

This Application Note is pertinent to the Unidrive SP, Commander SK and Affinity Families

Over Voltage Trips on Power Up

Over voltage trips (**OU**) are not an uncommon event on today's AC Drives. In general there are three main causes:

1. Voltage spikes on the ac supply (typically caused by dc drives, line starting of ac motors or power factor capacitor switching to name a few)
2. Regenerated energy from the connected motor / load
(quick deceleration or machine characteristics i.e. punch press drive)
3. Ground fault in the motor (**OU** condition based on how the fault is detected). All of the above occur while the drive is either running, started or randomly while powered up in an idle condition.

Over voltage trips occurring immediately after a power up results from a voltage doubling action caused by the "EMC" Filter Capacitor¹ supplied in the drive when applied to a grounded Delta power system. Although in rare cases a floating Delta or Wye system will exhibit the same problem .

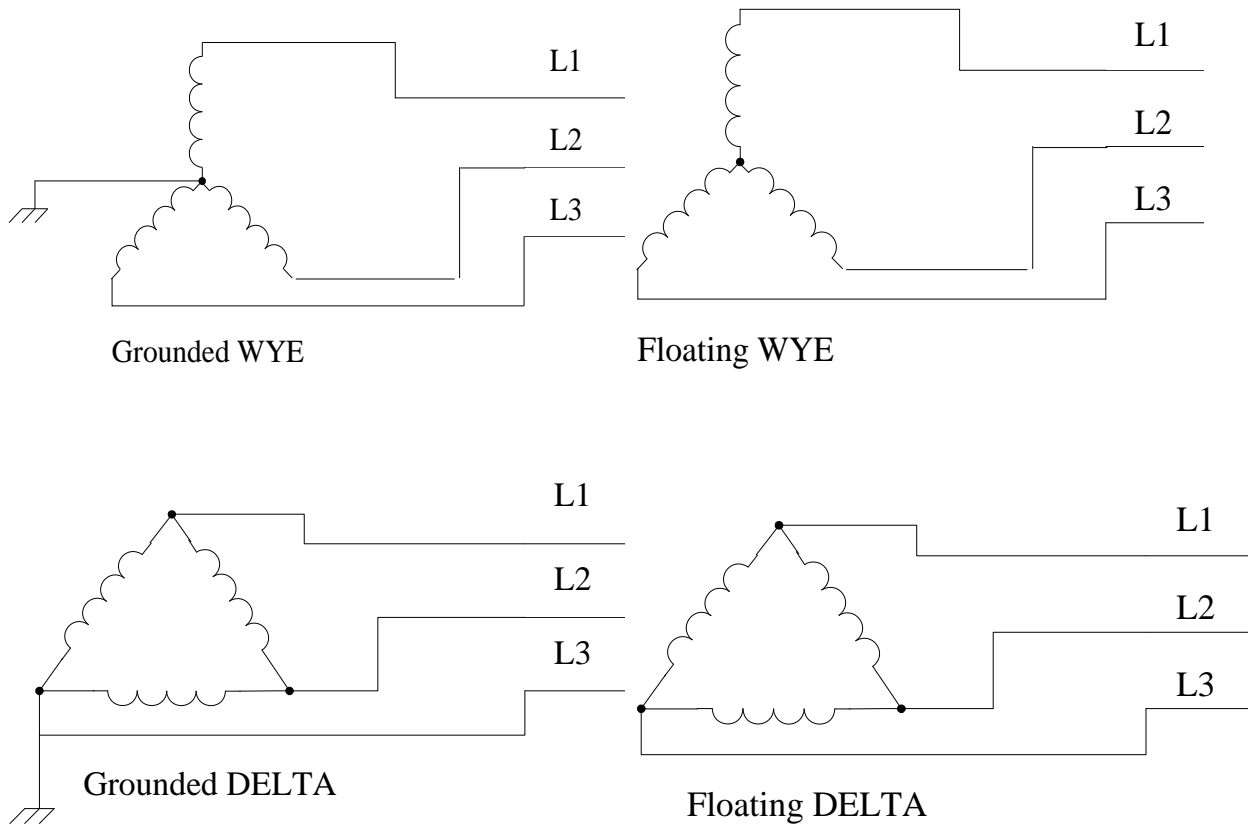
The solution to the problem is to simply remove the EMC capacitor. This capacitor is a requirement in Europe but not in the USA.

In an installation where EMC filters are required, an external EMC filter would be required but, the user would have to ensure that it is compatible for use on a grounded delta supply. In general, any facility requiring EMC filtering would also require a grounded wye system (which is the best and most reliable power system for an ac drive).

