Multi-Pump and Fan Software Application

Introduction

The PowerXL DG1 adjustable frequency drive Multi-Pump and Fan Control software application is designed to be utilized in applications where multiple pumps or fan systems are implemented to maintain a desired flow rate, pressure, or temperature value. It enables the drive to use a single PID loop to control auxiliary motors networked together to provide increase power on demand while reducing overall system control cost. The auxiliary motors can be powered by across the line starters, soft starters, or drives depending on the system performance requirements. There are two main features in the Multi-Pump and Fan Control software application: the auto-change feature, which will equalizes the run time of each motor; and the booster mode, that can add additional pumps or fans in periods of higher demand. Both features may also be used simultaneously and a total of five motors can be controlled by one PowerXL DG1 drive.

Motor Control Sequence

To provide a common example of how the system would operate, refer to Figure 1 and 2 on the next two pages. Figure 1 shows the basic control scheme used for the interlocked contactor system shown in Figure 2. In this configuration, the single PowerXL DG1 drive is controlling two motors. Upstream of each motor is a set of interlocked starters to both isolate and transfer power from the drive to a starter upon demand or vice versa. The interlocked starters are controlled by the relay output terminals on the drive. Once motor 1 ramps up to full speed, if additional demand is required, the second motor can be energized by the starter to provide increased capacity. If this configuration was using the auto-change features, the next time both motors reached zero speed, the interlocks would reverse via the drive relays, making motor 2 controlled by the drive and motor 1 by the starter. This would be done to equalize run time as discussed before. If they system had addition motors beyond these two, the same logic would apply as it system moved from motor to motor for run time equalization.

