

起动机和发电机

商用车的驱动力 – 更低油耗，更少二氧化碳排放

Starter Motors and Generators

**We get commercial vehicles moving –  
with lower consumption and CO<sub>2</sub> output**



**BOSCH**

博世 科技成就生活之美

清洁 & 经济  
clean &  
economical



## 致力于**安全、清洁和经济的商用车**

Active for **safe, clean and economical commercial vehicles**



博世起动机和发电机事业部是世界一流的汽车电力能源和起动机及设备供应商。我们的商用车产品系列包括高性能起动机和发电机。不断创新、技术成熟的产品在减少油耗和二氧化碳排量方面做出了显著的贡献 – 无论是驾驶或是工程作业，是更佳经济性、更长寿命、更强可靠性的杰出保障：科技成就生活之美。

The Bosch division Starter Motors and Generators is among the world's leading suppliers of equipment for the supply of electrical energy and starter motor solutions for motor vehicles. Our product portfolio for commercial vehicles includes high-performance starter motors and generators. Innovative, technically mature products that make a decisive contribution towards noticeable reductions in both fuel consumption and CO<sub>2</sub> output – trailblazing guarantors for more economy and long-term, responsible mobility on or off the road: invented for life.



### **博世 – 更好的驾驶性能**

#### **Better driving – with Bosch**

我们不仅担负着环保的责任，还致力于满足客户的需求。我们提供高质量的产品与服务，一如既往地满足商用车客户的高要求。包括与客户合作、全面的支持和完善的服务，当然还包括多样化的、创新、高性能、经济、环保、品质一流的部件、模块和系统。

Along with responsibility for the environment, our main consideration is the satisfaction of our customers. In order to continue to guarantee this and to fulfill the particularly high demands made in the commercial-vehicle sector, we set the highest standards for our services and products. This includes working in partnership with our customers, comprehensive support and excellent service. Plus, of course, a wide range of innovative, high-performance yet economical and environmentally-friendly components, modules and systems of first-class quality.





我们的产品确保商用车在任何环境下都能提供最佳的性能  
Our products are on board wherever commercial vehicles give of their best



我们丰富的经验和能力确保为客户提供满意的服务  
Our services are in demand wherever competence and experience count



博世全球起动机和发电机  
开发和生产基地  
Our development and production locations for starter motors and generators

**物有所值的品质 / Worthwhile quality**

无论是在哪个国家生产或使用的博世产品，均具有始终如一的卓越品质。全球统一的博世质量体系是品质的保障。任何由我们批量生产线制造出的产品都是成熟的，可靠且耐用 – 我们的客户因此获益，博世产品的售后服务的合作伙伴也都必须遵循全球一致的高质量标准。我们的产品和服务均符合相应的标准：ISO/TS 16949。

No matter where Bosch products are produced or used – their quality is always excellent. This is guaranteed by the strict, internationally binding Bosch quality guidelines. Everything that leaves our mass-production lines is mature, dependable technology with a long lifetime - and our customers benefit from this. High uniform worldwide quality standards also apply to our service partners who have taken over the after-sales service for Bosch products. Our products and services fulfill the corresponding standards ISO/TS 16949.

**精确匹配实现完美应用**

**Ideal application thanks to exact adaptation**

我们在汽车电机技术领域的经验使每种产品与任何其他产品精确匹配，也可单独应用于任何商用车。博世产品基于创新的平台理念，适用于全球任何体系。此外，我们的各种软件辅助解决方案和模拟方案帮助汽车制造商便利地扩展或升级相关的功能。

Our experience in every sector of motor-vehicle technology puts us in a position to carefully match every product to any other and to adapt them individually to every commercial vehicle. Bosch products are based on innovative platform concepts that can be used worldwide and integrated in any architecture. Additionally, our range of software-assisted solutions and simulations makes it easy for vehicle manufacturers to extend or update the extent of functions included.

**成功源自全球业务**

**Success via worldwide presence**

我们活跃于各大洲的市场：在每个大洲都拥有自己的开发、应用和制造基地。因此我们比其他公司都更加了解全球市场的地区差异和多样化的需求 – 并提供针对性的解决方案。博世起动机和发电机部门的6,300名员工，通过科技成就您的生活之美 – 我们的技术受全世界的青睐。

We are active on almost every continent: on the spot with our own development, application and manufacturing locations. So we know and understand the regionally varying requirements of the worldwide markets like no other company – and we offer corresponding solutions. With a staff of about 6,300, the technology of our Starter Motors and Generators division is invented for life – and this kind of technology is in demand all over the world.

# 可靠的发动机启动

## — 广泛适用于各种商用车

# Reliable engine starting

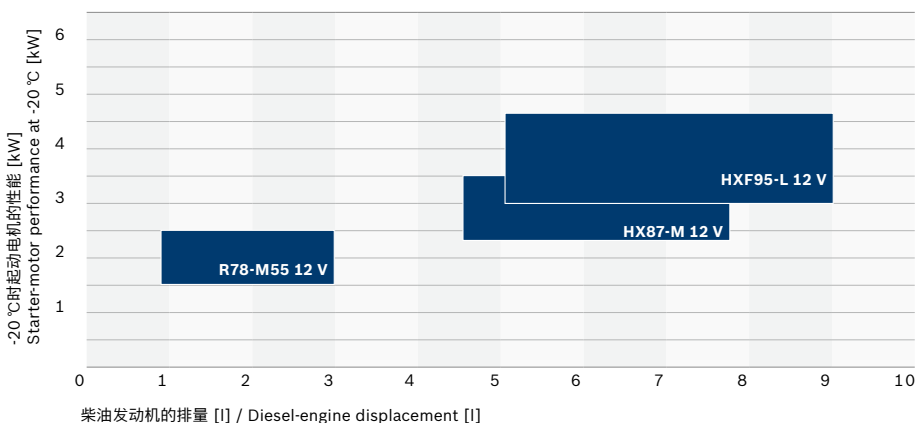
## for a very wide range of commercial vehicles



R78-M55 12 V 起动机  
R78-M55 12 V starter motor

博世为商用车和工程机械提供各种高品质起动机。无论是12V或24V电气系统、还是排量高达84升的柴油发动机或168升的汽油发动机，我们都能满足多样化的需求并为客户的特殊要求提供最佳的解决方案。博世起动机结构轻便紧凑，在商用车800,000 km和工程机械14,000小时的整个寿命中都会始终保持安全可靠。

Bosch offers a broad range of high-quality starter motors for on- and off-highway commercial vehicles. Whether for 12 or 24 V electrical systems, whether for diesels up to 84 liters or gasoline engines up to 168 liters, we always have the suitable solution for the most varied demands and special customer wishes. Light and compact in construction. Reliable throughout their entire long lifetime of up to 800,000 km on the road 14,000 hours respectively hours in off-highway use.



