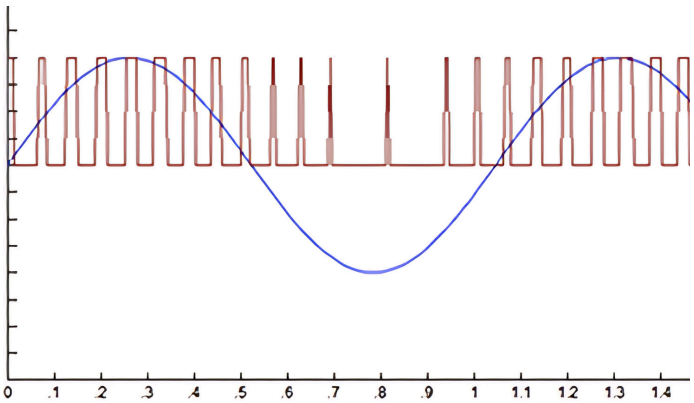
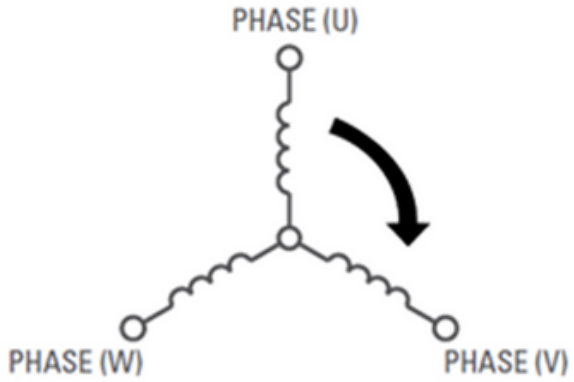
ON THE BLOG

EMC for Servo Drives and Motors

Electromagnetic interference (EMI) and electromagnetic compatibility (EMC) are crucial topics in any industrial system that uses servos and motors. In modern industrial automation, where servos and motors are found almost everywhere, EMI is a frequently overlooked but critical issue. This phenomenon can not only affect the performance of equipment but also potentially damage sensitive components.





WHAT CAUSES EMI IN SERVO SYSTEMS?

The sources of EMI in servo systems often stem from the pulse-width-modulated (PWM) servo drives, which transmit rapidly changing signals to the motors. These signals can generate differential or common-mode noise, which can occur in frequency ranges (spectrum) up to 30-60 MHz, affecting nearby devices and overall system performance.

COMMON-MODE AND DIFFERENTIAL-MODE NOISE

Common-mode noise: Caused by recirculating currents in the motor, induced by the parasitic capacitance between the motor and the circuit. This type of noise not only degrades motor performance but also generates environmental electromagnetic interference.

Differential-mode noise: Originates from the pulses generated by PWM signals. This noise is often measurable as ringing frequencies, impacting the system's precision and stability.

HOW TO MEASURE EMI?

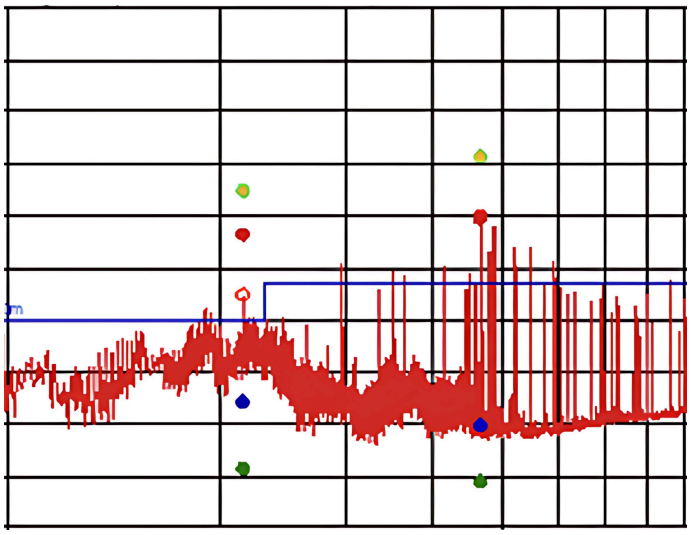
Accurately understanding EMI requires the use of oscilloscopes and differential probes. Time-domain and frequency-domain measurements can reveal characteristic noise patterns such as PWM ringing or voltage spikes. These tools help identify noise sources and develop effective mitigation strategies.

EFFECTS OF EMI ON SERVO DRIVES AND MOTORS

EMI can lead to the following issues:

Overheating and premature insulation failure: Repeated pulses, such as voltage peaks exceeding 1000 V in 480 V systems, can accelerate the aging of insulating materials.

Standing waves: Noise reflections coinciding with pulse frequencies can double or even triple the voltage, especially in cable lengths exceeding 25 meters. This can damage servo systems and reduce the lifespan of devices.



