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Danfoss EKD 316C Electronic Superheat Controller Installation Guide

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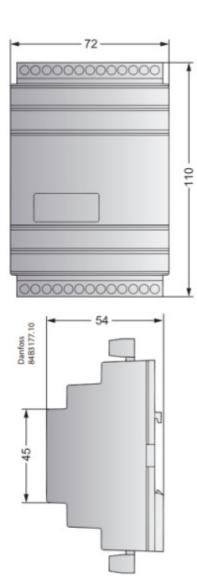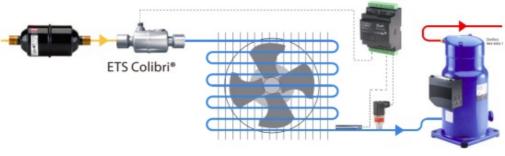
Contents

Introduction

EKD 316 is a superheat controller that can be used where there are requirements for accurate control of superheat.
Typically it will operate in Commercial air conditioning, heat pumps, commercial refrigeration, food retail and industrial application. Compatible valve – Danfoss ETS / ETS C, KVS / KVS C and CCM / CCMT valves.
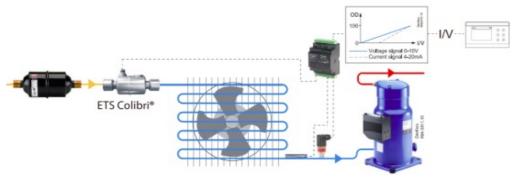
72

110

54

45

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| Supply voltage	24 V AC / DC ±15%, 50/60 Hz, 22 VA / 15 Watt(the supply voltage is not galvanically separated from the input and output signals)	
Power consumption	Controller ETS C / KVS CETS, KVS , CCM, CCMT	5 VA7.2 VA1.3 VA
Input signal*)Ri: mA: 400 Ohm V: 50 k O hm	Current signal *	4 – 20 mA or 0 – 20 mA
	Voltage signal *	0 – 10 V or 1 – 5 V
	Pressure transmitter. g. AKS 32R	0.5 – 4.5V DC radiometric type (10% – 90 % of supply voltage)
	Digital input from external contact function	
Sensor input	2 pcs. Pt 1000 ohm	DI : < 800 Ohm = ON DI : > 30 k O hm = OFF
Alarm relay	1 pcs. SPDT	Max 24V, 1A resistive – Class II
Step motor output	Pulsating 30 – 300 mA	
Data communication	RS 485 Modbus data communication	
Environments	Operations	0 – 55 °C / 32 – 131 °F
	Transportation	-40 – 70 °C / -40 – 158 °F
	Humidity 20 – 80 % Rh, none condensing	
	No shock influence/vibrations	
Enclosure	IP 20	
Compatible valves	Bipolar stepper motor valves	

Standalone controller
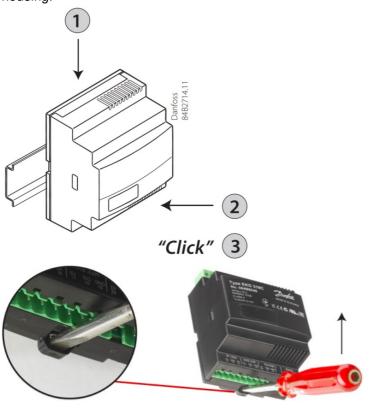
Valve driver

DIN rail mounting / dismounting

The unit can be mounted onto a 35 mm DIN rail (in accordance with EN 5022) simply by snapping it into place and

securing it with a stopper to prevent sliding. It is dismounted by gently pulling the stirrup located in the base of the housing.

Dismounting
Pull down the stirrup to dismount unit from din rail

General warnings

- Every use that is not described in this manual is considered incorrect and is not authorised by the manufacturer.
- Verify that the installation and operating conditions of the device respect the ones specified in the manual, specially concerning the supply voltage and environmental conditions.
- This device contains live electrical components therefore all the service and maintenance operations must be performed by qualified personnel.
- The device cannot be used as a safety device.
- Liability for injury or damage caused by the incorrect use of the device lies solely with the user.

