

TDC

软磁铁氧体材料介绍 Introduction to Soft Ferrite Materials

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01

Material Development Trend

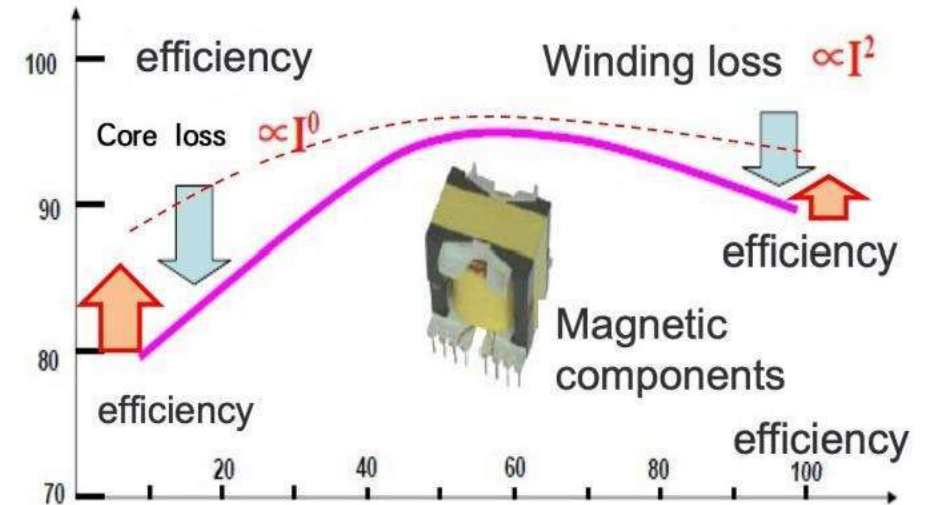
Material Development Trends

	80 PLUS	80 PLUS BRONZE	80 PLUS SILVER	80 PLUS GOLD	80 PLUS PLATINUM	80 PLUS TITANIUM
	白牌	铜牌	银牌	金牌	白金牌	钛金牌
Load	efficiency					
10%	\	\	\	\	\	90%
20%	80%	82%	85%	87%	90%	94%
50%	80%	85%	88%	90%	92%	96%
100%	80%	82%	85%	87%	89%	91%

Switching power supply:

- High efficiency
- High efficiency under low load

スイッチング電源：
- 高効率
- 低負荷時の高効率

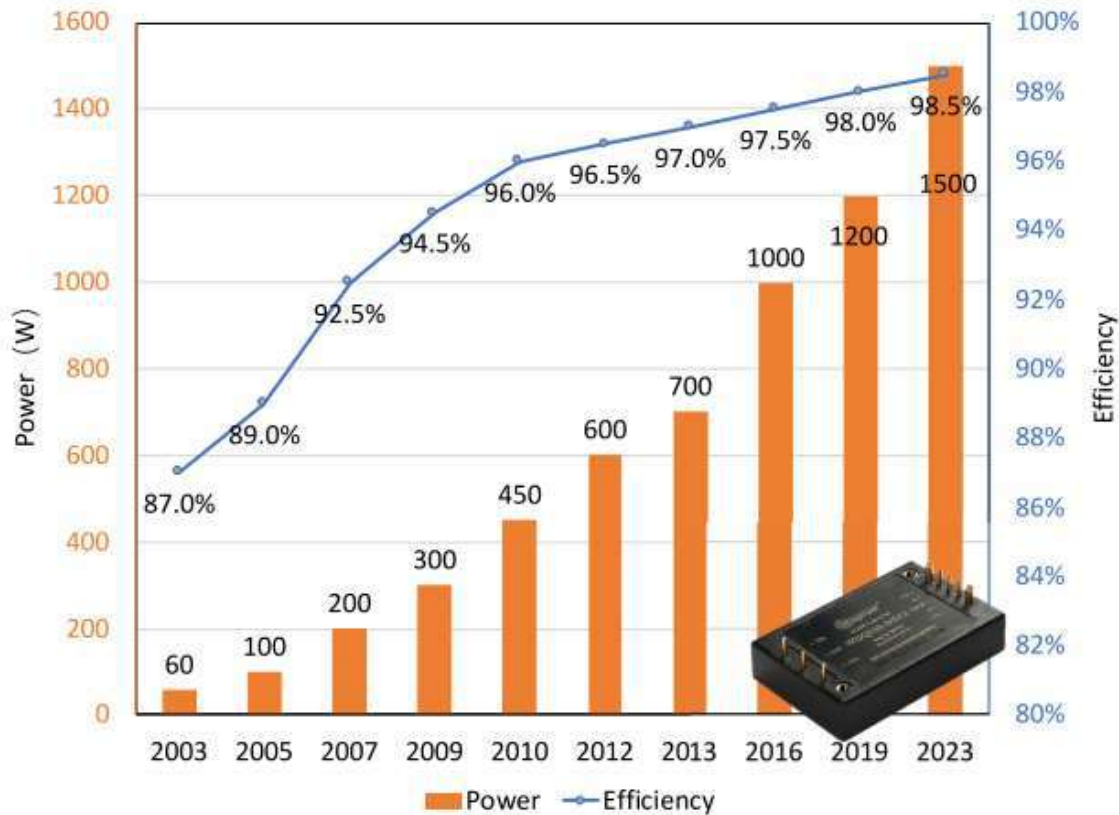


Demand for magnetic materials:

- Lower core loss Flat power
- Loss curve in the wide temperature range

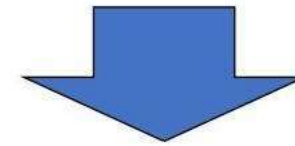
磁性材料の需要
- 低コアロス フラットパワー
- 広い温度範囲での損失曲線

Material Development Trends



Switching power supply:

- High Frequency
- Switching loss and device loss are reduced to reduce heat



Magnetic materials:

- Medium and high frequency low loss(above 300kHz)
- A flat temperature curve over the full temperature range

スイッチング電源

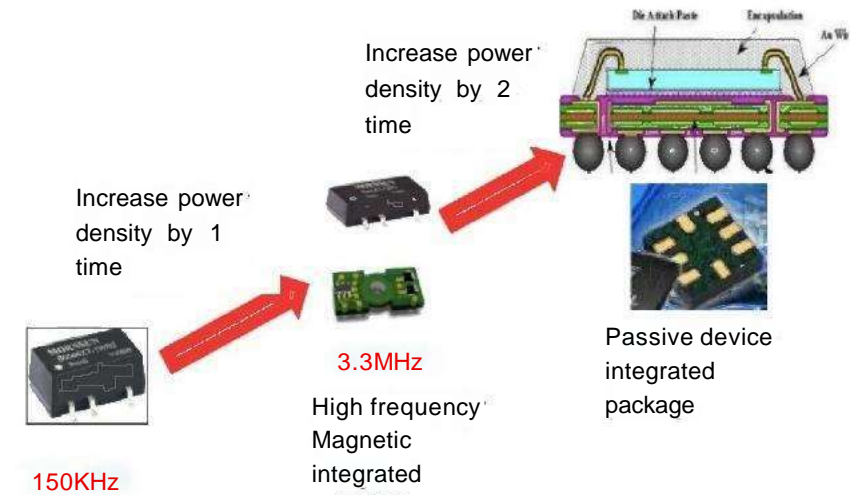
- 高周波
- スイッチング損失と電圧損失を低減し、発熱を抑える。

磁性材料:

- 中高周波低損失(300kHz以上)
- 全温度範囲にわたるフラットな温度カーブ

Material Development Trends

Semiconductor	Si	SiC	GaN
Energy gap Eg(eV)	1.1	3.2	3.4
Electronic mobility μ (cm/Vs)	1500	900	2000
Critical breakdown electric field Ec(MV/cm)	0.3	2.0	3.3
Saturation drift velocity Vs(10^7 cm/S)	1.0	2.0	2.5



Switching power supply:

- High Frequency
- Switching loss and device loss are reduced to reduce heat



Magnetic materials:

- Low loss at High working frequency (above 500k)
- High Bs used in large working current

スイッチング電源

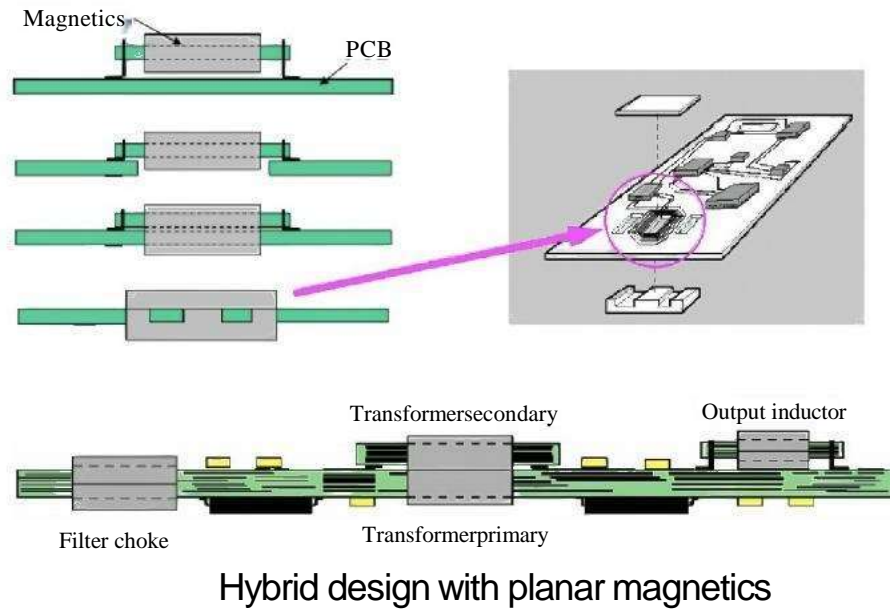
- 高周波対応。
- スイッチング損失とデバイス損失を低減し、熱を低減します。

磁性材料:

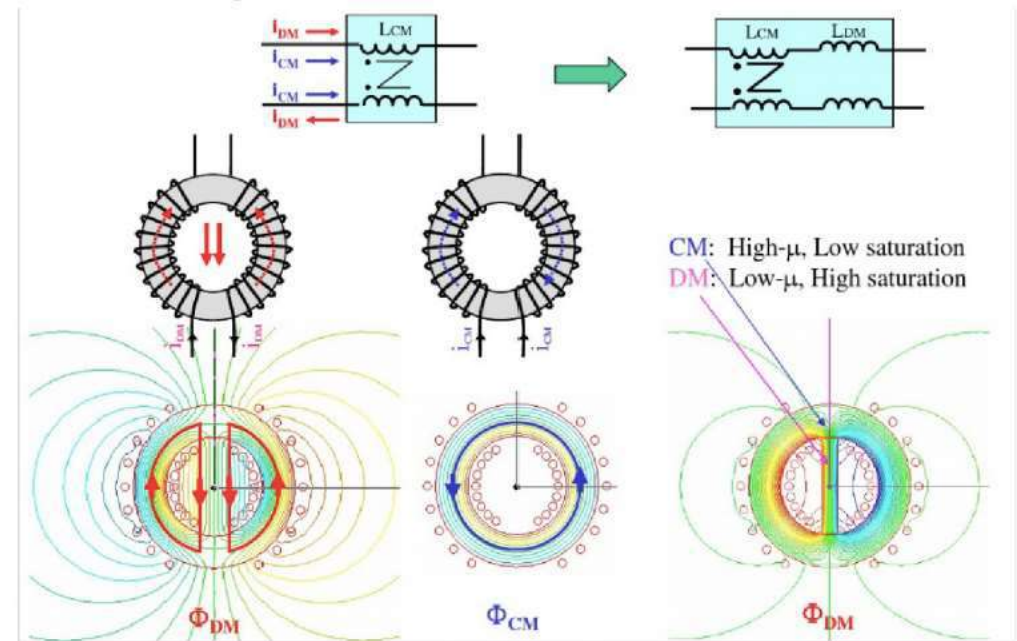
- 低損失で高い動作周波数 (above 500k)。
- 大きな動作電流時に使用する高いBs。

Material Development Trends

Magnetic device integrated with PCB

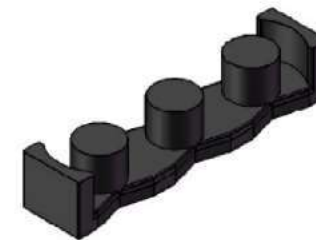


Integrated of CMC&DMC

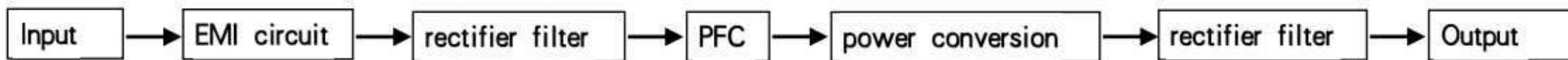
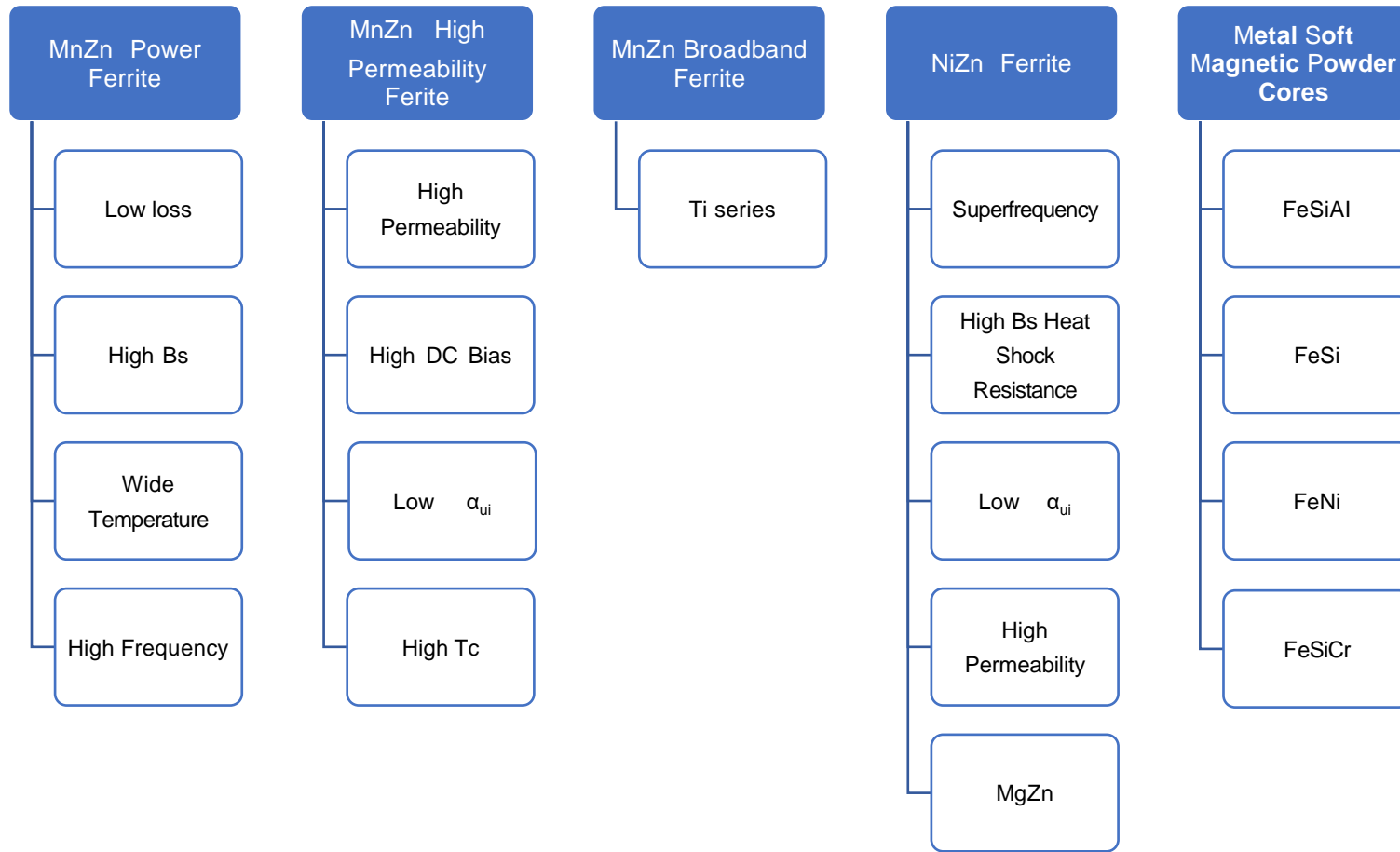


