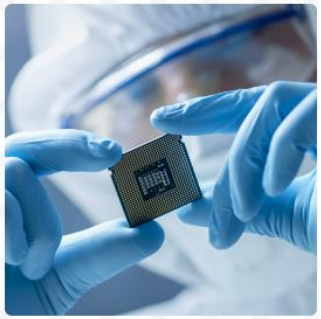
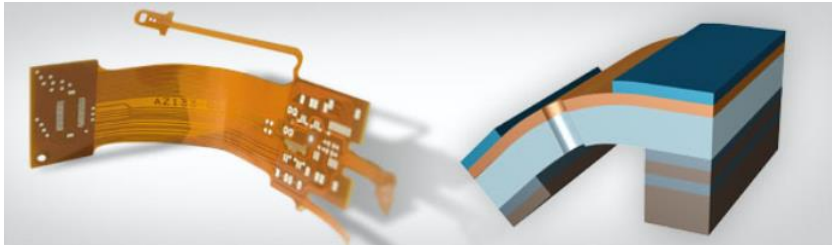
FLEXIBLE & RIGID FLEXIBLE PCB´S

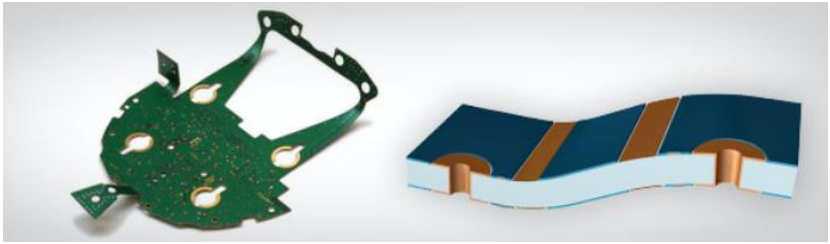
@ 

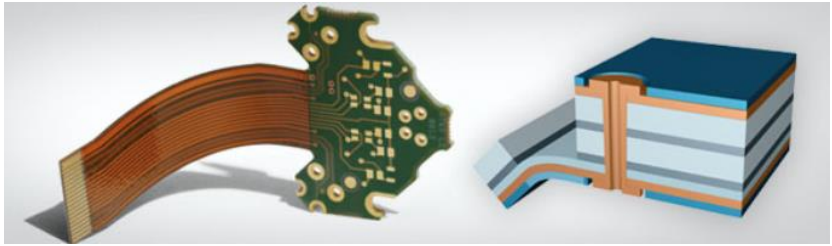
Helmut Raidl
Application Engineer for Flexible and Rigid-Flexible Pcb´s
Dec. 2023


Team robust electronics

AGENDA







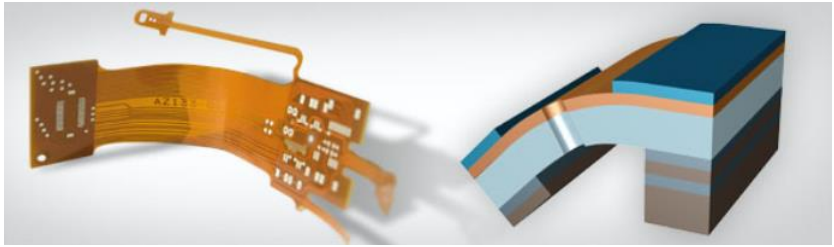
ABOUT US

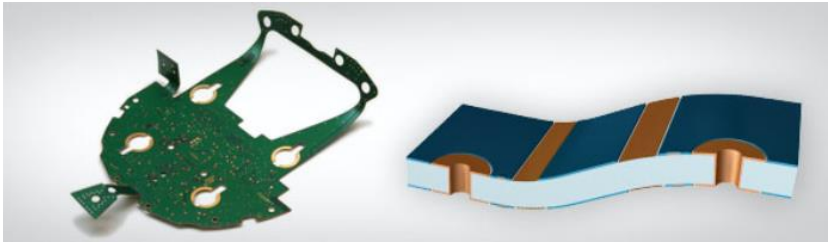
AT&S

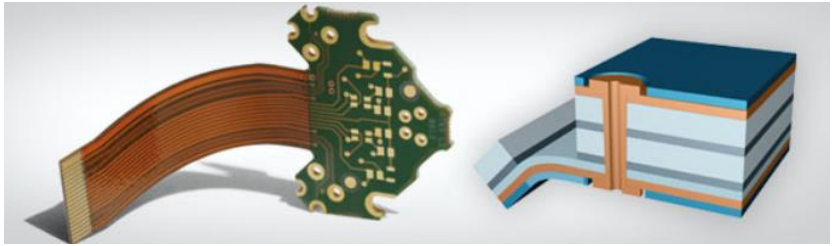
WORLD LEADING HIGH-TECH PCB & IC SUBSTRATES COMPANY

*Source: Prismark, CY2022, as of 15.05.2023
**Source: Prismark, CY2021, as of 15.05.2023

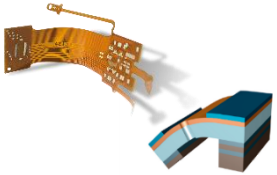
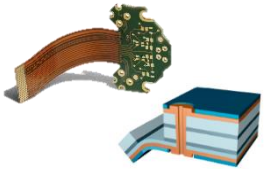
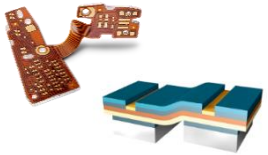
AGENDA







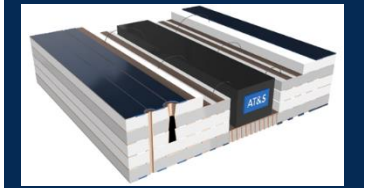
PORTFOLIO – FLEXIBLE SOLUTIONS

Flexible printed circuit boards	Semi-flexible printed circuit boards	Rigid-flex printed circuit boards	Flexible printed circuit boards on aluminum
			
Used to replace wiring and connectors, allowing for connections and geometries that are not possible with rigid printed circuit boards.	More limited bend radius than flexible printed circuit boards. The use of a standard thin laminate makes them a cost-effective alternative.	Combine the advantages of flexible and rigid printed circuit boards, yielding benefits for signal transmission, size and stability.	Used when installing LEDs in car headlights, for example, where the printed circuit board is bonded to an aluminum heat sink to which the LEDs are then attached.
Production site Ansan, Fehring	Fehring	Ansan, Fehring	Ansan
Applications Nearly all areas of electronics, including measuring devices and medical applications	Automotive applications	Industrial electronics, such as production machines and industrial robots	Lighting, automotive, building lighting

2.5D® Technology Platform

Combines mechanical and electronic miniaturization, and enables partial reduction of the thickness of a circuit board. Advantage: populated assemblies have a thinner profile. Can be also used to make cavities in the printed circuit board, e.g. for acoustic channels. Major application for this technology is the 2.5D® rigid-flex printed circuit board, a lower cost alternative for flex-to install applications.

