

High Performance Metal Chip Power Inductor for IVR

28.Sept.2023
TAIYO YUDEN Co., LTD.

Agenda

Introduction

Trend for Processor (CPU/GPU/AI) Package

Inductor proposal for Processor Package

~LSCN series metal type multi layer power inductor~

Summary

Corporate Overview

Corporate Name	TAIYO YUDEN CO., LTD.
Head Office	Kyobashi East Bldg., 2-7-19, Kyobashi, Chuo-ku, Tokyo 104-0031, Japan
Date of Establishment	March 23, 1950
Representative Director, President and CEO	Katsuya Sase
Capital	¥33,575 million (as of March 31, 2023)
Net Sales	¥319,504million (Fiscal year ended March 2023/on consolidated basis)
Number of Employees	21,819 (as of March 31, 2023/on consolidated basis)
Main Business	Development, production and sales of electronic components
Main Products	Multilayer ceramic capacitors Inductors FBAR/SAW devices for mobile communications Circuit modules Aluminum electrolytic capacitors Power Storage Device

Products of TAIYO YUDEN

Ceramic Capacitors



Small & High Value



Medium-high Voltage Type



For High-Frequency Applications



Super Low Distortion Type



Low ESL



Low-profile Type

Inductors



Multilayer Inductors



Wire-wound Inductors



SMD



Noise Suppression Components

FBAR / SAW Devices



Devices for Mobile Communications

Power Storage Devices (Capacitors)