Magnetic materials improve:

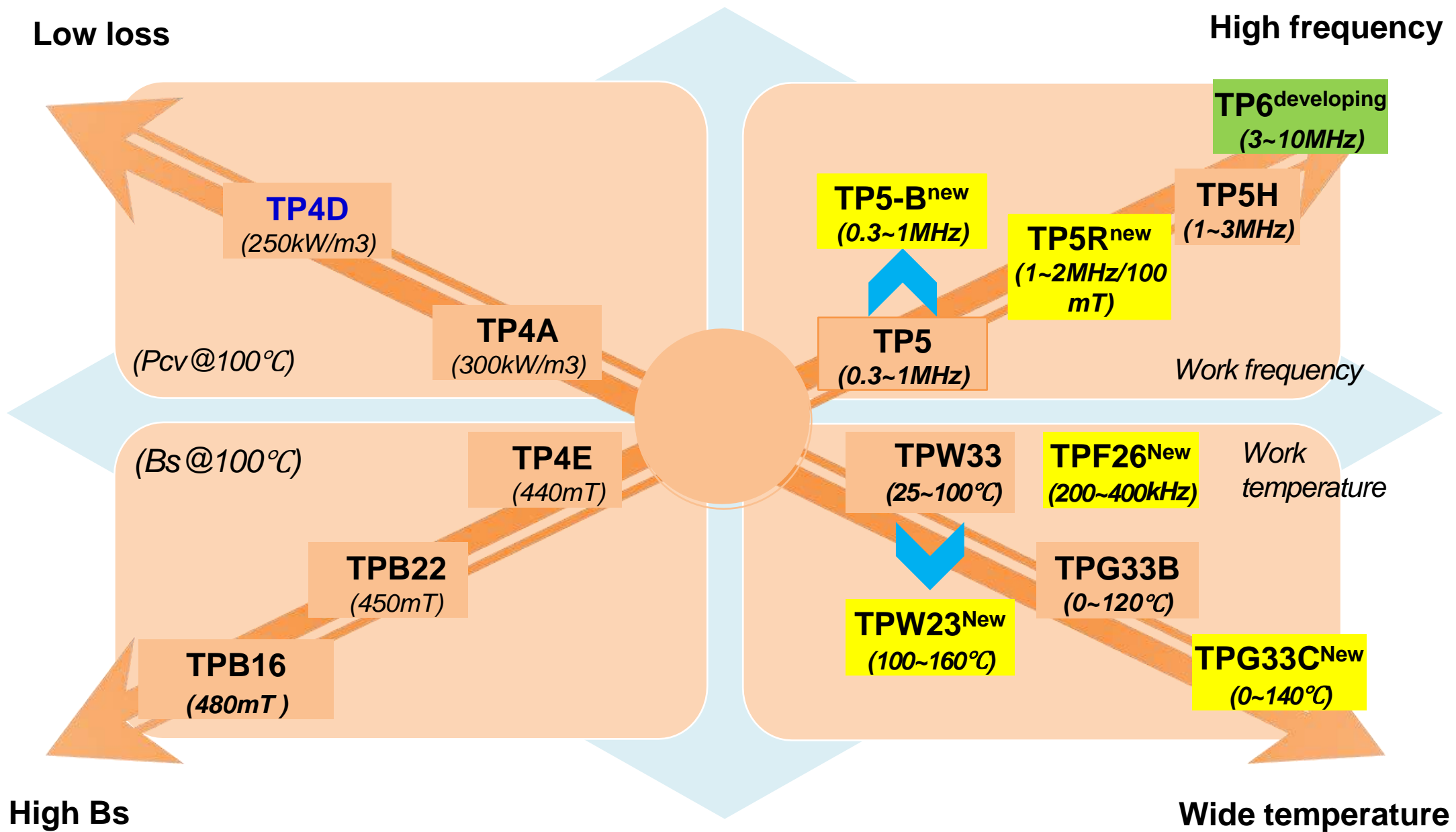
- DC Bias
- Power loss
- Customization



TDG soft magnetic materials Overview



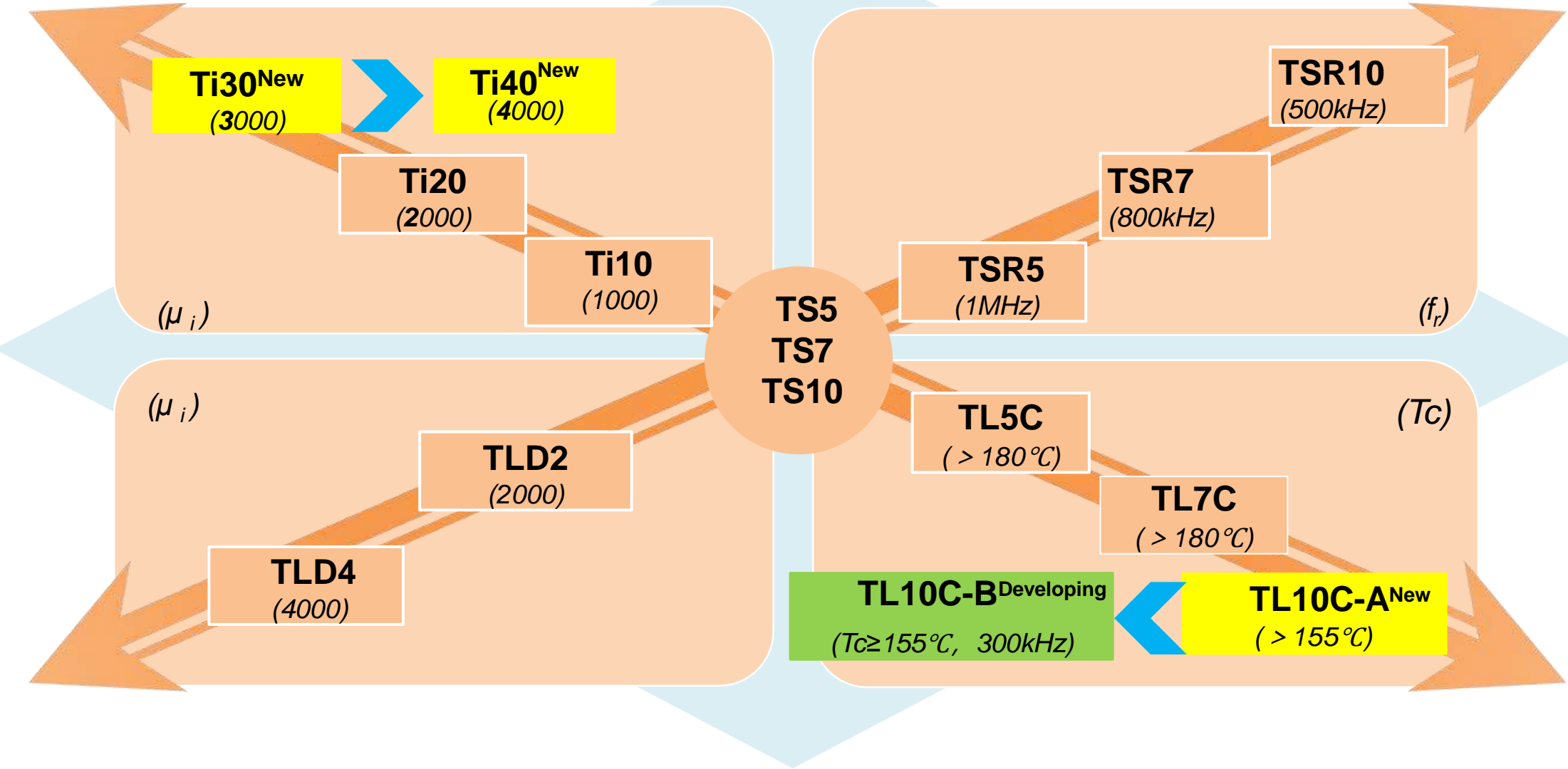
Power Materials Roadmap



High μ Materials Roadmap

Broudband

Wide frequency



Low $\alpha_{\mu ir}$

High T_c

NiZn Materials Roadmap

High frequency & Low $\tan\delta/\mu_i$

High Bs & Thermal Shock Resistance

TN10Q *Developing*
(150@13.56MHz, $\mu_i=80$)

TN8Q *new*
(125@13.56MHz, $\mu_i=80$)

($\tan\delta/\mu_i$ @RT)

TN65H
400mT (25°C)

TN40H
410mT (25°C)

TN25H
420mT (25°C)

TN35B
460mT (25°C)

TN25B
475mT (25°C)

(Bs@RT)

TN50D
 $\alpha_{\mu_{ir}}:1$ (20~60°C)

TN50D-A *new*
 $\alpha_{\mu_{ir}}:-2\sim 2$ (-25~80°C)

TN80L
($\mu_i:800$)

TN150P
($\mu_i:1500$)

TN200B
($\mu_i:2000$)

TN210P
($\mu_i:2100$)

Low $\alpha_{\mu_{ir}}$

High μ_i



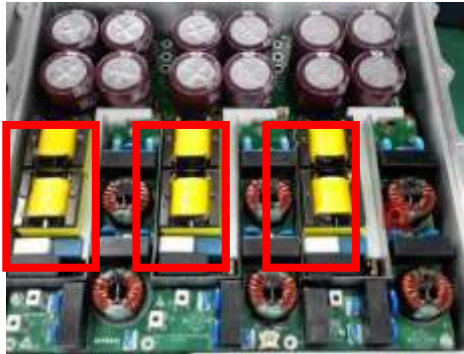
02

Power Ferrite Material

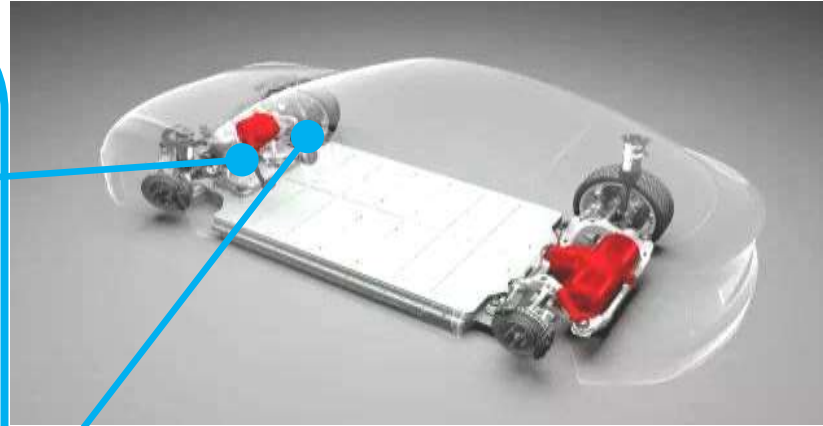
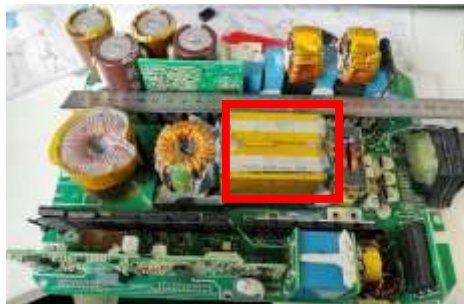
Wide temperature and low loss at 0~140°C-TPG33C

Working Temperature: 80~140 °C

OBC



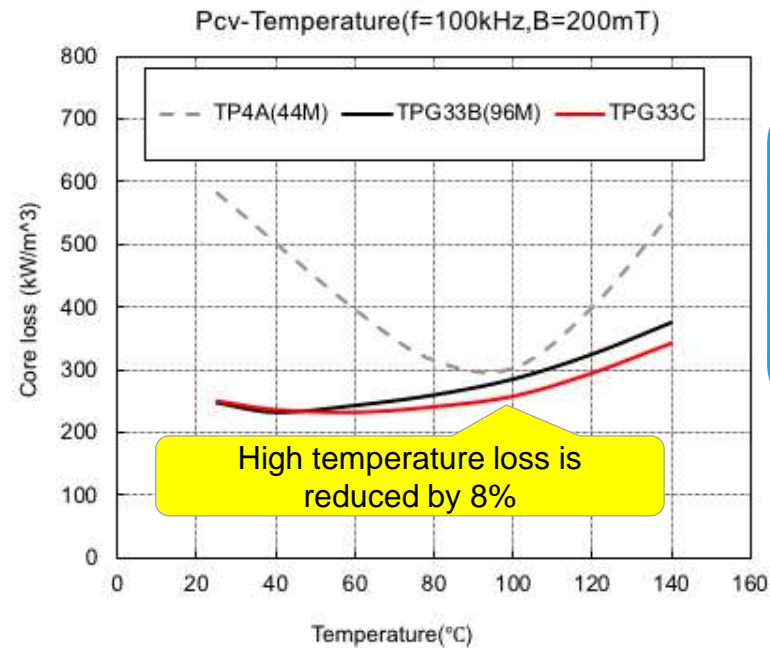
OBC+DC/DC



P_{cv} @ f=100kHz, B=200mT

	25°C	100°C	120°C	140°C
TP4A (44 material)	600	300	400	550
TPG33B (96 material)	240	280	320	370
TPG33C (97 material)	240	255	-	340

