

ULTRA-K

Series 600K-*he*

High Efficiency, K-Rated Power Conditioning Transformer

15kVA – 500kVA

3 Phase Guide Specification

(Optional Items in Red)

PART 1 - GENERAL

1.1 Description

This specification describes the design of a copper wound, multi-shielded, three phase, high efficiency, K-factor rated, power conditioning isolation transformer. The power conditioning transformer shall be continuous duty rated, 600 volt class, convection cooled, dry type, isolation transformer designed to support harmonic rich non-linear loads while maintaining safe operating temperatures, and shall include superior common and transverse mode noise attenuation. The power conditioning transformer shall meet the efficiency specified in 2.4 I of this specification, which meets and exceeds the U.S. Department of Energy (DOE) 2016 high efficiency standards identified under DOE 10 CFR Part 431, and complies with the Canadian Energy Efficiency Standard C802.2-12.

1.2 Standards

The power conditioning system shall be designed in accordance with applicable portions of the following standards:

- A. U.S. Department of Energy (DOE) 2016 high efficiency standards identified under DOE 10 CFR Part 431
- B. Canadian Energy Efficiency Standard C802.2-12
- C. American National Standards Institute (ANSI C57.110 & C62.41-2002)
- D. Institute of Electrical and Electronic Engineers (IEEE 519-2014)
- E. National Fire Protection Association (NFPA) 70, National Electrical Code (NEC)
- F. Federal Information Processing Standards Publication 94 (FIPS Pub 94)
- G. UL Listed to Standard 1561
- H. C-UL listed to CSA Standard C22.2, No. 47-13
- I. RoHS compliant

1.3 Submittals

A. Manufacturer Requirements:

- 1. The manufacturer shall be ISO 9001:2015 “Quality Assurance Certified” and shall upon request furnish certification documents.
- 2. The manufacturer shall be a United States based manufacturer with at least 15 years of experience in the design and fabrication of K-rated, shielded, power conditioning isolation transformers.

B. Product Data:

1. The manufacturer shall supply documentation for the installation of the system, including wiring diagrams and cabinet outlines showing dimensions, weights, BTUs, input/output connection locations and required clearances.
2. Factory test results and design data shall be provided to show compliance with the requirements.
3. The supplier shall furnish (6) equipment submittal copies. Submittals shall be specific for the equipment furnished and shall include as-built information.

PART 2 - PRODUCTS

2.1 Manufacturers

The equipment specified is the Ultra-K, Series 600K-*he*, manufactured by Trystar

2.2 Input Specifications

- A. The nominal AC input voltage rating of the power conditioner shall be (208 VAC) (240 VAC) (480 VAC) (600VAC) 3 phase with sufficient margin to sustain a constant input of +10% without saturation.

Engineer's Note: 225kVA, 300kVA, and 500kVA transformers shall be 600 VAC or 480 VAC.

- B. The nominal operating frequency shall be 60 hertz \pm 5%.
- C. The power conditioning transformer primary shall be configured in a three phase delta.
 (Transformers rated 15kVA to 75kVA shall include full capacity taps at 2.5% increments, two (2) above and four (4) below the nominal voltage tap.)
or
 (Transformers rated 112.5kVA to 150kVA at 208 VAC or 240 VAC shall include full capacity taps at 5% increments, one (1) above and two (2) below the nominal voltage tap.)
or
 (Transformers rated 112.5kVA to 300kVA at 480 VAC or 600 VAC shall include full capacity taps at 2.5% increments, two (2) above and four (4) below the nominal voltage tap.)
or
 (Transformers rated 500kVA at 480 VAC or 600 VAC shall include full capacity taps at 3.5% increments, one (1) above and two (2) below the nominal voltage tap.)
- D. When energized, the current inrush shall not exceed a maximum of 10 times the full load input current for ½ cycle.

2.3 Output Specifications

- A. The nominal AC output voltage rating of the power conditioning transformer shall be (208 VAC) (400 VAC) (460 VAC) (480 VAC) (600 VAC) wye derived, 60 hertz.
- B. The output impedance of the power conditioning transformer shall be 2% to 3.5% typical.
- C. The power conditioning transformer shall be (K-4) (K-7) (K-13) (K-20) rated in accordance with: $K = \sum I_h(\text{pu})^2 h^2$
- D. The power conditioning transformer shall provide a continuous duty, full load output power of (15) (30) (45) (75) (112.5) (150) (225) (300) (500) kVA.

