Microelectronics

Microelectronics at SAC – Design, fabrication, test and delivery of space qualified components and subsystems for microwave and mm-wave circuits and systems:

Major activities in RF microelectronics, where industry may contribute with or without SAC technology transfer

- Design, development, fabrication and testing of Surface Acoustic Wave (SAW) devices
- Design and testing of MMICs, RF MEMS, mm-wave components
- Development and fabrication of micro optics elements - calibration target, Micro Lens Array, optical gratings
- Design, fabrication using packaging technologies like MCM, LTCC, System in Package (SiP), advanced System-on-Chip (SoC) & Chip scale packaging
- Fabrication and assembly of MIC, SAW and LTCC based subsystems:
  - ✓ Thin Film Deposition, substrate processing for MIC and SAW devices
  - ✓ Microlithography for MIC and SAW – Optical, DWL, Mask fab, E-beam
  - ✓ Assembly and packaging of MMIC, MIC, LTCC and SAW including LASER hermetic sealing

Similar products and infrastructure (total or part) and expertise to fabricate, assemble and test these devices are expected from industries.

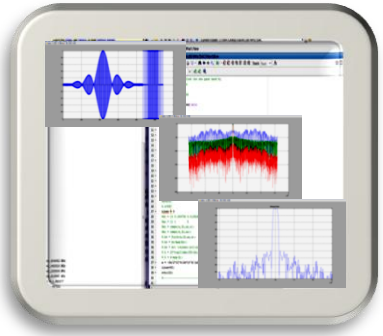
SAW: Space Applications Centre (SAC) has developed the expertise for the design of Surface Acoustic Wave (SAW) devices for frequency range from 10MHz to GHz & fabrication technology for space hardware to meet the functional requirements of various subsystems. SAW chips are realised mainly with two types of substrates i.e. Lithium Niobate (LiNbO3) and Quartz wafer having aluminium metallisation (thicknes-1000ºA to 2500 ºA). After fabrication, wafer is diced, assembled, tested and screened for use in subsystems.

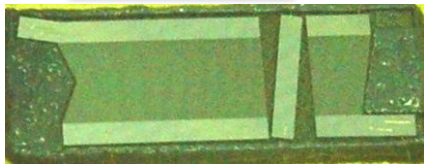
MMIC: SAC has the expertise in design and development of Monolithic Microwave Integrated Circuits. Multi function MMICs are designed and available covering S band to W-band frequencies. These MMICs are tested on wafer, diced and assembled to make satellite payload subsystems. Industry participation is expected in RF On-Wafer test, dicing, assembly, testing and screening.

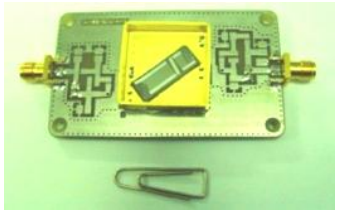
MIC: Microwave Integrated circuit on alumina is regularly used in different payload subsystems. Space qualified Thin film, Lithography, assembly and packaging processes are used for fabrication of MICs on Alumina. LTCC and Duroid are also used for microwave subsystems.

RF filter on Chip - SAW Design and Development: Vendor Opportunities

Design / Board Level Layout → **Fabrication Thin Film and Lithography** → **Assembly, Test & Screening**



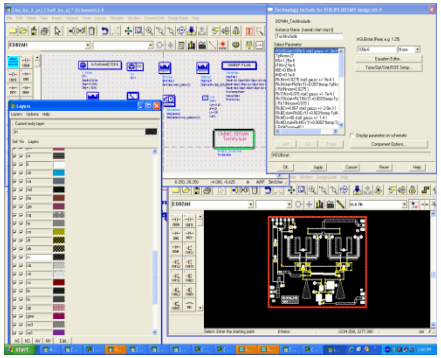


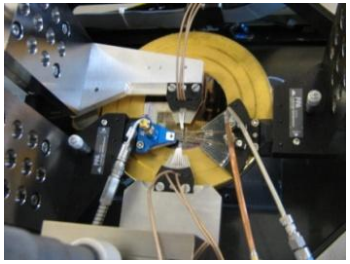


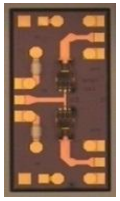
Parameter	Unit	Rep. Specs.
Centre freq.	MHz	160
0.5 dB BW	MHz	> 1.6
50-dB BW	MHz	< 4.0
Ultimate Rej.	dB	60
Phase ripple		± 2.0° (max.)

