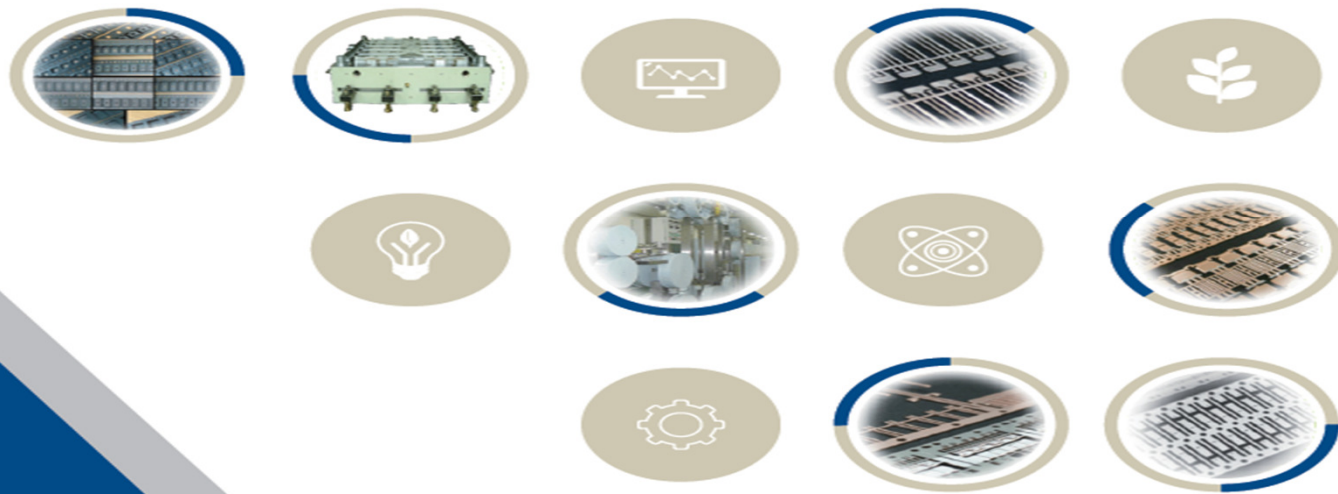


TSP

Lead frame / Plating / Carrier tape / Tooling



TSP CO., LTD.

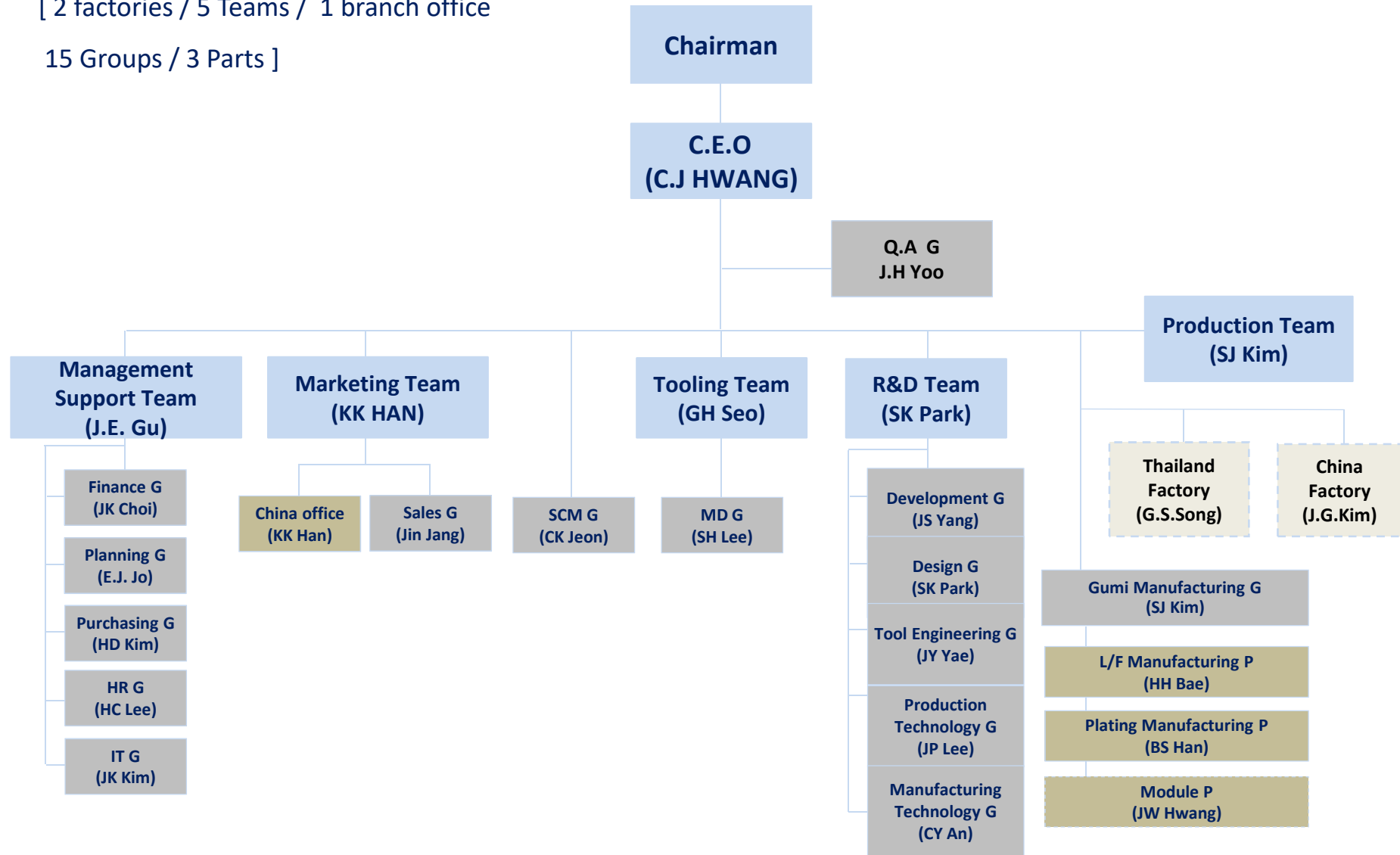
TSP TSP Brief History

HISTORY

- 2022 **Appointed as new supplier of Amkor & ASE Malaysia**
- 2021 **Appointed as new supplier of Infineon & Nexperia**
- 2018 **Certified IATF 16949**
- 2017 **Started Auto motive Power Module business**
- 2015 **Awarded Best Improvement Award from Fairchild Suzhou**
- 2014 **Expanded Automotive / Module Production in China market**
- 2011 **Expanded Plating Line**
- 2010 **Achieved Prize for Trade-day by Korea President**
- 2005 **Certified ISO 14001**
- 2004 **Started Carrier tape Business**
- 2003 **Certified ISO/TS 16949:2002**
- 2002 **Established TSP-China**
Changed company name to TSP Co., Ltd.
- 2001 **Certified QS-9000**
- 1996 **Established TSP-Thailand**
- 1995 **Started Plating Line**
- 1985 **Established TAE SUK Precision CO., LTD.**