Electric Double-Layer Capacitors

Products for High Reliability Usage



Multilayer Ceramic Capacitors



Inductors



Noise Suppression Components

Multilayer Ceramic Devices / Chip Antennas



Multilayer Ceramic Devices



Chip Antennas

Aluminum Electrolytic Capacitors for High Reliability Usage



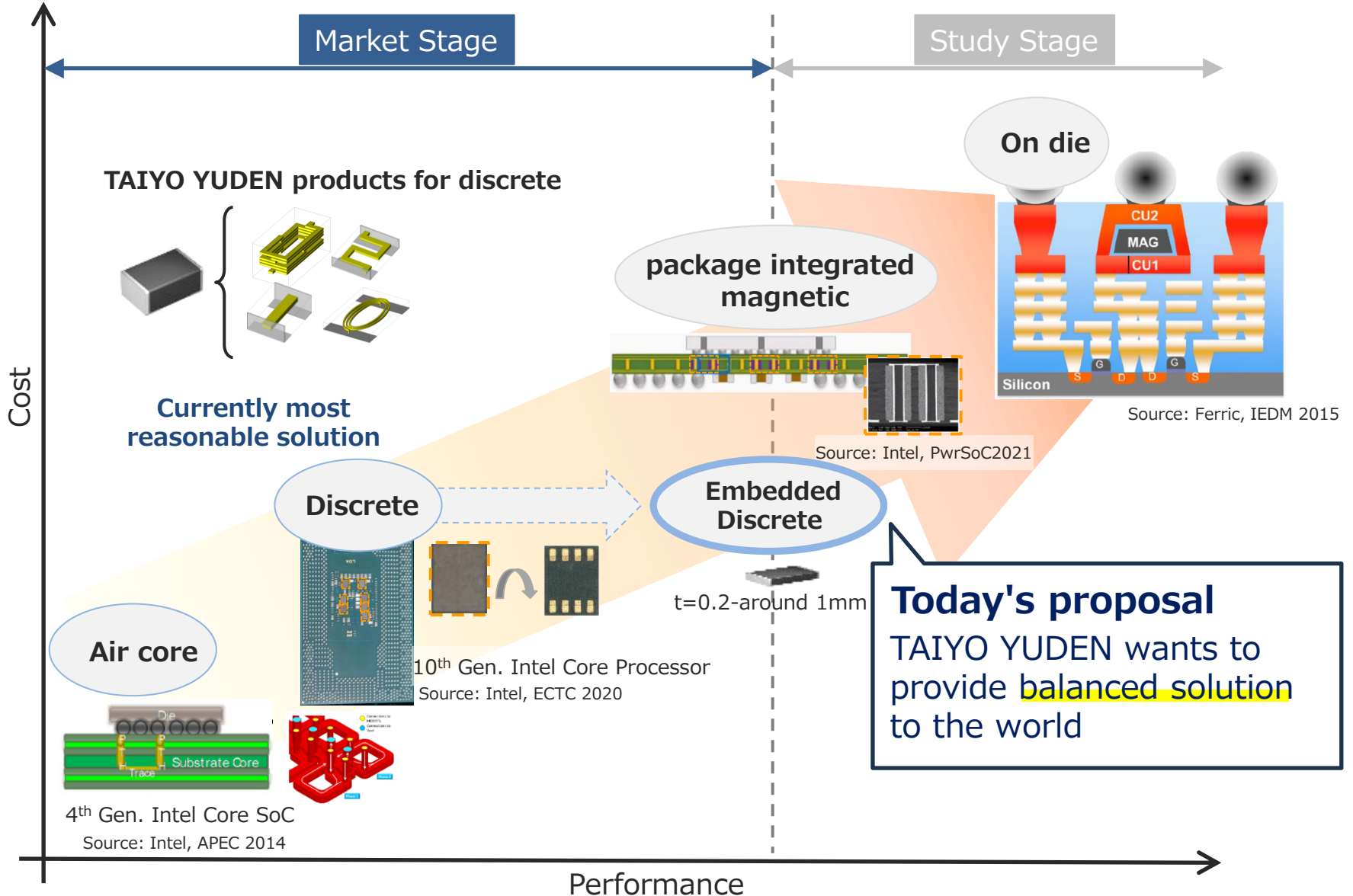
Aluminum Electrolytic Capacitors



Conductive Polymer Hybrid Aluminum Electrolytic Capacitors

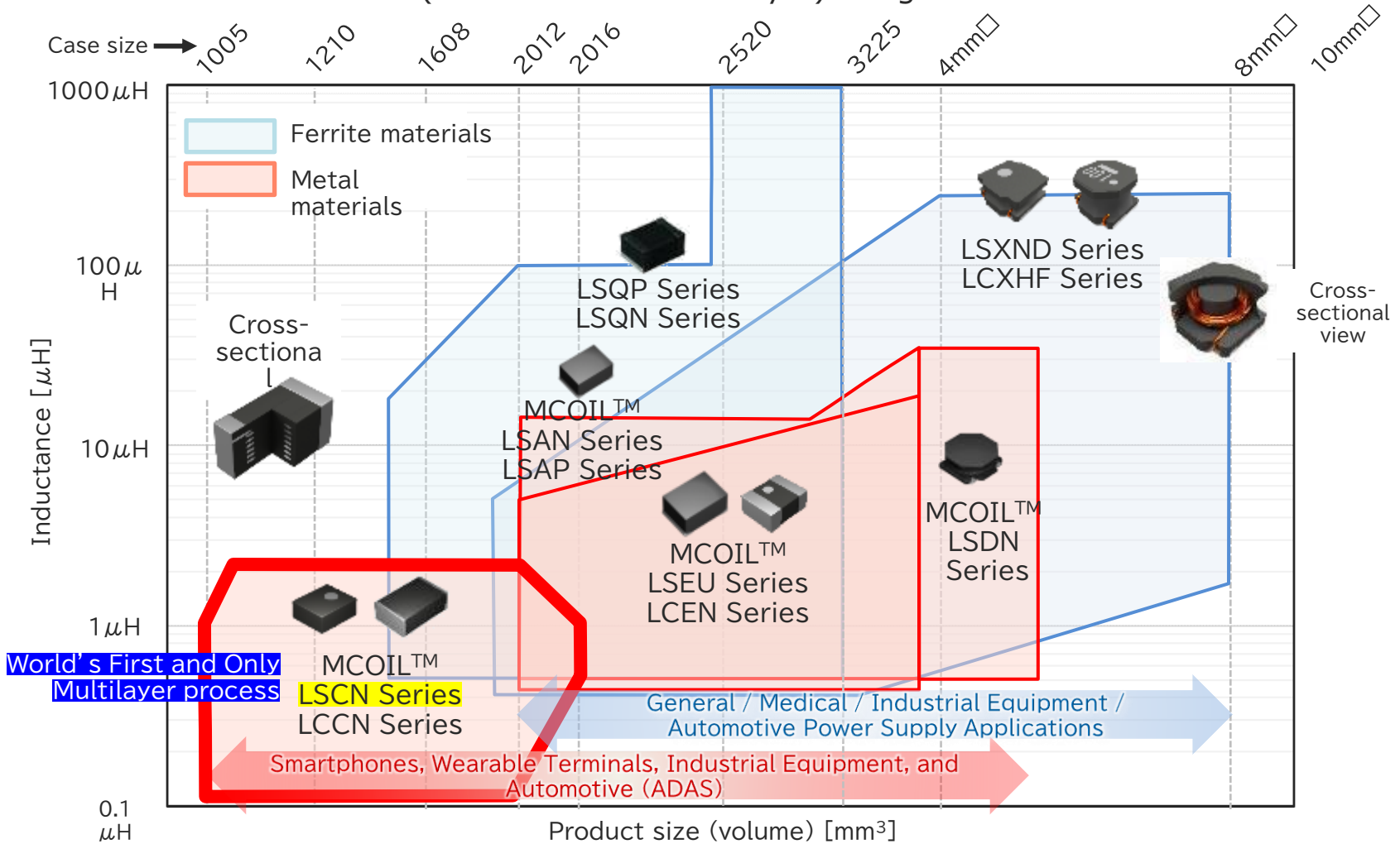
Trend for Processor (CPU/GPU/AI) Package

Inductor technologies for IVR



TAIYO YUDEN's Power inductor product line-up

Targeting a wide range of markets, from IoT device (wearables) and mobile equipment to high-reliability automotive and industrial equipment with optimum materials and structure (wire-wound or multilayer) design.

