



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

- Large 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

## 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)



## 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

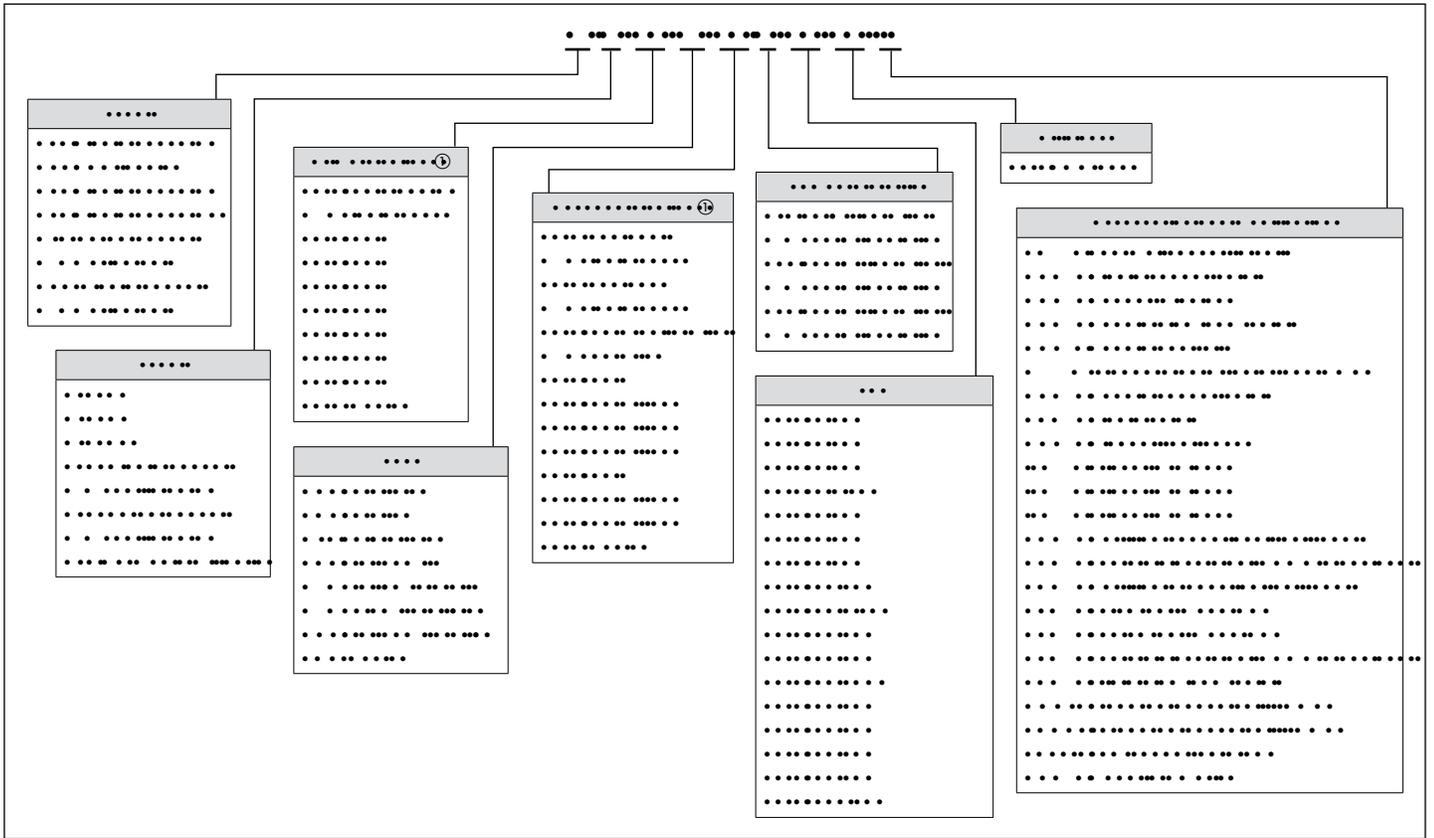
- IR viewing windows

- Primary or secondary circuit protective devices

- Custom electrostatic shielding options

- And more

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## 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

