





## Energy Efficiency

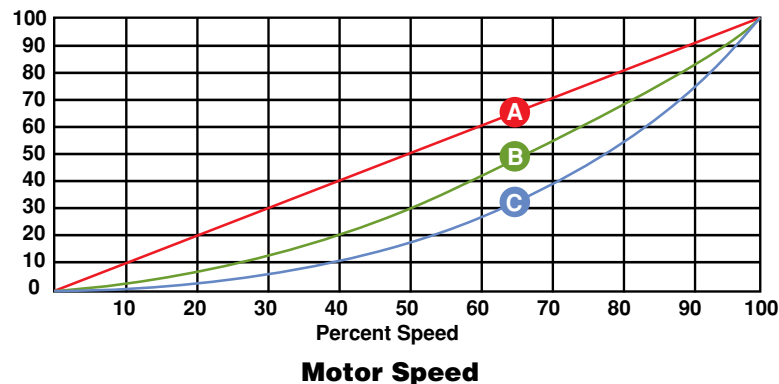
Square D E-Flex enclosed drive controllers can increase system energy efficiency by providing a means to reduce the motor speed of HVAC equipment based on the needs of the building environment (lower motor speed = lower energy costs).

Energy savings can be realized because of the Affinity laws of physics:

- Flow = f (motor speed)\*
- Pressure = f (motor speed)<sup>2</sup>
- Horsepower = f (motor speed)<sup>3</sup>

A motor running at 50% of full speed capacity has a motor torque of 25% of full speed. In addition, electricity required to operate the motor at 50% of full speed is 12.5% of the amount of electricity required if the motor was running at 100% full speed capacity. Thus, reducing motor speed can significantly reduce the electrical energy consumption.

Percent Flow, HP, Pressure



- A** = Flow as a function of motor speed
- B** = Pressure as a function of motor speed
- C** = Horsepower as a function of motor speed

### An Example Energy Saving Calculation\*\*

A fan with a 20 horsepower motor supplies air 10 hours a day for 260 days a year and the energy cost is \$0.10 cents per kilowatt-hour.

#### Cost of running full speed:

$$20 \text{ hp} \times 0.746 \text{ kW/hp} \times 2600 \text{ hours} \times \$0.10/\text{kWhr} = \mathbf{\$3879.20}$$

Assuming the fan does not need to run at full speed all of the time, let's use an example of:

- Running full speed (100%) for 25% of the time
- 80% speed for 50% of the time
- 60% speed for the remaining 25% of the time

#### Cost of running with an AC drive controlling the motor:

$$20 \text{ hp} \times (1)^3 \times 0.746 \text{ kW/hp} \times 650 \text{ hours} \times \$0.10/\text{kWhr} = \$969.80$$

$$20 \text{ hp} \times (0.8)^3 \times 0.746 \text{ kW/hp} \times 1300 \text{ hours} \times \$0.10/\text{kWhr} = \$993.08$$

$$20 \text{ hp} \times (0.6)^3 \times 0.746 \text{ kW/hp} \times 650 \text{ hours} \times \$0.10/\text{kWhr} = \$209.48$$

