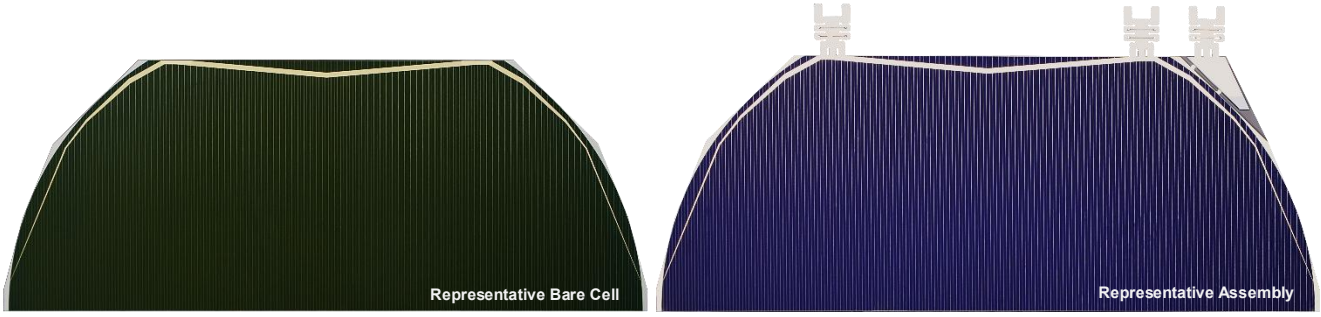
AZUR SPACE
A 5N PLUS COMPANY

32% Quadruple-Junction (QJ) III-V Bare Solar Cells & Assemblies

QJ 4G32-Advanced (HP)
Standard Thickness Devices

Enabling highest power and voltage for space applications



AZUR SPACE Product Identifiers	Bare Cell	Assembly (SCA / CIC)
AZUR SPACE Material (Part) Number	82902	82903
AZUR SPACE Drawing Number	ZP-00010238	ZP-00010239

AZUR SPACE's 4G32-Advanced bare solar cells and solar cell assemblies ("SCA"), or CICs (cell-interconnect-coverglass) are the ideal solution for space power applications to reach highest power levels on small areas and at low weight. This 4G32-Advanced technology design offers best-in-class beginning-of-life (BOL) and end-of-life (EOL) performances and exceptionally high voltage, enabling a multitude of options and missions.

The 4G32C-Advanced bare cell device is a space-qualified AlInGaP/AlInGaAs/InGaAs/Ge quadruple-junction solar cell originating from a 150 mm germanium (Ge) substrate and provides 32% class efficiency. This device includes AZUR SPACE's proprietary radiation-hardened design for best EOL performance. Our standard cell features well-proven metallization as well as an improved busbar and grid-design with two contact pads plus one for a discrete bypass diode connection and a standard cell size of 77.44 cm² (~6 cm x ~15 cm, multiple crops per corner, or "half-pipe"). This configuration offers a device with a total bare cell thickness of 245 µm. The 4G32C solar cell is compatible with an external bypass diode, which is also available from AZUR SPACE together with bare cell orders.

The 4G32A assembly includes a bare 77.44 cm^2 4G32C-Advanced solar cell, a corner-mounted silicon bypass diode, welded in-plane silver-coated Kovar interconnectors ("ICs"), and a 100 µm AR coated coverglass bonded with space-grade heritage adhesive. The assembly has a standard size of ~78.62 cm² (glass size) and has a total device thickness of 380 µm. A digital assembly CAD / CAM STEP file as well as digital device photographs of bare cell or assembly are available upon request.

Other non-standard sizes, thicknesses and configurations are also available upon request. Thickness and mass values and variations are shown below.

The 4G32-Advanced technology, cells and assemblies are ECSS-E-ST-20-08C (Rev. 1) qualified. These devices are all produced in our mature MRL-10 Heilbronn facility. Our technology and products have demonstrated in-orbit TRL-9 level heritage. AZUR SPACE is certified to ISO 9001:2015 (QMS), EN 9100:2018 (QMS, European equivalent to AS 9100D), as well as ISO 14001:2015 (Environmental) and ISO 45001:2018 (Health & Safety).

