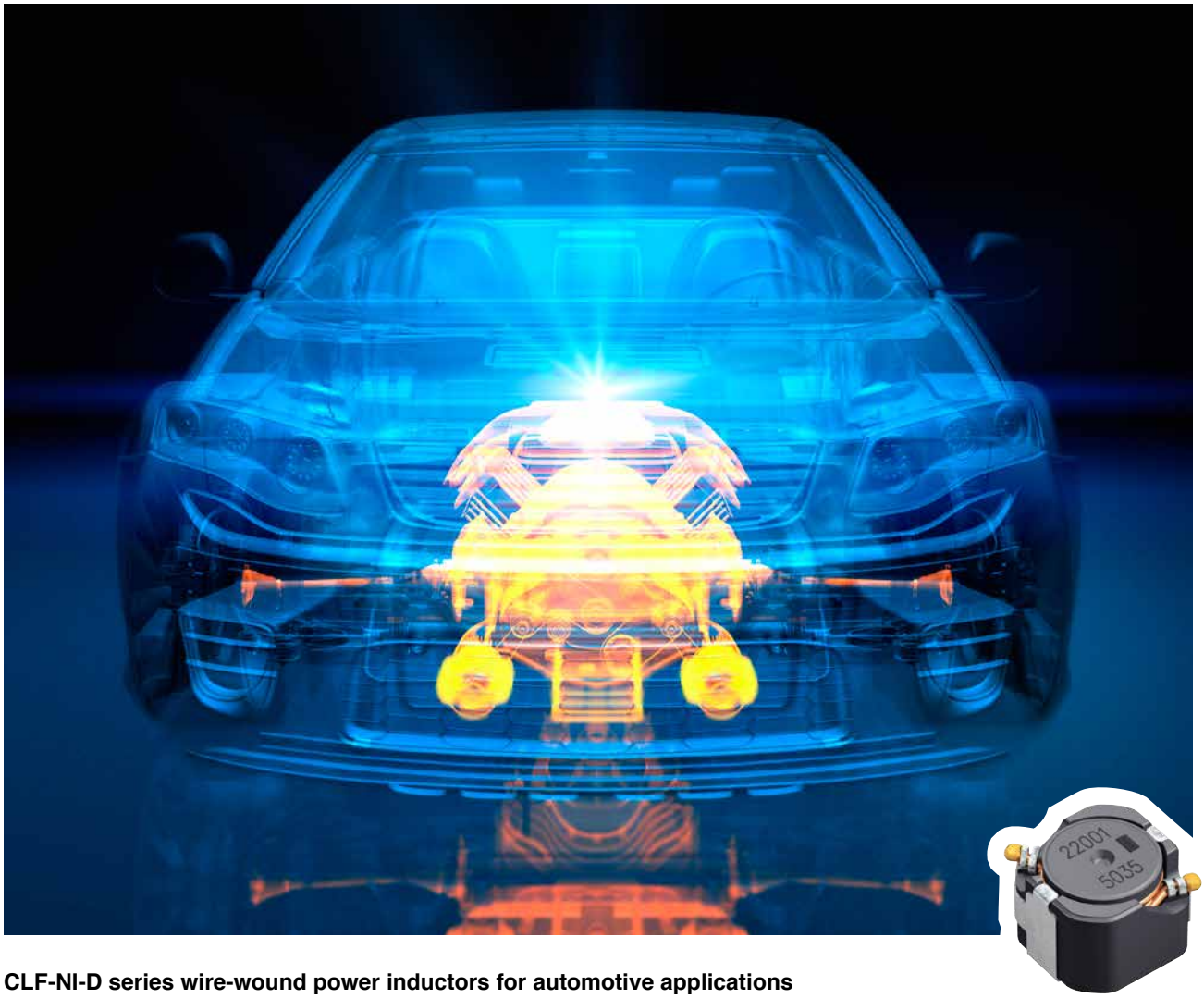


CLF-NI-D series wire-wound power inductors for automotive applications

Robust wire-wound power inductor withstands high temperatures and vibration

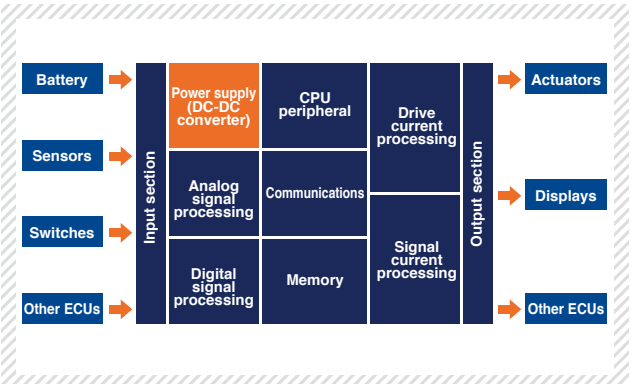
TDK's CLF-NI-D series wire-wound power inductors are products that benefit from the use of highly heat-resistant materials, unique structural designs and methods. The products offer high reliability across a wide range of temperatures from -55°C to +150°C, making them tolerant of the extreme environment found in the engine bay of automobiles, even under the most severe usage conditions.

Power inductors that satisfy strict requirements for automotive applications

Matching the rapid increase in the number of electrically-powered functions in automobiles, the number of ECUs (electronic control units) that control various onboard systems is also growing. An ECM (engine control module) is one of the ECUs, and it is responsible for monitoring and controlling all the processes in a combustion engine, from fuel injection and air intake to exhaust and cooling (Figure 1). Its primary objective is to achieve optimal fuel efficiency and minimal exhaust emissions.

In order to reduce the weight of cars by keeping heavy wire harnesses as short as possible, automotive engineers have

Figure 1: Basic design and structure of an ECM



The CLF-NI-D power inductor is a key component in the DC-DC converter and helps ensure an efficient power supply in the ECM.

moved ECMs ever closer to the engine in recent years. When mounted directly on the engine, ECMs and their components must be designed to withstand extreme temperatures and strong vibrations.

