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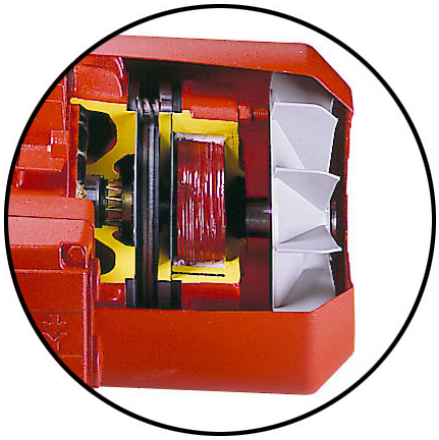
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Technical Note

BM / BMG / BE Brakes



SEW's patented brake system meets rigid design criteria ranging from electronic applications that require a simple holding brake to mechanical applications that require high dynamics and accurate positioning.

DT/DV motors accept the BM and BMG brakes; DR motors accept the BE brake.

Benefits

- Low brakemotor inertia maximizes position accuracy and duty cycle.
- Fast release maximizes brake life and reduces brake lining wear
- Multiple spring combinations provide several choices for brake torque
- Low radio interference with sensitive electronic equipment
- Patented damping plate provides reduced noise and low sound level (dB)
- Patented low energy holding coil consumes minimal power
- Minimal heat generation permits operation in higher ambient temperatures
- DC coil tolerates current fluctuations from the AC supply without nuisance brake "clacking"
- Low maintenance
- Compact

Inertia is very important in high dynamic applications. Due to its IEC dimensions, the SEW brakemotor contains a rotor with a smaller diameter than a NEMA motor of the same horsepower. Therefore, its inertia is considerably lower. Lower inertia allows the motor to stop faster, which increases positioning accuracy. Lower inertia also allows the motor to start faster with a shorter duration of in-rush current, which reduces heat and permits a higher duty cycle. For these reasons, SEW brakemotors frequently replace servomotors in many applications.

To achieve outstanding dynamic performance, SEW brakes incorporate two key features:

- Fast brake release
- Fast brake reaction

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Operation

Figure 1 is an exploded view of a single disc BMG or BE brake. Figure 2 is a cross sectional view.

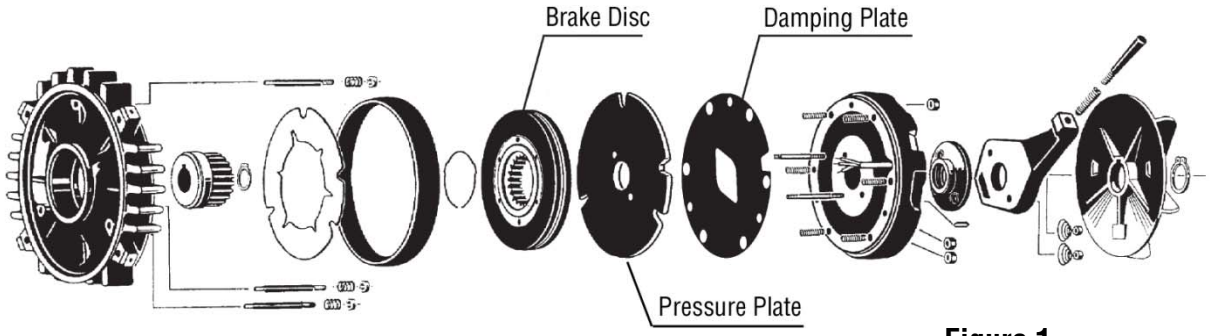


Figure 1

The disc brake is electronically controlled with dc current. When energized, current within the brake coil (1) creates a magnetic field that attracts and moves the pressure plate (2), which compresses the brake springs (3) and allows the brake disc (4) to rotate with the motor.

When de-energized, the magnetic field collapses. The force created by the compressed springs pushes the pressure plate and sandwiches the brake disc between the plate and the end shield (5). Both sides of the brake disc contain high friction material that stops the motor.

This "fail-safe" operation ensures that the brake engages and stops the motor automatically in case of a power failure.

With normal operation, the brake disc pad wears and increases the air gap (6). When the gap exceeds the recommended tolerance, the brake requires a simple adjustment to return the gap to an acceptable distance. Disassembly is not necessary.

