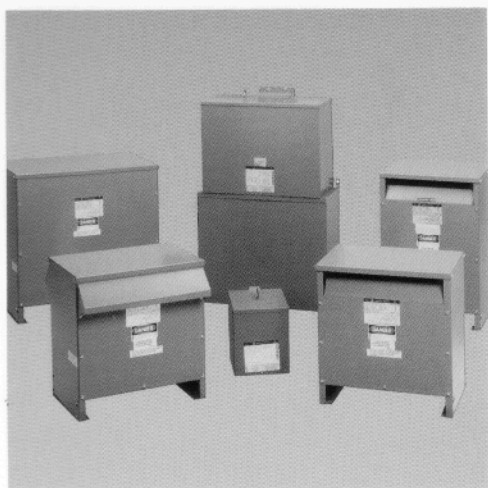


Dry Type Transformers



Application Guide



SQUARE D
GROUPE SCHNEIDER

This application guide is designed to provide a handy pocket reference for those who need to select and apply dry-type transformers in the course of their vocation. The information is also of use in all electrical work. Because it is a pocket guide, the information is brief and abbreviated, for detailed data and full descriptions on products ask your distributor.

SPECIAL TRANSFORMERS

Square D will build most special dry-type transformers your application requires. Your Square D distributor, Square D field sales representatives, or transformer headquarters will be happy to assist you in selecting the proper transformer. Data required to help you is: KVA or Load Amperage - Primary Voltage - Secondary or Load Voltage - Phase - Frequency - Taps - Insulation Class and Temperature Rise - Type of Enclosure - Sound Level - Physical Limitations - Accessories Required.

TRANSFORMERS AVAILABLE FROM YOUR DISTRIBUTOR'S STOCK

■ *Single Phase Loads*

Voltage: 240 x 480 — 120/240

Ratings: .050 — 167 KVA

Voltage: 480 — 120/240

Ratings: 3 — 25 KVA

Voltage: 600 — 120/240

Ratings: 3 — 50 KVA

■ *Three Phase Loads*

Voltage: 480 Δ — 208Y/120

Ratings: 3 — 500 KVA

Voltage: 480 Δ — 240 Δ

Ratings: 6 — 500 KVA

Voltage: 600 Δ — 208Y/120

Ratings: 6 — 75 KVA

■ *Buck and Boost (Single Phase)*

Voltage: 120 x 240 — 12/24 or 16/32

Ratings: .05 — 3 KVA

These are primarily used for boosting 208V to 230V or 240V, single or three phase. See page 7 for connection diagram.

Your local Square D distributor carries many of the above transformers in his stock. He is also advised weekly of factory stock levels. Feel free to call him for information and pricing.

**Full Load Current in Amperes
Single Phase Dry-Type Transformers**

* KVA Rating	Rated Line Voltage									
	120	240	277	480	600	2400	4160	7200	7620	13200
.25	2.08	1.04	.9	0.52	0.42					
.5	4.16	2.08	1.8	1.04	0.84	0.21	0.12			
.75	6.24	3.12	2.7	1.56	1.2	0.3	0.18			
1.0	8.33	4.16	3.6	2.08	1.6	0.4	0.24			
1.5	12.5	6.24	5.4	3.12	2.4	0.6	0.36	.21	.20	.114
2.0	16.66	8.33	7.2	4.16	3.2	0.8	0.48	.28	.26	.151
3.0	25	12.5	10.8	6.1	4.8	1.2	0.72	.42	.39	.23
5.0	41	21	18	10.4	8.3	2.0	1.2	.70	.66	.38
7.5	62	31	27	15.6	12.5	3.1	1.8	1.04	.98	.57
10.0	83	42	36	21	16.5	4.1	2.4	1.39	1.31	.76
15.0	124	62	54	31	25	6.2	3.6	2.10	1.97	1.14
20.0	166	83	72	42	33	8.2	4.8	2.78	2.62	1.5
25.0	208	104	90	52	42	10.4	6	3.48	3.28	1.9
30.0	249	125	108	62	50	12.5	7	4.18	3.94	2.3
37.5	312	156	135	78	62	15.6	9	5.2	4.92	2.8
50	416	208	180	104	84	21	12	6.9	6.56	3.8
75	624	312	270	156	124	31	18	10.4	9.85	5.6
100	830	415	360	207	168	42	24	13.9	13.1	7.5
125	1040	520	450	260	208	52	30	17.3	16.4	9.5
150	1248	624	540	312	248	62	36	20.8	19.7	11.8
167	1390	695	601	348	278	70	40	23.2	21.9	12.6
200	1660	833	720	416	336	84	48	27.8	26.2	15.0
250	2080	1040	900	520	420	105	60	34.8	32.8	19
333	2780	1390	1199	695	555	139	80	46.0	43.6	25
400	3320	1660	1440	830	672	168	96	55.6	52.5	30
500	4160	2080	1800	1040	840	210	120	69.5	65.5	38
600	5000	2500	2160	1250	1000	250	144	83.6	78.7	45
750	6240	3120	2700	1560	1240	310	180	104	98.5	57
1000	8300	4150	3600	2075	1680	420	240	139	131	76

