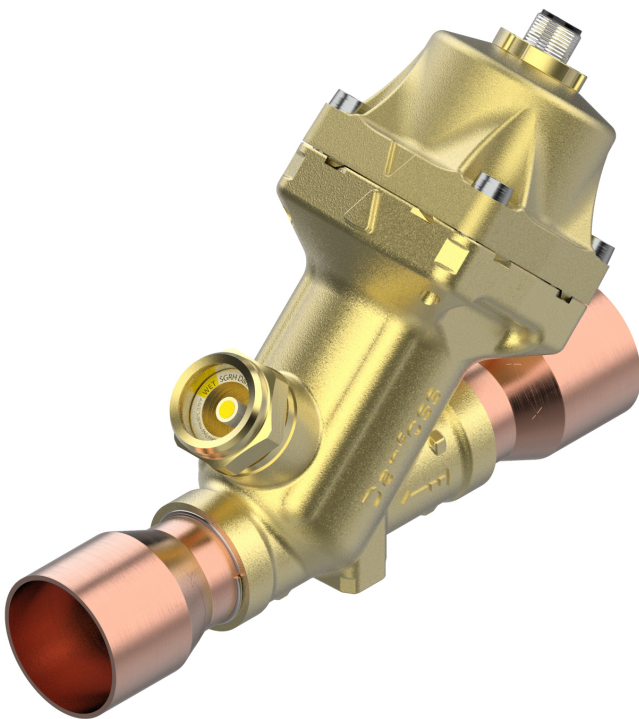


## Data Sheet

# Electric expansion valve Type **ETS 175L - 250L**

For liquid injection into evaporators



ETS 175L - 250L is a series of electric expansion valves for precise liquid injection into evaporators for air conditioning and refrigeration applications. The valve comes with two piston options, a linear and a S-shaped characteristics. The design is fully balanced, providing bi-flow feature as well as tight shut-off function in both flow directions. The valve design uses bi-polar drive providing very precise flow regulation.

ETS 175L - 250L valves are compatible with electronic control solutions from Danfoss and other manufacturers.

**Features**

- Precise positioning for optimal control of liquid injection.
- Wide range for all common refrigerants including A2L.
- ETS can be operated with flow in both directions.
- Balanced design allows to minimised the step loss.
- Designed with built-in sight glass with moisture indicator.
- Easy to service.
- Cable and connector assemblies as accessories.
- Danfoss EKE series, EKF series, MCX are examples of Danfoss controllers with drivers matching the ETS needs.
- For manual operation and service of ETS 175L - 250L valves an AST-g service driver is available.

## Portfolio overview

ETS 175L - 250L is an electric expansion valve series whose function is controlled through a Danfoss electronic controller, or a third party electronic controller that is compatible with the ETS 175L - 250L as to control functionality and connections.

Danfoss recommends the use of the EKE 1 series Superheat controllers or EKF driver units together with ETS 175L - 250L. With EKE1 series controllers a super heat accuracy better than 0.5K can be obtained.

The electronic controller requires precise temperature input from a temperature sensor (refrigerant temperature) and precise pressure inputs (evaporator pressure) from a pressure transmitter.

Table 1: System product






EKF 1A/2A Stepper Valve Driver	EKE 1 series superheat controllers (EKE 1B is shown)
	
EKF series is an economical stepper valve driver that translates analog signal provided by master controller to valve driving sequence.	EKE superheat controllers are for DIN rail mounting, and comes in three versions with different combinations of inputs and output relays and different functionality.

Table 2: Sensors and other products for ETS 175L - 250L

Figure 3: Pressure transmitter (DST P110 shown)	Figure 4: Temperature sensor (AKS 12 shown)	Backup power module EKE 2U
		
DST P110 is a digital ratiometric pressure transmitter. Depending on controller type, other ratiometric pressure transmitters can be used as well (e.g. AKS 32R).	AKS is a PT1000 temperature sensor. Depending on controller type, other temperature sensors can be used as well.	EKE 2U Backup power module ensures sufficient power in case of power failures to the controller to ensure closure of the electronic valves.

## Functions

### Valve operation

The ETS 175L - 250L valves operate modulating by electronically controlled activation of the stepper motor. The motor is a type 2-phase bi-polar, which stays in position, unless power pulses from a driver initiate the two discrete sets of motor stator windings for rotation in either directions. The direction of the rotation of the spindle depends on the phase relationship of the power pulses. This is decisive for the travel of the piston.

The motor is operating the spindle, whose rotating movements are transformed into linear motion by the transmission in the cage assembly. The motor housing has a glass sealed M12 connection as standard, which can be connected with a M12 A code 4-pin connector.

The piston design inside the ETS 175L - 250L valve is pressure balanced, giving identical bi-flow performance capabilities and nearby identical maximum capacities. Closing the valve by overdriving, ensures that the reference number in steps is always correct.

#### **NOTE:**

Depending on the type of controller or driver, there will be limitations in cable length between valve actuator and driver. Both the actual cable length, the level of EMC emission on the location and driver circuit has an impact on the actual distortion of the current to the actuator motor.

Do not overdrive the valve in open position. Please contact Danfoss for further information how and when to apply this counter measure in cases with questionable cable length.

