



# Package Solutions and Innovations with Compression Molding

IEEE SVC – CPMT  
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Presented by C.H. Ang – Towa USA



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# Company Profile

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## TOWA Corporate Overview

**MOLDING PIONEER**  
TOWA's molding technologies, Incorporated in your daily life

- Company: Towa Corp., Kyoto Japan
- Established: 1979
- Employees: >1000
- Average Sales (2000-15): US\$160M/year

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## TOWA Core Business

### Molding

~ Encapsulation Technology ~


Compression  
Mold

Transfer  
Mold

### Singulation

~ Cutting technology ~

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# Molding Technology Overview

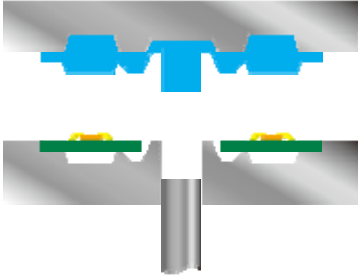
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 **Transfer molding with multi-plunger**

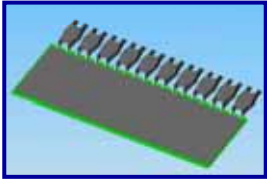
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"Y" System Series









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**TOWA** **TOWA Transfer Molding**

**“Multi Plunger Mold” Technology – game changer became “De Facto Standard”**

Conventional Mold      1982      Multi Plunger Mold

- Improve Resin Utilization
- Shorten Cycle Time
- Uniform molding quality
- Easier Mold Operation

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**TOWA** **Compression Molding**

