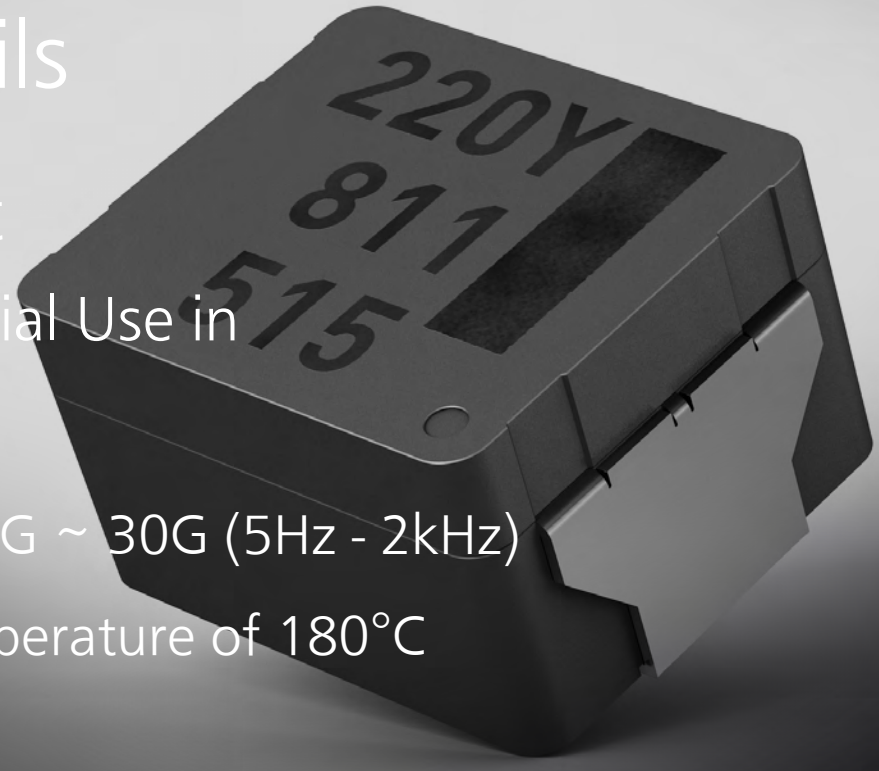
Panasonic

ETQP Series Inductor Product Guide Version 12/2018

Metal Composite Type Power Choke Coils

AEC-Q200 Compliant

For Automotive & Industrial Use in Harsh Enviroments



- Vibration Resistance of 10G ~ 30G (5Hz - 2kHz)
- Maximum Operating Temperature of 180°C
- Up to 40% Smaller
- Thermal Shock -40 ~+150°C, -55 ~+155°C
- Metal Composite Core with Magnetic Shielding
- Non-Hard Saturation

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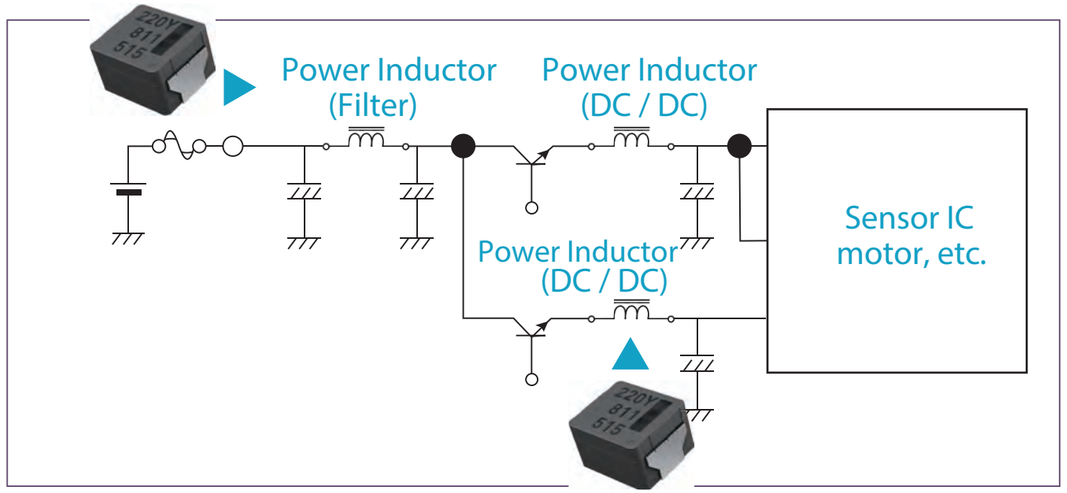
Introduction

Panasonic's ETQP Series Metal Composite Type Power Choke Coils are suited for filter, step-down and step-up circuits for DC/DC converters. They are AEC-Q200 Compliant offering reliability when exposed to high temperatures along with a high resistance to vibration.

