Ashley-Edison (UK)

K Factor Power Transformers

DTKF series

Low Voltage Dry Type

K Factor Power Transformers

The widespread use of static rectification equipments and electronics loads such as computers and adjustable-speed-drive motors in light industrial, commercial and residential loads have created a need to apply harmonic loading practices to transformers.

Transformers that are intended to supply loads with high harmonic content must be specified with a harmonic current distribution. Hence, a transformer has to be specially designed to cater such needs. To ensure the transformer is designed properly, our company has taken IEEE C57.110-1998 as the reference standard and tested accordance to IEC 60726.

In IEEE C57.110-1998 standard, in order to protect against transformer overheating caused by harmonics, designers can specify de-rated equipment, i.e., oversized transformers that will run at a fraction of their rated capacity, or K-factor transformers specifically designed to accommodate harmonic currents. K-factor transformers are preferred because they have additional thermal capacity of known limits, design features that minimize harmonic current losses, and neutral and terminal connections sized at 200% of normal. K-factor transformers allow operation up to nameplate capacity without de-rating.

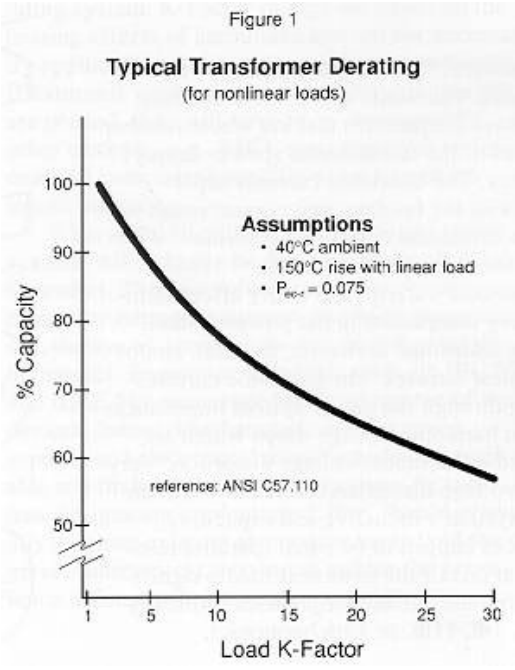
K-Factor transformers differ from standard transformers. They have additional thermal capacity to tolerate the heating effects of the harmonic currents. Beyond that, well-designed K-Factor transformers will also minimize the winding eddy current losses through the use of parallel conductors and other winding techniques. The K-Factor indicates the multiple of the 50 Hz winding eddy current losses that the transformer can safely dissipate: Transformer load losses consist of winding I^2R losses plus stray losses. Using UL1561 test methods, stray losses are assumed to be primarily winding eddy current losses for transformers 300 kVA and smaller. The result is a larger, more expensive transformer.

Figure 1 shows the relationship of a typical transformer capacity being de-rated as the K-factor increases.

For example,

For a load factor of K13, the capacity of the
A typical transformer is reduced by 27%.

Figure 1



Design Overview

K13 Dry Type Transformer is a 3 phase, indoor, insusceptibility to moisture, compact, common core and electro-statically shielded designed to provide a separately derived power source for computer and telecommunication equipment application. Its function is to absorb and reduce the harmonics generated by the equipments and to protect them from electrical noise and transient in the common modes. Due to isolation, there is no direct electrical connection between the primary and secondary within the transformer.

The K13 Transformer is designed and manufactured to operate at 100% rated current for both linear and non-linear odd harmonics load up to 25th harmonic. It is capable to withstand up to 27% overload with linear load at an ambient temperature of 40^{o}C.

Iron Core

- Cold rolled, oriented grain steel sheet with low specific losses, insulated on both sides by thin organic coating.

Windings

- Copper Strips with Class H (220^{o}C) enameled coated.
- Class H(NOMEX) Insulation material is used between overlapping turns or layers.
- Axial channels are used between layers of primary and secondary winding to provide air gap for uniform cooling.
- High temperature tolerant fiberglass boards are used as bobbins to separate the core and windings.
- Sized, transposed and shaped to minimize Eddy current losses.
- Sized additional 27% to carry triplen harmonics circulating current effect in the delta without overheating the transformer.
- Fully impregnated with class H varnish and oven dried.
- Electrostatic screen

Neutral Conductor

- 200% Neutral conductor to cater for triplen and odd harmonics and unbalanced single phase loads.

