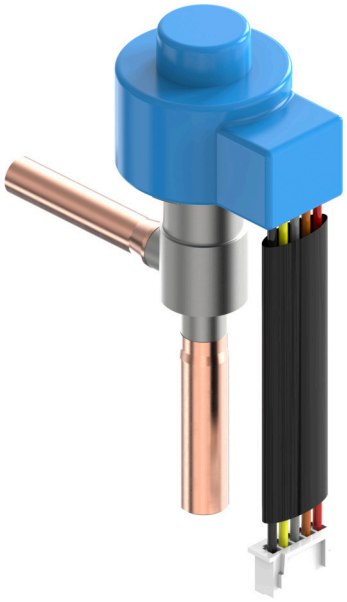
ENGINEERING TOMORROW

Data Sheet

Electric expansion valves Type **ETS 5M** (Version 2)

For liquid injection into evaporators



ETS 5M is a compact and lightweight stepper motor driven electric expansion valve with a high level of reliability. It provides a precise solution for expansion and flow control in a wide range of refrigeration and air conditioning systems.

The portfolio is available with a wide capacity range and is designed for use with various refrigerants.

ETS 5M can be applied for applications i.e VRF, close controls, Heatpump, Mini Chiller, Bus / Transport, Rooftops, cold rooms, food service, application in single/biflow operations.

Valve operation is by means of a uni-polar/bi-polar motor, and as such it is compatible with a number of electronic controllers from Danfoss or third-party vendors. With an EKE 100 series superheat controllers and AKS sensor, a superheat accuracy better than ± 0.5 K can be obtained.

Features

- Optimized valve flow characteristic.
- Accurate valve control, also at low opening degrees.
- Bi-flow, with full performance in both flow directions.
- High degree of freedom of installation orientation.
- Future-proof regarding refrigerants.
- Compatible with existing valve drivers.
- Largest nominal capacity, R410A : 41.0 kW, 11.6 TR.

Portfolio overview

ETS 5M is a system product whose function is controlled through a Danfoss electronic controller, or a third party vendor electronic controller that is compatible with the ETS 5M as to control functionality and connections.

Danfoss recommends the use of the EKE 100 series superheat controller together with ETS 5M. With EKE 100 series or EKE 110 for injection controller, a superheat accuracy better than 0.5 K 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.

System product

Figure 1: EKE100 superheat controllers

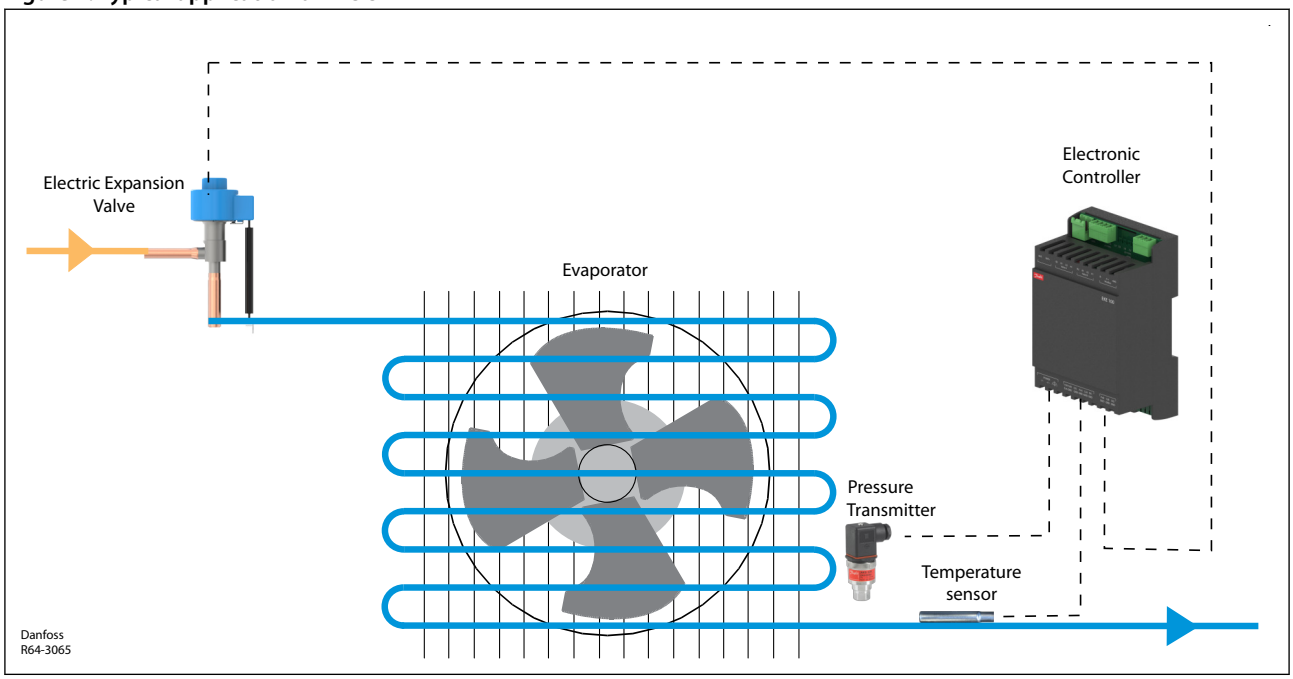
EKE superheat controllers are for DIN rail mounting, and come in three versions with different combinations of inputs and output relays and different functionality.

