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HAGENUK FAIVELEY GmbH

EMU Class72 (NSB)

Functional Discription
(Software specification)

passenger compartment

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1 <u>Regulation and control</u>

To control the HVAC system there are three modes implemented in the software:

testmode
failure mode
normal mode

There is one application software for three car types:
TT = trailor toilet
TP = trailor power
M = motor coach

In the TT car there is an additional convection heater for the toilet installed. One more digital output (BY020) will be controlled by one more analog input (AA006) in car typ TT. All other car types have a fixed resistance on input AA006 (287 Ohm = 106 °C) so the software knows about the car typ.

1.1 Test modes

This mode is available with all HFG service programs („SPP" or „ISP"). Further a PC and a serial link between PC and controller FPC20/2 is necessary.
It is possible to test single functions of the unit including all safety conditions:

	Testmode	Outputs to be set on	Input conditions
1.	[ ] supply_fan	- supply fans (BY006) - no emergency (BY010)	- 400V OK (BA018=1L)
2.	[ ]		
3.	[ ] exhaust_fan	- exhaust fan (BY011) - no emergency (BY010)	- 400V OK (BA018=1L)
4.	[ ] condenser_fan	- condenser fan (BY008) - no emergency (BY010)	- 400V OK (BA018=1L)
5.	[ ] flap_position_1	- flap to position „1" - no emergency (BY010)	
6.	[ ] flap_position_2	- flap to position „2" - no emergency (BY010)	
7.	[ ] flap_position_3	- flap to position „3" - no emergency (BY010)	
8.	[ ] 100%_fresh_air	- flap to position „100% outside air" (BY005) - no emergency (BY010)	
9.	[ ] 0%_fresh_air	- flap to position „100% recirculation air" (BY004) - no emergency (BY010)	
10.	[ ] cooling	- compressor (BY001) - mv liquid line (BY003) - supply fans (BY006) - exhaust fan (BY010) - condenser fan (BY008) - flap to position „2"	- 400V OK (BA018=1L) - not „compressor OFF (BA016=0L) - airflow OK (BA015=1L) - safety chain OK (BA003=1L while cooling) - low pressure OK (BA002=1L)

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	Testmode	Outputs to be set on	Input conditions
		- no emergency (BY010)	
11.	[ ] Bypass	- mv bypass (BY002) - no emergency (BY010)	- 400V OK (BA018=1L) - not „compressor OFF (BA016=0L) - airflow OK (BA015=1L) - safety chain OK (BA003=1L while cooling) - low pressure OK (BA002=1L)
12.	[ ] airheater	- airheater (BY009 / TY009) - supply fans (BY006) - exhaust fan (BY010) - flap to position „2" - no emergency (BY010)	- 400V OK (BA018=1L) - airflow OK (BA015=1L) - duct temperature<75°C
13.	[ ] conv_heat_saloon1	- covection heater saloon 1 (BY015 / TY015) - no emergency (BY010)	- thermostate BA007=1L
14.	[ ] conv_heat_saloon2	- covection heater saloon 2 (BY014 / TY014) - no emergency (BY010)	- thermostate BA008=1L
15.	[ ] conv_heat_saloon3	- covection heater saloon 3 (BY013 / TY013) - no emergency (BY010)	- thermostate BA009=1L
16.	[ ] conv_heat_vestibule	- covection heater vestibule (BY012 / TY012) - no emergency (BY010)	- thermostate BA006=1L - thermostate BA010=1L
17.	[ ] conv_heat_WC	- covection heater WC (BY020 / TY020) - no emergency (BY010)	- thermostate BA005=1L
18.	[ ] emergency_mode	- emergency mode (BY010) will be switched OFF	
19.	free		
20.	free		
21.	[ ] driver_prepare	- prepare (BY001 on FPC4R)	- 400V OK (BA004=1L on FPC4R)
22.	[ ] driver_convheat	- convection heater (BY002/TY002 on FPC4R)	---
23.	[ ] driver_cooling	- compressor (BY003 on FPC4R)	- 400V OK (BA004=1L on FPC4R) - ventilation on (BA003=1L on FPC4R) - low pressure OK (BA002=1L on FPC4R) - not „compressor OFF" signal (BA001=0L on FPC4R)
24.	[ ] driver_airheat	- airheater (BY004/TY004 on FPC4R)	- 400V OK (BA004=1L on FPC4R) - ventilation on (BA003=1L on FPC4R) - duct temperature<70°C
25.	[ ] mode_OFF	- no emergency mode (BY010)	
26.	[ ] mode_venting	- no emergency mode (BY010) - supply fans (BY006) - exhaust fan (BY011) - flap to position „100% fresh air"	- 400V OK (BA018=1L)
27.	[ ] mode_heating	regulation, same function as choosed by bus signal „heating - no emergency mode (BY010) - supply fans (BY006) - exhaust fan (BY011) - flap position, airheater and all convection heaters depends on ambient conditions (regulation)	different conditions needed
28.	[ ] mode_automatic	regulation, same function as choosed by bus signal „heating	different conditions needed