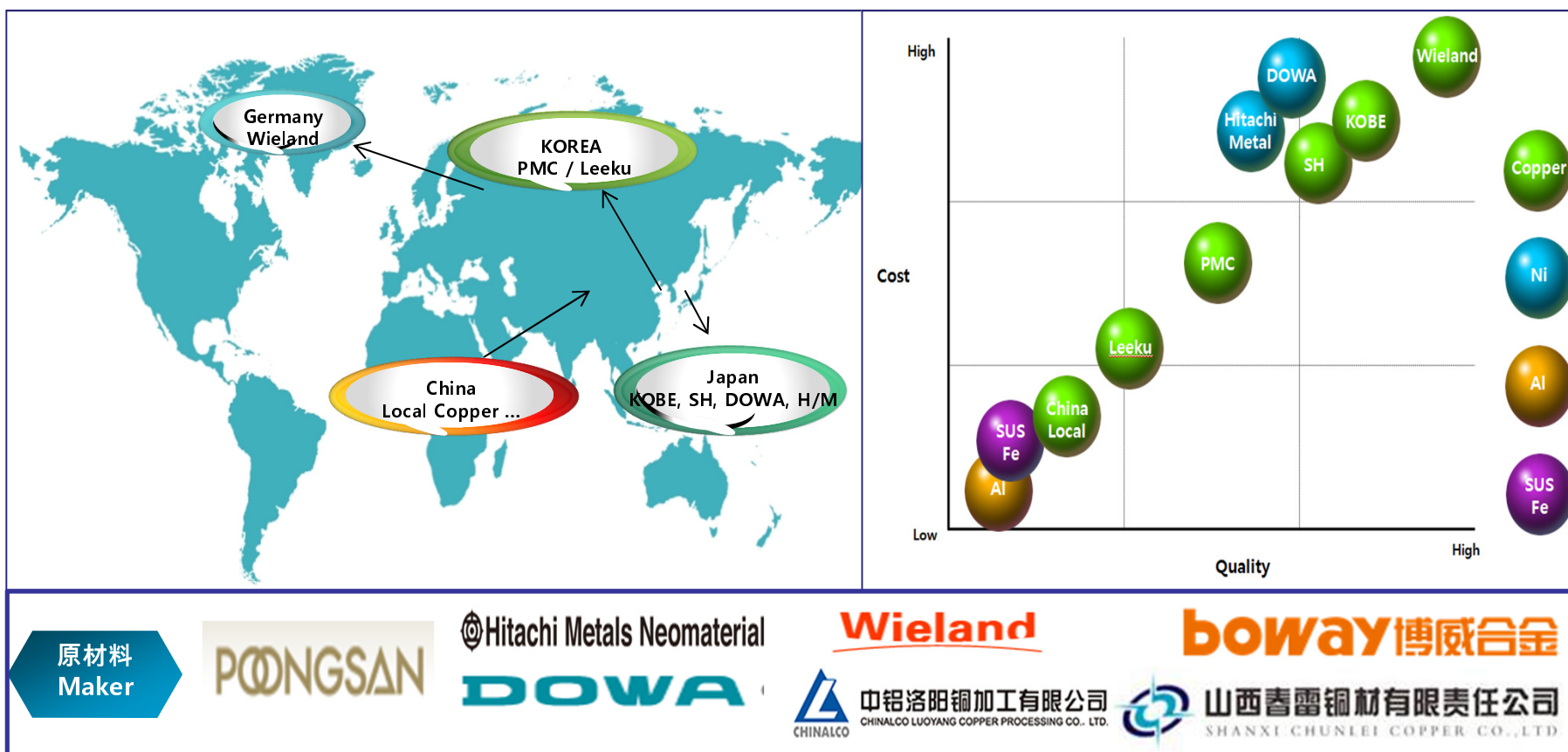


[2 factories / 5 Teams / 1 branch office
15 Groups / 3 Parts]



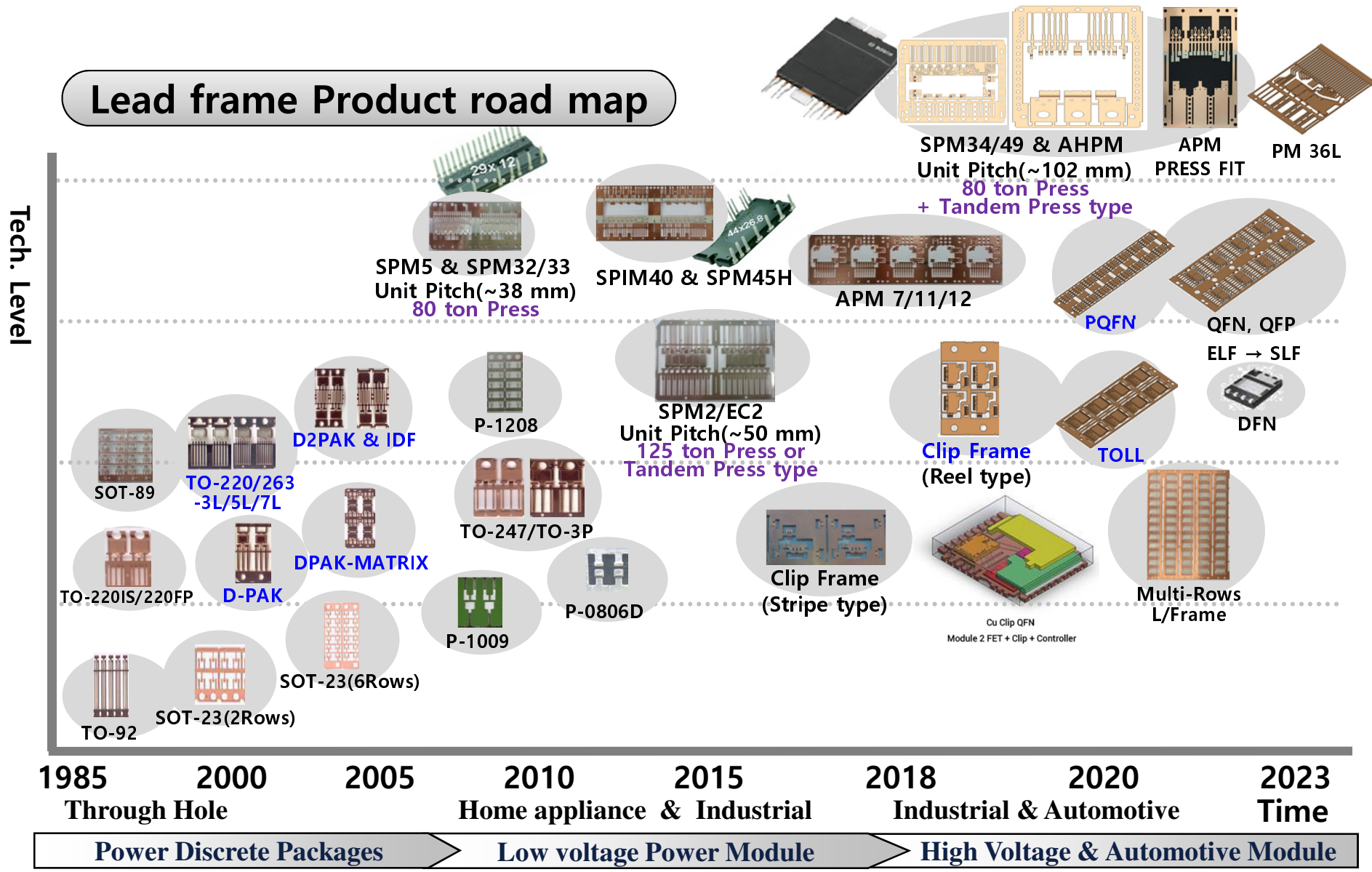
TSP Purchasing strong point

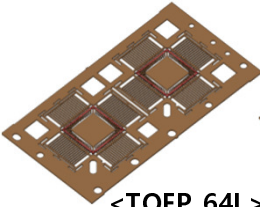
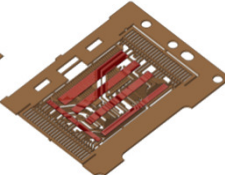
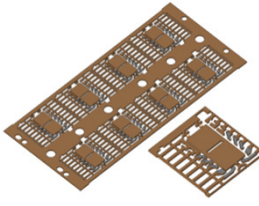
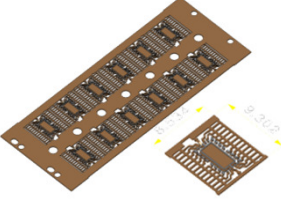
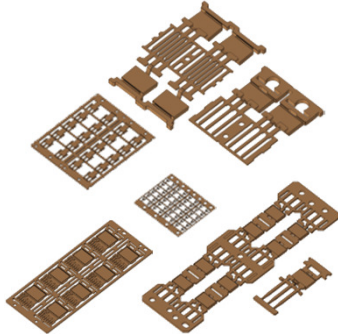
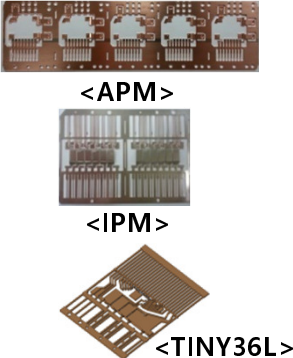


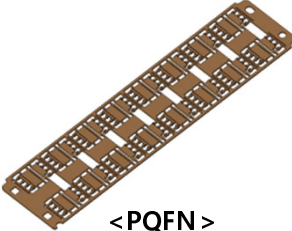
1. When lead frame suppliers faced shortage of raw material during semiconductor demand growth in 2010 ~ 2012, TSP have provided Lead frame very smoothly based on long-term partnership with Poongsan, China and Japanese material makers.
2. To secure price competitiveness from 2013 to 2016, TSP proposed conversion of low cost raw-material to business partners through TSP's production know-how & value engineering suggestion. That made business partner competitive in their sales market.
3. When supplying problem of global raw-material was happened in 2017 ~ 2022, TSP have solved the raw material problem by supplying and forecasting raw materials in advance.