**Since 2002**

FFT, PMC System Series

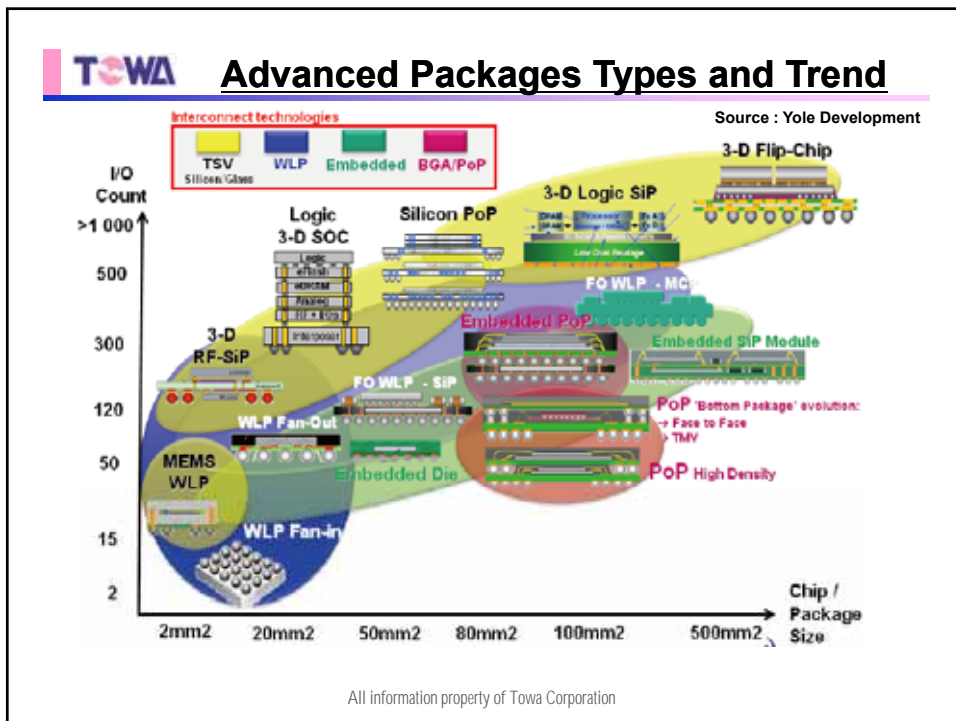
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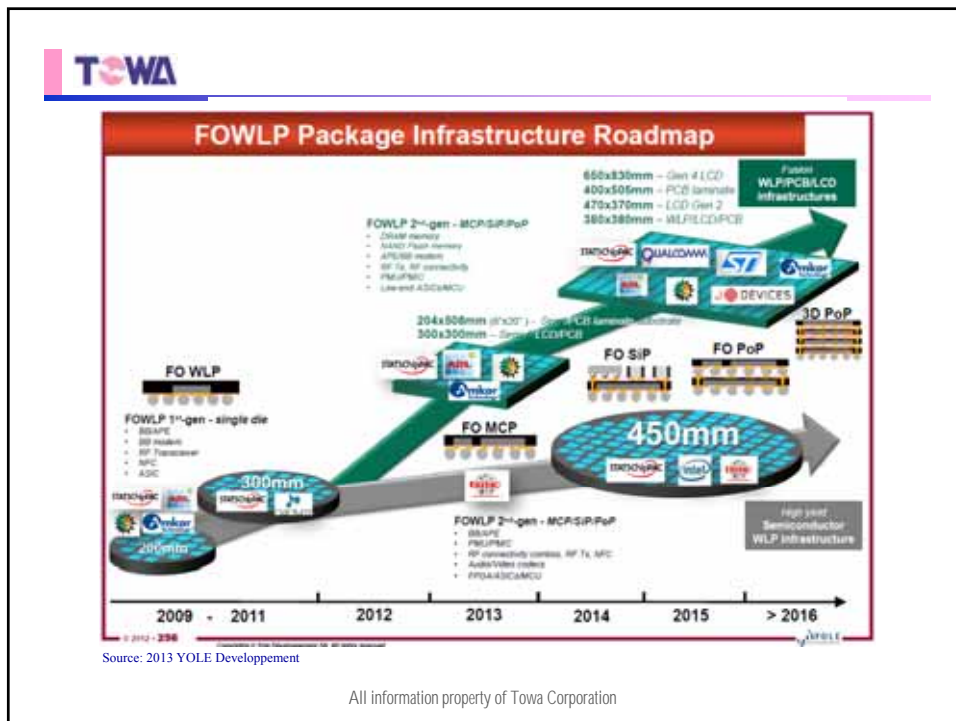
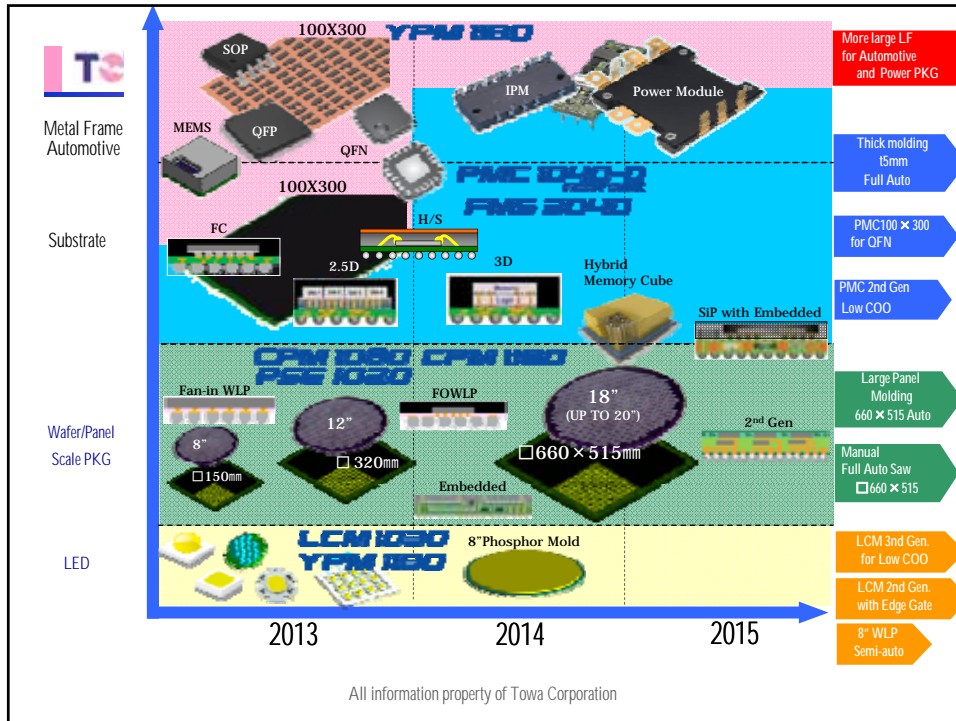



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## Package Trends

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## **Compression Molding Solutions, Innovations and Savings**

