8

15 to 500 KVA

Contents

Version JE901 0809 Date Sept 08

Non-Linear Three-Phase – Jefferson® Plus

Products

- *15 KVA through 500 KVA**

Applications

- *For electronic loads to meet non-linear load demands caused by modern office equipment*
- *For indoor/outdoor applications*

Specifications

- *K-4, K-13, and K-20 rated units standard**
- *Meets Federally Mandated NEMA TP-1 Standard for energy efficiency*
- *Cores of high quality electrical steel*
- *Cores designed for reduced flux densities to compensate for harmonic voltage distortion*
- *NEMA 1-rated enclosures standard*
- *Aluminum or copper windings*
- *Electrostatically shielded*
- *220ºC insulation class standard*
- *150ºC, 115°C, and 80°C temperature rise*
- *Heat-cured ASA-61 gray powder coat finish*

Features, Functions, Benefits

- *Designed with lower weight and smaller size for easier handling and installation*
- *Large connection compartment for ease of wiring and installation*
- *Quiet operation for installation flexibility*
- *Hassle-free front cover installation*
- *Taps provided on primary to compensate for voltage variations*

Standards

- *Built in accordance with NEMA, ANSI, UL and CSA standards*

*Options and Accessories

- *CE Marked units available*
- *Other sizes, voltages, and connections available as custom*
- *Other K-factor rated units available as custom*
- *NEMA 3R-rated weather shields available*
- *Wall mount brackets available*

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Transformers for today's electronic environment

These transformers are designed to meet the non-linear load demands caused by computers and other modern electronic equipment. These types of loads can cause severe overheating in distribution transformers designed to meet the needs of a pre-electronic era. The Jefferson® Plus™ line of non-linear transformers provides safe and efficient operation in non-linear load environments.

The K-factor

The K-factor is a rating devised by Underwriters Laboratories to provide uniform standards for transformers designed to handle non-linear loads. The more odd-harmonic currents present, the higher the K-factor specified in sizing the transformer.

To calculate the K-factor, multiply the square of the percentage of harmonic current by the square of the harmonic order and add the results. For example, if a load is 60% of the fundamental, 65% of the third harmonic, 30% of the fifth harmonic, and 35% of the seventh harmonic, the resulting K-factor would be 12.42:

$(.6)^2\ 1 + (.65)^2(3)^2 + (.30)^2(5)^2 + (.35)^2(7)^2 = 12.42$

In this example, a transformer with a K-factor of 13 should be specified. The K-factor rating defines the transformer's ability to withstand odd-harmonic currents while operating within its insulation class.

When the K-factor is unknown, a transformer may be selected by using the table to the right as a guide.

K-FACTOR	TYPE OF LOAD
K-1	Resistance heating Incandescent lighting Motors Transformers • Control • Distribution
K-4	Welders Induction heaters HID lighting Fluorescent lighting Solid state controls
K-13	Telecommunications equipment Branch circuits in classrooms and healthcare facilities
K-20	Mainframe computers Variable speed drives Branch circuits with exclusive loads of data processing equipment

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Non-Linear Three-Phase – Jefferson® Plus

Why Your Existing Transformer May Be Inadequate

Traditional transformers were designed to handle the purely resistive electrical loads created mainly by standard lighting and motors. The currents drawn by these loads are sinusoidal in shape, as is the waveshape of the supply voltage. When the loads are linear and balanced as in a typical three-phase system, the neutral current flow is zero. This is because the three-phase currents are 120 degrees out of phase with each other and cancel in the neutral. The sinusoidal current waveshape is the foundation for wire-size calculations, for determining how to balance loads to reduce neutral currents, and for subsequently reducing the size of neutral conductors to reduce material costs.