Installation warnings

- The installation must be executed according the local standards and legislation of the country.
- Always operate on the electrical connections with the device disconnected from the main power supply.
- Before carrying out any maintenance operations on the device, disconnect all the electrical connections.
- For safety reasons the appliance must be fitted inside an electrical panel with no live parts accessible.
- Don't expose the device to continuous water sprays or to relative humidity greater than 80%.
- Avoid exposure to corrosive or pollutant gases, natural elements, environments where explosives or mixes of flammable gases are present, dust, strong vibrations or chock, large and rapid fluctuations in ambient

temperature that in combination with high humidity can condensate, strong magnetic and/or radio interference (e.g. transmitting antennae).

- When connecting loads beware of the maximum current for each relay and connector.
- Use cable ends suitable for the corresponding connectors. After tightening the screws of connectors, slightly tug the cables to check their tightness.
- Use appropriate data communication cables. Refer to the Fieldbus Installation Guide for the kind of cable to be used and setup recommendations.
- Reduce the path of the probe and digital inputs cables as much as possible, and avoid spiral paths enclosing power devices. Separate from inductive loads and power cables to avoid possible electromagnetic noises.
- Avoid touching or nearly touching the electronic components fitted on the board to avoid electrostatic discharges. DIN rail mounting / dismounting
The unit can be mounted onto a 35 mm DIN rail (in accordance with EN 5022) simply by snapping it into placeand securing it with a stopper to prevent sliding. It is dismounted by gently pulling the stirrup located in the base of the housing.

⚠️ Warnings
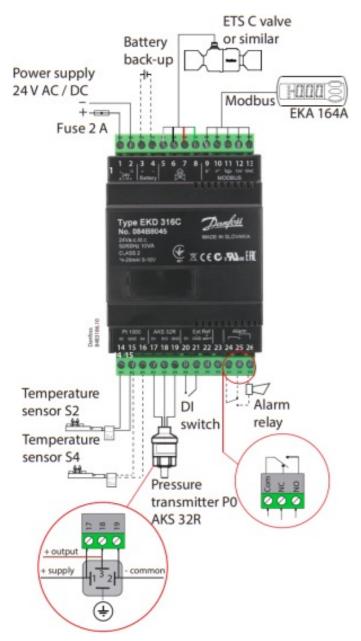
- Use a class II category transformer for 24 V AC power supply.
- Do not ground the 24 V AC wires.
- By connecting any EKD 316C inputs to mains voltage will permanently damage the controller.
- Do not apply voltage to the controller before the wiring is completed.

Connection of the terminals to earth will destroy the controller

Connection overview

Connections

ETS Colibri®		EKD 316C
White	A1	5
Black	A2	6
Red	B1	7
Green	B2	8

Connection overview table
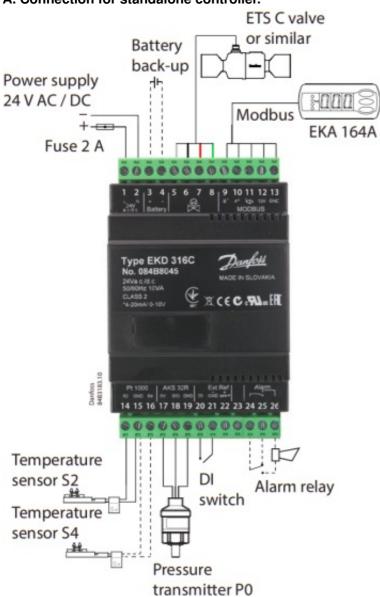
Function	Position	Pin name	Description
Power supply	1	24V L/+	Power supply
	2	24V N/ −	
Battery backup	3	Bat+	24 V DC Battery backup
	4	BAT-	
Stepper motor driver	5	A1	Stepper motor
	6	A2	
	7	B1	
	8	B2	
Data communication	9	RS485 B −	RS485 Modbus/ external display EK A 164A
	10	RS485 A+	
	11	Shield	
	12	12 V	
	13	GND	
Tempera- ture sensor	14	S2	Pt 1000
	15	GND	Common ground for S2 / S4
	16	S4	Pt 1000 sensor
Pressure transmitter	17	5 V	Supply +
	18	sig	Output +
	19	GND	Common −
External reference	20	DI	Switch
	21	GND (-)	Common ground for 20 /22
	22	Sig (+)	Analog signal
Not in use	23	–	–
Alarm	24	Com	Common
	25	NC	Normal closed
	26	NO	Normal open

Important notes

Terminals	
3 – 4	Battery backup (the voltage will close the ETS valve if the controller looses its supply voltage). The battery voltage must not be connected from terminals 1 and 2. Power of the battery lower than 16.5 V will trigger the low battery alarm.
9 – 13	Operation via modbus communication either EKA 164A or system unit + software. It is important that the installation of the data communication cable is done correctly. For detail refer to our EKD 316 manual.
20 – 21	Switch function for start / stop of regulation. **Note:** If a switch is not connected, terminals 20 and 21 must be short circuited. Do not connect exte rnal power supply to these terminals, else it will damage the controller.
24 – 26	Alarm relay: There is connection between 24 and 26 in alarm situations.