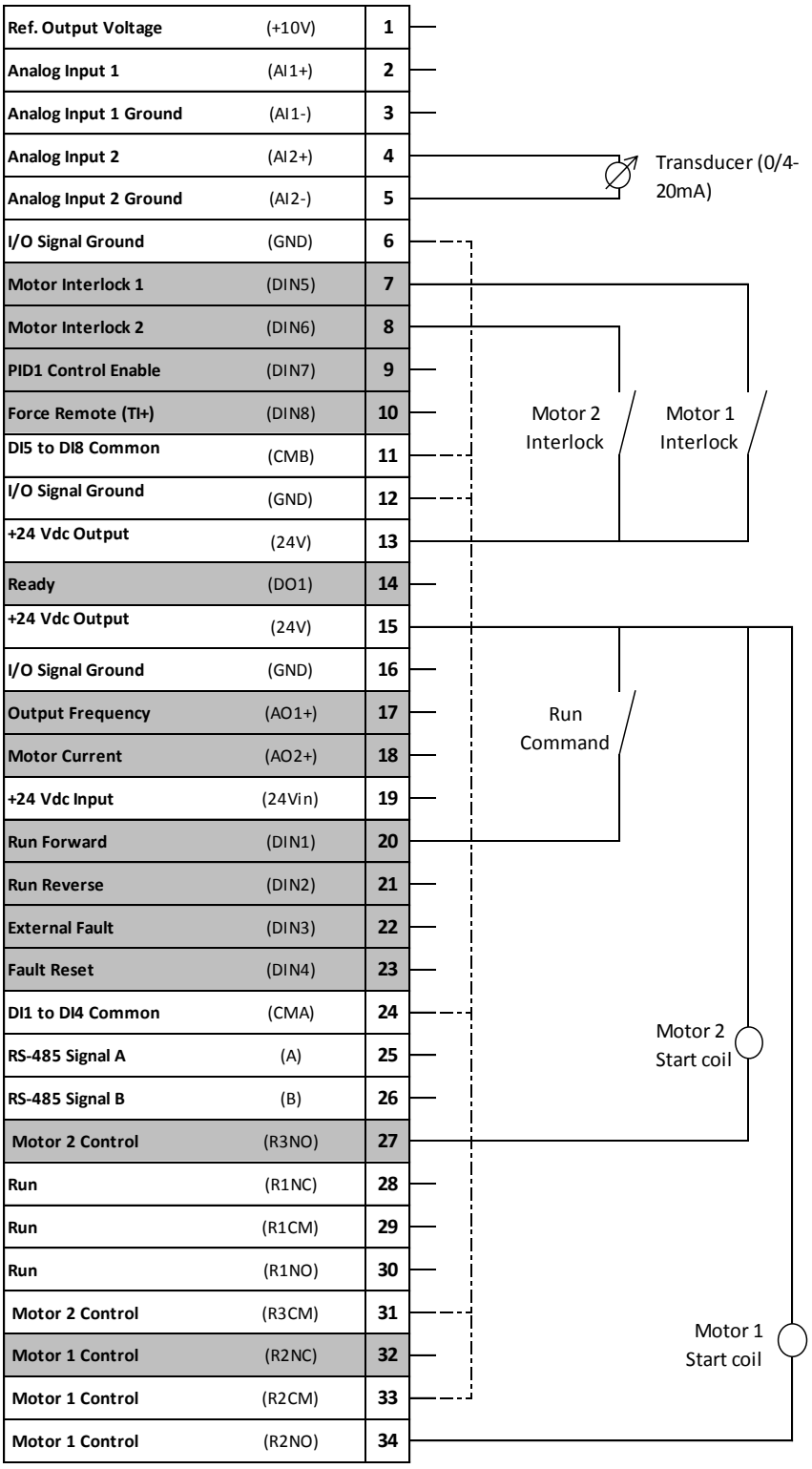

Figure 1: Multi-Pump Two Motor Control Scheme

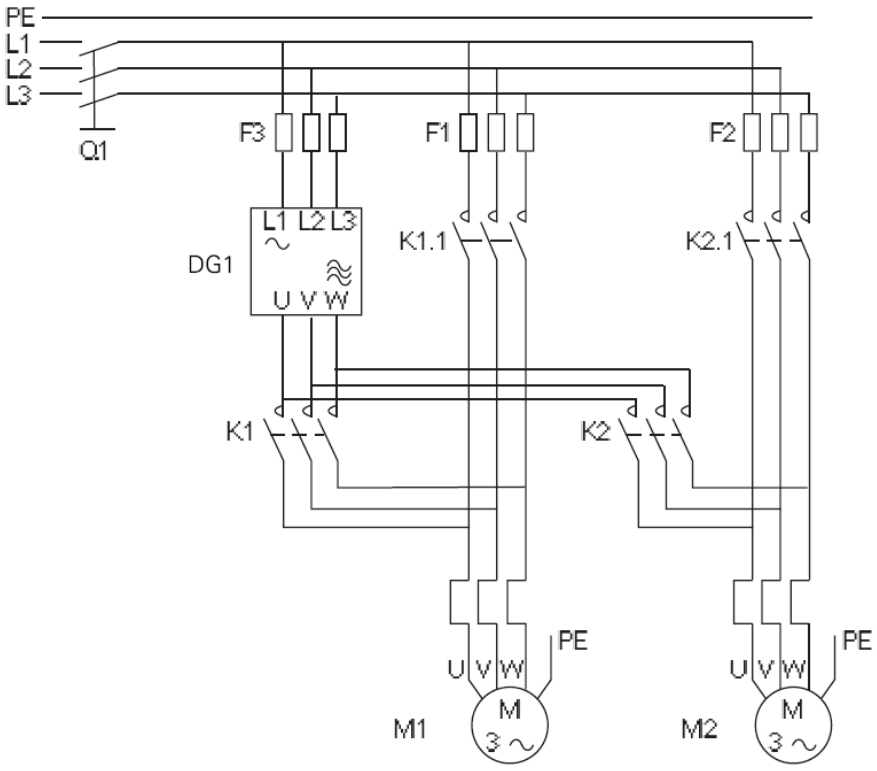

Figure 2: Multi-Pump Two Motor Power Wiring

Programming

First the PowerXL DG1 application should be set to any application other than Standard (P21.1.2) to enable this functionality, then the initial motor name plate information should be entered into the basic parameter group, this will set up the initial V/Hz curve that the drive will output to the motor. Along with the motor parameters, the control scheme needs to be set for both the Local and Remote control place. Typically this would be set up as follows:

P1.10: Local Control – Keypad

P1.11: Remote Control - I/O Terminal

P1.12: Local Reference – Keypad

P1.14: Remote Reference – PID1 Control

Upon completion of the basic parameters, the next group to set up is the Analog inputs. In this example we will just us the default values being AI2 set up for 0-20mA (P2.11) and a range of 20-100% (P2.12). If either AI1 or AI2 require being changed from either Voltage or Current, there are dip switches on the side of the control module along with parameters that will need to be adjusted. For more information refer to the PowerXL DG1 Application Manual.

Next will be the digital inputs that will require some additional configuration. With the default settings, the application will have the start command given on DIN1 for forward and DIN2 for Reverse. From this point, the number of motors will be need to be known to set up the required number of interlocks. (1 to 5 motors can be used in the sequence, refer to P3.37 to P3.41). These interlocks can be set up on any of digital

inputs from DIN3 through DIN8. It is suggested that the default settings be changed so that the functions are disabled in order for the inputs to not have multiple functions. Note: For most inputs, *Force Open* will cause the function to always be disabled, if *Force Closed* is used, that function is always enabled. See the PowerXL DG1 Application Manual for more parameter information.

Once the I/O control logic is set, then the analog output signal can be set, but it is not required for this particular example. The Relay outputs are used to trigger the interlocked starters to supply power to the auxiliary motors when they are required. Depending on how many motors are in the system will determine how many relays are necessary. For this example, two relays are required for the motor contacts and we will use the third for a run indication. See the PowerXL DG1 Application Manual for more parameter information.

