Eaton DOE 2016 efficient distribution transformers

DOE 2016 efficiency guidelines

The U.S. Department of Energy (DOE) is tasked with periodically reviewing energy efficiency requirements of many appliances, including distribution transformers. The latest DOE ruling, originally published on April 18, 2013, mandates new, higher, energy efficiency levels for liquid-filled and dry-type distribution transformers. This new ruling, 10 CFR Part 431, commonly referred to as DOE 2016, requires that distribution transformers manufactured starting on January 1, 2016 that are intended for sale or installation in the U.S. and U.S. Territories meet the new minimum efficiency levels.

Eaton is proud to support this new legislation that will have long-lasting positive environmental benefits lasting for decades into the future.

For low-voltage dry-type distribution transformers, the new minimum energy efficiency levels, required effective January 1, 2016 are:

Table 1. DOE 2016 minimum efficiency levels for low-voltage dry-type distribution transformers

Single-phase		Three-phase	
kVA	**Efficiency %**	**kVA**	**Efficiency %**
15	97.70	15	97.89
25	98.00	30	98.23
37.5	98.20	45	98.40
50	98.30	75	98.60
75	98.50	112.5	98.74
100	98.60	150	98.83
167	98.70	225	98.94
250	98.80	300	99.02
333	98.90	500	99.14
		750	99.23
		1,000	99.28

Powering Business Worldwide

There are several types of transformers specifically excluded from the scope of low-voltage dry-type distribution transformer efficiency requirements. The most common transformers excluded from the low-voltage standard are motor drive isolation transformers, control transformers, encapsulated transformers (including mini-power centers), and totally enclosed non-ventilated (TENV) transformers.

Eaton has completely redesigned their ventilated transformer product offering to meet the new DOE 2016 requirements. As part of this redesign, several enhancements were made to the product.

- Bonding ground bar added to the bottom panel as standard for compliance with NEC® 450.10 (A)
- Lower center of gravity to help minimize freight damage
- Minimum of 4 inches clearance between bottom panel and the floor to facilitate ease of moving the transformer with a variety of equipment
- Minimum clearance between front and back panels of just 2 inches when installed indoors without weathershields
- Larger wire bending space for ease of connection
- Larger recommended conduit entry locations in the enclosure
- OSHPD approved designs. 150 kVA and smaller are OSHPD approved for wall-mounting applications
- Third-party efficiency verification so customers can be sure their Eaton transformer meets the new DOE 2016 minimum efficiency requirements

c UL | Energy Verified
EV33871

Product scope

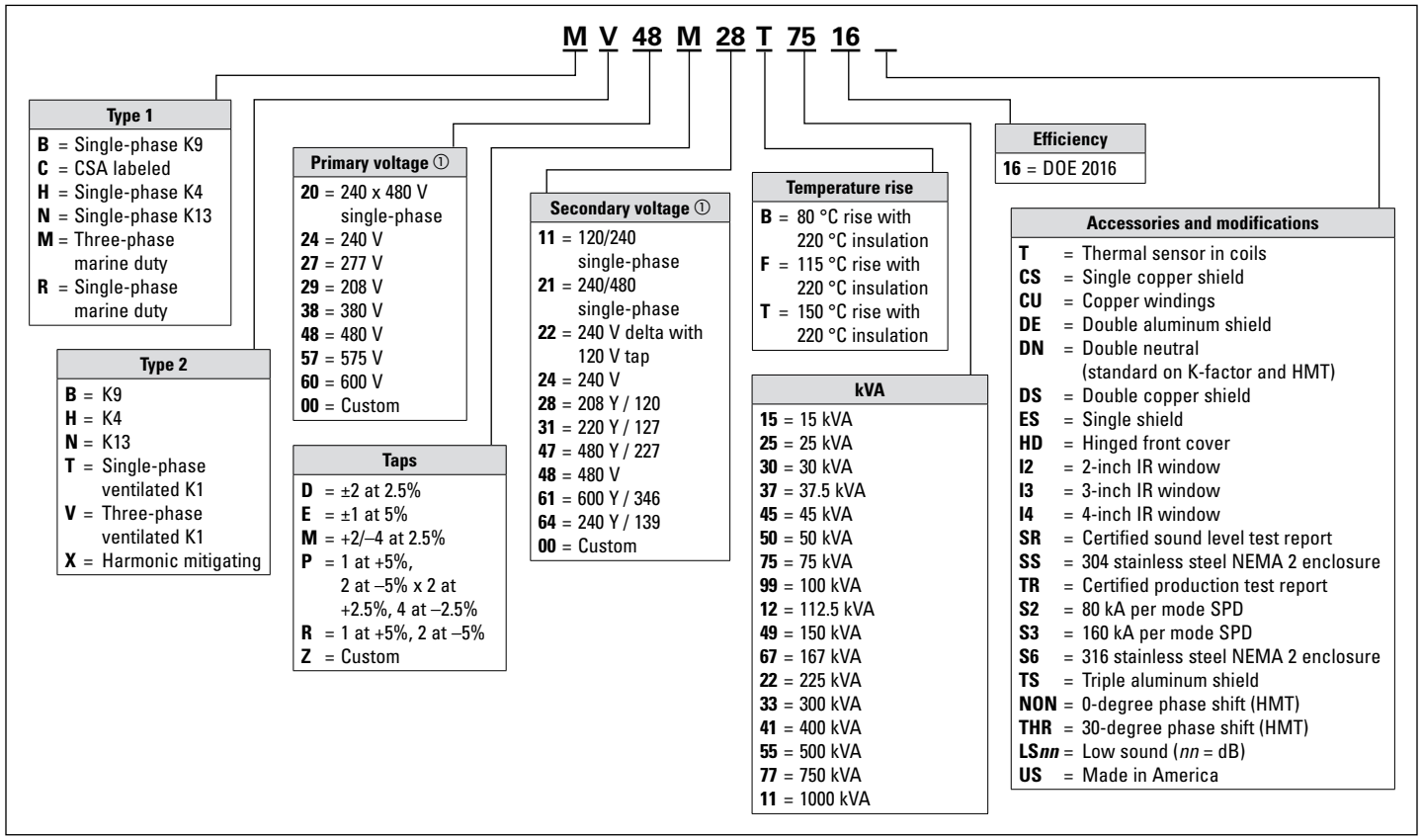
Eaton manufactures a diverse family of DOE 2016 compliant transformers, including:

- 150 °C temperature rise standard, 115 °C and 80 °C rise optional
- General purpose, K-factor, harmonic mitigating, and marine-duty transformers
- K-factor rating of K4, K9, K13, K20, K30
- Aluminum windings standard, copper windings optional
- Wide variety of accessories and custom options
  - Custom voltage combinations
  - Hinged front covers
  - Surge protective devices
  - Custom paint colors
  - IR viewing windows
  - Primary or secondary circuit protective devices
  - Custom electrostatic shielding options
  - And more

Technical specifications

- 15–167 kVA single-phase
- 15–500 kVA three-phase
- 150 °C temperature rise standard, 115 °C or 80 °C optional
- UL® Listed 220 °C insulation system
- 10 kV BIL on three-phase units
- NEMA® Type 2 enclosures; NEMA 3R when proper weathershield is installed
- Enclosure finish: ANSI 61 grey
- Upright mounting only
- Frequency: 60 Hz
- Short-term overload capability as required by ANSI
- Meet NEMA ST-20 audible sound levels
- UL 1561 Listed, UL File E78389
- cUL® energy efficiency verified EV33871
- Designed, manufactured, and tested per applicable portions of standards:
  - NFPA® (NEC)
  - UL 1561
  - NEMA ST-20
  - NEMA 250
  - 10 CFR Part 431
  - ANSI C57.12.70
  - ANSI C57.12.91
  - OSHPD California
  - Uniform Building Code
  - International Building Code
  - American Bureau of Shipping (marine-duty transformers)

Table 2. DOE 2016 catalog numbering system



① The most common voltages are listed. Contact Eaton for additional voltage combinations.

General construction features of DOE 2016 efficient transformers rated 600 V and below

General description

Eaton's single-phase and three-phase general purpose dry-type ventilated transformers are of the two-winding type, self-cooled, and are available in a variety of primary and secondary voltage combinations.

Eaton's transformers are designed, manufactured, and tested in accordance with all of the latest applicable ANSI, NEMA, and IEEE® standards. All 600 V class ventilated transformers with ratings through 1500 kVA are UL listed and bear the UL label. Open core and coil assemblies are UL recognized (UR) labeled products.

These transformers are designed for continuous operation at rated kVA for 24 hours a day, 365 days a year, with a normal life expectancy as defined in ANSI C57.96.

Efficiency validation

Eaton-manufactured transformers in compliance with 10 CFR Part 431 (2016), "DOE 2016 efficient" bear the UL Energy Efficiency Verification Mark to confirm that the transformer meets the minimum energy efficiency requirements set forth in federal law 10 CFR Part 431.

Insulation system

The design life of transformers having different insulation systems is the same; the lower temperature systems are designed to have the same life as the higher rated temperature systems.

