TTM Technologies™

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COMMUNICATIONS & COMPUTING BUSINESS UNIT
TTM TECHNOLOGIES, INC.

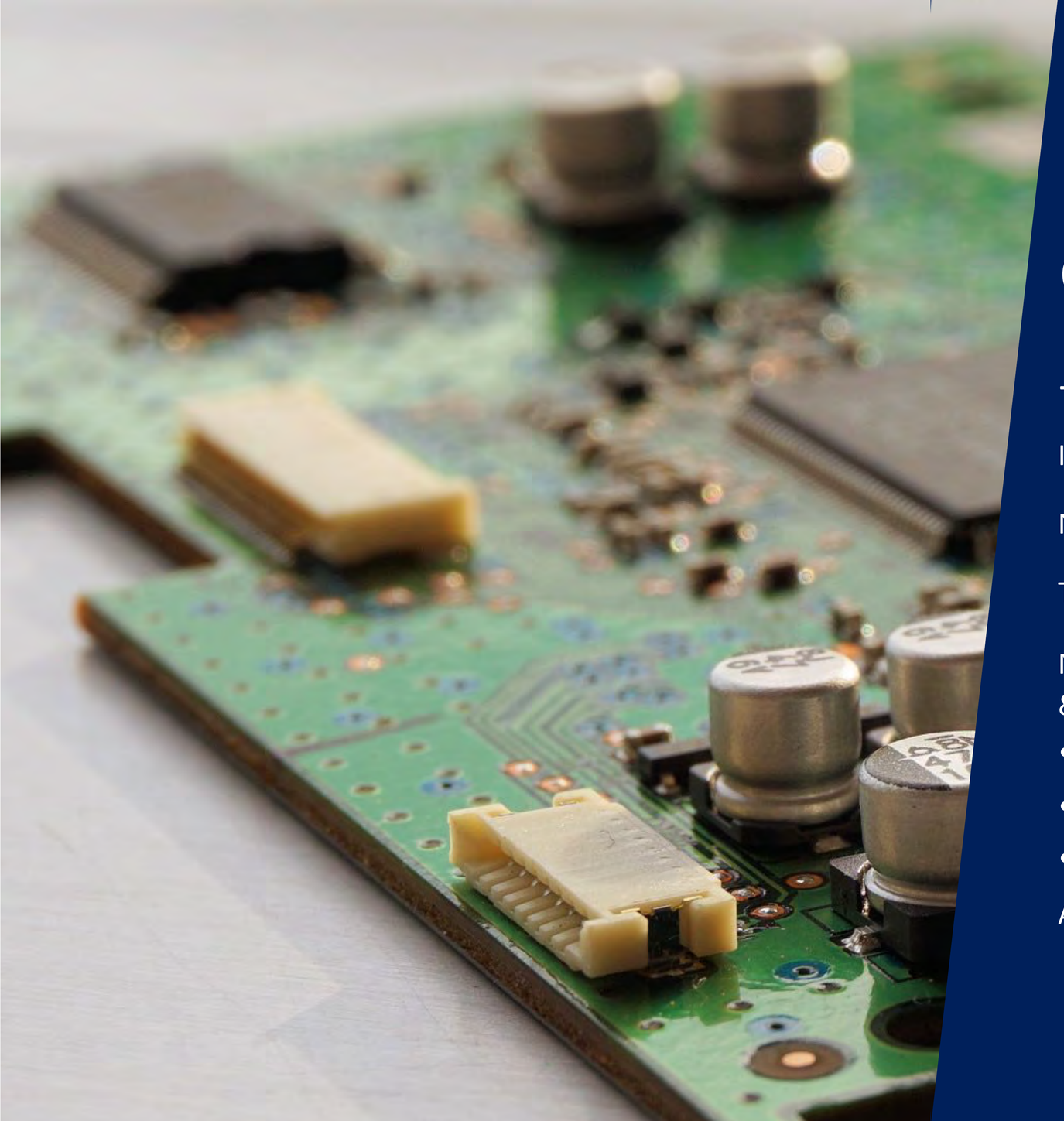
Introduction

It is important to know what our industry is trending towards and how to get ready for the manufacturing of future products.

This eBook will cover the next generation of PCB Technology drivers, our understanding of 5G and the expected challenges that may arise in PCB fabrication. 5G products are expected to require complex attributes in PCB designs.

The author, Joe Jiang, is the Field Application Engineering Manager of our Communications & Computing (C&C) Business Unit, supports our customers in the cellular, networking and communications, and computing end markets.

We look forward to meeting your technology and manufacturing needs.



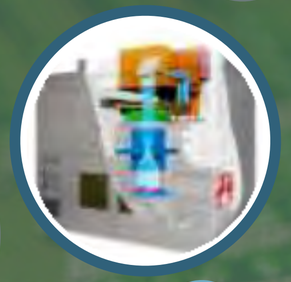
Content

Next Generation PCB Technology Drivers

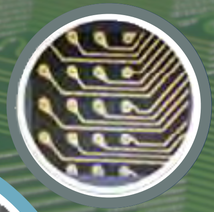
Year 2017 - 2020

5G

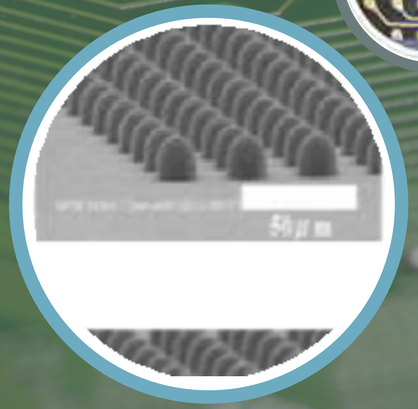
New material solutions



New processes



Controlled processes and design features



Component miniaturization and integration as driver

CUSTOMER NEW PRODUCTS

LINE WIDTH TOLERANCE
+/- 12.5 µm

THICKNESS TOLERANCE
+/- 5%

L2L REGISTRATION
100 µm

IMPEDANCE TOLERANCE
+/-5 %

PCB Design Trend Driven by 5G

3GPP standards for 5G are expected to be fixed by Q3/2018 which is currently driving exploration of non-standard approaches by leading Telecom companies. And it leads to complex attributes in PCB designs.