Low Inrush Current

Special design measures are implemented to reduce the inrush current, such as
- Primary winding at outer layers to increase resistance
- High grade iron core with high saturation to prevent core saturation during startup.

Protection Devices(Optional)

Thermal protection devices;
- Thermister (Normally Closed, activated at 160^{o}C)
- Digital Temperature Controller
- Relays (for Auxiliary contacts)

Testing

- Insulation Test at 1000Vdc and Hi-potential test at 2.5KV
- Resistance Test
- Open circuit Test (No-load Test)
- Short circuit Test
- Temperature Rise Test
- Noise Level Test

Standards

In accordance with standards:

- IEC 60726 Dry Type Transformers
- IEEE C57.110-1998 Establishing Transformer
  When supplying nonsinusoidal load currents;
- Quality Assurance ISO 9001:2000
  DNV Certification no. 0459-2003-AQ-SIN-RVA
- Conforming to European Union standards, EN 61558

Electrical Characteristics – K13 (50kVA – 400kVA)

Rated Power (Kva)		50	75	100	150	175	200	250	300	350	400
Rated Primary Voltage		Up to 690 Vac									
Secondary Voltage (At No Load)		Up to 690 Vac									
Frequency		50/60Hz									
Vector Group		Dyn11 (If not specified)									
Insulation Type		Class H									
Test Voltage		2.5kVac, 1 min									
Enclosure Protection Degree		IP21									
Max Ambient Temperature(^{O}c)		40									
Max Allowable Temperature Rise(^{O}c)		150									
Approx Impedance Voltage (%)		2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.5	3.5
Noise Level At 1m (dB)		45	45	48	50	50	51	51	52	53	54
Losses (W)	No-load Iron losses	400	500	600	700	800	900	1000	1100	1200	2500
	On-Load Copper losses	800	1000	1500	2000	2800	3200	4000	4500	5000	5500

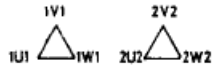
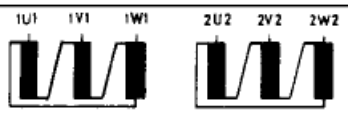
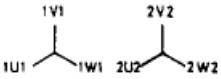
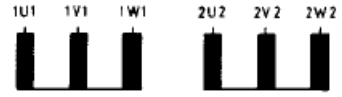
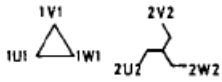
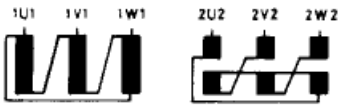
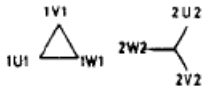
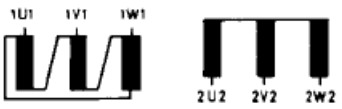
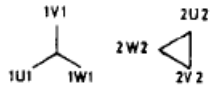
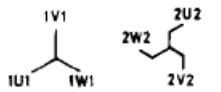
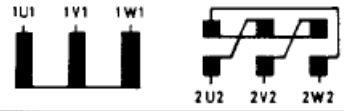
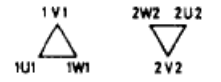
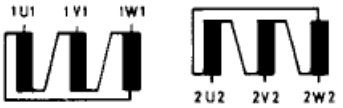
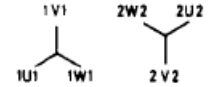
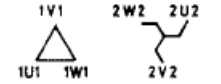
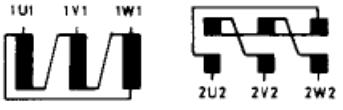
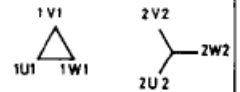
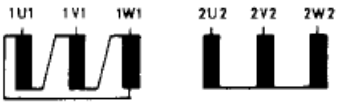
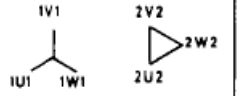
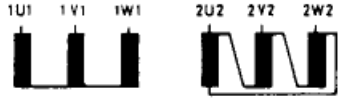
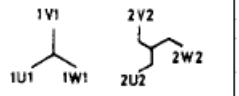
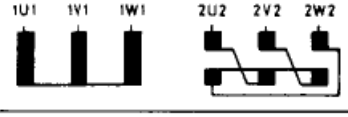
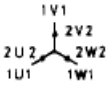
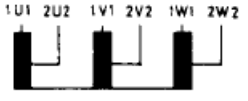
Electrical Characteristics – K13 (450kVA – 1000kVA)