Production sites: Leoben, Shanghai, Nanjangud



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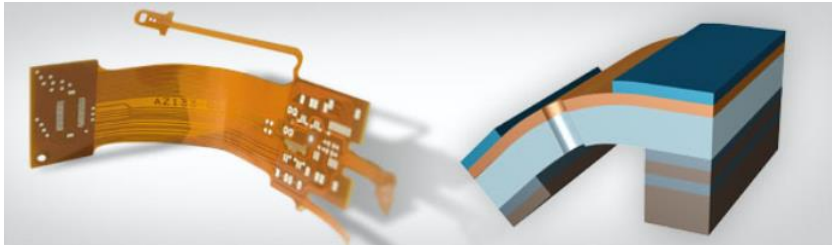
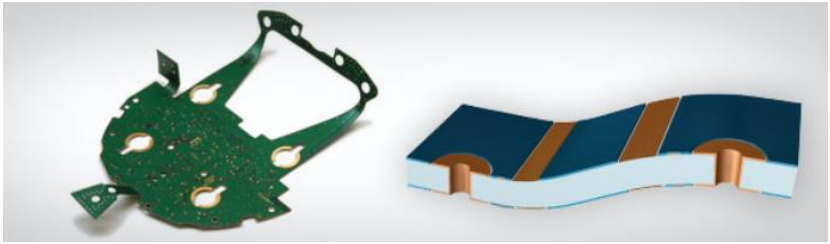
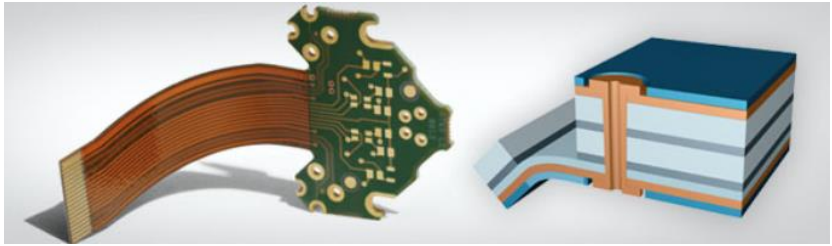






PRODUCTION SITES & CAPABILITIES

Leoben, Headquarters
Austria

Fehring
Austria

Nanjangud
India

Chongqing
China

Shanghai
China

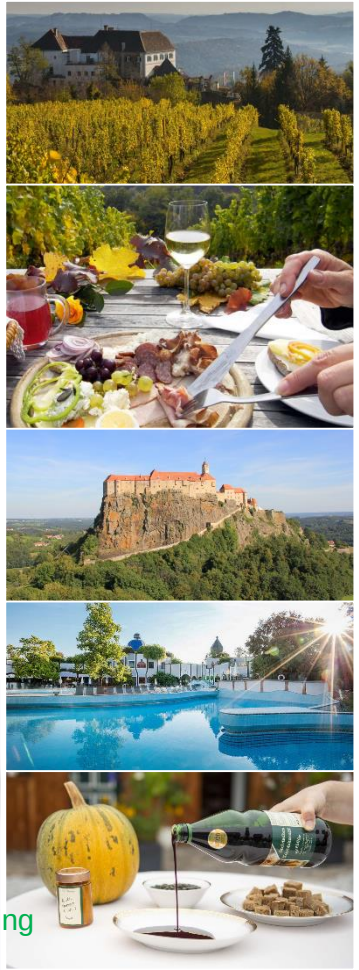
Ansan
Korea

Kulim
Malaysia

Start of Production 2024

PRODUCTION SITES & CAPABILITIES

Plant FEHRING



- **Located in the culinary region of Styrian Volcanic Land**

- **Management System:**

ISO 9001	ISO 14 001 [Environmental]
IATF 16 949 [Aut]	ISO 45 001 [Health & Safety]
ISO 13 485 [Med]	ISO 50 001 [Energy]
AS 9100 [Aerospace]	ISO 27 001 [Information-Security]

PRODUCTION SITES & CAPABILITIES

Plant Fehring / Austria

Capabilities	
Technology :	- Standard 2 Layer PTH - Standard Multilayer - High Frequency PCB's - Semi flexible PCB's - IMS (ALU or Copper) with HDI - Flex and Rigid Flex
Production Format:	- 609,6 x 457,2mm [18 x 24inch] - 609,6 x 530mm [21 x 24inch]
Base Material:	- FR4 (mid to high TG) - Teflon (High Frequency material) - Polyimide
PCB Thickness:	- 0,07mm – 2,4mm
Max. Layer Count:	- FPC: 2 Rigid-FPC: 6 Rigid: 10 IMS: 4
Minimum Line / Spacing :	- 100/100µm (Outer Layers) - 80/80µm (18µm Inner Layers)

Capabilities	
Base Copper Foil :	- 12µm/18µm/35µm/70µm/105µm
Smallest Drill size:	- Mech. Drilled: 0,2 mm Laser Drilled: 0,11mm
Annular Ring:	- Mech. Drilled Std. 150µm Advanced: 50µm (Rigid) - Laser Drilled: Std. 100µm Advanced: 75µm
Aspect Ratio:	- Mech. Drilled: Std.: 1 : 7 Advanced: 1 : 8 - Laser Drilled: Std.: 1 : 0,8 Advanced: 1 : 1
Soldermask :	- Curtain Coating Photosensitive Ink - Screen print Photosensitive Ink (Green / Blue / Black / Red / White / Amber [flexible]) - Dam width Std.: 100µm Advanced: 75µm - Misregistration Std.: 100µm Advanced: 50µm
Surface Finish :	- ENIG, ENEPIG - OSP - Immersion Tin, Immersion Silver - Electrolytic Gold - HASL lead-free (Rigid) - Carbon
Contour :	- Milling - Scoring - Laser Cutting
Additional Print :	- ID Print - Peelable Soldermask
Specials:	- Depth Milled Rigid Flex - IMS Copper 1mm - IMS with HDI Layers with filled Micro Vias - burr-free Edge Plating - Pattern Plating for High Frequency Applications

