Cutler-Hammer

CP9000 Adjustable Frequency Drives

Technical Data

New Information October 2003

CP9000 — 100 hp VT

Product Description

The Cutler-Hammer CP9000 Clean Power Drives by Eaton Corporation use advanced 18-pulse, clean power technology that significantly reduces line harmonics at the drive input terminals, resulting in one of the purest sinusoidal waveforms available.

Enhancements to the CP9000 Clean Power Drives include a smaller enclosure for the 200 hp drive and a higher temperature rating option for selected drives.

The CP9000 drive also delivers True Power Factor — in addition to reducing harmonic distortion, the CP9000 drive prevents transformer overheating and overloading of breakers and feeders, which enables the application of adjustable frequency drives on generators and other high impendance power systems.

CP9000 Enclosed Products Program

- **Standard Enclosed** — covers a wide range of the most commonly ordered options. Pre-engineering eliminates the lead time normally associated with customer specific options. Available configurations are listed on **Pages 10 – 14.**
- **Modified Standard Enclosed** — applies to specific customer requirements that vary from the Standard Enclosed offering, such as the need for an additional indicating light or minor modifications to drawings. *Contact your local sales office for assistance in pricing and lead time.*
- **Custom Engineered** — for those applications with more unique or complex requirements, these are individually engineered to the customer's needs. *Contact your local sales office for pricing and lead time.*

Contents

Features and Benefits

New CP9000 Clean Power Drive features include:

- 200 hp drives now available in standard 40" enclosure
- 50° ambient temperature rating on 25 – 700 hp VT drives
- NEMA Type 1, NEMA Type 1 with Gaskets and Filters or NEMA Type 12 enclosures
- Input Voltage: 380/480V
- Complete range of control, network and power options
- Horsepower range:
  - 480V: 20 to 700 hp CT; 25 to 800 hp VT
- Over ten years of Clean Power experience

Application Description

Designed to exceed the IEEE 519-1992 requirements for harmonic distortion, the CP9000 is the clear choice for applications in the water, wastewater, HVAC, industrial and process industries where harmonics are a concern.

What Are Harmonics?

Take a perfect wave with a fundamental frequency of 60 Hz, which is close to what is supplied by the power company.

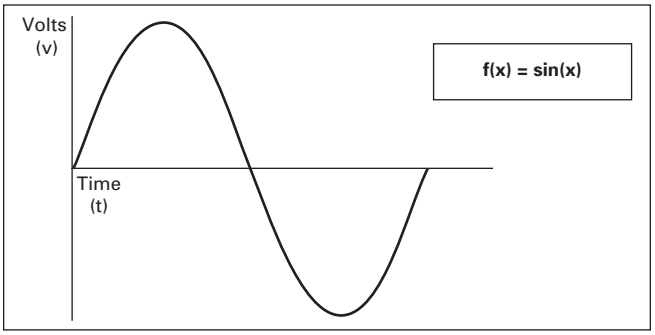


Figure 1. Perfect Wave

Add a second wave that is five times the fundamental frequency — 300 Hz (Typical of frequency added to the line by a fluorescent light).

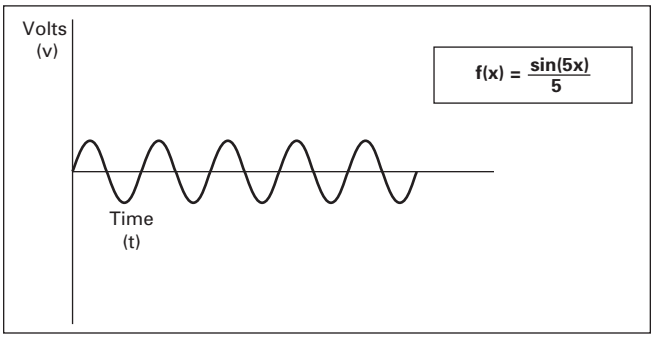


Figure 2. Second Wave

Combine the two waves. The result is a 60 Hz supply rich in fifth harmonics.

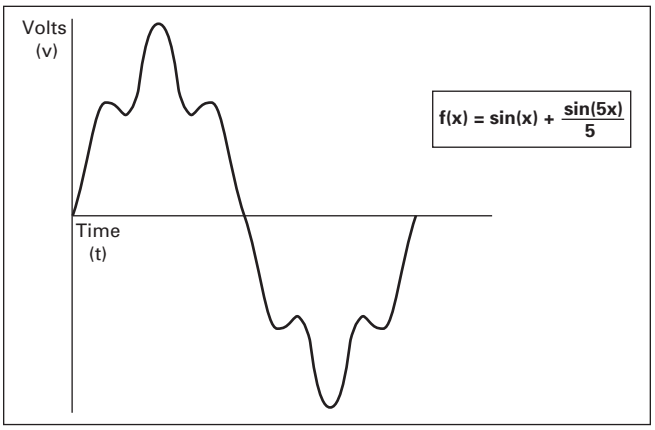


Figure 3. Resulting Supply

What Causes Harmonics?

Harmonics are nonlinear loads that convert AC line voltage to DC. Examples of equipment that are nonlinear loads are listed below:

- AC variable frequency drives
- DC drives
- Fluorescence lighting, computers, UPS systems
- Industrial washing machines, punch presses, welders, etc.

How Can Harmonics Due to VFDs Be Diminished?

By purchasing Eaton's Cutler-Hammer patented 18-Pulse drive that is guaranteed to meet IEEE Std. 519-1992 Harmonic Distortion Limits that has been on the market for over 10 years.

What Are Linear Loads?

Linear loads are primarily devices that run across the line and do not add harmonics. Motors are prime examples. The downside to having large motor linear loads is that they draw more energy than a VFD, because of their inability to control motor speed. In most applications there is a turn down valve used with the motor which will reduce the flow of the material, without significantly reducing the load to the motor. While this provides some measure of speed control, it is extremely inefficient.

Why Be Concerned About Harmonics?

1. ***Installation and utility costs increase.*** Harmonics cause damage to transformers and lower efficiencies due to the IR loss. These losses can become significant (from 16.6 – 21.6%) which can have a dramatic effect on the HVAC systems that are controlling the temperatures of the building where the transformer and drive equipment reside.
2. ***Downtime and loss of productivity.*** Telephones and data transmissions links may not be guaranteed to work on the same power grids polluted with harmonics.
3. ***Downtime and nuisance trips of drives and other equipment.*** Emergency generators have up to (3) three times the impedance that is found in a conventional utility source. Thus the harmonic voltage can be up to three times as large, causing risk of operation problems.
4. ***Larger motors must be used.*** Motors running across the line that are connected on polluted power distribution grids can overheat or operate at lower efficiency due to harmonics.
5. ***Higher installation costs.*** Transformers and power equipment must be oversized to accommodate the loss of efficiencies. This is due to the harmonic currents circulating through the distribution without performing useful work.

How Does a VFD Convert 3-Phase AC to a Variable Output Voltage and Frequency?

6-pulse VFD: The majority of all conventional drives that are built consist of a 6-pulse configuration. **Figure 4** represents a 6-diode rectifier design that converts 3-phase utility power to DC. The inverter section uses IGBTs to convert DC power to a simulated AC sine wave that can vary in frequency from 0 – 400 Hz.

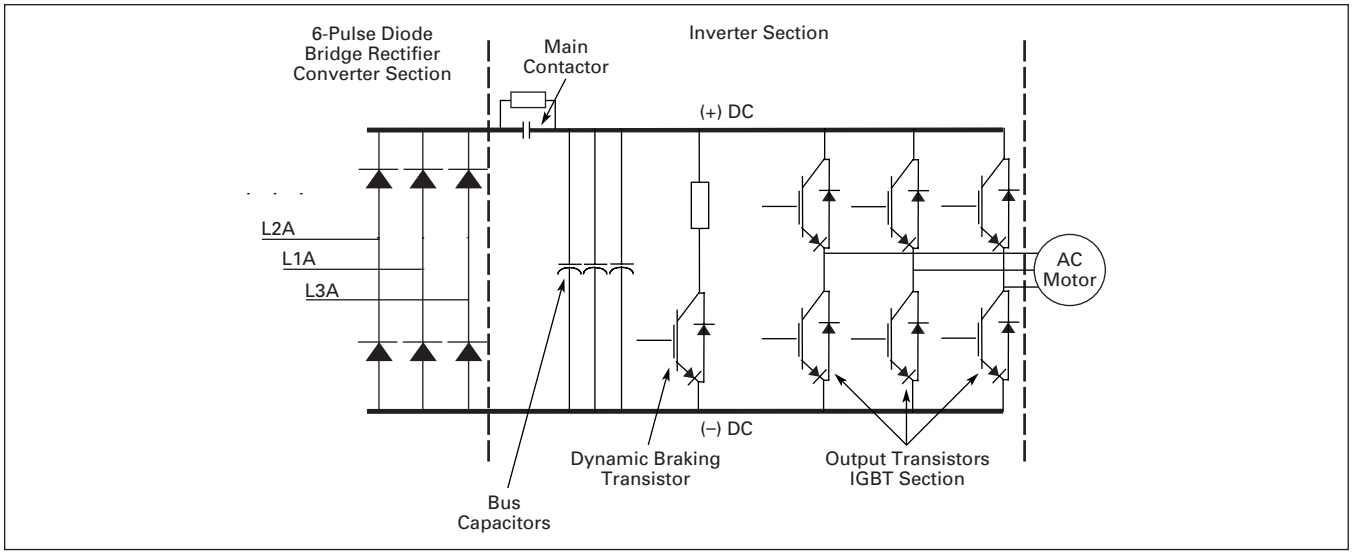


Figure 4. 6-Diode Rectifier Design

The 6-Pulse VFD drive creates harmonic current distortion. The harmonic current that is created is energy that can not be used by customers and causes external heat and losses to all components including other drives that are on the same power distribution. **Figure 5** is a 500 hp drive that has nonproductive 167A of harmonic current.

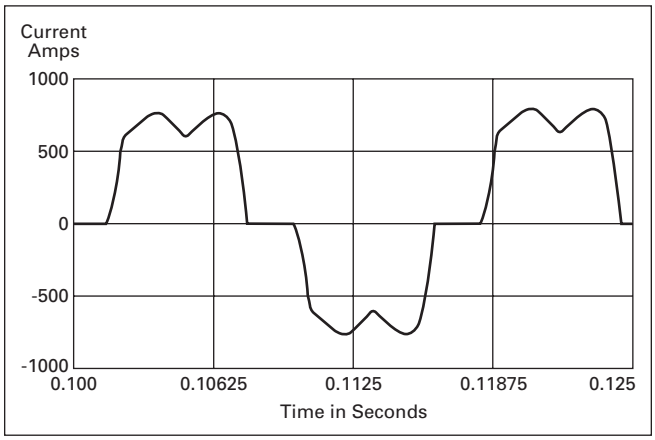


Figure 5. 6-Pulse Nonproductive Harmonic Current

Table 1. 6-Pulse Nonproductive Harmonic Current

6-Pulse Circuit		
Current Harmonics		
I_1 = 100%	I_{11} = 6.10%	I_{19} = 1.77%
I_5 = 22.5%	I_{13} = 4.06%	I_{23} = 1.12%
I_7 = 9.38%	I_{17} = 2.26%	I_{25} = 0.86%
Power = 500 hp		
Harmonic Current = 167 Amps		

Guidelines of Meeting IEEE Std. 519-1992 Harmonic Distortion Limits

IEEE 519-1992 Specification is a standard that provides guidelines for commercial and industrial users that are implementing medium and low voltage equipment.

Table 2. Maximum Harmonic Current Distortion in % of the Fundamental (120V through 69,000V)

Isc/I_L	**Harmonic Order (Odd Harmonics)**					**TDD**
	h<11	**11≤h<17**	**17≤h<23**	**23≤h<35**	**35≤h**	
<20	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Notes:
TDD = Total demand is the distortion is the harmonic current distortion in percent of the maximum demand load current (15 or 30 minute demand).

I_{SC} = Maximum short circuit current at the PCC not counting motor contribution.

I_L = Maximum demand load current for all of the connected loads (fundamental frequency component) at the PCC.
All of the limits are measured at a point of common coupling.

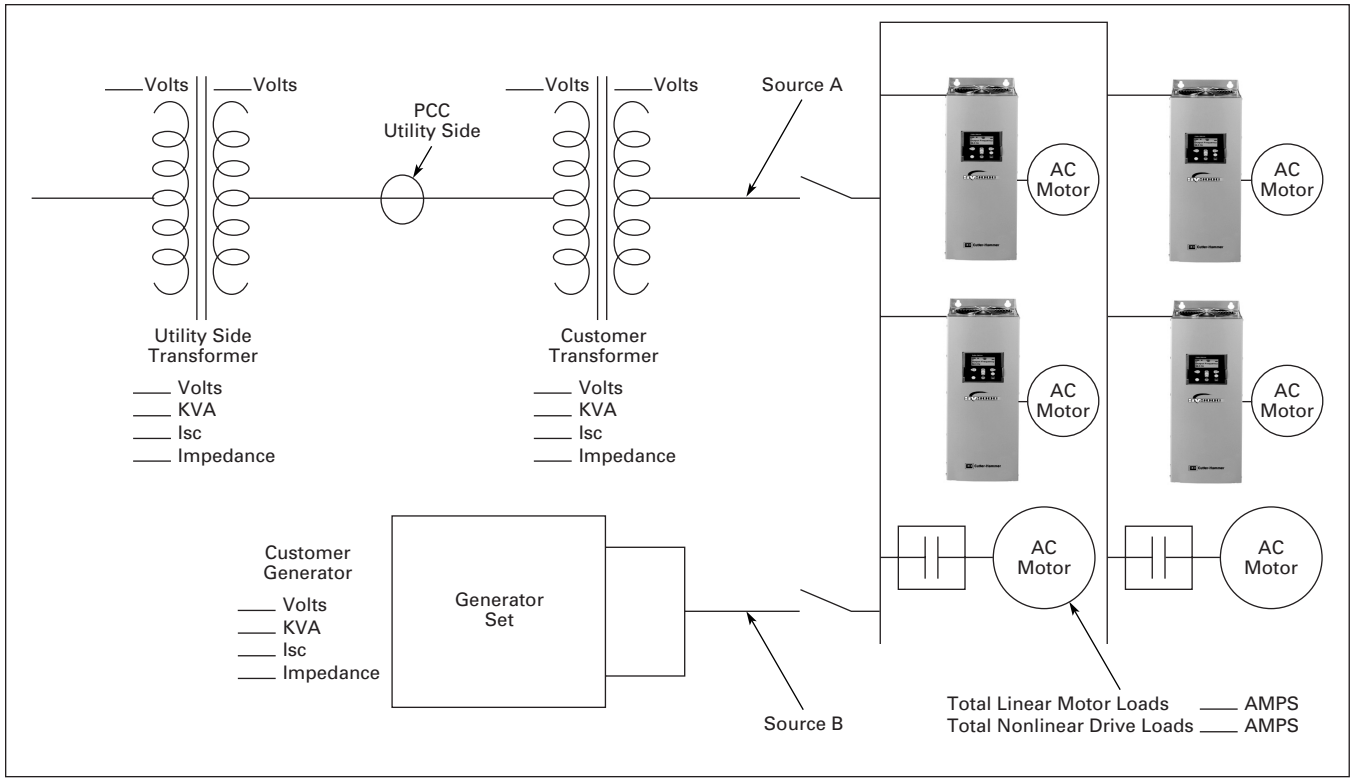


Figure 6. Oneline Diagram for Harmonic Analysis

The best way to estimate AFD harmonic contribution to an electrical system is to perform a harmonic analysis based on known system characteristics. The oneline in this Figure would provide the data to complete the calculations.

