Introduction to PolyStrata® Filters

January 20, 2021

CUBIC

NUVOTRONICS

CUBIC Acquisition and Moving Forward

TECHNOLOGY-DRIVEN, MARKET-LEADING SOLUTIONS

2019 Sales
$1.5B

Employees
6,200

Customers
(Blue Chips)

Backlog
$3.7B
>2x FY19 Sales

Transportation Systems
$850M Sales | $111M Adj. EBITDA[1]



Leading provider of payment systems and intelligent travel solutions

Mission & Performance Solutions
$647M Sales | $67M Adj. EBITDA[1]



Leading provider of training and expeditionary communications solutions

Nuvotronics



mmWAVE RF SOLUTIONS

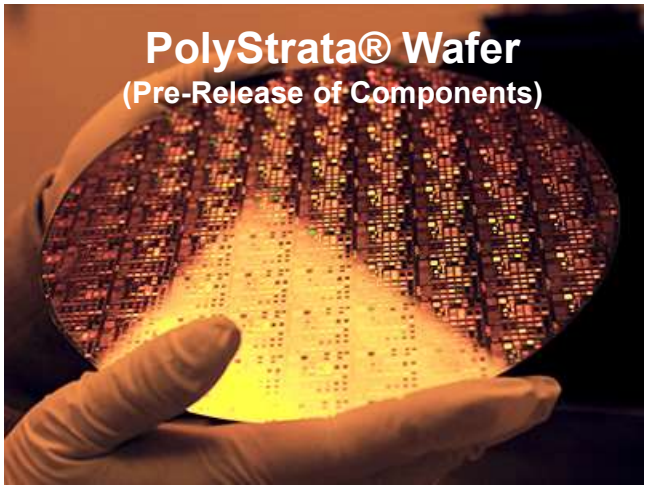
*We **efficiently provide** our global customers with **innovative, mission-critical solutions** to **reduce congestion** and increase **operational readiness and effectiveness** through superior **situational understanding**.*

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Cubic Nuvotronics Main Facility – Durham, NC

- 17,000 sq.ft., 8-inch wafer fab, cleanroom
- RF module design and assembly expertise in house, DC to 300 GHz
- Full Test capability to 110 GHz, power to 230 GHz
- Over 60,000 sq ft of manufacturing space
- AS9100D Certified
- Capable for ITAR and Classified work
- Additional offices locations: Blacksburg, VA; Colorado Springs, CO; and Boston, MA