Most Eaton ventilated transformers, regardless of their temperature rise, are manufactured using a 220 °C insulation system. Required performance is obtained without exceeding the insulation system rating at rated temperature rise in a 40 °C maximum ambient, with an average of 30 °C over a 24-hour period. Transformers manufactured with 220 °C insulation system meet the requirements of NEC 450.21(b) Exception No. 2. It is not necessary to install them in a special, fire-resistant room.

All insulation materials used are flame-retardant and do not support combustion, as defined in ASTM Standard Test Method D635.

Core and coil assemblies

The transformer core is constructed using high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities are substantially below the saturation point. The transformer core volume allows for efficient transformer operation at 10% above the nominal tap voltage. The core laminations are tightly clamped and compressed. The BIL (basic impulse level) for all 600 V-class windings is 10 kV. The core and coil assembly is installed on neoprene vibration-absorbing pads. Coils are treated with a varnish that does not support the growth of fungus.

Ventilated transformers with wye-connected secondaries have the neutral brought out to a separate terminal or busbar.

The core and coil assembly is grounded to the transformer enclosure by means of a flexible copper ground strap. The copper ground strap is sized per the NEC to be a grounding conductor.

Eaton three-phase DOE 2016 efficient transformers are provided with a bonding ground bar attached to the bottom panel for compliance with NEC 450.10(A).

Electrostatic shielding

There are no industry standards for electrostatic shield performance. Eaton-manufactured transformers have been tested by an independent laboratory to meet the following attenuation levels:

When tested per MIL-Std-220A, Method Of Insertion Loss Measurement, with matched impedance no load technique:

- Common mode noise attenuation:
  Minus 80 dBA minimum at 0.1 kHz to 1.5 kHz;
  minus 55 dBA minimum at 1.51 kHz to 100 kHz
- Normal mode (transverse mode) noise attenuation:
  Minus 30 dBA minimum at 1.5 kHz to 10 kHz.

Primary to secondary capacitance of 24.74 to 18.06 picofarads over the range 100 to 20 kHz.

Taps

Primary taps are available on most Eaton ventilated transformers to allow compensation for source voltage variations.

Winding terminations

Primary and secondary windings are terminated in the wiring compartment. Ventilated transformers have leads brought out to aluminum or copper pads that are pre-drilled to accept Al/Cu lugs. Aluminum-wound transformers have aluminum pads; copper-wound transformers have copper pads. Lugs are not supplied with Eaton transformers; however, lug kits are available as a field-installed accessory. Eaton recommends external cables be rated 75 °C for ventilated designs.

Enclosures

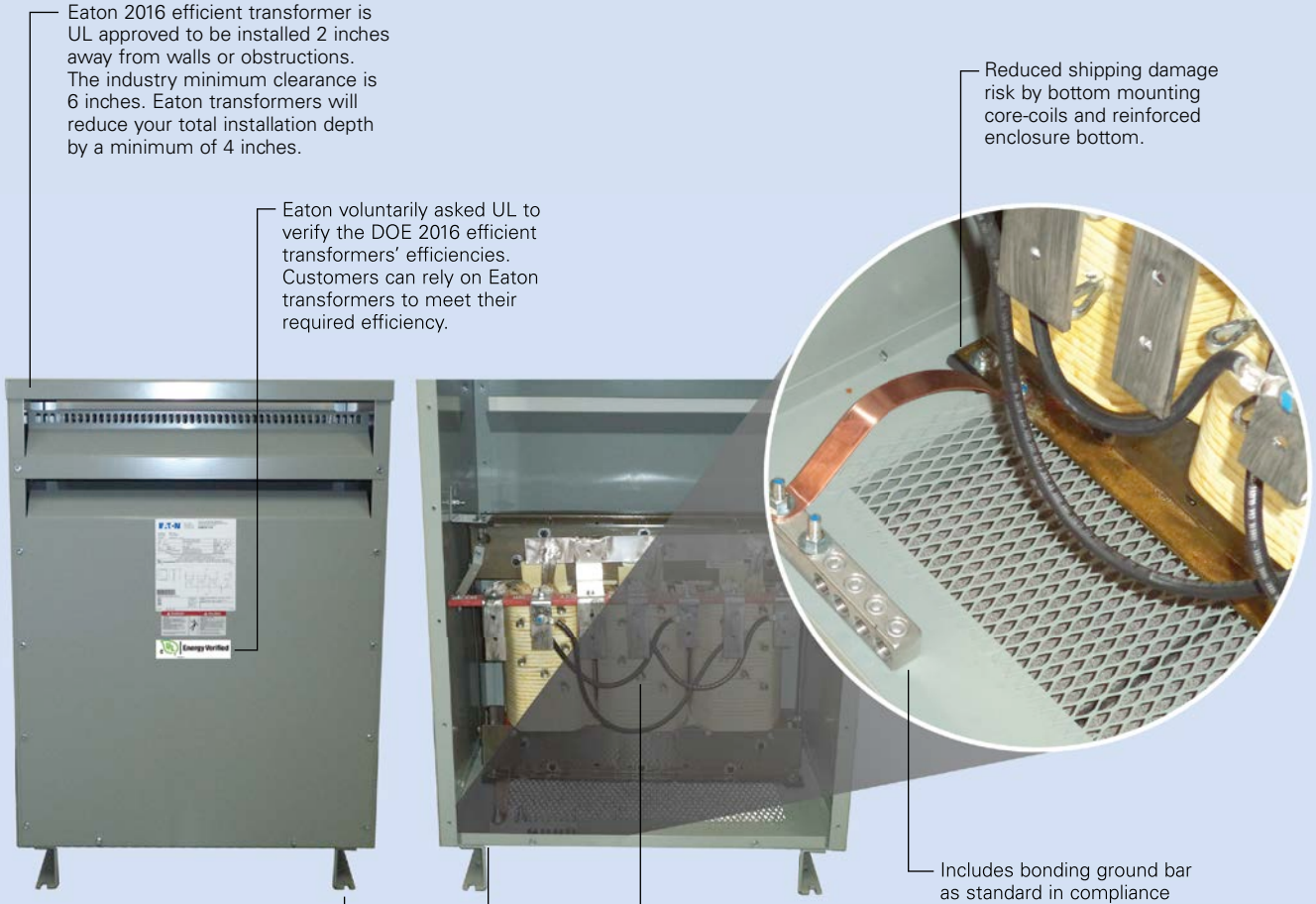
The transformer enclosure is made of heavy-gauge steel and is finished using a continuous process of degreasing, cleaning, and phosphatizing, followed by electrostatic deposition of a thermosetting polyester powder coating and subsequent baking. The coating color is ANSI 61 grey and is UL-recognized for indoor or outdoor use. In compliance with NEMA ST-20, Eaton's ventilated transformers are designed such that the maximum temperature on the top of the enclosure does not exceed 50 °C rise above the ambient temperature.

For ventilated transformers, the enclosure standard construction is drip-proof, NEMA 2, with lifting provisions on the top of the core. All ventilation openings are protected against falling dirt. Proper installation of weathershields makes the enclosure NEMA 3R rated and suitable for outdoor use.

To ensure proper ventilation and cooling of the transformer, follow manufacturer's recommended clearance around ventilation openings.

Installation clearances

Eaton's transformers should be installed with a minimum clearance around the transformer enclosure to prevent accidental contact with flammable or combustible materials.



Eaton 2016 efficient transformer

Selection tables

Aluminum wound, single-phase,

Table 3. 240 x 480 primary volts, 120/240 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**T20P11S1516**	842	196	3XA	WS45	WMB01
25	**T20P11S2516**	842	261	3XA	WS45	WMB01
37.5	**T20P11S3716**	843	304	3XA	WS43	—
50	**T20P11S5016**	843	410	3XA	WS43	—
75	**T20P11S7516**	844	688	3XA	WS44	—
100	**T20P11S9916**	844	699	3XA	WS44	—
167	**T48M11S6716** ③	814	1294	288A	WS13	—

① Frame drawings on **page 14** and **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ 480 V primary only.

Copper wound, single-phase

Table 4. 240 x 480 primary volts, 120/240 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**T20P11S1516CU**	816	270	3XA	WS11	WMB01
25	**T20P11S2516CU**	818	406	3XA	WS11	WMB01
37.5	**T20P11S3716CU**	818	453	3XA	WS11	WMB01
50	**T20P11S5016CU**	819	657	3XA	WS16	WMB01
75	**T20P11S7516CU**	820	803	3XA	WS16	—
100	**T20P11S9916CU**	821	960	3XA	WS13	—
167	**T48M11S6716CU** ③	814E	1665	288A	WS13	—

① Frame drawings on **page 14** and **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ 480 V primary only.