The ratio ISC/IL is the ratio of the short-circuit current available at the point of common coupling (PCC), to the maximum fundamental load current. Consequently, as the size of the user load decreases with respect to the size of the system, the percentage of harmonic current that the user is allowed to inject into the utility system increases.

Terms

- PCC (Point of Common Coupling) is defined as the electrical connecting point between the utility and multiple customers per the specifications in IEEE 519.
- POA (Point of Analysis) is defined as where the harmonic calculations are taken.

An oscilloscope can make all measurements at the PCC or POA to do an on-site harmonic evaluation.

Harmonic Reduction Methods to Meet IEEE 519

1. Line Reactor

A line reactor is a 3-phase series inductance on the line side of an AFD. If a line reactor is applied on all AFDs, it is possible to meet IEEE guidelines where 15% to 40% of system loads are AFDs, depending on the stiffness of the line and the value of line reactance. Line reactors are available in various values of percent impedance, most typically 1 – 1.5%, 3% and 5%. (Note: the SV9000 comes standard with a nominal 3% input impedance except for low horsepower drives).

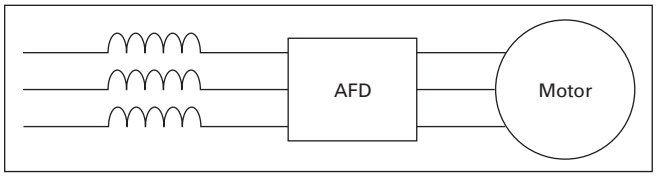


Figure 7. Line Reactor

Advantages

- Low cost
- Can provide moderate reduction in voltage and current harmonics
- Available in various values of percent impedance
- Provides increased input protection for AFD and its semiconductors from line transients

Disadvantages

- May not reduce harmonic levels to below IEEE 519-1992 guidelines
- Voltage drop due to IR loss

2. 12-Pulse Converters

A 12-pulse converter incorporates two separate AFD input semiconductor bridges, which are fed from 30° phase shifted power sources with identical impedance. The sources may be two isolation transformers, where one is a delta/wye design (which provides the phase shift) and the second a delta/delta design (which does not phase shift). The 12-pulse arrangement allows the harmonics from the first converter to cancel the harmonics of the second. Up to approximately 85% reduction of harmonic current and voltage distortion may be achieved (over standard 6-pulse converter). This permits a facility to use a larger percentage of AFD loads under IEEE 519-1992 guidelines than allowable using line reactors or DC chokes. A harmonic analysis is required to guarantee compliance with guidelines.

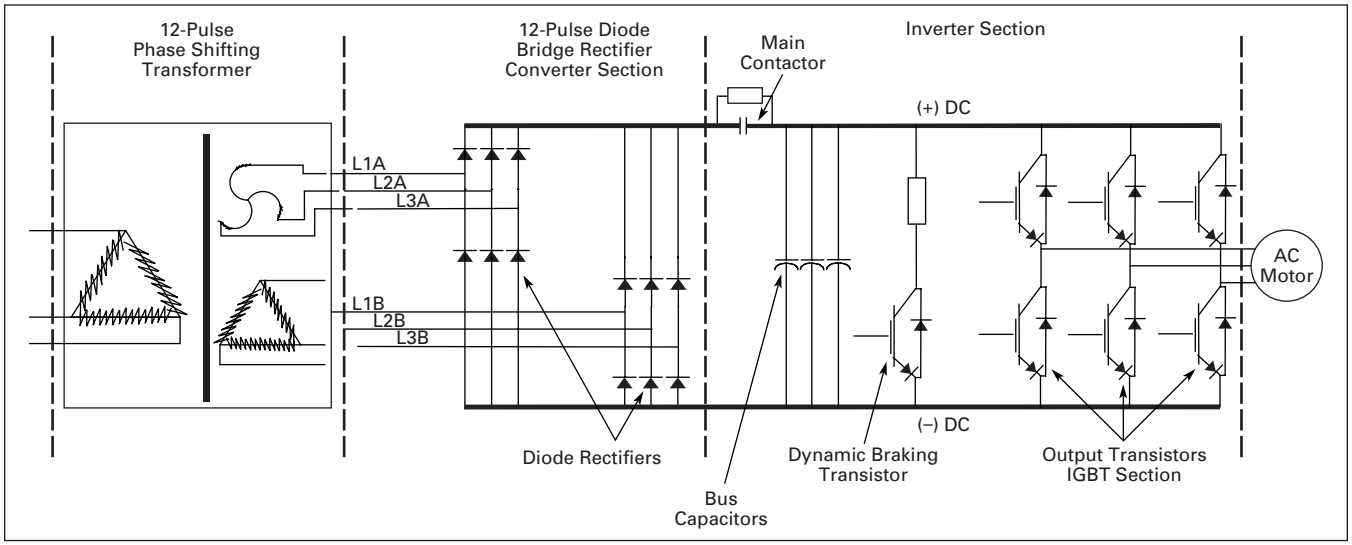


Figure 8. Basic 12-Pulse Rectifier with "Phase Shifting" Transformer

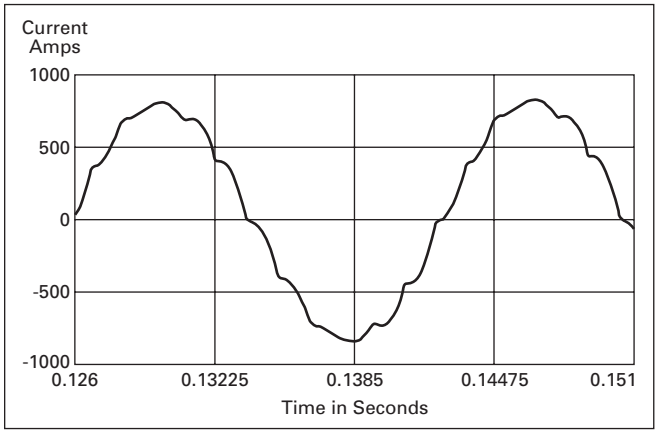


Figure 9. 12-Pulse Circuit

Advantages

- Reasonable cost, although significantly more than reactors or chokes
- Substantial reduction (up to approx. 85%) in voltage and current harmonics
- Provides increased input protection for AFD and its semiconductors from line transients

Disadvantages

- Impedance matching of phase shifted sources is critical to performance
- Transformers often require separate mounting or larger AFD enclosures
- May not reduce distribution harmonic levels to below IEEE 519-1992 guidelines
- Cannot retrofit for most AFDs

Table 3. 12-Pulse Circuit

12-Pulse Circuit		
Current Harmonics		
I_1 = 100%	I_{11} = 4.19%	I_{19} = 0.06%
I_5 = 1.25%	I_{13} = 2.95%	I_{23} = 0.87%
I_7 = 0.48%	I_{17} = 0.21%	I_{25} = 0.73%
Power = 419.6 kW		
H_c = 66.2 Amps		

3. Clean Power Drives

When the total load is comprised of non-linear load such as drives and the ratio is Isc/I_L, the greatest harmonic mitigation is required. Under these conditions the currents drawn from the supply need to be sinusoidal and "Clean" such that system interference and additional losses are negligible. The Cutler-Hammer CP9000 Clean Power Drive uses a phase-shifting auto transformer with delta connected winding that carries only the ampere-turns caused by the difference in load currents. The basic configuration of the transformer is shown in **Figure 10**. In this type of configuration the total KVA rating of the transformer magnetic system was only 48% that of the motor load. A traditional isolated transformer system, with multipulse windings, would require the full KVA rating to be supported, which is more common in a MV step-down transformer.

The integrated 18-pulse clean power drive, with near sine wave input current and low harmonics will meet the requirements of IEEE 519-1992 under all practical operating conditions. The comparisons with 6-pulse and 12-pulse systems are shown in **Figures 5**, **9** and **11**.

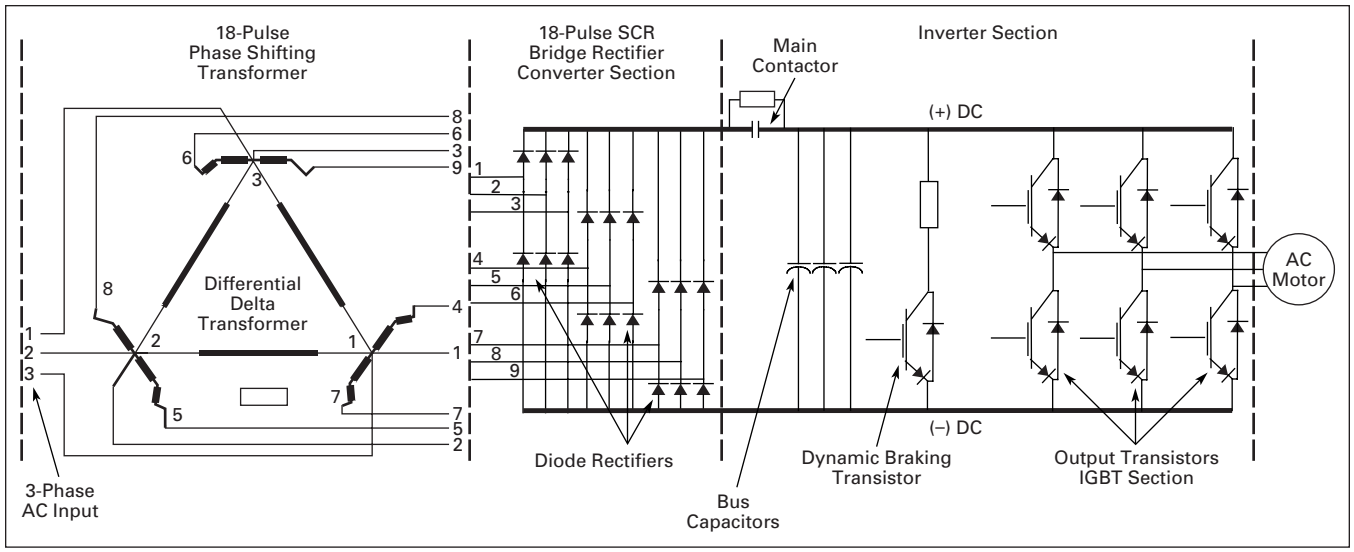


Figure 10. Basic 18-Pulse Rectifier with "Differential Delta" Transformer

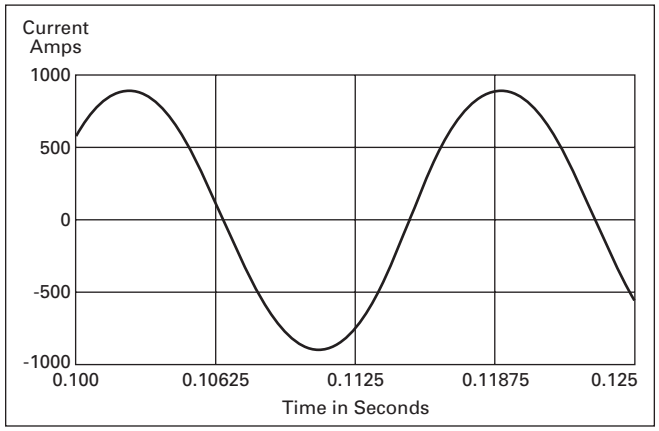


Figure 11. 500 hp 480V Drive with 18-Pulse Rectifiers

Table 4. 500 hp 480V Drive with 18-Pulse Rectifiers

18-Pulse Clean Power		
Current Harmonics		
I_1 = 100%	I_{11} = 0.24%	I_{19} = 1.00%
I_5 = 0.16%	I_{13} = 0.10%	I_{23} = 0.01%
I_7 = 0.03%	I_{17} = 0.86%	I_{25} = 0.01%
Power = 428.8 kW		
H_c = 24 Amps		

Advantages

- Virtually guarantees compliance with IEEE 519-1992
- Provides increased input protection for AFD and its semiconductors from line transients
- Up to 4 times the harmonic reduction of 12-pulse methods
- Smaller transformer than isolation transformer used in 12-pulse converter

Disadvantages

- Larger and heavier magnetics than some other methods

Technical Data and Specifications

Table 5. Drive Ratings

CP9000 Enclosed Products	480V 25 hp VT – 800 hp VT
NEMA Type 1	25 – 700 hp CT 25 – 800 hp VT
NEMA Type 1 with Gaskets and Filters	25 – 700 hp CT 25 – 800 hp VT
NEMA Type 12	20 – 300 hp CT 25 – 400 hp VT