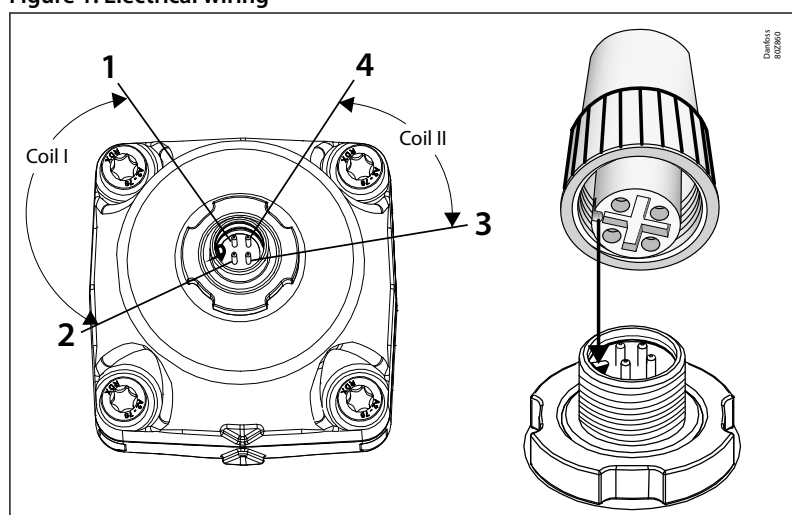
### Sight glass and indicator

ETS 175L - 250L are equipped with sight glass with moisture indicator. The physical position of the valve can be checked through the sight glass.

Insufficient sub cooling can produce flash gas which is visible through the sight glass. The moisture indicator in the sight glass indicates dry or wet state of the refrigerant by changing its colour.

### Electrical wiring

Figure 1: Electrical wiring



#### **NOTE:**

Electrical check of stepper motor and wiring coil I = 52 ohm, coil II = 52 ohm

## Stepper motor switch sequence

Table 3: Stepper motor switch sequence

Opening ↓↓		Coil I		Coil II		Closing ↑↑
		1	2	3	4	
	1	+12V	GRD	+12V	GRD	
	2	GRD	+12V	+12V	GRD	
	3	GRD	+12V	GRD	+12V	
	4	+12V	GRD	GRD	+12V	

If the controller driving the ETS 175L - 250L valves is from another manufacturer than Danfoss or a custom design, the following points must be considered in order to overcome potential step loss.

1. To ensure total closing of the valve, the controller should have a function to overdrive the valve in the closed direction. It is recommended to overdrive 5% of the full step range at appropriate intervals. Overdrive should not be performed in open direction of the valve.
2. The amount of lost steps may increase as a function of the amount of changes of the opening degree. Such designed controller should be able to compensate the lost step after a defined number of changes in opening degree.

### ⚠ WARNING:

At power failure the ETS 175L - 250L valves will remain in the opening position it has at the moment of power failure, unless a safety device in the form of a battery backup is installed. Danfoss recommends to use EKE 2U backup power module.

Table 4: Design

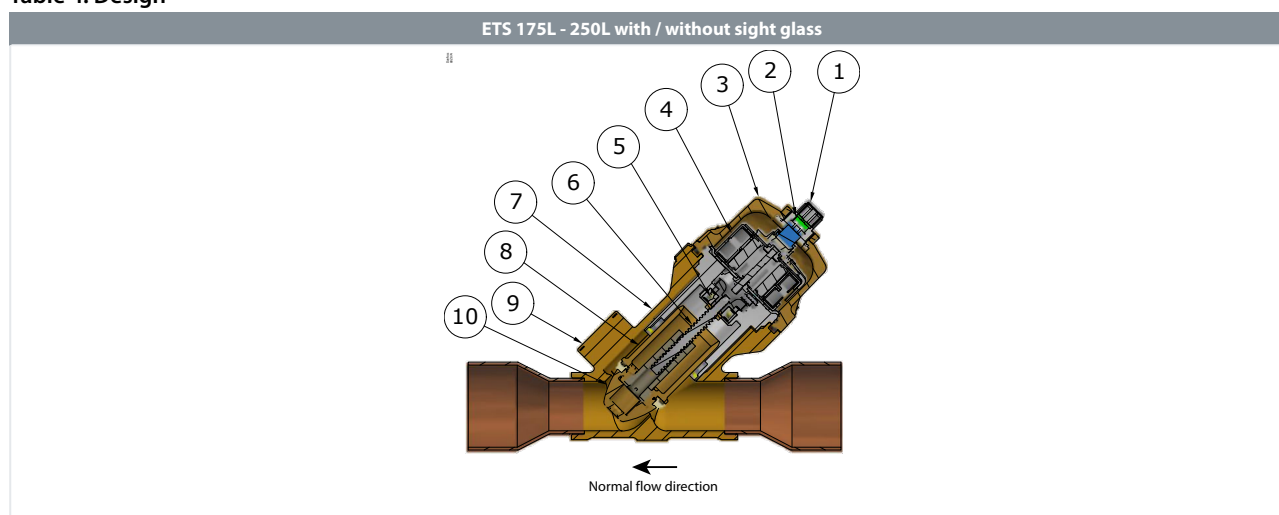
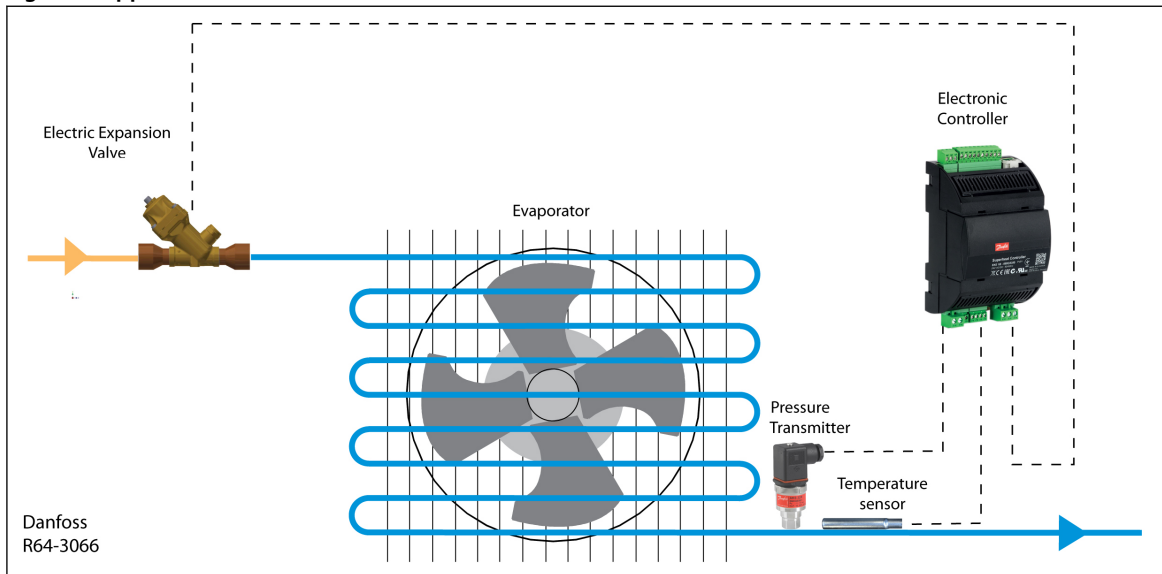


