

YANMAR

OPERATION MANUAL

(V2-12/2017 – based on software version 3.0.2)

HYDROBOX

KKU-HB 450-850 V(P)J3

HEAT PUMP UNIT FOR AIR/WATER SYSTEMS WITH CONTROL



Data subject to change without notice.

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1 General description

The controller in the Hydrobox regulates and monitors the integral components such as primary pump and heat exchanger. Moreover, the controller acts as the interface between a supervisory system or a building management system (BMS) and a YANMAR gas engine heat pump Type ENCP 450-850 J.

The controller controls the "Cooling" or "Heating" operating mode, the capacity request to GHP unit and superheat value by the opening steps of the electronic expansion valve on the heat exchanger as well as the water-side circulation pump.

Several input configurations are possible, which permit control and demand via a BMS. Moreover, an internal controller can be enabled, plus communication with the heat pump manager KKU-WPM-3K-V2. Analog 0...10 V and 4...20 mA signals or a Modbus connection (Modbus RTU) are available. Optionally, an interface module for Modbus TCP/IP, Bacnet or SNMP is also available. The function of the signalling contacts to the BMS is configurable. A collective fault signal is available in every configuration.

The internal controller is able to detect floating setpoints and switch-on points via the outdoor temperature with night setback. The controller can also take one or two storage buffers or a system sensor into account, and control the actual value accordingly. If no system sensor is available, control can also be effected via the system return flow. In every case, control only acts on the primary side. Downstream control devices must always be provided for the heating & cooling circuits. Also to be ensured is that the system's circulation pumps can determine their volume flow independently. It is not permitted to connect circulation pumps in series (generator operation).

Engine hot water supply control requires a heat buffer sensor, and is enabled in the Cooling mode when the motor temperature is high enough. The control stores the heat up to the adjusted limit value. Optionally, a cascade manager for controlling up to 8 GHP units can be enabled. The manager contains an automatic base load switchover that can be switched off, and operates acc. to the "first in first out" principle. The request can come from an external capacity or temperature request with mode selection, or via the internal controller. With two connected storage buffers and a corresponding input configuration, the cascade manager can control the temperatures in both storage buffers simultaneously.

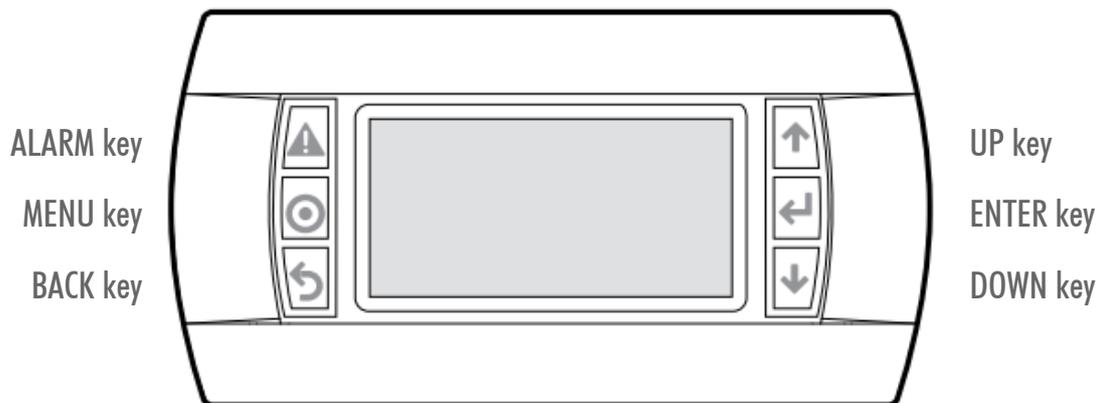
Another optional function is the control of an additional heater/cooler. This can be a cooling or heating unit that is combined with the storage buffer. The heat pump manager KKU-WPM-3K-V2 is necessary for controlling the total outflow temperature by including the additional heater/cooler in the flow to the manifold.

2 Controller operation

The display in the front of the Hydrobox serves as an indicator and to operate the actual controller.

