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ACH 400

User's Manual

ACH 400 with Option Pack
(Classic Bypass)

ABB Automation Inc.



ACH 400 with Option Pack (Classic Bypass)

Users Manual

ACH 400-US-08OPT
3AUA489002B4238 R0101 Rev. D
EFFECTIVE: 5/15/00
SUPERSEDES: 5/10/00

Safety Instructions

General Safety Instructions

Warnings in this manual appear in either of two ways:

- *Dangerous voltage warnings*, preceded by a Dangerous Voltage symbol, indicate the presence of voltages which may cause death or serious injury. These warnings describe procedures to avoid death or serious injury.
- *General warnings*, preceded by a General Warning symbol, indicate situations or conditions which may cause death or serious injury. These warnings describe procedures to avoid death or serious injury.

CAUTIONS inform you of situations or conditions which will damage machinery or cause additional motor operation down-time if you do not take suggested steps to correct or address such situations or conditions.

Note: Notes provide you with additional and useful information. Although less urgent than cautions and warnings, notes are important and should not be ignored.

Warning Symbols

For your own safety please pay special attention to instructions containing these symbols:



This warning symbol indicates the presence of dangerous voltage. This symbol informs you of high voltage conditions, situations, and locations that may cause death or serious injury if you do not follow precautions and proper steps.



This warning symbol indicates a general warning.



This warning symbol indicates an electrostatic discharge hazard.

**Warnings, Cautions,
and Notes**



WARNING! Your drive contains dangerous voltages when connected to the line power. Always check that the ACH 401/402 is safe, after disconnecting the power, by measuring the DC bus voltage and line input voltage. Failure to check voltages could cause death or serious injury. Only a qualified electrician should carry out the electrical installation.

The DC bus capacitors contain dangerous DC voltage levels ($1.35 \times V_{IN}$). After disconnecting the supply, wait at least five minutes after the display readout on the control panel has disappeared before taking any measurements.

Dangerous external control voltages may be present on the relay outputs of the Control Interface Card and Option Cards.



CAUTION: Electrostatic Discharge (ESD) can damage electronic circuits. Do not handle any components without following the proper ESD precautions.

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Chapter 1 – Introduction

This chapter explains the purpose and contents of this manual, intended audience, and conventions used in this manual.

How To Use This Manual

The purpose of this manual is to provide you with the information necessary to install and start-up your ACH 400 with Option Pack. This manual also explains features and functions of the Option Pack and requirements such as external drive control connections, wiring, cable sizes, and cable routing.

The ACH 400 with Option Pack user documentation also includes the ACH 400 AC Drives User's Manuals. Both this manual and the ACH 400 User's Manuals are required to properly install and operate the ACH 400 with Option Pack.

Chapter 1 – Introduction, the chapter you are reading now, introduces you to the *ACH 400 with Option Pack User's Manual*.

Chapter 2 – Overview of the ACH 400 with Option Pack explains drive identification, available features and functions, as well as provides a detailed description of operation.

Chapter 3 – Installation Instructions covers Option Pack pre-installation planning, initial inspection, mounting and electrical wiring.

Chapter 4 – Start-up Procedure includes safety precautions, installation inspection and initial start-up tests.

Intended Audience

The audience for this manual has:

- Minimal knowledge of ABB product names and terminology.
- No experience or training in installing, operating, or servicing the ACH 400 with Option Pack.
- Basic knowledge of standard electrical wiring practices, electronic components, and electrical schematic symbols.

The audience for this manual will install and start-up the ACH 400 with Option Pack.

Terminal Block Nomenclature

This manual expresses specific terminal blocks and connections as a number, a letter or letters, a colon (:), and another number. The number and letter(s) to the left of the colon identify the terminal block, for example 1TB. The number to the right of the colon identifies the terminal number, for example 9. In this manual, a terminal connection numbered 9, located on a terminal block named 1TB, is identified as 1TB:9.

Warranty and Liability Information

The warranty for your ABB Option Pack covers manufacturing defects. The manufacturer carries no responsibility for damage due to transport or unpacking.

In no event and under no circumstances shall the manufacturer be liable for damages and failures due to misuse, abuse, improper installation, or abnormal conditions of temperature, dust, or corrosives, or failures due to operation above rated capacities. Nor shall the manufacturer ever be liable for consequential and incidental damages.

The period of manufacturer's warranty is 12 months, and not more than 18 months, from the date of delivery.

An extended warranty may be available with certified start-up. Contact your local distributor for details.

Your local ABB Drives company or distributor may have a different warranty period, which is specified in their sales terms, conditions, and warranty terms.

If you have any questions concerning your ACH 400 with Option Pack, contact your local distributor or ABB Drives office.

The technical data and specifications are valid at the time of printing. ABB reserves the right to subsequent alterations.

Chapter 2 – Overview of the ACH 400 with Option Pack

This chapter explains the numbers and letters on the control nameplate, describes available Option Pack features and functions, and includes illustrations. It also describes the ACH 400 with Option Pack hardware components and terminal block connections.

General Information

Control Identification

The ACH 400 with Option Pack is a packaging arrangement that provides space for mounting factory installed options as designated by the type code characters following a plus sign (+) after the ACH 400 base unit type code. Locate the Control Nameplate on the Option Pack and use Table 1 on page 2-2 to verify model number.

Figure 2-1 Type Code Description for the ACH 400 Option Pack

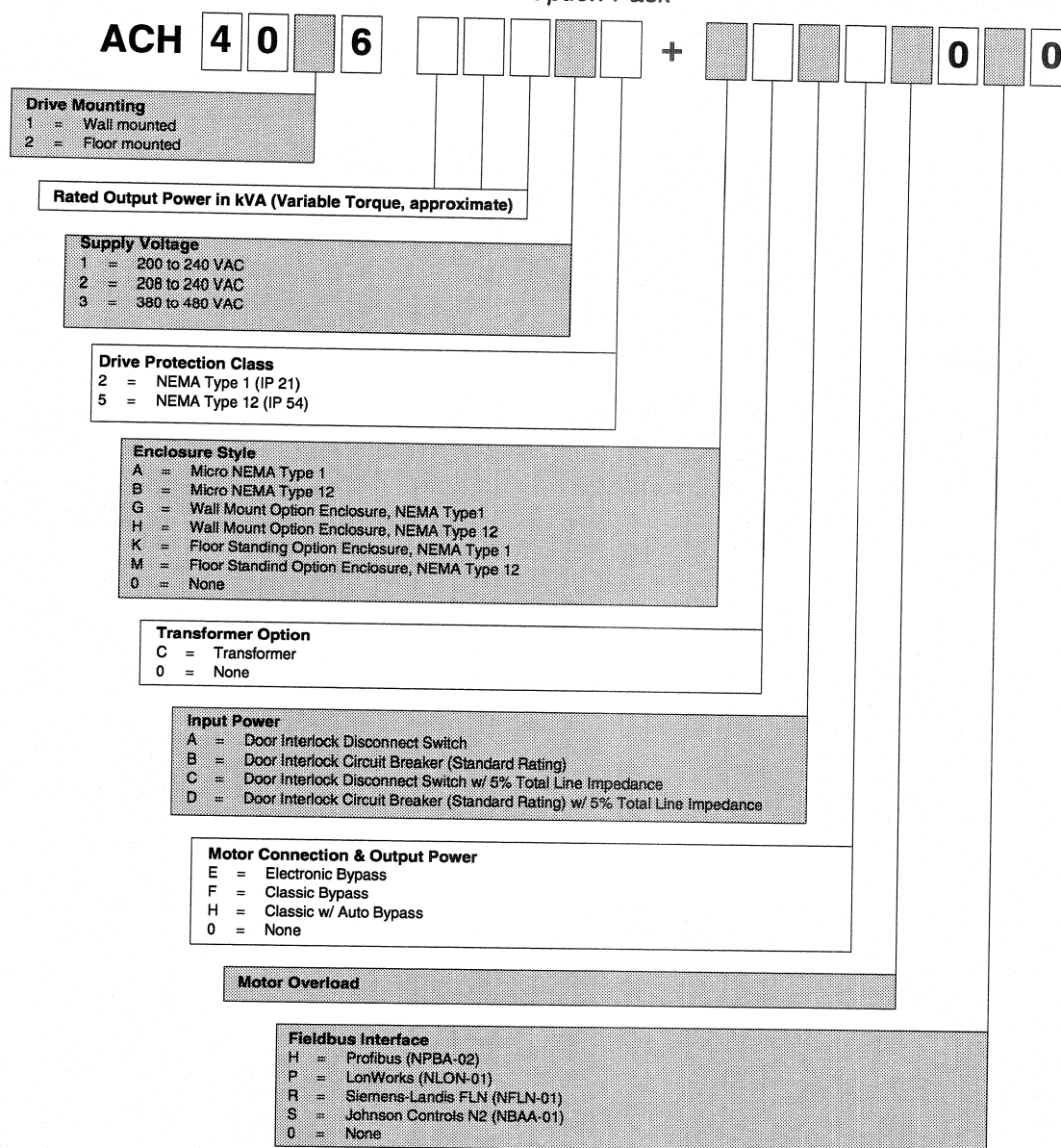


Table 2-1 Type Code Characters for Motor Overload Relays

Type Code Character	Trip Current Range			Type Code Character	Trip Current Range	
	R1 to R6	R7 to R9			R1 to R6	R7 to R9
A	4.74 to 5.21	108 to 113		L	32.1 to 34.9	277 to 307
B	6.96 to 8.09	114 to 125		M	35.0 to 37.8	308 to 345
C	10.5 to 10.9	126 to 138		N	37.9 to 41.7	346 to 381
D	12.1 to 14.5	139 to 153		P	46.0 to 49.0	382 to 420
E	14.6 to 16.8	154 to 163		R	49.1 to 54.2	421 to 465
F	16.9 to 18.4	164 to 180		S	57.1 to 62.8	466 to 529
G	18.5 to 20.9	175 to 194		T	62.9 to 69.1	
H	22.6 to 24.3	195 to 220		U	75.1 to 83.3	
J	24.4 to 27.2	221 to 247		W	93.0 to 100	
K	29.3 to 32.0	248 to 276		X	114 to 125.9	