$$\mathbf{Total = \$2172.36}$$

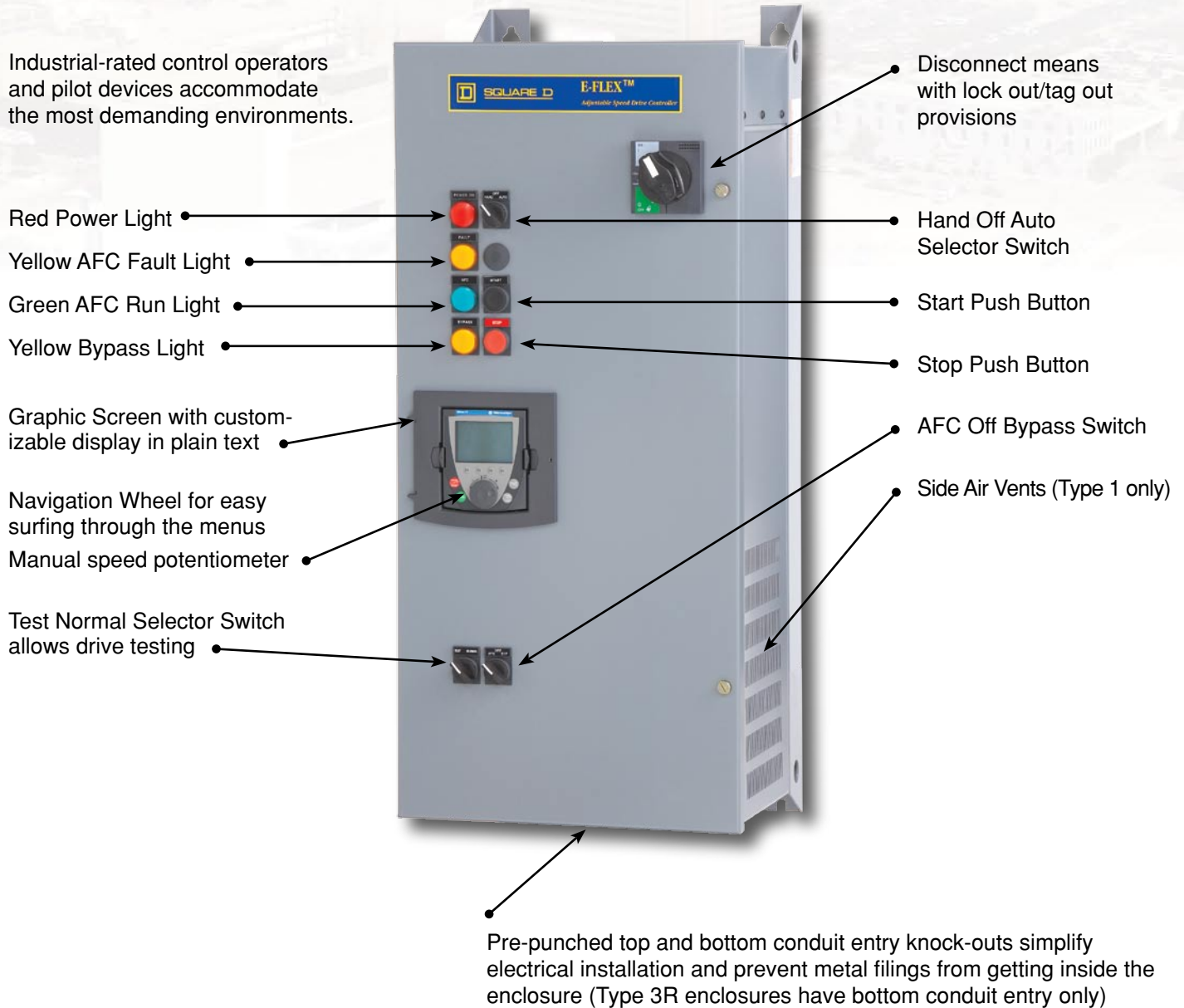
#### Annual savings: \$3879.20 - \$2172.36 = \$1706.84

- In many instances, the payback period for using an adjustable frequency drive in place of other flow control methods is less than 18 months.

\* Flow as a function of motor speed.

