



## Frequently Asked Questions

### V1k Output Filter

#### **1. How does the V1k compare to the KLC output filter?**

Essentially both are comparable dv/dt filters. Many of our customers have been asking us to reduce the required panel space for the filter and eliminate the “L” style base bracket used on the KLC. The V1k is an updated design responding to that request which focuses on mounting and installation convenience. They are very close in circuit design and thus both utilize the success of that filter on controlling dv/dt.

#### **2. What is the maximum lead length I can use for the V1k?**

The standard product is promoted for use on standard drive applications out to 1,000 feet of lead cable when setting up the system with a given set of drive and wiring parameters. Specific applications can reach 3,000 feet (consult factory for applications above 1,500 feet).

#### **3. How do you size the V1k?**

The V1k is rated and sized the same as the KLC output filter. It is a drive output filter that is designed to a 600 volt class and is sized by the full load current of the applied motor load.

#### **4. What are the required drive settings to use the V1k?**

The V1k is designed for use on modern PWM drives with a diode front end power structure. While being the latest in drive technology, these fast switching electronic drives have been found to produce a high amount of dv/dt or voltage distortion on the output voltage waveform. To operate the drive and motor properly, we recommend the drive carrier frequency be adjusted to 8 kHz or less and the drive be operated at an output frequency of 60 Hz and lower. The manual provided with the output filter and available on the website can assist in the other system considerations required.

#### **5. Can I use the V1k on multiple motor applications?**

The V1k can be used on multiple motor applications. We recommend the use of no more than 10 motors with a total lead length of 1,500 feet unless the application is discussed with TCI's Technical Support Department.

#### **6. Is the V1k connected the same way as the KLC output filter?**

The V1k is connected in the same fashion as the KLC filter. It is a simple series connection between the drive and motor. Again, the filter is designed to be installed directly next to the drive and simply connected to the drive output terminals. Unlike some output filters that are installed at the motor end, the V1k is conveniently located along side the drive and is useful at protecting both the motor and lead cables.

#### **7. What are typical applications for the V1k output filter?**

The V1k output filter can be used on most commercial and industrial applications where the motor is located at an extended distance from the VFD. Typical applications include HVAC fans, pumps, conveyors, drilling applications, and other drive applications where the motor is located from 100 to 3,000 ft from the drive.

### **8. Do I size the filter to match the drive input current or the motor full load current rating?**

Unlike input or line side devices where the drive input current becomes an important part of the selection and sizing criteria, output devices are sized based on the load itself. The load determines the current that will be drawn through the filter. Merely size the filter based on the full load amp, (FLA) rating of the motor. We suggest you size the filter no more than 110% of the motor FLA to ensure a proper match between drive, load, and filter.

### **9. Are there any guarantees with the V1k that my motor will not fail on my drive from dv/dt?**

Power system dynamics are very difficult to quantitatively evaluate due to a variety of power system dynamics that can add to the harmful effects of dv/dt. Such components as line capacitance, parasitic capacitance, induced voltages and the like can intensify the voltage distortion on the line and contribute to the degradation of the motors insulation system. The V1k filter does an outstanding job of controlling these elements and bringing the distortion voltage down to a level that can be supported by the motors insulation system. Even standard electric motors can be used on drives with the V1K output filter.

### **10. Does the V1k help with common mode current problems?**

The main purpose of the V1k is to address and control the effects of dv/dt on the VFD output. Because of the circuit used, the V1k also reduces the content of common mode current on the line by 30-40%. This is especially useful in the prevention of motor shaft bearing currents which are known to cause premature motor bearing failures in adjustable frequency drive applications.

### **11. Does the V1k help prevent motor bearing currents?**

A very positive effect of the V1k output filter is to greatly reduce the amount of common mode current on the line. Common mode current is the phenomenon which causes motor shaft bearing currents and the resulting motor bearing failures. By reducing this current, motor bearings can enjoy a longer service life. The V1k filter will not eliminate this current but will reduce the line content between 30 and 40%. This is notable and very much needed in motor and drive applications.