Features:

- Display for operation and visualization
- Illumination is switched on for 15 minutes by pressing a key
- Switching between settings with the ENTER key
- Changing the values with the "UP" and "DOWN" keys

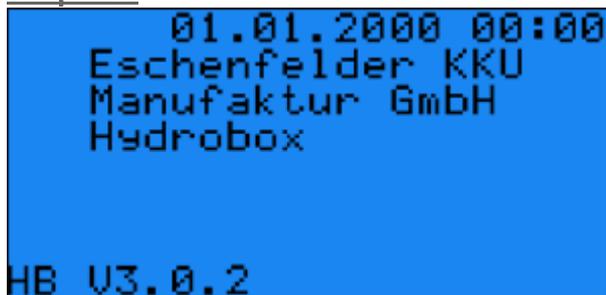


The controller has a GENERAL operating level, in which various templates are accessible. As described below, these templates can be used to display some of the system data, but no adjustments are possible. However, in case of a fault, the displays provide important information for the service partner. In addition, there is a CUSTOMER operating level, in which the user can change certain values. Further adjustments are possible in the MENU operating level (for this, the "Yanmar Control Manual KKU-HB450-850V(P)J3_V2" is necessary).

2.1 Display templates of GENERAL level

As soon as the Hydrobox is connected to the supply voltage, the "Start" display is shown:

Template 1



It shows date and time, the manufacturer, and the installed software version of the Hydrobox.

Depending on selected Input configuration and other settings, various system data are shown in the following display templates. The UP and DOWN keys are used to select the required templates:

Template 2 (with Input configurations 01, 02, 15 and 16)

Pump request [V]	PUMP 00.0	GHP 0000	GHP request [%]
Flow switch status	No	Off	GHP mode
Water inflow temperature	00.0	000.0	Suction gas & hot gas temp.
Capacity setpoint [%]	S 00.0	00.0	Pressure/temp. Heat Exchanger
Actual capacity value [%]	I 00.0	000.0	Liquid (Evap. or cond.) temp.
Water outflow temperature	00.0	00.0	E-valve opening value [%]

Template 3 (With Input configurations 03 to 14, 17 and 18)

Pump request [V]	PUMP 00.0	GHP 0000	GHP request [%]
Flow switch status	No	Off	GHP mode
Water inflow temperature	00.0	000.0	Suction gas & hot gas temp.
Water temp. setpoint	000	00.0	Pressure/temp. Heat Exchanger
Actual water temp.	000	000.0	Liquid (Evap. or cond.) temp.
Water outflow temperature	00.0	00.0	E-valve opening value [%]

Template 4

	Evaporation. or condensing temperature.	
E-valve opening value [%]	000.0%	T0/TC TS/TD
E-valve opening value [steps]	000.0st	00.0 % 000.0 %
Evap. or cond. pressure	Po 00.0	bar
Injection or liquid temp.	Te 00.0	% Digin1 Off
Super Heat	SH 00.0	K Digin2 Off
		Suction gas & hot gas temp.
		E-valve enable
		E-valve forced opening

Subsequently, the following display templates are shown:

Template 5

```

Ext./BMS inputs
Approval/switch      Off
Approval + MB-BMS   Off
Presel.mode          Heat.
Quiet mode           Off
Configuration        01
Pump config.         Auto
    
```

Here, the external inputs for operation on/off, mode selection, and quiet mode, as well as information on the selected HB Input configuration and the pump configuration are shown.

Template 6

```

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

Here, the actual water and refrigerant temperatures of the Hydrobox are shown.

Template 7

```

Actual values
Ambient temp.  00.0 °C
Average        00.0 °C
Heat.buffer    00.0 °C
Cool.buffer    00.0 °C
Main sens.     00.0 °C
    
```

Depending on the parameter settings, various actual external temperatures are shown here, e.g. that of the heat storage buffer. If an outdoor sensor is connected, also this temperature is shown.

Template 8

```
Cascade control
Act.val.heat.  00.0 °C
Setp. heating  00.0 °C
Appr.heating   No
Heat.active    Yes
Ctrl.deviation 000.0%
Ctrl.approval  000.0%
```

Display only with cascade control (Master):

Here, the Heating mode values of the cascade controller for the Master are shown.

Template 9

```
Cascade control
Act.val.cool.  00.0 °C
Setp.cooling   00.0 °C
Appr.cooling   No
Cool.active    Yes
Ctrl.deviation 000.0%
Ctrl.approval  000.0%
```

Display only with cascade control (Master):

Here, the Cooling mode values of the cascade controller for the Master are shown.

Template 10

```
Slave control
Actual value   00.0 °C
Setpoint       00.0 °C
Appr.heat.     No
Heat.active    No
Ctrl.deviation 000.0%
Ctrl.approval  000.0%
```

Display only with cascade control (Slave):

Here, the Heating mode values of the cascade controller for the Slave are shown.

Template 11