TDK has developed the new CLF-NI-D series of SMD wire-wound power inductors for applications in such extreme environments. Rated for operating temperatures from –55ºC to +150ºC, the series is compliant with the AEC-Q200 standard, and thus meets the demanding performance requirements of the automotive industry. It is ideal for use in the power lines of various automotive ECUs, including ECMs, ABS systems, HID lamps, and airbag systems.

Key component of the DC-DC converter in the ECM

The DC-DC converter in the ECM is a stepdown or buck converter. Figure 2 shows the basic circuit of a step-down converter. Switching elements such as MOSFETs connected to the circuit in series turns on and off cyclically according to the duty ratio to convert the 12 V voltage of the battery into the DC voltage necessary for the ECM subsystem (within a range from 1.2 V to 5 V depending on the IC). In this circuit, the power inductor plays the role of storing and releasing energy to ensure a constant flow of direct current. In addition, together with a capacitor, the power inductor forms a smoothing circuit in which the magnitude of the output voltage is determined by the duty ratio.

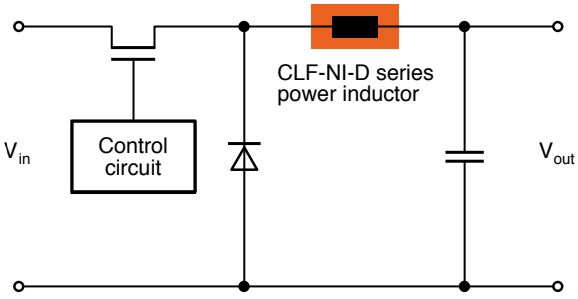
Fully automated production process provides for high reliability and quality

In order to withstand the extreme environmental conditions encountered so close to the engine, the CLF-NI-D series employs special heat-resistant materials throughout and a unique, simplified structural design that is capable of withstanding strong vibrations.

