10/04/16

Mr. Alex Chambers
Icon Mechanical

Project Name: Webster University - ISB
Project Number: 04561.01
Specification Section 235000, Para. 2.6 – Variable Frequency Drives

Dear Alex,

Thank you for the opportunity to provide you a submittal for this project. Enclosed please find the REVISED submittal documents for the project identified above.

We appreciate your continued interest in ABB Products. Please feel free to contact me with any questions you have regarding the information provided.

Sincerely,

Jerry Cowley
Sales Engineer
Motor Control Specialties

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Project Submittal for Webster University - ISB

Project Number: 04561.01

Specification Section 235000, Para. 2.6 – Variable Frequency Drives

Engineer: William Tao & Associates, Inc.

Contractor: Icon Mechanical

Architect: Cannon Design / KWA Architects

End Customer (User): Webster University

Submitted By: Jerry Cowley, Motor Control Specialties

Quotation Number: Q033016-1JCrev4

Submittal Revision: 1

Revised Submittal Date: 10/4/16

Submittal Schedule

This schedule includes the products supplied as part of this submittal.

Schedule			Motor Data[1]			Drive Data			
		Tagging /					Output		
Item	Qty	Equipment ID	HP	FLA	Voltage	Product ID	HP	Amps	Voltage
1	3	AHU-3, -4, -5	5	7.6	460 VAC	ACH550-VCR-08A8-4+F267	5	8.8	480 VAC
2	2	CP-1, CP-2, HEF-1A, -1B, -1C	25	34	460 VAC	ACH550-VCR-038A-4+F267	25	38	480 VAC
3	1	EF-2	7.5	11	460 VAC	ACH550-VCR-012A-4+F267	7.5	11.9	480 VAC
4	1	EF-3	3	4.8	460 VAC	ACH550-VCR-06A9-4+F267	3	6.9	480 VAC
5	2	HP-1, HP-2	10	14	460 VAC	ACH550-VCR-015A-4+F267	10	15.4	480 VAC
6	2	HRP-1, HRP-2	15	21	460 VAC	ACH550-VCR-023A-4+F267	15	23	480 VAC
7	2	AHU-1, AHU-2	4 @ 20	4 @ 23.5 (actual)	460 VAC	ACH550-BCR-125A-4+F267+G405(4x20HP)	100	124	480 VAC

Notes: 1. AC Motor Data is per National Electrical Code Table 430.250 for typical motors used in most applications and is provided as typical data only. DC motor data is per typical industry standards. Actual motor data may vary.

Clarifications and Exceptions to Specification and Terms

The comments and clarifications that follow are offered in response to the specification items identified below. Please refer to the specification section and paragraph indicated. Any contract executed based on this proposal is done based acceptance of the exceptions noted herein.

Item ID	Title	Clarifications and Exceptions
2	HEF-1A, -1B, -1C	Revised per Engineer's notation, requiring individual VFD per fan motor.
7	AHU-1 & AHU-2 VFDs	Single VFD to control 4 - 20HP fan motors at the same speed. Individual manual motor protectors included with means of disconnect and overload protection as integral to this VFD package.
1 - 7	All VFDs	**Exception**: Para. 2.6.14 - On site harmonic testing NOT provided.

Submittal Schedule Details for AHU-3, -4, -5

Item	Tag / Equipment ID	Product ID
1	AHU-3, -4, -5	ACH550-VCR-08A8-4+F267

Item Description
Input Voltage: 480 VAC **Rated Output Current:** 8.8 AMPS **Construction:** Vertical E-clipse-Bypass, Circuit Breaker **Enclosure:** NEMA/UL Type 1 **Nominal Horsepower:** 5 **Frame Size:** R1 **Input Disconnecting Means:** Circuit Breaker **Bypass:** E-Clipse Bypass **Input Impedance:** 5% **Short Circuit Current Rating:** 100 kA **Communication Protocols:** Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet **Other Options:** VFD Service Switch (+F267)

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	**Bussmann Type**
15	KTK-R-15

Wire Size Capacities of Power Terminals				
Circuit Breaker	**Disconnect Switch**	**Terminal Block**	**Overload Relay**	**Ground Lug**
#10 35 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs

Dimensions and Weights				
Height in / mm	**Width in / mm**	**Depth in / mm**	**Weight lbs / kg**	**Dimension Drawing**
40.2 / 1021	5.4 / 136	10.1 / 256	32 / 15	3AUA0000016371 Sheet 1

Heat Dissipation & Airflow Requirements			
Power Losses		**Airflow**	
Watts	**BTU/Hr**	**CFM**	**CM/Hr**
127	433	26	44

Reference Drawings		
Power Wiring	**Connection Diagram**	**Dimension Detail**
00VCR012PW-C	VCVDR014CC-A	3AUA0000016371 Sheet 1

Submittal Schedule Details for CP-1, CP-2, HEF-1A, -1B, -1C

Item	Tag / Equipment ID	Product ID
2	CP-1, CP-2, HEF-1A, -1B, -1C	ACH550-VCR-038A-4+F267

Item Description
Input Voltage: 480 VAC **Rated Output Current:** 38 AMPS **Construction:** Vertical E-clipse-Bypass, Circuit Breaker **Enclosure:** NEMA/UL Type 1 **Nominal Horsepower:** 25 **Frame Size:** R3 **Input Disconnecting Means:** Circuit Breaker **Bypass:** E-Clipse Bypass **Input Impedance:** 5% **Short Circuit Current Rating:** 100 kA **Communication Protocols:** Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet **Other Options:** VFD Service Switch (+F267)

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	**Bussmann Type**
60	JJS-60

Wire Size Capacities of Power Terminals				
Circuit Breaker	**Disconnect Switch**	**Terminal Block**	**Overload Relay**	**Ground Lug**
#3 50 in-lbs	N/A N/A	#2 50 in-lbs	N/A N/A	#2 50 in-lbs

Dimensions and Weights				
Height in / mm	**Width in / mm**	**Depth in / mm**	**Weight lbs / kg**	**Dimension Drawing**
47.7 / 1211	8.4 / 214	10.9 / 278	70 / 32	3AUA0000016373 Sheet 1

Heat Dissipation & Airflow Requirements			
Power Losses		**Airflow**	
Watts	**BTU/Hr**	**CFM**	**CM/Hr**
562	1918	79	134

Reference Drawings		
Power Wiring	**Connection Diagram**	**Dimension Detail**
00VCR024PW-C	VCVDR014CC-A	3AUA0000016373 Sheet 1

Submittal Schedule Details for EF-2

Item	Tag / Equipment ID	Product ID
3	EF-2	ACH550-VCR-012A-4+F267

Item Description
Input Voltage: 480 VAC **Rated Output Current:** 11.9 AMPS **Construction:** Vertical E-clipse-Bypass, Circuit Breaker **Enclosure:** NEMA/UL Type 1 **Nominal Horsepower:** 7.5 **Frame Size:** R1 **Input Disconnecting Means:** Circuit Breaker **Bypass:** E-Clipse Bypass **Input Impedance:** 5% **Short Circuit Current Rating:** 100 kA **Communication Protocols:** Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet **Other Options:** VFD Service Switch (+F267)

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	**Bussmann Type**
15	KTK-R-15

Wire Size Capacities of Power Terminals				
Circuit Breaker	**Disconnect Switch**	**Terminal Block**	**Overload Relay**	**Ground Lug**
#10 35 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs

Dimensions and Weights				
Height in / mm	**Width in / mm**	**Depth in / mm**	**Weight lbs / kg**	**Dimension Drawing**
40.2 / 1021	5.4 / 136	10.1 / 256	32 / 15	3AUA0000016371 Sheet 1

Heat Dissipation & Airflow Requirements			
Power Losses		**Airflow**	
Watts	**BTU/Hr**	**CFM**	**CM/Hr**
172	587	26	44

Reference Drawings		
Power Wiring	**Connection Diagram**	**Dimension Detail**
00VCR012PW-C	VCVDR014CC-A	3AUA0000016371 Sheet 1

Submittal Schedule Details for EF-3

Item	Tag / Equipment ID	Product ID
4	EF-3	ACH550-VCR-06A9-4+F267

Item Description
Input Voltage: 480 VAC **Rated Output Current:** 6.9 AMPS **Construction:** Vertical E-clipse-Bypass, Circuit Breaker **Enclosure:** NEMA/UL Type 1 **Nominal Horsepower:** 3 **Frame Size:** R1 **Input Disconnecting Means:** Circuit Breaker **Bypass:** E-Clipse Bypass **Input Impedance:** 5% **Short Circuit Current Rating:** 100 kA **Communication Protocols:** Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet **Other Options:** VFD Service Switch (+F267)

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	**Bussmann Type**
15	KTK-R-15

Wire Size Capacities of Power Terminals				
Circuit Breaker	**Disconnect Switch**	**Terminal Block**	**Overload Relay**	**Ground Lug**
#10 35 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs

Dimensions and Weights				
Height in / mm	**Width in / mm**	**Depth in / mm**	**Weight lbs / kg**	**Dimension Drawing**
40.2 / 1021	5.4 / 136	10.1 / 256	32 / 15	3AUA0000016371 Sheet 1

Heat Dissipation & Airflow Requirements			
Power Losses		**Airflow**	
Watts	**BTU/Hr**	**CFM**	**CM/Hr**
97	331	26	44

Reference Drawings		
Power Wiring	**Connection Diagram**	**Dimension Detail**
00VCR012PW-C	VCVDR014CC-A	3AUA0000016371 Sheet 1

Submittal Schedule Details for HP-1, HP-2

Item	Tag / Equipment ID	Product ID
5	HP-1, HP-2	ACH550-VCR-015A-4+F267

Item Description
Input Voltage: 480 VAC **Rated Output Current:** 15.4 AMPS **Construction:** Vertical E-clipse-Bypass, Circuit Breaker **Enclosure:** NEMA/UL Type 1 **Nominal Horsepower:** 10 **Frame Size:** R2 **Input Disconnecting Means:** Circuit Breaker **Bypass:** E-Clipse Bypass **Input Impedance:** 5% **Short Circuit Current Rating:** 100 kA **Communication Protocols:** Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet **Other Options:** VFD Service Switch (+F267)

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	**Bussmann Type**
30	KTK-R-30

Wire Size Capacities of Power Terminals				
Circuit Breaker	**Disconnect Switch**	**Terminal Block**	**Overload Relay**	**Ground Lug**
#8 40 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs

Dimensions and Weights				
Height in / mm	**Width in / mm**	**Depth in / mm**	**Weight lbs / kg**	**Dimension Drawing**
44.1 / 1120	5.4 / 136	10.3 / 262	40 / 18	3AUA0000016372 Sheet 1

Heat Dissipation & Airflow Requirements			
Power Losses		**Airflow**	
Watts	**BTU/Hr**	**CFM**	**CM/Hr**
232	792	52	88

Reference Drawings		
Power Wiring	**Connection Diagram**	**Dimension Detail**
00VCR012PW-C	VCVDR014CC-A	3AUA0000016372 Sheet 1

Submittal Schedule Details for HRP-1, HRP-2

Item	Tag / Equipment ID	Product ID
6	HRP-1, HRP-2	ACH550-VCR-023A-4+F267

Item Description
Input Voltage: 480 VAC **Rated Output Current:** 23 AMPS **Construction:** Vertical E-clipse-Bypass, Circuit Breaker **Enclosure:** NEMA/UL Type 1 **Nominal Horsepower:** 15 **Frame Size:** R2 **Input Disconnecting Means:** Circuit Breaker **Bypass:** E-Clipse Bypass **Input Impedance:** 5% **Short Circuit Current Rating:** 100 kA **Communication Protocols:** Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet **Other Options:** VFD Service Switch (+F267)

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	**Bussmann Type**
30	KTK-R-30

Wire Size Capacities of Power Terminals				
Circuit Breaker	**Disconnect Switch**	**Terminal Block**	**Overload Relay**	**Ground Lug**
#8 40 in-lbs	N/A N/A	#6 30 in-lbs	N/A N/A	#4 35 in-lbs

Dimensions and Weights				
Height in / mm	**Width in / mm**	**Depth in / mm**	**Weight lbs / kg**	**Dimension Drawing**
44.1 / 1120	5.4 / 136	10.3 / 262	40 / 18	3AUA0000016372 Sheet 1

Heat Dissipation & Airflow Requirements			
Power Losses		**Airflow**	
Watts	**BTU/Hr**	**CFM**	**CM/Hr**
337	1150	52	88

Reference Drawings		
Power Wiring	**Connection Diagram**	**Dimension Detail**
00VCR012PW-C	VCVDR014CC-A	3AUA0000016372 Sheet 1

Submittal Schedule Details for AHU-1, AHU-2

Item	Tag / Equipment ID	Product ID
7	AHU-1, AHU-2	ACH550-BCR-125A-4+F267+G405(4x20HP)

Item Description
Input Voltage: 480 VAC **Rated Output Current:** 124 AMPS **Construction:** E-clipse-Bypass, Circuit Breaker **Enclosure:** NEMA/UL Type 1 **Nominal Horsepower:** 100 **Frame Size:** R5 **Input Disconnecting Means:** Circuit Breaker **Bypass:** E-Clipse Bypass **Input Impedance:** 5% **Short Circuit Current Rating:** 50 kA (with Individual Manual Motor Protectors, +G405) **Communication Protocols:** Johnson Controls N2, Siemens Buildings Technologies FLN (P1), Modbus RTU, BACnet **Other Options:** VFD Service Switch (+F267), Individual Manual Motor Protectors (+G405)

Drive Input Fuse Ratings	
(Note: Drive is UL approved without the need for input fuses. Fuse rating information provided for customer reference)	
Amps (600 V)	**Bussmann Type**
200	170M1370 or M2617

Wire Size Capacities of Power Terminals				
Circuit Breaker	**Disconnect Switch**	**Terminal Block**	**Overload Relay**	**Ground Lug**
6-350MCM 274 in-lbs	N/A N/A	250 MCM 300 in-lbs	14-8 AWG 14 in-lbs	3 x #3/0 250 in-lbs

Dimensions and Weights				
Height in / mm	**Width in / mm**	**Depth in / mm**	**Weight lbs / kg**	**Dimension Drawing**
73.4 / 1864	35 / 889	18.6 / 472	415 / 189	ACH550-BCR-125A-4+F267+4G405+M652 Sheet 2

Heat Dissipation & Airflow Requirements			
Power Losses		**Airflow**	
Watts	**BTU/Hr**	**CFM**	**CM/Hr**
1940	6621	99	168

Reference Drawings		
Power Wiring	**Connection Diagram**	**Dimension Detail**
ACH550-BCR-125A-4+F267+4G405+M652 Sheet 1	ACH550-BCR-125A-4+F267+4G405+M652 Sheet 1	ACH550-BCR-125A-4+F267+4G405+M652 Sheet 2

ABB ACH550 Product Overview

Description

The ACH550 series is a microprocessor based Pulse Width Modulated (PWM) adjustable speed AC drive. The ACH550 drive takes advantage of sophisticated microprocessor control and advanced IGBT power switching technology to deliver high-performance control of AC motors for a wide range of HVAC applications.

With drives ranging from 1 to 550 HP, the ACH550 series features a universal full graphic interface that "speaks" to the operator in plain English phrases, greatly simplifying set-up, operation, and fault diagnosis. The ACH550 is also programmable in fourteen other languages.

Each ACH550 drive comes equipped with an extensive library of pre-programmed HVAC application macros which, at a touch of a button, allow rapid configuration of inputs, outputs, and performance parameters for specific HVAC applications to maximize convenience and minimize start-up time. The ACH550 series can handle the most demanding commercial applications in an efficient, dependable, and economic manner.