Option Pack Features and Functions

The ACH 400 with Option Pack is an ACH 400 AC adjustable frequency drive with an extended enclosure for optional equipment. The ACH 400 with Option Pack may contain a fused disconnect switch or circuit breaker with door mounted operator (padlockable in the OFF position), a 3-contactor bypass or 2-contactor with input switch, motor overload protection, local control devices, indicator lights, and provisions for external control connections.

Figure 2-2 shows the interior of the ACH 400 Option Pack with Classic Bypass and identifies all of the bypass components. The figure shows the R1 through R4 frame size. Frames R5 and R6 are similar.

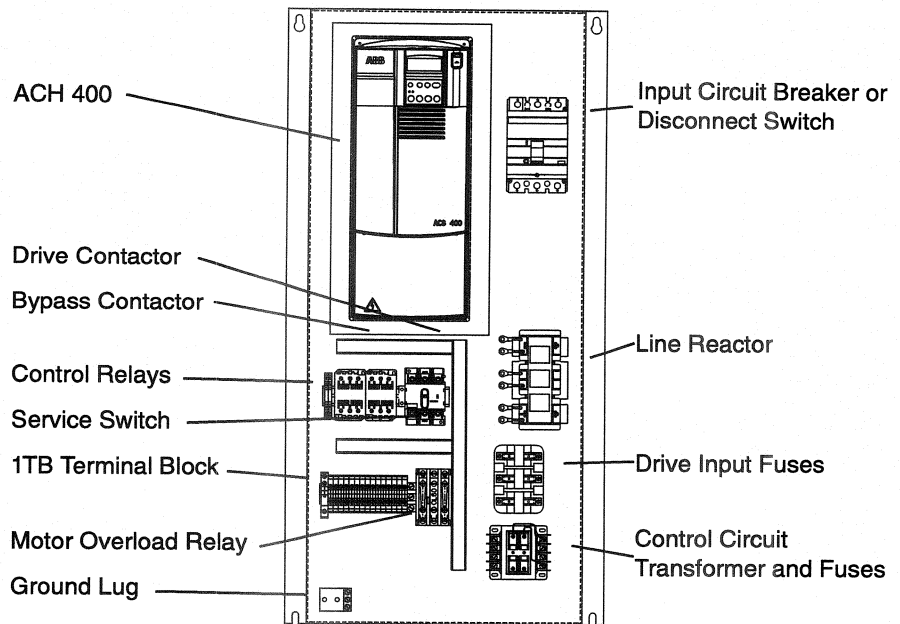


Figure 2-2 Option Pack Interior (R1-R4)

The Option Pack is furnished in either a NEMA Type 1 or NEMA Type 12 enclosure. The ACH 400 drive is mounted so the keypad is accessible through the door of the drive enclosure.

There are two sizes of wall mounted enclosure sizes for the R1 through R6 frame sizes and two sizes of floor mounted enclosures for the R7 through R9 frame sizes. Refer to Chapter 3 for enclosure dimensions and weights.

In the Option Pack with Classic Bypass, the basic control connections are made to 1TB, a din-rail terminal block at the bottom of the Option Pack compartment.

1TB is not present in units without the Classic Bypass. In these units, all control connections are made directly to Terminal Blocks X1 and X3 inside the ACH 400.

An analog output, additional digital outputs and other additional I/O connections are available on Terminal Blocks X1 and X3 inside the ACH 400. Refer to the *ACH 400 User's Manual*, for information about control connections on Terminal Blocks X1 and X3.

Detailed Description of Operation

The following paragraphs provide a detailed description of the various features and functions of the Option Pack. A circuit diagram is provided with the Option Pack.

Input Power	Input power is connected to the ACH 400 with Option Pack through a Door Interlocked Disconnect Switch or Circuit Breaker.
Door Interlocked Circuit Breaker	The Door Interlocked Circuit Breaker provides short circuit and ground fault protection for the motor in the bypass mode.
Door Interlocked Disconnect Switch	The Door Interlocked Disconnect Switch is a non-fused disconnect switch and is an alternative to the circuit breaker. If the Classic Bypass option is present, fuses are included to provide short circuit and ground fault protection for the motor in the bypass mode. Table 2-2 shows the UL listed fuse ratings for the fuses included with the Bypass.
Service Switch	A non-fused disconnect switch or switch and contactor is provided to allow power to be removed from the drive for servicing while the motor operates from line power. The service switch is mounted internally to prevent unauthorized persons from disrupting operation.
Drive Input Fuses	Drive input fuses are provided to disconnect the drive from power in the event that a component fails in the drive's power circuitry. These fuses are coordinated with the Option Pack input circuit breaker or Bypass fuses so that the input protection does not clear when the drive input fuses blow. If the drive input fuses blow, the motor can be switched to Bypass without replacing fuses or resetting the circuit breaker. The drive's electronic protection circuitry is designed to clear drive output short circuits and ground faults without blowing the drive input fuses. Table 2-2 shows the ACH 400 input fuse ratings. These fuses are UL Listed.
Line Reactor	The ACH 400 Option Pack may contain optional line reactors to provide impedance to supplement the drive's internal impedance and provide 5% total impedance to limit input harmonic currents.
Bypass Contactors	The bypass circuit available with the ACH 400 Option Pack includes two contactors. One contactor is the bypass contactor (2M) that can be used to manually connect the motor directly to the incoming power line in the event that the ACH 400 is out of service. The other contactor is the ACH 400 output contactor (3M) that disconnects the ACH 400 from the input power and the motor when the motor is operating in the Bypass mode. The drive output contactor and the bypass contactor are electrically and mechanically interlocked to prevent "back feeding," which occurs when line voltage is applied to the ACH 400 output terminals. An auxiliary contact on the drive output contactor starts the drive when the contactor is pulled in and stops the drive when the contactor is dropped out.

Table 2-2 Fuse Ratings

240 Volt Models		480 Volt Models		Frame	Input Disconnect Switch Fuse Ratings (Class J, Dual Element)		Drive Input Fuse Ratings (Semiconductor Protection)	
Type Codes	HP	Type Codes	HP		Amps (600 V)	Bussmann Type	Amps (660 V)	Bussmann Type
		ACH40160043x	3	R1	10	LPJ-10SP	10	KTK-R-10
		ACH40160053x	5		15	LPJ-15SP	15	KTK-R-15
ACH40160042x	3				20	LPJ-20SP	15	KTK-R-15
		ACH40160063x	7.5		20	LPJ-20SP	15	KTK-R-15
ACH40160052x	5				25	LPJ-25SP	25	KTK-R-25
		ACH40160093x	10	R2	25	LPJ-25SP	20	KTK-R-20
ACH40160062x	7.5				40	LPJ-40SP	30	KTK-R-30
		ACH40160113x	15		40	LPJ-40SP	30	KTK-R-30
ACH40160092x	10				50	LPJ-50SP	40	JJS-40
		ACH40160163x	20	R3	50	LPJ-50SP	40	JJS-40
		ACH40160203x	25		70	LPJ-70SP	50	JJS-50
ACH40160112x	15				70	LPJ-70SP	60	JJS-60
ACH40160162x	20				90	LPJ-90SP	80	JJS-80
ACH40160202x	25			R4	125	LPJ-125SP	100	JJS-100
		ACH40160253x	30		80	LPJ-80SP	60	JJS-60
		ACH40160303x	40		100	LPJ-100SP	80	JJS-80
		ACH40160413x	50		100	LPJ-100SP	100	JJS-100
ACH40160302x	30				125	LPJ-125SP	110	JJS-110
ACH40160412x	40				150	LPJ-150SP	150	JJS-150
		ACH40160603x	60	R5	125	LPJ-125SP	200	170M1370
		ACH40160703x	75	R6	150	LPJ-150SP	200	170M1370
ACH40160601x	50				175	LPJ-175SP	400	170M2621
		ACH40161003x	100		175	LPJ-175SP	200	170M1370
ACH40160701x	60				200	LPJ-200SP	400	170M2621
		ACH40261203x	125	R7			400	170M3169
		ACH40261403x	150				400	170M3169
ACH40160801x	75						400	170M3019
ACH40161001x	100						400	170M3019
		ACH40262103x	200	R8			550	170M5161
		ACH40262603x	250				700	170M5013
		ACH40263203x	300	R9			700	170M5013
		ACH40264003x	400				800	170M6012

Motor Overload Relay

The Motor Overload Relay is a bimetallic motor overload relay with a NEMA Class 20 trip curve. The overload relay provides thermal motor protection when operating a motor from the drive or from across the line power. If the overload trips, power is removed from the motor whether in Drive or Bypass mode. The Option Pack is shipped with heaters installed in the overload relay as specified by the Type Code. If the motor nameplate current is not within the range of the installed heaters, select replacement heaters from Table 2-3. The 30 through 180 amp overload relays are Siemens/Furnas products and the 500 amp overload is a Square D product with a current transformer.