Table 1: Sensors and other products for ETS 5M

Pressure transmitter (DST P110 shown)	EKF 1A/2A Stepper Valve Driver	EKE 2U Backup power module
		
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).	EKF series is an economical stepper valve driver that translates analog signal provided by master controller to valve driving sequence .	EKE 2U Backup power module ensures sufficient power in case of power failures to the controller to ensure closure of the electronic valves.

Applications

Figure 2: Typical application of ETS 5M



NOTE:
ETS 5M 10-24 can be used in oil-free system but with a limited MOPD 27 bar.

Media

ETS 5M is designed for use with various refrigerants with suitable lubricants.

Table 2: ETS 5M media data

Media data	Value
Refrigerants	R410A, R32 R290, R22, R454C, R515B, R1234ze, R452B, R1234yf, R452A, R454B, R454A, R455A, R449A, R407C, R134a, R407H, R513A, R449B, R404A, R448A, R463A
Refrigerants oil	POE, PVE, PAG, MO

NOTE:
For flammable refrigerants (R454C, R454A, R1234ze, R290, R32, R452B, R454B, R455A, R1234yf):
- This product is validated in accordance to ATEX, EN 378, ISO 5149, ASHRAE 15, IEC 60335-2-x or equivalent standards.
- Ignition risk is evaluated in accordance to ISO 5149 and IEC 60335.
- See safety note below.

NOTE:
- The product can be applied on systems with R454C, R454A, R1234ze, R290, R32, R452B, R454B, R455A, R1234yf 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 IEC 60335-2-x or equivalent standards.

Product specification

Design

The ETS 5M Electric expansion valves open and close to regulate refrigerant flow by means of a screw, whose rotating motion is transformed into linear motion. This occurs by the rotation of a magnet needle valve assembly which moves when electrical signals are applied to the surrounding coil. Within the coil structure, there are different winding configurations, and the polarities are changed by the electrical signals.

By application of the appropriate combination of signals, in the form of pulses, the coil forces the rotor of the valve to move in a stepwise fashion. Application of multiple pulses will make the valve mechanism move through a series of steps in the chosen direction, in order to set the valve with the required opening degree.