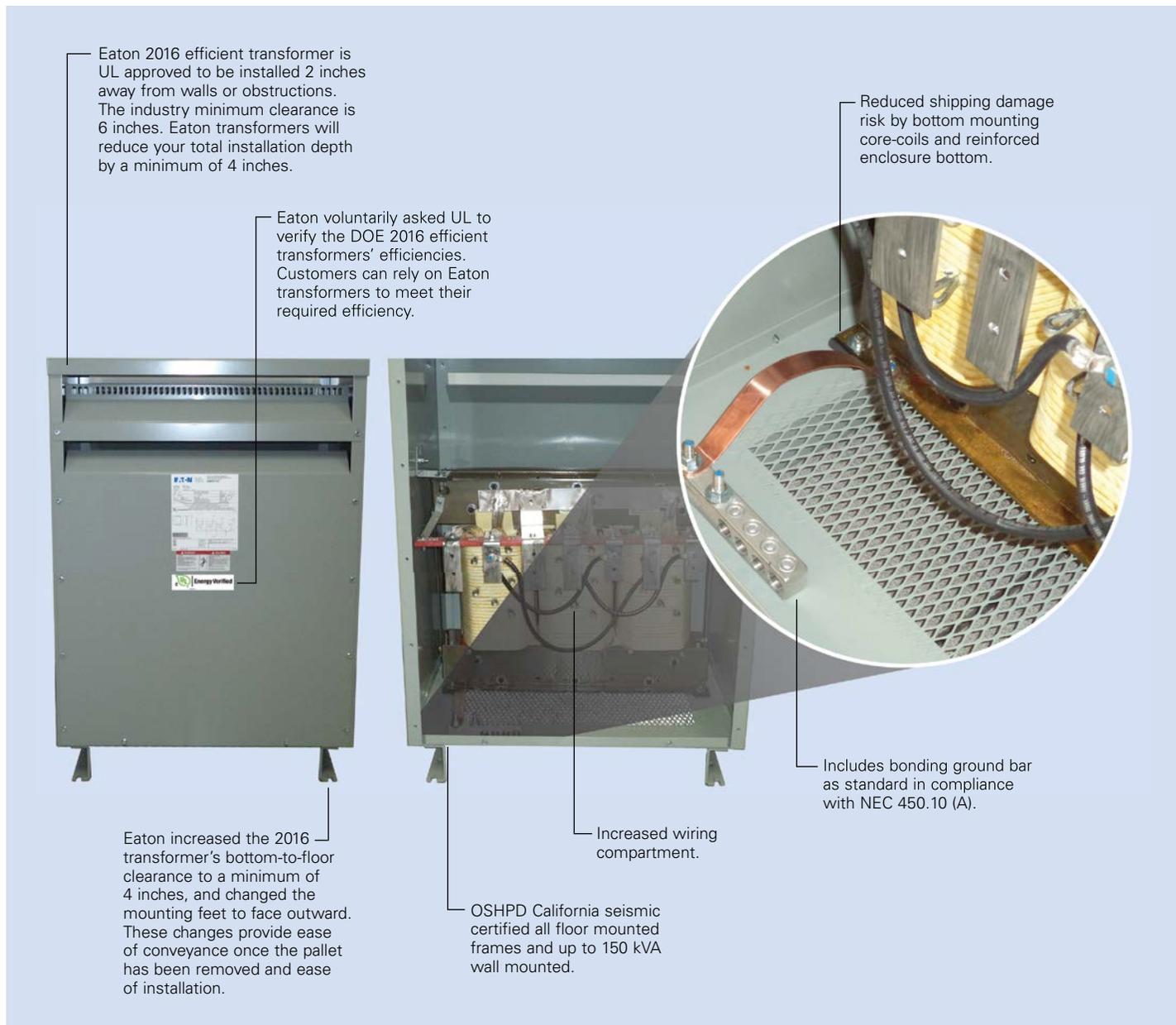
The transformer enclosure is made of heavy-gauge steel and is finished using a continuous process of degreasing, cleaning, and phosphatizing, followed by electrostatic deposition of a thermosetting polyester powder coating and subsequent baking. The coating color is ANSI 61 grey and is UL-recognized 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**

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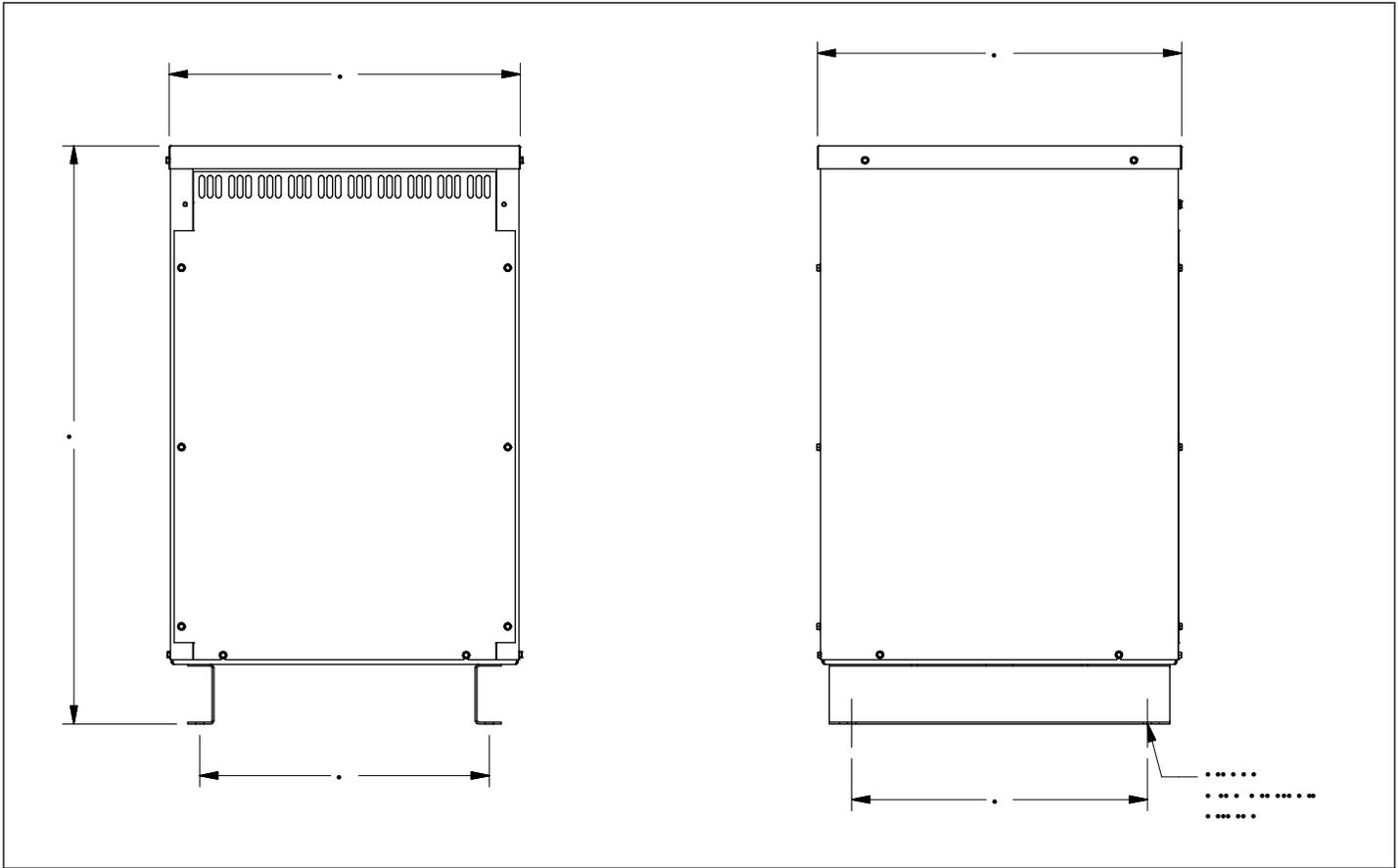
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**Enclosure drawings**