PCB structures pointing towards convergence of RF & Digital with thermal management solutions

End Device Trends

Increasing performance
Better stability and thermal performance

Increasing signal frequency
From below 6GHZ to mm wave

Increasing complexity
Combined functions & Flexible assembly

Increasing cost efficiency

Modularize

Decreasing size

Increasing signal speed
25Gbps to 112Gbps

DRIVING COMPLEXITY IN PCB ATTRIBUTES

PCB Features Trend By 5G

Material
Ultra low loss materials
Hybrid stack-up, nonsymmetrical stack-up (PTFE+HFFR4+VIPPO)

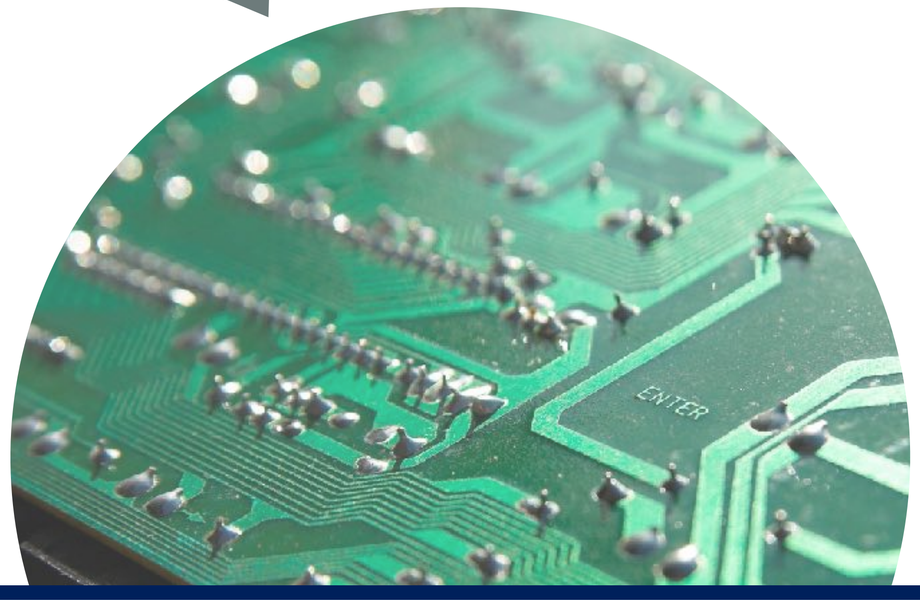
PCB with cavity

HDI, fine line, and fine pitch

New thermal solutions with Copper Inlay/Embedded/ Sheet/heavy copper in plated through holes

Thin cores/ SiP substrate

Tight tolerance



Rigid-Flex

New cost efficient material

Next level of complexity in PCBs

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TTM - Leading PCB Development towards 5G

INDUSTRY LEADER

One of the largest PCB product manufacturers in the world with 2016 sales of $2.5 billion

TECHNOLOGY

One Focus on advanced technology products and strategic R&D Evolution of 5G

MARKET & CUSTOMERS

Diverse end-market exposure and expansive customer base

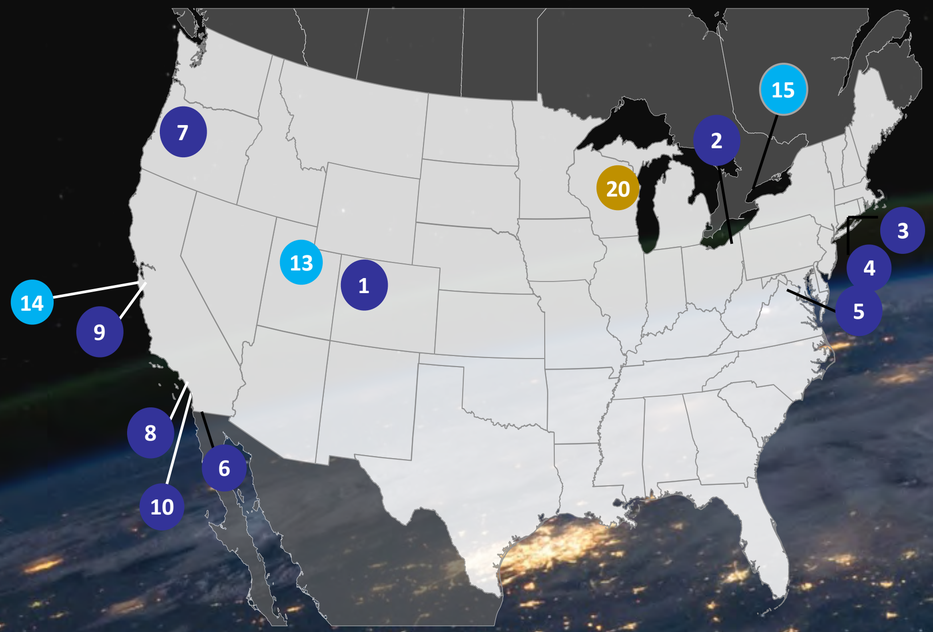
PRODUCTS

Broad product offering of PCBs, backplane assemblies and other custom electronic assembly solutions

MANAGEMENT TEAM

Experienced and successful management team

Our Global Footprint



A&D

Aerospace & Defense

- 1 Denver - DEN
- 2 North Jackson - NJ
- 3 Stafford - ST
- 4 Stafford Springs - SS
- 5 Sterling - STE

Specialty

- 6 Anaheim - ANA
- 7 Forest Grove - FG
- 8 Santa Ana - SA
- 9 Santa Clara - SC
- 10 San Diego - SD