T25 standard ring test



PQ : PQ35~PQ72
EE/EI : EE43~EE64

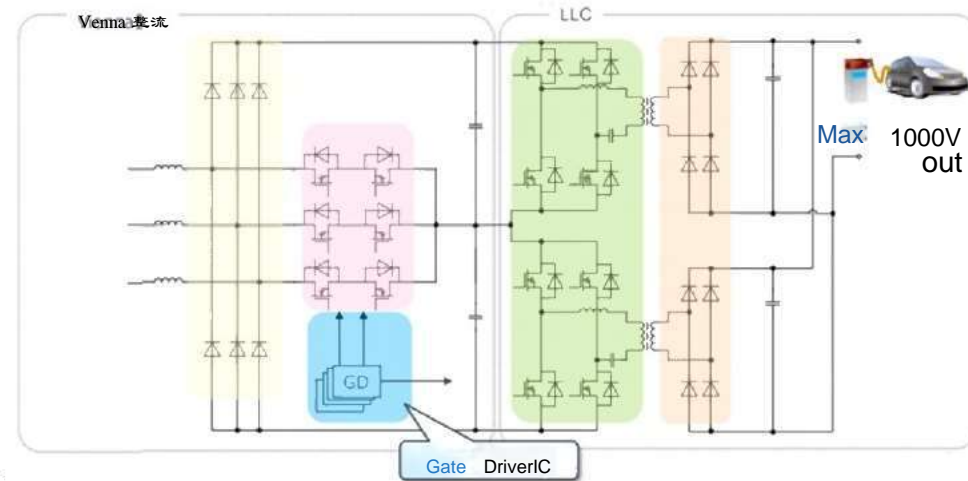
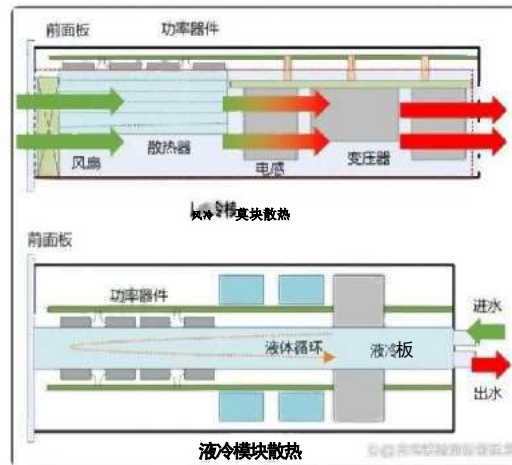
Low loss material at 100~160°C-TPW23

TPW23材料は、100 ~ 150 の温度範囲での消費電力に特別に最適化されており、96材料より低い(5%~15%)。

TPW23 materials are specially optimized for power consumption in the temperature range of 100°C~150°C, which is lower than 96 materials **5%~15%**.

P_{cv} @ f=100kHz, B=200mT

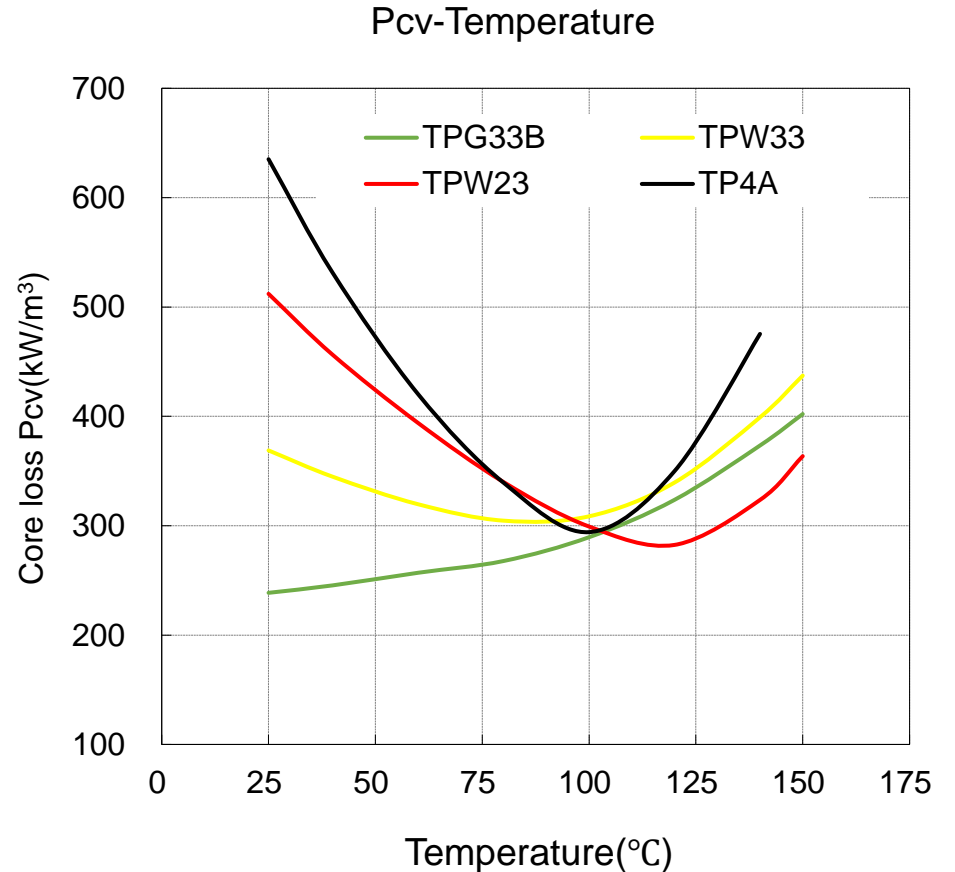
材质	25°C	100°C	120°C	140°C	150°C
TP4A(44 material)	600	300	400	550	/
TPW33(95 material)	380	300	350	400	450
TPG33B(96 material)	240	280	320	370	410
TPW23	520	310	300	330	370



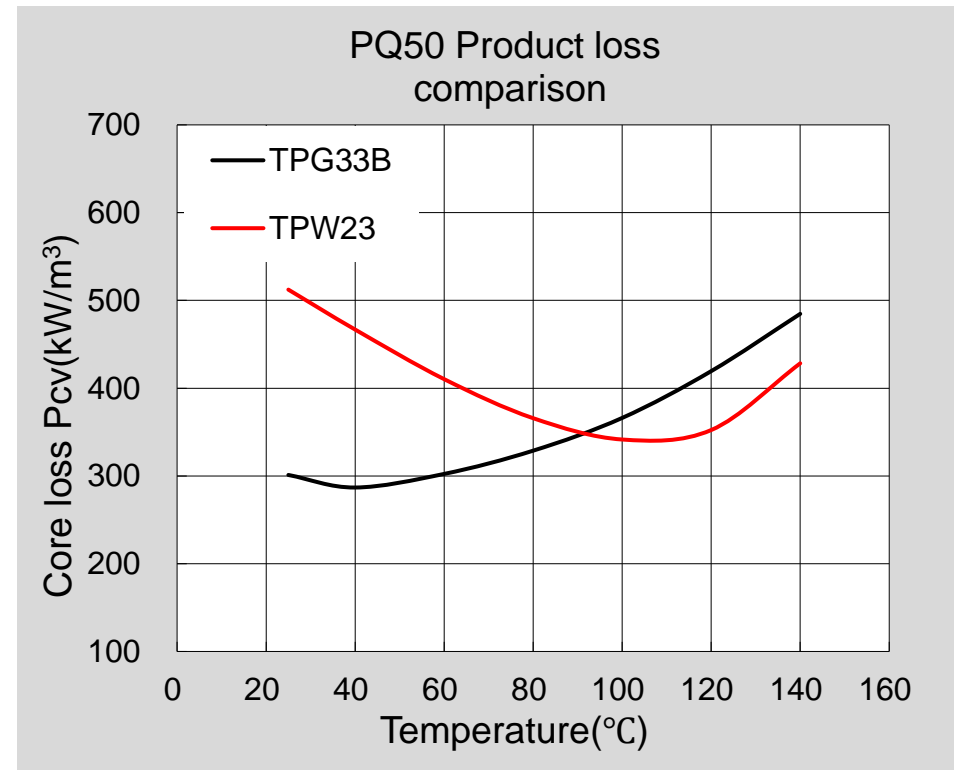
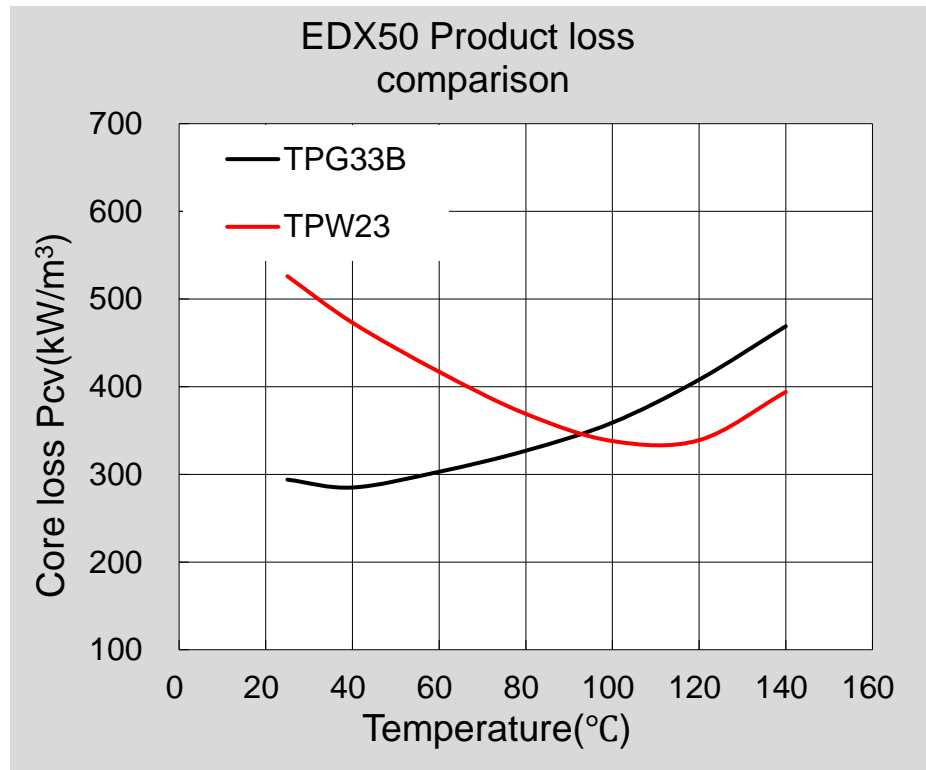
Low loss material at 100~160°C-TPW23

- ◇ Used at Middle Frequency. (Less than 300kHz)
- ◇ High temperature Low Core Loss at 100°C-150°C.

Initial permeability	μ_i	25°C	2300±25%	
Saturation magnetic flux density	$B_s(\text{mT})$	25°C	530	
	1194A/m	100°C	410	
Core loss	P_{cv} (kW/m ³)	25°C	520	
		80°C	340	
		100°C	310	
		f=100kHz	120°C	300
		B=200mT	140°C	330
		150°C	370	
Curie temperature	$T_c(°\text{C})$		≥215	
Electrical resistivity	$\rho(\Omega \cdot \text{m})$		10	
Density	$d(\text{kg}/\text{m}^3)$		4.9×10^3	



Low loss material at 100~160°C-TPW23

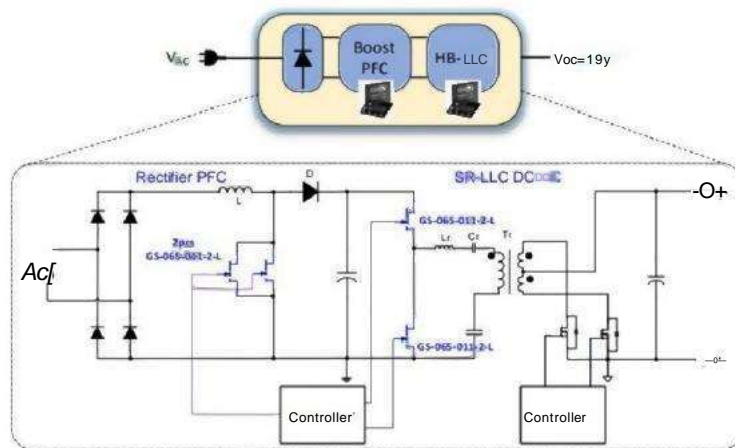


The new material TPW23 reduces the loss significantly in the temperature range above 100°C, which is more conducive to the high efficiency of devices and systems under high temperature conditions! (Test conditions: $f=100$ kHz, $B=200$ mT)

新材料TPW23は、100 を超える温度領域で損失を大幅に低減し、高温条件下でのデバイスやシステムの高効率化に貢献します。
(試験条件： $f=100$ kHz、 $B=200$ mT)

Material operating at 200~400kHz-TPF26

Material	Pcv @ f=200kHz,B=125mT					Pcv @ f=300kHz,B=100mT				
	25°C	60°C	80°C	100°C	120°C	25°C	60°C	80°C	100°C	120°C
TPG33-A	250	240	240	250	/	270	260	260	270	/
TPF33	170	195	205	210	230	190	215	225	235	270
TPF26	135	/	150	160	205	130	/	140	170	220

