TacLamPLUS

New Low-Loss Laser Ablatable Substrate for Microwave Circuitry

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New Low-Loss Laser Ablatable Substrate for Microwave Circuitry

Taclamplus background

- Evolved from Taconic participation of “PROKOSMOS”,
- BMBF-funded, EUREKA project E!2448. Completed February 2003
- EADS Germany GmbH as project leader
- Project objective “innovative ways of producing RF modules in a competitive manner.”

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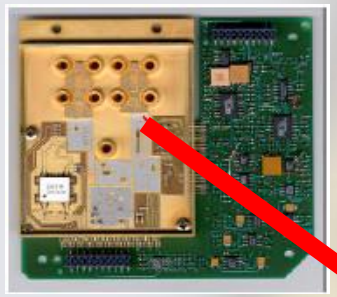
Taclamplus background

PROKOSMOS deliverable:



mm-Wave Transceiver module
mmW unit & PCB

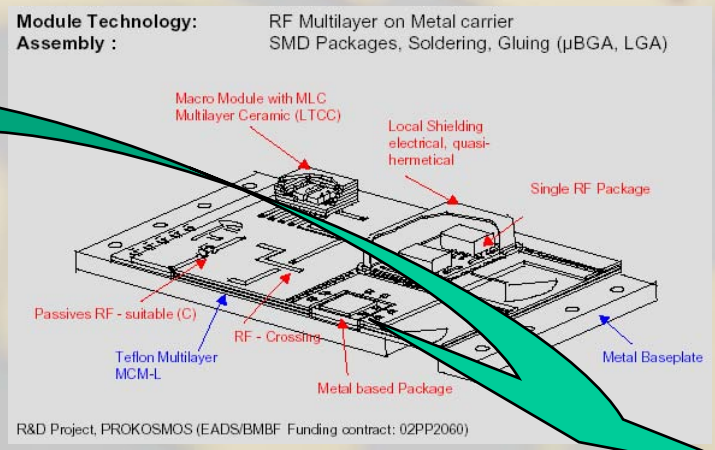
GaAs MMIC

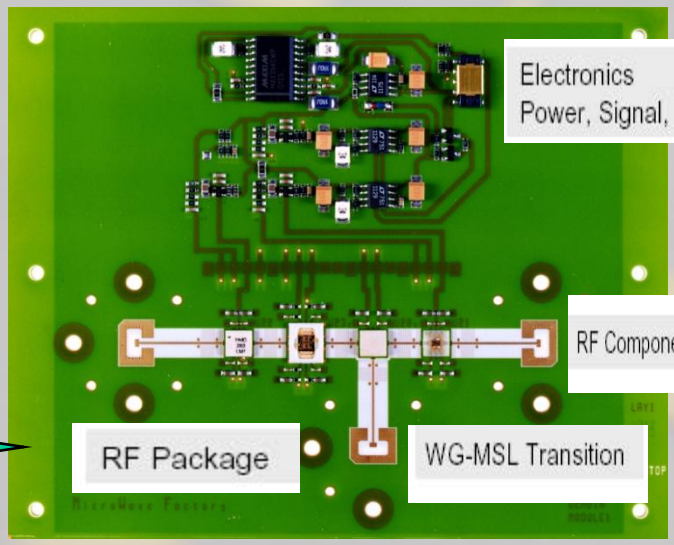
Alumina
Substrate

RF bonds, 60 GHZ
Ribbon

Interconnection:
MMIC-MMIC - Substrate

Example of RF-module





Assembly on one PCB

LMDS radio module, 42GHz

Courtesy Dr Martin Oppermann, EADS Microwave Factory

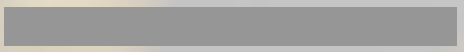
Material description

Material Description:

- Pre-bonded PTFE/ceramic laminate

Copper-foil
PTFE/ceramic dielectric
Metal-carrier

&



PTFE/ceramic dielectric – bond-ply

Requirements for a mm-wave substrate

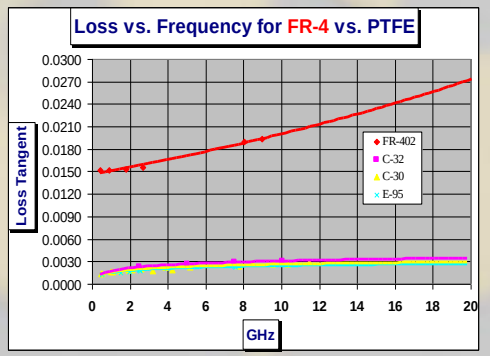
In general.....