Table 2-3 Overload Relay Heater Sizes

Heater Code	Overload Relay Trip Range (Amperes)				
	30 Amps	60 Amps	100 Amps	180 Amps	500 Amps
E44	4.36-4.73				
E46	4.74-5.21				
E51	6.96-8.09				
E55	10.5-10.9				
E57	12.1-14.5				
E60	14.6-16.8				
E61	16.9-18.4	16.9-18.4			
E62	18.5-20.9	18.5-20.9			
E66	22.6-24.3	22.6-24.7			
E67	24.4-27.2	24.8-27.2	27.1-30.0		
E70	29.3-30.0	29.3-32.0	33.3-35.7		
E71		32.1-34.9	35.8-39.4		
E73		35.0-37.8	43.5-46.9		
E73A		37.9-41.7			
E76		46.0-49.0	51.6-57.0		
E77		49.1-54.2	57.1-62.8		
E78		54.3-60.0	62.9-69.1		
E80			75.1-83.3		
E96			83.4-86.9		
E97			87-92.9		
E98			93-97.9		
E101				108-113	
E102				114-125	
E103				126-138	
E104				139-153	
E106				154-163	
E107				164-180	
AR3.28					175-194
AR3.62					195-220
AR3.98					221-247
AR4.37					248-276
AR4.80					277-307
AR5.30					308-345
AR5.80					346-381
AR6.40					382-420
AR7.00					421-465
AR7.70					466-529

**Overload Relay
Trip Reset**

In the event that the overload relay trips, it is necessary to open the door of the Option Pack and push the Reset Button on the front of the overload relay to reset it.

WARNING: If power is applied and the switches and contacts in the control circuit are commanding the motor to run, the motor will start as soon as the overload relay resets.

Use caution when manually resetting the overload relay to make sure it is safe to start the motor.

Control Circuits

The Control Circuits include a 115 VAC control power transformer, control relays, door mounted operator control devices and a terminal block for connection of external control circuitry.

**Control Power
Transformer**

The control power transformer provides 115 VAC power for the contactor, relay coils and door mounted pilot lights. At least 15 VA is available for external devices.

Pilot Lights

Door mounted push-to-test type pilot lights labeled “Drive” and “Bypass” indicate that the motor is running from either drive output power or AC line power. A pilot light labeled “External Fault” indicates that the motor overload relay has tripped or one of the external interlock devices has opened.

**External Speed
Reference Input**

The input identified as the “Auto Speed Signal” (1TB:1(–) & 1TB:2(+)) is an analog input signal that sets the speed of the drive when the ACH 400 is in the AUTO control mode.

Relay Contact Inputs

Terminals are provided for connecting three external contact inputs to the Option Pack control circuit.

One input is labeled “Customer Supplied External Start (Auto)” (1TB:9 & 1TB:10). This input is connected to a normally open contact that starts and stops the drive when the ACH 400 is in the AUTO control mode. A jumper can be installed between terminals 1TB:9 and 1TB:10 if this input is not used. If a jumper is installed, the drive will be started by pressing either the HAND or AUTO key.

One input is labeled “Customer Run Enable” (1TB:7 & 1TB:8). This input is connected to the series combination of any external normally closed interlock contacts that must be closed to allow the motor to run. If any of these external contacts is open, the External Fault relay is deenergized, the External Fault pilot light is illuminated, the Drive Contactor and the Bypass Contactor are deenergized, and the motor is prevented from running. The Option Pack is shipped with a jumper installed between terminals 1TB:7 and 1TB:8. This jumper must be removed before connecting the external fault contacts.

Control Relays

An External/MOL Fault relay (1CR) is energized when the motor overload relay is reset and all external fault interlock contacts are closed. When this relay is deenergized, the External Fault pilot light is illuminated and the auto start relay, the drive contactor and the bypass contactor are also deenergized.

Two Auto Start relays (2CR and 3CR) are energized when the customer's external start contact is closed. 2CR provides a contact closure to start the ACH 400 when *Drive* is selected and 3CR provides a contact closure to energize the bypass contactor when *Bypass* is selected.

An Auto Bypass relay (4CR) is provided when the Automatic Bypass option is furnished.

Drive/Off/Bypass Switch

The Drive/Off/Bypass switch is a door mounted switch, wired at the factory. This switch determines whether the motor will be powered from the output of the ACH 400 or from AC line power. When the switch is in the *DRIVE* position, the motor will be powered from the ACH 400. When the switch is in the *BYPASS* position, the motor will be powered from AC line power. When the switch is in the *OFF* position, the motor will be disconnected from all sources of power and prevented from operating regardless the status of the ACH 400 control panel keypad.

CAUTION: When changing from Bypass to Drive, place the Bypass Switch in the *OFF* position for five seconds before selecting Drive. Failure to do so could result in damage to the ACH 400.

Relay Contact Output

A Motor Running relay contact output is provided for external indication of the motor status. The output consists of a normally open auxiliary contact on the bypass contactor and a normally open Drive Running contact from the ACH 400. The two contacts are connected in parallel so that a contact closure is provided whenever the motor is running.

Automatic Bypass Option

With the Automatic Bypass option, the motor is automatically transferred to line power if the drive trips out on a protective trip. If automatic restart has been enabled on the drive, the drive will attempt to automatically restart before the motor is transferred to line power.

An Auto Bypass relay (4CR) is provided when the Automatic Bypass option is furnished. The auto bypass relay is energized by the drive's fault relay output (RO1) when a drive fault occurs. If the Drive-Off-Bypass switch is set to either Drive or Bypass, the auto bypass relay energizes the Bypass contactor. The automatic bypass relay does not deenergize when the drive fault is cleared or power is removed from the drive. To reset the auto bypass relay and allow the motor to be operated by the drive, switch the Drive-Off-Bypass switch to Off and then to Drive.

Chapter 3 – Installation Instructions

This chapter explains how to install the ACH 400 with Option Pack and connect all power, motor, and control wiring. It also explains the initial inspection procedures.

Pre-Installation Planning

Before beginning installation, review the installation instructions in this chapter and make sure that the installation requirements can be met. The following topics should be considered in pre-installation planning:

- Environment
- Heat Dissipation Requirements
- Mounting Area
- Wiring Requirements

Environment

These drives are to be used in a heated, indoor controlled environment that is relatively free of moisture and conductive contaminants such as condensation, carbon dust, and the like.

The maximum ambient temperature allowed is 104°F (40°C) for an ACH 400 in the NEMA Type 1 or NEMA Type 12 Option Pack enclosure. The rating is based on a variable torque load with the load current lower than or equal to the continuous maximum load current (I_{RSQ}).

Heat Dissipation Requirements

ACH 400 drives are self-cooled. The cooling air entering the drive must be clean and free from corrosive materials. The tables below give the heat dissipated into the hot air exhausted from the drives. If the drives are installed in a confined space, the heat must be removed from the area by ventilation or air conditioning equipment.

Table 3-1 Heat Dissipation for ACH 400 Option Pack Units

240 Volt Models		480 Volt Models		Heat Dissipation			
				Drive Only		Drive with Line Reactors	
Type Codes	HP	Type Codes	HP	Watts	BTU/Hr	Watts	BTU/Hr
ACH40160042x	3			80		95	
		ACH40160043x	3	100	340	115	390
ACH40160052x	5			120		140	
		ACH40160053x	5	130	440	145	490
ACH40160062x	7.5	ACH40160063x	7.5	180	610	195	670
ACH40160092x	10	ACH40160093x	10	240	820	260	700
		ACH40160113x	15	340	1160	360	1230
ACH40160112x	15			340		390	
		ACH40160163x	20	460	1570	490	1670
ACH40160162x	20			460		520	
		ACH40160203x	25	570	1950	620	2120
ACH40160202x	25			610		680	
		ACH40160253x	30	670	2290	730	2490
ACH40160302x	30			750		840	
		ACH40160303x	40	910	3110	970	3310
ACH40160402x	40			910		1010	
		ACH40160413x	50	1110	3790	1180	4030
		ACH40160603x	60	1800	6150	1910	6520
		ACH40160703x	75	2100	7170	2200	7510
ACH40160601x	50			2185	7500	2300	7850
ACH40160701x	60			2950	10100	3080	10500
		ACH40161003x	100	3000	10200	3120	10650
		ACH40261203x	125	3600	12300		
		ACH40261403x	150	4200	14300		
		ACH40262103x	200	6300	21500		
		ACH40262603x	250	7800	26600		
		ACH40263203x	300	9600	32800		
		ACH40264003x	400	12000	40900		

If the cooling air contains dust, clean the cooling surfaces of the unit regularly using clean compressed air and a brush. Avoid blowing air directly into the drive module. If the ACH 400 is in a NEMA 1 enclosure, cover the vents to prevent the dust from entering the unit.

