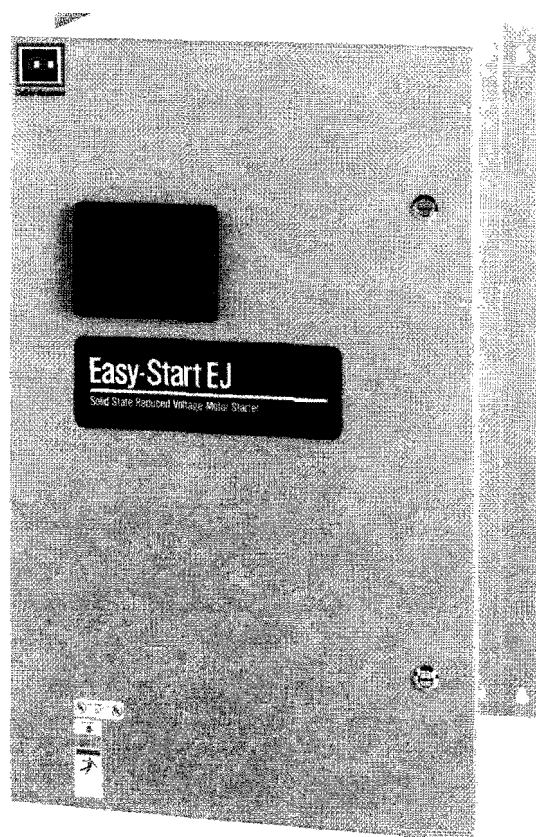




## Easy-Start EJ Solid State Reduced Voltage Motor Starter



Easy-Start EJ retains those features that most applications require and maintains the tradition of Cutler-Hammer Solid State Reduced Voltage Motor Starter quality and dependability.

The standard features of the Easy-Start EJ include:

- Adjustable Current Limit 250-500%
- Energy Saving Circuit
- Six position device panel
- Class-10 electronic overload protection
- 500% overload for 10 seconds;  
100% continuous
- Dimensions allow for mounting in standard width motor control centers and the open panel design makes it conducive to OEM mounting applications.





## Cutler-Hammer *Easy-Start EA Reduced Voltage Starter*

### APPLICATIONS AND FEATURES

#### Applications

The Easy-Start EA can be applied in a wide variety of industrial and commercial applications requiring reduced voltage starting of an ac induction motor. Solid state benefits include:

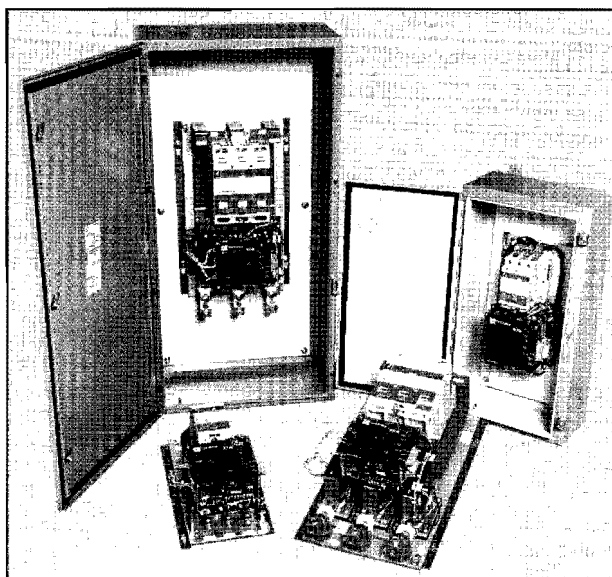
- Reduced torque on mechanical equipment providing longer life of belts, gears, pulleys and motor shafts commonly weakened by across-the-line starting.
- Elimination of voltage drop on weak utility systems where the performance of nearby equipment can be adversely affected.
- Reduced inrush currents during starting allowing better management of utility peak demand charges.
- Smooth, stepless acceleration with an abundance of torque and ramp time settings allowing superior flexibility over typical electromechanical starting methods.
- Solid state motor overload characteristics providing more accurate motor protection and flexibility of use with various motor sizes.

Typical customer applications include:

- Centrifugal compressors
- Screw compressors
- Conveyors
- Pumps
- Material handling equipment
- Chippers
- Rock crushers
- Textile machinery
- Fans and blowers
- Cranes and hoists
- Woodworking equipment
- Machine tools

#### Features and Benefits

- |                                  |   |
|----------------------------------|---|
| • Small physical size            | • Reduced panel space, smaller enclosures   |
| • Reduced heat losses            | • Better efficiencies/no heat dissipation concerns  |
| • Smooth start/stop              | • Stepless motor acceleration/deceleration, reduced initial torque and inrush currents  |
| • Adjustable torque              | • Wide range of initial step settings for various load starting requirements  |
| • Adjustable ramp time           | • Ability to control rate of current ramp   |
| • 600V rating                    | • One product for systems from 208 to 575V (60 Hz only)   |
| • Emergency backup               | • Advantage starter is rated to handle full across-the-line starting current, in a customer initiated backup mode, if a problem is encountered. |
| • Current limit                  | • Limits current inrush and current draw during ramp.   |
| • Electronic overload            | • Flexibility of use with various motor sizes, more accurate than bi-metallic methods   |
| • Selectable overload protection | • Overload curve can be tailored to Class 10 or 20 application requirements   |
| • Advantage starter bypass       | • Reduced contact bounce and contact wear, lifetime coil warranty; contactor closes and opens at 1 times current                                |
| • Communications                 | • Advantage starter can be modified to communicate on the IMPACC network  |



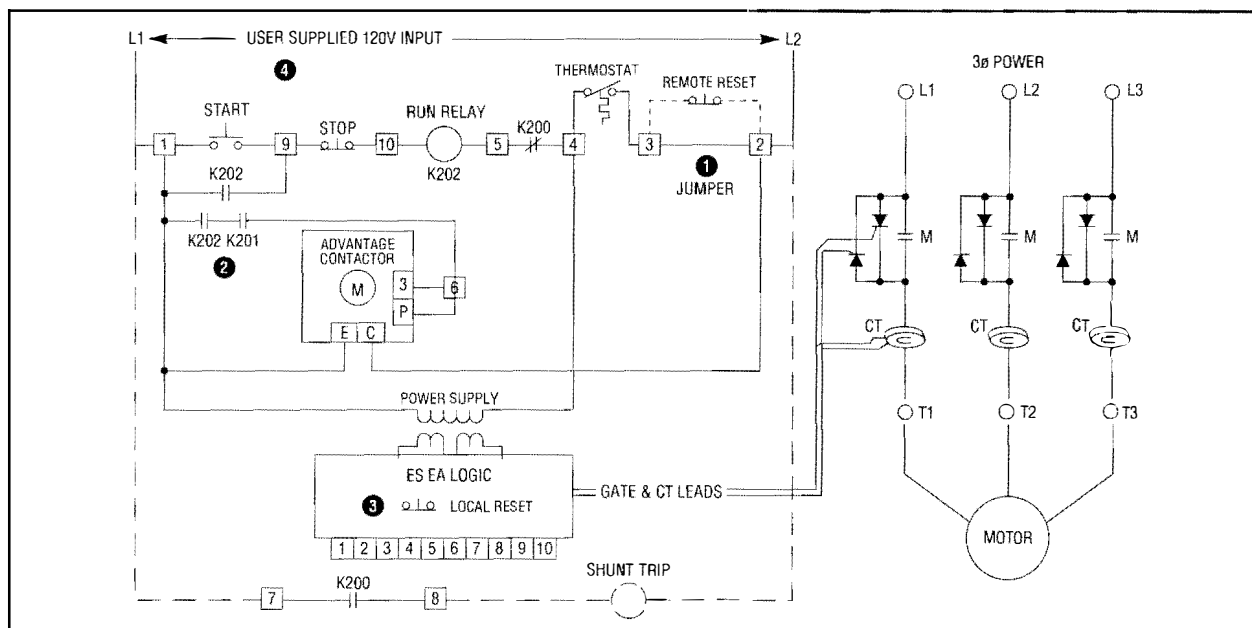
Easy-Start EA Family of Open and Enclosed Starters through 760A Base Rating



## Cutler-Hammer *Easy-Start* EA Reduced Voltage Starter

### DIAGRAMS AND DIMENSIONS

#### Schematic



- ① User supplied Remote Reset can be installed by removing jumper between terminals 2 and 3.
- ② End-of-ramp Relay (K201) and Trip Relay (K200) are part of Logic Board; a remote fault device, such as Shunt Trip, may be connected in series with the N.O., K200 contact at point 8.
- ③ Starter is reset by interrupting 120 volt supply at remote reset; or, by using the "RESET" push button on the main logic board, which is at low level voltage.
- ④ CPT and operator devices to be supplied by users. When using Models EA045 through EA135 use 150VA minimum CPT. When using Models EA270 through EA760 use 300VA minimum CPT.

#### Line and Load Lug Wire Size Ranges

Model	Open Starter Panel		Enclosed Starter Configuration			
			Non-Combination Type		Combination Type	
	Line	Load	Line	Load	Line	Load
EA045	#14 - 4 AWG	#14 - 6 AWG	#14 - 4 AWG	#14 - 6 AWG	#4 - 4/0 AWG	#14 - 6 AWG
EA090	#14 - 250 MCM	#6 - 250 MCM	#6 - 4/0	#6 - 4/0	#4 - 4/0	#6 - 4/0
EA135	#14 - 250 MCM	#6 - 250 MCM	#6 - 4/0	#6 - 4/0	#4 - 350 MCM	#6 - 4/0
EA270	(2) 2/0 - 500 MCM	#4 - 500 MCM	(2) 2/0 - 500 MCM	4 - 500 MCM	(2) 3/0 - 250 MCM	4 - 500 MCM
EA360	(2) 2/0 - 500 MCM	(2) 4 - 500 MCM	(2) 2/0 - 500 MCM	(2) 4 - 500 MCM	(2) 400 - 500 MCM	(2) 4 - 500 MCM
EA540	(2) 500 - 750 MCM	(2) 4 - 500 MCM	(2) 2/0 - 500 MCM	(2) 4 - 500 MCM	(3) 4/0 - 500 MCM	(3) 4 - 500 MCM
EA760	(2) 500 - 750 MCM	(3) 4 - 500 MCM	(2) 500 - 750 MCM	(3) 4 - 500 MCM	(3) 4/0 - 500 MCM	(3) 4 - 500 MCM



## Cutler-Hammer *Easy-Start EA* Reduced Voltage Starter

### GUIDE SPECIFICATIONS

#### Guide Specifications

The solid state reduced voltage starter shall be UL and CSA listed and consist of an SCR based power section, logic board and paralleling bypass contactor.

The SCR based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 PIV. Units using triacs or SCR/diode combinations shall not be acceptable. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dv/dt characteristics of the electric system.

The logic board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits. The logic board shall be identical through all ampere ratings and voltage classes and shall be conformally coated to protect from environmental conditions.

The paralleling bypass contactor shall energize when the motor reaches full speed and close/open under 1X motor current. The contactor shall be fully rated for across-the-line starting duty should this be desired. The contactor shall utilize an *energy balanced contact closure* to limit

contact bounce and an *intelligent coil controller* which optimizes coil voltage during varying system conditions. The coil shall have a lifetime warranty.

The overload protection shall be electronic and be based on an inverse time/current algorithm. Overload protection shall be adjusted via DIP (Dual Inline Package) switch on the logic board. Class 10/20 shall be selectable. Units using bi-metal overload relays are not acceptable. Overtemperature protection (on heat sink) shall be standard.

The solid state logic shall be phase sensitive, and shall inhibit starting on incorrect rotation. Improper phase rotation shall be indicated on the logic board of the starter.

Starters shall protect against a phase loss/unbalance condition shutting down if a 35% current differential between any two phases is encountered.

A normally open (NO) contact shall announce fault conditions, with contact ratings of 60VA (resistive load) and 20VA (inductive load). In addition, an LED display on the logic board shall indicate type of fault (current trip, phase loss, phase rotation).

The following logic board adjustments are required:

- Ramp Time; 1-45 seconds, on hexadecimal switch
- Initial Torque; 100-200% current, on hexadecimal switch
- Current limit; 100-500% current, on hexadecimal switch<sup>1</sup>
- FLA of motor; 4-1 range of starter, on DIP switch

Smooth stopping (optional) shall be available to provide a linear voltage deceleration should the load require it. It is to be adjustable from 1-45 seconds.

Enclosed units shall include a thermal magnetic circuit breaker for short circuit protection and quick disconnect means. Starters and breakers are to be tested in series and be rated for UL508 withstand rating of 65KAIC RMS.

Units enclosed in motor control centers shall be of the same manufacturer as that of the circuit breaker and motor control center manufacturer due to coordination and design issues.

The manufacturer of the solid state starter shall employ a factory trained field service organization for the purpose of start up and repair of units. (Third party service contractors are not acceptable.)

<sup>1</sup> Except EA360 which is Definite Purpose Rated at 417% (1500 Amps Max Starting).

## Cutler-Hammer

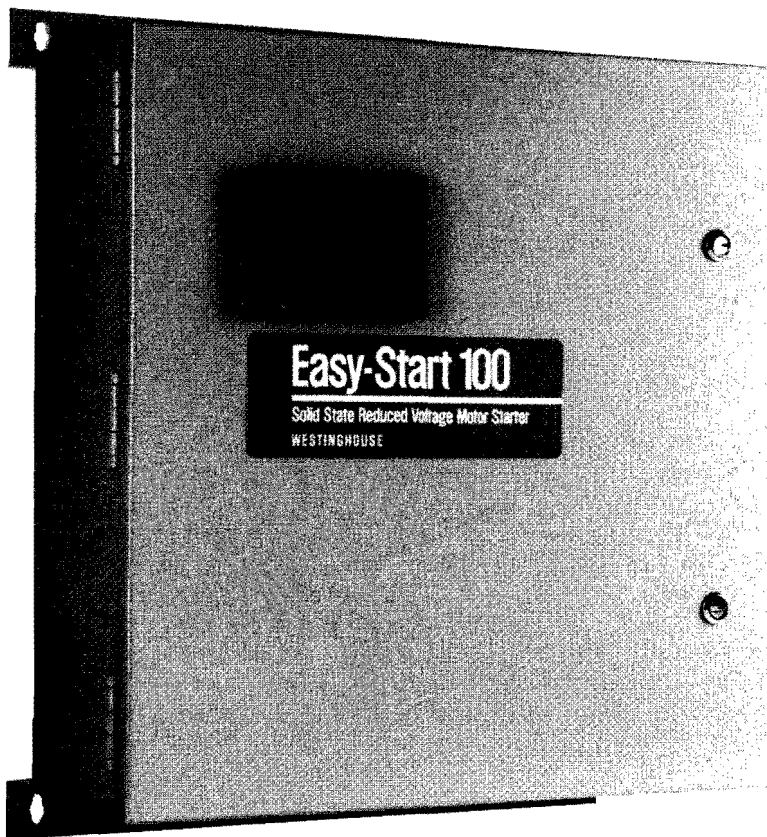
Westinghouse & Cutler-Hammer Products

110 Douglas Road, P.O. Box 819  
Oldsmar, Florida, U.S.A. 34677

**EAT•N**



## Easy-Start 100 Solid State Reduced Voltage Motor Starter



The Easy-Start 100 retains those features that most applications require and maintains the Tradition of Westinghouse Solid State Reduced Voltage Motor Starter quality and dependability.

The standard features of the Easy-Start 100 include:

- Adjustable Current Limit 250-500%
- Energy Saving Circuit
- Six position device panel
- Class-10 electronic overload protection
- 500% overload for 10 seconds;  
100% continuous
- Dimensions allow for mounting in standard width motor control centers and the open panel design makes it conducive to OEM mounting applications.