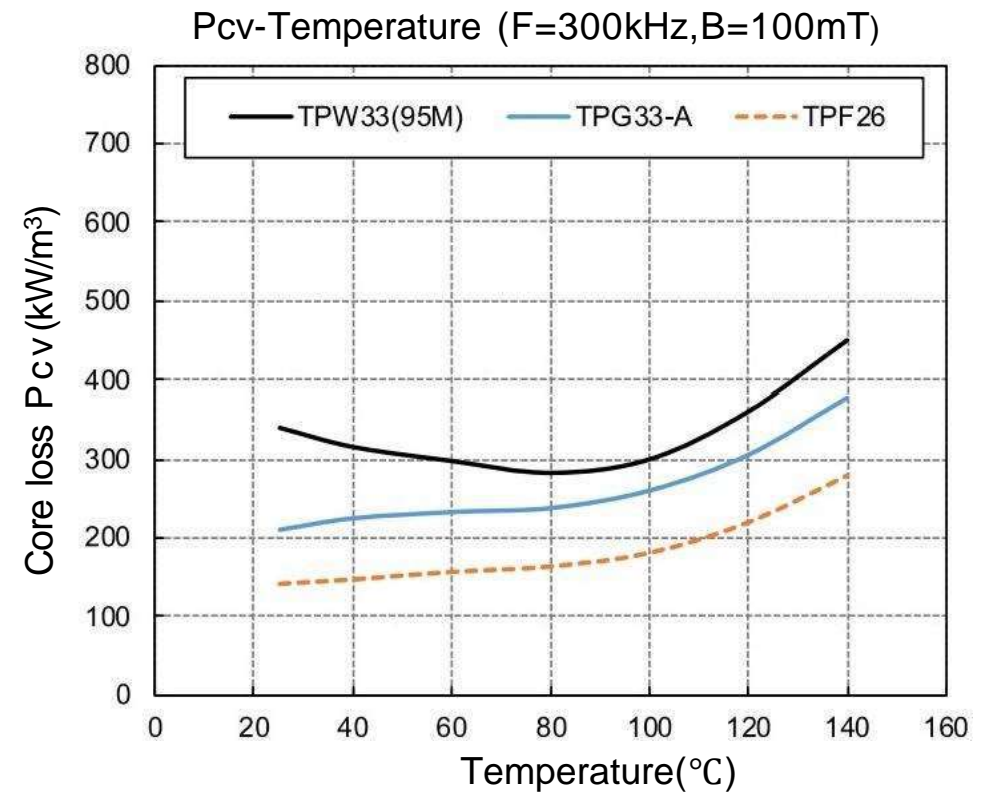
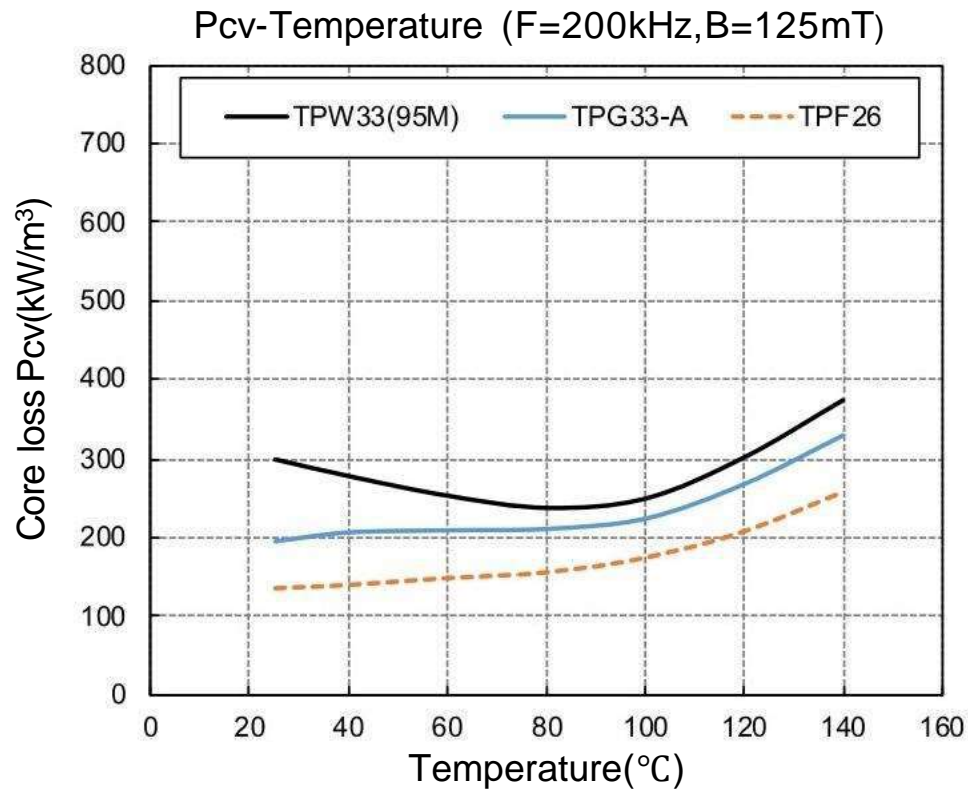


The application development of gallium nitride and other third-generation semiconductors has put forward new requirements for the loss of magnetic cores in the application **frequency range of 200kHz~400kHz. TPF26 material more TPG33 - A material consumption reduced by 30% ~ 40%.**

窒化ガリウムなどの第3世代半導体の応用開発により、200kHz~400kHzの応用周波数範囲における磁気コアの損失に対する新しい要件が提示されました。

TPF26材料はTPG33よりも材料消費量が30%~40%削減されます。

Material operating at 200~400kHz-TPF26



Compared with the previous generation material TPG33-A, the new material TPF26 can reduce the loss by more than 20% at 200kHz/125mT and by more than 30% at 300kHz/100mT!

前世代の材料TPG33-Aに比べ、新材料TPF26は200kHz/125mTで20%以上、300kHz/100mTで30%以上損失を低減できる！

Application 1: Electric vehicle charging system

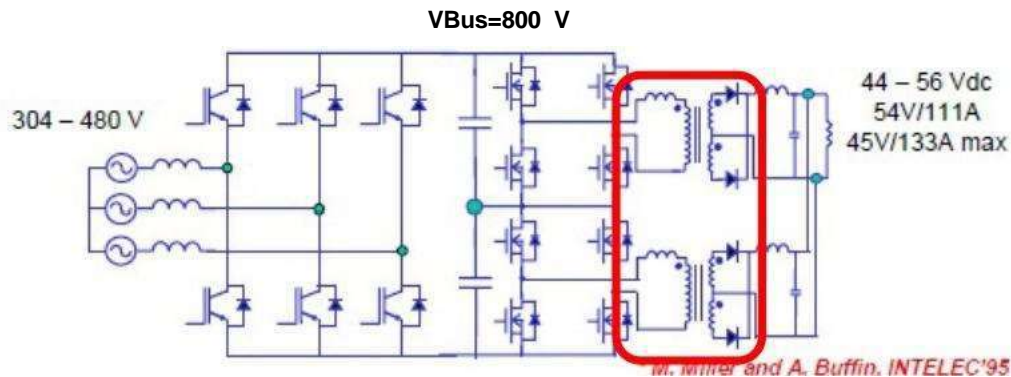


- ★ The cores for transformers asked for low core loss.
- ★ Wide temperature and low loss material is popular.
- ★ Dimensions getting bigger from 3.3KW up to 22KW.
- ★ How to get a excellent performance on such big core is a Challenge for manufacturer.

- * 低コアロスを追求したトランス用コア。
- * 広温度、低損失の材料が人気です。
- * 3.3KWから22KWまで大型化。
- * このような大きなコアの性能をいかに引き出すかがメーカーの課題。

Transformers:

Industry configuration -6000W three-phase rectifiers



Main Transformer:

PQ shape: PQ35~PQ72

EE/EI shape: EE43~EE64

PM or other customize shapes



Aux Transformer

EFD fly back EI PCBA mode



Three-phase modules

- Fault tolerant
- Higher power
- 800V bus voltage

DC/DC converter

- Established design
- Low-voltage devices
- Mechanism to balance the voltage
- High component count

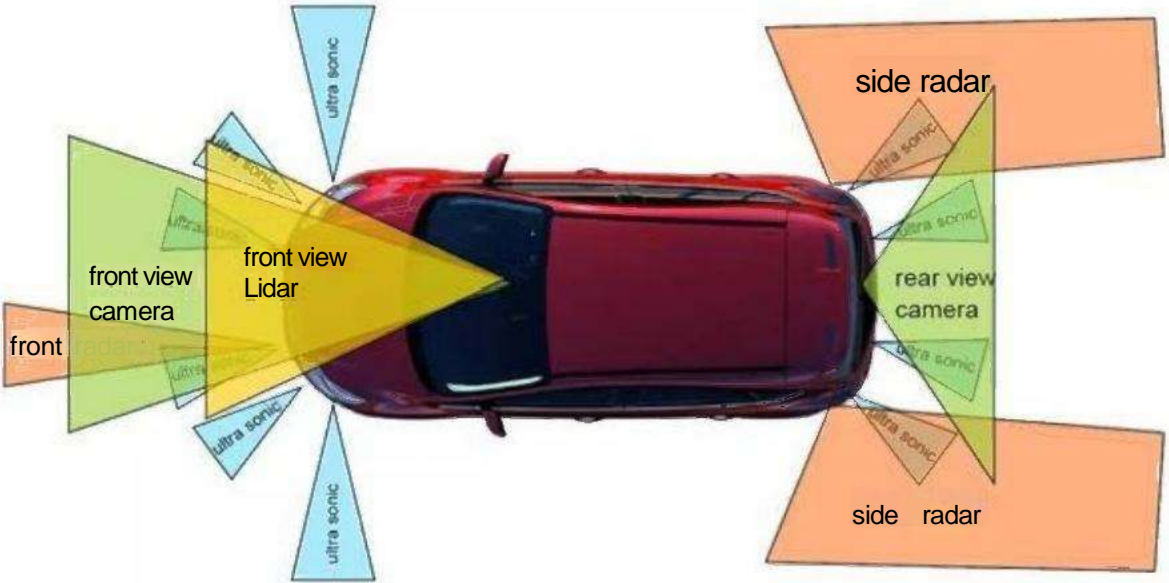
Application 2:Automotive ADAS



ADAS

ADAS: Advanced Driving Assistant System

Lots of sensors are using on ADAS, including CCD cameras.



Cores using on Camera

Core Shape: MnZn core-EP/SMD



EP

Sensors Application

Core Shape: MnZn core—P



Application 3: High-end consumer electronics, Wireless charging



$$U=4.44fNB\Delta e$$



High frequency ferrite material

3-5
MHz

TP6
($P_{cv} \leq 800 \text{ kW/m}^3$ (3MHz, 50mT)
 $B_s \geq 430 \text{ mT}$ (100°C)

1-3
MHz

TP5F
($P_{cv} \leq 150 \text{ kW/m}^3$ (1MHz, 50mT)
 $B_s \geq 430 \text{ mT}$ (100°C)

TP5H
($P_{cv} \leq 80 \text{ kW/m}^3$ (1MHz, 50mT)
 $B_s \geq 460 \text{ mT}$ (100°C)

0.5-1
MHz

TP5
($P_{cv} \leq 80 \text{ kW/m}^3$ (500kHz, 50mT)
 $B_s \geq 370 \text{ mT}$ (100°C)

TP5R (New)
($P_{cv} \leq 1100 \text{ kW/m}^3$ (1MHz, 100mT)
 $B_s \geq 430 \text{ mT}$ (100°C)

TP5-B (New)
($P_{cv} \leq 450 \text{ kW/m}^3$ (500kHz, 100mT)
 $B_s \geq 410 \text{ mT}$ (100°C)

2010年

2015年

2020年

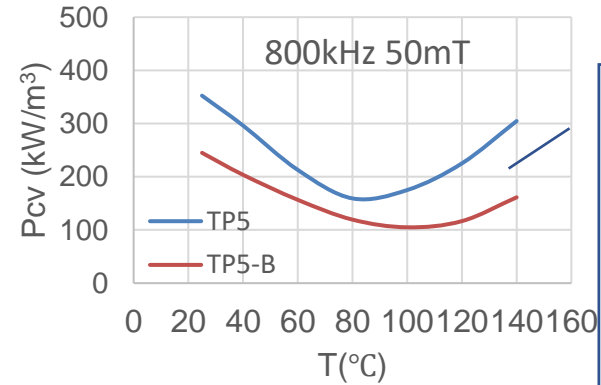
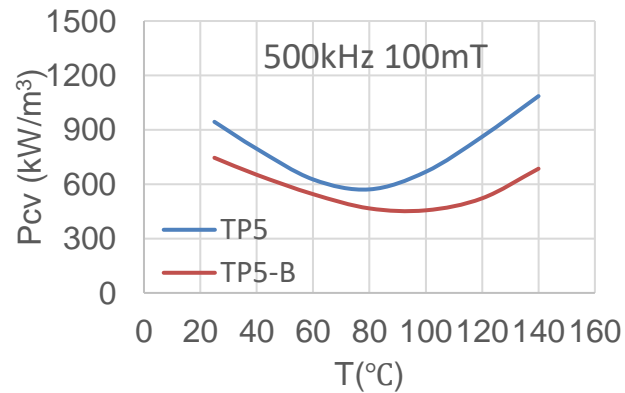
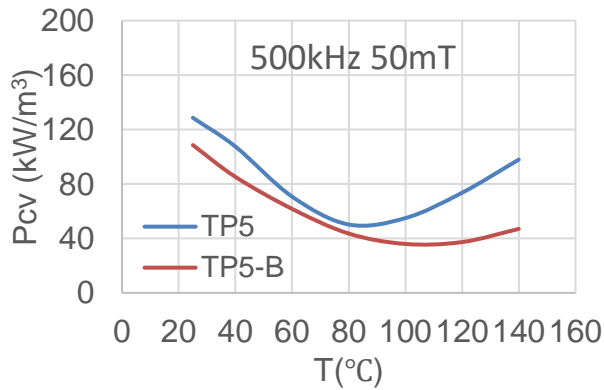
2025年

MnZn High-Frequency Materials-TP5-B(0.3-1MHz)

- OBC Main converter LLC integrates high frequency (180-700kHz) with low loss and high efficiency

OBCメインコンバータLLCは、高周波（180-700kHz）を低損失、高効率で統合しています。

Material			TP5	TP5-B New Material
Permeability μ_i		25°C	1400±25%	1200±25%
Flux density Bs(mT)	f=1kHz	25°C	470	500
	H=1194A/m	100°C	380	410
Core loss Pcv(kW/m ³)	f=500kHz B=50mT	25°C	130	130
		100°C	80	40
		140°C	-	55
	f=500kHz B=100mT	25°C	-	900
		100°C	-	450
		140°C	-	640
f=800kHz B=50mT	25°C	-	280	
	100°C	-	130	
	140°C	-	185	