	Testmode	Outputs to be set on	Input conditions
		- no emergency mode (BY010) - supply fans (BY006) - exhaust fan (BY011) - flap position, airheater, cooling unit and all convection heaters depends on ambient conditions (regulation)	
29.	[ ] mode_fire	- no emergency mode (BY010) - supply fans (BY006) - exhaust fan (BY011) - flap to position „100% fresh air"	- 400V OK (BA018=1L) - duct temperature < 80°C

1.2 Failure mode

1.2.1 Sensor error

In case of defect analog sensors (short circuit or open loop) the units will be work in reduced function:

Sensor error	Effect
supply air sensor defect (AA009)	no duct temp. regulation, only room regulation with a heating capacity limited to 50%, (controlled by the room sensors and switched off by the thermostats in the unit due to high temperature), no cold blowing limitation in cooling mode
room temp. saloon 1 defect (AA004)	room will be controlled by the room temperatures of the other saloons (middle value)
room temp. saloon 2 defect (AA003)	room will be controlled by the room temperatures of the other saloons (middle value)
room temp. saloon 3 defect (AA002)	room will be controlled by the room temperatures of the other saloons (middle value)
all room temperature sensors of all saloons defect	no influence of room temperature in regulation, supply air temperature will be like room temp. reference (set point) with the influence of outside temperature, convection heaters in the saloons will be controlled by the room temperature in both vestibules with the influence of outside temperature
all room and supply air sensors defect	no airheating possible, no cooling possible, convection heaters in the saloons will be controlled by the room temperature in both vestibules with the influence of outside temperature
room temperature vestibule 1 defect (AA001)	convection heater vestibule 1 will be controlled by the temperature in vestibule 2
room temperature vestibule 2 defect (AA010)	convection heater vestibule 2 will be controlled by the temperature in vestibule 1
all room temperature	vestibules will be controlled by the saloon temperature

Sensor error	Effect
sensors of the vestibule defect	(middle value)
outside air sensor defect	switch to fixed value (21°C)
room temperature sensor WC defect (AA006)	WC will be controlled by the saloon temperature (middle value)

1.2.2 Detection of too cold rooms

It is possible to try a compensation of a convection heater fault with the other existing heater groups (convection heater) and with the airheater. If the controller detects one or more rooms with too cold room temperature the software will switch into a special heating mode (requirement: automatic mode or heating mode and 1000V active for minimum 1 hour, depending on the outside temperature).

fault	fault condition	fault indication output	Effect of fault	Reset of fault
1.	one room is too cold (convection heater 100% on, for **15 minutes** there is a deviation to the set point for more than **-3K**)	--	The regulation will a) heat up the vestibule (convection heater vestibule) with **TR$_w$+3K** b) set the value for supply air higher (**10 %**)	If that cold room will be getting warmer (less than **-2K** to set point) the regulation will be work normal.
2.	fault no.1 will be present **10 times in 5 hours**	permanent warning	The regulation will a) heat up the vestibule (convection heater vestibule) with **TR$_w$+3K** b) set the value for supply air higher (**10 %**)	If that cold room will be getting warmer (less than **-2K** to set point) the regulation will be work normal.
3.	Two rooms are too cold (both convection heater 100% on, for **15 minutes** there is a deviation to the set point for more than **-3K**)	warning	The regulation will a) heat up the vestibule (convection heater vestibule) with **TR$_w$+3K** b) set the value for supply air higher (**10 %**)	If both rooms will be getting warmer (less than **-2K** to set point) the regulation will be work normal.

