VITOBLOC 200

CHP unit – heat and power from natural gas
High efficiency through cogeneration
Overall efficiency 65.7 %
Overall efficiency with optional exhaust gas heat exchanger* 90.3 %
Primary energy savings 13.8 %
** With a further 310 kW decoupled from the exhaust gas*

Technical description

VITOBLOC 200 type EM-530/660

Part no. 7727282 – SCR version

CHP unit for operation with natural gas
In accordance with the requirements of the
EU Gas Appliances Regulation and
EU Machinery Directive
Electrical output 505 kW
Thermal output 321+40 kW
Fuel use 1258 kW

In addition to the "SCR" version, this technical description also covers the "SCR ready" version.
For part numbers, see back page

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Company details

This appliance meets all basic requirements of the applicable standards and guidelines. Conformity has been verified. All associated documents and the original Declaration of Conformity are available from the manufacturer.

NOTE!

The Vitobloc 200 CHP unit is not suitable for 60 Hz operation. It is therefore not available for the American and Canadian markets in particular.

Important general application notes

Use this technical appliance only for its intended purpose and according to the installation, operating and service instructions. Maintenance and repairs may only be performed by authorised contractors.

Use this appliance only in those combinations and together with those accessories and spare parts indicated in the installation, operating and service instructions. Only use other combinations, accessories and wearing parts if they are designated explicitly for the intended application and they do not adversely affect performance characteristics or safety requirements.

Subject to technical modifications.

This is part of the original operating instructions.

Constant development may lead to minor deviations in the illustrations, functional steps and specifications from those described/shown.

Depiction of instructions

The safety instructions in this documentation are important for safety and must be observed.

DANGER!

This symbol warns against the risk of injury.

CAUTION!

This symbol warns against the risk of material losses and environmental pollution.

NOTE!

This symbol indicates information that will simplify work and ensure safe operation.

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1 General

1.1 Purpose

The combined heat and power unit (CHP unit) is a complete, fully wired unit with an air cooled synchronous generator for generating 400 V, 50 Hz three-phase power and domestic hot water.

Every CHP unit can be operated subject to either thermal or electrical load within the electrical load range of 50-100 % (corresponding to 60-100 % thermal output).

Standard delivery – standard equipment level	
- Exhaust gas scrubber for reducing exhaust gas emissions.	- Control system integrated into CHP unit for optimum space utilisation. No additional space required; no additional cabling.
- SCR system for the reduction of nitrogen oxides (NO_x), including intermediate tank for the urea-water solution.	- Control system including generator power unit, control, monitoring and auxiliary drive, as well as microprocessor controller.
- Reliable 4-stroke gas engine; series product from OEM.	- Certified according to grid connection guideline VDE-AR-N 4110.
- Three-phase synchronous generator with low harmonic content.	- Starter system with battery charger and maintenance-free, vibration-proof batteries.
- Gas control path according to DVGW and DIN 6280 Part 14, including thermal shut-off valve and gas ball valve.	- Data transfer via DDC interface for transferring the CHP unit parameters to the building management system as hardware module RS 232 with data protocol 3964 R (without RK512).
- Internal lubricant supply system with circulating oil lubrication via reservoir, designed for ≥ 1 maintenance interval.	- Fault memory for recording complete fault chains with operating parameters for specific fault analysis.
- Factory test run with complete CHP unit (engine, generator, heat exchanger, control panel) according to DIN 6280 Part 15.	- History memory – electronic machine log for seamless recording of the most important operating parameters.
- Designed in accordance with the Gas Appliances Regulation (EU) 2016/426 and EU Machinery Directive; manufactured according to DIN ISO 9001.	- Documentation according to DIN 6280 Part 14

Tab. 1 Standard delivery, standard equipment level

1.2 Continuous output in mains parallel mode

For outputs and efficiencies, see chapter 4 "Specification".

Output and efficiency levels comply with ISO 3046/1, at 25 °C air temperature, 100 kPa air pressure (installation up to 100 m above sea level), 30 % relative humidity and methane number 80 plus reactive factor cos phi = 1. The tolerance for all efficiencies and heating outputs is 7 %. The tolerance for energy input is 5 %.

All other CHP unit data applies to mains parallel mode. Details relating to the partial load range are provided for information only; these do, however, correspond to ISO (without guarantee).

Only the following fuel is permitted: Natural gas according to DVGW Guideline, Code of Practice G260, gas category II, group L. All the data required for other gas qualities and installation conditions is available on request.

Power index

The CHP unit is a series product with a product number without a heat delivery device in accordance with the EU Gas Appliances Regulation.

The power index is defined according to Code of Practice AGFW FW308 as the quotient of electrical output divided by the heating output. The value according to chapter 4 "Specification" is in the defined range between 0.5 and 0.9 for CHP systems with combustion engines.

Primary energy factor

The primary energy factor (abbreviated to "fp") represents the relationship between the primary energy consumed and the final energy generated, with not only the energy conversion influencing this factor, but also the transport. In other words, this means that the lower the primary energy factor, the more favourable the impact when determining the annual primary energy demand. The more environmentally responsible the energy employed and its conversion, the lower the primary energy factor.

Primary energy saving according to EU Cogeneration Directive

The amount of primary energy saved is the percentage saving made in fuel due to combined heat and power generation within a CHP process compared with the fuel heat consumption in reference systems with non-combined heat and power generation.

The calculation formula is defined in EU Directive 2012/27/EU on the promotion of combined heat and power generation based on a useful heat demand.

Every small and mini CHP system (< 1 MW_{el}) that delivers a primary energy saving is considered highly efficient.

This means that all Vitobloc 200 CHP units used for cogeneration are highly efficient.

1.3 Mains substitution mode

Charged gas engines are only suitable for use in mains substitution mode due to their characteristic torque curve (available on request).

The heating water return temperature must not exceed 65 °C in mains substitution mode.

The mains substitution function does **not** apply in conjunction with operation of an absorption refrigeration system.

1.4 Emissions

Depending on the version, the Vitobloc 200 CHP unit can meet various pollutant emission requirements, from average to top quality standards for exhaust emissions.

For emission values after exhaust gas scrubbing, see chapter 4 "Specification".

1.5 Energy balance

The energy balance graphically illustrates the energy flow of the CHP unit.

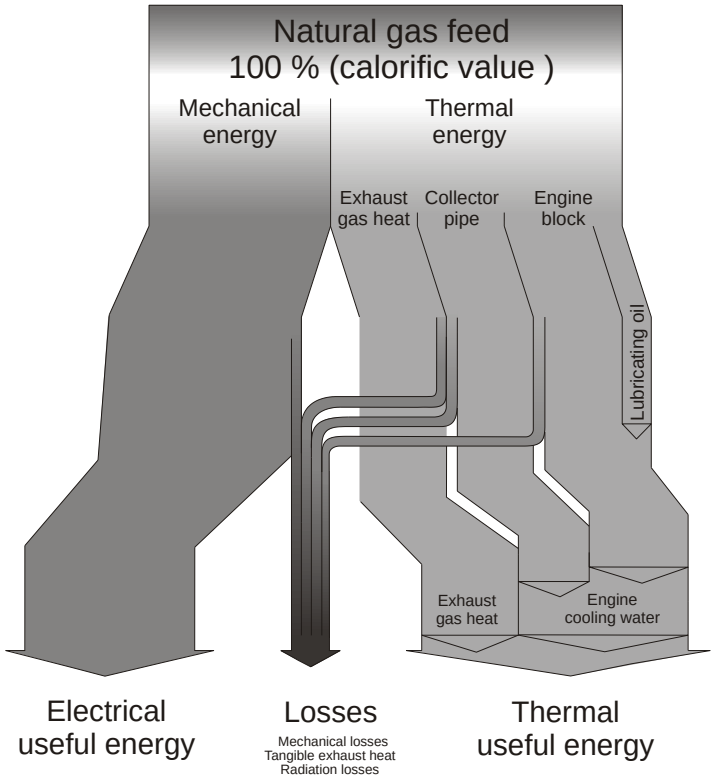
The energy balance illustrates the conversion of primary energy (natural gas, 100 %) into useful electrical and thermal energy. The losses occurring during this conversion are also shown and differ depending on the unit design (version). The maximum on-site electrical consumption is not illustrated; this may vary depending on the operating state.

The usable electrical energy is created by the combustion process within the 4-stroke gas engine, the rotational movement of which is converted into electricity via a synchronous generator.

The usable thermal energy is also created by the combustion process within the 4-stroke gas engine. It is divided between the exhaust gas heat, the header, the engine block and the engine lubricating oil and is used for heating purposes, e.g. for heating water.

The overall efficiency of the CHP unit is calculated by adding the usable electrical and thermal energy.

The efficiency according to the [German] Energy Tax Implementation Ordinance (EnergieStV) is defined as the ratio of the total thermal and mechanical output generated over the total energy and auxiliary energy consumed.



Vitobloc 200			
EM-530/660 SCR	**40.1 %**	**31.2 %**	**28.7 %**
EM-530/660 SCR with optional exhaust gas heat exchanger (external)	**40.1 %**	**6.6 %**	**53.3 %**
EM-530/660 SCR-ready	**39.1 %**	**31.8 %**	**29.1 %**
EM-530/660 SCR-ready with optional exhaust gas heat exchanger (external)	**39.1 %**	**6.1 %**	**54.8 %**

Fig. 1 Energy balance of a CHP unit

NOTE!

The thermal energy in the exhaust gas can either be used directly as process heat, or can be transferred to a heating system via an optionally available exhaust gas heat exchanger!

2 Product description

The CHP unit comprises various assemblies and components, which are explained in this chapter. The assemblies and components are part of the standard delivery of the CHP unit.

