Advantage
VARIABLE SPEED DRIVES

Water Circulation
Pumps & Circulators

E-Flex™ – Enclosed drives

E-Flex™ drives provide the optimum combination of efficiency and economy for HVAC and pump applications in both commercial and industrial environments. They are the ideal choice in adjustable speed drive solutions for applications such as: Chilled water pumps, Hot water pumps, Cooling tower pumps and Air handling units.

Taco®
systems made easy®

Supersedes: New

Effective Date: 08/26/10
Printed in USA

Features & Benefits

Industrial-grade reliability designed for HVAC and Pump applications

Seismic qualification for new generation of building codes

These drives are designed to meet International Building Code and ASCE 7 standards for seismic qualification in accordance with ICC ES AC156 testing protocol. Many states and jurisdictions are beginning enforcement of the seismic guidelines for installed equipment contained in the International Building Code.

E-Flex™ enclosed drive controllers were subjected to actual shaker table tests for seismic ratings, not just theoretical calculations for seismic ratings or obsolete requirements of the Uniform Building Code. The E-Flex™ enclosed drive controller provides structural integrity when installed to published guidelines and can be specified for use in applications that require Ip = 1.5, which means operational status can be restored after a seismic event.

Enclosure styles

E-Flex™ enclosed drive controllers can meet both indoor and outdoor application requirements with Type 1, Type 12/12K and Type 3R enclosures.

- Type 1 enclosures are designed specifically for indoor, non-dusty environments.
- Type 12/12K enclosures are designed for protection from dust and dripping liquid.
- Type 3R enclosures permit installation on rooftops or other outdoor locations to free up space in mechanical equipment rooms.

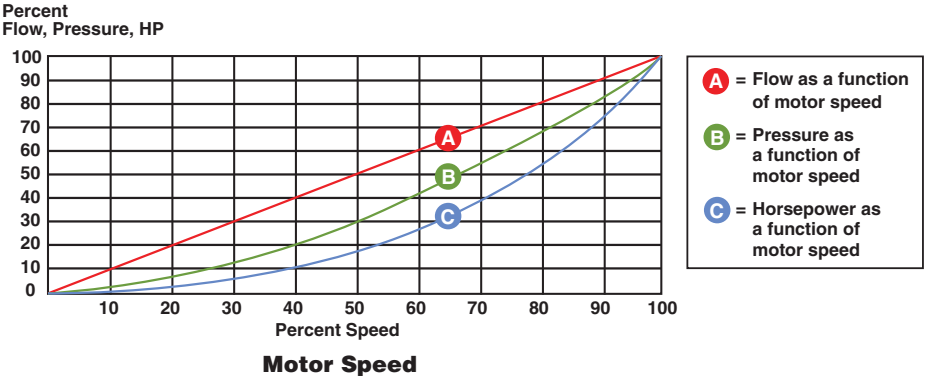
  Plus, Type 3R enclosures allow operations in temperature ranges from +14°F to +122°F (-10°C to +50°C).

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)^2
- Horsepower = f(motor speed)^3

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..



Motor Speed

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

Cost of running the motor at full speed:
20 HP x 0.746 kW/HP x 2600 hours x $0.10/kWhr **= $ 3,879.20**

Assuming the pump does not need to run at full speed for the full 2600 hours, let's use an example where it runs at full speed 25% of the time, at 80% for 50% of the time, and at 60% for the remaining 25% of the time:

Cost of running with an AC drive controlling the motor:

20 HP x $(1)^3$ x 0.746 kW/HP x 650 hours x $0.10/kWhr	= $ 969.80
20 HP x $(0.8)^3$ x 0.746 kW/HP x 1300 hours x $0.10/kWhr	= $ 993.08
20 HP x $(0.6)^3$ x 0.746 kW/HP x 650 hours x $0.10/kWhr	= $ 209.48
Total	**= $ 2,172.36**