Aluminum wound, three-phase

Table 5. 208 delta primary volts, 208Y/120 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**V29M28T1516**	939	225	280E	WS57	WMB05
30	**V29M28T3016**	940	409	280E	WS58	WMB05
45	**V29M28T4516**	940	416	280E	WS58	WMB05
75	**V29M28T7516**	942	602	280E	WS59	WMB04
112.5	**V29R28T1216**	943	976	324A	WS60	WMB04
150	**V29R28T4916**	943	1239	324A	WS60	WMB04
225	**V29R28T2216**	944	1624	289D	WS61	—
300	**V29R28T3316**	945	2283	289D	WS62	—
500	**V29E28T5516**	③	③	③	—	—
750	**V29N28T7716**	③	③	③	—	—
1000	**V29N28T1116**	③	③	③	—	—

① Frame drawings on **page 14** and **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Aluminum wound, three-phase

Table 6. 208 delta primary volts, 480Y/277 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**V29M47T1516**	939	229	E0342B	WS57	WMB05
30	**V29M47T3016**	940	407	E0342B	WS58	WMB05
45	**V29M47T4516**	940	438	E0342B	WS58	WMB05
75	**V29M47T7516**	942	505	E0342B	WS59	WMB04
112.5	**V29R47T1216**	943	973	E0351A	WS60	WMB04
150	**V29R47T4916**	943	1233	E0351A	WS60	WMB04
225	**V29R47T2216**	944	1624	E0351A	WS61	—
300	**V29R47T3316**	945	2083	E0351A	WS62	—
500	**V29E47T5516**	③	③	③	—	—
750	**V29E47T7716**	③	③	③	—	—
1000	**V29E47T1116**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 7. 480 delta primary volts, 208Y/120 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**V48M28T1516**	FR939	236	280B	WS57	WMB05
30	**V48M28T3016**	FR940	418	280B	WS58	WMB05
45	**V48M28T4516**	FR940	450	280B	WS58	WMB05
75	**V48M28T7516**	FR942	626	280B	WS59	WMB04
112.5	**V48M28T1216**	FR943	999	280B	WS60	WMB04
150	**V48M28T4916**	FR943	1257	280B	WS60	WMB04
225	**V48M28T2216**	FR944	1655	280B	WS61	—
300	**V48M28T3316**	FR945	2222	280B	WS62	—
500	**V48M28T5516**	③	③	③	—	—
750	**V48M28T7716**	③	③	③	—	—
1000	**V48D28T1116**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 8. 480 delta primary volts, 240 delta with 120 V center tap secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**V48M22T1516**	FR939	230	282B	WS57	WMB05
30	**V48M22T3016**	FR940	399	282B	WS58	WMB05
45	**V48M22T4516**	FR940	437	282B	WS58	WMB05
75	**V48M22T7516**	FR942	593	282B	WS59	WMB04
112.5	**V48M22T1216**	FR943	972	282B	WS60	WMB04
150	**V48M22T4916**	FR943	1232	282B	WS60	WMB04
225	**V48M22T2216**	FR944	1679	282B	WS61	—
300	**V48M22T3316**	FR945	2200	282B	WS62	—
500	**V48M22T5516**	③	③	③	—	—
750	**V48M22T7716**	③	③	③	—	—
1000	**V48D22T1116**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Aluminum wound, three-phase

Table 9. 480 delta primary volts, 480Y/277 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**V48M47T1516**	FR939	208	280B	WS57	WMB05
30	**V48M47T3016**	FR940	395	280B	WS58	WMB05
45	**V48M47T4516**	FR940	436	280B	WS58	WMB05
75	**V48M47T7516**	FR942	576	280B	WS59	WMB04
112.5	**V48M47T1216**	FR943	976	280B	WS60	WMB04
150	**V48M47T4916**	FR943	1241	280B	WS60	WMB04
225	**V48M47T2216**	FR944	1630	280B	WS61	—
300	**V48M47T3316**	FR945	2294	280B	WS62	—
500	**V48M47T5516**	③	③	③	—	—
750	**V48M47T7716**	③	③	③	—	—
1000	**V48D47T1116**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Copper wound, three-phase

Table 10. 208 delta primary volts, 208Y/120 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**V29M28T1516CU**	939	250	280E	WS57	WMB05
30	**V29M28T3016CU**	940	415	280E	WS58	WMB05
45	**V29M28T4516CU**	940	478	280E	WS58	WMB05
75	**V29M28T7516CU**	942	678	280E	WS59	WMB04
112.5	**V29R28T1216CU**	943	1263	324A	WS60	WMB04
150	**V29R28T4916CU**	943	1410	324A	WS60	WMB04
225	**V29R28T2216CU**	944	1760	289D	WS61	—
300	**V29R28T3316CU**	945	2361	289D	WS62	—
500	**V29E28T5516CU**	③	③	③	—	—
750	**V29N28T7716CU**	③	③	③	—	—
1000	**V29N28T1116CU**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 11. 208 delta primary volts, 480Y/277 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**V29M47T1516CU**	939	254	E0342B	WS57	WMB05
30	**V29M47T3016CU**	940	427	E0342B	WS58	WMB05
45	**V29M47T4516CU**	940	503	E0342B	WS58	WMB05
75	**V29M47T7516CU**	942	570	E0342B	WS59	WMB04
112.5	**V29R47T1216CU**	943	1255	E0351A	WS60	WMB04
150	**V29R47T4916CU**	943	1406	E0351A	WS60	WMB04
225	**V29E47T2216CU**	③	③	③	—	—
300	**V29E47T3316CU**	③	③	③	—	—
500	**V29E47T5516CU**	③	③	③	—	—
750	**V29E47T7716CU**	③	③	③	—	—
1000	**V29E47T1116CU**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Copper wound, three-phase

Table 12. 480 delta primary volts, 208Y/120 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**V48M28T1516CU**	FR939	262	280B	WS57	WMB05
30	**V48M28T3016CU**	FR940	415	280B	WS58	WMB05
45	**V48M28T4516CU**	FR940	478	280B	WS58	WMB05
75	**V48M28T7516CU**	FR942	676	280B	WS59	WMB04
112.5	**V48M28T1216CU**	FR943	1289	280B	WS60	WMB04
150	**V48M28T4916CU**	FR943	1432	280B	WS60	WMB04
225	**V48M28T2216CU**	FR944	1787	280B	WS61	—
300	**V48M28T3316CU**	FR945	2289	280B	WS62	—
500	**V48M28T5516CU**	③	③	③	—	—
750	**V48M28T7716CU**	③	③	③	—	—
1000	**V48D28T1116CU**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 13. 480 delta primary volts, 240 delta with 120 V center tap secondary volts, 150 °C temperature rise, 60 H

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**V48M22T1516CU**	FR939	255	282B	WS57	WMB05
30	**V48M22T3016CU**	FR940	419	282B	WS58	WMB05
45	**V48M22T4516CU**	FR940	463	282B	WS58	WMB05
75	**V48M22T7516CU**	FR942	640	282B	WS59	WMB04
112.5	**V48M22T1216CU**	FR943	1254	282B	WS60	WMB04
150	**V48M22T4916CU**	FR943	1404	282B	WS60	WMB04
225	**V48M22T2216CU**	FR944	1813	282B	WS61	—
300	**V48M22T3316CU**	FR945	2266	282B	WS62	—
500	**V48M22T5516CU**	③	③	③	—	—
750	**V48M22T7716CU**	③	③	③	—	—
1000	**V48D22T1116CU**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 14. 480 delta primary volts, 480Y/277 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**V48M47T1516CU**	FR939	231	280B	WS57	WMB05
30	**V48M47T3016CU**	FR940	415	280B	WS58	WMB05
45	**V48M47T4516CU**	FR940	457	280B	WS58	WMB05
75	**V48M47T7516CU**	FR942	673	280B	WS59	WMB04
112.5	**V48M47T1216CU**	FR943	1260	280B	WS60	WMB04
150	**V48M47T4916CU**	FR943	1415	280B	WS60	WMB04
225	**V48M47T2216CU**	FR944	1760	280B	WS61	—
300	**V48M47T3316CU**	FR945	2363	280B	WS62	—
500	**V48M47T5516CU**	③	③	③	—	—
750	**V48M47T7716CU**	③	③	③	—	—
1000	**V48D47T1116CU**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

K-factor 4, aluminum wound, three-phase

Table 15. 480 delta primary volts, 208Y/120 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**H48M28T1516**	FR940	407	283B	WS58	WMB05
30	**H48M28T3016**	FR940	437	283B	WS58	WMB05
45	**H48M28T4516**	FR940	439	283B	WS58	WMB05
75	**H48M28T7516**	FR942	599	283B	WS59	WMB04
112.5	**H48M28T1216**	FR943	987	283B	WS60	WMB04
150	**H48M28T4916**	FR944	1637	283B	—	—
225	**H48M28T2216**	FR944	1642	283B	—	—
300	**H48M28T3316**	FR945	2394	283B	—	—
500	**H48M28T5516**	③	③	③	—	—
750	**H48M28T7716**	③	③	③	—	—
1000	**H48D28T1116**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 16. 480 delta primary volts, 240 delta with 120 V center tap secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**H48M22T1516**	FR940	407	284B	WS58	WMB05
30	**H48M22T3016**	FR940	437	284B	WS58	WMB05
45	**H48M22T4516**	FR940	439	284B	WS58	WMB05
75	**H48M22T7516**	FR942	599	284B	WS59	WMB04
112.5	**H48M22T1216**	FR943	987	284B	WS60	WMB04
150	**H48M22T4916**	FR944	1637	284B	—	—
225	**H48M22T2216**	FR944	1642	284B	—	—
300	**H48M22T3316**	FR945	2394	284B	—	—
500	**H48M22T5516**	③	③	③	—	—
750	**H48M22T7716**	③	③	③	—	—
1000	**H48D22T1116**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 17. 480 delta primary volts, 480Y/277 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**H48M47T1516**	FR940	407	283B	WS58	WMB05
30	**H48M47T3016**	FR940	437	283B	WS58	WMB05
45	**H48M47T4516**	FR940	439	283B	WS58	WMB05
75	**H48M47T7516**	FR942	599	283B	WS59	WMB04
112.5	**H48M47T1216**	FR943	987	283B	WS60	WMB04
150	**H48M47T4916**	FR944	1637	283B	—	—
225	**H48M47T2216**	FR944	1642	283B	—	—
300	**H48M47T3316**	FR945	2394	283B	—	—
500	**H48M47T5516**	③	③	③	—	—
750	**H48M47T7716**	③	③	③	—	—
1000	**H48D47T1116**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

