HVAC&R

How to select the appropriate motor starters for your HVAC&R* equipments

* Heating, Ventilation, Air conditioning & Refrigeration

Control Panel Technical Guide

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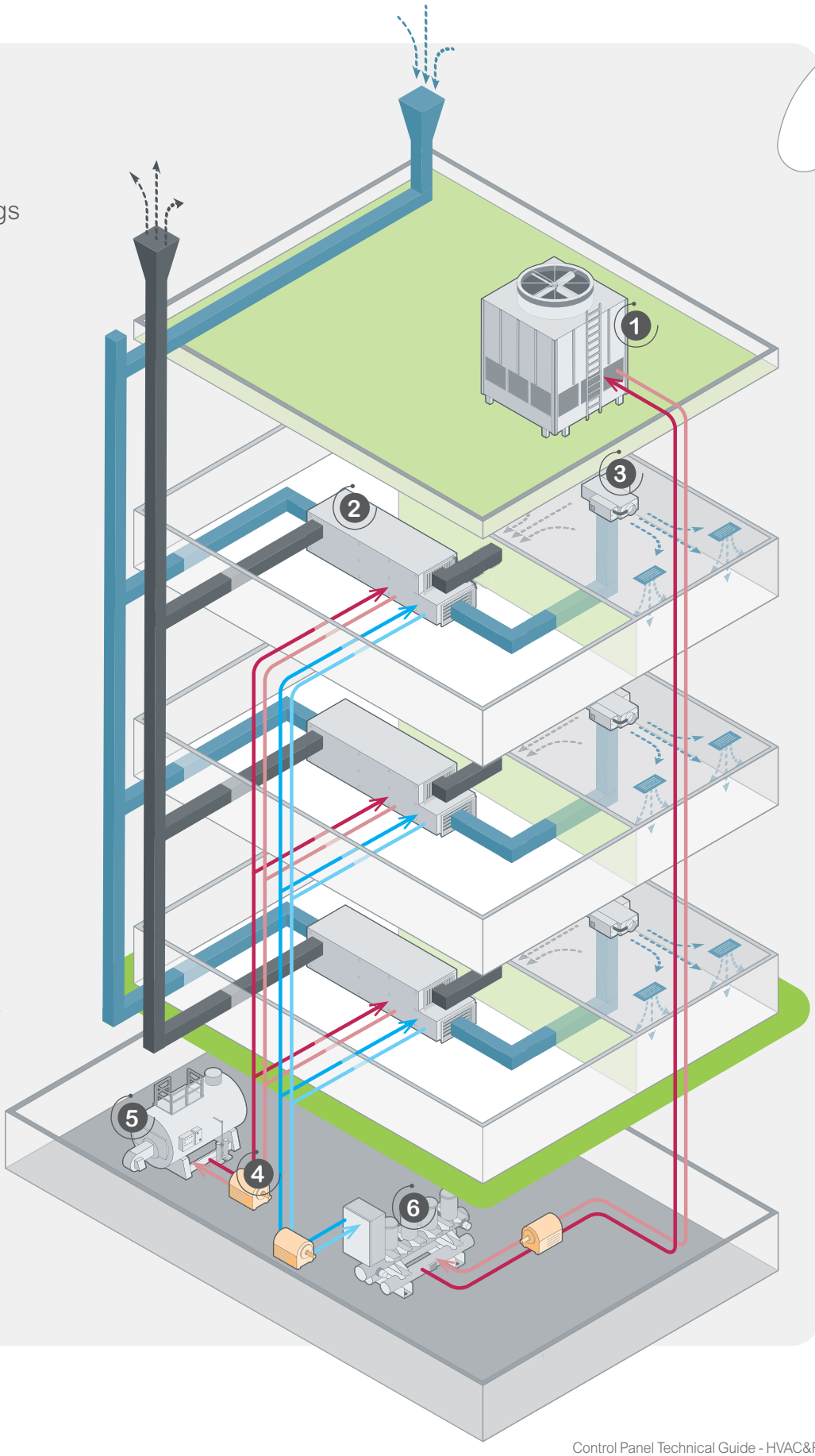
Many machines can be used in a HVAC&R installation

As an example, heating, cooling and ventilation of buildings may require, depending on the selected solution, the association of machines as various as chillers, boilers, cooling towers, air handling units, terminal units, etc.

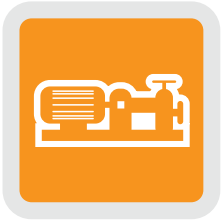
1. Cooling tower
2. Air handler
3. Terminal unit
4. Pump
5. Boiler
6. Water cooled chiller



All these machines embed electric motors for three kind of applications

Compressor

Fan



Pump

These motors must be protected and controlled by motor starters

Protection is usually provided by a motor circuit breaker.

Control is usually provided by a contactor, a Soft Starter or a Variable Speed Drive (VSD).

Why this guide?

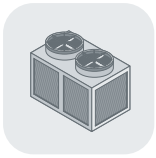
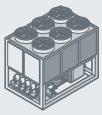
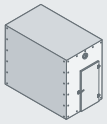
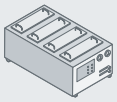
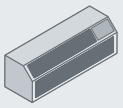
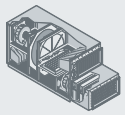
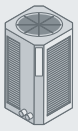
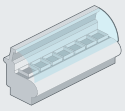
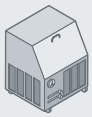
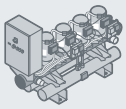
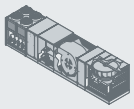
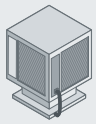
A guide **to choose** the **right contactor-based motor starter solution** for your 3 phase alternative motors:

A "Standard" solution **for general purpose application**

An "HVAC&R Adapted" solution **to definite purpose application**

Each solution of this guide combines **thermal-magnetic protection** by circuit breaker **+ control by contactors.**

Contents

	Condensing unit	Air cooled chiller	Cold room	Ice bank		Packaged terminal air conditioner	Air handler
							
	Heat pump	Showcase	Ice maker	Water cooled chiller	Cooling tower	Packaged unit / rooftop	Evaporative cooler
							
Composed of:							
	Compressors	Compressors	Compressors	Compressors		Compressors	
	Condenser and/or evaporator fans	Condenser and/or evaporator fans	Condenser and/or evaporator fans		Condenser fans	Exhaust, supply blower, condenser fans	Exhaust/ supply blower
	Recirculating pumps	Recirculating pumps	Recirculating pumps	Recirculating pumps	Recirculating pumps	Recirculating pumps	

How to read the table?

1 Select your HVAC&R machine

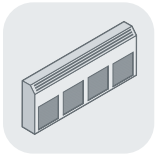
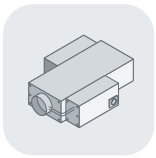
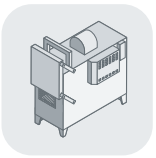
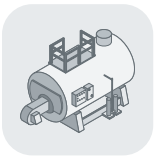
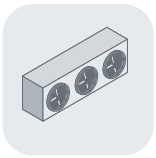
Eg.: Water Cooled Chiller

2 Find the motors that should be embedded

Eg.: Compressors + recirculating pumps

3 Go to correspondent motor starter selection pages

Eg.: page 6 for compressors and page 14 for pumps

 Fan coil unit			 Condenser		
 Terminal unit	 Furnace	 Boiler	 Evaporator		
				Select your starter:	
				 Starter for Compressors	P. 9
Fan	Blower		Evaporator or condenser fans	 Starter for Fans	P. 14
		Recirculating pumps		 Starter for Pumps	P. 16

- Glossary for HVAC&R machines
- Method for selection of circuit breakers and contactors
- Electrical diagrams for DOL and star-delta starters
- Products and catalogues that could also interest you

 Appendix P. 19

TeSys control and protection components compliance with the IEC 60335 standard

IEC 60335 series, published under the general title "Household and similar electrical appliances – Safety" is a product family standard dealing with the safety of appliances. Their rated voltage is not more than 250 V for single-phase appliances and 480 V for other appliances including direct current (DC) supplied appliances and battery operated appliances.