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Certified Company

32% Quadruple-Junction Bare Solar Cells & Assemblies

QJ 4G32-Advanced (HP) — Standard Thickness Devices

Design and Mechanical Data	4G32C-Adv. Bare Cell	4G32A-Adv. Assembly (SCA / CIC)
AZUR SPACE Material (Part) Number	82902	82903
Base Material	AlInGaP/AlInGaAs/InGaAs/Ge	AlInGaP/AlInGaAs/InGaAs/Ge
AR-Coating	TiO_2/Al_2O_3	TiO_2/Al_2O_3
Outer Dimensions (mm)	148.06 (± 0.1) x 60.56 (± 0.1)	148.26 (± 0.1) x 60.76 (± 0.1)
Cell Total Area (cm^2)	77.44	78.62 glassed area (cell area is 77.44)
Average Weight	≤ 134 mg/cm^2 / 10.4 grams	≤ 175 mg/cm^2 / 13.6 grams
Thickness (µm)	245 (± 25)	380 (± 50)
Coverglass	n/a	100 µm AR coated
Contacts	2x front side pads (plus diode pad)	3x Interconnects
Interconnect Configuration	n/a	In-Plane
Interconnector Material	n/a	Silver (Ag) coated Kovar
Interconnector Dimensions	n/a	8.1 mm x 12.89 mm x 25 µm

Typical Electrical Performance		BOL		5E13		2.5E14		5E14		1E15		1E16	
		Cell	CIC	Cell	CIC	Cell	CIC	Cell	CIC	Cell	CIC	Cell	CIC
V_{oc}	[mV]	3405	3405	3320	3320	3279	3279	3242	3242	3187	3187	2918	2918
I_{sc}	[mA]	1153	1134	1151	1132	1147	1128	1144	1125	1137	1118	921	906
V_{mp}	[mV]	2970	2970	2896	2896	2848	2848	2807	2807	2744	2744	2533	2533
I_{mp}	[mA]	1097	1078	1092	1073	1087	1068	1084	1065	1072	1053	813	799
η (1367 W/m^2)	[%]	30.8	30.3	29.9	29.3	29.2	28.7	28.7	28.2	27.8	27.3	19.5	19.1
η (1353 W/m^2)	[%]	31.1	30.6	30.2	29.6	29.6	29.0	29.0	28.5	28.1	27.6	19.7	19.3

QTR 5466-01-01, QTR 0005927-01, QTR 0006412-01. Spectrum: AM0 WRC, 1367 W/m^2; T = 25°C, fluence 1 MeV [e/cm^2],
Other fluences and proton degradation data available on request. Radiation hardness is periodically assessed.

Typical Temperature Coefficients		BOL	2.5E14	5E14	1E15
		Cell or CIC	Cell or CIC	Cell or CIC	Cell or CIC
$\Delta V_{oc}/\Delta T$	[mV/°C]	-8.4	-8.5	-8.8	-8.9
$\Delta I_{sc}/\Delta T$	[mA/°C]	0.179	0.261	0.359	0.359
$\Delta V_{mp}/\Delta T$	[mV/°C]	-8.6	-8.7	-9.0	-9.0
$\Delta I_{mp}/\Delta T$	[mA/°C]	0.078	0.122	0.179	0.179

QTR 5466-01-01, QTR 0005927-0100, QTR 0006412-01-00; Temperature range 28°C – 140°C; fluence 1 MeV [e/cm^2].

Other Information	Item	Typical Value
Diode (Assemblies)	External Si Protection Diode	$V_{forward}$ (620 mA) ≤ 0.8 V (T = 25°C ± 3°C) $I_{reverse}$ (4 V) ≤ 0.1 µA
Threshold Absorptivity	Absorptivity Value	≤ 0.91 (100 µm AR coverglass)
Threshold Pull Test	Pull Test Values	> 1.6 N at 45° (with 12.5 µm Ag strips) > 7.0 N at 0° (with standard Kovar interconnectors)

These performance data reflect a defined configuration at a specific mission environment across a large manufacturing population. Changes in configuration or production order volume may modify typical performance values.

Please refer to the AZUR SPACE **General Information Sheet** for additional information including on-orbit heritage, quality certifications, business licenses, product registrations and general company information at **www.azurspace.com**. Contact information is shown below and is also available on our website.

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