emission control, ltd.

12704 W. Arden Place
Butler, WI 53007
(262) 790-0092 Fax (262) 790-0095
www.emissioncontrol.com

Shielding the VSD Output Wiring

The pulse width modulated output voltage of a variable speed motor drive can generate a considerable amount of EMI. At voltage levels in the hundreds, the micro second transitions can generate sufficient radiation to mask any improvement made by the addition of a powerline EMI filter to the drive's input.

The basic problem is that the output wires from the drive to the motor can act as a transmitting antenna, while the input wires from the powerline to the filter can act as a receiving antenna. The end result is EMI noise will radiate around the filter, reducing the filter's effectiveness.

How important is it to shield the Variable Speed Drive output wires to minimize conducted EMI on the power line? This can be a difficult question to answer, so in order to document this effect, we tested an existing motor drive installation. The 10 HP drive was mounted on the sub-panel in a Hoffman type enclosure. Input power was 240 VAC, 3 phase delta through flexible metal conduit (BX, Greenfield) as was the wiring to the motor which was located about 8 feet away. The motor, which was running a conveyor system, loaded the drive to a steady 20 amps.

The original installation used the DL40 filter and it was thought that noise levels had improved but were still present due to less frequent shutdowns of associated equipment on the production line. The input power was re-routed thru a set of LISNs (Line Impedance Stabilization Networks) which had been brought in from our laboratory so that we could get an actual measurement with our EMI analyzer. Figure # 1 shows the EMI spectrum of the system without any input line filter. The "limit line" shown in the graph is the CISPR 14 class B limit. In this application there was no requirement to meet the class B , but since interference was still present in the installation, this is the level we adopted.

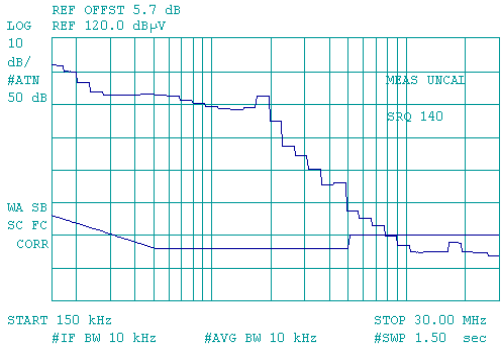

Fig. # 1 No Filter 20 Amp. Load

With the DL40 filter re-installed (Figure # 2), it was immediately seen that noise levels dropped from 150 kHz. to 700 kHz., it began to rise again and reached a 82 dB peak at 3 MHz. The single stage filter was replaced with a two stage DT40 filter (Figure # 3). Although the noise was further reduced within the 150 kHz. to 700 kHz. range, above this frequency the larger filter had no effect.

emission control, ltd.

12704 W. Arden Place
Butler, WI 53007
(262) 790-0092 Fax (262) 790-0095
www.emissioncontrol.com

The problem, which we have seen many times in the lab, was radiated noise being picked up on the powerline before the filter. The radiated noise was coming off the wires between the drive and the motor. These wires had to be shielded to eliminate the problem. The solution is to replace the flexible conduit with solid metal conduit. The solid metal conduit must be bonded to both the drive enclosure and the motor housing. The end results for both filters is shown in Figures # 4 and # 5.

With the shielding installed, both filters eliminated the frequent shutdowns of the associated equipment. The original decision for the single stage DL40 filter was based on price, but it was decided to leave the two stage DT40 filter installed since the extra performance proved to be cost effective and provided an extra margin of EMI reduction.

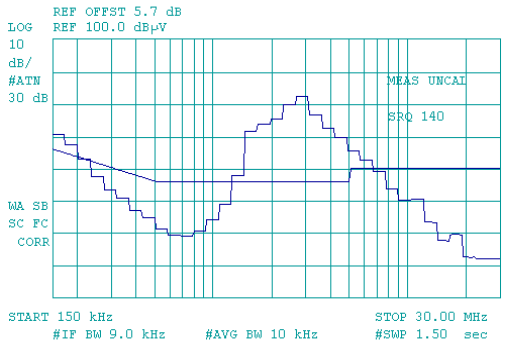

Fig. # 2 DL40 Filter 20 Amp. Load
Unshielded Wires

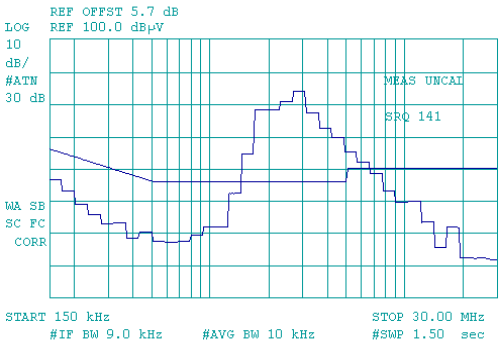

Fig. # 3 DT40 Filter 20 Amp. Load
Unshielded Wires

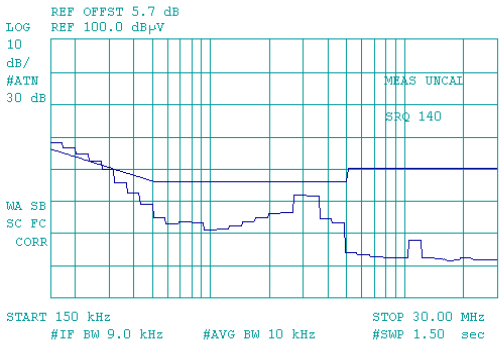

Fig. # 4 DL40 Filter
Shielded Output Wires

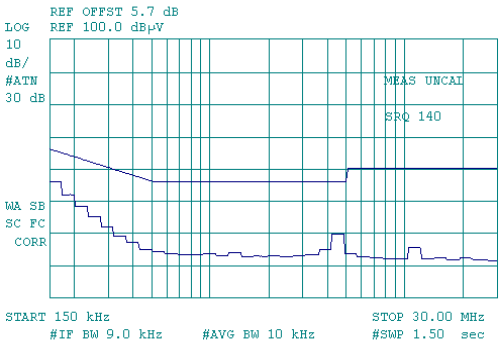

Fig # 5 DT40 Filter
Shielded Output Wires

emission control, ltd.

12704 W. Arden Place
Butler, WI 53007
(262) 790-0092 Fax (262) 790-0095
www.emissioncontrol.com

Summarizing key points:

1.) The input and output wiring of a motor drive must be kept isolated to prevent radiation around the filter.

2.) The least expensive shielding is to use solid metal conduit and do not run input and output wiring within the same conduit. A braided wire shield could also be used but will be more expensive.

3.) Never use flexible metal conduit for shielding. There is too much open space between the spiral wraps of the metal and the grounding contact between spiral wraps is poor.

Emission Control, Ltd. is dedicated to providing “EMC Solutions for Conducted EMI”. Since 1984, we have been focused on the design and manufacturing of the highest quality and most effective line of EMI filters available. We have no other objectives.

If you have a special product or application, which requires EMI filtering; we can supply our experience and expertise early in your planning, so as to achieve the most efficient and cost effective filter solution. Our in-house test facilities are available to guarantee your product will meet the applicable emission standards. We maintain a complete quality control system from design, through all phases of production, and to final delivery. We remain committed to our goal of providing a defect free product on which you can depend.

Whether you require a standard catalog filter, a modified standard, a full custom designed unit, or a short delivery cycle; we are determined to provide the individual level of service needed to meet your satisfaction.