



# Assembly Instructions

for Copeland Scroll™ compressors



# Safety Instructions for Copeland® brand compressors

Read these safety instructions thoroughly before installation. Failure to comply can result in personal injury. These instructions should be retained throughout the lifetime of the compressor.

Copeland® brand compressors are intended for installation in systems according to the EC Machines directive. They may be put to service only if they have been installed in these systems according to instructions and conform to the corresponding provisions of legislation.

## Safety statements

- Refrigerant compressors must be employed only for their intended use.
- Only qualified and authorized HVAC or refrigeration personnel are permitted to install, commission and maintain this equipment.
- Electrical connections must be made by qualified electrical personnel.
- All valid safety standards for connecting electrical and refrigeration equipment must be observed.



**Use personal safety equipment.** Safety goggles, gloves, protective clothing, safety boots and hard hats should be worn where necessary.

## General instructions



### WARNING

**Risk of collapse! Personal injuries!** Move compressors only with appropriate mechanical or handling equipment according to weight. Keep in the upright position. Stack pallets on top of each other when not exceeding 300 kg, max. 3 high for storage and 2 high for transport. Do not stack single boxes on top of each other. Keep the packaging dry at all times.

**Rapid release of pressurised gas! Personal injuries!** Compressors are factory charged with pressurised dry air to between 1.35 and 1.5 bar to ensure no ingress of air or moisture during transit. Pressure must be safely reduced prior to fully opening connections or removing blanking components.

**System breakdown! Personal injuries!** Systems without a full charge or with the service valves closed should be electrically locked/tagged if left unattended. Only approved refrigerants and refrigeration oils must be used.

**High pressure! Injury to skin and eyes possible!** Be careful when opening connections on a pressurized item.

**High pressure! Personal injuries!** Use of safety relief valves according to EN 378 is mandatory. Consider personal safety requirements and refer to test pressures prior to test.



### WARNING

**Conductor cables! Electrical shock!** Shut off the power supply and remove all of the fuses before working on the electrics.



### WARNING

**Diesel effect! Compressor destruction!** The mixture of air and oil at high temperature can lead to an explosion. Avoid operating with air.

**System explosion! Personal injuries!** Do not use other industrial gases.

**Explosive flame! Burning!** Oil-refrigerant mixtures are highly flammable. Remove all refrigerant before opening the system. Avoid working with an unshielded flame in a refrigerant charged system.



### WARNING

**High surface temperature! Burning!** Do not touch the compressor or pipe-work until it has cooled down. Ensure that other materials in the area of the compressor do not get in touch with it.

**Low surface temperatures! Frostbite!** Do not touch any surface or pipe-work of the compressor until they are at room temperature.

# Assembly Instructions for Copeland Scroll™ compressors

These Assembly Instructions deal with all single Copeland Scroll™ compressors. These instructions are intended to enable users to ensure the safe installation, starting, operation and maintenance of Copeland Scroll™ compressors. They are not intended to replace the system expertise available from system manufacturers.

## 1 Product description

### 1.1 Qualified refrigerants and oils

Models	Refrigerants	Copeland® Brand Standard oils	Servicing oils
ZP, ZPD	R410A	Emkarate RL32 3MAF	Emkarate RL32 3MAF
ZR, ZH	R407C, R134a		Emkarate RL32 3MAF Mobil Arctic 22CC
ZRD, ZH...KVE	R407C		
ZB, ZS, ZF	R404A, R507, R407A/C/F, R134a		
ZBD, ZFD	R404A, R407F		
ZO, ZOD	R744	Emkarate RL68 HB	Emkarate RL68 HB

Table 1: Qualified refrigerants and oils

### 1.2 Application limits

For the application envelopes please refer to Copeland® Brand Products Selection Software on [www.emersonclimate.eu](http://www.emersonclimate.eu).

## 2 Installation

### 2.1 Compressor handling

#### 2.1.1 Transport and storage



#### WARNING

**Risk of collapse! Personal injuries!** Move compressors only with appropriate mechanical or handling equipment according to weight. Keep in the upright position. Stack pallets on top of each other when not exceeding 300 kg. Do not stack single boxes on top of each other. Keep the packaging dry at all times.

