



Linwave Technology

Defence & Avionics Overview Presentation
March 2021

Company Confidential



L I N W A V E
T E C H N O L O G Y

Linwave Technology

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

Experienced in the supply of Transceivers, Amplifiers, Sources and Multi chip hybrids 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, thro 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 SAP, approved to AS9100 and utilises specialist design software such as MW Office, Solidworks and Altium.



Facilities & Capabilities

- 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 clearance as a government approved site for military projects
- Internal Access control points installed, perimeter security, cctv
- Environmental initiatives in-built – LED lighting, Rainwater harvesting.

Engineering

- Harsh environment specialists
- NPI Process
- Mech Design
- RF design
- PCB design and layout
- Digital embedded and control electronics

Test

- Frequency to 100GHz
- Spectrum, Vector, Power, Noise and Scalar Analysis
Modulated test sources & AW capability
- Phase noise capability
- Temp cycle (LN2) & operational vibs
- Measurement automation routines
- Environmental testing including hot / cold plates,
- Burn-in ovens and operational vibration

Assembly

- Fine pitch Solder assembly
- Hybrid chip & wire assy capability
- Gold wedge, ball, ribbon bonders
semi Auto and manual
- Epoxy & Eutectic die attach
- Dry Nitrogen backfill
- Bond pull tester
- Gap welder
- Hermetic sealing & Laser welded



Facilities & Capabilities - Assembly

- In-house manual fine pitch SMT assembly
 - LPKF fast prototyping PCB machine
 - Manual assembly and solder reflow
- Hybrid chip & wire assembly capability
 - Gold wedge, ball, ribbon bonders
 - Eutectic die attach
 - Epoxy die attach
 - Dry Nitrogen backfill
 - Bond pull tester
 - Gap welder
 - Hermetic sealing & Laser welded



Facilities & Capabilities – Clean Room

- Class 10000 clean room
- Temperature and humidity controlled
- Inert gas hermetic sealing - furnace and projection welding
- Wafer probe capability
- Manual and Semi-Automated wire bonding

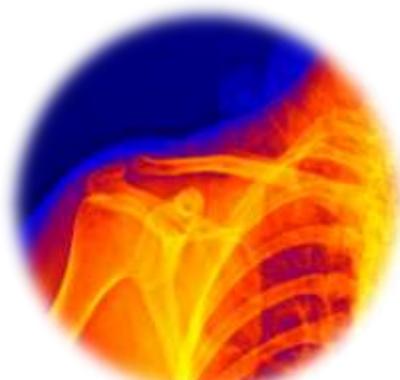


Facilities & Capabilities - Test

- Spectrum, Vector, Power, Noise and Scalar Analysis to 50 GHz
- Modulated test sources & AW capability
- Phase noise capability
- Temp cycle (LN2) & operational vibration capability
- Measurement automation routines for repetitive tests
- Environmental testing including hot / cold plates, Burn-in ovens and operational vibration



