ALARIS

LINWAVE

Mil/Aero Overview Presentation - January 2025

Alaris Linwave Technology

Linwave is a specialist in Custom Microwave Modules for harsh environments.

Experienced in the supply of Transceivers, Amplifiers, Converters, Timing Sources and Multi-Chip Hybrids (System in Package) for Defence and Aero applications. Customers engaging Linwave for External Enterprise Engineering solutions benefit from our experience in module integration, wide RF product knowledge and use of multiple manufacturing techniques based on work in diverse markets.

Heritage dates back to the early years of Microwave in Lincoln (UK), through companies like Marconi Electronic Devices(MEDL), AEI Semiconductors, EEV, Plessey. In 2003 the company was founded by an MBO from Celeritek – a Silicon Valley based leader in RF Semiconductors and systems.

Our business is powered by Business Central, approved to AS9100D, ISO14001, and Cyber Essentials, and utilises specialist design software such as Microwave Office, SolidWorks and Altium.

CERTIFIED LR AS 9100

ENVIRONMENTAL MANAGEMENT SYSTEM ISO 14001

CYBER ESSENTIALS

Microsoft Dynamics 365 Business Central

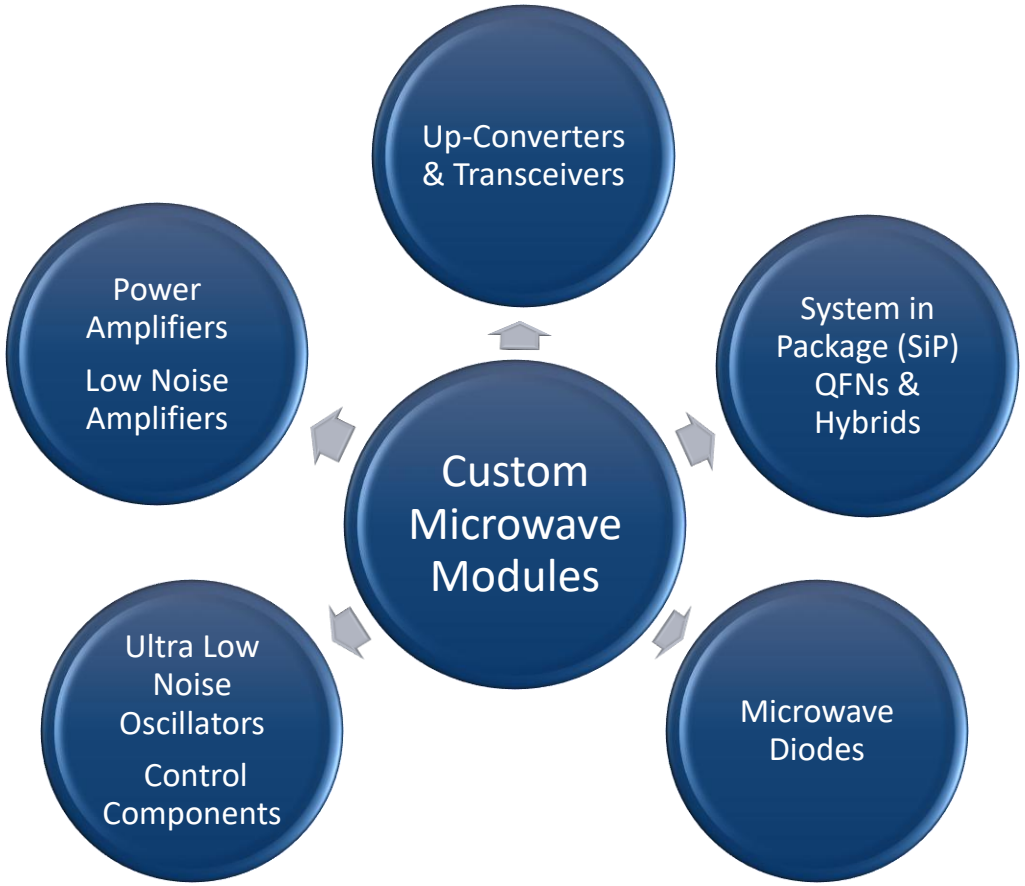
SOLIDWORKS

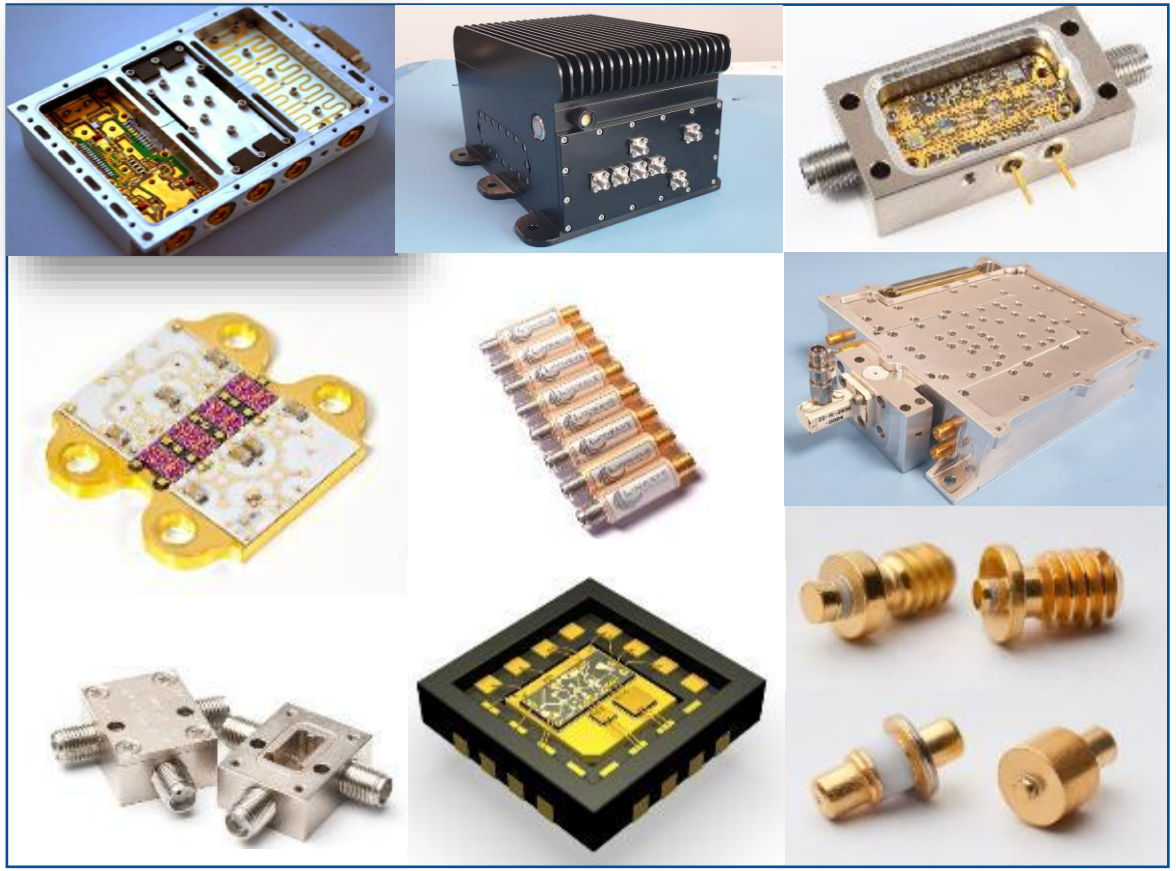
AWR®

Altium Designer 14

Company Group Structure

Products & Technologies - Summary





Capabilities & Facilities Summary

- Custom built design & manufacturing facility completed 2012
- 11,000sq ft over 2 floors with 2,500 sq ft class 10,000 clean room facility
- Targeting government approved site for military projects
- Internal Access control points installed
- Environmental initiatives in-built – LED lighting, rainwater harvesting
- Approved to AS9100D, ISO9001, ISO14001, Cyber Essentials

Engineering

- Harsh environment specialists
- NPI process
- RF design
- Analog design
- PCB design and layout
- Mechanical design
- Digital embedded and control electronics

Manufacture and Assembly

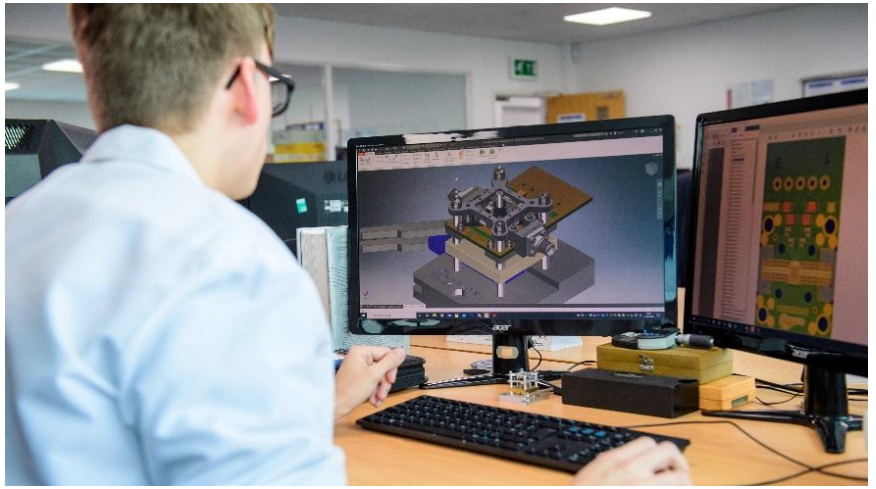
- Class 10000 clean room
- LPKF fast prototyping PCB machine
- Fine pitch assembly
- Manual placement and solder reflow
- Hybrid chip and wire assembly
- Gold wedge, ball, ribbon bonders
- Semi-automatic and manual bonding
- Epoxy and eutectic die attach
- Dry nitrogen backfill
- Hermetic sealing and laser welding

