Application Note DSD 412-112

DATE: July 8, 2004
SUBJECT: Design/Application Recommendations, Selecting an External Transformer/ Fuses for the DSD 412 Field Power Supply

This note is to clarify the issue of when one should or should not use an external transformer in conjunction with the DSD-412 Motor Field Power Supply circuit. Phasing and fusing are also discussed.

TRANSFORMER

The motor field control for the DSD-412 uses a single phase full-wave SCR control with a free-wheel diode. Although a closed loop current regulator is incorporated, the fundamental control mechanism is by voltage control. The electrical resistance of the motor field plays only a partial role in controlling the current. This circuit is capable of supplying an adjustable dc voltage to the motor field from a minimum of zero to a maximum of V**dc** = V**ac** x 0.9 volts, where V**ac** is the actual ac line-to-line rms voltage applied to the input of the motor field SCR/Rectifier circuit at AC1 &AC2. In the general application case this input voltage comes directly from the fused utility mains powering the armature control.

In order to maintain adequate motor field voltage and current with a hot field and a sagging line voltage, by design one should not count on more than V**dc**(actual) = V**ac** (nominal) x 0.8 being available. Some applications may require more dc voltage to be available to rapidly force the motor field current to increase to rated amperes. To meet these requirements, the minimum recommended nominal line voltage necessary to support a given motor field rated voltage can be calculated as:

$$\text{Vac(nominal min)} \geq 1.5 \times \text{Vdc(nominal reqd)}$$
$$\text{Vdc(nominal reqd)} = \text{Shunt Field Resistance (hot)} \times \text{Rated Field Current}$$

If the nominal ac input voltage is *less* than the nominal ac minimum value needed (or *more* Vdc is required), a *step-up* transformer must be used to get a higher ac voltage input to the field rectifier circuit.

However, there is a practical limit of adjustment resolution that affects the usefulness of SCR control to adjust the motor field voltage. The ratio of available dc voltage to motor field resistance defines the maximum amount of current that could possibly flow, a circuit “gain” if you will. Although the voltage adjustment range is continuous down to zero, *control stability may be erratic if the motor field resistance is so low that only a small portion of the range is actually used.* It is expected that some mis-match will occur, but it is recommended that operation at RATED motor field current should require more than 40 percent of the potentially available dc voltage.

This suggests a practical upper limit of AC input voltage to the motor field control exists as well.

The relationship range between V**AC**(nominal) and V**DC**(rated) by design should be

$$2.5 > \text{Vac/Vdc} > 1.5$$

To stay within this recommended range, it may be necessary to reconnect the motor field windings for a different VDC or to use a separate transformer to step the available line voltage Vac up or down. But in all cases the nominal AC voltage must never be greater than 480VAC.

PHASING OF THE AC VOLTAGE SUPPLIED TO THE FIELD INTERFACE BOARD

The DSD 412 syncronizes to the 3-phase line by monitoring L1, L2, L3 during the power up sequence. The voltage applied to AC1 and AC2 on the Field Control Assembly is not monitored by the DSD 412, but must remain in phase with L1, L2 when a transformer is used to step the voltage up or down. The following method is suggested:

1. Move factory wire labeled (AC1) to L1A.
2. Move factory wire labeled (AC2) to L2A.

This can now be wiring access for the single phase transformer.

3. Connect (H1) of the primary to L1A of the field board.
4. Connect (H4) of the primary to L2A of the field board.

(If external fuses are used it may be more desirable to make the primary fuse connections for H1, H4 directly to L1, L2 as this bypasses the main drive fuses)

5. The secondary (X1) needs to be connected to AC1.
6. The secondary (X2) needs to be connected to AC2.

Do not connect this single phase primary to the input of the 3ph isolation transformer because there will be a phase shift that will cause incorrect operation.

FUSING

The ac input power to the motor field circuit can be separately fused by adding panel wiring. If a step-up or down transformer is not used, one may use the procedure above but simply provide external fuses between L1A to AC1, ans L2A to AC2. The AC ampere demand for the motor field circuit will be approximately (Field I DC / 2). These amperes (divided by the step-up or step-down transformer voltage ratio [Vpri/Vsec], if used) should be less than 25% of the mains fuse rating. If not, provide separate external fuses for the motor field control connected to the line input side of the main fused L1 and L2.

Example -
Field Isolation transformer; Pri = 460VAC Sec = 230VAC
Rated Field Amps = 10ADC
Main Line Fuse rating = 150A
AC Current demand for the motor field circuit will be 10ADC/2 or 5amps at the wires AC1 & AC2. The primary side of the transformer will have 5 x 230/460 or only 2.5amps flowing. Since the main drive fuses are larger than 2.5amps the connections at L1A and L2A can be used.

LOCAL ELECTRICAL CODES

Additional requirements based on local electrical codes may need to be considered to properly fuse a transformer used in the motor field rectifier circuit according to local electrical codes.

FOR ADDITIONAL HELP ALWAYS REFER TO THE DSD 412 TECHNICAL MANUAL OR CALL THE MAGNETEK HELP LINE AT 1-800-236-1705.