

## DWM COPELAND SEMI-HERMETIC TWIN COMPRESSORS

### 1 Introduction

TWIN compressors provide distinctive advantages in high capacity plants, they are widely used with excellent results. Being of a compact design they offer uncomplicated installation. This method of parallel operation of two compressors reduces the potential for problems associated with oil and pressure equalisation lines used externally connected between crankcases.

Each compressor can be operated individually allowing capacity control with the maximum possible energy savings. To assist when there is a limitation on the starting current, each compressor can be started with a time delay between them if necessary in star-delta or part winding start.

Operational safety of the plant is available because the second compressor remains ready for use even if the first compressor is out of operation. For standby operation see the notes in the "Repair" section.

**Note:** An individual compressor can be used to replace a defective compressor.

**Note:** Copeland do not recommend the use of "Demand Cooling" with TWIN Discus compressors.

### 2 Design Features

TWIN compressors consist of two single compressors of the same designation, size etc. which are connected motor end to motor end joined by means of a suction manifold. The manifold forms a common suction chamber with one suction shut-off valve and suction filter. Within the manifold the crankcase pressure and the oil quantity will be equalised.

The TWIN compressors are mounted on two parallel "U" shaped rails. The compressor and frame are secured by using rubber shims to reduce stress, which may occur during the installation of the TWIN compressors. If the foundation base is light and if sound and vibration levels have to be reduced additional absorbers should be installed between the frame and foundations (installed on site).

Single-stage TWIN compressors are equipped with discharge shut-off valves on each compressor so that additional costs during installation compared with single compressors of the same capacity are kept to a minimum.

### 3 System Design

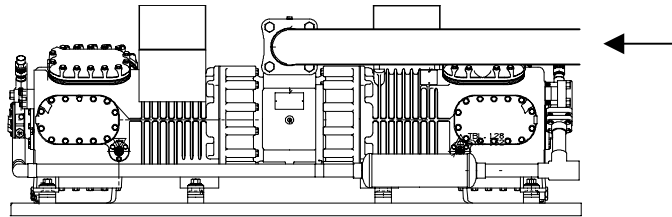
Both compressors in a TWIN configuration operate independently from each other. For each individual compressor all safety devices must be calibrated and effective, including the motor protection device, oil pressure safety and the HP pressure controls.

As with all systems pipelines, the lines must be sized considering a balance between the gas velocity high enough to entrain the oil and return it to the compressor and low pressure drop. When using full capacity control because of the reduced refrigerant velocity, double risers may be necessary to ensure oil return to the compressor. If the loads of several evaporators vary independently of each other it is recommended to lead individual suction lines to a single suction line header near the compressor in order to maintain sufficient gas velocity.

If an oil separator is used the oil return line should be connected to the suction chamber. For this purpose a threaded 1/8" – 27 NPTF connection is provided at crankshaft level. Alternatively the oil return can be connected into the main suction header / line near the compressor.

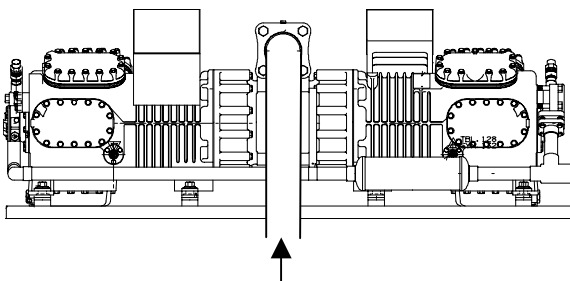
#### Suction Line Design:

Returning oil is only distributed equally to both compressors if it is distributed equally in the first place. From laboratory testing it was found that oil returning along a horizontal suction line passing through an elbow very close to the suction valve there is an unequal distribution of the returning oil. This method of suction line design should be avoided.

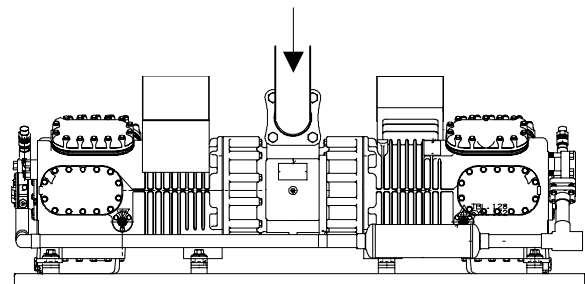


Horizontal Suction Line

This practice is only acceptable if the distance between the elbow and suction shut-off valve is longer than or equal to 1 metre. After 1 metre flow along a straight tube the oil distribution will be sufficiently equalised. If the elbows are mounted vertically we also get an **unequal** oil distribution after the elbows but this does not effect the oil distribution within the suction chamber of the TWIN compressor. These problems can be reduced with an external oil and gas equalisation line.



Recommended Suction Line



Suction Line acceptable under certain system design conditions

A rising vertical suction line into the suction service valve is highly recommended whereas a falling suction line may only be acceptable under certain system design conditions such as no liquid flood back, correct superheat setting etc.

The use of a sufficiently dimensioned replaceable core filter drier in the liquid line is recommended along with a very fine mesh, large dimensioned suction line filter during the initial start up.

If the ambient temperature surrounding the TWIN compressors is near to, or lower than the evaporator temperature and one of the compressors is switched off, there is a danger of a high refrigerant concentration in the oil. If under these conditions the crankcase heater is insufficient due to heat loss (low ambient temperature, strong winds) it is recommended that capacity control be by control devices as opposed to shutting down and starting up a single compressor. A pump down cycle can be used with both compressors.

