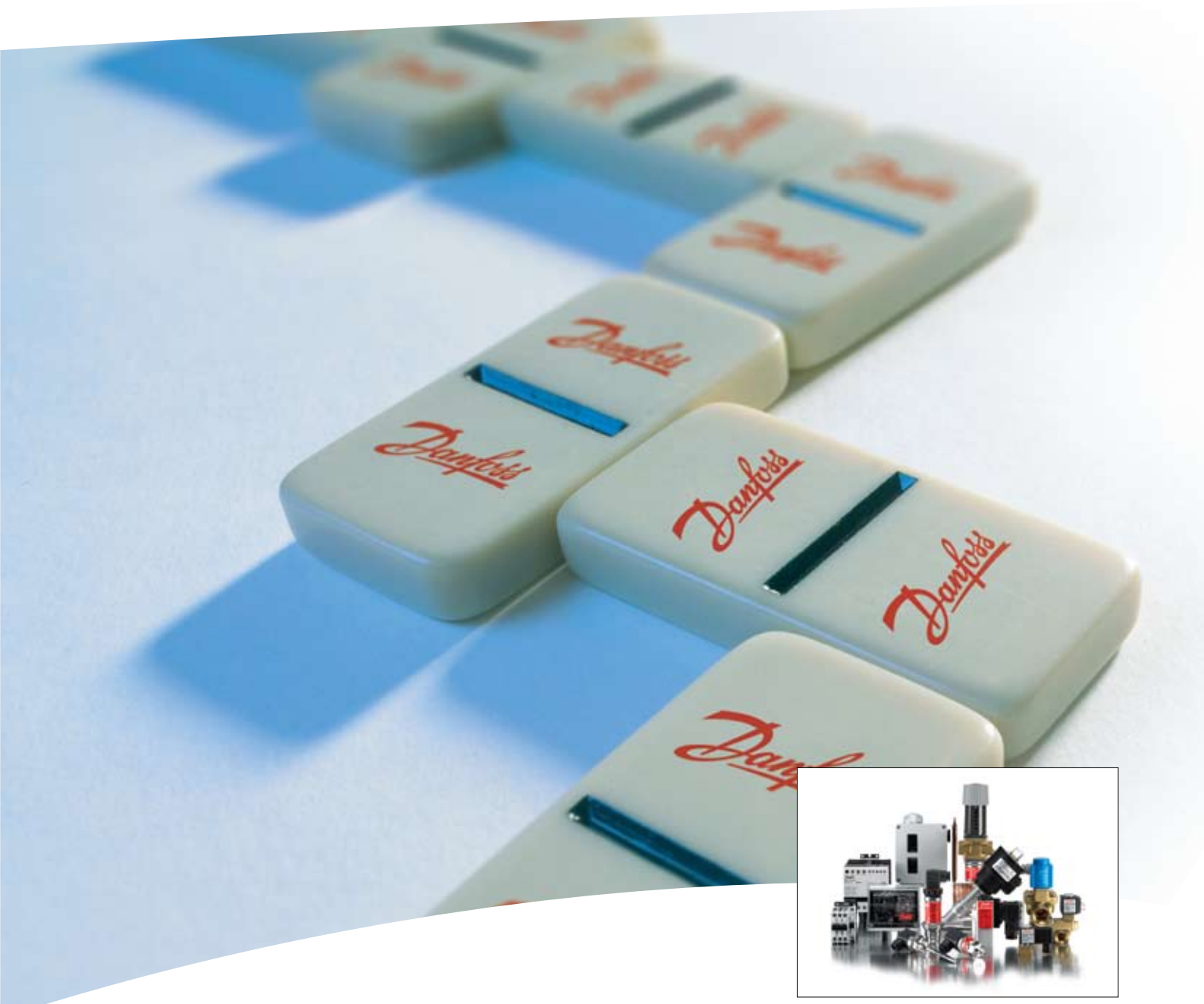
MAKING MODERN LIVING POSSIBLE



Catalogue of selected products

INDUSTRIAL AUTOMATION

The Danfoss Group

Danfoss A/S is an international Group and a leader in research, development and production of mechanical and electronic components and solutions.
Our products help to heat and cool homes and offices, refrigerate food and control production lines. In short, Danfoss contributes to the conveniences of modern life as well as to a safer and cleaner environment.
Our success as a producer stems from our ability to combine traditional mechanics-based technologies with electronic solutions. Through innovative mechanical design and electronics, often including embedded software, we provide robust products of high quality, reliability and versatility.
Danfoss strives to meet its goals with minimal consumption of raw materials and energy, the least possible impact on its surroundings, and the most efficient use of resources.
Danfoss is one of Denmark's largest industrial Groups and is based in Nordborg, in southern Denmark.

Danfoss Industrial Automation

Danfoss Industrial Automation offers you easy access to one of the widest ranges of quality industrial controls available, including:

- Solenoid valves
- Externally-operated valves
- Thermostatically-operated valves
- Electro-mechanical contactors
- Electronic contactors and motor controllers
- Pressure and temperature switches
- Pressure transmitters
- Temperature sensors and transmitters

More and more customers are turning to us to improve productivity and reduce costs through our combination of value-added services and product line competencies. Our specialists will be happy to advise you on product selection and configuration to meet your specific needs.

Solenoid valves

Type	EV210A	EV220A	EV310A	EV210B	EV220B 6-22 series	EV220B 15-50 series	EV225B	EV250B	EV310B
Pages	4	4	5	5	6	6	7	7	7
									
Function	NC	NC / NO	NC / NO	NC	NC / NO	NC / NO	NC	NC / NO	NC
Connection	G 1/8 - G 1/4	G 1/4 - G 2	G 1/8 - G 1/4	G 1/8 - G 1	G 1/4 - G 1	G 1/2 - G 2	G 3/8 - G 1	G 3/8 - G 1	G 1/8 - G 1/4
Orifice size	1.2 - 3.5 mm	6 - 50 mm	1.2 - 2 mm	1.5 - 25 mm	6 - 22 mm	15 - 50 mm	10 - 25 mm	10 - 22 mm	2 mm
Seal material	FKM / EPDM	EPDM / NBR	FKM	FKM / EPDM	FKM / EPDM	FKM / EPDM / NBR	PTFE	FKM / EPDM	FKM
Differential pressure	0 - 30 bar	0.2 - 16 bar	0 - 20 bar	0 - 30 bar	0.1 - 30 bar	0.3 - 16 bar	0.2 - 10 bar	0 - 10 bar	0 - 16 bar
Body material	Brass	Brass	Brass	Brass / DZR brass	Brass	Brass / DZR brass	DZR brass	DZR brass	Brass
Kv	0.04 - 0.26 m^3/h	1 - 32 m^3/h	0.04 - 0.08 m^3/h	0.08 - 8 m^3/h	0.7 - 6 m^3/h	4 - 40 m^3/h	2.2 - 6 m^3/h	2.5 - 7 m^3/h	0.15 m^3/h

Solenoid valves - Complete valves

Type	Complete valves (including coil) EV225B	Complete valves (including coil) EV210B	Complete valves (including coil) EV220B	Complete valves (including coil) EV250B
Pages	8	8	8	8
				
Function	NC	NC	NC	NC / NO
Connection	G 3/8 - G 1	G 1/8 - G 3/8	G 3/8 - G 2	G 3/8 - G 1
Orifice size	10 - 25 mm	1.5 - 4.5 mm	10 - 40 mm	10 - 22 mm
Seal material	PTFE	FKM / NBR	NBR	EPDM
Differential pressure	0.2 - 10 bar	0 - 30 bar	0.1 - 30 bar	0 - 10 bar
Body material	DZR brass	Brass	Bras	DZR brass
Kv	2.2 - 6 m^3/h	0.08 - 0.55 m^3/h	1.5 - 24 m^3/h	2.5 - 7 m^3/h

Industrial Valves

Solenoid valves

Danfoss solenoid valve bodies and electrical coils are normally supplied separately and then combined.
They are assembled quickly and simply without tools, providing optimum product flexibility and availibility. If a coil does need to be replaced, it can be done without stopping or draining any system.
The solenoid valves are also available as assembled units if required.

EV210A Direct-operated 2/2-way compact solenoid valves

EV210A covers a wide range of small, direct-operated 2/2-way solenoid valves for use in industrial machinery.
The compact design together with the broad range of coils means that EV210A covers a broad variety of industrial applications.

- 2/2-way
- Compact dimensions
- Direct-operated
- DN 1.2 - DN 3.5
- G 1/8 to G 1/4
- Brass or stainless steel valve body
- NC (normally closed) and NO (normally open) versions

Type	Code No	Pack Size	Weight *[kg]*	Function	Connection	Orifice size	Operation	Seal mat.	Diff. pressure *[bar]*	Body mat.	Kv m^3/h
EV210A	**032H8000**	16	0.10	N C	G 1/8	1.2 mm	Direct	EPDM	0 - 30 bar	Brass	0.04
EV210A	**032H8001**	16	0.10	N C	G 1/8	1.2 mm	Direct	FKM	0 - 30 bar	Brass	0.04
EV210A	**032H8002**	16	0.10	N C	G 1/8	1.5 mm	Direct	EPDM	0 - 30 bar	Brass	0.08
EV210A	**032H8003**	16	0.10	N C	G 1/8	1.5 mm	Direct	FKM	0 - 30 bar	Brass	0.08
EV210A	**032H8004**	16	0.10	N C	G 1/8	2 mm	Direct	EPDM	0 - 30 bar	Brass	0.11
EV210A	**032H8005**	16	0.10	N C	G 1/8	2 mm	Direct	FKM	0 - 30 bar	Brass	0.11
EV210A	**032H8006**	16	0.10	N C	G 1/8	2.5 mm	Direct	EPDM	0 - 20 bar	Brass	0.17
EV210A	**032H8007**	16	0.10	N C	G 1/8	2.5 mm	Direct	FKM	0 - 20 bar	Brass	0.17
EV210A	**032H8008**	16	0.10	N C	G 1/8	3 mm	Direct	EPDM	0 - 13 bar	Brass	0.22
EV210A	**032H8009**	16	0.10	N C	G 1/8	3 mm	Direct	FKM	0 - 13 bar	Brass	0.22
EV210A	**032H8014**	16	0.12	N C	G 1/4	2.5 mm	Direct	EPDM	0 - 20 bar	Brass	0.17
EV210A	**032H8015**	16	0.12	N C	G 1/4	2.5 mm	Direct	FKM	0 - 20 bar	Brass	0.17
EV210A	**032H8016**	16	0.12	N C	G 1/4	3 mm	Direct	EPDM	0 - 14 bar	Brass	0.22
EV210A	**032H8017**	16	0.12	N C	G 1/4	3 mm	Direct	FKM	0 - 14 bar	Brass	0.22
EV210A	**032H8018**	16	0.12	N C	G 1/4	3.5 mm	Direct	EPDM	0 - 11 bar	Brass	0.26

EV220A Servo-operated 2/2-way solenoid valves

EV220A is a compact indirect servo-operated 2/2-way solenoid valve program, especially designed for use in machines and equipment with limited space.

- 2/2-way
- Servo-operated
- DN 6 - DN 50
- G 1/4" to G 2"
- Brass valve body
- NC (normally closed) and NO (normally open) versions
- ISO 228/1 or NPT thread connection

Type	Code No	Pack Size	Weight *[kg]*	Function	Connection	Orifice size	Operation	Seal mat.	Diff. pressure *[bar]*	Body mat.	Kv m^3/h
EV220A	**042U4001**	15	0.51	N C	G 1/4	6 mm	Servo	EPDM	0.2 - 16 bar	Brass	1.00
EV220A	**042U4003**	15	0.52	N C	G 1/4	6 mm	Servo	NBR	0.2 - 16 bar	Brass	1.00
EV220A	**042U4011**	15	0.49	N C	G 3/8	10 mm	Servo	EPDM	0.2 - 16 bar	Brass	1.60
EV220A	**042U4013**	15	0.48	N C	G 3/8	10 mm	Servo	NBR	0.2 - 16 bar	Brass	1.60
EV220A	**042U4012**	15	0.46	N C	G 1/2	10 mm	Servo	EPDM	0.2 - 16 bar	Brass	1.60
EV220A	**042U4014**	15	0.46	N C	G 1/2	10 mm	Servo	NBR	0.2 - 16 bar	Brass	1.60
EV220A	**042U4022**	24	0.56	N C	G 1/2	14 mm	Servo	EPDM	0.3 - 16 bar	Brass	4.00
EV220A	**042U4024**	24	0.55	N C	G 1/2	14 mm	Servo	NBR	0.3 - 16 bar	Brass	4.00
EV220A	**042U4031**	24	0.82	N C	G 3/4	18 mm	Servo	EPDM	0.3 - 16 bar	Brass	7.00
EV220A	**042U4032**	24	0.82	N C	G 3/4	18 mm	Servo	NBR	0.3 - 16 bar	Brass	7.00
EV220A	**042U4041**	12	1.07	N C	G 1	22 mm	Servo	EPDM	0.3 - 16 bar	Brass	7.00
EV220A	**042U4042**	12	1.02	N C	G 1	22 mm	Servo	NBR	0.3 - 16 bar	Brass	7.00
EV220A	**042U4084**	1	2.01	N C	G 1 1/4	32 mm	Servo	NBR	0.3 - 16 bar	Brass	15.00
EV220A	**042U4085**	1	2.02	N C	G 1 1/2	32 mm	Servo	EPDM	0.3 - 16 bar	Brass	15.00
EV220A	**042U4086**	1	3.10	N C	G 1 1/2	40 mm	Servo	NBR	0.3 - 16 bar	Brass	18.00
EV220A	**042U4087**	1	3.10	N C	G 1 1/2	40 mm	Servo	EPDM	0.3 - 16 bar	Brass	18.00
EV220A	**042U4088**	1	4.88	N C	G 2	50 mm	Servo	NBR	0.3 - 16 bar	Brass	32.00
EV220A	**042U4089**	1	4.87	N C	G 2	50 mm	Servo	EPDM	0.3 - 16 bar	Brass	32.00
EV220A	**042U4053**	15	0.54	N O	G 1/4	6 mm	Servo	NBR	0.2 - 16 bar	Brass	1.00
EV220A	**042U4063**	15	0.50	N O	G 3/8	10 mm	Servo	NBR	0.2 - 16 bar	Brass	1.60
EV220A	**042U4074**	24	0.58	N O	G 1/2	14 mm	Servo	NBR	0.3 - 16 bar	Brass	4.00
EV220A	**042U4082**	12	0.80	N O	G 3/4	18 mm	Servo	NBR	0.3 - 16 bar	Brass	7.00
EV220A	**042U4092**	12	1.8	N O	G 1	22 mm	Servo	NBR	0.3 - 16 bar	Brass	7.00

EV310A Direct-operated 3/2-way compact solenoid valves

EV310A covers a wide range of small competitive, direct-operated 3/2-way solenoid valves for use within industrial applications, for example pilot valve applications.

- 3/2-way
- Direct-operated
- DN 1.2 - DN 2
- G 1/8" to G 1/4"
- Brass or stainless steel valve body
- NC (normally closed) and NO (normally open) versions

Type	Code No	Pack Size	Weight *[kg]*	Function	Connection	Orifice size	Operation	Seal mat.	Diff. pressure *[bar]*	Body mat.	Kv *m^3/h*
EV310A	**032H8087**	16	0.10	N C	G 1/8	1.5 mm	Direct	FKM	0 - 12 bar	Brass	0.07
EV310A	**032H8089**	16	0.10	N C	G 1/8	2 mm	Direct	FKM	0 - 8 bar	Brass	0.08
EV310A	**032H8095**	16	0.12	N C	G 1/4	1.2 mm	Direct	FKM	0 - 20 bar	Brass	0.04
EV310A	**032H8097**	16	0.12	N C	G 1/4	1.5 mm	Direct	FKM	0 - 12 bar	Brass	0.07
EV310A	**032H8099**	16	0.12	N C	G 1/4	2 mm	Direct	FKM	0 - 8 bar	Brass	0.08
EV310A	**032H8125**	16	0.10	N O	G 1/8	1.2 mm	Direct	FKM	0 - 13 bar	Brass	0.04

EV210B Direct-operated 2/2-way solenoid valves

EV210B covers a wide range of direct-operated 2/2-way solenoid valves for universal use. EV210B is a real robust valve program with high performance and can be used in all kind of tough working conditions.

- 2/2-way
- High Performance series
- Direct-operated
- DN 1.5 - DN 25
- Brass or stainless steel valve body
- NC (normally closed) and NO (normally open) versions
- ISO 228/1 G 1/8" to G 1"
- UL listed version with NPT. for North America (EVI)

Type	Code No	Pack Size	Weight *[kg]*	Function	Connection	Orifice size	Operation	Seal mat.	Diff. pressure *[bar]*	Body mat.	Kv *m^3/h*
EV210B	**032U5702**	20	0.19	N C	G 1/8	1.5 mm	Direct	FKM	0 - 30 bar	Brass	0.08
EV210B	**032U5704**	20	0.20	N C	G 1/8	2 mm	Direct	FKM	0 - 30 bar	Brass	0.15
EV210B	**032U5705**	20	0.24	N C	G 1/8	3 mm	Direct	EPDM	0 - 30 bar	Brass	0.30
EV210B	**032U5706**	20	0.24	N C	G 1/8	3 mm	Direct	FKM	0 - 30 bar	Brass	0.30
EV210B	**032U3629**	20	0.18	N C	G 1/4	1.5 mm	Direct	FKM	0 - 30 bar	Brass	0.08
EV210B	**032U5707**	20	0.18	N C	G 1/4	2 mm	Direct	EPDM	0 - 30 bar	Brass	0.15
EV210B	**032U5708**	20	0.18	N C	G 1/4	2 mm	Direct	FKM	0 - 30 bar	Brass	0.15
EV210B	**032U5709**	20	0.22	N C	G 1/4	3 mm	Direct	EPDM	0 - 30 bar	Brass	0.30
EV210B	**032U5710**	20	0.23	N C	G 1/4	3 mm	Direct	FKM	0 - 30 bar	Brass	0.30
EV210B	**032U3601**	20	0.22	N C	G 1/4	4.5 mm	Direct	FKM	0 - 13 bar	Brass	0.55
EV210B	**032U3642**	-	0.20	N C	G 3/8	3 mm	Direct	EPDM	0 - 30 bar	Brass	0.30
EV210B	**032U3643**	20	0.21	N C	G 3/8	3 mm	Direct	FKM	0 - 30 bar	Brass	0.30
EV210B	**032U3605**	20	0.21	N C	G 3/8	4.5 mm	Direct	EPDM	0 - 13 bar	Brass	0.55
EV210B	**032U3606**	20	0.21	N C	G 3/8	4.5 mm	Direct	FKM	0 - 13 bar	Brass	0.55
EV210B	**032U3607**	20	0.30	N C	G 3/8	6 mm	Direct	EPDM	0 - 6 bar	Brass	0.70
EV210B	**032U3608**	20	0.31	N C	G 3/8	6 mm	Direct	FKM	0 - 6 bar	Brass	0.70
EV210B	**032U3615**	20	0.28	N C	G 1/2	8 mm	Direct	EPDM	0 - 3 bar	Brass	1.00
EV210B	**032U3616**	20	0.28	N C	G 1/2	8 mm	Direct	FKM	0 - 3 bar	Brass	1.00
EV210B	**032U3617**	20	0.29	N C	G 1/2	10 mm	Direct	EPDM	0 - 1.6 bar	Brass	1.50
EV210B	**032U3618**	20	0.29	N C	G 1/2	10 mm	Direct	FKM	0 - 1.6 bar	Brass	1.50
EV210B	**032U3619**	24	0.58	N C	G 1/2	15 mm	Direct	EPDM	0 - 0.45 bar	DZR brass	2.85
EV210B	**032U3620**	24	0.60	N C	G 1/2	15 mm	Direct	FKM	0 - 0.45 bar	DZR brass	2.85
EV210B	**032U3621**	12	0.87	N C	G 3/4	20 mm	Direct	EPDM	0 - 0.4 bar	DZR brass	4.50
EV210B	**032U3622**	12	0.87	N C	G 3/4	20 mm	Direct	FKM	0 - 0.4 bar	DZR brass	4.50
EV210B	**032U3623**	12	1.12	N C	G 1	25 mm	Direct	EPDM	0 - 0.35 bar	DZR brass	8.00
EV210B	**032U3624**	12	1.12	N C	G 1	25 mm	Direct	FKM	0 - 0.35 bar	DZR brass	8.00

EV220B (6-22 series) Servo-operated 2/2-way solenoid valves

EV220B 6-22 is a direct servo-operated 2/2-way solenoid valve program with connections from 1/4" to 1".
This program is especially for OEM applications demanding a robust solution and moderate flow rates.

- 2/2-way
- Servo-operated
- DN 6 - DN 22
- Brass or DZR (de-zincification resistant) brass valve body
- NC (normally closed) and NO (normally open) versions
- ISO 228/1 or NPT thread connection (EVSI and EVSI-U)

Type	Code No	Pack Size	Weight *[kg]*	Function	Connection	Orifice size	Operation	Seal mat.	Diff. pressure *[bar]*	Body mat.	Kv *m^3/h*
EV220B	**032U1236**	20	0.26	N C	G 1/4	6 mm	Servo	EPDM	0.1 - 20 bar	Brass	0.70
EV220B	**032U1237**	20	0.26	N C	G 1/4	6 mm	Servo	FKM	0.1 - 30 bar	Brass	0.70
EV220B	**032U1241**	20	0.24	N C	G 3/8	6 mm	Servo	EPDM	0.1 - 20 bar	Brass	0.70
EV220B	**032U1242**	20	0.24	N C	G 3/8	6 mm	Servo	FKM	0.1 - 30 bar	Brass	0.70
EV220B	**032U1246**	20	0.34	N C	G 3/8	10 mm	Servo	EPDM	0.1 - 20 bar	Brass	1.50
EV220B	**032U1247**	20	0.34	N C	G 3/8	10 mm	Servo	FKM	0.1 - 30 bar	Brass	1.50
EV220B	**032U1251**	20	0.31	N C	G 1/2	10 mm	Servo	EPDM	0.1 - 20 bar	Brass	1.50
EV220B	**032U1252**	20	0.31	N C	G 1/2	10 mm	Servo	FKM	0.1 - 30 bar	Brass	1.50
EV220B	**032U1255**	15	0.35	N C	G 1/2	12 mm	Servo	FKM	0.3 - 10 bar	Brass	2.50
EV220B	**032U1256**	15	0.35	N C	G 1/2	12 mm	Servo	EPDM	0.3 - 10 bar	Brass	2.50
EV220B	**032U1260**	12	0.72	N C	G 3/4	18 mm	Servo	FKM	0.3 - 10 bar	Brass	6.00
EV220B	**032U1261**	12	0.73	N C	G 3/4	18 mm	Servo	EPDM	0.3 - 10 bar	Brass	6.00
EV220B	**032U1263**	12	0.96	N C	G 1	22 mm	Servo	EPDM	0.3 - 10 bar	Brass	6.00
EV220B	**032U1266**	12	0.95	N C	G 1	22 mm	Servo	FKM	0.3 - 10 bar	Brass	6.00
EV220B	**032U1238**	20	0.24	N O	G 3/8	6 mm	Servo	EPDM	0.1 - 10 bar	Brass	0.70
EV220B	**032U1239**	20	0.23	N O	G 3/8	6 mm	Servo	FKM	0.1 - 10 bar	Brass	0.70
EV220B	**032U1249**	20	0.32	N O	G 1/2	10 mm	Servo	FKM	0.1 - 10 bar	Brass	1.00

EV220B (15-50 series) Servo-operated 2/2-way solenoid valves

EV220B 15-50 is a universal indirect servo-operated 2/2-way solenoid valve program.
Valve body in brass, dezincification resistant brass and stainless steel ensures that a broad variety of application can be covered.
Built-in pilot filter as standard, adjustable closing time and enclosures up to IP67 ensures optimal performance even under critical working conditions.

- 2/2-way
- Servo-operated
- DN 15 - DN 50
- Valve body available in brass, DZR brass, gun metal or stainless steel
- NC and NO versions
- ISO 228/1 or NPT thread connection (EVSI and EVSI-U)
- Built in filter for protection of pilot system
- Water hammer damped
- Adjustable closing time available

Type	Code No	Pack Size	Weight *[kg]*	Function	Connection	Orifice size	Operation	Seal mat.	Diff. pressure *[bar]*	Body mat.	Kv *m^3/h*
EV220B	**032U5815**	24	0.73	N C	G 1/2	15 mm	Servo	EPDM	0.3 - 16 bar	DZR brass	4.00
EV220B	**032U7115**	24	0.76	N C	G 1/2	15 mm	Servo	EPDM	0.3 - 16 bar	Brass	4.00
EV220B	**032U7116**	24	0.74	N C	G 1/2	15 mm	Servo	FKM	0.3 - 10 bar	Brass	4.00
EV220B	**032U7170**	24	0.73	N C	G 1/2	15 mm	Servo	NBR	0.3 - 16 bar	Brass	4.00
EV220B	**032U5820**	24	0.92	N C	G 3/4	20 mm	Servo	EPDM	0.3 - 16 bar	DZR brass	8.00
EV220B	**032U7120**	24	0.93	N C	G 3/4	20 mm	Servo	EPDM	0.3 - 16 bar	Brass	8.00
EV220B	**032U7121**	24	0.92	N C	G 3/4	20 mm	Servo	FKM	0.3 - 10 bar	Brass	8.00
EV220B	**032U7171**	24	0.93	N C	G 3/4	20 mm	Servo	NBR	0.3 - 16 bar	Brass	8.00
EV220B	**032U7125**	12	1.40	N C	G 1	25 mm	Servo	EPDM	0.3 - 16 bar	Brass	11.00
EV220B	**032U7126**	12	1.40	N C	G 1	25 mm	Servo	FKM	0.3 - 10 bar	Brass	11.00
EV220B	**032U7172**	12	1.39	N C	G 1	25 mm	Servo	NBR	0.3 - 16 bar	Brass	11.00
EV220B	**032U5832**	9	2.08	N C	G 1 1/4	32 mm	Servo	EPDM	0.3 - 16 bar	DZR brass	18.00
EV220B	**032U7132**	9	2.05	N C	G 1 1/4	32 mm	Servo	EPDM	0.3 - 16 bar	Brass	18.00
EV220B	**032U7133**	9	2.07	N C	G 1 1/4	32 mm	Servo	FKM	0.3 - 10 bar	Brass	18.00
EV220B	**032U7173**	9	2.06	N C	G 1 1/4	32 mm	Servo	NBR	0.3 - 16 bar	Brass	18.00
EV220B	**032U5840**	6	3.07	N C	G 1 1/2	40 mm	Servo	EPDM	0.3 - 16 bar	DZR brass	24.00
EV220B	**032U7140**	6	3.11	N C	G 1 1/2	40 mm	Servo	EPDM	0.3 - 16 bar	Brass	24.00
EV220B	**032U7141**	6	3.13	N C	G 1 1/2	40 mm	Servo	FKM	0.3 - 10 bar	Brass	24.00
EV220B	**032U7174**	6	3.16	N C	G 1 1/2	40 mm	Servo	NBR	0.3 - 16 bar	Brass	24.00
EV220B	**032U5850**	4	4.49	N C	G 2	50 mm	Servo	EPDM	0.3 - 16 bar	DZR brass	40.00
EV220B	**032U7150**	4	4.91	N C	G 2	50 mm	Servo	EPDM	0.3 - 16 bar	Brass	40.00
EV220B	**032U7151**	4	4.91	N C	G 2	50 mm	Servo	FKM	0.3 - 10 bar	Brass	40.00
EV220B	**032U7175**	4	4.92	N C	G 2	50 mm	Servo	NBR	0.3 - 16 bar	Brass	40.00
EV220B	**032U7117**	24	0.73	N O	G 1/2	15 mm	Servo	EPDM	0.3 - 16 bar	Brass	4.00
EV220B	**032U7180**	24	0.73	N O	G 1/2	15 mm	Servo	NBR	0.3 - 16 bar	Brass	4.00
EV220B	**032U7122**	24	0.91	N O	G 3/4	20 mm	Servo	EPDM	0.3 - 16 bar	Brass	8.00
EV220B	**032U7181**	24	0.88	N O	G 3/4	20 mm	Servo	NBR	0.3 - 16 bar	Brass	8.00
EV220B	**032U7127**	12	1.38	N O	G 1	25 mm	Servo	EPDM	0.3 - 16 bar	Brass	11.00
EV220B	**032U7182**	12	1.43	N O	G 1	25 mm	Servo	NBR	0.3 - 16 bar	Brass	11.00
EV220B	**032U7134**	9	2.05	N O	G 1 1/4	32 mm	Servo	EPDM	0.3 - 16 bar	Brass	18.00
EV220B	**032U7183**	9	2.05	N O	G 1 1/4	32 mm	Servo	NBR	0.3 - 16 bar	Brass	18.00
EV220B	**032U7142**	6	3.12	N O	G 1 1/2	40 mm	Servo	EPDM	0.3 - 16 bar	Brass	24.00
EV220B	**032U7184**	6	3.15	N O	G 1 1/2	40 mm	Servo	NBR	0.3 - 16 bar	Brass	24.00
EV220B	**032U7152**	4	4.91	N O	G 2	50 mm	Servo	EPDM	0.3 - 16 bar	Brass	40.00
EV220B	**032U7185**	4	4.91	N O	G 2	50 mm	Servo	NBR	0.3 - 16 bar	Brass	40.00

EV225B Servo-operated 2/2-way solenoid valves for steam

EV225B is a servo-operated 2/2-way solenoid valve for use in steam application.
The design is based on a PTFE diaphragm concept, ensuring high reliable function even in connection with contaminated steam.
Valve body in dezincification resistant brass and valve seats made in stainless steel for ensuring a long life even in connection with aggressive steam media.
Coil type BR can be used on EV225B.

- 2/2-way
- Specifically designed for steam applications
- Servo-operated
- DN 6 - DN 25
- G 1/4" to G 1"
- DZR brass valve body
- NC (normally closed)
- ISO 228/1 or UL listed version with NPT for North America (EVSIS)

Type	Code No	Pack Size	Weight *[kg]*	Function	Connection	Orifice size	Operation	Seal mat.	Diff. pressure *[bar]*	Body mat.	Kv *m^3/h*
EV225B	**032U300399**	8	0.50	N C	G 3/8	10 mm	Servo	PTFE	0.2 - 10 bar	DZR brass	2.20
EV225B	**032U300499**	15	0.45	N C	G 1/2	10 mm	Servo	PTFE	0.2 - 10 bar	DZR brass	2.20
EV225B	**032U300599**	12	0.66	N C	G 1/2	15 mm	Servo	PTFE	0.2 - 10 bar	DZR brass	3.00
EV225B	**032U300699**	12	1.21	N C	G 3/4	20 mm	Servo	PTFE	0.2 - 10 bar	DZR brass	5.00
EV225B	**032U300799**	12	1.42	N C	G 1	25 mm	Servo	PTFE	0.2 - 10 bar	DZR brass	6.00

EV250B Assisted lift operated 2/2-way solenoid valves

EV250B with assisted lift can operate from zero and up to 10 bar differential pressure.
This 2/2-way valve program is especially to use in closed circuits with low differential pressure, but demanding moderate flow rates. Valve body in dezincification resistant brass for ensuring a long life even in connection with aggressive steam media.
EV250B is compatible with the broad Danfoss coil program with enclosures from IP00 up to IP67. Medium temperatures up to 140 °C (low pressure steam).

- 2/2-way
- assisted lift operated
- DN 10 - DN 22
- DZR brass valve body
- NC (normally closed) or NO (normally open)
- From zero differential pressure
- Especially suitable for closed circuits and for emptying tanks
- Available with WRAS, VA and UL approvals
- ISO or NPT thread connections

Type	Code No	Pack Size	Weight *[kg]*	Function	Connection	Orifice size	Operation	Seal mat.	Diff. pressure *[bar]*	Body mat.	Kv *m^3/h*
EV250B	**032U5250**	24	0.63	N C	G 3/8	10 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	2.50
EV250B	**032U5251**	24	0.62	N C	G 3/8	10 mm	Assisted lift	FKM	0 - 10 bar	DZR brass	2.50
EV250B	**032U5252**	24	0.59	N C	G 1/2	12 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	4.00
EV250B	**032U5253**	24	0.62	N C	G 1/2	12 mm	Assisted lift	FKM	0 - 10 bar	DZR brass	4.00
EV250B	**032U5254**	12	0.87	N C	G 3/4	18 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	6.00
EV250B	**032U5255**	12	0.88	N C	G 3/4	18 mm	Assisted lift	FKM	0 - 10 bar	DZR brass	6.00
EV250B	**032U5256**	12	1.8	N C	G 1	22 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	7.00
EV250B	**032U5257**	12	1.9	N C	G 1	22 mm	Assisted lift	FKM	0 - 10 bar	DZR brass	7.00
EV250B	**032U5350**	24	0.62	N O	G 3/8	10 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	2.50
EV250B	**032U5352**	1	0.58	N O	G 1/2	12 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	4.00
EV250B	**032U5354**	1	0.88	N O	G 3/4	18 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	6.00
EV250B	**032U5356**	1	-	N O	G 1	20 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	7.00

EV310B Direct-operated 3/2-way solenoid valves

EV310B covers a wide range of direct-operated 3/2-way solenoid valves for universal use.
EV310B is a real robust valve program with high performance and can be used in all kind of tough working conditions.
Clip-on coils can not be used on EV310B.

- 3/2-way
- Direct-operated
- DN 1.5 - DN 3.5
- Brass valve body
- Thread (G 1/8" to G 3/8") or flange (32x32 mm) connections
- NC (normally closed) and NO (normally open) versions
- Manual override versions

Type	Code No	Pack Size	Weight *[kg]*	Function	Connection	Orifice size	Operation	Seal mat.	Diff. pressure *[bar]*	Body mat.	Kv *m^3/h*
EV310B	**032U4901**	16	0.34	N C	G 1/8	2 mm	Direct	FKM	0 - 16 bar	Brass	0.15
EV310B	**032U4904**	16	0.33	N C	G 1/4	2 mm	Direct	FKM	0 - 16 bar	Brass	0.15
EV310B	**032U4919**	16	0.34	N C	G 1/4	2 mm	Direct	FKM	0 - 16 bar	Brass	0.15

Complete valves, Type EV220B, EV210B, EV225B and EV250B

Our solenoid valve program includes valves suitable for most open and closed systems. The program comes complete with the clip-on coil and IP65 electrical plug and has been carefully designed to simplify product selection. Appendix "02" for 24 V dc, "16"/"82" for 24 V ac and "31" / "84" for 230 V ac

To select the right valve all that is required to be known is:

- Open or closed pipe work system
- Pipe size
- Electrical voltage

If the system parametres are unknown, choose the safe solution - EV250B NO or NC version

Type	Code No	Pack Size	Weight *[kg]*	Function	Connection	Orifice size	Operation	Seal mat.	Diff. pressure *[bar]*	Body mat.	Kv m^3/h	Coil voltage
EV210B	**032U145816**	24	0.50	N C	G 1/8	1.5 mm	Direct	FKM	0 - 30 bar	Brass	0.08	24 V ac
EV210B	**032U145831**	24	0.50	N C	G 1/8	1.5 mm	Direct	FKM	0 - 30 bar	Brass	0.08	230 V ac
EV210B	**032U147002**	24	0.55	N C	G 1/4	3 mm	Direct	FKM	0 - 20 bar	Brass	0.30	24 V dc
EV210B	**032U147016**	24	0.53	N C	G 1/4	3 mm	Direct	FKM	0 - 20 bar	Brass	0.30	24 V ac
EV210B	**032U147031**	24	0.53	N C	G 1/4	3 mm	Direct	FKM	0 - 20 bar	Brass	0.30	230 V ac
EV210B	**032U146131**	24	0.50	N C	G 3/8	3 mm	Direct	NBR	0 - 10 bar	Brass	0.30	230 V ac
EV210B	**032U148002**	24	0.54	N C	G 3/8	4.5 mm	Direct	FKM	0 - 10 bar	Brass	0.55	24 V dc
EV210B	**032U148016**	24	0.50	N C	G 3/8	4.5 mm	Direct	FKM	0 - 10 bar	Brass	0.55	24 V ac
EV210B	**032U148031**	24	0.51	N C	G 3/8	4.5 mm	Direct	FKM	0 - 10 bar	Brass	0.55	230 V ac
EV220B	**032U151802**	20	0.70	N C	G 3/8	10 mm	Servo	NBR	0.1 - 30 bar	Brass	1.50	24 V dc
EV220B	**032U151816**	20	0.67	N C	G 3/8	10 mm	Servo	NBR	0.1 - 30 bar	Brass	1.50	24 V ac
EV220B	**032U151831**	20	0.66	N C	G 3/8	10 mm	Servo	NBR	0.1 - 30 bar	Brass	1.50	230 V ac
EV220B	**032U153802**	12	0.69	N C	G 1/2	12 mm	Servo	NBR	0.3 - 10 bar	Brass	2.50	24 V dc
EV220B	**032U153816**	12	0.64	N C	G 1/2	12 mm	Servo	NBR	0.3 - 10 bar	Brass	2.50	24 V ac
EV220B	**032U153831**	12	0.65	N C	G 1/2	12 mm	Servo	NBR	0.3 - 10 bar	Brass	2.50	230 V ac
EV220B	**032U528602**	24	-	N C	G 3/4	18 mm	Servo	NBR	0.3 - 10 bar	Brass	6.00	24 V dc
EV220B	**032U528616**	24	0.01	N C	G 3/4	18 mm	Servo	NBR	0.3 - 10 bar	Brass	6.00	24 V ac
EV220B	**032U528631**	24	0.99	N C	G 3/4	18 mm	Servo	NBR	0.3 - 10 bar	Brass	6.00	230 V ac
EV220B	**032U528702**	12	1.27	N C	G 1	22 mm	Servo	NBR	0.3 - 10 bar	Brass	6.00	24 V dc
EV220B	**032U528716**	12	-	N C	G 1	22 mm	Servo	NBR	0.3 - 10 bar	Brass	6.00	24 V ac
EV220B	**032U528731**	12	1.25	N C	G 1	22 mm	Servo	NBR	0.3 - 10 bar	Brass	6.00	230 V ac
EV220B	**032U451402**	12	1.03	N C	G 1/2	15 mm	Servo	NBR	0.3 - 16 bar	Brass	4.00	24 V dc
EV220B	**032U451416**	12	1.01	N C	G 1/2	15 mm	Servo	NBR	0.3 - 16 bar	Brass	4.00	24 V ac
EV220B	**032U451431**	12	1.02	N C	G 1/2	15 mm	Servo	NBR	0.3 - 16 bar	Brass	4.00	230 V ac
EV220B	**032U453002**	12	1.22	N C	G 3/4	20 mm	Servo	NBR	0.3 - 16 bar	Brass	8.00	24 V dc
EV220B	**032U453016**	12	1.18	N C	G 3/4	20 mm	Servo	NBR	0.3 - 16 bar	Brass	8.00	24 V ac
EV220B	**032U453031**	12	1.20	N C	G 3/4	20 mm	Servo	NBR	0.3 - 16 bar	Brass	8.00	230 V ac
EV220B	**032U453402**	12	1.69	N C	G 1	25 mm	Servo	NBR	0.3 - 16 bar	Brass	11.00	24 V dc
EV220B	**032U453416**	12	1.65	N C	G 1	25 mm	Servo	NBR	0.3 - 16 bar	Brass	11.00	24 V ac
EV220B	**032U453431**	12	1.68	N C	G 1	25 mm	Servo	NBR	0.3 - 16 bar	Brass	11.00	230 V ac
EV220B	**032U456802**	1	2.35	N C	G 1 1/4	32 mm	Servo	NBR	0.3 - 16 bar	Brass	18.00	24 V dc
EV220B	**032U456816**	1	2.33	N C	G 1 1/4	32 mm	Servo	NBR	0.3 - 16 bar	Brass	18.00	24 V ac
EV220B	**032U456831**	1	2.35	N C	G 1 1/4	32 mm	Servo	NBR	0.3 - 16 bar	Brass	18.00	230 V ac
EV220B	**032U458502**	1	3.46	N C	G 1 1/2	40 mm	Servo	NBR	0.3 - 16 bar	Brass	24.00	24 V dc
EV220B	**032U458516**	1	3.42	N C	G 1 1/2	40 mm	Servo	NBR	0.3 - 16 bar	Brass	24.00	24 V ac
EV220B	**032U458531**	1	3.50	N C	G 1 1/2	40 mm	Servo	NBR	0.3 - 16 bar	Brass	24.00	230 V ac
EV220B	**032U460402**	1	5.21	N C	G 2	40 mm	Servo	NBR	0.3 - 16 bar	Brass	24.00	24 V dc
EV220B	**032U460416**	1	5.19	N C	G 2	40 mm	Servo	NBR	0.3 - 16 bar	Brass	24.00	24 V ac
EV220B	**032U460431**	1	5.21	N C	G 2	40 mm	Servo	NBR	0.3 - 16 bar	Brass	24.00	230 V ac
EV225B	**032U300484**	8	0.89	N C	G 1/2	10 mm	Servo	PTFE	0.2 - 10 bar	DZR brass	2.20	230 V ac
EV225B	**032U300584**	8	1.06	N C	G 1/2	15 mm	Servo	PTFE	0.2 - 10 bar	DZR brass	3.00	230 V ac
EV225B	**032U300682**	6	1.70	N C	G 3/4	20 mm	Servo	PTFE	0.2 - 10 bar	DZR brass	5.00	24 V ac
EV225B	**032U300684**	6	1.66	N C	G 3/4	20 mm	Servo	PTFE	0.2 - 10 bar	DZR brass	5.00	230 V ac
EV225B	**032U300784**	6	1.86	N C	G 1	25 mm	Servo	PTFE	0.2 - 10 bar	DZR brass	6.00	230 V ac
EV250B	**032U157102**	24	0.94	N C	G 3/8	10 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	2.50	24 V dc
EV250B	**032U157116**	24	0.92	N C	G 3/8	10 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	2.50	24 V ac
EV250B	**032U157131**	24	0.94	N C	G 3/8	10 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	2.50	230 V ac
EV250B	**032U158002**	24	0.91	N C	G 1/2	12 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	4.00	24 V dc
EV250B	**032U158016**	24	0.87	N C	G 1/2	12 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	4.00	24 V ac
EV250B	**032U158031**	24	0.88	N C	G 1/2	12 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	4.00	230 V ac
EV250B	**032U161402**	12	1.17	N C	G 3/4	18 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	6.00	24 V dc
EV250B	**032U161416**	12	1.15	N C	G 3/4	18 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	6.00	24 V ac
EV250B	**032U161431**	12	1.16	N C	G 3/4	18 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	6.00	230 V ac
EV250B	**032U162402**	12	1.41	N C	G 1	22 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	7.00	24 V dc
EV250B	**032U162416**	12	1.41	N C	G 1	22 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	7.00	24 V ac
EV250B	**032U162431**	12	1.38	N C	G 1	22 mm	Assisted lift	EPDM	0 - 10 bar	DZR brass	7.00	230 V ac
EV250B	**032U537231**	24	0.86	N O	G 1/2	12 mm	Servo	EPDM	0 - 10 bar	DZR brass	-	230 V ac
EV250B	**032U537431**	24	-	N O	G 3/4	18 mm	Servo	EPDM	0 - 10 bar	DZR brass	-	230 V ac
EV250B	**032U537631**	24	1.40	N O	G 1	20 mm	Servo	EPDM	0 - 10 bar	DZR brass	-	230 V ac

Accessories & spare parts - solenoid valves

Spare part kits - for EV210B

Type	Code No	Pack Size	Weight [kg]	Application
Spare parts	032U1060	10	0.03	EV210B 1.5-3 NBR

Spare part kits - for EV220B

Type	Code No	Pack Size	Weight [kg]	Application
Spare parts	032U0296	20	0.10	EV220B 15-50 EPDM
Spare parts	032U1065	10	0.04	EV220B EPDM
Spare parts	032U1066	10	0.04	EV220B FKM
Spare parts	032U1068	10	0.04	EV220B 12 EPDM
Spare parts	032U1071	10	0.04	EV220B 15 EPDM
Spare parts	032U1072	10	0.04	EV220B 15 FKM
Spare parts	032U1070	10	0.05	EV220B 18 EPDM
Spare parts	032U1073	10	0.05	EV220B 20 EPDM
Spare parts	032U1074	10	0.05	EV220B 20 FKM
Spare parts	032U1075	10	0.08	EV220B 25 EPDM
Spare parts	032U1076	10	0.8	EV220B 25 FKM
Spare parts	032U6015	5	0.08	EV220B 25B NBR
Spare parts	032U1077	10	0.10	EV220B 32 EPDM
Spare parts	032U1078	5	0.11	EV220B 32 FKM
Spare parts	032U1079	5	0.16	EV220B 40 EPDM
Spare parts	032U1080	5	0.17	EV220B 40 FKM
Spare parts	032U1081	10	0.26	EV220B 50 EPDM
Spare parts	032U1082	5	0.27	EV220B 50 FKM
Spare parts	032U1063	10	0.04	EV220B 6 FKM

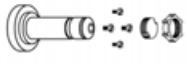
Spare part kits - for EV225B

Type	Code No	Pack Size	Weight [kg]	Application
Spare parts	032U3172	10	0.05	EV225 15 PTFE
Spare parts	032U3173	10	0.08	EV225 20 PTFE
Spare parts	032U3171	12	0.04	EV225 6-10 PTFE

Spare part kits - for EV250B

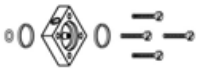
Type	Code No	Pack Size	Weight [kg]	Application
Spare parts	032u5271	20	0.07	EV250B 10-12BD FKM
Spare parts	032u5273	18	0.07	EV250B 18-22BD FKM
Spare parts	032u5315	15	0.29	EV250B NC 10-12 BD EPDM
Spare parts	032u5317	12	0.32	EV250B NC 18-22BD EPDM

Isolating diaphragm kits - for solenoid valves



Type	Code No	Pack Size	Weight [kg]	Description	Application
Spare parts	042U1010	50	0.13	Isolating diaphragm	EV212B 1.5, EV222B 15-50 FKM
Spare parts	042U1009	50	0.12	Isolating diaphragm	EV222 15-50 EPDM

Manual override kits - for solenoid valves



Type	Code No	Pack Size	Weight *[kg]*	Description	Application
Spare parts	**032U0150**	90	0.13	Manuel opening unit	EV220B 15-50 Brass

Coils for valves

Danfoss solenoid valves and coils are usually ordered separately to allow maximum flexibility, enabling you to select a valve and coil combination to best suit your needs.

The Danfoss coil program consists of both the easy-to-handle Clip-On system and traditional coils with threaded fastener. Also, with approvals such as EEx/ATEX and UL, we offer a wide range of application specific coils for e.g. steam or hazardous areas.

AB Compact coils

Compact coil with low power consumption for valve range A; 4.5W ac / 5W dc

- Compact
- Windings of class H insulated wire moulded in the coil body
- Ambient temperature: Up to +50°C
- All usual ac and dc voltages
- IP 00 version with 6.3 x 0.8 mm spade connectors
- IP 65 version with mounted cable plug

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V ac]*	Voltage *[V dc]*	Freq. *[Hz]*	Ambient temp. *[°C]*	Coil conn.	IP	Armature tube size
AB024C	**042N0802**	24	0.06	4.5 W	24 V	-	50/60 HZ	-40 - 50 °C	DIN	IP 00	9 mm
AB230C	**042N0800**	24	0.06	4.5 W	230 V	-	50/60 HZ	-40 - 50 °C	DIN	IP 00	9 mm
AB024D	**042N0803**	24	0.06	5 W	-	24.0 V	D.C.	-40 - 50 °C	DIN	IP 00	9 mm

AC Compact coils

Compact coil with high power consumption for valve range A; 7W ac / 10W dc

- Compact
- Windings of class H insulated wire moulded in the coil body
- Ambient temperature: Up to +50°C
- IP 00 version with 6.3 x 0.8 mm spade connectors
- IP 65 version with mounted cable plug

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V ac]*	Voltage *[V dc]*	Freq. *[Hz]*	Ambient temp. *[°C]*	Coil conn.	IP	Armature tube size
AC230C	**042N0821**	24	0.06	7 W	230 V	-	50/60 HZ	-40 - 50 °C	DIN	IP 00	9 mm
AC024C	**042N0823**	24	0.06	7 W	24 V	-	50/60 HZ	-40 - 50 °C	DIN	IP 00	9 mm
AC024D	**042N0824**	24	0.06	10 W	-	24.0 V	D.C.	-40 - 50 °C	DIN	IP 00	9 mm

AK Compact coils

Compact coil for valve range A; 3W dc

- Compact
- Windings of class H insulated wire moulded in the coil body
- Ambient temperature: Up to +50°C
- IP 00 version with terminals DIN 43650 form A
- IP 20 version with protective cap
- IP 65 version with mounted cable plug

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V dc]*	Freq. *[Hz]*	Ambient temp. *[°C]*	Coil conn.	IP	Armature tube size
AK024D	**042N0844**	24	0.11	3 W	24.0 V	D.C.	-40 - 50 °C	DIN	IP 00	9 mm

AM Compact coils

Compact coil for valve range A, 7.5W ac / 9.5W dc

- Compact
- Windings of class H insulated wire moulded in the coil body
- Ambient temperature: Up to +50°C
- IP 00 version with terminals DIN 43650 form A
- IP 20 version with protective cap
- IP 65 version with mounted cable plug

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V ac]*	Voltage *[V dc]*	Freq. *[Hz]*	Ambient temp. *[°C]*	Coil conn.	IP	Armature tube size
AM024C	**042N0842**	24	0.11	7.5 W	24 V	-	50/60 HZ	-40 - 50 °C	DIN	IP 00	9 mm
AM230C	**042N0840**	24	0.11	7.5 W	230 V	-	50/60 HZ	-40 - 50 °C	DIN	IP 00	9 mm
AM012D	**042N0848**	24	0.11	9.5 W	-	12.0 V	D.C.	-40 - 50 °C	DIN	IP 00	9 mm
AM024D	**042N0843**	24	0.12	9.5 W	-	24.0 V	D.C.	-40 - 50 °C	DIN	IP 00	9 mm

BA High performance coils

Non-demanding applications, with IP65, for valve range B, 9W ac / 15W dc

- Windings of class H insulated wire moulded in the coil body
- Ambient temperature: Up to +40°C
- IP 00 version with DIN 43650 A spade connectors
- IP 20 version with protective cap
- IP 65 version with mounted cable plug

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V ac]*	Voltage *[V dc]*	Freq. *[Hz]*	Ambient temp. *[°C]*	Coil conn.	IP	Armature tube size
BA024A	**042N7508**	84	0.18	9 W	24 V	-	50 HZ	-40 - 40 °C	DIN Spade	IP 00	13.5 mm
BA048A	**042N7510**	84	0.17	9 W	48 V	-	50 HZ	-40 - 40 °C	DIN Spade	IP 00	13.5 mm
BA115A	**042N7512**	84	0.16	9 W	115 V	-	50 HZ	-40 - 40 °C	DIN Spade	IP 00	13.5 mm
BA230A	**042N7501**	84	0.17	9 W	220 - 230 V	-	50 HZ	-40 - 40 °C	DIN Spade	IP 00	13.5 mm
BA240A	**042N7502**	84	0.15	9 W	240 V	-	50 HZ	-40 - 40 °C	DIN Spade	IP 00	13.5 mm
BA400A	**042N7504**	84	0.17	9 W	380 - 400 V	-	50 HZ	-40 - 40 °C	DIN Spade	IP 00	13.5 mm
BA012D	**042N7550**	84	0.19	15 W	-	12.0 V	D.C.	-40 - 40 °C	DIN Spade	IP 00	13.5 mm
BA024D	**042N7551**	84	0.19	15 W	-	24.0 V	D.C.	-40 - 40 °C	DIN Spade	IP 00	13.5 mm

BB High performance coils

Demanding applications, with IP65, for valve range B, 10W ac / 18W dc

- Clip-on system for fast, easy fitting and removal
- Windings of class H insulated wire moulded in the coil body
- Ambient temperature: Up to +80°C
- IP 00 version with DIN 43650 A spade connectors
- IP 20 version with protective cap
- IP 65 version with mounted cable plug

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V ac]*	Voltage *[V dc]*	Freq. *[Hz]*	Ambient temp. *[°C]*	Coil conn.	IP	Armature tube size
BB024AS	**018F7358**	50	0.26	10 W	24 V	-	50 HZ	-40 - 80 °C	DIN Spade	IP 00	13.5 mm
BB024BS	**018F7365**	50	0.26	10 W	24 V	-	60 HZ	-40 - 80 °C	DIN Spade	-	13.5 mm
BB110CS	**018F7360**	50	0.27	10 W	110 V	-	50/60 HZ	-40 - 50 °C	DIN Spade	IP 00	13.5 mm
BB115AS	**018F7361**	50	0.27	10 W	115 V	-	50 HZ	-40 - 80 °C	DIN Spade	IP 00	13.5 mm
BB230AS	**018F7351**	50	0.27	10 W	230 V	-	50 HZ	-40 - 80 °C	DIN Spade	IP 00	13.5 mm
BB230CS	**018F7363**	50	0.28	10 W	230 V	-	50/60 HZ	-40 - 50 °C	DIN Spade	IP 00	13.5 mm
BB240AS	**018F7352**	50	0.27	10 W	240 V	-	50 HZ	-40 - 80 °C	DIN Spade	IP 00	13.5 mm
BB400AS	**018F7353**	50	0.26	10 W	380 - 400 V	-	50 HZ	-40 - 80 °C	DIN Spade	IP 00	13.5 mm
BB012DS	**018F7396**	50	0.27	18 W	-	12.0 V	D.C.	-40 - 50 °C	DIN Spade	IP 00	13.5 mm
BB024DS	**018F7397**	50	0.28	18 W	-	24.0 V	D.C.	-40 - 50 °C	DIN Spade	IP 00	13.5 mm

BE High performance coils

Demanding applications, with IP67, for valve range B, 10W ac / 18W dc, IP67

- Clip-on system for fast, easy fitting and removal
- Encapsulated coils with long operation life
- Ambient temperature: Up to +80°C
- IP 67 for moist environments with terminal box

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V ac]*	Voltage *[V dc]*	Freq. *[Hz]*	Ambient temp. *[°C]*	Coil conn.	IP	Armature tube size
BE024AS	**018F6707**	32	0.31	10 W	24 V	-	50 HZ	-40 - 80 °C	Connection Box	IP 67	13.5 mm
BE230AS	**018F6701**	32	0.32	10 W	220 - 230 V	-	50 HZ	-40 - 80 °C	Connection Box	IP 67	13.5 mm
BE230CS	**018F6732**	32	0.33	10 W	220 - 230 V	-	50/60 HZ	-40 - 50 °C	Connection Box	IP 67	13.5 mm
BE240AS	**018F6702**	32	0.33	10 W	240 V	-	50 HZ	-40 - 80 °C	Connection Box	IP 67	13.5 mm
BE024DS	**018F6757**	32	0.34	18 W	-	24.0 V	D.C.	-40 - 50 °C	Connection Box	IP 67	13.5 mm

BG High performance coils

Tough applications, with IP67, 12W ac / 20W dc, IP67

- Clip-on system for fast, easy fitting and removal
- Encapsulated coils with long operation life
- Ambient temperature: Up to +80°C
- IP 67 for moist environments with terminal box

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V dc]*	Freq. *[Hz]*	Ambient temp. *[°C]*	Coil conn.	IP	Armature tube size
BG024DS	**018F6857**	24	0.60	20 W	24.0 V	D.C. I	-40 - 50 °C	Connection Box	IP 67	13.5 mm

BL High performance proportional coils

Special coil only for proportional valves, for valve range B, 4-20 mA pilot signal

- Max. 20W power
- Class H insulation of coil windings
- Ambient temperature: -25°C to +50°C
- IP67 coil enclosure with 3-core cable
- Supply voltage: 21-30V dc

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V dc]*	Ambient temp. *[°C]*	Coil conn.	IP	Armature tube size
BL024D	**018Z0291**	12	0.82	20 W	24.0 V	-40 - 50 °C	Cable	IP67	13.5 mm

BM High performance proportional coils

Special coil only for proportional valves, for valve range B, 0-10 V pilot signal

- Max. 20W power
- Class H insulation of coil windings
- Ambient temperature: -25°C to +50°C
- IP67 coil enclosure with 3-core cable
- Supply voltage: 21-30V dc

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V dc]*	Coil conn.	IP	Armature tube size
BM024D	**018Z0290**	12	0.83	20 W	24.0 V	Cable	IP67	13.5 mm

BN High performance hum-free coils

Hum-free coil for valve range B, with extra low noise level , 20W ac, IP67

- Clip-on system for fast, easy fitting and removal
- Hum-free for installations sensitive to noise, such as heating systems
- Built-in rectifier
- Encapsulated coils with long operation life
- Ambient temperature: Up to +50°C
- IP 67 for moist environments with flying lead

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V ac]*	Freq. *[Hz]*	Ambient temp. *[°C]*	Coil conn.	IP	Armature tube size
BN230C	**018F7301**	12	0.68	20 W	230 V	50/60 HZ	-40 - 50 °C	Cable	IP 67	13.5 mm

BR High performance coils for steam

High Performance coils for steam valves, 10W ac / 17W dc

- IP43 coil enclosure (IEC 529)
- Terminal box
- Class H insulation of coil windings (IEC 85)
- Ambient temperature: Max. +40° C

Type	Code No	Pack Size	Weight *[kg]*	Power cons. *[W]*	Voltage *[V ac]*	Voltage *[V dc]*	Freq. *[Hz]*	Ambient temp. *[°C]*	Coil conn.	IP	Armature tube size
BR024A	**032K143682**	18	0.46	10 W	24 V	-	50HZ	-10 - 40 °C	Cable for box	IP43	13.5 mm
BR230A	**032K143684**	18	0.41	10 W	230 V	-	50HZ	-10 - 40 °C	Cable for box	IP43	13.5 mm
BR240A	**032K143685**	18	0.42	10 W	240 V	-	50HZ	-10 - 40 °C	Cable for box	IP43	13.5 mm
BR024D	**032K140902**	18	0.61	17 W	-	24.0 V	D.C.	-10 - 40 °C	Cable for box	IP43	13.5 mm

Accessories & spare parts - coils

Cable plugs - for coils

Type	Code No	Pack Size	Weight *[kg]*	El. conn.	Voltage *[V ac]*	Voltage *[V dc]*	Encl.	Ambient temp. *[°C]*	Cable dia.	Contacts	Coil type
-	**042N0139**	100	0.03	11 mm (industrial std)	250 V	250.0 V	IP65	-40 - 176 °F / -40 - 80 °C	0.18 - 0.28 in / 4.5 - 7.0 mm	2 + PE	AB, AC
-	**042N0156**	100	0.03	DIN 43650-A, plug Pg 11	250 V	250.0 V	IP65	-40 - 176 °F / -40 - 80 °C	0.24 - 0.35 in / 6.0 - 9.0 mm	2 + PE	BA, BB, AM

Thermostatically operated valves

Thermostatically operated valves are a simple and reliable control solution requiring neither electricity nor control air. An example of application is automatic control of water temperature in cooling systems.
The valves are available with remote or built-in sensor.