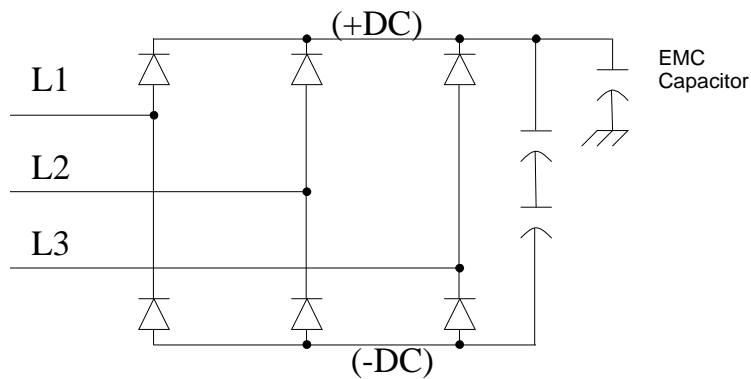
- 1 EMC Filter Capacitor- The EMC filter reduces radio-frequency emission into the line power supply. Used to achieve **E**lectro**M**agnetic **C**ompatibility compliance with regional requirements ie CE Compliance

CE is the European **compliance** mark and covers a range of requirements including **EMC**

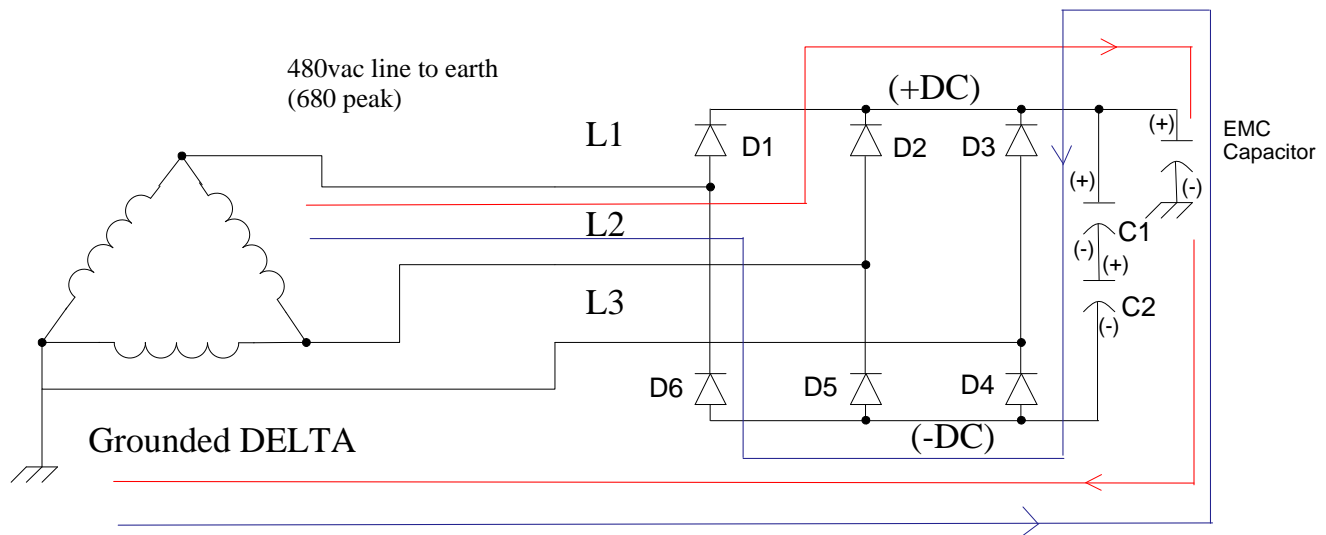
The diagrams below show the four most common power systems configurations;