* NOTE: KVA ratings in italics are not NEMA standard sizes, but are available on special order.

Formula: Single Phase KVA = Volts x Load Amperes/1000

**Full Load Current in Amperes
Three Phase Dry-Type Transformers**

* KVA Rating	Rated Line Voltage										
	120	208	240	480	600	2400	4160	7200	7620	12470	13200
6	28.8	16.6	14.4	7.2	5.8	1.4	.83	.48	.45	.28	.26
9	43.2	25.0	21.6	10.8	8.7	2.2	1.2	.72	.68	.42	.39
10	48.0	27.7	24	12	9.6	2.4	1.4	.8	.76	.46	.44
15	72.0	41.6	36	18	14.4	3.6	2.08	1.2	1.1	.69	.65
20	96	55.5	48	24	19.0	4.8	2.8	1.6	1.5	.92	.9
25	120	69.5	60	30	24.0	6.0	3.5	2.0	1.9	1.16	1.1
30	144	83.0	72	36	28.8	7.2	4.2	2.4	2.3	1.39	1.3
37.5	180	104	90	45	36	9.0	5.2	3.0	2.8	1.74	1.6
45	216	125	108	54	43	10.8	6.2	3.6	3.4	2.08	2.0
50	240	138	120	60	48	12	7.0	4	3.8	2.3	2.2
75	360	208	180	90	72	18	10.4	6	5.7	3.5	3.3
100	480	278	240	120	96	24	14.0	8	7.6	4.6	4.3
112.5	540	312	270	135	108	27	15.6	9	8.5	5.2	4.9
150	720	415	360	180	144	36	21.0	12	11.4	6.9	6.6
200	960	554	480	240	192	48	28.0	16	15.2	9.2	8.6
225	1080	625	540	270	216	54	31.2	18	17.1	10.4	9.8
250	1200	695	600	300	240	60	35.0	20	18.9	11.6	10.8
300	1440	830	720	360	288	72	42.0	24	22.8	13.9	13.2
400	1920	1110	960	480	384	96	55.6	32	30.4	18.5	17.5
500	2400	1380	1200	600	480	120	70	40	38	23.1	22.0
600	2880	1660	1440	720	576	144	84	48	45.6	27.7	26.2
750	3600	2080	1800	900	720	180	104	60	57	34.7	33
1000	4800	2780	2400	1200	960	240	140	80	76	46.2	44
1500	7200	4150	3600	1800	1440	360	208	120	114	69.4	66
2000	9600	5540	4800	2400	1920	480	278	160	151	92.4	87

* NOTE: KVA ratings in italics are not NEMA standard sizes, but are available on special order.

Formula: Three Phase KVA = Volts x Load Amperes x 1.73/1000

The following tables have been reproduced through the courtesy of the National Fire Protection Association from the National Electric code 1993 Edition.