AVTA Thermostatically operated valves with temperature sensitive sensor

AVTA is a self-acting, thermostatically operated valve for use in cooling applications. The valve is commonly used in connection with hydraulic stations, and is often named the "fit and forget" valve, due to its immense reliability, proven throughout decades.

- Self-acting cooling water valves for accurate flow control based on sensor temperature
- Capillary sensor with adsorption charge, mass charge or universal charge
- Open on rising temperature
- Brass or stainless steel valve body
- For extremely aggressive media, also available in titanium (please contact us)

Type	Code No	Pack Size	Weight [kg]	Sensor temp. range [°C]	Connection	Orifice size	Body mat.	Medium temp. range [°C]	Charge	Capillary tube length [mm]	Kv m^3/h
AVTA	**003N2132**	10	1.65	0 - 30 °C	G 1/2	15 mm	Brass	-25 - 130 °C	Universal	2.000 mm	1.90
AVTA	**003N3132**	10	1.70	0 - 30 °C	G 3/4	20 mm	Brass	-25 - 130 °C	Universal	2.000 mm	3.40
AVTA	**003N4132**	10	1.84	0 - 30 °C	G 1	25 mm	Brass	-25 - 130 °C	Universal	2.000 mm	5.50
AVTA	**003N1144**	10	1.58	10 - 80 °C	G 3/8	10 mm	Brass	-25 - 130 °C	Adsorption	2.300 mm	1.40
AVTA	**003N0107**	10	1.51	10 - 80 °C	G 1/2	15 mm	Brass	-25 - 130 °C	Adsorption	2.300 mm	1.90
AVTA	**003N0108**	10	1.56	10 - 80 °C	G 3/4	20 mm	Brass	-25 - 130 °C	Adsorption	2.300 mm	3.40
AVTA	**003N0109**	10	1.70	10 - 80 °C	G 1	25 mm	Brass	-25 - 130 °C	Adsorption	2.300 mm	5.50
AVTA	**003N4150**	10	1.64	10 - 80 °C	G 1	25 mm	Stainless steel	-25 - 130 °C	Adsorption	2.300 mm	5.50
AVTA	**003N1162**	10	1.69	25 - 65 °C	G 3/8	10 mm	Brass	-25 - 130 °C	Universal	2.000 mm	1.40
AVTA	**003N0045**	10	1.53	25 - 65 °C	G 1/2	15 mm	Brass	-25 - 130 °C	Mass	2.000 mm	1.90
AVTA	**003N2162**	10	1.64	25 - 65 °C	G 1/2	15 mm	Brass	-25 - 130 °C	Universal	2.000 mm	1.90
AVTA	**003N0046**	10	1.60	25 - 65 °C	G 3/4	20 mm	Brass	-25 - 130 °C	Mass	2.000 mm	3.40
AVTA	**003N3162**	10	1.70	25 - 65 °C	G 3/4	20 mm	Brass	-25 - 130 °C	Universal	2.000 mm	3.40
AVTA	**003N0047**	10	1.65	25 - 65 °C	G 1	25 mm	Brass	-25 - 130 °C	Mass	2.000 mm	5.50
AVTA	**003N4162**	10	1.81	25 - 65 °C	G 1	25 mm	Brass	-25 - 130 °C	Universal	2.000 mm	5.50
AVTA	**003N2182**	10	1.64	50 - 90 °C	G 1/2	15 mm	Brass	-25 - 130 °C	Universal	2.000 mm	1.90
AVTA	**003N3182**	10	1.69	50 - 90 °C	G 3/4	20 mm	Brass	-25 - 130 °C	Universal	2.000 mm	3.40
AVTA	**003N4182**	10	1.84	50 - 90 °C	G 1	25 mm	Brass	-25 - 130 °C	Universal	2.000 mm	5.50

Accessories & spare parts - thermostatically operated valves

Service sensor elements - for AVTA

Type	Code No	Pack Size	Weight *[kg]*	Cap. tube length (EO) *[mm]*	Sensor temp. range *[°C]*	Sensor diameter *[Ø mm]*	Application
Spare part	**003N0075**	20	0.46	2.000 mm	0 - 30 °C	18.0 mm	AVTA
Spare part	**003N0078**	20	0.43	2.000 mm	20 - 65 °C	18.0 mm	AVTA
Spare part	**003N0091**	20	0.35	2.000 mm	20 - 65 °C	9.5 mm	AVTA
Spare part	**003N0062**	20	0.44	2.000 mm	50 - 90 °C	18.0 mm	AVTA

Sensor pockets - for AVTA

Type	Code No	Pack Size	Weight *[kg]*	Material	Sensor type	Connection	Application
Accessory	**003N0050**	72	0.20	Brass	Ø 18 universal	G 3/4	AVTA
Accessory	**003N0192**	72	0.20	Stainless steel	Ø 18 universal	G 1/2	AVTA
Accessory	**003N0196**	10	0.9	Stainless steel	Ø 9.5 mass charge, adsorption	G 1/2	AVTA

Capillary tube glands - for AVTA

Type	Code No	Pack Size	Weight *[kg]*	Application
Accessory	**003N0155**	50	0.11	AVTA
Accessory bag	**017-422066**	5	0.05	KP / RT

Miscellaneous accessories & spare parts - for thermostatically operated valves

Type	Code No	Pack Size	Weight *[kg]*	Application
Accessory	**003N0388**	10	0.05	AVTA/WV

Externally operated valves

Externally operated valves are designed for more specialised applications, such as: Media with high dirt content, media with high viscosity, high ambient temperatures, large flow quantities, damp environments and where there is a risk of explosion

AV210 Angle-seated externally operated valves

AV210 is an externally operated angle seat valve for use in robust industrial applications. The valve can operate at very high medium temperatures and viscosities, and is insensitive to dirt particles in the medium; thus, it is often called a "trouble-shooter" valve. The valve is available in gun metal (RG5/bronze) and stainless steel (AISI316).

- High capacity basic program
- 2/2-way
- Angle-seated piston
- NC version: Both closing against and with flow direction
- NO version: Closing against the flow direction
- Bronze or stainless steel valve body

Type	Code No	Pack Size	Weight *[kg]*	Function	Conn.	Orifice size	Operation	Seal mat.	Body mat.	Closing	Control head dia. *[Ø mm]*	Kv *m^3/h*
AV210A	**042N4400**	8	0.77	N C	G 3/8	15 mm	Piston (angle)	PTFE	Gun metal	Against flow	40 mm	4.50
AV210A	**042N4402**	8	0.74	N C	G 1/2	15 mm	Piston (angle)	PTFE	Gun metal	Against flow	40 mm	5.30
AV210B	**042N4451**	8	1.16	N C	G 1/2	15 mm	Piston (angle)	PTFE	Stainless steel	Against flow	50 mm	5.70
AV210B	**042N4404**	8	1.29	N C	G 3/4	20 mm	Piston (angle)	PTFE	Gun metal	Against flow	50 mm	10.00
AV210B	**042N4452**	8	1.36	N C	G 3/4	20 mm	Piston (angle)	PTFE	Stainless steel	Against flow	50 mm	10.00
AV210C	**042N4453**	4	1.79	N C	G 3/4	20 mm	Piston (angle)	PTFE	Stainless steel	Against flow	63 mm	10.00
AV210C	**042N4406**	4	2.13	N C	G 1	25 mm	Piston (angle)	PTFE	Gun metal	Against flow	63 mm	20.00
AV210C	**042N4454**	4	2.03	N C	G 1	25 mm	Piston (angle)	PTFE	Stainless steel	Against flow	63 mm	20.00
AV210D	**042N4455**	4	3.50	N C	G 1	25 mm	Piston (angle)	PTFE	Stainless steel	Against flow	90 mm	20.00
AV210D	**042N4408**	4	4.01	N C	G 1 1/4	32 mm	Piston (angle)	PTFE	Gun metal	Against flow	90 mm	29.00
AV210D	**042N4409**	4	4.57	N C	G 1 1/2	40 mm	Piston (angle)	PTFE	Gun metal	Against flow	90 mm	46.00
AV210E	**042N4411**	32	7.9	N C	G 2	50 mm	Piston (angle)	PTFE	Gun metal	Against flow	110 mm	67.00

Pressure switches

Type	RT for general use	RT TÜV approved for steam plant	KPS heavy-duty	CAS heavy-duty	KP for light industy	KPI for light industry	CS for air and water	MBC 5000 block-type, compact	MBC 5100 block-type, com- pact with ship approvals
Pages	18	18	18	19	19	19	20	20	20
									
Pressure range	-1 - 30 bar	0 - 25 bar	0 - 60 bar	0 - 60 bar	-0.2 - 14 bar	-0.2 - 28 bar	2 - 20 bar	-0.2 - 400 bar	-0.2 - 100 bar
Connection size	G 3/8 A	G 1/2 A	G 1/4 A - G 3/8 A	G 1/4 A	G 1/4 A	G 1/4 A	G 1/4 A - G 1/2 A	G 1/4 A	G 1/4 A
Connection type	Pipe thread	Pipe thread	Pipe thread	Pipe thread	Pipe thread	Pipe thread	Pipe thread	Flange / Pipe thread	Flange / Pipe thread
Contact function	SPDT	SPDT	SPDT gold	SPDT	SPDT	SPDT	TPST	SPDT	SPDT
Max. working pressure	0.4 - 42 bar	7 - 42 bar	6 - 120 bar	10 - 120 bar	17 bar	18 - 30 bar	6 - 20 bar	15 - 600 bar	15 - 150 bar

Pressure Monitoring & Control

Pressure switches, single

The range of pressure switches includes components for general industrial use as well as specialised switches for demanding applications.

RT Pressure switches for general use

RT switches are used in general industrial and marine sectors.
The RT single pressure switches series consist of a variety of ordinary controls including neutral zone pressure switches, safety pressure switches for steam boiler plant, and gold plated fail-safe controls for applications in which safety or economical consequences are critical factors.
RT switches have been in service for more than 60 years.

- Pressure ranges: -1 to 30 bar
- Replaceable contact system
- Also available with gold plated contact systems
- Fail-safe
- Adjustable differential
- Enclosure IP66
- Available with min. and max. reset function (IP54)
- Also available as differential switch
- Available with TÜV approvals and with dead zone
- Available with all relevant marine approvals

Type	Code No	Pack Size	Weight *[kg]*	Regul. range *[bar] Pe*	Diff. *[bar]*	Max. working pressure *[bar] Pe*	Conn. size	Conn. type	Contact function	Reset
RT121	**017-521566**	15	0.96	-1.0 - 0.0 bar	0.09 - 0.40 bar	7.0 bar	G 3/8 A	Pipe thread	SPDT	-
RT113	**017-519666**	9	0.99	0.0 - 0.3 bar	0.01 - 0.05 bar	0.4 bar	G 3/8 A	Pipe thread	SPDT	-
RT112	**017-519166**	15	0.96	0.1 - 1.1 bar	0.07 - 0.16 bar	7.0 bar	G 3/8 A	Pipe thread	SPDT	-
RT112	**017-519266**	15	0.98	0.1 - 1.1 bar	0.07 bar	7.0 bar	G 3/8 A	Pipe thread	SPDT	Max
RT110	**017-529166**	15	0.98	0.2 - 3.0 bar	0.08 - 0.25 bar	7.0 bar	G 3/8 A	Pipe thread	SPDT	-
RT200	**017-523766**	15	0.96	0.2 - 6.0 bar	0.25 - 1.20 bar	22.0 bar	G 3/8 A	Pipe thread	SPDT	-
RT200	**017-523866**	15	0.97	0.2 - 6.0 bar	0.25 bar	22.0 bar	G 3/8 A	Pipe thread	SPDT	Max
RT200	**017-523966**	15	0.97	0.2 - 6.0 bar	0.25 bar	22.0 bar	G 3/8 A	Pipe thread	SPDT	Min
RT116	**017-520366**	15	0.97	1.0 - 10.0 bar	0.33 - 1.30 bar	22.0 bar	G 3/8 A	Pipe thread	SPDT	-
RT116	**017-520466**	15	0.97	1.0 - 10.0 bar	0.33 bar	22.0 bar	G 3/8 A	Pipe thread	SPDT	Max
RT5	**017-525566**	15	1.02	4.0 - 17.0 bar	1.20 - 4.00 bar	22.0 bar	G 3/8 A	Pipe thread	SPDT	-
RT117	**017-529566**	15	1.02	10.0 - 30.0 bar	1.00 - 4.00 bar	42.0 bar	G 3/8 A	Pipe thread	SPDT	-

RT Pressure switches, TÜV approved for steam plant

TÜV appoved RT switches are used in steam plant.
The RT single pressure switches series consist of a variety of ordinary controls including neutral zone pressure switches, safety pressure switches for steam boiler plant, and gold plated fail-safe controls for applications in which safety or economical consequences are critical factors.
RT switches have been in service for more than 60 years.

- Pressure ranges: 0 to 25 bar
- Replaceable contact system
- Also available with gold plated contact systems
- Fail-safe
- Adjustable differential
- Enclosure IP66
- Available with min. and max. reset function (IP54)
- Available with all relevant marine approvals

Type	Code No	Pack Size	Weight *[kg]*	Regul. range *[bar] Pe*	Diff. *[bar]*	Max. working pressure *[bar] Pe*	Conn. size	Conn. type	Contact function
RT33B	**017-526266**	15	1.02	0.0 - 2.5 bar	0.10 bar	7.0 bar	G 1/2 A	Pipe thread	SPDT
RT30AS	**017-518966**	15	1.04	1.0 - 10.0 bar	0.40 bar	22.0 bar	G 1/2 A	Pipe thread	SPDT
RT30AB	**017-518866**	15	1.05	1.0 - 10.0 bar	0.60 bar	22.0 bar	G 1/2 A	Pipe thread	SPDT
RT30AW	**017-518766**	15	1.03	1.0 - 10.0 bar	0.80 bar	22.0 bar	G 1/2 A	Pipe thread	SPDT
RT31S	**017-526966**	15	0.96	2.0 - 10.0 bar	0.30 bar	22.0 bar	G 1/2 A	Pipe thread	SPDT
RT19B	**017-518266**	15	1.16	5.0 - 25.0 bar	1.00 bar	42.0 bar	G 1/2 A	Pipe thread	SPDT
RT19W	**017-518166**	15	1.14	5.0 - 25.0 bar	1.20 bar	42.0 bar	G 1/2 A	Pipe thread	SPDT

KPS Heavy-duty pressure switches

In the KPS series, special attention has been given to meeting important demands for a high level of enclosure, a robust, compact construction and resistance to shock and vibration.
The KPS range covers most outdoor as well as indoor application requirements, and are suitable for use in alarm and regulation systems in factories, diesel plant, compressors, powerstation and on board ships.

- Pressure ranges: 0 to 60 bar
- Gold plated contact systems
- Adjustable or fixed differential
- Robust and compact construction
- Resistance to shock and vibrations
- Diaphragm version for applications with:
- pulsations/pressure peaks
- sea water as media
- Enclosure IP67. Sturdy and sea water resistant.
- Available with all relevant land and marine approvals

Type	Code No	Pack Size	Weight *[kg]*	Regul. range *[bar] Pe*	Diff. *[bar]*	Max. working pressure *[bar] Pe*	Conn. size	Conn. type	Contact function	Encl.
KPS31	**060-310966**	8	1.14	0.0 - 2.5 bar	0.10 bar	6.0 bar	G 3/8 A	Pipe thread	SPDT gold	IP67
KPS31	**060-311066**	8	1.15	0.0 - 2.5 bar	0.10 bar	6.0 bar	G 1/4	Pipe thread	SPDT gold	IP67
KPS33	**060-310366**	8	1.07	0.0 - 3.5 bar	0.20 bar	10.0 bar	G 3/8 A	Pipe thread	SPDT gold	IP67
KPS33	**060-310466**	8	1.06	0.0 - 3.5 bar	0.20 bar	10.0 bar	G 1/4	Pipe thread	SPDT gold	IP67
KPS35	**060-310066**	8	1.04	0.0 - 8.0 bar	0.40 - 1.50 bar	12.0 bar	G 3/8 A	Pipe thread	SPDT gold	IP67
KPS35	**060-310566**	8	1.03	0.0 - 8.0 bar	0.40 - 1.50 bar	12.0 bar	G 1/4	Pipe thread	SPDT gold	IP67
KPS35	**060-310866**	8	1.03	0.0 - 8.0 bar	0.40 bar	12.0 bar	G 1/4	Pipe thread	SPDT gold	IP67
KPS43	**060-312066**	8	1.19	1.0 - 10.0 bar	0.70 - 2.80 bar	120.0 bar	G 1/4	Pipe thread	SPDT gold	IP67
KPS45	**060-312166**	8	1.21	4.0 - 40.0 bar	2.20 - 11.00 bar	120.0 bar	G 1/4	Pipe thread	SPDT gold	IP67

Type	Code No	Pack Size	Weight [kg]	Regul. range [bar] Pe	Diff. [bar]	Max. working pressure [bar] Pe	Conn. size	Conn. type	Contact function	Encl.
KPS37	**060-310166**	8	1.05	6.0 - 18.0 bar	0.85 - 2.50 bar	22.0 bar	G 3/8 A	Pipe thread	SPDT gold	IP67
KPS37	**060-310666**	8	1.05	6.0 - 18.0 bar	0.85 - 2.50 bar	22.0 bar	G 1/4	Pipe thread	SPDT gold	IP67
KPS47	**060-312266**	8	1.21	6.0 - 60.0 bar	3.50 - 17.00 bar	120.0 bar	G 1/4	Pipe thread	SPDT gold	IP67
KPS39	**060-310266**	8	1.07	10.0 - 35.0 bar	2.00 - 6.00 bar	45.0 bar	G 3/8 A	Pipe thread	SPDT gold	IP67
KPS39	**060-310766**	8	1.05	10.0 - 35.0 bar	2.00 - 6.00 bar	45.0 bar	G 1/4	Pipe thread	SPDT gold	IP67

CAS Heavy-duty pressure switches

In the CAS pressure switches series, special attention has been given to meeting demands for a high level of enclosure, low differential, robust, compact construction and resistance to shock and vibration. The CAS series covers most outdoor as well as indoor application requirements. CAS pressure switches are suitable for use in alarm and regulation systems in factories, diesel plant, compressors, power stations and on board ships.

- Pressure ranges: 0 to 60 bar
- Low differential (fixed) micro switch
- Enclosure IP67. Sturdy and sea water resistant
- Robust and compact construction
- Resistance to shock and vibrations
- Diaphragm version applications with: Pulsations/pressure peaks and seawater as media
- Also available as differential pressure switch
- Available with all relevant land and marine approvals

Type	Code No	Pack Size	Weight [kg]	Regul. range [bar] Pe	Diff. [bar]	Max. working pressure [bar] Pe	Conn. size	Conn. type	Contact function
CAS133	**060-315066**	8	0.98	0.0 - 3.5 bar	0.10 bar	10.0 bar	G 1/4 A	Pipe thread	SPDT
CAS136	**060-315166**	8	1.01	0.0 - 10.0 bar	0.20 bar	22.0 bar	G 1/4 A	Pipe thread	SPDT
CAS143	**060-316066**	8	1.19	1.0 - 10.0 bar	-	120.0 bar	G 1/4 A	Pipe thread	SPDT
CAS145	**060-316166**	8	1.18	4.0 - 40.0 bar	-	120.0 bar	G 1/4 A	Pipe thread	SPDT
CAS147	**060-316266**	8	1.17	6.0 - 60.0 bar	-	120.0 bar	G 1/4 A	Pipe thread	SPDT

KP Pressure switches for light industry

Danfoss KP pressure switches are used for regulating, monitoring and alarm systems in industrial applications.
The KP series are suitable for gaseous media and air. They are fitted with a single-pole switch changeover (SPDT), and can control single-phase ac motors of up to 2 kW directly.

- Pressure ranges: -0.2 to 21 bar
- High contact load - Ultra short bounce-time
- Also available with gold plated contact systems
- Media: Gaseous media and air
- Enclosure IP44 when mounted with top cover and back plate
- Also available with enclosure IP55 for OEM customers
- Small dimensions - space saving - easy to install
- Shock and impact resistant

Type	Code No	Pack Size	Weight [kg]	Regul. range [bar] Pe	Diff. [bar]	Max. working pressure [bar] Pe	Conn. size	Conn. type	Contact function	Encl.
KP35	**060-113366**	36	0.33	-0.2 - 7.5 bar	-	17.0 bar	G 1/4 A	Pipe thread	SPDT	IP30
KP35	**060-538666**	30	0.49	-0.2 - 7.5 bar	-	17.0 bar	G 1/4 A	Pipe thread	SPDT	IP55
KP36	**060-110866**	36	0.33	2.0 - 14.0 bar	0.70 - 4.00 bar	17.0 bar	G 1/4 A	Pipe thread	SPDT	IP30
KP36	**060-538766**	30	0.48	2.0 - 14.0 bar	0.70 - 4.00 bar	17.0 bar	G 1/4 A	Pipe thread	SPDT	IP55

KPI Pressure switches for light industry

Danfoss KPI pressure switches are used for regulating, monitoring and alarm systems in industrial applications.
The KP series are suitable for plant in connection with liquid and gaseous media. They are fitted with a single-pole switch changeover (SPDT).

- Pressure ranges: -0.2 to 28 bar
- High contact load
- Ultra short bounce-time
- Available with gold plated contact systems
- Adjustable differential
- Enclosure IP44 when mounted with top cover and back plate

Type	Code No	Pack Size	Weight [kg]	Regul. range [bar] Pe	Diff. [bar]	Max. working pressure [bar] Pe	Conn. size	Conn. type	Contact function	Encl.
KPI35	**060-121766**	36	0.34	-0.2 - 8.0 bar	0.40 - 1.50 bar	18.0 bar	G 1/4 A	Pipe thread	SPDT	IP30
KPI36	**060-118966**	36	0.34	4.0 - 12.0 bar	0.50 - 1.60 bar	18.0 bar	G 1/4 A	Pipe thread	SPDT	IP30
KPI38	**060-508166**	36	0.34	8.0 - 28.0 bar	1.80 - 6.00 bar	30.0 bar	G 1/4 A	Pipe thread	SPDT	IP30

CS Pressure switches for air and water

CS pressure switches have a three-pole switch and adjustable differential.
The pressure switches are fitted with a manual switch that will lock the contact system in the open position independently of the pressure in the system.

- For automatic start and stop of air compressors and water boosters
- Pressure ranges: 2 to 20 bar
- Contact system: 3-pole (standard) and 1-pole (accessory)
- Adjustable differential
- Manual switch to lock the contact system
- Relief valve (accessory)
- Enclosure IP43 or IP55
- Also available with DVGW (KTW) drinking water approval

Type	Code No	Pack Size	Weight [kg]	Regul. range [bar] Pe	Diff. min. range setting [b]	Diff. max. range setting [b]	Max. working pressure [bar] Pe	Conn. size	Contact function	Encl.
CS	031E020066	30	0.50	2.0 - 6.0 bar	0.72 - 1.00 bar	1.00 - 2.00 bar	6.0 bar	G 1/4	TPST	IP43
CS	031E020566	30	0.50	2.0 - 6.0 bar	0.72 - 1.00 bar	1.00 - 2.00 bar	6.0 bar	G 1/4	TPST	IP55
CS	031E021066	30	0.49	2.0 - 6.0 bar	0.72 - 1.00 bar	1.00 - 2.00 bar	6.0 bar	G 1/2 A	TPST	IP43
CS	031E021566	30	0.49	2.0 - 6.0 bar	0.72 - 1.00 bar	1.00 - 2.00 bar	6.0 bar	G 1/2 A	TPST	IP55
CS	031E022066	30	0.45	4.0 - 12.0 bar	1.00 - 3.00 bar	2.00 - 4.00 bar	12.0 bar	G 1/4	TPST	IP43
CS	031E022566	12	0.50	4.0 - 12.0 bar	1.00 - 3.00 bar	2.00 - 4.00 bar	12.0 bar	G 1/4	TPST	IP55
CS	031E023066	30	0.49	4.0 - 12.0 bar	1.00 - 3.00 bar	2.00 - 4.00 bar	12.0 bar	G 1/2 A	TPST	IP43
CS	031E023566	30	0.49	4.0 - 12.0 bar	1.00 - 3.00 bar	2.00 - 4.00 bar	12.0 bar	G 1/2 A	TPST	IP55
CS	031E024566	30	0.45	7.0 - 20.0 bar	2.00 - 3.50 bar	3.50 - 7.00 bar	20.0 bar	G 1/4	TPST	IP55
CS	031E025066	30	0.49	7.0 - 20.0 bar	2.00 - 3.50 bar	3.50 - 7.00 bar	20.0 bar	G 1/2 A	TPST	IP43
CS	031E025566	30	0.49	7.0 - 20.0 bar	2.00 - 3.50 bar	3.50 - 7.00 bar	20.0 bar	G 1/2 A	TPST	IP55

MBC 5000 Block-type compact pressure switches

MBC pressure switches are used in marine applications where space and reliability are the most important features. MBCs are compact pressure switches, designed according to our new block design to survive in the harsh conditions known from machine rooms onboard ships.
MBCs have high vibration resistance and feature all commonly marine approvals. The fixed, but low differential guarantees accurate monitoring of critical pressures. MBV test valves can be delivered as standard option for MBC pressure switches.

- Pressure ranges: -0.2 to 400 bar
- Low differential (fixed) micro switch
- Resistant to shock and vibrations
- Enclosure IP65
- Diaphragm version for applications with pulsations/pressure peaks
- Compact design
- Low installations costs
- Fast and easy to operate
- Easy to mount on block test valve
- Available as differential pressure switch

Type	Code No	Pack Size	Weight [kg]	Regul. range [bar] Pe	Diff. min. range setting [b]	Diff. max. range setting [b]	Max. working pressure [bar] Pe	Conn. size	Conn. type	Contact function
MBC 5000	061B200566	32	0.29	-0.2 - 1.0 bar	0.30 bar	0.45 bar	15.0 bar	-	Flange	SPDT
MBC 5000	061B200066	32	0.29	-0.2 - 10.0 bar	0.40 bar	0.60 bar	15.0 bar	G 1/4	Pipe thread	SPDT
MBC 5000	061B301266	32	0.31	5.0 - 20.0 bar	1.00 bar	2.50 bar	150.0 bar	-	Flange	SPDT
MBC 5000	061B500266	32	0.31	16.0 - 160.0 bar	15.00 bar	30.00 bar	600.0 bar	G 1/4	Pipe thread	SPDT
MBC 5000	061B500166	32	0.30	25.0 - 250.0 bar	20.00 bar	40.00 bar	600.0 bar	G 1/4	Pipe thread	SPDT
MBC 5000	061B500066	32	0.31	40.0 - 400.0 bar	20.00 bar	50.00 bar	600.0 bar	G 1/4	Pipe thread	SPDT

MBC 5100 Block-type compact pressure switches with ship approvals

MBC pressure switches are used in marine applications where space and reliability are the most important features. MBCs are compact pressure switches, designed according to our new block design to survive in the harsh conditions known from machine rooms onboard ships.
MBCs have high vibration resistance and feature all commonly marine approvals. The fixed, but low differential guarantees accurate monitoring of critical pressures. MBV test valves can be delivered as standard option for MBC pressure switches.

- All relevant marine approvals
- Pressure ranges: -0.2 to 400 bar
- Low differential (fixed) micro switch
- Resistant to shock and vibrations
- Enclosure IP65
- Diaphragm version for applications with pulsations/pressure peaks
- Compact design
- Low installations costs
- Fast and easy to operate
- Easy to mount on block test valve
- Available as differential pressure switch

Type	Code No	Pack Size	Weight [kg]	Regul. range [bar] Pe	Diff. min. range setting [b]	Diff. max. range setting [b]	Max. working pressure [bar] Pe	Conn. size	Conn. type	Contact function
MBC 5100	061B000566	32	0.30	-0.2 - 1.0 bar	0.30 bar	0.45 bar	15.0 bar	-	Flange	SPDT
MBC 5100	061B000466	32	0.30	-0.2 - 4.0 bar	0.30 bar	0.45 bar	15.0 bar	-	Flange	SPDT
MBC 5100	061B001066	32	0.29	-0.2 - 4.0 bar	0.30 bar	0.45 bar	15.0 bar	G 1/4	Pipe thread	SPDT
MBC 5100	061B000266	32	0.30	-0.2 - 10.0 bar	0.40 bar	0.60 bar	15.0 bar	-	Flange	SPDT
MBC 5100	061B100466	32	0.31	1.0 - 10.0 bar	1.00 bar	2.50 bar	150.0 bar	-	Flange	SPDT
MBC 5100	061B110866	32	0.32	1.0 - 10.0 bar	1.00 bar	2.50 bar	150.0 bar	G 1/4	Pipe thread	SPDT
MBC 5100	061B100266	32	0.31	5.0 - 20.0 bar	1.00 bar	2.50 bar	150.0 bar	-	Flange	SPDT
MBC 5100	061B100566	32	0.30	5.0 - 40.0 bar	2.00 bar	7.00 bar	150.0 bar	-	Flange	SPDT
MBC 5100	061B100366	32	0.31	10.0 - 100.0 bar	4.00 bar	14.00 bar	150.0 bar	-	Flange	SPDT

Accessories & spare parts - pressure switches, single

Connection adapters - for pressure switches, single

Type	Code No	Pack Size	Weight [kg]	Conn. size	Conn. type	Conn. std.	Application
Transition nipple	**060-333266**	20	0.06	G 1/4 A x G 3/8 A	Pipe thread	ISO 228-1	KPS / CAS

Damping coils - for pressure switches, single

Type	Code No	Pack Size	Weight [kg]	Conn. size	Conn. type	Capillary tube length [mm]	Application
Armoured damping coil	**060-333366**	15	0.22	G 3/8 A	Pipe thread	1.000 mm	CAS
Capillary tube gland	**017-422066**	5	0.05	-	-	-	KP / RT
Damping coil	**060-016966**	14	0.20	G 1/2 A	Pipe thread	1.000 mm	MP
Damping coil	**060-104766**	25	0.17	G 3/8 A	Pipe thread	1.500 mm	CAS / KP

Pressure relief valves - for pressure switches, single

Type	Code No	Pack Size	Weight [kg]	Application
Pressure relief valve	**031E029866**	20	0.04	CS

Miscellaneous accessories & spare parts - for pressure switches, single

Type	Code No	Pack Size	Weight [kg]	Application
3 pole contact system	**031E029166**	5	0.06	CS
Protective cap	**017-436066**	20	0.01	RT

Pressure switches, differential

The range of differential pressure switches includes components for general industrial use as well as specialised switches for demanding applications

RT Differential pressure switches

RT differential switches are used in general industrial and marine sectors.
The RT differential pressure switches series consist of a variety of switches for applications in which safety or economical consequences are critical factors.
RT switches have been in service for more than 60 years.

- Pressure ranges: 0 - 11 bar
- Replaceable contact system
- Available with gold plated contacts
- Fail-safe function
- Adjustable differential
- Enclosure IP66
- Available with min. and max. reset function (IP54)
- Available as general pressure switch
- Available with neutral zone
- Available with marine approvals

Type	Code No	Pack Size	Weight *[kg]*	Pressure range *[bar] Pe*	Diff. range *[bar]*	Max. working pressure *[bar] Pe*	Conn. type	Conn. size	Contact function
RT262A	**017D002766**	9	1.34	-1 - 10 bar	0.00 - 0.30 bar	11.0 bar	Pipe thread	G $^{3}/_{8}$ A	SPDT (non snap action)

CAS Differential pressure switches

In the CAS pressure switches series, special attention has been given to meeting demands for a high level of enclosure, low differential, robust, compact construction and resistance to shock and vibration. The CAS series covers most outdoor as well as indoor application requirements.

- Pressure ranges: 0.2 - 2.5 bar
- Low differential (fixed) micro switch
- Enclosure IP67. Sturdy and sea water resistant
- Robust and compact construction
- Resistance to shock and vibrations
- Diaphragm version applications with: pulsations/pressure peaks
- seawater as media
- Also available as single pressure switch.
- Available with all relevant land and marine approvals .

Type	Code No	Pack Size	Weight *[kg]*	Operat. range LP side *[bar] Pe*	Diff. range *[bar]*	Max. working pressure *[bar] Pe*	Conn. size	Conn. type	Contact function	Encl.
CAS155	**060-313066**	8	1.65	0 - 8 bar	0.20 - 2.50 bar	22.0 bar	G $^{1}/_{4}$	Pipe thread	SPDT	IP67

MBC 5180 Block-type differential pressure switches with ship approvals

MBC 5180 differential pressure switches are used in marine applications where space and reliability are the most important features. MBCs are compact pressure switches, designed according to our new block design to survive in the harsh conditions known from machine rooms onboard ships.
MBCs have high vibration resistance and feature all commonly marine approvals. The fixed, but low differential guarantees accurate monitoring of critical pressures. MBV test valves can be delivered as standard option for MBC pressure switches.

- Pressure ranges: 0.3 to 5 bar
- Adjustable differential
- Resistant to shock and vibrations
- Enclosure IP65
- Compact design
- Low installations costs
- Fast and easy to operate
- Easy to mount on block test valve

Type	Code No	Pack Size	Weight *[kg]*	Operat. range LP side *[bar] Pe*	Diff. range *[bar]*	Max. working pressure *[bar] Pe*	Conn. type	Conn. notes	Contact function
MBC 5180	**061B128066**	10	0.39	0 - 30 bar	0.30 - 5.00 bar	45.0 bar	Flange	With G $^{1}/_{4}$	SPDT

Accessories & spare parts - pressure switches, differential

Contact sets - for pressure switches, differential

Type	Code No	Pack Size	Weight *[kg]*
RT switches	**017-403066**	24	0.07
RT switches	**017-424066**	24	0.07

Pressure transmitters

Type	MBS 33 for generel industry	MBS 33M with ship approvals	MBS 3000 Compact	MBS 3050 with pulse snubber	MBS 4010 With flush dia-phragm	MBS 4510 with flush diaphragm and adjustable zero and span	MBS 5100 Block-type with ship approvals	MBS 5150 Block-type with pulse snubber and ship approvals	EMP 2 Box-type
Pages	24	24	24	25	25	25	25	26	26
									
Pressure range	0 - 400 bar	0 - 10 bar	0 - 400 bar	0 - 600 bar	0 - 16 bar	0 - 1 bar	0 - 40 bar	0 - 40 bar	-1 - 40 bar
Output signal	4 - 20 mA	4 - 20 mA	4 - 20 mA	4 - 20 mA	4 - 20 mA	4 - 20 mA	4 - 20 mA	4 - 20 mA	4 - 20 mA
Voltage	10 - 30 V dc	10 - 30 V dc	10 - 30 V dc	9 - 34 V dc	10 - 30 V dc	10 - 30 V dc	10 - 32 V dc	10 - 32 V dc	11 - 32 V dc
Accuracy	± 0,3% FS	± 0,3% FS	± 0,5% FS	± 0,5% FS	± 0,3% FS	± 0,2% FS	± 0,1% FS	± 0,1% FS	± 0,5% FS
Medium tempe-rature range	-40 - 85° C	-40 - 85° C	-40 - 85° C	-40 - 85° C	-10 - 85° C	-10 - 85° C	-40 - 85° C	-40 - 85° C	-

Pressure transmitters

Danfoss pressure transmitters help you keep demanding industrial processes under control. Accurate, robust and built for long life, they perform reliably day after day, even in the harshest environments.

MBS 33 Pressure transmitters for general industry

Pressure transmitter MBS 33 is designed for use in almost all industrial applications, and offers a reliable pressure measurement, even under harsh environmental conditions.
The flexible pressure transmitter programme covers a 4-20 mA output signal, absolute and gauge (relative) versions, measuring ranges from 0-1 to 0-600 bar and a wide range of pressure and electrical connections.
Excellent vibration stability, robust construction, and a high degree of EMC/EMI protection equip the pressure transmitter to meet the most stringent industrial requirements.

- 4 - 20 mA output signal
- Operating temperature -40 to 85° C
- Measuring range 0 - 600 bar
- A wide range of pressure connections available
- For use in severe industrial environments
- Accuracy +/-0.3% FS

Type	Code No	Pack Size	Weight [kg]	Pr. reference	Pressure range	Output sign.	Voltage	El. conn.	Pressure conn.	Medium temp. range [°C]
MBS 33	060G3006	14	0.22	Gauge (relative)	0 - 1 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 EN 837	-40 - 85 °C
MBS 33	060G3008	14	0.23	Gauge (relative)	0 - 2.50 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 EN 837	-40 - 85 °C
MBS 33	060G3009	14	0.23	Gauge (relative)	0 - 4 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 EN 837	-40 - 85 °C
MBS 33	060G3010	14	0.23	Gauge (relative)	0 - 6 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 EN 837	-40 - 85 °C
MBS 33	060G3011	14	0.23	Gauge (relative)	0 - 10 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 EN 837	-40 - 85 °C
MBS 33	060G3012	14	0.23	Gauge (relative)	0 - 16 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 EN 837	-40 - 85 °C
MBS 33	060G3013	14	0.23	Gauge (relative)	0 - 25 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 EN 837	-40 - 85 °C
MBS 33	060G3014	14	0.23	Gauge (relative)	0 - 40 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 EN 837	-40 - 85 °C
MBS 33	060G3015	14	0.23	Gauge (relative)	0 - 60 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 EN 837	-40 - 85 °C
MBS 33	060G3018	14	0.24	Gauge (relative)	0 - 250 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 EN 837	-40 - 85 °C
MBS 33	060G3019	14	0.23	Gauge (relative)	0 - 400 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 EN 837	-40 - 85 °C

MBS 33M Pressure transmitters with ship approvals

The ship approved pressure transmitter MBS 33M is designed for use in almost all marine applications, and offers a reliable pressure measurement, even under harsh environmental conditions.
The flexible pressure transmitter programme is approved according to LR, DNV, GL, RINA, ABS, BV, NKK, PRS, MRS requirements and covers a 4-20 mA output signal, absolute and gauge (relative) versions, measuring ranges from 0-1 to 0-600 bar, plug and cable connections and a wide range of pressure connections.
Excellent vibration stability, robust construction, and a high degree of EMC/EMI protection equip the pressure transmitter to meet the most stringent marine requirements.

- 4 - 20 mA output signal
- Operating temperature -40 to 85° C
- Measuring range 0 - 600 bar
- A wide range of pressure connections available
- Available with all relevant marine applications and designed to meet the strict demands on marine equipment
- Accuracy +/-0.3% FS

Type	Code No	Pack Size	Weight [kg]	Pr. reference	Pressure range	Output sign.	Voltage	El. conn.	Pressure conn.	Medium temp. range [°C]
MBS 33M	060G3124	14	0.26	Gauge (relative)	0 - 4 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 13.5	G 1/2 EN 837	-40 - 85 °C
MBS 33M	060G3125	14	0.26	Gauge (relative)	0 - 6 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 13.5	G 1/2 EN 837	-40 - 85 °C
MBS 33M	060G3126	14	0.26	Gauge (relative)	0 - 10 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 13.5	G 1/2 EN 837	-40 - 85 °C

MBS 3000 Compact pressure transmitters

The compact pressure transmitter MBS 3000 is designed for use in almost all industrial applications, and offers a reliable pressure measurement, even under harsh environmental conditions.
The flexible pressure transmitter programme covers a 4-20 mA output signal, absolute and gauge (relative) versions, measuring ranges from 0-1 to 0-600 bar and a wide range of pressure- and electrical connections.
Excellent vibration stability, robust construction, and a high degree of EMC/EMI protection equip the pressure transmitter to meet the most stringent industrial requirements.

- 4 - 20 mA output signal
- Operating temperature -40 to 85° C
- Measuring range 0 - 600 bar
- Standard pressure connection G 1/4A ISO 228/1
- For use in severe industrial environments such as pumps, compressors, pneumatics and water treatment
- Accuracy +/-0.5% FS

Type	Code No	Pack Size	Weight [kg]	Pr. reference	Pressure range	Output sign.	Voltage	El. conn.	Pressure conn.	Medium temp. range [°C]
MBS 3000	060G1113	14	0.17	Gauge (relative)	0 - 1 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C
MBS 3000	060G1122	14	0.17	Gauge (relative)	0 - 2.50 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C
MBS 3000	060G1123	14	0.17	Gauge (relative)	0 - 4 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C
MBS 3000	060G1124	14	0.17	Gauge (relative)	0 - 6 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C
MBS 3000	060G1125	14	0.17	Gauge (relative)	0 - 10 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C
MBS 3000	060G1133	14	0.17	Gauge (relative)	0 - 16 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C
MBS 3000	060G1430	14	0.17	Gauge (relative)	0 - 25 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C
MBS 3000	060G1105	14	0.17	Gauge (relative)	0 - 40 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C
MBS 3000	060G1106	14	0.17	Gauge (relative)	0 - 60 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C
MBS 3000	060G1107	14	0.16	Gauge (relative)	0 - 100 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C
MBS 3000	060G1111	14	0.18	Gauge (relative)	0 - 250 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C
MBS 3000	060G1109	14	0.18	Gauge (relative)	0 - 400 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/4 EN 837	-40 - 85 °C

MBS 3050 Compact pressure transmitters with pulse snubber

The compact heavy duty pressure transmitter MBS 3050 is designed for use in hydraulic applications with severe medium influences like cavitation, liquid hammer or pressure peaks and offers a reliable pressure measurement, even under harsh environmental conditions.
The flexible pressure transmitter programme covers a 4-20 mA output signal, absolute and gauge (relative) versions, measuring ranges from 0-1 to 0-600 bar and a wide range of pressure- and electrical connections.
Excellent vibration stability, robust construction, and a high degree of EMC/EMI protection equip the pressure transmitter to meet the most stringent industrial requirements.

- 4 - 20 mA output signal
- Operating temperature -40 to 85° C
- Measuring range 0 - 600 bar
- Standard pressure connection DIN 3852 - G 1/4A
- With integrated pulse-snubber
- Especially suited for hydraulic applications
- Accuracy +/-0.5% FS

Type	Code No	Pack Size	Weight [kg]	Pr. reference	Pressure range	Output sign.	Voltage	El. conn.	Pressure conn.	Medium temp. range [°C]
MBS 3050	**060G1151**	14	0.17	Gauge (relative)	0 - 100 bar	4 - 20 mA	9 - 34 V dc	DIN 43650-A, plug Pg 9	G 1/4 DIN3852-G Special	-40 - 85 °C
MBS 3050	**060G1152**	14	0.17	Gauge (relative)	0 - 160 bar	4 - 20 mA	9 - 34 V dc	DIN 43650-A, plug Pg 9	G 1/4 DIN3852-G Special	-40 - 85 °C
MBS 3050	**060G1153**	14	0.18	Gauge (relative)	0 - 250 bar	4 - 20 mA	9 - 34 V dc	DIN 43650-A, plug Pg 9	G 1/4 DIN3852-G Special	-40 - 85 °C
MBS 3050	**060G1438**	20	0.15	Gauge (relative)	0 - 400 bar	4 - 20 mA	9 - 34 V dc	M12-5 pin	G 1/4 DIN3852-G Special	-40 - 85 °C
MBS 3050	**060G1408**	14	0.17	Gauge (relative)	0 - 600 bar	4 - 20 mA	9 - 34 V dc	DIN 43650-A, plug Pg 9	G 1/4 DIN3852-G Special	-40 - 85 °C

MBS 4010 Pressure transmitters with flush diaphragm

The flush diaphragm pressure transmitter MBS 4010 is designed for use in almost all industrial applications with non-uniform, high viscous or crystallizing media, and offers a reliable pressure measurement, even under harsh environmental conditions.
The pressure transmitter programme covers a 4-20 mA output signal, absolute and gauge (relative) versions, measuring ranges from 0-4 to 0-60 bar, plug and cable connections and a G1/2A pressure connection with a flush mounted diaphragm.
Excellent vibration stability, robust construction, and a high degree of EMC/EMI protection equip the pressure transmitter to meet the most stringent industrial requirements.

- 4 - 20 mA output signal
- Operating temperature -40 to 85° C
- Measuring range 0 - 60 bar
- With flush diaphragm
- For use in connection with aggressive, viscous, non-uniform and crystallizing media
- Accuracy +/-0.3% FS

Type	Code No	Pack Size	Weight [kg]	Pr. reference	Pressure range	Output sign.	Voltage	El. conn.	Pressure conn.	Medium temp. range [°C]
MBS 4010	**060G3212**	14	0.26	Gauge (relative)	0 - 6 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 Flush	-10 - 85 °C
MBS 4010	**060G3213**	14	0.27	Gauge (relative)	0 - 10 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 Flush	-10 - 85 °C
MBS 4010	**060G3214**	14	0.27	Gauge (relative)	0 - 16 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1/2 Flush	-10 - 85 °C

MBS 4510 Pressure transmitters with flush diaphragm and adjustable zero and span

The high accuracy flush diaphragm pressure transmitter MBS 4510 is designed for use in non-uniform, high viscous or crystallizing media within industry, food and beverage, and offers a reliable pressure measurement, even under harsh environmental conditions.
The pressure transmitter programme covers a 4-20 mA output signal, absolute and gauge (relative) versions, measuring ranges from 0-250 mbar til 0-25 bar, zero point and span adjustment, plug connection and a G1A conic pressure connection with a flush mounted diaphragm.
Excellent vibration stability, robust construction, and a high degree of EMC/EMI protection equip the pressure transmitter to meet the most stringent industrial requirements.

- 4 - 20 mA output signal
- Operating temperature -40 to 85° C
- Measuring ranges 0 - 250 mbar to 0 - 25 bar
- Available with many different pressure connections
- With zero point and span adjustment
- With flush diaphragm
- For use in food and beverage industry as well as industrial applications with aggressive, heterogeneous and highly viscous media
- Accuracy +/-0.2% FS

Type	Code No	Pack Size	Weight [kg]	Pr. reference	Pressure range	Output sign.	Voltage	El. conn.	Pressure conn.	Medium temp. range [°C]
MBS 4510	**060G2418**	12	0.40	Gauge (relative)	0 - 0.25 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1 Flush	-10 - 85 °C
MBS 4510	**060G2419**	12	0.40	Gauge (relative)	0 - 0.40 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1 Flush	-10 - 85 °C
MBS 4510	**060G2420**	12	0.40	Gauge (relative)	0 - 0.60 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1 Flush	-10 - 85 °C
MBS 4510	**060G2421**	12	0.40	Gauge (relative)	0 - 1 bar	4 - 20 mA	10 - 30 V dc	DIN 43650-A, plug Pg 9	G 1 Flush	-10 - 85 °C

MBS 5100 Block-type pressure transmitters with ship approvals

The ship approved high accuracy pressure transmitter MBS 5100 is designed for use in almost all marine applications, and offers a reliable pressure measurement, even under harsh environmental conditions.
The pressure transmitter programme in block design is approved according to LR, DNV, GL, RINA, ABS, BV, NKK, PRS, MRS, KRS requirements, and covers a 4-20 mA output signal, absolute and gauge (relative) versions, measuring ranges from 0-1 to 0-600 bar, zero point and span adjustment, plug connection and female/flange pressure connections.
Excellent vibration stability, robust construction, and a high degree of EMC/EMI protection equip the pressure transmitter to meet the most stringent industrial requirements.

- 4 - 20 mA output signal
- Operating temperature -40 to 85° C
- Measuring range 0 - 600 bar
- Pressure connect G ¼ female
- Available with all relevant marine approvals
- Designed to meet the strict demands in marine equipment
- Accuracy +/-0.1% FS

Type	Code No	Pack Size	Weight [kg]	Pr. reference	Pressure range	Output sign.	Voltage	El. conn.	Pressure conn.	Medium temp. range [°C]
MBS 5100	**060N1034**	12	0.37	Gauge (relative)	0 - 4 bar	4 - 20 mA	10 - 32 V dc	DIN 43650-A, plug Pg 11	G 1/4 Female with flange	-40 - 85 °C
MBS 5100	**060N1035**	12	0.37	Gauge (relative)	0 - 6 bar	4 - 20 mA	10 - 32 V dc	DIN 43650-A, plug Pg 11	G 1/4 Female with flange	-40 - 85 °C
MBS 5100	**060N1036**	12	0.37	Gauge (relative)	0 - 10 bar	4 - 20 mA	10 - 32 V dc	DIN 43650-A, plug Pg 11	G 1/4 Female with flange	-40 - 85 °C
MBS 5100	**060N1037**	12	0.37	Gauge (relative)	0 - 16 bar	4 - 20 mA	10 - 32 V dc	DIN 43650-A, plug Pg 11	G 1/4 Female with flange	-40 - 85 °C
MBS 5100	**060N1039**	12	0.37	Gauge (relative)	0 - 40 bar	4 - 20 mA	10 - 32 V dc	DIN 43650-A, plug Pg 11	G 1/4 Female with flange	-40 - 85 °C

MBS 5150 Block-type pressure transmitters with pulse snubber and ship approvals

The ship approved high accuracy pressure transmitter MBS 5150 is designed for use in marine applications with severe medium influences like cavitation, liquid hammer or pressure peaks, and offers a reliable pressure measurement, even under harsh environmental conditions.
The pressure transmitter programme in block design is approved according to LR, DNV, GL, RINA, ABS, BV, NKK, PRS, MRS, KRS requirements, and covers a 4-20 mA output signal, absolute and gauge (relative) versions, measuring ranges from 0-1 to 0-600 bar, zero point and span adjustment, plug connection and female/flange pressure connections.
Excellent vibration stability, robust construction, and a high degree of EMC/EMI protection equip the pressure transmitter to meet the most stringent industrial requirements.

- 4 - 20 mA output signal
- Operating temperature -40 to 85° C
- Measuring range 0 - 600 bar
- Pressure connect G ¼ female
- With integrated pulse-snubber
- Available with all relevant marine approvals
- Designed to meet the strict demands in marine equipment
- Accuracy +/-0.1% FS

Type	Code No	Pack Size	Weight [kg]	Pr. reference	Pressure range	Output sign.	Voltage	El. conn.	Pressure conn.	Medium temp. range [°C]
MBS 5150	**060N1063**	12	0.37	Gauge (relative)	0 - 6 bar	4 - 20 mA	10 - 32 V dc	DIN 43650-A, plug Pg 11	G 1/4 Female with flange	-40 - 85 °C
MBS 5150	**060N1064**	12	0.37	Gauge (relative)	0 - 10 bar	4 - 20 mA	10 - 32 V dc	DIN 43650-A, plug Pg 11	G 1/4 Female with flange	-40 - 85 °C
MBS 5150	**060N1065**	12	0.37	Gauge (relative)	0 - 16 bar	4 - 20 mA	10 - 32 V dc	DIN 43650-A, plug Pg 11	G 1/4 Female with flange	-40 - 85 °C
MBS 5150	**060N1066**	12	0.37	Gauge (relative)	0 - 40 bar	4 - 20 mA	10 - 32 V dc	DIN 43650-A, plug Pg 11	G 1/4 Female with flange	-40 - 85 °C

EMP 2 Box-type pressure transmitters

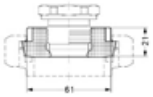
The ship approved pressure transmitter EMP 2 is designed for use in almost all marine and industrial applications, and offers a reliable pressure measurement, even under harsh environmental conditions.
The pressure transmitter programme in box design is approved according to LR, DNV, GL, RINA, ABS, BV, NKK, PRS, MRS, KRS requirements, and covers a 4-20 mA output signal, gauge (relative) versions, measuring ranges from 0-1 to 0-400 bar, zero point and span adjustment, Pg 13,5 cable entry and different pressure connections.
A robust construction enables the pressure transmitter to meet the strictest requirements.

