

Answering Today's Power Challenges

Jefferson Electric is continually updating its product line to remain on the forefront of transformer technology. Electrical harmonics have become a real world problem to many of our customers, especially those with high energy usage and very stable voltage needs. For these customers, we have a solution.

This section of our catalog contains our products line developed to mitigate harmonics.

13-3 HMT / Zig-Zag

13-7 Harmonic Suppression Systems

For further information, contact an Application Engineer at 800-892-3755, technical_services@jeffersonelectric.com

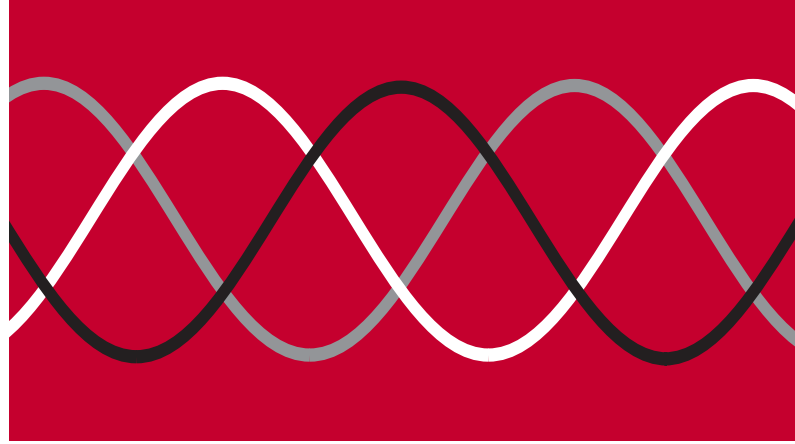
Why Your Existing Transformer May Be Inadequate

Traditional transformers were designed to handle the purely linear electrical loads created by standard lighting and motors. The currents drawn by these loads are sinusoidal in shape, as is the waveshape of the supply voltage. When 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, determining how to balance loads to reduce neutral currents, and reducing the size of neutral conductors to reduce material costs.

The Phenomenon of Odd Harmonics

Electronic equipment today is powered by SMSPs (switch mode power supplies) that convert AC current to DC current. SMSPs use rectifiers and capacitors drawing current in sharp bursts which distorts the sinusoidal waveform. It is now non-linear.

Non-linear loads, are rich in odd harmonics (3, 5, 7, etc.), 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. The 3rd harmonic current (180Hz) due to the



design of the 3-phase system, is additive in the neutral and can result in a neutral current twice the phase current, even in a balanced system.

How Harmonics Affect Transformers

When odd-harmonic currents are present, winding losses increase. The I^2R , conductor losses, are higher because harmonics increase the current. Stray losses in windings also increase losses due to additional eddy currents circulating within the conductors. The combination of these additional losses generate excess 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 may exceed 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 and provide poor energy efficiency due to increased core losses.

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

Harmonic Mitigation

Harmonic Mitigating Transformers (HMT/Zig-Zag) and K-rated transformers accommodate the flow of the third harmonic current. They dissipate the extra current as heat (I^2R losses) in the transformer.

Because they are so common to our product line, we included K-rated transformers (Chapter 3, Non-Linear Transformers) in our standard catalog.

The Harmonic Mitigating Transformer (HMT / Zig-Zag) line is defined in on the following pages.

Harmonic Suppression

Instead of filtering third harmonic currents from the line after they are generated, our patented Harmonics Suppression System (HSS™) works at the source to prevent the generation of these currents.

The HSS is extremely reliable, is UL certified, and is fully compliant with the National Electrical Code. It is the only harmonic mitigation system that “prevents” the formation of third harmonic currents throughout the electrical distribution system, rather than just “accommodating” these currents after they are formed. It is the only harmonic mitigation system that reduces wasted energy and has an energy payback. It is clearly the technology of choice for solving third harmonic current problems in electrical systems that power multiple computer and electronic loads.

Systemax™ is a stand alone third harmonic suppression filter that installs on the neutral of an existing distribution transformer. It is sized to the transformer (15 to 1,000 kVA). Enclosure type is UL/NEMA Type 1, steel with ANSI-61 gray paint.