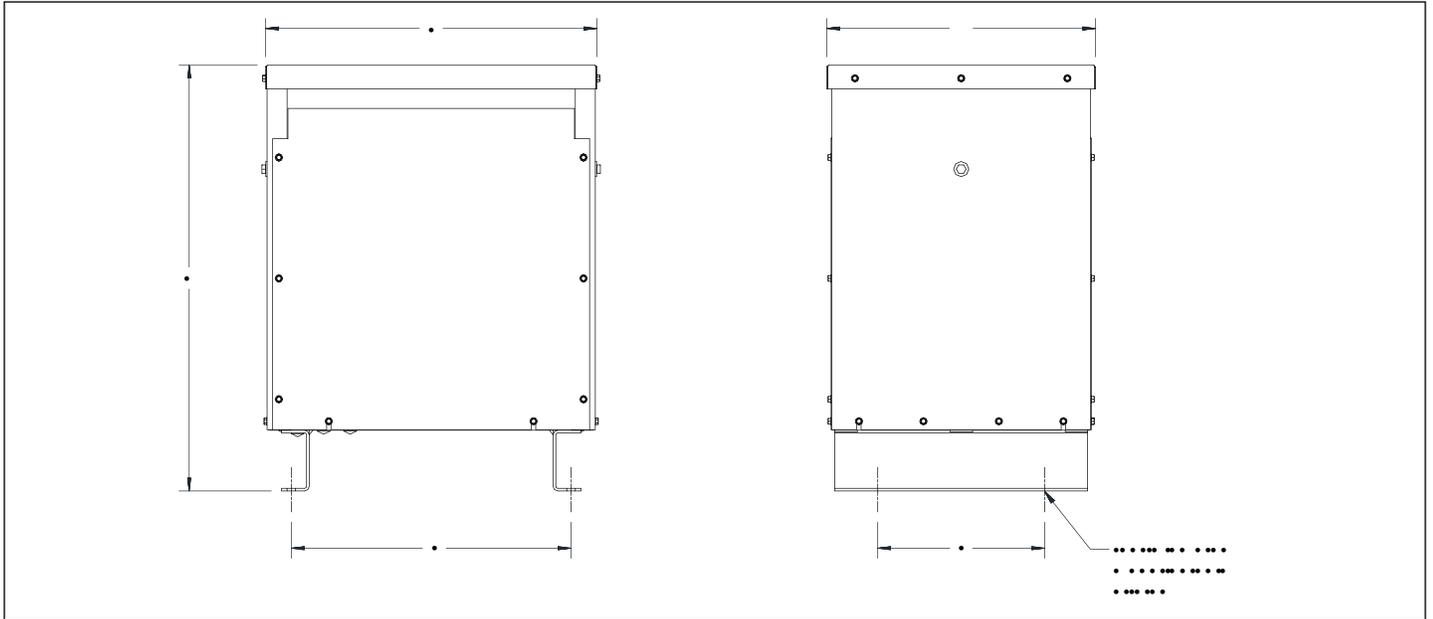


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