The CLF-NI-D series of power inductors consists of a ferrite drum core, around which a coil is wound (Figure 3). The coil is magnetically shielded by a ring-shape ferrite core to prevent magnetic coupling with other electronic parts, which would cause interference and power loss. Thanks to their magnetic shielding, CLF-NI-D series power inductors can be easily mounted in high densities and thus help to reduce the size of ECMs and other onboard ECUs.

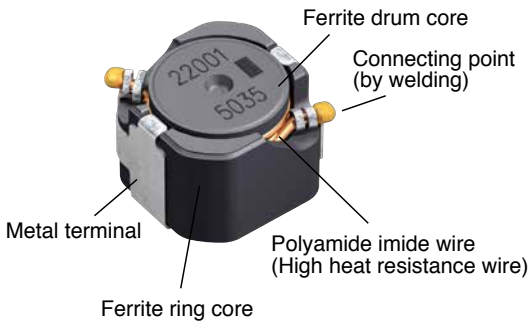
In addition, the CLF-NI-D series power inductors have a high-reliability design, featuring highly heat-resistant wire and wire connections, a property resulting from the use of welding material that does not melt during the reflow process. Moreover, the CLF-NI-D series is manufactured in a fully automated production process, which means finished products are of uniform high quality.

Figure 2: Basic circuit diagram of a step-down (buck) converter



The power inductor in a step-down converter fulfills two functions at the same time: storage of energy and smoothing of the output voltage.

Figure 3: Mechanical design of the CLF-NI-D series power inductors



The CLF-NI-D series is highly reliable because of its robust wire connection made with heat-resistant wire and welding.

Automotive electronic components that provide the best solutions

TDK's CLF-NI-D series of wire-wound power inductors consists of products featuring excellent quality and reliability, which employ a unique structural design with enhanced mechanical strength and a fully-automated manufacturing process, while obtain a wide operating temperature range from -55ºC to +150ºC enabled by the development of highly heat-resistant materials. The products are therefore best suited as power inductors for automotive ECUs, which must be capable of operating in severe conditions. TDK offers a wide variety of electronic components that are optimal for automotive applications, including "Mega Cap" multilayer ceramic chip capacitors with metal electrodes, capacitors and inductors with high operating temperatures, and various sensors, in addition to power inductors.

Main features, applications, and specifications (electrical characteristics) of the CLF-NI-D series power inductors

《Main features》

- Use of highly heat-resistant materials enables operation over a wide operating temperature range (-55ºC to +150ºC; including self-temperature rise)
- Solder-free design
- Fully-automated manufacturing process to consistently ensure the highest quality
- AEC-Q200 compliant
- RoHS-compatible and suitable for lead-free soldering

《Main applications》
Power circuits for various onboard ECUs, including ECMs, ABS systems, HID lamps, and airbag systems

《Main Specifications》 Available in dimensions from 5sq. mm to 12.5sq. mm, supporting inductances from 1μH to 470μH

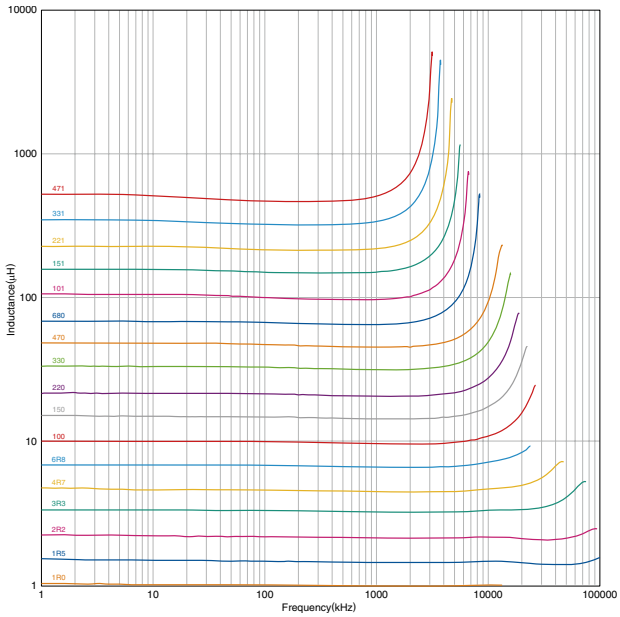
Type	Temperature range		Package quantity (pieces/reel)	Individual weight (g)
	Operating temperature (°C)*	Storage temperature (°C)**		
CLF6045NI-D	–55 to +150	–55 to +150	1,000	0.6