K-factor 4, copper wound, three-phase

Table 18. 480 delta primary volts, 208Y/120 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**H48M28T1516CU**	FR940	418	283B	WS58	WMB05
30	**H48M28T3016CU**	FR940	458	283B	WS58	WMB05
45	**H48M28T4516CU**	FR942	677	283B	WS59	WMB04
75	**H48M28T7516CU**	FR943	1274	283B	WS60	WMB04
112.5	**H48M28T1216CU**	FR943	1818	283B	WS60	WMB04
150	**H48M28T4916CU**	FR944	1883	283B	—	—
225	**H48M28T2216CU**	FR945	2674	283B	—	—
300	**H48M28T3316CU**	FR945	2845	283B	—	—
500	**H48M28T5516CU**	③	③	③	—	—
750	**H48M28T7716CU**	③	③	③	—	—
1000	**H48D28T1116CU**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 19. 480 delta primary volts, 240 delta with 120 V center tap secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**H48M22T1516CU**	FR940	418	284B	WS58	WMB05
30	**H48M22T3016CU**	FR940	458	284B	WS58	WMB05
45	**H48M22T4516CU**	FR942	677	284B	WS59	WMB04
75	**H48M22T7516CU**	FR943	1274	284B	WS60	WMB04
112.5	**H48M22T1216CU**	FR943	1818	284B	WS60	WMB04
150	**H48M22T4916CU**	FR944	1883	284B	—	—
225	**H48M22T2216CU**	FR945	2674	284B	—	—
300	**H48M22T3316CU**	FR945	2845	284B	—	—
500	**H48M22T5516CU**	③	③	③	—	—
750	**H48M22T7716CU**	③	③	③	—	—
1000	**H48D22T1116CU**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 20. 480 delta primary volts, 480Y/277 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**H48M47T1516CU**	FR940	418	283B	WS58	WMB05
30	**H48M47T3016CU**	FR940	458	283B	WS58	WMB05
45	**H48M47T4516CU**	FR940	485	283B	WS58	WMB05
75	**H48M47T7516CU**	FR942	1274	283B	WS59	WMB04
112.5	**H48M47T1216CU**	FR943	1448	283B	WS60	WMB04
150	**H48M47T4916CU**	FR944	1883	283B	—	—
225	**H48M47T2216CU**	FR945	2641	283B	—	—
300	**H48M47T3316CU**	FR945	2845	283B	—	—
500	**H48M47T5516CU**	③	③	③	—	—
750	**H48M47T7716CU**	③	③	③	—	—
1000	**H48D47T1116CU**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

K-factor 13, aluminum wound, three-phase

Table 21. 480 delta primary volts, 208Y/120 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**N48M28T1516**	FR940	412	283B	WS58	WMB05
30	**N48M28T3016**	FR940	416	283B	WS58	WMB05
45	**N48M28T4516**	FR942	594	283B	WS59	WMB04
75	**N48M28T7516**	FR943	1012	283B	WS60	WMB04
112.5	**N48M28T1216**	FR943	1297	283B	WS60	WMB04
150	**N48M28T4916**	FR944	1425	283B	—	—
225	**N48M28T2216**	FR945	2341	283B	—	—
300	**N48M28T3316**	③	③	③	—	—
500	**N48M28T5516**	③	③	③	—	—
750	**N48M28T7716**	③	③	③	—	—
1000	**N48D28T1116**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 22. 480 delta primary volts, 240 delta with 120 V center tap secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**N48M22T1516**	FR940	412	284B	WS58	WMB05
30	**N48M22T3016**	FR940	416	284B	WS58	WMB05
45	**N48M22T4516**	FR942	594	284B	WS59	WMB04
75	**N48M22T7516**	FR943	1012	284B	WS60	WMB04
112.5	**N48M22T1216**	FR943	1297	284B	WS60	WMB04
150	**N48M22T4916**	FR944	1425	284B	—	—
225	**N48M22T2216**	FR945	2341	284B	—	—
300	**N48M22T3316**	③	③	③	—	—
500	**N48M22T5516**	③	③	③	—	—
750	**N48M22T7716**	③	③	③	—	—
1000	**N48D22T1116**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 23. 480 delta primary volts, 480Y/277 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**N48M47T1516**	FR940	412	283B	WS58	WMB05
30	**N48M47T3016**	FR940	416	283B	WS58	WMB05
45	**N48M47T4516**	FR940	594	283B	WS58	WMB05
75	**N48M47T7516**	FR942	1012	283B	WS59	WMB04
112.5	**N48M47T1216**	FR943	1297	283B	WS60	WMB04
150	**N48M47T4916**	FR944	1425	283B	—	—
225	**N48M47T2216**	FR944	2341	283B	—	—
300	**N48M47T3316**	③	③	③	—	—
500	**N48M47T5516**	③	③	③	—	—
750	**N48M47T7716**	③	③	③	—	—
1000	**N48D47T1116**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

K-factor 13, copper wound, three-phase

Table 24. 480 delta primary volts, 208Y/120 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**N48M28T1516CU**	FR940	420	283B	WS58	WMB05
30	**N48M28T3016CU**	FR940	480	283B	WS58	WMB05
45	**N48M28T4516CU**	FR942	658	283B	WS59	WMB04
75	**N48M28T7516CU**	FR943	1115	283B	WS60	WMB04
112.5	**N48M28T1216CU**	FR943	1500	283B	WS60	WMB04
150	**N48M28T4916CU**	FR944	2132	283B	—	—
225	**N48M28T2216CU**	FR945	2628	283B	—	—
300	**N48M28T3316CU**	③	③	③	—	—
500	**N48M28T5516CU**	③	③	③	—	—
750	**N48M28T7716CU**	③	③	③	—	—
1000	**N48D28T1116CU**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 25. 480 delta primary volts, 240 delta with 120 V center tap secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**N48M22T1516CU**	FR940	420	284B	WS58	WMB05
30	**N48M22T3016CU**	FR940	480	284B	WS58	WMB05
45	**N48M22T4516CU**	FR942	658	284B	WS59	WMB04
75	**N48M22T7516CU**	FR943	1115	284B	WS60	WMB04
112.5	**N48M22T1216CU**	FR943	1500	284B	WS60	WMB04
150	**N48M22T4916CU**	FR944	2132	284B	—	—
225	**N48M22T2216CU**	FR945	2628	284B	—	—
300	**N48M22T3316CU**	③	③	③	—	—
500	**N48M22T5516CU**	③	③	③	—	—
750	**N48M22T7716CU**	③	③	③	—	—
1000	**N48D22T1116CU**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Table 26. 480 delta primary volts, 480Y/277 secondary volts, 150 °C temperature rise, 60 Hz

kVA	Catalog number	Frame ①	Weight (lb)	Wiring diagram ②	Type 3R WS	Wallmount bracket
15	**N48M47T1516CU**	FR940	420	283B	WS58	WMB05
30	**N48M47T3016CU**	FR940	480	283B	WS58	WMB05
45	**N48M47T4516CU**	FR942	658	283B	WS59	WMB04
75	**N48M47T7516CU**	FR943	1115	283B	WS60	WMB04
112.5	**N48M47T1216CU**	FR943	1500	283B	WS60	WMB04
150	**N48M47T4916CU**	FR944	2741	283B	—	—
225	**N48M47T2216CU**	FR945	3100	283B	—	—
300	**N48M47T3316CU**	③	③	③	—	—
500	**N48M47T5516CU**	③	③	③	—	—
750	**N48M47T7716CU**	③	③	③	—	—
1000	**N48D47T1116CU**	③	③	③	—	—

① Frame drawings on **page 15**.

② Wiring diagrams on **page 16** through **page 20**.

③ Contact local Eaton representative.