If the heatsink is not cleaned and is not able to dissipate the expended heat, the ACH 400's thermal protection will operate, causing a fault indication which stops the drive. The ACH 400 can be started again when the temperature of the heatsink has fallen below the tripping level.

Mounting Area

When mounting the control take the following precautions.

- DO NOT mount in direct sunlight.
- DO NOT mount on surfaces with a temperature above 104°F (40°C).
- DO NOT allow the ambient temperature around the ACH 400 to exceed the ambient temperature as previously stated in the *Environment* section.
- Mount the Option Pack enclosure vertically with the ACH 400 control panel at the top. There are no factory supplied knockouts at the bottom.
- Enclosure dimension drawings are supplied in the back of this manual.
- For proper cooling, each unit must have adequate free space around the enclosure for air flow as listed below.

Wall mounted units (R1-R6) require two inches (50 mm) of clear space on each side and 12 inches (300 mm) of free space above and below the enclosure. If units are to be mounted next to each other, there must be a total of four inches (100 mm) from unit to unit. The units can not be mounted one above the other.

Floor mounted units require 8 inches (200 mm) of free space above the top of the enclosure.

Wiring Requirements

The ACH 400 with Option Pack is designed for use on a three-phase system. Four wires (three phase wires plus a ground wire) are required for the input wiring. Input and output conductors, and branch circuit protection must be sized to local codes. All field power wiring shall be copper, rated for 60°C if rated for less than 100 amps or 75°C if rated 100 amps or more. At least three separate conduits are required, one for input power, one for output power and one for control signals. The External Speed Reference signal must be wired using a shielded, twisted pair cable. Refer to *Electrical Installation* on page 3-5 for detailed wiring information.

Initial Inspection Procedure

As you unpack the ACH 400 with Option Pack, check for any signs of damage and verify that the delivery is complete. In the event of damage, please contact the shipping company or the supplier. Locate the drive nameplate and confirm that the Option Pack is configured to the order specifications. Refer to *Chapter 2 – Overview of the ACH 400 with Option Pack* in this manual.

If the Option Pack is stored before start-up, verify that the environmental conditions in the storage room are acceptable:

- Temperature between -40°F and +158°F (-40°C and +70°C),
- Relative humidity is less than 95 percent, and
- No condensation.

The warranty covers defects in manufacturing. The manufacturer carries no responsibility for damage incurred during transport or unpacking.

If any questions arise concerning the ACH 400 with Option Pack, please contact your Distributor or local ABB Drives Office.

Mechanical Installation

Wall Mounted Units

Before mounting the unit, verify that the environmental conditions conform to the specifications listed in *Pre-Installation Planning* in this chapter. Mount the ACH 401 with Option Pack on a wall in a vertical position. Use the four mounting points at the top and bottom of the unit.

To ensure safe installation, check that the surface of the mounting location is flat.

Attach the Option Pack enclosure at the mounting points and tighten the bolts.

Floor Mounted Units

Before mounting the unit, verify that the environmental conditions conform to the specifications listed in *Pre-Installation Planning* in this chapter. The floor mounted units can be anchored to the floor using bolt holes in the floor of the enclosure or by using anchoring clips that can be inserted in slots in the bottom front and back edges of the enclosure.

Dimensions and Weights

Dimensions and weights of the ACH 400 Option Pack units are given in Table 3-2. Dimension drawings are provided in the back of this chapter.

Table 3-2 ACH 400 Option Pack Dimensions and Weights

240 Volt Models		480 Volt Models		Height mm/in	Width mm/in	Depth mm/in	Weight kg/lb		Frame Size	Dim. Ref.	
Type Codes	HP	Type Codes	HP				Option Pack	Reactor Option			
		ACH40160043x	3	1092 43	559 22	976 14.8	37 82	3 7	R1	G1	
ACH40160042x	3	ACH40160053x	5								
ACH40160052x	5	ACH40160063x	7.5								
ACH40160062x	7.5	ACH40160093x	10								
ACH40160092x	10	ACH40160113x	15								
ACH40160112x	15	ACH40160163x	20								
ACH40160162x	20	ACH40160203x	25								
ACH40160202x	25	ACH40160253x	30	1499 59	762 30	525 20.7	72 159	15 33	R4	G2	
ACH40160302x	30	ACH40160303x	40								
ACH40160412x	40	ACH40160413x	50								
		ACH40160603x	60								
ACH40160601x	50	ACH40160703x	75								
ACH40160701x	60	ACH40161003x	100								
		ACH40261203x	125				2063 (81.2)	830 (32.7)	644 (25.4)		290 (650)
		ACH40261403x	150	1430 (56.3)	460 (1010)	515 (1130)				R8	K2
		ACH40262103x	200								
		ACH40262603x	250								
		ACH40263203x	300								
		ACH40264003x	400								

Note: R8 and R9 units without bypass are 830mm/32.7' wide. For weights of units without bypass, deduct 14 kg/30 lbs. for R7 units and 73 kg/160 lbs. for R8 and R9 units. NEMA Type 12 floor-mounted units slightly higher, refer to the detail drawings at the end of this section.

Electrical Installation

Cable Entries

ACH 401 Option Pack drives are configured for wiring access from the bottom only. ACH 402 Option Pack drives are configured for wiring access from the top only. At least three separate conduits are required, one for input power, one or two for output power to each motor and one for control signals.

Terminal Sizes

Power and motor cable terminal sizes are shown in Table 3-3 for connections to an input circuit breaker or disconnect switch and an input or output terminal block or overload relay.

Table 3-3 Wire Size Capacities of Power Terminals

240 Volt Models		480 Volt Models		Wire Size Range							
Type Codes	HP	Type Codes	HP	Circuit Breaker	Disconnect Switch	Terminal Block	Overload Relay	Ground Lug			
ACH40160042x	3	ACH40160043x	3	#14 - #1/0: 50 in/lbs.	#14 - #4: 18 in/lbs.	#14 - #10: 35 in/lbs. #8: 40 in/lbs. #6 - #4: 45 in/lbs. #3 - #1/0: 50 in/lbs.	30 A OL #8 max. 35 in/lbs.	Qty (3) #14 - #2: 35 in/lbs. #14 - #10 35 in/lbs. #8: 40 in/lbs. #6 - #4: 250 in/lbs.			
ACH40160052x	5	ACH40160053x	5				60 A OL #2 max. 35 in/lbs.				
ACH40160062x	7.5	ACH40160063x	7.5				100 A OL #2/0 max. 50 in/lbs.				
		ACH40160093x	10								
		ACH40160113x	15								
		ACH40160163x	20		#8 - #1/0: 55 in/lbs.						
		ACH40160203x	25				#2 - 300 MCM: 375 in/lbs.				
ACH40160092x	10	ACH40160253x	30						Not Applicable	Bus bar connection: Two holes, 10mm (3/8") dia. 1" spacing. NEMA two hole lugs can be used. 350 in/lbs.	180 A OL 250 MCM maximum: 200 in/lbs.
ACH40160112x	15	ACH40160303x	40								
ACH40160162x	20	ACH40160413x	50								
ACH40160202x	25	ACH40160603x	60								
ACH40160302x	30	ACH40160703x	75								
				25 kAIC CB: #4 to 300 MCM: 275 in/lbs.	Make connection to terminal block	Bus bar connection as described at left in Terminal Block column.					
ACH40160412x	40	ACH40161003x	100				65 kAIC CB: #6 to 350 MCM: 275 in/lbs.				
ACH40160601x	50							Qty (2) 3/0 to 250 MCM: 275 in/lbs.			
ACH40160701x	60										Qty (2) 250 MCM to 500 MCM: 275 in/lbs.
		ACH40261203x	125								
		ACH40261403x	150								
		ACH40262103x	200								
		ACH40262603x	250								
		ACH40263203x	300								
		ACH40264003x	400								

Input Wiring

The ACH 400 with Option Pack is designed for use on a three-phase system. Four wires (three phase wires plus a ground wire) are required for the input wiring.

All field power wiring shall be copper, rated for 60°C if rated for less than 100 amps or 75°C if rated 100 amps or more.

When furnished with the 25 KAIC circuit breaker option, the ACH 400 with Option Pack is suitable for use on a circuit capable of delivering not more than 25,000 rms symmetrical Amperes, 480 V maximum or 65,000 rms symmetrical Amperes, 240 V maximum. When furnished with the 65 KAIC circuit breaker option, the ACH 400 with Option Pack is suitable for use on a circuit capable of delivering not more than 65,000 rms symmetrical Amperes, 480 V maximum.