AMI&I

Automotive

- 11 Zhongshan - ZS

Medical, Ind, Inst

- 12 Huiyang - HY
- 13 Logan - LG
- 14 San Jose - SJ
- 15 Toronto - TOR

C&C

Mobility

- 16 Guangzhou - GME
  Guangzhou - FPC
- 17 Shanghai - SME
- 18 Shanghai - SP

Communications

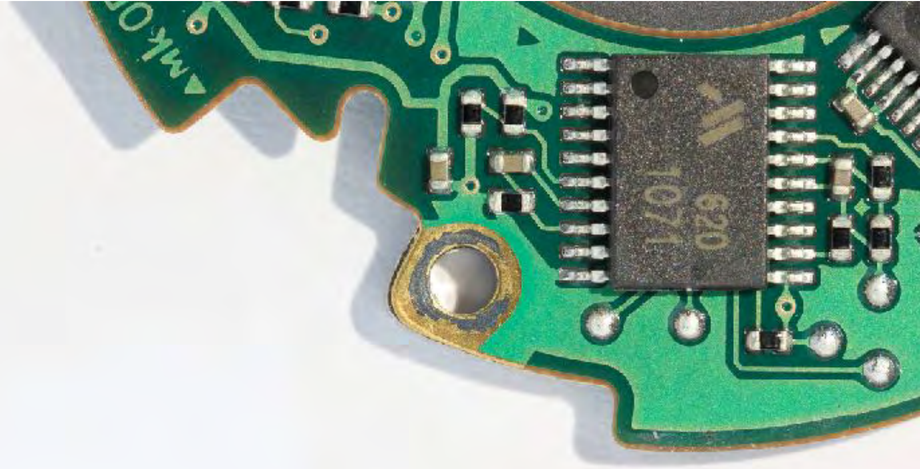
- 19 Hong Kong - OPCM
- 20 Chippewa Falls - CF
- 21 Dongguan - DMC
- 22 Guangzhou - GZ