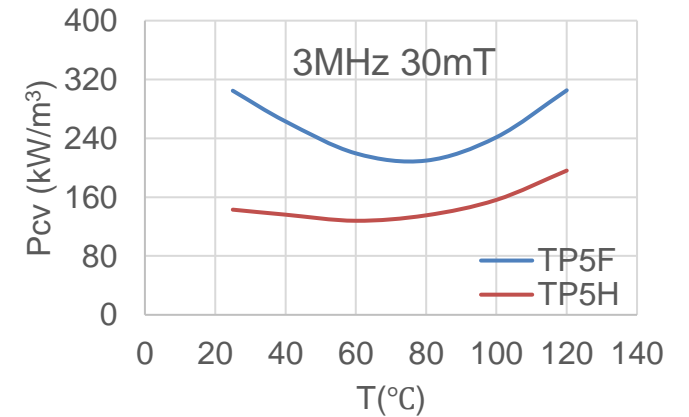
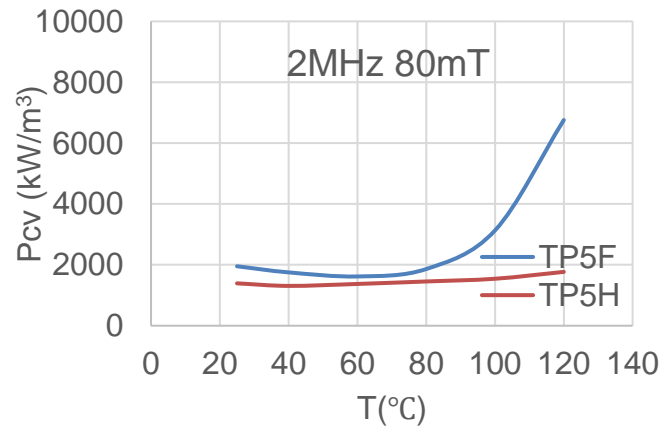
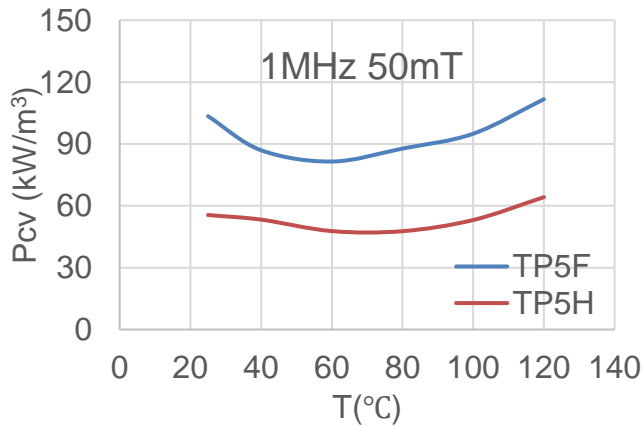


High temperature
loss reduction
35-50%

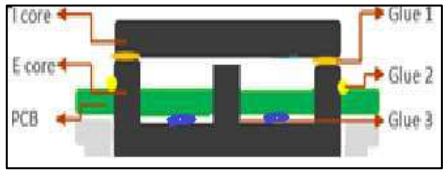
MnZn High-Frequency Materials-TP5H(1-3MHz)



Material			TP5F	DMR53	TP5H
Permeability μ_i	25°C		900±25%	900±25%	900±25%
Flux density	f=1kHz	25°C	510	560	550
Bs(mT)	H=1194A/m	100°C	430	460	460
Core loss $P_{cv}(\text{kW}/\text{m}^3)$	f=1MHz	25°C	200	100	80
	B=50mT	100°C	150	100	80
	f=2MHz	25°C	/	/	1600
	B=80mT	100°C	/	/	1800
	f=3MHz	25°C	550	230	200
	B=30mT	100°C	500	200	200
	f=5MHz	25°C	150	/	80
	B=9mT	100°C	150	/	80

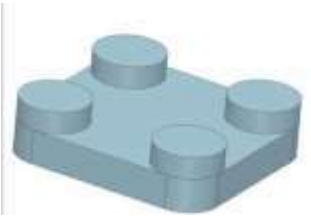


MnZn High-Frequency Materials-TP5R (0.8-1.5MHz)



High frequency high flux density material

·Greatly improve the power density

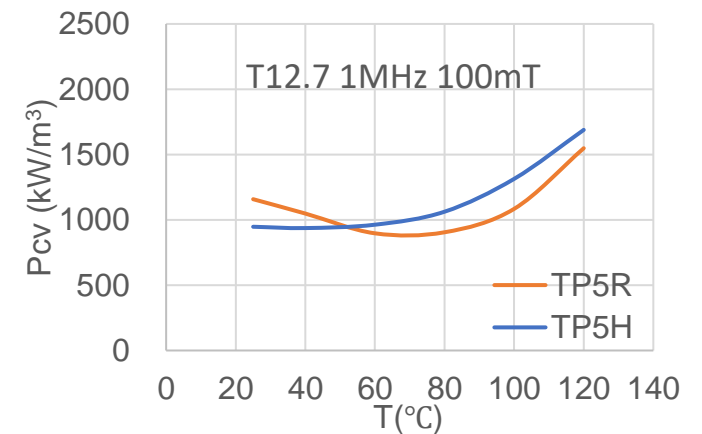
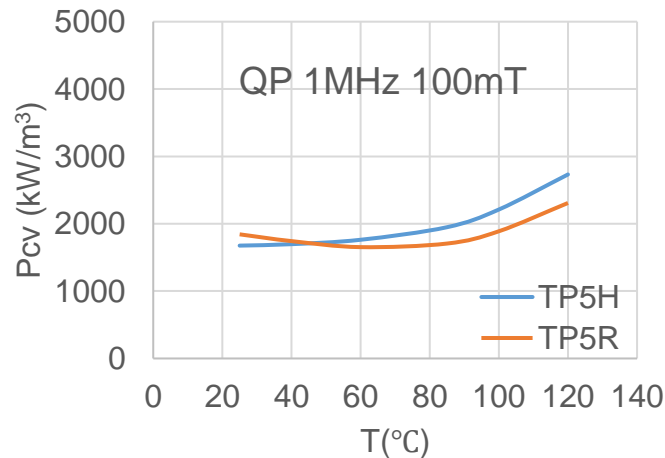
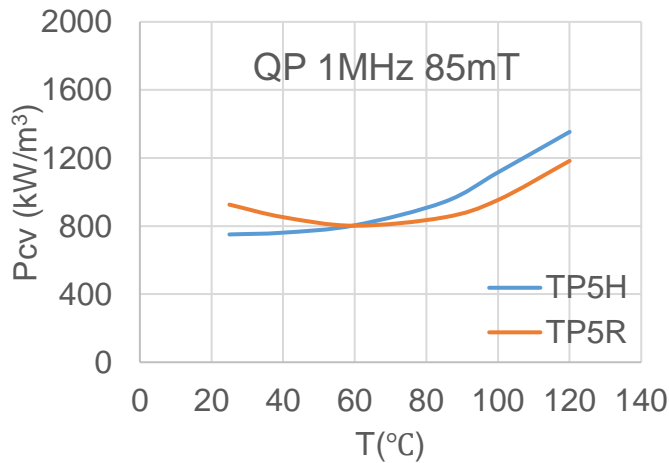


·Magnetic core miniaturization, magnetic integration design

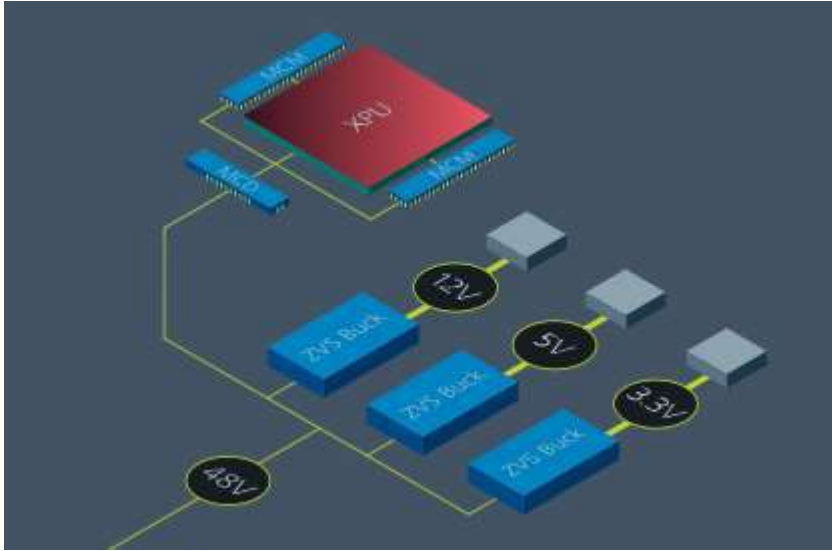


高周波高磁束密度 磁束密度材料
-大幅に改善 出力密度
-磁気コア 小型化 磁気統合 設計。

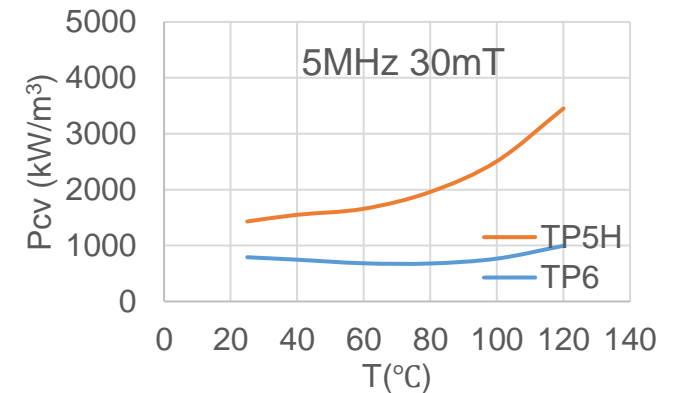
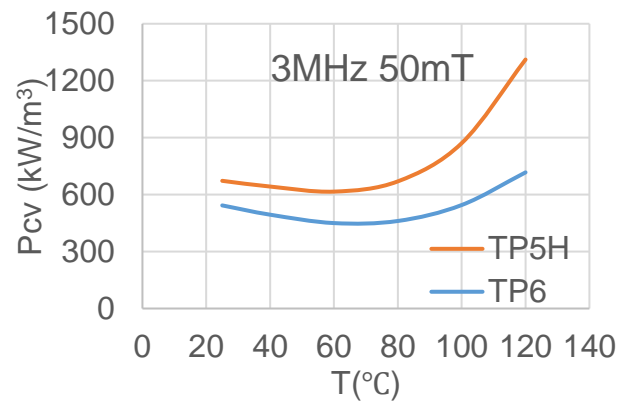
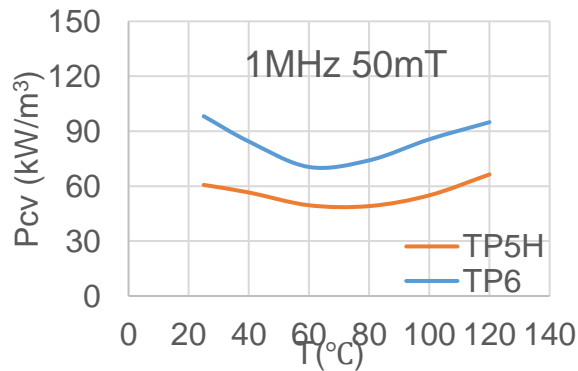
Material		TP5H	TP5R New Material
Permeability μ_i	25°C	900±25%	1100±25%
Flux density	f=1kHz 25°C	540	530
Bs(mT)	H=1194A/m 100°C	450	440
Core loss Pcv(kW/m ³)	f=1MHz 25°C	Typ1000	1200
	B=100mT 100°C	Typ1500	1100



MnZn High-Frequency Materials-TP6 (3-10MHz)



Material		TP5H	TP6 New Material
Permeability μ_i	25°C	900±25%	700±25%
Flux density	f=1kHz 25°C	550	510
Bs(mT)	H=1194A/m 100°C	460	430
Core loss Pcv(kW/m ³)	f=3MHz 25°C	700 _{Typ}	800
	B=50mT 100°C	900 _{Typ}	800
	f=5MHz 25°C	1500	800
	B=30mT 100°C	2500	800



03

EMI Ferrite Material

Broadband high impedance ferrite material

Through the formulation control, the material has high resistivity and maintains high impedance characteristics at high frequency