Enclosure drawings

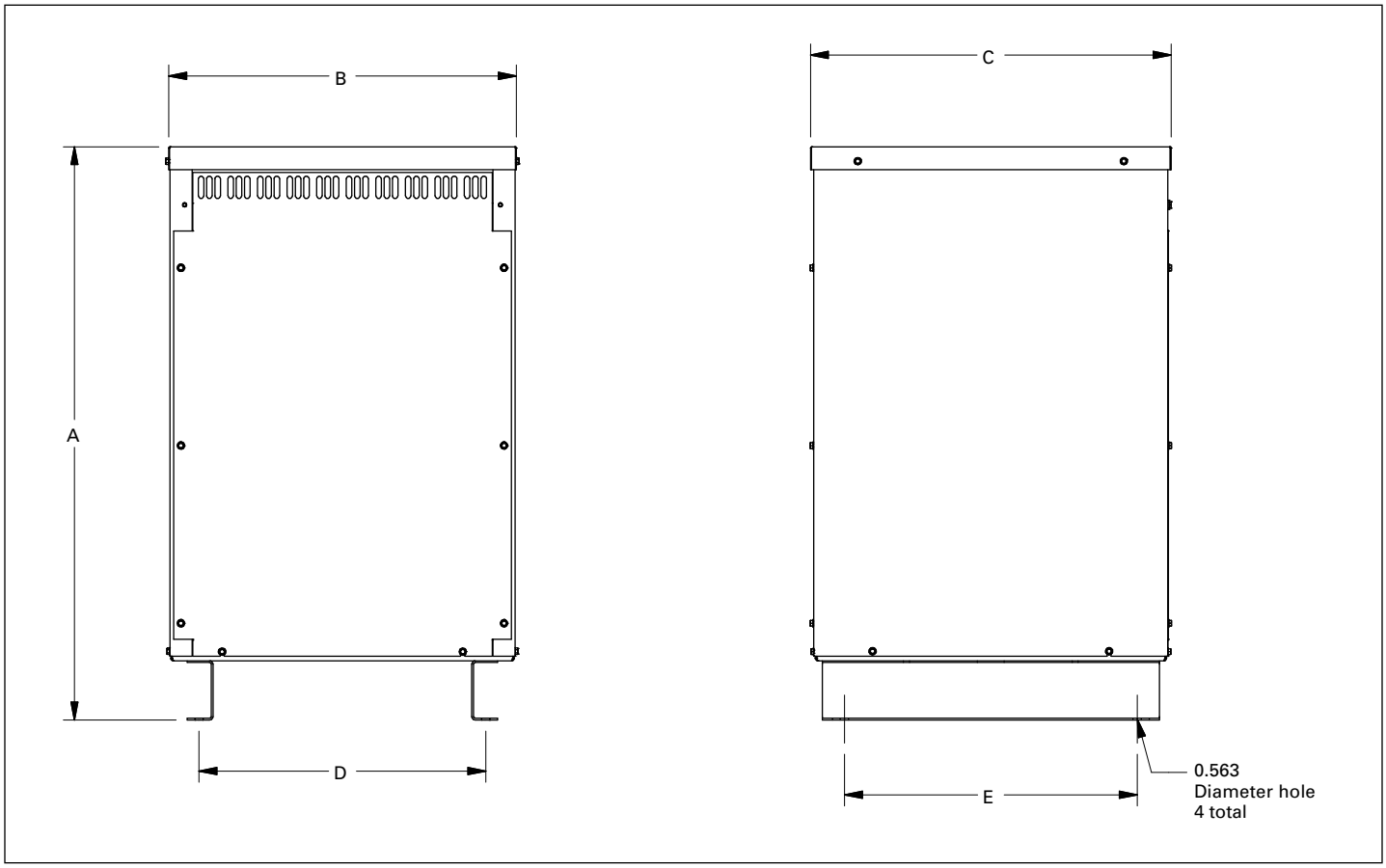


Figure 1. Single-phase enclosures—dimensions in inches (mm)

Frame	A	B	C	D	E
FR842	33.75 (857)	22.45 (570)	17.40 (442)	18.56 (471)	12.76 (324)
FR843	38.70 (983)	23.51 (597)	24.38 (619)	19.39 (493)	19.80 (503)
FR844	44.92 (1141)	26.27 (667)	27.12 (689)	23.21 (590)	22.50 (572)
FR814	62.91 (1598)	29.97 (761)	33.97 (863)	28.00 (711)	26.50 (673)
FR816	31.30 (795)	22.89 (579)	18.39 (467)	20.87 (530)	12.00 (304)

Frame	A	B	C	D	E
FR818	37.59 (955)	22.87 (581)	20.36 (517)	20.91 (531)	14.00 (355)
FR819	42.03 (1068)	24.22 (615)	23.84 (606)	22.35 (567)	19.20 (487)
FR820	42.02 (1067)	24.22 (615)	23.84 (606)	22.25 (565)	18.82 (478)
FR821	62.88 (1597)	29.97 (761)	33.97 (863)	28.00 (711)	26.50 (673)
FR814E	62.91 (1598)	29.97 (761)	33.97 (863)	28.00 (711)	26.50 (673)

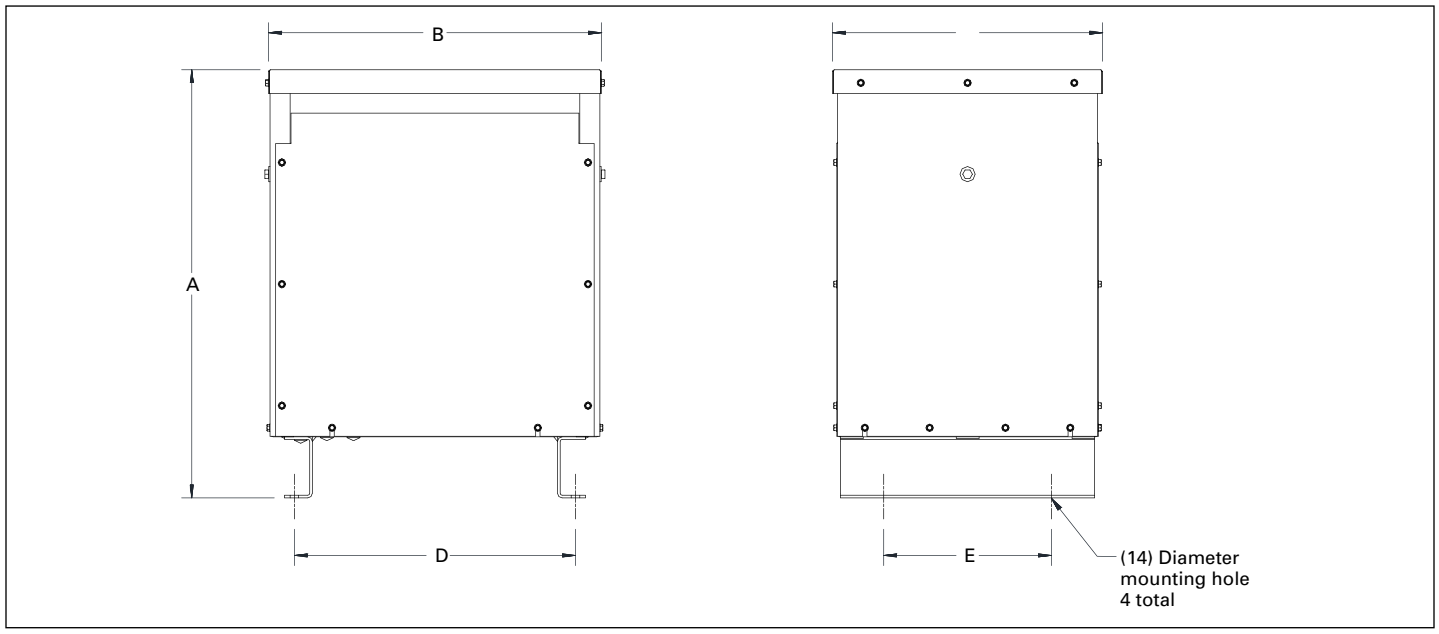


Figure 2. Three-phase enclosure FR939—dimensions in inches (mm)

Frame	A	B	C	D	E
FR939	28.00 (711)	21.88 (556)	17.75 (451)	18.44 (468)	11.00 (279)