Table 5: Design

Pos. no.	ETS 175L - 250L
1	M12 connector
2	Glass seal
3	Cover
4	Stepper motor
5	Bearing
6	Spindle
7	Valvehousing
8	Piston
9	Sight glass
10	Cone

## Applications

Figure 2: Applications



## Media

ETS L series is designed to be used with the below shown refrigerants and lubricants.

**Table 6: Refrigerants and lubricants**

Media Data	Value
Refrigerants	R22, R134a, R404A, R407A, R407C, R407F, R407H, R422B, R422D, R438A, R410A, R417A, R422A, R438A, R442A, R448A, R449A, R449B, R450A, R452A, R463A, R507, R513A, R513B, R515A, R515B, R1234ze
Refrigerant oil	POE, PVE, mineral oil
Oil free application	No
Media temperature range	-40 °C to +70 °C

### Refrigerant safety class (ASHRAE Standard 34/ISO 817)

**NOTE:**

For flammable refrigerants R1234ze :

- This product is validated in accordance to EN 378, ISO 5149, ASHRAE 15 or equivalent standards.
- Ignition risk is evaluated in accordance to ISO 5149.
- See safety note below.

**NOTE:**

- The product can be applied on systems with R1234ze as the working fluid.
- For countries where safety standards are not an indispensable part of the safety system Danfoss recommend the installer to get a third party approval of the system containing flammable refrigerant.
- Note, please follow specific selection criteria stated in the datasheet for these particular refrigerants.
- The valve must only be used in closed circuit refrigeration system, where no oxygen is present acc. EN 378, ISO 5149 ASHRAE 15 or equivalent standards.

## Product specification

### Valve technical specification

Table 7: Electrical specification

Valve technical specification	Value
Motor type	Bi-Polar
Coil resistance @ 25°C	52.4 ohm +/- 10%
Nominal voltage	Constant Voltage drive: 12V -4/+15%
Phase current	Chopper drive: 250 mA RMS
Phase inductance	70 mH +/- 20%
Power consumption	Voltage / current drive: 5.5 / 1.3 W (UL: NEC class 2)
Holding current	Recommended holding current 0-25%. For optimal performance, driver should keep 100% current on coils 10ms after last step.
Excitation methods	Full step, Half step and micro stepping
Number of steps	3810 -0/+400 Full steps
Nominal step rate	Constant voltage drive: 100pps recommended Chopper drive: 300pps recommended
Travel time	<15 sec @ 300pps
Max duty cycle	100% possible, requiring refrigerant flow through valve.
Dielectric strength	>100MΩ at 500VDC after 4 seconds
Minimum stable control opening degree	10% of opening degree
Reference position	Overdriving against the full close position
Valve configuration	Inline, Straightway
Electrical connections	M12 A-code 4 pin
Compatible Danfoss controllers	Danfoss EKE 1 series superheat controllers, EKF drivers, AK-XM 208C, MCX061V, MCX152V