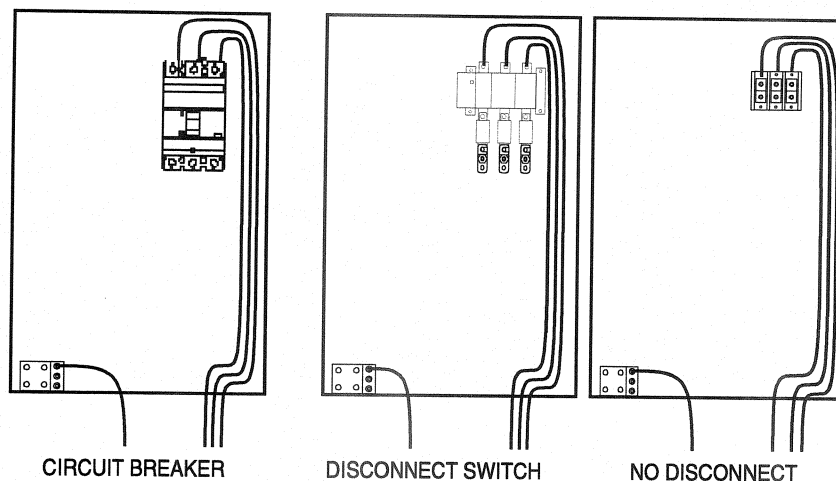
WARNING!

- Do not connect or disconnect input or output power wiring, or control wires, when power is applied.
- Never connect line voltage to drive output Terminals T1, T2, and T3.
- Do not make any voltage tolerance tests (Hi Pot or Megger) on any part of the unit. Disconnect motor wires before taking any measurements in the motor or motor wires.
- Make sure that power factor correction capacitors are not connected between the drive and the motor.

Connection Points

Connect input power to the terminals of the disconnect switch, circuit breaker, or terminal block. Connect the equipment grounding conductor to the ground lug at the bottom of the enclosure. Figure 3-1 shows the connection points for frames R1 through R6. For frames R7 through R9, refer to the detail drawings at the end of this chapter for conduit entry locations.

Figure 3-1 Input Power Connection Points



Output Wiring

Install the motor wiring away from other wire routes. Avoid long parallel runs with other wires. A dedicated conduit should be provided from the drive to the motor for the output wiring.



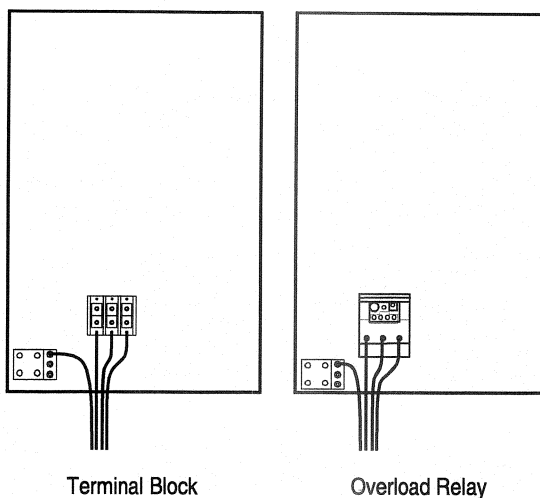
WARNING! Check the insulation on the motor wiring and the motor before connecting the ACH 400 to line power. Before proceeding with the insulation resistance measurements, check that the ACH 400 is disconnected from incoming line power. Failure to disconnect line power could result in death or serious injury.

1. Check that the motor wires are disconnected from the Option Pack output on Terminals T1, T2, and T3.
2. Check that the motor wires are disconnected from the motor and remove bridging connections at the motor.
3. Measure the insulation resistances of the motor. The voltage range of the insulation resistance meter must be at least equal to the line voltage, but not exceeding 1000 V. The insulation resistance must be greater than 1 megohm.
4. Measure the insulation resistance of the motor wiring between the phases and between each phase and ground. The insulation resistance must be greater than 1 megaohm.

Connection Points

Connect the motor cables to the overload relay or output terminal block. The motor grounding conductor can be connected to the ground lug. Figure 3-2 shows the connection points for frames R1 through R6. For frames R7 through R9, refer to the detail drawings at the end of this chapter for conduit entry locations.

Figure 3-2 Output Power Connection Points

**Motor Cable Length**

The rapid rate of voltage changes causes capacitive coupling between motor wiring and the grounded metallic conduit. This phenomenon can cause

substantially higher measured current than actual motor current, which may result in nuisance overcurrent trips. Table 3-4 lists the maximum motor cable length based on capacitive coupling. It may also be necessary to consider motor insulation requirements related to drive output dv/dt .

Table 3-4 Maximum Recommended Motor Wire Lengths

Frame Size	Maximum Cable Length	
	Feet	Meters
R1	330	100
R2, R3 & R4	660	200
R5, R6, R7, R8, R9	990	300

Note: Do not connect the motor wires before proceeding with the Keypad Control Test, Motor Disconnected. Refer to Keypad Control Tests, Chapter 4 – Start-up Procedure, in this manual.

Control Wiring

The control wiring includes connections to an analog speed command signal and start/stop relay contact for controlling the drive in the AUTO mode. There may also be connections to external run enable interlock contacts and a connection from the Motor Run contact to an external status indicating circuit. For a detailed description of the control circuit functions, refer to the section entitled *Detailed Description of Operation* on page 3-4.

Wiring Practices

The external control wiring to 1TB must not be run in the same conduit or raceway with any high power wiring. The external speed reference signal must be wired using a shielded, twisted pair cable. The shield connection must be terminated at the ground terminal provided (1TB:3). The other end of the shield should be cut and taped back at the signal source.

Connection Points

All of the basic control connections are made to 1TB, which is a din-rail terminal block at the bottom of the Option Pack compartment. 1TB accepts one wire per terminal in wire sizes ranging from 22 AWG to 8 AWG (10 AWG max. for ground terminal). Up to three wires per terminal can be connected with a proportional reduction in maximum wire size. The control terminals should be tightened to 13 inch - lbs. of torque.

Figure 3-5 shows connections 1TB1:1 through 1TB1:12. These connections are described in the following paragraphs.

Terminals 1TB:1 and 1TB:2 are low voltage signal input terminals (24 VDC maximum). Terminal 1TB:3 is a ground terminal for terminating the shielded cable. Terminals 1TB:4 to 1TB:8 are 115 VAC control circuit terminals connected to 115 VAC control power supplied by the control circuit transformer inside the Option Pack compartment. Terminals 1TB:9 to 1TB:12 are connected to un-powered relay contacts (dry contacts) provided for use with externally powered customer control circuits (250 VAC maximum).

Additional Connections

Analog outputs, additional relay outputs, and additional digital input connections are available on Terminal Block X1 inside the ACH 400. Note that the Option Pack control circuitry uses inputs and outputs AI2, DI1&2. These inputs are not available for any other purpose and must not be reconfigured. Input AI1 and output RO2 are wired to the Option Pack terminal block, 1TB. AI1, DI 3, 4 and 5, AO1 and RO1 are available for use. Refer to the *ACH 400 User's Manual* for information about control connections on Terminal Block X1. When making connections to Terminal Block X1, be careful not to disturb the factory installed wiring between X1 and the Option Pack control circuitry.

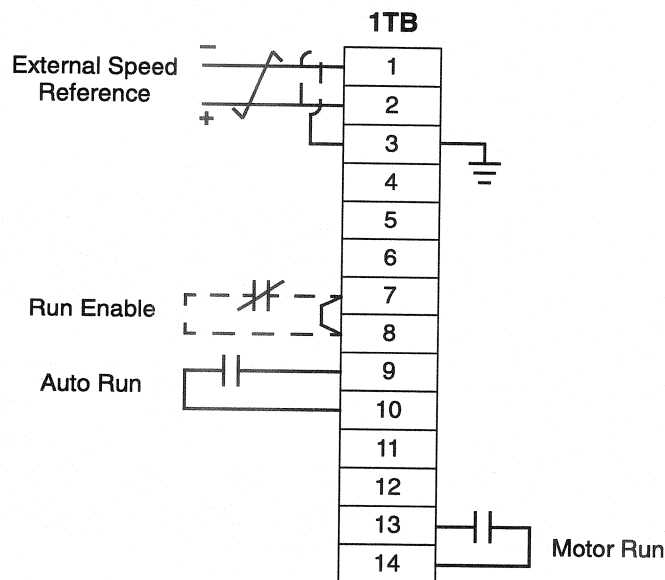
Terminal Block 1TB

Figure 3-3 Connections to 1TB

Analog Input

The customer's external "Auto" speed reference is connected to Terminals 1TB1: and 1TB2:. The Auto speed reference is factory wired from 1TB to ACH 400 analog input AI2.

The analog input can accept a voltage signal (0 – 10 VDC) or a current signal (0 – 20 mA). Jumpers S1 and S2, located on the Control Board in the ACH 400 (S1 for AI1 and S2 for AI2), determine the signal type. S1 can be set in either the voltage or current position according to the type of external signal that will be connected. Place the jumper in the V position for voltage or the I position for current. Figure 3-4 shows jumper positioning. The shaded areas represent jumper positioning.



Figure 3-4 Jumper Positions

Run Enable Interlocks Run Enable interlocks, such as Freeze, Fire, and Smoke protection are normally closed dry contacts connected in series between 1TB:7 and 1TB:8. When any of these contacts opens, the motor will stop, whether in DRIVE or BYPASS. The Option Pack is shipped with jumpers installed from 1TB:7 to 1TB:8. This jumper must be removed before connecting external contacts.

