HYDROBOX

Y-HB 450-850 V(P)J3.2

HEAT EXCHANGER UNIT FOR AIR/WATER SYSTEMS WITH CONTROL

OPERATION MANUAL

(V1a-08/2021 – BASED ON SOFTWARE VERSION 3.2.9)

CONTENT

1.   GENERAL DESCRIPTION

The controller in the Hydrobox controls and monitors the components installed such as the primary pump and heat exchanger. Additionally, the controller forms the interface between a higher-level control or building control system (BMS) and a gas engine heat pump, type ENCP 450-850 J.

The controller controls the function modes "Cooling" or "Heating", the output request to the gas engine heat pump and the overheating or the opening degree of the electronic expansion valve on the heat exchanger and the water-side circulation pump.

Several input configurations are possible which allow control and request via a BMS. In addition, an internal control can be activated as well as a communication with the heat pump manager. Possible signals are 0-10 V, 4-20 mA as analogue as well as various digital signals or a Modbus connection (Modbus RTU). An interface card is optionally available for Modbus TCP/IP, BACnet or SNMP. The function of the signal contacts in the BMS can be configured. A collective error notification is available in each configuration.

The internal control system is able to drive moving setpoints and to determine switch-on points by means of the outside temperature with night lowering. The control can take into account one or two buffers or a system sensor and control the actual value accordingly. If no system sensor is available, the control can also be performed via the system return flow. The control is always performed on the primary side. Subsequent control elements for the heating and cooling circuit must always be used. It must likewise be ensured that the circulation pumps in the system can determine their volume flow themselves. The series connection of circulation pumps (generator mode) is not permitted.

The heat recovery controller requires an additional heat buffer sensor and is activated when the engine temperature is high enough. The internal controller loads the heating buffer tank up to the set threshold. For external use of the heat recovery, there is a contact for the on-site BMS, which is switched when the engine temperature is high enough.

Optionally, a cascade manager can be activated to control up to 8 gas engine heat pumps. This contains an automatic base load change according to the "First in - first out" principle which can be switched off. The request can be made via an external power or temperature request with mode preselection or via the internal control. In the case of two connected buffers and corresponding input configurations, the cascade manager can simultaneously control the temperature in both buffers.

Likewise, the control of an additional generator can be optionally activated. This can be a cooling or a heating device. The additional generator is integrated in the buffer tank. The heat pump manager is required to control the total flow temperature by integrating the additional generator in the flow to the distributor.

2. CONTROLLER OPERATION

The display installed in the front of the Hydrobox is used to display and operate the actual controller

Properties:
- Display for operation and visualisation
- Lighting is switched on for 15 minutes by pressing a button
- Switch between fields with the ENTER button
- Changing the values with the "UP" and "DOWN" buttons

ALARM button   UP button

MENU button   ENTER button

BACK button   DOWN button
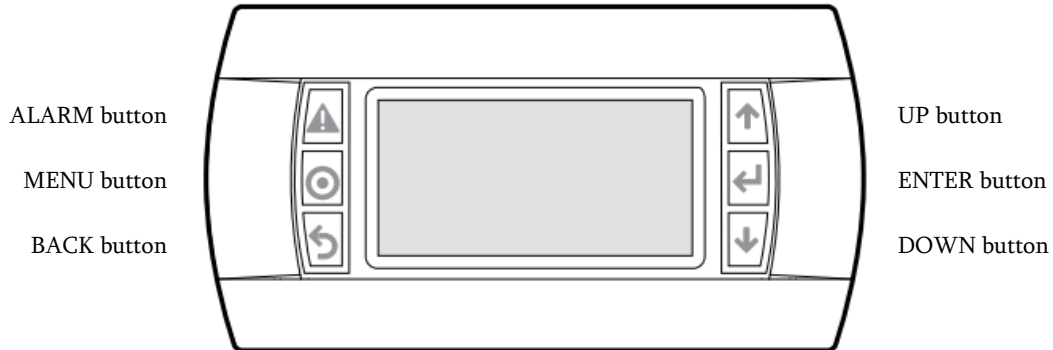
The display templates stored in the controller contain, at the highest level, the GENERAL level, display templates in which the user of the system already receives a great deal of information about the system. Below this level there is a menu structure that simplifies the display and the setting of many other parameters. The input is partly protected by passwords. If a password prompt appears, you must enter the appropriate password by pressing or holding down the UP or DOWN button.

