



The Global Leading One-stop RF Solution Provider

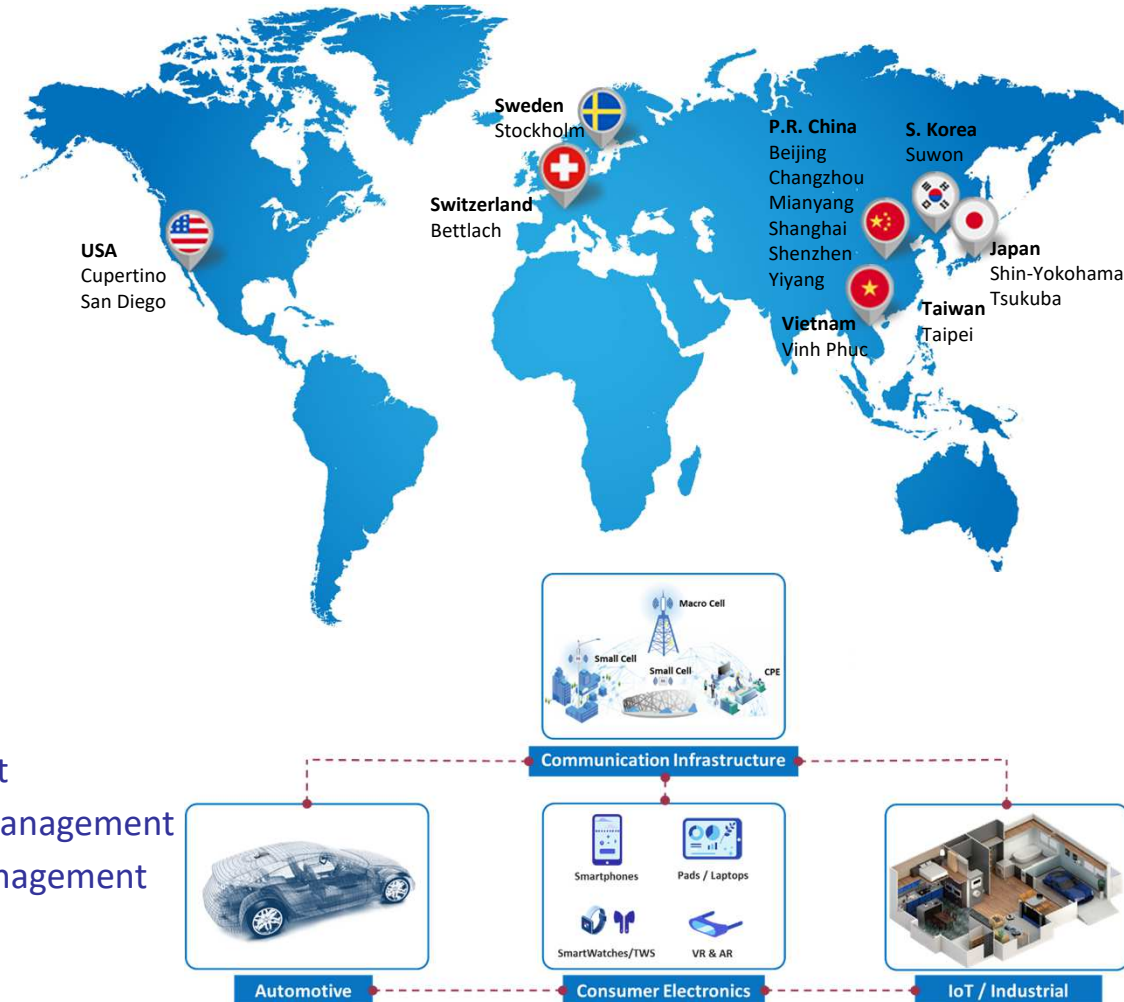
Sunway Communication Company Presentation

November 2021

Sunway Confidential

www.sz-sunway.com

- Publicly Listed and Member of MSCI China Index
- Employees: ~ 10,000 worldwide
- Revenues: ~ 1 BUSD
- R&D investments: 9%
- 1,583 Patent applications (through 2020)*
- Key Certifications:
 - ISO 9001 Quality management
 - ISO 13485 Medical devices
 - ISO 14001 Environmental management
 - IATF 16949 Automotive quality management
 - ISO 17025 Testing and calibration labs
 - ISO 27001 Information security management
 - ISO 45001 Occupational health and safety management
 - IECQ QC 080000 Hazardous substance process management



* Sunway ranks top 3 worldwide in terms of number of granted 5G antenna patents acc. to Yole research.

