CSC Soft Magnetic Powder Cores

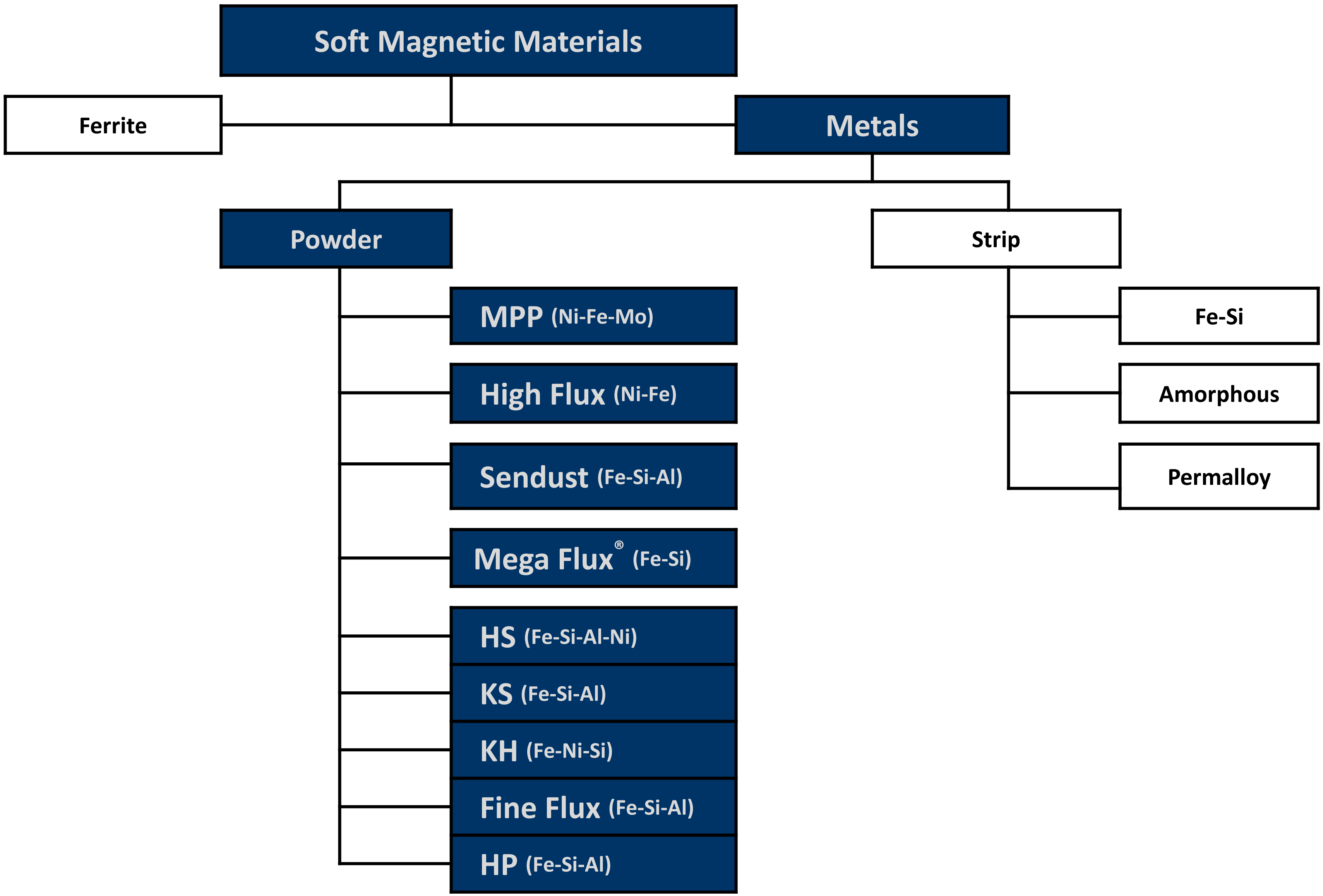
CSC Core Division

Section 1. About CSC Cores

Section 2. CSC Cores for Applications

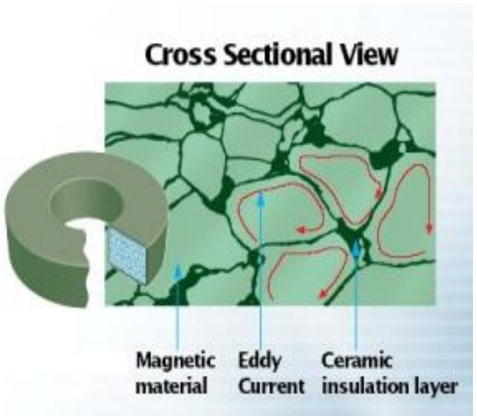
Section 1.
About CSC Cores

I. Soft Magnetic Materials



II. Soft Magnetic Powder Cores

■ What is Magnetic Powder Core ?

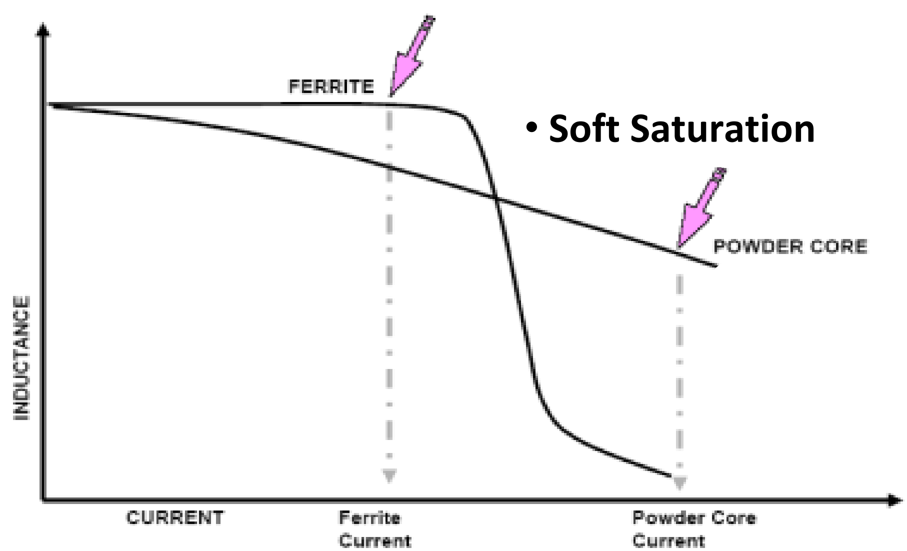


- Made from ferrous alloy powders
- Evenly **distributed air gap**
- **Low core losses** at high frequency
- Nearly no magnetic leakage flux
- **High DC Bias** characteristics

- Higher DC Bias at Large Current
- Lower Core Loss
- Minimized Audible Noise
- Free from Leakage Flux

→ No Heating & EMI Noise

■ Advantages of Distributed Air Gap



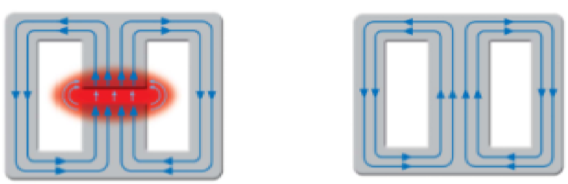
Large Air Gap	Distributed Air Gap

↓

Lower effective perm.(μ_e)

↓

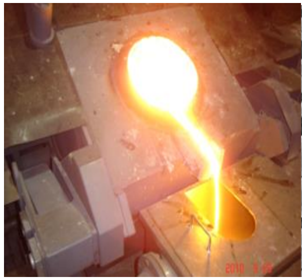
Better DC-Bias

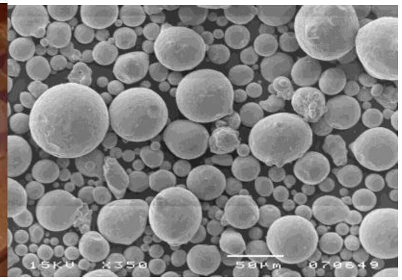


II. Soft Magnetic Powder Cores

Material			Perm.(μ)	Bs(kG)	Core Loss	DC Bias	Temp. Stability	Curie Temp(℃)
Powder	Ni-Fe Alloy	MPP	26-200	7	Lower	Good	Best	450
		High Flux	26-160	15	Low	Best	Better	500
		HS	60-90	13	Low	Better	Better	500
		KH	26-90	16	Medium	Best	Better	600
	Fe-Si Alloy	Mega Flux®	26-90	17	Medium	Best	Better	700
	Fe-Si-Al Alloy	KS	26-60	14	Medium	Better	Good	500
		HP	19-60	8.5	Lowest	Better	Good	500
		Fine Flux	26-60	12	Low	Better	Good	500
		Sendust	26-125	10	Low	Good	Good	500
	Iron		10-100	10	Highest	Poor	Poor	770
Strip	Fe-Si Strip (Gap)			20	High	Better	Good	740
	Amorphous (Gap)			15	Low	Better	Good	399
Ferrite	Ferrite (Gap)			3-5	Lowest	Poor	Poor	100-300

III. CSC's Soft Magnetic Powder Cores





Power of Stable High Quality

- In house Powder Making
- Accumulated Know-how for various powders
- Continuous Research and Development

■ Manufacturing process

Powder Making → **Ceramic Insulation** → **Pressing** ↓ **Core Annealing** → **Core Finish (Coating)** → **Inspectio Packing**

Powder Making
- Gas/Water Atomization
- Control of particle distribution & magnetic property

Ceramic Insulation
- Control of air gap, Core loss & Q value

Pressing
- Core shape & size

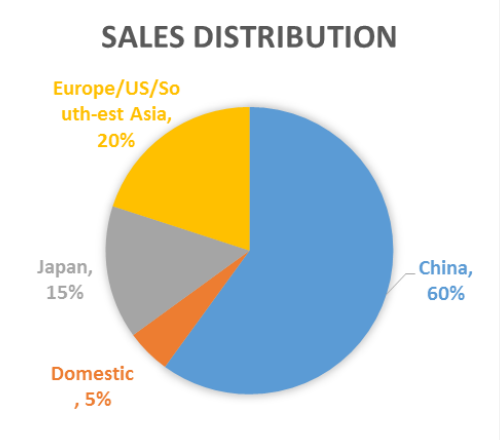
Core Annealing
- Control of magnetic property
- Core strength

Core Finish (Coating)
- Epoxy coating
- Anti-rust treatment

Inspectio Packing
- L, Q, DCB, Appearance
- Vacuum packing for uncoated core

- **Capacity**: 16Milion pcs/Month
- **Facilities:** 20~3000Tons press machines
  Basic analysis equipment
  Reliability test machines
  Automatic L/Q machines etc

III. CSC's Soft Magnetic Powder Cores



● Pyeongtaek Korea factory

- MPP Powder, MPP Cores, KH Cores,
- Customized special shape cores

(More for customized, small & special production)

● Weihai China factory

- Toroidal cores of HF, MF, HS, HP, CF, KS, SD
- Special shape cores of KEQ, SEQ, RK etc
- Powders of HF, MF, SD, HP
- Core finish (epoxy coating) line

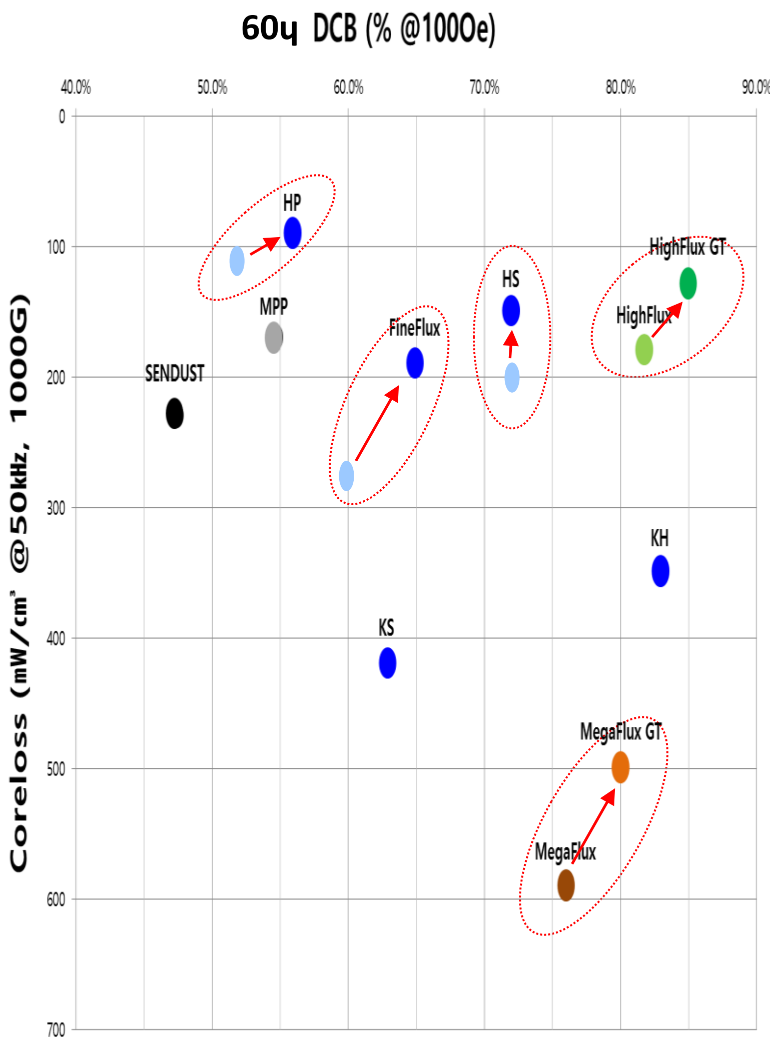
(More for mass production)

*Factory	PT	WH	Total
Employees	60	142	200

III. CSC's Soft Magnetic Powder Cores

◆ 2019 Improved Property in 60ų Toroidal Cores (Typ.)