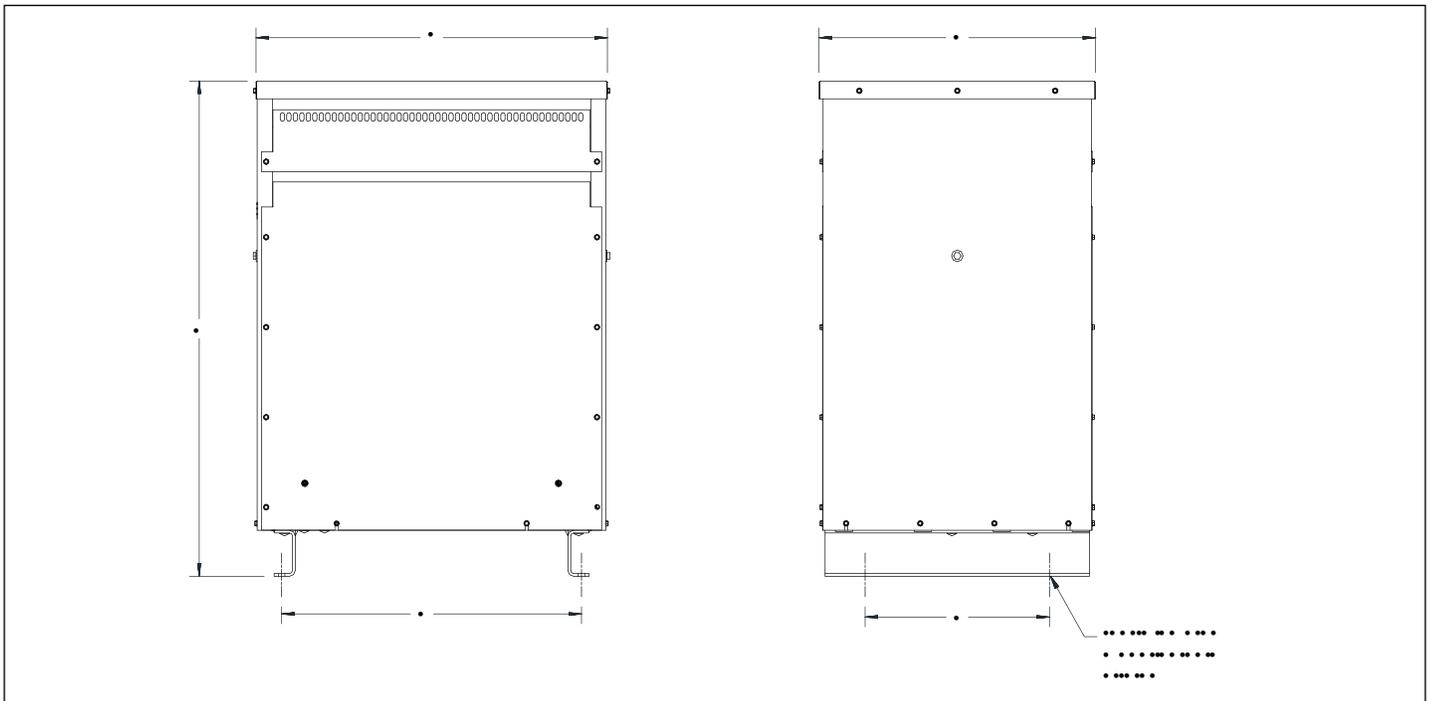
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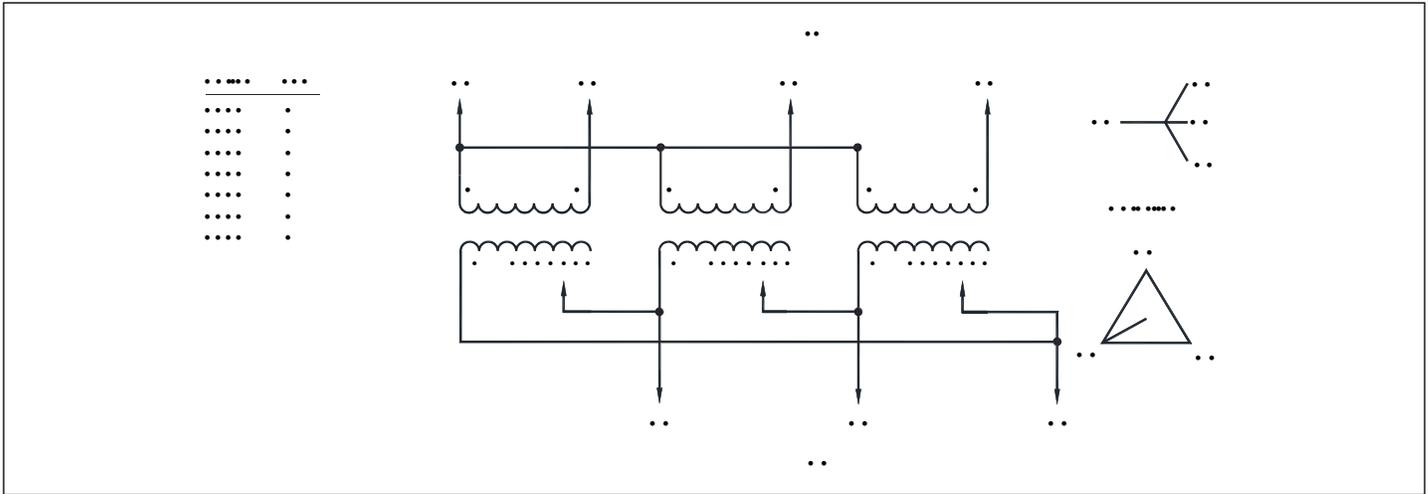


