Contents

Danfoss EIM 336 Super Heat Controller

The EIM 336 is the superheat controller that can be used to control the opening degree of a valve based on the superheat of the evaporator. This is applicable in applications such as air conditioning, heat pumps and refrigeration. An alternative option is to use the controller in manual mode via modbus communication and use it as a valve driver by setting the valve opening degree manually.

Advantages

- The evaporator is charged optimally even when there are large variations in load and suction pressure.
- The superheat control can save energy by ensuring optimum utilization of the evaporator.

Features

- Minimum Stable Superheat search regulation (MSS).
- Maximum Operating Pressure function (MOP).
- Defrost.
- Compressor protection functions.
- Evaporator temperature (Te) control for dehumidifying.
- Valve driver via Modbus Communication.
- Loss Of Charge indication (LOC).
- The superheat is controlled to the lowest stable value.
- It controls EEV in microsteps providing a smooth superheat curve and less noise.

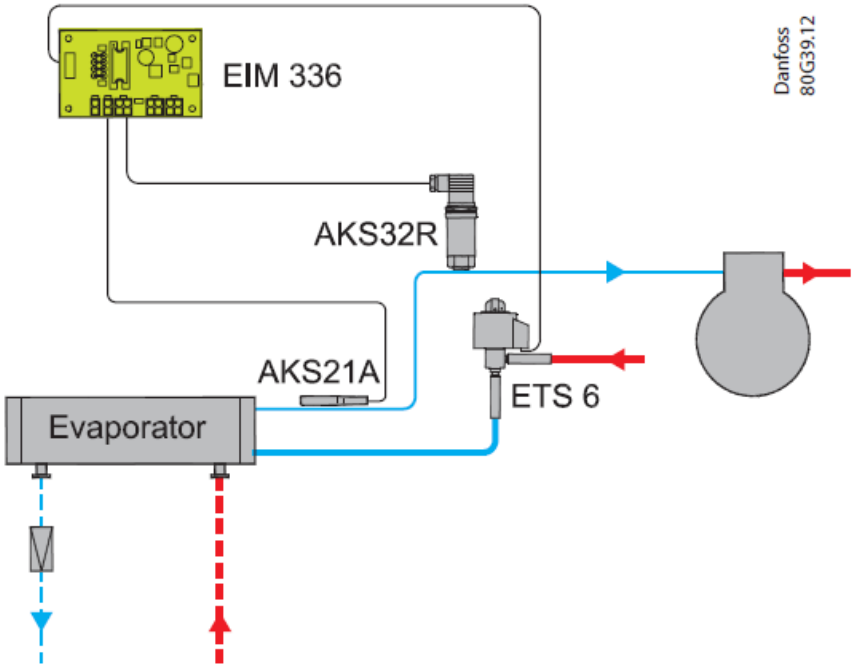
Acronyms and abbreviations used in this manual:

- LOC Loss of charge indication
- SH Superheat
- MOP Maximum operating pressure
- MSS Minimum stable superheat
- Te Saturated suction temperature
- Pe (Po) Evaporator pressure
- S2 Evaporator refrigerant outlet temperature
- S4 Evaporator medium outlet temperature
- OD Opening degree

PNU Parameter number – is equivalent to the modbus register no. (modbus adress + 1)

Applications

Regulation
The evaporator superheat is controlled by one pressure sensor Pe (evaporator pressure) and one temperature sensor S2 (refrigerant temperature). Alternatively the pressure and temperature signals can be received as data via modbus. This can be useful if the pressure and temperature sensors are mounted on a separate controller. Fitting the S4 (evaporator medium outlet temperature) is optional and has no effect on regulation, it is a readout value only. S4 can however be setup as a hardware main switch instead to provide an external ON/OFF function for the controller.



Function overview

Minimum Stable Superheat (MSS)
The controller will search for the minimum stable superheat between an upper and lower boundary. If the superheat has been stable for a period of 6 minutes, the superheat reference is decreased. If the superheat becomes unstable, the reference is raised again. This process continues as long as the superheat is within the bounds set by the user. The purpose of this is to search for the lowest possible superheat that can be obtained while still maintaining a stable system. The superheat reference can also be xed, in which case this function is disabled.

- **Maximum Operating Pressure (MOP)**
  In order to reduce the strain on the compressor, a maximum operating pressure can be set. If the pressure comes above
  this limit the controller will control the valve to provide a lower pressure instead of a low superheat. The limit for this function is usually a fixed pressure, but it is possible to offset the limit temporarily.
- **Evaporator temperature (Te) control for dehumidifying**
  A function is provided to control on the evaporator temperature instead of the superheat. This can be used to de-humidify the air flowing through the evaporator. By lowering the evaporators surface temperature, the water vapor in the air is condensed.
- **Superheat close**
  When the superheat is below a set minimum value, the valve will close faster in order to protect the compressor from the risk of getting liquid in the suction line.
- **Manual control**
  The valve can be controlled manually by setting the desired opening degree via modbus.
- **Start/stop of regulation**
  The start or stop of the regulation can be controlled by setting the software main switch, which is accessible via modbus. It is however also possible to use a digital input from an external hardware main switch.
- **Loss Of Charge indication (LOC)**
  A function is provided to indicate loss of refrigerant charge. This is only indicated by setting an alarm flag which

can be accessed via modbus. No special action is performed by the controller.

- **External sensor values**
  The EIM 336 has sensor inputs for the suction pressure and evaporator temperature (S2). It is however possible to substitute these sensor inputs by sending external sensor values via modbus. These external values need to be updated frequently.
- **Forced opening during startup**
  In some applications it is necessary to open the valve quickly when the compressor turns on, to prevent too low suction pressure. This is ensured by setting a fixed opening degree and a startup time for the controller. Note that this will give a fixed opening degree for the duration of the start time, regardless of the superheat value.
- **Forced opening during off**
  In some applications the valve must remain open when the controller is off. This can be done by setting a fixed opening degree. When normal control is switched off with the main switch, the valve will keep this opening degree.
- **Defrost**
  The controller does not itself handle defrost of the evaporator. It is however possible to enter a special defrost sequence, which will overrule the normal control of the valve.
- **Standalone function**
  The EIM 336 is designed to operate in conjunction with a system master controller, which will control the EIM 336 via modbus. It is however possible to use it in a standalone mode with no external control, except a digital input from the hardware main switch.
  In this configuration some of the other functions will not be available.

Technical Specifications

Supply voltage	24 V a.c./d.c. (+/-15%) Class II isolation	
Power consumption	Idle Operating	Max 10 mA @ 24 V d.c. Max. 150 mA @ 24 V d.c.
Input signals For the EMC compliance, sensor cable length must be < 3m. For longer sensor cable, the ferrite bead should be used.	Po	AKS 32R (or similar ratiometric pressure transmitter)
	S2	PT1000
	S4	PT1000 or digital input from external contact.
EEV driver	Max current 150 mA	
EEV	Uni- or bipolar coil.	
Data communication	RS485 – Modbus RTU	
Environment	Storage: -34 °C to 71 °C (-30 °F to 160 °F)	
	Operating: -25 °C to 60 °C (-13 °F to 140 °F)	
	Humidity: <95% RH, non condensing	
Dimensions	25 × 50 × 80 mm (0.98 × 1.97 × 3.15 inch)	
Operation	Stand alone or via Modbus data communication	
EMC	Immunity Class B – EN 55024 Emission Class A – EN 55022	

Approvals

RoHS	
	Immunity Class B – EN 55024
	Emission Class A – EN 55022
EMC	EN 61000 – 6 – 1: 2007
	EN 61000 – 6 – 2: 2005
	EN 61000 – 6 – 3: 2007 + A1: 2011

Ordering

Type	**Packaging**	**Code no.**
EIM 336	Single pack	080G1002

Accessories

Type /description	Packaging	Code no.
Connector kit for 5x EIM Controller	Single pack	*080G1601*
MYK – EIM interfacer*	Single pack	080G0073