技术数据 / Technical data		R78-M55 12 V	HX87-M 12 V	HXF95-L 12 V
重量/Weight	[kg]	4.1	7.5	10
定子外壳/Stator housing	(D1) [mm]	78	87	95
长度/Length	(L) [mm]	189	238	306
性能 (T = -20°C 时) Performance (at T = -20°C)	[kW]	2.5	3.2	4.2 (4.7)*
电磁/Solenoid	型号/Type	305	402	402
	D <sub>Relay</sub> (D2) [mm]	52.5	62	62
励磁绕组/Excitation winding		6 电极/pole	4 电极/pole	4 电极/pole
电枢/Armature	D <sub>A</sub> [mm]	59	56.5	60
	L <sub>A</sub> [mm]	36	43	54
最大蓄电池/Max. battery (DIN)	[Ah/A]	143/570	176/790	220/900 (286/1,140)*
柴油发动机排量/Diesel-engine displacement [l]		≤3.0	≤6.0	≤9.0

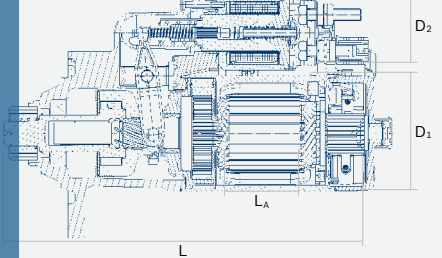
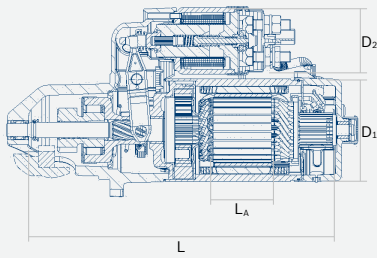
\* 视应用情况而定 / depending on application

### 12V电气系统的起动机 / Starter motors for 12 V electrical systems

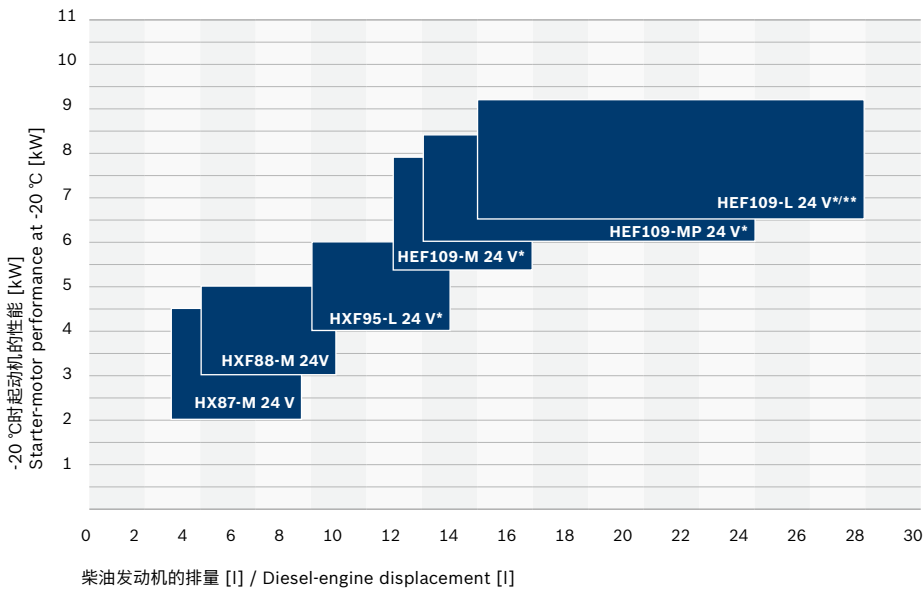
我们的R78、HX87起动机和HX(F)95系列一样适用于12V的商用车。由于我们的HX(F)系列起动机具有四极多线路绕组，使产品性能大幅提升。电枢和外壳改良设计也极大改进了冷启动性能。坚固而极其紧凑的结构能保护起动机免受振动以及灰尘和水的侵入，确保产品使用寿命更长。

With our R78 and HX87 starter motors as well as our HX(F)95 series we offer reliable starter motors for commercial vehicles in the 12 V segment. Thanks to the four-pole multiple-circuit winding of our HX(F) starter motors, we have achieved a further increase in performance. The enhanced design of the armature and stator housing considerably improves cold-start performance. The robust, yet extremely compact construction protects these starter motors from vibration, dirt and water intrusion, guaranteeing a long lifetime.

- ▶ 柴油发动机最大排量为9L  
For diesel engines up to 9 liters
- ▶ 起动机功率可达1.5 - 4.7 kW  
Starter-motor performance from 1.5 to 4.7 kW



HXF-95L 24 V 起动机  
HXF-95L 24 V starter motor



\* 2级启动

electrically 2-stage

\*\* 大容量的电池能够获得更好的输出表现 (DIN 360 Ah/1,200 A代替了 220 Ah/900 A)  
with extended performance range for use with larger battery  
(DIN 360 Ah/1,200 A instead of 220 Ah/900 A)

## 24 V电气系统的起动机 / Starter motors for 24 V electrical systems

我们的HXF88起动机和HX(F)95、HEF109可以涵盖24V市场。这些起动机具有良好的冷启动性能，结构设计紧凑，坚固耐用。我们起动机模块化的理念使HEF109和HX(F)95起动机能够准确有效地满足客户的不同需求。

The 24 V segment is covered by our HXF88 starter motor as well as by versions of the HX(F)95 series and the HEF109 series. These starter motors are also characterized by high cold-start performance, space saving design as well as robustness for a long lifetime. Our modular starter motor concept enables us to precisely and very efficiently adapt the HEF109 and HX(F)95 starter motors to the specific needs and requirements of our customers.

- ▶ 适用于最高排量为28 L的柴油发动机  
For diesel engines up to 28 L
- ▶ 起动机功率最高可达9.2 kW  
Starter-motor performance up to 9.2 kW

技术数据 / Technical data		HX87-M 24 V	HXF 88-M 24V	HXF95-L 24 V	HEF109-M 24 V	HEF109-MP 24 V	HEF109-L 24 V
重量/Weight	[kg]	7.5	7.5	10.0	11.6	14.0	14.0 - 17.0
定子外壳/Stator housing	(D1) [mm]	87	88	95	109	109	109
长度/Length	(L) [mm]	238	262	306	320	320	355
性能(T=-20 °C时)/Performance (at T=-20 °C)	[kW]	4.5	5.2	6.0 (6.5)*	7.8	8.4	9.2
电磁/Solenoid	型号/Type	402	303	402	402	402	402
	D <sub>Relay</sub> (D2) [mm]	62	56.5	62	62	62	62
励磁绕组/Excitation winding		4 电极/pole	4 电极/pole	4 电极/pole	6 电极/pole	6 电极/pole	6 电极/pole
电枢/Armature	D <sub>A</sub> [mm]	56.5	60	60	75	75	75
	L <sub>A</sub> [mm]	43	46	54	50	50	80
最大蓄电池/Max. battery (DIN)	[Ah/A]	110/450	180/600	143/570 (215/700)*	176/790	220/900	220/900
驱动端罩/Drive end shield		铸铝/Cast aluminum	铸铝/Cast aluminum	铸铝/Cast aluminum	铸铝/Cast aluminum	石墨铸铁/Graphite iron	石墨铸铁/Graphite iron
柴油发动机排量/Diesel-engine displacement	[l]	≤ 7.5	≤ 7.7	≤ 13.0	≤ 16.0	≤ 24.0	≤ 28.0

\* 视应用情况而定 / depending on application

# HXF88 和 HX(F)95起动机: 广泛应用

## HXF88 and HX(F)95 starter motors: applicable for a broad range of uses



HX(F)95起动机  
HX(F)95 starter motor

### 众多选择与定制解决方案

#### Lots of choice and tailored solutions

HXF88到HF(X)95系列起动机设计用于排量大约为3到13升的柴油发动机。两个系列都有非常强大的起动性能—12 V达3.2 kW到4.2 kW (根据不同的应用程序,最高可达4.7 kW) 和24V达4.5 kW到6.0 kW(按照需要增强电力最高可达6.5 kW)。

HX(F) starter motors from the 87 and 95 series are designed for diesel engines from approx. 3 to 13 l displacement. Both series have impressive high maximum starting performance – the 12 V versions from 3.2 to 4.2 kW (depending on the application, up to 4.7 kW) and the 24 V versions from 4.5 to 6.0 kW (optionally up to 6.5 kW with power enhancement).