E-MS

E-M Solutions

- 23 Shanghai - SH
- 24 Shanghai - SH E-MS
- 25 Shenzhen - SZ

High Density & Complexity Miniaturization



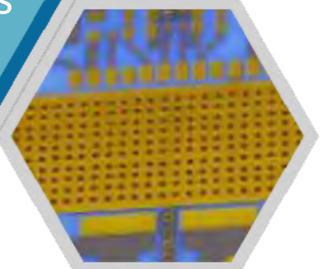
FINE LINE / SHAPE OPTIMIZATION

THERMAL SOLUTIONS

TIGHT DIMENSIONAL TOLERANCE & THICK PD ENEPIG

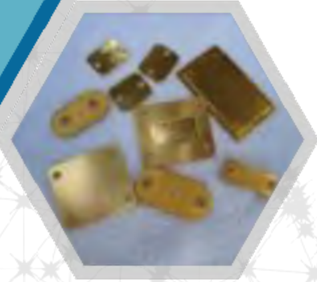
Thermal Solutions

Via Farms

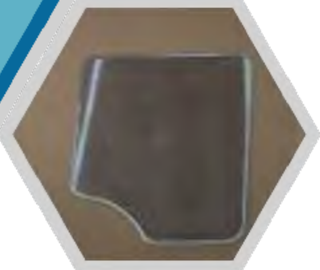


Heatsinks/ Pallets

Heatsink Coins



Embedded Coins

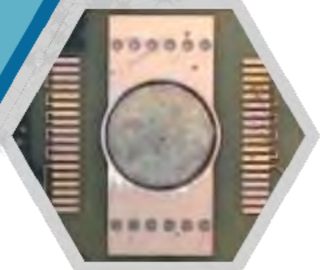


Cu Shim

Press Fit

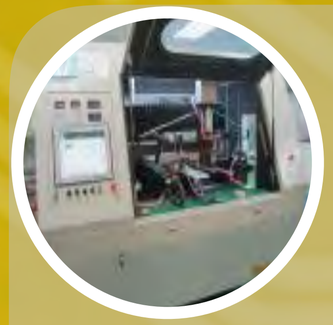
E-Coin

Metal In-lay



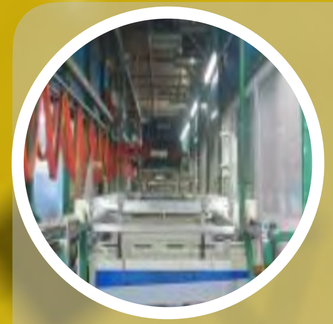
Solder Attach

Tight Dimensional Tolerance & Thick Pd ENEPIG



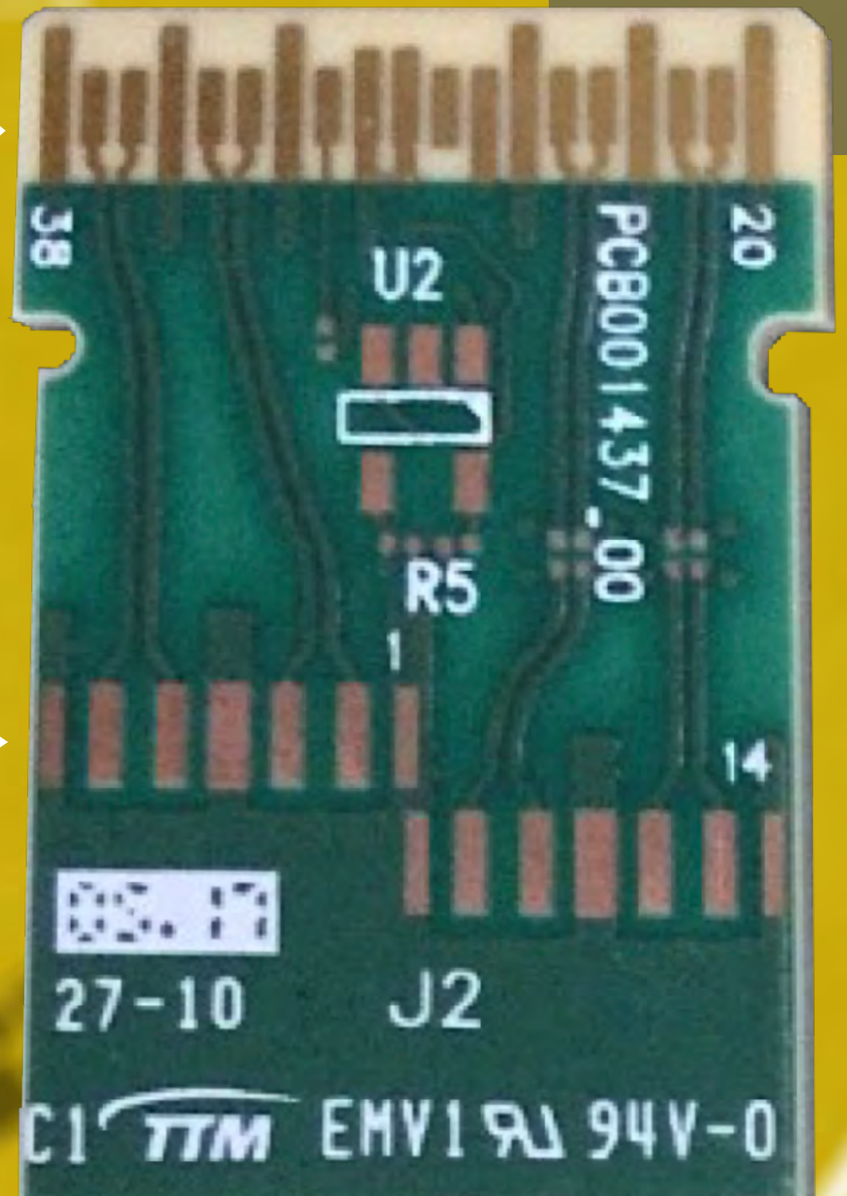
Auto Finger Bevel Machine

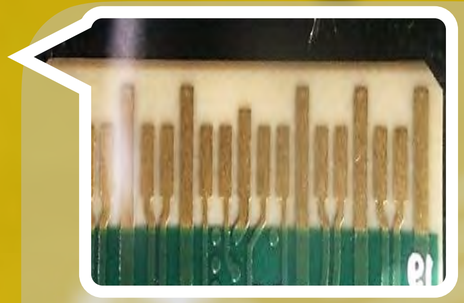
Manufacturer: Xiang Ying
System Installed: Oct 2016
Capability: ±0.05mm



ENEPIG Machine

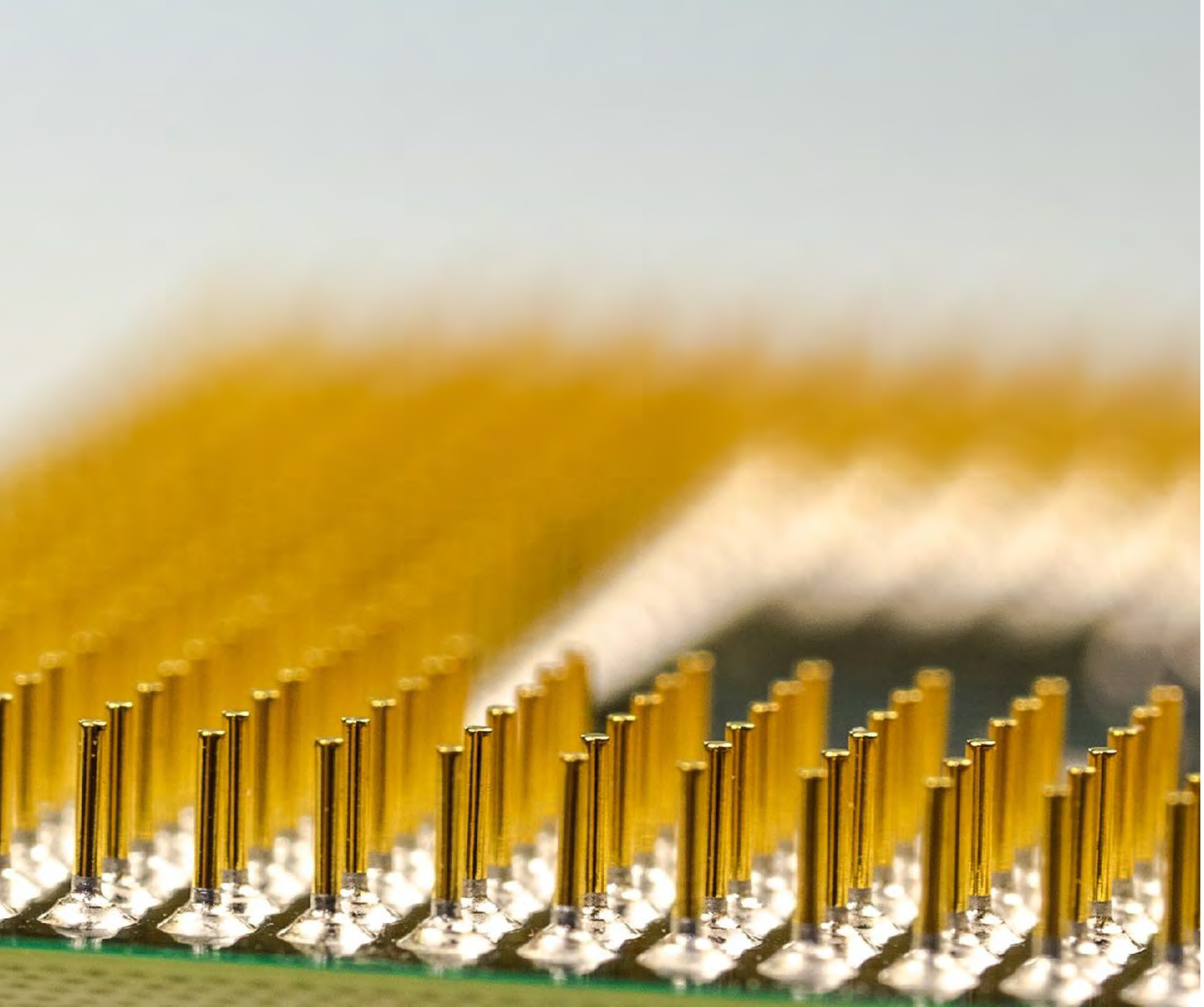
Manufacturer: PAL/Atotech
System Installed: Oct 2016
Capability: Ni: 3 – 7um; Au: 0.05 – 0.15um
Pd: 0.15 – 0.53um, meet 0.3 um min