AS9100D CERTIFIED



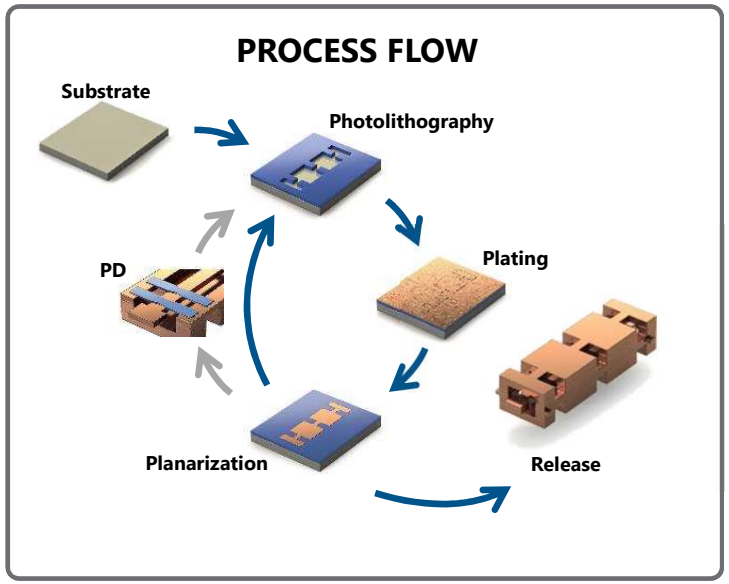


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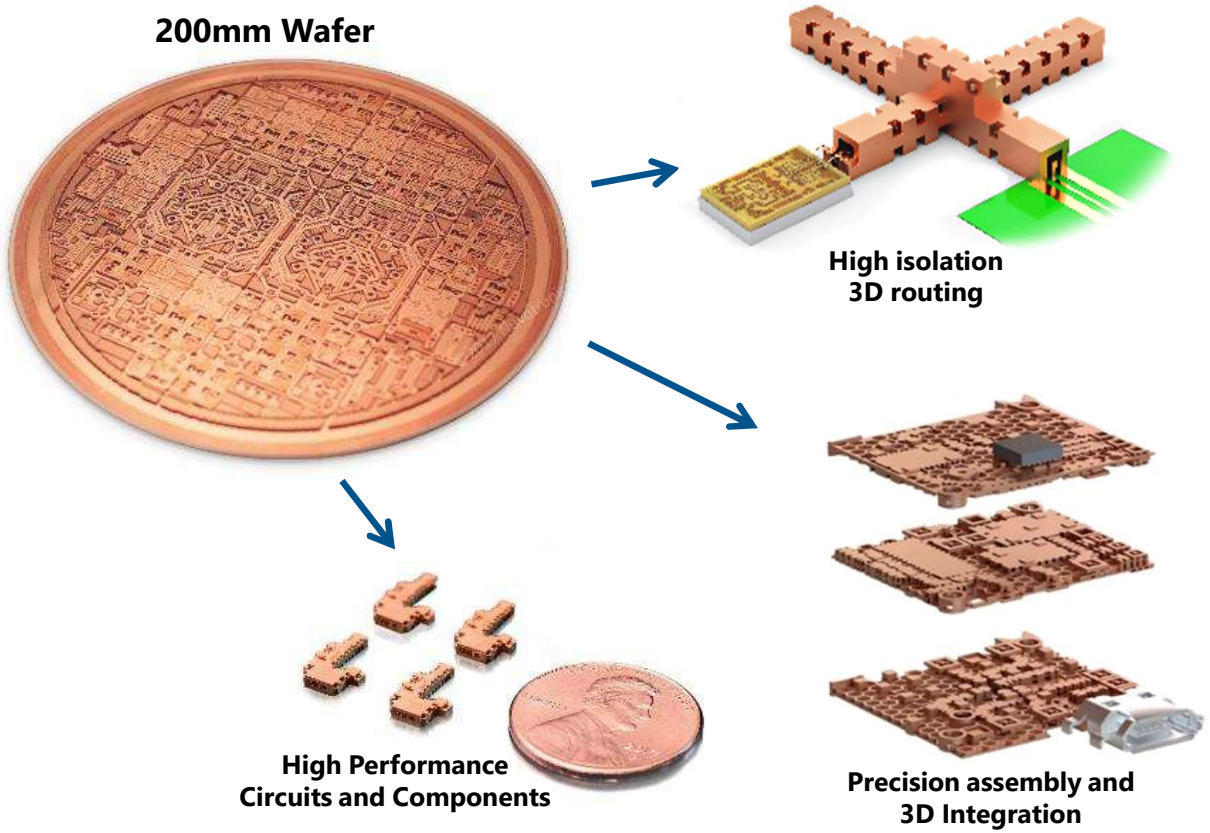
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PolyStrata® Technology

- 8” Wafer–Level Batch Fabrication
- Photolithographic Accuracy and Precision
- High thermal conductivity bulk metal (Copper)
- Shielded micro-air-coax



Typical Design to Delivery timeline of 12 weeks



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Markets for PolyStrata® Technology



Components

Flexible Front Ends

Wideband Antennas

Phased Arrays

Power Amplifiers

Wideband Phased Arrays

Enabling Capabilities for Multiple Industries

- RF and mmWave system design, manufacturing, and testing expertise
- Unique **additive manufacturing** technology that can deliver miniaturized RF parts and circuits in batch fabrication process
- Track record of first-time design success, designed such that tuning is unnecessary and lifetime calibration needs are reduced or eliminated
- Technology with **10x to 100x size and weight reductions** with low loss and added broadband applications