* Please contact your local Danfoss supplier for required software

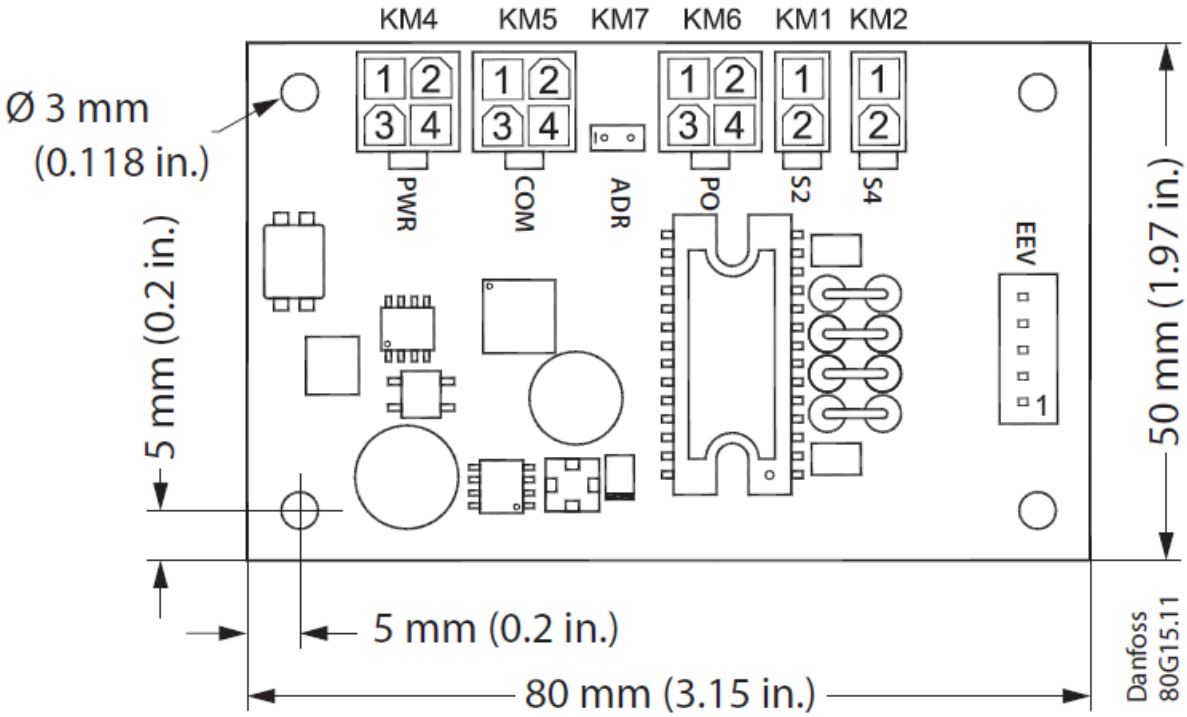
Related products

Pressure transducer AKS 32R, NSK BExx	Temperature sensor AKS 21, AKS 11	Programming key / display MYK - EIM interfacer	Electronic Expansion valve ETS6
			

Connections

S2	KM1	1	Pt 1000	
		2		
S4	KM2	1	PNU no 64100 = 1: Digital input for start/ stop.PNU no 64100 = 0: PT1000	
		2		
Power & com.	KM4	1	Power supply (+/-)	
		2	RS485 (+)	Used for daisy chain modbus connection
		3	RS485 (-)	
		4	Power supply (+/-)	
Modbus Adr.	KM7	Jumper mounted =Indoor unit (evaporator) Modbus address stored in PNU no 40041 (default = 165)		
		Jumper **not** mounted =Outdoor unit (condenser) Modbus address stored in PNU no. 40042 (default 164)		

Colours are only valid for Danfoss ETS 6 valve connections.



Safety note!

- Caution must be taken against direct grounding of sensor, communiation, power supply or EEV valve terminals.
- Failure to apply with this instruction can cause unrecoverable damaged to the controller.

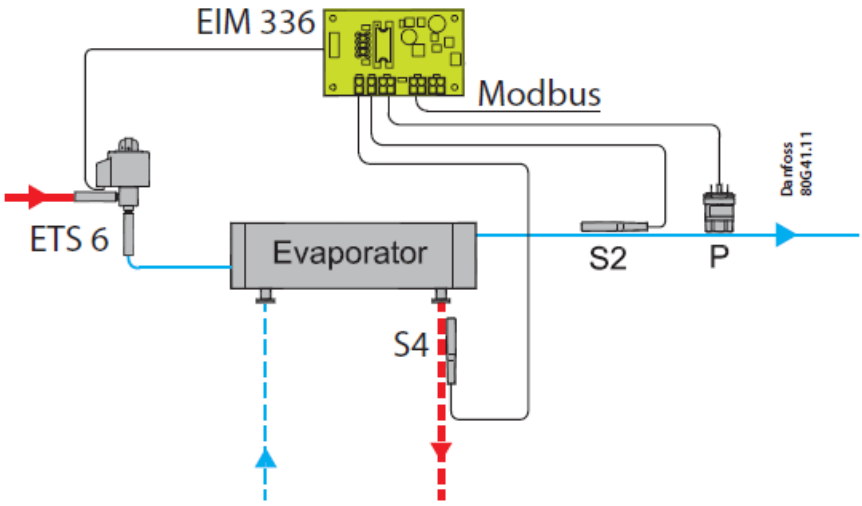
Configuration

System configuration

- The EIM 336 controller is designed to be operated via modbus and to rely on a constant connection to the master controller of the system it is located within.
- In this configuration the master controller reads the readout registers from the EIM 336 and uses the parameters to change the control behaviour of the EIM 336 (see parameter list).

The following control modes are available:

- Minimum Stable Superheat search (MSS) is the default control mode
- Manual control
- Defrost
- Maximum Operating Pressure control (MOP)
- Te control (De-humidifying)



Controlling manually via modbus
When setting the manual control register “o18 Manual ctrl.” to 1, the controller will be in manual control. During this mode the opening degree is controlled by setting the “Manual OD%”. The manual control mode does not depend on the “r12 Main Switch”, and will set the opening degree regardless of its setting. Setting “o18 Manual ctrl.” to 0 again, the controller will assume normal control, and will open or close from the current opening degree.

Related parameters:

Symbolic name	PNU	Description
o18 Manual ctrl.	2075	0 = Superheat control, 1 = Manual control
o45 Manual OD%	2064	Manual opening degree in percent. 0 = fully closed,100 = fully open.Used when the o18 Manual Control is set to 1.

Note:
On using system configuration , it is necessary to read the “Ctrl Stats” register 3100 continuosly, failure to do so will start the MSS regulation automatically irrespective to the different status of the External main switch. Refer Appendix 1 for detail.

Standalone configuration (no modbus communication)
The EIM 336 can be set in a standalone configuration by setting the “HWMain Switch” to 1. This will setup the S4 input to be used as a hardware main switch.

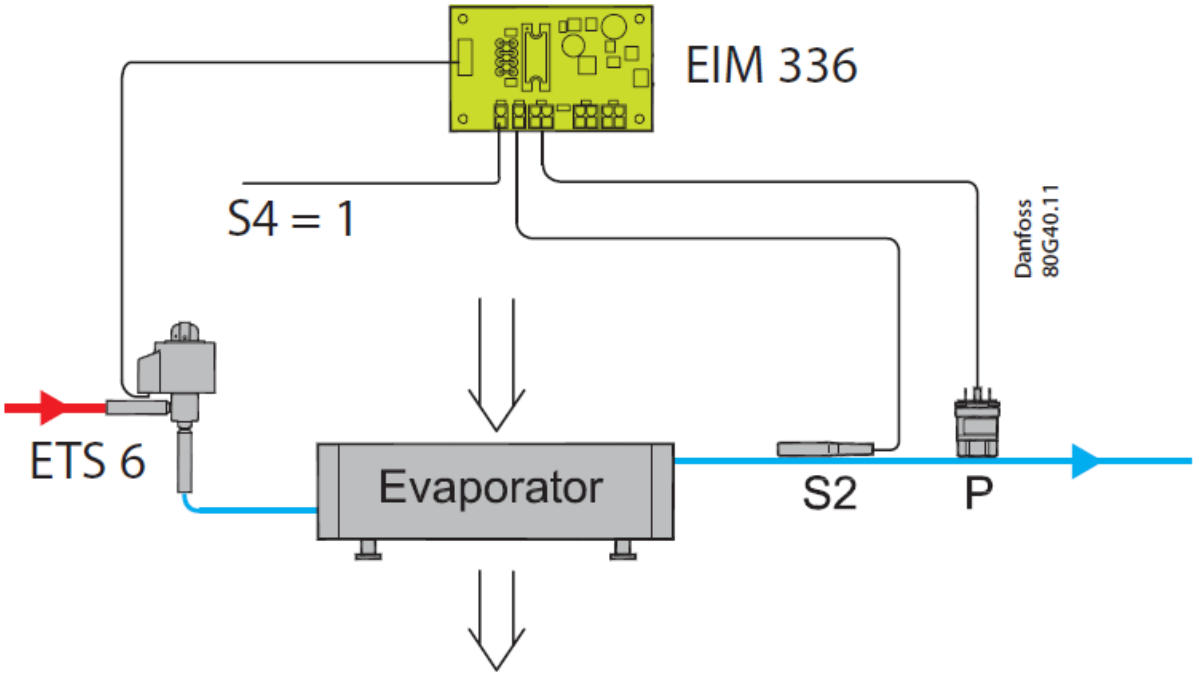
Note that the only external control of the EIM 336 in this configuration is through the hardware main switch.