ABB ACH550 Standard Features

- UL, cUL labeled and CE marked, BTL listed
- EMI/RFI Filter (1st Environment, Restricted Distribution)
- Seismic Certificate of Compliance in accordance with
  - IBC 2000 referencing ASCE 7-98 and ICC AC156
  - IBC 2003 referencing ASCE 7-02 and ICC AC156
  - IBC 2006 referencing ASCE 7-05 and ICC AC156
  - IBC 2009 referencing ASCE 7-05 and ICC AC156
- Start-Up Assistants
- Maintenance Assistants
- Diagnostic Assistants
- Real Time Clock
  - Includes Day, Date and Time
- Operator Panel Parameter Backup (read/write)
- Full Graphic and Multilingual Display for Operator Control, Parameter Set-Up and Operating Data Display:
  - Output Frequency (Hz) / Motor Speed (RPM)
  - Motor Current
  - Calculated Energy Savings ($, kWh/MWh, CO^2)
  - Calculated % Motor Torque
  - Calculated Motor Power (kW)
  - DC Bus Voltage
  - Output Voltage
  - Heatsink Temperature
  - Elapsed Time Meter (reset-able)
  - KWh (reset-able)
  - Input / Output Terminal Monitor
  - PID Actual Value (Feedback) & Error
  - Fault Text
  - Warning Text
  - Three (3) Scalable Process Variable Displays
  - User Definable Engineering Units
- Two (2) Programmable Analog Inputs
- Six (6) Programmable Digital Inputs
- Two (2) Programmable Analog Outputs
- Up to six (6) Programmable Relay Outputs (Three (3) Standard)
- Adjustable Filters on Analog Inputs and Outputs
- Mathematical Functions on Analog Reference Signals
- All Control Inputs Isolated from Ground and Power
- Four (4) Resident Serial Communication Protocols
  - BACnet (MS/TP)
  - Johnson Controls N2
  - Siemens Building Technologies FLN (P1)
  - Modbus RTU
- Input Speed Signals
  - Current 0 (4) to 20 mA
  - Voltage 0 (2) to 10 VDC
  - Increase/Decrease Reference Contacts (Floating Point)
  - Serial Communications
- Start/Stop
  - 2 Wire (Dry Contact Closure)
  - 3 Wire (Momentary Contact)
  - Application of Input Power
  - Application of Reference Signal (PID Sleep/Wake-Up)
  - Serial Communications
- Start Functions
  - Ramp
    - Flying Start
    - Pre-magnetization (DC Brake) on Start
  - Automatic Torque Boost
  - Automatic Torque Boost with Flying Start
  - Auto Restart (Reset) – Customer Selectable and Adjustable
- Stop Functions
  - Ramp or Coast to Stop
  - Emergency Stop
  - DC Braking / Hold at Stop
  - Flux Braking
- Accel/Decel
  - Two (2) sets of Independently Ramps
  - Linear or Adjustable 'S' Curve Accel/Decel Ramps
- HVAC Specific Application Macros
- Separate Safeties (2) and Run Permissive Inputs
- Damper Control
- Override Input (Fire Mode)
- Timer Functions
  - Four (4) Daily Start/Stop Time Periods
  - Four (4) Weekly Start/Stop Time Periods
  - Four Timers for Collecting Time Periods and Overrides
- Seven (7) Preset Speeds
- Supervision Functions
- Adjustable Current Limit
- Electronic Reverse
- Automatic Extended Power Loss Ride Through (Selectable)
- Programmable Maximum Frequency to 500 Hz
- PID Control
  - Two (2) Integral Independent Programmable PID Setpoint Controllers (Process and External)
  - External Selection between Two (2) Sets of Process PID Controller Parameters
  - PID Sleep/Wake-Up
- Motor Control Features
  - Scalar (V/Hz) and Vector Modes of Motor Control
  - V/Hz Shapes
    - Linear
    - Squared
  - Energy Optimization
  - IR Compensation
  - Slip Compensation
  - Three (3) Critical Frequency Lockout Bands
- Preprogrammed Protection Circuits
  - Overcurrent
  - Short Circuit
  - Ground Fault
  - Overvoltage
  - Undervoltage
    - Input Phase Loss
  - Output Device (IGBT) Overtemperature
  - Adjustable Current Limit Regulator
  - UL508C approved Electronic Motor Overload (I^2T)
- Programmable Fault Functions for Protection Include
  - Loss of Analog Input
  - Panel Loss
  - External Fault
  - Motor Thermal Protection
  - Stall
  - Underload
  - Motor Phase Loss
  - Ground Fault
- Input Impedance
  - 5% Equivalent Impedance with Internal Reactor(s)
    - Patented Swinging Choke Design for Superior Harmonic Mitigation (R1…R6 Frames)
  - 3% Equivalent Impedance (R8 Frame)

OPTIONAL FEATURES

- 3 Relay Extension Module (OREL-01)
- 115/230 V Digital input Interface Card (OHDI-01)
- Fieldbus Adapter Modules
  - LonWorks
  - BACnet IP to MS/TP Router
  - Profibus
  - DeviceNet
  - Ethernet
  - ControlNet
- DriveWindow Light Start-up, Operation, Programming and Diagnostic Tool
- Fan Replacement Kit

ABB ACH550 Specifications

Input Connection

Input Voltage (U_1) ..... 208/220/230/240 VAC 3-phase +/-10%
208/220/230/240 VAC 1-phase +/-10%
380/400/415/440/460/480 VAC 3-phase +/-10%
Frequency: ..... 48 - 63 Hz
Line Limitations: ..... Max +/-3% of nominal phase to phase input voltage
Fundamental Power Factor (cos□□: ..... 0.98 at nominal load
Connection: ..... U_1, V_1, W_1 (U_1, V_1, 1-phase)

Output (Motor) Connection

Output Voltage: ..... 0 to U_1, 3-phase symmetrical, U_2 at the field weakening point
Output Frequency: ..... -500 to 500 Hz
Frequency Resolution: ..... 0.01 Hz
Continuous Output Current:
Variable Torque: ..... 1.0 * I_{2N} (Nominal rated output current, Variable Torque)
Short Term Overload Capacity:
Variable Torque: ..... 1.1 * I_{2N}, (1 min/10 min)
Peak Overload Capacity:
Variable Torque: ..... 1.35 * I_{2N}, (2 sec/1 min)
Base Motor Frequency Range: ..... 10 to 500 Hz
Switching Frequency: ..... 1, 4, 8 or 12 kHz
Acceleration Time: ..... 0.1 to 1800 s
Deceleration Time: ..... 0.1 to 1800 s
Efficiency: ..... 0.98 at nominal power level
Short Circuit Withstand Rating: ..... 100,000 AIC (UL) w/o fuses
Connection: ..... U_2, V_2, W_2

Enclosure

Style: ..... UL (NEMA) Type 1, Type 12, or Type 3R

Agency Approval

Listing and Compliance: ..... UL, cUL, CE

Ambient Conditions, Operation

Air Temperature: ..... -15^0 to 40^0C (5^0 to 104^0F), above 40^0C the maximum output current is de-rated 1% for every additional 1^0C (up to 50^0C (122^0F) maximum limit.
Relative Humidity: ..... 5 to 95%, no condensation allowed, maximum relative humidity is 60% in the presence of corrosive gasses
Contamination Levels:
IEC: ..... 60721-3-1, 60721-3-2 and 60721-3-3
Chemical Gasses: ..... 3C1 and 3C2
Solid Particles: 3S2
Installation Site Altitude: ..... 0 to 1000 m (3300 ft) above sea level. At sites over 1000 m (3300 ft) above sea level, the maximum power is de-rated 1% for every additional 100 m (330 ft). If the installation site is higher than 2000 m (6600 ft) above sea level, please contact your local ABB distributor or representative for further information
Vibration: ..... Max 3.0 mm (0.12 in) 2 to 9 Hz, Max 10 m/s^2 (33 ft/s^2) 9 to 200 Hz sinusoidal
Seismic Certified referencing IBC 2000, 2003, 2006 and 2009

Ambient Conditions, Storage (in Protective Shipping Package)

Air Temperature: ..... -40^0 to 70^0C (-40^0 to 158^0F)
Relative Humidity: ..... Less than 95%, no condensation allowed
Vibration: ..... In accordance with ISTA 1A and 1B specifications
Shock (IEC 60086-2-29): ..... Max 100 m/s^2 (330 ft/s^2) 11 ms

Ambient Conditions, Transportation (in Protective Shipping Package)

Air Temperature: ..... -40^0 to 70^0C (-40^0 to 158^0F)
Relative Humidity: ..... Less than 95%, no condensation allowed
Atmospheric Pressure: ..... 60 to 106 kPa (8.7 to 15.4 PSI)
Vibration: ..... Max 3.5 mm (0.14 in) 2 to 9 Hz, Max 15 m/s^2 (49 ft/s^2) 9 to 200 Hz sinusoidal
Shock (IEC 60086-2-29): ..... Max 100 m/s^2 (330 ft/s^2) 11 ms
Free Fall: ..... R1: 76 cm (30 in)
R2: 61 cm (24 in)
R3: 46 cm (18 in)
R4: 31 cm (12 in)
R5 & 6: 25 cm (10 in)

Cooling Information

Cooling Method: ..... Integral fan(s)
Power Loss: ..... Approximately 3% of rated power

ABB ACH550 Specifications (continued)

Analog Inputs

Quantity	Two (2) programmable
Voltage Reference:	0 (2) to 10 V, 312kOhm, single ended
Current Reference:	0 (4) to 20 mA, 100Ohm, single ended
Potentiometer:	10 VDC, 10 mA (1K to 10KOhms)
Input Updating Time	8 ms
Terminal Block Size	2.3mm^2 / 14AWG

Reference Power Supply

Reference Voltage	+10 VDC, 1% at 25^{0}C (77^{0}F)
Maximum Load	10 mA
Applicable Potentiometer	1 kOhm to 10 kOhm
Terminal Block Size	2.3mm^2 / 14AWG

Analog Outputs

Quantity	Two (2) programmable current outputs
Signal Level	0 (4) to 20 mA
Accuracy	+/- 1% full scale range at 25^{0}C (77^{0}F)
Maximum Load Impedance	500 Ohms
Output Updating Time	2 ms
Terminal Block Size	2.3mm^2 / 14AWG

Digital Inputs

Quantity	Six (6) programmable digital inputs
Isolation	Isolated as one group
Signal Level	24 VDC, (10V Logic 0)
Input Current	15 mA at 24 VDC
Input Updating Time:	4 ms
Terminal Block Size	2.3mm^2 / 14AWG

Internal Power Supply

Primary Use	Internal supply for digital inputs
Voltage:	+24 VDC, max 250 mA
Maximum Current:	250 mA
Protection:	Short circuit protected

Relay Outputs

Quantity	Three (3) programmable relay (Form C) outputs
Switching Capacity:	8 A at 24 VDC or 250 VAC, 0.4 A at 120 VDC
Max Continuous Current:	2A RMS
Contact Material:	Silver Cadmium Oxide (AgCdO)
Isolation Test Voltage	4 kVAC, 1 minute
Output Updating Time	12 ms
Terminal Block Size	2.3mm^2 / 14AWG

Protections

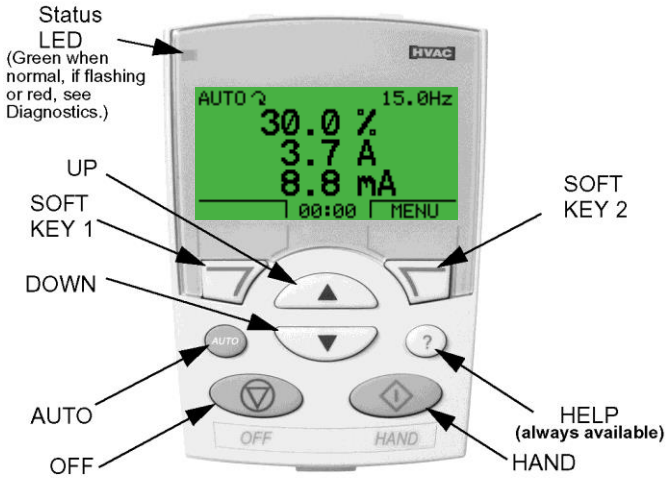
Single Phase	Protected (input & output)
Overcurrent Trip Limit:	3.5 x I_{2N} instantaneous
Adjustable Current Regulation Limit:	1.1 x I_{2N} (RMS) max.
Overvoltage Trip Limit:	1.30 x U_N
Undervoltage Trip Limit:	0.65 x U_N
Overtemperature (Heatsink):	+115°C (+239°F)
Auxiliary Voltage:	Short Circuit Protected
Ground Fault:	Protected
Short Circuit:	Protected
Microprocessor fault:	Protected
Motor Stall Protection:	Protected
Motor Overtemperature Protection (I^2t):	Protected
Input Power Loss of Phase:	Protected
Loss of Reference:	Protected
Short Circuit Current Rating:	100,000 RMS symmetrical Amperes
Input Line Impedance:	Swinging choke 5% equivalent R1-R6, 3% equivalent R8

U_1 = Input Voltage
U_2 = Output Voltage
P_N = Power – Normal Duty (HP)
U_N = Nominal Motor Voltage
f_N = Nominal Motor Frequency
I_{2N} = Nominal Motor Current – Normal Duty

Specifications are subject to change without notice. Please consult the factory when specifications are critical.

ACH550 Control Panel

The ACH550 Control Panel is a multifunction control panel with full graphic LCD display and multiple language capability. The control panel can be connected to and detached from the ACH550 at any time. The panel can be used to upload and copy parameters to other ACH550 drives.



Run Indication and Shaft Direction ↷ located in upper left corner of display.

Control Panel Display	Significance
Rotating arrow (clockwise or counterclockwise)	Drive is running and at set point Shaft direction is forward or reverse
Rotating arrow blinking	Drive is operating but not at setpoint
Stationary arrow	Drive is stopped

LED Indicators

The green LED indicates that the power is on and the drive is operating normally. The red LED indicates a fault. A blinking green LED indicates an alarm condition. A blinking red LED indicates a fault that requires power to be cycled off and on to reset the drive.

Fault Indications

The ACH550 Control Panel can display over 20 alarm and fault messages. The last fault and previous faults (1 to 9) are retained in memory. The last fault and previous faults (1 & 2) also record important diagnostic information to assist in troubleshooting. Most faults can be reset by pressing the RESET key (Soft Key 1).

Parameters

Application specific parameters are immediately accessible through a selection of start-up “Assistants”. A complete list of parameters is also available grouped by function in approximately 33 menu groups. One of the basic menu functions can be used to display the complete list of changed parameters.

Real Time Clock

The Operator Control Panel includes a real time clock which provides Day, Date and Time information, displayed in a choice of formats. The real time clock has a 10 year battery back up and provides time and date stamping of drive faults and other events. The clock is also used by the ACH550s internal timer functions, providing an integral time clock for start/stop control as well as other control operations.

Control Modes

When the HAND key is pressed, the drive starts and pressing the UP/DOWN keys can modify the reference frequency. The HAND (keypad) control mode is indicated.

When the OFF key is pressed, the drive stops and the OFF control mode is indicated.

When the AUTO key is pressed, the AUTO control mode is indicated. The drive can be started and stopped using whichever remote start/stop command has been configured, a contact closure applied to the start/stop input, a serial communication command or a process feedback signal. In AUTO mode the drive speed is typically controlled by the external speed reference input or by the PID controller.

If the HAND key is pressed while the drive is running in the AUTO control mode, the drive continues to run without changing speed, but ceases to respond to external input or PID speed reference changes. (Bumpless transfer) Pressing the UP/DOWN keys can modify the reference frequency.

If the AUTO key is pressed while the drive is running in the HAND control mode and an external start command is present, the drive continues to run and follows the acceleration or deceleration control ramp to the speed set by the external input or PID speed reference. (Bumpless transfer)

Cable Connections

Terminal	Description	Note
U1, V1, W1	3~ power supply input	Use of 1~ supply requires 50% derate of output current and is applicable for 208 to 240 VAC operation only.
PE / GND	Protective Ground	Follow local rules for cable size.
U2, V2, W2	Power output to motor	
Uc+, Uc-	DC bus	
X1 1 to 18	Control Wiring	Low voltage control – Use shielded cable
X1 19 to 27	Control Wiring	Low voltage or 115VAC
X1 28 to 32	Serial Communications	Use shielded cable

Follow local codes for cable size. To avoid electromagnetic interference, use separate metallic conduits for input power wiring, motor wiring, control and communications wiring. Keep these four classes of wiring separated in situations where the wiring is not enclosed in metallic conduit. Also, keep 115VAC control wiring separated from low voltage control wiring and power wiring.

Use shielded cable for control wiring.

Ampacity is based on the use of 60 °C rated power cable up to 100 Amps (75 °C over 100 Amps).

Refer to the included tables for current ratings, fuse recommendations and maximum wire size capacities and tightening torques for the terminals. The ACH550 is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 480 V maximum. The ACH550 has an electronic motor protection feature that complies with the requirements of the National Electric Code (NEC). When this feature is selected and properly adjusted. Additional overload protection is not required unless more than one motor is connected to the drive or unless additional protection is required by applicable safety regulations.

For CE installation requirements, see ABB publication CE-US-02 “CE Council Directives and Variable Speed Drives.” Contact your local ABB representative for specific IEC installation instructions.