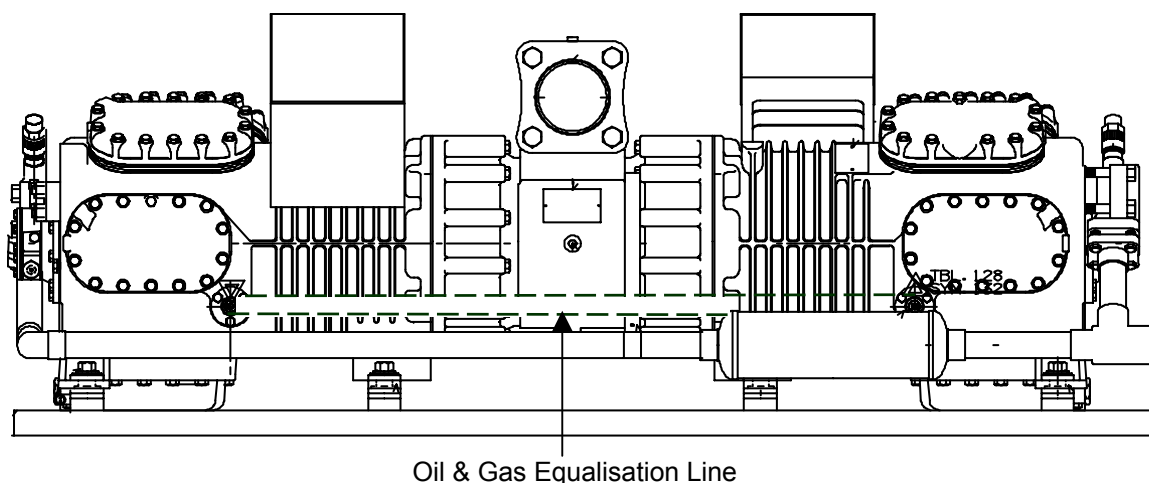
## 4 Operational Characteristics

It is normal for there to be a slight difference in oil level in both compressors with the TWIN combination. This can be influenced by various factors such as:

- Unequal oil throw of the two compressors caused by production tolerances, differences in wear and oil foaming.
- Changes in suction gas velocity because of capacity variations will influence the oil circulation and also the oil return.
- Oil being trapped from time to time in certain parts of the installation.

Because of these discrepancies an oil level at the bottom of the sight glass or even lower is not critical as long as the oil pressure failure switch is not cutting out. It can be remedied by adding a small quantity of oil and changing the rotational direction of one or both compressors.

If a single compressor is switched off a higher oil level can occur in the running compressor. Once both are switched off with a sufficient oil flow provided, oil equalisation will occur after a short time. The D88 has an external two-phase oil / gas equalisation line, that is factory fitted between compressor sight glasses on one side of the TWIN set. This leaves the sight glass on the other side free for checking the oil level. The correct oil level can be obtained only after the completion of refrigerant charging.



When using TWIN compressors in parallel it is recommended to use an oil management system so that each individual compressor receives the correct amount of oil via a common reservoir and a float switch installed at its sight glass. If the oil of one compressor is dirty the other compressor can be affected so it is recommended to install an oil filter in the oil supply line to each individual float control valve or directly behind the oil reservoir.

Generally the application of separately connected TWIN compressors is preferred to their parallel operation. This gives the advantage of an easier exchange of any defective compressor as well as the improved control on contamination, which could for example arise after many years of operation. Motor speeds in each of the compressors could differ, which occasionally leads to higher noise development in the discharge line. This phenomenon happens rarely and can be eliminated by installing mufflers in the discharge line. At times low frequency noises occur which increase and decrease in intensity, this is as a result of slight differences in motor speed it does not have a negative effect on compressor operation.

## 5 Repair

When a suction line filter is used dirty oil returning from the system is unlikely to cause damage to the compressor. If an individual compressor motor is damaged (such as burnt out) the other compressor will take over the operation and low gas and oil movement from the damaged compressor will occur. It is recommended that the damaged compressor be replaced as soon as possible. Polluted oil will enter the running compressor in small quantities. If the correct suction and liquid line filters are installed contamination will be effectively removed but part of the solution is to change the oil to reduce acid and contamination further.

Experience has shown the electronic protection modules used by DWM Copeland on their compressors have reduced the number of motor defects.

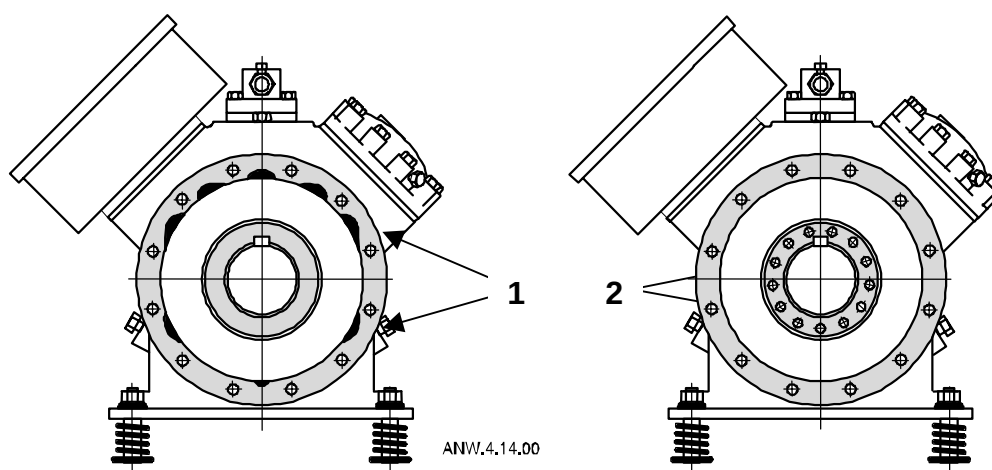
Prior to replacing a faulty compressor it is important the oil is removed and depending on the fault the system cleaned. After replacing the compressor a new dry oil filling is required and all filters renewed as with standard refrigeration practice.

#### **Limited Stand-By Control:**

One of the distinctive advantages of the TWIN unit is the capacity control. Since each compressor is operated individually the TWIN provides simple foolproof capacity reduction and the maximum power savings. In the mode of standby one compressor switches off to standby while the other remains running. Uncontrolled standby time of an individual compressor should be avoided. We recommend the use of a time switch to limit the standby time to 8 hours.

