EATON | Cutler-Hammer

Choosing Enclosed Control AF Drive Options

Application Note

New Information
March 2007

9000X Series Option Boards

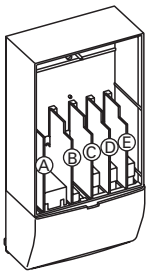

Table 1. Option Board Kits

Option Kit Description ②	Allowed Slot Locations ①	Field Installed		SVX Ready Programs						
		Catalog Number	Option Designator	Basic	Local/ Remote	Standard	MSS	PID	Multi-P.	PFC
Standard I/O Cards (shown above)										
2 RO (NC/NO)	B	**OPTA2**	**—**	X	X	X	X	X	X	X
6 DI, 1 DO, 2 AI, 1AO, 1 +10V DC ref, 2 ext +24V DC/ EXT +24V DC	A	**OPTA9**	**—**	X	X	X	X	X	X	X
Extended I/O Card Options										
6 DI, 1 ext +24V DC/EXT +24V DC	B, C, **D**, E	**OPTB1**	**B1**	—	—	—	—	—	X	X
1 RO (NC/NO), 1 RO (NO), 1 Therm	B, C, **D**, E	**OPTB2**	**B2**	—	—	—	—	—	X	X
1 AI (mA isolated), 2 AO (mA isolated), 1 ext +24V DC/EXT +24V DC	B, C, **D**, E	**OPTB4**	**B4**	X	X	X	X	X	X	X
3 RO (NO)	B, C, **D**, E	**OPTB5**	**B5**	—	—	—	—	—	X	X
1 ext +24V DC/EXT +24V DC, 3 Pt100	B, C, **D**, E	**OPTB8**	**B8**	—	—	—	—	—	—	—
1 RO (NO), 5 DI 42 – 240V AC Input	B,C, **D**, E	**OPTB9**	**B9**	—	—	—	—	—	X	X
Communication Cards ③										
Modbus	D, **E**	**OPTC2**	**C2**	X	X	X	X	X	X	X
Johnson Controls N2	D, **E**	**OPTC2**	**CA**	—	—	—	—	—	—	—
Profibus DP	D, **E**	**OPTC3**	**C3**	X	X	X	X	X	X	X
LonWorks	D, **E**	**OPTC4**	**C4**	X	X	X	X	X	X	X
Profibus DP (D9 Connector)	D, **E**	**OPTC5**	**C5**	X	X	X	X	X	X	X
CanOpen (Slave)	D, **E**	**OPTC6**	**C6**	X	X	X	X	X	X	X
DeviceNet	D, **E**	**OPTC7**	**C7**	X	X	X	X	X	X	X
Modbus (D9 Type Connector)	D, **E**	**OPTC8**	**C8**	X	X	X	X	X	X	X
Modbus TCP	D, **E**	**OPTCI**	**CI**	X	X	X	X	X	X	X
BACnet	D, **E**	**OPTCJ**	**CJ**	X	X	X	X	X	X	X
Ethernet IP	D, **E**	**OPTCK**	**CK**	X	X	X	X	X	X	X
RS-232 with D9 Connection	D, **E**	**OPTD3**	**D3**	X	X	X	X	X	X	X

① Option card must be installed in one of the slots listed for that card. Slot indicated in **Bold** is the preferred location.
② AI = Analog Input; AO = Analog Output, DI = Digital Input, DO = Digital Output, RO = Relay Output
③ OPTC2 is a multi-protocol option card.

