YASKAWA

E7 Drive and E7 Bypass Packages for HVAC Fan and Pump Applications

1/2 to 500 Horsepower

E7 Drive

Design Benefits

The E7 drive is an application-specific, variable torque, ac drive designed to meet the needs of the Building Automation System (BAS) marketplace. This drive continues the trend to reduce size and cost while increasing performance and quality. The right solution for centrifugal loads on applications such as: VAV air handler supply and return air fans, outdoor air injection fans, exhaust fans, cooling tower fans, chilled and hot water distribution pumps, constant air volume fan conversions, DX condenser fans, clean room circulating fans, condenser water pumps, variable primary pumps, boiler combustion fans, ventilation fans, smoke control fans, fume hood fans, filtration control fans or pumps and centrifugal compressors. The E7 design specification, default parameters and option choices are based on our industry and application knowledge as the largest global drives manufacturer with over 30 years of BAS and HVAC experience.

Quiet Motor Operation

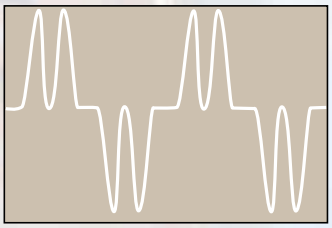
One of the major advantages of new IGBT technology is the significant reduction in audible motor noise. This reduction is a direct result of the variable switching frequency and the low harmonic content of the waveform. At 60 Hz output, the drive-induced motor noise is the same level as across-the-line sinewave operation.

Integral Setpoint Control

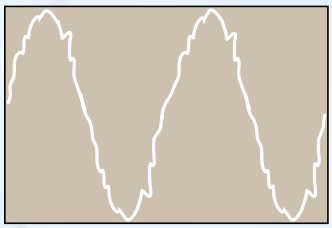
The E7 drive features an internal PI controller, eliminating the need for closed loop output signals from the BAS. The PI controller includes feedback inverse, square root and differential control functions. A Sleep function allows motor operation to be stopped when demand is at a low level for a selected time period, the motor is reactivated automatically when demand increases. Sleep provides significant energy savings by minimizing operating hours on driven equipment.

Improved Power Quality

The E7 combines sophisticated IGBT power switching with advanced microprocessor logic specifically for HVAC motor loads. Environmentally friendly with lower EMI/RFI emission and lower total harmonic distortion, the E7 meets or exceeds accepted power quality standards. Inherent motor protection features resulting from low noise/low carrier technology allows longer lead lengths without additional protection devices. The innovative E7 drive makes product selection easy and additional power quality or motor protection devices seldom needed. For critical power quality situations such as hospitals, clean rooms, research facilities the E7 provides an easy solution via a dual bridge input rectifier. When combined with a phase shifting input transformer, the drive operation is changed to 12 pulse rectification and THD contribution by the drive is further reduced. Current distortion improvement is shown.



6-pulse input without reactor.



12-pulse input with phase-shift transformer.

Easy Setup

The E7 drive advancements simplify set up, using the built in program storage and copying features. The digital keypad provides a copy function to make all set-up parameters portable when programming multiple drives with similar application requirements. Factory "default" parameters are selected for typical fan and pump applications. These initial values can be refined with more project-specific data, retained and recalled as "user default" parameters. Industry standard Hand/Off/Auto functionality is built into the drive's digital keypad, allowing easy selection of operation from remote (Auto) or local (Hand) signals.

HVAC-Specific Features

- H-O-A functionality
- Embedded network communications
- Multi-parameter display
- PI Control
- Sleep
- 12-pulse ready
- Copy function
- Motor pre-heat circuit
- Bi-directional catch a spinning load
- Auto-restart with adjustable time interval
- 3 skip frequencies with adjustable band width
- 2 programmable analog outputs
- Motor auto tuning
- Loss of load monitor

Communications and Keypad

The E7 drive has embedded network communications capabilities, including Johnson Controls Metasys N2 and Siemens APOGEE FLN, with optional interface for the LonWorks® protocol. Extensive parameter selection via serial communication allows efficient management of BAS applications for energy efficiency and closed loop control, without consuming building automation system points. Serial communication allows customers to save wiring costs and BAS points while providing access to all the information accumulated by the drive's internal logic. Commissioning, control supervision and monitoring of the drive can be accomplished over a single RS422/485 connection.

Metasys® N2 is Johnson Controls' answer to open connectivity. This embedded protocol complies with Johnson Controls' guidelines for direct connection to the Metasys N2 bus.

Siemens APOGEE™ FLN is an open interoperable network standard that complies with Siemens Inter-operability guidelines and functional profile for a 3-phase motor drive.