PRODUCTION SITES & CAPABILITIES

Plant ANSAN

- **Located in the Ansan industrial area & 1 hour away from the capital Seoul**
- **Management System:**

ISO 9001	ISO 14 001 [Environmental]
IATF 16 949 [Aut]	ISO 45 001 [Health & Safety]
ISO 13 485 [Med]	ISO 27 001 [Information-Security]

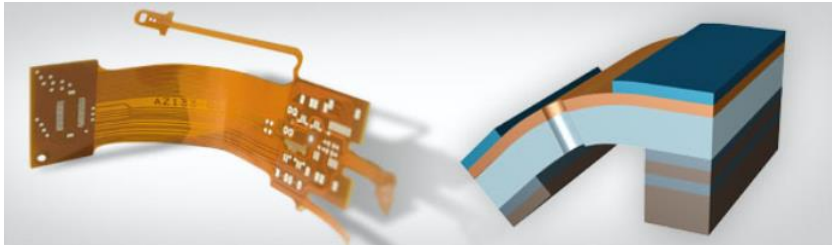
PRODUCTION SITES & CAPABILITIES

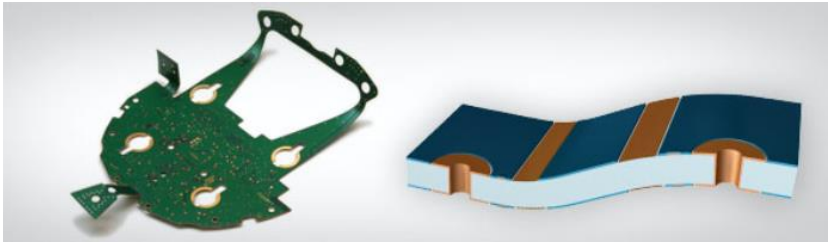
Plant Ansan / South-Korea

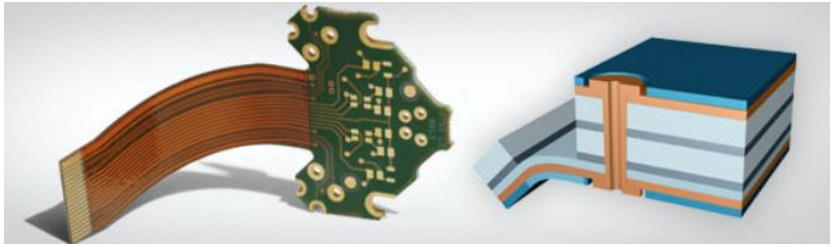
Capabilities		
Technology :	-	Single Side & Double Side Flex PCB - Multilayer Flex & Rigid Flex PCB - HDI Multilayer Flex & Rigid Flex PCB - Flex on Aluminum - Thin Rigid PCB's
Production Format:	-	250mm x 315 - 420mm (max.)
Base Material:	-	FR4 (mid to high TG) - FCCL Polyimide ≥ 12,5µm - BT (high performance material)
PCB Thickness:	-	0,05mm – 1,6mm
Max. Layer count	-	FPC: 10 Rigid-FPC: 12 Layer
Minimum Line/Spacing :	-	50 µm / 50 µm (40µm / 40µm)

Capabilities		
Base Copper Foil :	-	6µm (Half Etching)/9µm/12µm/18µm/35µm
Smallest Drill size:	-	Mech. Drilled 0,1 mm Laser Drilled: 0,05mm
Annular Ring:	-	Mech. Drilled Std. 100µm Advanced: 75µm - Laser Drilled: Std. 100µm Advanced: 50µm
Aspect Ratio:	-	Mech. Drilled: Std.: 1 : 4 Advanced: 1 : 5 - Laser Drilled: Std.: 1 : 0,8 Advanced: 1 : 1
Soldermask :	-	Screen print Photosensitive Ink (Green / Blue / Black) - Dam width Std.: 100µm Advanced: 75µm - Misregistration Std.: 50µm Advanced: 25µm
Cover Layer	-	Laser Cutted - Soft Tool punch - Hard Tool punch
Surface Finish :	-	ENIG, ENEPIG, - DIG [Direct Immersion Gold] … Ni free!! - Electrolytic Gold - Electrolytic Tin
Contour :	-	Milling - Laser Cutting - Punching
Additional Print :	-	ID Print
Specials:	-	Metal Stiffener (etched SUS stiffener) - Edge plating (half holes) - Epoxy Via Fill - EMI shielding, Ferrite Sheet application - Copper Filled stacked Microvias - SMT assembly on Flex