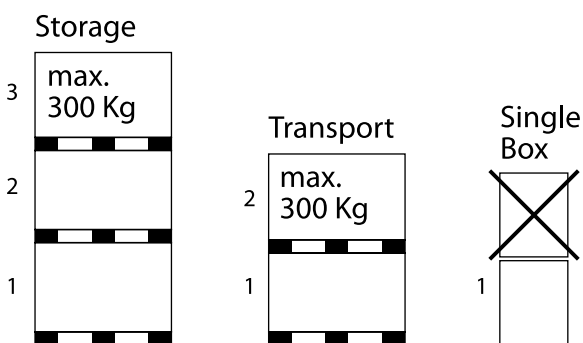
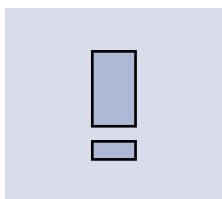


Figure 1

#### 2.1.2 Positioning and securing



#### IMPORTANT

**Handling damage! Compressor malfunction!** Only use the lifting eyes whenever the compressor requires positioning. Using discharge or suction connections for lifting may cause damage or leaks.

If possible, the compressor should be kept vertical during handling. The discharge connection plug should be removed first before pulling the suction connection plug to allow the dry air pressure inside the compressor to escape. Pulling the plugs in this sequence prevents oil mist from coating the suction tube making brazing difficult. The copper-coated steel suction tube should be cleaned before brazing. No object, eg, a swaging tool should be inserted deeper than 51 mm into the suction tube or it might damage the suction screen and motor.

### 2.1.3 Installation location

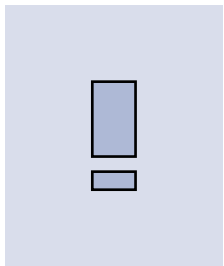
Ensure the compressors are installed on a solid level base.

### 2.1.4 Mounting parts

Four vibration absorber grommets are usually supplied with each compressor. They dampen the start-up surge of the compressor and minimise sound and vibration transmission to the compressor base during operation. The metal sleeve inside is a guide designed to hold the grommet in place. It is not designed as a load-bearing member, and application of excessive torque to the bolts can crush the sleeve. Its inner diameter is approximately 8.5 mm to fit, eg, an M8 screw. The mounting torque should be  $13 \pm 1$  Nm. It is critically important that the grommet is not compressed.

**NOTE: For information about the mounting parts, please refer to Technical Information C7.11.2 “Scroll Mounting Parts” available on [www.emersonclimate.eu](http://www.emersonclimate.eu).**

## 2.2 Brazing procedure



### IMPORTANT

**Blockage! Compressor breakdown!** Maintain a flow of oxygen-free nitrogen through the system at very low pressure during brazing. Nitrogen displaces the air and prevents the formation of copper oxides in the system. If allowed to form, the copper oxide material can later be swept through the system and block screens such as those protecting capillary tubes, thermal expansion valves, and accumulator oil return holes.

**Contamination or moisture! Bearing failure!** Do not remove the plugs until the compressor is set into the unit. This minimises any entry of contaminants and moisture.

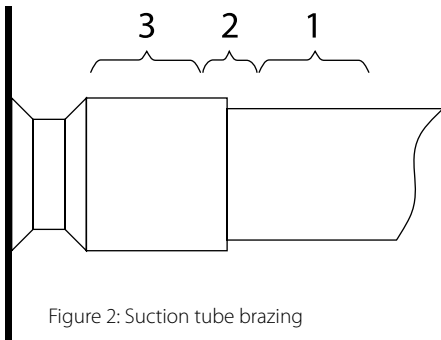


Figure 2: Suction tube brazing

Copeland Scroll™ compressors have copper-plated steel suction and discharge tubes. These tubes are far more robust and less prone to leaks than copper tubes. Due to the different thermal properties of steel and copper, brazing procedures may have to be changed from those commonly used.

**Figure 2** shows the proper procedures for brazing the suction and discharge lines to a Scroll compressor.

- The copper-coated steel tubes on Scroll compressors can be brazed in approximately the same manner as any copper tube. Recommended brazing materials: any silfos material is recommended, preferably with a minimum of 5% silver. However, 0% silver is acceptable.
- Be sure tube fitting inner diameter and tube outer diameter are clean prior to assembly.
- Using a double-tipped torch, apply heat in area 1.
- As the tube approaches brazing temperature, move the torch flame to area 2.
- Heat area 2 until braze temperature is attained, moving the torch up and down and rotating around the tube as necessary to heat the tube evenly. Add braze material to the joint while moving the torch around the joint to flow braze material around the circumference.
- After the braze material flows around the joint, move the torch to heat area 3. This will draw the braze material down into the joint.
- The time spent heating area 3 should be minimal. As with any brazed joint, overheating may be detrimental to the final result.