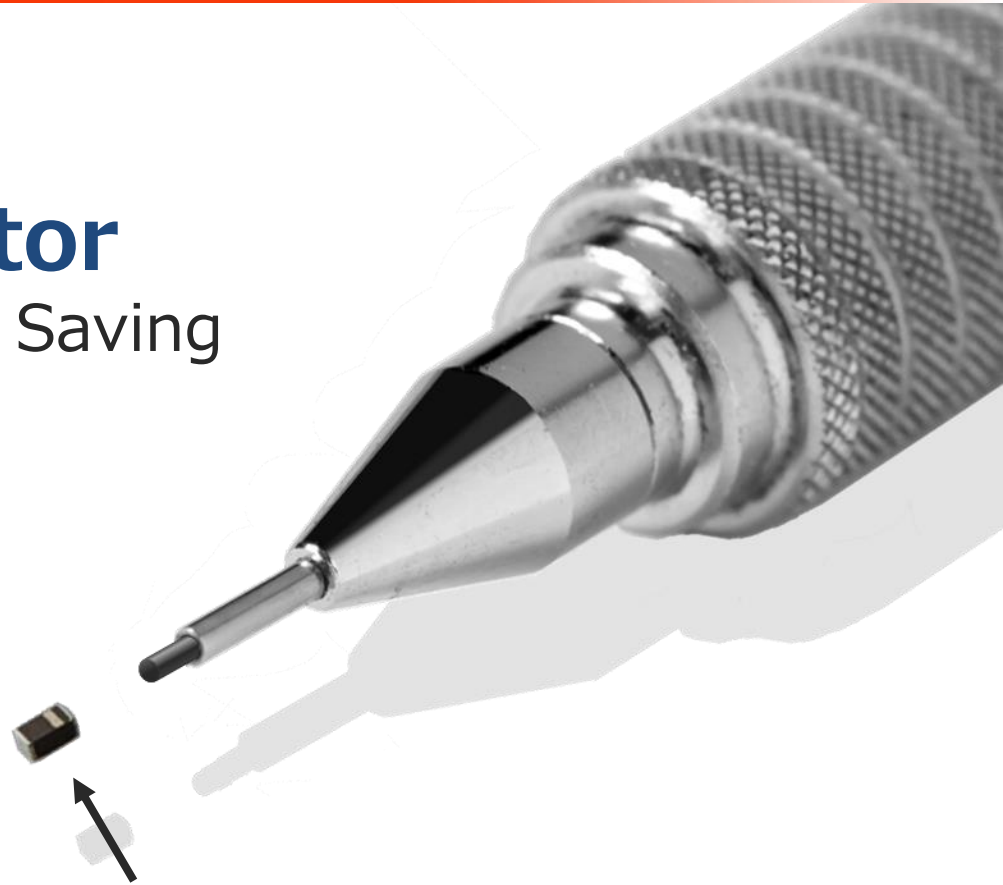


※MCOIL is a registered trademark or trademark of TAIYO YUDEN CO., LTD. in Japan and other countries.

The names of series noted in the text are excerpted from part numbers that indicate the types and characteristics of the products, and therefore are neither product names nor trademarks.

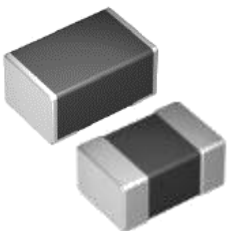
Ultra Small & Thin Metal Power Inductor

for Miniaturization / Energy Saving



For example, Case Size **0402inch**
Inductance **1.0 μ H**
Saturation current **1.0A**

What's LSCN series ? : Metal base multi layer power Inductor

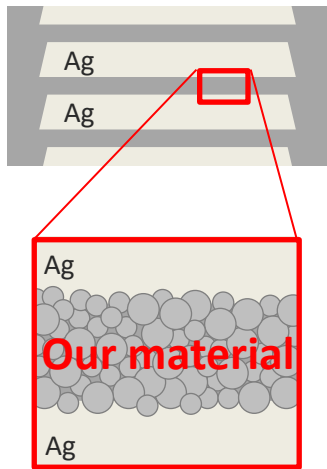
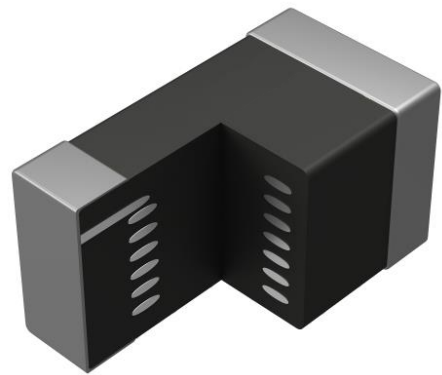


LSCN series use multi layer process & unique Metal material.

- High current with small package
- Small case size and low profile
- Customizability (e.g. flexibility in size and array like 2 in 1).

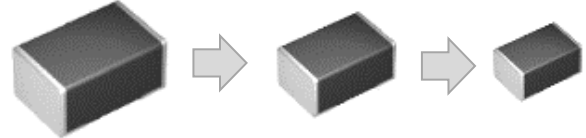
Basic structure of LSCN

- First in the world -

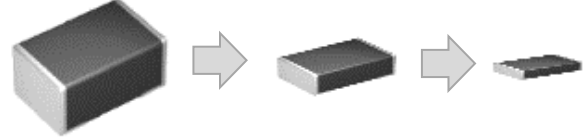


Strong points for LSCN(MC)

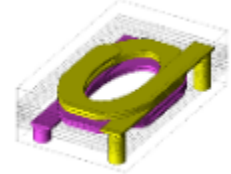
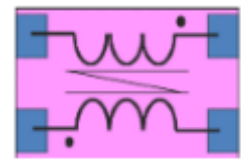
A). Further smaller size ($\leq 1005\text{mm}$)



B). Further lower profile ($\leq 0.2\text{-}0.3\text{mm}$)



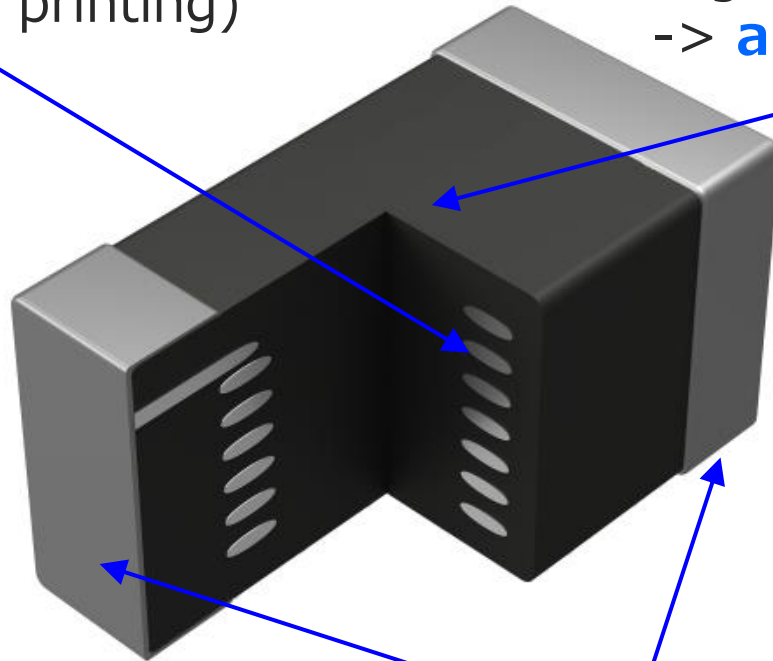
C). Capability of 2 in 1 (Mutually Coupled)