ACH550 Control Terminals - Main I/O Terminal X1

X1	Identification	Description	
1	SCR	Terminal for signal cable screen. (Connected internally to chassis ground.)	
2	AI 1	Analog input channel 1, programmable. Default[2] = External reference Resolution 0.1 % accuracy ±1 %. 0 (4) - 20 mA (R_i = 312 kΩ) (J1:AI1 ON) 0 (2) - 10 V (R_i = 100 Ω) (J1:AI1 OFF)	
3	AGND	Analog input common. (Connected internally to chassis ground through 1 MΩ)	
4	10 V	10 V/10 mA reference voltage output for analog input potentiometer, accuracy ±2 %. (1 kΩ ≤ R ≤ 10 kΩ)	
5	AI 2	Analog input channel 2, programmable. Default[2] = PID Feedback Resolution 0.1 % accuracy ±1 %. 0 (4) - 20 mA (R_i = 312 kΩ) (J1:AI2 ON) 0 (2) - 10 V (R_i = 100 Ω) (J1:AI2 OFF)	
6	AGND	Analog input common. (Connected internally to chassis ground through 1 MΩ)	
7	AO1	Analog output channel 1, programmable. Default[2] = Output frequency 0 (4) - 20 mA (load < 500 Ω), accuracy ±3% full scale.	
8	AO2	Analog output channel 2, programmable. Default[2] = Output current 0 (4) - 20 mA (load < 500 Ω), accuracy ±3% full scale.	
9	AGND	Analog output common. Connected internally to chassis ground through 1 MΩ)	
10	24 V	Auxiliary voltage output 24 V DC / 250 mA (Reference to AGND). Short circuit protected.	
11	GND	Common for digital input (DI) return signals.	
12	DCOM	Digital input circuit common for all digital inputs (DIs). Connected internally as floating.	
DI Configuration[1]		To activate a digital input, there must be ≥ +10 V (or ≤ -10 V) between that input and DCOM. The 24 V may be provided by the ACH550 (X1:10) or by an external 12-24 V source of either polarity.	
13	DI 1	Digital input 1, programmable. Default[2] = Start/Stop (AUTO mode) Activation starts the drive	
14	DI 2	Digital input 2, programmable. Default[2] = Not configured.	
15	DI 3	Digital input 3, programmable. Default[2] = Constant (Preset) speed. Activation selects constant speed 1	
16	DI 4	Digital input 4, programmable. Default[2] = Start enable 1 (safety interlock) Deactivation stops the drive.	
17	DI 5	Digital input 5, programmable. Default[2] = Not configured.	
18	DI 6	Digital input 5, programmable. Default[2] = Not configured.	
19	RO1C	Common	Relay output 1, programmable (Default[2] = Ready – 19 connected to 21). 12 - 250 V AC / 30 V DC, 10 mA - 2 A
20	RO1A	Normally Closed (NC)	
21	RO1B	Normally Open (NO)	
22	RO2C	Common	Relay output 2, programmable (Default[2] = Running - 22 connected to 24). 12 - 250 V AC / 30 V DC, 10 mA - 2 A
23	RO2A	Normally Closed (NC)	
24	RO2B	Normally Open (NO)	
25	RO3C	Common	Relay output 3, programmable (Default[2] = Fault (-1)[3]- 25 connected to 27). 12 - 250 V AC / 30 V DC, 10 mA - 2 A
26	RO3A	Normally Closed (NC)	
27	RO3B	Normally Open (NO)	
28	Screen	Terminal for signal cable screen. (Connected internally to chassis ground.)	
29	B	RS-485 Serial Communications Positive input connection	
30	A	RS-485 Serial Communications Negative input connection	
31	AGND	Analog input common. (Connected internally to chassis ground through 1 MΩ.)	
32	Screen	Terminal for signal cable screen. (Connected internally to chassis ground.)	

Notes: 1. Digital input impedance 1.5 kΩ. Maximum voltage for digital inputs is 30 V. Use multi-strand wire, size range: 20-16 AWG (0.5-1.5 mm^2)
2. Default values depend on the macro used. Values specified are for the HVAC default macro.
3. For fail-safe reasons, the Fault (-1) Relay signals a “Fault”, when the ACH550 is powered down.

ACH550 with ABB E-Clipse bypass – Overview

ABB E-Clipse bypass Standard Features

- Door Interlocked Disconnect or Circuit Breaker
- English Language Back-Lit LCD Display
- Operator Control Panel
- LED Status Pilot Lights
- Smoke Control
- Override Mode
- Serial Communications
- 5 Programmable Relay Outputs (Form C)
- 100% Functionality with Drive Removed
- Programmable Auto Transfer to Bypass
- Plain English Safety Annunciation
- UL & cUL Listed
- Seismic Zone 4 Certified (IBC 2006)
- UL Type 1, Type 12 or Type 3R Enclosure
- Programmable Class 10, 20, or 30 OL
- Automatic Restart
- 24 Month Parts and Labor Warranty (with Certified Start-up)
- Two Contactor Bypass
- System Status Display
- Bypass Diagnostics Display
- Drive Exclusive Fast-Acting Fuses
- Electronic Motor Overload Protection
- Damper Control - VFD and Bypass Modes
- 6 Digital Inputs (5 programmable)
- Single Phase Protection in VFD & Bypass Mode
- Bullet Proof Contactor Protection
- Serial Communications Pass Through I/O
- Proof-of-Flow Indication & Action
- Conformal Coated Circuit Boards
- +30%; -35% Input Voltage Tolerance
- Run Permissive Circuit
- Supervisory Control
- UL Listed I^2T Electronic Overload
- UL Listed and tested 100,000 Ampere SCCR (VCR and BCR Units)

The ACH550 with ABB E-Clipse bypass is an ACH550 HVAC Drive in an integrated UL Type 1, UL Type 12 or NEMA 3R enclosure with a bypass motor starter. The ACH550 with ABB E-Clipse bypass provides an input disconnect switch or circuit breaker with door mounted and interlocked operator (padlockable in the OFF position), a bypass starter, electronic motor overload protection, a local programming and operator keypad with indicating lights, provisions for external control connections, and serial communications capability. Certain configurations (+F267) also provide a drive service switch.

UL Type 1 (NEMA 1) and UL Type 12 (NEMA 12) E-Clipse units are available from 1 to 100 HP at 208/240V, 1 to 400 HP at 480V, and 2 to 150 HP at 600V. UL Type 1 and UL Type 12 units are wall mounted from 1 to 200 HP and floor mounted from 250 to 550 HP. The operator keypad is mounted on the door of the enclosure.

For outdoor applications, UL Type 3R (NEMA 3R) E-Clipse unit are available from 1 to 100 HP at 208/240V, 1 to 200 HP at 480V and 2 to 150 HP at 600V. Construction is sheet steel with a tough powder coat paint finish for corrosion resistance. A thermostatically controlled space heater and thermostatic control of the force ventilated cooling system are standard. The operator keypads are mounted on the enclosure door and covered by a hinged panel.

The ACH550 with ABB E-Clipse bypass includes two contactors. One contactor is the bypass contactor, used to connect the motor directly to the incoming power line in the event that the ACH550 is out of service. The other contactor is the ACH550 output contactor that disconnects the ACH550 from the motor when the motor is operating in the Bypass mode. The drive output contactor and the bypass contactor are electrically interlocked to prevent “back feeding”.

The ACH550 with ABB E-Clipse bypass is a microprocessor-controlled “intelligent” system which features programmable Class 20 or 30 overload curves, programmable underload (broken belt) and overload trip or indication. Also included as standard features are single-phase protection in bypass mode, programmable manual or automatic transfer to bypass, fireman’s override, smoke control, damper control, no contactor chatter on brown-out power conditions and serial communications. Should a drive problem occur, fast acting fuses exclusive to the ACH550 drive path disconnect the drive from the line prior to clearing upstream branch circuit protection, maintaining bypass capability.

Damper Control Circuit (Run Permissive)

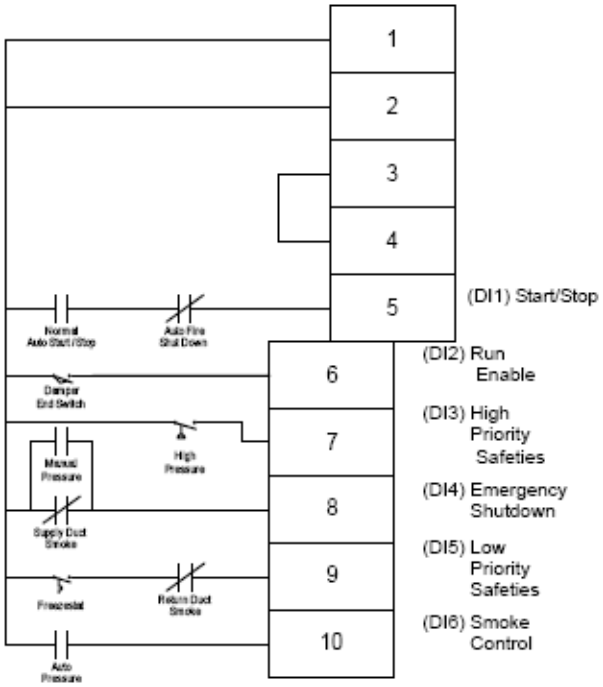
The damper control circuit closes a dry contact upon a start command to open a damper such as an outdoor air damper, fire damper, isolation damper, etc. before the motor is allowed to operate in drive mode or bypass mode regardless of the source of the run command. When the damper is fully open, a normally open dry contact from the damper end-switch closes and allows the motor to operate. Up to four dedicated inputs are provided for safety interlocks such as firestats, smoke detectors, etc.

The safety interlock inputs may also be linked to plain English keypad diagnostic indications to be displayed on the LCD. The unit may be set-up to display any of the following diagnostics upon opening of a digital input: Vibration Switch; Firestat; Freezestat; Over Pressure; Vibration Trip; Smoke Alarm; Safety Open; Low Suction; Start Enable; Run Enable; Damper End Switch; Valve Open Proof; or Pre-Lube Cycle. When any of these contacts open, the motor stops (in drive or bypass mode) and the damper is commanded to close. Although it is not a recommend sequence of operation, this run permissive circuit may also be controlled via serial communications.

Smoke Control and Override Modes

The ACH550 with ABB E-Clipse bypass has two Override modes of operation for critical control situations. The Smoke Control Override accepts a normally open dry contact that forces the motor to run in bypass and ignores all keypad inputs. In Smoke Control Override mode, the system acknowledges high priority digital inputs such as overpressure safeties and damper end-switch run permissive proofs, and disregards other, low priority digital inputs. See the attached sample wiring diagram for further details. Smoke Control Override (Override 1) response is not field programmable. The unit will go into smoke Override mode whenever DI6 is closed.

X2 E-Clipse Bypass Controller Input



Normal Operation:

- Close Start/Stop (X2:5)
- Fan starts, assuming that X2: 6, 7, 8, and 9 are all closed

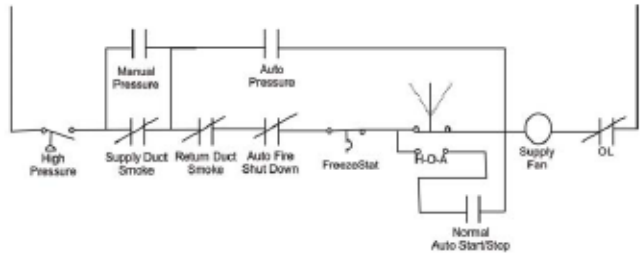
Emergency Shutdown:

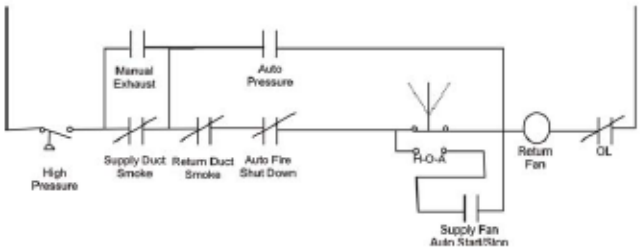
- Open auto fire shutdown, unit stops

Smoke Control Mode:

- Close contact on X2:10
- Fan starts regardless of position of internal HOA switch and inputs X2:6 and X2:9
- Inputs X2:6, 7 and 8 followed
- Internal overloads followed

Typical Starter Wiring for a Smoke Control listed System Today:





Notes:

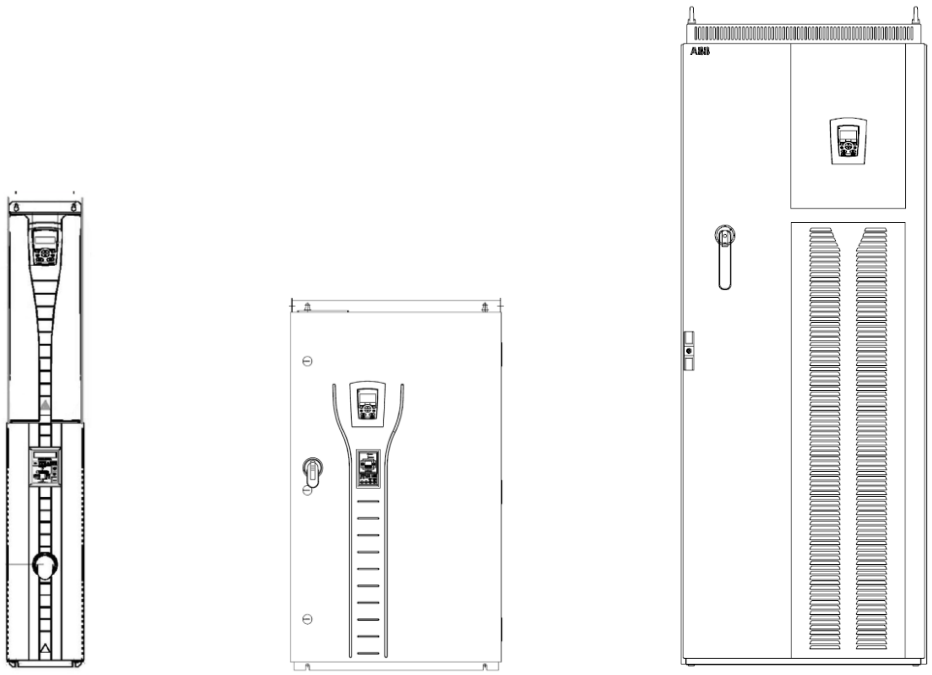
1. Pressure cutouts, duct smoke detectors and auto shutdown are 2-pole.
2. Manual control also activates "auto control" relays.

The second mode, Override 2, is fully programmable. Override 2 default programming is designed for "Run to Destruction" operation. However, the end user can program the unit to acknowledge some external inputs while ignoring others, ignore all external inputs or acknowledge all external inputs. This mode is fully programmable to allow the user to program the response of the unit to match his local AHJ.

Serial communications

All ABB E-Clipse bypass units have the following Embedded Fieldbus (EFB) protocols included as standard: Modbus RTU; Johnson Controls N2; Siemens Building Technologies FLN (P1); and BACnet (MS/TP).

The ACH550 with ABB E-Clipse bypass has the ability to monitor VFD/Bypass mode of operation, the status of the bypass H-O-A switch, bypass fault and override status over serial communication. In addition, the user can monitor and / or control over 45 points of bypass information via the communications protocols. Serial communication capabilities include - bypass run-stop control; the ability to force the unit to bypass; and the ability to control all relay outputs. The DDC system can monitor bypass feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC system is also capable of monitoring the bypass relay output status, and all digital input status'. All bypass diagnostic warning and fault information is transmitted over the serial communications bus. Remote system (drive or bypass) fault reset is possible.



Vertical & Standard ABB E-Clipse bypass Exterior Views

ABB E-Clipse bypass Operator Control

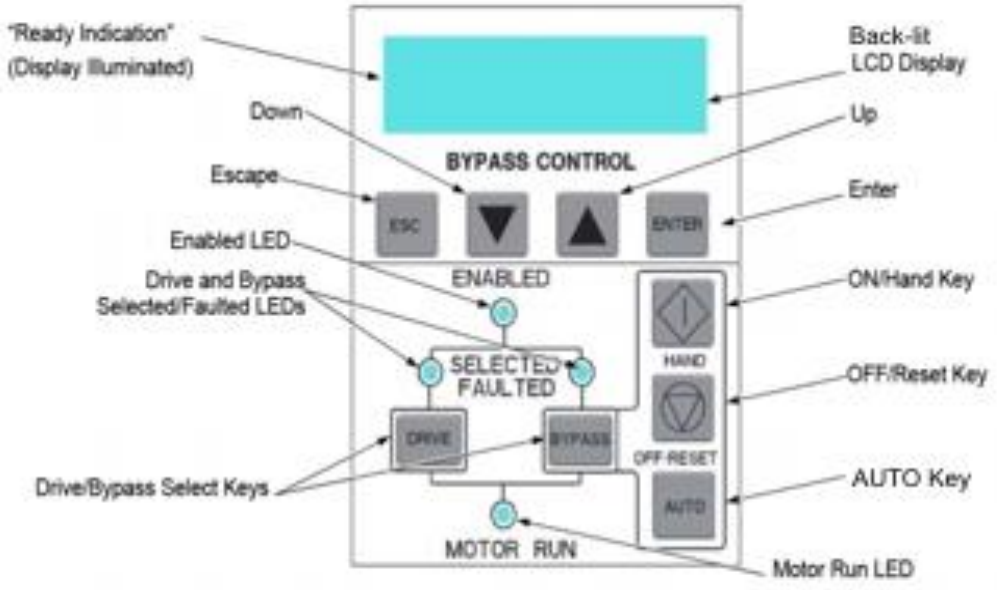
ACH550 Control Panel

The ACH550 Control Panel is a keypad with an LCD unit that provides status indication and operator controls for the ACH550 drive. In normal operation with the ABB E-Clipse bypass, the ACH550 should be placed in the *Auto* mode of operation by pressing the *Auto* key on the ACH550 Control Panel. Refer to the *ACH550 User's Manual* for additional information on the ACH550 Control Panel and other aspects of ACH550 operation.