这些起动机是带鼻式的, 95系列也有悬臂式的(悬臂式小齿轮)。商用车起动机使用寿命为 800,000 km, 工程机械起动机使用寿命为14,000 h, 这些起动机使用寿命已经达到了最高等级。齿轮二级啮合原理确保即使在强力起动中也能实现可靠顺畅地啮合。

These starter motors are nose-type, with the 95 series also available noseless (free overhung pinion). With a lifetime of about 800,000 km on the road or 14,000 h in off-high-way operation, these starter motors achieve top marks for longevity. The two-stage pinion-engagement principle employed in the more powerful versions ensures reliable and smooth engagement of the pinion.

集成的机械式继电器 (IMR)的低电流控制可直接通过发动机控制单元或车载计算机触发, 以实现电子控制操作。

Low current control by Integrated Mechanical Relay (IMR), which can be triggered direct via the engine control unit or the on-board computer, can serve as the interface for electronic control of operation.

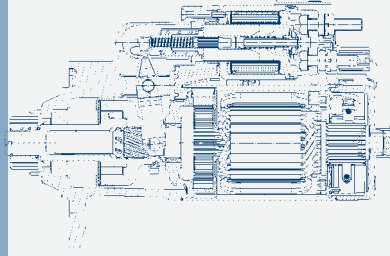
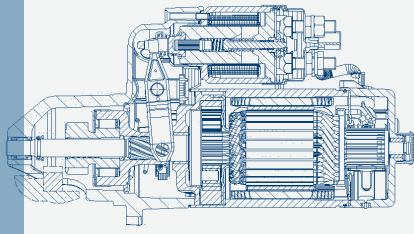
### 重型车起动机HXF88,HX(F)95

#### Heavy Duty Starter Motors HXF88 and HX(F)95



- ▶ 用于最大排量为13 l的柴油发动机  
For diesel engines up to 13 l
- ▶ 用于12和24 V电气系统  
For 12 and 24 V electrical systems
- ▶ 起动机性能: 2.0 - 6.0 kW  
Starter-motor performance from 2.0 to 6.0 kW (optionally up to 6.5 kW with power enhancement)
- ▶ 坚固耐用的设计  
Robust design
- ▶ 具有过载保护功能  
With overload protection
- ▶ 安装所需空间小  
Low space requirements
- ▶ 多型号可选  
Various versions possible
- ▶ 其它特性可根据需求配置  
Additional characteristics/benefits can be configured via optional performance features.





各种 HX(F)95起动机  
的截面图

Sectional drawings  
of various HX(F)95  
starter motors

### 贴切的设计/Designed to meet requirements

HX(F)起动机有多种不同的型号可供选择。概述说明请参见第4、5页的表格。此外，我们起动机模块化的理念甚至不需要额外工作或费用，即可针对性地满足每个客户特定的期望和要求。产品的性能和特征可根据客户需求配置，也可组合运用。

HX(F) starter motors can be supplied in a variety of different versions. An overview of these will be found in the tables on pages 4 and 5. Additionally, our modular starter-motor concept makes it possible to match the motor individually and with little effort or expense to the specific wishes and requirements of every customer. The optional performance features are configurable as per customer needs and in some cases be combined.

### 悬臂式驱动齿轮/Free overhung pinion

起动机设计为悬臂式。永久密封，不受环境影响并可避免灰尘、水或油雾等侵入。  
Starter motors designed as noseless versions. Permanently sealed against environmental influences and the intrusion of dust, water or oil spray etc.

- ▶ 非常坚固耐用  
Extremely robust
- ▶ 提供保护，避免受到飞轮飞射物的影响  
Protected against influences emanating from the flywheel
- ▶ 提高功率  
Power-increase feasible

### 防尘/Dust protection

普通起动机其它位置和/或径向轴向密封。

Sealing of rest position and/or radial axle for nose-type starter motors.

- ▶ 改良的保护，避免受到飞轮飞射物的影响  
Improved protection against influences emanating from the flywheel
- ▶ 适用于工程机械  
Ideal for off-highway applications

### 橡胶保护罩/Rubber boot

改良的对普通式起动机继电器的保护。

Improved relay protection for starter motors of nose design.

- ▶ 继电器受到保护，免受恶劣环境的影响  
Relay protected against aggressive ambient conditions
- ▶ 装配安全性和灵活性更高  
Improved safety and flexibility when fitting

### 通过集成机械继电器(IMR)实现低电流控制 / Low current control by integrated Mechanical Relay (IMR)

用于12V和24V起动机集成继电器，是可选的插头式连接。

Integrated relay for 12 and 24 V starter motors with optional plug connection.

- ▶ 简化线束  
Simplified cable connection
- ▶ 无需外部继电器  
No external relay required
- ▶ 通过发动机控制单元可自动启动  
Automatic starting via engine control unit

### 软啮合/Soft engagement

24V起动机二级软啮合。

Two-stage gentle engagement for 24 V starter motors.

- ▶ 齿圈和起动机驱动齿轮使用寿命更长  
Increased lifetime for ring gear and starter pinion

### 扭矩/Torque

普通式和悬臂式起动机在内部都采用了可变的减速机构。

Scalable internal reduction gearing for nose-type and noseless starter motors.

- ▶ 优化的冷起动性能  
Optimization of cold-start performance

### 过热保护/Thermal protection

该特性可保护起动机避免由于过热而失效，例如频繁地起动或车辆仅靠起动机提供动力。

This feature protects the starter motor from failing due to overheating following improper use, such as continual starts or vehicle propulsion using the starter motor only.

# HEF109起动机： 专为高性能需求而定制

## HEF109 starter motors: created for high performance demands



HEF109-M 24V起动机  
HEF109-M 24V starter motor

### 令人信服的优势

#### Convincing advantages

24V电压、最大可提供9.2 kW功率的HEF109起动机是排量最大为28L的柴油发动机的理想解决方案。使用长寿命的碳刷、圆锥螺线管触点以及二级起动等特点能确保使用寿命约为800,000 km。二级衔接原理确保了起动机驱动齿轮可靠、平缓地啮合。集成的机械式继电器 (IMR) 确保起动机和发动机控制单元或车载计算机之间所有起动功能的启用。这一系列的重量和尺寸也实现最小化。

With a performance of up to 9.2 kW at 24 V, HEF109 starter motors are the right solution for diesel engines up to 28 l displacement. Specially equipped features such as long-life carbon brushes, conical solenoid contacts and two-stage solenoid switching ensure a lifetime of about 800,000 km. The two-stage engagement principle guarantees reliable, gentle engagement of the starter-motor pinion. The Integrated Mechanical Relay (IMR) provides dependable switching of all starting functions between starter motor and engine control unit or on-board computer. And for this series, too, weight and dimensions have been kept to a minimum.

- ▶ 可应用于排量最大为28 L的柴油发动机和排量最大为56 L的汽油发动机  
For diesel engines up to 28 l and gasoline engines up to 56 l
- ▶ 适用于24 V电气系统  
For 24 V electrical systems

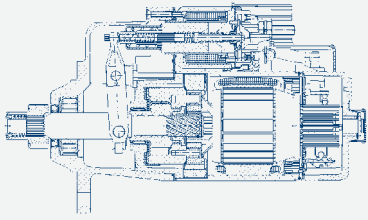
重型车起动机 HEF-109 / Heavy Duty Starter Motor HEF109

可选的性能特点 / Optional performance features

		
功率 Power	可旋转的法兰面 Rotatable flange	防水(IP 5/7) Water protection(IP 5/7)
		
接地绝缘 Insulated ground	二极绝缘开关 Bipolar insulation switch	过热保护开关 Thermal switch
		
低电流控制 Low current control	软啮合 Soft engagement	扭矩 Torque

- ▶ 起动机性能高达9.2 kW  
Starter-motor performance of up to 9.2 kW
- ▶ 坚固耐用的设计  
Robust design
- ▶ 满足最小安装空间的要求  
Minimum installation-space requirements
- ▶ 已有各种型号可供选择和使用  
Various versions available and adaptations feasible





HEF 109起动机截面图  
Section drawing of an  
HEF 109 starter motor

我们起动机模块化的理念也应用于109系列使这些起动机能满足每个客户特定的期望和要求，而只需花费最少的精力和最低的费用。可选的性能和特征可根据客户需求配置和组合。

Our modular starter-motor concept also employed in the 109 series enables us to individually adapt these starter motors to the specific needs and requirements of every customer at a minimum of effort and expense. The optional performance features are configurable as per customer needs and in some cases be combined.

