New Generation Power Packaging Technology

IC Embedded Substrate Solution for Advanced Package/SiP

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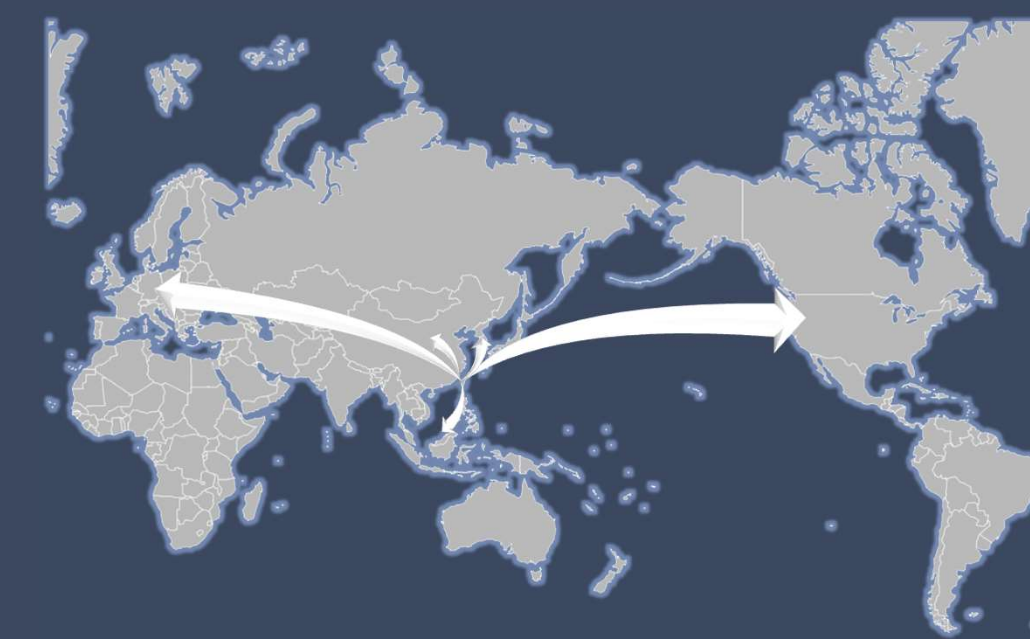