Control/Communication Options

Table 2. Available Control/Communications Options

Option	Description	Option Type
K1	**Door-Mounted Speed Potentiometer** — Provides the DRIVE with the ability to adjust the frequency reference using a door-mounted potentiometer. This option uses the 10V DC reference to generate a 0 – 10V signal at the analog voltage input signal terminal. When the HOA bypass option is added, the speed is controlled when the HOA switch is in the hand position. Without the HOA bypass option, a 2-position switch (labeled local/remote) is provided on the keypad to select speed reference from the Speed Potentiometer or a remote speed signal.	Control
K2	**Door-Mounted Speed Potentiometer with HOA Selector Switch** — Provides the DRIVE with the ability to start/stop and adjust the speed reference from door-mounted control devices or remotely from customer supplied inputs. In HAND position, the drive will start and the speed is controlled by the door-mounted speed potentiometer. The drive will be disabled in the OFF position. When AUTO is selected, the drive run and speed control commands are via user-supplied dry contact and 4 – 20 mA signal.	Control
K3	**3 – 15 psig Follower** — Provides a pneumatic transducer which converts a 3 – 15 psig pneumatic signal to either 0 – 8V DC or a 1 – 9V DC signal interface with the DRIVE. The circuit board is mounted on the inside of the front enclosure panel and connects to the user's pneumatic control system via 6 ft. (1.8m) of flexible tubing and a 1/4 inch (6.4 mm) brass tube union.	Control
K4	**HAND/OFF/AUTO Switch for Non-bypass Configurations** — Provides a three-position selector switch that allows the user to select either a Hand or Auto mode of operation. Hand mode is defaulted to keypad operation, and Auto mode is defaulted to control from an external terminal source. These modes of operation can be configured via drive programming to allow for alternate combinations of start and speed sources. Start and speed sources include Keypad, I/O and Fieldbus.	Control
K5	**MANUAL/AUTO Speed Reference Switch** — Provides door-mounted selector switch for Manual/Auto speed reference.	Control
K6	**START/STOP Pushbuttons** — Provides door-mounted START and STOP pushbuttons for either bypass or non-bypass configurations.	Control
K9	**(2) Factory Installed Auxiliary Contacts** — Provides two NO/NC auxiliary contacts.	Power
KA	**115V Control Transformer – 250 VA** — Provides a fused control power transformer with 115V for customer use.	Control
KB	**115V Control Transformer – 500 VA** — Provides a fused control power transformer with 115V for customer use.	Control
KF	**Bypass Test Switch for RB and RA** — Allows the user to energize the AF drive for testing while operating the motor on the bypass controller. The Test Switch is mounted on the inside of the enclosure door.	Addl. Bypass
KO	**Standard Elapsed Time Meter** — Provides a door-mounted elapsed run time meter.	Control
KQ	**Volt Meter** — Provides an analog voltmeter and three-position switch for phase selection. Includes PTs connected to drive input.	Control
KR	**Amp Meter** — Provides an analog ammeter and three-position switch for phase selection. Includes CTs connected to drive input.	Control
KS	**Frequency Meter** — Provides a separate analog frequency meter connected to drive analog output.	Control
KT	**IQ100 Meter** — Provides a digital ammeter/voltmeter. Includes CTs and PTs connected to drive input.	Control
KU	**MP3000 w/URTD, CT** — Provides a motor protection relay with CTs to monitor 3-phase current and ground current and a universal RTD module to monitor up to 11 individual RTDs.	Control
KV	**MP3000 URTD w/out CT** — Provides motor protection relay with universal RTD module to monitor up to 11 individual RTDs.	Control
KW	**469 Motor Management Relay** — Includes the 469 motor management relay with provision to monitor up to 12 RTDs, CTs to monitor 3-phase current and ground current and PTs to monitor line voltage.	Control
KX	**IQ200 Meter** — Provides measurement and display of power line conditions, includes 3-phase CTs.	Control
L1	**Power On and Fault Power Lights** — Provides a white power on light that indicates power to the enclosed cabinet and a red fault light that indicates a drive fault has occurred.	Light
L2	**Bypass Pilot Lights for RB, RA Bypass Options** — A green light indicates when the motor is running in inverter mode and an amber light indicates when the motor is running in bypass mode. The lights are mounted on the enclosure door, above the switches.	Addl. Bypass
LA	**Green RUN Light (22 mm)** — Provides a green run light that indicates the drive is running.	Light
LD	**Green STOP Light (22 mm)** — Provides a green stop light that indicates the drive is stopped.	Light
LE	**Red Run Pilot Light (22 mm)** — Provides a red run pilot light that indicates the drive is running.	Light
LF	**Red STOP Light (22 mm)** — Provides a red stop light that indicates the drive is stopped.	Light
LJ	**Power On Light (22 mm)** — Provides a white power on light that indicates the drive enclosure power is on.	Light
LU	**Misc. Light (22 mm)** — Provides misc. "user defined" pilot light. User to define light function and color.	Light
LW	**PTT (Push-To-Test) Light (22 mm)** — Provides misc. "user defined" PTT pilot light. User to define light function and color.	Light
LY	**Adder for LED Each** — Changes light packages from standard incandescent bulb to LED style bulb.	Light
P1	**Input Disconnect Assembly Rated to 100 kAIC** — High Interrupting Motor Circuit Protector (HMCP) or Circuit Breaker that provides a means of short circuit protection for the power cables between it and the DRIVE, and protection from high-level ground faults on the power cable. Allows a convenient means of disconnecting the DRIVE from the line and the operating mechanism can be padlocked in the OFF position. This is factory mounted in the enclosure.	Input
P3	**Input Line Fuses Rated to 200 kAIC** — Provides high-level fault protection of the DRIVE input power circuit from the load side of the fuses to the input side of the power transistors. This option consists of three 200 kA fuses, which are factory mounted in the enclosure.	Input
P5	**Additional 3% Reactor** — This option is recommended to meet drive specifications with 5% line reactor requirement. Provides a separate 3% line reactor mounted inside the drive cabinet and provides a total of 6% line reactance at full load.	Input