Generally, a brake can be adjusted 3-4 times before it requires a new brake disc.

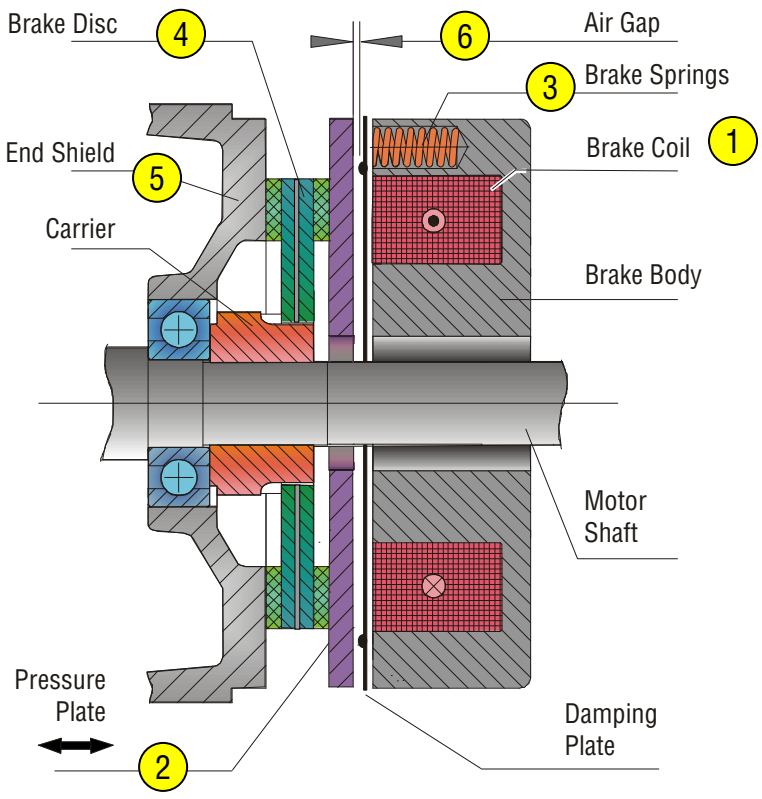


Figure 2 – Brake Cross Section

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DT/DV motors have one brake size available for each motor frame. However, DR motors offer two or three sizes per motor. When the application requires reduced brake torque, a smaller brake offers additional cost savings. Nonetheless, the torque is adjustable on any brake by changing the number and color of springs. For a complete listing of spring combinations, refer to **Technical Note B-104**.

Noise Level

To minimize noise, the BMG and BE brake includes two patented damping plates (US Patent 5,274,290) in the following locations.

- Between the pads of the brake disc (Figure 3)
- Between the pressure plate and the brake body, as shown in Figures 1 and 2. Notice the raised dimples on the damping plate in Figure 2. These dimples provide reduced surface area, which reduces noise when the pressure plate contacts the damping plate.

Damping plates are not included on BM brakes on motor sizes 132M and above. However, all SEW brakemotors comply with *IEC 60034-9: Rotating Electrical Machines – Part 9, Noise Limits.*



Figure 3 – Brake Disc with Damping Plate

Brake Release



At the instant the motor receives power, the brake must release as quickly as possible. Otherwise, the motor works against the brake, producing excessive wear on the brake lining and additional heat inside the motor. Thus, fast release provides longer brake life, longer periods between brake adjustments, and a higher duty cycle.

All SEW brakes contain a patented holding coil (Patent 5,278,483) that consists of two separate windings: the accelerator coil and the fractional coil, as shown in Figure 4.

The **accelerator** coil contains a few turns of large diameter wire with low resistance. Low resistance produces high current and strong electromagnetism.

The **fractional** coil contains more turns of smaller diameter wire with higher resistance, producing lower current and weaker magnetism.

