VITOBLOC 200

Block-type thermal power plant – electricity and heat
from natural gas and biogas
Very efficient due to cogeneration
Total efficiency 96%
Primary energy savings to 30,74%

Technical Description
CHP switching cabinet

VITOBLOC 200

Block-type thermal power plant for natural gas operation
pursuant to the requirements of the EU Gas Equipment Directive and EU Machine Directive

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

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Please keep for later reference.

Legal notice

This equipment satisfies the basic requirements of the appropriate standards and directives. Its conformity has been demonstrated. These documents and the original conformity declaration are stored on the premises of the manufacturer.

NOTE

The Vitobloc 200 cogeneration module is not suited to 60 Hz operation which means that it is in particular not available to the American and Canadian market.

Important general instructions for application

Only use this technical equipment as intended and complying with the assembly instructions, operating instructions and service instructions. Only authorised professionals should service and repair it.

Only operate this technical equipment in the combinations and with the accessories and replacement parts referred to in the assembly instructions, operating instructions and service instructions. Only use other combinations, accessories and wear parts if they are explicitly intended for the specific application and do not impair the performance features or safety requirements.

Subject to change without notice.

This is a component of the original operating instructions.

Figures, steps in certain functions and technical data may differ slightly due to constant advancements.

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1 Switching cabinet

1.1 Utilisation

This cogeneration switchgear is equipped with a control, output and auxiliary drive component and it is factory-tested together with the cogeneration module. The customer only has to connect the power cable (power current 400 V) of the standard version to the main low-voltage distribution. The outgoing cable unit should be secured with fuses and the customer should provide a contact for selecting or deselecting with the standard version that selects or deselects depending upon heat or power needs. Then the cogeneration module is automatically started by the internal cogeneration switchgear, switched to the mains and adjusted to the set or specified load output. The load adjustment can be either specified by an external analog signal (0/4–20 mA) or changed right on the cogeneration module. If there are malfunctions, the cogeneration module turns itself off automatically and the centralised fault indication is available potential-free for passing onto any control equipment of the customer. The customer then has to provide space ventilation and a heating water pump control system and return temperature increasing mechanism should also be provided. The pump is requested through a potential-free contact from the switchgear. The return control valve is supplied with 24 V~ and triggered with a 0–10-V signal.

1.2 Equipment and Dimensions

Equipment Vitobloc 200 CHP switching cabinet	**EM-50/81 EM-70/115 EM-100/173 EM-140/207**	**EM-199/263 EM-238/363 EM-260/390 EM-401/549 EM-530/660[1)]**
cogeneration switchgear 400/230 V, 50 Hz, cos φ = 1 (adjustable)	1-field	2-field
door	single door, catch on the right	double door, catch in the middle
door lock	8 mm square	8 mm square
protection class	IP 41	IP 41
coat of paint, structured lacquer	silver	silver

[1)] *one additional self-supporting control cubicle with one door, a generator switch and output counter*

Tab. 1 Equipment and dimensions

USER NOTE

Design in accordance with DIN VDE 0660, Part 500 and DIN 6280 Part 7, for ambient temperatures from 0° C to + 40° C and 70% relative humidity.

1.3 Displays and measurements

The display shows actual values, targets, limits and fault/status messages.

Display of electrical parameters	
1. alternator voltage (L1, L2, L3)	5. network frequency
2. mains voltage (L1, L2, L3)	6. actual cogeneration output
2. busbar voltage (L1, L2)	7. battery voltage
3. alternator current (L1, L2, L3)	8. reactive power factor cos φ
4. alternator frequency	
Display of engine parameters	
1. oil pressure	4. lambda probe voltage
2. cooling water temperature	5. heating water return temperature into the block-type thermal power plant (PT 100/2)
3. exhaust gas temperature A	6. total optional heating water return (PT 100/3)
Added potential engine parameters with modules with ANA 16 (EM-199/263, EM-238/363, EM-260/390, EM-401/549, EM-530/660)	
7. engine oil temperature (PT 100/4)	10. exhaust gas temperatures B / C / D
8. mixed gas temperature (PT 100/5)	11. load pressure (optional)
9. mixed cooling water temperature (PT 100/6)	
Display of fault messages	
1. emergency stop	25. synchronising malfunctioning
2. minimum oil level	26. speed < 50 / pick-up defective
3. minimum cooling water pressure	27. maximum oil level
4. minimum gas pressure	28. maximum return temperature PT 100/2
5. safety temperature limiter tripped	29. maximum heating water temperature PT 100/3
6. maximum alternator winding temperature	30. maximum output exceeded
7. maximum sound hood temperature	31. reverse power (delayed to 50% output – over 50% undelayed)
8. ventilator malfunctioning	32. power regulator malfunctioning
9. cooling water pump malfunctioning	33. lambda regulator malfunctioning
10. maximum exhaust gas counterpressure	34. alternator contact malfunctioning
11. feed switch tripped or turned off	35. ignition malfunctioning
12. external malfunction	36. oil pressure malfunctioning
13. overspeed	37. lambda starting position
14. cooling water temperature	48. knocking malfunction
15. maximum exhaust gas temperature A	54. safety shutdown
16. minimum exhaust gas temperature A	55. engine not stopped (speed > 50 Upm)
17. minimum oil pressure	56. battery low voltage
18. maximum gas pressure	57. alternator low voltage
19. heating water pump malfunctioning	58. alternator excess voltage
20. starting speed < 50 Upm	59. alternator excess current
21. ignition speed	60. alternator load unbalance
22. speed range not reached	61. sealing test / seal test malfunctioning
23. speed < 1,200 Upm	62. line protection malfunctioning
24. enabling malfunctioning	63. sensors malfunctioning

Added potential fault messages for modules with ANA 16 (EM-199/263, EM-238/363, EM-260/390, EM-401/549, EM-530/660)	
66. maximum exhaust gas temperature B	71. minimum exhaust gas temperature D
67. minimum exhaust gas temperature B	72. exhaust gas temperature difference A / B
68. maximum exhaust gas temperature C	76. excess engine temperature PT 100/4
69. minimum exhaust gas temperature C	77. excess gas mixture temperature PT 100/5
70. maximum exhaust gas temperature D	78. excess mixed cooling water temperature PT 100/6
General displays	
1. operating hours	3. messages on preliminary start conditions and mode
2. number of starts	

Tab. 2 Displays and measurements

1.4 Operating equipment

There are operating elements on the front plate (foil keyboard)

selector buttons for	visual display for
start-stop-manual-automatic	LED display malfunction
fault acknowledgement	LED ready for operation
alternator switch on/off	display alternator voltage
output higher/lower	display alternator frequency
keyboard for keying in the actual and targets values and limits	display alternator switch on
emergency-off button (resting, with key)	display mains switch on
Manual switch for	
manual-zero-automatic for selecting heat	

Tab. 3 Selector buttons, visual displays and manual switches

1.5 Power circuit

consisting of	Vitobloc 200					
	EM-50/81	EM-70/115	EM-100/173 EM-140/207	EM-199/263 EM-238/363 EM-260/390	EM-401/549	EM-530/660
4-pole power switch	160 A	160 A	250 A	630 A	1,000 A	1,000 A
3-pole alternator contact	55 kW	75 kW	160 kW	250 kW	400 kW	560 kW
3 special current transformers	120/0.05 A	120/0.05 A	300/0.05 A	500/0.05 A	800/0.05 A	3 times 1,000/5A and 5/0.05A

Tab. 4 Power circuit for various cogeneration modules

1.6 Control component

The control component is equipped with a fully automatic monitoring and control mechanism, 2 separate microprocessors for the start-stop process for parallel and stand-by operation including lambda regulation and line protection/mains monitoring. You can find a more detailed description in Chapter 2 (Control BMS 2007).

Software functions	
start/stop and monitoring program	
engine output regulation with start-up function for gentle engine loading/relief with adjustable ramp function	
relief control	
control function for fixed value/floating value control	
lambda regulation including triggering a control valve	
analog value processing of the following analog values for limits/switching values and control functions: – oil pressure, cooling water temperature, exhaust gas temperature, busbar voltage, alternator voltage – current (L1, L2, L 3), specified output, alternator output, lambda probe voltage – engine speed, battery voltage	
parametering triggering and release values and delay/release times	
triggering the coupling relay for controlling the driving machine, auxiliary drives and alternator	
synchronising	
separate password-protected access levels for EVU, parametering and manual operation	
controller for heating water return increasing mechanism including sensors (output signal 24 V~ / 0–10 V⎓)	
module release and deselecting in heat operation with added optional modulation tool with external Pt100 sensors in the overall heating water return to the block-type thermal power plant	
Analog box for	
battery voltage, Pt100, NiCrNi, mV, mA, speed, heating water return, lambda regulation, cooling water temperature	
Alternator protection, line protection and synchronising	
1. low alternator voltage	6. excess alternator temperature
2. excess alternator voltage	7. reverse power protection
3. low alternator frequency/speed	8. precision synchronising blocking relay
4. excess alternator frequency/speed	9. recording speed
5. excess alternator current/alternator short-circuit	
Guard function, 3-phase for recording mains failure in parallel operation for	
1. low/excess mains voltage	
2. low/excess mains frequency	
3. vector jump	
triggering and release values and the triggering and return delay can be parametered	
Potential-free contacts (transferred to terminal)	
1. block-type thermal power plant available	5. auxiliary drive requirement with after-run time
2. alternator switch on (cogeneration module in operation)	6. group alarm
3. mains failure	7. service message
4. external mains switch on/off	

Tab. 5 Control component, Part 1- software functions, measuring transducer, alternator protection, line protection, synchronising, guard function and potential-free contacts

Inputs (transferred to terminal)	
1. remote start with potential-free contact provided by the customer	3. analog signal (0–20 mA) for output regulation in current operation
2. external system malfunction with potential-free contact provided by the customer	4. external emergency-off with potential-free contact provided by the customer
5. Pt100 sensor input for selecting module with modulation after the heating/overall return temperature	
Data transmission	
Telecontrol LAN as standard, site-side connection	
Electronic machine log	
historical memory for recording the min-max-analog values for streamlining operation	
fault memory for undeletably recording complete fault chains with operation parameters for selective malfunction analysis	
OPTION remote monitoring	
Telecontrol GPRS / Network Connection	
the specified variant can be used to monitor the block-type thermal power plant via modem and analyse operating states	

Tab. 6 Control component, part 2 – inputs, data transmission, electronic machine log and remote monitoring

1.7 Auxiliary drive component

Functions
automatic battery charger (24 V, 18 or 40 A) according to the I/U characteristic curve for lead batteries (24 V)
control system for the sound hood exhaust ventilator cowl (0.5 kW-1.5 kW) or ventilator selected by the customer
control system for the cooling water pump (1 kW-2.5 kW)
control system for the gas lane with 2 magnetic valves (24 V, GS; >= 60 VA) and OPTIONAL seal check (24 V, GS)
triggering for lambda valve
transformer for special lambda heater (12 V~)
triggering for cos-φ-controller
control system for speed regulation
triggering for three-way valve (0–10 V) for heating water return increasing mechanism including supply (24 V~)
coupled time relay, contact, motor protection switch and fuses for controlling the driving machine, auxiliary drives and alternator switch-on
control system for the heating water pump (230 V, 6 A; optional 400 V)

Tab. 7 Auxiliary drive component - software functions

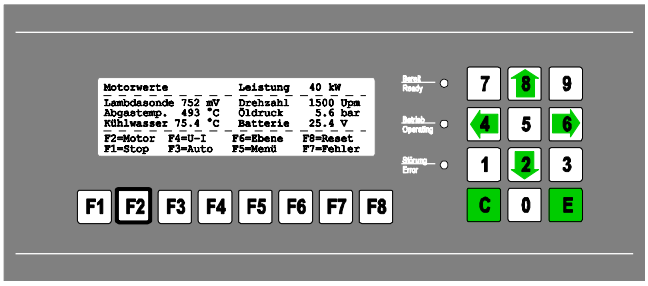
2 Control system (BMS 2007)

2.1 Operating and display panel

The operating and display panel consists of an LCD display with graphic capabilities, a resolution of 240 × 64 pixels and a foil keyboard. The LCD display shows measurements and operational/fault messages. The foil keyboard has eight function keys (F1–F8) that make it possible to directly impact the start-stop process and adjust target values via a numerical keypad.