LSCN series Structure and Materials

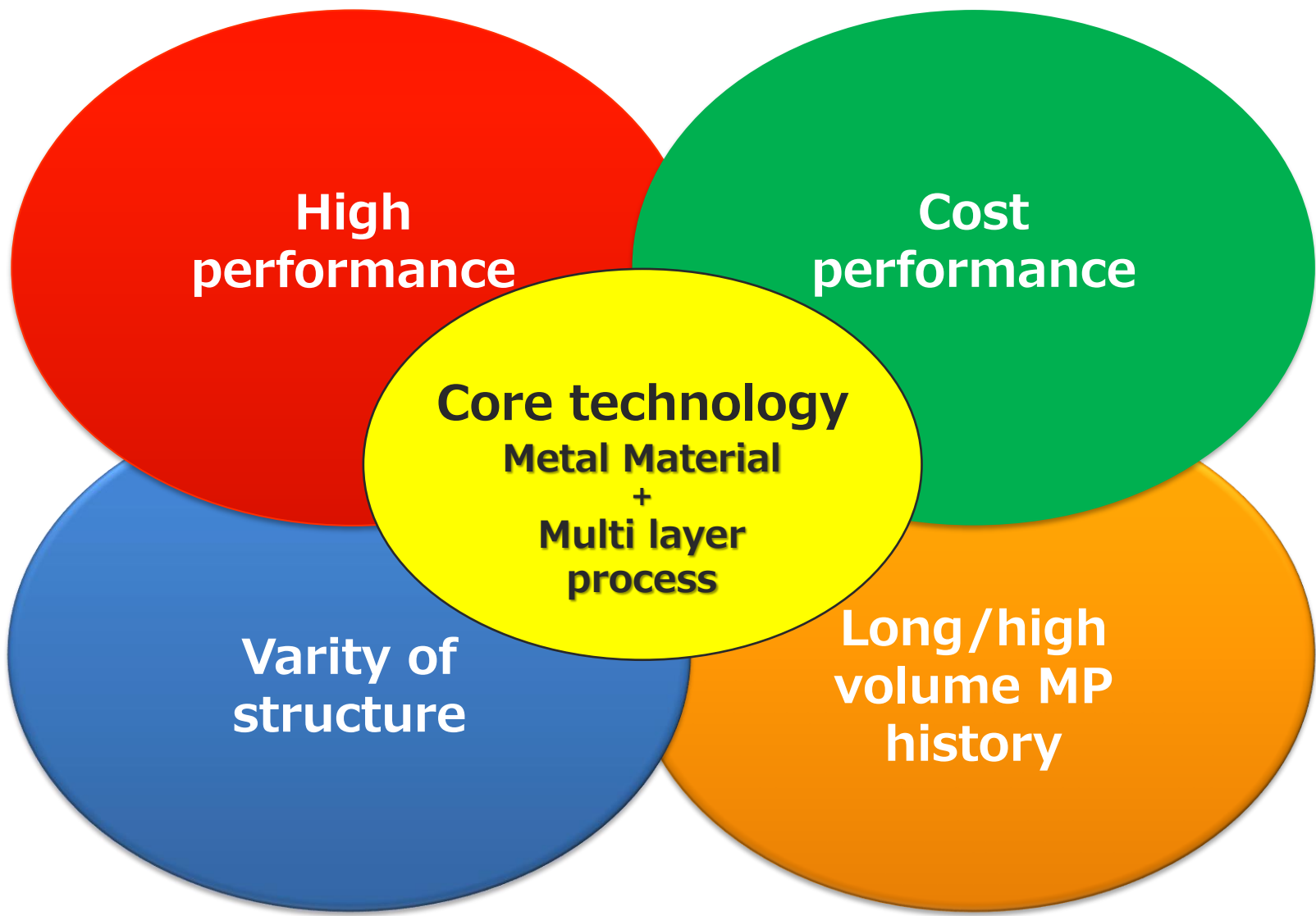
Internal electrode :
Ag (Screen printing)