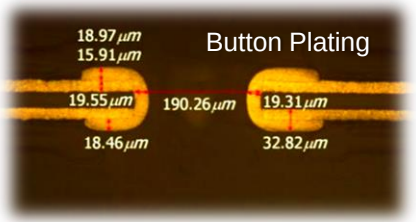
AGENDA

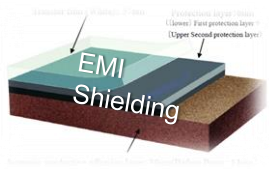






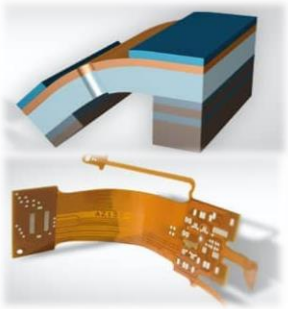
KEY FACTS

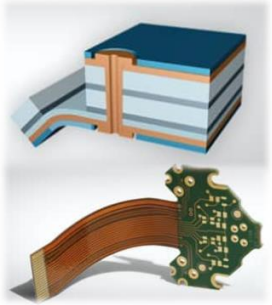




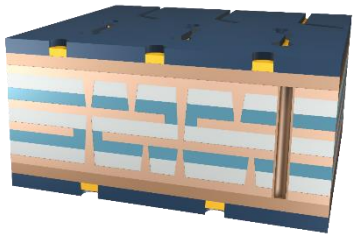
Flexible Pcb

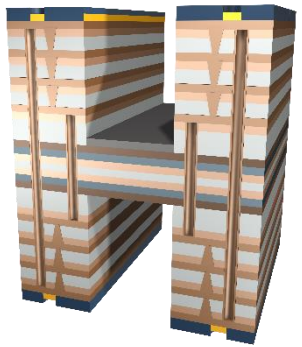
Rigid-Flexible Pcb





- Max. Layer Count: FPC: 10 R-FPC:12
- Base-Copper: ≥ 6µm – 35µm (70µm)
- Line/Space: ≥ 40µm
- Soldermask opening: ≥ 25µm
- Laser-Drill-ø: ≥ 50µm
- Polyimid Thickness: ≥ 12,5µm – 125µm
- Stiffener: FR4, Cu, Al, SuS, PI
- Flex: offers the highest level of miniaturization
- Rigid-Flex: combine rigid & flex areas
  offers the highest grate of reliability





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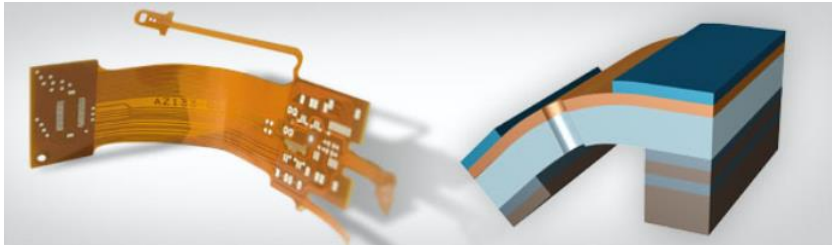
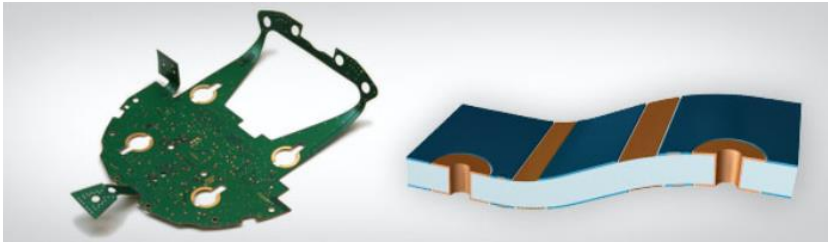
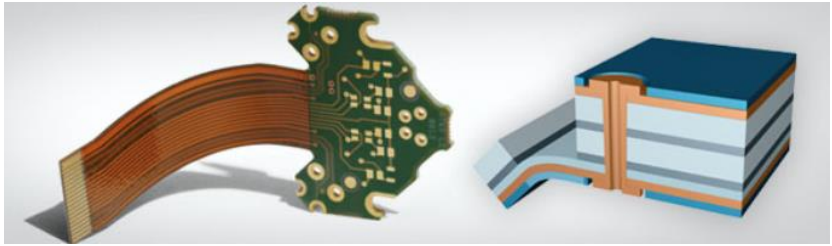


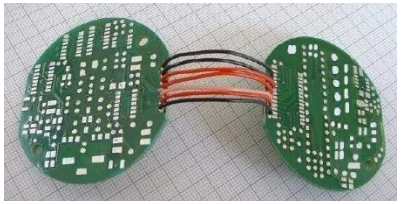




BENEFITS FLEX & RIGID-FLEX

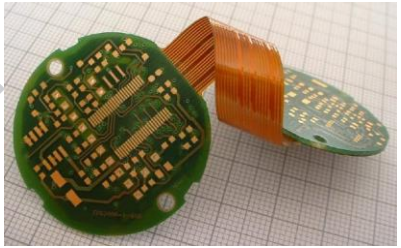
Reliability

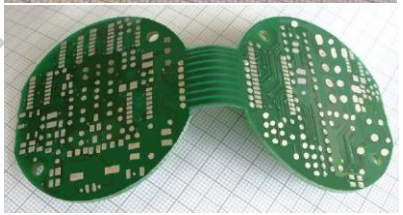
- robust against vibrations (less connectors & solder joints)
- robust against environmental influence



Miniaturization

- Less weight & reduced size
- small flex area length & tight bending radii
- save space in the housing & realizes complex 3D shapes
- smallest design rules by using thinnest PI foils





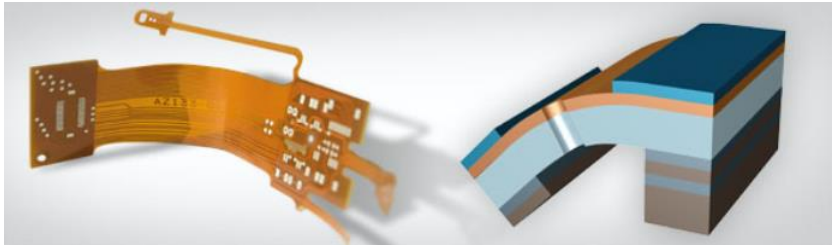
Better Performance

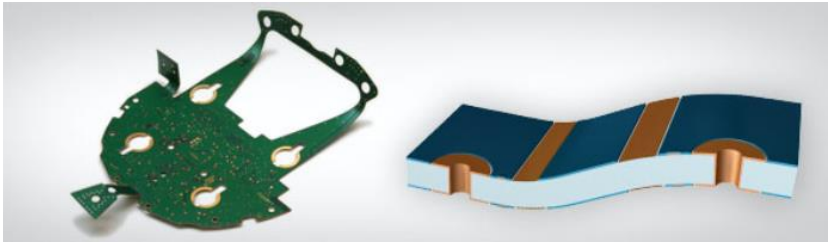
- better signal integrity:
  constant impedance (connector = impedance shift)
  direct copper connection from rigid to rigid area
- rolled copper for high bending performance