2.1.1 Display

The basic image appears on the LCD display by showing the cogeneration module, alternator contact, system-tie circuit breaker and mains with a graph. The left-hand column shows the mode (off, automatic mode or manual mode), the selection (heat, current or stand-by operation) and operating hours/starts. In addition, it has a large display for the momentary mains voltage, alternator current (single-phase means) and electrical active power.



2.1.2 Foil keyboard

The control system is operated with the foil keyboard (numerical buttons and function keys F1–F8).

button	assignment
F1	stop
F2	engine (operational values)
F3	automatic
F4	U-I (voltage and current values)
F5	menu
F6	level (selecting levels 2, 3, EVU and FACTORY – only with password)
F7	fault messages
F8	reset fault acknowledgement

Tab. 8 Assignment of the function keys

Control system (BMS 2007)

F1 - stop	
The stop button runs down and stops the cogeneration module secured from all modes.	
F2 - engine	
speed	oil pressure
cooling water temperature	lambda probe voltage
exhaust gas temperature	battery voltage
F3 - automatic	
The automatic button passes the operation of the cogeneration module to module control.	
F4 - U-I (voltage and current values)	
mains voltage	active power
network frequency	cos φ
alternator voltage	
alternator frequency	
alternator current	
F5 - menu	
When you select the F5 key, you are in the menu and the numerical keypad enables you to call up the functions below:	
password	keying in the password, date and time
controller	keying in the target value and showing the actual value for the temperature controller
release	module, select and deselect parameters after release temperature / modulation (optional)
com	activating the interface for the printer, 3964 passive, 3964 active
option	other optional submenus
version	checking the module serial number and software version
status	print-out of the status of the present operational values
parameter	print-out of the parameters set in level 3 and EVU level
Service	submenu for service and fault archive
F6 - level	
When you key in a password for each level, you can reach the following levels with the F6 key:	
level 2	manual operation: manual mode, start, alternator release, speed or output higher/lower, manual cooling water pump operation, manual ventilator operation and min-max values
level 3	parametering: showing and changing all module parameters
EVU level	showing and changing all EVU parameters
FACTORY level	showing and changing all factory parameters
Specific passwords are only issued to authorised persons (such as start-up personnel, service personnel or operators).	

Tab. 9 Assignment of function keys , Part 1 – F1-F6

Service menu (submenu)	
There are the "service" and "archive" submenus in the service menu where you can read and set the following parameters.	
service interval	such as 1,800 hours adjustable with a password at the FACTORY level
module block	such as –200 hours adjustable with a password at the FACTORY level
prewarning time	such as 100 hours adjustable with a password at level 2
next service call	time to next service call
If the service interval is defined at 1,800 operating hours and the prewarning time is set to 100 hours (as an example), a screen saver appears with the message “service due in 100 hours” after 1,700 operating hours and it is constantly updated. The service technician deletes the message after the service call (password, level 2) and the next service interval is started. When a module block is activated (FACTORY level), the cogeneration module is automatically shut down and blocked after the service interval has been overrun 200 operating hours and this module block can only be deleted with a special password. As many as 8,000 of the last fault messages are shown in the archive menu. There is also the option of printing out the fault messages separately page for page where one page is 60 messages. You can also delete the archive with a password (FACTORY level).	
F7 – fault messages	
Pressing the F7 key shows the current faults with date and time. If a different menu is opened when a fault occurs, the display automatically jumps to the fault menu. You can acknowledge corrected faults with the F8 key.	
emergency stop	synchronising malfunctioning
minimum oil level	alternator low voltage
maximum oil level	alternator excess voltage
minimum cooling water pressure	alternator excess current
minimum gas pressure	alternator load unbalance
maximum gas pressure	maximum output exceeded
safety temperature limiter tripped	reverse power (delayed to 50% output – over 50% undelayed)
maximum alternator windings temperature	power regulator malfunctioning
maximum sound hood temperature	alternator contact malfunctioning
ignition malfunctioning	feed switch tripped or turned off
ventilator malfunctioning	system-tie circuit breaker not turned on
cooling water pump malfunctioning	lambda regulator malfunctioning
minimum oil pressure	external malfunction
oil pressure malfunctioning	battery low voltage
maximum cooling water temperature	network breakdown (message)
maximum temperature PT100/2	deselect after HZW return (message)
heating water control deselect	free after HZW return (message)
maximum exhaust gas temperature	lambda starting position
minimum exhaust gas temperature	engine not stopped
exhaust gas counterpressure too high (OPTIONAL)	line protection malfunctioning

Tab. 10 Assignment of function keys , Part 2 – service menu and F7

F7 – fault messages	
starting speed < 50 Upm	sensors malfunctioning
ignition speed	seal test malfunctioning (OPTIONAL)
speed range not reached	safety shutdown (OPTIONAL)
speed < 1,200 Upm	heating water pump malfunctioning (OPTIONAL)
overspeed	malfunction knocking (OPTIONAL)
speed < 50 / pick-up defective	past service date
enabling malfunctioning	
F8 – Reset, fault acknowledgement	
You can acknowledge corrected faults with the F8 key.	

Tab. 11 Assignment of function keys , Part 3 – F7 and F8

2.2 Analog measurement converter (analog box)

The analog measurement converter is installed directly in the area of the sensitive measuring points on the engine. It converts the special signals into a serial data protocol that is transmitted to the control unit via data line.

Measuring points	Signals to be converted
oil pressure	4–20 mA
cooling water temperature	PT 100
temperature heating water return PT 100/2	PT 100
heating water control deselect PT 100/3	PT 100
exhaust gas temperature A	NiCrNi
lambda probe voltage	0–50 mV
battery voltage	0–30 V⎓
Additionally available measuring points with modules with ANA 16 (EM-199/263, EM-238/363, EM-260/390, EM-401/549, EM-530/660)	**Signals to be converted**
engine oil temperature PT 100/4	PT 100
mixed gas temperature PT 100/5	PT 100
mixed cooling water temperature PT 100/6	PT 100
exhaust gas temperature B	NiCrNi
exhaust gas temperature C	NiCrNi
exhaust gas temperature D	NiCrNi
load pressure (Option)	4–20 mA

Tab. 12 Analog measurement converter

2.3 Control, measuring and regulating unit

The control, measuring and regulating unit consists of
a 19” rack with the following components.

Components	Number
power supply unit (24 V⎓)	1
CPU engine control	1
digital inputs (24 V⎓)	32
digital outputs (24 V⎓)	16
analog measuring inputs (0–20 mA)	6
analog target value outputs (0–10 V)	2
CPU line protection	1
voltage inputs (0–300 V~	6
current conversion inputs (0–50 mA ~)	3

Tab. 13 The components of the control, measuring and regulating unit

The control unit carries out the following functions:

Functions	
mains monitoring	output regulation and monitoring
alternator voltage monitoring	lambda regulation and gas monitoring
alternator current monitoring	enabling in stand-by operation and 50 Hz regulation
speed regulation and monitoring	temperature controller
synchronising	automatic select and deselect after internal or external heating water return temperature
oil pressure and oil level monitoring	start-stop process
cooling water, exhaust gas and alternator temperature monitoring	

Tab. 14 Functions

Control system (BMS 2007)

The specific functions:

Mains monitoring
Mains monitoring checks whether it is above or below the five limits listed below:
excess mains voltage
low mains voltage
excess mains frequency
low mains frequency
vector jump
The limits and response times are adjustable (EVU level). If mains monitoring detects an unacceptable deviation from limits and the response time has expired, the cogeneration module will be disconnected from the mains by turning off the alternator contact. It is enabled again if the mains are within limits within 3 seconds. The machine idles 10 seconds if the network breakdown > 3 seconds. The cogeneration module goes into stand-by operation if external stand-by operation selection is made within these 10 seconds. Otherwise, the cogeneration module is shut down. The set mains settling time expires before the system goes into parallel operation after system recovery.
Alternator voltage monitoring
Alternator voltage monitoring leads to one of the two malfunctions listed below if at least one of the three phases of mains voltage is outside of set limits (level 3):
excess alternator voltage
low alternator voltage
Alternator current monitoring
Monitoring checks to see whether the alternator current is unacceptably high or whether the three current-phases have excessively high deviations among one another (limits level 3). There is also hardware-supported alternator current monitoring that works with a thermo-magnetic trip in the feed switch. If there is a malfunction, it generates at least one of the fault messages below.
excess alternator current
alternator load imbalance
feed switch malfunctioning
Speed regulation and monitoring
Speed is recorded by the pick-up and the control system regulates speed by passing on an analog target value (0–10 V) to the governor. Speed monitoring generates the two malfunctions below in the case of an unacceptable deviation from the appropriate limit:
overspeed
speed <50 Upm or pick-up defective

Tab. 15 Description of the functions, Part 1 – mains, alternator voltages, alternator current monitoring and speed regulation or monitoring

Synchronising
You can use speed regulation to synchronise the alternator to the connected mains. The following criteria are included for issuing the enabling pulse:
frequency difference 0.0–0.5 Hz (EVU level)
voltage difference 0–40 V (EVU level)
phase angle difference 0–10° (EVU level)
synchronising time monitoring (level 3)
oil pressure and oil level monitoring
Oil pressure is monitored with a 4-20 mA oil pressure sensor that transforms oil pressure into an analog signal where the range of 0-10 bar is transformed into 4-20 mA. The oil pressure plausibility is also monitored when the machine is stationary. A floater switch automatically refills the oil. A digital limit contact indicates to the control system that a malfunction has occurred if the oil level still drops below the acceptable limit generating the following fault messages:
minimum oil pressure
oil pressure malfunctioning
minimum oil level
cooling water, exhaust gas and alternator temperature monitoring
The hardware records the following malfunctions and gives the control system a message via digital contacts:
cooling water pump malfunctioning (tripped by motor protection switch)
minimum cooling water pressure (tripped by pressure switch)
safety temperature limiter (tripped by thermostat at 99° C and the cogeneration module is shut down via emergency stop chain)
Alternator temperature monitoring (tripped by the temperature switch in the alternator windings) The cooling water temperature is recorded with a PT 100 and the exhaust gas temperature is recorded with a NiCrNi temperature sensor and transmitted directly to the control system via analog measurement converter. It evaluates the following faults: – maximum cooling water temperature – maximum exhaust gas temperature – minimum exhaust gas temperature (sensor short-circuit)

Tab. 16 Description of the functions, Part 2 – synchronising, oil pressure, oil levels, cooling water, exhaust gas and alternator temperature monitoring

Control system (BMS 2007)

output regulation and monitoring	
The governor is used to adjust the alternator's active power to an adjustable target value in parallel operation. All parameters are listed below (level 3) that are relevant to output regulation and output monitoring.	
output target	**tolerance window** +/- kW with time monitoring for fault clearance
warm-up limit	**maximum limit monitoring** for fault clearance
target value ramp (kW/s)	**reverse power monitoring** for fault clearance
Temperature controller (return increasing mechanism)	
A constant controller is built into the module control under the controller menu. The controller uses a signal (0–10 V⎓) to trip the customer's control valve with reference to the regular temperature (either PT100/2 or PT100/3 adjustable in level 2) and the set target value. Its supply voltage (24 V, AC) is available in the module control switchgear. The KP and TN regulating parameters (level 3) are adjustable along with the direction of control action and control valve minimum opening.	
Module select and deselect after temperature heating water return (only active in the heat mode)	
Two limits are built into the module control under the release menu that enable you to deselect and release after temperature (either PT100/2 or PT100/3 adjustable in level 2). The precise adjustment of these parameters makes sense when there is no control equipment and you want to prevent emergency shutdown due to high return temperature. The cogeneration module is internally deselected when it exceeds the deselect limit. The cogeneration module is automatically reselected after the temperature has cooled down to below the release limit. PT100/2 is the internal return sensor and PT100/3 is available for other work, preferably in the main return of the module. Optional modulation: A percentage output value is assigned to the release and deselects limits so you can enter at release (60°C/100%) and deselect (70°C/50%). That would mean that the module starts at a return temperature of 60°C and would run at 100% output. The module would only run at 50% load at 70°C and it would be deselected above 70°C. The module would automatically run flexibly in output between the select and deselect values such as at a return temperature of 65°C at 75% output. Beyond this, a freely adjustable delay is available for the release and deselect limit.	
Lambda regulation	
Lambda regulation makes sure that the combustion air fed to the system corresponds to the combustion air actually needed (lambda = the ratio of fed combustion air to needed combustion air; lambda=1 regulation). At this ratio, the emission of pollution is lowest using a (lambda regulated) three-way catalyst at the same module output. A step motor uses a control valve to adjust the mixture feed. The lambda probe voltage (0–1,000 mV) is used as a control variable for the mixture of fuel/air. The control valve is shut if the lambda probe voltage is greater than the target value set on the control system and the control valve is opened if the lambda probe voltage drops below the target value. The cogeneration module is shut down when the step motor is not regulated to the target value within an adjustable period. The step motor is triggered via two digital contacts. The pulse-interval ratio is adjustable just like all targets and limits (level 3).	