Body:
Magnetic metal material
-> **a unique metal material**



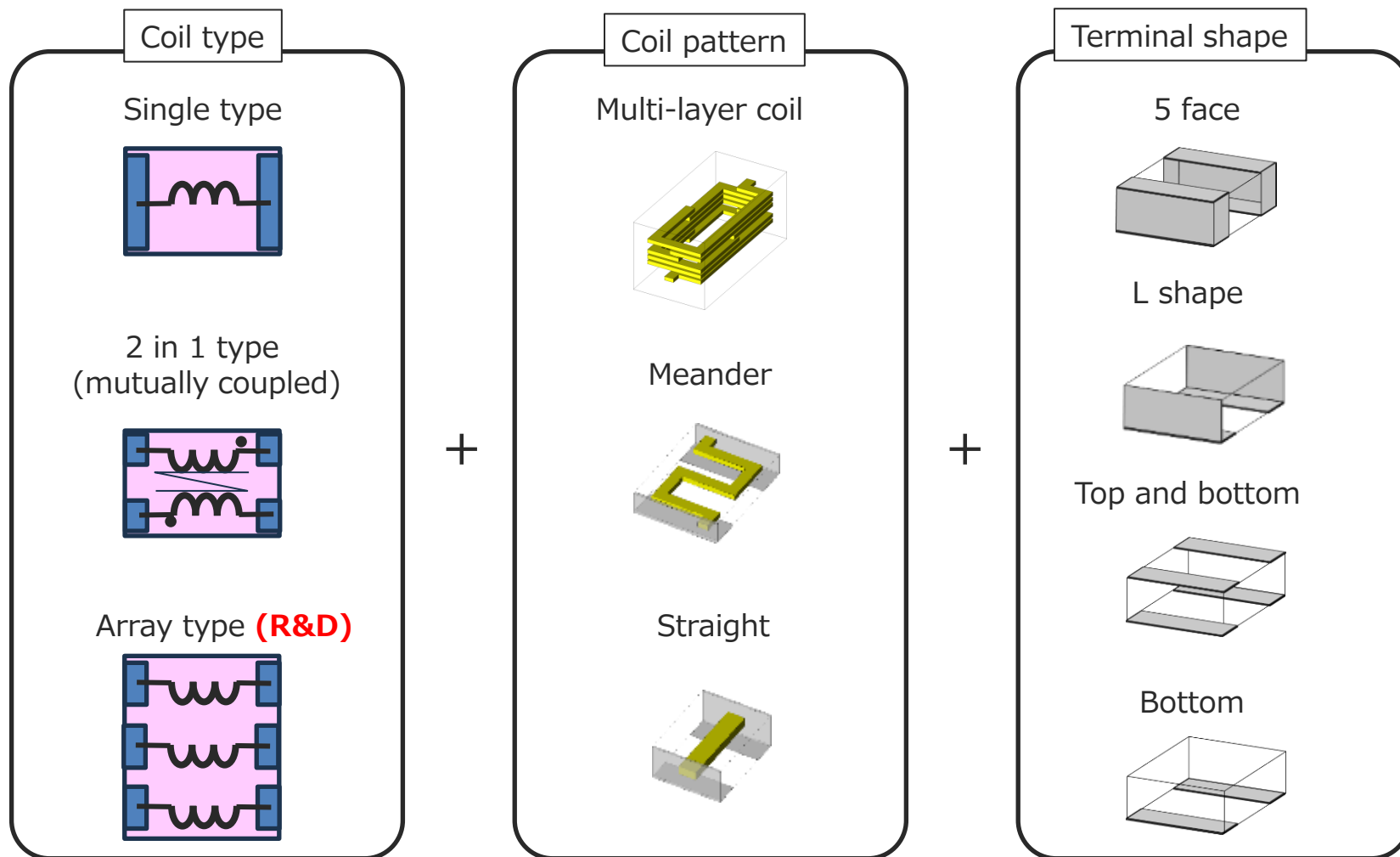
Terminal Electrode:
Ag base + Ni/Sn (or Cu) plating

Why LSCN series is good for processor package ?



Variety of Structure

LSCN series has a high variety of structure because of multilayer process.



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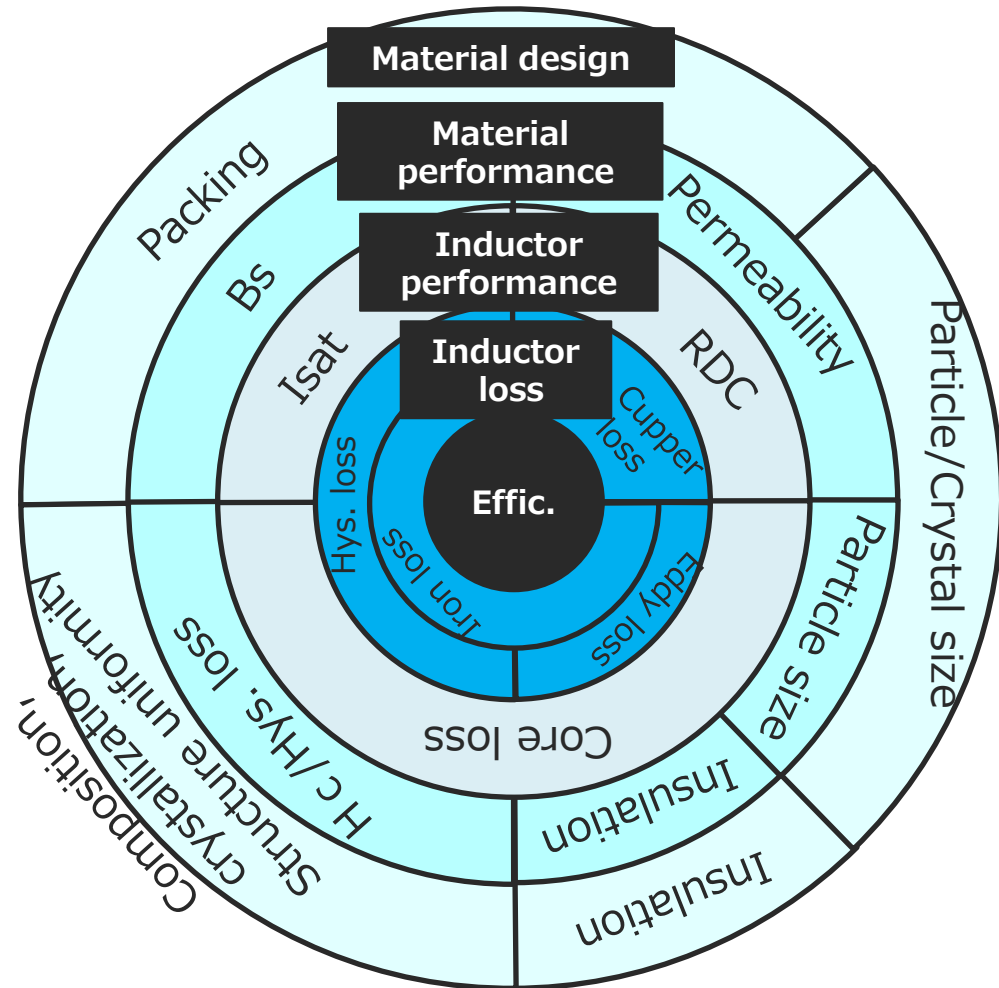
Concept of Inductor and material design

High performance

Target; To contribute to high efficiency power supplies.
Both of **Static** and **Dynamic** characteristics are considered to inductor and materials design.