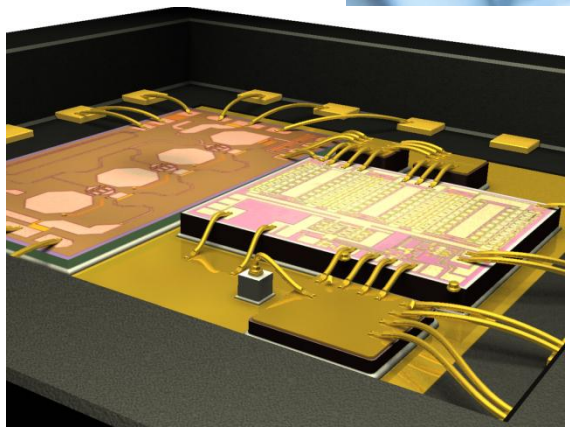
Test

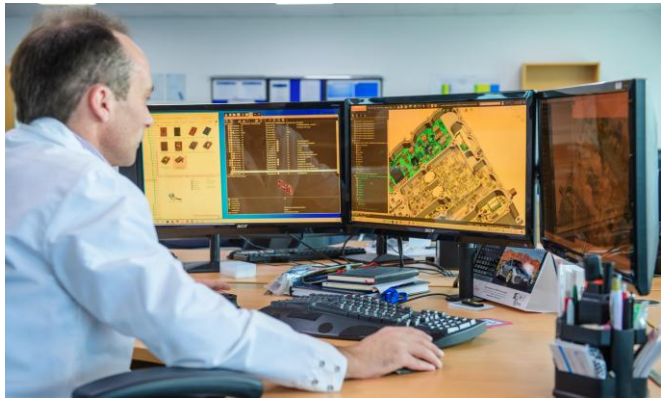
- Test capability to 100GHz
- Spectrum, vector, scalar measurement
- Power, noise figure, phase noise measurement
- Modulated test sources & AW capability
- Environmental testing (temp cycle, hot/cold plates, vibe)
- Measurement automation routines
- Die probe
- Bond pull testing

Design

- Capabilities
  - Experienced and extensive design team
  - RF, microwave, analogue, digital
  - Frequency DC to 100 GHz
  - Output power up to 200W
  - PCB design and layout
    - 16 layers
    - Buried RF layers
    - Analogue control circuitry
    - Splitters, combiners, filters
    - Multiple PWR/GND planes
    - Integrated 50ohm terminations
  - Mechanical design
- Design Tools
  - SolidWorks
  - Altium Designer
- Simulation Tools
  - Cadence AWR Microwave Office
  - Altair FEKO
  - Dassault systems CST
  - PSPICE







Assembly and Integration

- Class 10000 clean room
  - Temperature and humidity controlled
- In-house manual fine pitch SMT assembly
  - LPKF fast prototyping PCB machine
  - Fine pitch assembly
  - Manual placement and solder reflow
  - Vacuum furnace
- System in Package (SiP) capability
  - Hybrid chip and wire assembly
  - Gold wedge, ball, ribbon bonders
  - Semi-automatic and manual wire bonding
  - Epoxy and eutectic die attach
  - Dry nitrogen backfill
  - Hermetic sealing and laser welding

Test

- Test capability to 100GHz
- Spectrum, vector, scalar analysis and measurement
- Power, noise figure, phase noise measurement
- Modulated test sources & AW capability
- Measurement automation routines for repetitive tests
- Environmental testing (temp cycle, hot/cold plates, burn-in ovens and operational vibration)
- Die probe test
- Bond pull testing

