipation when compared with the rigid substrates.



3.5. Solar panel

- The solar panels include the upper and lower solar panels, which are carriers of satellite primary energy solar cells.
- Assembled into a whole structure by panel, aluminum honeycomb, embedded parts and others after adhesive bonding
- Diameter $\phi 2100\text{mm}$, height 720mm , the exterior surface is FRP, which is insulated.
- Mainly used in spin-stabilized satellites, such as meteorological satellites, bi-satellite explorer satellite, and communications satellites, etc.



3.6. Bearing cylinders

The bearing cylinders are the structures of hard panels/aluminum honeycomb sandwich cylinder/column-cone integration, which are assembled into a whole structure by the carbon panels, the aluminum honeycomb, the embedded part, the upper, middle and lower end frame, the stringers and others through adhesive bonding.

The overall height of a typical product is 1238mm , the outer diameter of the cylinder column is $\phi 500\text{mm}$, the outer diameter at the bottom of the vertebral segment is $\phi 910\text{mm}$, the weight is no more than 22.5kg .



Mainly applied to the satellite platform structure taking the bearing tube as the main support.

3.7. Engine supports of satellites

The engine supports of satellites belong to truss-type structure of carbon fiber composites, which is a universal support for satellite platforms.

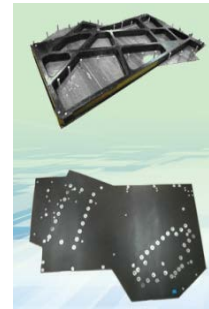


Mainly composed of composite joints and connecting rods, the shape of joint is special, the spatial angle is complex, which adopted three-dimensional textile RTM forming technology. The connecting rod is a thin-walled slender pipe fitting, which adopts winding forming technology.

Product height: 257mm, small end diameter: $\phi 262\text{mm}$, large end diameter: $\phi 1140\text{mm}$, weight: no more than 2.3kg, the maximum operating temperature: 200°C .

3.8. Camera backplane

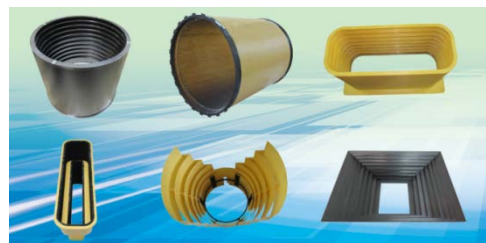
The camera backplane is used to support a wide range of optical components of remote sensing cameras and other equipment, which adopts high-modulus carbon fiber composites, and has the characteristics of strong designability, low weight, high rigidity, high strength and low expansion, etc. It has been widely used in small and medium-sized types of remote sensing camera support structures.



Dimensions: $1622\text{mm} \times 1311\text{mm} \times 60\text{mm}$, the flatness of the whole plate: no more than 0.5mm, the position of the mounting hole: no more than $\phi 0.15\text{mm}$, and the weight of the whole plate: no more than 25kg.

3.9. Ultra-thin and ultra-light hood

The hood is an important part of the remote sensing camera, which is mainly used to block and absorb external stray radiation or reduce the temperature gradient of the window, through which to improve imaging quality or detection performance. In recent years, hoods have been developing towards the direction of "functionalization" and "lightweight", and more and more optical remote sensor hoods are made of composite materials. For example, the main body of hoods adopts fiber (carbon fiber, aramid fiber, glass fiber) reinforced resin matrix composites or honeycomb sandwich structure (aluminum honeycomb, Nomex honeycomb).



3.10. Space-borne 2.2m antenna reflector

The spaceborne 2.2m antenna is made of carbon fiber composites, and is the currently existing antenna reflector with the largest diameter and highest accuracy of spaceborne antennas in China, which is mainly composed of the main reflector and the back frame. Of which, the main reflector is the carbon panel-aluminum honeycomb sandwich structure and surface is metallized. The back frame is the carbon fiber molded parts, there is no unstressed mechanical connection in the main reflector and the carbon fiber back frame.

Diameter: $2200\text{mm} \times 2000\text{mm}$, weight: no more than 45kg,



resolution of molded surface (RMS): no more than 0.2mm.

3.11. Space-borne 0.6m/ 1.0m antenna reflector

- The main reflector is a carbon panel/aluminum honeycomb sandwich structure.
- It has a series of advantages such as high resolution of molded surface precision, good overall rigidity, light weight and corrosion resistance, etc.
- Diameter: $\phi 600\text{mm}$, resolution of molded surface (RMS): no more than 0.08mm, weight: no more than 1.9kg.
- Diameter: $\phi 1000\text{mm}$, resolution of molded surface (RMS): no more than 0.15mm, weight: no more than 3.2kg.

3.12. OSR (Optical Solar Reflector)

Products	Description	Maturity
Non-conductive CeO ₂ -doped glass OSR	Solar absorptance: ≤ 0.10 Hemi-sphere emittance: ≥ 0.76 Dimension: 40×40 (20) mm	F
Conductive CeO ₂ -doped glass OSR	Solar absorptance: ≤ 0.10 Hemi-sphere emittance: ≥ 0.76 Front surface sheet resistance: $\leq 21\text{k}\Omega$ Dimension: 40×40 (20) mm	F

Notes:

Maturity: F(Flight-proven); D(Developed); U (Under development).

This product shall meet specified values for a minimum of 24 months after the date of shipment provided that the material is stored in its original unopened container at normal interior temperatures($10^{\circ}\text{C} \sim 30^{\circ}\text{C}$)

3.13. Conductive Aluminum Coated Polyimide Film

Products	Description	Maturity
12 μm ITO coated aluminized polyimide	$\alpha_s: \leq 0.41$ $\epsilon_H: \geq 0.52$ Surface resistivity: $\leq 250\text{K}\Omega$ Typical Weight: 19 g/m ²	F
25 μm ITO coated aluminized polyimide	$\alpha_s: \leq 0.44$ $\epsilon_H: \geq 0.64$ Surface resistivity: $\leq 250\text{K}\Omega$ Typical Weight: 36 g/m ²	F
50 μm ITO coated aluminized polyimide	$\alpha_s: \leq 0.49$ $\epsilon_H: \geq 0.75$ Surface resistivity: $\leq 250\text{K}\Omega$ Typical Weight: 71 g/m ²	F
75 μm ITO coated aluminized polyimide	$\alpha_s: \leq 0.51$ $\epsilon_H: \geq 0.77$ Surface resistivity: $\leq 250\text{K}\Omega$ Typical Weight: 109 g/m ²	F

Products	Description	Maturity
125μm ITO coated aluminized polyimide	$\alpha_s \leq 0.54$ $\epsilon_H \geq 0.89$ Surface resistivity: $\leq 250 K\Omega$ Typical Weight: 181 g/m ²	F

Notes:

Maturity: F(Flight-proven), D(Developed), U (Under development)

This product shall meet specified values for a minimum of 24 months after the date of shipment provided that the material is stored in its original unopened container at normal interior temperatures(10°C~30°C)

3.14. Germanium Coated Polyimide Film

Products	Description	Maturity
25μm Polyimide H Germanium Coated Polyimide Film	$\alpha_s \leq 0.41$ $\epsilon_H \geq 0.52$ Surface resistivity: $\leq 10^8 \Omega$ Microwave loss: $\leq 0.1 \text{ dB}$ Typical Weight: 19 g/m ²	F
50μm Polyimide H Germanium Coated Polyimide Film	$\alpha_s \leq 0.41$ $\epsilon_H \geq 0.72$ Surface resistivity: $\leq 10^8 \Omega$ Microwave loss: $\leq 0.1 \text{ dB}$ Typical Weight: 71 g/m ²	F
75μm Polyimide H Germanium Coated Polyimide Film	$\alpha_s \leq 0.41$ $\epsilon_H \geq 0.72$ Surface resistivity: $\leq 10^8 \Omega$ Microwave loss: $\leq 0.1 \text{ dB}$ Typical Weight: 109 g/m ²	F
125μm Polyimide H Germanium Coated Polyimide Film	$\alpha_s \leq 0.41$ $\epsilon_H \geq 0.72$ Surface resistivity: $\leq 10^8 \Omega$ Microwave loss: $\leq 0.1 \text{ dB}$ Typical Weight: 181 g/m ²	F
25μm 100CB Black Germanium Coated Polyimide Film	$\alpha_s \leq 0.60$ $\epsilon_H \geq 0.72$ Surface resistivity: $\leq 10^8 \Omega$ Microwave loss: $\leq 0.1 \text{ dB}$ Typical Weight: 36 g/m ²	F
25μm 1000XC Black Germanium Coated Polyimide Film	α_s : 0.50 typical ϵ_H : 0.78 typical Surface resistivity: $\leq 10^8 \Omega$ Microwave loss: $\leq 0.1 \text{ dB}$ Typical Weight: 36 g/m ²	F

Notes:

Maturity: F(Flight-proven), D(Developed), U(Under development)

This product shall meet specified values for a minimum of 24 months after the date of shipment provided that the material is stored in its original unopened container at normal interior temperatures(10°C~30°C).

V. Attitude and orbit control

1. Flywheel

1.1. Micro-flywheels Assembly (AOFW-3-1A)

The flywheel is an inertial performing assembly in the control system of the satellite. The flywheel assembly achieves optimal performances by low-cost design based on the realization of digital control and miniaturization of motor, bearing unit and circuitry. The assembly can provide three orthogonal output torques. The assembly has many capabilities such as light weight, small volume, easy to use, etc.



Performance Introduction

Micro-flywheels Assembly			
Type	Application Specification	Flight heritage	Application domain
AOFW-3-1A	60mNms	2017 first flight	Micro-satellites

Key Feature

- Low-cost design and realization
- Mechatronic
- Light weight, small volume, low power
- Optimal capabilities to adapt space environments

Performance Index

No.	Item	Unit	Capability
1	Dimensions	mm	120×100×95
2	Mass	g	≤ 1.6
3	Working temperature	°C	-5 ~ +45
4	Storage temperature	°C	-10 ~ +50
5	Communication Interface	--	RS422
6	Angular Momentum	mNms	60 (single)
7	Reaction torque	mNm	3 (single)

8	Steady state power	W	$\leq 1.3(\text{single})$
9	Maximum Power	W	$\leq 4.3(\text{single})$
10	Tolerance of radiation	Rad	$>10K$

1.2. 090 Digital Flywheel (SRMWI-090-0.1A)

The flywheel is an inertial performing assembly in the control system of the satellite. The flywheel achieves optimal performances by low-cost design based on the realization of digital control and circuitry miniaturization. The flywheel has many capabilities such as light weight, small volume, easy to use and so on. The flywheel can be used in micro satellites.