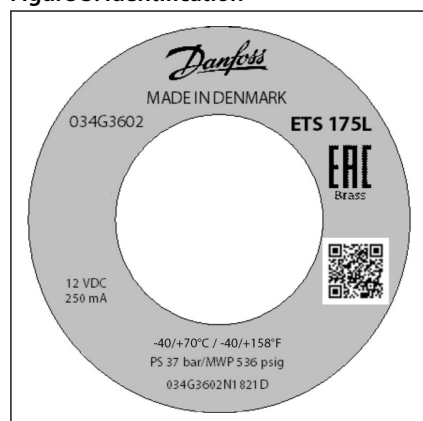
### Pressure and temperature data

Table 8: Valve Specification

Data	Value (SI units)	Value (IMP units)
Max working pressure (MWP)	37 barg	537 Psig
Maximum operating pressure differential (MOPD, measured at initial opening)	26 barg	377 psig
Ambient temperature	-40 °C to 70 °C	-40 °F to 158 °F
Ambient relative humidity	Max 95% RH	Max 95% RH
Inlet fluid temperature range	-40 °C to 70 °C	-40 °F to 158 °F
Flow direction	Bi-Flow	
Sightglass / moisture indicator	Type N moisture indicator	

### Identification

Figure 3: Identification



## Flow characteristics

Figure 4: ETS 175L flow curve

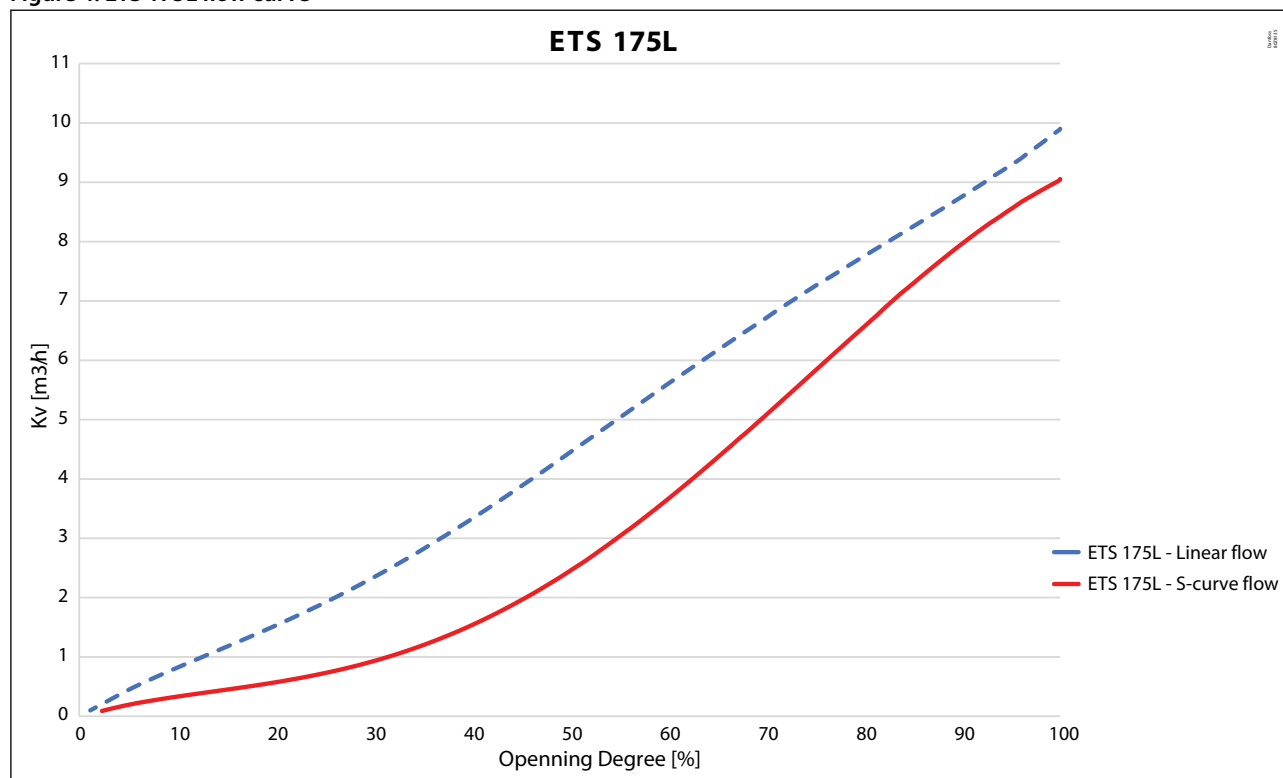
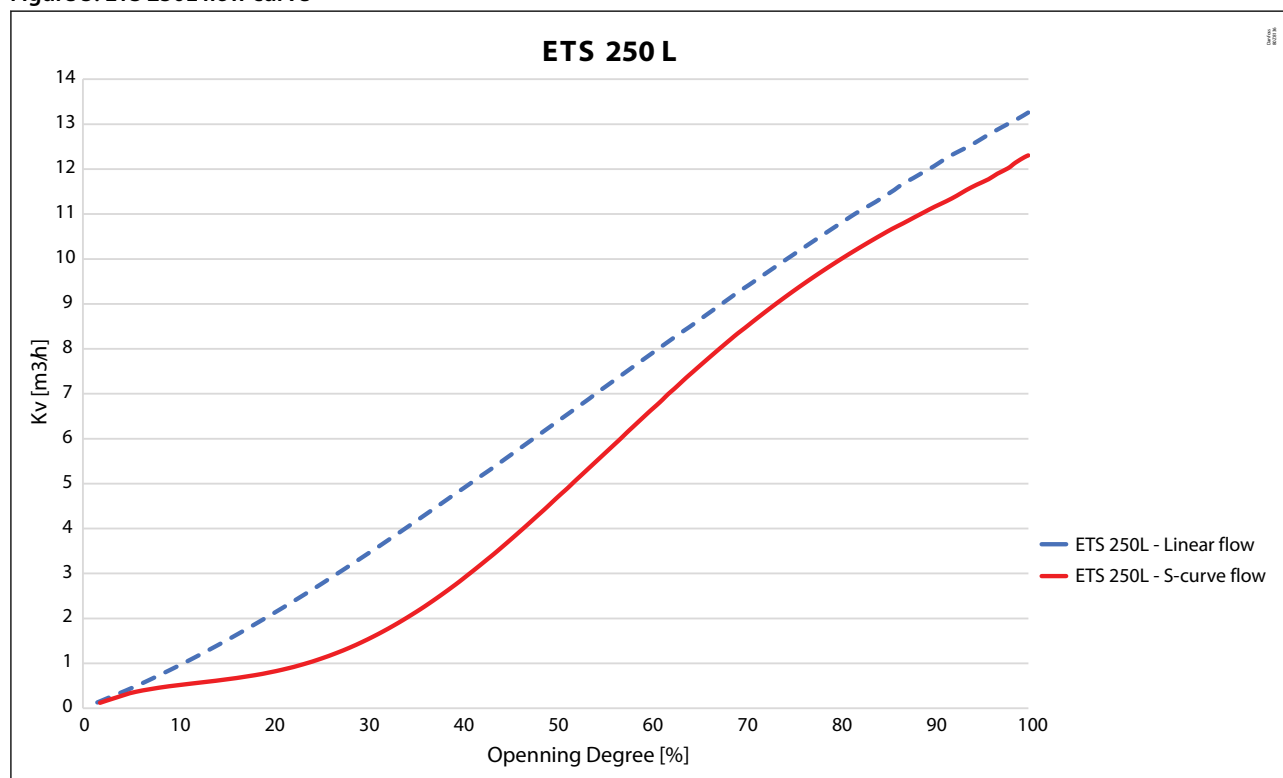