LonWorks® is another common interoperable network standard. An optional circuit card complies with the LonMark Inter-operability guidelines and LonMark® functional profile for a 3-phase motor drive.

E7 Keypad

Display
LCD alpha-numeric display (large 1" display), 5 lines,16 characters each, 7 languages (English, Spanish, French, German, Italian, Protuguese, Japanese).

HAND Mode
The drive is given a start command, operation is via the local speed input (digital keypad or speed pot.).

OFF
The start command is removed, all speed inputs are ignored.

AUTO Mode
The drive is enabled to receive a start command and speed input from a building automation system.

MONITOR
Selects the monitor mode (shown) from any display location.

MENU
Scrolls through the five main menu selections.

Increase or Decrease Arrows
Change speed in Hand mode, change displayed values or parameter numbers and scroll within menus.

E7/Bypass

Building Automation Ready Package

The E7 Bypass packages are designed for optimum performance when used with today's Building Automation Systems (BAS). The E7 drive with bypass allows motors to be operated from either the drive or directly across the AC line. Bypass capability is selected for any critical application that must have redundant motor control to insure continued operation. The bypass function transfers motor operation from the drive to the AC line via drive isolation contactors and a bypass contactor.

Our Safety Interlock enables building safety devices (i.e. Freeze-stat, high pressure switch or Fire-stat) to override drive or bypass operation in order to protect mechanical equipment, even if drive control originates from the BAS. This interlock technology also provides the capability to monitor safety device status via the BAS.

The E7 Bypass package has a UL rated (MCP) motor circuit protector and does not require additional branch circuit protection, unlike some competitors.

Switch Selectable Features

• Smoke Purge - Firemans' Override • Auto Transfer to Bypass - Transfers to Bypass on Fault • Remote Transfer to Bypass - Switch to Bypass via BAS

Bypass Operator Control

HAND
The drive is given a start command, operation is via the local speed input (digital keypad or speed pot). If in bypass mode, the motor runs across the line.

OFF
The motor stops in either bypass or drive mode.

AUTO
The drive is enabled to receive a start command and speed input from a Building Automation System. If in bypass mode, the motor start/stop is controlled by the Building Automation System.

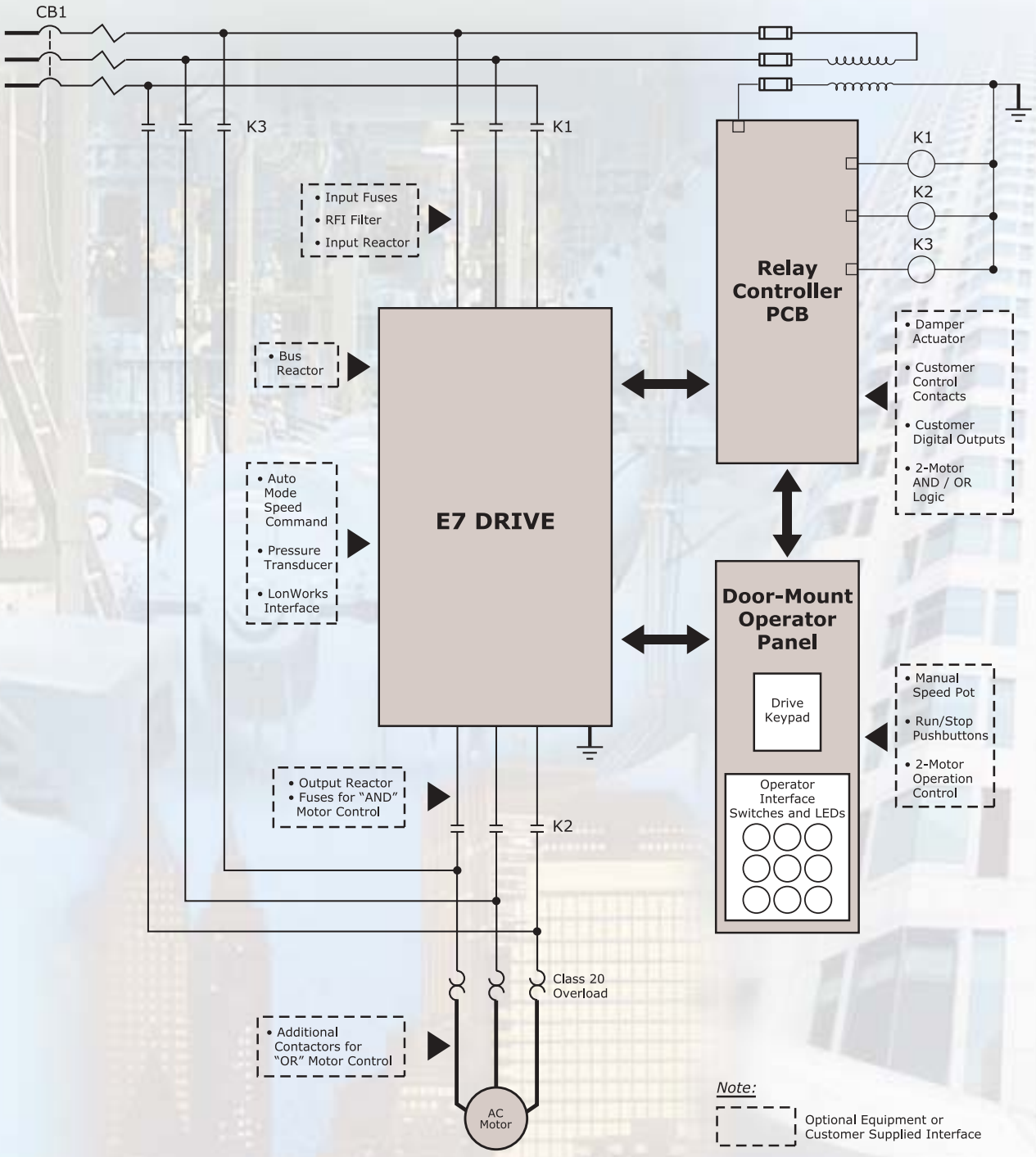
BYPASS
Power is applied to enable the bypass circuit, the drive is de-energized (unless the Normal/Test switch is in the Test position).