## **6 TWIN Compressors D44 – D88**

Compressors D4 and D6 are manufactured using by-pass bodies. The suction gas flows through passages around the stator (1) and not through holes in the rotor (2) as in the past, this reduces losses and thereby increases efficiency. The D8S has not been affected by these changes.



View of compressor motor after removal of suction chamber

### **6.1 New Suction Chamber**

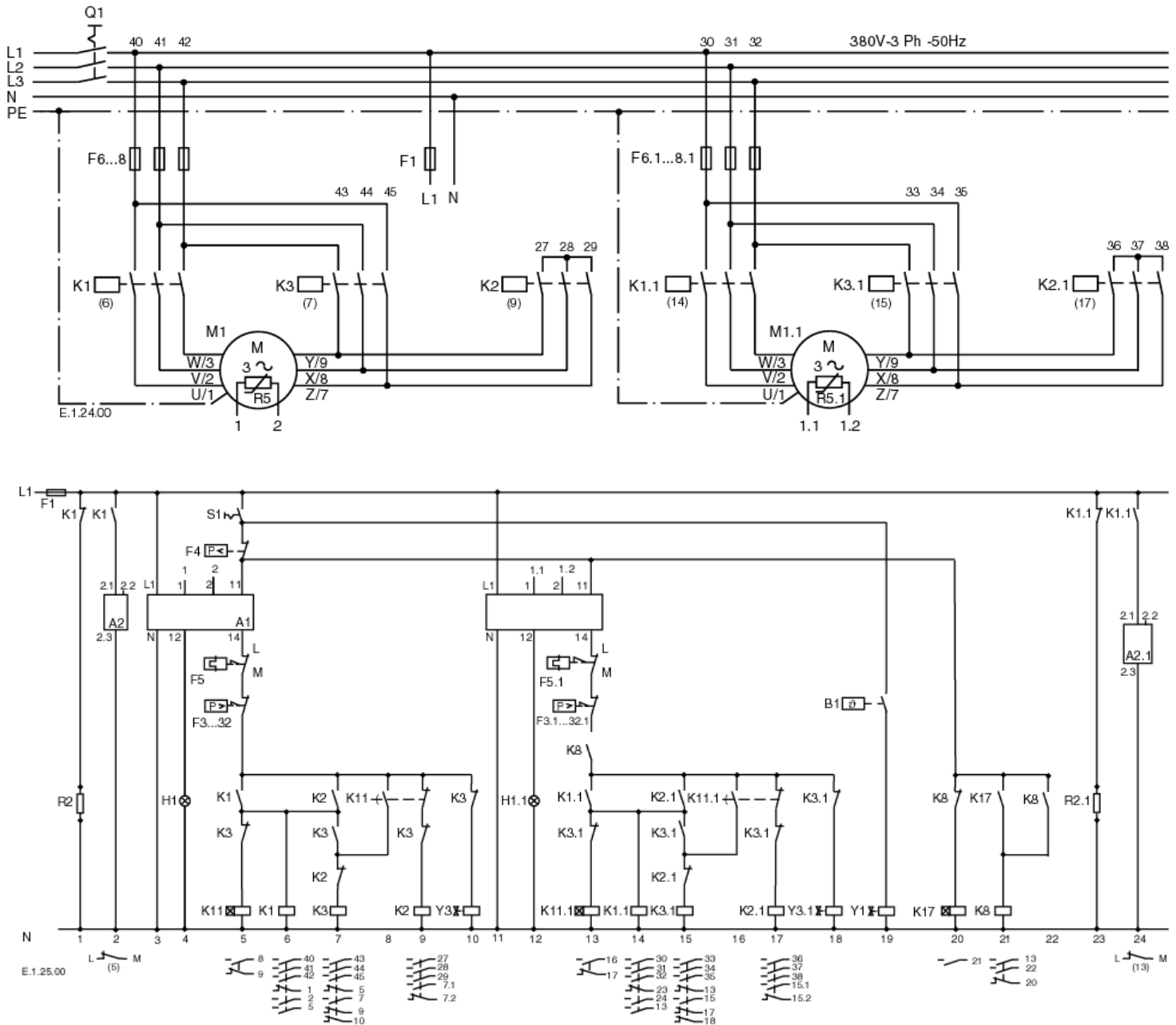
Due to the change in the motor cooling, a new suction chamber for D44S/D & D66S/D TWIN compressors is necessary. The new chamber has by-pass slots that the previous suction chamber does not have. Therefore it is not allowed to use the previous suction chamber with compressors with by-pass bodies. However compressors that still have the holes in the rotor can use the new suction chamber.

TWIN compressors with by-pass bodies require the new suction chamber that has by-pass slots. When replacing one compressor of a TWIN with the old suction chamber it is also necessary to replace the suction chamber for a new one.