Sunway Product Snapshot

Sunway's broad capabilities provide for one-stop RF connectivity solutions

ANTENNAS

➤ Function

- main / diversity
- BLE / WiFi
- GNSS
- NFC
- UWB
- mm-wave
- proprietary

➤ Process

- LDS 3D
- sheet metal
- FPC flexfilms
- LCP, MPI, MPF mtrls



WIRELESS CHARGING

➤ Induction coils

➤ Magnetic Materials

- soft magn. mtrls
 - ferrite
 - amorphous
 - nanocrystalline
- perm. magn. mtrls
 - NdFeB

➤ Qi Rx Modules

➤ Qi Tx Modules

➤ NFC/Qi Rx Combos

➤ Charger Products

- 5W/15W/40W



RF SPRING CONTACTS

➤ Off-the-Shelf

- O-Shape
- S-Shape
- U-Shape
- L-Shape
- D-Shape

➤ Customized

➤ General Features

- SMT
- reel-to-reel
- high reliability
- suitable for RF



RF FRONT-END

➤ SAW Filters

- Rx
- Tx
- duplexers
- quadruplexers

➤ Switches

- SPxT
- DPDT

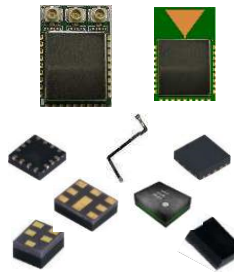
➤ Tuners

➤ RF Modules

- UWB (NXP chip)
- mm-wave

➤ Transmission Lines

- 5G mm-wave



CABLES & CONNECTORS

➤ BTB Connectors

- signal BTB
- RF BTB

➤ RF Coaxial Cables

➤ I/O Conn.

➤ Customized Conn.

➤ Automotive Conn.

➤ Cables

- consumer
- automotive
- industrial
- medical



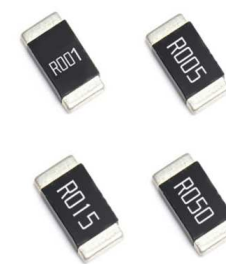
PASSIVE COMPONENTS

➤ Alloy Resistance

- 0805 Series
- 1206 Series
- 2512 Series

➤ Ceramic Chip Resistance

- 01005 Series
- 0201 Series
- 0402 Series
- 0603 Series
- 0805 Series
- 1206 Series
- 1210 Series
- 2010 Series
- 2512 Series



METALLIZED PLASTIC

➤ 3D MID Technologies

- LDS
- LAP
- proprietary

➤ Products

- antennas
- sensor frames
- camera frames
- light reflectors
- catheters

➤ Applications

- consumer electronics
- macro, small cells, CPEs
- automotive
- IoT / smart home
- medical devices



PRECISION METALS

➤ Stamping

- clips
- deep drawing
- metal structures
- shielding cans

➤ Molding Parts

- injection molding
- insert molding
- overmolding

➤ Metal and Ceramic Injection Molding

- hinges
- keys
- frames

➤ Complex Laser Welding Parts



Sunway RF & Wireless One-stop Solution



RF MATERIALS

- LCP (Liquid Crystal Polymer)
- MPI (Modified PI)
- MPF (Modified PTFE)



TRANSMISSION SOLUTIONS

- RF Coaxial
- Flex Cable



ANTENNAS

- Virtually any system
- Virtually any frequency
- Most applications
- Most mechanical realizations



RF FRONT-END COMPONENTS

- Tuners
- Switches
- SAW Filters
- UWB Modules



WIRELESS CHARGING MODULES

- Rx
- Tx
- NFC/Rx Combos
- Magnetic Materials



EMI/EMC SOLUTIONS

- Board Level Shieldings
- Connector Shieldings



RF BTB CONNECTORS

- Sub-6 GHz
- mm-wave



RF SPRING CONTACTS

- Standardized Clips
- Customized Clips



ANTENNA & ACOUSTIC INTEGRATED SOLUTIONS

- Integrated
- Drop-in solutions



Innovation is at the heart of Sunway. We invest in cutting-edge technology to ensure robust growth in the future.

