

DIGI-FIRE MEDIUM VOLTAGE STARTER SPECIFICATION GUIDE DOC: 04-1165A

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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, Medium 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 medium voltage 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 Manufacturers 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" Medium Voltage motor controllers are designed to operate on 3 phase, 50/60 hertz, AC power at the following nominal line voltages:

2300 VAC
3300 VAC
4160 VAC
6600 VAC

Line Voltage Tolerance: +/- 10%

Control Voltage: 120 Volts AC, 50/60 Hz Single Phase
Other voltage options are available

3.0 FEATURES

- 3.1 **General:** The power section of the Digi-Fire Medium Voltage motor controllers is comprised of three individual phase modules. Each module contains one or more inverse parallel pair of Silicon Controlled Rectifiers (SCR's) mounted on an isolating base with RC snubbers and transient voltage protection.
- Multiple pairs of SCR's may be utilized in order to provide a total repetitive peak inverse voltage (PIV) rating of at least 3 times the system line voltage.

- 3.2 **Enclosures:** NEMA 12/3R enclosures are standard. Consult factory for other requirements.
- 3.3 **Components:**
- 3.3.1 **Combination Starter** The Digi-Fire Medium Voltage Combination Solid State Starter consists of the following major components:
- a) incoming load break disconnect switch
 - b) solid state starter
 - c) fully rated isolation and bypass vacuum contactors I
 - d) motor overload relay
 - e) fused control power transformer
- 3.3.2 **Non-Combination Starter** A non-combination starter does not include an incoming load break disconnect switch
- 3.3.3 **Isolation & Bypass Contactors** Isolation and bypass vacuum contactors are required for all Digi-Fire Medium Voltage Starters. All supplied contactors are fully rated to start the motor across the line.
- 3.3.4 **Overload Relay** Overload relays provided 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 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 modules inverse voltage (piv) is equal to or greater than 3 times the line voltage.

4.0 ELECTRICAL SPECIFICATIONS

4.1 Technical:

Control Type:	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">- Closed loop current control- Closed loop tachometer feedback for linear acceleration and deceleration control- Closed loop pump control
Horsepower Range:	250 to 6500HP
Power State Ratings:	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
SCR PIV Ratings:	2300V Series - 9000V 3300V Series - 13,000V 4160V Series - 13,500V 6600V Series - 26,000V
Transient Protection:	RC/MOV high energy snubber network
SCR Firing Philosophy:	Continuous hard firing through 180 degrees of conduction angle to ensure positive control with highly inductive loads
Diagnostics:	9 element Digi-Fire monitor to display control status and alarms

4.1 Technical: (Continued)

Efficiency: 99% or better

Control Input: 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 85C)
- 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:

Parameter	Standard Duty	Pump Duty
- 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/Relay
- 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