TABLE 310-16. Allowable Ampacities of Insulated Conductors Rated 0-2000 Volts, 60° to 90°C (140° to 194°F) Not More than Three Conductors in Raceway or Cable or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F)

Size	Temperature Rating of Conductor. See Table 310-13.						Size
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
AWG kcmil	Types TW†, UF†	Types FEPW†, RH†, RHW†, THHW†, THW†, THWN†, XHHW†, USE†, ZW†	Types TA, TBS, SA, SIS, FEP†, FEPB†, MI, RHH†, RHW- 2, THHN†, THHW†, THW-2, THWN-2, USE-2, XHH, XHHW†, XHHW-2, ZW-2	Types TW†, UF†	Types RH†, RHW†, THHW†, THW†, THWN†, XHHW†, USE†	Types TA, TBS, SA, SIS, THHN†, THHW†, THW-2, THWN-2, RHH†, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	AWG kcmil
	Copper			Al or Copper-Clad Al			
18	....	....	14	....	....	....	....
16	....	....	18	....	....	....	....
14	20†	20†	25†	....	....	....	....
12	25†	25†	30†	20†	20†	25†	12
10	30	35†	40†	25	30†	35†	10
8	40	50	55	30	40	45	8
6	55	65	75	40	50	60	6
4	70	85	95	55	65	75	4
3	85	100	110	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	150	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	190	230	255	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500
600	355	420	475	285	340	385	600
700	385	460	520	310	375	420	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	450	800
900	435	520	585	355	425	480	900
1000	455	545	615	375	445	500	1000
1250	495	590	665	405	485	545	1250
1500	520	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	560	665	750	470	560	630	2000
Correction Factors							
Amb Temp °C	For ambient temperatures other than 30°C (86°F), multiply the allowable ampacities shown above by the appropriate factor shown below.						Amb Temp °F
21-25	1.08	1.05	1.04	1.08	1.05	1.04	70-77
26-30	1.00	1.00	1.00	1.00	1.00	1.00	78-86
31-35	.91	.94	.96	.91	.94	.96	87-95
36-40	.82	.88	.91	.82	.88	.91	96-104
41-45	.71	.82	.87	.71	.82	.87	105-113
46-50	.58	.75	.82	.58	.75	.82	114-122
51-55	.41	.67	.76	.41	.67	.76	123-131
56-60	....	.58	.71	....	.58	.71	132-140
61-70	....	.33	.58	....	.33	.58	141-158
71-80	....	....	.41	....	....	.41	159-176

Unless otherwise specifically permitted elsewhere in this Code, the overcurrent protection for conductor types marked with an obelisk (†) shall not exceed 15 amperes for No. 14, 20 amperes for No. 12, and 30 amperes for No. 10 copper; or 15 amperes for No. 12 and 25 amperes for No. 10 aluminum and copper-clad aluminum after any correction factors for ambient temperature and number of conductors have been applied.

TABLE 310-18. Allowable Ampacities of Three Single Insulated Conductors Rated 0-2000 Volts, 150 to 250 C (302 to 482 F) in Raceway or Cable Based on Ambient Air Temperature of 40 C (104F)