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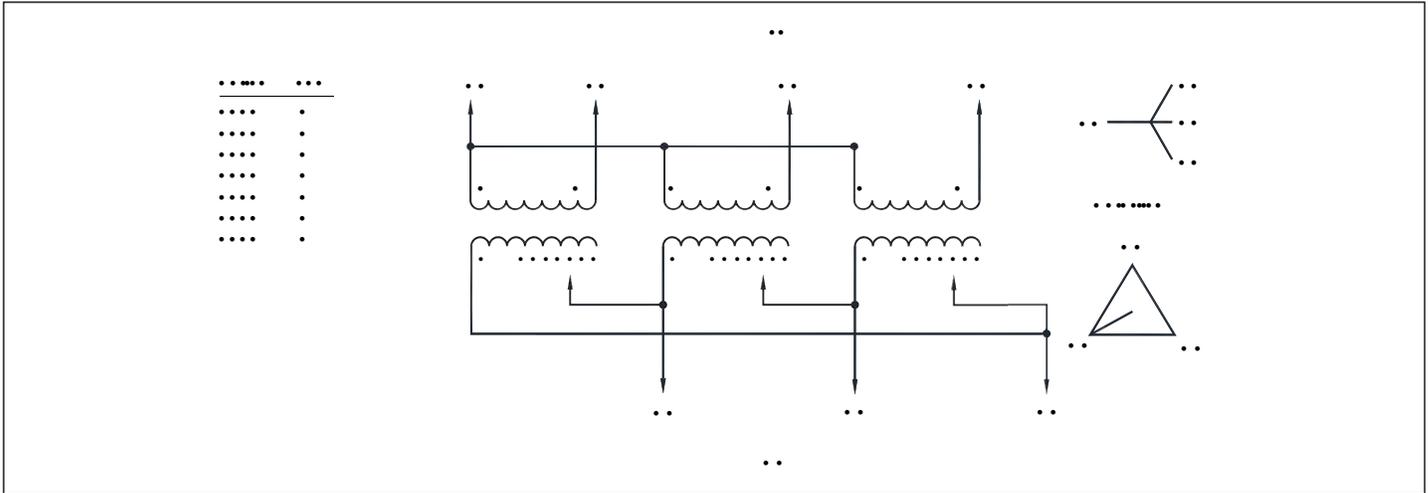


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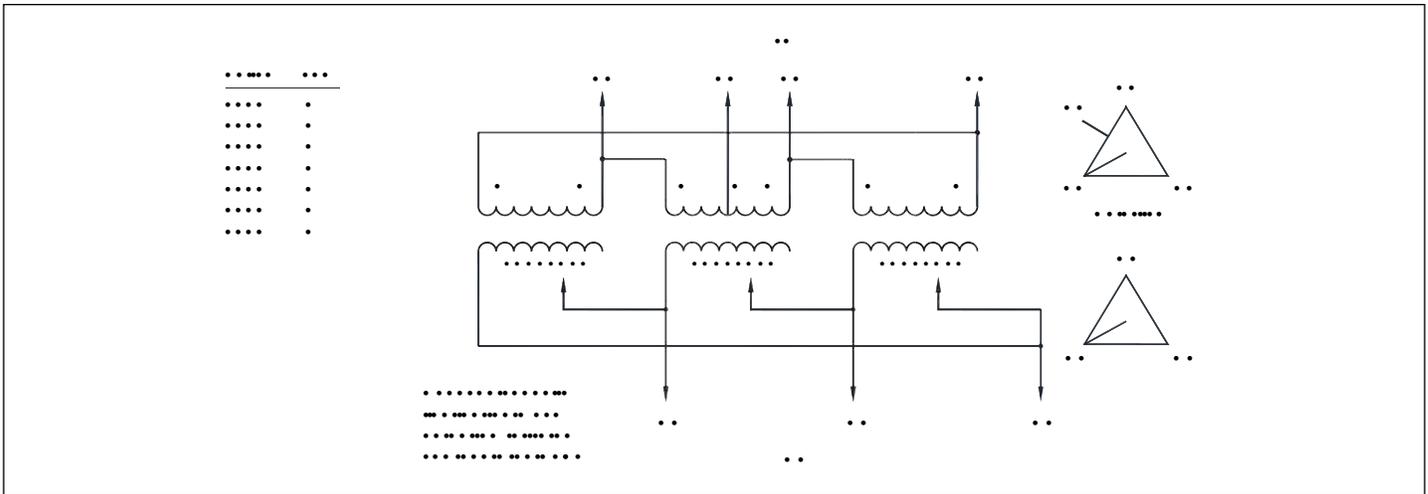
### Wiring diagrams