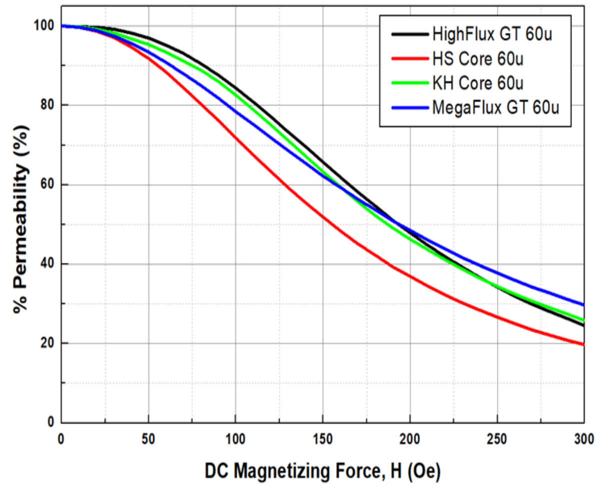
Materials	Part No# Identification	Available Perm.(ų)	Max. Bs(kG)	DC Bias		Core Loss[mW/cm^3] @50kHz, 1000Gauss	
				26ų @ 200 Oe	60ų @ 100 Oe	26ų	60ų
High Flux	CH270060G	26-160	15	82%	82%	230	180
High Flux Titanium	CH270060GT	60	15	—	85%	—	130
Mega Flux	CK270060G	19-90	17	82%	76%	661	590
Mega Flux Titanium	CK270060GT	60	17	—	80%	—	500
MPP	CM270060G	26-200	10	60%	55%	170	170
KH	KH270060G	26-90	16	85%	83%	469	350
HS	HS270060G	60-90	13	—	72%	—	206 -> 150
HP	HP270060G	19-60	8.5	75%	53% -> 56%	136	110 -> 90
Fine Flux	CF270060G	26-60	12	74%	59% -> 65%	273	273 -> 190
KS	KS270060G	26-60	14	71%	63%	565	420
Sendust	CS270060G	26-125	10	50%	48%	230	230

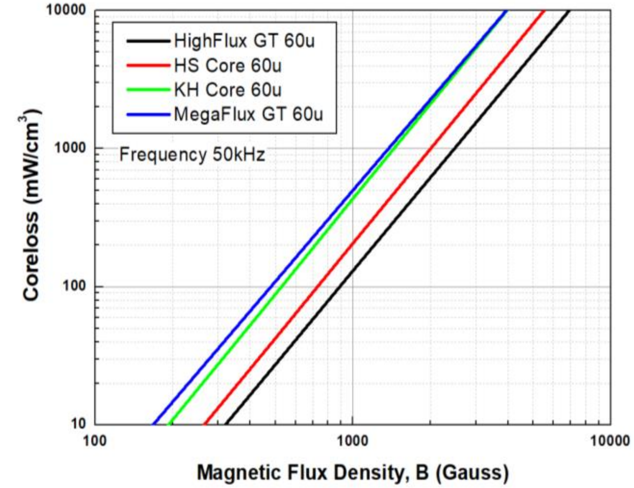


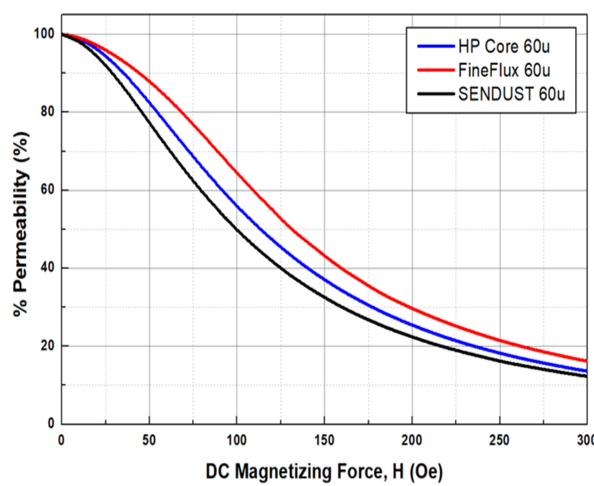
III. CSC's Soft Magnetic Powder Cores

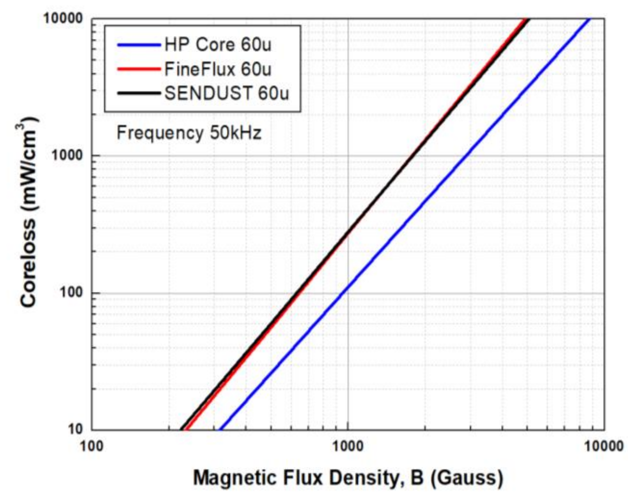
◆ 60u Toroidal Core Comparison data

	DCB (%)			Core Loss (㎽/㎤)	
	50 Oe	100 Oe	200 Oe	50㎑ 1000G	100㎑ 500G
HF GT	97	85	48	130	70
HF	95	82	45	180	90
HS	91	72	37	150	80
KH	95	83	46	350	180
MF GT	93	80	48	500	280
MF	93	76	49	590	330
Fine Flux	88	65	30	190	100
HP	82	56	25	90	60
SD	77	48	22	230	120