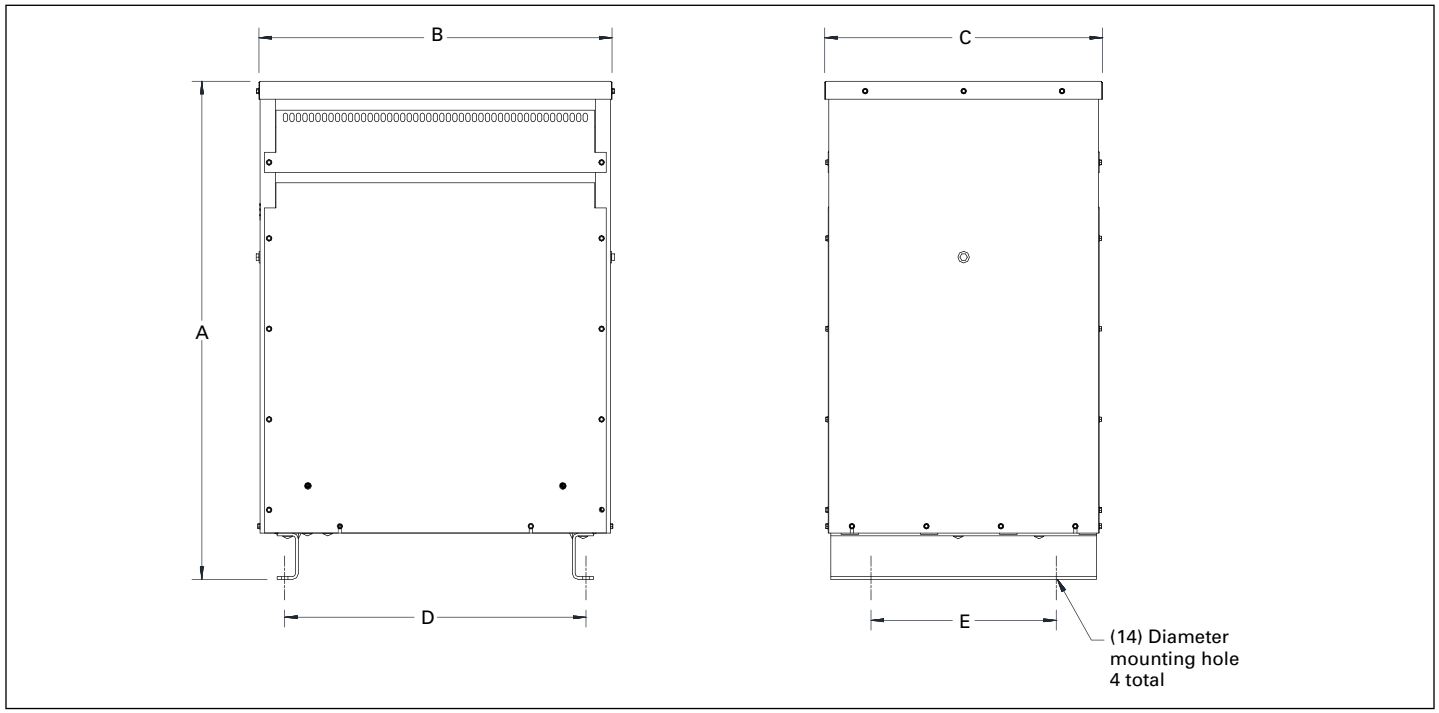


Figure 3. Three-phase enclosures FR940 to FR945—dimensions in inches (mm)

Frame	A	B	C	D	E
FR940	36.88 (937)	24.88 (6320	21.13 (537)	21.44 (545)	11.00 (279)
FR942	43.00 (1092)	30.50 (775)	24.00 (610)	26.03 (661)	16.00 (406)
FR943	51.00 (1295)	34.50 (876)	31.50 (800)	31.19 (792)	18.82 (478)
FR944	60.00 (1524)	38.00 (965)	33.70 (856)	33.83 (859)	24.88 (632)
FR945	66.18 (1681)	42.18 (1071)	33.50 (851)	35.39 (899)	24.88 (632)