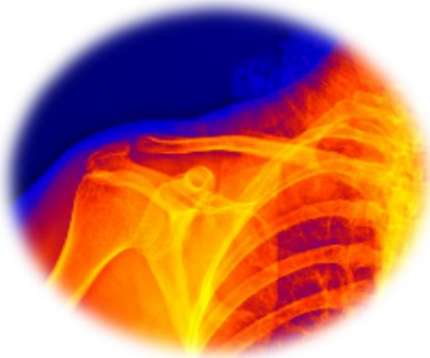
Markets

Defence
Radar, C-IED, Seekers, EW

Satcom & Broadcast
BUC's , SSPAs

Space
Converters, Amps, Oscillators, Phased Arrays

Aerospace
Transceivers, BUC's



Healthcare
RF Therapy, RF Energy

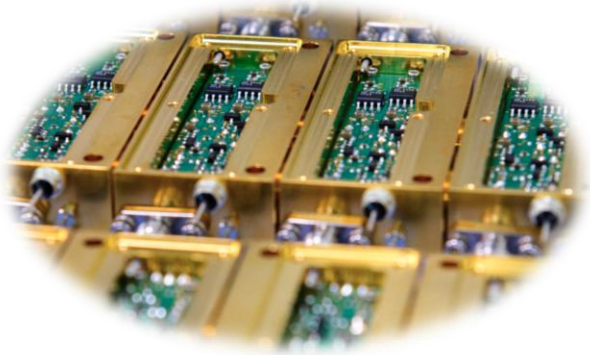
Marine
Safety Beacon

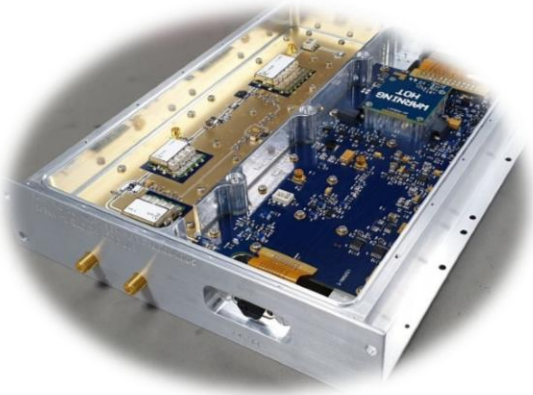
Industrial
RF Heating, Moisture Detection, FOD

Wireless & Radio
Boosters and Repeaters

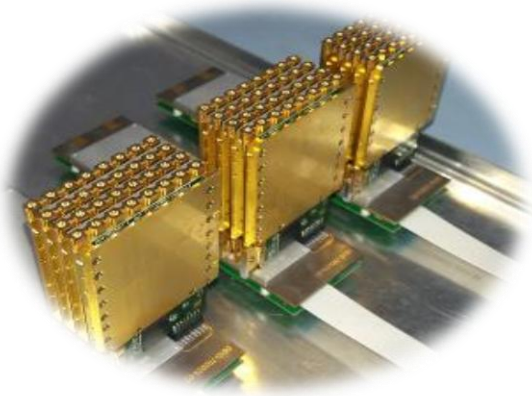
Transport
Speed Detection and Traffic monitoring

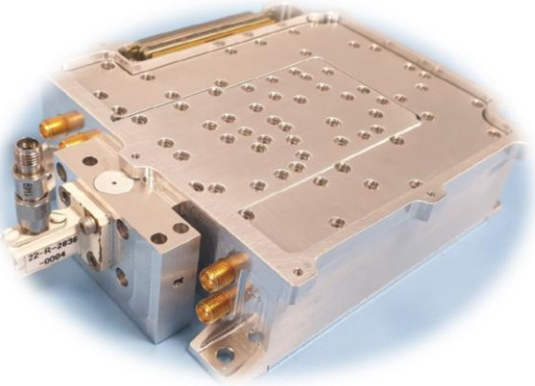
Security & Imaging
Sensors





Product Examples

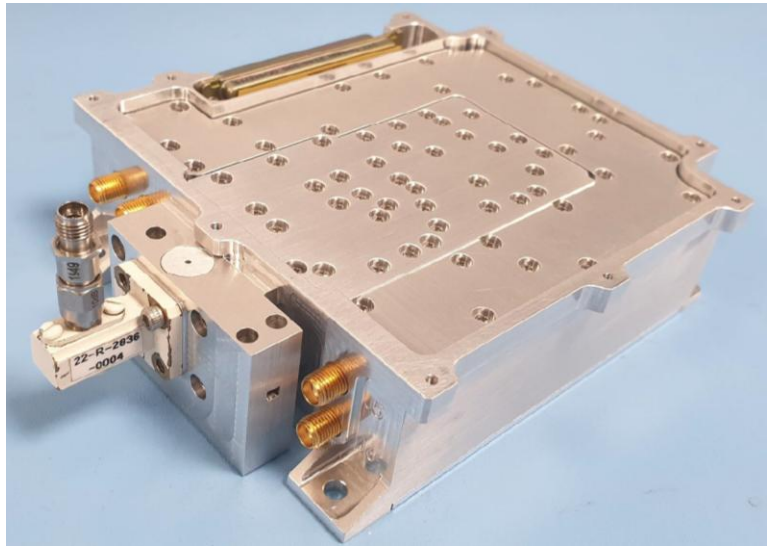




Ka-band Block Up-Converters (BUC)

Applications: Ground and Airborne SATCOM, Secure Comms

- Frequency range 27.5GHz to 31GHz
  - 4 selectable bands
- IF input frequencies 950MHz to 2GHz
- Output power 10W or 16W linear
  - Lower power options available
- Adjustable gain
- GUI controlled custom interface
  - CANbus, Ethernet, I2C, SPI also available
- iDirect OpenBMIP™ compatible



- Integrated power amp for SWaP improvements
- Temperature compensated
- Fan-less operation
  - Conduction cooled
- Temperature range -55 to +85 deg. C
- Custom enclosure for exposure to high altitude 55,000ft
- IESS 308/309 compliant
  - DO-160 testing option

Ku-band Block Up-Converters (BUCs)