Performance Introduction

Micro-flywheels Assembly			
Type	Application Specification	Flight heritage	Application domain
SRMWI-090-0.1A	0.12Nms	2016 first flight	Micro-satellites

Key Feature

- Low-cost design and realization
- Mechanical
- Light weight, small volume, low power
- optimal capabilities to adapt space environments

Performance Index

No.	Item	Unit	Capability
1	Dimensions	mm	101×101×82
2	Mass	g	≤ 900
3	Working temperature	°C	-5 ~ +45
4	Storage temperature	°C	-10~+50
5	Communication Interface	--	RS422 or CAN
6	Angular Momentum	mNms	0.12
7	Reaction torque	mNm	≥5
8	Steady state power	W	≤4.5
9	Maximum Power	W	≤7
10	Tolerance of radiation	Rad	>10K

1.3. 160 Digital Flywheel (SRMWI-160-4A)

The flywheel is an inertial performing assembly in the control system of the satellite. The flywheel achieves upper performances by low-cost design based on the realization of digital control and circuitry miniaturization. The flywheel has many capabilities such as light weight, small volume, easy to use and so on. The flywheel can be used in micro satellites.



Performance Introduction

Micro-flywheels Assembly			
Type	Specification	Flight heritage	Application domain
SRMWI-160-4A	4Nms	2015 first flight	Micro-satellites

Key Feature

- Low-cost design and realization
- Mechatronic
- Light weight, small volume, low power
- Optimal capabilities to adapt space environments

Performance Index

No.	Item	Unit	Capability
1	Dimensions	mm	160×160×135
2	Mass	g	≤ 3.8
3	Working temperature	°C	-5 ~ +45
4	Storage temperature	°C	-10~+50
5	Communication Interface	--	RS422 or CAN
6	Angular Momentum	mNms	4
7	Reaction torque	mNm	≥0.04
8	Steady state power	W	≤9
9	Maximum Power	W	≤48
10	Tolerance of radiation	Rad	>10K

1.4. General Flywheel with Ball Bearings (FW-GR.420.100-1A)

FW-GR.420.100-1A flywheels provide MEO/GEO satellites with control torques and momentum exchange capability, via the internal speed adjustable inertia rotors.

As a mechatronic product, this flywheel has low power consumption, perfect performance in longevity and reliability. With advanced shafting design and lubrication, the flywheel is insensitive to severe environment, including temperature variation, radiation, and vibration.



Application

FW-GR.420.100-1A flywheels have been fully flight qualified and have been flying on the DFH-5 series satellites.

Performance Index

No.	Item	Unit	Capability	Note
1	Angular momentum	Nms	$100 \times (1 \pm 1\%)$	@ Nominal speed
2	Nominal speed	r/min	6000	
3	Operation speed range	r/min	± 6000	
4	Control mode		Torque control	
5	Operational mode		Momentum/ Reaction	
6	Max. output torque	Nm	≥ 0.13	
7	Max. loss torque	Nm	< 0.04	
8	Max. static friction torque	mNm	≤ 15	
9	Static imbalance	gcm	≤ 2	
10	Dynamic imbalance	gcm ²	≤ 30	
11	Start-up time	min	≤ 15	0 to Nominal speed
12	Power consumption	W	≤ 35	Steady state @Nominal speed
13	Mass	Kg	13.6	
14	Dimensions	mm	$\Phi 420 \times 134$	
15	Lifetime (in-orbit)	Year	≥ 15	
16	Zero-cross lifetime	Time	$\geq 100,000$	

17	Operational temperature range	°C	-5 ~ +45	
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1.5. General Flywheel with Ball Bearings (FW-GR.260.12-1B)

FW-GR.260.12-1B flywheels provide LEO/MEO satellites and Mini-satellites with control torques and momentum exchange capability, via the internal speed adjustable inertia rotors.

As a mechatronic product, this flywheel has low power consumption, perfect performance in longevity and reliability. With advanced shafting design and lubrication, the flywheel is insensitive to severe environment, including temperature variation, radiation, and vibration.



Application

The qualification of the FW-GR.260.12-1B flywheels come from flight heritage on 12 satellites, with 48 wheels onboard, totally 180 years of in-orbit operational time, and no failure record. The FW-GR.260.12-1B flywheels are used mainly on China's EO satellites series.

Performance Index

No.	Item	Unit	Capability	Note
1	Angular momentum	Nms	$12 \times (1 \pm 1\%)$	@ Nominal speed
2	Nominal speed	r/min	2500	
3	Operation speed range	r/min	± 2500	
4	Control mode		Torque control	
5	Operational mode		Momentum/ Reaction	
6	Max. output torque	Nm	≥ 0.1	
7	Max. loss torque	Nm	< 0.02	
8	Max. static friction torque	mNm	≤ 5	
9	Static imbalance	gcm	≤ 1	
10	Dynamic imbalance	gcm ²	≤ 15	
11	Start-up time	min	≤ 3	0 to Nominal speed
12	Power consumption	W	< 9	Steady state @Nominal speed
13	Mass	kg	7.3	
14	Dimensions	mm	$\Phi 260 \times 128$	
15	Lifetime (in-orbit)	Year	≥ 8	

16	Zero-cross lifetime	Time	$\geq 100,000$	
17	Operational temperature range	°C	-5 ~ +45	

1.6. 260 Flywheel with General Ball Bearing

The product is a kind of mechanical and electrical integrated product with digital control interfaces. It has the highest rotating speed measuring precision and the angular momentum resolution in China.

Application scope:

MEO and LEO

Main specifications



No	Item	Capability
1	Angular momentum	15Nms
2	Reaction torque	0.15Nm
3	Speed range	$\pm 3500\text{rpm}$
4	Supply voltage	28V
5	Mass	9kg
6	Steady power	8W
7	Operating temperature range	$-10^{\circ}\text{C} \sim +45^{\circ}\text{C}$
8	Design life	5 years
9	Overall dimension	$\Phi 252\text{mm} \times 116\text{mm}$
10	Lead time	T0+12months
11	Flight Heritage	over 10 years
12	Delivery quantity	68

1.7. 260 Flywheel with Great Moment

The product is a kind of mechanical and electrical integrated product. It is a torque mode flywheel with analog control interface, and it has high anti-radiation circuit and excellent environment adaptability.

Application scope

MEO and LEO

Main specifications



No.	Item	Capability
1	Angular momentum	25Nms
2	Anti-reaction torque	0.075Nm
3	Speed range	$\pm 6000\text{rpm}$
4	Supply voltage	28V/42V
5	Mass	8.5kg
6	Operating temperature range	$-10^{\circ}\text{C} \sim +45^{\circ}\text{C}$
7	Steady power	20W
8	Design life	5 years
9	Overall dimension	$\Phi 260\text{mm} \times 106\text{mm}$
10	Lead time	T0+12months

1.8. 350 Flywheel with Great Moment

The product is a kind of mechanical and electrical integrated product with digital control interfaces. It firstly adopts high-precision speed measuring unit which improves the angular momentum control momentum, and it has an excellent zero speed characteristic.



Application scope

MEO and LEO

Main specifications

No.	Item	Capability
1	Angular momentum	25Nms
2	Reaction torque	0.2Nm
3	Speed range	±2500rpm
4	Supply voltage	28V
5	Mass	12.5kg
6	Steady power	8W
7	Operating temperature range	-10°C~+45°C
8	Design life	5 years
9	Overall dimension	Φ337mm×128.5mm
10	External interface	flange dimensionΦ90; 6-M8 uniform
11	Lead time	T0+12months
12	Flight heritage	over 10 years experience
13	Delivery quantity	24

2. Gyroscope

2.1. 5Nms Variable Speed Control Moment Gyroscope

The 5Nms Variable Speed Control Moment Gyroscope (VSCMG) is a single gimbal Control Moment Gyroscope (CMG), which has variable rotor angular speed. A VSCMG can be considered as a hybrid device comprised of a CMG and a momentum (or reaction) wheel, with large output torque like a single gimbal CMG, and accurate output torque like a wheel. The VSCMG works in the regular CMG mode during rapid attitude reorientation, and alternates to the wheel control mode, when approaching the desired position for high pointing allocation.



The 5Nms VSCMG has the advantages of compact structure, small volume, light weight, low power consumption, and is insensitive to severe environment, including temperature variation, radiation, and vibration.

One drive electronics (VSCMGE) can offer five control channels, each for one 5Nms VSCMG, with power supply voltage range between 36V and 42V, and CAN bus used for telemetry and telecommand to the onboard computer.

Performance Characteristics of 5 Nms VSCMG

No.	Item			Capability
1	Angular momentum			5Nms
2	Rotor speed stability			0.02%
3	Wheel mode	Max. output torque		$\geq 0.03\text{Nm}$
4		Output torque accuracy		0.002 Nm
5		Peak power consumption		$\leq 45\text{W}$
6	CMG mode	Max. output torque		$\geq 6\text{Nm}$
7		Bandwidth		$\geq 20\text{Hz}$
8		Gimbal rate resolution		$0.01^\circ/\text{s}$
9		Gimbal rate range	Lower limit	$0.01^\circ/\text{s}$
10			Upper limit	$72^\circ/\text{s}$
11		Power consumption (single channel)	Steady state	$\leq 20\text{W}$
12			Peak	$\leq 35\text{W}$
13	Mass (Drive Electronics included, single channel)			$\leq 10\text{Kg}$
14	Life			5 years

2.2. CMG-1500/200-A Control Moment Gyroscope

CMG-1500/200-A Control Moment Gyroscope (CMG) is designed for the attitude control of large spacecrafts, such as space station, by changing the orientation of its spin axis, while the angular momentum has a constant magnitude.

The technical highlights of the CMG-1500/200-A CMG are system redundancy, long-life shafting design and lubrication, with completely independent intellectual property right.

CMG-1500/200-A CMG has low power consumption, complex structure with light weight, and is insensitive to severe environment, including temperature variation, radiation, and vibration.