Compared with nickel zinc ferrite material, the cost is more advantageous



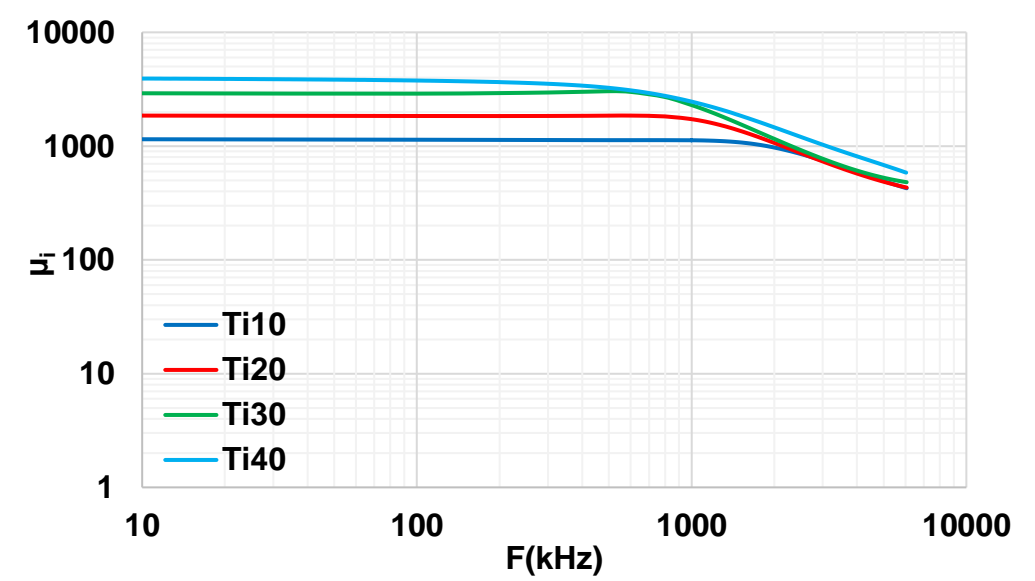
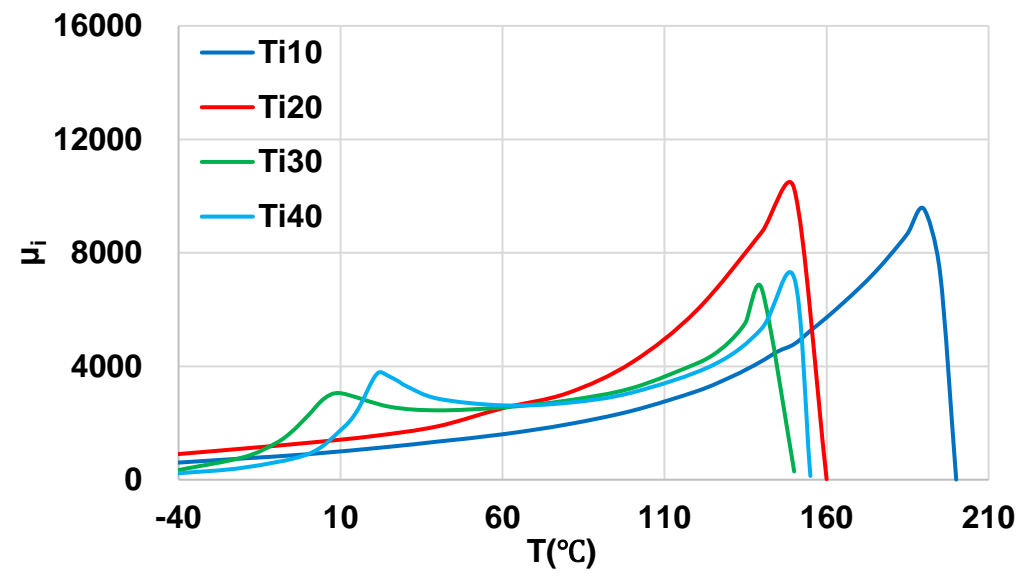
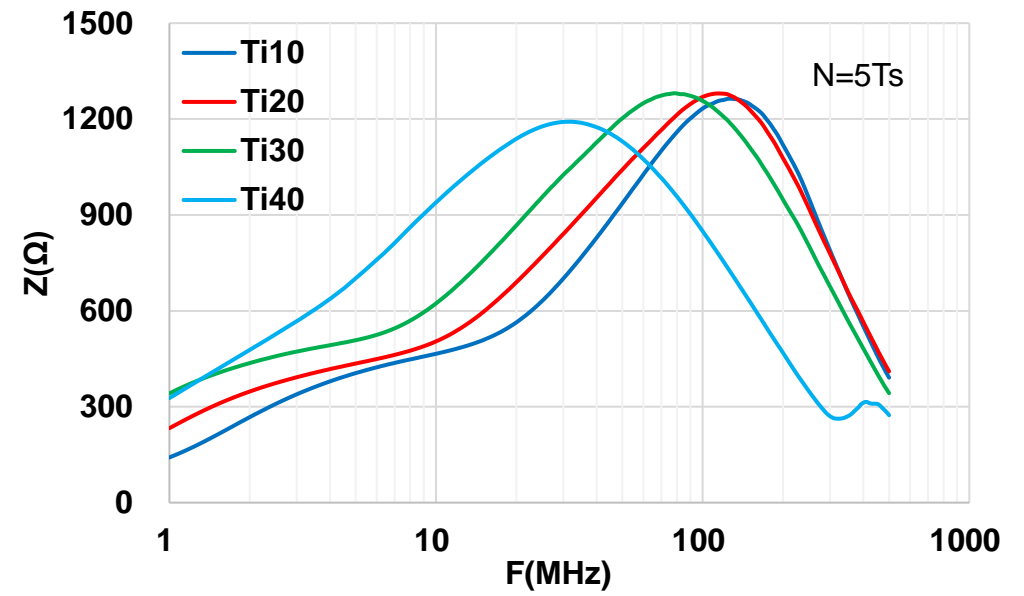
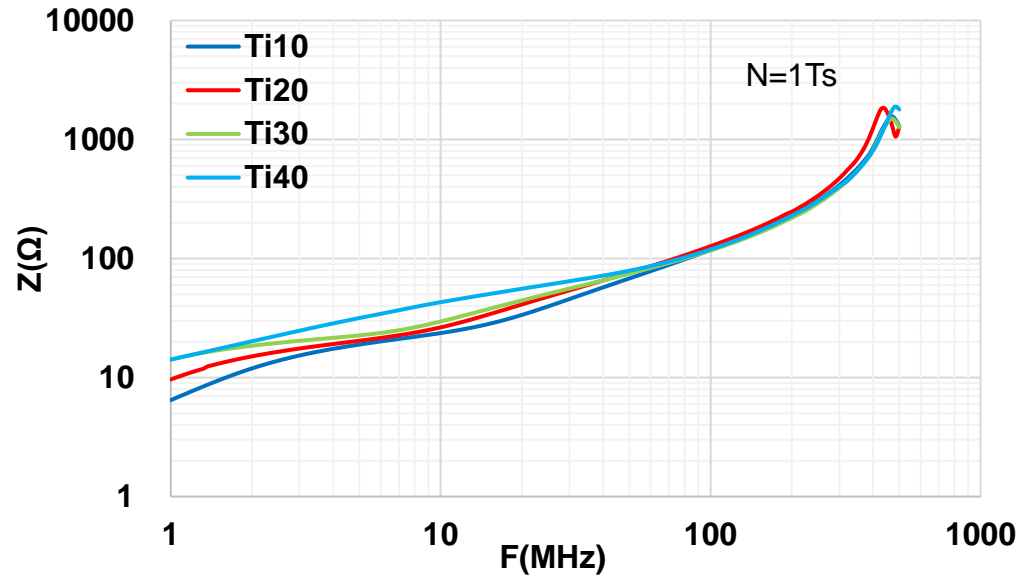
Considering the impedance characteristics of 10kHz-100MHz, it is beneficial to broadband filtering and saves filter design space

Compared with nickel-zinc ferrite material, the upper limit of permeability development is high, it can achieve more than 4000, the material potential is larger

Broadband high impedance ferrite material

Material			Ti10	Ti20	Ti30	<i>developing</i> Ti40
Permeability μ_i		25°C	1000 $\pm 25\%$	2000 $\pm 25\%$	3000 $\pm 25\%$	4000 $\pm 25\%$
Flux density Bs(mT)	f=1kHz H=1194A/m	25°C	440	420	400	400
Loss factor $\tan\delta/\mu_i$	10kHz $\times 10^{-6}$	25°C	<40	<20	<15	< 15
Impedance Z(Ω)	1MHz 25MHz 100MHz	25°C 25°C 25°C	6 40 120	8 55 110	10 55 110	10 50 110
Curie temperature Tc (°C)			≥ 170	≥ 150	≥ 150	≥ 150

Broadband high impedance ferrite material

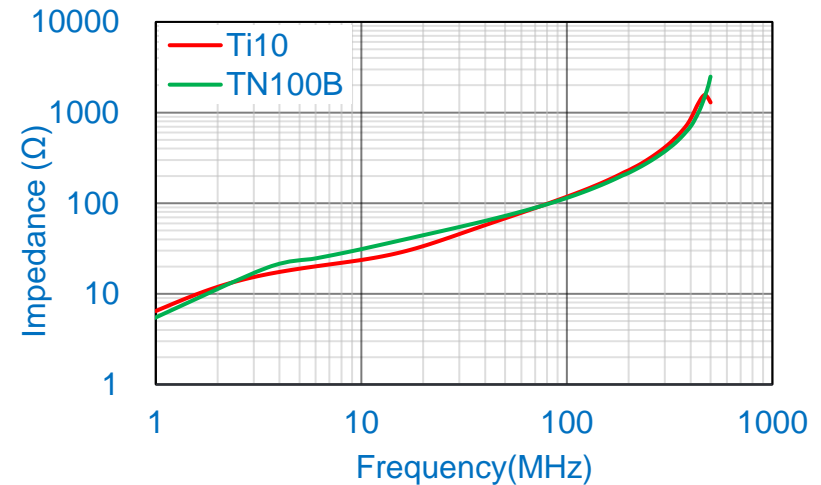


Broadband high impedance ferrite material

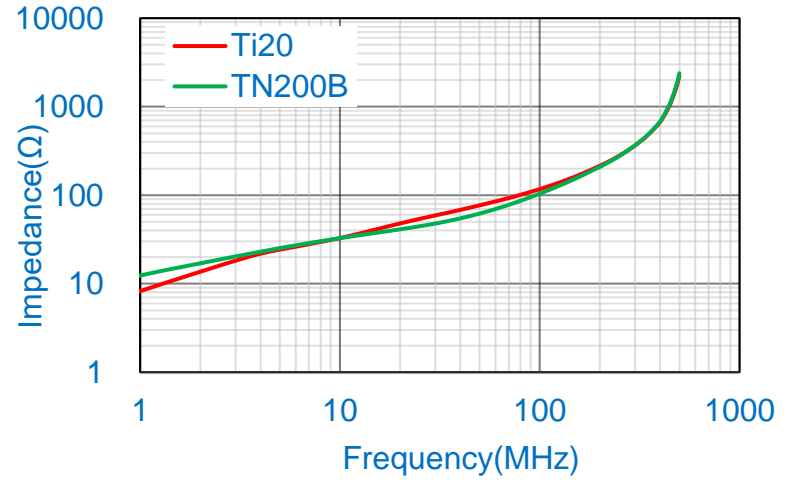
Ti系材料と他の材料とのインピーダンス比較し、Ti系は10MHzから100MHzのインピーダンス特性が優れている。

Impedance comparison between Ti series materials and other kinds of materials, Ti series materials have better impedance characteristics from 10MHz to 100MHz

