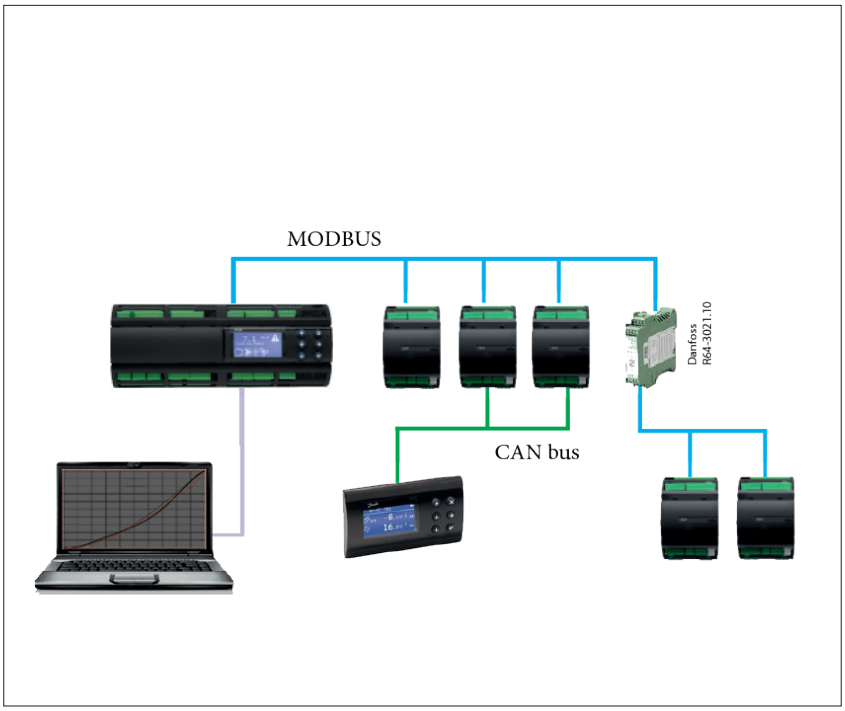
ENGINEERING
TOMORROW

Design guide

DATA COMMUNICATION MODBUS RS 485 RTU

For product type - EKD / EIM controllers



This User guide document provides general information on the setup of Modbus RS-485 networks and explains how to configure the communication between EKD/EIM and a system controller, using the Modbus RTU.

Features

- Simplicity
- Standard Ethernet
- Open protocol
- Availability on many devices

Part 1 - Hardware network specification

Part 2 - Software specification and configuration

Introduction

Making a network means to connect devices together with a communication bus. But to make reliable and high performance networks strict rules must be followed.

References

Modbus specifications, Modbus.org
EIA-485 RS-485 fieldbus specification

Definitions and abbreviations

RTU	Remote Terminal Unit
SW	Software
HW	Hardware
AWG	American Wire Gauge
EKE / EIM / EKD	Superheat Controller/driver
Parameter	The parameter number indicates the number of a given parameter.
Value	Indicates the factory settings.
Type	Group. Group (number) indicates the group the relevant parameter belongs to. The group number is only of importance for presentation in AKM PC software.
PNU	Short for Parameter NUmber. In Modbus terminology it corresponds to the register number which is also often referred to as the offset. The PNU numbers can have values in the range from 1 to 65535. The corresponding Modbus address is found by subtracting 1 from the PNU number. For instance PNU number 117 would correspond to Modbus address 116."

Wiring

Wiring characteristics

The wires should have the following characteristics:
- Characteristic impedance: 120 Ohm +/- 10%;
- Specific resistance depending on network length.
- Cable must be with Screen if the bus cable exceeds 3m.
- The cable is connected from controller to controller and no branches are allowed on the cable
- Each shield must be grounded at one side only.

Wiring types

Two types of wires can be used based on required ruggedness:
1. Twisted pair with ground: short leads, no power lines in proximity.
2. Twisted pair + ground and shield: long leads, disturbed environment.

Recommendations

(Source Modbus.org)

When choosing a transmission line for RS-485, it is necessary to examine the required distance of the cable and the data rate of the system.
An RS485-Modbus must use a balanced pair (for D+-D-) and a third wire (for the Common/Gnd).
For RS485-Modbus, Wire Gauge must be chosen sufficiently wide to permit the maximum length (1000 m). AWG 22 is always sufficient for the Modbus Data.
Category 5 cables may operate for RS485-Modbus, to a maximum length of 600m.
For the balanced pairs used in an RS485-system, a Characteristic Impedance with a value higher than 100 Ohms may be preferred, especially for 19200 and higher baud rates.

Use one twisted pair of conductors for connecting the differential signals and use another conductor (for example a second twisted pair) for connecting the ground.

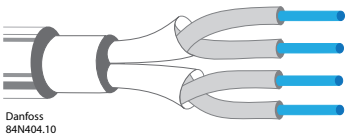


Fig. 1 Connection example

Modbus connections

EKE	EKD	EIM
D+	A+	TxD+
D-	B-	TxD-
Gnd	Gnd	[1]

[1]) Gnd has been omitted from EIM.

Note!

Connection of a twisted cable in a 2-wire Modbus system may cause damages.

RS-485 specific

The RS-485 consists of three wires:
- RS-485-A (D+);
- RS-485-B (D-);
- GND.