DRIVE
Power is applied to enable the drive circuit, the bypass is de-energized.

NORMAL
All operating modes available.

TEST
Drive input contactor energized during bypass operation (in hand or auto mode) to energize the drive for testing.

E7/Bypass Schematic



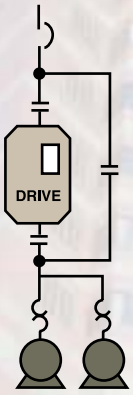
E7 and E7/Bypass Packaging

Additional Packages

Yaskawa can design and build drive packages to meet any HVAC application need, from custom panels to drives in NEMA 3R enclosures. Contact us for configuration assistance. Common package designs include:

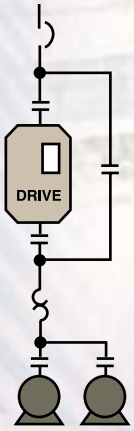
"And" Bypass Package

Allows one drive to control two or more motors simultaneously. Note: all motors will run at the same speed. Drive must be sized to handle the total full load amps of all connected motors.



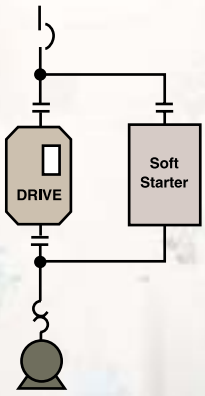
"Or" Bypass Package

Controls two motors in lead / lag scenarios allowing the operator to specify which motor is to be operated via selector switch or contact closure.



Soft-Start Bypass Package

A soft starter can be used to minimize mechanical wear and machine noise associated with transferring motor control from the drive to across-the-line operation.



Enclosures

Flexible packaging provides the right enclosure for different HVAC applications. Yaskawa's UL panel shop has created standard, modified and custom enclosures for thousands of building installations protecting your investment from dust, dirt, or, water in both indoor and outdoor mounting situations. Yaskawa has the exact enclosure you need for a variety of HVAC environmental conditions:

- NEMA Type 1: Used for clean, dry indoor locations. Typically mounted on the wall of a mechanical equipment room.
- NEMA Type 12 (filtered and blowered): Selected when the indoor location is not free of dust accumulation, such as equipment rooms containing air intake plenums.
- NEMA Type 3R: The outdoor installation standard. Used when suitable indoor locations cannot be found for drives serving rooftop equipment or cooling towers.