The Phenomenon of Odd Harmonics

The switched mode power supply (SMPS) current drawn by electronic equipment bears little resemblance to the current drawn by purely resistive loads. Instead of the traditional sinusoidal waveform, SMPS current waveforms occur in sharp bursts. This irregularity of the SMPS waveform produces a non-linear load as opposed to the linear load produced by the sinusoidal waveform. Non-linear loads on the other hand, are rich in odd harmonics, which are multiples of the fundamental 60 Hertz frequency. The major components of harmonic currents in switched mode power supplies are the third and fifth harmonics. Non-linear, off-harmonic current components become additive in the neutral and can result in a neutral current as much as double the phase current, even in a balanced system.

How Harmonics Affect Transformers

When these odd-harmonic currents are present, winding losses increase. The I^2R or conductor losses are higher because harmonics increase the current. Stray losses in windings also increase because of additional eddy currents circulating within the conductors. The combination of these additional losses generate excessive heat in the transformer coils. Transformer insulation systems are designed to accommodate temperature increases due to normal stray losses. However, when required to carry non-linear loads, the heat generated exceeds the designed rating, reducing the life of the transformer and creating the possibility of premature failure.

De-rating is Not the Answer

De-rating a traditional linear transformer to compensate for heat build-up requires higher installation costs, provides poor energy efficiency due to increased core losses, and leaves a system that will become increasingly obsolete.

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K-4 Three-Phase

150°C Temperature Rise • Electrostatic Shield

Taps: 15 to 112.5 KVA 2@ 2.5% FCAN & 4@ 2.5% FCBN
150 to 300 KVA 1@ 5% FCAN & 2@ 5% FCBN

KVA	Catalog Number*	Fig.	Height A (in.)	Width B (in.)	Depth C (in.)	Est. Ship Wgt. (lbs.)	Wiring Diagram	Weather Shield Kit	Wall Bracket Kit
208 V - 208Y/120 V – Aluminum windings*									
15	424-7168-001	7	22.0	19.0	16.0	295	T208B	423-0007-019	223-7008-030
30	424-7198-001	7	25.0	22.0	17.0	385		423-0007-022	223-7008-075
45	424-7218-001	7	28.0	25.0	18.5	565		423-0007-025	
75	424-7238-001	7	32.0	27.0	21.0	750		423-0007-027	
112.5	424-7258-001	7	38.0	29.0	23.0	960		423-0007-029	N/A
150	424-7268-001	7	42.0	33.0	26.0	1280	T208F	423-0007-033	
225	424-7298-001	7	46.0	35.0	30.0	1645		423-0007-035	
300	424-7318-001	7	52.0	35.0	30.0	1660		423-0007-035	
500	424-7348-001	7	60.0	48.0	33.0	2460		423-0007-048	
208 V - 480Y/277 V – Aluminum windings*									
15	424-7161-001	7	22.0	19.0	16.0	295	T208D	423-0007-019	223-7008-030
30	424-7191-001	7	25.0	22.0	17.0	385		423-0007-022	223-7008-075
45	424-7211-001	7	28.0	25.0	18.5	565		423-0007-025	
75	424-7231-001	7	32.0	27.0	21.0	750		423-0007-027	
112.5	424-7251-001	7	38.0	29.0	23.0	960		423-0007-029	N/A
150	424-7261-001	7	42.0	33.0	26.0	1280	T208G	423-0007-033	
225	424-7291-001	7	46.0	35.0	30.0	1645		423-0007-035	
300	424-7311-001	7	52.0	35.0	30.0	1660		423-0007-035	
500	424-7341-001	7	60.0	48.0	33.0	2460		423-0007-048	
240 V - 208Y/120 V – Aluminum windings*									
15	424-7162-001	7	22.0	19.0	16.0	295	T240B	423-0007-019	223-7008-030
30	424-7192-001	7	25.0	22.0	17.0	385		423-0007-022	223-7008-075
45	424-7212-001	7	28.0	25.0	18.5	565		423-0007-025	
75	424-7232-001	7	32.0	27.0	21.0	750		423-0007-027	
112.5	424-7252-001	7	38.0	29.0	23.0	960		423-0007-029	N/A
150	424-7262-001	7	42.0	33.0	26.0	1280	T240F	423-0007-033	
225	424-7292-001	7	46.0	35.0	30.0	1645		423-0007-035	
300	424-7312-001	7	52.0	35.0	30.0	1660		423-0007-035	
500	424-7372-001	7	60.0	48.0	33.0	2460		423-0007-048	
240 V - 480Y/277 V – Aluminum windings*									
15	424-7163-001	7	22.0	19.0	16.0	295	T240D	423-0007-019	223-7008-030
30	424-7193-001	7	25.0	22.0	17.0	385		423-0007-022	223-7008-075
45	424-7213-001	7	28.0	25.0	18.5	565		423-0007-025	
75	424-7233-001	7	32.0	27.0	21.0	750		423-0007-027	
112.5	424-7253-001	7	38.0	29.0	23.0	960		423-0007-029	N/A
150	424-7263-001	7	42.0	33.0	26.0	1280	T240E	423-0007-033	
225	424-7293-001	7	46.0	35.0	30.0	1645		423-0007-035	
300	424-7313-001	7	52.0	35.0	30.0	1660		423-0007-035	
500	424-7372-001	7	60.0	48.0	33.0	2460		423-0007-048	
480 V - 208Y/120 V – Aluminum windings*									
15	424-7164-001	7	22.0	19.0	16.0	295	T480E	423-0007-019	223-7008-030
30	424-7194-001	7	25.0	22.0	17.0	385		423-0007-022	223-7008-075
45	424-7214-001	7	28.0	25.0	18.5	565		423-0007-025	
75	424-7234-001	7	32.0	27.0	21.0	750		423-0007-027	
112.5	424-7254-001	7	38.0	29.0	23.0	960		423-0007-029	N/A
150	424-7264-001	7	42.0	33.0	26.0	1280		423-0007-033	
225	424-7294-001	7	46.0	35.0	30.0	1645		423-0007-035	
300	424-7314-001	7	52.0	35.0	30.0	1660		423-0007-035	
500	424-7348-001	7	60.0	48.0	33.0	2460		423-0007-048	