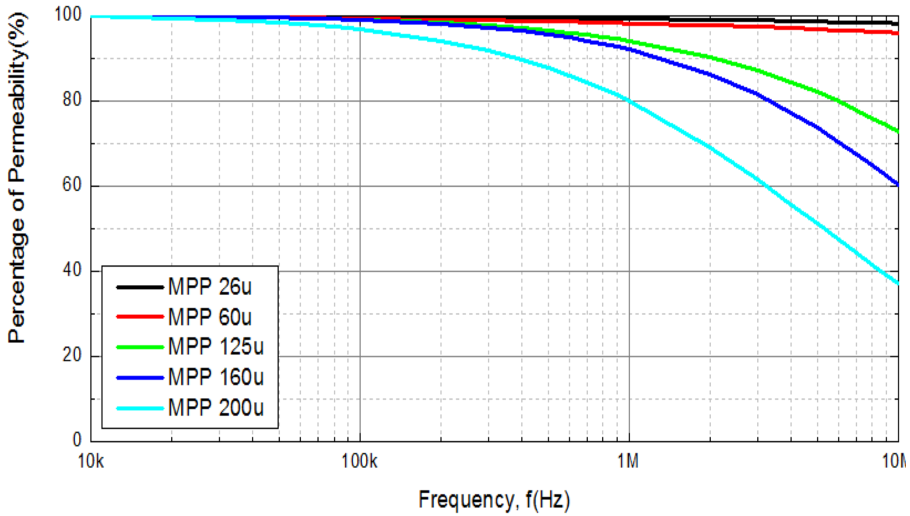




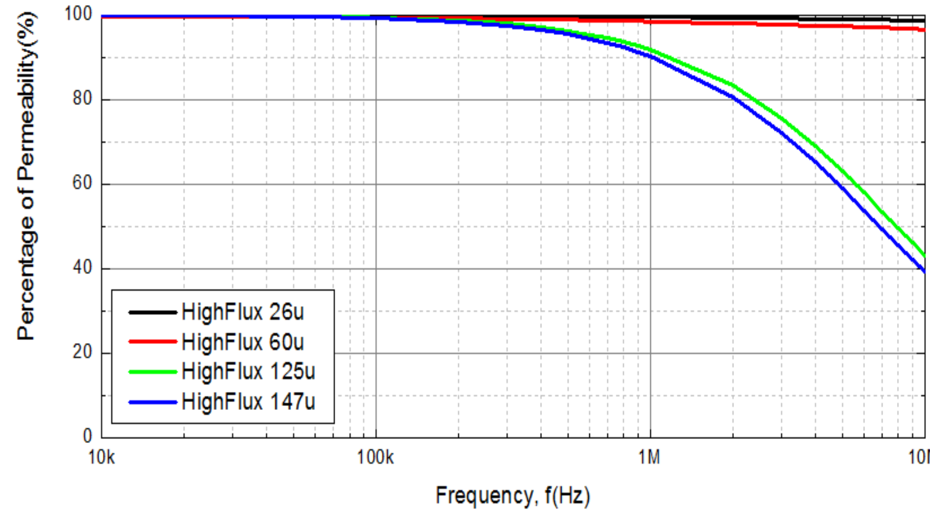
III. CSC's Soft Magnetic Powder Cores

◆ Permeability vs. Frequency Curves

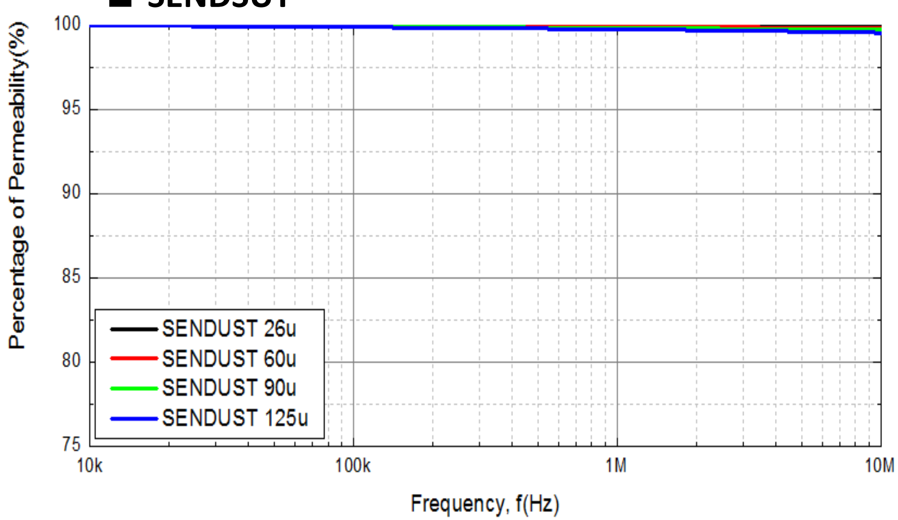
■ MPP



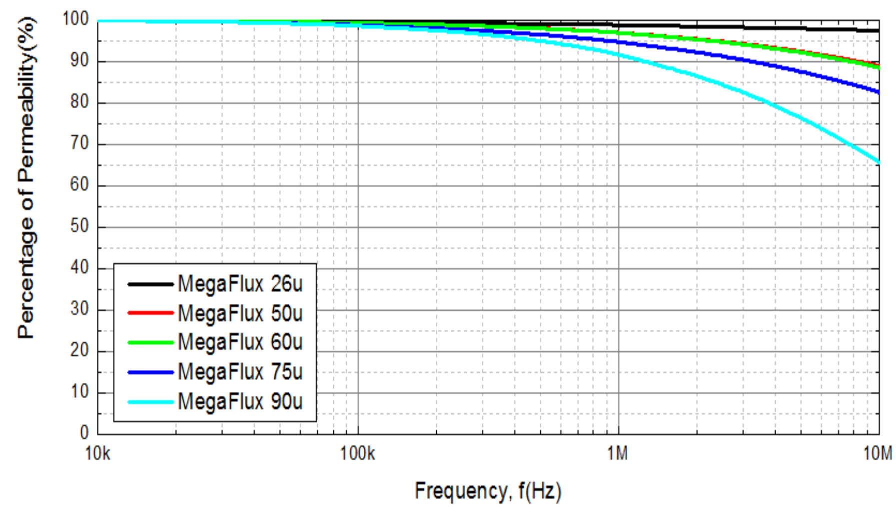
■ HighFlux



■ SENDSUT



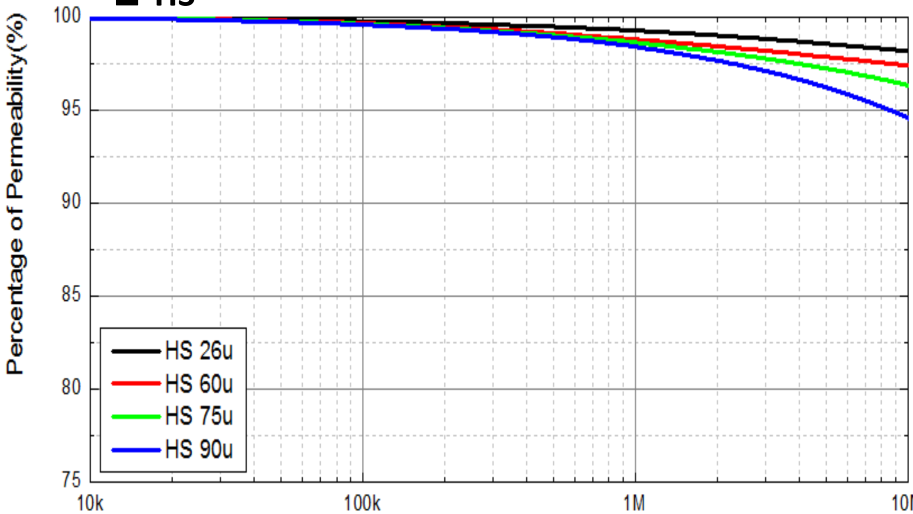
■ MegaFlux®



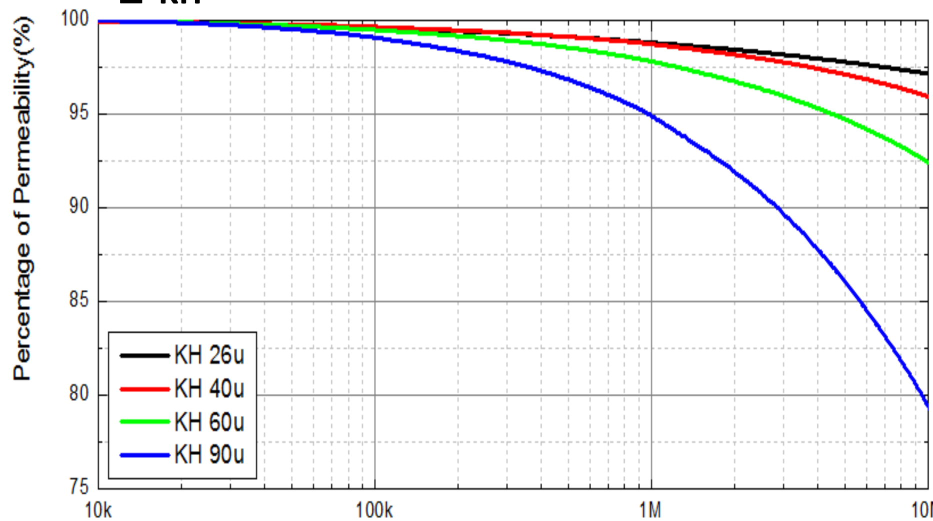
III. CSC's Soft Magnetic Powder Cores

◆ Permeability vs. Frequency Curves

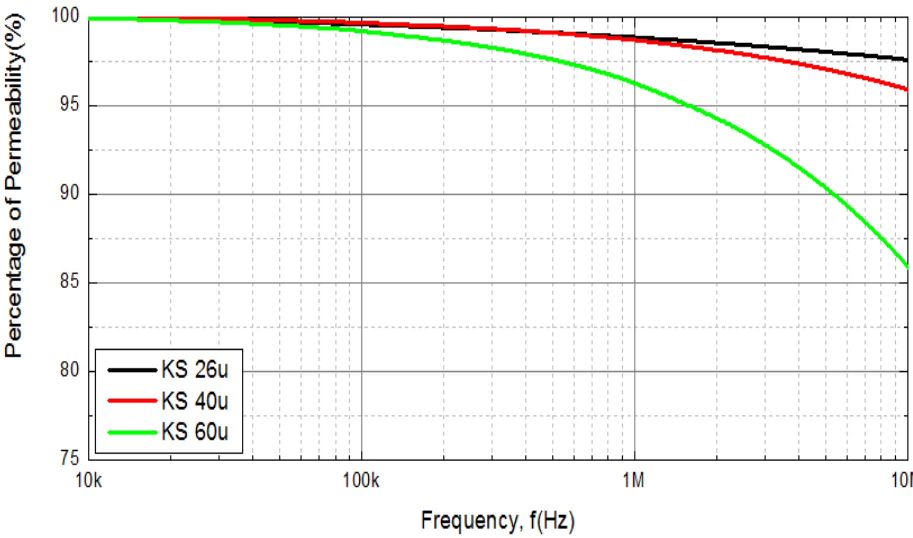
■ HS



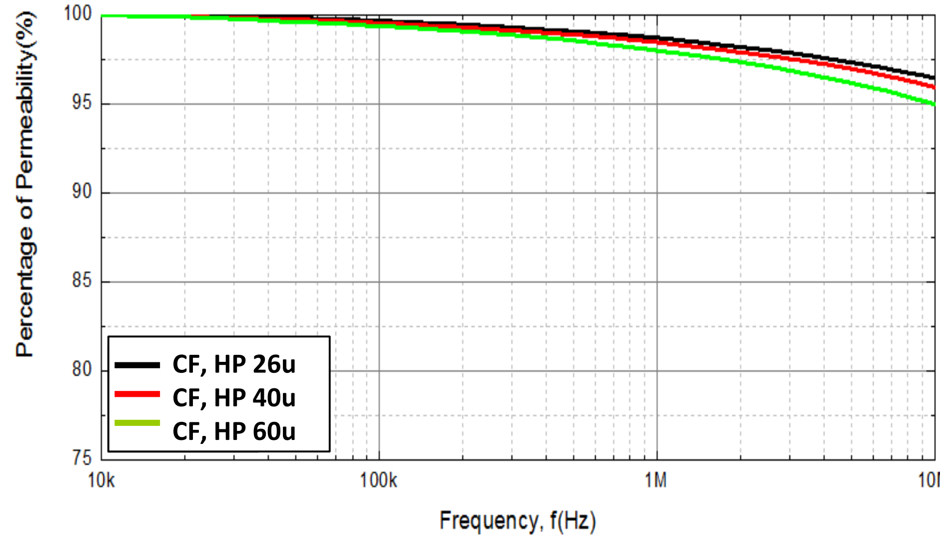
■ KH



■ KS

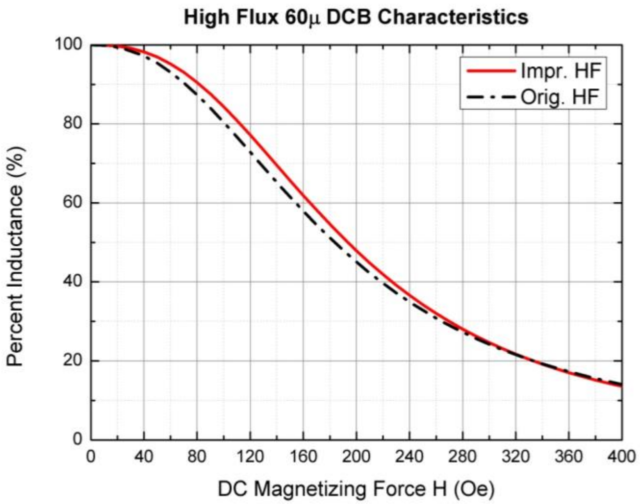


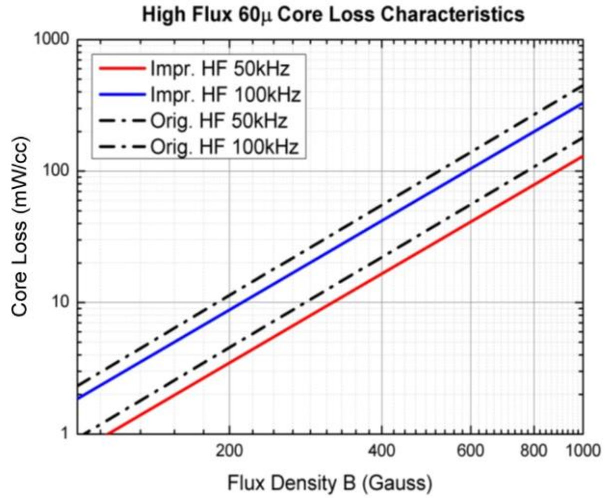
■ FineFlux, HP



IV. CSC's Titanium Line (Grade 'GT')

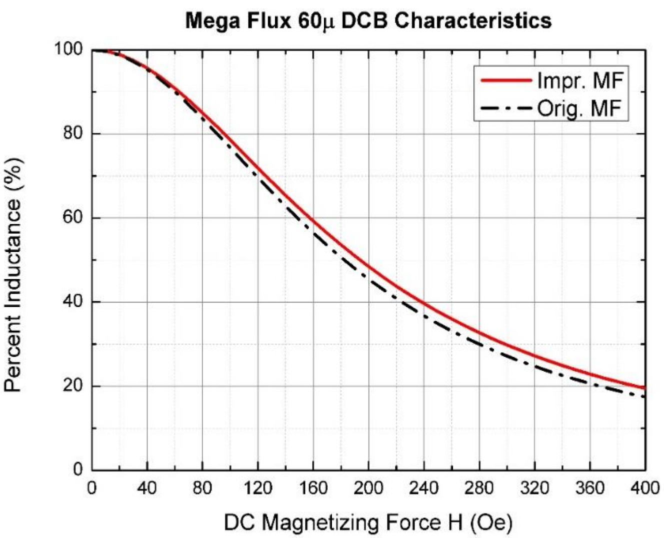
◆ Property of Titanium Line (GT) _ High Flux 60μ & Mega flux 60μ

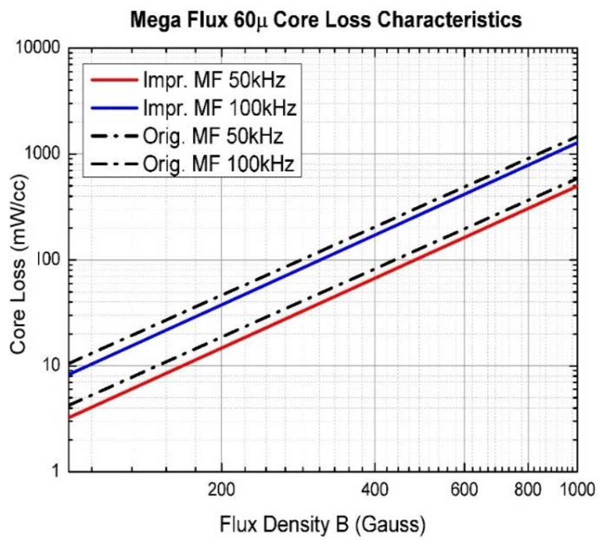




High Flux GT DC-Bias (%)		
@50 Oe	@100 Oe	@200 Oe
97%	85%	48%

High Flux GT Coreloss (㎽/㎤)		
@50 ㎑ 500 G	@50 ㎑ 1000 G	@100 ㎑ 1000G
27.4	130	330





Mega Flux GT DC-Bias (%)		
@50 Oe	@100 Oe	@200 Oe
93%	80%	48%

Coreloss (㎽/㎤)		
@50 ㎑ 500 G	@50 ㎑ 1000 G	@100 ㎑ 1000G
109.5	500	1280

IV. CSC's Titanium Line (Grade 'GT')

◆ Customer's Feedback about Hight Flux GT

2.2kW Server Power PFC choke Efficiency Comparison

P/N	Efficiency
CH270060G18	95.887%
CH270060GT18	96.187%

Titanium Grade

96% @ 230V, 50% Load

80 PLUS Test Type	115V Internal Non-Redundant				230V Internal Redundant			
Fraction of Rated Load	10%	20%	50%	100%	10%	20%	50%	100%
80 PLUS		80%	80%	80%				
80 PLUS Bronze		82%	85%	82%		81%	85%	81%
80 PLUS Silver		85%	88%	85%		85%	89%	85%
80 PLUS Gold		87%	90%	87%		88%	92%	88%
80 PLUS Platinum		90%	92%	89%		90%	94%	91%
80 PLUS Titanium					90%	94%	96%	91%

◆ Customer's Feedback about Hight Flux GT

1.3kW Server Power PFC choke

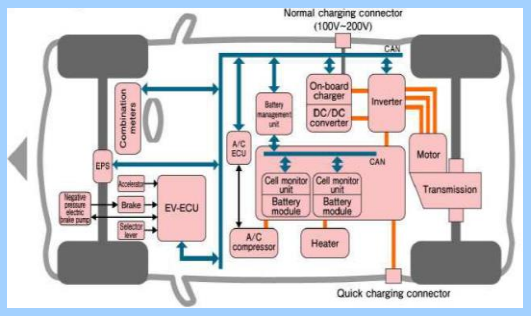
Spec.

- Frequency = 70kHz
- Rms Current= 10.8A / Peak Current= 19.3A / Ripple Current= 7.2A
- L(10.8A) = 277.16μH
- L(19.3A) = 138.6μH Min

Condition	CH270060G14	CH270060GT14
# of Turns	Φ1.1 * 75Ts	Φ1.1 * 75Ts
L(10.8A)	316.7μH	326.8μH
L(19.3A)	141.4μH	142.2μH
Core Loss	2.6W	1.9W
Copper Loss	7.7W	7.7W
Total Loss	10.3W	9.6W

IV. CSC's Titanium Line (Grade 'GT')

◆ **Customer's Feedback about Hight Flux GT**



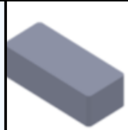
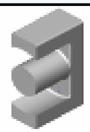
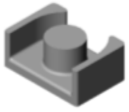
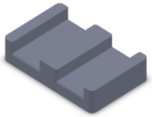
6.6kW OBC PFC Choke

Spec.

- Frequency = 30kHz
- Rms Current = 45A , Peak Current= 52A , Ripple Current= 7A
- L(52A) = 98μH Min

Condition	CH467060G 2EA	CH467060GT 2EA
# of Turns	Φ3.0 * 24Ts	Φ3.0 * 23Ts
L(52A)	101.4μH	99.4μH
Core Loss	1.2W	1W
Copper Loss	12.8W	12.3W
Total Loss	14W	13.3W

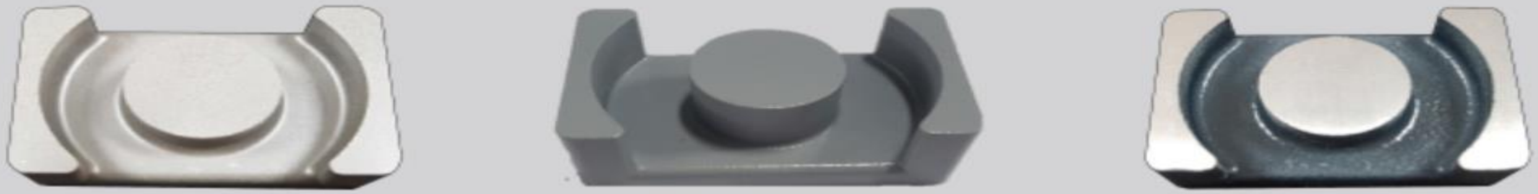
V. CSC's Special Shape Cores

		Block	E	EER	EQ	Cylinder	Round Block	U	ER	Ellipse	Planar E
Materials	Perm.										
Mega Flux®	26µ	○	○	○	○	○	○	○	○	○	○
	40µ	○	○	○	○	○	○	○	○	○	○
	60µ	○	○	○	○	○	○	○	○	○	○
Sendust	26µ	○	○	○	○	○	○	○	○	○	○
	40µ	○	○	○	○	○	○	○	○	○	○
	60µ	○	○			○	○	○		○	
High Flux	26µ-60µ	○	○	○	○	○	○	○	○	○	○
	75µ-90µ				○ (+ I Core)				○ (+ I Core)		
HS	60µ	○			○	○	○	○	○	○	
HP	19-60µ	○			○	○	○		○	○	

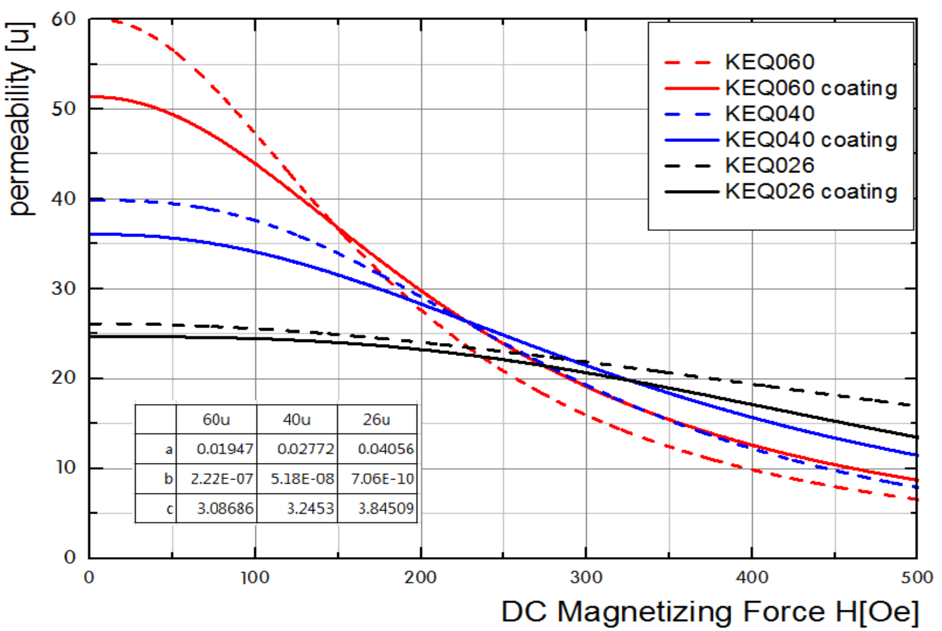
- ❖ Various shapes & Size
- ❖ Small volume with high DC Bias
- ❖ Low wire usage
- ❖ Automatic winding – High productivity
- ❖ Customized distinctive design

V. CSC's Special Shape Cores

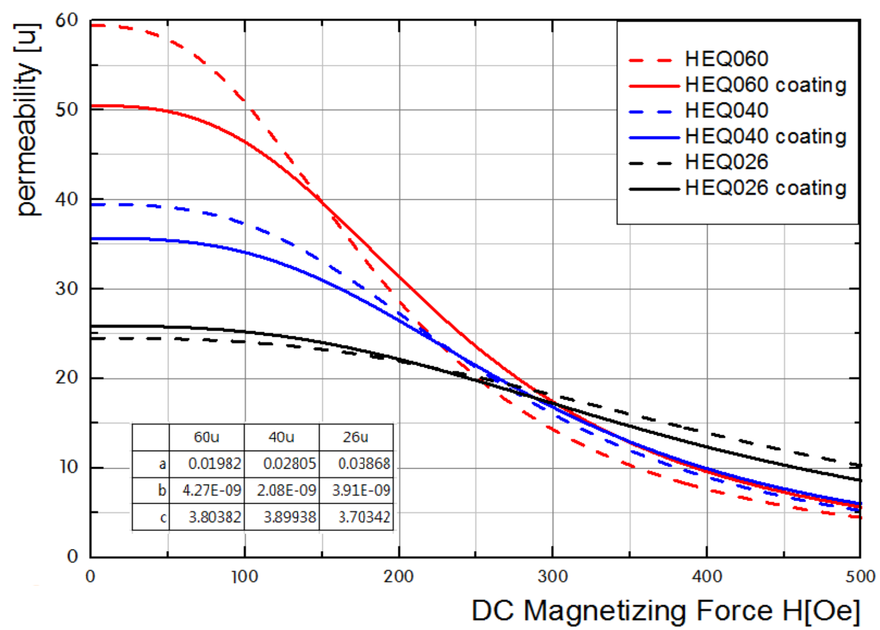
Uncoating	vs.	Coating	vs.	AQ (Mirror face)



HEQ3222R-060 HEQ3222R-060A HEQ3222R-060AQ



	60u	40u	26u
a	0.01947	0.02772	0.04056
b	2.22E-07	5.18E-08	7.06E-10
c	3.08686	3.2453	3.84509



	60u	40u	26u
a	0.01982	0.02805	0.03868
b	4.27E-09	2.08E-09	3.91E-09
c	3.80382	3.89938	3.70342

- **Uncoated and AQ cores show same DC Bias performance**
- **Coated cores have anti-rust function**

Section 2.

