

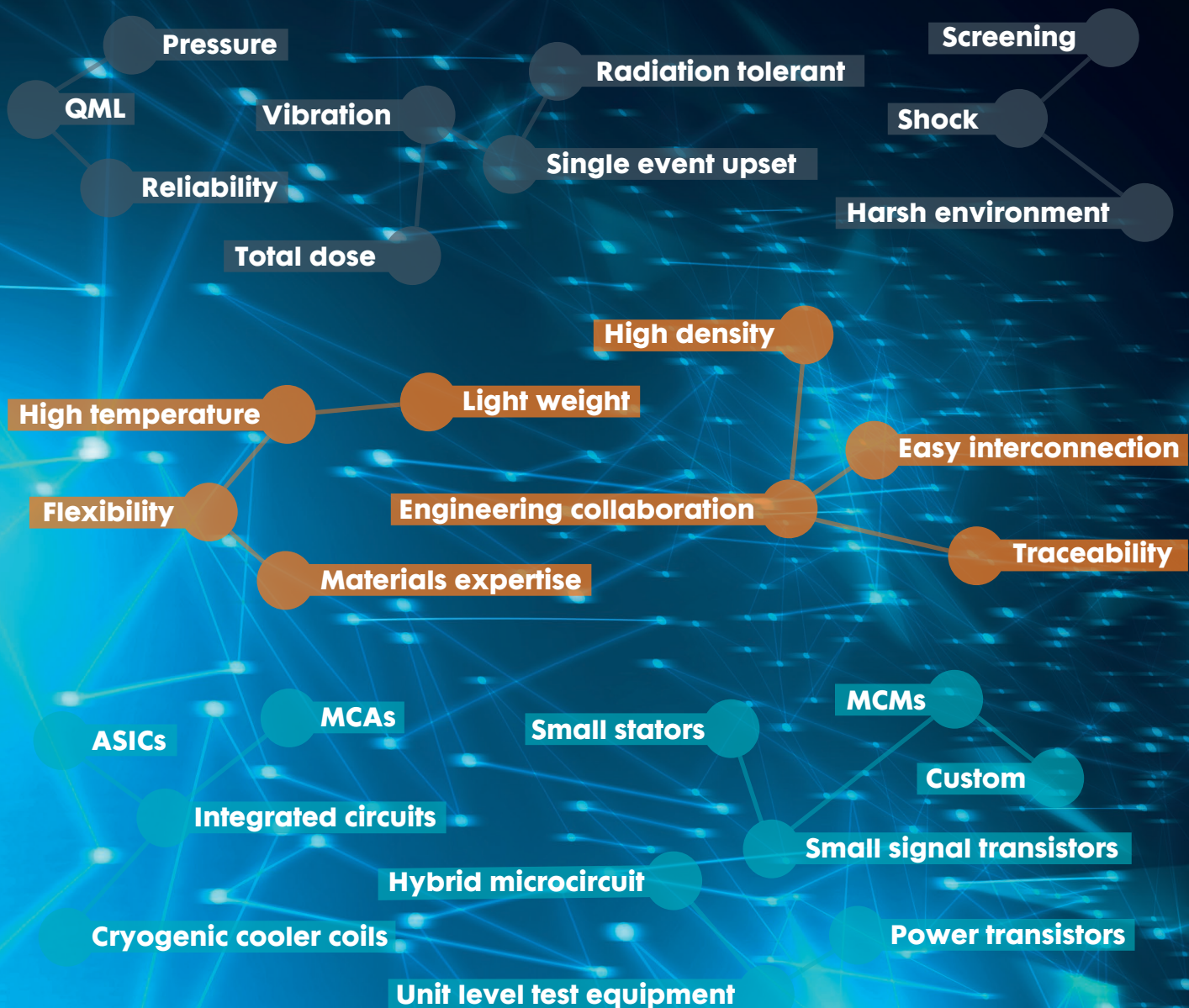


New Space Electronics®

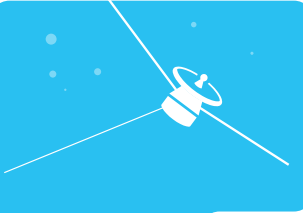
**Tackling the challenges of new space flights
with traceable, innovative solutions**

The New Space Challenge

Higher volume satellite constellations in low earth orbit are driving a requirement for increasingly cost effective components. TT's New Space Electronics® offer a solution that delivers reduced screening but fully traceable and proven space grade heritage.




Just some of our notable Missions



In December 2017, Voyager 2, 11 billion miles from Earth, fired its thrusters leaving our Solar System for interstellar space, joining its sister probe Voyager 1.

Voyager 1 also fired its thrusters recently after 37 years of laying dormant; a demonstration of the reliability of our electromagnetics, made in Medina, Ohio.

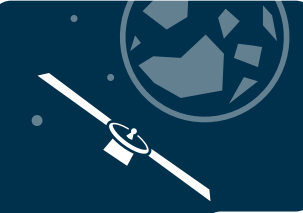
VOYAGER 1 AND 2
LAUNCH DATE 1977



Cassini saw Europe and the US align to revolutionise human understanding of Saturn and where life might be found elsewhere in the Solar System.