Markets

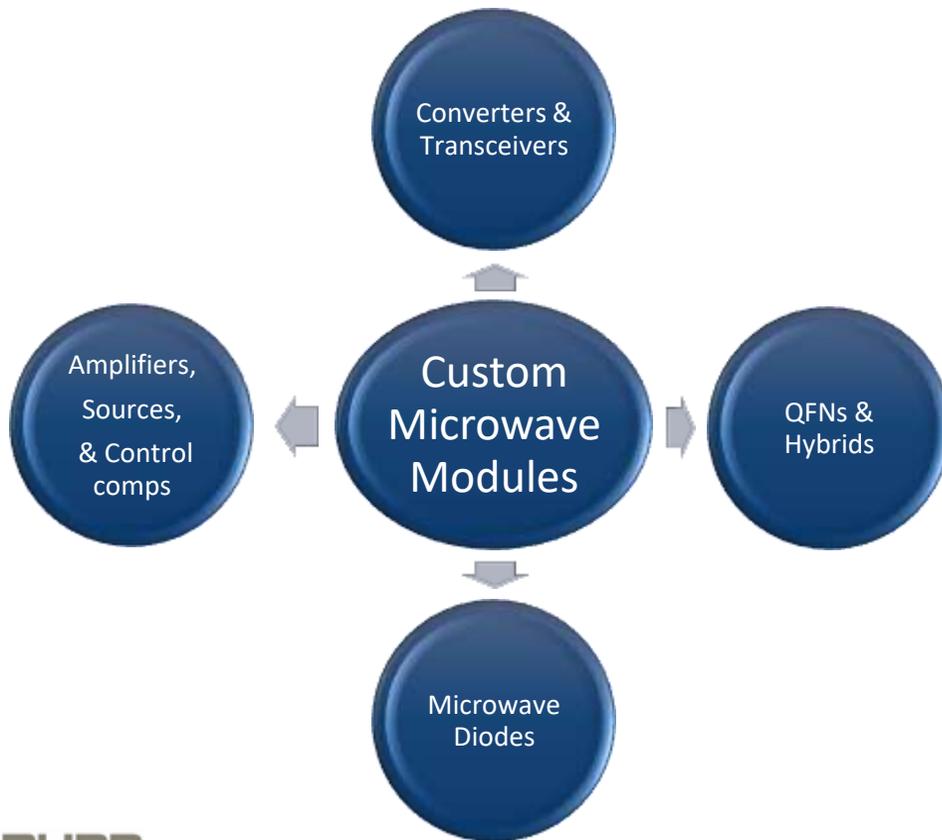


Defence	Marine	Avionics	Industrial	Healthcare
Radar, C-IED, Seekers, EW	Safety Beacon	Transceivers	RF Heating, Moisture Detection, FOD	RF Therapy, RF Energy



Satcom & Broadcast	Space/Hi Rel	Wireless & Radio	Transport	Security and Imaging
	LEO -Converters, Amps	Boosters and Repeaters	Speed Detection and Traffic monitoring	Sensors

Products & Technologies - Summary



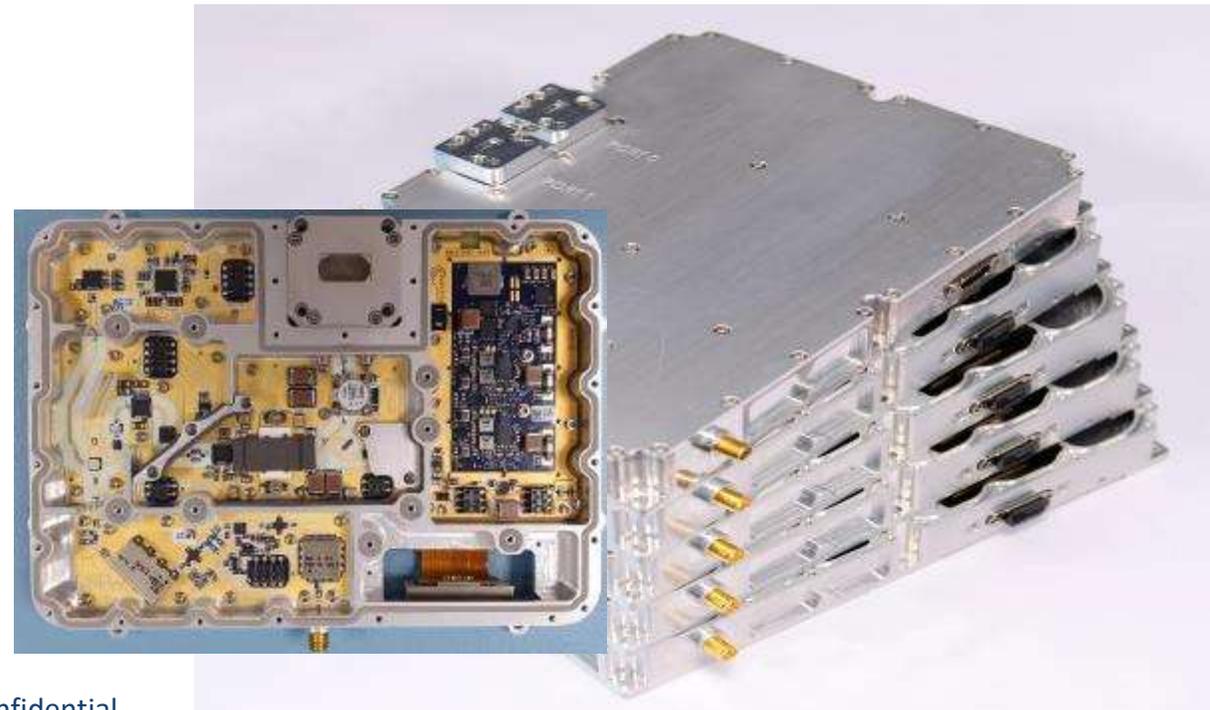
Case Study – Data link Converters Ka & ku