## Easy-Start 100 Solid State Reduced Voltage Motor Starter

### Easy-Start 100 Specifications:

<b>Current Ratings:</b>	<u>NEMA-12 Enclosed</u>			<u>NEMA-1 Enclosed</u>	
	26 Amps			190 Amps	
	52 Amps			270 Amps	
	68 Amps			390 Amps	
	75 Amps				
	100 Amps				
	130 Amps				
<b>AC Line Voltage:</b>	208/230/460	+ 10%	- 15%	50/60 Hz	3-Phase
	380/415	+ 10%	- 15%	50/60 Hz	3-Phase
	500/575	+ 10%	- 15%	50/60 Hz	3-Phase
<b>Power Semiconductors:</b>	<u>Starter Voltage Rating:</u>			<u>Semiconductor Rating:</u>	
	208/230/460 VAC			1200 V	
	380/415 VAC			1200 V	
	500/575 VAC			1500 V	
<b>Overload Capacity:</b>	Continuous @ 100% of rating				
	30 seconds @ 250% of rating				
	10 seconds @ 500% of rating				
<b>Standard Adjustments:</b>	<ul style="list-style-type: none"> <li>• Current Calibration Dip Switches</li> <li>• Energy Saving On/Off Switch</li> <li>• Initial Voltage Step: 20%-90%</li> <li>• Voltage Ramp Time: 2 to 70 seconds</li> <li>• Current Limit: 250%-500%</li> </ul>				
<b>Motor Protection:</b>	Electronic overload current trip with inverse time trip curve equivalent to IEC class-10. See Figure 1.				
<b>Energy Saving:</b>	Standard on all models; the Easy-Start 100 senses motor load and slip speed and adjusts the motor voltage to conserve power whenever the motor is lightly loaded.				
<b>UL and CSA Listed</b>	All units built to UL and CSA standards.				
<b>Enclosure:</b>	NEMA-12 EJ026 ( 26 Amp)				
	EJ052 ( 52 Amp)				
	EJ068 ( 68 Amp)				
	EJ075 ( 75 Amp)				
	EJ100 (100 Amp)				
	EJ130 (130 Amp)				
	NEMA-1 EJ190 (190 Amp)				
	EJ270 (270 Amp)				
	EJ390 (390 Amp)				
	Open Panel Available on all Models				
<b>Ambient Temperature:</b>	Operating Range - 20 to +40°C				
<b>Phase Rotation Protection:</b>	Inhibits starting of motor unless input line is A-B-C rotation. LED on logic board indicates improper phase sequence.				
<b>Auxiliary Run Relay (K2):</b>	1 Form-C contact (rated 120 VAC, 3 Amps)				
<b>Alarm Relay (K1):</b>	N.O. Contact (rated 120 VAC, 1 Amp Resistive)				

**WARNING:** This literature is a general description of the equipment only. For proper installation, operation and maintenance of the equipment, consult the Instruction Manual. This should not be considered all inclusive. Improperly installing and maintaining these products can result in death or serious personal injury. Before attempting installation or maintenance, read and understand all instructional materials related to the product. If further information is required, you should consult Westinghouse Electric Corporation.

Sale of the product discussed in this literature is subject to terms and conditions out-

lined in appropriate Westinghouse Electric Corporation selling policies. The sole source governing the rights and remedies of any purchaser of this equipment is the relevant Westinghouse selling policy.

**NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OR WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, ARE MADE REGARDING THE INFORMATION, RECOMMENDATIONS AND DESCRIPTIONS CONTAINED HEREIN.** In no event will Westinghouse be responsible to the purchaser or user in contract, in tort

(including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations and descriptions contained herein.



## Easy-Start 100 Solid State Reduced Voltage Motor Starter

Features	What They Are	What They Do For You
• Current Limit	<ul style="list-style-type: none"><li>• 500% current limit for 10 seconds on all models</li><li>• Adjustable 250-500%</li></ul>	<ul style="list-style-type: none"><li>• Setting can be tailored to specific application</li><li>• Higher limit can be set for hard to start loads</li></ul>
• Energy Savings	<ul style="list-style-type: none"><li>• Reduces voltage applied to the motor if the motor is underloaded</li><li>• Can be defeated if desired</li></ul>	<ul style="list-style-type: none"><li>• Reduces power cost</li><li>• Flexibility</li></ul>
• 6 SCR Power Section	<ul style="list-style-type: none"><li>• Each leg has 2 SCRs</li><li>• SCR PIV (peak inverse voltage) 208 to 460V SCR – 1200 PIV 575V – 1500V PIV</li></ul>	<ul style="list-style-type: none"><li>• Better control and less motor heating than 3 SCR diode models.</li></ul>
• Digital Firing Circuit	<ul style="list-style-type: none"><li>• Digital trigger is used for firing</li></ul>	<ul style="list-style-type: none"><li>• Digital trigger output provides more balanced voltage to monitor</li><li>• Digital trigger responds faster to rapidly changing loads</li></ul>
• Current Calibration DIP Switches	<ul style="list-style-type: none"><li>• Each model covers a wide range of motor full load Amps 2.5:1 range</li></ul>	<ul style="list-style-type: none"><li>• Reduced distributor inventory</li><li>• Increased user/OEM flexibility</li><li>• Simple to adjust</li></ul>
• Potentiometer Adjustments for Current Limit, Initial Voltage Step and Ramp Time	<ul style="list-style-type: none"><li>• Adjustments that can be made to the starter to fit a wide range of applications and customer requirements.</li></ul>	<ul style="list-style-type: none"><li>• Better fit between starter and application</li><li>• Simple to adjust</li><li>• Flexibility</li></ul>
• Voltage Plugs	<ul style="list-style-type: none"><li>• Two voltage plugs shipped with each unit 208/230 volt and 460 volt, 380 and 415 volt, 500 and 575 volt</li></ul>	<ul style="list-style-type: none"><li>• Reduced distributor inventory</li><li>• Increased user/OEM flexibility</li><li>• Suitable for multiple line voltages</li></ul>
• Motor Control Center Mounting	<ul style="list-style-type: none"><li>• Fourteen inch panel width</li><li>• Six inch depth</li></ul>	<ul style="list-style-type: none"><li>• Allows two-high mounting in standard 20 inch width motor control centers up to 130 amp</li><li>• Minimizes motor control center structure investment</li><li>• Reduces need for valuable plant and panel mounting space</li></ul>
• Common Logic Board	<ul style="list-style-type: none"><li>• One logic board style for all ampere ratings within a specified voltage model</li></ul>	<ul style="list-style-type: none"><li>• Reduces spare parts inventory</li><li>• Increased user/OEM flexibility</li></ul>
• Phase Rotation LED	<ul style="list-style-type: none"><li>• Phase rotation LED on logic board illuminates whenever phase rotation is not correct</li></ul>	<ul style="list-style-type: none"><li>• Simplifies troubleshooting</li><li>• Handy for proper start-up</li></ul>
• Extended Acceleration Adjustments	<ul style="list-style-type: none"><li>• Voltage ramp up – adjustable from 2-70 seconds</li></ul>	<ul style="list-style-type: none"><li>• Allows soft starting of loads that required additional time to reach full speed when reducing the initial voltage</li></ul>
• Device Panel Standard on all Enclosed Units	<ul style="list-style-type: none"><li>• Plastic device panels have six knock-out positions for mounting pushbuttons, indicating lights and mini meters</li></ul>	<ul style="list-style-type: none"><li>• Easy field mounting of pilot devices</li><li>• Saves installation costs and time</li><li>• Conducive to distributor modification services</li></ul>
• High Line Voltage Control	<ul style="list-style-type: none"><li>• With energy saver circuit on, the Easy-Start 100 will limit the voltage applied to the motor to controller's rated voltage under high-line conditions. Incoming voltage should be within the Easy-Start 100's rating.</li></ul>	<ul style="list-style-type: none"><li>• Reduces power costs in installations with high-line voltage which are common in off-peak hours</li></ul>
• 120 Volt Control Connection	<ul style="list-style-type: none"><li>• Board mounted terminal strip</li></ul>	<ul style="list-style-type: none"><li>• Allows for interface with customer's 120 volt control devices</li><li>• Easy access for customer connections</li></ul>
• Smooth Stop Option	<ul style="list-style-type: none"><li>• Voltage ramp down – adjustable from 2-125 seconds</li></ul>	<ul style="list-style-type: none"><li>• Reduces the shock effect when stopping high friction loads</li><li>• Reduces water hammer in pumping applications</li></ul>



## Easy-Start 100 Solid State Reduced Voltage Motor Starter

**Table 1: Easy-Start 100 Standard Adjustments**

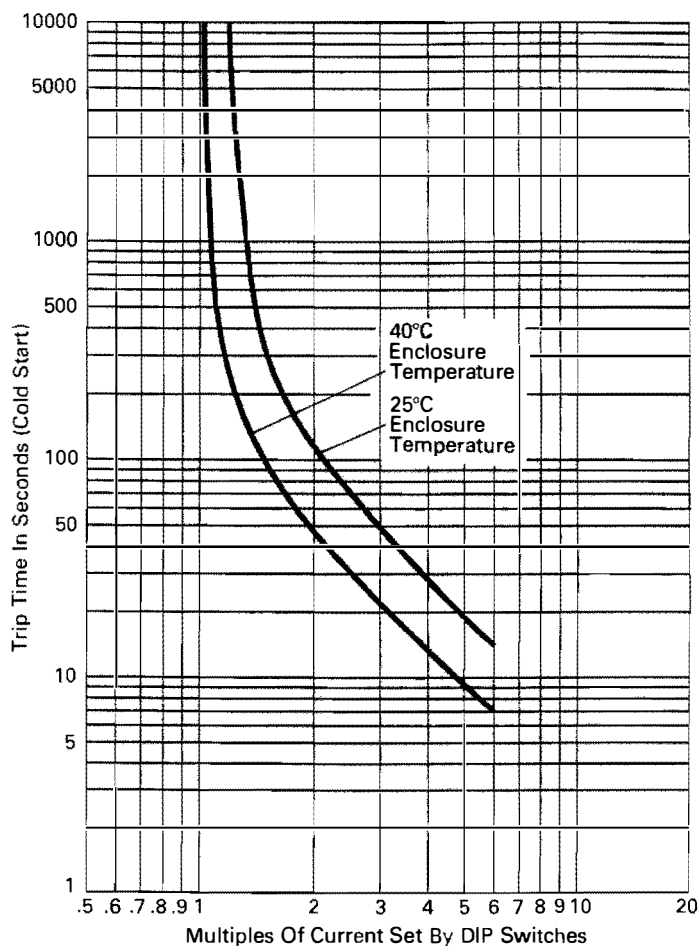
Adjustment	Range	Approximate Factory Setting/ Comments
Acceleration Time	2 to 70 seconds	2 seconds
Initial Voltage Step	20-90% of line voltage	40%
Current Limit	250-500% of Full Load Amp DIP Switch Setting	450%
Current Calibration DIP Switches	37% to 100% of current rating	Set in field for motor full load amps
Energy Saver Circuit	On/Off	On: DS1-5 open Off: DS1-5 closed
Voltage Rating Plug	230 or 460 volts 380 or 415 volts 500 or 575 volts	• 2 plugs supplied • install the one applicable to source voltage

**Table 2: Easy-Start 100 Protective Features**

Function	Range and Description
Inverse-Time Overcurrent Trip	See time current curve class-10 protection (Figure 1)
Phase Rotation	Inhibits starting unless incoming line voltage is in A-B-C phase rotation (LED indication)
Current Limit	Adjustable 250-500% effective during starting only
DV/DT Protection	R-C snubber network

**Table 3: Easy-Start 100 Standard Conditions for Application**

- Humidity: 20-95% non condensing
- Altitude: To 3300 feet (1000 meters)
- Ambient temperature operations: -20°C to +40°C (enclosed)  
-20°C to +50°C (open panel)
- AC control voltage 120V single phase 50/60 Hertz (approx. 50VA required) supplied externally by others, or by optional control power transformer.
- AC line voltage 208, 230, 380, 415, 460, 500 or 575 Volt. +10-15% 3-phase, 50/60 Hertz



**Figure 1. Easy-Start 100 Overload Characteristics**



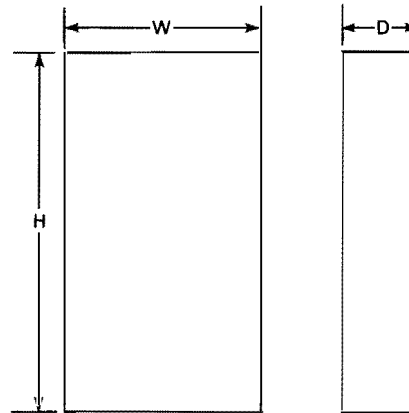


## Easy-Start 100 Solid State Reduced Voltage Motor Starter

**Table 4: Dimensions and Weights**

*Approximate only. Not to be used for construction purposes.*

Catalog Number <sup>①</sup>	Enclosure <sup>②</sup>	Height (inches)	Width (inches)	Depth (inches)	Weight (lbs.)
EJ026-EP	Open <sup>③</sup>	15	14	8	22
EJ026-ER	NEMA 12	17.6	13.5	10.75	35
EJ052-EP	Open <sup>③</sup>	15	14	8	22
EJ052-ER	NEMA 12	17.6	13.5	10.75	35
EJ068-EP	Open <sup>③</sup>	15	14	8	26
EJ068-ER	NEMA 12	28.5	25.25	10.75	86
EJ075-EP	Open <sup>③</sup>	15	14	8	26
EJ075-ER	NEMA 12	28.5	25.25	10.75	86
EJ100-EP	Open <sup>③</sup>	15	14	8	26
EJ100-ER	NEMA 12	28.5	25.25	10.75	86
EJ130-EP	Open <sup>③</sup>	27	14	8	40
EJ130-ER	NEMA 12	33.8	24.5	13	107
EJ190-NP	Open <sup>④</sup>	39	26.75	14	100
EJ190-NR	NEMA 1 <sup>④</sup>	46.38	30.87	15.5	220
EJ190-NC	Open <sup>④⑤</sup>	47.68	18.50	9.5	100
EJ270-NP	Open <sup>④</sup>	39	26.75	14	100
EJ270-NR	NEMA 1 <sup>④</sup>	46.38	30.87	15.5	220
EJ270-NC	Open <sup>④⑤</sup>	47.68	18.50	9.5	100
EJ390-NP	Open <sup>④</sup>	39	26.75	14	110
EJ390-NR	NEMA 1 <sup>④</sup>	46.38	30.87	15.5	230
EJ390-NC	Open <sup>④⑤</sup>	47.68	18.50	9.5	110



- ① \_in Catalog Number is '4' for 280/230/460 volt models, '3' for 380/415 volt models and '5' for 500/575 volt models.  
② The starter must be mounted with the heat sink fins in the vertical position. A minimum clearance of six (6) inches on top and bottom is required for enclosed units and minimum clearances for open models will depend upon enclosure provided by others.  
③ When mounting open panel starters, isolated heat sink fins should be brought out in open air through a properly gasketed cutout in the enclosure.  
④ Heat sinks are non-isolated.  
⑤ SlimLine Open Panel Design suitable for mounting in 20 inch wide MCC structure.

**Table 5: Model Selection Table**

NEMA Starter Size	Open Panel	Enclosed	Amps	Volts	HP or Kw Ratings <sup>⑥</sup>				
					380V	208V	230V	460V	575V
1	EJ026-4EP	EJ026-4ER	26	208/230/460	11 Kw	7.5 HP	7.5 HP	15 HP	25 HP
	EJ026-3EP	EJ026-3ER	26	380/415					
	EJ026-5EP	EJ026-5ER	26	500/575					
2	EJ052-4EP	EJ052-4ER	52	208/230/460	22 Kw	15 HP	15 HP	40 HP	50 HP
	EJ052-3EP	EJ052-3ER	52	380/415					
	EJ052-5EP	EJ052-5ER	52	500/575					
3	EJ068-4EP	EJ068-4ER	68	208/230/460	30 Kw	20 HP	25 HP	50 HP	60 HP
	EJ068-3EP	EJ068-3ER	68	380/415					
	EJ068-5EP	EJ068-5ER	68	500/575					
3	EJ075-4EP	EJ075-4ER	75	208/230/460	37 Kw	20 HP	25 HP	60 HP	75 HP
	EJ075-3EP	EJ075-3ER	75	380/415					
	EJ075-5EP	EJ075-5ER	75	508/575					
4	EJ100-4EP	EJ100-4ER	100	208/230/460	50 Kw	30 HP	30 HP	75 HP	100 HP
	EJ100-3EP	EJ100-3ER	100	380/415					
	EJ100-5EP	EJ100-5ER	100	500/575					
4	EJ130-4EP	EJ130-4ER	130	208/230/460	55 Kw	40 HP	50 HP	100 HP	125 HP
	EJ130-3EP	EJ130-3ER	130	380/415					
	EJ130-5EP	EJ130-5ER	130	500/575					
5	EJ190-4NP <sup>⑦</sup>	EJ190-4NR	190	208/230/460	90 Kw	60 HP	75 HP	150 HP	150 HP
	EJ190-3NP	EJ190-3NR	190	380/415					
	EJ190-5NP	EJ190-5NR	190	500/575					
5	EJ270-4NP <sup>⑦</sup>	EJ270-4NR	270	208/230/460	110 Kw	75 HP	100 HP	200 HP	250 HP
	EJ270-3NP	EJ270-3NR	270	380/415					
	EJ270-5NP	EJ270-5NR	270	500/575					
5	EJ390-4NP <sup>⑦</sup>	EJ390-4NR	390	208/230/460	200 Kw	125 HP	150 HP	300 HP	350 HP
	EJ390-3NP	EJ390-3NR	390	380/415					
	EJ390-5NP	EJ390-5NR	390	500/575					