### To disconnect:

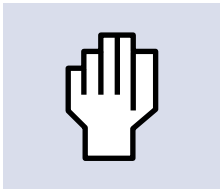
- Heat joint areas 2 and 3 slowly and uniformly until the braze material softens and the tube can be pulled out of the fitting.

### To reconnect:

- Recommended brazing materials: Silfos with minimum 5% silver or silver braze used on other compressors. Due to the different thermal properties of steel and copper, brazing procedures may have to be changed from those commonly used.

**NOTE: Since the discharge stub contains a check valve, care must be taken not to overheat it to prevent brazing material to flow into it.**

## 2.3 Shut-off valves and adaptors



### CAUTION

**Leaking system! System breakdown!** It is strongly recommended to periodically re-torque all pipe and fixing connections to the original setting after the system has been put into operation.

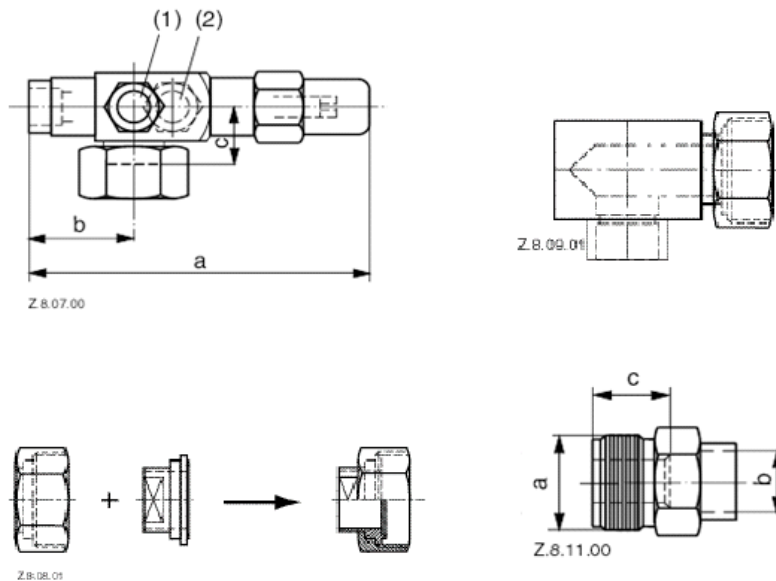


Figure 3

Copeland Scroll™ compressors are delivered with brazing or Rotalock connections. There are options to fit either Rotalock valves, Rotalock adaptors or just make brazing connections.

	Torque [Nm]
Rotalock 3/4"-16UNF	40-50
Rotalock 1"-14UNF	70-80
Rotalock 1 1/4"-12UNF	110-135
Rotalock 1 3/4"-12UNF	135-160
Rotalock 2 1/4"-12UNF	165-190

Table 2

**NOTE: More information concerning adaptors and shut-off valves can be found in the "Spare parts list".**

## 3 Electrical connection

### 3.1 General recommendations

The compressor terminal box has a wiring diagram on the inside of its cover. Before connecting the compressor, ensure the supply voltage, the phases and the frequency match the nameplate data.

### 3.2 Electrical installation

Recommended wiring diagrams (power circuit and control circuit) are shown on pages 11 and 12.

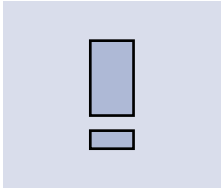
**NOTE: For AC and HP applications, we recommend using a K2 contactor for the safety chain in order to comply with EN 60335.**

	Single-phase PF*	Three-phase TF*	Three-phase TW*	
			with INT69SC2	with INT69SCY2
<b>Power circuit</b>	Figure 5	Figure 6	Figure 7	Figure 7
<b>Control circuit</b>	Figures 9/10		Figure 11	Figure 12

Table 3

Single-phase compressors are connected to the Common (C), Start (S) and Run (R) connections. Three-phase compressors are connected to the T1, T2 and T3 connections (see **Figure 8**).

### 3.3 Crankcase heater



**IMPORTANT**

**Oil dilution! Bearing malfunction!** Turn the crankcase heater on 12 hours before starting the compressor.

A crankcase heater is used to prevent refrigerant migrating into the shell during standstill periods. Due to the Copeland scroll's inherent ability to handle liquid refrigerant in flooded conditions a crankcase heater is not required when the system charge does not exceed the charge limits shown in **Table 4**.

A crankcase heater is always required with **ZO compressors**.