2.1 Display templates GENERAL level

After the Hydrobox is energised, a start-up screen appears:

Template 1
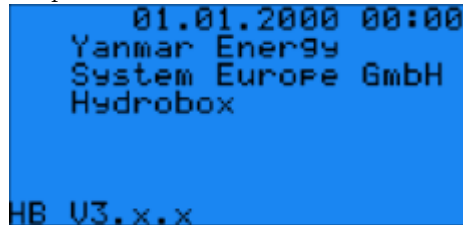
The date and time, the manufacturer and the installed software version of the Hydrobox appear.

```
   01.01.2000 00:00
Yanmar Energy
System Europe GmbH
Hydrobox



HB V3.x.x
```

The following templates display various system data, depending on the selected input configuration and other settings. The UP and DOWN buttons can be used to switch between templates.

Template 2
(for input configuration 01, 02, 15 and 16):

Pump request [V]		GEHP request [%]
Flow switch status		GEHP mode
Water inlet temperature		Suction gas / hot gas temp.
Capacity control setpoint [%]		Plate pressure-temp.
Actual capacity value [%]		E-valve opening degree [%]
Water outlet temperature		Injection / condensate temp.

```
Pump   00.0   GHP   0000
 no                    Off
00.0              000.0
     000           00.0
     000          000.0
00.0              00.0
```

Template 3
(for input configuration 03 to 14, 17 and 18):

Pump request [V]		GEHP request [%]
Flow switch status		GEHP mode
Water inlet temperature		Suction gas / hot gas temp.
Temperature setpoint		Plate pressure-temp.
Actual temperature		E-valve opening degree [%]
Water outlet temperature		Injection / condensate temp.

```
Pump   00.0   GHP   0000
 no                    Off
00.0              000.0
  S:00.0          00.0
  A:00.0         000.0
00.0              00.0
```

Template 4
(for all input configurations):

Evaporation- / condensing temp.

E-valve opening degree [%]		
E-valve opening degree [steps]		Suction gas / hot gas temp.
Evaporation / condensing pressure		
Injection / liquid temperature		E-valve release
Superheating		E-valve forced opening

```
000.0%  T0/TC  TS/TD
000.0st 00.0 ‡ 000.0 ‡

P0 00.0  bar
Ti 00.0  ‡ Digin1 Off
SH 00.0  K Digin2 Off
```

The following templates appear in the following:

Template 5

```
Ext./BCS inputs
Release/switch      Off
Release+MB-BCS      Off
Presel.mode        heat.
Quiet mode          Off
Input config.        1
Pump config.       Auto
```

The external inputs for release, mode pre-selection and silent mode as well as information on the selected HB input configuration and pump configuration are displayed here.

Template 6

```
Actual values
HB inlet         00.0 °C
HB outlet        00.0 °C
Ref.gaseous     000.0 °C
Ref.liquid       00.0 °C
Press.-temp.     00.0 °C
```

The current water and refrigerant temperatures of the Hydrobox are displayed here.

Template 7

```
Actual values
Outside temp.    00.0 °C
Average temp.    00.0 °C
Heat.buffer      00.0 °C
Cool.buffer      00.0 °C
Main sensor      00.0 °C
```

Here, depending on the parameterisation, various current external temperatures, e.g. of the buffer tank are displayed. If an outdoor sensor is connected, this temperature is also displayed.

Template 8

```
Cascade control
Act.val.heat.    00.0 °C
Setpoint heat.   00.0 °C
Release heat.        No
Heat.active         Yes
Ctrl.deviation  000.0%
Ctrl.release    000.0%
```

<u>Display only with cascade control (Master):</u>
Data for the heating mode of the cascade control for the Master are displayed here.