Bypass Control Keypad

The ABB E-Clipse bypass has a separate keypad with an LCD unit that provides status indication and programming of the system. This keypad is also used for selecting the *Drive* or *Bypass* mode of operation and manually starting and stopping the motor in the *Bypass* mode. The bypass keypad has LED indicating lights that indicate the status of both the bypass and the drive as well as an LCD display that provides programming, status and warning/fault indications.

The illustration below shows the bypass control keypad and identifies the keys and LED indicating lights.



The functions of the various keys and LEDs are described in the following table.

Enabled LED	The *Enabled* LED is illuminated green under the following conditions: • Both the Safety Interlock(s) and Run Enable contacts are closed. • The Safety Interlock(s) contact are closed with no Start command present. The *Enable* LED flashes green if the Run Enable contact is open and when the Safety Interlock contact(s) are closed and a Start command is present. The Enable LED is illuminated red when the Safety Interlock contact(s) are open.
Drive Selected LED	The *Drive Selected* LED is illuminated green when the drive has been selected as the power source for the motor and no drive fault is present.
Bypass Selected LED	The *Bypass Selected* LED is illuminated green when the bypass has been selected as the power source for the motor and no bypass fault is present.
Motor Run LED	The *Motor Run* LED is illuminated green whenever the system is running. The *Motor Run* LED flashes green to indicate the system has been placed in an Override operating mode.
Drive Faulted LED	The *Drive Fault* LED is illuminated red when the bypass has lost its' communications link with the drive or when the motor or drive protection functions have shut down the drive.
Bypass Faulted LED	The *Bypass Faulted* LED is illuminated or flashes red when the motor or bypass protective functions have shut down the bypass.
Drive Key	The *Drive* Key selects the drive as the power source for the motor.
Bypass Key	The *Bypass* Key selects the bypass as the power source for the motor.
Auto Key	The *Auto* key selects the *Auto Start* contact or serial communications as the means for starting and stopping the motor in the bypass mode.
Off/Reset Key	The *Off*/*Reset* key may be used to manually stop the motor if the motor is running on bypass power. The *Off*/*Reset* Key also resets most bypass faults. It may take several minutes before the bypass can be reset after an overload trip. If a bypass fault condition is present, the second push of the *Off*/*Reset* key puts the bypass in the Off mode.
Hand Key	The *Hand* key can be used to manually start the motor when the bypass has been selected as the power source for the motor.
UP Key	Used to navigate through system programming steps.
Down Key	Used to navigate through system programming steps.

Control Modes

Drive mode

Under normal conditions the system is in the *Drive* mode. The ACH550 drive provides power to the motor and controls its speed. The source of the drive's start/stop and speed commands is determined by the *Auto* or *Hand* mode selection of the drive's keypad. Commands come from the control terminals or serial communications when the *Auto* mode has been selected or from the drive keypad when the *Hand* mode has been selected. The user can normally switch to the *Drive* mode by pressing the *Drive* key on the bypass keypad.

Bypass mode

In the *Bypass* mode, the motor is powered by AC line power through the bypass contactor. The source of the bypass'start/stop commands is determined by the *Auto* or *Hand* mode selection of the bypass' keypad. Commands come from the control terminals or serial communications when the *Auto* mode has been selected or from the bypass keypad when the *Hand* mode has been selected. The user can normally switch to the *Bypass* mode by pressing the *Bypass* key on the bypass keypad.

Smoke Control mode

In the *Smoke Control (Override 1)* mode, the motor is powered by AC line power through the bypass contactor. The source of the Smoke Control command is DI 6 and is unaffected by external stop commands. The VFD Keypad and the Bypass Keypad will not accept user commands when the system is in Smoke Control mode (the keypad user inputs are disabled). The user can switch to the *Smoke Control* mode by closing the *Smoke Control* input contact (DI 6). When the *Smoke Control* input contact is closed, the system is forced to bypass and runs the motor. The Motor Run LED flashes green when the system is in override. While in *Smoke Control*, the system only responds to certain inputs. Normally when the *Smoke Control* input contact is switched from closed to open, the system returns to the operating mode that existed prior to entering *Smoke Control* and can once again be controlled using the *Drive* and *Bypass* keys. The exception to this is when the *Bypass Override (Override 2)* input contact is closed, in which case the system switches to *Bypass Override* operation.

Bypass Override mode

In the *Bypass Override (Override 2)* mode, the motor is powered by AC line power through the bypass contactor. The source of the start command is internal and unaffected by external stop commands. The VFD Keypad and the Bypass Keypad will not accept user commands when the system is in Bypass Override mode (the keypad user inputs are disabled). The user can switch to the *Bypass Override* mode by closing the *Bypass Override* input contact (DI 5-if programmed). When the *Bypass Override* input contact is closed, the system is forced to bypass and does not respond to the *Drive* and *Bypass* keys. The Motor Run LED flashes green when the system is in override. While in *Bypass Override* the system responds to bypass overloads and programmed faults. The system may be custom programmed to acknowledge or disregard certain faults, safeties and enables. The unit is default programmed to ignore all external safeties and run enables. See Group 17 for programmability of the digital input and fault functions. Normally when the *Bypass Override* input contact is switched from closed to open, the system switches to the *Drive* mode and can be controlled using the *Drive* and *Bypass* keys. The exception to this is when the *Smoke Control (Override 1)* input contact is closed, in which case the system remains in *Smoke Control* operation.

Hand mode

When the system is in the *Bypass* mode, the operator can manually start the motor by pressing the *Hand* key. The motor will run and the *Hand* LED will be illuminated green. In order to run the motor, the *Safety Interlock* and *Run Enable* contacts must be closed (green *Enable* LED) and any bypass fault must be reset.

Auto mode

In the *Auto* mode the bypass start/stop command comes from the *Start/Stop* input terminal on the bypass control board or from serial communications – if programmed. The *Auto* mode is selected by pressing the

Auto key on the bypass keypad. The *Auto* LED is illuminated green when the bypass is in the *Auto* mode. If the system is in the *Bypass* mode, the motor will run across the line if the *Auto* mode is selected, the *Start/Stop, Safety Interlock* and *Run Enable* contacts are closed and any bypass fault is reset.

Off Mode

If the motor is running in the *Bypass* mode, the operator can manually stop the motor by pressing the *OFF* key. The *Motor Running* LED will go out. The motor can be restarted by pressing the *Hand* key or the bypass can be returned to the *Auto* mode by pressing the *Auto* key. If the system is in the *Drive* mode, pressing the *OFF* key will take the bypass out of the *Auto* mode, but will not affect motor operation from the drive. If the system is switched to the *Bypass* mode, a motor that is running will stop.

Programmable Relay Contact Outputs

The ABB E-Clipse bypass has five programmable relay outputs as standard. The default programming descriptions for these relay outputs is described below.

Bypass Not Faulted

The *Bypass Not Faulted* relay is energized during normal operation. The *Bypass Not Faulted* relay is de-energized when a bypass fault has occurred.

System Running

The *System Running* relay is energized when the ABB E-Clipse bypass System is running. The *System Running* relay provides an output when the motor is running whether powered by the ACH550 drive or the bypass.

System Started

The *System Started* relay is energized when the ABB E-Clipse bypass system is started. Three conditions must be met in order for the relay to energize. 1) a *Start* command must be present, 2) the *Safety Interlock* input contact must be closed and 3) there can be no fault present in the system. The *Start* command can come from the bypass control board terminal block, the ACH550 keypad, the bypass keypad, or serial communications depending on the operational mode selected. The *System Started* relay is ideal for use in damper actuator circuits, opening the dampers only under those conditions where the system is preparing to run the motor. The *System Started* relay will de-energize, closing the dampers if the safeties open, the system faults, or when a *Stop* command is issued.

Bypass Selected

Relay output four is factory default programmed for Bypass Selected. The relay will be energized anytime the user has placed the system in Bypass mode.

Bypass Auto

Relay Output five is factory default programmed for *Bypass Auto*. The relay will be energized anytime the user has placed the bypass in the Auto mode.

The complete list of programmable relay output functions follows:

0 = NOT SEL	10 = DRV NOT FLT	20 = BYP UNDERLD
1 = SYS READY	11 = DRIVE ALARM	21 = PCB OVERTMP
2 = SYS RUNNING	12 = OVERRIDE	22 = SYS UNDERLD
3 = SYS STARTED	13 = BYPASS HAND	23 = SYSTEM FLT
4 = BYPASS SEL	14 = BYPASS OFF	24 = SYS FLT/ALM
5 = BYPASS RUN	15 = BYPASS AUTO	25 = SYS EXT CTL
6 = BYPASS FLT	16 = COM CTRL	26 = SYS OVERLD
7 = BYP NOT FLT	17 = SYS ALARM	27 = CONTACT FLT
8 = BYPASS ALRM	18 = BYPASS FLT/ALM	
9 = DRIVE FAULT	19 = BYP OVERLD	

Cable Connections

The following illustrations show the ACH550 with ABB E-Clipse bypass cable connection points for the various enclosure styles. The illustrations indicate the location of input and output power connections as well as equipment and motor grounding connection points.

ACH550 drives are configured for wiring access from the bottom only on Vertical ABB E-Clipse bypass units and from the top only on Standard ABB E-Clipse bypass units. At least three separate metallic conduits are required, one for input power, one for output power to the motor and one for control signals.

All ABB E-Clipse bypass units provided with a circuit breaker input - VCR and BCR configurations have a panel short circuit current rating of 100,000 RMS symmetrical Amperes. Units provided with a disconnect input - VDR and BDR configurations require separate external low peak fuses (supplied by others) to obtain the 100,000 KAIC SCCR.

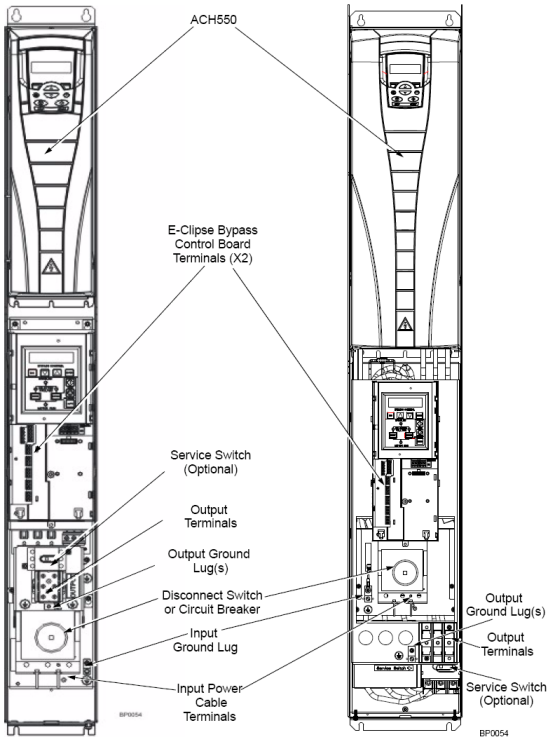
Terminal Sizes

Power and motor cable terminal sizes are shown in the *Submittal Schedule Details* and in the *Wire Size Capacities of Power Terminals* Table. The information provided is for connections to an input circuit breaker or disconnect switch, a motor terminal block, overload relay and ground lugs. The table also lists torque that should be applied when tightening the connections.

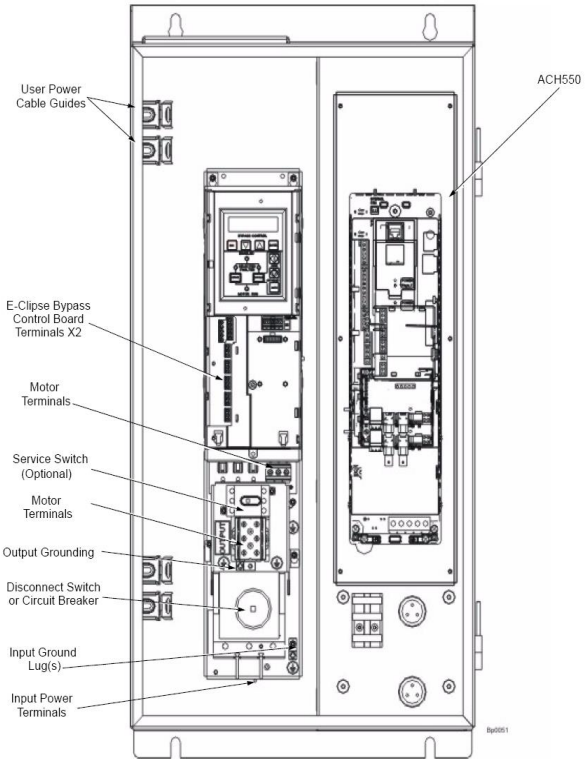
Protections

All ABB E-Clipse bypass units include the following protective features: single phase input and output; motor open phase; motor overload (UL Listed); stuck contactor; contactor coil open; undervoltage; motor underload (proof-of-flow / broken belt); serial communications loss; and overtemperature. All printed circuit boards are conformally coated as standard.

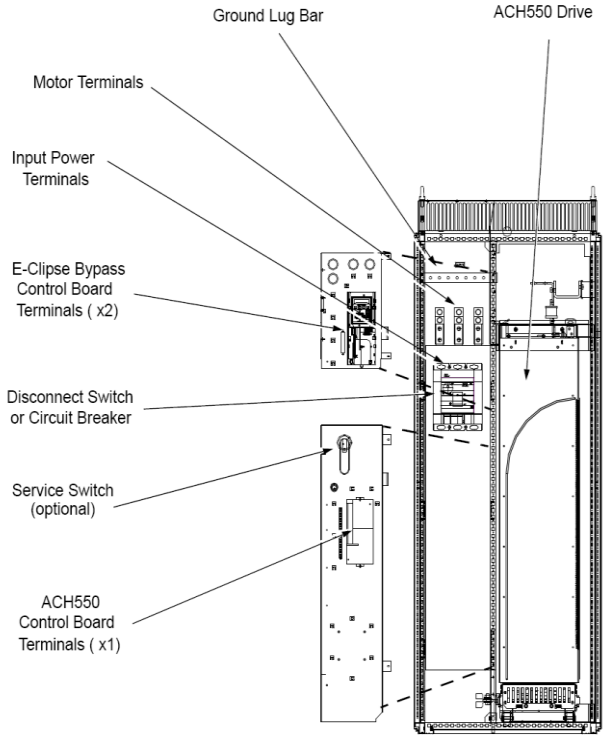
Internal Layout Drawings



Vertical ABB E-Clipse Bypass
(UL Type 1 / 12)