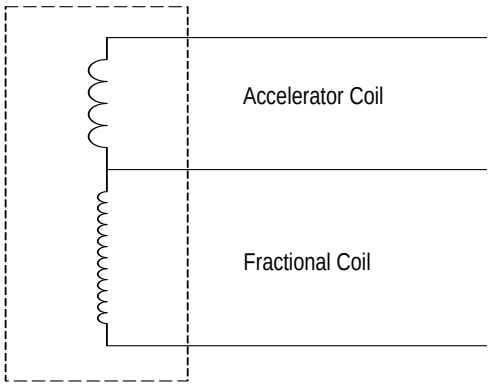


Figure 4 – Brake Holding Coil

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Normal Release (BG, BMS)
Not all applications require the fastest release time, especially applications with infrequent starting. For these situations, SEW offers BG and BMS rectifiers. The BG mounts in the brake conduit box and is standard on smaller brake sizes BMG05 – BMG4 (DT/DV motor) and on BE05 – BE2 (DR motor). A BMS is optional for mounting on a DIN rail inside a control panel.

During release, the BG rectifier places the two windings of the holding coil in series. This combination yields a resistance that is higher than either coil by itself. Thus, it has a lower current and a weaker electromagnetic field (EMF) than either coil by itself. Figure 5 shows the circuit pathway for a BG.

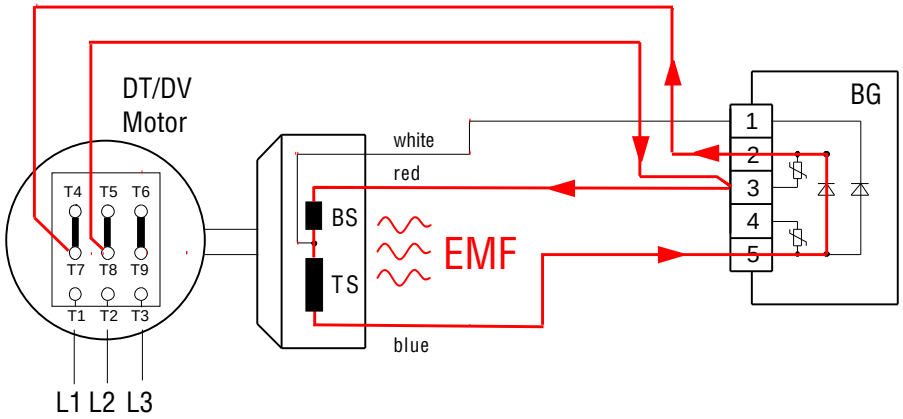


Figure 5 – BG Rectifier

Fast Release (BGE, BMH, BMS, BME, BMP, BMK, BSG)
Moving a pressure plate to release the brake is similar to accelerating an automobile. A car needs a lot of horsepower to accelerate quickly. But once it reaches desired velocity, considerably less power is required to keep it moving. Likewise, moving a pressure plate and overcoming the spring force requires a large electromagnetic force from the brake coil. The greater the force, the quicker the plate moves. After movement, a force just slightly larger than the spring force is enough to hold it stationary.

To achieve the greatest electromagnetic force and the fastest release time, SEW offers a BGE rectifier that contains a SCR thyristor. The BGE mounts inside the motor conduit box and is available on all brakes as follows:

	DT/DV Motor	DR Motor
BGE Optional:	BM(G)05 thru BM(G)4	BE05 thru BE2
BGE Standard:	BM(G)8 and larger	BE5 and larger

The SCR is also available within the BME, BMH, BMS, BMP, BMK and BSG rectifiers that mount on a DIN rail. For more information on SEW rectifiers see **Technical Note B-103**.

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The goal of the SCR is to remove the brake with high energy, and then hold it with reduced energy. Therefore, when the motor initially receives power, the SCR is conductive. As such, the path with the least resistance is the one that permits current flow through the accelerator coil only. Having low resistance, the accelerator coil produces a strong electromagnetic field (EMF) that rapidly attracts the pressure plate, as shown in Figure 6. Then after 120ms, the SCR becomes non-conductive, forcing the current to flow through both coils in series. The combined resistance of both coils produces a lower current and a lower magnetic field that holds the plate stationary, as shown in Figure 7.