While Systemax can be installed on any transformer, Harmonics Limited recommends it be placed on at least a high efficiency DOE compliant transformer. If the existing transformer does not meet DOE-2016 specifications then replacement with a TransMax is advised.

TransMax™ is harmonic suppression technology incorporated in a single enclosure with a high efficiency transformer. The basic transformer has a 480V primary, 208Y/120V secondary, with copper or aluminum windings, 115°C rise and electrostatic shielding. Standard sizes range from 30 kVA to 500 kVA. More information can be found in on page 13-7.

GenMax™ addresses issues arising when multiple generators of different pitch are paralleled. Each pitch has a slight variation in the voltage waveform which can cause excessive 3rd harmonic current to flow in the system.

HMT Three-Phase Zig-Zag Transformers

The HMT (Harmonic Mitigating Transformer) is a three phase transformer with 0° or -30° displacement between the primary and the secondary.

An HMT is used to reduce current harmonics on the primary side of a transformer and voltage distortion on the secondary. A single HMT reduces the flow of triplen harmonics, 3rd, 9th, 15th, 21st, etc into the transformer primary. Used together on the same power line a 0° and -30° HMT will also reduce the 5th and 7th harmonics.

These transformers are designed to reduce voltage distortion when powering non-linear loads.

Applications

- For use in environments with non-linear loads such as computers, printers and communication equipment where stable load and operation is necessary
- Medical facilities including hospitals
- Data centers
- Office buildings
- Schools

Specifications

- K-13 standard
- DOE-2016 efficiency
- NEMA3R enclosure
- 3 phase, 60 Hz
- 480V primary
- Zig-Zag secondary design voltage 208Y/120V
- 0° and -30° phase shifts
- 15 – 1,500 kVA range
- Aluminum windings
- 150°C temperature rise
- 220°C insulation class
- Heat-cured ASA-61 gray powder coating finish
- Electrostatic shield
- Cores of high quality electrical steel



Standards

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

Options and Accessories

Consult factory for more information

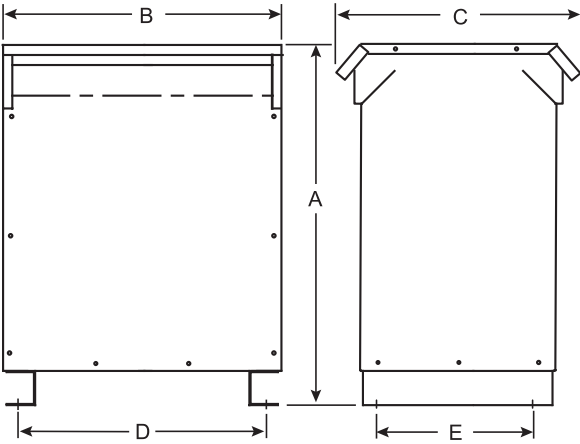
- 50 Hz
- Other sizes, voltages and temperature rises available
- Copper windings
- K-4 and K-20
- Dual electrostatic shields
- 115°C, 80°C temperature rise

Approvals



Enclosure Figures

Figure 24



Model Numbers Defined

424-TXXY-ABC

3 Phase Ventilated
Non-Linear Zig-Zag
All models with electrostatic shield

Enclosure Type
DOE-2016 9

kVA Rating / XX		kVA Rating / XX	
15.0	16	150	26
20	17	167	27
25	18	200	28
30	19	225	29
37.5	20	250	30
45	21	300	31
50	22	333	32
75	23	400	33
100	24	500	34
112.5	25		

Primary	Secondary	
208	480Y/277	1
240	208Y/120	2
240	480Y/277	3
480	208Y/120	4
480	480Y/277	5
Specials*		6
Not assigned		7
208	208Y/120	8
600	208Y/120	9

Wiring

Aluminum	0
Copper	8

Temperature Rise

150°C Rise	0
115°C Rise	1
80°C Rise	8

Third Harmonic

K=4, Zig-Zag, -30 degrees	4
K=13, Zig-Zag, -30 degrees	5
K=20, Zig-Zag, -30 degrees	6
K=4, Zig-Zag, 0 degrees	7
K=13, Zig-Zag, 0 degrees	8
K=20, Zig-Zag, 0 degrees	9