- 4 - 20 mA output signal
- Operating temperature -10 to 70° C
- Measuring range 0 - 400 bar
- Pressure connections G ¼, G ½A standard, G 3/8 A mano
- With zero point and span adjustment
- Available with all relevant marine approvals
- For use in harsh industrial / marine environments
- Accuracy +/-0.5% FS

Type	Code No	Pack Size	Weight [kg]	Pr. reference	Pressure range	Output sign.	Voltage	El. conn.	Pressure conn.
EMP 2	**084G2101**	8	1.06	Gauge (relative)	-1 - 5 bar	4 - 20 mA	11 - 32 v dc	Terminal block / Pg 13.5	G 1/2 A / G 1/4
EMP 2	**084G2106**	8	1.8	Gauge (relative)	0 - 4 bar	4 - 20 mA	11 - 32 v dc	Terminal block / Pg 13.5	G 1/2 A / G 1/4
EMP 2	**084G2107**	8	1.8	Gauge (relative)	0 - 6 bar	4 - 20 mA	11 - 32 v dc	Terminal block / Pg 13.5	G 1/2 A / G 1/4
EMP 2	**084G2109**	8	1.07	Gauge (relative)	0 - 10 bar	4 - 20 mA	11 - 32 v dc	Terminal block / Pg 13.5	G 1/2 A / G 1/4
EMP 2	**084G2111**	8	1.07	Gauge (relative)	0 - 16 bar	4 - 20 mA	11 - 32 v dc	Terminal block / Pg 13.5	G 1/2 A / G 1/4
EMP 2	**084G2113**	8	1.07	Gauge (relative)	0 - 40 bar	4 - 20 mA	11 - 32 v dc	Terminal block / Pg 13.5	G 1/2 A / G 1/4

Accessories & spare parts - pressure transmitters

Connection adapters - for pressure transmitters



Type	Code No	Pack Size	Weight *[kg]*	Conn. std.	Application
Accessory bag	**060-333266**	20	0.06	ISO 228-1	KPS / CAS
Accessory	**060G0252**	6	0.11	-	MBS G 1/2
Welding nipple	**060G2501**	60	0.21	-	MBS 4510
Accessory	**060G2505**	45	0.21	DIN 11851 Dairy DN 40	MBS 4510
Accessory	**060G2506**	20	0.42	DIN 11851 Dairy DN 50	MBS 4510
Accessory	**060G2502**	45	0.16	Clamp ISO 2852 G1 1/2	MBS 4510
Accessory	**060G2510**	24	0.37	Clamp ISO 2852 G 2	MBS 4510
Accessory	**060G2503**	45	0.19	SMS 1145 G 1 1/2	MBS 4510

Damping coils - for pressure transmitters

Type	Code No	Pack Size	Weight *[kg]*	Conn. type	Conn. size	Conn. std.	Capillary tube length *[mm]*	Prot. tube mat.	Application
Armoured damping coil	**060-333366**	15	0.22	Pipe thread	G $^{3}/_{8}$ A	ISO 228-1	1.000 mm	-	CAS
Damping coil	**060-016966**	14	0.20	Pipe thread	G $^{1}/_{2}$ A	ISO 228-1	1.000 mm	Stainless steel	MP
Damping coil	**060-104766**	25	0.17	Pipe thread	G $^{3}/_{8}$ A	ISO 228-1	1.500 mm	-	CAS / KP

Plug-in displays - for pressure transmitters

Type	Code No	Pack Size	Weight *[kg]*	Description	Electrical connection *[kg]*
MBD 1000	**060G2850**	23	0.11	Plug-in display unit MBD	EN 175301-803

MBV 2000 isolation valves - for pressure transmitters

The MBV 2000 isolation valve is designed for mounting between a Danfoss pressure transmitter and fluid-filled systems and offers a fast and efficient method of connection and removal.
The isolation valve automatically closes when a pressure transmitter is removed, so transmitters can be changed easily without having to first drain a system. The valve re-opens when a transmitter is connected.
The valve meets demands for fast installation, simple and effective isolation and easy connection.

- Operating pressure: Up to 600 bar
- Burst pressure: 1500 bar
- Temperature: -20° C to 200° C
- Wetted parts: All metal parts in contact with medium DIN 17440-1.4404 (AISI 316L)
- Gasket: Viton
- Designed to fit between Danfoss pressure transmitters and fluid-filled systems and offers a fast and efficient method of connection and removal of Danfoss products

Type	Code No	Pack Size	Weight *[kg]*	Ext. connection	Width across flats *[mm]*	Max. working pressure *[bar]*	Max. burst pressure *[bar]*	Operating temp. *[°C]*
MBV 2000	**061B6001**	60	0.11	G $^{1}/_{4}$ A DIN3852E	24 mm	600,0 bar	1500 bar	-20 - 200 °C
MBV 2000	**061B6002**	60	0.11	G $^{1}/_{2}$ A DIN3852E	30 mm	600,0 bar	1500 bar	-20 - 200 °C
MBV 2000	**061B6003**	60	0.12	G $^{1}/_{2}$ A DIN3852E	30 mm	600,0 bar	1500 bar	-20 - 200 °C

MBV 5000 test valves - for MBS and MBC

The MBV 5000 is a part of a block concept covering block pressure switches, block pressure transmitters, block test valves and accessories.
The block concept has been developed to save space, weight, and costs and meet the strict demands on marine equipment, including EU stipulations on such products.
MBV 5000 is designed in many different configurations for use in many different marine applications, for example: Monitoring, alarm indication, shut-down, diagnosing on equipment such as motors, gears, thrusters, pumps, filters, compressors, etc.
The block valve meets demands for fast installation, simple isolation, and easy test pressure connection.

- The MBV block valves designed in many configurations are for use with the MBC pressure switch or the MBS block pressure transmitter within the marine industry
- The valve meets demands for fast installation, simple isolation and easy test pressure connection

Type	Code No	Pack Size	Weight *[kg]*	Inputs	Outputs	Ball valves	Pressure conn.	Test pressure conn.	Test function
MBV 5000	**061B7000**	15	0.43	1	1	1	G $^1/_4$ DIN3852-E	M16 x 2	Separate
MBV 5000	**061B7001**	18	0.87	2	2	2	G $^1/_4$ DIN3852-E	M16 x 2	Separate
MBV 5000	**061B7002**	12	1.32	3	3	3	G $^1/_4$ DIN3852-E	M16 x 2	Separate
MBV 5000	**061B7005**	18	0.86	1	2	2	G $^1/_4$ DIN3852-E	M16 x 2	Separate
MBV 5000	**061B7006**	12	1.31	1	3	3	G $^1/_4$ DIN3852-E	M16 x 2	Separate
MBV 5000	**061B7009**	18	0.79	1	2	1	G $^1/_4$ DIN3852-E	M16 x 2	Common
MBV 5000	**061B7010**	12	1.12	1	3	1	G $^1/_4$ DIN3852-E	M16 x 2	Common

Miscellaneous accessories & spare parts - for MBV

Type	Code No	Pack Size	Weight *[kg]*	Conn. size	Conn. std.	Conn. type	Application
Adaptor	**061B720601**	70	0.11	G $^1/_4$	ISO 228-1	Pipe thread	MBV 5000
Adaptor	**061B720201**	70	0.11	G $^1/_8$	ISO 228-1	Pipe thread	MBV 5000

Miscellaneous accessories & spare parts - for pressure transmitters

Type	Code No	Pack Size	Weight *[kg]*	El. conn.	Conn. std.
PLUG	**060G1034**	8	0.39	Plug with 5 meter cable (EN 145301-803)	DIN 43650-A
PLUG	**060G0007**	8	0.03	Pg 11 plug (EN 145301-803)	-
PLUG	**060G0005**	8	0.06	Pg 13.5 plug (EN 145301-803)	DIN 43650
PLUG	**060G0008**	8	0.03	Pg 9 plug (EN 145301-803)	-

Temperature switches

Type	RT	KPS	KP
Pages	30	30	31
			
Temperature range	-5 - 300 °C	-10 - 200 °C	0 - 150 °C
Sensor type	Room sensor or Remote sensor with capillary tube	Remote sensor with armoured tube, Rigid sensor or Remote sensor with capillary tube	Room sensor or Remote sensor with capillary tube
Capillary tube length	2000 - 5000 mm	2000 - 5000 mm	2000 mm
Enclosure	IP 66 / 54	IP 67	IP 30
Max. sensor temperature	75 - 350 °C	80 - 300 °C	80 - 200 °C

Temperature Monitoring & Control

Temperature switches

The range of temperature switches includes components for general industrial use as well as specialised switches for demanding applications.

RT Temperature switches

RT controls are used in general industrial and marine sectors.
The RT temperature switch series consist of a variety of ordinary room temperature switches and remote sensor temperature switches including neutral zone temperature switches. RT temperature switches are generally recommended for applications where safety or economical consequences are critical factors.
RT controls have been in service for more than 60 years.

- Temperature ranges: - 60°C to 300°C
- Replaceable contact system
- Also available with gold plated contact systems
- Fail-safe
- Adjustable differential
- Enclosure IP66
- Available with min. and max. reset function (IP54)
- Available with dead zone
- Available with all relevant marine approvals

Type	Code No	Pack Size	Weight [kg]	Temp. range [°C]	Diff. min. range setting [°C]	Diff. max. range setting [°C]	Max. sensor temp. [°C]	Encl.	Sensor type	Capillary tube length [mm]	Contact function	Reset	Sensor size (Ø x L) [mm]
RT4	**017-503666**	15	0.92	-5 - 30 °C	1.5 – 7 °C	1.2 - 4.0 °C	75 °C	IP66	Room Sensor	-	SPDT	-	-
RT103	**017-515566**	15	0.92	10 - 45 °C	1.3 – 7 °C	1.0 - 5.0 °C	100 °C	IP66	Room Sensor	-	SPDT	-	-
RT106	**017-504866**	15	1.10	20 - 90 °C	4 – 20 °C	2.0 - 7.0 °C	120 °C	IP66	Remote Sensor w/cap. tube	2.000 mm	SPDT	-	13 x 80 mm
RT101	**017-500366**	15	0.94	25 - 90 °C	2.4 – 10 °C	3.5 - 20.0 °C	300 °C	IP66	Remote Sensor w/cap. tube	2.000 mm	SPDT	-	9.5 x 80 mm
RT101	**017-500466**	15	0.96	25 - 90 °C	2.4 – 10 °C	3.5 - 20.0 °C	300 °C	IP54	Remote Sensor w/cap. tube	2.000 mm	SPDT	Max	9.5 x 80 mm
RT101	**017-500666**	15	0.99	25 - 90 °C	2.4 – 10 °C	3.5 - 20.0 °C	300 °C	IP66	Remote Sensor w/cap. tube	3.000 mm	SPDT	-	9.5 x 80 mm
RT101	**017-502266**	15	1.11	25 - 90 °C	2.4 – 10 °C	3.5 - 20.0 °C	300 °C	IP66	Remote Sensor w/cap. tube	5.000 mm	SPDT	-	9.5 x 110 mm
RT108	**017-506066**	12	1.22	30 - 140 °C	5 – 20 °C	4.0 - 14.0 °C	220 °C	IP66	Remote Sensor w/cap. tube	2.000 mm	SPDT	-	9.5 x 410 mm
RT107	**017-513566**	15	0.95	70 - 150 °C	6 – 25 °C	1.8 - 8.0 °C	215 °C	IP66	Remote Sensor w/cap. tube	2.000 mm	SPDT	-	9.5 x 110 mm
RT107	**017-513666**	15	0.93	70 - 150 °C	6 – 25 °C	1.8 - 8.0 °C	215 °C	IP54	Remote Sensor w/cap. tube	2.000 mm	SPDT	Max	9.5 x 110 mm
RT107	**017-513966**	15	0.99	70 - 150 °C	6 – 25 °C	1.8 - 8.0 °C	215 °C	IP66	Remote Sensor w/cap. tube	3.000 mm	SPDT	-	9.5 x 110 mm
RT107	**017-514066**	15	1.10	70 - 150 °C	6 – 25 °C	1.8 - 8.0 °C	215 °C	IP66	Remote Sensor w/cap. tube	5.000 mm	SPDT	-	9.5 x 110 mm
RT107	**017-514166**	15	1.10	70 - 150 °C	6 – 25 °C	1.8 - 8.0 °C	215 °C	IP54	Remote Sensor w/cap. tube	5.000 mm	SPDT	Max	9.5 x 110 mm
RT120	**017-520866**	15	0.98	120 - 215 °C	7 – 30 °C	1.8 - 9.0 °C	260 °C	IP66	Remote Sensor w/cap. tube	2.000 mm	SPDT	-	9.5 x 80 mm
RT120	**017-521466**	15	0.98	120 - 215 °C	7 – 30 °C	1.8 - 9.0 °C	260 °C	IP54	Remote Sensor w/cap. tube	2.000 mm	SPDT	Max	9.5 x 80 mm
RT123	**017-522066**	15	0.94	150 - 250 °C	6.5 – 30 °C	1.8 - 9.0 °C	300 °C	IP66	Remote Sensor w/cap. tube	2.000 mm	SPDT	-	9.5 x 110 mm
RT123	**017-522466**	15	0.95	150 - 250 °C	6.5 – 30 °C	1.8 - 9.0 °C	300 °C	IP54	Remote Sensor w/cap. tube	2.000 mm	SPDT	Max	9.5 x 110 mm
RT124	**017-522766**	15	0.95	200 - 300 °C	5 – 25 °C	2.5 - 10.0 °C	350 °C	IP66	Remote Sensor w/cap. tube	2.000 mm	SPDT	-	11 x 110 mm
RT124	**017-523166**	15	0.95	200 - 300 °C	5 - 25 °C	2.5 - 10.0 °C	350 °C	IP54	Remote Sensor w/cap. tube	2.000 mm	SPDT	Max	11 x 110 mm

KPS Temperature switches

In the KPS thermostats series, special attention has been given to meeting important demands for a high level of enclosure, a robust, compact construction and resistance to shock and vibration. The KPS range covers most outdoor as well as indoor application requirements, and are suitable for use in monitoring, alarm and regulation systems in factories, diesel plant, compressors, powerstation and on board ships.

- Temperature ranges: -10 to +200 deg C
- Gold plated contact systems
- Adjustable or fixed differential
- Robust and compact construction
- Resistance to shock and vibrations
- Enclosure IP67. Sturdy and sea water resistant.
- Available with all relevant land and marine approvals

Type	Code No	Pack Size	Weight [kg]	Temp. range [°C]	Max. sensor temp. [°C]	Sensor type	Capillary tube length [mm]	Contact function	Ambient temp. [°C]	Sensor size (Ø x L) [mm]
KPS76	**060L311266**	10	1.26	-10 - 30 °C	80 °C	Remote Sensor w.armoured tube	2.000 mm	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS77	**060L310066**	10	0.94	20 - 60 °C	130 °C	Rigid Sensor	-	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS77	**060L310166**	10	1.23	20 - 60 °C	130 °C	Remote Sensor w.armoured tube	2.000 mm	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS77	**060L310266**	10	1.11	20 - 60 °C	130 °C	Remote Sensor w/cap. tube	2.000 mm	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS77	**060L311866**	8	0.90	20 - 60 °C	130 °C	Rigid Sensor	-	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS79	**060L310366**	10	0.91	50 - 100 °C	200 °C	Rigid Sensor	-	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS79	**060L310466**	10	1.22	50 - 100 °C	200 °C	Remote Sensor w.armoured tube	2.000 mm	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS79	**060L310566**	10	1.13	50 - 100 °C	200 °C	Remote Sensor w/cap. tube	2.000 mm	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS79	**060L312166**	8	0.88	50 - 100 °C	200 °C	Rigid Sensor	-	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS81	**060L310666**	10	1.23	60 - 150 °C	250 °C	Remote Sensor w.armoured tube	2.000 mm	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS80	**060L312666**	8	0.89	70 - 120 °C	220 °C	Rigid Sensor	-	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS80	**060L312866**	10	1.21	70 - 120 °C	220 °C	Remote Sensor w.armoured tube	2.000 mm	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS80	**060L312966**	10	1.10	70 - 120 °C	220 °C	Remote Sensor w/cap. tube	2.000 mm	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS80	**060L313066**	10	1.56	70 - 120 °C	220 °C	Remote Sensor w.armoured tube	5.000 mm	SPDT gold	-40 - 70 °C	13 x 90 mm
KPS80	**060L315666**	10	1.35	70 - 120 °C	220 °C	Remote Sensor w.armoured tube	3.000 mm	SPDT gold	-40 - 70 °C	13 x 63 mm
KPS83	**060L310866**	10	1.24	100 - 200 °C	300 °C	Remote Sensor w.armoured tube	2.000 mm	SPDT gold	-40 - 70 °C	13 x 63 mm

KP Temperature switches

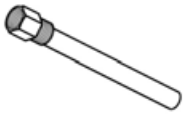
Danfoss KP thermostats are used for regulating, monitoring and alarm systems in industry. The KP series are temperature-operated electric circuit breakers. The thermostats are fitted with a single-pole switch (SPDT), and can control single-phase ac motors of up to 2 kW directly.

- Temperature ranges: 0° C to 150° C
- High contact load - Ultra short bounce-time
- Also available with gold plated contact systems
- Enclosure IP44 when mounted with top cover and back plate
- Also available with enclosure IP55 for OEM customers
- Small dimensions - space saving - easy to install
- Shock and impact resistant

Type	Code No	Pack Size	Weight *[kg]*	Temp. range *[°C]*	Max. sensor temp. *[°C]*	Encl.	Sensor type	Capillary tube length *[mm]*	Contact function	Ambient temp. *[°C]*	Sensor size (Ø x L) *[mm]*
KP75	**060L117166**	32	0.42	0 - 40 °C	80 °C	IP30	Room Sensor	-	SPDT gold	-40 - 65 °C	25 x 78 mm
KP76	**060L120066**	32	0.51	5 - 45 °C	120 °C	IP30	Room Sensor	-	SPDT	-40 - 65 °C	40 x 30 mm
KP78	**060L118466**	32	0.43	30 - 90 °C	150 °C	IP30	Remote Sensor w/cap. tube	2.000 mm	SPDT	-40 - 65 °C	9.5 x 85 mm
KP79	**060L112666**	14	0.44	50 - 100 °C	150 °C	IP30	Remote Sensor w/cap. tube	2.000 mm	SPDT	-40 - 65 °C	9.5 x 85 mm
KP81	**060L112566**	14	0.44	80 - 150 °C	200 °C	IP30	Remote Sensor w/cap. tube	2.000 mm	SPDT	-40 - 65 °C	9.5 x 85 mm

Accessories & spare parts - temperature switches

Sensor pockets - for temperature switches



Type	Code No	Pack Size	Weight *[kg]*	Conn. size	Conn. std.	Conn. type	Sens. pocket min. *[mm]*	Prot. tube mat.	Application
Sensor pocket	**060L326466**	10	0.08	1/2-14 NPT	ANSI/ASME B1.20.1	Pipe thread	75 mm	Brass	CAS / KPS
Sensor pocket	**060L326566**	10	0.07	1/2-14 NPT	ANSI/ASME B1.20.1	Pipe thread	65 mm	Brass	CAS / KPS
Sensor pocket	**060L333366**	10	0.10	1/2-14 NPT	ANSI/ASME B1.20.1	Pipe thread	65 mm	Brass	-
Sensor pocket	**017-437066**	10	0.10	G ½ A	ISO 228-1	Pipe thread	112 mm	Brass	KP / RT
Sensor pocket	**060L326266**	10	0.07	G ½ A	ISO 228-1	Pipe thread	75 mm	Brass	-
Sensor pocket	**060L326366**	10	0.11	G ½ A	ISO 228-1	Pipe thread	160 mm	Brass	-
Sensor pocket	**060L326766**	10	0.07	G ½ A	ISO 228-1	Pipe thread	75 mm	Stainless steel	CAS / KPS
Sensor pocket	**060L326866**	10	0.8	G ½ A	ISO 228-1	Pipe thread	110 mm	Stainless steel	CAS / KPS
Sensor pocket	**060L326966**	10	0.9	G ½ A	ISO 228-1	Pipe thread	160 mm	Stainless steel	CAS / KPS
Sensor pocket	**060L327166**	10	0.8	G ½ A	ISO 228-1	Pipe thread	110 mm	Brass	CAS / KPS
Sensor pocket	**060L332666**	10	0.10	G ½ A	ISO 228-1	Pipe thread	75 mm	Brass	-
Sensor pocket	**060L332866**	10	0.10	G ½ A	ISO 228-1	Pipe thread	75 mm	Stainless steel	-
Sensor pocket	**060L332966**	10	0.12	G ½ A	ISO 228-1	Pipe thread	160 mm	Stainless steel	-
Sensor pocket	**060L333066**	10	0.11	G ½ A	ISO 228-1	Pipe thread	110 mm	Brass	-
Sensor pocket	**060L333166**	10	0.11	G ½ A	ISO 228-1	Pipe thread	110 mm	Stainless steel	-

Covers - for temperature switches

Type	Code No	Pack Size	Weight *[kg]*	Application
IP55 enclosure	**060-062866**	30	0.20	KP single

Miscellaneous accessories & spare parts - for temperature switches

Type	Code No	Pack Size	Weight *[kg]*	Application
Capillary tube gland	**003N0155**	50	0.11	AVTA/B
Capillary tube gland	**017-422066**	5	0.05	KP / RT
Protective cap	**017-436066**	20	0.01	RT

Temperature sensors

	MBT 3260	MBT 5250	MBT 5252	MBT 3560
	34	34	34	35
				
Temperature range	-50 - 120 °C	-50 - 200 °C	-50 - 200 °C	0 - 200 °C
Resistance value	1 x Pt 100	1 x Pt 100 or 1 x Pt1000	1 x Pt 100	1 x Pt 1000
Insertion/Extension length	Ins. 50 - 250 mm	Ins. 50 - 200 mm	Ext. 50 mm	Ext. 33 mm
Electrical connection	DIN 43650, plug Pg 9 (IP65)	DIN 43650/Pg 9 -13.5	Type B / Pg 16	DIN 43650, plug Pg 9
Process connection size	G 1/2 A	G 1/2 A, G 3/4 A or 1/2-14 NPT	G 1/2 A	G 1/4 A

Temperature sensors

The Danfoss range of temperature sensors is based on decades of global experience within the marine industry and in refrigeration plants - undoubtedly some of the toughest environments around.

Even in these demanding surroundings you can trust our products; they have a long life thanks to their robust design.

MBT 3260 Temperature sensors with fixed insert

The MBT 3260 is a light duty temperature sensor that can be used for measuring and regulation in piping and ventilation systems and other light industrial applications. Due to the fact that the protection tube is made of copper the MBT 3260 has a very short response time of down to t0,5 = 2 sec. in water. This temperature sensor is based on a standardized Pt100 or Pt1000 element, which gives a reliable and accurate measurement.
Parts in contact with the media are made of copper or brass.
The MBT 3260 is delivered with a DIN 43650 plug as standard.

- Pt100 or Pt1000 resistance element
- Temperature range -50 to 120° C
- Copper tube
- Short response times
- G½A brass process connection
- Gold plated connectors
- Fixed measuring insert
- Multiple insertion lengths: 50, 100 or 250 mm

Type	Code No	Pack Size	Weight [kg]	Resistance value	Temp. range [°C]	Ins. length [mm]	Insert	Output sign.	Process conn. size	El. conn.	Wires [pcs]
MBT 3260	**084Z6055**	20	0.12	1 x Pt 100	-50 - 120 °C	50 mm	Fixed	Ohm	G ½ A	DIN 43650, plug PG 9 (IP65)	2 pc
MBT 3260	**084Z8181**	20	0.13	1 x Pt 100	-50 - 120 °C	100 mm	Fixed	Ohm	G ½ A	DIN 43650, plug PG 9 (IP65)	2 pc
MBT 3260	**084Z8183**	21	0.15	1 x Pt 100	-50 - 120 °C	250 mm	Fixed	Ohm	G ½ A	DIN 43650, plug PG 9 (IP65)	2 pc

MBT 5250 Temperature sensors

The MBT 5250 is a heavy-duty temperature sensor that can be used for controlling cooling water, lubrication oil, hydraulic oil and refrigeration plants within general industry and marine applications. This temperature sensor is based on a standardized Pt100 or Pt1000 element, which gives a reliable and accurate measurement. It can be delivered with NTC/PTC elements on request. The measuring insert is based on a silicone cable, which makes the sensor very resistant towards vibrations. All parts in contact with the media are made of stainless steel AISI 316 Ti. The MBT 5250 is equipped with a DIN 43650 plug as standard, but can be delivered with M12 or DIN 72585 Bayonet on request.

- For gaseous or liquid media, e.g. air, gas, vapour, water or oil
- Up to +200°C media temperatures
- Pt100 or Pt1000 resistance element
- Can be used with 2- or 3-wire connections
- Gold plated male and female connector
- Interchangeable measuring insert
- Available with all relevant marine approvals

Type	Code No	Pack Size	Weight [kg]	Resistance value	Temp. range [°C]	Ins. length [mm]	Output sign.	Process conn. size	El. conn.	Wires [pcs]
MBT 5250	**084Z8011**	20	0.14	1 x Pt 100	-50 - 200 °C	50 mm	Ohm	G ½ A	DIN 43650/Pg 9	2 pc
MBT 5250	**084Z8036**	20	0.14	1 x Pt 100	-50 - 200 °C	50 mm	Ohm	G ½ A	DIN 43650/Pg 11	2 pc
MBT 5250	**084Z8066**	20	0.14	1 x Pt 100	-50 - 200 °C	50 mm	Ohm	1/2-14 NPT	DIN 43650/Pg 11	2 pc
MBT 5250	**084Z8083**	14	0.14	1 x Pt 1000	-50 - 200 °C	50 mm	Ohm	G ½ A	DIN 43650/Pg 11	2 pc
MBT 5250	**084Z8146**	20	0.19	1 x Pt 100	-50 - 200 °C	60 mm	Ohm	G ¾ A	DIN 43650/Pg 13.5	2 pc
MBT 5250	**084Z8220**	12	0.25	1 x Pt 100	-50 - 200 °C	60 mm	Ohm	G ¾ A	DIN 43650/Pg 13.5	2 pc
MBT 5250	**084Z8019**	20	0.15	1 x Pt 100	-50 - 200 °C	80 mm	Ohm	1/2-14 NPT	DIN 43650/Pg 11	2 pc
MBT 5250	**084Z8056**	10	0.19	1 x Pt 100	-50 - 200 °C	80 mm	Ohm	G ¾ A	DIN 43650/Pg 13.5	2 pc
MBT 5250	**084Z8006**	12	0.19	1 x Pt 100	-50 - 200 °C	100 mm	Ohm	G ¾ A	DIN 43650/Pg 11	2 pc
MBT 5250	**084Z8012**	20	0.16	1 x Pt 100	-50 - 200 °C	100 mm	Ohm	G ½ A	DIN 43650/Pg 9	2 pc
MBT 5250	**084Z8039**	20	0.15	1 x Pt 100	-50 - 200 °C	100 mm	Ohm	G ½ A	DIN 43650/Pg 11	2 pc
MBT 5250	**084Z8134**	12	0.16	1 x Pt 100	-50 - 200 °C	100 mm	Ohm	G ½ A	DIN 43650/Pg 13.5	2 pc
MBT 5250	**084Z8008**	12	0.17	1 x Pt 100	-50 - 200 °C	150 mm	Ohm	G ½ A	DIN 43650/Pg 11	2 pc
MBT 5250	**084Z8010**	12	0.16	1 x Pt 100	-50 - 200 °C	150 mm	Ohm	G ½ A	DIN 43650/Pg 9	2 pc
MBT 5250	**084Z8014**	15	0.21	1 x Pt 100	-50 - 200 °C	150 mm	Ohm	G ¾ A	DIN 43650/Pg 13.5	2 pc
MBT 5250	**084Z8022**	12	0.18	1 x Pt 100	-50 - 200 °C	200 mm	Ohm	G ½ A	DIN 43650/Pg 9	2 pc
MBT 5250	**084Z8042**	12	0.25	1 x Pt 100	-50 - 200 °C	200 mm	Ohm	G ¾ A	DIN 43650/Pg 9	2 pc
MBT 5250	**084Z8043**	20	0.17	1 x Pt 100	-50 - 200 °C	200 mm	Ohm	G ½ A	DIN 43650/Pg 11	2 pc
MBT 5250	**084Z8218**	13	0.22	1 x Pt 100	-50 - 200 °C	200 mm	Ohm	G ¾ A	DIN 43650/Pg 13.5	2 pc

MBT 5252 Temperature sensors

The MBT 5252 is a heavy-duty temperature sensor that can be used for controlling cooling water, lubrication oil, hydraulic oil and refrigeration plants within general industry and marine applications.
This temperature sensor is based on a standardized Pt100 or Pt1000 element, which gives a reliable and accurate measurement. The MBT 5252 can be delivered with NTC/PTC elements on request. If needed, a transmitter (MBT 9110) can be ordered as an integrated part of the sensor. In the low temperature version (-50 °C to +200 °C) the measuring insert is based on a silicone cable, which makes the sensor very resistant towards vibrations. All parts in contact with the media are made of stainless steel AISI 316 Ti. The MBT 5252 is equipped with a B-head as standard, but can be delivered with B-mini or B-head with screw cap on request.

- For gaseous or liquid media, e.g. air, gas, vapour, water or oil
- Up to +400° C media temperatures
- Available with built-in transmitter
- Available with all relevant marine approvals

Type	Code No	Pack Size	Weight [kg]	Transmitter setting range [°C]	Insert	Resistane value	Temp. range [°C]	Ext. length [mm]	Output sign. [mA]	Output sign.	Process conn. size	El. conn.	Wires [pcs]
MBT 5252	**084Z8210**	10	0.37	-	Exchangeable	1 x Pt 100	-50 - 200 °C	50 mm	-	Ohm	G ½ A	Type B / Pg 16	2 pc
MBT 5252	**084Z8211**	10	0.39	-	Exchangeable	1 x Pt 100	-50 - 200 °C	50 mm	-	Ohm	G ½ A	Type B / Pg 16	2 pc
MBT 5252	**084Z8214**	10	0.37	0 - 100 °C	Exchangeable	1 x Pt 100	-50 - 200 °C	50 mm	4 - 20 mA	-	G ½ A	Type B / Pg 16	2 pc
MBT 5252	**084Z8215**	10	0.41	0 - 100 °C	Exchangeable	1 x Pt 100	-50 - 200 °C	50 mm	4 - 20 mA	-	G ½ A	Type B / Pg 16	2 pc
MBT 5252	**084Z8216**	10	0.41	0 - 100 °C	Exchangeable	1 x Pt 100	-50 - 200 °C	50 mm	4 - 20 mA	-	G ½ A	Type B / Pg 16	2 pc
MBT 5252	**084Z8217**	8	0.43	0 - 100 °C	Exchangeable	1 x Pt 100	-50 - 200 °C	50 mm	4 - 20 mA	-	G ½ A	Type B / Pg 16	2 pc

MBT 3560 Temperature sensors with built-in transmitter

With MBT 3560 we have combined the technology of our standard temperature sensors and the electrical connections from the MBS pressure transmitters with a new developed electronics which has resulted in a compact temperature sensor with a built-in transmitter.The MBT 3560 is designed for use in harsh industrial enviroments where reliable, robust and accurate equipment is required.
Available with a wide selection of process and electrical connections. Can be delivered with a 33 mm extension length which makes it possible to measure temperatures up to 200°C without damaging the built-in electronics.

- Ultra compact design
- Acid-resistant stainless steel enclosure (AISI 316L)
- Temperature range -50 °C - +200°C
- Pt 1000 resistance element
- Output signals: 4 - 20 mA or Ratiometric
- Protection tube: ø 8 mm
- Multiple insertion lengths: 50 mm - 250 mm

Type	Code No	Pack Size	Weight *[kg]*	Transmitter setting range *[°C]*	Ins. length *[mm]*	Insert	Ext. length *[mm]*	Output sig. *[mA]*	Process conn. size	El. conn.
MBT 3560	**084Z4032**	13	0.17	0 - 100 °C	150 mm	Fixed	-	4 - 20 mA	G 1/4 A	DIN 43650/Pg 9
MBT 3560	**084Z4034**	8	0.22	0 - 100 °C	250 mm	Fixed	-	4 - 20 mA	G 1/4 A	DIN 43650/Pg 9
MBT 3560	**084Z4037**	20	0.18	0 - 200 °C	150 mm	Fixed	33 mm	4 - 20 mA	G 1/4 A	DIN 43650/Pg 9
MBT 3560	**084Z4039**	8	0.20	0 - 200 °C	250 mm	Fixed	33 mm	4 - 20 mA	G 1/4 A	DIN 43650/Pg 9

Accessories & spare parts - temperature sensors

Plug-in displays - for temperature sensors

Type	Code No	Pack Size	Weight *[kg]*	Description	Electrical connection *[kg]*
MBD 1000	**060G2850**	23	0.11	Plug-in display unit MBD	EN 175301-803

Contactors

The contactor range includes minicontactors from 2.2. to 4 kW and control relays/ contactors from 2.2 to 238 kW.
The range of auxiliary functions and accessories is very comprehensive and includes: auxiliary contact blocks, timer blocks, interface modules, suppression blocks, mechanical interlocks, rating plates and many more.

CI 4 Mini contactors

The mini contactor is a small, compact unit, typically with 3 NO main contacts and a built-in normally open (NO) or normally closed (NC) auxiliary contact.

Operation, overload protection and phase failure protection of induction motors are typical applications for the mini contactor, combined with a thermal overload relay.

- Compact design
- Screw or DIN rail mounting
- Power range 1.5 to 5.9 kW
- Basic module with one built-in aux. contact (NO or NC)
- For ac and dc coil voltages
- Low-power dc coils suitable for p_c and PLC control

Type	Code No	Pack Size	Weight *[kg]*	AC-3 power *220-240 V*	AC-3 power *380-500 V*	AC-3 Ie	AC-1 Ith *open*	AC-1 Ithe *encl.*	Built-in aux. NC contacts	Built-in aux. NO contacts	Coil voltage *50 Hz*	Coil voltage *60 Hz*	Coil voltage *dc*
CI 4-2	**037H321013**	20	0.16	1.1 kW	1.5 kW	3.7 A	16.0 A	12.0 A	-	4	24 V	24 V	-
CI 4-2	**037H321032**	20	0.16	1.1 kW	1.5 kW	3.7 A	16.0 A	12.0 A	-	4	220 - 230 V	230 - 240 V	-
CI 4-2	**037H321113**	10	0.16	1.1 kW	1.5 kW	3.7 A	16.0 A	12.0 A	2	2	24 V	24 V	-
CI 4-2	**037H321132**	20	0.16	1.1 kW	1.5 kW	3.7 A	16.0 A	12.0 A	2	2	220 - 230 V	230 - 240 V	-
CI 4-5	**037H311413**	20	0.17	1.5 kW	2.2 kW	5.3 A	20.0 A	16.0 A	-	1	24 V	24 V	-
CI 4-5	**037H311432**	20	0.16	1.5 kW	2.2 kW	5.3 A	20.0 A	16.0 A	-	1	220 - 230 V	230 - 240 V	-
CI 4-5	**037H311513**	20	0.16	1.5 kW	2.2 kW	5.3 A	20.0 A	16.0 A	1	-	24 V	24 V	-
CI 4-5	**037H311532**	20	0.16	1.5 kW	2.2 kW	5.3 A	20.0 A	16.0 A	1	-	220 - 230 V	230 - 240 V	-
CI 4-5	**037H314302**	20	0.21	1.5 kW	2.2 kW	5.3 A	20.0 A	16.0 A	-	1	-	-	24 V
CI 4-5	**037H314402**	20	0.21	1.5 kW	2.2 kW	5.3 A	20.0 A	16.0 A	1	-	-	-	24 V
CI 4-9	**037H311613**	20	0.16	3.0 kW	4.0 kW	9.0 A	20.0 A	16.0 A	-	1	24 V	24 V	-
CI 4-9	**037H311623**	20	0.16	3.0 kW	4.0 kW	9.0 A	20.0 A	16.0 A	-	1	110 V	110 - 120 V	-
CI 4-9	**037H311632**	20	0.16	3.0 kW	4.0 kW	9.0 A	20.0 A	16.0 A	-	1	220 - 230 V	230 - 240 V	-
CI 4-9	**037H311633**	20	0.16	3.0 kW	4.0 kW	9.0 A	20.0 A	16.0 A	-	1	240 V	240 V	-
CI 4-9	**037H311713**	20	0.16	3.0 kW	4.0 kW	9.0 A	20.0 A	16.0 A	1	-	24 V	24 V	-
CI 4-9	**037H311723**	70	0.16	3.0 kW	4.0 kW	9.0 A	20.0 A	16.0 A	1	-	110 V	110 - 120 V	-
CI 4-9	**037H311732**	20	0.16	3.0 kW	4.0 kW	9.0 A	20.0 A	16.0 A	1	-	220 - 230 V	230 - 240 V	-
CI 4-9	**037H311813**	20	0.16	3.0 kW	4.0 kW	9.0 A	20.0 A	16.0 A	-	-	24 V	24 V	-
CI 4-9	**037H311832**	20	0.16	3.0 kW	4.0 kW	9.0 A	20.0 A	16.0 A	-	-	220 - 230 V	230 - 240 V	-
CI 4-9	**037H314502**	20	0.21	3.0 kW	4.0 kW	9.0 A	20.0 A	16.0 A	-	1	-	-	24 V
CI 4-9	**037H314602**	20	0.20	3.0 kW	4.0 kW	9.0 A	20.0 A	16.0 A	1	-	-	-	24 V
CI 4-12	**037H345713**	10	0.17	3.3 kW	5.9 kW	12.0 A	20.0 A	16.0 A	-	1	24 V	24 V	-
CI 4-12	**037H345732**	20	0.16	3.3 kW	5.9 kW	12.0 A	20.0 A	16.0 A	-	1	220 - 230 V	230 - 240 V	-
CI 4-12	**037H345813**	20	0.17	3.3 kW	5.9 kW	12.0 A	20.0 A	16.0 A	1	-	24 V	24 V	-
CI 4-12	**037H345832**	20	0.16	3.3 kW	5.9 kW	12.0 A	20.0 A	16.0 A	1	-	220 - 230 V	230 - 240 V	-
CI 4-12	**037H346002**	10	0.20	4.0 kW	5.9 kW	12.0 A	20.0 A	16.0 A	1	-	-	-	24 V

CI (6-50 series) Contactors

The contactor programme CI 6-50 is based on three frame sizes. The smallest frame size consists of CI 6-15 (2.2-7.5 kW), the middle contains the CI 16-30 range (7.5-15 kW) and the largest frame size is represented by the CI 32-50 (15-25 kW). All frame sizes are provided with three NO main contacts. CI 6-15 are available with four NO main contacts.

- Compact design in three frame sizes
- Screw or DIN rail mounting
- Power range 2.2 to 25 kW
- For ac/dc coil voltages

Type	Code No	Pack Size	Weight *[kg]*	AC-3 power *220-240 V*	AC-3 power AC-3 *380-690 V*	AC-3 Ie	AC-1 Ith *open*	AC-1 Ithe *encl.*	Main cont.	Coil voltage *50 Hz*	Coil voltage *60 Hz*	Coil voltage *dc*
CI 6	**037H001531**	30	0.30	1.5 kW	2.2 kW	6.0 A	20.0 A	16.0 A	3	220 - 240 V	-	-
CI 6	**037H001831**	30	0.31	1.5 kW	2.2 kW	6.0 A	20.0 A	16.0 A	4	220 - 240 V	-	-
CI 9	**037H002113**	30	0.29	2.2 kW	4.0 kW	9.0 A	25.0 A	16.0 A	3	24 V	24 V	-
CI 9	**037H002116**	30	0.28	2.2 kW	4.0 kW	9.0 A	25.0 A	16.0 A	3	24 V	29 V	-
CI 9	**037H002131**	30	0.30	2.2 kW	4.0 kW	9.0 A	25.0 A	16.0 A	3	220 - 240 V	-	-
CI 9	**037H002132**	30	0.30	2.2 kW	4.0 kW	9.0 A	25.0 A	16.0 A	3	220 - 230 V	220 V	-
CI 9	**037H002137**	30	0.29	2.2 kW	4.0 kW	9.0 A	25.0 A	16.0 A	3	380 - 400 V	440 V	-
CI 9	**037H002231**	30	0.31	2.2 kW	4.0 kW	9.0 A	25.0 A	16.0 A	4	220 - 240 V	-	-
CI 9DC 24	**037H807166**	24	0.33	2.2 kW	4.0 kW	9.0 A	25.0 A	16.0 A	3	-	-	24 V
CI 12	**037H003116**	30	0.28	3.0 kW	5.5 kW	12.0 A	25.0 A	20.0 A	3	24 V	29 V	-
CI 12	**037H003131**	30	0.29	3.0 kW	5.5 kW	12.0 A	25.0 A	20.0 A	3	220 - 240 V	-	-
CI 12	**037H003132**	30	0.30	3.0 kW	5.5 kW	12.0 A	25.0 A	20.0 A	3	220 - 230 V	220 V	-
CI 12	**037H003137**	30	0.29	3.0 kW	5.5 kW	12.0 A	25.0 A	20.0 A	3	380 - 400 V	440 V	-
CI 12	**037H003231**	30	0.31	3.0 kW	5.5 kW	12.0 A	25.0 A	20.0 A	4	220 - 240 V	-	-
CI 15	**037H004931**	30	0.29	4.0 kW	7.5 kW	16.0 A	25.0 A	20.0 A	3	220 - 240 V	-	-
CI 15	**037H005031**	30	0.31	4.0 kW	7.5 kW	16.0 A	25.0 A	20.0 A	4	220 - 240 V	-	-

Type	Code No	Pack Size	Weight [kg]	AC-3 power 220-240 V	AC-3 power AC-3 380-690 V	AC-3 Ie	AC-1 Ith open	AC-1 Ithe encl.	Main cont.	Coil voltage 50 Hz	Coil voltage 60 Hz	Coil voltage dc
CI 15DC 24	037H807366	24	0.32	4.0 kW	7.5 kW	16.0 A	25.0 A	20.0 A	3	-	-	24 V
CI 16	037H004116	25	0.34	4.0 kW	7.5 kW	16.0 A	40.0 A	25.0 A	3	24 V	29 V	-
CI 16	037H004131	25	0.34	4.0 kW	7.5 kW	16.0 A	40.0 A	25.0 A	3	220 - 240 V	-	-
CI 16	037H004137	25	0.34	4.0 kW	7.5 kW	16.0 A	40.0 A	25.0 A	3	380 - 400 V	440 V	-
CI 20	037H004531	25	0.34	5.5 kW	10.0 kW	20.0 A	40.0 A	25.0 A	3	220 - 240 V	-	-
CI 25	037H005116	25	0.34	5.5 kW	11.0 kW	25.0 A	40.0 A	25.0 A	3	24 V	29 V	-
CI 25	037H005131	25	0.34	5.5 kW	11.0 kW	25.0 A	40.0 A	25.0 A	3	220 - 240 V	-	-
CI 25	037H005132	25	0.34	5.5 kW	11.0 kW	25.0 A	40.0 A	25.0 A	3	220 - 230 V	220 V	-
CI 25	037H005137	25	0.33	5.5 kW	11.0 kW	25.0 A	40.0 A	25.0 A	3	380 - 400 V	440 V	-
CI 30	037H005531	25	0.35	8.5 kW	15.0 kW	32.0 A	40.0 A	30.0 A	3	220 - 240 V	-	-
CI 30	037H005532	25	0.35	8.5 kW	15.0 kW	32.0 A	40.0 A	30.0 A	3	220 - 230 V	220 V	-
CI 32	037H006131	18	0.82	8.5 kW	15.0 kW	32.0 A	63.0 A	63.0 A	3	220 - 230 V	-	-
CI 37	037H005631	18	0.83	10.0 kW	18.5 kW	37.0 A	80.0 A	63.0 A	3	220 V	-	-
CI 45	037H007131	18	0.83	11.0 kW	22.0 kW	45.0 A	80.0 A	80.0 A	3	220 V	-	-
CI 45	037H007132	18	0.81	11.0 kW	22.0 kW	45.0 A	80.0 A	80.0 A	3	220 - 230 V	220 V	-
CI 50	037H008031	18	0.82	15.0 kW	25.0 kW	52.0 A	80.0 A	80.0 A	3	220 V	-	-

CI (61-86 series) Contactors

The contactor programme CI 61-86 consists of one frame size with three NO main contacts. Coils are standard for dual frequency.
A long electrical lifetime makes the CI 61-86 contactors suitable for operation of all kinds of electrical loads in modern industry. Combined with a thermal overload relay, the contactor switches and protects induction motors against overload and asymmetric load.
A wide range of clip-on aux. contacts, timers, surge suppressors, mechanical interlock and marking plates makes the CI 61-86 programme very flexible and suitable both for OEMs and panel builders.

- Compact design
- Screw or DIN rail mounting
- Power range 30 kW to 45 kW
- For ac coil voltages

Type	Code No	Pack Size	Weight [kg]	AC-3 power 220-240 V	AC-3 powerAC-3 380-690 V	AC-3 Ie	AC-1 Ith open	AC-1 Ithe encl.	Main cont.	Coil voltage 50 Hz	Coil voltage 60 Hz
CI 61	037H306113	7	1.46	18.5 kW	30.0 kW	60.0 A	100.0 A	100.0 A	3	24 V	24 V
CI 61	037H306132	7	1.48	18.5 kW	30.0 kW	60.0 A	100.0 A	100.0 A	3	220 - 230 V	220 - 230 V
CI 73	037H306213	1	1.46	22.0 kW	37.0 kW	72.0 A	100.0 A	100.0 A	3	24 V	24 V
CI 73	037H306232	7	1.48	22.0 kW	37.0 kW	72.0 A	100.0 A	100.0 A	3	220 - 230 V	220 - 230 V
CI 86	037H306313	7	1.48	25.0 kW	45.0 kW	85.0 A	100.0 A	100.0 A	3	24 V	24 V
CI 86	037H306332	1	1.48	25.0 kW	45.0 kW	85.0 A	100.0 A	100.0 A	3	220 - 230 V	220 - 230 V

CI (110-180 series) Contactors

The contactor programme CI 110-180 consists of one frame size with three NO main contacts and one auxiliary contact block with one NO and one NC auxiliary contact. Spare contacts are available and by maintenance, the moveable system blocks when removing the chamber. By replacing contacts, wire separation from terminals is not necessary. A long electrical lifetime makes the CI 110-180 contactors suitable for operation of all kinds of electrical loads in modern industry. Combined with a thermal overload relay or an electronic motor protection relay, the contactor switches and protects induction motors against overload and asymmetric load. A wide range of clip-on aux. contacts, timers, surge suppressors, mechanical interlock and marking plates makes the CI 110-180 programme very flexible and suitable both for OEMs and panel builders.

- Compact design
- Screw mounting
- Power range 55 kW to 90 kW
- Basic modules with aux. contacts (1 NO + 1 NC)
- For ac coil voltages

Type	Code No	Pack Size	Weight [kg]	AC-3 power 220-240 V	AC-3 power 380-1000 V	AC-3 Ie	AC-1 Ith open	AC-1 Ithe encl.	Coil voltage 50 Hz	Coil voltage 60 Hz
CI 110	037H308122	1	3.98	32.0 kW	55.0 kW	110.0 A	160.0 A	135.0 A	110 V	127 V
CI 110	037H308131	1	3.98	32.0 kW	55.0 kW	110.0 A	160.0 A	135.0 A	220 - 230 V	260 V
CI 110	037H308137	1	3.98	32.0 kW	55.0 kW	110.0 A	160.0 A	135.0 A	380 - 400 V	440 V
CI 141	037H333916	2	3.92	45.0 kW	75.0 kW	140.0 A	250.0 A	210.0 A	24 V	28 V
CI 141	037H333922	1	4.17	45.0 kW	75.0 kW	140.0 A	250.0 A	210.0 A	110 V	127 V
CI 141	037H333931	1	3.98	45.0 kW	75.0 kW	140.0 A	250.0 A	210.0 A	220 - 230 V	260 V
CI 141	037H333937	2	3.98	45.0 kW	75.0 kW	140.0 A	250.0 A	210.0 A	380 - 400 V	440 V
CI 180	037H308222	2	4.16	55.0 kW	90.0 kW	180.0 A	250.0 A	210.0 A	110 V	127 V
CI 180	037H308231	1	4.20	55.0 kW	90.0 kW	180.0 A	250.0 A	210.0 A	220 - 230 V	260 V
CI 180	037H308237	1	4.14	55.0 kW	90.0 kW	180.0 A	250.0 A	210.0 A	380 - 400 V	440 V

CI EI (210-420 series) Contactors with interface relay

The contactor programme CI 210 EI - 420 EI consist of one frame size. The series are equipped with three NO main contacts and an auxiliary contact block with one NO and one NC auxiliary contact. Spare contacts are available and by maintenance, the moveable system blocks when removing the chamber. The factory setting makes the contactors operate as standard conventional contactors, but for PLC application, the built-in interface relay can be activated. A long electrical lifetime makes the CI 210 EI - 420 EI contactors suitable for operation of all kinds of electrical loads in modern industry. A wide range of clip-on aux. contacts, timers, surge suppressors, mechanical interlock and marking plates makes the CI 210 EI - 420 EI programme very flexible and suitable both for OEMs and panel builders.

- Compact design
- Screw mounting
- Power range 110 kW to 220 kW
- Basic modules with built-in aux. contacts
- Electronic control of switching coil voltage
- Wide voltage range
- Dual frequency coil at 50-60 Hz as standard
- Integrated interface relay for PLC application

Type	Code No	Pack Size	Weight [kg]	AC-3 power 220-240 V	AC-3 power 380-1000 V	AC-3 Ie	AC-1 Ith open	AC-1 Ithe encl.	Main cont.	Coil voltage 60 Hz
CI 210 EI	037H325932	1	7.55	63.0 kW	110.0 kW	210.0 A	350.0 A	300.0 A	3	208 - 277 V
CI 250 EI	037H326732	1	7.86	80.0 kW	132.0 kW	250.0 A	350.0 A	300.0 A	3	208 - 277 V
CI 300 EI	037H326932	1	7.98	90.0 kW	160.0 kW	300.0 A	450.0 A	380.0 A	3	208 - 277 V
CI 420 EI	037H327932	1	8.10	132.0 kW	220.0 kW	420.0 A	500.0 A	425.0 A	3	208 - 277 V

Accessories & spare parts - contactors

Auxiliary contacts - for contactors

Type	Code No	Pack Size	Weight *[kg]*	Function	Mounting	Comments	Application
CBD-11	**037H3064**	10	0.04	1 NO+1 NC	Front	-	CI 61,73,86
CBM-11	**037H3151**	150	0.03	1 NO+1 NC	Front	-	CI 4-
CBC-11	**037H3231**	10	0.9	1 NO+1 NC	Right hand side	-	CI 105,141,170EI,420EI
CBD S-11	**037H3069**	10	0.04	1 NO+1 NC	Side	-	CI 61,73,86
CBD-22	**037H3065**	10	0.07	2 NO+2 NC	Front	-	CI 61,73,86
CBM-22	**037H3152**	150	0.04	2 NO+2 NC	Front	-	CI 4-
CB-NC	**037H0112**	20	0.01	Break	Front	-	CI 6-50
CB-NC	**037H0122**	20	0.01	Break	Front	Gold-plated contacts	CI 6-50
CB-EM	**037H0113**	20	0.01	Early make	Front	-	CI 6-50
CB-LB	**037H0114**	20	0.01	Late break	Front	-	CI 6-50
CB-NO	**037H0111**	20	0.01	Make	Front	-	CI 6-50
CB-NO	**037H0121**	20	0.01	Make	Front	Gold-plated contacts	CI 6-50
CB-S	**037H0110**	20	0.01	Start	Front	-	CI 6-50

Charge suppressors - for contactors

Type	Code No	Pack Size	Weight *[kg]*	Description	Voltage *V, 50 Hz*	Voltage *V, 60 Hz*	Application
RC 250	**037H0076**	10	0.02	RC element	110 - 205 V	110 - 205 V	CI 6-30

Clip-on timers - for contactors

Type	Code No	Pack Size	Weight *[kg]*	Function	Control voltage *50/60 Hz*	Control voltage *dc*	Time range	Application
ETB	**047H0183**	100	0.03	Off-delay	110 - 240 V	-	0.5 - 20.0 s	CI 6-50
ETB	**047H0184**	100	0.03	Off-delay	110 - 240 V	-	4.0 - 160.0 s	CI 6-50
ETB	**047H0185**	100	0.03	Off-delay	110 - 240 V	-	0.5 - 20.0 min	CI 6-50
ETB	**047H0180**	100	0.03	Off-delay	24 - 65 V	-	0.5 - 20.0 s	CI 6-50
ETB	**047H0181**	100	0.03	Off-delay	24 - 65 V	-	4.0 - 160.0 s	CI 6-50
ETB	**047H0190**	100	0.02	On-delay	-	24 - 65 V	0.5 - 20.0 s	CI 6-50
ETB	**047H0173**	100	0.03	On-delay	110 - 240 V	-	0.5 - 20.0 s	CI 6-50
ETB	**047H0174**	100	0.03	On-delay	110 - 240 V	-	4.0 - 160.0 s	CI 6-50
ETB	**047H0175**	100	0.03	On-delay	110 - 240 V	-	0.5 - 20.0 min	CI 6-50
ETB	**047H0170**	100	0.03	On-delay	24 - 65 V	-	0.5 - 20.0 s	CI 6-50

Contactor coils - for contactors

Type	Code No	Pack Size	Weight *[kg]*	Voltage *V, 50 Hz*	Voltage *V, 60 Hz*	Application
Accessory	**037H6087**	8	0.13	110 V	110 V	CI 32-50
Accessory	**037H6487**	6	0.06	110 V	110 V	CI 6-30
Accessory	**037H6469**	6	0.05	183 V	220 V	CI 6-30
Accessory	**037H6461**	72	0.05	20 V	24 V	CI 6-30
Accessory	**037H6072**	8	0.13	220 - 230 V	-	CI 32-50
Accessory	**037H6088**	8	0.12	220 - 230 V	220 - 230 V	CI 32-50
Accessory	**037H6488**	6	0.06	220 - 230 V	220 V	CI 6-30
Accessory	**037H6472**	6	0.06	220 - 240 V	-	CI 6-30
Accessory	**037H6084**	8	0.12	24 V	24 V	CI 32-50
Accessory	**037H6484**	6	0.05	24 V	24 V	CI 6-30
Accessory	**037H6062**	8	0.13	24 V	29 V	CI 32-50
Accessory	**037H6462**	6	0.05	24 V	29 V	CI 6-30
Accessory	**037H6078**	8	0.13	380 - 400 V	440 V	CI 32-50
Accessory	**037H6478**	6	0.05	380 - 400 V	440 V	CI 6-30
Accessory	**037H6479**	6	0.05	415 V	500 V	CI 6-30
Accessory	**037H6463**	6	0.05	42 V	42 - 50 V	CI 6-30

Covers - for contactors

Type	Code No	Pack Size	Weight *[kg]*	Description	Push buttons	Application
BCI	**047B010666**	18	0.38	Enclosure	None	Control relay/ contactor 6-30A
BCI 2	**047B010266**	18	0.40	Enclosure	Start-stop/reset	Motor starter 6-30A
BCI 1	**047B010466**	18	0.39	Enclosure	Stop/reset	Motor starter 6-30A

Jumpers - for contactors

Type	Code No	Pack Size	Weight *[kg]*	Description	Application
Accessory	**037H010466**	75	0.24	3-pole jumper	CI 6-15

Mechanical interlocks - for contactors

Type	Code No	Pack Size	Weight *[kg]*	Application
Accessory	**037H010666**	18	0.03	CI 32-50
Accessory	**037H010066**	10	0.03	CI 6-30

Overload relays

The thermal overload range TI 9C, TI 16C, TI 25C, TI 30C, TI 80 & TI 86 are used with the contactor range CI 4 - CI 86 to give protection of squirrel-cage motors.
The electronic motor protection relays TI 180E and TI 630E give effective protection of electric motors exposed to thermal overload, phase failure and asymmetrical load.