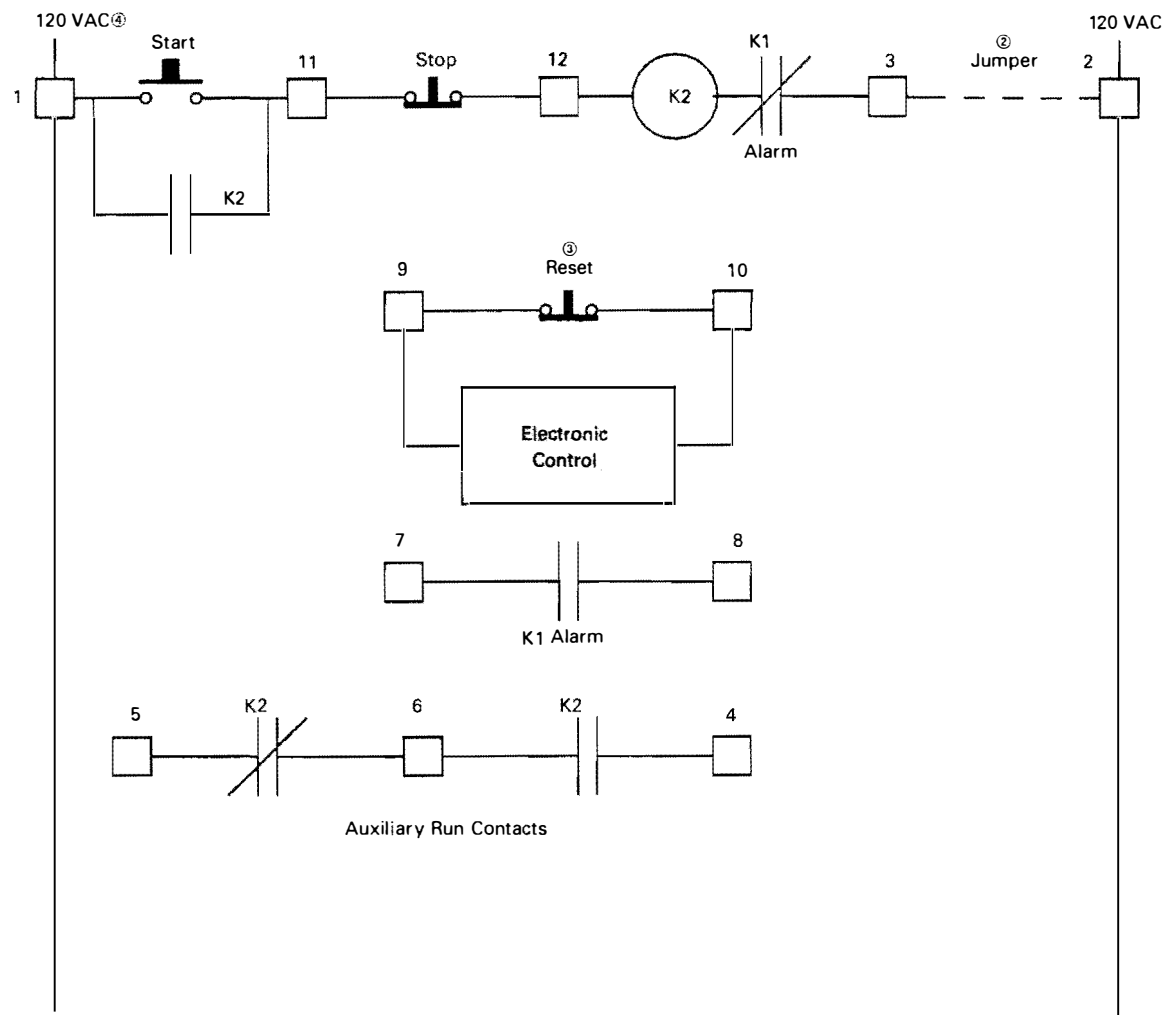
⑥ Ratings are for guidelines only, and may vary with motor design and construction.

⑦ These ratings also apply to the SlimLine Open Panel Design. Change "P" in suffix to "C".



## Easy-Start 100 Solid State Reduced Voltage Motor Starter

Figure 2. Easy-Start 100 Ladder Diagram—Operator Devices Supplied by Customer; Not Included with Standard Easy-Start 100



Notes:

- 12 indicates terminal block no. 12 on main logic board.
- ② - - - indicates jumper. This jumper can be replaced by overload/interlock devices. Factory installed thermostats are connected in place of the jumper on starters rated 190 amps and above.
- ③ Customer supplied contacts for reset should be dry type.
- ④ 120 volt supply must be provided by customer.



## Easy-Start 100 Solid State Reduced Voltage Motor Starter

### Application Considerations

#### Installation

- Ventilated NEMA 1 enclosures should be mounted so that enough clearance is available for air to enter and exit the enclosure. Specific clearance requirements are shown on dimensions table.
- NEMA 12 enclosures should be mounted so that heat sink fins are vertical. For wall mounted units a minimum clearance of 6" on top and bottom is required.
- Open panel units should be mounted in a box so the temperature inside the box does not exceed 50°C (122°F).

For sizing the enclosure the heat loss in watts can be estimated at 3 times the full load current.

EXAMPLE: For EJ190 the maximum current rating is 190 amps. The approximate watts loss at maximum current rating is  $3 \times 190 = 570$  watts.

For units with non isolated heat sinks①, all the watt loss must be dissipated thru box surface.

For units with isolated heat sinks②; the heat sink fins should be brought out in open air thru a properly gasketed cut out in the enclosure. Approximately 50% watt loss is dissipated thru the heat sinks and the remaining 50% should be dissipated thru the remainder of the box surface, not counting the heat sink.

#### Ambient Temperature

Easy-Start 100 is rated for 40°C (104°F) ambient temperature. For above 40°C derate by 5% for every 5°C rise over 40°C up to 50°C (122°F) max.

EXAMPLE: EJ190 is rated 190 amps @ 40°C. For 50°C the rating would be  $190 \times .9 = 171$  amps.

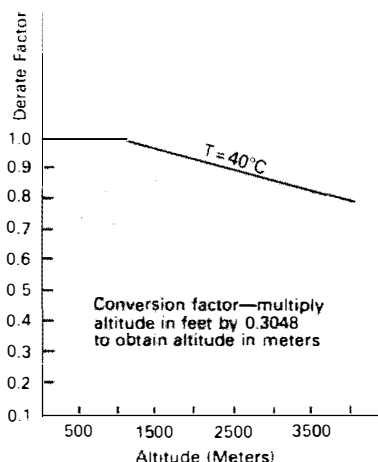
#### Altitude

Easy-Start 100 is rated for 3300 ft. [1000 meters]. Use Derate Curve for derating above 3300 ft.

#### Multi-Motor Operation

Easy-Start 100 can be used to control multiple motors if the following conditions are met:

- The current rating of Easy-Start 100 should be equal to or greater than the total of individual motor full load amps and dip switches must be set for the cumulative full load amps of the motors.
- Individual motor overcurrent protection is provided by others.
- Energy Saver circuit should be turned OFF.



Derate Curve For Altitude

- The motors should not be mechanically coupled together, i.e. two motors on same shaft.
- NEC and local code requirement for individual motor protection and branch circuit protection are met.

#### Frequent Starting/Stopping

The number of starts and stops depends upon many factors. The most important ones are:

- Position of current limit potentiometer which can be anywhere from 250-500% of the current rating set by the DIP switches.
- Start time.
- Run time.
- Off time before next start.

The following tables (Table 6 thru Table 14, page 8) can be used for guidance in frequent starting/stopping applications. These tables are based on worst case condition that the controller will be running at the indicated starting current during the entire start time.

The number of starts per hour in the following tables is based on the current carrying capacity of the SCR's. If a high number of multiple starts is used, the starter may trip due to the inverse-time overload current protection function.

If a trip should occur, due to multiple starts, it is advisable to wait a period of 10 minutes before re-starting to avoid damage to the Easy-Start 100.

The motor manufacturer should be consulted about the effect of a high number of multiple starts on motor life.

Zero off-time in the starts per hour tables indicates jog duty.

① Non-Isolated heat sinks are indicated by suffix 'NC', 'NP' or 'NR' at the end of the Easy-Start 100 Catalog Number.

EXAMPLE: If an application requires 1 start per minute, 60 starts per hour, for a 460V, 50 HP, 70 Amp motor; the cycle time is 60 seconds between starts. Assume a start time of 5 seconds, at a starting current of 500% (350 amps) is needed, with an off-time between run and start of 12 seconds, and a run time of 43 seconds.

The percent off-time is therefore  $12/60 \times 100 = 20\%$ . We next look at the starts per hour tables on page 12 for a 75 amp starter (EJ075)①. We can see that the model EJ075 can do only 37 starts per hour at 375 amps with a start time of 5 seconds and an off-time of 20%.

Therefore, we need to use the next larger size starter, (EJ100) from the tables on page 12 we can see that 60 starts per hour are allowed at a starting current of 400 amps with a start time of 5 seconds and a 20% off-time, by using the model EJ100. Easy-Start 100 may trip due to overcurrent if repeated starts at high current and long starting times are used.

#### Starting Torque

The reduced voltage applied to the motor results in reduced inrush current and soft start. However, it reduces the starting torque of the motor. The relationship is as follows:

$$\frac{\text{Torque at Reduced Current}}{\text{Torque at Full Current}} = \left[ \frac{\text{Current at Reduced Voltage}}{\text{Current at Full Voltage}} \right]^2$$

EXAMPLE: A 100 HP 1800 RPM 460V NEMA B motor draws six times full load amps for starting and starting torque is 150% of full load torque.

If the same motor is started with Easy-Start 100 at 300% current limit.

$$\begin{aligned} \text{Starting Torque at 300\% Current Limit} &= \left[ \frac{300}{600} \right]^2 \times \text{starting torque at 600\% current} \\ &= 1/4 \times 150\% \text{ full load torque} = 37.5\% \text{ full load torque} \end{aligned}$$

#### NEMA Design C & D Motors

These motors are used due to their high starting torque characteristics. Therefore, these will not be a good application for reduced voltage starting.

#### Wound Rotor Motors

Wound rotor motors are generally used for high starting torque they can deliver. This again does not make them suitable for reduced voltage starter application.

It is not recommended that a wound rotor motor be started with reduced voltage starter with all the resistors shorted out.

② Isolated heat sinks are indicated by suffix 'EP' or 'ER' at the end of the Easy-Start 100 Catalog Number.



## Easy-Start 100 Solid State Reduced Voltage Motor Starter

**Table 6**

Model Number EJ026		Starts Per Hour				
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	65	2	40	60	80	100
		5	20	30	40	50
		10	15	20	25	30
300%	78	2	30	40	60	80
		5	15	20	30	40
		10	10	15	20	25
400%	104	2	12	16	20	24
		5	6	8	10	12
		10	4	6	8	10
500%	130	2	4	6	8	12
		5	2	4	6	8
		10	-	-	2	4

**Table 9**

Model Number EJ075		Starts Per Hour				
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	188	2	20	40	80	160
		5	8	20	40	80
		10	4	8	12	16
300%	225	2	10	20	40	80
		5	4	8	12	16
		10	2	4	8	12
400%	300	2	4	8	12	16
		5	1	2	4	8
		10	-	1	2	4
500%	375	2	-	4	8	12
		5	-	-	1	2
		10	-	-	-	1

**Table 12**

Model Number EJ190		Starts Per Hour				
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	475	2	150	200	300	400
		5	60	80	120	160
		10	30	40	60	80
300%	570	2	120	180	240	300
		5	40	0	100	120
		10	20	30	50	60
400%	760	2	40	80	120	160
		5	20	40	60	80
		10	8	16	24	32
500%	950	2	20	40	80	100
		5	8	16	24	32
		10	4	8	12	16

**Table 7**

Model Number EJ052		Starts Per Hour				
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	130	2	30	40	70	140
		5	20	30	40	60
		10	12	16	24	30
300%	156	2	20	30	60	80
		5	15	20	30	60
		10	10	15	20	30
400%	208	2	10	12	16	20
		5	4	8	12	16
		10	2	4	6	8
500%	260	2	4	6	8	12
		5	2	3	4	6
		10	-	-	1	2

**Table 10**

Model Number EJ100		Starts Per Hour				
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	250	2	50	100	200	300
		5	20	40	80	160
		10	10	20	30	40
300%	300	2	10	20	40	60
		5	4	8	12	20
		10	-	2	4	6
400%	400	2	1	2	4	8
		5	-	1	2	3
		10	-	-	1	2
500%	500	2	-	1	2	3
		5	-	-	1	2
		10	-	-	-	1

**Table 13**

Model Number EJ270		Starts Per Hour				
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	675	2	120	180	240	300
		5	40	60	100	120
		10	20	30	50	60
300%	810	2	40	80	120	160
		5	20	40	60	80
		10	12	20	30	40
400%	1080	2	20	40	80	120
		5	8	16	24	40
		10	4	8	12	20
500%	1350	2	10	20	40	60
		5	2	4	8	16
		10	-	2	6	12

**Table 8**

Model Number EJ068		Starts Per Hour				
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	170	2	40	80	120	240
		5	20	40	60	120
		10	8	20	30	40
300%	204	2	16	20	40	80
		5	8	16	30	40
		10	4	8	12	16
400%	272	2	4	8	12	16
		5	1	2	4	8
		10	-	1	2	4
500%	340	2	1	4	8	12
		5	-	1	2	4
		10	-	-	1	2

**Table 11**

Model Number EJ130		Starts Per Hour				
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	325	2	40	80	160	240
		5	10	20	40	80
		10	4	10	20	40
300%	390	2	10	20	40	80
		5	4	8	20	40
		10	2	4	10	20
400%	520	2	2	4	8	16
		5	1	2	4	8
		10	-	1	2	4
500%	650	2	1	3	8	16
		5	-	1	2	4
		10	-	-	1	2

**Table 14**

Model Number EJ390		Starts Per Hour				
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	975	2	60	90	120	180
		5	40	60	80	120
		10	20	30	40	60
300%	1170	2	40	60	80	120
		5	20	30	40	60
		10	10	15	20	30
400%	1560	2	10	20	40	60
		5	2	5	10	20
		10	-	1	4	6
500%	1950	2	5	10	20	30
		5	2	3	4	6
		10	-	-	1	2

Westinghouse Electric Corporation  
Distribution and Control Business Unit  
Electrical Components Division  
110 Douglas Road, P.O. Box 819  
Oldsmar, Florida, U.S.A. 34677

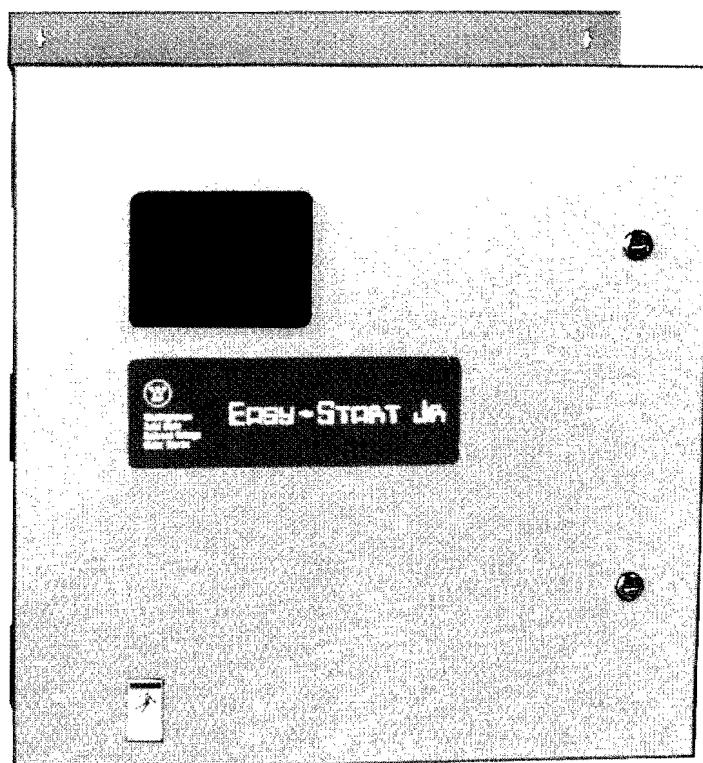
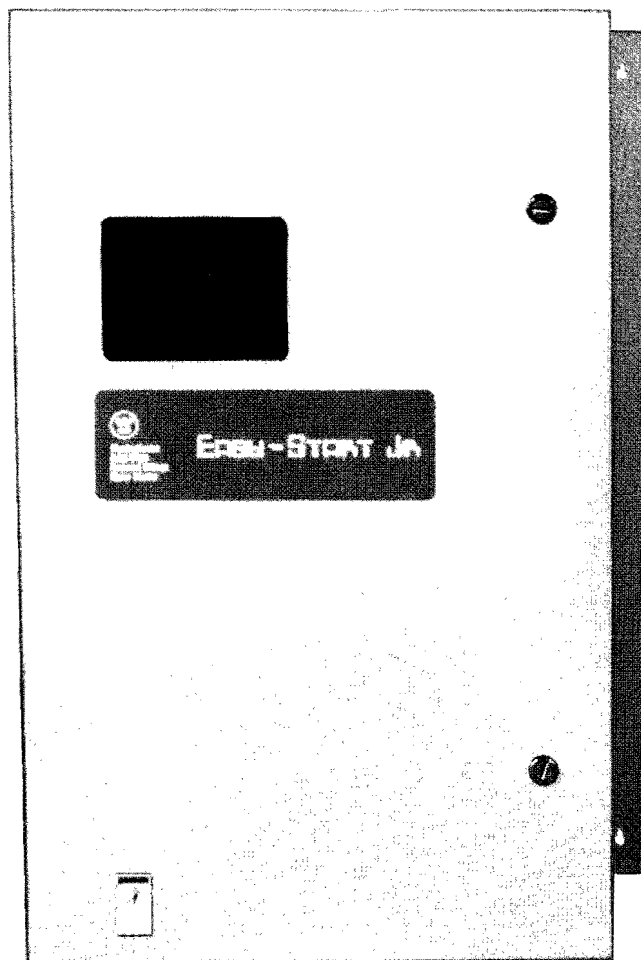


## **EASY-START JR Solid State Reduced Voltage Motor Starter**

The Easy-Start Jr. retains those features that most applications require and maintains the Tradition of Westinghouse Solid State Reduced Voltage Motor Starter quality and dependability.