Application dependent /optional Connections

A. Connection for standalone controller.

Application dependent connections
A. Superheat control

Terminals	Necessary connections
14 – 15	Pt 1000 sensor at evaporator outlet (S2) for measuring superheat.
15 – 16	Pt 1000 sensor for measuring air temperature (S4).
17 – 19	Pressure transmitter type AKS 32R. **Note:** The signal cannot be shared with other controllers.
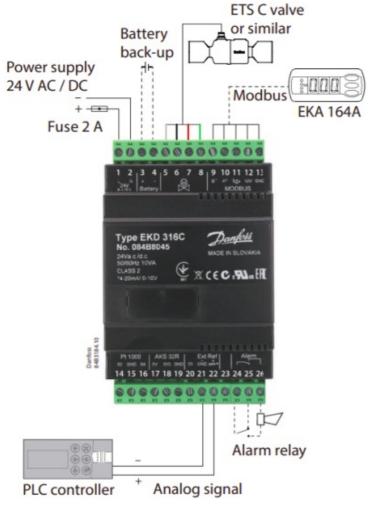
B. Control of the valve opening degree with analog signal

21 – 22	Current signal or voltage signal from other regulation (Ext. Ref.)
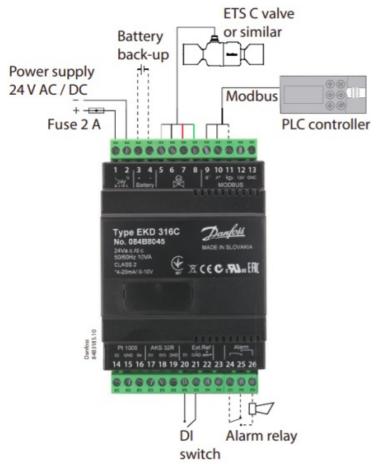
C. Control of the valve with Modbus signal

9 – 10	Operation via RS 485 data communication
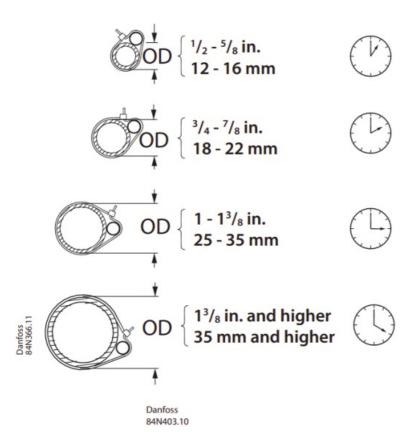
B. Connection for Valve Driver using analog sign
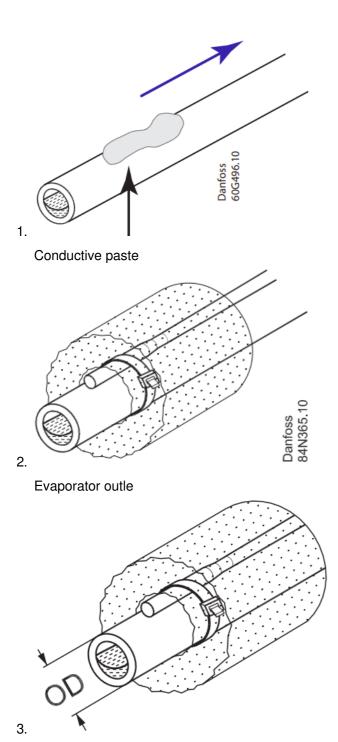
C. Connection for valve driver using Modbus signal.

Sensor mounting: Temperature sensor

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1.

Conductive paste

2.