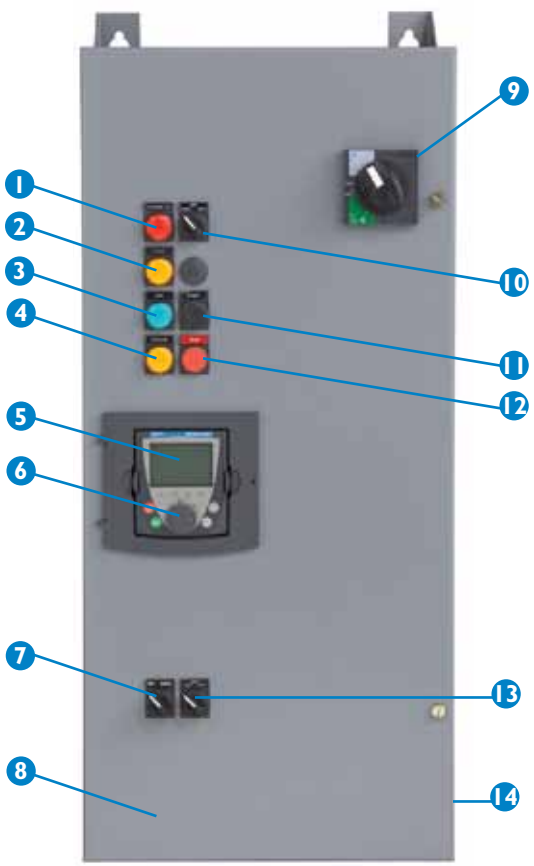
Annual savings: $3,879.20 - $2,172.36 = $1,706.84

**Actual results may vary.*

Well suited for commercial building, healthcare and educational cam

Industrial-rated control operators and pilot devices accommodate the most demanding environments

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/freeze stats for full-speed fire safety override and lock-out terminations.

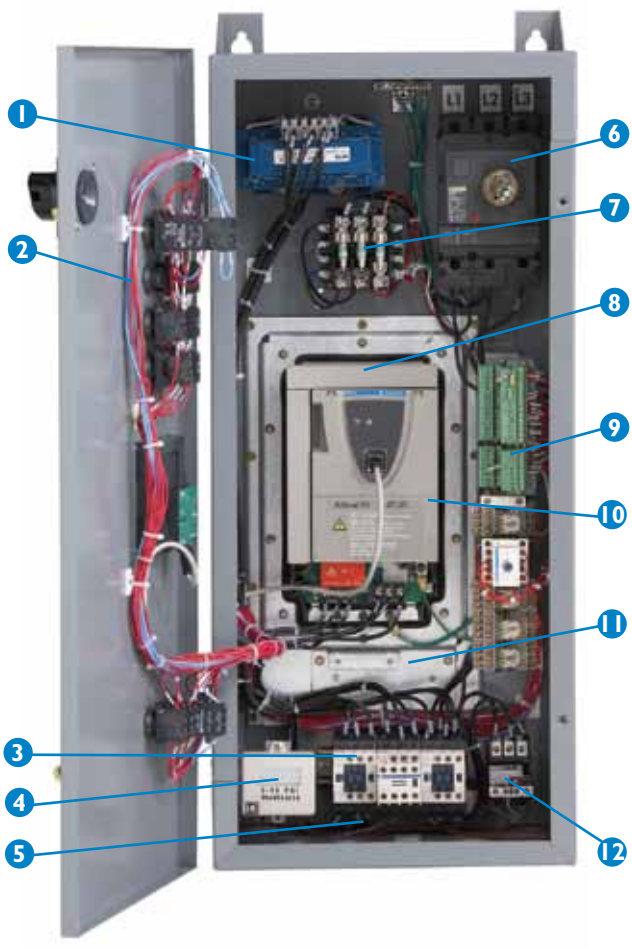


1. Red power light
2. Yellow AFC detected fault light
3. Green AFC run light
4. Yellow bypass light
5. Graphic screen with customizable display in plain text
6. Navigation wheel for easy surfing through the menus
7. Test normal selector switch allows drive testing
8. Pre-punched top and bottom conduit entry knock-outs simplify electrical installation and prevent metal filings from getting inside the enclosure (Type 3R enclosures have bottom conduit entry only)
9. Disconnect means with lock out/tag out provisions
10. Hand off auto selector switch
11. Start push button
12. Stop push button
13. AFC off bypass switch
14. Side air vents (Type 1 only)