Table 6. CP9000 Enclosed Products Specifications

Feature Description	NEMA Type 1, NEMA Type 1 with Gaskets and Filters and NEMA Type 12
Primary Design Features	
Reduced Voltage Starter (RVS) ***IT.*** Bypass	Optional
45 – 66 Hz Input Frequency	Standard
Output: AC Volts Maximum	Input Voltage Base
Output Frequency Range: Hz	.0 – 500
Initial Output Current (CT) ①	250% for 2 seconds
Overload: 1 Minute (CT/VT)	150%/110%
Enclosure Space Heater	Optional
Oversize Enclosure	Standard
Output Contactor	Optional
Bypass Motor Starter/RVS(***IT.***)	Optional
Listings	UL
CE Mark	—
Protection Features	
Incoming Line Fuses	Standard
AC Input Circuit Disconnect	Optional
Line Reactors	Standard
Phase Rotation Insensitive	Standard
Input Phase Loss Protection	Standard
Input Overvoltage Protection	Standard
Line Surge Protection	Standard
Output Short Circuit Protection	Standard
Output Ground Fault Protection	Standard
Output Phase Protection	Standard
Overtemperature Protection	Standard
DC Overvoltage Protection	Standard
Drive Overload Protection	Standard
Motor Overload Protection	Standard
Programmer Software	Optional
Keypad Lockout	Standard
Fault Alarm Output	Standard
Built-In Diagnostics	Standard
Performance Features	
Sensorless Vector Control	Standard
Closed Loop Vector Control	Optional
Volts/Hertz Control	Standard
IR and Slip Compensation	Standard
Electronic Reversing	Standard
Dynamic Braking	Optional
DC Braking	Standard
PI Setpoint Controller	Programmable
Critical Speed Lockout	Standard
Current (Torque) Limit	Standard
Adjustable Acceleration/Deceleration	Standard
Linear or S Curve Accel/Decel	Standard
Jog at Preset Speed	Standard
Thread/Preset Speeds	7
Automatic Restart	Selectable
Coasting Motor Start	Standard
Coast or Ramp Stop Selection	Standard
Elapsed Time Meter	Standard
Carrier Frequency Adjustment	1 – 16 kHz

Table 6. CP9000 Enclosed Products Specifications (Continued)

Feature Description	NEMA Type 1, NEMA Type 1 with Gaskets and Filters and NEMA Type 12
Input/Output Interface Features	
Setup Adjustment Provisions:	
Remote Keypad/Display	Standard
Personal Computer	Standard
Operator Control Provisions:	
Drive Mounted Keypad/Display	Standard
Remote Keypad/Display	Standard
Conventional Control Elements	Standard
Serial Communications	Standard
115V AC Control Circuit	Standard
Speed Setting Inputs:	
Keypad	Standard
Potentiometer/Voltage Signal	Standard
4 – 20 mA Isolated	Optional
4 – 20 mA Differential	Standard
3 – 15 psig	Optional
Analog Outputs:	
Speed/Frequency	Standard
Torque/Load/Current	Programmable
Motor Voltage	Programmable
Kilowatts	Programmable
0 – 10V DC Signals	Optional
4 – 20 mA DC Signals	Standard
Isolated Signals	Optional
Discrete Outputs:	
Fault Alarm	Standard
Drive Running	Standard
Drive at Set Speed	Programmable
Optional Parameters	14
Dry Contacts	1
Open Collector Outputs	1
Additional Discrete Outputs	Optional
Communications:	
RS-232	Standard
RS-422/485	Optional
DeviceNet™	Optional
Modbus RTU	Optional
Interbus-S	Optional
Profibus-DP	Optional
Lonworks®	Optional
Standard Conditions for Application and Service	
Operating Ambient Temperature	0 – 40°C, 0 – 50°C ① ②
Storage Temperature	-40 – 60°C
Humidity (Maximum), Non-condensing	95%
Altitude (Maximum without Derate)	3300 ft. (1000m)
Line Voltage Variation	+10/-15%
Line Frequency Variation	45 – 66 Hz
Efficiency	>96%
Power Factor (Displacement)	.96

① Drive can be derated by one hp 480V AC size to become CT.

② Increase drive by one frame size.
Example: 60 hp VT = 50 hp CT

I/O Specifications

Table 7. I/O Specifications for the Control/Communication Options

Option	Specification
Analog Voltage, Input	0 – ±10V, $R_i \geq 200\ k\Omega$
Analog Current, Input	0 (4) – 20 mA, $R_i = 250\ \Omega$
Digital Input	24V: "0" ≤ 10V, "1" ≥ 18V, $R_i > 5\ k\Omega$
Aux. Voltage	24V (±20%), max. 50 mA
Reference Voltage	10V ±3%, max. 10 mA
Analog Current, Output Analog Voltage, Output	0 (4) – 20 mA, $R_L = 500\ k\Omega$, resolution 10 bit, accuracy ≤ ±2% 0 (2) – 10V, $R_L \geq 1\ k\Omega$, resolution 10 bit, accuracy ≤ ±2%
Relay Output	Maximum switching voltage: 300V DC, 250V AC Maximum switching load: 8A/24V DC .4A/300V DC 2 kVA/250V AC Maximum continuous load: 2A rms
Thermistor Input	$R_{trip} = 4.7\ k\Omega$
Encoder Input	24V: "0" ≤ 10V, "1" ≥18V, $R_i = 2.2\ k\Omega$ 5V: "0" ≤ 2V, "1" ≥ 3V, $R_i = 330\ \Omega$

A detailed listing of voltage, horsepower and enclosure configurations along with matching options is provided in the Product Selection and Options sections. Stocking and manufacturing location information is contained in **Table 8**.

Table 8. Vista Suffix

QWT	All VISTA registered CP9000 Enclosed Products, manufacturing location Watertown Plant
VWD	Non-registered CP9000 Enclosed Products, manufacturing location Watertown Plant

Table 9. Enclosed Products Program

CP9000 Enclosed Products	25 hp VT to 800 hp VT
Standard Enclosed	Covers a wide range of the most commonly ordered options. Pre-engineering eliminates the lead time normally associated with customer specific options. Contact local sales office for lead time.
Modified Standard Enclosed	Applies to specific customer requirements that vary from the Standard Enclosed offering, such as the need for an additional indicating light or minor modifications to drawings. Contact local sales office for lead time.
Custom Engineered	Applies to those applications with more unique or complex requirements. These are individually engineered to specific customer needs. Lead time is based on design complexity and drawing approval time. Contact local sales office for lead time.

Enclosure Definitions

NEMA Type 1

Enclosures are intended for indoor use primarily to provide a degree of protection against contact with enclosed equipment and provide a degree of protection against falling dirt in locations where unusual service conditions do not exist. Top or side openings in the NEMA Type 1 enclosure allow for the free exchange of inside and outside air while meeting the NEMA rod entry and rust resistance design tests.

NEMA Type 1 with Gaskets and Filters

Enclosures are intended for indoor use primarily to provide a degree of protection against dust and falling dirt. Filtered air passed through gaskets and enclosure meets the NEMA rod entry and rust resistance design tests.

NEMA Type 12

Enclosures are intended for indoor use primarily to provide a degree of protection against dust, falling dirt and dripping noncorrosive liquids. To meet NEMA drip, dust and rust resistance tests, NEMA Type 12 enclosures have no openings to allow for the exchange of inside and outside air.

Catalog Number Selection

Table 10. CP9000 Catalog Numbering System

CP 050 A G V 5 M 0 A 00 CX3X7

Build Suffix Alphabetically and Numerically

Model CP9000

Horsepower Designations

025 = 25	**200** = 200
030 = 30	**250** = 250
040 = 40	**300** = 300
050 = 50	**400** = 400
060 = 60	**500** = 500
075 = 75	**600** = 600
100 = 100	**700** = 700
125 = 125	**800** = 800
150 = 150	

Series

A = A Series

Enclosure Rating

G = NEMA Type 1
H = NEMA Type 1 w/Gaskets & Filters
D = NEMA Type 12

Torque

V = Variable
C = Constant

Voltage

5 = 480V

Control Panel

M = SVMulti-line Alphanumeric
G = SVGraphic

Software
(other than **0** denotes Special)

Dynamic Braking Chopper Circuit

A = No Chopper Circuit

Enclosed Options		Type
C	= Input Disconnect (HMCP) 65 kAIC	Input
D	= Output Contactor	Output
I3	= Manual IOB Bypass Controller	Bypass
I4	= Manual HOA Bypass Controller	Bypass
L7	= MotoRx (300 – 600 Ft.) 1000 V/us DV/DT Filter	Output
L8	= MotoRx (100 – 300 Ft.) 1500 V/us DV/DT Filter	Output
L9	= EMI/RFI Filter	Input
L10	= Output Filter	Output
M	= 3 – 15 psig Follower	Control
M5	= 4 Channel – 120V AC Control Interface	Control
M6	= Isolated Process Follower	Control
M8	= Speed Potentiometer	Control
M9	= Speed Potentiometer with HOA	Control
M15	= 8 Channel – 120V AC Control Interface	Control
N1	= Custom Plastic Nameplate	Enclosure
N2	= Custom Metal Nameplate	Enclosure
R3	= Manual IOB Reduced Voltage Starter Bypass Controller	Bypass
R4	= Manual HOA Reduced Voltage Starter Bypass Controller	Bypass
T1	= 115V Control Transformer — 105 VA	Control
T2	= 115V Control Transformer — 300 VA	Control
T3	= 115V Control Transformer — 550 VA	Control
V2	= Space Heater	Enclosure
V5	= 10" Expansion	Enclosure
V6	= 20" Expansion	Enclosure
V7	= 26" Expansion	Enclosure
X5	= Bypass Pilot Lights for **I3** and **I4** Options	Addl. Bypass
X6	= Dual Overloads for Bypass	Addl. Bypass
X7	= Bypass Test Switch for **I3**, **I4**, **R3** and **R4**	Addl. Bypass
Y4	= Single Overload Relay	Output
Y5	= Dual Overload Relays	Output

Control/Communication Options

00 = No Modifications
01 = 5 Digital Inputs, 2 Analog Inputs (1 Voltage, 1 Current), 3 Relay Outputs, Analog (Current) Output, Thermister Input, Encoder Input
02 = 5 Digital Inputs, Relay Output, Thermistor Input
03 = 5 Digital Inputs, 2 Analog (Voltage) Inputs, 3 Relay Outputs, Analog (Voltage) Output, Thermister Input, Encoder Input
04 = 5 Digital Inputs, 3 Relay Outputs, Analog Output, Thermistor Input
05 = Encoder Board
06 = 6 Digital Input 120V AC Interface Card with 1 Analog Output. Provides isolation to existing 6 digital 24V DC inputs.
30 = DeviceNet Network Communications
31 = ProfiBus Network Communications
32 = ModBus RTU Network Communications
33 = InterBus S Network Communications
34 = LonWorks Network Communications

Product Selection

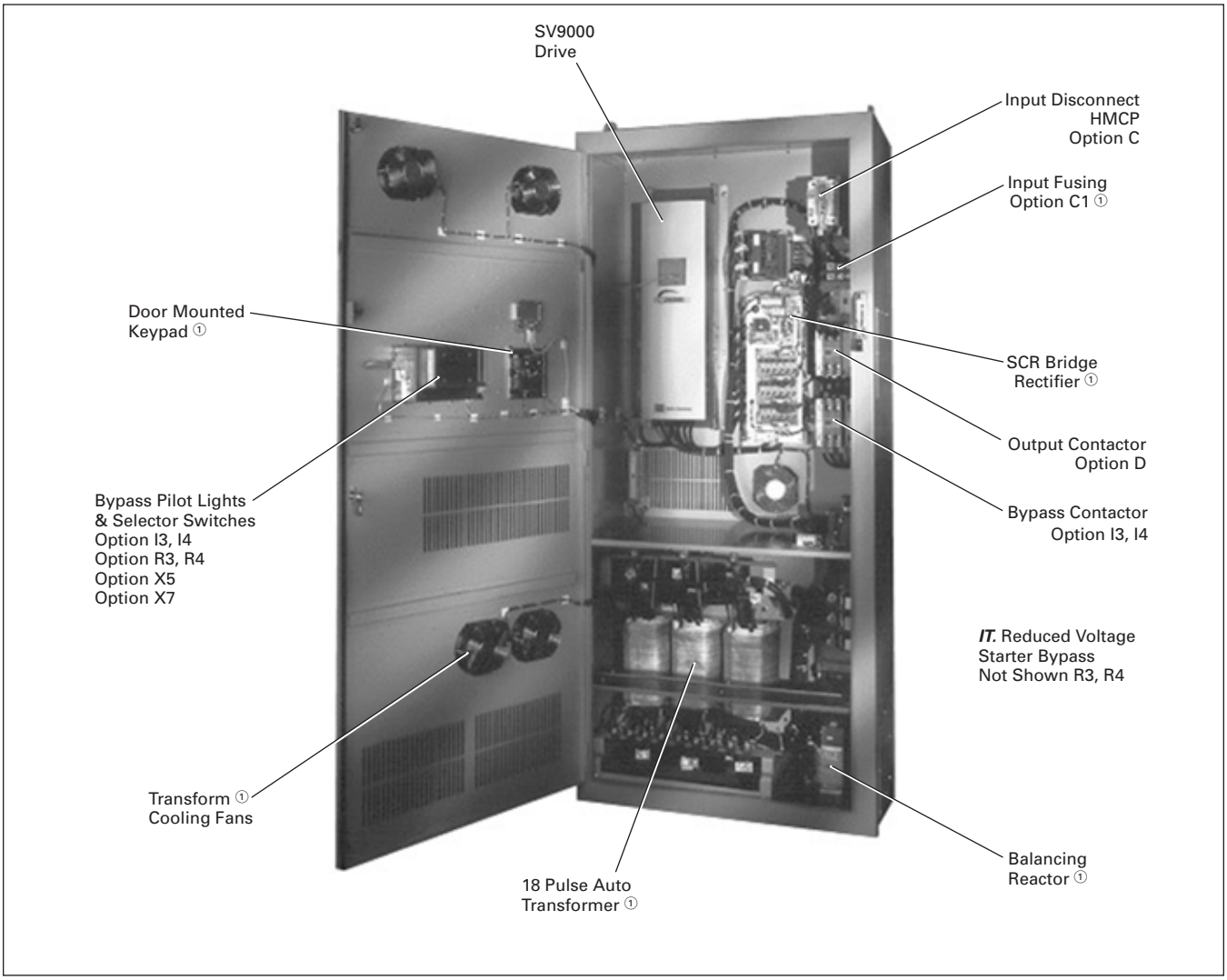


Figure 12. NEMA 1 with Gasket and Filter, 25 – 200 hp (40 x 90 x 26)

① Included with all CP9000 Drives.

When Ordering

- Select a Base Catalog Number that meets the application requirements — nominal horsepower, voltage and enclosure rating (the enclosed drive's continuous output amp rating should be equal to or greater than the motor's full load amp rating). The base enclosed package includes a standard drive, door mounted SVMulti-line Control Panel and enclosure.
- If SVGraphic Control Panel, Dynamic Brake Chopper, or Control/ Communication option is desired, change the appropriate code in the Base Catalog Number.
- **Note**: All of the programming is exactly the same as the standard SV9000 drive.
- Select Enclosed Options. Add the codes as suffixes to the Base Catalog Number in alphabetical and numeric order.