TI C 9 Thermal overload relays

The thermal overload relays TI 9 C cover the range from 0.13 - 9.2 Amp. The phase failure function accelerates the trip function by three phase run if a phase drop-out occurs. This is particularly important for delta connected motors.

- For use with mini contactors CI 4
- Compact design
- Stop/reset button
- Manual/automatic reset function
- Test trip function
- Double scale for direct start or Y-∆ start
- Galvanically isolated signal contacts
- Single phase failure protection

Type	Code No	Pack Size	Weight *[kg]*	Current. motor starter	Current. star-delta starter
TI 9C	**047H3063**	10	0.12	0.40 - 0.62 A	-
TI 9C	**047H3065**	10	0.12	0.85 - 1.30 A	-
TI 9C	**047H3066**	10	0.12	1.20 - 1.90 A	-
TI 9C	**047H3067**	10	0.12	1.80 - 2.80 A	3.20 - 4.80 A
TI 9C	**047H3068**	10	0.12	2.70 - 4.20 A	4.70 - 7.30 A

TI C (16-30 series) Thermal overload relays

The thermal overload relays TI 16C-30C cover the range from 0.13-32 Amp and protect squirrel cage motors of up to 15 kW against overload.

The phase failure function accelerates the trip function by three phase run if a phase drop-out occurs. This is particularly important for delta connected motors.

- For use with contactors CI 6 - CI 30
- Compact design
- Stop/reset button
- Manual/automatic reset function
- Test trip function
- DOL scale / Y-∆ scale
- Galvanically isolated signal contacts
- Single phase failure protection

Type	Code No	Pack Size	Weight *[kg]*	Current. motor starter	Current. star-delta starter
TI 16C	**047H0200**	10	0.12	0.13 - 0.20 A	-
TI 16C	**047H0201**	10	0.12	0.19 - 0.29 A	-
TI 16C	**047H0202**	10	0.12	0.27 - 0.42 A	-
TI 16C	**047H0203**	10	0.12	0.40 - 0.62 A	-
TI 16C	**047H0204**	10	0.12	0.60 - 0.92 A	-
TI 16C	**047H0205**	10	0.12	0.85 - 1.30 A	-
TI 16C	**047H0206**	10	0.12	1.20 - 1.90 A	-
TI 16C	**047H0207**	10	0.12	1.80 - 2.80 A	3.20 - 4.80 A
TI 16C	**047H0208**	10	0.12	2.70 - 4.20 A	4.70 - 7.30 A
TI 16C	**047H0209**	10	0.12	4.00 - 6.20 A	6.90 - 10.70 A
TI 16C	**047H0210**	10	0.12	6.00 - 9.20 A	10.00 - 16.00 A
TI 16C	**047H0211**	10	0.12	8.00 - 12.00 A	13.00 - 20.80 A
TI 16C	**047H0212**	10	0.12	11.00 - 16.00 A	19.00 - 27.00 A
TI 25C	**047H0213**	10	0.12	15.00 - 20.00 A	26.00 - 35.00 A
TI 25C	**047H0214**	10	0.12	19.00 - 25.00 A	33.00 - 43.00 A
TI 30C	**047H0215**	10	0.12	24.00 - 32.00 A	41.00 - 55.00 A

TI (80-86 series) Thermal overload relays

The thermal overload relays TI 80-86 cover the range from 16-85 Amp and protect squirrel cage motors of up to 45 kW against overload.

- For use with contactors CI 32 to CI 86
- Compact design
- Stop/reset button
- Manual/automatic reset function
- Test trip function
- DOL scale / Y-∆ scale
- Changeover contact
- Single phase failure protection

Type	Code No	Pack Size	Weight *[kg]*	Current. motor starter	Current. star-delta starter
TI 80	**047H1013**	10	0.34	16.00 - 23.00 A	28.00 - 40.00 A
TI 80	**047H1014**	10	0.33	22.00 - 32.00 A	38.00 - 56.00 A
TI 80	**047H1015**	10	0.34	30.00 - 45.00 A	52.00 - 78.00 A
TI 80	**047H1016**	10	0.34	42.00 - 63.00 A	75.00 - 109.00 A
TI 80	**047H1017**	10	0.34	60.00 - 80.00 A	105.00 - 138.00 A
TI 86	**047H1018**	10	0.35	74.00 - 85.00 A	130.00 - 147.00 A

Circuit breakers

Circuit breakers for short circuit- and overload protection of motor applications, covering the current range from 0.1 to 90 A AC-3 rating. CTI 25MB breakers offer a higher short circuit breaking capacity than the CTI 25M type due to their built-on current limiter. The program is very flexible, featuring add-on accessories such as auxiliary contacts, alarm contacts, voltage-and under voltage trips, connection terminals and bus bars.

CTI 15 Circuit breakers

Circuit breakers / manual motor starters range is modular, flexible and offers a large selection of clip-on auxiliary functions and accessories: auxiliary contact blocks, shunt releases, connection terminal, bus bars and enclosures.

- Power ranges 0.09 – 7.5 Kw / 0.09 – 12.5 kW
- Short-circuit protection
- Operation switch (manual motor starter)
- Isolation switch (with locking device)
- Emergency stop switch (with undervoltage trip)
- Indication functions: (On/Off)
- A large selection of clip-on auxiliary functions and accessories are available

Type	Code No	Pack Size	Weight *[kg]*	Current range	Max. load, AC-3 *[kW]*	Trip current *max.*	Breaking cap. Ics *380 - 415 V*
CTI 15	**047B3051**	21	0.27	0.25 - 0.40 A	0.09 kW	4.4 A	50 kA
CTI 15	**047B3052**	21	0.27	0.40 - 0.63 A	0.12 kW	6.9 A	50 kA
CTI 15	**047B3053**	21	0.27	0.63 - 1.00 A	0.37 kW	11.0 A	50 kA
CTI 15	**047B3054**	21	0.28	1.00 - 1.60 A	0.55 kW	18.0 A	50 kA
CTI 15	**047B3055**	21	0.27	1.60 - 2.50 A	0.75 kW	28.0 A	50 kA
CTI 15	**047B3056**	21	0.31	2.50 - 4.00 A	1.50 kW	44.0 A	30 kA
CTI 15	**047B3057**	21	0.31	4.00 - 6.30 A	2.50 kW	69.0 A	20 kA
CTI 15	**047B3058**	21	0.30	6.30 - 10.00 A	5.50 kW	110.0 A	8 kA
CTI 15	**047B3059**	21	0.31	10.00 - 16.00 A	7.50 kW	176.0 A	6 kA

CTI M Circuit breakers

The CTI product range is modular, flexible and offers a large selection of clip-on auxiliary functions and accessories: Aux. contacts, alarm contacts, voltage- and undervoltage trips.

- Compact design
- Screw or DIN rail mounting
- Motor application
- Overload protection of motors (0.02-11 kW)
- Short-circuit protection
- Standard breaking capacity
- Setting range 0.1-25A
- Operation switch (manual motor starter)
- Isolation switch (with locking device)
- Emergency switch (with undervoltage trip)
- Indications: Test and reset functions / ON or OFF
- Thermal and electromagnetic trip

Type	Code No	Pack Size	Weight *[kg]*	Current range	Max. load, AC-3 *[kW]*	Trip current *max.*	Breaking cap. Ics *380 - 415 V*
CTI 25M	**047B3142**	20	0.29	0,25 - 0,40 A	0,09 kW	5,2 A	100 kA
CTI 25M	**047B3143**	21	0.29	0,40 - 0,63 A	0,18 kW	8,2 A	100 kA
CTI 25M	**047B3144**	21	0.33	0,63 - 1,00 A	0,25 kW	13,0 A	100 kA
CTI 25M	**047B3145**	21	0.33	1,00 - 1,60 A	0,55 kW	21,0 A	100 kA
CTI 25M	**047B3146**	21	0.34	1,60 - 2,50 A	0,75 kW	33,0 A	100 kA
CTI 25M	**047B3147**	21	0.34	2,50 - 4,00 A	1,50 kW	52,0 A	100 kA
CTI 25M	**047B3148**	21	0.33	4,00 - 6,30 A	2,20 kW	82,0 A	100 kA
CTI 25M	**047B3149**	21	0.33	6,30 - 10,00 A	4,00 kW	130,0 A	100 kA
CTI 25M	**047B3150**	21	0.34	10,00 - 16,00 A	7,50 kW	208,0 A	50 kA
CTI 25M	**047B3151**	21	0.34	14,50 - 20,00 A	10,00 kW	260,0 A	15 kA
CTI 25M	**047B3152**	21	0.34	18,00 - 25,00 A	11,00 kW	325,0 A	15 kA

CTI MB Circuit breakers with built-in current limiter

The CTI product range is modular, flexible and offers a large selection of clip-on auxiliary functions and accessories: Aux. contacts, alarm contacts, voltage- and undervoltage trips.

- Compact design
- Screw or DIN rail mounting
- Motor application
- Overload protection of motors (4-22 kW)
- Short-circuit protection
- High breaking capacity
- Setting range 1.6-45A
- Operation switch (manual motor starter)
- Isolation switch (with locking device)
- Emergency switch (with undervoltage trip)
- Indications: Test and reset functions / ON or OFF
- Thermal and electromagnetic trip

Type	Code No	Pack Size	Weight *[kg]*	Current range	Max. load, AC-3 *[kW]*	Trip current *max.*	Breaking cap. Ics *380 - 415 V*
CTI 45MB	**047B3164**	10	0.83	23.00 - 32.00 A	15.00 kW	416.0 A	50 kA
CTI 45MB	**047B3165**	10	0.83	32.00 - 45.00 A	22.00 kW	585.0 A	50 kA

CTI 100 Circuit breakers with built-in current limiter

The CTI product range is modular, flexible and offers a large selection of clip-on auxiliary functions and accessories: Aux. contacts, alarm contacts, voltage- and undervoltage trips.

- Compact design
- DIN rail mounting
- Motor application
- Short-circuit protection
- Overload protection of motors (31.5 - 45 kW)
- Setting range: 40 - 90A
- Operation switch (manual motor starter)
- Isolation switch (with locking device)
- Emergency switch (with undervoltage trip)
- Indications: Test and reset functions / ON or OFF
- Thermal and electromagnetic trip

Type	Code No	Pack Size	Weight *[kg]*	Current range	Max. load, AC-3 *[kW]*	Trip current *max.*	Breaking cap. Ics *380 - 415 V*
CTI 100	**047B3014**	6	2.03	40.00 - 63.00 A	31.50 kW	882.0 A	50 kA
CTI 100	**047B3015**	6	2.00	63.00 - 90.00 A	45.00 kW	1.260.0 A	25 kA

Accessories & spare parts - circuit breakers

Auxiliary contacts - for circuit breakers

Type	Code No	Pack Size	Weight *[kg]*	Function	Mounting	Aux. contacts	Application
CBA-11	**047B3200**	10	0.02	1 make+1 break	Front, max 1 pr circuit breaker	1 NO+1 NC (13-14, 21-22)	CTI 25M-MB, CTI 45MB
CBI 11	**047B3049**	39	0.05	1 make+1 break	Lefthand	1 NO+1 NC (13-14, 21-22)	CTI 25
CBA S-11	**047B3203**	70	0.05	1 make+1 break	Side, max 1 pr circuit breaker	1 NO+1 NC (33-34, 41-42)	CTI 25M-MB, CTI 45MB
CBI-NC	**047B3042**	150	0.01	Break	Building in	1 NC (11-12)	CTI 25
CBI-NO	**047B3040**	150	0.01	Make	Building in	1 NO (13-14)	CTI 25
CBA-10	**047B3198**	10	0.01	Make	Front, max 1 pr circuit breaker	1 NO (13-14)	CTI 25M-MB, CTI 45MB

Covers - for circuit breakers

Type	Code No	Pack Size	Weight *[kg]*	Application	IP
BXI	**047B3091**	40	0.29	Circuit breaker CTI 25	IP41/55
BMG	**047B3284**	1	0.39	CTI 25M-MB	IP65
BMY	**047B3285**	20	0.36	CTI 25M-MB	IP65

Trips - for circuit breakers

Type	Code No	Pack Size	Weight *[kg]*	Description	Control voltage *50 Hz*	Control voltage *60 Hz*	Coil conn.	Application
CBI-UA	**047B3061**	32	0.11	Under voltage trip	220 - 230 V	254 V	D1-D2	CTI 25

Electronic timers

The electronic timers with their robust design and many built-in functions are ideal for OEMs and panel builders.
Easy time setting, electrical noise immunity, mechanical shock and vibration resistance, compact standard dimensions og DIN rail or adaptor mounting

ATI Electronic on-delay timers

The electronic timers with their robust design and many built-in functions are ideal for OEMs and panel builders.

- ON delay
- Easy time setting
- Electrical noise immunity
- Mechanical shock and vibration resistance
- Time ranges: 0.1 s to 30 min
- Compact standard dimensions
- DIN rail or adaptor mounting

Type	Code No	Pack Size	Weight *[kg]*	Function	Control voltage	Control voltage *dc*	Time range
ATI	**047H3092**	21	0.8	On-delay	24/220-240V AC	24 V	0.1 - 10.0 s
ATI	**047H3093**	21	0.8	On-delay	24/220-240V AC	24 V	3.0 - 300.0 s
ATI	**047H3104**	21	0.8	On-delay	24/220-240V AC	24 V	0.3 - 30.0 s
ATI	**047H3105**	21	0.8	On-delay	24/220-240V AC	24 V	0.3 - 30.0 min

BTI Electronic off-delay timers

The electronic timers with their robust design and many built-in functions are ideal for OEMs and panel builders.

- OFF delay
- Easy time setting
- Electrical noise immunity
- Mechanical shock and vibration resistance
- Time ranges: 0.1 s to 300 s
- Compact standard dimensions
- DIN rail or adaptor mounting

Type	Code No	Pack Size	Weight *[kg]*	Function	Control voltage *50/60 Hz*	Time range
BTI	**047H3099**	25	0.8	Off-delay	220 - 240 V	3.0 - 300.0 s

MTI Electronic multi-function timers

The electronic timers with their robust design and many built-in functions are ideal for OEMs and panel builders.

- Easy time setting
- Electrical noise immunity
- Mechanical shock and vibration resistance
- Time ranges: 0.05 s to 300 h
- Compact standard dimensions
- DIN rail or adaptor mounting
- Features:
- On delay
- Off delay
- single pulse pause or pause pulse
- flasher pulse pause or pause pulse
- star-delta start

Type	Code No	Pack Size	Weight *[kg]*	Function	Control voltage	Control voltage *50/60 Hz*	Control voltage *dc*	Time range
MTI	**047H3076**	21	0.15	Multi function	4/42-48/110-240V AC / 24/42-48V DC	-	-	0.05 s - 300 h
MTI	**047H3075**	25	0.16	Multi function	-	24 - 240 V	24 - 240 V	0.05 s - 300 h

SDT Electronic star-delta timers

The star-delta timer has a built-in pause of 30ms switching motor from star configuration to delta run. The electronic timers with their robust design and many built-in functions are ideal for OEMs and panel builders.

- Easy time setting
- Electrical noise immunity
- Mechanical shock and vibration resistance
- Time ranges: 0.3 s to 30 s
- Compact standard dimensions
- DIN rail or adaptor mounting

Type	Code No	Pack Size	Weight *[kg]*	Function	Control voltage	Control voltage *50/60 Hz*	Control voltage *dc*	Time range
SDT	**047H3111**	21	0.9	Star-delta	24/220-240V AC	-	24 V	0.3 - 30.0 s
SDT	**047H3112**	1	0.9	Star-delta	-	380 - 415 V	-	0.3 - 30.0 s

Electronic soft starters

The MCI soft starter range are designed for soft starting and stopping of 3 phase a.c. motors,
starting of 3 phase compressors (MCI C) and starting small commercial refrigeration units & heat pump (MCI-CH) thus reducing the inrush current and eliminating the damaging effects of high starting torque surges.

MCI CI-tronic™ soft starters

Covering the power range from 0.1 to 22 kW, the MCI soft starters are ideal for a wide range of start and stop applications where smooth operation is required.

Use them on pumps, compressors, fans, conveyors, gear or belt driven machinery and countless other types of equipment.

MCI is designed for unlimited number of operations per hour and is just as easy to specify and install as an ordinary contactor.

- Individual adjustable acceleration and deceleration times, up to 60 seconds
- Initial torque adjustable from 0 - 85%
- Breakaway function (Kick Start)
- Universal control voltage: 24-480V ac/dc
- Automatic detection of missing phases
- Automatic adaptation to 50/60 Hz
- LED status indicator
- Built-in varistor protection
- Unlimited start/stop operations per hour
- Optional aux. contacts
- Compact DIN rail mountable design

Type	Code No	Pack Size	Weight *[kg]*	Max. load *[Amp]*	Control voltage *dc*	Control voltage *50/60 Hz*
MCI 3	**037N0074**	12	0.29	3 A	24 - 415 V	24 - 415 V
MCI 12CH	**037N0095**	20	0.39	12 A	-	208 - 240 V
MCI 15CH	**037N0096**	20	0.39	15 A	-	208 - 240 V
MCI 15	**037N0037**	12	0.71	15 A	24 - 240 V	24 - 240 V
MCI 15	**037N0039**	12	0.72	15 A	24 - 480 V	24 - 480 V
MCI 15C	**037N0076**	12	0.69	15 A	24 - 480 V	24 - 480 V
MCI 25CH	**037N0097**	20	0.43	25 A	-	208 - 240 V
MCI 25	**037N0040**	8	1.16	25 A	24 - 480 V	24 - 480 V
MCI 25B	**037N0062**	8	1.21	25 A	24 - 480 V	24 - 480 V
MCI 30 I-O	**037N0070**	8	1.17	30 A	24 - 480 V	24 - 480 V
MCI 50-3 I-O	**037N0090**	1	2.87	50 A	24 - 480 V	24 - 480 V

TCI CI-tronic™ torque limiters

TCI starting torque limiters are designed for soft starting of 1- and 3-phase AC motors.

The TCI unit is easy to install between the motor starter and the motor, and features adjustable ramp-up time and initial torque.

- Single and three-phase operation
- Adjustable ramp-up times from 0.5 - 5 seconds
- Initial torque from 0-85%
- Built-in varistor protection
- Unlimited start/stop operations per hour
- Compact DIN-rail mountable design

Type	Code No	Pack Size	Weight *[kg]*	Line volt. *@ 50/60 Hz*	Max. load *[Amp]*
TCI 15	**037N0045**	12	0.67	230 - 480 V	15 A
TCI 15CH-C	**037N0111**	20	0.39	380 - 415 V	15 A
TCI 25C	**037N0086**	12	0.70	220 - 240 V	25 A
TCI 25	**037N0046**	12	0.68	230 - 480 V	25 A
TCI 25CH-C	**037N0112**	20	0.43	380 - 415 V	25 A

Electronic motor starters

Complete electronic motor starter with integrated protection and control features. Offers better reduction of starting current than traditional star/delta starter.

MCI CL Complete electronic motor starters

Offers better reduction of starting current than a traditional star/ delta starter

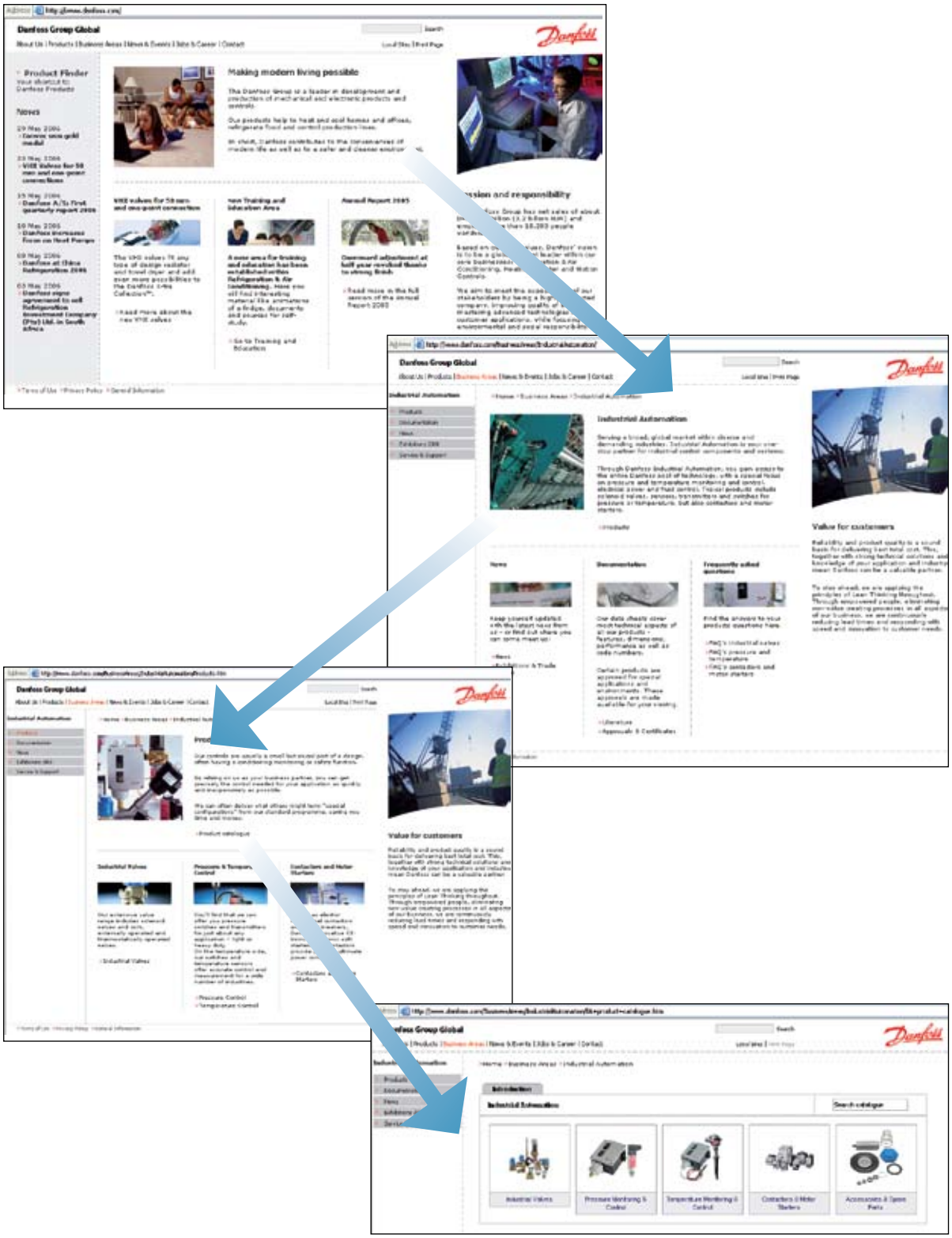
- IP 65
- Main and repair switch
- Short circuit and overload protection
- Manual and remote operation of starter
- Terminal strip for connection
- Control circuit fuses
- Only 3 conductors for motor
- No zero conductor necessary
- CE approval

Type	Code No	Pack Size	Weight *[kg]*	Control voltage *50/60 Hz*	Control voltage *dc*	Line volt. *@ 50/60 Hz*	Max. load *[Amp]*	Max. load, AC-3 *[kW]*
MCI 15CL	**037N0150**	1	5.32	24 - 480 V	24 - 480 V	400 V	15 A	7.50 kW
MCI 25CL	**037N0151**	1	6.38	24 - 480 V	24 - 480 V	400 V	25 A	11.00 kW
MCI 30CL	**037N0152**	1	6.84	24 - 480 V	24 - 480 V	400 V	30 A	15.00 kW
MCI 45CL	**037N0153**	1	9.36	24 - 480 V	24 - 480 V	400 V	45 A	22.00 kW

Code No

All the information you need at http://www.danfoss.com

Use our website - the fastest route to product information on our entire product range, technical datasheets for download and much more on http://www.danfoss.com. The site will guide you through to all the information you need.



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MAKING MODERN LIVING POSSIBLE

Danfoss VLT Drives
VLT® Product Catalogue

50%

Energy saving

Speed control of fans and pumps can in many cases lead to significant energy savings.

www.danfoss.com/drives

VLT® THE REAL DRIVE

Contents

VLT® AutomationDrive

The premier, globally supported drive concept for exceptional control of motor driven applications.

Designed for variable speed control of all asynchronous motors and permanent magnet motors, on any industrial machine or production line, a VLT® AutomationDrive helps its owner save energy, increase flexibility, and optimize processes.

Flexible and expandable

Built on a flexible, modular design concept the AutomationDrive is packed with standard, industry features out of the box. These can be expanded with plug-and-play options with additional features, positioning control, fieldbuses, safety functions such as STO, SS1, SLS, SMS and SSM, motor protection and more.

Robust and safe

VLT AutomationDrives are proven performers in all industrial environments and grid voltages, including 690V. Enclosures are available up to IP 66 (depending on model), and integrated DC chokes and RFI filters in all models protect installations by minimizing harmonic distortion and electromagnetic interferences. All drives are fully tested at the factory before they are shipped.

Feature	Benefit
Reliable	**Maximum uptime**
Ambient temperature 50° C without derating	Less need for cooling or oversizing
Available in IP 00, 20, 21, 54, 55 and 66 enclosures	Enclosures for all environments
Resistant to wear and tear	Low lifetime cost
Back-channel cooling for frame D, E and F	Prolonged lifetime of electronics
User-friendly	**Saves commissioning and operating cost**
Plug-and-Play technology	Easy upgrade and changeover
Awarded control panel	User-friendly
Intuitive VLT® interface	Saves time
Pluggable cage clamp connectors	Easy connection
Exchangeable languages	User-friendly
Intelligent	
Intelligent warning systems	Warning before controlled stop
Smart Logic Control	Reduces need for PLC capacity
Advanced plug-in features	Easy commissioning
Safe stop	Safety cat. 3, PL d (ISO 13849-1), Stop cat. 0 (EN 60204-1)
STO: Safe Torque Off (IEC 61800-5-2)	SIL 2 (IEC 61508) SIL CL 2 (IEC 62061)
Intelligent heat management	Intelligent heat management

Easy to set up and operate via the user-friendly graphical control panel, a VLT AutomationDrive only requires little maintenance once in operation. The result is an market leading control solution that provides a fast return on investment and a highly competitive cost of ownership.

Power range

3 x 200 – 240 V..... 0.25 – 37 kW
3 x 380 – 480/500 V..... 0.37 – 800 kW
3 x 525 – 600 V.....0.75 kW – 75 kW
3 x 525 – 690 V..... 1.1 kW – 1.2 MW
Normal overload.....1.5 kW – 1.4 MW

Fieldbus options
- VLT® PROFIBUS DP MCA 101
- VLT® DeviceNet MCA 104
- VLT® CanOpen MCA 105
- VLT® Profibus Converter MCA 113
- VLT® Profibus Converter MCA 114
- VLT® PROFINET MCA 120
- VLT® Ethernet/IP MCA 121
- VLT® Modbus TCP MCA 122
- VLT® POWERLINK MCA 123
- VLT® EtherCAT MCA 124
- VLT® DeviceNet Converter MCA 194

I/O and feedback options
- VLT® General Purpose I/O MCB 101
- VLT® Encoder Input MCB 102
- VLT® Resolver Input MCB 103
- VLT® Relay Card MCB 105
- VLT® 24 V External Supply MCB 107
- VLT® Extended Relay Card MCB 113
- VLT® Sensor Input MCB 114

Safety options
- VLT® Safe PLC I/O MCB 108
- VLT® PTC Thermistor Card MCB 112
- VLT® Safe Option MCB 140 Series
- VLT® Safe Option MCB 150 Serie

Motion Control Options
- VLT® Motion Control Option MCO 305
- VLT® Synchronizing Controller MCO 350
- VLT® Position Controller MCO 351
- VLT® Center Winder MCO 352

Power options
- VLT® Brake resistors MCE 101
- VLT® Sine-Wave Filters MCC 101
- VLT® dU/dt Filters MCC 102
- VLT® Common Mode Filter MCC 105
- VLT® Advanced Harmonic Filters AHF 005/010

Other accessories
- IP 21/NEMA 1 Kit (convert IP 20 to IP 21)
- PROFIBUS adapter
- Sub-D9 Connector
- Decoupling plate for fieldbus cables
- USB connection cable to PC
- Panel Through option
- LCP panel mounting kit
- Mounting brackets
- Mains disconnect option
- USB Extension
- Interbus gateway MCA 110
- Option Adapter
- RCMB20/RCMB35 Leakage Current Monitor Module

Specifications

Mains supply (L1, L2, L3)	
Supply voltage	200 – 240 V ±10% FC 301: 380 – 480 V ±10% FC 302: 380 – 500 V ±10%, 525 – 600 V ±10% 525 – 690 V ±10%
Supply frequency	50/60 Hz
True Power Factor (λ)	0.92 nominal at rated load
Displacement Power Factor (cos φ) near unity	(> 0.98)
Switching on input supply L1, L2, L3	Maximum 2 times/min.

Output data (U, V, W)	
Output voltage	0 – 100% of supply voltage
Output frequency	FC 301: 0.2 – 590 Hz (0.25 – 75 kW) FC 302: 0 – 590 Hz (0.25 – 75 kW) 0 – 590 Hz (90 – 1200 kW) 0 – 300 Hz (Flux mode)
Switching on output	Unlimited
Ramp times	1–3600 sec.

Note: 160% current can be provided for 1 minute.
Higher overload rating is achieved by oversizing the drive.

Digital inputs	
Programmable digital inputs	FC 301: 4 (5) / FC 302: 4 (6)
Logic	PNP or NPN
Voltage level	0 – 24 VDC

Note: One/two digital inputs can be programmed as digital output for FC 301/FC 302.

Analogue input	
Analogue inputs	2
Modes	Voltage or current
Voltage level	FC 301: 0 to +10 V FC 302: -10 to +10 V (scaleable)
Current level	0/4 to 20 mA (scaleable)

Pulse/encoder inputs	
Programmable pulse/encoder inputs	FC 301: 1 / FC 302: 2
Voltage level	0 – 24 V DC (PNP positive logic)

Digital output*	
Programmable digital/pulse outputs	FC 301: 1 / FC 302: 2
Voltage level at digital/frequency output	0 – 24 V

Analogue output*	
Programmable analogue outputs	1
Current range	0/4 – 20 mA

Relay outputs*	
Programmable relay outputs	FC 301: 1 / FC 302: 2

Cable lengths	
Max. motor cable lengths	FC 301: 50 m / FC 302: 150 m (screened/armoured) FC 301: 75 m / FC 302: 300 m (unscreened/unarmoured)

**More analogue and digital inputs/outputs can be added with options.*

Brake chopper (IGBT) option
Limits the load on the intermediate circuit in the case the motor acts as a generator.

High power options
- Emergency stop with Safety Relay
- Safety Stop with Safety Relay
- RFI Filters
- NAMUR terminals
- Residual Current Device
- Insulation Resistance Monitor
- Mains shielding
- Regen terminals

Please see the VLT® High Power Drive Selection Guide for the complete range of options.

Current and power ratings

	T2 200 – 240 V							T4/T5 380 – 480/500 V									
	kW		Amp.					Amp. HO		Amp. NO							
FC 300	HO	NO	HO	NO	IP 20	IP 21	IP 55	IP 66	≤440 V	>440 V	≤440 V	>440 V	IP 00	IP 20	IP 21	IP 54	IP 55	IP 66
PK25	0.25		1.8		A1*/A2	A2	A4/A5	A4/A5										
PK37	0.37		2.4						1.3	1.2	1.3	1.2		A1*/A2	A1*/A2		A4/A5	A4/A5
PK55	0.55		3.5						1.8	1.6	1.8	1.6						
PK75	0.75		4.6						2.4	2.1	2.4	2.1						
P1K1	1.1		6.6						3	2.7	3	2.7						
P1K5	1.5		7.5						4.1	3.4	4.1	3.4						
P2K2	2.2		10.6		A2				5.6	4.8	5.6	4.8		A2	A2			
P3K0	3		12.5		A3	A3	A5	A5	7.2	6.3	7.2	6.3						
P3K7	3.7		16.7															
P4K0	4.0								10	8.2	10	8.2		A2	A2		A4/A5	
P5K5	5.5	7.5	24.2	30.8	B3	B1	B1	B1	13	11	13	11		A3	A3		A5	A5
P7K5	7.5	11	30.8	46.2					16	14.5	16	14.5						
P11K	11	15	46.2	59.4	B4	B2	B2	B2	24	21	32	27		B3	B1		B1	B1
P15K	15	18	59.4	74.8					32	27	37.5	34						
P18K	18.5	22	74.8	88	C3	C1	C1	C1	37.5	34	44	40		B4	B2		B2	B2
P22K	22	30	88	115					44	40	61	52						
P30K	30	37	115	143	C4	C2	C2	C2	61	52	73	65		C3	C1		C1	C1
P37K	37	45	143	170					73	65	90	80						
P45K	45	55							90	80	106	105						
P55K	55	75							106	105	147	130		C4	C2		C2	C2
P75K	75	90							147	130	177	160						
N55K																		
N75K																		
N90K	90	110							177	160	212	190		D3h	D1h/ D5h/ D6h	D1h/ D5h/ D6h		
N110	110	132							212	190	260	240						
N132	132	160							260	240	315	302						
N160	160	200							315	302	395	361		D4h	D2h/ D7h/ D8h	D2h/ D7h/ D8h		
N200	200	250							395	361	480	443						
N250	250	315							480	443	588	535						
N315	315																	
P250	250	315							480	443	600	540	E2		E1	E1		
P315	315	400							600	540	658	590						
P355	355	450							658	590	745	678						
P400	400	500							695	678	800	730						
P450	450	500							800	730	880	780			F1/F3	F1/F3		
P500	500	560							880	780	990	890						
P560	560	630							990	890	1120	1050						
P630	630	710							1120	1050	1260	1160						
P710	710	800							1260	1160	1460	1380			F2/F4	F2/F4		
P800	800	1000							1460	1380	1720	1530						
P900	900	1000																
P1M0	1000	1200																
P1M2	1200	1400																
P1M4	*Consult factory*																	
P1M6																		

* For selection of A1 see enclosure types in the code position 4 (FC 301 only)

IP 00/Chassis	IP 20/Chassis	IP 21/Type 1	With upgrade kit – available in US only	IP 54/Type 12	IP 55/Type 12	IP 66/NEMA 4X

			T6 525 – 600 V								T7 525 – 690 V									
	kW		Amp. HO		Amp. NO		IP20	IP 21	IP 55	IP 66	Amp. HO		Amp. NO		IP 00	IP 20	IP 21	IP 54	IP 55	IP 66
FC 300	HO	NO	≤550 V	>550 V	≤550 V	>550 V					550 V	690 V	550 V	690 V						
PK25	0.25																			
PK37	0.37																			
PK55	0.55																			
PK75	0.75				1.8	1.7	A3	A3	A5	A5										
P1K1	1.1				2.6	2.4					2.1	1.6				A3	A3			
P1K5	1.5				2.9	2.7					2.7	2.2								
P2K2	2.2				4.1	3.9					3.9	3.2								
P3K0	3				5.2	4.9					4.9	4.5								
P3K7	3.7																			
P4K0	4.0				6.4	6.1	A3	A3	A5	A5	6.1	5.5				A3	A3			
P5K5	5.5	7.5			9.5	9					9	7.5								
P7K5	7.5	11			11.5	11					11	10	14	13						
P11K	11	15	19	18	23	22	B3	B1	B1	B1	14	13	19	18		B4	B2		B2	
P15K	15	18	23	22	28	27					19	18	23	22						
P18K	18.5	22	28	27	36	34	B4	B2	B2	B2	23	22	28	27						
P22K	22	30	36	34	43	41					28	27	36	34						
P30K	30	37	43	41	54	52		C1	C1	C1	36	34	43	41			C2		C2	
P37K	37	45	54	52	65	62	C3				43	41	54	52		C3				
P45K	45	55	65	62	87	83					54	52	65	62						
P55K	55	75	87	83	105	100	C4	C2	C2	C2	65	62	87	83						
P75K	75	90	105	100	137	131					87	83	105	100						
N55K	55	75									76	73	90	86		D3h	D1h/D5h/D6h	D1h/D5h/D6h		
N75K	75	90									90	86	113	108						
N90K	90	110									113	108	137	131						
N110	110	132									137	131	162	155						
N132	132	160									162	155	201	192						
N160	160	200									201	192	253	242		D4h	D2h/D7h/D8h	D2h/D7h/D8h		
N200	200	250									253	242	303	290						
N250	250	315									303	290	360	344						
N315	315	400									360	344	418	400						
P250	250	315																		
P315	315	400																		
P355	355	450									395	380	470	450	E2		E1	E1		
P400	400	500									429	410	523	500						
P450	450	500																		
P500	500	560									523	500	596	570	E2		E1	E1		
P560	560	630									596	570	630	630						
P630	630	710									659	630	763	730			F1/F3	F1/F3		
P710	710	800									763	730	899	850						
P800	800	900									889	850	988	945						
P900	900	1000									988	945	1108	1060			F2/F4	F2/F4		
P1M0	1000	1200									1108	1060	1317	1260						
P1M2	1200	1400									1317	1260	1479	1415						

Dimensions [mm]

	A1	A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4	D1h	D2h	D3h	D4h	D5h	D6h	D7h	D8h	E1	E2	F1	F2	F3	F4
H	200	268		390	420	480	650	399	520	680	770	550	660	901	1107	909	1122	1324	1665	1978	2284	2000	1547	2280	2280	2280	2280
W	75	90	130	200	242			165	230	308	370	308	370	325	420	250	350	325		420		600	585	1400	1804	1997	2401
D	207	205		175	200	260		249	242	310	335	333		378		375		381		384	402	494	498	607	607	607	607
H+		375						475	670			755	950														
W+		90	130					165	255			329	391														

Note: *H and W dimensions are with back-plate. H+ and W+ are with IP upgrade kit. D dimensions are without option. A or B for A2 and A3.*

VLT® HVAC Drive

The VLT® HVAC Drive series is available in a wide power range designed for all HVAC applications. An advanced drive built on HVAC dedication.

The VLT® HVAC Drive is a full-featured, HVAC dedicated drive with built-in intelligence. Every VLT® HVAC Drive is based on 25 years of experience and innovation.

The VLT® HVAC Drive has a vast number of functions developed to meet the diverse needs of the HVAC business. Easy to use, all models follow the same basic design and operating principle. Once you know one, you know them all.

It is the perfect match for pumps, fans and compressors in modern buildings that are fitted with increasingly sophisticated solutions.

Product range

3 x 200 – 240 V..... 1.1 – 45 kW
3 x 380 – 480 V.....1.1 – 1000 kW
3 x 525 – 600 V..... 1.1 – 90 kW
3 x 525 – 690 V..... 1.1 – 1400 kW
With 110% over load torque

Available enclosure ratings

IP 00.....335 – 630 kW
IP 20.....1.1 – 400 kW
IP 21 (Type 1).....1.1 – 1400 kW
IP 54 (Type 12) ..... 75 – 1400 kW
IP 55 (Type 12) ..... 1.1 – 90 kW
IP 66 (NEMA 4X indoor)..... 1.1 – 90 kW

Optional coating providing extra protection for aggressive environments.

Feature	Benefit
All built-in – low investment	
Modular product concept and a wide range of options	Low initial investment – max. flexibility, later upgrade possible
Dedicated HVAC I/O functionality for temperature sensors etc.	External conversion saved
Decentral I/O control via serial communication	Reduced wiring costs, and external controller I/O saved
Wide range of HVAC protocols for BMS controller connectivity	Less extra gateway solutions needed
4 x auto tuned PID's	No external PID controller needed
Smart Logic Controller	Often makes PLC unnecessary
Real Time Clock	Enables daily and weekly settings
Integrated fan, pump and compressor functionality i.e.	Saves external control and conversion equipment
Fire Override Mode, Dry run Detection Constant Torque etc.	Protects equipment and saves energy
Back-channel cooling for frame D, E and F frame	Prolonged lifetime of electronics
Save energy – less operation cost	
Automatic Energy Optimizer function, advanced version	Saves 5 – 15% energy
Advanced energy monitoring	Overview on energy consumption
Energy saving functions i.e. flow compensation, sleep mode etc.	Saves energy
Unequalled robustness – maximum uptime	
Robust single enclosure	Maintenance-free
Unique cooling concept with no ambient air flow over electronics	Problem-free operation in harsh environments
Max ambient temp. 50° C without derating	No external cooling or oversize necessary
User-friendly – save commissioning and operating cost	
Smart start	Quick and precise start-up
Awarded graphical display, 27 languages	Effective commissioning and operation
USB plug and play connection	Easy to use PC software tools
Global HVAC support organisation	Local service – globally
Built-in DC coils and RFI filters – no EMC concerns	
Integrated DC link harmonic filters	Small power cables. Meets EN 61000-3-12
Integrated EMC filters	Meets EN 55011 Class B, A1 or A2 and IEC61800-3 Category C1, C2 and C3

Application options

A wide range of integrated HVAC options can be fitted in the drive:

VLT® General Purpose I/O MCB 101
3 digital inputs, 2 digital outputs, 1 analogue current output, 2 analogue voltage inputs.

VLT® Relay Card MCB 105
Adds 3 relay outputs

VLT® Analog I/O MCB 109
3 PT1000/Ni1000 inputs, 3 analogue voltage outputs and back-up power for Real-Time Clock.

VLT® 24 V External Supply MCB 107
24 V DC external supply can be connected to supply, control and option cards.

Sensor input card
Sensor input card for motor protection with 2 or 3 PT100 or PT1000 inputs (VLT® Sensor Input MCB 114).

Brake chopper (IGBT) option
Connected to an external brake resistor, the built-in brake chopper limits the load on the intermediate circuit in the case the motor acts as a generator.

Power options

A wide range of external power options are available for VLT® HVAC Drive in critical networks or applications:

- **Advanced Harmonic Filters:** For critical demands on harmonic distortion
- **dU/dt filters:** For special demands on motor isolation protection
- **Sine-Wave filters**

HVAC PC software tools

- **VLT® Motion Control Tool MCT 10:** Ideal for commissioning and servicing the drive
- **VLT® Energy Box:** Comprehensive energy analysis tool. Energy consumption with and w/o drive can be calculated (drive payback time). Online function for accessing drives energy log.
- **VLT® Motion Control Tool MCT 31:** Harmonics calculations tool

Specifications

Mains supply (L1, L2, L3)	
Supply voltage	200–240 V ±10% 380–480 V ±10% 525–600 V ±10% 525–690 V ±10%
Supply frequency	50/60 Hz
Displacement Power Factor (cos φ) near unity	(> 0.98)
Switching on input supply L1, L2, L3	1–2 times/min.
Output data (U, V, W)	
Output voltage	0 – 100% of supply voltage
Switching on output	Unlimited
Ramp times	1–3600 sec.
Output frequency	0–590 Hz
Digital inputs	
Programmable digital inputs	6*
Logic	PNP or NPN
Voltage level	0 – 24 VDC

** 2 can be used as digital outputs*

Pulse inputs	
Programmable pulse inputs	2*
Voltage level	0–24 VDC (PNP positive logic)
Pulse input accuracy	(0.1–110 kHz)

** Utilize some of the digital inputs*

Analogue input	
Analogue inputs	2
Modes	Voltage or current
Voltage level	0 V to +10 V (scaleable)
Current level	0/4 to 20 mA (scaleable)
Analogue output	
Programmable analogue outputs	1
Current range at analogue output	0/4 – 20 mA
Relay outputs	
Programmable relay outputs	2 (240 VAC, 2 A and 400 VAC, 2 A)
Fieldbus communication	
Standard built-in: FC Protocol N2 Metasys Modbus RTU BACnet embedded	Optional: VLT® LonWorks MCA 108 VLT® BACnet MCA 109 VLT® DeviceNet MCA 104 VLT® PROFIBUS DP MCA 101 VLT® PROFINET MCA 120 VLT® EtherNet/IP MCA 121 VLT® Modbus TCP MCA 122

High power options

- IEC Emergency stop with Safety Relay
- Safety Stop with Safety Relay
- RFI Filters
- NAMUR terminals
- RCD
- IRM
- Mains shielding
- Regen terminals

Please see the VLT® High Power Drive Selection Guide for the complete range of options.

Current and power ratings

		T2 200 – 240 V					T4 380 – 480 V							T6 525 – 600 V					T7 525 – 690 V						
							Amp.							Amp.					Amp.						
FC 102	kW	Amp.	IP 20	IP 21	IP 55	IP 66	≤440 V	>440 V	IP 00	IP 20	IP 21	IP 54	IP 55	IP 66	≤550 V	>550 V	IP 20	IP 21	IP 55	IP 66	550 V	690 V	IP 00	IP 20	IP 21	IP 54	IP 55	IP 66
P1K1	1.1	6.6	A2	A2	A4/A5	A4/A5	3	2.7		A2	A2		A4/A5	A4/A5	2.6	2.4	A3	A3	A5	A5	2.1	1.6		A3				
P1K5	1.5	7.5					4.1	3.4							2.9	2.7					2.7	2.2						
P2K2	2.2	10.6					5.6	4.8							4.1	3.9					3.9	3.2						
P3K0	3	12.5	A3	A3	A5	A5	7.2	6.3							5.2	4.9					4.9	4.5						
P3K7	3.7	16.7																										
P4K0	4.0						10	8.2		A2	A2		A4/A5		6.4	6.1					6.1	5.5						
P5K5	5.5	24.2	B3	B1	B1	B1	13	11		A3	A3		A5	A5	9.5	9	A3	A3	A5	A5	9	7.5		A3				
P7K5	7.5	30.8					16	14.5							11.5	11					11	10						
P11K	11	46.2					24	21		B3	B1		B1	B1	19	18	B3	B1	B1	B1	14	13			B2		B2	
P15K	15	59.4	B4	B2	B2	B2	32	27							23	22					19	18						
P18K	18	74.8					37.5	34							28	27					23	22						
P22K	22	88	C3	C1	C1	C1	44	40		B4	B2		B2	B2	36	34	B4	B2	B2	B2	28	27						
P30K	30	115					61	52							43	41					36	34						
P37K	37	143	C4	C2	C2	C2	73	65							54	52					43	41						
P45K	45	170					90	80		C3	C1		C1	C1	65	62	C3	C1	C1	C1	54	52		C3	C2		C2	
P55K	55						106	105							87	83					65	62						
P75K	75						147	130		C4	C2		C2	C2	105	100	C4	C2	C2	C2	87	83						
P90K	90						177	160							137	131					105	100						
N75K*	75																				90	86		D3h	D1h/ D5h/ D6h	D1h/ D5h/ D6h		
N90K*	90																				113	108						
N110	110						212	190		D3h	D1h/ D5h/ D6h	D1h/ D5h/ D6h									137	131						
N132	132						260	240													162	155						
N160	160						315	302													201	192						
N200	200						395	361		D4h	D2h/ D7h/ D8h	D2h/ D7h/ D8h									253	242		D4h	D2h/ D7h/ D8h	D2h/ D7h/ D8h		
N250	250						480	443													303	290						
N315	315						588	535													360	344						
N400	400																				418	400						
P355	355						658	590	E2		E1	E1																
P400	400						745	678																				
P450	450						800	730													470	450	E2		E1	E1		
P500	500						880	780			F1/F3	F1/F3									523	500						
P560	560						990	890													596	570						
P630	630						1120	1050													630	630						
P710	710						1260	1160													763	730			F1/F3	F1/F3		
P800	800						1460	1380			F2/F4										889	850						
P900	900																				988	945						
P1M0	1000						1720	1530			F2/F4										1108	1060			F2/F4	F2/F4		
P1M2	1200																				1317	1260						
P1M4	1400																				1479	1415						

* @ 690 V

IP 00/Chassis	IP 20/Chassis	IP 21/Type 1	With upgrade kit – available in US only	IP 54/Type 12	IP 55/Type 12	IP 66/NEMA 4X

Dimensions [mm]

	A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4	D1h	D2h	D3h	D4h	D5h	D6h	D7h	D8h	E1	E2	F1	F2	F3	F4
H	268		390	420	480	650	399	520	680	770	550	660	901	1107	909	1122	1324	1665	1978	2284	2000	1547	2280	2280	2280	2280
W	90	130	200	242			165	230	308	370	308	370	325	420	250	350	325		420		600	585	1400	1804	1997	2401
D	205		175	200	260		249	242	310	335	333		378		375		381		384	402	494	498	607	607	607	607
H+	375						475	670			755	950														
W+	90	130					165	255			329	391														

Note: *H and W dimensions are with back-plate. H+ and W+ are with IP upgrade kit. D dimensions are without option. A or B for A2 and A3.*

VLT® Refrigeration Drive

Dedicated

to refrigeration application

Specially designed for the needs of refrigeration applications, but also capable of running pump and fan applications.

Regardless if you want to operate compressors, pumps or fans, the VLT® Refrigeration Drive FC 103 provides you the possibility to save energy and extend the lifetime of the components.

Speed control provides many benefits in all motor driven parts of refrigeration applications. The VLT® Refrigeration Drive moves the user in the position to profit from this in a very simple way by saving energy and prolonging lifetime of essential equipment.

One drive for all

The VLT® Refrigeration Drive FC 103 covers a power range between 1.1-315 kW. Available in a variety of protection classes the drive suits the needs of pump, fan and compressor applications. Every application and power size can be operated and programmed with the same common user interface.

Easy commissioning

The VLT Refrigeration Drive FC 103 offers a setup Wizard, using common refrigeration terms rather than computer language, making installation quick and easy for service technicians and installers.
The wizard menu also supports the commissioning engineers if they encounter any problems. The menu will help the engineer troubleshoot and offer solutions to get the drive up and running again if there is a problem.

Feature	Benefit
Robust single enclosure	Maintenance free
Protection classes IP 20/21/55/66	Fits every application
Coated electronics (class 3C2 or 3C3)	Withstands challenging environments
Max. ambient temp. 50˚ C without derating	No external cooling or oversize necessary
Software features	**Benefits**
Sleep mode	Optimum system efficiency
Thermostat/Pressostat function	System protection
Fieldbus (AKD LON, Modbus RTU…)	Open for all kind of controllers
Velocity-to-flow conversion	Saves costs
Day/Night Control	Reduces wear and energy consumption
Advanced energy monitoring	Overview of energy consumption
Pressure to temperature conversion	Saves costs
Compressor features	**Benefits**
High starting torque	Operates all types of compressor
PO optimization	Optimum system efficiency
Injection on/off	Improves refrigeration processes
Discharge temperature monitor	Protects the compressor
Pack controller	Saves energy and reduce maintenance
Neutral zone controller	Handling of unsymmetrical zones
Pump features	**Benefits**
Pump cascade controller	Saves energy and reduce maintenance
Dry pump protection and end of curve	Protects the pump
Flow compensation	Saves energy
Fan features	**Benefits**
Broken belt detection	Protects the system
Operate induction motors in parallel	Reduces investment cost
Automatic Energy Optimizer AEO function	Saves energy
No EMC concerns	**Benefits**
Integrated DC link harmonic filters	Low harmonic load on mains
Integrated EMC filters	No external filters required

Product range

3 x 200 – 240 V..... 1.1 – 45 kW
3 x 380 – 480 V.....1.1 – 315 kW
3 x 525 – 600 V..... 1.1 – 90 kW
With 110% overload torque

Available enclosure ratings

IP 20 (NEMA 1).....1.1 – 315 kW
IP 21 (NEMA 1).....1.1 – 315 kW
IP 54 (NEMA 12).....110 – 315 kW
IP 55 (NEMA 12)..... 1.1 – 90 kW
IP 66 (NEMA 4X)..... 1.1 – 90 kW
Standard coating providing extra protection for aggressive environments.

Options

A wide range of VLT® Refrigeration Drive FC 103 options are available mounted and tested from the factory or as plug-and-play options for later upgrades.

VLT® General purpose I/O MCB 101
3 digital inputs, 2 digital outputs,
1 analogue current output,
2 analogue voltage inputs

VLT® Relay Card MCB 105
3 relay outputs

VLT® Analogue I/O MCB 109
3 Pt1000/Ni1000 inputs,
3 analogue voltage outputs
Buffer for Real Time Clock

VLT® 24 V External Supply MCB 107
24 V DC external supply can be connected to supply control- and option cards.

Filters

- **Advanced Harmonic Filters:** For critical demands on harmonic distortion
- **dU/dt filters:** For special demands on motor isolation protection
- **Sine-Wave filters:** For noiseless motor operation or special demands on motor isolation protection

PC software tools

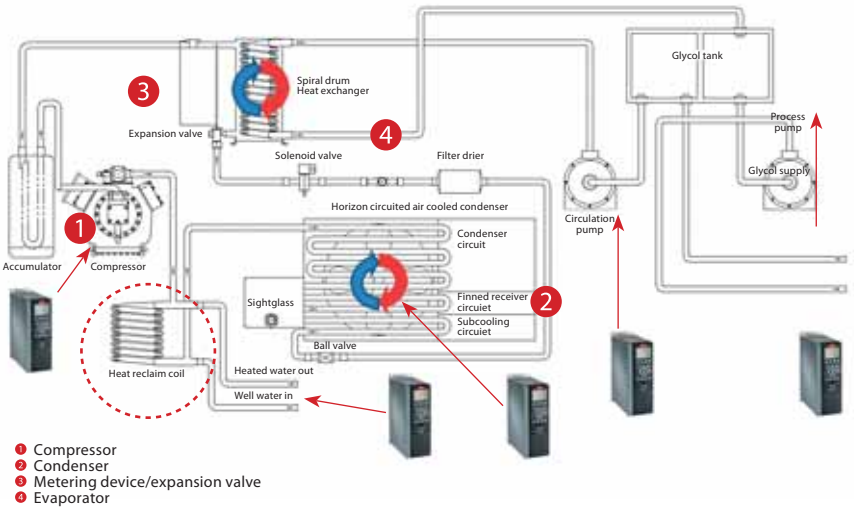
- **VLT® Motion Control Tool MCT 10:** Ideal for commissioning and servicing the drive

Specifications

Mains supply (L1, L2, L3)	
Supply voltage	200 – 240 V ±10% 380 – 480 V ±10% 525 – 600 V ±10%
Supply frequency	50/60 Hz
Displacement Power Factor (cos φ)	Near unity (> 0.98)
Switching on input supply L1, L2, L3	1-2 times/min.
Output data (U, V, W)	
Output voltage	0 – 100% of supply voltage
Switching on output	Unlimited
Ramp times	1 – 3600 sec.
Output frequency	0 – 590 Hz
Digital inputs	
Programmable digital inputs	6*
Logic	PNP or NPN
Voltage level	0 – 24 V

** 2 can be used as digital outputs*

Analogue input	
Analogue inputs	2
Modes	Voltage or current
Voltage level	0 – 10 V (scaleable)
Current level	0/4 to 20 mA (scaleable)
Relay outputs	
Programmable relay outputs	2 (240 VAC, 2 A and 400 VAC, 2 A)
Fieldbus communication	
Standard built-in: FC Protocol Modbus RTU N2 Metasys	Optional: VLT® AK-LonWorks MCA 107 VLT® PROFIBUS MCA 101 VLT® PROFINET MCA 120



VLT® Refrigeration Drive FC 103 provides speed control of all motor driven components and interacts with the major components

Current and power ratings

		T2 200 – 240 V					T4 380 – 480 V							T6 525 – 600 V*					
							Amp.							Amp.					
FC 103	kW	Amp.	IP 20	IP 21	IP 55	IP 66	≤440 V	>440 V	IP 20	IP 21	IP 54	IP 55	IP 66	≤550 V	>550 V	IP 20	IP 21	IP 55	IP 66
P1K1	1.1	6.6	A2	A2	A4/A5	A4/A5	3	2.7	A2	A2		A4/A5	A4/A5	2.6	2.4	A3	A3	A5	A5
P1K5	1.5	7.5					4.1	3.4						2.9	2.7				
P2K2	2.2	10.6					5.6	4.8						4.1	3.9				
P3K0	3	12.5	A3	A3	A5	A5	7.2	6.3						5.2	4.9				
P3K7	3.7	16.7																	
P4K0	4.0						10	8.2	A2	A2		A4/A5		6.4	6.1	A3	A3	A5	A5
P5K5	5.5	24.2	B3	B1	B1	B1	13	11	A3	A3		A5	A5	9.5	9				
P7K5	7.5	30.8					16	14.5						11.5	11				
P11K	11	46.2					24	21	B3	B1		B1	B1	19	18	B3	B1	B1	B1
P15K	15	59.4	B4	B2	B2	B2	32	27						23	22				
P18K	18	74.8		C1	C1	C1	37.5	34						28	27				
P22K	22	88	C3				44	40	B4	B2		B2	B2	36	34	B4	B2	B2	B2
P30K	30	115					61	52						43	41				
P37K	37	143	C4	C2	C2	C2	73	65	C3	C1		C1	C1	54	52	C3	C1	C1	C1
P45K	45	170					90	80						65	62				
P55K	55						106	105						87	83				
P75K	75						147	130	C4	C2		C2	C2	105	100	C4	C2	C2	C2
P90K	90						177	160						137	131				
N110	110						212	190	D3h	D1h	D1h								
N132	132						260	240											
N160	160						315	302											
N200	200						395	361	D4h	D2h	D2h								
N250	250						480	443											
N315	315						588	535											

* available in US only

IP 00/Chassis	IP 20/Chassis	IP 21/Type 1	With upgrade kit – available in US only	IP 54/Type 12	IP 55/Type 12	IP 66/NEMA 4X

Dimensions [mm]

	A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4	D1h	D2h	D3h	D4h
H	268		390	420	480	650	399	520	680	770	550	660	901	1107	909	1122
W	90	130	200	242			165	231	308	370	308	370	325	420	250	350
D	205		175	200	260		248	242	310	335	333		378		375	
H+	375						475	670			755	950				
W+	90	130					165	255			329	391				

Note: *H and W dimensions are with back-plate. H+ and W+ are with IP upgrade kit. D dimensions are without option. A or B for A2 and A3.*

VLT® AQUA Drive

Dedicated

features for water applications

User friendly setup of water and pump settings reduces installation time ensuring maximum energy efficiency and motor control.