pus HVAC and Pump applications requiring a disconnect and bypass

Motor isolation and bypass contactors with electrical interlocks prevent accidental voltage back feed

The adjustable carrier frequency is optimized at 8kHz to reduce motor noise levels and is programmable from 1kHz to 16kHz. 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.



1. A 3% equivalent DC choke is included as standard minimizes line harmonic currents; 5% line reactor (shown) is optional
2. Type 2B wiring simplifies wiring identification and termination to industrial-rated terminals
3. Drive output and bypass contactors for emergency full-speed operation
4. 3–15PSI pressure transducer input for pneumatic applications (optional)
5. UL 508C listed and coordinated with NEMA ICS 7.1 standards100kA symmetrical exceeds UL short-circuit requirements
6. Circuit breaker disconnect (L1, L2, L3) provides short circuit protection without current limiting fuses
7. Control transformer
8. Advantage 61 drive power converter with 6-pulse bridge rectifier input and IGBT inverter with pulse width modulated output
9. Customer interface terminal blocks
10. Integrated Modbus® and CANopen port; Serial communication card options include LonWorks®, BACnet®, Ethernet, Profibus, Modbus® Unitelway, Apogee P1 and Metasys® N2 protocols
11. Front removable heat sink fan assembly eliminates rear access requirements, improving maintenance and minimizing downtime
12. Motor terminal connection (T1, T2, T3)

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						Modification		
8839	EFD	•	•	•	V	•	•	•	•
1	2	3	4	5	6	7	8	9
Product	Horsepower Code	Enclosure Type	Voltage Rating	Application Type	Device Type	Control Option	Light Option	Misc. Option

1 Product

Code	Drive Type
EFD	E-Flex™ Controller

2 Horsepower Code

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

3 Enclosure Type

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

4 Voltage Rating

Code	Voltage
2	208V
3	230V
4	460V

5 Application Type

Code	Applied Rating
V	Variable Torque

6
Device Type

Code	Power Circuit
W [5]	Without Bypass
Y [8]	Bypass

7
Control Option

Code	AFC Controls
A07 [7]	Hand-Off-Auto, Speed Potentiometer
B07 [7]	Hand-Off-Auto, Start-Stop, Speed Potentiometer
C07 [1]	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 [2]	Red Power On
	Green AFC Run
	Yellow AFC Detected Fault
	Yellow Auto
B08 [2], [3]	Red Power On
	Green AFC Run
	Yellow AFC Detected Fault
	Yellow Bypass
C08 [2], [4]	Red Power On
	Green AFC Run
	Yellow AFC Detected Fault
N08	No lights

9
Miscellaneous Option

Code	Feature
A09	Line Reactor, 5%
B09 [5]	Line Contactor
C09 [10]	3–15PSI Transducer
D09 [13]	Omit Keyboard
E09 [6]	Smoke Purge (Fireman's Override)
F09 [9], [14]	Profibus
H09 [11]	I/O Extension Card, 0–20mA
J09 [12]	0-10Vdc Differential Input
K09	cUL Listing Certification
L09 [14], [9]	LonWorks
M09 [14], [9]	Modbus Unitelway
O09 [14], [9]	Apogee P1
P09 [14], [9]	Metasys N2
Q09 [14], [9]	Ethernet TCP/IP
R09 [14], [9]	BACnet
S09	End Damper Control
T09 [15]	Service Entrance
U09	Seismic Qualification

[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 potentiometer) or E07(hand-off-Comm, start-stop, speed potentiometer)

[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.