Tab. 17 Description of the functions, Part 3 – output regulation and monitoring, temperature controller, module deselect and select after temperature and lambda regulation

Gas monitoring	
The gas pressure is monitored via gas pressure guard and a digital input is set at the control system if there is a malfunction. There is not only a gas pressure guard, but also an optional sealing test for the gas lane. The optional sealing test is carried out on the cogeneration module when the cogeneration module is shut down (the ignition and governor are off). A fault message is generated if the sealing test is deficient and the sealing test starts again if the fault message is acknowledged via acknowledge button on the control system. The cogeneration module can only be restarted when the sealing test has positive results.	
Enabling in stand-by operation	
The release of the enabling pulse in stand-by operation depends on voltage and frequency:	
frequency window	
voltage window	
The governor adjusts the machine to 50 Hz in stand-by operation depending upon alternator load and relief.	
Start-stop process	
This is what the start-stop process looks like (no details):	
start process	stop process
1. start request	1. request off
2. cooling water pump on	2. relief active
3. ventilation on	3. relief limit reached
4. starter on	4. gas valves closed
5. governor on	5. alternator contact off
6. starting speed reached	6. lambda regulation off
7. ignition on	7. after-run time ignition and governor active
8. gas valves open	8. ignition and governor off
9. ignition speed reached	9. sealing test active (OPTIONAL)
10. starter off	10. after-run time cooling water pump and ventilation active
11. speed range reached (1,500 Upm)	11. cooling water pump and ventilation off
12. release synchronising	12. lambda control valve moves into the starting position
13. synchronising impulse	13. cogeneration module is off
14. alternator contact on	
15. output regulation active	
16. lambda regulation active	
17. cogeneration module in operation	

Tab. 18 Description of the functions, Part 4 – gas monitoring, enabling in stand-by operation and start-stop process changes

2.4 Modes

Automatic operation	
The following modes are available:	
heat operation	
current priority operation	
stand-by operation	
The cogeneration module can be operated in the heat operation (parallel operation 100% output), current priority operation (floating mode after external 0–20 mA signal 50–100% output) and stand-by operation modes. Preliminary start conditions are necessary for starting the cogeneration module such as lambda controller ready. There may not be any malfunctions and all fault messages have to be acknowledged. In automatic operation, either there has to be an external start request for parallel operation (heat or current) for starting (no network breakdown and the system-tie circuit breaker has to be on) or the external start request for stand-by operation (with network breakdown; system-tie circuit breaker has to be turned off). Internal release has to be issued (deselect and select after temperature).	
Manual mode	
Manual mode is available via level 2 (only with password) for start-up and service and you can run through the start-stop process with the buttons below in individual steps.	
manual	cogeneration module in start readiness (basic prerequisite for all other buttons)
start	cogeneration module starts until it reaches the idle speed range (1,450–1,550 Upm)
alternator	synchronising release and enabling
higher/lower	speed regulation in idle output regulation after enabling
cooling water pump	on/off
ventilator	on/off

Tab. 19 Automatic and manual mode

You can find other functions in the same menu that might be helpful in troubleshooting.

Historical memory min-max values)
You can find this button in the same menu on level 2:
min-max values
The min-max values menu is a volatile memory that stores the lowest and highest analog values to the next reset F8. This menu is an excellent aid for start-up, service and troubleshooting. These values are only reset when the min-max menu is also open.
Options
You can get to the following submenus in the Option menu:
voltages
misfire menu for gas A and gas B
timer
The "Voltages" item on the menu shows the mains voltage, alternator voltage and busbar voltage with their frequencies. Pressing the F2 key twice shows the cooling water temperature and temperature sensors PT 100/2 and PT 100/3.

Tab. 20 Historical memory and options

2.5 Parameters

The following are adjustable on level 3 (only with password):

Level 3 – parametering	
1. output target	electrical active power
2. warm-up limit	cooling water temperature limit at 50% output
3. output limit	emergency shutdown if limits exceeded
4. reverse power	emergency shutdown with negative output limit
5. output ramp higher/lower	output target change in kW/s
6. monitoring power regulator	emergency shutdown with target value deviation after time
7. power regulator dead band	regular dead band in kW
8. knocking	output reduction with digital knocking input
9. lambda probe target value	
10. lambda regulation impulse time	impulse duration open/close command
11. lambda regulation dead time	interpulse period between the open/close commands
12. lambda regulator dead band	regular dead band
13. monitoring lambda regulator	emergency shutdown with target value deviation after time
14. maximum cooling water	emergency shutdown if limits exceeded
15. maximum exhaust gas temperature	emergency shutdown if limits exceeded
16. minimum exhaust gas temperature	emergency shutdown if below limits
17. exhaust gas temperature release	maximum release if below limit after exhaust gas
18. battery low voltage	emergency shutdown if below limits
19. starter limit	speed limit for starter off
20. overspeed	emergency shutdown if limits exceeded
21. after-run time / start-up time ventilator	after-run time or start-up time of ventilator
22. after-run time / start-up time cooling water pump	after-run time or start-up time of cooling water pump
23. minimum temperature controller, target value	minimum opening, spare target
24. Kp/Tn temperature controller	Kp and Tn value input
25. governor 0=10–0 V, 1=0–5 V	target controller specification 10–0 V (GAC) or 0–5 V (Heinzmann)
26. spare	
27. excess alternator current	emergency shutdown if limits exceeded
28. alternator load imbalance	emergency shutdown if limits exceeded
29. low alternator voltage	emergency shutdown if below limits
30. excess alternator voltage	emergency shutdown if limits exceeded
31. temperature PT 100/2	emergency shutdown if limits exceeded
32. temperature PT 100/3	emergency shutdown if limits exceeded
33. minimum oil pressure	emergency shutdown if below limits
34. offset lambda probe	potential adjustment if there are analog parameter differences
35. offset NiCrNi	potential adjustment if there are analog parameter differences
36. offset engine cooling water	potential adjustment if there are analog parameter differences
37. offset temperature PT 100/2	potential adjustment if there are analog parameter differences
38. offset temperature PT 100/3	potential adjustment if there are analog parameter differences
39. offset oil pressure	potential adjustment if there are analog parameter differences
40. offset battery voltage	potential adjustment if there are analog parameter differences

Tab. 21 Parameter, Part 1 – level 3

EVU level	
The following parameters are adjustable on the EVU level (only with password):	
1. low mains voltage	shutdown if below limits
2. excess mains voltage	shutdown if limits exceeded
3. low mains frequency	shutdown if below limits
4. excess mains frequency	shutdown if limits exceeded
5. mains settling time	release after system recovery
6. synchronising delta-F	frequency difference to enabling release
7. synchronising delta-U	voltage difference to enabling release
8. phase angle difference	phase angle difference to enabling release
9. vector jump angle	sudden phase change, shutdown if limits exceeded
10. spare	
FACTORY level	
The following parameters are adjustable on the FACTORY level (only with password):	
1. module number	serial number
2. operating hours	correct option
3. starts	correct option

Tab. 22 Parameter, Part 2 –EVU and FACTORY level

2.6 Description of the RS 3964-interface

Interface parameter	
The module interface is configured as below:	
type	RS232 (9-pole plug)
baud rate	9,600 baud
parity	none
data bits	8
stop bits	1
The parameters are fixed so that they cannot be changed with the operator panel.	
DK3964R data request	
Remote service requests the module data by sending the character Hex 22 in the DK3964R procedure. Then module control sends a data block of 102 bytes to remote service. Section data item list CHP UNI 001 describes the structure of the data block from page 21.	

Tab. 23 Interface parameters and DK3964R data request

Data item list CHP UNI 001

USER NOTE

These data are transmitted in INTEL notation.
The DL and DR data bytes have to be changed around before the table below is written in STEP-5 writing.

Internal module values

address	length	designation	type	unit	comment
0	1	format identifier	U8	-	A1 (Hex): identifier for CHP UNI 001
1	1	cogeneration number	U8	-	Lo nibble: cogeneration number (1..F) Hi nibble: reserved for upgrades
2	2	module mode	U16	-	0: off 1: manual 2: auto
4	2	module status	U16	-	0: off 1: ready 2: start 3: operation 4: malfunction
6	2	module mode	U16	-	0: off 1: manual 2: stand-by operation 3: --- 4: selection 100% 5: target value 0-100%
8	2	target value floating operation	I16	%	
10	2	fault message bits 1-8	16 bits	-	One bit is assigned every malfunction. Tab. 26 (List of fault messages) describes the significance of the bits with the appropriate fault message text.
12	2				
14	2				
16	2				
18	2				
20	2				
22	2				
24	2				
26	2	operating hours	U16	h	
28	2	operating minutes	U16	min	
30	2	number of starts	U16		
32	2	service interval	I16	h	
34	2	module block	I16	h	
36	2	prewarning time	I16	h	
38	2	next service call	U16	h	

Tab. 24 Data item list, Part 1 – internal module values

Data item list CHP UNI 001 Analog values from the analog box					
address	**length**	**designation**	**type**	**exp.**	**unit**
40	2	NiCr-Ni / 1 temperature A	I16	0	°C
42	2	NiCr-Ni / 2 temperature B	I16	0	°C
44	2	NiCr-Ni / 3 temperature C	I16	0	°C
46	2	NiCr-Ni / 4 temperature D	I16	0	°C
48	2	PT100/1 cooling water	I16	-1	°C
50	2	PT100/2 heating water return	I16	-1	°C
52	2	PT100/3 heating water	I16	-1	°C
54	2	PT100/4 oil temperature	I16	-1	°C
56	2	PT100/5 mixed temperature	I16	-1	°C
58	2	PT100/6 mixed cooling water temperature	I16	-1	°C
60	2	battery voltage	I16	-1	V
62	2	oil pressure	I16	-1	bar
64	2	lambda probe voltage	I16	-1	mV
66	2	spare	-	-	-
68	2	spare	-	-	-
70	2	spare	-	-	-
72	2	spare	-	-	-
74	2	speed	U16	0	rpm
76	2	temperature controller	I16	-1	°C
78	2	temperature release	I16	-1	°C
line protection					
address	**length**	**designation**	**type**	**exp.**	**unit**
80	2	mains voltage L1	I16	0	V
82	2	mains voltage L2	I16	0	V
84	2	mains voltage L3	I16	0	V
86	2	alternator voltage L1	I16	0	V
88	2	alternator voltage L2	I16	0	V
90	2	alternator voltage L3	I16	0	V
92	2	alternator current L1	I16	0	A
94	2	alternator current L2	I16	0	A
96	2	alternator current L3	I16	0	A
98	2	total mains voltage	I16	0	V
100	2	total alternator voltage	I16	0	V
102	2	total alternator current	I16	0	A
104	2	output	I16	0	kW
106	4	network frequency	F32	0	Hz
110	4	alternator frequency	F32	0	Hz
114	2	spare	-	-	-
116	2	spare	-	-	-
118	2	CosPhi	I16	-3	-
120	4	spare	U32	0	kWh
124	16	spare	-	-	-

Tab. 25 Data item list, Part 3 – analog values and line protection

Control system (BMS 2007)

