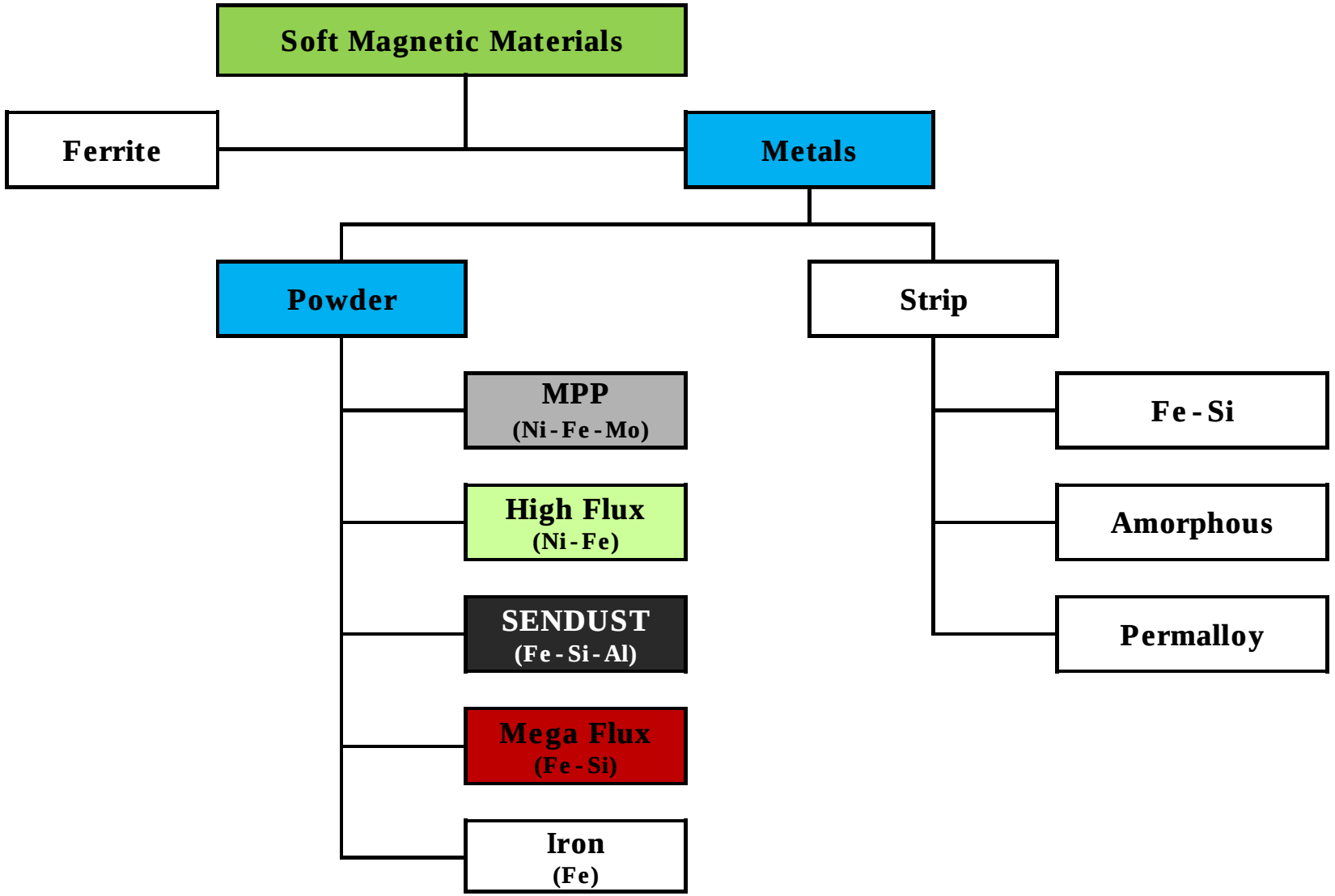
Changsung Corp.

CSC Powder Core for Automotive Application

1. CSC Powder Core
2. Boost Inductor in EV(PHEV, FCEV)
3. Low Voltage DC-DC Converter
4. Electric A/C Compressor
4. Electric Power Steering (EPS)
5. On Board Charger (OBC)
6. Common Rail Direct Injection (CRDI)

1. CSC Powder Core

1. Soft Magnetic Materials

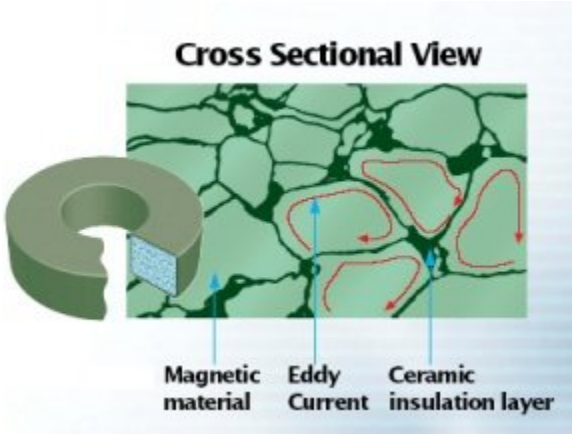


1. CSC Powder Core

2. What is Powder Core ?

Powder Cores are **distributed air gap** cores made from ferrous alloy powders for **low losses** at elevated frequencies.

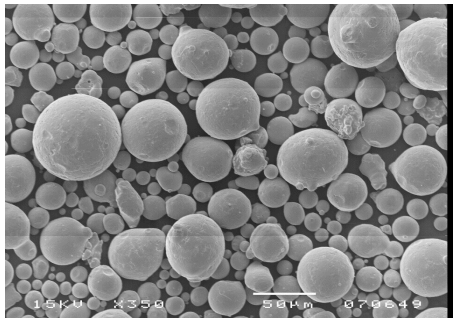
Small air gaps distributed evenly throughout the cores increase the amount of **DC** that can be passed through the winding before core saturation occurs.



3. Manufacturing process

Powder Making → Ceramic Insulation → Pressing → Core Annealing → Core Finish → Inspection

Material	Composition
High Flux : CH	Ni + Fe Alloy
Sendust : CS	Fe + Si +Al Alloy
Mega Flux : CK	Fe + Si Alloy
MPP : CM	Ni + Fe + Mo Alloy



4. Material Comparison

Materials	Perm. (μ_I)	Bs (kG)	Core Loss	DC Bias	Relative Cost	Temp. Stability	Curie Temp [℃]
MPP	26-200	7	Lower	Better	High	Best	450
High Flux	26-160	15	Low	Best	Medium	Better	500
Sendust	26-125	10	Low	Good	Low	Good	500
Mega Flux	26-90	16	Medium	Best	Low	Better	700
Iron	10-100	10	High	Poor	Lowest	Poor	770
Fe-Si Strip (Gap)		20	High	Better	Lowest	Good	740
Amorphous (Gap)		15	Low	Better	Medium	Good	399
Ferrite (Gap)		3-5	Lowest	Poor	Lowest	Poor	100~300

1. CSC Powder Core

Special Shape Powder Core

Ni-Fe alloy
Khaki Color
Lower Core Loss,Excellent DC Bias
Large Energy Storage Capability
Perm 26, 60, 125, 147, 160u

Ni-Fe-Mo alloy
Gray Color
Lowest Core Loss
Excellent Temperature Stabiliy
Perm 26, 60, 125, 147, 160, 173, 200u

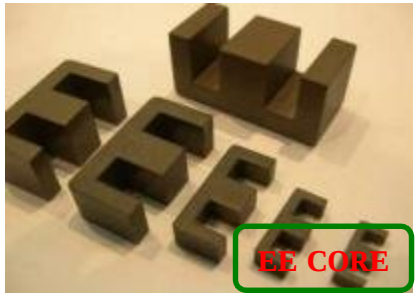
High Flux Cores

MPP Cores

Sendust Cores

Mega Flux Cores

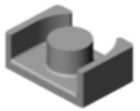
Fe-Si-Al alloy
Black Color
Low Core Loss
Moderate Price
Perm 26, 60, 75, 90, 125u