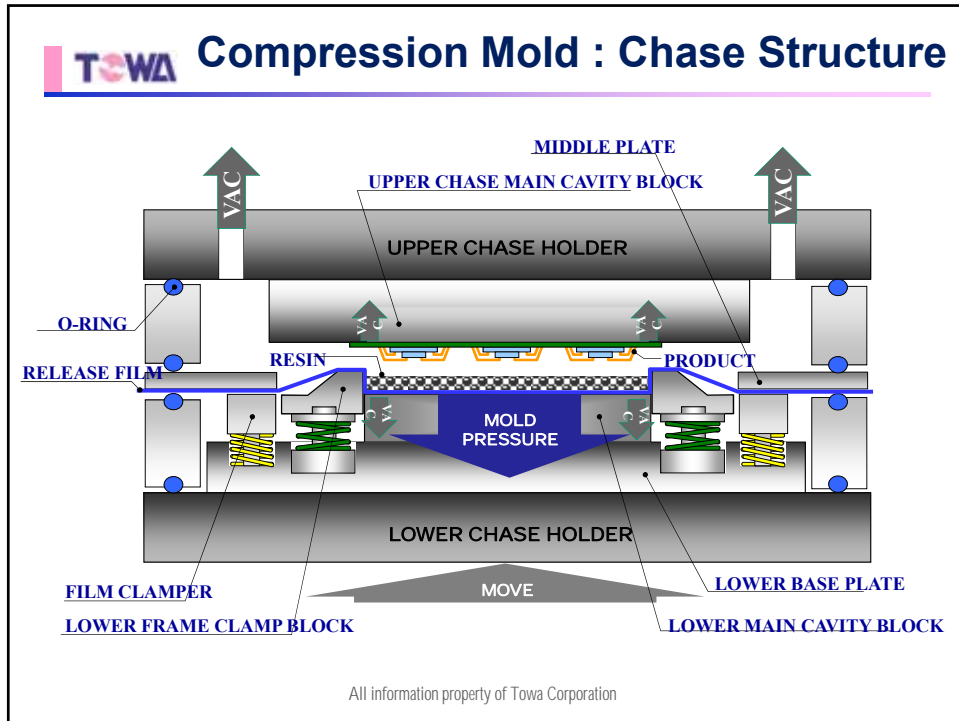
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## **TOWA Why Compression Mold Technology**

### **◆ Advantages:**

- **Scales up to wafer and large panel sizes**
- **Thinner and Smaller Packages**
  - **Tight Tolerance requirement (+/- 7 um)**
- **Minimize mold compound cost, wastage and storage**
- **Enable finer and longer wires**
- **Minimum Packing Pressure**
- **Minimal process disruption and tool changes**

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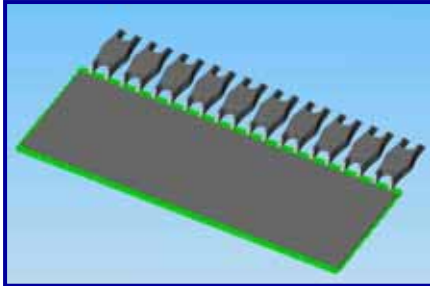
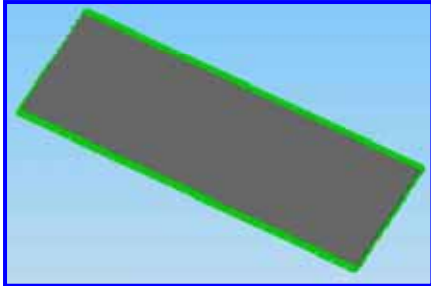


**TOWA Compression Molding Comparison**

	Compression Mold	Transfer Mold
Compound usage	+ 100%	○ Around 70%
Moisture Sensitivity Level	+ Better due to even filler distribution	○ Filler distribution uneven
Stress to Die & Wire	+ Negligible Stress	○ Stress from resin flow
Mold ability (Thin mold cap and large substrate w/o void)	+ Very good Scalability	○ Limited
Flexible Package Thickness	+ Mold recipe change	○ Tool change required
Production ratio	+ 95% without Cleaning	○ 80% inc. Cleaning



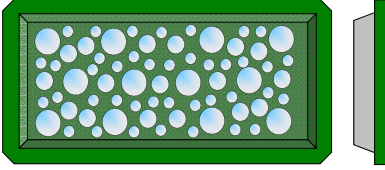
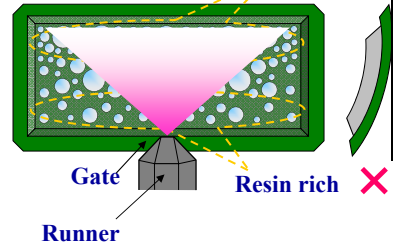
**TOWA Compound usage**