The standard features of the Easy-Start Jr. include:

- Adjustable Current Limit 250-500%
- Energy Saving Circuit
- Six position device panel
- Class-10 electronic overload protection
- 500% overload for 10 seconds;  
100% continuous
- Dimensions allow for mounting in standard width motor control centers and the open panel design makes it conducive to OEM mounting applications.





## Easy-Start Jr. Solid State Reduced Voltage Motor Starter

### Easy-Start Jr. Specifications:

<b>Current Ratings:</b>	<u>NEMA-12 Enclosed</u>			<u>NEMA-1 Enclosed</u>	
	68 Amps				
	75 Amps			190 Amps	
	100 Amps			270 Amps	
	130 Amps				
<b>AC Line Voltage:</b>	208/230/460	+ 10%	- 15%	50/60 Hz	3-Phase
	380/415	+ 10%	- 15%	50/60 Hz	3-Phase
	500/575	+ 10%	- 15%	50/60 Hz	3-Phase
<b>Power Semiconductors:</b>	<u>Starter Voltage Rating:</u>			<u>Semiconductor Rating:</u>	
	208/230/460 VAC			1200 V	
	380/415 VAC			1200 V	
	500/575 VAC			1500 V	
<b>Overload Capacity:</b>	Continuous @ 100% of rating				
	30 seconds @ 250% of rating				
	10 seconds @ 500% of rating				
<b>Standard Adjustments:</b>	● Current Calibration Dip Switches				
	● Energy Saving On/Off Switch				
	● Initial Voltage Step: 20%-90%				
	● Voltage Ramp Time: 2 to 70 seconds				
	● Current Limit: 250%-500%				
<b>Motor Protection:</b>	Electronic overload current trip with inverse time trip curve equivalent to IEC class-10. See Figure 1.				
<b>Energy Saving:</b>	Standard on all models; the Easy-Start Jr. senses motor load and slip speed and adjusts the motor voltage to conserve power whenever the motor is lightly loaded.				
<b>Enclosure:</b>	NEMA-12 EJ068 ( 68 Amp)				
	EJ075 ( 75 Amp)		NEMA-1 EJ190 (190 Amp)		
	EJ100 (100 Amp)		EJ270 (270 Amp)		
	EJ130 (130 Amp)		EJ390 (390 Amp)①		
	Open Panel Available on all Models				
<b>Ambient Temperature:</b>	Operating Range -20 to +40°C				
<b>Phase Rotation Protection:</b>	Inhibits starting of motor unless input line is A-B-C rotation. LED on logic board indicates improper phase sequence.				
<b>Auxiliary Run Relay (K2):</b>	1 Form-C contact (rated 120 VAC, 3 Amps)				
<b>Alarm Relay (K1):</b>	N.O. Contact (rated 120 VAC, 1 Amp Resistive)				

① Consult factory for availability.

**WARNING:** This literature is a general description of the equipment only. For proper installation, operation and maintenance of the equipment, consult the Instruction Manual. This should not be considered all inclusive. Improperly installing and maintaining these products can result in death or serious personal injury. Before attempting installation or maintenance, read and understand all instructional materials related to the product. If further information is required, you should consult Westinghouse Electric Corporation.

Sale of the product discussed in this literature is subject to terms and conditions out-

lined in appropriate Westinghouse Electric Corporation selling policies. The sole source governing the rights and remedies of any purchaser of this equipment is the relevant Westinghouse selling policy.

**NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OR WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, ARE MADE REGARDING THE INFORMATION, RECOMMENDATIONS AND DESCRIPTIONS CONTAINED HEREIN.** In no event will Westinghouse be responsible to the purchaser or user in contract, in tort

(including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations and descriptions contained herein.



## Easy-Start Jr. Solid State Reduced Voltage Motor Starter

Features	What They Are	What They Do For You
* Current Limit	<ul style="list-style-type: none"><li>• 500% current limit for 10 seconds on all models</li><li>• Adjustable 250-500%</li></ul>	<ul style="list-style-type: none"><li>• Setting can be tailored to specific application</li><li>• Higher limit can be set for hard to start loads</li></ul>
* Energy Savings	<ul style="list-style-type: none"><li>• Reduces voltage applied to the motor if the motor is underloaded</li><li>• Can be defeated if desired</li></ul>	<ul style="list-style-type: none"><li>• Reduces power cost</li><li>• Flexibility</li></ul>
* 6 SCR Power Section	<ul style="list-style-type: none"><li>• Each leg has 2 SCRs</li><li>• SCR PIV (peak inverse voltage) 208 to 460V SCR – 1200 PIV 575V – 1500V PIV</li></ul>	<ul style="list-style-type: none"><li>• Better control and less motor heating than 3 SCR diode models.</li></ul>
* Digital Firing Circuit	<ul style="list-style-type: none"><li>• Digital trigger is used for firing</li></ul>	<ul style="list-style-type: none"><li>• Digital trigger output provides more balanced voltage to monitor</li><li>• Digital trigger responds faster to rapidly changing loads</li></ul>
* Current Calibration DIP Switches	<ul style="list-style-type: none"><li>• Each model covers a wide range of motor full load Amps 2.5:1 range</li></ul>	<ul style="list-style-type: none"><li>• Reduced distributor inventory</li><li>• Increased user/OEM flexibility</li><li>• Simple to adjust</li></ul>
* Potentiometer Adjustments for Current Limit, Initial Voltage Step and Ramp Time	<ul style="list-style-type: none"><li>• Adjustments that can be made to the starter to fit a wide range of applications and customer requirements.</li></ul>	<ul style="list-style-type: none"><li>• Better fit between starter and application</li><li>• Simple to adjust</li><li>• Flexibility</li></ul>
* Voltage Plugs	<ul style="list-style-type: none"><li>• Two voltage plugs shipped with each unit 208/230 volt with 460 volt, 380 with 415 volt and 500 with 575 volt</li></ul>	<ul style="list-style-type: none"><li>• Reduced distributor inventory</li><li>• Increased user/OEM flexibility</li><li>• Suitable for multiple line voltages</li></ul>
* Motor Control Center Mounting	<ul style="list-style-type: none"><li>• Fourteen inch panel width</li><li>• Six inch depth</li></ul>	<ul style="list-style-type: none"><li>• Allows two-high mounting in standard 20 inch width motor control centers up to 130 amp</li><li>• Minimizes motor control center structure investment</li><li>• Reduces need for valuable plant and panel mounting space</li></ul>
* Common Logic Board	<ul style="list-style-type: none"><li>• One logic board style for all ampere ratings within a specified voltage model</li></ul>	<ul style="list-style-type: none"><li>• Reduces spare parts inventory</li><li>• Increased user/OEM flexibility</li></ul>
* Phase Rotation LED	<ul style="list-style-type: none"><li>• Phase rotation LED on logic board illuminates whenever phase rotation is not correct</li></ul>	<ul style="list-style-type: none"><li>• Simplifies troubleshooting</li><li>• Handy for proper start-up</li></ul>
* Extended Acceleration Adjustments	<ul style="list-style-type: none"><li>• Voltage ramp up – adjustable from 2-70 seconds</li></ul>	<ul style="list-style-type: none"><li>• Allows soft starting of loads that required additional time to reach full speed when reducing the initial voltage</li></ul>
* Device Panel Standard on all Enclosed Units	<ul style="list-style-type: none"><li>• Plastic device panels have six knock-out positions for mounting pushbuttons, indicating lights and mini meters</li></ul>	<ul style="list-style-type: none"><li>• Easy field mounting of pilot devices</li><li>• Saves installation costs and time</li><li>• Conducive to distributor modification services</li></ul>
* High Line Voltage Control	<ul style="list-style-type: none"><li>• With energy saver circuit on, the Easy-Start Jr. will limit the voltage applied to the motor to controller's rated voltage under high-line conditions. Incoming voltage should be within the Easy-Start Jr.'s rating.</li></ul>	<ul style="list-style-type: none"><li>• Reduces power costs in installations with high-line voltage which are common in off-peak hours</li></ul>
* 120 Volt Control Connection	<ul style="list-style-type: none"><li>• Board mounted terminal strip</li></ul>	<ul style="list-style-type: none"><li>• Allows for interface with customer's 120 volt control devices</li><li>• Easy access for customer connections</li></ul>
* Smooth Stop Option	<ul style="list-style-type: none"><li>• Voltage ramp down – adjustable from 2-125 seconds</li></ul>	<ul style="list-style-type: none"><li>• Reduces the shock effect when stopping high friction loads</li><li>• Reduces water hammer in pumping applications</li></ul>



## Easy-Start Jr. Solid State Reduced Voltage Motor Starter

**Table 1: Easy-Start Jr. Standard Adjustments**

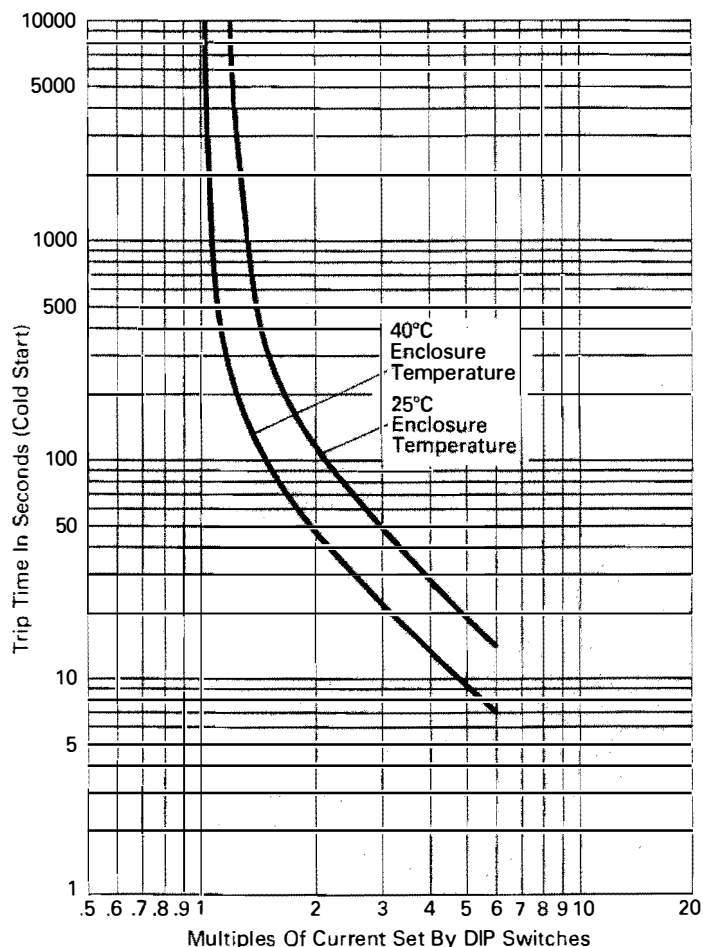
Adjustment	Range	Approximate Factory Setting/ Comments
Acceleration Time	2 to 70 seconds	20 seconds
Initial Voltage Step	20-90% of line voltage	40%
Current Limit	250-500% of Full Load Amp DIP Switch Setting	450%
Current Calibration DIP Switches	37% to 100% of current rating	Set in field for motor full load amps
Energy Saver Circuit	On/Off	On: DS1-5 open Off: DS1-5 closed
Voltage Rating Plug	230 or 460 volts 380 or 415 volts 500 or 575 volts	• 2 plugs supplied • install the one applicable to source voltage

**Table 2: Easy-Start Jr. Protective Features**

Function	Range and Description
Inverse-Time Overcurrent Trip	See time current curve class-10 protection (Figure 1)
Phase Rotation	Inhibits starting unless incoming line voltage is in A-B-C phase rotation (LED indication)
Current Limit	Adjustable 250-500% effective during starting only
DV/DT Protection	R-C snubber network

**Table 3: Easy-Start Jr. Standard Conditions for Application**

- Humidity: 20-95% non condensing
- Altitude: To 3300 feet (1000 meters)
- Ambient temperature operations: -20°C to +40°C (enclosed)  
-20°C to +50°C (open panel)
- AC control voltage 120V single phase 50/60 Hertz (approx. 50VA required) supplied externally by others, or by optional control power transformer.
- AC line voltage 208, 230, 380, 415, 460, 500 or 575 Volt. +10-15% 3-phase, 60 Hertz



**Figure 1. Easy-Start Jr. Overload Characteristics**



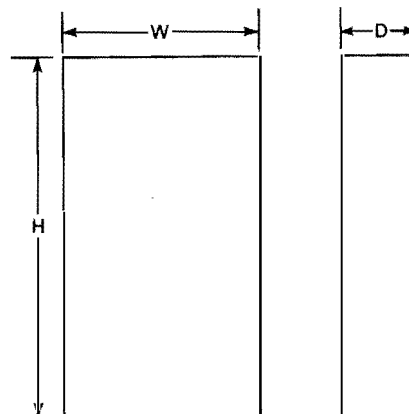


## Easy-Start Jr. Solid State Reduced Voltage Motor Starter

**Table 4: Dimensions and Weights**

*Approximate only. Not to be used for construction purposes.*

Catalog Number <sup>①</sup>	Enclosure <sup>②</sup>	Height <sup>⑤</sup> (inches)	Width <sup>⑤</sup> (inches)	Depth <sup>⑤</sup> (inches)	Weight (lbs.)
EJ068-XEP	Open <sup>③</sup>	15	14	8	26
EJ068-XER	NEMA 12	28.5	25.25	10.75	86
EJ075-XEP	Open <sup>③</sup>	15	14	8	26
EJ075-XER	NEMA 12	28.5	25.25	10.75	86
EJ100-XEP	Open <sup>③</sup>	15	14	8	26
EJ100-XER	NEMA 12	28.5	25.25	10.75	86
EJ130-XEP	Open <sup>③</sup>	27	14	8	40
EJ130-XER	NEMA 12	33.8	24.5	13	107
EJ190-XNP	Open <sup>④</sup>	39	26.75	14	100
EJ190-XNR	NEMA 1 <sup>④</sup>	46.38	30.87	15.5	220
EJ270-XNP	Open <sup>④</sup>	39	26.75	14	100
EJ270-XNR	NEMA 1 <sup>④</sup>	46.38	30.87	15.5	220
EJ390-XNP	Open <sup>④</sup>	39	26.75	14	110
EJ390-XNR	NEMA 1 <sup>④</sup>	46.38	30.87	15.5	230



① X in Catalog Number is '4' for 280/230/460 volt models, '3' for 380/415 volt models and '5' for 460/500/575 volt models.

② The starter must be mounted with the heat sink fins in the vertical position. A minimum clearance of six (6) inches on top and bottom is required for enclosed units and minimum clearances for open models will depend upon enclosure provided by others.

③ When mounting open panel starters, isolated heat sink fins should be brought out in open air through a properly gasketed cutout in the enclosure.

④ Heat sinks are non-isolated.

⑤ Refer to dimension sheets on pages 7-10 for detailed dimensions.