fault	fault condition	fault indication output	Effect of fault	Reset of fault
4.	All three rooms are too cold (all convection heater 100% on, for **15 minutes** there is a deviation to the set point for more than **-3K**)	alarm	The regulation will a) heat up the vestibule (convection heater vestibule) with **TR$_w$+3K** b) set the value for supply air higher (**10 %**)	If all rooms will be getting warmer (less than **-2K** to set point) the regulation will be work normal.

1.2.3 Mode „fire"

In case of a „fire" signal given by the CAN-bus following procedure will be started:
- the cooling unit and all heaters are switched off
- the supply fans and the exhaust fan are switched on
- the flap will drive to position „100% outside air"

The fans will be switched off if the duct temperature is higher than 80°C
(switch on again if duct is less than 40°C).

1.3 CAN-bus information

By the RS458 interface and with the HFG - CAN-bus the FPC20/2 controller gets additional information

- about the choosed mode (OFF, ventilation mode, heating mode, automatic mode)
- about the choosed setpoint (19 .. 23°C)
- about the power supply (400V ok, 1000V ok)
- about the test modes (choosed from the the car bus or from the drivers cab controller)

The FPC20/2 controller will give status and service informations (errors) to the CAN-bus.

1.4 Modes

The regulation of HVAC system is controlled by a microcontroller FPC20/2.
If the controller is running (supply voltage on) and a valid mode is active (CAN-bus information or digital input „local ventilation" or „local auto" is active) the regulation will start working.

The mode information is given by the „Status SP-X1" Bits (CAN-bus)

bit3	bit2	bit1	choosed mode
0	0	0	OFF

0	0	1	Ventilation
0	1	0	Heating
0	1	1	Automatic

In case of communication error (no CAN-bus information) the software will choose the mode „OFF" automaticly, fix the setpoint to 21°C, set the signals for power supply (400V, 1000V) to zero and will send out an error signal.

If one of the digital inputs „local ventilation" (BA019) or „local auto" (BA020) is active that new mode will be choosed and will overwrite the mode given by the CAN-bus.
In *„local ventilation"* only the supply fans (BY006) and the exhaust fan (BY011) are running and the flap is in position „100% outside air".
In *„local auto"* the whole HVAC unit is working with a fixed room temperature setpoint of 20°C. The signals sendet by the CAN-bus will be ignored. Also the driver´s cab is able to work in normal mode (no information from the RS485-bus is needed).

1.4.1 No emergency mode

If the FPC20/2 controller is running the output „no emergengy" (BY010) is switched on.

1.4.2 Mode „OFF"

No heating / venting / cooling possible.

1.4.3 Mode „Ventilation"

Only ventilation is active. Both supply fans (BY006 and BY007) are on, the exhaust fan (BY011) is running and the flap is in position 100% outside air.

1.4.4 Mode „Heating"

Only ventilation and heating functions are active.
Both supply fans and the exhaust fan are on. The airheater will heat up the supplied air to reach the aimed room temperature. All convection heaters are controlled by the room temperatures. The flap is in position 1, 2 or 3 according table „flap positions" .

If this mode will be switched from the „OFF"-position and the middle room temperature (saloon) is 2K colder than setpoint the mode „preheating" will be choosed automaticly (for maximum 30 minutes). The flap is in position „100% return air".

1.4.5 Mode „Automatic"

All functions (heating, venting, cooling) are available.
Both supply fans and the exhaust fan are on. The airheater or the cooling unit will controll the supplied air to reach the aimed room temperature. All convection heaters are controlled by the room temperatures. The flap is in position 1, 2 or 3 according table „flap positions" .

If this mode will be switched from the „OFF"-position and
- the middle room temperature (saloon) is 2K colder than setpoint the mode „*preheating*" will be choosed automaticly (for maximum 30 minutes). The flap is in position „100% return air".
- the middle room temperature (saloon) is 2K higher than setpoint the mode „*precool*" will be choosed automaticly (for maximum 30 minutes). The flap is in position „100% return air".