Size AWG kcmil	Temperature Rating of Conductor. See Table 310-13.				Size AWG kcmil
	150°C (302°F)	200°C (392°F)	250°C (482°F)	150°C (302°F)	
	Type Z Copper	Types FEP, FEPB, PFA Copper	Types PFAH, TFE Nickel or Nickel- Coated Copper	Type Z Aluminum or Copper-Clad Aluminum	
14	34	36	39	....	14
12	43	45	54	30	12
10	55	60	73	44	10
8	76	83	93	57	8
6	96	110	117	75	6
4	120	125	148	94	4
3	143	152	166	109	3
2	160	171	191	124	2
1	186	197	215	145	1
1/0	215	229	244	169	1/0
2/0	251	260	273	198	2/0
3/0	288	297	308	227	3/0
4/0	332	346	361	260	4/0
250	....	....	....	....	250
300	....	....	....	....	300
350	....	....	....	....	350
400	....	....	....	....	400
500	....	....	....	....	500
600	....	....	....	....	600
700	....	....	....	....	700
750	....	....	....	....	750
800	....	....	....	....	800
1000	....	....	....	....	1000
1500	....	....	....	....	1500
2000	....	....	....	....	2000
Correction Factors					
Ambient Temp. °C	For ambient temperatures other than 40°C (104°F), multiply the allowable ampacities shown above by the appropriate factor shown below.				Ambient Temp. °F
41-50	.95	.97	.98	.95	105-122
51-60	.90	.94	.95	.90	123-140
61-70	.85	.90	.93	.85	141-158
71-80	.80	.87	.90	.80	159-176
81-90	.74	.83	.87	.74	177-194
91-100	.67	.79	.85	.67	195-212
101-120	.52	.71	.79	.52	213-248
121-140	.30	.61	.72	.30	249-284
141-160	....	.50	.65	....	285-320
161-180	....	.35	.58	....	321-356
181-200	....	....	.49	....	357-392
201-225	....	....	.35	....	393-437

TABLE 3A
Maximum Number of Conductors in Trade Sizes of Conduit
or Tubing (Based on Table 1, Chapter 9)

Conduit Trade Size (Inches)	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6
Conductor Size AWG, kcmil												
*14	9	15	25	44	60	99	142					
*12	7	12	19	35	47	78	111	171				
*10	5	9	15	26	36	60	85	131	176			
**8	2	4	7	12	17	28	40	62	84	108		
**14	6	10	16	29	40	65	93	143	192			
**10	4	6	11	19	26	43	61	95	127	163		
*8	1	3	5	10	13	22	32	49	66	85	133	
***6	1	2	4	7	10	16	23	36	48	62	97	141
***3	1	1	2	4	6	10	15	23	31	40	63	91
***1/0		1	1	2	3	5	8	12	16	21	33	49
***2/0		1	1	1	3	5	7	10	14	18	29	41
***3/0		1	1	1	2	4	6	9	12	15	24	35
***4/0			1	1	1	3	5	7	10	13	20	29
***250			1	1	1	2	4	6	8	10	16	23
***300			1	1	1	2	3	5	7	9	14	20
***350			1	1	1	1	3	4	6	8	12	18
***400			1	1	1	2	4	5	7	11	16	
***500			1	1	1	1	3	4	6	9	14	
***600					1	1	1	3	4	5	7	11
***700					1	1	1	2	3	4	7	10
***750					1	1	1	2	3	4	6	9

Conductor Types

*TW, XHHW (14 thru 8), RH (14 & 12)

**RHW and RHH (without outer covering), THW, THHW, RH (10 & 8)

***TW, THW, FEPB (6 thru 2), RHW and RHH (without outer covering), RH, THHW

SOUND LEVELS

Square D Dry-Type Transformers are the quietest available, whether standard or special sound level limits are ordered. Testing is done in accordance with NEMA standards.

Sorgel Sound Levels	
600 Volts and Below	
KVA	NEMA Standard Sound Levels
0-9	40 dB
10-50	45 dB
51-150	50 dB
151-300	55 dB
301-500	60 dB
501-700	62 dB
701-1000	64 dB

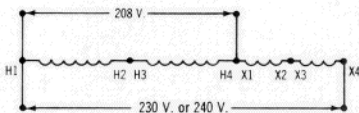
NOTE: Lower sound levels than those shown above are available at a slight additional charge.