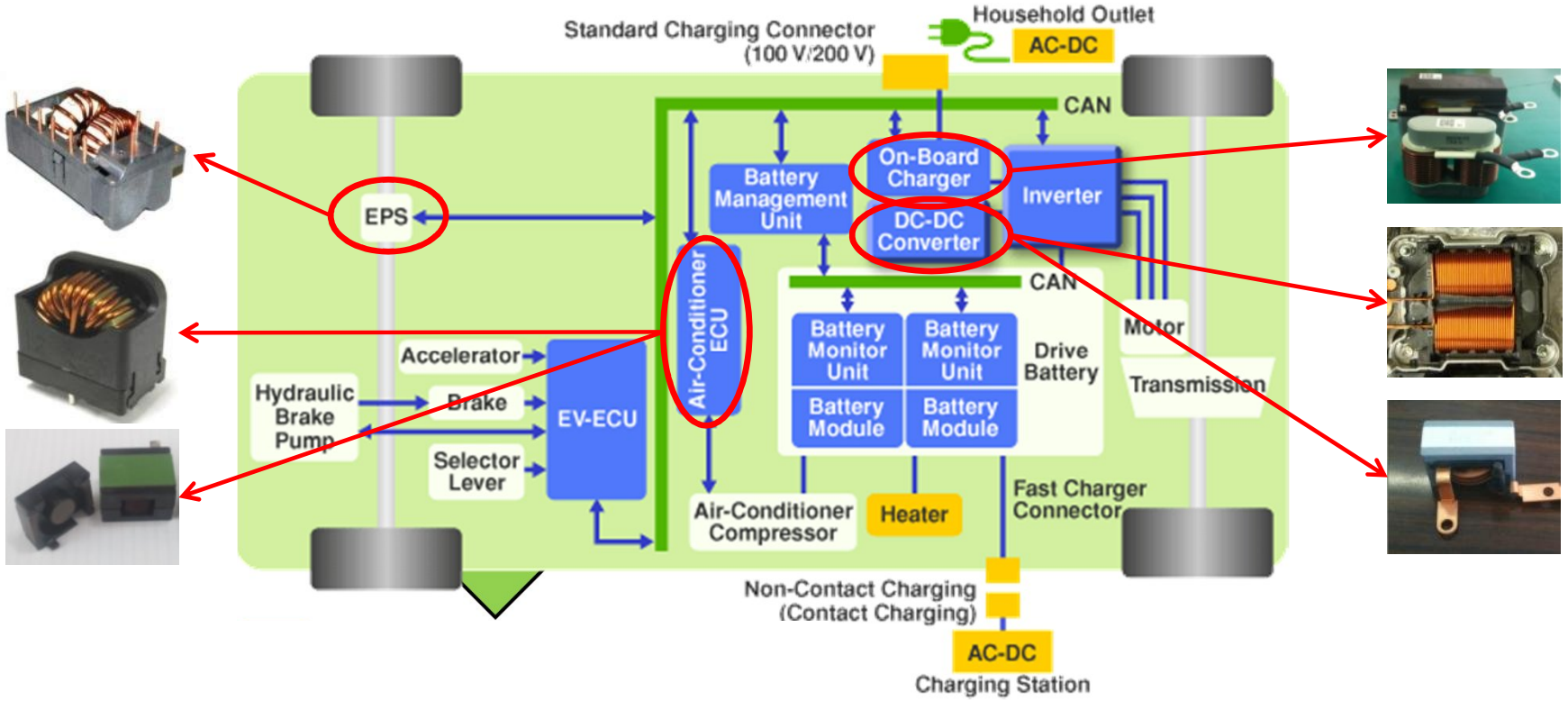
Fe-Si alloy
Dark Brown Color
Excellent DC Bias
Large Energy Storage Capability
Moderate Price
Perm 26, 40, 50, 60, 75, 90u

1. CSC Powder Core

Special Shape Powder Core

		Block	E	EER	EQ	Cylinder	Round Block	U	ER	Ellipse
Materials	Perm.									
MegaFlux	26μ	○	○	○	○	○	○	○	○	○
	40μ	○	○	○	○	○	○	○	○	○
	60μ	○	○	○	○	○	○	○	○	○
Sendust	26μ	○	○	○	○	○		○		
	40μ	○	○	○	○	○		○		
	60μ	○	○			○		○		
HighFlux	26μ	○		○	○	○		○	○	
	40μ	○		○	○	○		○	○	
	60μ	○		○	○	○		○	○	
Design Tool		○	○		○			○	△	○

CSC Powder Core for Automotive Application



CRDI (Common Rail Direct Injection)

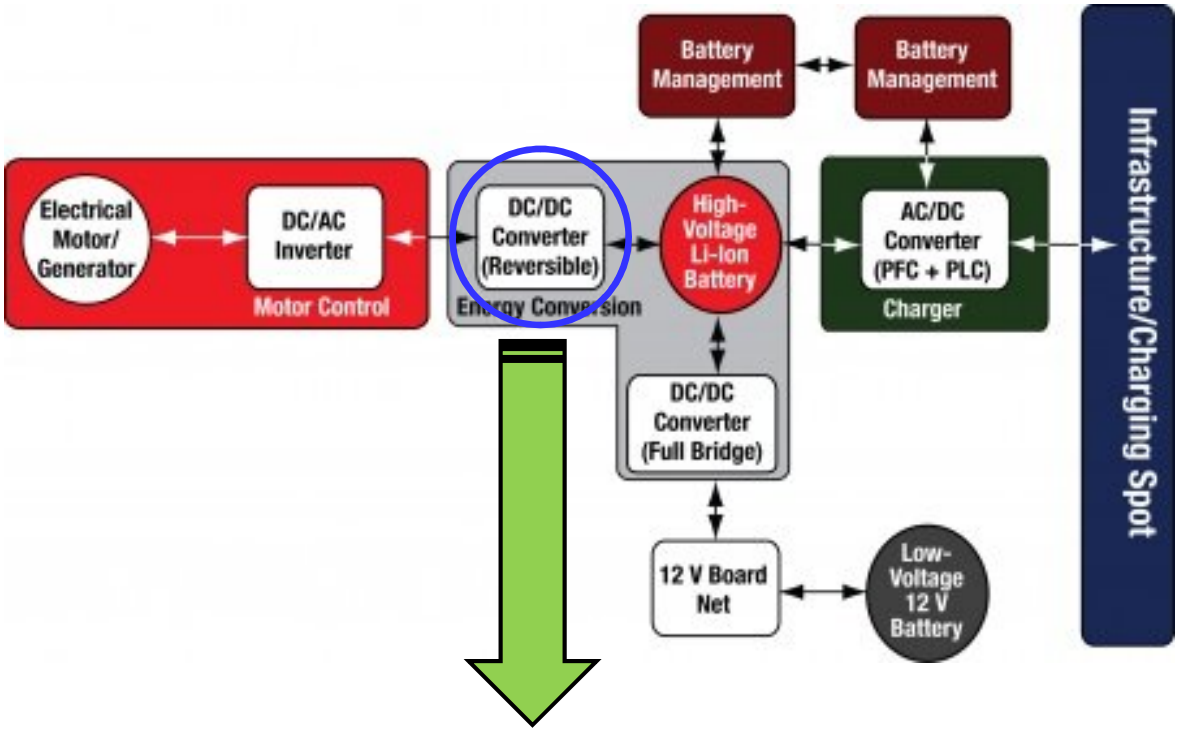
Navigation

ISG (Idle Stop & Go)

Noise Filter

2. Boost Inductor in EV(PHEV, FCEV)

1. Applications

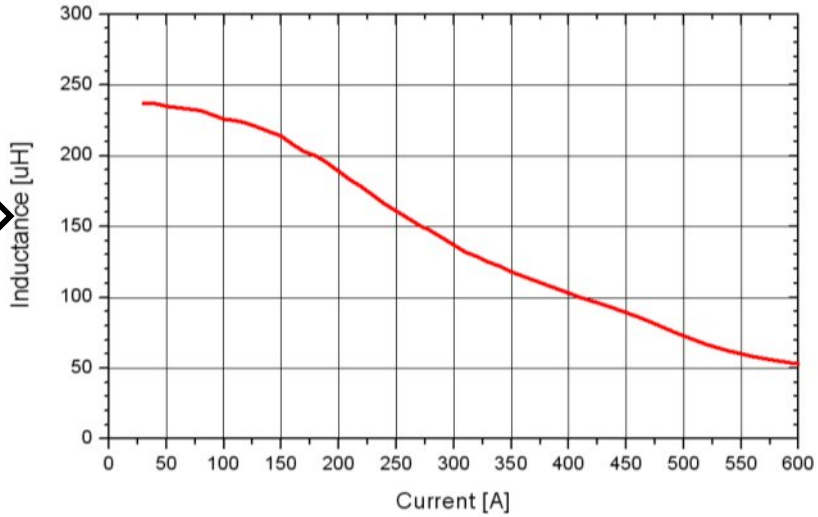


A Boost converters(High DC/DC converter) pump up voltage in battery to the higher voltage up to 650V for high torque in inverter motor of EV(PHEV/FCEV). Boost inductors in boost converters should be small, light with excellent electrical performance.