480 AC Input — Constant /Variable Torque Base Drive

Table 11. 480V Drive and Enclosure ①

Drive Frame Size	CT hp	Continuous Output Amps NEC @ 50°C	VT hp	Continuous Output Amps NEC @ 40°C	NEMA Type 1 Base Catalog Number ②	NEMA Type 1 with Gaskets and Filters Base Catalog Number ②	NEMA Type 12 Base Catalog Number ②
M5	20	20	25	32	**CP9025AGV5M0A00**	**CP9025AHV5M0A00**	**CP9025ADV5M0A00**
M6	25	32	30	40	**CP9030AGV5M0A00**	**CP9030AHV5M0A00**	**CP9030ADV5M0A00**
M6	30	40	40	52	**CP9040AGV5M0A00**	**CP9040AHV5M0A00**	**CP9040ADV5M0A00**
M6	40	52	50	65	**CP9050AGV5M0A00**	**CP9050AHV5M0A00**	**CP9050ADV5M0A00**
M6	50	65	60	77	**CP9060AGV5M0A00**	**CP9060AHV5M0A00**	**CP9060ADV5M0A00**
M6	60	77	75	96	**CP9075AGV5M0A00**	**CP9075AHV5M0A00**	**CP9075ADV5M0A00**
M7	75	96	100	124	**CP9100AGV5M0A00**	**CP9100AHV5M0A00**	**CP9100ADV5M0A00**
M7	100	124	125	156	**CP9125AGV5M0A00**	**CP9125AHV5M0A00**	**CP9125ADV5M0A00**
M7	125	156	150	180	**CP9150AGV5M0A00**	**CP9150AHV5M0A00**	**CP9150ADV5M0A00**
M8	150	180	200	240	**CP9200AGV5M0A00**	**CP9200AHV5M0A00**	**CP9200ADV5M0A00**
M8	200	240	250	302	**CP9250AGV5M0A00**	**CP9250AHV5M0A00**	**CP9250ADV5M0A00**
M9	250	302	300	361	**CP9300AGV5M0A00**	**CP9300AHV5M0A00**	**CP9300ADV5M0A00**
M9	300	361	400	477	**CP9400AGV5M0A00**	**CP9400AHV5M0A00**	**CP9400ADV5M0A00**
M10	400	477	500	590	**CP9500AGV5M0A00**	**CP9500AHV5M0A00**	**CP9500ADV5M0A00**
M10	500	590	600	720	**CP9600AGV5M0A00**	**CP9600AHV5M0A00**	**CP9600ADV5M0A00**
M11	600	720	700	840	**CP9700AGV5M0A00**	**CP9700AHV5M0A00**	**CP9700ADV5M0A00**
M12	700	840	800	960	**CP9800AGV5M0A00**	**CP9800AHV5M0A00**	**CP9800ADV5M0A00**

① Enclosure dimensions listed on **Pages 17 – 26.**
② Includes drive, SVMulti-line Control Panel and enclosure.

Table 12. NEMA Type 1 & NEMA Type 1 w/ Gasket & Filters Enclosure Requirements

CT hp	VT hp	CB (C)	Output Contactor (D)	CB (C) with OC (D) (C with D)	CB (C) with Output Filter (L7) or (L8) or (L10)	CB (C) with OC (D) & Output Filter (L7) or (L8) or (L10)	EMI/RFI Filter Input Filter (L9)	Bypass (I3) or (I4)	Bypass (R3) or (R4)	Bypass (I3) or (I4) with (L7), (L8) or (L10)	Bypass (R3) or (R4) with (L7), (L8) or (L10)
20, 25, 30	25, 30, 40	B	B	B	B	B	②	B	B	B	B
40, 50, 60	50, 60, 75	B	B	B	B	B	②	B	B	B	B
75	100	B	B	B	B	B	②	B	B	B	B
100	125	B	B	B	B	B	②	B	B	B	B-3P
125	150	B	B	B	B	B	②	C	B	B	B-3P
175	200	B ①	B ①	B ①	B ①	C	②	C	C	C	C
175, 200	200, 250	C	C	C	C	C	②	C	C	C	C
250	300	C	C	C	C	C	②	C	C-3P	C using L7, or L8	C-3P
300	400	C	C	C	C	C	②	C	C-3P	C using L7, or L8	C-3P
400, 500	500, 600	D	D	D	D	D without L10	②	D-3P	D-3P	D-3P	D-3P without L10
600	700	E	E	E	E	E	②	—	—	②	②
700	800	②	②	②	②	②	②	—	—	②	②

① Compact enclosure.
② Contact sales office.

Table 13. NEMA Type 1 & NEMA Type 1 w/ Gasket & Filters Enclosure Approximate Dimensions in Inches

Enclosure	Page	Drive	Transformer	Expansion Enclosure	Total Enclosure
B	**17**	90 x 40 x 26	Included	N/A	90 x 40 x 26
B-3P	**19**	90 x 40 x 26	Included	90 x 26 x 26	90 x 66 x 26
C	**20**	90 x 40 x 26	90 x 36 x 26	N/A	90 x 76 x 26
C-3P	**22**	90 x 40 x 26	90 x 36 x 26	90 x 26 x 26	90 x 102 x 26
D	**23**	90 x 60 x 26	90 x 41 x 26	N/A	90 x 101 x 26
D-3P	**24**	90 x 60 x 26	90 x 41 x 26	90 x 26 x 26	90 x 127 x 26
E	**25, 26**	Qty 2 90 x 40 x 26	Qty 2 90 x 36 x 26	90 x 26 x 26	90 x 178 x 26

Table 14. NEMA Type 12 Enclosure Requirements

CT hp	VT hp	CB (C)	Output Contactor (D)	CB (C) with OC (D) (C with D)	CB (C) with Output Filter (L7) or (L8) or (L10)	CB (C) with OC (D) & Output Filter (L7) or (L8) or (L10)	EMI/RFI Filter Input Filter (L9)	Bypass (I3) or (I4)	Bypass (R3) or (R4)	Bypass (I3) or (I4) with (L7), (L8) or (L10)	Bypass (R3) or (R4) with (L7), (L8) or (L10)
20, 25, 30	25, 30, 40	B	B	B	B	B	③	B	B	B	B
40, 50, 60	50, 60, 75	B	B	B	B	B	③	B	B	B	B
75	100	B	B	B	B	B	③	B	B	B	B
100, 125	125,150	CN12	CN12	CN12	CN12	CN12	③	CN12	CN12	CN12	CN12
150, 200	200, 250	CN12	CN12	CN12	CN12	CN12	③	CN12	CN12	CN12	CN12
250, 300	300, 400	—	—	—	③	③	③	—	—	③	③

③ Contact sales office.

Table 15. NEMA Type 12 Enclosure Approximate Dimensions in Inches

Enclosure	Page	Drive	Transformer	Expansion Enclosure	Total Enclosure
B	**17**	90 x 40 x 26	Included	N/A	90 x 40 x 26
CN12	**21**	90 x 40 x 26	90 x 36 x 26	90 x 26 x 26	90 x 102 x 26

Options

Control/Communication Options

Table 16. Control/Communication Products Options NEMA Type 1, NEMA Type 1 with Gaskets and Filter, NEMA Type 12 ①

Description	Factory Installed Option Designator	Field Installed Catalog Number
Expander I/O Cards — The Expander I/O Cards provide isolated I/O in addition to the standard I/O included with the CP9000.		
5 Digital Inputs, 2 Analog Inputs (1 voltage, 1 current), 3 Relay Outputs, Analog (current) Output, Thermistor Input, Encoder Input ②	**01**	**SV9IOC100**
5 Digital Inputs, Relay Output, Thermistor Input	**02**	**SV9IOC101**
5 Digital Inputs, 2 Analog (voltage) Inputs, 3 Relay Outputs, Analog (voltage) Output, Thermistor Input, Encoder Input ②	**03**	**SV9IOC102**
5 Digital Inputs, 3 Relay Outputs, Analog Output, Thermistor Input	**04**	**SV9IOC103**
6 Digital Input 120V AC Interface Card with 1 Analog Output. Provides isolation to existing 6 digital 24V DC inputs.	**06**	**SV9IOC105**
Encoder Board — Provides closed loop speed regulation. ②	**05**	**SV9IOC104**
Network Cards		
DeviceNet Network Communications — The DeviceNet Network Card is used for connecting the CP9000 on a DeviceNet Network. It includes a 5.08 mm pluggable connector. Transfer method is via CAN using a 2-wire twisted shielded cable with 2-wire bus power cable and drain. The baud rates used for communication include 125K baud, 250K baud and 500K baud.	**30**	**SV9NCDN**
Profibus Network Communications — The Profibus Network Card is used for connecting the CP9000 as a slave on a Profibus-DP network. The interface is connected by a 9-pin DSUB connector (female). The baud rates range from 9.6K baud to 12M baud, and the addresses range from 1 to 127. The Profibus card additionally includes the following control I/O — 4 digital inputs, 4 digital outputs, 1 relay output, thermistor input, and an encoder input.	**31**	**SV9NCPB**
ModBus RTU Network Communications — The Modbus Network Card is used for connecting the CP9000 as a slave on a Modbus network. The interface is connected by a 9-pin DSUB connector (female) and the baud rate ranges from 300 to 19200 baud. Other communication parameters include an address range from 1 to 247; a parity of None, Odd or Even; and the stop bit is 1. The ModBus card additionally includes the following control I/O — 4 digital inputs, 4 digital outputs, a thermistor input and an encoder input.	**32**	**SV9NCMB**
InterBus-S Network Communications — The InterBus-S Network Card is used for connecting the CP9000 as a remote bus device within the InterBus-S system. The interface is connected into the remote bus using a 9-pin DSUB connector. The InterBus card additionally includes the following control I/O — 4 digital inputs, 4 digital outputs, 1 relay output, a thermistor input and an encoder input.	**33**	**SV9NCIB**
LonWorks Network Communications — The LonWorks Network Card is used for connecting the CP9000 on a LonWorks network. This interface uses Standard Network Variable Types (SNVT) as data types. The channel connection is achieved using a FTT-10A Free Topology transceiver via a single twisted transfer cable. The communication speed with LonWorks is 78 kBits/s. The LonWorks card additionally includes the following control I/O — 4 digital inputs, 4 digital outputs, 1 relay output, a thermistor input and an encoder input.	**34**	**SV9NCLWCN**
DeviceNet Network Close Loop Communications — The DeviceNet Network Card is used for connecting the CP9000 on a DeviceNet Network. It includes a 5.08 mm plug Cable connector. Transfer method is via CAN using a 2-wire twisted shielded cable with 2-wire bus power cable and drain. The baud rates used for communication include 125K baud, 250K baud and 500K baud. The device incorporates an encoder input.	**35**	**SV9NCDNCL**

① Provisions allow for only one control/communication option at a time.
② Requires specific application software and optional motor mounted encoder, contact sales office for details.

Other Options

Table 17. Miscellaneous Options

Description	Catalog Number
SVDrive — A PC-based tool for control and monitoring of the CP9000. Features include: loading parameters that can be saved to a file or printed, setting references, starting and stopping the motor, monitoring signals in graphical or text form, and real-time display. To avoid damage to the drive or computer, SVDrivecable must be used.	**SVDRIVE**
SVDrivecable — 6 ft. RS-232 cable (22 gauge) with a 7-pin connector on each end. Should be used in conjunction with the SVDrive option to avoid damage to the CP9000 or computer. The same cable can be used for downloading specialized applications to the drive.	**SVDRIVECABLE**
RWT — The Reflective Wave Trap (RWT) decreases the reflective wave voltage spikes at the motor terminals. The RWT is recommended for cable lengths exceeding 100 ft. This option must be installed within 25 ft. of the motor terminals, and operates with a carrier frequency of up to 12 kHz. *(See Publication No. B.37F.01.SE for more information.)*	**RWTCHR1** **RWTCHR4**

Control Panel Options

Table 18. Control Panel Factory Options — Enclosed Products

Description	Factory Installed	Field Installed on Enclosure Door	
		NEMA Type 1, NEMA Type 1 w/Gaskets & Filter	NEMA Type 12
	Option Designator	Catalog Number	Catalog Number
SVMulti-line Control Panel — This option is standard on all drives and consists of a 4-line, 16 character/line, backlit alphanumeric LCD display with five indicators for the RUN status and two indicators for the control source. The eight pushbuttons on the panel are used for panel programming and monitoring of all CP9000 parameters. The panel is detachable and isolated from the input line potential.	M	SV9REMMLPNL	SV9REMMLPNL
SVGraphic Control Panel — Includes eight lines of text or a 64 x 128 pixel graphical display of key waveforms, or a combination of both text and graphs. **It provides:** ■ 3 monitored parameters at the same time in text or graphical trend display ■ one monitored parameter can be shown in increased text size with a graph bar ■ the selected parameter value is shown on a graph bar ■ the parameters of the drive can be uploaded to the panel and then downloaded to another drive	G	SV9GRPNL	SV9GRPNL

Enclosed Options

Table 19. Available Options — Build Alphabetically and Numerically

Option	Description	Option Type
C	Input Disconnect (HMCP) 65 kAIC	Input
D	Output Contactor	Output
I3	Manual IOB Bypass Controller	Bypass
I4	Manual HOA Bypass Controller	Bypass
L7	MotoRx (300 – 600 Ft.) 1000 V/us DV/DT Filter	Output
L8	MotoRx (100 – 300 Ft.) 1500 V/us DV/DT Filter	Output
L9	EMI/RFI Filter	Input
L10	Output Filter	Output
M	3 – 15 psig Follower	Control
M5	4 Channel — 120V AC Control Interface	Control
M6	Isolated Process Follower	Control
M8	Door-Mounted Speed Potentiometer	Control
M9	Door-Mounted Speed Potentiometer with HOA	Control
M15	8 Channel — 120V AC Control Interface	Control
N1	Custom Plastic Nameplate	Enclosure
N2	Custom Metal Nameplate	Enclosure
R3	IOB Bypass Controller with RVS	Bypass
R4	HOA Bypass Controller with RVS	Bypass
T1	115 Volt Control Transformer — 105 VA	Control
T2	115 Volt Control Transformer — 300 VA	Control
T3	115 Volt Control Transformer — 550 VA	Control
V1	Floor Stand 22"	Enclosure
V2	Space Heater	Enclosure
V4	Floor Stand 12"	Enclosure
V5	10" Expansion	Enclosure
V6	20" Expansion	Enclosure
V7	26" Expansion	Enclosure
X5	Bypass Pilot Lights for **I3, I4** Options	Addl. Bypass
X6	Dual Overloads for Bypass	Addl. Bypass
X7	Bypass Test Switch for **I3, I4, R3, R4**	Addl. Bypass
Y4	Single Overload Relay	Output
Y5	Dual Overload Relays	Output

Note: For complete descriptions, see **Pages 15 – 16**.