The two wires RS-485-A (D+) and RS-485-B (D-) propagate a differential communication signal.
In addition there is the ground wire for the common mode voltage reference.
The recommended maximum Modbus cable length between the EKE(/EKD/EIM) and the system controller should not exceed 1000 meters (3300 feet).

Wire length

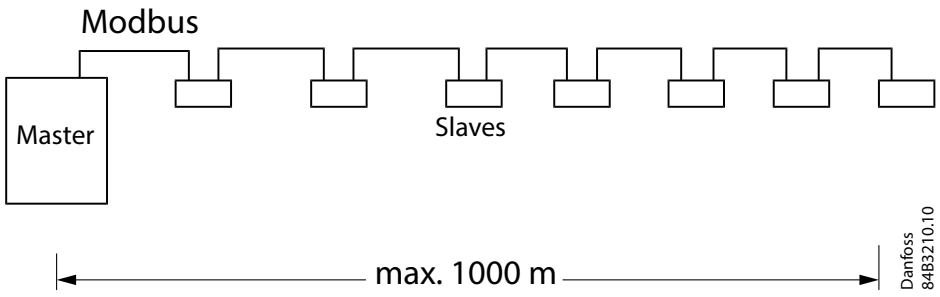
Length (m)	Max. baudrate	Min. Wire size	Suggested types
1000	125 K	AWG22	Belden 3106A / 3107A

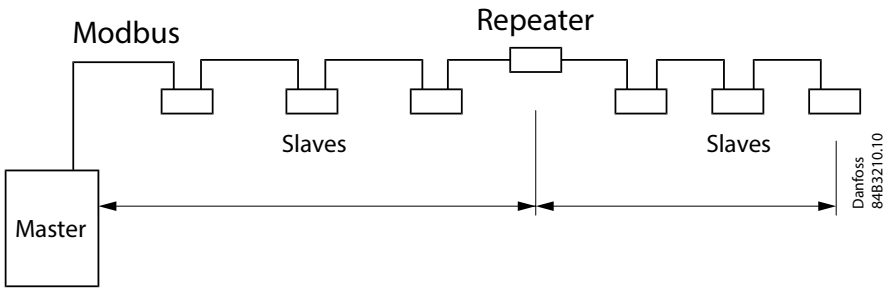
RS-485: Controllers

The maximum number of controllers that can be connected to a Modbus line is 120.
One repearter must be added for every 32 controllers. If the data communication cable runs through an electrically noisy environment which impairs the data signal, one or more repeaters must be added to stabilize the signal.

Repeater

A repeater has no address.
A repeater from the company "Phoenix" can be used:
Danfoss code no. = 084B2240 (type AKA 222).

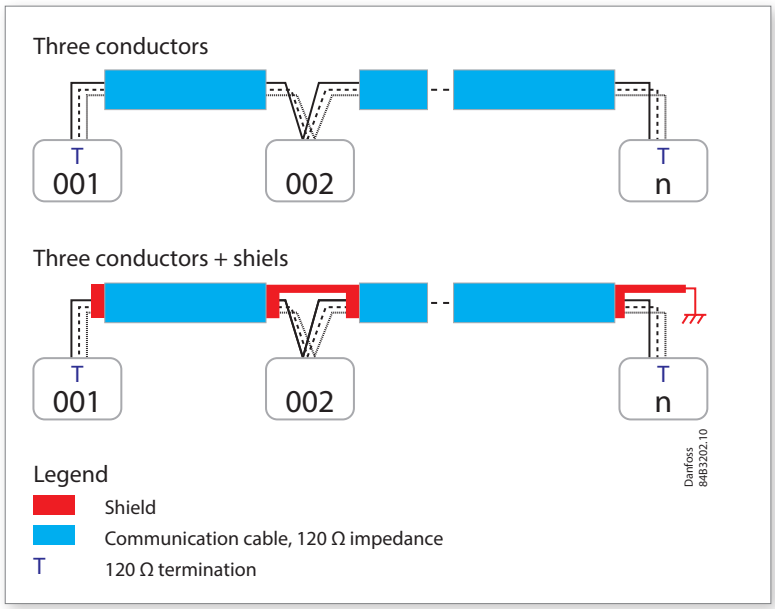




Topology

Standard topology

The controller should be connected according to the bus topology. That means that the communication cable is wired from one controller to the next without branches.



Recommendations

Avoid making stubs on the line.
If stubs are present in the network they should be kept as short as possible (<0.3 m at 1 Mbit; <3 m at 50 kbit).