2. Boost Inductor in EV(PHEV, FCEV)

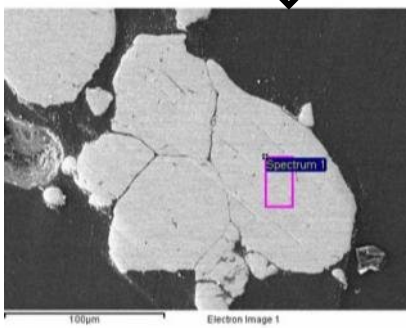
[Real Boost Inductor]

Inductance



<Soft and slow saturation at high Current >

EDS



Element	Weight%
Si	11.02
Fe	88.98
Totals	100%

<Fe-Si alloy powder cores>

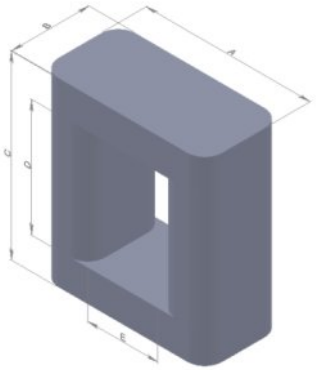
Requirements

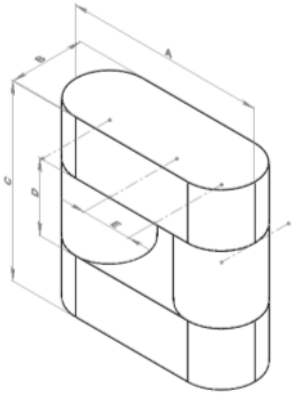
* Particle Shape **à** Powder Shape for Low Core Loss
* Core Material **à** High Saturation Flux Density Material for Small Size
* Gap Type **à** Distributed Air Gap + Bulk Air Gap to Prevent Saturation at High Current
* Core Shape **à** Short Winding 1 Turn Length for Low DCR

CSC Suggestion

* CSC Powder Core
* Fe-Si Alloy Material
  Mega Flux (Bs=16,000 Gauss)
* Smaller Bulk Air Gap
* Ellipse or Cylinder Shape

[Ellipse Core]





[Cylinder + Round Block]

Mega Flux Ellipse Core,
Cylinder + Round Block Core
with Bulk Air Gap

2. Boost Inductor in EV(PHEV, FCEV)

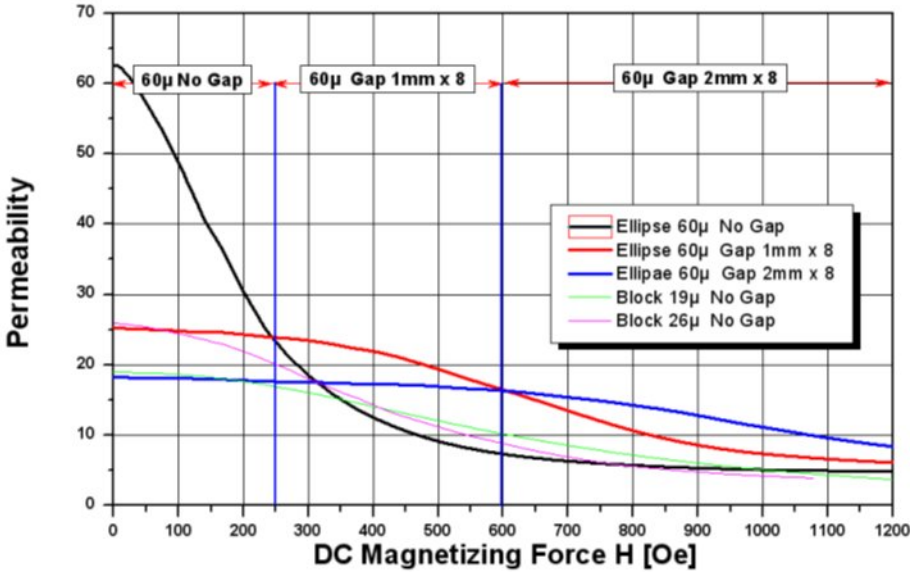
4. Bulk Air Gap Effect

Ellipse Core assembly

*** Plate = LK6035-18C**

*** Post = LK3520-20C 3 Stacks**

*** Gap = No bulk gap**



Bulk gap Ellipse Core assembly

*** Plate = LK6035-18C**

*** Post = LK3520-20C 3 Stacks**

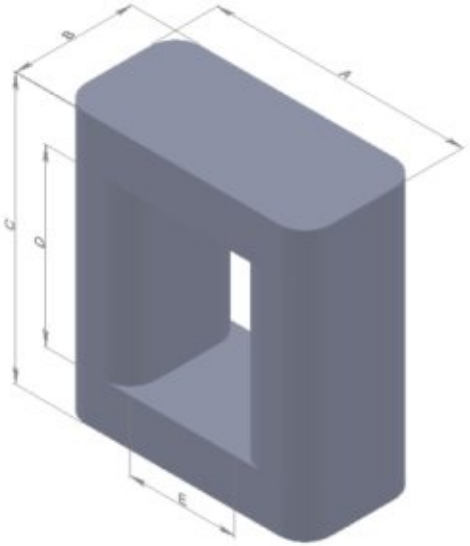
*** Gap = Air gap 1mm x 8**

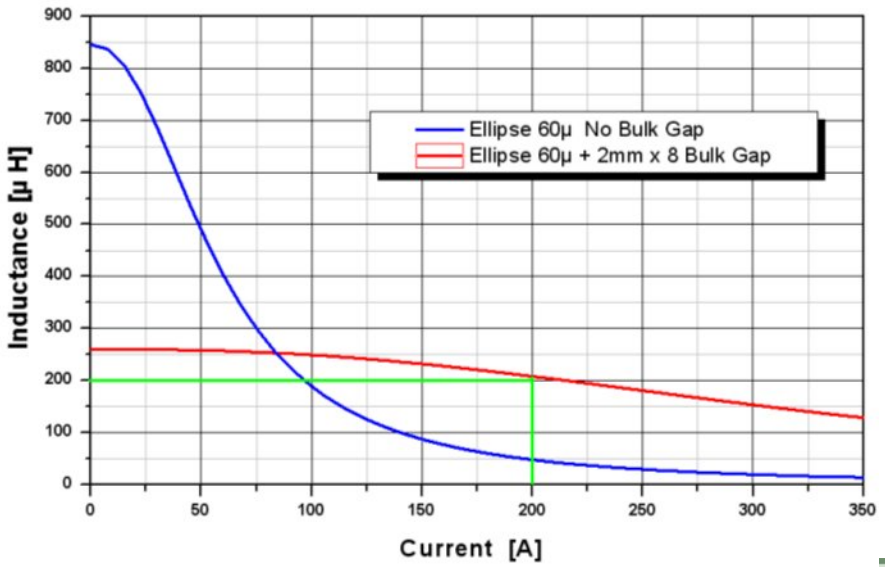
2mm x 8

DC magnetizing force	The highest effective μ
0 ~ 250 Oe	No bulk gap Ellipse 60μ
250 ~ 600 Oe	1mm x 8 air gap (Better than 26μBlock)
600 Oe ~	2mm x 8 air gap (Better than 19μBlock)