Auto Start Contact To start the ACH 400 by dry contact (maintained), connect the contact to 1TB:9 and 1TB:10. Closing this contact will start the motor when the drive is in the AUTO mode.

Relay Contact Output A “Motor Running” relay contact output is provided at terminals 1TB:13 and 1TB:14 for external indication of the motor status. The output consists of a normally open auxiliary contact on the bypass contactor and a normally open “Drive Running” contact from the ACH 400. The two contacts are connected in parallel so that a contact closure is provided whenever the motor is running.

“Drive Run” contact ratings:

Maximum Voltage: 30 VDC / 250 VAC

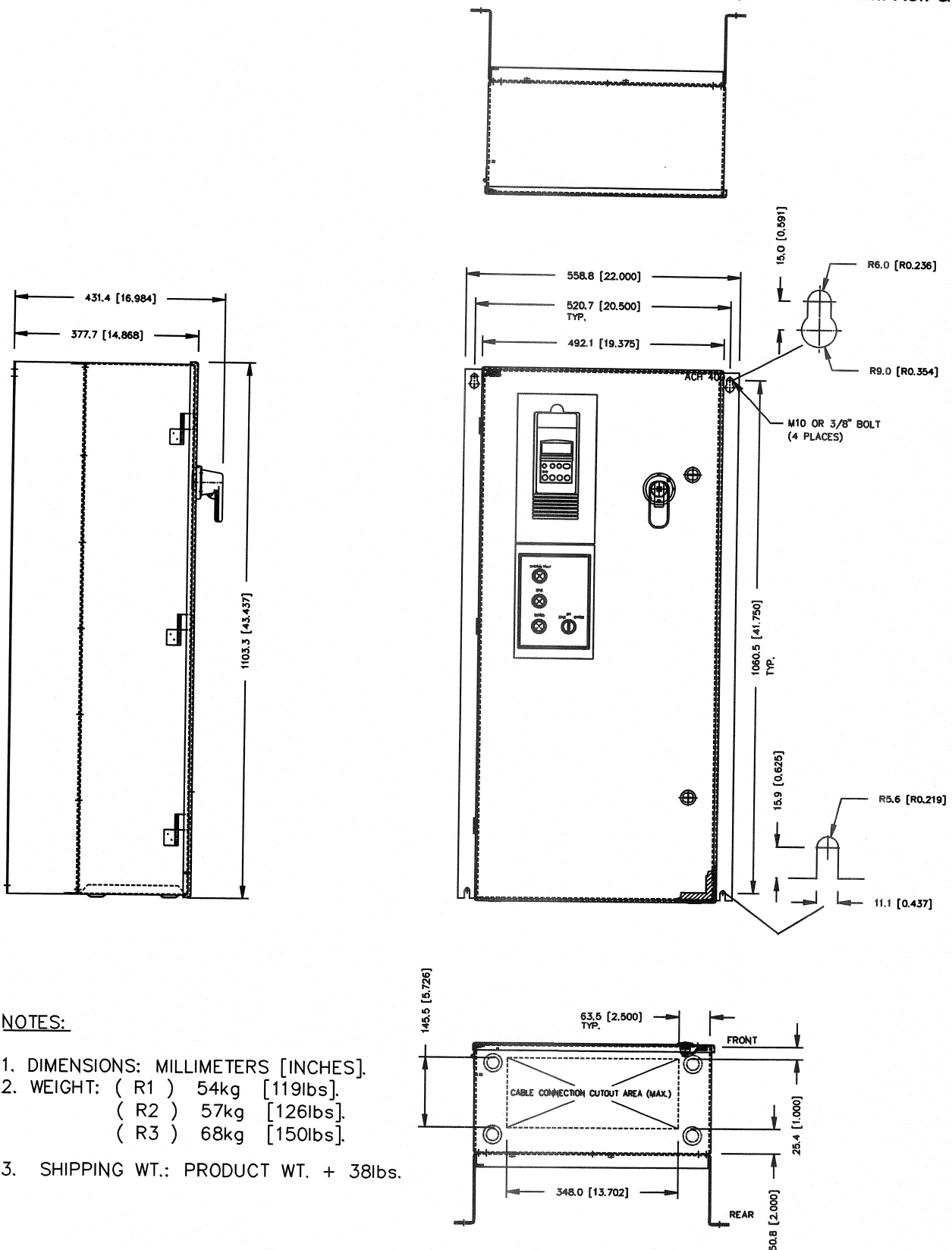
Maximum Current: 2 A

If the relay contacts are used to control inductive loads, such as the coils of relays or contactors, some form of noise suppression must be provided at the load. This is to reduce the electrical noise that could interfere with the electronics in the drive, as well as increase the life of the contacts in the relay.

AC coils should be suppressed with an MOV (metal oxide varistor) or a series connected RC (resistor capacitor) network. MOV should be rated 120 VAC - 240 VAC for 115 VAC circuits, 240 VAC - 320 VAC for 230 VAC circuits, minimum 10 joules. Values for the RC network vary, as they effect the opening and closing time. Contact the contactor manufacturer for recommended values.

DC coils should be suppressed with a diode, although this is not required because of the small amount of noise generated by these type of circuits. If a diode is used, it should have a voltage rating greater than or equal to the supply voltage rating.

Figure 3-5 ACH 401 Option Pack Extended Enclosure Dimensions – Frames R1, R2 & R3 - Dim. Ref. G1



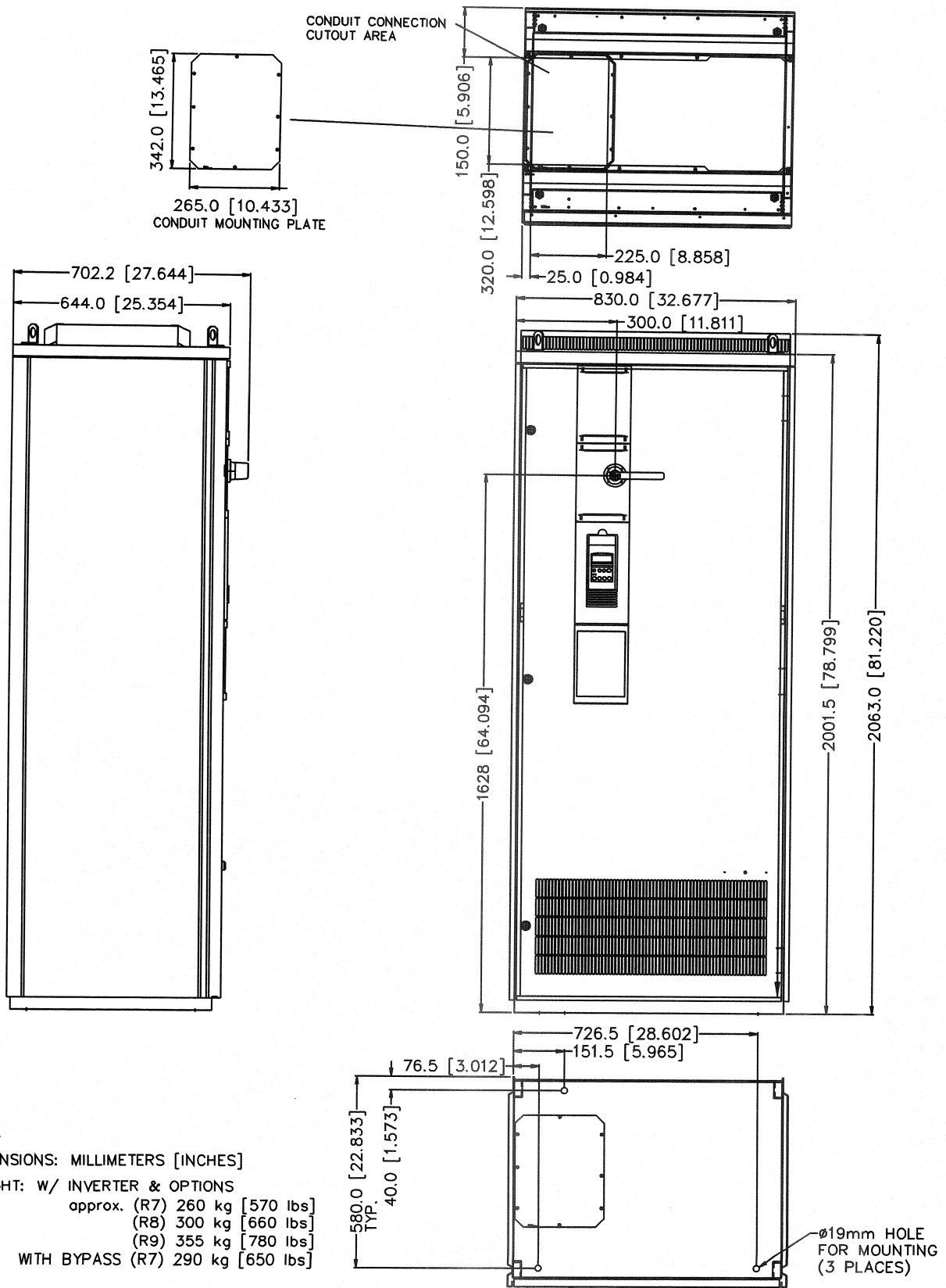
NOTES:

1. DIMENSIONS: MILLIMETERS [INCHES].
2. WEIGHT: (R1) 54kg [119lbs].
(R2) 57kg [126lbs].
(R3) 68kg [150lbs].
3. SHIPPING WT.: PRODUCT WT. + 38lbs.



