Electric compressor basic concepts

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Project Management HDT/OHW

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Agenda

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2. Electric Compressor History
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5. Electric Compressor Usage
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7. Electric Compressor Performance
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9. Parking Cooling
10. Electric Compressor Connections & Communication
11. Software Control
12. Harnesses
13. Safety Considerations
14. Hybrid/Electric A/C System Oil
15. General Service

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Sanden Holding Corporate Profile – History

1943 Established Sankyo Electric Company in Isesaki, Gunma

1948 Launched production of the dynamo bicycle lamp

1958 Launched production of ice cream freezer

1961 Launched production of juice vending machine

1963 Launched production of pot-type oil heater

1970 Entered a technical collaboration agreement with Mitchell Corporation in the U.S.

1971 Launched production of automotive air-conditioners and SD compressors

1973 Established a new trade name "Sanden"

1974 Established Sankyo International(U.S.)

1977 Established Sankyo International (Singapore)

1981 Launched production of scroll-type compressors

1982 Changed its name to Sanden Corporation

1988 Acquired Vendo Company, a U.S. vending machine manufacture

1994 Issued "the introduction of STQM" declaration

1995 Established Sanden Manufacturing Europe (France)

1996 Received "EPA prize" (contribution to ozone layer preservation) by the U.S. Environment Protection Agency

1998 Received "Deming Prize" (Implementation Prize)

2001 Total production of compressors reached 100 million units

2002 Established Sanden Forest/Akagi Plant

2004 Established Sanden Manufacturing Poland

2005 Launched Eco-Cute business

2007 Masayoshi Ushikubo, a Chairman, received "Deming Prize for Individuals"

2008 Established Sanden Global Center of Technology in Isesaki, Gunma

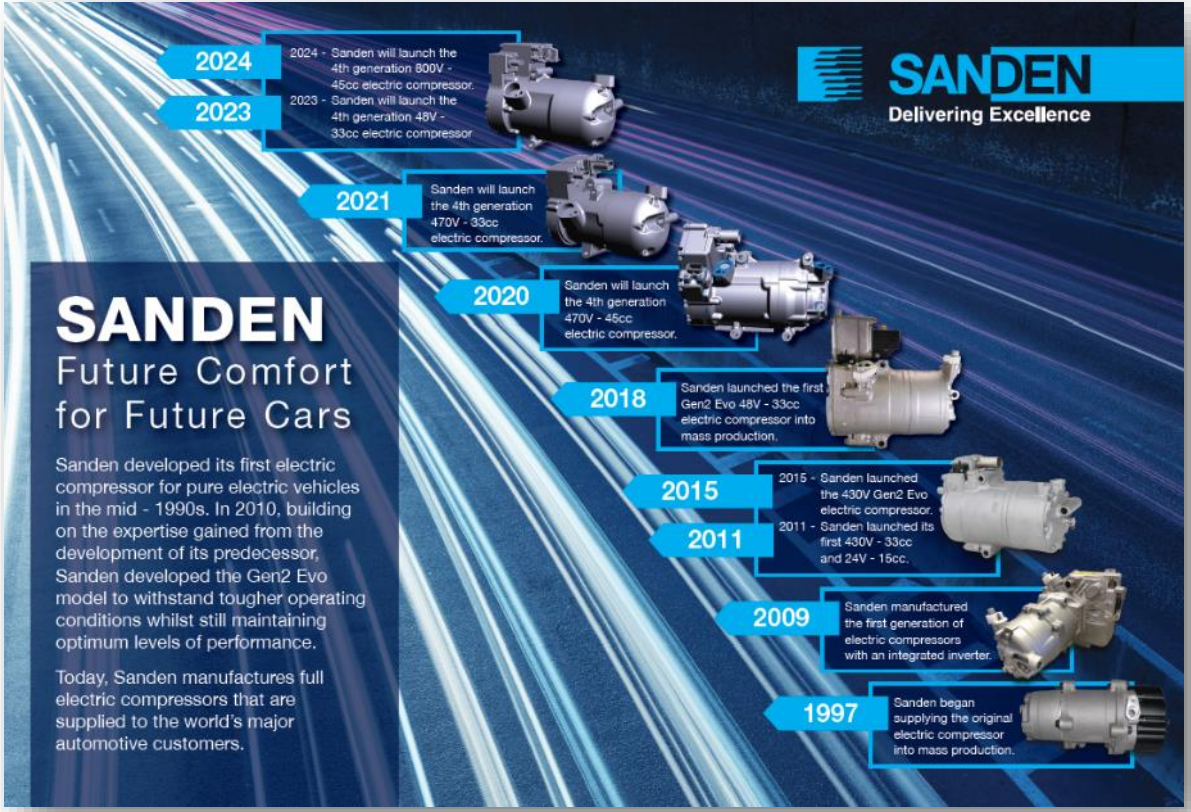
2010 Total production of compressors for car-air conditioning reached 200million units on a global basis