- Mm-wave frequencies need *very* low-loss materials
- Printed component feature size & tolerances reduce as frequency increases
- Microwave components can run hot
- RF/MW grounding needs to be sound
- Ideally module assembly should be accommodated on SMT lines

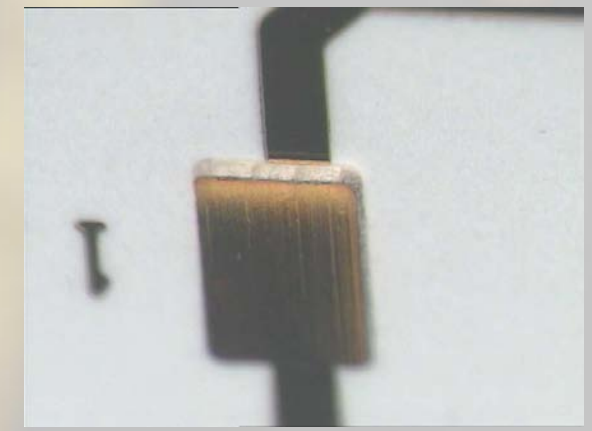
How Taclam*plus* satisfies:

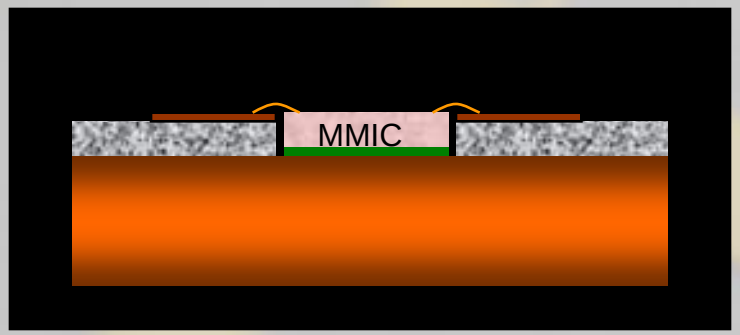
Higher frequencies need low-loss materials:

- High PTFE content, exceptionally low loss
- Dielectric properties are isotropic
- Taclam*plus* will ablate cleanly with infa-red laser to create cavities for MMIC's
- Helps minimise conductor losses be minimising length of wire/ribbon bonds.



Comparison of loss: PTFE to FR4





How Taclam*plus* satisfies:

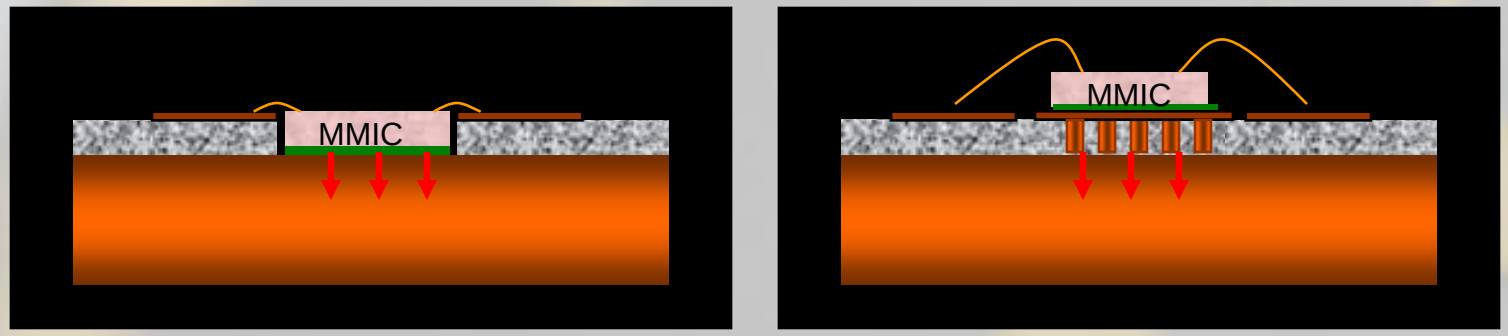
Printed component feature size & tolerances reduce as frequency increases:

- Taclam*plus* offers excellent peel strength with copper foils; 17ųm ED copper > 8lb/in [1.4N/mm]
- 12ųm ED copper is available
- Zero surface wavyness for best photo-image conditions

How Taclam*plus* satisfies:

Microwave components can run hot

• Components can be sunk in direct contact with metal plate or placed on surface with thermal vias sunk into metal plate



How Taclam*plus* satisfies:

RF/MW grounding needs to be sound

- Metal base plate has dual function; heat-sink and ground plane
- Dielectric is bonded straight to ground-plane.
- May minimise the need for expensive thermally-conductive adhesive in module assembly

How Taclam*plus* satisfies:

Ideally module assembly should be accommodated on SMT lines

- Module is a robust PCB
- Have example of 50GHz module assembled using conveyorised IR ovens (attached aluminium wave-guide)

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Examples of Builds – 2 layer

Pre-bonded metal-backed laminate

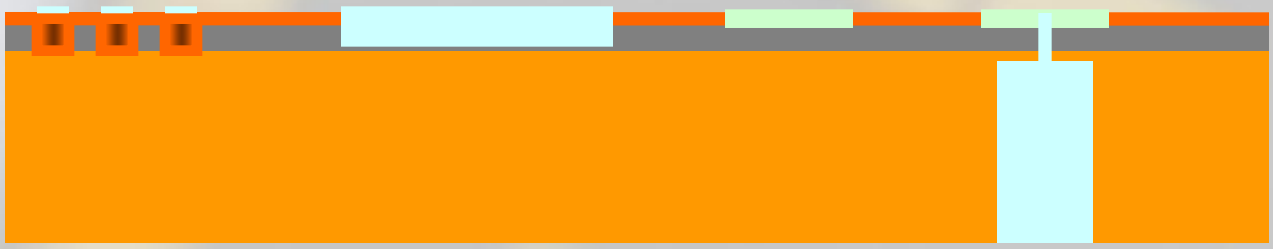
UV laser ablate copper (vias) & etch copper (cavities)

CO2 Laser ablate vias & cavities

1st copper, image > pattern plate> DES

Machine glass-bead pin – K connector - cavity

Finish



Copper/brass plate provides (could be matched CTE Copper Moly or Aluminium Silicon) :

1. Mechanical support during assembly; gives excellent dimensional stability
2. Thermal disapation
3. Sound electrical grounding
4. Flat surface
5. Controlled XY CTE for GaAs matching

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Examples of Builds – 3 layer

Pre-bonded metal-backed laminate

UV laser ablate copper (vias L2-L3)

CO2 Laser ablate vias (L2-L3)

1st copper, image > pattern plate> DES

Sequential lamination, dielectric & copper foil

Etch aperture for MMIC cavity

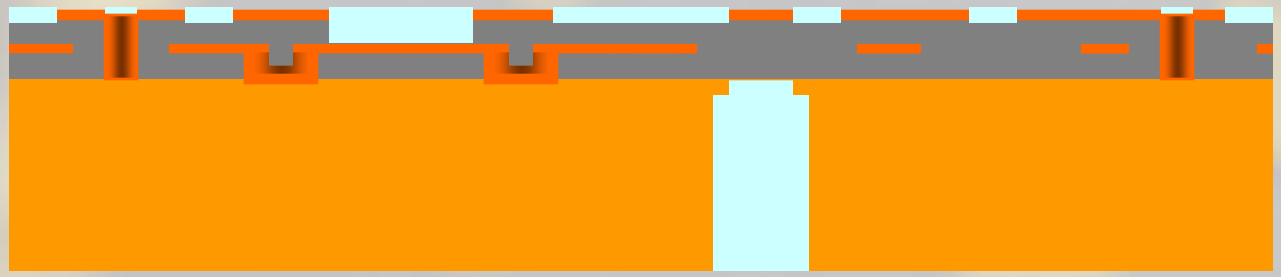
UV laser ablate copper (vias L1-L3)