Transfer Molding	Compression Molding
	
Approx. 40~60% resin usage	100% resin usage

**Improved resin utilization and reduction of waste material and disposal cost**

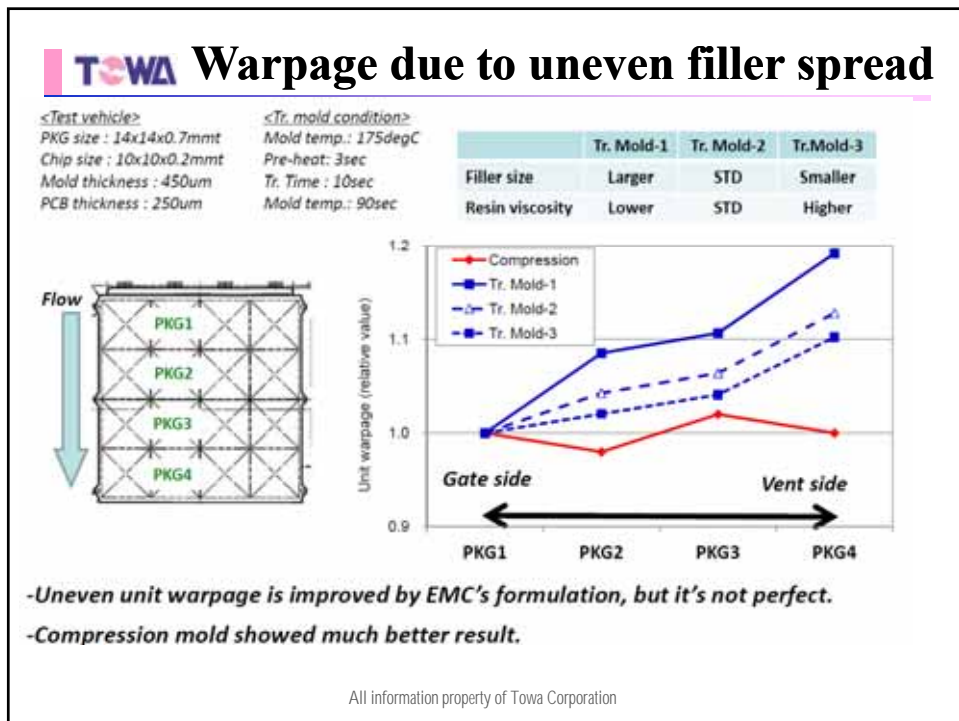
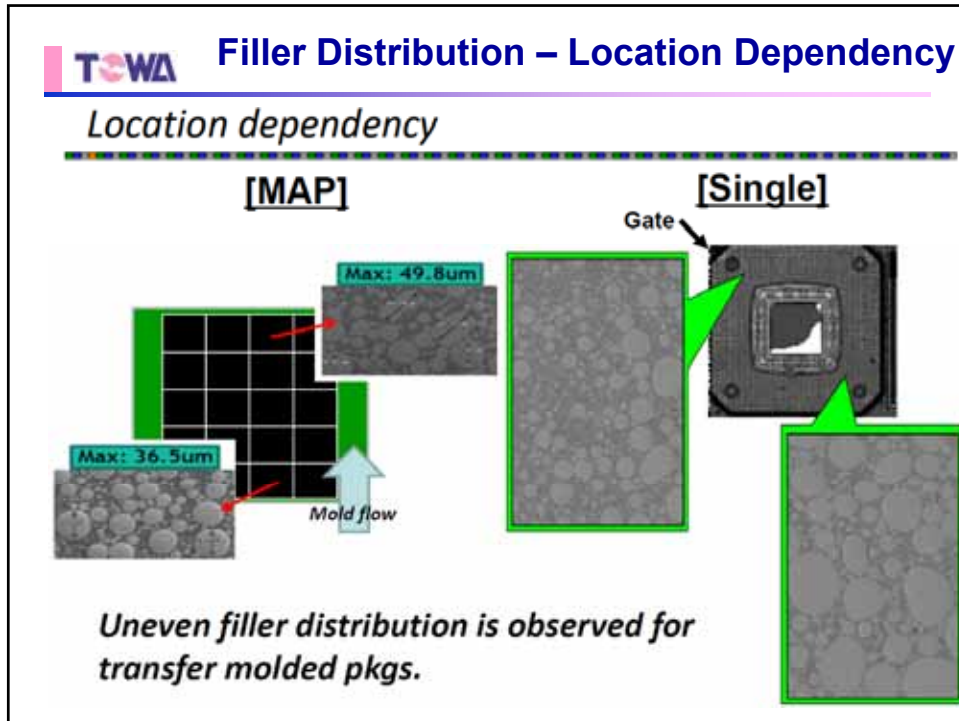
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**TOWA Filler Distribution**