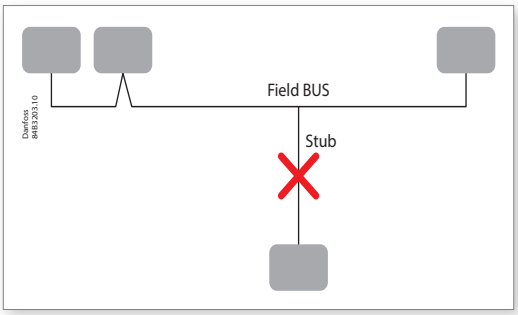


Fig Fieldbus with "STUB" 01

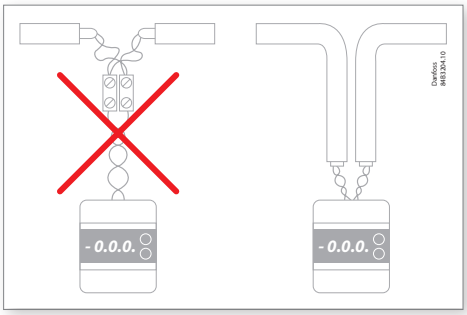


Fig Fieldbus with "STUB" 02

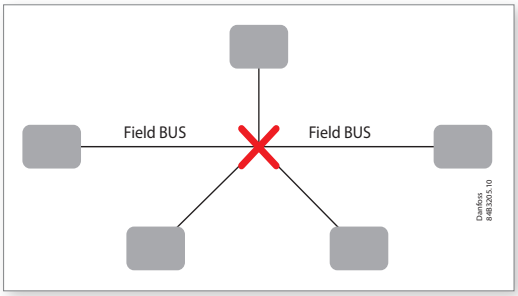


Fig Star topology
Do not use a 'STAR topology'

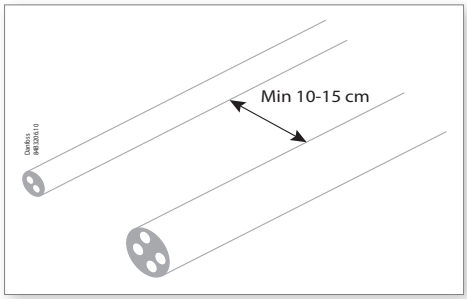


Fig Fieldbus wire
Do not route the fieldbus wires close to power lines or wires leading to heavy loads

Cabinet mounting

Route the wires close to the devices separating the twisted wires only for the shortest possible distance needed for inserting them into the screw terminals.

When controllers are installed in a cabinet, internal cable ducting must also comply with the relevant requirements. Use this cable ducting when one or more controllers are installed in a cabinet. The short connections between controllers must also be of the correct cable types.

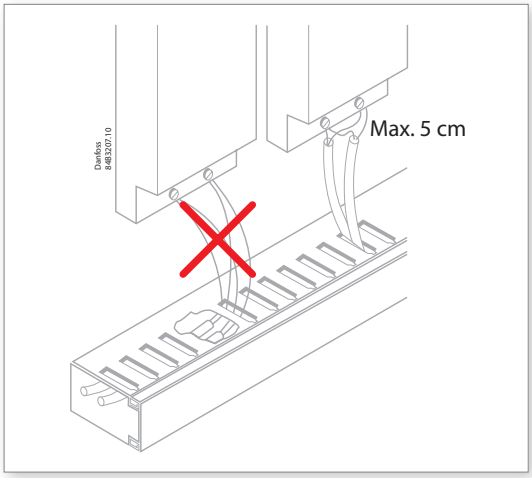
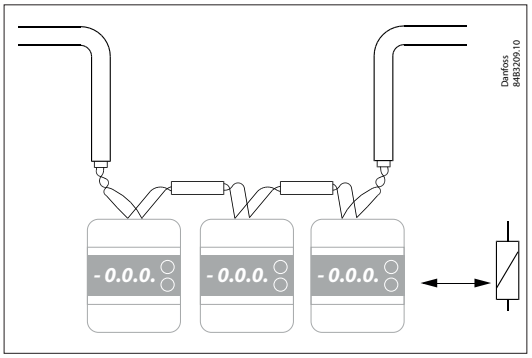


Fig Wires close

- *Do not use different wire types on a network, even for short distances.*
- *Do not route through terminal blocks*

Note!

On running/bundling the communication wires very close to high power wires or other sources of electrical noise (frequency converters etc.) could cause electromagnetic interference. Therefore, try to separate the wires from such sources if possible.



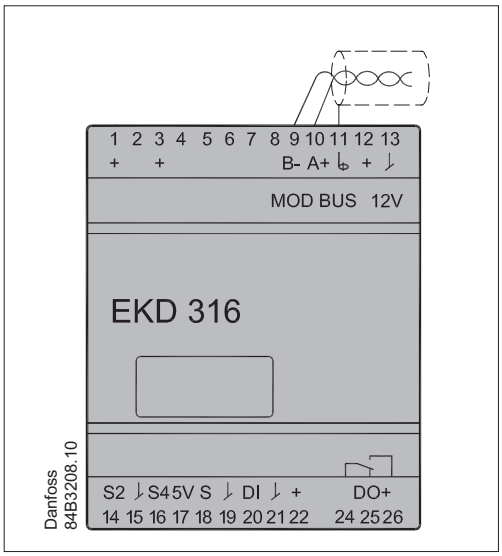
Keep a distance to relays, their cables and other things emitting electric noises

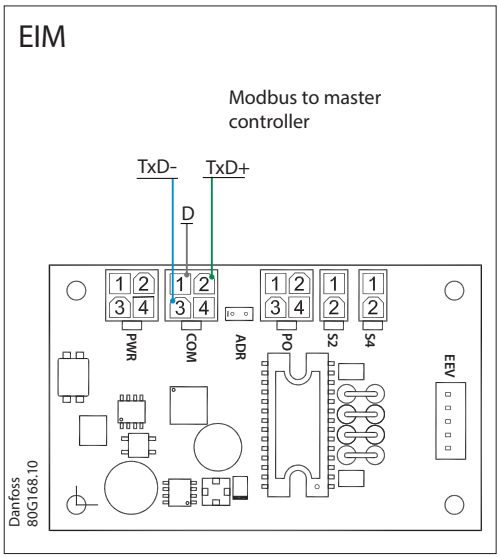
Cable connection and termination Modbus

Connect the RS-485 cable to the dedicated terminals of the EKD controller:

- Negative (B-) polarity wire to terminal 9
- Positive (A+) polarity wire to terminal 10
- Cable screen to terminal 11.