List of fault messages				
message	**byte**	**bit**	**designation**	**comment**
0	0	7		
1	0	6	emergency stop	
2	0	5	minimum oil level	
3	0	4	minimum cooling water pressure	
4	0	3	minimum gas pressure	
5	0	2	safety temperature	
6	0	1	alternator temperature	
7	0	0	sound hood temperature	
8	1	7	ventilator malfunctioning	
9	1	6	cooling water pump malfunctioning	
10	1	5	maximum exhaust gas counterpressure	
11	1	4	feed switch	
12	1	3	external malfunction	
13	1	2	overspeed	
14	1	1	cooling water temperature	
15	1	0	maximum exhaust gas temperature	
16	2	7	minimum exhaust gas temperature	
17	2	6	minimum oil pressure	
18	2	5	maximum gas pressure	
19	2	4	heating water pump malfunctioning	
20	2	3	starting speed < 50 Upm	
21	2	2	ignition speed	
22	2	1	speed range	
23	2	0	speed < 1,200 Upm	
24	3	7	enabling malfunctioning	
25	3	6	synchronising malfunctioning	
26	3	5	speed < 50 / pick-up	
27	3	4	maximum oil level	
28	3	3	maximum temperature Pt100_2	from V.49
29	3	2	maximum temperature Pt100_3	from V.49
30	3	1	maximum output	
31	3	0	reverse power	
32	4	7	power regulator malfunctioning	
33	4	6	lambda regulator malfunctioning	
34	4	5	alternator contact malfunctioning	
35	4	4	ignition malfunctioning	
36	4	3	oil pressure malfunctioning	
37	4	2	lambda starting position	
38	4	1	knocking ON	
39	4	0	knocking OFF	
40	5	7	timer deselect	message
41	5	6	timer release	message
42	5	5	network breakdown F <	warning
43	5	4	network breakdown F >	warning
44	5	3	network breakdown U+F <>	warning
45	5	2	minimum knocking output	

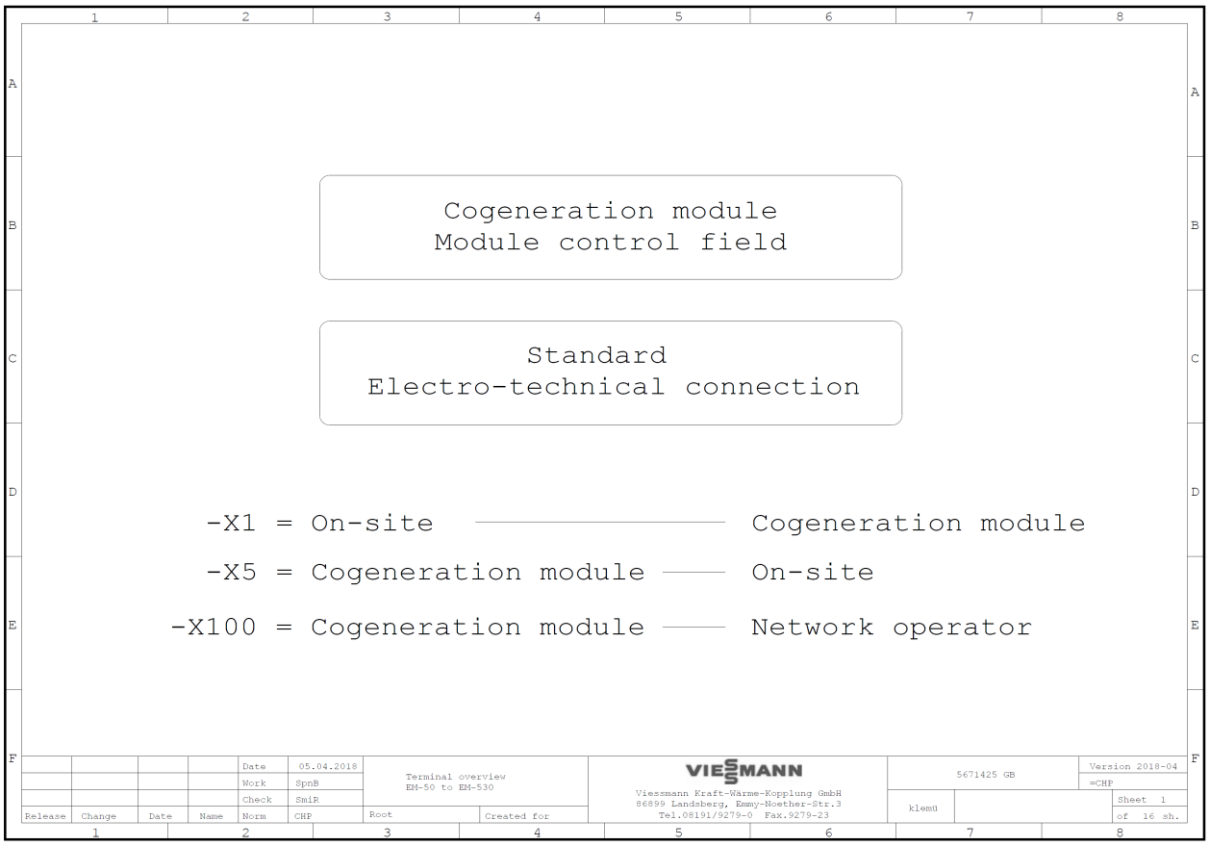
Control system (BMS 2007)

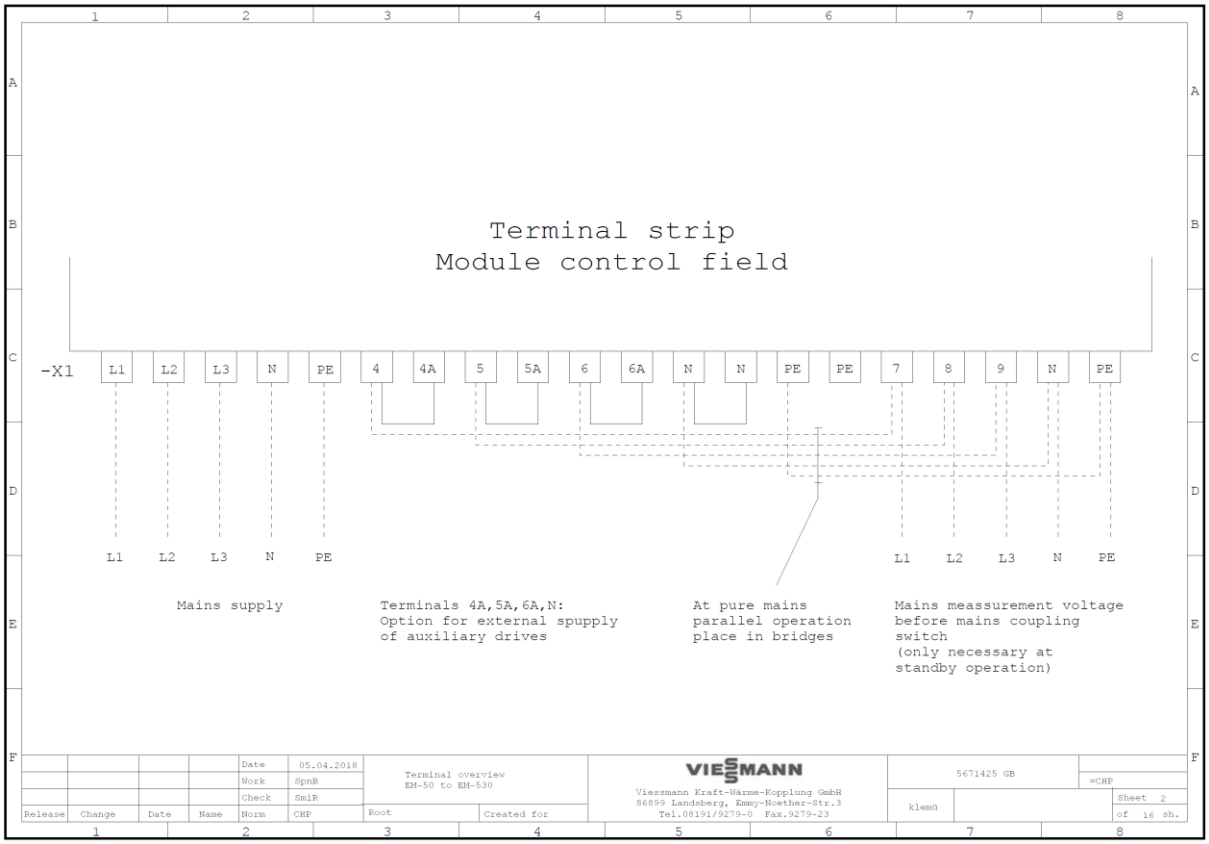
List of fault messages				
message	**message**	**message**	**message**	**message**
46	5	1	maximum knocking output	
47	5	0	system-tie circuit breaker	
48	6	7	knocking malfunction	
49	6	6	mains OK	message
50	6	5	network breakdown	warning
51	6	4	temperature deselect	message
52	6	3	temperature release	message
53	6	2	past service date	
54	6	1	emergency shutdown	
55	6	0	engine not stopped	
56	7	7	battery low voltage	
57	7	6	alternator low voltage	
58	7	5	alternator excess voltage	
59	7	4	alternator overcurrent	
60	7	3	alternator load unbalance	
61	7	2	seal test malfunctioning	
62	7	1	line protection malfunctioning	
63	7	0	sensors malfunctioning	
64	8	7	maximum exhaust gas temperature A	
65	8	6	minimum exhaust gas temperature A	
66	8	5	maximum exhaust gas temperature B	
67	8	4	minimum exhaust gas temperature B	
68	8	3	maximum exhaust gas temperature C	
69	8	2	minimum exhaust gas temperature C	
70	8	1	maximum exhaust gas temperature D	
71	8	0	minimum exhaust gas temperature D	
72	9	7	exhaust gas temperature difference A/B	
73	9	6	spare	
74	9	5	maximum temperature return PT100/2	from V.49
75	9	4	maximum temperature heating water PT100/3	from V.49
76	9	3	maximum temperature engine oil	
77	9	2	maximum temperature gas mixture	
78	9	1	maximum temperature mixed cooling water	
79	9	0	spare	
80	10	7	spare	
81	10	6	spare	
82	10	5	maximum load pressure	from V.49
83	10	4	minimum load pressure	from V.49
84	10	3	spare	spare
85	10	2	spare	spare
86	10	1	spare	spare
87	10	0	spare	spare

Tab. 26 List of fault messages

The customer should couple it to the computer (RK512 or other) for establishing communication between the cogeneration hardware and the customer's control equipment hardware to guarantee it meets the operator's hardware and convenience requirements.

