



Supplementary Instructions for Reduced-Voltage Ampgard® Motor Controllers

**DANGER**

HAZARDOUS VOLTAGE.

READ AND UNDERSTAND THIS LEAFLET AND ITS RELATED INSTRUCTION MATERIAL FOR FULL-VOLTAGE CONTROLLERS IN THEIR ENTIRETY BEFORE INSTALLING OR OPERATING THE CONTROLLER. SEE TABLE I.

INSTALLATION, ADJUSTMENT, REPAIR AND MAINTENANCE OF THIS TYPE OF EQUIPMENT MUST BE PERFORMED BY QUALIFIED PERSONNEL. A QUALIFIED PERSON IS ONE WHO IS FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED.

THE CONTROLLER

Each Ampgard® full-voltage motor starter (controller) consists of one non-load break isolating switch, one contactor, current-limiting fuses, a set of current transformers, and some form of overload protection. A reduced-voltage starter includes all of the components of a full-voltage starter plus one or two additional contactors and related control components.

APPLICATIONS

The primary reason for using a reduced-voltage starter is to minimize the current drawn from the system supply while the motor is accelerating from rest to rated speed. The reduced current drawn by the motor also results in reduced torque produced by the motor and hence produces a slightly softer start. The reduced torque of the motor, however, must be sufficient to drive the load to a reasonable speed by the time of transfer to full voltage or the application of full voltage will significantly increase the current drawn from the line and also create a shock to the motor and mechanical system it is driving.

OPERATION

All Ampgard® reduced-voltage starters are closed-transition, meaning that the motor is never disconnected from a source of voltage while transferring from reduced voltage to full voltage. The transition is controlled by the

TABLE I. REFERENCE MATERIAL

Contactors Type	Ampere Rating	Instruction I.L. or I.B.
Type SJA	360A	I.B. 48002
Type SJA	720A	I.B. 48005
Type SJD	360A	I.B. 48004
Type SJO	360A	I.L. 16-200-33
Type SJO	720A	I.L. 17047
Type SJS	360A	I.B. 48003

TABLE II. TAP SETTING

Starter Type	% Motor Voltage	% Motor Current	% Line Current	% Torque
Reactor Reduced Voltage				
80% Tap	80	80	80	64
65% Tap	65	65	65	42
50% Tap	50	50	50	25
Autotransformer Reduced Voltage				
80% Tap	80	80	67	64
65% Tap	65	65	45	42
50% Tap	50	50	28	25

operation of a current relay set to operate at a selected percentage of motor full-load current. As the motor accelerates, the current drawn decreases. Solid-state equivalents of the current transition relay (such as an IQ1000) operate on the same principle. These relays sense the lowering of motor current as the motor approaches rated speed. In the event that the starting torque of the motor is not sufficient to bring the connected load up to speed within 30 seconds max, an incomplete sequence timer will operate to cause the contactors to open and disconnect the motor from voltage. If the incomplete sequence timer or its IQ1000 equivalent functions as described above, the motor load must be reduced or a higher tap setting on the reactor or auto transformer coils must be used. A higher tap setting increases motor current and increases motor torque. See Table II. To extend the time allowed for transition beyond 30 seconds abuses the reactor, autotransformer and motor windings and voids the factory warranty. Reduced-voltage starters have taps set at 65% when they leave the factory.

SETTINGS

For starters with a current transition relay (CTR on diagram) the recommended setting is the equivalent of 120 percent of motor full-load current. This setting may be increased as needed to obtain transition before the incomplete sequence timer operates, but the relay current setting should never be greater than that equivalent to 130 percent of motor full-load current. The maximum permissible incomplete sequence timer setting is 30 seconds.

Because of the conversion ratios of the current transformers (CT's) that provide the input signal to the CTR, determining the proper setting of the dial on the CTR requires a calculation. Table III provides the multipliers to be used to convert full-load motor current expressed in amperes (FLA) to a percent (%) setting on the relay. For example, if the motor full-load current is 350 amperes and the Amgard motor controller is furnished with CT's having a ratio of 400:5, a setting of 87.5 percent on the relay is equivalent to 100 percent of motor full-load current and a setting of 105 percent on the relay is equivalent to 120 percent of motor full-load current, calculated as follows:

1. In the first column of Table III locate the line for 400:5 current transformers.
2. Follow that line across to the last two columns to find the two multipliers, (0.250 and 0.300).
3. Multiply 350 by 0.250 to obtain the 87.5 percent setting equivalent to 100 percent of FLA and multiply 350 by 0.300 to obtain the 105 percent setting equivalent to 120 percent of FLA.