Pressure and temperature data

Table 3: Pressure and temperature data in SI and Imperial units

Data		Value [SI units]	Value [IMP. units]
Max working pressure (MWP)		49 barg	770 psig
Burst pressure		5 x MWP	5 x MWP
Maximum operating pressure differential (MOPD)[1]	ETS 5M 10 - 24	A->B 35 barg B->A 35 barg	A->B 508 Psig B->A 508 Psig
	ETS 5M 25 - 40	A->B 42 barg B->A 42 barg	A->B 609 Psig B->A 609 Psig
Ambient temperature		-40 - 80 °C	-40 - 176 °F
Ambient relative humidity		Max. 95 % RH	Max. 95 % RH
Fluid temperature range		-30 - 80 °C	-22 - 176 °F

[1] A = Valve outlet
B = Valve inlet

Enviromental conditions

Table 4: Enviromental conditions

Environmental conditions		Value
Max. Internal leakage @10 bar, A-> B and B->A[1]	ETS 5M 10 - 24	< 150 cm3/min
	ETS 5M 25 - 40	< 500 cm3/min
Mechanical noise		< 60 dB(A)
Enclosure rating IP (Valve and coil combined)		IP 67
Insulation class		B
Insulation resistance		>100 MΩ
Storage temperature range [°C]		-30 - 70 °C / -22 - 158 °F
Relative humidity		Max. 95 % RH

[1] A = Valve outlet
B = Valve inlet

Flow characteristics

Air flow characteristics are provided for ETS 5M with normal and reverse flows.

Figure 3: Normal flow B -> A

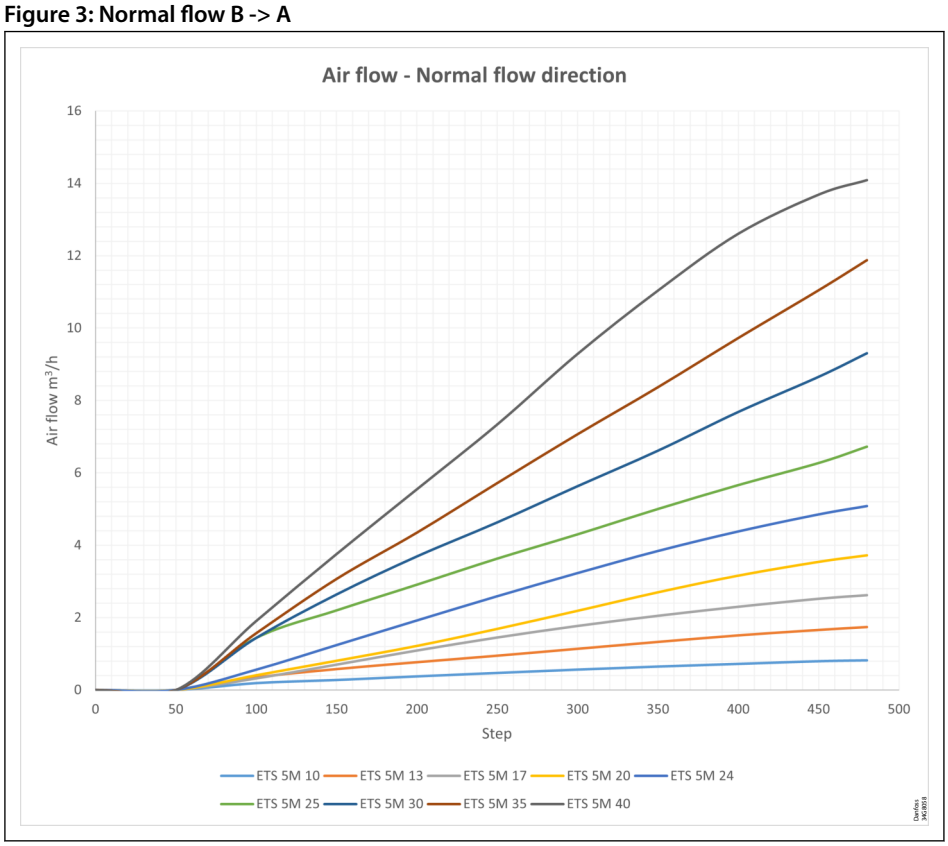
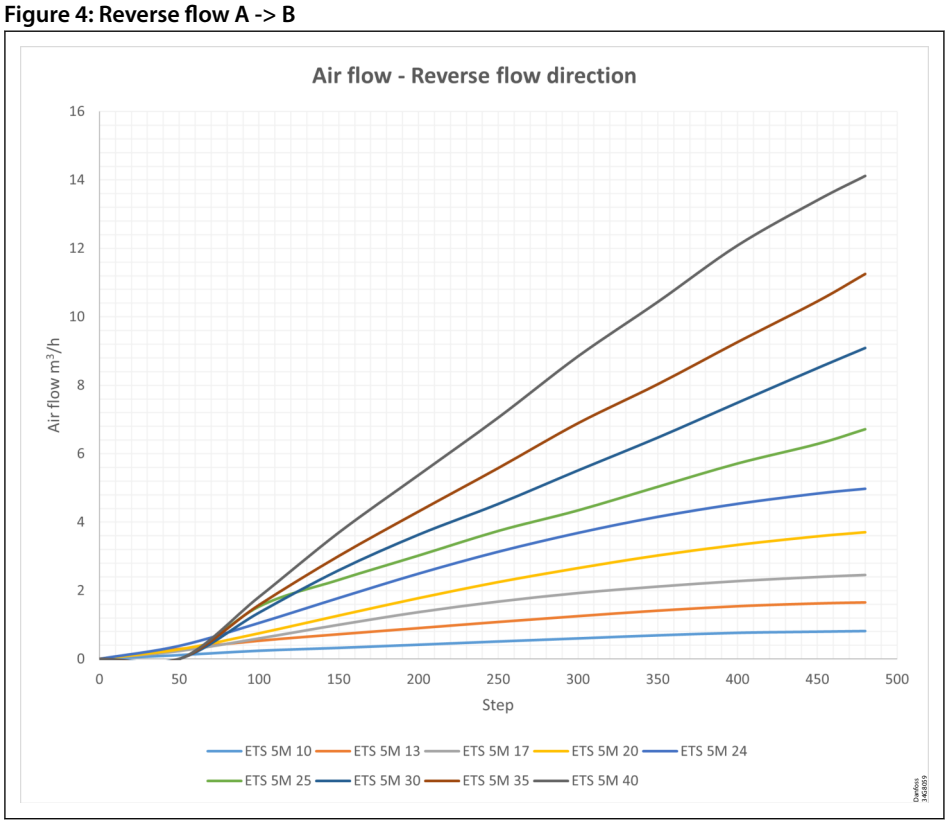