2013 Sanden Forest/Akagi Plant received "Prime Minister's Award for Outstanding Merit concerning Greenification Campaigns"

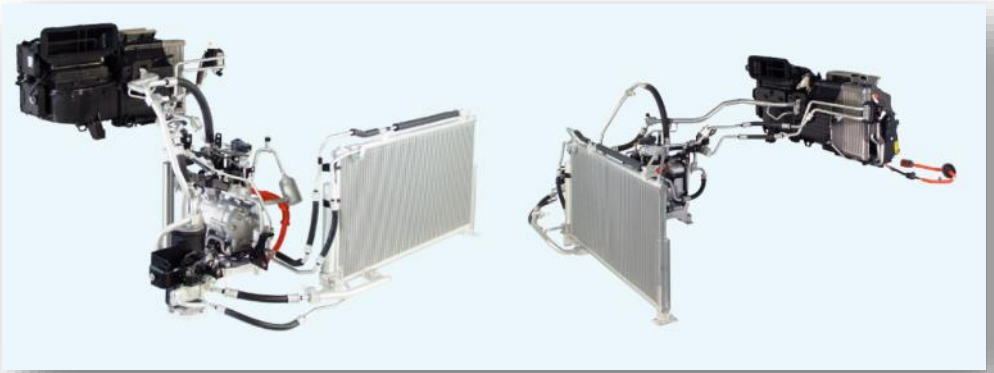
2015 Transferred to a holding company structure and changed its name to Sanden Holdings Corporation

SANDEN HD
- SANDEN AS
- SANDEN AC
- SANDEN RS
- SANDEN LS
- SANDEN EP
- SANDEN AT
- SANDEN BE

Sanden Electric compressor history…

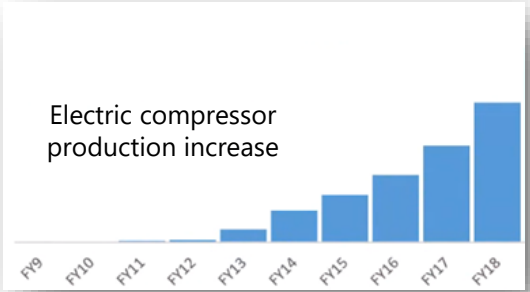


Sanden Electric compressor applications



Sanden Heat Pump System

- More than 2.5 million of electric compressors produced.
- Fitted on **Cars** from Audi, BMW, Daimler, Geely, Honda, JLR, Porsche, PSA, Volvo, VW and **HDT** manufacturers as Daimler Trucks, Iveco, MAN, Scania and Volvo Trucks