This International Standard is divided into two main parts:
> Part 1 (IEC 60335-1): General requirements
> Part 2 (IEC 60335-2-xx): Particular requirements for each type of appliance.

Part 1 is to be used in conjunction with the appropriate Part 2 of IEC 60335, which contains clauses to supplement or modify the corresponding clauses in Part 1, for providing the relevant requirements for each type of appliance.

In this guide we will focus on the TeSys components compliance with IEC 60335-1 Section 30: "Resistance to heat and fire" and with the IEC 60335-2-40: “Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers“, shown in the tables below:

Standard	Test Item	GV2ME	GV2P	GV3P/L	LRK	LRD01...35	LRD313...380	LRD33/43
IEC 60335-1 Resistance to heat and fire		✓	Under Testing	✓	✓	Under Testing	✓	✓
IEC 60335-2-40 Conformity to flammable refrigerants	R32	✓	✓	✓	Under Testing	✓	✓	Under Testing
	R1234ze(E)	✓	✓	✓	Under Testing	✓	✓	Under Testing
	R1234yf	✓	✓	✓	Under Testing	✓	✓	Under Testing
	Other A2L refrigerants with burning velocity ≤ 6.7 cm/s	✓	✓	✓	Under Testing	✓	✓	Under Testing

Standard	Test Item	LC1K06...16	LC1D09...38	LC1D40A…65A(1)	LC1D40...95	LC1D115...150	LC1G115...800
IEC 60335-1 Resistance to heat and fire		✓	Under Testing	Under Testing	Under Testing	✓	Under Testing
IEC 60335-2-40 Conformity to flammable refrigerants	R32	✓	✓	✓	Under Testing	✓	Under Testing
	R1234ze(E)	✓	✓	✓	✓	✓	✓
	R1234yf	✓	✓	✓	✓	✓	✓
	Other A2L refrigerants with burning velocity ≤ 6.7 cm/s	✓	✓	✓	Under Testing	✓	Under Testing

(1) Power connections by EverLink®, BTR screw connectors.

The use of TeSys components compliant with the IEC 60335 standard offers to our customers important benefits:
> It allows the replacement of the refrigerants with a high GWP (Global Warming Potential) with new refrigerants with a low GWP (more “Environmental Friendly”) and/or a low flammability (A2L refrigerants), for answering the European and International directives and for more safety. In Household Appliances these refrigerants can be found in heat pumps, airconditioners, or dehumidifiers.
> Stock optimization: as the standard TeSys control and protection components are certified (not special design ones), no need to manage an additional stock of special products.

Nota: *Variable Speed Drives ATV320 and ATV212 mentionned in this guide are compliant with the IEC 60335-2-40 standard.*

COMPRESSOR PROTECTION AND CONTROL

Starter type selection

Direct On-Line

Constant speed
ON-OFF control

Star-Delta

Constant speed
ON-OFF control
Inrush current limitation

Soft Starter

Constant speed
Soft start/stop
Inrush current limitation

Variable Speed Drive

Variable speed
Soft start/stop
Fine control
Inrush current limitation

Thermal-Magnetic motor circuit breakers TeSys:
GV2ME, GV2P, GV3P, GV4P, GV5P
Compact NSX, NSXm

Contactors:
TeSys LC1K or LC1D,
Or
LC1D or LC1G
Assembly
Or
Soft Starter
Altistart ATS01, ATS22
Or
Variable Speed Drive
Altivar ATV212, ATV320, ATV600

Product selectors:
see next pages

Other Schneider Electric components for building your Control Panels

More information on page 27

Direct On-line starters

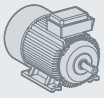
① Your need: select the type of solution for your DOL Starter regarding your constraints

Operating specifications						> Solution
Ambient temp. in the panel	Motor inrush current	Starting time	Electrical durability (cycles)	Mini. interval between motor stop & start	Compacity requirements between devices	Type
≤ 60°C	≤ 6 x RLA*	≤ 5 s (RLA ≤ 40 A) ≤ 10 s (RLA > 40 A)	≈ 1 million	≥ 1 s	Close or separate mounting	Standard
≤ 45°C	≤ 4 x RLA*	≤ 1 s (RLA ≤ 40 A) ≤ 5 s (RLA > 40 A)	≤ 300,000	≥ 15 min	Separate mounting	HVAC&R Adapted

For understanding your Use Case conditions and choosing the suitable Starter Solution: ***refer to page 12***.
For other specifications, please contact Schneider Electric support.
**RLA = Rated Load Amperage (∿)*

② Our TeSys solution: find references for a Standard or Adapted solution

The main input for selection is the current which will go through the circuit breaker (Rated Load Amperage). Corresponding nominal power (Pn) is given as information for 400 V – 50 Hz.

Motor		> Thermal-magnetic CB	> Contactor	
		 (1) (Q1)	 (KM1) Standard solution	 (KM1) HVAC&R Adapted solution
Rated Load Amperage (RLA), 400 V (A ∿)	or Corresponding average nominal power (Pn) under 400 V (kW)			
0.2	0.06	GV2ME02	LC1D09••	LC1K06••
0.3	0.09	GV2ME03		
0.4	0.12	GV2ME04		
0.6	0.18	GV2ME04		
0.9	0.25	GV2ME05		
1.1	0.37	GV2ME06		
1.5	0.55	GV2ME06		
1.9	0.75	GV2ME07		
2.7	1.1	GV2ME08		
3.6	1.5	GV2ME08		
4.9	2.2	GV2ME10		
6.5	3	GV2ME14		
8.5	4	GV2ME14		LC1K09••
11.5	5.5	GV2ME16	LC1D12••	LC1K12••
15.5	7.5	GV2ME20	LC1D18••	LC1D12••
22	11	GV2ME22	LC1D25••	LC1D18••
29	15	GV2ME32	LC1D32••	LC1D25••
35	18.5	GV3P40	LC1D40A••	LC1D32••
41	22	GV3P50	LC1D50A••	LC1D40A••
55	30	GV3P65	LC1D65A••	LC1D50A••
66	37	GV3P73	LC1D80A•••	LC1D65A••
80	45	GV4P115	LC1D95••	LC1D80A•••
97	55	GV4P115	LC1D115••	LC1D95••
132	75	GV5P150F	LC1D150••	LC1D115••

(1) Check circuit breaker breaking capacity (Icu) from TeSys Catalogue ref. MKTED210011EN. Refer to page 18, for details as how to access TeSys Catalogue.

Nota: *Dots in the contactor reference should be replaced by the coil code. Example: 0.55 kW motor - 230 Vac / 50/60 Hz control voltage > GV2ME14 circuit breaker + LC1K06**P7** contactor*

Coil codes	12 V	24 V	230 V	400 V	415 V
AC (50/60 Hz)	-	B7	P7	V7	N7
DC	JD	BD	-	-	-
DC low consumption	JL (1)	BL	-	-	-

Coil codes for LC1D80A	24 V (DC only)	24-60 V	48-130 V	100-250 V
AC (50/60 Hz) / DC	BBE	BNE	EHE	KUE

(1) JL coil not available for TeSys K.

References given relatively to **power diagram A page 25**

Warning:
Contactors references selected for the HVAC&R solution **have been optimized for this application** and should not be used for another application.

Star-Delta starters

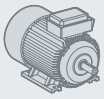
① Your need: select the type of solution for your Star-Delta Starter regarding your constraints

Operating specifications						> Solution
Ambient temp. in the panel	Motor inrush current	Starting time	Electrical durability (cycles)	Mini. interval between motor stop & start	Compacity requirements between devices	Type
≤ 60°C	≤ 8 x RLA*	≤ 30 s (RLA ≤ 230 A) ≤ 20 s (RLA ≤ 280 A)	≈ 1 million	≥ 2 min Deca range ≥ 5 min Giga range	Close or separate mounting	Standard
≤ 45°C	≤ 6 x RLA*	≤ 5 s (RLA ≤ 97 A) ≤ 10 s (RLA > 97 A)	≤ 300,000	≥ 15 min Deca range ≥ 60 min Giga range	Separate mounting	HVAC&R Adapted

For understanding your Use Case conditions and choosing the suitable Starter Solution: ***refer to page 12****.*
For other specifications, please contact Schneider Electric support.
**RLA = Rated Load Amperage (∿)*

② Our TeSys solution: find references for a Standard solution

The main input for selection is the current which will go through the circuit breaker (Rated Load Amperage).
Corresponding nominal power (Pn) is given as information for 400 V – 50 Hz.

