Sizing Recommendations for Matrix® AP Filters to Support Various Drive Topologies

General Sizing Recommendations:

MTE filters are designed to carry their rated current at the published ambient temperatures. The Matrix AP filter service factor is one (1) with an overload 1.5 times the rated current for only one minute. Generally, it is always best to select a filter by its current rating so that it's slightly higher than the current required by the nonlinear load, i.e. a drive. Be cautious with application sites having high background voltage harmonics, extreme altitudes, and harsh environmental conditions. These applications may require derating the harmonic filter. Refer to the harmonic filter technical reference manual for background voltage distortion derating curves, maximum ambient temperature derating curves, and high elevation derating curves.

Conventional Six Pulse VFDs Employing PWM for Motor Control:

To get the optimum harmonic mitigation and cost benefits choose the filter amperage based on the drive's worst-case input current due to motor loading not on the current rating of the drive. Usually input drive current is unknown for most applications. Use load motor HP/FLA or KW to choose the right filter for specific applications. Selecting filters based on motor HP has been successful because conventional 6 Pulse Bridge supplies typically have a slightly lower input current than what the VFD provides to its motor. As a benefit using the motor load provides headroom for a worst case current the filter could see at the drives input. If the motor FLA is unavailable only then use the drive output rating to make a filter selection. The Matrix AP has the "adaptive passive" advantage if a filter selection is oversized in maintaining consistent filtering at light loads and won't degrade like other passive filters when not at full load. Note: some inspectors want to see a correlation of the filter current rating to the motor nameplate FLA.

Multiple VFD Loads:

A single filter can be sized to mitigate harmonics of multiple VFD loads by summing all connected VFD loads and choosing a filter current rating that supports this total. The Matrix AP with adaptive passive technology tolerates wide load variations and maintains excellent harmonic mitigation. A drawback of using a single filter on multiple drives is possible cross talk between adjacent connected drives. Consider adding a capacitor contactor to prevent leading power factor at light loads. See Application Note "Harmonic Filters with Multiple Drives" for more information.

DC Drives:

For DC drives, use the current rating of the DC drive and choose the filter's current rating to equal or slightly exceed that of the DC drive. See Application Note AN0105 "Solving DC Drive Harmonics with Matrix Harmonic Filters" for more information.

Variable Voltage Inverter (VVI), Variable Speed Drive (VSD), or "6-Step" VSD:

The Variable Voltage Inverter (VVI), Variable Speed Drive (VSD), or "6-Step" VSD is often used in Electrical Submersible Pump (ESP) applications. This type of drive uses a 6-pulse silicon-controlled rectifier (SCR) front end to convert the incoming AC power to a variable voltage DC power. An inductor and series of capacitors are then used to filter the AC ripple riding on the DC bus. The inverter section uses power insulated gate bipolar transistors (IGBT's) to create a 6-step quasi-sinusoidal output waveform. Electrical Engineering and physics dictate that motor operating torque, motor operating speed, motor efficiency, motor power factor, drive efficiency, drive power factor and drive modulation scheme determine how much input current is required by the drive. That said, Baker Hughes recommends that a harmonic filter used with the 6-step drive should be selected based on the maximum input current rating of the drive, regardless of the size of the motor connected to the drive.

Chillers HVAC:

For HVAC chillers the RLA (Run Load Amps) is used to choose an AP filter and requires a selection of the filter current rating to be greater than the specified RLA current. Verify with the chiller manufacturer that the RLA rating will not be exceeded. If for some reason there is a service factor that will exceed RLA, use the higher current to prevent filter stress.

Battery Chargers, Power Supplies and UPSs:

Battery chargers, UPS and resistive heaters require sizing of the filter to the worst-case current loading at the input of the device. Sizing to nominal current will result in excessive voltage drop during worst case loading on these devices if they are SCR based.

Sizing Recommendation for Matrix ONE Filters

Single Phase Drives for Three Phase Motors (Phase Converters):

Most drives controlling a three-phase motor connected to single phase power are oversized to increase the bridge current rating plus add more capacitance to the bus. Single phase filters

selection requires having the correct single phase input drive current either by specification data or using the motor FLA * √3. To be properly sized, the Matrix ONE current rating must equal or exceed the worst-case current of the drive input current.

Non-drive and DC motor drives or any phase back SCR based loads require getting the worst-case current at the input of the nonlinear single-phase device. Follow user manual guidelines and basic recommendation of the Matrix AP three phase filters for choice of a filter.

Additional Support

For help sizing other topologies, contact MTE Applications Engineering by email at appengrg@mtecorp.com or by phone at 262-946-2818.