Optimized drive for AC motor driven water and wastewater applications. User friendly setup makes installation easy and enables owners to reach the highest level of performance and lowest cost of ownership.

Featuring a wide range of powerful, standard features, which can be expanded with performance improving options, the VLT® AQUA Drive is equally suited to both new and retrofit projects.

Set up the drive quickly and easily with the user friendly quick menu. By collecting the most important water and pump parameters in one place, the risk of incorrect configuration is reduced significantly.

Instantly benefit from high efficiency, fast payback and the lowest overall cost of ownership for water and wastewater applications.

Power range

1 x 200 – 240 V AC: ..... 1.1 – 22 kW
1 x 380 – 480 V AC: ..... 7.5 – 37 kW
3 x 200 – 240 V AC: ..... 0.25 – 45 kW
3 x 380 – 480 V AC: ..... 0.37 – 1000 kW
3 x 525 – 600 V AC: ..... 0.75 – 90 kW
3 x 525 – 690 V AC: ..... 11 – 1400 kW

Feature	Benefit
Dedicated features	
Dry run detection	Protects the pump
Flow compensation function	Saves energy
2 step ramps (initial/final ramp)	Protects deep well pumps
Check valve ramp	Protects against water hammering and saves installation cost for soft close valves
Pipe fill mode	Eliminates water hammering
Built-in motor alternation feature	Duty stand by operation, cost reduction
Sleep Mode	Saves energy
No/low flow detection	Protects the pump
End of pump-curve detection	Pump protection, leakage detection
Pump cascade controller	Lower equipment cost
Built-in Smart Logic Controller	Often makes PLC omissible
Deragging	Preventive/reactive pump cleaning
Back-channel cooling for frame D, E and F	Prolonged lifetime of electronics
Energy saving	**Less operation cost**
VLT® efficiency (98%)	Saves energy
Automatic Energy Optimisation (AEO)	Saves 3 – 8% energy
Auto Tuning of Staging Speeds	Smoothens the staging and saves energy
Reliable	**Maximum uptime**
IP 00 – IP 66 enclosures (depending on power size)	Choose the protection class you need
All power sizes available in IP 54/55 enclosures	Broad usability in standard enclosure
Password protection	Reliable operation
Mains disconnect switch	No need for external switch
Optional, built-in RFI suppression	No need for external modules
One Wire safe stop	Safe operation/less wiring
Max. ambient temperature up to 50°C without derating (D-frame 45°C)	Reduced need for cooling
User-friendly	**Save initial and operation cost**
One drive type for the full power range	Less learning required
Intuitive user interface	Time saved
Integrated Real Time Clock	Lower equipment cost
Modular design	Enables fast installation of options
Auto tuning of PI-controllers	Time saved
Payback time indication	Monitor performance

Application options

Extend the functionality of the drive with integrated options:

VLT® General Purpose I/O MCB 101
3 digital inputs, 2 digital outputs, 1 analogue current output, 2 analogue voltage inputs.

VLT® Extended Cascade Controller MCO 101, VLT® Advanced Cascade Controller MCO 102
Upgrade the built-in cascade controller to operate more pumps with higher energy efficiency using master/follower pump control. Run the pumps in use at the same speed and optimise staging speeds automatically during operation. Runtime of all pumps is balanced to distribute wear and tear evenly.

VLT® Sensor Input MCB 114
Monitors the PT100/PT1000 and protects motors from overheating.

VLT® PTC Thermistor Card MCB 112
The MCB 112 is connected to safe stop and protects the motor from overheating. It is approved for controlling a certified Ex proof motor in a potentially explosive atmosphere (ATEX) in zones 1 + 2 (gas) zones 21 + 22 (dust).

VLT® 24 V External Supply MCB 107
Back-up option to keep the control system alive during mains loss.

Coated PCB available
For harsh environments according to levels in IEC61721-3-3, standard 3C2, optional 3C3.

Relay & Analogue I/O option
(VLT® Relay Card MCB 105, VLT® Analog I/O MCB109)
Flexible I/O options adding 3 relays or 3 analogue inputs and 3 analogue outputs respectively.

High power options

See the VLT® High Power Drive Selection Guide for a complete list.

Specifications

Mains supply (L1, L2, L3)	
Supply voltage	200 – 240 V ±10%, 380 – 480 V ±10%, 525 – 600 V ±10%, 525 – 690 V ±10%
Supply frequency	50/60 Hz
Displacement Power Factor (cos φ) near unity	(> 0.98)
True power factor (λ)	≥ 0.9
Switching on input supply L1, L2, L3	1 – 2 times/min.

Output data (U, V,W)	
Output voltage	0 – 100% of supply
Switching on output	Unlimited
Ramp times	0.1 – 3600 sec.
Output frequency *(dependent on power size)*	590 Hz

Note: VLT® AQUA Drive can provide 110% current for 1 minute.
Higher overload rating is achieved by oversizing the drive.

Digital inputs	
Programmable digital inputs	6*
Logic	PNP or NPN
Voltage level	0 – 24 V DC

** Two of the inputs can be used as digital outputs.*

Analogue inputs	
Number of analogue inputs	2
Modes	Voltage or current
Voltage level	-10 to +10 V (scaleable)
Current level	0/4 to 20 mA (scaleable)

Pulse inputs	
Programmable pulse inputs	2
Voltage level	0 – 24 V DC (PNP positive logic)
Pulse input accuracy	(0.1 – 110 kHz)

** Two of the digital inputs can be used for pulse inputs.*

Analogue output	
Programmable analogue outputs	1
Current range at analogue output	0/4 – 20 mA

Relay outputs	
Programmable relay outputs	2 (240 VAC, 2 A and 400 VAC, 2 A)

Fieldbus Communication
FC Protocol and Modbus RTU built-in (Optional: Modbus TCP, Profibus, Profinet, DeviceNet, Ethernet IP)

Ambient temperature
Up to 55° C (50°C without derating; D-frame 45°C)

Power options

Choose from a wide range of external power options for use with our drive in critical networks or applications:

- **VLT® Low Harmonic Drive:** Optimum reduction of harmonic distortion with built-in active filter.
- **VLT® Advanced Harmonic Filter:** For applications where reducing harmonic distortion is critical.
- **VLT® dU/dt filter:** Provides motor isolation protection.
- **VLT® Sine-Wave filter:** For noiseless motor

PC software tools

- **VLT® Motion Control Tool MCT 10** Ideal for commissioning and servicing the drive, including guided programming of cascade controller, real time clock, smart logic controller and preventive maintenance.
- **VLT® Energy Box** Comprehensive energy analysis tool. Energy consumption with and w/o drive can be calculated (drive payback time). Online function for accessing drives energy log.
- **VLT® Motion Control Tool MCT 31** Harmonics calculations tool.

Current and power ratings

		S2/T2 200 – 240 V									S4/T4 380 – 480 V									T6 525 – 600 V						T7 525 – 690 V							
		1 ph					3 ph				1 ph			3 ph																		
		Amp.									Amp.			Amp.						Amp.						Amp.							
FC 202	kW	Amp.	IP 20	IP 21	IP 55	IP 66	IP 20	IP 21	IP 55	IP 66	≤440 V	>440 V	IP 21/ 55/ 66	≤440 V	>440 V	IP 00	IP 20	IP 21	IP 54	IP 55	IP 66	≤550 V	>550 V	IP 20	IP 21	IP 55	IP 66	550 V	690 V	IP 00	IP 20	IP 21	IP 54	IP 55	IP 66
PK25	0.25	1.8					A2	A2	A4/A5	A4/A5																								
PK37	0.37	2.4												1.3	1.2		A2	A2		A4/A5	A4/A5												A5	A5
PK55	0.55	3.5												1.8	1.6																			
PK75	0.75	4.6												2.4	2.1							1.8	1.7											
P1K1	1.1	6.6	A3	A3	A5	A5								3	2.7		A2	A2				2.6	2.4					2.1	1.6					A5	A5
P1K5	1.5	7.5		B1	B1	B1								4.1	3.4							2.9	2.7	A3	A3	A5	A5	2.7	2.2		A3*				
P2K2	2.2	10.6												5.6	4.8							4.1	3.9					3.9	3.2						
P3K0	3	12.5					A3	A3	A5	A5				7.2	6.3							5.2	4.9					4.9	4.5						
P3K7	3.7	16.7																																
P4K0	4.0													10	8.2		A2	A2		A4/A5		6.4	6.1					6.1	5.5						
P5K5	5.5	24.2		B1	B1	B1	B3	B1	B1	B1				13	11		A3	A3		A5	A5	9.5	9	A3	A3	A5	A5	9.0	7.5		A3*			A5	A5
P7K5	7.5	30.8		B2	B2	B2					33	30	B1	16	14.5							11.5	11					11	10						
P11K	11	46.2									48	41	B2	24	21		B3	B1		B1	B1	19	18	B3	B1	B1	B1	14	13			B2		B2	
P15K	15	59.4		C1	C1	C1	B4	B2	B2	B2				32	27							23	22					19	18						
P18K	18	74.8									37.5	34	C1	37.5	34							28	27					23	22						
P22K	22	88		C2	C2	C2	C3	C1	C1	C1				44	40		B4	B2		B2	B2	36	34	B4	B2	B2	B2	28	27						
P30K	30	115												61	52							43	41					36	34						
P37K	37	143					C4	C2	C2	C2	151	135	C2	73	65							54	52					43	41						
P45K	45	170												90	80		C3	C1		C1	C1	65	62	C3	C1	C1	C1	54	52		C3	C2		C2	
P55K	55													106	105							87	83					65	62						
P75K	75													147	130		C4	C2		C2	C2	105	100	C4	C2	C2	C2	87	83						
P90K	90													177	160							137	131					105	100						
N75K	75																											90	86						
N90K	90																											113	108						
N110	110													212	190		D3h	D1h/ D5h/ D6h	D1h/ D5h/ D6h									137	131		D3h	D1h/ D5h/ D6h	D1h/ D5h/ D6h		
N132	132													260	240													162	155						
N160	160													315	302													201	192						
N200	200													395	361		D4h	D2h/ D7h/ D8h	D2h/ D7h/ D8h									253	242		D4h	D2h/ D7h/ D8h	D2h/ D7h/ D8h		
N250	250													480	443													303	290						
N315	315													600	540													360	344						
N400	400																											418	400						
P315	315													600	540	E2		E1	E1																
P355	355													658	590																				
P400	400													745	678																				
P450	450													800	730													470	450	E2		E1	E1		
P500	500													880	780			F1/F3	F1/F3									523	500						
P560	560													990	890													596	570						
P630	630													1120	1050													630	630						
P710	710													1260	1160													763	730			F1/F3	F1/F3		
P800	800													1460	1380			F2/	F4									889	850						
P900	900																											988	945						
P1M0	1000													1720	1530			F2/	F4									1108	1060			F2/F4	F2/F4		
P1M2	1200																											1317	1260						
P1M4	1400																											1479	1415						

* Expected release: Q1, 2013

IP 00/Chassis | IP 20/Chassis | IP 21/Type 1 | With upgrade kit – available in US only | IP 54/Type 12 | IP 55/Type 12 | IP 66/NEMA 4X

Dimensions [mm]

	A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4	D1h	D2h	D3h	D4h	D5h	D6h	D7h	D8h	E1	E2	F1	F2	F3	F4
H	268		390	420	480	650	399	520	680	770	550	660	901	1107	909	1122	1324	1665	1978	2284	2000	1547	2280	2280	2280	2280
W	90	130	200		242		165	230	308	370	308	370	325	420	250	350	325		420		600	585	1400	1804	1997	2401
D	205		175	200	260		249	242	310	335	333		378		375		381		384	402	494	498	607	607	607	607
H+	375						475	670			755	950														
W+	90	130					165	255			329	391														

Note: *H and W dimensions are with back-plate. H+ and W+ are with IP upgrade kit. D dimensions without option. A or B for A2 and A3.*

Option overview

An overview of available options for
VLT® HVAC Drive, VLT® Refrigeration Drive, VLT® AQUA Drive,
VLT® AutomationDrive, VLT® Lift Drive and VLT® Decentral Drive.

	Options	VLT® HVAC Drive	VLT® Refrigeration Drive	VLT® AQUA Drive	VLT® Automation Drive		VLT® Lift Drive	VLT® Decentral Drive	
		FC 102	FC 103	FC 202	FC 301	FC 302	LD 302	FCD 300	FCD 302
Slot A	VLT® PROFIBUS DP MCA 101	■	■	■	■	■		■	■
	VLT® PROFINET MCA 120	■	■	■	■	■			■
	VLT® DeviceNet MCA 104	■		■	■	■			
	VLT® DeviceNet Converter MCA 194					■			
	VLT® EtherNet/IP MCA 121	■		■	■	■			■
	VLT® CANopen MCA 105				■	■			
	VLT® EtherCAT MCA 124					■			■
	VLT® POWERLINK MCA 123				■	■			■
	VLT® LonWorks MCA 108	■							
	VLT® BACnet MCA 109	■							
	VLT® Modbus TCP MCA 122	■		■	■	■			
	VLT® PROFIBUS Converter MCA 113					■			
	VLT® PROFIBUS Converter MCA 114					■			
	VLT® AK-LonWorks MCA 107		■						
Slot B	VLT® General Purpose I/O MCB 101	■	■	■	■	■			
	VLT® Encoder Input MCB 102				■	■	■		
	VLT® Resolver Input MCB 103				■	■			
	VLT® Relay Card MCB 105	■	■	■	■	■			
	VLT® Safe PLC I/O MCB 108	■	■	■	■	■			
	VLT® Analog I/O Option MCB 109	■	■	■					
	VLT® PTC Thermistor Card MCB 112	■		■		■			
	VLT® Sensor Input MCB 114	■		■	■	■			
	VLT® Safe Option MCB 140 Series	■	■	■	■	■			
	VLT® Safe Option MCB 150 Series					■			
	VLT® Extended Cascade Controller MCO 101			■					
Slot C	VLT® Advanced Cascade Controller MCO 102			■					
	VLT® Motion Control MCO 305				■	■	■		
	VLT® Extended Relay Card MCB 113				■	■			
	VLT® Synchronizing Controller MCO 350				■	■			
	VLT® Position Controller MCO 351				■	■			
	VLT® Lift Controller MCO 361						■		
Slot D	VLT® 24 V Supply MCB 107	■	■	■	■	■			

VLT® Lift Drive

2.1 million

Load cycles

Is the minimum life time of the VLT® Lift Drive at 16 KHz frequency and 45 °C ambient temperature.

Developed specifically for lifts to provide reliable and excellent ride comfort.
Operates without motor contactors and can be commissioned in less than 10 minutes.

Designed specifically for lifts

The VLT® Lift Drive's compact, rugged design is optimized for easy installation. Built in features ensure a long life of reliable operation, a smooth ride, and low total costs.

Easy commissioning with customized software

Setup and service is easily handled using the drive's dedicated software, which can be accessed at your convenience via the graphical display, VLT® Control Panel LCP 102. Read-outs are simple and clear, including the scope function that presents analog and digital data.

With parameterization tailored specifically for lifts all settings use "elevator language". This means that specialists are not required, as owners can set up and service their lift themselves in the shortest possible time.

Feature	Benefit
Patented Safe Stop technology	– Save space – Reduce costs for materials – No switching noise – Higher reliability
IP 20, 21, 55, 66 protection rating	– Flexible installation options – Mount the drive outside the lift cabinet
Dedicated lift functionality	– Increases comfort during start-up, operation, and passenger entry/exit – Very little noise from the lift shaft – Reduces total system costs
Integrated RFI filter and DC coils	– Reduces space requirements – Lowers installation costs – Easy compliance with EMC and harmonics standards

Operates without motor contactors

The patented Safe Stop function eliminates the need for motor contactors, increasing the reliability of the elevator installation, which is at least as safe as a solution with motor contactors.

An integrated RFI filter and DC coils eliminate the costly installation of external components. This reduces space requirements and eliminates a complex EMC-compliant wiring.

Power range

- 4 – 55 kW (380-400 V) IP 20/21/55

Reliable in all environments

The Lift Drive can be installed in challenging ambient conditions outside the control of the variety of available housing and protection classes. For example, a unique feature of the Lift Drive means that when the temperature rises, the drive maintains the output current so that only the switching frequency is derated.

Specifications

Mains supply (L1, L2, L3)	
Supply voltage	380 – 400 V ±10%

Motor and Motor Feedback	
Load profile and lifetime expectancy	2.1 million load cycles
Motor feedback supported types	Incremental: 5V TTL (RS422) Incremental: 1Vpp SinCos Absolute: ENDAT, Hiperface

Acoustics	
Acoustic noise	55 dB
Maximum switching frequency	16 kHz

Environment	
Temperature operation	0 to 45°C
Enclosure IP protection	IP 20/21, IP 55
RFI filter	Included as standard

Power rating	4 kW	5.5 kW		7.5 kW		11 kW		15 kW	18 kW		22 kW	30 kW		37 kW	45 kW	55 kW	
IP Class	IP 20	IP 20	IP 55	IP 20	IP 55	IP 20	IP 55	IP 20	IP 20	IP 55	IP 20	IP 20	IP 55	IP 20	IP 20	IP 20	IP 55
Frame size	A2	A3	A5	A3	A5	B3	B1	B4	B4	B2	B4	C3	C1	C4	C4	C4	C2
Voltage [V]	400 V																
Continuos output current 100%	10	13		16		26	21	35	44	35	51	60	50	75	90	110	98
Overload 6s/60s [A]	16	20.8		26.6		46.8/ 41.6	33.6	60/ 56	74,4	56	91.3/ 81.6	180/ 90	75	135/ 112,5	162/ 135	198/ 165	147
Current @ 16kHz [A]	10	13		16		N/A	N/A	32	35	35	44	N/A	50	N/A	N/A	N/A	N/A
Current @ 14kHz [A]	10	13		16		N/A	N/A	32	35	35	44	N/A	50	N/A	N/A	N/A	N/A
Current @ 12kHz [A]	10	13		16		21	21	35	44	35	51	60	50	75	83	98	98
Current @ 10kHz [A]	10	13		16		26	21	35	44	35	51	60	50	75	90	98	98
Current @ 8kHz [A]	10	13		16		26	21	35	44	35	51	60	50	75	90	110	98
Ambient temperature	45 °C																
Duty cycle	50%																

VLT® 2800 Series

18.5 kW

maximum motor size

Energy efficient control of a wide range of applications, with built-in brake chopper and coated printed circuit board as standard features.

The multi purpose drive with a perfect match between price and performance in a wide range of industrial applications.

The VLT® 2800 series is designed to fit the needs in a wide range of general purpose drive applications up to 18.5 kW.

Over the years it has shown its value to a large number of customers, resulting in a large base of installed drives all over the world.

The VLT® 2800 is delivered with a factory fitted brake chopper and coated printed circuit boards for increased protection as standard features.

Power range

1/3 x 200 – 240 V.....0.37 – 3.7 kW
3 x 380 – 480 V..... 0.55 – 18.5 kW

With 160% overload torque (normal overload)

Feature	Benefit
Easy to integrate and operate	
Quick menu	Easy start-up and fast parameter access
Automatic Motor Tuning	Ensures optimal match and performance increase between VLT 2800 and motor
PID-controller	Optimized process control
Fieldbus communication	Control and surveillance from PLC or PC
Built-in brake chopper	Standard feature that increases flexibility. Eliminates need to decide up front if a brake chopper is needed
Application dedication	
Counter precise stop	The drive counts pulses and stops safely after the programmed number of counts.
Precise stop function	Increases performance in packaging applications
Dry run protection	Protects the pump in dry run situations
Enhanced sleep mode	Excellent control for shutting down the drive in low flow situations
Pipe fill mode	Prevents water hammering in pump applications
Flexible and robust	
Max. ambient temperature 45°C without derating	No external cooling or oversizing required
Mounting with ventilated heat sink	Flexible mounting incl. horizontal mounting
Side by side mounting	Saves space in installations
Built-in RFI filter	Complies with EMC standards incl. EN55011 1A
Coated Printed Circuit Boards	Standard feature that increases protection of electronics against condensation and hazardous substances in the surroundings

PC software tools

- **VLT® Motion Control Tool MCT 10:** Ideal for commissioning and servicing the drive.
- **VLT® Motion Control Tool MCT 31:** Harmonics calculations tool.

RFI filter

The RFI filter ensures that the frequency converter will not disrupt other electrical components that are connected to the mains and might cause operating disruption.

By fitting an RFI 1B filter module between the mains supply and the VLT® 2800, the solution complies with the EMC norm EN 55011-1B.

		Power	Input current	
Mains	Type	$P_{N,M}$ [kW]	I_{INV} [A]	$I_{L,N}$ [A]
1 x 220–240 V	2803	0.37	2.2	5.9
	2805	0.55	3.2	8.3
	2807	0.75	4.2	10.6
	2811	1.1	6.0	14.5
	2815	1.5	6.8	15.2
	2822*	2.2	9.6	22.0
	2840*	3.7	16.0	31.0
3 x 200–240 V	2803	0.37	2.2	2.9
	2805	0.55	3.2	4.0
	2807	0.75	4.2	5.1
	2811	1.1	6.0	7.0
	2815	1.5	6.8	7.6
	2822	2.2	9.6	8.8
	2840	3.7	16.0	14.7
3 x 380–480 V	2805	0.55	1.7	1.6
	2807	0.75	2.1	1.9
	2811	1.1	3.0	2.6
	2815	1.5	3.7	3.2
	2822	2.2	5.2	4.7
	2830	3.0	7.0	6.1
	2840	4.0	9.1	8.1
	2855	5.5	12	10.6
	2875	7.5	16	14.9
	2880	11.0	24	24.0
	2881	15.0	32	32.0
	2882	18.5	37.5	37.5

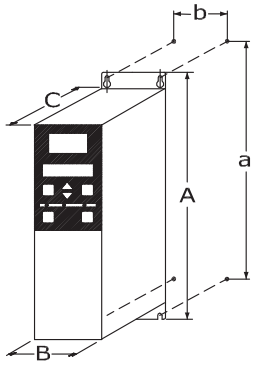
** Not available with RFI filter*

Specifications

Mains supply (L1, L2, L3)	
Supply voltage	200-240 V ±10%, 380-480 V ±10%
Supply frequency	50/60 Hz
Displacement Power Factor (cos φ) near unity	(> 0.98)
Switching on input supply L1, L2, L3	1–2 times/min.
Output data (U, V, W)	
Output voltage	0 – 100% of supply voltage
Switching on output	Unlimited
Ramp times	0.02–3600 sec.
Output frequency	0–590 Hz
Digital inputs	
For start/stop, reset, thermistor, etc.	5
Logic	PNP or NPN
Voltage level	0 – 24 VDC
Analogue input	
No. of analogue inputs	2
Voltage level	-10 to +10 V (scaleable)
Current level	0/4 to 20 mA (scaleable)
Pulse inputs	
No. of pulse inputs	2
Voltage level	0 – 24 V DC (PNP positive logic)
Pulse input accuracy	(0.1–110 kHz)
Digital output	
No. of digital outputs	1
Analogue output	
Programmable analogue outputs	1
Current range	0/4 – 20 mA
Relay outputs	
No. of relay outputs	1
Communication	
Standard built-in	RS485 Modbus RTU Metasys N2 protocols
Fieldbus built-in	PROFIBUS DP V1 12 Mbit/s DeviceNet
Ambient temperature	
50˚C	

Cabinet sizes [mm]

	Height			
	A	B	C	D
A	200	267.5	267.5	505
a	191	257	257	490
	Width			
B	75	90	140	200
b	60	70	120	120
	Depth			
C	168	168	168	244



VLT® Micro Drive

The VLT® Micro Drive is a general purpose drive that can control AC motors up to 22 kW. It's a small drive with maximum strength and reliability.

VLT® Micro Drive is a full member of the VLT® family sharing the overall quality of design, reliability and user-friendliness.

Due to high quality components and genuine VLT® solutions, VLT® Micro Drive is extremely reliable.

RoHS compliant

The VLT® Micro Drive is manufactured with respect for the environment, and it complies with the RoHS Directive.

Power range

1 phase 200–240 V AC ..... 0.18–2.2 kW
3 phase 200–240 V AC ..... 0.25–3.7 kW
3 phase 380–480 V AC ..... 0.37–22 kW

Feature	Benefit
User friendly	
Minimum commissioning	Saves time
Mount – connect – go!	Minimum effort – minimum time
Copy settings via local control panel	Easy programming of multiple drives
Intuitive parameter structure	Minimal manual reading
Complies with VLT® software	Saves commissioning time
Self-protecting features	Lean operation
Process PI-controller	No need for external controller
Automatic Motor Tuning	Ensure optimal match between drive and motor
150% motor torque up to 1 minute	Plenty of brake-away and acceleration torque
Flying start (catch a spinning motor)	Doesn't trip when started on a spinning (freewheeling) motor
Electronic Thermal Relay (ETR)	Replaces external motor protection
Smart Logic Controller	Often makes PLC unnecessary
Built-in RFI filter	Saves cost and space
Energy saving	**Less operation cost**
Energy efficiency 98%	Minimises heat loss
Automatic Energy Optimisation (AEO)	Saves 5-15% energy in HVAC applications
Reliable	**Maximum uptime**
Earth fault protection	Protects the drive
Over temperature protection	Protects the motor and drive
Short circuit protection	Protects the drive
Optimum heat dissipation	Longer lifetime
Unique cooling concept with no forced air flow over electronics	Problem-free operation in harsh environments
High quality electronics	Low lifetime cost
High quality capacitors	Tolerates uneven mains supply
All drives full load tested from factory	High reliability
Dust resistant	Increased lifetime
RoHS compliant	Protects the environment
Designed for WEEE	Protects the environment

Coated PCB standard
For harsh environments.

Power options
Danfoss VLT Drives offers a range of external power options for use together with our drives in critical networks or applications:

- **VLT® Advanced Harmonic Filter:** For applications where reducing harmonic distortion is critical.

PC software tools
- **VLT® Motion Control Tool MCT 10:** Ideal for commissioning and servicing the drive including guided programming of cascade controller, real time clock, smart logic controller and preventive maintenance.
- **VLT® Energy Box:** Comprehensive energy analysis tool, shows the drive payback time.
- **VLT® Motion Control Tool MCT 31:** Harmonics calculations tool.

Cabinet sizes
(mounting flange incl.)

[mm]	M1	M2	M3	M4	M5
Height	150	176	239	292	335
Width	70	75	90	125	165
Depth	148	168	194	241	248

+ 6 mm with potentiometer

Specifications

Mains supply (L1, L2, L3)	
Supply voltage	1 x 200–240 V ±10%, 3 x 200–240 V ±10% 3 x 380–480 V ±10%
Supply frequency	50/60 Hz
Displacement Power Factor (cos φ) near unity	(> 0.98)
Switching on input supply L1, L2, L3	1–2 times/min.
Output data (U, V, W)	
Output voltage	0–100% of supply voltage
Output frequency	0–200 Hz (VVC+ mode), 0–400 Hz (U/f mode)
Switching on output	Unlimited
Ramp times	0.05–3600 sec
Digital inputs	
Programmable digital inputs	5
Logic	PNP or NPN
Voltage level	0–24 VDC
Pulse inputs	
Programmable pulse inputs	1*
Voltage level	0–24 V DC (PNP positive logic)
Pulse input frequency	20–5000 Hz

** One of the digital inputs can be used for pulse inputs.*

Analogue input	
Analogue inputs	2
Modes	1 current/1 voltage or current
Voltage level	0 – 10 V (scaleable)
Current level	0/4 to 20 mA (scaleable)
Analogue output	
Programmable analog outputs	1
Current range at analog output	0/4–20 mA
Relay outputs	
Programmable relay outputs	1 (240 VAC, 2 A)
Approvals	
CE, C-tick, UL	
Fieldbus communication	
FC Protocol, Modbus RTU	

Ordering numbers

	200 V			400 V	
Power [kW]	**Current [I-nom.]**	**1 ph.**	**3 ph.**	**Current [I-nom.]**	**3 ph.**
0.18	1.2	132F 0001			
0.25	1.5		132F 0008		
0.37	2.2	132F 0002	132F 0009	1.2	132F 0017
0.75	4.2	132F 0003	132F 0010	2.2	132F 0018
1.5	6.8	132F 0005	132F 0012	3.7	132F 0020
2.2	9.6	132F 0007	132F 0014	5.3	132F 0022
3.0				7.2	132F 0024
3.7	15.2		132F 0016		
4.0	Micro drives from 1.5 kW and up have built in brake chopper			9.0	132F 0026
5.5				12.0	132F 0028
7.5				15.5	132F 0030
11.0				23.0	132F 0058
15.0				31.0	132F 0059
18.5				37.0	132F 0060
22.0				43.0	132F 0061

VLT® Control Panel LCP 11 ..... Without potentiometer: 132B0100
VLT® Control Panel LCP 12 ..... With potentiometer: 132B0101

VLT® Decentral Drive FCD 302

IP 66

enclosure

for conveyor applications, installations in wash-down areas or widely distributed applications with a large number of drives

The VLT® Decentral Drive FCD 302 is the new generation of the VLT® Decentral Drive FCD 300, based on the VLT® AutomationDrive FC 302 platform. Combining the key features of both products in a completely re-designed enclosure, the drive is made for the best fit for direct machine mounting.

Designed for simplicity and robustness the new VLT® Decentral Drive FCD 302 is a user-friendly product with high performance and strong protection degree.

Decentral drives are meant for decentral mounting, eliminating the need for space-consuming control cabinets. With the drives placed near the motor, there is no need for long screened motor cables.

One-box concept

All options are built into the unit, reducing the number of boxes to be mounted, connections and terminations in the installation. Consequently labor costs for mounting and risk of failures are dramatically reduced.

Power range

0.37 – 3 kW, 3 x 380 – 480 V

Feature	Benefit
Reliable	**Maximum uptime**
Pluggable twin-part design (installation box and electronic part)	Easy and fast service
Integrated lockable service switch available	Local disconnection possible
User-friendly	**Saves commissioning and operation cost**
Smooth surface	Easy cleaning; no dirt trap
Adapts to any brand of motor and geared motor, induction as well as permanent magnet motors	Easy and flexible installation
Integrated power and fieldbus looping terminals	Cable savings
Visible LEDs	Quick status check
Set-up and control through pluggable control panel, fieldbus communication and set-up software VLT® Motion Control Tool MCT 10	Easy commissioning
Awarded control panel with on-board manual (accessory)	Easy operation
Screwless spring-loaded terminals	Easy and fast connection
Integrated USB port	Direct connection to PC
Intelligent	**Built-in feature**
Smart Logic Control	Reduces need for PLC capacity
Safe Torque Off (Safe Stop) as standard	Reduces the need for extra components
Intelligent warning systems	Warning before controlled stop

Enclosure

- IP 66 standard black
- IP 66 standard white
- IP 66 hygienic white

(all enclosures are rated as NEMA 4X)

Integrated 24 V supply
24 V DC control supply is provided by the drive. Separate supply terminals have been made for remote I/Os distribution.

Power looping
The new FCD 302 facilitates internal power looping. Terminals for 6 mm² (big box) or 4 mm² (small box) power cable inside the enclosure allows connection of multiple units in the same branch.

Ethernet switch
Integrated Ethernet switch/ hub with the two RJ-45 ports are available in the drive for easy daisy-chaining of Ethernet communication. Fieldbuses are routed easily, without adding commissioning time, by connecting Ethernet or Profibus based fieldbuses to a M12 pluggable interface.

Safety
The VLT® Decentral Drive FCD 302 is delivered as standard with the Safe Torque Off (Safe Stop) function in compliance with EN ISO 13849-1 Category 3 PL d and SIL 2 according to IEC 61508 low demand and high demand mode.

Fieldbus options
(integrated into the control card)
- PROFIBUS DP
- PROFINET
- EtherNet/IP
- EtherCAT
- POWERLINK

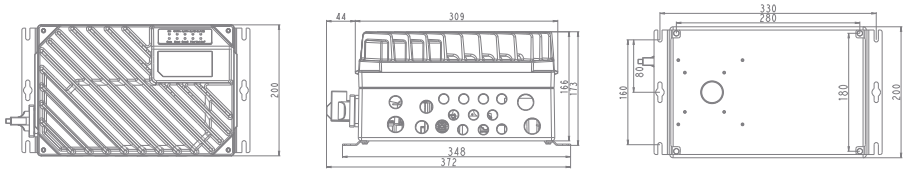
Application options
- VLT® Encoder Input MCB 102
- VLT® Resolver Input MCB 103
- VLT® Safe PLC I/O MCB 108

Hardware options
- Mounting brackets
- Service switch
- Internal circuit breaker
- M12 sensor plugs
- 24 V DC input for control supply
- Brake chopper
- Electromechanical brake control and supply
- Fieldbus plugs

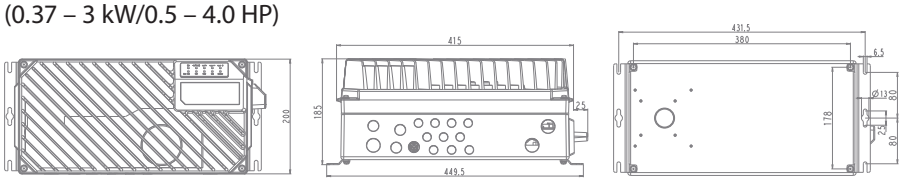
Specifications

Mains supply (L1, L2, L3)	
Supply voltage	380 – 480 V ±10%
Supply frequency	50/60 Hz
True Power Factor (λ)	0.92 nominal at rated load
Displacement Power Factor (cos ϕ)	(>0.98)
Switching on input supply	2 times/min.
Output data (U, V, W)	
Output voltage	0 – 100% of supply
Output frequency	0 – 590 Hz 0 – 300 Hz (Flux mode)
Switching on output	Unlimited
Ramp times	0.01 – 3600 sec.
Digital inputs	
Programmable digital inputs	4 (6)
Logic	PNP or NPN
Voltage level	0 – 24 V DC
Note: One/two digital inputs can be programmed as digital output	
Analogue inputs	
Number of analogue inputs	2
Modes	Voltage or current
Voltage level	-10 to +10 V (scaleable)
Current level	0/4 – 20 mA (scaleable)
Pulse/encoder inputs	
Programmable pulse/encoder inputs	2
Voltage level	0 – 24 V DC (PNP positive logic)
Digital output	
Programmable digital/pulse outputs	2
Voltage level at digital/frequency output	0 – 24 V
Analogue output	
Programmable analogue outputs	1
Current range	0/4 – 20 mA
Relay outputs	
Programmable relay outputs	2
Integrated 24 V supply	
Max. load	600 mA

Dimensions
Small frame
(0.37 – 2.2 kW/0.5 – 3.0 HP)



Large frame
(0.37 – 3 kW/0.5 – 4.0 HP)



All measurements are in mm

VLT® Decentral Drive FCD 300

The VLT® Decentral Drive FCD 300 is a complete frequency converter designed for decentral mounting. It can be mounted on the machine or wall close to the motor, or directly on the motor.

The VLT® Decentral Drive FCD 300 comes in very robust enclosure, with a special painting treatment to withstand harsh environments and typical cleaning agents used in wash-down areas. Its design offers a smooth cleaning-friendly surface.

The decentral design reduces the need for central control panels and eliminates the need for space-consuming motor control cabinets. The need for long screened motor cables is significantly reduced.

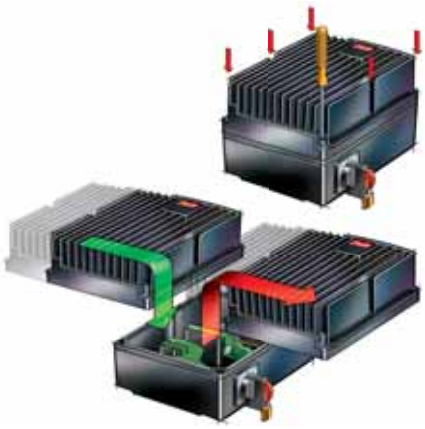
Feature	Benefit
Reliable	**Maximum uptime**
Special surface treatment as protection against aggressive environments	Easy cleaning; no dirt trap
Twin part design (installation box and electronic part)	Easy and fast service
Integrated lockable service switch available	Local disconnection possible
Full protection is offered	Protects the motor and drive
User-friendly	**Saves commissioning and operating cost**
Adapts to any brand of motor and geared motor	Easy and flexible installation
Designed for power and fieldbus looping	Cable savings
Visible LEDs	Quick status check
Set-up and controlled through a remote control panel or fieldbus communication and dedicated MCT 10 set-up software	Easy commissioning

Power range

0.37 – 3.3 kW, 3 x 380 – 480 V

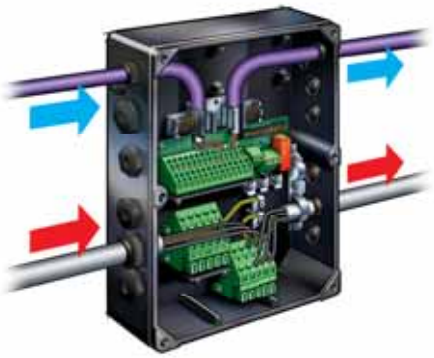
Enclosure

IP 66/Type 4X (indoor)



Plug-and-drive

The bottom section contains maintenance-free Cage Clamp connectors and looping facilities for power and fieldbus cables. Once installed, commissioning and upgrading can be performed in no time by plugging in another control lid.



Flexible installation

The FCD 300 series facilitates internal power line and fieldbus looping. Terminals for 4 mm² power cables inside the enclosure allows connection of up to 10+ units.

Available options

- Service switch
- Connector for control panel
- M12 connectors for external sensors
- Han 10E motor connector
- Brake chopper and resistor
- 24 V external back up of control and communication
- External electromechanical brake control and supply

Specifications

Mains supply (L1, L2, L3)	
Supply voltage	3 x 380/400/415/440/480 V ± 10%
Supply frequency	50/60 Hz
Max. imbalance on supply voltage	±2.0% of rated supply voltage
Switching on input supply	2 times/min.
Power Factor (cos φ)	0.9 /1.0 at rated load
Output data (U, V, W)	
Output voltage	0–100% of supply
Overload torque	160% for 60 sec.
Switching on output	Unlimited
Ramp times	0.02 - 3600 sec.
Output frequency	0.2 - 132 Hz, 1 - 1000 Hz
Digital inputs	
Programmable digital inputs	5
Voltage level	0–24 V DC (PNP positive logic)
Analog inputs	
Analog inputs	2 (1 voltage, 1 current)
Voltage level/Current level	0– ±10 V DC / 0/4–20 mA (scaleables)
Pulse inputs	
Programmable pulse inputs	2 (24 V DC)
Max. frequency	110 kHz (push-pull) / 5 kHz (open collector)
Analog output	
Programmable analog output	1
Current range	0/4–20 mA
Digital output	
Programmable digital/frequency output	1
Voltage/frequency level	24 V DC/10 kHz (max.)
Relay output	
Programmable relay output	1
Max. terminal load	250 V AC, 2 A, 500 VA
Fieldbus communication	
FC Protocol, Modbus RTU, Metasys N2	Built-in
Profibus DP, DeviceNet, AS-interface	Optional (integrated)
Externals	
Vibration test	1.0 g (IEC 60068)
Max. relative humidity	95 % (IEC 60068-2-3)
Ambient temperature	Max. 40˚C (24 hour average max. 35˚C)
Min. ambient temperature in full operation	0˚C
Min. ambient temperature at reduced performance	-10˚C
Approvals	CE, UL, C-tick, ATEX*

** Contact Danfoss for details*

Technical data

VLT® Decentral FCD		303	305	307	311	315	322	330	335*
Output current (3 x 380 – 480 V)	$I_{INV\ (60s)}$ [A]	1.4	1.8	2.2	3.0	3.7	5.2	7.0	7.6
	$I_{MAX\ (60s)}$ [A]	2.2	2.9	3.5	4.8	5.9	8.3	11.2	11.4
Output power (400 V)	S_{INV} [KVA]	1.0	1.2	1.5	2.0	2.6	3.6	4.8	5.3
Typical shaft output	$P_{M,N}$ [kW]	0.37	0.55	0.75	1.1	1.5	2.2	3.0	3.3
	$P_{M,N}$ [HP]	0.5	0.75	1.0	1.5	2.0	3.0	4.0	5.0
Mechanical dimensions H x W x D (mm)	Motor mounting	244 x 192 x 142					300 x 258 x 151		
	Stand alone	300 x 192 x 145					367 x 258 x 154		

** t_{amb} max. 35˚C*

VLT® DriveMotor FCP 106

IE4
efficiency

The VLT® DriveMotor FCP 106 complies with both IE3 and IE4 (fprEN 60034-30-1) efficiency requirements.

Standalone frequency converter for mounting on any standard induction or permanent magnet motor from 0.55 – 7.5 kW.

With a wide range of standard integrated pump and fan features, the VLT® DriveMotor FCP 106 can provide efficient control of motors in the 0.55 – 7.5 kW range.

By mounting the drive directly on the motor, owners are free to choose their own manufacturer and design the optimal system for their application. Once attached to the motor the drive automatically sets the optimal parameters to provide stable, energy efficient operation.

The FCP 106 is the perfect solution for both OEMs and end-users. By mounting the drive directly on the motor, with an adjustable adaptor plate, you eliminate the need for cabinets and reduce cable costs significantly.

Setup is easy with Danfoss VLT® Motion Control Tool MCT 10.

Compatible with VLT® DriveMotor FCM 300

The FCP 106 can be retrofitted on a FCM 300 motor with an adaptor plate.

Feature	Benefit
Alphanumerical display, 7 languages	Effective commissioning
External connection for display as standard	Fast connectivity
Motor data pre-programmed	No programming needed
IP 55/66 enclosure	Reliable in wet and dirty environments
PCB protection class 3C3	Reliable in corrosive environments
Vibration up to 2 g/shock 25 g (3M6: IEC721-3-3)	Suitable for all motor mounted challenges
110% overload (0.55 – 7.5 kW)	Optimised for fans and pumps
160% overload (0.55 – 5.5 kW)	High starting torque
Asynchronous or permanent magnet motor	Free choice of motor technology
Sleep mode	Save energy and extend lifetime
Automatic Energy Optimizer function	Saves an additional 5-15% energy
AHU dedicated functions	Reduces cost and saves energy
Pump dedicated functions	Protects the pump and extends the lifetime
Built-in PI controller	No external PI controller required
Smart Logic Controller	Often makes PLC/DDC unnecessary
Control signal for mechanical brake	Reduce effort in PLC
FC Protocol, Modbus, Metasys, BACnet, integrated	Flexible connectivity
Integrated DC link	Meets EN 61000-6-12, small power cable
Integrated EMC filters	Meets EN 61800-3, (C1 and C2), and EN 55011 Class (B and A1)

Power range

3 x 380 – 480 V..... 0.55 – 7.5 kW
(with 110% overload torque)
3 x 380 – 480 V.....0.55 – 5.5 kW
(with 160% overload torque)

Enclosure ratings

IP 66 (NEMA 4X)..... 0.55 – 7.5 kW

VLT® Control Panel LCP 31 (LCP only)

Alphanumerical display for commissioning and status indication during operation. Connection easy accessible through cable gland.

Ordering number: 132B0200

VLT® Control Panel LCP 31 Mounting Kit

Including 3 m cable, panel mounting bracket, gasket and fastners.

Ordering number: 134B0557

Local Operation Pad LOP

Panel for start/stop and setting the reference.

Ordering number: 175N0128

Potentiometer for cable gland

For setting the reference directly at the drive.

Ordering number: 177N0011

PC software tool:

VLT® Motion Control Tool MCT 10

Ideal for commissioning and servicing the drive with induction motor attached.

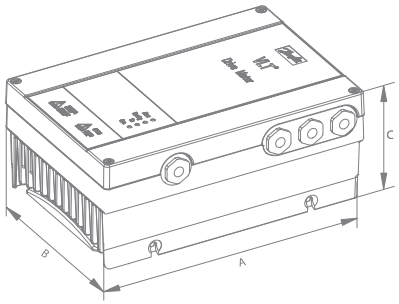
Specifications

Mains supply (L1, L2, L3)	
Supply voltage	380 – 480 V ±10%
Supply frequency	50/60 Hz
Displacement Power Factor (cos φ)	near unity (> 0.98)
Switching on input supply L1, L2, L3	1–2 times/min.
Output data (U, V, W)	
Output voltage	0 – 100% of supply voltage
Switching on output	Unlimited
Ramp times	1–3600 sec.
Output frequency	0 – 200 Hz
Digital inputs	
Programmable digital inputs	4
Logic	PNP or NPN
Voltage level	24 V
Analogue input	
Analogue inputs	2
Modes	Voltage and current
Voltage level	0 – 10 V (scaleable)
Current level	0/4 to 20 mA (scaleable)
Digital/Analogue Output	
Programmable outputs	2
Analogue output current level	0/4 to 20 mA (scaleable)
Relay output	
Programmable relay outputs	2 (resistive load 250 VAC, 3 A 30VDC, 2A)

Additional features when mounting the electronic (FCP 106) on your motor	
Note your production info into the drive	Identification of your programming
Change motor data to fit your motor	Optimize settings for your motor settings
Create new factory settings (CSIV Technology)	Ensure correct motor data settings
Motor cable length upto 0,5m	Mount FCP on every side of the motor
Custom adapter plate	Mount FCP on every motor make
Oversized FCP can be mounted on motor	Higher overload for critical applications
Motor independent cooling	FCP fits on any motor

Mount the FCP 106 on your preferred motor.

Dimensions



Dimensions (mm)	Length	Width	Height
	A	B	C
MH1	231	162	107
MH2	277	187	113
MH3	322	220	124

VLT® DriveMotor FCM 106

IE4

efficiency

The VLT® DriveMotor FCM 106 complies with both IE3 and IE4 (fprEN 60034-30-1) efficiency requirements.

Easy to install and delivered with either permanent magnet or standard induction motor mounted.

With a wide range of standard, integrated pump and fan features, the VLT® DriveMotor FCM 106 is a highly dedicated, space saving motor and control solution in the 0.55-7.5 kW range.

The drive is delivered from the factory mounted to either a standard induction motor or a size optimized permanent magnet motor.

This enables the FCM 106 to reduce both installation costs and complexity significantly. The compact design of the motor mounted drive solution also eliminates the need for cabinets.

Due to the fact that the drive is mounted directly on the motor, long motor cables are eliminated, reducing costs further for both OEMs and end users. A plug connects the drive to the motor making assembly/disassembly fast and service friendly.

The DriveMotor is part of Danfoss EC+ concept, which maximizes the advantages and efficiency of permanent magnet motors, variable speed drives and plugfan technologies.

Feature	Benefit
Alphanumerical display, 7 languages	Effective commissioning
External connection for display as standard	Fast connectivity
Motor data pre-programmed	No programming needed
IP 66 (drive) / IP 55 (motor)	Reliable in wet and dirty environments
PCB protection class 3C3	Reliable in corrosive environments
Vibration up to 2 g / shock 25 g (3M6: IEC721-3-3)	Suitable for all motor-mounted challenges
110% overload (0.55 – 7.5 kW)	Optimised for fans and pumps
160% overload (0.55 – 5.5 kW)	High starting torque
Asynchronous or permanent magnet motor	Free choice of motor technology
Sleep mode	Save energy and extend lifetime
Automatic Energy Optimizer function	Saves an additional 5 – 15% energy
AHU dedicated functions	Reduces cost and saves energy
Pump dedicated functions	Protects the pump and extends the lifetime
Built-in PI controller	No external PI controller required
Smart Logic Controller	Often makes PLC/ DDC unnecessary
Control signal for mechanical brake	Reduce effort in PLC
FC Protocol, Modbus, Metasys, BACnet, integrated	Flexible connectivity
Integrated DC link	Meets EN 61000-6-12, small power cable
Integrated EMC filters	Meets EN 61800-3, (C1 and C2), and EN 55011 Class (B and A1)

Power range

3 x 380 – 480 V..... 0.55 – 7.5 kW
(with 110% overload torque)
3 x 380 – 480 V.....0.55 – 5.5 kW
(with 160% overload torque)

Enclosure ratings

IP 66 (UL type 4X outdoor) .....
0.55 – 7.5 kW

VLT® Control Panel LCP 31 (LCP only)

Alphanumerical display for commissioning and status indication during operation. Connection easy accessible through cable gland.

Ordering number: 132B0200

VLT® Control Panel LCP 31 Mounting Kit

Including 3 m cable, panel mounting bracket, gasket and fastners.

Ordering number: 134B0557

Local Operation Pad LOP

Panel for start/stop and setting the reference.

Ordering number: 175N0128

Potentiometer for cable gland

For setting the reference directly at the drive.

Ordering number: 177N0011

PC software tool:

VLT® Motion Control Tool MCT 10

Ideal for commissioning and servicing the drive with induction motor attached.

Specifications

Mains supply (L1, L2, L3)	
Supply voltage	380 – 480 V ±10%
Supply frequency	50/60 Hz
Displacement Power Factor (cos φ)	near unity (> 0.98)
Switching on input supply L1, L2, L3	1–2 times/min.
Output data (U, V, W)	
Output voltage	0 – 100% of supply voltage
Switching on output	Unlimited
Ramp times	1–3600 sec.
Output frequency	IM: 0 – 200 Hz / PM: 0 – 390 Hz
Digital inputs	
Programmable digital inputs	4
Logic	PNP or NPN
Voltage level	24V
Analogue input	
Analogue inputs	2
Modes	Voltage and current
Voltage level	0 – 10 V (scaleable)
Current level	0/4 to 20 mA (scaleable)
Digital/Analogue Output	
Programmable outputs	2
Analogue output current level	0/4 to 20 mA (scaleable)
Relay output	
Programmable relay outputs	2 (resistive load 250 VAC, 3 A 30VDC, 2A)

Choose the FCM 106 with a standard induction motor or permanent magnet motor.

IEC Standard Motor Frame Sizes

PM 1500 rpm	PM 3000 rpm	IM 3000 rpm	IM 1500 rpm	MH frame size	kW
71	NA	NA	NA	MH1	0.55
71	71	71	80		0.75
71	71	80	90		1.1
71	71	80	90		1.5
90	71	90	100	MH2	2.2
90	90	90	100		3
90	90	100	112		4
112	90	112	112	MH3	5.5
112	112	112	132		7.5

VLT® DriveMotor FCM 300

IE2

motors for high efficiency

combined with a high-performance, energy saving VLT®.

The VLT® DriveMotor FCM 300 Series is an integrated drive-motor solution which combines a VLT® frequency converter and a high standard quality motor in a single product.

The frequency converter is attached in place of the motor terminal box and it is no higher than the standard terminal box nor wider or longer than the motor.

Incorporated to a high standard quality motor, the VLT® DriveMotor FCM 300 is also available in a multitude of variants, individualised to meet customer requirements.

On the motor

The VLT® electronic motor control together with the motor totally eliminates motor cables and thereby minimises EMC problems. Heat from the drive is dissipated together with the motor heat.

Power range

0.55 – 7.5 kW, 3 x 380 – 480 V

Feature	Benefit
Reliable	**Maximum uptime**
Robust enclosure	Withstands harsh environments
No power cable length limitation	Increased flexibility
Thermal protection	Total motor-inverter protection
Straightforward EMC compliance	No problem with electromagnetic interferences
User-friendly	**Saves commissioning and operating cost**
Motor and drive perfectly matched to each other	Saves commissioning time
No panel space required – the DriveMotor is placed on the machine	Saves space
Flexible mounting – foot/flange/face/ foot-flange/foot-face	Meets customer requirements
Retrofit without mechanical changes	Easy service
Set-up and controlled through a remote control panel or fieldbus communication and dedicated MCT 10 set-up software	Easy commissioning

Enclosure

IP 55 (standard)
IP 65/IP 66 (optional)

Motor type

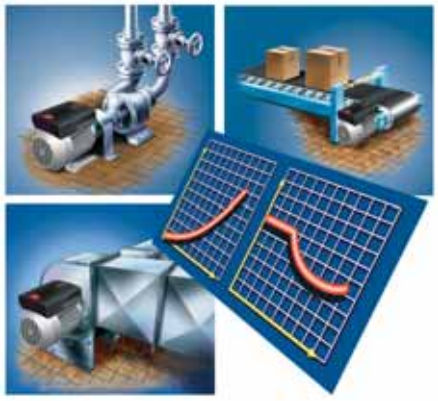
2-pole
4-pole

Mounting versions

B03 foot
B05 flange
B35 foot + flange
B14 face
B34 foot + face

Control panel

A Local Control Panel is available for operating, setup and diagnostics. The LCP can be handheld or mounted in a panel front (IP65).



Sleep Mode

In Sleep Mode the motor will stop in a no load situation. When the load returns, the frequency converter will restart the motor.

Motor drain holes

For applications where formation of condensate water might occur.