Model				Refrigerant Charge Limit
Medium Temperature	Low Temperature	A/C	Heat Pump	
		ZR18K*		2.7 kg
ZB15K* to ZB26K* ZS21K* to ZS26K*	ZF06K* to ZF11K*		ZH15K* to ZH26K* ZH09KVE	3.6 kg
ZB30K* to ZB45K* ZS30K* to ZS45K*	ZF13K* & ZF18K*	ZR22K* to ZR81K* ZP24K* to ZP83K*	ZH30K* to ZH45K* ZH13KVE to ZH18KVE	4.5 kg
		ZR94K* to ZR190K* ZP24K* to ZP91K*		7.0 kg
ZB56K* to ZB11M* ZB50K* to ZB114K* ZS56K* to ZS11M*	ZF24K* to ZF48K*		ZH56K* to ZH11M* ZH24KVE to ZH48KVE	7.5 kg
ZB220K*		ZR250K* & ZP235K*		11.3 kg
		ZR310K* to ZR380K* ZP295K* to ZP385K*		13.6 kg
		ZP485K*		16.0 kg

Table 4

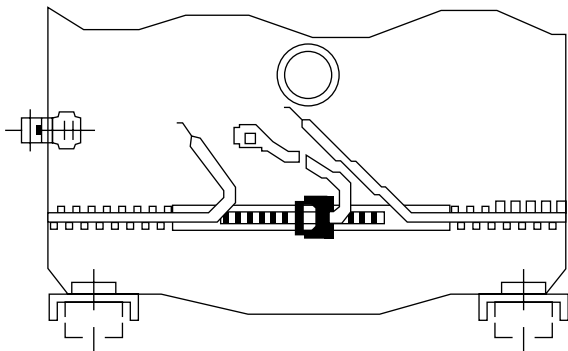


Figure 4

If a crankcase heater is fitted it is recommended that the heater be turned on for a minimum of **12 hours** prior to starting the compressor. This will prevent oil dilution and bearing stress on initial start up. The crankcase heater must remain energised during compressor off cycles.

The crankcase heater must be mounted below the oil schraeder valve located on the bottom shell.

### 3.4 Pressure safety controls

High-pressure and low-pressure cut-outs with a manual reset feature for the highest level of system protection are recommended. Required setting points are given in **Table 5** below:

	HP bar(g)	LP bar(g)
<b>ZB, ZBD</b>	28	2.6
<b>ZS</b>		
<b>ZF</b>		0.3 (R404A), 0.0 (R22), 1.5 (R134a)
<b>ZFD</b>		0.3 (R404A)
<b>ZH</b>		0.5 (R407C), 0.0 (R134a)
<b>ZR</b>	28.8	2 - 0.5* (R407C), 2.3 (R134a), 2.8 (R22)
<b>ZRD</b>		2 - 0.5*
<b>ZP, ZPD</b>	43	4.4 - 2*
<b>ZO, ZOD</b>		5.8

\* Recommendation for use in heat pump system

Table 5

### 3.5 Motor protection

The motor protection system is identified by the centre letter in the motor code:

- **“F”** for conventional inherent internal line break motor protection
- **“W”** for electronic motor protection system.

### 3.6 Discharge temperature protection

Internal discharge temperatures reached under some extreme operating conditions (such as loss of refrigerant injection charge or extremely high compression ratio) could cause compressor damage.

**Table 6** hereunder describes the various discharge temperature protection devices available on Scroll compressors.

Additional information about discharge temperature protection is available in the Application Guidelines.

	ZR	ZP	ZB	ZF	ZS	ZH	ZO
<b>Internal thermo-protection “Klixon”</b>	ZR18K* to ZR81K*	ZP24K* to ZP83K*	ZB15K* to ZB45K*				
<b>Internal thermo-protection “ASTP”</b>	ZR94K* to ZR190K*	ZP90K* to ZP182K*	ZB50K* to ZB114K*				
<b>Internal thermistor + Electronic module</b>	Only motor version TW..						
<b>External Thermostat</b>	ZRD / ZRH	ZPD	ZBD / ZBH	Only TF.. or PF..			All
<b>NTC Sensor</b>	ZRD	ZPD	ZBD	ZFD			All

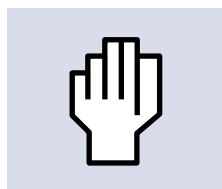
Table 6: Discharge temperature protection devices

### 3.7 High-potential testing



#### WARNING

**Conductor cables! Electrical shock!** Shut off power supply before highpotential testing.



#### CAUTION

**Internal arcing! Motor destruction!** Do not carry out high-voltage or insulation tests if the compressor housing is under vacuum.