Application: Airborne Data link Ka band

Product Features:

- L band to Ku @ 25W linear o/p
- L band to Ka @ 8W linear
- Fan-less Operation
- Custom enclosure for exposure to high altitude 55,000ft
- Integrated Power Amp and Converter for SWaP improvements
- IESS 308 compliant



Defence Case Study – Radar TX/RX

Application: Airborne RADAR

Product Features :

- Transceiver containing 2 channel down converters
- Analogue to digital conversion capability
- Internally generated high accuracy system clock levels
- Built in test circuitry for fault detection and isolation
- Selectable TX filtering
- Programmable gain
- Digital interface
- Wide operational temp range -40 / +85C



Case Study – High Freq Ref Oscillator



Application: High freq Ref for Radar and 5G Test

Product Features:

- High freq fundamental for fast clocks and high freq refs
- Fc options up to 10GHz
- Phase noise -151dBc (5GHz @ 1MHz offset)
- Ageing 5×10^{-9} dBc/Hz
- Ref 10MHz
- O/P power 20dBm



Case Study – Naval Digital Rx



Application: EW Receiver for Passive surveillance

Product Features:

- High target tracking capacity
- Passive Receiver
- Utilises key feature sets for direct conversion to baseband
 - Track and hold,
 - Fibre conversion,
 - Use of ADC's
- Broad operational band of 2.0-18GHz
- Flexible system allows configuration with multiple sub-bands



Capability Case Study – Doppler Radar



Application: FMCW Radar head

Product Features:

- 77GHz FMCW Radar Head
- Applications include border surveillance, perimeter monitoring and foreign object detection on runways and railway level crossings (24GHz variant – safety critical environment)
- Lightweight & low power consumption
- High available bandwidth