Design parameters

Electric / hybrid vehicles

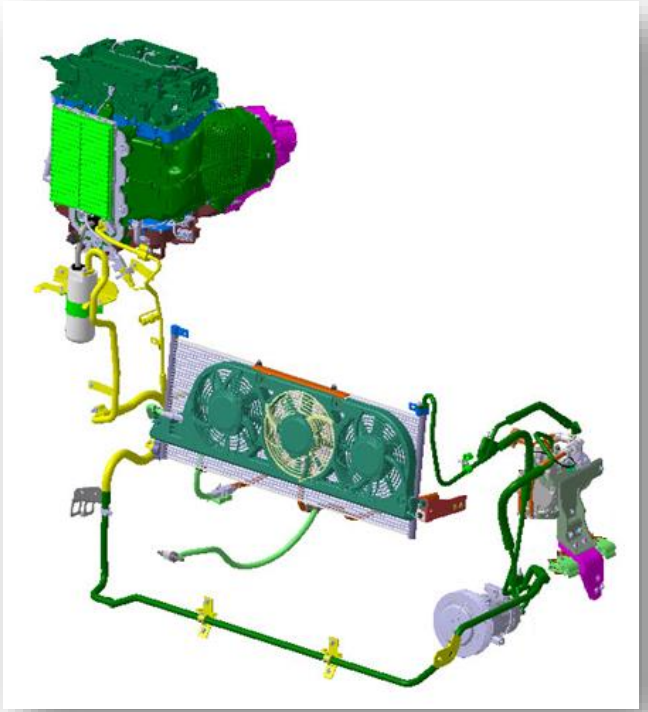
- **Similar cooling performance as mechanical compressor**
- **High voltage supply**
- **Must comply with high voltage regulations**
- **Must comply with electromagnetic compatibility regulations**
- Minimum noise level
- Compact design (fits mechanical 160cc compressor space)
- Vehicle communication LIN/CAN
- Can be used for battery thermal management
- Can be used for Heat Pump systems

Sanden Heat Pump System

Design parameters

Parking cooling A/C

- **Cooling performances adapted to parking cooling conditions**
- **Low voltage supply (24V**)
- **Must comply with electromagnetic compatibility regulations**
- Minimum noise level
- Compact compressor
- Vehicle intercommunication LIN/CAN



Electric Compressor Usage – Sanden's point of view

FULLY ELECTRIC
HV
33cc & 45cc
R134a / R1234yf
Cab Cool & BTM






HYBRID ELECTRIC
48v + HV
33cc & 45cc
R134a / R1234yf
Cab Cool & BTM





START / STOP SYSTEM
R134a / R1234yf
24v (15cc)
Cab Cooling / IPC (retro fit)
Bus Driver Cooling




Gen2 Evo Generic Model Range – General Info

Sanden Generic Electrical Compressor 288V			
Part Number		3142	3143
Displacement		33cc	
Operational Speed	Min	700rpm	
	Max	8500rpm	
High Voltage Range (Operational Guarantee)	Min	165V	
	Max	432V	
Size		ø123mm L=235mm	
Weight		6.3kg	
Oil	Type	SP-A2	
	Amount	120g	
Cooling Performance		5.0kW*	
Communication		LIN	CAN

*5.0 Kw at rpm: 5000 Pd/Ps = 1.5/0.3 MPa SH/SC= 25/10 °K

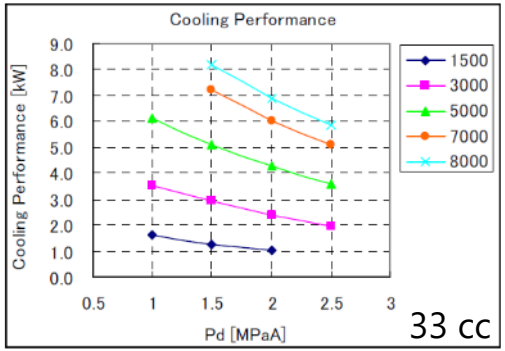
Sanden Generic Electrical Compressor 24V		
Part Number		4199
Displacement		15cc
Operational Speed	Min	700rpm
	Max	5000rpm
High Voltage Range (Operational Guarantee)	Min	18V
	Max	32V
Size		ø123mm L=235mm
Weight		5.2kg
Oil	Type	SP-A2
	Amount	120g
Cooling Performance		2.5kW*
Communication		CAN

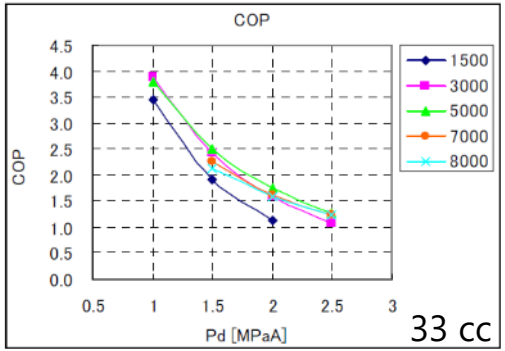
*2.78Kw at rpm: 4250 Pd/Ps = 1.1/0.4 MPa, SH/SC = 10/5°K