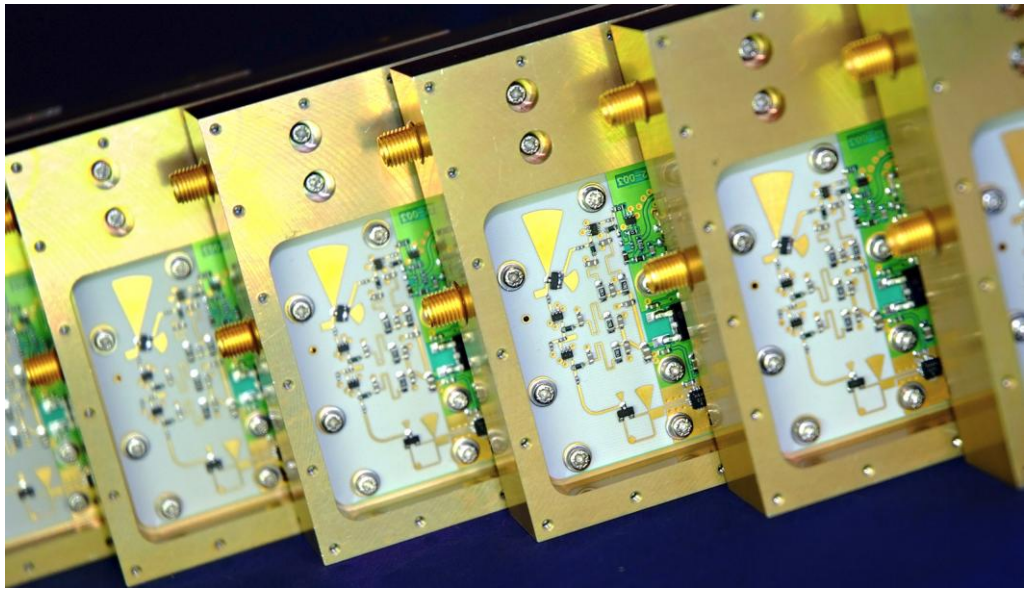
Applications: Ground and Airborne SATCOM, Secure Comms

- Frequency range 13.75 - 14.5GHz
- IF input frequencies 950MHz to 1700MHz
- Output power 16W linear
- Integrated power amp and output filtering
- RS422 interface
- IESS 308 compliant
- Temperature range -55 to +85 deg. C
- Fan-less operation
- Custom enclosure for exposure to high altitude 55,000ft

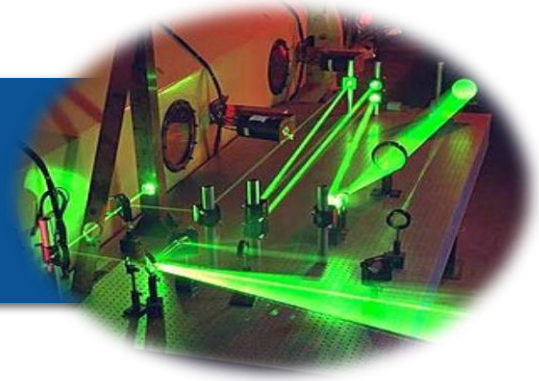
Block Up-Converters - Options

Applications: Ground and Airborne SATCOM, Secure Comms

- Lower Ku-band 12.75GHz – 13.25GHz
- Dual band 12.75 - 13.25GHz & 13.75 – 14.5GHz option
- Output power 1mW (0dBm) linear
- IESS 308/9 compliant
- DO-160 testing option
- Temperature compensated
- Adjustable gain
- CANbus, Ethernet, I2C, SPI interfaces
- iDirect OpenBMIP™ compatible
- C-band, X-band & DBS band versions also available