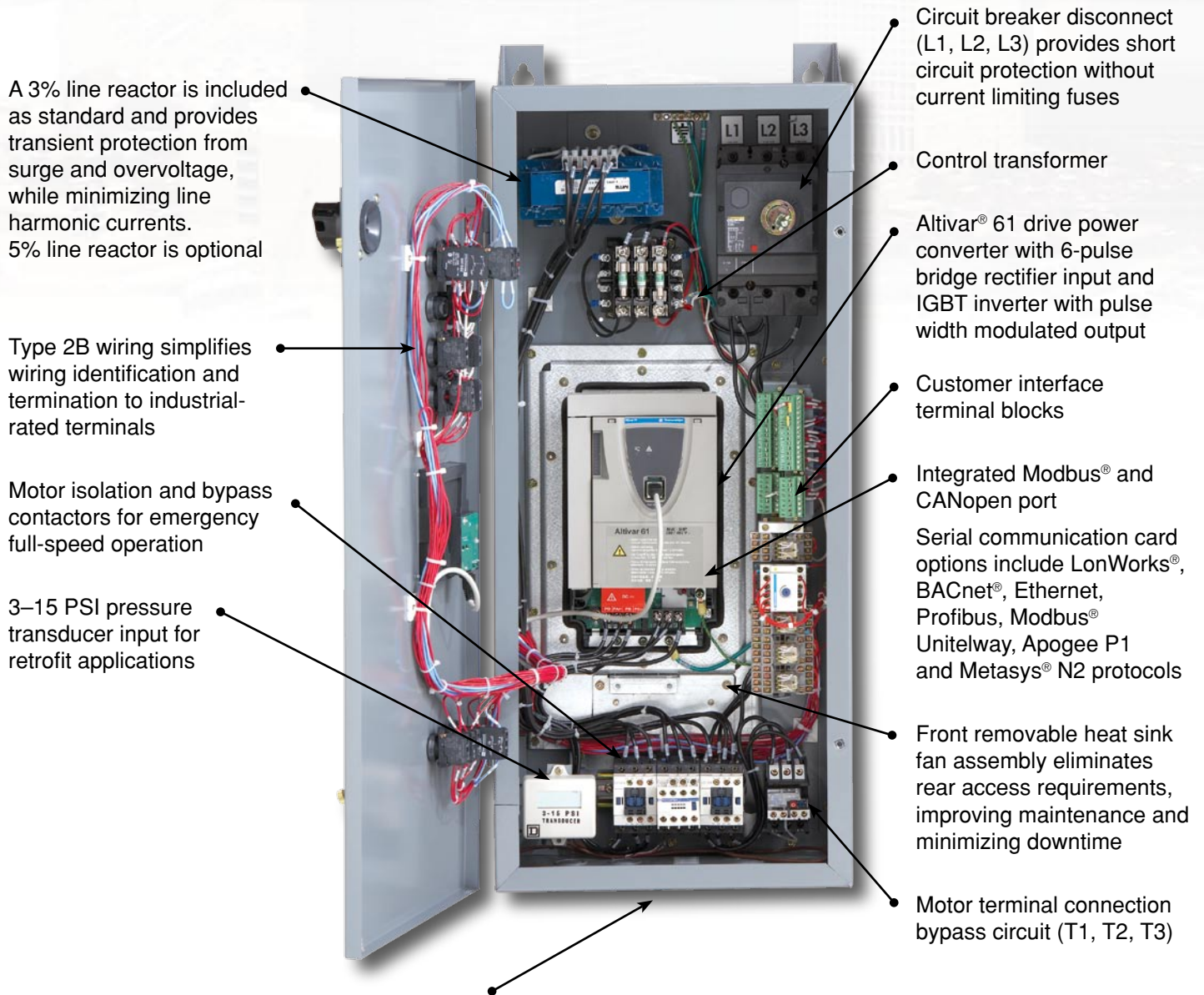
\*\* Actual results may vary for closed loop pumping and variable air volume systems.

The Square D® E-Flex™ family of enclosed drive controllers is well suited for commercial building, hospital, and school HVAC applications requiring a disconnect and bypass. These controllers offer a compact metal enclosure designed to reduce Radio Frequency Interference (RFI). In addition, HVAC specific control interface is pre-programmed for HVAC variable torque operation to permit ease of set-up and installation. HVAC controls provide end damper control, smoke purge relays and fire/freezestats for full-speed fire safety override and lock-out terminations.