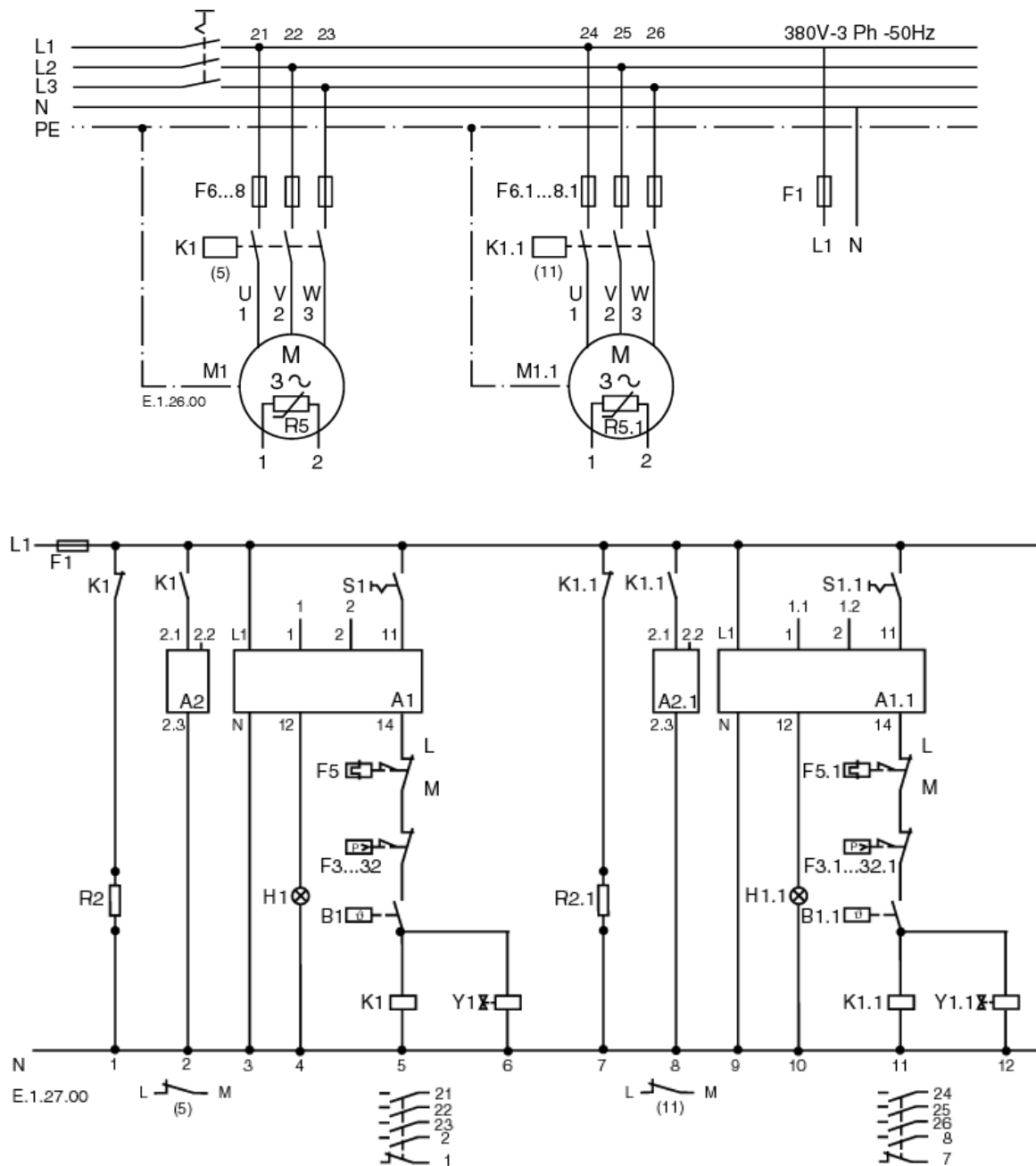
The following table will help to identify the old and new suction chamber castings. These numbers are not to be used for ordering spares.

| TWIN-Compressor  | TWIN-Compressor   | Old Casting No.    | New Casting No.    |
|------------------|-------------------|--------------------|--------------------|
| D44SF - 2000     | D44DF - 2000      | <b>019-0042-99</b> | <b>019-0050-99</b> |
| D44SF - 3000     | D44DH - 3000      |                    |                    |
| D44SA - 4000     | D44DA - 2000/4000 |                    |                    |
| D44SH - 5000     | D44DL - 3000      | <b>019-0004-99</b> | <b>019-0049-99</b> |
| D44SJ - 6000     | D44DH - 5000      |                    |                    |
| D66S . - . . . . | D44DJ - 4000/6000 |                    |                    |
| D66T . - . . . . | D66D* - . . . . . |                    |                    |

## 6.2 Schematic Diagram - TWIN compressors each with delayed start, Star-Delta start, unloaded start, pump-down cycle.



### 6.3 Schematic Diagram - TWIN compressor each with Direct-on-Line start, thermostat piloting.



## 6.4 WIRING DIAGRAMS – LEGEND

Selection of electrical connections according to mains voltage available and compressor nameplate specifications.

### Attention !

Compressor are protected by thermistors, connect thermistors only at terminals 1 and 2 of module A1. Do not connect mains voltage.

See diagram ! Maximum thermistor test voltage 3V. Cold resistance of thermistors <750Ω.

Fans are thermo-protected.

Direct On Line or Star-Delta Start (YΔ) - K2 and K3 only with Star-Delta Start (YΔ)

Direct On Line or Star (Y) Part Winding Start - K4 Only with Star (Y) Part Winding Start

Direct On Line(use bridges / jumpers)

### 6.4.1 Recommended Control Circuit

A1 = Electronic Module for M1  
A2 = Oil Differential Pressure Switch  
A3 = Capacitor and Relay Assembly  
A5 = Terminal Box Compressor  
A6 = Electronic Module DEMAND COOLING  
A7 = Terminal Box Condensing Unit  
B1 = Room Thermostat  
C1 = Run Capacitor M2  
C2 = Run Capacitor M1  
C3 = Start Capacitor M1  
F1 = Fuse for Control Circuit  
F3 = Pressure Control Switch  
F31 = Pressure Cut-Out  
F32 = Safety Pressure Cut-Out  
F10 = Thermal Protection Switch M2  
F11 = Overcurrent Thermal Protector  
F12 = Thermal Protection Switch M3  
H1 = Signal Lamp A1  
H2 = Signal Lamp A2  
H3 = Signal Lamp A6 DEMAND COOLING  
H4 = Signal Lamp F3 - Discharge pressure too high  
H5 = Signal Lamp F3 Suction pressure too low  
K1 = Contactor M1  
K2 = Y-Contactor M1  
K3 = Δ- Contactor M1  
K4 = Contactor M1 for second Part Winding  
K5 = Contactor M2  
K51 = Contactor M21  
K52 = Contactor M22  
K55 = Contactor M3  
K11 = Time Delay Relay 1.....3s for Y/Δ Start  
K12 = Time Delay 1s + 0.1 for Part Winding Start  
K14 = Time Delay for Unloaded Start  
M1 = Compressor Motor  
M2 = Fan Motor / Condenser  
M21= Fan Motor / Condenser  
M22= Fan Motor / Condenser  
M3 = Motor Cylinder Head Cooling  
N1 = Speed Control Fan  
Q1 = Main Switch  
R2 = Crankcase Heater