### **12. Is the V1k the same as a sine wave filter?**

The V1k is a drive output filter that addresses dv/dt. This filter is very effective in this cause and can protect standard and special service electric motors from the damaging affects of dv/dt. The V1k filter, however, does not return the drive output square wave to a sinusoidal waveform and thus is not referred to as a sine wave filter. TCI has designed a specific filter for those applications where extremely low distortion and near perfect sine wave performance is required. For those applications, please refer to the KMG MotorGuard sine wave filter.

### **13. If I need a V1k above 750 amps, what do I do?**

TCI has designed and developed the V1k to cover the vast majority of NEMA frame motor applications through 600 HP at 480 volts. Above that current level the V1k can be paralleled to achieve the performance of using a single device. For example if 1,500 amps is required, two 750 amp units can be wired in parallel and connected through a common power block on both the line and load side of the filter. While TCI does not provide this configuration, TCI Technical Support will assist you in these applications.

### **14. What is the warranty of the V1k?**

V1k Output Filters are warranted against Manufacturer's defect for one year from the date of original purchase.

**15. Are there considerable line losses with the V1k?**

Line losses from the V1k are not published because they vary greatly due to the system dynamics and such settings as drive carrier frequency. From independent testing done by a major drive manufacturer, the V1k was found to be 98% efficient in operation. From a line voltage drop consideration, the impedance of the filter is 1.5% at rated load. For example, a 21 amp V1k will have a line voltage drop of approximately 1.5% when applied to a 480 volt line at 21 amps. Because impedance is proportionate to the load, the line voltage drop will decrease as the percent of load decreases.

**16. Does the V1k come with field connection terminals?**

The V1k filter comes complete with connection terminals such as a terminal block on the smaller units and compression lugs on the larger size units. Please see the outline drawings for the connections provided on the specific size needed.

**17. Is the V1k a 600 volt product?**

The product has a 600 volt class of insulation and is safe for operation on 600 volt drive systems. Because this product focuses on the 480 volt product, it will operate safely on a 600 volt line but the level of dv/dt will be slightly higher than on a 480 volt system. Performance tests resulted in distortion voltage peaks of around 1,200 volts instead of the 1,000 volt limits on a 480 volt system. This level is still considerably less than the typical peak distortion voltage of up to 2,100 volts found on 600 volt systems and should greatly assist in extending the life of the electric motor.

**18. Can I place the V1k anywhere on the output side of the drive?**

The V1k output filter is designed to be located directly next to the VFD. TCI recommends the filter be located within 10 feet of the drive to properly handle the voltage distortion, dv/dt, before it escalates on the line and causes damage to the motor and lead cables. If this is not possible due to the location or configuration of the drive system, we recommend our customers contact TCI Technical Support to discuss the application and ways to address this situation.

**19. What are the key components of the V1k output filter?**

The V1k consists of two major components. The first part of the filter is a series line reactor which dampens the voltage distortion on the output of the VFD. The second component is a snubber circuit which effectively reduces the voltage distortion, dv/dt, to 1,000 volts per micro second on a typical 480 volt system. These two components are very effective at protecting the electric motor and the affects of dv/dt on the output side of the drive.

**20. Can I use any type of lead cable with the V1k output filter?**

Yes, any standard approved type of lead cable can be use along with the V1K. From testing conducted at TCI, we have found the use of flat ribbon and armored cable to produce the best results in keeping the motor terminal peak voltage to the lowest point of line distortion.

**21. What is the maximum ambient temperature rating of the V1k?**

Like most electrical equipment, all testing and rating data has been established having an ambient temperature of 40 degrees Celsius. Operating the filter in an ambient temperature above this should only be practiced when conferring with TCI Technical support to ensure the service life of the filter and the integrity of the filter performance is not in jeopardy.

**22. Can I use the V1k on 50 Hz applications?**

Yes, the V1k can be operated on 50 Hz input applications. The input frequency of 50 Hz to the drive will not have a negative impact on the performance or service life of the V1k drive output filter.

