



***ASTAT-SD™ Solid-State Reduced Voltage Starter***





## DEH-036

### ***WARNINGS, CAUTIONS, AND NOTES AS USED IN THIS PUBLICATION***

**WARNINGS:** Warning notices are used in this publication to emphasize that hazardous voltages, currents, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

Warning notices are also used for situations in which inattention or lack of equipment knowledge could cause either personal injury or damage to equipment.

**CAUTIONS:** Caution notices are used for situations in which equipment might be damaged if care is not taken.

**NOTES:** Notes call attention to information that is especially significant to understanding and operating the equipment.

This document is based on information available at the time of its publication. While efforts have been made to ensure accuracy, the information contained herein does not cover all details or variations in hardware and software, nor does it provide for every possible contingency in connection with installation, operation, and maintenance. Features may be described herein that are not present in all hardware and software systems. GE Electrical Distribution & Control assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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### 1-1 IEC Ratings

450% nominal current for 30 sec. max.

Catalog No.	Current Rating Amps	HP				KW			
		220/240V	380/415V	440V	480V/500V	220/240V	380/415V	440V	480V/500V
QS2BNA	5	1.5	3	3	4	1.1	2.2	2.2	3
QS2DNA	9	3	5.5	5.5	7.5	2.2	4	4	5.5
QS2FNA	12	4	7.5	7.5	10	3	5.5	6.3	7.5
QS2GNA	16	5	7.5	10	13.5	3.7	6.3	7.5	10
QS2HNA	22	7.5	13.5	14.5	17.5	5.5	10	12	13
QS2INA	34	10	20	20	25	7.5	15	17	20
QS2INA*	34	10	20	25	25	7.5	15	18.5	20

\*300% nominal current for 30 sec. max.

### 1-2 UL Ratings

450% nominal current for 30 sec. max.

Catalog No.	Current Rating Amps	Max. Starting Current	HP		
			200V	230V	460V
QS2BNA	5	25	1	1	3
QS2DNA	9	45	2	2	5
QS2FNA	12	60	3	3	7.5
QS2GNA	16	80	3	5	10
QS2HNA	22	110	5	7.5	15
QS2INA	34	160	7.5	10	20
QS2INA*	34	160	10	10	25

\*300% nominal current for 30 sec. max.

**1-3 Technical Characteristics**

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**Environmental**

Temperature	0 to 45°C <sup>1</sup>
Storage temperature	-20 to +70°C
Relative humidity	95% without condensation
Maximum altitude	3300 feet (1000m) <sup>2</sup>
Mounting positions	Vertical

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**Electrical characteristics**

Three phase supply voltage	500VAC +10% maximum
Frequency	48-62 Hz
Rated current	6 ratings, 5-34A
Motor horsepower (KW)	3-25hp at 460V (3-20 KW at 500V)
Motor voltages	200V, 230V, 460V (220V, 380/415V, 440V, 500V for IEC)
Control voltages	110/120VAC or 220/240VAC, 50/60Hz

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**Control characteristics**

<b>Control system</b>	Digital system with microcontroller Starting ramp with progressive increase in voltage and current limitation
Loss of control voltage	3 cycle ride thru
<b>Starting</b>	
Initial (starting) torque	15 to 80% full voltage starting torque
Kick start	90% line voltage (80% full voltage starting torque), 400ms
Current limit	200 to 500% starter current
Acceleration ramp time	.5 to 60 sec. <sup>3</sup>
<b>Running</b>	
Energy savings	Output voltage reduction based on power factor of running motor to optimize system energy consumption
Override - energy savings	Energy saving mode turned OFF
<b>Stopping</b>	
Coasting	With no soft stop, power removed from motor
Stop time by ramp	Soft stop time fixed at $2 \times t_{\text{ramp}}$

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**Inputs/Outputs**

Starter control	Start/Stop or remote contact
Inputs	2 isolated inputs for Start/Stop
Input ratings	12VDC supplied by ASTAT to solid state optoisolators
Output auxiliary relays	Run/End of Ramp (at speed), DIP switch selectable

**Inputs/Outputs** *(continued)*

Relay output ratings	5A maximum 120VAC 360 VA pilot duty B300 & 1/3hp 45LRA 7.2FLA 240VAC 470VA pilot duty B300 & 1/2hp 30LRA 5.0FLA General purpose DC ratings: 24VDC 8A 48VDC 0.8A 240VDC 0.1A
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**Protections**