BUCK AND BOOST

The nameplate rating on buck and boost transformers indicates the load they will handle as an insulating transformer. (Pri. 120 x 240, Sec. 12/24*, Ex.: A 1KVA buck and boost will reduce 120 or 240V to 12 or 24V and be able to carry a continuous load of 1KVA.) The majority of buck and boost transformers sold, however, are used to boost 208V to either 230V or 240V, or buck these voltages down to 208V. To use these transformers in this way, the primary and secondary windings are connected to form an auto transformer as follows:

SINGLE PHASE

Connect H2 to H3
X1 to H4
X2 to X3



Connect 208V to H1 and H4-X1
Connect 230V or 240V to H1 and X4
KVA Capacity - 10 x Nameplate Rating

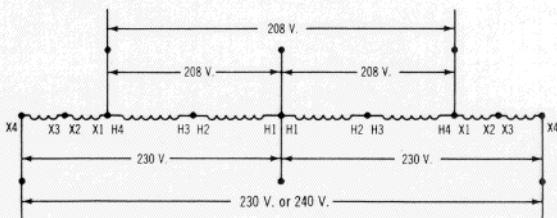
**Also available with 16/32 volt secondary to boost 208V to 240V.*

THREE PHASE, Open Delta-Power Loads Only (Use 2 Single Phase Units)

Connect
On each unit X3 to X2
X1 to H4
H3 to H2

NOTE: This connection for power loads only. Three phase lighting loads require (3) transformers, and source neutral must be carried through to load.

Then connect H1's from each unit.
Connect 208V to X1-H4, H1-H1, H4-X1
Connect 230V or 240V to X4, H1-H1, X4



Three Phase KVA Rating = (Total Nameplate KVA of Both Units x 10) x .86

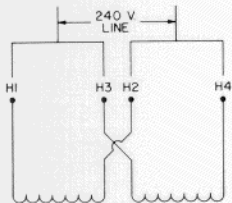
Note, when used as an auto transformer the buck and boost unit will carry greater loads than shown on the nameplate. For other uses and connections ask your distributor for a copy of the Product Data Bulletin 7414PD9301 or a "BUCK-BOOST SLIDE RULE". Check local codes relative to the use of auto transformers before applying buck and boost transformers.

SINGLE PHASE CONNECTIONS

Note: Non-standard ratings - increase to nearest larger standard.

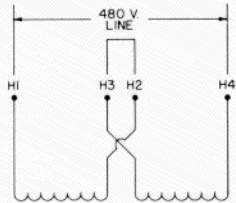
Type S Single Phase 240 x 480 to 120/240 Volts Primary Connections

240 Volt Service



Connect H1 & H3
Connect H2 & H4
Connect H1-H3 & H2-H4
to 240 Volt Service

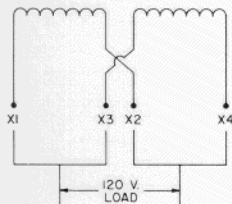
480 Volt Service



Connect H3 & H2
Connect H1 & H4
to 480 Volt Service

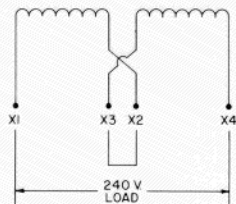
Secondary Connections

120 Volt 2-Wire Circuit



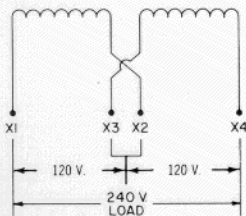
Connect X1 & X3
Connect X2 & X4
Connect Load
to X1-X3 & X2-X4

240 Volt 2-Wire Circuit



Connect X3 & X2
Connect Load
to X1 & X4

120/240 Volt 3-Wire Circuit

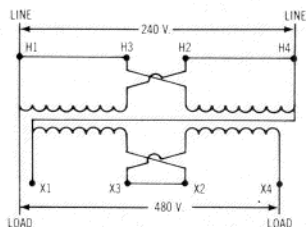


The junction of X3-X2 may be used as the neutral of a 3 wire system and must be grounded per N.E.C. requirements.

The following diagrams show special ways that standard 240x480 - 120/240 single phase transformers can be connected for special applications.