Table 20. Engineered Enclosed Options

Option	Description
A	Amp Meter (Digital) (Drive 4 – 20 mA)
CR	120V Control Relay
E	Elapse Time Meter
E2	ESTOP (22 mm)
E3	ESTOP (30 mm)
K2	Key Lockable Selector Switch 2-Position (22 mm)
K3	Key Lockable Selector Switch 3-Position (22 mm)
K4	Key Lockable Selector Switch 4-Position (22 mm)
MP	MP3000 Motor Protection, 5 Amp, URTD, IPONI, F.O. Link with CT and PT
P2	Pushbuttons — 22m
P3	Pushbuttons — 30m
PT	Push to Test Pilot Lights (30 mm)
Q	Frequency Meter
RT	Durant RTD Temperature Module with Alarm Trip Module and LED Readout
S2	2-Position Selector Switch (22 mm)
S3	3-Position Selector Switch (22 mm)
S4	4-Position Selector Switch (22 mm)
SP	10 Turn Speed Pot
T20	Customer Terminal Block 20 Terminals
TD	Timing Relay Type M Relay with Timing Attachment
V	Volt Meter (digital) (Drive 4 – 20 mA)
W	Witness Test/Day

Note: Engineered options include mounting and wiring.

Enclosed Options Descriptions

Table 21. Options Descriptions

Option	Description	Option Type
C	**Input Disconnect 65 kAIC** — High Interrupting Motor Circuit Protector (HMCP) that provides a means of short circuit protection for the power cables between it and the CP9000, and protection from high-level ground faults on the power cable. Allows a convenient means of disconnecting the CP9000 from the line and the operating mechanism can be padlocked in the OFF position. This is factory mounted in the enclosure.	Input
D	**Output Contactor** — Provides a means for positive disconnection of the drive output from the motor terminals. The contactor coil is controlled by the drive's run or permissive logic. NC and NO auxiliary contacts rated at 10A, 600V AC are provided for customer use. Bypass Options I3, I4, R3 and R4 include an Output Contactor as standard. This option includes a low VA 115V AC fused Control Power Transformer and is factory mounted in the enclosure.	Output
I3	**Manual IOB Bypass Controller** — The Manual INVERTER/OFF/BYPASS (IOB) — 3-contactor — bypass option provides a means of bypassing the CP9000, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted IOB selector switch. For applications up to 100 hp, a Freedom Series IEC input contactor, a Freedom Series IEC output contactor, and a Freedom Series IEC starter with a bimetallic overload relay is included. For applications above 100 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked (see power diagram on **Page 27**).	Bypass
I4	**Manual HOA Bypass Controller** — The Manual HAND/OFF/AUTO (HOA) — 3-contactor — bypass option provides a means of bypassing the CP9000, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter with a door mounted HOA selector switch and an INVERTER/BYPASS switch. The HOA switch provides the ability to start and stop the drive in the inverter mode. For applications up to 100 hp, a Freedom Series IEC input contactor, a Freedom Series IEC output contactor, and a Freedom Series IEC starter with a bimetallic overload relay is included. For applications above 100 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked (see power diagram on **Page 27**).	Bypass
L7	**MotoRx (300 – 600 Ft.) 1000 V/µ DV/DT Filter** — Used to reduce transient voltage (DV/DT) and peak voltages at the motor terminals. This option is comprised of a .5% line reactor, followed by capacitive filtering and an energy recovery/clamping circuit. Unlike the Output Filter (See option **L10**), the MotoRx recovers most of the energy from the voltage peaks, resulting in a lower voltage drop to the motor, and therefore conserving power. This option is used when the distance between a single motor and the drive is 300 – 600 feet.	Output
L8	**MotoRx (100 – 300 Ft.) 1500 V/µ DV/DT Filter** — Used to reduce transient voltage (DV/DT) and peak voltages at the motor terminals. This option is comprised of a .5% line reactor, followed by capacitive filtering and an energy recovery/clamping circuit. Unlike the Output Filter (See option **L10**), the MotoRx recovers most of the energy from the voltage peaks, resulting in a lower voltage drop to the motor, and therefore conserving power. This option can be used with up to 300 feet of cable between the drive and a single motor. The MotoRx is recommended for cable lengths exceeding 100 ft. with a drive of 3 hp and above.	Output
L9	**EMI/RFI Filter** — Intended for use as conducted noise filters when AF drives are used around or near sensitive equipment such as computers, medical instruments, or communication or navigation radios. Helps to comply with FCC requirements by filtering unwanted noise in the range of 10 kHz to 30 MHz. This option is factory mounted in the enclosure. *This is not intended to meet the EMC requirements of CE.*	Input
L10	**Output Filter** — Used to reduce the transient voltage (DV/DT) at the motor terminals. The Output Filter is recommended for cable lengths exceeding 100 ft. This option is mounted in the enclosure.	Output
M	**3 – 15 psig Follower** — Provides a pneumatic transducer which converts a 3 – 15 psig pneumatic signal to either 0 – 8V DC or a 1 – 9V DC signal interface with the CP9000. The circuit board is mounted on the inside of the front enclosure panel and connects to the user's pneumatic control system via 6 ft. of flexible tubing and a 1/4 inch brass tube union.	Control
M5	**4 Channel – 120V AC Control Interface** — Allows the CP9000 to be interfaced with remote 120V AC controls. This option uses four interposing relays to convert up to four 120V AC input signals into dry contact inputs. In addition, each relay coil has arc suppression circuitry to reduce the effects of EMI on other components. The interface is a printed circuit board that is mounted on the inside of the enclosure door.	Control
M6	**Isolated Process Follower** — Provides signal isolation in order to avoid common mode currents (ground loops) between the AF drive and remote instrumentation and control equipment. This option provides one isolated analog (0 – 10V DC/4 – 20 mA) input, and two isolated analog (0 – 10V DC/4 – 20 mA) outputs. The follower is a printed circuit board that is mounted on the inside of the enclosure door.	Control
M8	**Door-Mounted Speed Potentiometer** — Provides the CP9000 with the ability to adjust the frequency reference using a door-mounted potentiometer. This option uses the 10V DC reference to generate a 0 – 10V signal at the analog voltage input signal terminal. When the HOA bypass option is added, the speed is controlled when the HOA switch is in the hand position. Without the HOA bypass option, a 2-position switch (labeled local/remote) is provided to select speed reference from the Speed Potentiometer or a remote speed signal.	Control
M9	**Door-Mounted Speed Potentiometer with HOA Selector Switch** — Provides the CP9000 with the ability to start/stop and adjust the speed reference from door-mounted control devices or remotely from customer supplied inputs. In HAND position, the drive will start and the speed is controlled by the door-mounted speed potentiometer. The drive will be disabled in the OFF position. When AUTO is selected, the run enable and speed reference are controlled from remote inputs. Speed reference can be either 0 – 10V DC or 4 – 20 mA. The drive default is 4 – 20 mA, parameter is field programmable. Run enable is controlled by a dry contact closure. *This option requires a customer supplied 115V power source. If not available, add **T1** option.*	Control

Table 21. Options Descriptions (Continued)

Option	Description	Option Type
M15	**8 Channel – 120V AC Control Interface** — Allows the CP9000 to be interfaced with remote 115V AC controls. This option uses eight interposing relays to convert up to eight 120V AC input signals into dry contact inputs. In addition, each relay coil has arc suppression circuitry to reduce the effects of EMI on other components. The interface is a printed circuit board that is mounted on the inside of the enclosure door.	Control
N1	**Custom Plastic Nameplate** — A 3 x 5 inch laminated plastic sheet, which can include up to two lines of 15 characters each.	Enclosure
N2	**Custom Metal Nameplate** — A 3 x 5 inch stainless steel sheet, which can include up to two lines of 15 characters each.	Enclosure
R3	**Manual IOB Bypass Controller** — The Manual INVERTER/OFF/BYPASS (IOB) — 3-contactor — bypass option provides a means of bypassing the CP9000, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter and (***IT.***) reduced voltage starter with a door mounted IOB selector switch. For applications up to 100 hp, a Freedom Series IEC input contactor, a Freedom Series IEC output contactor, and a Freedom Series IEC starter with a bimetallic overload relay is included. For applications above 100 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked (see power diagram on **Page 27**).	Bypass
R4	**Manual HOA Bypass Controller** — The Manual HAND/OFF/AUTO (HOA) — 3-contactor — bypass option provides a means of bypassing the CP9000, allowing the AC motor to be operated at full speed directly from the AC supply line. This option consists of an input disconnect, a fused control power transformer, and a full voltage bypass starter and (***IT.***) reduced voltage starter with a door mounted HOA selector switch and an INVERTER/BYPASS switch. The HOA switch provides the ability to start and stop the drive in the inverter mode. For applications up to 100 hp, a Freedom Series IEC input contactor, a Freedom Series IEC output contactor, and a Freedom Series IEC starter with a bimetallic overload relay is included. For applications above 100 hp, an Advantage input contactor, an Advantage output contactor and an Advantage starter with electronic overload protection is included. The contactors are mechanically and electrically interlocked (see power diagram on **Page 27**).	Bypass
T1	**115V Control Transformer – 105 VA** — Provides a fused control power transformer with additional 105 VA at 115V for customer use.	Control
T2	**115V Control Transformer – 300 VA** — Provides a fused control power transformer with additional 300 VA at 115V for customer use.	Control
T3	**115V Control Transformer – 550 VA** — Provides a fused control power transformer with additional 550 VA at 115V for customer use.	Control
V2	**Space Heater** — Prevents condensation from forming in the enclosure when the drive is inactive or in storage. Includes a thermostat for variable temperature control. A 200W heater is installed in enclosures 0 and 1, and a 400W heater is installed in enclosures 2 – 6. Requires a customer supplied 115V remote supply source.	Enclosure
V5	**10" Expansion** — The extension allows for bottom cable entry and additional space for customer mounted components. **NOTE:** Enclosure expansion rated NEMA Type 1 only.	Enclosure
V6	**20" Expansion** — The extension allows for bottom cable entry and additional space for customer mounted components. **NOTE:** Enclosure expansion rated NEMA Type 1 only.	Enclosure
V7	**26" Expansion** — The extension allows for bottom cable entry and additional space for customer mounted components. The enclosure also has a subpanel with C3 flange. **NOTE:** Enclosure expansion rated NEMA Type 1 only.	Enclosure
X5	**Bypass Pilot Lights for I3, I4 Bypass Options** — A green light indicates when the motor is running in inverter mode and an amber light indicates when the motor is running in bypass mode. The lights are mounted on the enclosure door, above the switches.	Addl. Bypass
X6	**Dual Overloads for Bypass** — This option is recommended when a single drive is operating 2 motors in the bypass mode and overload current protection is needed for each of the motors. The standard configuration includes two bimetallic overload relays, each sized to protect a motor with 50% of the drive hp rating. For example, a 100 hp drive would include two overload relays sized to protect two 50 hp motors. The relays are mounted within the enclosure, and are manually resettable.	Addl. Bypass
X7	**Bypass Test Switch for I3, R3, I4 and R4** — Allows the user to energize the AF drive for testing while operating the motor on the bypass controller. The Test Switch is mounted on the inside of the enclosure door.	Addl. Bypass
Y4	**Single Overload Relay** — Uses a bimetallic overload relay to provide additional overload current protection to the motor on configurations without bypass options. It is included with the Bypass Configurations for overload current protection in the bypass mode. The Overload Relay is mounted within the enclosure, and is manually resettable.	Output
Y5	**Dual Overload Relays** — This option is recommended when a single drive is operating 2 motors and overload current protection is needed for each of the motors. The standard configuration includes two bimetallic overload relays, each sized to protect a motor with 50% of the drive hp rating. For example, a 100 hp drive would include two overload relays sized to protect two 50 hp motors. The relays are mounted within the enclosure, and are manually resettable.	Output

Dimensions

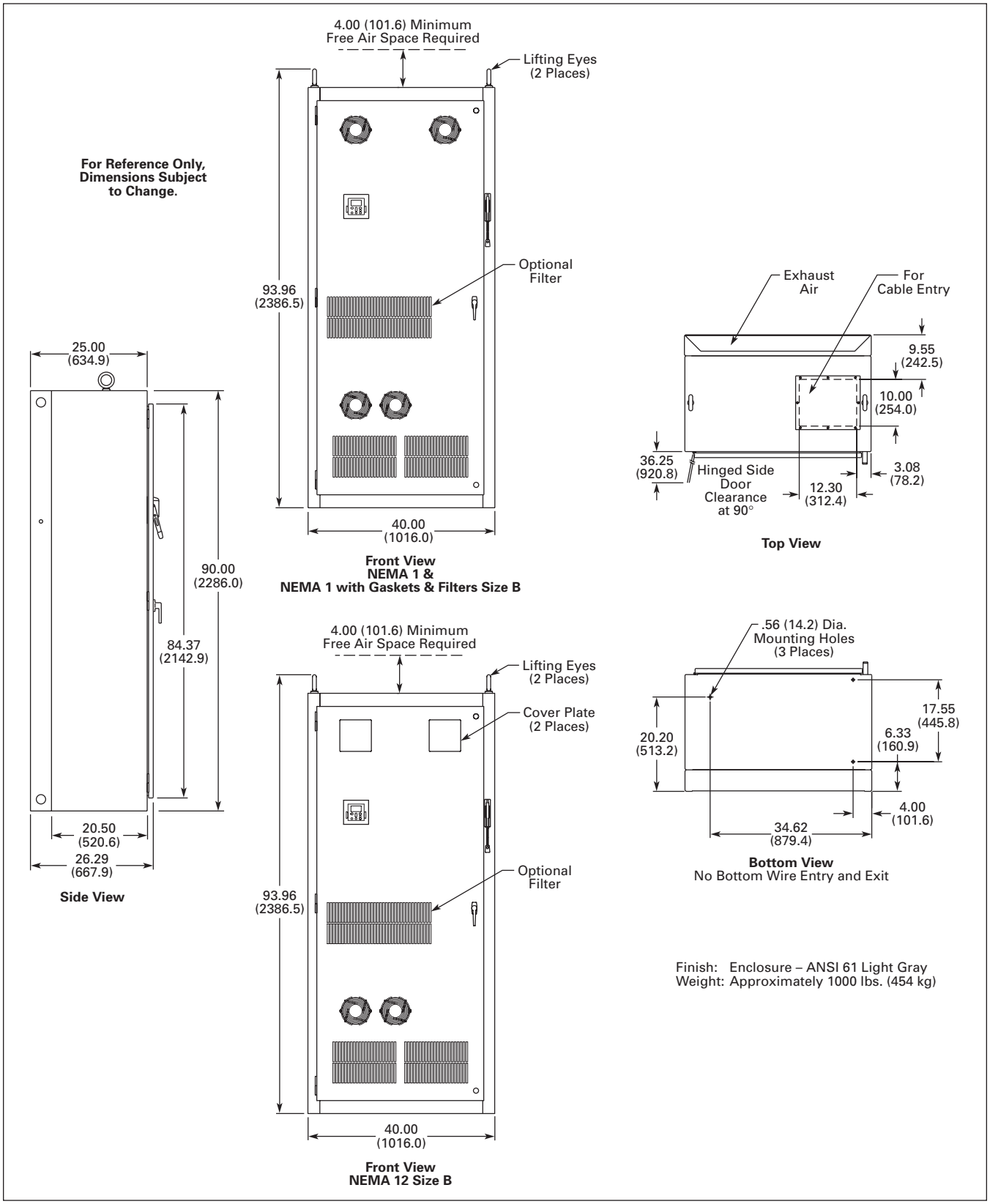


Figure 13. 25 – 200 hp, Size B Approximate Dimensions in Inches (mm)