Current limit	Adjustable from 200 to 500% starter rating
Loss of input phase	Trip at 3 sec
Thyristor short circuit	Trip at 200ms
Loss of output phase	Trip at 3 sec
Supply frequency error	If frequency <48Hz or >62Hz, will not start
Error (CPU)	60ms
Overload protection	Separate overload relay required

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**Description of terminals**

1L1, 3L2, 5L3	Power supply inputs +10%, -15%
2T1, 4T2, 6T3	Outputs to motor
A1/A2, B1/B2	Command supply inputs (110/120 - 220/240V AC), +10%, -15%
11, 14	Run/End of ramp internal relay output (1NO)
1, 57	Run command input
2, 57	Stop command input
3, 4	Not used


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**Features**

SCR repetitive peak inverse voltage (PIV)	1600V
Transient protection - metal oxide varistors	QC2B through QC2I: 120 joules

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**Standards and listings**

UL 508, File E 153901  
 CSA 22.2/14, File LR30821  
 IEC 947-4-2   
 In conformity with EN500B-1, EN500B2-2, EN 53001,  
 EN 60801-2, ENV 50140,  
 EN 61000-4-4, EN 610004-5  
 Complies with Electromagnetic Compatibility Directives  
 89/336/EEC 5/3/89

<sup>1</sup>Reduce rated controller current (I<sub>r</sub>) by 1.5%/°C above 45°C, maximum 55°C.

<sup>2</sup>Reduce rated controller current (I<sub>r</sub>) by 1%/330 feet above 3300 feet, maximum 10,000 feet (1%/1000m above 1000m, 3000m maximum).

<sup>3</sup>See page 9 for start time limitations.

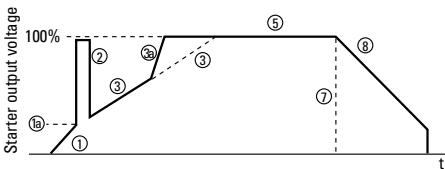
### 1-3 Technical Characteristics (continued)

#### Operating modes

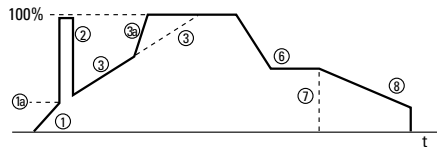
Initial ramp	①	5 main frequency cycles
Initial voltage (pedestal)	Ⓛ	40% - 90% V (adjustable by torque setting)
Kick start	②	90% V (DIP switch selectable)
Acceleration ramp	③	0.5 to 60 seconds (adjustable)
	Ⓢ	Fast ramp (if motor is up to speed prior to end of normal ramp time)
Current limit	④	2 to 5 I <sub>n</sub>
Permanent state choice	⑤	Nominal voltage (override)
	Ⓜ	Nominal current
	⑥	Energy savings
Stop mode	⑦	Motor power cutoff (stopped by inertia)
	⑧	Deceleration ramp (Max. time 2x t <sub>ramp</sub> )
	⑨	Evolution of current in deceleration ramp mode