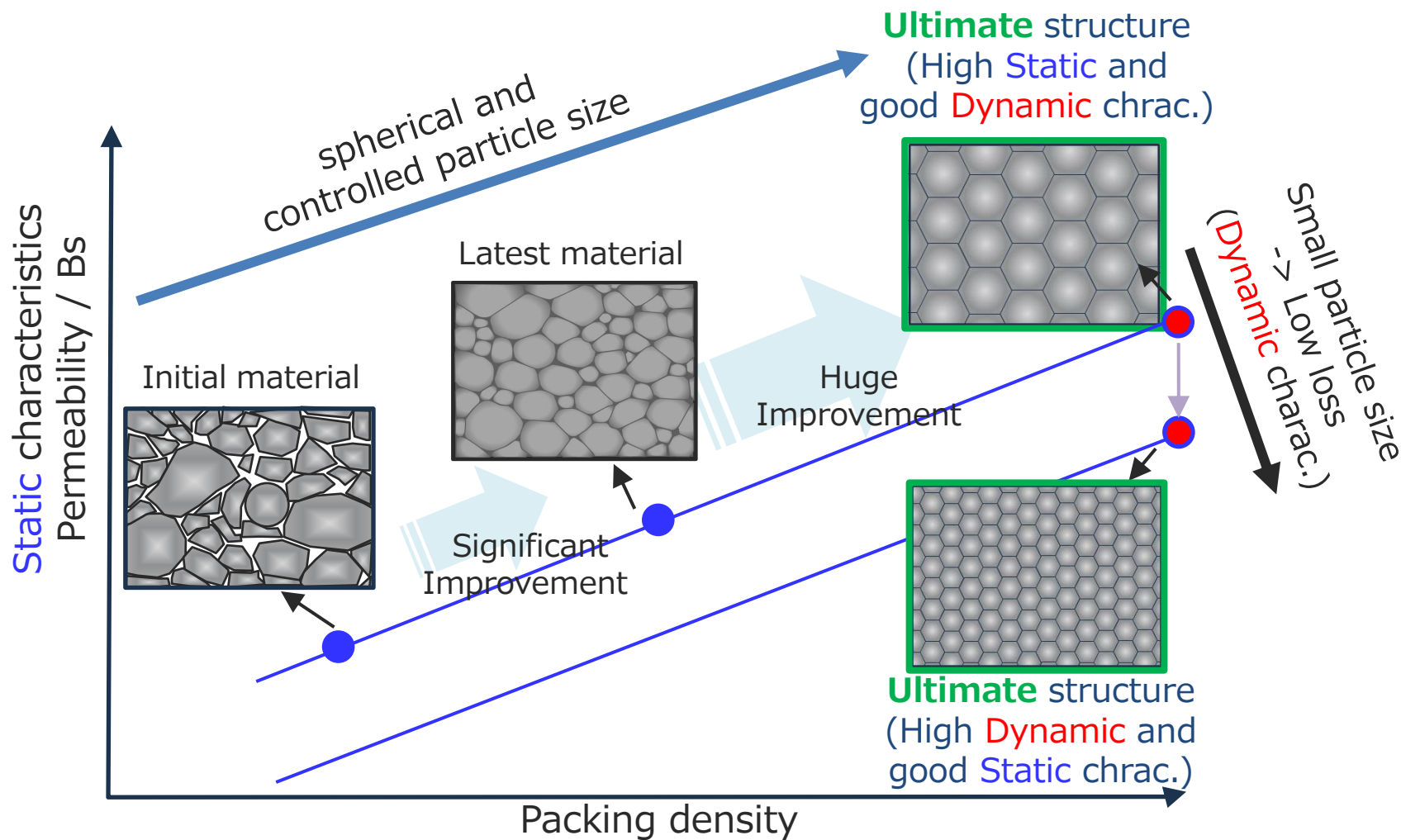
Static characteristics
(Inductance, RDC, Isat...)

Dynamic characteristics
Core loss



Outline of Magnetic Material Improvement

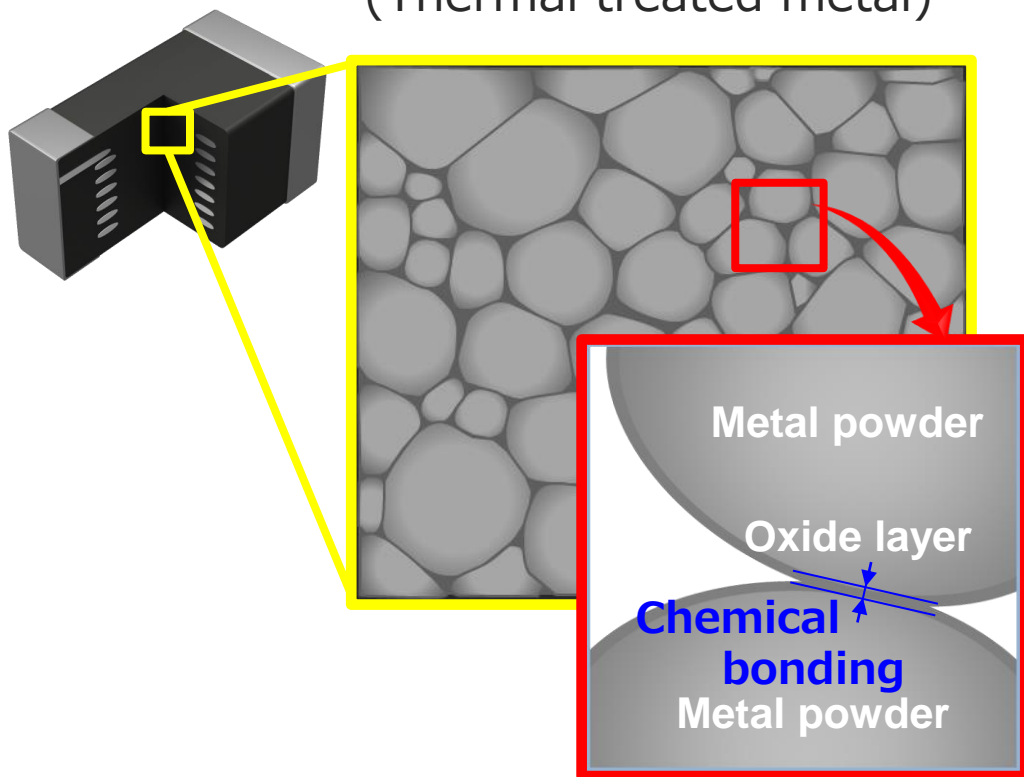
Both of High **static** and **dynamic** characteristics will be achieved by focusing on the improvement of packing density.