**Table 5: Model Selection Table**

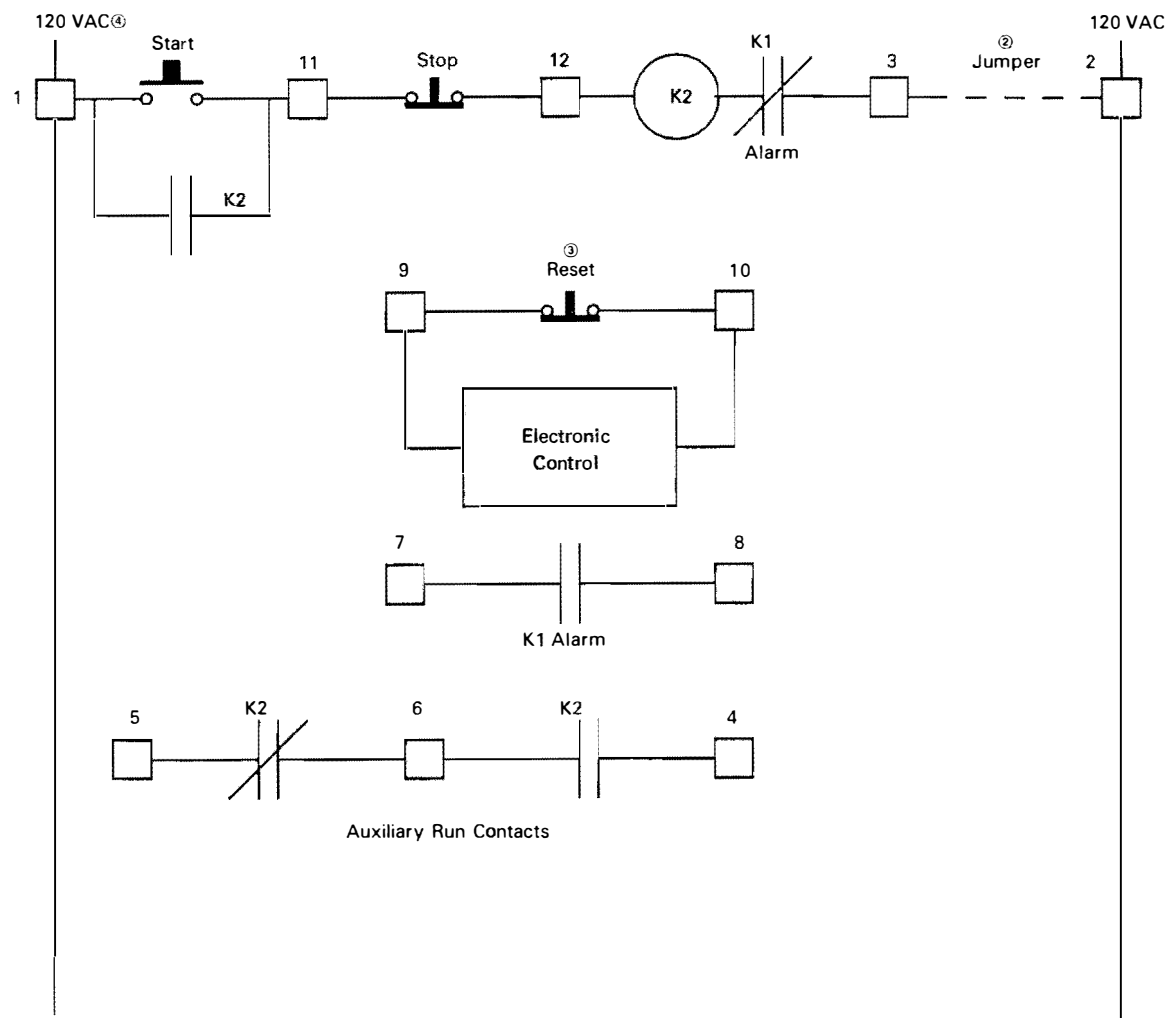
NEMA Starter Size	Open Panel	Enclosed	Amps	Volts	HP or Kw Ratings <sup>①</sup>				
					380V	208V	230V	460V	575V
3	EJ068-4EP	EJ068-4ER	68	208/230/460	30 Kw	20 HP	25 HP	50 HP	60 HP
	EJ068-3EP	EJ068-3ER	68	380/415					
	EJ068-5EP	EJ068-5ER	68	500/575					
3	EJ075-4EP	EJ075-4ER	75	208/230/460	37 Kw	20 HP	25 HP	60 HP	75 HP
	EJ075-3EP	EJ075-3ER	75	380/415					
	EJ075-5EP	EJ075-5ER	75	508/575					
4	EJ100-4EP	EJ100-4ER	100	208/230/460	50 Kw	30 HP	30 HP	75 HP	100 HP
	EJ100-3EP	EJ100-3ER	100	380/415					
	EJ100-5EP	EJ100-5ER	100	500/575					
4	EJ130-4EP	EJ130-4ER	130	208/230/460	55 Kw	40 HP	50 HP	100 HP	125 HP
	EJ130-3EP	EJ130-3ER	130	380/415					
	EJ130-5EP	EJ130-5ER	130	500/575					
5	EJ190-4NP	EJ190-4NR	190	208/230/460	90 Kw	60 HP	75 HP	150 HP	150 HP
	EJ190-3NP	EJ190-3NR	190	380/415					
	EJ190-5NP	EJ190-5NR	190	500/575					
5	EJ270-4NP	EJ270-4NR	270	208/230/460	110 Kw	75 HP	100 HP	200 HP	250 HP
	EJ270-3NP	EJ270-3NR	270	380/415					
	EJ270-5NP	EJ270-5NR	270	500/575					
5	EJ390-4NP	EJ390-4NR	390	208/230/460	200 Kw	125 HP	150 HP	300 HP	350 HP
	EJ390-3NP	EJ390-3NR	390	380/415					
	EJ390-5NP	EJ390-5NR	390	500/575					

● Ratings are for guidelines only, and may vary with motor design and construction.



## Easy-Start Jr. Solid State Reduced Voltage Motor Starter

Figure 2. Easy-Start Jr. Ladder Diagram—Operator Devices Supplied by Customer; Not Included with Standard Easy-Start Jr.

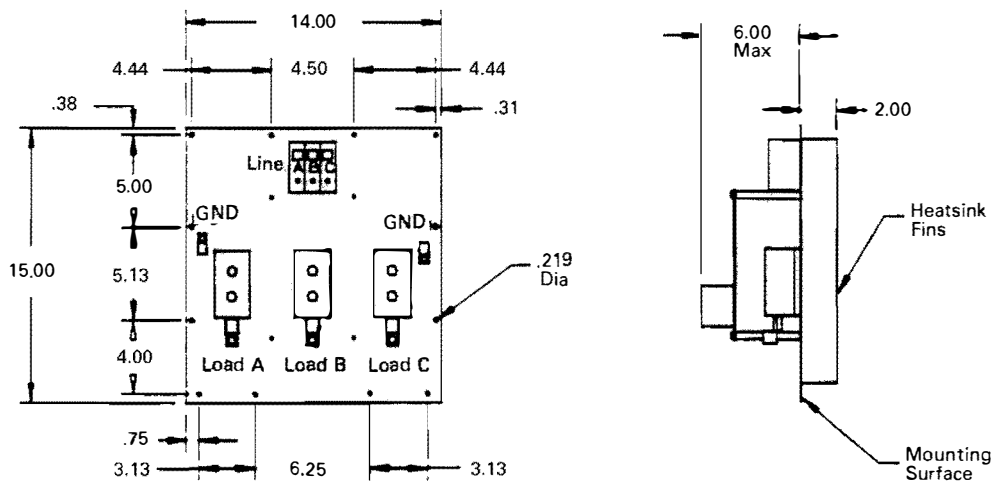


Notes:

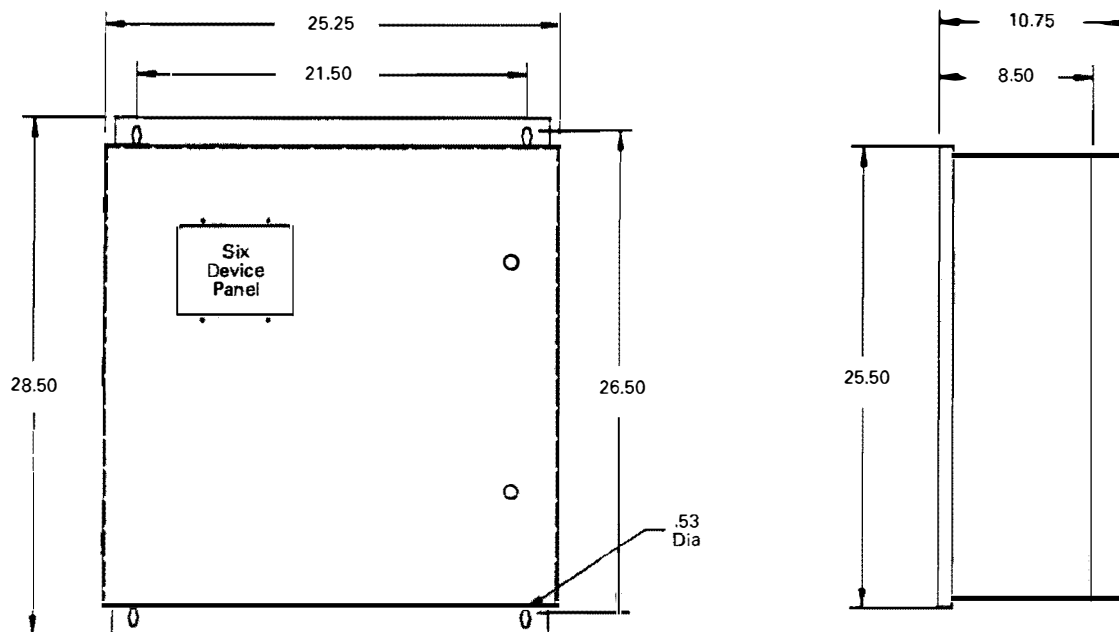
- ① indicates terminal block no. 12 on main logic board.
- ② - - - indicates jumper. This jumper can be replaced by overload/interlock devices.  
Factory installed thermostats are connected in place of the jumper on starters rated 190 amps and above.
- ③ Customer supplied contacts for reset should be dry type.
- ④ 120 volt supply must be provided by customer.



## Easy-Start Jr. Solid State Reduced Voltage Motor Starter



Dimension and Installation Open Panel – EJ068-EP, EJ075-EP, EJ100-EP



Notes:

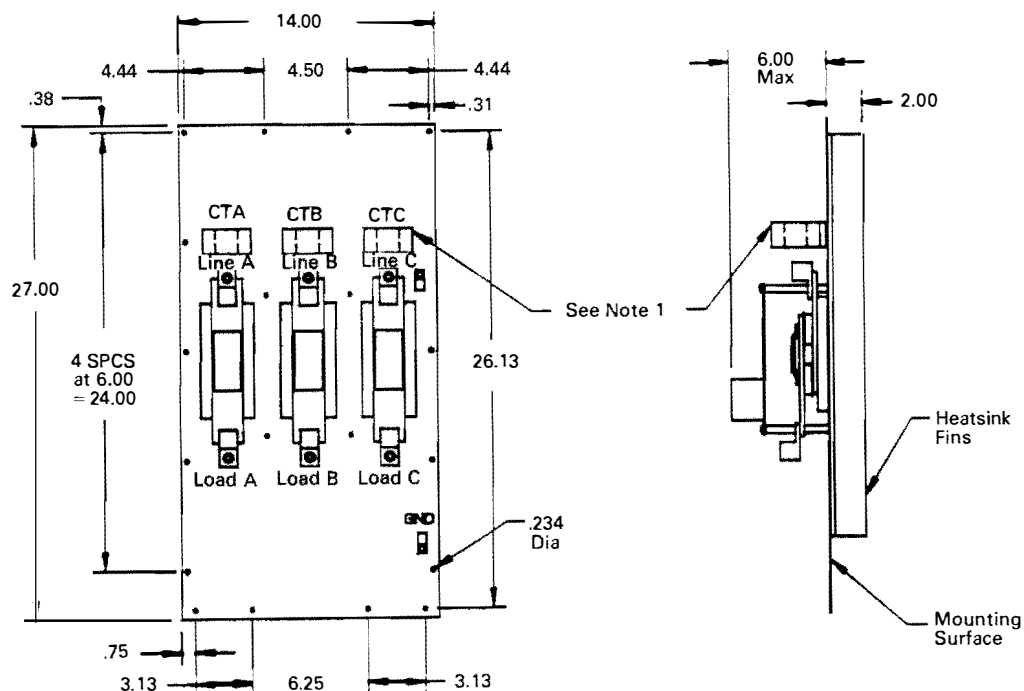
1. When mounting open panel starters, heat sink fins should be brought out in open air thru a properly gasketed cutout in the enclosure.
2. The starter must be mounted with the heat sink fins in the vertical position. A minimum clearance of 6 inches on top and bottom is required.

Field Wiring Lugs			Starter Weight Lbs
Model	Wire Gauge		
	Line/Load Lugs	Ground Lugs	
EJ068-EP	AWG14-1/0	AWG14-2	26
EJ068-ER	AWG14-1/0	AWG14-2	86
EJ075-EP	AWG14-1/0	AWG14-2	26
EJ075-ER	AWG14-1/0	AWG14-2	86
EJ100-EP	AWG14-1/0	AWG14-2	26
EJ100-ER	AWG14-1/0	AWG14-2	86

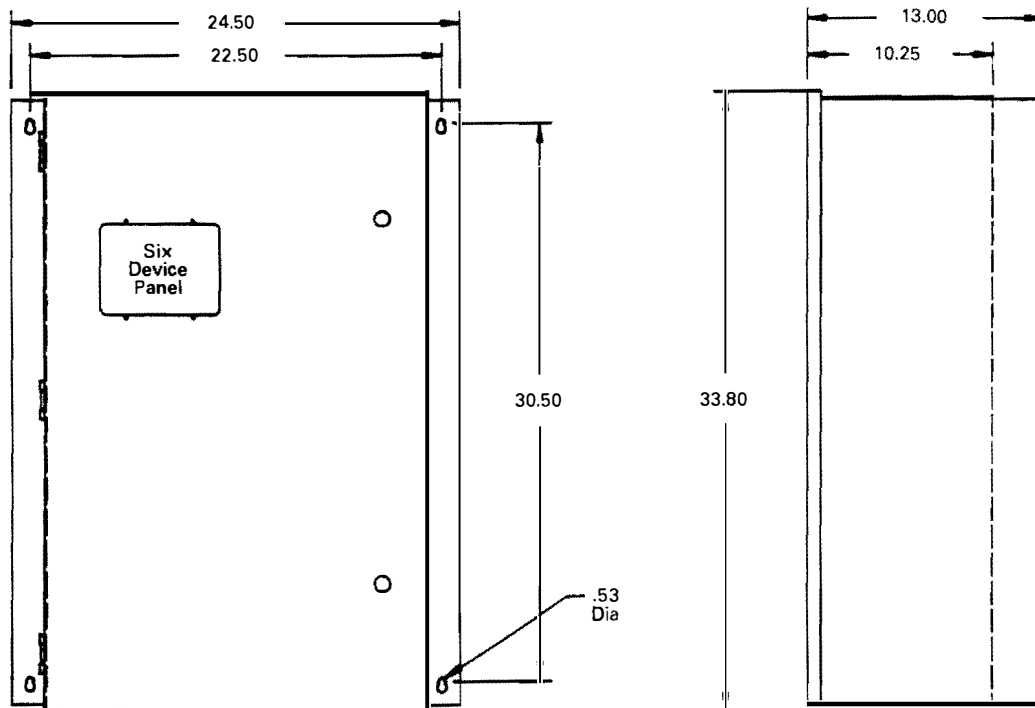
Dimension and Installation NEMA-12 Enclosure – EJ068-ER, EJ075-ER, EJ100-ER



## Easy-Start Jr. Solid State Reduced Voltage Motor Starter



Dimension and Installation Open Panel – EJ130-EP



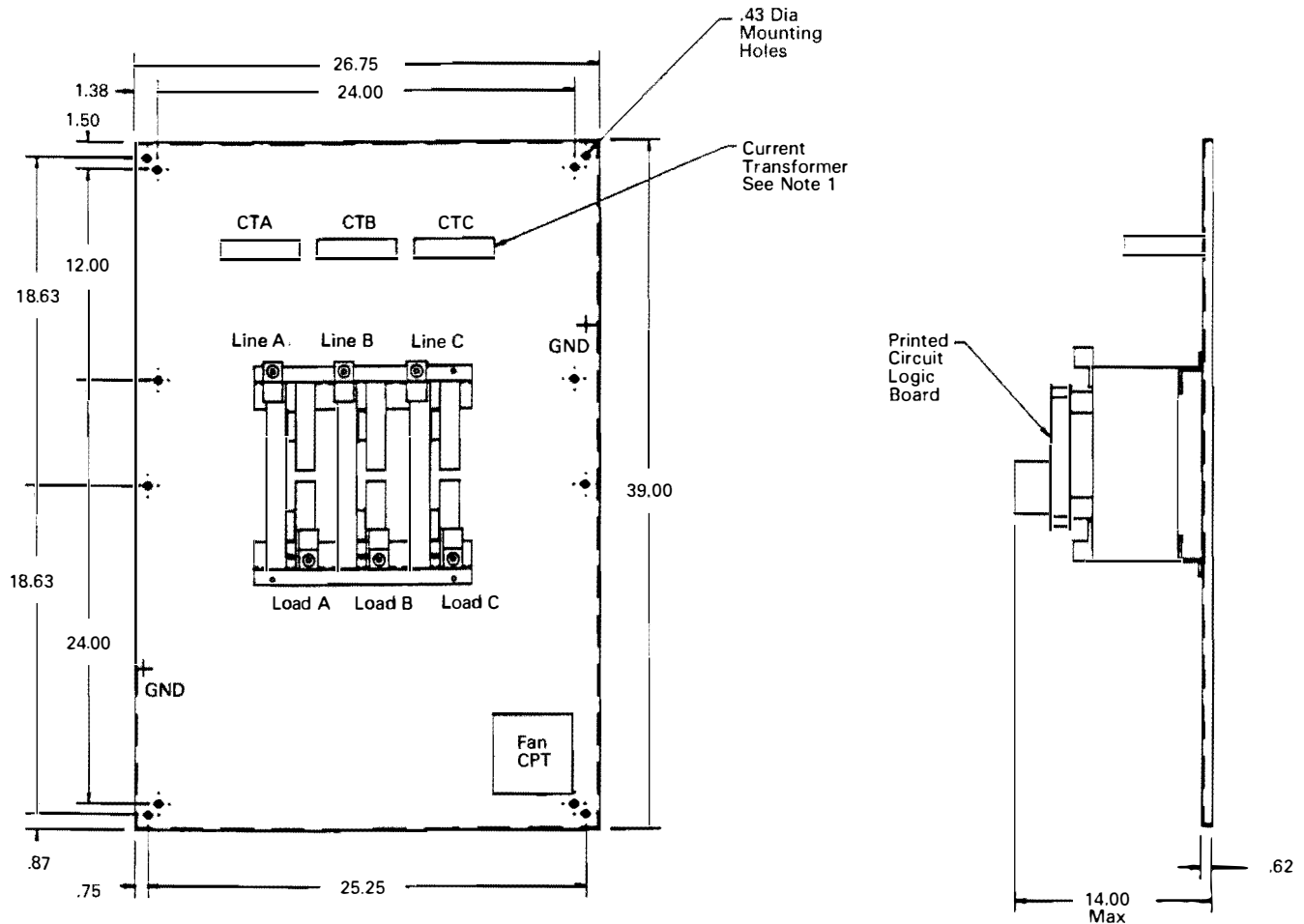
Notes:

1. Each incoming line cable must pass thru the corresponding current transformer.
2. When mounting open panel starters, heat sink fins should be brought out in open air thru a properly gasketed cutout in the enclosure.
3. The starter must be mounted with the heat sink fins in the vertical position. A minimum clearance of 6 inches on top and bottom is required.