CSC Cores for Applications

CSC Cores for

Server / Telecom Power

I. Technical Trend of Server/Telecom power

- **Better efficiency**
- **Lower loss**
- **Reducing wire loss**

The most suitable core materials for your PFC Choke

**** Titanium level with CSC Cores! 0.1 ~ 0.3% Real efficiency improvement !***

80 PLUS Test Type	115V Internal Non-Redundant				230V Internal Redundant			
Fraction of Rated Load	10%	20%	50%	100%	10%	20%	50%	100%
80 PLUS		80%	80%	80%				
80 PLUS Bronze		82%	85%	82%		81%	85%	81%
80 PLUS Silver		85%	88%	85%		85%	89%	85%
80 PLUS Gold		87%	90%	87%		88%	92%	88%
80 PLUS Platinum		90%	92%	89%		90%	94%	91%
80 PLUS Titanium					90%	94%	96%	91%

Material	60µ Core Loss
HP Core	**90**
High Flux	**130**
HS Core	150
MPP Core	170

Verified Quality by Global leading server makers

- HPE, DELL, Inspur, Huawei, Cisco, Juniper & many ODM companies like Delta, FSP, Greatwall …

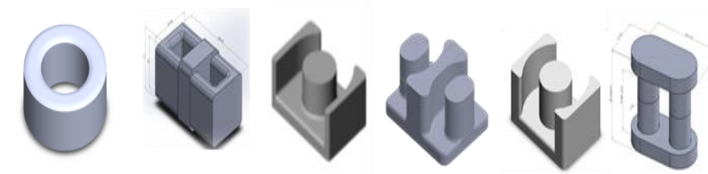
II. Recommended Materials for Server/Telecom power

■ Materials

Materials	High Flux (CH)	HP (HP)	HS (HS)	Mega Flux® (CK)	MPP
Market Preference	• Toroid: 229~330 60u • EQ, Round Block + Cylinder, Various customized shapes				
Perm. (μ_i)	26-160	19-60	60-90	19-90	26-200
Bs (kG)	15	8.5	13	17	10
Bs (kG@60u)	14	8.5	11.5	16	9
Curie Temp [℃]	500	500	500	700	450
Frequency Range [Hz]	10M	10M	10M	5M	10M

DC Bias	CH GT > CH > CK GT > CK > HS > HP > MPP
Core Loss	HP < CH GT < HS < MPP < CH < CK
Temp. Stability	MPP, CH > HS , CK > HP
Cost	CH > HS > CF ≥ CK, KS > CS

800W 1.2kW 2kW 3kW



- High Efficiency
- PFC / Output Choke
- 600W~3kW

- Suitable for Lower Rack(1U = 40mm)

→ EQ, EI, UIU, ER, UR.. Shape cores

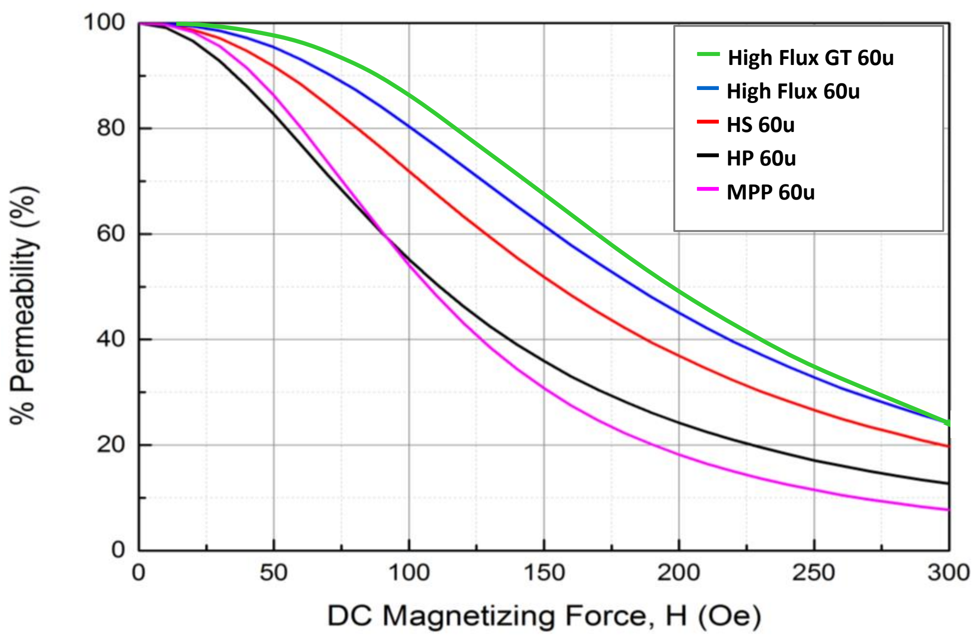
- High Density & Lower Heating

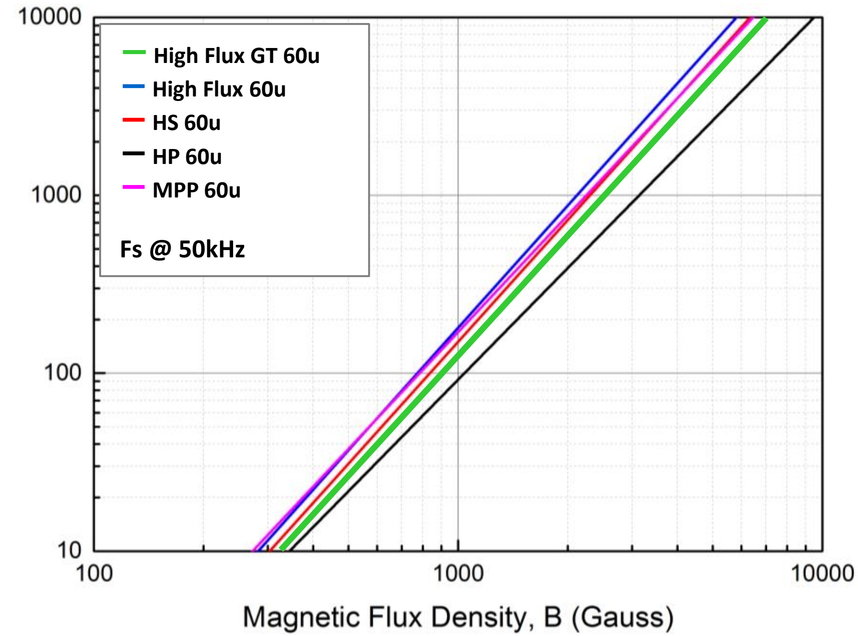
→ High DCB, Low Loss: HF GT, HP

III. DCB & Core Loss – 60u

■ Material Comparison

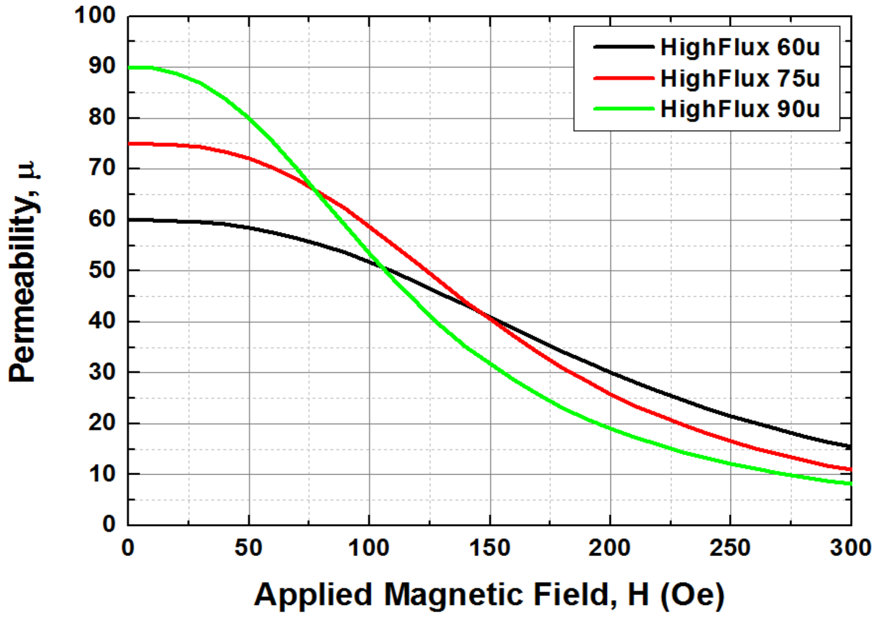
Material	60µ DCB (%)			60µ Coreloss (㎽/㎤)	
	@100 Oe	@200 Oe	@300 Oe	@50 ㎑, 500 G	@50 ㎑, 1000 G
HP Core	55	24	13	22	92
HS Core	72	37	20	31	150
High Flux (GT/G)	85/80	48/45	25/24	70/90	130/180
MPP	54	18	8	38	170

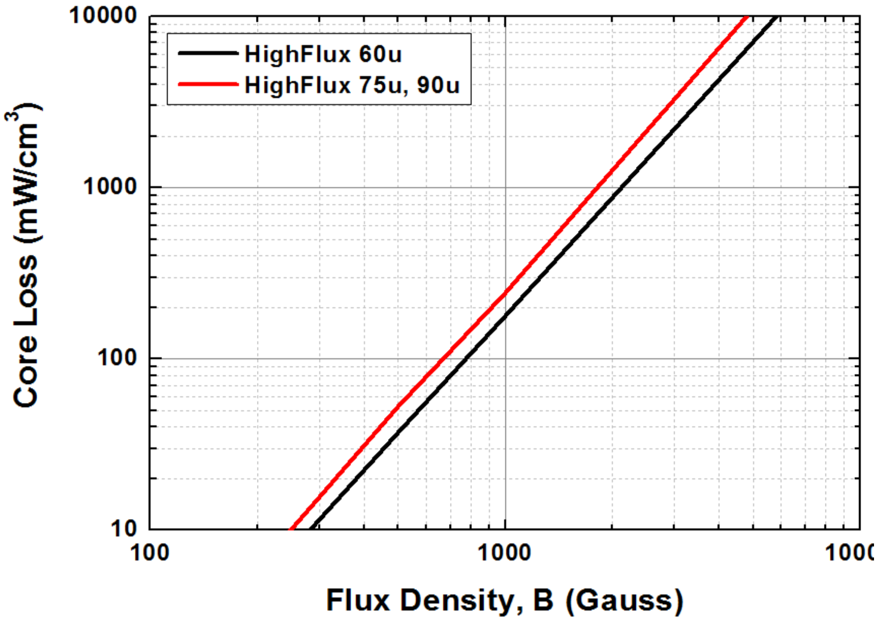




IV. New High Permeability HEQ

◆ HEQ 75u/90µ





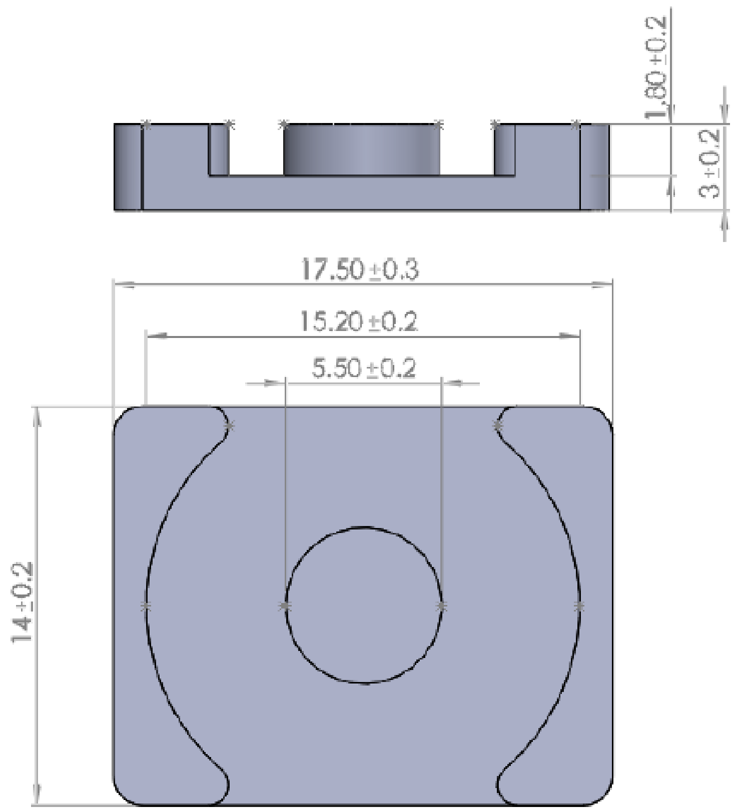
Perm.	DC-Bias (%)			Coreloss (㎽/㎤)	
	@50 Oe	@100 Oe	@200 Oe	@50 ㎑, 500 G	@50 ㎑, 1000 G
60u	58.5u (97.5%)	51.7u (86.2%)	30.1u (50.2%)	37	180
75u	72.1u (96.1%)	58.7u (78.3%)	25.8u (34.5%)	53	245
90u	79.9u (88.8%)	53.4u (59.3%)	19.1u (21.2%)	53	245

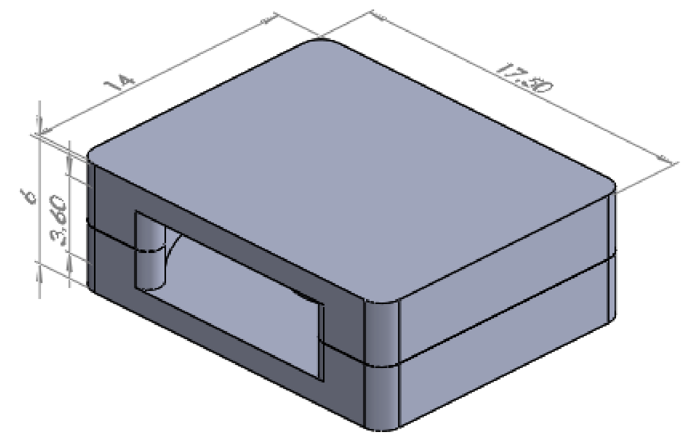
IV. New High Permeability HEQ_Design example

◆ HEQ 75µ

Choke for Laptop - End User: A* (TAIWAN)**

Choke spec.: 100KHZ, L(17A)=10µH





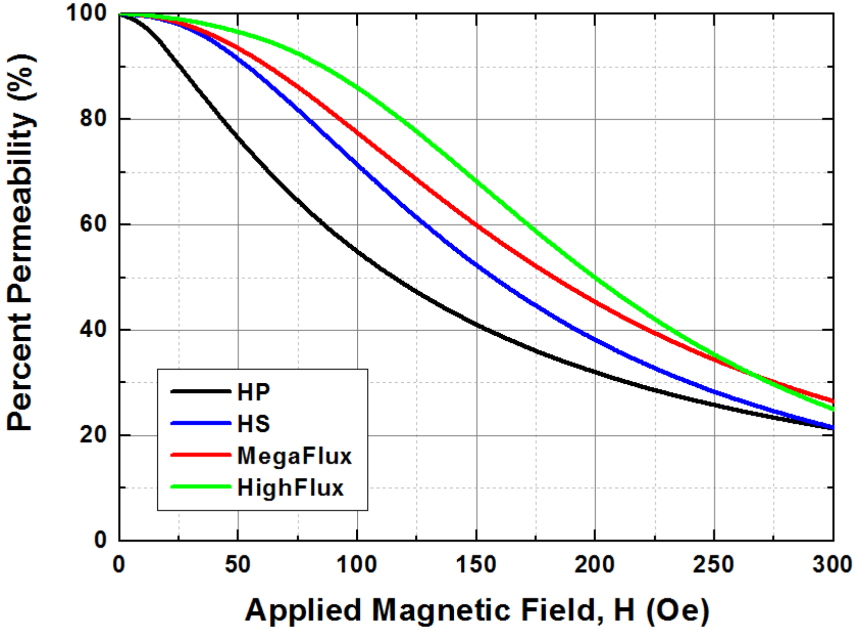
Material=	High Flux 75µ	High Flux 60µ
AL Value=	125nH/N^2	99nH/N^2
L(0A)=	12.5µH @10Ts	11.98µH @11Ts
L(17A)=	10.8µH	10.6µH

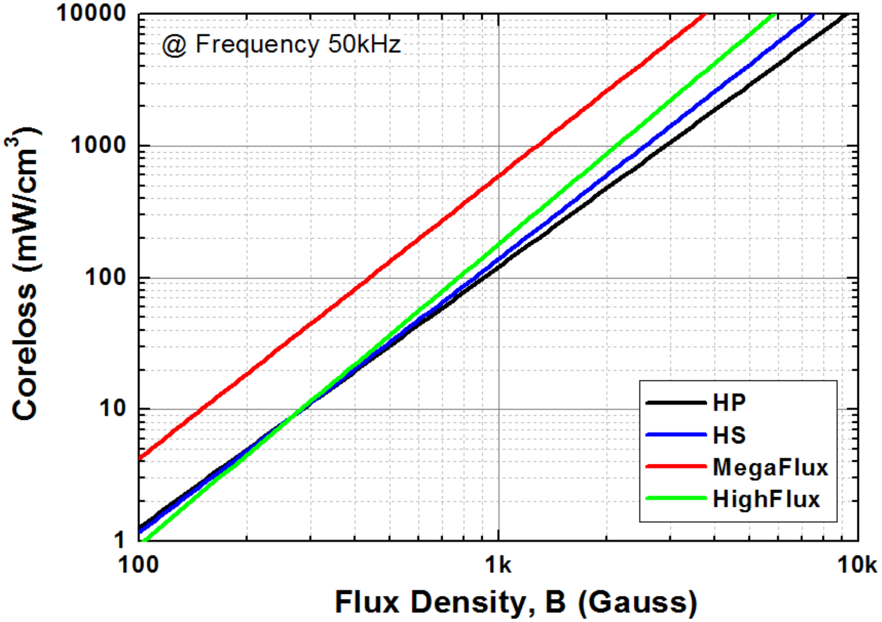
- Higher inductance with less number of turns
- Lower copper loss

V. New HSEQ / HPEQ

◆ HSEQ / HPEQ 60μ

Why HS or HP?