Figure 5: ETS 250L flow curve



- Measured at 1 barg differential pressure
- $K_v$  flow provided in m³/hour (Y axis)
- Valve position provided by pulses in full steps
- Flow direction: Normal flow



## Performance and enviroment conditions

Table 9: Environmental condition data

Environmental conditions	Value
Max, internal leakage @ 6.9 barg (100 Psig) @20 °C, Normal flow	380 cc/min
Max, internal leakage @ 6.9 barg (100 Psig) @20 °C, Reverse flow	380 cc/min
Max, external leakage @37bar @20C with 100% helium	1.56*10-5 mbarL/s
Enclosure rating IP	IP67
Insulation resistance	>100 MΩ
Storage temperature range (C)	-30 °C to 70 °C
Shipping and Shelf life	EC 60068-2-30 (damp heat, cyclic), at 25/55 °C. valve in packaging
Relative humidity	Max 95% RH

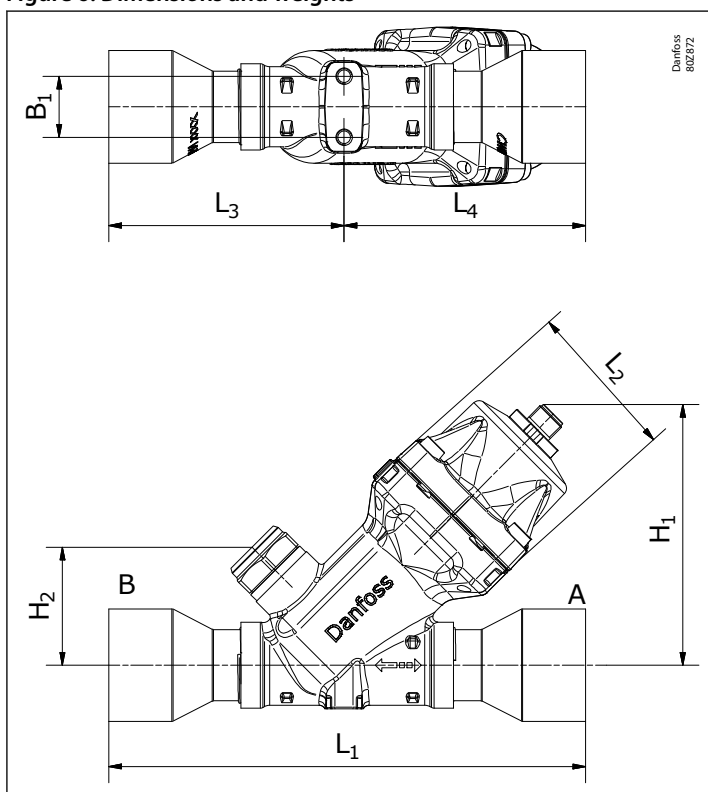
## Mounting

Table 10: Mounting

Installation	Value
Installation orientation	Vertical +-90 °C
Ex-factory delivery position	90° open position
Bi flow application	Yes