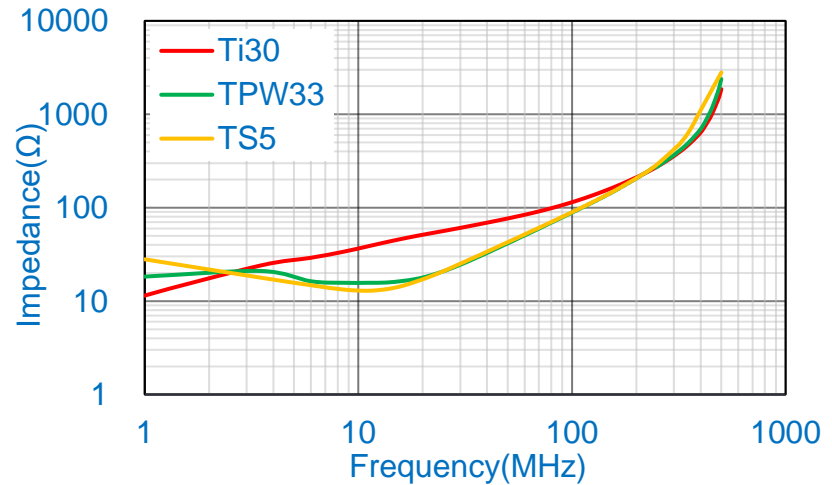
Impedance comparison Z-Frequency



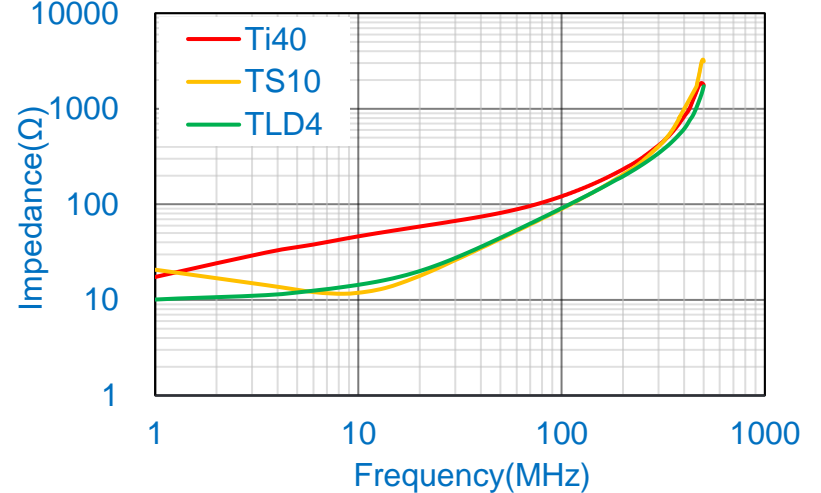
Impedance comparison Z-Frequency



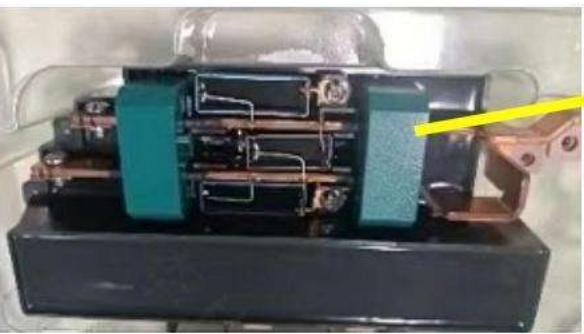
Impedance comparison Z-Frequency



Impedance comparison Z-Frequency



Broadband high impedance ferrite material

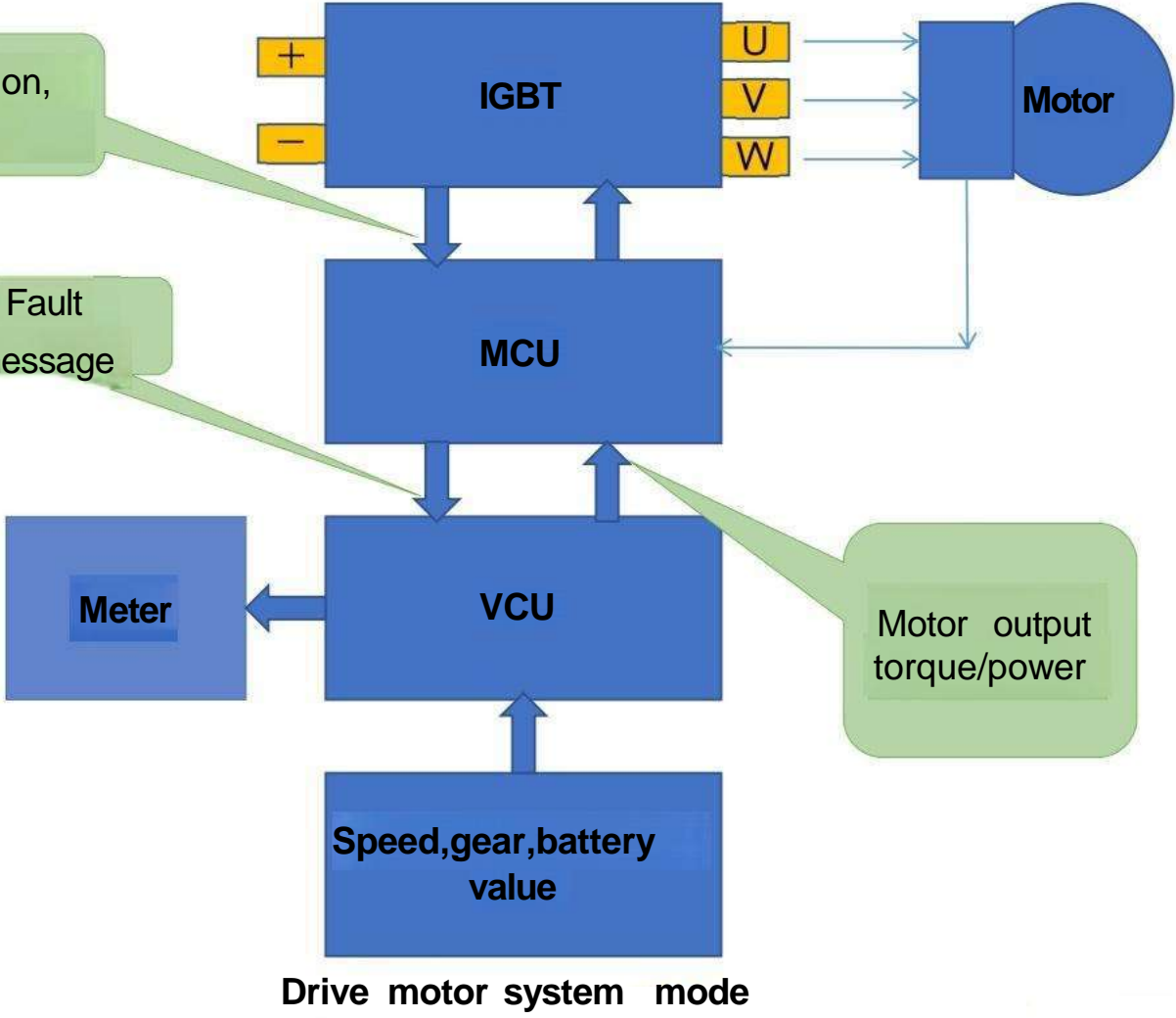


Temperature, insulation, current, voltage

Fault message

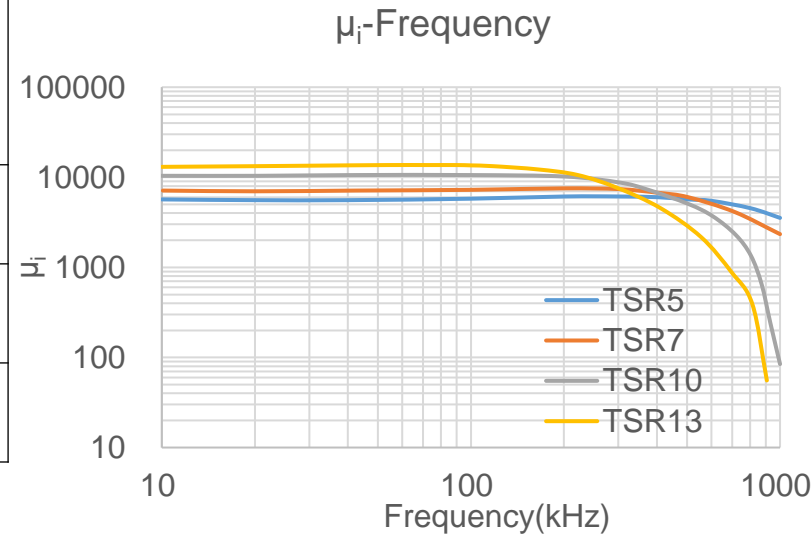
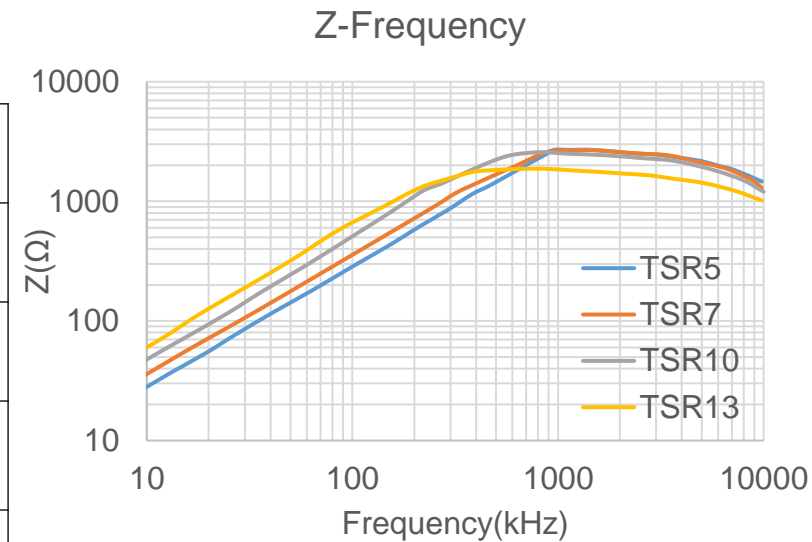


Ti30 —ET49.5 core is used for electric drive filtering

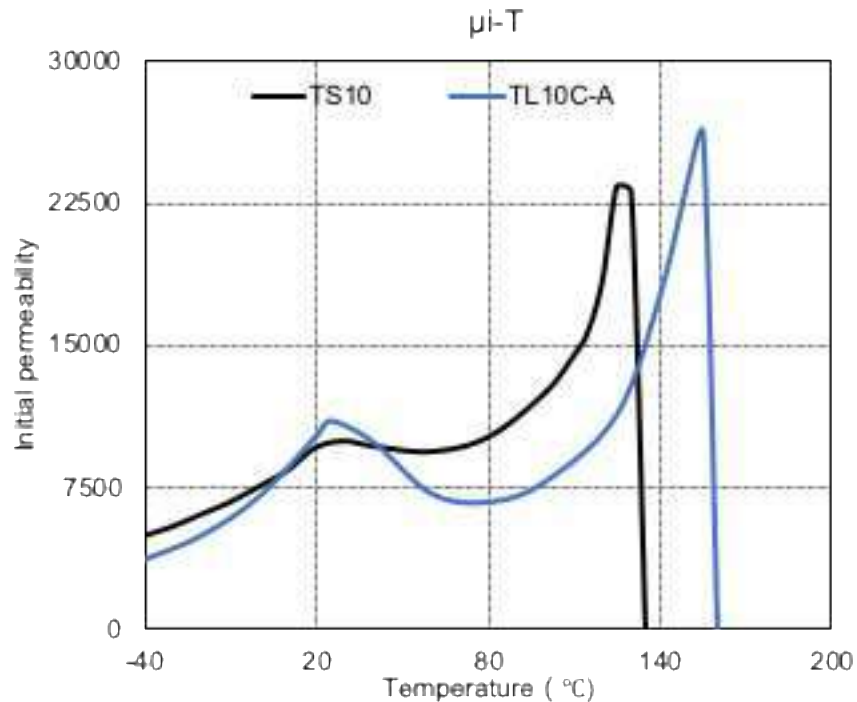


Broadband high permeability ferrite material

Materials			TSR5	TSR7	TSR10
Initial permeability	μ_i	10kHz	5500 $\pm 30\%$	7000 $\pm 30\%$	10000 $\pm 30\%$
			3000 (1MHz)	3500 (800kHz)	9500 (200kHz)
flux density	Bs(mT) 1194A/m	25°C	430	430	410
Relative loss factor	$\tan\delta/\mu_i$ ($10^{-6}/^\circ\text{C}$)	25°C 100kHz	<10	<15	<20
Relative temperature coefficient	$\alpha_{\mu i r}$ ($10^{-6}/^\circ\text{C}$)	20°C~60°C	-0.5~2.0	-0.5~2.0	-0.3~1.0
Curie temperature	Tc(°C)	10kHz	≥ 150	≥ 150	≥ 130
Electrical resistivity	$\rho(\Omega \cdot \text{m})$	/	1.0	0.3	0.2
Density	d(kg/m ³)	/	4.9×10^3	4.9×10^3	4.95×10^3



High reliability and high permeability material



			TL10C-A	TS10
Initial permeability	μ_i	25°C 10kHz	10000±30%	10000±30%
Flux density	Bs(mT)	25°C	470	380
Relative loss factor	$\tan\delta/\mu_i(\times 10^{-6})$	25°C 100kHz	< 30	< 30
Relative temperature coefficient	$\alpha_{\mu ir}(\times 10^{-6}/^{\circ}\text{C})$	20°C~60°C	-1.0~2.0	-0.5~2.0
Curie temperature	Tc(°C)		≥155	≥125
Electrical resistivity	($\Omega\cdot\text{m}$)		0.15	0.2
Density	d(kg/m ³)		4.9×10 ³	4.9×10 ³

Automotive grade temperature is -40°C~+125°C

High reliability and high permeability material



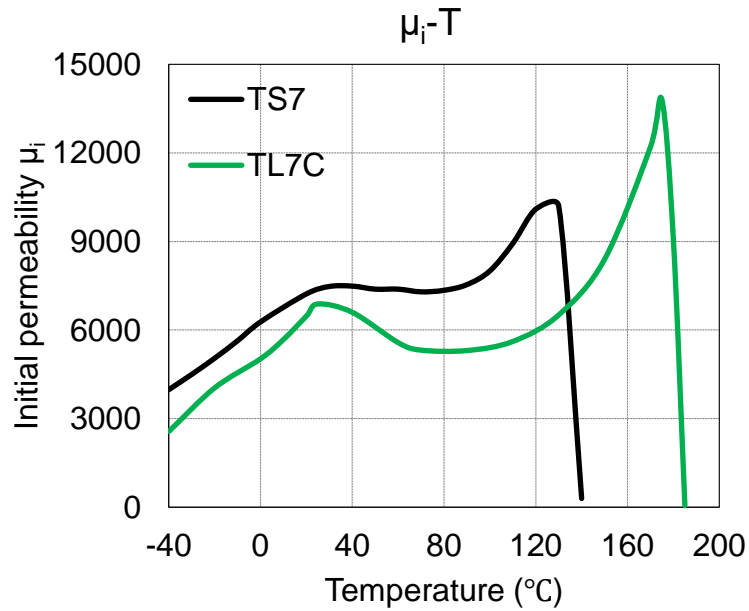
车载充电机



developing

			TL10C-A	TL10C-B
Initial permeability	μ_i	25°C 10kHz	10000±30%	10000±30%
		25°C 300kHz	/	9500±30%
Flux density	$B_s(\text{mT})$	25°C	470	480
Relative loss factor	$\tan\delta/\mu_i(\times 10^{-6})$	25°C 100kHz	< 30	< 30
Relative temperature coefficient	$\alpha_{\mu_{ir}}(\times 10^{-6}/^\circ\text{C})$	20°C~60°C	-1.0~2.0	-1.0~2.0
Curie temperature	$T_c(^\circ\text{C})$		≥155	≥155
Electrical resistivity	$(\Omega\cdot\text{m})$		0.15	0.15
Density	$d(\text{kg}/\text{m}^3)$		4.9×10^3	4.9×10^3

High reliability and high permeability material

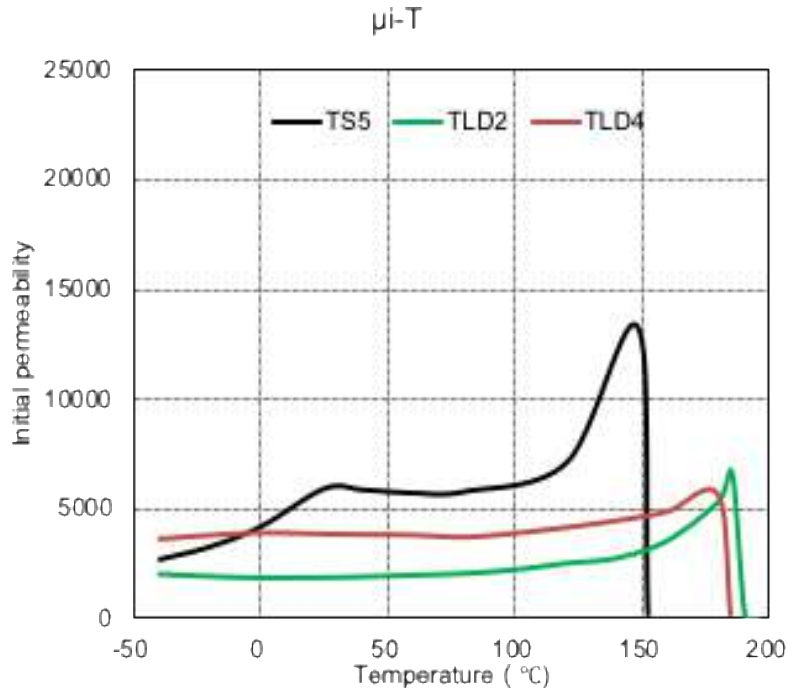


		TL7C	TS7
Initial permeability	μ_i	25°C 10kHz 7000±30%	7500±30%
Flux density	B_s (mT)	25°C 480	410
Relative loss factor	$\tan\delta/\mu_i(\times 10^{-6})$	25°C 100kHz < 20	< 20
Relative temperature coefficient	$\alpha_{\mu ir}(\times 10^{-6}/^{\circ}\text{C})$	20°C~60°C -1.0~1.0	-0.5~2.0
Curie temperature	$T_c(^{\circ}\text{C})$	≥180	≥125
Electrical resistivity	($\Omega\cdot\text{m}$)	0.15	0.3
Density	$d(\text{kg}/\text{m}^3)$	4.9×10^3	4.8×10^3

Low temperature coefficient ferrite material

TLD2&TLD4材料は、-40 から高温125 の範囲で温度係数が低い。

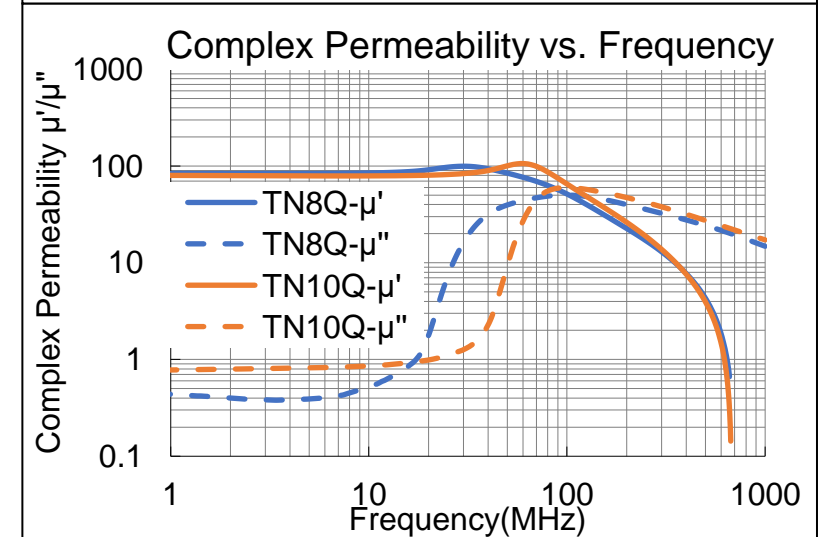
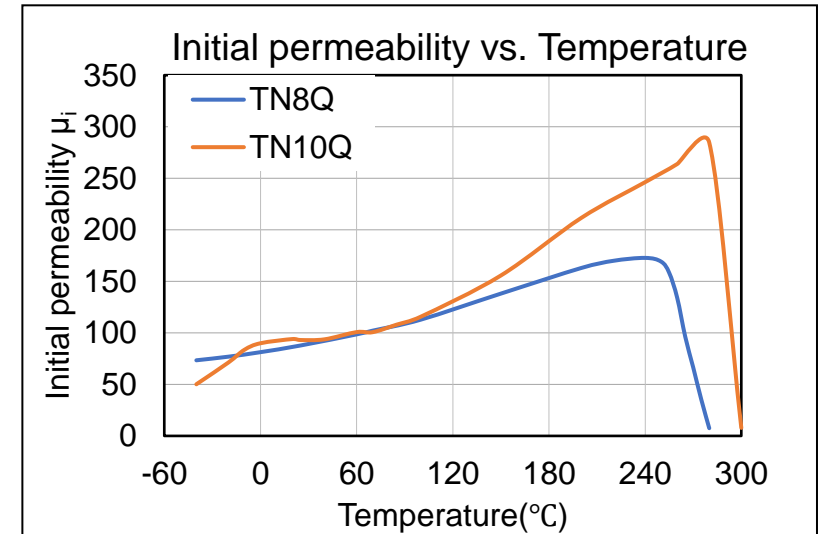
TLD2&TLD4 materials have low temperature coefficient in the range from -40°C to high temperature 125°C