0 – 120 ms (Accelerating Coil Only):

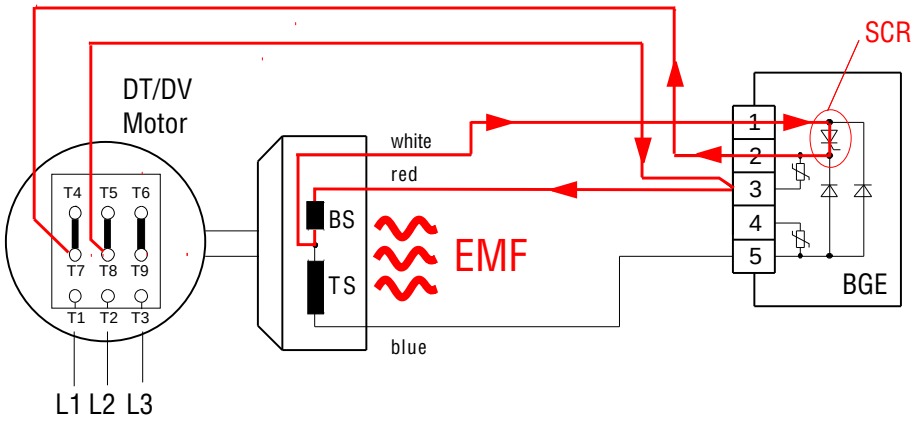


Figure 6 – Strong Magnetic Field

After 120 ms (Both Coils):

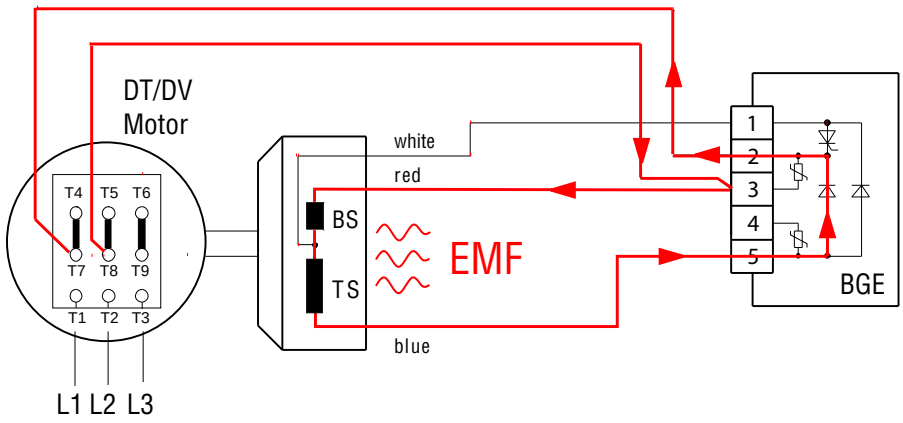


Figure 7 – Weaker Magnetic Field

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Brake Reaction



At the instant the motor power ceases, energy stored within the brake coil must decay as rapidly as possible in order to stop the motor quickly. Fortunately, the weaker magnetic field that holds the pressure plate is advantageous not only during operation, but also during stopping. Its low current provides minimal heat while the motor is operating. And, its low energy allows it to decay quickly.

Nonetheless, the holding coil may be wired so that its low energy decays even faster. With appropriate wiring, all SEW rectifiers can convert the residual energy into heat using a varistor.

Normal Reaction

Normal reaction is commonly used for horizontal applications with a low duty cycle or those that do not require the most precise stopping distance. Figure 8 shows the path that occurs within a BG or BGE rectifier after ac power is removed from the motor. Since there is no additional resistance in the path besides the coils, the residual coil energy must decay naturally.