Microelectronics



Electronic Warfare

5G

Commercial Telecom

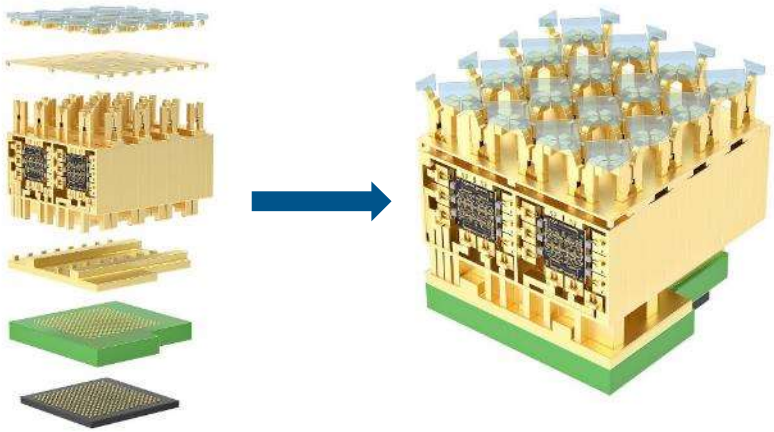


New Space – LEO/MEO

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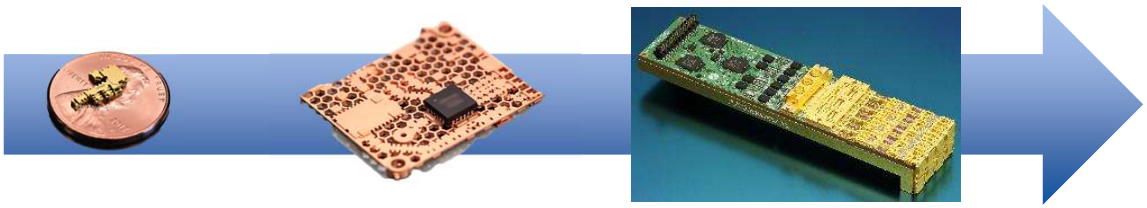
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Advantages of PolyStrata®



Versatile Manufacturing

- Easily integrates with other devices & boards/substrates
- Compatible with standard assembly processes: BGA, solder attach, wirebonding, epoxy, tape & reel, flip chip, and QFNs



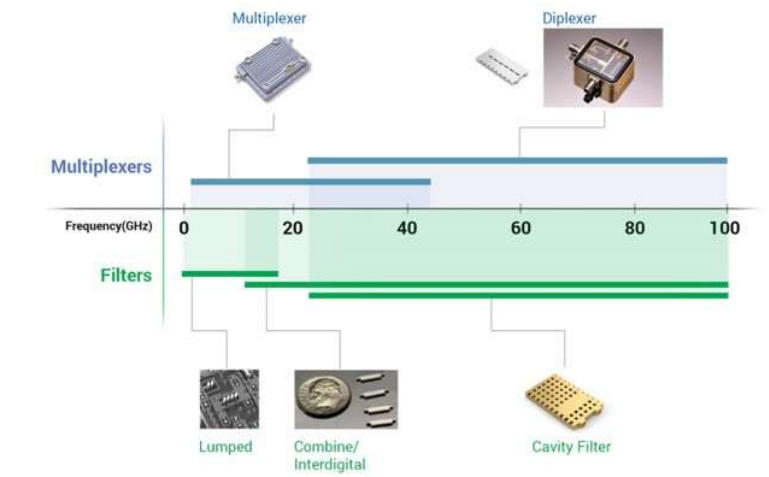
Typical Customer Growth Patterns

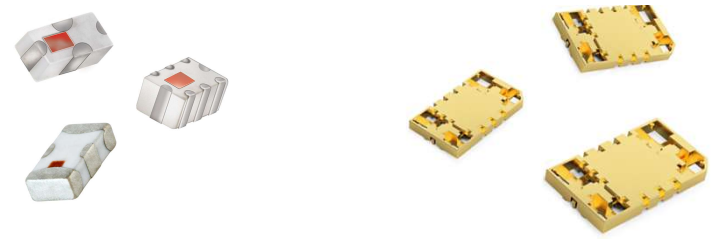
- Component Level Evaluation
- Growing into sub-systems
- Integration of full modules