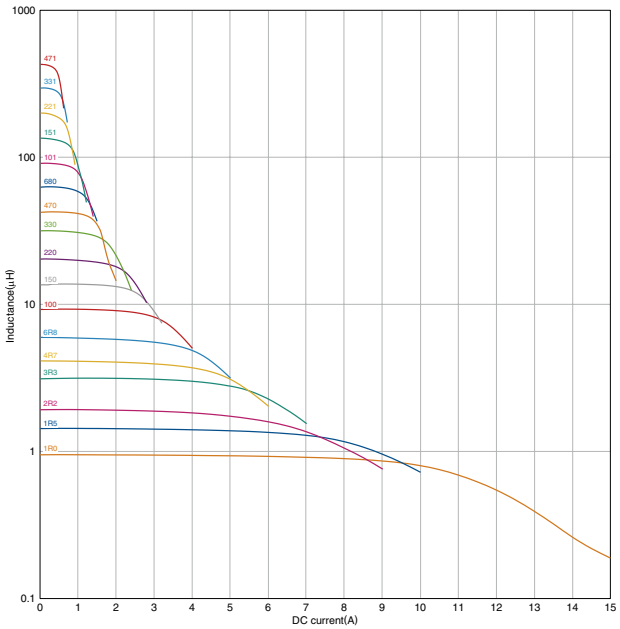
*Operating temperature range includes self-temperature rise.
**The Storage temperature range is for after the circuit board is mounted.

《Main electrical characteristics (example)》

L		Measuring frequency	DC resistance	Rated current*		Part No.
				Idc1	Idc2	
(μH)	Tolerance	(kHz)	(Ω)	(A)	(A)	
1.0	±30%	100	0.011±30%	6.7	4.8	CLF6045NIT-1R0N-D
1.5	±30%	100	0.013±30%	5.5	4.5	CLF6045NIT-1R5N-D
2.2	±30%	100	0.015±30%	4.2	4.1	CLF6045NIT-2R2N-D
3.3	±30%	100	0.019±30%	3.5	3.7	CLF6045NIT-3R3N-D
4.7	±30%	100	0.023±30%	3.1	3.3	CLF6045NIT-4R7N-D
6.8	±30%	100	0.027±30%	2.5	3.1	CLF6045NIT-6R8N-D
10	±20%	100	0.035±20%	2.1	2.6	CLF6045NIT-100M-D
15	±20%	100	0.060±20%	1.7	2.0	CLF6045NIT-150M-D
22	±20%	100	0.075±20%	1.4	1.8	CLF6045NIT-220M-D
33	±20%	100	0.100±20%	1.1	1.6	CLF6045NIT-330M-D
47	±20%	100	0.130±20%	0.97	1.4	CLF6045NIT-470M-D
68	±20%	100	0.200±20%	0.81	1.1	CLF6045NIT-680M-D
100	±20%	100	0.320±20%	0.61	0.86	CLF6045NIT-101M-D
150	±20%	100	0.480±20%	0.53	0.72	CLF6045NIT-151M-D
220	±20%	100	0.720±20%	0.47	0.57	CLF6045NIT-221M-D
330	±20%	100	0.920±20%	0.36	0.49	CLF6045NIT-331M-D
470	±20%	100	1.300±20%	0.28	0.41	CLF6045NIT-471M-D

*Rated current: smaller value of either Idc1 or Idc2.
Idc1: When based on the inductance change rate (30% below the nominal value)
Idc2: When based on the temperature increase (Temperature increase of 40° C by self heating)





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