## Dimensions and weights

Figure 6: Dimensions and weights



## Electric expansion valve, Type ETS 175L - 250L

**Table 11: Dimensions and weights**

Type	Sight glass	Connections		B <sub>1</sub>		H <sub>1</sub>		H <sub>2</sub>		L <sub>1</sub>		L <sub>2</sub>		L <sub>3</sub>		L <sub>4</sub>	
		ODF x ODF (A x B)		[in.]	[mm]	[in.]	[mm]	[in.]	[mm]	[in.]	[mm]	[in.]	[mm]	[in.]	[mm]	[in.]	[mm]
		[in.]	[mm]														
ETS 175L	Yes	1 1/8 X 1 1/8	29 X 29	0.9	24.0	3.9	98.8	1.8	46.4	6.6	167.5	2.5	62.5	3.2	82.5	3.3	85.0
	Yes	1 1/8 X 1 1/8	29 X 29	0.9	24.0	3.9	98.8	1.8	46.4	6.6	167.5	2.5	62.5	3.2	82.5	3.3	85.0
	No	1 1/8 X 1 1/8	29 X 29	0.9	24.0	3.9	98.8	1.5	38.1	6.6	167.5	2.5	62.5	3.2	82.5	3.3	85.0
	Yes	1 3/8 X 1 3/8	35 X 35	0.9	24.0	3.9	98.8	1.8	46.4	7.0	177.5	2.5	62.5	3.4	87.7	3.5	90.0
	Yes	1 3/8 X 1 3/8	35 X 35	0.9	24.0	3.9	98.8	1.8	46.4	7.0	177.5	2.5	62.5	3.4	87.5	3.5	90.0
	Yes	1 5/8 X 1 5/8	41 X 41	0.9	24.0	3.9	98.8	1.8	46.4	7.4	187.5	2.5	62.5	3.6	92.5	3.7	95.0
	Yes	1 5/8 X 1 5/8	41 X 41	0.9	24.0	3.9	98.8	1.8	46.4	7.4	187.5	2.5	62.5	3.6	92.5	3.7	95.0
	Yes	1 21/32 X 1 21/32	42 X 42	0.9	24.0	3.9	98.8	1.8	46.4	7.4	187.5	2.5	62.5	3.6	92.5	3.7	95.0
	Yes	1 21/32 X 1 21/32	42 X 42	0.9	24.0	3.9	98.8	1.8	46.4	7.4	187.5	2.5	62.5	3.6	92.5	3.7	95.0
ETS 250L	Yes	1 1/8 X 1 1/8	29 X 29	0.9	24.0	3.9	98.8	1.8	46.4	6.6	167.5	2.5	62.5	3.2	82.5	3.3	85.0
	Yes	1 1/8 X 1 1/8	29 X 29	0.9	24.0	3.9	98.8	1.8	46.4	6.6	167.5	2.5	62.5	3.2	82.5	3.3	85.0
	Yes	1 3/8 X 1 3/8	35 X 35	0.9	24.0	3.9	98.8	1.8	46.4	7.0	177.5	2.5	62.5	3.4	87.7	3.5	90.0
	Yes	1 3/8 X 1 3/8	35 X 35	0.9	24.0	3.9	98.8	1.8	46.4	7.0	177.5	2.5	62.5	3.4	87.5	3.5	90.0
	Yes	1 5/8 X 1 5/8	41 X 41	0.9	24.0	3.9	98.8	1.8	46.4	7.4	187.5	2.5	62.5	3.6	92.5	3.7	95.0
	Yes	1 5/8 X 1 5/8	41 X 41	0.9	24.0	3.9	98.8	1.8	46.4	7.4	187.5	2.5	62.5	3.6	92.5	3.7	95.0
	Yes	1 5/8 X 2 1/8	41 X 54	0.9	24.0	3.9	98.8	1.8	46.4	8.0	202.0	2.5	62.5	8.0	107.0	3.7	95.0
	Yes	1 5/8 X 2 1/8	41 X 54	0.9	24.0	3.9	98.8	1.8	46.4	8.0	202.0	2.5	62.5	8.0	107.0	3.7	95.0
	Yes	1 21/32 X 1 21/32	42 X 42	0.9	24.0	3.9	98.8	1.8	46.4	7.4	187.5	2.5	62.5	3.6	92.5	3.7	95.0
	Yes	1 21/32 X 1 21/32	42 X 42	0.9	24.0	3.9	98.8	1.8	46.4	7.4	187.5	2.5	62.5	3.6	92.5	3.7	95.0
	No	1 21/32 X 1 21/32	42 X 42	0.9	24.0	3.9	98.8	1.5	38.1	7.4	187.5	2.5	62.5	3.6	92.5	3.7	95.0
	No	1 21/32 X 1 21/32	42 X 42	0.9	24.0	3.9	98.8	1.5	38.1	7.4	187.5	2.5	62.5	3.6	92.5	3.7	95.0