2.1 4-stroke gas engine with accessories

2.1.1 4-stroke gas engine

The 4-stroke gas engine is operated as a combustion engine with turbocharging, two-stage mixture cooling and gas mixture control.

2.1.2 Engine lubricating oil system

The engine is lubricated by a force-feed lubrication system.

The oil reservoir is integrated into the engine's lubrication circuit by means of a bypass on the oil pressure line and a return to the engine oil sump.

Crankcase ventilation is connected to the combustion air intake via an oil separator.

2.1.3 Engine cooling system

The engine is cooled by means of a sealed, internal water circuit driven by a pump.

The engine must be protected against coolant temperatures which are too low caused by the heating water return being too low or due to the heating water flow rate being too high. Suitable protective measures should be in place, such as return temperature raising or hydraulic controls. Consequential damages resulting from continuous operation outside of the permissible operating parameters are not covered under warranty.

2.1.4 Ignition system

The ignition system assists the starting procedure for the 4-stroke gas engine.

The ignition system is designed as a contactless electronic condenser discharge ignition system (DIS) on camshaft basis.

It comprises ignition coils (one coil per cylinder) and electronic ignition distribution system, a camshaft speed sensor, a silicone ignition cable, spark plug caps and high performance industrial spark plugs for stationery gas engines.

The ignition system offers timing adjustment options during operation, as well as inputs and outputs for external timing adjustment.

2.1.5 Battery starter system

Two maintenance-free batteries supply the engine starter and the ignition system with electrical power for the engine starting procedure.

2.1.6 Combustion air filter

The combustion air supplied to the 4-stroke gas engine is filtered by the combustion air filter.

2.1.7 Clutch

The clutch connects the 4-stroke gas engine to the three-phase synchronous generator.

2.2 Unit components

2.2.1 Three-phase synchronous generator

Rotational movement by the three-phase synchronous generator generates electrical power.

The three-phase synchronous generator is equipped with an automatic cos-φ control unit.

2.2.2 Gas supply and gas/air mixer

Gas is supplied to the CHP unit via a modular safety gas train (components approved according to DVGW), which is delivered loose.

The gas train should be positioned in direct proximity to the engine above the unit.

- Flexible stainless steel hose pipe (part of the standard delivery)
- Ball valve with thermally activated shut-off equipment
- Gas filter
- Gas pressure switch for minimum pressure
- Two solenoid valves designed as gas safety valves, normally closed.
- Leak detector for checking the safety valves before starting up or after shutting down the CHP unit
- Zero governor for adjusting to zero pressure downstream of the gas solenoid valve
- Linear actuator for fuel gas admixing
- Regulated gas/air mixer

The gas flow pressure must be ensured at the transfer point between the CHP unit and the gas control path according to chapter 4 "Specification".

2.2.3 Base frame

The base frame accommodates the components of the CHP unit.

To facilitate installation, the CHP unit control panel and fan assembly can optionally be removed. Lifting eyes at the top and at the sides towards the bottom can be removed to enable lifting of larger components during modifications using lifting gear, cranes or similar without hindrance.

The hydraulic interfaces for gas, exhaust gas, condensate, heating water and unit ventilation have been prepared ready to connect on-site on the "connection side". The other three sides are freely accessible for operation and maintenance. Anti-vibration elements for mounting the engine/generator unit are provided on the base frame. The base frame is mounted on Sylomer strips on the floor without rigid anchors.

2.2.4 Pipework

The pipework is pre-assembled at the factory and connects the most important elements of the CHP unit (coolant heat exchanger, exhaust gas heat exchanger and engine). Coolant, heating and exhaust gas pipework between the elements is fully assembled and insulated where necessary.

For the purpose of vibration isolation, all pipe joints are provided with metal expansion joints or flexible hose connections and are designed as flanged or flat-gasket threaded connections. Pipes conveying water and exhaust gas are made of stainless steel.

2.2.5 Heat transfer system

The heat transfer system consists of the coolant heat exchanger. Via heat transfer, this heat exchanger uses the waste heat generated by the engine.

The heat exchanger is designed according to the Pressure Equipment Directive 2014/68/EU and is insulated along with the pipes where necessary.

2.2.6 Mixture cooling

Mixture cooling takes place in two stages.

The high temperature stage is integrated in the engine coolant circuit.

The low temperature stage must be supplied separately with external coolant. According to the engine manufacturer's installation guidelines, a water/glycol mixture with 40-50 % glycol must be used.

CAUTION!

The system pressure in the low temperature stage must not exceed 3 bar (safeguard as per flow diagram on page 10 Fig. 2)!
Otherwise hydraulic system separation should be provided with the heat exchanger on site.

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2.2.7 Exhaust gas scrubber

An SCR (selective catalytic reduction) system reduces the pollutant emissions of the exhaust gas using additional AdBlue™ operating fluid. This enables the reduction of NO_x. An oxidation catalyst reduces the CO and C_nH_m content.

To avoid premature ageing of the catalyst, its operating temperature should be kept below 530 °C.

The catalyst is installed downstream of the engine in the exhaust pipe where it is easy to service; the Lambda probe for Lambda control mode is fitted in the exhaust system of the CHP unit downstream of the engine exit.

2.2.8 Lubricating oil supply system with recirculating lubrication

Each CHP unit is equipped with a facility to monitor the lubricating oil level. Use the sight glass to note and check the oil level. The minimum and maximum value can be checked via an electronic level control with alarm contact. Oil consumption is covered by a lubricating oil reservoir, with a volume designed for ≥ one maintenance interval.

The lubricating oil reservoir is arranged in series in the engine oil circuit. Oil heated to operating temperature is diverted through a defined bypass on the engine to fill the reservoir. A return line between the reservoir and the engine oil sump closes the circuit. Metering is performed via a solenoid valve which is actuated by the electric level control. The reservoir has overflow protection to prevent overfilling.

For safety reasons, the floor pan can hold the total content of both the engine oil pan and the fresh oil reservoir in the event of a fault.

2.2.9 OPTION: Noise attenuating elements and extract air fan

The optional CHP unit casing consists of noise attenuating elements for the engine/generator unit. Two extract air fans are used to aerate and ventilate the CHP unit.

The combustion air intake is located outside the silencer hood on the top casing.

Fresh air is drawn in at the side through integrated louvres in the silencer hood casing.

For sound emissions with and without noise attenuating elements, see chapter 4 "Specification".

Extract air canvas flanges are already installed on the optional extract air box, plain flange 700 x 700 mm P20.

The CHP unit casing can easily be removed for installation work

2.2.10 OPTIONAL exhaust gas heat exchanger and insulation (external)

In order to be able to use the thermal energy stored in the exhaust gas, e.g. in the form of energy for heating, an optional exhaust gas heat exchanger is available which can be connected to the compact CHP unit.

The secondary side of the heat exchanger is directly integrated into the heating circuit. Different flow temperatures can therefore be achieved, depending on the system sizing.

The exhaust pipe between the exhaust gas outlet from the CHP unit and the optional exhaust gas heat exchanger is not included in the standard delivery. When carrying out sizing, note that the exhaust gas temperatures can be as high as 500 °C.

2.2.11 Materials provided as standard

The following material is provided with the CHP unit as standard:

- 1 exhaust gas axial expansion joint – nominal diameter DN 250, flange PN 10, with DVGW approval
- 2 corrugated heating lines – nominal diameter DN 80, flange PN 10, nominal length NL 1000, with loose-type flange PN 10, steel
- 2 corrugated heating lines – nominal diameter DN 50, nominal length NL 1000 for mixture intercooling
- 1 corrugated gas hose – nominal diameter DN 65, nominal length NL 1000
- Sylomer pads for noise dampening
- Hoses for connecting compressed air and AdBlue(TM) supply

Delivery as parts provided loose for on-site installation.

The material can be found in a box labelled "Material for commissioning EM-530 SCR".

2.2.12 General description of monitoring equipment for the Vitobloc 200

Monitoring via transmitters for oil pressure, coolant temperature, exhaust gas temperature, heating water temperature and engine speed, as well as transmitters for min. coolant pressure, lubricating oil level, safety pressure limiter and high limit safety cut-out, including wiring to the control panel.

