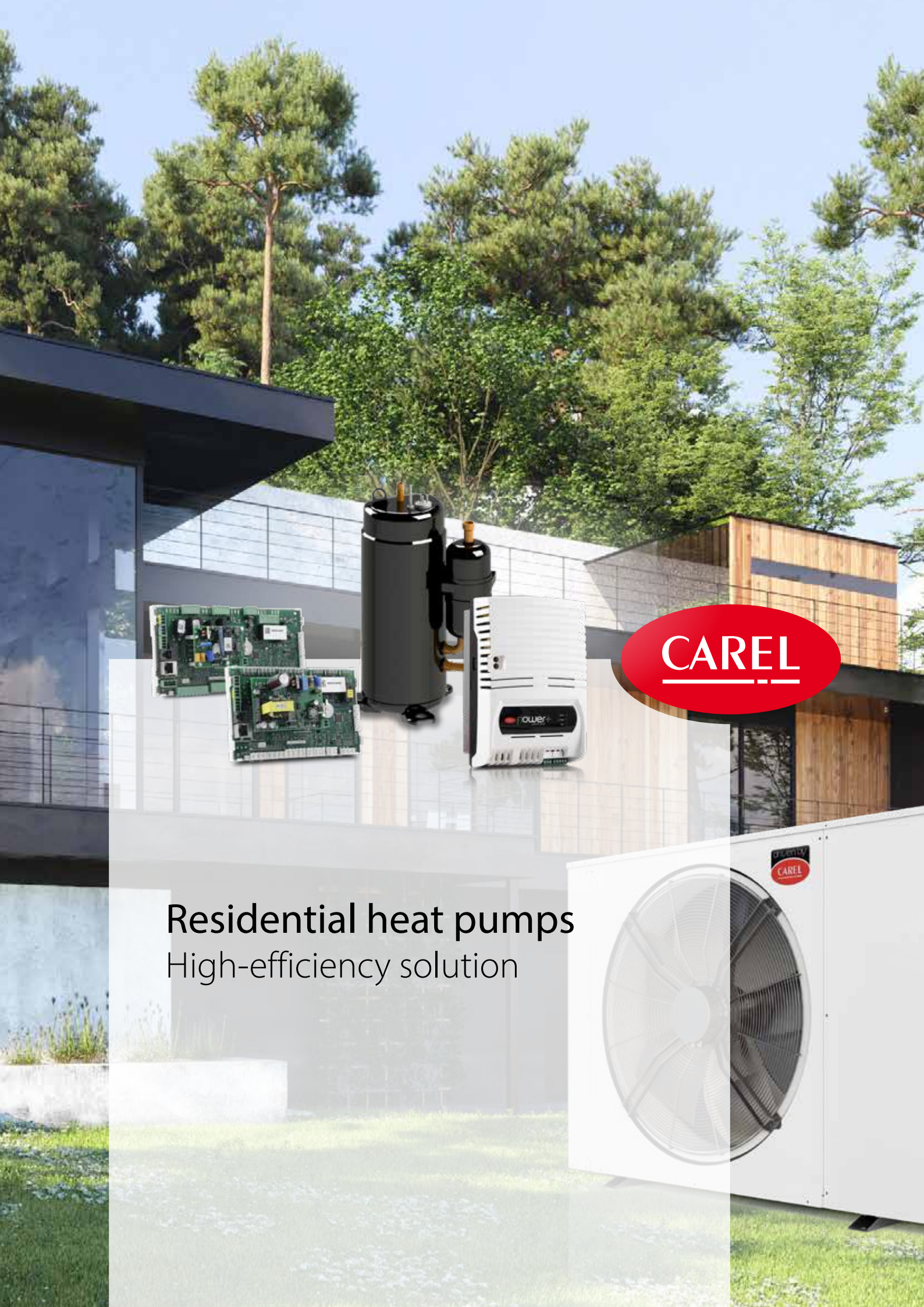


# Residential heat pumps

## High-efficiency solution

# Complete solution for the management of heat pumps in residential application

System developed to obtain the highest results in terms of energy efficiency and promote environmental sustainability by using devices compatible with low GWP natural refrigerants.

- Integrated management of BLDC compressors and electronic expansion valves;
- Basic software as starting point for the development of custom solutions;
- Compatibility with the use of natural refrigerants and HFOs (A3 Ready);
- Collaboration with selected partners to ensure fast integration while expanding system features.

Heat pumps are redefining the standards of modern heating, becoming a key element in the transition to climate neutrality. When integrated with renewable energy sources, they reduce emissions and reliance on fossil fuels, contributing to a more efficient and sustainable energy system.