Materials	Perm. (μ_i)	Bs (kG)	Core Loss	DC Bias	Temp. Stability	Curie Temp [℃]
HP	60	8.5	Lowest	low	good	500
HS	60	13	Lower	medium	Best	500
Mega Flux	26~60	17	High	Good	Best	700
High Flux	26~60	15	Low	Best	Best	500

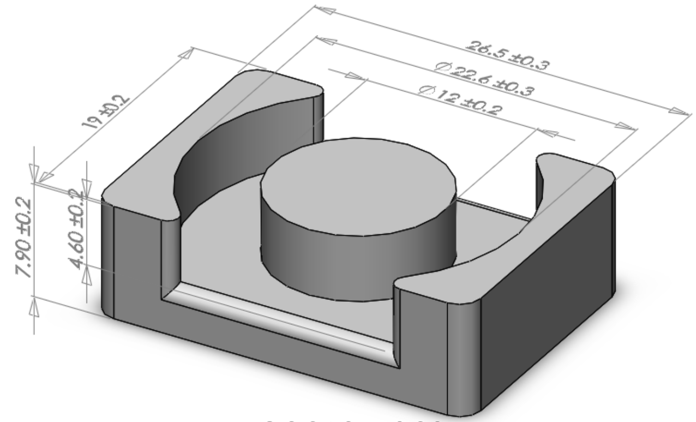
V. New HSEQ / HPEQ_Design example

◆ Design Example – HPEQ 60µ

Output choke (80 PLUS Titanium 900W Server Power) - Maker: L***** (TAIWAN)

- Customer Requirements

No	Inductance	Remarks
1	3.72uH±13%	@130KHz, 1Vrms
2	4.86uH±13%	



Part #: HPEQ2619K-060

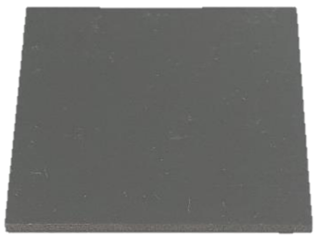
HP Toroidal → HS Toroidal → HP EQ

Part #	Material	Efficiency
HP234060E13	HP 60µ	96.65
HS234090E13	HS 90µ	96.62
HPEQ2619K-060	HP 60µ	Testing

Input voltage: 230V @50% Load

VI. New Special Shape Cores _ Plate Core

1. Part Type	Plate Core Ex.) KP2626A-026
2. Shape	Plate
3. Material	Mega Flux, Fine Flux
4. Permeability	26u ~ 50u
5. Size(mm)	W x L : 400 x 400 Max. H : 0.5~3 mm
6. Features	Good core strength Good flatness Large surface Less leakage flux by no bulk air gap



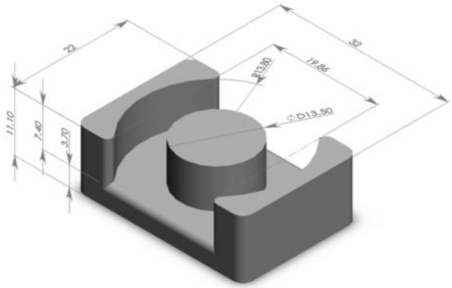
<Plate Core : KP2626A-026>

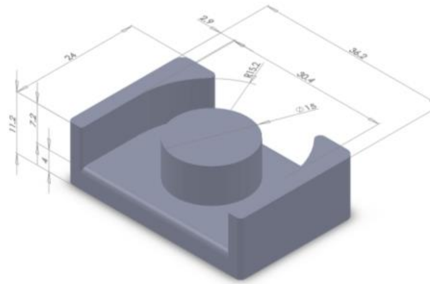
Surge Inductor for 5G base station

IV. Application Example

Out put choke (96% 3KW Server power)

Choke specification: 100KHZ, L(0A)=2.5uH, L(Ip=200A)=1.5uH, DCR=0.3m ohm, ΔI =±10A. Space: 24mm*36mm.





P/N	CH330060*2pcs	HEQ3222S-060*2pcs	RH3624A-060*2pcs
Path Length	8.15cm	6.35cm	6.78cm
Cross Section Area	1.344㎠	1.523㎠	1.77㎠
AL	122nH/N2	181nH/N2	197nH/N2
Inductance	Φ4.6mm*5Turns	Φ3.7mm*4Turns	Φ3.7mm*3.5Turns
L(0A)	3.05μH ± 8%	2.90μH ± 12%	2.41μH ± 12%
L(200A)	1.87μH ref. / 1.50μH min.	1.88μH ref. / 1.50μH min.	1.83μH ref. / 1.50μH min.
Inductor Size	33.83*33.83*23.22 (Excluding coil)	32*22*22.2	36.2*24*22.4
Total Loss	DC 11.51 / AC 11.64	DC 11.70 / AC 11.84	DC 11.38 / AC 11.55
Wire Length & Weight	30.5cm / 50g	16.9cm / 21g	16.5cm / 21g

CSC Cores for
<u>Solar</u>

I. Technical Trend of Solar Inverter

- ***With CSC power cores***

✓ **Decentralization (Central → String, Modular, Micro)**

-> Smaller & Lighter (more than 50% ↓ vs. Silicon steel)

✓ **High integration (efficient space utilization, cost saving)**

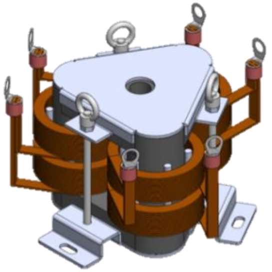
-> High power density, Small size design

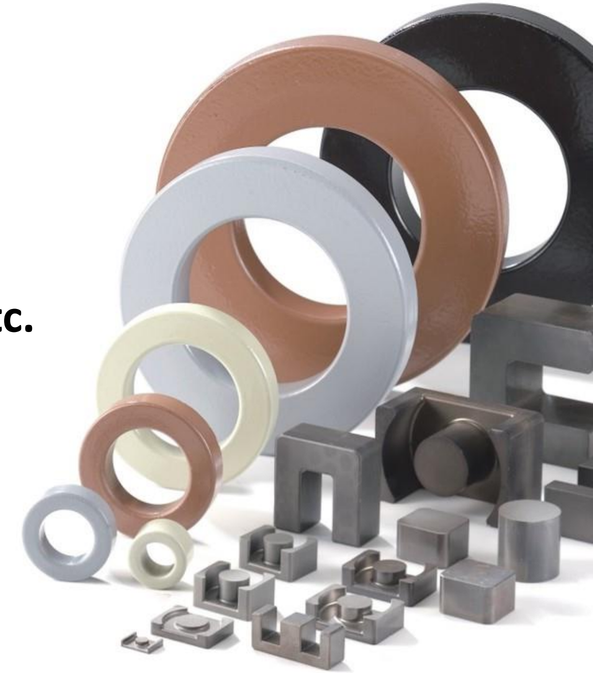
✓ **Better Solution to your customers**

-> Solving your noise & Heat problem, High efficiency

✓ **Duration (High reliability & Long life)**

-> Fully verified products passed all the reliable test of temperature, humidity, thermal shock, etc.





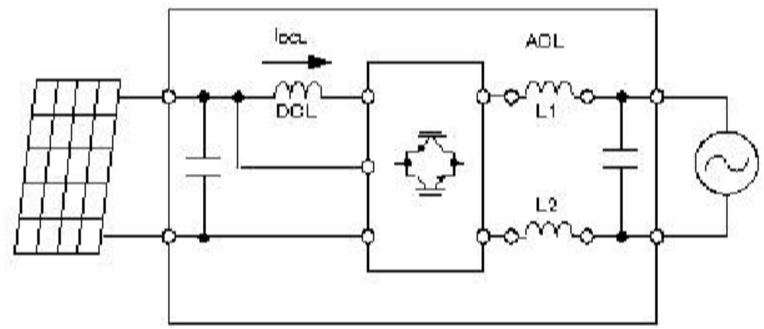
II. Recommended Materials for Solar

■ Materials

Materials	High Flux (CH)	HS (HS)	Fine Flux (CF)	KS (KS)	SENDUST (CS)	Mega Flux® (CK)
Market Preference	• Big size toroidal core: OD467 ~1625 / 26u ~90ui • Block/Cylinder/Ellipse Cores: 40~60ui					
Perm. (μ_i)	26-160	60-90	19-60	26-60	26-125	19-90
Bs (kG)	15	13	12	14	10	17
Bs (kG@60u)	14	11.5	10	14	8.5	16
Curie Temp [℃]	500	500	500	500	500	700
Frequency Range [Hz]	10M	10M	10M	5M	10M	5M

DC Bias	CH > CK > HS > CF > KS > CS
Core Loss	CH < HS < CF < CS < KS < CK
Temp. Stability	CH > HS , CK > CF, CS, KS
Cost	CH > HS > CF ≥ CK, KS > CS

• DC-DC boost converter • DC-AC filter



PV inverter

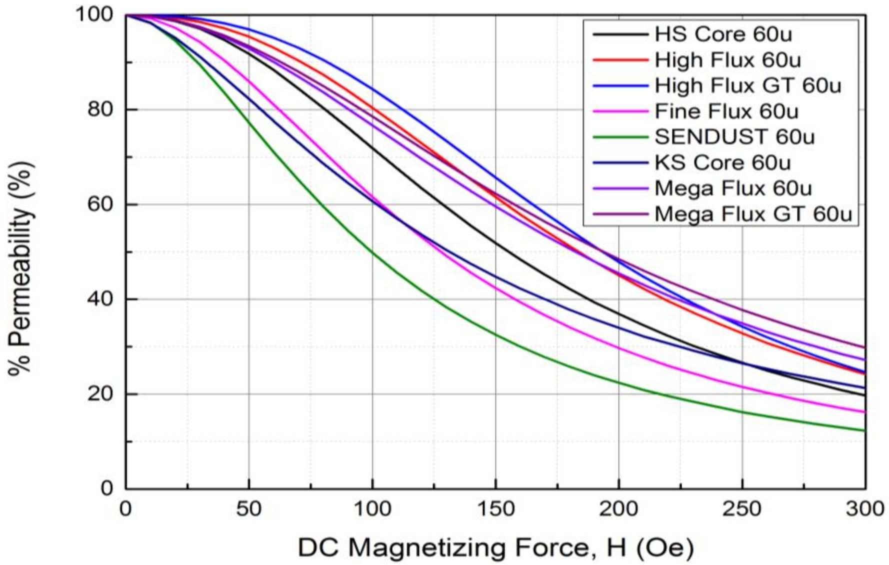
- **HS**: Good DC Bias with Low core loss
  => small volume, high power, high efficiency, low heat
- **CF**: Economically optimized DCB & Core loss
  => Value for cost
- **CS, KS, MF**: The most cost-effective design
  Easy assembly

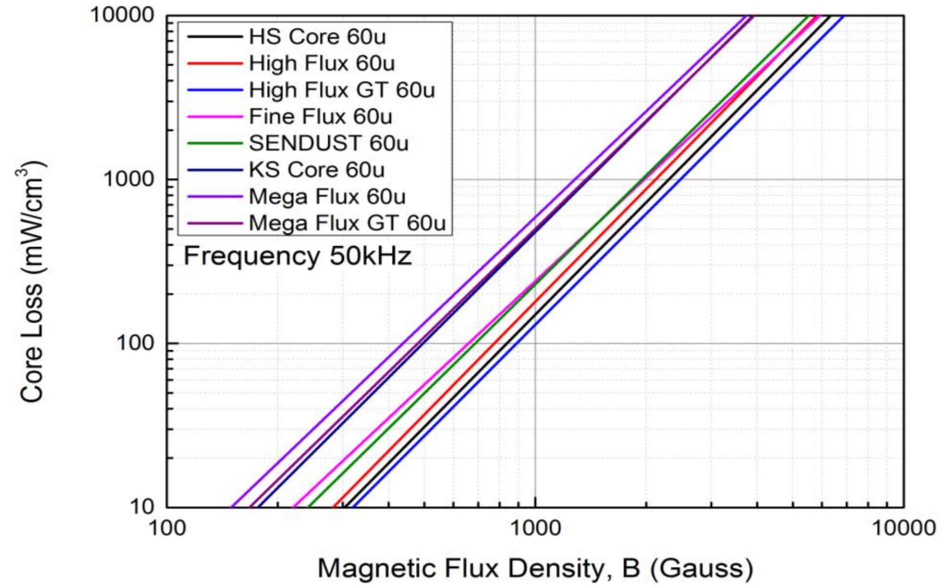
III. DCB & Core Loss – 60u

■ Material Comparison

Material	60µ DCB (%)			60µ Coreloss (㎽/㎤)	
	@100 Oe	@200 Oe	@300 Oe	@50 ㎑, 1000 G	@100 ㎑, 500G
High Flux (GT/G)	85/80	48/45	25/24	130/180	70/90
HS Core	72	37	20	150	80
Fine Flux	62	30	16	240	125
SENDUST	48	22	12	230	120
KS Core	61	34	21	480	260
Mega Flux® (GT/G)	78/76	48/45	30/27	500 / 590	280/330

