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Supply Module
TVM 2.4

Applications Manual

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Indramat

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The purpose of this document In this document you will find:
- the applications,
- the electrical lay-out,
- the mechanical lay-out of the control cabinet,
- assembly and installation guidelines,
- guidelines for selecting optional components and,
- fault clearance guidelines.

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1. Installing INDRAMAT'S modular AC drive system

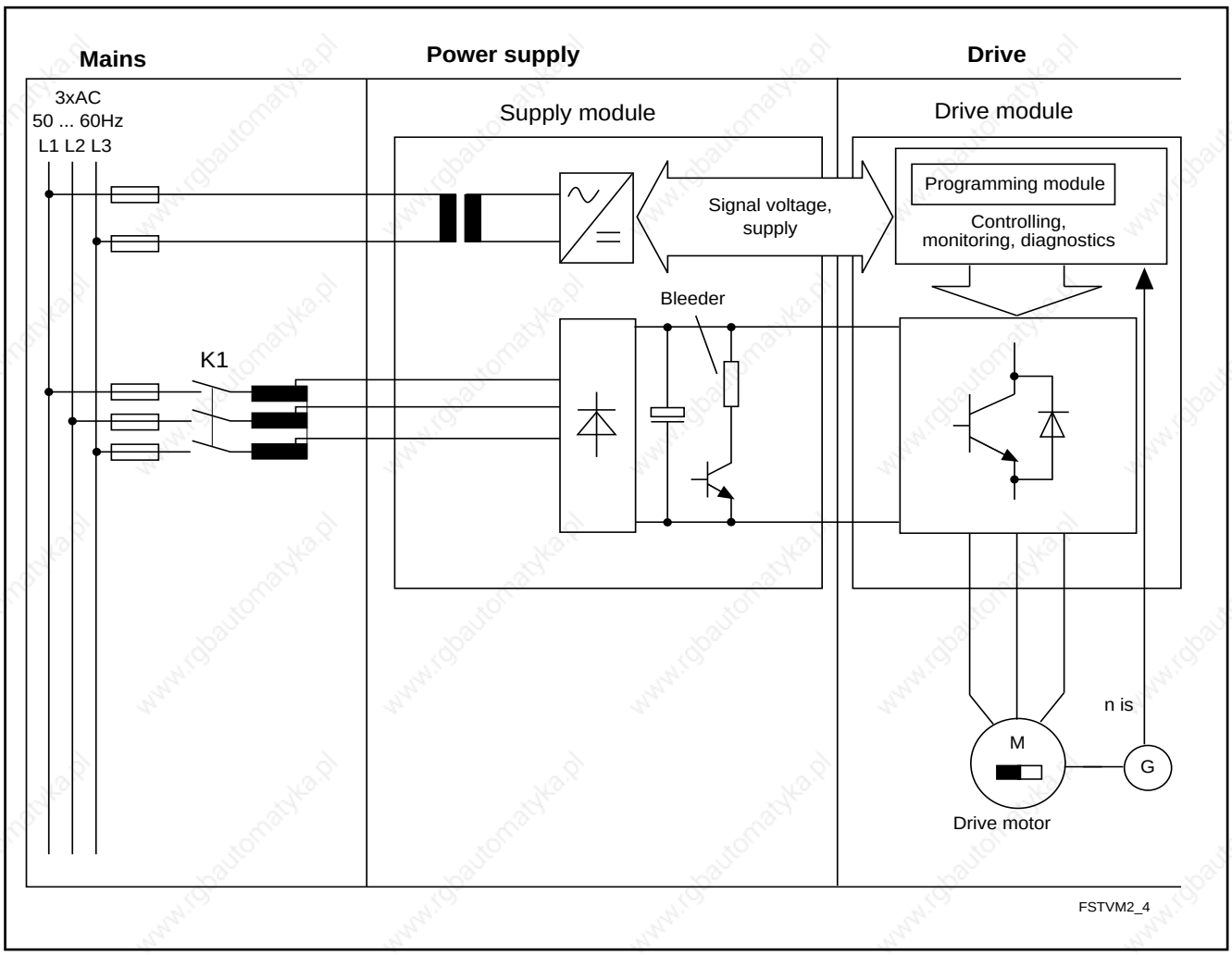


Figure 1.1: The TVM 2.4 supply module as a part of Indramat's A.C. drive system

INDRAMAT's A.C. drive system is made up of one supply module and the drive modules. Several drives can be run from one supply module. The TVM 2.4 supply module is a component part of INDRAMAT's ac modular drive system.

The TVM 2.4 supply module provides the d.c. high voltage for the motor power and the control voltages for all connected INDRAMAT drive.

1.1. The main functions of the TVM 2.4 supply module

Power supply to drives

The power rectifier of the TVM 2.4 rectifies the three-phase mains A.C. voltage and provides theD.C. high voltage for the drives.

When the drives are in generator mode, the regenerated power is absorbed by the bleeder resistor in the TVM 2.4.

The buffer capacitance provides sufficient smoothing.

Power supply to the electronics

The TVM 2.4 supplies the electronics of the drive module via the wire ribbon cable.

Monitoring the drive system

The TVM 2.4 is equipped with extensive monitoring functions. These communicate with the drive modules via the signal bus voltage.

The Bb1 contact of the TVM 2.4 is very important to drive system readiness. Power can only be switched on when this contact is closed.

2. Applications

It is possible to operate INDRAMAT's TVM 2.4 series of supply modules with a continuous mechanical output of 4.1 kW. For this reason, it is the preferred power supply for servo drives.

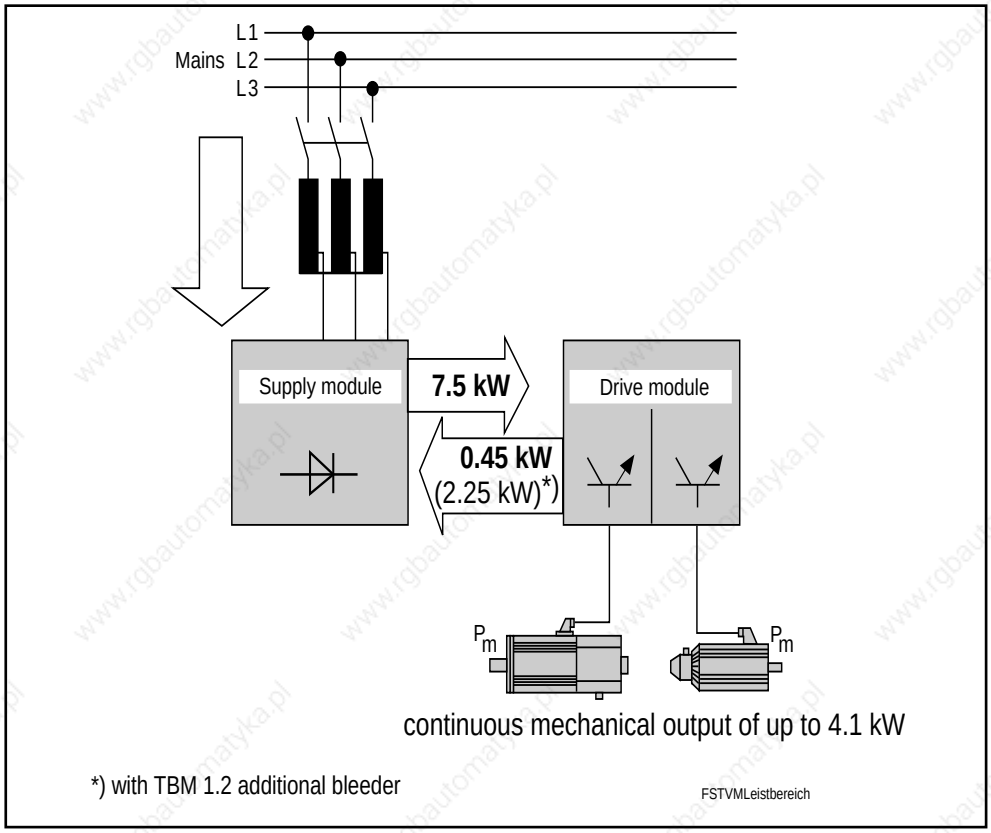


Figure 2.1: The power range of the TVM 2.4 supply module

2.1. Power ratings

With the use of additional components, it is possible to optimize the usable power of the TVM 2.4 to meet the requirements of the respective application.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	Mains supply module TVM 2.4-050-220/300-W1/.../... + accessories	
$\frac{P_{DC}}{kW}$	$\frac{P_{KB-3}}{kW}$	$\frac{P_{KB-03}}{kW}$	$\frac{P_{BD}}{kW}$	$\frac{P_{BM}}{kW}$	$\frac{W_{max}}{kWs}$	$\frac{P_m}{kW}$	$\frac{P_{mKB-03}}{kW}$	Additional bleeder	Transformer
2.4	5.5	11	0.45 2.25	10 50	14 114	1.3	6.1	 TBM 1.2-40-W1-024	2.5 kVA
3.8	10	20	0.45 2.25	10 50	14 114	2.1	11.1	 TBM 1.2-40-W1-024	4 kVA
4.8	14	28	0.45 2.25	10 50	14 114	2.6	15.6	 TBM 1.2-40-W1-024	5 kVA
7.1	20	42	0.45 2.25	10 50	14 114	4.0	23.3	 TBM 1.2-40-W1-024	7.5 kVA
7.5	20	60	0.45 2.25	10 50	14 114	4.1	33.3	 TBM1.2-40-W1-024	10 kVA

(1) P_{DC} = Continuous D.C. bus power

(2) P_{KB-3} = D.C. bus short-time power for 3s (accelerating main drives)

(3) P_{KB-03} = D.C. bus peak power for 0.3s (accelerating servo drives)

(4) P_{BD} = Continuous bleeder power

(5) P_{BM} = Peak bleeder power

(6) W_{max} = Maximum regenerated energy

(7) P_m = Continuous mechanical power

(8) P_{mKB-03} = Peak mechanical power for 0.3s (accelerating servo drives)

Figure 2.2: Selection data

2.2. TVM 2.4 dimensional data

Designation	Symbol	Unit	TVM 2.4-50-220/300-W1/.../...
Power section			
Input voltage	U(ACN)	(V)	3 x 220V (+15/-10%) or 3 x 230 V (+10/-15%)
Frequency	f(N)	(Hz)	50 ...60
D.C. bus d.c. voltage	U(DC)	(V)	300 (± 15%)
D.C. bus continuous power	P(DC)	(kW)	7.5
D.C. bus peak power	P(KB-03)	(kW)	60
Continuous bleeder power	P(BD)	(kW)	0.45
Peak bleeder power	P(BM)	(kW)	10
Maximum regenerated power	W(max)	(kWs)	14
Power loss (at maximum load without bleeder losses)	P(v)	(W)	130
Weights	m	(kg)	15
Supply to electronics			
Input voltage	U(AC)	(V)	230/400 (+10/-15%) or 115/230 (±10%)
Frequency	f(N)	(Hz)	50 ... 60
Power consumption at maximum load	S(el)	(VA)	550
Control voltage output			
+ 24V load voltage	U(L)	(V)	24 ... 30
+ 24VL continous current	I(UL)	(A)	8
+ 24VL ripple		(%)	10
± 15V measuring voltage	U(M)	(V)	14.9 ... 15.1
+ 15VM continuous current	I(+UM)	(A)	1.3
- 15VM continuous current	I(-UM)	(A)	1.0
± 15VM ripple		(%)	0.1
Ambient conditions			
Permissible ambient temperature with rated data	T(um)	(°C)	+5 ... +45
Maximum ambient temperature for derated output	T(umr)	(°C)	55
Storage and transportation temperature	T(L)	(°C)	-30 ... +85
Installation altitude without reduction of rated data			maximum 1000 meters above sea level
Humidity class			F per DIN 40 040
Insulation class			C per DIN VDE 0110
Protection category			IP 10 per DIN 40 050

Figure 2.3: TVM 2.4 supply module - technical data

2.3. Ambient conditions

Increased ambient temperature

The ratings and loads of the control voltages listed in the TVM 2.4 data sheets are valid within an ambient temperature range of +5 to 45° C. Maximum permissible ambient temperature can equal up to +55° C. The reduction in power ratings is depicted in the following diagram.

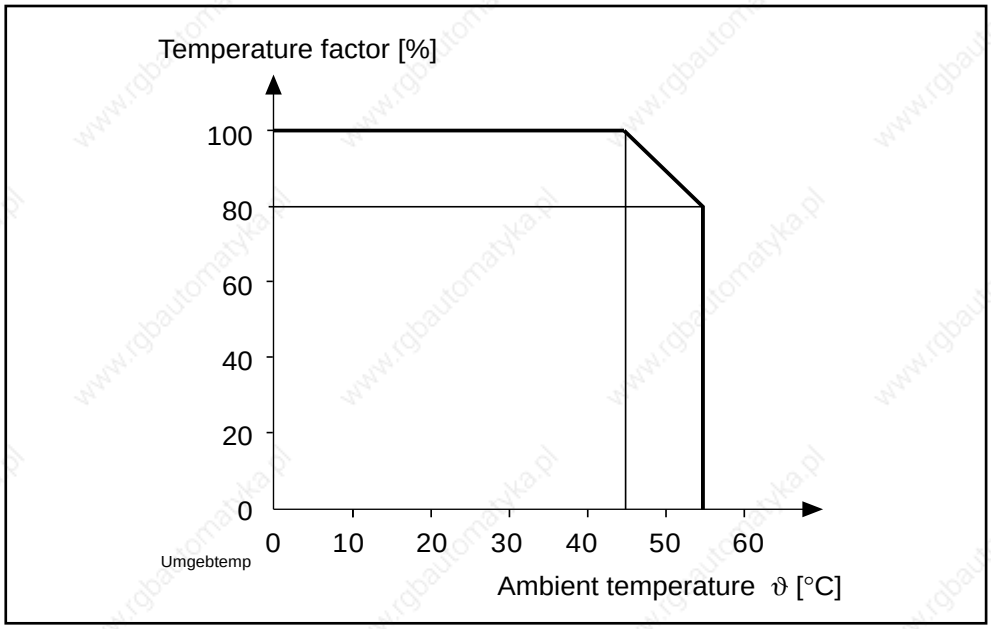


Figure 2.4: Reduction in power ratings with increased ambient temperature

Installation altitude above 1000 m

The TVM's power ratings drop as per the following diagram when installation altitude exceeds 1000 meters above sea level.

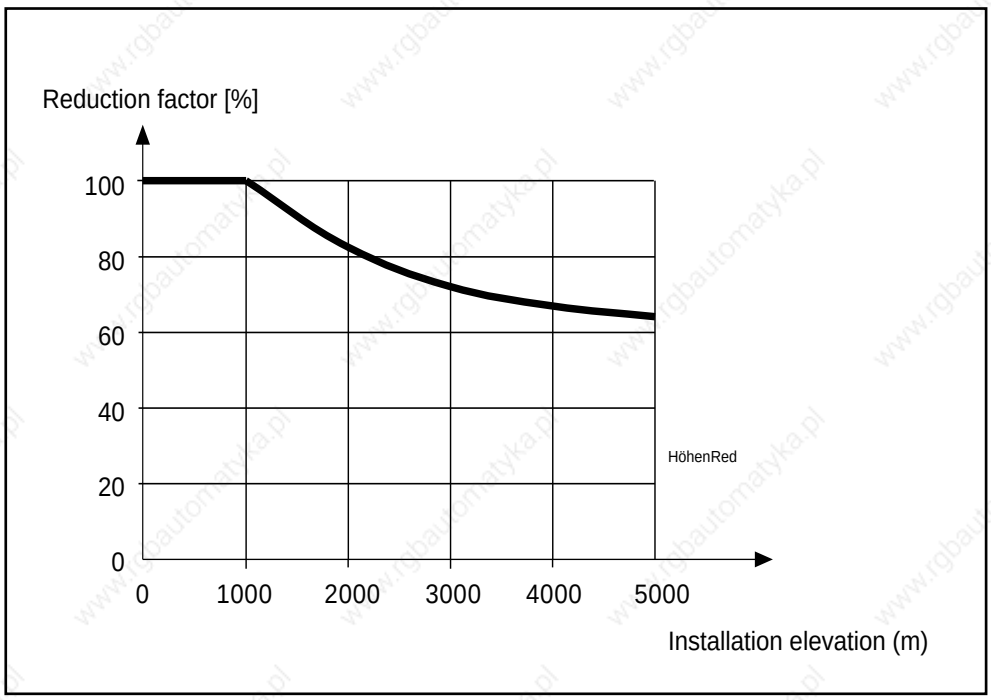


Figure 2.5: Reduction in power ratings for installation altitudes above 1000 meters

2.4. Functional power features

- **Simple and problem-free voltage matching**

  In most cases, an autotransformer can be used to adapt the mains voltage to the connection voltage.

- **Fuse protection with the use of circuit breakers**

  – expensive semi-conductor fuses are not required,

  – and, no special fuses are needed if the unit is exported.

- **Using additional capacitance means drive energy can be stored**

  Heat losses and energy consumption are minimized, if the energy created during braking is stored in the additional capacitance.

- **Braking synchronous drives to standstill in the event of mains failure or problems in the drive's electronics**

  The drive can be braked to standstill in the event of a malfunction by the dynamic brake.

- **High load capabilities of the control voltage**

  The high load capabilities of the control voltage make it possible to connect six or more drives to one supply module.

- **Monitoring all drive components**

  The ready contact of the TVM 2.4 immediately switches power off in the event of a malfunction.

- **Ease of servicing**

  The TVM 2.4 uses LED displays to make fault finding and clearance easy.

- **UL-Approval**

  A more simplified machine inspection, if UL approval is required.

3. Electrical connections - installation guidelines

The TVM's terminal connection diagram as shown in this document is a recommendation of the unit manufacturer. The circuit diagrams of the machine builder must be used for installation.