Emerson Climate Technologies subjects all Scroll compressors to a high-voltage test after final assembly. Each motor phase winding is tested, according to EN 0530 or VDE 0530 part 1, at a differential voltage of 1000V plus twice the nominal voltage. Since high-voltage tests lead to premature ageing of the winding insulation further additional tests of that nature are not recommended.

If it has to be done for any reason, a lower voltage must be used. Disconnect all electronic devices, eg, motor protection module, fan speed control, etc prior to testing.

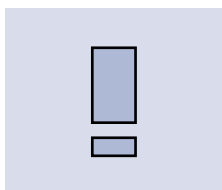
## 4 Starting up & operation

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### WARNING

**Diesel effect! Compressor destruction!** The mixture of air and oil at high temperature can lead to an explosion. Avoid operating with air.



### IMPORTANT

**Oil dilution! Bearing malfunction!** Turn the crankcase heater on 12 hours before starting the compressor.

### 4.1 Strength pressure test

The compressor has been strength-tested in the factory. It is not necessary for the customer to strength- or leak-test the compressor again although the compressor will normally be exposed to the testing made as part of system testing.

### 4.2 Tightness/pressure test



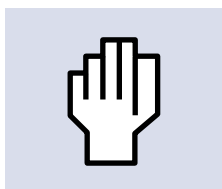
### WARNING

**High pressure! Personal injuries!** Consider personal safety requirements and refer to test pressures prior to test.



### WARNING

**System explosion! Personal injuries!** DO NOT USE other industrial gases.



### CAUTION

**System contamination! Bearing malfunction!** Use only dry nitrogen or dried air for pressure testing.

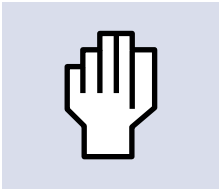
If using dry air do not include the compressor in the pressure test – isolate it first. Never add refrigerant to the test gas (as leak indicator).

### 4.3 System evacuation

Before the installation is put into commission, it has to be evacuated with a vacuum pump. Proper evacuation reduces residual moisture to 50 ppm. During the initial procedure, suction and discharge shut-off valves on the compressor remain closed. The installation of adequately sized access valves at the furthest point from the compressor in the suction and liquid lines is advisable.



#### 4.4 Charging procedure



##### CAUTION

**Low suction pressure operation! Compressor damage!** Do not operate with a restricted suction. Do not operate with the low-pressure cut-out bridged. Do not operate compressor without enough system charge to maintain at least 0.5 bar suction pressure. Allowing pressure to drop below 0.5 bar for more than a few seconds may overheat scrolls and cause early drive bearing damage.

The system should be liquid-charged through the liquid-receiver shut-off valve or through a valve in the liquid line. The use of a filter drier in the charging line is highly recommended. Because scrolls have discharge check valves, systems should be liquid-charged on both the high and low sides simultaneously to ensure a positive refrigerant pressure is present in the compressor before it runs. The majority of the charge should be placed in the high side of the system to prevent bearing washout during first-time start on the assembly line.

#### 4.5 Preliminary checks – Pre-starting

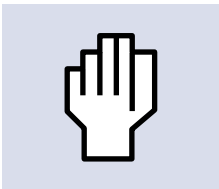
Discuss details of the installation with the installer. If possible, obtain drawings, wiring diagrams, etc. It is ideal to use a check-list but always check the following:

- Visual check of the electrics, wiring, fuses etc
- Visual check of the plant for leaks, loose fittings such as TXV bulbs etc
- Compressor oil level
- Calibration of HP & LP switches and any pressure actuated valves
- Check setting and operation of all safety features and protection devices
- All valves in the correct running position
- Pressure and compound gauges fitted
- Correctly charged with refrigerant
- Compressor electrical isolator location & position

#### 4.6 Rotation direction

Scroll compressors, like several other types of compressors, will only compress in one rotational direction. Direction of rotation is not an issue with single-phase compressors since they will always start and run in the proper direction. Three-phase compressors will rotate in either direction depending upon phasing of the power to L1, L2 and L3. Since there is a 50/50 chance of connecting power in such a way as to cause rotation in the reverse direction, **it is important to include notices and instructions in appropriate locations on the equipment to ensure proper rotation direction is achieved when the system is installed and operated.**

#### 4.7 Deep vacuum operation



##### CAUTION

**Vacuum operation! Compressor damage!** Copeland Scroll™ compressors should never be used to evacuate a refrigeration or air-conditioning system.