Growing environmental awareness is accelerating the adoption of natural low-GWP refrigerants, which are often highly flammable (A3) and require specific solutions and expertise to ensure safe use.

Whether air-to-water or water-to-water heat pumps, CAREL offers solutions specifically designed for A3 refrigerants, simplifying unit certification in accordance with regulations and enabling large-scale production.

Thanks to advanced technologies and strategic partnerships, CAREL supports manufacturers and installers throughout the entire unit life cycle - from design to commissioning - ensuring application expertise, operational reliability, and a forward-looking technological vision.

### Compatibility with the latest refrigerants

Compatibility with HFOs and flammable natural refrigerants to meet the needs of unit manufacturers in terms of regulations such as F-Gas.

### High efficiency and low power consumption

Combined use of EEV technology and BLDC compressors to ensure higher efficiency and lower power consumption (high SCOP).

### Compressor + inverter system qualification

Functional safety across the entire operating range of the compressor. Tested and certified solution

# Software and tools for developing your ideas

CAREL offers "DC Residential HP", an application program for advanced management of residential heat pumps. The software coordinates control of the main high-efficiency components in the refrigeration circuit (inverter, BLDC compressor, electronic expansion valve) and the indoor hydronic circuit, including zone pumps.

In addition to standard operating logic for the highest performance, the solution includes advanced protection and safety functions to safeguard components under all operating conditions.
The software can be used during initial configuration or adapted in simple steps to the layout of the customer's unit using the STone development environment.

**SW design**
- Teamwork
- Automated testing
- Advanced debugging

**Gen AI**
- Code generation
- Code optimisation
- HMI translation

STone manages the application software development, testing and validation stages and is the pivot around which the entire life cycle of the HVAC/R unit revolves. The software and function system created around STone are used to meet the customers' needs at every step of the machine's life, from design to spare part management in the field.

DEVELOPMENT PROCESS

**STone Virtual Loop**
A digital-twin-based emulator to test and validate software developed with STone.

**SPARKLY**
Integration with third party production tools

**STone Simula**
Stand-alone simulator for training

DEVELOPMENT PROCESS

**APPLICA**
**APPLICA DESKTOP**
Commissioning and maintenance

**STone Gate**
Remote advanced maintenance and debug

**STone Digital Signature**
Original spare parts

## Main software functions

### Refrigeration circuit management
- Primary water (heating/cooling) and domestic hot water (DHW)
- High-efficiency device management: power+ inverter and DC compressor, EEVs
- Modulated control of external devices (fans, pumps)
- Intelligent control of operating limits and optimised low-load compressor management
- Defrost, antifreeze, anti-legionella and other specific functions for the residential market
- Compatible with pGD*, pLDPRO, pGDx user interfaces
- Fast commissioning and correct operation monitoring using the "Applica" app installed locally on smartphones
- Alarms with integrated troubleshooting

### Indoor environment hydronic management
- Circulation pump activation for controlling up to three zones
- SG ready
- Screed drying
- Climate curve management

# System components

The ready-to-use CAREL solution for managing the cooling circuit of air-water and water-water heat pumps, consisting of reliable, safe and highly-efficient devices.

1

**Programmable controller (µPC3*)**

- High configurability of the I/O mix for high flexibility;
- Up to 2 built-in driver for the management of electronic expansion valves (EEV);
- RS485 and Ethernet ports for high field connectivity and BMS;
- Compatibility with traditional and natural refrigerants (A3 ready).

2

**Pressure transducers (SPKT* / SPKS*)**

- High EMC immunity for precise measurement;
- Can be installed directly on the pipe, eliminating the need for fittings and joints;
- Available in screw-on and weld-on versions;
- ATEX certification, compatibility with traditional and natural refrigerants (A3 ready).

3

HMI user interface

- 6-button semi-graphic terminal with monochromatic display (pGDn);
- Touch screen graphic terminal with 65K or 16M colour display, depending on the model (pGDx);
- Available for indoor and outdoor applications;
- Compatibility with traditional refrigerants and specific versions for natural refrigerants (A3 ready).

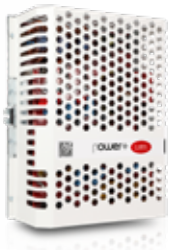
- Seven-segment display with integrated Bluetooth connectivity;
- Suitable for use with the Applica app installed on smartphones;
- Quick system configuration wizard;
- Dedicated synoptic for unit display.

4

Electronic expansion valve (E²V-F)

- Suitable for use with refrigerants reaching condensation temperatures of up to 100°C;
- High-precision bidirectional valve, independent of fluid direction;
- Compatibility with traditional and natural refrigerants (A3 ready).