1.4.6 Set point

For the regulation there is a set point switches placed on the switched panel. The information is binary coded.

„Status SP-X2" Bits (CAN-bus)

bit3	bit2	bit1	set point TR_w
0	0	0	not valid
0	0	1	19°C
0	1	0	20°C
0	1	1	21°C
1	0	0	22°C
1	0	1	23°C

1.5 Regulation

The heating, cooling and ventilation function will be controlled by different regulation circuits. The aimed room temperature is given by the choosed setpoint (incl. UIC553 correcture in case of high outside temperature):

$TR = TR_w + 0.25*(TO-19°C)$ (for outside temperature >19°C)

The setpoint TR_w is given by the „Status SP-X2" Bits .

1.5.1 Air duct regulation

The air condition unit will be controlled by the room temperatures of the three saloons. The room with the highest cooling demand will influence the nominal duct temperature. All other rooms will be also controlled by the convection heaters to prevent a cold room.

The nominal duct temperature is a function of
- room temperature (main regulation)
- room temperature set point (switch)
- outside temperature

The minimal duct temperature is fixed to 5°C.

1.5.2 Regulation convection heater saloon

Each saloon has its own convection heater group so it is possible to control each room by ist own heating demand.
The heating demand is a function of
- room temperature (AA002, AA003, AA004)
- room temperature set point (switch)

1.5.3 Regulation convection heater vestibule

Both vestibule areas are controlled by one convection heater output group.
The heating demand is a function of
- middle value of both room temperatures vestibule 1 and 2 (AA001 , AA010)
- room temperature set point (switch)

1.5.4 Regulation convection heater toilet

The convection heater in the toilet will be controlled by room temperature WC.
The heating demand is a function of
- room temperature toilet (AA006)
- room temperature set point (switch)

1.6 Supply and exhaust fans

Both supply fans and the exhaust fan are switched on together.

The fans will be switched off, if

- no valid mode is selected,
- no 400V power supply are present (BA018= 0L)
- the thermostate supply fans has switched off the relais (BA014=0L during output supply fan is on). The fans will be switched off for 30 sec. If that failure will occure 5 times in 30 minutes the fans are switched off permanent and an error signal will be generated.

1.7 Flap outside / return air

The flaps in the HVAC unit are for to control the fresh air rate.
To bring the flap in a new position the controller will drive the flap to a defined end position („0% outside air") . After getting the end position signal for both flaps (BA001=1L) or after 120 sec. the flap will drive for „x" seconds in the other direction. The correct time for „x" has to be defined during the first tests on the coach. The runtime for the flap from one to the other end is 68 sec.

mode	fresh air rate	return air rate	flap position	seconds from end position
venting (manuel choosed)	1620 m^3/h	380 m^3/h	max. outside air	68sec.
preheating	0 m^3/h	<2000 m^3/h	0% outside air	0 sec.
precooling	0 m^3/h	<2000 m^3/h	0% outside air	0 sec.
heating (T0<-20C)	810 m^3/h	1190 m^3/h	position 1	9 sec
heating (-20C<TO< -5C)	1215 m^3/h	785 m^3/h	position 2	18 sec
heating or cooling (-5C<TO<26C)	1620 m^3/h	380 m^3/h	position 3 (=max. outside air)	68 sec
cooling (TO > 26C)	1215 m^3/h	785 m^3/h	position 2	18 sec

The air flap will be switch off if
- no valid mode is selected

1.8 Air heating command

The airheater is controlled by a regulation circuit to regulate the duct temperature. The nominal duct temperature is a function of room temperatures, room temperature set point and the outside temperature.

The duct regulation is realised by a pulsing heating output. The time shedule for the heating regulation will be 1 minute (max. 60 switches per hour, every minute a new decision how long the heating time will be).

If heating command is less than 5 seconds the controller do not switch on the heater.
If heating command is more than 55 seconds the controller do not switch off the heater.