```
Cascade control
Act.val.cool.  00.0 °C
Setp.cooling   00.0 °C
Appr.cooling   No
Cool.active    Yes
Ctrl.deviation 000.0%
Ctrl.approval  000.0%
```

Display only with cascade control (Slave):

Here, the Cooling mode values of the cascade controller for the Slave are shown.

Template 12

```

Temp.control
Act.val.heat.  00.0 °C
Set.val.heat.  00.0 °C
Basic setpoint 00.0 °C
Approval heat. Off
Ctrl.deviation 000%
Ctrl.approval  000%

```

Display only with certain Input configurations:

Here, the Heating mode values for the temperature controller are shown.

Template 13

```

Temp.control
Act.val.cool.  00.0 °C
Set.val.cool.  00.0 °C
Basic setpoint 00.0 °C
Approval cool. Off
Ctrl.deviation 000%
Ctrl.approval  000%

```

Display only with certain Input configurations:

Here, the Cooling mode values of the temperature controller are shown.

Template 14

```

Temp.control
Control active Off
Actual value   00.0 °C
Setpoint       00.0 °C
Output value   000%
Mode           Off
Operation      Off

```

Display only with certain Input configurations:

Here, the values for the temperature controller are shown.

Template 15

```

Capacity control
Approval/switch Off
Preselect.mode Heat,
Request         000%
Mode           Off
Ctrl.deviation 000%
Ctrl.approval  000%

```

Display only with certain Input configurations (Master):

Here, the Heating mode values of the capacity controller for the Master are shown.

Template 16

```
Capacity slave
Approval/switch      Off
Presel.mode          Heat,
Modb.request         000%
Int. Request         000%
Ctrl.deviation       000%
Ctrl.approval        000%
```

Display only with certain Input configurations (Slave):

Here, the Heating mode values of the capacity controller for the Slaver are shown.

Template 17

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

Display only with certain Input configurations:

Here, the values of the capacity controller are shown.

Template 18

```
GHP step request
Control request      000%
Min.-max.request    000%
System on           Off
Ctrl.approval       Off
Control active       Off
Step ctrl.request   000%
```

Display only with certain Input configurations:

Here, the values of the capacity controller are shown.

Template 19

```
HB PUMP
Actual value         00.0K
Setpoint             00.0K
Request              Off
```

Here, the pump control values for temperature difference is shown, together with the information whether the pump is presently being requested.

Template 20

```

HB PUMP
Mode                Off
Power supply        On
Control request     000%
Threshold request   000%
Min.-max.request   000%
Analogue val.      00.0V

```

Here, pump values such as pump mode, request for pump via the internal control mechanisms are shown, together with the resulting output voltage to the pump.

Template 21

```

GHP mode           Quiet
Request            On   Off
Request cool.      On   Off
Ctrl.variable      0000 %
No error           No
GHP report         Tmax
                  Off

```

Here, the GHP values such as mode, general request and temperature difference, requested operation mode and feedback, capacity request, error-free operation, and a possible capacity limit are shown.

Template 22

```

HWS PUMP
Buffer temp.       00.0°C
Threshold          50.0°C
Outlet temp.       00.0 °C
Request            Off
Engine temp.       000.0 °C
Start value        65.0°C

```

Display only with engine HWS:

Here, the different temperature values that are relevant for engine HWS control, the HWS pump request, and the engine cooling water temperature are shown.

Template 23

```

HWS PUMP
Mode                Off
Power supply        On
Control request     000%
Threshold request   000%
Min.-max.request   000%
Analogue val.      00.0V

```

Display only with engine HWS:

Here, values for the HWS pump mode, the HWS pump request via the internal control mechanisms are shown, together with the resulting output voltage to the pump.

Template 24

```
Additional heater
Actual value    00.0 °C
Setpoint       00.0 °C

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

Display only with additional heater (setpoint request):

Here, the setpoint request values for the external additional heater are shown.

Template 25

```
Additional heater
Actual value    00.0 °C
Setpoint       00.0 °C

Approval        On
Request         000%
Output         00.0V
```

Display only with additional heater (capacity request):

Here, the capacity request values for the external additional heater are shown.