5



Power+ inverter (PS2*)

- Designed specifically for driving BLDC compressors and equipped with active and passive filters for harmonic reduction;
- Compressor protection in the event of a fault, ensured by class B certified FW and the dedicated STO safety input;
- Wide temperature range with the guaranteed maximum output power (-20T60);
- Compatible with traditional and natural refrigerants (A3 ready).

6

AVIC rotary compressor

- Twin rotary technology combined with BLDC electric motor;
- Wide operating range, with evaporating temperatures down to -30°C and condensing temperatures up to +82°C;
- Range suitable for residential heat pump applications;
- Available for both traditional gases, such as R410A or R32, as well as for R290.

# AVIC rotary compressor for R290

CAREL's offering includes an exclusive range of rotary compressors: environmentally **friendly** because it uses R290, **efficient** thanks to BLDC technology, with **specific** capacities suitable for residential applications, and **flexible** to adapt to multiple climatic conditions.

- **Qualification**: free with CAREL inverter
- **Availability**: stock at CAREL
- **Exclusivity**: Europe

沈阳中航机电三洋制冷设备有限公司
AVIC ELECTROMECHANICAL (SHENYANG) SANYO REFRIGERATION EQUIPMENT CO., LTD.

The CAREL proposal has been further extended and completed with the addition of the AVIC rotary compressor.

The partnership with AVIC allows CAREL to offer an efficient, tested and certified solution in terms of compressor-inverter combination.

AVIC EM SANYO manufactures more than 6 million rotary compressors a year. The company was founded in 1990, with solid roots in Sanyo, still a valuable partner in the areas of design, production and quality.

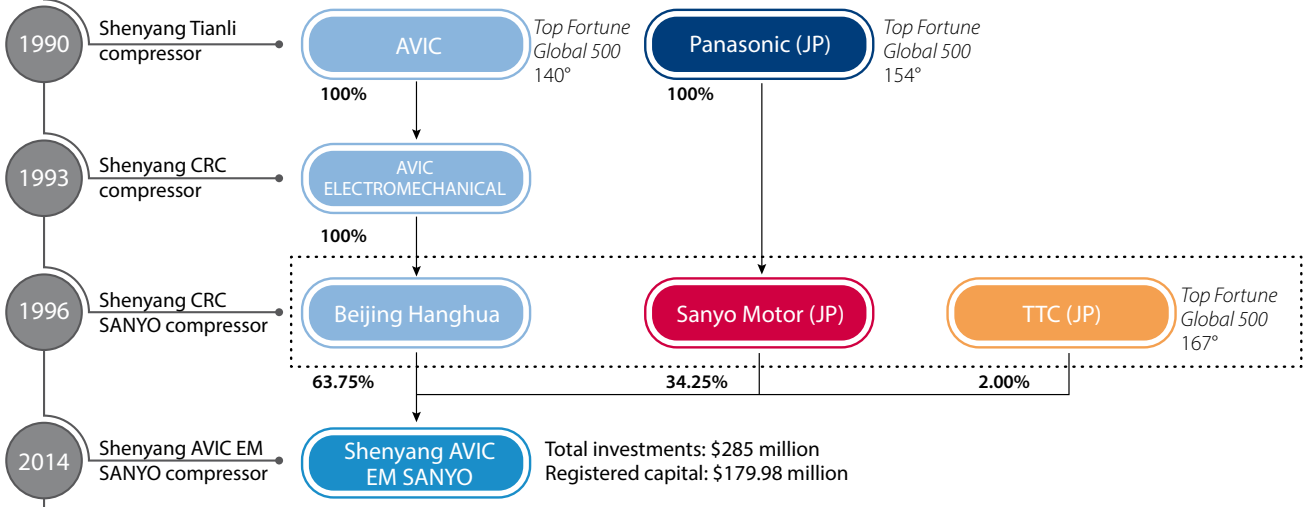
Indeed, the company can boast almost 60 years of experience in the field of rotary compressors for HVAC applications. In the mid 1980s it was the first company to launch a twin solution combined with permanent magnet electric motors.

Today, the natural evolution of this experience is the new R290 range, which CAREL has approached with the desire to offer the market a tested, high-performance inverter-compressor solution.