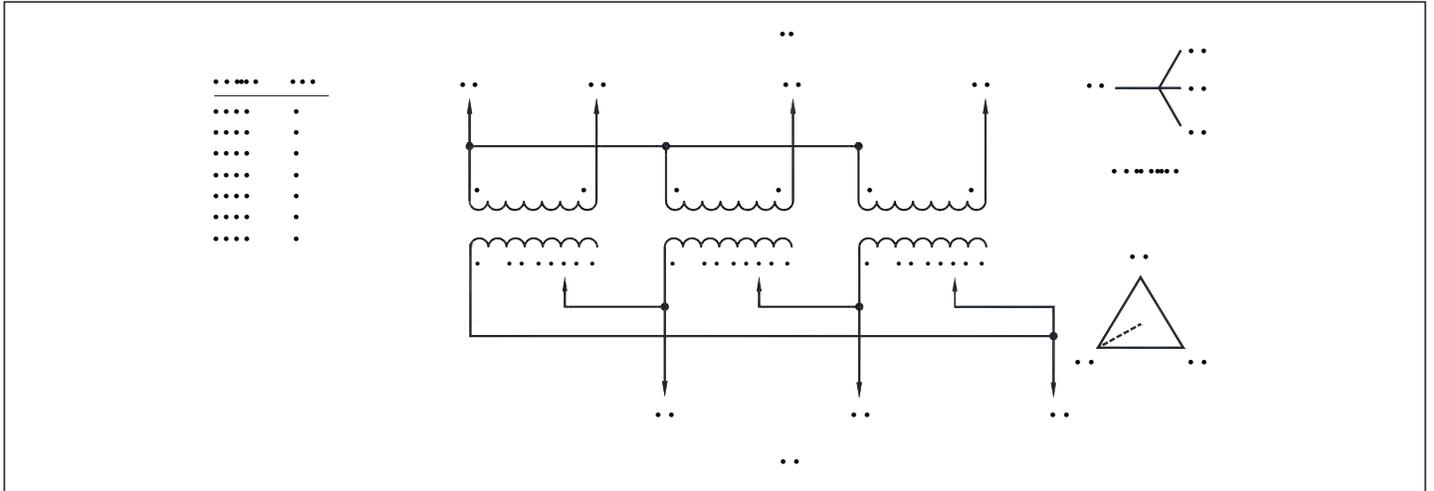
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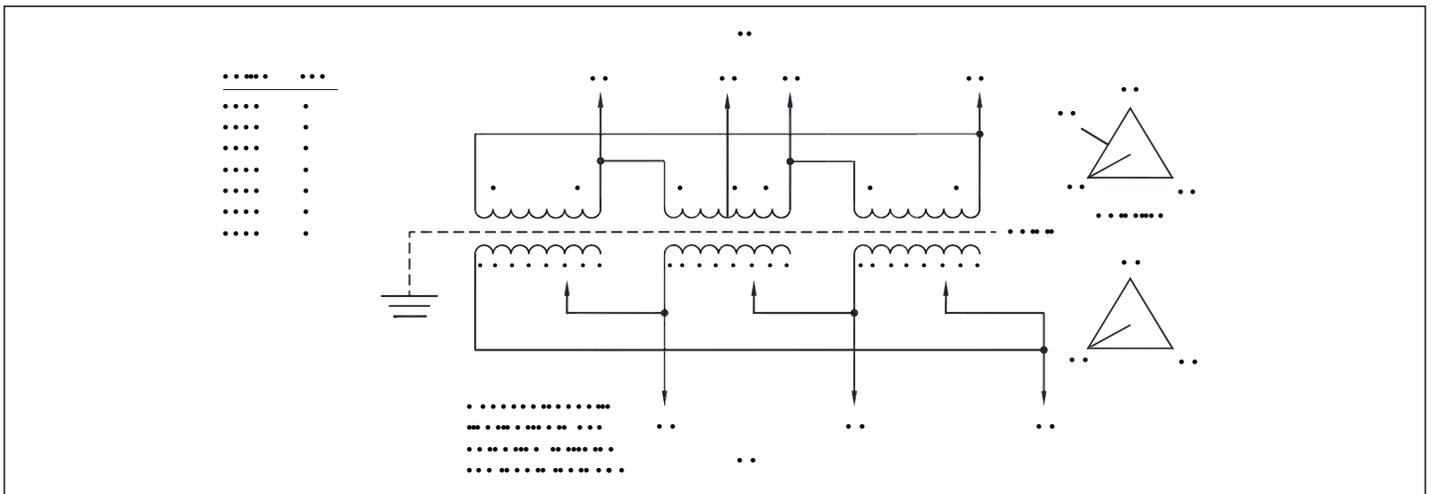
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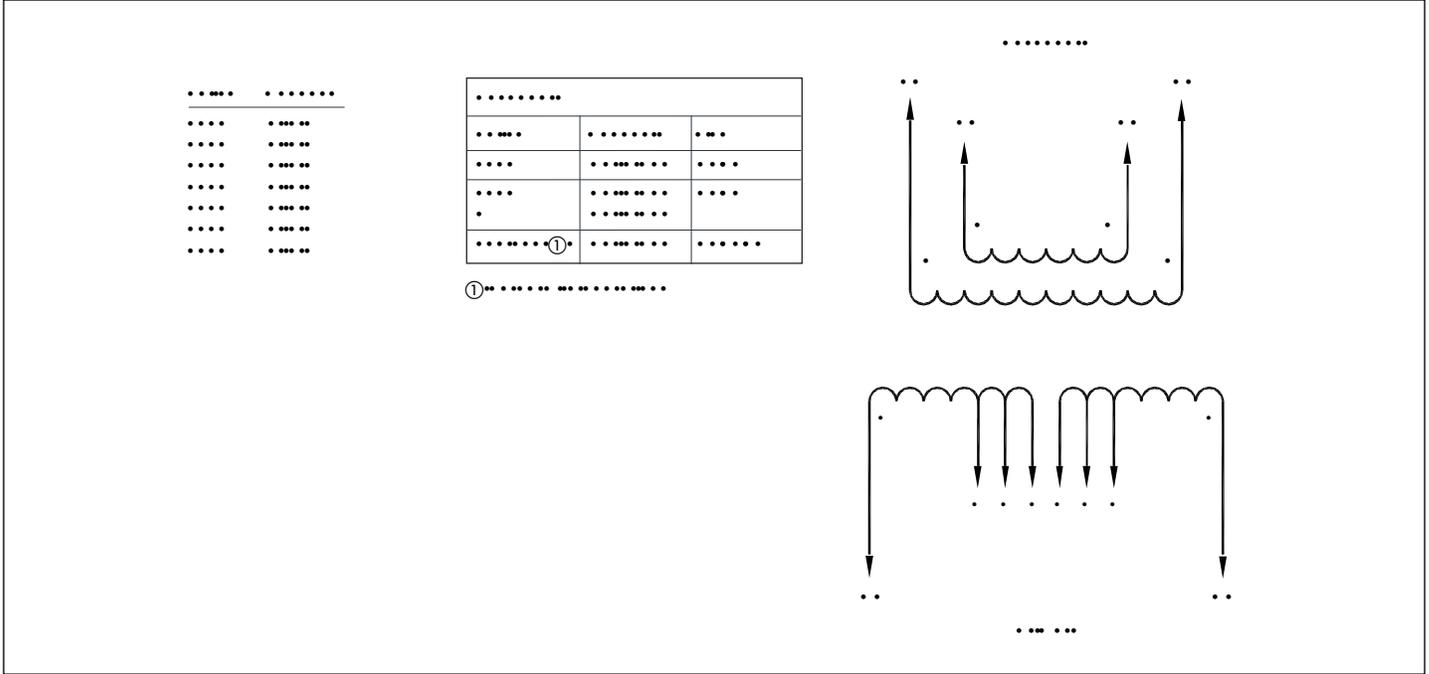