Field Wiring Lugs			Starter Weight Lbs
Model	Wire Gauge		
	Line/Load Lugs	Ground Lugs	
EJ130-EP	AWG6-250MCM	AWG14-2	40
EJ130-ER	AWG6-250MCM	AWG14-2	107



## Easy-Start Jr. Solid State Reduced Voltage Motor Starter



**Notes:**

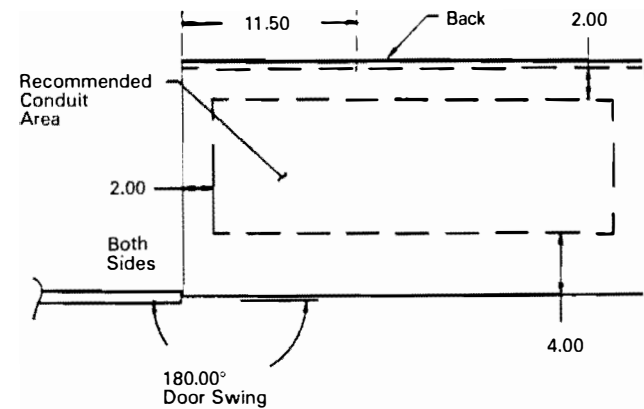
1. Each incoming line cable must pass thru the corresponding current transformer.
2. Panel should be mounted in a vertical position to provide proper cooling.
3. Heat sinks are non-isolated.

**Dimension and Installation Open Panel EJ190-\_NP, EJ270-\_NP**

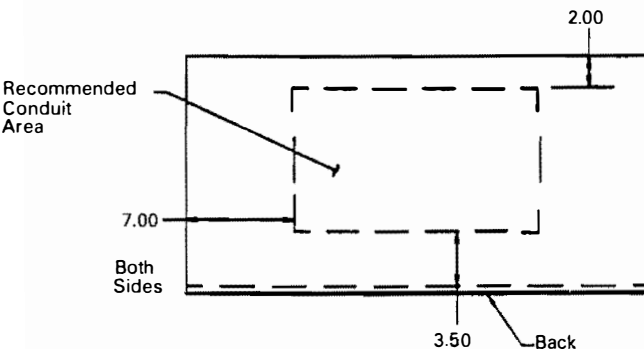
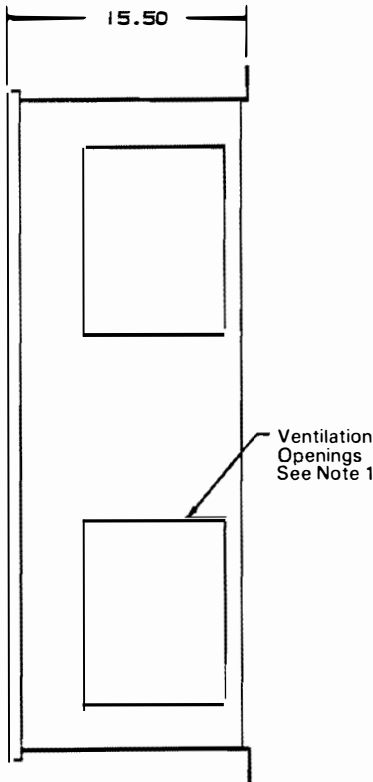
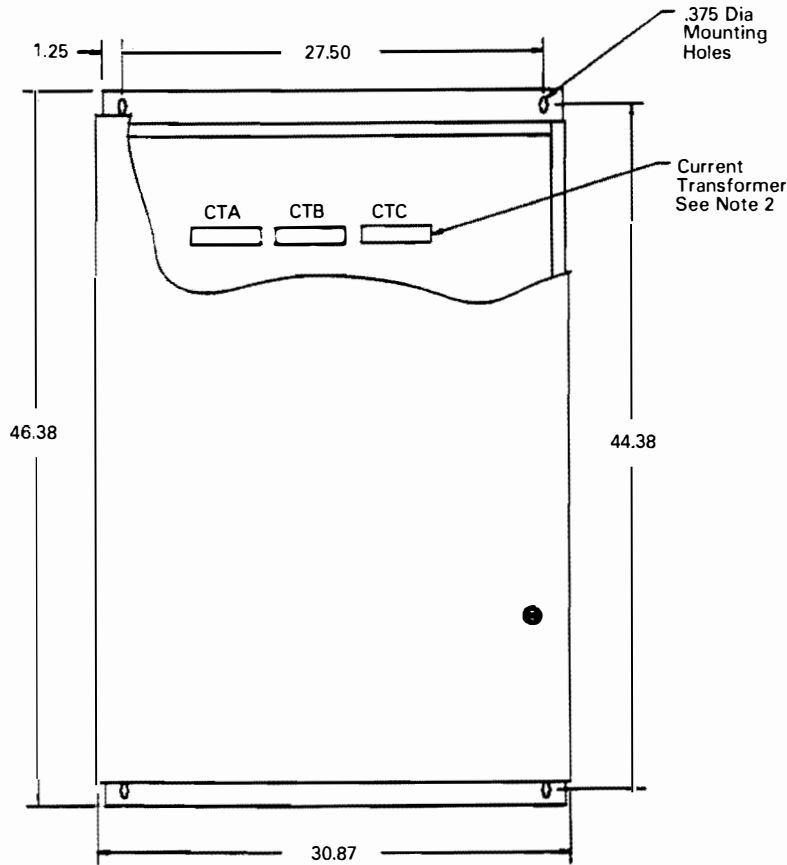
Field Wiring Lugs			Starter Weight Lbs
Model	Wire Gauge		
	Line/Load Lugs	Ground Lugs	
EJ190-_NP	AWG6-350MCM	AWG14-2/0	100
EJ270-_NP	AWG6-350MCM	AWG14-2/0	100



Easy-Start Jr. Solid State Reduced Voltage Motor Starter



- Notes:
- 1. Allow 12" minimum clearance from adjacent wall or next unit on each side for ventilation.
  - 2. Each incoming line cable must pass thru the corresponding current transformer.
  - 3. Heat sinks are non-isolated.



Field Wiring Lugs			Starter Weight Lbs
Model	Wire Gauge		
	Line/Load Lugs	Ground Lugs	
EJ190__NR	AWG6-350MCM	AWG14-2/0	220
EJ270__NR	AWG6-350MCM	AWG14-2/0	220

Dimension and Installation NEMA-1 Enclosure EJ190-NR, EJ270-NR



## Easy-Start Jr. Solid State Reduced Voltage Motor Starter

### Application Considerations

#### Installation

- Ventilated NEMA 1 enclosures should be mounted so that enough clearance is available for air to enter and exit the enclosure. Specific clearance requirements are shown on dimensions table.
- NEMA 12 enclosures should be mounted so that heat sink fins are vertical. For wall mounted units a minimum clearance of 6" on top and bottom is required.
- Open panel units should be mounted in a box so the temperature inside the box does not exceed 50°C (122°F).

For sizing the enclosure the heat loss in watts can be estimated at 3 times the full load current.

EXAMPLE: For EJ190 the maximum current rating is 190 amps. The approximate watts loss at maximum current rating is  $3 \times 190 = 570$  watts.

For units with non isolated heat sinks①, all the watt loss must be dissipated thru box surface.

For units with isolated heat sinks②; the heat sink fins should be brought out in open air thru a properly gasketed cut out in the enclosure. Approximately 50% watt loss is dissipated thru the heat sinks and the remaining 50% should be dissipated thru the remainder of the box surface, not counting the heat sink.

#### Ambient Temperature

Easy-Start Jr. is rated for 40°C (104°F) ambient temperature. For above 40°C derate by 5% for every 5°C rise over 40°C up to 50°C (122°F) max.

EXAMPLE: EJ190 is rated 190 amps @ 40°C. For 50°C the rating would be  $190 \times .9 = 171$  amps.

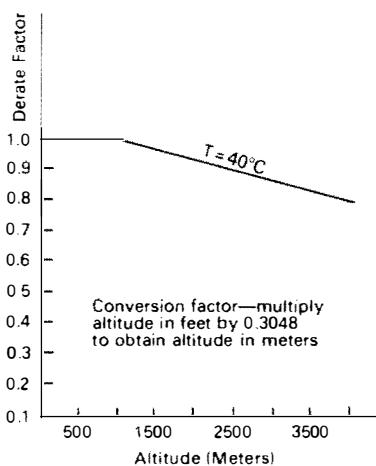
#### Altitude

Easy-Start Jr. is rated for 3300 ft. [1000 meters]. Use Derate Curve for derating above 3300 ft.

#### Multi-Motor Operation

Easy-Start Jr. can be used to control multiple motors if the following conditions are met:

- The current rating of Easy-Start Jr. should be equal to or greater than the total of individual motor full load amps and dip switches must be set for the cumulative full load amps of the motors.
- Individual motor overcurrent protection is provided by others.
- Energy Saver circuit should be turned OFF.



Derate Curve For Altitude

- The motors should not be mechanically coupled together, i.e. two motors on same shaft.
- NEC and local code requirement for individual motor protection and branch circuit protection are met.

#### Frequent Starting/Stopping

The number of starts and stops depends upon many factors. The most important ones are:

- Position of current limit potentiometer which can be anywhere from 250-500% of the current rating set by the DIP switches.
- Start time.
- Run time.
- Off time before next start.

The following tables (Table 6 thru Table 11, page 12) can be used for guidance in frequent starting/stopping applications. These tables are based on worst case condition that the controller will be running at the indicated starting current during the entire start time.

The number of starts per hour in the following tables is based on the current carrying capacity of the SCR's. If a high number of multiple starts is used, the starter may trip due to the inverse-time overload current protection function.

If a trip should occur, due to multiple starts, it is advisable to wait a period of 10 minutes before re-starting to avoid damage to the Easy-Start Jr.

The motor manufacturer should be consulted about the effect of a high number of multiple starts on motor life.

Zero off-time in the starts per hour tables indicates jog duty.

● Non-isolated heat sinks are indicated by suffix 'NP' or 'NR' at the end of the Easy-Start Jr. Catalog Number.

EXAMPLE: If an application requires 1 start per minute, 60 starts per hour, for a 460V, 50 HP, 70 Amp motor; the cycle time is 60 seconds between starts. Assume a start time of 5 seconds, at a starting current of 500% (350 amps) is needed, with an off-time between run and start of 12 seconds, and a run time of 43 seconds.

The percent off-time is therefore  $12/60 \times 100 = 20\%$ . We next look at the starts per hour tables on page 12 for a 75 amp starter (EJ075)①. We can see that the model EJ075 can do only 37 starts per hour at 375 amps with a start time of 5 seconds and an off-time of 20%.

Therefore, we need to use the next larger size starter, (EJ100) from the tables on page 12 we can see that 60 starts per hour are allowed at a starting current of 400 amps with a start time of 5 seconds and a 20% off-time, by using the model EJ100. Easy-Start Jr. may trip due to overcurrent if repeated starts at high current and long starting times are used.

#### Starting Torque

The reduced voltage applied to the motor results in reduced inrush current and soft start. However, it reduces the starting torque of the motor. The relationship is as follows:

$$\frac{\text{Torque at Reduced Current}}{\text{Torque at Full Current}} = \left[ \frac{\text{Current at Reduced Voltage}}{\text{Current at Full Voltage}} \right]^2$$

EXAMPLE: A 100 HP 1800 RPM 460V NEMA B motor draws six times full load amps for starting and starting torque is 150% of full load torque.

If the same motor is started with Easy-Start Jr. at 300% current limit.

$$\begin{aligned} \text{Starting Torque at 300\% Current Limit} &= \left[ \frac{300}{600} \right]^2 \times \text{starting torque at 600\% current} \\ &= 1/4 \times 150\% \text{ full load torque} = 37.5\% \text{ full load torque} \end{aligned}$$

#### NEMA Design C & D Motors

These motors are used due to their high starting torque characteristics. Therefore, these will not be a good application for reduced voltage starting.

#### Wound Rotor Motors

Wound rotor motors are generally used for high starting torque they can deliver. This again does not make them suitable for reduced voltage starter application.

It is not recommended that a wound rotor motor be started with reduced voltage starter with all the resistors shorted out.

● Isolated heat sinks are indicated by suffix 'EP' or 'ER' at the end of the Easy-Start Jr. Catalog Number.



## Easy-Start Jr. Solid State Reduced Voltage Motor Starter

**Table 6**

Model Number EJ068			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	170	2	185	247	330	494
		5	82	124	155	185
		10	41	62	72	84
		20	21	31	36	46
300%	204	2	124	206	247	330
		5	41	62	103	124
		10	21	31	41	62
		20	8	17	21	31
400%	272	2	62	124	165	206
		5	31	41	62	84
		10	12	21	31	41
		20	4	8	17	21
500%	340	2	41	82	124	144
		5	12	25	41	62
		10	4	8	17	21
		20	—	4	8	12

**Table 8**

Model Number EJ100			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	250	2	144	216	288	432
		5	84	108	144	180
		10	36	60	72	84
		20	18	24	30	36
300%	300	2	120	144	216	288
		5	48	72	96	120
		10	24	36	48	72
		20	12	19	24	29
400%	400	2	72	96	120	144
		5	36	48	60	72
		10	5	10	19	24
		20	—	2	10	14
500%	500	2	14	24	48	60
		5	10	14	24	29
		10	—	2	5	7
		20	—	—	1	2

**Table 10**

Model Number EJ190			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	475	2	105	168	252	315
		5	42	63	84	105
		10	21	32	47	63
		20	11	16	21	32
300%	570	2	84	126	189	231
		5	32	42	63	84
		10	13	21	32	42
		20	8	11	13	17
400%	760	2	42	63	95	126
		5	21	32	42	53
		10	8	13	17	21
		20	4	8	11	13
500%	950	2	25	42	84	105
		5	13	21	32	42
		10	4	8	13	17
		20	1	2	4	6

**Table 7**

Model Number EJ075			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	188	2	167	223	297	446
		5	74	112	140	167
		10	37	56	65	74
		20	19	28	33	42
300%	225	2	112	186	223	298
		5	37	56	93	112
		10	19	28	33	56
		20	7	15	19	28
400%	300	2	56	112	149	186
		5	28	37	56	74
		10	11	19	28	37
		20	4	7	15	19
500%	375	2	37	74	112	130
		5	11	22	37	56
		10	4	7	15	19
		20	—	4	7	11

**Table 9**

Model Number EJ130			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	325	2	130	194	259	389
		5	76	97	130	162
		10	32	54	65	86
		20	16	22	27	32
300%	390	2	108	130	194	259
		5	43	65	86	108
		10	22	32	43	54
		20	11	17	27	32
400%	520	2	65	86	108	130
		5	32	43	54	65
		10	4	9	17	22
		20	—	2	4	7
500%	650	2	13	22	43	54
		5	9	13	22	26
		10	1	2	4	7
		20	—	1	2	3

**Table 11**

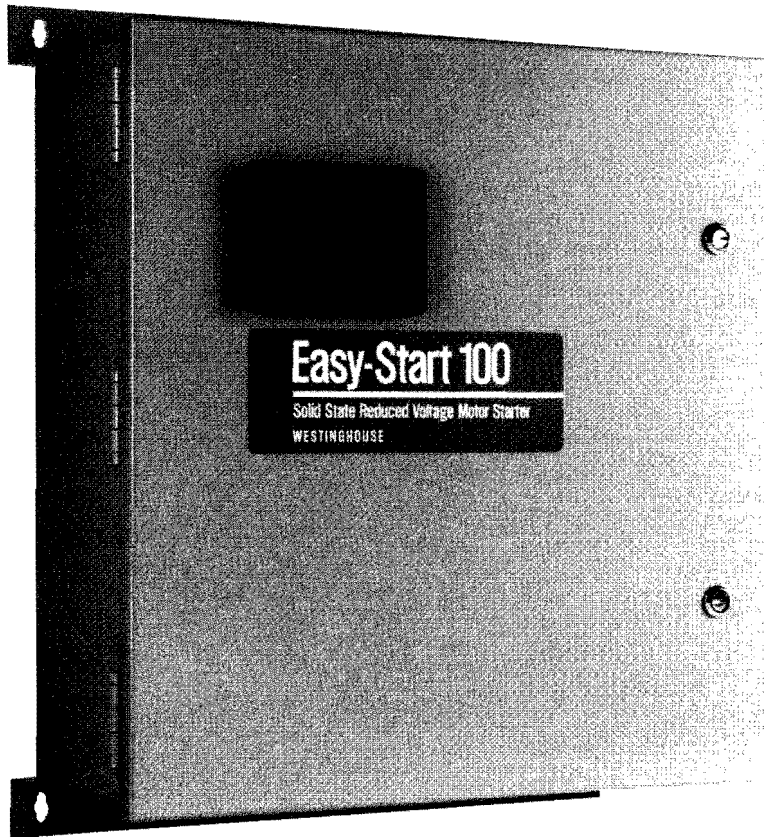
Model Number EJ270			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	675	2	125	187	250	312
		5	42	62	104	125
		10	21	31	52	62
		20	10	17	26	31
300%	810	2	62	125	166	229
		5	31	52	73	94
		10	13	21	31	42
		20	8	13	17	21
400%	1080	2	42	62	104	125
		5	21	31	42	52
		10	8	13	17	25
		20	4	8	13	17
500%	1350	2	21	42	62	83
		5	8	13	21	31
		10	4	8	13	17
		20	1	2	4	7

Westinghouse Electric Corporation  
Distribution and Control Business Unit  
Electrical Components Division  
Oldsmar, Florida, U.S.A. 34677





## Easy-Start 100 Solid State Reduced Voltage Motor Starter



The Easy-Start 100 retains those features that most applications require and maintains the Tradition of Westinghouse Solid State Reduced Voltage Motor Starter quality and dependability.