For EIM , connect it as shown in the figure to terminal COM





Termination

There must be always two terminations on the network, one at each bus end.
The termination can be installed by connecting a 120 Ohm ± 10 % resistor between D+ and D- for RS-485.

Here is shown a picture of how a Modbus network is typically terminated. The resistors are in this picture called LT (Line Termination) and are typically 120 Ohm.
The pull up and pull down are usually built into the master on the Modbus. They are not built in Danfoss controllers i.e EIM 336, EKD 316**.**

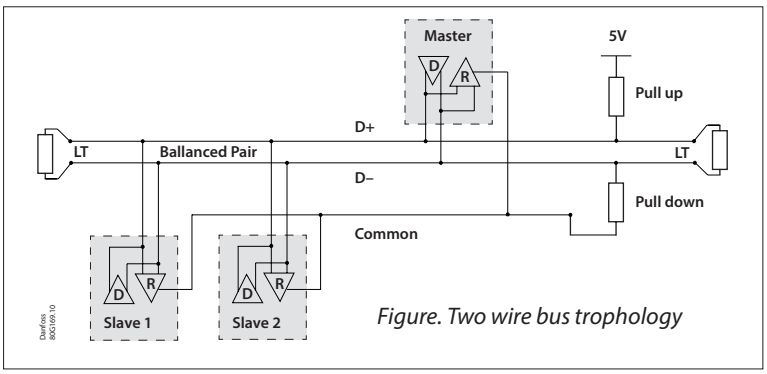
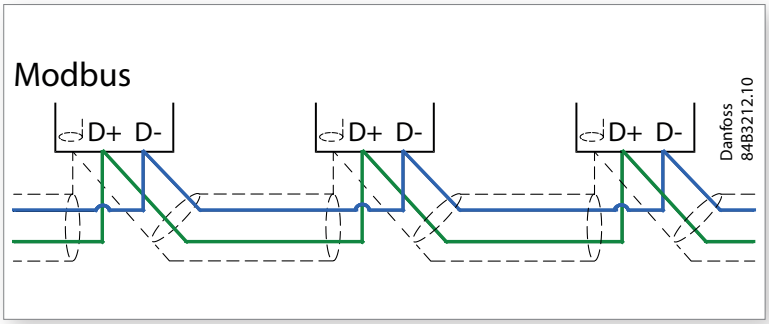


Figure. Two wire bus trophology

Conductors in a daisy chain

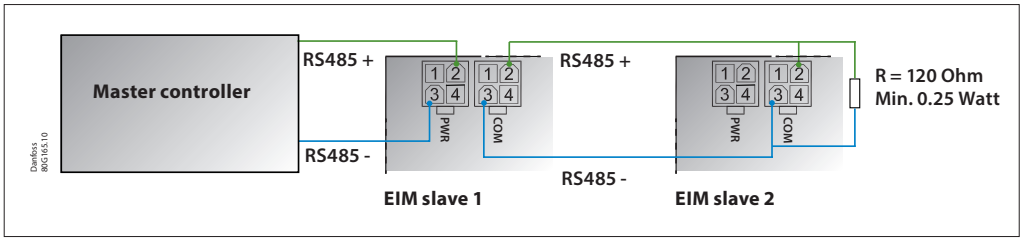
The wires are looped from device to device
D+ is connected to D+
D- is connected to D-
In other words, Start Node (with termination resistor) from Node x to Node Y …. to End Node (with Termination Resistor)in such a way that the polarity of the wires matches with the polarity of the controller terminals.

Conducters



Shield (drain) should only be connected in one end, not both ends.

In case of EIM, this is how it is done. The communication line in PWR and COM are internally connected.



Note!

If two EIMs are connected remember to remove the addressing jumper on one of the EIMs.

Ground connections

There must be a clean ground connection between all devices connected in the network.
In unisolated controller like EKD and EIM, if grounding is required , it should strick followed the guideline as explained on section 3.1

Note!

Be careful when connecting the bus to devises that have non isolated communication interfaces. If the units are tied to different ground potentials, this may lead to communication problems or even to damage to the units!

Part 2 Software specification and configuration

Introduction

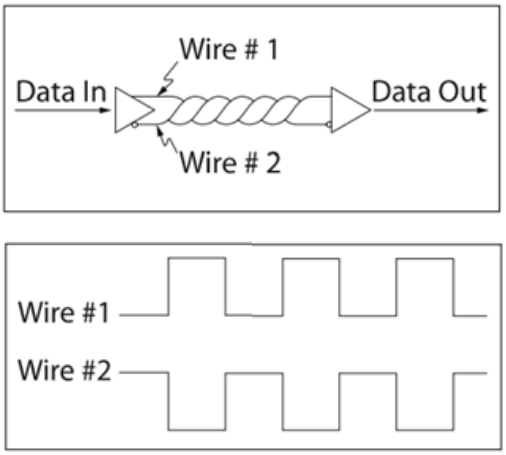
This Chapter explains how to configure the communication between a EKE(/EKD/EIM) and a system controller, using the Modbus RTU (Remote Terminal Unit) protocol. For detailed information about Modbus communication, refer to Modbus Application Protocol Specifications V1.1b from www.modbus.org

RS-485 Communication

The Electronics Industry Association (EIA) established the RS-485 standard as a guide for developing a multi-drop, bi-directional communication network.