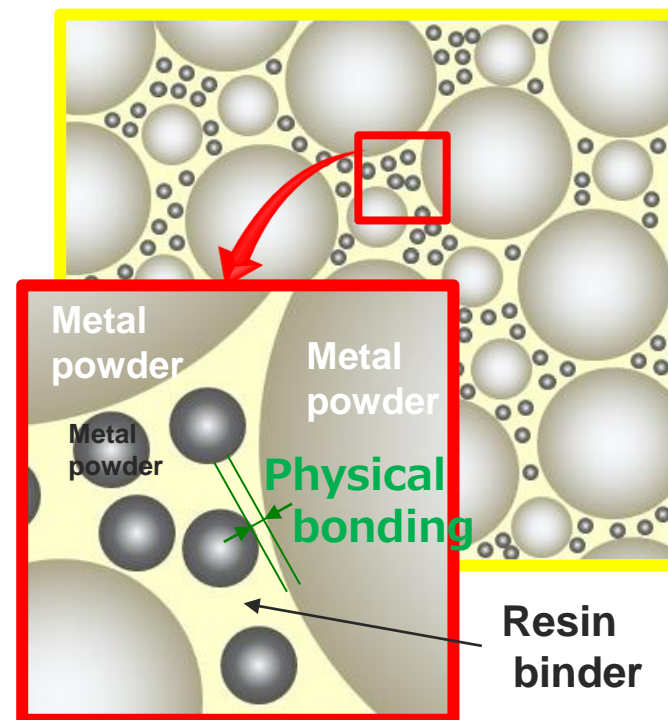
A unique metal material (patented)

No resin binder -> High Packing density
Particle bonding; Oxide layer (chemical bonding)
-> High heat resistance and stability

LSCN series material
(Thermal treated metal)



General metal material
(Metal composite)



Comparison of Inductor technologies for IVR

LSCN series has high performance and variety due to high packing density material and design flexibility.

Inductor Technology	Conventional		LSCN series	
	ACI ^{*1)}	Composite core ^{*1)}	Coil	
Magnetic Material	— (Non-Magnetic)	Low	High	
Inductor specifications	Inductance	1.2nH ^{*1)}	2.5nH ^{*1)}	40nH
	DC Resistance	7mΩ ^{*1)}	12mΩ ^{*1)}	8mΩ
	I _{max}	8A ^{*1)}	8A ^{*1)}	4.4A
	L/R _{dc}	171nH/Ω ^{*1)}	208nH/Ω ^{*1)}	5000nH/Ω
	Area	2.0mm ² ^{*1)}	0.4mm ² ^{*1)}	0.5mm ²
	Current Density	4A/mm ²	20A/mm ² ^{*1)}	8.8A/mm ²
	Thickness	0.2mm	0.7mm	0.5mm

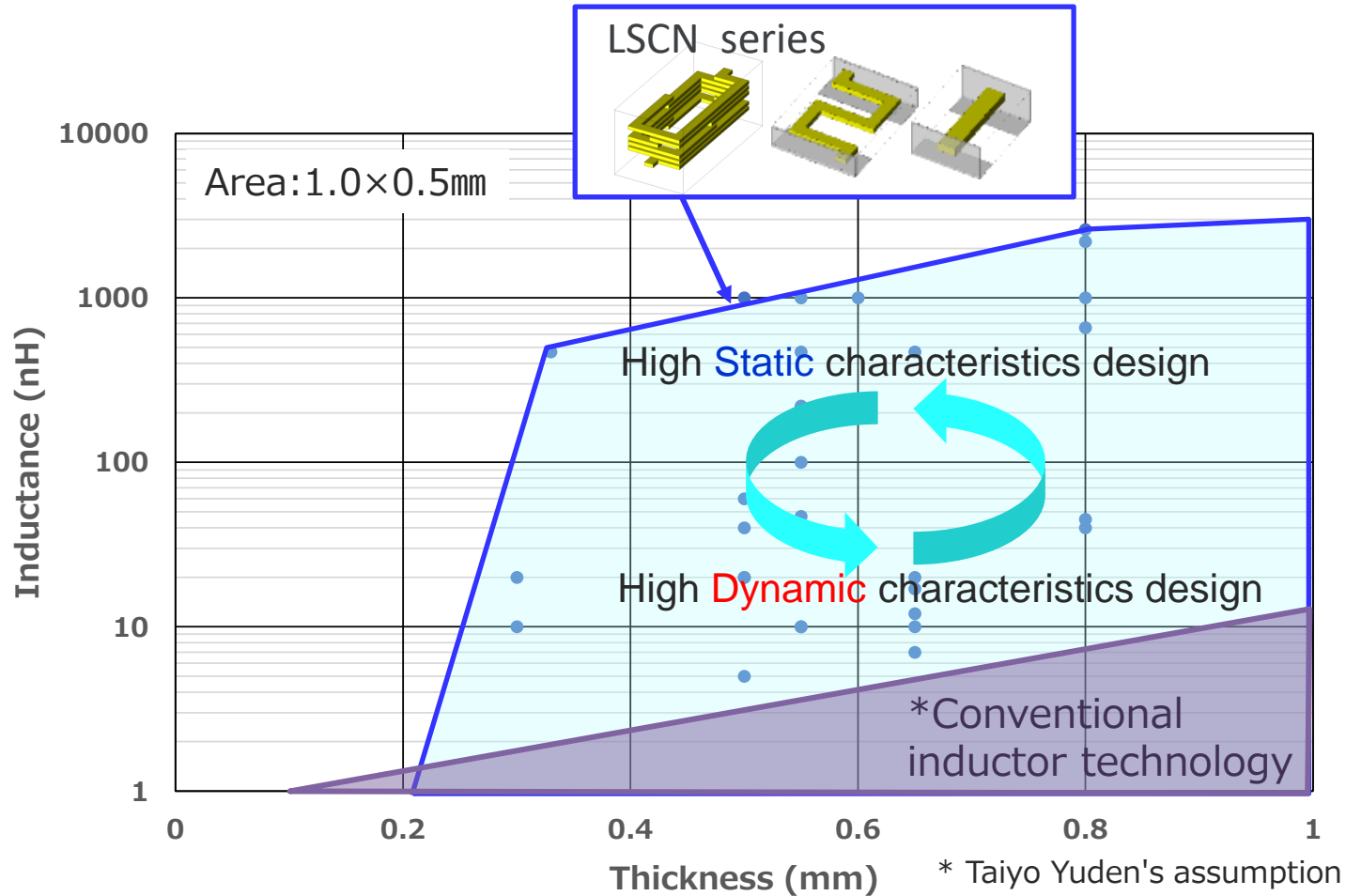
^{*1)} Source; Intel Corporation, 2021 IEEE 71st Electronic Components and Technology Conference (ECTC)