Fully-rated, AC3 duty-rated motor isolation and bypass contactors with mechanical and electrical interlocks prevent accidental voltage back feed. The adjustable carrier frequency is optimized at 8 kHz to reduce motor noise levels and is programmable from 0.5 kHz to 16 kHz. The advanced ASIC technology platform increases reliability and uptime and lowers the component count. The motor soft start inherent in the drive reduces mechanical stress and routine maintenance.



A 3% line reactor is included as standard and provides transient protection from surge and overvoltage, while minimizing line harmonic currents. 5% line reactor is optional

Type 2B wiring simplifies wiring identification and termination to industrial-rated terminals

Motor isolation and bypass contactors for emergency full-speed operation

3–15 PSI pressure transducer input for retrofit applications

Circuit breaker disconnect (L1, L2, L3) provides short circuit protection without current limiting fuses

Control transformer

Altivar® 61 drive power converter with 6-pulse bridge rectifier input and IGBT inverter with pulse width modulated output

Customer interface terminal blocks

Integrated Modbus® and CANopen port

Serial communication card options include LonWorks®, BACnet®, Ethernet, Profibus, Modbus® Unitelway, Apogee P1 and Metasys® N2 protocols

Front removable heat sink fan assembly eliminates rear access requirements, improving maintenance and minimizing downtime

Motor terminal connection bypass circuit (T1, T2, T3)

UL 508C listed and coordinated with NEMA ICS 7.1 standards to exceed minimum UL short-circuit requirements (this structural integrity will provide enhanced personnel safety under short-circuit conditions for the drive and bypass operation)

# Selection Guide

The controller catalog number, located on the inside of the door, is coded to describe the configuration and options present. Use the following grid to translate the catalog number into a description of the controller.

## Class Type

8839	EFD	•	•	•	V	•	
		1	2	3	4	5	6

## Modifications

Control	Light	Misc.
•	•	•
7	8	9

### 1 Product

Code	Drive Type
EFD	E-Flex Controller

### 2 Horsepower Code

Code	HP Rating	Code	HP Rating
C	1	L	25
D	2	M	30
E	3	N	40
F	5	P	50
G	7.5	Q	60 (460 V only)
H	10	R	75 (460 V only)
J	15	S	100 (460 V only)
K	20		

### 3 Enclosure Type

Code	Environmental Rating
A	Type 12K
G	Type 1
H	Type 3R

### 4 Voltage Rating

Code	Voltage
2	208 V
3	230 V
4	460 V

### 5 Application Type

Code	Applied Rating
V	Variable Torque

### 6 Device Type

Code	Power Circuit
W <sup>[5]</sup>	Without Bypass
Y <sup>[8]</sup>	Bypass

[1] Control option C07 (Start/Stop, Speed Potentiometer) is not compatible with Power Circuit Y Bypass or Light Option A08 or B08.

[2] Light Option A08, B08 and C08 cannot be selected together. Select only one.

[3] Light Option B08 is not compatible with Power Circuit W (Without Bypass).

[4] Light Option C08 is not compatible with Control Options A07 (Hand-Off-Auto, Speed Potentiometer), B07 (Hand-Off-Auto, Start-Stop, Speed Potentiometer), D07 (Hand-Off-Comm, Speed Pot.) or E07 (Hand-Off-Comm, Start-Stop, Speed Pot.).

[5] Line Contactor B09 is not compatible with Power Circuit W (Without Bypass).

[6] Smoke purge E09 permits the motor to run at full speed.

[7] Hand-Off-Auto switch must be placed in Off position for AFC fault reset.

[8] Includes AFC-Off-Bypass switch and Test-Normal switch.

[9] D07 or E07 must be selected.

