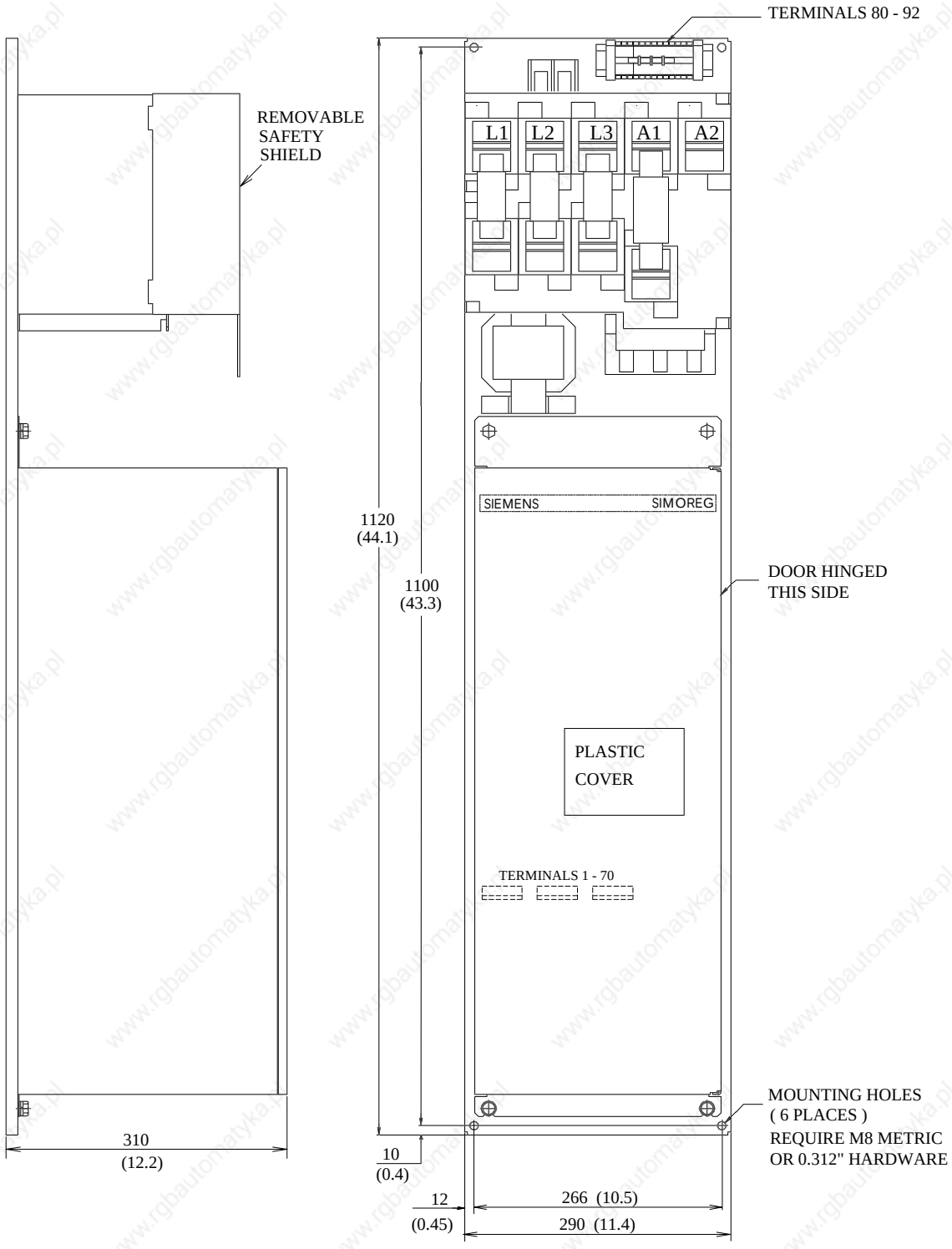
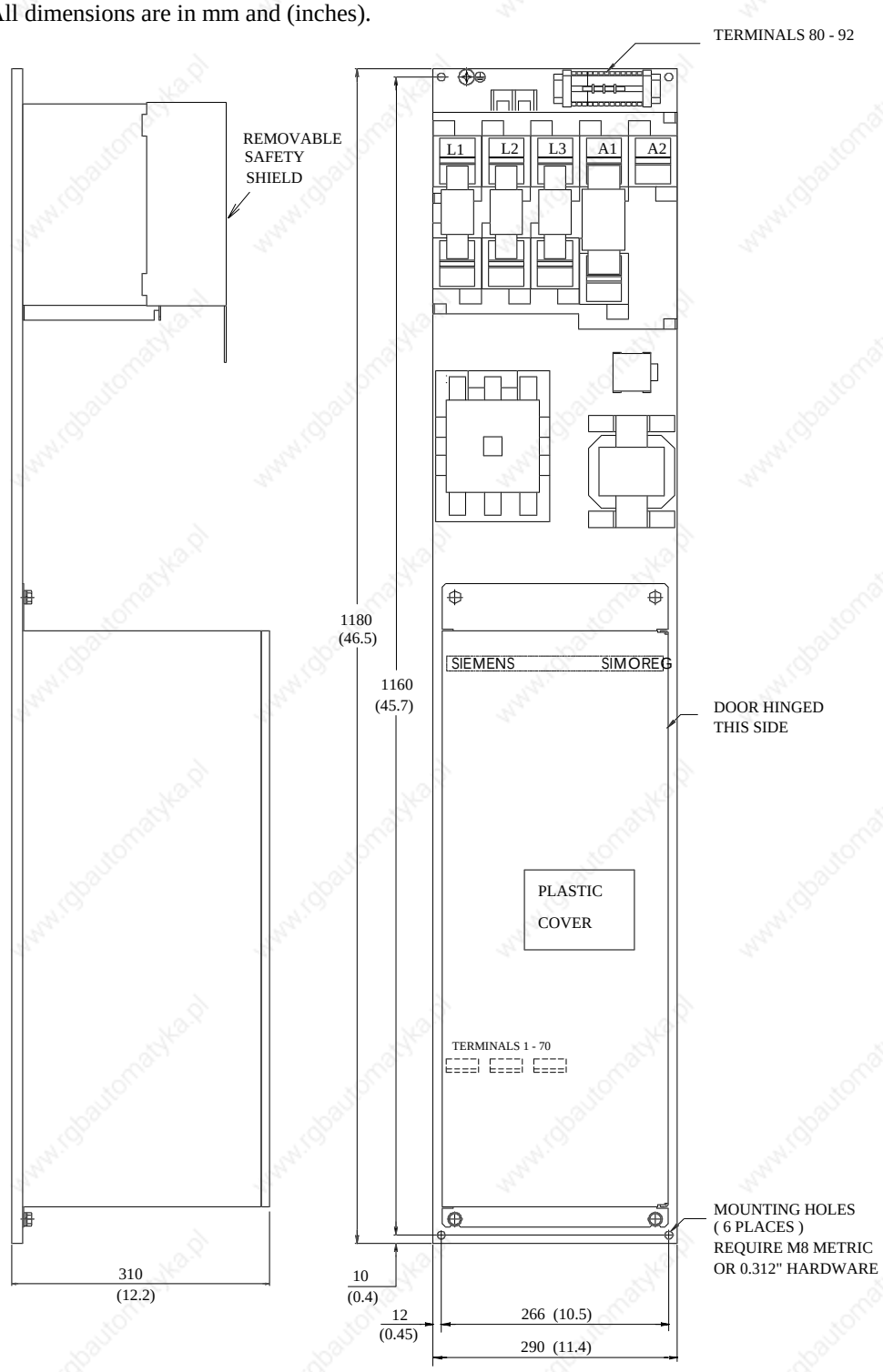
NOTE: All dimensions are in mm and (inches).