DC / DC Converter Application Example



Applications

Circuit

- Noise Filter For Drive Circuits
- DC/DC Converter
- Voltage Regulator
- Buck/Boost Converters

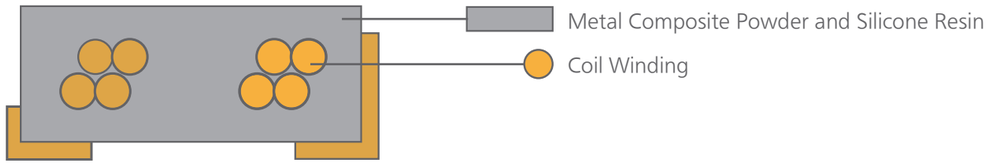
Automotive

- HEV/EV
- Engine ECU
- ADAS
- Power-Train
- Lighting
- Autonomous Driving

Industrial

- Automation
- Server
- LED Driver
- Power Supply Module

High Current, High Heat Resistance and Excellent Thermal Stability



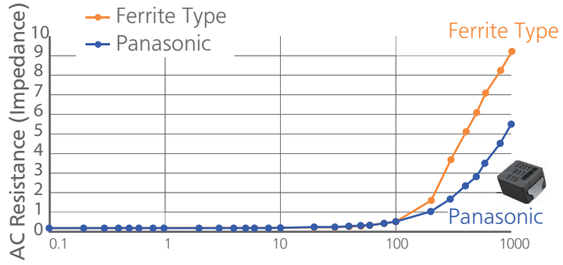
Cross-section view of an ETQPM Power Choke Coil.

- The ETQP Power Inductor consists of metal powder, silicone resin and coil winding. The magnetic material, which is created from Fe-based powder, enables high current, high heat resistance and excellent thermal stability.
- Excellent magnetic saturation characteristics (i.e. Ferrite core = 0.4T vs. Metal Composite Type=above 1.5T) make it difficult to magnetically saturate, resulting in good inductance vs. current performance without substantial drop off.
- By using a high temperature capable resin material, an operating temperature up to 160°C is achievable.
- *Low Profile Series 155°C
- *High Performance Series 160°C

* 180°C under Special Conditions

Frequency Characteristics of AC Resistance

Size: 7x7mm

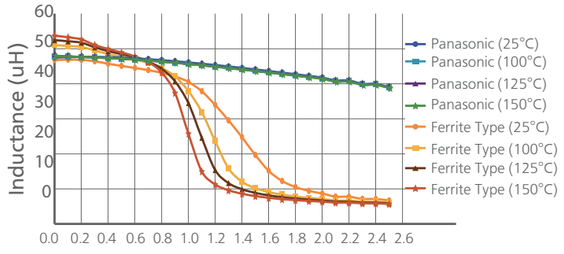


Frequency (kHz)

The metal composite molded structure has a distributed gap rather than a discrete gap resulting in low AC resistance (impedance) at higher frequencies.

Effect of DC Bias Current on Inductance

Size: 7x7mm



DC Bias (A)

The ETQP Inductor allows for large currents. The inductance levels do not drop significantly as the current increases regardless of the temperature.