The airheater will be switch off if
- duct temperature is too high (more thanTR_w+10K, AA009) (switch off for minimum 30 sec.), in case of diagnosis „too cold room" the max. duct temperature is fixed to 40°C
- no airflow is detected (BA016=0L) (switch off for minimum 30 sec.)
- no valid mode is selected
- if all room sensors and the supply air sensor are defect
- if the power supply is not available (no 400V, BA018=0L)
- the high voltage is off (bus information „1000V ok")
- the thermostate airheater has switched off the relais (BA004=0L during output airheater is on)
- the thermostate supply fans has switched off the relais (BA014=0L during output supply fan is on)
- if the compressor is on (BY001) and 5 minutes after

1.9 Convection heaters saloon

The convection heaters in all saloons will be controlled by the room temperature sensors in the saloons. Each sensor has its own regulation circuit (room regulation).

The regulation is realised by a pulsing output. The time shedule for the heating regulation will be 1 minute (max. 60 switches per hour, every minute a new decision how long the heating time will be).

If heating command is less than 5 seconds the controller do not switch on the heater.
If heating command is more than 55 seconds the controller do not switch off the heater.

The convection heaters will be switch off if
- no valid mode is selected (all heaters)
- the temperature inside the convection heater is too high (termostate BA007, BA008 and BA009 for each heating group) (switch off for minimum 30 sec.)
- the high voltage is off (bus information „1000V ok")

1.10 Convection heaters vestibule

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The convection heaters in the vestibules will be controlled by both room temperature sensors in vestibule 1 and 2. There is a common output for both heaters (BY012 / TY012).

The regulation is realised by a pulsing output. The time shedule for the heating regulation will be 1 minute (max. 60 switches per hour, every minute a new decision how long the heating time will be).

If heating command is less than 5 seconds the controller do not switch on the heater.
If heating command is more than 55 seconds the controller do not switch off the heater.

The convection heaters will be switch off if
- no valid mode is selected (all heaters)
- the temperature inside the convection heater is too high (termostate BA006=0L or BA010=0L) (switch off for minimum 30 sec.)
- the high voltage is off (bus information „1000V ok")

1.11 Convection heater toilet

In cartype TT is a toilet installed. The convection heaters toilet will be controlled by one room temperature sensor.

The regulation is realised by a pulsing output. The time shedule for the heating regulation will be 1 minute (max. 60 switches per hour, every minute a new decision how long the heating time will be).

If heating command is less than 5 seconds the controller do not switch on the heater.
If heating command is more than 55 seconds the controller do not switch off the heater.

The convection heater toilet will be switch off if
- no valid mode is selected (all heaters)
- the temperature inside the convection heater is too high (termostate BA005=0L) (switch off for minimum 30 sec.)
- if no room temperature sensor is connected (no failure)
- the high voltage is off (bus information „1000V ok")

1.12 Cooling unit

The cooling unit will be controlled by the room temperatures in the saloon. If one or more rooms need cooling capacity and the outside air is not cold enough the cooling unit starts to work. The liquid line valve (BY003) and the first condenser fan (BY008) start 5 sec. before the compressor (BY001) will start.

The second condenser fan will be controlled by a separate pressostate in the HVAC unit (hardware) if output BY008 is active.

After switch off the compressor the output for condenser fan (BY008) is active for additional 60 seconds.

The cooling unit will be switched off due to missing 400V (set compressor and condenser fan off). If the power comes back (BA018=1L) the condenser fan (BY008) is active for 1 minute and after the compressor is able to start.

For a small cooling demand the cooling unit can be work in reduced mode (cool step 1) with an active bypass (valve BY002). If the regulation needs more cooling capacity ythe bypass will be switched off (cool step 2).

After switch on the compressor the high pressure will be controlled by the safety chain. If a high pressure situation is detected (BA003=1L while cooling output BY001 is active) the software will switch off the cooling outputs for the minimum waiting time and will generate an error signal.

120 seconds after switch on the compressor the low pressure switch will be controlled. If a low pressure situation is detected (BA002=0L) the software will switch off the cooling outputs for the minimum waiting time. The compressor is able to start if the low pressure is switched to OK (BA002=1L).
If a low pressure will be detected three times in 30 minutes an error signal will be generated and the cooling unit will switch off permanently.

The time between two compressor starts is fixed to maximum 15 starts per hour.
The minimum waiting time between compressor stop and start is fixed to one minute.