RS-485 systems can be implemented using two-wires or four-wires modes. Danfoss uses the two-wires system with shield. With the two-wires system, communication is half-duplex (cannot transmit and receive at the same time).

The Modbus line uses one twisted–pair line – two wires twisted around themselves. This is known as balanced data transmission. The signal on one wire is ideally the exact opposite of the signal on the second wire. In other words, if one wire is transmitting a high, the other wire will be transmitting the low, and vice versa. Since RS-485 is a multipoint communication system, all devices are connected to the single twisted-pair cable.



The RS-485 system uses master/slave architecture, where each slave device (EKE/EKD/EIM)) has its unique address and responds only to requests packets addressed to this device. The requests packets are generated by the master (system controller), which periodically polls all connected slave devices. Data travels over the single line in both directions.

A basic RS-485 system requires an I/O driver with differential outputs and an I/O receiver with differential inputs. Since the signal is transferred via a twisted pair of wires, if noise or interference is introduced into the line, the voltage difference (between twisted pair wires) of this interference is almost zero. Because the input to the receiver is differential, this interference is eliminated. Differential inputs also ignore different earth potentials of the transmitter and the receiver.

Modbus RTU message

The controllers are set up to communicate on the Modbus network using RTU (Remote Terminal Unit) mode, with each byte in a message containing consisting of 11 bit. The format for each byte is shown below.

Start bit	Date byte								Stop Parity	Stop

Cooling system	8-bit binary, hexadecimal 0–9, A–F. Two hexadecimal characters contained in each 8-bit field of the message
Bits Per Byte	1 start bit
	8 data bits, least significant bit send first
	1 bit for even/odd parity; no bit for no parity
	1 stop bit if parity is used; 2 bit if no parity
Error check field	Cylindric Redundance Check (CRC)

Danfoss controller follows the standard modbus communication with the following defaults :19200 Baudrate, Even parity and one stop bit.

In EIM/EKD, communication frequency (baudrate) can be one of the following: 9600 baud, 19200 baud and 38400 baud.
The only available fixed communication setting in EKD is 8 data bit, EVEN parity and 1 stop bit.
The default unit address is 240 which, can be changed using parameter “03 unit address”. Whereas a wide range of selection bits are available in EIM modbus , check the product manual for detail.

Modbus RTU message structure

A typical message frame is shown below.

Start	Address	Sunction	Data	CRC check	End
Start	8 bits	8 bits	N x 8 bits	16 bits	end

Example

Slave Address	Function Code	H1 Byte Address	Lo byte Adress	NumRegs		CRC	
				Hi	Lo		
A5	03	00	10	00	02	DC	EA

How to access parameters

The PNU (Parameter Number) is translated from the register address contained in the Modbus read or write message. For detail check the section ‘Example’
When addressing holding registers on Modbus, the range of valid addresses is 0-65535 (0x0000 to 0xFFFF). In the documentation they are however often described in two different ways.
The first is using register numbers instead of addresses. By this convention the range of valid register numbers is 1-65536, and the register address 0 is refered to as register number 1. Danfoss follows this convention so when reading the PNU (Parameter Number) 117, the actual request asks for data from address 116. So address = PNU – 1.
The second convention defines seperate ranges for different types of registers (coils, discrete inputs, input register and holding registers). The number of available registers were originally limited to 10000 for each type, and in order to easily distinguish between the register types, in manuals etc., each type was assigned a part of the numbering range. In this way holding registers were numbered from 40001 to 50000. The address range is however the same as before so the first holding register with register number 40001 still is addressed on Modbus as address 0. So address = register number – 40001. This convention was introduced by the company Modicon and is therefore often referred to as the Modicon convention.

Note!

Modicon conventionway of addressing is available in EIM 336/316 controller only.

RS485 bus function codes overview

EKD/EIM RS485	Function code	Comment
Read PNU	0x03	Read holding registers
Write PNU	0x06	Write Single PNU/holding register only

Example	**The following examples illustrate various Modbus RTU commands in EKD**

Note!

1. Requests are shown in blue and the hexadecimal representation of the data on the Modbus .
2. Responses are shown in green. The text in green is an interpretation of the response.