## Ordering

**Table 12: Ordering**

Type	Linear/S-shape	Built-in sight glass	Rated capacity						Connections		Code no.	
			R513A		R134a		R407C		ODF x ODF		Single pack	Industrial pack
			(kW)	(TR)	(kW)	(TR)	(kW)	(TR)	(in)	(mm)		
ETS 175L	Linear	Yes	703	200	822	233	1133	322	1-1/8 x 1-1/8		034G3602	
	S-shape	Yes	647	184	757	215	1042	296	1-1/8 x 1-1/8		034G3624	
	Linear	No	703	200	822	233	1133	322	1-1/8 x 1-1/8		034G3604	
	Linear	Yes	703	200	822	233	1133	322	1-3/8 x 1-3/8			034G3603
	Linear	No	703	200	822	233	1133	322	1-3/8 x 1-3/8		034G3625	
	Linear	Yes	703	200	822	233	1133	322	1-3/8 x 1-3/8		034G3600	
	S-shape	Yes	647	184	757	215	1042	296	1-3/8 x 1-3/8		034G3601	
	Linear	Yes	703	200	822	233	1133	322	1-5/8 x 1-5/8		034G3626	
	S-shape	Yes	647	184	757	215	1042	296	1-5/8 x 1-5/8		034G3627	
	Linear	Yes	703	200	822	233	1133	322		42 x 42	034G3628	
	S-shape	Yes	647	184	757	215	1042	296		42 x 42	034G3629	
ETS 250L	Linear	Yes	925	263	1081	307	1495	425	1-1/8 x 1-1/8		034G3616	
	S-shape	Yes	862	245	1007	286	1392	395	1-1/8 x 1-1/8		034G3617	
	Linear	Yes	925	263	1081	307	1495	425	1-3/8 x 1-3/8		034G3607	
	S-shape	Yes	862	245	1007	286	1392	395	1-3/8 x 1-3/8		034G3608	
	Linear	Yes	925	263	1081	307	1495	425	1-3/8 x 1-3/8			034G3610
	Linear	Yes	925	263	1081	307	1495	425	1-5/8 x 1-5/8		034G3605	
	Linear	Yes	925	263	1081	307	1495	425	1-5/8 x 1-5/8			034G3609
	Linear	No	925	263	1081	307	1495	425	1-5/8 x 1-5/8		034G3618	
	S-shape	Yes	862	245	1007	286	1392	395	1-5/8 x 1-5/8		034G3606	
	Linear	Yes	925	263	1081	307	1495	425	1-5/8 x 1-5/8		034G3619	
	S-shape	Yes	862	245	1007	286	1392	395	1-5/8 x 1-5/8		034G3620	
	Linear	Yes	925	263	1081	307	1495	425		42 x 42	034G3621	
	S-shape	Yes	862	245	1007	286	1392	395		42 x 42	034G3622	
	Linear	No	925	263	1081	307	1495	425		42 x 42	034G3611	
	S-shape	No	862	245	1007	286	1392	395		42 x 42	034G3623	

**NOTE:**

The Rated capacity is based on:

Evaporating temperature  $t_e$  : 5 °C / 40 °F

Liquid temperature  $t_l$  : 28 °C / 82 °F

Condensing temperature  $t_c$  : 32 °C / 90 °F

Full stroke opening in normal flow direction

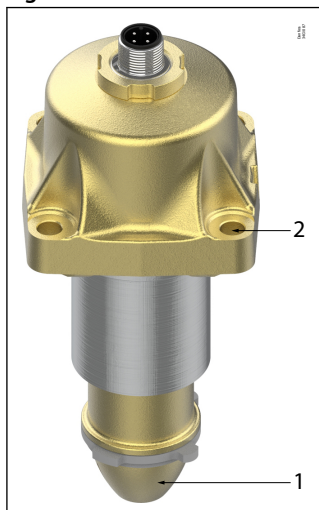


### Valve sizing using calculation software

It is strongly recommended to use Coolselector®2 to find the correct valve for your application. The software can be downloaded from the Danfoss website. You can download it from [http:// coolselector.danfoss.com](http://coolselector.danfoss.com)

### Spare parts for ETS valve

Figure 7: Actuator Kit



- |   |                              |
|---|------------------------------|
| 1 | Piston i.e Linear or S-curve |
| 2 | Position for Screw (x4)      |

Table 13: Spare parts

Code no.	034G3612	034G3613	034G3614	034G3615
Item	ETS175L-linear-Actuator kit	ETS175L-SCurve-Actuator kit	ETS250L-linear-Actuator kit	ETS250L-SCurve-Actuator kit
<b>Parts</b>				
1 pcs.	Actuator assembly O-ring Screw M6x25mm			
1 pcs.				
4 pcs.				

### Accessories

#### M12 angle cable

M12 angle female connector is intended for use with a standard M12 male connector, available on stepper motor valves.

This cable is designed to offer high flexibility and small outer diameters with tensile strength.

The angle way M12 cable consist of paired, twisted wires, which decreases mutual influence between signals transmitted along the cable and reduces influence of external sources of interference.

The cables thus provides a higher degree of protection against lost steps compared to other cables.

#### Approvals

Table 14: Approvals

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#### Specification

Table 15: Specification

Jacket	PVC - black
Cable outer sheath	Oil - resistant
Water proof rating	IP 67
Operating temperature range	-40 – +80 °C

## Electric expansion valve, Type ETS 175L - 250L

Wire type	Twisted pair, cross section 20 AWG / 0.5 mm <sup>2</sup>
Cable outer diameter	7.0 mm
Minimum bending radius	10 x cable diameter
Cable combustibility / test	Flame retardant / VW-1 / CSA FT - 1
M12 standard	EN 61076-2-101
Reference standard	UL style 2464 and DIN VDE 0812
LVD directive	2014/35/EU