Template 9

```
Cascade control
Act.val.cool.    00.0 °C
Setpoint cool.   00.0 °C
Release cool.        No
Cool.active         Yes
Ctrl.deviation  000.0%
Ctrl.release    000.0%
```

<u>Display only with cascade control (Master):</u>
Data for the cooling mode of the cascade control for the Master are displayed here.

Template 10

```
Slave control
Act.value        00.0 °C
Setpoint         00.0 °C
Release heat.        No
Heat.active          No
Ctrl.deviation  000.0%
Ctrl.release    000.0%
```

<u>Display only with cascade control (Slave):</u>
Data for the heating mode of the cascade control for the Slave are displayed here.

Template 11

```
Slave control
Act.value      00.0 °C
Setpoint       00.0 °C
Release cool.      No
Cool.active        No
Ctrl.deviation 000.0%
Ctrl.release   000.0%
```

Display only with cascade control (Slave):
Data for the cooling mode of the cascade control for the Slave are displayed here.

Template 12

```
Temperature control
Act.val.heat.   00.0 °C
Setpoint heat.  00.0 °C
Basic setpoint  00.0 °C
Release heat.       Off
Ctrl.deviation     000%
Ctrl.release       000%
```

Display only with corresponding input configurations:
Values for the heating mode of the temperature control are displayed here.

Template 13

```
Temperature control
Act.val.cool.   00.0 °C
Setpoint cool.  00.0 °C
Basic setpoint  00.0 °C
Release cool.       Off
Ctrl.deviation     000%
Ctrl.release       000%
```

Display only with corresponding input configurations:
Values for the cooling mode of the temperature control are displayed here.

Template 14

```
Capacity control
Release/switch     Off
Presel.mode       Heat.
Request            000%
Mode               Off
Ctrl.deviation     000%
Ctrl.release       000%
```

Display only with corresponding input configurations (Master):
Values for the heating mode (as well as cooling mode) of the capacity control for the Master are displayed here.

Template 15

```
Capacity slave
Release/switch     Off
Presel.mode       Heat.
Modb.request       000%
Int.request        000%
Ctrl.deviation     000%
Ctrl.release       000%
```

Display only with corresponding input configurations (Slave):
Values for the heating mode (as well as cooling mode) of the capacity control for the Slave are displayed here.

Template 16

```
Temperature control
Control active     Off
Act.value      00.0 °C
Setpoint       00.0 °C
Output value       000%
Mode               Off
Operation          Off
```

Display only with corresponding input configurations:
Values of the temperature control are displayed here.

Template 17

```
Capacity request
Ext.request        Off
Control active     Off
Setpoint          000%
Output value      000%
Mode               Off
Operation          Off
```

Display only with corresponding input configurations:
Values of the requested capacity are displayed here.

Template 18

```
GHP stage request
Ctrl.request      000%
Min.max.request   000%
System on          Off
Ctrl.release       Off
Controll active    Off
St.-switch.req.   000%
```

Display only with corresponding input configurations:
Values of the requested GEHP stage are displayed here.

Template 19

```
HB pump
Act.value        00.0K
Setpoint         00.0K
Request            Off
```

Values of the pump control for the temperature spread as well as information on whether the pump is currently requested are displayed here.

Template 20

```
HB pump
Mode               Off
Power supply        On
Ctrl.request      000%
Thresh.request    000%
Min.-max.request  000%
Analogue val.    00.0V
```

Values of the pump, such as pump mode, request of the pump via the internal control and the resulting voltage output to the pump are displayed here.

Template 21

```
GHP mode         Quiet
Request         On Off
Cool.request    On Off
Ctrl.variable  0000 %
No fault            No
GHP message       Tmax
                   Off
```

GEHP values such as the "noise" mode, the general request and its response, the requested mode and its response, the capacity request, fault freeness and any capacity limitation are displayed here.