### 7 Control Option

Code	AFC Controls
A07 <sup>[7]</sup>	Hand-Off-Auto, Speed Potentiometer
B07 <sup>[7]</sup>	Hand-Off-Auto, Start-Stop, Speed Potentiometer
C07 <sup>[1]</sup>	Start-Stop, Speed Potentiometer
D07	Hand-Off-Comm, Speed Potentiometer
E07	Hand-Off-Comm, Start-Stop, Speed Potentiometer
N07	None

### 8 Light Option

Code	Light Cluster
A08 <sup>[2]</sup>	Red Power On
	Green AFC Run
	Yellow AFC Fault
	Yellow Auto
B08 <sup>[2], [3]</sup>	Red Power On
	Green AFC Run
	Yellow AFC Fault
	Yellow Bypass
C08 <sup>[2], [4]</sup>	Red Power On
	Green AFC Run
	Yellow AFC Fault

### 9 Miscellaneous Option

Code	Feature
A09	Line Reactor, 5%
B09 <sup>[5]</sup>	Line Contactor
C09 <sup>[10]</sup>	3–15 PSI Transducer
D09 <sup>[13]</sup>	Omit Keyboard
E09 <sup>[6]</sup>	Smoke Purge (Fireman's Override)
F09 <sup>[9], [14]</sup>	Profibus
H09 <sup>[11]</sup>	I/O Extension Card, 0–20 mA
J09 <sup>[12]</sup>	0-10 Vdc Differential Input
K09	cUL Listing Certification
L09 <sup>[14], [9]</sup>	LonWorks
M09 <sup>[14], [9]</sup>	Modbus Unitelway
O09 <sup>[14], [9]</sup>	Apogee P1
P09 <sup>[14], [9]</sup>	Metasys N2
Q09 <sup>[14], [9]</sup>	Ethernet TCP/IP
R09 <sup>[14], [9]</sup>	BACnet
S09	End Damper Control
U09	Seismic Qualification

[10] C09 3–15 PSI Transducer is not compatible with C07 Start-Stop, Speed Potentiometer, J09 0-10 V Auto Speed Reference or H09 Analog Card.

[11] H09 Analog Card is not compatible with C09 3–15 PSI Transducer or Serial Communication F09, L09, M09, O09, P09, Q09, R09.

[12] J09 0-10 V Differential Input is not compatible with C07 Start-Stop Potentiometer or C09 3-15 PSI Transducer.

[13] Omit the keypad D09. User must buy a separate device to program the controller.

[14] Serial communication F09, L09, M09, O09, P09, Q09 and R09 cannot be selected together. Select only one. Serial communication cannot be selected with H09.

# Electrical Specifications

Input Voltage	208 V ±10%, 230 V ±10%, 460 V ±10%
Displacement Power Factor	98% through speed range
Input Frequency	60 Hz +/- 5%
Output Voltage	Three-phase output Maximum voltage equal to input voltage
Galvanic Isolation	Galvanic isolation between power and control (inputs, outputs and power supplies)
Frequency Range of Power Converter	0.1 to 500 Hz (factory setting of 60 Hz)
Torque/Overtorque	110% of nominal motor torque for 60 s
Current (Transient)	110% of controller rated current for 60 s
Switching Frequency	Selectable from 0.5 to 16 kHz <sup>[1]</sup> Factory setting: 8 kHz for 208 V, 230 V and 1-100 hp @460 V
Speed Reference	AI1: 0 to +10 V, Impedance = 30 kΩ Can be used for speed potentiometer, 1–10 kΩ AI2: Factory setting: 4 to 20 mA, Impedance = 242 Ω
Factory Resolution in Analog Reference	0.1 for 100 Hz (11 bits)
Speed Regulation	V/f control: equal to the motor's rated slip SLFV (sensorless flux vector): 10% of motor's rated slip from 20% to 100% of nominal motor torque.
Efficiency	97% at full load typical
Reference Sample Time	2 ms ±0.5 ms
Acceleration and Deceleration Ramps	0.1 to 999.9 seconds (definition in 0.1 s increments)
Drive Controller Protection	Thermal protection of power converter Phase loss of AC mains circuit breaker rated at 100 kAIC
Motor Protection	Class 10 electronic overload protection Class 20 electromechanical overload protection with bypass <sup>[2]</sup>
Graphic Display Terminal	Self diagnostics with fault messages in three languages also refer to the Programming Manual, supplied on CD-ROM W817574030111 with power converter.
Codes and Standards	UL Listed per UL 508C under category NMMS. Conforms to applicable NEMA ICS, NFPA, and IEC standards. Manufactured under ISO 9001 standards.