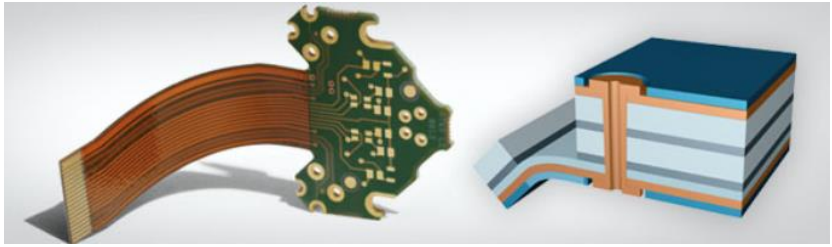
Logistik & Cost

- source & store only 1 Pcb – no connector, cable, …
- Reduced process steps – no connector assembly
- reduced test effort – full electrical function given after assembly – no need to connect the cable manually before testing

AGENDA

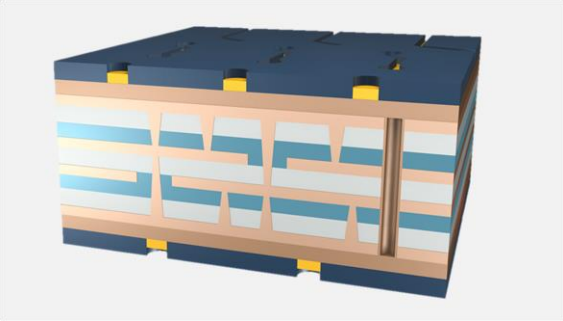






APPLICATIONS

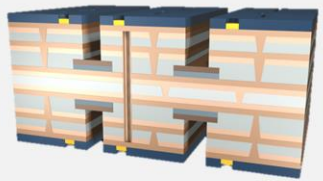
Hearing Aids



- Very thin full flexible PCB buildups
  - PI FCCL 12,5µm / Adhesive 13µm
  - Anylayer buildup structure
  - 2 - 6 layer
- Miniaturized design
  - Down to 40µm Line/Space with tight tolerances
  - Flip Chip Designs
- Less annular rings
  - 150µm Pads for laser drilling

APPLICATIONS

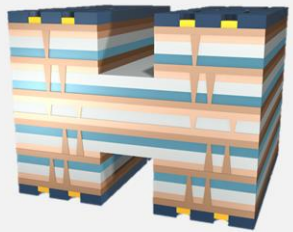
Camera boards



- For High End Cameras
- Rigid Flex 6 layer Anylayer structure
- High Inspection standards
  - Cleanliness – no particles or residues allowed
- High accuracy needed
- High reliability requirements
  - In use between -30° to +40°

APPLICATIONS

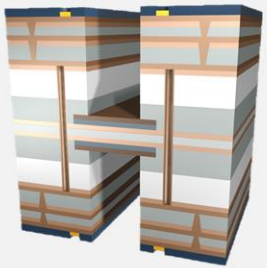
Cardiac bionics



- Pacemaker, Leadless pacemaker & ICDs
- Flex & Rigid Flex buildup structures
- High testing standards
  - Special Inspection requirements
  - IST Testing required
  - 4 wire testing
- Miniaturized design
  - Very tight BGA design (copper to copper distance, soldermask dams)
- Tight contour tolerances

APPLICATIONS

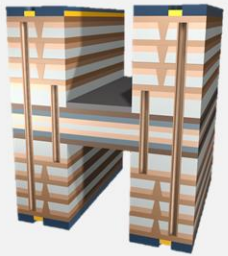
Automotive Camera Imager



- For Front cameras in cars
- Complex 8 layer Rigid Flex build up structure
- For smallest possible bending radius
- High automotive reliability
- IATF 16949 automotive certification

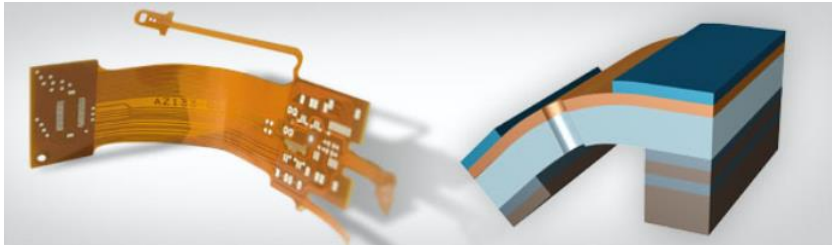
APPLICATIONS

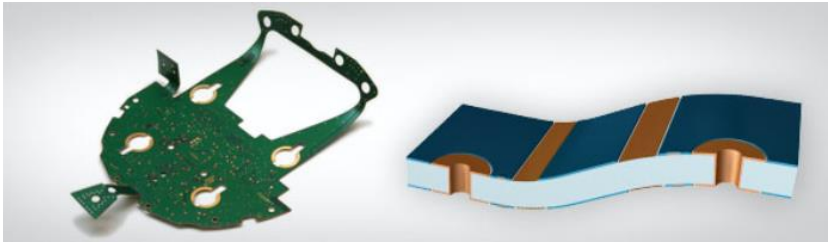
Sport watches

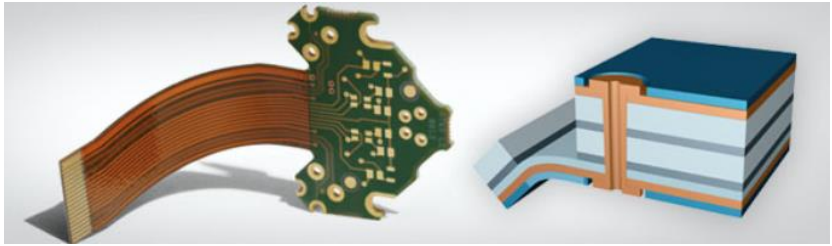


- Need of added functionality to the basic features of a sport watch
- FDA approved devices
- Up HDI 10 layer & Anylayer
- Complex build ups
- Mechanical stability needed
- High drop test requirements
- Fine design requests

AGENDA



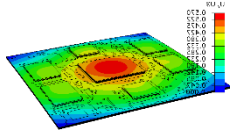




AISS

ADVANCED INTERCONNECT SOLUTION SERVICES

PPS
Product & Process Simulation

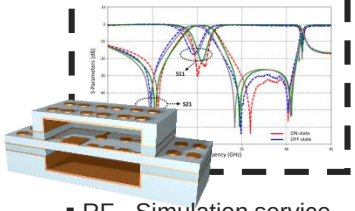


- Warpage simulation
- Reliability simulation
- Failure analysis
- Heat management