Action	**Description**
Setup	**Switching the Main switch OFF/ON.** 1 = Set "r12 Main switch " PNU 117 to 0 (using address 240). 2 = Set "r12 Main switch " PNU 117 to 1 (using address 240).
Result	Verify that the EKD respond the Modbus master with an accept message.
Conclusion	**Writing r12 (PNU 117) to 0** **[F0][06][00][74][00][00][DC][F1]** **[F0][06][00][74][00][00][DC][F1] – Slave acknowledges** **Writing r12 (PNU 117) to 1** **[F0][06][00][74][00][01][1D][31]** **[F0][06][00][74][00][01][1D][31] – Slave acknowledges**

Action	**Description**
Setup	**Setting up the Superheat maximum parameter n09** 1 = Write "r12 Main switch " PNU 117; Set it to 0. 2 = Write "n09 Max. SH " PNU 3015; Set to 60. 3 = Read "n09 Max. SH " PNU 3015; veryfying step 2.
Result	Reading n09 max. SH i.e. PNU 3015 must be 60.
Conclusion	**Write r12 (PNU 117) to 0** **[F0][06][00][74][00][00][DC][F1]** **[F0][06][00][74][00][00][DC][F1] – Slave acknowledges** **Reading PNU 3015** **[F0][03][0B][C6][00][01][73][32]** **[F0][03][02][00][64][C4][7A] – Slave responds 100** **Writing PNU 3015 to 60** **[F0][06][0B][C6][00][3C][7E][E3]** **[F0][06][0B][C6][00][3C][7E][E3] – Slave acknowledges** **Reading PNU 3015 again** **[F0][03][0B][C6][00][01][73][32]** **[F0][03][02][00][3C][C5][80] – Slave responds 60**

Example	The following examples illustrate various Modbus RTU commands in EKD

Note!

1. Requests are shown in blue and the hexadecimal representation of the data on the Modbus .
2. Responses are shown in green. The text in green is an interpretation of the response.

Action	Description
Setup	**Changing the device address** 1 = Read "o03 Unit addr. " PNU 2008 using address: 240. 2 = Set "o03 Unit addr. " PNU 2008 to 239
Result	1 = Verify that it's possible to use address 240. 2 = Verify that it's possible to use address 239.
Conclusion	**Reading PNU 2008 from ID 240** **[F0][03][07][D7][00][01][20][67]** **[F0][03][02][00][F0][C5][D5] – Slave responds 240** **Setting PNU 2008 to 239 on ID 240** **[F0][06][07][D7][00][EF][6C][2B]** **[F0][06][07][D7][00][EF][6C][2B] – Slave acknowledges** **Reading PNU 2008 from ID 240** **[F0][03][07][D7][00][01][20][67]** **No response since the address is changed** **Reading PNU 2008 from ID 239** **[EF][03][07][D7][00][01][22][08]** **[EF][03][02][00][EF][11][DF] – Slave responds 239**

Action	Description
Setup	**Reading Evaporator Pressure** 1 = Read "u25 EvapPress Pe " PNU 2543 using Modbus function code 0x03. 2 = Read "u25 EvapPress Pe " PNU 2543 using Modbus function code 0x04.
Result	Note: Read 0x04 function is only available in some selective danfoss controllers. 1 & 2 = Both Modbus commands responds with the same answer.
Conclusion	**Reading PNU 2543 with function code 03** **[F0][03][09][EE][00][01][F2][82]** **[F0][03][02][00][87][85][F3] – Slave responds 135** **Reading PNU 2543 with function code 04** **[F0][04][09][EE][00][01][47][42]** **[F0][04][02][00][87][84][87] – Slave responds 135**

Action	Description
Setup	Setting the controller in Manual mode Set "o45 Manual OD%" PNU 2064 to 45.
Result	Verify that the message and responds are: Message: 0xA5 0x06 0x08 0x0F 0x00 0x2D 0x62 0x90 Responds: 0xA5 0x06 0x08 0x0F 0x00 0x2D 0x62 0x90
Conclusion	**Setting PNU 2064 to 45** **[A5][06][08][0F][00][2D][62][90]** **[A5][06][08][0F][00][2D][62][90] – Slave acknowledges**

Example	The following examples illustrate various Modbus RTU commands in EKD

Note!

1. Requests are shown in blue and the hexadecimal representation of the data on the Modbus .
2. Responses are shown in green. The text in green is an interpretation of the response.

Action	Description
Setup	Examples explaining some illegal addressing and request with 0x03 (Read function) and 0x06 (Write).
Result	The device must respond with illegal address or no response.
Conclusion	**Read 2 register starting from PNU 2008 from slave 240** **[F0][03][07][D7][00][02][60][66]** **[F0][83][02][91][02] - slave responds illegal address because 2009 is not defined** **Read o03 unit address (PNU 2008) from slave 240 with wrong CRC** **[F0][03][07][D7][00][01][20][68]** **no response** **Read PNU 2009 (undefined) from slave 240** **[F0][03][07][D8][00][01][10][64]** **[F0][83][02][91][02] - slave responds illegal address because 2009 is not defined** **Write 2 to r12 main switch (PNU 117) on slave 240** **[F0][06][00][74][00][02][5D][30]** **[F0][86][03][53][92] - slave responds illegal data** **Write 1 to PNU 118 (undefined) on slave 240** **[F0][06][00][75][00][01][4C][F1]** **[F0][86][02][92][52] - slave responds illegal address** **Write 1 to r12 main switch (PNU 117) on slave 240 with wrong CRC** **[F0][06][00][74][00][01][1D][31]** **no response** **Use function code 5 (undefined)** **[F0][05][00][74][00][01][59][31]** **[F0][85][01][D2][A3] - slave responds illegal function**

Example	The following examples illustrate various Modbus RTU commands in EIM

Note!

1. Requests are shown in blue and the hexadecimal representation of the data on the Modbus .
2. Responses are shown in green. The text in green is an interpretation of the response.