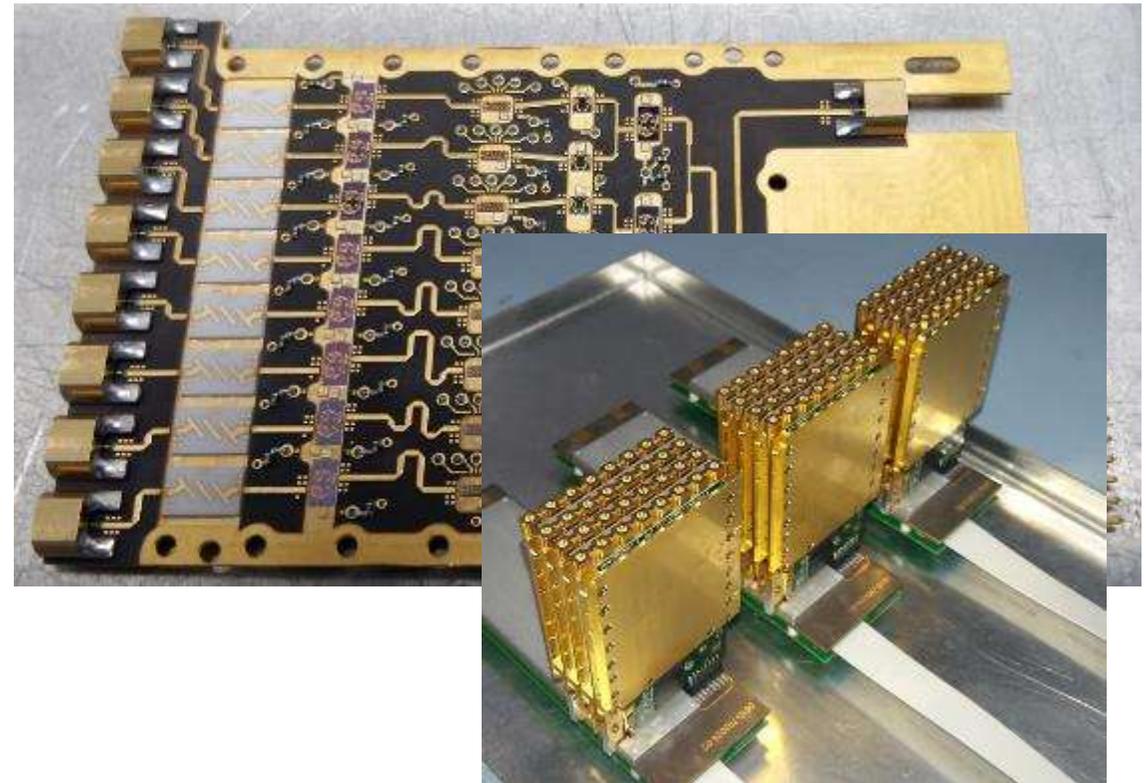
Case Study – Ka Band Converter



Application: Airborne Data link TX RX Ka band Array

Product Features:

- Steerable phased array Ka band system
- Combined Tx and Rx active elements
- Small physical size
- Designed to minimise effects of phase noise
- Design re-use and standardisation for Tx and Rx channels



Case Study – Power amplifier



Application: Solid State GaN Amp X band

Product Features:

- 200W Pulsed o/p power 8.5-9.5GHz
- Capable of high duty cycle 80%
- High performance GaN
- 69dB Gain
- -70dBc non harmonic spurious
- Applications ATC, Radar
- Conduction cooled to external heatsink