Motor		> Thermal-magnetic CB	> Contactors			> Interlock	
		 (1) (Q1)	 (KM2) (KM3) (KM1)				
Rated Load Amperage (RLA), 400 V (A ∿)	or Corresponding average nominal power (Pn) under 400 V (kW)		Line Contactor	> Delta Contactor	> Star Contactor	> Electrical interlock / Connection kit	> Mechanical interlock
			Standard solution			Standard solution	
55	30	GV3P65	LC1D40A••	LC1D40A••	LC1D40A••	Customer cabling	LAD4CM
66	37	GV3P73	LC1D40A••	LC1D40A••	LC1D40A••	Customer cabling	LAD4CM
80	45	GV4P115	LC1D50A••	LC1D50A••	LC1D40A••	Customer cabling	LAD4CM
97	55	GV4P115	LC1D50A••	LC1D50A••	LC1D40A••	Customer cabling	LAD4CM
132	75	GV5P150F	LC1D80A••	LC1D80A••	LC1D80A••(2)	Customer cabling	LAD4CM
160	90	GV5P220F	LC1D115••	LC1D115••	LC1D115••(3)	LA9D11502	
195	110	GV5P220F	LC1D115••	LC1D115••	LC1D115••(3)	LA9D11502	
230	132	GV6P320F	LC1D150••	LC1D150••	LC1D115••	LA9D11502	
280	160	GV6P320F	LC1G185••	LC1G185••	LC1G115••	LA9GQQ330	LA9G970

(1) Check circuit breaker breaking capacity (Icu) from TeSys Catalogue ref. MKTED210011EN.
Refer to page 18, for details as how to access TeSys Catalogue.
(2) The Star Contactor LC1D80A can be replaced by LC1D50A, but without mechanical interlocking.
(3) The Star Contactor LC1D115 can be replaced by LC1D80A, but without mechanical interlocking.

References given relatively to **power diagram B1 page 25**

Nota: *Dots in the contactor reference should be replaced by the coil code.*
Example: 30 kW motor under 400 V - 230 Vac / 50/60 Hz control voltage **>** *GV3P65 circuit breaker + 3 x LC1D40A****P7*** *contactor*

Coil codes	12 V	24 V	230 V	400 V	415 V
AC (50/60 Hz)	-	B7	P7	V7	N7
DC	JD	BD	-	-	-
DC low consumption	JL	BL	-	-	-

Those coil references correspond to most common contactors. Please, refer to catalogue for more details.

Coil codes for LC1D80A	24 V (DC only)	24...60 V	48...130 V	100...250 V
AC (50/60 Hz) / DC	BBE	BNE	EHE	KUE

"Coil codes for TeSys Giga contactors" Advanced version - "A"	24…48 V	48...130 V	200...500 V
AC (50/60 Hz) / DC	BEE(4)	EHE	LSE
Standard version - "S"		**48...130 V**	**100...250 V**
AC (50/60 Hz) / DC		EHE	KUE

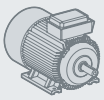
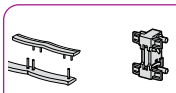
Example:
LC1G400LSEA: TeSys Giga Contactor Advanced version 400 A, 3-pole, 200...500 V AC/DC coil, with PLC control.
LC1G1854EHEN: TeSys Giga Contactor Standard version 185 A, 4-pole, 48...130 V AC/DC coil, without PLC control.

(4) 24...48 V AC/DC control voltage option is available for LC1G115...LC1G500 ratings.

Star-Delta starters

② Our TeSys solution: find references for an HVAC&R Adapted solution

The main input for selection is the current which will go through the circuit breaker (Rated Load Amperage).
Corresponding nominal power (Pn) is given as information for 400 V – 50 Hz.

Motor			> Thermal-magnetic CB	or Fuse + Thermal relay	> Contactors			> Interlock	
			 (1) (Q1)	 (F1)	 (KM2) (KM3) (KM1)				
Rated or Load Amps (RLA), 400 V (A ∿)	Corresp. average nom. power (Pn) under 400 V (kW)	*Delta contactor current (A) (informative)*		Thermal protection ref.(4) + Independent mounting accessory	Line Contactor	> Delta Contactor	> Star Contactor	> Electrical interlock / Connection kit	> Mechanical interlock
					HVAC&R Adapted solution			HVAC&R Adapted solution	
55	30	*31.8*	GV3P65	LRD35 + LAD7B106	LC1D32••	LC1D32••	LC1D25••	LAD9V1	LAD9V2
66	37	*38.1*	GV3P73	LRD350 + LAD96560	LC1D38••	LC1D38••	LC1D32••	LAD9V1	LAD9V2
80	45	*46.2*	GV4P115	LRD350 + LAD96560	LC1D40A••	LC1D40A••	LC1D40A ••(2)	Customer cabling	LAD4CM
97	55	*56*	GV4P115	LRD365 + LAD96560	LC1D40A••	LC1D40A••	LC1D40A ••(2)	Customer cabling	LAD4CM
132	75	*76.2*	GV5P150F	LRD3363 + LA7D3064	LC1D65A••	LC1D65A••	LC1D40A••	Customer cabling	LAD4CM
160	90	*92.4*	GV5P220F	LRD4367 + LA7D3064	LC1D95••	LC1D95••	LC1D80••	LA9D8018(3)	
195	110	*112.6*	GV5P220F	LRD4367 + LA7D3064	LC1D95••	LC1D95••	LC1D80••	LA9D8018(3)	
230	132	*132.8*	GV6P320F	LRD4369 + LA7D3064	LC1D115••	LC1D115••	LC1D115••	LA9D11502	
280	160	*161.7*	GV6P320F	LR9G225	LC1G150••	LC1G150••	LC1G115••	LA9GQQ330	LA9G970

(1) Check circuit breaker breaking capacity (Icu) from TeSys Catalogue ref. MKTED210011EN.
Refer to page 18, for details as how to access TeSys Catalogue.
(2) The Star Contactor LC1D40A can be replaced by LC1D32, but without mechanical interlocking.
(3) The Star Contactor LC1D80 can be replaced by LC1D80A, but without electrical or mechanical interlocking.
(4) Trip class for type LRD: 10A

References given relatively to power diagram page 25:
B1 for Thermal-magnetic circuit breaker solution
B2 for fuse + relay solution

Nota: *Dots in the contactor reference should be replaced by the coil code.*
*Example: 0.55 kW motor - 230 Vac / 50/60 Hz control voltage > GV2ME14 circuit breaker + LC1K06**P7** contactor*

Coil codes	12 V	24 V	230 V	400 V	415 V
AC (50/60 Hz)	-	B7	P7	V7	N7
DC	JD	BD	-	-	-
DC low consumption	JL	BL	-	-	-

Coil codes for LC1D80A	24 V (DC only)	24-60 V	48-130 V	100-250 V
AC (50/60 Hz) / DC	BBE	BNE	EHE	KUE

Warning:
Electrical and mechanical interlocking between star and delta contactor should always be recommended for improved reliability.

Warning:
Contactors references selected for the HVAC&R solution **have been optimized for this application** and should not be used for another application.

Understand your Use Case conditions and choose the suitable Starter Solution

Example: COMPRESSOR PROTECTION AND CONTROL - Direct On-line starters - page 10 - **2nd line**:

If your Use Case is as below:

> The Ambient temperature inside the panel is ≤ 45 °C and
> Your compressor motor inrush current is ≤ 4 x RLA* and
> Your motor starting time is ≤ 1 s (for RLA ≤ 40 A) or ≤ 5 s (for RLA > 40 A) and
> The requested Electrical durability is ≤ 300 000 cycles and
> The minimum interval between motor stop & start is ≥ 15 min and
> Your motor starter components are mounted separately

Then you can choose a "**HVAC&R Adapted solution**" Direct On-line starter for your compressor.