The cooling unit will be switched off, if
- no valid mode is selected
- the control signal „compressor OFF" is active (BA017)
- the duct temperature is too cold (less than 5°C, AA009)
- the outside air is too cold (less than 10°C, AA005)
- no airflow is detected (BA016=0L)
- if all room sensors and the supply air sensor are defect
- if the power supply is not available (no 400V, BA018=0L, fast switch off also for short line breaks >50ms)
- the thermostate supply fans has switched off the relais (BA014=0L during output supply fan is on)
- the thermostate condenser fans has switched off the relais (BA015=0L during output condenser fans is on). The fans will be switched off for 30 sec. If that failure will occure 5 times in 30 minutes the fans are switched off permanent and an error signal will be generated
- the airheater is on (BY009) and 5 minutes after.

1.13 Error messages

If an failure occurs during the normal conditions (valid mode selected) or during the test modes the failure will be switch off parts of the HVAC system. The failure situation will also be sended via CAN-bus to the car bus (bit coding).

All faults will be stored in the error memory of the controller.

1.14 Error memory

The error memory of the microcontroller FPC20/2 is able to store some faults of the units. The memory can be read or erase with a HFG service program or a standard terminal program.

Following are listed all error numbers:

error number	defect (saloon)
01	sensor room temp. vestibule 1 short circuit (AA001)
02	sensor room temp. saloon 3 short circuit (AA002)
03	sensor room temp. saloon 2 short circuit (AA003)
04	sensor room temp. saloon 1 short circuit (AA004)
05	sensor outside short circuit (AA005)
06	sensor room temp. toilet short circuit (AA006) (only TT car)
07	free
08	free
09	sensor duct temp. short circuit (AA009)
10	sensor room temp. vestibule 2 short circuit (AA010)
11	sensor room temp. vestibule 1 open loop (AA001)
12	sensor room temp. saloon 3 open loop(AA002)
13	sensor room temp. saloon 2 open loop (AA003)
14	sensor room temp. saloon 1 open loop (AA004)
15	sensor ouitside open loop (AA005)
16	sensor room temp. toilet open loop (AA006) (only TT car)
17	free
18	free
19	sensor duct temp. open loop (AA009)
20	sensor room temp. vestibule 2 open loop (AA010)
21	AIC failure (internal hardware error)
22	c0 failure (internal hardware error)
23	c1 failure (internal hardware error)
24	high pressure failure (BY001=1L but BA003=0L)
25	low pressure failure (3 times in 30 minutes)
26	overtemp. airheater (thermostate BA004=0L during heating, 5 times in 30 minutes)
27	overtemp. supply fans (thermostate BA014=0L during BY006=1L, 5 times in 30 minutes)
28	overtemp. condenser fans (thermostate BA015=0L during BY008=1L, 5 times in 30 minutes)

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error number	defect (saloon)
29	overtemp. toilet heater (thermostate BA005, 5 times in 15 minutes)
30	overtemp. vestibule 1 heater (thermostate BA006, 5 times in 15 minutes)
31	overtemp. saloon 1 heater (thermostate BA007, 5 times in 15 minutes)
32	overtemp. saloon 2 heater (thermostate BA008, 5 times in 15 minutes)
33	overtemp. saloon 3 heater (thermostate BA009, 5 times in 15 minutes)
34	overtemp. vestibule 1+2 heater (thermostate BA010, 5 times in 15 minutes)
35	airflow fault (supply fans active and 5 minutes no responce, BA016=0L)
36	room temperature saloon 1 too cold (10 times in 5 hours, room colder than TR_w-3K)
37	room temperature saloon 2 too cold (10 times in 5 hours, room colder than TR_w-3K)
38	room temperature saloon 3 too cold (10 times in 5 hours, room colder than TR_w-3K)

error number	defect (driver´s cab)
101	driver´s cab: sensor outside temp. defect (AA001)
102	driver´s cab: sensor duct temp. defect (AA002)
103	driver´s cab: sensor room temp. defect (AA003)
104	setpoint switch defect (AA004)
105	driver´s cab: c0 failure (internal hardware error AIC, analog input control)
106	driver´s cab: c1 failure (internal hardware error AIC, analog input control)
107	driver´s cab: low pressure failure (3 times in 30 minutes)