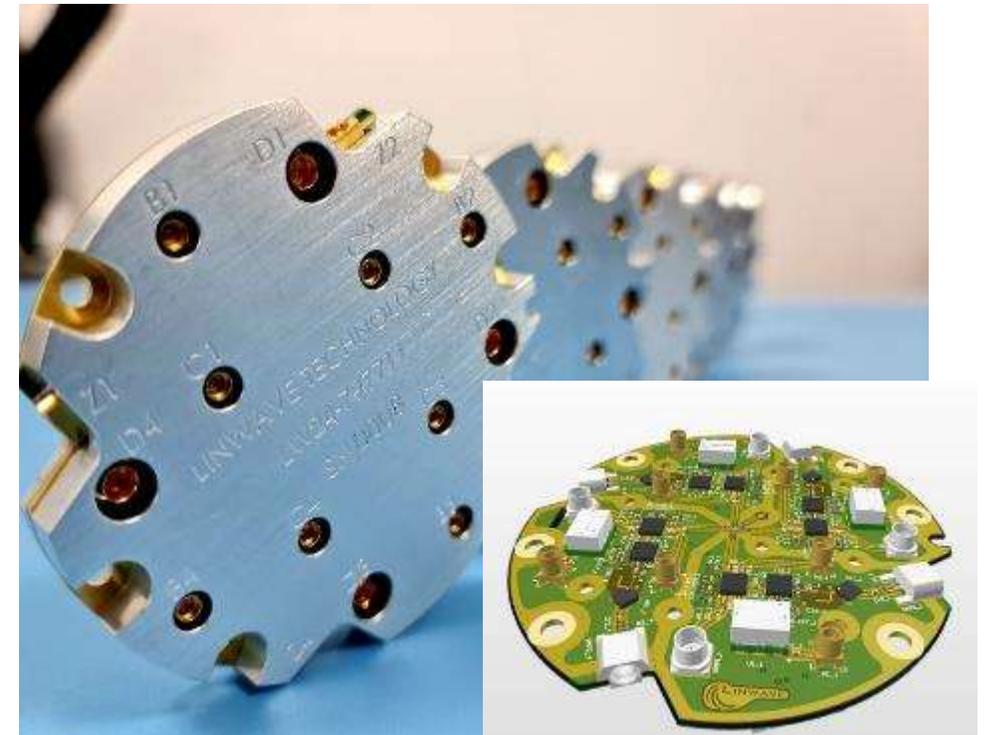
Case Study – Land EW



Application: Signal control for Direction Finding

Product Features:

- Antenna 4 channel control and switching
- Broadband module with channel bands at 1MHz – 9GHz.
- Integrated Noise source for self calibration
- Bespoke interface and mechanical considerations for antenna integration
- Channel isolation 50dB
- Integrated channel filtering and gain compensation



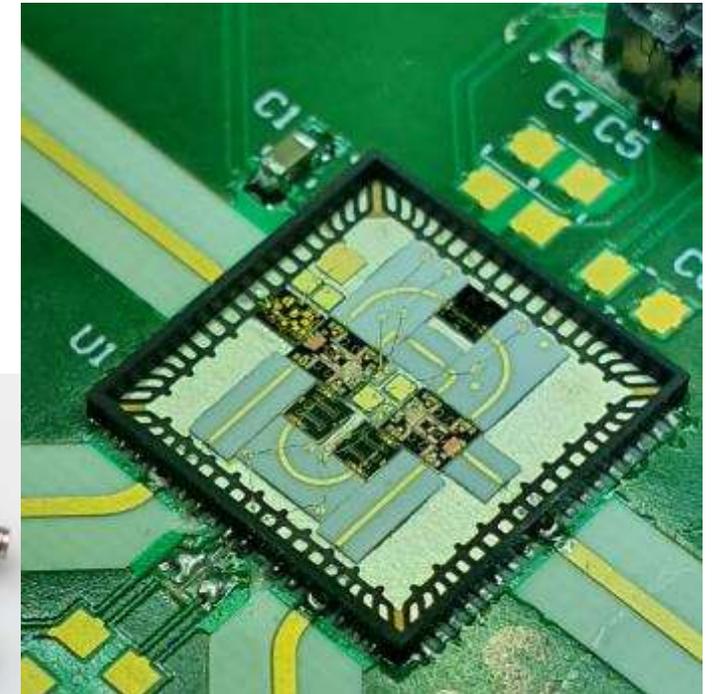
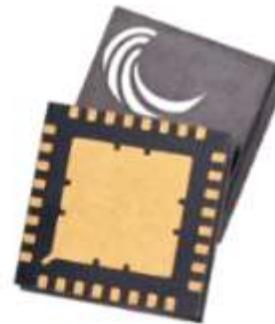
Case Study – QFN Limiter, LNA/switched Filter



Application: Integrated Protected LNA for Radar, EW

Product Features:

- Multi chip packaging for integrated solutions
- 2-18GHz Limiter + LNA
- High isolation 2 stage limiter
- 5W CW power handling
- Nominal gain 16dB with 3dB NF
- Multi function variants available
 - Feature sets – Filters, switches, LNA
- Optimised selection or banding of die parts for specific applications





Comms Case Study – Receiver



Application: SIGINT RECEIVER

Product Features:

- Satcom and Sat-phone receiver
- Thurya, Iridium & Inmarsat compatible
- Accepts up and downlink signals
- Integrated PC for DSP control and high res graphics interface
- Integrated Geo-location
- Compatible LNA designs available