Sanden Generic Electrical Compressor 48V		
Displacement		33cc
Operational Speed	Min	700rpm
	Max	8500rpm
High Voltage Range (Operational Guarantee)	Min	24V
	Max	54V
Size		ø123mm L=235mm
Weight		7.5kg
Oil	Type	SP-A2
	Amount	120g
Cooling Performance		5.0kW*
Communication		LIN | CAN

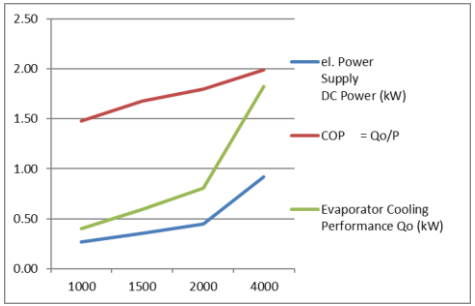
*5.0 Kw at rpm: 5000 Pd/Ps = 1.5/0.3 MPa SH/SC= 25/10 °K

Electric compressor performance



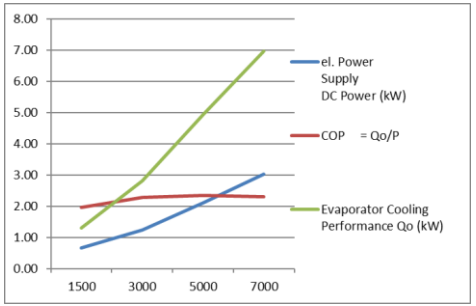


Parking cooling A/C system
15 cc



R134a Pd/Ps = 1.5/0.3 MPa(abs.)

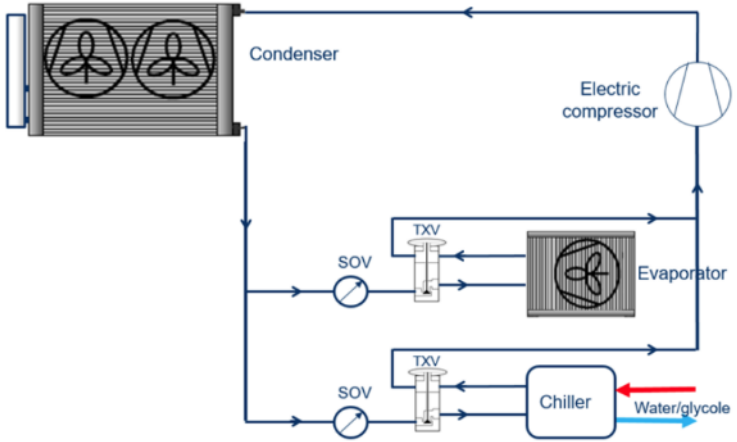
Electric / Hybrid vehicles
33 cc



R134a Pd/Ps = 1.5/0.3 MPa(abs.)

Condensation capacity is key to improve the performances and reduce power consumption

A/C circuit with battery cooler included



- Compressor is working all the seasons
- Vehicle performances are affected in case of compressor failure

A/C system with integrated parking cooling

Sanden IPC is a combination of A/C components.
IPC can be realized either by adding a 24V compressor into an existing A/C System (electric condenser fans are mandatory), or by designing a complete new System.

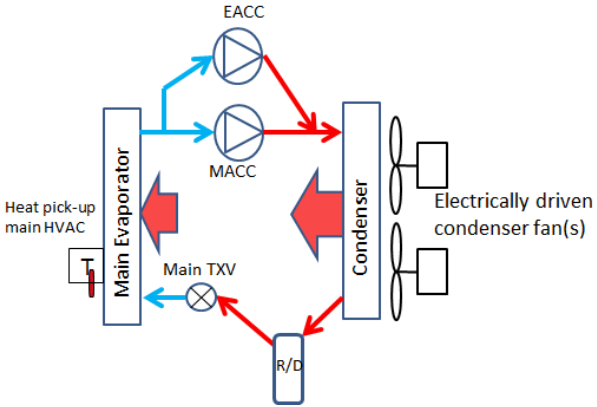
- There are two compressors working in the same A/C system: One mechanical and the other electrical
- They do not work simultaneously. They share the oil and the rest of the A/C system components.