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2 Interface to system software FPC20/2

2.1 Supply voltage

SW adress	connector X..	meaning
	104:1	P24V DC
	104:2	N24V DC

2.2 Analog inputs (NTC sensor)

SW adress	connector X..	meaning
AA001	402:9	room temperature vestibule 1
	402:10	AGD (analog ground)
AA002	402:7	room temperature saloon 3
	402:8	AGD
AA003	402:5	room temperature saloon 2
	402:6	AGD
AA004	402:3	room temperature saloon 1
	402:4	AGD
AA005	402:1	outside temperature
	402:2	AGD
AA006	403:9	room temperature WC *(only car typ TT)*
	403:10	AGD
AA007	403:7	---
	403:8	AGD
AA008	403:5	---
	403:6	AGD
AA009	403:3	duct temperature
	403:4	AGD
AA010	403:2	room temperature vestibule 2
	403:1	AGD

2.3 Analog input (4-20mA) (not in use)

SW Adress	connetor X..	meaning
	401:3	VCC (24V output voltage)
AA081	401:4	messured input 4-20mA
	401:1	VCC (24V output voltage)
AA082	401:2	messured input 4-20mA

2.4 Digital inputs

SW Adress	connector X..	meaning
BA001	701:1	end position flap
BA002	701:2	low pressure OK
BA003	701:3	safety chain OK
BA004	701:4	thermostate airheater ok
BA005	701:5	temp. WC OK
	701:6	N24V DC
BA006	701:7	temp. vestibule 1 ok
BA007	701:8	temp. saloon group 1 ok
BA008	701:9	temp. saloon group 2 ok
BA009	701:10	temp. saloon group 3 ok
BA010	701:11	temp. vestibule 1+2 ok
	701:12	N24V DC

SW Adress	connector X..	meaning
BA011	702:11	---
BA012	702:10	---
BA013	702:9	---
BA014	702:8	thermostate supply fans ok
BA015	702:7	thermostate condenser fans ok
	702:6	N24V DC
BA016	702:5	airflow OK
BA017	702:4	compressor OFF
BA018	702:3	400V ok
BA019	702:2	local ventilation
BA020	701:1	local auto

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2.5 Relais outputs

SW Adress	connector X..	meaning
	301:1	P24V DC
BY001	301:2	compressor on
BY002	301:3	mv bypass
BY003	301:4	mv liquid line
BY004	301:5	flap recirc. air
BY005	301:6	flap outside air
	302:1	P24V DC
BY006	302:2	supply fans
BY007	302:3	---
BY008	302:4	condenser fan on
BY009	302:5	airheater
BY010	302:6	**no** emergency mode
	501:6	P24V DC
BY011	501:5	exhaust fan
BY012	501:4	conv.heat vestibule
BY013	501:3	conv.heat saloon group 3
BY014	501:2	conv.heat saloon group 2
BY015	501:1	conv.heat saloon group 1
	502:6	P24V DC
BY016	502:5	---
BY017	502:4	---
BY018	502:3	---
BY019	502:2	---
BY020	502:1	conv.heat toilet *(only car typ TT)*

2.6 Analog output (not in use)

SW Adress	connector X..	meaning
AY001	404:1	0..10V DC
	404:2	GND

2.7 Interface CAN-BUS

SW Adress	connector X..	meaning
	101:1	resistor
	101:2	CAN high
	101:3	CAN low
	101:4	GND
	102:1	resistor
	102:2	CAN high
	102:3	CAN low
	102:4	GND

2.8 Serial interface RS232C

SW Adress	connector X..	meaning
	103:1	TX
	103:2	GND
	103:3	RX

2.9 DIP-switches (on board)

SW Adress	switch	meaning
BA021	S1	DIP 1.1 (CAN)
BA022	S1	DIP 1.2 (CAN)
BA023	S1	DIP 1.3 (CAN)
BA024	S1	DIP 1.4 (CAN)
BA025	S2	DIP 2.1 (application software „on")
BA026	S2	DIP 2.2
BA027	S2	DIP 2.3
BA028	S2	DIP 2.4