Our small signal transistors travelled amongst Saturn's rings for 20 years until the spacecraft was destroyed in 2017 to prevent contamination of Saturn's moons.


CASSINI - HUYGENS
SATURN OBSERVATION LAUNCH DATE 1997



Our UK Lutterworth facility supplied mission critical power supply componentry for the travelling wave tubes used in the communications system on Rosetta.

In one of the last systems remaining operational, the parts helped beam back data and photos from over 8 billion km away as the satellite crashed into comet 67P.

ROSETTA
COMET CHASER LAUNCH DATE 2004



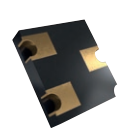
Juno explored the biggest and baddest planet in the solar system - Jupiter. During its scientific exploration, our devices in mission critical applications endured exceptionally challenging environmental conditions.

Upon entering Jupiter's gravitational pull, the spacecraft was accelerated to around 130,000 mph, a little faster than your average family saloon!

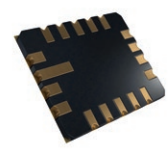
JUNO
JUPITER EXPLORATION LAUNCH DATE 2007

1970 1980 1990 2000

Product Introduced




LCC1



MCA



Low Profile Hermetic Power Module



ARIANE VEGA
LAUNCH VEHICLE FIRST LAUNCH 2011

TT Electronics have developed thrust vector actuation control systems for the European small satellite launch system known as Ariane Vega.

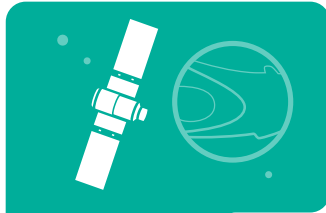
The same control system has been trialed on IXV, the experimental re-entry vehicle that may ensure astronaut survivability in the event of operational rescue requirements.



ALTIKA
EARTH OBSERVATION LAUNCH DATE 2013

TT Electronics developed the first Si₃N₄ packaging to fly within the space environment. Our solutions for AltiKa improved the PCB real-estate usage and lowered overall component weight.


Over the course of its three year lifespan, AltiKa observed ocean wave height, aiding early anticipation of climatic change and natural disasters.



BEPI COLUMBO
MERCURY EXPLORATION PLANNED LAUNCH 2018

Our critical components for the solar vein current conditioning circuitry must survive extremes of temperature change when arriving at Mercury in late 2025.

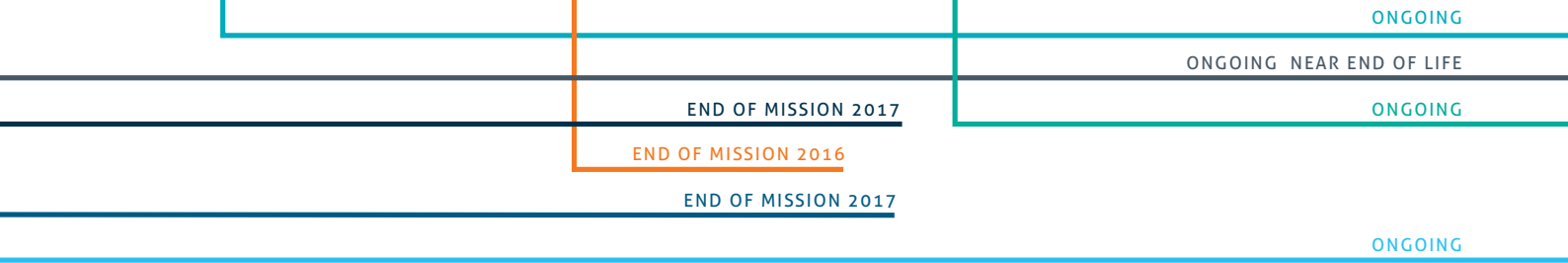
The satellite will see conditions in excess of 350°C when conducting its exploration of the smallest and least explored terrestrial planet in our Solar System.



GALILEO F.O.C
LAUNCH DATE 2019

Enhancing the performance of the European Global Satellite Navigation system, TT Electronics multi-chip arrays will be used in key applications to help Galileo reach Full Operational Capability (FOC).

The 30 satellites orbiting at 23,222 km altitude above the Earth's surface will enable location identification to within 1m anywhere in the world.