P5.2: RO1 Function - Run

P5.3: RO2 Function – Motor 1 Control

P5.4: RO3 Function – Motor 2 Control

The next steps would be to set up the PID function for the drive in order to try and maintain a required flow, pressure, or temperature. These values would be set in the *PID1 Control* group. For this example, the set point will be coming from the keypad P10.14, with the feedback being monitored at AI2 P10.32. The keypad set point would be set at P10.11. The P10 group also has addition values that will allow you for further tuning of the PID loop.

After setting up the PID loop parameters the *Multi Pump Control* parameter can be setup P18 group. This is where the number of motors would be set, in this example there are two. Then the *Bandwidth* and *Bandwidth Delay* can be set for how the PID loop is tracked, if the feedback is outside the bandwidth value for the delay time, the drive will use the relay outputs to engage the next motor. In our case, we choose to use auxiliary contacts on the starters to indicate if they are connected, so this needs to be enabled. In addition, the *Interlock Auto Change* can be set up to equal the run time on each motor by setting up the parameters to control the auto change feature.

At this point the drive should be set to run and maintain the set reference value, the system will start out using the first motor and if the set point can't be reached it will bring in the second motor online to assist. Once the auto change time and frequency is met the lead motor will switch.

Operation

The below images show how the relay output interlock functions are used to tell it which motors are active, and then what the change sequence of motors that are running will be maintain to achieve the required set point. If one of the interlock drops out, the drive will continue to run, but the relay output that controls the starter powering a particular auxiliary motor will drop out. With each motor that is engaged, the main motor will slow down to compensate for the large inrush of bringing a motor on across the line. This helps to allow for improved performance in controlling the flow and these transitions occur based off the bandwidth values and the feedback from the system.

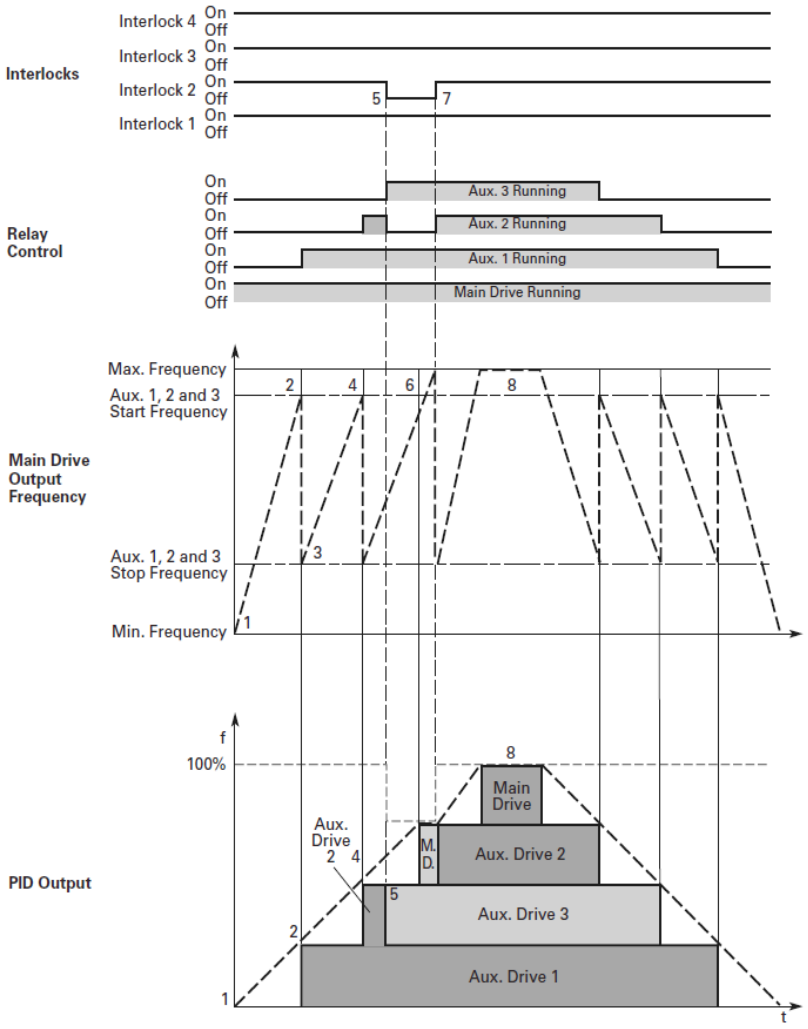

Figure 3: Multi-Pump Interlock Control Scheme

Additional Help

In the US or Canada: please contact the Technical Resource Center at 1-877-ETN-CARE or 1-877-326-2273 option 2, option 6.

All other supporting documentation is located on the Eaton web site at www.eaton.com/Drives

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122 USA
Eaton.com

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