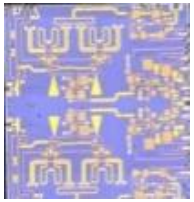
Microwave and mm-wave MMIC System on Chip - Design and Development: Opportunities

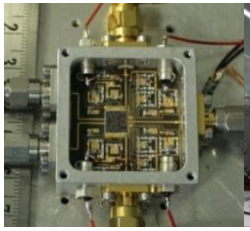
Design / Board Level Layout → **Wafer Level Test and Diced Chip** → **Board Level Design, Assembly, Test and Screening**

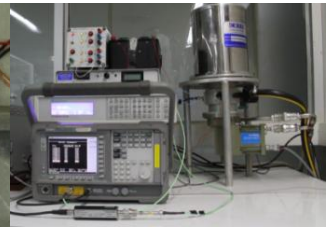










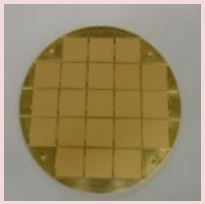


Parameter	Unit	Rep. Specs.
Frequency	GHz	RF: 29-31 LO: 13.75 IF: 2.5GHz
LO freq		> 40
Gain	dB	> 40
NF	dB	2.0

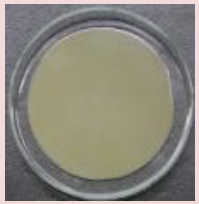
Thin Film Deposition for MIC and SAW devices

VENDOR OPPORTUNITIES

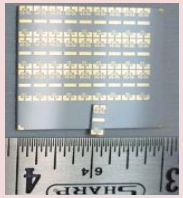
Multilayer metallization on Alumina substrates



Multilayer metallization on Quartz & LNB/LNT Wafers



Substrate/wafer processing using laser & non-laser based techniques



MAJOR FACILITIES REQUIRED

Sputtering Unit

Evaporation Unit

Clean room

Certified Manpower

PROCESS SPECIFICATIONS FOR MIC

• **Multilayer metallization on Alumina substrate**

Substrate type : 99.6% pure, fine-grain, Thickness: 10mil, 25mil
Métallisation: Cr-Cu-Au, Cr-Au, Overall metallisation thickness: 5 to 7 micron
Uniformity of film thickness: ±10% over 1 square inch area

PROCESS SPECIFICATIONS FOR SAW

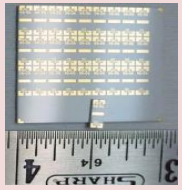
• **Multilayer metallization on Quartz, Lithium Niobate and Lithium Tantalate wafers**

Substrate : Single Crystal, 3″/4″ dia wafers, 350um-1500um thick
Metallization schème: NiCr-Al
Overall metallisation thickness: 100 to 300 nm
Uniformity of film thickness: ±10% over wafer area

Substrate Processing for MIC and SAW Devices

VENDOR OPPORTUNITIES

Substrate/wafer processing using laser & non-laser based techniques: Dicing, drilling, slot cutting



MAJOR FACILITIES REQUIRED

Dicing Unit

Laser Unit

Certified Manpower

PROCESS SPECIFICATIONS FOR MIC

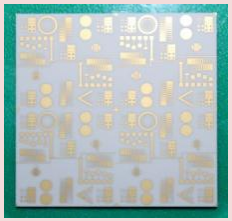
• **Substrate processing of Alumina substrate**