L(200A)=200μH Design : Water Cooling

Plate Core	LK6035-18C : Mega Flux Ellipse Core 60μ, 60mm x 35mm x18.5mm Size
Post Core	LK3520-20C : Mega Flux Ellipse Core 60μ, 35mm x 20mm x 20.0mm Size 3Stack
Air Gap	1leg 2mm x 4 = 8mm, 2leg à Total 16mm air gap
Assembled Core Size	A x B x C = 60mm x 35mm x 105mm(Core 97mm + Air Gap 8mm)
Copper Size & Turns	Rectangular wire Width 7mm x Thickness 1.6mm, 62(31+31)Turns

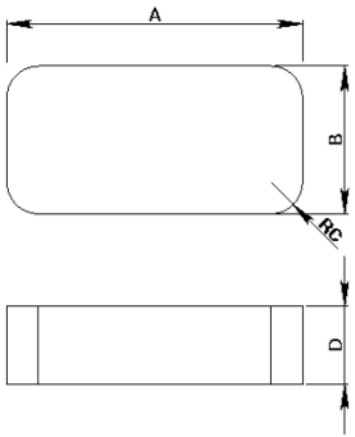




L(0A)	260μH
L(200A)	208μH
L(300A)	154μH
DCR	13mΩ

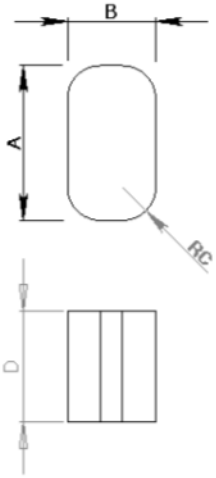
(1) Plates

P/N	Dimensions				Cross Section Area(㎠)
	A Length (mm)	B Width (mm)	RC Radius (mm)	D Height (mm)	
LK5035-13	50.5±0.5	35.3±0.3	7.5±0.2	13.5±0.2	4.77
LK5035-18	50.5±0.5	35.3±0.3	7.5±0.2	18.5±0.2	6.52
LK6035-13	60.5±0.5	35.3±0.3	7.5±0.2	13.5±0.2	4.77
LK6035-18	60.5±0.5	35.3±0.3	7.5±0.2	18.5±0.2	6.52
LK7035-13	70.5±0.5	35.3±0.3	7.5±0.2	13.5±0.2	4.77
LK7035-18	70.5±0.5	35.3±0.3	7.5±0.2	18.5±0.2	6.52



(2) Posts

P/N	Dimensions				Cross Section Area (㎠)
	A Length (mm)	B Width (mm)	RC Radius (mm)	D Height (mm)	
LK3515-20	35.3±0.3	15.2±0.2	7.5±0.2	20.0±0.2	4.77
LK3515-25	35.3±0.3	15.2±0.2	7.5±0.2	25.0±0.2	4.77
LK3520-20	35.3±0.3	20.2±0.2	7.5±0.2	20.0±0.2	6.52
LK3520-25	35.3±0.3	20.2±0.2	7.5±0.2	25.0±0.2	6.52



2. Boost Inductor in EV(PHEV, FCEV) 6-2. Ellipse Core Assembly

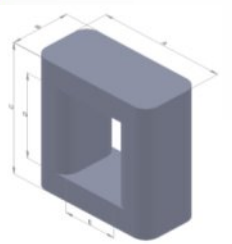
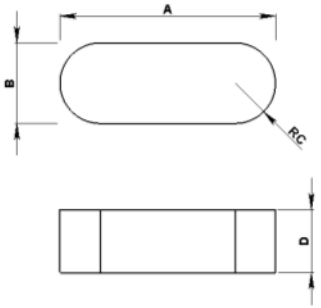


PLATE	POST		Dimensions					Path length (㎝)	Cross Section Area (㎠)	Window Area (㎠)	AL value (nH/n²)±12%		
	P/N	1 LEG STACK	A Length (mm)	B Width (mm)	C Height (mm)	D Inner HT (mm)	E Inner Length (mm)				A= 026u	B= 040u	C= 060u
LK5035-13	LK3515-20	2	50.5±0.5	35.3±0.3	67.0±0.5	40.0±0.4	20.0±0.4	16.47	4.77	8	113	146	218
	LK3515-25	2	50.5±0.5	35.3±0.3	77.0±0.5	50.0±0.4	20.0±0.4	18.47	4.77	10	101	130	195
	LK3515-20	3	50.5±0.5	35.3±0.3	87.0±0.5	60.0±0.4	20.0±0.4	20.47	4.77	12	91	117	176
LK5035-18	LK3515-20	2	50.5±0.5	35.3±0.3	67.0±0.5	40.0±0.4	10.0±0.4	16.04	6.52	4	158	204	306
	LK3515-25	2	50.5±0.5	35.3±0.3	77.0±0.5	50.0±0.4	10.0±0.4	18.04	6.52	5	141	182	273
	LK3515-20	3	50.5±0.5	35.3±0.3	87.0±0.5	60.0±0.4	10.0±0.4	20.04	6.52	6	127	164	245
LK6035-13	LK3515-20	2	60.5±0.5	35.3±0.3	67.0±0.5	40.0±0.4	30.0±0.4	18.47	4.77	12	101	130	195
	LK3515-25	2	60.5±0.5	35.3±0.3	77.0±0.5	50.0±0.4	30.0±0.4	20.47	4.77	15	91	117	176
	LK3515-20	3	60.5±0.5	35.3±0.3	87.0±0.5	60.0±0.4	30.0±0.4	22.47	4.77	18	83	107	160
LK6035-18	LK3520-20	2	60.5±0.5	35.3±0.3	77.0±0.5	40.0±0.4	20.0±0.4	18.04	6.52	8	141	182	273
	LK3520-25	2	60.5±0.5	35.3±0.3	87.0±0.5	50.0±0.4	20.0±0.4	20.04	6.52	10	127	164	245
	LK3520-20	3	60.5±0.5	35.3±0.3	97.0±0.5	60.0±0.4	20.0±0.4	22.04	6.52	12	115	149	223
LK7035-13	LK3515-20	2	70.5±0.5	35.3±0.3	67.0±0.5	40.0±0.4	40.0±0.4	20.47	4.77	16	91	117	176
	LK3515-25	2	70.5±0.5	35.3±0.3	77.0±0.5	50.0±0.4	40.0±0.4	22.47	4.77	20	83	107	160
	LK3515-20	3	70.5±0.5	35.3±0.3	87.0±0.5	60.0±0.4	40.0±0.4	24.47	4.77	24	76	98	147
LK7035-18	LK3520-20	2	70.5±0.5	35.3±0.3	77.0±0.5	40.0±0.4	30.0±0.4	20.04	6.52	12	127	164	245
	LK3520-25	2	70.5±0.5	35.3±0.3	87.0±0.5	50.0±0.4	30.0±0.4	22.04	6.52	15	115	149	223
	LK3520-20	3	70.5±0.5	35.3±0.3	97.0±0.5	60.0±0.4	30.0±0.4	24.04	6.52	18	106	136	204

Cylinder cores Part List

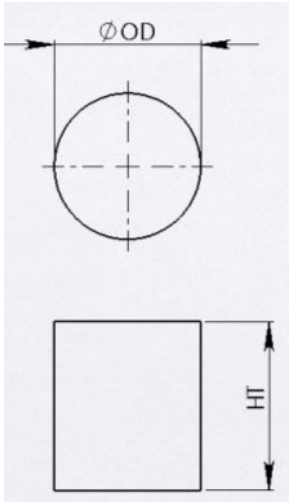
1) Plates : Round Block Core

P/N	Dimensions				Cross Section Area (㎠)	POST
	A Length (mm)	B Width (mm)	RC Radius (mm)	D Height (mm)		
RBK5420A	54.5±0.5	20.2±0.3	10.0±0.2	15.7±0.2	3.14	CK2020
RBK6424A	64.5±0.5	24.2±0.3	12.0±0.2	18.8±0.2	4.52	CK2424
RBK6725A	67.5±0.5	25.2±0.3	12.5±0.2	19.6±0.2	4.91	CK2525
RBK7428A	74.5±0.5	27.5±0.3	13.7±0.2	21.7±0.2	6.00	CK2828
RBK8030A	80.5±0.5	30.2±0.3	15.0±0.2	23.5±0.2	7.07	CK3030