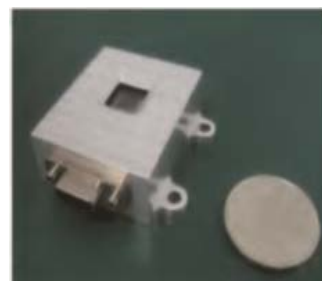
Performance Index

No.	Performance item	Unit	Capability
1	Max. output torque	Nm	200
2	Angular momentum	Nms	1500
3	Gimbal angle measurement resolution	arc sec	≤ 1
4	Gimbal angle measurement accuracy	arc sec	$<5(3\sigma)$
5	Gimbal rotation range	deg	± 180
6	Start-up time	min	≤ 240
7	Control mode		Gimbal angle velocity control
8	Gimbal positioning during launch phase		Available
9	Bandwidth	Hz	≥ 5
10	Gimbal rate control resolution	$^{\circ}/s$	≤ 0.001
11	Envelope specification	mm	980×700×700
12	Operational temperature range	$^{\circ}C$	-10 ~ +45
13	Mass	kg	≤ 135
14	Steady state power consumption	W	≤ 133
15	Rate of failures	fit	820
16	Lifetime (in-orbit)	Year	≥ 10

3. Sun sensor

3.1. Mini Dual-axis Analog Sun Sensor (SS-SiC-Ana/B-2B)

Based on 4-quadrant silicon cell, the sun incident angle about two axes can be got precisely and simultaneously within a large field of view. It's also designed with small size, light quality and modularization, standardization, long-life and has been applied in space station and other model projects



Product Introduction

Mini-Dual-axial Analog Sun sensor			
Type	Application Specification	Flight Heritage	Application domain
SS-SiC-Ana/B-2B	Accuracy better than 0.5°	Maiden Flight in Sep.2005	Pico/nano-satellite

Key Feature

- Low-cost, High reliability
- Passive product, analog current output
- Light quality, small size
- Wide operating temperature
- Strong resistance to irradiation

Performance Index

Size(mm)	40×34.5×13.5
Weight (g)	37
Structure Material	LY12 BCZYu
Operating Temperature	-100~+90°C
Strong Temperature	-105~+105°C
Signal Temperature	-105~+105°C
Signal Interface	Analog Current output
Field of View	Larger than ±45°
Accuracy	Better than 0.5°
Power Consumption	Passive product

3.2. II-type Dual-axis Analog Sun Sensor

Silicon photo-electric cell slice is used as photo-sensitive device for measuring biaxial solar vector angle. The product adopts 2-point/2-wire connection mode and panel mounting.

Application scope

This product is suitable for spacecraft.

Main specifications

Main performance	Accuracy	20°~36° Range: $\pm 2^\circ$
		0°~20° Range: $\pm 1^\circ$
	Field of view	$\pm 36^\circ \times \pm 36^\circ$
	Operation temperature	-90°C~+90°C
Technical parameters	Mass	0.15Kg
	Design Life	5a
	Dimension	82mm×50mm×45mm
Interface	<ul style="list-style-type: none"> ● This product provides 8 channels of signal lines and 2 channels of signal circles to combined switchbox or computer. ● Input signal: outputting current signal lines and signal circles of cell slice a, b, c and d. ● Signal content: 8 channels of current signal (+) and 2 channels of signal circles (-) of cell slice a, b, c and d. 	
Lead time	T0+3 months	
Delivery & Flight	Delivery prototype samples	6
	Delivery formal products	33
	First flight	Apr. 2009
Total flight time	360 months in total	



3.3. Sun Capture (0-1) Sensor

Silicon photo-electric cell is used as photo-sensitive device for sensing whether there is sun in field of view, and outputs state “0” or “1”. The product adopts 1-point/2-wire connection mode.



Application scope

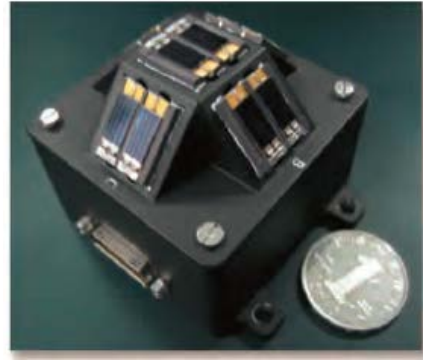
This product is suitable for spacecraft.

Main specifications

Main performance	Accuracy	Deviation in FOV $\leq 2^\circ$
	Field of view	$\pm 60^\circ \times \pm 60^\circ$
	Operation temperature	$-90^\circ\text{C} \sim +90^\circ\text{C}$
	FOV asymmetry	$\leq 3\%$
Technical parameters	Mass	0.14Kg
	Design life	5a
	Dimension	63mm \times 40mm \times 47mm
Interface	<ul style="list-style-type: none"> ● This product provides 6 channels of signal lines and 3 channels of signal circles to combined switchbox or computer. ● Input signal: simulation sunlight ● Output signal: outputting current signal lines and signal circles of X, Y and Z. ● Signal content: 6 channels of current signal (+) and 3 channels of signal circles (-) of X, Y and Z.. 	
Lead time	T0+3 months	
Delivery & Flight	Delivery prototype samples	6
	Delivery formal products	32
	First flight	Apr 2009
Total flight time	30 months in total	

3.4. Coarse Sun Sensor

The Coarse Sun Sensor can measure the solar aspect angle about two axis direction in a hemispherical field of view(FOV). The sensor is designed with high reliability, self-redundancy. The CSS has features of small size and mass, low power consumption, high reliability, low cost, and quick manufacture.



Key Feature

Hemispherical field of view (FOV)
Integrated with optical, mechanical and electronic technologies
Low power consumption
Self-redundant

Main Specification

Field of View(deg)	180°×180°
Accuracy(deg)	Better than 0.5° in the range of $\pm 10^\circ \times \pm 10^\circ$
Power (W)	0.25
Update rate (Hz)	50Hz

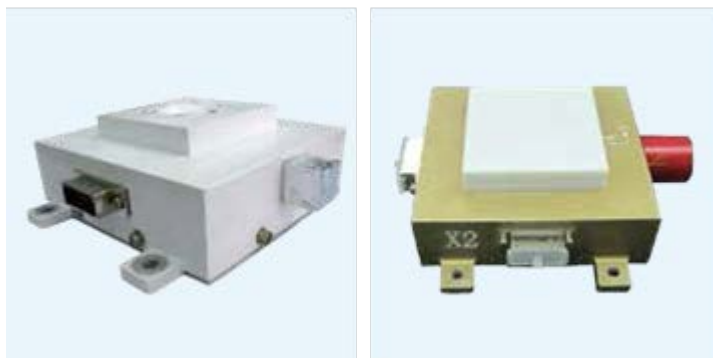
3.5. Digital Sun Sensor

The digital sun sensor adopts APS area array detector and digital signal processing in wide field of view, The sensor is designed with High accuracy and low power consumption, small size and with RS422 interface.

Application scope

Geosynchronous/medium/low earth orbit satellites or other spacecraft

Main specifications



Main performance	Accuracy	System error $\leq 0.05^{\circ}$
	Field of view	Random error $\leq 0.03^{\circ}$
Technical parameters	Mass	0.48kg \pm 0.05kg
	Operating temperature	-30 $^{\circ}$ C~+60 $^{\circ}$ C
	Design life	8 years
	Update rate	not less than 20Hz(at tracking)
	Power consumption	Not higher than 1W
	Dimension	106mm \times 126mm \times 42mm
Interface	Standard RS422 signal	
Lead time	T0+6 months	
Delivery & Flight	Delivery prototype samples	7
	Delivery formal products	2
	First formal products	25 th , Oct, 2013
Total flight time	77 months in total	

3.6. APS Sun Sensor (Line Array)

APS sun sensor (line array) adopts the optical-electronic-mechanical-integration design, and consists of the light slit glass, the electronic circuit system, the mechanical structure and the software. The line-array APS is employed as the imaging device, which, under the N-shaped 3-slit light slit glass, directly obtains the two-axis attitude angles of the sun vector with respect to the body coordinate system of the sun sensor. Finally, the two-axis angle information is output by RS422 serial port.

Applications

First flew on the SJ-9A satellite in 2012, this product is applicable to all kinds of spacecrafts.

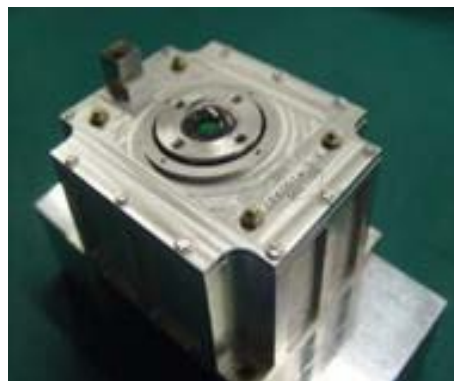
Technical Specifications

Overall dimension (mm)	100×80×60
FOV (deg)	128×128
Accuracy (deg)	Axis $\alpha \leq 0.02$
	Axis $\beta \leq 0.03$
Mass (kg)	0.46
Power (W)	1.1
Update rate (Hz)	10
Operating temperature (°C)	-40~+70
Design lifetime (year)	5

3.7. APS Sun Sensor (Area Array)

Product Description

APS sun sensor (area array) adopts the optical-electronic-mechanical-integration design, and consists of the mask with dust cover, the electronic circuit system, the mechanical structure and the software. The area-array APS is employed as the imaging device to directly obtain the two-axis attitude angles of the sun vector with respect to the body coordinate system of the sun sensor. The APS sun sensor exchanges data through the CAN bus with the integrated electronic sub-system.



Applications

Adopted in Chang E lunar exploration project, this product is applicable to all kinds of spacecraft.

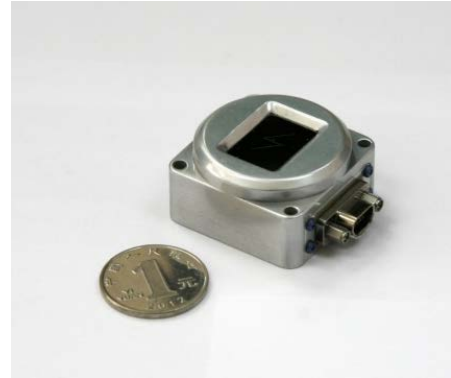
Specifications

Overall dimension (mm)	90×74×60
FOV (deg)	128× 128
Accuracy (deg)	Full field of view: 0.03
Mass (kg)	0.42
Power (W)	1.1
Operating temperature (°C)	-50~+70
Design lifetime (year)	15

3.8. Nano-Sun sensor(NSS-1)

Product Description

Sun sensor is used for attitude measurement by measuring the vector of sun light. With sun light projected onto the image sensor through a slit of the special mask, sun sensor can locate the sun spot by image processing algorithm and determine the incident angle of sun light.