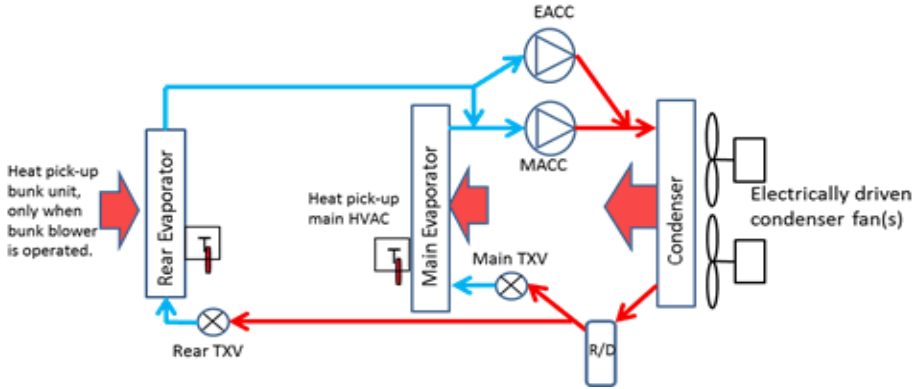
In both cases the system will include the following components:

- HVAC
- Mechanical Compressor
- 24V Electrical Compressor
- Condenser
- Climate Control Panel/ -Unit
- Refrigerant Pipes
- Electric condenser fans
- Rear HVAC unit (optional, or additional if bunk area is separated from driver cab by curtain)