Optical Rout Machine

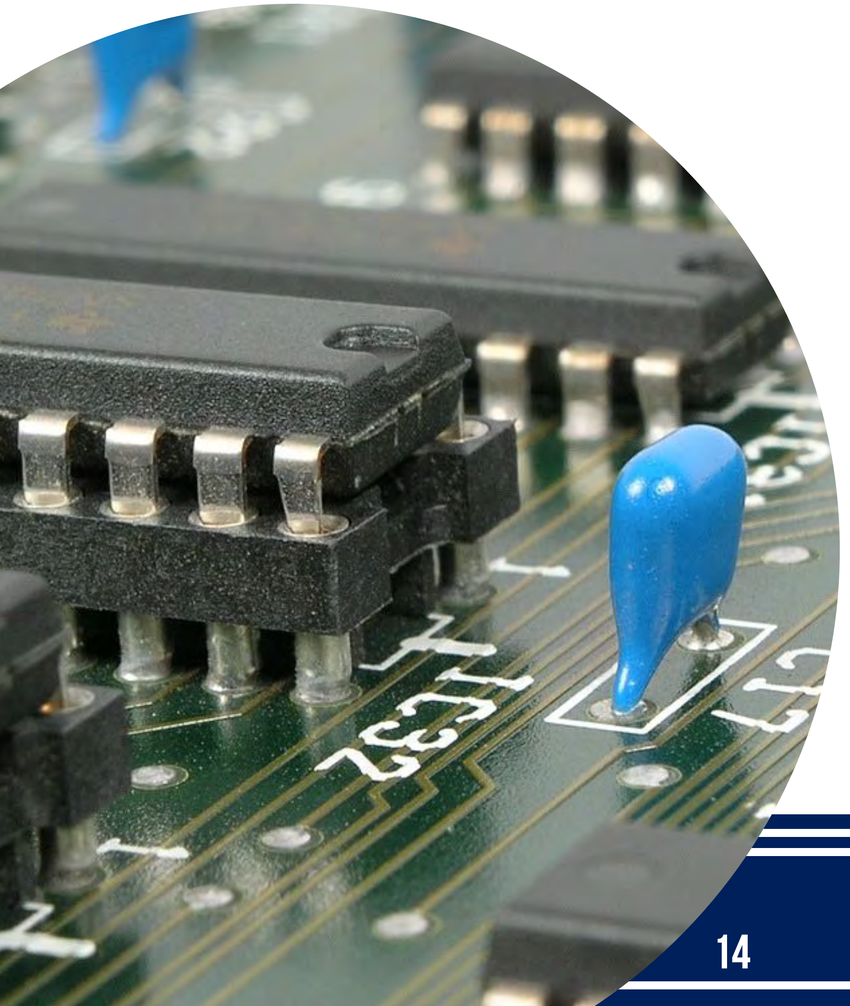
Manufacturer: Schmoll
System Installed : Nov 2016
Capability : ±0.05mm



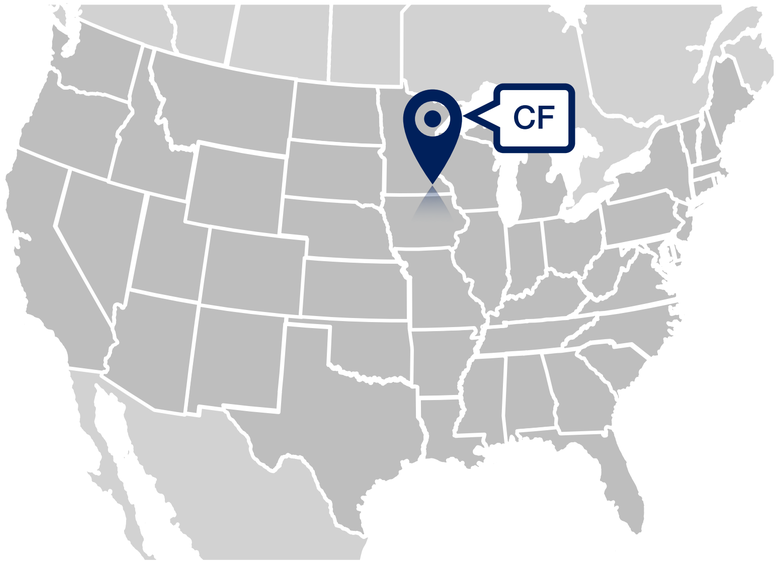
ADVANCE MATERIAL & SIGNAL INTEGRITY

Advance Material - Materials Evaluation Overview

All TTM facilities are engaged in process development and the evaluation of new materials including two Corporate Technology Centers of Expertise



CF - Chippewa Falls, WI



GZ - Guangzhou

The TTM Corporate Technology organization facilitates and leverages materials development activities and manages a database for access to evaluation results.

- TTM test programs provide materials knowledge benefitting all TTM facilities and customers