Compression Mold	Transfer Mold
	
Even Filler distribution ○	Filler rich Resin rich ✗

**Effects of uneven filler distribution – Warpage and MSL**

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**TOWA Warpage Effect on MSL**

PKG : MAP-QFN48L (8x8x0.85mmt)      EME : Experimental grade  
 L/F : Cu/Ag spot      D/A : CRM-1076WA  
 Die : SiN (4x4x0.2mmt)      Wire : None  
 Pad : 6mmsq  
 L1.5 : 85degC/85%RH/72hrs/IR260x3      Level 2 : 85degC/60%RH/168hrs/IR260x3

Mold type	MSL	Gate	Vent
<b>Transfer</b> Pre-heat: 0sec Tr. time: 10sec Tr. pressure: 70kgf/cm2 Cure time: 120sec Mold temp.: 175degC	L1.5		
	L2		
<b>Compression</b> Pre-heat: 8sec Comp. time: 9sec Comp. pressure(#): 70kgf/cm2 Cure time: 120sec Mold temp.: 175degC	L1.5		
	L2		

(#): Comp. pressure=Clamp pressure – Substrate clamp pressure – Vacume pressure

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**TOWA Stress to Die & Wire**

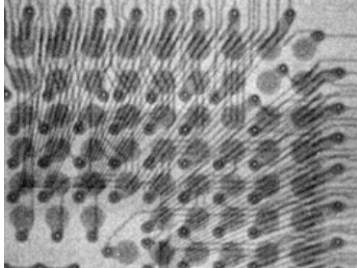
**Compression Mold** ○

**Transfer Mold** ✗

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**TOWA Stress to Die & Wire**

● Mold evaluation example of fine & long Wire



**[MOLDING CONDITION]**  
Wire :  $\phi 15\mu\text{m}$   
Wire length 5mm

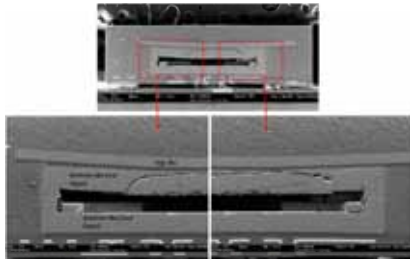
● Cost down proposal of finer gold wire

$\phi 25\mu\text{m} \Rightarrow \phi 15\mu\text{m}$	Approx. 64% reduction
$\phi 22\mu\text{m} \Rightarrow \phi 15\mu\text{m}$	Approx. 54% reduction

※Cross-section ratio

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**TOWA Molding Pressure Effects**



**Transfer Molding Minimum Packing Pressure**  
- 75 kg/cm<sup>2</sup>

**Compression mold minimum pressure**  
-10 kgf/cm<sup>2</sup>

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**TOWA Moldability – Scalable and Thin Cap**

**Transfer molding**

**Longer flow distance**

**Compression molding**

**Compound flow-free**

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**TOWA**

**High quality Molding: Achieved PKG thickness accuracy  $\pm 10 \mu\text{m}$**

**Liquid Resin**

Product defects

**Granular Compound**

No defect

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### TOWA Very Large Panel/Wafer Molding

PCB : 600mm x 913mm  
HCLD : 640mm x 495mm

PCB : 210mm x 210mm  
HCLD : 300mm x 300mm

12 inch wafer

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### TOWA Moldability (Module device)

Compression Mold ○

Transfer Mold ✗

Air trap

Memory

Gate Runner

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### TOWA Void Free Molding

**Transfer molding**

**Compression molding**

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### TOWA Package Thickness reduction