The standard features of the Easy-Start 100 include:

- Adjustable Current Limit 250-500%
- Energy Saving Circuit
- Six position device panel
- Class-10 electronic overload protection
- 500% overload for 10 seconds; 100% continuous
- Dimensions allow for mounting in standard width motor control centers and the open panel design makes it conducive to OEM mounting applications.





## Easy-Start 100 Solid State Reduced Voltage Motor Starter

### Easy-Start 100 Specifications:

<b>Current Ratings:</b>	<u>NEMA-12 Enclosed</u>			<u>NEMA-1 Enclosed</u>	
	26 Amps				
	52 Amps				
	68 Amps				
	75 Amps			190 Amps	
	100 Amps			270 Amps	
	130 Amps			390 Amps	
<b>AC Line Voltage:</b>	208/230/460	+ 10%	- 15%	50/60 Hz	3-Phase
	380/415	+ 10%	- 15%	50/60 Hz	3-Phase
	500/575	+ 10%	- 15%	50/60 Hz	3-Phase
<b>Power Semiconductors:</b>	<u>Starter Voltage Rating:</u>			<u>Semiconductor Rating:</u>	
	208/230/460 VAC			1200 V	
	380/415 VAC			1200 V	
	500/575 VAC			1500 V	
<b>Overload Capacity:</b>	Continuous @ 100% of rating				
	30 seconds @ 250% of rating				
	10 seconds @ 500% of rating				
<b>Standard Adjustments:</b>	● Current Calibration Dip Switches				
	● Energy Saving On/Off Switch				
	● Initial Voltage Step: 20%-90%				
	● Voltage Ramp Time: 2 to 70 seconds				
	● Current Limit: 250%-500%				
<b>Motor Protection:</b>	Electronic overload current trip with inverse time trip curve equivalent to IEC class-10. See Figure 1.				
<b>Energy Saving:</b>	Standard on all models; the Easy-Start 100 senses motor load and slip speed and adjusts the motor voltage to conserve power whenever the motor is lightly loaded.				
<b>UL and CSA Listed</b>	All units built to UL and CSA standards.				
<b>Enclosure:</b>	NEMA-12 EJ026 ( 26 Amp)				
	EJ052 ( 52 Amp)				
	EJ068 ( 68 Amp)				
	EJ075 ( 75 Amp)				
	EJ100 (100 Amp)				
	EJ130 (130 Amp)				
	NEMA-1 EJ190 (190 Amp)				
	EJ270 (270 Amp)				
	EJ390 (390 Amp)				
	Open Panel Available on all Models				
<b>Ambient Temperature:</b>	Operating Range - 20 to + 40°C				
<b>Phase Rotation Protection:</b>	Inhibits starting of motor unless input line is A-B-C rotation. LED on logic board indicates improper phase sequence.				
<b>Auxiliary Run Relay (K2):</b>	1 Form-C contact (rated 120 VAC, 3 Amps)				
<b>Alarm Relay (K1):</b>	N.O. Contact (rated 120 VAC, 1 Amp Resistive)				

**WARNING:** This literature is a general description of the equipment only. For proper installation, operation and maintenance of the equipment, consult the Instruction Manual. This should not be considered all inclusive. Improperly installing and maintaining these products can result in death or serious personal injury. Before attempting installation or maintenance, read and understand all instructional materials related to the product. If further information is required, you should consult Westinghouse Electric Corporation.

Sale of the product discussed in this literature is subject to terms and conditions out-

lined in appropriate Westinghouse Electric Corporation selling policies. The sole source governing the rights and remedies of any purchaser of this equipment is the relevant Westinghouse selling policy.

**NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OR WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, ARE MADE REGARDING THE INFORMATION, RECOMMENDATIONS AND DESCRIPTIONS CONTAINED HEREIN.** In no event will Westinghouse be responsible to the purchaser or user in contract, in tort

(including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations and descriptions contained herein.



## Easy-Start 100 Solid State Reduced Voltage Motor Starter

Features	What They Are	What They Do For You
● Current Limit	<ul style="list-style-type: none"><li>● 500% current limit for 10 seconds on all models</li><li>● Adjustable 250-500%</li></ul>	<ul style="list-style-type: none"><li>● Setting can be tailored to specific application</li><li>● Higher limit can be set for hard to start loads</li></ul>
● Energy Savings	<ul style="list-style-type: none"><li>● Reduces voltage applied to the motor if the motor is underloaded</li><li>● Can be defeated if desired</li></ul>	<ul style="list-style-type: none"><li>● Reduces power cost</li><li>● Flexibility</li></ul>
● 6 SCR Power Section	<ul style="list-style-type: none"><li>● Each leg has 2 SCRs</li><li>● SCR PIV (peak inverse voltage) 208 to 460V SCR – 1200 PIV 575V – 1500V PIV</li></ul>	<ul style="list-style-type: none"><li>● Better control and less motor heating than 3 SCR diode models.</li></ul>
● Digital Firing Circuit	<ul style="list-style-type: none"><li>● Digital trigger is used for firing</li></ul>	<ul style="list-style-type: none"><li>● Digital trigger output provides more balanced voltage to monitor</li><li>● Digital trigger responds faster to rapidly changing loads</li></ul>
● Current Calibration DIP Switches	<ul style="list-style-type: none"><li>● Each model covers a wide range of motor full load Amps 2.5:1 range</li></ul>	<ul style="list-style-type: none"><li>● Reduced distributor inventory</li><li>● Increased user/OEM flexibility</li><li>● Simple to adjust</li></ul>
● Potentiometer Adjustments for Current Limit, Initial Voltage Step and Ramp Time	<ul style="list-style-type: none"><li>● Adjustments that can be made to the starter to fit a wide range of applications and customer requirements.</li></ul>	<ul style="list-style-type: none"><li>● Better fit between starter and application</li><li>● Simple to adjust</li><li>● Flexibility</li></ul>
● Voltage Plugs	<ul style="list-style-type: none"><li>● Two voltage plugs shipped with each unit 208/230 volt and 460 volt, 380 and 415 volt, 500 and 575 volt</li></ul>	<ul style="list-style-type: none"><li>● Reduced distributor inventory</li><li>● Increased user/OEM flexibility</li><li>● Suitable for multiple line voltages</li></ul>
● Motor Control Center Mounting	<ul style="list-style-type: none"><li>● Fourteen inch panel width</li><li>● Six inch depth</li></ul>	<ul style="list-style-type: none"><li>● Allows two-high mounting in standard 20 inch width motor control centers up to 130 amp</li><li>● Minimizes motor control center structure investment</li><li>● Reduces need for valuable plant and panel mounting space</li></ul>
● Common Logic Board	<ul style="list-style-type: none"><li>● One logic board style for all ampere ratings within a specified voltage model</li></ul>	<ul style="list-style-type: none"><li>● Reduces spare parts inventory</li><li>● Increased user/OEM flexibility</li></ul>
● Phase Rotation LED	<ul style="list-style-type: none"><li>● Phase rotation LED on logic board illuminates whenever phase rotation is not correct</li></ul>	<ul style="list-style-type: none"><li>● Simplifies troubleshooting</li><li>● Handy for proper start-up</li></ul>
● Extended Acceleration Adjustments	<ul style="list-style-type: none"><li>● Voltage ramp up – adjustable from 2-70 seconds</li></ul>	<ul style="list-style-type: none"><li>● Allows soft starting of loads that required additional time to reach full speed when reducing the initial voltage</li></ul>
● Device Panel Standard on all Enclosed Units	<ul style="list-style-type: none"><li>● Plastic device panels have six knock-out positions for mounting pushbuttons, indicating lights and mini meters</li></ul>	<ul style="list-style-type: none"><li>● Easy field mounting of pilot devices</li><li>● Saves installation costs and time</li><li>● Conducive to distributor modification services</li></ul>
● High Line Voltage Control	<ul style="list-style-type: none"><li>● With energy saver circuit on, the Easy-Start 100 will limit the voltage applied to the motor to controller's rated voltage under high-line conditions. Incoming voltage should be within the Easy-Start 100's rating.</li></ul>	<ul style="list-style-type: none"><li>● Reduces power costs in installations with high-line voltage which are common in off-peak hours</li></ul>
● 120 Volt Control Connection	<ul style="list-style-type: none"><li>● Board mounted terminal strip</li></ul>	<ul style="list-style-type: none"><li>● Allows for interface with customer's 120 volt control devices</li><li>● Easy access for customer connections</li></ul>
● Smooth Stop Option	<ul style="list-style-type: none"><li>● Voltage ramp down – adjustable from 2-125 seconds</li></ul>	<ul style="list-style-type: none"><li>● Reduces the shock effect when stopping high friction loads</li><li>● Reduces water hammer in pumping applications</li></ul>



## Easy-Start 100 Solid State Reduced Voltage Motor Starter

**Table 1: Easy-Start 100 Standard Adjustments**

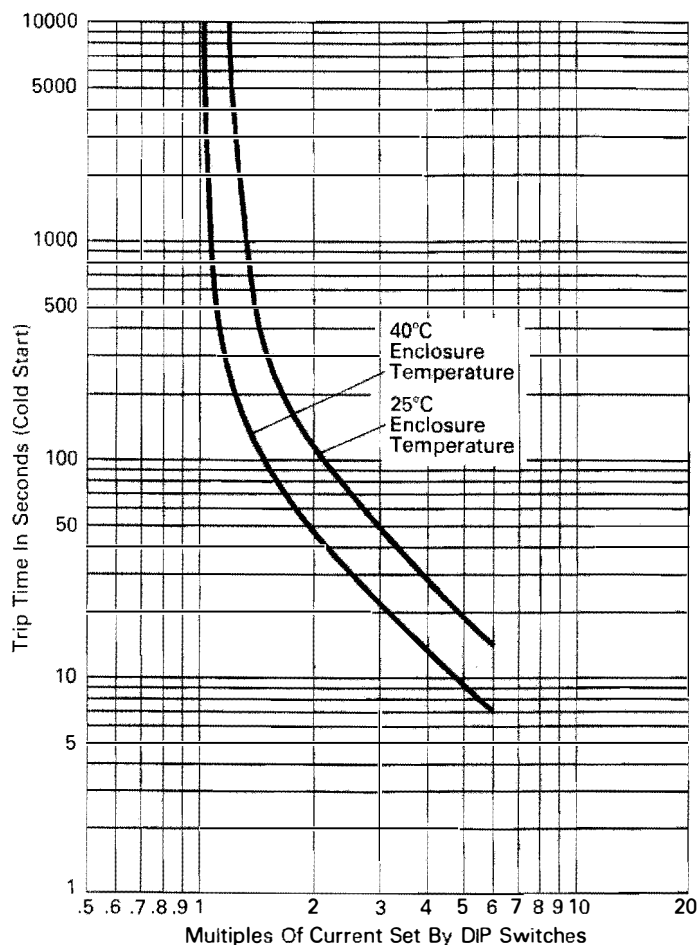
Adjustment	Range	Approximate Factory Setting/ Comments
Acceleration Time	2 to 70 seconds	2 seconds
Initial Voltage Step	20-90% of line voltage	40%
Current Limit	250-500% of Full Load Amp DIP Switch Setting	450%
Current Calibration DIP Switches	37% to 100% of current rating	Set in field for motor full load amps
Energy Saver Circuit	On/Off	On: DS1-5 open Off: DS1-5 closed
Voltage Rating Plug	230 or 460 volts 380 or 415 volts 500 or 575 volts	• 2 plugs supplied • install the one applicable to source voltage

**Table 2: Easy-Start 100 Protective Features**

Function	Range and Description
Inverse-Time Overcurrent Trip	See time current curve class-10 protection (Figure 1)
Phase Rotation	Inhibits starting unless incoming line voltage is in A-B-C phase rotation (LED indication)
Current Limit	Adjustable 250-500% effective during starting only
DV/DT Protection	R-C snubber network

**Table 3: Easy-Start 100 Standard Conditions for Application**

- Humidity: 20-95% non condensing
- Altitude: To 3300 feet (1000 meters)
- Ambient temperature operations: -20°C to +40°C (enclosed)  
-20°C to +50°C (open panel)
- AC control voltage 120V single phase 50/60 Hertz (approx. 50VA required) supplied externally by others, or by optional control power transformer.
- AC line voltage 208, 230, 380, 415, 460, 500 or 575 Volt. +10-15% 3-phase, 50/60 Hertz



**Figure 1. Easy-Start 100 Overload Characteristics**

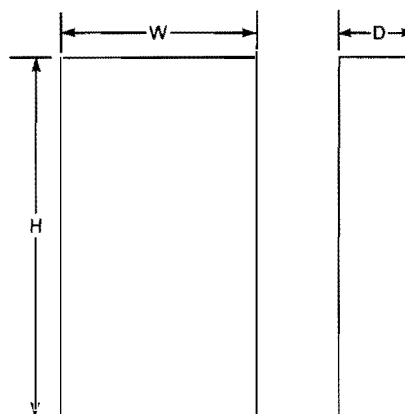


## Easy-Start 100 Solid State Reduced Voltage Motor Starter

**Table 4: Dimensions and Weights**

*Approximate only. Not to be used for construction purposes.*

Catalog Number●	Enclosure②	Height (inches)	Width (inches)	Depth (inches)	Weight (lbs.)
EJ026-_EP	Open③	15	14	8	22
EJ026-_ER	NEMA 12	17.6	13.5	10.75	35
EJ052-_EP	Open③	15	14	8	22
EJ052-_ER	NEMA 12	17.6	13.5	10.75	35
EJ068-_EP	Open③	15	14	8	26
EJ068-_ER	NEMA 12	28.5	25.25	10.75	86
EJ075-_EP	Open③	15	14	8	26
EJ075-_ER	NEMA 12	28.5	25.25	10.75	86
EJ100-_EP	Open③	15	14	8	26
EJ100-_ER	NEMA 12	28.5	25.25	10.75	86
EJ130-_EP	Open③	27	14	8	40
EJ130-_ER	NEMA 12	33.8	24.5	13	107
EJ190-_NP	Open④	39	26.75	14	100
EJ190-_NR	NEMA 1④	46.38	30.87	15.5	220
EJ190-_NC	Open④⑤	47.68	18.50	9.5	100
EJ270-_NP	Open④	39	26.75	14	100
EJ270-_NR	NEMA 1④	46.38	30.87	15.5	220
EJ270-_NC	Open④⑤	47.68	18.50	9.5	100
EJ390-_NP	Open④	39	26.75	14	110
EJ390-_NR	NEMA 1④	46.38	30.87	15.5	230
EJ390-_NC	Open④⑤	47.68	18.50	9.5	110



- ① \_in Catalog Number is '4' for 280/230/460 volt models, '3' for 380/415 volt models and '5' for 500/575 volt models.  
 ② The starter must be mounted with the heat sink fins in the vertical position. A minimum clearance of six (6) inches on top and bottom is required for enclosed units and minimum clearances for open models will depend upon enclosure provided by others.  
 ③ When mounting open panel starters, isolated heat sink fins should be brought out in open air through a properly gasketed cutout in the enclosure.  
 ④ Heat sinks are non-isolated.  
 ⑤ SlimLine Open Panel Design suitable for mounting in 20 inch wide MCC structure.