Vitobloc 200 EM-530/660 SCR flow diagram

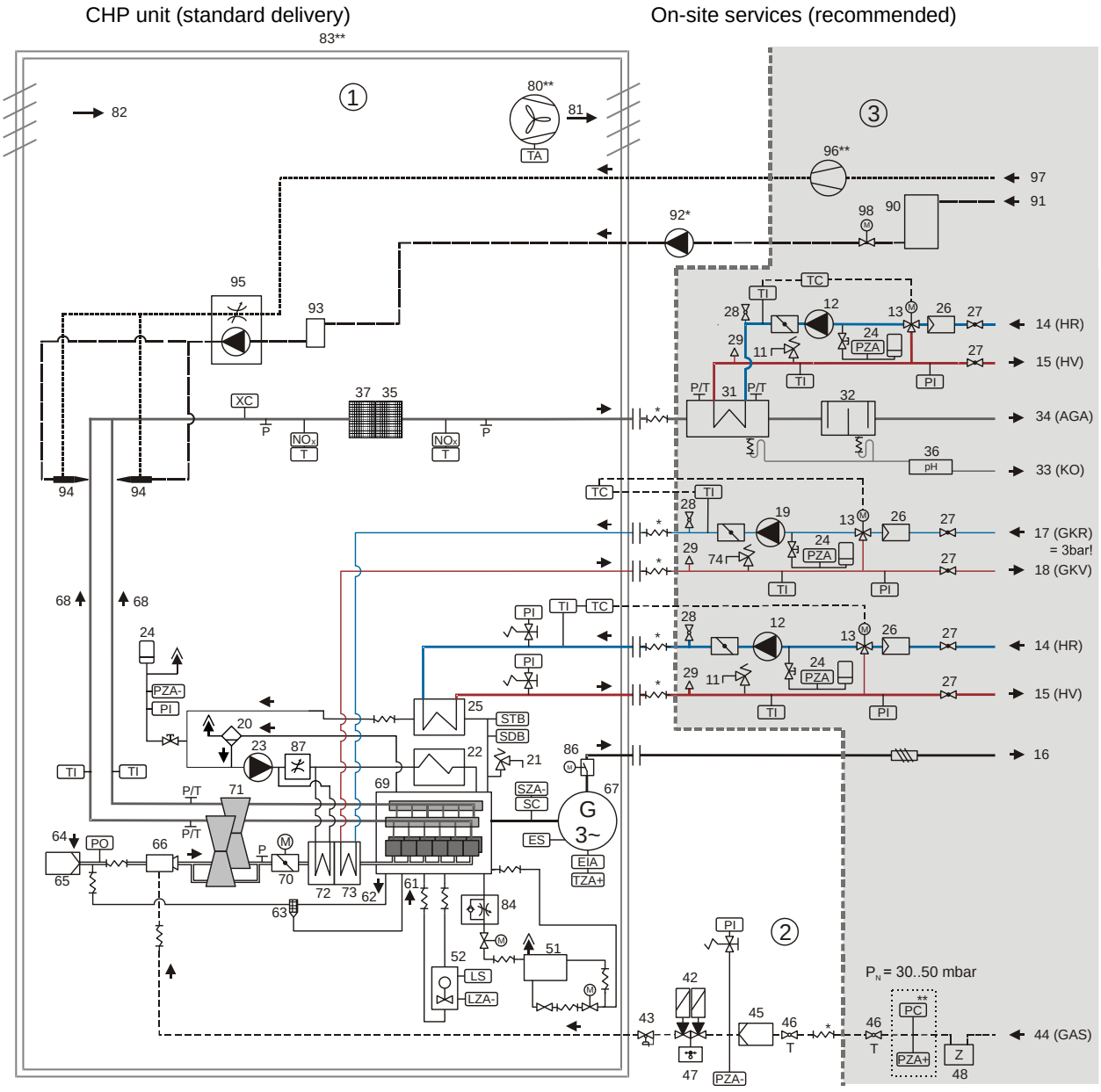

Fig. 2 Vitobloc 200 EM-530/660 SCR monitoring equipment

Product description

Complete key to Fig. 2 and 3:

① *CHP unit (standard delivery)*
② *Gas train (standard delivery, provided loose)*
③ *On-site services (recommended)*
11 *Safety valve (heating water)*
12 *Heating water pump*
13 *Return temperature control*
14 *Heating water return (HR)*
15 *Heating water flow (HV)*
16 *Power current 400 V, 50 Hz*
17 *Coolant mixture flow*
18 *Coolant mixture return*
19 *Coolant mixture pump*
20 *Bypass flow gas separator*
21 *Safety valve (engine coolant)*
22 *Oil cooler*
23 *Coolant pump*
24 *Diaphragm expansion vessel*
25 *Coolant heat exchanger*
26 *Dirt trap*
27 *Shut-off valve*
28 *Heating water drain & fill valve*
29 *Air vent valve*
31 *Exhaust gas heat exchanger*
32 *Silencer*
33 *Condensate outlet (KO)*
34 *Exhaust gas outlet (AGA)*
35 *Oxidation catalyst*
36 *Neutralisation*
37 *SCR catalyst*
41 *Lambda control valve*
42 *Solenoid valve*
43 *Zero governor*
44 *Gas connection (GAS)*
45 *Gas filter*
46 *Gas ball valve with thermally activated safety valve*
47 *Leak detector*
48 *Gas meter*
51 *Additional tank for recirculating oil lubrication*
52 *Automatic top up with lubricating oil level indicator*
61 *Lubricating oil return (from oil separator)*
62 *Crankcase vent*
63 *Oil separator*
64 *Combustion air*
65 *Air filter*
66 *Gas/air mixer*
67 *Generator*
68 *Exhaust gas header*
69 *Engine*
70 *Speed governor and throttle*
71 *Turbocharger*
72 *Mixture intercooler (stage 1)*
73 *Mixture intercooler (stage 2)*
74 *Safety valve, low temperature circuit*
80 *Extract air fan*
81 *Extract air*
82 *Supply air*
83 *Silencer hood*
84 *Non-return throttle valve*
85 *Generator contactor*
86 *Circuit breaker with motor operator*
87 *Motor coolant butterfly valve*
90 *Urea storage tank*
91 *Urea refuelling line*
92 *Urea refill pump*
93 *Urea intermediate tank*
94 *Urea injection nozzle*
95 *SCR dosing system*
96 *Air compressor*
97 *Air intake for compressed air*
98 *Lift protection valve*

Test points:

EIA	*Generator display monitoring*
ES	*Generator output control*
LS	*Fill level control*
LZA	*Low fill level check*
P	*Pressure*
P_N	*Gas flow pressure*
PC	*Pressure control*
PI	*Pressure indicator*
PO	*Optical pressure indicator*
PZA-	*Low pressure shutdown*
PZA+	*High pressure shutdown*
SC	*Speed controller*
STB	*High limit safety cut-out*
SZA-	*Low speed*
T	*Temperature*
TA	*Extract air temperature upstream of fan*
TC	*Temperature control*
TI	*Temperature indicator*
TZA+	*Generator winding temperature monitoring*
XC	*Lambda probe*

* *Provided loose for on-site installation*
** *Optional equipment*

NOTE!

Use only type-tested parts for the safety equipment of the heating circuit connection!

Product description

EM-530/660 SCR-ready flow diagram

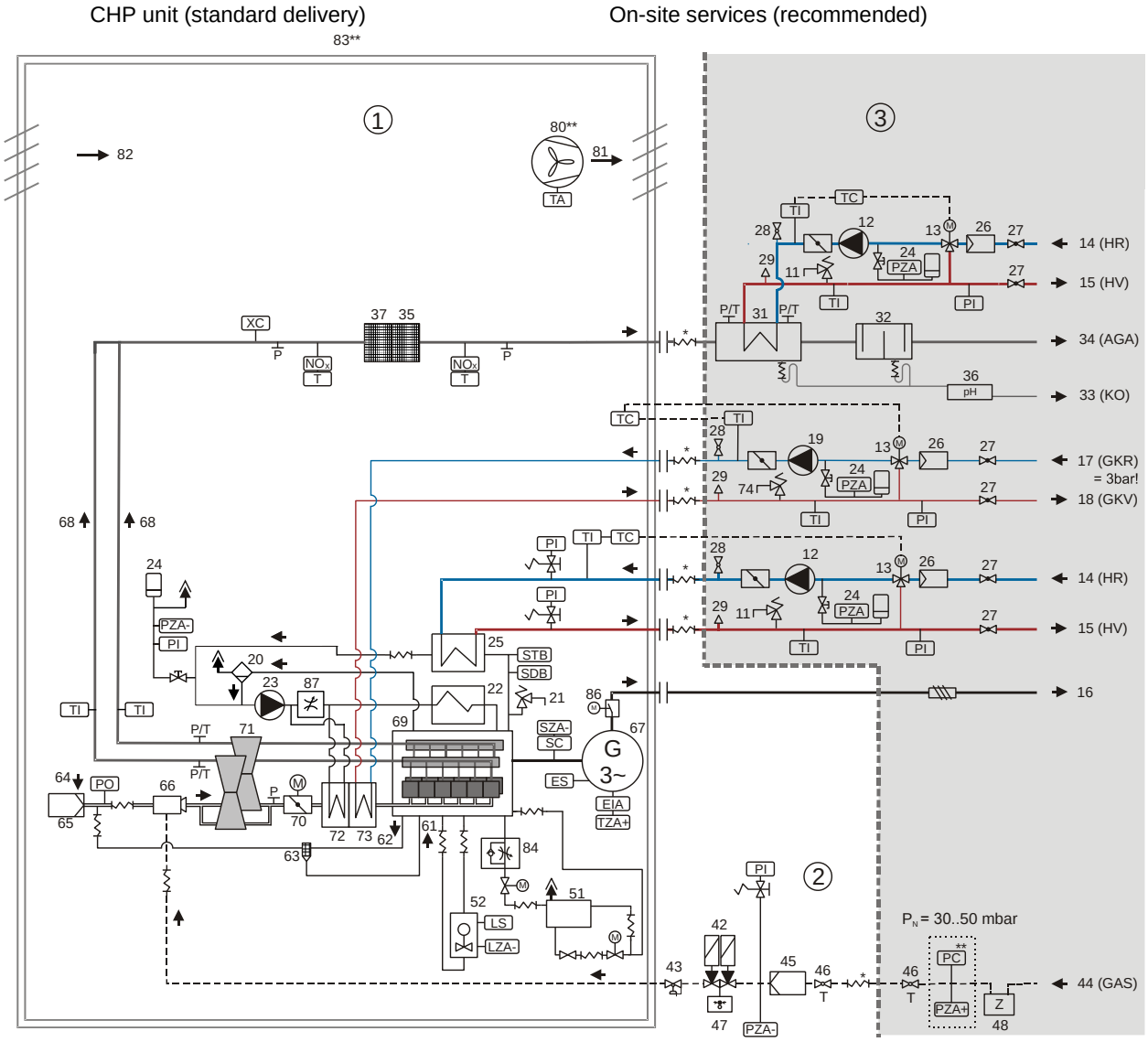

Fig. 3 Monitoring devices for Vitobloc 200 EM-530/660 SCR-ready (for key see Fig. 2)

2.2.13 Control system

The control panel is fitted to the CHP unit. All the following components, including wiring, are located inside the CHP unit.