Substrate type : 99.6% pure, fine-grain
Substrate thickness: 10 mil, 25 mil
Substrate size: 0.5 sq. inch to 1.0 sq inch
Minimum chip size after dicing: 1.0 sq mm
Slot size: 0.5 sq mm
Minimum via hole size: 0.3 mm

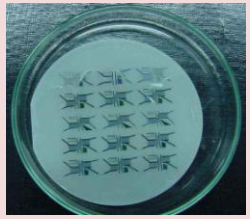
Microlithography for MIC and SAW Devices

VENDOR OPPORTUNITIES

Lithography on metallised MIC and SAW substrates and delivering patterned MIC and SAW devices as shown



MIC



SAW

FACILITIES REQUIRED

Photo Lithography System

Laser Lithography Systems

Electron beam Lithography System

PROCESS SPECIFICATIONS

Sr. No.	Required Process Examples	Process Capability Required
1.	SAW Fabrication using Photolithography & Wet Etching Process on NiCr-Al Metallised Piezoelectric Wafers (Metallisation Thickness = 1000 - 4000A°)	CD=3µm, Tolerance = ±20% or 3µm whichever less
2.	MIC Fabrication using Mask Based Photolithography & Wet Etching Process on Cr-Au Metallised Alumina Substrates (Metallisation Thickness = 5 - 7µm)	CD=40µm, Tolerance = ± 10 % or 25µm whichever less
3.	MIC Fabrication using Direct LASER Write & Wet Etching Process on Cr-Cu-Au Metallised Alumina Substrates (Metallisation Thickness = 5 - 7µm)	CD=100µm, Tolerance = ± 10 % or 25µm whichever less
4.	Mask Based Photolithography & Wet Etching Process for SAW Fabrication on NiCr-Al Metallised Piezoelectric Wafers (Metallisation Thickness = 1000 - 2000A°)	CD=1µm, Tolerance = ±20% or 3µm whichever less

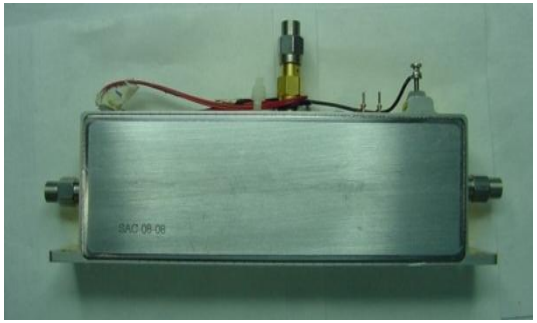
Microelectronics Assembly and Packaging

MMIC MCM assembly on Alumina

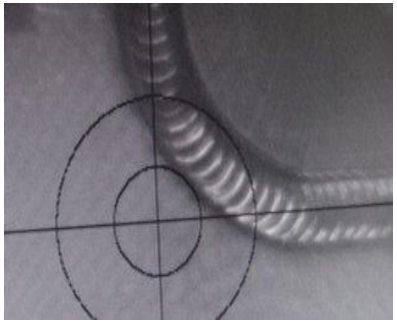
Assembly Process	Specifications
Die attach GaAs & Si chips	Die shear > 10.8N
Gold wire Dia 1 mil bonding	BPS > 3.0gms
Cu wire bonding 32 AWG	BPS > 100.0gms
Laser welding micro D connector	Leak rate < 1×10^{-7}
Laser Hermetic sealing	Leak rate < 1×10^{-7}

HERMETIC SEALING OF MICROWAVE PACKAGES

In the context of microelectronics, hermetic sealing implies an airtight seal to keep moisture and other harmful gases from penetrating the sealed package. Al Metal package is used for sealing the package. Laser hermetic sealing has got the advantages like non contact, low HAZ (Heat Affected Zone), high repeatability, high throughput. Laser Hermetic Sealing process has been successfully developed for sealing Al6061 alloy box with Al 4047 lid.



Typical Laser Hermetically sealed Aluminium package



Typical Laser weld view of corner in sealed Al package

Laser Hermetic Sealing Facility