Sensorless Pump Control – OEM version

Offers precise pressure (head) control without using a pressure transmitter.

Specifications

Mains supply (L1, L2, L3)	
Supply voltage	3 x 380/400/415/440/460/480V ±10%
Supply frequency	50/60 Hz
Power factor (cos φ)	Max. 0.9/1.0 at rated load
Max. imbalance of supply voltage	±2% of rated supply voltage
Switching on supply input	Once every 2 minutes
Control Characteristics (frequency converter)	
Frequency range	0 – 132 Hz
Overload torque	160% for 60 sec.
Resolution on output frequency	0.1%
System response time	30 msec. ±10 msec.
Speed accuracy	±15 RPM (open loop, CT mode, 4-pole motor 150 – 1500 RPM)
Digital inputs	
Programmabel digital inputs	4
Voltage level	0 – 24 V DC (PNP positive logic)
Analog inputs	
Analog inputs	2 (1 voltage, 1 current)
Voltage/current level	0 – 10 V DC / 0/4 – 20 mA (scaleables)
Pulse input	
Programmable pulse input	1 (24 V DC)
Max. frequency	70 kHz (push-pull) / 8 kHz (open collector)
Analog/digital output	
Programmable analog/digital output	1
Current/voltage range	0/4 – 20 mA / 24 V DC
Relay output	
Programmable relay output	1
Max. terminal load	250 V AC, 2 A, 500 VA
Fieldbus communication	
FC Protocol, Modbus RTU	Built-in
Profibus DP	Optional (integrated)
Externals	
Vibration test	1.0 g (IEC 60068)
Max. relative humidity	95% (IEC 60068-2-3)
Ambient temperature	Max. 40° C (24 hour average max. 35° C)
Min. ambient temperature in full operation	0°C
Min. ambient temperature at reduced performance	-10° C

Technical data

FCM	305	307	311	315	322	330	340	355	375
Motor output									
[HP]	0.75	1.0	1.5	2.0	3.0	4.0	5.0	7.5	10.0
[kW]	0.55	0.75	1.1	1.5	2.2	3.0	4.0	5.5	7.5
Motor torque									
2-pole [Nm] 1)	1.8	2.4	3.5	4.8	7.0	9.5	12.6	17.5	24.0
4-pole [Nm] 2)	3.5	4.8	7.0	9.6	14.0	19.1	25.4	35.0	48.0
Frame size									
[mm]	80	80	90	90	100	100	112	132	132
Input current [A] 380 V									
2-pole	1.5	1.8	2.3	3.4	4.5	5.0	8.0	12.0	15.0
4-pole	1.4	1.7	2.5	3.3	4.7	6.4	8.0	11.0	15.5
Input current [A] 480 V									
2-pole	1.2	1.4	1.8	2.7	3.6	4.0	6.3	9.5	11.9
4-pole	1.1	1.3	2.0	2.6	3.7	5.1	6.3	8.7	12.3

1) at 400 V, 3000 RPM, 2) at 400 V, 1500 RPM

VLT® OneGearDrive®

VLT® OneGearDrive® Hygienic

VLT® OneGearDrive® Standard with brake

Up to 89%

system efficiency

can be acheived with VLT® OneGearDrive® together with VLT® AutomationDrive FC 302 or VLT® Decentral Drive FCD 302. Exceed the IE4 Super Premium Efficiency class today.

VLT® OneGearDrive® is a highly efficient permanent-magnet three-phase synchronous motor coupled to an optimised bevel gear box. As part of the Danfoss VLT® FlexConcept® the VLT® OneGearDrive® is an energy-efficient drive system that helps to optimise plant productivity and reduce energy costs.

With only one motor type and three available gear ratios, the motor concept covers all typical versions of conveyor drives commonly used in the food and beverage industry. Furthermore, the restricted range of physical configurations of the VLT® OneGearDrive® simplifies spares holding and makes it more cost efficient, easing engineering and installation thanks to uniform mechanical dimensions.

Flexible plant design

In combination with the VLT® AutomationDrive FC 302 or the VLT® Decentral Drive FCD 302 the VLT® OneGearDrive® is equally suited to central and decentral installations, giving the plant designer complete flexibility from the outset. As a whole, the system can reach energy savings of up to 40% compared with conventional systems.

Two versions

The VLT® OneGearDrive® comes in two versions, the VLT® OneGearDrive® Standard for use in dry and wet production areas and the VLT® OneGearDrive® Hygienic for use in wet areas, areas with high cleaning intensity and aseptic and clean room production areas.

Feature	Benefit
High system efficiency incl. frequency converter	Save money and energy – up to 40% energy savings compared to conventional systems
High-efficiency Permanent-magnet three-phase synchronous 10-pole motor with bevel gear drive	Better than Super Premium Efficiency class IE4
Available hollow shaft diameters: 30, 35, 40 mm and 3 impertial shaft sizes	Flexible adaption to customer standards
Completely smooth enclosure leaves no crevices or dirt traps	– Easy to clean – Safe production
Motor connection with Danfoss CleanConnect® stainless steel circular connector	– Safe connection in wet areas – Fast installation and replacement – High cleanability
Motor and brake connections via terminal box with CageClamp® technology	– Fast, reliable connection – Lower installation cost
Aseptic coating	– Resistant to detergents and disinfectants (pH 2..12)
Gearbox without breather vents and use of food grade lubricants compliant with FDA and NSF requirements	Up to 35,000 operating hours in partial loa between oil change
High degrees of protection: – IP 67 and IP 69K (OGD- H) – IP 65 and IP 67 (OGD- S)	– Unrestricted use in wash down areas – High protection in wash down areas
Fan-free operation	– Less noise emission – No air-born germs and dirt particles to be drawn into the motor and then expelled back into the surrounding air
Only 3 gearbox ratios in one common design	Up to 70% reduction in variants reduces spare part stock
Compatible with all Danfoss frequency converters FC/D 302 from 1.5-3 kW	Free choice of central and decentral instalations

In both versions, completly smooth, easy to clean surface without cooling fins, prevents pockets of dirt from forming and allows detergents to drain off freely. The fan-free motor avoids the risk of air-borne germs and dirt particles being drawn in and then expelled back into the surrounding air.

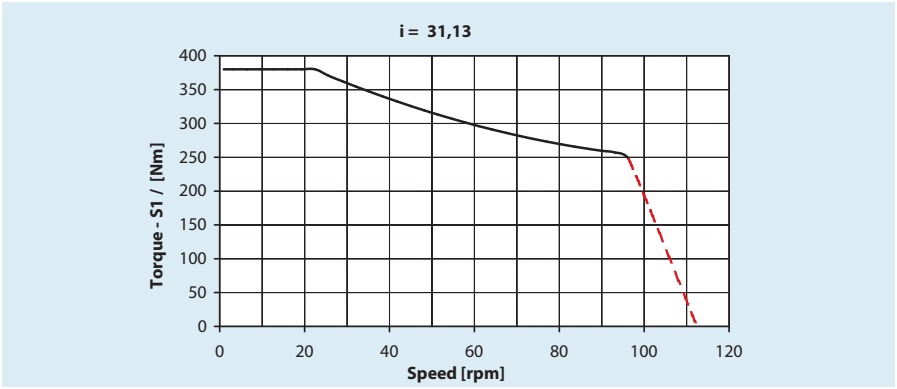
Hygienic design

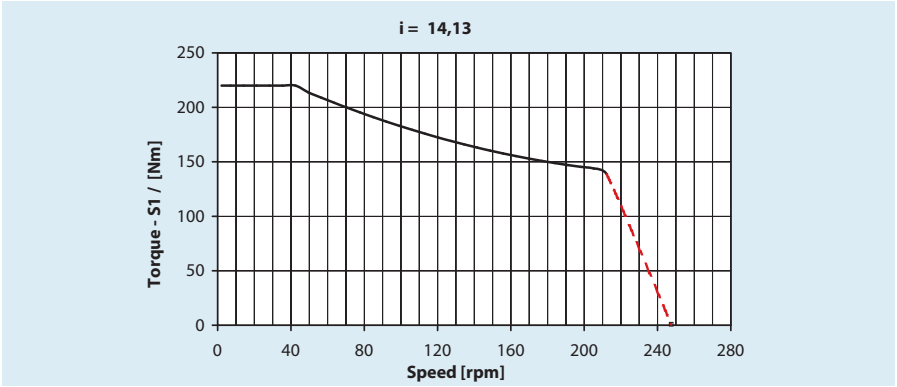
The VLT® OneGearDrive® Hygienic complies with the requirements for best cleaning and hygienic design – with certification according to EHEDG (European Hygienic Engineering & Design Group). It is certified as usable for clean rooms and aseptic filling by IPA (Fraunhofer institute) according to the dedicated "Air Cleanliness Classification" DIN EN ISO 14644-1.

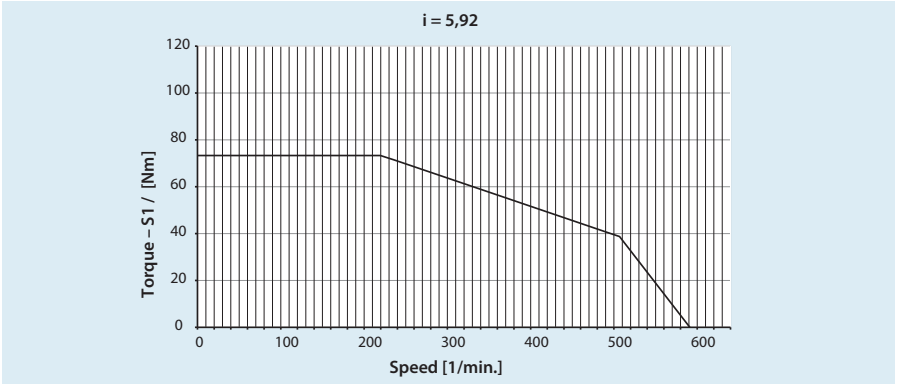
Specifications

Power rating.....1.5 – 3.0 kW
Speed max.....3000 rpm
Frequency max.....250 Hz
Current max.....7.2 A
Torque .....1.7 Nm/A
Voltage .....120 V/1000 rpm
Weight ..... Approx. 28 kg

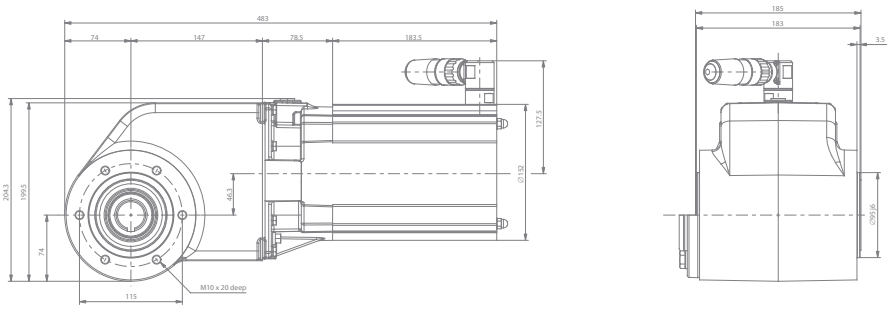
Speed/ torque characteristics for gear ratios i = 31.13; i = 14.13 and i = 5.92 (max 3.0 kW)







Dimensions



Dimensions of Danfoss VLT® OneGearDrive® Hygienic in mm

VLT® Integrated Servo Drive System ISD 410

The integration of servomotor and electronic drive unit in the same housing makes this drive system predestined for applications requiring high flexibility and dynamics, such as those in the food & beverage and packaging industries. The decentralisation of the drive unit offers benefits in mounting, installation and operation. Depending on the application, up to 60 drives can be integrated into the servo drive system.

Servo Drive

The motion control is integrated into the drive so that the motion sequences can take place independently. This releases the higher-ranking controller and offers a highly flexible drive concept. The master can be programmed via IEC 61131-3 and hybrid cables are used to connect the drives, making installation fast and simple.

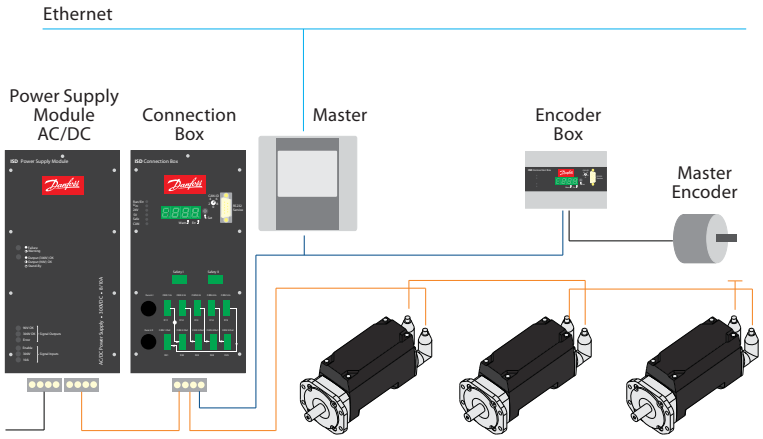
Feature	Benefit
Compact and decentral servo drive	Reduced costs and high flexibility
Dynamic servo performance	Fast, accurate and energy-efficient
System setup performance	Simple and fast configuration of several drives
DC supply to drives from a central power supply module	Fast installation, reduced number of cables
Control via IEC 61131-3	Open system
Hybrid cable	Easy and fast installation, reduced number of cables
All components support CAN	Enhanced diagnostics, reduced downtime

Power Supply Module

The system is powered with DC 300 V via the power supply module. LEDs on the front of the unit enable easy monitoring of operating status. The maximum current output is 10 A and nominal power is 3 kW.

Connection Box

The connection box creates the link between the servomotors and the power supply. Two independent groups of up to 30 motors can be connected. The hybrid cable contains the DC supply, CAN and safety.



Encoder Box

The encoder box enables a master encoder to be connected, this to be read with high precision, and time information to be sent to the drives via CAN. If no encoders are connected, the encoder box functions as a virtual axis for the ISD 410 servo drive system.

Available Options

- Safe Torque Off (STO)
- Brake
- Feedback:
  - Resolver
  - Singleturn
  - Multiturn
- Flexible hybrid loop cable
- IEC flange
- Customised flange on request

Available Accessories

- Shaft seal
- Connector kits for:
  - Power Supply Module
  - Connection Box
  - Encoder Box
- Terminating resistor

Specifications

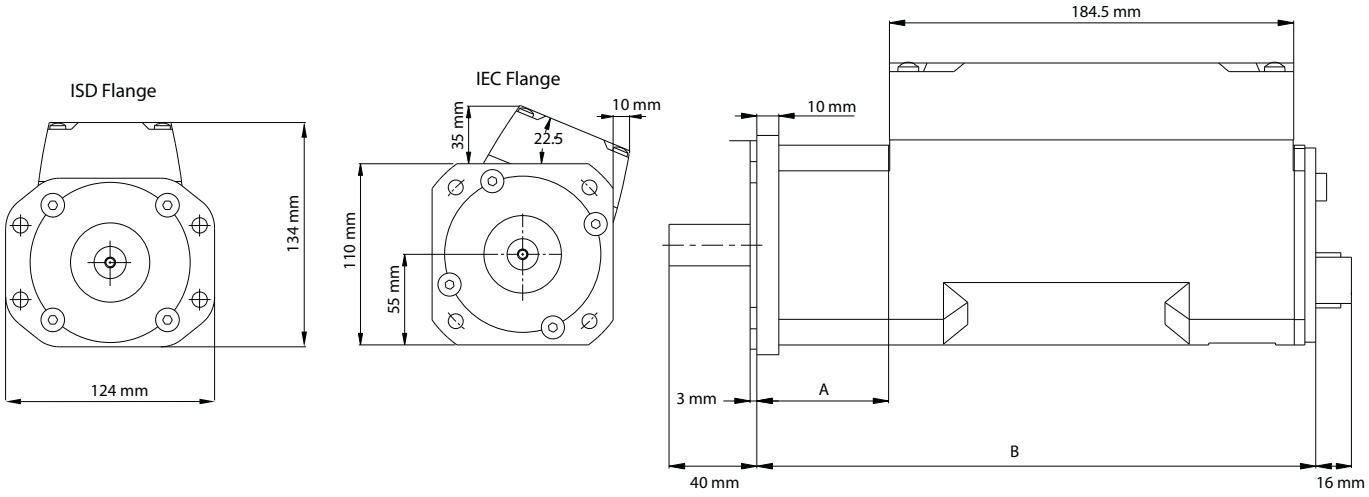
Servomotor	
Rated voltage	DC 300 V
Rated torque	1.7-2.1 Nm
Max. torque	8-11 Nm
Rated current	0.6-1.15 A
Max. current	3.95-7.05 A
Rated speed	600-1000 rpm
Max. speed	1000-1500 rpm
Rated power	180-345 W
Inertia	3.5 10^{-4} to 6.5 10^{-4} kgm^2
Shaft diameter	19 mm
Enclosure	IP 54/IP 65

Power Supply Module	
Input voltage	AC 380-480 V ±10 %, 3-phase: L1, L2, L3, PE
Input current	6 A_{rms} each phase
Output voltage	DC 300 V
Rated power	3000 W
Rated current	10 A
Dimensions (H x W x D)	268 x 130 x 205 mm

Connection Box	
Input voltage	DC 300 V
Output voltage lines 1 & 2	DC 300 V
Rated power	3000 W
Rated current	10 A
Dimensions (H x W x D)	268 x 130 x 205 mm

Encoder Box	
Input voltage	DC 24 V
Supported encoder inputs	SSI, SSI-CRC, QEP, BiSS
Dimensions (H x W x D)	105.2 x 142.0 x 70.8 mm

Dimensions



Motor ISD 410	Dimensions [mm]	
	A	B
ISD / IEC flange with brake	60	255
ISD / IEC flange without brake	35	230

VLT® Soft Starter MCD 500

VLT® Soft Starter MCD 500 is a total motor starting solution. Current transformers measure motor current and provide feedback for controlled motor ramp profiles.

AAC, Adaptive Acceleration Control, automatically employs the best starting and stopping profile for the application.

Adaptive Acceleration Control means, that for each start and stop, the soft starter compares and adapts the process to the chosen profile fitting to the application.

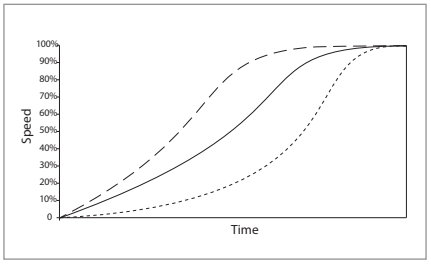
VLT® Soft Starter MCD 500 has a four line graphical display and a logic keypad making programming easy. Advanced setup is possible displaying operational status.

Three menu systems: Quick Menu, Application Setup and Main Menu provide optimum programming approach.

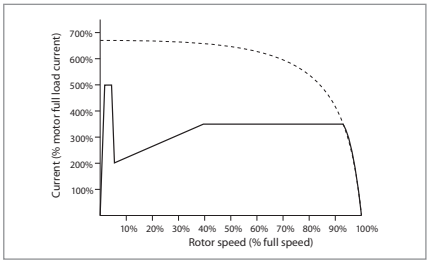
Power range

21 – 1600 A, 7.5 – 850 kW
(1.2 MW inside Delta Connection)
Versions for 200 – 690 VAC

Feature	Benefit
AAC Adaptive Acceleration Control	Automatically adapts to the chosen starting and stopping profile
Adjustable bus bars allow for both top and bottom entry (360–1600 A, 160–850 kW)	Space saving, less cable cost and easy retrofitting
DC injection braking distributed evenly over three phases	Less installation cost and less stress on the motor
Inside Delta (6-wire connection)	Smaller soft starter can be selected for the application
Log menus, 99 events and trip log provide information on events, trips and performance	Eases analysis of the application
Auto Reset	Less down-time
Jog (slow-speed operation)	Application flexibility
Second-order thermal model	Allows motors to be used to their full potential without damage from overloading
Internal bypass contactors (21–215 A, 7.5–110kW)	– Saves space and wiring compared to external bypass – Very little heat dissipates when running. Eliminates costly external fans, wiring or bypass contactors
Auto-start/stop clock	Application flexibility
Compact size – amongst the smallest in their class	Saves space in cabinets and other application setups
4-line graphical display	Optimum programming approach and setup for viewing operational status
Multiple programming setup (Standard Menu, Extended Menu, Quick Set)	Simplifies the programming, but still holding to maximum flexibility
Multiple languages	Serving the whole world



Three Adaptive Acceleration Control (AAC) start profiles; early, constant and late acceleration



Constant current/ current ramp – here shown with kickstart

Fully featured Soft Starter for motors up to 850 kW

- Total motor starting solution
- Advanced start, stop and protection features
- Adaptive Acceleration Control
- Inside Delta connection
- 4-line graphical display
- Multiple programming setup menus

Optional

- Modules for serial communication:
  - DeviceNet
  - PROFIBUS
  - Modbus RTU
  - PROFINET
  - Modbus TCP
  - EtherNet IP

- Remote operator kit
- PC software:
  - WinMaster
  - USB
  - VLT® Motion Control Tool MCT10

VLT® Control Panel LCP 501

- A full function HMI interface – everything you can do on the VLT® Soft Starter MCD 500 is possible via the LCP 501
- Danfoss "FC" menu structure and button interface concept
- Multiple language selection – incl. Russian and Chinese
- Full graphics
- Real language in 4 lines
- Full parameter list, Quick Menu and application setup
- Adjustable multiple monitoring views
- A "copy-paste" function allows the user to copy parameter settings in the LCP and load to other unit.
- IP 65, NEMA3R
- 3 m cable and mounting kit included

Specifications

Mains voltage (L1, L2, L3)	
MCD5-xxxx-T5	200 VAC ~ 525 VAC (± 10%)
MCD5-xxxx-T7	380 VAC ~ 690 VAC (± 10%)
MCD5-xxxx-T7	380 VAC ~ 600 VAC (± 10%) (inside delta connection)
Control voltage (terminals A4, A5, A6)	
CV1 (A5, A6)	24 VAC/VDC (± 20%)
CV2 (A5, A6)	110~120 VAC (+ 10% / - 15%)
CV2 (A4, A6)	220~240 VAC (+ 10% / - 15%)
Mains frequency	50/60 Hz (± 10%)
Rated insulation voltage to earth	600 VAC
Rated impulse withstand voltage	4 kV
Form designation	Bypassed or continuous, semiconductor motor starter form 1
Short circuit capability	
Coordination with semiconductor fuses	Type 2
Coordination with HRC fuses	Type 1
MCD500-0021B to 0215B	Prospective current of 65 kA
MCD500-0245C	Prospective current of 85 kA
MCD500-1200C to 1600C	Prospective current of 100 kA
Electromagnetic capability (compliant with EU Directive 89/336/EEC)	
EMC Emissions (Terminals 13 & 14)	IEC 60947-4-2 Class B and Lloyds Marine No. 1 Specification
EMC Immunity	IEC 60947-4-2
Outputs	
Relay Outputs	10A @ 250 VAC resistive, 5A @ 250 VAC AC15 pf 0.3
Programmable Outputs	
Relay A (13, 14)	Normally open
Relay B (21, 22, 24)	Changeover
Relay C (33, 34)	Normally open
Analogue Output (07, 08)	0 – 20 mA or 4 – 20 mA (selectable)
Maximum load	600 Ω (12 VDC @ 20 mA) (accuracy ± 5%)
24 VDC Output (16, 08) Maximum load	200 mA (accuracy ± 10%)
Environmental	
Protection MCD5-0021B ~ MCD5-0105B	IP 20 & NEMA, UL Indoor Type 1
Protection MCD5-0131B ~ MCD5-1600C	IP 00, UL Indoor Open Type
Operating temperature	-10° C to 60° C, above 40° C with derating
Storage temperature	-25° C to + 60° C
Operating Altitude	0 – 1000 m, above 1000 m with derating
Humidity	5% to 95% Relative Humidity
Pollution degree	Pollution Degree 3
Heat Dissipation	
During start	4.5 watts per ampere
During run (approx.)	MCD5-0021B - MCD5-0053B = 39 watts MCD5-0068B - MCD5-0105B = 51 watts MCD5-0131B - MCD5-0215B = 120 watts MCD5-0245C - MCD5-0927C 4.5 watts per ampere MCD5-1200C - MCD5-1600C 4.5 watts per ampere

Dimensions

Current rating [A]	Weight [kg]	Height [mm]	Width [mm]	Depth [mm]	Frame size
21, 37, 43 and 53	4.2	295	156	192	G1B
68	4.5				
84, 89 and 105	4.9			223	
131	14	438	282	250	G2B
141	14.2				
195 and 215	15				
245	26	440	424	298	G3B
331 and 396	29.4				
469 and 525	49	640	433	297	G4B
632 and 744	62.5				
826 and 961	63				
245	23	417	390	284	G3C
360, 380 and 428	36	698	430	302	G4C
595, 619 and 790	39				
927	51				
1200	128.5	750	574	361	G5C
1410	130				
1600	140				

VLT® Compact Starter MCD 200

The VLT® Compact Starter MCD 200 from Danfoss includes two families of soft starters in the power range from 7.5 to 110 kW.

The series offer easy DIN rail mounting for sizes up to 30 kW, 2-wire or 3-wire start/stop control and excellent starting duty (4 x I_e for 6 seconds).

Heavy starting ratings at 4x I_e for 20 seconds.

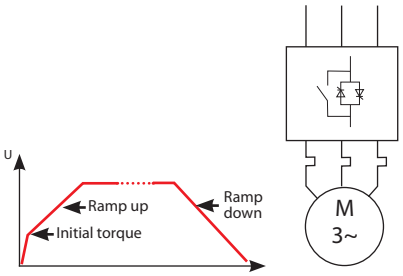
Compatible with grounded delta power systems.

Power range

7.5 – 110 kW

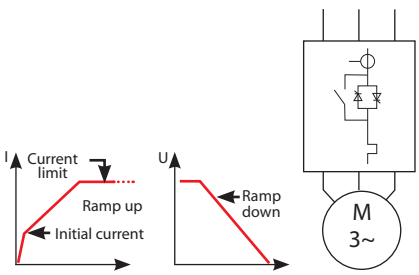
Feature	Benefit
Small footprint and compact size	Saves panel space
Built-in bypass	– Minimises installation cost and eliminates power loss – Reduces heat build up. Savings in components, cooling, wiring and labor
Advanced accessoires	Allows enhanced functionality
Advanced SCR Control Algorithms balances output waveform	Allowing more starts per hour, accepting higher load
User friendly	**Save commissioning and operating cost**
Easy to install and use	Saves time
Easy DIN rail mounting for sizes up to 30 kW	Saves time and space
Reliable	**Maximum uptime**
Essential motor protections (MCD 202)	Reduces overall project investment
Max. ambient temperature 40° C without derating	No external cooling or oversizing necessary

MCD 201



MCD 202

MCD 202 provides enhanced soft start functionality and various motor protection features



Soft Starter for motors up to 110 kW

- Total motor starting solution
- Start, stop and protection features
- Local programming keypad and display

Optional

- Modules for serial communication:
  - DeviceNet
  - PROFIBUS
  - Modbus RTU
  - PROFINET
  - Modbus TCP
  - EtherNet IP
- Remote operator kit
- PC software
  - WinMaster
  - USB

Specifications

Mains supply (l1, L2, L3)	
Supply voltage	3 x 200 VAC – 440 VAC or 3 x 200 – 575 VAC
Supply frequency	45 – 66 Hz
Control voltage	110 – 240 VAC 380 – 440 VAC 24 VDC/24 VAC
Control inputs	
Control inputs	Start, Stop Reset push button on the unit
Relay outputs	
Relay outputs	1 x main contactor 1 x programmable (Trip or Run) (MCD 202 only)
Protections, MCD 201	
	Supply fault
Protections, MCD 202	
	Power Circuit (SCRs and Supply fault) Excess Start Time Motor Overload - Thermal model Motor thermistor Phase imbalance Supply Frequency Phase rotation - sequence Network Coms Starter Com Bypass Overload
LED indications	
Indications	Ready/Fault Run
Ambient operating temperature	
Ambient temperature	-10 to 60˚C (above 40˚C without derating)
Standards approvals	
Approvals	CE, UL, C-UL, CCC, C-tick, Lloyds

Remote operation kit

Remote Operator and display with 4–20 mA analogue output proportional to motor current (MCD 202) Serial communication: Modbus/485, ASCII. PC-based MCD set-up software.

Cabinet sizes

Power range (400 V)	7 – 30 kW	37 – 55 kW	75 – 110 kW
Height [mm]	203	215	240
Width [mm]	98	145	202
Depth [mm]	165	193	214

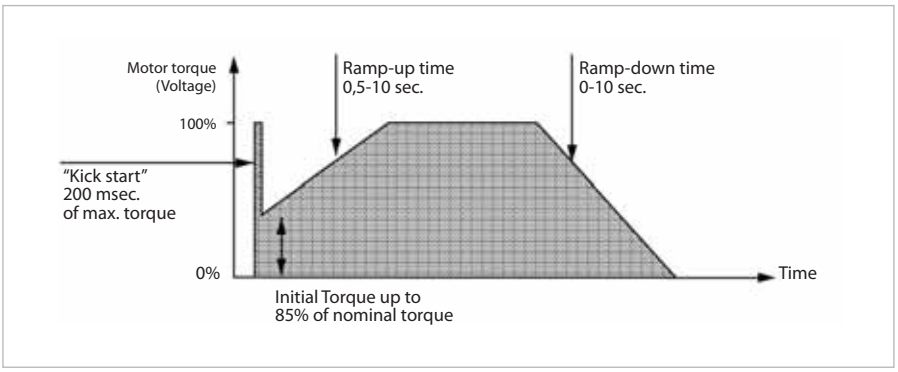
VLT® Soft Start Controller MCD 100

VLT® Soft Start Controller MCD 100 is a cost effective and extremely compact soft starter for AC motors.

A true "fit and forget" soft starter for DIN rail mount, VLT® Soft Start Controller MCD 100 provides basic soft start and stop function.

- A robust semiconductor design – selection can be based on motor power which ensures easy selection.
- Can be used for an almost unlimited number of starts per hour without derating.
- A universal control voltage (24-480 V AC/ V DC) – simplifies selection and keeps stock at a minimum.
- A "fit and forget" contactor design – simplifies installation and reduces required panel space.
- Digitally controlled rotary switches – secures precise settings and simplifies installation.
- Ratings for heavy duty as standard – simplifies installation and reduces the risk of breakdown

Feature	Benefit
Small footprint and compact size	Saves panel space
Selection can be based on motor power	Easy selection
Universal control voltage	– Simplifies selection – Keeps stock at a minimum
"Fit and forget" contactor design	– Simplifies installation – Reduces required panel space
User friendly	**Save commissioning and operating cost**
Easy to install and use	Saves time
Digitally controlled rotary switches	Secures precise settings and simplifies installation
Easy DIN rail mounting for sizes up to 30 kW	Saves time and space
Reliable	**Maximum uptime**
Robust semiconductor design	Reliable operation
Almost unlimited number of starts per hour without derating	Prevents unauthorized changes
Max. ambient temperature 50° C without derating	No external cooling or oversizing necessary



Timed voltage ramp

- Micro Soft Start Controller for motors up to 11 kW
- Extremely robust SCR design with heavy ratings as standard
- Unlimited number of starts per hour
- Contactor style design for easy selection, installation and commissioning

Power range

MCD 100-001 ..... 1,5 kW
MCD 100-007 ..... 7.5 kW
MCD 100-011 ..... 11 kW

All sizes are rated for line voltage up to 600 V AC.

Specifications

Mains supply (L1, L2, L3)	
MCD 100	3 x 208 VAC ~ 600 VAC (+10% / -15%)
Supply frequency (at start)	45 Hz – 66 Hz
Control circuit (A1, A2)	
MCD 100	24 – 480 VAC/VDC (-15% +10%)
Environmental	
Degree of protection MCD 100	IP 20
Operating temperatures	-5° C/+40° C (60° C with de-rating)
Pollution Degree	Pollution Degree 3
EMC Emission	
Equipment class (EMC)	Class A
Conducted radio frequency emission	
0.15 MHz – 0.5 MHz	< 90 dB (µV)
0.5 MHz – 5 MHz	< 76 dB (µV)
5 MHz – 30 MHz	80-60 dB (µV)
Radiated radio frequency emission	
30 MHz – 230 MHz	< 30 dB (µV/m)
230 MHz – 1000 MHz	< 37 dB (µV/m)

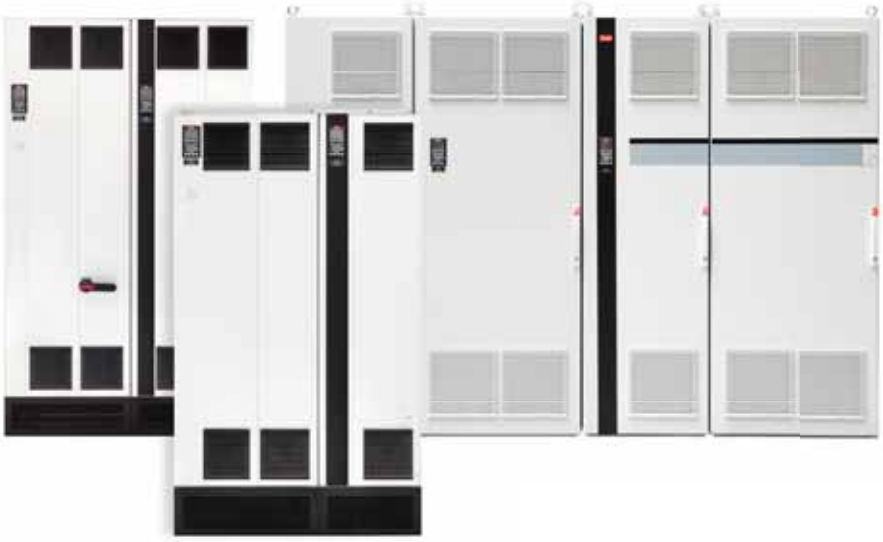
This product has been designed for Class A equipment. Use of the product in domestic environments may cause radio interference, in wich case the user may be required to employ additional mitigation methods.

EMC Immunity	
Electro static discharge	4 kV contact discharge, 8 kV air discharge
Radio-frequency electromagnetic field	
0.15 MHz – 1000 MHz	140 dB (µV)
Rated impulse withstand voltage (Fast transients 5/50 ns – Burst)	4 kV line to earth
Rated insulation voltage (Surges 1.2/50 µs – 8/20 µs)	4 kV line to earth, 2 kV line to line
Voltage dip and short time interruption	100 ms (at 40% nominal voltage)
Short Circuit	
Rated short-circuit current MCD 100-001	Normal fuses: 25 A gL/gG
SCR I2t rating for semiconductor fuses	72 A2s
Rated short-circuit current MCD 100-007	Normal fuses: 50 A gL/gG
SCR I2t rating for semiconductor fuses	1800 A2s
Rated short-circuit current MCD 100-011	Normal fuses: 80 A gL/gG
SCR I2t rating for semiconductor fuses	6300 A2s
Heat Dissipation	
MCD 100-001	Max. 4 watts
MCD 100-007 to MCD 100-011	2 watts/Ampere
Standards Approvals	
UL/C-UL	UL508
CE	IEC 60947-4-2

Dimensions

Model	Power size (kW)	Rated current (Amps)	Dimensions (mm) H x W x D	Approvals
MCD 100	1.5	3 A: 5-5:10 (AC 53b)	102x22,5x124	UL, CSA, CE
	7.5	15 A: 8-3: 100-3000 (AC 53a)	110x45x128	
	11	25 A: 6-5:100-480 (AC 53a)	110x90x128	

VLT® Low Harmonic Drive



The Danfoss VLT® Low Harmonic Drive is the first solution combining an active filter and a drive in one package.

The VLT® Low harmonic drive continuously regulates harmonic suppression according to the load and grid conditions without affecting the connected motor.

The total harmonic current distortion is reduced to less then 3% on grids with balanced mains, a minimum pre-distortion to less than 5% on grids with high harmonic distortion and 2% phase unbalance. As individual harmonics also fulfil toughest harmonic requirements, the VLT® Low harmonic drive meets all present harmonic standards and recommendations.

Unique features such as sleep mode and back channel cooling offers unmatched energy efficiency for Low Harmonic Drives.

The VLT® Low harmonic drive requires the same set-up and installation as a standard VLT® drive and out of the box it ensures optimum harmonic performance.

The VLT® Low harmonic drive has the same modular build-up as our standard high power drives and shares similar features: Built-in RFI filters, coated PCB and user-friendly programming.

Feature	Benefit
Reliable	**Maximum uptime**
No increased winding stress on motor	– Longer motor lifetime – Less initial cost (no output filter needed)
– 100% factory tested – Coated PCBs	Low failure rate
Innovative cooling concept	Prolonged lifetime of electronics
User-friendly	**Saves commissioning and operating cost**
No extra wiring and set-up needed	Easy comissioning and low initial costs
Modular design	Easy serviceability
Full readout of grid conditions	Reduces needed harmonic testing
Energy saving	**Lower operation costs**
– High efficiency – Sleep mode and progressive switching freq.	Low running expenses
Independent of grid and load changes	– Increased transformer efficiency – Reduced cable losses

Voltage range

- 380 – 480 V AC 50 – 60 Hz

Power Range

- **High overload:**
  132-630 kW
  200-900 hp
- **Normal overload:**
  160-710 kW
  250-1000 hp

Enclosure degree

- IP 21/NEMA 1
- IP 54/NEMA 12

Options

The following options are available:

- RFI filters
- Disconnect
- Fuses
- Mains shielding
- Feedback and I/O options
- Fieldbus options
- dU/dt filters
- Sine wave filters

PC software

VLT® Motion Control Tool MCT 10 offers advanced programming functionality for all Danfoss drive products, greatly reducing programming and set-up time.

MCT 10 Basic (available free of charge from www.danfoss.com) allows access to a finite number of drives with limited functionality.
The advanced edition, offering a higher level of functionality, is available from your Danfoss sales partner.

Calculation Software

With VLT® Motion Control Tool MCT 31, you can determine whether harmonics will be an issue in your installation when drives are added.

MCT 31 estimates the benefits of adding various harmonic mitigation solutions from the Danfoss product portfolio and calculates system harmonic distortion. Furthermore the software provides quick indication of whether the installation complies with the most recognised harmonic norms and recommendations.

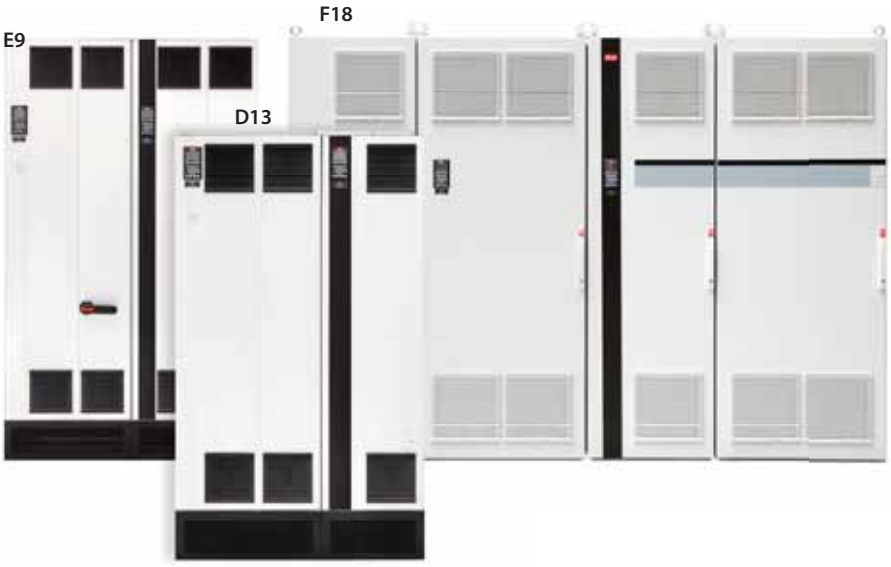
From www.danfoss.com you can down-load the free tool MCT 31 – the most up-to-date version of the calculation software.

Specifications

THiD* at: – 40% load – 70% load – 100% load	 < 5.5% < 3.5% < 3%
Efficiency* at: – 40% load – 70% load – 100% load	 > 93% > 95% > 96%
True power factor* at: – 40% load – 70% load – 100% load	 > 98% > 98% > 98%
Ambient temperature	50° C without derating (D-frame 45° C)
Cooling	Back-channel air cooling

** Measured at balanced grid without pre-distortion*

Norms and recommendations	Compliance
IEEE519	Always
IEC61000-3-2 (up to 16 A)	Out of scope
IEC61000-3-12 (between 16 and 75 A)	Out of scope
IEC61000-3-4 (above 75 A)	Always



400 VAC (380 – 460 VAC)									
Normal Overload			High Overload			Frame	Dimensions	Weight	
Power		Current	Power		Current		H x W x D		
kW	HP	[A]	kW	HP	[A]		IP 21/54	kg	lbs
160	250	315	132	200	260	D13	1780 x 1020 x 380 mm 70 x 40 x 15 inches	390	860
200	300	395	160	250	315			390	860
250	350	480	200	300	395			390	860
315	450	600	250	350	480	E9	2000 x 1200 x 500 mm 79 x 47 x 19 inches	676	1491
355	500	658	315	450	600			676	1491
400	625	745	355	500	658			676	1491
450	700	800	400	625	695			676	1491
500	780	880	450	700	800	F18	2277 x 2800 x 600 mm 90 x 110 x 24 inches	1899	4187
560	875	990	500	780	880			1899	4187
630	985	1120	560	875	990			1899	4187
710	1100	1260	630	985	1120			1899	4187

12-pulse VLT® drive

Robust and cost effective harmonic solution for the higher power range. The Danfoss 12-pulse VLT® drive offers reduced harmonics for demanding industry applications above 250 kW.

The 12-pulse VLT® drive is a high efficiency variable frequency converter which is built with the same modular design as the popular 6-pulse VLT® drives. It is offered with similar drive options and accessories and can be configured according to customer need.

Together with the needed 30°-phase shifting transformer the solution provides durability and reliability at a low cost.

Under ideal grid conditions the solution eliminates the 5th, 7th, 17th and 19th harmonics and results in a THiD of around 12% at full load.

The needed transformer makes this solution ideal for applications where stepping down from medium voltage is required or where isolation from the grid is needed.

The Danfoss 12-pulse VLT® drive provides harmonic reduction without adding capacitive or inductive components which often require network analysis to avoid potential system resonance problems.

Feature	Benefit
Reliable	**Maximum uptime**
Maintenance free	No running expenses
Durability	Long lifetime
Coated PCBs	Environmental robustness
100% factory tested	Low failure rate
Backchannel cooling	Prolonged lifetime of electronics
Design	**Easy operation and user-friendly set-up**
Modular design	Easy serviceability
Same easy programming as a 6-pulse drive	User-friendly operation
– Standard award-winning control panel (LCP) – Available in 27 languages	Effective commissioning and operation

Power Range

- 250 kW – 1.4 MW

Voltage Range

- 380 – 690 V

Enclosure

- IP 21/NEMA Type 1
- IP 54/NEMA Type 12

Options

The following options are available:

- RFI filters
- Disconnect
- Fuses
- Mains shielding
- Feedback and I/O options
- Fieldbus options
- dU/dt filters
- Sine wave filters

PC software

VLT® Motion Control Tool MCT 10 offers advanced programming functionality for all Danfoss drive products, greatly reducing programming and set-up time.

MCT 10 Basic (available free of charge on www.danfoss.com) allows access to a finite number of drives with limited functionality. The advanced edition, offering a higher level of functionality, is available from your Danfoss sales partner.

Calculation Software

With VLT® Motion Control Tool MCT 31 you can determine whether harmonics will be an issue in your installation when drives are added.

MCT 31 estimates the benefits of adding various harmonic mitigation solutions from the Danfoss product portfolio and calculates system harmonic distortion.

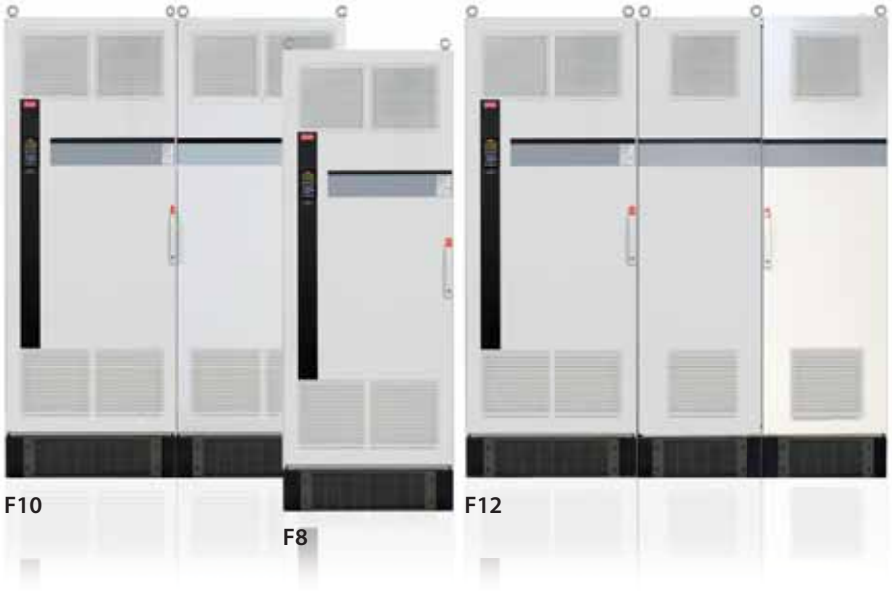
From www.danfoss.com you can download the free tool MCT 31.

Specifications

THiD* at: – 40% load – 70% load – 100% load	 20% 14% 12%
Efficiency* at: – 40% load – 70% load – 100% load	 95% 97% 98%
True power factor* at: – 40% load – 70% load – 100% load	 91% 95% 97%
Ambient temperature	45° C without derating
Cooling	Back-channel air cooling

** Measured at balanced grid without pre-distortion*

Norms and recommendations	Compliance
IEEE519	Depends on grid and load conditions
IEC61000-3-2 (up to 16 A)	Out of scope
IEC61000-3-12 (between 16 and 75 A)	Out of scope
IEC61000-3-4 (above 75 A)	Always



400 V AC				460 V AC				690 V AC				Frame dimensions	
Normal Overload		High Overload		Normal Overload		High Overload		Normal Overload		High Overload		Without options cabinet H x W x D IP 21 [mm]	With options cabinet H x W x D IP 21 [mm]
Power [kW]	Current [A]	Power [kW]	Current [A]	Power [HP]	Current [A]	Power [HP]	Current [A]	Power [kW]	Current [A]	Power [kW]	Current [A]		
315	600	250	480	450	540	350	443	450	450	355	380		
355	658	315	600	500	590	450	540	500	500	400	410	F8	F9
400	745	355	658	600	678	500	590	560	570	500	500	2280 x 800 x 607	2280 x 1400 x 607
450	800	400	695	600	730	550	678	630	630	560	570		
500	880	450	800	650	780	600	730	710	730	630	630		
560	990	500	880	750	890	650	780	800	850	710	730	F10	F11
630	1120	560	990	900	1050	750	890	900	945	800	850	2280 x 1600 x 607	2280 x 2400 x 607
710	1260	630	1120	1000	1160	900	1050						
800	1460	710	1260	1200	1380	1000	1160	1000	1060	900	945		
1000	1720	800	1460	1350	1530	1200	1380	1200	1260	1000	1160	F12	F13
								1400	1415	1200	1260	2280 x 2000 x 607	2280 x 2800 x 607

VLT® Advanced Active Filter AAF 006

A flexible and adaptable solution for central or decentral harmonic mitigation.

VLT® Advanced Active Filter AAF 006 cancompensate for individual VLT® drives or can be installed as a compact stand-alone solution at a common point of coupling, compensating for several loads simultaneously.

Consequently the filter ensures optimal harmonic suppression independent of the number of loads and their individual load profile. In addition the active filter corrects the power factor and balances the phase load providing an optimal energy utilization.

This improves the system efficiency and increases the grid robustness to avoid downtime.

The extensive re-use of proven VLT® components and the modular construction ensures a high reliability and at the same time offers high energy efficiency, back channel cooling and high enclosure grades without size encrease.

The VLT® Advanced Active Filter is easily controlled via the user-friendly LCP, sharing design and programming structure with the VLT® drives series.

Feature	Benefit
Reliable	**Maximum uptime**
– 100% factory tested – Coated PCBs – >90% components re-used from proven VLT® FC series	Low failure rate
Innovative cooling concept	Prolonged lifetime of electronics
User-friendly and flexible	**Saves commissioning and operating cost**
Innovative programming possibilities	Low running expenses
Modular design	Easy serviceability
Wide range of options	– Low initial investment – High degree of customisation
Energy saving	**Lower operation costs**
– High efficiency – Sleep mode and progressive switching freq. – Power factor correction	Low running expenses

Without dismounting existing installation, the VLT® Advanced Active Filters are easily retrofitted to the existing installation, where harmonics are increased because of enlarged employment of non-linear loads such as variable speed drives.

Voltage range

380 – 480 V AC 50 – 60 Hz

Current range

190 A, 250 A, 310 A, 400 A.
Up to 4 units can be paralleled for higher power.

Enclosure degree

- IP 21/NEMA Type 1
- IP 54/NEMA Type 12

Options

The following options are available:

- RFI filters
- Disconnect
- Fuses
- Mains shielding

PC software

VLT® Motion Control Tool MCT 10 offers advanced programming functionality for all Danfoss drive products, greatly reducing programming and set-up time.

MCT 10 Basic (available free of charge from www.danfoss.com) allows access to a finite number of drives with limited functionality.
The advanced edition, offering a higher level of functionality, is available from your Danfoss sales partner.

Calculation Software

With VLT® Motion Control Tool MCT 31, you can determine whether harmonics will be an issue in your installation when drives are added.

MCT 31 estimates the benefits of adding various harmonic mitigation solutions from the Danfoss product portfolio and calculates system harmonic distortion. Furthermore the software provides quick indication of whether the installation complies with the most recognised harmonic norms and recommendations.

From www.danfoss.com you can down-load the free tool MCT 31 – the most up-to-date version of the calculation software.

Specifications

THiD* at: – 40% load – 70% load – 100% load	 < 7% < 5.5% < 5%
Efficiency* at: – 40% load – 70% load – 100% load	 > 95% > 98% > 98%
True power factor* at: – 40% load – 70% load – 100% load	 > 0.98 > 0.98 > 0.98
Ambient temperature	40° C without derating
Cooling	Back-channel air cooling

** Measured at balanced grid without pre-distortion and with VLT® drive matching full load demand*

Norms and recommendations	Compliance
IEEE519	Application and load dependent
IEC61000-3-2 (up to 16 A)	Out of scope
IEC61000-3-12 (between 16 and 75 A)	Out of scope
IEC61000-3-4 (above 75 A)	Out of scope

400 V AC (380 – 480 V AC)					
Total Current [A]	Max. Reactive [A]	Max. Harmonic [A]	Frame	Dimensions H x W x D mm [Inches]	Weight Kg [Lbs]
190	190	170	D14	1780 x 600 x 380 [70 x 24 x 15.0]	238 [525]
250	250	225	E1	2000 x 600 x 500 [79 x 24 x 20]	429 [945]
310	310	280			
400	400	360			453 [998]

Total Current [A]	Max. individual harmonic compensation [A]							
	I_5	I_7	I_{11}	I_{13}	I_{17}	I_{19}	I_{23}	I_{25}
190	133	95	61	53	34	34	30	27
250	175	125	80	70	50	45	40	35
310	217	155	99	87	62	56	50	43
400	280	200	128	112	80	72	64	56

VLT® Advanced Harmonic Filter AHF 005/ 010

Optimised harmonic performance with the FC series up to 250 kW.

The VLT® Advanced Harmonic Filter AHF 005/ 010 have been specially designed to match the Danfoss frequency converters for unmatched performance and design.

Compared to traditional harmonic trap filters they offer a smaller foot print and higher harmonic reduction.

The solution is available in two variants, AHF 005 and AHF 010. When connected in front of a Danfoss VLT® frequency converter, the harmonic current distortion generated back to the mains is reduced to 5% and 10% Total Harmonic Current Distortion at full load.

With a >98% efficiency the passive Advanced Harmonic Filters offer cost effective and very robust harmonic solutions specifically for power up to 250 kW.

As stand-alone options the advanced harmonic filters feature a compact housing that is easily integrated into existing panel space. This makes them well-suited for retrofit applications with limited adjustments of the frequency converter.

Feature	Benefit
Reliable	**Maximum uptime**
– 100% factory tested – Based on proven and tested filter concept	Low failure rate
Energy saving	**Lower operation costs**
– High efficiency – Electrically matched to the individual VLT® FC drives	Low running expenses
Design	**Compact and aesthetic enclosure**
– Innovative coil design – Side-by-side mounting – Optimized for mounting in panels	– Smaller footprint – Less wall space needed
Easy commissioning	Low commissioning costs
Enclosure size and colour matches	Danfoss look and feel

Line Voltage

- 380 – 415 V AC (50 and 60 Hz)
- 440 – 480 V AC (60 Hz)
- 600 V AC (60 Hz)
- 500 – 690 V AC (50 Hz)

Filter current

- 10A-480A (380-415V AC, 50 and 60 Hz)
- 10A-436A (440-480V AC, 60 Hz)
- 15A-395A, 600V AC, 60 Hz)
- 15A-395A (500-690V AC, 50 Hz)
- (Modules can be paralleled for higher power)

Enclosure degree

- IP 20/IP 00*

* *Forced cooling is required. There are no fans in the IP00 units and the required air-flow must be implemented in the cabinet.*

Options

The following options are available:

- IP 21/NEMA 1 kit
- IP 21/NEMA 1 kit with capacitor disconnect feature

Calculation Software

With VLT® Motion Control Tool MCT 31, you can determine whether harmonics will be an issue in your installation when drives are added.

MCT 31 estimates the benefits of adding various harmonic mitigation solutions from the Danfoss product portfolio and calculates system harmonic distortion. Furthermore the software provides quick indication of whether the installation complies with the most recognised harmonic norms and recommendations.

From www.danfoss.com you can down-load the free tool MCT 31 – the most up-to-date version of the calculation software.

Specifications

	AHF 010	AHF 005
THiD* at: – 40% load – 70% load – 100% load	 ~ 12% ~ 11% < 10%	 ~ 7% ~ 6% < 5%
Efficiency* at 100% load	>98.5%	
True power factor* at: – 40% load – 70% load – 100% load	 ~ 81% ~ 96% > 99%	 ~ 80% ~ 95% > 98%
Ambient temperature	45° C without derating	
Cooling	Back-channel air cooling	

** Measured at balanced grid without pre-distortion*

Norms and recommendations	Compliance
IEEE519	AHF 005 always AHF 010 depends on grid and load conditions
IEC61000-3-2 (up to 16 A)	Always
IEC61000-3-12 (between 16 and 75 A)	Always
IEC61000-3-4 (above 75 A)	Always

Enclosures

AHF current rating [A]										Enclosure Type
380–415 V 50 Hz		380–415 V 60 Hz		440–480 V 60 Hz		600 V 60 Hz		500–690 V 50 Hz		
AHF005	AHF010	AHF005	AHF010	AHF005	AHF010	AHF005	AHF010	AHF005	AHF010	Type
10 14						-				X1
22 29				19 25		-				X2
34 40 55				31 36 48		15 20				X3
66 82				60 73		24 29 36				X4
96 133				95 118		50 58				X5
171 204				154 183		77 87 109 128				X6
251 304	251 304 325 381	251	251 304 325 381	231	231 291 355 380	155 197	155 197 240	155 197	155 197 240	X7
325 381 480	480	304 325 381 480	480	291 355 380 436	436	240 296	296 366 395	240 296	296 366 395	X8

Dimensions

Enclosure Type	Dimensions in mm		
	Height*	Width	Depth
X1	347	190	206
X2	451	230	248
X3	605	378	242
X4	634	378	333
X5	747	418	333
X6	778	418	400
X7	900	468	450
X8	900	468	515

* *Maximum dimension. Actual dimension depends on fan concept. Please consult manual for actual dimension*

VLT® Common Mode Filters MCC 105

Effective

kit to reduce

electromagnetic interference

VLT® Common Mode Filters MCC 105 core kit reduce electromagnetic interference and eliminate bearing damage by electrical discharge.