The Scroll compressor can be used to pump down refrigerant in a unit as long as the pressures remain within the operating envelope. Low suction pressures will result in overheating of the scrolls and permanent damage to the compressor drive bearing. Scroll compressors incorporate internal low vacuum protection; the floating seal unloads when the pressure ratio exceeds approximately 20:1 for ZS and ZF and 10:1 for ZB, ZH, ZO, ZP and ZR.

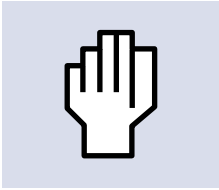
## 5 Maintenance & repair

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### 5.1 Rotalock valves

Rotalock valves should be periodically re-torqued to ensure that leak prevention tightness is maintained.

### 5.2 Replacing a compressor



#### CAUTION

**Inadequate lubrication! Bearing destruction!** Exchange the accumulator after replacing a compressor with a burned out motor. The accumulator oil return orifice or screen may be plugged with debris or may become plugged. This will result in starvation of oil to the new compressor and a second failure.

### 5.3 Unbrazing system components



#### WARNING

**Explosive flame! Burning!** Oil-refrigerant mixtures are highly flammable. Remove all refrigerant before opening the system. Avoid working with an unshielded flame in a refrigerant charged system.

## 6 Dismantling & disposal

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Removing oil and refrigerant:

- Do not disperse in the environment.
- Use the correct equipment and method of removal.
- Dispose of oil and refrigerant properly.
- Dispose of compressor properly.

## 7 Wiring diagrams

### 7.1 Wiring diagram legend

B1 ..... Room thermostat  
 B3 ..... Discharge gas thermostat  
 C2 ..... Run capacitor  
 F1, F6 ... Fuses  
 F3 ..... HP switch  
 F4 ..... LP switch  
 K1 ..... Contactor

K2..... Recommended contactor compliant w/ EN 60335 AC/HP  
 K35 .... Current relay (if needed)  
 Q1 .... Main switch  
 R2 ..... Crankcase heater  
 S1..... Auxiliary switch  
 Y5..... Solenoid valve for injection (if available)