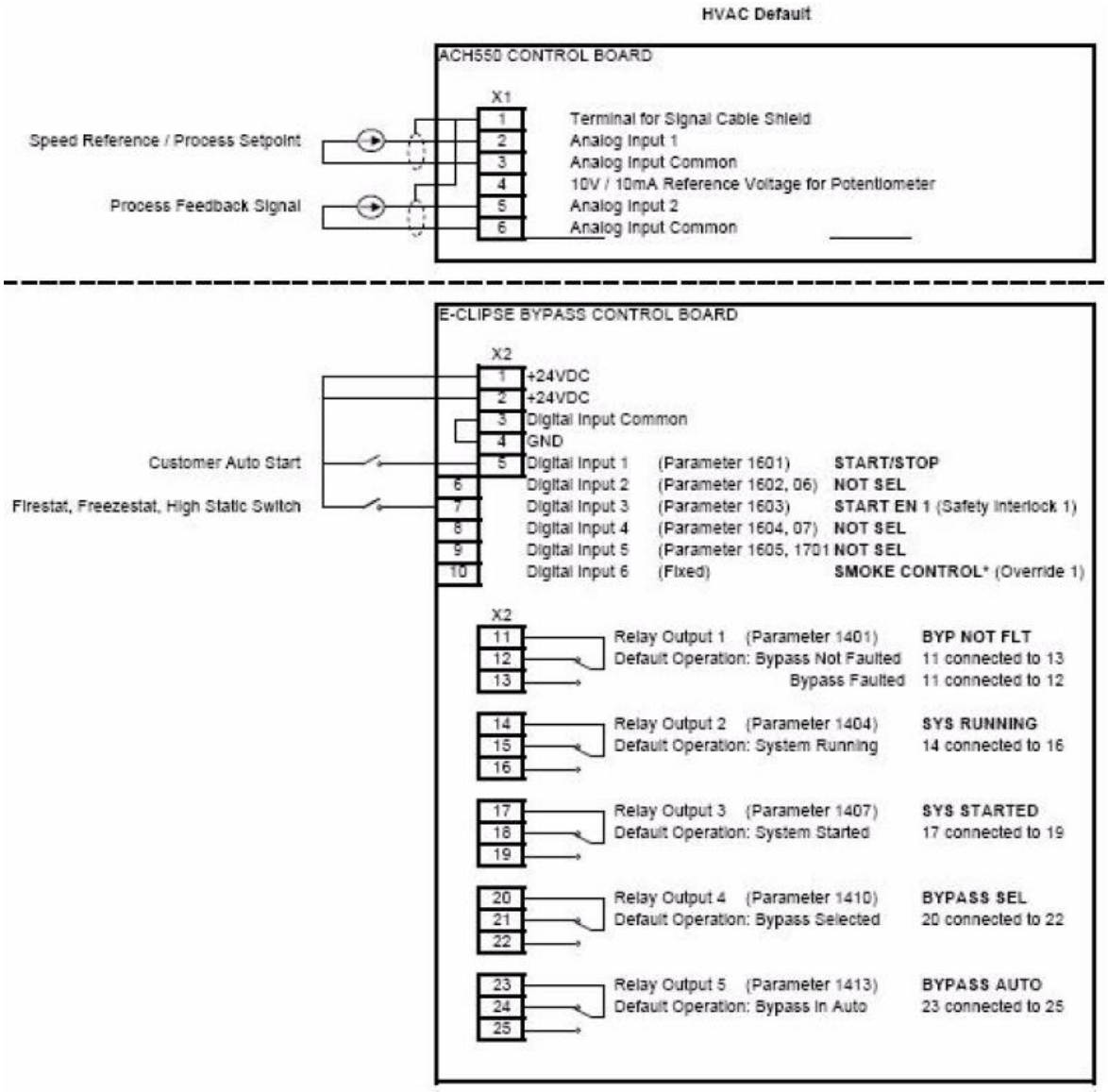
Standard Wall Mount ABB E-Clipse Bypass



Standard Floor Mount ABB E-Clipse Bypass

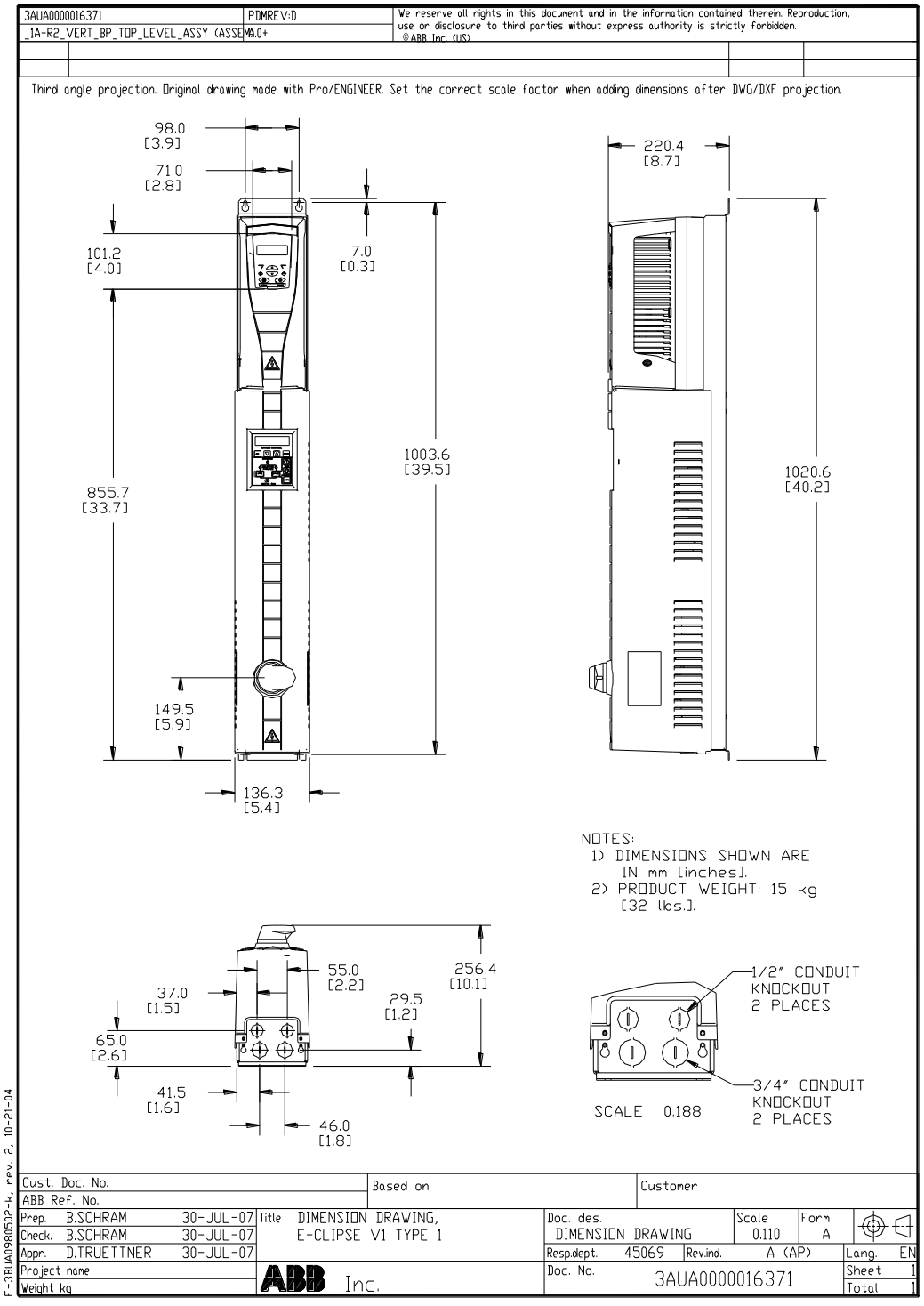
Control Terminals

The control wiring includes connections to an analog speed command signal and a start/stop relay contact for controlling the motor 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 indication circuit. For a detailed description of the control circuit functions and alternate Control Connection diagrams, refer to the *ACH550 with ABB E-Clipse bypass Users Manual.*

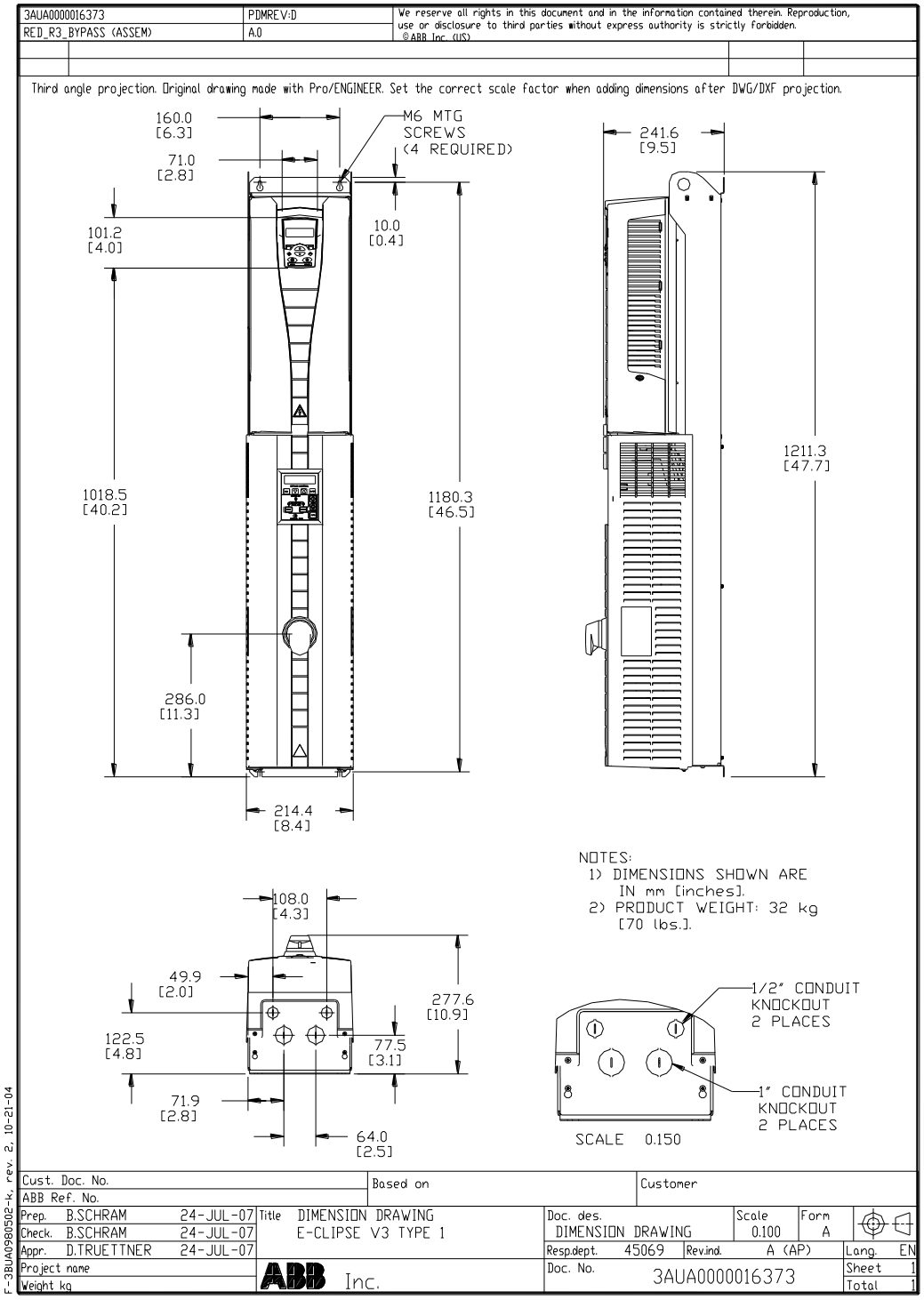


Basic Control Connections for Damper Actuator Control

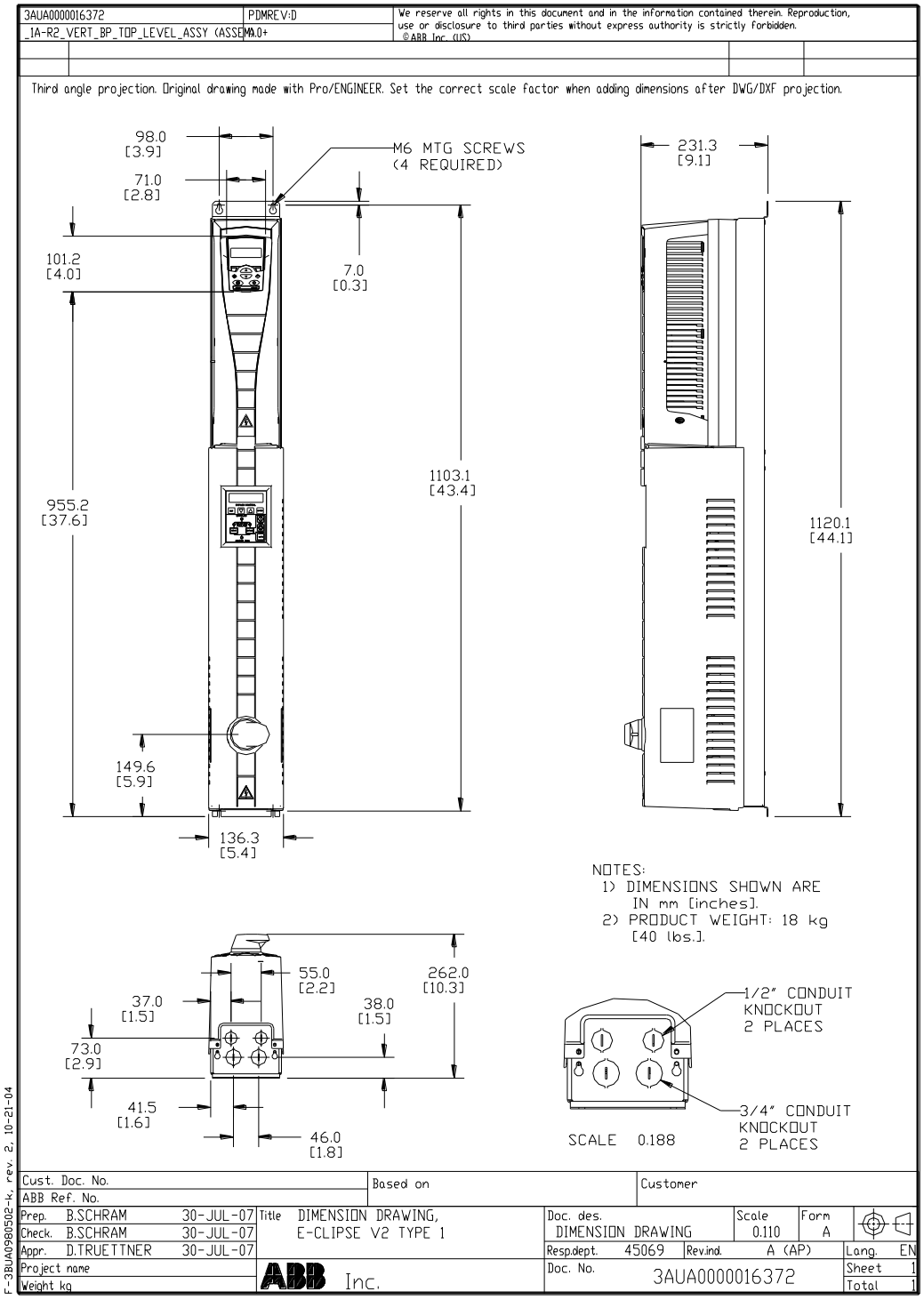
Dimension Drawing for AHU-3, -4, -5, EF-2, EF-3



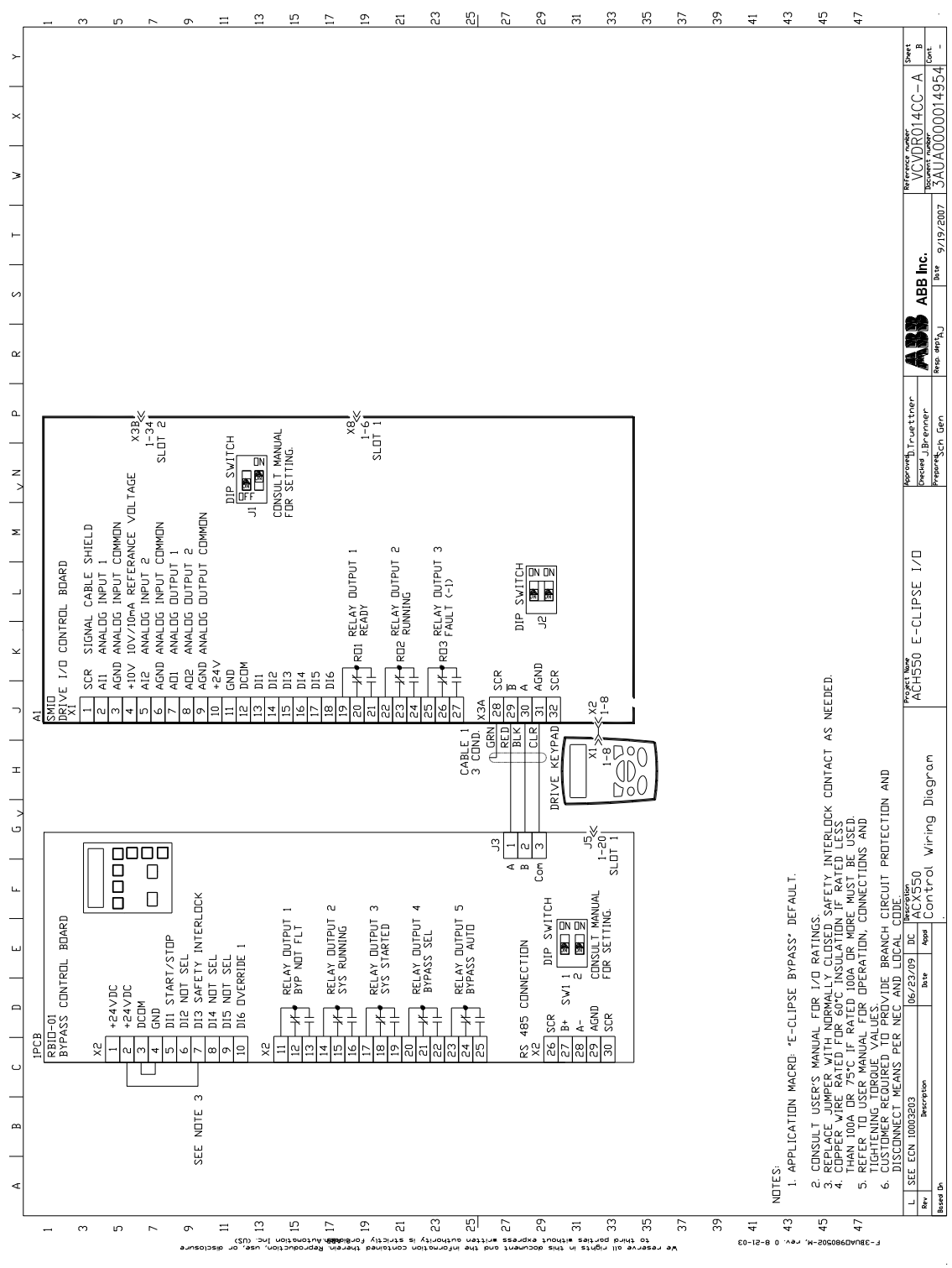
Dimension Drawing for CP-1, CP-2, HEF-1A, -1B, -1C