Evaporator outle

3.
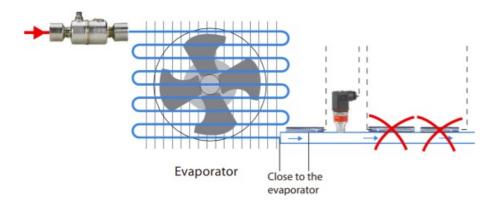
⚠️ **Important Note**

- Mount sensor on a clean surface without any paints.
- Remember to put on heat conducting paste and insulate the sensor.
- Sensor mounting max. 5 cm from the outlet of the evaporator to get the precise measurements.

Evaporator   Close to the evaporator
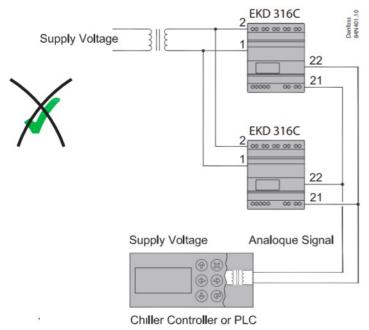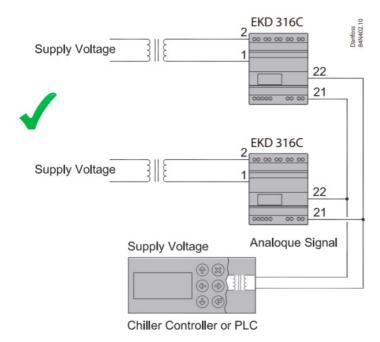
Pressure transmitter

Installation of the pressure transmitter is less critical, but mounting of pressure transmitter should be closer to the temperature sensor, right after the evaporator and with its head in upright position"

Power supply

- Grounding of secondary (output) of transformer is not recommended.
- Do not reverse the polarity of the power connection cables and avoid ground loops (i.e. avoid connecting one field device to several controllers as this may result in short circuits and can damage your device.
- Use individual transformers for EKD 316C controller to avoid possible interference or grounding problems in the power supply.

Relay Outputs

EKD 316C has 1 relay outputs:

- SPDT relay, connected to terminals 24 – 26 can be used either to connect solenoid valve or to connect alarm.
- Relay is designed for switching max. 24 V, 1A resistive – Class II.

Cable and wiring

- The cable distance between the controller and the valve depends on many factors like shielded/unshielded cable, the wire size used in the cable, the output power for the controller and EMC. In general, for the cable distance up to 10 m, it is recommended to use cable with wire size 22AWG or lower. For cable distance up to 30 m, wire diameter of 20 AWG or lower is recommended.
- In case of electrical noises in the system, use cable filter AK 211.
- Keep controller and sensor wiring well separated from mains wiring. Minimum recommended distance 30mm.
- Connecting sensors by wires more than 6 m long may decrease the accuracy of measured values.
- Sensors and secondary (output) of transformer may not be grounded simultaneously.
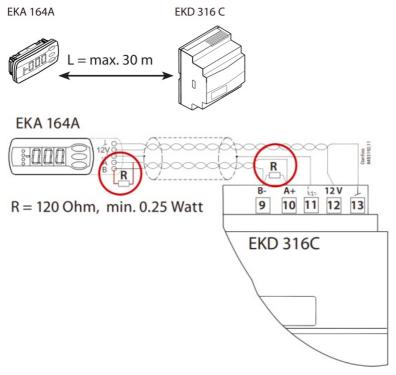
⚠️ **Warning**

Separate the sensor and digital input cables as much as possible (at least 3 cm) from the power cables to the loads to avoid possible electromagnetic disturbance. Never lay power cables and probe cables in the same conduits (including those in the electrical panels).

Connecting external display EKA 164A

To setup the EKD 316C an EKA 164A display is needed. The display can be used not only for setting up the necessary parameter but also to use as an external display during operating to show the important parameters i.e. opening degree of the valve, superheat etc.

EKA 164A   EKD 316 C

L = max. 30 m

EKA 164A

R = 120 Ohm, min. 0.25 Watt

B- A+ ⊥₁₂ 12 V ⊥
9   10 11   12   13

EKD 316C
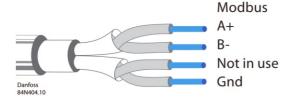
Important Note:

- Max. distance between controller and display is 30 m.
- The supply voltage to the display must be maintained at 12 V ± 15%.
- Terminal resistor of 120 Ohm is recomanded at both sides of the wire for
- length longer than 1 m to prevent electrical noice.