2) Posts : Cylinder Core

P/N	Dimensions		1Turn length (mm)	Cross Section Area (㎠)	PLATE
	OD (mm)	HT (mm)			
CK2020	20.2±0.3	20.0±0.2	62.80	3.14	RBK5420A
CK2424	24.2±0.3	24.0±0.2	75.40	4.52	RBK6424A
CK2525	25.2±0.3	25.0±0.2	78.50	4.91	RBK6725A
CK2828	27.5±0.3	27.5±0.2	86.40	6.00	RBK7428A
CK3030	30.2±0.3	30.0±0.2	94.20	7.07	RBK8030A



2. Boost Inductor in EV(PHEV, FCEV)

7-2. Round blocks + Cylinder cores Assembly

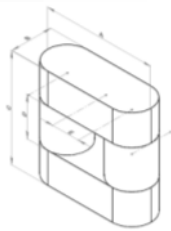
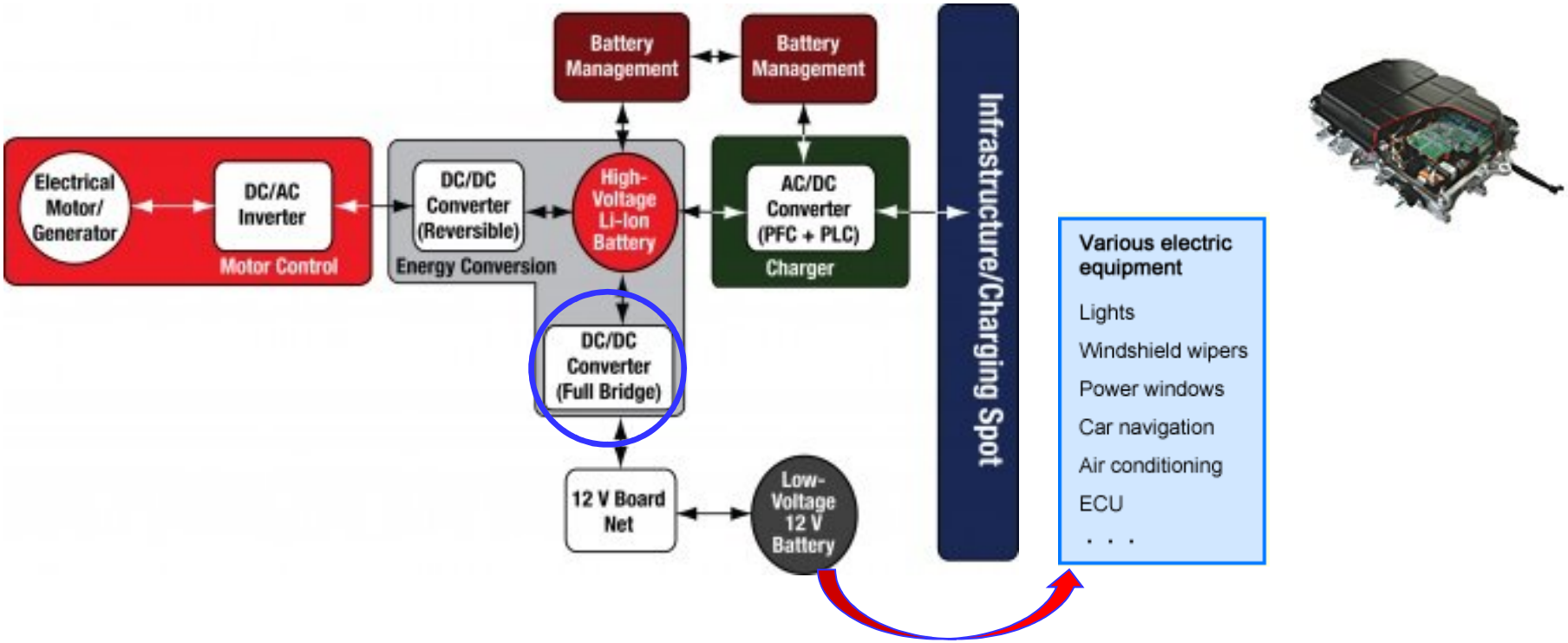


PLATE P/N	POST		Dimensions					Path Length (㎝)	Cross Section Area (㎠)	Window Area (㎠)	AL value (nH/n^2) ± 12%		
	P/N	1 LEG STACK	A Length (mm)	B Width (mm)	C Height (mm)	D Inner Height (mm)	E Inner Length (mm)				026u	040u	060u
RBK5420A	CK2020	1	54	20	51.4	20	14	12.41	3.14	2.8	99	127	191
		2	54	20	71.4	40	14	16.41	3.14	5.6	75	96	144
		3	54	20	91.4	60	14	20.41	3.14	8.4	60	77	116
RBK6424A	CK2424	1	64	24	61.6	24	16	14.72	4.52	3.84	120	154	232
		2	64	24	85.6	48	16	19.52	4.52	7.68	90	116	175
		3	64	24	109.6	72	16	24.32	4.52	11.52	72	93	140
RBK6725A	CK2525	1	67	25	64.2	25	17	15.41	4.91	4.25	124	160	240
		2	67	25	89.2	50	17	20.41	4.91	8.5	94	121	181
		3	67	25	114.2	75	17	25.41	4.91	12.75	75	97	146
RBK7428A	CK2828	1	74	27.5	71.4	28	19	17.13	6.00	5.32	136	176	264
		2	74	27.5	99.4	56	19	22.73	6.00	10.64	103	133	199
		3	74	27.5	127.4	84	19	28.33	6.00	15.96	83	106	160
RBK8030A	CK3030	1	80	30	77	30	20	18.4	7.07	6	150	193	290
		2	80	30	107	60	20	24.4	7.07	12	113	146	218
		3	80	30	137	90	20	30.4	7.07	18	91	117	175

3. Low Voltage DC-DC Converter

1. Application



In EVs and HEVs, applications for DC-DC converters start at the high-voltage (HV) battery.

Although battery voltages are still typically in the range of 300 to 350 Vdc, some exceed 450 Vdc.

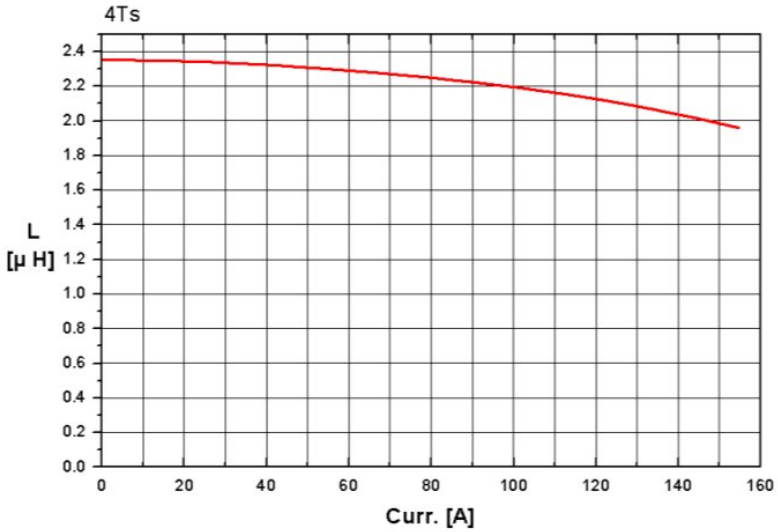
The most basic requirement for DC-DC conversion is to power the traditional 12 V loads.

This DC-DC converter charges the 12 V battery from the HV bus eliminating the 14 V alternator.

A bi-directional DC-DC converter is required where the 12 V battery may be used to supply the HV system.