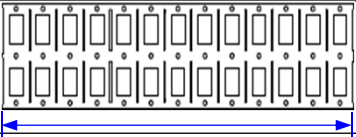
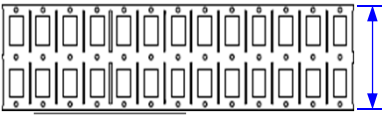
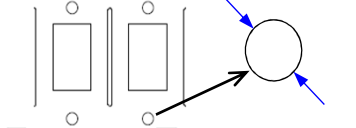
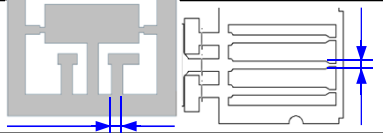



1. **Secure core technology based on development know-how of module lead frame**
2. **Provide samples of normal lead time (56 days) vs short lead time (7 days)**
 - * **Punch press machine can be used to provide pilot type lead frame samples.**
 - * **Feasibility testing is possible without investing stamping tooling costs.**
 - * **If customer want to change the leadframe design after feasibility test, we can provide various L/F.**
 - * **TSP can minimize cost and time by using punch press machine.**
3. **Apply differentiated quality control system and manufacturing line**
 - * **Module L/F & Auto motive type L/F: differentiated quality control system**
 - * **Application of IPM L / F dedicated manufacturing line (various size (pitch) of lead frame can be provided)**
4. **TSP has exclusive process for developing module LF with collaborative development with customers.**

Lead frame Product road map

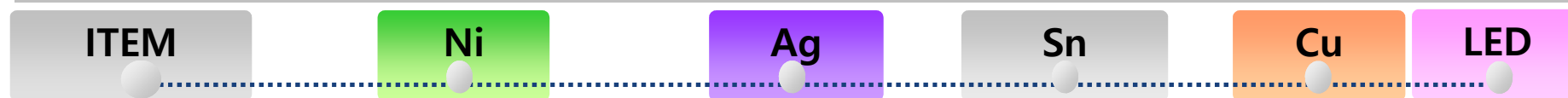


구분	Package류	비고
2024年	<div style="border: 1px dashed gray; padding: 5px; text-align: center; margin-bottom: 10px;"><i>IC (High Pin)</i></div> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p><TQFP 64L></p> </div> <div style="text-align: center;">  <p><TSOP 48L></p> </div> </div>	
	<div style="border: 1px dashed gray; padding: 5px; text-align: center; margin-bottom: 10px;"><i>IC (Low Pin)</i></div> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p><SOIC 20L></p> </div> <div style="text-align: center;">  <p><TSOP 24L></p> </div> </div>	
2023年 현재	<div style="display: flex; justify-content: space-between; margin-bottom: 10px;"> <div style="border: 1px solid gray; padding: 5px; text-align: center;">SOT & PW- TR</div> <div style="border: 1px solid gray; padding: 5px; text-align: center;">Module</div> <div style="border: 1px solid gray; padding: 5px; text-align: center;">Cu- Clip</div> <div style="border: 1px solid gray; padding: 5px; text-align: center;">PQFN</div> </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  <p><APM></p> <p><IPM></p> <p><TINY36L></p> </div> <div style="text-align: center;">   </div> <div style="text-align: center;">  <p><PQFN></p> </div> </div>	

TSP Lead Frame Capability

Classification	Shape	IC		PW-TR		SOT		Module	
		t= 0.1~0.15		t= 0.5~2.0		t= 0.08~0.4		t= 0.4~0.8	
		SPEC	Tolerance	SPEC	Tolerance	SPEC	Tolerance	SPEC	Tolerance
1.Strip Length		208.8~218	± 0.1	168.5~254.4	± 0.1	Reel	± 0.1	187.4~272.0	± 0.1
2.Strip Width		50.8~67.5 3	± 0.05	30.3~45.00 9	± 0.1	13.7~38.6	± 0.1	35.7~93.0	± 0.05
3. Pilot Hole Size		Ø1.5	+0.03/0	Ø1.3~Ø3.5	± 0.03	Ø1.5~Ø2.0	± 0.02	Ø2.0~Ø3.5	± 0.03
4. External Lead Width		0.18~0.25	± 0.03	0.6~1.2	± 0.05	0.14~0.4	± 0.03	0.5~8.0	± 0.05
5. Lead Planarity		Max 0.05		Max 0.1		Max 0.08		Max 0.05	
6. Down set (Bending)		0.1~0.15	+0.04/-0.02	1.07~2.4	± 0.05	0.1~0.2	± 0.02	1.3~8.57	± 0.04 ~ ± 0.07
7. Metal to Metal Clearance (Lead & Pad)		Min 0.15		Min 0.2		Min 0.092		-	
8.Thickness (mm)		t= 0.1~0.15		t= 0.5~2.0		t= 0.08~0.4		t= 0.4~0.8	

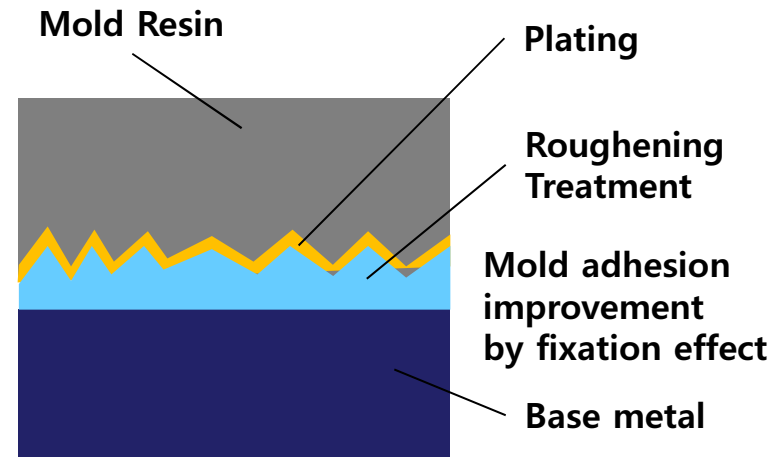
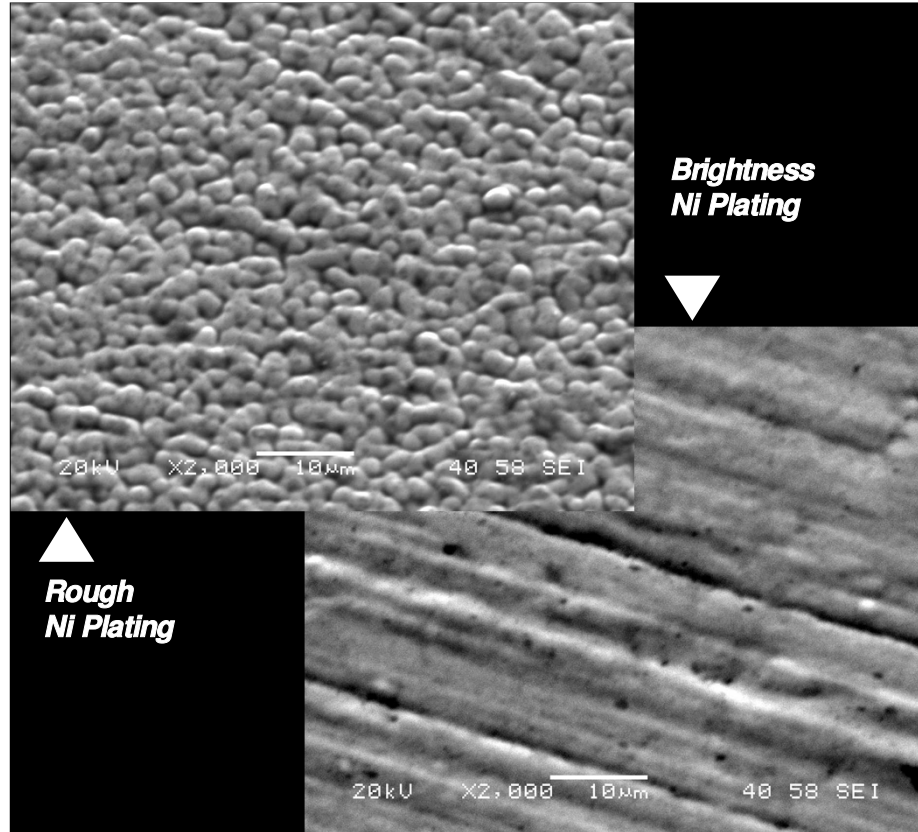
TSP Plating Capability



