

### **DIGI-FIRE STARTER SPECIFICATION GUIDE DOC: 04-1144A**

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## **1.0 SCOPE**

### **1.1 PURPOSE**

DNH INDUSTRIES has prepared this design specification guide to identify the minimum requirements and performance parameters for the selection, and application of Solid State Reduced Voltage Motor Controllers.

### **1.2 INTRODUCTION**

The DNH INDUSTRIES "Digi-Fire" unit is a fully controlled SCR based, solid state reduced voltage motor controller that has been designed to provide smooth, stepless, closed loop acceleration and deceleration control for all types of three phase squirrel cage induction motors, synchronous motors, and wound rotor motors.

The multiple Start and Stop Modes, along with Fault Diagnostics, and a Controller Monitor Panel provide Consulting Engineers, Plant Maintenance Personnel, and OEM's a product that has the maximum flexibility for matching a solid state motor controller to various load requirements.

### **1.3 DESIGN STANDARDS**

All DNH INDUSTRIES "Digi-Fire" solid state motor controllers have been designed, tested and manufactured to conform, where applicable, to the following industry specification standards:

UL	Underwriters Laboratories
NEMA	National Electrical Manufacturers Association
CSA	Canadian Standards Association
IEEE	Institute of Electronic and Electrical Engineers
EEMAC	Electrical and Electronic Manufactures Association of Canada
NEC	National Electrical Code
ANSI	American National Standards Institute
OSHA	Occupational Safety and Health Act

### **1.4 POINT OF ORIGIN**

All DNH INDUSTRIES "Digi-Fire" SOLID STATE MOTOR CONTROLLERS are manufactured in the United States of America.

## **2.0 ENVIRONMENTAL STANDARDS**

- 2.1 Operating Temperature:** 0-50C (32-122F), Derate output current by 2% per deg C above 50C (122 F) up to a maximum of 60C (140F).
- 2.2 Altitude:** up to 3300 ft. (1000 meters), between 3300 ft (1000 meters) and 6600 ft. (2000 meters) derate output current by 10%
- 2.3 Storage Temperature:** -25C (13F) to 70C (158F)
- 2.4 Humidity:** 5% to 95% relative humidity, non condensing
- 2.5 Power Requirements:**
- Line Voltage:** All DNH INDUSTRIES "Digi-Fire" motor controllers are designed to operate on 3 phase, 50/60 hertz, AC power at the following nominal line voltages:
- 208-230 VAC  
380-415 VAC  
460-480 VAC  
575-600 VAC
- Line Voltage Tolerance:** +/- 10%
- Control Voltage:** 120 Volts AC, 50/60Hz Single Phase  
Other voltage options are available

## **3.0 MECHANICAL FEATURES**

- 3.1 GENERAL:** The power section of all DNH INDUSTRIES "Digi-Fire" motor controllers is comprised of phase controlled SCR's connected in three (3) inverse parallel pairs which provide variable AC output voltage for smooth motor acceleration. All components are conservatively rated to ensure that maximum amps are available. This provides acceleration throughout the motor torque/speed curve with minimal motor heating. These units can be provided in an open chassis configuration or mounted in a free standing or wall mounted enclosure.

- 3.2 Enclosures:** NEMA 12 enclosures are standard, NEMA 1, 4, or 3R enclosures can be supplied as an option.
- 3.3 Components:**
- 3.3.1 Combination Starter** The Digi-Fire combination solid state starter consists of the following major components:
- a) incoming circuit breaker
  - b) solid state starter
  - c) fully rated bypass contactor
  - d) motor overload relay
  - e) fused control power transformer
- 3.3.2 Non-Combination Starter** A non-combination starter does not include an incoming circuit breaker and may or may not include an overload relay or a control power transformer depending on the users requirements.
- 3.3.3 Bypass Contactor** A bypass contactor is required for all Digi-Fire shunt duty starters. All DNH INDUSTRIES supplied contactors are fully rated to start the motor across the line. Continuous duty starters do not require a bypass contactor.
- 3.3.4 Overload Relay** Overload relays provided by DNH INDUSTRIES are Class 10 thermal type that monitor the motor current through three (3) current transformers. Consult factory for Class 20 or 30 relays, electronic relays or available motor management devices.
- 3.3.5 Control Power Transformers** All control power transformers provided by DNH INDUSTRIES are provided with dual primary fusing and single secondary fusing unless specified otherwise. All transformers have, at least, 100-150 VA excess capacity.
- 3.3.6 Power Devices** The SCR's used in all Digi-Fire starters are rated to carry at least 600% of the full load motor current. The SCR's peak inverse voltage (piv) is equal to or greater than 2.5 times the line voltage.