3 Terminal assignment for the CHP module control field





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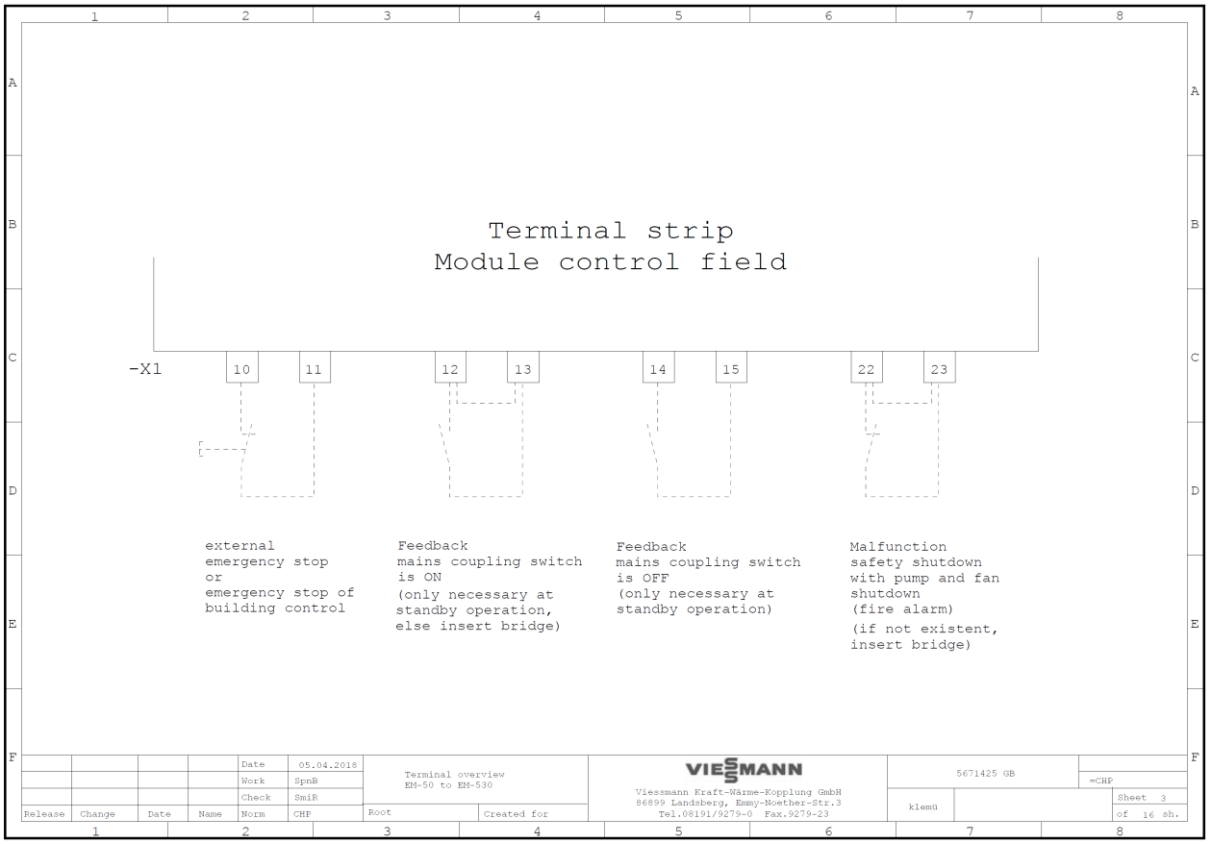
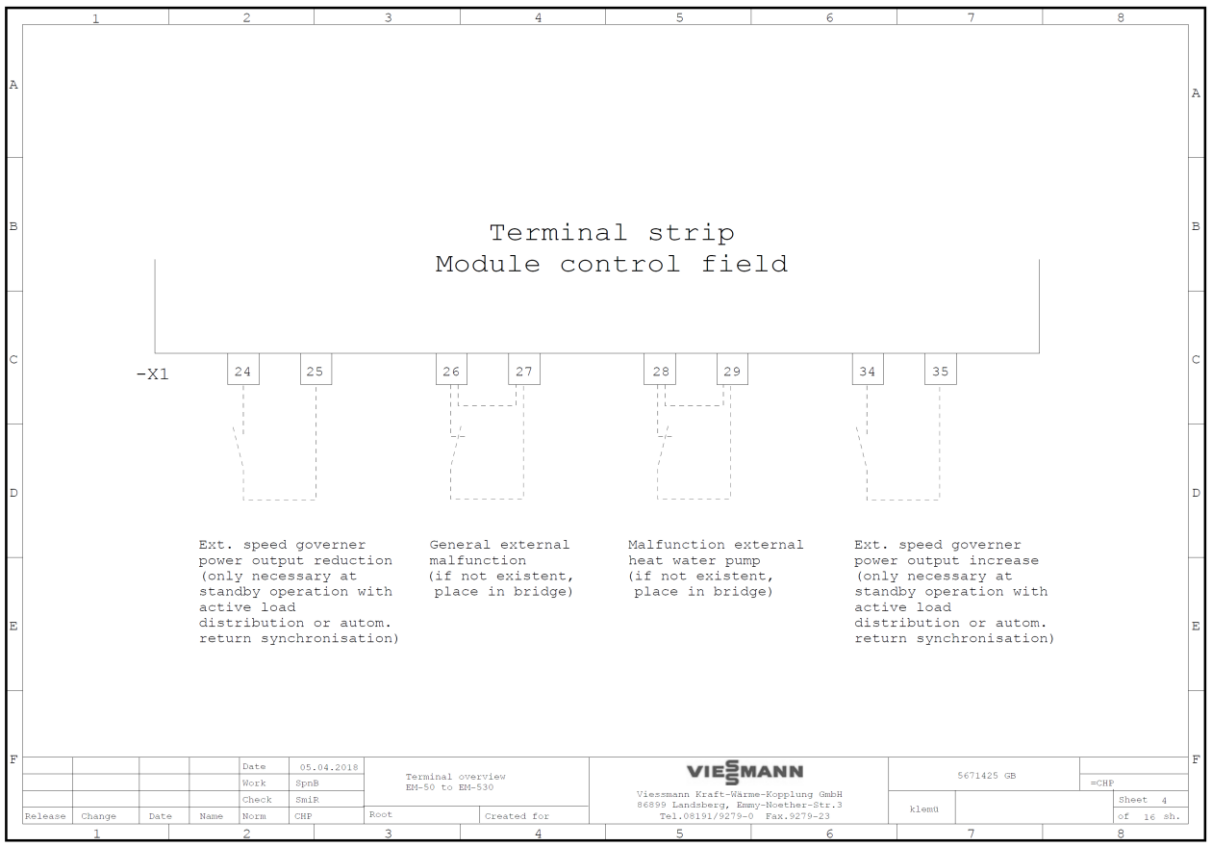
Terminal assignment for the CHP module control field





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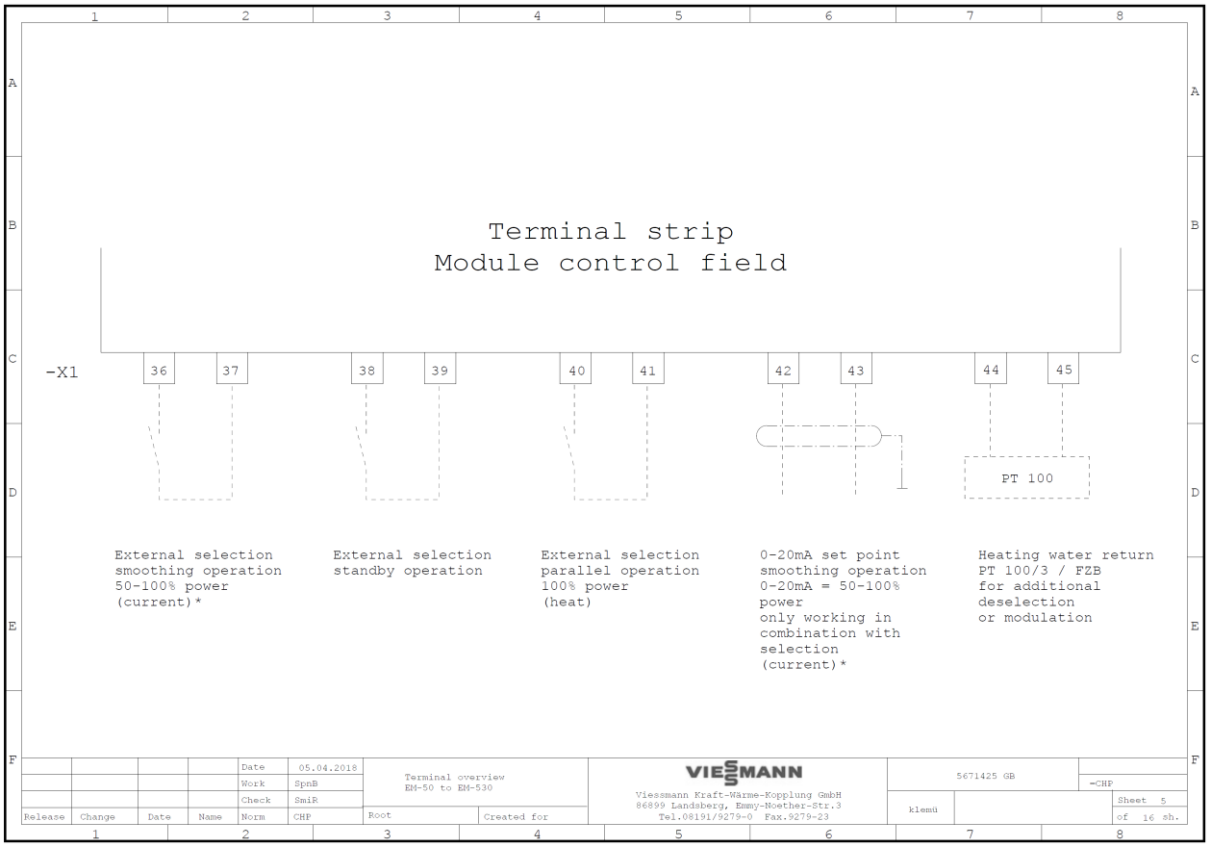