Division	Ni (Bright)	Ni-NiP (Bright)	Ag (Semi)	Sn (Matt)		Cu (Matt)	Ag (Bright)
				REEL	BARREL		
PLATING AREA WIDTH (mm)	MIN 0.80 MAX 90.0	MIN 0.80 MAX 90.0	MIN 0.80 MAX 20.0	MIN 20.0 MAX 65.5	small & single item	MIN 18.0 MAX 150.0	MIN 45.0 MAX 80.0
PLATING LINE	MAX 10rows	MAX 10rows	MAX 10rows	-	FULL	-	-
PLATING TOLERANCE (mm)	PW : ±0.12 SOT : ±0.09	PW : ±0.12 SOT : ±0.09	PW : ±0.12 SOT : ±0.09 SPOT: 0.075	-	-	-	-
PLATING THICKNESS (um)	Stripe : 0.5~4.0 Full : 2.0~6.0	Ni : 1.27~3.05 NiP : 0.127~0.508 (P : 6~12%)	1.0~5.0	3.5~5.5	3.0~20.0um	3.5~9.0	Ni : Min 0.1 Ag : Min 1.0
PLATING BRIGHT (GAM)	0.8~2.5	0.8~2.5	MAX 0.8	Matt	Matt	MAX 0.5	1.3~2.1
APPLIED PLATING	STRIPE & FULL	STRIPE & FULL	STRIPE & SPOT	FULL	FULL	FULL	STRIPE & FULL
	Ni+Ag	-	Cu+Ag	Ag+Sn	Ni+Sn, Ni	HALF Cu Cu+Cu	Ni+Ag, Ag

* Stripe Plating : Masking Tape / * Spot Plating : Reel to Reel Mask

■ Roughening Treatment



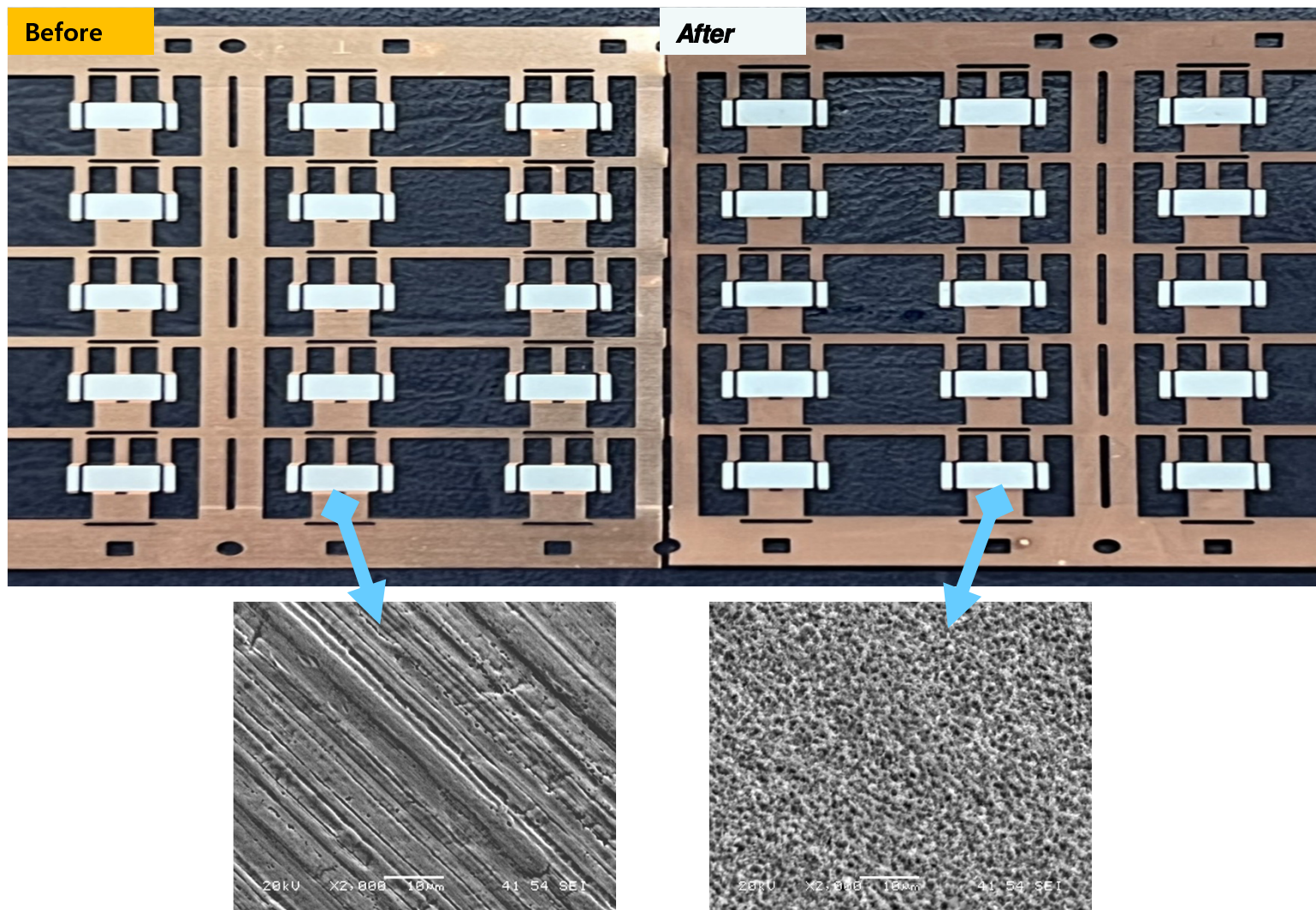
Since it is not by additives or alloying, it maintains the original properties of the plated metal, such as the prevention of diffusion of the underlying metal.