**RLA = Rated Load Amperage (∿)*

COMPRESSOR PROTECTION AND CONTROL

Variable speed drive starters

Choice of variable speed drives for compressor motor applications
Open loop speed control for synchronous and asynchronous motors.

ATV320	ATV212	ATV630
Application		
Simple HVAC systems	HVAC in building applications	Simple and advanced HVAC systems
Motor power at 240, 400, 600 V according to model		
• 0.18 to 15 kW, • 1-phase, 3-phase Synch/asynch motors	• 0.75 to 75 kW • 3-phase Synch/asynch motors	• 0.75 to 315 kW (wall mounted)… 800 kW (floor standing) • 3-phase Synch/asynch motors
Communication		
Advanced connectivity with automation architectures such as Modbus, BACnet, CAnopen, Ethernet/IP, etc., according to model		
Setup		
SoMove software	PC soft software	SoMove software
Main features		
• Book or compact format • IP20	• Energy efficient • Low harm. level • IP21 – IP55	• Services oriented • Pump status and energy management • Embedded pump functions • IP 21 – IP55

Green Premium™

Green Premium is the only label that allows you to effectively develop and promote an environmental policy whilst preserving your business policy.
This ecolabel guarantees compliance with up-to-date environmental regulations, but it does more than this.

More information about variable speed drives

ATV320

Scan or click on QR code

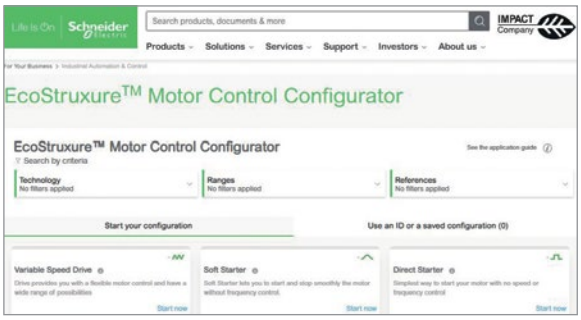
ATV212

Scan or click on QR code

ATV630

Scan or click on QR code

For association with the TeSys offer, use the Ecostruxure Motor Control Configurator:



Scan or click on QR code to reach the configurator

FAN PROTECTION AND CONTROL

Starter type selection

Direct On-Line

Constant speed
ON-OFF control

Thermal-magnetic motor circuit breaker:
TeSys GV2ME

Contactor:
TeSys LC1K or LC1D

Product selectors:
see next pages

Other Schneider Electric components for building your Control panels

More information on page 27

Variable speed drive

- Variable speed
- Soft start
- Inrush current limitation
- Fine control
- Significant energy savings

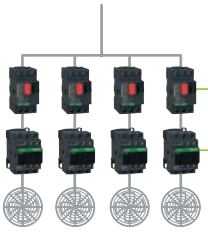
Products to be chosen in the product ranges:

Thermal-magnetic motor circuit breaker: TeSys GV2L
Alternative protection:
fuse holder TeSys DF

Variable Speed Drive (VSD):
Altivar

Incremental air flow adjustment
Cascading control with contactor

Products to be chosen in the product ranges:

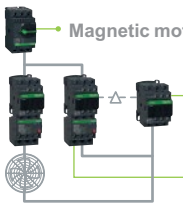


Thermal-magnetic motor circuit breaker GV2, GV3

LC1K••, LC1D•• type contactor

Two-speed air flow adjustment
Dahlander motor with Dahlander coupling

Products to be chosen in the product ranges:

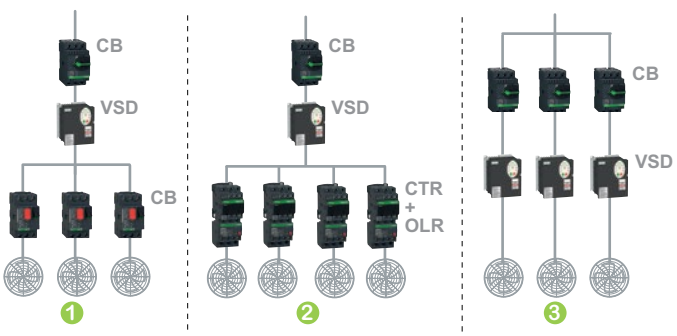


Magnetic motor circuit breaker GV2

LC1K or LC1D type contactor with mechanical interlock

LR2K or LRD type thermal relay

Fine air flow adjustment
Variable control with Variable Speed Drive



Products to be chosen in the product ranges:

> GV2 or GV3 motor circuit breakers (CB)
> LC1K•• or LC1D•• contactors (CTR)
> LR2K or LRD type thermal relays (OLR)
> Altivar variable speed drives (VSD)

1. Identical variable speed for all the fans in operation simultaneously.
2. Identical variable speed for all the motors, with possibility of starting and stopping the fans according to the load.
3. Separate variable speed for each motor, with possibility of starting and stopping the fans according to the load.

Direct On-line starters

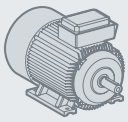
① Your need: select the type of solution for your Star-delta starter regarding your constraints

Operating specifications						> Solution
Ambient temperature in the panel	Motor inrush current	Starting time	Electrical durability (cycles)	Mini. interval between motor stop & start	Compacity requirements between devices	Type
≤ 60°C	≤ 6 x RLA*	≤ 10 s	≈ 1.5 million	≥ 1 s	Close or separate mounting	Standard
≤ 45°C	≤ 6 x RLA*	≤ 1 s	≤ 500,000	≥ 5 min	Separate mounting	HVAC&R Adapted

For understanding your Use Case conditions and choosing the suitable Starter Solution: ***refer to page 12****.*
For other specifications, please contact Schneider Electric support.
**RLA = Rated Load Amperage (∿)*

② Our TeSys solution: find references for a Standard or Adapted solution

The main input for selection is the current which will go through the circuit breaker (Rated Load Amperage). Corresponding nominal power (Pn) is given as information for 400 V – 50 Hz.

Motor		> Thermal-magnetic CB	> Contactor	
		 (1) (Q1)	 (KM1) Standard solution	 (KM1) HVAC&R Adapted solution
Rated Load Amperage (RLA), 400 V (A ∿)	or Corresponding average nominal power (Pn) under 400 V (kW)			
0.2	0.06	GV2ME02	LC1D09••	LC1K06••
0.3	0.09	GV2ME03		
0.4	0.12	GV2ME04		
0.6	0.18	GV2ME04		
0.9	0.25	GV2ME05		
1.1	0.37	GV2ME06		
1.5	0.55	GV2ME06		
1.9	0.75	GV2ME07		
2.7	1.1	GV2ME08		
3.6	1.5	GV2ME08		
4.9	2.2	GV2ME10		
6.5	3	GV2ME14		LC1K09••
8.5	4	GV2ME14		LC1K09••

(1) Check circuit breaker breaking capacity (Icu) from TeSys Catalogue ref. MKTED210011EN.
Refer to page 18, for details as how to access TeSys Catalogue.

References given relatively to **power diagram A page 25**

Nota: *Dots in the contactor reference should be replaced by the coil code.*
Example: 0.55 kW motor - 230 Vac / 50/60 Hz control voltage >
*GV2ME14 circuit breaker + LC1K06**P7** contactor*

Coil codes	12 V	24 V	230 V	400 V	415 V
AC (50/60 Hz)	-	B7	P7	V7	N7
DC	JD	BD	-	-	-
DC low consumption	JL (2)	BL	-	-	-

(2) JL coil not available for TeSys K.

Warning:
Contactors references selected for the HVAC&R solution **have been optimized for this application** and should not be used for another application.