2.4 Performance Specifications

- A. The output voltage of the power conditioning transformer shall be maintained within 2.5% or less of nominal, from no load to full load.
- B. The overload rating of the power conditioning transformer shall be 500% for 10 seconds, and 1000% for 1 cycle.

- C. The power conditioning transformer shall add no more than 1% total harmonic distortion to the output waveform under a linear load.
- D. Output voltage shall remain sinusoidal with no flat topping when high crest factor (3.0 : 1), non-linear loads are present at the output.
- E. The audible noise of the power conditioning transformer shall be no greater than ___ dBA, measured at 1 meter from the unit with the transformer at full load and rated K factor.

Engineer’s Reference:

Output kVA	K4 & K7 dBA Ratings	K13 & K20 dBA Ratings
15	45	45
30	45	45
45	45	48
75	50	53
112.5	50	53
150	50	53
225	55	58
300	55	58
500	60	63

- F. The power conditioning transformer shall incorporate (2) (3) solid copper foil, full-length electrostatic shields to minimize inner winding capacitance and noise coupling between primary and secondary windings.
- G. Transformer shall be (double-shielded and capable of 126dB) (triple-shielded and capable of 146dB) common mode noise attenuation.
- H. Transformer shall be capable of transverse mode noise attenuation of 3 dB down at 10kHz, decaying 20 dB per decade.
- I. The power conditioning transformer shall have an efficiency of ___% or greater, which meets and exceeds U.S. Department of Energy (DOE) 2016 high efficiency standards. Efficiency value is at 35% of nameplate-rated load with a transformer operating temperature of 75 °C, determined according to the DOE Test Method for Measuring the Energy Consumption of Distribution Transformers under Appendix A to Subpart K of 10 CFR part 431.

Engineer’s Reference:

Output kVA	Ultra-K Efficiency @ 35% Load
15	> 97.89%
30	> 98.23%
45	> 98.40%
75	> 98.60%
112.5	> 98.74%
150	> 98.83%
225	> 98.94%
300	> 99.02%
500	> 99.14%

2.5 Main Transformer Construction

- A. The transformer windings shall be all copper conductor construction, with separate primary and secondary, isolated windings. The transformer shall conform to NEC article 250, that specifies a separately derived power source. The neutral conductor shall be provided at 2 times the ampacity of the phase conductor.

- B. Copper bus connections shall be provided for isolated three phase output conductors, neutral conductor, and ground.
- C. Output neutral shall be bonded to ground via a removable jumper wire or bus bar.
- D. All leads, wires and terminals shall be labeled to correspond with the circuit wiring diagram.
- E. Basic impulse level shall be no less than 10,000 Volts.
- F. Mean Time Between Failure (MTBF) shall be no less than 200,000 hours.
- G. Grain oriented, M3 grade, silicon transformer steel and miter cut joint construction shall be utilized to provide maximum efficiency. Flux density shall not exceed 15k gauss. Core losses shall be limited to 0.4% or less of the kVA rating.
- H. Class N, 200°C insulation system shall be utilized throughout with a maximum temperature rise above ambient of 115°C under a linear load, not to exceed 135°C under non-linear loading per UL 1561 standard.
- I. The transformer shall be designed for natural convection cooling.

2.6 Cabinet Construction

- A. The cabinet shall be a (NEMA 1) (NEMA 2) (NEMA 3R) general purpose, floor mounted, (indoor) (outdoor) enclosure. Dimensions shall not exceed ___"W x ___"D x ___"H.

Engineer's Reference:

Output kVA	NEMA 2 Cabinet Dimensions (inches)	Weight (lbs.)	NEMA 3R Cabinet Dimensions (inches)	Weight (lbs.)
15	23"W x 20"D x 28"H	370	23"W x 24"D x 28"H	382
30	23"W x 20"D x 28"H	495	23"W x 24"D x 28"H	507
45	28"W x 25"D x 39"H	700	28"W x 29"D x 39"H	707
75	28"W x 25"D x 39"H	830	28"W x 29"D x 39"H	837
112.5	38"W x 32"D x 57"H	1210	38"W x 39"D x 57"H	1231
150	38"W x 32"D x 57"H	1470	38"W x 39"D x 57"H	1491
225	38"W x 32"D x 57"H	1880	38"W x 39"D x 57"H	1901

Output kVA	NEMA 1 Cabinet Dimensions (inches)	Weight (lbs.)
300	56"W x 41.5"D x 48"H	2656
500	45"W x 48"D x 62.75"H	4820

Engineer's Note: IR scanning window option adds 2" to the depth of the 112.5kVA – 225kVA enclosure. 300kVA and 500kVA models available in NEMA 1 enclosure only.