R&D Focus of Sunway Corporate Research

- 5G antennas
- Dielectric materials
- Magnetic materials
- RF front-end components
- New manufacturing processes

Research Institute Collaborations

- University of Missouri
- KTH Royal Institute of Technology, Stockholm
- Nanjing University
- Southeast University Nanjing
- University Of Science and Technology Beijing
- Wuhan University of Technology

Granted 5G Antenna Patents Worldwide

#1



#2



#3



Data source: Yole research.

Center for Electromagnetic Compatibility (CEMC)



3-D MID e.V.



Cellular Telecommunications Industry Association (CTIA)



Wireless Power Consortium (WPC)



FiRa Consortium



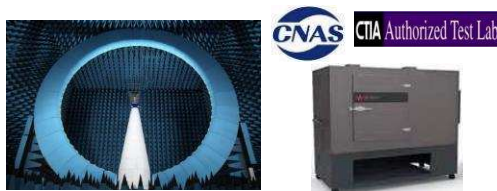
Car Connectivity Consortium (CCC)



Product Testing Capabilities

Sunway RF Test Labs are CTIA, CNAS, and SIEMIC certified

RF / EMC



3D Anechoic Chambers

Keysight Z2160A 5G mmWave
GTS Raypact-1000 5G mmWave
MVG/Satimo StarGate 24/32
MVG/Satimo StarLab Sub6GHz
ETS-Lindgren 8500/8600/8800
HWA-Tech Z6100A (MIMO)
TDK 9*6*6 and 8*5*4 (EMC)
R&S 8980 (RF conformance)
Anite 9000 (Protocol conformance)
Rider and FIME (NFC)

Others

SAR/HAC Speag DASY 4/5
PIM Testing

MECHANICAL



Reliability Test Systems

Temperature & Humidity
Air Thermal Shock
Rapid Temperature Change
Low Temperature
Salt Spray
Orientation Drop
Tumbling
Random Vibration
RoHS and Halogen
3D Scanners
Scanning Electron Microscope
etc.

WIRELESS CHARGING



E.E. and Mag.E. Test Equipment

Impedance Analyzer
B-H Loop Analyzer
Dynamic Power Analyzer
Saturation Current Test System
Impulse Winding Tester
Gauss Meter
Thermal Analyzer
EDX Spectroscope
Communication Testers (CAN/LIN)

Vertical Integration Capabilities

Toolings

Stamping Tool
Injection Molding Tool
MIM Tool
Fixtures and Jigs
Assembly Equipment



Components/ Processes

Plastic Molding
(injection/insert molding...)
3-D MID
(LDS/LAP)
Coils
(wire/flexfilm)
Metals
(CNC/stamping/deep drawing...)
MIM
(metal/ceramic)
Plating
(electrolytic/electroless)
Magnetic materials
(annealing/cracking...)
Die cutting
SMT
(PCB, FPC, LDS)



Assembly & Testing

Antennas
Precision Metals
Plastic Parts
Speakers/Receivers/Speaker boxes
Spring Contacts
Cable Harnesses
Precision Connectors
RF Coaxial Cables
Wireless Charging Modules
LCP/Flex
Finished Products



Tooling Center



Stamping Machine



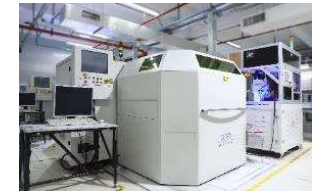
Molding Machine



Plating Line



LDS Laser



SMT

Automation Capabilities

Examples of fully automated assembly lines for components/modules manufacturing



Antenna Assembly



SMT Components
on PCB or FPC



Acoustic Components
Assembly



Precision Connector Assembly



Spring Contact
Automated Packaging

Automation Capabilities:

- 200 experienced mechanical / electrical / software engineers
- Centralized automation organization to enhance capability
- Rapid prototyping capability
- Full in-house tooling/fixture fabrication capabilities
- Ability to design full-auto line for high volume parts
- Specialized in RF related test fixture and equipment
- In-line Automated Optical Inspection (AOI)