The following control modes are available:

- Minimum Stable Superheat search (MSS) is the default control mode
- Maximum Operating Pressure control (MOP), but the Diff MOP option is not available

The following control modes are not available:

- Manual control
- Defrost
- Te control (De-humidifying)



Using stand alone configuration
The EIM 336 is designed to operate in conjunction with a system master controller, which will control the settings and mode of the EIM 336 via modbus. It is however possible to use it as a standalone controller by setting the “HWMain Switch” to 1. This will setup the S4 input to be used as a digital input main switch. When the main switch is OFF, the valve opening degree will be 0%, when it is ON the opening degree is controlled with the settings in the registers, and the sensor inputs.

Note:
That the only external control of the EIM 336 in this configuration is through the hardware main switch. It is not possible to manually control the opening degree or change settings, and the defrost and Te control modes are not available.

Related parameters:

Symbolic name	PNU	Description
— HWMainSwitch	64100	0 = no external main switch, 1 = S4 input is main switch

MODBUS Communication

Setting up modbus parameters
The modbus baud rate, “Modbus Baud”, can be set to three different baud rates. The modbus parity “Modbus Parity” can be set to either no parity, odd parity or even parity. The modbus stop bit can be set to either 1 or 2 stop bits. The default settings are 19200 baud, even parity and 1 stop bit. A jumper KM7 has been added to the EIM 336, for selecting between two predefined addresses. This is useful for applications such as reversible air conditioning/heat pump systems with both an indoor and an outdoor unit. In this way the address can be changed without the need to reconfigure the controllers settings. The primary unit address “o03 Unit addr.” is used when the jumper is mounted. The secondary unit address “Unit Addr. 2” is used when the jumper is not mounted. The default primary address is 165, the default secondary address is 164.

Note:
Changes to these parameters will become active immediately. This means that a modbus tool or controller that changes these settings will loose connection to the EIM 336 and will need to reestablish connection using the new settings. The EIM 336 “read holding registers” function (0x03) is limited to a maximum of 20 consecutive registers

per read request. If a modbus tool or a controller is used to read parameters over modbus, it needs to take this into account. During the communication the transmitted Modbus requests are checked for CRC errrors. If the CRC is not correct, the request is discarded and the EIM 336 waits for a new request. In this case no exception response is issued.

Related parameters:

Symbolic name	PNU	Description
o03 Unit addr.	2008	Primary unit address is used when jumper KM7 is mounted
Unit Addr. 2	2009	Secondary unit address is used when the jumper KM7 is not mounted
Modbus Baud	50060	Communication setting baud rate, 0 =9600 , 1 = 19200, 2 = 38400
Modbus Parity	50061	Communication setting parity, 0 = no parity, 1 = odd parity, 2 = even
Modbus Stop B	50062	Communication setting stop bit, 1 = 1 stop bit, 2 = 2 stop bit

Operation

Selecting a refrigerant
The controller needs to know which refrigerant is used in order to accurately control the superheat. This can be selected by setting the “o30 Refrigerant” to the desired refrigerant as defined in the list below. If no refrigerant is selected (“o30 Refrigerant” is set to 0 or an undefined refrigerant), the “No Rfg. Sel.” alarm is set and the controller will not start regulating.

Refrigerant setting
Before refrigeration can be started , the refrirant has to be defined. You can select the following refrigerant.

Related parameters:

Symbolic name	PNU	Description				
		1 = R12	9 = R500	17 = R507	25 = R290	33=R422D
		2 = R22	10 = R503	18 = R402A	26 = R600	34=427A
		3 = R134a	11 = R114	19 = R404A	27 = R600a	35=R438A
		4 = R502	12 = R142b	20 = R407C	28 = R744	R36=Opteon
o30 Refrigerant	2551	5 = R717	13 = User defined	21 = R407A	29 = R1270	XP10
		6 = R13	14 = R32	22 = R407B	30 = R417A	37 =R407F
		7 = R13b1	15 = R227	23 = R410A	31 = R422A	
		8 = R23	16 = R401A	24 = R170	32=R413A	

Warning: Wrong selection of refrigerant may caurse damage to the compressor.

Connecting and setting up a valve
The EIM 336 controller is designed to be used with Danfoss ETS 6 valves with a maximum of 480 pulses from fully closed to fully open. This setting should not be changed. The speed of the valve can be changed by increasing or decreasing the number of pulses per second, “n38 Max StepsSec”. A larger value will make the value open or close faster. Note that the torque of a stepper motor decreases as the speed increases. Too high speeds should therefore be avoided. For the ETS 6 valve, the recommended speed setting is 31 pulses per second.

When the controller is powered, the valve will first be closed fully so that the controller starts from a known opening degree (0%). In order to make sure that it is fully closed, the valve will be closed 100% plus an additional contribution known as backlash. The backlash takes into account that the stepper motor may loose some steps due to too low torque or mechanical slippage in the gears etc. The start backlash is the amount of extra steps in percent to close once the valve is closed (less than 1%). If the valve is opening and reaches its destination, it will move additional steps in the opening direction, then move the same amount of steps in the closing direction. This is called backlash and is the amount of steps to add to compensate for spindle play.

Related parameters:

Symbolic name	**PNU**	**Description**
n38 Max StepsSec	3033	Steps per second
n39 Start BckLsh	3034	Backlash, is the additional amount of steps, in percent, to close at startup and when the valve opening degree is less than 1%.
n40 Backlash	3035	Start Backlash is the amount of steps to compensate for spindle play

Connecting and setting up a pressure sensor
The pressure sensor input is setup by default to accept an AKS32R pressure transducer. If another sensor is to be used, it is important to note that it needs to be a 0.5 – 4.5 V d.c. ratiometric type (10% – 90% of supply voltage). The default range for the sensor is 0 to 16 bar absolute. This can be changed by setting the minimum transducer pressure, “o20 MinTransPres” and the maximum transducer pressure, “o21 MaxTransPres” to the new values. The values must be entered in bar absolute so a sensor with a range of -1 to 12 bar gauge, needs to be entered as 0 to 13 bar absolute.

Related parameters:

Symbolic name	**PNU**	**Description**
o20 MinTransPres	2034	Minimum transducer pressure (in bar absolute x 10)
o21 MaxTransPres	2033	Maximum transducer pressure (in bar absolute x 10)

Using external sensor values
In some applications, the suction pressure and/or the refrigerant temperature on the evaporator outlet, is measured by a system controller. This is often the case if the suction pressure is used to trigger low temperature/pressure alarms by the systems main controller. In these cases the sensors can be omitted from the

EIM 336, and the sensor values can be received via modbus instead. This requires that the systems main controller continuously transmits these values to the EIM 336. If no new sensor value is received within 5 seconds of the last transmission, the sensor will revert to using the physical sensors. The suction gas temperature S2 and the evaporator pressure Pecan be set by writing to the registers “ext S2 Temp” and “ext EvapPress P0” respectively.

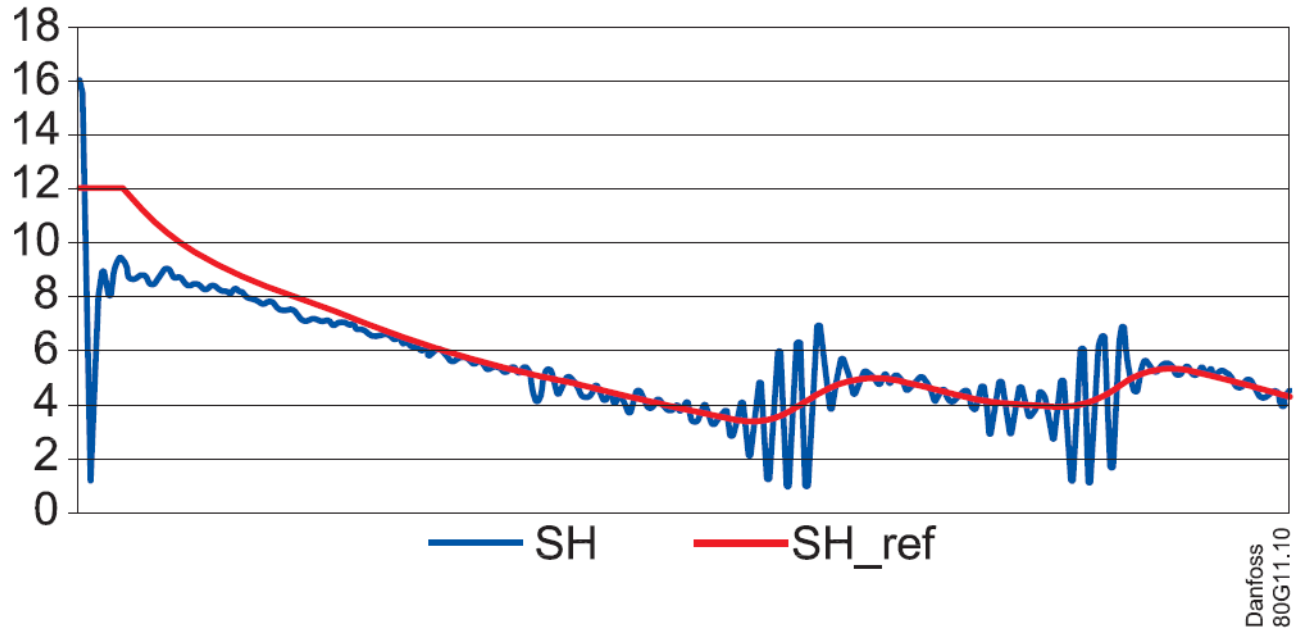
Note that the external evaporator pressure is received in millibar so 8.4 bar absolute must be sent as 8400.
It is possible to set the S4 temperature as an external sensor value also, but since this sensor is not used in the superheat regulation, this has little practical use.