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Interconnect Evolution

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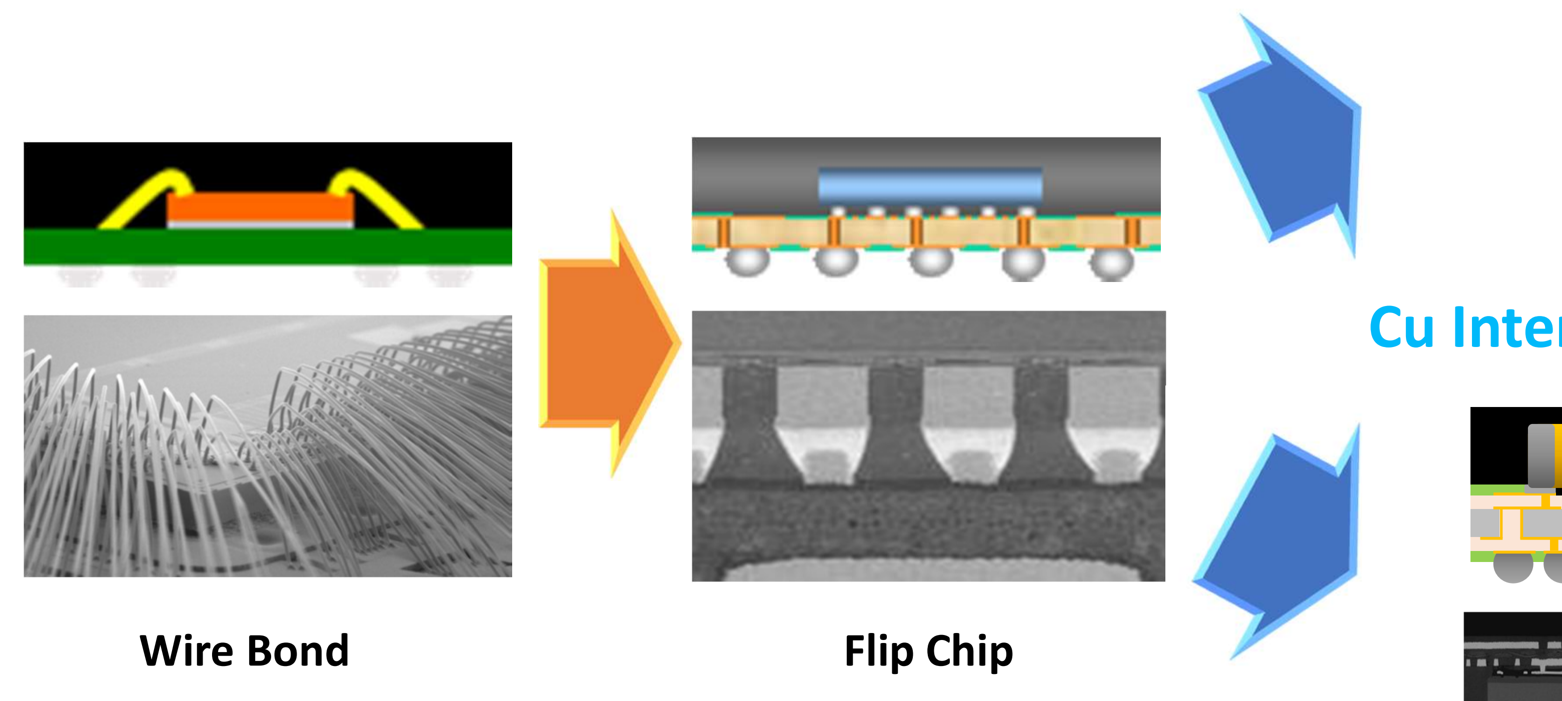
Interconnect Evolution



Wafer Level CSP &
Wafer Level Fan out

Cu Interconnection

Embedding Chip

- **Embedding chip into substrate, and electrical contacts to the embedded chips by drilled & metalized vias.**
- **By mounting passives and packages on such substrate to form a SiP Module.**

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Benefits of Embedded Solution

Miniaturization & Design Flexibility

- Embedded chip enables more space for other components or shrinks overall solution
- Design flexibility now shifts from 2D to 3D

Improved Thermal & Electrical Thermal Performance

- Shorter interconnections reduce parasitics - minimizes distortion and power loss
- Lower electrical & thermal resistivity in package improves power performance

Improved Reliability and Mechanical Stability

- High mechanical system stability due to stable Cu interconnections.

Main Drivers of Embedded SiP Module

Miniaturization

Enhanced Performance

High Integration

ASE Embedded Solutions & Applications

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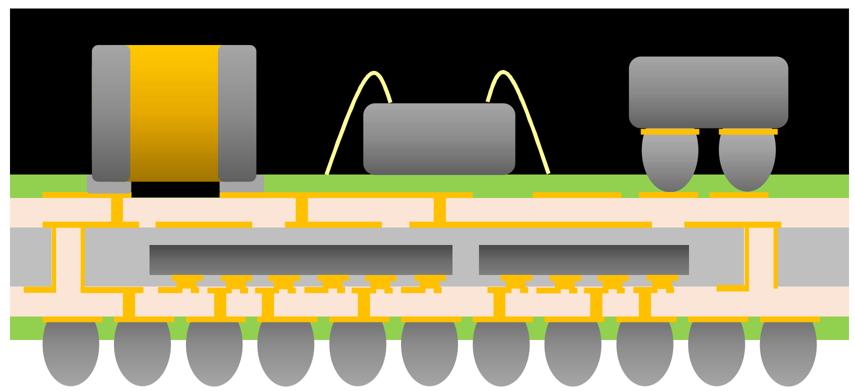
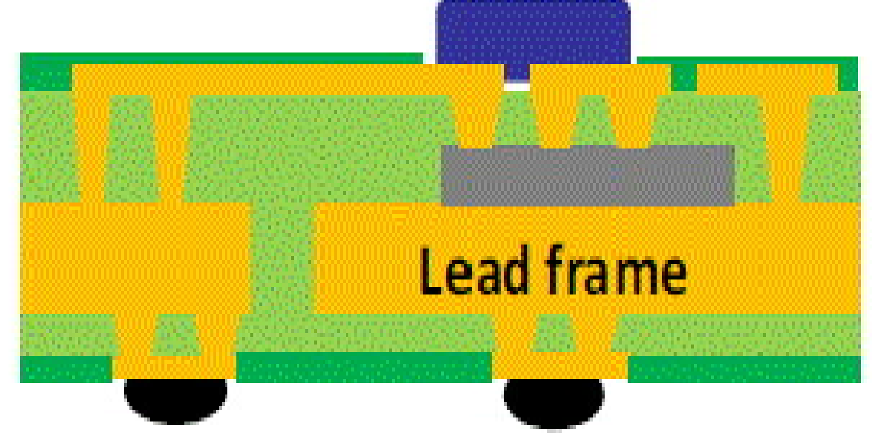