			TLD2	TLD4
Initial permeability	μ_i	25°C, 10kHz	2300±25%	4000±25%
Saturation flux density	B_s (mT)	25°C	460	450
		1194A/m	/	315
Relative loss factor	$\tan\delta/\mu_i(\times 10^{-6})$	25°C, 100kHz	< 3	< 40
Relative temperature coefficient	$\alpha_{\mu ir}(10^{-6}/^\circ\text{C})$	-30~20°C	-0.5~0.5	
		0~20°C	-0.5~0.5	-1.0~1.0
		20~70°C	0~1.0	-1.0~1.0
Hysteresis Material Constant	$\eta B(10^{-6}/\text{mT})$	25°C, 10kHz, 1.5~3.0mT	<0.5	<0.5
Disaccommodation Factor	$D_F(10^{-6})$	25°C, 10kHz	/	<2
Curie temperature	$T_c(^\circ\text{C})$		≥170	≥170
Electrical resistivity	$\rho(\Omega\cdot\text{m})$	25°C	>7	1
Density	$d(\text{kg}/\text{m}^3)$		4.8×10^3	4.9×10^3

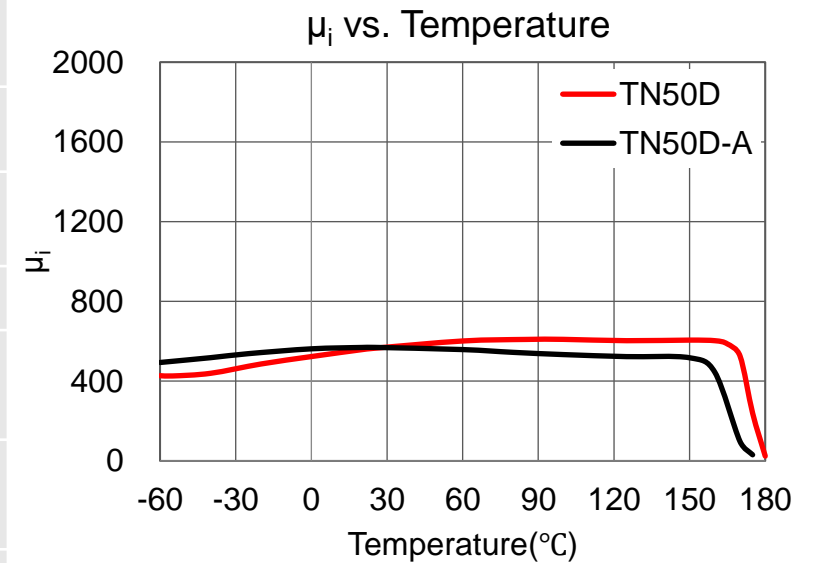
NiZn high Q material

Material				TN8Q	TN10Q
Initial permeability	μ_i	/	25°C	80	80
Flux density 4000A/m	Bs	mT	25°C	340	400
Relative loss factor	$\tan\delta/\mu_i$	$\times 10^{-6}$	25°C	/	/
Relative temperature factor	$\alpha_{\mu ir}$	$\times 10^{-6}/^{\circ}\text{C}$	20°C ~ 60°C	60	25
Curie temperature	Tc	°C	/	> 260	> 300
Density	d	g/cm ³	/	5.10	5.10



NiZn Low temperature coefficient material

Material				TN50D	TN50D-A
Current Status	Under Development				
	Ready for mass production			◎	◎
	Mass Production				
Initial permeability	μ_i	/	25°C	500	500
Flux density 4kA/m	Bs	mT	25°C	350	350
Relative loss factor 0.1MHz	$\tan\delta/\mu_i$	$\times 10^{-6}$	25°C	18	18
Relative temperature factor	$\alpha_{\mu ir}$	$\times 10^{-6}/^\circ\text{C}$	20°C ~ 60°C	1 20~60°C	2(-25~20°C) -2(20~80°C)
Curie temperature	Tc	°C	/	>160	>150
Density	d	g/cm ³	/	5.20	5.20



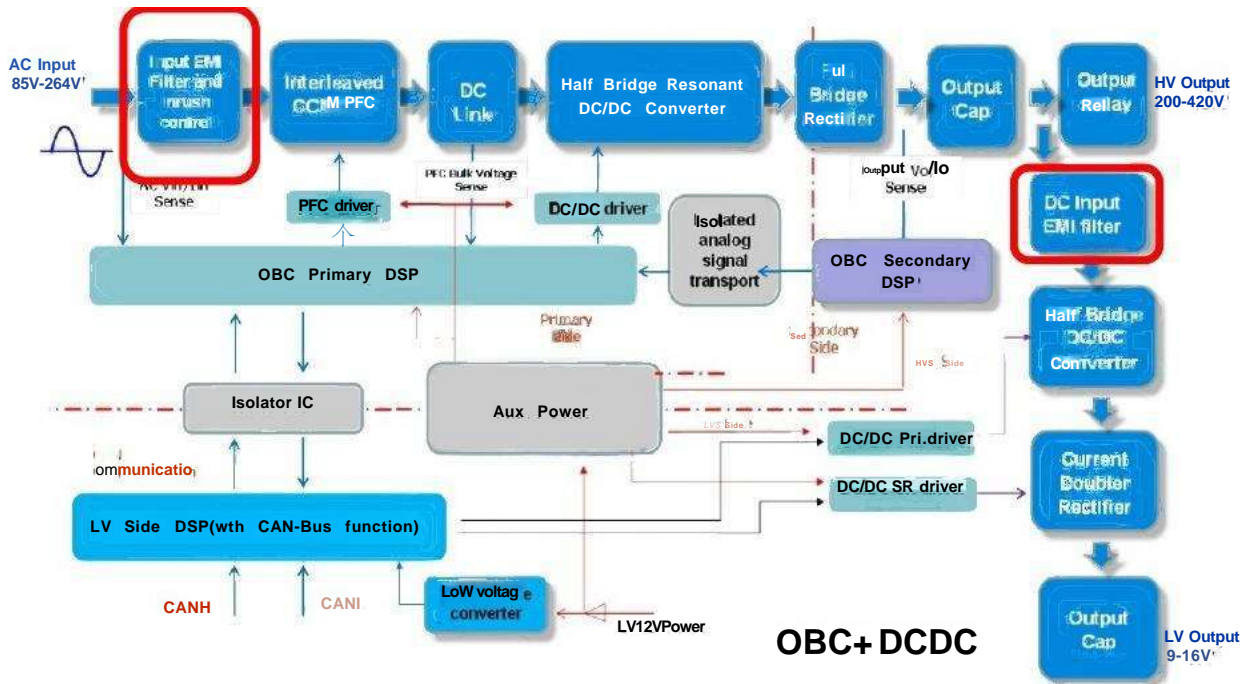
- Used at wide temp. & low $\alpha_{\mu ir}$ area.
- Main application: DRC、T and etc.

Application 1

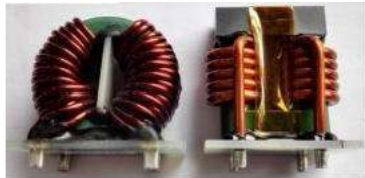


Filter

- ★ Input EMI filters.
- ★ CMC in PFC/OBC/DCDC/CAN BUS
- ★ High μ i High Z materials



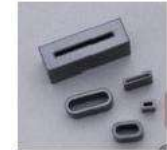
CMC:



CAN BUS Choke:



E-Driver Filter:



Application 2



Different kinds of Chokes using as inductor or filter .
Working on 12v motors or CAN -BUS EMI .

インダクタ or フィルターとして使用される異なった種類のチョーク。
12Vモーター or CAN-BUS EMIで使えます。

EMI filters in brushes of motors
(wipers, windows, fan, seat adjuster, fuel
pump...)
Core shape : NiZn ROD core



EMI common mode suppression on main
controller
Core shape : MnZn core---T / RH



EMI differential suppression on control PCB's
Core Shape: MnZn core---I Bar

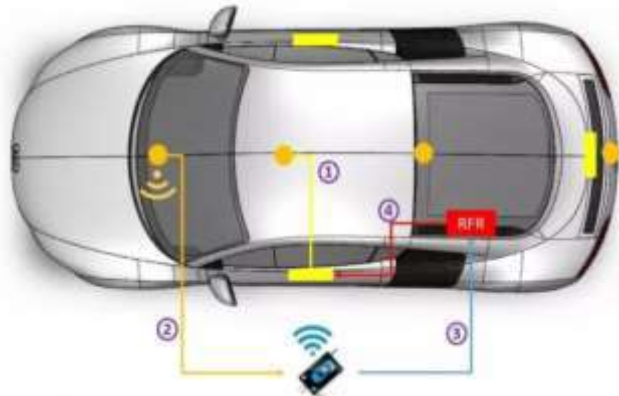



Application 3



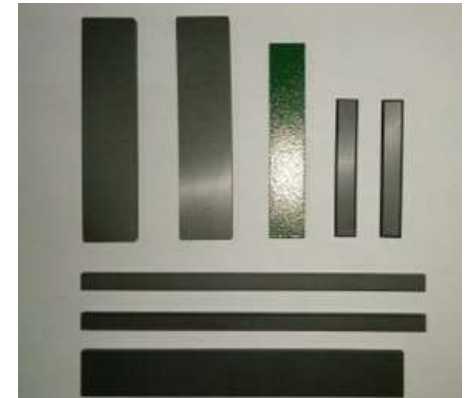
PEPS: Passive Enter Passive Start
TX Modules: 3D smart Key , RX Modules: Handle Antenna Bar

PEPS



- Low Frequency Antenna
- Door Handle Antenna Bar
-  3D Smart Key

Handle Antenna : Low Frequency 125 KHz
Core Shape: MnZn core---I Bar



Power Ferrite Materials Cross Reference between TDG and other companies

μ_i	Series	TDG	TDK	FERROXCUBE	JFE	ACME	DMEGC	A-CORE	NCD	
2300	Low loss	TP4	PC40/N67	3C90	MB3	P4	DMR40	JPP-4	LP3	
2400		TP4A	PC44/N87	3C94	MB4	P41	DMR44	JPP-44	LP3A	
2500		TP4D	PC47	3C98			DMR47	JPP-44A	LP3S	
2500	Low loss at low temperature	TP4B	PC45							
3200		TP4C	PC46/N51				DMR46			
3000		TPG30		3C91						
1800	Low loss at high temperature	TP4F		3C93			DMR25	JPP-4T		
2000		TP4S		3F3		P5	DMR44T			
2300		TPW23					DMR98			
3000		TPW30		3C97		P45		JPP-97		
1500	High Bs and low loss	TP4E	PC33				DMR21			
2000		TP4G	PE90		MB1	P42				
1200		TPB12								
1600		TPB16		3C92A			P491	DMR28	LP4A	
2200		TPB22	PC90	3C96	MB1H	P49	DMR90	JPP-90	LP90	
3300	Wide temperature and low loss	TPW33	PC95	3C95	MBT1/MBT2	P47	DMR95	JPP-95	LP9	
3300		TPG33			MBT3			JPP95A	LP9A	
3500		TPG33B				MBT3		DMR96/DMR96A	JPP97	LP10/LP10A
3300		TPG33C						DMR97		
3300		TPG33-A		3C95F						
2600		TPF26								
1400	High working Frequency	TP5	PC50/N49	3F36	MC2	P51	DMR50		LP5	
1200		TP5-B		3F4		P53	DMR51/DMR50B	JPP-5A	LP6	
900		TP5H	PC200	3F45			P61/P63	DMR53	LP7	
700		TP6		3F5				DMR52W		

High μ Ferrite Materials Cross Reference between TDG and other companies

Series	TDG	TDK	FERROXCUBE	JFE	ACME	DMEGC	A-CORE	NCD
Wide temperature	TLD2							LT1
	TLD4				A044			
	TLD5						JPH-5/JPH-5L	
	TLD10							
High Permeability	Ts5	T65	3E25/3E27	MA055	A05	R5K		HP1
	Ts7	HS72/T36/T37	3E26	MA070	A07	R7K	JPH-7F	HP2
	Ts10	HS10		MA100	A10/A102	R10K	JPH-10F	HP3
	TL5C							HPB
	TL7C							
	TL10C-A					A104		
	TL13		3E6	MA120	A121	R12K		
TL15	H5C/3T46		MA150	A151	R15K			
High impedance	TSR5		3E65					
	TSR7				A071			
	TSR10	T38	3E10			R10KZ		HP3Z
	TSR13	T66			A13	R12KZ		
THD	TH2	N48			N4	DMR70		
	TH4	HP5/T57			A043/N2			
	TH7	H5B2			N07			
	TH10	T38			A101			
High Current	TD3	H5A						
	TD5B	N45	3S5		N42	DMR71	JPB45	
High Frequency High impedance	Ti10	HF60						HFZ
	Ti20					DMR31	JPZ-2	
	Ti30					DMR32	JPZ-3	
	Ti40							

NiZn Ferrite Materials Cross Reference between TDG and other companies

μ i	TDG	TDK	FDK	HITACHI	FERROXCUBE	HUOHYOW
18	TN2D	T6F	F14F			
55	TN6D	T5FB			4D2	HD9
120	TN12B	Q5F		ND12S	4C65	
200	TN20H	L9H				
200	TN20B		K41H	NL25S		TB50
250	TN25B		L19H			TB48
250	TN25H			NH25S		T13SH
350	TN35B		L51	NL40S		TB46
350	TN35H		L51			TB46SH
400	TN40H	L2H	L33H	NH45S		T12SH
400	TN41H					
500	TN39H					T8S, T8SH
650	TN65B		L42H	NB65S		TL70
650	TN65H		L42H	NH65S		TL70H
800	TN80L	L7R	L47	NL80S	3R1,4A11,4S2	TL80
800	TN80G					
900	TN90H					
1000	TN100B	HF60	L55	NP10D		TL10D
1200	TN120L			NL12D	4A15	
1300	TN130G	HF65				
1500	TN150P	HF70		DL-2		TL16D
2000	TN200B		L68	NP20D	4A20,4S60	T25S

TDCG

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