Key features:

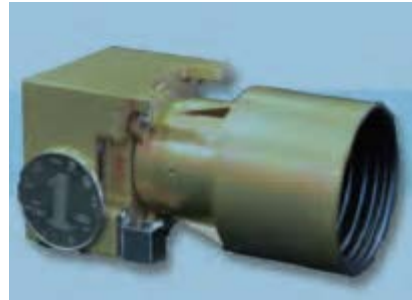
- wide field of view
- minimized dimensions and low mass
- low cost
- radiation hardened

Specifications

Field of view	120°×120°
Accuracy	0.3deg (3 σ)
Update rate	15Hz
Immunity of stray light	0.6 solar constant
Mass	35g
Power consumption	0.2W
Power supply	5V
Data interface	RS422 (CAN optional)
Operation temperature	-30℃ ~+65℃

4. Star Tracker

4.1. Nano Star Tracker (ST-MA-APS1-1)



The ST-MA-APS1-1 is an Autonomous Star Tracker based on COTS high reliable design. The fine capabilities of this product, such as low cost, low power consumption and various types of interface, match perfectly to Micro-Nano satellite of application platform.

Key Features

Based on COTS high reliable design
High integration design, batch production
Various types of interface, high platform applicability
Flying experience and plan: First fly at 2017

Specifications

Dimension	40×42×86
Mass (g)	108
Update rate	10Hz
Temperature	-30~+45°C
Power	4.5V~5.5V
Interface	CAN/RS-422/12C
FOV	20°×15°
Accuracy	10° (3)
Slew Consumption	1.2W
SEA	35°

4.2. Micro Star Tracker (ST-HA-APS4-1)

The ST-HA-APS4-1 is an Autonomous and highly integrated design Star Tracker. The fine capabilities of this product, such as low cost, low power consumption and miniaturization, match perfectly to high demanding LEO satellite application platform.

Key Features

High-resolution CMOS detector, low noise
 High integration, high thermal stability
 Low mass, low power consumption, low cost
 Advanced performance on-orbit



Specifications

Dimension	110×105×208
Mass (g)	1000
Update rate	10Hz
Temperature	-30~+60°C
Power	20V~50V
Interface	RS-42
FOV	17°circle
Accuracy	3°
Power Consumption	4.5W@28V
SEA	35

4.3. I-type Integrated High-accuracy APS Star Tracker

Product introduction

The I-type Integrated High-accuracy APS star tracker adopt APS area array detector and digital signal processing.

Key feature

Wide field of view,
High accuracy,
Low power consumption,
Small size



Application scope

Geosynchronous/medium/low earth orbit satellites or other spacecraft

Main specifications

Main performance	Accuracy	System error $\leq 0.05^{\circ}$
		random error $\leq 0.03^{\circ}$
	Field of view	Better than $-64^{\circ}\sim +64^{\circ}$ (conical FOV)
Technical parameters	Mass	0.48kg ± 0.05 kg
	Operating temperature	$-30^{\circ}\text{C}\sim +60^{\circ}\text{C}$
	Design life	8a
	Update rate	Not less than 20HZ (at tracking)
	Power consumption	Not higher than 1W
	Dimension	106mm \times 126mm \times 42mm
Interface	Standard RS422 signal	
Delivery & Flight	Delivered prototype sample	7
	Delivered formal products	2
	First flight	25 th , Oct, 2013
Total flight time	72 months in total	
Electrical interface	RS422	

4.4. II-type High-accuracy CCD Star Tracker

Product introduction

The II-type High-accuracy CCD star tracker adopts 1024×1024 area array CCD detector and integration structure. The fine capabilities of high accuracy and with RS422 interface.

Application scope

Geosynchronous/medium/low earth orbit satellites or other spacecraft

Main specifications



Main performance	Optical axis pointing accuracy	3 (arc-second/3o, <0.2°/s)
	Update rate	10Hz
	Dynamic performance	≥1°/s
	Field of view	17°×17°
	Sensitivity magnitude	6.5Mv
	Optimum operating temperature	-40°C~+40°C
	Strong sunlight protection angle	Against stray light that included angle with optical axis is larger than 27°
Technical parameters	Mass	≤3.5kg
	Power consumption	8.4W (OFF at cooling)
		14.4W (ON at cooling)
	Design life	8a
	Dimension	330mm×194mm×160mm
Interface	Standard RS422 or 1553B	
Lead time	T0+6 months	
Delivery & Flight	Prototype samples and formal products for delivery at Dec.2015	4 and 2 respectively
	Delivery prototype sample	3
	First flight	June 2015

4.5. III-type High-accuracy CCD Star Tracker

Product introduction

The III-type High-accuracy CCD Star Tracker adopts integration structure. The fine capabilities of Low weight, high accuracy, Good dynamic performance, High reliability and with RS422 and LVDS interface.

Application scope

Geosynchronous/medium/low earth orbit satellites or other spacecraft



Main specifications

Main performance	Optical axis pointing accuracy	1° (arc-second/ 3a, <0.2°/s)
	Update rate	10Hz
	Dynamic performance	≥1°/s
	Field of view	20°×20°
	Sensitive magnitude	6.5Mv
	Optimum operating temperature	-30°C~+40°C
	Strong sunlight protection angle	Against stray light that included angle with optical axis is larger than 27°
	Thermal stability	0.1°/°C
Technical parameters	Mass	≤2.5kg
	Power consumption	8W (OFF at cooling)
		15W (On at cooling)
	Design life	8a
	Dimension	318mm×131mm×131mm
Interface	Standard RS422 and LVDS	
Lead time	T0+6 months	
Delivery & Flight	Prototype samples and formal products for delivery at Dec. 2015	3 and 1 respectively
	First flight	Aug 2015 on schedule

4.6. High accuracy star tracker(HAST-2)

Product introduction

HAST-2 star tracker can measure 3-axis attitude from an arbitrary star field without any prior information. It is characterized by minimized dimensions, low mass, low power and high radiation tolerance, which can meet 7-year life of aerospace applications.

Key features:

- High accuracy up to 1 arcsec
- High Sensibility
- radiation tolerant



Specifications

Field of view	$\Phi 15^{\circ}$
Accuracy	1 arcsec (3σ) pitch/yaw; 10 arcsec (3σ) roll
Slew rate	$3^{\circ}/s$
Update rate	10Hz
Sensitivity	>7 Mi
Power consumption	3.3W (28V supply)
Power supply	28V (5V optional)
Data interface	RS422 (MIL-STD-1553B and CAN optional)
Baffle	40° (35° and 30° optional) sun exclusion angle
Operation temperature	$-40^{\circ}\text{C} \sim +65^{\circ}\text{C}$
Mass	985g
Dimension	$121*121*255 \text{ mm}^3$
Life	5-8 years

4.7. Micro-star tracker(MST-1)

Product introduction

MST-1 star tracker can measure 3-axis attitude from an arbitrary star field without any prior information. It is characterized by minimized dimensions, low mass, low power , which can meet 5-year life of aerospace applications.

Key features:

- minimized dimensions
- low mass and power
- radiation hardened



Specifications:

Field of view	$\Phi 25^{\circ}$
Accuracy	3 arcsec (3 σ) pitch/yaw; 20 arcsec (3 σ) roll
Slew rate	$2^{\circ}/s$
Update rate	5Hz
Sensitivity	>5.5 Mi
Power consumption	1.8W (5V supply)
Power supply	5V (28V optional)
Data interface	RS422 (CAN optional)
Baffle	35° sun exclusion angle
Operation temperature	$-40^{\circ}\text{C} \sim +65^{\circ}\text{C}$
Mass	350g(include baffle with 40° sun exclusion angle)
Dimension	60*60*55 mm ³
Life	3-5 years

4.8. Nano-star tracker(NST-1)

Product introduction

NST-1 star tracker can measure 3-axis attitude from an arbitrary star field without any prior information. It is characterized by minimized dimensions, low mass, low power and low cost, which can meet 5-year life of aerospace applications.

Key features:

- minimized dimensions
- low mass and power
- radiation hardened



Specifications:

Field of view	$25^{\circ} \times 25^{\circ}$
Accuracy	5 arcsec (3σ) pitch/yaw; 40 arcsec (3σ) roll
Slew rate	$2^{\circ}/s$
Update rate	5Hz
Sensitivity	>5.0 Mi
Power consumption	1.2W (5V supply)
Power supply	5V
Data interface	RS422 (CAN optional)
Baffle	40° sun exclusion angle
Operation temperature	$-40^{\circ}\text{C} \sim +65^{\circ}\text{C}$
Mass	79g
Dimension	$50 \times 50 \times 34 \text{ mm}^3$
Life	1-3 years

VI. Antenna

1. Telemetry & Control Antenna

This product is applied for the high and low orbit aircrafts to transmit/receive telemetry/remote control information. It covers UHF, S, X, Ka frequency ranges, involving broad beam, spot beam and electric scanning beam.

Application scope

This product is applied to low, medium and high-orbit satellites.

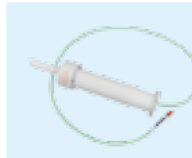


Environmental condition



Operating temperature $-100^{\circ}\text{C}\sim+100^{\circ}\text{C}$
Lead time 6 months

Application status

This product is applied to meteorological satellite, remote sensing satellite and deep space exploration satellite.

Main specifications

Frequency Range	Bandwidth (MHz)	Polarization (optional)	Gain (dB)	Dimension (mm)	Mass (kg)	Remarks
UHF	4	Linear polarization	Omnidirectional radiation in horizontal plane $\pm 30^{\circ}$: 3	72×235	0.15	 CKTX-UHF-ZZ-1
S: wide beam Electric scanning	200/20	Circular polarization	Wide beam: $\pm 90^{\circ}$: -4	$\Phi 90 \times 260$	0.5	 CKTX-X-LB-1(R)
S: wide beam Electric scanning	12	Circular polarization	Beam: 25° , scanning scope in circumferential direction: $\pm 60^{\circ}$, in axial direction $\pm 45^{\circ}$: 26dBW	430×280×90	7.5	 CKTX-S.ZZ-2

X	50	Circular polarization	$\pm 3^\circ$ beam ≥ 31	950×750×450	3	
Ka	200	Circular polarization	Within 7° beam ≥ 23	250×110×240	0.3	

2. Data Transmission Antenna

This product is applied to transmission of satellite-to-ground data transmission signals, wave beams and shape matching at frequency ranges of L, S and Ka.

Environmental condition

Operating temperature: $-100^{\circ}\text{C} \sim +100^{\circ}\text{C}$

Lead time: 6 months

Application scope

This product is applied to meteorological satellite, remote sensing satellite and deep space exploration satellite.