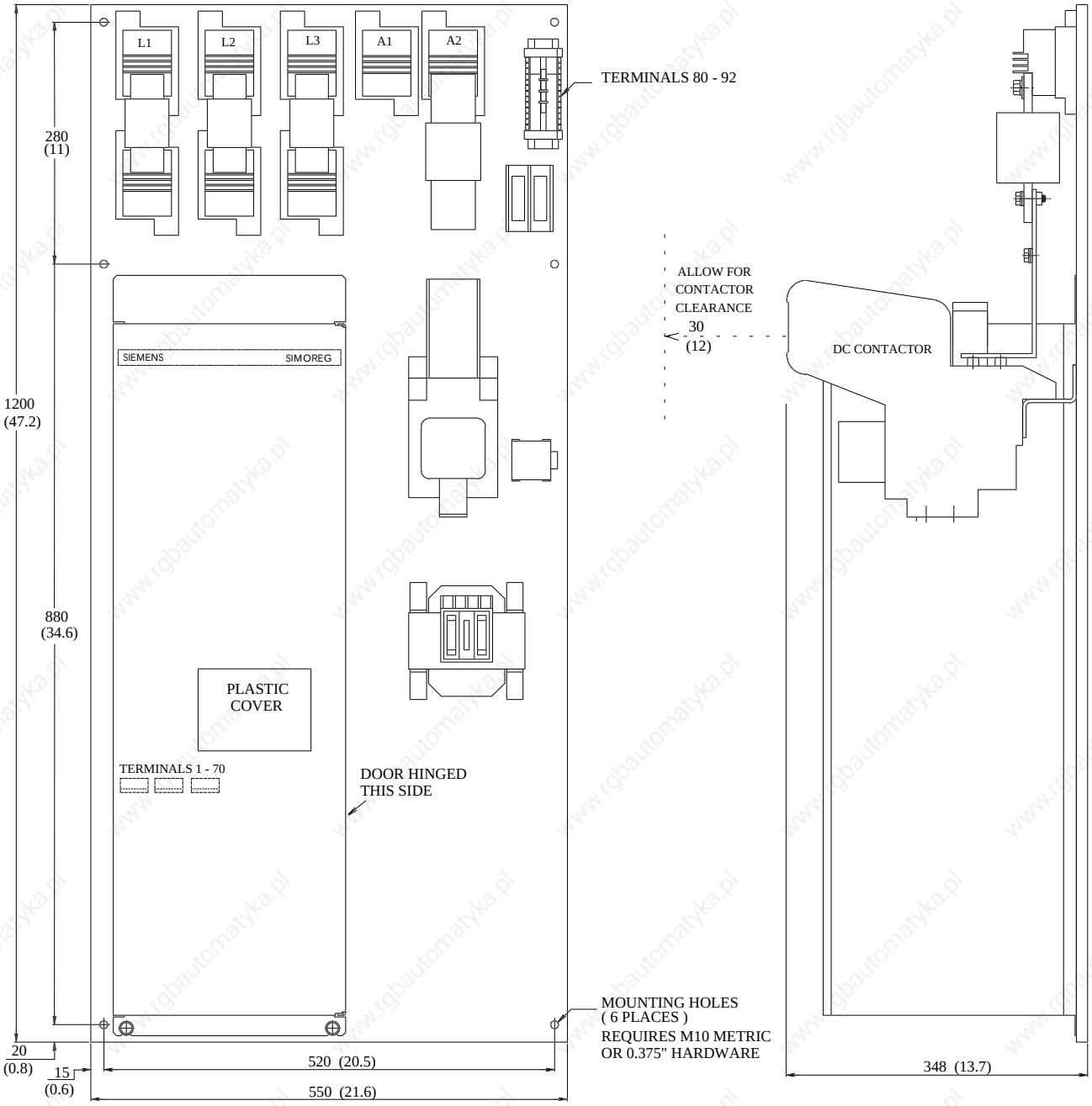
175 Amp Base Drive (1 & 4Q)

NOTE: All dimensions are in mm and (inches).