* Suffix defined incrementally

Mounting Brackets

Part Number	Description	Max Unit Wgt (lbs)
223-7008-030	For 15 kVA units, 150°C rise	250
223-7008-075	For 16 to 50 kVA units, 150°C rise	750

Lugs

Part Number	kVA	Primary Lug	Qty	Secondary Lug	Qty
4PT-2007-LUG	15	#14 - 2	2	#2/0 - 6	2
4PT-2017-LUG	25	#14 - 2	2	250MCM - 6	2
4PT-2008-LUG	37.5	#14 - 2	2	350MCM - 6	2
4PT-2009-LUG	50	#2/0 - 6	2	600MCM - 6	2
4PT-2018-LUG*	75	#2/0 - 6	2	600MCM - 6	4

* Must be ordered, not included on stock units

Three-Phase Harmonic Mitigation (Zig-Zag) Transformers—DOE Compliant

K-13 • Electrostatic Shields • 150°C Temperature Rise • Aluminum Windings • NEMA3R Enclosures

Taps: 2@2.5% FCAN, 2@2.5% FBCN

480V Delta — 208Y/120V

kVA	Catalog Number	Enclosure Figure	Height (A) inches	Width (B) inches	Depth (C) inches	(D) inches	(E) inches	Est Ship Wgt	Mounting Kit	Wiring Diagram
15	424-9164-008	24	25	22	22	17.4	13	310	223-7008-030	T480M
30	424-9194-008	24	28	25	23.5	20.8	14.5	400	223-7008-075	T480M
45	424-9214-008	24	32	27	26	23.5	16	585	223-7008-075	T480M
75	424-9234-008	24	38	29	29	25.5	18	775	n/a	T480M
112.5	424-9254-008	24	42	33	32.5	29.5	21	1,000	n/a	T480M
150	424-9264-008	24	46	35	37	31.5	24	1,530	n/a	T480M
225	424-9294-008	24	52	35	37	31.5	24	1,660	n/a	T480M
300	424-9314-008	24	60	48	43.5	42.0	27	2,460	n/a	T480M
500	424-9344-008	24	72	52	44	35.0	42	3,750	n/a	T480M

Three-Phase Harmonic Mitigation (Zig-Zag) Transformers—C802 Compliant

K-13 • Electrostatic Shields • 150°C Temperature Rise • Aluminum Windings • NEMA3R Enclosures

Taps: 2@2.5% FCAN, 2@2.5% FBCN

600V Delta — 208Y/120V

kVA	Catalog Number	Enclosure Figure	Height (A) inches	Width (B) inches	Depth (C) inches	(D) inches	(E) inches	Est Ship Wgt	Mounting Kit	Wiring Diagram
15	424-9169-008	24	25	22	22	17.4	13	310	223-7008-030	T600G
30	424-9199-008	24	28	25	23.5	20.8	14.5	400	223-7008-075	T600G
45	424-9219-008	24	32	27	26	23.5	16	585	223-7008-075	T600G
75	424-9239-008	24	38	29	29	25.5	18	775	n/a	T600G
112.5	424-9259-008	24	42	33	32.5	29.5	21	1,000	n/a	T600G
150	424-9269-008	24	46	35	37	31.5	24	1,530	n/a	T600G
225	424-9299-008	24	52	35	37	31.5	24	1,660	n/a	T600G
300	424-9319-008	24	60	48	43.5	42.0	27	2,460	n/a	T600G
500	424-9349-008	24	72	52	44	35.0	42	3,750	n/a	T600G

See website for additional kVA, copper windings and temperature options.