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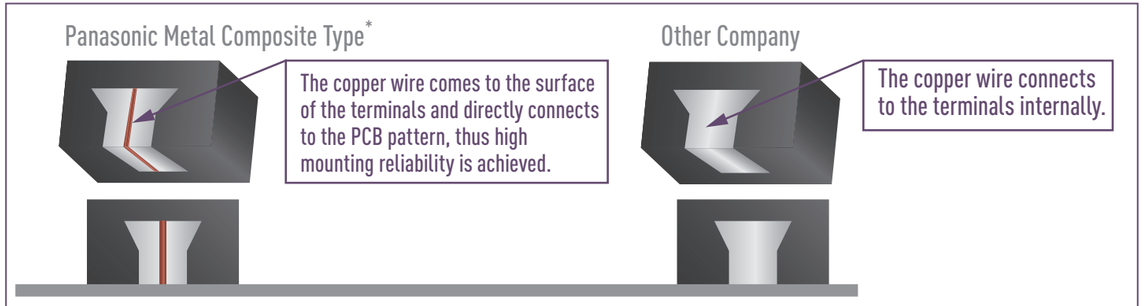
Comparison of Panasonic vs. Ferrite Type (At The Same Inductance (Current) Capability)		
Manufacturer	Panasonic Metal Composite	Ferrite (Alternative Product)
Series	MO645	Ferrite Type
Size (mm)	6.5 × 6.0	7.4 × 6.9
Height (mm)	4.5 max	4.7 max
Volume (mm)^3	187	240
Core Material	Metal Composite	Ferrite
L1 (uH) at 100kHz	47.0 (0.8A)	47.0 (0.7A)
ISAT (A) at 125°C , L-10%	1.3	0.7
DCR (mΩ)	210	158
Performance Index Per Volume	100%	60%
Max Operating Temperature	160°C	125°C

Achieved 22% downsizing

Temperature condition 125°C

Unique Terminal Structure

The copper wire of the internal coil is brought out directly to the terminal mounting part to ensure the reliability of mounting to the PCB. Other products make the connection inside the Metal Composite, thus it is hard to verify the connection condition and long-term reliability issues may occur with environmental stresses.



*For the actual product, dip solder is applied on the copper wire part and terminal to keep good mountability. The corresponding part numbers are included in the Selection Guide on page 10 of this document.

Low Leakage Flux

The integrated molded and magnetic shielded structure of the Metal Composite Type with its distributed gap has low leakage flux from the core resulting in noise and interference reduction, facilitating high density layouts.

AEC-Q200 Compliant For Use In Harsh Environments

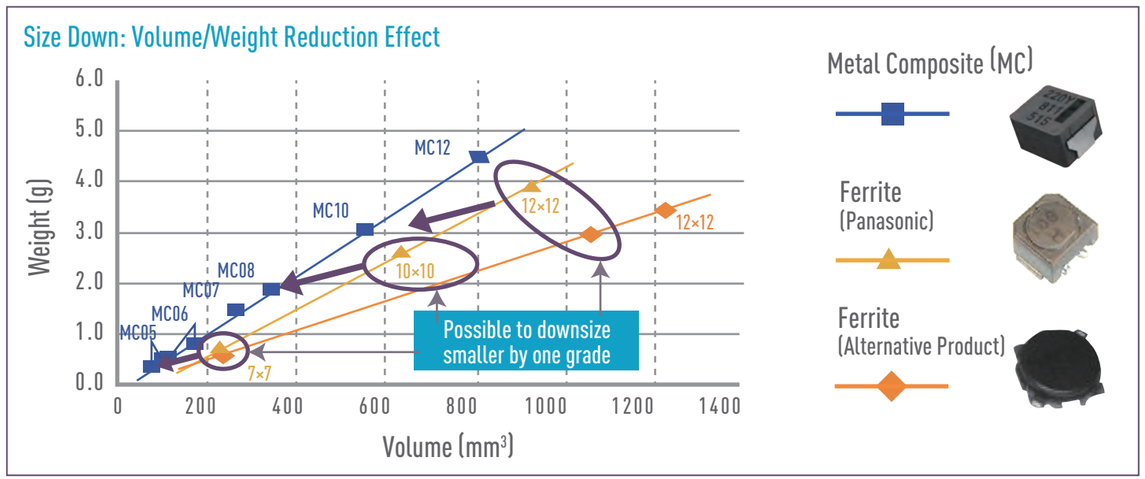
Through the previously mentioned improvements, the ETQP Series product provides 150°C temperature and excel vibration resistance characteristics.