## **4.0 ELECTRICAL SPECIFICATIONS**

### **4.1 TECHNICAL:**

<b>Control Type:</b>	The Digi-Fire control is hard logic utilizing analog signal processing in combination with digital firing of the SCR's. Power matching techniques minimizes set up time. The only field programming required is the adjustment of three (3) potentiometers. The following control modes are available: <ul style="list-style-type: none"><li>- Closed loop current control</li><li>- Closed loop tachometer feedback for linear acceleration and deceleration control</li><li>- Closed loop pump control</li></ul>
<b>Horsepower Range:</b>	25 to 1500HP
<b>Power State Ratings:</b>	Standard Duty: 115% FLA Continuous, 250% FLA for 60 seconds, 600% FLA for 30 seconds Pump Duty: 115% FLA Continuous, 350% FLA for 75 seconds, 600% FLA for 30 seconds
<b>SCR PIV Ratings:</b>	240V Series - 1000V, 380-480V Series - 1200V, 600V Series - 1600V
<b>Transient Protection:</b>	RC/MOV high energy snubber network
<b>SCR Firing Philosophy:</b>	Continuous hard firing through 180 degrees of conduction angle to ensure positive control with highly inductive loads.
<b>Diagnostics:</b>	9 element Digi-Fire monitor to display control status and alarms
<b>Efficiency:</b>	99% or better
<b>Control Input:</b>	2 or 3 wire control, 120 VAC dry contacts

- 4.2 CONTROL LOGIC:** The control for the starter is contained on two printed circuit boards, one for control logic protection and sequencing and the other for generating the SCR gating signals while continuously monitoring motor accelerating currents, acceleration times, and the solid state starter for operating faults. The logic protection and sequencing board starts and stops the motor, operates the line isolation and the bypass contactors. Faults, when detected, are latched and annunciated at the Digi-Fire monitor panel. To reset an alarm, remove power or manually reset.
- 4.3 START/STOP MODES:** The following start modes are available as standard:
- Current Limit Start with adjustable initial current limit
  - Current Ramp Start with initial adjustable current start level and acceleration ramp
  - Pump Control with adjustable current start level and acceleration ramps
- The following stop modes are available as standard:
- Coast to Stop
  - Soft Stop with adjustable turn off level and stopping time
  - Pump Stop with adjustable step down level, stopping time, and turn off level
- 4.4 PROTECTION:** The protective features on each starter are as follows:
- Instantaneous Over-current (activated when the value of the line current exceeds 600% of full load amps)
  - Phase Loss/Current Unbalance
  - Heatsink Over-temperature (activated when the heatsink temperature exceeds 85 C).
  - Motor overload protection is provided by Class 10 ambient compensated thermal overload relay. Optional Class 20 or 30 overload relays for high inertia type loads can be supplied

**4.5 KEY PARAMETERS:**

The following is a listing of the key adjustable parameters that can be accessed:

<b>Parameter</b>	<b>Standard Duty</b>	<b>Pump Duty</b>
- Initial Limit Level	150-500% FLA	150-500% FLA
- Target Current	150-500% FLA	150-500% FLA
- Acceleration Ramp	0.5-15 secs	0.5-60 secs
- Deceleration Ramp	0.5-15 secs	0.5-90 secs
- Current Limit Alarm	1-30 secs	1-100 secs
- Current Unbalance Alarm	5-50%	5-50%
- Instantaneous Overload	150-600% FLA	150-600% FLA
- Current On Level	5-30%	5-30%
- Pump Turn Off Level	2-50%	2-50%

**4.6 FAULT ALARMS:**

Each controller comes complete with a Digi-Fire diagnostic monitor panel with LED's to indicate starter status and alarm conditions. All alarms are cleared by a reset pushbutton. Indicator LED's and alarms are as follows:

- Power On/Ready
- Starter On
- Current On
- Start Complete
- Current Limit Timer Alarm protects the motor against stall or failure to reach running speed
- Run Contactor Failure when the bypass contactor fails to close within 5 seconds after the starter reaches full voltage
- Phase Loss/IOL shuts down on phase loss or current unbalance
- Thermal Overload
- Control/SCR Failure when current is present after the starter has been turned off