* For copper and/or low temp rise K-13 or K-20 units see suffix chart on page 8.6

Note: Housing dimensions subject to change without notice. Consult website or factory where dimensions are critical.

Version JE901 0809 Date Sept 08

K-4 Three-Phase

150°C Temperature Rise • Electrostatic Shield, Taps: 2@ 2.5% FCAN & 4@ 2.5% FCBN

KVA	Catalog Number*	Fig.	Height A (in.)	Width B (in.)	Depth C (in.)	Est. Ship Wgt. (lbs.)	Wiring Diagram	Weather Shield Kit	Wall Bracket Kit
480 V - 480Y/277 V – Aluminum windings*									
15	424-7165-001	7	22.0	19.0	16.0	295	T480J	423-0007-019	223-7008-030
30	424-7195-001	7	25.0	22.0	17.0	385		423-0007-022	223-7008-075
45	424-7215-001	7	28.0	25.0	18.5	565		423-0007-025	
75	424-7235-001	7	32.0	27.0	21.0	750		423-0007-027	
112.5	424-7255-001	7	38.0	29.0	23.0	960		423-0007-029	N/A
150	424-7265-001	7	42.0	33.0	26.0	1280		423-0007-033	
225	424-7295-001	7	46.0	35.0	30.0	1645		423-0007-035	
300	424-7315-001	7	52.0	35.0	30.0	1660		423-0007-035	
500	424-7348-001	7	60.0	48.0	33.0	2460		423-0007-048	
600 V - 208Y/120 V – Aluminum windings*									
15	424-7169-001	7	22.0	19.0	16.0	295	T600B	423-0007-019	223-7008-030
30	424-7199-001	7	25.0	22.0	17.0	385		423-0007-022	223-7008-075
45	424-7219-001	7	28.0	25.0	18.5	565		423-0007-025	
75	424-7239-001	7	32.0	27.0	21.0	750		423-0007-027	
112.5	424-7259-001	7	38.0	29.0	23.0	960		423-0007-029	N/A
150	424-7269-001	7	42.0	33.0	26.0	1280		423-0007-033	
225	424-7299-001	7	46.0	35.0	30.0	1645		423-0007-035	
300	424-7319-001	7	60.0	48.0	33.0	2460		423-0007-035	
500	424-7348-001	7	60.0	48.0	33.0	2460		423-0007-048	