Connecting Modbus

- For the modbus cable, it is best to use 24 AWG shielded twisted-pair cable with a shunt capacitance of 16 pF/ft and 100Ω impedance.
- The controller provides an insulated RS485 communication interface which is connected to terminals 9 to 11 (see connection overview).
- The max. permissible number of devices simultaneously connected to RS485 output is 32. The RS485 cable is of impedance 120 Ohm with maximum length of 1000 m.
- Terminal resistors 120 Ohm for terminal devices are recommended for length > 1 m.
  In EKD 316C communication frequency (baudrate) can be one of the following: 9600 baud, 19200 baud and 38400 baud.
- The only available fixed communication settings in EKD 316C are 8 data bit, EVEN parity and 1 stop bit.
  The default unit address is 240 which, can be changed using parameter "03 unit address".

Modbus
A+
B-
Not in use
Gnd

Detail explanation on Modbus installation and software parameter setting can be found on Installation guide RC8AC602 and manual DKRCC.PS.RI0.F1.02.

Stepper Motor Output

- All Valves are driven in a bipolar mode with a 24V supply that is chopped to control the current (Current driver).
- The stepper motor is connected to terminals 5 to 8 (see terminal assignment) with M12 motor cable.
- To configure stepper motor valves other than Danfoss stepper motor valve, it is necessary to set the right valve parameters as described on section Valve configuration. The default valve setting in EKD 316C is 16 (i.e. 'non')
- It is neccesary to define correct valve in 'Valve type' i,e parameter n03. The overview of the valve types has been defined in section "valve overview".

Valve overview

n03	EKA 164A	Danfoss valve type	n37	n38
0	25	ETS 12.5, ETS 25, KVS 15	262	300
1	50	ETS 50, CCM 10, CCM 20, CCM30	262	300
2	100	ETS 100, CCM 40	353	300
3	250	ETS 250, KVS 42	381	300
4	400	ETS 400	381	300
5	uSr	User defined	–	–
6	SA9	UKV, SKV, VKV, PKV	24	16
7	6	ETS 6	24	16
8	CC	CCMT 2, CCMT 4, CCMT 8	110	220
9	C16	CTM16	80	200
10	C24	CCMT 24	140	200

11	`030`	CCMT 30	230	200
12	`C42`	CCMT 42	220	200
13	`Ctr`	CTR	660	75
14	`080`	CCMT 0	24	16
15	`081`	CCMT 1	24	16
16	`0`	No valve selected	10	160
17	`CoL`	ETS 12C, ETS 24C, ETS 25C, ETS 50C, ETS 100C, KVS 2C, KVS 3C, KVS 5C	60	160

For detail parameter list and explanation, please check the EKD 316C Manual.

Application specific setup

Parameter	Name	PNU	A. Superheat control Use as controller (SH). Value	B. Valve driver Using analog signal. Value
o10	Ai type	2027	No signal	0 – 20 mA / 4 – 20 mA / 0 – 10 V / 1 – 5 V
o18	Manual control	2075	No override	No override
o30	Refrigerant	2551	See EKD instruction for refrigerant setting.	See EKD instruction for refrigerant setting.
o61	App. mode	2077	2 = Superheat	1= Valve driver using analog signal
o20	Min. trans. press.	2034	Min. value on transmitter	–
021	Max. trans. press	2033	Max. value on transmitter	–
r12	Main switch	117	On	On

Valve configuration

Parameter	Name	PNU	Description
n03	Valve type	3002	Define the proper valve type, check Valve overview for detail.
n37	Max. steps x 10	3032	Total number of full steps. on using EKA display, 800 step is display as 80.
n38	Max. step / second (PPS)	3033	Define the require/recommended steps per sec.
n39	Start backlash (% of FS)	3034	(extra closing steps at 0 % opening (in % of n37))
n40	Backlash (steps)	3035	Compensation for spindle play.
n56	Motor current (mA)	3051	Define the require current in mA RMS.

Note: Please refer to Danfoss EKD 316 manual for details.

Parameter setup

A. Setting controller in Superheat control mode.

Make sure that r12 = 0 (OFF) and change the settings The setting will depends on the system requirement.
Select Refrigerant
o30 = 1-42 (default non selected)

Select valve type
n03 = 0 – 9 (default is "non" i.e non valve selected).
On using EKA 164A display, check the valve overview chart.