HDC
Hardware Development Center

- PCB / Substrate - Layout
- Technical concepts
- Data conversion
- Drawings

RF
Radio Frequency



- RF - Simulation service
- Integration of passive RF functionality
- Integrated antenna systems

PDS
Product Development Services

- Project management
- Assembly services
- Technology consulting

FTD
Functional Test Development

- Test services
- Laboratory services

FIELDS OF ACTIVITY

PPS Product & Process Simulation

FTD Functional Test Development

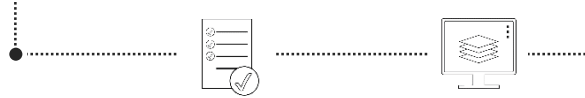
- **Prediction of RF, thermal, reliability and warpage characteristics**
- **Speed-up product qualification by industry unique PCB(A) simulation**
- **Design for test and test development**

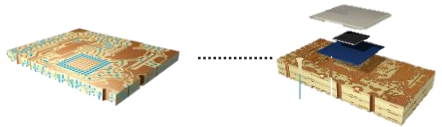
HDC Hardware Development Center

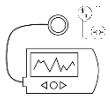
RF Radio Frequency

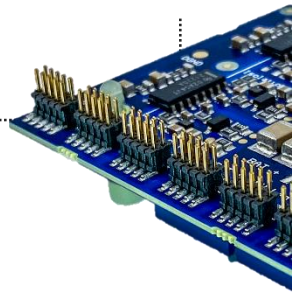
- **Cost reduction**
- **Yield optimization**
- **Performance improvement**

Project start → Specification of Process & technology → Design / Layout & Verification → Product Simulation → PCB / Substrate manufacturing → PCB / Substrate assembly → PCBA system integration & test → **FINAL PRODUCT**









PDS Product Development Services

- **Turnkey solution provider**
- **Assembly service**
- **Project management**

THANK YOU FOR YOUR ATTENTION

ADDITIONAL SLIDES

AISS SERVICE PORTFOLIO

PPS
Product & Process Simulation

WARPAGE
- Panel
- Card
- System

RELIABILITY
- Copper Interconnections
- Solder Interconnections

FAILURE ANALYSIS
- Stress in PCB / Substrate
- Stress in Component
- Bendable PCB

HEAT MANAGEMENT
- Spreading
- Dissipation

HDC
Hardware Development Center

TECHNICAL CONCEPTS
- Requirement Analysis
- Optimization in Context of AT&S Technologies
- Improved Build-ups

DATA CONVERSION
- Connection between Chip & PCB / Substrate Design
- Mechanical & Electrical Design Collaboration

DRAWINGS
- Mechanical
- Electrical
- 3D - PCB / Substrate

PCB / SUBSTRATE - LAYOUT
- Conventional PCBs
- Advanced PCBs
- Substrates / Packaging

RF
Radio Frequency

INTEGRATION OF PASSIVE RF FUNCTIONALITY
- Novel Build-up Concepts & Demonstrator Design
- Simulation and Measurement Comparison

INTEGRATED ANTENNA SYSTEMS
- Advanced Concept to Module Design
- Antenna Concepts
- System Level and Antenna Measurements

RF - SIMULATION SERVICE
- Antenna Analysis
- Filters Analysis
- Transmission Line Analysis

PDS
Product Development Services

PROJECT MANAGEMENT
- Turnkey Solution Provider
- Project Coordination for Modules & Assembly
- Module & Assembly Cost Calculation

BACKEND SERVICES
- Technical Interface to External Partners
- Project Coordination & Consulting
- Wafer-Level Services

TECHNOLOGY CONSULTING
- Technology Roadmap Support
- Embedding

FTD
Functional Test Development

TEST SERVICES
- Test assessment & optimization
- Test Program & HW Development
- EMS & OSAT coordination

LABORATORY SERVICES
- Validation
- Characterization
- Failure analysis support

PPS - PRODUCT AND PROCESS SIMULATION CAPABILITIES

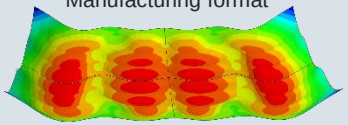
PPS Product & Process Simulation | PDS Product Development Services | RF Radio Frequency | HDC Hardware Development Center | FTD Functional Test Development

WARPAGE

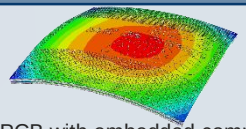
Increasing Complexity & Modelling Effort

PANEL:

Manufacturing format

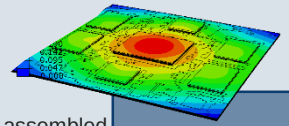


CARD (PCB / SUBSTRATE):



e.g.: PCB with embedded components

SYSTEM (PCBA / SUBSTRATE):



Fully assembled PCB

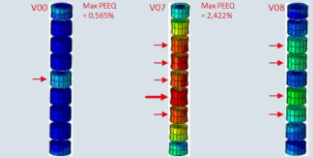
Objective: Design & Material Optimization

RELIABILITY

Modelling in PCB / Substrate & PCBA Domain

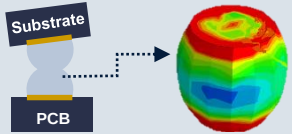
COPPER INTERCONNECTIONS:

Material A | Material B | Material C



Via stress in different materials

SOLDER INTERCONNECTIONS:



Solder ball

Stress in critical solder ball

Objective: Lifetime Optimization

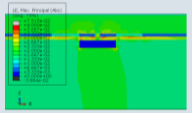
FAILURE ANALYSIS

Increasing Complexity & Modelling Effort

STRESS IN PCB / SUBSTRATE:

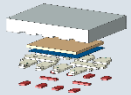
PCB Cross-Section

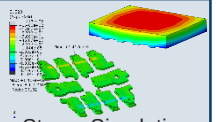
Stress-Simulation



STRESS IN COMPONENT:

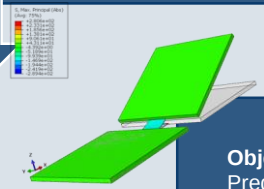
Component build-up





Stress-Simulation

BENDABLE PCB:

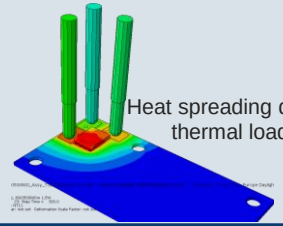


Objective: Failure Prediction

HEAT MANAGEMENT

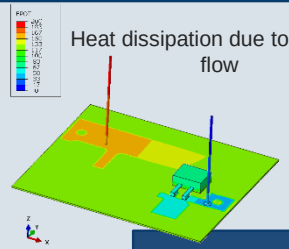
Increasing Complexity & Modelling Effort

SPREADING:



Heat spreading due to thermal loads

DISSIPATION:



Heat dissipation due to current flow

Objective: Thermal Optimization

HDC - HARDWARE DEVELOPMENT CENTER CAPABILITIES

PPS Product & Process Simulation | PDS Product Development Services | RF Radio Frequency | HDC Hardware Development Center | FTD Functional Test Development

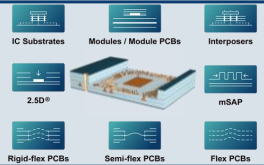
Analyze System & Plan Optimization Strategy

TECHNICAL CONCEPTS

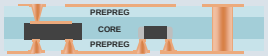
REQUIREMENT ANALYSIS:

OPTIMIZATION IN CONTEXT OF AT&S TECHNOLOGIES:

ECP, 2.5D
Anylayer
Flex
mSAP
Substrates
…



FUNCTIONAL INTEGRATION:



State of the art embedding technology

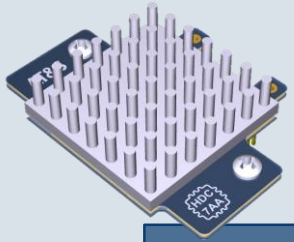
Objective: Optimized performance & low complexity

Connect & Work in all Domains

DATA CONVERSION

CONNECTION BETWEEN CHIP & PCB DESIGN:

MECH. & ELECTRICAL DESIGN COLLABORATION:

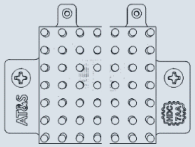


Objective: Fast & reliable data conversion

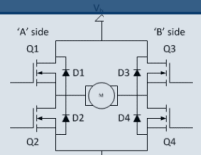
Multi-Level Drawing Experience

DRAWINGS

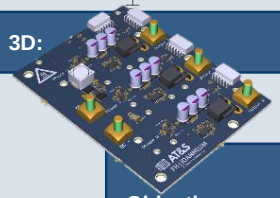
MECHANICAL:



ELECTRICAL:



3D:

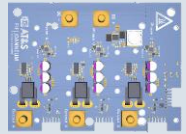


Objective: Documentation

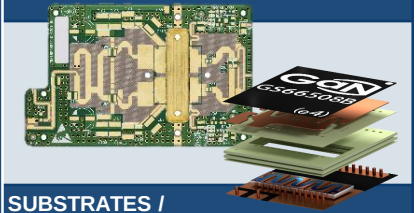
Advanced Layouts in Special Design Suites

PCB / SUBSTRATE - LAYOUTS

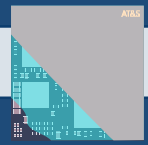
CONVENTIONAL PCBS:



ADVANCED PCBS:



SUBSTRATES / PACKAGING:



Objective: First class PCBs / Substrates

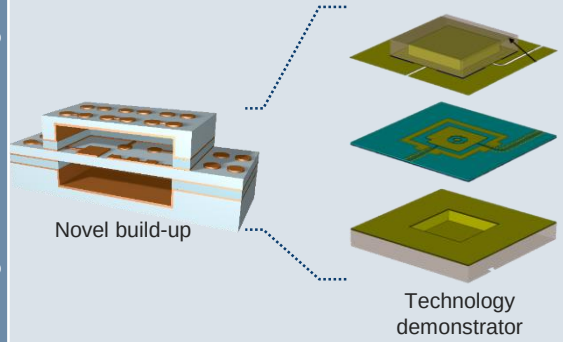
RF - RADIO FREQUENCY CAPABILITIES

PPS Product & Process Simulation | PDS Product Development Services | RF Radio Frequency | HDC Hardware Development Center | FTD Functional Test Development

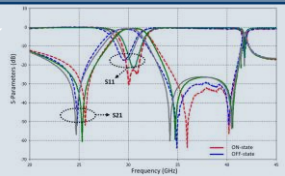
RF advantages for AT&S technologies

INTEGRATION OF PASSIVE RF FUNCTIONALITY:

NOVEL BUILD-UP CONCEPTS & DEMONSTRATOR DESIGN:



SIMULATION AND MEASUREMENT COMPARISON:

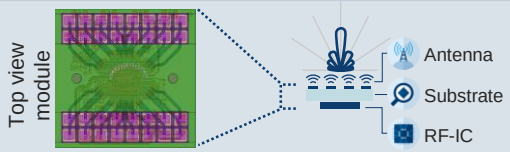


Objective: Demonstrate high RF performance using new technologies

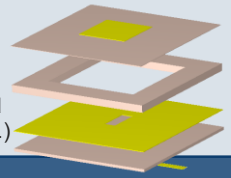
Novel RF modules and systems

INTEGRATED ANTENNA SYSTEMS

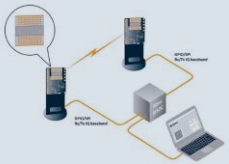
ADVANCED CONCEPT TO MODULE DESIGN:



STATE OF THE ART ANTENNA CONCEPTS:



SYSTEM LEVEL AND ANTENNA MEASUREMENT:



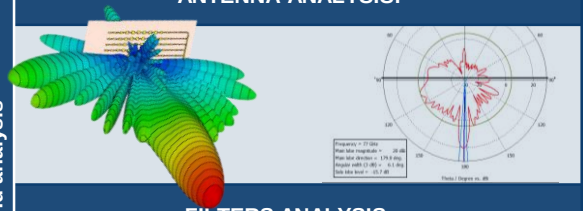
IMST

Objective: Optimize high frequency systems
Partner: IMST

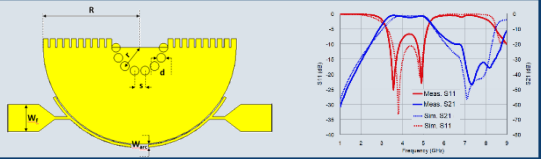
RF simulation and analysis

RF - SIMULATION SERVICE

ANTENNA ANALYSIS:

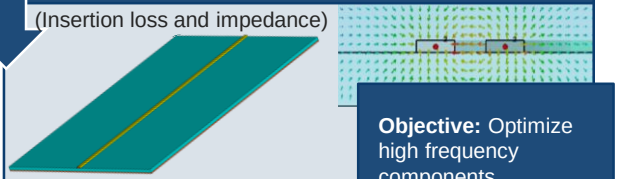


FILTERS ANALYSIS:



TRANSMISSION LINE ANALYSIS:

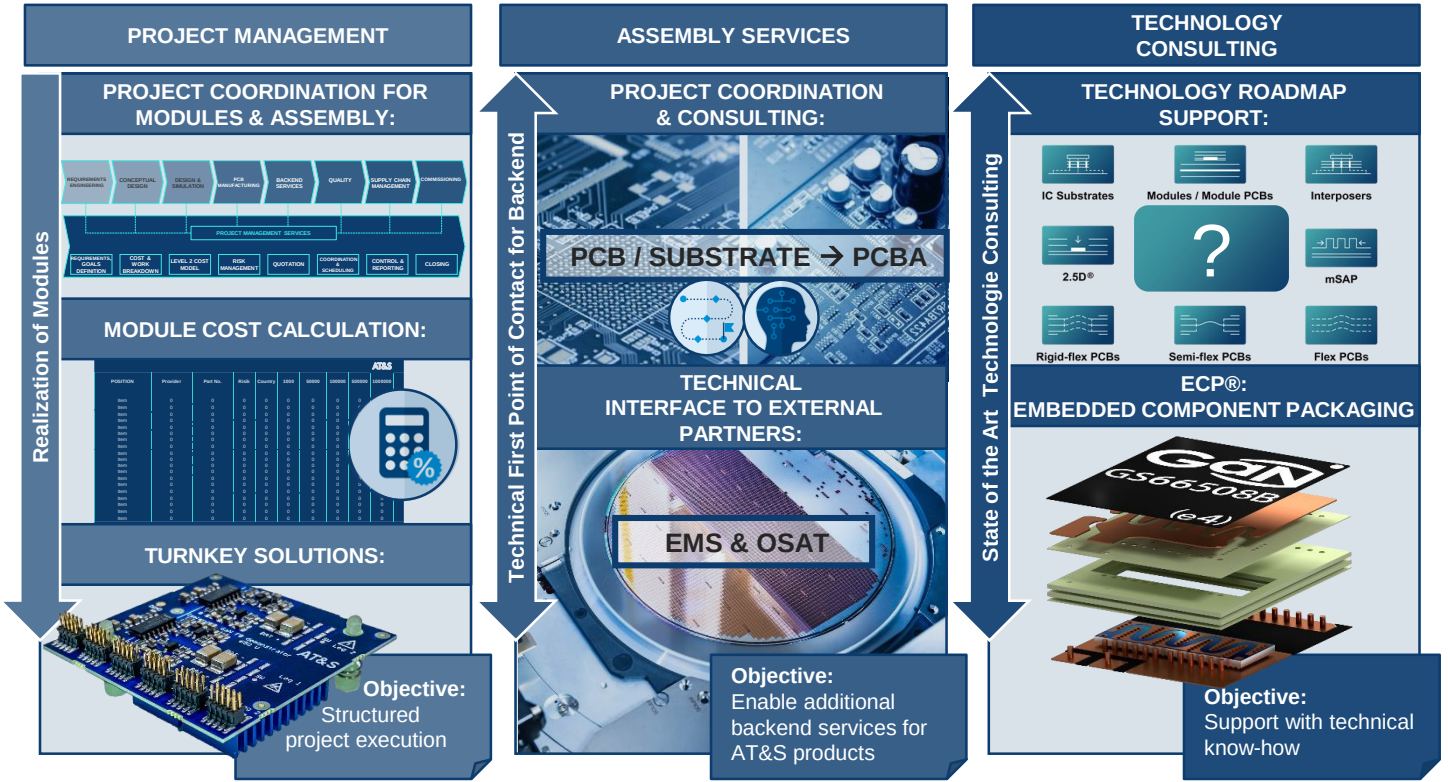
(Insertion loss and impedance)



Objective: Optimize high frequency components

PDS - PRODUCT DEVELOPMENT SERVICES CAPABILITIES

PPS Product & Process Simulation
PDS Product Development Services
RF Radio Frequency
HDC Hardware Development Center
FTD Functional Test Development



Printed Circuit Board … PCB
Printed Circuit Board with Assembly … PCBA
Outsourced Semiconductor Assembly and Test … OSAT
Electronic Manufacturing Services … EMS
Business Unit … BU
Group Function … GF

FTD - FUNCTIONAL TEST DEVELOPMENT CAPABILITIES

PPS Product & Process Simulation
PDS Product Development Services
RF Radio Frequency
HDC Hardware Development Center
FTD Functional Test Development

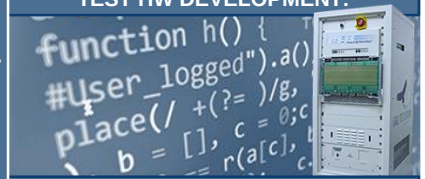
TEST SERVICES

Test Development & Optimization

TEST ASSESSMENT & OPTIMIZATION:

- Test Requirements
- Test Methodology
- DfT
- Test System Suitability
- Test Optimization

TEST PROGRAM & TEST HW DEVELOPMENT:



EMS & OSAT TEST COORDINATION :

Objective: Highest test coverage and optimized test process for stable production

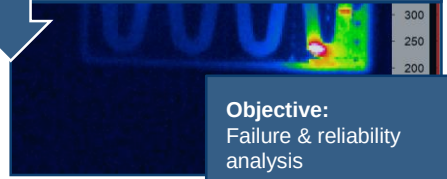
LABORATORY SERVICES

Product & Material Characterization

VALIDATION:

CHARACTERIZATION:

FAILURE ANALYSIS SUPPORT:



Objective: Failure & reliability analysis

CONTACT

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