Figure 4: Reverse flow A -> B



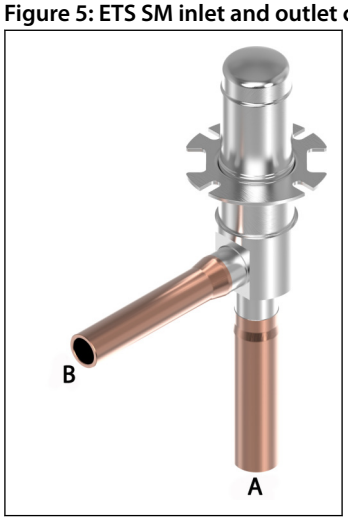
Flow characteristics

- Measured at 1 barg differential pressure.
- Air flow provided in m^3 /hour (Y axis).
- Valve position provided by pulses in half steps (X axis).

Mechanical configuration options

ETS 5M is an angleway valve designed with a valve body in steel and ODM or ODF solder connections in stainless steel wih copper plating, with inlet and outlet sizes ¼ in, 5⁄16 in or ½ in.

Figure 5: ETS SM inlet and outlet configuration



A	Outlet
B	Inlet

The copper connections are highly configurable and can be produced with the following shapes.

Table 5: Connection configuration

Shape L		
		
1/4 in	5/16 in	1/2 in
ODM	ODM	ODM

NOTE:
Not all combinations of sizes and configurations are available. The table shows currently available configurations

Table 6: Mechanical configuration options

L Shape	ODM with straight connectors

Electrical connection

Electrical connection is via a fixed cable in a number of lengths from the coil to the controller. Cables up to 4 m length are available with a JST XHP-5 / JST-XHP6 / SUPU connector. See ETS 5M coil Ordering for details.

Electrical and motor specifications

Valve operation is by means of a uni-polar / bi-polar motor, designed as a separate coil that clicks onto the valve body.