* For copper and/or low temp rise K-13 or K-20 units see suffix chart on page 8.6

Suffix Chart

The catalog number on the standard Non-Linear products have a suffix of -001 for K-4, -002 for K-13, -003 for K-20.

To order alternate version transformers choose the suffix to match the desired features.

Suffix	Wire	Temperature Rise	K-Factor
001	Aluminum	150	K-4
011	Aluminum	115	K-4
081	Aluminum	80	K-4
801	Copper	150	K-4
811	Copper	115	K-4
881	Copper	80	K-4
002	Aluminum	150	K-13
012	Aluminum	115	K-13
082	Aluminum	80	K-13
802	Copper	150	K-13
812	Copper	115	K-13
882	Copper	80	K-13
003	Aluminum	150	K-20
013	Aluminum	115	K-20
083	Aluminum	80	K-20
803	Copper	150	K-20
813	Copper	115	K-20
883	Copper	80	K-20

Note: The weight, dimensions, weather shield and mounting brackets may be different than the standard version.

Check our website **www.jeffersonelectric.com** for details

Note: Housing dimensions subject to change without notice. Consult website or factory where dimensions are critical.

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Figure 7

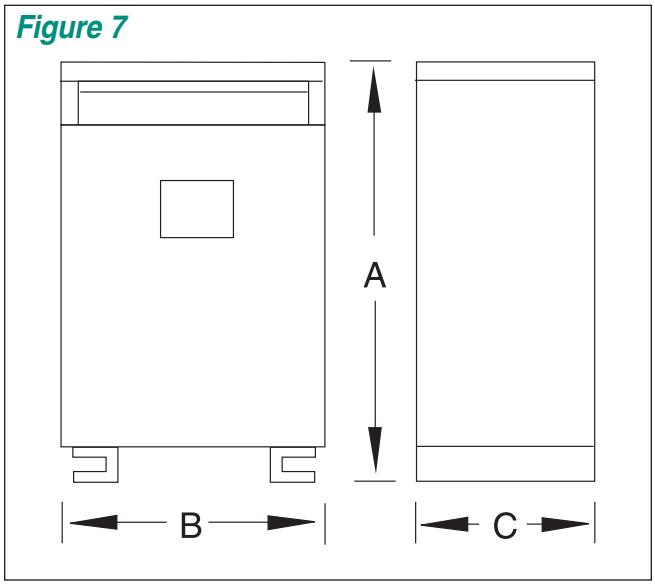
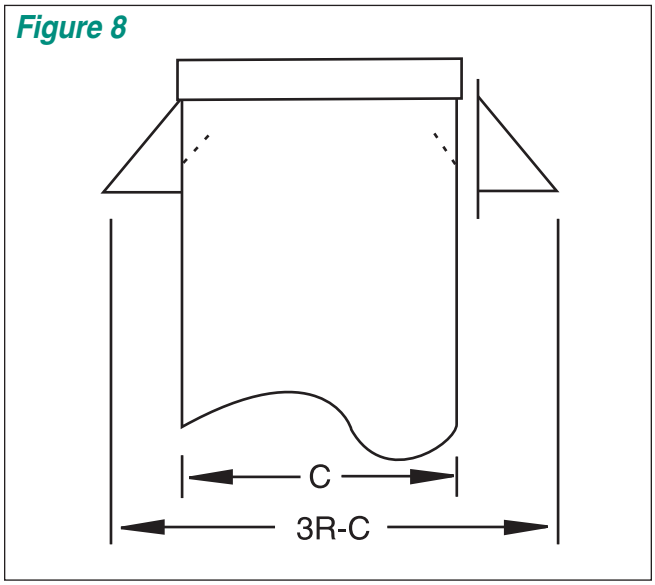