### 贴切的设计/Designed exactly to requirements

HEF109起动机有不同的型号。第5页的表格提供了概述说明。

HEF109 starter motors are available in different versions. The table on page 5 provides an overview.

新开发的HEF109-L24 V起动机功能强大，专为以下几种用途设计：

- ▶ 空间有限
- ▶ 尤其是低温环境下的大排量发动机
- ▶ 长时间旋转下对热应力的高要求
- ▶ 显著的额外液压

这些使HEF109-L 24 V型代替双并联起动机成为可能，(见页10/11)。

The newly developed HEF109-L 24 V starter motor is the most powerful version and is designed for use:

- ▶ Where space is limited
- ▶ With engines with especially large displacement in conjunction with low ambient temperatures
- ▶ For applications with high requirements in terms of thermal stress, for instance where there are long periods of spinning
- ▶ Where applications have significant additional hydraulic loads

These make the HEF109-L 24 V type a possible alternative to the parallel starter systems that are also available (see pages 10/11).

### 功率/Power

起动机具有铁驱动端盖和加固的电气连接。

Starter-motor version with spherulitic graphite iron drive end shield and reinforced electrical connections.

- ▶ 优异的性能密度  
Excellent power density
- ▶ 增强的冷起动机性能

Increased cold-start performance

- ▶ 机械紧凑性更强

Increased mechanical robustness

### 可旋转的法兰面/Rotatable flange

悬臂式起动机法兰面由石墨铁组成。多个装配位置可供选择。

Flange made of spherulitic graphite iron for noseless starter motors. Several mounting positions are feasible.

- ▶ 针对大量的中小型项目，灵活性和经济性更强

Improved flexibility and economy for small and medium volume projects

### 防水 (IP 5/7)

#### water protection (IP 5/7)

对于特殊应用，可对起动机采用额外防护。

Additional protection for the starter motor. Required for special applications.

- ▶ 抵抗恶劣的环境

Resistant to aggressive ambient conditions

- ▶ 短期浸水保护

Protected against short-term immersion

### 接地绝缘/Insulated ground

31端的绝缘。

Insulation of Terminal 31.

- ▶ 更好的抗腐蚀性

Improved corrosion protection

- ▶ 适用于船舶和其它有特殊要求如工程机械等的应用

Ideal for marine applications and special application requirements such as construction machines in off-highway

### 两极绝缘开关

#### Bipolar insulation switch

可主动断开绝缘端T31连接的开关

Switch for active disconnection of insulated T31.

- ▶ 整个使用寿命期中，高绝缘电阻 > 20 kΩ

High insulation resistance > 20 kΩ over its entire lifetime

- ▶ 针对特殊要求的免维护解决方案

Free-of-maintenance solution for special requirements

### 过热保护/Thermal protection

起动机装配有可逆的热保护开关。

Starter motor equipped with a reversible thermal protection switch..

- ▶ 可靠的过载/过热保护

Reliable protection against overload / overheating

- ▶ 无需额外的线束

No additional wiring required

### 通过集成机械继电器进行低电流控制 by Integrated Mechanical Relay (IMR)

集成继电器带有可选的插头连接。

Integrated relay with optional plug connection.

- ▶ 简化线束连接

Simplified cable connection

- ▶ 无需外部继电器

No external relay required

- ▶ 通过发动机控制单元自动启动

Automatic starting via engine control unit

### 软啮合/Soft engagement

二级平缓啮合。

Two-stage gentle engagement.

- ▶ 环形齿圈和起动机驱动齿轮寿命更长

Increased lifetime for ring gear and starter pinion

### 扭矩/Torque

可扩展底部内部减速齿轮。

Scalable internal reduction gearing.

- ▶ 优化的冷起动机性能

Optimization of cold-start performance

# HEP109并联起动系统： 大型发动机的完美搭档

## HEP109 parallel starting system: perfect for large engines

### 强大的组合/A strong combination

并联起动系统适用于大型发动机或带大型液压系统的发动机。并联起动系统包括2或3个连接的HEP109起动机，使用寿命长达800,000 km (公路操作) 或14,000 h (工程机械操作)，或固定机器运行时间等效。

Parallel starting systems are recommended for use with large engines or engines with high additional hydraulic loads. They consist of two or three coupled HEP109 starter motors and have a lifetime of up to 800,000 km (on-highway) or 14,000 h in off-highway operation, or the equivalent in operating hours for stationary machines.

只有当所连接的起动机啮合后主电流才会接通，以此确保合理的分配机械和电气负载，避免单个起动机过载，以确保长使用寿命。此外，配有集成并联起动继电器的并联起动系统的另一个优势就是减少了所需的安装空间。

The main current is only switched on after the coupled starter motors have been engaged, which ensures ideal distribution of the mechanical and electrical loads. This prevents the overloading of an individual starter motor and ensures a long lifetime. Yet another advantage of the parallel starting system with integrated parallel-starting relay is the reduction of the space required for installation.

- ▶ 适用于高达84 l的柴油发动机  
For diesel engines from up to 84 l
- ▶ 适用于最大排量为168 l的汽油发动机  
For gasoline engines up to 168 l
- ▶ 适用于24 V电气系统  
For 24 V electrical systems
- ▶ 起动机性能高达27.6 kW  
Starter-motor performance up to 27.6 kW
- ▶ 性能特性满足特定应用需求  
Various adaptations feasible according to intended use/operation



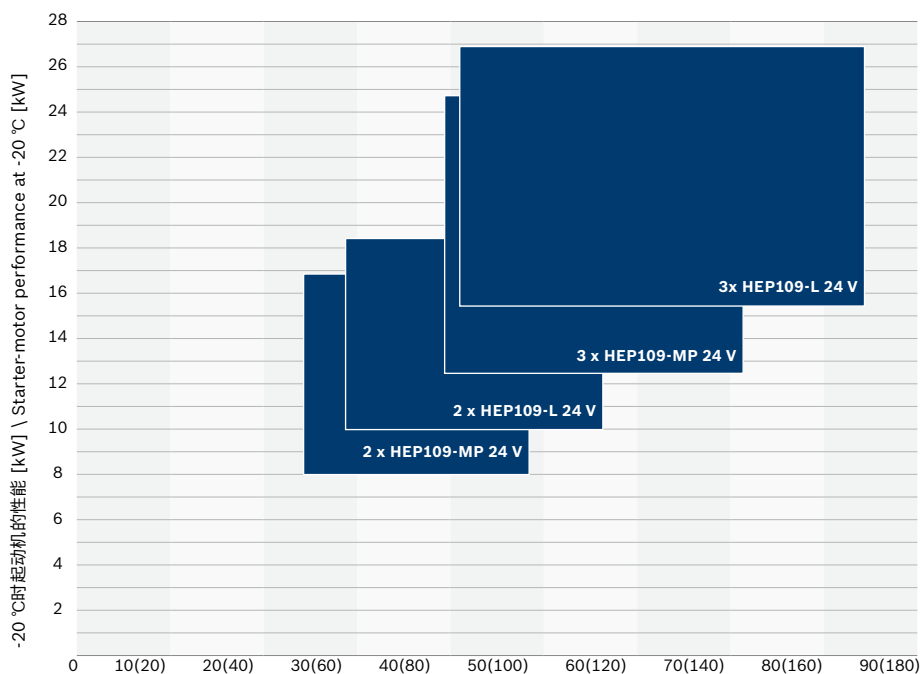
HEP 109MP 24 V 并联起动系统  
HEP 109MP 24 V parallel starting system



并联起动系统在大型发动机上的典型应用。  
图示为工程机械建筑/采矿图

Typical applications of parallel starting systems in large engines for machinery.