**Transfer molding**

Big Mold gap necessary for compounds flow

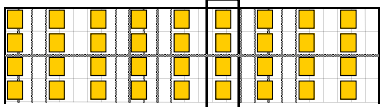
**Compression molding (Filler size coverage)**

Minimum Mold Gap 0.1mm over Die

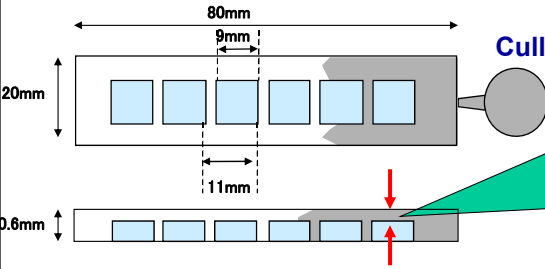
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## TOWA Mold Flow Effects of Transfer Molding


**Model Mold Die for MAP BGA**



Model Mold Die for MAP



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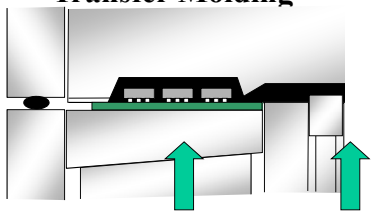


Test Results (Weld Void)

	Grade	7730L / 75 $\mu$ m	G760 / 55 $\mu$ m
GAP			
	220 $\mu$ m	0/6	0/6
	200 $\mu$ m	1/6	0/6
	180 $\mu$ m	2/6	0/6
	160 $\mu$ m	6/6	1/6

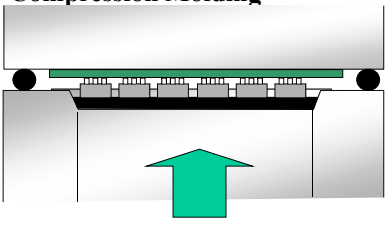
## TOWA Simple Tooling Design

### Transfer Molding

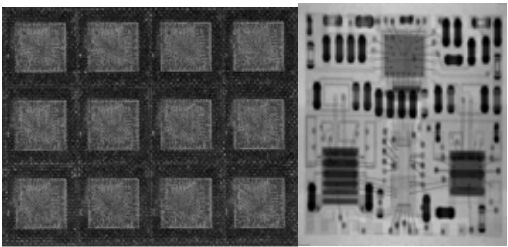


- Substrate thickness compensation,
- Two-step clamping

### Compression Molding



Not require for substrate thickness compensation



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**TOWA** **Mold Tool Flexibility**

**PKG thickness range of 0.3mm within the same Mold**

PKG thickness 0.4-0.7mm

Upper main cavity

Lower Outside cavity

Lower main cavity

Spring

PKG thickness 0.8-1.1mm

Upper main cavity

Lower Outside cavity

Lower main cavity

Spring

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**TOWA** **Reduction of CMP, back grinding process**

**By reducing CMP, Back grinding process,  
Reduction of one process and equipment cost**

**CMP, Back grinding process is required**

**CMP/Back grind not required to achieve thin package**

Minimum Mold Gap over Die

**Transfer molding**

**Compression molding**

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## Summary

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- TOWA's Compression Molding technology with fine molding offers
  - innovative solutions to advanced package demands
  - application versatility (IC package, LED, Solar)
  - scales up to large panel
  - cost effective



**“ONE MORE THING”**

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# TOWA USA LAB

Morgan Hill, CA

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### FFT 1030 – Manual Compression Molding



**Strip size: 100x300mm**

**Mold Cavity : 65 x 260 x 0.3 ~1.2 mm**

**Pieces per shot: 1 strip / press**

**Clamp capacity: ~ 294 kN ( ~ 30 tonf)**

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### CPM1080 Manual Wafer or Panel Molding



**Large Panel Molding:**

**Panel size: 320 x 320 mm**

**Mold cap: 300 x 300 x 0.3 ~ 1.2 mm**

**Wafer Level Molding:**

**Wafer size: 12" (Diameter 300mm)**

**Mold cap: Ø 290 x 0.3~1.2 mm**

**Pieces per shot: 1 panel or wafer**

**Clamp capacity: 98 ~ 784 kN (10 ~ 80 tonf)**

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**Thank you for your time and attention!**

- **Call us for your package solutions:**

**Websites:** <http://towa-usa.com/>  
[www.towajapan.co.jp](http://www.towajapan.co.jp)

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