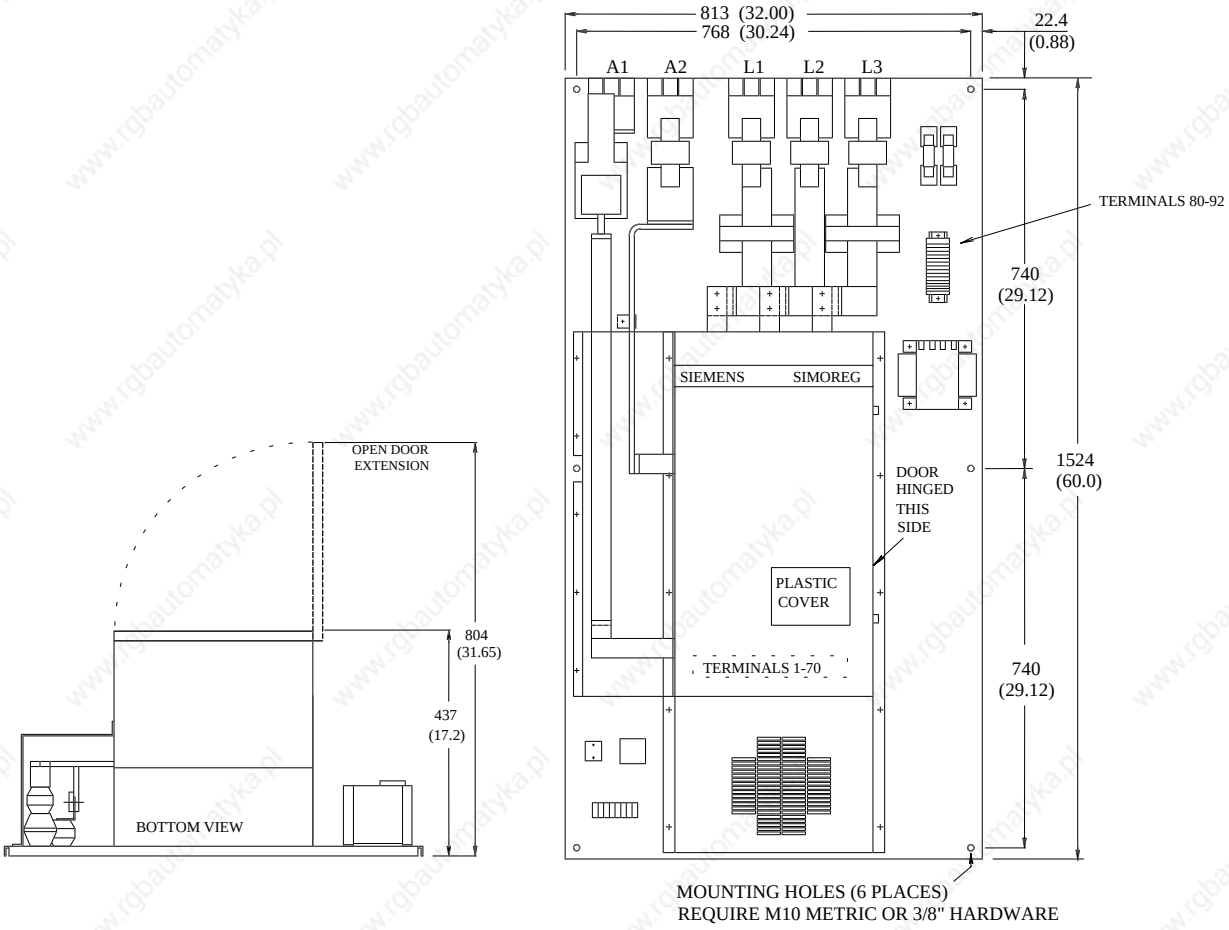
255 Amp Base Drives (1 & 4Q)

NOTE: All dimensions are in mm and (inches).



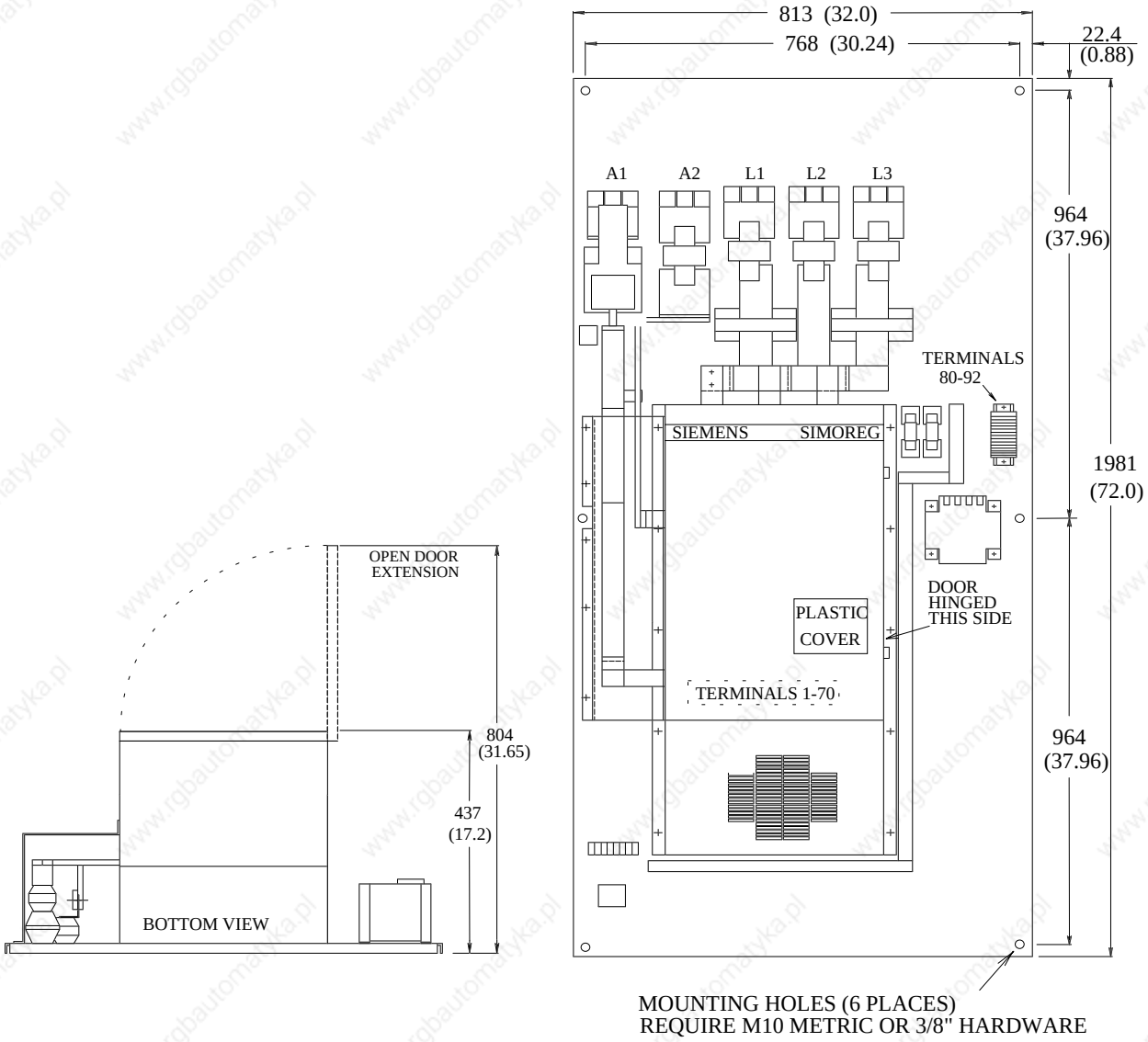
510 Amp Base Drives (1 & 4Q)

NOTE: All dimensions are in mm and (inches).