Define pressure sensor range in gauge bar
o20 = Min. Transducer pressure
o21 = Max. Transducer pressure

Set the application mode
For MSS control **n21 = 1** (default)
For Load define control **n21 = 2**

Define min/max superheat
n10 = min. superheat reference
n09 = max. superheat reference
For fixed superheat define n09 = n10

Define MOP (optional)
n11 = maximum operating pressure
(default is 20 bar, max. 200 = **MOP off**)

Set force opening of the valve (optional)
Start OD% **(n17)**
Start Up time **(n15)**

To start the supeheat control
Set r12= ON

B. Setting controller in valve driver mode using analog signal

Make sure that **r12 = 0** (OFF) and change the settings so they fit to their application:

Select Appication mode
o61 = 1 (remote/AI control)

Select Analog signal type
o10 = 2 (4-20mA)
(for other analog signal check the parameter list)
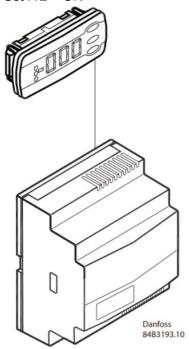
Select valve type
n03 = 17 (**valve type, ETS C = 17**)
for other valve types refer to valve overview table.

To start the controller in Valve driver mode
Set r12 = ON

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EKD 316C – Parameter identification (Modbus)

Lock – the value can only be changed when the main switch is off
PNU – equivalent to to the mod bus register no. (mod bus address + 1).

Actual value
Values are read/written as 16 bit integer values without decimals. This is the default value as read via modbus.

Scale
This shows the scaling factor of the value. *1 means that there is no scaling. *10 means that the read value is 10 times larger than the actual value.

	Parameter		PNU	R/W	Lock	Min.	Max.	Default	Actual value	Scale
Regu- la tion Control	r12	Main switch (Off = 0 / On = 1)	117	R/W	–	0	1	0	0	*1
	o10	AI type (0: no signal 1: 0-20 mA, 2: 4-20 mA 3: 0-10 V, 4: 1-5 V) o61 should be set to 1 in order to use this feature	2027	R/W	–	0	4	0	0	*1
	o18	Manual control	2075	R/W	–	0	3	0	0	*1
	o45	Manual OD%	2064	R/W	–	0	100	0	0	*1
	o56	Reg. type 1= Normal2 = With inner loop	2076	R/W	x	1	2	1	1	*1
	o61	Appl.mode1: Valve driver mode using analogue signal2: Superheat regulation	2077	R/W	x	1	2	2	2	*1

	Parameter		PNU	R/W	Lock	Min.	Max.	Default	Actual value	Scale
Valve	n03	Valve typeRef. valve overview	3002	R/W	x	0	17	16	1	*1
	n32	ETS OD% Max	3023	R/W	–	0	100	100	100	*1
	n37	Max. steps [Stp]	3032	R/W	x	10	999	60	60	*1
	n38	Max. Stp/Sec (Hz)	3033	R/W	x	5	300	160	160	*1
	n39	Start backlash [%]	3034	R/W	x	0	100	10	3	*1
	n40	Backlash [Stp]	3035	R/W	x	0	100	0	0	*1
	n56	Motor current (mA RMS)	3051	R/W	x	0	600	0	0	*1
	h22	Holding current [%]	2198	R/W	x	0	100	0	0	*1

	Parameter		PNU	R/W	Lock	Min.	Max.	Default	Actual value	Scale
Refri- ge rant	o30	Refrigerant(Ref. appendix 1)	2551	R/W	x	0	42	0	0	*1
	—	Rfg.Fac.A1	2548	R/W	–	8000	–	10428	10428	*1
	—	Rfg.Fac.A2	2549	R/W	–	-4000	–	-2255	-2255	*1
	—	Rfg.Fac.A3	2550	R/W	–	1000	3000	2557	2557	*1

Sensors	r05	Temp.unit	105	R/W	–	0	1	0	0	*1
	r09	Adjust S2 [K]	113	R/W	–	-1	10	0	0	x10
	r10	Adjust S4 [K]	114	R/W	–	-1	10	0	0	x10
	o20	Min. Trans. Pres. (bar relative)	2034	R/W	–	-1	0	-1	-10	*10
	o21	Max. Trans. Pres. (bar relative)	2033	R/W	–	1	200	12	120	*10
	o99	Enable high pressure alarm	2199	R/W	–	0	1	0	0	*1