3.1. Terminal diagram

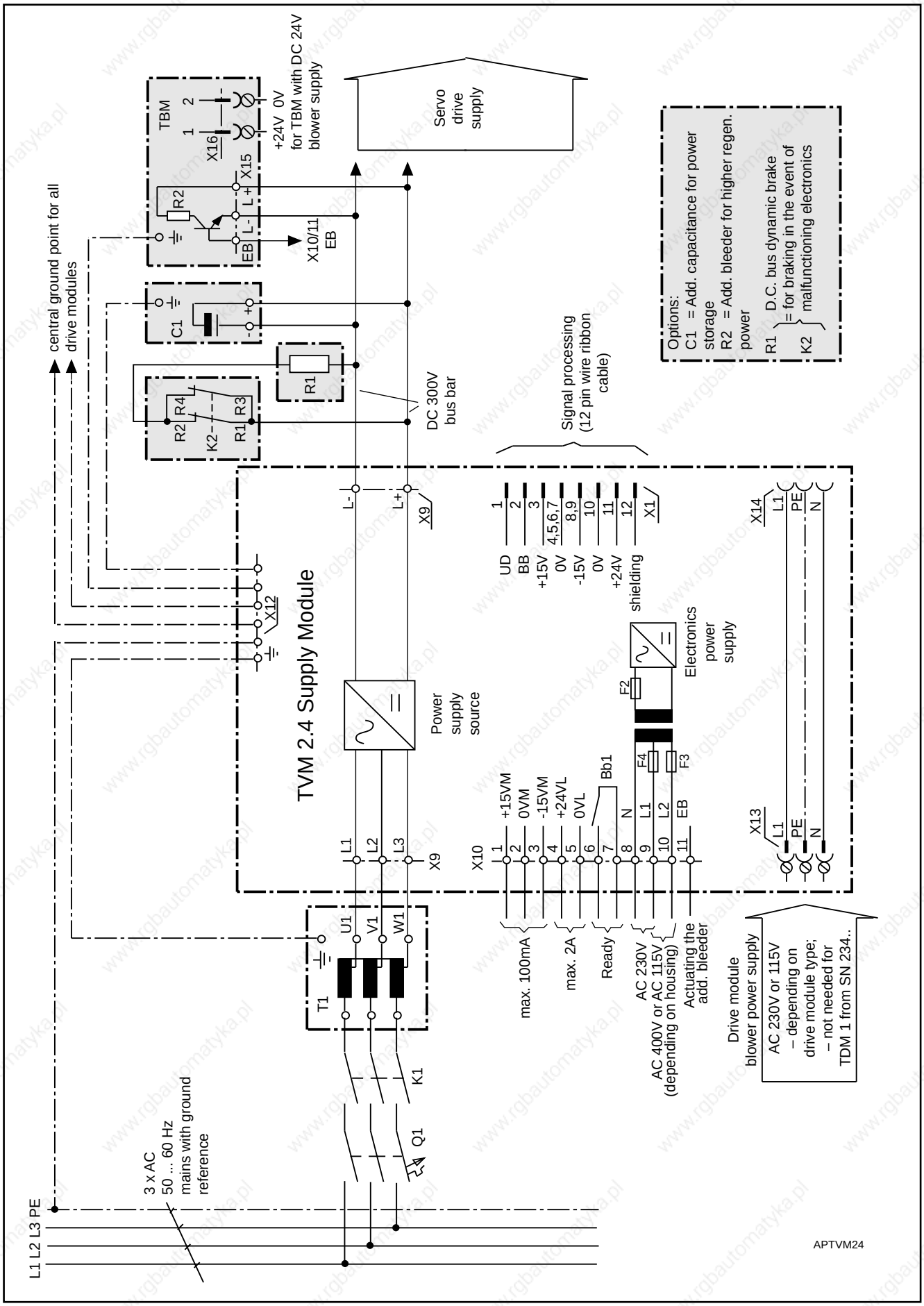


Figure 3.1: TVM 2.4 supply module terminal diagram

3.2. Mains connection - power section

Connecting voltage

3x AC 220 V (± 15 %) or
3x AC 230 V (+10 / -15%)

Frequency

50 ... 60 Hz

Mains connection via a transformer without soft-start resistor

In most cases, an autotransformer can be used to adapt the mains voltage (see section 3.5). The autotransformer simultaneously limits the inrush current of the TVM 2.4.

As a result, soft-start resistors are often not needed.

Soft-start resistors are not needed:

with transformer power ≤ 10 kVA without additional capacitance

with transformer power ≤ 2.5 kVA with additional capacitance

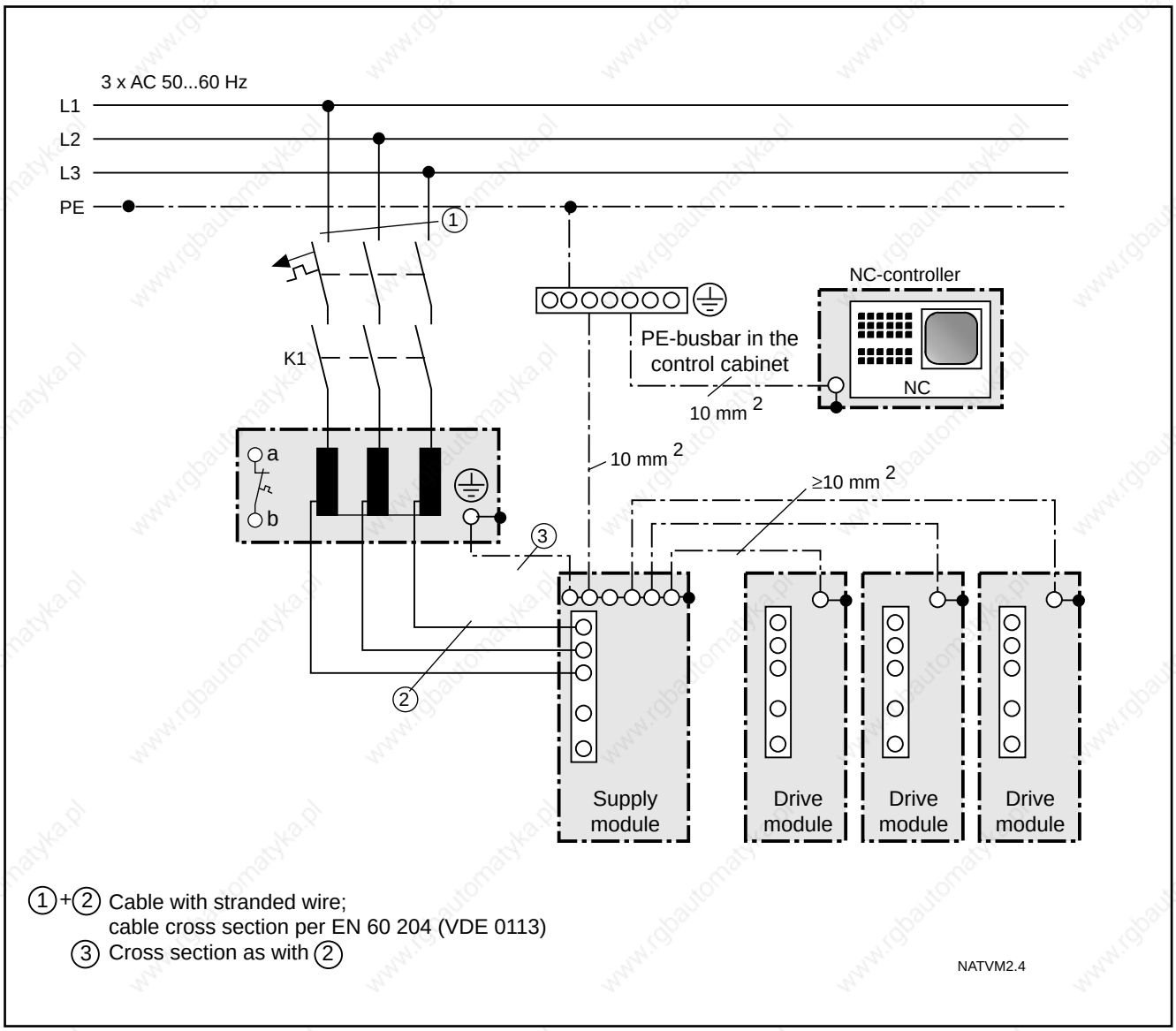


Figure 3.2: Mains connection via autotransformer - without soft-start resistor

See section 3.3 for the cross sections of the power supply line.

Each drive module must be separately connected with a ground wire to the PE busbar of the TVM.

Mains connection using a transformer - with soft-start resistor

Soft-start resistors are used to limit the inrush current where the transformer power is greater than 10 kVA or 2.5 kVA, and with additional capacitors.

DANGER

The DC bus short-circuit resistor is not secured against accidental contact. There is the danger of high-voltages (greater than 50 V).

Electrical shock resulting from contact

==> use an appropriate cover, see that it is in place or properly mounted

CAUTION

Thermal damage caused by DC bus short-circuit contactor and resistor in the event of faults in the control or contactor is possible.

Damage or loss due to fire is possible inside the control cabinet.

==> use an appropriate cover, see that it is in place or properly mounted

(See Fig. 4.1, recommended cover for the DC bus short-circuit switch)

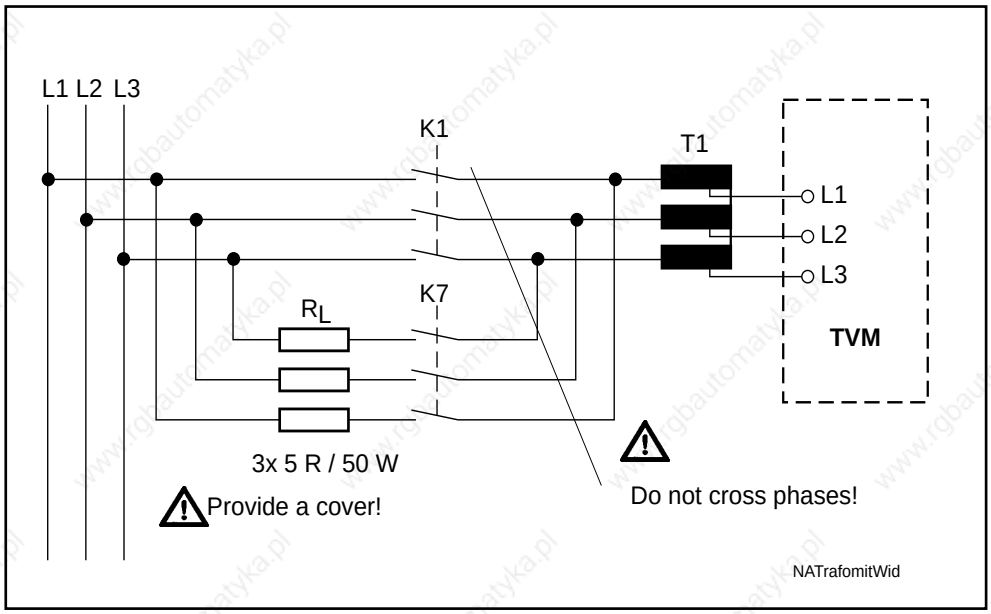


Figure 3.3: Power connections on the primary side of the transformer with soft-start resistors

Direct connection to the mains

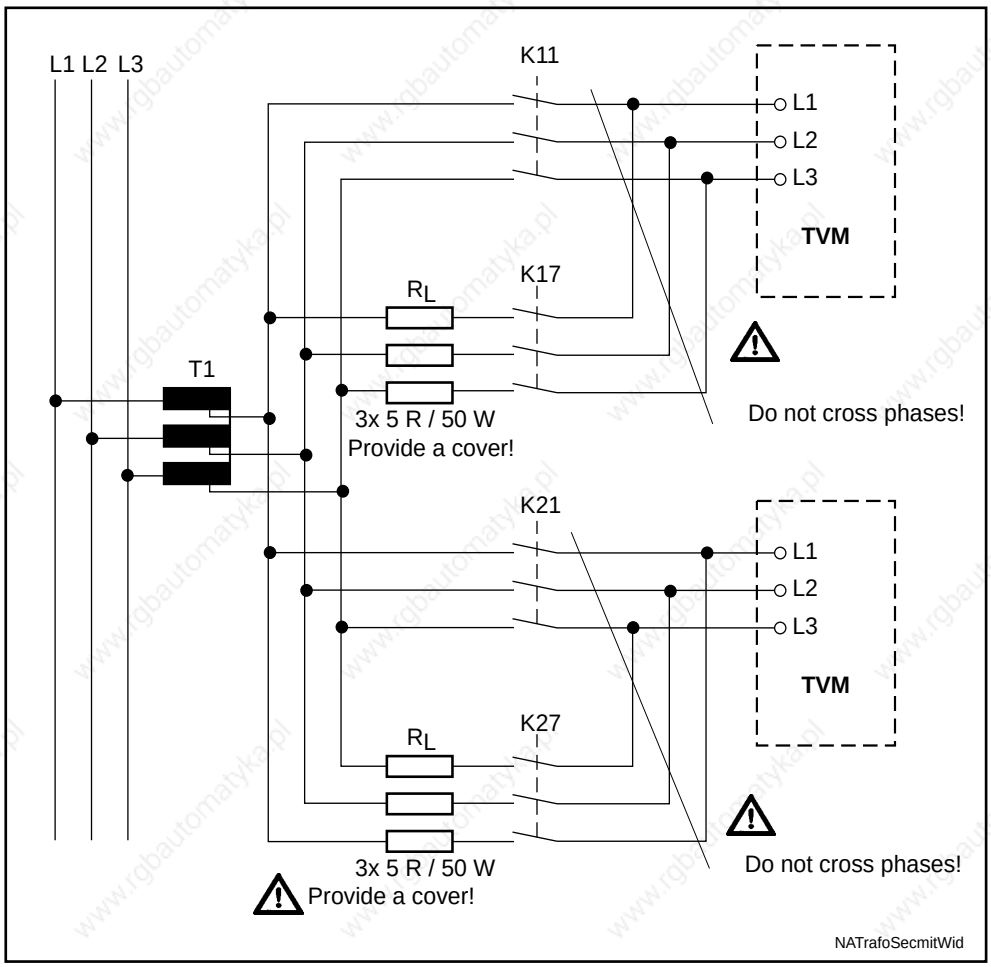


Figure 3.4: Power connections on the transformer secondary side with soft-start resistors

The TVM 2.4 can be directly connected to 3 x AC 220 V. There is no need for a transformer. Soft-start resistors are needed to limit the inrush current.

3.3. Fuse protection for the power connection

The TVM mains connection can be protected with the use of either circuit breakers or gL classification (slow-blow) fuses. The protective device is generally placed on the primary side of the transformer. Do not select conductor cross sections smaller than the recommendations in the following tables, especially for low power isolation transformers. Otherwise, short-circuit protection of the secondary will be compromised.

Maximum permissible fusing

Fuses on the primary side of the transformer
The fuse or circuit breaker rating (gL) must not exceed:

- 3 x AC 460 V, I_N = 25 A;
- 3 x AC 525 V, I_N = 20 A

Fuses on the secondary side of the transformer or for 3 x A. 220 V mains

- I_N = 35 A.

Safety fuses

The safety fuses can be selected per the following recommendations, if INDRAMAT transformers are used, and connections are made as outlined in section 3.1.

Power circuit breakers

Using power circuit breakers has the advantage that faulty operation with two phases is generally not possible. The following recommendations apply when selecting power circuit breakers where INDRAMAT transformers are used and connections are per section 3.1.

Selecting the power circuit breakers and fuses for the following conditions:

- connection voltage 3x AC 400 V
- without additional capacitance on the D.C. bus, or if soft-start resistors are used

Transformer power in kVA	Connection cross sections in mm2 2)		Rated current in A		Recommended safety fuses (class gL*)	Power circuit breakers Siemens: Series 3VU 1)	Setting range in A	Setting value in A
	primary	secondary	primary	secondary				
2.0	1.5	1.5 (4)	2.9	5	6 A slow-blow	3VU1300-•MK00	4 ... 6	4
2.5	1.5	1.5 (4)	3.6	6.3	10 A slow-blow	3VU1300-•ML00	6 ... 10	6
3.5	1.5	1.5 (6)	5.1	8.8	16 A slow-blow	3VU1300-•MM00	10 ... 16	10
4.0	1.5	1.5 (6)	5.8	10	16 A slow-blow	3VU1300-•MM00	10 ... 16	10
5.0	1.5	1.5 (6)	7.2	12.6	20 A slow-blow	3VU1300-•MN00	14 ... 20	14
7.5	1.5	4	10.8	18.8	20 A slow-blow	3VU1300-•MP00	18 ... 25	18
10	2.5	6	14.5	25.1	20 A slow-blow	3VU1300-•MP00	18 ... 25	18

1) Note maximum backup fuse as per manufacturer recommendations!

2) Cable cross section per EN 60204 - type B1 - without regard for correction factors. Values in brackets apply to the use of DLT type isolation transformers.

* gL = cable and conductor protection

Selecting the power circuit breakers and fuses for the following conditions:

- connection voltage 3x AC 400 V
- with additional capacitance (to 16 mF) and transformer power of ≤ 2.5 kVA

Transformer power in kVA	Connection cross sections in mm2 2)		Rated current in A		Recommended safety fuses (class. gL)	Power circuit breakers Siemens: Series 3VU 1)	Setting range in A	Setting value in A
	primary	secondary	primary	secondary				
2,0	1.5	1.5 (4)	2.9	5	16 A slow-blow	3VU1300-•ML00	6 ... 10	6
2.5	1.5	1.5 (4)	3.6	6.3	16 A slow-blow	3VU1300-•MM00	10 ... 16	10

1) Maximum fuse sizing as per manufacturer recommendations!

2) Conductor cross section per EN 60204 - installation type B1 - without taking correction factors into consideration. Values in brackets apply to the use of DLT type isolation transformers.

3.4. Selecting the mains contactor

Do not select the mains contactor smaller than is recommended in the following table because of the inrush current. If smaller mains contactors are used, the contacts may be fused together.

Without soft-start

The following recommendations apply to mains 3 x 400 V:

- mains disconnect on the primary side of the matching transformer
- without soft-start resistor

Transformer kVA	Additional capacitance	Peak inrush current in A	Mains contactor Siemens 3TF type
2.0	---	230	3TF 44
2.0	max. 8 mF	270	3TF 44
2.5	---	260	3TF 44
2.5	max. 8 mF	330	3TF 46
3.5	---	320	3TF 46
4.0	---	340	3TF 46
5.0	---	400	3TF 47
7.5	---	470	3TF 47
10		500	3TF 47

With soft-start

The following recommendations apply to mains 3 x 400 V:

- connecting the mains to the primary side of the matching transformer, and,
- with soft-start resistor.

The mains contactor can be sized according to the rated current of the transformer. Do not select the rated current of the mains contactor, per user category AC 3, smaller than 32 A (typical AC 3 application = switching a squirrel cage motor).

Do not select the rated current of the charging contactor, per user category AC 3, smaller than 16A.

Transformer power in kVA	Remaining peak inrush current in A (peak value)	Mains contactor Siemens: 3TF type	Charging contactor Siemens: 3TF type
2.0 ... 20	200	3TF 44	3TF 42
25	200	3TF 45	3TF 42
35	200	3TF 47	3TF 42

Connecting voltage is not 3 x 400 V

For connection to voltages other than 3 x 400 V, or if the mains contactor is installed on the secondary side of the transformer, the contactor sizing can be determined with the following relation:

$$I_{AC3} = \frac{400V}{U_N} \times \frac{i_{peak}}{6 \times \sqrt{2}}$$

I_{AC3} = rated current per use category AC 3
i_{peak} = peak inrush current in A per above table
U_N = connection voltage in V

3.5. Power supply requirements

Grounded mains

Voltages can be adapted with an autotransformer for grounded mains systems, either star systems with a grounded neutral or system with a grounded phase (TN or TT mains). It is possible to directly connect the TVM 2.4 to 3 x AC 200 V mains .

Ungrounded mains

There is the increased danger in ungrounded mains (IT-mains) that overvoltages can occur between the phases and the housing. The TVM 2.4 can only be operated with such systems if:

- the TVM 2.4 is connected across an isolation transformer, or,
- the installation is protected with an overvoltage conductor.

Connecting the TVM 2.4 via an isolation transformer offers the best protection against overvoltage and the greatest possible operating safety.