BTB Connector Assembly

System Certifications



ISO9001



ISO14001



QC080000



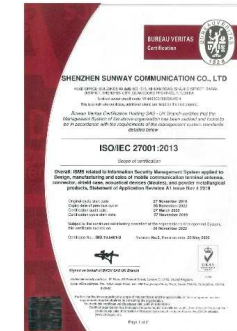
ISO/IEC17025



IATF16949



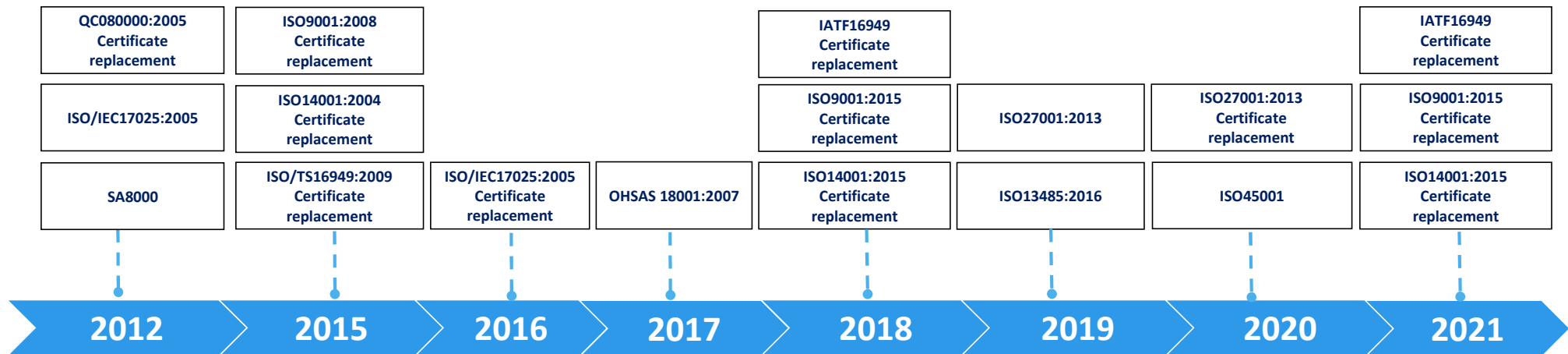
ISO45001



ISO27001



ISO 13485





Sunway Charity Foundation

Help people who live under difficult circumstances and still persist in doing good for others.



China Clean Energy Fund

Invested in Apple-launched clean energy program.



Green Electricity

Selecting electric energy from sources with greatly reduced or eliminated emissions.



Mineral Policy

Committed to following OECD's Due Diligence Guidelines for Responsible Mineral Supply Chains from Conflict-Affected and High-Risk Areas.



➤ Services

- Project Management
- Mechanical Design
- Design for Manufacturing Analyses (DFM) and Simulations
- 3D Antenna/Electromagnetic Simulations
- RF & Antenna Design
- RF & Antenna Measurements
- Prototypes and Pre-series

Project Examples

Industry	Application	Sunway Product
Automotive	Connectivity	TCU integrated antennas
	Wireless Charging	15 W free placement Qi charger
Telecom	Macro Base Station	Metallized 5G antenna radiator array
	CPE	mm-wave antenna modules
IoT	Trackers	Antennas
	RTLS Systems	UWB modules
Medical	Hearing Aids	SMT antenna connectors
	Drug Delivery Connectivity	MID antennas
Industrial	Smart Meters	FPC/Sheet metal antennas
	Smart Door Locks	UWB modules
Consumer Electronics	Smart Watch	MIM frame bezel
	TWS Earphones	LDS antennas

Contact us: europe@sz-sunway.com

MEP Europe B.V. - Technical Center
Group of Mitsubishi Engineering-Plastics Corporation



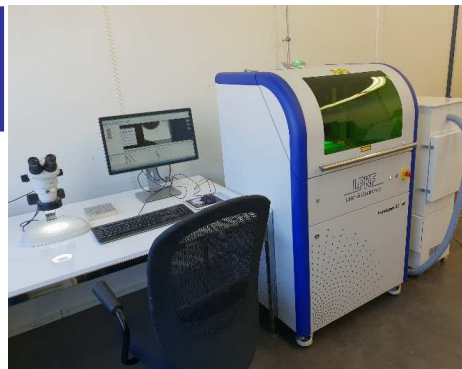
BOSCH



LPKF
Laser & Electronics

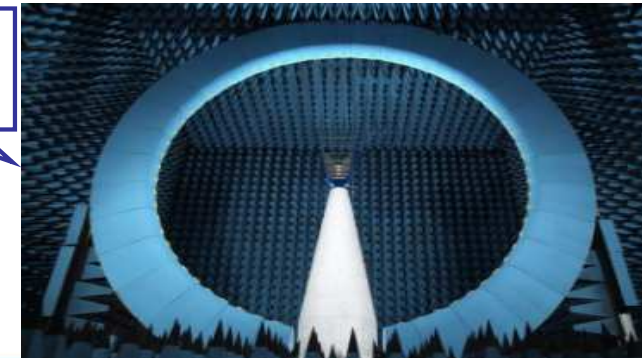
Fraunhofer
IST

Member of
3-D MID e.V.