[Real Inductor]

Inductance



<High Current, Low Inductance, Soft Saturation >

Coil

Core Shape

<Helical Coil>

<EQ, ER, EER Powder Core >

Requirements

* Particle Shape **à** Powder Shape for Low Core Loss
* Core Material **à** High Saturation Flux Density Material for Small Size
* Gap Type **à** No Bulk Air Gap
* Center Leg Shape **à** Round Center Leg for Low DCR & Helical Coil Winding

CSC Suggestion

* CSC Powder Core
* Fe-Si Alloy Material : Mega Flux
  Ni-Fe Alloy Material : High Flux
* Smallest Air Gap
* EQ, ER, EER Shape Core

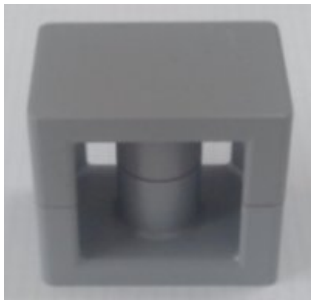
EQ CORE

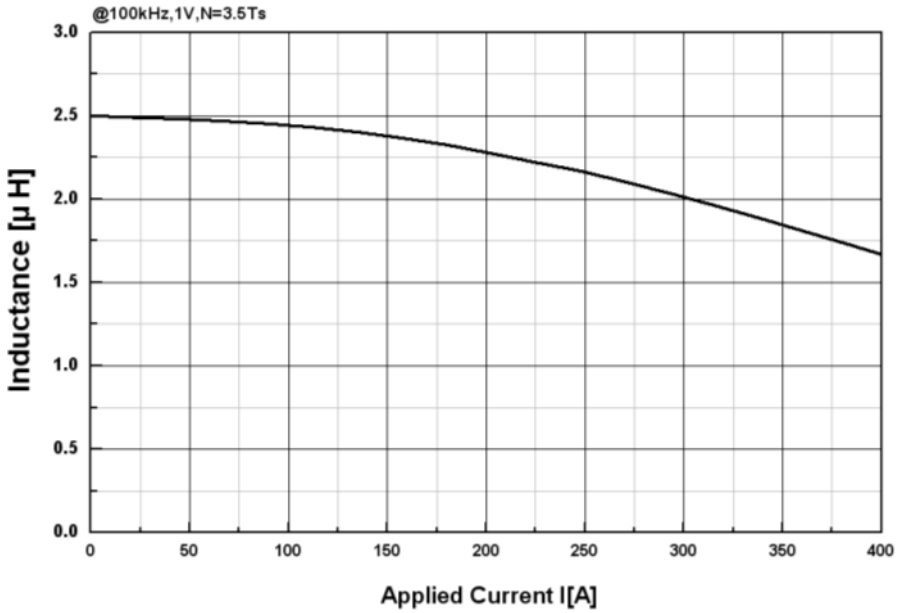
ER CORE

EER CORE

L(300A)=2μH Design : Air Cooling

Core	**HEQ5032C-060 : 50mm x 32mm x 40mm**
Coil	**Width=9.7mm, Thickness = 5.2mm Helical Coil**
Air Gap	**No Bulk Air Gap**
Turns	**3.5 Turns**

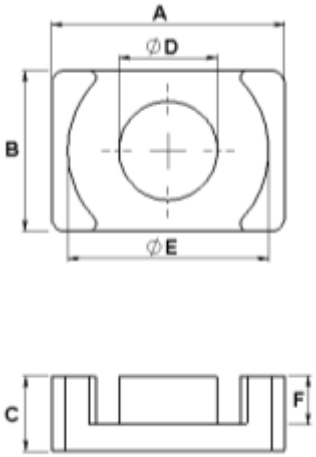




L(0A)	**2.5μH**
L(300A)	**2.1μH**
L(400A)	**1.6μH**
DCR	**0.1mΩ**

(1) Material Comparison

Material	Advantage	Disadvantage	60μ DCB%		Core Loss @25kHz, 1,000G
			@100 Oe	@200 Oe	
Mega Flux (KEQ)	High DCB Moderate Price	Core Loss	76%	42%	219mW/cc
High Flux (HEQ)	High DCB Low Core Loss	Cost	76%	43%	102mW/cc

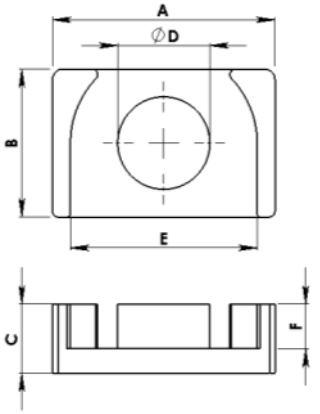


(2) Dimension

P/N	Dimensions						Path length (㎝)	Cross Section Area (㎠)	AL value (nH/n²)±12%		
	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)			026u	040u	060u
HEQ2014A	20.5±0.3	14.0±0.2	8.1±0.2	8.8±0.2	18.0±0.2	5.7±0.3	4.52	0.608	44	68	101
HEQ2014B	20.5±0.3	14.0±0.2	10.1±0.2	8.8±0.2	18.0±0.2	7.7±0.3	5.32	0.608	37	57	86
HEQ2619A	26.5±0.3	19.0±0.2	10.1±0.2	12.0±0.2	22.6±0.3	6.8±0.3	5.47	1.198	72	110	165
HEQ2619B	26.5±0.3	19.0±0.2	12.4±0.2	12.0±0.2	22.6±0.3	9.1±0.3	6.39	1.198	61	94	141
HEQ3222A	32.0±0.4	22.0±0.3	10.3±0.2	13.5±0.2	27.6±0.3	6.6±0.3	6.03	1.523	83	127	190
HEQ3222B	32.0±0.4	22.0±0.3	15.2±0.2	13.5±0.2	27.6±0.3	11.5±0.3	7.99	1.523	62	96	144
HEQ3626A	36.0±0.5	26.0±0.3	17.4±0.3	14.4±0.2	32.0±0.4	13.4±0.3	9.47	1.808	62	96	144
HEQ4128A	41.5±0.5	28.0±0.4	19.9±0.3	14.9±0.2	36.5±0.4	15.4±0.3	11.52	1.997	57	87	131
HEQ5032A	50.0±0.6	32.0±0.4	25.0±0.4	20.0±0.3	44.0±0.5	19.5±0.4	13.34	3.141	77	118	178

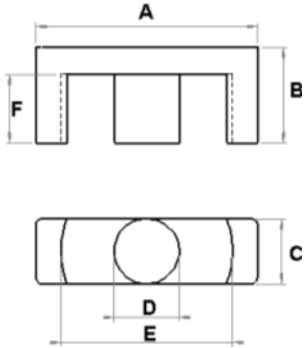
(1) ER Core (RH : HighFlux, RK : MegaFlux)

P/N	Dimensions						Path length (㎝)	Cross Section Area (㎠)	AL value (nH/n²)±12%		
	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)			026u	040u	060u
RH1911A	18.8±0.3	11.0±0.2	6.0±0.2	7.4±0.2	15.6±0.2	4.0±0.2	3.54	0.425	39	60	90
RH2314A	23.4±0.3	14.0±0.2	8.7±0.2	9.2±0.2	19.4±0.2	6.2±0.2	4.91	0.670	45	69	103
RH2518A	25.0±0.3	18.0±0.2	8.4±0.2	11.0±0.2	21.0±0.3	5.4±0.2	4.97	0.960	63	97	146
RH2518B	25.0±0.3	18.0±0.2	10.8±0.2	11.0±0.2	21.0±0.3	7.8±0.2	5.93	0.960	53	81	122
RH3020A	30.0±0.4	20.0±0.3	9.2±0.2	12.0±0.2	25.6±0.3	5.9±0.2	5.81	1.140	64	99	148
RH3020B	30.0±0.4	20.0±0.3	11.8±0.2	12.0±0.2	25.6±0.3	8.5±0.2	6.85	1.140	54	84	125
RH3222A	32.0±0.4	22.0±0.3	10.3±0.2	13.5±0.2	27.0±0.3	6.6±0.2	6.25	1.430	75	115	172
RH3222B	32.0±0.4	22.0±0.3	13.4±0.2	13.5±0.2	27.0±0.3	9.7±0.2	7.49	1.430	62	96	144
RH3222C	32.0±0.4	22.0±0.3	15.2±0.2	13.5±0.2	27.0±0.3	11.5±0.2	8.21	1.430	57	88	131
RH3624A	36.2±0.4	24.0±0.3	11.2±0.2	15.0±0.2	30.4±0.4	7.2±0.2	6.78	1.770	85	131	197
RH3624B	36.2±0.4	24.0±0.3	14.4±0.2	15.0±0.2	30.4±0.4	10.4±0.2	8.06	1.770	72	110	166
RH4225A	42.0±0.5	25.0±0.3	12.3±0.2	16.2±0.3	35.2±0.4	7.9±0.2	7.61	2.060	88	136	204
RH4225B	42.0±0.5	25.0±0.3	15.8±0.2	16.2±0.3	35.2±0.4	11.4±0.2	9.01	2.060	75	115	172