850 Amp Base Drives (SHORT PANEL 1 & 4Q)

NOTE: All dimensions are in mm and (inches).



850 Amp Base Drives (FULL PANEL 1 & 4Q)

5.3 Installation Instructions for Proper EMC Protection

In order for the 6RA24 to meet the EMC Directive as required by the European Economic Area (EEA) it is necessary that the following installation guidelines be followed when installing a 6RA24 drive.

5.3.1 EMC Basics

5.3.1.1 What is EMC

EMC stands for electromagnetic compatibility and defines the capability of a piece of equipment to operate satisfactorily in an electromagnetic environment without itself causing electromagnetic disturbances which would be unacceptable for other electrical equipment in this environment. Thus, the electrical equipment should not mutually disturb each other.

5.3.1.2 Noise Radiation and Noise Immunity

EMC is dependent on two characteristics of the equipment involved, namely, the radiated noise and noise immunity. Electrical equipment can either be a noise source (transmitter) and / or noise receiver. Electromagnetic compatibility exists if the noise sources do not negatively influence the function of the noise receivers. A piece of electrical equipment can be both a noise source and noise receiver at the same time. For example, the power section of a drive converter can be considered as noise source, and the control section (gating unit, etc.), as noise receiver.

5.3.1.3 Maximum Values

The Product Standard E DIN IEC 22G/21/CDV is now available in draft form for electric drives. According to this product standard, all EMC measures are not necessarily required for industrial supply networks, and a solution should be defined and adapted to the actual installation. In this way, it may be more cost effective to increase the noise immunity of a sensitive piece of equipment than implementing noise suppression measures for the drive converter. Thus, a solution is selected dependent on its cost-effectiveness.

Until the Product Standard E DIN IEC 22G/21/CDV comes into force, the basic EN 50081 and EN 50082 Standards are valid and these specify that EN 55011 must be maintained. These standards define maximum values for noise radiation in industrial and domestic environments. Cable carried noise at the supply connection point is measured under standardized conditions as radio interference noise voltage and electromagnetically radiated noise as radio interference (radiated noise). The standard defines maximum values “A1” and “B1”, which are valid for radio interference voltage in the range between 150 kHz and 30 MHz and for radio interference radiation between 30 MHz and 2 GHz. “A1” levels are valid for industrial installations whereas “B1” levels are valid for residential installations. Because SIMOREG drive converters are used in industrial applications, limit value “A1” is valid. **To achieve value “A1”, SIMOREG K drive converters must be installed per the following guidelines.**

Noise immunity defines the behavior of a piece of equipment subject to electromagnetic noise. For industrial applications, the EN50082-2 Standard defines the demands and evaluation criteria for the behavior of the equipment. **This standard is fulfilled by the 6RA24 converter family when properly installed.**

5.3.1.4 SIMOREG Drive Converters in Industrial Applications

In an industrial environment, equipment must have a high level of noise immunity whereas lower demands are placed on noise radiation. SIMOREG drive converters are components of an electric drive system, along with contactors and switches etc. Professionally trained personnel must integrate them to form a complete drive system. A drive system will typically involve as a minimum, the drive converter itself, motor feeder cables, motor, AC supply cable and disconnect. Limiting to the maximum allowed values can only be maintained if these components are installed and mounted in the correct way**. In order to limit the radiated noise from the drive converter, according to limit value "A1", a radio interference suppression filter and a commutation reactor are required**. If SIMOREG drive converters are not equipped with radio interference suppression filters, the radiated noise will slightly exceed the limit value "A1", specified in EN55011.

If the drive is part of an overall system, initially it does not have to fulfill any requirements regarding radiated noise. However, the EMC Law specifies that the system as a whole must be electromagnetically compatible with its environment. If all of the system control components (e.g. PLCs) have noise immunity for industrial environments, then it is not necessary that each drive maintains a limit value "A1".

5.3.1.5 Non-Grounded AC Supplies

Non-grounded AC supplies (IT-supplies) are often used in various industrial sectors in order to increase the availability of the plant. If one ground fault occurs a fault current does not flow, and the plant can still produce. However, when a radio interference suppression filter is used on such a system and a ground fault should occur, a fault current path now exists through the filter. This can result in the drive being shutdown and possible damage to the radio interference suppression filter. Thus, the Product Standard does not define limit values for these non-grounded supplies. From a cost standpoint, if radio interference suppression is required, this should be implemented at the grounded primary of the supply transformer.

5.3.1.6 EMC Planning

If two units are not electromagnetically compatible, you can either reduce the noise radiated by the noise source, or increase the noise immunity of the noise receiver. Noise sources are generally power electronic units with a high current requirement. In order to reduce the radiated noise from these units, complex and somewhat costly filters are required. Noise receivers usually involve control units and sensors. It is sometimes less complex and less costly to increase the noise immunity of low-power equipment. Thus, in an industrial environment it is often more cost-effective to increase the noise immunity rather than reduce the radiated noise. For example, in order to maintain limit value Class "A1" of EN 55011, the radio interference voltage at the supply connection point between 150 kHz and 500 kHz, may not exceed 79 dB(µV) and between 500 kHz and 30 MHz, 73 dB(µV) (9 mV or 4.5 mV). In industrial environments, the EMC of the equipment used must be based on a well-balanced mixture of noise radiation (low level) and noise immunity.

The most favorably priced interference measure is to physically separate noise sources and noise receivers, assuming that this is taken into account when designing the machine or plant. The first step is to define whether each unit is a potential noise source (noise radiator) or noise receiver. Noise sources are, for example, drive converters, contactors. Noise receivers are, for example, PLCs, and sensors. The components must be physically separated in the cabinet (noise sources and noise receivers), using metal partitions or by mounting the components in individual metal enclosures. A possible component layout configuration in a typical 6RA24 cabinet is illustrated in Fig. 1.

5.3.2 EMC-Correct Installation of Drive Converters

5.3.2.1 General information

As drives can be operated in a wide range of differing environments, and as the electrical components used (controls, switched-mode power supplies etc.) can widely differ regarding noise immunity and noise radiation, any mounting / installation guideline can only represent a typical general situation. Consequently, deviations can be made from the EMC regulations, under the assumption that they are checked-out on a case by case basis.

In order to guarantee electromagnetic compatibility (EMC) in cabinets in rugged electrical environments, and also fulfill the standards specified by the relevant legal bodies, the following EMC regulations must be observed when designing and manufacturing the drive cabinets.