Figure 8



Weather Shield Kit to Make Enclosures NEMA 3R Rated

kVA*	Part Number	Width (B)	Depth w/o weather shield (C)	Depth with weather shield (3R-C)	Shipping weight (lbs.)
15	423-0007-019	19.0	16.0	23.0	3.2
30	423-0007-022	22.0	17.0	24.0	3.6
45	423-0007-025	25.0	18.5	25.5	4.1
75	423-0007-027	27.0	21.0	28.0	4.4
112.5	423-0007-029	29.0	23.0	31.0	5.3
150	423-0007-033	33.0	26.0	34.0	6.3
225	423-0007-035	35.0	30.0	38.0	6.7
300	423-0007-035	35.0	30.0	38.0	6.7
500	423-0007-048	48.0	33.0	43.5	12.2

*kVA for 150 degree rise and K-4 units

Mounting Brackets

Part Number	Description	Shipping weight (lbs.)
223-7008-030	For 15 KVA unit at 150 degree C rise	18
223-7008-075	For 16 to 75 KVA unit at 150 degree C rise	20

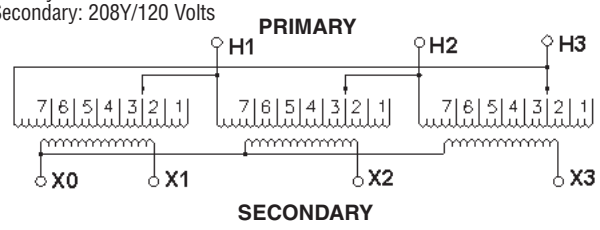
Version JE901 0809 Date Feb 09

Non-Linear Three-Phase – Jefferson® Plus

T208B Wiring Diagram & Connections*

Wiring Diagram

Primary: 208 Volts Delta
Secondary: 208Y/120 Volts



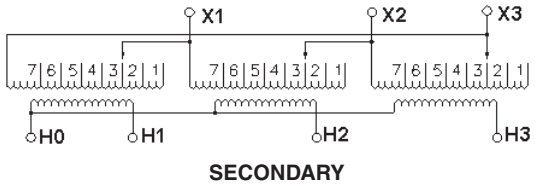
Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Connect To
218	1	H1, H2, H3
213	2	H1, H2, H3
208	3	H1, H2, H3
203	4	H1, H2, H3
198	5	H1, H2, H3
192	6	H1, H2, H3
187	7	H1, H2, H3
Sec. Volts		**Secondary Lines Connect To**
208		X1, X2, X3
120 1 Phase		Between X0 and X1 or X2 or X3

T208D Wiring Diagram & Connections*

Wiring Diagram

Primary: 208 Volts Delta
Secondary: 480Y/277 Volts



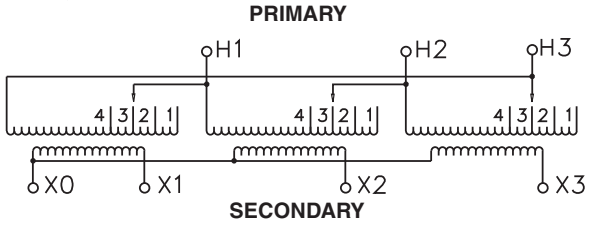
Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Connect To
218	1	X1, X2, X3
213	2	X1, X2, X3
208	3	X1, X2, X3
203	4	X1, X2, X3
198	5	X1, X2, X3
192	6	X1, X2, X3
187	7	X1, X2, X3
Sec. Volts		**Secondary Lines Connect To**
480		H1, H2, H3
277 1 Phase		Between H0 and H1 or H2 or H3