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Comparison of Filtering Technologies

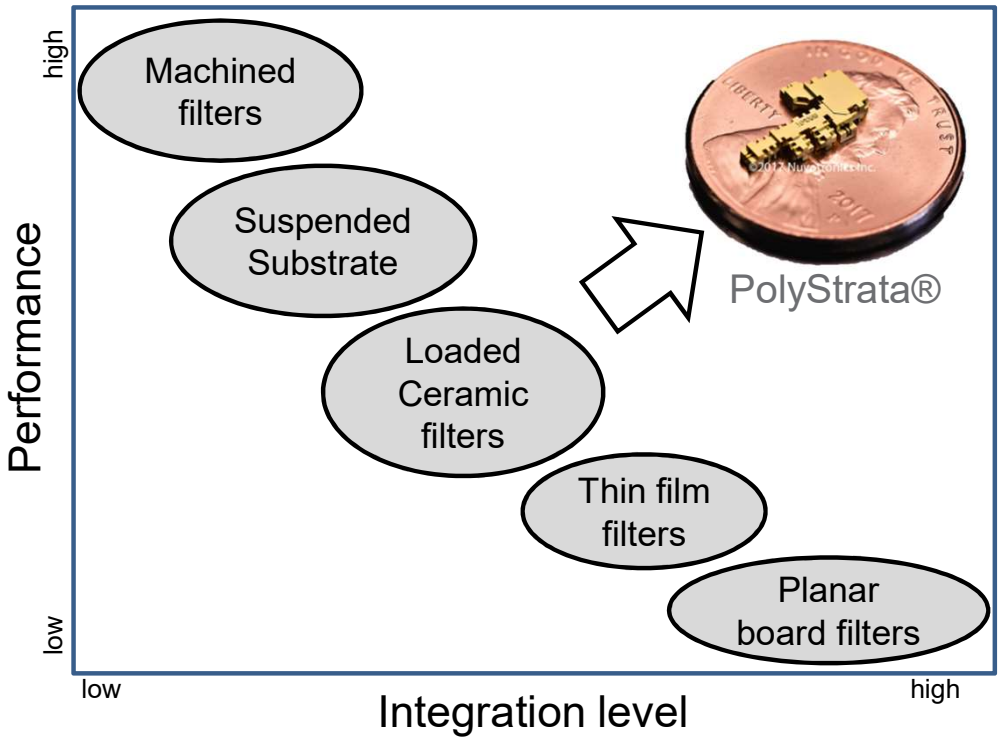




LTCC Filters

PolyStrata® Filters

Similar SMT footprint but PolyStrata® filters offer higher frequency and lower loss.



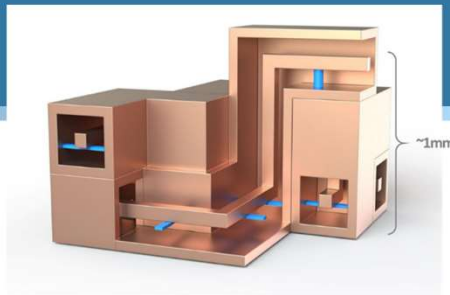
- Repeatable
- Low loss
- High frequency
- Broadband
- Integrates with actives, PCB, waveguide
- 3D design flexibility

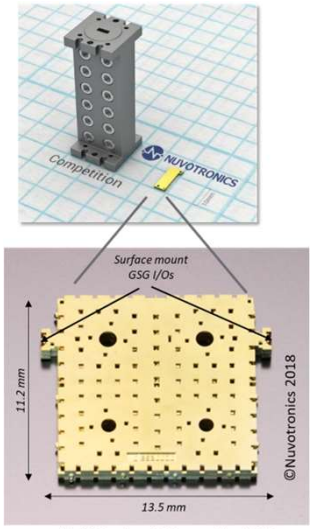
- Custom part requires mask
- Fabrication cycle ~12 weeks