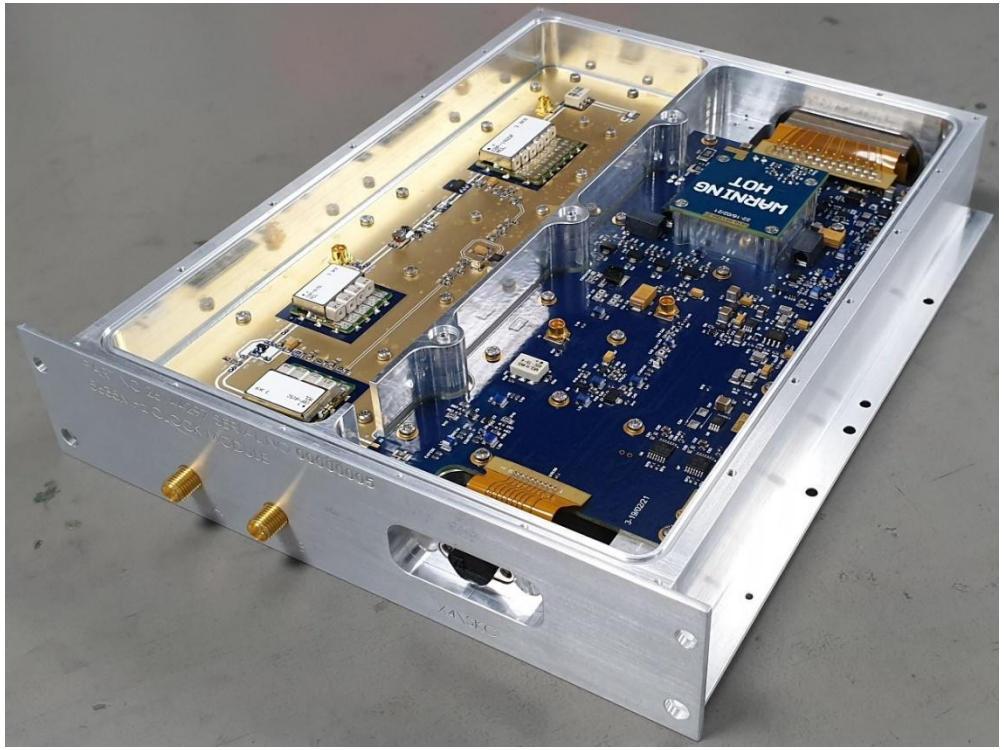


Ultra Low Phase Noise Oscillator



Frequency Synthesis, Master Reference Oscillator, Clock Distribution, Quantum Computing, Test and Measurement

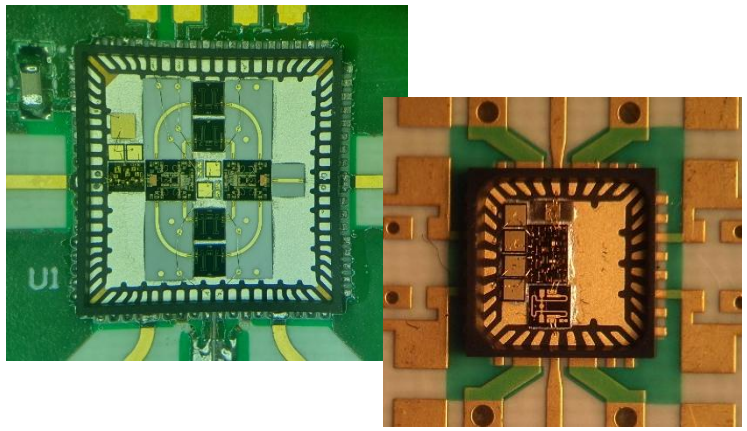
- Frequency range 200 MHz – 12 GHz
- Integrated Integer Multiplier Stages
- RS-422 Electronic Tuning Capability
- Phase noise @ 200 MHz output
  - -181 dBc/Hz (1 MHz)
  - -137 dBc/Hz (100Hz)
- Phase noise @ 11 GHz output
  - -143 dBc/Hz (1 MHz)
  - -100 dBc/Hz (100 Hz)
- RF Output Power up to +22 dBm
- Input Output Isolation 50 dB
- RF interface SMA
- High Reliability MTBF > 50,000 Hours



System in Package (SiP) Capability

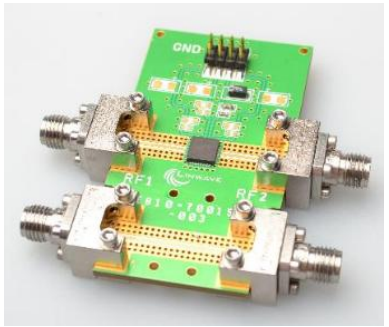
Overview

- Complex Multi-Die Systems
- RF Designs up to 30GHz
- Gold on Alumina Tracking
- Standard QFN Packages (20GHz)
- Other Custom Packages Available



Designs

- Attenuators
- Limiters
- Limiter + LNA
- Zero-bias Detectors
- Beamforming Elements
- Switched Filter Banks
- Customer Specific Designs
- VCO



MAIT

- Hybrid Chip and Wire Assembly
- Wet Etch Capability
- Gold Wedge, Ball, Ribbon Bonders
- Semi-Auto and Manual Bonding
- Epoxy and Eutectic Die Attach
- Dry Nitrogen Backfill
- Hermetic Sealing and Laser Welding
- Test Capability to 100GHz
- Spectrum, Vector, Scalar Measurement
- Power, Noise Figure, Phase Noise Measurement
- Full Environmental Testing
- Die Probe
- Bond Pull Testing
- Unique Solderless Test Fixture

Wide-Band Naval Digital Receiver

Application: EW Receiver for Passive Surveillance

- Broad operational band 2.0-18GHz
- 3U VPX form factor
- High target tracking capacity
- Utilises key feature sets for direct conversion to baseband
  - Track and hold
  - Fibre conversion
  - Use of ADCs
- Configuration with multiple sub-bands possible

FMCW Radar Front End

Application: Surveillance

- 77GHz Integrated FMCW Radar Head
- Applications include border surveillance, perimeter monitoring and foreign object detection on runways and railway crossings
- 24GHz variant available
- Lightweight & low power consumption
- 1GHz operational bandwidth
- Integrated IF amplifier and filtering