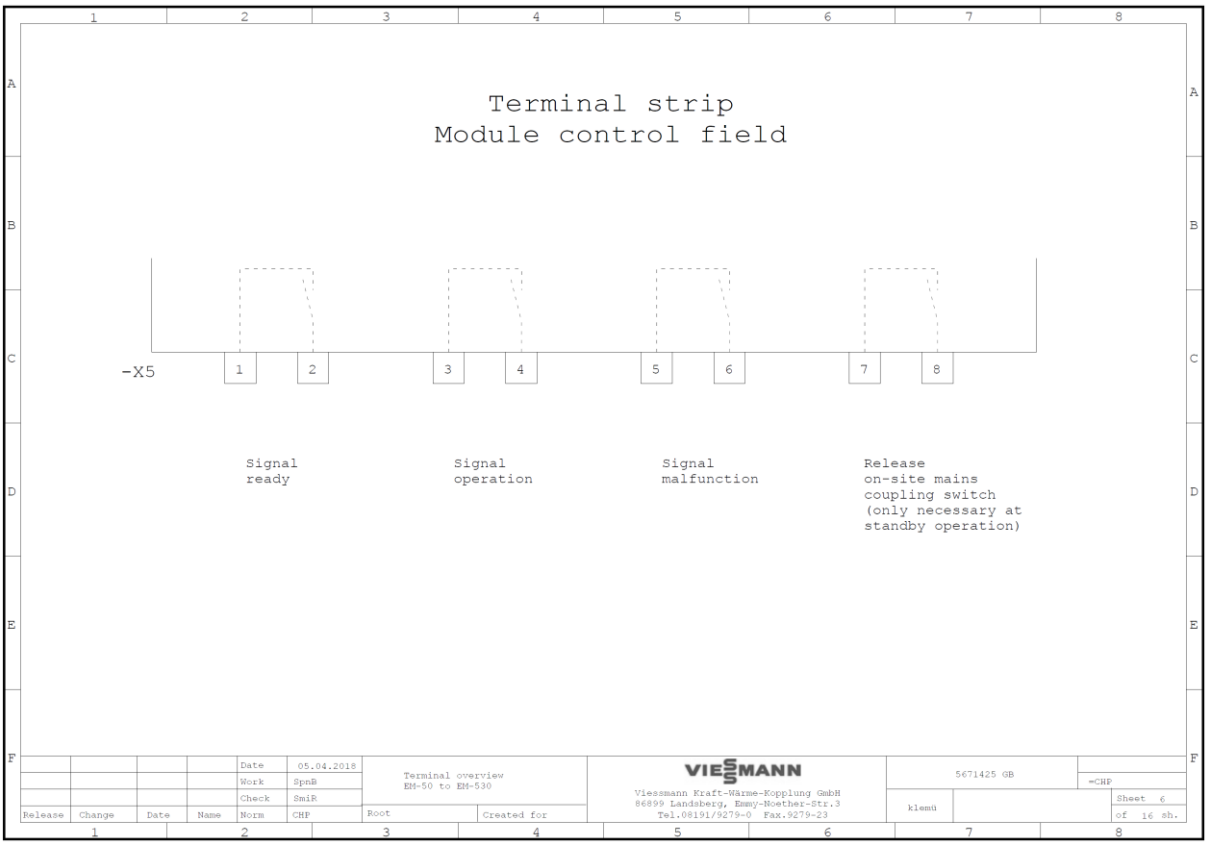

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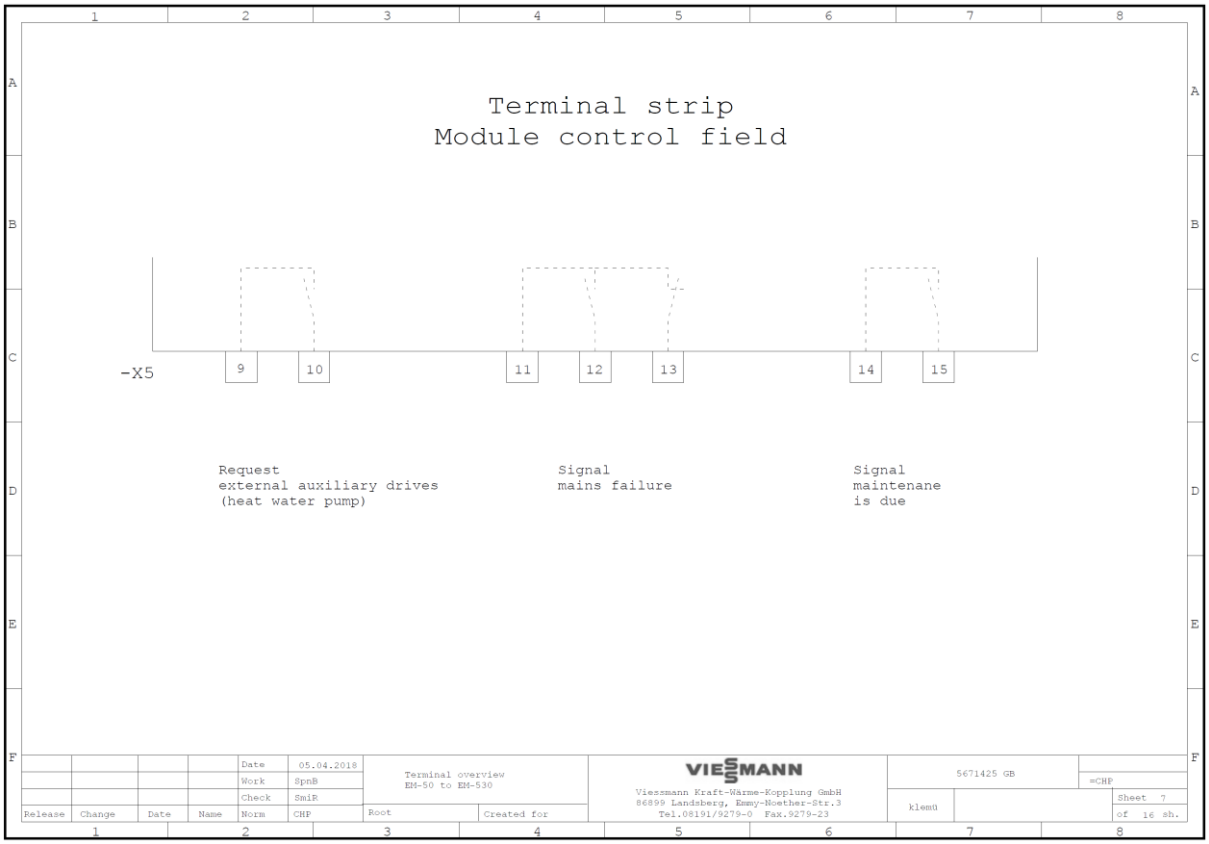

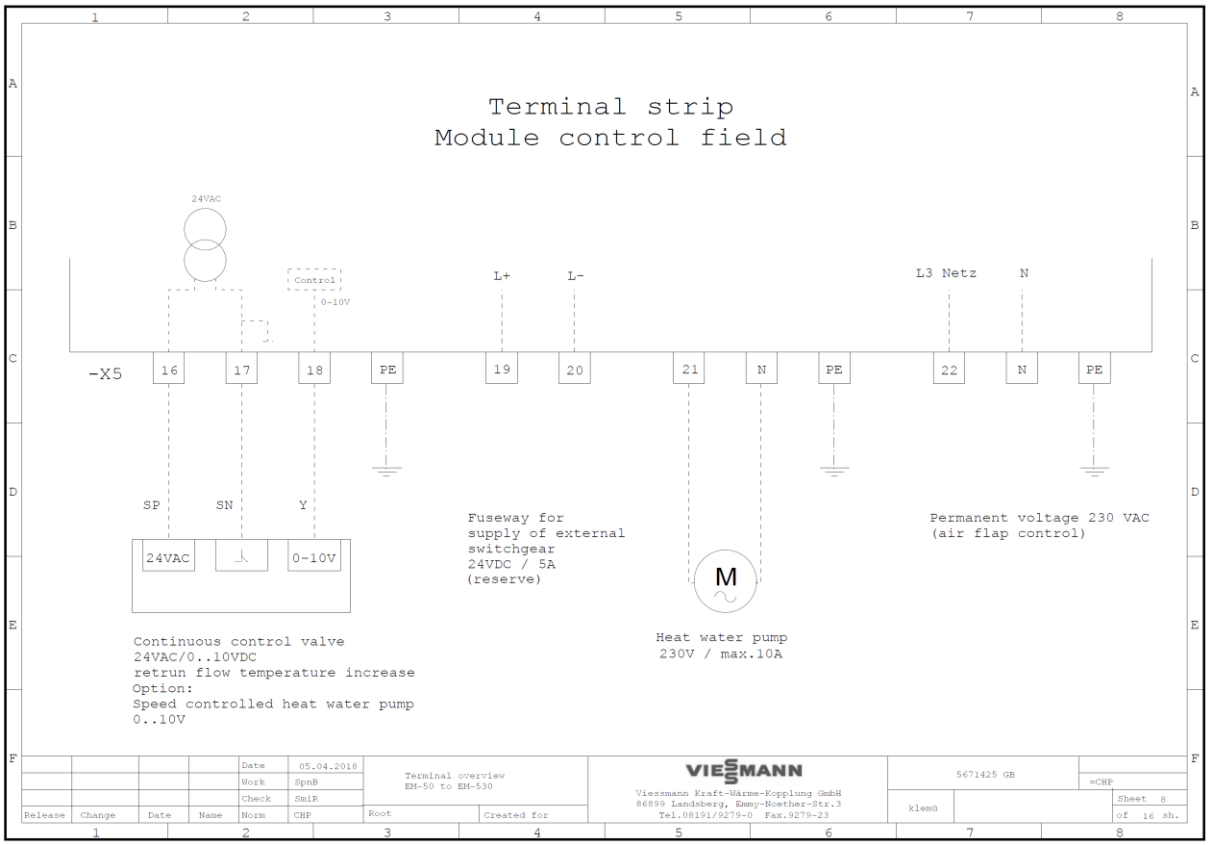

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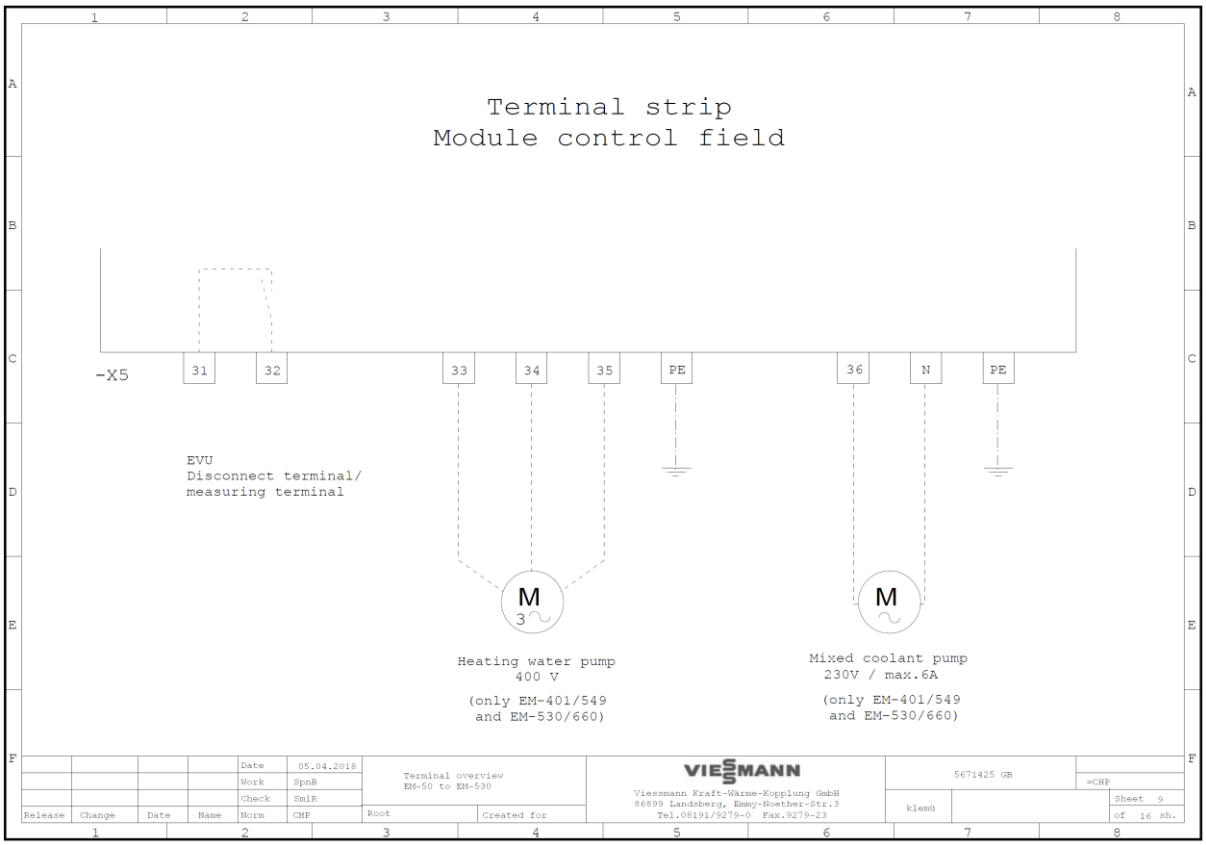