Generator power unit
Three-pole circuit breaker, with thermal-magnetic trip element, undervoltage trip 24 V⎓, motor operator
Current transformer set for generator
Current transformer set for SCR control (output control, overload protection)
Control, monitoring and auxiliary drive
Synchronisation and mains monitoring
Controllers and relays for coolant pump, starter, extract air fan, gas train
Output control for warm-up, fixed and modulating valve with ramp function for start and stop and output control via electronic speed regulator with electric actuator acting on mixture throttle valve
Remote monitoring with TeleControl LAN
Key switch for safety shutdown (emergency stop)
Battery charger
Microprocessor control
Display for indicating operating and fault values using window technology
Two separate microprocessors for the start-stop procedure – one for mains parallel and one for mains substitution mode including Lambda control, as well as mains protection/mains monitoring
Separate, password-protected access levels for power supply utility, setting parameters and manual mode
Potential-free inputs for remote start, fixed and modulating control plus mains substitution start-up
History memory for recording min./max. analogue values to optimise operation
Fault memory for permanent recording of complete fault chains with operating parameters for specific fault analysis
DDC interface via RS 232 with 3964R protocol (assemble RK 512 subject to on-site hardware and software) – other interfaces available on request
Operating and central fault messages sent via floating contacts

Tab. 2 Control panel components

Product description

Main wiring diagram of the electrical connection for mains parallel and mains substitution mode

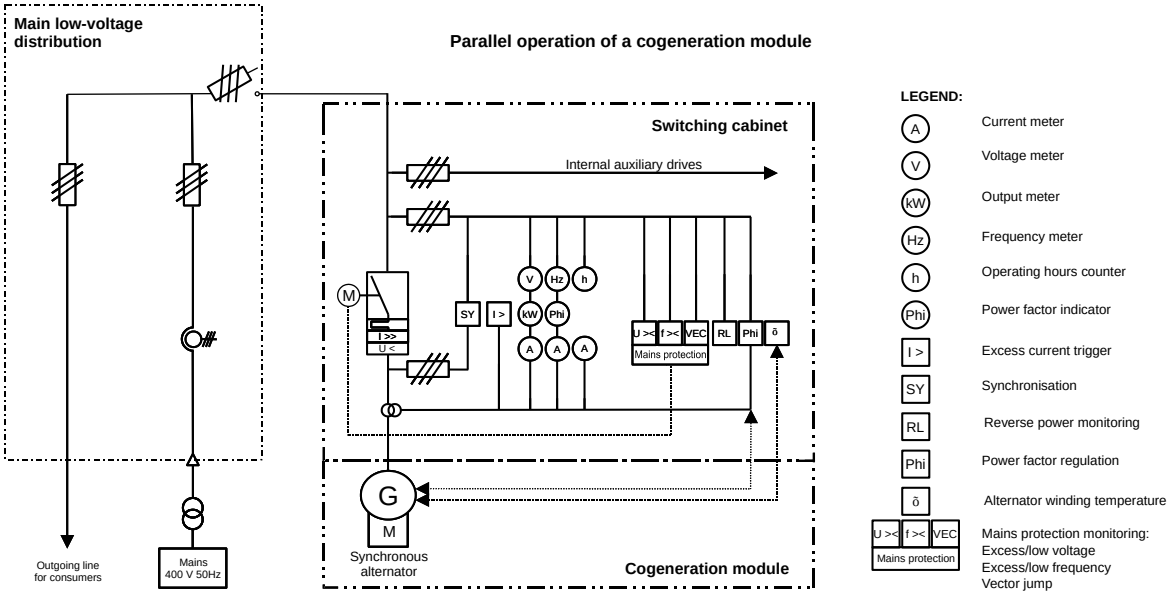

Fig. 4 Main wiring diagram of the electrical connection for mains parallel mode

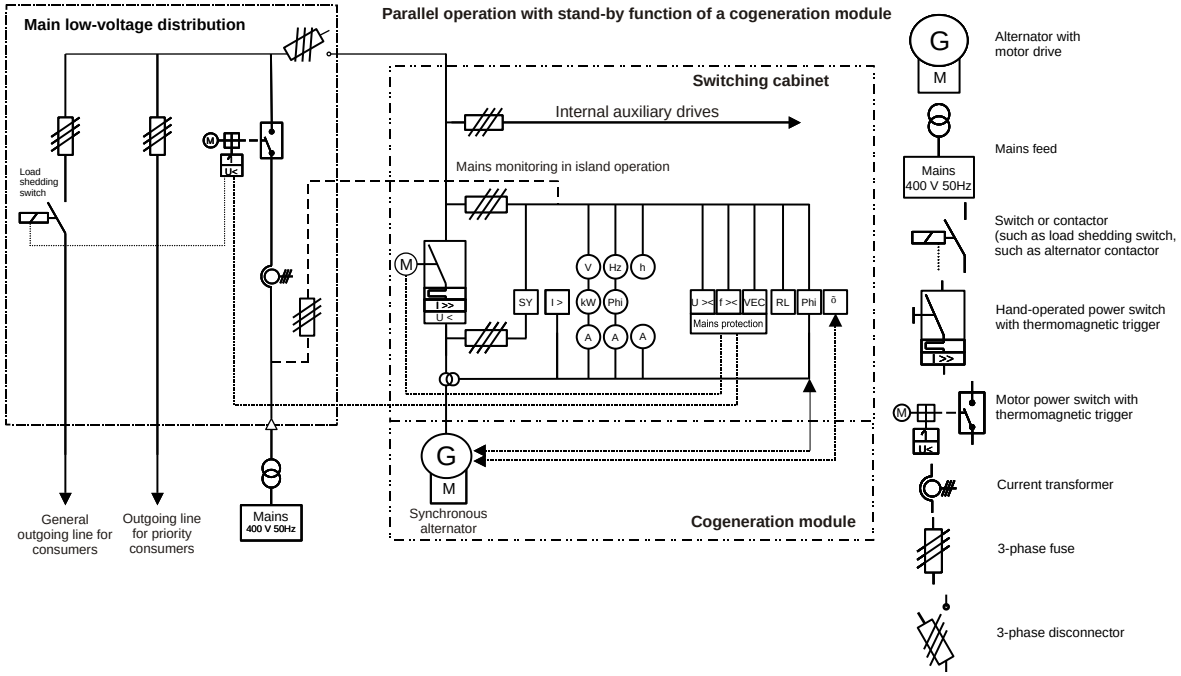

Fig. 5 Main wiring diagram of the electrical connection for mains parallel and mains substitution mode

2.2.14 Mains substitution mode checklist

When designing CHP systems in mains substitution mode, the following points should be clarified and coordinated with the CHP unit manufacturer:

- Operating method of the mains substitution system?
  At least one single-line diagram must be provided for clarity. The switches triggered by the CHP unit must be indicated or labelled on the diagram.
- Which loads to supply?
  A list of the heaviest users with details of outputs and currents must be provided. The CHP unit manufacturer will use these to establish the permissible load connections. If necessary after clarification, a load shedding circuit should be provided on site.
- Protective measure: Selectivity of the fuses must be checked on site.
- The maximum permissible heating water return temperature in CHP systems for mains substitution mode is 65 °C. These CHP systems are therefore not suitable for supplying absorption refrigeration units.
- If an external exhaust gas heat exchanger is installed in the heating network as a separate heat generator rather than in series with the CHP unit, the secondary flow through the exhaust gas heat exchanger must also be ensured in the case of mains substitution mode.
- The main gas solenoid valve, the mains coupling switch and the corresponding shunt release must be equipped with a power supply that has battery back-up.
  A 230 V power supply for the main gas solenoid valve or the mains coupling switch is not permissible!
  The main gas solenoid valve and the drive of the mains coupling switch are not supplied by the CHP unit!
- Actuation and feedback of the switches are set up with the on-site electrician and the CHP unit supplier.
- If the on-site higher ranking control unit cannot perform a fault-free restart after a mains failure, the fault messages from the on-site systems, such as those for heating or ventilation, can cause the CHP unit to shut down, for example by reducing heat consumption. In this case the higher ranking control unit should be equipped with a separate uninterruptible power supply (UPS).
- Mains substitution mode should be tested with all participants immediately following CHP unit commissioning. If this is not possible, a separate appointment billable at cost will be required.
- The supply of a sprinkler pump is subject to strict VdS regulations and cannot be guaranteed with the standard version CHP unit.
- When using several CHP units at once in mains substitution mode, a suitable management system (e.g. MMM – multi module management) with active load distribution should be provided.
- Connection of the CHP unit to an available backup diesel generator is not recommended due to the different control characteristics of gas and diesel engines! It would require the backup diesel generator to be technically suitable for parallel mode alongside other generators (e.g. controllable generator voltage, digital inputs for active load distribution to the diesel generator control unit).

3 Service and maintenance

Consequential operating costs arise for the CHP unit, relating to inspection, servicing and corrective maintenance.

Due to its intended use, the CHP unit is exposed to various influences, such as wear, ageing, corrosion, and thermal and mechanical loads. These are all referred to in DIN 31051 as "wear". Components of the CHP unit are designed with a wear margin that ensures reliable operation of the CHP system in accordance with the operating conditions up to impairment of the functional capability. Once this point has been reached, these parts – differentiated into wearing parts and parts with a finite service life – must be replaced.

CAUTION!

