Series A dV/dt Filters

MTE SERIES A dV/dt FILTERS are designed to protect AC motors from the destructive effects of peak voltages facilitated by long cable runs between the inverter and motor. Depending on the switching time of the power semiconductor used in the inverter and the size of the motor, cable lengths as short as eight feet can result in peak motor voltages that exceed the rating of the motor’s insulation system. The longer the cable, the greater the problem.

GUARANTEED RESULTS - The MTE dV/dt Filter is guaranteed to meet its maximum peak motor voltage specification (150% of bus voltage) with up to 1,000 feet of cable between the filter and the motor. It is also rated for a maximum dV/dt of 400V per microsecond. In specific applications, the filter has provided excellent performance with cable runs up to 3,000 feet. The dV/dt Filter has a “3% insertion impedance” which ensures motor torque is not affected by added voltage drops from the filter. Additional benefits include cooler running motors (typically 20-40°C cooler) and a 5dBa reduction in audible motor noise.

EASY TO APPLY TECHNOLOGY ADVANTAGE - The MTE dV/dt Filter is a passive fourth order device that reduces transmission line effects of motor cables by dampening the rate of voltage increase and minimizes the peak voltage that occurs at the motor terminals. MTE Series A dV/dt Filters are designed for use with inverters operated at switching frequencies between 900Hz and 8kHz.

The dV/dt Filter has a continuous current rating of 100% RMS, with intermittent current ratings of 150% for 1 minute and 200% for 10 seconds.

PRODUCT SELECTION: Please refer to the selection tables in this brochure or visit the MTE website at www.mtecorp.com for complete product selection. Please note that Series A dV/dt Filters can only be used with PWM inverters with switching frequencies between 900Hz and 8kHz.

BASIC SPECIFICATION RANGES - The dV/dt Filter is available in voltage ranges of 380VAC to 600VAC & for motor sizes from 0.5 Hp to 600 Hp. For applications with motors rated 100 hp & below & standard NEMA B motors (MG1 Part 30) are prone to failure as a result of high voltage spikes & will benefit from an MTE dV/dt filter. The dV/dt Filter has a continuous current rating of 100% RMS & intermittent current ratings of 150% for 1 minute & 200% for 10 seconds. The maximum peak motor terminal voltage with 1000 ft cable or less is guaranteed not to exceed 150% of bus voltage.

INSTALLATION OPTIONS: Panel-mount or NEMA 1, 2 and 3R enclosures are available.

Typical uses include:
- Submersible Pumps
- HVAC Equipment
- Process Automation Lines
- Protect Motors from Long Lead Effects
- Reduce Output Voltage dV/dT
- Reduce Motor Temperature
- Reduce Motor Audible Noise

Model Number Code Configuration:
- dV/dt filter
- Series Version. A, X
- “X” denotes non-standard configurations
- Mechanical Configuration
  - P = Panel Mount
  - G = General Purpose NEMA 1 or 2
  - W = NEMA 3R
- Indicates Physical Size: A, B, C, D, etc. (A is smallest)
- Current Rating (i.e. 0045 is 45 Amps)

Options
Reflected Wave Phenomenon:
Reflected voltage wave generation occurs as a function of the output voltage rise time (dV/dt), the length of the cables in the system, and the impedance characteristics of the motor. Motor cables become complex transmission lines with increasing distributed parallel capacitance, series inductance and resistance, which build up with length. At one end of the transmission line is a low impedance inverter drive. At the other end of the transmission line is the is the soft impedance motor. The PWM variable switched energy from the drive will reach a resonance as the leading edge works against the soft impedance motor and reflects back, then adds to the next energy wave from the drive. This effect can cause voltage at the motor terminals to reach 2 to 4 times the drive’s normal DC bus voltage.

The Solution:
The MTE dV/dt Filter is a passive fourth order device that reduces transmission line effects of motor cables by dampening the rate of voltage increase and minimizes the peak voltage that occurs at the motor terminals.

When to add an MTE dV/dt Filter

<table>
<thead>
<tr>
<th>Rise Time (microseconds)</th>
<th>Critical Lead Length (meters)</th>
<th>Critical Lead Length (feet)</th>
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<tr>
<td>2.00</td>
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<td>0.05</td>
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Effects of Transients on the Motor

![Motor pu Over-Voltage vs. Cable Length vs. Risetime](image)

In the graph, the x-axis represents cable distance in feet, and the y-axis represents motor pu over-voltage in volts. The graph shows how the over-voltage increases with cable length at different semiconductor risetimes.

![dV/dt Filter Current Derating for Drive Output Frequency](image)

In the graph, the x-axis represents output drive frequency in Hz, and the y-axis represents dV/dt filter current derating factor. The graph illustrates the current derating factor for different drive output frequencies.

![dV/dT Filter Performance](image)

In the graph, the x-axis represents cable length in feet, and the y-axis represents peak voltage at motor in volts. The graph compares the performance of the dV/dT filter with and without dV/dt filter.
**Selection Table**  Series A dV/dt Filter Technical Data - 380VAC to 600VAC

<table>
<thead>
<tr>
<th>Filter Amps</th>
<th>380 Volts</th>
<th>480 Volts</th>
<th>550-600 Volts</th>
<th>Open Panel</th>
<th>NEMA 1-2 Cat. No.</th>
<th>NEMA 1-2 Cab</th>
<th>NEMA 3R Cat. No.</th>
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</table>

**dV/dt Filter Selection:**

Select filters based on the current rating of the motor for both variable torque and constant torque applications. MTE Series A dV/dt Filters have been designed to meet motor current requirements based on NEC motor ratings. For applications that use motors that exceed NEC current ratings, use the next larger dV/dt Filter. MTE Series A dV/dt Filters are available as open frame panel mount or enclosures with ratings including NEMA 1, NEMA 2, and NEMA 3R.
Performance:
Maximum Peak Motor Terminal Voltage with 1000 ft cable: 150% of bus voltage
Maximum dV/dt: 400 Volts per microsecond

Ratings:
Continuous Current Rating: 100% RMS
Intermittent Current Ratings:
- 150% for 1 minute
- 200% for 10 seconds

Minimum Inverter Switching Frequency: 900Hz
Maximum Inverter Switching Frequency: 8kHz
Nominal Inverter Operating Frequency:
- Minimum: 6Hz
- Maximum with de-rating: 120Hz
Altitude without de-rating: 1000 meters
Maximum ambient temperature:
- 50° C open filters
- 40° C enclosed filters
Insertion Loss: 3% of rated voltage maximum
Audible Noise:
Maximum Audible Noise Level at Two Meters for Standard Configuration: 76dB-A

Output Compatibility/Loading:
Conventional 3 phase motors, "No Load / Open Circuit" continuous operation

Agency Approvals, UL& cUL:
Listed to UL508 type MX and CSA-C22.2 No 14-95, File E180243
3HP to 1000HP, 120VAC to 600VAC, 50/60Hz Three Phase
Note: Short Circuit rating not required under Exception No.1 of UL508A SB4.2.1

Data subject to change without notice.

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