PUMP PROTECTION AND CONTROL

Starter type selection

Direct On-Line

Constant speed
ON-OFF control

Thermal-magnetic motor circuit breaker:
TeSys GV2ME, GV3P

Contactor:
TeSys LC1K or LC1D

Product selectors:
see next pages

Other Schneider Electric components for building your Control panels

More information on page 27

- Constant speed
- ON-OFF control
- Inrush current limitation
- Soft start and/or stop

Soft Starter

Products to be chosen in the product ranges:

Thermal-magnetic motor circuit breaker GV2, GV3 or GV4

Altistart Soft Starter

- Variable speed
- Inrush current limitation
- Soft start and/or stop
- Fine control
- Significant energy savings

Variable Speed Drive (VSD)

Products to be chosen in the product ranges:

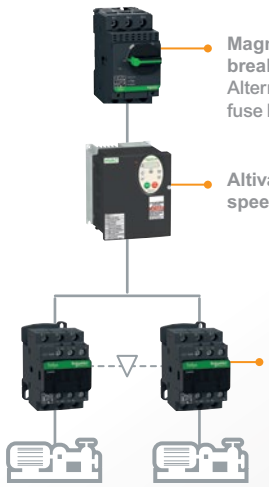
Magnetic motor circuit breaker GV2, GV3 or GV4
Alternative protection:
fuse holder TeSys DF

Altivar Variable Speed Drive (VSD)

- Motor redundancy (eg.: twin pumps)

2 mechanically interlocked contactors alternately driven by a Variable Speed Drive

Products to be chosen in the product ranges:



Magnetic motor circuit breaker GV2, GV3 or GV4
Alternative protection:
fuse holder TeSys DF

Altivar variable speed drive (VSD)

LC1K or LC1D type contactors
Optional interlocking

Direct-On-Line starter

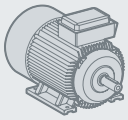
① Your need: select the type of solution for your DOL starter regarding your constraints

Operating specifications						> Solution
Ambient temperature in the panel	Motor inrush current	Starting time	Electrical durability (cycles)	Mini. interval between motor stop & start	Compacity requirements between devices	Type
≤ 60°C	≤ 6 x RLA*	≤ 5 s	≈ 1 million	≥ 1 s	Close or separate mounting	Standard
≤ 45°C	≤ 6 x RLA*	≤ 1 s	≤ 300,000	≥ 5 min	Separate mounting	HVAC&R Adapted

For understanding your Use Case conditions and choosing the suitable Starter Solution: ***refer to page 12****.*
For other specifications, please contact Schneider Electric support.
**RLA = Rated Load Amperage (∿)*

② Our TeSys solution: find references for a Standard or Adapted solution

The main input for selection is the current which will go through the circuit breaker (Rated Load Amperage).
Corresponding nominal power (Pn) is given as information for 400 V – 50 Hz.

Motor		>	Thermal-magnetic CB	>	Contactor	
			 (1) (Q1)		 (KM1)	 (KM1)
Rated Load Amperage (RLA), 400 V (A ∿)	or Corresponding average nominal power (Pn) under 400 V (kW)				Standard solution	HVAC&R Adapted solution
2.7	1.1		GV2ME08		LC1D09••	LC1K06••
3.6	1.5		GV2ME08			
4.9	2.2		GV2ME10			
6.5	3		GV2ME14			
8.5	4		GV2ME14			LC1K09••
11.5	5.5		GV2ME16		LC1D12••	LC1K12••
15.5	7.5		GV2ME20		LC1D18••	LC1D12••
22	11		GV2ME22		LC1D25••	LC1D18••
29	15		GV2ME32		LC1D32••	LC1D25••
35	19		GV3P40		LC1D40A••	LC1D32••
41	22		GV3P50		LC1D50A••	LC1D40A••
55	30		GV3P65		LC1D65A••	LC1D50A••

(1) Check circuit breaker breaking capacity (Icu) from TeSys Catalogue ref. MKTED210011EN.
Refer to page 18, for details as how to access TeSys Catalogue.

References given relatively to **power diagram A page 25**

Nota: *Dots in the contactor reference should be replaced by the coil code.*
Example: 0.55 kW motor - 230 Vac / 50/60 Hz control voltage **>** *GV2ME14 circuit breaker + LC1K06**P7** contactor*

Coil codes	12 V	24 V	230 V	400 V	415 V
AC (50/60 Hz)	-	B7	P7	V7	N7
DC	JD	BD	-	-	-
DC low consumption	JL (2)	BL	-	-	-

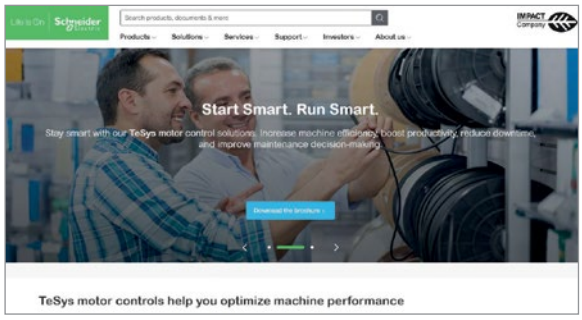
(2) JL coil not available for TeSys K.

Warning:
Contactors references selected for the HVAC&R solution **have been optimized for this application** and should not be used for another application.

For detailed electrical characteristics and dimensions, please consult:

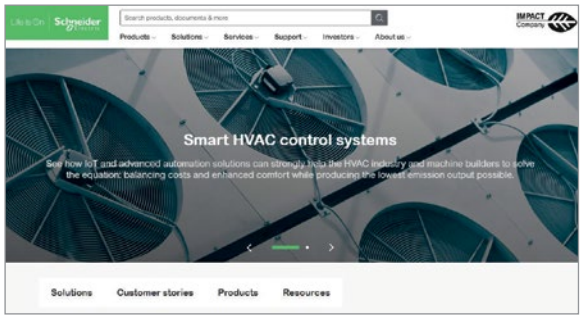
Schneider Electric - TeSys web portal

www.se.com/tesys



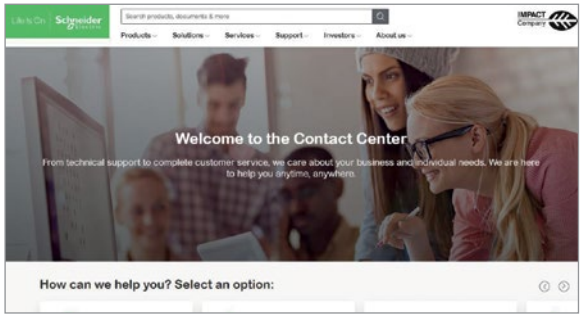
Scan or click on QR code to reach the portal

HVAC control solutions web portal



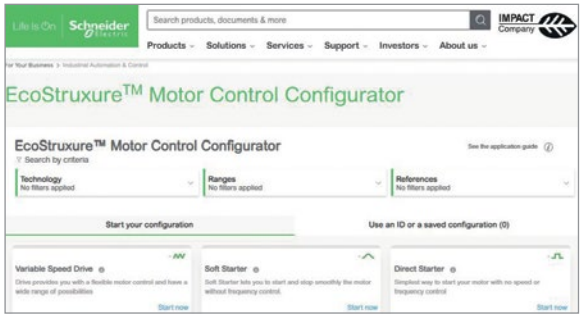
Scan or click on QR code to reach the portal

More questions, contact Schneider Electric Customer Care Center



Scan or click on QR code to reach the portal

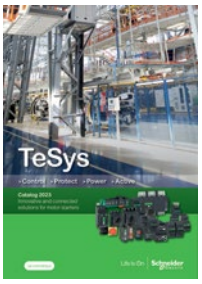
EcoStruxure Motor Control Configurator



Scan or click on QR code to reach the configurator

Innovative and connected solutions for motor starters Catalogue

(Ref. MKTED210011EN)



Scan or click on QR code to download the catalog

Control Panel Technical Guide - How to quickly design optimized contactor assemblies

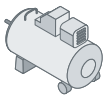
(Ref. CPTG011_EN)

Scan or click on QR code to download the catalog

Appendix

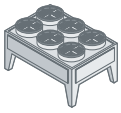
HVAC&R machine definitions

Components for refrigeration



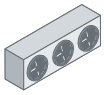
Compressor

In a refrigeration cycle, a compressor is a device which compresses the refrigerant gas up to a high pressure and temperature.



Condenser

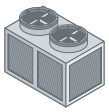
A condenser or condensing coil is a heat exchanger incorporated in a refrigeration cycle. It is designed to enable the liquid refrigerant to lose energy (heat) to the outside in order to cool, while it condenses into its liquid phase.