Related parameters:

Symbolic name	PNU	Description
ext Evap Press P0	2643	External evaporator pressure. This value can be used instead of a sensor. This register must be written at least every 5 second, otherwise the sensor value will be used. The entered value is in millibar
ext S2 temp	2644	External S2. This value can be used instead of a sensor .This register must be written at least every 5 second, otherwise the sensor value will be used.
ext S4 air temp.	2646	External S4. This value can be used instead of a sensor. This register must be written at least every 5 second, otherwise the sensor value will be used.

Configuring the superheat control

- The superheat control algorithm will attempt to regulate the superheat down to the lowest stable value between the minimum superheat setting, “n10 Min SH” and the maximum superheat setting, “n09 Max SH”. If a fixed superheat reference is desired instead, the “n10 Min SH” and “n09 Max SH” can both be set to the desired reference value. This will disable the minimum stable superheat search algorithm and the controller will instead regulate the superheat according to this reference.
- The time constant for the superheat control can be changed by setting “Tn SH”.
- The alpha value is the design time constant and should be in reasonable proximity to the time constant of the evaporator. A large alpha means a slow reaction, a small alpha means a fast reaction.
- If the superheat drops below “n22 SH close”, the controller will close the valve faster to avoid the risk of liquid in the compressors suction line.



Symbolic name	PNU	Description
n09 Max SH	3015	Maximum superheat reference setting.
n10 Min SH	3021	Minimum superheat reference setting.
n20 Kp T0	3025	Pressure feedback gain.
n22 SH close	3027	Superheat close level. If the superheat goes below this value, the valv e will close faster.
— Tn SH	3103	Integration time for superheat control
— Alpha	3111	Design time constant. A large alpha means a slow response, a small a lpha mean a fast response.
— Max SH shdw	64301	Copy of 3015. If it is required to write n09 frequently, this should be us ed instead.
— Min SH shdw	64302	Copy of 3021. If it is required to write n10 frequently, this should be us ed instead.
— Tn SH shdw	64303	Copy of 3103. If it is required to write TnSH frequently, this should be used instead.
— Alpha shdw	64304	Copy of 3111. If it is required to write alpha frequently, this should be u sed instead.

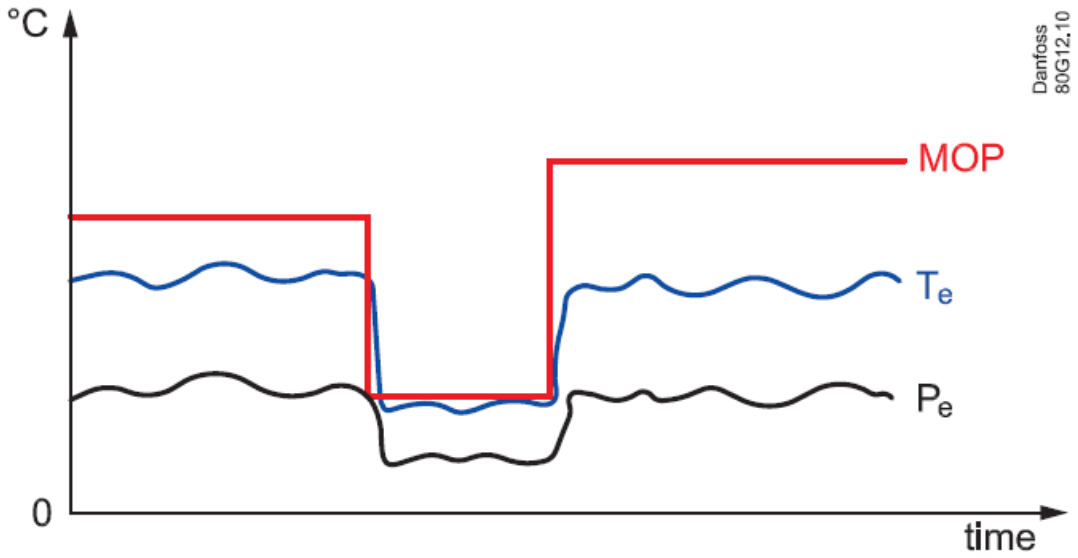
Note:
Main Switch r12 should be ON to start the regulation. This can also be accomplished with the external hardware mainswitch.
See appendix 1 for details.

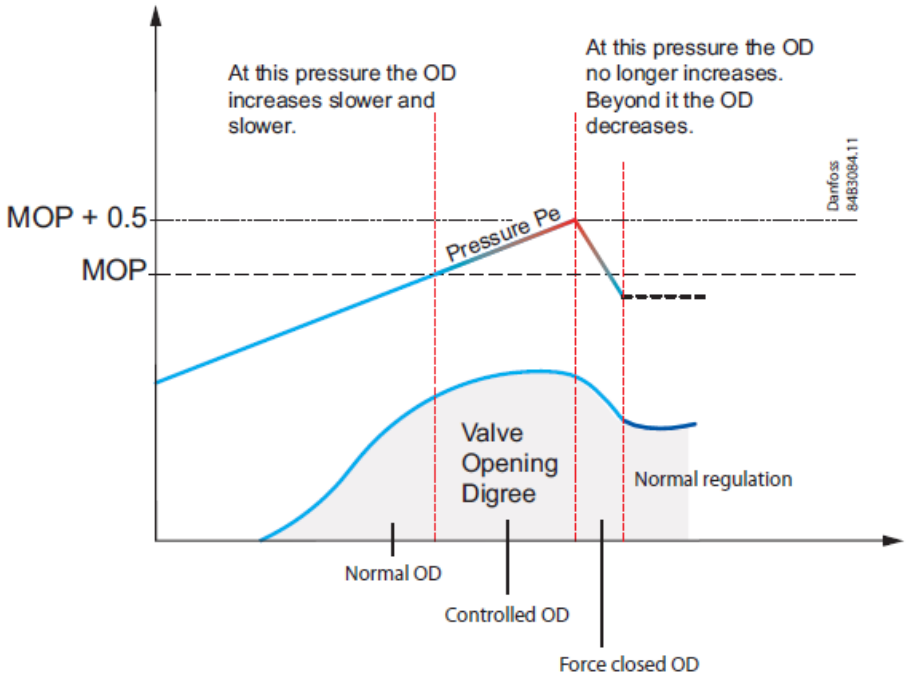
Using the MOP

- In order to reduce the current to the compressor it is possible to control the maximum operating pressure of the

evaporator. Evaporator pressure exceeds the “MOP” limit, the valve opening degree is controlled by the MOP function which will keep the pressure below the “MOP” limit. This function takes precedence over the superheat control, so during MOP control the superheat is not controlled.

- The MOP function can be disabled by setting the “MOP” to the maximum value (600 equalling 60.0 bar absolute). When the pressure reaches the set MOP point, an increase in OD is restricted. If the pressure reaches MOP + 0.5 Bar, an increase in OD is prohibited, and instead the OD will start to decrease. If the pressure goes below the MOP point, the controller will start to regulate the superheat normally.
- The MOP controller consists of a separate PI control, which settings can be changed by setting “Kp MOP” and “Tn MOP”.
- A large Kp will lead to a large change in opening degree even at small changes in the evaporator pressure, but may lead to instability. A large Tn will lead to a slow reacting system, while a small Tn will lead to a fast reacting system.