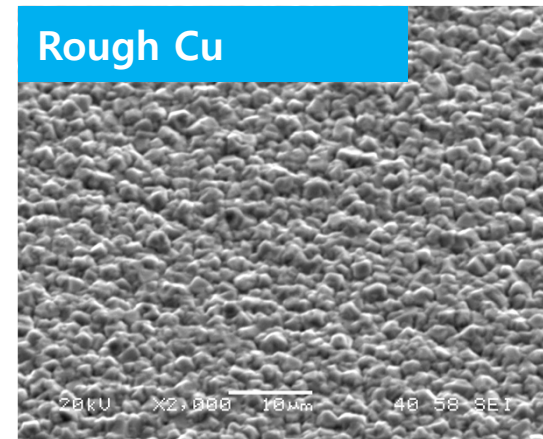
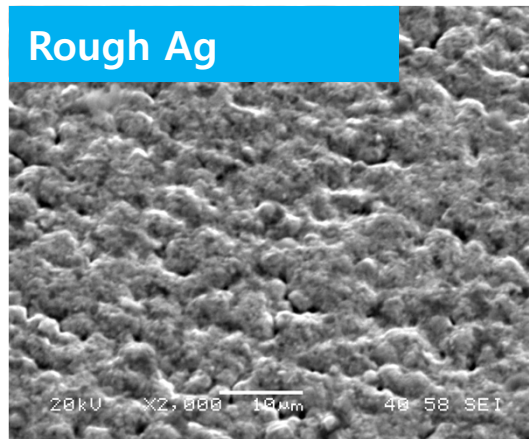
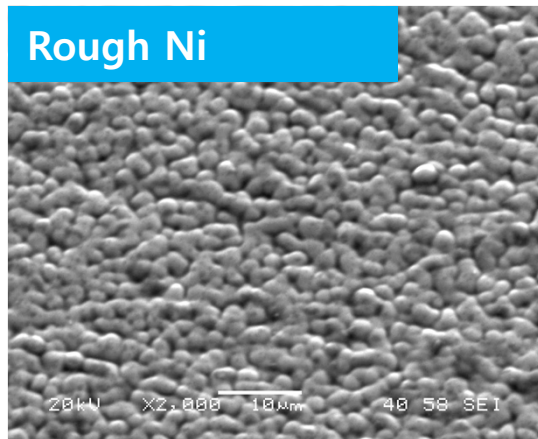
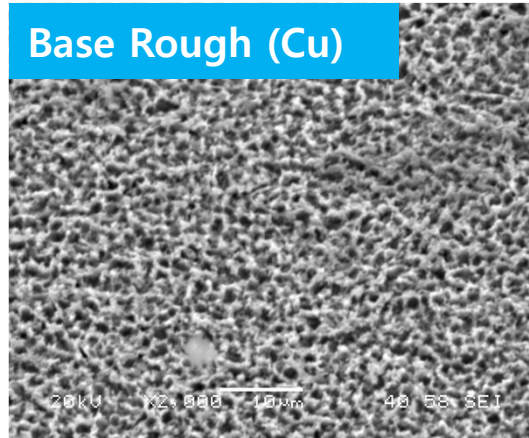
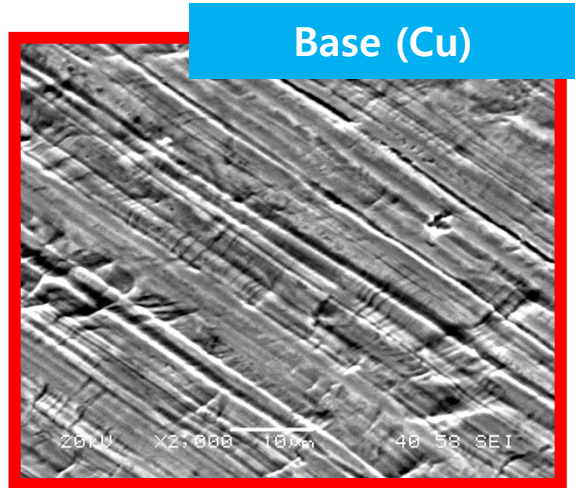
Improvement

Adhesion to mold resin

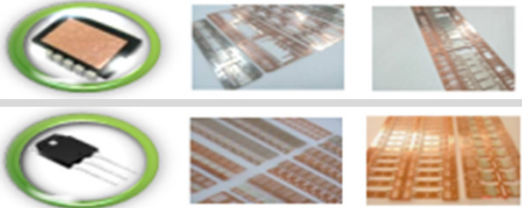
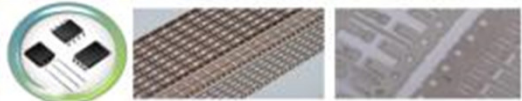



Merit

Adhesion improvement by various changes





- END -

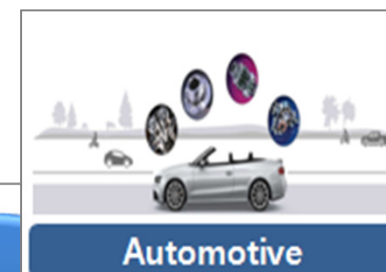
PRODUCTS	Monthly Capacity	Remark
	IPM, APM TO-247/3P/220/220F SO8/14/16	440,000 Kp .-TSP have still valid capacity to fill in more Module & Power discrete such Nexperia Global MFG sites as Malaysia, PHP, China etc.
	SOD 123/323 SMA/B/C SOT-23/89/223 (Reel to Reel) TSOP	2,030,000 Kp .- TSP Lamphun, Thailand capacity is optimized to produce SMD type lead frame. .- Based on high productivity and technology, supplying SMD type lead frame with competitive price. → Plating type : Cu, Ag, Cu + Ag → Raw material : Cu, Alloy .- Supplying SMD lead frame to East Asia Area. (Main)
	SOIC DNS2 (0603~1006) PQFN, QFN,	690,000 Kp .-TSP has been focusing IC type Stamped lead frame. .-Work with TSP R&D Center (Stamping & Etching) .-Various Package Line up (PPF Plating)
L/F Total		3,180,000 Kp
	Carrier Tape	5,000 Roll TSP Thailand, Korea is providing Carrier tape and tooling.
	Tooling (Stamping & Mold Set Spare Parts)	15 Set TSP is Total Semiconductor material supplier. Supplying not only L/F but also Carrier tape, Tooling



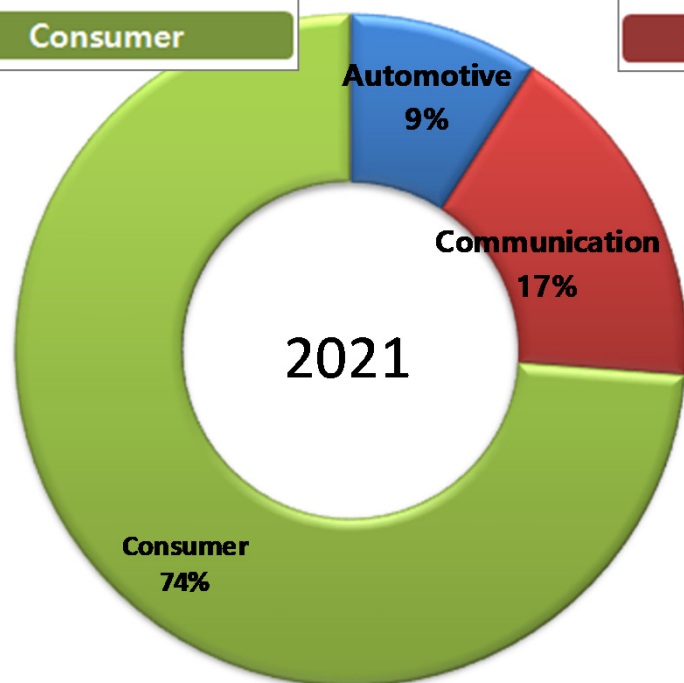
Consumer



Communication

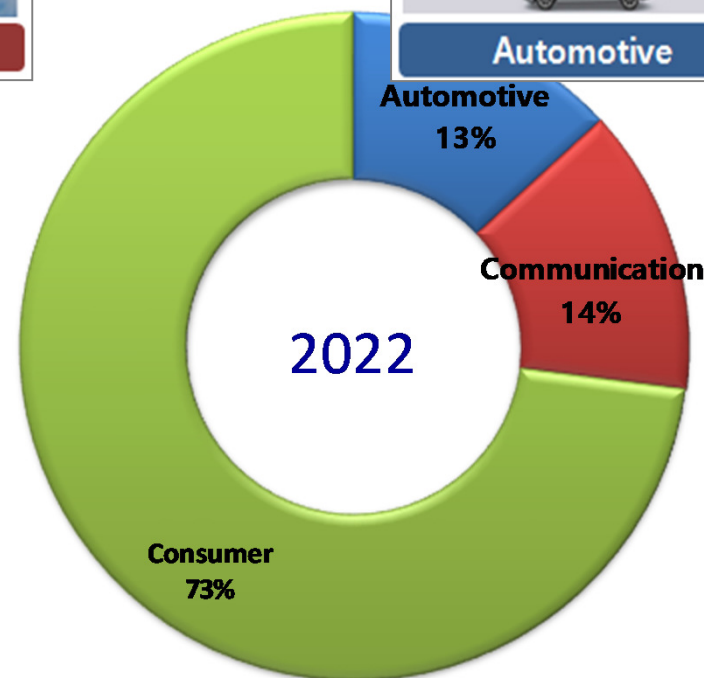


Automotive



Sales Revenue Break down as Package

- 1)Automotive : 9 %
- 2)Communication : 17%
- 3)Consumer : 74%



Sales Revenue Break down as Package

- 1)Automotive : 13%**
- 2)Communication : 14%
- 3)Consumer : 73%



PRODUCTS	WUXI CHINA
Module & Power Discrete	400,000 Kp
SMD	830,000 Kp
IC	340,000 Kp
SUB Total	1,570,000 Kp

PRODUCTS	Lamphun THAILAND
Module & Power Discrete	20,000 Kp
SOD 123/323 SMA/B/C SOT-23/89/223 (Reel to Reel) TSOP	700,000 Kp
IC	350,000 Kp
SUB Total	1,070,000 Kp



PRODUCTS	TSP KOREA
Module & Power Discrete	20,000 Kp
SMD	500,000 Kp
IC	20,000 Kp +@
SUB Total	540,000 Kp

Geographically, TSP-T has the advantage of being able to supplying product to China & South East Asia site.