X1 = Terminal Block  
Y21 = Solenoid Valve Capacity Control 1  
Y22 = Solenoid Valve Capacity Control 2  
Y3 = Solenoid Valve Unloaded Start M1  
Y4 = Solenoid Valve for Inter-Stage Liquid Line  
Y5 = Solenoid Valve for Liquid Injection  
Y6 = Solenoid /Injection Valve DEMAND COOLING

#### Cable Colours:

White  
Grey  
Black  
Brown  
Blue  
Red  
Orange  
Green / Yellow

#### Applied Symbols e.g.

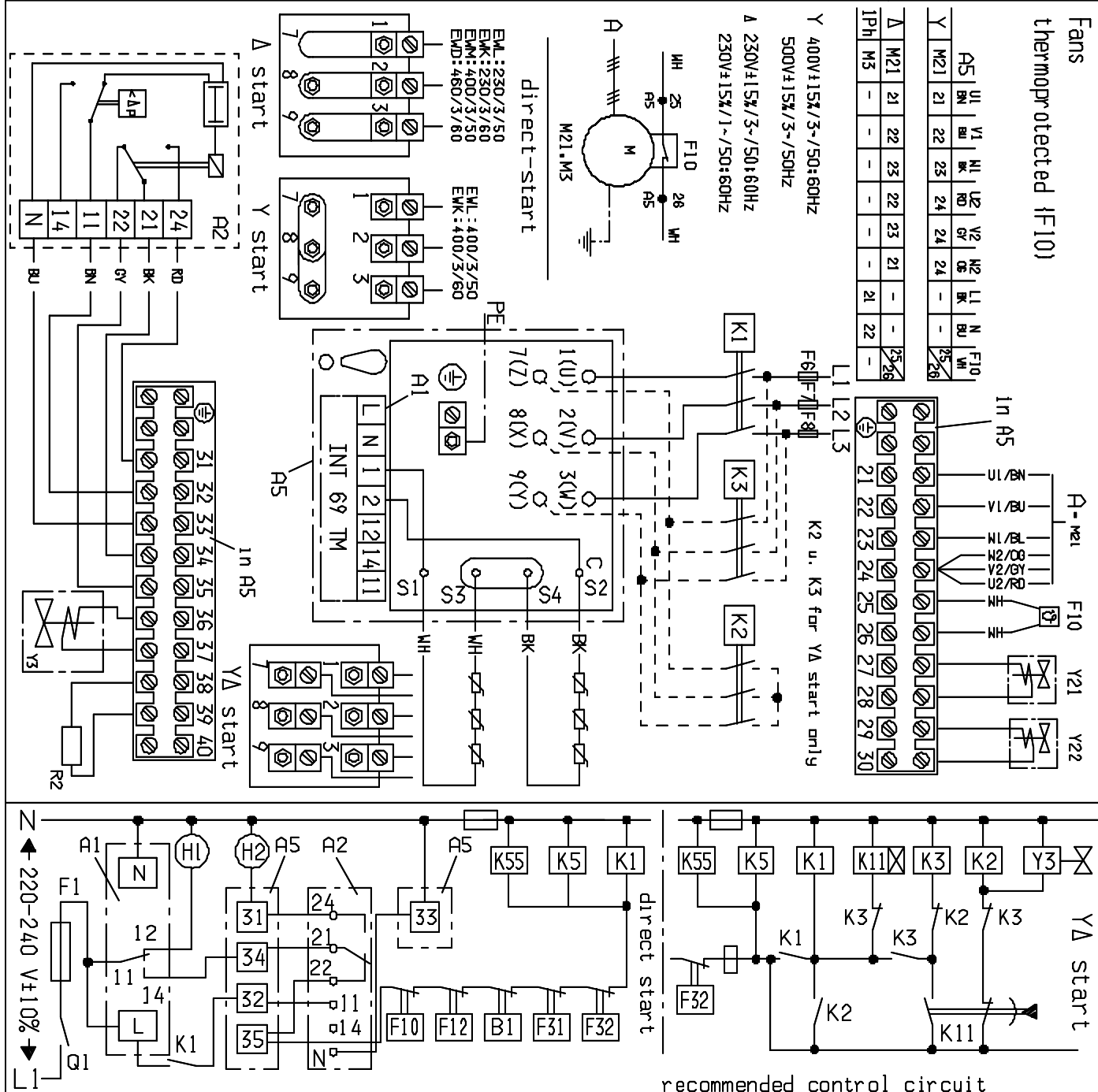
  = Contactor Coil K1  
  = Normally Open K1  
  = Normally Closed K2

D4. . , D6. . Compressor

Direct or YΔ start (EWL, EWM, EWD, EWK)

0700-2999351-2

See enclosure  
0700-2728744-2



## Attention

Compressor equipped with protection by thermistors  
Connect thermistors only at terminals 1+2 of module A1.

Do not apply mains voltage. See wiring diagram.

Max.thermistor test voltage 3V.

