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Correcting Problems Caused by Variable Frequency Drives

Switching from an on/off pump control to a variable frequency drive pump may result in flow measurement errors and pH measurement errors. This section details many solutions that H.E. Anderson has observed to help correct electrical noise problems.

A power line filter of the type and size indicated by the VFD manufacturer should be used to reduce the electrical noise being fed into the A.C. power wiring. Power line filters are usually listed as optional equipment. All VFD drive cables should be of a shielded type. All power and signal wires to and from H.E. Anderson equipment should be kept at least 12 inches away from VFD wiring. If the VFD wiring must cross any H.E. Anderson Product wiring make sure they cross at a 90° angle. H.E. Anderson J Plus controllers should be kept as far away VFD's as possible. Use separate branch circuits for VFD's and H.E. Anderson equipment. If flow measurement errors occur, it may be necessary to change the meter cable from a 2 conductor with shield to a 3 conductor with shield and connect the shield to earth ground. If pH measurement errors occur, it may be necessary to connect the water stream at the pH probe to earth ground. One option is to use a grounding rod close to the pH probe. Another option is to connect the grounding conductor to earth ground at the receptacle where the P-1 is plugged in. Often times the second option will correct pH measurement errors when the first option did not.

This section contains information regarding motor installation collected from various sources. Short motor leads, when used with an EMI/RFI filter or drive isolation transformer, will help reduce electrical noise generated by VFD's (1). One way to control common-mode noise

is to provide a known path to ground for noise captured at the motor's frame. A low impedance path, such as a properly designed cable ground/shield system, can provide the noise with an easier way to get back to the drive than using the building ground grid, steel or equipment, etc.

(2). VFD Cables with heavy thermoset insulation are recommended because of the proven electrical benefits and improved high temperature stability they offers. Shielding systems including copper tape, combination of foil and braid and continuous armoring types are most appropriate for VFD applications because of the low impedance path they provide for common-mode noise to return to the drive. (2). The high frequency current ripple in the motor cables may also cause interference with other cabling in the building. This is another reason to use a motor cable designed for VSDs that has a symmetrical three-phase structure and good shielding. Further, it is highly recommended to route the motor cables as far away from signal cables as possible. (2)

Conducted disturbances can propagate to other equipment via all conductive parts including cabling, earthing and the metal frame of an enclosure. Conductive emissions can be reduced in the following way:

- By RFI filtering for HF disturbances
- Using ferrite rings in power connection points
- Using an AC or DC choke (even meant against harmonics, it reduce HF disturbances as well.)
- Using an LCL filter in the case of regenerative drives
- Using a du/dt filter. (3)

To be able to effectively prevent disturbance through the air, all parts of the power drive system should form a Faraday cage against radiated emissions. The installation of a power

drive system includes cabinets, auxiliary boxes, cabling, motors, etc. Some methods for ensuring the continuity of the Faraday cage are listed as follows:

Enclosure

- The enclosure must have an unpainted non-corroding surface finish at every point where other plates, doors, etc. make contact.
- Unpainted metal-to-metal contacts shall be used throughout, with conductive gaskets, where appropriate.
- Use unpainted installation plates, bonded to a common earth point, ensuring all separate metal items are firmly bonded to achieve a single path to earth.
- Use conductive gaskets in doors and covers. Separate the radiative i.e. “dirty” side from the “clean side” by metal covers and design.
- Holes in enclosure should be minimized.

Cabling & wiring

- Use special HF cable entries for high frequency earthing of power cable shields.
- Use conductive gaskets for HF earthing of control cable shield.
- Use shielded power and control cables. See product specific manuals.
- Allow no breaks in the cable shields.
- Select low impedance shield connections on the MHz range.
- Route power and control cables separately.
- Use twisted pairs to avoid disturbances.
- Use ferrite rings for disturbances, if necessary.
- Select and route internal wires correctly.
- See product specific manuals

Installation

- Auxiliaries used with complete drive modules (CDMs) should be CE marked products conforming to both the EMC & Low Voltage Directives, NOT ONLY to the LV directive, unless they are intended for incorporation into an apparatus by another manufacturer or assembler.
- Selection and installation of accessories in accordance with manufacturers' instructions.
- For wall-mounted units, strip the sheathing of a motor cable back far enough to expose the copper wire screen so that the screen can be twisted into a pigtail. Keep the short pigtail short and connect it to the ground.
- For cabinet –models, lead the cables into the inside of the enclosure. Apply 360° grounding of the cable shield at the entry into the cabinet. See product specific manuals.
- 360° earthing at motor end. See motor manuals.(3)

Sources:

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2. Shuman, Brian. (2009). *Building a Reliable VFD System*. Belden. Retrieved March 25, 2011 from http://www.belden.com/pdfs/Techpprs/VFD_WP.pdf
3. (2008). *EMC Compliant Installation and Configuration for a Power Drive System*. (Technical guide No. 3). ABB drives. Retrieved March 25, 2011 from [http://library.abb.com/global/scot/scot201.nsf/veritydisplay/a8dc0a0e66d66118c12575d6002fd22d/\\$File/Tg3_EMC_CompliantInstallation_61348280_Rev_D.pdf](http://library.abb.com/global/scot/scot201.nsf/veritydisplay/a8dc0a0e66d66118c12575d6002fd22d/$File/Tg3_EMC_CompliantInstallation_61348280_Rev_D.pdf)