■ Graph



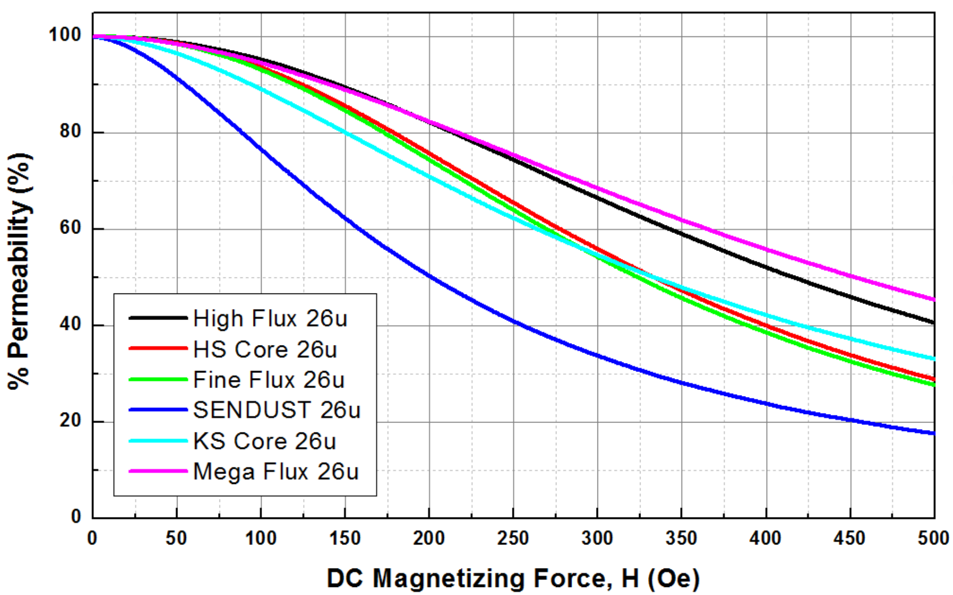


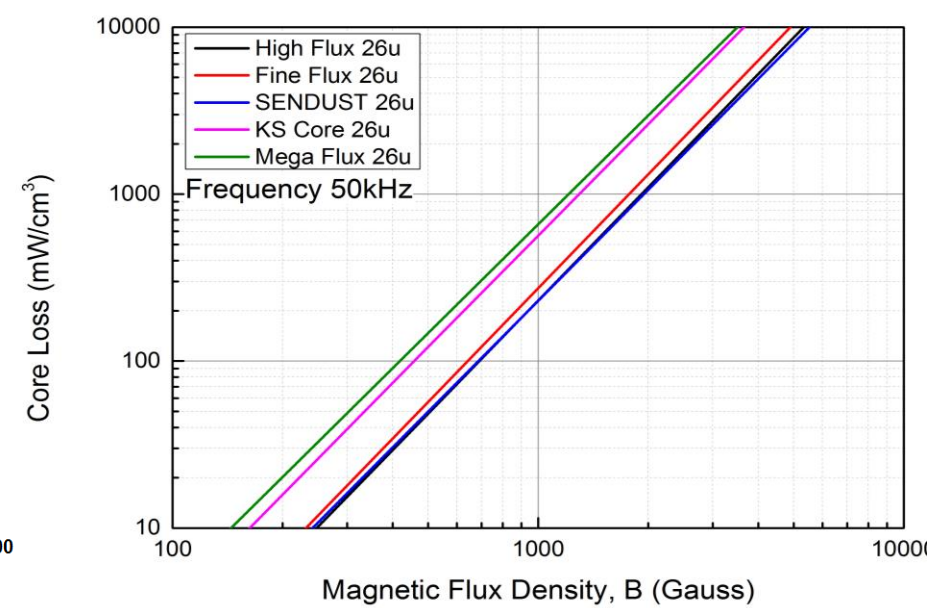
III. DCB & Core Loss – 26u

■ Material Comparison

Material	26μ DCB (%)			26μ Coreloss (㎽/㎤)	
	@200 Oe	@300 Oe	@500 Oe	@50 ㎑, 500 G	@50 ㎑, 1000 G
High Flux	82	67	41	48	230
Fine Flux	74	54	28	57	273
SENDUST	50	34	18	50	230
KS Core	71	55	33	121	565
Mega Flux®	82	69	45	147	660

■ Graph

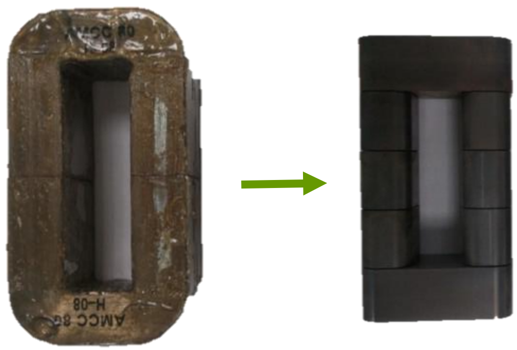




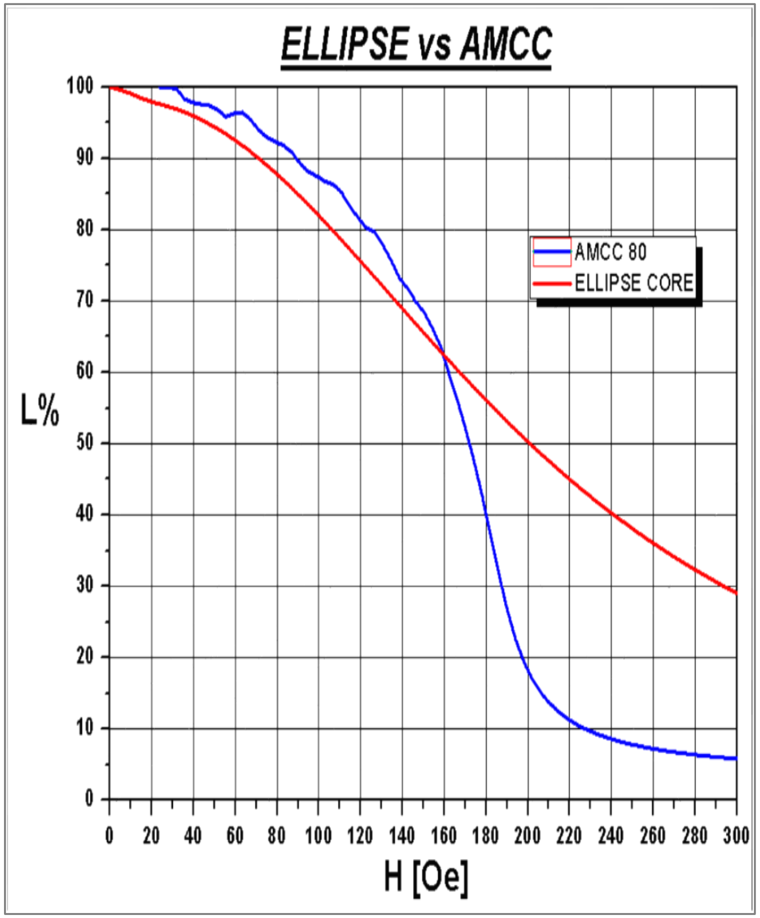
IV. Application Example

❖ Design Example #1 : Mega Flux Ellipse Core vs Amorphous C Core

1) Current = 40A,
   Inductance = 900μH min,
   fs=18 kHz
2) Assembled Core Size
   Length = 60mm max,
   Width = 40mm max,
   Height = 110mm max
3) Total Weight = 2.0 kg max
4) DCR = 38mΩ max
5) Core Loss = 40W max
6) Total Loss = 100W max



		Mega Flux Ellipse Cores LK6035A X LK3520A-060	Amorphous C Cores AMCC 80
Inductance [μH]	L(0A)	1,887	1,465
	L(30A)	1,210	1,270
	L(40A)	911	988
	L(50A)	678	290
Size (Core)		60mm x 35mm x 97mm	52mm x 40mm x 102mm
Weight	Core	1.086 kg	0.938 kg
	Copper	0.607 kg	0.787 kg
	Total	1.693 kg(98%)	1.725 kg(100%)
Loss [W]	Core	32.9	36.6
	Copper	42.5	55.2
	Total	75.4(82%)	91.8(100%)



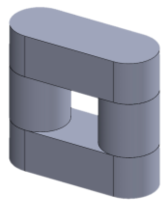
Mega Flux Ellipse Cores have more softer saturation then Amorphous C Cores

IV. Application Example

❖ Design Example #2 : Mega Flux Round Block + Cylinder vs NPH226060

1) Current = 101.8A, Inductance = 100μH min, fs=1 kHz
2) Assembled Core Size
   Length = 150.1mm max, Width = 73.6mm max, Height = 73.6mm max
3) DCR = 10mΩ max
4) Total Loss = as low as possible

Original Design: NPH226060 9Stacks



RBK8030A-060 X CK3030-060

		Mega Flux Round Bloack + Cylinder Cores	NPH Cores
Bobbin		No	No
1 Turn Length		122.5mm	354.4mm
Current Capacity		5.3 A/㎟	5.3 A/㎟
Wire Size		5.2mm x 2.6mm	Φ2.4mm x 2P
Winding Turns		38Ts	16Ts
Total Wire Weight		566g	690g
Winding Factor		43%	42%
DCR		5.8 mΩ	7.1 mΩ
Inductance	0A	314.8μH	318.0μH
	101.8A	159.2 μH	127.4μH

		Mega Flux Round Bloack + Cylinder Cores	NPH Cores
Inductance [μH]	L(0A)	314.8	318.0
	L(101.8A)	159.2	127.4
Size (Core)		80.5mm x 30.2mm x 107mm	58.04mm x 58.04mm x 145.17mm
Weight	Core	1.334 kg	1.6272 kg
	Copper	0.566 kg	0.69kg
	Total	1.9 kg(82%)	2.3172 kg(100%)
Loss [W]	Core	3.9	1.6
	Copper	30.2	36.8
	Total	34 (88.5%)	38.4 (100%)