Here: off-highway-construction/mining. Photo Liebherr



HEP109并联起动系统的应用范围  
Range of applications for  
HEP109 parallel starting system

柴油(汽油/天然气)发动机的排量 [l] / Displacement of diesel (gasoline/natural gas) engine [l]

技术数据 / Technical data			2 x HEP109-MP 24 V	3 x HEP109-MP 24 V	2 x HEP109-L 24 V	3 x HEP109-L 24 V
重量/Weight		[kg]	2 x 16.5	3 x 16.5	2 x 19.5	3 x 19.5
定子外壳/Stator housing	(D1)	[mm]	109	109	109	109
长度/Length	(L)	[mm]	320	320	355	355
性能(T=-20°C时)Performance	(at T=-20°C)	[kW]	16.8	25.2	18.4	27.6
电磁/Solenoid	类型Type		402	402	402	402
	DRelay (D2)	[mm]	62	62	62	62
励磁绕组/Excitation winding			6 pole	6 pole	6 pole	6 pole
电枢/Armature	DA	[mm]	75	75	75	75
	LA	[mm]	50	50	80	80
最大蓄电池/Max. battery	(DIN)	[Ah/A]	2 x 220/900	3 x 220/900	2 x 220/900	3 x 220/900
驱动端盖/Drive end shield			石墨铸铁/Graphite iron	石墨铸铁/Graphite iron	石墨铸铁/Graphite iron	石墨铸铁/Graphite iron
柴油/汽油发动机的排量/Displacement of diesel/gasoline engine		[l]	≤ 48/≤ 96	≤ 72/≤ 144	≤ 56/≤ 112	≤ 84/≤ 168



# 可靠的能量供应 – 用于所有车辆和电气系统

## Reliable energy supply – for every vehicle and every electrical system



由于长途运输以及工程机械全天候运行的工作要求, 安全、舒适、广泛而多样化的功能是首要考虑的方面, 因而用电设备的数量也相应增多。博世商用车发电机的设计适用于各种应用, 能满足所有能源需求并保证对整个电气系统可靠的能源供应。此外, 其高功率密度、高性能和高效率有助于降低油耗和减少二氧化碳的排放。

In road haulage and also in the off-highway sector, long trip times are all in a day's work. Safety and comfort as well as a wide variety of functions are thus prime considerations. So the number of electrical consumers is correspondingly large. Bosch generators for commercial vehicles are designed for a variety of applications, cover all energy requirements and guarantee the reliable supply of the entire electrical system. In addition, their high density of performance and efficiency contribute to reductions in fuel consumption and CO<sub>2</sub> output.

### 发电机商用车产品系列 / Commercial-vehicle generator series

目标市场: 高端卡车和工程机械

Target segment: premium trucks and off-highway



#### HD系列: Heavy Duty Line

70 to 240 A @ 14 V<sup>1)</sup>  
90 to 150 A @ 28 V<sup>1)</sup>

- ▶ 全球可用的具有多种可选特性的模块化设计  
Globally available modular design with a big variety of optional features
- ▶ 高效减少燃料消耗和二氧化碳排放量  
High efficiency reduces fuel consumption and CO<sub>2</sub> emissions
- ▶ 使用寿命长, B10使用寿命高达120万km  
High availability, B10 lifetime of up to 1.2 million km

目标市场: 经济型卡车和工程机械

Target segment: value trucks and off-highway

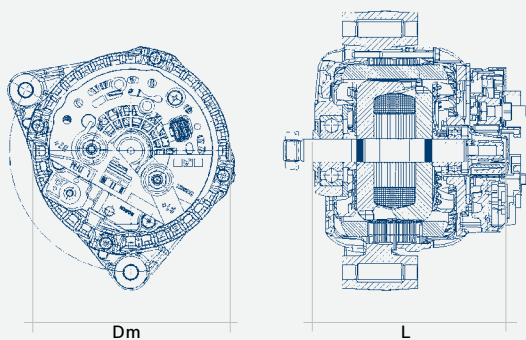


#### C系列: Classic Line

70 to 150 A @ 14 V<sup>1)</sup>  
50 to 80 A @ 28 V<sup>1)</sup>

- ▶ 全球可用的具有多种可选特性的模块化设计  
Globally available modular design with a big variety of optional features
- ▶ 高效减少燃料消耗和二氧化碳排放量  
High efficiency reduces fuel consumption and CO<sub>2</sub> emissions
- ▶ 使用寿命长, B10使用寿命高达40万km  
High availability, B10 lifetime of up to 0.4 million km

1) Output in A @ 6,000 rpm



HD发电机的主要尺寸图。  
图中所示为HD 8  
Main dimensions of the generator. The illustration shows the HD 8

**C系列**

**Classic Line:**

适合低功率的经济解决方案

the economical solution for the lower power range

新的C系列发电机完善了商用车的产品系列，适用于低成本市场，涵盖14V到28V的商用车。该发电机为低功率需求的重型商用车提供了成本优化的解决方案，同时保持其坚固耐用和高品质。

The new Classic Line series completes the generator portfolio for commercial vehicles to the low end segment. It is available in various sizes for 14 and 28 V. The generators are a cost-effective alternative to the HD program for the lower power range, without compromising on robustness or quality.

C系列的产品平台可在全球的博世工厂生产，即使在最低的自动化程度下也能保证其高品质，此外，材料的使用也得到了优化，以确保在最小的体积和重量下也能获得最高的输出和效率。该发电机的B10寿命可达40万km，可满足了全球中低端市场商用车的需求。

The focus for their development was on having a single platform that can be manufactured by all Bosch production plants around the world and of-

fers the highest quality even with minimal degree of automation. In addition, effort went in to optimizing the use of raw materials so as to achieve the highest power and best efficiency at the lowest possible size and weight. The result is a generator with a B10 lifetime of up to 400,000 km, which meets the requirements in most regions as well as in the low and medium segment around the world.



**客户获益**

**Customer benefits:**

- ▶ 高输出、提升的效率、小尺寸  
High output, improved efficiency and small dimensions
- ▶ 坚固耐用型设计，产品使用寿命长  
Robust design and extended lifetime
- ▶ 全球统一平台，生产基地遍布欧洲、巴西、中国和印度  
Global platform with production locations in Europe, Brazil, China

C系列发电机的技术参考 Technical data for Classic Line generators			C3		C5				C5M	
			14 V	28 V	14 V	14 V	14 V	28 V	28 V	28 V
重量/Weight*	[kg]	5.0	5.0	5.3	5.4	5.5	5.1	5.2	5.3	5.3
长度/Length*	(L) [mm]	125	125	125	125	125	125	125	125	12.5
转子直径/Rotor diameter	[mm]	98.4	98.4	103.2	103.2	103.2	103.2	103.2	103.2	103.2
直径/Diameter	(Dm) [mm]	136	136	141	141	141	141	141	141	141
功率/Power	1,800 U/min [A]	57	20	50	65	70	30	30	34	34
	6,000 U/min [A]	91	50	110	125	150	55	75	80	80
惯量/Mass inertia moment*	[kg cm <sup>2</sup> ]	20	20	25	25	25	25	25	25	25
评估效率/Weighted efficiency in	%	63	68	68	68	71	70	71	72	72

\*无皮带轮 / \*without belt pulley

# 模块化理念 – 完全满足个性化要求

## The modular concept – exact adaptation to individual requirements



博世的模块化发电机理念使生产满足客户期望的发电机成为现实。我们的产品包括各种规格、各种型号, 并具有各种不同特征的HD发电机。具备7种可选性能特征的模块化理念可细分为两个部分。因此我们推出的新机型解决方案不仅能减少油耗和降低二氧化碳的排放, 还可针对特殊要求以及项目应用。

The modular generator concept from Bosch permits the efficient realization of generators that exactly fulfill the wishes of our customers. Our product range comprises HD generators of several sizes and versions with a variety of different characteristics. The seven optional performance features of our modular concept can be subdivided into two sectors. Thus we offer innovative versions for reduced fuel consumption and emissions as well as special, application-dependent solutions.