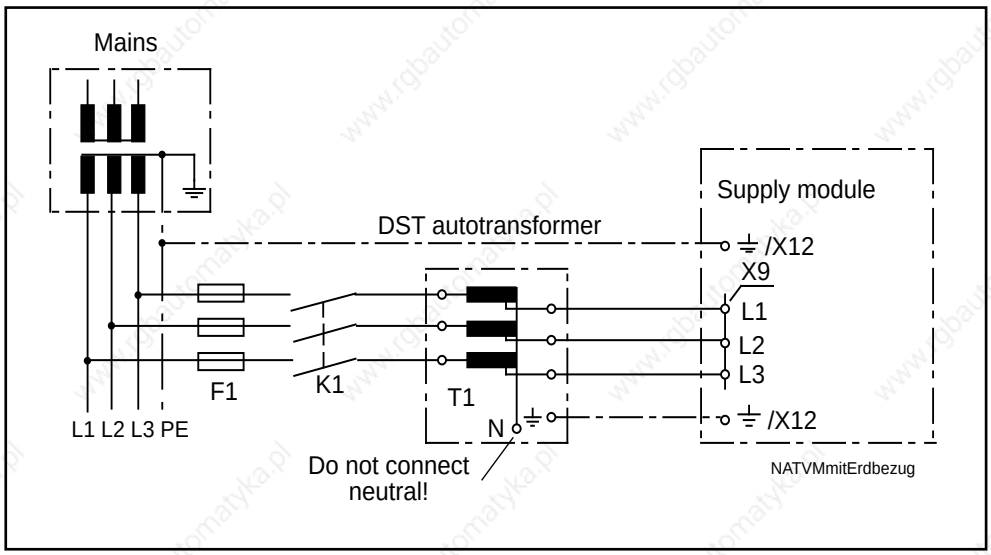


Figure 3.5: Connecting the TVM 2.4 to a grounded power system

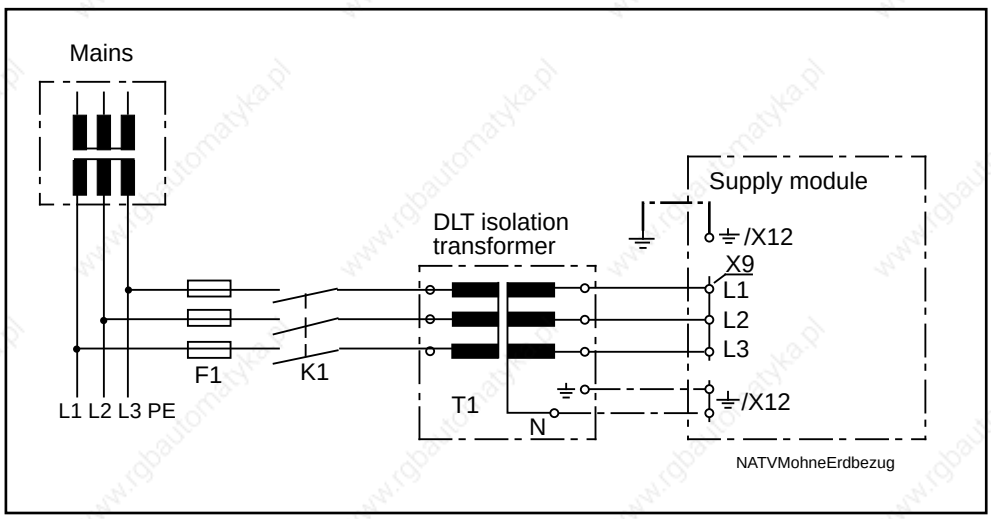


Figure 3.6: Connecting the TVM 2.4 to an ungrounded power system

3.6. D.C. bus

Use the busbars found in the connection accessories of the drive module to connect the drive modules to the d.c. bus.

Use individual cables with stranded wires for longer connections (maximum length of one meter).

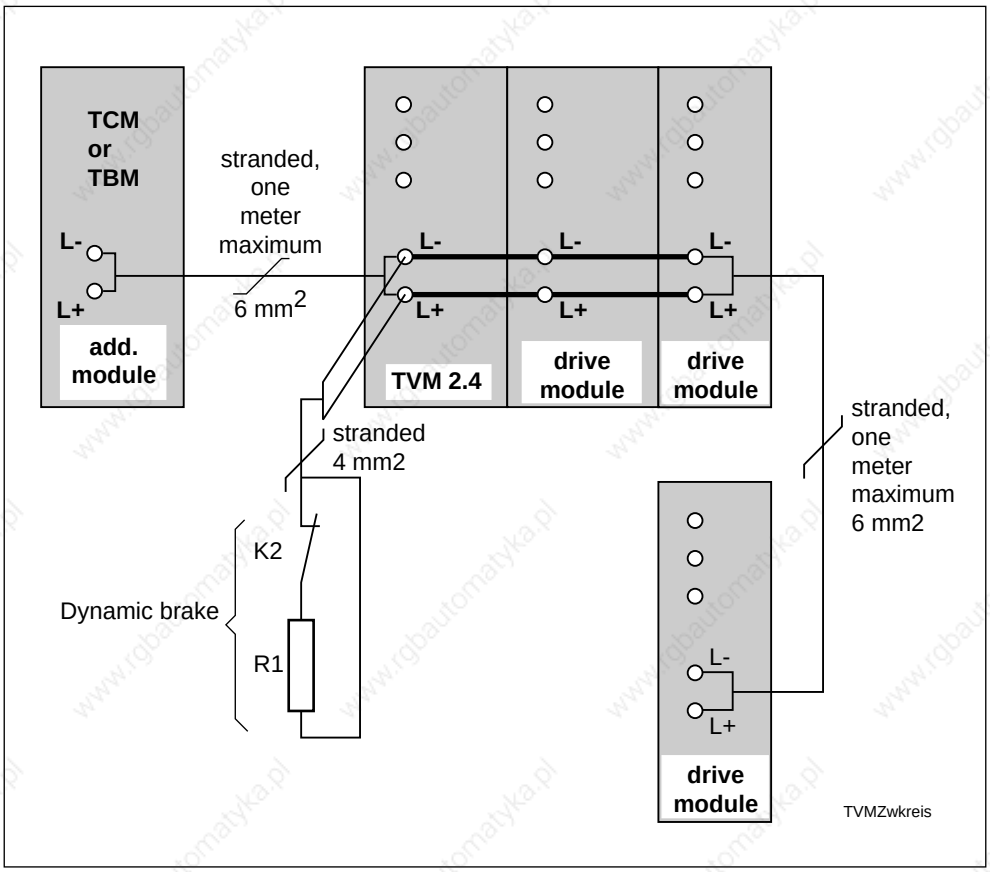


Figure 3.7: Wiring the D.C. bus

During normal operation, the dynamic brake resistor R1 has DC 150 V applied to it with respect to ground. The cabinet builder must provide protection against accidental contact (e.g., with the use of plexiglass).

3.7. Additional capacitance on the D.C. bus

Additional capacitiance modules can be connected to the D.C. bus for energy storage. When the drives are decelerated, the drive energy is stored and can be used for acceleration. This means that both the heat lost within the control cabinet and energy consumption are minimized. Approximately 30 watt-sec. can be stored for each mF of additional capacitance.

Soft-start resistors are needed if additional capacitance is used and the transformer for high-voltage power is larger than 2.5 kVA (see section 3.2).

3.8. Additional bleeder

The TBM 1.2 additional bleeder module can be installed to increase continuous and peak regenerated power. The following power ratings can be achieved by combining the TVM 2.4 and the TBM 1.2.

Continuous bleeder power (continuous regenerated power)	Peak bleeder power (peak regenerated power)	Maximum regenerated power
2.25 kW	50 kW	114 kWs

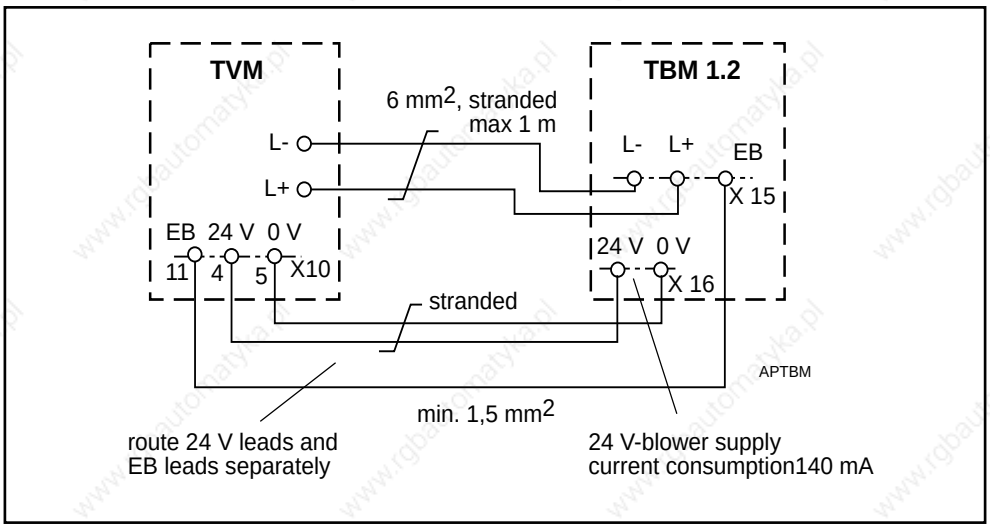


Figure 3.8: Connecting the TBM 1.2 additional bleeder module

3.9. AC Input power for electronics and blowers

Electronic power supply

Connector: X 10 /8/9/10
Maximum connection diameter: 2.5 mm^2

Input voltage: depends on unit
AC 115/230 V or AC 230/400 V, 50...60Hz

Power consumption: 550 VA
(when electronic supply is at maximum load)

Back-up fuse:

The disconnect switch can be installed with line fuses or circuit breakers.

Connection voltage	Safety fuses utilitzation gL	Power circuit breakers (tripping characteristics C)
115/230 V	10 A slow-blow	10 A
230/400 V	10/6 A slow-blow	10/6 A

Blower supply voltage

Connector X 13 is located on the bottom of the TVM. The voltage can be jumpered from there to the drive module with the use of a ready-made cable.

For drive modules of the newer series (TDM 1.2-...-300-W1-**000,** TDA, DDS 2 and the TVM 2.4 itself), the blower is supplied through the wire ribbon cable from the electronic power supply. These drive modules **do not** require an external blower voltage source. X13 remains unused.

Only in those cases where a TDM 1.2-...-300-W1-**220,** TDM 1.2-...-300-W1-**115,** KDA, KDS, KDF, or a TFM are used, connect AC 115 V or 230 V to X13, depending on the type of blower used.

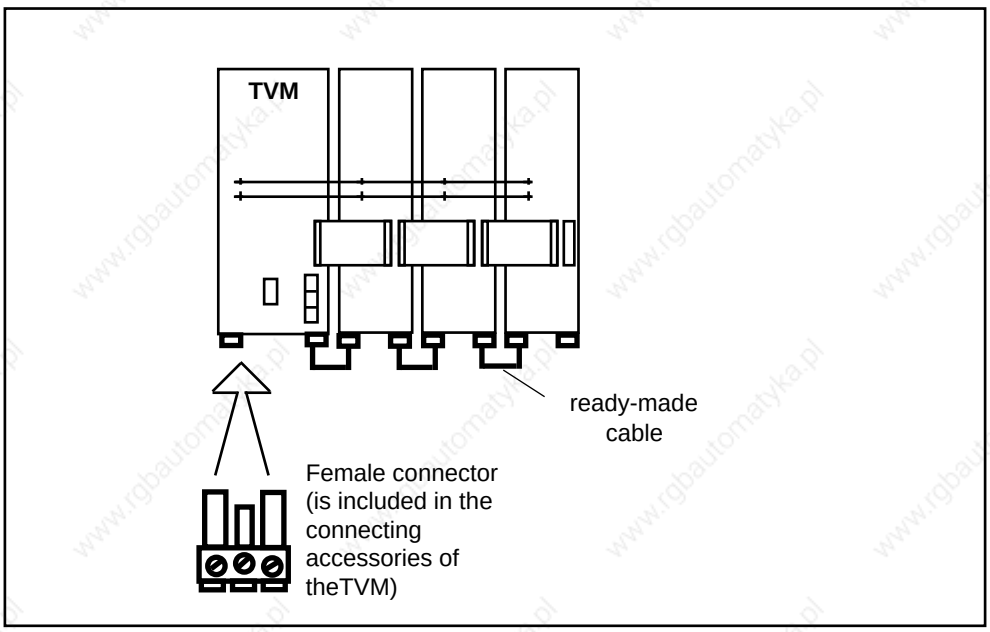


Figure 3.9: Drive module blower supply

3.10. Wire ribbon connection for the electronics

The wire ribbon connection X1 has two functions:

- supplying power to the drive electronics, and,
- signal exchange between the supply and drive modules.

The wire ribbon cable is included in the connecting accessories of the drive module.

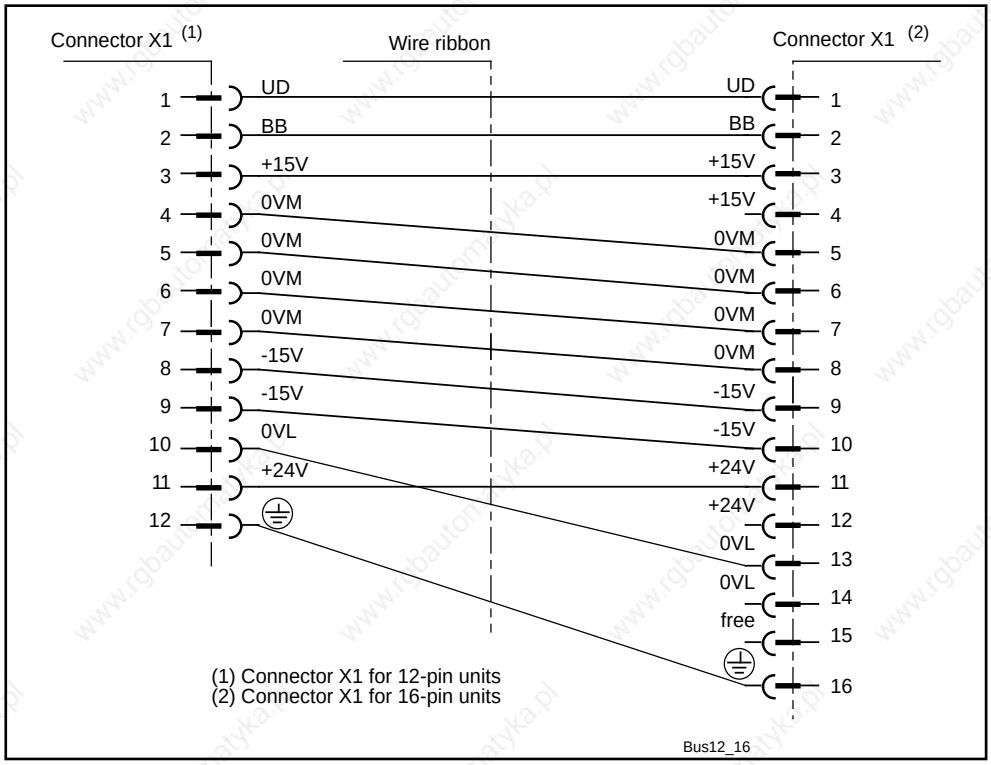


Figure 3.10: Wire-ribbon for transition from 12-pin to 16-pin connector

The wire-ribbon connection receives a termination connector used in verification of the connections. If the termination connector is not installed, the Bb1 contact of the power supply will not close.

The TVM 2.4 can also be installed in the middle of the drive system. In this case, it is sufficient to install the termination connector on one end of the wire-ribbon connection.

The termination connector is a component of the TVM electrical accessory kit.

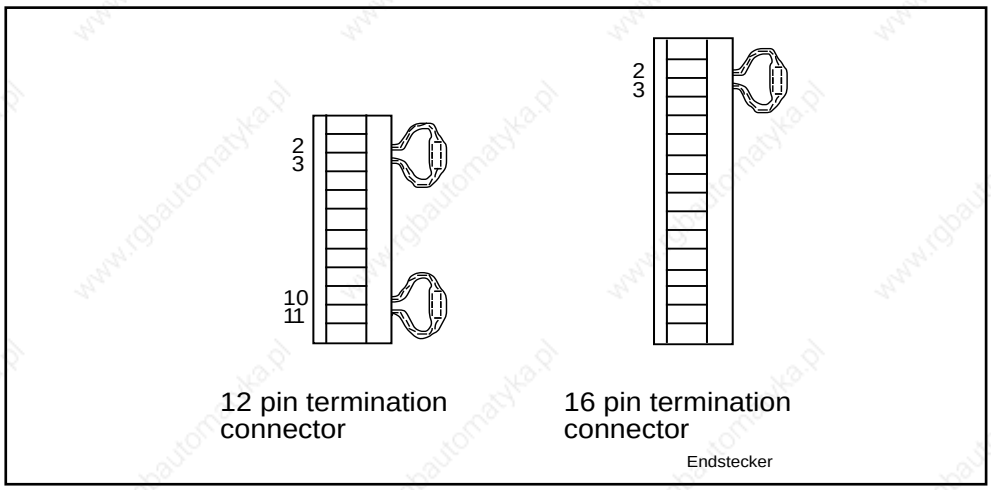


Figure 3.11: Termination connector for the wire-ribbon connection

3.11. Fault current protective device

No FI current limiting type circuit breakers are to be installed in the power lines to the TVM 2.4 (per VDE 0160, section 6.5).

3.12. Checking the control cabinet

There must be no voltages connected outside of those specified in the data sheet or interface description.

Before performing any high voltage test on the enclosure, remove all connections to the TVM 2.4.

3.13. Installing the TVM 2.4

The protection category of the TVM 2.4 is IP 10. It is designed for installation into a control cabinet.

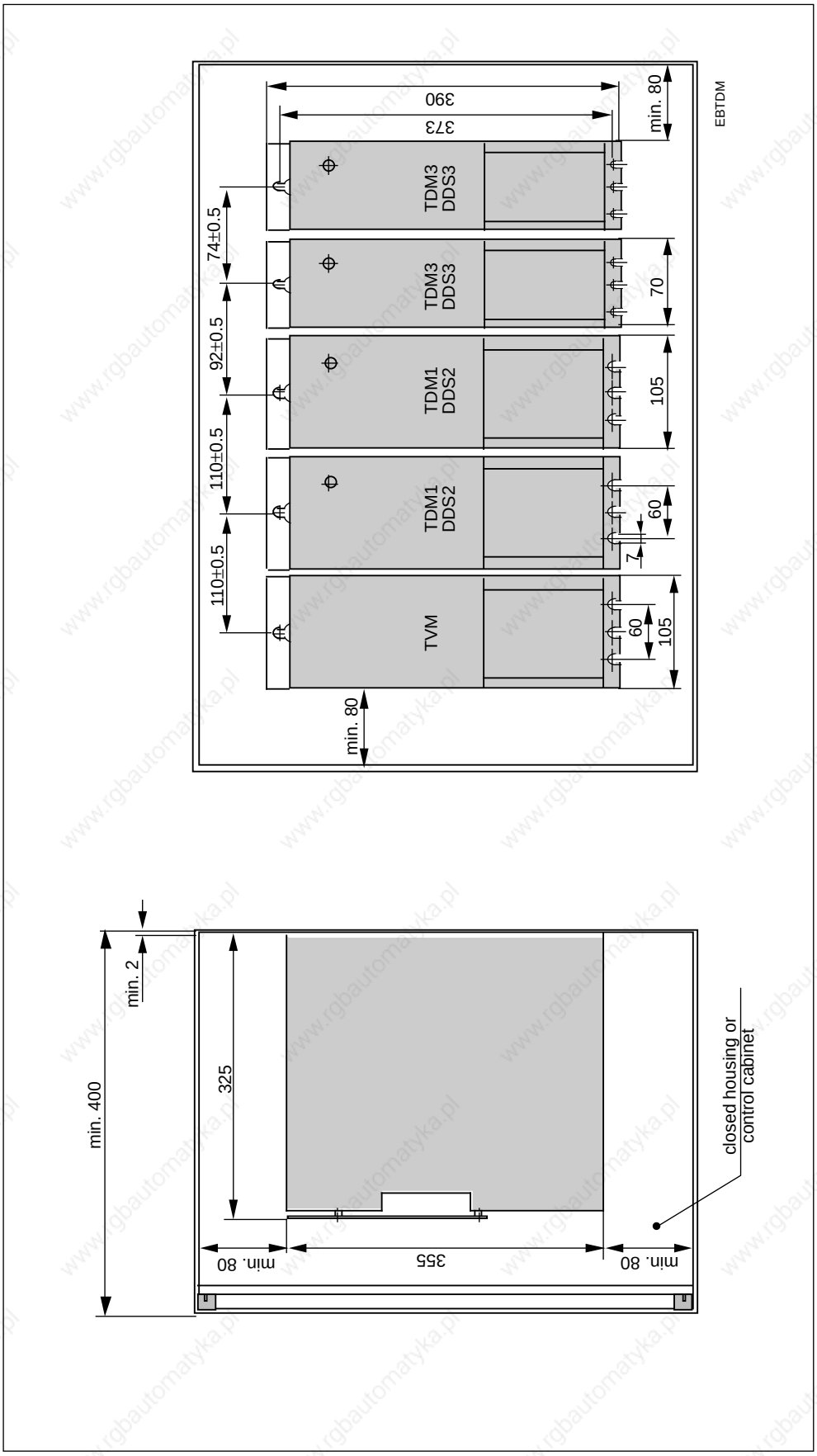


Figure 3.12: Installation dimensions and hole locations

3.14. Safety clearances

The bleeder resistors in the TVM 2.4 and TBM 1.2 modules heat up during operation. The path for heat away from the unit must not be obstructed.