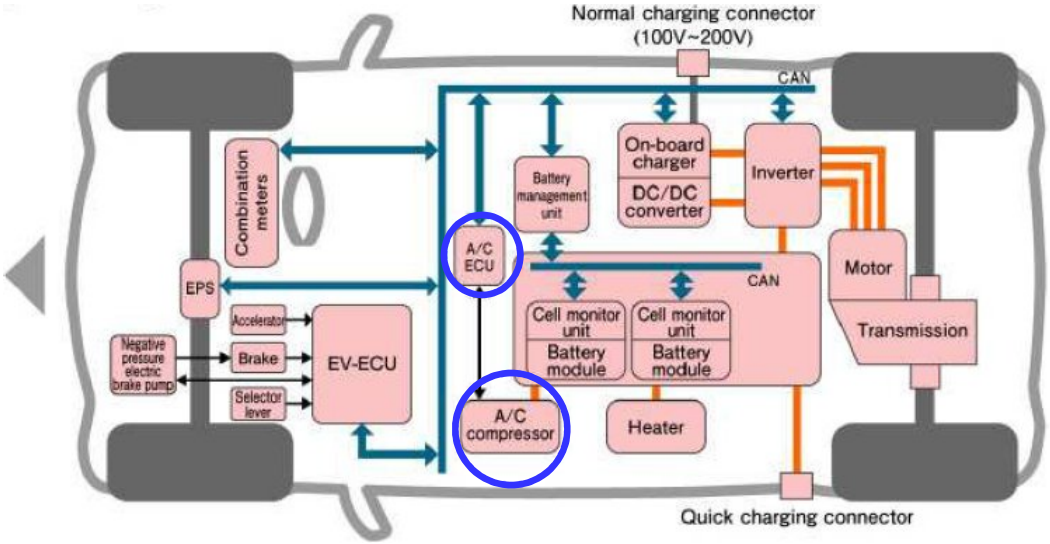


(2) EER Core (HER : HighFlux, KER : MegaFlux)

P/N	Dimensions						Path length (㎝)	Cross Section Area (㎠)	AL value (nH/n²)±12%		
	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)			026u	040u	060u
HER2507A	25.5±0.3	9.3±0.2	7.5±0.2	7.5±0.2	19.8±0.2	6.2	5.10	0.450	39	53	73
HER2507B	25.5±0.3	11.0±0.2	7.5±0.2	7.5±0.2	19.8±0.2	7.9	5.78	0.450	34	47	65
HER3010A	30.6±0.3	15.8±0.2	9.8±0.2	9.8±0.2	22.0±0.2	11	8.66	0.754	38	53	72
HER3511A	35.0±0.4	15.8±0.2	11.3±0.2	11.3±0.2	25.6±0.3	9.8	8.30	1.078	57	78	108
HER3511B	35.0±0.4	20.7±0.2	11.3±0.2	11.3±0.2	25.6±0.3	14.7	10.27	1.078	46	63	87
HER4013A	40.0±0.5	17.4±0.3	13.3±0.3	13.3±0.3	29.0±0.4	10.4	9.13	1.491	72	99	135
HER4013B	40.0±0.5	22.4±0.3	13.3±0.3	13.3±0.3	29.0±0.4	15.4	11.13	1.491	59	81	111
HER4215A	42.0±0.6	22.4±0.4	15.5±0.4	15.5±0.4	29.4±0.5	15.4	10.64	2.026	84	115	158
HER4215B	42.0±0.6	25.4±0.4	15.5±0.4	15.5±0.4	29.4±0.5	18.4	11.84	2.026	75	103	142
HER4917A	49.0±0.7	18.8±0.5	17.2±0.5	17.2±0.5	36.5±0.6	12.2	9.57	2.353	99	136	185
HER4917B	49.0±0.7	24.7±0.5	17.2±0.5	17.2±0.5	36.5±0.6	18.1	11.93	2.353	79	109	149



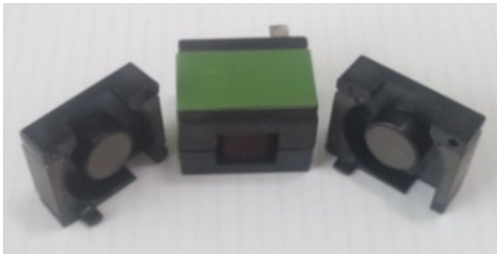
4. Electric A/C Compressor



Noise Filter for Inverter
: CSC High Flux Material
: Toroidal Core

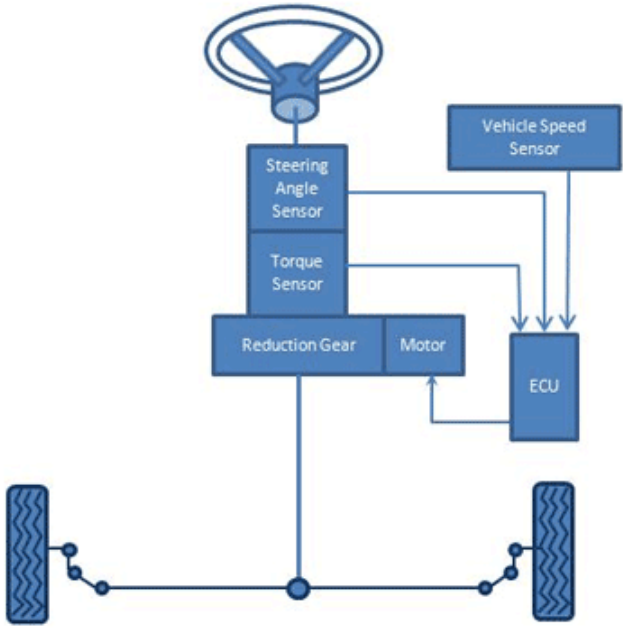
A/C compressor is driven by electric motor incorporating its own high voltage inverter

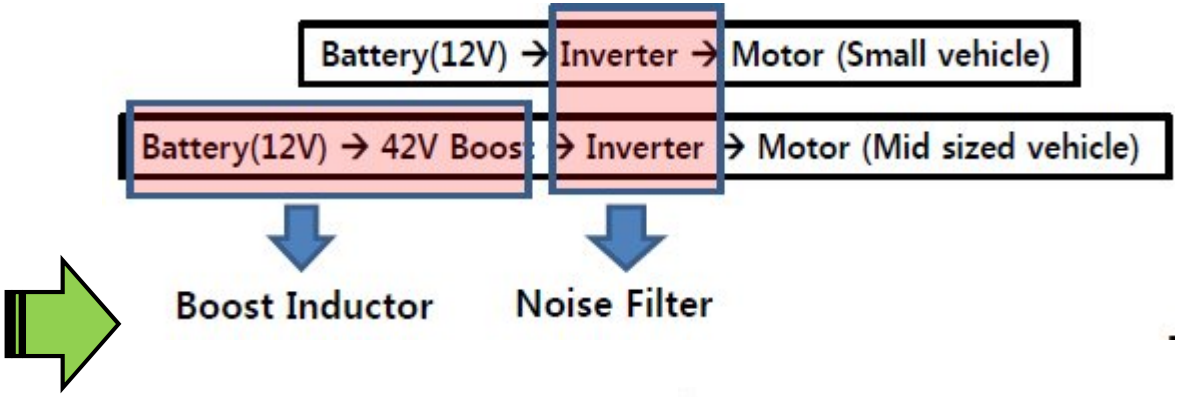
Electric compressors are compressors that are equipped with a built-in motor. The built-in motor can still operate even when the vehicle's engine is stopped allowing for better fuel efficiency and continued use of the air conditioner for a comfortable cabin temperature even during an idling stop.