### 7.2 Wiring diagrams

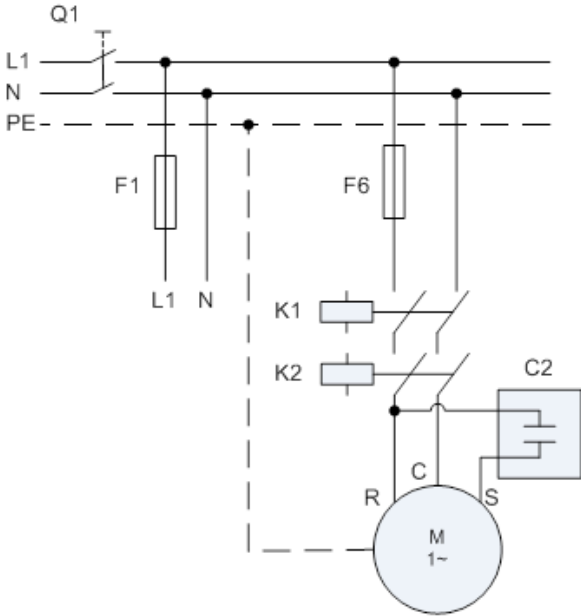


Figure 5

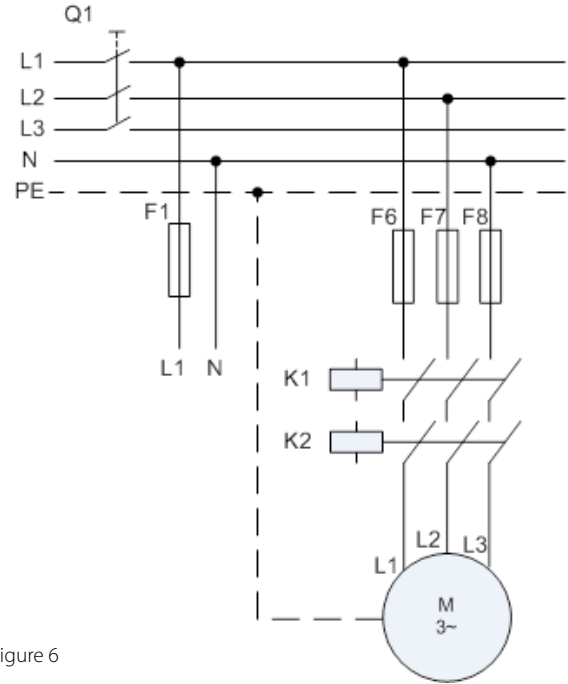


Figure 6

### TW\* - INT69SCY2

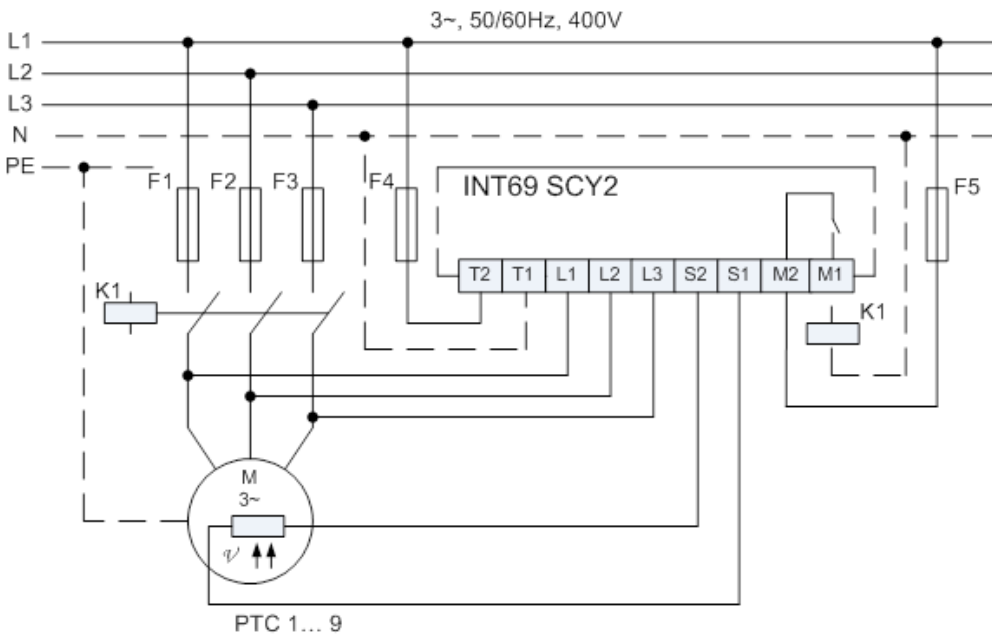


Figure 7

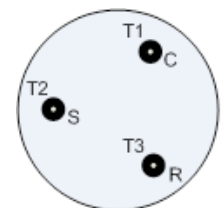