[10] C09 3–15 PSI transducer is not compatible with C07start/stop, speed potentiometer, J09 0-10V 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 0-10V 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.

[15] Available with NEMA Type 3R configurations.

Specifications

Electrical Specifications

Input Voltage	208V ±10%, 230V ±10%, 460V ±10%
Short Circuit Current Rating	100,000A symmetrical
Displacement Power Factor	98% through speed range
Input Frequency	50/60Hz ±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	0.5 to 500Hz (factory setting of 60Hz)
Torque/Overtorque	130% of nominal motor torque for 60s
Current (Transient)	120% of controller rated current for 60s
Switching Frequency	Selectable from 1 to 16kHz [1] Factory setting: 8kHz
Speed Reference	AI1: 0 to +10V, Impedance = 30k Ω Can be used for speed potentiometer, 1–10k Ω AI2: Factory setting: 4 to 20mA, Impedance = 242 Ω
Factory Resolution in Analog Reference	0.029 for 60Hz (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% nominal motor torque
Efficiency	Varies from 93% to 97% full load typical
Reference Sample Time	2ms ±0.5ms
Acceleration and Deceleration Ramps	0.1 to 999.9s (definition in 0.1s increments)
Drive Controller Protection	Thermal protection of power converter Phase loss of AC mains' enclosure short circuit protection rated at 100kAIC
Motor Protection	Class 20 electronic overload protection Class 20 electromechnical overload protection with bypass [2]
Graphic Display Terminal	Self diagnostics with status messages in three languages. Plain user language with ability to customize the display
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 1-100HP VT controllers, above 8kHz, select the next largest drive controller.
[2] Class 10 electromechanical for 1HP at 460V.

Environmental Specifications

Temperature	Storage for all enclosures: -13°F to +149°F (-25°C to +65°C) Type 1 and Type 12 Operation: +14°F to + 104°F (-10°C to +40°C) Type 3R Operation: +14°F to +122°F (-10°C to +50°C)
Humidity	95% with no condensation or dripping water, conforming to IEC 60068-2-3.
Altitude	3,300 ft. (1,000m) maximum without derating; derating of current by 1% for each additional 330ft. (100m) up to 3000m [1]
Enclosure	Type 1, Type 12/12K, and Type 3R
Polution Degree	Type 1: Pollution 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 60028-2-6 1.5 peak to peak from 3Hz to 13Hz 1g from 13Hz to 200Hz
Transit Test to Shock	Conforming to National Safe Transit Association and International Safe Transit Association test for packages
Operational Shock	15g, 11ms conforming to IEC/EN 60068-2-27
Seismic Qulaification	2003 IBC, NFPA 5000, and ASCE 7 ICC ES AC156 acceptance criteria test protocol with importance factor of 1.5
Certifications	American Bureau of Ship Building (ABS) Type Approval in compliance with marine specifications

[1] Limited to 2000m altitude for common grounded power systems.

Type 1 or Type 12K Enclosures

HP		Height		Width		Depth		Weight [2]	
208/230V	460V	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 [2]	
208/230V	460V	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

[2] Weight may vary based on options selected.

Notes

Notes

In order to provide the most efficient pump solution to our customers, Taco is now working with Schneider Electric.

This collaboration brings together Taco's pump technology with Schneider Electric Variable Frequency Drives and the drive packaging of Square D enclosures to offer the best overall pumping solution for our customers.

SQUARE D

by Schneider Electric

systems made easy®

Taco Inc., 1160 Cranston Street. Cranston, RI 02920 / (401) 942-8000 / Fax (401) 942-2360
Taco (Canada) Ltd., 8450 Lawson Road, Unit #3, Milton, Ontario L9T 0J8 / (905) 564-9422 / Fax (905) 564-9436
www.taco-hvac.com