Technical note
Two-Contactor Vs. Three-Contactor Bypass

ABB factory designed VFDs with Bypass take advantage of a proven two-contactor bypass design rather than a less reliable three-contactor design. This two-contactor design philosophy was implemented because it includes several inherent advantages for the end user. When paired with the VFD service switch (drive isolation mechanical only disconnect) a two contactor bypass provides all the features of a three contactor system and more.

A two-contactor design provides a safer bypass.

One of the common rationalizations used for a three-contactor bypass is drive serviceability. A common perception is that an input contactor provides a safe disconnect method for removing input power from the VFD during servicing. Our competitors may state that the three-contactor bypass allows the customer to remove and replace the VFD while the motor is run in the bypass mode. While this may have occasionally occurred in the field, a customer should never attempt to swap a drive on the load side of a contactor when power exists on the line side. The fact is that several conditions can result in unexpected power being applied to the load side of a contactor.

- The contactor could be mechanically jammed or have welded contacts.
- Coil voltage could be inadvertently applied to the contactor while the VFD control wiring is being removed and reinstalled.
- Accidental pressure could be placed on the plunger, engaging the three phase contacts

Any of these conditions could result in equipment damage and physical harm. Safe electrical maintenance practices require removal of fuses and/or the use of a disconnect switch. How many electrical equipment enclosures do you know of that utilize a contactor as the method for removing power from the equipment inside? After all, a contactor is not an NEC recognized, lockable, physical disconnect. A two-contactor, two disconnect (one drive isolation, one external main disconnect) bypass is the only type of bypass that will allow a customer to change out the drive while running the motor in bypass. Additionally, all factory designed ABB drive / bypass systems have fast acting drive input fuses that can be easily removed to isolate (disconnect) the VFD from the line with a visible air gap if no VFD service switch is optioned.

A two-contactor design provides a more reliable bypass.

One of the main problems experienced with a typical 115 VAC, three-contactor bypass design is input contactor coil burnout. Under abnormal operating conditions such as a “brownout” or single-phase condition, an unregulated 115 VAC control transformer can cause the voltage across the input contactor coil to fall below the “hold-in” level of the contactor. Under these conditions the input contactor can chatter or drop out ending in contactor coil failure, contacts welding, or contacts failing open*. So now the three contactor Bypass system, which was purchased to make the system more reliable, has failed due to input voltages that the VFD without a bypass, would likely have not failed. Additionally if the input contactor drops out during a “brownout” or power outage, the system ride-through is reduced as the VFD immediately has zero power to draw from the line. These two types of failure scenarios cannot happen to a system that does not use a third contactor, as there is no voltage sensitive device upstream of the VFD in ABB systems.

VFD – Test –Bypass functionality

Three contactor systems are often specified with a three position selector switch “VFD-Test-Bypass”. ABB two contactor bypass systems can perform all three modes of operation without the three position switch, third contactor and associated wiring.

VFD mode AND Bypass mode, as they imply, power the motor through one of the two parallel paths. These modes and the ability to manually switch to them are bare necessities in both the three contactor and two contactor solutions. VFD mode functionality is identical in both systems.

– In Bypass mode, the only operational difference between them is:
  • In the three contactor solution the VFD is not powered because the input contactor is disengaged;
  • In the two contactor solution the VFD (and all its functions like serial communication) remain powered up, though not providing power to the motor.

– Test Mode, is specific to the three contactor solution in name only.
  • When selected, test mode applies power to the input (third) contactor, and therefore the VFD, allowing the operator to “test” the VFD functionality without the VFD providing power to the motor because of the open drive contactor. The two contactor solution inherently has this function, as the VFD remains powered in all operation modes, unless specifically powered down via the service disconnect switch or removal of the VFD fuses.

*The fix for the contactor chatter issue of a typical bypass with a control transformer is to add expensive phase monitor relay and interlocks. The ABB E-Clipse Bypass eliminates this issue across the product line from 0.5 thru 400Hp. The ABB E-Clipse Bypass utilizes a regulated power supply with a voltage monitoring circuit to power the 115V coils on both contactors. The power supply operates with an input line voltage that is □ 30% of the input voltage. On a 380 – 480 VAC bypass this translates to an entire system (VFD and bypass) voltage limits of 266 – 624 VAC. Additionally The E-Clipse System recognizes welded or mechanically jammed contactors, open contactor coils, and single phase power conditions; taking appropriate actions for each scenario.

The ABB two-contactor bypass designs ultimately give the end user better and safer functionality than a three-contactor bypass. Service capability, reliability and safety are improved through the use of drive input disconnect switch, rather than a third contactor. We feel the advantages listed will lead to a win-win situation for you and your customers, and feel that a two-contactor bypass design offers more than a three-contactor design.

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