1) IPM/APM Lead Frame Business Status

Number of Customers	Number of Items	Customer Nationality	IPM Lead Frame Production Site	Monthly Production Quantity
11	40	China, USA, Japan, Korea, Malaysia etc.	TSP-K TSP-C, TSP-T	10,000Kp

2) IPM/APM Lead Frame Milestones

Year	History
2003	Started IPM L/F business for F
2005	Qualified as supplier of Fxxx and started mass production
2007	Developed IPM for Industrial high voltage
2011	Developed and mass production IPM for Air-con Invert (Korea, Japan)
2012	Started mass production IPM for Air-con Invert (China)
2014~2015	Developed new IPM (VE type) & Large Module [Tandem Press]
2016.8	Developing Automotive Power Module(APM) with O & I
2017.4	Started mass production APM
2021.12	Developed IPM for INFINEON

TSP IPM/APM Lead Frame

IPM/APM Lead Frame List

NO	ITEM	Customer	Material	Plating	Unit Size	Site
1	SPM32CA	O	Cu	Ag Stripe	68.58(P)X62.1(W)	TSP-C
2	EPM7		Cu	Bare	104.6(P)X85.7(W)	TSP-C
3	SPM22-23		Cu	Ag Stripe	37.60(P)X35.7(W)	TSP-C
4	SPIM40		Cu	Ag Stripe	102.0(P)X93.0(W)	TSP-C
5	SPM32-EA		Cu	Ag Stripe	68.58(P)X62.1(W)	TSP-C
6	SPM33-CAA		Cu	Ag Stripe	68.58(P)X62.1(W)	TSP-C
7	SPM33-CAC		Cu	Ag Stripe	68.58(P)X62.1(W)	TSP-C
8	SCMF-1	S	Cu	Ag Stripe	54.40(P)X63.0(W)	TSP-C
9	SN-1		Cu	Ni Full	45.00(P)X70.0(W)	TSP-K
10	SMPD	I	Cu	Bare	33.00(P)X50.0(W)	TSP-K
11	S3D-I	S	Cu	Bare	43.00(P)X50.0(W)	TSP-K
12	S3D-IC		Cu	Bare	41.67(P)X72.0(W)	TSP-K
13	SPM26	O	Cu	Ag Stripe	47.00(P)X59.1(W)	TSP-C
14	SPM27-CA		Cu	Ag Stripe	58.00(P)X55.1(W)	TSP-C
15	SPM32-AA		Cu	Ag Stripe	68.58(P)X62.1(W)	TSP-C
16	SPM8		Cu	Ag Spot	36.00(P)X39.0(W)	TSP-C
17	TM Relay	I	Cu	Ni Full	47.50(P)x57.0(W)	TSP-K
18	APM6	O	Cu	Ni+ Ag spot	26.00(P)x48.6(W)	TSP-C
19	APM7		Cu	Ni Stripe	45.3(P)X69.0(W)	TSP-C
20	APM11		Cu	Ni Stripe	45.4(P)X58.5(W)	TSP-C

TSP IPM/APM Lead Frame

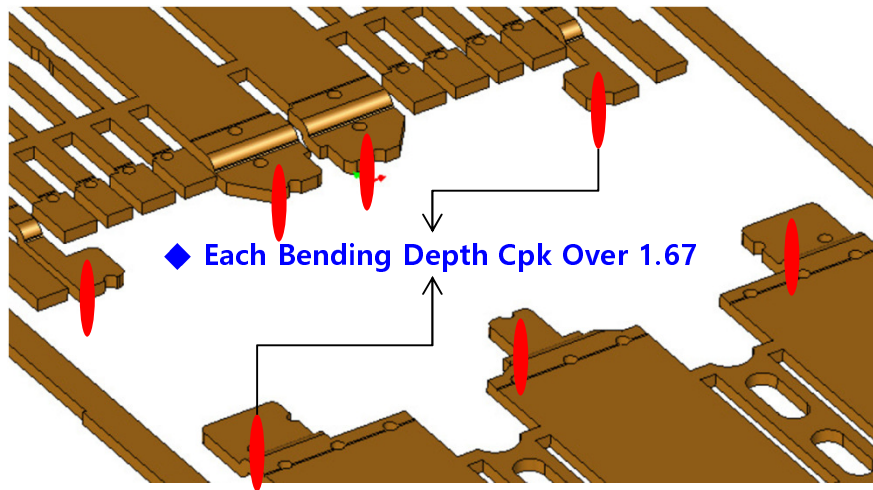
IPM/APM Lead Frame List

NO	ITEM	Customer	Material	Plating	Unit Size	Site
21	LDIP	S	Cu	-	58.0(P)X65.88(W)	TSP-C
22	APM16-CAA/CBA	O	Cu	Ni Full	45.4(P)X58.5(W)	TSP-C
23	MG02	S	Cu	-	51.0(P)X60.0(W)	TSP-T
24	TSB		Cu	-	50.0(P)X55.5(W)	TSP-C
25	SPM26-N	O	Cu	Ag Stripe	47.0(P)X54.8(W)	TSP-C
26	SIM2	E	Cu	Spot Ag	43.46(P)X55.0(W)	TSP-K
27	SCMG3-1		Cu	Full Ni+Ag Stripe	45.4(P)X63.0(W)	TSP-C
28	ASPM16-CAA	O	Cu	Full Ni	42.8(P)X51.5(W)	TSP-C
29	DN8 HPM	I	Cu	Ni Stripe	62.0(P)X90.0(W)	TSP-K
30	E-COMP		Cu	Ni Stripe	72.0(P)X80.0(W)	TSP-K
31	APM12-CAA	O	Cu	Ni Stripe	45.4(P)X58.5(W)	TSP-C
32	IPM-C-013A	G	Cu	Full Ni	62.0(P)X63.0(W)	TSP-K
33	APM32-CxA	O	Cu	Ni Stripe	52.5(P)X60.9(W)	TSP-C
34	STD EPS	I	Cu	Ni Stripe	47.0(P)X70.0(W)	TSP-C
35	APM17-MDx	O	Cu	Ni Stripe	52.0(P)X81.0(W)	TSP-C
36	APM21-CGA		Cu	Ni Stripe	50.5(P)X70.7(W)	TSP-C
37	GAC EOP Module	I	Cu	Ni Stripe	54.0(P)X70.0(W)	TSP-C
38	CIPOS TINY 36L	I	Cu	Spot Ag	35.7(P)X48.0(W)	TSP-K
39	APM32-CxC	O	Cu	Ni Stripe	52.5(P)X60.9(W)	TSP-C
40	TPAK-2LD	C	Cu	Spot Ag	31.2(P)X75.0(W)	TSP-K

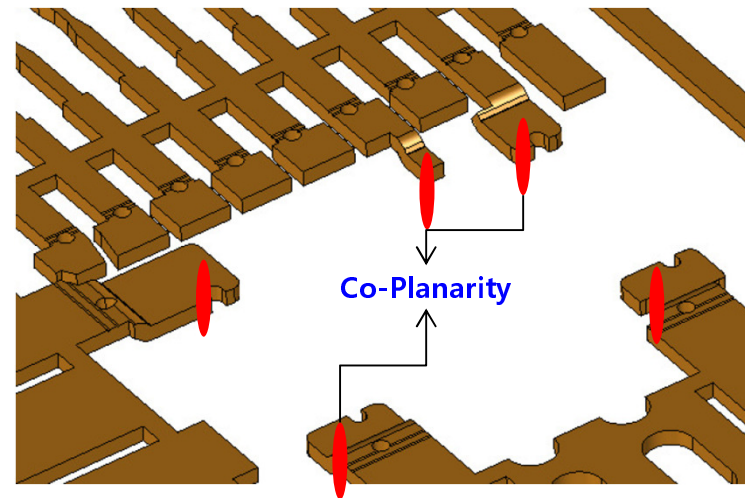


TSP IPM/APM Design Strength

- Stamping Tool Design, Processing, Assembly and Build
- Specialized Stamping Tooling Design Rule (Tool Life, Productivity, Quality)
- Automotive Item Cpk Over 1.67 (Customer Requirements Items)