SESUB

Semiconductor **E**mbedded in **Sub**strate

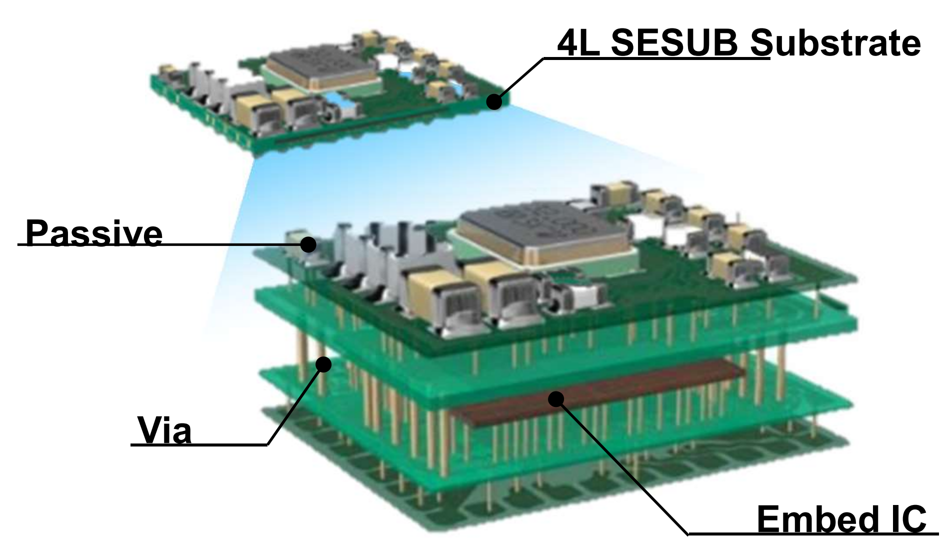


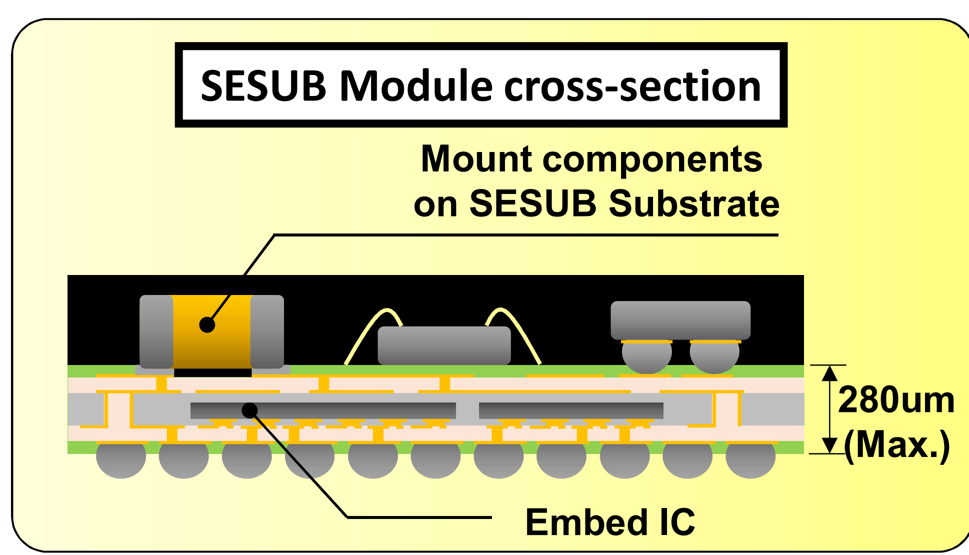
a-EASI

Advanced **E**mbedded **A**ctive **S**ystem **I**ntegration

What's *SESUB* ?