#### Starting by voltage ramp

Override

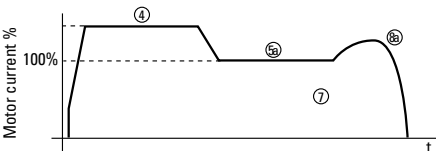


Energy savings

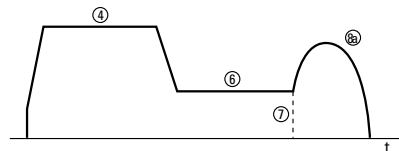


#### Starting by current limitation

Override



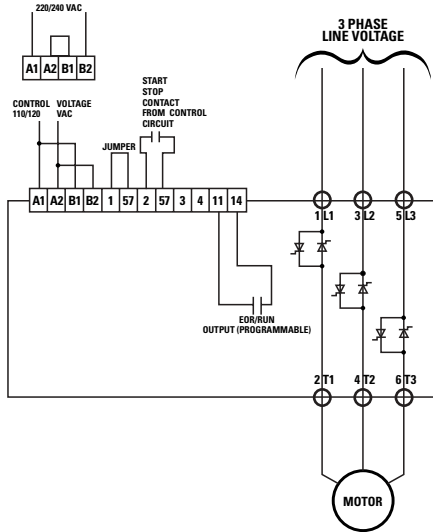
Energy savings



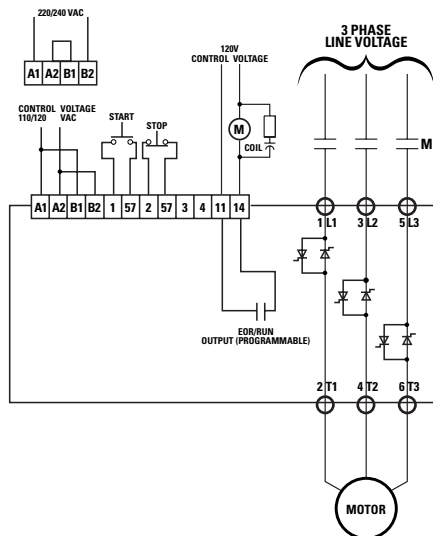


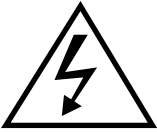
### 1-4 Recommended Diagrams

**Fig. 1**  
 Start/stop by remote contact



**Fig. 2**  
 Start/stop by push button control





### **Warnings**

1. Disconnect power before installing or servicing.
2. Hazardous voltages are present in the motor circuit even when the soft starter is OFF. An isolation contactor is recommended, configured to provide automatic isolations when motor is turned off.
3. Unit may contain more than one live circuit. Disconnect both control and main circuits before installing or servicing.
4. SOFT STOP should not be used as an EMERGENCY STOP.
5. Stopping mode must be set to meet applicable standards for operator safety.

### **Cautions**

1. Semi-conductor fuses specified may not provide branch circuit protection. Refer to local applicable electrical codes.
2. Overload relay setting should be properly coordinator with motor.

### **Précautions**

1. Débranchez l'alimentation en courant électrique avant de raccorder ou d'intervenir.
2. Des tensions dangereuses sont présente dans le circuit moteur même si le soft starter indique la position "arrêt." Un contacteur d'isolement assurant un isolement automatique quand le moteur est arrêté, est recommandé.
3. L'appareil peut renfermer plus d'un circuit sous tension débrancher les circuits principaux et les circuits de controle avant de raccorder ou d'intervenir.
4. Délestage "Softstop" ne devrait jamais être utilisé en lieu de délestage d'urgence.
5. Procédés de délestage doivent être conforme aux normes de sécurité des utilisateurs.

### **Avertissements**

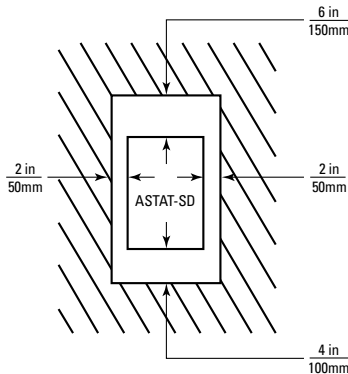
1. Les fusibles semi-conducteurs spécifiés ne protègent pas obligatoirement les circuits se conformer aux codes locaux d'installations électriques.
2. Le relais de courant de surcharge doit être proprement coordonné avec le marche du moteur.

## **2-1 Mounting Position/Required Clearances**

When installing the equipment, the following criteria must be observed:

- The equipment should be installed in a vertical position to ensure proper cool air circulation.
- Do not install equipment in environments containing explosive or flammable gases.
- Equipment should be well ventilated, with minimum clearances as indicated in the following illustration:

### **Minimum Clearances**

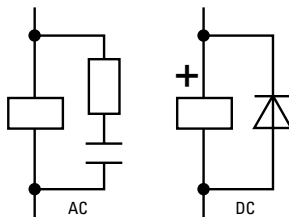


## **2-2 Installation Recommendations**

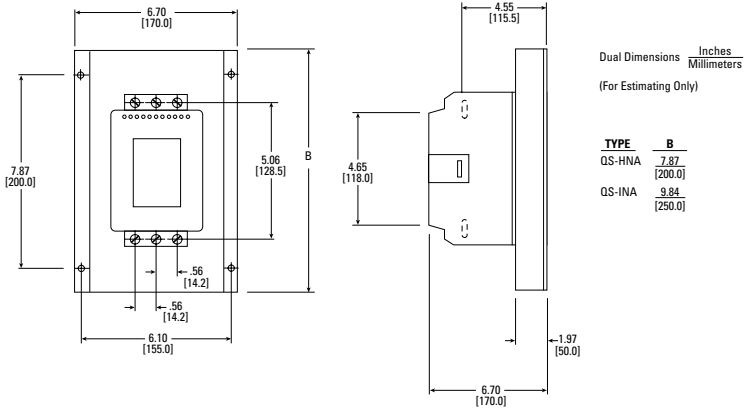
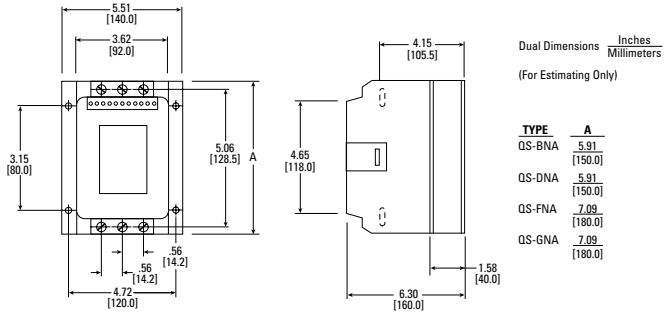
**It is recommended that all signal wiring be shielded wiring or twisted pairs.**

Do not install capacitors to correct the power factor between the reduced voltage starter output and the motor.

Relays and contactors located in the same housing as the reduced voltage starter should have an RC suppressor parallel to the coil (or a reverse diode, if controlled by DC).



**2-3 Dimensions**



**2-4 ASTAT-SD total losses at 100% rated current**

Type	Power losses at 100% rated current (W)	Control circuit losses (W)	Total losses, power & control (W)
QS2BNA	15	2	17
QS2DNA	29	2	31
QS2FNA	35	2	37
QS2GNA	47	2	49
QS2HNA	59	2	61
QS2INA	90	2	92

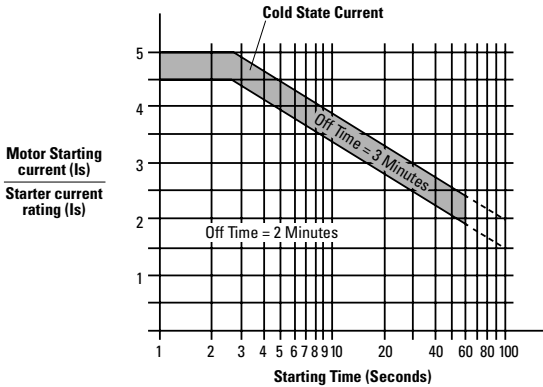
## 2-5 Isolation contactors

Type	Isolation
QS2BNA	CL00
QS2DNA	CL00
QS2FNA	CL01
QS2GNA	CL02
QS2HNA	CL25
QS2INA	CL45

## 2-6 Motor Starting and Duty Cycle Conditions

The following illustration shows allowable motor starting currents according to the starting time.

The OFF TIME is the minimum amount of time between the motor stop and motor start. The duty cycle is the start time + stop time + off time. This graphic will enable the user to develop a duty cycle within the capabilities of the motor starter ratings.



### Maximum Starting Time

$\frac{I_s}{I_r}$	For standard duty HP rating	For heavy duty HP rating
500%	1 sec.	3 sec.
450%	5 sec.	30 sec.
300%	20 sec.	55 sec.
200%	120 sec.	120 sec.

## 2-7 Terminal connections

Use minimum 75°C copper wire only.

Minimum wire size must conform to 75°C table per electrical codes.

Tighten connections with following torque:

- QS2B-QS2I, wire range #14-#8 AWG, torque 20 in lb.

### Output Relay

**Run mode:** Contact 11-14 closes when the run order is given to start the unit. Contact 11-14 opens if either the stop order is given or an error is found, and the unit turns off. If soft stop is programmed, contact opens when the soft stop ramp is complete.

**End-of-ramp (at speed) mode:** Contact 11-14 closes when the starting ramp voltage reaches the end of ramp (i.e., full voltage). Contact 11-14 opens if either the stop order is given or an error is found, and the unit turns off. If soft stop is programmed, contact opens prior to the beginning of soft stop ramp.