Reliability Results for AEC-Q200 Compliance

Item	Condition	Time	Remark
Thermal Shock	-40 ~ +150°C	2000cycles	• Inductance is ±10% from initial value • DCR is ±10% from initial value • Insulation resistance is above 10KΩ • Nothing abnormal on appearance and structures • No open wire or mechanical damage
Vibration Resistance	10G ~ 30G (5Hz - 2kHz)	XYZ (Each for 2 hours)	
Heat Resistance High Temperature Life- time	150°C 150°C (Rated current applied)	2000 hours	
Anti-Humidity	85°C, 85%RH	2000 hours	
Anti-Humidity Lifetime Test	85°C, 85%RH (Rated current applied)		
Low Temperature Test	-40°C	2000 hours	

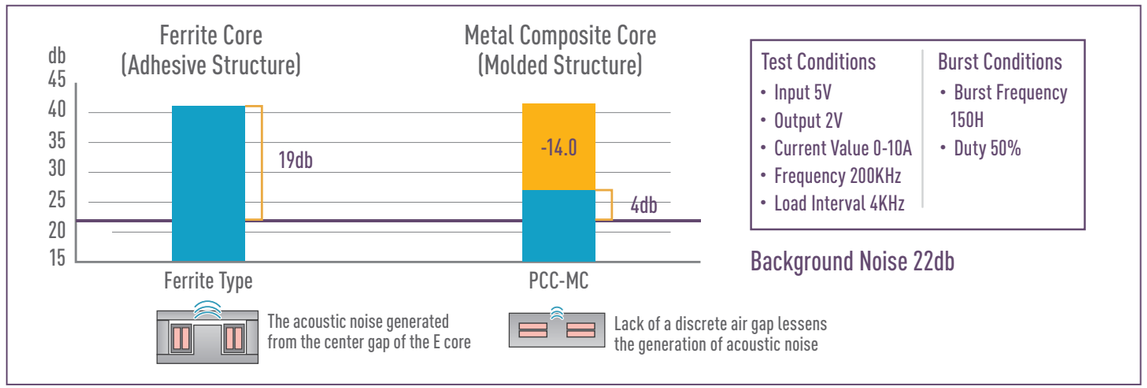
Facilitates Smaller And Lighter Designs

Panasonic Metal Composite Core Types facilitate smaller designs compared with Ferrite Type Choke Coils. Around 20-40% down in size and 5-25% down in weight.



Acoustic Noise Reduction

Troublesome acoustic noise at audible frequencies is reduced by having a distributed gap structure where the resin replaces the air gap. This enables a large reduction of acoustic noise compared to Ferrite Types.



Excellent Withstanding Voltage Characteristics

ETQP Series Metal Composite Type achieves excellent withstanding voltage characteristics that can be used in various applications.

Rated Voltage Table

Size mm \ Inductance uH	0.68	1	1.5	2.2	3.3	4.7	6.8	10	15	22	33	47	68	100
12.6×12.8×8.0mm	50V													
10.9×10.0×6.0mm			70V	70V										
10.9×10.0×5.0mm	70V													
10.7×10.0×5.4mm			70V									65V		45V
8.5×8.0×5.4mm		60V										65V		45V
7.5×7.0×5.4mm				50V									45V	25V
6.5×6.0×4.5mm				40V	35V					35V	35V	25V		
6.5×6.0×3.0mm	40V				35V									
5.5×5.0×4.0mm						40V	35V							
5.5×5.0×3.0mm				40V	35V									

Panasonic's ETQP Series Part Number Breakdown

Y	High Performance
J	High Current
K	Low Profile

E T Q P [ ] M [ ] [ ] [ ] [ ] [ ] [ ]

Product Code | Classification | Height | Winding | Inductance | Core | Suffix | Size

Classification

3	3-3.9mm max.
4	4-4.9mm max.
5	5-5.9mm max.
6	6-6.9mm max.
8	8-8.9mm max.

Inductance

Example
4R7 → 4.7 µH
220 → 22 µH
101 → 100 µH

Size

P	5x5mm size
N	6x6mm size
M	7x7mm size
K	8x8mm size
C	10x10mm size
A	12x12mm size

Panasonic's ETQP Series Vs. Alternative Products

With unique metal magnetic material technology, the ETQP Series displays low loss and downsizing compared with alternative products.