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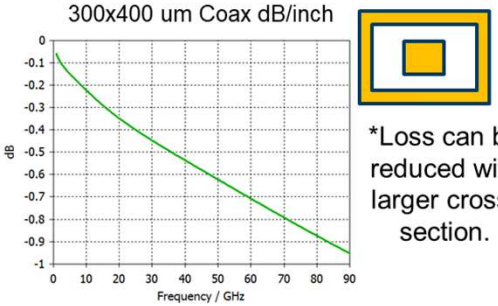
Why We Win

Unique combination of size, performance, and integration



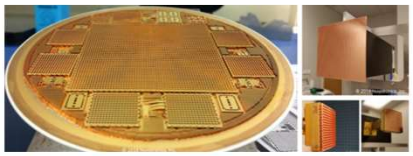


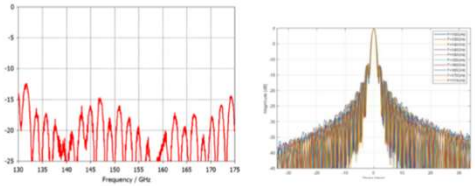
SMT Ka-band Waveguide BPF

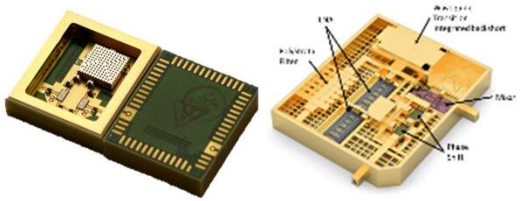


*Loss can be reduced with larger cross-section.

Dielectric free circuit board (or very close)
ε_r=1.05
Electric Loss Tangent = 0.001
Unmatched fabrication tolerance and repeatability (+/-2μm)
Pure Copper: 10nm RA, 400W/(m.K)
Unmatched Electrical performance
DC to 300 GHz+
low loss
high isolation >80dB







Size: Waveguide performance in a SMD form factor

Low Loss: low loss transmission lines and high Q filters, Q > 1000

High Frequency: demonstrated performance > 100 GHz

Integration: compatible with solder, wire bonding, and flip chip

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Initial Products

Part Number	Description
PSF39B03SWP	5G Band n260 Bandpass Filter 37.5-40GHz
PSF26B04SWP	5G Band n258 Filter - Low Loss 24.25-28.3GHz
PSF26B04V2STR	Bandpass Filter 24-28GHz
PSF32B04STR	Bandpass Filter 30-34Ghz
PSF39B04STR	Bandpass Filter 37-41GHz
PSF42B04STR	Bandpass Filter 40-44GHz
PSF19B02SWP	K Band Bandpass Filter 17.7-20.2 GHz
PSF29B02SWP	K Band Bandpass Filter 17.8-20.2Ghz
PSF29B02V2SWP	Ka Band Bandpass Filter 27.5-30GHz
PSF28B04STR	Bandpass Filter 26.5 - 30.5GHz

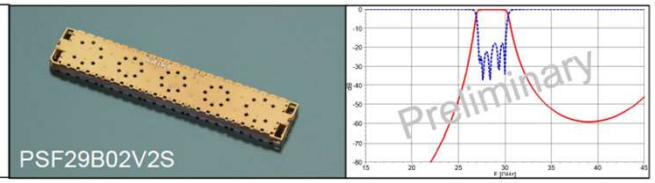
5G Communications

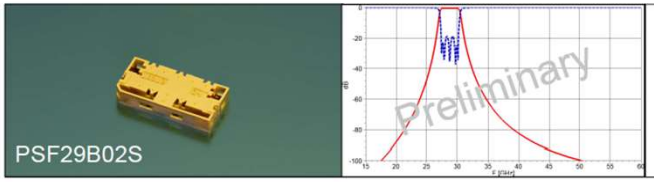
General Purpose

Satellite Communications

Initial Parts List

Ka Band Bandpass Filter
27.5 GHz - 30 GHz
0.5 dB insertion loss
5.6mm x 29.2mm





Ka Band Bandpass Filter
27.5 GHz - 30 GHz
1.0 dB insertion loss
4.1mm x 8.6mm

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