**23. Will the V1k fit into the same panel space as the KLC output filter?**

Because of the new design, the V1k is smaller than the KLCUL in most instances and in many instances, smaller than the KLC output filter. This was one of the design parameters of the new filter configuration. Outline drawings are posted on the TCI website for both the KLC and V1k product lines.

**24. Can I mount the V1k filter on top of my drive cabinet?**

For most sizes, the V1k can be mounted on top of a drive cabinet. Please see the outline drawing of the specific rating you request for an exact layout and mounting configuration.

**25. What is the lowest ambient temperature the V1k can be used in?**

In most applications this is not a critical question. When an application does arise where the ambient temperature can be excessively low, we suggest the filter be exposed to a temperature of no lower than minus 15 degrees Fahrenheit unless special provisions are made. In some cases devices such as space heaters may be required when the device is not in operation. This follows true to most electronic equipment incorporating capacitors and other extreme-temperature sensitive components.

**26. Can I use the V1k on SCR based drives as well as diode front end drives?**

The V1K is designed for use with modern PWM drives where  $dv/dt$  and the reflected wave phenomenon is a prevalent issue. Older series current source and SCR based drives incorporate early technology and switching speeds that do not produce as harmful a content of  $dv/dt$  and thus would not require this type of device for motor protection. Your drive manufacturer can respond to this question should you be using an earlier series of drive technology.

**27. Is there an overload rating for the V1k?**

The V1k drive output filter is designed to perform with the ratings and performance of both the drive and motor. TCI has sized and rated the V1k filter to coincide with the ratings of standard NEMA design B, 2 and 4 pole motors. If you are using a slow speed motor or non-standard NEMA design, we suggest you use the FLA rating of the motor as a guide to selecting the filter. For example, if you have a special 25 HP, 480 volt pump motor with a nameplate FLA rating of 38 amps should you select a 30 HP filter or will the 25 HP, 35 amp unit work? Our suggestion is to use a 30 HP filter with a normal continuous current rating of 45 amps due to the fact the unit could operate continuously at 38 amps or perhaps even go into the service factor and possibly reduce the service life of the output filter. If you have application questions regarding sizing please contact TCI Technical Support for a complete system evaluation.

**28. Will the output waveform of the V1k look like a sine wave?**

The V1k is a very effective  $dv/dt$  filter and will provide excellent protection for your motor when use on a PWM, variable frequency drive. The output waveform will show a notable reduction in the magnitude of the voltage excursions found on a conventional drive output waveform. It is designed to limit the voltage spikes to 1000 volts per  $\mu$  Second or less and our tests indicate it is very effective at that goal. It is not however, a sine wave filter and it does not return the drive output square wave to a smooth sine wave profile. For this type of performance on the output of the VFD, we recommend you consider using the TCI, KMG MotorGuard Sine Wave Filter.

**29. Do I need a different V1k filter when I have a 208 or 240 volt power system?**

The V1k is sized from a current standpoint and the series inductor is based on a 600 volt power system or less. You can use the V1k on 208 and 240 volt systems by merely sizing the device based on the FLA current rating of the motor just as you would for a 480 volt power system.

**30. Can I use the V1k on a single-phase voltage input system?**

The V1k is made for three phase drive systems. If the drive is being fed by a single phase input power, the output will be three phase and the system will utilize a three phase motor. Because the output of the drive is three phase, the system will experience the same effects of  $dv/dt$  that a conventional three phase input power system will have. Yes, the V1k is well suited for this application to protect the motor from the effects of  $dv/dt$ .

**31. Do I still need to purchase a V1k filter for the output of my drive if I am using an inverter duty motor?**

If you can add the low cost of the filter to your long lead drive application to preserve and extend the life of your drive system, it is typically very well spent dollars. Considering the cost of the motor, removal, re-installation, and the associated downtime and cost of frustration, the cost of the filter is minimal. Regardless if the motor's insulation system can handle the spike voltage, it will be much less stressed and burdened with the filter in place. This will always help extend the service life of the system.