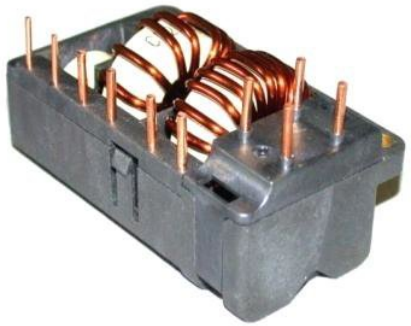


Noise Filter for Inverter
: CSC High Flux Material
: ER Core

5. Electric Power Steering



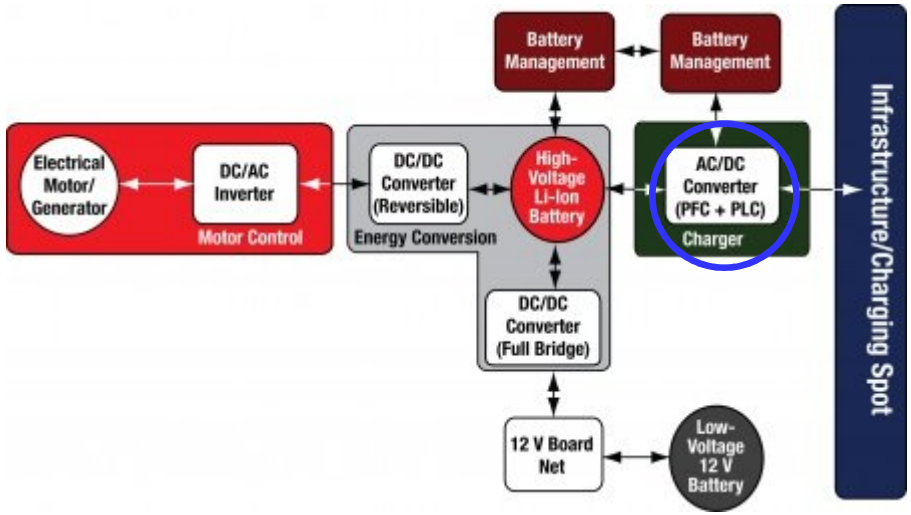


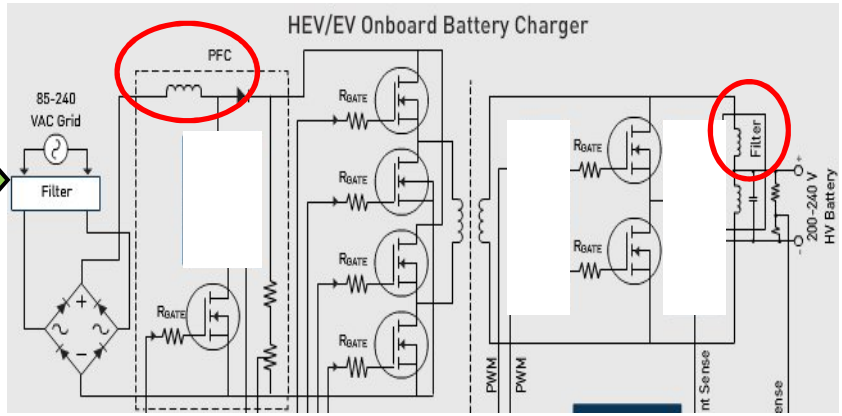


Boost Inductor, Noise Filter
: CSC High Flux Material
: Toroidal Core

Electric Power Steering (EPS) is favored over hydraulic power steering in most new vehicles. Eliminating the power steering pump can reduce weight and improve fuel economy. EPS also offers greater handling and steering feel while improving vehicle safety by adapting the steering torque to the vehicle's speed and providing active torque in critical driving situations.

6. On Board Charger

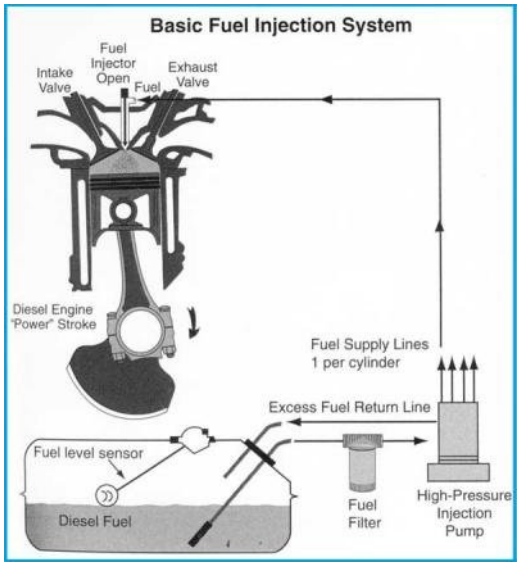


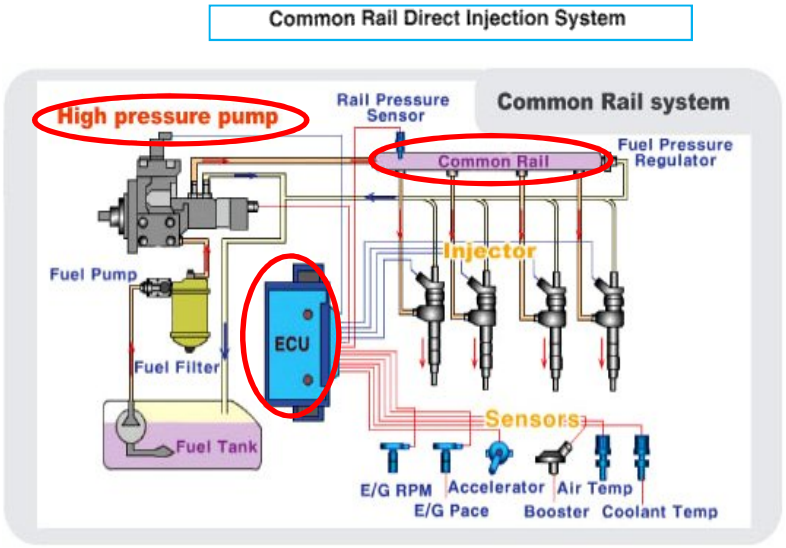


PHEVs and BEVs must be recharged on a periodic basis, typically by connecting to the power grid in some form. For most users, Level 1 charging (120 VAC at 15 A-20 A) will be the most available power supply that all onboard chargers should be capable of handing, as it will be easily accessible to all users. The Level 1 and 2 charging system for these vehicles consists of an AC/DC converter to generate a DC voltage from the AC line. This incoming power needs to undergo power factor correction (PFC) to boost the power factor to meet regional regulatory standards.

PFC Inductor, Noise Filter
: CSC MegaFlux, SENDUST, HighFlux Material
: Toroidal Core or Other Special Shape Core

7. Common Rail Direct Injection (CRDI)





Ordinary diesel direct fuel-injection systems have to build up pressure anew for each and every injection cycle, the new common rail (line) engines maintain constant pressure regardless of the injection sequence. This pressure then remains permanently available throughout the fuel line. The engine's electronic timing regulates injection pressure according to engine speed and load. The electronic control unit (ECU) modifies injection pressure precisely and as needed, based on data obtained from sensors on the cam and crankshafts. In other words, compression and injection occur independently of each other. This technique allows fuel to be injected as needed, saving fuel and lowering emissions.

Boost Inductor
: CSC HighFlux Material
: Toroidal Core


Audi

BMW

TOYOTA


GM


NISSAN

HONDA

HYUNDAI


KIA


mazda

Ford

BOSCH

Continental

US Hybrid
Mobile Energy Technologies

HCC

HYUNDAI
MOBIS

MITSUBISHI
ELECTRIC

SCHAFFNER

TOYOTA

sumida

Panasonic

DENSO

DELPHI

MANDO

Thank You !