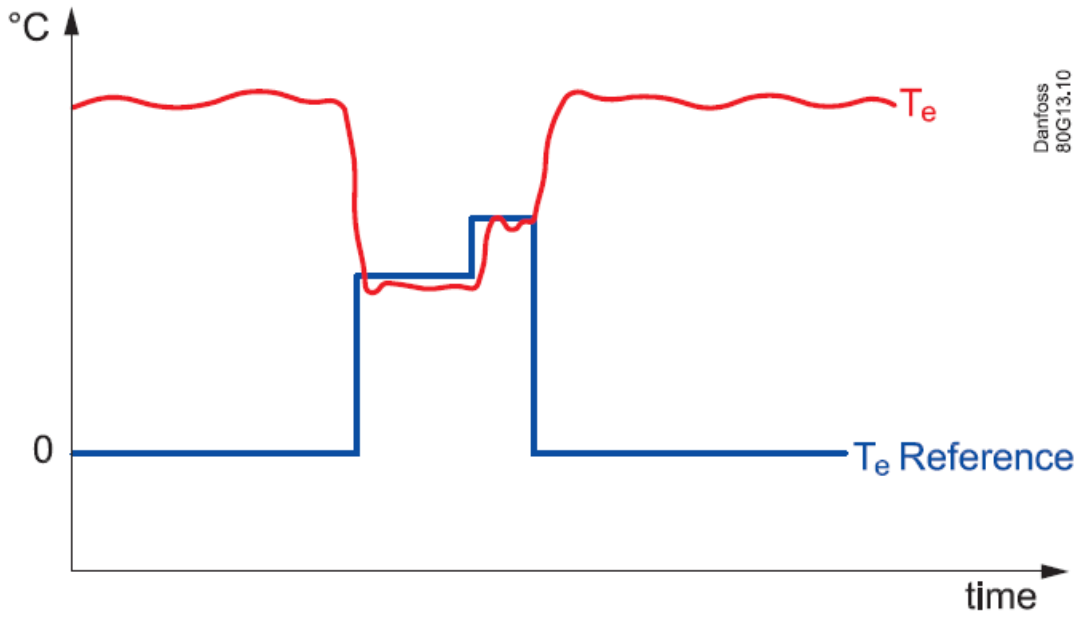


Related parameters:

Symbolic name	PNU	Description
n11 MOP	3013	Maximum operation pressure. If Pe goes above this value, the controller will control on Pe, and not on superheat.
— Kp MOP	3113	Kp proportional gain while in MOP control mode.
— Tn MOP	3114	Tn integration time while in MOP control mode.

Using Te control

For applications with a need to dehumidify the evaporator, it is possible to control on the saturated evaporator temperature instead of the normal control signal. If the “Te Reference” register is set to a value above 0, Te control is activated. Te and the ‘Te Reference’ to calculate a new reference for the superheat control. The Te control consists of a separate PI control, which settings can be changed by setting the gain, “Kp Te” and time constant, “Tn Te”. A large Kp will lead to a large change in the output even at small changes in the evaporator temperature, but may lead to instability. A large Tn will lead to a slow reacting system, while a small Tn will lead to a fast reacting system. The MOP function is still active during Te control and it will assume control, if the evaporator is above the “MOP” limit.

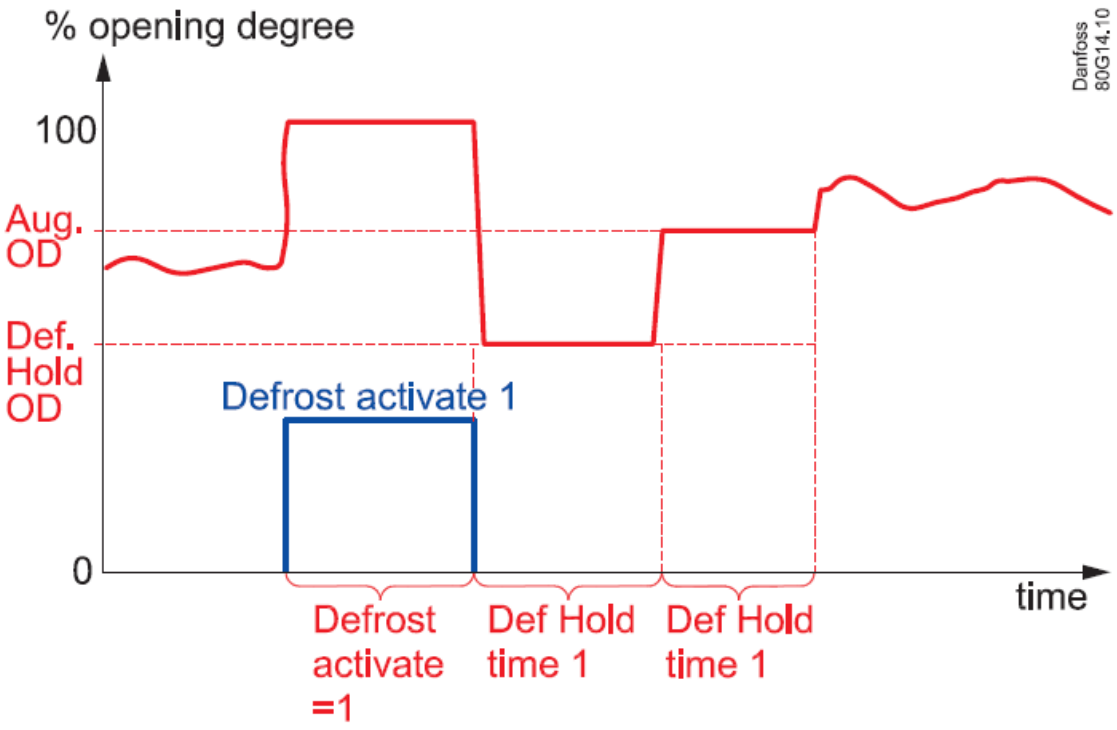


Related parameters:

Symbolic name	PNU	Description
— Kp Te	3115	Kp proportional gain while in Te control mode
—Tn Te	3116	Tn integration time while in Te control mode
— Te Reference	3117	Te reference while in Te control mode

Defrosting
A defrost sequence is initiated by setting the defrost activate register “Def Activate” to 1. As long as this register is kept at 1, the valve opening degree is 100%. When “Def Activate” returns to 0, the valve opening degree is kept at “Def Hold OD” for “Def Hold Ti 1” seconds. When this time expires, the valve opening degree is set to a calculated average opening degree for “Def Hold Ti 2” seconds. When this time expires the controller resumes normal operation.

Note:
That defrost is not initiated by the EIM 336, but must be initiated by the master controller. In a standalone configuration the defrost mode is not possible. If a more dynamic control of the opening degree during defrost is required, the user should disable the “Def Hold Ti 2” by setting it to 0, and only use the “Def Hold Ti 1”. If frequent changes are to be made to the “Def Hold OD”, the parameter “DefHold shdw” should be used instead. This parameter is an exact copy of the “Def Hold OD” except that it is not placed in the Eeprom.



Related parameters:

Symbolic name	PNU	Description
— Def Activate	50011	Defrost activating, 0 = no defrost, 1 = defrost active
— Def Hold OD	50008	Opening degree during Def Hold Ti 1
— Def HoldTi 1	50009	Defrost hold time 1
— Def HoldTi 2	50010	Defrost hold time 2
— DefHold shdw	64305	Copy of 50008. If it is required to write Def Hold OD frequently, this should be used instead.

LOC detection
When a system loses refrigerant charge the controller will have difficulties keeping the superheat low, even when increasing the valve opening degree. Therefore, if both the valve opening degree and the superheat are high for a long period of time, this could indicate that refrigerant charge was lost. When the valve opening degree exceeds the trigger level “LOC Trig, and the superheat exceeds the superheat trigger level “LOC SH Trig”, a timer is started.

When the timer exceeds the user defined time “LOC Timer” the “LOC Alarm” is set. If the valve opening degree drops below the user defined reset level “LOC Reset”, the timer and the alarm are reset. The loss of charge alarm does not perform any actions, except setting the “LOC Alarm”.

Related parameters:

Symbolic name	PNU	Description
— LOC Trig	50003	Trigger value for loss of charge
— LOC Reset	50004	Reset value for loss of charge
— LOC Timer	50005	Timer to trigger LOC alarm
— LOC Alarm	50006	Loss of charge alarm flag, 0 = no alarm, 1 = LOC alarm
— LOC SH Trig	50007	SH error trigger level for LOC alarm
— LOC Tmr	3102	Loss Of Charge time readout displays the elapsed time since the alarm became active.

Alarms and clearing alarms
Several alarms are registered and made available on modbus. Most of these are automatically cleared when the error is no longer present.

Related parameters:

Symbolic name	PNU	Description
— Reset alarm	2046	1 = Clear alarm
— EKC Error	20001	Common error flag. EKC Error is SET if any other Error Alarm is ON.
— S2 Error	20002	S2 sensor error. If the sensor error occurs, the valve OD will be set to 80% of the Avg. opening (PNU 50021) – see troubleshooting.
— Pe inp.error	20005	Pressure transmitter out of range. If the sensor error occurs, the valve OD will be set to 80 % of the Avg. opening (PNU 50021) – see troubleshooting
— No Rfg. Sel.	20006	Refrigerant not selected
— LOC Alarm	50006	Loss of charge alarm. No action will be performed except setting the alarm.
— Ctrl Status	3100	Bit mappped status register, see also appendix 2

Parameter list

Row text	Explanation
PNU	The Parameter Number in the EIM 336 controller. All parameters are addressed as holding register. The Modbus PDU address corresponds to PNU -1. If no translation table is used, this is the register number in modbus.
Min.	Minimum value
Def.	Factory default value
Max.	Maximum value
e2	Is the value stored in EEPROM
W	Is writing to the register possible
*10	The scaling of the parameter. All values are read/ written as integers over modbus. Parameters need to be scaled, these are marked with a checkmark. This means that 0.1 is sent as 1 over modbus, 1.0 is sent as 10 etc.
Symbolic name	The name of the parameter
Description	Short parameter description

Note:
Some parameters have what is called a “config lock”. This means that they can only be changed when the main switch of the EIM 336 is set to OFF (r12 = 0). This applies for instance to the type of refrigerant (o30). So if you want to change the refrigerant, the main switch (r12) must first be set to 0, then the refrigerant type (o30) can be changed.