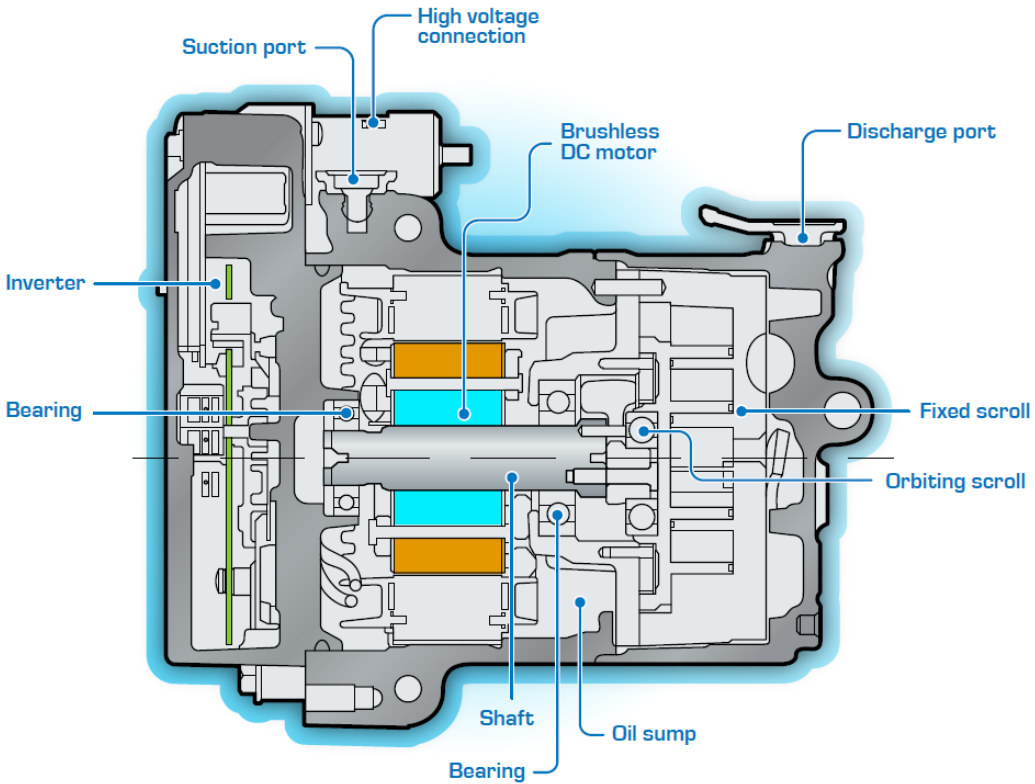
EACC

MACC





Electric compressor connections



Electric / Hybrid vehicles
- 33 cc
- High voltage (260V to 432 V) + 48V

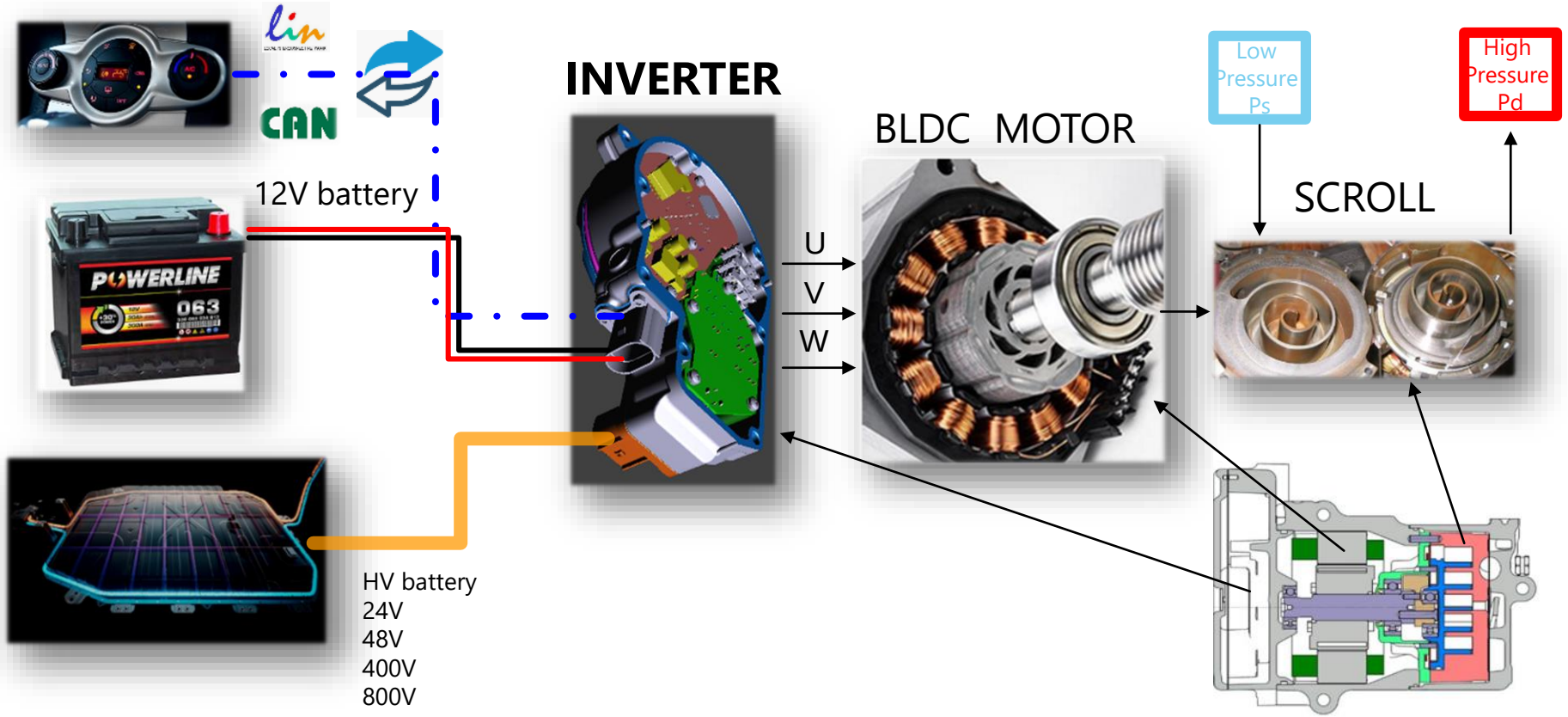
Parking cooling A/C system
- 15 cc
- 24 Volt