Template 26

```
Add.cooler
Actual value    00.0 °C
Setpoint       00.0 °C

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

Display only with additional cooler (setpoint request):

Here, the setpoint request values for the external additional cooler are shown.

Template 27

```
Add.cooler
Actual value    00.0 °C
Setpoint       00.0 °C

Approval        On
Request         000%
Output         00.0V
```

Display only with additional cooler (capacity request):

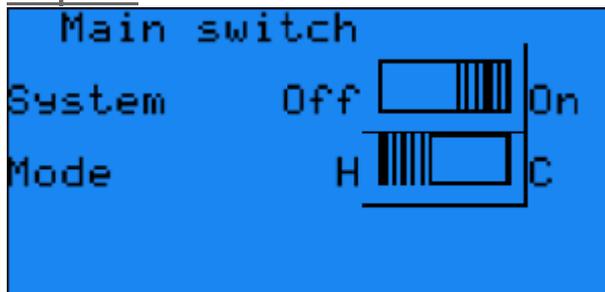
Here, the capacity request values for the external additional cooler are shown.

2.2 Display templates of CUSTOMER level

Pressing the **MENU and ENTER keys simultaneously** 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. the default controller settings. The Input configuration parameters are shown in the GENERAL operating level (Template 5).

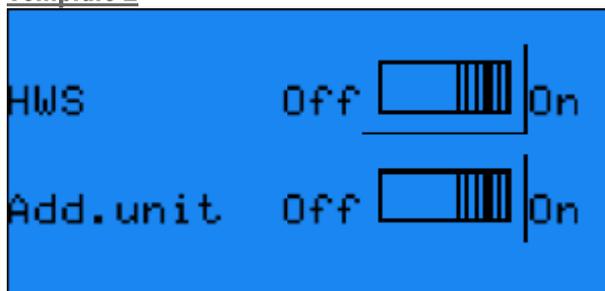
Template 1



The first template enables the system to be switched On/Off.

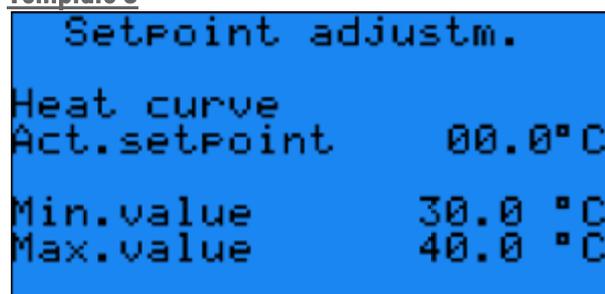
If the system is not programmed for external mode switchover (i.e. via the superordinate BMS), also the operating mode (Heating or Cooling) can be changed here.

Template 2



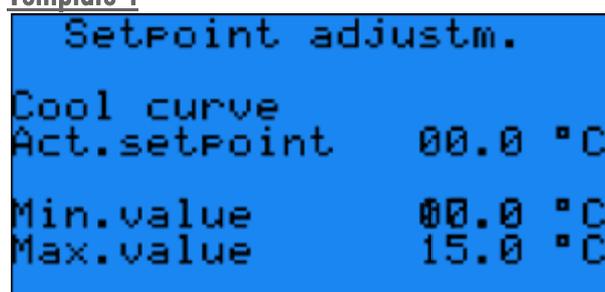
If installed, the engine HWS or the additional heater/cooler (i.e. the peak load boiler OR the peak load chiller unit) can be switched On/Off in this template.

Template 3



If a configuration with outdoor temperature sensor is selected for external BMS (i.e. IC 9 or 10), the min. & max. values (between 27 and 45 °C) for the Heating mode can be adjusted here.

Template 4



If a configuration with outdoor temperature sensor is selected for external BMS (i.e. IC 9 or 10), the min. & max. values (between 10 and 18 °C) for the Cooling mode can be adjusted here.

Template 5

```

Fixed setpoints *
Standard version
Heat.setpoint 35.0 °C
Setp.increase Off
Increase 00.0 K
Cool.setpoint 15.0 °C
Setp.decrease Off
Decrease of 00.0 K
    
```

For Input configurations 11 and 12 (with fixed setpoints), the Heating and Cooling setpoints (27...45 °C and 10...18 °C respectively) can be adjusted here. In addition, a setpoint increase in the Heating mode, and a setpoint decrease in the Cooling mode can be preset.

The * indicates that pressing the MENU key will open a Help page with an explanation of the template: Setpoint increase/decrease means that after starting GHP unit, the setpoint can be lowered (Cooling) or raised (Heating) in order to obtain a switching hysteresis.

Template 6

```

Manual operation
Operation mode Auto
Manual mode Heatin
Manual setpoint 20.0 °C
    
```

For Input configurations 3 to 18, the operating mode can be switched from AUTO to MANUAL, and HEATING or COOLING selected (if the system has been designed for both operating modes). In addition, the setpoint can be adjusted in the range 8...45 °C.

Template 7

```

Ambient temp. 00.0 °C
Average temp. 00.0 °C
Cooling limit exceeded Off
Falling below heating limit Off
    
```

If an Input configuration with outdoor temperature sensor has been selected (i.e. IC 9, 10, 13 or 14), the outdoor temperature and the average value for internal Heating/Cooling switchover are shown here. With control via the heat pump manager (i.e. IC 13 or 14), there is no indication for an exceeded cooling or heating limit.

Template 8

```

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

This template shows the current set time, which can be adjusted/corrected if necessary.