Rules 1 to 10 illustrate good wiring practices and generally must be followed. In order to further comply with the radiated noise standards Rules 11 to 15 are mandatory.

5.3.2.2 Rules for EMC-Correct Installation

Rule 1:
All of the metal cabinet components must be electrically connected with one another through the largest possible surface area (not paint on paint!). If required, use serrated washers and / or grounding straps to connect the cabinet parts. The cabinet door should be connected to the cabinet through a grounding strap which should be kept as short as possible.

Rule 2
Contactors, relays, solenoid valves, electromagnetic operating hour counters etc. in the cabinets should be provided with coil suppression devices such as RC elements, varistors, diodes etc. These devices must be connected directly at the coil with very short wires to be effective.

Rule 3
If possible, signal cables[1)] should enter the cabinet at only one level.

Rule 4
Non-shielded cables belonging to the same circuit (incoming and return conductors) should be twisted, or the distance between the two conductors kept as close as possible in order to prevent unnecessary coupling effects.

Rule 5
Connect reserve (spare) conductors to the cabinet ground at both ends. This offers an additional shielding effect.

Rule 6
Unnecessary cable / conductor lengths should be avoided so that coupling capacitance's and inductance's are kept low.

Rule 7
Crosstalk is kept low if cables are routed close to the cabinet ground. Thus, wiring shouldn't be routed freely in the cabinet, but as close as possible to the cabinet frame and mounting panels. This is also true for reserve (spare) cables.

Rule 8
Signal and power cables should be routed separately from one another (to avoid noise being coupled from one to another). **A minimum 20 cm (8 inches) clearance should be maintained.**
If it is not possible to physically separate encoder and motor cables, then the encoder cable must be routed either using a metal partition or in a separate metal conduit. The partition or metal conduit must be grounded at several locations along this length.

Rule 9
The shields of digital signal cables must be connected to ground at both ends (source and destination) through the largest possible surface area. If there is poor potential bonding between the equipment pieces where the shields connect, then an additional potential bonding cable of at least 10 mm² (AWG 6) must be connected in parallel to the shield. The shields can be grounded to the cabinet frame at several positions along the cable length. The shields can also be connected to ground at several locations outside the cabinet. Foil-type shields should be avoided if possible. They are not as effective as braided shields by a factor of at least 5.

Rule 10
The shields of analog signal cables can be connected to ground at both ends if potential bonding is good (through the largest possible surface area). Good potential bonding can be assumed, if all metal parts are well connected and all of the electronic components involved are supplied from one source.

The single-ended shield ground connection prevents low-frequency, capacitive noise from being coupled into the analog signal (e.g. 60 Hz hum). In this case the shield should be connected to ground only in the receiving cabinet.

Rule 11
Always locate the radio interference suppression filter close to the assumed noise source. The filter must be mounted through the largest possible surface area at the cabinet housing or mounting panel etc. The input and output cables must be physically separated.

Rule 12
Radio interference suppression filters must be used ahead of the converter in order to maintain limit value class "A1". Additional loads must be connected to the line supply side of the filter. The type of control used and how the remaining cabinet is wired defines whether an additional line filter needs to be installed for auxiliary equipment.

Rule 13
A commutation reactor is required in the field circuit AC supply for controlled field supplies to limit filter discharge current through the converter thyristors.

Rule 14
A commutation reactor is required in the drive converter armature circuit AC supply to limit filter discharge current through the converter thyristors.

Rule 15
For SIMOREG drives, the motor cables can be unshielded. The line supply cable must be a minimum of 20 cm (8 inches) away from the motor cables (field, armature).
If required, use a metal partition or metal conduit.

Footnotes:
1) Signal cables are defined as:
   Digital signal cables
   Analog signal cables. (e.g. ± 10 V setpoint cable)
   Pulse encoder cables
   Serial interface cables, e.g. PROFIBUS-DP or USS
   24 VDC Binary I/O circuits

2) Generally, all metallic conductive parts, which can be connected to a protective conductor, e.g. cabinet housing, motor frame, foundation ground, etc., are considered as ground.

5.3.2.3 Cabinet Design and Shielding
The cabinet design illustrated in **Fig. 1** is intended to make the user sensitive and aware of EMC-critical components and parts. The example does not claim to handle all possible cabinet components and their respective mounting possibilities but does give a good representation of a typical assembly that meets the EMC requirements.

Details which influence the noise immunity / noise radiation of the cabinet and which aren't absolutely clear in the overview diagram, are further described in detail **Figures 1a - 1c**.

Different shield connecting techniques are illustrated in detail **Figures. 2a - 2b**.

Mounting radio interference suppression filters and commutation reactors:
Radio interference suppression filter and commutation reactor mounting for SIMOREG drives is described in Section 2.3. The sequence when installing the reactor and filter must be maintained. The semiconductor protection fuses are selected according to the Instruction Manual of the drive converters or are included in the base drive chassis.