Template 22

```
HR pump
Buffer temp.    00.0°C
Threshold       00.0°C
Outlet temp.    00.0 °C
Request            Off
Engine temp.    000.0 °C
Start value     65.0°C
```

Display only for heat recovery:
Values of the various temperatures relevant to heat recovery control, the heat recovery pump request and the temperature of the engine cooling water are displayed here.

Template 23

```
HR pump
Mode              Off
Power supply       On
Ctrl.request      000%
Thresh.request    000%
Min.max.request   000%
Analogue value   00.0V
```

Display only for heat recovery:
Values of the heat recovery pump mode, the request of the heat recovery pump via the internal control and the resulting voltage output to the pump are displayed here.

Template 24

```
Additional heater
Act.value      00.0 °C
Setpoint       00.0 °C

Release           On
Setpoint      009.9°C
Output         00.0V
```

Display only for additional generator heating (temperature setpoint):
Values for the temperature setpoint of the external additional generator heating are displayed here.

Template 25

```
Additional heater
Act.value      00.0 °C
Setpoint       00.0 °C

Release           On
Request          000%
Output         00.0V
```

Display only for additional generator heating (capacity request):
Values for the capacity request of the external additional generator heating are displayed here.

Template 26

```
Additional cooler
Act.value      00.0 °C
Setpoint       00.0 °C

Release           On
Setpoint      009.9°C
Output         00.0V
```

Display only for additional generator cooling (temperature setpoint):
Values for the temperature setpoint of the external additional generator cooling are displayed here.

Template 27

```
Additional cooler
Act.value      00.0 °C
Setpoint       00.0 °C

Release           On
Request          000%
Output         00.0V
```
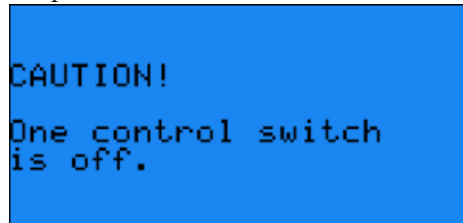
Display only for additional generator cooling (capacity request):
Values for the capacity request of the external additional generator cooling are displayed here.

2.1.1 General information templates

There are general information templates that indicate various system states:
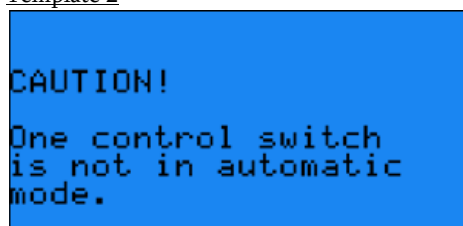
Template 1

CAUTION!

One control switch
is off.

A component such as the GHP, the internal pump, the heat recovery system or the additional generator is switched off.
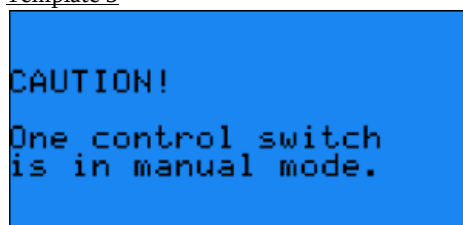
Template 2

CAUTION!

One control switch
is not in automatic
mode.

A component such as the GHP, the internal pump, the heat recovery system or the additional generator is switched off or is in manual mode.
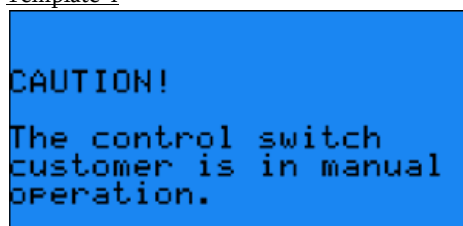
Template 3

CAUTION!

One control switch
is in manual mode.

A component such as the GHP, the internal pump, the heat recovery system or the additional generator is in manual mode
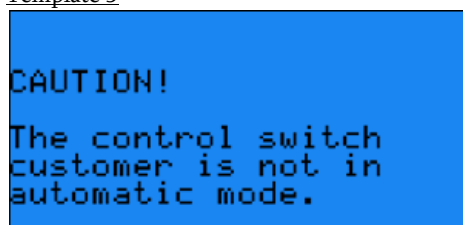
Template 4

CAUTION!