Defence Case Study – Radar Beacon



Application: Marine Beacon

Product Features:

- S & X band Radar Receiver
- Responds to multiple simultaneous Signals
- Onboard Digital card integration
- Integrated Dual antenna, de-interleaver FPGA, LNA and PA modules



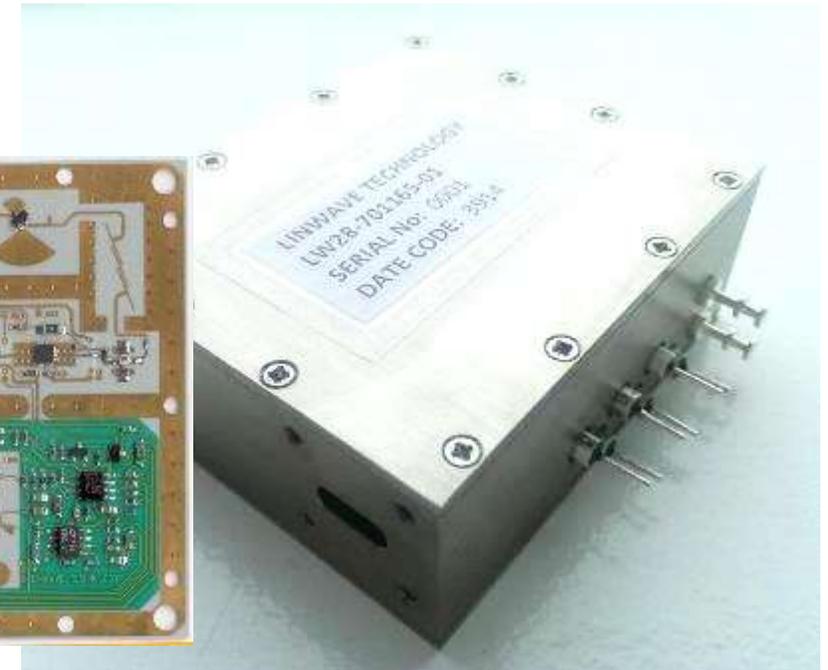
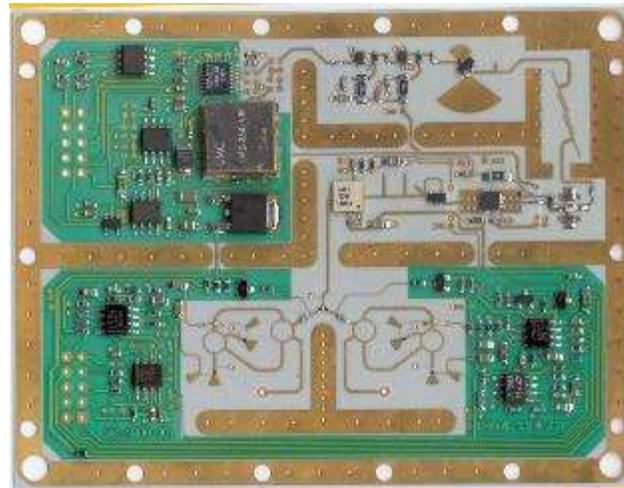
Security Case Study – FMCW Radar



Application: Security sensors

Product Features:

- Doppler radar for intrusion detection
- Debris monitoring
- 300MHz FMCW Sweep
- Low phase noise source
- Two switched TX/RX channels
- Inbuilt BITE functions
- Low cost SMT design
- Automotive environmental



Case Study – Military Comms



- 30-512 MHz 50W Booster Amp
- Combined multiband integrated transmit amplifier and high quality receive LNA with fast DAMA compatible Tx/Rx switching and automatic bypass upon power failure
- Designed to work seamlessly with any tactical half duplex radio or radio repeater
- Its small size and low power consumption makes it particularly suitable for manpack, ground mobile and marine applications, including ultra small vehicle fits where power is at a premium
- ITAR Free