Dimensions

E7 Drive

Rated Input Voltage	Rated Output Current (Amps)	Nominal HP	Dimensions (inches)			Weight (lbs.)[1]	Standard Enclosure
			Height	Width	Depth		
208 V	3.6	1/2 & 3/4	11.02	5.51	6.30	6.6	NEMA 1
	4.6	1					
	7.8	2					
	10.8	3					
	16.8	5			7.09	8.8	
	31.0	7.5 & 10	11.81	7.87	7.87	13.2	
	46.2	15	12.20			15.4	
	59.4	20	13.78	9.45	8.27	24.2	
	74.8	25	14.96				
	88	30	21.06	10.00	10.24	53	
	115	40	24.21	10.98		59	
	162	50	23.62	14.76	11.81	125	Protected Chassis
	192	60			12.99	139	
	215	75	28.54	17.72	13.78	189	
	312	100				191	
	360	125	33.46	19.69	14.17	238	
	415	150	34.84	22.64	14.96	330	
240 V	3.6	1/2 & 3/4	11.02	5.51	6.30	6.6	NEMA 1
	4.6	1					
	7.8	2					
	10.8	3					
	16.8	5			7.09	8.8	
	23	7.5					
	31	10	11.81	7.87	7.87	13.2	
	46.2	15	12.20			15.4	
	59.4	20	13.78	9.45	8.27	24.2	
	74.8	25	14.96				
	88	30	21.06	10.00	10.24	53	
	115	40	24.21	10.98		59	
230 V	162	50 & 60	23.62	14.76	11.81	125	Protected Chassis
	192	75			12.99	139	
	312	100 & 125	28.54	17.72	13.78	191	
	360	150	33.46	19.69	14.17	238	
480 V	1.8	1/2 & 3/4	11.02	5.51	6.30	6.6	NEMA 1
	2.1	1					
	3.7	2					
	5.3	3			7.09	8.8	
	7.6	5					
	12.5	7.5					
	17	10	11.81	7.87	7.87	13.2	
	27	15 & 20					
	34	25	13.78	9.45	8.27	22	
	40	30					
	67.2	40 & 50	21.06	10.98	10.24	53	
	77	60	25.00	12.95	11.22	88	
	96	75	28.15				
	125	100					Protected Chassis
	156	125	28.54	17.72	13.78	194	
	180	150				196	
	240	200	33.46	19.69	14.17	224	
	304	250	36.06	22.64	14.96	352	
	414	300 & 350	27.95	51.38	16.34	572	
	515	400 & 450				616	
	675	500	36.06	58.07	16.34	891	

[1] *Note that weight represents drive weight only, not shipping weight*

[2] *All NEMA 1 Enclosures*

[3] *Weight may vary with options; maximum weight of bypass with all options is listed*

E7 / Bypass Package[2]

Rated Input Voltage	Rated Output Current (Amps)	Nominal HP	Dimensions (inches)			Weight (lbs.)[3]
			Height	Width	Depth	
208 V	2.4	1/2	29.00	19.00	13.66	115
	3.5	3/4				
	4.6	1				
	7.5	2				
	10.6	3				
	16.7	5				
	24.2	7.5				
	30.8	10				127
	46.2	15				
	59.4	20	40.00	25.63	14.66	208
	74.8	25				
	88	30				221
	114	40				
	143	50	84.00	37.75	20.00	847
	169	60				943
	211	75				
	273	100				1214
	343	125				1330
	396	150				1423
240 V	2.2	1/2	29.00	19.00	13.66	115
	3.2	3/4				
	4	1				
	6.8	2				
	9.6	3				
	15.2	5				
	22	7.5				
	28	10				127
	42	15				
	54	20	40.00	25.63	14.66	208
	68	25				
	80	30				221
	104	40				
230 V	130	50	84.00	37.75	20.00	847
	154	60				943
	192	75				
	248	100				1214
	312	125				1330
	396	150				1376
480 V	1.1	1/2	29.00	19.00	13.66	115
	1.6	3/4				
	2.1	1				
	3.4	2				
	4.8	3				
	7.6	5				
	11	7.5				
	14	10				127
	21	15				
	27	20				142
	34	25				
	40	30				
	52	40	40.00	25.63	14.66	203
	65	50				232
	77	60				
	96	75				241
	124	100				
	156	125	84.00	37.75	20.00	943
	180	150				
	240	200				1240
	302	250				1352

Specifications

Performance Features

- VT Ratings: 1/2-150 HP, 208 VAC
  1/2-150 HP, 230/240 VAC
  1/2-500 HP, 480 VAC
- Overload capacity: 110% for 60 sec (150% peak)
- Starting torque: 100% at 3 Hz
- DC injection braking: at start or stop, adjustable, current limited (anti-windmilling)
- Motor preheat function
- Adjustable accel/decel: 0.1 to 6000 sec.
- Controlled speed range: 40:1
- Critical frequency rejection: 3 selectable, adjustable bands
- Energy $aving control
- Power loss ride-thru: 2 sec
- Auto restart after power loss or resettable fault, programmable
- Feedback signal loss detection
- Serial communications loss detection
- "Up/Down" floating point control
- Stationary motor auto-tuning
- Customizable monitor display
- Sleep function
- Run permissive input
- Runtime changes in control and display
- Project-specific parameter reinitialization