SESUB = Semiconductor Embedded in SUBstrate





- SESUB technology had been proven a mature technology
- Transferred SESUB technology from TDK and production in a panel form of 512x408 mm^2 (2X) with cost benefit
- IC wafer grinded to 50um (min.) and embedding in resin substrate
- Thickness normally 4L 250um (Max. 280um)
- Multiple dies (Max. 4 to date) could be embedded

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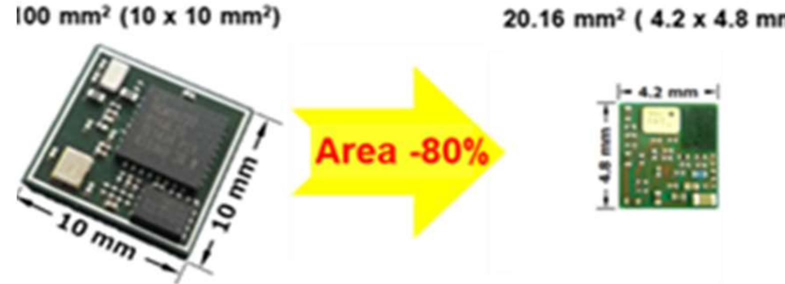
Embedded SESUB SiP Module Benefits

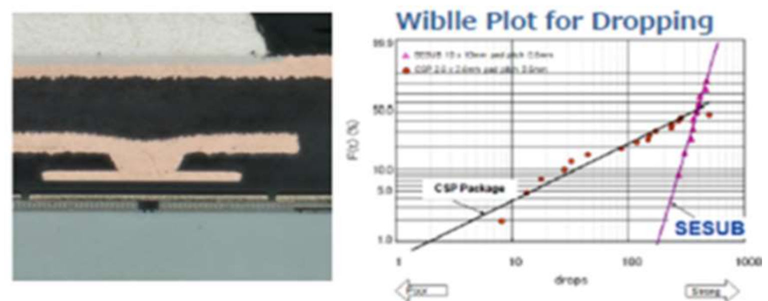
PCB Miniaturization

- Average Package Body Size Shrink of >40%
- Top and Bottom surfaces of substrate free for other components (Maximizing Component Surface Area)



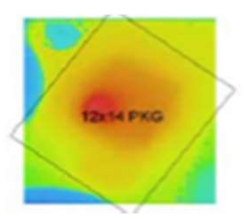
Mechanical Robustness

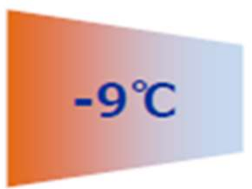
- Highly Reliable Copper Interconnections (No Solder)
- Weibull Plots Show > than 200 Drop to 1st Fail

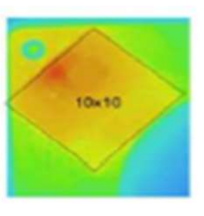


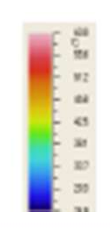
Improved Heat Dissipation

- Reduction of Insulate Materials to PCB
- Allows Top Side Surface for Heat Distribution
- 7-15% usually seen for standard designs