**Single Unit Connected as Auto Transformer
240 Volt to 480 Volt**

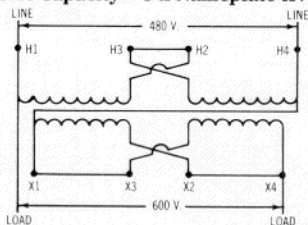
KVA Capacity = 2 x Nameplate KVA



$$\frac{\text{Load KVA}}{2} = \text{KVA Rating of Transformer Required}$$

**Single Unit Connected as Auto Transformer
480 Volt to 600 Volt**

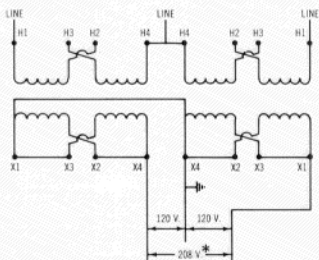
KVA Capacity = 5 x Nameplate KVA



$$\frac{\text{Load KVA}}{5} = \text{KVA Rating of Transformer Required}$$

Two unit transformers connected in "Hoppy Hookup" for single phase lighting and single phase power loads from three phase supply.

This connection allows changeover of existing single phase service to three phase service without changing existing lighting panels or secondary neutrals. The neutral current will be the same as with the original single phase service rather than increasing by the factor of 1.73 (3). Note: The primary common current will be the 3 x the current in the other two lines.



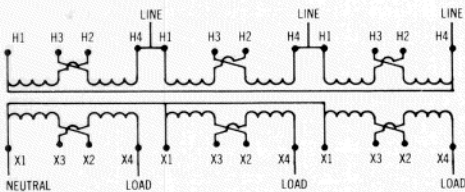
For 480 Volt Primary - Connect H2 to H3 in Each Unit
For 240 Volt Primary - Connect H3 to H1 and H2 to H4 in Each Unit
Secondary KVA Capacity = Total Nameplate KVA of Both Transformers

*Secondary voltage is 120/208 Volt, 3-wire only; NOT 120/240 Volt, 3-wire.

THREE PHASE CONNECTIONS

Note: Non-standard ratings - increase to nearest larger standard, using single phase 240 x 480 to 120/240.

Three Units Connected Delta-Wye, for Three Phase Operation

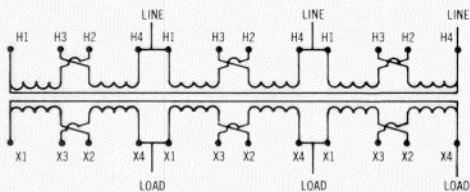


For 480 Volt Delta Primary -
Connect H3 to H2 in Each Phase
For 240 Volt Delta Primary -
Connect H3 to H1
and H2 to H4 in Each Phase

For 416Y/240 Volt Secondary -
Connect X3 to X2 in Each Phase
For 208Y/120 Volt Secondary -
Connect X3 to X1 and X2 to X4
in Each Phase

Three Phase KVA Capacity = Total KVA of Three Units

Three Units Connected Delta Delta, for Three Phase Operation

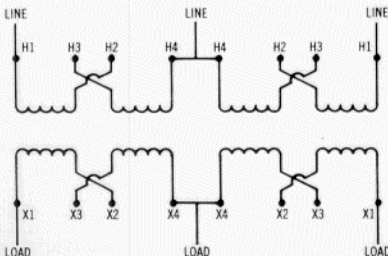


For 480 Volt Delta Primary -
Connect H3 to H2 in Each Phase
For 240 Volt Delta Primary -
Connect H3 to H1
and H2 to H4 in Each Phase

For 240 Volt Delta Secondary -
Connect X3 to X2 in Each Phase
For 120 Volt Delta Secondary -
Connect X3 to X1 and X2 to X4
in Each Phase