Table 2. Available Control/Communications Options (Continued)

Option	Description	Option Type
P7	**MOV Surge Suppressor** — Provides a Metal Oxide Varistor (MOV) connected to the line side terminals and is designed to clip line side transients.	Input
P8	**TVSS Transient Voltage Surge Suppressor** — Provides transient voltage surge suppression of the unit. Consult factory for ratings.	Input
PE	**Output Contactor** — Provides a means for positive disconnection of the drive output from the motor terminals. The contactor coil is controlled by the drive's run or permissive logic. NC and NO auxiliary contacts rated at 10A, 600V AC are provided for customer use. Bypass Options **RB** and **RA** include an Output Contactor as standard. This option includes a low VA 115V AC fused Control Power Transformer and is factory mounted in the enclosure.	Output
PF	**Output Filter** — Used to reduce the transient voltage (DV/DT) at the motor terminals. The Output Filter is recommended for cable lengths exceeding 100 ft. (30m) or for a drive rated at 525 – 690V. This option is mounted in the enclosure, and may be used in conjunction with a Brake Chopper Circuit.	Output
PG	**MotoRx (300 – 600 Ft.) 1000 V/µS DV/DT Filter** — Used to reduce transient voltage (DV/DT) and peak voltages at the motor terminals. This option is comprised of a .5% line reactor, followed by capacitive filtering and an energy recovery/clamping circuit. Unlike the Output Filter (See option **PF**), the MotoRx recovers most of the energy from the voltage peaks, resulting in a lower voltage drop to the motor, and therefore conserving power. This option is used when the distance between a single motor and the drive is 300 – 600 feet (91 – 183m). *This option can not be used with the Brake Chopper Circuit. The Output Filter (option **PF**) should be investigated as an alternative.*	Output
PH	**Single Overload Relay** — Uses a bimetallic overload relay to provide additional overload current protection to the motor on configurations without bypass options. It is included with the Bypass Configurations for overload current protection in the bypass mode. The Overload Relay is mounted within the enclosure, and is manually resettable. Heater pack included.	Output
PI	**Dual Overload Relays** — This option is recommended when a single drive is operating two motors and overload current protection is needed for each of the motors. The standard configuration includes two bimetallic overload relays, each sized to protect a motor with 50% of the drive hp rating. For example, a 100 hp drive would include two overload relays sized to protect two 50 hp motors. The relays are mounted within the enclosure and are manually resettable. Heater packs not included.	Output
PN	**Dual Overloads for Bypass** — This option is recommended when a single drive is operating 2 motors in the bypass mode and overload current protection is needed for each of the motors. The standard configuration includes two bimetallic overload relays, each sized to protect a motor with 50% of the drive hp rating. For example, a 100 hp drive would include two overload relays sized to protect two 50 hp motors. The relays are mounted within the enclosure, and are manually resettable.	Addl. Bypass
RA	**Manual HOA Bypass Controller** — The Manual HAND/OFF/AUTO (HOA) — 3-contactor — bypass option provides a means of bypassing the DRIVE, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted HOA selector switch and an INVERTER/BYPASS switch. The HOA switch provides the ability to start and stop the drive in the inverter mode. For applications up to 250 hp, an ***IT.*** Series IEC input contactor, an ***IT.*** Series IEC output contactor, and an ***IT.*** Series IEC starter with an electronic overload relay is included. For applications above 250 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked.	Bypass
RB	**Manual IOB Bypass Controller** — The Manual INVERTER/OFF/BYPASS (IOB) — 3-contactor — bypass option provides a means of bypassing the DRIVE, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted IOB selector switch. For applications up to 250 hp, an ***IT.*** Series IEC input contactor, an ***IT.*** Series IEC output contactor, and an ***IT.*** Series IEC starter with an electronic overload relay is included. For applications above 250 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked.	Bypass
RC	**Auto Transfer HOA Bypass Controller** – The Manual HAND/OFF/AUTO (HOA) — 3-contactor — bypass option provides a means of bypassing the DRIVE, allowing the AC motor to be operated at full speed directly from the AC supply line. The circuitry provides an automatic transfer of the load to "across the line" operation after a drive trip. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted HOA selector switch and an INVERTER/BYPASS switch. The HOA switch provides the ability to start and stop the drive in either mode. For applications up to 250 hp, an ***IT.*** Series IEC input contactor, an ***IT.*** Series IEC output contactor, and an ***IT.*** Series IEC starter with an electronic overload relay is included. For applications above 250 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked. Door mounted pilot lights are provided which indicate bypass or inverter operation. A green light indicates when the motor is running in inverter mode and an amber light indicates when the motor is running in bypass mode. **WARNING**: The motor may restart when the overcurrent relay is reset when operating in bypass, unless the IOB selector switch is turned to the OFF position.	Bypass
RD	**Auto Transfer IOB Bypass Controller** — The Auto INVERTER/OFF/BYPASS (IOB) — 3-contactor — bypass option provides a means of bypassing the DRIVE, allowing the AC motor to be operated at full speed directly from the AC supply line. The circuitry provides an automatic transfer of the load to "across the line" operation after a drive trip. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted IOB selector switch. For applications up to 250 hp, an ***IT.*** Series IEC input contactor, an ***IT.*** Series IEC output contactor, and an ***IT.*** Series IEC starter with an electronic overload relay is included. For applications above 250 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked. Door mounted pilot lights are provided which indicate bypass or inverter operation. A green light indicates when the motor is running in inverter mode and an amber light indicates when the motor is running in bypass mode. **WARNING**: The motor may restart when the overcurrent relay is reset when operating in bypass, unless the IOB selector switch is turned to the OFF position.	Bypass
RG	**Reduced Voltage Starter for Bypass** — Used in conjunction with bypass option RA, RB, RC or RD. This option adds ***IT.*** Series reduced voltage soft starter to bypass assembly for soft starting in bypass mode.	Bypass