The control switch
customer is in manual
operation.

A component such as the GHP, the heat recovery system or the additional generator is switched off at the customer level.

Template 5

CAUTION!

The control switch
customer is not in
automatic mode.

A component such as the GHP, the heat recovery system or the additional generator is switched off or is in manual mode at the customer level.

Template 6

This message appears when the system is outside the operating limits for heating mode (outside temperature> 35 ° C).
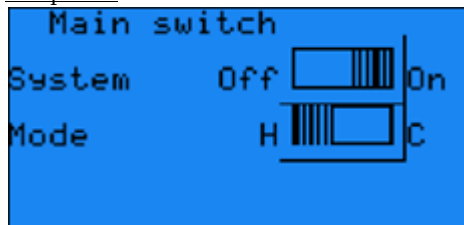
Template 7

This message appears when the system is outside the operating limits for cooling mode (outside temperature <0 ° C, without or <-10 ° C with air guards).

2.2 Display templates CUSTOMER level

Pressing the <u>MENU and ENTER keys simultaneously</u> opens the CUSTOMER level, where various settings can be made without entering a password, i.e. in the manual mode. The setting possibilities depend on the parameters of the respective input configuration, i.e. disabled display templates are not shown in any level.
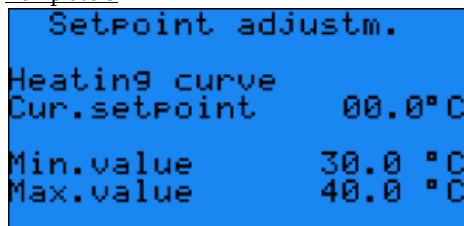
<u>Template 1</u>

The first template enables the system to be switched On/Off.
If the system is not programmed for external mode changeover (i.e. via the BMS), also the operating mode H(eating) or C(ooling) can be changed here.
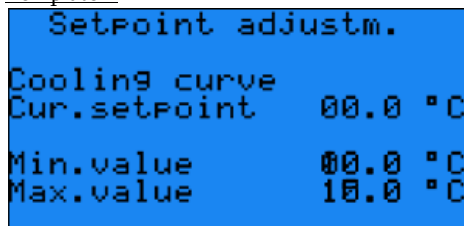
<u>Template 2</u>
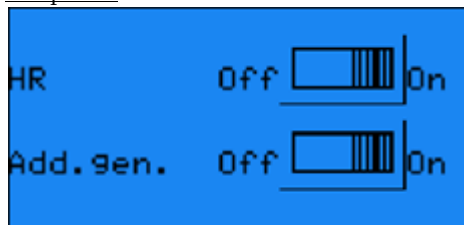
If installed, the H(eat)R(ecovery) or the Add(itional)gen(erator), i.e. the peak load boiler OR the peak load chiller) can be switched On/Off in this template.

<u>Template 3</u>

If a configuration with outdoor temperature sensor is selected for external BMS (i.e. IC09 or 10), the min. / max. values (between 25 and 48 °C) for the heating mode can be adjusted here.

<u>Template 4</u>

If an input configuration with outdoor temperature sensor is selected for external BMS (i.e. IC09 or 10), the min. / max. values (between 6 and 18 °C) for the cooling mode can be adjusted here.

<u>Template 5</u>
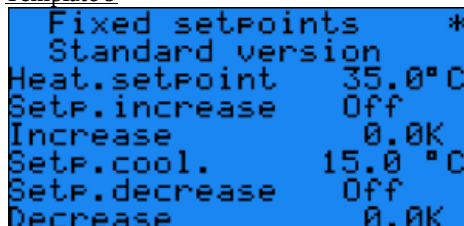
For input configurations 11 and 12 (with fixed setpoints), the heating and cooling setpoints (between 25 - 48 °C and 8 - 18 °C) can be adjusted here. In addition, a setpoint increase in the heating mode, and a setpoint decrease in the cooling mode can be pre-set.