T208F Wiring Diagram & Connections*

Wiring Diagram

Primary: 208 Volts Delta
Secondary: 208Y/120 Volts



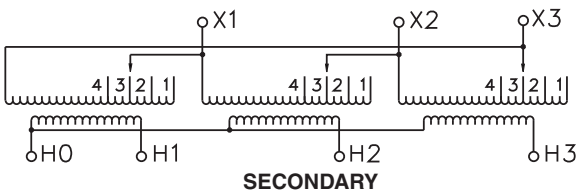
Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Connect To
218	1	H1, H2, H3
208	2	H1, H2, H3
198	3	H1, H2, H3
187	4	H1, H2, H3
Sec. Volts		**Secondary Lines Connect To**
208		X1, X2, X3
120 1 Phase		Between X0 and X1 or X2 or X3

T208G Wiring Diagram & Connections*

Wiring Diagram

Primary: 208 Volts Delta
Secondary: 480Y/277 Volts



Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Connect To
218	1	X1, X2, X3
208	2	X1, X2, X3
198	3	X1, X2, X3
187	4	X1, X2, X3
Sec. Volts		**Secondary Lines Connect To**
480		H1, H2, H3
277 1 Phase		Between H0 and H1 or H2 or H3

Version JE901 0612 Date Dec. 06

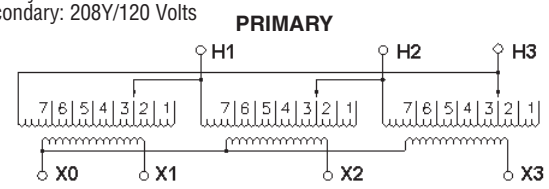
NOTE: Electrostatic shields are optionally available and not shown in all wiring diagrams. * Insulate unused taps individually.

Non-Linear Three-Phase – Jefferson® Plus

T240B Wiring Diagram & Connections*

Wiring Diagram

Primary: 240 Volts Delta
Secondary: 208Y/120 Volts



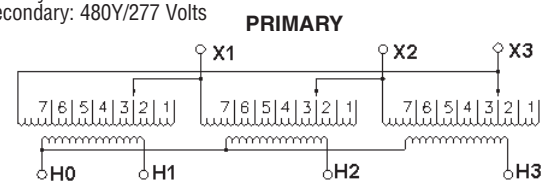
Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Connect To
252	1	H1, H2, H3
246	2	H1, H2, H3
240	3	H1, H2, H3
234	4	H1, H2, H3
228	5	H1, H2, H3
222	6	H1, H2, H3
216	7	H1, H2, H3
Sec. Volts		**Secondary Lines Connect To**
208		X1, X2, X3
120 1 Phase		Between X0 and X1 or X2 or X3

T240D Wiring Diagram & Connections*

Wiring Diagram

Primary: 240 Volts Delta
Secondary: 480Y/277 Volts



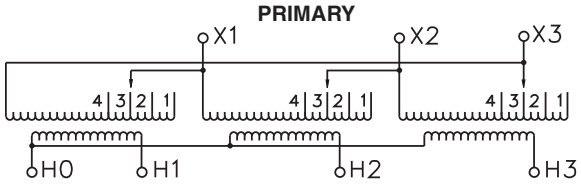
Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Connect To
252	1	X1, X2, X3
246	2	X1, X2, X3
240	3	X1, X2, X3
234	4	X1, X2, X3
228	5	X1, X2, X3
222	6	X1, X2, X3
216	7	X1, X2, X3
Sec. Volts		**Secondary Lines Connect To**
480		H1, H2, H3
277 1 Phase		Between H0 and H1 or H2 or H3

T240E Wiring Diagram & Connections*

Wiring Diagram

Primary: 240 Volts Delta
Secondary: 480Y/277 Volts



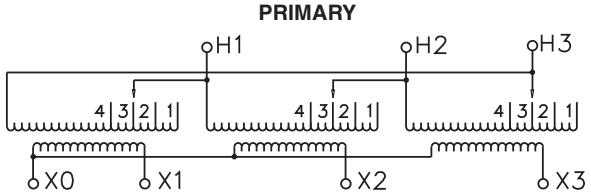
Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Connect To
252	1	X1, X2, X3
240	2	X1, X2, X3
228	3	X1, X2, X3
216	4	X1, X2, X3
Sec. Volts		**Secondary Lines Connect To**
480		H1, H2, H3
277 1 Phase		Between H0 and H1 or H2, or H3