Antenna
Measurement Lab.
Stockholm, Sweden

LDS Proto
Manufacturing
Bettlach, Switzerland



Metallized Plastics (3-D MID)

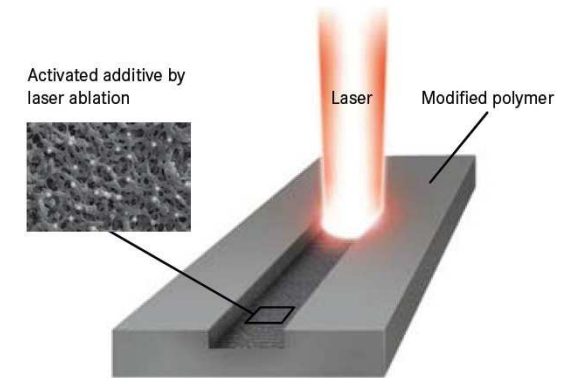
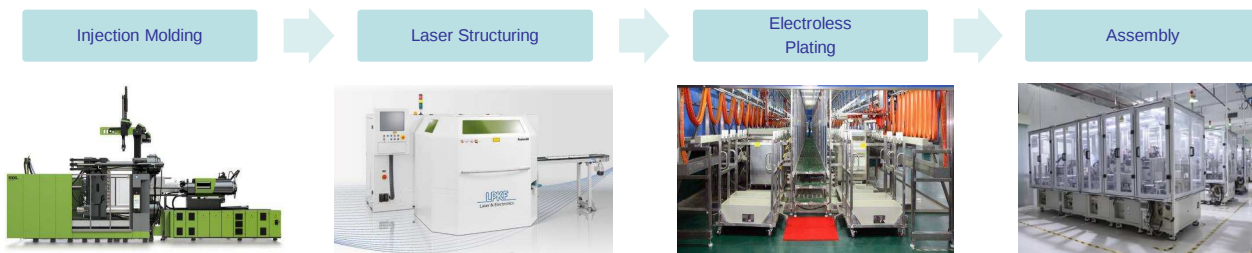
Applications

- Medical Devices
- Consumer Electronics
- Telecom
- Automotive
- Sensors

3D-MID makes conductive patterns on 3-dimensional surfaces

- Metallization through laser activation of polymer followed by electroless plating.
- Laser Direct Structuring (LDS)
 - still the most commonly used technology for 3D-MID
- Laser Activation Plating (LAP)
 - developed by Sunway and capable of using more a wider range of plastics

Typical LDS Process Flow



Drivers

- Integration, less components, smaller size
 - increased reliability
- Low weight
 - reduced metal content with better performance
- Circuitry design flexibility
 - circuit line width from 150 μm
- Reliability
 - used in automotive, medical and more since 20 years
- Sustainable
 - recyclable and biocompatible
- Cost efficient
 - fewer parts

Sunway Communication 3D-MID⁺

Sunway teams have >20 years experience of global 3D-MID R&D and project support

Arguably the largest 3D-MID/LDS supplier worldwide offering 3D-MID⁺

Sunway Communication
3D-MID⁺



Simulation, Design for Manufacturing,
 Tooling, Automation,
 Product Qualification,
 Manufacturing,
 Electronic Assemblies



Integration/connectivity to
 other components and
 mechatronic modules, like
 overmolding, inserts, bonding,
 cable connection, SMT, PCB, FPC, ...



Industry Camera Sensor Frames	Medical Device Connectivity Module	Secure Payments Terminal Security Cover	Pet Tracker Connectivity Antennas	Automotive Conformal Antennas	Smartwatch Connectivity Antennas	High-end Smartphone 5G Antennas	Laptop Computer LTE MIMO Antennas	Macro Base Station 5G Antenna Array
T&R packaging SMT mounting	3D connector bumps Ø 0.15 mm vias >1000h @ 90°C / RH 90%	0.05 mm line+0.05 spacing 14 m plated lines >1000h @ 85°C / RH 85%	Device cover integration LoRa system frequencies O-shape clip antenna feed	TCU cover LDS integration FPC, sheet metal, PWB ant. Cell+WiFi+BT+GNSS+SDARS	Bluetooth+GPS Spring clip integration	Insert molding Laser welding PCR materials	Soldered cable SMT connectors PCR materials	Sub 6 GHz bands Radiator&transmission line Low weight vs. sheet metal
Part A: 3 x 3 x 3 mm Part B: 8 x 9 x 0.8 mm Part C: Ø 6 x 7 mm	15 x 10 x 1.5 mm	50 x 60 x 10 mm	25 x 25 x 5 mm	150 x 280 x 30 mm	Ø 35 x 4 mm	50 x 75 x 4 mm	250 x 8 x 5 mm	300 x 300 x 11 mm