Injection control	n04	Kp factor	3003	R/W	–	0.5	20	2	20	*10
	n05	Tn seconds	3004	R/W	–	30	600	120	120	*1
	n06	Td seconds	3005	R/W	–	0	90	0	0	*1
	n09	Max SH	3015	R/W	–	1	100	10	100	*10
	n10	Min SH	3021	R/W	–	1	100	6	60	*10
	n11	MOP [bar] (max = off)	3013	R/W	–	0	200	20	200	*10
	n15	Start time [sec]	3017	R/W	–	1	90	0	0	*1
	n17	Min Od At Start [%]	3012	R/W	–	0	100	0	0	*1
	n18	Stability	3014	R/W	–	0	10	5	5	*1
	n19	Kp min.	3024	R/W	–	0	1	0.3	3	*10
	n20	Kp T0	3025	R/W	–	0	10	0.4	4	*10
	n21	SH mode1= MSS, 2 = Load app.	3026	R/W	–	1	2	1	1	*1
	n22	SH close [K]	3027	R/W	–	1	15	4	40	*10
	n44	TnT0 sec.	3039	R/W	–	10	120	30	30	*1

Service	—	AL/Light rel	2509	R	–	0	1	0	0	*1
	—	Reset alarm	2046	R/W	–	0	1	0	0	*1
	—	EKC State	2007	R	–	0	100	0	0	*1

	A34	A34 Battery low	10035	R/W	–	0	1	0	0	*1
	—	Standby	20000	R	–	0	1	0	0	*1
	—	EKC Error	20001	R	–	0	1	0	0	*1
	—	S2 Error	20002	R	–	0	1	0	0	*1
Alarms	—	S3 Error	20003	R	–	0	1	0	0	*1
	—	Peinp. error	20004	R	–	0	1	0	0	*1
	—	AI inp.error	20005	R	–	0	1	0	0	*1
	—	No Rfg. Sel.	20006	R	–	0	1	0	0	*1

	u06	Analog input [mA]	2504	R	–	0	30	0	0	*10
	u10	DI1 status	2002	R	–	0	1	0	0	*1
Read out	u20	S2 temp. [°C]	2537	R	–	-200	200	0	0	*10
	u21	Superheat [K]	2536	R	–	0	100	0	0	*10
	u22	Superheat Ref [K]	2535	R	–	0	100	0	0	*10
	o03	Unit addr.	2008	R/W	x	1	240	240	240	*1

Appendix 1

1 = R12	7 = R13b1	13 = User-defined	19 = R404A	25 = R290	31 = R422A	R36 = Opteon XP10	41 = R449A
2 = R22	8 = R23	14 = R32	20 = R407C	26 = R600	32 = R413A	37 = R407F	42 = R452A
3 = R134a	9 = R500	15 = R227	21 = R407A	27 = R600a	33 = R422D	38 = R1234ze	
4 = R502	10 = R503	16 = R401	22 = R407B	28 = R744	34 = 427A	39 = R1234yf	
5 = R717	11 = R114	17 = R507	23 = R410A	29 = R1270	35 = R438A	40 = R448A	
6 = R13	12 = R142b	18 = R402A	24 = R170	30 = R417A			

Installation considerations

Accidental damage, poor installation, or site conditions can give rice to malfunctions of the control system, and lead to a plant breakdown. Every possible safeguard is incorporated into our products to prevent this. However, an incorrect installation, for example, could still present problems. Electronic controls are no substitute for normal, good engineering practice. Danfoss will not be responsible for any goods, or plant components, damaged as a result of the above defects. It is the installers responsibility to check the installation thoroughly, and to fit the necessary safety devices. Particular attention is drawn to the need for a "force closing" signal to controllers in the event of compressor stoppage and to the signal requirement for suction line accumulators.
Your local Danfoss agent will be pleased to assist with further advice, etc.

Documents / Resources

	Danfoss EKD 316C Electronic Superheat Controller [pdf] Installation Guide EKD 316C Colibri, 084R8047, 84B3177.10, EKD 316C Electronic Superheat Controller, Electronic Superheat Controller, Superheat Controller, Controller

References

- **User Manual**