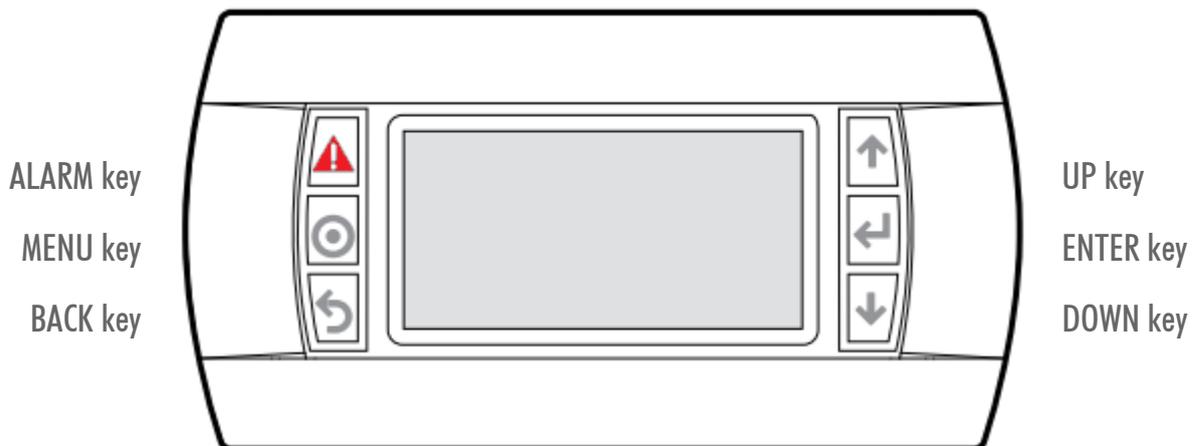
3 Fault messages

The system monitors and controls itself automatically. To a great extent, the occurrence of faults or disturbances is automatically prevented by control and protective mechanisms.

However, should a fault occur, this indicates an instable operating condition. Therefore, such a fault may only be reset fault once without consulting YANMAR partner. If the fault cannot be acknowledged, please contact your system manufacturer.

In case of a fault, the ALARM key on the display flashes. After pressing this key, the currently newest fault is shown in plain text in the display. By means of the UP or DOWN key, you can toggle between the currently existing faults.

Further details about the fault are provided in the ALARM MEMORY menu (see „Controller Manual KKU-HB450-850V(P)J3_V2“).



An alarm is reset by pressing the ENTER key for 3 seconds.

3.1 List of general fault messages

The Hydrobox fault messages can be as follows:

Message	Description / meaning
GHP unit alarm Code: xx-x	Fault in the GHP unit (see Section 3.2).
Expansion valve Batterie fault	Expansion valve battery is defective.
Expansion valve Eeprom fault	Fault in the EEPROM of the expansion valve driver.
Expansion valve Fault in sensor S1 Pressure sensor	Fault in the pressure sensor.
Expansion valve Fault in sensor S2 Temperature sensor	Fault in the suction pipe sensor.
Expansion valve Firmware fault	Fault in the firmware of the expansion valve driver.
Expansion valve Configuration fault	Fault in the configuration of the expansion valve driver.
Expansion valve MOP fault	Expansion valve has been tripped due to an excessively high suction pressure.
Expansion valve Motor fault	Fault in the expansion valve motor.
Expansion valve Not ready for operation	Expansion valve is not ready for operation.
Expansion valve Not online	No communication can be established with the internal expansion valve controller.