VLT® Common Mode Filters MCC 105 (HF-CM) cores are special nanocrystalline magnetic cores which have superior filtering performance compared to regular ferrite cores. They act like a common-mode inductor (between phases and ground).

Installed around the three motor phases (U, V, W), they reduce high-frequency common-mode currents. As a result, high-frequency electromagnetic interference from the motor cable is reduced. However, the core kit should not be used as the sole mitigation measure, and even when the cores are used, the EMC installation rules shall be followed.

Prevent motor bearing currents

The most important function is to reduce high-frequency currents associated with electrical discharges in the motor currents. These discharges contribute to the premature wear-out and failure of motor bearings. By reducing or even eliminating discharges, the wear-out of the bearings is reduced and the lifetime extended. Thus, maintenance and down-time costs are lowered.

Feature	Benefit
High-performance nanocrystalline magnetic material	– Effective reduction of electrical discharges in the motor bearings – Reduces bearing wear-out, maintenance costs and down-time – Reduces high-frequency electromagnetic interference from the motor cable
– Oval shape – Scalable solution: longer cables handled by stacking more cores	Easy to install in restricted places such as the VLT® enclosure or the motor terminal box
Only 4 core sizes cover the entire VLT® power range	– Easy logistics, fast delivery and comprehensible product program – Allows the addition to a service tool-kit
Low investment	Cost-effective alternative to, for example, sine-wave filters if the only phenomena to be mitigated is bearing wear-out through electrical discharge

Ideal for retrofitting

Bearing current problems are most often discovered after commissioning. Therefore, the cores have an oval shape which makes them ideal for retrofitting and for installation in restricted places.

Only 4 variants cover the entire VLT® product range making it possible to carry these valuable aids in a service tool kit.

A flexible solution

The cores can be combined with other output filters, and especially in combination with dU/dt filters they offer a low cost solution for protection of both motor bearings and insulation.

Product range

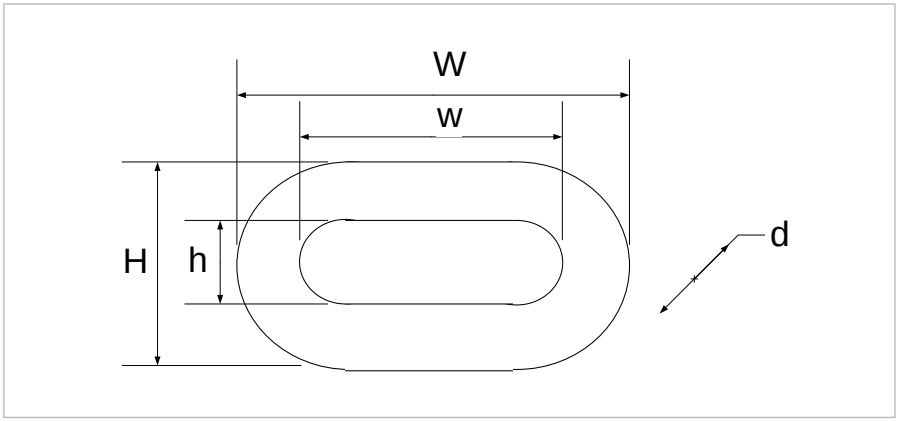
- Available for all power sizes from 0.18 kW to 1.4 MW
- 4 core sizes cover the entire VLT® power range

HF-CM selector

The cores can be installed at the frequency converter's output terminals (U, V, W) or in the motor terminal box. When installed at the frequency converter's terminals, the HF-CM kit reduces bearing stress and high-frequency electromagnetic interference from the motor cable. The number of cores depends on motor cable length and frequency converter voltage. A selection table is shown to the right.

Cable length [m]	A and B frame		C frame		D frame		E and F frame	
	T5	T7	T5	T7	T5	T7	T5	T7
50	2	4	2	2	2	4	2	2
100	4	4	2	4	4	4	2	4
150	4	6	4	4	4	4	4	4
300*	4	6	4	4	4	6	4	4

** Longer cable lengths are easily handled by stacking more HF-CM cores.*



Ordering numbers and dimensions

Ordering numbers for the core kits (2 cores per package) are given in the table below.

VLT® Frame Size	Danfoss ordering number	Core dimension [mm]					Weight	Packaging dimension
		W	w	H	h	d	[kg]	[mm]
A and B	130B3257	60	43	40	25	22,3	0.25	190 x 100 x 70
C1	130B7679	82,8	57,5	45,5	20,6	33		
C2, C3, C4	130B3258	102	69	61	28	37	1.6	190 x 100 x 70
D	130B3259	189	143	126	80	37	2.45	235 x 190 x 140
E and F	130B3260	305	249	147	95	37	4.55	290 x 260 x 110

Installation

The HF-CM cores are easy to install: Simply pass the three motor phase leads (U, V, W) through the cores.

VLT® Sine-Wave Filter MCC 101

VLT® Sine-wave Filter MCC 101 output filters are low-pass filters that suppress the switching frequency component from the drive and smooth out the phase-to-phase output voltage of the drive to become sinusoidal. This reduces the motor insulation stress and bearing currents.

VLT® Sine-wave Filter MCC 101 output filters are differential-mode low-pass filters that suppress the switching frequency component from the drive and smooth out the phase-to-phase output voltage of the drive to become sinusoidal. This reduces the motor insulation stress and bearing currents.

By supplying the motor with a sinusoidal voltage waveform, the switching acoustic noise from the motor is also eliminated.

Thermal losses and bearing currents

The sinusoidal voltage supply to the motor reduces hysteresis thermal losses in the motor. Since the motor insulation lifetime is dependent on the motor temperature, the sine-wave filter prolongs the lifetime of the motor.

The sinusoidal motor terminal voltage from the sine-wave filter furthermore has the advantage of suppressing any bearing currents in the motor. This reduces the risk of flashover in the motor bearings and thereby also contributes to extended motor lifetime and increased service intervals.

Feature	Benefit
Supplies the motor with a sinusoidal voltage waveform	– Prevents flashover in motor windings
Eliminates over-voltages and voltage spikes caused by cable reflections	– Protects the motor insulation against premature aging
Reduces electromagnetic interference by eliminating pulse reflection caused by current ringing in the motor cable. This allows the use of unshielded motor cables in some applications.	– Trouble-free operation
Eliminates acoustic noise in motor	– Noiseless motor operation
Reduces high frequent losses in motor	– Prolongs service interval of motor

Quality and Design

All filters are designed and tested for operation with the VLT® Automation-Drive FC 302, VLT® AQUA Drive FC 202, and the VLT® HVAC Drive FC 102. They are rated for the nominal switching frequency of the VLT® FC series and therefore no derating of the drive is needed.

The enclosure is designed to match the look and quality of the VLT® FC series drives.

Advantages

- Compatible with all control principles including flux and VVC+
- Parallel filter installation is possible for applications in the high power range

Range

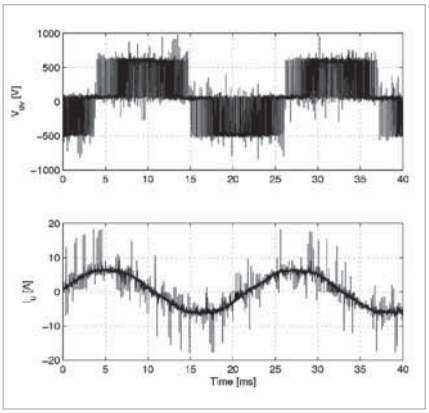
3 x 200 – 500 V, 2.5 – 800 A
3 x 525 – 690 V, 4.5 – 660 A

Enclosures

- IP 00 and IP 20 wall-mounted enclosure up to 75 A (500 V)/ 45 A (690 V)
- IP 23 floor-standing enclosure from 115 A (500 V)/76 A (690 V)

Mounting

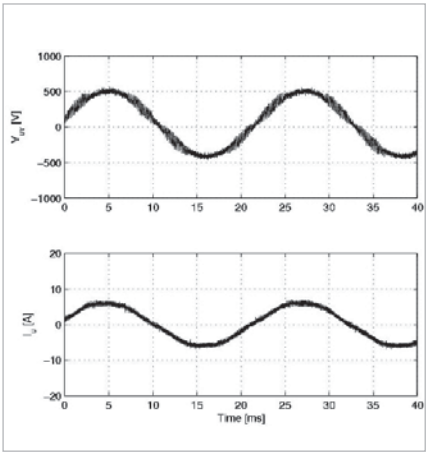
- Side by side mount with the drive up to 75 A (500 V) and 45 A (690 V)



Voltage and current without filter

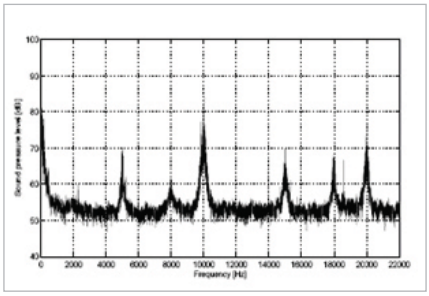
Specifications

Voltage rating	3 x 200 – 500 V and 3 x 525 – 690 V
Nominal current I_N @ 50 Hz	2.5 – 800A for higher power modules can be paralleled
Motor frequency	0 – 60 Hz without derating 100/120 Hz (up to 10 A) with derating
Ambient temperature	-25° to 45°C without derating
Min. switching frequency	f_{min} 1,5 kHz – 5 kHz depending on filter type
Max. switching frequency	f_{max} 8 kHz
Overload capacity	160% for 60 sec every 10 min.
Enclosure degree	IP 00/IP 20/IP 23 (ref. page 1)
Approvals	CE, UL508

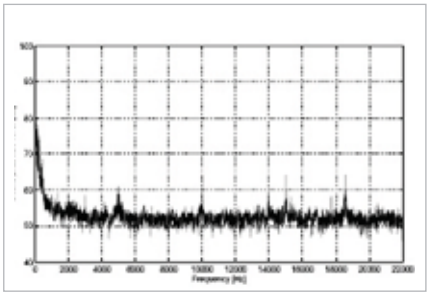


Voltage and current with filter

Relative sound pressure measurements from the motor with and without sine-wave filter



No filter



With sine-wave filter

Performance Criteria	du/dt filters	Sine-wave filters
Motor insulation stress	Up to 100 m cable (shielded/unshielded) complies with the requirements of IEC60034-17* (general purpose motors). Above this cable length the risk of "double pulsing" increases.	Provides a sinusoidal phase-to-phase motor terminal voltage. Complies with IEC-60034-17* and NEMA-MG1 requirements for general purpose motors with cables up to 500 m (1 km for frame size D and above).
Motor bearing stress	Slightly reduced, mainly in high power motors.	Reduces bearing currents caused by circulating currents. Does not reduce common-mode currents (shaft currents).
EMC performance	Eliminates motor cable ringing. Does not change the emission class. Does not allow longer motor cables as specified for the frequency converter's built-in RFI filter.	Eliminates motor cable ringing. Does not change the emission class. Does not allow longer motor cables as specified for the frequency converter's built-in RFI filter.
Max. motor cable length	100 m ... 150 m With guaranteed EMC performance: 150 m screened Without guaranteed EMC performance: 150 m unscreened	With guaranteed EMC performance: 150 m shielded and 300 m unshielded (only conducted emissions). Without guaranteed EMC performance: up to 500 m (1 km for frame size D and above).
Acoustic motor switching noise	Does not eliminate acoustic switching noise from the motor.	Eliminates acoustic switching noise from the motor caused by magnetostriction.
Relative size	15 – 50% (depending on power size).	100%
Relative price	50%	100%

**Not 690 V*

VLT® dU/dt Filter MCC 102

VLT® dU/dt Filter MCC 102 reduce the dU/dt values on the motor terminal phase-to-phase voltage – an issue that is important for short motor cables.

VLT® dU/dt Filter MCC 102 are differential-mode low-pass filters which reduce motor terminal phase-to-phase peak voltages spikes and reduce the rise time to a level that lowers the stress on the insulation of motor windings.

Compared to sine-wave filters, the dU/dt filters have a cut-off frequency above the switching frequency. The voltage at the motor terminals is still PWM pulse shaped, but the rise time and Upeak are reduced. They are smaller, weigh less and have a lower price compared to sine-wave filters. Furthermore, because of the smaller inductance and capacitance, the dU/dt filters introduce a negligible reactance between inverter and motor and are therefore suitable for high dynamic applications.

Superior compared to output chokes

Output chokes cause undamped oscillations at the motor terminals which increase the risk of double pulsing and over-voltages higher than twice the DC link voltage.
The dU/dt filters are low-pass L-C filters with a well defined cut-off frequency. Therefore the ringing oscillations at the motor terminals are damped and there is a reduced risk of double pulsing and voltage peaks.

Feature	Benefit
Reduces dU/dt stresses	Increases motor service interval
Lowers the magnetic interference propagation on surrounding cables and equipment	Trouble-free operation
Low voltage drop makes dU/dt filters the ideal solution for highly dynamic applications with flux vector regulation	Small size and cost compared to sine-wave filters

Quality and Design

All dU/dt filters are designed and tested for operation with the VLT® AutomationDrive FC 302, VLT® AQUA Drive FC 202, and the VLT® HVAC Drive FC 102. They are designed to match the look and quality of the FC series.

Advantages

- Compatible with all control principles, including flux and VVC+
- Parallel filter installation is possible for applications in the high power range

Range

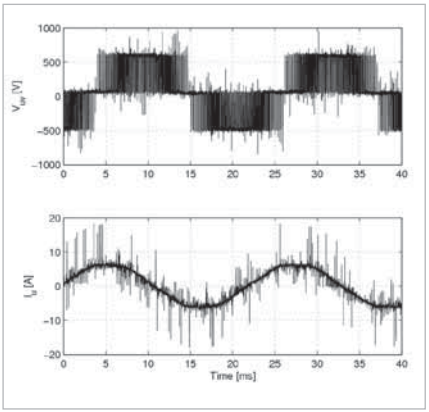
3 x 200 – 690 V (up to 880 A)

Enclosures

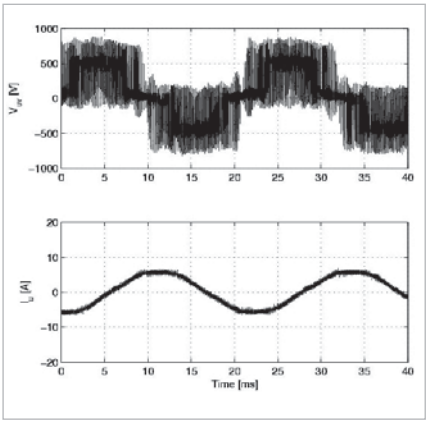
- IP 00 and IP 20/23 enclosure in the entire power range.
- IP 54 enclosure available up to 177 A.

Mounting

- Side by side mounting with the drive
- Filters wall mounted up to 177 A (380 V) and floor mounted above that size



Voltage and current without filter

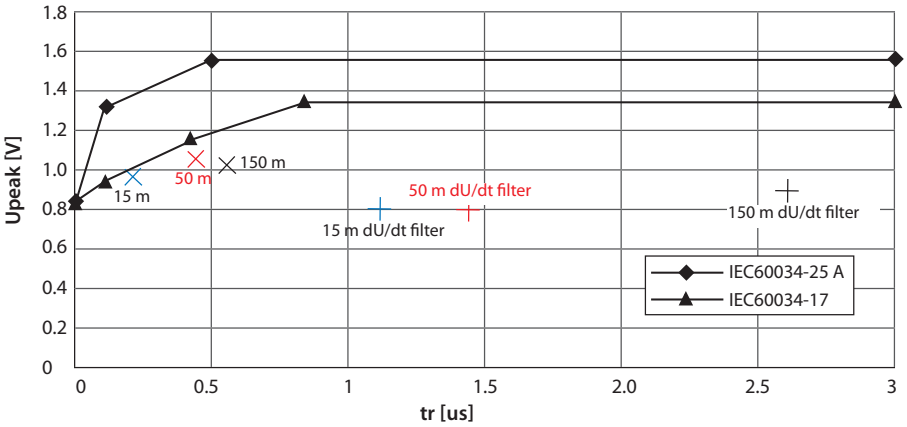


Voltage and current with filter

Specifications

Voltage rating	3 x 200 – 690 V
Nominal current I_N @ 50 Hz	44 – 880 A @ 200 – 380 V, 40 – 780 A @ 460 V 32 – 630 A @ 600 V and 27 – 630 A @ 690 V for higher power modules can be paralleled
Motor frequency	0 – 60 Hz without derating Max. 100 Hz (with derating)
Ambient temperature	-25° to 45° C without derating
Max. switching frequency	f_{sw} 1,5 kHz – 4 kHz depending on filter type
Mounting	Side-by-side
Overload capacity	160% for 60 sec every 10 min.
Enclosure degree	IP 00, IP 20/23 and IP 54
Approvals	CE, UL508

dU/dt limit curves



The dU/dt value decreases with the motor cable length whereas the peak voltage increases. Therefore it is recommended to use sine-wave filters in installations with motor cable lengths above 150 m.

Performance Criteria	du/dt filters	Sine-wave filters
Motor insulation stress	Up to 100 m cable (shielded/unshielded) complies with the requirements of IEC60034-17* (general purpose motors). Above this cable length the risk of "double pulsing" increases.	Provides a sinusoidal phase-to-phase motor terminal voltage. Complies with IEC-60034-17* and NEMA-MG1 requirements for general purpose motors with cables up to 500 m (1 km for frame size D and above).
Motor bearing stress	Slightly reduced, mainly in high power motors.	Reduces bearing currents caused by circulating currents. Does not reduce common-mode currents (shaft currents).
EMC performance	Eliminates motor cable ringing. Does not change the emission class. Does not allow longer motor cables as specified for the frequency converter's built-in RFI filter.	Eliminates motor cable ringing. Does not change the emission class. Does not allow longer motor cables as specified for the frequency converter's built-in RFI filter.
Max. motor cable length	100 m ... 150 m With guaranteed EMC performance: 150 m screened Without guaranteed EMC performance: 150 m unscreened	With guaranteed EMC performance: 150 m shielded and 300 m unshielded (only conducted emissions). Without guaranteed EMC performance: up to 500 m (1 km for frame size D and above).
Acoustic motor switching noise	Does not eliminate acoustic switching noise from the motor.	Eliminates acoustic switching noise from the motor caused by magnetostriction.
Relative size	15 – 50% (depending on power size).	100%
Relative price	50%	100%

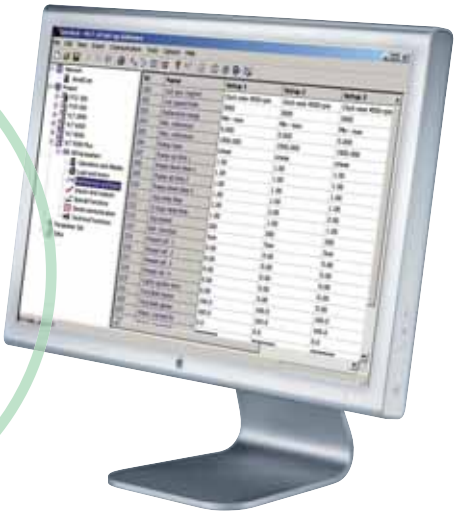
**Not 690 V*

VLT® Motion Control Tool MCT 10

Optimised

for:

- Commissioning
- Servicing
- Programming



The VLT® Motion Control Tool MCT 10, is ideal for commissioning and servicing the drive including graphical configuration of cascade controller time-based actions, real-time clock, smart logic controller and preventive maintenance.

The setup software provides easy control of details as well as a general overview of systems, large or small. The tool handles all drive series, VLT® Advanced Active Filters and VLT® Soft Starter related data.

Feature	Benefit
One PC tool for all tasks	Save time
"Explorer-like" view	Easy to use
Option programming	Save time
Online and offline commissioning	Flexible and save cost
Scope & logging	Easy and fast analyzing – less downtime
Alarm history	Easy fault finding
Multiple interfaces	Easy connection
USB connection	Easy connection
Flexible Ethernet connection	Easy connection – save time (utilizing all Danfoss Ethernet based fieldbus options) Remote connection, also through different subnets

More efficient service organization

- Scope & logging: analyse problems easily
- Read out alarms, warnings and fault log in one view.
- Compare saved project with on-line drive
- Update drive or option firmware. One tool handling all
- Conversation wizard suitable for retrofit of VLT® 5000 to FC 302

More efficient commissioning

- Off-line commissioning off site
- Save/send/mail projects anywhere
- Easy field-bus handling, multiple drives in project file scalable to the application size

Basic version

- Off-line commissioning (max. 4 drives)
- Scope & Graph (max. 2 channels)
- Multiple fieldbus support
- Alarm history in saved projects
- MCO 305 support
- Graphical Smart Logic Controller
- Graphical Clock functions, Time-based Actions, Preventive Maintenance and Basic Cascade Controller (FC 102/FC 202 only)
- Update drive support to support new firmware (future compatible)
- FC drive conversion (FC 102/FC 202 & FC 300 series)

Advanced version

- Basic version functionality +
- No limitation in number of drives
- Scope & Graph (max. 8 channels)
- Real Time Logging from drive
- Motor Database
- Graphical Sensorless pump control
- Graphical Extended Cascade Controller (FC 202 only)
- Support for CSIV file creation and upload of CSIV-, SAS-, SPLASH- and language files to the drive
- Full drive password protection support
- Configuration support of the functional safety options

Fieldbusses

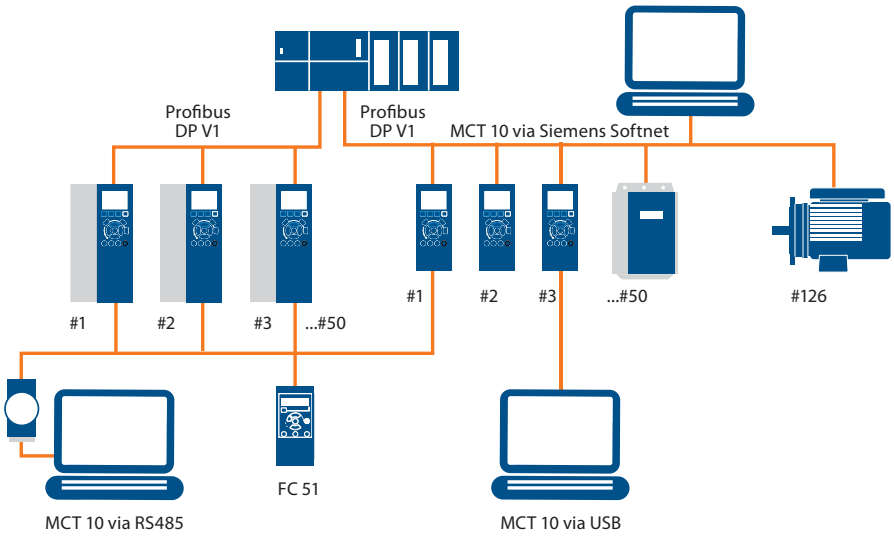
- PROFIBUS DP-V1
- RS485
- USB
- EtherNet-TSC

Internet download

For further information and download of the free basic version visit:
http://www.danfoss.com/drives

System requirements

- MS Windows® NT 4.0, 2000, XP, Vista 7 and 8
- Pentium III 350 MHz or better
- 512 MB RAM or better
- 200 MB free hard disk space
- CD-ROM drive
- VGA or XGA graphic adapter



VLT® Motion Control Tool MCT 31

Optimised

for:

- Application specific simulations
- Various Power Supply sources
- Norm compliance indication
- Project Documentation

With VLT® Motion Control Tool MCT 31, you can determine whether harmonics will be an issue in your installation when drives are added. MCT 31 estimates the benefits of adding various harmonic mitigation solutions from the Danfoss product portfolio and calculates system harmonic distortion.

Save money and reduce running costs

On the basis that it is better to avoid a problem rather than cure one after it happens, it is preferable to calculate the effect of installing non-linear loads before doing so, to estimate the degree of harmonic distortion that may result.

Danfoss offers free to download, the VLT® Motion Control Tool MCT 31, a simple to use and fast software tool for calculating the harmonic distorsion from your existing or intended drives installation.

A fast estimate is vital as, in this case, more is not better, simply more costly, so the MCT 31 can help save money when selecting harmonic mitigation solutions.

Simply over-specifying a harmonic mitigation solution will lead to unnecessary initial cost escalation and increased running expenses.

Feature	Benefit
Explore-like view	Easy to use
Simple simulation model with less parameters	Easy to use and fast simulation – save time
Configurable for various Power supply sources	Matching all customer needs
One tool supporting all Danfoss harmonic mitigation solutions	Matching all customer needs
Configurable Norm compliance indication	Save time
User configurable reports	Project documentation
Simulate the setup before installation	Save time and money. Prevent problems appear later

Calculate the harmonic disturbance

The MCT 31 tool can easily be used to evaluate the expected grid quality and includes a range of passive and active counter-measures which can be selected to ease system stress.

The power quality impact of electronic devices can be estimated in the frequency range up to 2.5 kHz, depending on the system configuration and standard limits.

The analysis includes indication of compliance with various standards and recommendations.

The Windows-like interface of the MCT 31 tool makes possible intuitive operation of the software. It is built with a focus on user-friendliness and the complexity is limited to system parameters that are normally accessible.

The Danfoss VLT® frequency converter and mitigation equipment is included, allowing offline configuration.

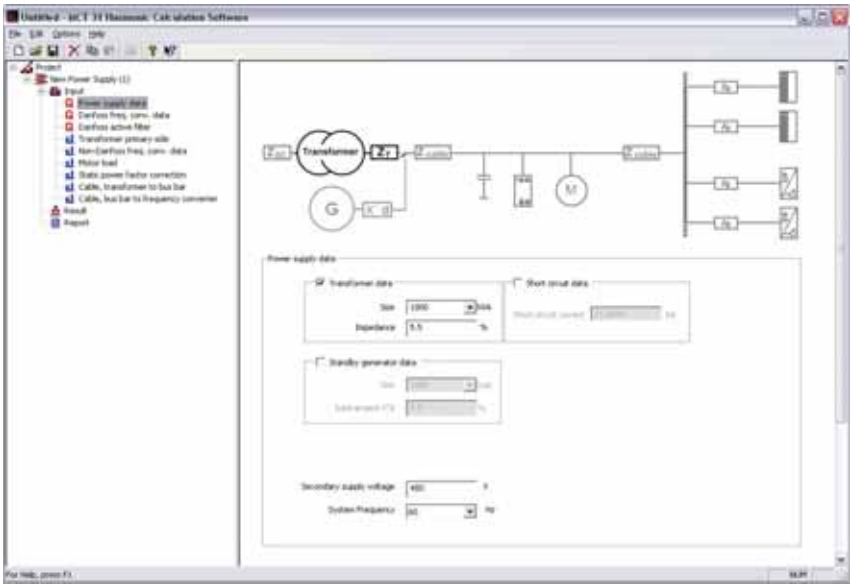
Your local Danfoss consultant will be very happy to provide all the assistance you need to evaluate your power quality and advice in the selection of the correct mitigation for your circumstances.

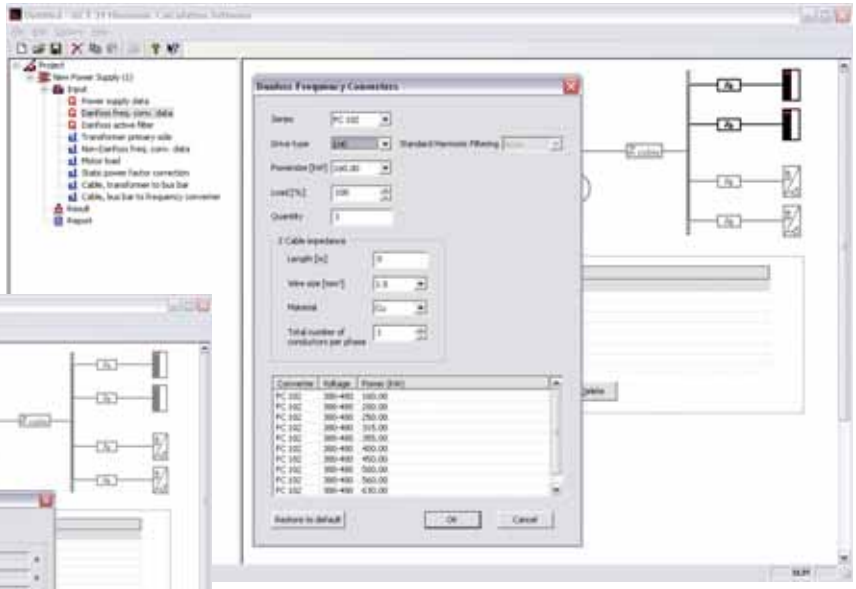
Internet download

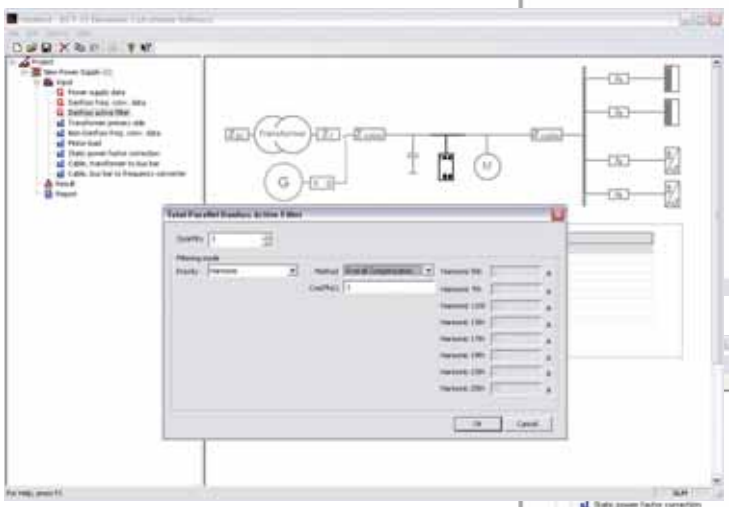
For further information and download of the MCT 31software visit: http://www.danfoss.com/drives

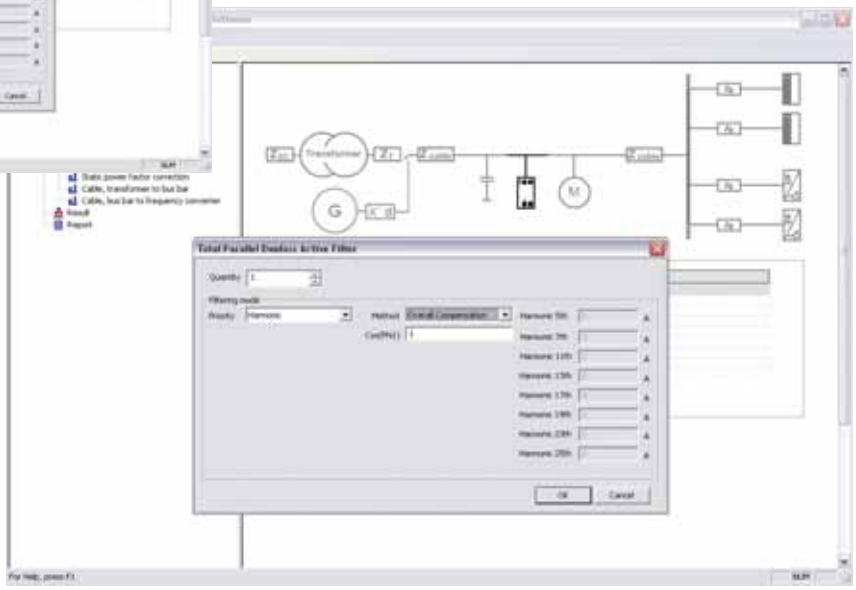
System requirements

- MS WindowsR NT 4.0, 2000, XP, Vista or 7
- Pentium III 350 MHz or better
- 512 MB RAM or better
- 200 MB free hard disk space
- CD-ROM drive
- VGA or XGA graphic adapter









VLT® Energy Box

Optimised

for:

- Designing HVAC installations
- Obtaining energy savings
- Calculating pay-back time

With the VLT® Energy Box Software you can early in the project estimate the energy savings. Later you can easily compare your estimations with the actual energy savings and carbon footprint reduction using the trend and energy data stored in your drive.

VLT® Energy Box makes energy consumption calculations of fan, pump and cooling tower applications driven by VLT® HVAC Drives from Danfoss and compares it with alternative methods of flow control.

The program compares the total operation costs of various traditional systems compared to operation of the same system with a VLT® HVAC Drive.

With the VLT® Energy Box Software you can early in the project estimate the energy savings. Later you can easily compare your estimations with the actual energy savings and carbon footprint reduction using the trend and energy data stored in your drive.

The VLT® Energy Box communicates with the drives through the USB/ RS485 port and can read all data about duty cycles and energy consumptions.

Data about duty cycles and energy consumptions can be downloaded from the VLT® HVAC Drive, making it easy to monitor your energy savings and return on investment. Monitoring via fieldbus often makes energy meters omissible.

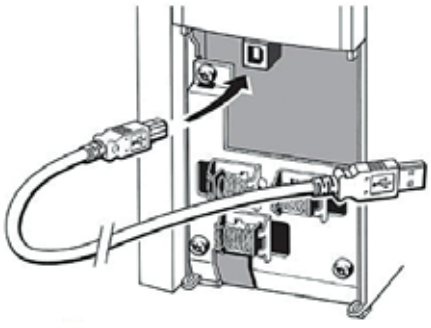
Feature	Benefit
Estimate savings	– Make purchase decision easy
Calculates pay back based on investments and annual costs	– Economical overview
Generates a report	– Easy communication
Special cooling tower mode based on climate data	– Easy calculation
Possible to adjust climate region to local conditions	– More accurate calculations
Download of energy data from the drive via serial communication and USB	– Facilitates the drives payback function – Visualize actual load profile
Covers several projects and systems in same file	– Generation of common project report

The software allows you to download trend and energy data from your drive and even create one report with the total energy savings, if you have several drives in the same system.

Complete financial analysis

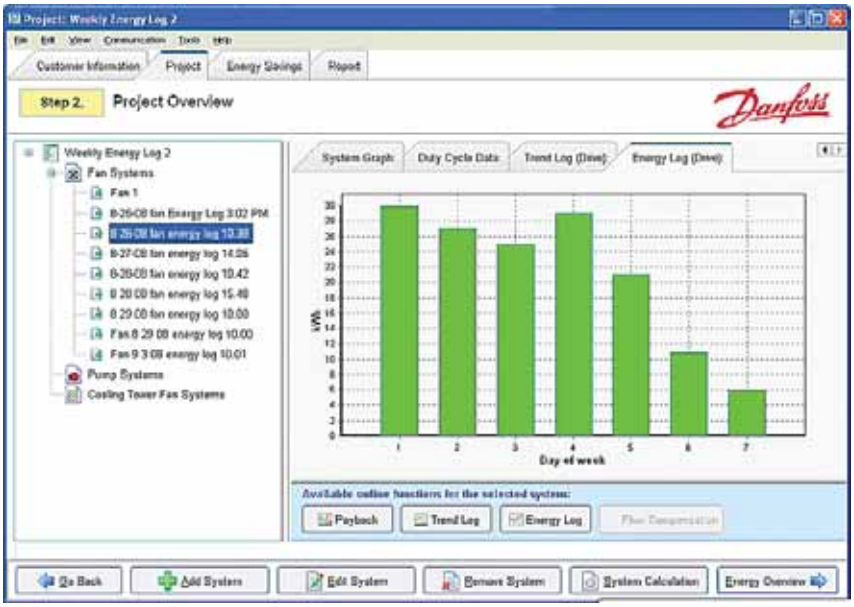
VLT® Energy Box provides a complete financial analysis including:

- Initial cost for the drive system and the alternative system
- Installation and hardware costs
- Annual maintenance costs and any utility company incentives for installation of energy conservation products
- Payback time and accumulated savings and carbon footprint are calculated



No nonsense

Since VLT® Energy Box both estimates and afterwards can compare the estimation to the real energy savings the real energy savings, it is a very trustworthy means for calculating projects involving many fans, pumps and cooling towers. You can simply install a single VLT® HVAC Drive and check the actual savings to exactly calculate the benefits from installing VLT® HVAC Drives on the other applications.



Internet download

The software can be downloaded free of charge from:
http://www.danfoss.com/drives

System requirements

- Windows XP, Vista, 7 or 8
- 512 MB RAM or better
- VGA or higher with a minimum resolution of 1024 x 768
- 30 MB free harddisk Space

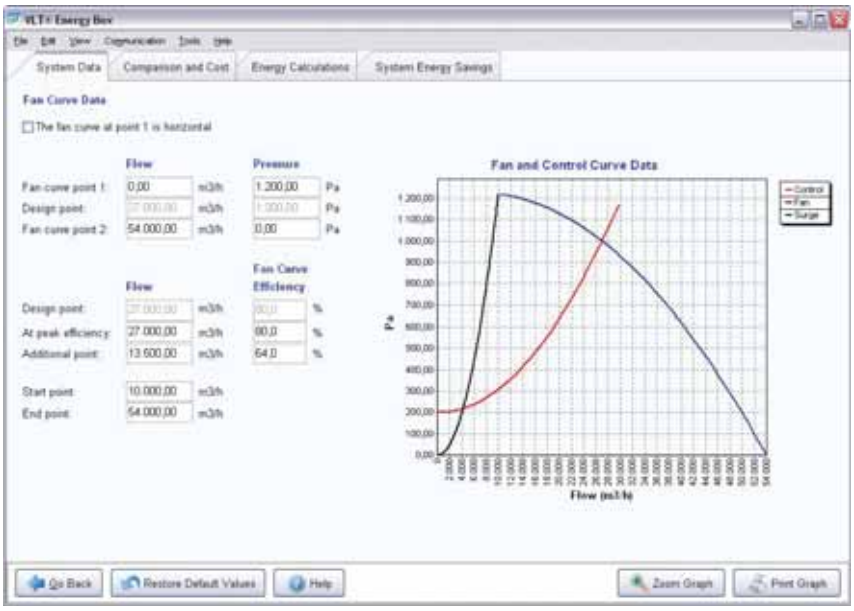
Considers local conditions

VLT® Energy Box use local weather data in its calculations for cooling towers.

Data from weather zones around the Globe are pre-installed, but the user is free to adjust these data according to local conditions.

Specify the curve

Energy Box offers an advanced mode to specify the fan or pump curve in more detail.
The fan or pump (equipment) curve can be adjusted to match almost any shape.
Choose flow and pressure points to generate an equipment curve similar to the published fan or pump curve over the relevant section of the curve using the mechanical flow control method.
The program will not allow calculations in regions that are in a surge region or beyond the end of the curve.



VLT® Service
VLT® DrivePro™ LifeCycle Service Packages

VLT® DrivePro™ Plus
The Plus Package offers a program of support to help customers realize improved drive availability and reliability.

Features
- Preventative Maintenance
- Standard Training
- 24 hour Hotline
- 24 hour response time
- On-site service

VLT® DrivePro™ Premium
Our Premium Program provides a combination of basic and advanced service and support resources aimed at extending the life of your drives and ensure peak economic performance.

Features
- Preventative Maintenance
- Standard and scheduled training
- 24 hour Hotline
- 6 hour response time
- On-site service, inc. labour & travel
- Start-up
- Extended warranty – Depot
- Extended warranty – On-site
- Environmental disposal

VLT® DrivePro™ Supreme
The Supreme Package provides a full scope of service to meet your operational needs, help you achieve business critical KPI metrics and last but not least give you total peace of mind.

Features
- Preventative Maintenance
- Customer-specifi c training
- 24 hour Hotline
- 6 hour response time
- On-site service, inc. labour & travel
- Start-up
- Extended warranty – Depot
- Extended warranty – On-site
- Environmental disposal
- Analysis and surveys
- Spare Parts/Drives
- SmartStep
- Stock Maintenance & Consignment
- Stock

VLT® DrivePro™ SmartStep

Upgrade and replace equipment proactively for total peace of mind

Upgrade sensibly
DrivePro™ SmartStep is a comprehensive replacement and upgrade program for customers to assure optimal efficiency and cost performance.
It's an easy upgrade program for substantially reduced cost that's backed by professional service support.

DrivePro™ SmartStep advantages
- Customized service and upgrade program
- Flexible replacement plan
- Fixed costs

Designed for success
- Minimize down-time costs
- Extend mean-time-to-repair intervals
- Control your maintenance budget
- Avoid unexpected investments in equipment

Available for application areas such as:
- Food & Beverage
- HVAC
- CTM (chemical, textile, materials)
- Water and wastewater

Service you can rely on 24/7 – around the world

Sales and Service
Contacts worldwide. Helping to optimise your productivity, improve your maintenance, and control your finances.
- 24/7 availability
- Local hotlines, local language and local stock

The Danfoss service organisation is present in more than 100 countries – ready to respond whenever and wherever you need, around the clock, 7 days a week.

Find your local expert team on
www.danfoss.com/drives

Configure your VLT® drive to fit your needs on http://driveconfig.danfoss.com

The Drive Configurator gives you the possibility to configure (select) the right drive for your purpose
You don't have to consider if the combinations are valid, while the configurator only gives you valid selections.

Drive Configurator

The Danfoss Drive Configurator is an advanced but easy-to-use tool to configure the Danfoss VLT® frequency converter that exactly matches your requirements.

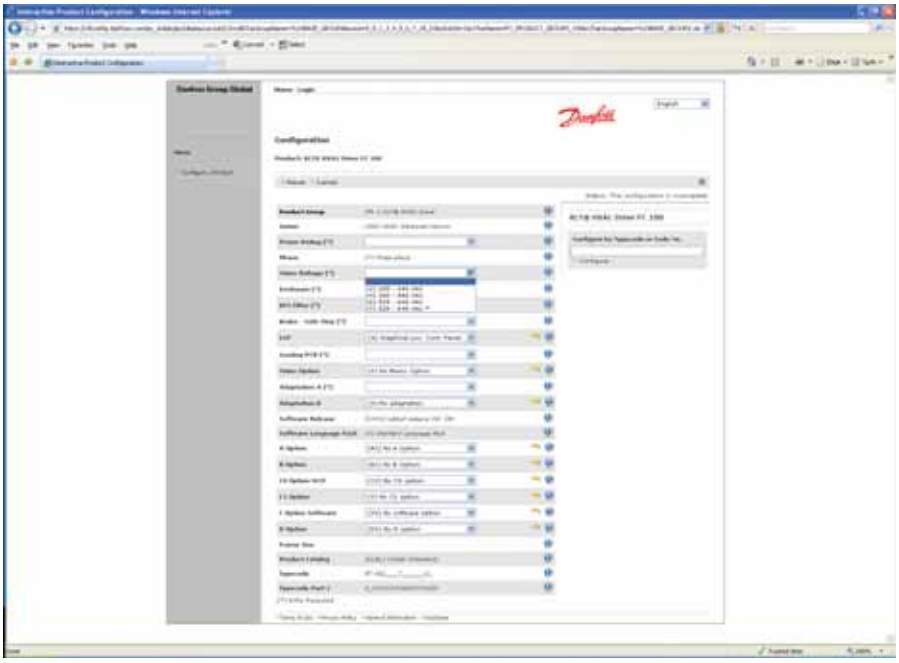
The Drive Configurator generates the unique article number for the drive you need, preventing errors during order entry.

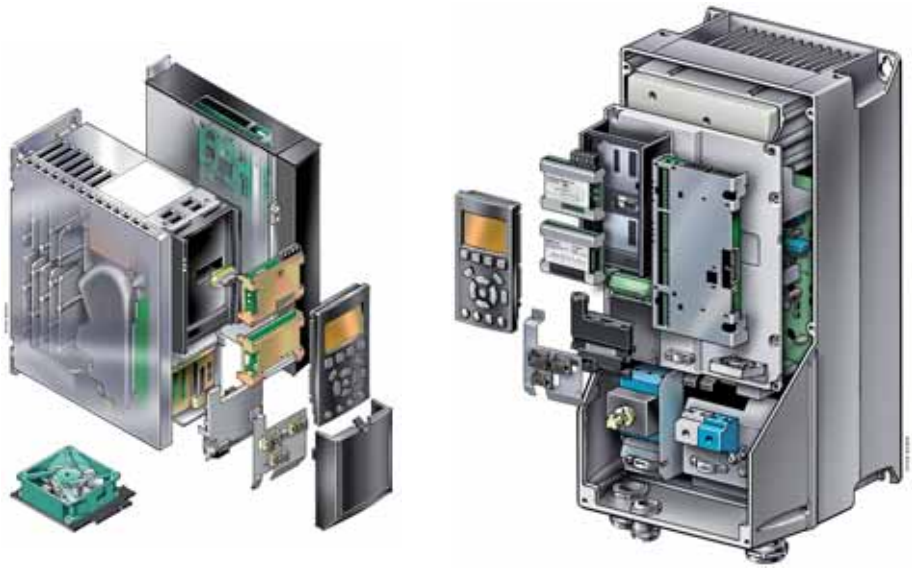
"Decoding" is also available: Enter a Typecode and the Drive Configurator will decode the configuration and show configuration for your drive.

"Reverse engineering" is also supported: Enter an article number and the Drive Configurator will display the exact configuration for the drive in question, including all options and special features. A further advantage of using the Drive Configurator is that it tells you exactly which options and features are avaible and so prevents you selecting conflicting or nonsensical combinations.

If you need to replace an obsolete product, just enter the article number of the older VLT® and the Drive Configurator will provide details of the appropriate newer generation replacement.

Last but by no means least, the Drive Configurator provides quick access to the available spare parts and accessories for both current and obsolete products.





What VLT® is all about

Danfoss VLT Drives is the world leader among dedicated drives providers – and still gaining market share.

Environmentally responsible

VLT® products are manufactured with respect for the safety and well-being of people and the environment.
All frequency converter factories are certified according to ISO 14001 and ISO 9001 standards.

All activities are planned and performed taking into account the individual employee, the work environment and the external environment. Production takes place with a minimum of noise, smoke or other pollution and environmentally safe disposal of the products is pre-prepared.

UN Global Compact

Danfoss has signed the UN Global Compact on social and environmental responsibility and our companies act responsibly towards local societies.

Impact on energy savings

One year's energy savings from our annual production of VLT® drives will save the energy equivalent to the energy production from a major power plant. Better process control at the same time improves product quality and reduces waste and wear on equipment.

Dedicated to drives

Dedication has been a key word since 1968, when Danfoss introduced the world's first mass produced variable speed drive for AC motors – and named it VLT®.

Twenty five hundred employees develop, manufacture, sell and service drives and soft starters in more than one hundred countries, focused only on drives and soft starters.

Intelligent and innovative

Developers at Danfoss VLT Drives have fully adopted modular principles in development as well as design, production and configuration.

Tomorrow's features are developed in parallel using dedicated technology platforms. This allows the development of all elements to take place in parallel, at the same time reducing time to market and ensuring that customers always enjoy the benefits of the latest features.

Rely on the experts

We take responsibility for every element of our products. The fact that we develop and produce our own features, hardware, software, power modules, printed circuit boards, and accessories is your guarantee of reliable products.

Local backup – globally

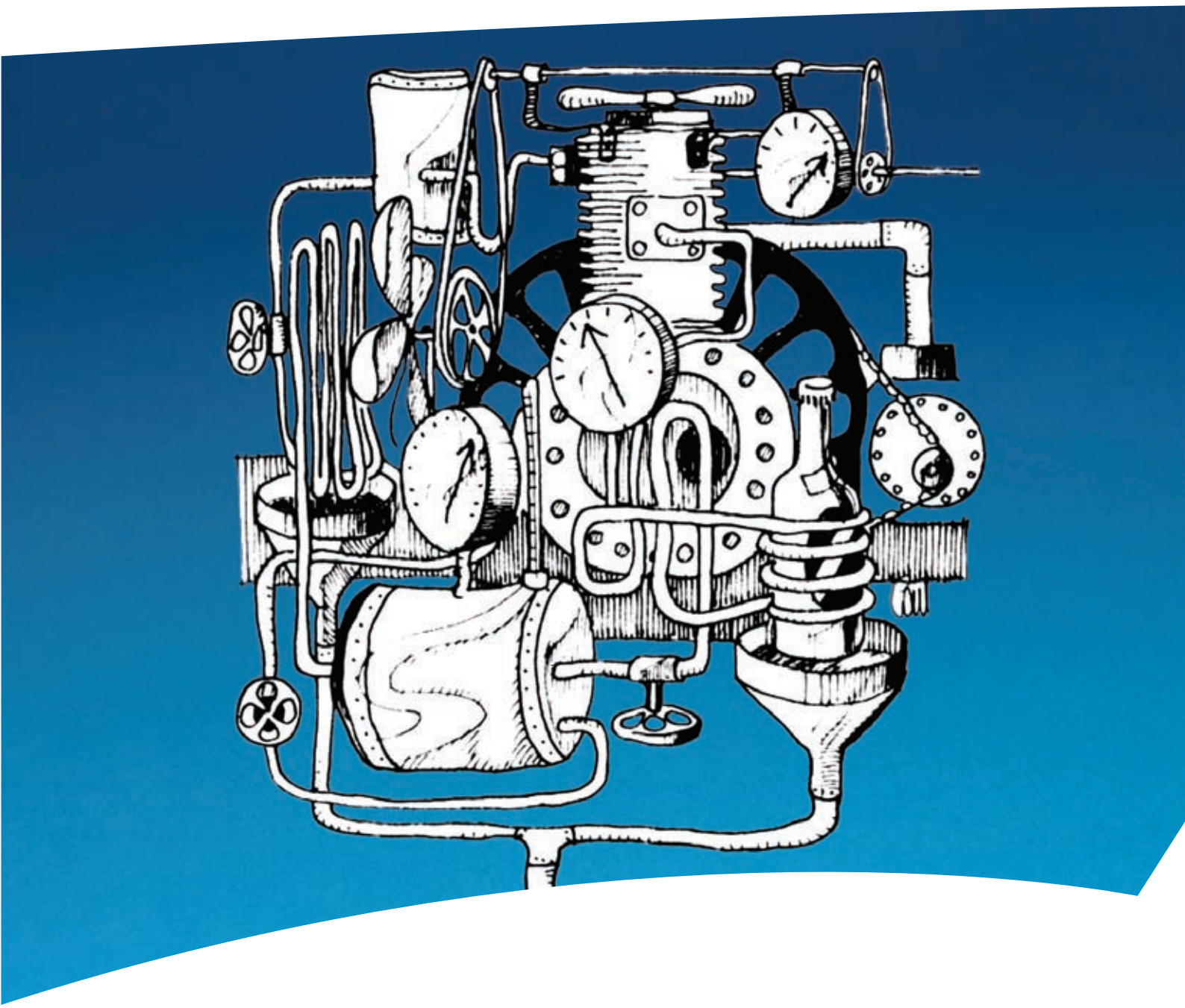
VLT® motor controllers are operating in applications all over the world and Danfoss VLT Drives' experts located in more than 100 countries are ready to support our customers with application advice and service wherever they may be.

Danfoss VLT Drives experts don't stop until the customer's drive challenges are solved.

Danfoss VLT Drives, Ulsnaes 1, DK-6300 Graasten, Denmark, Tel. +45 74 88 22 22, Fax +45 74 65 25 80
www.danfoss.com/drives • info@danfoss.com

DKDD.PB.408.A4.02 VLT® is a trademark of Danfoss A/S Produced by PE-MMSC 2014.01

MAKING MODERN LIVING POSSIBLE



Refrigeration

- an introduction to the basics

REFRIGERATION &
AIR CONDITIONING DIVISION

Lecture

Automatic Controls and Compressors for refrigeration

Automatic controls for commercial refrigeration

Automatic controls for Industrial refrigeration

Electronic controls for refrigeration

Appliance controls

Compressors for household and commercial refrigeration

Condensing units

Refrigeration - an introduction to the basics

This Danfoss publication must be regarded as a supplement to the comprehensive literature on refrigeration that is available today and which is primarily aimed at readers with a professional relationship to the refrigeration industry/trade e.g. refrigeration engineers and installers.

The contents of this book are intended to interest those who are not engaged every day with refrigeration plant but who wish to extend their knowledge on the basic principles of appliances they see every day.

When compiling the material for the booklet a deliberate attempt was made to provide a thorough description of the elementary principles involved together with an explanation in everyday language of the practical design of the individual components.

For additional training material we refer to:

http://www.danfoss.com/BusinessAreas/RefrigerationAndAirConditioning

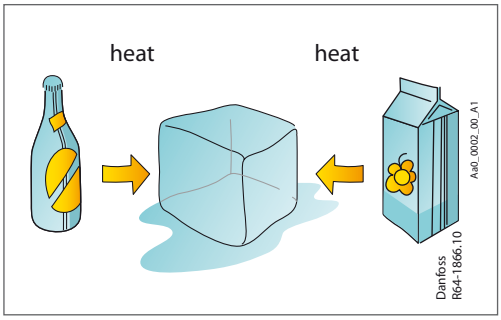
Choose "Training & Education".

Nordborg, 2007

Contents

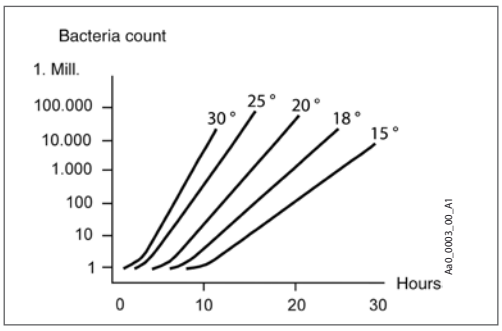
1. Introduction

The job of a refrigeration plant is to cool articles or substances down to, and maintain them at a temperature lower than the ambient temperature. Refrigeration can be defined as a process that removes heat.



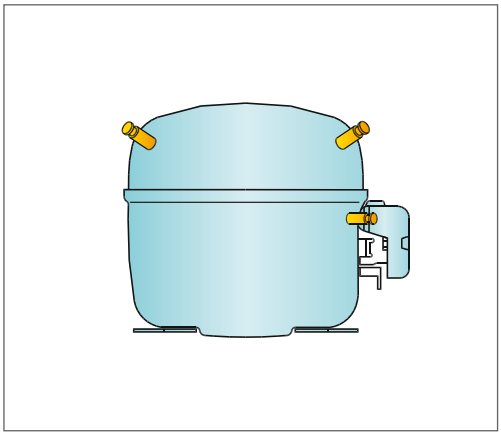
The oldest and most well-known among refrigerants are ice, water, and air. In the beginning, the sole purpose was to conserve food. The Chinese were the first to find out that ice increased the life and improved the taste of drinks and for centuries Eskimos have conserved food by freezing it.

At the beginning of the last century, terms like bacteria, yeast, mould, enzymes etc. were known. It had been discovered that the growth of micro-organisms is temperature-dependent, that growth declines as temperature falls, and that growth becomes very slow at temperatures below +10 °C.



As a consequence of this knowledge, it was now possible to use refrigeration to conserve foodstuffs and natural ice came into use for this purpose.