2010 **2020**



Discretes

Readily available packages and die with space heritage.
Other options available on request.

| Select your package | Select your semiconductor | Select your required screening options |
|---|---|---|
| Packages | Semiconductors | Screening Options |
| Standard Ceramic Small Signal LCC1 (UB) (3 or 4 Pad Variant) LCC2 (U) LCC3 (UA) | Small signal BJT 2N2222A 2N2907A 2N2369 2N5551 2N5401 | Stabilising Bake Pre-Cap Inspection High Temperature Reverse Bias High Temperature Gate Bias |
| SMT Power Packages LCC4 (U5) SMD05 (U3) SMD1 (U1) | Small Signal Diodes 1N4148 1N6642 BAT54 BZX55XXX | Operation Life Temperature Cycling Acceleration |
| Ceramic Diodes DLCC2 DLCC3 | JFETs 2N4391 2N4392 2N4393 2N4416 | Particle Impact Noise Detection Hermetic Seal Testing Residual Gas Analysis |
| Traditional Metal Can TO18 TO5 TO39 | Power Diodes SiC-1A SiC-2A SiC-10A 1N5806 1N5811 1N5819 | Radiography Total Irradiated Dose Single Event Upset Buy-Off Inspection |
| Modern Metals TO257 TO254 TO258 | Power MOSFETs Si N and P channel up to 50A SiC-1200V 35A SiC-650V 25A | Lot Validation and Group Testing |
| MCAs LCC-18 Pad LCC-20 Pad LCC-28 Pad | Schottky Barrier BYV32 SB30-45 | |
| Low Cost Packaging TO220 TO247 | | |

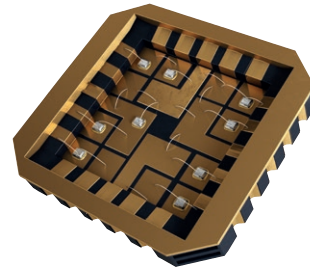
Details of our part number generator for our New Space Electronics® range can be found on our website at:
www.ttelectronics.com/new-space-electronics

Multi Chip Arrays

Reference Designs

Key Advantages

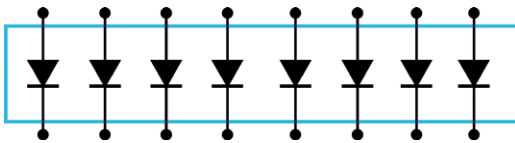
- PCB real-estate saving
- Lower cost
- Light weight
- Traceable
- Improved reliability
- Full customisation option available



MCA Reference Designs

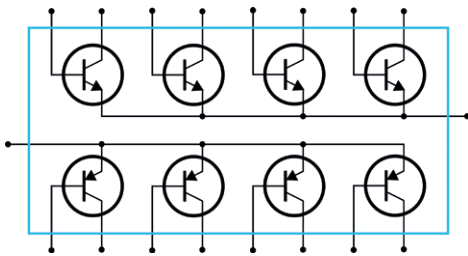
Applications

Diode Arrays



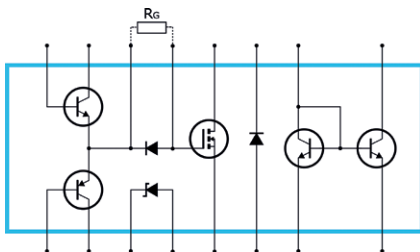
- Power rectification
- Voter circuits
- Dual redundancy

Transistor or MOSFET Arrays



- Individual switches or common junction arrays
- Bridge circuits
- Current multipliers
- High impedance switches
- Voltage rectifiers

Mixed Technology Arrays



- Amplifiers
- Drive circuits
- Protection circuits

Custom Design

Our multi-chip arrays are based on industrial standard leadless chip carriers to provide you, the customer, with the option to fully utilise the package in your required configuration, and with the ability to mix technologies or manufacturers die within the package.

Baseline Screening Options

Our suggested entry point for New Space Electronics® discrete semiconductors is shown in NS1 below. The sequence provides an assurance basis with manufacture utilising robust, controlled, space proven processes and designs, including traceability to all materials and operations. NS2 adds baseline mechanical and electrical screening to provide the next level of assurance.

New Space Screening requirements ^{1,2}

| Step | Screen | Condition | NS1 | NS2 |
|------|--|--|------|------|
| 1 | Internal visual inspection ⁵ | | 100% | 100% |
| 2 | High temperature non-operating life (stabilization bake) | $T_{STG} \leq$ maximum rated storage temp t = as specified | 100% | 100% |
| 3 | Temperature cycling | 5 cycles. -55°C to +125°C or as specified in maximum ratings | | 100% |
| 4 | Constant acceleration ⁴ | γ_1 direction | | 100% |
| 5 | Serialization | | 100% | 100% |
| 6 | Initial electrical test | DC electrical attributes as specified | | 100% |
| 7 | Burn-in ³ | Operating or reverse biased as specified. 48 hours (minimum) | | 100% |
| 8 | Final electrical test | DC electrical attributes as specified | 100% | 100% |
| 9 | Hermetic seal ⁴ | Fine & Gross Leak Detection | | 100% |
| 10 | External visual examination | | 100% | 100% |

Notes:

1. All screening operations are performed in accordance with MIL-STD-750 or equivalent ESA methods.
2. All products can be screened in accordance with the full MIL-STD-19500 or ESA 5000 Generic standard flows – contact TT Electronics Sales.
3. Conditions for burn-in are set according to the device type and standard operating conditions for ambient or case rated devices.
4. Applicable for cavity devices, plastics excluded.
5. Internal visual inspection carried out by TT Electronics in accordance with appropriate standard – only on cavity devices.



www.ttelectronics.com