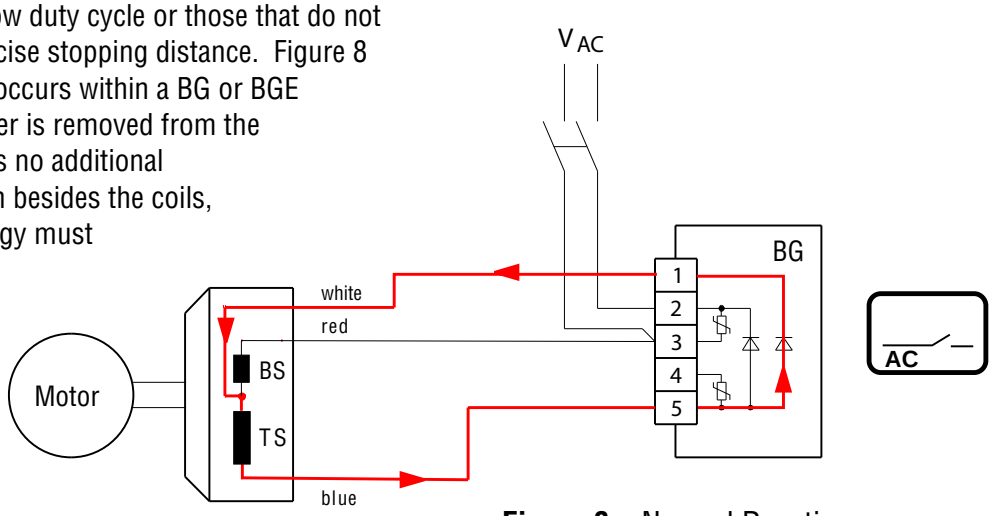


Figure 8 – Normal Reaction

Fast Reaction

Fast reaction is required for applications with a high duty cycle and applications that require the best position accuracy. On vertical applications that work against gravity, such as palletizers and lifts, fast reaction minimizes the stopping distance on downward motion and minimizes the downward drop that could occur when stopping during upward motion.

All rectifiers that mount within a control panel may be wired for fast reaction by using an auxiliary contact from the motor starter. However, the BG and BGE rectifiers that mount within the motor conduit box may be wired in one of three ways:

1. Auxiliary contact from motor starter
2. SR Relay
3. UR Relay (commonly used with inverter)

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Auxiliary Contact

Figures 9 and 10 show the open and closed circuit paths for a BG or BGE rectifier that is wired for fast reaction using an auxiliary contact attached to the motor starter. When the contact is closed, notice how it acts as a jumper between terminals 4 and 5 so that rectified dc current can flow in and out of 4 and through 5. Also, notice the difference in the path during operation and during braking.

Operation (contact closed):
During operation, the auxiliary contact is closed so dc current flows through terminal 5. After entering terminal 5, it exits through terminal 2 without encountering any resistance.

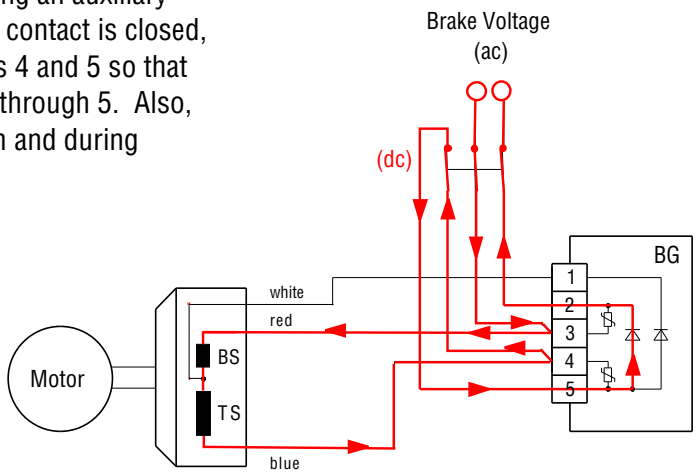
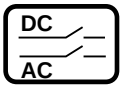


Figure 9 - Operation

Braking (contact open):
During braking, the motor starter opens the ac current that supplies terminals 2 and 3. In addition, the auxiliary contact opens the dc path between terminals 4 and 5. Now, the residual coil energy cannot flow from 4 into 5, so it must flow through 4 and across a varistor. Since the varistor has resistance, the energy rapidly dissipates as heat.

The symbol below represents the concurrent switching of ac and dc current.