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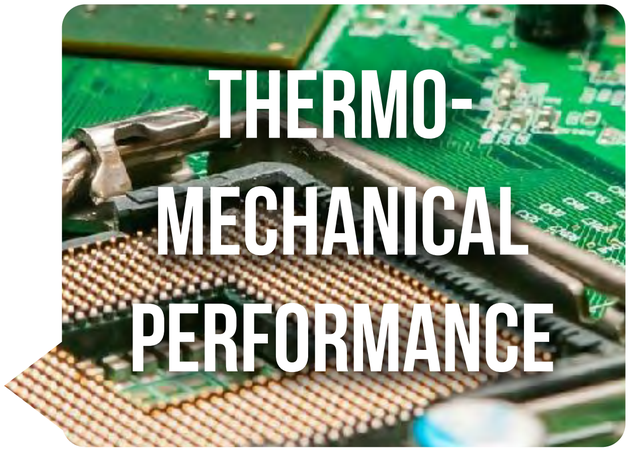
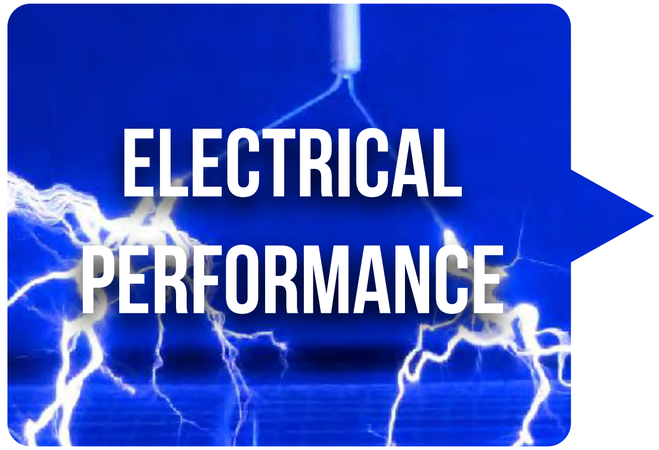
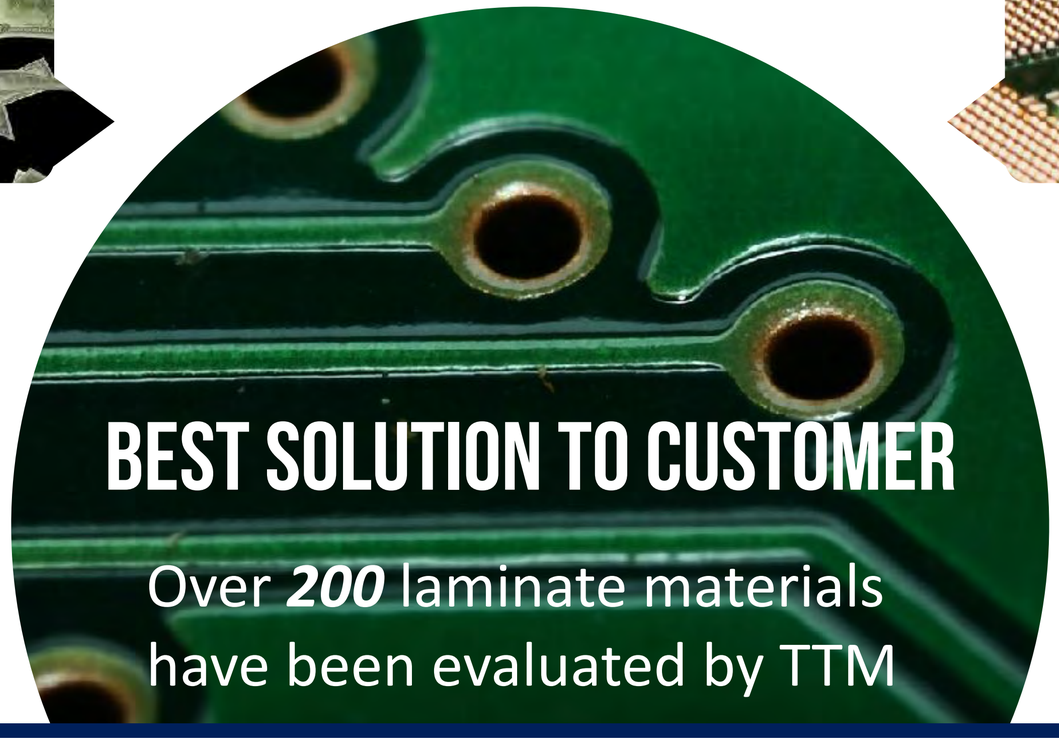
Materials Evaluation Overview







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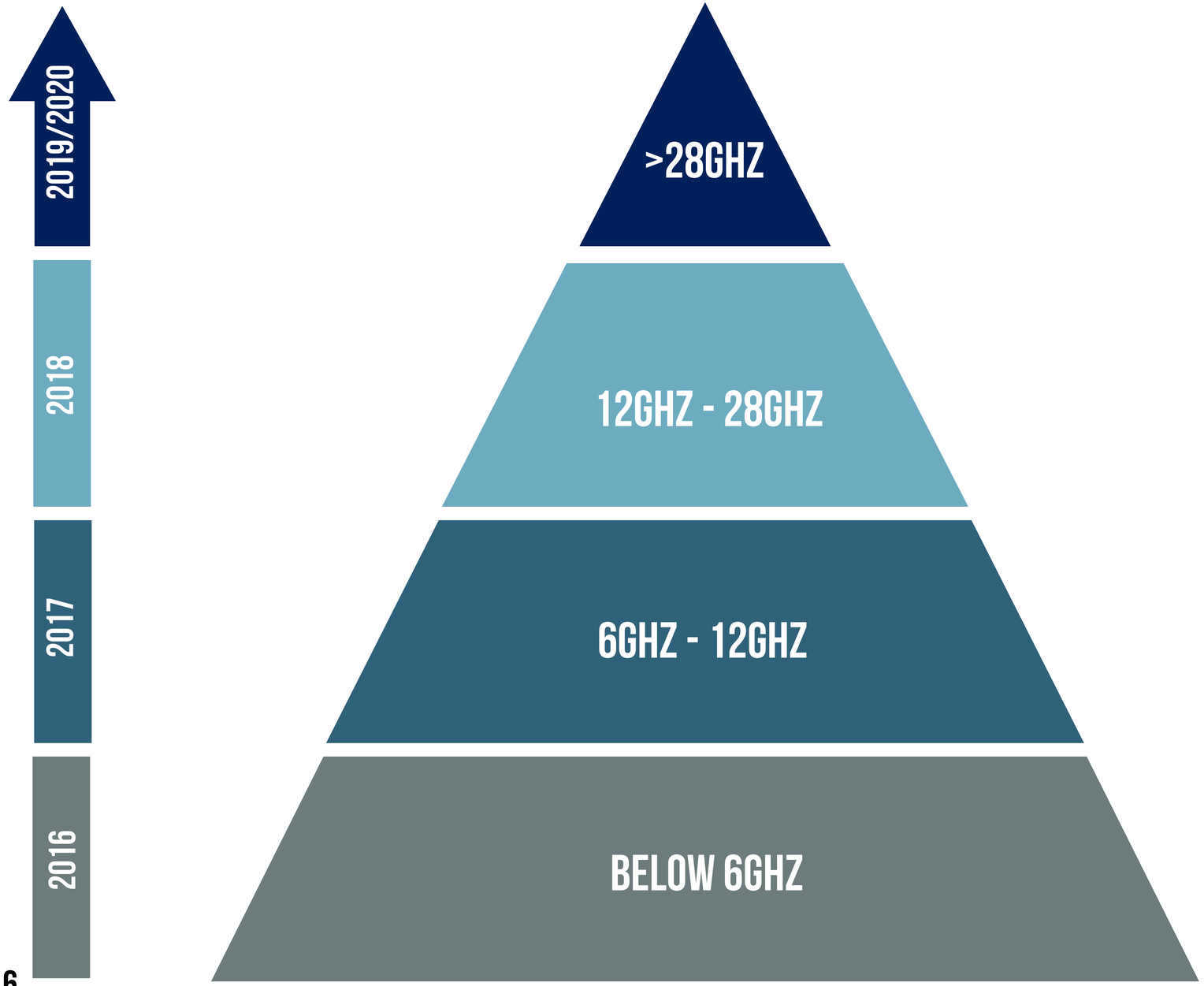
Material Roadmap – From Below 6Ghz to 77Ghz