Combustible materials such as wires and cable channels must be positioned at least 200 mm away on top and 40 mm to the side and front of the unit.

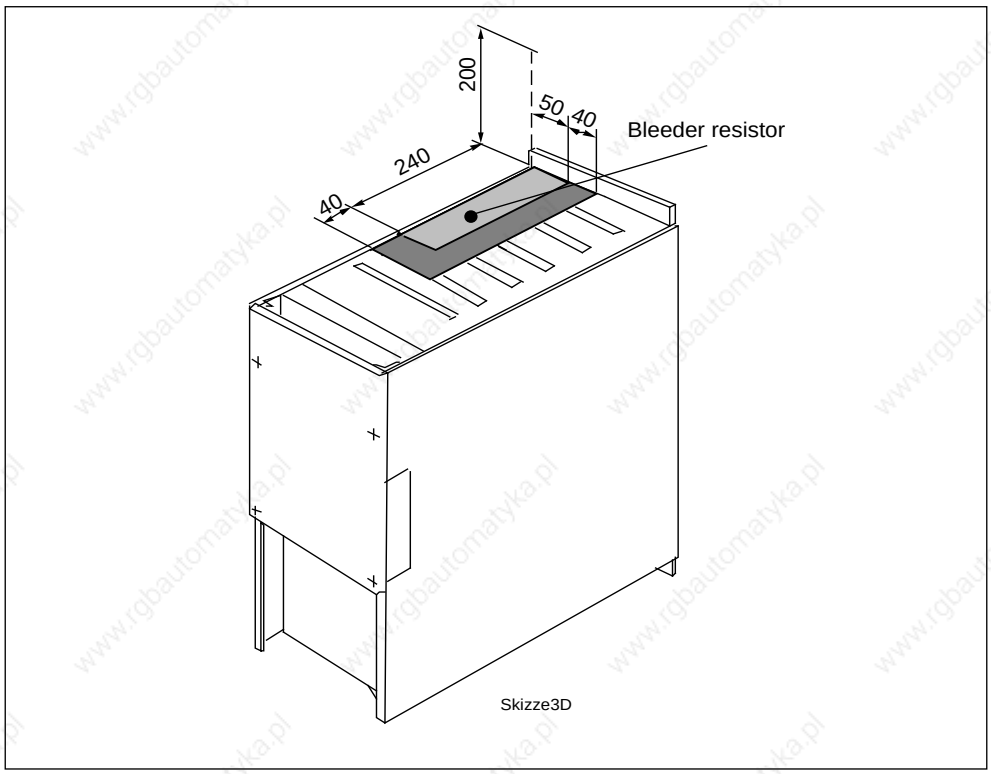


Figure 3.13: Spacing requirements for the TVM bleeder resistor

3.15. Heat loss within the control enclosure

In the TVM 2.4, basic losses due to the generation of signal voltages, power losses and bleeder losses occur.

Basic losses approximately 80 W

Power losses 7 W per kW continuous D.C. bus power.

Bleeder losses The bleeder losses are dependent upon the rotary drive energy, the potential energy of unbalanced masses and the number of machine cycles.

$$P_{RD} = \frac{W_{rotg} + W_{potg}}{t_z}$$

P_{RD} = continuous regenerated power or bleeder losses in kW
t_z = cycle time in seconds
W_{potg} = sum of potential energy in kWs
W_{rotg} = sum of rotational energy in kWs

For further details see selection and dimensioning guidelines!

3.16. Front view of the TVM 2.4

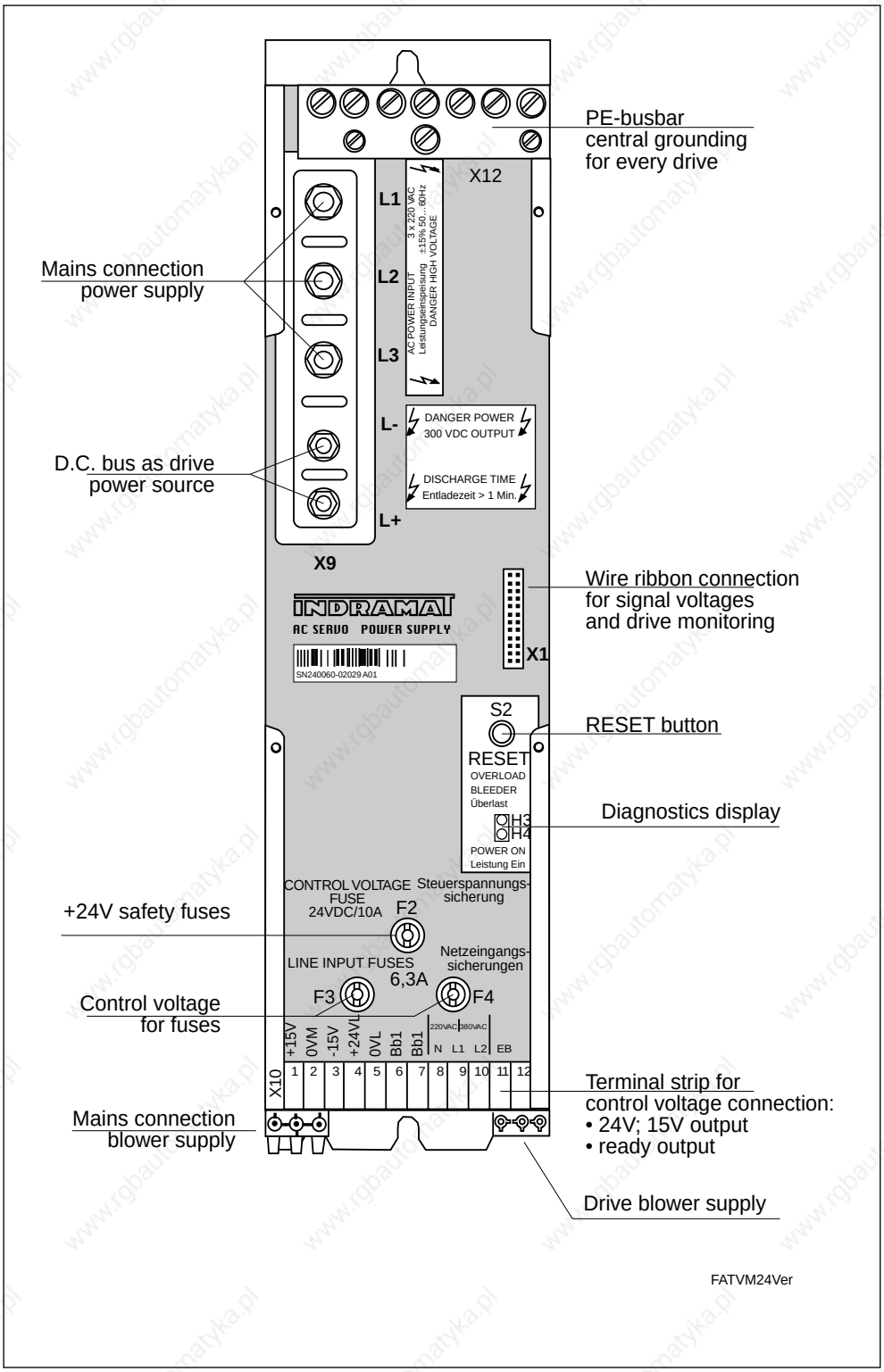


Figure 3.14: Front view of the TVM 2.4

4. Control circuits (control of input power)

The control signals for the mains contactor and the dynamic brake in the TVM 2.4 that are suggested by INDRAMAT illustrate the operating principle. Various control circuit possibilities are shown in this chapter.

The control scheme selected and its effect depends on the features and timing of the entire machine and is the responsibility of the machine builder.

4.1. Possible error reactions

Stopping because of drive faults

Bringing the drives to a standstill **with** or **without** dynamic braking.

With dynamic braking, synchronous motors (MAC or MDD) are always braked to a standstill whether or not the drive electronics are still operational. Asynchronous motors (2AD or 1MB) are not braked when the D.C. bus is short-circuited.

Without dynamic braking, intact drives can be braked at maximum torque. Drives with drive electronics malfunctions or interrupted feedback lines will coast down uncontrolled without electrical braking.

The dynamic brake can only be dispensed with if uncontrolled coasting will not damage the system. Motors with a mechanical holding brake can be used as an alternative.

4.2. Recommended error reactions

The best way to bring the drives to a standstill in a fault situation depends on the drive equipment used, and on the features of the machine. Thus, only the designer of the installation can make this decision. The following recommendations should, therefore, only be viewed as a support for the machine builder.

A few typical machine faults are listed below. The list of faults cannot, for the lack of space, be complete.

Bb1 open

TVM Bb1 contact open, limit switch open or following error signal from the NC

The Bb1 contact of the supply module opens if there is an error in the drive electronics or in the feedback line. Synchronous drives can, in this case, only be braked to a standstill with the use of the dynamic brake. For this reason, the dynamic brake should be applied if the Bb1 contact is open.

Limit switch open

The main purpose of the dynamic brake is the protection of the facility. The limit switches are only activated if there is an error in the control or in the drive. Thus, the dynamic brake should be applied when the limit switch is open. The distance overtravelled beyond the braking distance during a dynamic braking action should be measured.

Following error message from the NC controller

This message means that there is a fault in the drive. Therefore, when a following error signal occurs, have dynamic braking occur.

Dynamic braking can only be dispensed with, with respect to the above errors, if a coasting of the drives cannot damage the facility. Motors with mechanical holding brakes can be used as an alternative.

E-STOP, safety doors, light barriers or step-pad activated

Safety doors, light barriers, step pads or similar monitoring devices serve to protect personnel.

A: Facilities with modular asynchronous drives

Dynamic braking cannot be used in installations equipped with modular asynchronous drives (e.g., main spindle drives) once these monitoring devices are actuated because asynchronous drives cannot be braked. On a machine tool, for example, the danger from moving main drives should generally be estimated higher than the danger from feed drives.

Thus, if the referenced monitoring devices are actuated in installations of this type, then only the mains contactor and the drive enable signal should be switched off and dynamic braking should not be used.

B: Installations with modular synchronous drives, e.g., handling systems

Switching off the mains contactor and the drive enable achieves the shortest possible braking distances with intact drives. Only if the energy stored in the D.C. bus capacitors can cause a dangerous drive motion, must the dynamic braking be used with a fault.

Set-up operations with pendant enable key

Here as well, the shortest possible braking distances are achieved by switching the mains contactor and the drive enable off.

Dynamic brake contactors and resistors are not suited for jogging operations. If this is ignored, then there will be damage in the control cabinet.

Summary

Input signal ("error signal")	**Dynamic braking**			**Drive enable and mains contactor OFF**
	Individual components of the drive system			
	modular asynchronous and synchronous drives	only modular synchronous drives	only modular asynchronous drives	
Bb1 contact of the supply module is open	yes	yes	no	yes
Limit switch open	yes	yes		
Following error signal from the NC	yes	yes		
E-STOP button pressed	no	no For exceptions see above "B: facility with modular synchronous drives“		
Light barrier, step-pad or safety doors actuated	no	no For exceptions see above "B: facility with modular synchronous drives“		
Pendant enable button	no Danger of damage!			

4.3. DC bus short-circuiting switch

The DC bus short-circuit switch recommended by INDRAMAT is conceived to protect either machine or plant against damage in the event of a drive failure. This can be used to brake motors with permanent magnetic excitation even in the event of drive control failure. This function cannot, however, be the only safety device used to protect personnel.

Circuit design

This DC bus short-circuit contactor can switch the "short-circuit current" on but not off. The DC bus short-circuit contactor may not be re-applied, once released, until the DC bus has discharged. The following recommended circuits (section 4.4 to 4.6) will make interference-free operations possible. Programming the PLC appropriately does not guarantee the correct switching sequence. The varying contactor actuating times can possibly trigger the mains contactor before the DC bus short-circuit contactor is opened. This means that the mains contactor should additionally be locked by means of an auxiliary contact of the DC bus short-circuit contactor.

DANGER

The DC bus short-circuit resistor is not secured against accidental contact. There is the danger of high-voltages (greater than 50 V).

Electrical shock resulting from contact

==> use an appropriate cover, see that it is in place or properly mounted

CAUTION

Thermal damage caused by DC bus short-circuit contactor and resistor in the event of faults in the control or contactor is possible.

Damage or loss due to fire is possible inside the control cabinet.

==> use an appropriate cover, see that it is in place or properly mounted

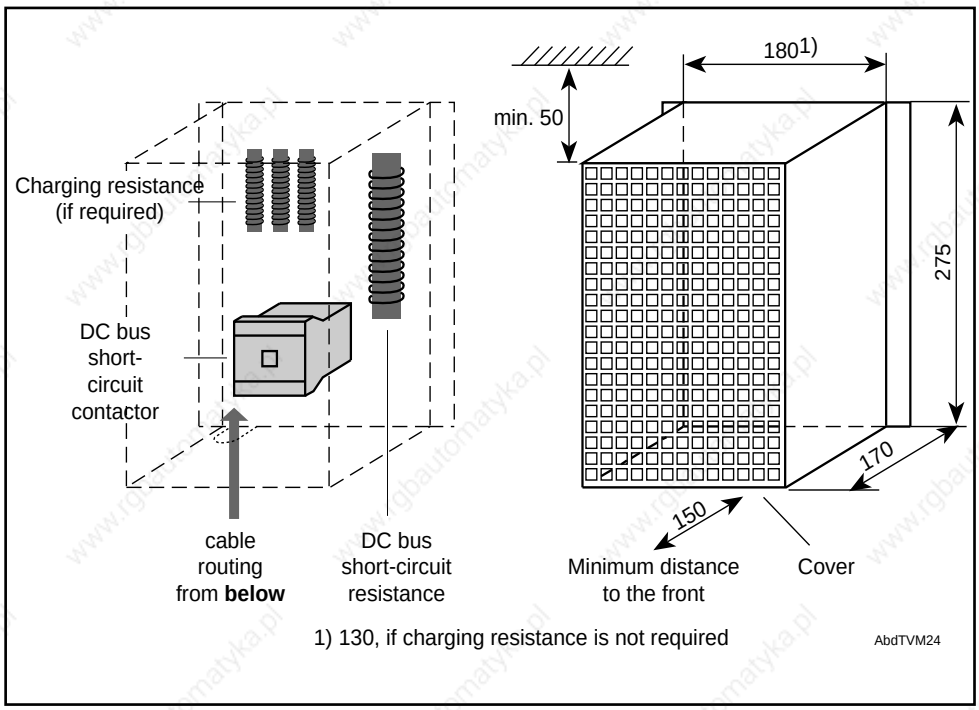


Fig. 4.1: Suitable covers and unit arrangements for the DC bus short-circuit

Switching frequency

A maximum of six switching procedures is permitted per minute.

The number of possible switching sequences is reduced if the sum of the rotary drive energy and the energy stored in the additional capacitance is greater than 1500 Ws. Otherwise, the DC bus short-circuit resistor will be overloaded. The number of the permissible DC bus short-circuit actuations can be calculated as follows:

$$S = \frac{150W \cdot 60\frac{s}{min}}{(W_{rot} + W_{ZW})}$$

S = number of permissible actuations per minute (max. 6)
W_{rot} = energy content of the drive given in Ws
W_{ZK} = energy stored in the additional capacitance given in Ws

Service life

The DC bus circuit contactor has a service lifespan of 20,000 actuations.

Maximum drive torque

Once the DC bus is short circuited, the drive will be decelerated with the short-circuit torque. This torque may be higher than the maximum torque indicated in the selection list. Particularly, if the relationship maximum torque to short-term operating torque is less than 1.3, then there will probably be increased torque.

CAUTION

Increased torque with short-circuited DC bus is possible.

Damage to mechanical transmission parts, machine damage from dimensional shifting that has gone unnoticed.

==> mechanical transmission elements must be laid out in terms of the torque at with a short-circuited DC bus.

A list of the short-term torque for MDD motors can be requested. The following formula can be used to calculate maximum torque with a short-circuited DC bus.

$$M_{ZK} = \frac{Km^2 \cdot \omega}{\sqrt{(R_A + R_{ZK})^2 + (\omega p L_A)^2}}$$

$$M_{maxZK} = M_{ZK} + M_H$$

M_{maxZK} = max . drive torque with short-circuited DC bus
M_{ZK} = short-circuit torque in Nm
M_H = decel torque of the holding brake in Nm
Km = current torque or voltage constant in Vs/rad
ω = angle speed in rad/s
R_A = winding resistance of the motor in Ω
R_{ZK} = DC bus short-circuit resistance in Ω (2.2 Ω)
p = number of pole pairs; for MAC and MDD the following applies:
size ≤ 41; p = 2
size ≥ 63; p = 3
L_A = winding inductance of the motor in H

4.4. Control circuit without soft-start resistor with dynamic braking

Applications

A power transformer capacity of up to and including 10 kVA, without added capacitors.

A power transformer capacity of up to and including 2.5 kVA, with added capacitors.

Features

Power is switched on directly without soft-start resistors. The inrush current is limited by the power transformer.

Dynamic braking will always stop synchronous motors regardless of whether the drive is still functioning or not. Dynamic braking **is only activated for drive faults**.

For emergency stop or if a monitor of the TVM 2.4 is tripped, drives are stopped **electrically under drive regulation at maximum torque**.