◆ Co-Planarity for DBC Bonding Cpk Over 1.67



- We can meet our customers' needs for packaging reliability.
(Locking Hole, Dimple, Swaging, Groove, Etc,)

TSP Best Delivery for New Product

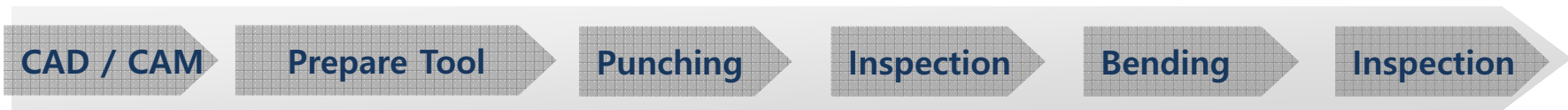
Punch Press machine

- * By using Punch Press machine.
 1. TSP can provide the Proto type lead frame sample in 7 days in case of preparing raw material.
 - Can reduce development cycle time / cost.
 2. Can reduce failure cost when build stamping tooling for mass production.
 - Remove/Improve failure mode before build stamping tooling.
 3. Can reduce lead time for making stamping tool (8weeks→6 weeks)

Classification		PROCESS	Total
Normal new stamping tooling Lead Time			56 days (8 weeks)
Improved	Using P/Press Machine		7 days (1 week)
	Build stamping Tooling		42 days (6 weeks)

Punch Press machine

Facility	Manufacture Capability				EA	Tool Maker	Note
	Working SIZE	Working Thickness	Weight Capability	Working Precision			
Punch Press	460 * 460mm	0.1~2.3t	7ton	±0.05mm (±0.10mm)	1	AMADA (Japan)	Dual Gage Separately need Negotiation
Bending Machine	200mm (length)	-	6ton		1		



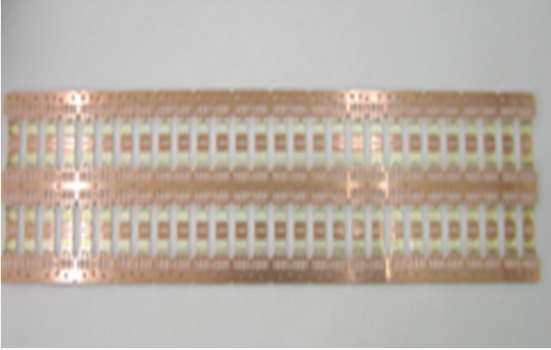
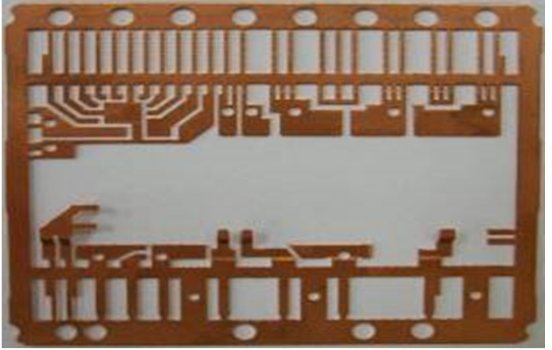
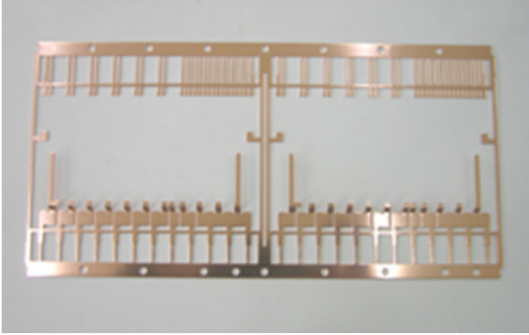
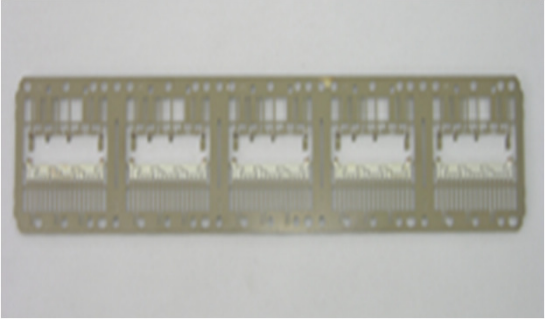
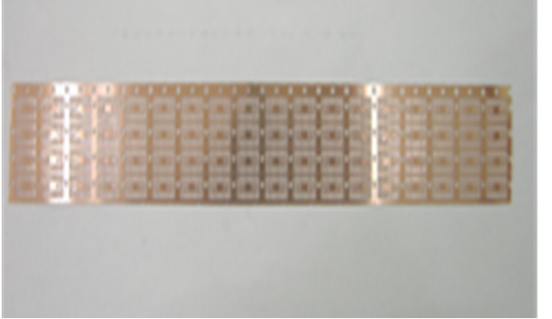

Punch Press machine



Bending machine



Punch Press Type Lead Frame Press machine

Level of Difficulty		
High LEVEL	Middle LEVEL	Low LEVEL
		
		



Lead-frame Seminar with Customer

- ◆ Implement L/Frame Technology Seminar → L/Frame Design rule, Process Flow, Plating introduction
- ◆ TSP – Customer engineering Co-work for leadframe Design-in for NPI phase

No	Customer	Date (YR)	Customer Attendee	Remarks
1	ON-SEMI (Korea)	2022	Purchasing, Engineering, Production, Quality	
2	SANKEN (Korea)	2022	Purchasing, Engineering, Production, Quality	
3	IAPT (Korea)	2023	Development, Engineering, Production	
4	ASE-K	2023	Development, Engineering, Production	
5	INFINEON (Korea)	2023	Development, Engineering, Production, Quality Oversea site etc	
6	AMKOR (Korea)	2023	R&D, Engineering	
7	ON-SEMI (Korea)	2023	Purchasing, Engineering, Production, Quality	



Lead Frame & Plating

Stamping press

Pre Plating, Spot Plating

Tool

Stamping die Tool

Mold die Tool

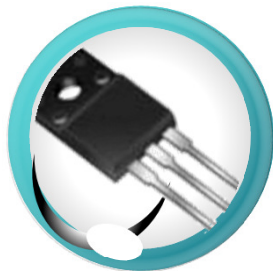
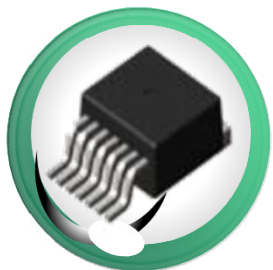
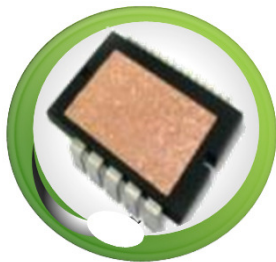
Trimming & Forming die Tool