Rated Power (Kva)		450	500	550	650	750	800	850	900	950	1000
Rated Primary Voltage		Up to 690 Vac									
Secondary Voltage (At No Load)		Up to 690 Vac									
Frequency		50/60Hz									
Vector Group		Dyn11 (If not specified)									
Insulation Type		Class H									
Test Voltage		2.5kVac, 1 min									
Enclosure Protection Degree		IP21									
Max Ambient Temperature(^{O}c)		40									
Max Allowable Temperature Rise(^{O}c)		150									
Approx Impedance Voltage (%)		3.5	3.5	3.5	4.0	4.0	4.0	4.0	5.0	5.0	5.0
Noise Level At 1m (dB)		55	56	56	57	57	58	58	60	60	61
Losses (W)	No-load Iron losses	3600	4000	4400	5200	6000	6400	6800	7000	7500	8000
	On-Load Copper losses	6000	6500	7000	7500	8200	9000	9500	10000	10500	11000

Non-standard ratings available upon request

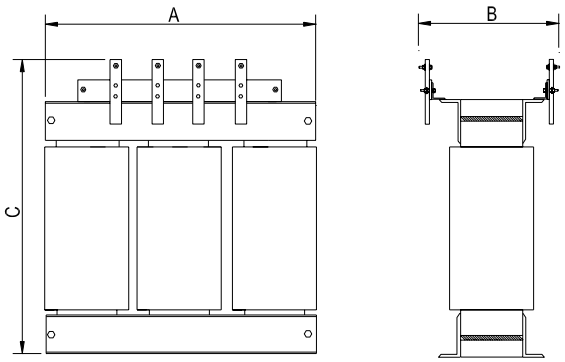
Vector groups

The vector group marks the circuitry of windings and their phase position to each other. It consists of a capital and small letter plus a code number. The capital letter refers to the input winding, the small to the output winding. The upper voltage is marked by 1 in front, the undervoltage by a 2 in front, regardless of input or output voltage. The numbers correlate to letters U V W and distinguish the 3 phases. The neutral point (star point) is always marked N.

Designation Code no.	Vector group	Vector diagram	Circuit configuration	Secondary star point
0	Dd0			none
	Yy0			10% load capacity
	Dz0			full load capacity
5	Dy5			full load capacity
	Yd5			none
	Yz5			full load capacity
6	Dd6			none
	Yy6			10% load capacity
	Dz6			full load capacity
11	Dy11			full load capacity
	Yd11			none
	Yz11			full load capacity
0	Ya0			10% load capacity

Dimensions and weights - without enclosure housing(IP00)

(1) Dimensions and weights indicated apply to the transformers with electrical characteristics shown in the previous table and subjected to minor variation of ± 5%.