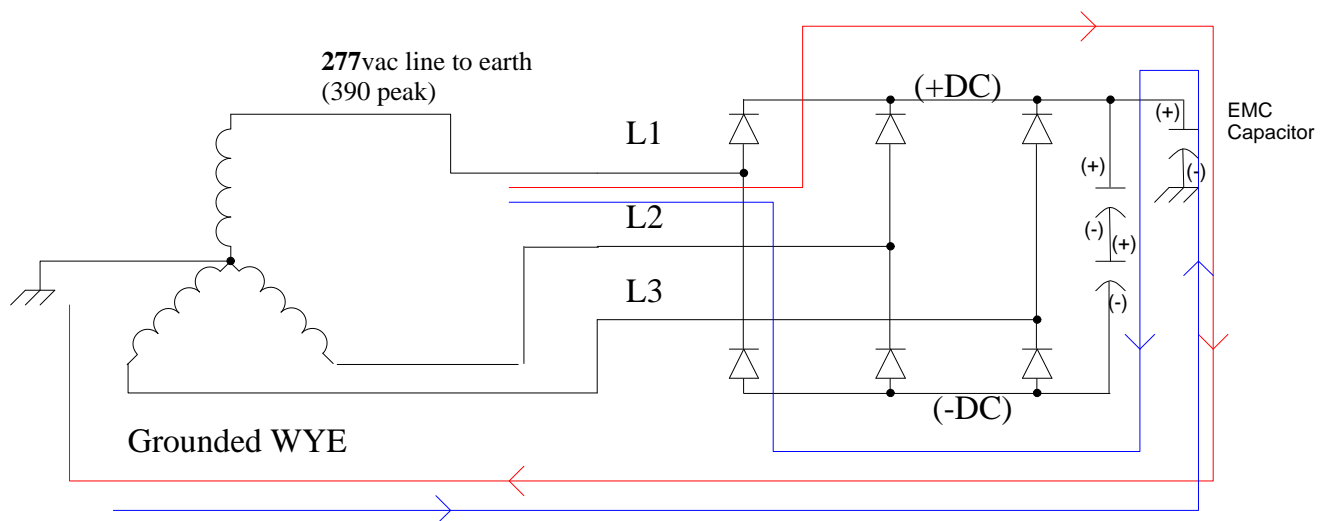
These transformer configurations feed 3 phase power to our drive's "rectifier front end" as shown below. As can be seen, the 3 phase rectifier feeds a DC bus with the EMC filter providing a high frequency shunt path from DC+ to Earth.



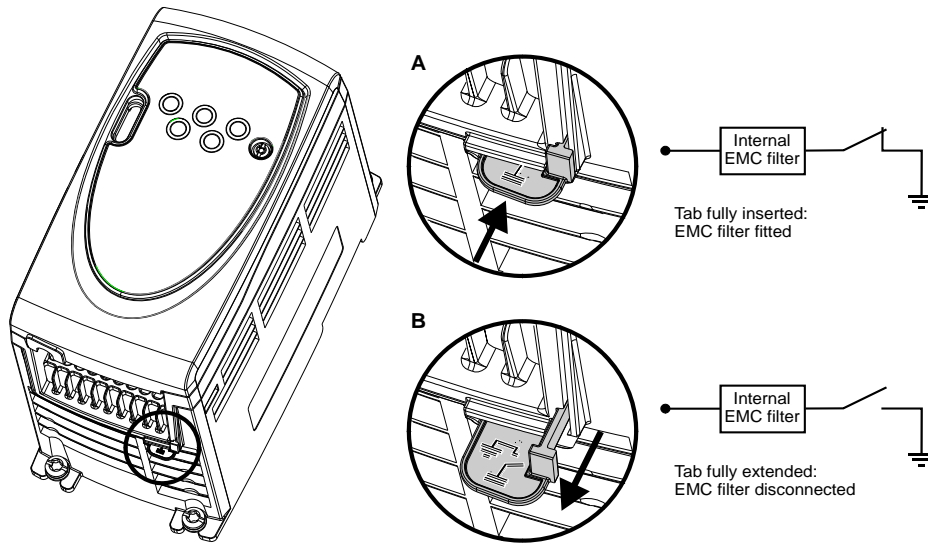
The drawing below shows the basic charge paths of the “voltage doubler” circuit. When line L1 goes positive, it charges the EMC capacitor (thru diode D1) to the peak of the ac line (680vdc for a 480vac line) with respect to earth common. When L1 goes negative with respect to earth, the negative side of C2, is “pulled down” towards the negative peak voltage of L1 (-680volts) causing charge stored in the EMC capacitor to be transferred to the bus capacitors, charging them to the dc bus trip level. This is somewhat simplified but does demonstrate the current paths that cause the problem. If the EMC capacitor is removed, you can see that the path no longer exists and the over voltage trips will stop.



In the grounded wye connection shown below, the same process occurs with the exception that the peak voltage with respect to earth ground is only 390 volts instead of the 680 volts as above. In this case the energy transferred will not be enough to cause the dc bus to charge to the over voltage trip level.



The other two configurations, ungrounded Delta and Wye connections do not typically exhibit the over voltage charging. In rare cases if the coupling capacitance to earth ground in the power system is unusually high on one phase a charging path could be created. In this case, (in fact any configuration other than grounded Wye) the capacitor should be removed.



Commander SK A thru D uses pull tab

For a summary of Internal EMC Filter locations and removal procedures click the following:

[Internal EMC Filter Removal](#)

Questions: Ask the author ??

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