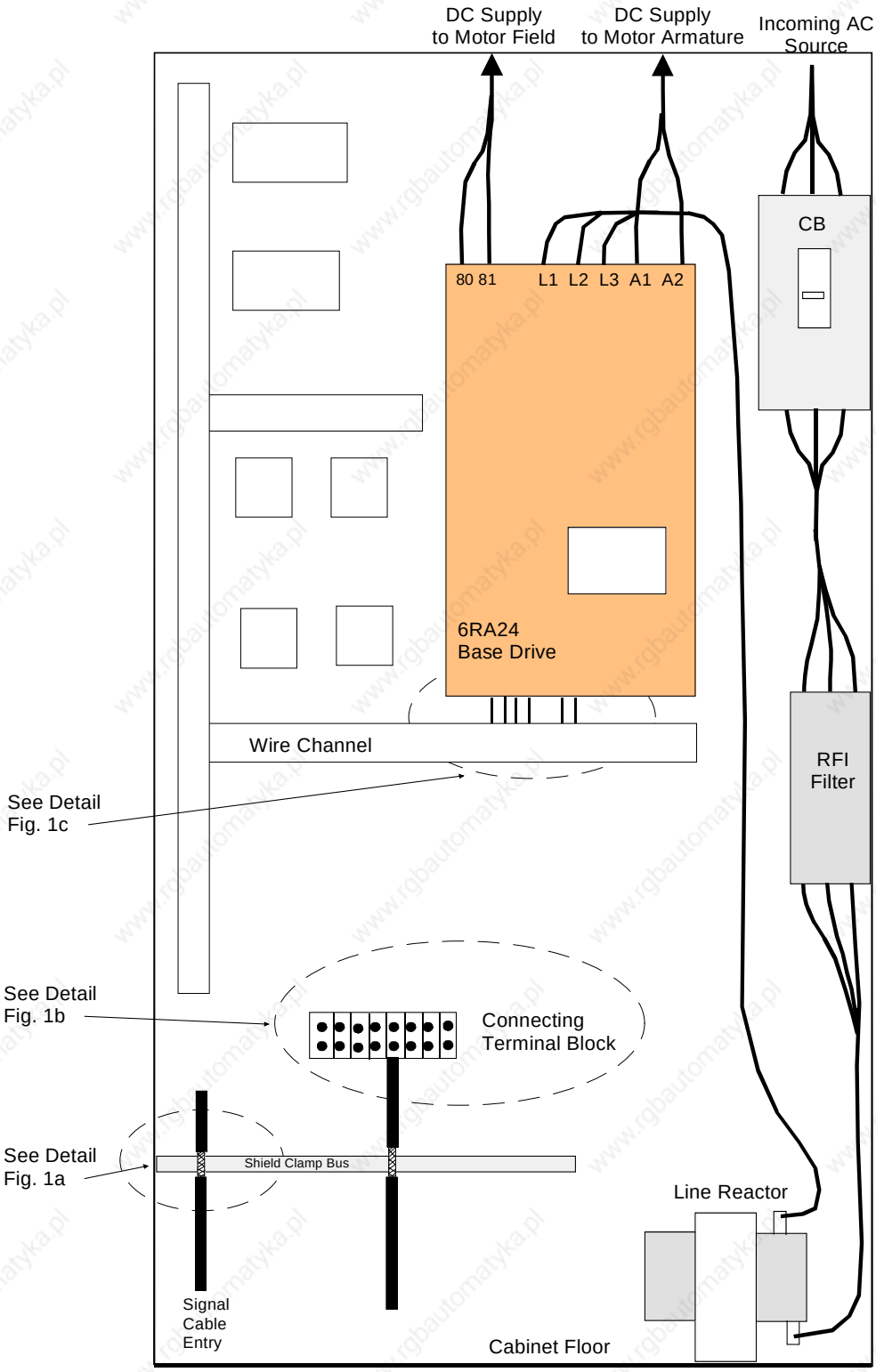


Fig. 1
Typical Cabinet Panel Layout

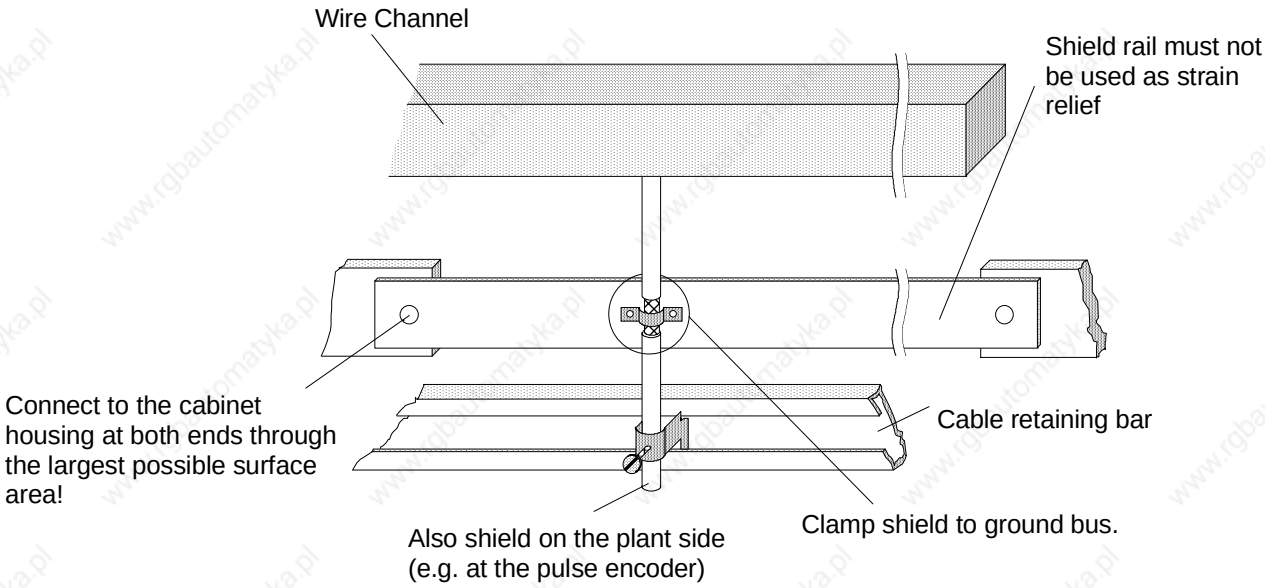


Fig. 1a Shielding Where the Cable Enters the Cabinet

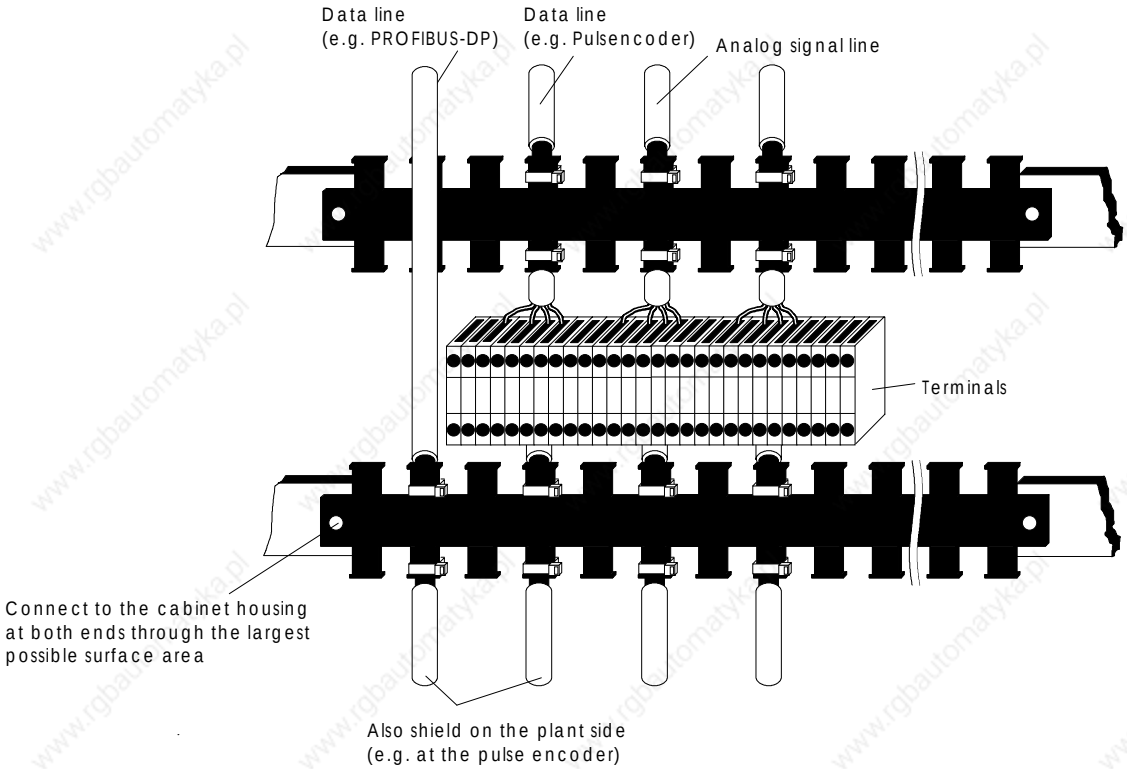


Fig. 1b: Shielding in the cabinets