X-band Radar Transceiver

Application: Airborne RADAR

- Transceiver containing dual channel down converter
- Analogue to digital conversion capability
- Internally generated high accuracy system clock
- Built in test circuitry for fault detection and isolation
- Selectable Tx filtering
- Programmable gain
- Digital interface
- Wide operational temp range -40 / +85C

X-band Power Amplifiers

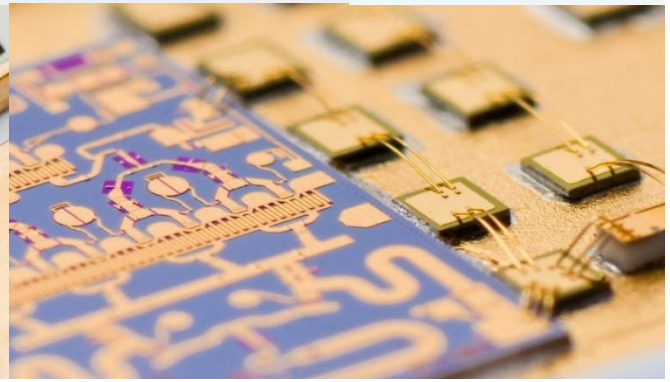
Application: Solid State GaN Amp X-band

- 200W Pulsed output power 8.5-9.5GHz
- Capable of high duty cycle 80%
- High performance GaN output stage
- High gain – typ.70 dB
- -70dBc non-harmonic spurious
- Applications ATC, Radar
- Conduction cooled to external heatsink

Gunn Diodes

Applications: Signal Generation, Modulation, Radar Systems, Proximity Detectors

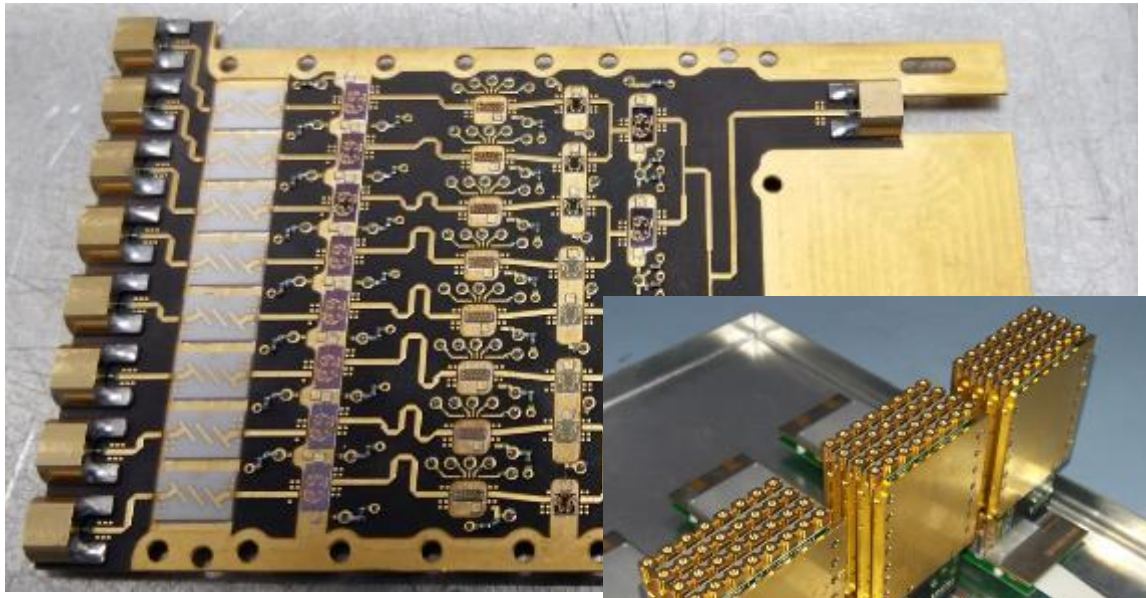
- Packaged GaAs Gunn Diodes
  - 24 - 110GHz frequency range
  - 50mW output power typically
  - Obsolescence Replacements
  - Custom Packaging Options
- ASPAT Diodes
  - Design optimisation
  - Stand-alone components
  - Package optimization – compensation for package parasitics
  - Matching components and associated circuitry