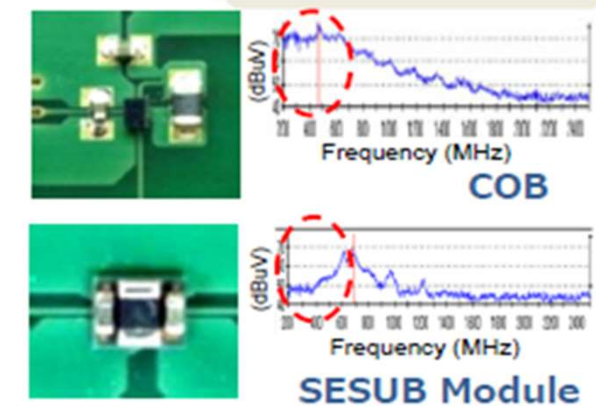






Improved Electrical Performance

- Short Cu Connections Improve Parasitic and Distortions



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SESUB Existing Major Applications

Data Center

- Power Convertor
- Optical
- Memory
- Controller

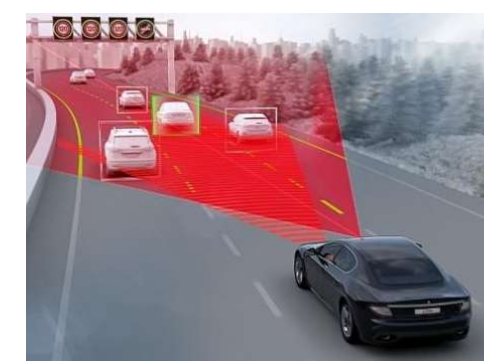
SESUB

Smart Phone

Power Management -
Wireless Charge -
WIFI/BT -
AR/VR/MR -
Audio -
5G -
AI -

Automotive

- Image Sensor
- Radar
- Infotainment



Sensor & Optical

HRM -
PD -
Controller -

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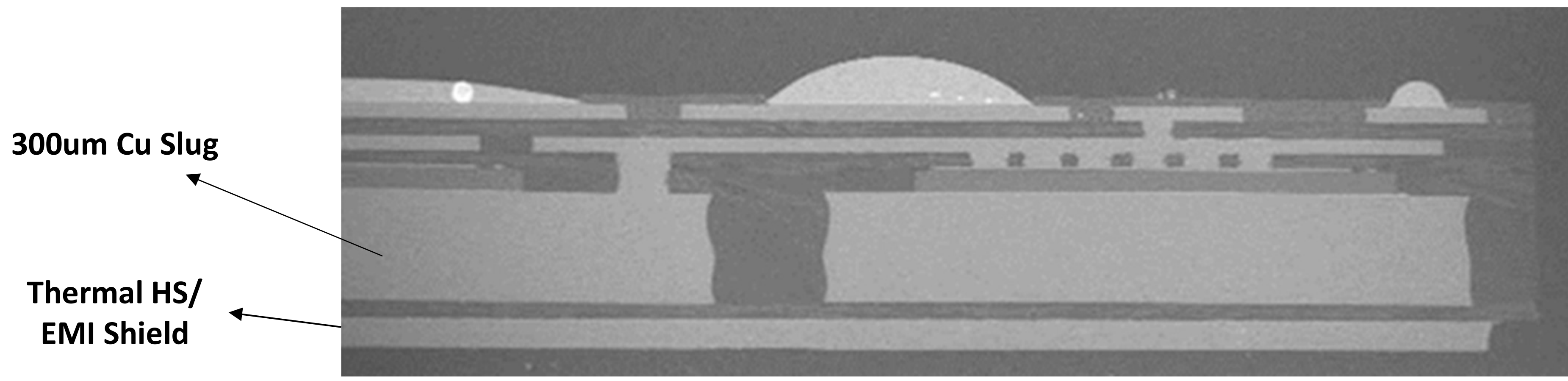
What’s *a-EASI*?

aEASI = Advanced Embedded Active System Integration



- Utilizes Mature Organic Substrate Process Modified to Meet High Power Applications
- Hybrid Power Package Combining Lead frame & Substrate Technologies
- Good Current Capability- ~60A (Integrated Power Stage Example), ~ 1.9W/mm^2
- 300um thick Copper Heat Spreader/Electrical Pad (Back of Die)
- Deep Full Filled Vias to Die ~ 130um Diam
- Ultra Low Resistivity Die Attach Interface

