Application of generator power for reduced-voltage soft starters

How to configure an S811+ reduced-voltage soft starter for generator power applications

Application

To provide application availability when a mains power grid is not available in a remote location or to provide standby capability during power outages, generators are commonly used to provide power. To reduce the power demand on the generator in the interest of economy, soft starters are being more frequently applied to reduce outrush currents from the generator when starting the application.

Overview

Soft starter sizing is determined by the horsepower or kW rating of the (load) motor, coupled with the generator's operating voltage. Using this information, a table or graph is consulted to determine the minimum size of the soft starter for the application. If the application is considered to be severe duty, it is commonplace to select the next size larger soft starter to accommodate the higher load currents.

In a new application, caution must be exercised when selecting the capacity of the generator in relation to the motors utilizing reduced-voltage soft starters (RVSS). While the RVSS will reduce the initial start current loading, there are practical limitations. With any power source, a current load value of 2.5 x FLA an absolute minimum for generator sizing should be considered. For example, when the application calls for a 50 hp motor at 480 Vac three-phase with an FLA of 65A, the minimum generator capacity should be 2.5 x 65 = 162.5A. Recommended generator sizing would be 3 x FLA or 195A or greater. Generator sizing of 2.25 x FLA or less is considered to be inadequate for successful motor starts, even if the load motor is unloaded and/or uncoupled from the load.

In the event that the generator will be providing power to more than one load, the most extreme conditions should be used to determine the minimum generator capacity that would be required for all predictable combinations of loads.

Generator fuel control protocol should be understood when adjusting start cycle parameters on the RVSS. Older gensets will typically have mechanical methods (governors), whereas new units will most likely have electronic fuel control. Electronic fuel-controlled units, while being responsive and economical, may have additional load control features that electrically abort a motor start in the event of a "black smoke" condition to prevent excessive genset engine RPM decay or other negative emissions.

S811+ sizing

The catalog tables for the S811+ are based on an inrush value of 300–450 percent FLA of the motor, with maximum start ramp times of 180 seconds. On motors with quadratic loads, current values are generally 250–300 percent FLA. Applications with generators for primary power may be sized from the normal product selection tables.

S811+ start parameters

The following soft start parameter values may be used as initial values. Additional parameters, such as phase sequence, may need to be adjusted. Motor rotation should begin within two seconds of energization. Increase kick-start time and then initial torque to achieve the proper characteristics.

- Soft start config menu:
  - Start method: Current limit
  - Soft start time: 20 seconds
  - Initial torque: 30 percent
- Overload config menu:
  - Overld trip FLA: Set to motor nameplate FLA
  - Ovrld trip class: 30
- Protection setup menu:
  - Motor rated volt: Line voltage

Procedure: Note the time required to achieve synchronous speed. The internal bypass contactors will close when the motor has achieved synchronous speed regardless of the start ramp time. Reduce the start ramp time to the time required to achieve synchronous speed plus five seconds. This is to allow for minor variations in generator operation such as running loads during a start attempt. If the RVSS trips on a stall fault, increase the start ramp time. Adjustment of the initial torque parameter may also be necessary.

All other operational characteristics and any troubleshooting information, if needed, may be found in the S811+ user manual.

Circuit protection devices such as breakers and fuses are to be sized according to accepted standards based on motor capacity and conductor size.

Background information

Please note that the recommended values noted in this publication pertain to a motor connected in the delta configuration.

From the soft start config menu, set the start method parameter to current limit. This will allow the RVSS to maintain a constant current during the start cycle. It is also possible to use the voltage ramp, as this method will allow a slightly lower initial torque if needed to lower initial start currents.

The initial torque parameter default value is 45 percent, and the start ramp time default value is 20 seconds. These values may be used for initial motor starts and may be adjusted as necessary to achieve a smooth motor start without placing excessive load on the genset. Most applications are operated with initial torque parameter values set between 33 and 45 percent. Please refer to **Table 1** for initial torque settings and their corresponding locked rotor torque values.

Voltage ramp starts may also be possible with gensets; however, the voltage ramp characteristics are noticeably different from the current limit profile. In order to achieve proper motor rotation during the initial moments of the start cycle with either start method, the initial torque settings will be similar, inducing a similar initial load on the genset. As the start ramp progresses during a voltage ramp profile, the current may increase due to the increase of voltage, up to the normal "limit" determined by the impedance of the motor and the current voltage. This may place excessively high loads on the genset, and possibly initiate a genset shutdown and/or breaker trip.

Note: 33 percent initial torque equates to 57 percent locked rotor torque. This torque value is approximately equivalent to the torque developed if the motor was started in the wye configuration of a wye-delta starting system.

Table 1. Initial Torque Parameter Values

Torque Setting	Current as % Locked Rotor	Initial Torque
85%	92%	Maximum
71%	84%	
56%	75%	
45%	67%	Default value
36%	60%	
33%	57%	Wye-delta
27%	52%	Minimum current limit
19%	44%	
14%	37%	
9%	30%	
5%	23%	
3%	16%	
1%	10%	Minimum

Note: Voltage ramp starts are not recommended on variable torque load applications like fans and pumps. Attempting starts with the current limit set to a value of 20 percent initial torque or lower are not recommended, as the motor may not develop sufficient motor torque to achieve a smooth acceleration.

Troubleshooting during commissioning

It is important to understand the relationship between the operating parameters of the genset, the soft starter, and the load. In a failed start attempt, determine if the event was a trip condition of the soft starter, a stop command being sent to the soft starter from the control system and/or the genset, or a discrepancy with the motor's operating condition. One of the most common occurrences during commissioning is a control system monitoring device sending a stop command to the soft starter, rather than a soft starter trip condition. Use the checklist below to isolate potential problems in the operating conditions of the application:

Soft starter—resulting in a fault trip

- ❑ Protection parameters not set to proper values (overload, current, or voltage trip)
- ❑ Start ramp time insufficient—extend ramp time (stall fault)
- ❑ Open circuit—line or load open (SCR not firing, SCR shorted)
- ❑ Improper phase rotation (phase sequence)
- ❑ Overload (overload)—insufficient initial torque, excessive start ramp time

Genset—system control aborted start

- ❑ "Black smoke" condition—excessive load, engine RPM sag (excessive)
- ❑ Monitoring system discrepancies
  - Current/voltage sensor not connected
  - Breaker opens
    - Proper settings
    - Current transformer size and/or ratios improper
  - Excessive initial current demand
- ❑ Excessive existing load(s)
- ❑ Engine monitoring system
  - Mechanical/electrical issue
  - Low oil shutdown
  - Fuel

Motor (Load)

- ❑ Undersized for application
- ❑ Initial torque too low
- ❑ Excessive load during start cycle

Supporting documentation

Manuals	Reference Number
S811+ User Manual	MN03900001E

Additional help

In the event that additional help is needed, please contact the Technical Resource Center at 1-877-ETN-CARE, Option 2, Sub Option 2.

Eaton Corporation
Electrical Sector
1111 Superior Avenue
Cleveland, OH 44114 USA
Eaton.com

Printed in USA
Publication No. AP03902013E / Z12537
July 2012

Powering Business Worldwide