Table 7: Electrical and motor specifications

Electrical and motor specifications	Value
Motor type	Uni/bi-polar coil
Nominal voltage	12 V +10% / -15%
Coil resistance@ 20 °C	50 Ohm ± 6%

Electrical and motor specifications	Value
Rated current	0.24 A
Power consumption	4.1 W
Holding current after each sequence of steps	Min. 30 ms, max. 1 s
Permanent holding current	Not allowed
Recommended excitation method Possible, but not recommended excitation method	1- 2 2- 2
Number of pulses	480 half-step pulse (Don't over drive to more than 480 steps when open the valve)
Nominal pulse rate	31 pulses per second (PPS)
Maximum duty cycle (30s)	50 %
Insulation resistance	> 100 MΩ
Dielectric strength	< 5 mA

Stepper motor switch sequence

Table 8: Unipolar Motor Excitation Sequence

Coil	Wire	Excitation Sequence Valve Opening Valve Closing							
		1	2	3	4	5	6	7	8
A1	Orange	ON	ON	OFF	OFF	OFF	OFF	OFF	ON
B1	Red	OFF	ON	ON	ON	OFF	OFF	OFF	OFF
A2	Yellow	OFF	OFF	OFF	ON	ON	ON	OFF	OFF
B2	Black	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
COM	Grey	ON	ON	ON	ON	ON	ON	ON	ON

Table 9: Bipolar Motor Excitation Sequence

Coil	Wire	Excitation Sequence Valve Opening Valve Closing							
		1	2	3	4	5	6	7	8
A1	Orange	-	-	OFF	+	+	+	OFF	-
A2	Yellow	+	+	OFF	-	-	-	OFF	+
B1	Red	OFF	-	-	-	OFF	+	+	+
B2	Black	OFF	+	+	+	OFF	-	-	-

Dimensions (in mm)