High Voltage
harness
Orange colour

CAN

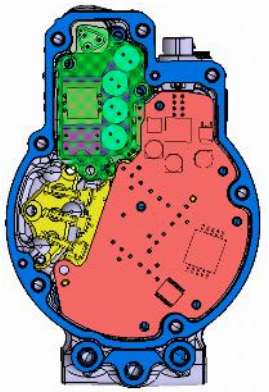
lin
LOCAL INTERCONNECT NETWORK

Electric compressor communication: LIN + CAN

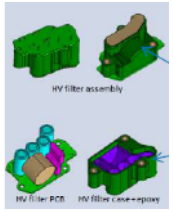


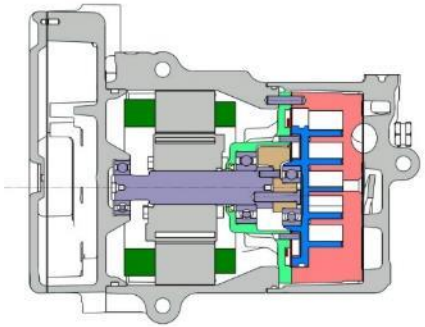
Electric compressor. Main components.

Inverter

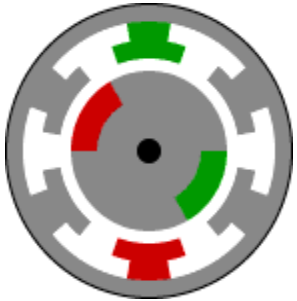


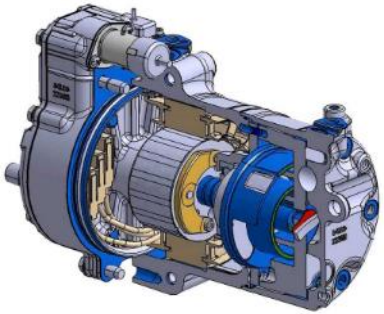
EMC filter





Brushless DC Motor

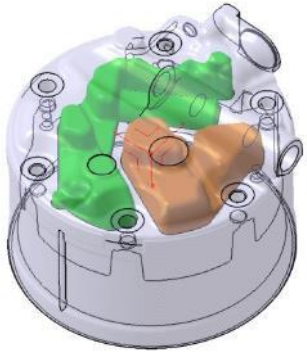




Scroll Compression

Muffler

With oil storage chamber



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Ways to control the electric compressor

There are 3 possible ways:

IFB Module

Laptop +
CAN/LIN Adapter

Vehicle ECU

Ways to control the electric compressor

1. - IFB module provided by Sanden

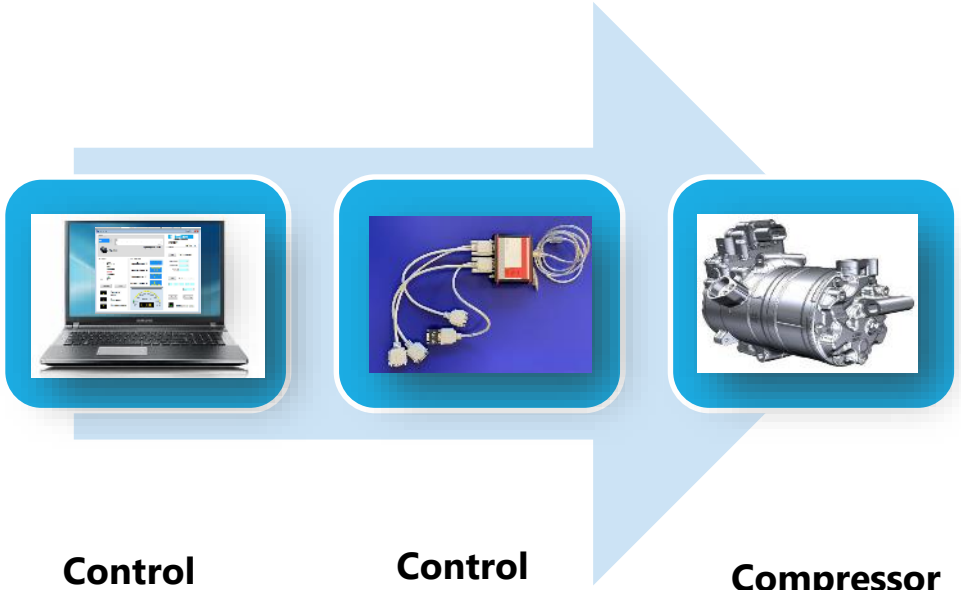
- Direct connection from module to compressor
- Module available in LIN and CAN (valid for 24V and high voltage)
- Functions: ON/OFF + Speed control + Diagnosis
- IFB module instructions can be provided by Sanden.