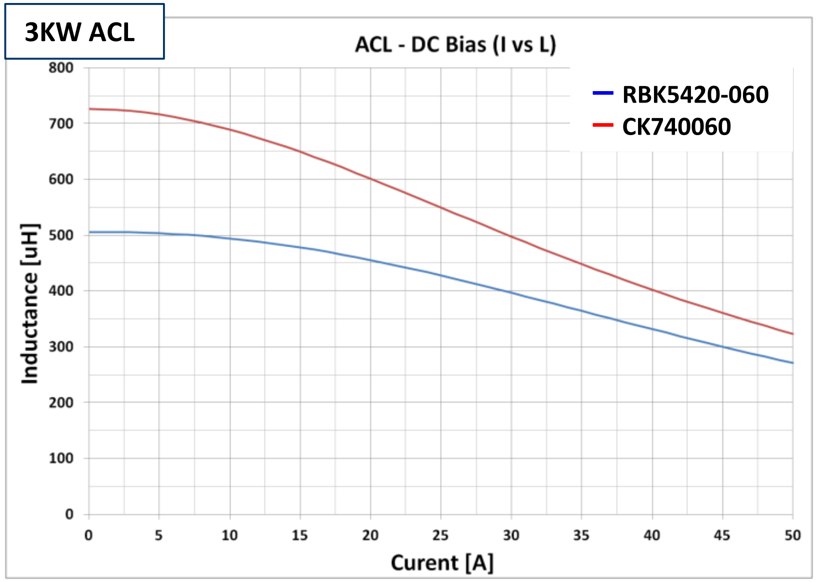
✓ **Less Weight**

✓ **Lower Loss**

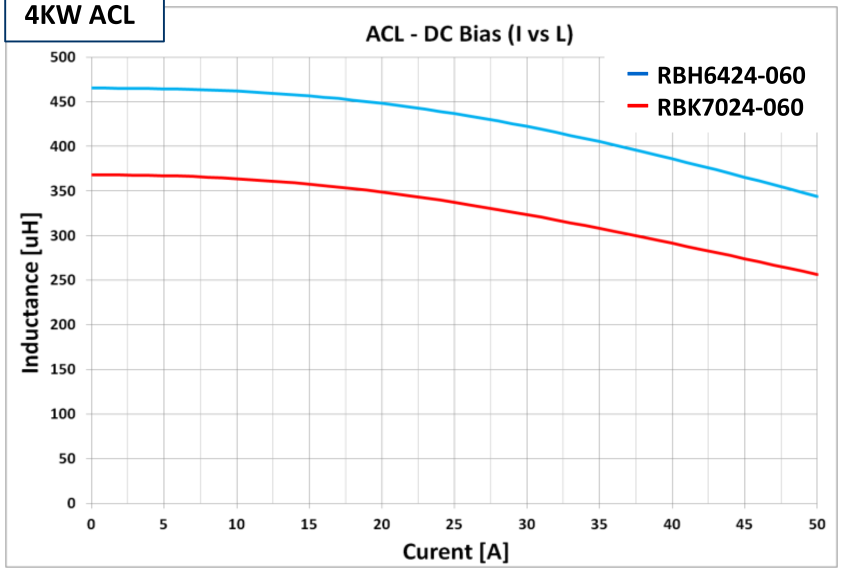
V. Application Example

■ Actual Coil performance using CSC Cores

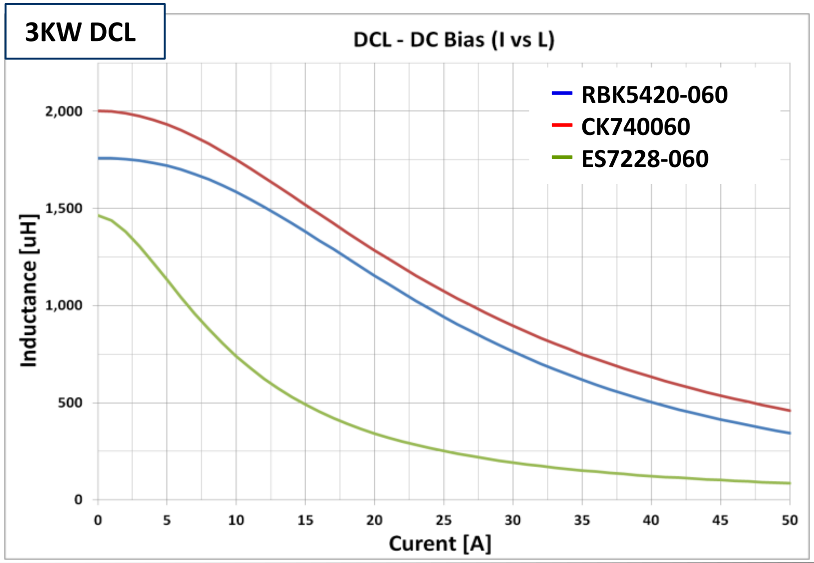
3KW ACL



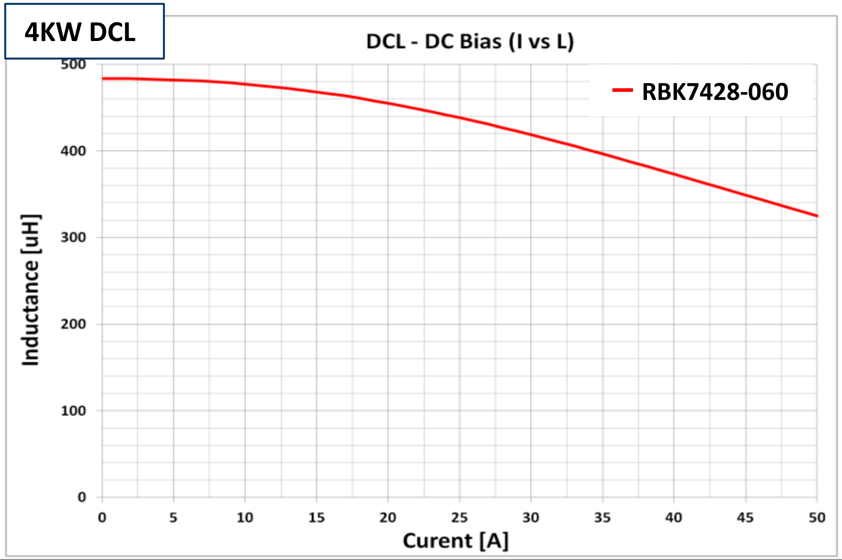
4KW ACL



3KW DCL



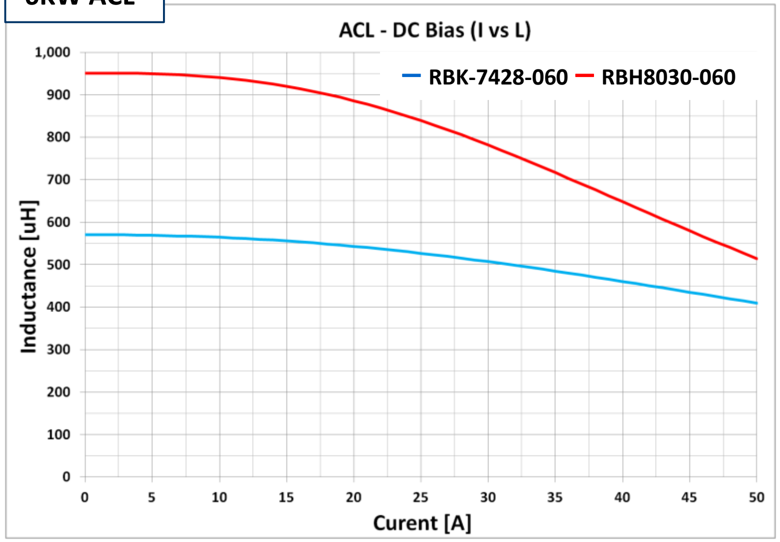
4KW DCL



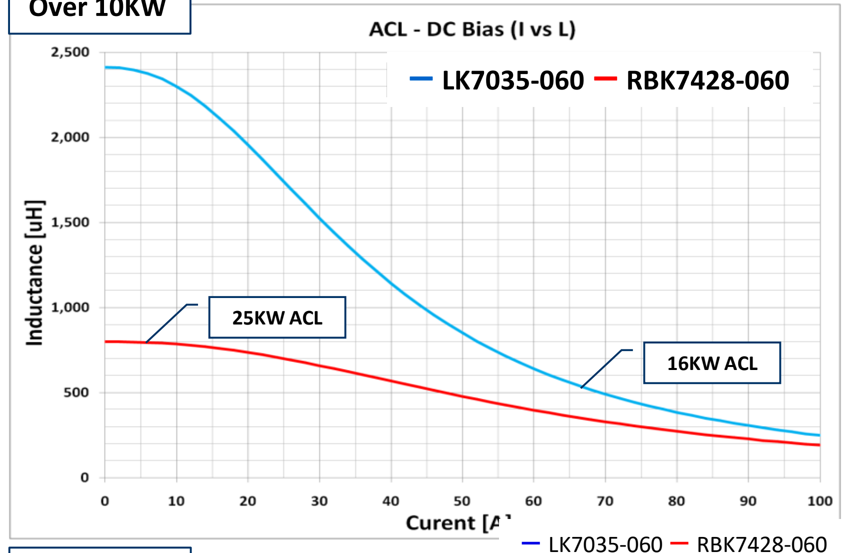
V. Application Example

■ **Actual Coil performance using CSC Cores**

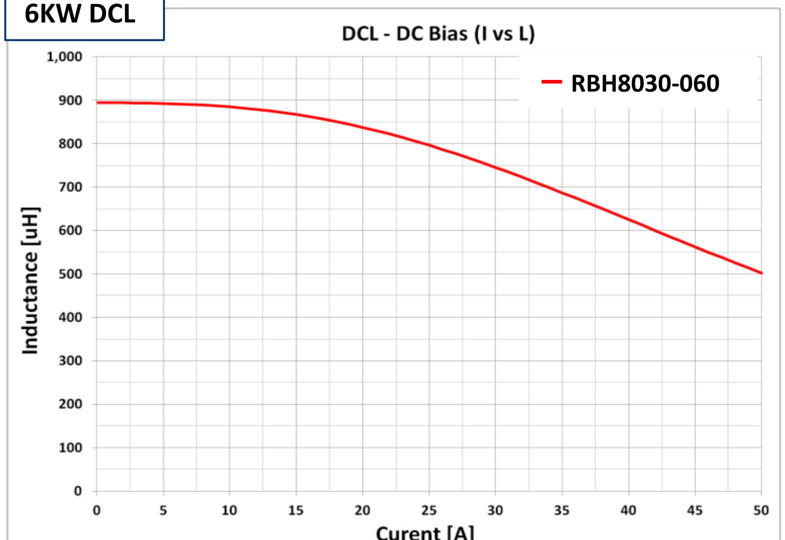
6KW ACL



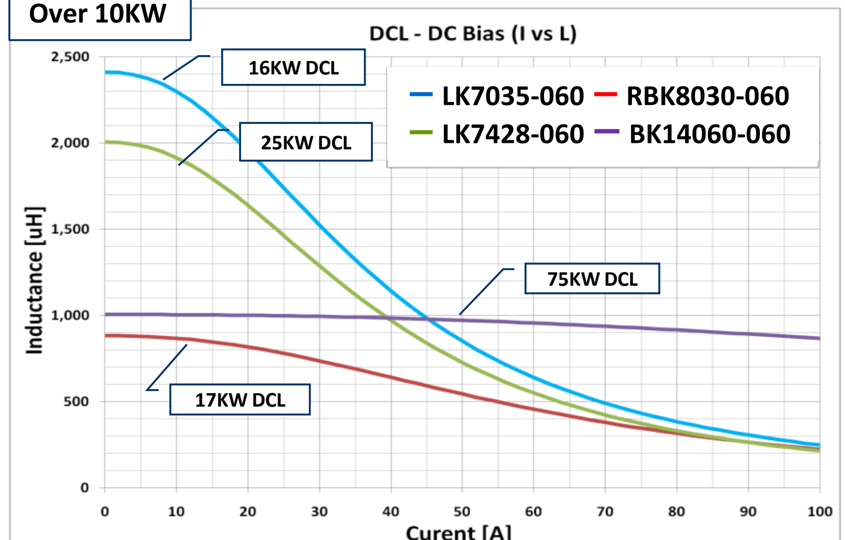
Over 10KW



6KW DCL



Over 10KW



CSC Cores for UPS *(Uninterruptible Power Supply)*

I. Technical Trend of UPS Inverter

- ***With CSC power cores***

✓ **Modular for fast & easy replacement**

→ **Accomplish compact, Lightweight, Flexible and Versatile products**

✓ **Better Solution to your customers**

→ **99% High efficiency**

✓ **Duration (High reliability & Long life)**

→ **With fully verified products passed all the reliable test of temperature, humidity, thermal shock, etc.**

II. Recommended Materials for UPS

■ Materials

Materials	High Flux (CH)	HP (HP)	Fine Flux (CF)	KS (KS)	SENDUST (CS)	Mega Flux® (CK)
Market Preference	• Big size toroidal core: OD467 ~1625 19ui ~ 40ui • Block/Cylinder/Ellipse/U Cores: 26ui					
Perm. (μ_i)	26-160	19-60	19-60	26-60	26-125	19-90
Bs (kG)	15	8.5	12	14	10	17
Bs (kG@60u)	14	8.5	10	14	8.5	16
Curie Temp [℃]	500	500	500	500	500	700
Frequency Range [Hz]	10M	10M	10M	5M	10M	5M

DC Bias	CH > CK > HP > CF > KS > CS
Core Loss	CH < HP < CF < CS < KS < CK
Temp. Stability	CH > CK > CF, CS, KS, HP
Cost	CH > HP > CF ≥ CK, KS > CS

- **HP**: High Efficiency with Low core loss

  => Great performance at High switching frequency

- **HF**: Good DC Bias with Low core loss

  => small volume, high power, high efficiency, low heat

- **CF**: Economically optimized DCB & Core loss

  => Value for cost

- **CS, KS, MF**: The most cost-effective design

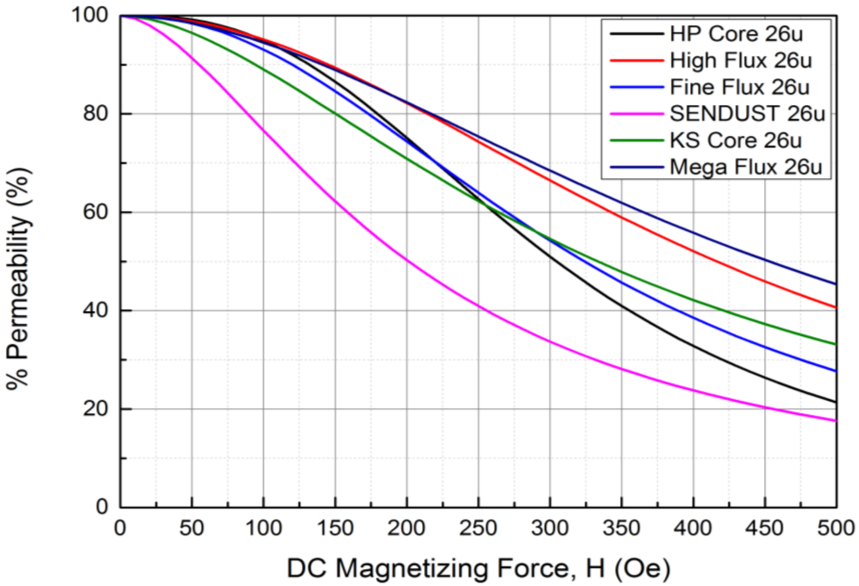
  => Easy assembly, Easy winding with shaped cores

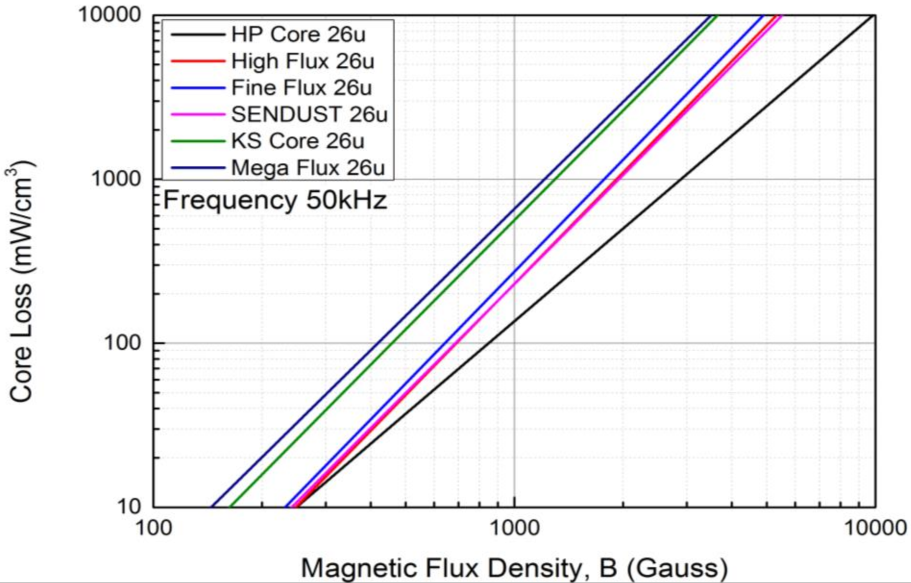
III. Recommended Materials for UPS

■ Material Comparison

Material	26μ DCB (%)			26μ Coreloss (㎽/㎤)	
	@200 Oe	@300 Oe	@500 Oe	@50 ㎑, 500 G	@50 ㎑, 1000 G
High Flux	82	67	41	48	230
HP Core	75	51	21	37	136
Fine Flux	74	54	28	57	273
SENDUST	50	34	18	50	230
KS Core	71	55	33	121	565
Mega Flux®	82	69	45	147	660

■ Graph





III. Recommended Materials for UPS

■ New Block Core 26u

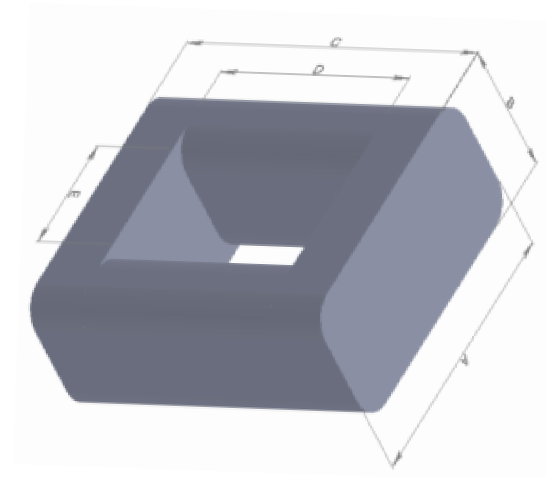
		L	L(%)	Q	LDC	DCB(%)	CORE LOSS @50kHz, 1000G
BK7320-026	Now	1,329	1.42	88.3	1,224	92.10	414.0
		1,332	1.65	88.0	1,226	92.04	
		1,331	1.57	87.8	1,223	91.89	
		1,329	1.42	87.0	1,223	92.02	
		1,352	3.17	89.4	1,239	91.64	
	Loss improved	1,334	1.80	99.8	1,244	93.25	300.0
		1,329	1.42	98.5	1,242	93.45	
		1,327	1.27	98.4	1,246	93.90	
		1,335	1.88	99.7	1,243	93.11	
		1,328	1.34	98.6	1,243	93.60	
BK6320-026	Now	1,104	3.18	89.3	1,020	92.39	420.0
		1,105	3.27	89.4	1,019	92.22	
		1,106	3.36	89.4	1,022	92.41	
		1,101	2.90	88.7	1,016	92.28	
		1,103	3.08	89.3	1,017	92.20	
	Loss improved	1,084	1.31	94.4	1,015	93.63	300.0
		1,081	1.03	93.6	1,012	93.62	
		1,081	1.03	93.8	1,014	93.80	
		1,082	1.12	93.5	1,015	93.81	
		1,082	1.12	93.6	1,014	93.72	

IV. Application Example

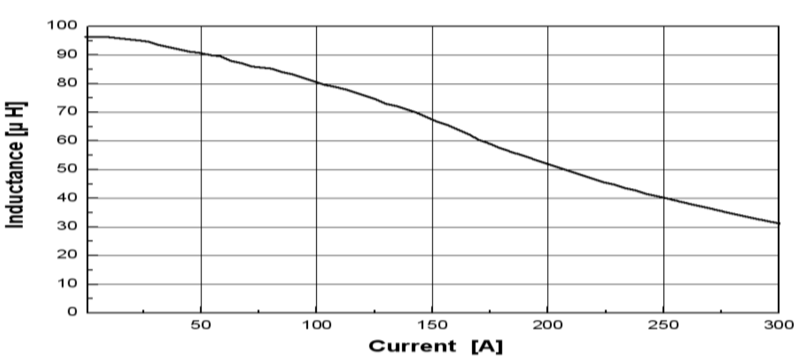
❖ Design Example #1 : Mega Flux Ellips Core

A. Design Target : L(100A)=63μH

		Mega Flux Ellipse Core	Original Design
Plate	Unit Shape	LK6035A-040	CS571026 3pcs + CK571026 2 pcs Total 5pcs Stacking
	Unit Size	60mm x 35mm x 13.5mm	
	pcs	Upper 1pcs, Lower 1pcs Total 2pcs	
	Weight	194g x 2pcs = 388g	
Post	Unit Shape	LK3515A-040	
	Size	35mm x 15mm x 20mm	
	pcs	1 post stack 3pcs Total 6pcs	
	Weight	67g x 6pcs = 402g	
Total	Core Size	87mm x 60mm x 35mm	80.5mm x 58.0mm x 58.0mm
	Core Weight	388g + 402g = 790g	168g x 3 +195g x 2 = 894g



LK6035A x LK3515A-040



		Mega Flux Ellipse Core		Original Design
Bobbin		Thickness 0.8mm		No
1 Turn Length		87.1mm		193.4mm
Wire Size		6.0mm x 3.3mm	4.2mm x 3.3mm	Φ2.1mm x 4P
Current Capacity		5.05 A/㎟	7.22 A/㎟	7.22 A/㎟
Winding Turns		30Ts	30Ts	18Ts
Total Wire Weight		603g	422g	605g
Winding Factor		33%	23%	49%
DCR		3.1 mΩ	4.5 mΩ	5.3 mΩ
Inductance	0A	96μH		92~100μH
	100A	81 μH		63μH min
	300A	31 μH		24μH min