Table 10: ETS 5M 10-24 1/4 inch male

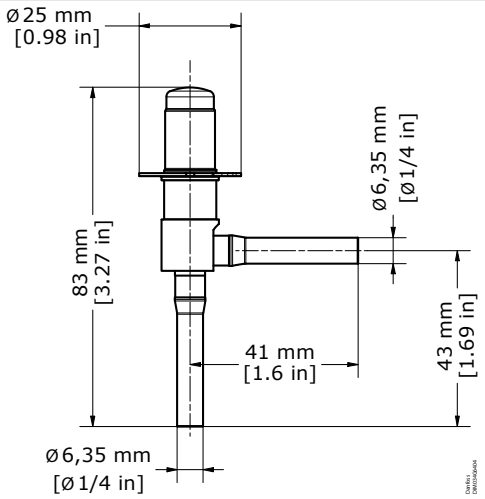


Table 11: ETS 5M 10-24 5/16 inch male

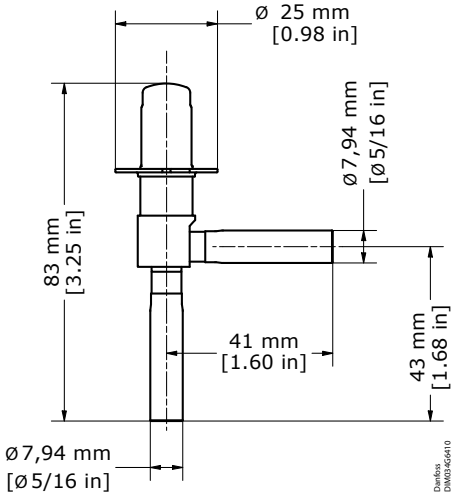


Table 12: ETS 5M 25-40 5/16 inch male

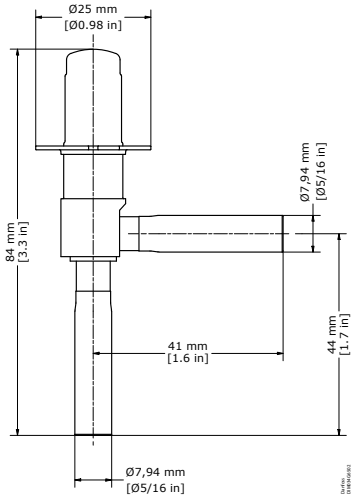


Table 13: ETS 5M 25-40 1/2 inch male

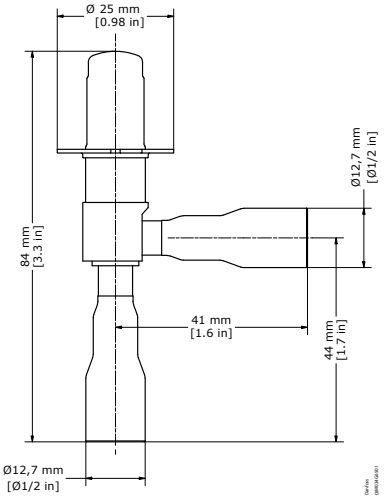
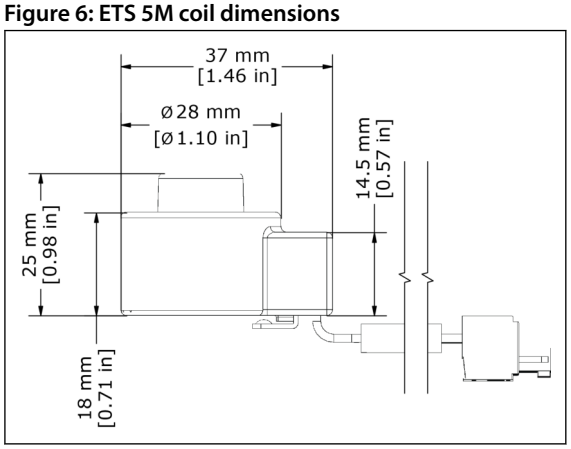


Figure 6: ETS 5M coil dimensions



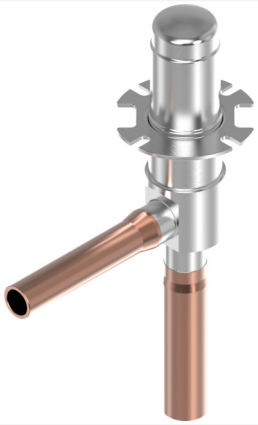
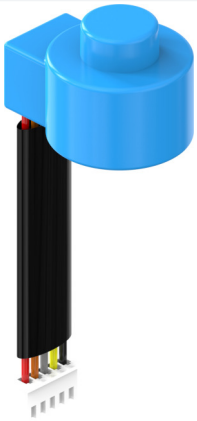
Ordering

Being highly configurable, ETS 5M can be delivered with a number of different mechanical connections according to requirements. This includes design configuration shape types L, h and u. See ordering details below.

Parts program

ETS 5M is a parts program consisting of a valve body and a separate Uni-polar/bi-polar motor coil (ETS 5M coil). Each component is purchased separately.

Table 14: 5/16 inch male

ETS 5M valve body, with L connection configuration	ETS 5M coil (stator)
	

Besides using the ETS SM coil as spare part, ETS 5M valve is hermetic and cannot be taken apart, there are no other spare parts.