Dimensions: 50-400KVA

Rated power (kVA)		50	75	100	150	175	200	250	300	350	400
Dimensions (mm)	A	500	600	650	720	800	850	880	900	930	960
	B	300	330	350	380	380	400	450	450	480	480
	C	550	650	700	750	800	850	900	950	980	1000
Approx Weight (Kg)		280	400	500	650	800	900	980	1050	1150	1200

Dimensions: 450-1000KVA

Rated power (kVA)		450	500	550	650	750	800	850	900	950	1000
Dimensions (mm)	A	1000	1050	1100	1200	1300	1400	1450	1500	1550	1600
	B	500	550	600	650	700	750	800	850	900	950
	C	950	1000	1050	1200	1350	1450	1600	1700	1800	2000
Approx Weight (Kg)		1350	1400	1500	1650	1800	1900	2000	2150	2350	2550

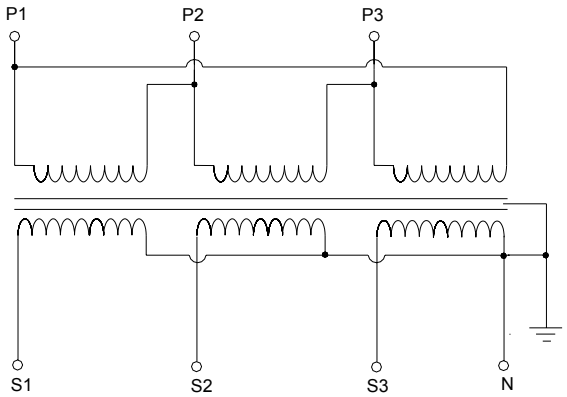
Customized configuration available upon request.

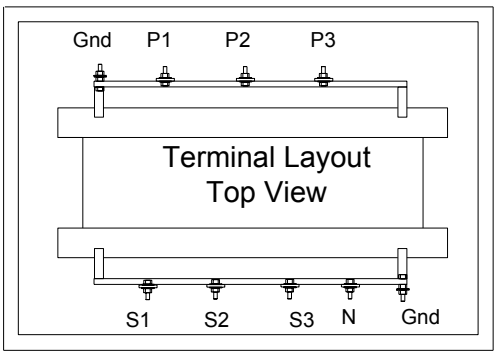
Schematic And Terminal Layout

Vector Group :Dyn11

(1) Electrostatic screen and neutral are solidly grounded.

(2) P1, P2, P3 refer to primary; S1, S2, S3 refer to secondary.





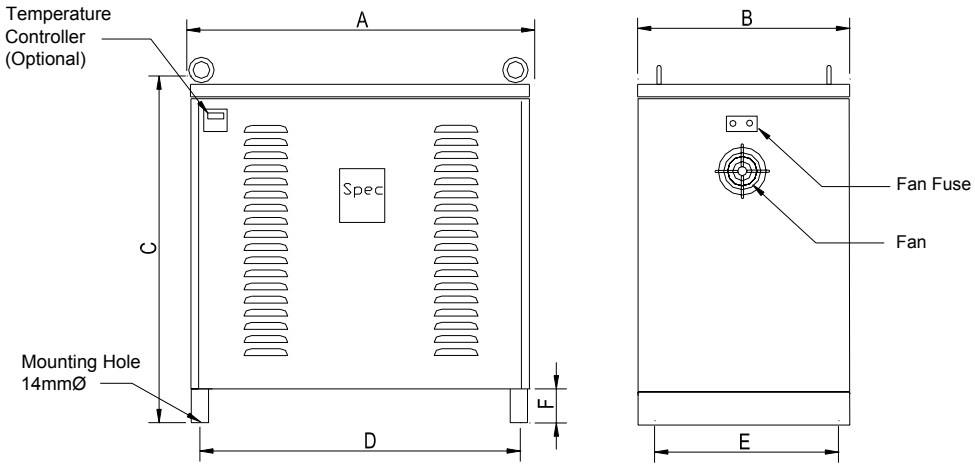
Dimensions and weights - with metal enclosure IP21

Accessories:

- ❑ Rating Plate
- ❑ Earthing points
- ❑ Lifting Lugs
- ❑ Mounting skids
- ❑ Forced air cooled fans
- ❑ Busbar terminals for primary and secondary
- ❑ Metal enclosure IP21
- ❑ Electrostatic screen

Optional

- ❑ Thermistors
- ❑ Temperature Controller
- ❑ Protection Relay (for Auxiliary Contacts)



