EMI/RFI Filters

 ✓ EMI Sources
 ✓ EMC Standards
 ✓ Solutions
Capacitive Coupled Noise Current from Unshielded Phase Conductor of VFD
Power Electronics can cause Conducted Electromagnetic Interference Problems

Power Switching Devices Cause EMI

- Improvements in static switching devices have led to higher speeds
- Higher speed devices generate more EMI
- The problem: Common mode high frequency noise

\[ I = c \frac{dv}{dt} \]
RFI/EMI Filter Applications

- Adjustable Speed Drives

- Computers
- Automatic Lighting
- Telecommunications
- Laboratory Equipment
- Factory Automation
- Radio Controls
- Overhead Cranes
- AM Radio Equipment
- TVs and Monitors
- Energy Mgt Systems
Adjustable Speed Drives
Conducted Electromagnetic Interference Problems

Drive EMI Affects:

- Communication Links
- Control Signals
- Encoder Feedback
- Programmable Controllers
- Remote I/O
- Sensors
- Vision Systems
MTE RFI/EMI Filters block high frequency electrical noise

“RF3” RFI/EMI filter

VFD

noise

Parasitic Capacitance
RFI / EMI FILTERS

- Help meet EMC directive
- Solve high frequency interference problems
- Have minimal panel space requirements
- RFI filter installed base over 15,000
EMI Mitigation

- Wiring Practices
  - Shield power cables
  - Separate power and control
- EMI/RFI Filter
- Motor sine wave filter
RFI/EMI Filter Insertion Loss

- I.L. (dB) = \(20 \log_{10} \frac{V_{out}}{V_{in}}\)
- 50 ohm source; 50 ohm load
- Useful for comparison
- Does not predict actual results
MTE “RF” Series Filters

Typical Common Mode Insertion Loss

- 100 KHz > 60 dB (uV)
- 150 KHz > 70 dB (uV)
- 1 MHz > 70 dB (uV)
- 10 MHz > 40 dB (uV)
European (CE) RFI/EMI Filter Requirements

EMC Directive Limits

- 150 KHz - <500 KHz 66 dB (uV)
- 500 KHz - <5 MHz 60 dB (uV)
- 5 MHz - <30 MHz 60 dB (uV)
RFI/EMI Filters

FCC Limits

- 500 KHz - <2 MHz  
  60 dB (uV)

- 2 MHz - <30 MHz  
  70 dB (uV)
PWM Drive RFI Interference

Frequency (KHz/MHz)

W/O Filter

W/Filter

dB / μVolts
MTE "RF" Series
RFI/EMI Filters

- UL Approved through 600 volts
- CE (LVD) Marked (up to 600 volts)
- All ratings STOCKED at MTE
- Fingersafe terminals
- 3-phase (6 amps thru 330 amps)
- 1-phase (10, 16 and 20 amps)
RFI/EMI Filter Selection

- Install on VFD input only
- Size for total RMS current:
- Select proper voltage rating
- Connect in parallel for higher current ratings
MTE Gives You...

- Delivery from stock
- Availability of high current ratings
- All standard voltages available
- Lowest installed cost
- High insertion loss
- A global delivery system