Valve body, standard code

Valve body ordering data

Table 15: ETS 5M valve body

Type	Designconfig. shape	Orifice size	Conn. type	Inlet x Out- let	Rated cap. R410A	Rated cap. R410A	Pack format	Qty/ pack	Code no
		[mm]		[in]	[kW]	[TR]			
ETS 5M10	L	1.0	Solder, ODM	1/4 x 1/4	4.52	0.93	Multi-pack	20 pc	034G6423
ETS 5M10	L	1.0	Solder, ODM	5/16 x 5/16	4.52	0.93	Multi-pack	20 pc	034G6425
ETS 5M13	L	1.3	Solder, ODM	1/4 x 1/4	8.9	2.52	Multi-pack	20 pc	034G6404
ETS 5M13	L	1.3	Solder, ODM	5/16 x 5/16	8.9	2.52	Multi-pack	20 pc	034G6418
ETS 5M17	L	1.65	Solder, ODM	1/4 x 1/4	12.5	3.54	Multi-pack	20 pc	034G6407
ETS 5M17	L	1.65	Solder, ODM	5/16 x 5/16	12.5	3.54	Multi-pack	20 pc	034G6419
ETS 5M20	L	2.0	Solder, ODM	1/4 x 1/4	16.7	4.74	Multi-pack	20 pc	034G6409
ETS 5M20	L	2.0	Solder, ODM	5/16 x 5/16	16.7	4.74	Industrial pack	40 pc	034G6410
ETS 5M20	L	2.0	Solder, ODM	5/16 x 5/16	16.7	4.74	Multi-pack	20 pc	034G6411
ETS 5M24	L	2.4	Solder, ODM	1/4 x 1/4	20.6	5.84	Multi-pack	20 pc	034G6412
ETS 5M24	L	2.4	Solder, ODM	5/16 x 5/16	20.6	5.84	Multi-pack	20 pc	034G6420
ETS 5M25	L	2.5	Solder, ODM	5/16 x 5/16	23.5	6.68	Multi pack	20 pc	034G6500
ETS 5M25	L	2.5	Solder, ODM	1/2 x 1/2	23.5	6.68	Multi pack	20 pc	034G6501
ETS 5M30	L	3.0	Solder, ODM	5/16 x 5/16	32.5	9.24	Multi pack	20 pc	034G6502
ETS 5M30	L	3.0	Solder, ODM	1/2 x 1/2	32.5	9.24	Multi pack	20 pc	034G6503
ETS 5M35	L	3.5	Solder, ODM	5/16 x 5/16	36.0	10.24	Multi pack	20 pc	034G6504
ETS 5M35	L	3.5	Solder, ODM	1/2 x 1/2	36.0	10.24	Multi pack	20 pc	034G6505
ETS 5M40	L	4.0	Solder, ODM	5/16 x 5/16	41.0	11.66	Multi pack	20 pc	034G6506
ETS 5M40	L	4.0	Solder, ODM	1/2 x 1/2	41.0	11.66	Multi pack	20 pc	034G6507

NOTE:
The rated capacity is based on :

- Refrigerant: R410A
- Evaporating temperature: Te = 5 °C
- Condensing temperature: Tc = 38 °C
- Refrigerant temperature ahead of valve:
  - Tliquid = 34 °C
  - Subcooling = 4k
  - Superheat = 0K
  - Driving steps = 480steps

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

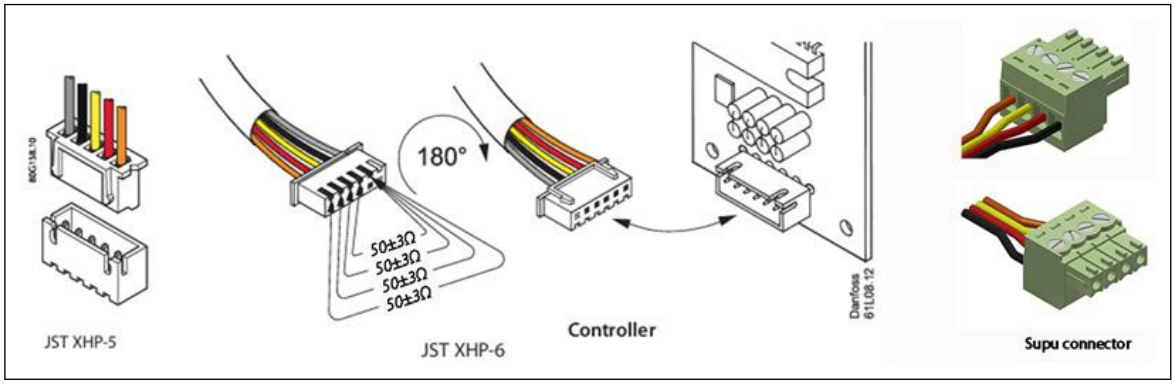
ETS 5M coil

Coils for ETS 5M are dedicated for the product.