Table III also shows the range of motor full-load currents for which the combination of current transition relay and each current transformer is suitable.

For starters with an IQ1000 protective relay, transition is controlled by the internal transition relay. Four set points on the IQ1000 are required for proper operation of the starter:

1. **Motor Start Transition Current**, Set Point 37, should be programmed for 50-150% of full-load current. Recommended default setting is 120%.
2. **Motor Start Transition Time**, Set Point 38, should be set for the motor's reduced-voltage acceleration time plus two seconds. This time should not exceed 30 seconds.
3. **Transition or Trip on Time-Out**, Set Point 39, should be set to trip on time-out (TRP TOUT). Forced transition on time-out (TRN TOUT) should not be chosen because of potential damage to the starter or the driven load.

TABLE III. TRANSITION RELAY SETTINGS

Current Transformer Ratio	Range of Full-Load Current (FLA)	Transformer Ratio Factor	Multiplier to Convert FLA to Relay % Setting	
			100% FLA	120% FLA
200:5	80 to 200A	0.0250	0.500	0.600
250:5	100 to 250A	0.0200	0.400	0.480
300:5	120 to 300A	0.1667	0.333	0.400
400:5	160 to 400A	0.1250	0.250	0.300
500:5	200 to 500A	0.0100	0.200	0.240
600:5	240 to 600A	0.0083	0.167	0.200
750:5	300 to 750A	0.0067	0.133	0.160
800:5	320 to 800A	0.0063	0.125	0.150
1000:5	400 to 1000A	0.0050	0.100	0.120
1200:5	480 to 1200A	0.0042	0.083	0.100
1500:5	600 to 1500A	0.0033	0.067	0.080
1600:5	640 to 1600A	0.0031	0.063	0.075
2000:5	800 to 2000A	0.0025	0.050	0.060

4. **Incomplete Sequence Report Back**, Set Point 40, should be set for the time required for the RUN contactor to pull-in after the transition signal is given. Recommended setting is one second.

Tap settings on reactors or autotransformers are changed by disconnecting the leads attached to the reactor or transformer coils at the points marked 50%, 65% or 80% and reconnecting the leads to a higher or lower percent number to respectively increase or decrease the motor starting torque.



DANGER

OPEN THE STARTER ISOLATING SWITCH BEFORE ATTEMPTING TO MAKE TAP CHANGES OR PERFORMING ANY MAINTENANCE.

MECHANICAL INTERLOCKS

In addition to the mechanical interlock on the medium-voltage compartment door that prevents the door from being opened with the isolating switch ON, reduced-voltage motor controllers have a key-operated mechanical interlock between the isolating switch and the reduced-voltage compartment door. This interlock system is based on the use of a single key for two locks.

With the key in the isolating switch, the switch can be turned ON but the key cannot be removed and carried to the reduced-voltage compartment until the isolating switch has been turned OFF. The key in the reduced-voltage compartment position permits that door to be opened, but the key cannot be removed until the reduced-voltage compartment door is closed and locked, which then permits the key to be returned to the isolating switch.



CAUTION

BOTH LOCKS ARE SHIPPED WITH KEYS IN THE CYLINDERS. FOR SAFE OPERATION, USE ONLY ONE KEY. STORE THE OTHER KEY AT A REMOTE LOCATION AND USE ONLY AS A SPARE IF THE PRIMARY KEY IS LOST.

A mechanical interlock between the isolating switch and the RUN contactor prevents the isolating switch from being opened when the RUN contactor is closed.

DUTY CYCLE

The reactors and autotransformers furnished in reduced-voltage starters are designed in accordance with industry standards (NEMA ICS 9) for medium duty per Table IV. Longer start times or more frequent starts will shorten the life of these components. If duty cycle requirements are different, please consult the factory.

TABLE IV. MEDIUM-DUTY CYCLE TIMES FOR MOTORS RATED 201 TO 3000 HORSEPOWER, INCL.

ON	30 Seconds
OFF	30 Seconds
REPEAT	2 Times (for a total of three cycles)
REST	1 Hour
ON	30 Seconds
OFF	30 Seconds
REPEAT	2 Times (for a total of three cycles)

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