



MINISTRY OF DEFENCE



BAE SYSTEMS

THALES



EMRS DTC
Electro-Magnetic Remote Sensing (EMRS) Defence Technology Centre (DTC)

Transduction Devices and Materials Theme

Research Overview 2009

Paul Robertson
(Selex Galileo)

TDM Theme Leader

David Bruce
(Dstl)

TDM Theme Knowledge Integrator

TDM Research Theme - Overview

Science Providers

Technical Areas

Military Drivers

- Multi-Function Systems
- UAV Payloads
- Situation Awareness
- Long Range Operation
- Covert Operation
- Affordability

- New RF Power Technologies
- RF Design methodologies for high PAE and UWB
- Wideband A to D conversion
- Passive mmW sensing
- RF Signal Processing Technologies
- Microwave photonics

- **Cardiff University**
- **University of Glasgow**
- **BAE Systems ATC**
- **Manchester University**
- **University of Sheffield**
- **Diamond Microwave Devices**
- **Element Six**
- **Oxford Applied Surfaces**
- **INEX**
- **Heriot Watt University**
- **RFMD**
- **QinetiQ**
- **Selex Galileo**

Current TDM Research Projects

- Ultra High Speed InAlAs - InGaAs - InP HBTs for mixed BIFET Technology (*University of Manchester*)
- High Speed Sampling Downconverters for Radar and EW Applications (*BAE Systems ATC & University of Glasgow*)
- Novel Miniature Reconfigurable Filters for adaptive Ultra Wideband Radar and EW Systems (*INEX*)
- GaN for Next Generation Sensors (*QinetiQ*)
- CVD Diamond MESFETs for RF Power applications (*Element 6 / DMD*)
- Novel Development Methodology for Highly Efficient & Ultra-Broadband Remote Sensing Applications (*Cardiff University*)
- Technology Groundwork to De-risk Compact mm-wave Imagers for Urban Operations (*QinetiQ*)

GaN on Silicon (QinetiQ / Sheffield) Key Achievements

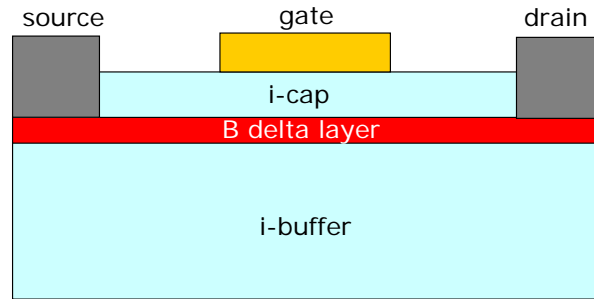
- Development of stable HFET layer growth on 150mm Si
 - Demonstration of HFET on 150mm Si with low bow (57um) and good 2DEG properties
 - 2DEG properties meet KORRIGAN spec for HFETs on SiC
 - Layer properties compliant with processing at RFMD
- Device processing
 - Devices fabricated on Q079 wafer at both QinetiQ and Sheffield
 - DC parameters are consistent with expectation
 - Good ohmic contacts
 - G_m , V_p , pinch-off good
 - RF performance poor due to use of conducting Si substrate – performance using high resistivity Si substrates part of current QinetiQ programme
- Structure
 - Gate recess, field plate and passivation extensively investigated to improve breakdown and reduce dispersion.

RF Power Devices and Components

- CVD Diamond MESFET (Element 6 / DMD)

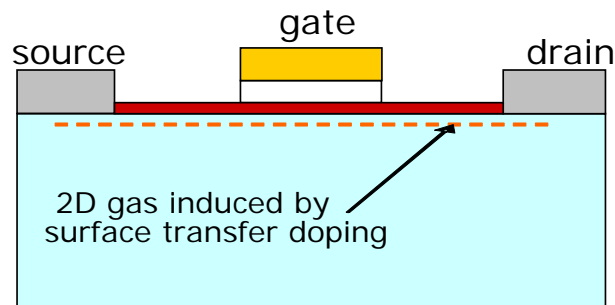
Motivation – to harness the high thermal conductivity, voltage breakdown and carrier mobility to deliver record levels of microwave power

Delta Doped MESFET



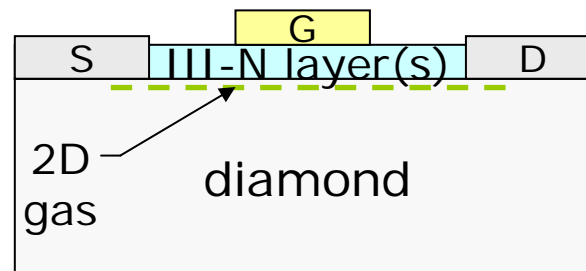
Early work under DTC – now in development by DMD

SURFET



Offers easier manufacture but stability is an

PEFET



Highest microwave performance potential but very difficult growth problem.