Action	Description
Setup	Switching the Main switch OFF/ON (using address 165).
Conclusion	Reading r12 main switch (PNU 117) [A5][03][00][74][00][01][DD][34] [A5][03][02][00][00][C9][9D] – Slave responds 1 Setting r12 main switch (PNU 117) to 1 [A5][06][00][74][00][01][11][34] [A5][06][00][74][00][01][11][34] - Slave acknowledges Setting r12 main switch (PNU 117) to 0 [A5][06][00][74][00][00][D0][F4] [A5][06][00][74][00][00][D0][F4] – Slave responds 0

Action	Description
Setup	Setting up the Superheat Max. SH value on address 165
Conclusion	Reading PNU 3015 [A5][03][0B][C6][00][01][7F][37] [A5][03][02][00][A0][C9][E5] – Slave responds Setting PNU 3015 to 100 [A5][06][0B][C6][00][64][73][1C] [A5][06][0B][C6][00][64][73][1C] – Slave acknowledges Reading PNU 3015 again [A5][03][0B][C6][00][01][7F][37] [A5][03][02][00][64][C8][76] – Slave responds 100

Action	Description
Setup	Changing EIM addressing from PNU to Modicon addressing
Conclusion	Reading PNU 64200 (Modbus translation table) [A5][03][FA][C7][00][01][1C][0B] [A5][03][02][00][00][C9][9D] – Slave responds 0 (use PNU) Setting PNU 64200 to 1 [A5][06][FA][C7][00][01][D0][0B] [A5][06][FA][C7][00][01][D0][0B] – Slave acknowledges Reading PNU 64200 again [A5][03][FA][C7][00][01][1C][0B] [A5][03][02][00][01][08][5D] – Slave responds 1

Example	The following examples illustrate various Modbus RTU commands in EIM

Note!

1. Requests are shown in blue and the hexadecimal representation of the data on the Modbus .
2. Responses are shown in green. The text in green is an interpretation of the response.

Action	Description
Setup	**Switching the Main switch OFF/ON with Modicon addressing**
Conclusion	**Setting Modicon 40011 (r12 main switch) to 0** **[A5][06][00][0A][00][00][B0][EC]** **[A5][06][00][0A][00][00][B0][EC] – Slave acknowledges** **Reading Modicon 40011 (r12 main switch)** **[A5][03][00][0A][00][01][BD][2C]** **[A5][03][02][00][00][C9][9D] – Slave responds 0** **Setting Modicon 40011 (r12 main switch) to 1** **[A5][06][00][0A][00][01][71][2C]** **[A5][06][00][0A][00][01][71][2C] – Slave acknowledges** **Reading Modicon 40011 (r12 main switch) again** **[A5][03][00][0A][00][01][BD][2C]** **[A5][03][02][00][01][08][5D] – Slave responds 1**

Action	Description
Setup	**Reading the registers with Modicon addressing.**
Conclusion	**Reading Modicon 40001 to 4004** **[A5][03][00][00][00][04][5D][2D]** **[A5][03][08][FC][E0][07][08][05][DC][00][00][4D][7A] – Slave responds -800, 1800, 1500, 0**

Appendix.1

EIM Modbus Conversion table

Parameter	PNU	Modicon address
u25 EvapPress Pe	2543	40001
u20 S2 temp.	2537	40002
u16 S4 air temp.	2531	40003
u27 Temp. S3	2545	40004
--- Ctrl Status	3100	40005
u26 EvapTemp Te	2544	40006
u22 SuperheatRef	2535	40007
u21 Superheat	2536	40008
u24 Opening %	2542	40009
--- LOC Alarm	50006	40010
r12 Main switch	117	40011
--- Te Reference	3117	40012
--- Comp Speed	3120	40013
ext EvapPress P0	2643	40014
ext S2 temp	2644	40015
--- Diff MOP	3121	40016
r09 Adjust S2	113	40017
o45 Manual OD%	2064	40018
n09 Max SH	3015	40019
n10 Min SH	3021	40020
n22 SH close	3027	40021
--- Tn SH	3103	40022
n11 MOP	3013	40023
--- SH Low	3105	40024
--- SH High	3106	40025
--- Gain High	3107	40026
--- Gain Low	3108	40027
--- Tau High	3109	40028
--- Tau Low	3110	40029
--- Alpha	3111	40030
--- Kp MOP	3113	40031
--- Tn MOP	3114	40032
--- Kp Te	3115	40033

Parameter	PNU	Modicon address
--- Tn Te	3116	40034
n20 Kp T0	3025	40035
o18 Manual ctrl.	2075	40036
--- LOC Trig	50003	40037
--- LOC Reset	50004	40038
--- LOC Timer	50005	40039
--- LOC SH Trig	50007	40040
o03 Unit addr.	2008	40041
--- Unit Addr. 2	2009	40042
--- Modbus Baud	50060	40043
--- ModbusParity	50061	40044
--- ModbusStopB	50062	40045
--- ClosedValveT	3101	40046
--- Def Activate	50011	40047
--- Def Hold OD	50008	40048
--- Def HoldTi 1	50009	40049
--- Def HoldTi 2	50010	40050
--- Max SH shdw	64301	40051
--- Min SH shdw	64302	40052
--- Tn SH shdw	64303	40053
--- Alpha shdw	64304	40054
--- DefHold shdw	64305	40055
--- SWVer shdw	64306	40056
--- Startup	64307	40057
n15 StartUp time	3017	40058
n17 Start OD %	3012	40059
--- Off Min.OD %	64308	40060
--- HwMainSwitch	64100	40061
o20 MinTransPres	2034	40062
o21 MaxTransPres	2033	40063
o30 Refrigerant	2551	40064
--- Rfg.Fac.A1	2548	40065
--- Rfg.Fac.A2	2549	40066