Ways to control the electric compressor

2. – Laptop + CAN/LIN adapter

- Connection from computer to compressor using a module.
- Software needed to “input” the program to the module.
- Control files needed in LIN or CAN versions.

  Can this be provided by Sanden?
  Yes
  Sanden can provide LDF (LIN) and DBC (CAN) files
  Sanden can provide CAN OE configurations for LIN and CAN HV and LV



Ways to control the electric compressor

3. – Final stage. From vehicle ECU

- Direct connection from vehicle ECU to compressor

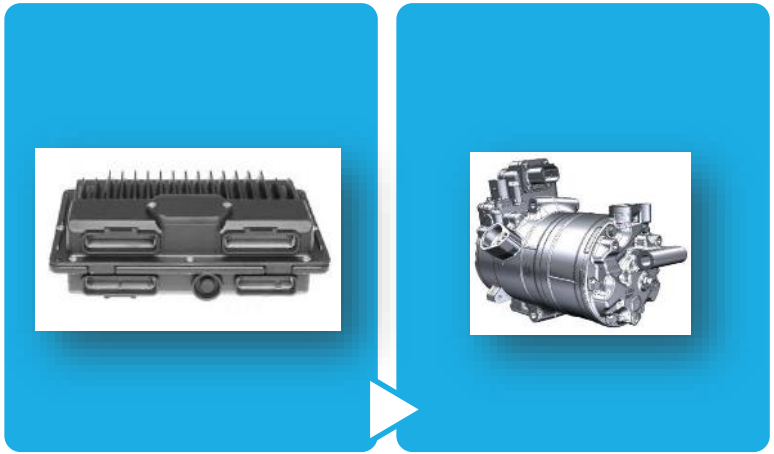
Software to program the modules

- LDF = LIN Description File.

Ready and can be provided by Sanden.

- DBC = Data Base CAN **for CAN compressors**

Ready and can be provided by Sanden.



Electric harness for testing

SANDEN # - SK-14811-001 (code A, variant 1 (no CPA)) - High Voltage
Wire Length – 5 metre
Wire Thickness – 6mm
Pin 1 – Red
Pin 2 - Black

SANDEN # - 805-031-551 (variant 3) – Low Voltage
Wire Length – 5 metre
Wire Thickness – 1mm

Electric components associated risks

HIGH VOLTAGE

High voltage electric shock.
Sanden compressors are equipped with auto discharge devices
(<60V after 5 Seconds from Umax)

Capacitor discharge!

Electromagnetic interferences can create malfunctioning of other devices.

EMC Approved!

Electromagnetic compatibility.
Sanden compressors are equipped with EMC filters

Water jet:
Do not spray directly on connectors

Electric compressor repair precautions

Risks due to high voltage. Can produce serious personal injures or death

- Handle the compressor without proper training
- Handle the compressor connected to electric current
- Handle a damaged compressor
- Use of wrong oil
- Use of other refrigerants than the recommended ones or contaminated refrigerants
- To try to modify the compressor or electric connections.
- Handle the compressor with damaged harness/connectors
- Avoid the use of water jets on the compressor

Risk that can cause serious personal injures or death

- Refrigerant only must be manipulated by trained staff and authorised according to the regulations.
- Use of other refrigerants than the recommended ones or contaminated refrigerants
- Air conditioning circuit only must be serviced with the use of proper personal safety equipment.

Risk of component damage

- The electric connectors are designed to be connected/disconnected a maximum of 50 times
- The presence of particles/humidity in the AC system

Fire risks

- Do not smoke during refrigerant manipulation, avoid the contact of oil/refrigerant with flames, sparks or hot surfaces.

Manipulation of refrigerants must be done only by trained personnel who are in possession of the required permissions according to European or local applicable regulations

Electric compressor service

Electric shock risk due to:

- The use of wrong oil can damage the electric motor wiring protection
- Wrong oils can have reduced dielectric insulation

SANDEN'S ELECTRIC COMPRESSOR: USE ONLY SP-A2 OIL

SP-A2 oil is compatible with R123yf and R134a

Questions?

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