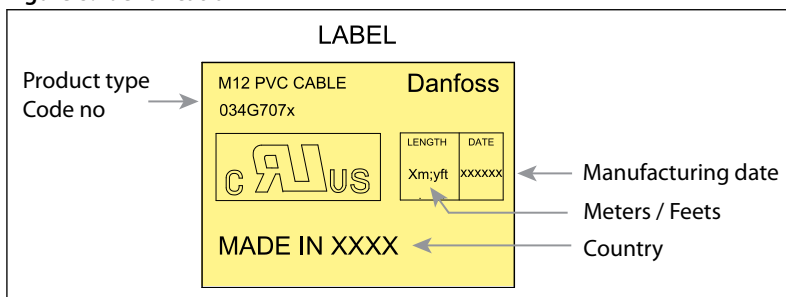
### Ordering

Table 16: Ordering

Cable	Cable length (L)	Insulation	Packing format	Code no.
PVC - black	2 + 0.089 m / 6.6 + 0.3 ft	SR-PVC	Single pack	034G7073
	8 + 0.3 m / 26.2 + 1 ft	SR-PVC	Single pack	034G7074

### Identification

Figure 8: Identification



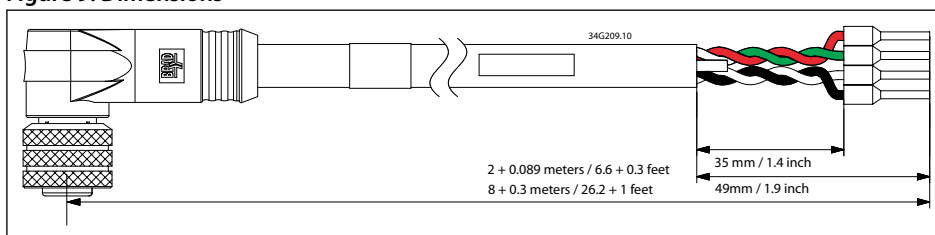
### Connections

Table 17: Connections



### Dimensions

Figure 9: Dimensions



## Troubleshooting

Symptom	Possible Cause	Remedy
No valve movement	Lack of proper electrical connection	• Check the connection between valve and a controller
	Wrong parameter setting in controller	• Check valve settings in controller i.e pre-selected valves, no. of steps, phase current, direction of valve rotation, steps per second
	Broken motor/ short circuit	• Check the resistance between coil I and coil II. Resistance in each coil should be 52.4 ohms @20°C. Details on Electrical wiring • Replace a complete valve
	Insufficient power supply to valve	• Check the current/voltage supply from controller to valve
Internal leakage (due to 'Step Loss')	Control pulse to valve is influenced by high external electrical noise	• Separate the cable from high power lines
	Longer cable length between valve and controller	• Check the maximum cable length allowed between the controller and the valve • For longer cable distance, use cable with bigger wire diameter • Use cable filter
	Accumulated backlash in valve	• Controller should overdrive the valve to compensate the lost steps after a number of changes in opening degree
	Insufficient power supply to the valve	• Check the current/voltage supply from controller to valve • Check the supply power to controller
Insufficient capacity	Expansion valve too small	• Check refrigeration system capacity and compare with expansion valve capacity. Replace with larger valve if necessary
	Suction pressure too low Evaporator superheat too high	• Check superheat performance, the settings SH min and SH max. in the super heat controller • Check valve capacity • Check 'total number of steps' defined in the controller • Also check section 'High Superheat'
	Expansion valve blocked with foreign material	• Remove and examine the valve
	Evaporator wholly or partly iced up	• De-ice evaporator
High superheat	Lack of sub-cooling	• Check refrigerant • Also refer to section Insufficient capacity
	Controller is not setup/tuned properly	• Check the controller superheat settings and sensors connected to it • Tune PID parameters in the controller
Flash gas	Lack of sub-cooling ahead of expansion valve	• Check refrigerant for flash gas ahead of expansion valve / external subcooler • If the valve is placed much higher than condenser outlet, check pressure difference
	Oversized valve selected	• Limit max opening degree of the valve setting in controller • Check refrigeration system capacity and compare with expansion valve capacity. Use proper valve size suitable for the system

## Certificates, declarations and approvals

The list contains all certificates, declarations, and approvals for this product type. Individual code number may have some or all of these approvals, and certain local approvals may not appear on the list.

Some approvals may change over time. You can check the most current status at [danfoss.com](https://danfoss.com) or contact your local Danfoss representative if you have any questions.

**Table 18: Valid approvals**

File name	Document type	Document topic	Approval authority
EAC RU Д-ДК.БЛ08.В.00191_18	EAC Declaration	Machinery & Equipment	EAC
LLC CDC EURO-TYSK UA.089.D.00188-17	UA Declaration	PED	LLC CDC EURO TYSK
LLC CDC EURO-TYSK UA.TR-089.0993-17	Pressure - Safety Certificate	PED	LLC CDC EURO TYSK
EAC RU Д-ДК.БЛ08.В.00189_18	EAC Declaration	EMC	EAC
EAC RU Д-ДК.АИ30.В.04973	EAC Declaration	PED	EAC
EAC RU Д-ДК.АИ30.В.04995	EAC Declaration	PED	EAC
Manufacturers Declaration Danfoss 034R9813.01	Manufacturers Declaration		Danfoss
EAC RU Д-ДК.ГА02.В.08524	EAC Declaration	PED	EAC

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