Wiring diagrams

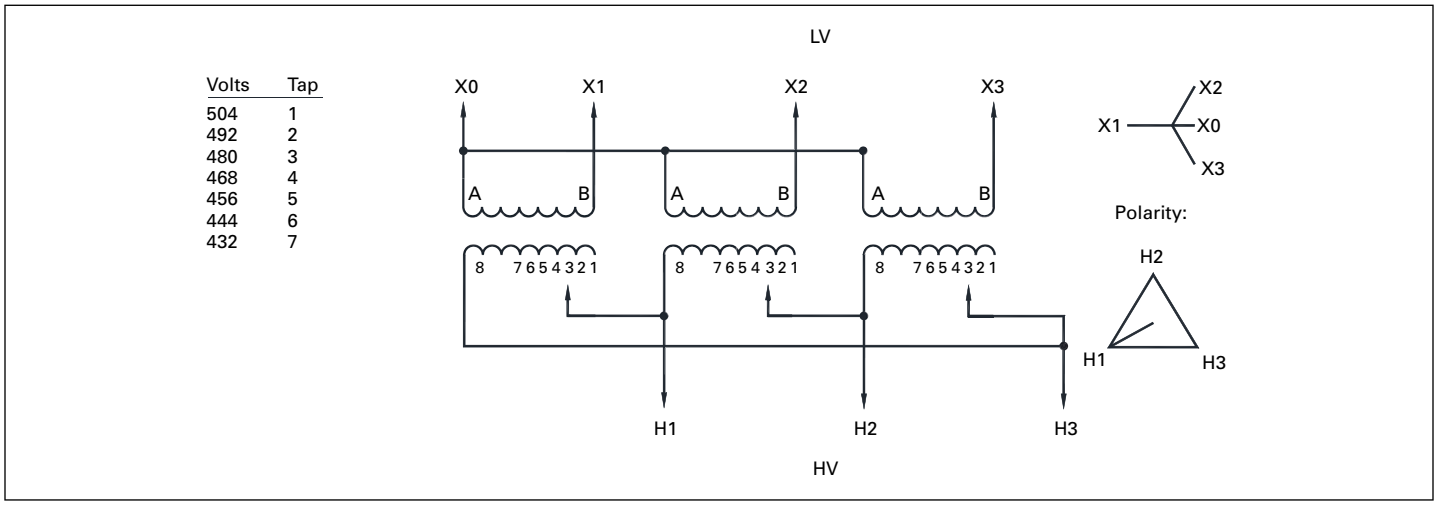


Figure 4. 280B

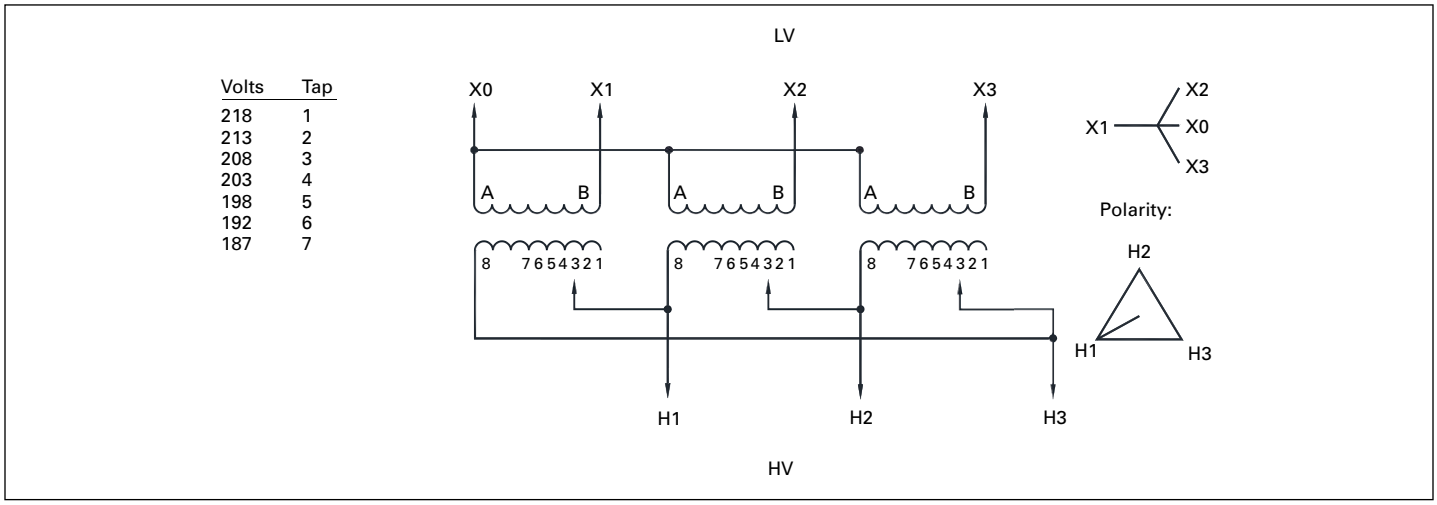


Figure 5. 280E

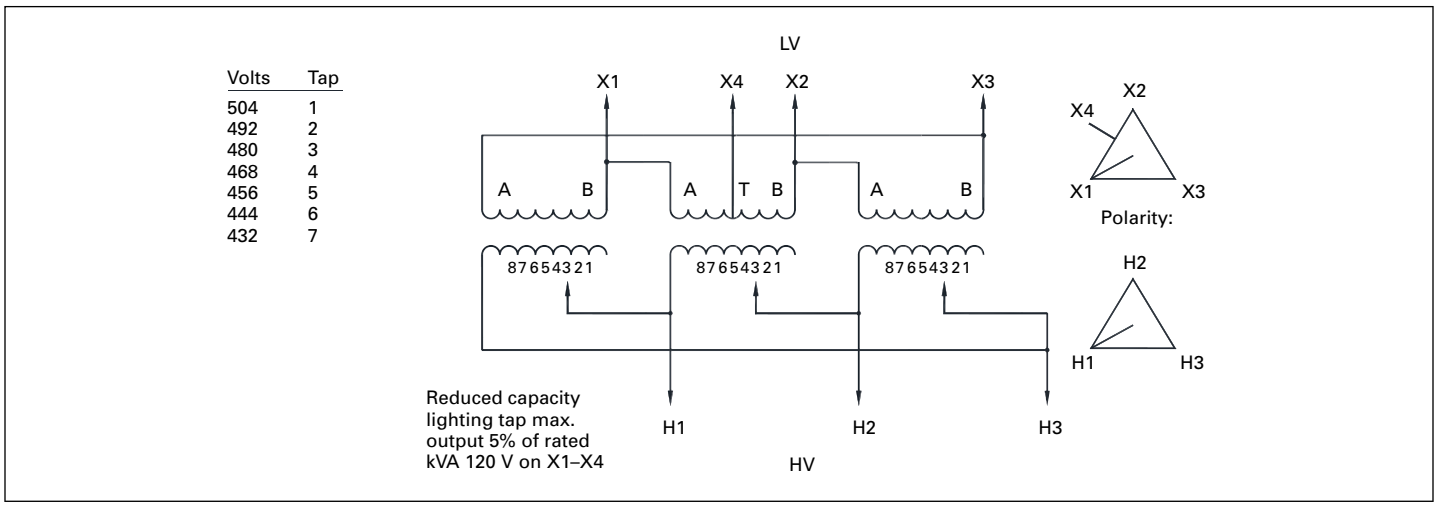


Figure 6. 282B

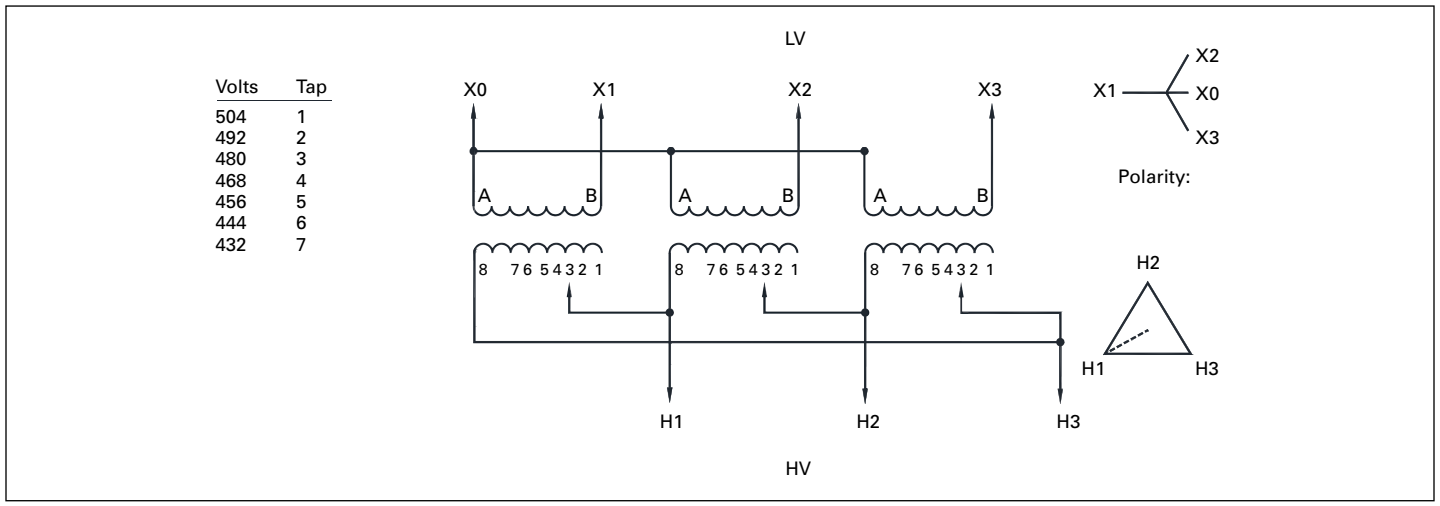


Figure 7. 283B

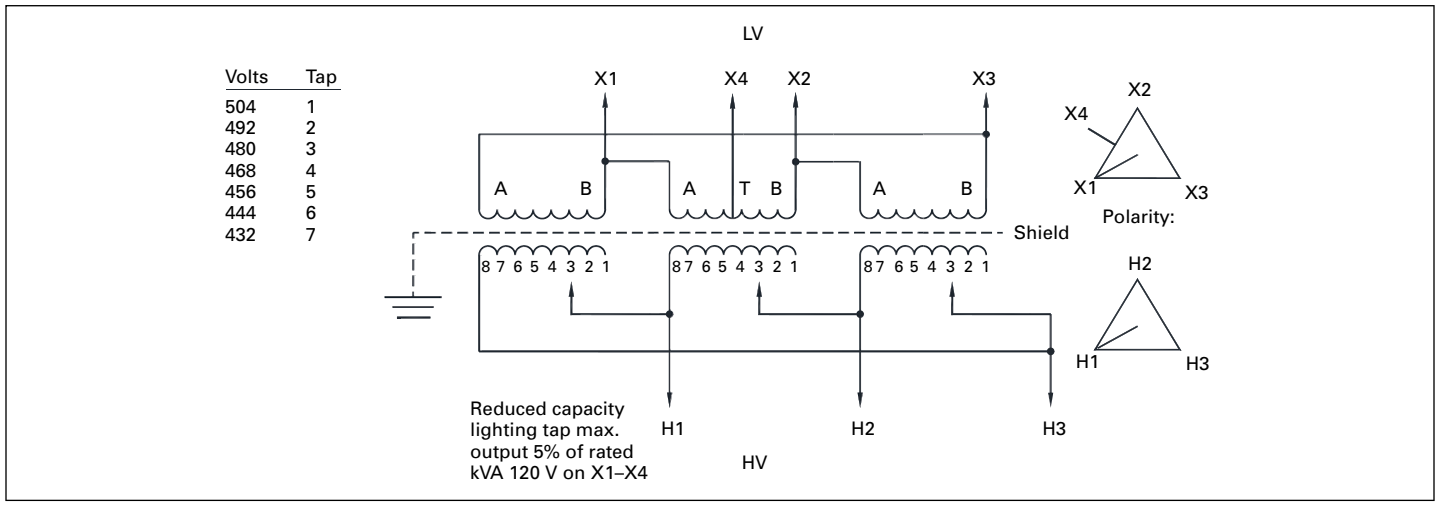


Figure 8. 284B

Volts	Connect
504	4 to 5
492	4 to 6
480	4 to 7
468	3 to 6
456	3 to 7
444	2 to 6
432	2 to 7

Secondary		
Volts	Connect	Line
240	X2 to X3	X1–X4
120	X1 to X3 X2 to X4	X1–X4
120/240 ①	X2 to X3	X1–X2–X4

① Three-wire operation.