Main specifications

Frequency Range	Bandwidth (MHz)	Polarization (optional)	Gain (dB)	Dimension (mm)	Mass (kg)
L、S	20	Circular polarization	Beam-forming, scope of coverage $\pm 60^{\circ}$ Maximum: gain $\geq 2.5\text{dB}$	L- $\Phi 185 \times 360$ S- $\Phi 130 \times 230$	≤ 0.5
Mechanical movable data transmission antenna of beams at X Frequency Range	8000~9000	Circular polarization	Beam-forming, scope of coverage $\pm 60^{\circ}$, Maximum gain $\geq 2.5\text{dB}$	Compacted: $460 \times 445 \times 550$ Extended: $460 \times 445 \times 690$	≤ 7.5
Ka	20~30GHz	Dual Circular polarization	Beam width $\pm 1^{\circ}$, gain $\geq 38\text{ dB}$	Overall: $\Phi 1012 \times 596$ Antenna: $\Phi 1000 \times 415$	≤ 13.5

3. Antenna Pointing Mechanism

Antenna Pointing Mechanism (APM) is capable of moving and locating the two orthogonal axes in space. It can carry out the real-time tracking and locating of the antenna to the targets. APM realizes communication and data transmission between satellites and land stations. Also, APM meets the requirements of radars and observation devices for two-axis pointing motion.



APM-22-2-XY-1A

Main specifications

Code	APM-22-2-XY-1A	APM-22-2-EA-1A
Type	X-Y	Azimuth-Elevation
Tracking range	Rx: $\pm 100^\circ$, Ry: $\pm 100^\circ$	RA: $\pm 165^\circ$, RE: $\pm 200^\circ$
Tracking rate	0.005~8°/s	0.005~1.5°/s
Nominal torque	≤ 16 Nm	≤ 9 Nm
Mass	4.3~10.2kg	3.5kg
Power consumption	≤ 10 W	≤ 10 W
Operating temperatures range	-40°C~+60°C	-40°C~+60°C
Sensor type	Resolver, Encoder	Resolver
Pointing error	0.01°	0.1°
Design life	5 years	5 years
Lead time	T0+12 months	T0+12 months

4. S-band TT&C antenna

Brief Description

Compact
Light weight
Hemisphere pattern, high bore-sight gain
Excellent axially symmetric gain pattern
Excellent wide angle axial ratio

Applications

Use on satellites in low, medium and high orbit

Specifications

Gain ³ -2.5dBi	(area $\pm 75^\circ$ from bore-sight)
Operation temperature range	-170°C ~112°C
Supply period	5 months

5. X-band shaped reflector Data transmission antenna

Brief Description:

Excellent axially symmetric shaped beam for earth coverage.
High power handling capacity.

Applications

Used on remote sensing satellites in medium and low orbit for
high-speed broadband
data transmission



Technical Specifications

Frequency	8045～8400 MHz
Gain maximum	6.5dBi
Power handling capacity	140W
In-orbit life	12 years
Supply period	5 months

6. Dual-frequency GPS antenna

Brief Description

Utilizing an optimized wideband micro strip antenna element and sturdy aluminum alloy construction ensure the antenna will withstand harsh space environment and delivers reliable performance with high accuracy

Applications

Used on satellites in medium and low orbit for dual-frequency GPS signal receiving



Specifications

Gain ³ -3dBi	area $\pm 70^\circ$ from bore-sight
PCV	<2mm
In-orbit life	8 years
Supply period	4 months

VII. Integrate Circuit

Design Ability

- National leading space/military qualified IC design ability, offering customer customized IC design and R&D services.
- R&D ability of radiation hardened 10 million system gates level IC, SoC and microsystem integration with 28nm, 40nm, 65nm, 0.13/0.18μm, 0.25/0.35μm and 0.5μm processes.
- Several radiation hardening platforms (28nm/65nm/0.18μm/0.5μm).
- Standard ASIC development process and self-controlled serialized IP

Product profile

- Space qualified microelectronics product family, offering system level IC solution. International advanced radiation hardening design technology, leading domestic radiation hardening design technology development, firstly designed the space qualified microprocessor, FPGA, memory, bus and interface, ADC/DAC, etc.
- Microprocessor Initially proposed and adopted radiation hardening design technology to develop radiation hardened microprocessor. Successfully launched the first 32-bit radiation hardened microprocessor in China with its performance, function and radiation hardening ability equal to the AT697F developed by ESA in 2012. Successfully developed 300MHz radiation hardened microprocessor. Qualified with the design ability of radiation hardened multi-core high-performance microprocessor with 28nm process.
- FPGA Initially adopted radiation hardening design technology to solve the SEU problem of SRAM based FPGA in the world, making the SEU performance improved by 3-4 orders of magnitude than international counterpart FPGA. Successfully developed 10 thousand to 10 million system gates level FPGA series for space and military application with the logic scale up to 24 million system gates. Qualified with the design ability of 100 million system gates level FPGA for military application with performance compatible to Virtex-7 FPGA series of Xilinx.
- ADC/DAC Equipped with various core technologies of femtosecond low-jitter clock design, successive approximation redundancy calibration and multi channel noise isolation. Established space and military qualified mature product series with ultrahigh speed, high resolution and multi channel characteristics, including 8-bit to 16-bit AD convertors with sampling rate of 3MSPS~3GSPS and 12-bit to 16-bit DA convertors with sampling rate of 120MSPS~2.5GSPS. Qualified with the design ability of 12-bit 4GSPS ADC, 14-bit 1.25GSPS ADC, 16-bit 2.8GSPS DAC and 16-bit 12GSPS DAC.
- Memory Successfully developed SRAM series with memory capacity from 256kbit to 64Mbit and PROM series with memory capacity from 64Kb to 16Mb for high reliability space application. Qualified with the design ability of radiation hardened high speed synchronous sequential SRAM with large capacity (for QDR type SRAM, the memory data bandwidth is up to 36Gbps and memory capacity is 144Mbit).
- Bus and Interface Initially developed radiation hardened 1553B bus, 100M/200M/400Mbps Spacewire bus router and controller and high speed interface series in China, which have been applied in several national projects. Qualified with the design ability of 1553B bus series, Spacewire, high speed Serdes and high speed Ethernet product.
- RF and MMIC Established 0.35μm~55nm silicon based RF design technology platform and RF/MMIC testing platform under 40GHz, developed series products of Beidou RF, C/X waveband radiation hardened frequency synthesizer. Qualified with the design ability of RF transceiver with operating frequency of 6GHz and bandwidth under 56MHz and MMIC under 18GHz. The design technology of RF transceiver with operating frequency of 18GHz and bandwidth under 500MHz and MMIC under 40GHz is under development.

- Microsystem Integration Equipped with domestic advanced SoC/SiP platform and abundant IP library, successfully designed SoPC (BM3109IB) and mixed signal SiP (BAF1000/BAF300). Realized the integration of FPGA, microprocessor and large capacity memory, and the coprocessing of analog and digital signals.

Packaging Ability

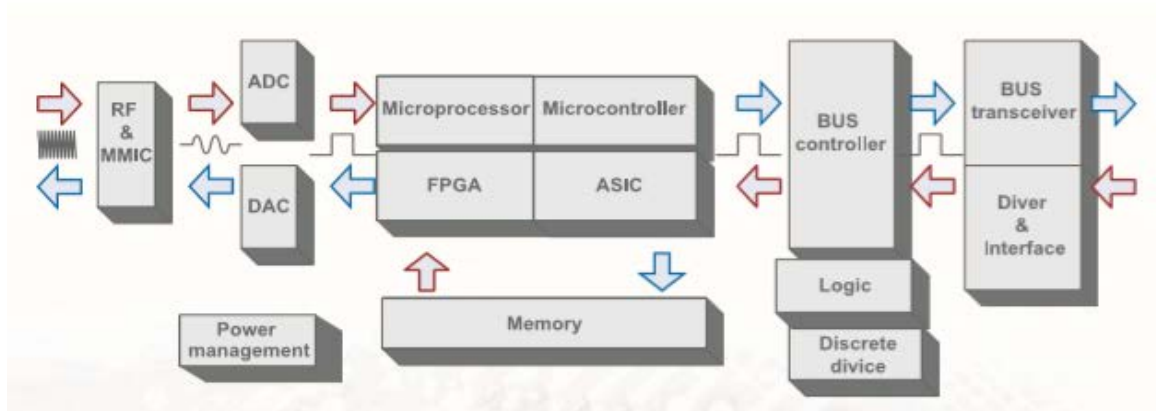
With over 6400m² clean room, and packaging ability of 500k pcs per year which accounts for 75% of domestic space qualified IC packaging market share. Equipped with 3 packaging lines (space qualified IC wire bonding ceramic packaging line, flip-chip packaging line, space level diode and transistor packaging line) with the ability of various packaging forms (DIP/ FP/ SOP/ CLCC/ PGA/ QFP/ BGA/ CGA/ FC/ MCM/ SiP). Up to 2000Pin packaging ability for space and military qualified IC. Packaging and assembling ability of ultra large scale single chip IC, hybrid IC, 3D assembly and microsystem, power device and photoelectric device. Ability to provide various services such as IC package design, packaging process development, mass production and application.

Testing and Reliability Examination Ability

Equipped with high performance IC testing equipments with the testing ability of 2048 channels, 32.5Gbps data transmission speed, 256MB/Pin vector storage depth and 24-bit analog signal resolution rate. Equipped with reliability examination equipments with the ability of screening and quality conformance inspection for military qualified IC and discrete device, which meets the national military standard requirements of complete environment, mechanical test, life test, and other reliability examinations. Equipped with domestic advanced testing and reliability examination equipments and methods with the ability of test program development, production and quality assurance for core signal processing devices such as 100 million system gates level FPGA, high performance processor and high-speed high-resolution convertor. IC products meet the national military standard requirements and the purchasing specification requirements of space customers.