### HD发电机:

**高效、坚固耐用、适用范围广**

#### HD generator:

**efficient, sturdy and versatile**

博世的HD发电机有多种系列以及14 V和28V的两种额定电压。合理的分级不仅能完美匹配不同的车的功率, 还能适应于各种发动机的空间要求。

HD generators from Bosch can be supplied in several sizes with rated voltages of 14 V and 28 V. Their fine gradation permits ideal adaptation to each vehicle's specific power requirements and to the varying amount of space available in the engine compartment.

HD 发电机最大的特点是性能优良、使用寿命长。而这两项特点均得益于先进的绕线技术和改良的碳刷/集电环系统的保障。多功能调节器确保车辆电气系统优秀的充电平衡, 因为该调节器将补偿充电电缆中的电压损失。

HD generators are mainly characterized by their high performance and long lifetime. Both these are guaranteed by the efficient winding technology and an improved brush/slip-ring system. An excellent charging balance for the vehicle's electrical system is guaranteed by a multifunction voltage regulator which compensates for voltage losses in the charging cable.

### 更多特点和优势:

#### Further features and advantages:

- ▶ 增强安全性, 通过内部风扇改良冷却性能  
Increased safety and improved cooling via internal fans
- ▶ 紧凑的结构和有张力的中部迭片结构确保了高机械稳定性。  
High mechanical stability thanks to compact construction and tensioned center lamination
- ▶ 模块化理念实现了个性化设计  
Individual design due to modular concept

HD发电机的技术数据 Technical data for HD generators	HD 9		HD 10	
	14V	28V	14V	28V
重量/Weight* [kg]	7	7	7.6	7.6
长度/Length* (L)	142	142	142	142
转子直径/Rotor diameter [mm]	111.3	111.3	111.3	111.3
直径/Diameter (Dm) [mm]	153	153	156	156
功率/Power 1,800 U/min [A]	87	41	100	42
6,000 U/min [A]	155	110	160	100
惯量/Mass inertia moment* [kg cm <sup>2</sup> ]	46	46	46	46
评估效率/Weighted efficiency in %	63	70	68	70

\*无皮带轮 / \*without belt pulley





**HD10: 无限可能性**

**HD 10: unlimited possibilities**

HD 10发电机可配备所有性能特征, 而且 还能按实际需求对个性化特征进行组合搭配。下一页的图表展示的是可行的组合 搭配和版本。

The HD 10 generator can be equipped with all features, and the individual features can be combined in virtually any desired combination. The diagrams on the following pages show which combinations are possible and which versions are sensible.

	标准 Standard	E 效率 E Efficiency	P 功率 P Power	D 数据互换 D Digital Interface	L 使用寿命 L Longlife	T 温度 T Temperature	B 张紧皮带 B Belt Tension	H 热环境 H Hot Environment
9	14 V, 28 V	-	-	14 V, 28 V	14 V, 28 V	14 V, 28 V	-	-
10	14 V, 28 V	14 V, 28 V	14 V, 28 V	14 V, 28 V	14 V, 28 V	14 V, 28 V	14 V, 28 V	14 V, 28 V

HD系列发电机的大小和可选性能特点  
Sizes and optional features of our HD generators

**HD发电机 / HD-generator**



可选的性能特点 / Optional features

						
E 效率 E Efficiency	P 功率 P Power	D 数据互换 D Digital Interface	L 使用寿命 L Longlife	T 温度 T Temperature	B 张紧皮带 B Belt Tension	H 热环境 H Hot Environment
<p>降低油耗, 减少CO<sub>2</sub>排放, 并提升输出功率的性能特征 Features to reduce fuel consumption and CO<sub>2</sub> output and to increase output performance</p>			<p>性能特性满足特定应用的需求 Features for application specific adaptation</p>			

# 模块化理念 – 降低油耗，减少二氧化碳排放

## The modular concept – lower fuel consumption, less CO<sub>2</sub> output



数字接口选项：改善能源管理

Digital Interface option: improves energy management

性能更强，经济性更高，排放更少？我们的模块化发电机理念让这一切成为可能。基于这些特点，HD发电机能在满足任何动力需求的同时，开拓了新的经济潜能，从而使驾驶员、运输方、尤其是环境三方受益。

More performance with greater economy and fewer pollutant emissions? Our modular generator concept makes this possible. With the features presented here, HD generators can meet any power requirements while at the same time opening up new savings potentials which will benefit drivers, hauliers and, in particular, the environment.

### PWM接口：优化的蓄电池充电

#### PWM Interface: for optimized battery charging

凭借PWM数字接口的版本，我们已建立的多功能调节器产品的范围得到了扩展，因为它可以通过发动机控制单元直接进行电压调节。

Our established product range of multifunction regulators has been expanded by a version with a digital PWM interface. This permits voltage regulation direct via the engine control unit.

- ▶ 可调节的充电电压使蓄电池使用寿命更长久  
Longer battery life thanks to controllable charge voltage
- ▶ 根据温度调节充电电压  
Optimum adjustment of charging voltage to ambient temperature
- ▶ 通过调节充电电压帮助减少油耗和二氧化碳排放  
Helps to reduce fuel consumption and CO<sub>2</sub> output by adapting the charge voltage
- ▶ 齐纳二极管跟所有HD发电机的组合应用  
Combinable with all HD generators



### LIN 接口：智能解决方案

#### LIN Interface: the smart solution

接下来的发展方向是双向接口的调节器。这使得它不仅有可能使用发动机控制单元来调整各种调节器参数，也能发回不同的发电机状态参数的报告。更重要的是，24 V包含了在一个电器系统内同步不同发电机的能力。

The next development step is the regulator with bidirectional LIN interface. This makes it possible not only to use the engine control unit to adjust various regulator parameters but also to send back reports on different generator status parameters. What is more, the 28 V version incorporates the ability to synchronize various generators within one electrical system.

### 功能超越PWM接口：

#### Functions that go beyond the PWM Interface:

- ▶ 通过发电机控制单元详细检测发电机状态的双向通信  
Bidirectional communication for detailed detection of generator condition by the engine control unit
- ▶ 在一个电气系统内最高同步四个发电机  
Synchronization of up to four generators within one electrical system



功率选项: 针对最大功率和性能  
Power option: for maximum power and performance

效率选项: 对所有商用车应用程序具有最佳效率  
Efficiency option: optimum efficiency for all commercial vehicle applications



**效率: 效率提高**

**Efficiency: improved efficiency**

通过改进定子几何结构和磁回路, 不仅实现了高功率输出(28 V下3.4 kW), 而且平均效率达75%, 最高可达80%, 功率密度1.05 W/cm<sup>3</sup>。

High power output (up to 3.4 kW at 28 V) with average efficiency of up to 75% and a maximum of 80%, as well as a power density of 1.05 W/cm<sup>3</sup> due to improvements in the stator geometry and the magnetic circuit.