Evaporator

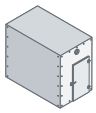
An evaporator or evaporating coil is a heat exchanger incorporated in a refrigeration cycle. It is designed to enable the liquid refrigerant to absorb energy (heat) from the outside in order to warm up, while it evaporates into its gas phase.

Commercial and industrial refrigeration



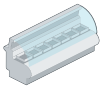
Condensing unit

The function of a condensing unit is to cool down the incoming refrigerant vapour and condense it into liquid. A condensing unit embeds a compressor and a condenser fan.



Cold room

A cold room is a sealed box which is used to store goods in a fresh or frozen ambient atmosphere.
It contains an evaporator. Either an integrated or remote condensing unit is connected to the evaporator.



Refrigerated/low-temperature showcase

A refrigerated (or low-temperature) showcase/display cabinet is used for sale of chilled (or frozen) foodstuffs.
It can be self-refrigerated or connected to a remote condensing unit.

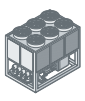
Ice-maker machine

An ice-maker machine produces ice for industrial processes. It can be self-refrigerated or connected to a remote condensing unit.

Ice bank

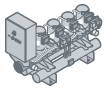
An ice bank produces and stores ice in order to increase cooling power for peak loads. This device has three benefits:
1- Generation of ice at low night tariffs
2- Limitation of max. electricity peaks
3- Use of smaller refrigeration machines, designed for average demand only.
It can be self-refrigerated or connected to a remote condensing unit.

Cooling



Chiller

A chiller is a device forming part of an air conditioning system, that removes heat from a liquid via a vapour-compression or absorption refrigeration cycle. The cooled liquid usually supplies coils in air handlers, fan-coil units, or other systems. Chillers are of two types:



> **Air-cooled chillers** are usually outdoors and consist of a condenser coil cooled by fan-driven air.
> **Water-cooled chillers** are usually located inside a building, and heat from these chillers is carried by recirculating water to a heat sink such as an outdoor cooling tower.

Cooling tower

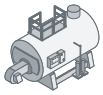
A cooling tower is a heat discharge device installed outside of the building envelope. It is used to cool water that has been heated in the condenser of a water-cooled chiller (in a refrigerant/water fluid exchanger).

HVAC&R machine definitions

Heating

Heat pump

A heat pump is a device that warms or cools a building by transferring heat from a relatively low-temperature reservoir to one at a higher temperature (air to water or water to water or direct expansion circuit).



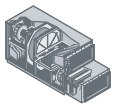
Boiler

A boiler is a closed vessel in which water or another fluid is heated. The heated or vaporized fluid leaves the boiler for use in various processes or heating applications, including central heating in a hydronic system.

Furnace

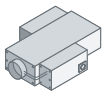
A furnace is a heating system component designed to heat air for distribution in a building.

Ventilation and air conditioning



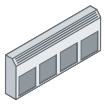
Air handler / Air Handling Unit (AHU)

An air handler is a device used to condition and circulate air as part of a Heating, Ventilation and Air Conditioning (HVAC) system, to meet environmental requirements. It includes cooling coils and possibly heating coils to cool and/or warm air. Cold/warm water is supplied by a remote chiller and/or heater.



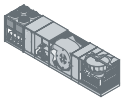
Terminal Unit (TU)

A Terminal Unit is an outlet in ductwork to allow air delivery to an environment such as a room.
Terminal units may have built-in heating and cooling coils connected to central heating and/or cooling systems.



Fan Coil Unit (FCU)

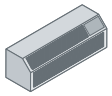
A Fan Coil Unit is a Terminal Unit which is not connected to air ductwork but to a hydronic system.



Packaged Unit (PU)

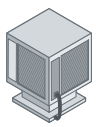
A Packaged Unit is an AHU equipped with its own heating and cooling sources. It can be classified according to the place of installation:

> **Roof Top Unit** (RTU), installed on the roof and completely weatherproof
> **Indoor Packaged Unit,** installed indoors, usually connected to a cooling tower



Packaged Terminal Air Conditioner (PTAC)

A Packaged Terminal Air Conditioner is a Packaged Unit dedicated to a single room. It consists of a wall sleeve and a separate encased combination of heating units (by hot water, steam, or electric resistance) and cooling units (includes refrigeration components) for mounting through the wall.

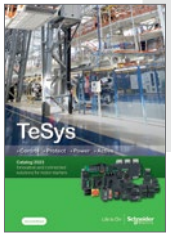


Evaporative cooler

An evaporative cooler (also called swamp cooler, desert cooler, and wet air cooler) is a device that cools air through the evaporation of water. This method uses far less energy than refrigeration, but once evaporated, the water is lost. In extremely dry climates, evaporative cooling of air has the added benefit of conditioning the air with more moisture for the comfort of building occupants.

Method for selection of the circuit breaker and contactor

The selection of control and protection components requires a good knowledge of the application data but, above all, a knowledge of the components' characteristics.



These characteristics are available in the Schneider Electric **"TeSys - Innovative and connected solutions for motor starters" catalogue.**

(Ref. MKTED210011EN)

1 Choice of the contactor, based on the type of motor starting:

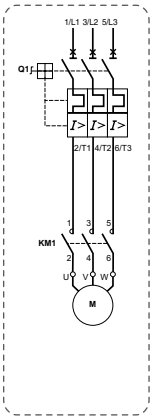
Examples of project data

❶ Squirrel Cage Induction Motor
Starting shall be ***quick***, while the Starting torque shall be at the ***nominal value***.

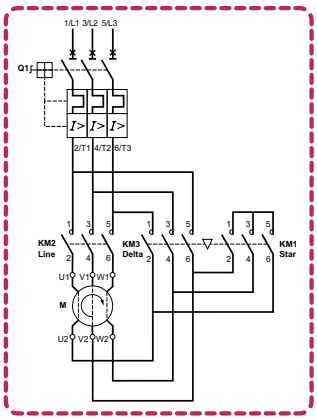
❷ Squirrel Cage Induction Motor
Starting must be ***gradual*** to avoid peak currents.
Starting torque is ***lower than one-third of nominal torque***.

Selection criteria

Standard layouts



❶ **Direct-On-Line starting:**
The motor starts quickly, with its natural characteristics (nominal torque), creating a current peak on the network.



❷ **Star-Delta starting:**
Condition: starting torque must be lower than one-third of nominal torque.
The motor starts gradually, at reduced voltage.
Low current peak (one-third) at starting.
3 contactors are used, 2 of which are mechanically interlocked.

2 Choice of motor circuit breaker

Examples of project data

Data concerning the electrical network:
50 kA ❶ short-circuit current at the motor level

Data concerning the motor:

BRAND — MOT. 3 ~ XYZ100 — N° 8945/79 — 22 kg

Code : — T

IP 55 — I cl. F — 40°C — S1 — % — c/h

	Hz	min⁻¹	kW	cos φ	A
Δ 380	50	1415	3	0.83	7.1
Δ 400 ❷	50	1420	3	0.78	7.2 ❸
Δ 415	50	1430	3	0.74	7.3

DE NDE — g h — MOTEURS — MADE IN FRANCE — IEC XXXXX — DM1502

The inrush current is 6 times the Rated Load Amperage (or nominal current): 6 x 7.2 = ***43.2 A*** ❹

Selection criteria

To select your motor protection properly, you must check that:

Motor circuit-breakers from 0.06 to 15 kW / 400 V, with screw clamp terminals

GV2 ME with pushbutton control

Standard power ratings of 3-phase motors 50/60 Hz in category AC-3									Setting range of thermal trips (2)	Magnetic tripping current	Reference	Weight
400/415 V ❷			500 V			690 V				Id ± 20 % ❹		
P	Icu	Ics (1)	P	Icu	Ics (1)	P	Icu	Ics (1)				
kW	kA	%	kW	kA	%	kW	kA	%	A	A		kg
2.2			3	50	100	4	3	75	4…6.3	78	GV2ME10	0.260
3	>100 ❶	100	4	10	100	5.5	3	75	6…10 ❸	138 ❹	GV2ME14	0.260
4	>100	>100	5.5	10	100	7.5	3	75				

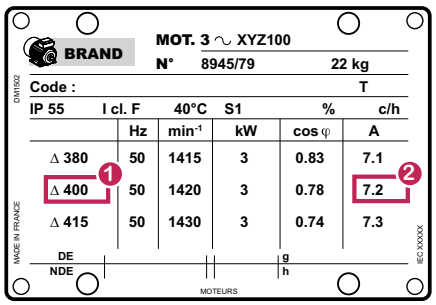
> The maximum operating voltage of the CB is greater than the motor nominal voltage;
> The short-circuit current does not exceed the circuit breaker's breaking capacity (Icu);
> The inrush current does not exceed the magnetic tripping current;
> The motor's nominal current is within the thermal trip setting range of the overload protection system.