Product Family

product family including SoC, FPGA, memory, ADC/DAC, bus and interface, logic, power management, RF and MMIC, ASIC and discrete devices



Processor and SoC							
Device Model	Features (Instruction Set)	Radiation Hardness	Max Frequency (MHz)	Operating Voltage (V)	Power Consumption (W)	Package	Compatible Model
BM3803MGRH	Based on SPARC V8 architecture, BM3803 is a 32-bit radiation hardened processor. It includes an Integer Unit , a Floating Point Unit , Cache, Interrupt Controller, Debug Unit, Timer, GPIO, WatchDog, UART, a flexible Memory Controller supporting PROM, SRAM, SDRAM and I/O mapping space, a PCI Controller supporting Host Bridge and Guest Bridge.	$TID \geq 100KRad(Si)$ $SEL \geq 75MeV \cdot cm^2/mg$	70	Core: 1.8	1	CPGA391	AT697E
		$SEU \leq 8E-5$ error/day/device		I/O: 3.3			



BM3803FMGRH	Based on SPARC V8 architecture, BM3803 is a 32-bit radiation hardened processor. It includes an Integer Unit , a Floating Point Unit , Cache, Interrupt Controller, Debug Unit, Timer, GPIO, WatchDog, UART, a flexible Memory Controller supporting PROM, SRAM, SDRAM and I/O mapping space, a PCI Controller supporting Host Bridge and Guest Bridge.	TID \geq 100KRad(Si) SEL \geq 75MeV · cm ² /mg	100	Core: 1.8	1	CPGA391	AT697E
		SEU \leq 8E-5 error/day/device		I/O: 3.3			
BM3803GMCCRH	Based on SPARC V8 architecture, BM3803GMCCRH is a 32-bit radiation hardened processor. It includes an Integer Unit, a Floating Point Unit (FPU), Cache, Interrupt Controller, Debug Unit, Timer, GPIO, WatchDog, UART, a flexible Memory Controller supporting PROM, SRAM, SDRAM and I/O mapping space, a PCI	day/device	100	Core: 1.8 I/O: 3.3	1	CCGA320	--



	Controller supporting Host Bridge and Guest Bridge.						
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Note: “*” means product under developmen

Space Qualified FPGA						
Device Model	Source	Radiation Hardness	Max Operating Frequency (MHz)	Operating Voltage (V)	Package	Compatible With
BQVR300RH	300k system gates, max user I/O: 162	$TID \geq 100\text{KRad(Si)}$ $SEL \geq 75\text{MeV} \cdot \text{cm}^2/\text{mg}$ $SEU \geq 15\text{MeV} \cdot \text{cm}^2/\text{mg}$	180	$V_{ccint}: 2.5$ $V_{cco}: 1.5 \sim 3.3$	CQFP228	XQVR300
BQR2V1000 BQR2V1000CCGA575	1 million system gates, max user I/O: 328	$TID \geq 100\text{KRad(Si)}$ $SEL \geq 75\text{MeV} \cdot \text{cm}^2/\text{mg}$ $SEU \geq 0.8 \sim 1.2\text{MeV} \cdot \text{cm}^2/\text{mg}$	300	$V_{ccint}: 1.5$ $V_{cco}: 1.2 \sim 3.3$	CBGA575 CCGA575	XQR2V1000



BQR2V3000	3 million system gates, max user I/O: 516	$TID \geq 100\text{KRad(Si)}$ $SEL \geq 75\text{MeV} \cdot \text{cm}^2/\text{mg}$ $SEU \geq 0.8 \sim 1.2\text{MeV} \cdot \text{cm}^2/\text{mg}$	300	$V_{ccint}: 1.5$ $V_{cco}: 1.2 \sim 3.3$	CCGA717	XQR2V3000
BQR2V6000	6 million system gates, max user I/O: 824	$TID \geq 100\text{KRad(Si)}$ $SEL \geq 75\text{MeV} \cdot \text{cm}^2/\text{mg}$ $SEU \geq 0.8 \sim 1.2\text{MeV} \cdot \text{cm}^2/\text{mg}$	300	$V_{ccint}: 1.5$ $V_{cco}: 1.2 \sim 3.3$	CCGA1144	XQR2V6000
BQR5VSX35T	3.5 million system gates, max user I/O: 360	$TID \geq 150\text{KRad(Si)}$ $SEL \geq 90\text{MeV} \cdot \text{cm}^2/\text{mg}$	450	$V_{ccint}: 1$ $V_{cco}: 1.2 \sim 3.3$	CCGA665	XQ5VSX35T
BQR5VSX50T	5 million system gates, max user I/O: 640	$TID \geq 150\text{KRad(Si)}$ $SEL \geq 90\text{MeV} \cdot \text{cm}^2/\text{mg}$	450	$V_{ccint}: 1$ $V_{cco}: 1.2 \sim 3.3$	CCGA665	XQ5VSX50T



BQR5VSX95T	9.5 million system gates, max user I/O: 640	TID \geq 150KRad(Si) SEL \geq 90MeV · cm ² /mg	450	Vccint: 1 Vcco: 1.2 ~ 3.3	CCGA1136	XQ5VSX95T
BQR5VSX240T	24 million system gates, max user I/O: 960	TID \geq 150KRad(Si) SEL \geq 90MeV · cm ² /mg	450	Vccint: 1 Vcco: 1.2 ~ 3.3	CCGA1738	XQ5VSX240T
BQR5VLX155T	15.5 million system gates, max user I/O: 640	TID \geq 150KRad(Si) SEL \geq 90MeV · cm ² /mg	450	Vccint: 1 Vcco: 1.2 ~ 3.3	CCGA1738	XQ5VLX155T
*BQR7V330T	33 million system gates, max user I/O: 700	TID \geq 150KRad(Si) SEL \geq 90MeV · cm ² /mg	700	Vccint: 1 Vcco: 1.2 ~ 3.3	CCGA1157	XQ7VX330T



*BQR7V690T	69 million system gates, max user I/O: 1000	TID \geq 150KRad(Si) SEL \geq 90MeV \cdot cm ² /mg	700	Vccint: 1 Vcco: 1.2 \sim 3.3	CCGA1926	XQ7VX690T
*BQR7K325T	32.5 million system gates, max user I/O: 500	TID \geq 150KRad(Si) SEL \geq 90MeV \cdot cm ² /mg	700	Vccint: 1 Vcco: 1.2 \sim 3.3	CCGA900	XQ7K325T
*BQR7K410T	41 million system gates, max user I/O: 500	TID \geq 150KRad(Si) SEL \geq 90MeV \cdot cm ² /mg	700	Vccint: 1 Vcco: 1.2 \sim 3.3	CCGA900	XQ7K410T
BSV1	1st generation intelligent scrubbing controller for FPGA	TID \geq 100KRad(Si) SEL \geq 75MeV \cdot cm ² /mg SEU \geq 37MeV \cdot cm ² /mg	20	3.3	CQFP44 CLCC44	--



BSV2CQRH	2nd generation intelligent scrubbing controller for FPGA	$TID \geq 100\text{KRad(Si)}$ $SEL \geq 75\text{MeV} \cdot \text{cm}^2/\text{mg}$ $\text{SEU} \geq 37\text{MeV} \cdot \text{cm}^2/\text{mg}$	20	3.3	CQFP48	--
BSV5CBRH	3rd generation intelligent scrubbing controller for FPGA	$TID \geq 100\text{KRad(Si)}$ $SEL \geq 75\text{MeV} \cdot \text{cm}^2/\text{mg}$ $\text{SEU} \geq 37\text{MeV} \cdot \text{cm}^2/\text{mg}$	20	$V_{\text{ccint}}: 1.8$ $V_{\text{cco}}: 3.3$	CBGA256	--

Note: “*” means product under development



Space Qualified Memory								
Device Model	Type	Radiation Hardness	Capacity (Bit)	Access Time (ns)	Operating Voltage (V)	Input Level	Package	Compatible Model
B7156ARH	SRAM		32Kx8	40	5	TTL	CDIP28	UT7156
B65608EARH	SRAM		128Kx8	45	5	TTL	CQFP68	M65608E
B8R128K32RH	SRAM		128Kx32	15	Core:1.8 I/O:3.3	CMOS	CQFP68	UT8R128K32
B8CR256K32RH	SRAM		256Kx32	25	Core:1.8 I/O:3.3	CMOS	CQFP68	--
B8R512K8ARH	SRAM		512Kx8	17	Core:1.8 I/O:3.3	CMOS	CFP36	UT8R512K8
*B9Q512ERH	SRAM		512Kx8	20	5 or 3.3	TTL	CFP36	UT8Q512E UT9Q512E
B8CR512K32ARH	SRAM	$SEL \geq 75\text{MeV} \cdot \text{cm}^2/\text{mg}$ SEU Error Rate $\leq 1\text{E-}10$	512Kx32	19	Core:1.8 I/O:3.3	CMOS	CQFP68	UT8CR512K32
*B9Q512K32ERH	SRAM	error/bit-day in Geosynchronous Orbit	512Kx32	25	5 or 3.3	TTL	CFP68	UT8Q512K32E UT9Q512K32E
B8R512K39RH	SRAM		512Kx39	Read: 20 Write:10	Core:1.2 I/O:3.3	CMOS	CQFP84	--



B8CR1M32RH	SRAM		1Mx32	Read: 20 Write:10	Core:1.2 I/O:3.3	CMOS	CQFP84	UT8ER1M32
B8CR1M39RH	SRAM		1Mx39	Read: 20 Write:10	Core:1.2 I/O:3.3	CMOS	CQFP84	UT8R1M39
B8CR2M32RH	SRAM		2Mx32	Read: 20 Write:10	Core:1.2 I/O:3.3	CMOS	CQFP84	UT8ER2M32
*B7134RH	Dual port SRAM		4Kx8	35	5	TTL	CDIP48	IDT7134
*B7006RH	Dual port SRAM		16Kx8	40	5	TTL	CQFP68	IDT7006
*B1245RH	QDR SRAM	TID $\geq 300\text{KRad(Si)}$	1Mx36	Operating requency: 250MHz	Vdd:1.8, I/O: 1.4 ~ vdd	HSTL	CCGA165	CY7C12451KV18
*B1545RH	QDR SRAM	SEL $\geq 75\text{MeV} \cdot \text{cm}^2/\text{mg}$ SEU Error Rate $\leq 1\text{E-}10$ error/bit-day in	2Mx36	Operating requency: 250MHz	Vdd:1.8, I/O: 1.4 ~ vdd	HSTL	CCGA165	CYRS1545AV18
*B1645RH	QDR SRAM	Geosynchronous Orbit	4Mx36	Operating requency: 400MHz	Vdd:1.8, I/O: 1.4 ~ vdd	HSTL	CCGA165	CY7C1645KV18
*B4141RH	QDR SRAM	TID $\geq 300\text{KRad(Si)}$ SEL $\geq 75\text{MeV} \cdot \text{cm}^2/\text{mg}$ SEU Error Rate $\leq 1\text{E-}10$	4Mx36	Operating requency:	Vdd:1.3, I/O:	HSTL	CCGA165	CY7C4141KV13



		error/bit-day in Geosynchronous Orbit(add EDAC)		666MHz	1.2±0.05			
B7204ARH	Asynchronous FIFO	TID ≥ 100KRad(Si) SEL ≥ 75MeV · cm ² /mg SEU ≥ 37MeV · cm ² /mg	4K×9	25	5	TTL	CDIP28	IDT7204
B6664RH	PROM		8K×8	45	5	TTL	CDIP28	HS-6664RH
B28F256RH	PROM		32K×8	45	5	TTL	CFP28 CDIP28	UT28F256QLE
B28F256LVRH	PROM		32K×8	65	3.3	CMOS	CFP28 CDIP28	UT28F256LVQLE
*B28F1024RH	PROM	TID ≥ 100KRad(Si)	32K×32	65	5	TTL	CQFP64	--
*B28C64RH	FLASH	SEL ≥ 75MeV · cm ² /mg SEU ≥ 37MeV · cm ² /mg SEU (memory cell)	64K	65	5	TTL	CDIP28	--
*B28C256RH	FLASH	≥ 75MeV · cm ² /mg	256K	65	5	TTL	CFP28 CDIP28	--
*B28C256LVRH	FLASH		256K	65	3.3	CMOS	CFP28	--