- ▶ 油耗更低 (低至0.16 l/100 km) \*  
Lower fuel consumption (as low as 0.16 l/100 km)\*
- ▶ 二氧化碳排放更少 (降至1.5 g/km) \*  
Lower CO<sub>2</sub> output (down to 1.5 g/km)\*
- ▶ 组件温度低/Low component temperature
- ▶ 蓄电池使用寿命更长  
Longer battery life(\*与HD 8相对比/\* by comparison with HD 8)

**功率: 高效地满足高功率要求**

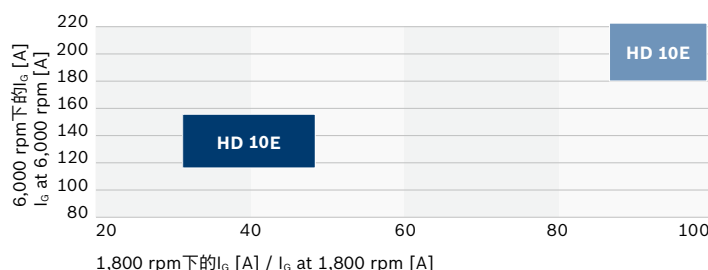
**Power: efficient for high power requirements**

可选的更高的铜填充率和改良的绕线结构: 进一步提高了性能(28 V下最高达4.2 kW), 并将效率提升至77%。

The option with higher copper-fill factor and improved winding geometry: for a further increase in performance (up to 4.2 kW at 28 V) and to boost efficiency to as much as 77%.

- ▶ 油耗更低 (低至0.1 l/100 km) \*  
Lower fuel consumption (as low as 0.1 l/100 km)\*
- ▶ 二氧化碳排放更少 (降至2.7 g/km) \*  
Lower CO<sub>2</sub> output(down to 2.7 g/km)\*
- ▶ 极其有效的冷却  
Extremely effective cooling  
\* 与HD8对比 / by comparison with HD8

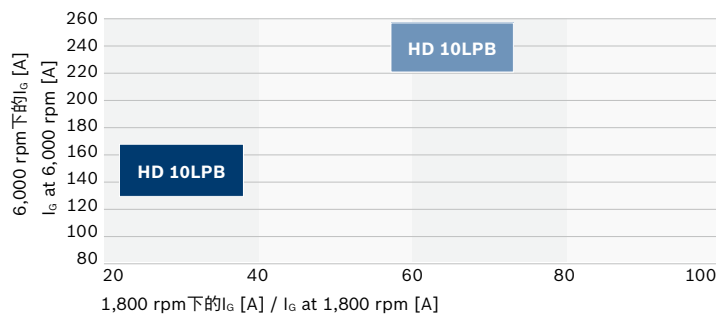
HD-E发电机的应用范围  
Field of application for HD-E generator



技术数据/Technical data	HD 10E	
	14 V	28 V
重量/Weight** [kg]	7.8	7.7
长度/Length** (L) [mm]	142	142
转子直径/Rotor diameter [mm]	111.3	111.3
直径/Diameter (Dm) [mm]	156	156
功率/Power 1,800 rpm [A]	93	42
6,000 rpm [A]	202	135
惯量/Mass inertia moment** [kg cm <sup>2</sup> ]	46	46
评估效率/Weighted efficiency in %	73	75

\*\*无皮带轮 / \*\*without belt pulley

HD-LP发电机的应用范围  
Field of application for HD-LP generator



技术数据/Technical data	HD 10LPB	
	14 V	28 V
重量/Weight** [kg]	8.4	8.4
长度/Length** (L) [mm]	151	151
转子直径/Rotor diameter [mm]	111.3	111.3
直径/Diameter (Dm) [mm]	156	156
功率/Power 1,800 rpm [A]	65	30
6,000 rpm [A]	240	150
惯量/Mass inertia moment** [kg cm <sup>2</sup> ]	47	47
评估效率/Weighted efficiency in %	72	77

\*\*无皮带轮 / \*\*without belt pulley



# 模块化理念 – 针对 个性化需求的创新解决方案

## The modular concept – innovative solutions for individual requirements



### 使用寿命长：特别坚固耐用，使用寿命长 Long-life: particularly sturdy and with a long life

HD-L (使用寿命长) 发电机特性：具有更大的轴承，增强型端盖，改良的碳刷/集电环和冷却系统。

The HD-L (Long-life) generators feature larger ball bearings, strengthened end-shields and improvements in the brush/slip-ring and cooling system.

- ▶ B10使用寿命更长 (长达800,000 km)  
Longer B10 lifetime (up to 800,000 km)
- ▶ 维护方便，费用更低  
Low servicing costs due to freedom from maintenance
- ▶ 极其坚固耐用  
Extreme robustness
- ▶ 可选的防溅套件提供防水保护  
Waterproof due to optional splash-protection package

### 温度：耐高温

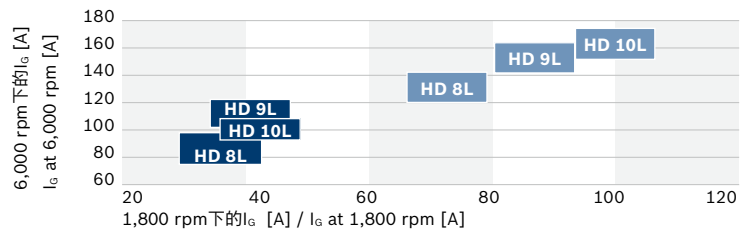
HD-T (温度) 发电机配有特殊的轴承。它们非常适合在发动机舱温度通常都很高的客车上使用。

HD-T (Temperature) generators are fitted with special ball bearings. They are ideally suitable for use in buses, where temperatures in the engine compartment are generally high.

- ▶ 采用改装的塑料架和耐热的轴承密封，产品能耐高达180°C的高温。  
Heat-resistant up to bearing temperatures of 180°C due to modified plastic cage and temperature-resistant ball-bearing seals
- ▶ 特殊、长期有效的轴承润滑脂帮助降低维护费用  
Low maintenance costs due to special, long-lasting bearing grease

HD-L发电机的  
应用范围  
Field of application for  
HD-L generators

■ 14 V  
■ 28 V



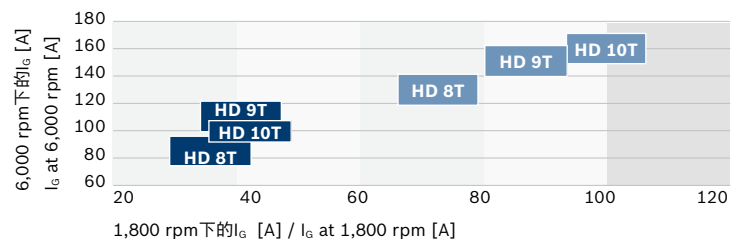
长使用寿命的选择：极其坚固耐用的结构  
Long-life option:  
extremely sturdy construction

技术数据/Technical data	HD8L		HD9L		HD10L	
	14V	28V	14V	28V	14V	28V
重量/Weight* [kg]	6.6	6.6	7.1	7.1	7.7	7.7
长度/Length* (L) [mm]	146	146	146	146	146	146
转子直径/Rotor diameter [mm]	103.3	103.3	111.3	111.3	111.3	111.3
直径/Diameter (Dm) [mm]	147	147	153	153	156	156
功率/Power 1,800 rpm [A]	73	36	87	41	100	42
6,000 rpm [A]	129	83	155	110	160	100
惯量/Mass inertia moment* [kg cm <sup>2</sup> ]	32	32	46	46	46	46
评估效率/Weighted efficiency in %	65	70	63	70	68	70

\*无皮带轮 / \*without belt pulley

HD-T发电机的应用范围  
Field of application for HD-T generators

■ 14 V  
■ 28 V



技术数据/Technical data	HD8L		HD9L		HD10L	
	14V	28V	14V	28V	14V	28V
重量/Weight* [kg]	6.5	6.5	7	7	7.6	7.6
长度/Length* (L) [mm]	142	142	142	142	142	142
转子直径/Rotor diameter [mm]	103.3	103.3	111.3	111.3	111.3	111.3
直径/Diameter (Dm) [mm]	147	147	153	153	156	156
功率/Power 1,800 rpm [A]	73	36	87	41	100	42
6,000 rpm [A]	129	83	155	110	160	100
惯量/Mass inertia moment* [kg cm <sup>2</sup> ]	32	32	46	46	46	46
评估效率/Weighted efficiency in %	65	70	63	70	68	70