The first mechanical refrigerators for the production of ice appeared around the year 1860. In 1880 the first ammonia compressors and insulated cold stores were put into use in the USA.

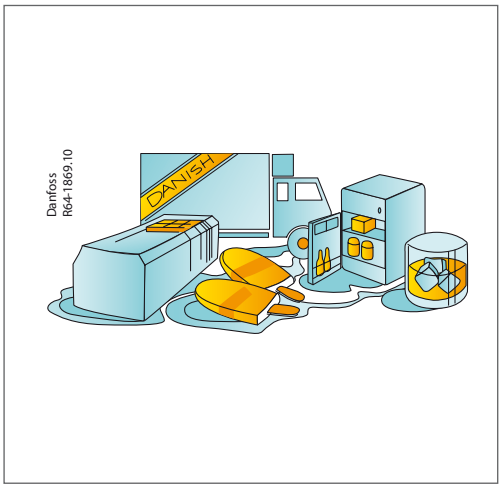


Electricity began to play a part at the beginning of this century and mechanical refrigeration plants became common in some fields: e.g. breweries, slaughter-houses, fishery, ice production, for example.

After the Second World War the development of small hermetic refrigeration compressors evolved and refrigerators and freezers began to take their place in the home. Today, these appliances are regarded as normal household necessities.

There are countless applications for refrigeration plants now. Examples are:

- Foodstuff conservation
- Process refrigeration
- Air conditioning plants
- Drying plants
- Fresh water installations
- Refrigerated containers
- Heat pumps
- Ice production
- Freeze-drying
- Transport refrigeration



In fact, it is difficult to imagine life without air conditioning, refrigeration and freezing - their impact on our existence is much greater than most people imagine.

2. Fundamental terms

2.1 *Unit systems*

On an international level, agreement has been reached on the use of the *Systeme International d'Unités* - often referred to as the *SI-system*. For a number of countries the implementation of the SI-system is still an on-going process.

In this booklet the SI-system will be the primary unit system used. However, in many parts of the refrigeration community it is still practice to use metric units or other alternative units. Therefore, the practically used alternative units will be given in parenthesis where needed.

The table shows the SI-units and the other often used alternative units for the quantities that are used in this booklet.

Quantity	SI-unit	Alternative units
Time	s (second)	h (hour)
Length	m (meter)	in (inch) ft (foot)
Mass	kg (kilogram)	lb (pound)
Temperature	K (Kelvin)	°C (Celsius) °F (Fahrenheit)
Force	N (Newton)	kp (kilopond)
Pressure	Pa (Pascal) = N/m²	bar atm (atmosphere) mm Hg (millimeter mercury column) psi (pound per square inch)
Energy	J (Joule) = Nm	kWh (kilowatt hour) cal (calorie) Btu (British thermal unit)
Power	W (Watt) = J/s	calorie/h, Btu/h

The practical use of the SI-units is strongly associated with the use of the decadic prefixes to avoid writing either very small or large numbers. A part of the prefixes used can be seen in the table below.

Example:
The atmospheric air pressure is 101325 Pa. Using the decadic prefixes from the table below the best way of writing this would be 101.325 kPa.

The choice of prefix is "free" but the best choice will normally be the one where the value written will be in the range from 0.1 to 999.9.

Prefixes should not be used for combined SI-units - except when [kg] is used.

Example:
2000 W/m² K should be written as 2.000×10^3 W/m² K and not as 2 kW/m² K.

Name	pico	nano	micro	mili	kilo	Mega	Giga	Tera	Peta
Prefix	p	n	μ	m	k	M	G	T	P
Factor	10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{3}	10^{6}	10^{9}	10^{12}	10^{15}

2.2 *Temperature*

Temperature is a very central property in refrigeration. Almost all refrigeration systems have the purpose of reducing the temperature of an object like the air in a room or the objects stored in that room.

The SI-unit for temperature *Kelvin [K]* is an absolute temperature because its reference point [0 K] is the lowest temperature that it in theory would be able to obtain.

When working with refrigeration systems the temperature unit *degree Celsius [°C]* is a more practical unit to use. Celsius is not an absolute temperature scale because its reference point (0 °C) is defined by the freezing point of water (equal to 273.15 K).

The only difference between Kelvin and Celsius is the difference in reference point. This means that a temperature difference of 1 °C is exactly the same as a temperature difference of 1 K.

In the scientific part of the refrigeration community temperature differences are often described using [K] instead of [°C]. This practice eliminates the possible mix-up of temperatures and temperature differences.

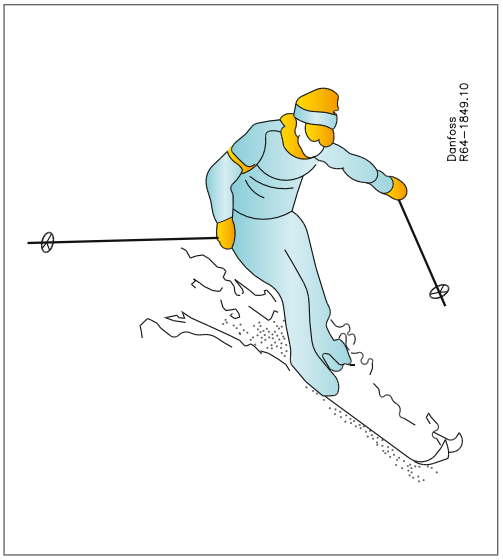
Fundamental terms

2.3 *Force and pressure*

The SI-unit for force is *Newton (N)* which is actually a [kg m/s^2].

A man wearing skis can stand in deep snow without sinking very deep - but if he steps out of his skis his feet will probably sink very deep into the snow. In the first case the weight of the man is distributed over a large surface (the skis). In the second case the same weight is distributed on the area of his shoe soles - which is a much smaller area than the area of the skis. The difference between these two cases is the pressure that the man exerts on the snow surface.

Pressure is defined as the force exerted on an area divided by the size of the area. In the example with the skier the force (gravity) is the same in both cases but the areas are different. In the first case the area is large and so the pressure becomes low. In the second case the area is small and so the pressure becomes high.



In refrigeration pressure is mostly associated with the fluids used as refrigerants. When a substance in liquid or vapour form is kept within a closed container the vapour will exert a force on the inside of the container walls. The force of the vapour on the inner surface divided by its area is called the *absolute* pressure.

For practical reasons the value for pressure is sometimes stated as "pressure above atmospheric pressure" - meaning the atmospheric pressure (101.325 kPa = 1.013 bar) is subtracted from the absolute pressure. The pressure above atmospheric pressure is also often referred to as *gauge pressure*.

The unit used should reflect the choice of absolute pressure or gauge pressure. An absolute pressure is indicated by the use of lowercase "a" and a gauge pressure is indicated by a lowercase "g".

Example:
The absolute pressure is 10 bar(a) which converted to gauge pressure becomes (10 - 1.013) bar(g) ≈ 9 bar(g). The combination of the SI-unit for pressure [Pa] and the term gauge pressure is not recommended.

Other units for pressure that are still used today are *mm of mercury column [mmHg]*, and *meter water gauge [mwg]*. The latter is often used in connection with pumps to indicate the height of the water column that the pump is able to generate.

Vacuum is defined as an absolute pressure of 0 Pa - but since it is almost impossible to obtain this the term "vacuum" is used generally to describe a pressure much lower than the atmospheric pressure. Example: The absolute pressure is 0.1 bar(a) which converted to gauge pressure becomes (0.1 - 1.013) bar(g) ≈ –0.9 bar(g). Vacuum is also often described in *Torr* (1 Torr is equal to 10 Pa) and *millibar* (a thousandth of a bar).

2.4 *Heat, work, energy and power*

Heat and work are both forms of energy that can be transferred between objects or systems. The transfer of heat is closely connected to the temperature (or temperature difference) that exists between two or more objects. By itself heat is always transferred from an object with high temperature to objects with lower temperatures. Heating of water in a pot on a stove is a good everyday example of the transfer of heat. The stove plate becomes hot and heat is transferred from the plate through the bottom of the pot and to the water. The transfer of heat to the water causes the temperature of the water to rise. *In other words, heating an object is the same as transferring energy (heat) to the object*.

In many practical applications there is a need to reduce the temperature of an object instead of increasing it. Following the example above this can only be done if you have another object with a lower temperature than that of the object you wish to cool. Putting these two objects into contact will cause a transfer of heat away from the object you wish to cool and, consequently, its temperature will decrease. *In other words, cooling an object is the same as transferring energy (heat) away from the object*.

The transfer of work is typically connected to the use of mechanical shafts like the one rotating in an electric motor or in a combustion engine. Other forms of work transfer are possible but the use of a rotating shaft is the primary method used in refrigeration systems.

As mentioned both heat and work are forms of energy. The methods of transfer between objects are different but for a process with both heat and work transfer it is the sum of the heat and work transfer that determines the outcome of the process.

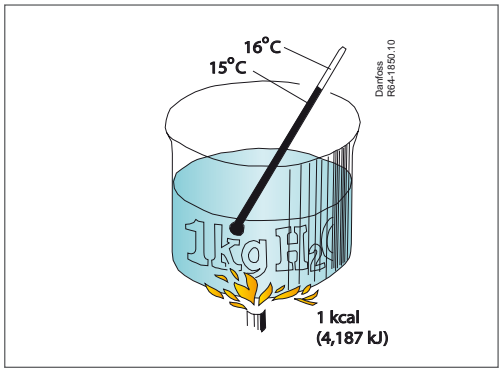
Fundamental terms

2.4 Heat, work, energy and power (cont.)

The SI-unit *Joule [J]* is used to quantify energy, heat and work. The amount of energy needed to increase the temperature of 1 kg of water from 15 to 16 °C is 4.187 kJ. The 4.178 kJ can be transferred as heat or as work - but heat would be the most used practical solution in this case.

There are differences in how much energy is required to increase the temperature of various substances by 1 K. For 1 kg of pure iron app. 0.447 kJ is needed whereas for 1 kg of atmospheric air only app. 1.0 kJ is needed. The property that makes the iron and air different with respect to the energy needed for causing a temperature increase is called the "specific heat capacity". It is defined as the energy required to cause a temperature increase of 1 K for 1 kg of the substance. The unit for specific heat capacity is *J/kg K*.

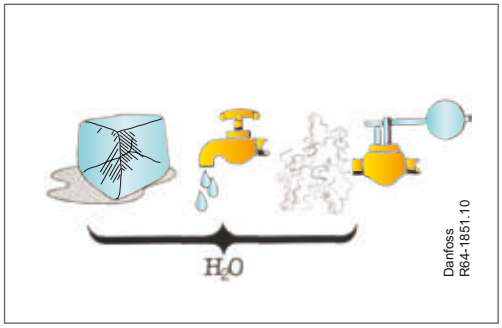
The rate at which energy is transferred is called *power*. The SI-unit for power is *Watt (W)*.



Example:
If 10 J is transferred per second, the rate of energy transfer is stated as 10 J/s = 10 W. In the SI-system the choice of unit for power is the same for transfer of heat and work. In other unit systems the transfer rates for heat and work could have different units.

2.5 Substances and phase change

All substances can exist in three different phases: solid, liquid, and vapour. Water is the most natural example of a substance that we use almost everyday in all three phases. For water the three phases have received different names - making it a bit confusing when using it as a model substance. The solid form we call ice, the liquid form we just call water, and the vapour form we call steam. What is common to these three phases is that the water molecules remain unchanged, meaning that ice, water, and steam all have the same chemical formula: H_2O.



When taking a substance in the solid to the liquid phase the transition process is called melting and when taking it further to the vapour phase the transition process is called boiling (evaporation). When going in the opposite direction taking a substance from the vapour to the liquid phase the transition process is called condensing and when taking it further to the solid phase the transition process is called freezing (solidification).

At constant pressure the transition processes display a very significant characteristic. When ice is heated at 1 bar its temperature starts rising until it reaches 0 °C - then the ice starts melting. During the melting process the temperature does not change - all the energy transferred to the mixture of ice and water goes into melting the ice and not into heating the water. Only when the ice has been melted completely will the further transfer of energy cause its temperature to rise. The same type of behaviour can be observed when water is heated in an open pot. The water temperature increases until it reaches 100 °C - then evaporation starts. During the evaporation process the temperature remains at 100 °C. When all the liquid water has evaporated the temperature of the steam left in the pot will start rising.

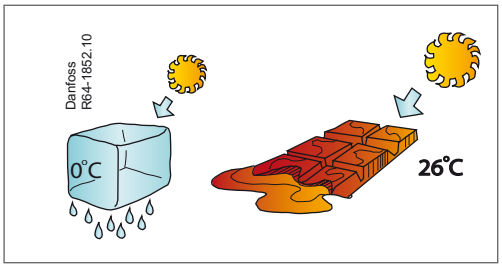
The temperature and pressure a substance is exposed to determine whether it exists in solid, liquid, or vapour form - or in two or all three forms at the same time. In our local environment iron appears in its solid form, water in its liquid and gas forms, and air in its vapour form.

Fundamental terms

2.5 Substances and phase change (cont.)

Different substances have different melting and boiling points. Gold for example melts at 1064 °C, chocolate at 26 °C and most refrigerants melt at temperatures around -100 °C!

For a substance that is present in two of its phases at the same time - or undergoing a phase change - pressure and temperature become dependent. If the two phases exist in a closed container and the two phases are in thermal equilibrium the condition is said to be saturated. If the temperature of the two-phase mixture is increased the pressure in the container will also increase. The relationship between pressure and temperature for saturated conditions (liquid and vapour) is typically called the vapour pressure curve. Using the vapour pressure curve one can determine what the pressure will be for an evaporating or condensing process.



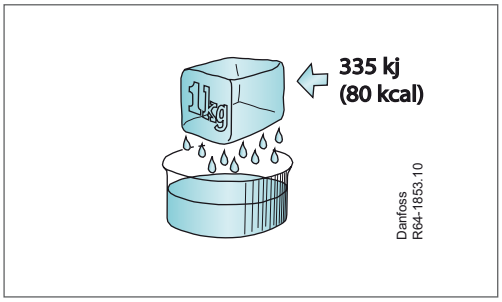
2.6 Latent heat

Going back to the process of ice melting it is important to note that the amount of energy that must be transferred to 1 kg of ice in order to melt it is much higher than the energy needed to change the temperature of 1 kg of water by say 1 K. In section 2.4 the specific heat capacity of water was given as 4.187 kJ/kg K. The energy needed for melting 1 kg of ice is 335 kJ. The same amount of energy that can melt 1 kg of ice can increase the temperature of 1 kg of water by (335 kJ/4.187 kJ/kg K) = 80 K!

When looking at the boiling process of water the energy needed for evaporating 1 kg of water is 2501 kJ. The same amount of energy that can evaporate 1 kg of water can increase the temperature of not 1 but 6 kg of water by 100 K!

These examples show that energy transfer related to the transitional processes between phases is significant. That is also why ice has been used for cooling - it takes a lot of energy to melt the ice and while the ice melts the temperature stays at 0 °C.

The refrigerating effect in refrigeration systems is based on the use and control of the phase transition processes of evaporation. As the refrigerant evaporates it absorbs energy (heat) from its surroundings and by placing an object in thermal contact with the evaporating refrigerant it can be cooled to low temperature.



2.7 Superheat

Superheat is a very important term in the terminology of refrigeration - but it is unfortunately used in different ways. It can be used to describe a process where refrigerant vapour is heated from its saturated condition to a condition at higher temperature. The term superheat can also be used to describe - or quantify - the end condition of the before-mentioned process.

Superheat can be quantified as a temperature difference - between the temperature measured with a thermometer and the saturation temperature of the refrigerant measured with a pressure gauge. Therefore, superheat can not be determined from a single measurement of temperature alone - a measurement of pressure or saturation temperature is also needed. When superheat is quantified it should be quantified as a temperature difference and, consequently, be associated with the unit [K]. If quantified in [°C] it can be the cause of mistakes where the measured temperature is taken for the superheat or vice versa.

The evaporation process in a refrigeration system is one of the processes where the term superheat is used. This will be explained further in the next chapter.

Fundamental terms

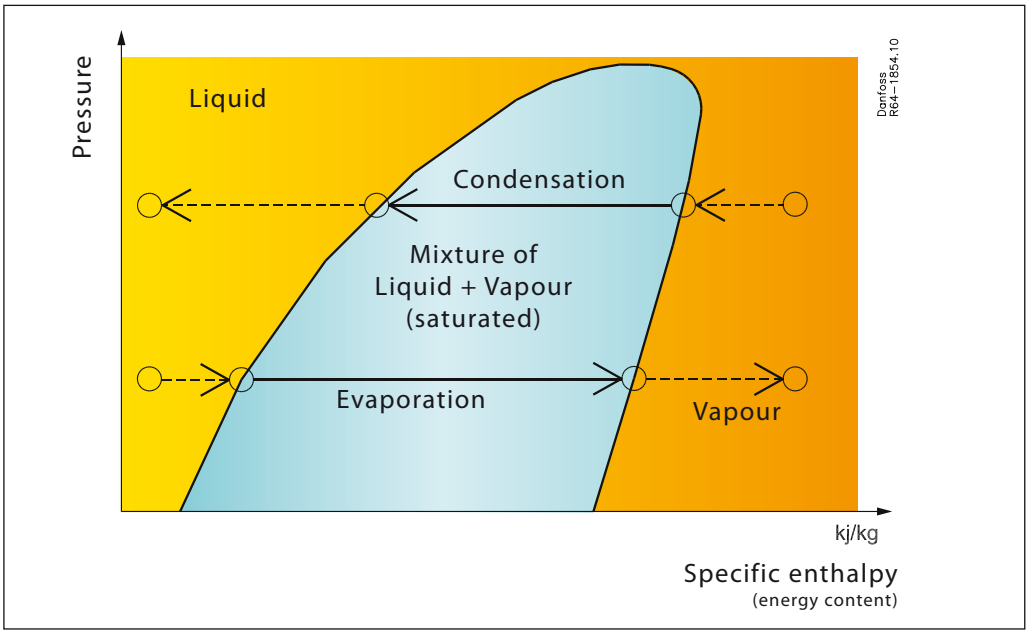
2.8 Refrigerant diagrams

The characteristics of a refrigerant can be illustrated in a diagram using the primary properties as abscissa and ordinate. For refrigeration systems the primary properties are normally chosen as energy content and pressure. Energy content is represented by the thermodynamic property of specific enthalpy - quantifying the change in energy content per mass unit of the refrigerant as it undergoes processes in a refrigeration system. An example of a diagram based on specific enthalpy (abscissa) and pressure (ordinate) can be seen below. For a refrigerant the typically applicable interval for pressure is large - and therefore diagrams use a logarithmic scale for pressure.

The diagram is arranged so that it displays the liquid, vapour and mixture regions for the refrigerant. Liquid is found to the left (with a low energy content) - vapour to the right (with a high energy content). In between you find the mixture region. The regions are bounded by a curve - called the saturation curve. The fundamental processes of evaporation and condensation are illustrated.

The idea of using a refrigerant diagram is that it makes it possible to represent the processes in the refrigeration system in such a way that analysis and evaluation of the process becomes easy. When using a diagram determining system operating conditions (temperatures and pressures) system refrigerating capacity can be found in a relatively simple and quick manner.

Diagrams are still used as the main tool for analysis of refrigeration processes. However, a number of PC programmes that can perform the same analysis faster and with more details have become generally available.



3. Refrigerant circuit

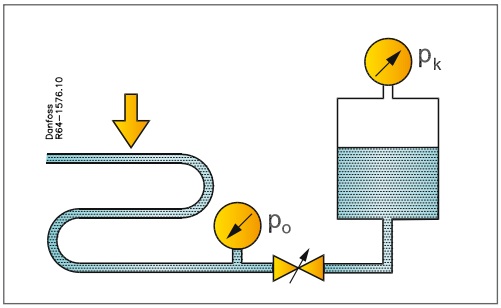
The physical terms for the refrigeration process have been dealt with previously, even though for practical reasons water is not used as a refrigerant.

A simple refrigerant circuit is built up as shown in the sketch below. In what follows, the individual components are described to clarify a final overall picture.

3.1 *Evaporator*

A refrigerant in liquid form will absorb heat when it evaporates and it is this conditional change that produces cooling in a refrigerating process. If a refrigerant at the same temperature as ambient is allowed to expand through a hose with an outlet to atmospheric pressure, heat will be taken up from the surrounding air and evaporation will occur at a temperature corresponding to atmospheric pressure.

If in a certain situation pressure on the outlet side (atmospheric pressure) is changed, a different temperature will be obtained since this is analogous to the original temperature - it is pressure-dependent.

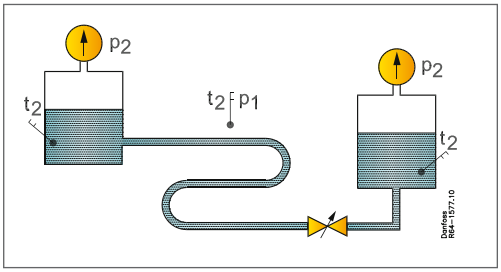


The component where this occurs is the evaporator, whose job it is to remove heat from the surroundings, i.e. to produce refrigeration.

3.2 *Compressor*

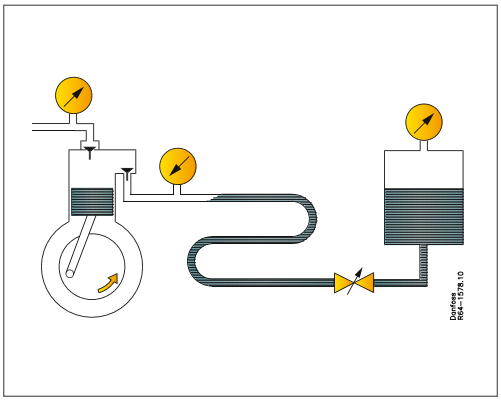
The refrigeration process is, as implied, a closed circuit. The refrigerant is not allowed to expand to free air.

When the refrigerant coming from the evaporator is fed to a tank the pressure in the tank will rise until it equals the pressure in the evaporator. Therefore, refrigerant flow will cease and the temperature in both tank and evaporator will gradually rise to ambient.



To maintain a lower pressure, and, with it a lower temperature it is necessary to remove vapour. This is done by the compressor, which sucks vapour away from the evaporator. In simple terms, the compressor can be compared to a pump that conveys vapour in the refrigeration circuit.

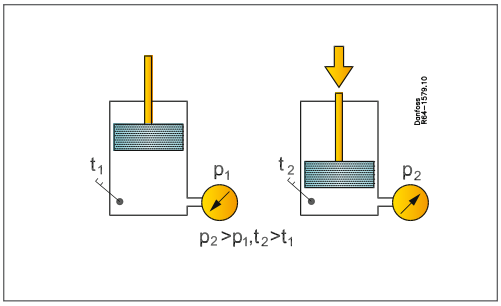
In a closed circuit a condition of equilibrium will always prevail. To illustrate this, if the compressor sucks vapour away faster than it can be formed in the evaporator the pressure will fall and with it the temperature in the evaporator. Conversely, if the load on the evaporator rises and the refrigerant evaporates quicker, the pressure and with it the temperature in the evaporator will rise.



3.3 *Compressor, method of operation*

Refrigerant leaves the evaporator either as saturated or weak superheated vapour and enters the compressor where it becomes compressed. Compression is carried out as in a petrol engine, i.e. by the movement of a piston. The compressor requires energy and carries out work. This work is transferred to the refrigerant vapour and is called the compression input.

Because of the compression input, vapour leaves the compressor at a different pressure and the extra energy applied causes strong superheating of the vapour. Compression input is dependent on plant pressure and temperature. More work is of course

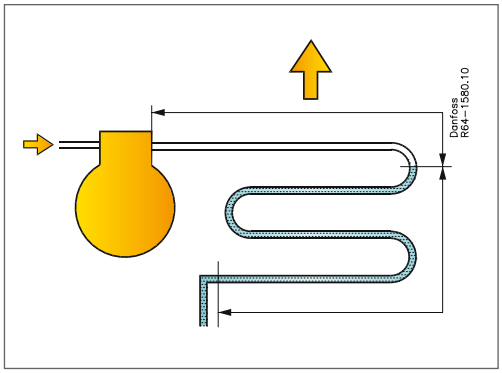


required to compress 1 kg vapour 10 bar than to compress the same amount 5 bar.

3.4 *Condenser*

The refrigerant gives off heat in the condenser, and this heat is transferred to a medium having a lower temperature. The amount of heat given off is the heat absorbed by the refrigerant in the evaporator plus the heat created by compression input.

The heat transfer medium can be air or water, the only requirement being that the temperature is lower than that which corresponds to the condensing pressure. The process in the condenser can otherwise be compared with the process in the evaporator except that it has the opposite "sign", i.e. the conditional change is from vapour to liquid.

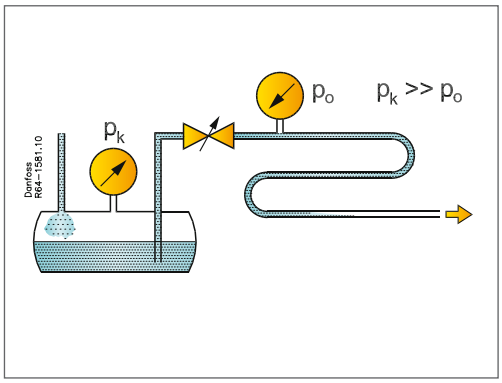


3.5 *Expansion process*

Liquid from the condenser runs to a collecting tank, the receiver. This can be likened to the tank mentioned under section 3.1 on the evaporator.

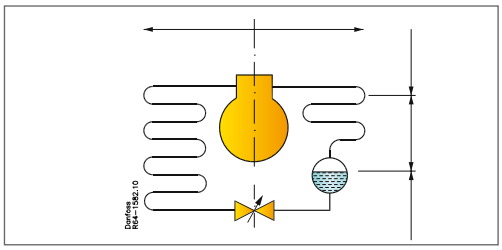
Pressure in the receiver is much higher than the pressure in the evaporator because of the compression (pressure increase) that has occurred in the compressor. To reduce pressure to the same level as the evaporating pressure a device must be inserted to carry out this process, which is called throttling, or expansion. Such a device is therefore known either as a throttling device or an expansion device. As a rule a valve is used - a throttle or expansion valve.

Ahead of the expansion valve the liquid will be a little under boiling point. By suddenly reducing pressure a conditional change will occur; the liquid begins to boil and evaporate. This evaporation takes place in the evaporator and the circuit is thus complete.



3.6 *High and low pressure sides of the refrigeration plant*

There are many different temperatures involved in the operation of a refrigeration plant since there are such things as subcooled liquid, saturated liquid, saturated vapour and superheated vapour. There are however, in principle, only two pressures; evaporating pressure and condensing pressure. The plant then is divided into high pressure and low pressure sides, as shown in the sketch.



4. Refrigeration process, pressure/enthalpy diagram

The condensed refrigerant in the condenser is in condition A which lies on the line for the boiling point of the liquid. The liquid has thus a temperature t_c, a pressure p_c also called saturated temperature and pressure.

The condensed liquid in the condenser is further cooled down in the condenser to a lower temperature A^1 and now has a temperature t_l and an enthalpy h_0. The liquid is now sub-cooled which means that it is cooled to a lower temperature than the saturated temperature.

The condensed liquid in the receiver is in condition A^1 which is sub-cooled liquid. This liquid temperature can change if the receiver and liquid is either heated or cooled by the ambient temperature. If the liquid is cooled the sub-cooling will increase and visa versa.

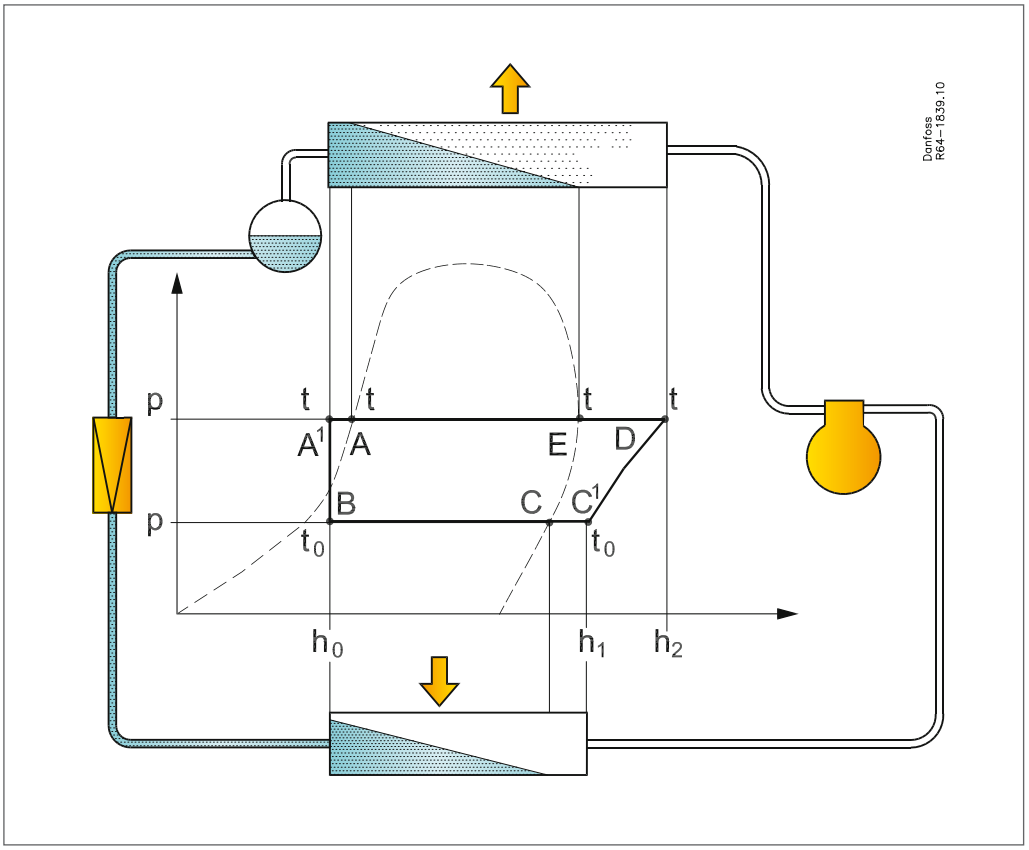
When the liquid passes through the expansion valve its condition will change from A^1 to B. This conditional change is brought about by the boiling liquid because of the drop in pressure to p_0. At the same time a lower boiling point is produced, t_0, because of the drop in pressure.

In the expansion valve the enthalpy is constant h_0, as heat is neither applied nor removed.

At the evaporator inlet, point B, there is a mixture of liquid and vapour while in the evaporator at C there is saturated vapour. At the evaporator outlet point C^1 there is super-heated vapour which means that the suction gas is heated to a higher temperature than the saturated temperature. Pressure and temperature are the same at point B and at outlet point C^1 where the gas is super-heated the evaporator has absorbed heat from the surroundings and the enthalpy has changed to h_1.

When the refrigerant passes through the compressor its condition changes from C^1 to D. Pressure rises to condensing pressure p_c. The temperature rises to $t_{hot\text{-}gas}$ which is higher than the condensing temperature t_c because the vapour has been strongly superheated. More energy (from the electrical motor) in the form of heat has also been introduced and the enthalpy therefore changes to h_2.

At the condenser inlet, point D, the condition is thus one of superheated vapour at pressure p_c. Heat is given off from the condenser to the surroundings so that the enthalpy again changes to main point A^1. First in the condenser there occurs a conditional change from strongly superheated vapour to saturated vapour (point E), then a condensation of the saturated vapour. From point E to point A the temperature (condensing temperature) remains the same, in that condensation and evaporation occurs at constant temperature. From point A to point A^1 in the condenser the condensed liquid is further cooled down, but the pressure remains the same and the liquid is now sub-cooled.



t_c = condensing temperature
p_c = condensing pressure

t_l = liquid temperature

t_0 = evaporating temperature
p_0 = evaporating pressure

5. Refrigerants

5.1 General requirements

During the examination of the refrigeration process the question of refrigerants was not discussed since it was not necessary to do so in connection with the basic physical principles of the conditional change of substances. It is well known, however, that in practice different refrigerants are used according to the specific application and requirements. The most important factors are as follows:

- The refrigerant ought not to be poisonous. Where this is impossible, the refrigerant must have a characteristic smell or must contain a tracer so that leakage can quickly be observed.
- The refrigerant ought not to be flammable nor explosive. Where this condition cannot be met the same precautions as in the first point must be observed and local legislations must be followed.
- The refrigerant ought to have reasonable pressure, preferably a little higher than atmospheric pressure at the temperatures required to be held in the evaporator.
- To avoid heavy refrigerator design the pressure, which corresponds to normal condensing pressure, must not be too high.
- Relatively high evaporating temperature is required so that heat transmission can occur with least possible circulating refrigerant.
- Refrigerant vapour ought not to have too high a specific volume because this is a determinant for compressor stroke at a particular cold yield.
- The refrigerant must be chemically stable at the temperatures and pressures normal in a refrigeration plant.
- The refrigerant ought not to be corrosive and must not, either in liquid or vapour form, attack normal design materials.
- The refrigerant must not break down lubricating oil.
- The refrigerant must be easy to obtain and handle.
- The refrigerant must not cost too much.

5.2 Fluorinated refrigerants

Fluorinated refrigerants always carry the designation "R" followed by a number, e.g. R22, R134a, R404A and R407C. Sometimes they are met bearing their trade names. The fluorinated refrigerants all have the following features:

- Vapour is smell-free and non-irritant.
- Extensively non-poisonous. In the presence of fire the vapour can give off fluoric acid and phosgene, which are very poisonous.
- Non-corrosive.
- Non-flammable and non-explosive.

The most common fluorinated refrigerants are:

R134a, which is a substance of the ethane group with the formula CH_2FCF_3 and has a normal boiling point of –26.1 °C. Its thermodynamic properties make it suitable as a refrigerant for medium temperature applications such as domestic refrigerators.

R22, which is a substance of the methane group with the formula CHF_2Cl and has a boiling point of –40.8 °C. Its thermodynamic properties make it suitable as a refrigerant for a wide range of applications in commercial refrigeration and air conditioning. R22 is being phased out as refrigerant in many countries due to its ozone depleting potential.

R404A/R507A (also known as R507), which is a mixture of the refrigerants R125 (CHF_2CF_3) and R143a (CH_3CF_3) with a boiling point at (–46.7 °C) which is slightly lower than for R22. Its thermodynamic properties makes it suitable as a refrigerant for low and medium temperature applications in commercial refrigeration (e.g. supermarkets).

R407C, which is a mixture of the refrigerants R32 (CH_2F_2), R125 (CHF_2CF_3) and R134a (CH_2FCF_3) with a boiling point at (–43.6 °C) which is slightly lower than for R22. Its thermodynamic properties make it suitable as a refrigerant for medium and high temperature applications in residential and commercial air conditioning.

R410A, which is a mixture of the refrigerants R32 (CH_2F_2) and R125 (CHF_2CF_3) with a boiling point at (–51.4 °C) which is lower than for R22. Its thermodynamic properties make it suitable as a refrigerant for medium and high temperature applications in residential and commercial air conditioning.

Apart from these fluorinated refrigerants there is a long series of others not seen very often today: R23, R123, R124 and R218.

Except for R22, systems with fluorinated hydrocarbons are in general lubricated with polyol ester oils (POE). These oil types are much more sensitive to react chemically with water, the so-called "hydrolysis" reaction. For that reason systems today are kept extremely dry with filter driers.

5.3 Ammonia NH_3

Ammonia NH_3 is used extensively in large industrial refrigeration plants. Its normal boiling point is –33 °C. Ammonia has a characteristic smell even in very small concentrations in air. It cannot burn, but it is moderately explosive when mixed with air in a volume percentage of 13 to 28%. Because of corrosion, copper or copper alloys must not be used in ammonia plants.

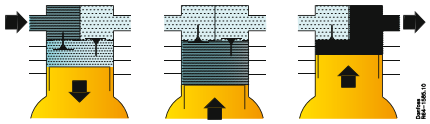
5.4 Secondary refrigerants

The refrigerants mentioned above are often designated "primary refrigerants". As an intermediate link in heat transmission from the surroundings to the evaporator, the so-called "secondary refrigerants" can be used, e.g. water, brine, atmospheric air etc.

6. Refrigeration plant main components

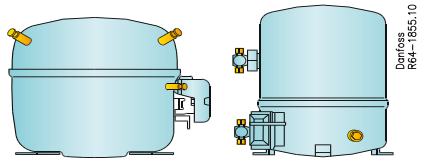
6.1 *Compressor*

The job of the compressor is to suck vapour from the evaporator and force it into the condenser. The most common type is the piston compressor, but other types have won acceptance, e.g. centrifugal scroll and screw compressors.

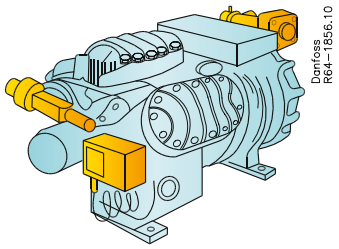


The piston compressor covers a very large capacity range, right from small single cylinder models for household refrigerators up to 8 to 12 cylinder models with a large swept volume for industrial applications.

In the smallest applications the hermetic compressor is used, where compressor and motor are built together as a complete hermetic unit.

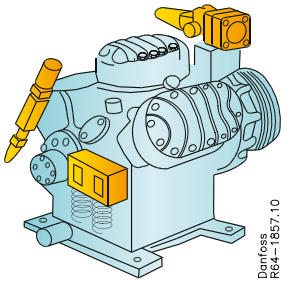


For medium sized plants one of the most common compressors is the larger sizes of hermetic compressors in either piston or scroll versions. The applications are both air conditioning, general commercial refrigeration and chillers.



For larger plants the most common is the semi-hermetic compressor. The advantage here is that shaft glands can be avoided; these are very difficult to replace when they begin to leak. However, the design cannot be used on ammonia plants since this refrigerant attacks motor windings.

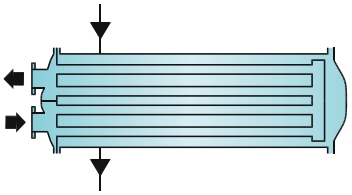
Still larger HFC compressors, and all ammonia compressors, are designed as "open" compressors, i.e. with the motor outside the crankcase. Power transmission can be direct to the crankshaft or through a V-belt drive.



For quite special applications there is the oil-free compressor. But lubrication of bearings and cylinder walls with oil is normally always necessary. On large refrigeration compressors oil is circulated by an oil pump.

6.2 *Condenser*

The purpose of the condenser is to remove the amount of heat that is equal to the sum of the heat absorbed in the evaporator and the heat produced by compression. There are many different kinds of condenser.



Shell and tube condenser. This type of condenser is used in applications where sufficient cooling water is available. It consists of a horizontal cylinder with welded-on flat end caps, which support the cooling tubes. End covers are bolted to the end plates.

The refrigerant condensate flows through the cylinder, the cooling water through the tubes. The end covers are divided into sections by ribs. The sections act as reversing chambers for the water so that it circulates several times through the condenser. As a rule, the water becomes heated 5-10 °C when it has passed through a condenser.

Refrigeration plant main components

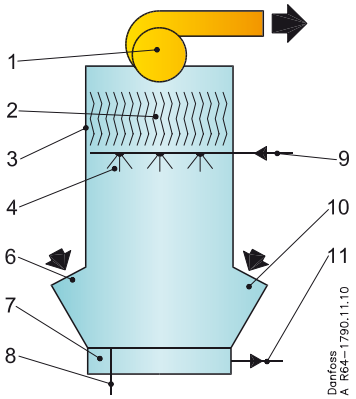
6.2 Condenser (cont.)

If it is desirable or necessary to cut down on the amount of water an *evaporating condenser* can be used instead. This type of condenser consists of a housing in which there is a condensing coil, water distribution tubes, deflection plates and fans.

The warm refrigerant vapour is led to the top of the condensing coil after which it condenses and runs from the bottom of the coil as liquid.

Water distribution tubes with nozzles are placed over the condensing coil so that water is spread over and runs down the coil. The fans direct a strong flow of air across the condensing coil. When the falling drops of water meet the upward air flow some of the water will evaporate. This absorbs the necessary evaporating heat from the refrigerant vapour and causes it to condense.

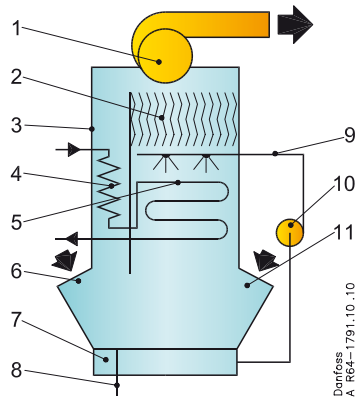
1. Fan
2. Deflector plate
3. Outer covering
4. Superheat remover
5. Condenser tubing
6. Air intake
7. Collecting tray
8. Overflow pipe
9. Water distribution pipe
10. Water circulation pump
11. Air intake



The principal involving water evaporation is also used in connection with *cooling towers*. These are installed when the most practical is to place a shell and tube condenser near a compressor. The water is then circulated in a circuit between condenser and cooling tower.

In principle, the cooling tower is built up the same as the evaporating condenser, but instead of condensing elements there are deflector plates. Air is heated on its way through the tower by direct contact with the trickle of water travelling downwards and is, therefore, able to absorb an increasing amount of moisture coming from part-evaporation. In this way, the cooling water loses heat. Water loss is made up by supplying more water.

1. Fan
2. Deflector plate
3. Outer covering
4. Nozzle
6. Air intake
7. Collecting tray
8. Overflow pipe
9. Cooling water from condenser
10. Air intake
11. Cooling water return to condenser



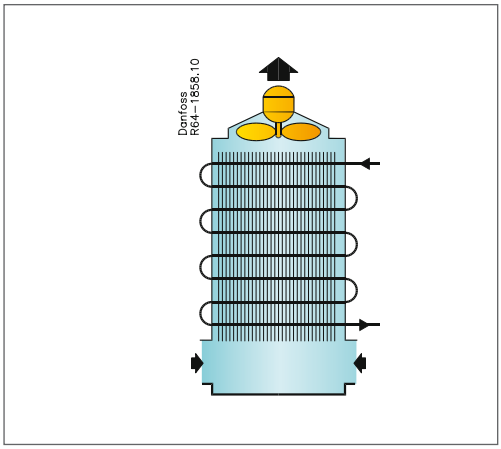
Refrigeration plant main components

6.2 Condenser (cont.)

It is possible to save 90-95% water consumption by using evaporating condensers or cooling towers, when compared to the water consumption of shell and tube condensers.

For one reason or another it is not always possible to use water for the condensing process. In such cases an *air-cooled condenser* must be used. Since air has poor heat transfer characteristics, compared with water, a large surface on the outside of the condensing tubes is necessary. This is achieved using large ribs or fins and, in addition, by ensuring generous air circulation mechanically.

This is the normal condenser for commercial refrigeration.

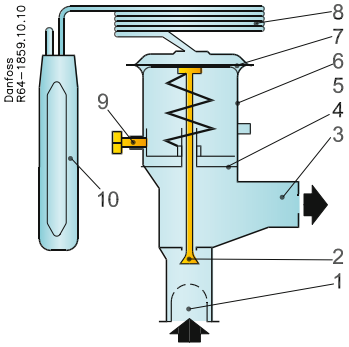


6.3 Expansion valve

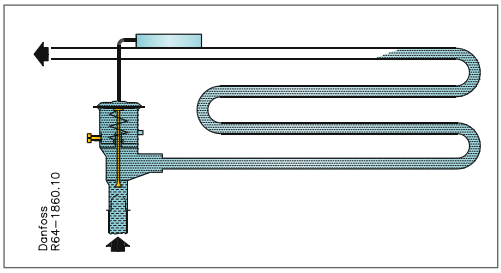
The main purpose of the expansion valve is to ensure a sufficient pressure differential between the high and low pressure sides of the plant. The simplest way of doing this is to use a capillary tube inserted between the condenser and evaporator.

The capillary tube is, however, only used in small, simple appliances like refrigerators because it is not capable of regulating the amount of liquid that is injected into the evaporator. A regulating valve must be used for this process, the most usual being the thermostatic expansion valve, which consists of a valve housing, capillary tube and a bulb. The valve housing is fitted in the liquid line and the bulb is fitted on the evaporator outlet.

1. Inlet with strainer
2. Cone
3. Outlet
4. Bore
5. Connection for pressure equalizing
6. Spring housing
7. Diaphragm
8. Capillary tube
9. Spindle for setting spring pretension (opening superheat)
10. Bulb



This figure shows an evaporator fed by a thermostatic expansion valve. A small amount of liquid is contained in a part of the bulb. The rest of the bulb, the capillary tube and the space above the diaphragm in the valve housing is charged with saturated vapour at a pressure corresponding to the temperature at the bulb. The space under the diaphragm is in connection with the evaporator and the pressure is therefore equal to the evaporating pressure.



Refrigeration plant main components

6.3 Expansion valve (cont.)

The degree of opening of the valve is determined by:

- The pressure produced by the bulb temperature acting on the top surface of the diaphragm.
- The pressure under the diaphragm, which is equal to the evaporating pressure.
- The pressure of the spring acting on the underside of the diaphragm.

During normal operation, evaporation will cease some distance up in the evaporator.

Then, saturated gas appears which becomes superheated on its way through the last part of the evaporator. The bulb temperature will thus be evaporating temperature plus superheat, e.g. at –10 °C evaporating temperature the bulb temperature could be 0 °C.

If the evaporator receives too little refrigerant the vapour will be further superheated and the temperature at the outlet pipe will rise. The bulb temperature will then also rise and with it the vapour pressure in the bulb element since more of the charge will evaporate. Because of the rise in pressure the diaphragm becomes forced down, the valve opens and more liquid is supplied to the evaporator. Correspondingly, the valve will close more if the bulb temperature becomes lower.

Thermostatic expansion valves are produced in several versions and of course there are many variants within each type.

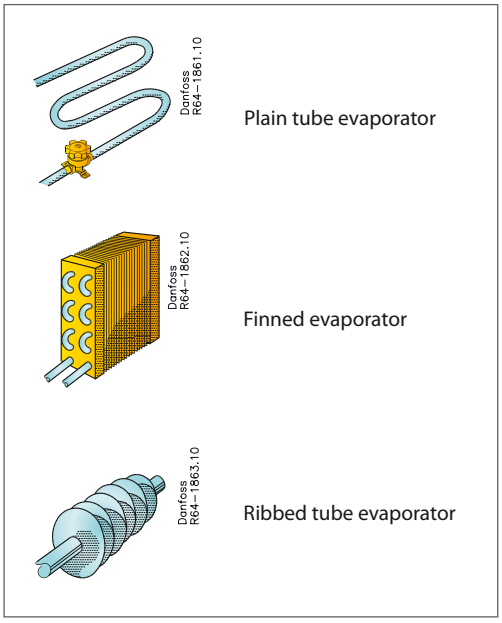
6.4 Evaporation systems

Depending on the application, various requirements are imposed on the evaporator. Evaporators are therefore made in a series of different versions.

Evaporators for natural air circulation are used less and less because of the relatively poor heat transfer from the air to the cooling tubes. Earlier versions were fitted with plain tubes, but now it is common to use ribbed tubes or finned elements.

Evaporator performance is increased significantly if *forced air circulation* is used. With an increase of air velocity the heat transfer from air to tube is improved so that for a given cold yield a smaller evaporator surface than for natural circulation can be used.

As the name implies, a *chiller* cools down liquid. The simplest method is to immerse a coil of tube in an open tank. Closed systems are coming into use more and more. Here, tube coolers made similar to shell and tube condensers are employed.



7. The practical build-up of a refrigeration plant

Figure A shows the principle build-up of a refrigeration plant for a simple cold store - much like those that can be seen in butchers' shops and supermarkets.

The compressor unit can, for example, be installed in an adjacent storage room with an outlet to fresh air. Such a unit consists of a compressor driven by V-belt and electric motor. Additionally, the base frame carries an air-cooled condenser and a receiver. A fan is mounted on the shaft of the electric motor to force air through the condenser and ensure the necessary degree of cooling. The line between compressor and condenser is known as the discharge line.

Today the majority of compressors used are of the semi-hermetic and hermetic types.

From the receiver, an uninsulated line, the liquid line, is taken out to the cold store where it is connected to the thermostatic expansion valve at the evaporator inlet. The evaporator is built up with close-pitch fins attached to tubes. It is also equipped with a fan for forced air circulation and a drip tray.

From the outlet side of the evaporator a line, the suction line, is led back to the compressor. The diameter of the suction line is somewhat larger than the liquid line because it carries vapour. For this reason the suction line is as a rule insulated.

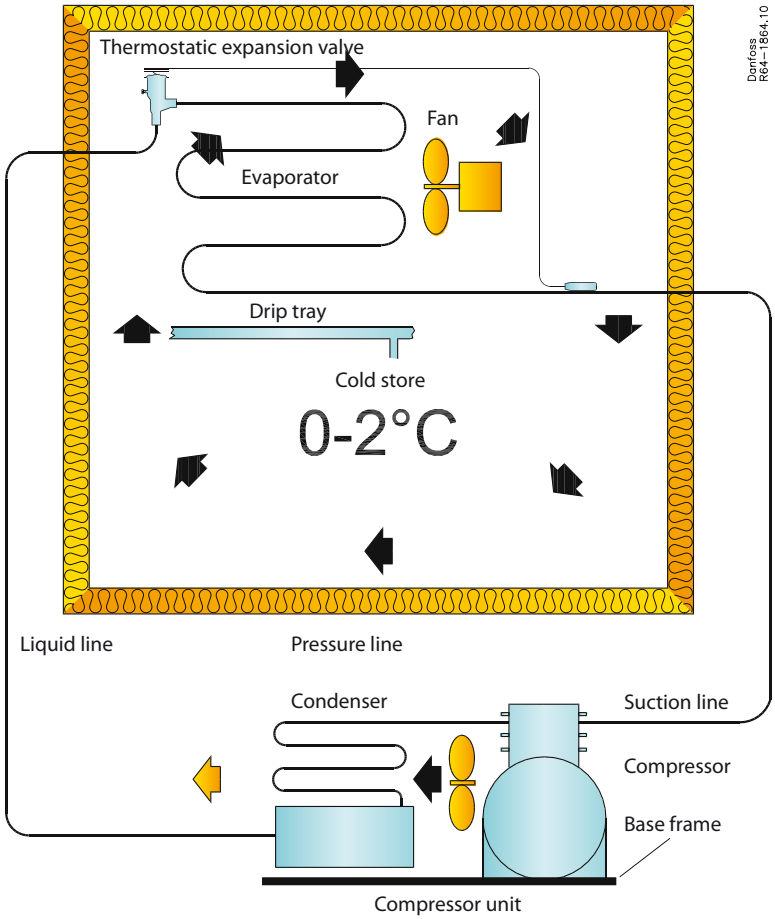


Fig. A

The practical build-up of a refrigeration plant

Figure B gives details of momentary temperatures in a refrigeration plant. At the compressor outlet the pressure is 7.6 bar and the temperature is 60 °C because of the presence of superheated gas. The temperature in the upper part of the condenser will quickly fall to saturation temperature, which at the pressure concerned will be 34 °C, because superheat is removed and condensation begins.

Pressure at the receiver outlet will remain more or less the same, while subcooling of the liquid begins because the temperature has fallen by 2 °C to 32 °C.

In the evaporator a pressure of 1 bar and an evaporating temperature of –10 °C are indicated. In the last part of the evaporator the vapour becomes superheated so the temperature at the thermostatic expansion valve bulb becomes +2 °C, corresponding to the superheat set on the valve.

As illustrated below, air temperature will vary, in that the air will take up heat on its way round the store from products, walls, ceiling, etc. The temperature of the air blown across the condenser will also vary with the time of year.

A refrigeration plant must then be dimensioned according to the largest load it will be subjected to. To be able to accommodate smaller loads, facilities must exist in the plant for altering yield. The process of making such alterations is called regulation and it is precisely regulation that Danfoss' automatic controls are made for. But that is a subject, which is outside the scope of this publication.

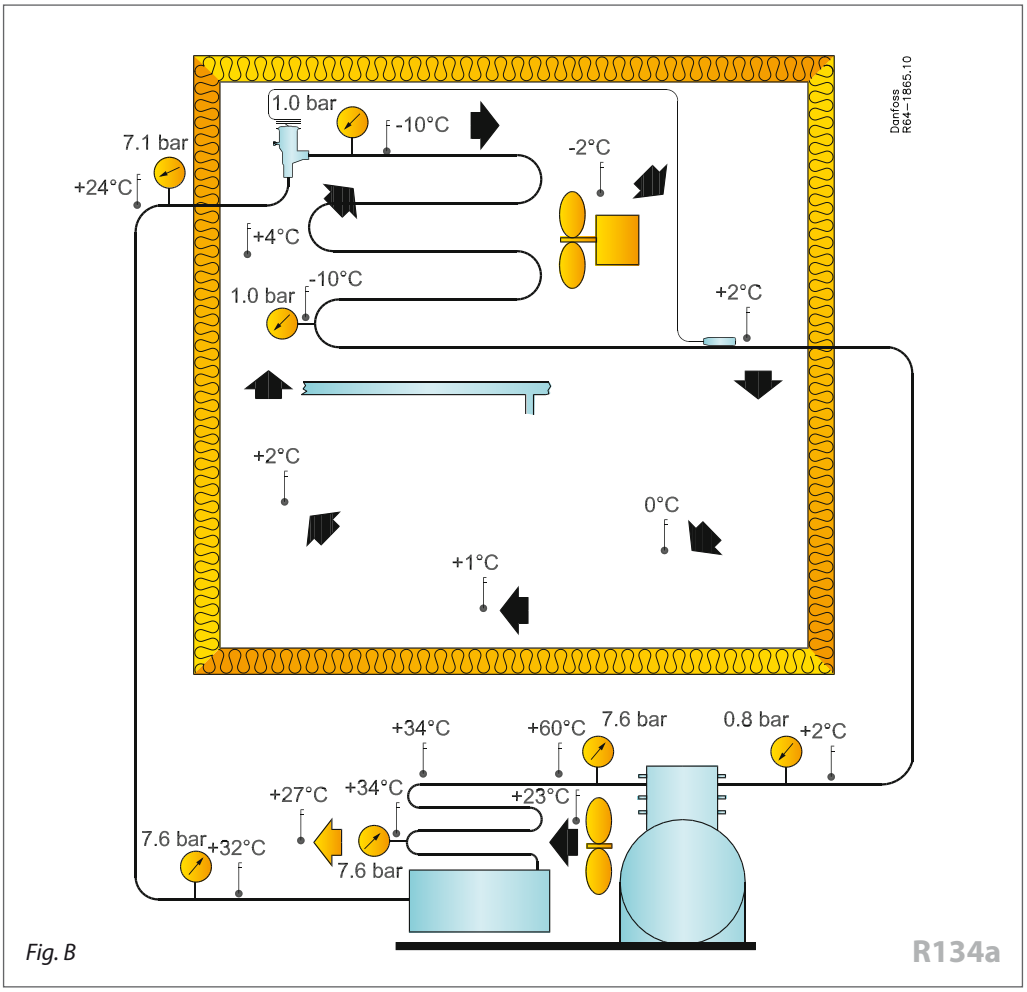


Fig. B

Notes

Notes

The Danfoss product range for the refrigeration and air conditioning industry

Danfoss Refrigeration & Air Conditioning is a worldwide manufacturer with a leading position in industrial, commercial and supermarket refrigeration as well as air conditioning and climate solutions.

We focus on our core business of making quality products, components and systems that enhance performance and reduce total life cycle costs – the key to major savings.

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