1. DIMENSIONS: MILLIMETERS [INCHES].
2. WEIGHT: (R4) 114kg [251lbs].
(R5) 122kg [269lbs].
(R6) 137kg [302lbs].
3. SHIPPING WT.: PRODUCT WT. + 50lbs.

Figure 3-7 ACH 401 Option Pack Extended Enclosure - Frame R7 - Dim. Ref. K1



NOTES:

1. DIMENSIONS: MILLIMETERS [INCHES]
2. WEIGHT: W/ INVERTER & OPTIONS
 approx. (R7) 260 kg [570 lbs]
 (R8) 300 kg [660 lbs]
 (R9) 355 kg [780 lbs]
 WITH BYPASS (R7) 290 kg [650 lbs]

Figure 3-8 ACH 401 Option Pack Extended Enclosure - Frames R8 & R9 - Dim. Ref. K2

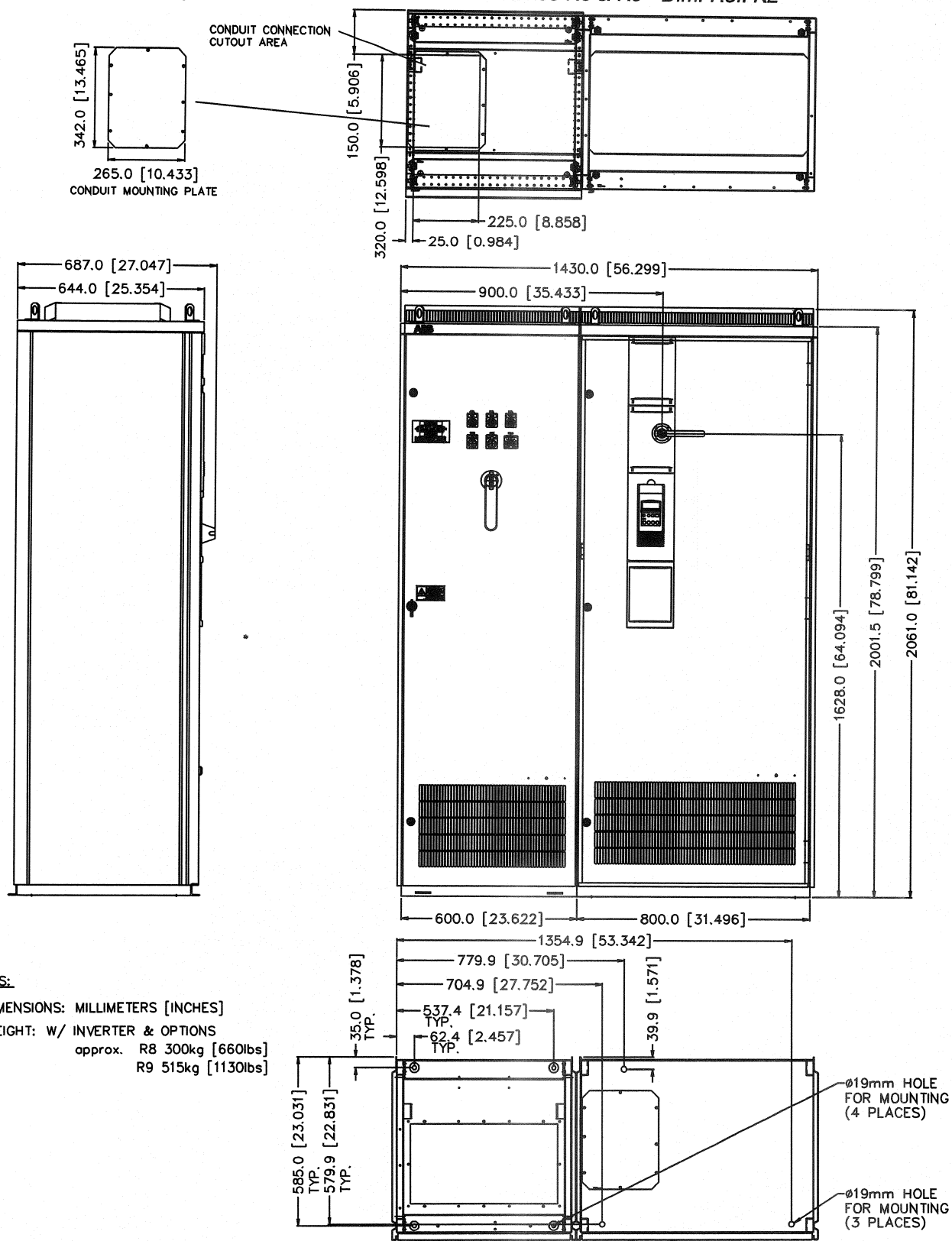


Figure 3-9 ACH 401 Option Pack Extended Enclosure NEMA Type 12 - Frame R7- Dim. Ref. M

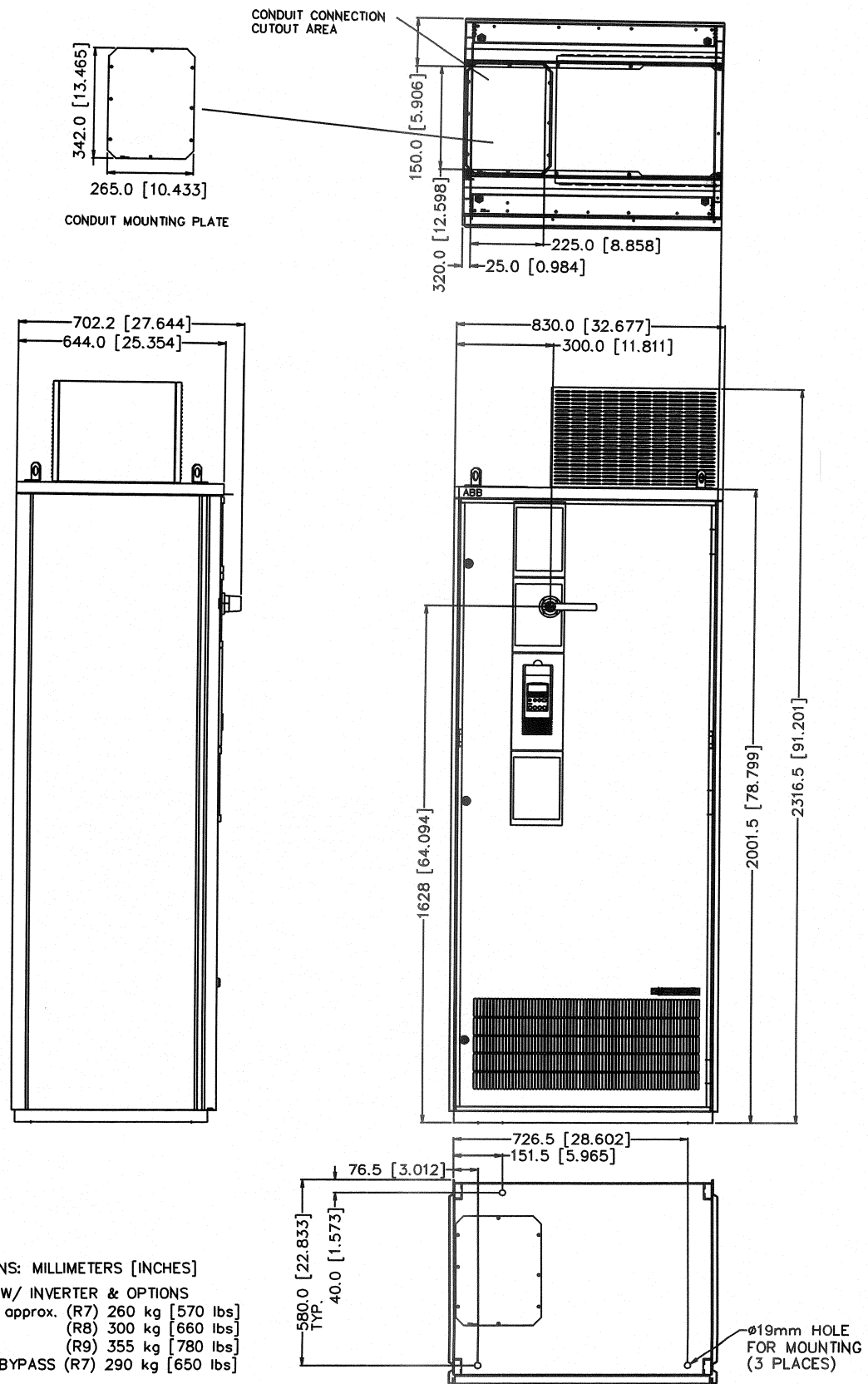
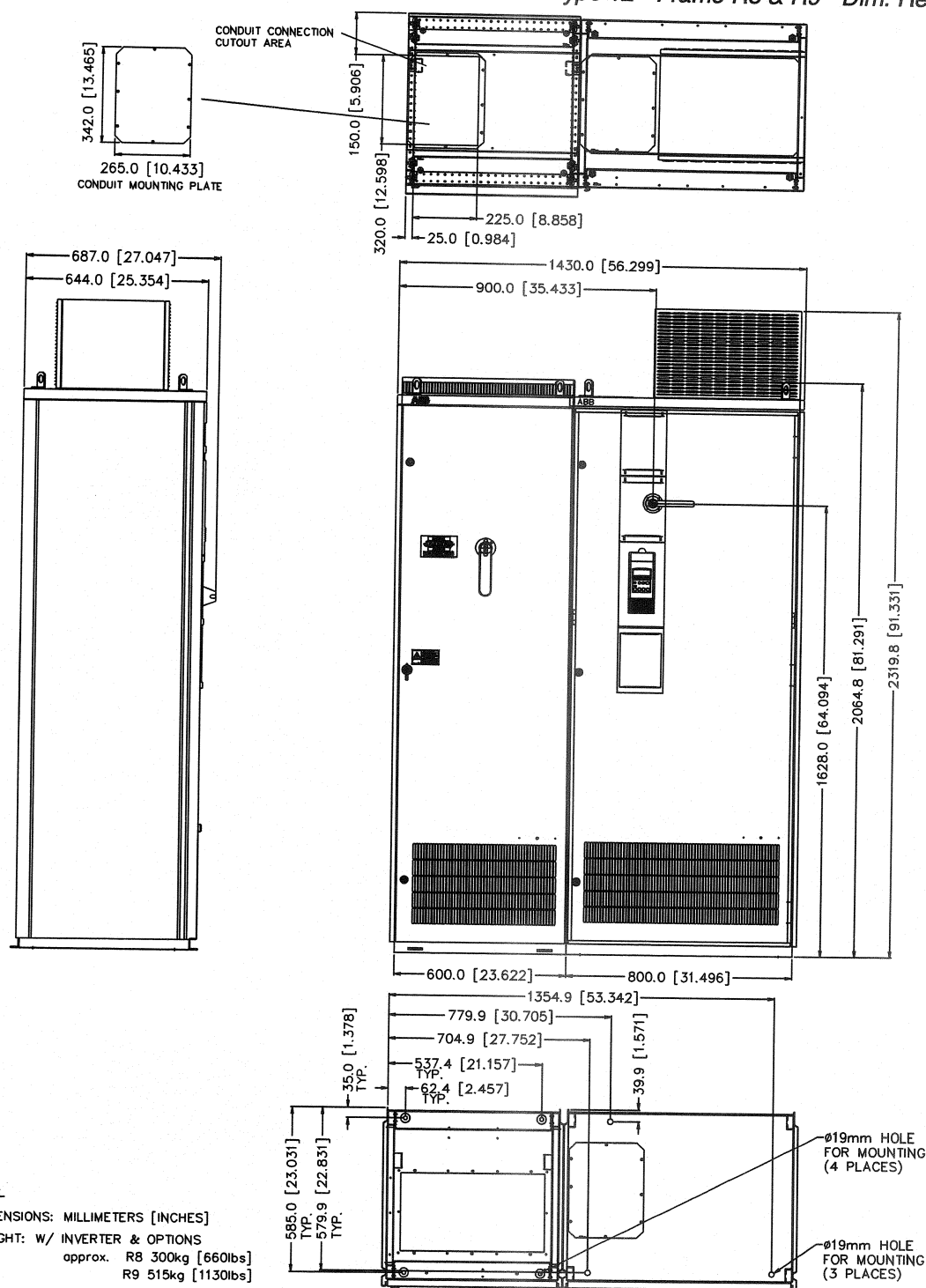