Figure 8

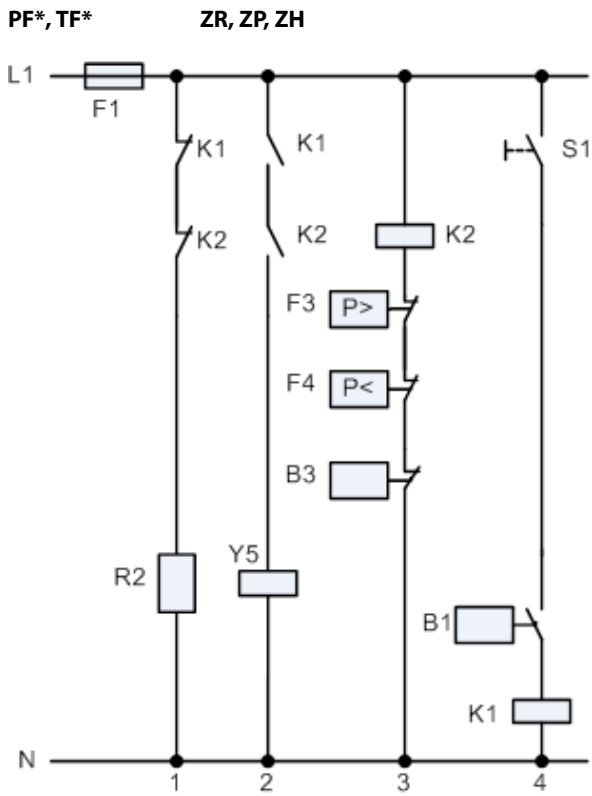


Figure 9

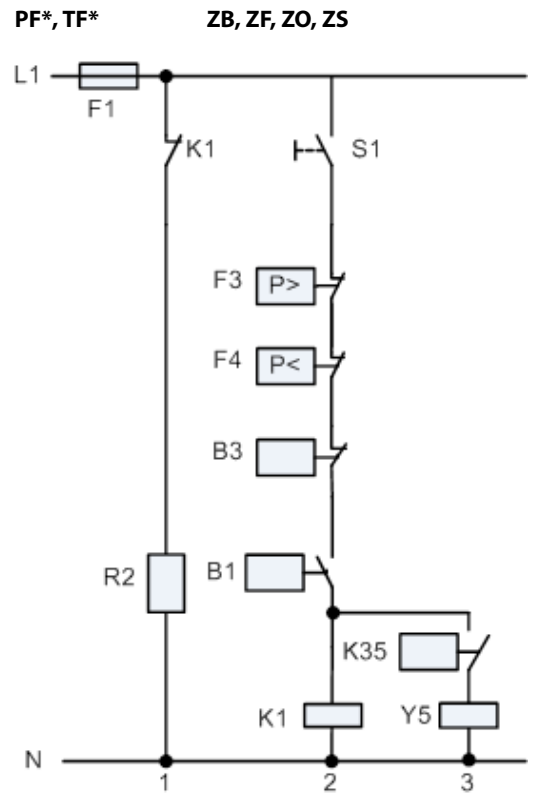


Figure 10

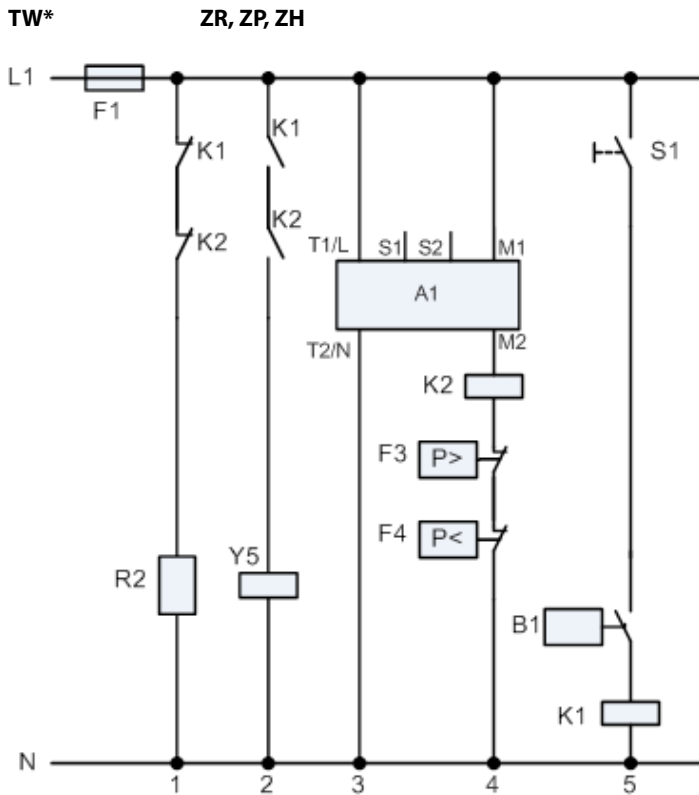


Figure 11

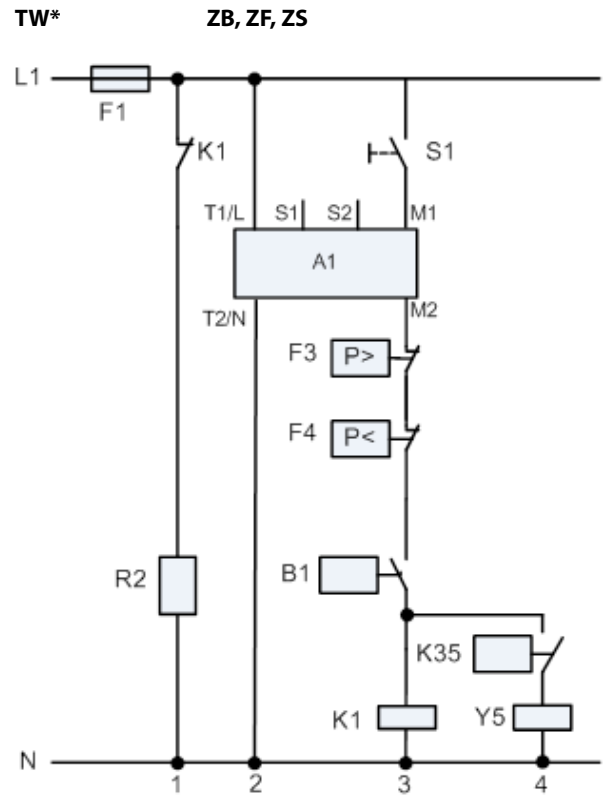


Figure 12