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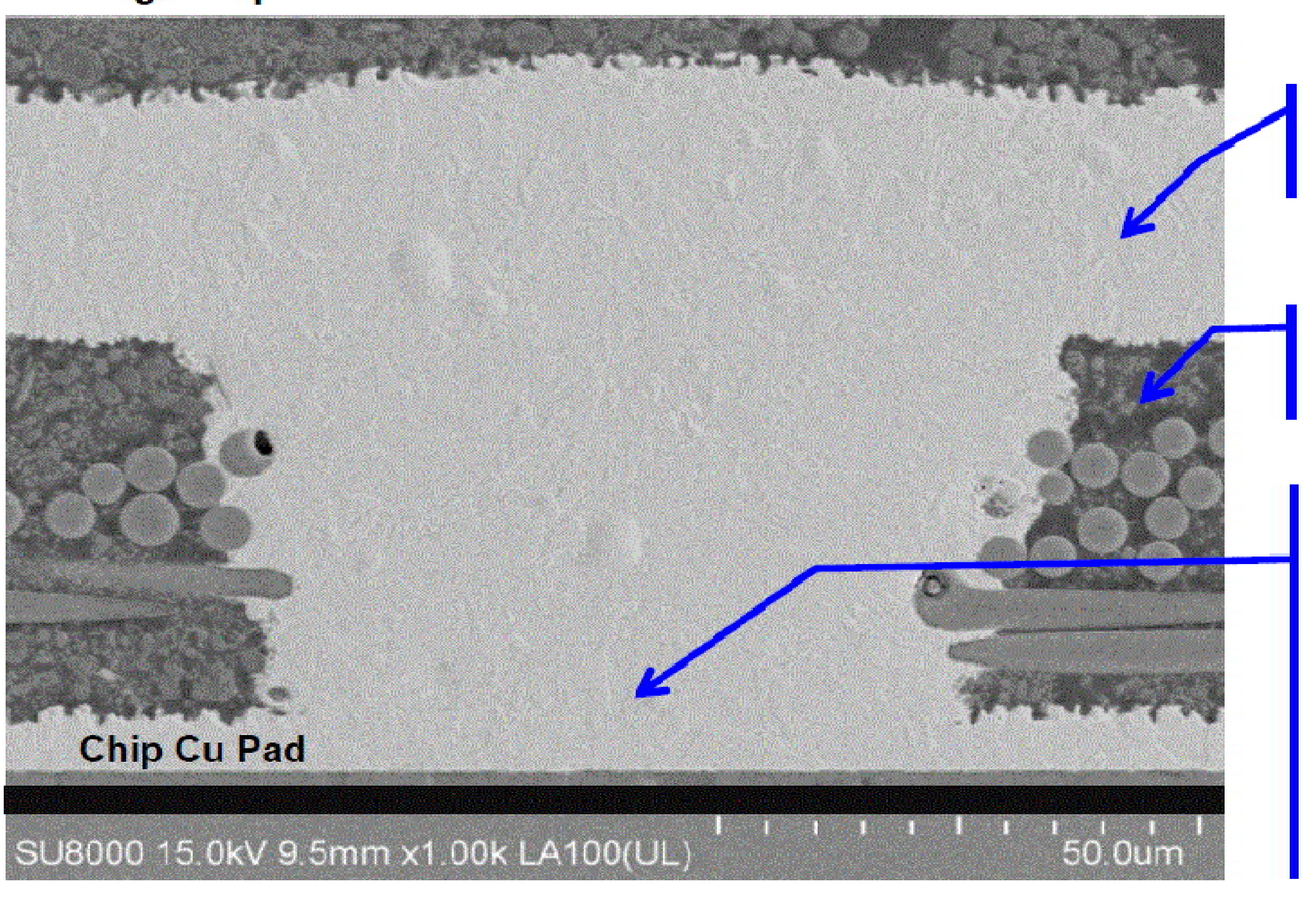
a-EASI Cu Interconnect Highlights



- Thick Cu RDL (32 um). Minimize turn on resistance.
- Prepreg material provide >2.5KV breakdown voltage
- 50um via diameter (Equal to 4 x 1 mil wire bond in conductor area)
- Cu to Cu interface. Minimize reliability risk in high current density condition

ASE Embedded Solution Comparison

Solution	SESUB	a-EASI
Structure		
Base	Organic core & Pre-preg	Lead frame
Pinout	BGA/LGA	BGA/LGA/QFN
Package size	**200+ (mm^2)**	<50(mm^2)
Thermal	Good	**Excellent**
IOs	**Up to 1000**	Up to 100
Power	<20+ (W)	**1000+(W)**
Application	PMIC, Audio, Sensor, Optical, Connectivity, MCU, FEM, Memory, Image module, etc.	MOSFET, Regulator, DCDC, IGBT, power modules, etc.