Figure 3-10 ACH 401 Option Pack Extended Enclosure NEMA Type 12 - Frame R8 & R9 - Dim. Ref. M2



Chapter 4 – Start-up Procedure

This chapter explains how to inspect the installation and how to start up the ACH 400 with Option Pack.

Safety Precautions

Before commencing start-up, read and follow the precautions listed below.

- After the supply voltage is disconnected from the input, the DC Bus capacitors should discharge to a safe voltage in about five minutes.
- To ensure that the voltage level is safe, measure the voltage between the DC Bus terminals, UC+ and UC- inside the ACH 400 drive unit. The testing meter must be rated for 1000 VDC.



WARNING! When the ACH 400 with Option Pack is connected to the line power, the Motor Terminals T1, T2, and T3 are live even if the motor is not running. Do not make any connections when the ACH 400 with Option Pack is connected to the line. Disconnect and lock out power to the drive before servicing the drive. Failure to disconnect power may cause death or serious injury.

Installation Inspection

Inspect the mechanical and electrical installation of the ACH 400 with Option Pack for compliance with the prevailing electrical installation regulations and codes.

Note: Do not connect the motor wires before proceeding with the Keypad Control Test with Motor Disconnected. Refer to Keypad Control Tests in this chapter.

After installation, inspect the following:

- ACH 400 with Option Pack and motor grounding.
- Supply and motor wire size and connections.
- Control cable connections, wire shield grounding, and control cable location away from the power wires.
- Quantity and quality of cooling air for the ACH 400 with Option Pack.

Connect the ACH 400 with Option Pack to supply voltage. Check that the voltage between $L_1 - L_2$, $L_1 - L_3$, and $L_2 - L_3$ is $V_N \pm 10\%$.

Refer to *Chapter 3 – Installation Instructions* in this manual for detailed installation instructions and requirements.

Macros and Parameter Settings

Apply power to the Option Pack unit. The display should show the operating status of the drive. If the motor is a standard 240 V, 60 Hz motor connected to a 240 V drive or a 480 V, 60 Hz motor connected to a 480 V drive, the default parameter settings should be suitable for the initial tests described below. If the motor's rating is not 240 V or 480 V, 60 Hz, the MOTOR NOM VOLT and MOTOR NOM FREQ parameters will need to be properly set before proceeding. Refer to the ACS 400 User's Manual and set the parameters as required.

The default macro is HVAC. If the HVAC FLOATING POINT macro or the HVAC PID macro will be used, the selected macro can be set after completing the initial tests.

Keypad Control Tests

Motor Disconnected from the ACH 400 with Option Pack

After setting the Start-up Data parameters, test the drive as follows:

1. Disconnect and lock out power to the Option Pack unit, wait at least five minutes after disconnecting power.
2. Disconnect the motor from the Option Pack unit.
3. Apply power to the Option Pack unit.
4. Press the HAND key. Note that the bottom line of the display indicates "HAND" and "RUN" and a Right Arrow.
5. Press the UP arrow. Note that the reference frequency indication in the top line of the display increases from "0.0 Hz." The large actual output frequency indication in the center line of the display should also increase from "0.0 Hz."
6. In the top line of the display, the output current indication should indicate "0.0 A" and the torque indication should indicate "0%."
7. Press the DOWN arrow until the frequency indications return to "0.0 Hz"
8. Press the OFF key. Note that the bottom line of the display indicates "Off."

If the drive operates according to these steps, disconnect and lock out power to the ACH 400 to prepare for the next test.



WARNING! Wait at least five minutes after disconnecting power from the drive before you attempt to service the drive. Bus capacitors in the intermediate DC circuit must discharge before servicing the drive. Check for zero volts at Terminals UC+ and UC-. Meter must be rated for 1000 VDC.

If the drive does not operate according to these steps, refer to the *ACH 400 User's Manual*.

**Motor Connected
to the ACH 400
with Option Pack**

After successfully testing the drive with the motor disconnected, continue testing the drive as follows:

1. Disconnect and lock out power to the Option Pack unit.
2. Connect the motor to the output terminals.
3. Apply power to the Option Pack unit.
4. (Classic Bypass **ONLY**)
Set the Drive/Off/Bypass switch to DRIVE.
5. Press the “HAND” key

CAUTION: Check motor rotation direction as soon as the motor begins to move. If motor does not rotate in the correct direction, shut down the drive, disconnect and lock out power to the drive and wait five minutes. Swap any two motor output wires at Terminals T1, T2, and T3. Incorrect motor rotation direction may cause equipment damage.

6. Slowly increase the output frequency by pressing the UP ARROW key. Verify that motor speed varies as frequency varies.
7. Increase the speed to 60 Hz or the greatest safe operating speed.
8. Measure the output current in all three phases. The current should be balanced, and should not exceed the motor or drive rating.
9. Press the “Off” key.
10. Set the Drive/Off/Bypass switch to OFF and wait for the motor to coast to a stop.

(Classic Bypass **ONLY**)

CAUTION: Check the motor rotation direction in bypass.

Switch the Drive/Off/Bypass switch to BYPASS and quickly back to OFF to “bump” the motor. If the motor turns in the wrong direction, swap any two input power leads at the disconnect switch or circuit breaker. Do not swap the motor leads.

If the drive does not operate according to these steps, refer to the *ACH 400 User's Manual*.

If the drive operates according to these steps, your ACH 400 with Option Pack is ready to use with preset or modified macro settings. Refer to the *ACH 400 User's Manual* for programming instructions.

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