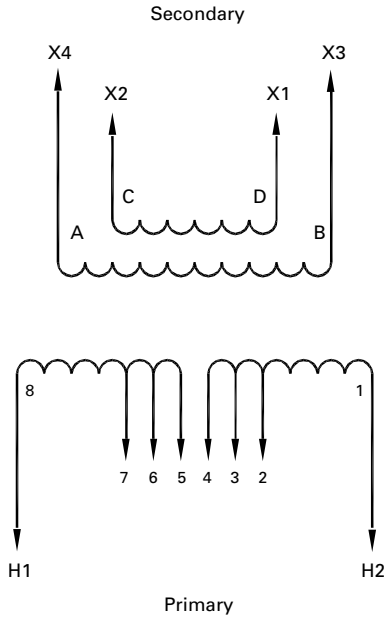


Figure 9. 288A

Volts	Connect
218	3 to 4
208	3 to 5
198	2 to 4
187	2 to 5

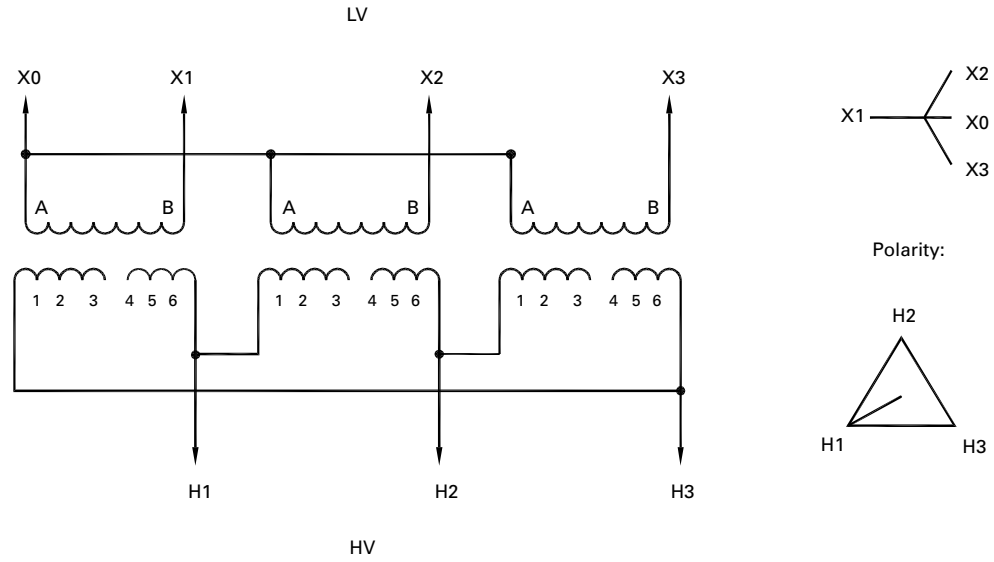


Figure 10. 289D

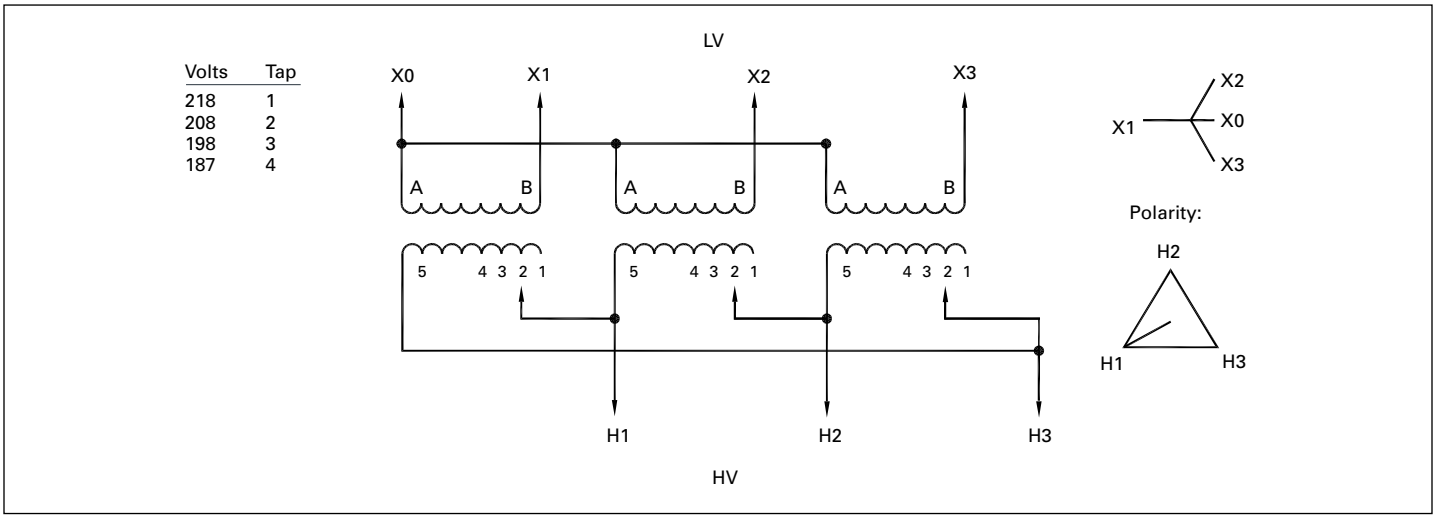


Figure 11. 324A

WDG	Volts	Connect	Line
		Use both cables provided	
Primary	504	5 to 10	H1–H2
	492	5 to 9	H1–H2
	480	4 to 9	H1–H2
	468	4 to 8	H1–H2
	456	3 to 8	H1–H2
	444	3 to 7	H1–H2
	432	2 to 7	H1–H2
		Use 1 cable per connection	
	252	5 to H2 and 10 to H1	H1–H2
	240	4 to H2 and 9 to H1	H1–H2
	228	3 to H2 and 8 to H1	H1–H2
	216	2 to H2 and 7 to H1	H1–H2
Secondary	240	X2 to X3	X1–X4
	120	X1 to X3 and X2 to X4	X1–X4
	120/240 ①	X2 to X3	X1–X3–X4

① Three-wire operation.

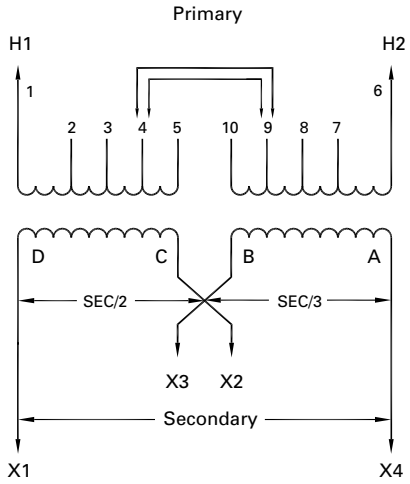


Figure 12. 3XA

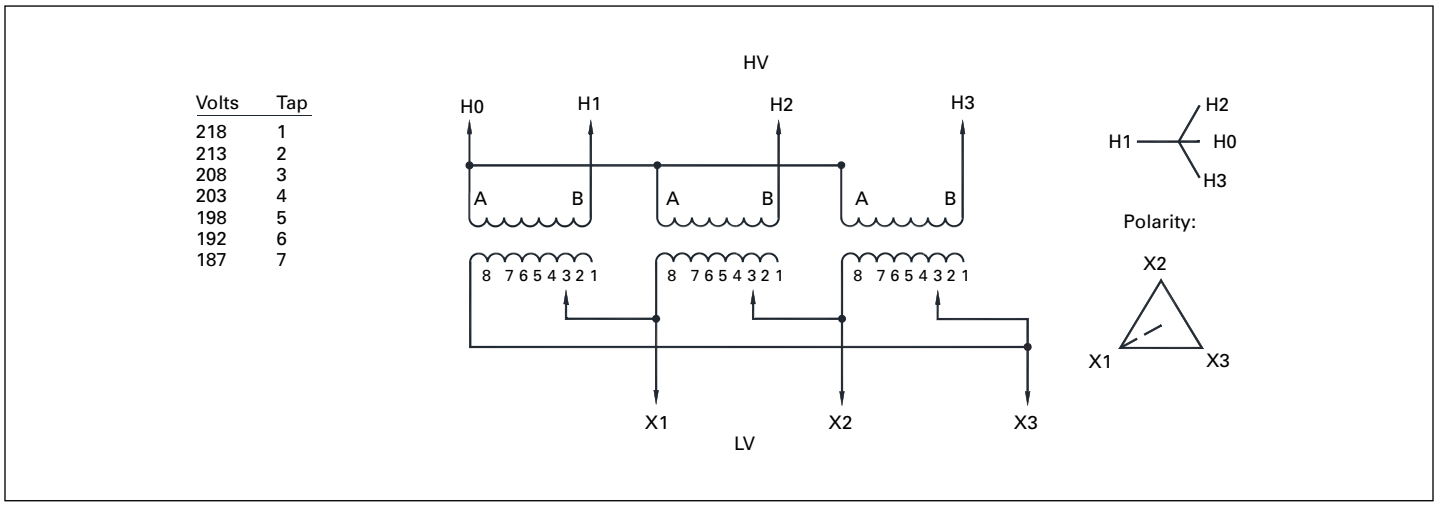


Figure 13. E0342B

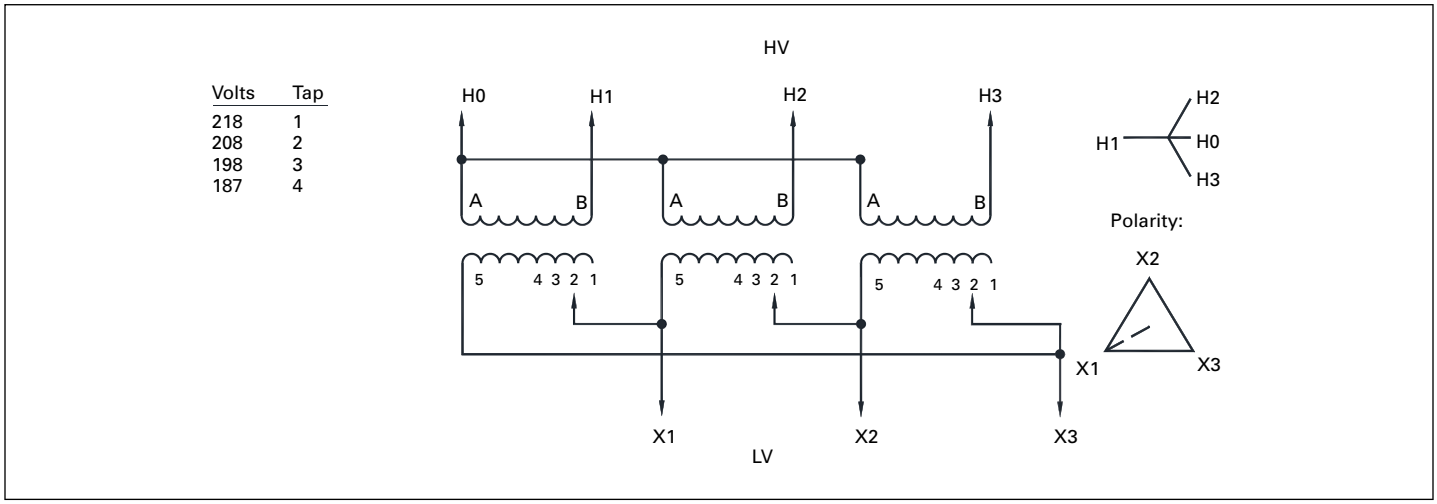


Figure 14. E0351A

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