Method for selection of the circuit breaker and contactor

3 Choice of contactor

Examples of project data

The max. temperature of the panel in operation must not exceed ***35°C***



Nominal voltage (Un) in delta cabling = ***400 V*** ❶

Rated Load Amperage (RLA) for this voltage = ***7.2 A*** ❷

Maximum starting current: ***6 x 7.2 A***

Maximum starting time: ***5 sec*** ❶

Minimum interval between two cycles: ***15 min*** ❷

Contactor characteristics

To select your contactor properly, you must check that:

Contactor type		LC1	D09…D18 DT20 and DT25	D25…D38 DT32 and DT40	D40A…D65A DT60A and DT80A	D80…D95	D115 and D150
Environment							
Ambient air temperature around the device	Storage	°C	- 60…+ 80				
	Operation	°C	- 5…+ 60				
	Permissible	°C	- 40…+ 70, for operation at Uc				

The panel temperature acceptable by the selected contactor must be compatible with the project data.

Contactor type		LC1	D09 (3P)	DT20 D098	D12 (3P)	DT25 D128	D18 (3P)	DT32 D188	D25 (3P)	DT40 D258
Pole characteristics										
Rated operational current (Ie) (Ue y 440 V)	In AC-3, θ ≤ 60 °C	A	9		12		18		25	
	In AC-1, θ ≤ 60 °C	A	25 *(1)*	20	25 *(1)*	25	32 *(1)*	32	40 *(1)*	40
Rated operational voltage (Ue)	Up to	V	690		690		690		690	
Frequency limits	Of the operational current	Hz	25…400		25…400		25…400		25…400	

The maximum voltage (Ue) that can be withstood by each pole of the contactor must be greater than the motor's working voltage Un.

Contactor type		LC1	D09 (3P)	DT20 D098	D12 (3P)	DT25 D128	D18 (3P)	DT32 D188	D25 (3P)	DT40 D258
Pole characteristics										
Rated operational current (Ie) (Ue y 440 V)	In AC-3, θ ≤ 60 °C	A	9		12		18		25	
	In AC-1, θ ≤ 60 °C	A	25 *(1)*	20	25 *(1)*	25	32 *(1)*	32	40 *(1)*	40
Rated operational voltage (Ue)	Up to	V	690		690		690		690	
Frequency limits	Of the operational current	Hz	25…400		25…400		25…400		25…400	
Conventional thermal current (Ith)	θ ≤ 60 °C	A	25 *(1)*	20	25 *(1)*	25	32 *(1)*	32	40 *(1)*	40

The maximum continuous current (Ith) that can be withstood by each pole of the contactor must be greater than the RLA of the motor.

Contactor type		LC1	D09 (3P)	DT20 D098	D12 (3P)	DT25 D128	D18 (3P)	DT32 D188	D25 (3P)	DT40 D258
Pole characteristics										
Rated operational current (Ie) (Ue y 440 V)	In AC-3, θ ≤ 60 °C	A	9		12		18		25	
	In AC-1, θ ≤ 60 °C	A	25 *(1)*	20	25 *(1)*	25	32 *(1)*	32	40 *(1)*	40
Rated operational voltage (Ue)	Up to	V	690		690		690		690	
Frequency limits	Of the operational current	Hz	25…400		25…400		25…400		25…400	
Conventional thermal current (Ith)	θ ≤ 60 °C	A	25 *(1)*	20	25 *(1)*	25	32 *(1)*	32	40 *(1)*	40
Rated making capacity (440 V)	Conforming to IEC 60947	A	250		250		300		450	
Rated breaking capacity (440 V)	Conforming to IEC 60947	A	250		250		300		450	
Permissible short time rating No current flowing for preceding 15 minutes with θ ≤ 40 °C	For 1 s	A	210		210		240		380	
	For 10 s	A	105		105		145		240	
	For 1 min	A	61		61		84		120	
	For 10 min	A	30		30		40		50	

The Rated Making Capacity (RMC) and Rated Breaking Capacity (RBC) of the contactor must be greater than the maximum starting current (expressed as a multiple of the motor's nominal current (A): coef. 6 in the example).

Contactor type		LC1	D09 (3P)	DT20 D098	D12 (3P)	DT25 D128	D18 (3P)	DT32 D188	D25 (3P)	DT40 D258
Pole characteristics										
Rated operational current (Ie) (Ue y 440 V)	In AC-3, θ ≤ 60 °C	A	9		12		18		25	
	In AC-1, θ ≤ 60 °C	A	25 *(1)*	20	25 *(1)*	25	32 *(1)*	32	40 *(1)*	40
Rated operational voltage (Ue)	Up to	V	690		690		690		690	
Frequency limits	Of the operational current	Hz	25…400		25…400		25…400		25…400	
Conventional thermal current (Ith)	θ ≤ 60 °C	A	25 *(1)*	20	25 *(1)*	25	32 *(1)*	32	40 *(1)*	40
Rated making capacity (440 V)	Conforming to IEC 60947	A	250		250		300		450	
Rated breaking capacity (440 V)	Conforming to IEC 60947	A	250		250		300		450	
Permissible short time rating No current flowing for preceding 15 minutes with θ ≤ 40 °C	For 1 s	A	210		210		240		380	
	For 10 s	A	105		105		145		240	
	For 1 min	A	61		61		84		120	
	For 10 min	A	30		30		40		50	

Check that the starting current value and the maximum starting time are compatible with the contactor's thermal constraint.

For short times, a contactor (e.g. star contactor) can be used above its design current, provided one check that:

> the current does not exceed the maximum permissible current for the given operating time

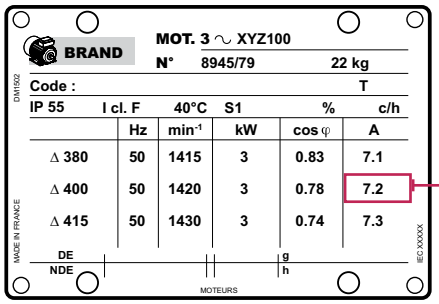
> the minimum interval between two cycles is complied with.

Method for selection of the circuit breaker and contactor

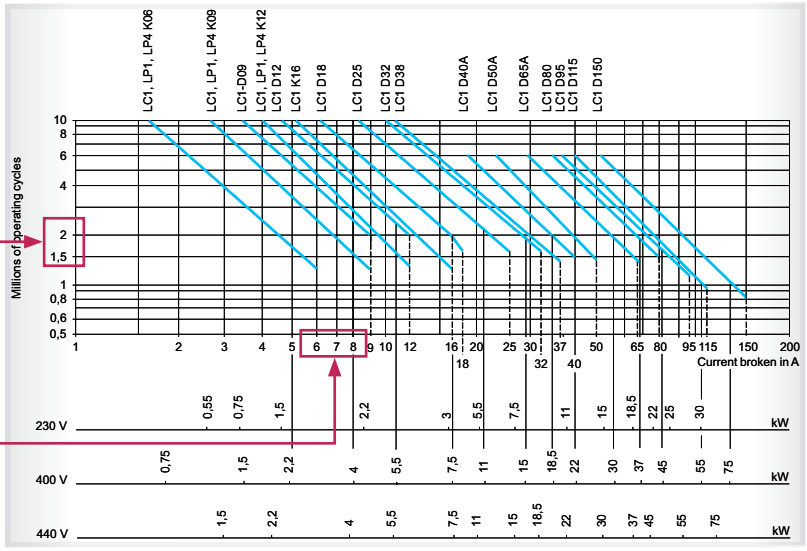
3 Choice of contactor (continuation)

Examples of project data

The motor shall perform at most 11 starts per hour during 15 years, i.e.:
11 x 24 x 365 x 15 = ***1.5 m cycles***



Contactor characteristics



When a contactor has been selected, you must check that its durability will be greater than or equal to the required value.