>28Ghz: Df <0.002
- High frequency RF material hybrids
- Rogers RO3003
- Taconic TSM DS3, Isola Astra MT77
- Rogers RO1200

12Ghz~28Ghz: Df <0.005
- Rogers RO4835 Lopro, RO4350 ect…
- T3 +, Doosan 7409DJN
- Megtron 7N; EM891K
- Doosan 7409DV(N)
- TU-933 (T3); Tachyon100G

6Ghz-12Ghz: Df 0.005 to 0.0099
- Megtron 6, 6G, M7
- Doosan 7409DV; TU-883 (T2)
- N4800-20 Si, I-TeraMT40
- EM-888K, EM891

Below 6Ghz: Df 0.010 to 0.0149
- Megtron 4, 4S, MM
- TU 872SLK, TU-862S
- Hitachi 679G(S)

Advanced Signal Integrity Characterization

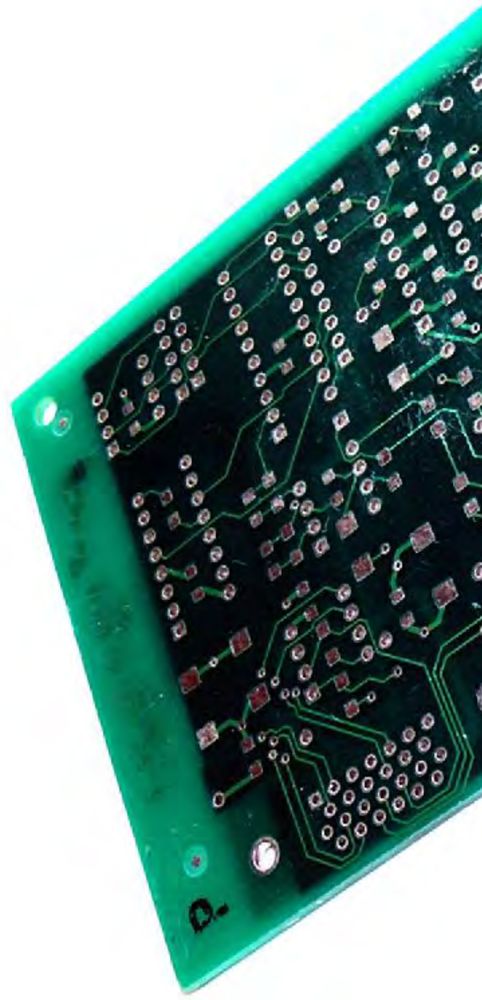
N5247A-400, 10 MHz to 67 GHz PNA-X network analyzer with 4 port option

Test port cables, 3ft, 1.85mm (m-f) (67GHz)

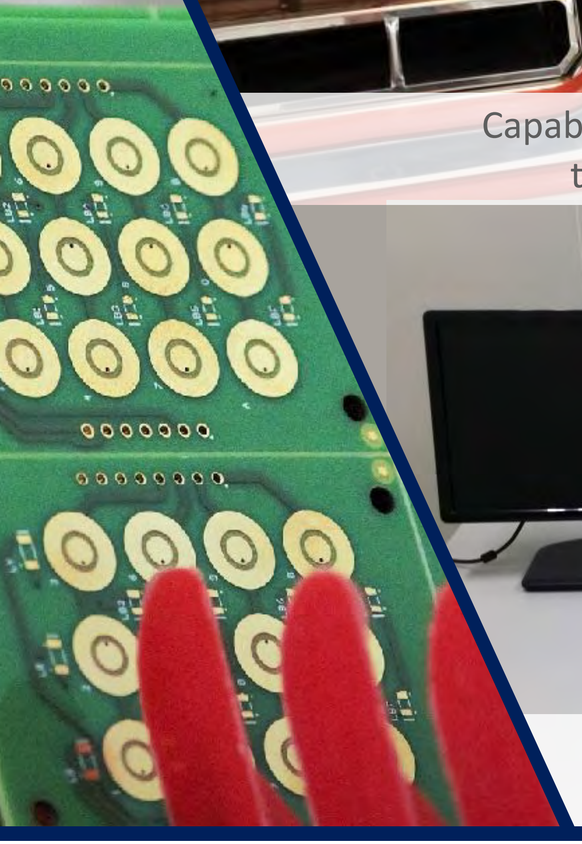
Test port cables, 72 in, 1.85mm (m-f) (26,5GHz), TEMP range -55C – 125C

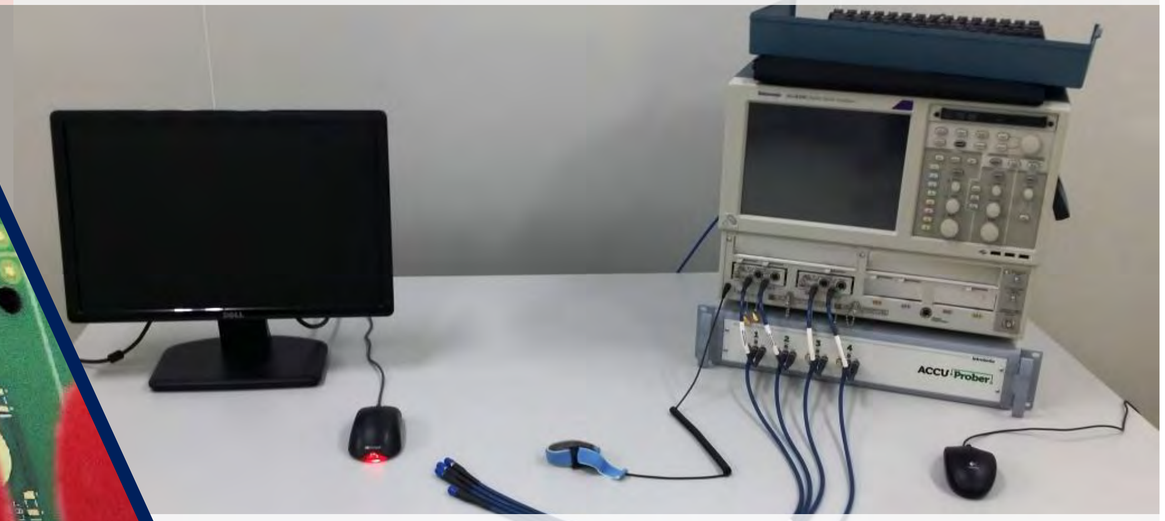
ECal module, 10 MHz to 67 GHz, 1.85 mm, 2-port