Maintenance should be carried out at least once a year and the coolant should be changed after 2 years at the latest.

CAUTION!

Proper servicing of the CHP unit may only be carried out by authorised personnel. Use only original spare parts and operating fluids (lubricating oil) approved by the CHP unit manufacturer. The operator is responsible for safeguarding and observing the regulations regarding operating fluids.

NOTE!

The expected service life of the CHP unit is at least 10 years, provided that regular service and maintenance work is carried out.

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4 Specification

All the following design and operating data relates to one CHP unit.

Detailed information regarding design and implementation can be found in the "Technical series natural gas CHP unit – Technical guide".

4.1 CHP unit operating parameters

4.1.1 Outputs and efficiencies

CHP unit outputs and efficiencies				**Vitobloc 200**	
Continuous output[1] in mains parallel mode			**Versions**	**EM-530/660 SCR**	**EM-530/660 SCR-ready**
Electrical output [2]	Cannot be overloaded	100 % load	kW	505	515
		75 % load	kW	380	386
		50 % load	kW	253	258
Heating output, high temperature [3]	Tolerance 7 %	100 % load	kW	321	339
		75 % load	kW	261	277
		50 % load	kW	206	197
Heating output, low temperature [3]	Tolerance 7 %	100 % load	kW	40	44
		75 % load	kW	29	31
		50 % load	kW	19	20
Fuel use	Tolerance 5 %	100 % load	kW	1258	1316
(at Hi [net cv] = 10 kWh/m³)		75 % load	kW	965	1003
		50 % load	kW	681	710
Power index according to AGFW FW308 (electrical output/thermal output)				1.545	1.492
Primary energy factor f_{PE} as per DIN V 18599-9 [4]				-0.014	0.092
Primary energy savings PEE as per directive 2012/27/EU (verification of high efficiency)			%	13.80	12.32
Efficiency as per EnergieStV [5]			%	72.4	70.9
Efficiency in mains parallel mode					
Electrical efficiency		100 % load	%	40.1	39.1
		75 % load	%	39.4	38.5
		50 % load	%	37.2	36.3
Heat efficiency high temperature		100 % load	%	25.5	25.8
		75 % load	%	27.0	27.6
		50 % load	%	30.2	27.7
Heat efficiency low temperature		100 % load	%	3.2	3.3
		75 % load	%	3.0	3.1
		50 % load	%	2.8	2.8
Overall efficiency		100 % load	%	65.7	64.9
		75 % load	%	66.4	66.1
		50 % load	%	67.4	64.1

1) Output ratings according to ISO 3046 Part 1
(at air pressure 1000 mbar, air temperature 25 °C, relative humidity 30 % and cos φ = 1)
All further unit data applies to mains parallel mode; data for other installation conditions on request
2) The output indicated on the display is based on the generator reference arrow system and not the consumer reference arrow system, i.e. when outputting power (exporting), the output on the display is prefixed by a plus sign!
3) Measured at a heating water return temperature of 65 °C
4) Calculation acc. to DIN V 18599-9 with primary energy factor for natural gas/LPG of 1.1 and for electricity of 2.8 (EnEV 2014).
The CHP coverage is assumed to be 1.0.
5) The efficiency according to the [German] Energy Tax Implementation Ordinance (EnergieStV) is defined as the ratio of the total thermal and mechanical output generated to the total energy and auxiliary energy consumed.

Tab. 3 Operating parameters, CHP unit – outputs and efficiencies

Specification

4.1.2 Operating parameters, energy

Operating parameters, energy				Vitobloc 200	
Heat generation (heating)			**Versions**	**EM-530/660 SCR**	**EM-530/660 SCR-ready**
Return temperature upstream of unit		Min./max.	°C	65/75	
Standard temperature differential		Return/flow	K	20	
Flow temperature [1]		Min./max.	°C	84/86	
Heating water flow rate		At flow/return = 85/65 °C	m³/h	14.2	14.9
		At flow/return = 85/75 °C	m³/h	27.6	29.2
Highest permissible operating pressure			bar	10	
Pressure drop at standard flow rate (ΔT = 20 K) in the unit			mbar	50	55
Pressure drop incl. connection hoses [2]			mbar	55	60
Mixture cooling, low temperature					
Coolant temperature		Inlet max.	°C	42	
Coolant flow rate			m³/h	6.8	7.5
Highest permissible operating pressure			bar	3	
Pressure drop in the unit			mbar	375	382
Pressure drop incl. connection hoses			mbar	385	395
Electrical energy (power-generating unit)					
Rated voltage			V	400	
Rated current I_n	cos φ = 1		A	729	743
Rated current (AC) I_r			A	811	827
Frequency			Hz	50	50
Apparent power $S_{e.max}$	cos φ = 0.9		kVA	561	572
Electrical output at	cos φ = 1 and U_n		kW	505	515
	cos φ = 0.95 and U_n		kW	505	515
	cos φ = 1 and U_n - 10 %		kW	505	515
	cos φ = 0.95 and U_n - 10 %		kW	505	515
Power consumption [3]	Rated/max.		kW	9.2/13.5	9.1/13.2

1) If using an optional exhaust gas heat exchanger (e.g. in series), significantly higher flow temperatures can be achieved
2) If using an optional exhaust gas heat exchanger, additional pressure drops must be taken into account (depending on the hydraulic connection)
3) Coolant pump, fan, battery charger, control transformer

Tab. 4 Operating parameters, energy

4.1.3 Operating fluids and capacities

Operating fluids and capacities			Vitobloc 200	
	Versions		EM-530/660 SCR	EM-530/660 SCR-ready
Properties of fuel, lubricating oil, coolant and heating water			See latest operating regulations!	
Refrigerant charge	Lubricating oil	litres	102	
	Additional tank for recirculating oil lubrication	litres	150	
	Coolant	litres	100	
	Heating water	litres	50	
	AdBlue™ intermediate tank	litres	40	–
	AdBlue™ dosing quantity	kg/h	1.6	–
Gas supply pressure [1]		mbar	30 - 50	
Compressed air (min. 1 barg)		slpm	20	–
Compressed air supply		barg	6-10	–

1) The gas supply pressure is equal to the gas flow pressure at the start of the unit's gas control path, in accordance with DVGW-TRGI 1986/96

Tab. 5 Operating fluids and capacities

4.1.4 Emissions

Operating parameters, CHP unit emissions			Vitobloc 200	
Emissions at 100 % load [1]			EM-530/660 SCR	EM-530/660 SCR-ready
NOx content (measured as NO_2)		mg/Nm³	< 100	< 250
CO content		mg/Nm³	< 100	
Formaldehyde CH_2O		mg/Nm³	< 20	
NH_3 content		mg/Nm³	< 10	
THC		mg/Nm³	< 1300	
Sound emissions Sound pressure level at 1 m distance in the open to DIN 45635 (tolerance to specified values 3 dB(A))				
Exhaust gas [2]	With optional exhaust gas heat exchanger and 1 optional silencer	dB(A)	75	
Unit	With silencer hood	dB(A)	90	
	Without silencer hood	dB(A)	99	

1) Emission values downstream of catalytic converter based on dry exhaust gas and 5 % residual oxygen by volume
2) If installing the CHP unit in the living space, we strongly recommend the use of 2 consecutive exhaust gas silencers in order to meet the requirements of rooms requiring particular protection (at night 25 dB(A)).

Tab. 6 Operating parameters, CHP unit emissions

4.1.5 Ventilation and exhaust gas

Ventilation and exhaust gas			Vitobloc 200	
Combustion air and ventilation			**EM-530/660 SCR**	**EM-530/660 SCR-ready**
Radiated heat of the unit	Without connecting cable	kW	84.4	91.8
Installation room ventilation	Nominal supply air flow rate at 30 °C supply air temperature	m³/h	20,163	20,786
	Combustion air flow rate at 30 °C supply air temperature	m³/h	2163	2286
	Nominal extract air flow rate at 30 °C supply air temperature	m³/h	18,000	18,500
	Extract air flow at ΔT = 30 K ($T_{Supply\ air}$ = 25 °C / $T_{Extract\ air\ max.}$ = 55 °C)	m³/h	9516	10,351
Residual pressure of extract air fan	at nominal extract air flow rate	Pa	250	
Supply air temperature	Min./max.	°C	10 / 35 [1)]	
Exhaust gas				
Exhaust gas mass flow rate, humid		kg/h	2750	2848
Exhaust gas flow rate, dry	0 % O_2 (0 °C; 1012 mbar)	Nm³/h	2200	2277
Max. permissible back pressure	Downstream of unit	mbar	25	25
Exhaust gas temperature	Max.	°C	480	500

1) Ambient temperature no higher than 35 °C and its average over a period of 24 hours no higher than 30 °C

Tab. 7 General operating parameters, ventilation and exhaust gas

4.2 Specification

4.2.1 Engine and generator

Specification			Vitobloc 200 EM-530/660 SCR EM-530/660 SCR-ready
Engine with accessories			
4-stroke gas engine	Manufacturer		MAN
	Engine type		E 3262 LE 202
Standard output [1]	Cannot be overloaded	kW	550
Lubricating oil consumption	Average value/max.	g/h	80/180
Synchronous generator			
Generator type			LSA 49.3 M8
Rated apparent power S_n	cos φ = 0.8	kVA	760
Three-phase current	Voltage/frequency	V / Hz	400/50
Speed		rpm	1500
Efficiency at rated output of the unit and cos φ = 1 [2]		%	96.0
Rated current	cos φ = 0.8	A	1097
Sub-transient short-circuit current I''_k Initial short-circuit alternating current as per EN 60909-0 (VDE 0102)		A	8899
Continuous short-circuit current I_k		A	3291
Max. permissible load connection		A	200
Stator connection			Star
IP rating			IP 23