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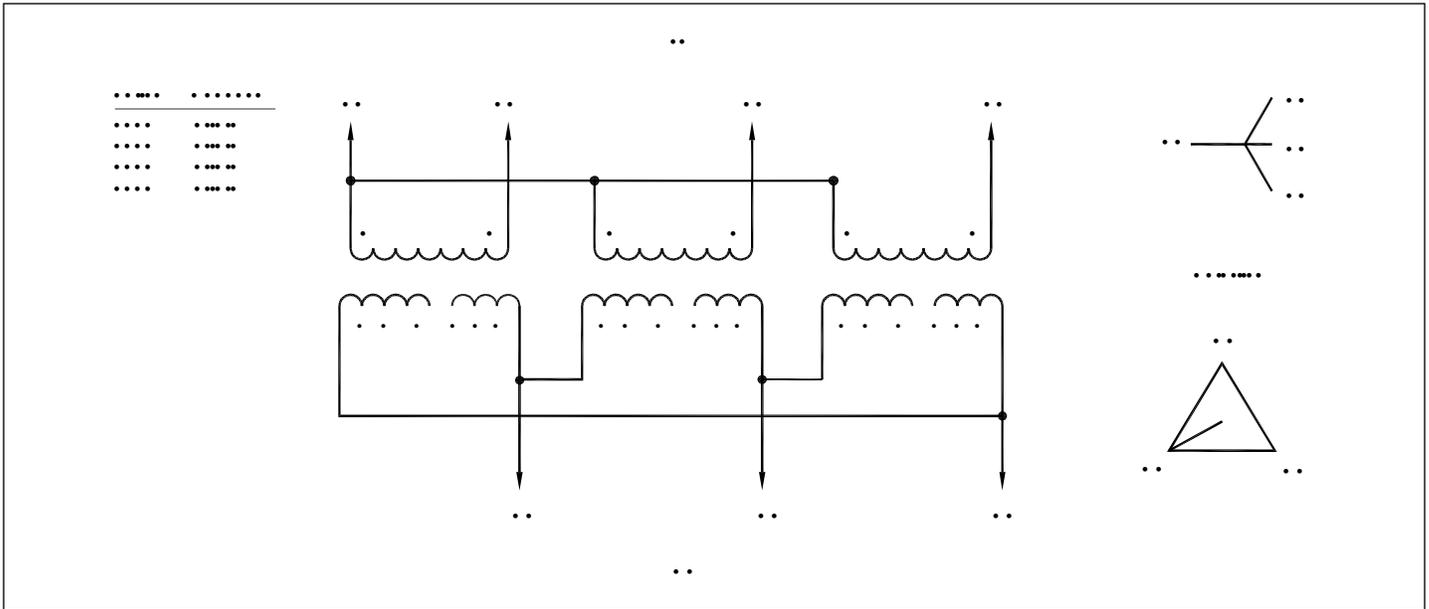
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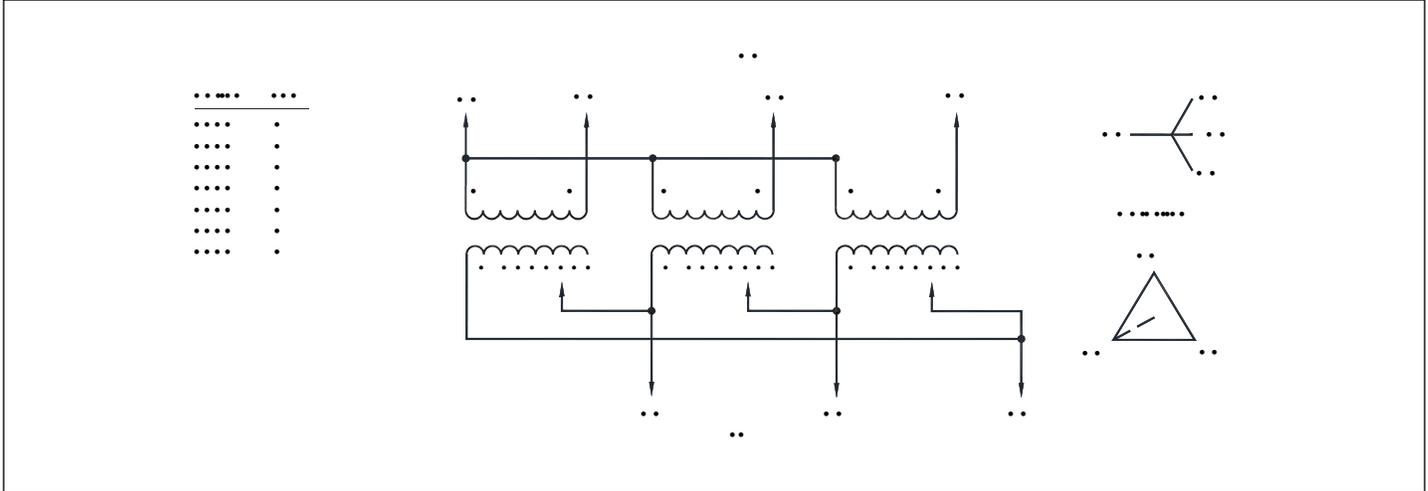