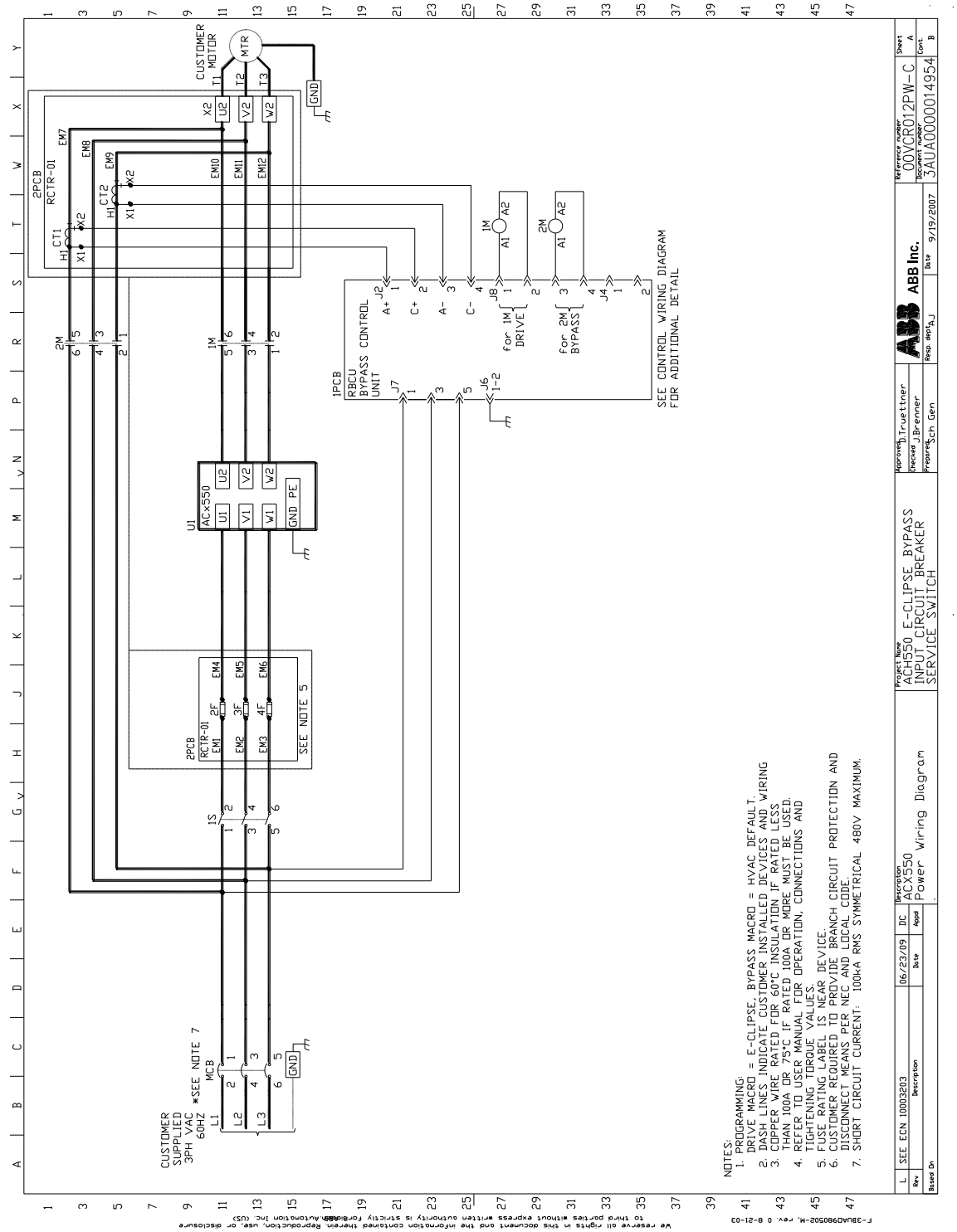
Dimension Drawing for HP-1, HP-2, HRP-1, HRP-2



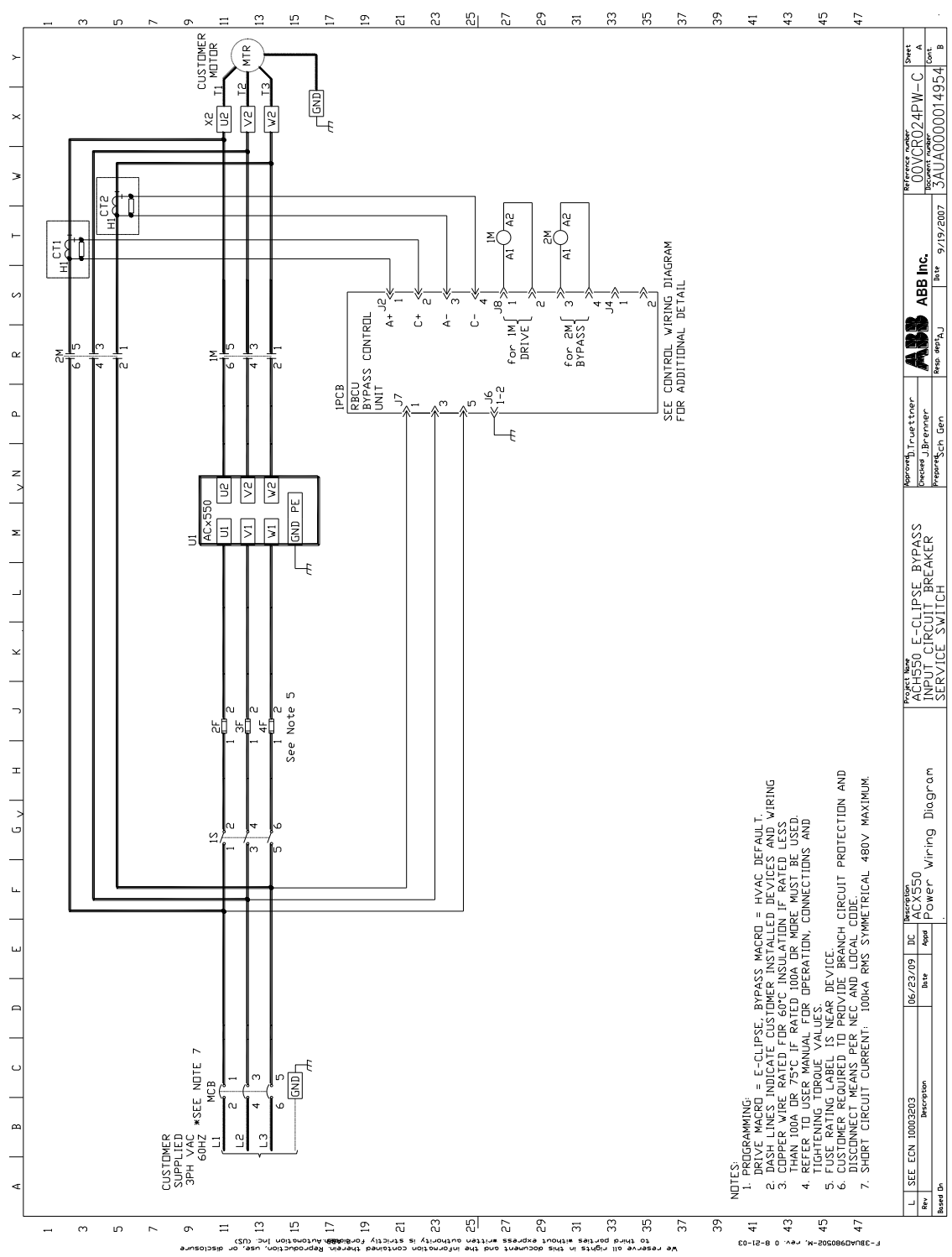
Connection Drawing for AHU-3, -4, -5, CP-1, CP-2, HEF-1A, -1B, -1C, EF-2, EF-3, HP-1, HP-2, HRP-1, HRP-2



Power Drawing for AHU-3, -4, -5, EF-2, EF-3, HP-1, HP-2, HRP-1, HRP-2

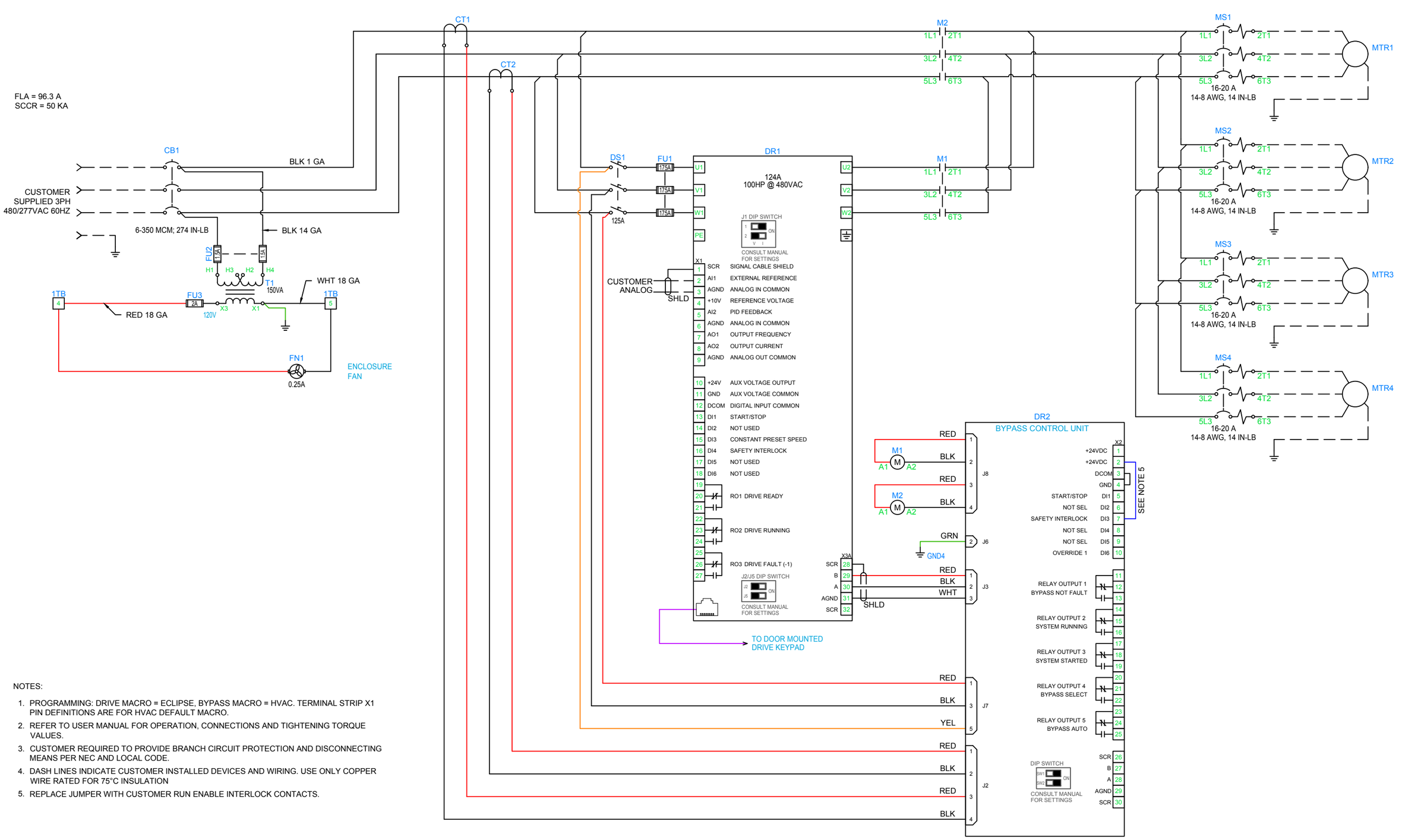


Power Drawing for CP-1, CP-2, HEF-1A, -1B, -1C



Dimension Drawing for AHU-1, AHU-2
Reference attached drawing number "ACH550-BCR-125A-4+F267+4G405+M652, Sheet 2"

Power and Connection Drawing for AHU-1, AHU-2
Reference attached drawing number "ACH550-BCR-125A-4+F267+4G405+M652, Sheet 1"



NOTES:

1. PROGRAMMING: DRIVE MACRO = ECLIPSE, BYPASS MACRO = HVAC. TERMINAL STRIP X1 PIN DEFINITIONS ARE FOR HVAC DEFAULT MACRO.
2. REFER TO USER MANUAL FOR OPERATION, CONNECTIONS AND TIGHTENING TORQUE VALUES.
3. CUSTOMER REQUIRED TO PROVIDE BRANCH CIRCUIT PROTECTION AND DISCONNECTING MEANS PER NEC AND LOCAL CODE.
4. DASH LINES INDICATE CUSTOMER INSTALLED DEVICES AND WIRING. USE ONLY COPPER WIRE RATED FOR 75°C INSULATION
5. REPLACE JUMPER WITH CUSTOMER RUN ENABLE INTERLOCK CONTACTS.

REV	DESCRIPTION	DATE	BY
A	INITIAL REVISION	5/31/16	JDA

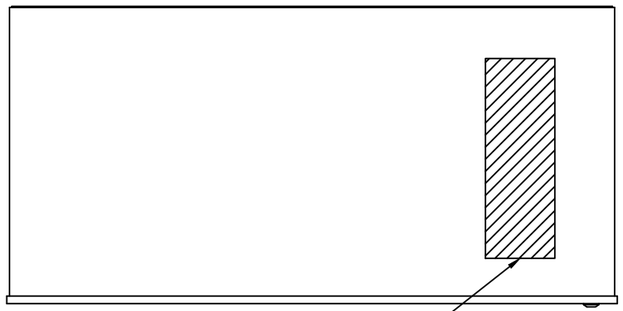
ABB Inc.