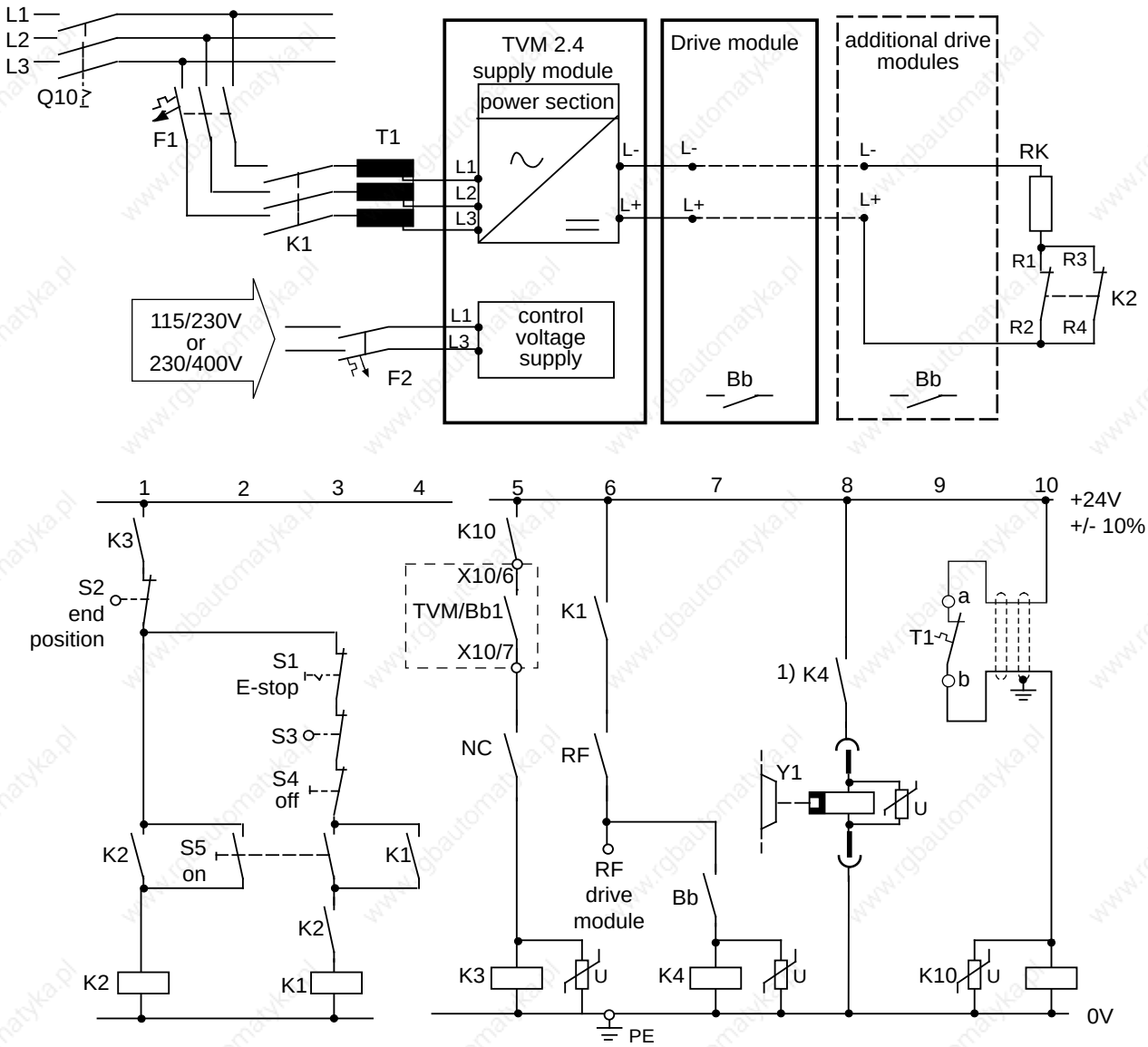
Mode of functioning

When the ON-button is pressed, then both mains contactor and dynamic braking contactor pick up immediately and are latched.

The mains contactor drops out immediately when the emergency-stop button is pressed. The drive enable is switched off by an auxiliary contact of the mains contactor. This leads to the velocity command being switched to zero on all drives. There is a controlled braking of all drives.

A drive fault message from the TVM 2.4 (Bb1 contact), a fault signal from the NC controller (servo error), or the tripping of an axis travel limit switch cause the mains contactor to switch off and dynamic braking to be activated (see section 3.6, Installation of dynamic brake).

Control circuit: • with dynamic brake
• without soft-start resistor



1) Only for feed drive holding brakes which are not controlled by the drive module.

Bb1 = supply module ready (drive system)
Bb = drive ready contact of drive module
F1 = fuse for input power
F2 = electronics and blower fuses
K1 = main contactor
K2 = dynamic brake contactor
K3 = decouple Bb1
K4 = holding brake control
K10 = decouple thermal contact for power transformer
NC = error signal from the control
- open for fault drive (servo error)
- closed for E-STOP

Q10 = main disconnect
RF = drive enable signal from controller
RK = dynamic brake resistor
S1 = E-STOP
S2 = axis limit switch
S3 = safety doors
S4 = power off
S5 = power on, cancel dynamic braking
T1 = power transformer
Y1 = Take delay time of electrically released holding brake of feed axes into account! Do not apply a velocity command until 100 ms after RF-ON.

NOTE! After K2 drops out, the contact must not be switched on for 0.5 seconds. Opening and closing of K2 due to S2 or K3 being activated intermittently must absolutely be prevented, otherwise K2 may be damaged. After it is switched off, contactor K2 must only be re-energized by a defined command, for example, S5.

SSTVM2.4/1

Figure 4.2: Control circuits without soft-start resistor, with dynamic braking

4.5. Control circuits with soft-start resistors, for applications withTDM drive modules

Applications

With the use of drive modules of the TDM, KDS and TDA series and under the following conditions:

- a power transformer capacity greater than 10 kVA, without added capacitors,
- a power transformer capacity greater than 2.5 kVA, with added capacitors, or,
- direct connection to a 3x AC 220 V mains.

Features

The soft-start resistors limit the inrush current.

Synchronous motors are always braked to a standstill by dynamic braking regardless of whether the drive electronics are still functioning or not. Dynamic braking **is only applied in the presence of a drive fault**.

There is a **controlled braking of the drives under drive regulation** at maximum torque if either an E-STOP should become necessary or if the TVM's monitors are triggered.

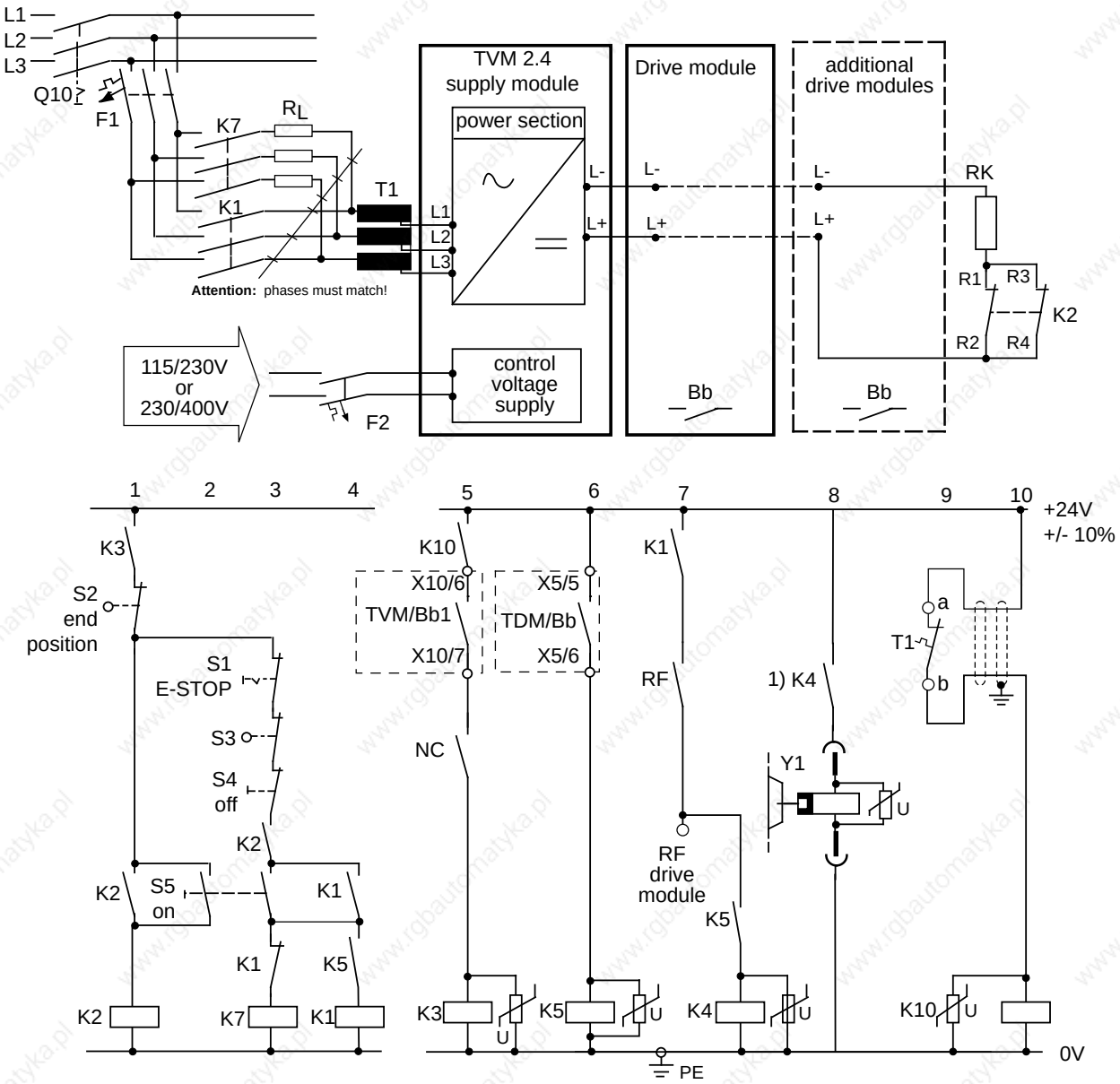
Operation

When the ON-button is pressed, then both mains contactor and dynamic brake contactor immediately pull in. Once the DC bus is charged and the Bb contact of the drive module is closed, then the soft-start is by-passed.

The mains contactor drops out immediately when the E-STOP button is pressed. An auxiliary contact on the mains contactor switches the drive enable signal off. Internal to the drive, this leads to the velocity command being switched to zero on all drives. There is a controlled braking of all drives.

A drive fault signal from the TVM 2.4 (Bb1 contact), a fault signal from the NC controller (servo error), or the tripping of an axis travel limit switch results in the main contactor being switched off and activation of dynamic braking (see section 3.6, Installation of dynamic brake).

Control circuit: • with dynamic braking
•with soft-start resistors



1) Only in the holding brakes of feed drives that are not controlled by the drive module.

Bb1 = supply module ready (drive system)
Bb = drive module ready
F1 = power supply fuses
F2 = electronics and blower fuses
K1 = mains contactor
K2 = dynamic brake contactor
K3 = decouple Bb1
K4 = holding brake control
K5 = decouple Bb of drive modules
K7 = soft-start contactor
K10 = decouple thermal contact of power transformer
NC = error signal from the control
- open for fault drive (servo error)
- closed for E-STOP

Q10 = main disconnect
RF = drive enable signal from controllerl
RK = dynamic brake resistor
RL = soft-start resistors
S1 = E-STOP
S2 = axis limit switch
S3 = safety doors
S4 = power off
S5 = power on, release link circuit dyn. braking
T1 = power transformer
Y1 = Take delay time of electrically released holding brake of feed axes into account! Do not apply a velocity command until 100 ms after RF-ON.

ATTENTION! After K2 drops out, the contact must not be switched on for 0.5 seconds. Opening and closing of K2 due to S2 or K3 being activated intermittently must absolutely be prevented, otherwise K2 may be damaged. After it is switched off, contactor K2 must only be re-energized by a defined command, for example, S5.

SSTVM2.4/2

Figure 4.3: Control circuits with soft-start resistor with the use of a TDM drive module

4.6 Control circuit with soft-start resistor, for applications with DDS drive controllers

Applications

For use with DDS series drives and under the following conditions:

- power transformer greater than 10 kVA, without added capacitors,
- power transformer greater than 2.5 kVA, with added capacitors, or,
- direct connection to a 3x AC 220 V mains.

The soft-start resistors limit the inrush current.

Features

Dynamic braking will always stop synchronous motors regardless of whether the drive is still functioning or not. Dynamic braking **is only activated for drive faults**.

For emergency stop or if a monitor of the TVM 2.4 is tripped, drives are stopped **electrically under drive regulation** at maximum torque.

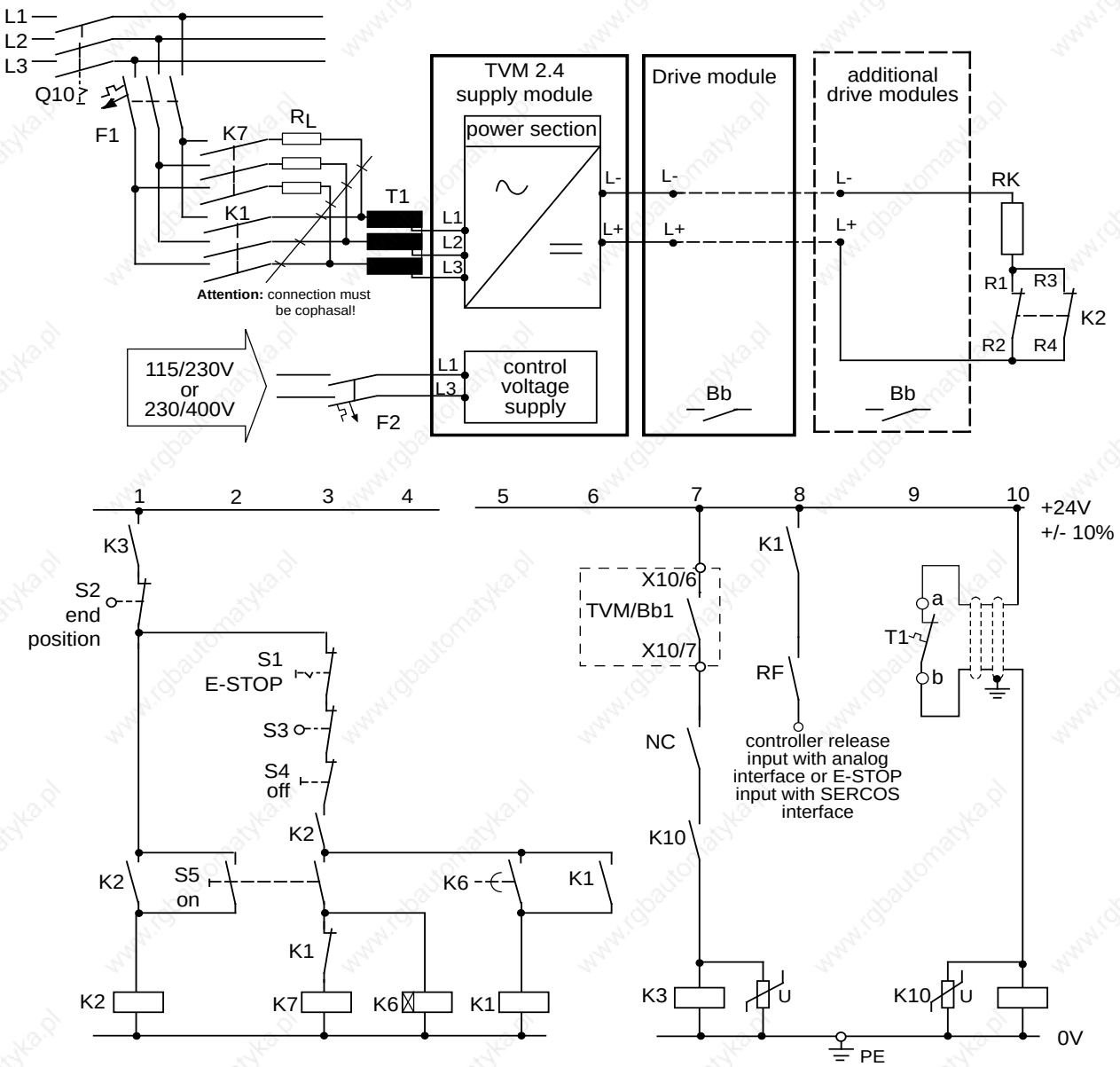
Operation

When the ON-button is pressed, then both the soft-start contactor and D.C. bus dynamic brake contactor pull in. After the soft-start charging time has passed, the main contactor pulls in by means of a time relay and by-passes the soft-start contactor.

The mains contactor drops out immediately once the E-STOP button is pressed. An auxiliary contact of the mains contactor switches the drive enable signal off. Internal to the drive, this leads to the velocity command being switched to zero on all drives. All drives are braked under drive control.

A drive fault signal by means of the TVM Bb1 contact, a NC fault signal (servo fault), or the tripping of an axis travel limit switch results in the main contactor being switched off and actiation of dynamic braking (see section 3.6).

Control circuit: • with DC bus dynamic brake
• with soft-start resistors for use with DDS drives



Bb1 = supply module ready (drive system)
Bb = drive module ready
F1 = power supply fuses
F2 = felectronics and blower fuses
K1 = main contactor
K2 = dynamic brake contactor
K3 = decouple Bb1
K6 = pull-in delay approx. 500 ms
K7 = soft-start contactor
K10 = decouple thermal contact of power transformer
NC = error signal from the control
– open for fault drive (servo error)
– closed for E-STOP

Q10 = main disconnect
RF = drive enable signal from controller
RK = dynamic brake resistor
RL = soft-start resistors
S1 = E-STOP
S2 = axis limit switch
S3 = safety doors
S4 = power off
S5 = power on, cancel dynamic braking
T1 = power transformer drops off at 3x AC 220 V

ATTENTION! After K2 drops out, the contactor must not be switched on for 0.5 seconds. Opening and closing of K2 due to S2 or K3 being activated intermittently must absolutely be prevented, otherwise K2 may be damaged. After it is switched off, contactor K2 must only be re-energized by a defined command, for example, S5.

SSTVM2.4/3

Figure 4.4: Control circuits with soft-start resistors, for use with DDS drive controllers

5. Interface descriptions

5.1. Signal voltages

The signal voltages can be obtained from terminal strip X10. These terminals are intended for measuring and test purposes. If these voltages are used outside of the TVM, then ensure that no interference voltages are coupled in (use short, shielded cables; relay coils should have no voltage suppression).

To ensure proper operation of the drives, do not exceed the load capacity of the signal voltage outputs.

Terminal	Signal voltage	Maximum load capacity
X 10/1	+ 15 V_M	100 mA
X 10/2	0 V_M	——
X 10/3	- 15 V_M	100 mA
X 10/4	+ 24 V_L	2 A
X 10/5	0 V_L	——

5.2. Ready signal

Output Bb1

Potential-free contact - terminal X 10/6 - X 10/7

Maximum load: DC 24V/1A
(Do not connect relay coils with high inrush current directly to this contact.)

Operation	**Relay voltage-free**	**Fault**	**Ready to operate**
Output	open	open	closed

The Bb1 contact of the TVM 2.4 has a high priority significance. The emergency stop chain of the drive system is tied into the Bb1 contact. Only when it is closed may the three-phase AC power supply be applied.

The Bb1 contact closes when power for the electronics supply is applied to X10 /8/9/10, and there is no fault.