Table 16: Coils for ETS 5M

Type	Cable length/m [m]	Cable length/inch [in]	Electrical connector	Pack format	Qty/pack	Code no
ETS 5M	0.7	27.56	Uni-polar JST XHP-5	Multi pack	20	034G3853
ETS 5M	0.7	27.56	Uni-polar JST XHP-5	Industrial pack	40	034G3854
ETS 5M	0.7	27.56	Uni-polar JST XHP-6	Industrial pack	40	034G3858
ETS 5M	1	39.37	Uni-polar JST XHP-6	Multi pack	20	034G3852
ETS 5M	1	39.37	Uni-polar JST XHP-5	Industrial pack	40	034G3871
ETS 5M	1.5	59.06	Uni-polar JST XHP-5	Multi pack	20	034G3850
ETS 5M	1.7	66.93	Uni-polar JST XHP-6	Industrial pack	40	034G3859
ETS 5M	2	78.74	Uni-polar JST XHP-5	Industrial pack	24	034G3867
ETS 5M	2.7	106.30	Uni-polar JST XHP-5	Multi pack	20	034G3851
ETS 5M	2.7	106.30	Uni-polar JST XHP-6	Industrial pack	24	034G3855
ETS 5M	2.7	106.30	Uni-polar JST XHP-6	Multi pack	20	034G3856
ETS 5M	4	157.48	Uni-polar JST XHP-5	Industrial pack	24	034G3869
ETS 5M	4	157.48	Uni-polar JST XHP-6	Industrial pack	24	034G3870
ETS 5M	1	39.37	Bi-polar SUPU MC	Industrial pack	40	034G3860
ETS 5M	1.5	59.06	Bi-polar SUPU MC	Industrial pack	40	034G3861
ETS 5M	2	78.74	Bi-polar SUPU MC	Industrial pack	24	034G3862
ETS 5M	2.7	106.30	Bi-polar SUPU MC	Industrial pack	24	034G3863
ETS 5M	4	157.48	Bi-polar SUPU MC	Industrial pack	24	034G3868
ETS 5M	1	39.37	Uni-polar JST XHP-6 (Reverse)	Industrial pack	40	034G3866
ETS 5M	1.5	59.06	Uni-polar JST XHP-6 (Reverse)	Industrial pack	40	034G3864
ETS 5M	2.7	106.30	Uni-polar JST XHP-6 (Reverse)	Industrial pack	24	034G3865

Figure 7: Electrical wiring



Accessories

Tools for ETS 5M service

Table 17: Accessories for ETS 5M

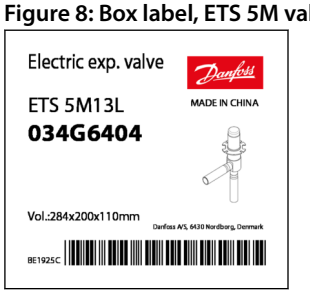
Image	Accessory	Description	Code no.
	AST-G service driver	Driver for service of the valve	034G0013

Product identification

Valve body identification

Relevant product data is available on the box label and product label. On the product, information is laser engraved in 3 different fields on the steel valve body (not shown).

Figure 8: Box label, ETS 5M valve body



ETS 5M Coil identification

Relevant product data is available on the box label and product label.

Figure 9: Box label

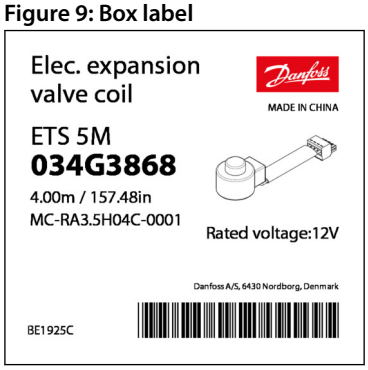


Figure 10: Product label

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 or contact your local Danfoss representative if you have any questions.

Table 18: Certificates, declarations and approvals

File name	Document type	Document topic	Approval Authority
CQC21002287020	Electrical - safety certificates		CQC

Compliance

ETS 5M complies with:

Table 19: Compliance table ETS 5M

	Pressure Equipment Directive
RoHS	Restriction of Hazardous Substances
REACH COMPLIANCE	Registration, Evaluation, Authorisation and Restriction of Chemicals
CQC	CQC Approved

ENGINEERING
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