## History

- 1990 — Shenyang Tianli compressor
- 1993 — Shenyang CRC compressor
- 1996 — Shenyang CRC SANYO compressor
- 2014 — Shenyang AVIC EM SANYO compressor

## Shareholding structure




## some other numbers...

**1990**

Year of foundation

**>2,200**

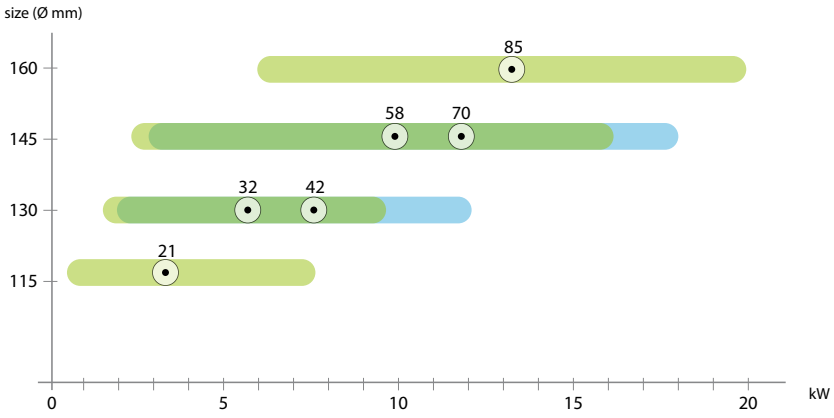
Exployees

**142,000**

$m^2$

Total indoor area

## Capacity range - heat pump mode

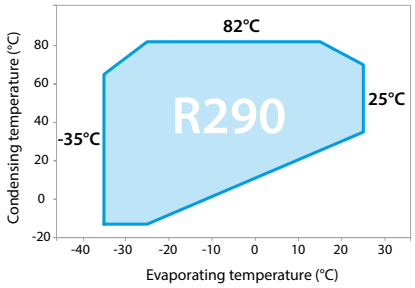



0/75 °C= evaporation temperature/condensing temperature
10/5 K= superheat/subcooling
⊙= capacity values at 60 rps

## Main technical specifications

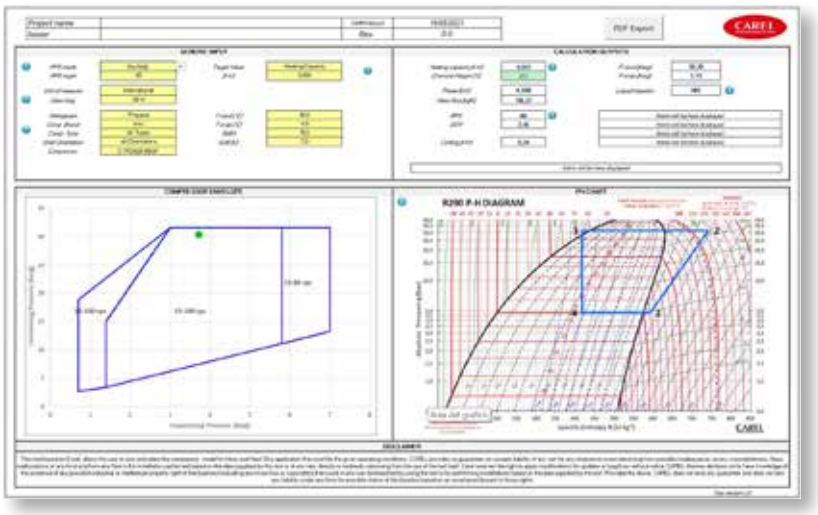
| Model | 210 | 320 | 420 | 580 | 700 | 850 |
|---|---|---|---|---|---|---|
| Size (mm) | 115 | 130 | 130 | 145 | 145 | 160 |
| Displacement (cm³/rev) | 21 | 32 | 42 | 58 | 70 | 85 |
| Vmin - Vmax (rps) | 8 - 120 | 15 - 100 | 15 - 100 | 15 - 100 | 15 - 100 | 15 - 100 |
| Single-phase power supply - 230 V | ● | ● | ● | | | |
| Three-phase power supply - 400 V | | ● | ● | ● | ● | ● |
| PED class | I | II | II | II | II | II |

## R290 compressor verification software




## Compressor verification software

CAREL provides software for verifying compressor performance.
Easy, intuitive and highly useful.



## Operating range

Evaporation temperature: -35T25 °C
Condensing temperature: -13T82 °C

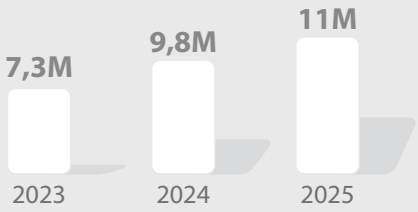
## Tests conducted in the laboratory

- Calorimeter
- Test bench for electric motors
- Anechoic chamber
- Vibration analysis
- Accelerated life cycle tests

## Research and development

- Two Research and Development centres:
  - Shenyang, PRC since 1990;
  - Gunma, JP since 1968
- over 200 technical staff

## Units manufactured




over 10 million - annual production capacity
Fully automated production lines
(2024 and 2025: two new lines added)

## Headquarters

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+3000239EN - 1.3 - 18.03.2026

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