Precision Metals – Overview

Metals Processes

- Stamping
- Deep Drawing
- Cold Forging
- Die Casting
- CNC
- Metal Injection Molding (MIM)

Plastics Processes

- Injection Molding
- Insert Molding / Overmolding
- Two-shot Molding

Others

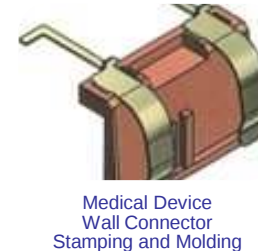
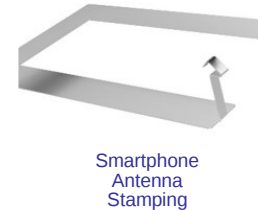
- Die Cutting
- Ceramic Injection Molding (CIM)

Post Processing

- mesh stamping $\varnothing 0.2$ mm
- PVD
- Sand Blast
- Grinding
- Electro-deposit
- Chemical Polishing
- Plating
- Printing

Metal Assembly

- Laser Welding
- Riveting
- Complex Assembly
- Glueing
- Painting
- Marking



Spring Connector Series



	Min	Max
L	1.4	1.4
W	1.4	1.4
H	1.2	2.0

D-Shape Connector

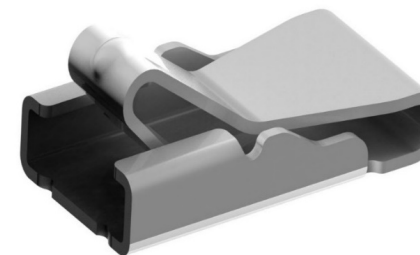
- Grounding



	Min	Max
L	3.0	5.2
W	1.0	1.5
H	1.5	4.6

L-Shape Connector

- Antenna RF
- Battery
- Grounding and DC
- For side-board connection



	Min	Max
L	2.0	5.2
W	1.0	1.5
H	0.8	4.6

O-Shape Connector

- Antenna RF
- Battery
- Grounding and DC



	Min	Max
L	3.0	7.5
W	1.3	3.0
H	4.3	8.0

S-Shape Connector

- Grounding



	Min	Max
Cable Ø	0.81	1.4

U-Shape Connector

- Cable fixation on PCB

Sunway standard spring connector series include a number of different connector types in various shapes and sizes.

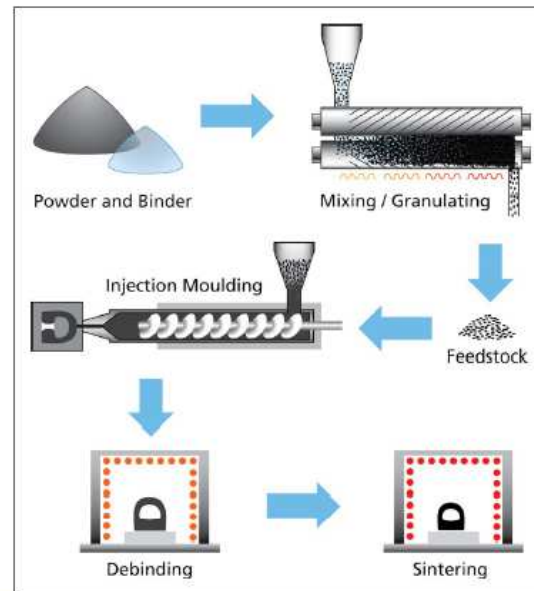
Notes:

- Units are in mm.
- Min and max refers to the connector height H (unloaded).
- All connectors are gold plated, except U-shape.
- L-shape contact direction is parallel to PCB, others perpendicular to the PCB.
- All connectors are packed in tape-on-reel for PnP and SMT use.