PROJECT NAME: ACH550 DRIVE W/ ECLIPSE BYPASS & MMP'S 100HP 460VAC N1

DESCRIPTION: WIRING DIAGRAM

DRAWN BY: JDA
CHECKED BY:
APPRD BY:

DRAWING NUMBER: ACH550-BCR-125A-4+F267+4G405+M652
DATE PREPARED: 5/31/16
REFERENCE NUMBER:
SHEET: 1

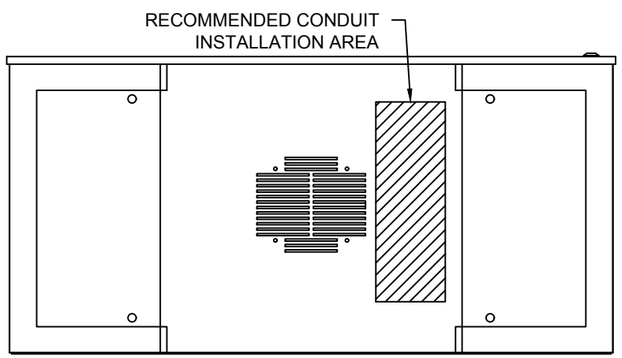


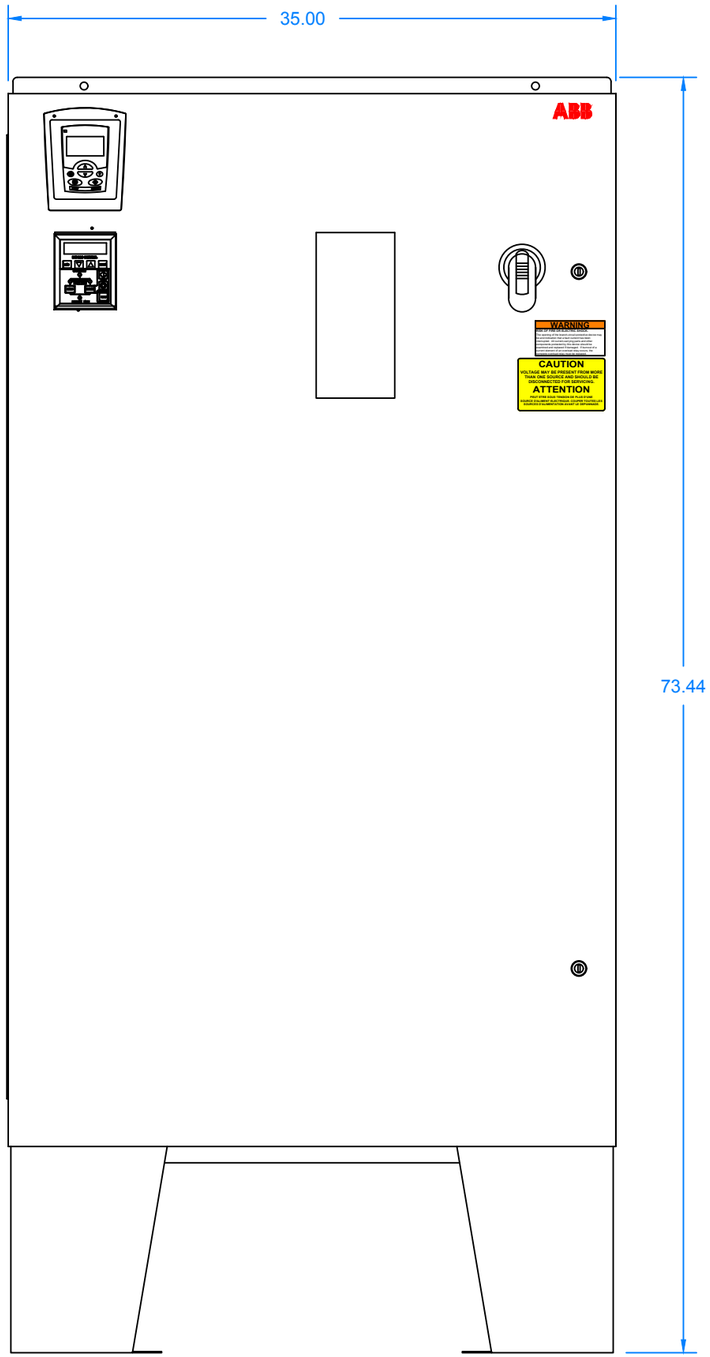
TOP VIEW

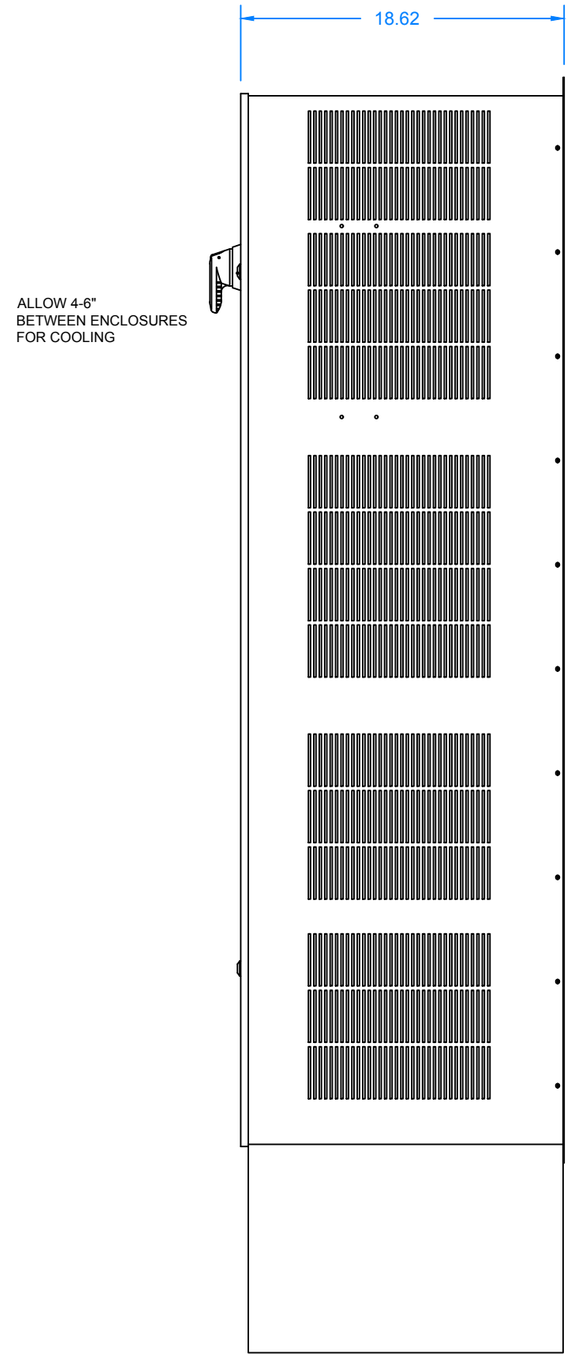
ELECTRICAL SERVICE:
TOP ENTRY/BOTTOM EXIT

APPROX. WEIGHT = 415 LBS

BOTTOM VIEW







REV	DESCRIPTION	DATE	BY
A	INITIAL REVISION	5/31/16	JDA

ABB Inc.

PROJECT NAME: ACH550 DRIVE
W/ ECLIPSE BYPASS & MMP'S
100HP 460VAC N1

DESCRIPTION: ENCLOSURE LAYOUT

DRAWN BY: JDA
CHECKED BY:
APPR'D BY:

DRAWING NUMBER: ACH550-BCR-125A-4+F267+4G405+M652
DATE PREPARED: 5/31/16
REFERENCE NUMBER:
SHEET: 2

ABB	Drive Harmonic Calculator	Harmonic-US-3.0	Revision 3.9.2 mam: 11-16-06	ID #	0

Zsource,Isc,Idmd Calculator
Detailed Inputs are in green
Critical Inputs are in red

Application (Spc, Gen, Ded) =	Gen	Isc/Idmd=	499.9	Idmd/Idrv =	3.43	Isc/Idrv=	1715.041	Isc@PCC V	%Zs
T1 KVA dxfmr=	1,000	Primary Impedance: R =		Primary MVA SC =	400	Pri Isc =	55,250	55,250	0.058298
Dist Xfmr % Z =	5.75	+jX =	ohms,	Z=		ohm X/R =		1E+15	3.22E-12
% Demand: T1 KVA =	80	Primary Wire AWG Size:		Wire Length(ft) =		# in Paral=		1E+15	3.22E-12
PCC Location =	utility	Vdxfmrpri =	4,180	Idistxfmrrated@Vpcc =	138.1261	Amps	Total =	2,402	1.340848
		Vdxfmrsec =	480	Idmd t1pri =	110.5	Vll @ pcc =	4,180	2,302	1.399145
		KVA dmd =	800	Idmd t1sec=	962.2787	Idmd@pcc	110.5	UsedHPpcc=	256.322
		Ave %Mtr Loading:	80	LineFreq =	60	Idrv@pcc	32.2097	DrvHPpcc=	400.5

Transformer		Network Inputs:		AveSysEff*PF:	0.82	Bus#	ID TAG	Fed From	Wire Size	# in Paral	W Length	Ampacity
#	ID TAG	Fed From	KVA	% Z	Vsec	Irated pcc	B1					0
T1	XFRMR T-US1	Utility	1,000	5.75	480	138.1261	B2					0
T2						0	B3					0
T3						0	B4					0
T4						0	B5					0
T5						0	B6					0
T6						0	B7					0
T7						0	B8					0
T8						0	B9					0
T9						0	B10					0

Drive #	ID TAG	Fed From	Conv Type	Hp Drive	% Z Int	% Z Ext	% Load	Wire Size	# in Paral	W Length	Ampacity	%Z Total	Vll@drv
1	AHU-1 (4@20)	T1	1	100	5		80				0	3.2	480
2	AHU-2 (4@20)	T1	1	100	5		80				0	3.2	480
3	AHU-3	T1	1	5	5		80				0	3.2	480
4	AHU-4	T1	1	5	5		80				0	3.2	480
5	AHU-5	T1	1	5	5		80				0	3.2	480
6	CP-1	T1	1	25	5		80				0	3.2	480
7	CP-2	T1	1	25	5		80				0	3.2	480
8	EF-2	T1	1	7.5	5		80				0	3.2	480
9	EF-3	T1	1	3	5		80				0	3.2	480
10	HP-1	T1	1	10	5		80				0	3.2	480
11	HP-2	T1	1	10	5		80				0	3.2	480
12	HRP-1	T1	1	15	5		80				0	3.2	480
13	HRP-2	T1	1	15	5		80				0	3.2	480
14	HEF-1A	T1	1	25	5		80				0	3.2	480
15	HEF-1B	T1	1	25	5		80				0	3.2	480
16	HEF-1C	T1	1	25	5		80				0	3.2	480
17											0	0	0
18											0	0	0
19											0	0	0
20											0	0	0
21											0	0	0
22											0	0	0
23											0	0	0
24											0	0	0
25											0	0	0

All % Impedances are with respect to the total drives connected thru the PCC.

I-demand includes both drive currents and sinusoidal currents. The ratio I-demand / I-drives is assumed the same at all points in network unless sine loads are added at a point.

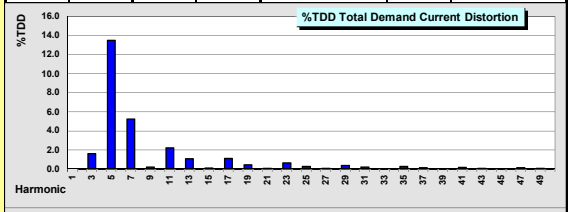
ABB 6 pulse drives have built-in internal line reactor or equivalent bus choke. For ACS800: 3/2.5% for VT, 2.3/1.9% for CT; for ACH/S550: 5/4% @ 60/50Hz.

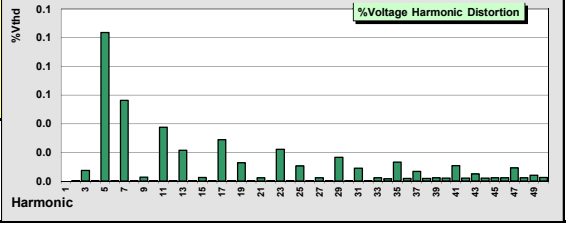
For Converter Input above: Input 1 = 6 pulse, 2 = 12 pulse, 3 = 18 pulse, 4 = 5th harmonic trap and 5% filter, 5 = Mirus Coupled filter, 6 = ACS800-11, 17, 31, 37

7 = New TCI Trap Filter, 8 = Active Filter, 9 = Sine Load, 10 = MTE Low Pass Filter, 11 = 18 Pulse w/AutoTransformer

ABB	HARMONIC ANALYSIS REPORT		
Project ID #:		DATE:	October 4, 2016
Description:	Webster Univ - ISB		
Requested By:	Motor Control Specialties		
Contact:	Jerry Cowley		
FAX:	(314)209-0212		
Phone:	(314)209-0211		
By:	Jerry Cowley	Phone:	(314)209-0211
Email:	jcowley@motorcontrolspecialties.com	Fax:	(314)209-0212

System Data:	PCC =	utility			
MVAsc before Xfmr =	400	MVA	Line Freq =	60	Hz
			Vll @ PCC =	4,180	Volts
Other Z primary: R =		ohm	Total Drive HP @ PCC	400.5	HP
X =		ohm	Total Used HP @ PCC	256.322	HP
Z =		ohm	I Short Ckt @ PCC =	55,241	Amps
AWG Wire Size =			I demand @ PCC =	110.5	Amps
Wire Length =		feet	I drives in @ PCC =	32.2	Amps
# in Parallel =			Isc / Idmd =	499.9	
% Wire Voltage Drop		%	Idmd/Idrv =	3.4	
Dist Xfmr KVA:	1000	KVA	Isc/Idrv =	1,715.0	
Dist Xfmr % Z:	5.75	%	%Zs before PCC =	0.1	%
DXfmr Irate @ PCC:	138.126	Amps	% Zf after PCC =	1.0	%
Demand % KVA Xfmr:	80	%	% Z loop @ PCC=	1.0	%
Demand KVA:	800	KVA	If drvs@ PCC =	27.7	Amps
Ave % Motor Loading:	80	%	Ih @ PCC =	16.4	Amps
Meets IEEE-519: % TDD at PCC			Irms @ PCC =	32.2	Amps
% Ithdf: 59.105	IEEE-519 Limits:		K factor =	9.854	
% TDD 14.832	%TDD limit		Disp PF =	0.972	
	@ PCC	15	Act PF =	0.837	
	@ t1 Pri	15	Vrms @ PCC =	4,167	Volts AC
% Vthdf: 0.135	% Vthdlm	5	Vbus @ D1 =	632.9	Volts DC





Harmonic	Frequency	%TDD Limit	%Ithd	Ih amps	% Vthd	% TDD
1	60		100.0	27.73	0.000	0.000
2	120	3.00	0.03	0.01	0.000	0.009
3	180	3.00	6.45	1.79	0.007	1.620
4	240	3.00	0.03	0.01	0.000	0.008
5	300	12.00	53.73	14.90	0.104	13.483
6	360	3.00	0.01	0.00	0.000	0.002
7	420	12.00	20.81	5.77	0.056	5.223
8	480	3.00	0.02	0.01	0.000	0.005
9	540	3.00	0.80	0.22	0.003	0.200
10	600	3.00	0.01	0.00	0.000	0.003
11	660	5.50	8.82	2.44	0.037	2.212
12	720	1.38	0.00	0.00	0.000	0.001
13	780	5.50	4.27	1.19	0.021	1.072
14	840	1.38	0.02	0.00	0.000	0.004
15	900	1.38	0.43	0.12	0.002	0.107
16	960	1.38	0.01	0.00	0.000	0.003
17	1020	5.00	4.38	1.22	0.029	1.100
18	1080	1.25	0.00	0.00	0.000	0.001
19	1140	5.00	1.75	0.49	0.013	0.440
20	1200	1.25	0.02	0.00	0.000	0.004
21	1260	1.25	0.29	0.08	0.002	0.073
22	1320	1.25	0.01	0.00	0.000	0.002
23	1380	2.00	2.50	0.69	0.022	0.627
24	1440	0.50	0.00	0.00	0.000	0.001
25	1500	2.00	1.09	0.30	0.011	0.273
26	1560	0.50	0.02	0.00	0.000	0.004
27	1620	0.50	0.22	0.06	0.002	0.055
28	1680	0.50	0.01	0.00	0.000	0.002
29	1740	2.00	1.48	0.41	0.017	0.371
30	1800	0.50	0.00	0.00	0.000	0.001
31	1860	2.00	0.75	0.21	0.009	0.187
32	1920	0.50	0.02	0.00	0.000	0.004
33	1980	0.50	0.17	0.05	0.002	0.044
34	2040	0.50	0.13	0.03	0.002	0.032
35	2100	1.00	0.98	0.27	0.013	0.246
36	2160	0.25	0.13	0.03	0.002	0.032
37	2220	1.00	0.47	0.13	0.007	0.119
38	2280	0.25	0.13	0.03	0.002	0.032
39	2340	0.25	0.15	0.04	0.002	0.037
40	2400	0.25	0.13	0.03	0.002	0.032
41	2460	1.00	0.68	0.19	0.011	0.171
42	2520	0.25	0.13	0.03	0.002	0.032
43	2580	1.00	0.30	0.08	0.005	0.075
44	2640	0.25	0.13	0.03	0.002	0.032
45	2700	0.25	0.13	0.03	0.002	0.032
46	2760	0.25	0.13	0.03	0.002	0.032
47	2820	1.00	0.50	0.14	0.009	0.127
48	2880	0.25	0.13	0.03	0.002	0.032
49	2940	1.00	0.22	0.06	0.004	0.054
50	3000	0.25	0.13	0.03	0.002	0.032

ABB	Drive Harmonic Calculator	Harmonic-US-3.0	Revision 3.9.2 mam: 11-16-06	ID #	0

Zsource,Isc,Idmd Calculator											
Detailed Inputs are in green		Isc/Idmd=	20.8	Idmd/Idrv =	3.43	Isc/Idrv=	71.47198	Isc@PCC V	%Zs
Critical Inputs are in red		Primary Impedance: R=		Primary MVA SC =	400	Pri Isc =	55,250	481,139	0.058297
Application (Spc, Gen, Ded) =	Gen	+jX=		ohms, Z=		ohm X/R =		1E+15	2.8E-11
T1 KVA dxfmr =	1,000	Primary Wire AWG Size:		Wire Length(ft)=		# in Paral=		1E+15	2.8E-11
Dist Xfmr % Z =	5.75	Vdxfmrpri=	4,180	Idistxfmrrated@Vpcc=	1202.848	Amps		20,919	1.340842
% Demand: T1 KVA =	80	Vdxfmrsec=	480	Idmd t1pri =	110.5	VII @ pcc =	480	Total=	20,047	1.39914
PCC Location =	t1	KVA dmd =	800	Idmd t1sec=	962.2787	Idmd@pcc	962.3	UsedHPpcc=	256	
		Ave %Mtr Loading:	80	LineFreq =	60	Idrv@pcc	280.4917	DrvHPpcc=	401	

Transformer		Network Inputs:		AveSysEff*PF:	0.82	Bus#	ID TAG	Fed From	Wire Size	# in Paral	W Length	Ampacity
#	ID TAG	Fed From	KVA	% Z	Vsec	Irated pcc	B1					0
T1	XFRMR T-US1	Utility	1,000	5.75	480	1202.848	B2					0
T2						0	B3					0
T3						0	B4					0
T4						0	B5					0
T5						0	B6					0
T6						0	B7					0
T7						0	B8					0
T8						0	B9					0
T9						0	B10					0

Drive #	ID TAG	Fed From	Conv Type	Hp Drive	% Z Int	% Z Ext	%Load	Wire Size	# in Paral	W Length	Ampacity	%Z Total	VII@drv
1	AHU-1 (4@20)	T1	1	100	5		80				0	3.2	480
2	AHU-2 (4@20)	T1	1	100	5		80				0	3.2	480
3	AHU-3	T1	1	5	5		80				0	3.2	480
4	AHU-4	T1	1	5	5		80				0	3.2	480
5	AHU-5	T1	1	5	5		80				0	3.2	480
6	CP-1	T1	1	25	5		80				0	3.2	480
7	CP-2	T1	1	25	5		80				0	3.2	480
8	EF-2	T1	1	7.5	5		80				0	3.2	480
9	EF-3	T1	1	3	5		80				0	3.2	480
10	HP-1	T1	1	10	5		80				0	3.2	480
11	HP-2	T1	1	10	5		80				0	3.2	480
12	HRP-1	T1	1	15	5		80				0	3.2	480
13	HRP-2	T1	1	15	5		80				0	3.2	480
14	HEF-1A	T1	1	25	5		80				0	3.2	480
15	HEF-1B	T1	1	25	5		80				0	3.2	480
16	HEF-1C	T1	1	25	5		80				0	3.2	480
17											0	0	0
18											0	0	0
19											0	0	0
20											0	0	0
21											0	0	0
22											0	0	0
23											0	0	0
24											0	0	0
25											0	0	0

All % Impedances are with respect to the total drives connected thru the PCC.