The * indicates that pressing the MENU button will open a help page with an explanation of the template:
Setpoint increase or decrease means the setpoint is increased (Heating) or decreased (Cooling) after the start of the GHP, in order to achieve a switching difference.

Template 6

```
Manual operation

Operation mode      Au
Manual mode     Heating
Manual setpoint 20.0°C
```

In the input configurations 3-18, the mode can be changed from AUTO to MANUAL, the mode between HEATING and COOLING (if the system is intended for both modes) and the SETPOINT between 8 and 48 °C.

Template 7

```
Outside temp.   00.0 °C
Average temp.   00.0 °C

Cooling limit
exceeded          Off
Heating limit
fallen below      Off
```

If an input configuration with outside temperature sensor is selected (i.e. IC 9, 10, 13 or 14), the outside temperature and the average value (for internal switching between heating/cooling) are displayed here. Whether the cooling or heating limit is exceeded does not appear in the case of control via the heat pump manager (i.e. IC 13 or 14).

Template 8

```
Clock settings

Set clock
00.00.2000 00:00
Act.time
01.01.2000 00:00
```

Here, the time currently set in the controller is displayed and can be corrected, if necessary.

3.   ERROR MESSAGES

The system controls and regulates itself automatically. The occurrence of faults is largely prevented independently by control and protective mechanisms (limit control).

If a fault nevertheless occurs, this indicates an unstable operating condition. Therefore, an occurring fault may be acknowledged only once without consulting YANMAR.

In the event of a fault, the ALARM button on the display flashes. After pressing this button, the latest pending error appears as text on the display. Using the UP or DOWN button you can switch between the currently pending faults.

To see details of the fault you have to go to the menu ALARM MEMORY.

ALARM button		UP button
MENU button		ENTER button
BACK button		DOWN button
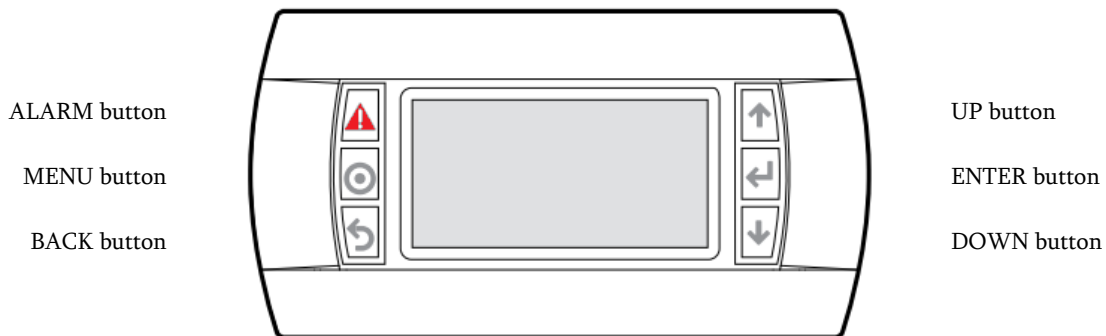
An acknowledgment is made by pressing the ENTER button for 3 seconds.

A fault should not be acknowledged often, as it could be due to a system technical problem.

If it is a fault that cannot be acknowledged, contact your system manufacturer.

3.1   Menu ALARM MEMORY

In the alarm memory (Menu -> Alarm memory) the last 50 messages are stored.

The display of a fault is structured as follows:

Date / time
Current fault (1-50)
Error status
Main code of GEHP fault / sub code of GEHP fault

T0 (evaporation/condensing temp.)/ Tin (water inlet temp.)
Ti (injection/liquid temp.) / Tout (water outlet temp.)
PU (request) / GHP (request)

The "Threshold switch-off too often" error message described in chapter 8.2 occurs when the following warnings have occurred together 48 times within 24 hours:

Warning	Description / meaning
Pump force temp.	This warning occurs when the circulating pump has been requested in forced operation due to exceeding or falling below various threshold temperatures.
Pump force operat. GHP	This warning occurs when the GHP was running due to special programs although it was not requested by the controller.