Ka-band Phased Array

Application: Airborne Data link Tx Rx Ka-band Array

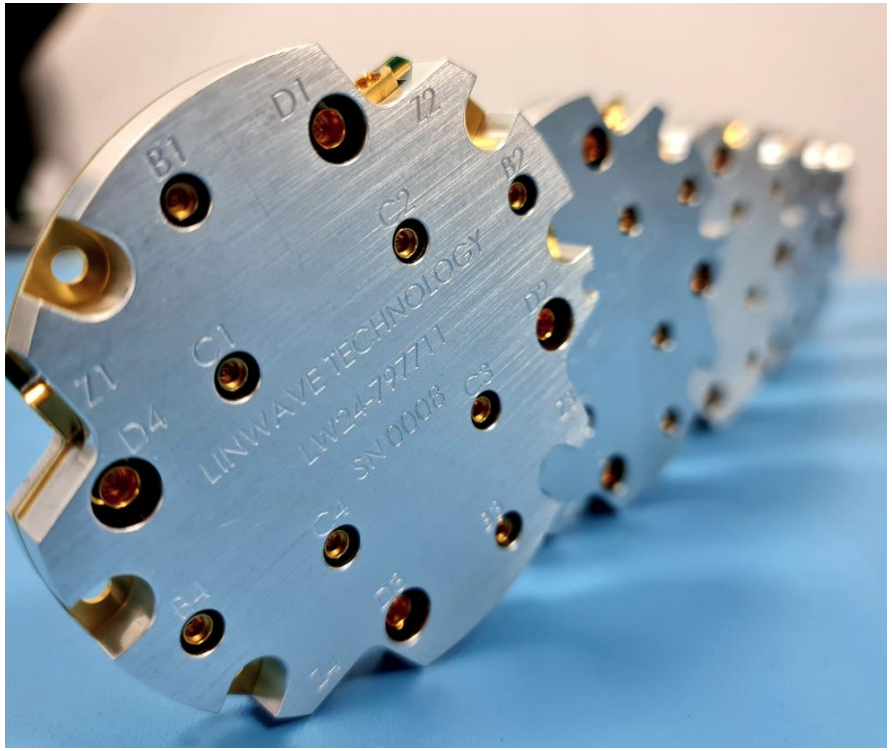
- Steerable phased array Ka-band system
- Separate Tx and Rx active elements
- Small physical size – chip and wire design
- Designed to minimise effects of phase noise
- Integrated up/down conversion
- Design re-use and standardisation for Tx and Rx channels
- Custom control GUI for active gain and phase control of each array element



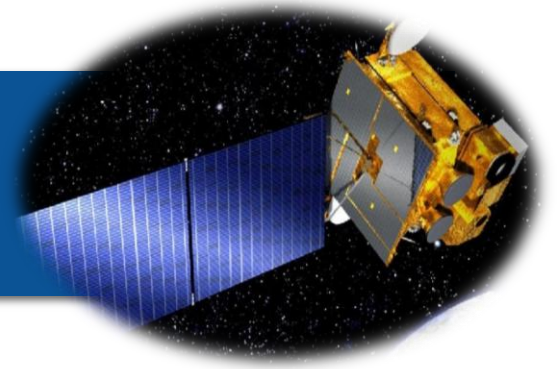
Wide-Band EW

Application: Signal control for Direction Finding

- 4-channel amplified antenna control and switching
- Broadband module with channel bands at 5MHz – 8GHz.
- Integrated noise source for self-calibration
- Bespoke interface and mechanical considerations for antenna integration
- Channel isolation 50dB
- Integrated channel filtering and gain compensation
- Small form factor



Space Roadmap Summary



Upgrade selected existing products for Space

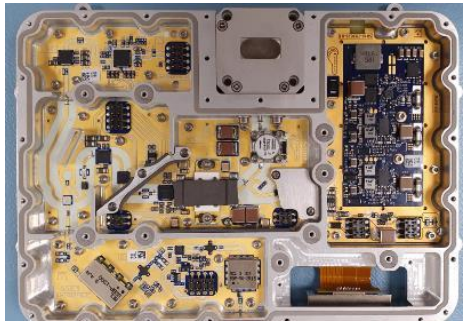
- Converters / Amplifiers
- Ultra Low Phase Noise Oscillators
- Phased Arrays
- System in Package (SiP)
- TRMs
- Space qualified to customer specification

New designs to address European capability gaps

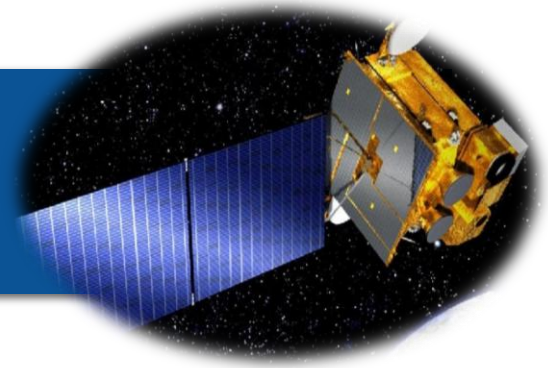
- 17.7-21.2GHz BUC/SSPA
- 26GHz BUC/SSPA
- Beam forming elements in SiP/MCM
- Higher output powers
- Q/V-band frequencies
- Market surveys and intel gathering ongoing

Funding

- ESA
  - ARTES, GSTP
- UK Space Agency
- Other UK agencies



Space Applications



Satellite Applications

- Downlinks and TT&C
- Transmit and receive comms chain
- Beam forming
- Inter Satellite Links
- Earth observation instruments
- SAR Radar
- SIGINT
- Frequency generation
- Clock distribution

Ground Applications

- Ground Stations
- User Terminals