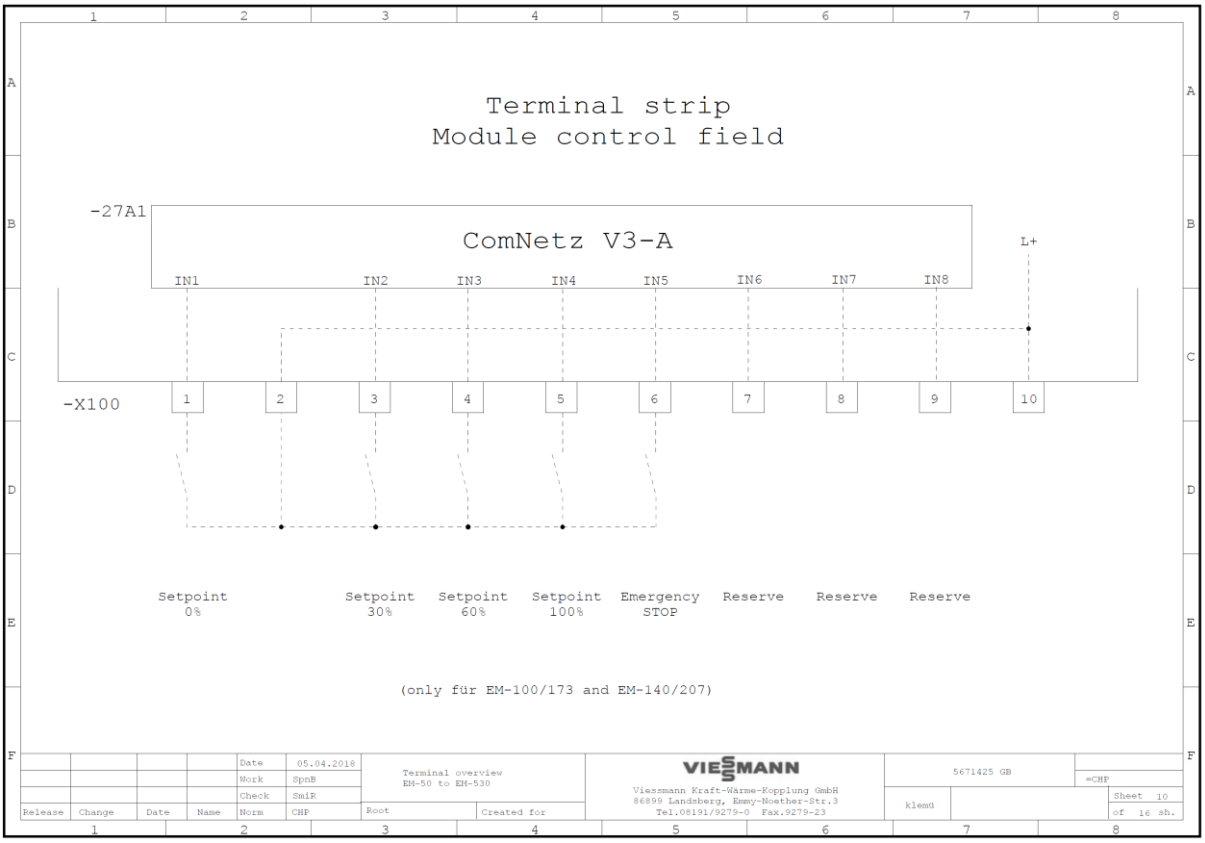

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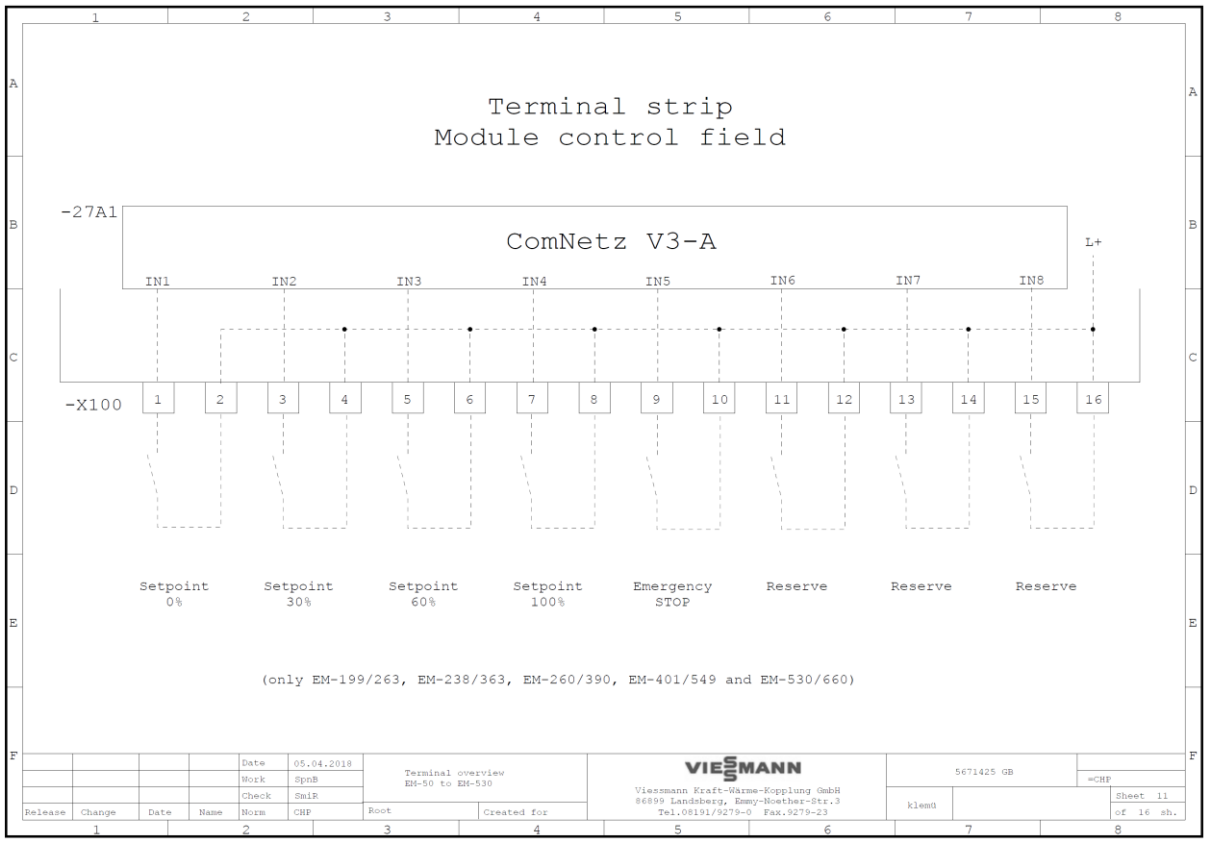

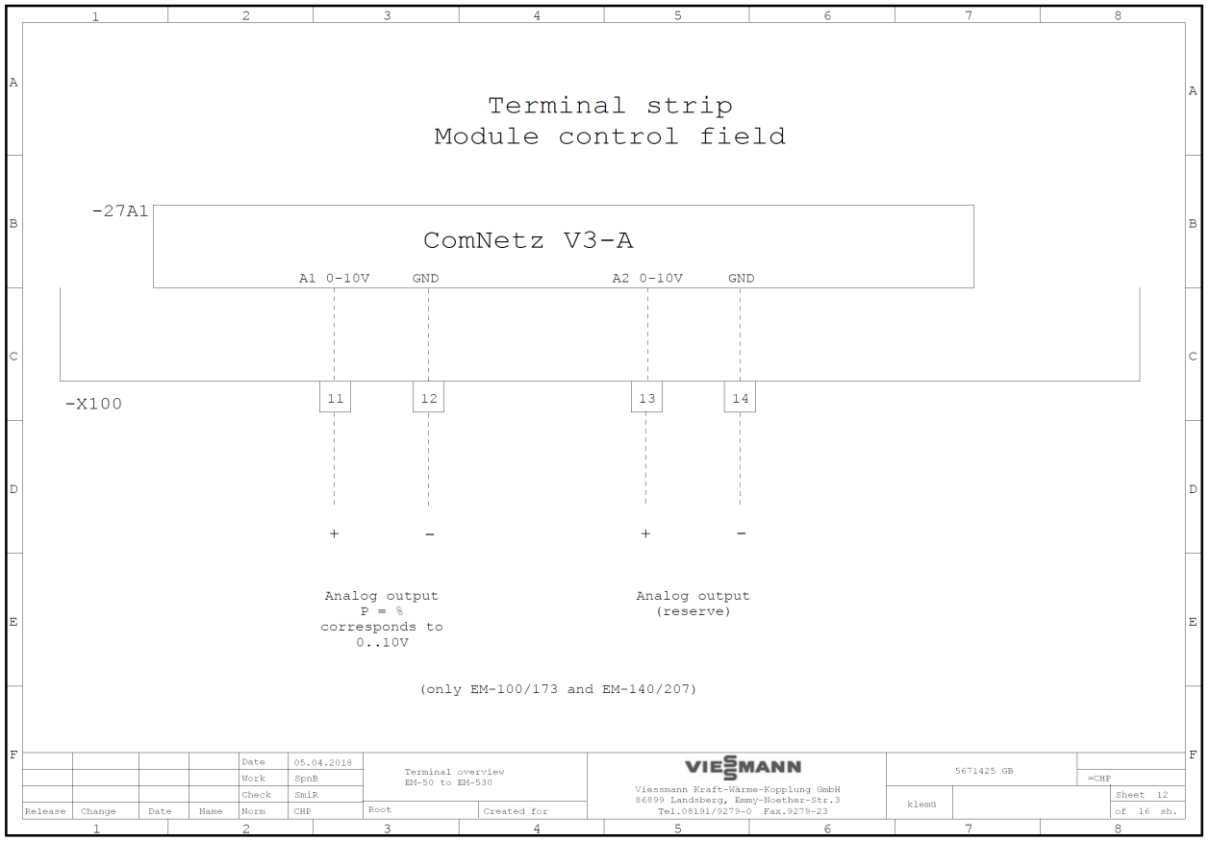

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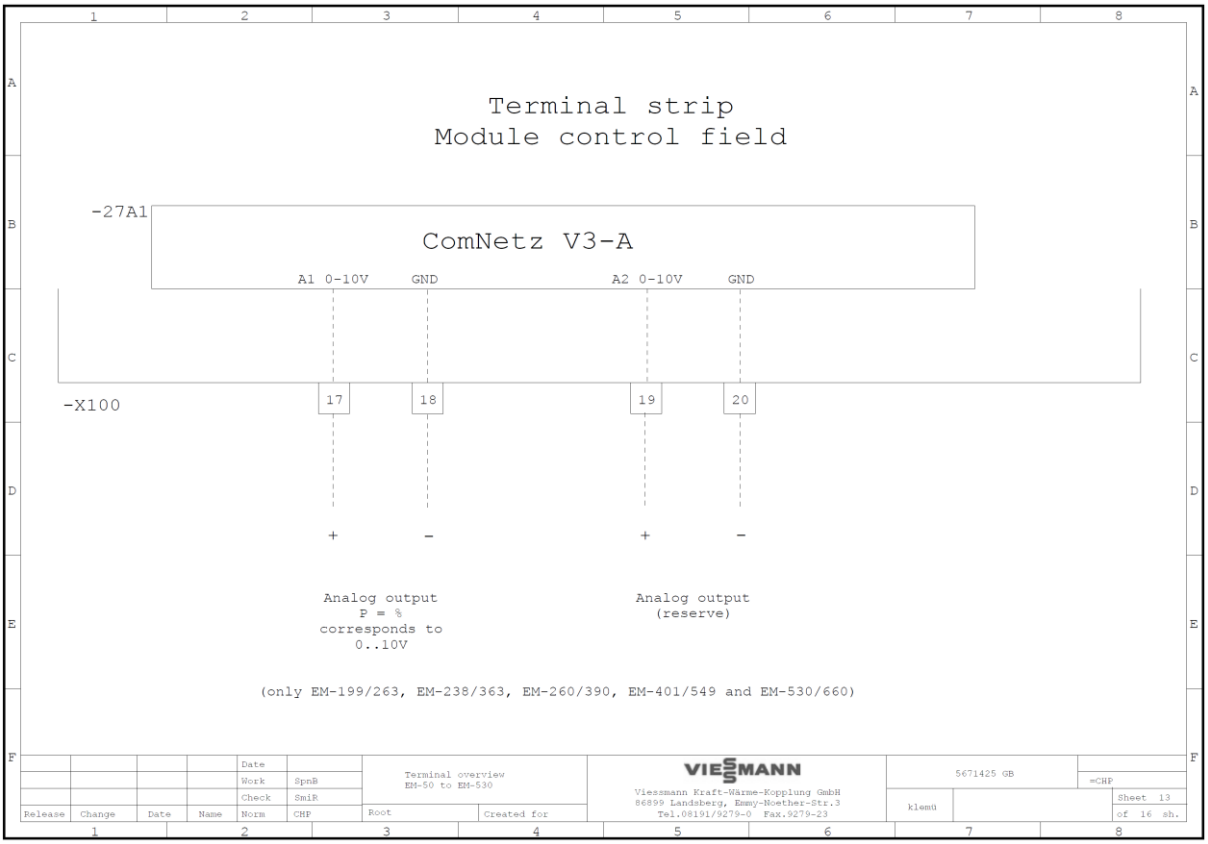