Parameter	PNU	Modicon address
--- Rfg.Fac.A3	2550	40067
--- Standby	20000	40068
--- EKC Error	20001	40069
--- S2 Error	20002	40070
--- S4 Error	20004	40071
--- Pe inp.error	20005	40072
--- No Rfg. Sel.	20006	40073
--- Valve error	20007	40074
--- Reset alarm	2046	40075
n37 Max steps	3032	40076
n38 Max StepsSec	3033	40077
n39 Start BckLsh	3034	40078
n40 Backlash	3035	40079
n56 MotorCurrent	3051	40080
--- Factory2User	64060	40081
--- User2Factory	64062	40082
--- ControlState	3099	40083
--- LOC Tmr	3102	40084
--- Avg Opening	50033	40085
--- OpenHighRes	50052	40086
--- InputMeas 1	64050	40087
--- InputMeas 3	64052	40088
--- Sw. version	2003	40089
--- OrderNoLow	2011	40090
--- OrderNoHigh	2015	40091
--- Avg KT0 Time	50020	40092
--- Avg OD 3hour	50021	40093
--- Avg CompTime	50022	40094
--- AvgFltTime	3118	40095
--- Modbus trans	64200	Not available in BO address range

For detail description on the above parameters, please refer to the product user guide

Appendix 2

EKD modbus table

Parameter	PNU
r05 Temp.unit	105
r09 Adjust S2	113
r10 Adjust S3	114
r12 Main switch	117
A34 Battery low	10035
n03 Valve type	3002
n04 Kp factor	3003
n05 Tn seconds	3004
n06 Td seconds	3005
n09 Max SH	3015
n10 Min SH	3021
n11 MOP	3013
n15 Start time	3017
n17 MinOdAtStart	3012
n18 Stability	3014
n19 Kp min.	3024
n20 Kp T0	3025
n21 SH mode	3026
n22 SH close	3027
n32 ETS OD% Max	3023
--- Kp Actual	64090
n37 Max steps	3032
n38 Max StepsSec	3033
n39 Start BckLsh	3034
n40 Backlash	3035
n42 Comp. dir.	3037
n43 Atten.Factor	3038
n44 TnT0 sec.	3039
n45 Min.Lim.Ref	3040
n56 MotorCurrent	3051
--- EKC state	2007
o10 AI type	2027

Parameter	PNU
o18 Manual ctrl.	2075
o20 MinTransPres	2034
o21 MaxTransPres	2033
o30 Refrigerant	2551
o45 Manual OD%	2064
o56 Reg. type	2076
o61 Appl.mode	2077
--- Rfg.Fac.A1	2548
--- Rfg.Fac.A2	2549
--- Rfg.Fac.A3	2550
--- Sw. version	2003
--- OrderNoLow	2011
--- Factory2User	64060
--- Open Hyst.	64091
--- Close Hyst.	64092
--- Cal.Interval	64093
--- Alarm relay	2509
--- Reset alarm	2046
u06 Analog input	2504
u10 DI status	2002
u20 S2 Temp	2537
u21 Superheat	2536
u22 SuperheatRef	2535
u24 Opening OD%	2542
u25 EvapPres Pe	2543
u26 EvapTemp Te	2544
u27 Temp S3	2545
P67 Open Hyst.	2181
P68 Close Hyst.	2182
P69 OvD Enable	2183
P70 OvDProtect T	2184
P71 ForcedCloseT	2185

For detail description on the above parameters, please refer to the product user guide/installation guide.

Appendix 3.

Modbus exception code

For a full explanation of the structure of an exception code response, please refer to the Modbus specification."

Code	Name	Meaning
1	Illegal function	This function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices and was not implemented in the unit selected. It could also indicate that the server (or slave) is in the wrong state to process a request of this type, for example because it is not configured and is being asked to return register values.
2	Illegal data adress	The data address received in the query is not an allowable address for the server (or slave). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, a request with offset 96 and length 4 would succeed. a request with offset 96 and length 5 will will generate exeption 02.
3	Illegal data value	A value contained in the query data field is not an allowable value for the server (or slave). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in the register has a value outside the expectation of the application program since the Modbus protocol is unaware of the significance of any particular value of any particular register.
4	Slave device failure	An unrecoverable error occurred while the server (or slave) was attemptingto perform the requested action.

Appendix 4.

Following are some of the free modbus tool available on the Internet.
Please note that Danfoss doesn't provide any support on any third party modbus communication tools.

Some non commercial free programs are:
ModbusMat - http://www.ataytugal.com/ModbusMat.htm
Modbus Request Pro:
http://forums.mrplc.com/index.php?app=downloads&showfile=465

Please note that there may be restrictions on the use of above stated modbus tools for commercial applications

For your own notes