Three Phase KVA Capacity = Total KVA of Three Units

Two Units Connected Open Delta

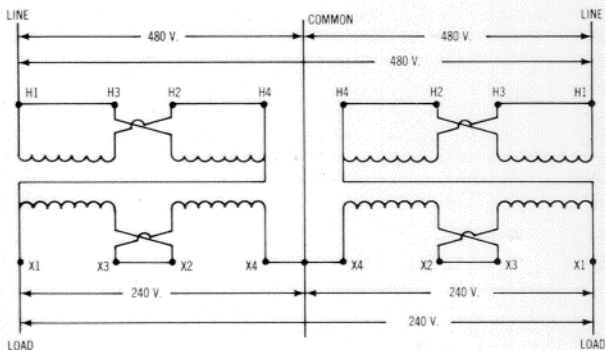


For 480 Volt Delta Primary - Connect H3 to H2 in Each Phase
For 240 Volt Delta Primary - Connect H3 to H1 and H2 to H4 in Each Phase
For 240 Volt Delta Secondary - Connect X3 to X2 in Each Phase
For 120 Volt Delta Secondary - Connect X3 to X1 and X2 to X4 in Each Ph.
Three Phase KVA Capacity = Total KVA of Both Units x .86

$$\frac{\text{Load KVA}}{1.73} = \text{KVA of Each Single Phase Unit}$$

**Two Units Connected as Open Delta Auto Transformer
for Three Phase Operation**

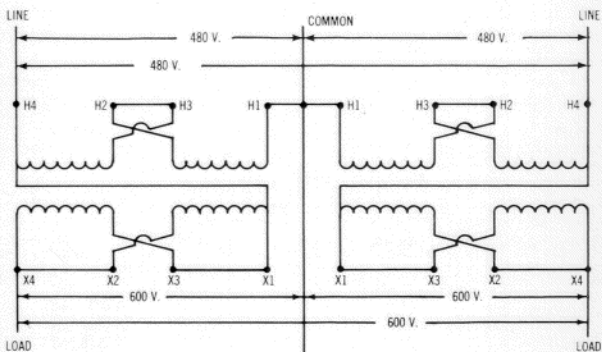
Three Phase KVA Capacity = (Total KVA of Both Units x 2) x .86



$$\frac{\text{Load KVA}}{3.44} = \text{KVA of Each Single Phase Unit}$$

**Two Units Connected as Open Delta Auto Transformer
for Three Phase Operation**

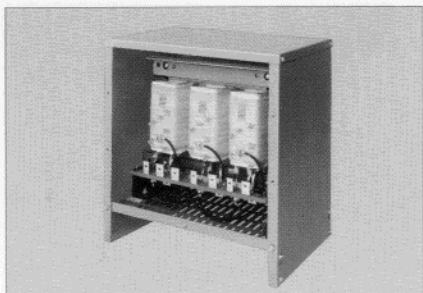
Three Phase KVA Capacity = (Total KVA of Both Units x 5) x .86



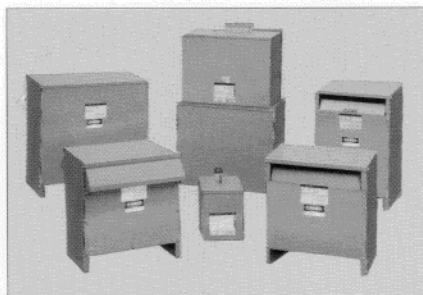
$$\frac{\text{Load KVA}}{8.6} = \text{KVA of Each Single Phase Unit}$$

Note: Can be used for 480 Volt, 3-wire to 384 Volt, 3-wire as follows:

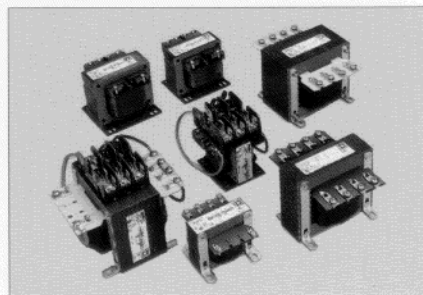
$$\frac{\text{Load KVA}}{6.88} = \text{KVA of Each Single Phase Unit}$$



Non-Linear Transformers— Square D expertise in power management is evident with the broad line of transformers for non-linear loads.



General Purpose Transformers— Square D's general purpose and lighting transformers are known as the industry standard.



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