1) Output ratings according to ISO 3046 Part 1
(at air pressure 1000 mbar, air temperature 25 °C, relative humidity 30 % and cos φ = 1)
All further unit data applies to mains parallel mode; data for other installation conditions on request
2) cos φ display value in generator reference arrow system

Tab. 8 Specification, engine and generator

4.2.2 Electrical connection (recommendation)

Cables to CHP unit terminal box		
Fuse rating NSHV (recommendation)	A	1000
Minimum required configuration for proper connection of CHP system [1]		
Power supply to NSHV, grid coupling section or transformer station	X1: L1,L2,L3, N PE	H07 RNF 5 x 3 x 240 mm²
On-site long-range selection **"Heating mode" 100 % output**	X1: Terminal 40 / 41	Ölflex 12 x 1.5 mm²
Unit feedback (floating contact) **"Ready"**	X5: Terminal 1 / 2	
Feedback (floating contact) unit **"Operating"**	X5: Terminal 3 / 4	
Unit feedback (floating contact) **"Error"**	X5: Terminal 5 / 6	
Selection **heating water pump** (floating contact)	X5: Terminal 9 / 10	
Heating water control valve (return temperature raising)	X5: Terminal 16 / 17 / 18 / PE	Ölflex 4 x 0.75 mm²
Coolant mixture control valve	X7: Terminal 1 / 2 / 3 / PE	Ölflex 4 x 0.75 mm²
Heating water pump 230 V or 400 V / 10 A	X5: Terminal 21 / N / PE (230 V) X5: Terminal 33/34/35/PE (400 V)	Ölflex 3 x 1.5 mm² Ölflex 5 x 1.5 mm²
Coolant mixture pump	X5: Terminal 36 / N / PE	Ölflex 3 x 1.5 mm²
Additional Pt100 sensor in **heating water return** for optional unit selection and deselection	X1: Terminal 44 / 45	Ölflex 2 x 1.5 mm²
Earth cable from unit to on-site equipotential busbar	Earth connection on unit frame	Sizing according to on-site conditions
Mains coupling switch on the system side		
Measured mains voltage upstream of mains coupling switch	X1: Terminal 7 / 8 / 9 / N / PE	Ölflex 5 x 1.5 mm²
Mains coupling switch feedback is on (Feedback from the NSHV or grid coupling section)	X1: Terminal 12 / 13	Ölflex 5 x 1.5 mm²
Mains coupling switch feedback is off (Feedback from the NSHV or grid coupling section)	X1: Terminal 14 / 15	
Selection of mains substitution mode [2]	X1: Terminal 38 / 39	Ölflex 3 x 1.5 mm²
Mains coupling switch activation "Enable mains coupling switch" (floating contact)	X5: Terminal 7 / 8	Ölflex 3 x 1.5 mm²
SCR-specific interfaces		
Control of SCR refill pump	X8: Terminal 9, N, PE	Ölflex 3 x 1.5 mm²
Control of lift protection valve	X8: Terminal 10, L-, PE	Ölflex 3 x 1.5 mm²
Compressor power supply	X8: Terminal 11, N, PE	Ölflex 3 x 1.5 mm²

1) This cable list contains the required minimum version for proper connection of a CHP system and serves merely as a guideline. The relevant power supply utility is responsible for correct wiring of the system, which must be carried out in accordance with the local conditions and applicable VDE and PSU regulations.

2) The selection for mains substitution mode is made by the external control system after the load has been disconnected on site. The selection can be automatically processed inside the unit, but without load shedding monitoring.

Tab. 9 Complete CHP unit specification

CAUTION!

The mains coupling switch on the system side is enabled for start-up by the CHP unit controller.
If the CHP unit circuit breaker fails, the CHP unit is disconnected from the mains via the system-side mains coupling switch!

4.3 Dimensions, weights and colours

CHP unit dimensions			Frame size	Incl. silencer hood and extract air fan[1)]
Length incl. control panel		mm	3982	4834
Width		mm	1600	1652
Height		mm	2000	2114
CHP unit weight				
Dry weight	(approx.)	kg	7300	
Operating weight	(approx.)	kg	7750	
Colours				
Engine, generator			Light grey (RAL 7035)	
Frame			Anthracite grey (RAL 7016)	
Control panel			Vitosilver	
Silencer hood			Vitosilver	

Connections		Version	Standard	Size
AGA	Exhaust gas outlet	Flange	EN 1092-1	DN 250 / PN 10
GAS	Gas inlet	Flange	EN 1092-1	DN 65 / PN 16
HV/HR	Heating flow/return	Flange	EN 1092-1	DN 80 / PN 16
GKV/GKR	Mixture coolant flow/return	Pipe connector	EN 10226	R 2" male thread
AL	Extract air outlet	Flange	—	700 x 700 P20
UR	Urea inlet	Cable gland	—	M50x1.5
DL	Compressed air inlet	Cable gland	—	M20x1.5
Electrical connections and earthing (as per installation instructions)		Sizing as per local conditions and current VDE and power supply utility regulations (see Tab. 9 for a recommendation)		

[1)] *The Vitobloc 200 EM-530 SCR CHP unit is optionally available with silencer hood and extract air fan.*

Tab. 10 Dimensions, weights, colours and connections

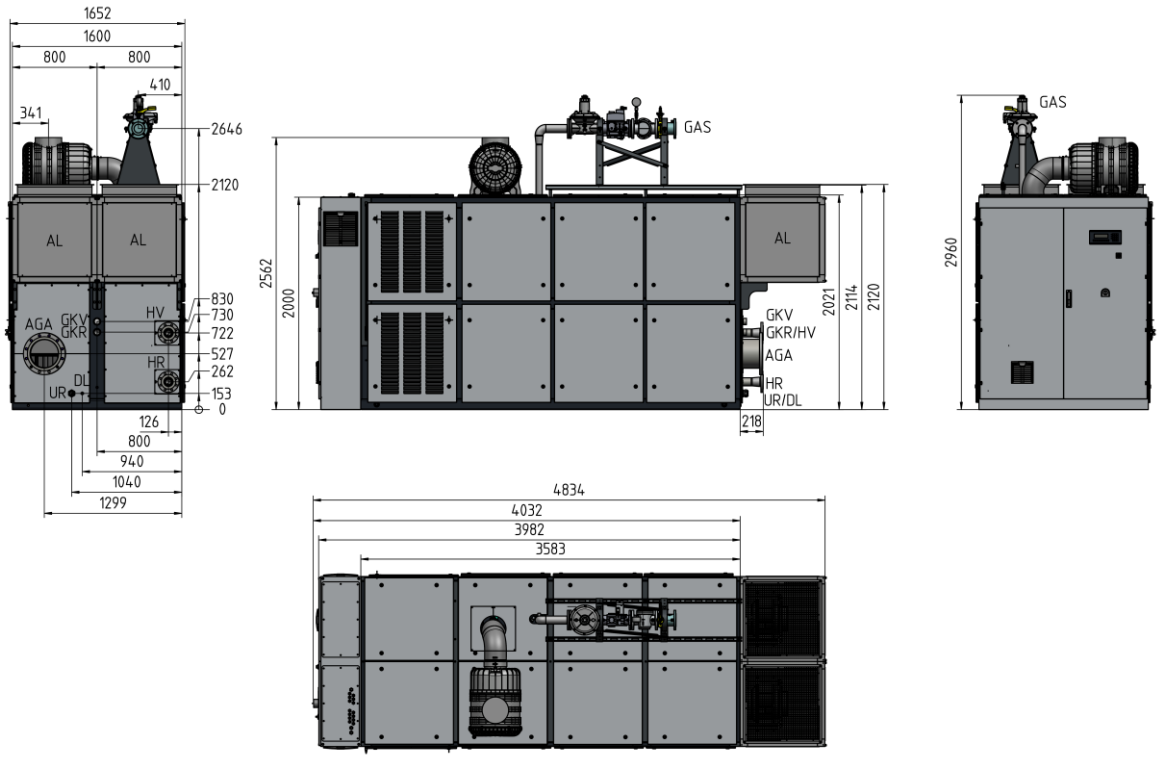

Fig. 6 Dimensions and connections of the Vitobloc 200 EM-530 SCR CHP unit with optional silencer hood (dimensions in mm); the pre-installed fan box at the back can be removed to facilitate transport of the unit to its installation location.

4.4 Siting

Detailed information regarding implementation can be found in "Technical series natural gas CHP unit – Technical guide" and the corresponding installation instructions.

Observe the following points when siting the CHP unit:

- The installation room must be configured in accordance with the applicable combustion ordinance and applicable building ordinances/regulations. For safe operation, it is recommended that the CHP unit be integrated into the relevant fire protection concept.
- To increase safety for operating personnel, we recommend installing gas, smoke and CO detectors in the installation room.
- For operating and servicing purposes, maintain a clearance as shown in the installation diagram on page 25.
- For maintenance work, a drain & fill valve (e.g. ½" BDF valve) and an air vent valve must be installed on site in the heating water flow and the heating water return respectively, both in the immediate vicinity of the CHP unit.
- The dimensions apply up to a straight pipe length of 10 m – otherwise it will be necessary to perform a separate calculation.
- We recommend designing the gas connection line of the CHP system to be larger in order to use this section as buffer storage. This allows pressure fluctuations to be absorbed when boilers are switched on and off.
- We recommend using a calibrated gas meter, type G100.
- The optional extract fan box can be removed for easier transportation of the CHP unit. If this will be necessary, please let us know in good time before delivery.
- Temperatures below the dew point in the exhaust gas system must be prevented. Condensate that is produced must be continuously drained off. Provide a hydraulic seal at the condensate drain. For systems with multiple units, separate exhaust gas routing is recommended for each CHP unit. If using an exhaust gas header, the back flow of exhaust gas into idle CHP units must be reliably prevented by a 100 % gas-tight motorised shut-off damper for each unit.
- If the heating water return temperature is below the minimum permissible value (see specification), a return temperature raising facility is required.
  A separate return temperature raising facility must be provided for the low temperature mixture cooling circuit.

