

ULTRA-K

Series 600K-he

High Efficiency, K-Rated Power Conditioning Transformer

15kVA – 500kVA

3 Phase General Specification

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 is a 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 includes superior common and transverse mode noise attenuation. The power conditioning transformer meets and exceeds 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 is 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

PART 2 - PRODUCTS

2.1 Input Specifications

- A. Nominal AC input voltage ratings: 208 VAC, 240 VAC, 480 VAC or 600 VAC, 3 phase for transformers rated at 150kVA and below, and 480 VAC or 600 VAC, 3 phase for transformers rated at 225kVA and above. All are designed with sufficient margin to sustain a constant input of +10% without saturation.
- B. The nominal operating frequency: 60 hertz \pm 5%.
- C. The power conditioning system's primary is configured in a three phase delta and includes the following full capacity voltage compensation taps.
 - 15kVA to 75kVA: (2) above and (4) below the nominal voltage tap at 2.5% increments.
 - 112.5kVA to 150kVA at 208 VAC or 240 VAC: (1) above and (2) below the nominal voltage tap at 5% increments.
 - 112.5kVA to 300kVA at 480 VAC or 600 VAC: (2) above and (4) below the nominal voltage tap at 2.5% increments.
 - 500kVA at 480 VAC or 600 VAC: (1) above and (2) below the nominal voltage tap at 3.5% increments.

- D. Energizing inrush current will not exceed 10 times the full load input current for ½ cycle.

2.2 Output Specifications

- A. Nominal AC output voltage ratings: 208 VAC, 400 VAC, 460 VAC, 480 VAC, or 600 VAC wye derived, 60 hertz. Special voltages available, consult factory.
- B. Output impedance: 2% to 3.5% typical.
- C. Harmonic k-rating: K-4, K-7, K-13, or K-20 rated in accordance with: $K = \sum I_h(\text{pu})^2 h^2$

2.3 Performance Specifications

- A. Load regulation: 2% typical, from no load to full load.
- B. Overload: Up to 500% for 10 seconds, 1000% for 1 cycle.
- C. THD: ≤ 1% added to the output voltage waveform under a linear load.
- D. Harmonic attenuation: Load generated triplen harmonics are attenuated at the primary.
- E. Output voltage: Sinusoidal with no flat topping when high crest factor (3.0 : 1), non-linear loads are present at the output.
- F. Audible noise measured at 1 meter from the unit will not exceed the following values with the transformer at full load and rated K factor.

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

- G. Electrostatic shielding: Incorporates two, or an optional three, solid copper foil electrostatic shields which minimize inner winding capacitance and noise coupling between primary and secondary windings.
- H. Common mode noise attenuation: 126 dB with two shields, or 146dB with optional three shields.
- I. Transverse mode noise attenuation: 3 dB down at 10kHz, decaying 20 dB per decade.

- J. Efficiency: Meets and exceeds U.S. Department of Energy (DOE) 2016 high efficiency standards. All efficiency values are 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.

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%

2.4 Output Power Ratings, Dimensions and Weights

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

2.5 Main Transformer Construction

- A. Transformer windings: All copper conductor construction, with separate primary and secondary isolated windings. The transformer conforms to NEC article 250 that specifies a separately derived power source. The neutral conductor is sized for 200% of the ampacity of the phase conductor.
- B. Copper bus connections are provided for isolated three phase output conductors, neutral conductor, and ground.
- C. All leads, wires and terminals are labeled to correspond with the circuit wiring diagram.
- D. Basic impulse level: No less than 10,000 Volts.
- E. MTBF: \geq 200,000 hours.
- F. Transformer steel: Grain oriented, M3 grade, silicon steel, miter cut joint construction.
- G. Flux density: \leq 15k gauss.

- H. Core losses: 0.2% to 0.4% of the kVA rating, model dependent.
- I. Insulation: Class N, 200 °C with a maximum temperature rise above ambient of 115°C under a linear load, not exceeding 135°C under non-linear loading per UL 1561 standard.
- J. Cooling: Natural convection.

2.6 Cabinet

- A. 10kVA – 225kVA cabinets: NEMA type 2 general purpose, floor mounted, indoor enclosure is standard. Optional NEMA 3R enclosure is available.
- B. 300kVA and 500kVA cabinets: NEMA type 1 general purpose, floor mounted, indoor enclosure.
- C. Construction: Cabinets are manufactured from 14 gauge steel with base sub-structure suitable for fork lifting. Galvanized steel is used to manufacture NEMA 3R enclosures.
- D. Paint: Baked on, powder coat paint finish with proper pre-treatment.
- E. Provisions exist to hardwire input and output to copper bus connections located behind the front panel of the transformer cabinet. Input and output landing locations are available on either side of the transformer cabinet. 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.

2.7 Environment

- A. Operating ambient temperature range: -25°C to +40°C.
- B. Humidity: 0 to 95% non-condensing.
- C. Altitude: Up to 5000 feet above sea level without de-rating.

2.8 Options

- A. Output Voltage Surge Protection Device (SPD):
 - 1. SPD with High Frequency Filter. The SPD is an integral, fused, three phase, secondary connected, 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 40kA (8x20 µsec) per mode. The suppression network will remain functional when subjected to ANSI/IEEE C62.41 Category B-3 waveforms. The SPD includes 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 is provided to show that the SPD and filter are fully operational and functioning properly.
 - 2. SPD with peak surge current capacity ratings from 50kA to 200kA per phase, UL 1449 4th Edition Listed, Type 2. The SPD has a nominal discharge current rating of 20kA, and a short circuit current rating (SCCR) of 200kA. Includes EMI/RFI filtering, Form C relay contacts rated for 2 amps at 30VDC or 250VAC, and LED protection status indicators. (Option not available for 300kVA and 500kVA models.)
- B. Main input or output circuit breaker: Molded case, 3 pole circuit breaker provided in a separate NEMA 1 enclosure for external mounting and installation.

- C. High temperature / over temperature alarm contacts: Thermal warning alarm contacts provided for customer hardwired connection. Thermal sensors at 180°C and 200°C. (Option not available for 300kVA and 500kVA models.)
- D. IR scanning window: Infrared transparent polymer IR window(s) for safe routine thermal scanning of transformer connections under load, without exposing personnel to arc flash hazards (one or two 4” viewing windows provided, model dependent). Durable IR windows are industrial-grade with a patented reinforced grill, are fully impact-resistant, and are UL and C-UL Listed. This option adds 2” to the depth of the 112.5kVA – 225kVA enclosure. (Option not available for 300kVA and 500kVA models.)
- E. NEMA 3R enclosure: UL listed NEMA 3R enclosure for outdoor installation. Enclosure is constructed using 14 gauge galvanized steel and provided with a durable powder coat paint finish. (Option not available for 300kVA and 500kVA models.)
- F. Lug kit: Mechanical (screw-type) lugs shipped for installer convenience. 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.
- G. Special designs: Special voltage configurations are available, including high leg delta designs.

2.9 Warranty

Controlled Power Company warrants the Ultra-K, Series 600K-*he* 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 are covered by a 2 year full replacement warranty. The warranty periods begin following the original factory ship date.