The Bb1 contact opens for the following faults:

- tachometer fault
- overtemperature in one of the drives
- overcurrent fault in one of the drives
- a fault in the +/-15VM / +24VL signal voltages
- an open in the wire-ribbon connection or missing termination connector
- bleeder overloaded

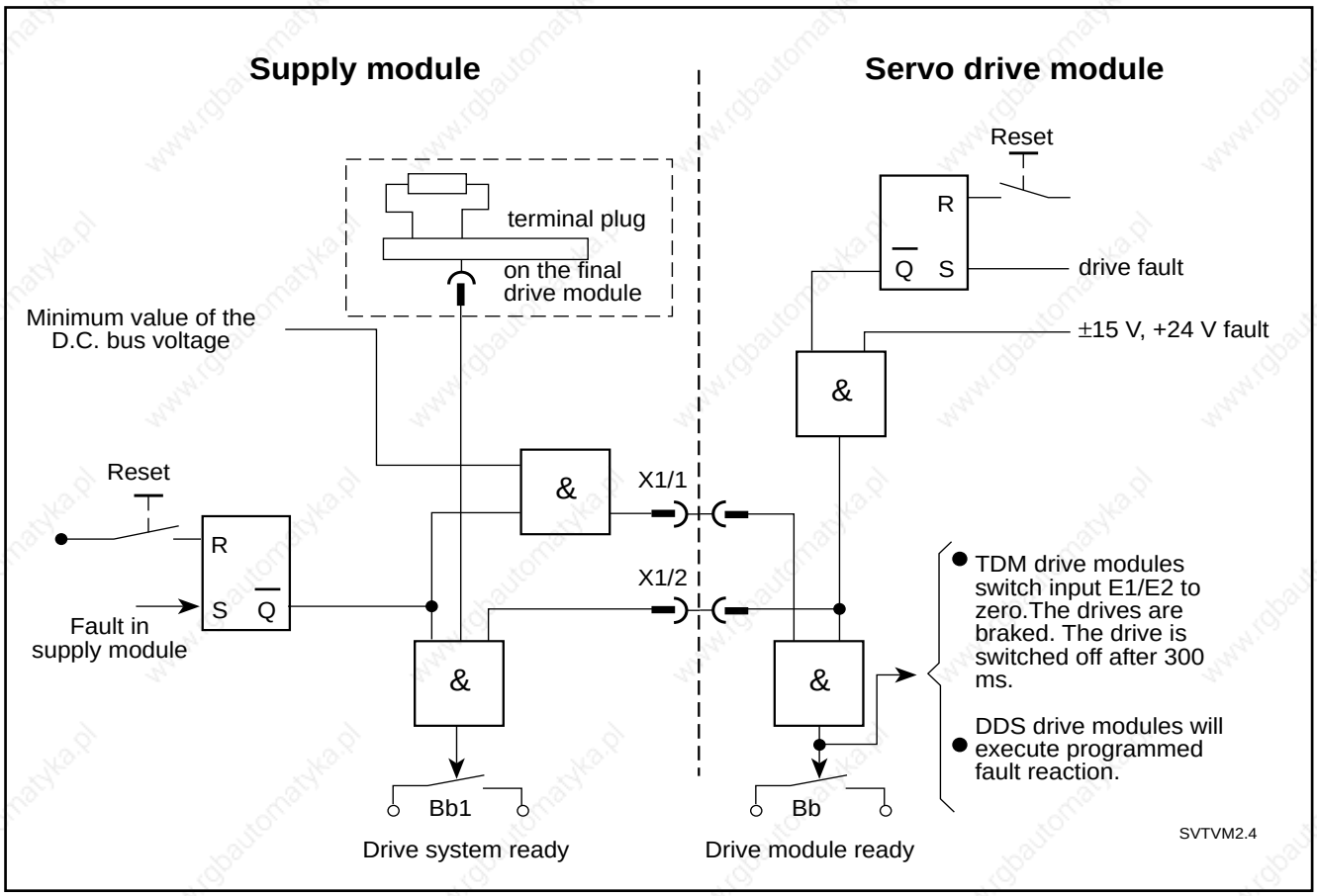


Figure 5.1: Drive monitoring and diagnostics systems

5.3. Additional bleeder control

Output EB

Terminal X10 /11

An output voltage of up to 425 V; output current of 500 mA

Additional bleeder module TBM 1.2 can be controlled over output EB.

The cross section of the cable between output EB and input EB of the TVM 2.4 may not be less than 1,5 mm^2 (maximum connecting cross section equals 2.5 mm^2).

The output voltage can equal up to 425 V !

6. Trouble-shooting guides

Because of the resulting production down-time, lengthy fault-finding and repairs to drive components on the machine are unacceptable.

Thanks to their construction, INDRAMAT A.C. drives enable individual functional units to be easily and completely replaced without the need for tuning.

This means that, in the event of a fault, servicing is limited to fault-location either in the motor, the power supply module or the drive, or simply exchanging the faulty component.

6.1. Troubleshooting

Because of the interaction between NC controller, supply and drive modules, motor, mechanical system and position measurement, poor performance of axis movements can be caused either by a fault in the above devices or incorrect interfacing of individual components. The TVM 2.4 is fitted with a comprehensive diagnostic system for rapid fault location.

6.2. Safety guidelines

There is increased risk of an accident in the presence of a fault. Personnel, the machinery and the drives are at risk.

Troubleshooting and equipment repair must only be performed by trained personnel.

Danger due to drive axis motion:
When troubleshooting, undesired axis motion is possible.

There should be no personnel within the danger zone. Safety measures such as safety screens, covers and light barriers must be present.

There must be free and ready access to the E-STOP button.

The following applies when working within the danger zone:

The power to the installation must be switched off and lock-out the system so that it cannot be switched back on when working within the danger zone.

Wait until the DC bus circuit has completely discharged (approximately five minutes).

Verify voltage by measuring at X9 /L+/L-.

Danger due to voltage conductive parts

Dangerous voltages can be present at the following connections:

- at all supply module connections and associated transformers, capacitors and additional bleeders. In particular, at the power connections (terminal X9), control voltage input X10, as well as the blower supply connections X13 and X14.
- At the drive modules, motors and the plug-in connections of the motor connections.

Before working on electrical devices:

Use the main disconnect to cut power to the entire installation and make sure it cannot be switched back on.

Wait for the DC bus to discharge (approximately five minutes). Verify voltage by measuring it at X9 /L+/L.

Do not run motor. The motor connections are energized during any movements of the motor.

Before switching on:

Only turn on the power after installing the touch-cover shipped with each unit.

Notes on protecting the machine

To avoid damage to the machine, note:

The initial start-up should only be performed by trained personnel. Make sure that the E-STOP and the axis limit switches operate properly.

Notes on protecting the unit

Before switching on:

Make sure that the circuitry agrees with the TVM interconnect diagram and the schematic for the machine.

Electrostatic loads

Electrostatic loads are hazardous to electronic components.

Ground all objects prior to contact with the units.

6.3. Diagnostics displays

Attention: The signals are only valid if the "+24V, ±15V"- LED display is lit.

(1) Signal and unit disabling are latched.
Reset by pressing the reset button or by cycling power to the electronic power supply.

Light-emitting diodes			Off	Constant light
H3	**Überlast** **OVERLOAD BLEEDER**	red	Continous bleeder operation is in the permissible range **OK**	Shutdown due to high bleeder power, mains voltage too high, or defective supply module.
H4	**Leistung Ein** **POWER ON**	green	Power not switched on or power outage.	High voltage power **OK**

DiagTVM2.4

Figure 6.1: Diagnostic displays of the TVM 2.4

6.4. List of faults and their remedies

Signal

BLEEDER OVERLOAD **Shutdown due to high bleeder power**

Possible causes:

- The continuous regenerated power is greater than the permissible continuous bleeder power of the TVM 2.4.
- Energy of the drives is too high.
- Fault in the TVM 2.4

Remedies:

- Check the start-stop frequency of the drive.
- Check the drive energy.

POWER ON **No DC bus voltage**

Possible causes:

- Mains fuse have blown out.
- No mains voltage applied because the mains contactor is not pulled in.
- Mains voltage too low.
- Missing phase.

Remedies:

- Check the mains fuses.
- Check control circuit for mains contactor.
- Check transformer connections; measure mains voltage.

Fault

Bb1 contact "open"

Drive system not ready for three-phase power.

Possible causes:

- Fault in one of the drives.
- Termination connector missing.

Remedies:

- Check diagnostics display on the drive.
- Check installation of the wire ribbon cable.
- Check for the termination connector.

+24 V ±15 V "missing"

+ 24 V ± 15 V control voltages have a fault.

Possible causes:

- Control voltage input to X10 is wrong of not connected.
- Maximum signal voltage load exceeded.
- The fuses F2, F3 or F4 on the TVM 2.4 have been burned out.

Remedies:

- Check the fuses in the enclosure.
- Disconnect the wire-ribbon cable to the drives and recheck the voltages.
- Disconnect the signal voltages tappped off from the TVM for use outside the TVM and drive modules and check these for short-circuits.
- Check fuses F2, F3 and F4.

6.5. Fuses

The signal voltage fuses are easily accessible and located on the front of the TVM 2.4.

Designation of fuse	Type of fuse
F 2	T 10 A / 250 V
F 3 and F 4	with TVM 2.4-050-300-W1/**115/220** T 10 A / 250 V with TVM 2.4-050-300-W1/**220/380** M 6.3 A / 250 V

7. Dimensional data

7.1. TVM 2.4 supply module - dimensional data

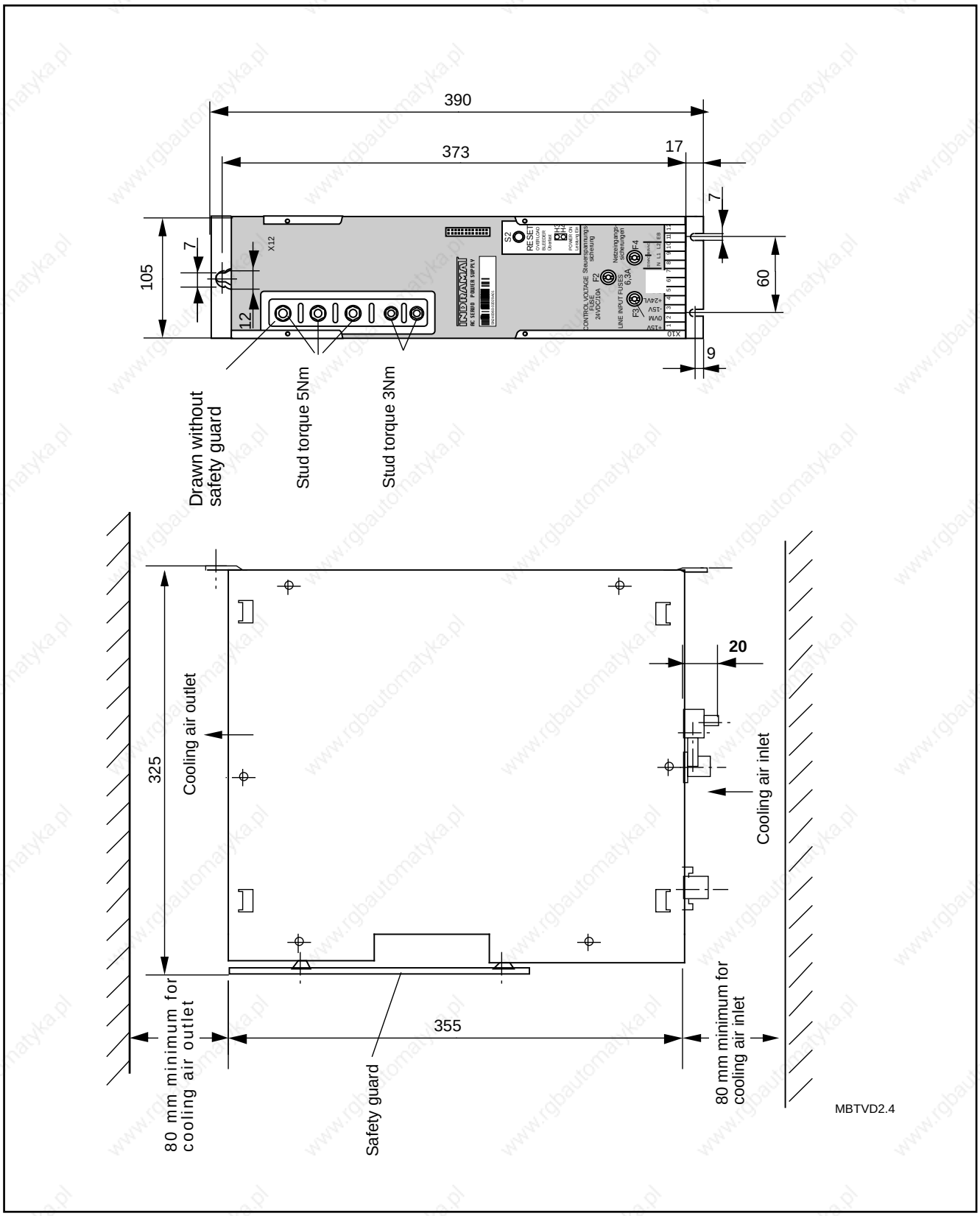
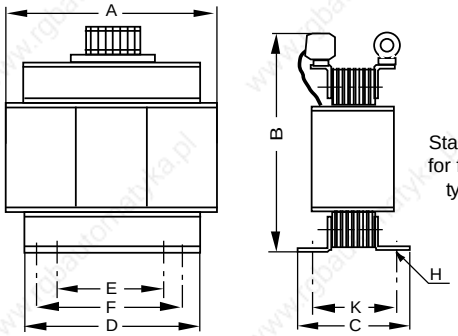
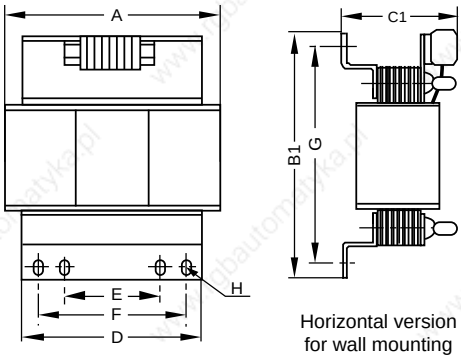


Figure 7.1: TVM 2.4 - dimensional data

7.2. Dimensions for DST autotransformers



Standing version
for foot mounting
type DST.../S

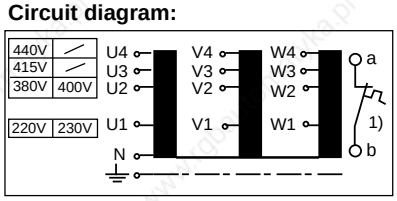


Horizontal version
for wall mounting
type DST.../L

Example: rating plate

Type:	DST 2,5/S/380/415/440-220	**Bj.**	1993		
Prim.:	380-400/415/440 V				
Sec.:	220-230V				
S	2,5 kVA	YNa0	**T**	40/B	**f** 50/60 Hz

Circuit diagram:



1) Maximum load: DC 24 V/1 A
AC 230 V/1 A

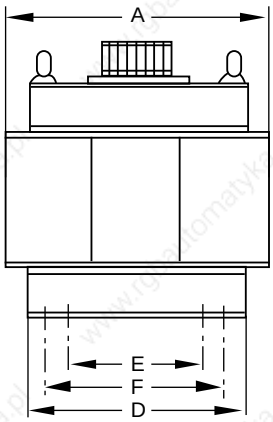
Dimensions and technical data for 3-phase current autotransformer with U_{sec} = 220-230 V; U_{pri} = 380-400 V, 415 V, 440 V, 460 V, 500 V, f = 50/60 Hz

Type designation DST	Dimensions in mm											Heat loss in W	Max. conn. cross sec. in mm²	Wgt. in kg
	A	B	B1	C	C1	D	E	F	G	H	K			
0,5/ • /380/415/440–220	150	165	170	75	80	125	70	100	154	6	55	30	4	4
0,5/ • /380/460/500–220	150	165	170	90	95	125	70	100	154	6	70	40	4	6
1,0/ • /380/415/440–220	180	190	205	105	100	125	80	125	185	7	75	45	4	8.5
1,0/ • /380/460/500–220	180	190	205	115	100	150	80	125	185	7	85	55	4	10
1,5/ • /380/415/440–220	180	190	205	115	110	150	80	125	185	7	85	55	4	10
1,5/ • /380/460/500–220	205	210	235	120	110	150	95	145	209	7	85	75	4	11.5
2,0/ • /380/415/440–220	205	210	235	120	110	170	95	145	209	7	85	80	4	11.5
2,0/ • /380/460/500–220	240	260	270	120	135	200	110	170	240	11	90	90	4	18
2,5/ • /380/415/440–220	240	260	270	120	135	200	110	170	240	11	90	95	4	18
2,5/ • /380/460/500–220	240	260	270	140	155	200	110	170	240	11	110	110	4	21
3,5/ • /380/415/440–220	240	260	270	140	155	200	110	170	240	11	110	125	10	21
3,5/ • /380/460/500–220	240	260	270	150	165	200	110	170	240	11	120	130	10	24.5
4,0/ • /380/415/440–220	240	260	270	150	165	200	110	170	240	11	120	140	10	24.5
4,0/ • /380/460/500–220	240	260	270	155	170	200	110	170	240	11	125	150	10	26
5,0/ • /380/415/440–220	240	260	270	155	170	200	110	170	240	11	125	160	10	26
5,0/ • /380/460/500–220	300	325	340	140	165	250	140	210	310	11	110	180	10	30.5
7,5/ • /380/415/440–220	300	325	340	155	180	250	140	210	310	11	125	200	10	36
7,5/ • /380/460/500–220	300	325	340	165	195	250	140	210	310	11	135	230	10	42
10/ • /380/415/440–220	300	325	340	180	205	250	140	210	310	11	150	245	10	50
10/ • /380/460/500–220	300	325	340	195	220	250	140	210	310	11	165	250	10	53
12,5/ • /380/415–220	300	325	340	195	220	250	140	210	310	11	165	260	10	53
12,5/ • /440/460–220	335	365	380	195	225	280	160	230	350	11	160	270	10	65
12,5/ • /500/525–220	335	365	380	195	225	280	160	230	350	11	160	285	10	65
15/ • /380/415–220	335	365	380	195	225	280	160	230	350	11	160	290	16	65
15/ • /440/460–220	360	395	400	190	215	300	170	250	370	11	160	305	16	68
15/ • /500/525–220	360	395	400	190	215	300	170	250	370	11	160	310	16	68
18/ • /380/415–220	360	395	400	190	215	300	170	250	370	11	160	330	16	68
18/ • /440/460–220	360	395	400	205	230	300	170	250	370	11	175	350	16	80
18/ • /500/525–220	360	395	400	205	230	300	170	250	370	11	175	375	16	80
20/ • /380/415–220	360	395	400	190	215	300	170	250	370	11	160	380	16	70
20/ • /440/460–220	360	395	400	205	230	300	170	250	370	11	175	395	16	80
20/ • /500/525–220	420	450	460	215	210	350	190	280	420	14	165	430	16	92
25/ • /380/415–220	420	450		215		350	190	280		14	165	450	35	92
25/ • /440/460–220	420	450		215		350	190	280		14	165	470	35	92
25/ • /500/525–220	420	450		245		350	190	280		14	195	490	35	122
35/ • /380/415–220	420	450		245		350	190	280		14	195	540	35	122
35/ • /440/460–220	420	450		245		350	190	280		14	195	630	35	122
35/ • /500/525–220	420	450		275		350	190	280		14	225	670	35	152
50/ • /380/415–220	420	450		275		350	190	280		14	225	720	70	152
50/ • /440/460–220	580	540		255		550	270	400		18	205	790	70	180
50/ • /500/525–220	580	540		265		550	270	400		18	215	850	70	195

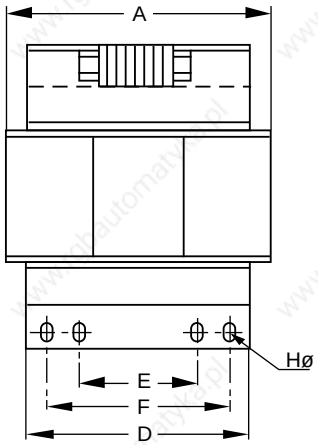
MBDST

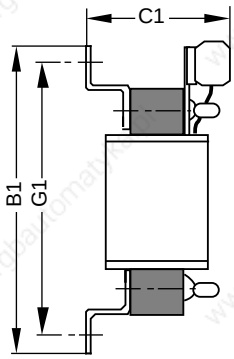
Figure 7.2: 3-phase current DST autotransformer dimensional data