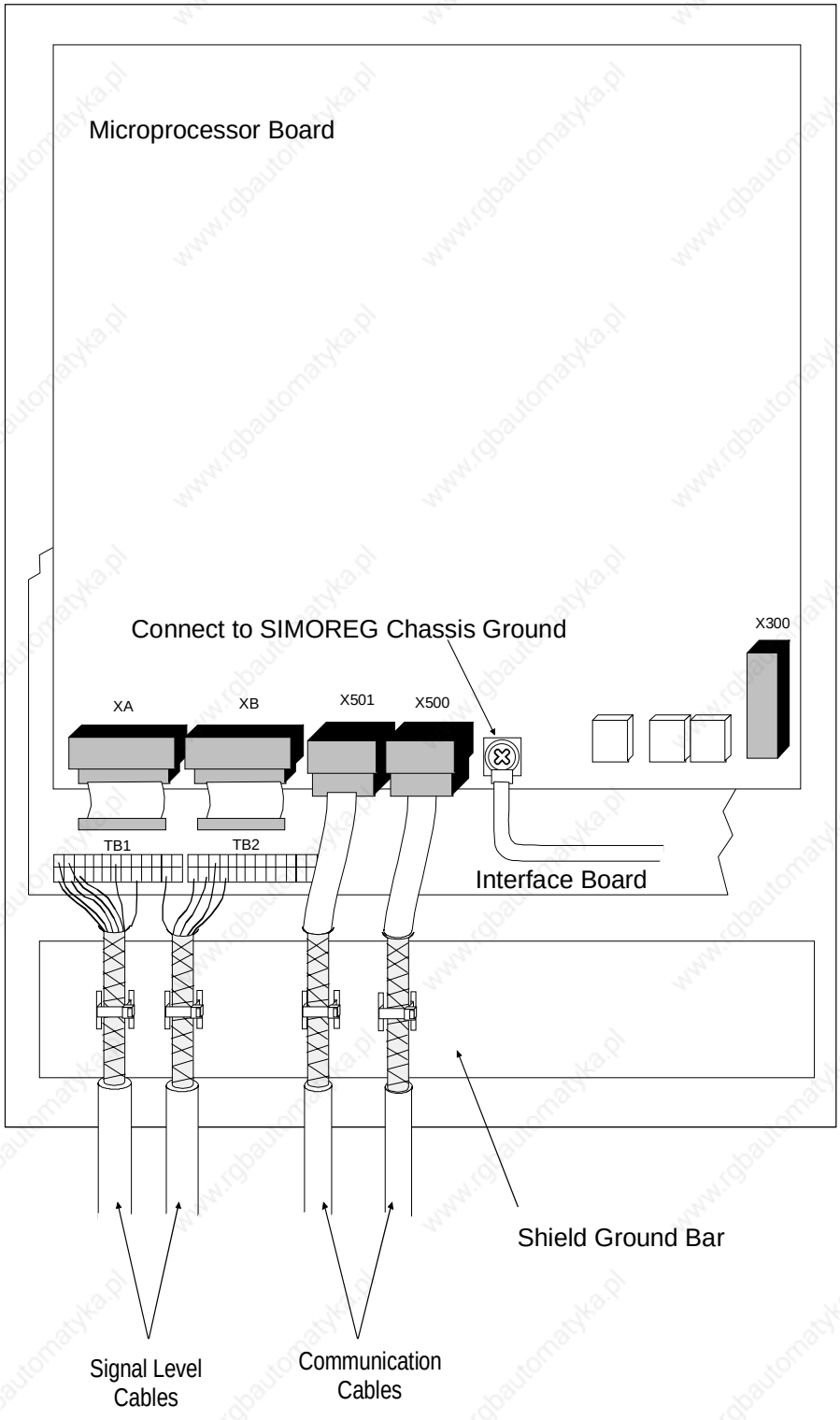


Fig. 1c Connecting Shields at the SIMOREG

Typical Shield connection methods:

Cable Tie:

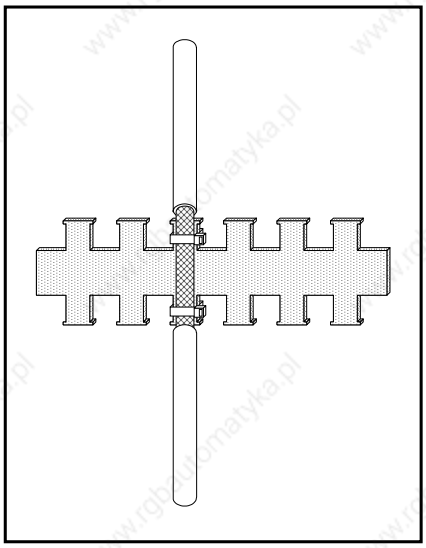


Figure 2a
Metalized tubing or cable ties on a bare metal serrated rail

Clamp:

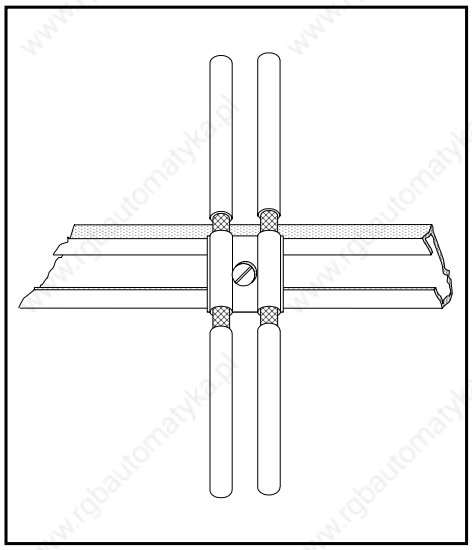
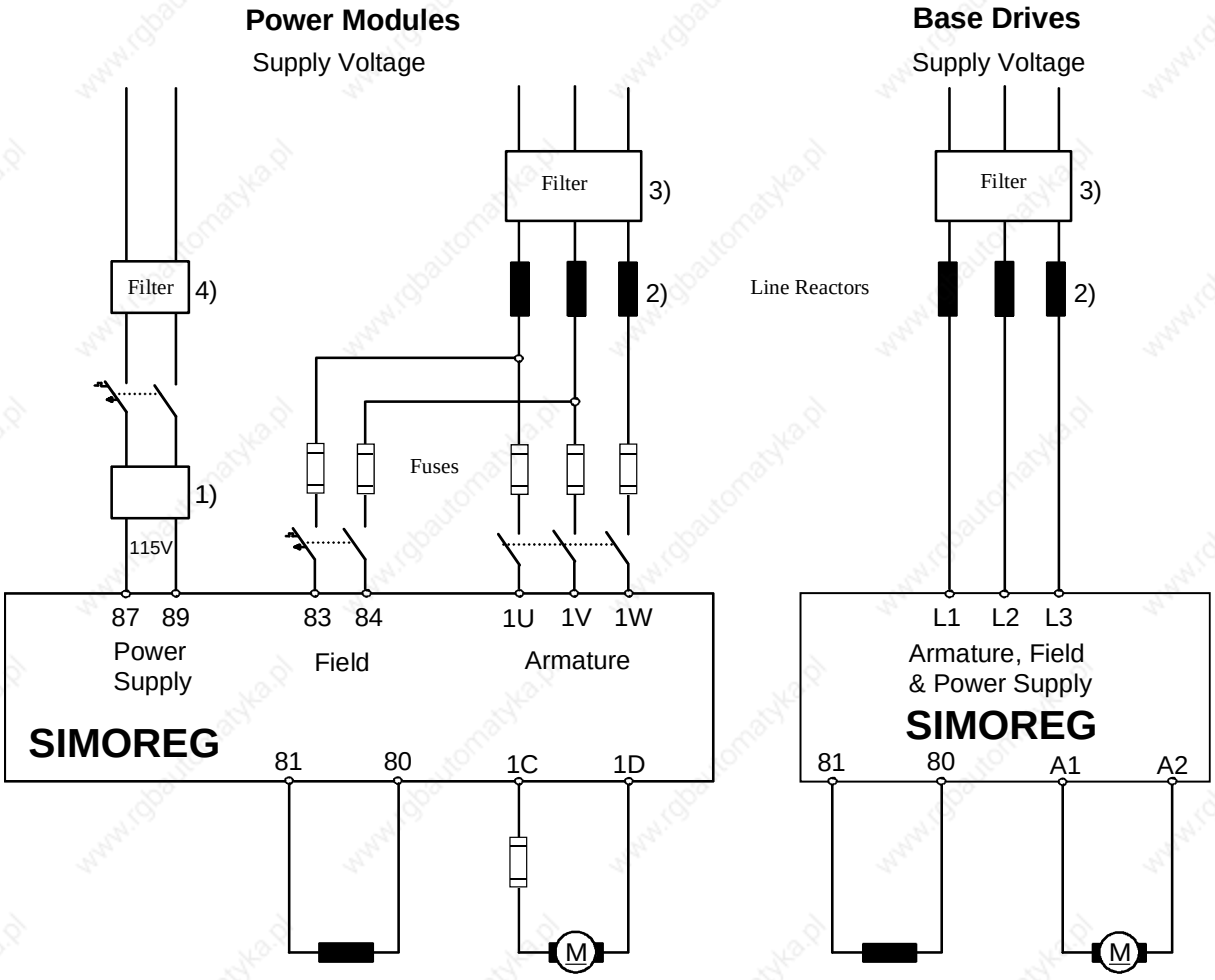


Figure 2b
Clamp and metalic mating piece on a cable support rail.

5.3.2.4 Drive converter component arrangement

6RA24 SIMOREG K drive converter, US version (power modules & base drives): Reactor and filter arrangement



1) Power supply transformer (adapts the unit for 115 V supplies).

2) The commutating reactor for the armature- and field circuits is dimensioned for the nominal motor armature current (the line supply current is the DC current x 0.82) plus the nominal motor field current.

3) The filter for the armature and field circuits is dimensioned for the nominal motor armature current (the line supply current is the DC current x 0.82) plus the nominal motor field current.

4) Filter for power supply of SIMOREG

Note:
When filters are used, commutating reactors are always required at the drive converter input to decouple the filter circuitry. The commutating reactors are standard line reactors with 2 to 4% impedance based on the drive rating.

5.3.2.5 List of the recommended radio interference suppression filters

Nominal current, radio interference suppression filter (A)	Radio interference suppression filter Order No.	Terminal cross-section (mm^2)	Weight (kg)	Dimensions HxWxD (mm)
12	6SE7021-0ES87-0FB0	10*)	2,2	215x90x81
18	6SE7021-8ES87-0FB0	10*)	2,2	215x90x81
36	6SE7023-4ES87-0FB0	25	3,7	245x101x86
80	6SE7027-2ES87-0FB0	50	9,5	308x141x141
120	6SE7031-0ES87-0FA0	50	10	348x171x141
180	6SE7031-8ES87-0FA0	95	13	404x171x141
500	6SE7033-7ES87-0FA0	Connecting lug	49	590x305x154
1000	6SE7041-0ES87-0FA0	Connecting lug	90	840x465x204
1600	6SE7041-6ES87-0FA0	Connecting lug	130	870x465x204

*) The filters generate discharge currents. VDE 0160 specifies a protective ground conductor connection using 10 mm^2 (AWG 6) cable.

For 6RA24 drive converters, the RMS AC line current (filter current) is equal to the DC current x 0.82.

Important technical data of the radio interference protection filter:

Nominal supply voltage	3-ph. 380-460 V AC (+/- 15%)
Rated frequency	50/60 Hz (+/- 6%)
Operating temperature	0° C to +40° C
Degree of protection	IP20 (EN60529) < 500A IP00 ≥ 500 A

Notes