The following parameters require the main switch (r12) to be OFF:

- n37 Max steps
- n38 Max steps/sec
- o03 Unit address
- o30 Refrigerant

Please refer to the list below. It should be possible to change all other parameters while the unit is running (regulation parameters etc.). Shdw (x): Shdw values are stored in the volatile memory and will revert back to the previously stored value in its main parameter if the power failure occurs. Altering the main parameter will automatically change the shdw value. If frequent change in parameter required, it is recommended to use shdw parameter.

Group	PNU	Parameter	Symbolic name	Min.	Max.	Default	Units	e2	W	*10	Description
Control											
Regulation Control	117	r12	Main switch	0	1	0			√		Start/stop of regulation. With this setting the regulation can be started and stopped. This can also be accomplished with the external hardware main switch. See also appendix 1
	2075	o18	Manl control	0	1	0			√		0 = Superheat control, 1= Manual control
	2064	o45	Manual OD	0	100 / 480	0	% / step		√		Manual opening degree for manual control . Used when the o18 Manual Control is set to 1. 0%/0 step = fully closed,100%/480 step = fully open. % is chosen by default.See PNU 64309 for changing to step.
	3017	n15	Startup time	0	1000	0	s	√	√		Time for startup state (in seconds)
	3012	n17	Startup OD	0	100	0	%	√	√		Opening degree during startup state
	6430 8	OOD	OD while OFF	0	100	0	%	√	√		Opening degree during Off state
Regulation											
	3015	n09	Max. superheat	2	20	16	K	√	√	√	Maximum superheat reference setting
	3021	n10	Min. superheat	1	20	4	K	√	√	√	Minimum superheat reference setting

Super Heat Control		3025	n20	KpT0	-1	20	-1		√	√	√	Pressure feedback gainAutomatic = -1, OFF = 0 , Fixed = 1 and above
		3027	n22	SH close	0	16	0.5	K	√	√	√	Superheat close level. If the superheat goes below this value, the valve will close faster
		3103	TSH	Tn SH	10	1800	600		√	√		Tn integration time for the superheat control. Lower value give fast regulation response.Very low value give the risk of unstable regulation.
	For Danfoss only!	3105	SHL	SH Low	3	20	6	K	√	√	√	Superheat low setting for non-linear control
		3106	SHH	SH High	8	40	16	K	√	√	√	Superheat high setting for non-linear control
		3107	GaH	Gain High	0.5	10	1		√	√	√	Expected gain at SH high for non-linear control
		3108	GaL	Gain Low	0.1	50	12.5		√	√	√	Expected gain at SH low for non-linear control
		3109	TaH	Tau High	10	600	45		√	√		Expected tau at SH high for non-linear control
		3110	TaL	Tau Low	10	600	110		√	√		Expected tau at SH low for non-linear control
		3111	Aph	Alpha	15	600	130		√	√		Design time constant.A large alpha means a slow response, a small alpha mean a fast response.
		3120	CoS	Comp Speed	0	100	0	%		√	√	Compressor speedTn=2x Tn if compressor speed is set to 0%Tn= Tn if the compressor speed is set between 25 – 100% – ref. parameter 3103
		64301	n09^{x}	Max. superheat shdw	2	20	16	K		√	√	Copy of 3015. If it is required to write Max superheat frequently, this should be used instead
		64302	n10^{x}	Min. superheat shdw	1	20	4	K		√	√	Copy of 3021. If it is required to write Min superheat frequently, this should be used instead
		64303	TSH^{x}	Tn SH shdw	10	1800	600			√		Copy of 3103. If it is required to write TnSH frequently, this should be used instead.
		64304	Aph^{x}	Alpha shdw	15	600	130			√		Copy of 3111. If it is required to write alpha frequently, this should be used instead.

Group	PNU	Parameter	Symbolic name	Min.	Max.	Default	Units	e2	W	*10	Description
MOP	3013	n11	MOP	0	200	12.5	bar (abs.)	√	√	√	Maximum operation pressure. If Pe goes above this value, the controller will control on Pe, and not on superheat
	3113	KpM	Kp MOP	0.5	10	0.5		√	√	√	Kp proportional gain while in MOP control mode
	3114	TnM	Tn Mop	30	600	180		√	√		Tn integration time while in MOP control mode
	3121	DMO	Diff MOP	-20	0	0	bar (abs.)		√	√	Differential MOP. A remote offset that is added to the MOP. Needs to be written every 5 seconds, else the offset is set to 0.
Defrost	50011	DeA	Def Activate	0	1	0			√		Defrost activating
	50008	DHO	Def Hold OD	0	100	30	%	√	√		Defrost holding level
	50009	DH1	Def Hold Ti 1	0	32000	120	s	√	√		Defrost holding timer 1
	50010	DH2	Def Hold Ti 2	0	32000	60	s	√	√		Defrost holding timer 2
	64305	DDO	Def hold OD shdw	0	100	30	%	√	√		Copy of 50008. If it is required to write Def Hold OD frequently, this should be used instead.
Te Control	3115	KpTe	Kp Te	0.5	10	1		√	√		Kp proportional gain while in Te control mode
	3116	TnT	Tn Te	30	600	60		√	√		Tn integration time while in Te control mode
	3117	TeR	Te Reference	-200	200	0	°C		√	√	Te reference while in Te control mode

External sensors	2643	PEV	ext. EvapPress P0	0	65535	0	milli bar		√		External evaporator pressure. This value can be used instead of a sensor. This register must be written at least every 5 seconds, otherwise the sensor value will be used.
	2644	TS2	ext. S2 temp	-200	200	0	°C		√	√	External S2. This value can be used instead of a sensor. This register must be written at least every 5 seconds, otherwise the sensor value will be used.
	2646	TS4	ext. S4 Air temp	-200	200	0	°C		√	√	External S4. This value can be used instead of a sensor. This register must be written at least every 5 seconds, otherwise the sensor value will be used.
LOC	50003	LTR	LOC Trig	0	100	95	%	√	√		Trigger value for loss of charge
	50004	LRe	LOC Reset	0	100	85	%	√	√		Reset value for loss of charge
	50005	LTm	LOC Timer	0	7200	3600	s	√ √			Timer to trigger LOC alarm
	50007	LST	LOC SH Trig	0	50	20	K	√	√	√	SH error trigger level for LOC alarm

Setup

Modbus	2008	003	Unit Addr	1	240	165		√	√		Primary unit address is used when jumper KM7 is mounted
	2009	UA2	Unit Addr 2	1	240	164		√	√		Secondary unit address is used when the jumper KM7 is not mounted
	50060	MBa	MB Baud	0	2	1		√	√		Communication setting baud rate, 0=9600 , 1 = 19200, 2 = 38400
	50061	MPa	MB Parity	0	2	2		√	√		Communication setting parity, 0 = no parity, 1 = odd parity, 2 = even
	50062	MSB	MB StopB	1	2	1		√	√		Communication setting stop bit, 1 = 1 stop bit, 2 = 2 stop bit
	64200	–	Modbus trans	0	3	1		√	√		1 = Enabling translation tables. If the translation table is enabled, only registers some are accessible.
Valve	3032	n37	Max steps	100	1000	384		√	√		Maximum number of steps(384 x 10 microsteps = 480 half steps)
	3033	n38	Max steps/sec	5	300	31		√	√		Steps per second
	3034	n39	Start backlash	1	100	10	%	√	√		Backlash (steps) to close in percent at startup (power on).
	3035	n40	Backlash	0	100	20	%	√	√		Backlash (steps) for spindle play compensation. This is active during normal control
	3037	n42	Comp. dir.	1	2	1		√	√		Compensation direction
	3051	n56	Motor current	0	300	150	mA	√	√		Motor current

Regfrigerant	2551	o30	Refrigerant	0	31	20		√	√		1 = R12 2 = R22 3 = R134a4 = R5025 = R7176 = R137 = R13b18 = R239 = R50010 = R50311 = R11412 = R142b13 = User defined	14 = R32 15 = R22716 = R401A17 = R50718 = R402A19 = R404A20 = R407C21 = R407A22 = R407B23 = R410A24 = R17025 = R29026 = R60027 = R600a	28 = R74429 = R127030 = R417A31 = R422A32=R413A33=R422D34=427A35 =R438A36=Opteon XP1037 =R407F
	2548	RF1	Rfg. fac. A1	8000	12000	10428		√	√		Adiabatic constant A1		
	2549	RF2	Rfg. fac. A2	-4000	-1000	-2255		√	√		Adiabatic constant A2		
	2550	RF3	Rfg. fac. A3	1000	3000	2557		√	√		Adiabatic constant A3		
Sensors	113	r09	Adjust S2	-10	0	0	K	√	√√		S2 Offset adjustment to correct the sensor signal due to long wires etc.		
	2033	o21	Max. transducer pressure	1	200	12	bar (abs.)	√	√	√	Maximum transducer pressure (in bar absolute * 10)		
	2034	o20	Min. transducer pressure	0	1	0	bar (abs.)	√	√	√	Minimum transducer pressure (in bar absolute * 10)		
	50020	–	Avg KT0 time	10	3600	180		√	√		Average time for KT0 used as filtervalue for the average opening degree calcula- tion when calculating the KT0		
	50021	–	Avg OD 3 hours	0	1000	100	per mill	√	√	√	Average OD, updated every 3 hours		