### Branch Circuit Protection

Catalog No.	Semi-conductor Fuses <sup>1</sup> Gould Shawmut Type A50QS	Maximum Fuses <sup>2</sup> Class RK5 & J	Maximum Circuit Breakers <sup>3</sup>
QS2BNA	40A	10A	15A
QS2DNA	40A	20A	25A
QS2FNA	50A	30A	35A
QS2GNA	60A	35A	40A
QS2HNA	80A	40A	50A
QS2INA	100A	70A	80A

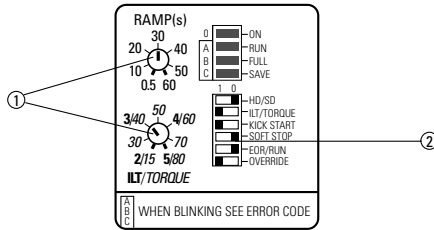
**Note: When ASTAT-SD reduced voltage starters are used in conjunction with semi-conductor fuses, Type 2 Coordination to IEC 947-4 is attained. These fuses are recommended for best overall short-circuit protection. The semi-conductor fuse specified may provide branch circuit protection. Refer to local applicable electrical codes.**

<sup>1</sup>Suitable for use on a circuit capable of delivering not more than 100KA rms symmetrical amperes, for 208V, 240V and up to 480V maximum, when used with the semi-conductor fuse for short-circuit protection. Listed with Gould Shawmut Form 101, Type A50QS.

<sup>2</sup>Suitable for use on a circuit capable of delivering not more than 25KA rms symmetrical amperes, for 208V, 240V and up to 480V maximum, when used with Class RK5 and J fuse.

<sup>3</sup>Suitable for use on a circuit capable of delivering not more than 25KA rms symmetrical amperes, for 208V, 240V and up to 480V maximum, when used with circuit breakers.

## 2-8 Control panel description



### ① Potentiometers

RAMP	Acceleration ramp time, in seconds
ILT/TORQUE	Current limit 2-5 starter current rating/Starting torque (15-80% DOL), selected by DIP switch ILT/TORQUE

### ② DIP Switches\*

DIP Switches*	Position	Function
HD/SD	1	Not used
	0	Not used
ILT/TORQUE	1	Select ILT/TORQUE potentiometer for current limit
	0	Select ILT/TORQUE potentiometer for initial torque
KICK START	1	Kick start function ON. When started, a 90% voltage pulse is applied for 400 ms duration. Subsequently, the ramp continues with the preselected starting torque and ramp time.
	0	Kick start function OFF.
SOFT STOP	1	Soft stop. On receiving stop command, equipment stops by decreasing voltage ramp over a maximum of 2 x t (acceleration ramp).
	0	No soft stop. Equipment coasts to stop after receiving stop command.
EOR/RUN	1	Select internal relays (terminals 11-14) as end of ramp relay; contact 11-14 closes when the starting ramp voltage reaches end of ramp. If soft stop is programmed, contact closes prior to the beginning of soft stop ramp.
	0	Select internal relay (terminals 11-14) as RUN relay; contact 11-14 closes when the RUN order is given to the unit, and opens after the STOP order is given (coast), when the soft stop ramp is completed, or an error is found.
OVERRIDE	1	Override function ON. The energy-saving feature is disabled.
	0	Override function OFF. The energy-saving feature is enabled.

\*Factory default setting is DIP switches off.

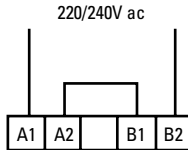
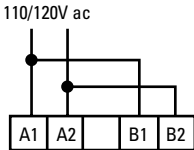
# ASTAT-SD™ Solid-State Reduced Voltage Starters

## Chapter 2. Installation & Start-up

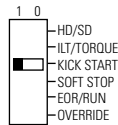
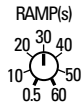
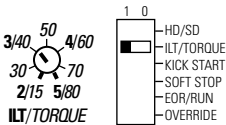
### 2-9 Start-up

Make sure equipment wiring corresponds to one of the recommended wiring diagrams or equivalent.

Make sure the control wiring corresponds to the control voltage used.



Set starting parameters according to your application.

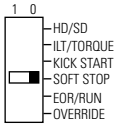


Voltage ramp or current limit

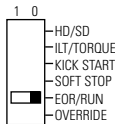
Acceleration ramp time

Kick start feature

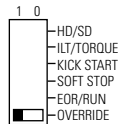
Set stopping parameters according to your application.