T240F Wiring Diagram & Connections*

Wiring Diagram

Primary: 240 Volts Delta
Secondary: 208Y/120 Volts



Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Connect To
252	1	H1, H2, H3
240	2	H1, H2, H3
228	3	H1, H2, H3
216	4	H1, H2, H3
Sec. Volts		**Secondary Lines Connect To**
208		X1, X2, X3
120 1 Phase		Between X0 and X1 or X2, or X3

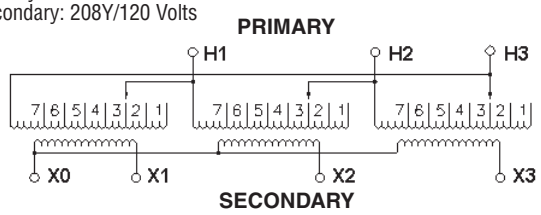
NOTE: Electrostatic shields are optionally available and not shown in all wiring diagrams. *** Insulate unused taps individually.**

Version JE901 0612 Date Dec 06

T480E Wiring Diagram & Connections*

Wiring Diagram

Primary: 480 Volts Delta
Secondary: 208Y/120 Volts



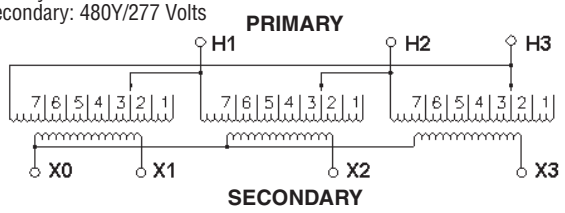
Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Connect To
504	1	H1, H2, H3
492	2	H1, H2, H3
480	3	H1, H2, H3
468	4	H1, H2, H3
456	5	H1, H2, H3
444	6	H1, H2, H3
432	7	H1, H2, H3
Sec. Volts		**Secondary Lines Connect To**
208		X1, X2, X3
120 1 Phase		Between X0 and X1 or X2 or X3

T480J Wiring Diagram & Connections*

Wiring Diagram

Primary: 480 Volts Delta
Secondary: 480Y/277 Volts



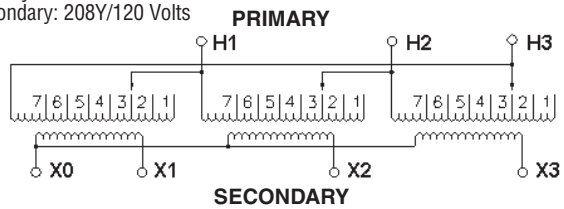
Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Connect To
504	1	H1, H2, H3
492	2	H1, H2, H3
480	3	H1, H2, H3
468	4	H1, H2, H3
456	5	H1, H2, H3
444	6	H1, H2, H3
432	7	H1, H2, H3
Sec. Volts		**Secondary Lines Connect To**
480		X1, X2, X3
277 1 Phase		Between X0 and X1 or X2 or X3

T600B Wiring Diagram & Connections*

Wiring Diagram

Primary: 600 Volts
Secondary: 208Y/120 Volts



Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Between Lines
630	1	H1, H2, H3
615	2	H1, H2, H3
600	3	H1, H2, H3
585	4	H1, H2, H3
570	5	H1, H2, H3
555	6	H1, H2, H3
540	7	H1, H2, H3
Sec. Volts		**Secondary Lines Connect To**
208		X1, X2, X3
120 1 Phase		Between X0 and X1 or X2 or X3

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NOTE: Electrostatic shields are optionally available and not shown in all wiring diagrams. * Insulate unused taps individually.