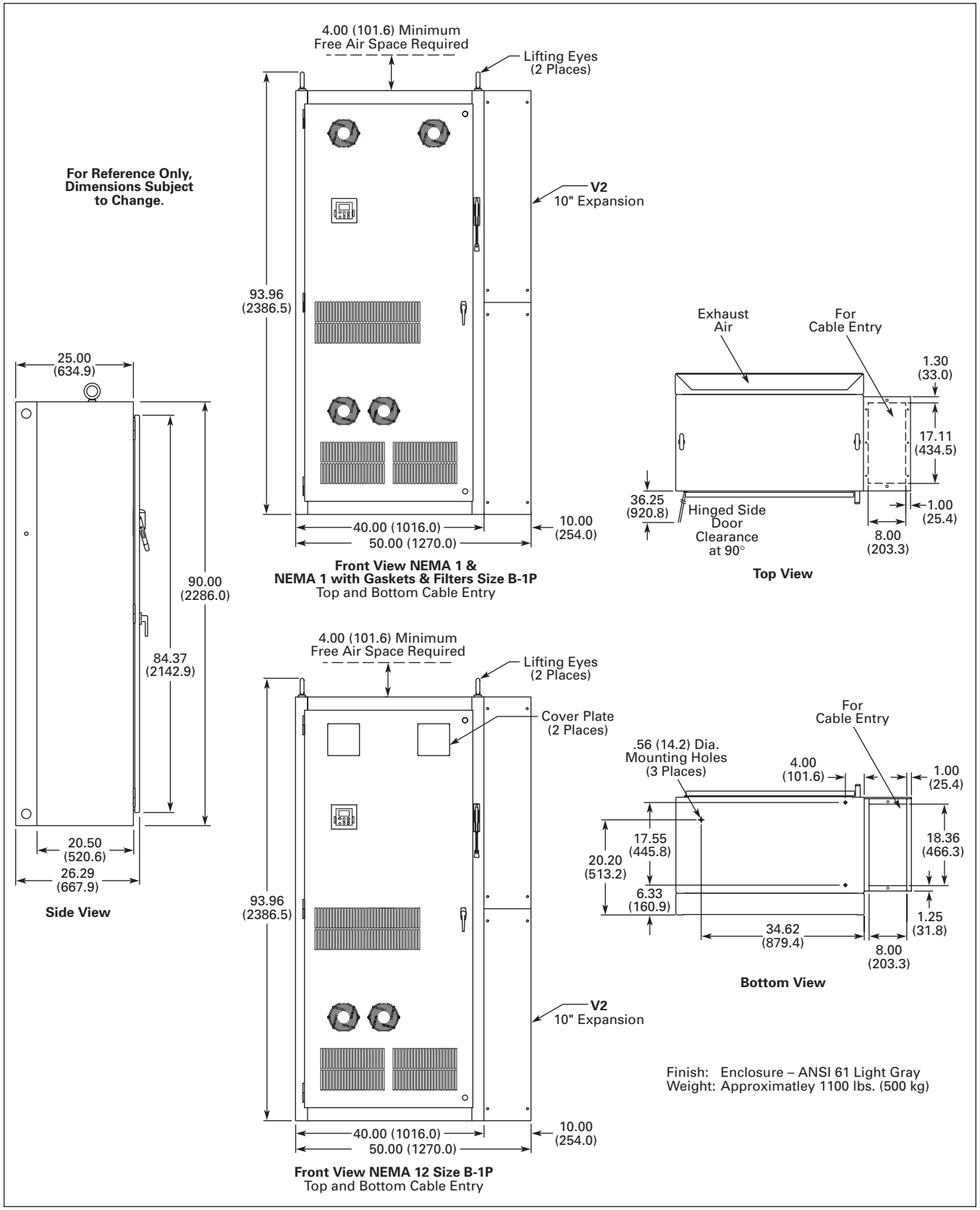


Figure 14. 25 – 200 hp, Size B-1P Approximate Dimensions in Inches (mm)

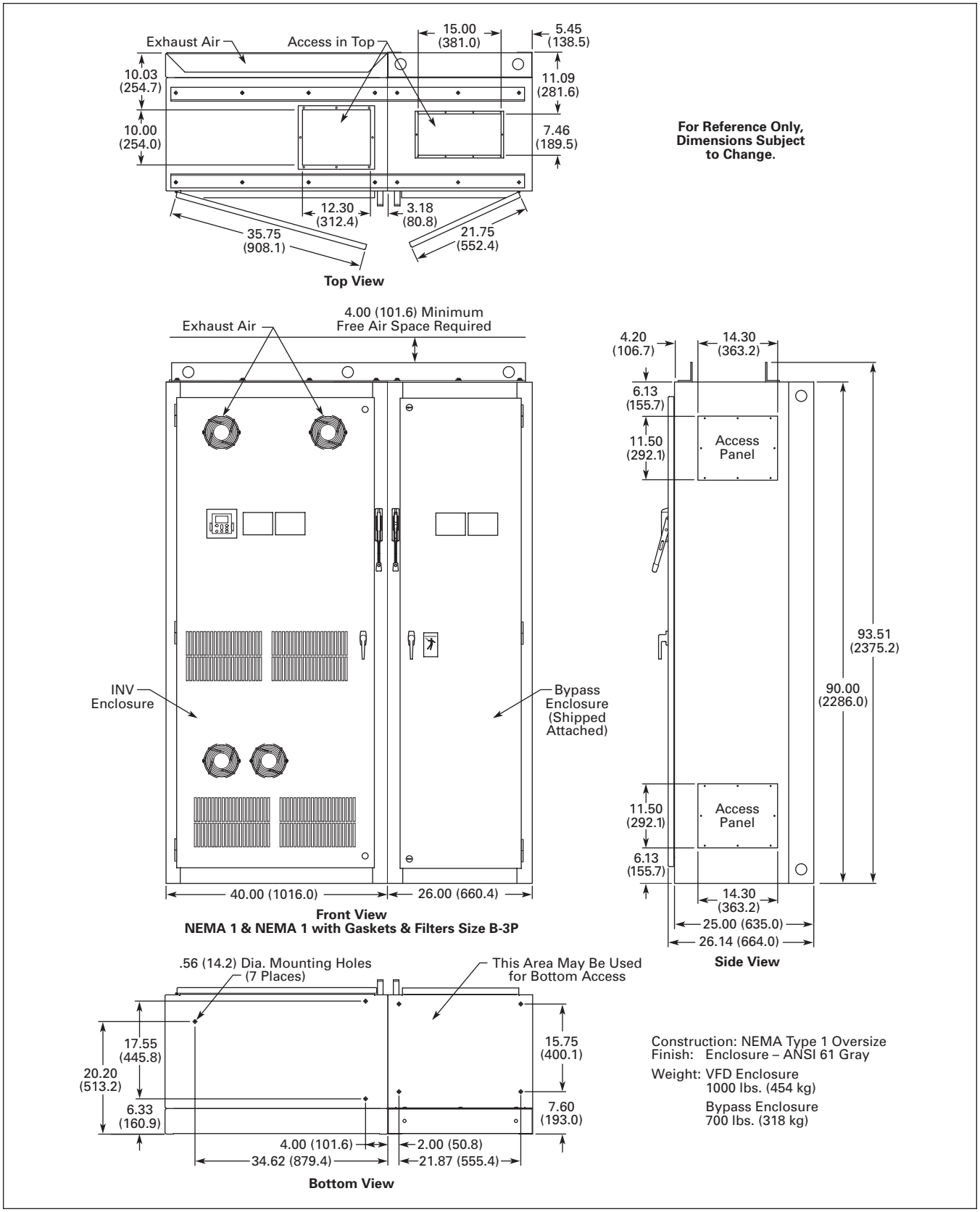


Figure 15. 100 – 200 hp, Size B-3P Approximate Dimensions in Inches (mm)

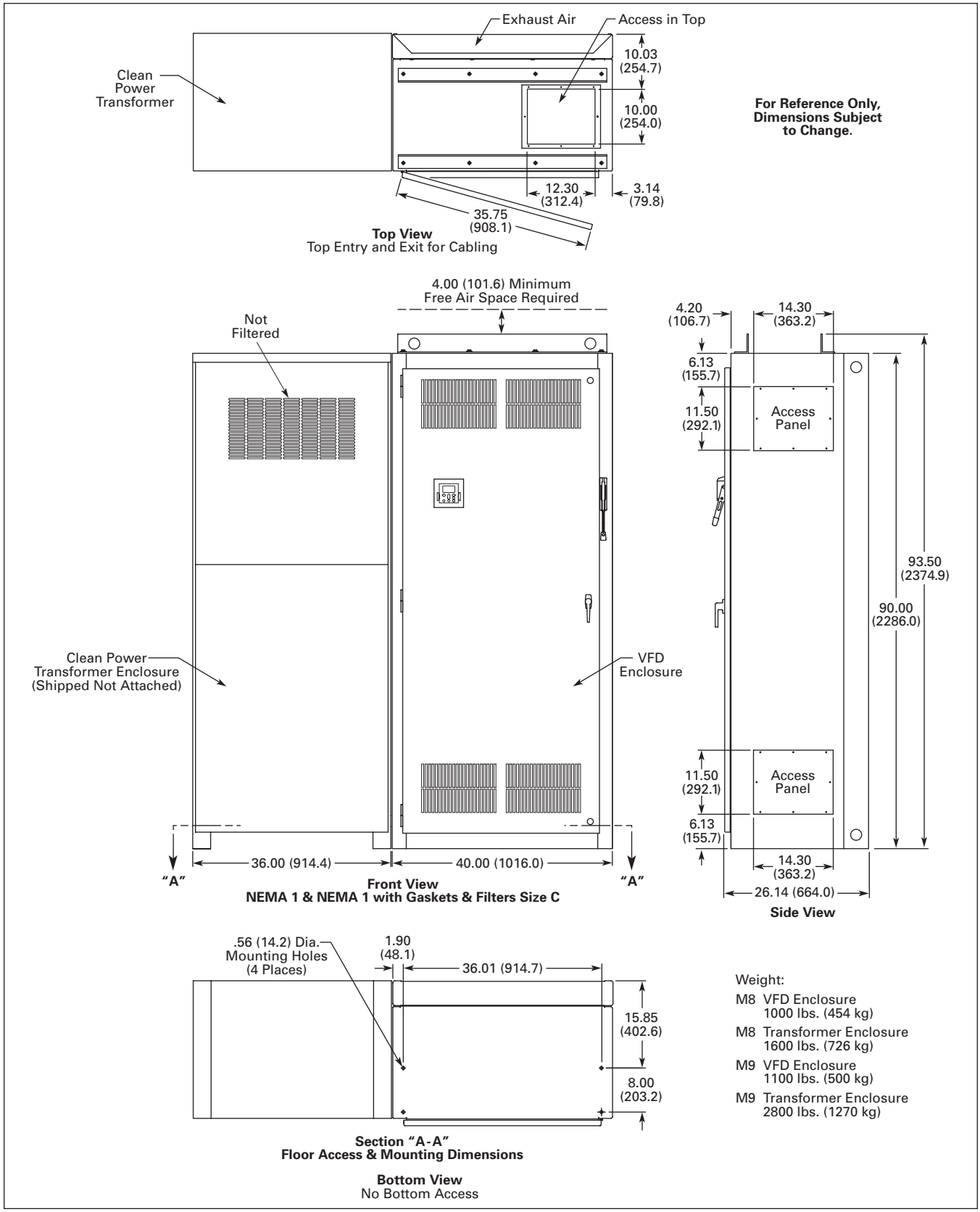


Figure 16. 200 – 400 hp, Size C Approximate Dimensions in Inches (mm)