Dimensions: 50-400KVA

Rated power (kVA)		50	75	100	150	175	200	250	300	350	400
No of Fans		2 X 4"	2 X 4"	2 X 6"	2 X 6"	2 X 6"	4 X 6"	4 X 6"	4 X 6"	6 X 6"	6 X 6"
Dimensions (mm)	A	700	800	950	950	1000	1100	1200	1200	1300	1300
	B	550	600	650	650	700	750	800	800	850	900
	C	800	900	1000	1000	1100	1100	1200	1250	1300	1400
	D	660	760	910	910	950	1050	1150	1150	1225	1225
	E	400	500	550	550	550	550	600	600	650	700
	F	100									
Approx Weight (Kg)		300	430	530	700	850	950	1050	1150	1250	1350

Dimensions: 450-1000KVA

Rated power (kVA)		450	500	550	650	750	800	850	900	950	1000
No of Fans		6 X 6"	8 X 6"	8 X 6"	12X6"	12X6"	12X6"	16X6"	16X6"	16 X 6"	16X 6"
Dimensions (mm)	A	1400	1500	1500	1600	1700	1700	1800	2000	2000	2000
	B	900	900	950	950	1000	1000	1050	1100	1200	1200
	C	1500	1600	1700	1800	1900	2000	2100	2200	2300	2500
	D	1325	1425	1425	1525	1625	1625	1725	1925	1925	1925
	E	700	700	750	750	800	800	850	900	1000	1000
	F	100									
Approx Weight (Kg)		1500	1600	1700	1800	2000	2100	2200	2400	2600	2800

Note: Number of fans and louvers are added depending on the capacity of transformer.

Ordering Specifications

AET Dry Type Transformer DTKF series, in accordance with IEC 60726, EN 61558, IEEE C57.110-1998 for high harmonic environment application, suitable for indoor use, in ventilated rooms with a room temperature of -15°C / +40°C.

Mandatory Information for quotation/order:

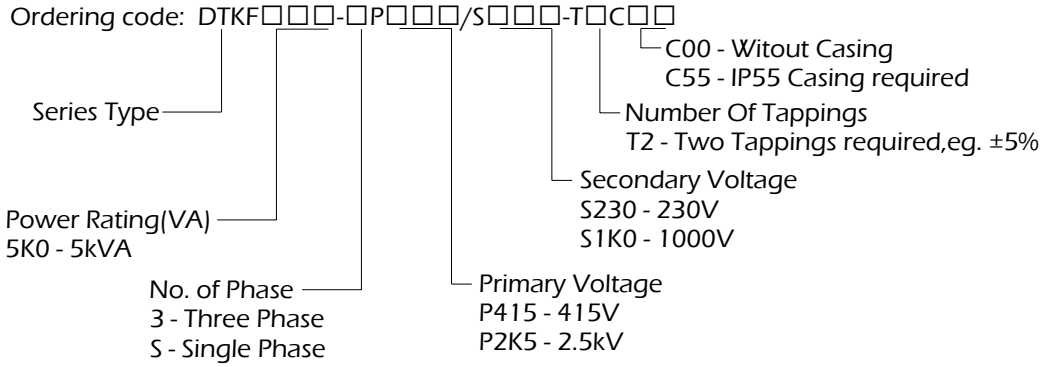
Rated Power (kVA)	:
No. of Phase	:
Input Voltage	:
Output Voltage	:
Frequency	:
Vector Group	:
Enclosure Protection Degree:	:
Quantity	:

Standard Material

- Iron Core:
- Cold rolled, oriented grain steel sheet insulated on both sides by thin organic coating.
- Windings:
- Copper Strips with Class H (220°C) enameled coated.
- Class H(NOMEX) Insulation material.
- Fully impregnated with class H varnish and oven dried.
- Oversized by additional 27% of the rated current.
- 200% Neutral conductor
- Electrostatic screen

Optional components:

- Thermal protection devices
- Thermister (Normally Closed, activated at 160°C)
- Digital Temperature Controller
- Relays (for Auxiliary contacts)



Example, DTKF250-3P400/S230-T1C00 denote;
250kVA, 3 Phase transformer with input voltage 400V step-down to 230V, casing not required.
Frequency by default will be 50/60Hz if not specified.