3.2 List of general error messages

The error messages of the Hydrobox can be as follows:

Error message	Description / meaning
Additional generator	The additional generator has a fault.
Cascade offline Master Hydrobox 1	The bus connection of the Master, Hydrobox 1, is not available.
Cascade offline Slave 1 (-7) Hydrobox 2 (-8)	The bus connection of the Slave 1 (-7), Hydrobox 2(-8), is not available.
Collective fault HPM 1 (2)	The heat pump manager 1 (2) has a fault.
Expansion valve Battery fault	The battery of the expansion valve is defective.
Expansion valve Configuration fault	The configuration of the expansion valve driver is faulty.
Expansion valve EEPROM fault	The EEPROM of the expansion valve driver is faulty.
Expansion valve Fault sensor S1 Pressure sensor	The pressure transducer is faulty.
Expansion valve Fault sensor S2 Temperature sensor	The suction line sensor is faulty.
Expansion valve Firmware fault	The firmware of the expansion valve driver is faulty.
Expansion valve Low pressure	The minimum operating pressure has not been reached.
Expansion valve Low superheating	The evaporator overheating was too low for a certain period of time.
Expansion valve MOP fault	The protective function of the expansion valve was triggered due to too high suction pressure.
Expansion valve Motor fault	The expansion valve motor is faulty.
Expansion valve Not online	No communication with the internal expansion valve controller can be established.
Expansion valve Out of order	The expansion valve is not ready.

(Continuation of general error messages)

Error message	Description / meaning
Expansion valve Suction temperature too low	The minimum suction gas temperature has not been reached.
Expansion valve Valve performed an emergency shutdown	The expansion valve has carried out an emergency closure.
Expansion valve Valve does not close completely	The expansion valve does not close completely.
Frost protection Heat exchanger	The minimum refrigerant/water temperature has not been reached.
Gas heat pump Code xx-x	The gas engine heat pump has a fault (see 8.3).
Gas heat pump Maintenance is due	The engine maintenance on the GEHP is to be carried out shortly (pre-alarm, at 9,500 h).
Gas heat pump Mode response cooling	The GEHP does not switch to cooling mode despite the request.
Gas heat pump Mode response heating	The GEHP does not switch to heating mode despite the request.
Gas heat pump Operation response	Feedback GEHP: after 15 minutes request the GEHP has not started.
Heat recovery Flow switch or pressure switch	The flow switch or the pressure switch of the heat recovery has triggered.
Heat recovery Motor protection pump	The engine protection of the heat recovery pump has triggered.
Modbus / BACnet BMS offline	The bus connection to the BMS is not available.
Modbus offline HPM 1 (2)	There is no communication with the heat pump manager 1 (2).
Primary pump Flow switch bridged or pump ext. driven	The flow monitor has detected a flow, even though the primary pump is off.
Primary pump Flow switch measures no flow	The flow switch has fallen despite the primary pump in operation.
Primary pump Motor protection	The engine protection of the primary pump has triggered.

(Continuation of general error messages)

Error message	Description / meaning
Temperature sensor Cooling buffer	The cooling buffer temperature sensor is faulty.
Temperature sensor Heating buffer	The heating buffer temperature sensor is faulty.
Temperature sensor HR buffer	The heat recovery buffer temperature sensor is faulty.
Temperature sensor HR eng. temp.	The heat recovery engine temperature sensor is faulty.
Temperature sensor HR outlet temp.	The heat recovery outlet temperature sensor is faulty.
Temperature sensor Hydrobox inlet	The inlet temperature sensor is faulty.
Temperature sensor Hydrobox outlet	The outlet temperature sensor is faulty.
Temperature sensor Injection/suction gas line	The injection or hot gas temperature sensor is faulty.
Temperature sensor Main sensor	The main temperature sensor is faulty.
Temperature sensor Outside temperature	The outside temperature sensor is faulty.
Threshold switch-off too often	This fault means that the warnings "Pump force temp." and "Pump force operat. GHP" together have occurred 48 times within 24 hours (see 8.1).
Watchdog bus failure GHP connection	The bus connection to the gas engine heat pump is not available.
Wiring diagram not selected	The wiring diagram suitable for the Hydrobox was not selected.