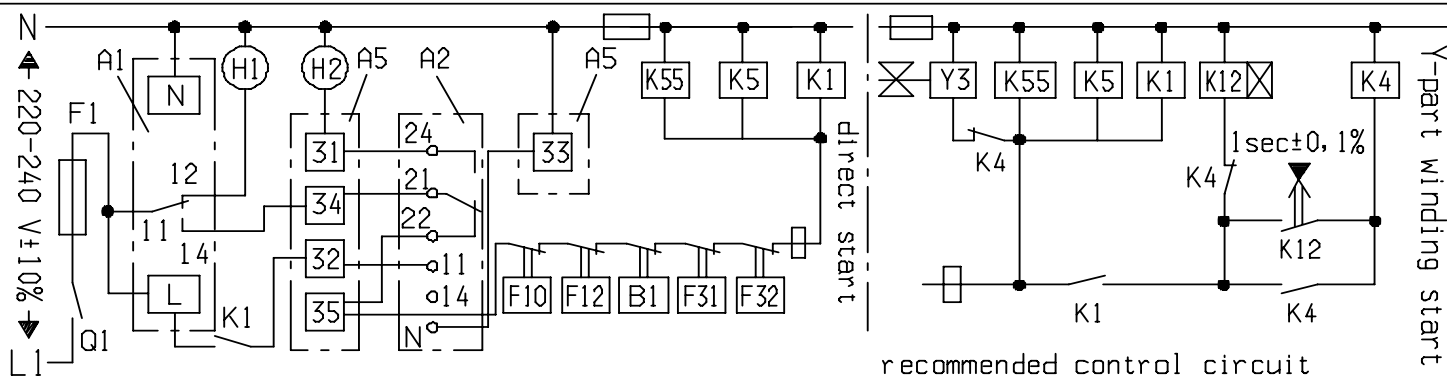
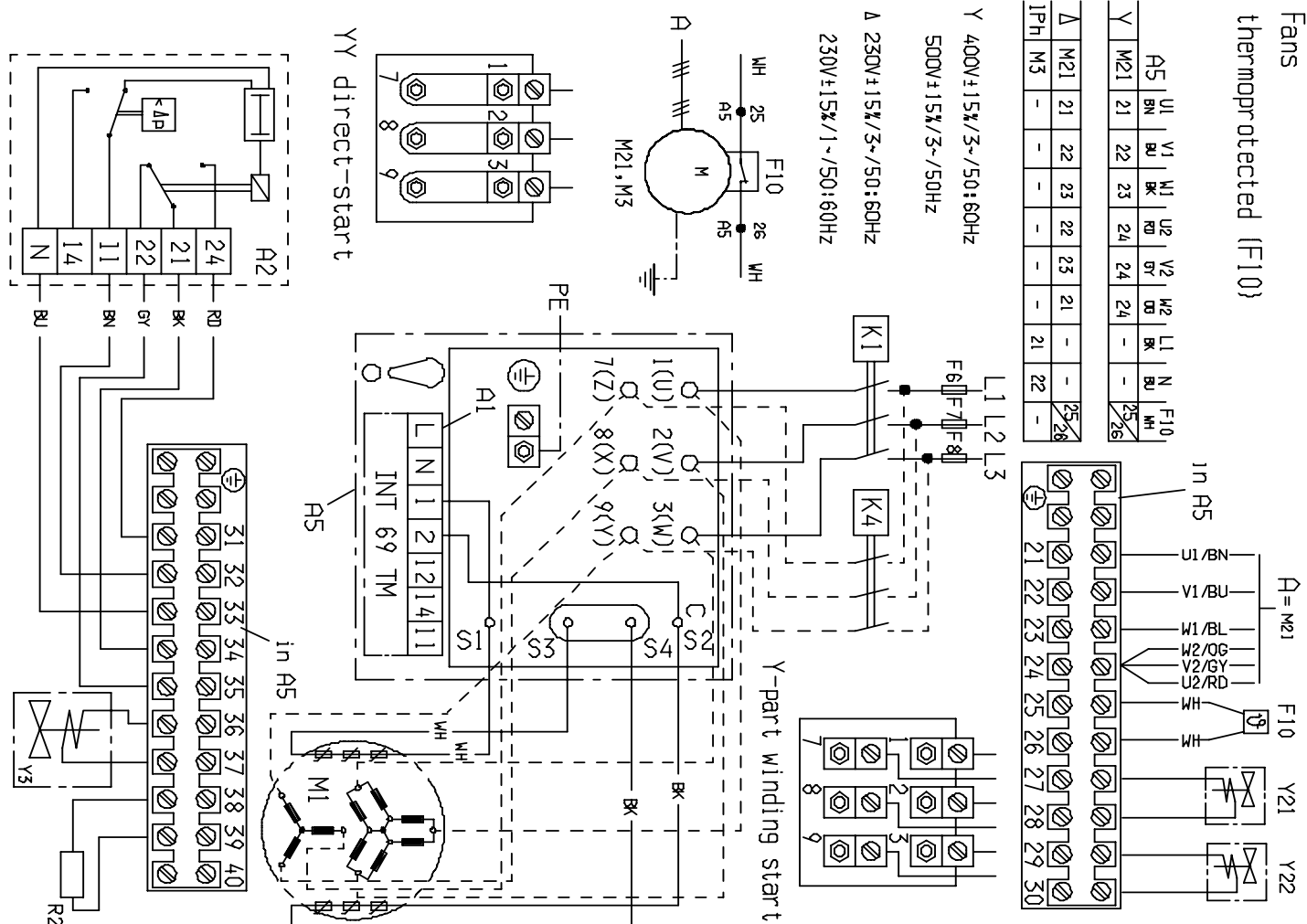
Cold resistance of thermistors  $\leq 750 \Omega$

# D4.., D6.. Compressor

Direct or Y-part winding start (AWM/D, AWR, AWY, AWC, AWX)

0700-2998869-2

See enclosure  
0700-2728744-2



## Attention



Compressor equipped with protection by thermistors  
Connect thermistors only at terminals 1+2 of module A1.

Do not apply mains voltage. See wiring diagram.

Max. thermistor test voltage 3V.