Table 2. Available Control/Communications Options (Continued)

Option	Description	Option Type
RI	**IntelliPass Bypass** — This option provides a means of bypassing the HVX9000, allowing the motor to be operated at full speed directly from the AC supply line. This option consists of an input disconnect, a 24V DC power supply and a full voltage bypass starter. Selection of inverter/bypass is at the keypad. Bypass starters are ***IT.*** Series IEC.	Bypass
S4	**Floor Stand 6"** — Raises "E" box off the ground 6" (152.4 mm). Recommended when box is not installed on an appropriate concrete pad.	Enclosure
S5	**Floor Stand 22"** — Converts a Size B or C, normally wall mounted enclosure to a floor standing enclosure with a height of 22" (558.8 mm).	Enclosure
S6	**Floor Stand 12"** — Converts a Size C, normally wall mounted enclosure to a floor standing enclosure with a height of 12" (304.8 mm).	Enclosure
S7	**10" Expansion** — In a Size 5 enclosure, the extension allows for bottom cable entry and additional space for customer mounted components. **NOTE:** Enclosure expansion rated NEMA Type 1 only.	Enclosure
S8	**20" Expansion** — In a Size 5 enclosure, the extension allows for bottom cable entry and additional space for customer mounted components. When the Output Filter (option **PF**) is selected for a drive using a Size 5 enclosure, this expansion box is required and included in the option pricing. **NOTE:** Enclosure expansion rated NEMA Type 1 only.	Enclosure
S9	**Space Heater** — Prevents condensation from forming in the enclosure when the drive is inactive or in storage. Includes a thermostat for variable temperature control. Heater requires a customer supplied 115V remote supply source.	Enclosure
SA	**Space Heater with CPT**— Prevents condensation from forming in the enclosure when the drive is inactive or in storage. Includes a thermostat for variable temperature control. A 200W heater is installed in enclosures A and B, and 400W heater is installed in enclosures C – D. Provided with CPT connected to load side of input disconnect.	Enclosure
SB	**Standard Control Relay** — Provides D2 series misc. "user defined" 4PDT control relay. Requires user to define functionality. Contacts are rated for 5 amps.	Enclosure
SC	**Heavy-Duty Control Relay** — Provides D7 series misc. "user defined" 4PDT control relay. Requires user to define functionality. Contacts are rated for 10 amps.	Enclosure
SD	**Terminal Blocks** — Provides four spare terminal block connections for customer use.	Enclosure
SE	**On-Delay Timer (Delay on Make)** — Provides misc. "user defined" time delay relay. Requires user to define functionality and time setting requirement.	Enclosure
SF	**Off-Delay Timer (Delay on Break)** — Provides misc. "user defined" time delay relay. Requires user to define functionality and time setting requirement.	Enclosure

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