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Map of LSCN series Strong point

High performance

LSCN series can provide high performance over a wide range (inductance x thickness) due to variety of structure and material.



Long Mass Production history

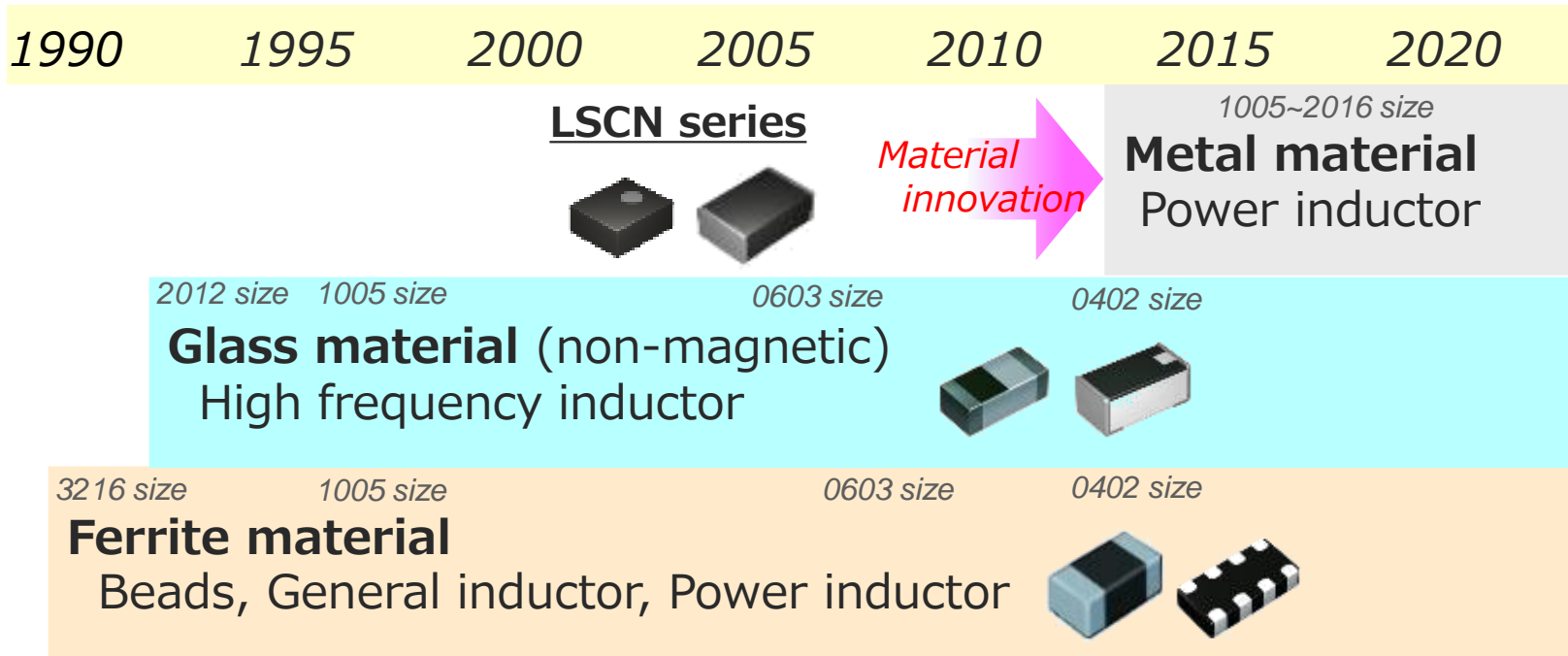
Long/high volume MP history

Cost performance

TAIYO YUDEN's multilayer inductors; more than 30 years.
Metal inductor LSCN series ;based on common technologies and has a history of 10 years.

- > Stable mass production, high productivity
- > High cost performance

History of TAIYO YUDEN's multilayer inductors



Summary

- ✓ **Proposal of Inductor for IVR with good performance and cost competitiveness.**
- ✓ **TAIYO YUDEN LSCN series is good for IVR in the following points.**
 - 1. A unique product, metal material × multi layer process,
-> variety of structure and high performance.**
 - 2. based on multi layer inductor technology with a 30 years history
-> Stable mass production, High cost performance.**

Please contact us below

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TAIYO YUDEN