Panasonic Vs. Alternative Products

	22µH			47µH		
Manufacturer	Panasonic		Alternative Products	Panasonic		Alternative Products
Power Inductor	8 × 8.5 × 5.4 ETQP5M220YFK	10 × 10.7 × 5.4 ETQP5M220YFC	10 × 10.7 × 4.0 22uH	8 × 8.5 × 5.4 ETQP5M470YFK	10 × 10.7 × 5.4 ETQP5M470YFC	10 × 10.7 × 4.0 47uH
Frequency	400kHz	400kHz	400kHz	400kHz	400kHz	400kHz
DCR 20℃	63mΩ	45mΩ	70mΩ	125mΩ	96mΩ	165mΩ
ACR	1190mΩ	861mΩ	1254mΩ	2416mΩ	2171mΩ	2805mΩ
Rated Current	4.33A	4.33A	4.33A	2.47A	2.47A	2.47A
Iac (Ripple)	1.11A	1.11A	1.11A	0.52A	0.52A	0.52A
Idc RMS	4.42A	4.42A	4.42A	2.51A	2.51A	2.51A
Iac RMS	0.64A	0.64A	0.64A	0.30A	0.30A	0.30A
DC Loss	1.65W	1.18W	1.83W	1.06W	0.81W	1.39W
AC Loss	0.46W	0.34W	0.52W	0.22W	0.20W	0.25W
Total Loss	2.11W	1.51W	2.35W	1.27W	1.01W	1.65W
⊿T (Top)	78.1K	49.9K	80.9K	47.1K	33.2K	56.8K
⊿T (Terminal)	58.0K	35.5K	58.6K	35.0K	23.6K	41.1K

Panasonic's ETQP__YF_,YL_,YG_Series Selection Guide

High Performance Series

Type	5x5 ETQP*MxxxYFP		6x6 ETQP*MxxxYFN		7x7 ETQP5MxxxYFM		8x8 ETQP*MxxxY*K		10x10 ETQP*MxxxY*C		10x10 (Low DCR) ETQP*MxxxYLC	
(Size) WxLxT Height=t	5.5x5.0mm t=3.0mm (<4.7μH) t=4.0mm (≥4.7μH)		6.5x6.0mm t=3.0mm (<6.8μH) t=4.5mm (≥6.8μH)		7.5x7.0mm t=5.4mm (<95μH) t=5.0mm (≥95μH))		8.5x8.0mm t=5.4mm (<95μH) t=5.0mm (≥95μH)		10.7x10.0mm t=5.4mm (<95μH) t=5.0mm (≥95μH)		10.9x10.0mm t=5.0mm (<1.5μH) t=6.0mm (≥1.5μH)	
L0 (μH)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)
100					1.4(*1)	348	1.7	302	1.6(*2)	208		
68					1.8	251			3.0(*7)	136		
47			1.8	210	2.3 (*3)	156	2.9 (*3)	125	3.5	99		
33			2.0	172	2.6	120			4.2	68.5		
22	1.9	163	2.3	126	3.0	92.0	4.1	63.0	5.2(*5)	45.0		
15							4.7	48.2	5.8	35.6		
10			3.3	54.2	4.7	37.6	5.7	33	7.1	23.8		
6.8			4.1	39.3	5.5	26.7						
4.7	4.0	36.0			6.3	20			10.9	10.2	11.8	8.7
3.3	4.1	31.3	6.6	15.4	8.3	11.9			13.1	7.1	14.2 (*6)	6.0
2.2	4.8	22.6	8.0	10.4			11.9 (*4)	7.6	15.1(*4)	5.3	16.3 (*4)	4.55
1.5									17.9	3.8	19.5	3.2
1.0			8.8	7.9							23.0	2.3
0.68			9.8	6.3							26.3	1.75

*please contact Panasonic for availability

Note: Current value (Rated Current) is the typical value when overall temperature rise is 40k
(*1) 95μH (*2) 97μH (*3) 48μH (*4) 2.5μH (*5) 21.5μH (*6) 3.2μH (*7) 66μH