Protective Features

- Current limited stall prevention
- Heat sink over-temperature, speed fold-back
- Cooling fan operating hours recorded
- Bi-directional start into rotating motor at synchronized speed
- DC bus charge indicator
- Current limiting DC bus fuse
- Optically-Isolated controls
- Short circuit protection: phase-phase and phase-neutral
- Ground fault protection
- Short circuit withstand rating: 65K RMS, 100K RMS with bus reactor
- Electronic motor overload: UL
- Current and torque limit
- Fault display: last 10 faults
- Fault trace
- Fault circuit: OC, OV, OT
- Program security code
- Reverse prohibit selectability

Design Features

- 32-bit microprocessor logic
- Flash upgradeable firmware
- Non-volatile memory, program retention
- Surface-mount components
- Displacement power factor: 0.98
- Output frequency: 0.1 to 120 Hz
- Frequency resolution: 0.06 Hz
- Frequency regulation: 0.1%
- Control Terminal Board: quick disconnect, removable
- Carrier frequency: selectable to 15 kHz
- 3% DC bus reactor: 30-150 HP, 208 VAC; 30-150 HP, 240 VAC; 40-500 HP, 480 VAC; optional on lower ratings
- Keypad Operator: Hand/Off/Auto, built-in copy feature, 7 languages
- LCD display: 5 lines, 16 characters each
- 24 VDC control logic
- Transmitter/Option power supply 15 VDC, 20 mA
- Output contacts: one form C and two programmable form A
- Input/output terminal status
- Input terminals: 5 programmable multi-function input terminals
- Fault input: programmable
- Diagnostic fault indication in selected language
- Timer function: Elapsed time, Delay on start, Delay on stop
- RS-422/485 port: embedded Metasys N2, APOGEE FLN, and Modbus
- Volts/hertz ratio: 15 preset and 2 programmable V/Hz patterns
- Multi-speed settings: 5 available
- Remote speed command: 0-10 VDC or 4-20 mA, direct or reverse-acting
- Setpoint (PI) control with inverse or square root input, differential control via two feedback capability
- Feedback signal: low pass filter
- Speed command: bias and gain
- Analog outputs: programmable, two, 0-10 VDC
- Meter Functions: volt, amp, kilowatt, elapsed run time, speed command
- Output Current Transformers, three
- NEMA 1 or protected chassis
- UL, cUL listed and CE marked; IEC 146;
- MTBF: exceeds 28 years

Service Conditions

- Ambient Temperature: -10°C to 40°C NEMA 1, 45°C protected chassis (14°F to 104°F, 113°F)
- Humidity: 95% RH, non-condensing
- Altitude: 3300 ft; higher by derate
- Input voltage: +10% or -15%
- Input frequency: 50/60 Hz ± 5%
- 3-phase, 3-wire, phase sequence insensitive
- Plenum rated (UL 1995)

Bypass Features

- Standard package to 250 HP
- Input, output, and bypass contactors
- Circuit breaker disconnect (MCP), with interlocked, through-the-door operating mechanism
- Thermal motor overload relay, class 20
- 115 VAC control transformer, fused
- Drive/Bypass selector switch
- Hand/Off/Auto selector switch
- Normal/Test selector switch
- Pilot lights, 22mm LED, for Control Power, Drive Run, Drive Fault, Bypass Run, Motor OL/Safety Fault and Smoke Purge
- Switch selectable auto transfer to bypass on drive fault
- Switch selectable remote transfer to bypass via contact closure
- Switch selectable smoke purge function
- Run mode and Fault contacts
- Control and safety circuit terminal strip
- Damper circuit safety interlock
- Customer use, 115V, 100VA

Options

- Remote digital operator kit
- Input fuses, I^2t; circuit breakers
- Oversized control transformer
- NEMA 3R and 12 enclosures
- Input and/or output reactor
- Twelve-pulse rectification with input transformer: 30 -150 HP, 208 VAC; 30-150 HP, 240 VAC; 40-500 HP, 480 VAC
- Communication Interface: LonWorks
- RFI/EMI filter
- Pressure transducer, 3-15 PSI
- Multiple motor operation logic
- Speed potentiometer
- Run/Stop push buttons
- Motor protection load reactor
- Engraved nameplates
- Analog outputs: programmable, two, 4-20 mA
- DriveWizard™ upload/download and monitoring/graphing software

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