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

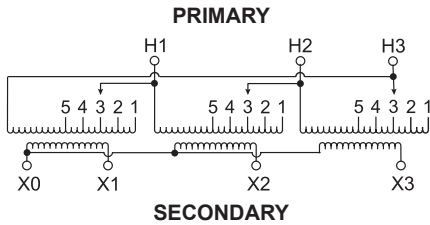
For further information, contact an Application Engineer at 800-892-3755, technical_services@jeffersonelectric.com

Wiring Diagrams

T480M Wiring Diagram & Connections

Wiring Diagram

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



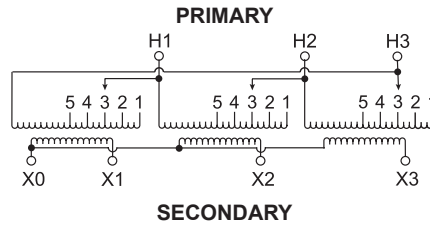
Connections

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
Secondary Volts	Secondary Lines Connect To	
208	X1, X2, X3	
120	Between X0 and X1 or X2 or X3	
1 phase		

T600G Wiring Diagram & Connections

Wiring Diagram

Primary: 600 Volts Delta
Secondary: 208Y/120 Volts



Connections

Primary Volts	On Each Coil Jumper Taps To	Primary Lines Connect To
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
Secondary Volts	Secondary Lines Connect To	
208	X1, X2, X3	
120	Between X0 and X1 or X2 or X3	
1 phase		

More wiring diagrams can be found in catalog's appendix, section 15.

For further information, contact an Application Engineer at 800-892-3755, technical_services@jeffersonelectric.com

Solutions for Harmonics in the Power System

The Harmonic Suppression System (HSS™) eliminates the harmful 3rd harmonic current generated by the operation of electronic power supplies. An HSS eliminates the 3rd harmonic current, removing it from the distribution system.

Patented HSS technology allows transformers to be sized to the load. There is no need to de-rate or oversize panels, reducing installation costs and energy consumption and increasing equipment life. ROI can be less than 24 months.

Three Options

SystemMax™ is a stand alone 3rd harmonic suppression filter that is connected to the neutral of an existing distribution transformer. It is sized to the transformer (15 kVA to 1,000 kVA).

TransMax™ is a SystemMax filter incorporated in an enclosure with a high efficiency transformer. The basic transformer is 480V primary, 208Y/120V secondary, with either copper or aluminum windings, 115°C rise and electrostatic shielding. Options include 80°C rise, low noise (-3dB) and 208V primary. Enclosure type is UL/NEMA Type 1, ANSI-61 gray paint. Standard sizes range from 30 kVA to 500 kVA.

GenMax™ is a passive, tuned harmonic suppression system for generators. This new technology allows generators with different winding pitches to operate at full capacity by reducing circulating 3rd harmonic ground currents.

Applications

- Where there is a large amount of computer, printer and communication equipment load, and stable operation is necessary
- Where there are slight differences in the pitch of the paralleled generators
- Medical facilities including hospitals
- Call, data and technology centers
- Office and commercial buildings
- Gaming industry
- Schools



Features, Functions, Benefits

- Patented HSS technology allows transformers to be sized exactly to the load. No need to de-rate or oversize panels.
- Lower installation costs
- Reduced energy consumption
- Longer equipment life
- ROI can be less than 24 months

Standards

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

Options and Accessories

Consult factory for more information

- 50 Hz
- Other sizes, voltages and temperature rises available
- Aluminum windings
- Dual electrostatic shield
- 115°C, 80°C temperature rise