[1] On 1-100 hp VT controllers, above 8 kHz, select the next largest drive controller.

[2] Class 10 electromechanical for 1 hp at 460 V.

# Environmental Specifications

Temperature	Storage for all enclosures: -13°F to +149°F (-25°C to +65°C) Operation: +14°F to + 104°F (-10°C to +40°C).
Humidity	95% with no condensation or dripping water, conforming to IEC 60068-2-3.
Altitude	3,300 ft. (1,000 m) maximum without derating; derating of current by 1% for each additional 330 ft. (100 m)
Enclosure	Type 1, Type 12/12K, and Type 3R
Polution Degree	Type 1: Polution degree 2 per NEMA ICS-1 Annex A and IEC 60664-1 Type 12/12K: Pollution degree 3 per NEMA ICS-1 and IEC17.560664-1
Operational Test Vibration	Conforming to IEC 60721-3-3-3M3 amplitude 1.5 peak to peak from 3 Hz to 13 Hz 1g from 13 Hz to 200 Hz
Transit Test to Shock	Conforming to National Safe Transit Association and International Safe Transit Association test for packages
Operational Shock	15 g, 11 ms
Seismic Qualification	2003 IBC, NFPA 5000, and ASCE 7 ICC ES AC156 acceptance criteria test protocol with importance factor of 1.5



Schneider Electric is a global supplier of electrical distribution, automation and control equipment products under the brand names of Square D®, Telemecanique® and Merlin Gerin®. For over 100 years, Schneider Electric has been an innovator in manufacturing products that are tailored to the demanding specifications of our customers. Backed by a global organization of 80,000 employees in 130 countries, Schneider Electric is a global electrical industry leader. With one of the strongest distribution networks in the U.S. and around the world, you can count on Schneider Electric to keep your business running smoothly and efficiently.

Schneider Electric has been providing adjustable frequency drive solutions for HVAC and pumping applications for over 30 years. Schneider Electric has made a significant investment in research and development to design a new generation of products to serve the HVAC and pumping marketplace.

## Dimensions and Weights

### Type 1 or Type 12K Enclosures

HP		Height		Width		Depth		Weight	
208/230 V	460 V	mm	in.	mm	in.	mm	in.	kg.	lbs.
1-5	1-7.5	889	35	374.9	14.76	353.91	13.93	37.7	83
7.5-10	10-25	1041.4	41	521.21	20.52	353.91	13.93	57.2	126
15-25	30-50	1244.6	49	524.51	20.65	427.49	16.83	80.5	177
30-50	60-100	1600.2	63	651.51	25.65	427.49	16.83	95.9	211

### Type 3R Enclosures

HP		Height		Width		Depth		Weight	
208/230 V	460 V	mm	in.	mm	in.	mm	in.	kg.	lbs.
1-5	1-7.5	889	35	620.52	24.43	347.73	13.69	52.3	115
7.5-10	10-25	1041.4	41	766.83	30.19	347.73	13.69	74.1	163
15-25	30-50	1326.39	52.22	770.13	30.32	415.04	16.34	96.8	213
30-50	60-100	1681.99	66.22	897.13	35.32	415.04	16.34	112.3	247

For additional information on Square D® E-Flex™ adjustable frequency AC drives, visit our website at [www.us.squared.com](http://www.us.squared.com).

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