4.5 Start/stop ratio

The unit should be operational for 180 min per start (ratio of hours run to starts approx. 3:1).
Premature wear of the starting equipment caused by shorter operation times is a result of operating conditions, and is not a fault.

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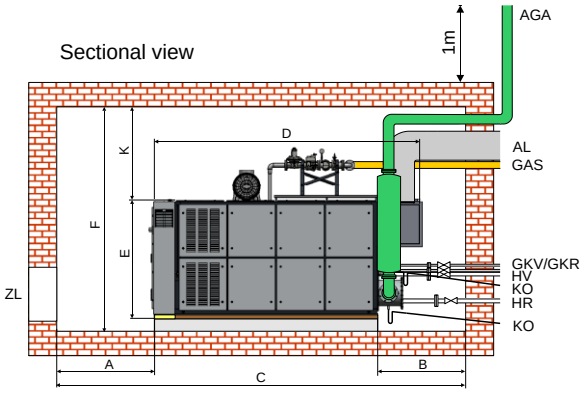
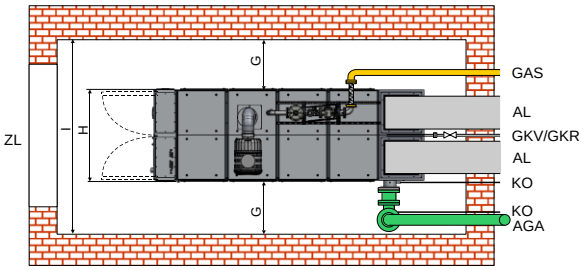
Specification

Siting in the plant room





Key:

AGA	*Exhaust gas*	*HR*	*Heating water return*
AL	*Extract air*	*HV*	*Heating water flow*
GAS	*Natural gas*	*KO*	*Condensate*
ZL	*Supply air*		

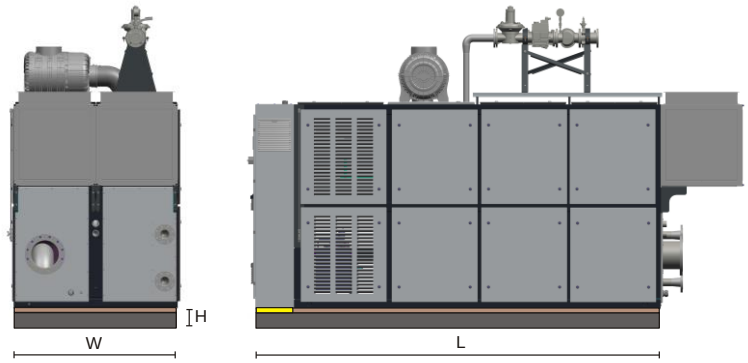
Fig. 7 Sample installation designs – depiction without fittings and safety equipment (dimensions in mm)

Fig. 7		Comments
A	2000 mm	Not installed
B	2000 mm	Recommendation
C	8000 mm	
D	4850 mm	
E	2070 mm	
F	3800 mm	
G	1500 mm	Not installed
H	1650 mm	
I	4650 mm	
K	1500 mm	Not installed

Tab. 11 Installation dimensions

Designation	L x W x H [mm]
AdBlue™ storage tank (e.g. 1000 litres IBC)	1200 x 1200 x 1200
Air compressor; not required if there is a compressed air supply on site	500 x 500 x 500
Exhaust gas heat exchanger, horizontal	3100 x 1000 x 1000
Exhaust gas heat exchanger, vertical	1000 x 1000 x 3100

Tab. 12 Space required for additional components (guide values; actual sizing may differ)



Minimum base dimensions
Vitobloc 200 EM-530 SCR
L 4000 mm
W 1600 mm
H 150 mm

Fig. 8 CHP unit with base

5 General design and operating information

Observing the following points will improve operational reliability.
Faults and consequential losses resulting from prohibited operating conditions are not covered by the warranty or any service contract.

Design

- Avoid cyclical on/off operation and provide a buffer store if necessary:
  $V_{buffer} = Q_{th} \times 43\ l/kW_{th}$ (minimum buffer size)
- The ratio of hours run to starts relative to average runtime must be greater than 3, i.e. after 3000 hours runtime, the unit should have started less than 1000 times.

Installation room

- Install exhaust gas and extract air silencers in buildings where noise levels are critical; always factor in flexible connections (expansion joints).
- Ensure correct sizing and routing of the extract air and exhaust pipes (pressure drops, nominal diameters, flow noise).
- Use anti-vibration elements during installation to prevent structure-borne noise.

DANGER!

Do not install in the same room as a boiler system with atmospheric burner or an NH_3 refrigeration unit.

Heating

- Ensure a constant, adequate heating water flow rate.
- The heating water quality must at least meet the requirements of VDI 2035.
- The CHP unit must be protected from sludge from the existing heating system. It is recommended that a dirt trap and a dirt separator be installed in the return to the CHP unit.
- Prevent fault shutdowns due to excessive heating water return temperatures. The heating water return temperature must not exceed the permissible value in either mains substitution mode or mains parallel mode.
- With heating water return temperatures of less than the min. value according to the specification (section 4.1.2), a return temperature raising facility should be installed, as near as possible to the CHP unit.
- The mains substitution function does not apply in conjunction with operation of an absorption refrigeration system.
- If the optional exhaust gas heat exchanger is installed in the heating network, higher heating water quality must be ensured (see description of accessories).

Exhaust gas

- Size the exhaust gas cross-section adequately.
- In the case of prefabricated systems, the exhaust system must be type-approved, pressure-tight and **pulsation-proof up to 50 mbar**. At this test pressure, leakage must not exceed 0.006 l/m³s (corresponds to H1).
- For the condensate, provide an unrestricted drain with a fall of at least 3 %, which must be installed above the trap (U-bend) at a height of min. 250 mm to prevent exhaust gas escaping through it.
- Hydraulic seals must be designed so that the water level can be checked and topped up. The condensate drain pipe must be checked regularly for obstructions and to see if there is a sufficient hydraulic seal.
- Observe the exhaust system installation instructions for the Vitobloc 200.
- If installing the CHP unit in the living space, we strongly recommend use of 2 consecutive exhaust gas silencers in order to meet the requirements of rooms requiring particular protection (at night 25 dB(A)).

Ventilation

- Ensure non-preheated and dust, sulphur & halogen-free cooling and combustion air.
- Ensure an adequate supply of fresh air and that extract air is discharged securely.
- In the case of air containing chlorine (e.g. in swimming pools), provide a separate supply air intake.

Fuel

- Ensure a gas flow pressure of 30 mbar to 50 mbar and a methane number ≥ 80.
- Recommendation: Oversize the gas supply pipe to create a pressure buffer with double the diameter approx. 5 m upstream of the CHP system.
- Optional gas volumeters mostly measure operating cubic metres: These values must be converted according to DVGW-TRGI G 600 guidelines into standard cubic metres ("z number").

Electrics

- The CHP unit generates 400 V of power. For safety reasons, it has sensitive electrical mains protection systems, which respond according to regulations to asynchronous network loads in the customer network. Safety shutdowns do not constitute a CHP unit fault.

CAUTION!

The mains coupling switch on the system side is enabled for start-up by the CHP unit controller.
If the CHP unit circuit breaker fails, the CHP unit is disconnected from the mains via the system-side mains coupling switch!

- Incorrect sizing of the electrical loads in mains substitution mode can lead to fault shutdowns due to overload (inductive or capacitive start-up currents carry up to 20 times the rated current and lead to overloading of the CHP unit!).
- Always avoid shutting down at full load, as this would subject the components to the highest mechanical loads.
- CHP units **must** be connected to the on-site equipotential busbar via an earth cable (for earth connection, see the installation instructions).

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Maintenance + operating fluids

- Regular servicing and maintenance by qualified personnel. We recommend a service contract.
- An external AdBlue™ storage tank must be provided for continuous operation. Care must be taken to avoid direct contact with sunlight. AdBlue™ freezes at -11 °C and should not be kept above 25 °C for any extended period.
- According to the [German] Hazardous Substances Ordinance, AdBlue™ is a harmless chemical substance.
- The SCR system requires a permanent, external supply of compressed air. The compressed air can be provided either through an air compressor or from a compressed air network (air quality at least as per ISO 8573-1:2010 [4:-:4]).
- Elimination of drip leaks, proper disposal of used oil, regular checking of exhaust gas condensate lines for correct function.
- During longer idle periods, disconnect the batteries when decommissioning the unit and, in the case of shutdowns lasting longer than 12 weeks, perform a warranty preservation.
- Perform the warranty preservation no later than 24 weeks after delivery.