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Selection Guide

Panasonic's ETQP Series Selection Guide

Low Profile Series // LE Series

Type	5x5 ETQP3MxxxKVP		6x6 ETQP3MxxxKVN		8x8 ETQP4MxxxKVK		10x10 ETQP4MxxxKVC		6x6 ETQP4MxxxKFN		7x7 ETQP4MxxxKFM	
(Size) WxLxT Height=t	5.5x5.0mm t=3.0mm		6.5x6.0mm t=3.0mm		8.5x8.0mm t=4.0mm		10.7x10.0mm t=4.0mm		6.5x6.0mm t=4.8mm		7.5x7.0mm t=4.8mm	
L0 (μH)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)
68							2.4	174.0				
47							2.8	132.0			2.2	148.6
33			1.7	207	2.6	118	3.4	84.6				
22	2.2	160.9	2.2	128	3.3	76.3	4.1	60.0	2.4	113.0	2.9	84.1
15			2.5	99.2	3.8	55	5.2	37.0	3.3	63.8	3.4	60.7
10	2.4	96	2.9	71.0	4.4	41.6	6.3	25.4	4.1	40.4	4.5	36.0
6.8	2.9	65.7	3.6	45.6	5.9	23.5	7.4	18.5				
4.7	3.4	45.6	4.6	29.0	7.1	16.1	9.2	11.8	5.7	20.7	6.5	16.8
3.3	4.4	27.3	5.0	24.1	7.6	14	10.3	9.4	7.2	13.1		
2.2	5.2	20.0	6.5	14.5	9.8	8.5	12.1	6.8				
1.5	6.7	12.0	7.4	11.0	12.8	4.9	14.3	4.0				
1.0	7.5	9.6	9.9	6.2	14.8	3.7	19.6	2.6				
0.68	8.4	7.6	10.8	5.2	16.7	2.9						
0.47	8.9	6.8			19.3	2.2						
0.33	10.5	4.85										

*please contact Panasonic for availability

Note: Current value (Rated Current) is the typical value when overall temperature rise is 40k (*1) 2.5μH

Panasonic's ETQP Series Selection Guide

High Frequency Series // High Vibration Resistance Series // Large Current Series

Type	5x5 ETQP3MxxxHFP		6x6 ETQP3MxxxHFN		8x8 ETQP5MxxxYSK		10x10 ETQP5MxxxYSC		12x12 ETQP*MxxxJFA	
(Size) WxLxT Height=t	5.5x5.0mm t=3.0mm		6.5x6.0mm t=3.0mm		8.5x8.0mm t=5.4mm		10.9x10.0mm t=5.0mm		12.6x13.2mm t=8.0mm	
L0 (µH)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)	Rated Current (A)	DCR (mOhm)
47										
33										
22			2.1	144						
15										
10			3.0	68						
6.8										
4.7									16.8	4.9
3.3									19.6(*1)	3.6
2.2	5.2	19.5			12.0 (*1)	7.4			23.0	2.6
1.5									27.7	1.8
1.0									31.8	1.36
0.68							27.0	1.7	35.4	1.1
0.33									44.4	0.7

*please contact Panasonic for availability

Note: Current value (Rated Current) is the typical value when overall temperature rise is 40k
(*1) 2.5µH

Panasonic offers for its Power Inductor portfolio a device library for circuit simulators, CAD data as well as many other additional information that help design circuits more efficiently. For further information please refer to the related data as it is listed under the QR code.

Simulation Data Libraries	Industrial & Automotive Use LC Filter Simulator	Power Inductor Loss Simulator	CAD Data
Equivalent circuit models and S-parameter data can be downloaded for each individual item number.	The Industrial & Automotive use LC filter simulator enables the simulation of attenuation amouts when configuring a filter using Panasonic's power inductor and aluminium electrolytic capacitor suitable for industrial & automotive use.	The Power Inductor loss simulator for automotive application enables the simulation of losses and temperature rises according to the current for Panasonic's power inductors designed for automotive use.	CAD data can be download. (3D STEP, 3D PDF)
Download	Start Simulation	Start Simulation	Download

Characteristic Viewer
Characteristic Viewer is the tool which represent various characteristics of a selected part by means of a graph of the frequency axis and temperature axis, etc.
Start Simulation

Local Technical Support	Sample Support
Our Business Development Team as well as our respective Product Manager are available for technical on-site support.	For sample support, please contact Panasonic Industry Europe directly.

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