Set the rest of the parameters as needed.



Select relay output (contact 11-14) as RUN or End of Ramp (at speed) relay

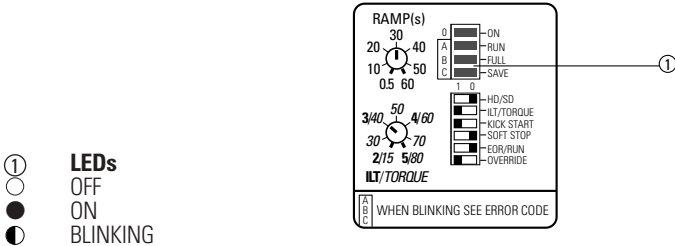


Select full voltage or energy saving at steady state

Start motor and make sure that operation is correct.



## 2-10 Error detection



O	A	B	C	OPERATION CODE
●	○	○	○	Equipment is connected to main supply
●	●	○	○	Run
●	●	●	○	End of ramp
●	●	●	●	Effective energy saving
●	○	●	○	Stop order

LEDs			Symptom or Error	Possible Cause	Measures to be Taken
A	B	C			
LED "0" off			Equipment does not respond to STOP/ START controls	No control voltage	Check wire harness and control voltage
				Defective control PCB,s	Change control PCB,s
● ◐ ○			Frequency error 48Hz < f main < 62 Hz)	No 1L1 phase of frequency is out of range	Check 1L1 phase and/or main frequency
● ◐ ●				Phase sequence loss	Disturbance in supply voltage
			Defective thyristor		Check thyristors
			No input phases	Check 1L1, 3L2 and 5L3 phases	
◐ ○ ○			Synchronism loss	Phase 1L1 lost	Check 1L1 phase, ground connection and/or output voltage to ground
◐ ● ○				Phase A, B, C thyristor	Short-circuited thyristor
◐ ○ ●			No output phases		Check 2T1, 4T2 and 6T3 phases
◐ ● ●			Phase A, B, C lost	No input/output phases	Check power wire harness for 1L1, 3L2, 5L3, 2T1, 4T2 and 6T3
○ ● ●				Defective thyristor or bad wire harness	Verify gate and cathode wire harness and verify thyristors
● ● ●			Internal failure	Microcontroller malfunction	Check that IC2 is correctly inserted in socket

**Troubleshooting Checklist**

To assist you in troubleshooting, the following information is required in order to evaluate the cause and avoid further failures.



<b>Item</b>	<b>Circle correct choice or fill in the blank</b>
Catalog No. (located on right side of ASTAT)	_____
Date code:	_____
Startup date:	_____
RGA No.:	_____
Failure date:	_____
Contact name:	_____
Company:	_____
Address:	_____
Telephone:	_____
Fax:	_____
Application type/characteristics:	_____
Motor hp:	_____
RPM:	_____
Service factor:	_____
NEMA design:	_____
Observations and comments:	_____
Power system data:	3-phase volts: _____ Frequency, Hz: _____
	System grounding: _____ kVA: _____
Transformer data:	Yes No NP Data: _____ KVA
Engine generator:	Yes No NP Data: _____ KW
Power factor correction:	Yes No NP Data: _____ $\mu$ f

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**Troubleshooting Checklist** *(continued)*

Item	Circle correct choice or fill in the blank		
Line (V)	A-B phase: _____	B-C phase: _____	C-A phase: _____
Line-Ground (V) A:	A: _____	B: _____	C: _____
Bypass contactor:	Yes	No	
NEMA enclosure type:	1	12/3R	
Motor overload relay	Cat. No.: _____		
	Setting: _____		
	Amps: _____		

Application description:

Status when failure occurred:	Power up	Running	Starting	Stopping
Last 4 error codes:				
● ON ○ OFF ◐ BLINKING	1 ○ ○ ○ ○	2 ○ ○ ○ ○	3 ○ ○ ○ ○	4 ○ ○ ○ ○
Parameters: (Enter indicators on potentiometer controls)	 RAMP(s)	 ILT/TORQUE		

DIP switch settings (circle setting for each):

HD/SD	1	0	Soft Stop	1	0
ILT/Torque	1	0	EOR/Run	1	0
Kick Start	1	0	Override	1	0



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