**Table 5: Model Selection Table**

NEMA Starter Size	Open Panel	Enclosed	Amps	Volts	HP or Kw Ratings⑥				
					380V	208V	230V	460V	575V
1	EJ026-4EP	EJ026-4ER	26	208/230/460	11 Kw	7.5 HP	7.5 HP	15 HP	25 HP
	EJ026-3EP	EJ026-3ER	26	380/415					
	EJ026-5EP	EJ026-5ER	26	500/575					
2	EJ052-4EP	EJ052-4ER	52	208/230/460	22 Kw	15 HP	15 HP	40 HP	50 HP
	EJ052-3EP	EJ052-3ER	52	380/415					
	EJ052-5EP	EJ052-5ER	52	500/575					
3	EJ068-4EP	EJ068-4ER	68	208/230/460	30 Kw	20 HP	25 HP	50 HP	60 HP
	EJ068-3EP	EJ068-3ER	68	380/415					
	EJ068-5EP	EJ068-5ER	68	500/575					
3	EJ075-4EP	EJ075-4ER	75	208/230/460	37 Kw	20 HP	25 HP	60 HP	75 HP
	EJ075-3EP	EJ075-3ER	75	380/415					
	EJ075-5EP	EJ075-5ER	75	500/575					
4	EJ100-4EP	EJ100-4ER	100	208/230/460	50 Kw	30 HP	30 HP	75 HP	100 HP
	EJ100-3EP	EJ100-3ER	100	380/415					
	EJ100-5EP	EJ100-5ER	100	500/575					
4	EJ130-4EP	EJ130-4ER	130	208/230/460	55 Kw	40 HP	50 HP	100 HP	125 HP
	EJ130-3EP	EJ130-3ER	130	380/415					
	EJ130-5EP	EJ130-5ER	130	500/575					
5	EJ190-4NP⑦	EJ190-4NR	190	208/230/460	90 Kw	60 HP	75 HP	150 HP	150 HP
	EJ190-3NP	EJ190-3NR	190	380/415					
	EJ190-5NP	EJ190-5NR	190	500/575					
5	EJ270-4NP⑦	EJ270-4NR	270	208/230/460	110 Kw	75 HP	100 HP	200 HP	250 HP
	EJ270-3NP	EJ270-3NR	270	380/415					
	EJ270-5NP	EJ270-5NR	270	500/575					
5	EJ390-4NP⑦	EJ390-4NR	390	208/230/460	200 Kw	125 HP	150 HP	300 HP	350 HP
	EJ390-3NP	EJ390-3NR	390	380/415					
	EJ390-5NP	EJ390-5NR	390	500/575					

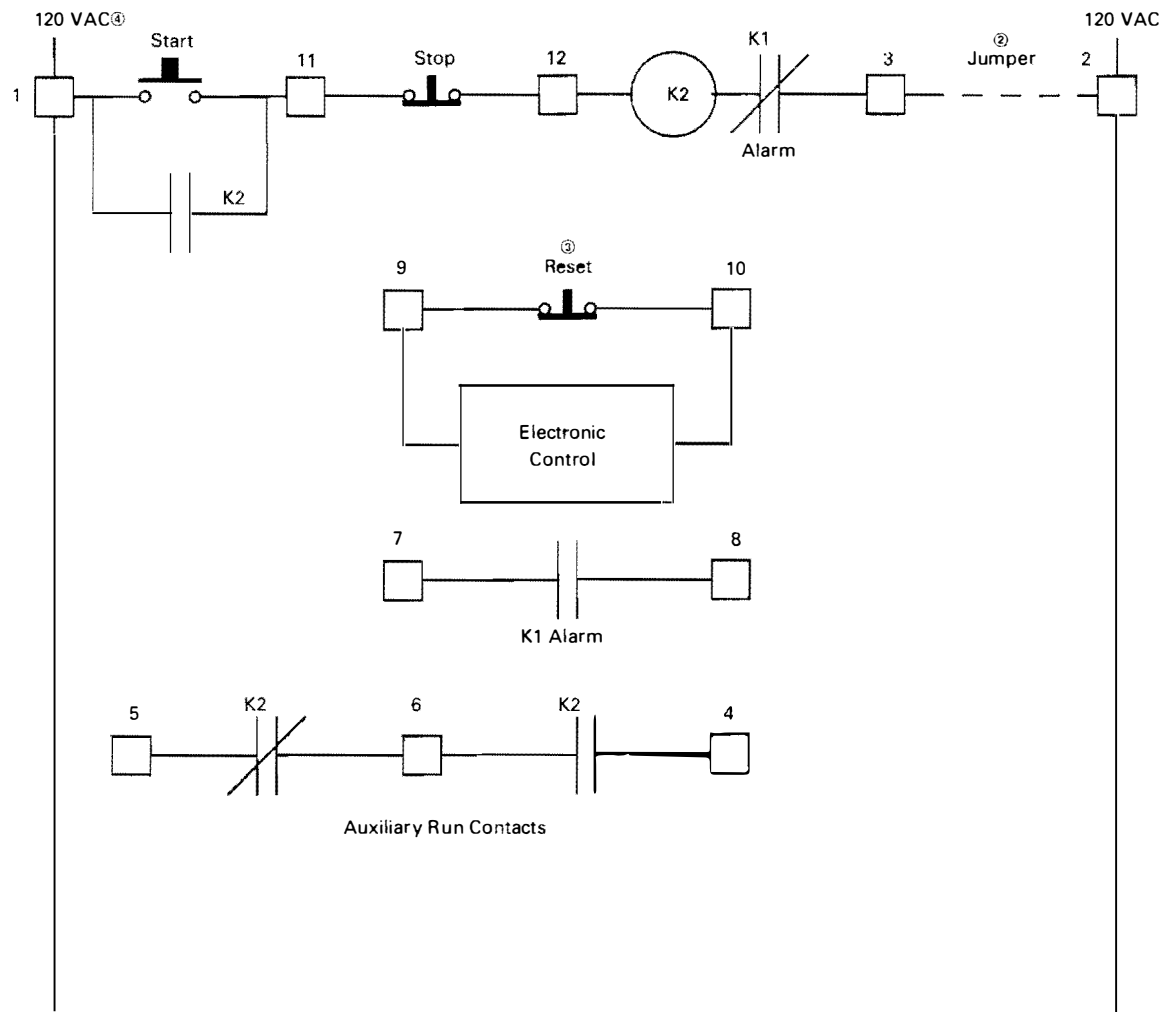
⑥ Ratings are for guidelines only, and may vary with motor design and construction.

⑦ These ratings also apply to the SlimLine Open Panel Design. Change "P" in suffix to "C".



## Easy-Start 100 Solid State Reduced Voltage Motor Starter

Figure 2. Easy-Start 100 Ladder Diagram—Operator Devices Supplied by Customer; Not Included with Standard Easy-Start 100



Notes:

- ① indicates terminal block no. 12 on main logic board.
- ② - - - indicates jumper. This jumper can be replaced by overload/interlock devices.  
Factory installed thermostats are connected in place of the jumper on starters rated 190 amps and above.
- ③ Customer supplied contacts for reset should be dry type.
- ④ 120 volt supply must be provided by customer.



## Easy-Start 100 Solid State Reduced Voltage Motor Starter

### Application Considerations

#### Installation

- A. Ventilated NEMA 1 enclosures should be mounted so that enough clearance is available for air to enter and exit the enclosure. Specific clearance requirements are shown on dimensions table.
- B. NEMA 12 enclosures should be mounted so that heat sink fins are vertical. For wall mounted units a minimum clearance of 6" on top and bottom is required.
- C. Open panel units should be mounted in a box so the temperature inside the box does not exceed **50°C (122°F)**.

For sizing the enclosure the heat loss in watts can be estimated at 3 times the full load current.

**EXAMPLE:** For EJ190 the maximum current rating is 190 amps. The approximate watts loss at maximum current rating is  $3 \times 190 = 570$  watts.

For units with non isolated heat sinks①, all the watt loss must be dissipated thru box surface.

For units with isolated heat sinks②, the heat sink fins should be brought out in open air thru a properly gasketed cut out in the enclosure. Approximately 50% watt loss is dissipated thru the heat sinks and the remaining 50% should be dissipated thru the remainder of the box surface, not counting the heat sink.

#### Ambient Temperature

Easy-Start 100 is rated for 40°C (104°F) ambient temperature. For above 40°C derate by 5% for every 5°C rise over 40°C up to 50°C (122°F) max.

**EXAMPLE:** EJ190 is rated 190 amps @ 40°C. For 50°C the rating would be  $190 \times .9 = 171$  amps.

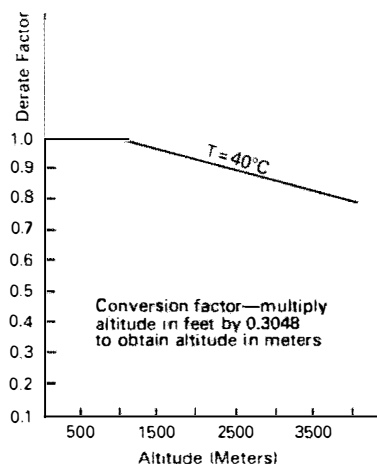
#### Altitude

Easy-Start 100 is rated for 3300 ft. [1000 meters]. Use Derate Curve for derating above 3300 ft.

#### Multi-Motor Operation

Easy-Start 100 can be used to control multiple motors if the following conditions are met:

- The current rating of Easy-Start 100 should be equal to or greater than the total of individual motor full load amps and dip switches must be set for the cumulative full load amps of the motors.
- Individual motor overcurrent protection is provided by others.
- Energy Saver circuit should be turned OFF.



Derate Curve For Altitude

- The motors should not be mechanically coupled together, i.e. two motors on same shaft.
- NEC and local code requirement for individual motor protection and branch circuit protection are met.

#### Frequent Starting/Stopping

The number of starts and stops depends upon many factors. The most important ones are:

1. Position of current limit potentiometer which can be anywhere from 250-500% of the current rating set by the DIP switches.
2. Start time.
3. Run time.
4. Off time before next start.

The following tables (Table 6 thru Table 14, page 8) can be used for guidance in frequent starting/stopping applications. These tables are based on worst case condition that the controller will be running at the indicated starting current during the entire start time.

The number of starts per hour in the following tables is based on the current carrying capacity of the SCR's. If a high number of multiple starts is used, the starter may trip due to the inverse-time overload current protection function.

If a trip should occur, due to multiple starts, it is advisable to wait a period of 10 minutes before re-starting to avoid damage to the Easy-Start 100.

The motor manufacturer should be consulted about the effect of a high number of multiple starts on motor life.

Zero off-time in the starts per hour tables indicates jog duty.

① Non-Isolated heat sinks are indicated by suffix 'NC', 'NP' or 'NR' at the end of the Easy-Start 100 Catalog Number.

**EXAMPLE:** If an application requires 1 start per minute, 60 starts per hour, for a 460V, 50 HP, 70 Amp motor; the cycle time is 60 seconds between starts. Assume a start time of 5 seconds, at a starting current of 500% (350 amps) is needed, with an off-time between run and start of 12 seconds, and a run time of 43 seconds.

The percent off-time is therefore  $12/60 \times 100 = 20\%$ . We next look at the starts per hour tables on page 12 for a 75 amp starter (EJ075)①. We can see that the model EJ075 can do only 37 starts per hour at 375 amps with a start time of 5 seconds and an off-time of 20%.

Therefore, we need to use the next larger size starter, (EJ100) from the tables on page 12 we can see that 60 starts per hour are allowed at a starting current of 400 amps with a start time of 5 seconds and a 20% off-time, by using the model EJ100. Easy-Start 100 may trip due to overcurrent if repeated starts at high current and long starting times are used.

#### Starting Torque

The reduced voltage applied to the motor results in reduced inrush current and soft start. However, it reduces the starting torque of the motor. The relationship is as follows:

$$\frac{\text{Torque at Reduced Current}}{\text{Torque at Full Current}} = \left[ \frac{\text{Current at Reduced Voltage}}{\text{Current at Full Voltage}} \right]^2$$

**EXAMPLE:** A 100 HP 1800 RPM 460V NEMA B motor draws six times full load amps for starting and starting torque is 150% of full load torque.

If the same motor is started with Easy-Start 100 at 300% current limit.

$$\begin{aligned} \text{Starting Torque at 300\% Current Limit} &= \left[ \frac{300}{600} \right]^2 \times \text{starting torque at 600\% current} \\ &= 1/4 \times 150\% \text{ full load torque} = 37.5\% \text{ full load torque} \end{aligned}$$

#### NEMA Design C & D Motors

These motors are used due to their high starting torque characteristics. Therefore, these will not be a good application for reduced voltage starting.

#### Wound Rotor Motors

Wound rotor motors are generally used for high starting torque they can deliver. This again does not make them suitable for reduced voltage starter application.

It is not recommended that a wound rotor motor be started with reduced voltage starter with all the resistors shorted out.

② Isolated heat sinks are indicated by suffix 'EP' or 'ER' at the end of the Easy-Start 100 Catalog Number.



## Easy-Start 100 Solid State Reduced Voltage Motor Starter

**Table 6**

Model Number EJ026			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	65	2	40	60	80	100
		5	20	30	40	50
		10	10	15	20	25
300%	78	2	30	40	60	80
		5	15	20	30	40
		10	10	15	20	25
400%	104	2	12	16	20	24
		5	6	8	10	12
		10	4	6	8	10
500%	130	2	4	6	8	12
		5	2	4	6	8
		10	—	—	2	4

**Table 9**

Model Number EJ075			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	188	2	167	223	297	446
		5	74	112	140	167
		10	37	56	65	74
300%	225	2	112	186	223	298
		5	37	56	93	112
		10	19	28	33	56
400%	300	2	56	112	149	186
		5	28	37	56	74
		10	11	19	28	37
500%	375	2	37	74	112	130
		5	11	22	37	56
		10	4	7	15	19

**Table 12**

Model Number EJ190			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	475	2	105	168	252	315
		5	42	63	84	105
		10	21	32	47	63
300%	570	2	84	126	189	231
		5	32	42	63	84
		10	13	21	32	42
400%	760	2	42	63	95	126
		5	21	32	42	53
		10	8	13	17	21
500%	950	2	25	42	84	105
		5	13	21	32	42
		10	4	8	13	17

**Table 7**

Model Number EJ052			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	130	2	30	40	70	140
		5	20	30	40	60
		10	12	16	24	30
300%	156	2	20	30	60	80
		5	15	20	30	60
		10	10	15	20	30
400%	208	2	10	12	16	20
		5	4	8	12	16
		10	2	4	6	8
500%	260	2	4	6	8	12
		5	2	3	4	6
		10	—	—	1	2

**Table 10**

Model Number EJ100			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	250	2	144	216	288	432
		5	84	108	144	180
		10	36	60	72	84
300%	300	2	120	144	216	288
		5	48	72	96	120
		10	24	36	48	72
400%	400	2	72	96	120	144
		5	36	48	60	72
		10	5	10	19	24
500%	500	2	14	24	48	60
		5	10	14	24	29
		10	—	2	5	7

**Table 13**

Model Number EJ270			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	675	2	125	187	250	312
		5	42	62	104	125
		10	21	31	52	62
300%	810	2	62	125	166	229
		5	31	52	73	94
		10	13	21	31	42
400%	1080	2	42	62	104	125
		5	21	31	42	52
		10	8	13	17	25
500%	1350	2	21	42	62	83
		5	8	13	21	31
		10	4	8	13	17

**Table 8**

Model Number EJ068			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	170	2	185	247	330	494
		5	82	124	155	185
		10	41	62	72	84
300%	204	2	124	206	247	330
		5	41	62	103	124
		10	21	31	41	62
400%	272	2	62	124	165	206
		5	31	41	62	84
		10	12	21	31	41
500%	340	2	41	82	124	144
		5	12	25	41	62
		10	4	8	17	21

**Table 11**

Model Number EJ130			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	325	2	130	194	259	389
		5	76	97	130	162
		10	32	54	65	86
300%	390	2	108	130	194	259
		5	43	65	86	108
		10	22	32	43	54
400%	520	2	65	86	108	130
		5	32	43	54	65
		10	4	9	17	22
500%	650	2	13	22	43	54
		5	9	13	22	26
		10	1	2	4	7

**Table 14**

Model Number EJ390			Starts Per Hour			
Curr. Lim.	Starting Current AC Amps	Start Time Sec.	Percent Off-Time			
			0%	10%	20%	30%
250%	975	2	60	90	120	180
		5	20	30	40	60
		10	10	15	20	30
300%	1170	2	40	60	90	120
		5	20	30	60	90
		10	10	15	30	40
400%	1560	2	10	20	40	60
		5	2	5	10	20
		10	—	1	4	6
500%	1950	2	5	10	20	30
		5	2	3	4	6
		10	—	—	1	2

Westinghouse Electric Corporation  
Distribution and Control Business Unit  
Electrical Components Division  
110 Douglas Road, P.O. Box 819  
Oldsmar, Florida, U.S.A. 34677