Cold resistance of thermistors  $\leq 750 \Omega$

# D8...Compressor

Direct or part winding start (BWM/D, BWR, BWY, BWX)

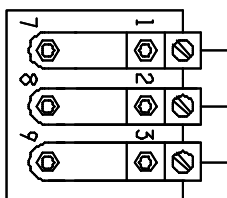
0700-2999373-2

See enclosure  
0700-2728744-2

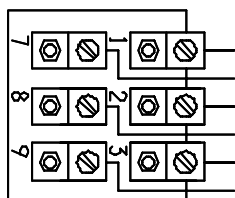
Fans  
thermoprotected (F10)

| Δ | U1  | U2 | U3 | U4 | U5 | U6 | U7 | U8 | U9 | U10 |
|---|-----|----|----|----|----|----|----|----|----|-----|
| Y | M21 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29  |
| Δ | M21 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29  |
| Δ | M21 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29  |

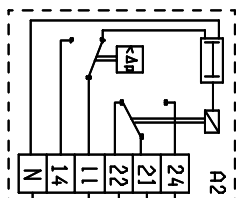
Y 400V±15%/3-/50/60Hz  
500V±15%/3-/50Hz  
Δ 230V±15%/3-/50/60Hz  
230V±15%/1-/50/60Hz



direct-start

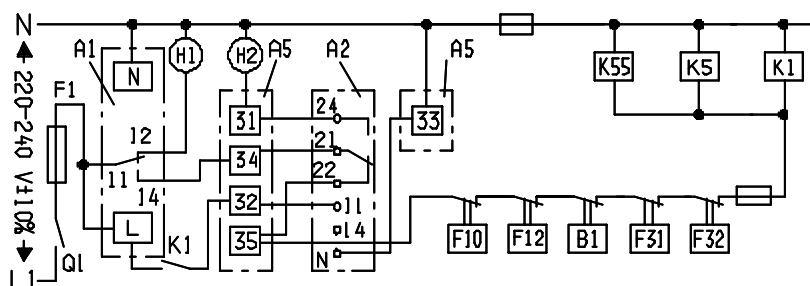
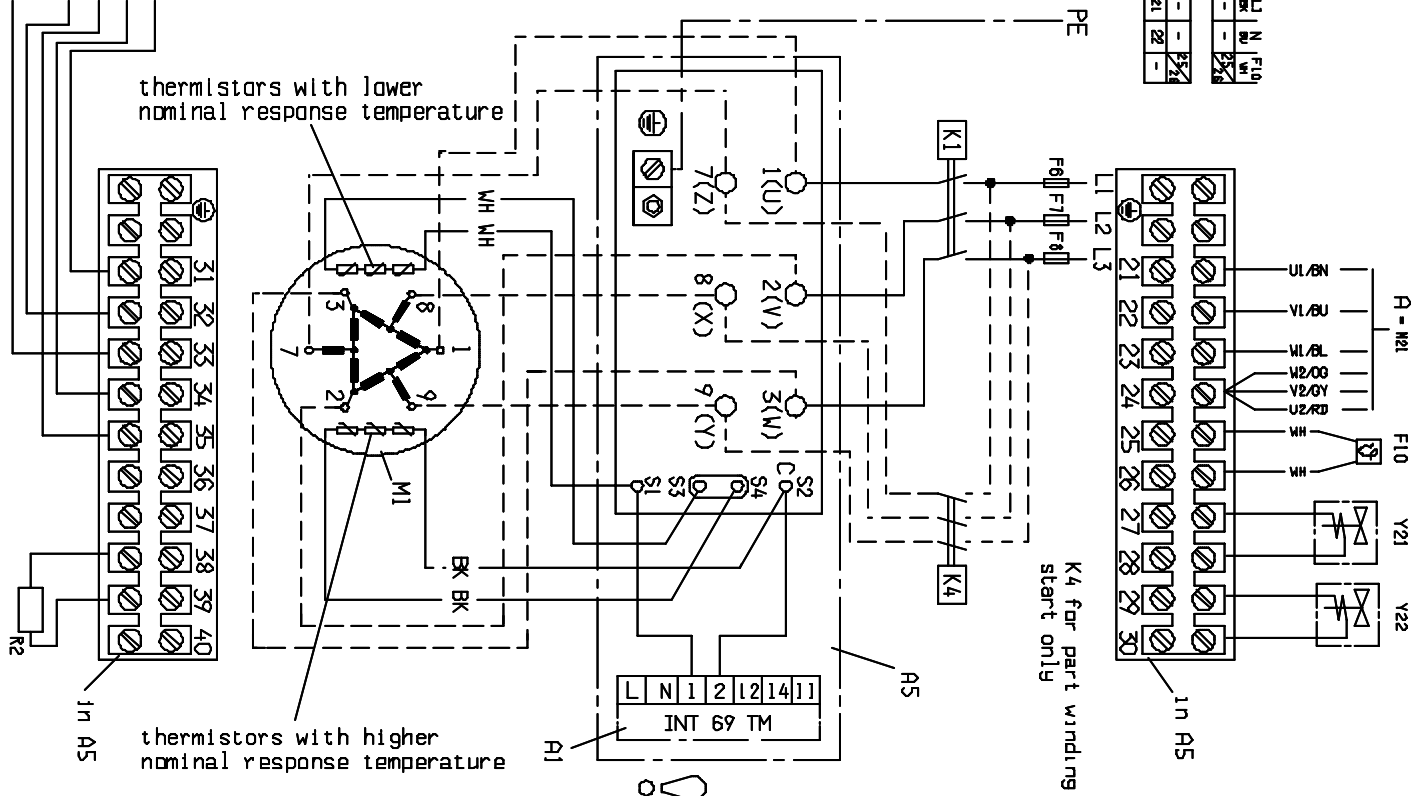