3.3 List of error messages of the gas engine heat pump

The codes in the general error message „Gas heat pump, Code xx-x= have the following meanings:

Main code	Sub code(s)	Description
E0	0 to 1	Engine start is faulty, Gas Low-Pressure Switch Faulty
E1	0	Engine Overspeed
E2	0 to 1	Engine stall, Gas pressure low
E3	0	Engine oil pressure too low
E4	0 to 1	Abnormal Cooling Water Temperature
E6	0 to 4	Abnormal Discharge Temperature
E7	0 to 5	Abnormal High-Side Pressure
E9	0	Abnormal Low-Side Pressure
EA	0	Abnormal EEPROM
EH	0 to 2	Software Version Mismatch / Circuit Board Mismatch
F0	0	Starter System Failure
F2	0	Outdoor Fan Failure
F3	0	Oil Pressure Switch Failure
F4	0 to 1	Cooling Water Temperature Sensor Disconnected / Shorted
F6	0 to 5	Discharge Temperature Sensor Disconnected / Shorted
F7	0	Abnormal Engine Room Temperature
F9	0 to 1	Short of Refrigerant, Mixer Failure
FH	0, 2, 3	Short of Refrigerant Oil
FJ	0 to 1	Abnormal High-Side Differential Pressure
H0	0 to 4	Engine Misfiring
H1	0 to 2	Compressor Clutch Failure
H6	0	Indoor Unit (here: Hydrobox) Electronic Expansion Valve Failure
HA	0 to 7	ROM/RAM Abnormal at Start, Cooling Water Temperature SW Failure at Start, Gas Valve Output Failure at Start, Speed Detection Failure at Start, Abnormal Main Sequence Time at Start, EEPROM Malfunction at Start, High Pressure SW Failure at Start, Sensor Input Failure at Start
HC	0	Abnormal Control Box Temperature
HH	0	Difference between Dual-CPUs
HJ	0	High cooling water temperature
J1	0 to 1	Air-Fuel Ratio Controller Failure
J2	0 to 9, A, C, J, H	Suction Temperature Sensor 1 Disconnected / Shorted
J3	0 to 1	Outdoor Air Temperature Sensor Disconnected / Shorted
J5	0 to 3	Outdoor Unit Electronic Expansion Valve Failure

(Continuation error messages of the gas engine heat pump)

Main code	Sub code(s)	Description
J6	0 to 4	Oil Return Solenoid Valve Failure
J7	0 to 9	High-Side Pressure Sensor System Failure
J8	0	Exhaust Temperature Sensor Disconnected
J9	0 to 1	Low-Side Pressure Sensor Disconnected / Shorted
JA	0 to 9	Compressor Automatic Emergency Run
JF	0 to 1	Receiver Temperature Sensor System Failure
JH	0 to 2	Pressure Sensor Failure
JJ	0 to 7	Oil Temperature Sensor Disconnected / Shorted
L1	0	Abnormal Exhaust Temperature
L8	0 to 1	Periodic Inspection Reminder (Note: This is not an error message) In the case of 200 or less hours remaining before the next periodic inspection.
LA	0	Cam Pulse Sensor Disconnected, Malfunction of Engine Pulse Sensor
LE	0 to 1	Starter Relay Failure
LJ	0 to 2	Excess of Periodic Inspection Term
P4	0	Optional Equipment Failure (here: Hydrobox)
U2	0 to 5	Inter-CPU Communication Failure / Software Mismatch / ROM Failure
U3	0 to 2	Inter-Unit Communication Failure
U3	5	Modbus Communication Failure To The Optional Device (here: Hydrobox)