(General fault messages continued)

Message	Description / meaning
Expansion valve low pressure	Operating pressure has fallen below minimum value.
Expansion valve low superheat	Evaporator superheat was too low for a certain period.
Expansion valve Suct. gas temperature too low	Suction gas temperature has fallen below minimum value.
Expansion valve triggers an emergency closure	Expansion valve has triggered an emergency closure.
Expansion valve not fully closed	Expansion valve not fully closed.
Freez protection in heat exchanger	Refrigerant or water temperature has fallen below minimum value.
GHP unit Operating response	Response from GHP: The GHP has not started within 15 minutes after request.
GHP unit Heating mode response	GHP does not change to Heating mode in spite of a request.
GHP unit Cooling mode response	GHP does not change to Cooling mode in spite of a request.
GHP unit Maintenance request	GHP maintenance must be carried out soon.
Limit value exceeded too often	This fault means that the internal limit values have been exceeded too often.

(General fault messages continued)

Message	Description / meaning
Cascade offline Master Hydrobox 1	Bus connection of the Master, Hydrobox 1, is not available.
Cascade offline Slave 1 (-7) Hydrobox 2 (-8)	Bus connection of the Slave 1 (-7), Hydrobox 2(-8), is not available.
Modbus / BACnet BMS offline	Bus connection to BMS is not available.
Modbus offline HPM 01 (02)	No communication with the heat pump manager 1 (2).
Engine HWS Motor pump protection	Motor protection of the HWS pump has been tripped.
Engine HWS flow switch or pressure switch	Flow switch or the pressure switch of the engine HWS has been tripped.
Primary pump motor protection	Motor protection of the primary pump has been tripped.
Primary pump generator operation or flow switch jumpered	Flow switch has detected a flow although the primary pump is Off.
Primary pump flow switch signals 'No flow'	Flow switch has been tripped although the primary pump is operating.
Collective alarm HPM 01 (02)	Fault in the heat pump manager 1 (2).
Circuit diagram not selected	Correct circuit diagram for the Hydrobox has not been selected.

(General fault messages continued)

Message	Description / meaning
Temperature sensor Outdoor sensor	Outdoor temperature sensor is faulty.
Temperature sensor Main control	Main temperature sensor is faulty.
Temperature sensor Heating buffer	Heating buffer temperature sensor is faulty.
Temperature sensor Hydrobox outflow	HB outflow temperature sensor is faulty.
Temperature sensor Hydrobox inflow	HB inflow temperature sensor is faulty.
Temperature sensor Cooling buffer	Cooling buffer temperature sensor is faulty.
Temperature sensor engine HWS coolant temperature	Engine HWS temperature sensor is faulty.
Temperature sensor HWS outflow temperature	HWS outflow temperature sensor is faulty.
Watchdog fault in GHP bus connection	Bus connection with GHP unit is not available.

3.2 List of fault messages from GHP unit

The general fault messages "GHP unit alarm 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 not connected or short circuited
F6	0 to 5	Discharge temperature sensor not connected or short circuited
F7	0	Abnormal Engine Room Temperature
F9	0	Short of Refrigerant
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-CPU's
HJ	0	High cooling water temperature
J1	0 to 1	Air-Fuel Ratio Controller Failure
J2	0 to 9	Suction Temperature Sensor 1 Disconnected / Shorted

(Fault messages from gas engine heat pump continued)

Main code	Sub-code(s)	Description
J3	0 to 1	Outdoor temperature sensor not connected or short circuited
J5	0 to 3	Outdoor Unit Electronic Expansion Valve Failure
J6	0 to 4	Oil Return Solenoid Valve Failure
J7	0 to 9	High-Side Pressure Sensor System Failure
J8	0	Exhaust gas temperature sensor not connected or short circuited
J9	0 to 1	Low-pressure sensor not connected or short circuited
JA	0 to 9	Compressor Automatic Emergency Run
JH	0 to 2	Pressure Sensor Failure
JJ	0 to 7	Oil temperature sensor not connected or short circuited
L1	0	Abnormal Exhaust Temperature
L8	0 to 1	Reminder (not a fault message): A regular maintenance is due. -> Message is generated when 200 or less operating hours remain before the next maintenance is due
LA	0	Engine pulse sensor not connected, faulty engine pulse sensor
LE	0 to 1	Starter Relay Failure
P0 *	0	Too many indoor units connected
P3 *	0	Total capacity of indoor units too large
P4	0	Optional equipment failure (here: Hydrobox)
U2	0 to 5	Inter-CPU Communication Failure / Software Mismatch / ROM Failure
U3	0 to 2, 5	Communication fault between the devices
U4	0	Outdoor/Indoor Unit Transmission Failure
UA *	2, 5	Indoor Unit and Remote Control Mismatch

* Does not occur in connection with a Hydrobox.

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