System	50051	–	Sampling time	1	10	1	sec.	√	√		Algorithm sampling time
	64200	LBO	Limited list	0	1	0		√	√		Modbus translation table for limited list of sequential registers
	64100	HWM	HW main switch	0	1	0		√	√		1 = S4 input is HW Main Switch
	64309	–	Manual OD as steps	0	1	0		√	√		Enable the manual OD in o45 to be entered as half steps. Readouts are still in percent

Service

Alarm	2046	RAL	Reset alarm	0	1	0			√		1 = clear alarm
	20001	–	EKC Error	0	1	0					Common error flag. EKC Error is SET if any other Error Alarm is ON.
	20002	–	S2 Error	0	1	0					S2 sensor error. If the sensor error occurs, the valve OD will be set to 80% of the Avg. opening (PNU 50021) – see troubleshooting.
	20005	–	Pe inp.error	0	1	0					AKS 32R out of range. If the sensor error occurs, the valve OD will be set to 80% of the Avg. opening (PNU 50021) – see troubleshooting.
	20006	–	No Rfg. Sel.	0	1	0					Refrigerant not selected
	50006	–	LOC Alarm	0	1	0					Loss of charge alarm. No action will be performed except setting the alarm.
	2531	u16	S4 air temp	-200	200	0	°C			√	S4 temperature in °C measured with PT 1000 sensor connected to KM2
	2535	u22	Superheat Ref	0	100	0	K			√	Current superheat reference
	2536	u21	Superheat	0	100	0	K			√	Current superheat (S2 – evaporator temperature)
	2537	u20	S2 Temp	-200	200	0	°C			√	S2 temperature in °C measured with a PT 1000 sensor connected to KM1.

Readout	2542	u24	opening %	0	100	0	%				Actual opening degree
	2543	u25	Evap Press P_e	-200	200	0	bar (abs.)			√	Evaporator pressure measured with ratiometric pressure transmitter at KM6.
	2544	u26	Evap Temp T_e	-200	200	0	°C			√	Evaporator temperature (converted from evaporator pressure)
	3101	–	Closed valve T	0	2000	0					Closed valve timer
	3102	–	LOC Tmr	0	2000	0					Loss Of Charge time
	50033	–	Avg opening	0	100	0	%				Average opening degree. If it has never run before it will give the value of PNU 50021 at start up.
	64306	–	SWVer shdw	x	x	x					Copy of 2003. This displays the version number in a non-EKC format. For example 123 means vers 1.23

Group	PNU	Parameter	Symbolic name	Min.	Max.	Default	Units	e2	W	*10	Description
Control status	3099	–	Control State	0	5	0					Current state of internal control state machine.
	3100	–	Ctrl Status	0	20000	0					Bit mappped status register. See also appendix 2.

Troubleshooting

Symptom	Possible Cause	Remedy
Suction pressure too low	Pressure drop across the evaporator too high	
	Lack of subcooling ahead of expansion valve	Check refrigerant ahead of expansion valve .If the valve is placed much higher than condenser outlet, check pressure difference.
	Evaporator superheat too high	1. Check superheat performance, the settings SH min and SH max.2. Check valve capacity.3. Check that the maximum number of steps of valve is same as parameter n37.
	Pressure drop across the expansion valve less than valve is sized for	Check pressure drop across expansion valve. Replace with larger valve.
	Expansion valve too small	Check refrigeration system capacity and compare with expansion valve capacity. Replace with larger valve if neces- sary.
	Expansion valve block with foreign material	Remove valve and examine the orifice.
	Evaporator wholly or partly iced up	De-ice evaporator
Liquid hammer in compressor	Superheat of expansion valve too low	Increase the values of SH close and SH min.
	Superheat reference set too low	Increase the value of SH min
	The S2 sensor not in good contact with the suction line	Ensure that S2 sensor is secured on suction line. Insulate sensor.
S2 sensor error: PNU 20002	Bad connection or damaged S2 sensor	The controller will go to either the low or high boundary depending on the error. The lowest value will be shown at a short circuit. The highest value will be shown for a missing connection. Check the temperature sensors.
AKS32R out of range: PNU 20005	The suction pressure is above the maximum limit or below the minimum limit	The controller will go to either the low or high boundary depending on the error. The highest value will be shown if the signal is above the maximum value. The lowest value willbe shown if the signal is below the minimum value or for amissing connection. Check the pressure range.

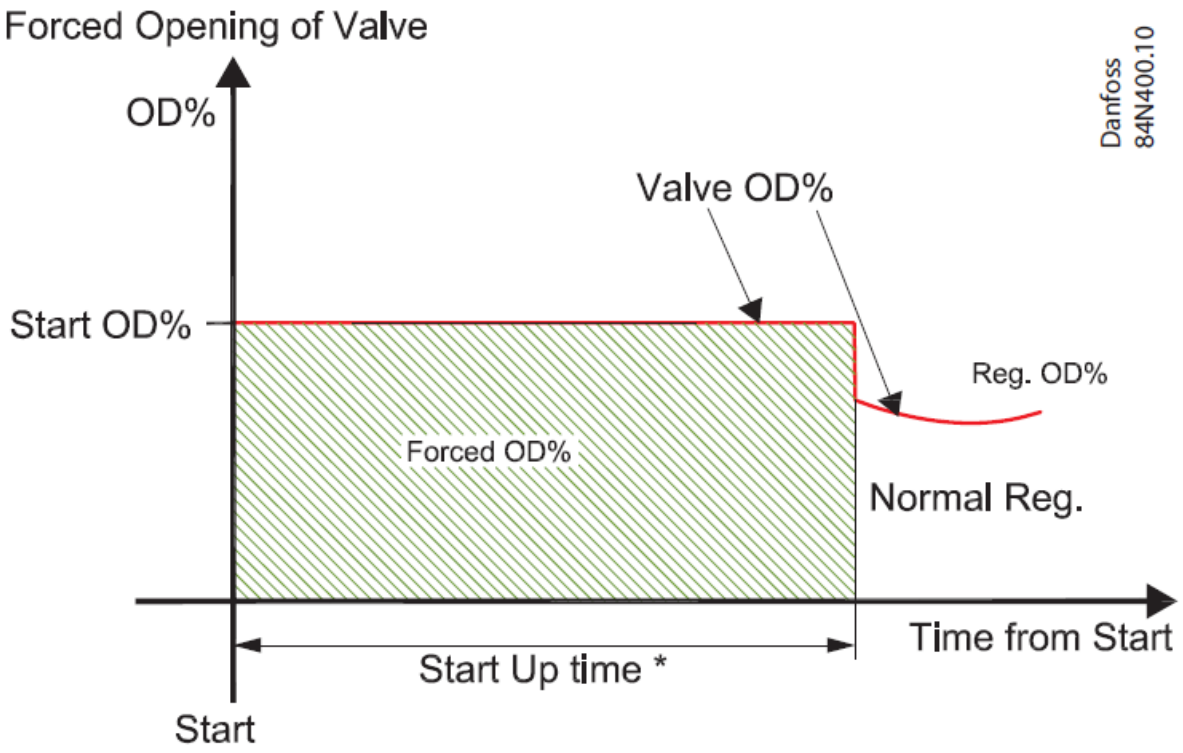
Finding the optimum settings
Details on the controller algorithm and settings

Problems with startup

- Sometimes in one-to-one applications, the valve does not open sufficiently on startup, and troublesome low pressure trips may occur.
- The force opening of valve function has been implemented in the EIM 336 controller. After startup, this function will provide a constant, set minimum opening degree during a set time period, regardless of the superheat

value. The setting parameters are called Start OD% (n17) and StartUp time (n15).

- Low Pressure Issue due to compressor cut in and cut out
- One of the features of TEX valves is the external pressure equalization making a direct and fast responding pressure connection between the compressor suction line and underside of the diaphragm in the valve. This enables the valve to open-/ close momentarily with compressor capacity cut in and out .
- The same function has been implemented into EIM 336, which is controlled by the parameter n20, KpTo. In this function. kp factor related directly to the suction pressure (To) with direct effect on the requested signal to the ETS6 valve .