Carrier tape

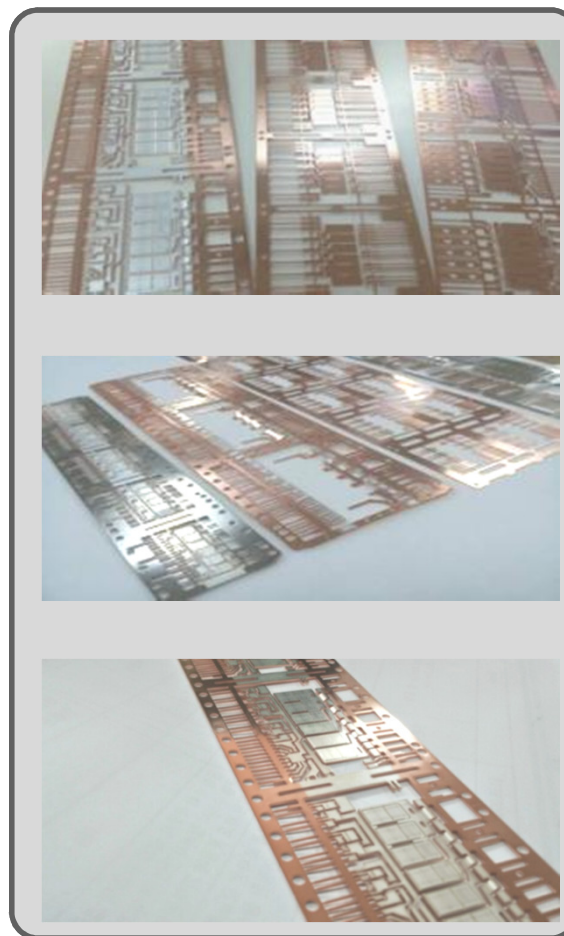
Press type / Drum type (PS)

Direct Press Type (PC)

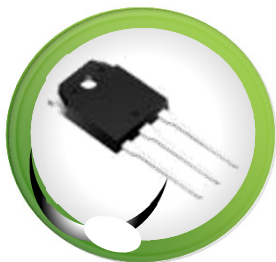
MODULE PACKAGE

**Module**

- ITEM : SCMF-1, SPIM 40, APM, IPM, SPM
- Material : Copper
- Plating : Bare, Ni, Ni + Ag

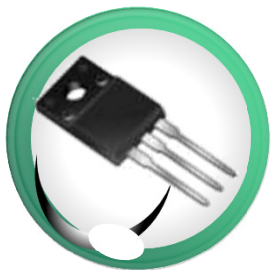


POWER PACKAGE



Automotive Type

- ITEM : TO-220/263-3L, TO-247-3L
- Material : Copper
- Plating : Bare, Ni, Ni + Ag



Commercial Type

Conventional

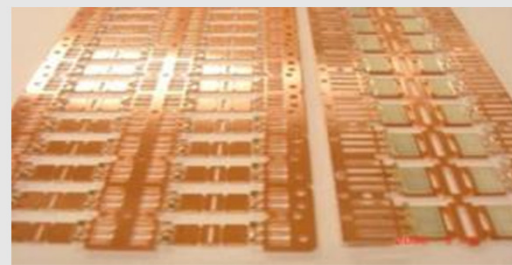
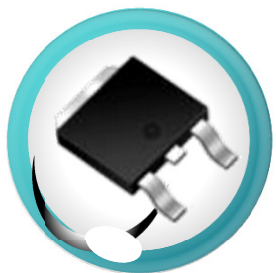
- Item : TO-220-2/3L, TO-263-3L
TO-3P, TO-247, TO-3PF
- Material : Copper
- Plating : Bare, Ni, Ni + Ag

Matrix

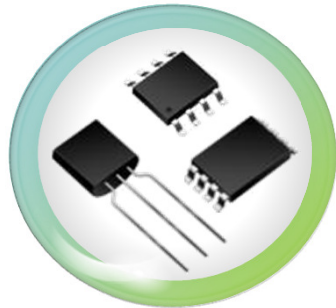
- Item : D-Pak matrix, TO-252 (D/I-PAK)
- Material : Copper
- Plating : Bare, Ni

IDF

- Item : TO-220
- Material : Copper
- Plating : Bare, Ni



SMALL PACKAGE

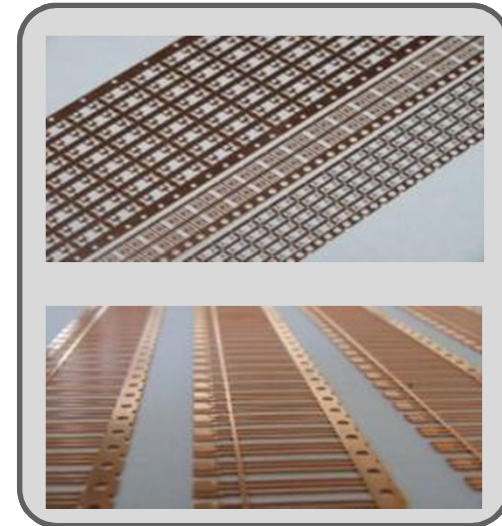


SMD

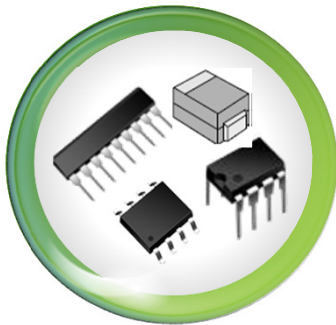
- ITEM : TO-236, TO-243, SC89 / SOD523, SC70/SOD323, SOT490
- Material : Alloy42, Copper
- Plating : Cu, Ag, Cu + Ag, Spot Ag

Through Hole

- ITEM : TO-92 Strip, Reel
- Material : Copper
- Plating : Bare, Ag



IC/TANTAL PACKAGE

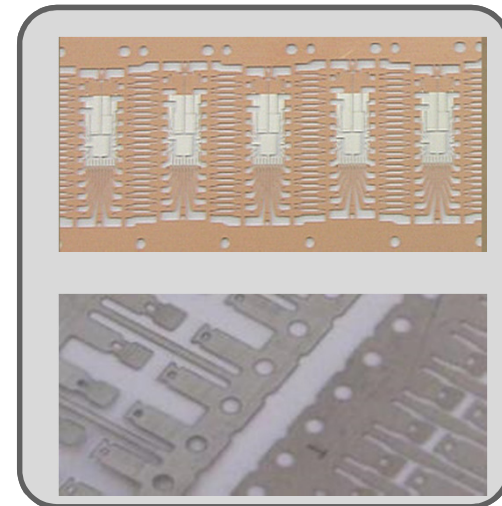


Integrated Circuit

- ITEM : SOP8, SOP-14,16
- Material : Copper
- Plating : Ag (Spot)

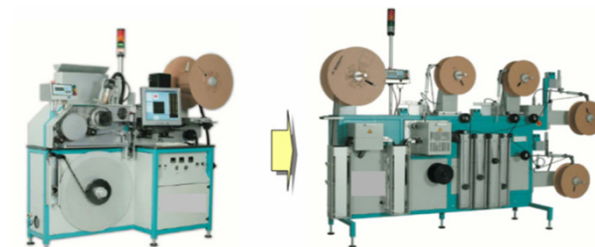
Tantal

- ITEM : Tantal A, B, C, D, P, PS, J type
- Material : Alloy42
- Plating : Sn, Ag



Carrier tape Machine

Drum type	Press type	In-Line Type
5 Set	2 Set	1 Set



Carrier tape

Material	Item Name
PC	TFSC(0806), USC(1712)
PS	TO-236, TO-243, TO-261, SOP8
	D-PAK, SOP14/16
	SZ-10, D2-PAK, MR-SAD



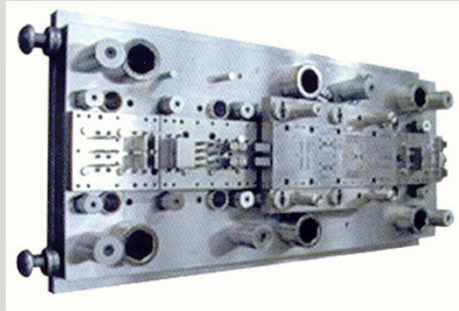
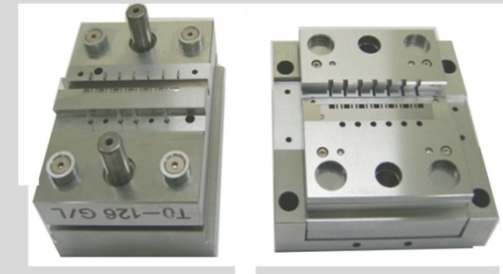
TOTAL CAPACITY

4,500 Roll

Stamping Dies



Power-Transistor Type

Module Type
(Power & Battery Pack)

Trim & Forming

Features

- All Stamping type of dies available
- Material : SLD/ S45C / CD650
- High Precision & quality
- PKG: Power Module PKG, Battery Pack Module PKG, Power-Transistor PKG, SMD, IC Type . (Package Type)

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