- B. Cabinets shall be manufactured from 14 gauge steel with base sub-structure suitable for fork lifting. Galvanized steel shall be used to manufacture NEMA 3R enclosures.
- C. The cabinet shall have a baked on powder coat paint finish with proper pre-treatment.
- D. Provisions shall exist to hardwire input and output to copper bus connections located behind the front panel of the transformer cabinet. Input and output landing locations shall be available on either side of the transformer cabinet.

Engineer's Note: Mechanical (screw-type) lugs are standard and factory-installed on all models 30kVA and below. An optional lug kit is available for Ultra-K models 45kVA – 500kVA, and may be specified in Section 2.8 F of this specification.

2.7 Environment

- A. Temperature: The power conditioning system shall be required to operate without overheating in an ambient temperature range of -25°C to +40°C.
- B. Humidity: The power conditioning system shall operate in a relative humidity of 0 to 95% non-condensing.
- C. Altitude: The power conditioning system shall operate up to 5000 feet above sea level without de-rating.

2.8 Optional Equipment

The following options shall be included.

- A. Output Voltage Surge Protection Device (SPD): **Engineer's Note:** Select only one (1) of the two SPD options specified below.

SPD with High Frequency Filter. An integral, fused, three phase, secondary connected, surge protection device (SPD) shall be provided. The SPD shall be a 6 mode transient voltage suppression network comprised of high energy metal oxide varistors with less than a 5 nanosecond response time and a maximum peak current handling capability of 40,000 amps (8x20µsec) per mode. The suppression network shall remain functional when subjected to ANSI/IEEE C62.41 Category B-3 waveforms. The SPD shall include a high frequency noise filter that increases the transverse mode noise attenuation to 3 dB down at 10kHz, decaying 40 dB per decade. A single status indicator light shall be provided to show that the SPD and filter are fully operational and functioning properly.

OR

SPD with peak surge current capacity ratings of (50kA) (80kA) (100kA) (120kA) (150kA) (160kA) (200kA) per phase, UL 1449 4th Edition Listed, Type 2, shall be provided. The SPD shall have a nominal discharge current rating of 20kA, and a short circuit current rating (SCCR) of 200kA. The SPD shall include EMI/RFI filtering, Form C relay contacts rated for 2 amps at 30VDC or 250VAC, and LED protection status indicators. **Engineer's Note:** Option not available for 300kVA and 500kVA models.

- B. Main input or output circuit breaker: A molded case, 3 pole circuit breaker shall be provided in a separate NEMA 1 enclosure for external mounting and installation.
- C. High temperature / over temperature alarm contacts: Thermal warning alarm contacts shall be provided within the enclosure for customer hardwired connection. High temperature alarm shall be at 180°C, and over temperature alarm shall be at 200°C.

Engineer's Note: Option not available for 300kVA and 500kVA models.

- D. IR scanning window: Infrared transparent polymer IR window(s) shall be provided on the enclosure for safe routine thermal scanning of transformer connections under load, without exposing personnel to arc flash hazards. The IR window(s) shall be industrial-grade with a patented reinforced grill, shall be fully impact-resistant, and shall be UL and C-UL Listed.

Engineer's Note: IR scanning window option adds 2" to the depth of the 112.5kVA – 225kVA enclosure. Two (2) IR windows are provided on 45kVA – 75kVA models with a 208/120 VAC output, and on all 112.5kVA – 225kVA models. Option not available for 300kVA and 500kVA models.

- E. NEMA 3R enclosure: Power conditioning transformer shall be provided in a UL listed NEMA 3R enclosure for outdoor installation. Enclosure shall be constructed using 14 gauge galvanized steel and provided with a durable powder coat paint finish.

Engineer's Note: Option not available for 300kVA and 500kVA models.

- F. Lug kit: Mechanical (screw-type) lugs shall be shipped loose for installer convenience.

Engineer's Note: Lug kit option is available on Ultra-K models 45kVA – 500kVA. Lugs are standard and factory-installed on all models 30kVA and below. Consult factory for number of conductors per lug and wire range.

2.9 Warranty

The manufacturer shall warrant the transformer (core and coil) to be free from defects in material and workmanship for a period of 1 year full, and an additional 24 years prorated. All other unit components shall be covered by a 2 year full replacement warranty. The warranty periods shall commence following the original factory ship date.