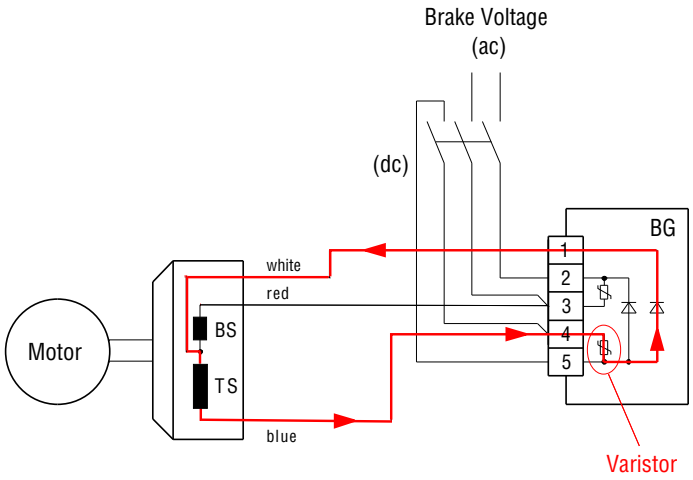


Figure 10 - Braking

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Technical Note

SR Relay



As long as an inverter does not control the motor, an SR relay can perform the same function as an auxiliary contact. It contains a current activating switch that jumpers terminals 4 & 5. See Figure 11.

The advantage of the SR is that it does not require additional wiring from the control panel because it mounts directly at the motor conduit box. Its actuator switch is open when there is zero current at the motor terminals. For detailed information on the SR relay, see **Technical Note B-104**.

Both the SR Relay and the BGE rectifier are available separately, or as a package – the **BSR** brake control system.

BSR = SR relay + BGE rectifier

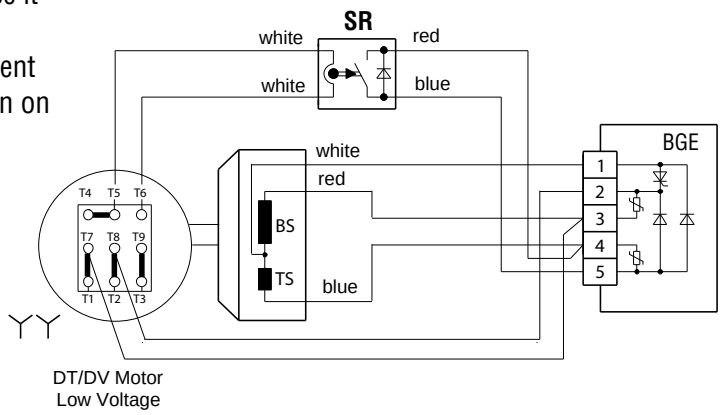


Figure 11 – SR Wiring

UR Relay

The UR Relay looks like the SR Relay. Also like the SR, the UR mounts directly at the motor and performs the same task as an auxiliary contact. The difference is that the UR contains a voltage actuated switch and requires a separate brake voltage source from the control cabinet, not from the motor.

UR is normally used with a 2-speed motor or when an inverter operates the motor. An inverter produces variable voltage, which is why the UR requires a separate voltage source.

Both the UR Relay and the BGE rectifier are available separately, or as a package – the **BUR** brake control system.

BUR = UR relay + BGE rectifier

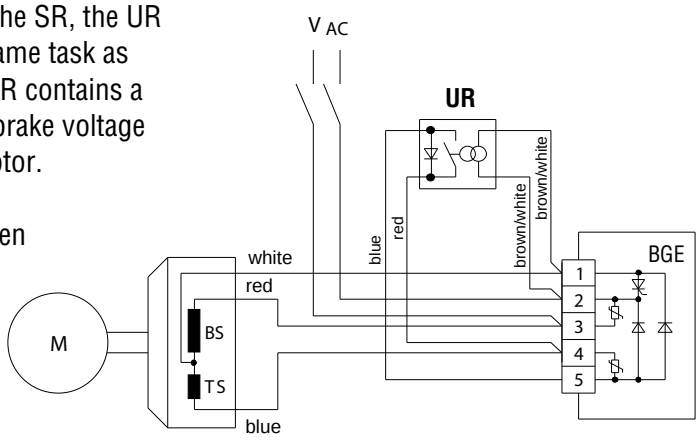


Figure 12 – UR Wiring

NOTE: Since the UR is a voltage relay, it is not interchangeable with the SR current relay. Also, in high ambient temperatures, the UR and SR are unnecessary. Rather than using a rectifier in the conduit box, use a DIN mount rectifier with built in fast reaction, such as the BMP, mounted in the control panel.

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