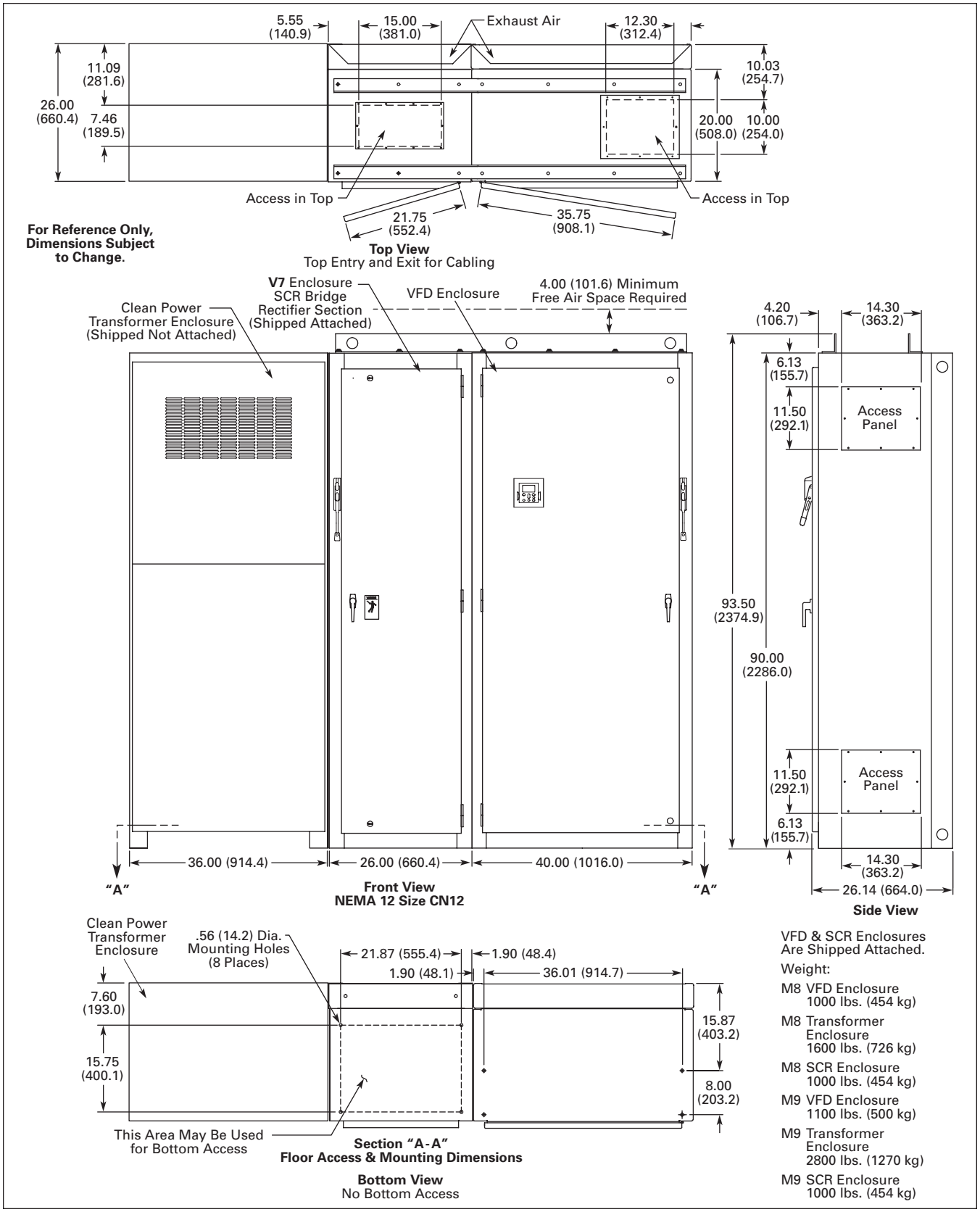


Figure 17. 200 – 400 hp, CN12 Approximate Dimensions in Inches (mm)

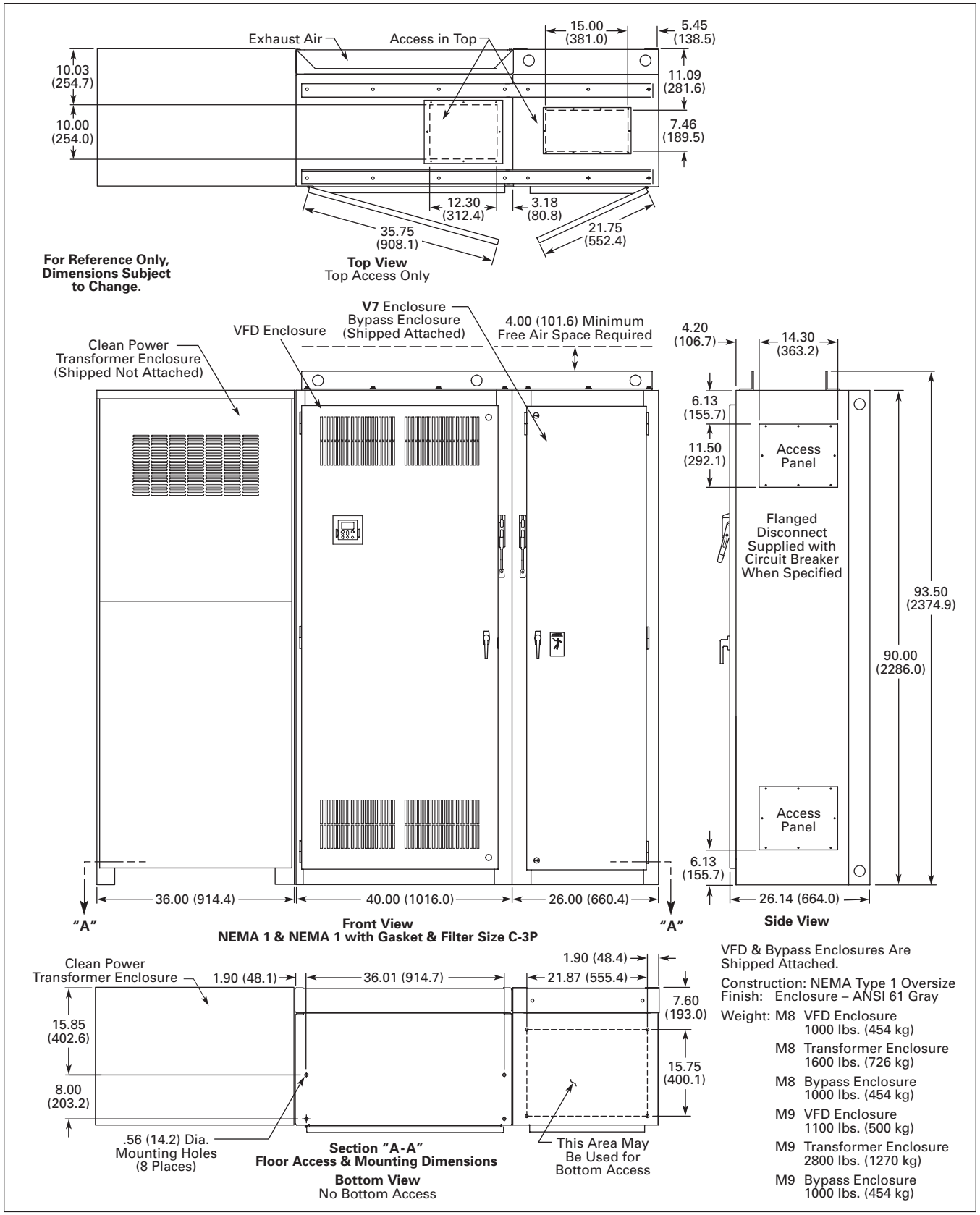


Figure 18. 400 hp, C-3P Approximate Dimensions in Inches (mm)

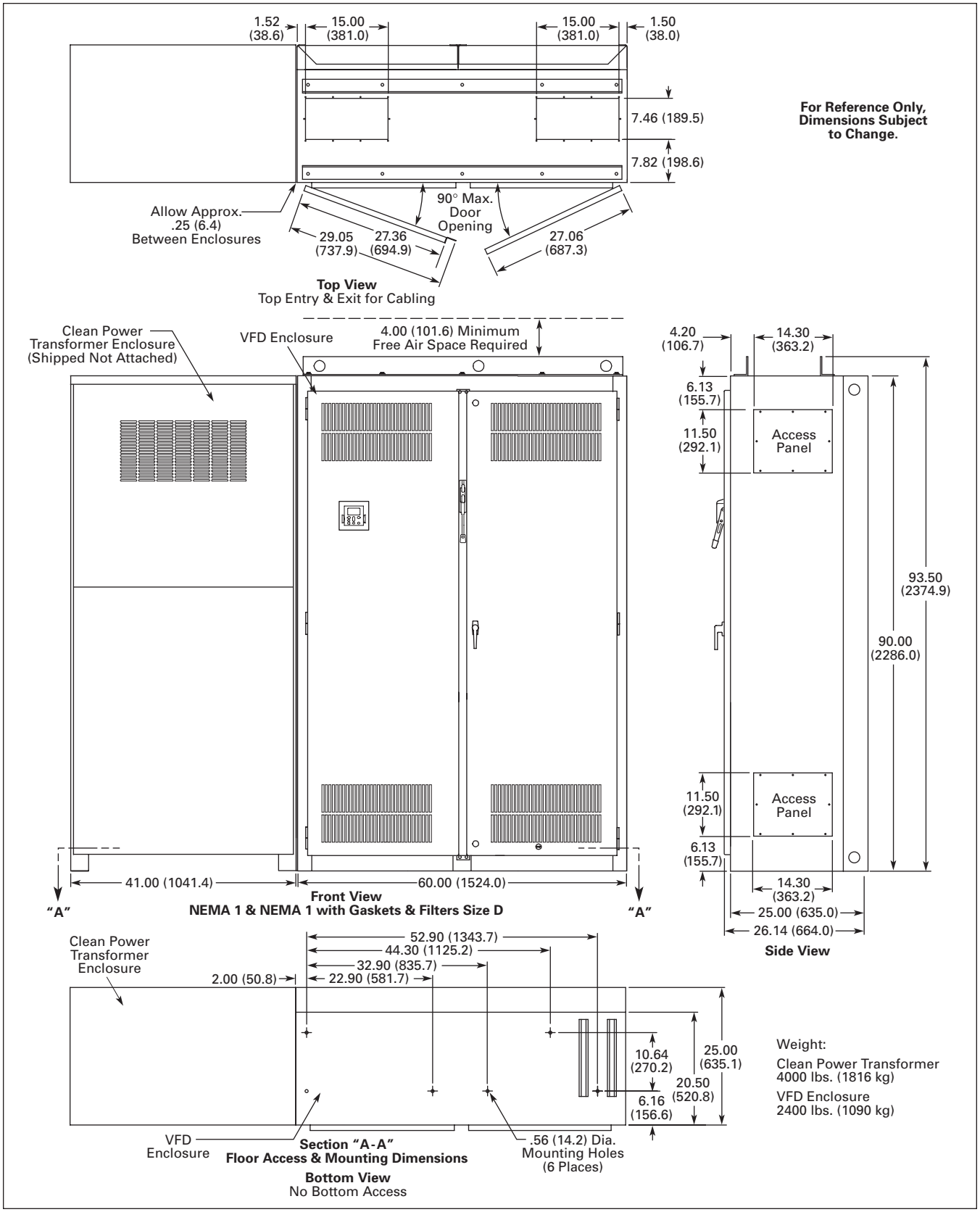


Figure 19. 500 – 600 hp, Size D Approximate Dimensions in Inches (mm)

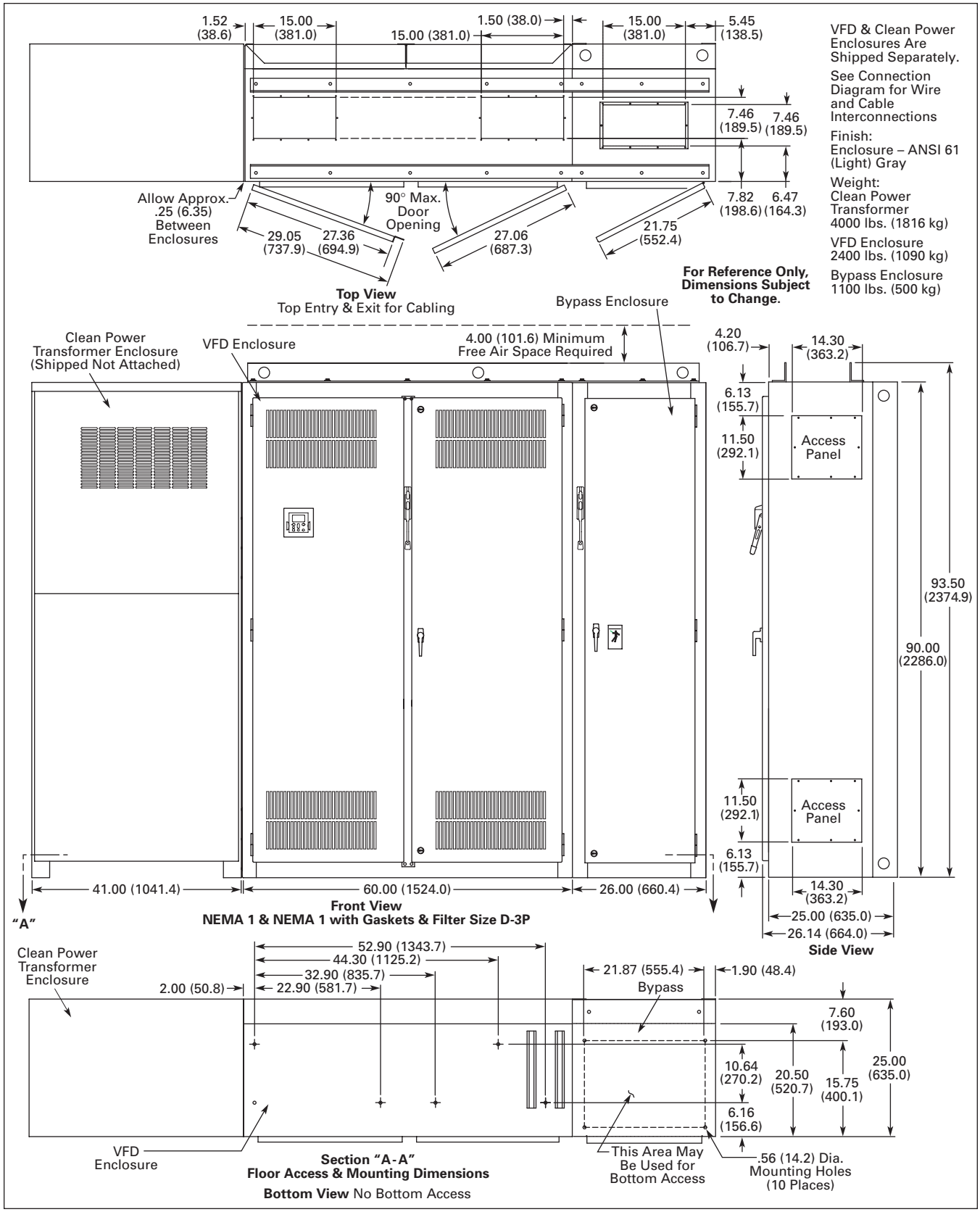


Figure 20. 500 – 600 hp, Size D-3P Approximate Dimensions in Inches (mm)