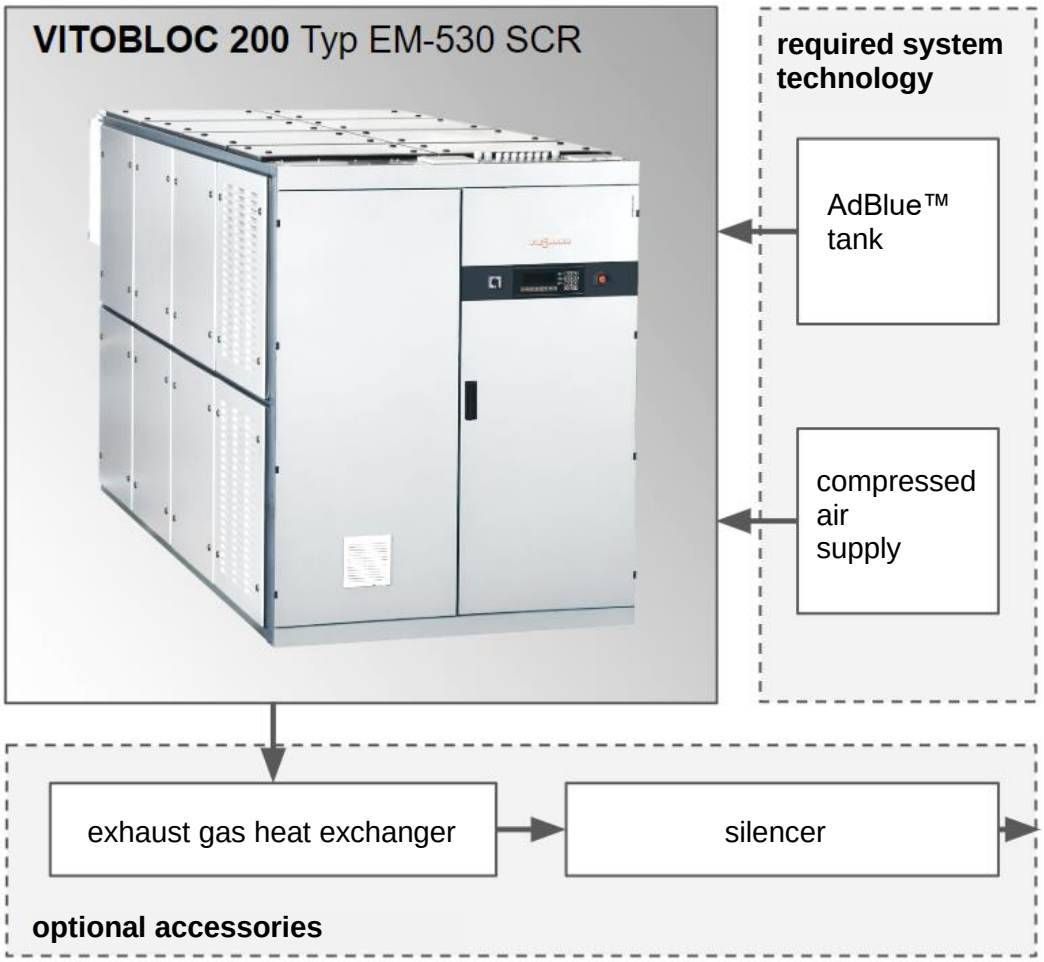

Fig. 9 Schematic overview of components that are required or optional for operation of the CHP unit with SCR exhaust gas post-treatment system.

6 Keyword index

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7 Declaration of Conformity

EU-Konformitätserklärung

VIESMANN

Vitobloc 200

Blockheizkraftwerk (BHKW) mit Schaltschrank für Erdgasbetrieb

Vitobloc 200 folgende Typen:

EM-50/81	**EM-199/293**
EM-70/115	**EM-238/363**
EM-100/167	**EM-260/390**
EM-100/173	**EM-363/498**
EM-140/207	**EM-401/549**
EM-199/263	**EM-530/660**

Wir, die Viessmann Werke GmbH & Co. KG, D-35107 Allendorf, erklären in alleiniger Verantwortung, dass die bezeichneten Produkte die Bestimmungen folgender Richtlinien und Verordnungen erfüllen:

EU 2016/426	Gasgeräteverordnung
2006/42/EG	Maschinenrichtlinie
2014/30/EU	EMV-Richtlinie
2014/35/EU	Niederspannungsrichtlinie

Angewandte Normen:

ISO 12100:2011	EN 61439-1:2012 (VDE 0660-600-1:2012)
ISO 13857:2008	EN 61439-2:2012 (VDE 0660-600-2:2012)
EN 437:2009-09	VDE 0100 Beiblatt 2:2001
EN 762-2:2011	VDE 0100 Teil 410:2007
EN 1443:2003	VDE 0100 Teil 420:2016
DIN 6280-14:1997	VDE 0100 Teil 430:2010
DIN 6280-15:1997	VDE 0100 Teil 450:1990
EN 55011: 2017	VDE 0100 Teil 460:2015
EN 61000-6-2:2006	VDE 0100 Teil 510:2014
EN 60204-1:2014	VDE 0100 Teil 520:2013
EN 60034-1:2011	VDE 0100 Teil 560:2013
EN 60034-5:2007	VDE 0100 Teil 600:2017

Gemäß den Bestimmungen der genannten Richtlinien wird dieses Produkt mit
CE - 0433 gekennzeichnet.

Allendorf, den 15. Mai 2018

Viessmann Werke GmbH & Co. KG

ppa. Reiner Jansen
Leiter Strategisches Qualitätsmanagement

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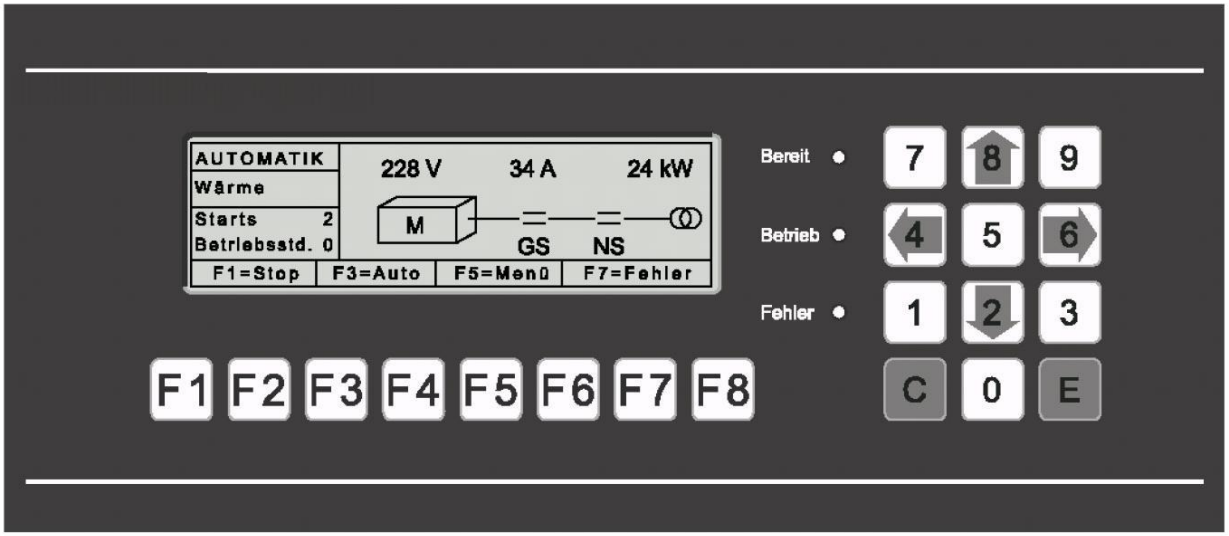
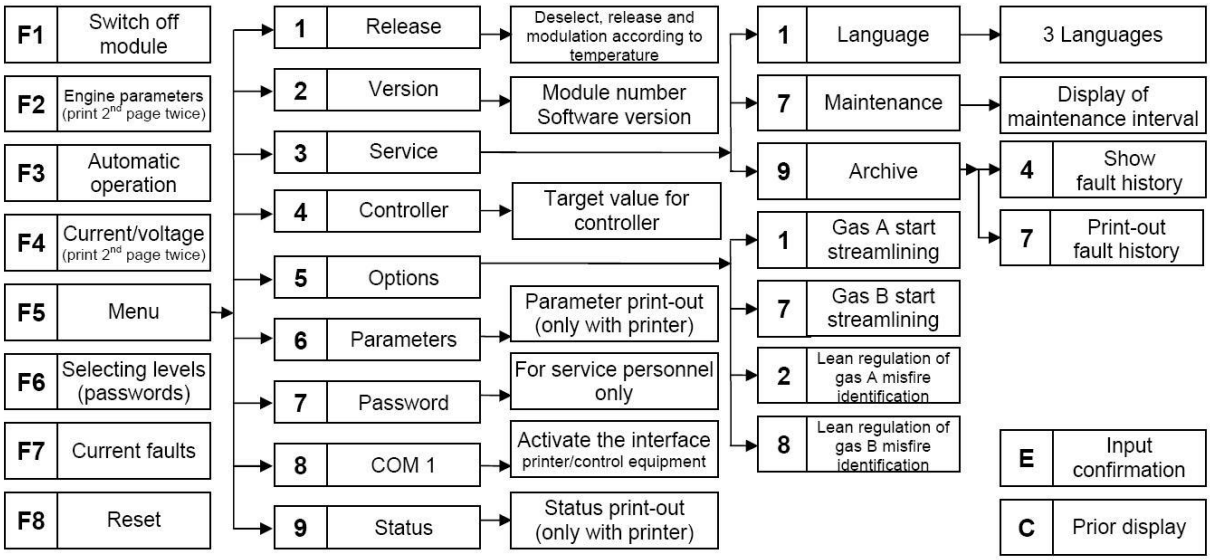
8 Getting started





Fault menu messages:	0	no reaction	3	Soft shut down
	1	Warning	4	Immediate shutdown
	2	Performance drop 20%		

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Notes

Applicability

7727282	Vitobloc 200 EM-530/660, SCR version
7727283	Vitobloc 200 EM-530/660, SCR-ready version

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