part winding start

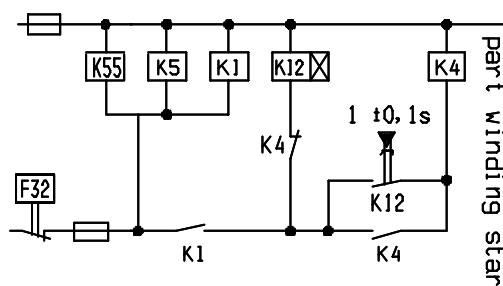


thermistors with lower  
nominal response temperature

thermistors with higher  
nominal response temperature



direct start



part winding start

recommended control circuit

## Attention



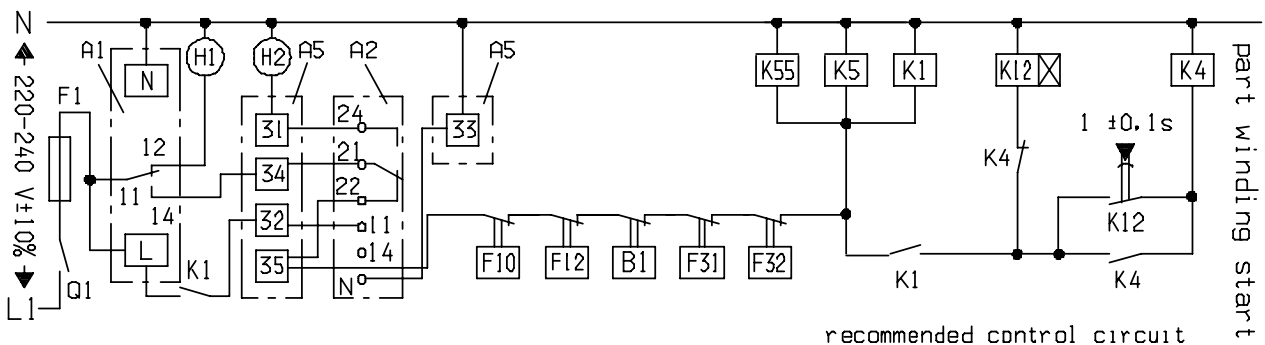
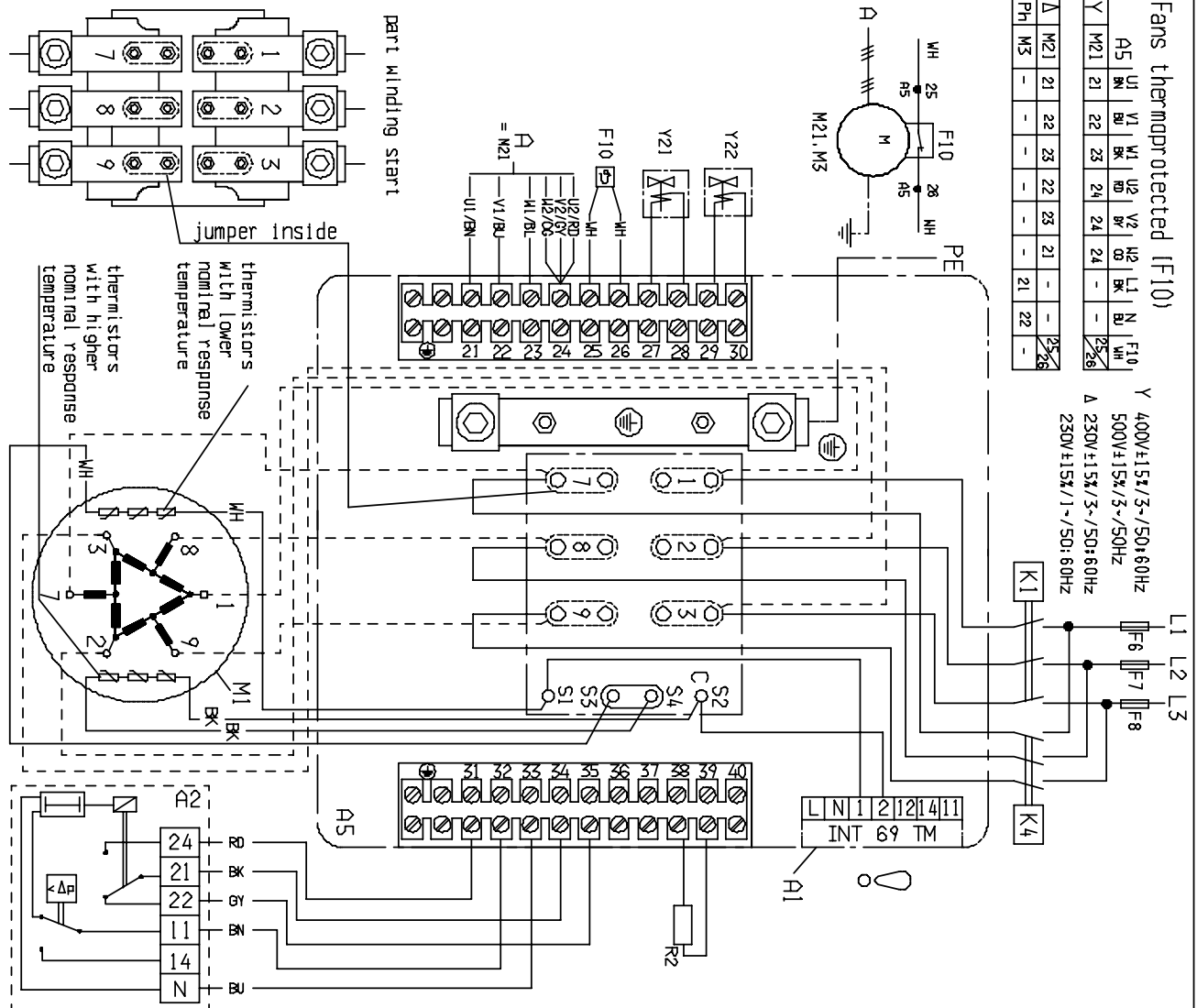
Compressor equipped with protection by thermistors  
Connect thermistors only at terminals 1+2 of module A1.  
Do not apply mains voltage. See wiring diagram.  
Max. thermistor test voltage 3V.  
Cold resistance of thermistors < 750 Ω

D8... Compressor  
part winding start BWC

0700-29999384-2

See enclosure

0700-2728744-2



Attention



Compressor equipped with protection by thermistors  
Connect thermistors only at terminals 1+2 of module A1.  
Do not apply mains voltage. See wiring diagram.  
Max. thermistor test voltage 3V.  
Cold resistance of thermistors  $\leq 750 \Omega$