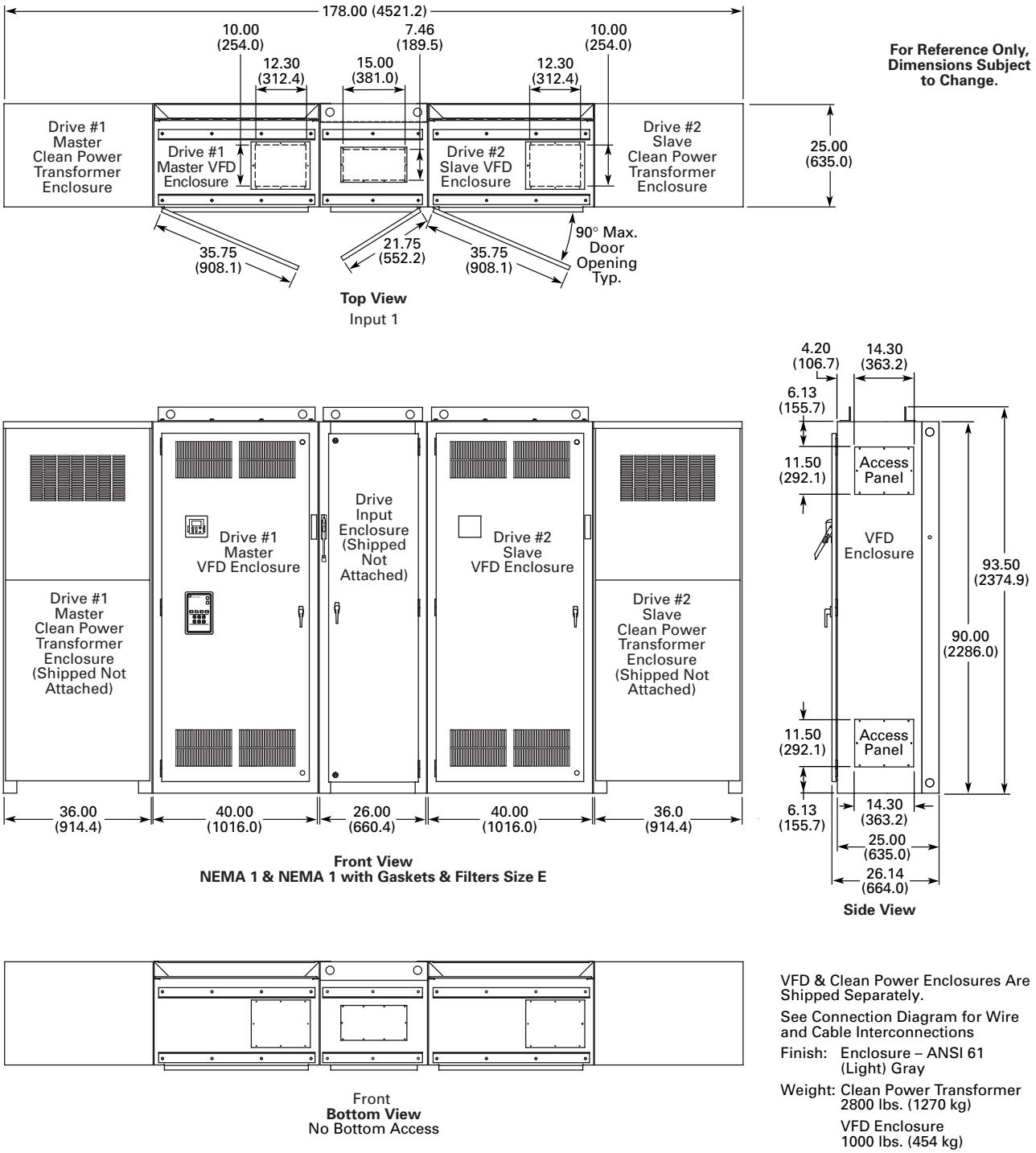
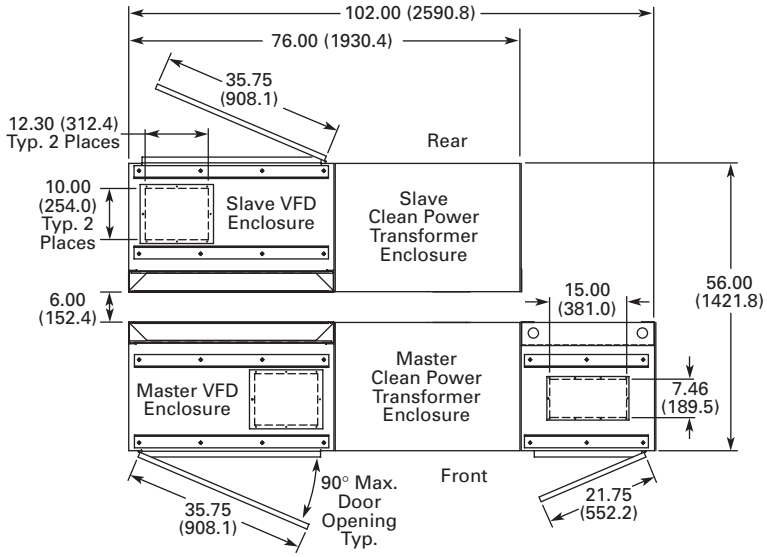
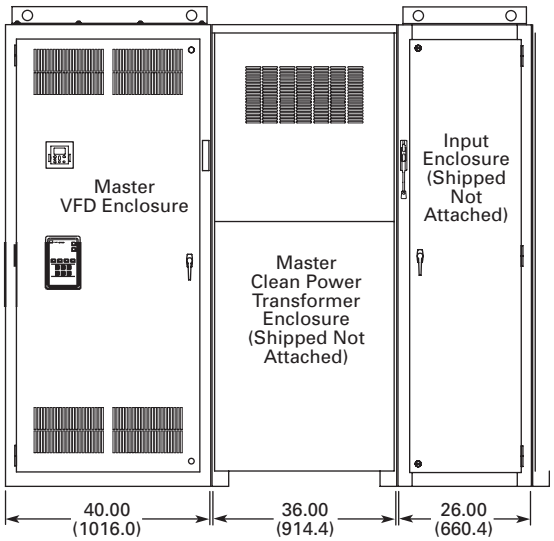


Figure 21. 700 – 800 hp, Size E Straight Lineup Approximate Dimensions in Inches (mm)

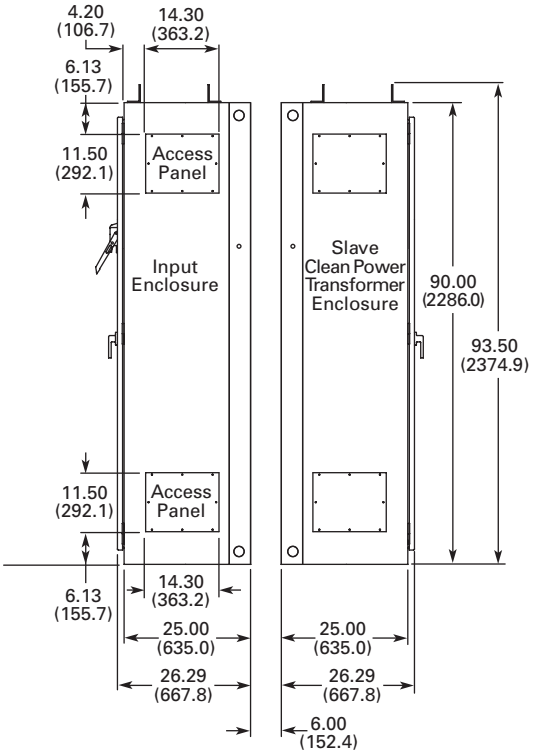


Input 1
Top View

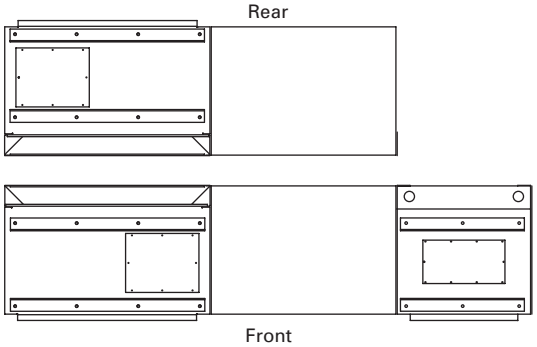
For Reference Only, Dimensions Subject to Change.



Front View
NEMA 1 & NEMA 1 with Gaskets & Filters Size E



Side View



Bottom View
No Bottom Access

VFD & Clean Power Enclosures Are Shipped Separately.

See Connection Diagram for Wire and Cable Interconnections

Finish: Enclosure – ANSI 61 (Light) Gray

Weight: Clean Power Transformer 2800 lbs. (1270 kg)

VFD Enclosure 1000 lbs. (454 kg)

Figure 22. 700 – 800 hp, Size E Back to Back Approximate Dimensions in Inches (mm)

Wiring Diagrams

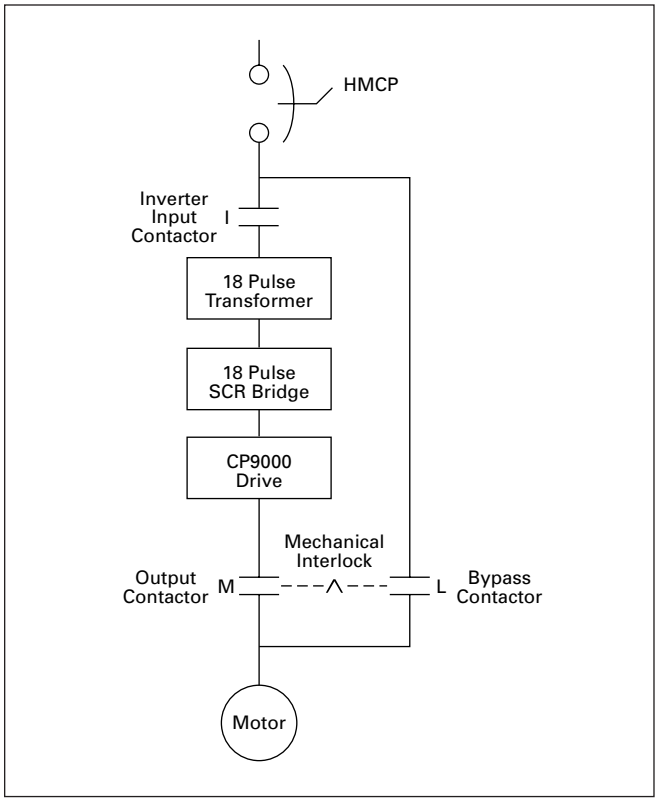


Figure 23. Power Diagram I3, I4

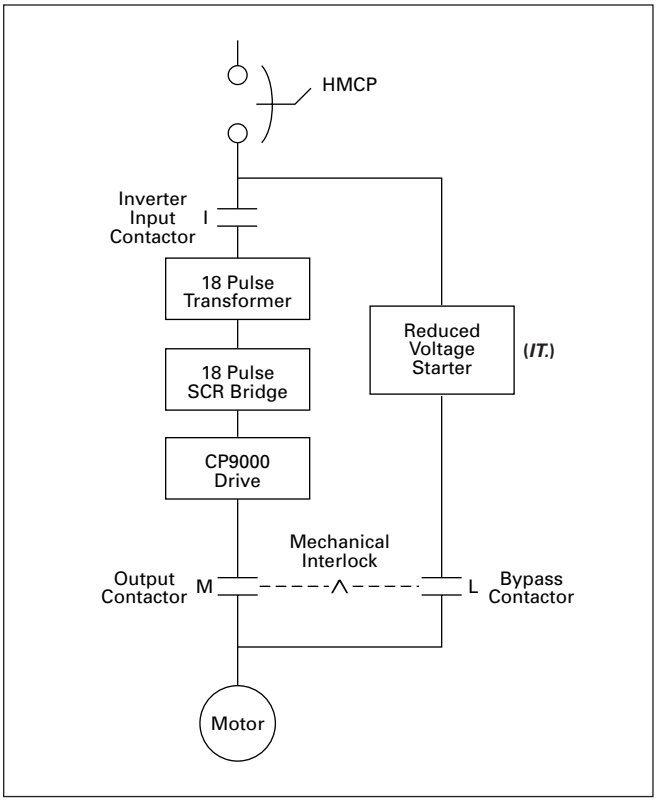


Figure 25. Power Diagram R3, R4

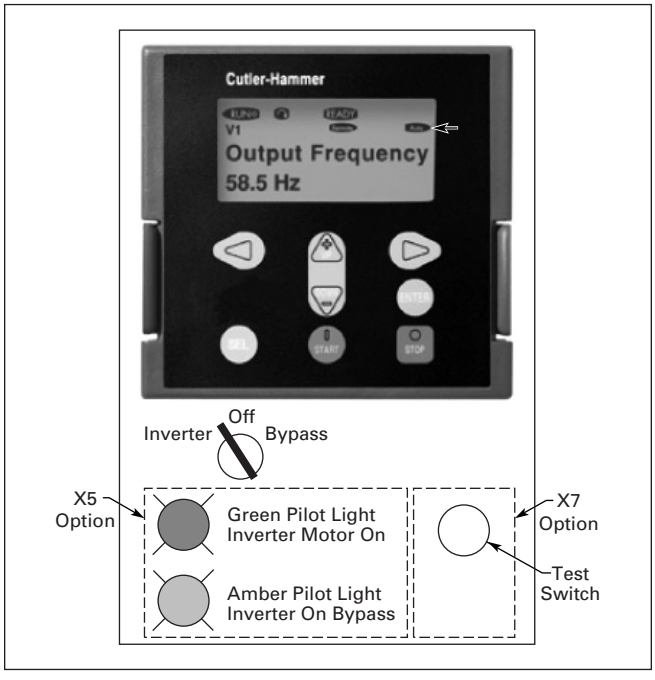


Figure 24. Panel Layout I3, R3

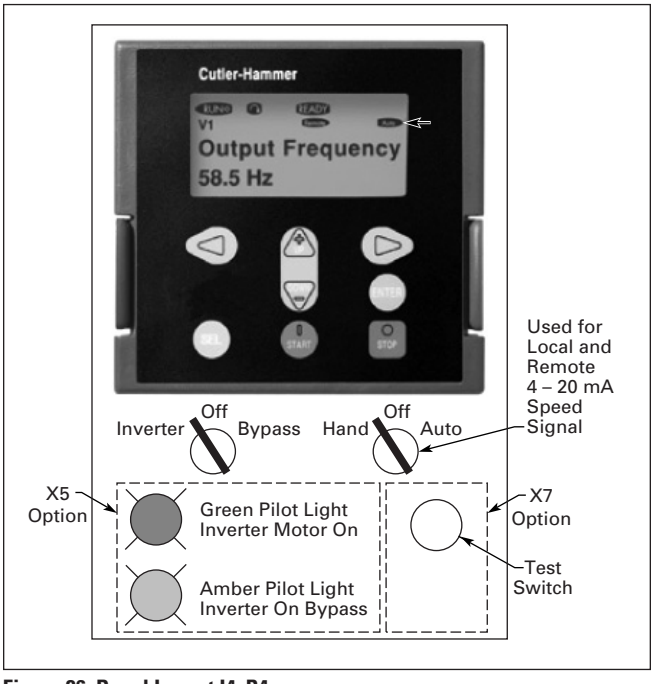


Figure 26. Panel Layout I4, R4

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