CO2 Laser ablate vias (L1-L3) and cavities

1st copper, image > pattern plate> DES

Machine glass-bead pin – K connector – cavity or Wave-guide aperture

Finish



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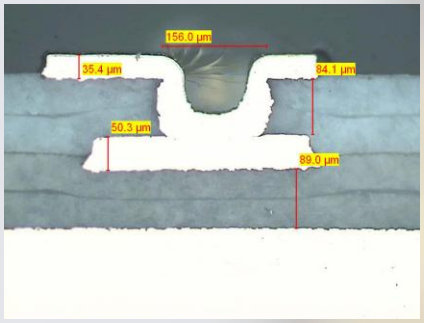
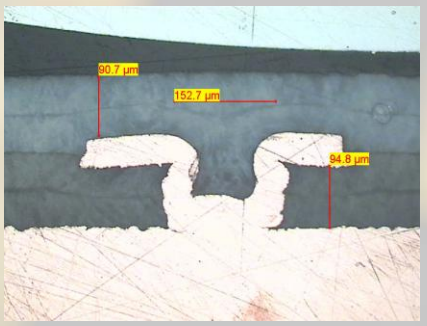
Examples of Builds - micrographs

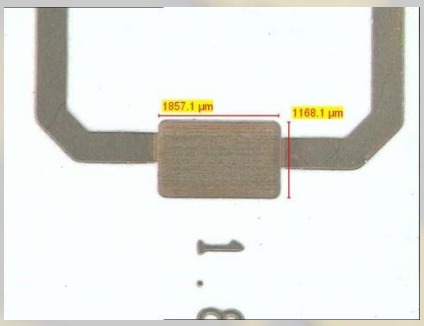


6mil via L1-L2

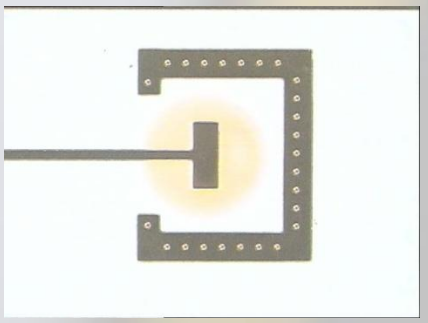


6mil via L2-L3

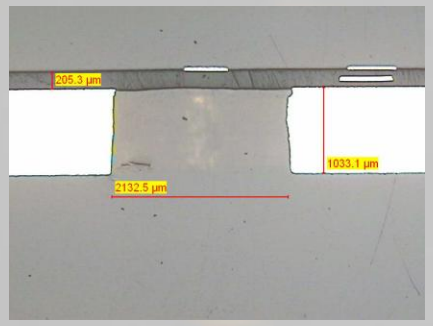
10 mil via L1-L3



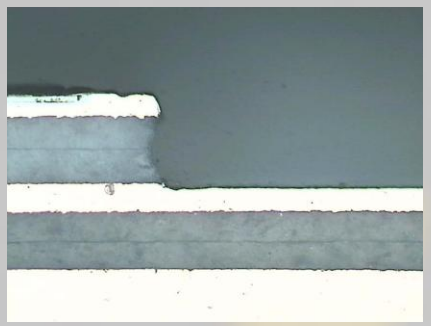
10 mil via L1-L3



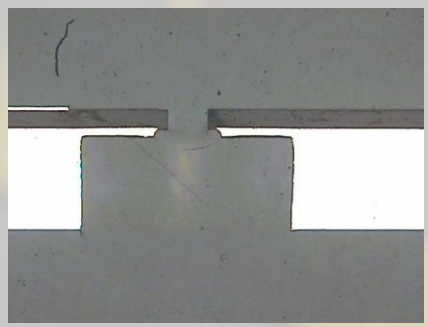
Wave guide interface



Wave guide aperture



MMIC cavity side-wall



K-type pin cavity

Courtesy Varioprint AG

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Summary of Properties

Taclam*plus*

- Low Loss, Df ~0.0055 @ 50GHz
- Insertion loss; 0.04dB/mm @ 50GHz (150µm Taclam*plus*)
- Consistent Dk : 2.20 ± 0.02 & 3.1 ± 0.02
- CO2 Laser ablatable for vias & MMIC cavities
- Supports sequential lamination
- Excellent copper peel strength; ≥ 12lb/in [2.16N/mm]for 17 µm
- Fine-feature resolution (12 µm copper available)
- Exceptional surface flatness – zero wavyness
- Taclam*plus* available thicknesses; 0.1mm, 0.15mm

The author would like to thank the following organisations for their assistance:

- *Varioprint AG*
- *EADS Microwave Factory*