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Miniaturization

Enhanced Performance

High Integration

- **Future Trend & Demand**

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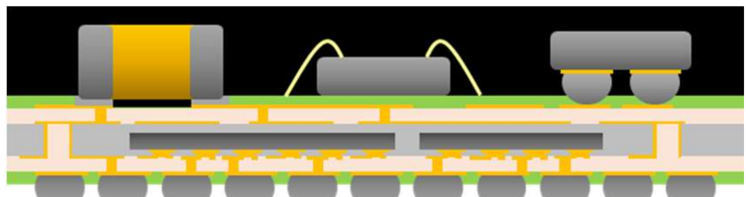

SESUB

IPO
RF Transceiver
SAW
SAW
SAW
IPO
IPO
Baseband Module
PA
PA
DCDC
MOSFET
LED driver
Camera Module
LED Flash
IPO
IPO
Power Management
IC
APE
Stacked Memories
DCDC
Audio Module
Audio amplify
MEMS
DCDC
DCDC
Bluetooth/ FM/GPS Module
LCD display driver
IPO
DCDC
WLAN Module

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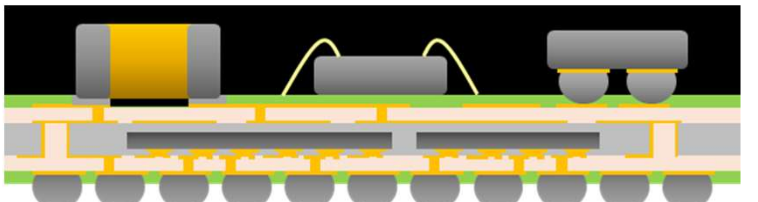

SESUB

CPU/GPU Module
Cellular Radio Module
MEMS
MEMS
MEMS
MEMS
LED Flash
Camera Module
Bluetooth FM/GPS Module
IPD network
WLAN
Baseband Module
Audio
Audio amplify
Digital TV Module
Power M
Display interface

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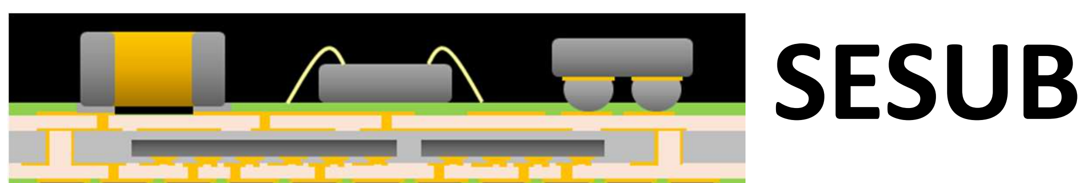

SESUB

Cellular Radio Module

CPU/GPU Module

LED Flash

MEMS

MEMS

MEMS

MEMS

Bluetooth FM/GPS Module

Camera Module

IPD network

WLAN

Baseband Module

Audio

Audio amplify

Digital TV Module

Power M

Display interface

5G

AI

AR/VR/MR

OTHER NEW FUNCTION

- **Board assembly simplification** and **X-Y dimension reduction** could be enabled by embedded die architecture.

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Targeted Application Domain

Ball Pin Count

1000
500
150
100
50
30
10

PMIC
Wi-Fi
Camera Module
NFC
Charger
DC-DC
RF Module
LCD Power Supply
Sensor

5 10 20 30 40 50 100 120

Substrate Size (mm^2)

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Summary

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Design

Embedded Substrate

Simulation

Embedded Package / SiP

Test

Bumping

Assembly / SMT

Offer All Manufacturing Service to Customer

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Thank You

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