Appendix 1
Interaction between internal and external Main switch.(Only when using the Modbus communication)

Main switch (r12)	**External main switch (DI) (if enabled be setting r egister 64100 = 1)**	**Super Heat Regulation**		**Alarm monitoring**
Off	Off	→	Off	No
Off	On	→	On	Yes
On	Off	→	Off	No
On	On	→	On	Yes

Appendix 2

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Unused						MOPActive	Close Timer active	Sensor Errors				Control state			

Variables / parameters

CTRLstatus :
bit 0…3 : Controlstate

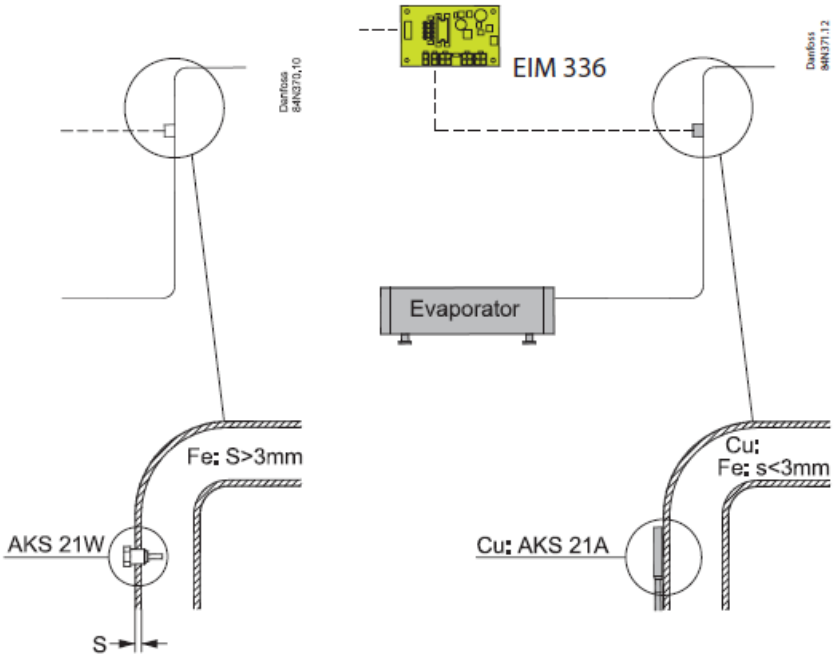
- 0: closed
- 1: Error
- 2: Inject
- 3: De-humidify
- 4: Force OD
- 5: Defrost state
- 6: Hold1 state (defrost sequence)
- 7: Hold2 state (defrost sequence)
- 8: Startup stage
- 9 -15: unused
- bit 4 …7: Sensor Errors
- bit 4 : Te error
- bit 5 : S2 error
- bit 6 : S4 error, (not active)
- bit 7 : (not active)
- bit 8 : Close timer bit 8: timer active
- bit 9 : MOP
- bit 9 : MOP active.
- bit 10…15: unused

Appendix 3

Installation sensors
S2 sensor positioning in the suction line
The position of the S2 sensor is crucial for an optimal control of the liquid injection. The main purpose is to measure temperature of the superheated gas leaving the evaporator. In addition to this, the S2 sensor plays an important role detecting fast changes of superheat. Suction pressure is on the whole stable where as the leaving gas condition is depending on the temporary mixture of gas, liquid refrigerant and oil. The sensor is also there to react quickly on liquid passing the evaporator, to avoid damage of the compressor.

S2 sensor placed 2/3 up a riser after an oil trap is where conditions are at their optimum i.e. good mixture of gas, oil and liquid droplets provided this is not more than 0.5 m from the evaporator. If a horizontal pipe is the only option, the S2 sensor must be placed close to the outlet of the evaporator. Pressure transmitter (Pe pressure) is less critical but must be close to the actual suction pressure right after the evaporator. If the measured value is 1-2 K lower than the actual value of Pe right after the evaporator, it may cause the evaporator to flood. This is the case

when the pressure transmitter is located in the machine room away from the evaporator. A measure higher value will suffer the evaporator of liquid.



Choice of S2 sensor type

- **Surface sensor S2**

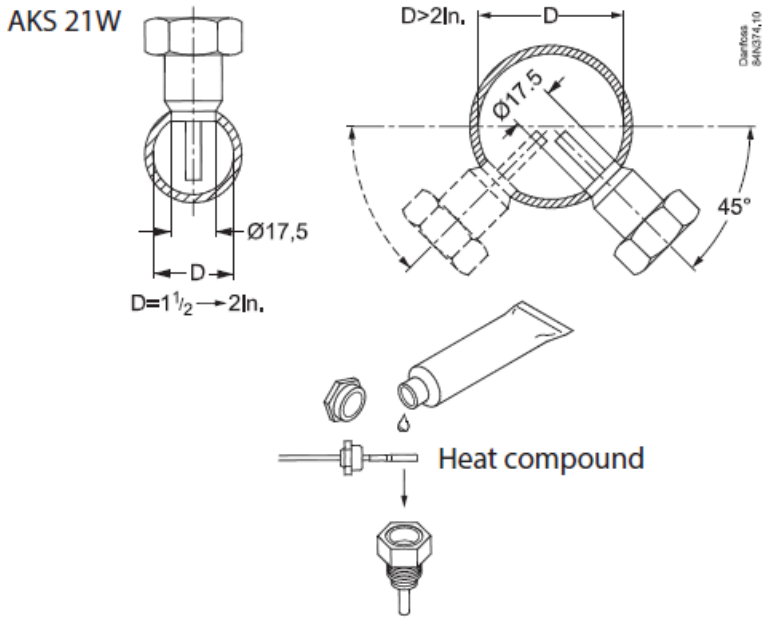
  Pt1000 Ω – Type AKS21, AKS 11 or AKS10.

  Suction pipe of copper or on thin (≤ 3mm) steel pipe.
- **Pocket sensor S2**

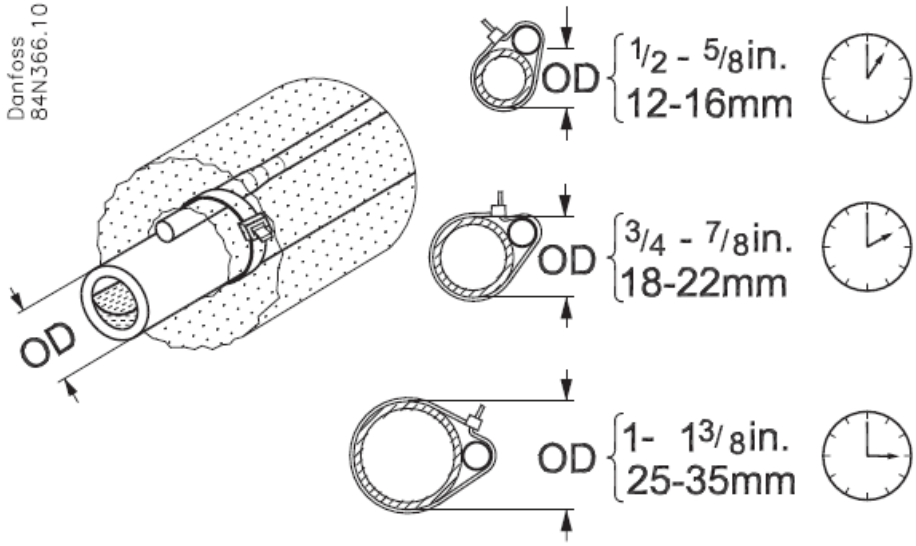
  Pt1000 Ω Type AKS21W.

  Suction pipe of steel ≥ 3mm

Remember to put on heat conducting paste and insulate the sensor.



S2 sensor fixing on the suction pipe:
When the S2 sensor is fixed to surface of the suction pipe, the angle of the sensor position will depend on the diameter of the pipe as given in the following diagram:



Warnings:

- Accidental damage, poor installation, or site conditions, can give rise to malfunctions of the control system, and ultimately lead to a plant breakdown.
- Every possible safeguard is incorporated into our products to prevent this. However, a wrong 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 installer’s 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 requirement for suction line accumulators.

Danfoss can accept no responsibility for possible errors in catalogues, brochures and other printed material. Danfoss reserves the right to alter its products without notice-This also applies to products already on order provided that such alterations can be made without subsequential changes being necessary in specifications already agreed. All trademarks in this material are property of the respective companies. Danfoss and the Danfoss logotype are trademarks of Danfoss A/S. All rights reserved,

Frequently Asked Questions

- **Q: Can the EIM 336 be used in manual mode?**

  A: Yes, the controller can be used in manual mode via modbus communication to set the valve opening degree manually.
- **Q: What is the purpose of the Loss Of Charge indication (LOC) function?**

  A: The LOC function is to indicate loss of refrigerant charge by setting an alarm flag, which can be accessed via modbus.

Documents / Resources

	Danfoss EIM 336 Super Heat Controller [pdf] Instruction Manual EIM 336 Super Heat Controller, EIM 336, Super Heat Controller, Heat Controller

References

- User Manual