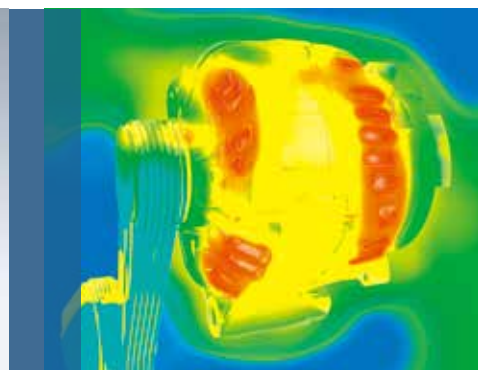
\*无皮带轮 / \*without belt pulley



温度选项: 特殊的轴承  
Temperature option:  
with special ball bearings



张紧皮带选项: 针对皮带的高受力加固  
Belt-Tension option:  
strengthened for high belt forces



热环境选项: 耐高温  
Hot-Environment option:  
resistant to even the strongest heat

**张紧皮带:  
针对皮带高受力**

**Belt Tension:  
for extreme belt forces**

HD-B (张紧皮带) 发电机具有加固的端盖、更大的 'A' 轴承和新开发的冷却系统。

HD-B(Belt Tension) generators have a strengthened end-shield, larger 'A' ball bearings and a newly-developed cooling system.

- ▶ 适合于高皮带张力的应用  
Suitable for applications with high belt tension
- ▶ 进一步改良零件以延长使用寿命  
Long life thanks to further improved components

**热环境: 用于新一代发动机 (欧 6)**

**Hot environment: for new generations of engines (Euro 6)**

采用了优化的通风系统、高温轴承、定子绝缘材料和恒温 ZR 二极管。

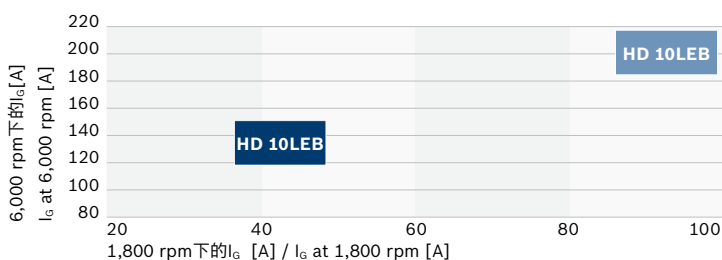
Equipped with an optimized ventilation system, high-temperature ball bearings and stator-insulation materials as well as temperature-stable ZR diodes.

- ▶ 85°C 的平均环境温度下设计使用寿命为 800,000 km\*  
Designed to run for 800,000 km\* at an average ambient temperature of 85 °C
- ▶ 在 65°C 的平均环境温度下使用寿命为 1,200,000 km\*  
1.2 million km\* at an average ambient temperature of 65 °C

\* B10 的使用寿命  
\* B10 lifetime

**HD-B 发电机的应用范围**  
Field of application for HD-B generators

- 14 V
- 28 V

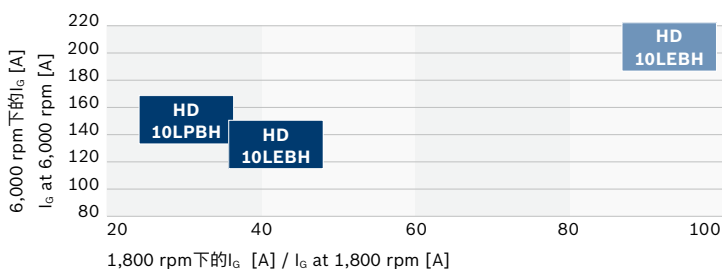


技术数据/Technical data	HD10LEB	
	14V	28V
重量/Weight* [kg]	7.9	7.9
长度/Length* (L) [mm]	147	147
转子直径/Rotor diameter [mm]	111.3	111.3
直径/Diameter (Dm) [mm]	156	156
功率/Power 1,800 rpm [A]	93	42
6,000 rpm [A]	202	135
惯量/Mass inertia moment* [kg cm <sup>2</sup> ]	46	46
评估效率/Weighted efficiency in %	73	75

\* 无皮带轮 / without belt pulley

**HD-H 发电机的应用范围**  
Field of application for HD-H generators

- 14 V
- 28 V



Technical data	HD 10LEBH		HD 10LPBH
	14V	28V	28V
重量/Weight** [kg]	7.9	7.8	8.4
长度/Length** (L) [mm]	147	147	150
转子直径/Rotor diameter [mm]	111.3	111.3	111.3
直径/Diameter (Dm) [mm]	156	156	156
功率/Power 1,800 rpm [A]	93	42	30
6,000 rpm [A]	202	135	150
惯量/Mass inertia moment** [kg cm <sup>2</sup> ]	46	46	47
评估效率/Weighted efficiency in %	73	75	77

\*\* 无皮带轮 / without belt pulley

# 最佳解决方案 – 对每辆车、 为所有客户及环境

## The best solution – for every vehicle, for all customers and for the environment

博世的工程师们一直致力于开发创新型系统解决方案。数十年间，这些成功的方案开发使博世一直位于全球专利发明的前列。

Bosch engineers are constantly working on novel system solutions. The success of these developments speaks for itself: for decades Bosch has been one of the leading companies worldwide in patenting inventions.

### 起动机

#### Starter motors

博世创新型、强劲的起动机可广泛应用于各种乘用车汽油及柴油发动机上。除了高标准的起动可靠性外，博世起动机紧凑、轻质的结构还保障了汽车制造商能完美应用。另外，博世推出的带有起动-停止功能的常规起动机，经过试验及测试证实，可与清洁性、经济性都相当高的起动-停止系统良好匹配。

Our comprehensive range includes innovative, robust starter motors for all passenger cars with gasoline or diesel engines. In addition to their high degree of starting reliability, Bosch starter motors guarantee, thanks to their compact, light construction, problem-free application by vehicle manufacturers. Alongside conventional starter motors, our start-stop starter motor offers a tried-and-proven solution for use in particularly clean and economical start-stop systems.

博世汽车部件(长沙)有限公司  
Bosch Automotive Products(Changsha) Co., Ltd.

地址: 湖南省长沙市星沙漓湘中路26号  
邮编: 410100

Address: No.26, Lixiang Road Middle, Xingsha,  
Changsha Hunan, 410100, P.R.China  
电话/Tel: +86 731 8292 9110  
传真/Fax: +86 731 8292 9072

[www.bosch.com.cn](http://www.bosch.com.cn)

中国印刷  
SG-201403-CNEN

### 发电机

#### Generators

博世推出了应用广泛的紧凑、静音型发电机，可满足各种需求，并可装备在各种乘用车上。博世发电机以其高性能及高效率，保证了在各种车辆电机系统中均可进行稳定的电力供应，同时显著改善了车辆油耗和排放。

Bosch offers a broad range of compact, quiet-running generators for a wide variety of different applications and all types of passenger cars. Our generators are characterized by high performance and efficiency. They thus guarantee a reliable supply of energy to every vehicle's electrical system and contribute towards a noticeable reduction in fuel consumption and emissions.

### 商用车解决方案

#### Solutions for commercial vehicles

博世商用车产品包括高性能、强劲的起动机及普遍适用的高效发电机。高质量及高寿命(使用寿命可达1,200,000km)的博世产品，既可在指定场合，也可用于条件苛刻的公路及非公路工况下。

Our product portfolio for commercial vehicles comprises robust, high-performance starter motors and matchlessly efficient generators. High-quality products with a lifetime of up to 1.2 million km, suitable for demanding applications and the toughest work in on- and off-highway operation.