Approvals



Enclosure Figures

Figure 32

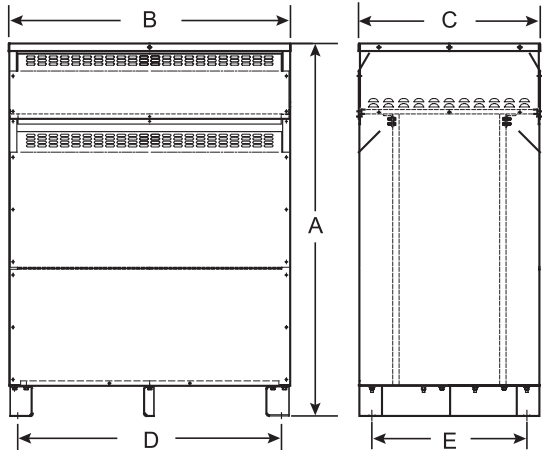


Figure 33

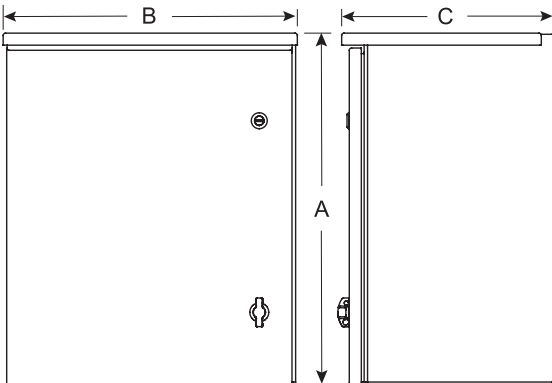
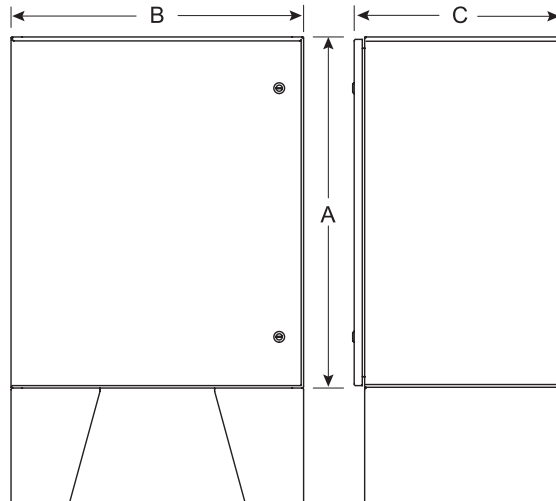


Figure 34



Model Numbers

Model numbers for these units are developed to match unique needs. Contact an Application Engineer at 800-892-3755, technical_services@jeffersonelectric.com for more information.

TransMax™

Three Phase • Harmonic Suppression System + Transformer • Electrostatic Shields
115°C Temperature Rise • Copper Windings • NEMA1 Enclosures

480V Delta — 208Y/120V • Taps: 2@2.5% FCAN, 2@2.5% FBCN, DOE-2016 compliant

kVA	Catalog Number	Model	Enclosure Figure	Height (A) inches	Width (B) inches	Depth (C) inches	Est Ship Wgt
30	300-4600-130	HLTM030	32	46	24	18	500
45	300-4600-131	HLTM045	32	46	24	18	570
75	300-4600-132	HLTM075	32	55	28	23	900
112	300-4600-133	HLTM112	32	63	28	23	1,200
150	300-4600-134	HLTM150	32	63	28	23	1,350
225	300-4600-135	HLTM225	32	71	35	30	2,150
300	300-4600-136	HLTM300	32	71	35	30	2,475
400	300-4600-137	HLTM400	32	74	56	36	3,290
500	300-4600-138	HLTM500	32	74	56	36	4,100

SystemMax™

Three Phase • Harmonic Suppression System • NEMA1 Enclosures

kVA	Amp Rating	Catalog Number	Model	Enclosure Figure	Height (A) inches	Width (B) inches	Depth (C) inches	Est Ship Wgt
30	83	300-4600-140	HLSM0030	33	20	16	15	132
45	125	300-4600-141	HLSM0045	33	20	16	15	147
75	208	300-4600-142	HLSM0075	33	24	20	15	218
112	311	300-4600-143	HLSM0112	33	30	24	15	300
150	416	300-4600-144	HLSM0150	33	30	24	15	327
225	625	300-4600-145	HLSM0225	34	60	30	21	565
300	833	300-4600-146	HLSM0300	34	60	30	21	644
500	1,388	300-4600-148	HLSM0500	34	72	48	25	1,350
750	2,080	300-4600-855	HLSM0750	34	84	60	25	1,960
1,000	2,780	300-4600-856	HLSM1000	34	84	60	25	2,900

* Legs typically add 12 inches to overall height, may vary. Call for exact dimensions if critical.

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

For further information, contact an Application Engineer at 800-892-3755, technical_services@jeffersonelectric.com

GenMax™

GenMax is available for generators from 100kW to 2,000kW (208V, 480V and 600V) with ampacity ratings from 50 to 2,800 amps.

GenMax is sized to the generator, phase current and connected loads.

Consult the factory with your application for a specific recommendation on the GenMax to meet your needs.