The contactor's durability depends on the current that it will have to shut off (generally the operating current).

Following thermal sizing of the cables, it was decided to use ***2.5 mm² flexible cable*** to connect the contactor.

Contactor type			LC1 D09 and D12 DT20 and DT25	D18 (3P)	D25 (3P)	D32	D38	D18 and D25 (4P) DT32 and DT40	D40A to D65A DT60A and DT80A (1)	D80 and D95	D115 and D150
Power circuit connections											
Screw clamp terminal connections											
Tightening			Screw clamp terminals					Connector 2 inputs	Screw clamp terminals	Connector 1 input	Connector 2 inputs
Flexible cable without cable end	1 conductor	mm²	1…4	1.5…6	2.5…10			2.5…10	1…35	4…50	10…120
	2 conductors	mm²	1…4	1.5…6	2.5…10			2.5…10	1…25 and 1…35	4…25	10…120 + 10…50
Flexible cable with cable end	1 conductor	mm²	1…4	1…6	1…10			2.5…10	1…35	4…50	10…120
	2 conductors	mm²	1…2.5	1…4	1.5…6			2.5…10	1…25 and 1…35	4…16	10…120 + 10…50

The selected contactor must be able to receive the specified cables.

Star-delta starting with ***mechanical*** and electrical interlocking of the contactors is required.

Mechanical interlocks			
Mechanical interlock with integral electrical interlocking	LC1 D80 and D95 (~)	LA9D4002	0.170
	LC1 D80 and D95 (⎓)	LA9D8002	0.170
	LC1 D115 and D150	LA9D11502	0.290
Mechanical interlock without integral electrical interlocking	LC1 D09 to D38	LAD9V2	0.040
	LC1 D40A to D65A	LAD4CM	0.040
	LC1 D80 and D95 (~)	LA9D50978	0.170
	LC1 D80 and D95 (⎓)	LA9D80978	0.170

In star-delta configuration, the selected contactor must be capable of mechanical and electrical interlocking.

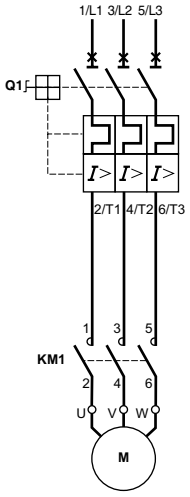
If electrical interlocking equipment does not exist for the selected contactor, the interlocking system must be cabled by the user (see next page).

Electrical diagrams

Power diagrams

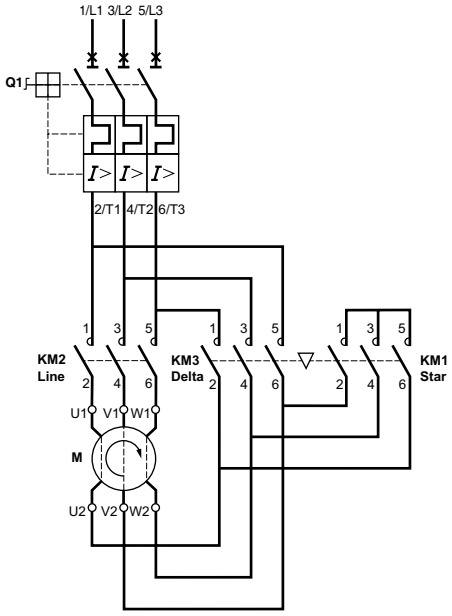
A• Direct-On-Line

With thermal-magnetic motor circuit breaker.



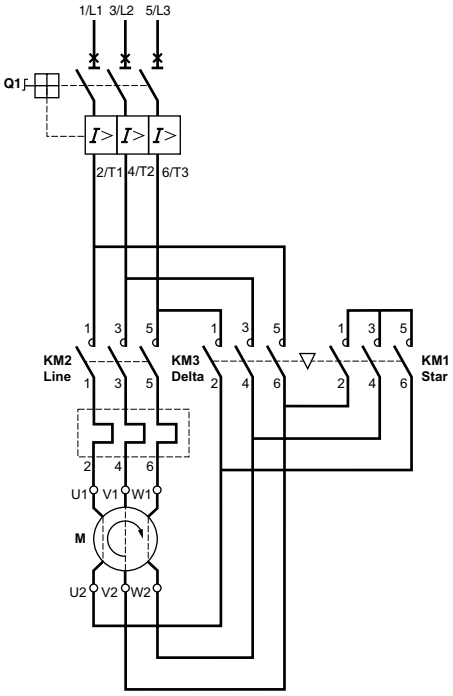
B1• Star-Delta for Standard solution

With thermal-magnetic motor circuit breaker.



B2• Star-Delta for Adapted solution

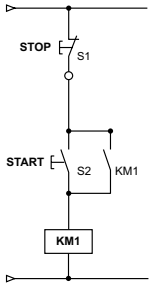
With fuse (or magnetic motor circuit breaker) and separate thermal overload relay.



The current in KM2 and KM3 contactors is $(1/\sqrt{3})$ the nominal current. Using a separate overload relay, as proposed in the "Adapted solution" makes it possible to lower rating than if it was directly downstream the magnetic protection circuit breaker Q1.

Control diagrams

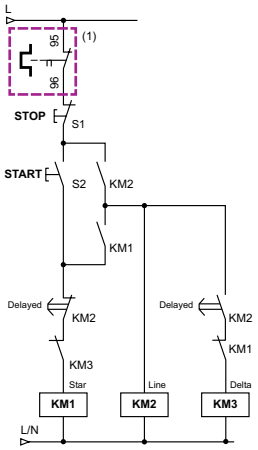
A• Direct-On-Line



Push button S2 instantaneously activates contactor KM1, which is then self-maintained. When activated, push-button S1 opens the line.

B• Star-Delta – Electrical interlocking

≤ 80 A



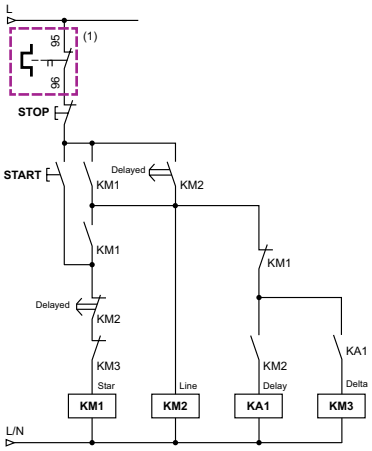
Push button S2 instantaneously activates contactor KM1 (Star contactor), which is self-maintained.

> KM1 activates KM2 (Line contactor), which is self-maintained, and locks KM3 (Delta contactor) open.

> KM2 activates the time delay.

> Once the time delay is over, KM1 is deactivated and KM3 (Delta contactor) is activated.

> 80 A



*(1) Thermal overload relay contact to be added for the **Adapted solution**.*

Same principle as beside, except KA1.

This relay provides a short extra delay before KM3 is closed, thereby avoiding the risk of short-circuit during Star-Delta transition.

Acti9 iC60, Multi9 for OEMs
Circuit breakers

TeSys Deca, Giga
GV Motor Motor circuit breakers

Harmony
Push buttons and switches

Spacial
Enclosures

Climasys
Enclosure thermal management (fans, heating elements, thermostats)

TeSys Vario
Switch disconnectors

Linergy DS
Distribution blocks

Linergy TR
Terminal blocks

Modicon
DC power supplies

Harmony
Relays

TeSys K, Deca, Giga
Contactors, relays, thermal overload relays

Altivar & Altistart
Variable speed drives and soft starters

Modicon M171/M172
Logic controllers

Acti 9 iEM3000
Energy meters

Harmony
HMI

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