Precision Metals – MIM Examples

MIM (Metal Injection Molding)

- Cost-effective manufacture of high volume complex metal parts with high accuracy
- Ideal part weight 0.2 - 30 g, but can be as heavy as 200 g
- Net-shape manufacture with minimal material waste
- Minimum of post-process operations
- Superior mechanical properties: fine particle size and high sintered density
- Wide range of pre-alloys and master alloys available
 - Stainless steels, low alloy steels, titanium etc.
- Surface structure $R_a < 1.2 \mu m$ ($< 0.8 \mu m$ with polishing)
- PVD can be applied for decorations
- Applications for
 - consumer products
 - medical devices
 - automotive
 - machinery, etc.
- Typically used for
 - housings
 - hinges
 - gear wheels, etc.



Consumer Headset



Cosmetic Metal Frame



Automotive



Gear



Wireless Headset Case



Case Hinge



Wireless Headset Case



Case Hinge

Antenna Examples

Applications

- Consumer Electronics
- Internet-of-Things Devices
- Medical Devices
- Smart Home
- Communication Infrastructure
- Automotive

Manufacturing Processes

- 3D-MID (LDS, LAP, PEP etc.)
- Flexible Printed Circuits (FPC)
- Sheet Metal
- Mechanically Integrated Antennas
- LCP, MPI, and MPF FPCs

Systems

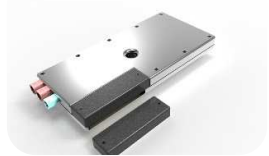
- Cellular
 - 2G-5G
- Connectivity
 - Bluetooth, WiFi, ...
- Satellite Positioning
 - GNSS (GPS, Galileo, Glonass, Baidu...)
- Others
 - NFC, UWB...



Smartwatch
LDS Antenna



Smartphone
FPC Antenna



Automotive eCall
LDS Antenna



Smartwatch
LCP Flex



Smartphone
LDS Antenna



Macro Base
3D MID Antenna



IoT Tracker
Device Antenna



Smart Meter
4G FPC Antenna



5G CPE
PCB Antenna

Wireless Charging Examples

Magnetic Materials

- Permanent Magnet
- Ferrite
- Nanocrystalline & Amorphous
- Customized design
- Vertical integration



Electrical Components

- Coil design & simulation
- Coil manufacturing & testing
- SMT / PCBA
- Desense / EMC debug



Magnetic Materials



SUNWAY
Tx & Rx

One-Stop Solution

Precision Mechanics

Precision Mechanics

- Precision metal & plastic
- Precision die cut
- Laser/hot bar soldering
- Laser/ultrasonic welding



Assembly, Test & Automation

- Assembly process & tooling
- Test process & fixtures
- Reliability test & analysis
- Semi & full automation



Assembly, Test, & Automation

Applications

- Smartphones
- Headsets
- IoT devices
- Medical devices
- Smart home
- Automotive

Products

- Induction wire coils or flexfilm coils
- Magnetic materials
- Rx (and NFC) modules
- Tx modules
- Tx finished products



Deskstand
Tx charger



Automotive
In-cabin Tx charger



Smartphone
Rx module



TWS Earphone
Rx Coil



Soft Magnetic Material

UWB introduced in iPhone 11 and later, Samsung etc.

- Currently included in keyless entry, smart speakers, tags, etc linking to smartphones
- Sunway already offers antennas and low loss LCP flexfilms to the consumer electronics market

FiRa Consortium drives standardization and certification of UWB

- UWB for ranging operates at 6.5 – 9 GHz
- Builds on the IEEE 802.15.4z foundation
- Sunway is a member of FiRa Consortium

UWB functionality integrated to equipment and devices for cm-level positioning

- Wide range of use cases in IoT, consumer, industrial, medical, automotive sectors, and more
- Sunway is module partner of NXP
- Sunway offers one-stop solution for UWB implementation



Source: FiRa Consortium

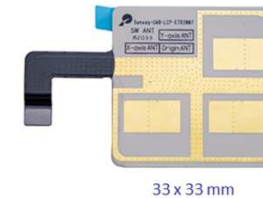
UWB Modules



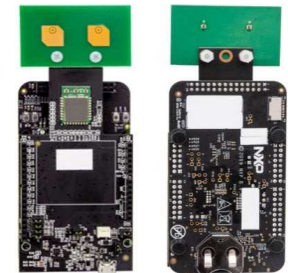
UWB Tag Platform



UWB Antennas



UWB Eval. Kit



Thanks!