							DIP28	
B18V04RH	FLASH		4M	Operating frequency: 20MHz	3.3	TTL	CQFJ44	XQR18V04
B17V16RH	Anti-fuse type PROM		16M	20	3.3	CMOS	CQFJ44	XQR17V16

Note: “*” means product under development



Space Qualified A/D Converter													
Device Model	Radiation Hardness	Resolution (bit)	Channels	Update/ Sample Rate (MSPS)	Operating Voltage (V)	Power Consumption (mW)	Analog Input Range	INL (LSB)	DNL (LSB)	SNR (dB)	SFDR (dBc)	Package	Compatible Model
B9288ARH	TID \geq 100Krad (Si) SEL \geq 75MeV \cdot cm ² /mg	8	2	100	3	180	1Vp-p	± 1.5	± 1	43	50	CQFP48	AD9288
B08D1000RH	TID \geq 100Krad (Si) SEL \geq 75MeV \cdot cm ² /mg	8	2	1000	1.9	1600	0.6 ~ 0.8Vp-p	± 3	± 1	43	47	CQFP128	ADC08D1000
B08D1500RH	TID \geq 100Krad (Si) SEL \geq 75MeV \cdot cm ² /mg	8	2	1500	1.9	1900	0.6 ~ 0.8Vp-p	± 2	± 1	40.3	43.9	CQFP128	ADC08D1500
B083000RQC	TID \geq 100Krad (Si) SEL \geq 75MeV \cdot cm ² /mg	8	1	3000	1.9	1900	0.6 ~ 0.8Vp-p	± 2	± 1	40	45	CQFP128	ADC083000
B7892RH	TID \geq 100Krad(Si) SEL \geq 75MeV \cdot cm ² /mg SEU \geq 37MeV \cdot cm ² /mg	10	1	0.5	5	100	-10V ~ +10V	± 1	± 1	56	68	CDIP24	AD7892



B7892-5RH	TID \geq 100Krad(Si) SEL \geq 75MeV · cm ² /mg SEU \geq 37MeV · cm ² /mg	10	1	0.5	5	100	0~ 5V	± 1	± 1	56	68	CDIP24	AD7892
B2543ARH	TID \geq 60Krad (Si) SEL \geq 75MeV · cm ² /mg	12	11	0.066	5	≤ 20	0~ 5V	± 1.5	± 1	--	--	CDIP20	TLC2543
B128S102RH	TID \geq 100Krad (Si) SEL \geq 75MeV · cm ² /mg	12	8	1	2.7~5.25	≤ 20	0~V _{cc}	± 2	(-0.9, +1.9)	67	75	CFP16	ADC128S10 2QML-SP
B12D1000RH	TID \geq 100Krad (Si) SEL \geq 75MeV · cm ² /mg	12	2	1000	1.9	3200	0.6 ~ 0.8V _{p-p}	± 6	± 1	52.3	57	CCGA376	ADC12D1000
B12D1600RH	TID \geq 100Krad (Si) SEL \geq 75MeV · cm ² /mg	12	2	1600	1.9	3600	0.6 ~ 0.8V _{p-p}	± 6	± 1	51.1	55	CCGA376	ADC12D16 00QML-SP
B9243AMG	TID \geq 100Krad (Si)	14	1	3	5	≤ 350	0~ 5V	± 2.5	± 1	71	80	CPGA40	AD9243
B9240MGRH	TID \geq 60Krad (Si) SEL \geq 75MeV · cm ² /mg	14	1	10	5	≤ 450	0~ 5V	± 3.5	± 1.5	75.5	75	CPGA40	AD9240



B9240MQRH	TID \geq 100Krad (Si) SEL \geq 75MeV \cdot cm ² /mg	14	1	10	5	\leq 450	0 \sim 5V	\pm 3.5	\pm 1.5	75.5	75	CQFP44	AD9240
B1401RH	TID \geq 100Krad (Si) SEL \geq 75MeV \cdot cm ² /mg	14	1	20	2.5	\leq 100	2Vp-p	\pm 4	\pm 1	61	65	CFP48	RHF1401
*B9942RH	TID \geq 100Krad(Si) SEL \geq 75MeV \cdot cm ² /mg SEU \geq 37MeV \cdot cm ² /mg	14	2	40	3.3	600	0 \sim 1V	--	1	--	--	CCGA100	AD9942BBCZ
*B9690RB	TID \geq 100Krad (Si) SEL \geq 75MeV \cdot cm ² /mg	14	1	400	1.25/2.5 /3.3	\leq 4000	1.7Vp-p	\pm 6	\pm 1	64	75	CBGA92	AD9690
*B9652RB	TID \geq 100Krad (Si) SEL \geq 75MeV \cdot cm ² /mg	16	1	250	3.3/1.8	\leq 2500	2 \sim 2.5Vp-p	--	--	70	75	CBGA144	AD9652

Note: “*” means product under development



Space Qualified D/A Convertor

Device Model	Radiation Hardness	Resolution (bit)	Channels	Update/Sample Rate (MSPS)	Operating Voltage (V)	Power Consumption (mW)	Full-scale output current (mA)	INL (LSB)	DNL (LSB)	SFDR (dBc)	Package	Compatible Model
B9762AMG	TID \geq 100KRad (Si)	12	1	120	3.3or5	\leq 220	2 ~ 20	\pm 4.5	\pm 2.5	66	CPGA28	AD9762
*B121S101RH	TID \geq 100 KRad (Si) SEL \geq 75MeV \cdot cm ² /mg	12	1	Clock Frequency: 20MHz	3.3 ~ 5.5	5	--	\pm 12	\pm 2	--	--	DAC121S101QML-SP
BM6106MGRH	TID \geq 100 KRad (Si) SEL \geq 75MeV \cdot cm ² /mg	14	1	120	3.3or5	\leq 200	2 ~ 20	\pm 6.5	\pm 4.5	66	CPGA28	AD9764
B9739RB	TID \geq 100Krad (Si) SEL \geq 75MeV \cdot cm ² /mg	14	1	2000	3.3/1.8	\leq 1600	9 ~ 30	\pm 5	\pm 3	50	CBGA160	AD9739
B9129RB	TID \geq 100Krad (Si) SEL \geq 75MeV \cdot cm ² /mg	14	1	3000	1.9/-1.5	\leq 1500	10 ~ 34	\pm 9	\pm 5	47	CBGA160	AD9129



B9726RHQN	TID \geq 100Krad (Si) SEL \geq 75MeV · cm ² /mg	16	1	400	3.3/2.5	\leq 520	2 ~ 20	\pm 9	\pm 4	68	CQFP80	AD9726
B9122RH	TID \geq 100Krad (Si) SEL \geq 75MeV · cm ² /mg	16	2	1000	3.3/1.8	\leq 1500	9 ~ 30	\pm 5.5	\pm 3.5	70	CQFP72	AD9122
*B9144RB	TID \geq 100Krad (Si) SEL \geq 75MeV · cm ² /mg	16	4	1500	1.2/1.8/3.3	\leq 3000	14 ~ 27	\pm 10	\pm 6	50	CBGA92	AD9144

Note: “*” means product under development

VIII. Power Supply

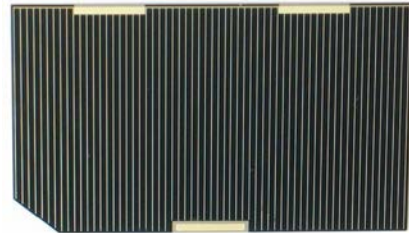
1. Triple-Junction GaAs Solar Cell

Features

high-efficiency, high reliability, thermal stability and strong radiation resistance.

Applications

Applied on remote-sensing, weather, navigation and science experiment satellites, and so on. The success rate of mission undertaken is 100%.



2. Typical parameters of solar cell - 27%

Item		Parameters
First generation of GaAs solar cell	p/n structure	n-on-p structure, GaInP2/InGaAs/Ge Triple Junction Solar Cell
	bypass diode	Integrated bypass diode of solar cell
	dimension (mm)	$(40.0 \pm 0.1) \times (30.3 \pm 0.1)$
	thickness (mm)	0.185 ± 0.020
cover glass		anti-radiation glass
interconnector		Ag as interconnector
cover glass adhesive		silicon adhesive for space use
average efficiency		27% (AM0, 25°C)

radiation degradation	degradation $\leq 17\%$ (1MeV, $1 \times 10^{15} \text{e/cm}^2$)
solar absorptance	0.92 ± 0.02
emittance (Normal)	0.84 ± 0.03
International similar product	America EMCORE26.8%; Germany Azur27%

Applications: Applicable for LEO, MEO and GEO.

3. Typical parameters of solar cell - 28.6%

Item		Parameters
Third generation of GaAs solar cell	p/n structure	n-on-p structure, GaInP ₂ /InGaAs/Ge Triple Junction Solar Cell
	bypass diode	separated bypass diode of solar cell
	dimension (mm)	(80.0±0.1) × (40.0±0.1)
	thickness (mm)	0.155±0.020
cover glass		anti-radiation glass
interconnector		Ag as interconnector
cover glass adhesive		silicon adhesive for out space use
average efficiency		30.0% (AM0, 25°C)
radiation degradation		degradation ≤15% (1MeV, 1×10 ¹⁵ e/cm ²)
solar absorptance		0.92±0.02
emittance (Normal)		0.84±0.03
International similar product		America EMCORE: 29.5%; Germany Azur: 29.4%

Applications: Planned for high-resolution satellite, applicable for LEO, MEO and GEO.