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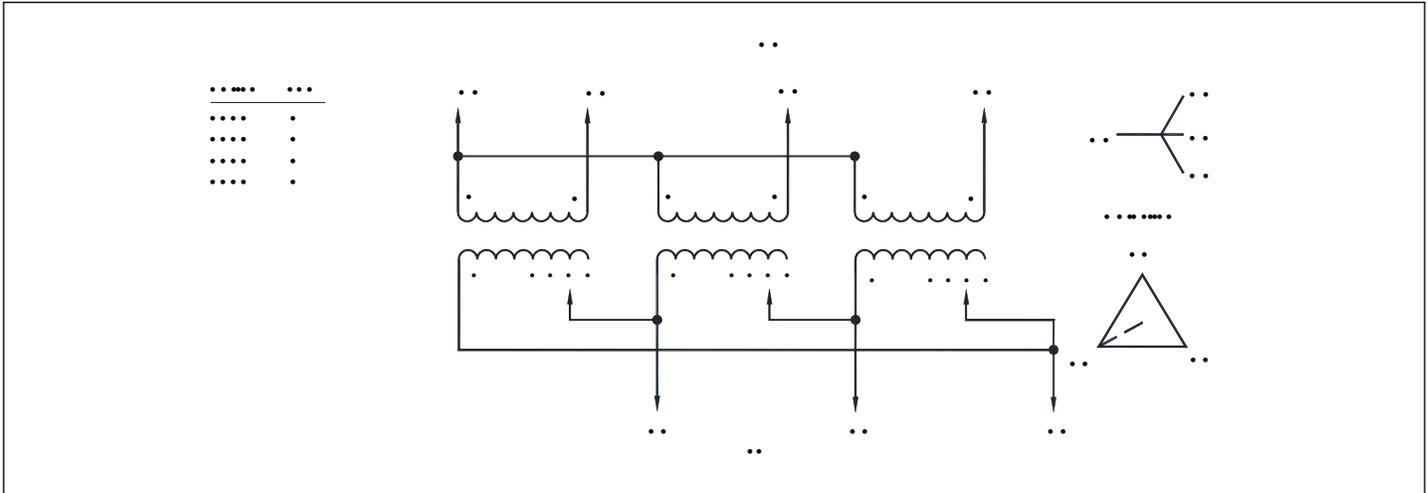


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