- SI Lab is located in Guangzhou , PRC
- Keysight PNA-X N5247A 10MHz-67GHz, N527A-400 4 port dual source option
- Mixed-mode time, frequency, TDR/TDT and S-parameter capability in one mainframe
- PLTS software for full signal path characterization
- Various cable, probe & connector sets (e.g., 1.85, 2.4, 3.5mm SMA, coaxial, co-planar, etc.)
- SPDR fixtures for isolation materials loss tangent & permittivity characterization
- E-calibration traceable to NIST primary standards
- Giga Test Labs GTL 5050 probing station with 4 micro positioners, 18” x 24” max DUT, 180rotation; probe holder can accommodate coaxial or microprobes
- Introbotix SET2DIL/SPP platform
- Temperature & humidity controlled lab with ESD controlled room & facilities
- Experienced electrical engineering team



Capability to measure effects of ambient environmental temperature and humidity on signal integrity





Temperature & humidity controlled lab with ESD controlled room & facilities

The capabilities of TTM SI lab extend beyond those of a typical test and R&D facility in the industry.

Full Wave 3D EM Field Simulation Tool

TTM is moving forward in SI engineering and is having full wave simulation tool to

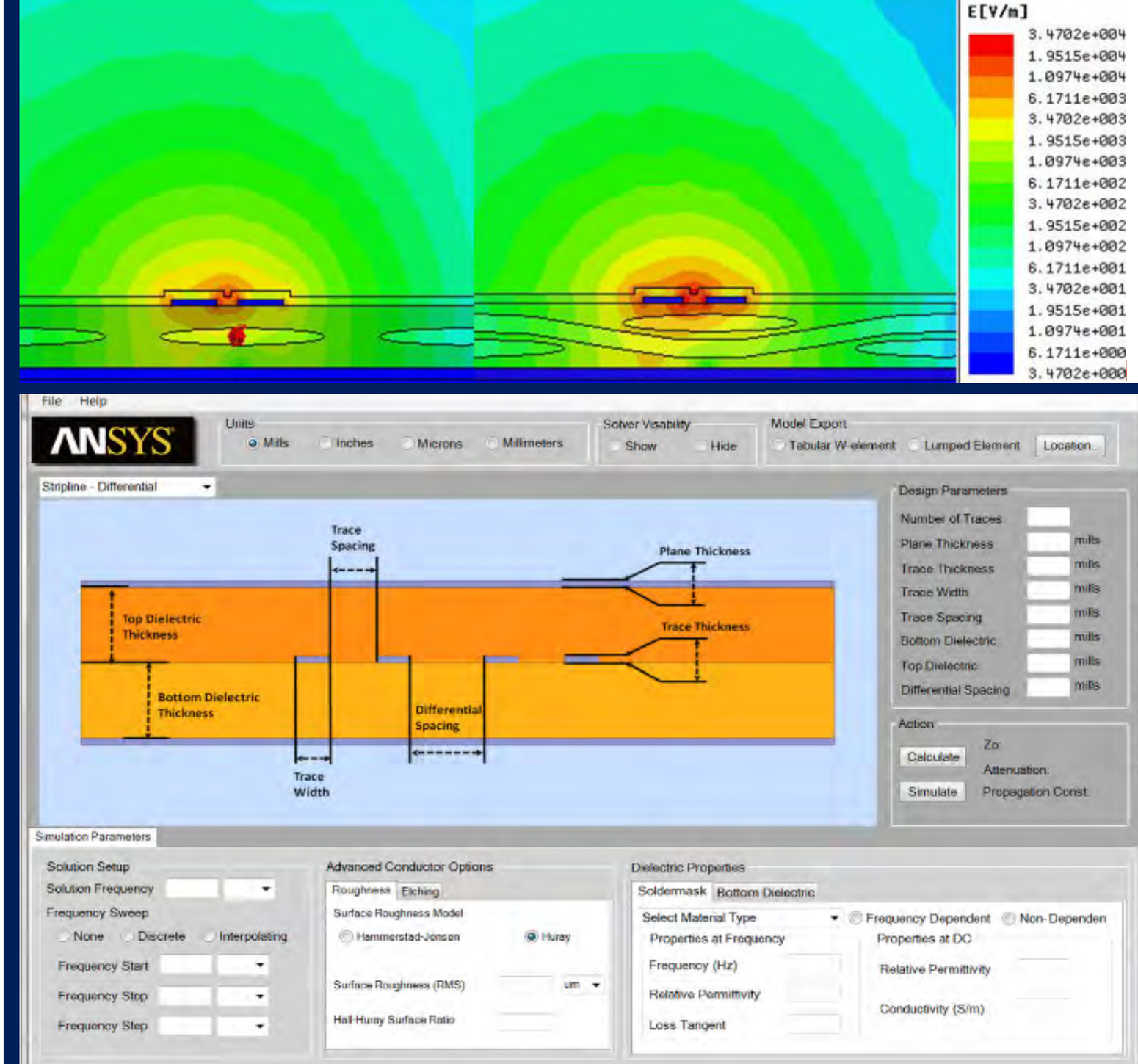
- Simulate PCB geometries, materials, boundaries, and processes impact on signal integrity
- Customers technical support
- Global technical support for all TTM plants and other sites
- Advanced board designing

TTM Concept

- Ansys HFSS (frequency domain)
- Ansys HFSS TR-solver (time domain)
- Ansys Optimetrics (design tool)

Location & Schedule

- The software will be installed in TTM Advanced Development SI Lab in GZ where it is used global technical support for all sites within TTM



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About TTM Technologies, Inc.

TTM Technologies, Inc. is a leading global printed circuit board (“PCB”) manufacturer, focusing on quick-turn and volume production of technologically advanced PCBs, flex and rigid flex PCBs, backplane assemblies and electro-mechanical solutions. TTM stands for time-to-market, representing how TTM's time-critical, one-stop manufacturing services enable customers to shorten the time required to develop new products and bring them to market. Additional information can be found at www.ttm.com.