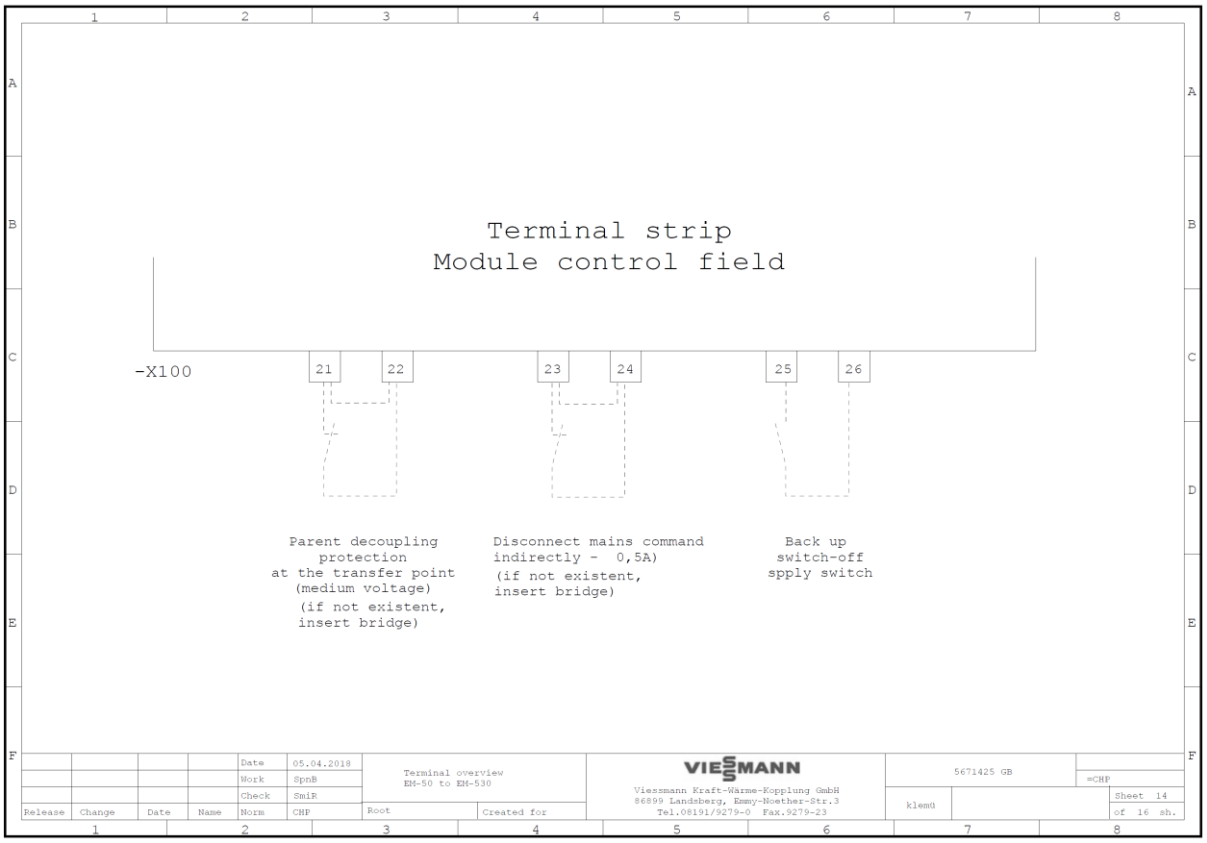

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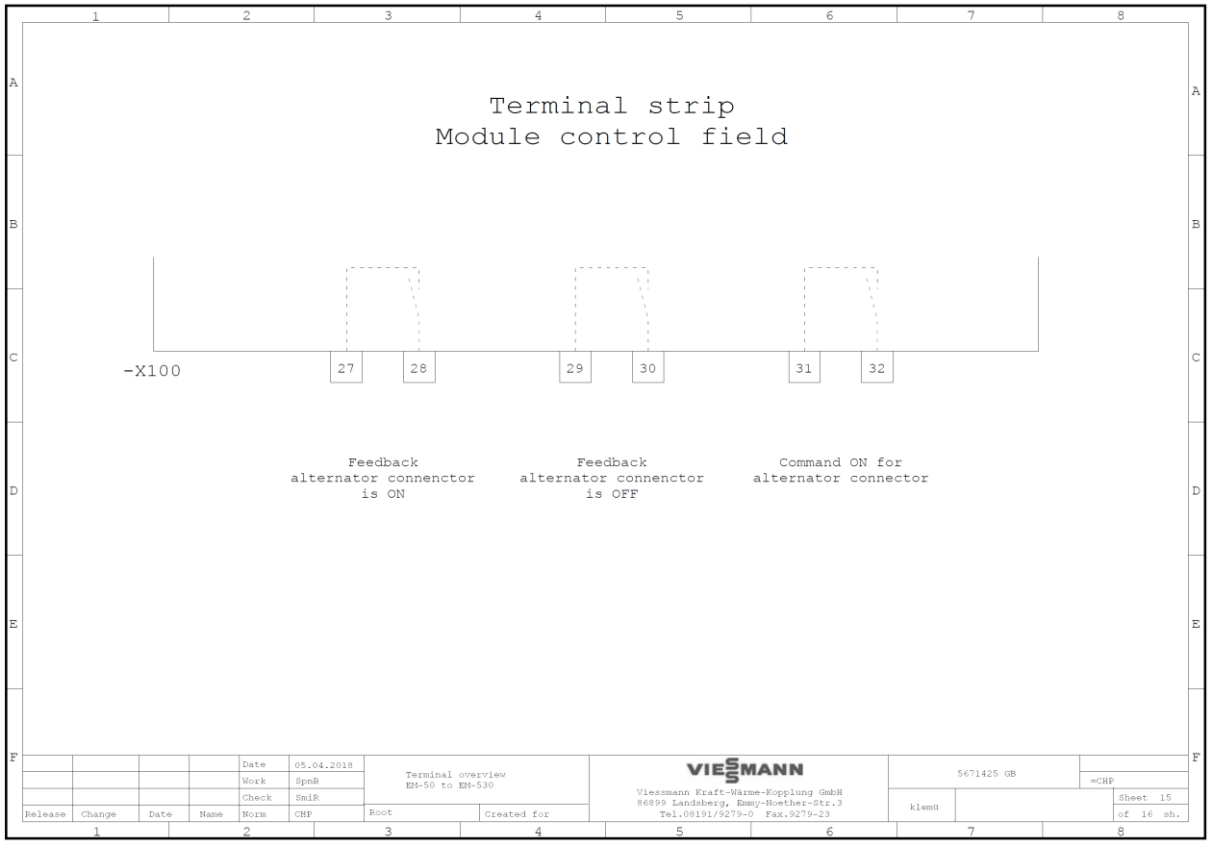

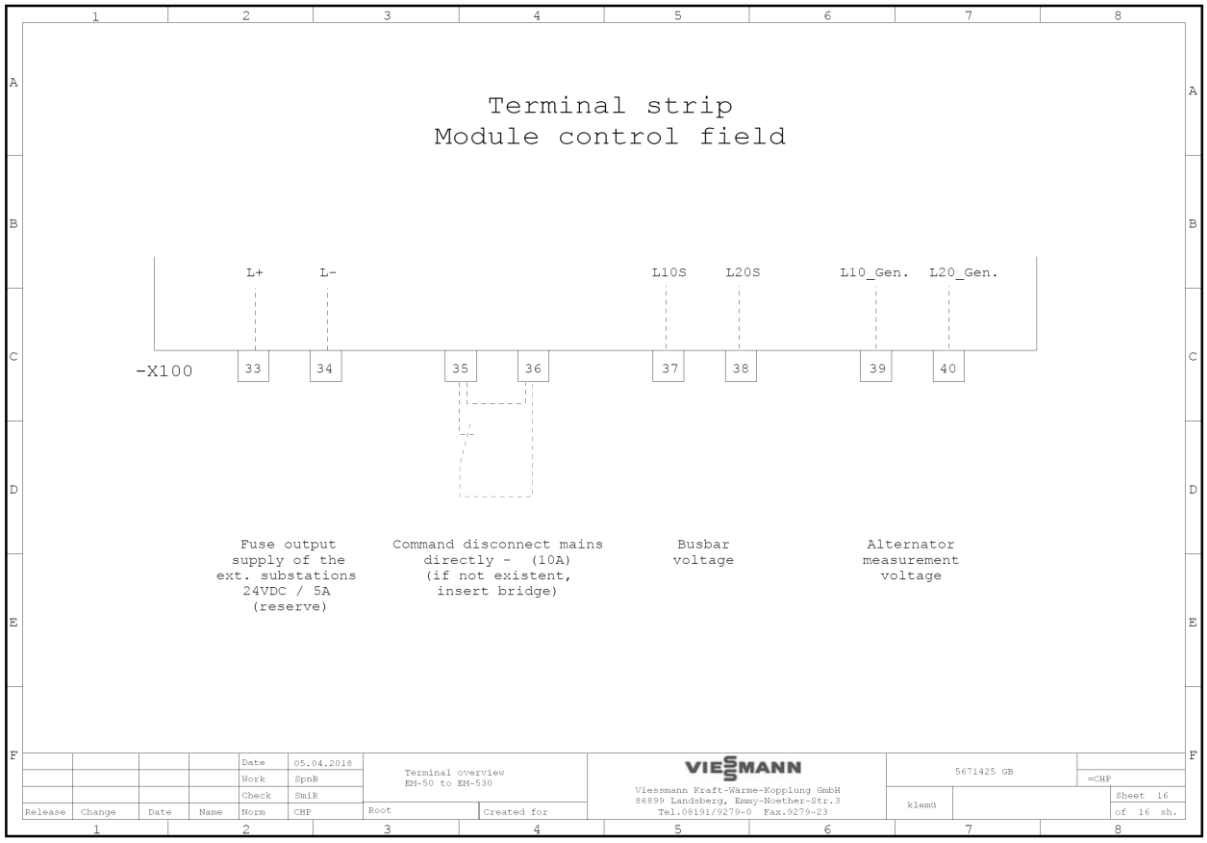

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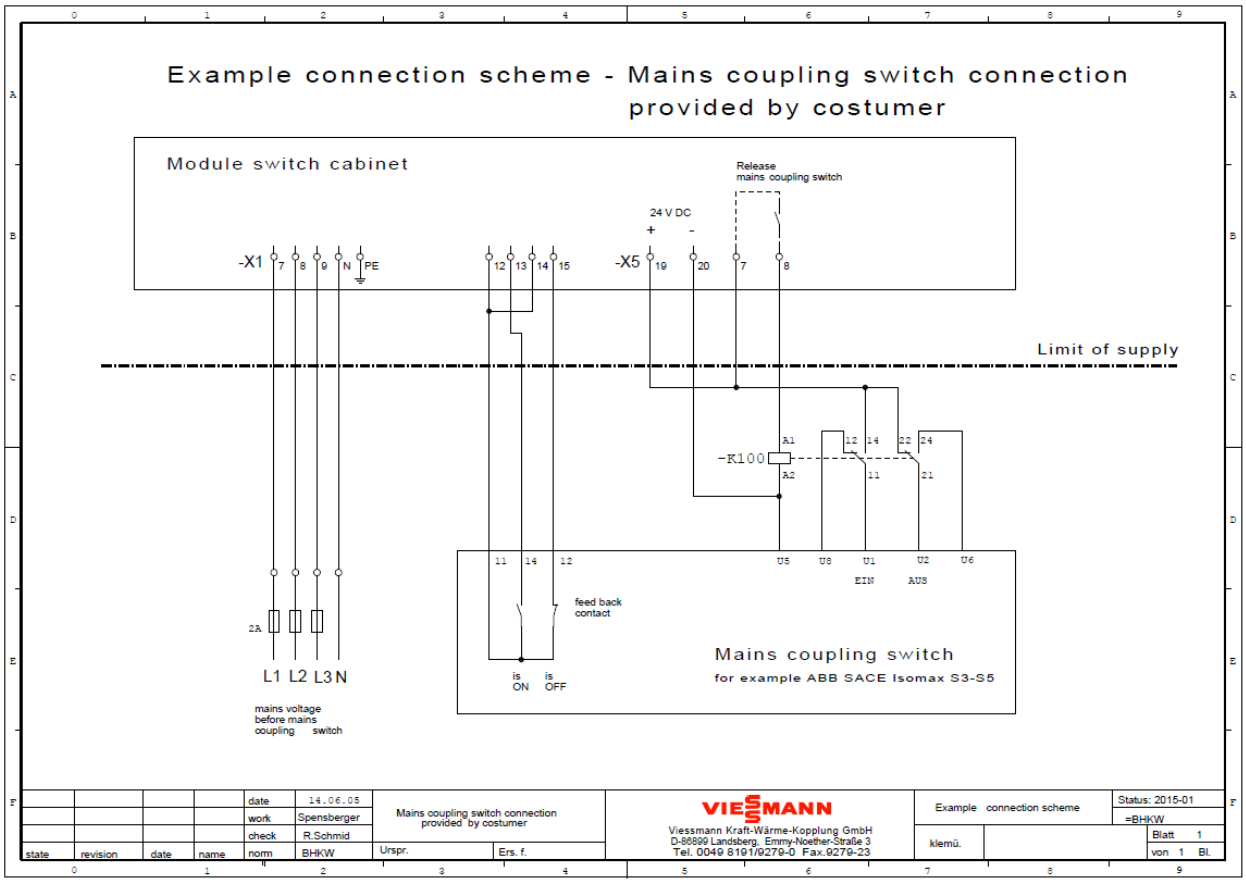

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Notes

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