ABOUT TTM

TTM Technologies, Inc. is a leading global printed circuit board manufacturer, focusing on quick-turn and volume production of technologically advanced PCBs and backplane assemblies as well as a global designer and manufacturer of high-frequency radio frequency (RF) and microwave components and assemblies. 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.

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OUR WEBSITE WWW.TTM.COM

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TTM Technologies

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AUTOMOTIVE

RF & Microwave Technology for Automotive Applications

TTM Technologies is Driving the Future of Advanced Automotive Electronics

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A New Era in Automotive Electronic Technology: We're Ready, Are you?

WHY CHOOSE TTM?

Advanced Driver-Assistance Systems (“ADAS”) have introduced a new era in advanced high-volume printed circuit technologies for microwave (“mmWave”) Radar and 5G connectivity. Printed circuit boards (“PCBs”) are now a critical component, forming Antenna Structures, Baluns, Feed Lines, and Power Dividers, at mmWave frequencies; precision is essential to meet performance requirements. PCB structures must maintain exact dielectric constant over environment and geometric tolerances generally exceed industry standards.

At TTM Technologies (“TTM”), we have been at the forefront of ADAS requirements delivering proven interconnect solutions through deep expertise in high-reliability, design for manufacture, and custom mmWave engineered solutions.

TTM offers differentiated values in terms of market-leading RF and microwave expertise and component miniaturization. We have unique testing, fabrication, and in-house talent that help our customers bring enhanced safety to roadways—each year, life-saving safety features are made possible, in part, because of our collaborative development of a one-stop, complete lifecycle solution for our customers.

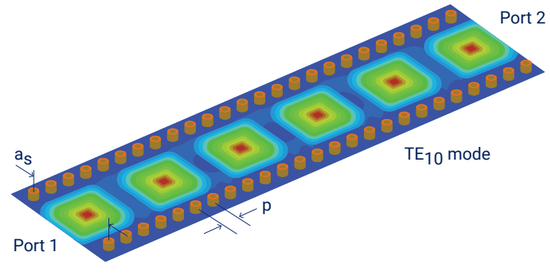
Engineering Production Costs

At TTM, we believe collaborative engineering is essential to meeting both product performance and production cost targets. Whether it’s laminate selection, interconnect structure or critical tolerances, TTM engineers stress cost considerations in all aspects of product design from initial product concept through prototypes, pre-production and volume.

Structures

TTM’s extensive knowledge of materials, modeling, and tolerances are an essential part of our strategy to develop high performance RF & Microwave structures meeting and/or exceeding our consumers' requirements at the lowest possible cost.

- Microstrip
- Stripline
- Coplanar waveguides
- Hybrid material builds
- Substrate Integrated Waveguides (SIW)
- Precision Controlled Depth Drilling
- Back drilling
- Blind and buried via’s
- Microvias
- mmWave Feed Through Crossover Components



TTM Technologies Inspiring Innovation

SEAMLESS TRANSFER FROM PROTOTYPE TO VOLUME PRODUCTION WITH TTM

Reduced risk, faster time-to-market, and the superior quality the automotive industry expects from TTM.

TTM's global network of printed circuit board manufacturing facilities, R&D centers, and mmWave solutions teams mitigates our customers' risk. We have developed strategies that provide our customers with efficient, streamlined approaches to help their products move seamlessly from one stage of the lifecycle to another. These processes aid in the consistent outcomes that high-reliability applications depend on in the field.

Critical benefits of TTM's seamless transfer strategy and full lifecycle support:

- Streamlined quoting including one-time NRE / test charges
- Data transfer packages including "best practices" for manufacturing
- Common / in-parallel stack-ups and DFM reviews
- Efficient technical query ("TQ") process
- Common materials for both FR4 and RF materials
- Global customer profiles
- Global TQ waiver forms

Capabilities

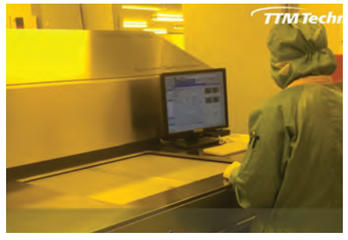
With the advent of high volume mmWave applications, TTM has been aggressively adopting new technologies to meet the geometric tolerances required for next generation applications including:

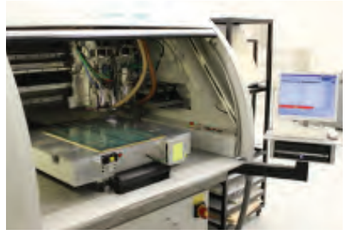
- Precision etching capabilities allowing +/- 13 micron accuracy
- C²eT (Controlled copper etch technology) / selective plating thickness improving etching tolerances on plated layers
- State of the art Vacuum Etching Technology
- Exact registration/Laser Direct Imaging (LDI)
- Laser Drilling/ Precision machining
- LDI Solder mask

Modeling Capabilities

TTM's internal modeling capabilities allow our engineering team to assist our customers in developing more accurate models for product development as well as analyzing performance issues and providing corrective actions.

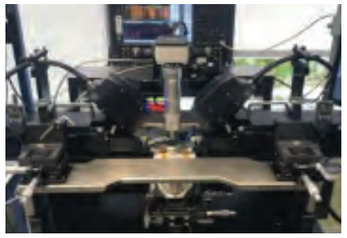
- Applied Simulation APSIM 2D Field modeling
- ANSYS HFSS Full Wave Field Solver
- ANSYS Q3D Static 3D Field Solver





Common Materials

Unlike digital designs where loss is the predominant issue, RF & mmWave require precise “effective dielectric constant” as well as reliability over environmental conditions. TTM materials team evaluates all aspects of the laminates including tolerances, copper foil properties, and CAF before a material can go to production manufacturing.



Testing

TTM offers a number of ways to verify product attributes to assure performance and compliance to customer specifications and stringent industry regulations.

- Time Domain Reflectometer (TDR)
- VNA test capabilities up to 110 GHz over 35 to 235 C
- 3D Laser scanning for copper profile evaluation
- Automated optical measurement for critical RF features
- Metrology and failure analysis capabilities

For more information on TTM Automotive solutions or applications, please speak with your TTM Sales representative or contact us by:

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