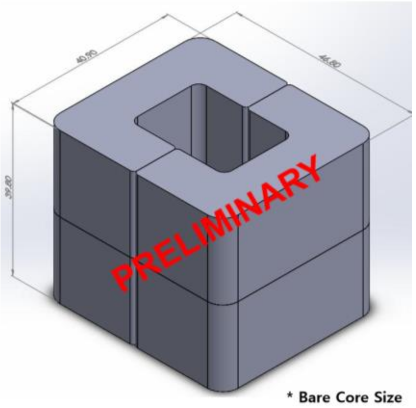
IV. Application Example

Customer	UPS Power	Part Number
A** E****	20 – 1200KVA	HP1016019/ HP1016026/ CK1016060/ HP572019 HP1320019
V****		BK53/63/73/83/9320-026
		CK467/CH571/CH610/CF610026
		BH6020/7020/8020-026
S******		CK7770/778040
A**/S********		CS571026/CK571026
D****		UK4123A-026 / KS467026

* <u>Low loss, low heat, small volume, high efficiency solution</u>

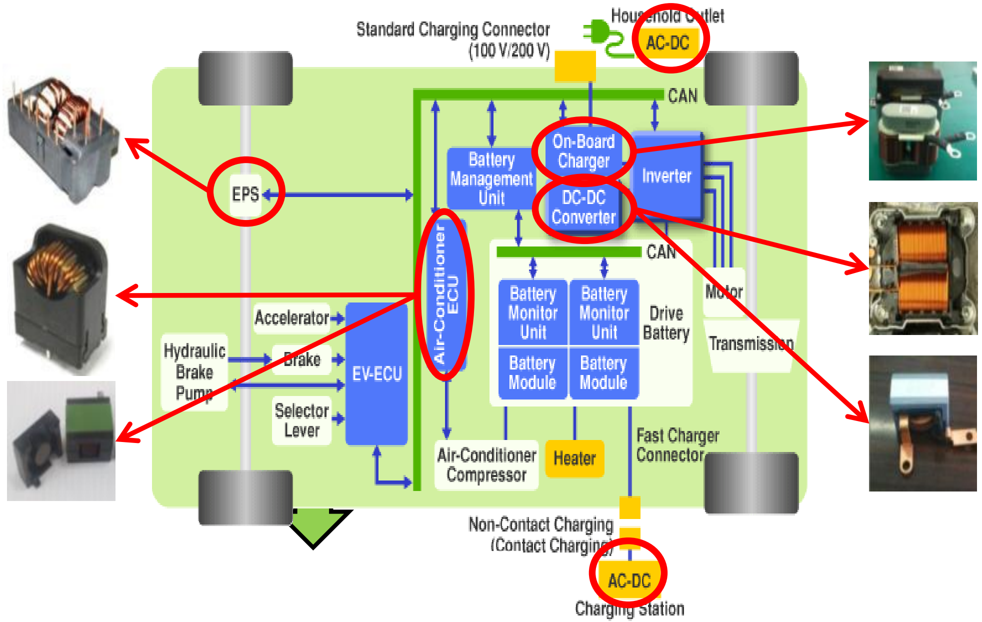
1. Design trend in Materials
   High quality MF, HP, High Flux

2. Design trend in Shapes
   Toroid, Block, U cores



CSC Cores for
Automotive

I. Technical Trend of Electric Automobile



High Power Density with small size

Temperature Stability

High Reliability

Application	Power	Material	
		Materials	Shape & Size
OBC	3.3kW ~ 22kW	HF, HS, MF	T - 270 ~467 HEQ/3241/50, KEQ41/50 RK26/29/54
LDC	1.7kW ~ 2kW	MF	KEQ20 ~41, RK12, KSQ21
HDC	20kW ~ 70kW	MF	Block/Cylinder
EMI Filter	1.7kW ~10kW	HF, SD	RH19, CS330/434
Charging	3kW ~ 50kW	HF, HS, MF	T –203~ 467, LK/UK/BK
Etc.	KH, HP,KS – Toroid, EE, SQ shapes		

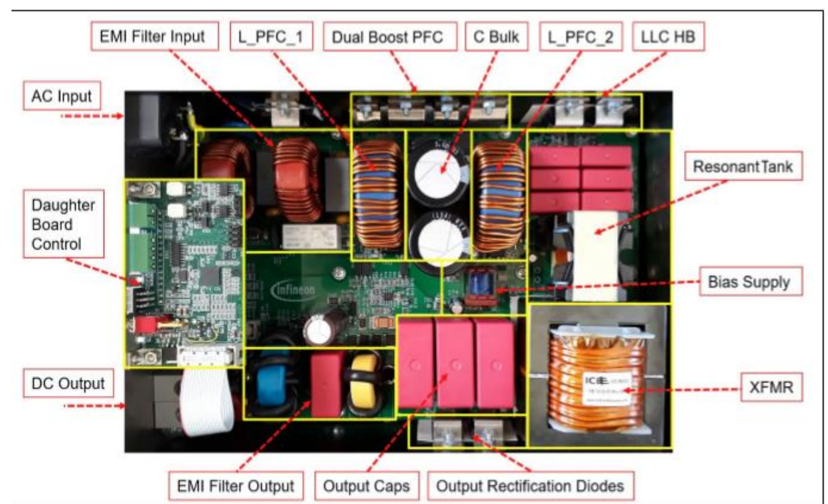


Figure 12 Functional groups of the 2 kW industrial battery charger design

II. Recommended Materials for Automobile

■ Materials

Materials	High Flux (CH)	HS (HS)	KH (KH)	Mega Flux® (CK)
Market Preference	• High Flux troid 60ui for small size inductor • HEQ, KEQ, KSQ, ER shaped core 60ui for high power density with small & easy winding design			
Perm. (μ_i)	26-160	60-90	26-90	19-90
Bs (kG)	15	13	16	17
Bs (kG@60u)	14	11.5	15	16
Curie Temp [℃]	500	500	600	700
Frequency Range [Hz]	10M	10M	10M	5M

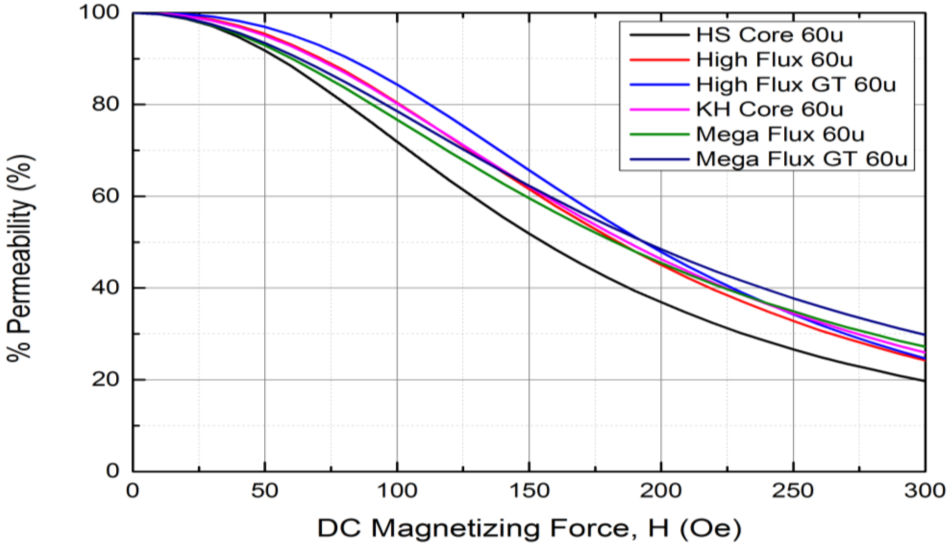
DC Bias	CH GT > KH > CH > HS > CK
Core Loss	CH GT < HS < CH < KH < CK
Temp. Stability	CH, KH > CK

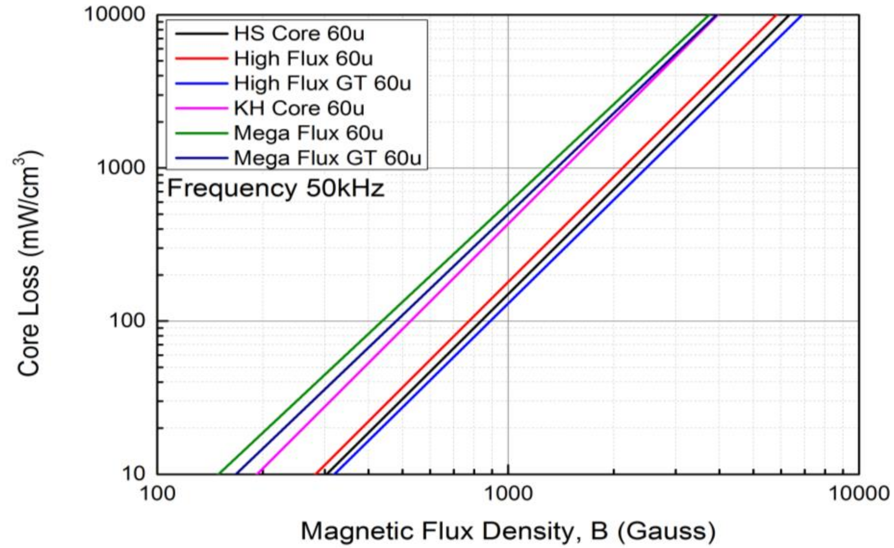
III. DCB & Core Loss – 60u

■ Material Comparison

Material	60μ DCB (%)			60μ Coreloss (mW/cm^3)	
	@100 Oe	@200 Oe	@300 Oe	@50 kHz, 1000 G	@100 kHz, 500G
High Flux (GT/G)	85/80	48/45	25/24	130/180	70/90
KH Core	80	46	26	430	222
HS Core	72	37	20	150	80
Mega Flux® (GT/G)	78/76	48/45	30/27	500 / 590	280/330

■ Graph



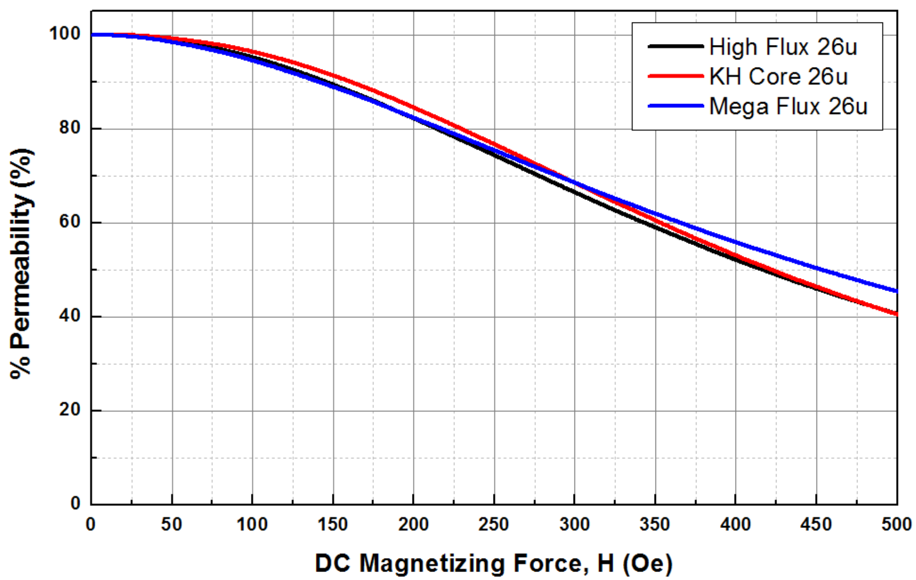


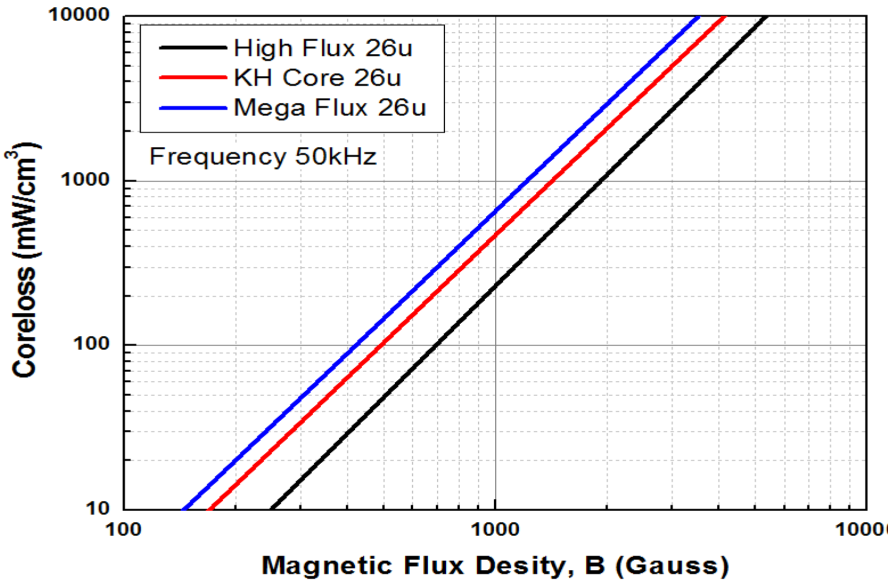
III. DCB & Core Loss – 26u

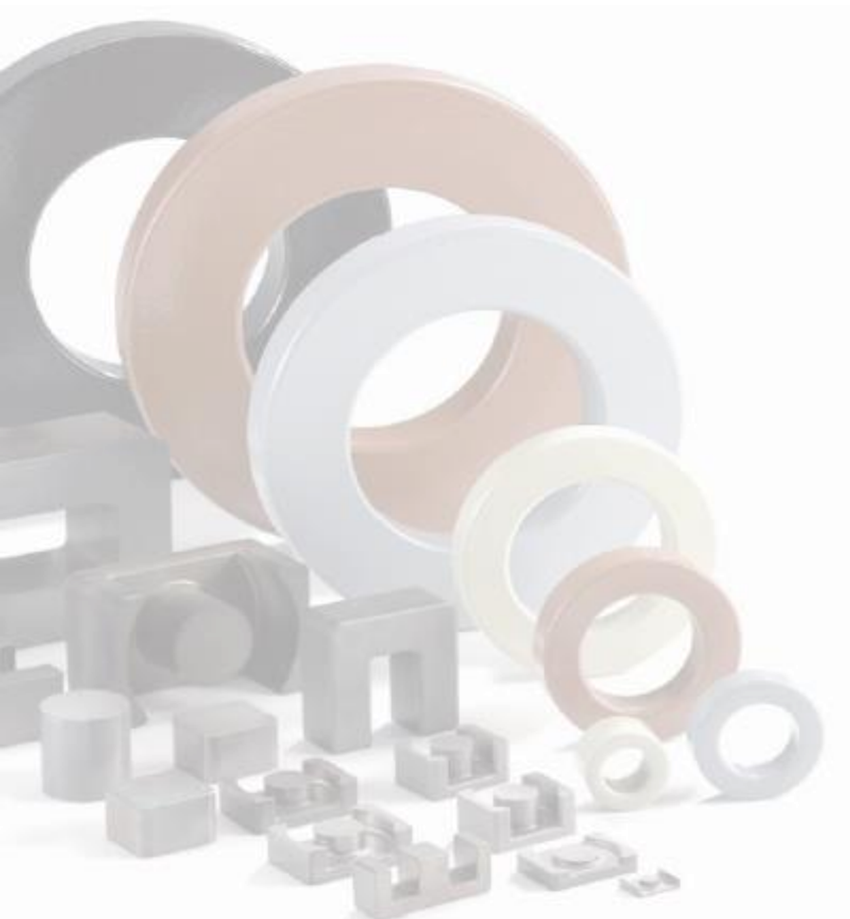
■ Material Comparison

Material	26μ DCB (%)			26μ Coreloss (㎽/㎤)	
	@200 Oe	@300 Oe	@500 Oe	@50 ㎑, 500 G	@50 ㎑, 1000 G
High Flux	82	67	41	48	230
KH Core	85	69	41	104	469
Mega Flux®	82	69	45	147	660

■ Graph







Thank You