New Active Measurement and Modelling Methods (Cardiff)

Motivation

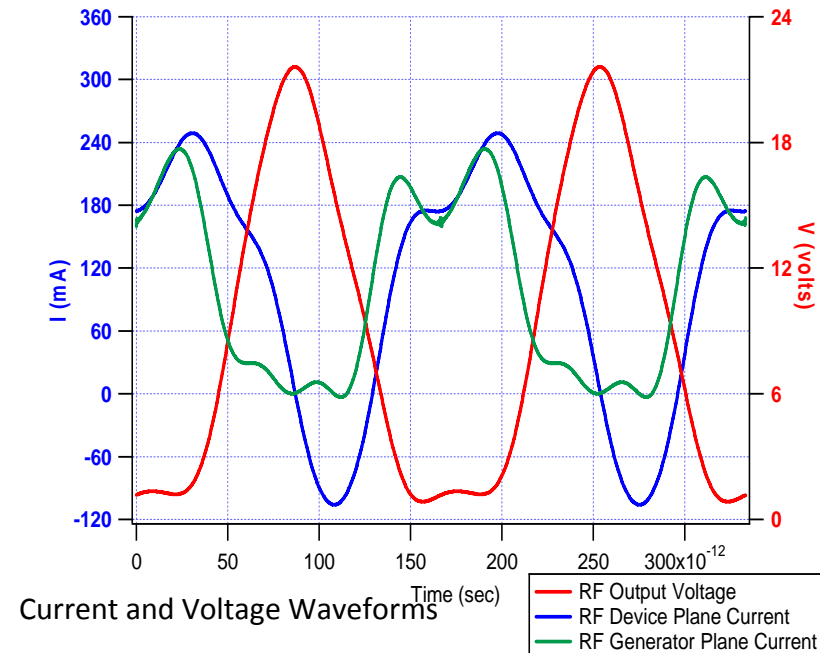
- Advance MMIC PA design loop by increasing knowledge of operation of active devices.
- Improving the efficiency of the CAD process through creation of accurate models under real operating conditions

Waveform Measurement

- Extend mobile comms modelling and design methods to military frequency bands, i.e. to 40 GHz

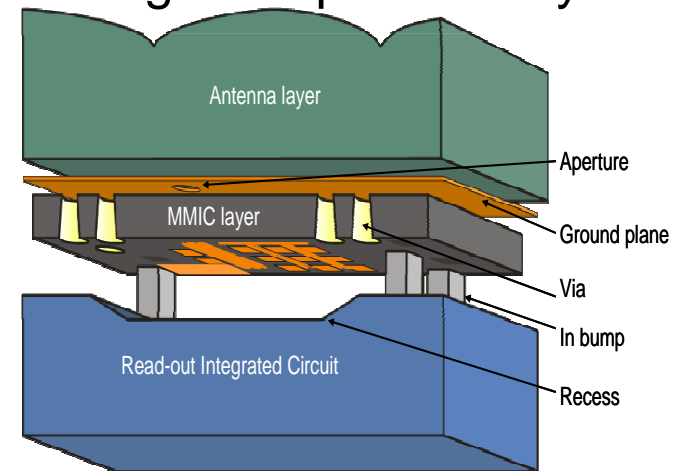
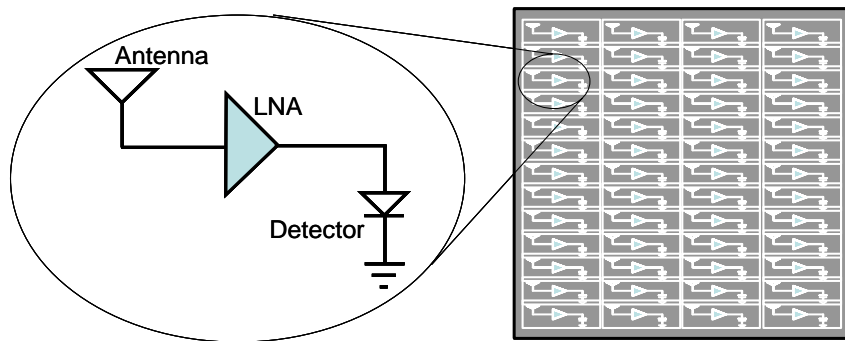
Application

- High PAE X band HPA, wideband EW HPA and wide dynamic range MMICs



Passive mmW Focal Plane Array (QinetiQ)

- Radical change in passive mmW technology from assembled arrays of discrete modules to a single fully integrated, staring focal plane array



- Introduction of QinetiQ uncooled indium antimonide (InSb) technology to enable
 - Operation at higher frequency with low power dissipation to enable good spatial resolution, with acceptable array size and on-focal-plane power dissipation, small apertures and small systems
 - potential for THz cut-off frequencies whilst requiring < 0.5 V bias.
 - Integration of amplifier and detector components

TDM Theme - Conference Programme



- **Tuesday, 14:10 to 16:00 in the Sidlaw Auditorium (Level +3)**
 - GaN X band Power Transistors – A UK Foundry Compatible Process
 - Optimisation of AlGaN / GaN HFETS using Field Plate and Gate Recess Tech'y
 - Recent Developments in high power CVD diamond MESFET technology
 - Keynote Lecture: UK Defence Technology Plan – Sensors Dr Alistair Jolly
- **Wednesday, 09:15 to 09:40 in the Sidlaw Auditorium (Level +3)**
 - InSb Technology for Integrated Passive Millimetre Wave Focal Plane Arrays
- **Wednesday, 14:30 to 16:10 in the Sidlaw Auditorium (Level +3)**
 - High Speed Sampling Downconvertors for Radar and EW Applications
 - Novel Miniature Reconfigurable Filters for adaptive Ultra Wideband Radar and EW Systems
 - Wideband Transmit / Receive Modules for Phased Array Antennas
 - Development Methodology for Highly Efficient and Ultra Broadband remote sensing applications
- **Poster Displays in the Cromdale Hall (Level -2)**
 - throughout the Conference



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