7.3. Dimensions for DLT isolation transformers



Standing version
for foot mounting
type DLT.../S



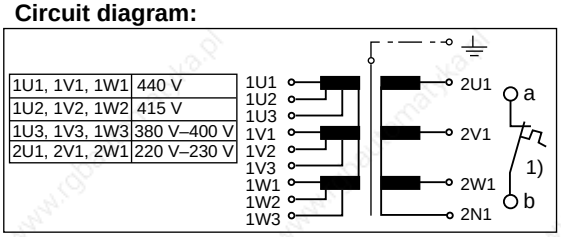


Horizontal version
for wall mounting
type DLT.../L

Example: rating plate

Type:	DLT 2,5/S/380/415/440-220	**Bj.**	1993		
Prim.:	380-400/415/440 V				
Sec.:	220-230V				
S	2,5 kVA	Yyn0	**T**	40/B	**f** 50/60 Hz

Circuit diagram:



1) Maximum load: DC 24 V/1 A; AC 230 V/1 A

Dimensions and technical data for 3-phase current isolating transformer with U_{sec} = 220-230 V; U_{pri} = 380-400 V, 415 V, 440 V, 460 V, 500 V, f = 50/60 Hz

Type designation DLT	Dimensions in mm											Heat loss in W	Max. conn. cross sec. in mm²	Wgt. in kg
	A	B	B1	C	C1	D	E	F	G	G1	H			
0,5/ • /380/415/440–220	180	190	205	105	100	150	80	125	75	185	7	65	4	8.5
0,5/ • /380/460/500–220	180	190	205	105	100	150	80	125	75	185	7	70	4	8.5
1,0/ • /380/415/440–220	205	210	235	130	120	170	95	145	95	209	7	120	4	13
1,0/ • /380/460/500–220	205	210	235	130	120	170	95	145	95	209	7	140	4	13
1,5/ • /380/415/440–220	240	260	270	140	155	200	110	170	110	240	11	155	4	21
1,5/ • /380/460/500–220	240	260	270	140	155	200	110	170	110	240	11	165	4	21
2,0/ • /380/415/440–220	240	260	270	150	165	200	110	170	120	240	11	180	4	24.5
2,0/ • /380/460/500–220	240	260	270	150	165	200	110	170	120	240	11	195	4	24.5
2,5/ • /380/415/440–220	300	325	340	140	165	250	140	210	110	310	11	220	4	30.5
2,5/ • /380/460/500–220	300	325	340	140	165	250	140	210	110	310	11	235	4	30.5
4,0/ • /380/415/440–220	300	325	340	165	195	250	140	210	135	310	11	240	10	42
4,0/ • /380/460/500–220	300	325	340	165	195	250	140	210	135	310	11	265	10	42
5,0/ • /380/415/440–220	335	365	380	175	210	280	160	230	145	350	11	300	10	55
5,0/ • /380/460/500–220	335	365	380	175	210	280	160	230	145	350	11	350	10	55
7,5/ • /380/415/440–220	360	395	400	190	215	300	170	250	160	370	11	375	10	70
7,5/ • /380/460/500–220	360	395	400	190	215	300	170	250	160	370	11	395	10	70
10/ • /380/415/440–220	360	395	400	205	230	300	170	250	175	370	11	500	10	85
10/ • /380/460/500–220	360	395	400	205	230	300	170	250	175	370	11	510	10	85
15/ • /380–220	420	450		245		350	190	280	195		16	600	16	122
20/ • /380–220	420	450		275		400	190	280	225		16	800	35	152
25/ • /380–220	580	540		255		– –	270	400	205		18	875	35	180
35/ • /380–220	660	590		295		– –	270	480	245		18	1000	70	275
50/ • /380–220	660	655		305		– –	270	480	255		18	1170	70	320

MBDLT

Figure 7.3: 3-phase current DLT isolation transformer dimensional data

7.4. Dimensions additional capacitor CZ 1.02

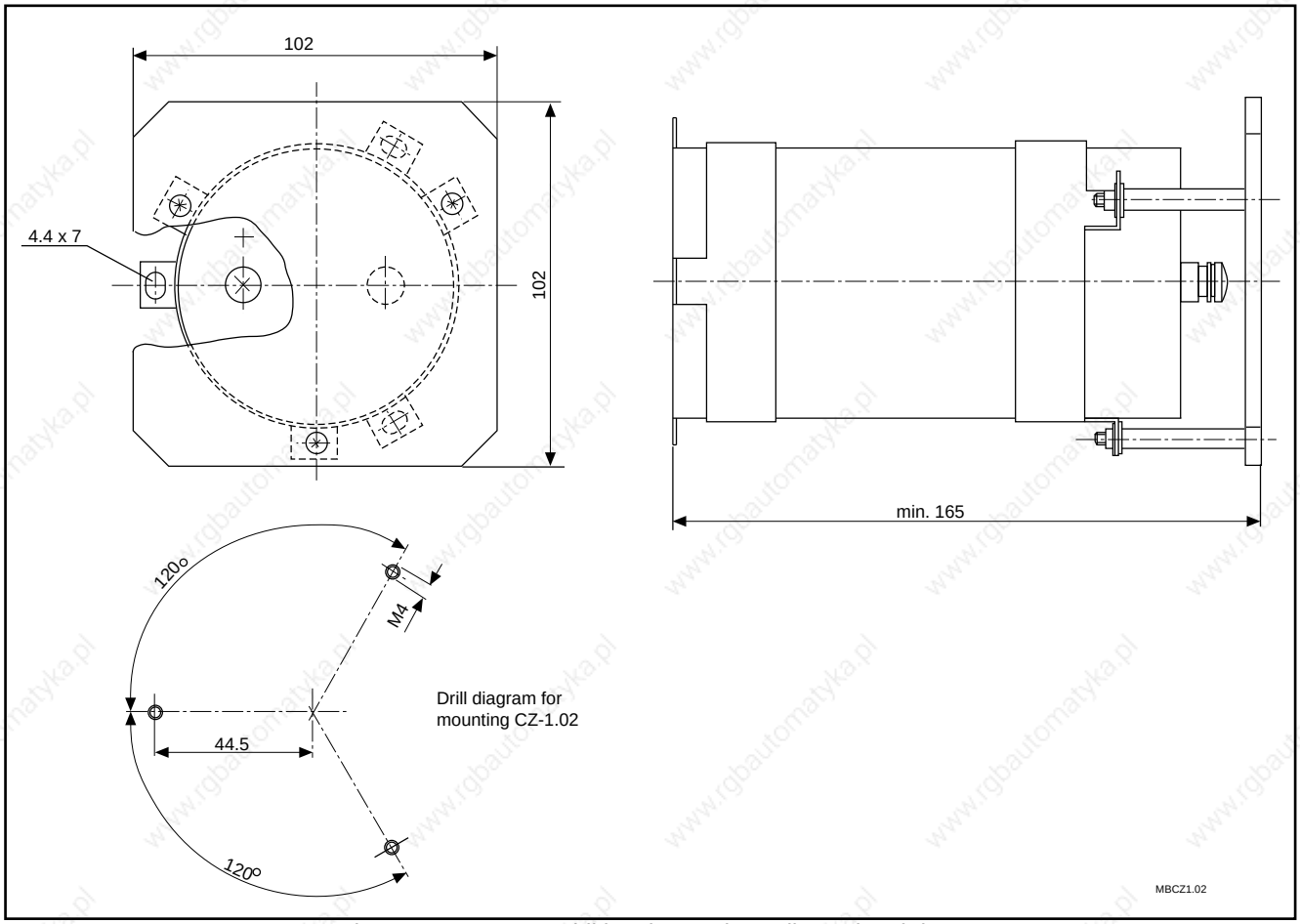


Figure 7.4: CZ 1.02 additional capacitor - dimensional data

7.5. Dimensions additional capacitor TCM 1.1

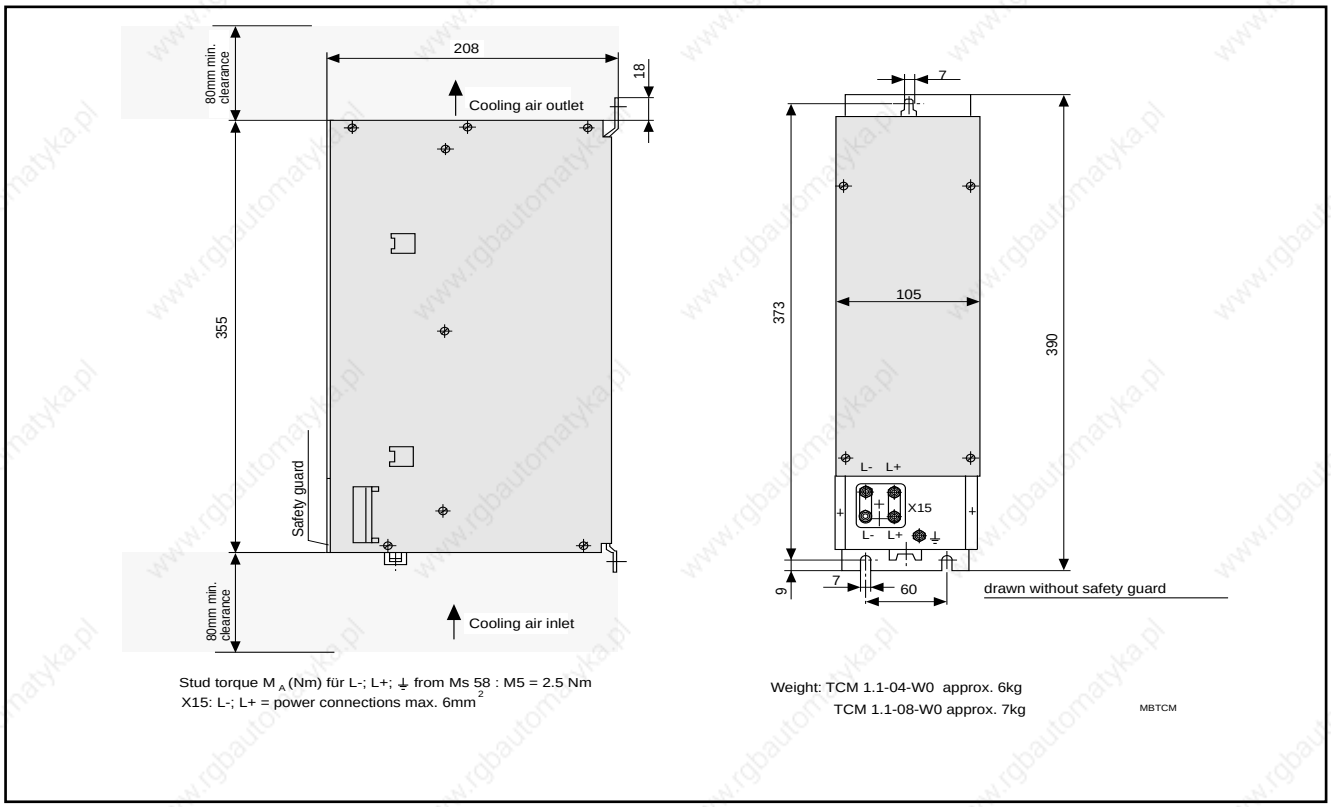


Figure 7.5: TCM 1.1 additional capacitance module - dimensional data

7.6. Dimensions for bleeder module TBM 1.2

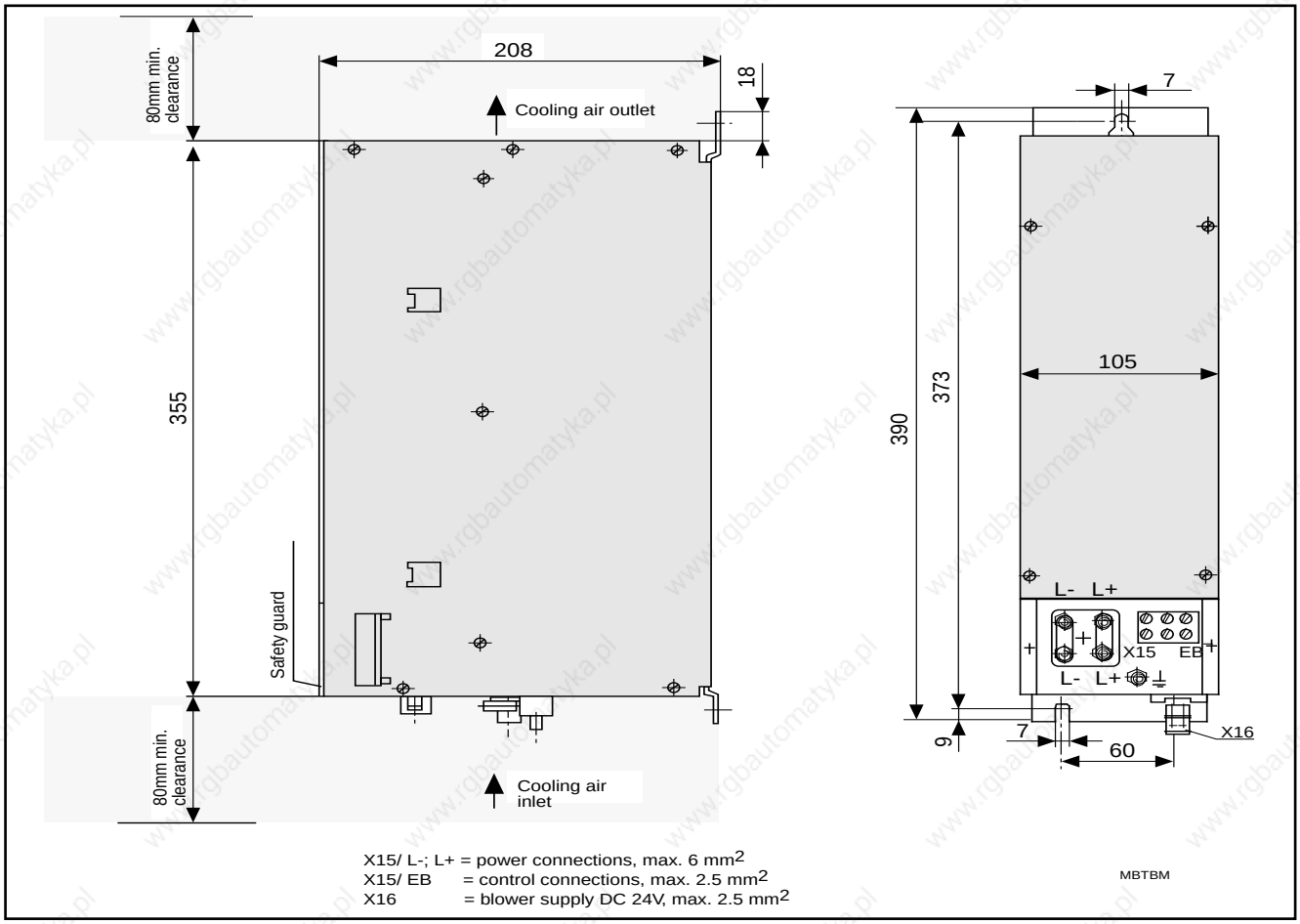
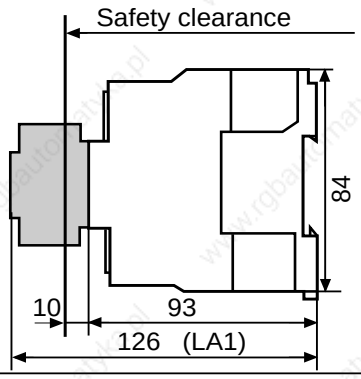


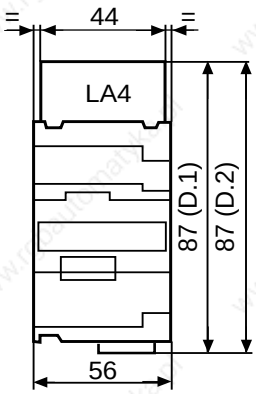
Figure 7.6: TBM 1.2 additional bleeder module - dimensional data

7.7. Dynamic brake contactor

Alternating current device:

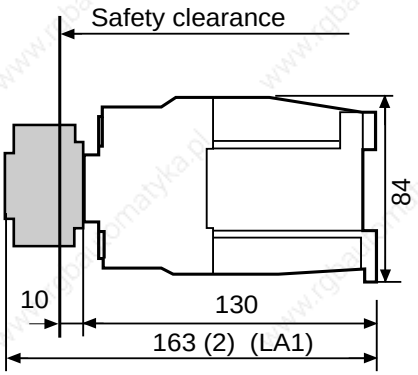
- 220V AC 50/60Hz contactor LC1-D25008 MA
- 110V AC 50/60Hz contactor LC1-D25008 F7
- Auxililary block LA1-DN22
- Overvoltage limiter LA4 DA 1U (RC-section)

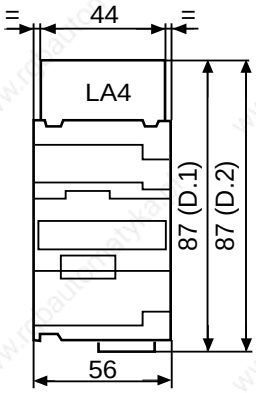




Direct current device

- 24V DC contactor LP1-D25008 BW
- auxiliary block LA1-DN22
- overvoltage limiter LA4 DE 1E (Varistor)