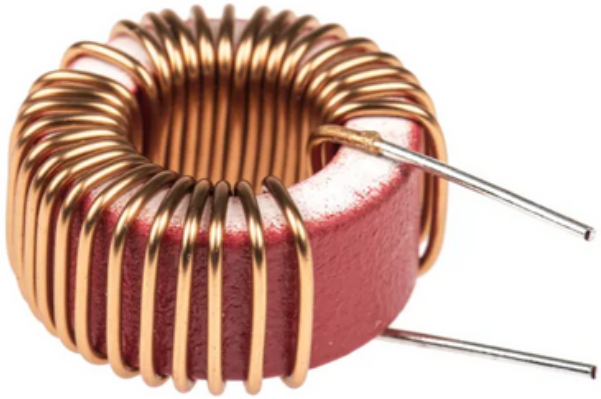
EMI MITIGATION TECHNIQUES

Regular EMI measurement is essential to ensure optimal system performance. Below are various noise reduction methods:

1.Use of Common-Mode and Differential-Mode Chokes

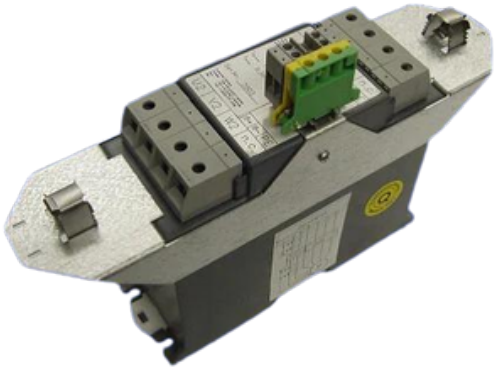
Common-mode chokes effectively suppress common-mode noise. In these inductors, all three phases of the drive are wound around a common core to reduce noise sources.

Differential-mode chokes help reduce differential-mode noise and can also partially mitigate common-mode noise, though they are not always the optimal solution.



2. Shielding and Grounding

Proper design and implementation of shielding and grounding are critical tools for combating EMI. Improper grounding and shielding can lead to noise coupling, especially in high-power installations where DC noise dominates. By monitoring grounding noise, one can determine whether additional shielding or improved grounding is required.

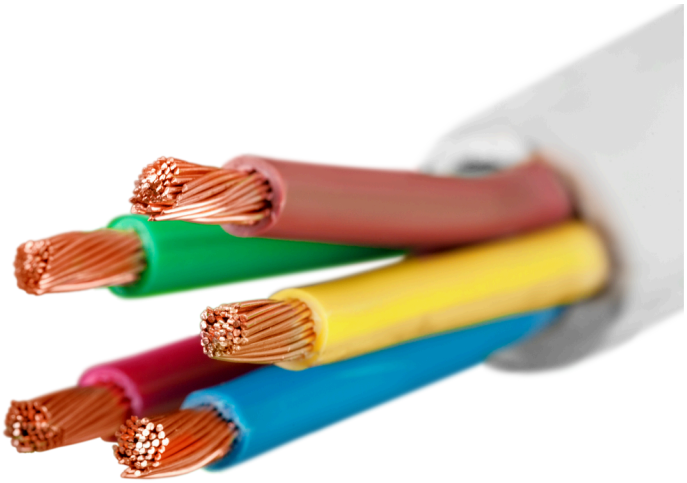


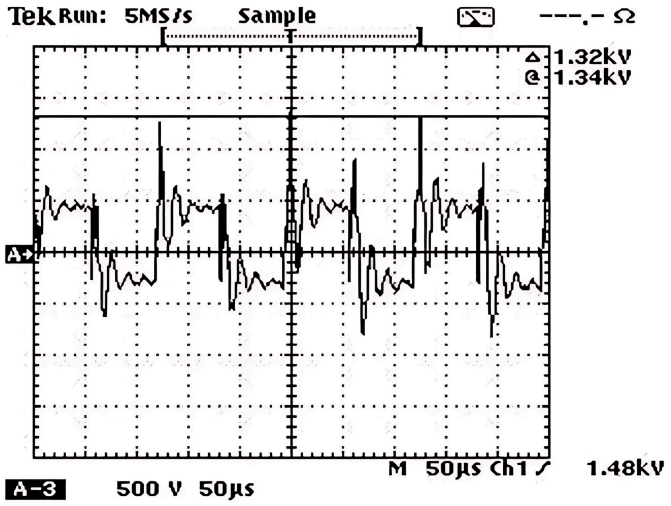
3. Application of LRC Filters

LRC filters are effective in addressing high-frequency noise in PWM controls. These filters are designed to minimize pulse ringing by combining inductance, capacitance, and resistance, which mitigates noise caused by cable length and motor impedance.

4. Empirical Testing and Modeling

Detailed empirical testing and modeling of the motor and cable parameters are essential to understand potential noise effects and implement optimal solutions. Without knowledge of the motor's internal capacitance, EMI measurements provide more accurate guidance for necessary adjustments.





WHY IS EMC COMPLIANCE IMPORTANT?

Compliance with EMC standards is not only a legal requirement but also essential for ensuring the proper functioning of the system and the satisfaction of customers. Inadequate noise management can lead to malfunction, thus jeopardizing uptime and safety.

Electromagnetic interference is not just an inconvenient phenomenon but can also cause significant damage to industrial servo systems. By using appropriate inductors, shielding, grounding, LRC filters, and regular empirical testing, the effects of EMI can be mitigated. It is essential to pay special attention to EMI protection in order to minimize the risk of costly downtime and maximize the system's lifespan.