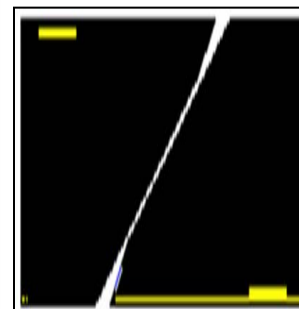
4. Heterotypic Solar Cell

Features

Heterotypic solar cell is the shape-variation of traditional triple-junction GaAs solar cell. Characteristics are high efficiency, affordable and small-size, so more solar cells can be mounted at limited areas.



Triangular Solar Cell



Trapezoidal Solar Cell

Applications: Micro-nano satellite, Terrestrial photovoltaic module. efficiency,

Item		Parameters
Heterotypic GaAs solar cell	p/n structure	n-on-p structure, GaInP2/InGaAs/Ge Triple Junction Solar Cell
	dimension (mm)	35.4×16.7 (35.4×13.6) ×14.7
	weight (g)	0.34
cover glass		anti-radiation glass
cover glass adhesive		silicon adhesive for out space use
average efficiency		27% (AM0, 25°C)

affordable and small-size, so more solar cells can be mounted at limited areas.

5. GaAs Solar Array

Features: high output power, high strong anti-radiation capacity, wide application range.

Applications: LEO, MEO, GEO and explorations of the spacecraft.

BOL specific power of area (W/m²): 285~325

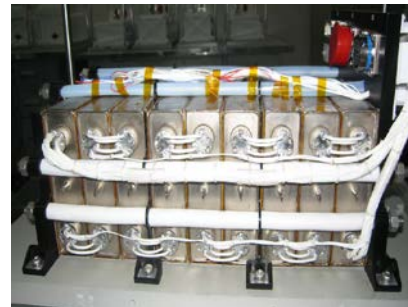
BOL specific power of area (W/kg): 140~165



6. Ni-Cd Battery

Definition:

Nickel –cadmium battery is an important part of satellite power supply sub-system. As an energy storage device, it is used for each phase of flight in the service life of satellite, and can provide sufficient electric energy for satellite.



Technical Parameters:

Designed lifetime: 3~5a (DOD≤15%)

Applications:

Satellites of FY series, satellites of ZY series, satellites of SJ series, satellites of YG series, spacecraft of SZ series.

7. Power Control Unit

Definition:

This product integrates discharge circuit, charge circuit and shunt circuit to regulate multiple solar arrays with combined array design, it can realize the follow-up charge for energy storage products.



Technical Parameters:

Model	PCU			
Output Voltage (V)	28	28	free	42
Output Power (W)	800	2500	4000	3200
Discharge Regulation Efficiency(%)	92	88	91	94
Weight(Kg)	18.3±0.2	31±0.2	21±0.2	30±0.2
Dimension(mm)	385×300×210	520×302×245	431×300×214	484×420×203

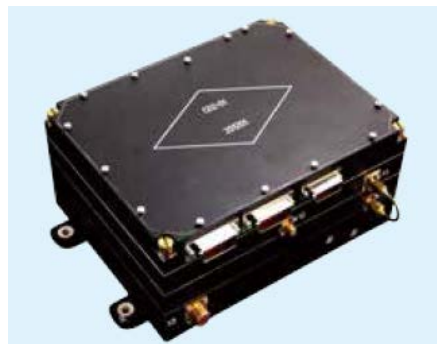
Applications: Satellites of YG, SJ, FY series.

IX. Transponder & Receiver & Transmitter

1. S-Frequency Range Spread-Spectrum Transponder

Product introduction

This product relies on non-coherent spectrum spread system to enable the aircraft to complete satellite-to-ground communication for tracking, telemetry and command. Five channels (one channel of remote control signal and four channels of ranging signals) are available at the uplink and two channels (one channel of telemetry signal and one channel of ranging signals) at the downlink. The satellite-to-ground integrated functions can be achieved by combined design.



Application scope

Low, medium and high-orbit satellite

Application status

This product is applied to meteorological satellites and remote sensing satellite.

Main specifications

Modulation mode	PCM-CDMA-BPSK
Remote control & demodulation sensitivity	superior to -112dBm
Dynamic range of received signal level	$\geq 60\text{dB}$
Range of frequency acquisition	$\pm 90\text{kHz}$
Acquisition duration	$\leq 5\text{s}$
Remote control/ telemetry rate	2000bps/4096bps
Spreading code rate	10.23Mcps
Velocity measuring/ranging accuracy	(superior to 2.5cm/s)/(superior to 1.5m)
Doppler rate of change	-2.5kHz/s~+2.5kHz/s
Anti-interference	15dB
Operating temperature	-20°C~+45°C
Dimension	160mm×130mm×120mm (main dimensions)
Mass	$\leq 3.5\text{kg}$

Power consumption	$\leq 22\text{W}$
Lead time	12 months

2. Satellite-Borne Dual-Mode Four-Frequency GNSS Receiver

Characteristic

Dual-Mode Four-Frequency: GPS L1/L2, BDS B1/B3

Millimeter-Scale High Raw Data Quality

Precise Orbit Determination: <2m

First High Precise Orbit Determination Using BDS as One of the Main Mission Payloads of XW-2

Highly miniaturized and Low-Power: > 95% Reduced in Volume and Power Consumption Compared to Functionally Equivalent Products

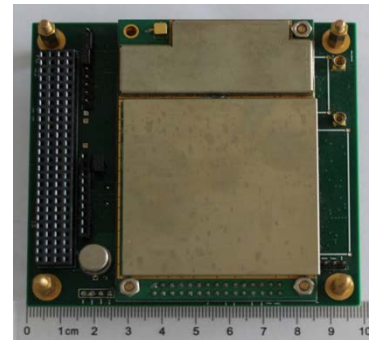
-90°C Ultra-Low Temperature Antenna Supporting a Wide Range of all Frequencies

Orbit Calculation and On-Board Telemetry

Reliability Design and Structure Design

Integrated Test System

Perfect Quality Assurance System and Standard Process Control



Main specifications

Type	Payload, Orbital Altitude 400km
GNSS Signals	GPS L1 L2, BDS B1 B3
Work Mode	GPS, BDS, GPS+BDS, Backup
Accuracy	Position: 10m, Velocity: 0.2m/s
Post-Accuracy	Centimeter-Scale
Sensitivity	-160dBW
Start Time	60s
Dynamics	$V < 10\text{km/s}$, $a < 4g$
Self-Monitoring	Yes
Power Consumption	<3.5W(GPS+BDS), <2.5W(GPS), <1.1W(BDS), <1W(Backup)
Temperature	Receiver: -30°C~+70°C, Antenna: -90°C~+90°C
Size	99.2mm×96mm×15mm
Weight	Receiver: 95g, Antenna:80g

Interface	RS422
Present	On-Orbit Performance on PN1 >3 Flight-Years

3. X-Wave Band Digital Transmission Transmitter III

Product introduction

This product is applied to transmission of satellite-to-ground data transmission signals, wave beams and shape matching at frequency ranges of L, S and Ka.



DTEU-X-50-IC (RJ)

Application scope

This product is applied to low, medium and high-orbit satellites.

Application status

This product is applied to remote sensing satellite.

Main specifications

Frequency accuracy	superior to $\pm 2 \times 10^{-6}$
Frequency stability	Long-term: $1 \times 10^{-5}/8$ year
	Short-term: $\leq 1 \times 10^{-9}/0.1s$ (allan variance)
Rate of input signal code	5Mbps~450Mbps (NRZ-L)
Differential mode	NRZ-M/DNRZ optional
Coding mode	CONV (4,3,7) /LDPC (7136,8192) optional
Modulation mode	DQPSK/ QPSK /OQPSK optional
Phase unbalance	superior to $\pm 4^\circ$
Amplitude unbalance	superior to 1dB
Spectral density of SSB phase noise	-62dBc/Hz@100Hz -70dBc/Hz@1kHz
	-77dBc/Hz@10kHz -92dBc/Hz@100kHz
	-102dBc/Hz@1MHz -112dBc/Hz@10MHz
Operating temperature	-25°C~+60°C
Dimension	200mm×160mm×94mm (body dimension)
Mass	$\leq 3.8kg$
Power consumption	$\leq 9W$
Lead time	12 months

4. Ultra-High speed D Type Data Transmission Terminal

Product introduction

This product is an ultra-high speed data processor with 10T memory, featuring ultra-high speed data processing and enhanced single event upset capacity.

Application scope

This product is applied to low, medium and high-orbit satellites.



DITU-D-1

Application status

This product is applied to remote sensing satellite.

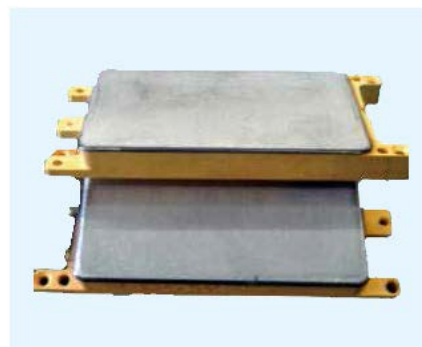
Main specifications

Processing speed	10Gbps
Memory	10T
Operating voltage	28~40V
Power consumption	45W
Mass	≤12.9kg
Dimension	290mm×280mm×225mm
Lead time	12 onths

5. Two-Channel T/R component for X Frequency Range

Product introduction

The two-channel X-Frequency Range TR component is applied to active phase array with both channels transmitting amplified output power up to 10W, contributing to reception gain of 26dB, 5 digital phase shifts and 6 digital control attenuations.



Application status

This product is suitable for a variety of active phased-array antenna arrays at X wave band.

Main specifications

Operating Frequency Range	X waveband $\pm 500\text{MHz}$
Output power for transmitting	10W, Max.duty cycle 50%
Power added efficiency	$\geq 28\%$
Reception gain	$\geq 26\text{dB}$
Coefficient of reception noise	$\leq 3.5\text{dB}$
Phase shift	5 phases, step-by-step 5.625° , RMS accuracy ≤ 30
Attenuation	6 phases, step-by-step 0.5dB, accuracy ≤ 0.5
Received input signal P1dB	$\geq -24\text{dBm}$
Operating temperature	$-40^\circ\text{C} \sim +60^\circ\text{C}$
Range of storage temperature	$-50^\circ\text{C} \sim +70^\circ\text{C}$
Dimension	78mm \times 38.8mm \times 8.8mm
Mass	$\leq 40\text{g}$
Lead time	12 months