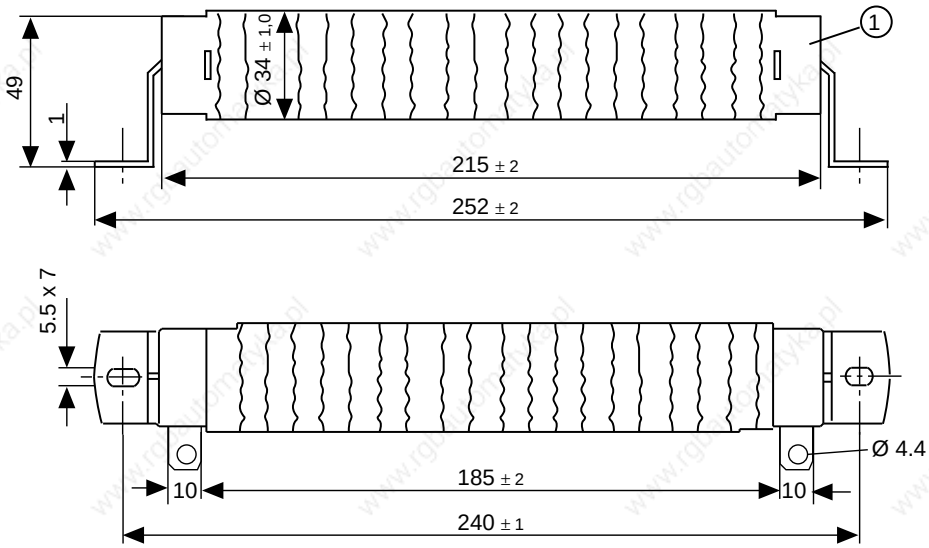


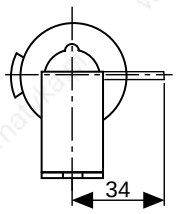


TVMZwKrschütz

Figure 7.7: Dynamic brake contactor

7.8. Dynamic brake resistor



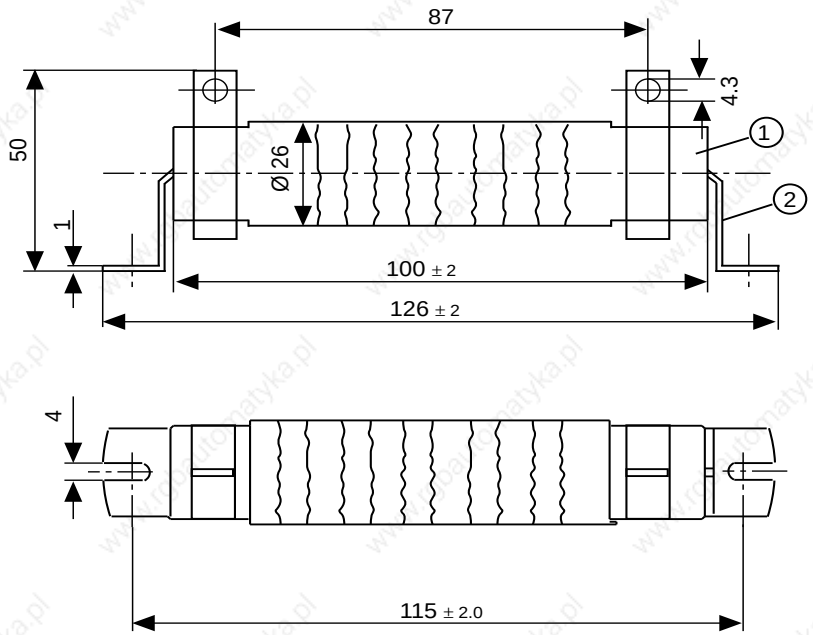


(1) Dynamic brake resistor with Mounting bracket
Type: HLZ-300-07Z, 2R2, 300 W

TVMWidZSB

Figure 7.8: Dimensional data for dynamic brake resistor

7.9. Soft-start resistor

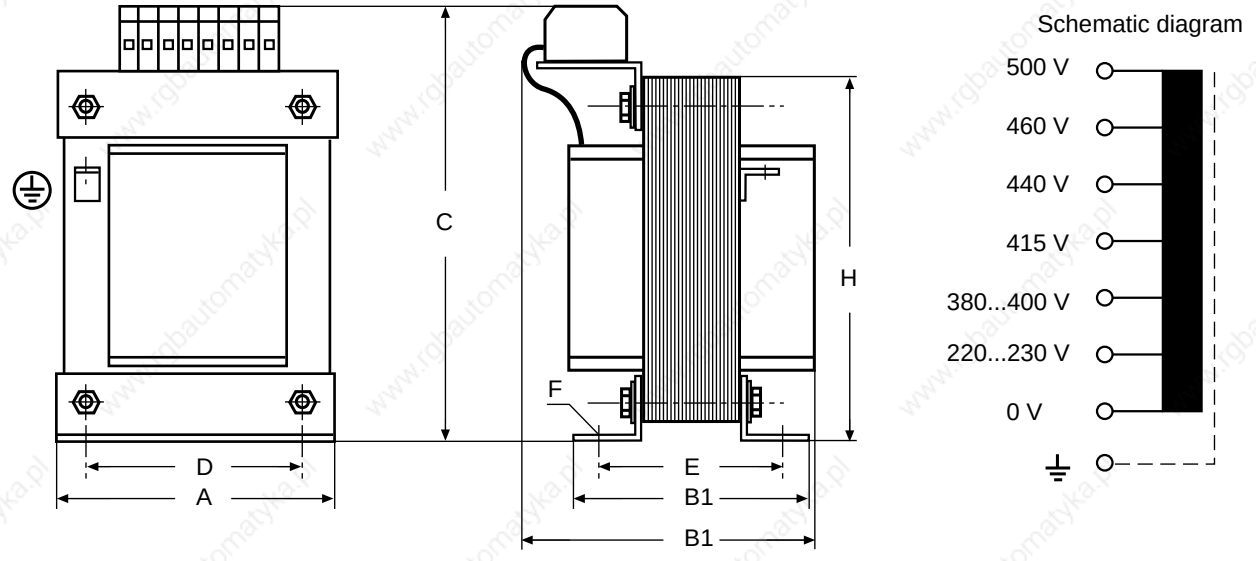


① Soft-start resistor
Type: ZDBS 24 x 100 5R0
Part number: 217 765

② Z-clip mounting bracket
Type A3
Part number: 233 295

Figure 7.9: Soft-start resistor

7.10. Single-phase transformer



Dimensions and technical data of single-phase autotransformer EST
(Input voltages 500V; 460V; 440V; 415V; 380 ... 400 V; output voltages 220 ... 230 V)

Type designation EST	Power in kVA	Dimensions in mm								m in kg	P_V in W	uK in %	Terminals in mm^2 (max)
		A	B	B1	C	D	E	F	H				
0.5/S /500/460/440/415/380–220	0.5	120	112	104	120	100	89	6 x 10	105	5.1	40	2.5	4
0.7/S /500/460/440/415/380–220	0.7	100	106	96	148	84	80	6 x 11	123	5.5	45	2.5	4
1.0/S /500/460/440/415/380–220	1.0	130	135	128	143	113	108	7 x 14	118	8.5	55	2.0	4
1.5/S /500/460/440/415/380–220	1.5	150	165	155	160	125	130	7 x 14	132	12.5	70	1.5	4

m = weight; PV = heat dissipation; uK =short-circuit voltage

MBEST01

Figure 7.10: Single-phase transformer

8. Order information

8.1. TVM 2.4 type codes

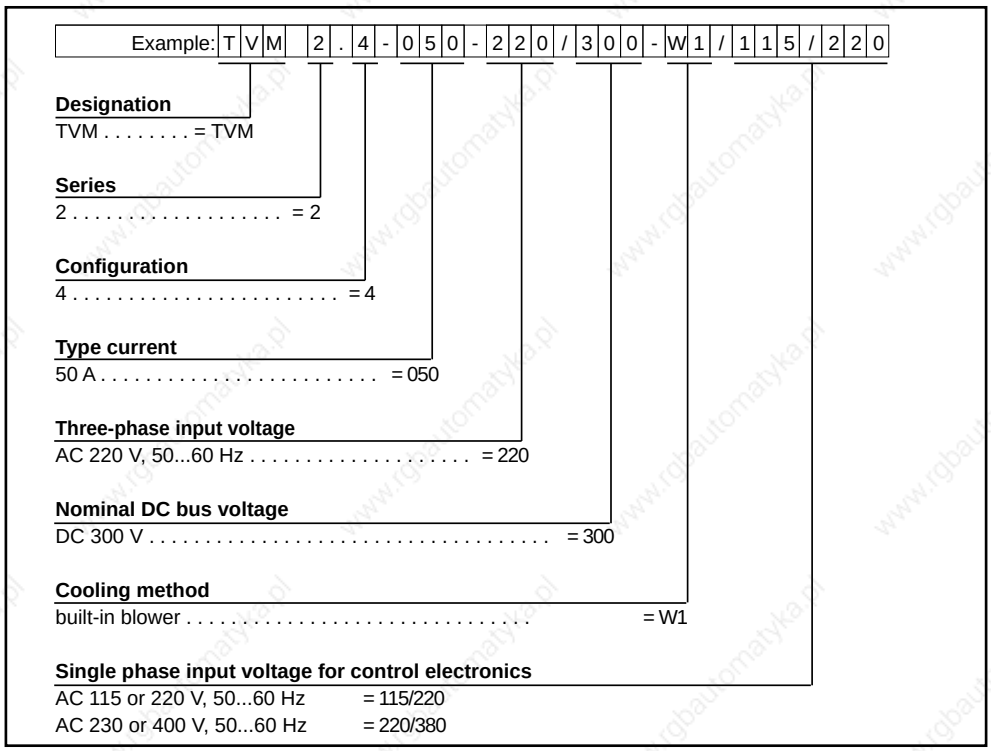


Figure 8.1: Type codes for a TVM 2.4

8.2. Available configurations of supply module TVM 2.4 and accessories

	Available configurations:
1. Supply module	TVM 2.4-050-220/300-W1/115/220
	TVM 2.4-050-220/300-W1/220/380
1.1 Electrical accessories	E1-TVM
	E2-TVM
	E3-TVM
2. Add. bleeder module	TBM 1.2-40-W1-024
3. Add. capacitance	
3.1 Add. capacitor	CZ 1.02 (2mF capacitor)
3.2 Add. capacitor mod.	TCM 1.1-04-W0 (4 mF)
	TCM 1.1-08-W0 (8 mF)

4. Dynamic braking

4.1 Dynamic brake contactor

Coil voltage	DC 24 V	LP1 D25 008BW
Coil voltage	AC 220 V 50/60 Hz	LC1 D25 008M7
Coil voltage	AC 110 V 50/60 Hz	LC1 D25 008F7
Auxiliary block		LA1 DN 22
4.2 Dynamic brake resistor		HLZ-300-07 Z (includes mounting bracket)

8.3. Available autotransformers

Standard autotransformers are available in either floor mount or wall mount configuratins in the power range up to 20 kVA.

The tap marked „380“ is used for either 3x 380 V (+15% / -10%) or 3x 400V (+10% / -15%)(see dimensional data, section 7).

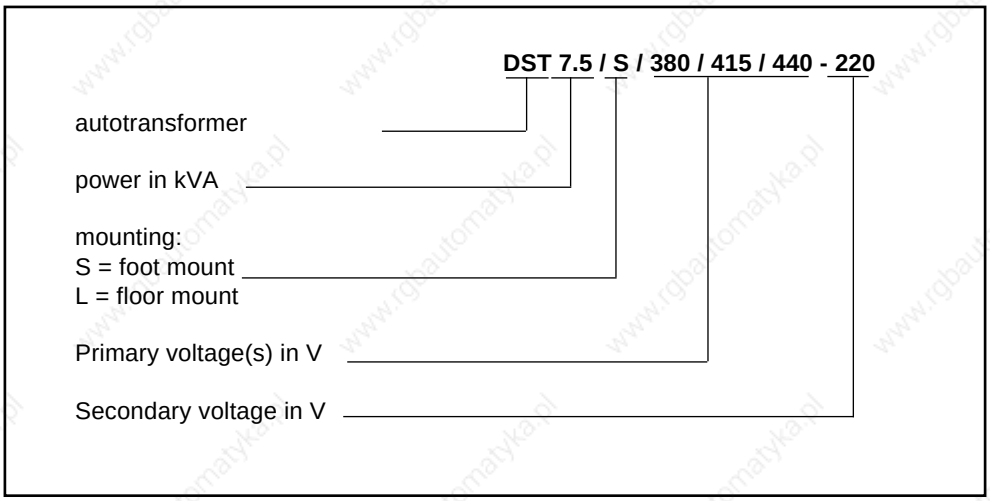


Figure 8.2: Type codes for tautotransformers

Available configurations:

DST 0.5/./380/415/440-220
DST 0.5/./380/460/500-220

DST 1.0/./380/415/440-220
DST 1.0/./380/460/500-220

DST 1.5/./380/415/440-220
DST 1.5/./380/460/500-220

DST 2.0/./380/415/440-220
DST 2.0/./380/460/500-220

DST 2.5/./380/415/440-220
DST 2.5/./380/460/500-220

DST 3.5/./380/415/440-220
DST 3.5/./380/460/500-220

DST 4.0/./380/415/440-220
DST 4.0/./380/460/500-220

DST 5.0/./380/415/440-220
DST 5.0/./380/460/500-220

DST 7.5/./380/415/440-220
DST 7.5/./380/460/500-220

DST 10/./380/415/440-220
DST 10/./380/460/500-220

Autotransformer

Available configurations:

DST 12.5/./380/415-220
DST 12.5/./440/460-220
DST 12.5/./500/525-220

DST 15/./380/415-220
DST 15/./440/460-220
DST 15/./500/525-220

DST 18/./380/415-220
DST 18/./440/460-220
DST 18/./500/525-220

DST 20/./380/415-220
DST 20/./440/460-220
DST 20/./500/525-220

DST 25/S/380/415-220
DST 25/S/440/460-220
DST 25/S/500/525-220

DST 35/S/380/415-220
DST 35/S/440/460-220
DST 35/S/500/525-220

DST 50/S/380/415-220
DST 50/S/440/460-220
DST 50/S/500/525-220

Other connection voltages available upon request.

8.4. Available isolation transformers

Standard isolation transformers are available in either floor mount or wall mount configurations in the power range up to 10kVA.

The tap marked „380“ is used for either 3x 380 V (+15% / -10%) or 3x 400V (+10% / -15%) (see dimensional data, section 7).

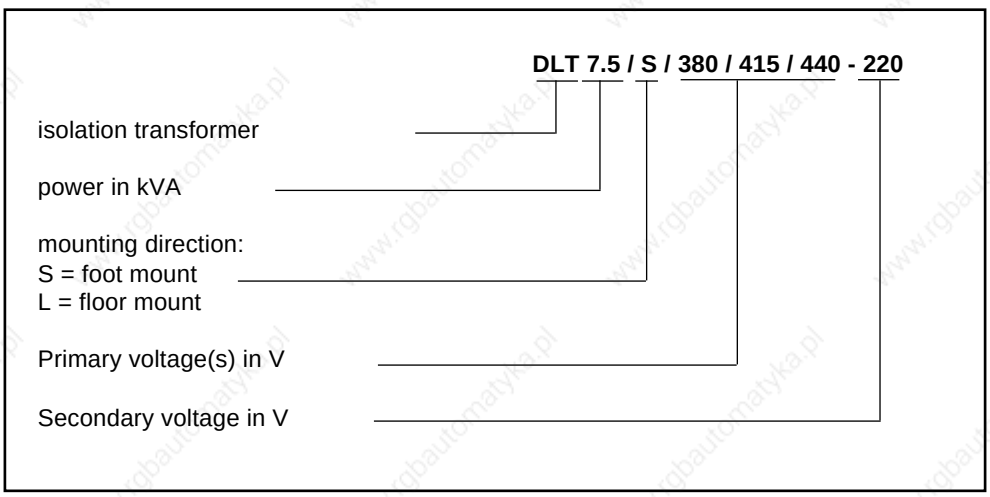


Figure 8.3: Type codes for isolation transformers

Isolation transformer

Available configurations:

DLT 0.5/./380/415/440-220
DLT 0.5/./380/460/500-220

DLT 1.0/./380/415/440-220
DLT 1.0/./380/460/500-220

DLT 1.5/./380/415/440-220
DLT 1.5/./380/460/500-220

DLT 2.0/./380/415/440-220
DLT 2.0/./380/460/500-220

DLT 2.5/./380/415/440-220
DLT 2.5/./380/460/500-220

DLT 4.0/./380/415/440-220
DLT 4.0/./380/460/500-220

DLT 5.0/./380/415/440-220
DLT 5.0/./380/460/500-220

DLT 7.5/./380/415/440-220
DLT 7.5/./380/460/500-220

DLT 10/./380/415/440-220
DLT 10/./380/460/500-220

DLT 15/S/380-220

DLT 20/S/380-220

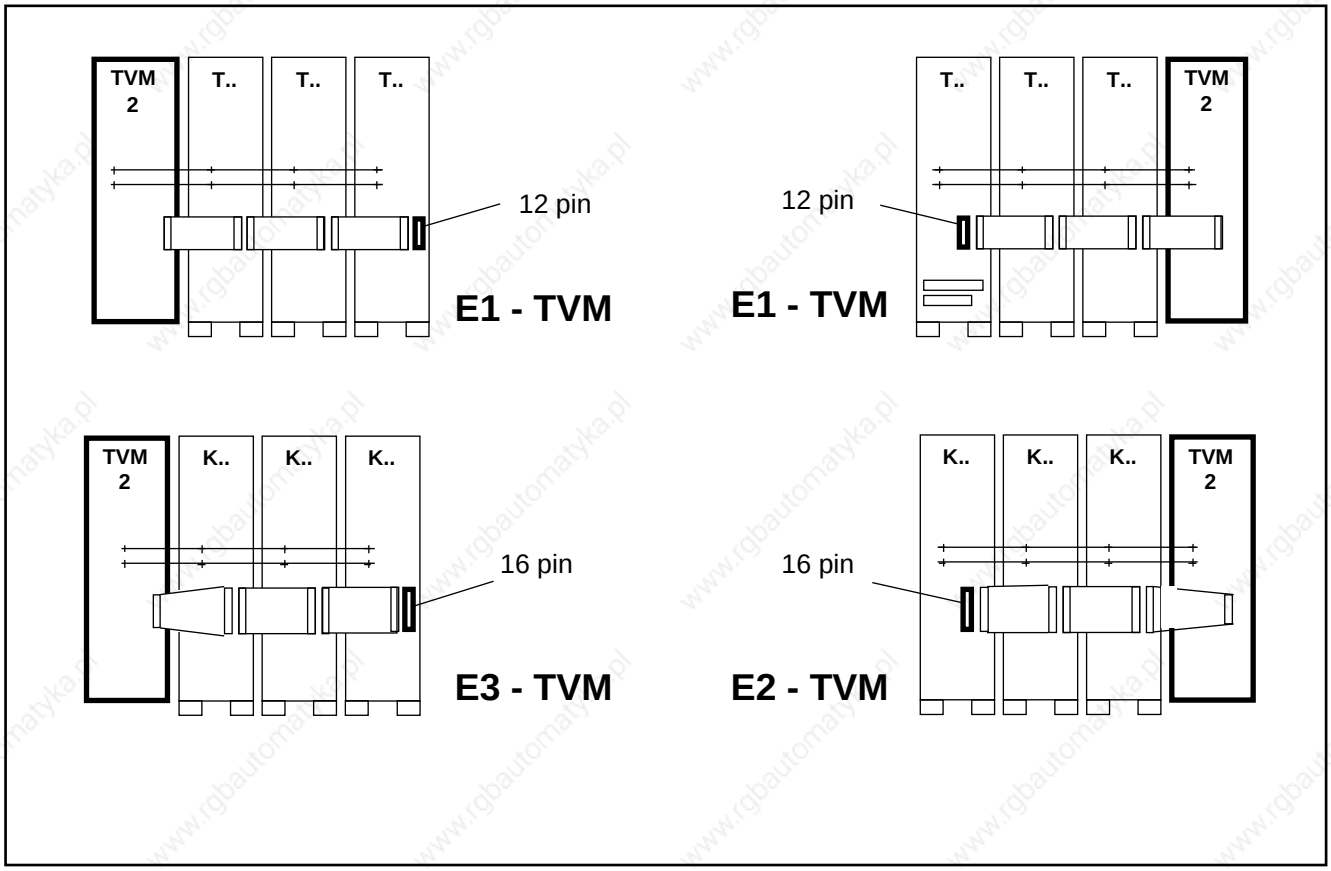
DLT 25/S/380-220

DLT 35/S/380-220

DLT 50/S/380-220

Other connection voltages available upon request.

8.5. Overview of electrical accessories



8.6. Order list for TVM 2.4 power supply module

Item	Article	For selection see
1.1	TVM 2.4-050-220/300-W1/.../...	section 8.2
1.2	electrical accessories E.-TVM	section 8.5
2.1	autotransformer DST ../../.../.../...-220	section 2.1 and 8.3
3.1	add. bleeder (option) TBM 1.2-40-W1-024	section 2.1 and 8.2
4.1	add. capacitance (option) CZ 1.02 or TCM 1.1-..-W0	section 3.7 and 8.2
5.1	dynamic brake contactor L.1 D25 008..	section 8.2
5.2	Auxiliary block LA1 DN 22	
5.3	dynamic braking resistor	HLZ-300-07 Z

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