I-demand includes both drive currents and sinusoidal currents. The ratio I-demand / I-drives is assumed the same at all points in network unless sine loads are added at a point.

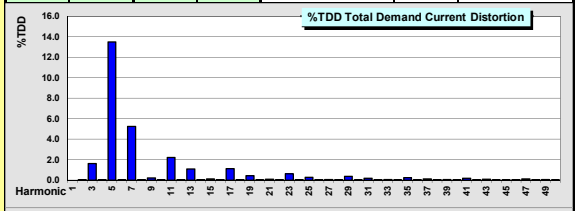
ABB 6 pulse drives have built-in internal line reactor or equivalent bus choke. For ACS800: 3/2.5% for VT, 2.3/1.9% for CT; for ACH/S550: 5/4% @ 60/50Hz.

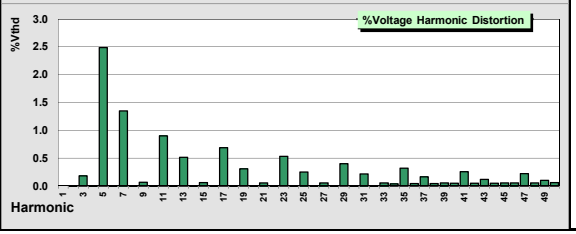
For Converter Input above: Input 1 = 6 pulse, 2 = 12 pulse, 3 = 18 pulse, 4 = 5th harmonic trap and 5% filter, 5 = Mirus Coupled filter, 6 = ACS800-11, 17, 31, 37

7 = New TCI Trap Filter, 8 = Active Filter, 9 = Sine Load, 10 = MTE Low Pass Filter, 11 = 18 Pulse w/AutoTransformer

ABB	HARMONIC ANALYSIS REPORT			
Project ID #:	0	DATE:	October 4, 2016	
Description:	Webster Univ - ISB			
Requested By:	Motor Control Specialties			
Contact:	Jerry Cowley			
Phone:	(314)209-0212			
Fax	(314)209-0211			
By:	Jerry Cowley	Phone:	(314)209-0211	
Email:	jcowley@motorcontrolspecialties.com	Fax:	(314)209-0212	

System Data:	PCC =	t1			
MVAsc before Xfmr =	400	MVA	Line Freq =	60	Hz
Other Z primary: R =		ohm	VII @ PCC =	480	Volts
X =		ohm	Total Drive HP @ PCC	400.5	HP
Z =		ohm	Total Used HP @ PCC	256.321	HP
AWG Wire Size =			I Short Ckt @ PCC =	20,047	Amps
Wire Length =		feet	I demand @ PCC =	962	Amps
# in Parallel =			I drives in @ PCC =	280	Amps
% Wire Voltage Drop		%	Isc / Idmd =	20.8	
Dist Xfmr KVA:	1000	KVA	Idmd/Idrv =	3.4	
Dist Xfmr % Z:	5.75	%	Isc/Idrv =	71.5	
DXfmr Irate @ PCC:	1202.85	Amps	%Zs before PCC =	1.4	%
Demand % KVA Xfmr:	80	%	% Zf after PCC =	3.2	%
Demand KVA:	800	KVA	% Z loop @ PCC=	4.6	%
Ave % Motor Loading:	80	%	If drvs@ PCC =	241.5	Amps
Meets IEEE-519: % VThd at PCC			Ih @ PCC =	142.7	Amps
% Ithdf:	59.105	IEEE-519 Limits:	Irms @ PCC =	280.5	Amps
% TDD	14.832	%TDD limit	K factor =	9.855	
		@ PCC 8	Disp PF =	0.968	
		@ t1 Pri 15	Act PF =	0.834	
% Vthdf:	3.249	% VthdIm 5	Vrms @ PCC =	475.2	Volts AC
			Vbus @ D1 =	632.9	Volts DC





Harmonic	Frequency	%TDD Limit	%Ithd	Ih amps	% Vthd	% TDD
1	60		100.0	241.47	0.000	0.000
2	120	1.75	0.03	0.08	0.001	0.009
3	180	1.75	6.45	15.59	0.179	1.620
4	240	1.75	0.03	0.07	0.001	0.008
5	300	7.00	53.73	129.74	2.489	13.483
6	360	1.75	0.01	0.02	0.000	0.002
7	420	7.00	20.81	50.26	1.350	5.223
8	480	1.75	0.02	0.05	0.002	0.005
9	540	1.75	0.80	1.92	0.066	0.200
10	600	1.75	0.01	0.03	0.001	0.003
11	660	3.50	8.82	21.29	0.898	2.212
12	720	0.88	0.00	0.01	0.000	0.001
13	780	3.50	4.27	10.32	0.515	1.072
14	840	0.88	0.02	0.04	0.002	0.004
15	900	0.88	0.43	1.03	0.059	0.107
16	960	0.88	0.01	0.03	0.002	0.003
17	1020	2.50	4.38	10.58	0.690	1.100
18	1080	0.63	0.00	0.01	0.001	0.001
19	1140	2.50	1.75	4.23	0.309	0.440
20	1200	0.63	0.02	0.04	0.003	0.004
21	1260	0.63	0.29	0.71	0.057	0.073
22	1320	0.63	0.01	0.02	0.002	0.002
23	1380	1.00	2.50	6.04	0.533	0.627
24	1440	0.25	0.00	0.01	0.001	0.001
25	1500	1.00	1.09	2.63	0.252	0.273
26	1560	0.25	0.02	0.04	0.004	0.004
27	1620	0.25	0.22	0.53	0.055	0.055
28	1680	0.25	0.01	0.02	0.002	0.002
29	1740	1.00	1.48	3.57	0.398	0.371
30	1800	0.25	0.00	0.01	0.001	0.001
31	1860	1.00	0.75	1.80	0.214	0.187
32	1920	0.25	0.02	0.04	0.005	0.004
33	1980	0.25	0.17	0.42	0.053	0.044
34	2040	0.25	0.13	0.30	0.040	0.032
35	2100	0.50	0.98	2.37	0.318	0.246
36	2160	0.13	0.13	0.30	0.042	0.032
37	2220	0.50	0.47	1.14	0.162	0.119
38	2280	0.13	0.13	0.30	0.044	0.032
39	2340	0.13	0.15	0.35	0.053	0.037
40	2400	0.13	0.13	0.30	0.047	0.032
41	2460	0.50	0.68	1.65	0.259	0.171
42	2520	0.13	0.13	0.30	0.049	0.032
43	2580	0.50	0.30	0.72	0.119	0.075
44	2640	0.13	0.13	0.30	0.051	0.032
45	2700	0.13	0.13	0.30	0.053	0.032
46	2760	0.13	0.13	0.30	0.054	0.032
47	2820	0.50	0.50	1.22	0.220	0.127
48	2880	0.13	0.13	0.30	0.056	0.032
49	2940	0.50	0.22	0.52	0.098	0.054
50	3000	0.13	0.13	0.30	0.058	0.032

WM TAO & ASSOCIATES
CONSULTING ENGINEERS

Shop Drawing Submittal Review

Transmitted To: Cannon Design

Date: October 11, 2016

Attention: **stl-cac@cannondesign.com**

Contact Person / WTA Field Inspector: Patrick Garner

Project Name: Webster University-**ISB**

Reviewed by: Mark Schaefer

Project No. WT 14127.01

☐ UPS ☐ Courier ☒ **Email**

Copies	No.	Description
1 PDF	235000M12A	(Submittal No.'s) ~~(R&B CxSRC~~)
		(Cannon #235000-012-REV 1) - ~~(Paric #15051-) – (WES #607)~~
		➢ **Variable Requency Drives Product Data REV 1**

Remarks:

c: **Kelvin Patel**
Kpatel@cannondesign.com

☒ **Furnish as Submitted** ☐ Furnish as Noted

☐ Rejected ☐ Revise & Resubmit

☐ Reviewed ☐

Corrections or comments made on shop drawings during this review do not relieve contractor from compliance with requirements of drawings and specifications. This check is only for review of general conformance with the design concept of project and general compliance with information given in contract documents. Contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

14127.01 - 235000 M12A
MWS TO REVIEW
10/07/16

From: STL-CAC <STL-CAC@CANNONDESIGN.COM>
To: 'Patrick Garner' <pgarner@wmtao.com>, "WTASHOP (WTASHOP@wmtao.com)" <WTA...
CC: "Patel, Kelvin" <kpatel@CANNONDESIGN.COM>
Date: 10/7/2016 3:27 PM
Subject: Webster ISB - 23 5000-012 REV002
Attachments: 235000-012 Variable Frequency Drives Product Data REV 1.pdf

Attached for review.

Melissa Pirtle
Construction Admin
[cid:image001.png@01D220AF.2BB19670]
1100 Clark Ave
St. Louis, Missouri 63102
T 314.425.8797 * M
cannondesign.com

CANNONDESIGN

SUBMITTAL IDENTIFICATION SHEET

To be completed by Contractor/CM

WEBSTER UNIVERSITY ISB
PROJECT NAME

8274 BIG BEND BLVD
ADDRESS

NUMBER

WEBSTER UNIVERSITY
OWNER

CANNON DESIGN
ARCHITECT / ENGINEER

DEVIN D GATES
SUBMITTED BY

235000-012
CONTRACTOR / CM SUBMITTAL NO.

CANNON DESIGN SUBMITTAL NO.

DRAWING / DETAIL REFERENCE

235000
SPECIFICATION SECTION / PARAGRAPH

MANUFACTURER / SUPPLIER

ITEM / PRODUCT ID

REQUIRED DATE

PRIORITY

◯ CRITICAL

ITEM BEING SUBMITTED (check only one)

- ◯ Shop Drawings
- ◯ Samples (_____ copies)
- ◯ LEED Submittal
- ◯ Certification / Qualifications
- ◉ Record Documents
- ◯ Product Data
- ◯ Coordination Drawing
- ◯ Calculations
- ◯ Schedules
- ◯ O&M Manuals
- ◯ Other _____

ITEM BEING SUBMITTED FOR (check only one)

◉ Action ◯ Information Only ◯ Record

REMARKS OR DEVIATIONS

Revised with appropriate VFDs at fan motors.

CONTRACTOR / CM CERTIFICATION
(SUBMITTALS NOT CERTIFIED WILL BE RETURNED WITHOUT REVIEW)

PARIC

PARIC CORPORATION
SUBMITTAL STAMP

THIS SHOP DRAWING HAS BEEN REVIEWED BY PARIC CORPORATION

Subcontractor remains responsible for dimensions, quantities, coordination with other trades and compliance with contract documents.

By:
Devin D. Gates

DEVIN D GATES
REVIEWED BY

10/7016
DATE

To be completed by Reviewer

23 5000-012
CANNON DESIGN SUBMITTAL NUMBER

10/7/16
RECEIVED DATE

- ◯ A. No Exceptions Taken
  No further review of submittal is required.
- ◯ B. Make Corrections Noted
  Incorporate corrections in work; resubmission is not required.
- ◯ C. Revise and Resubmit
  Revise as noted, and resubmit for review.
- ◯ D. Rejected
  Submittal is not in compliance with Contract Documents; provide new submittal.
- ◯ E. For Record / Information Only
  Submittal was reviewed for Record / Information purposes only.
- ◯ F. Not Required for Review
  Submittal is not required by Contract Documents and has not been reviewed.

Review is for conformance with the design concept of this project and for general compliance with contract documents. Contractor is responsible for quantities, dimensions and compliance with contract documents and for information that pertains to fabrication processes, construction techniques and coordination of this work with all trades which will be affected thereby. This review is null and void if submittal deviates from contract documents and does not indicate or note deviations.

A/E COMMENTS ◯ See attached sheet(s) for additional comments

REVIEWED BY

DATE

Mechanical

LETTER OF TRANSMITTAL

TO: Paric Corporation
77 West Port Plaza #250
St. Louis, MO 63146

ATTN: Jason Szachnieski, Devin Gates

DATE: 10/6/16
JOB # : 5768
RE: Webster ISB

We are sending you
( ) Attached ( ) Under separate cover
(X) Shop drawings ( ) Prints ( ) Plans ( ) Samples ( ) Specifications
( ) Copy of letter ( ) Change order ( ) Other

COPIES	DATE	NO.	DESCRIPTION
1	10/6/16	230514	Variable Frequency Drives

These are transmitted as checked below:

( ) For signature ( ) Approved as submitted (X) Resubmit ( ) copies for approval
( ) For your use ( ) Approved as noted ( ) Submit ( ) copies for distribution
( ) As requested ( ) Returned for corrections ( ) Return ( ) corrected prints
( ) For bids due ( ) Prints returned after loan to us
( ) For review and comment ( ) Other

Remarks: Submittal FOR RECORD ONLY

COPY TO: file

SIGNED: Alex Chambers

Webster University ISB
Webster Groves, MO

Submittal #:	230514
Submittal Description:	Variable Frequency Drives
Return By:	FOR RECORD ONLY

Please Note: To avoid scheduling delays and equipment release delays, please submit by the "Return By" date.

CHECKED BY:

DESIGNER: ENGINEER:

X	NO EXCEPTION TAKEN		MAKE CORRECTIONS NOTED
	SUBMIT SPECIFIED ITEM		REVISE AND RESUBMIT
	REJECTED		

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Equipment supplier is responsible for: dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and satisfactory performance of his work.

Job #:	5768
Date:	10/6/16
By:	ARC

WM TAO & ASSOCIATES
CONSULTING ENGINEERS

Shop Drawing Submittal Review

Transmitted To: Cannon Design

Date: September 28, 2016

Attention: **stl-cac@cannondesign.com**

Contact Person / WTA Field Inspector: Patrick Garner

Project Name: Webster University-**ISB**

Reviewed by: Mark Schaefer

Project No. WT 14127.01

[ ] UPS [ ] Courier [X] **Email**

Copies	No.	Description
1 PDF	235000M12	(Submittal No.'s) ~~(R&B CxSRC)~~
		(Cannon #235000-012) - (Paric #15051-0236) – ~~(WES #607)~~
		• **Variable Frequency Drives Product Data**

Submittal Review Comments

Addressed in Record submittal below.

- **Provide a VFD for each fan motor for HEF-1, (3) three 25 hp VFD's, as shown on sheet E0104.B.**
- **Furnish as Noted. <u>Revise and resubmit for record and maintenance manuals.</u>**

c: **Kelvin Patel**
Kpatel@cannondesign.com

[ ] Furnish as Submitted	[X] ***Furnish as Noted**
[ ] Rejected	[X] **<u>Revise & Resubmit For Record & Maintenance</u>**
[ ] Reviewed	[ ]

Corrections or comments made on shop drawings during this review do not relieve contractor from compliance with requirements of drawings and specifications. This check is only for review of general conformance with the design concept of project and general compliance with information given in contract documents. Contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.