

Selection Steps

- A. An online transformer product selector is available in the Transformer section of our website or you can use the following steps below to manually select a transformer.
- B. Find the electrical load requirements. These are:
1. Load operating voltage.
 2. Load frequency (expressed in Hz).
 3. Determine load size - usually expressed in kVA, amperage or horsepower.
 4. Is the load designed to operate on single phase or three phase power?

This information is available from the equipment manufacturer and is typically listed on the nameplate of the equipment.

- C. Know the supply voltage conditions:
1. Available source voltage.
 2. Available source frequency (a transformer will not change frequency. The frequency of the supply voltage and the needed load voltage must be equal).
 3. Number of phases on power source.
- D. Determine the transformer kVA rating:
1. If the load is expressed in kVA, select the appropriate transformer from the following selection charts (make sure the selected transformer's kVA rating is equal to or greater than the required load kVA).
 2. If the load is expressed in amperage, use either the appropriate kVA formula listed below or the appropriate sizing chart on the next page.

$$\text{kVA (1}\phi\text{)} = \frac{\text{Volts} \times \text{Amps}}{1000}$$

$$\text{kVA (3}\phi\text{)} = \frac{\text{Volts} \times \text{Amps} \times 1.732}{1000}$$



3. If the load is expressed in wattage, either utilize the formula below to convert to kVA or refer to the equipment nameplate to obtain amperage requirement.

$$\text{kVA} = \frac{\text{Wattage}}{(1000 \times \text{Power Factor of the load})}$$

4. If the load is a motor and expressed in horsepower, refer to the motor horsepower charts on the next page.

Some sizes may require an optional weather shield (order separately) for outdoor use.

Always size the transformer to the load requirements.

Single Phase:
Full Load Current Chart

kVA Rating	120 V	208 V	240 V	277 V	480 V	600 V
Amperes						
0.05	0.42	0.24	0.21	0.18	0.1	0.08
0.075	0.63	0.36	0.31	0.27	0.16	0.13
0.1	0.83	0.48	0.42	0.36	0.21	0.17
0.15	1.3	0.72	0.63	0.54	0.31	0.25
0.25	2.1	1.2	1	0.9	0.52	0.42
0.5	4.2	2.4	2.1	1.8	1.4	0.83
0.75	6.3	3.6	3.1	2.7	1.6	1.3
1	8.3	4.8	4.2	3.6	2.1	1.7
1.5	12.5	7.2	6.3	5.4	3.1	2.5
2	16.7	9.6	8.3	7.2	4.2	3.3
3	25	14.4	12.5	10.8	6.3	5
5	41.7	24	20.8	18.1	10.4	8.3
7.5	62.5	36.1	31.3	27.1	15.6	12.5
10	83.3	48.1	41.7	36.1	20.8	16.7
15	125	72.1	62.5	54.2	31.3	25.0
25	208.3	120.2	104.2	90.3	52.1	41.7
37.5	312.5	180.3	156.3	135.4	78.1	62.5
50	416.7	240.4	208.3	180.5	104.2	83.3
75	625	361	313	271	156	125.0
100	833	481	417	361	208	167.0
167	1392	803	696	603	348	278.0
200	1667	962	833	722	417	333.0
250	2083	1202	1042	903	521	417.0

Three Phase: Full Load Current Chart

kVA Rating	208 V	240 V	480 V	600 V
Amperes				
3	8.3	7.2	3.6	2.9
6	16.7	14.4	7.2	5.8
9	25	21.7	10.8	8.7
15	41.6	36.1	18	14.4
30	83.3	72.2	36.1	28.9
45	125	108.3	54.1	43.3
75	208.2	180.4	90.2	72.2
112.5	312	271	135	108.0
150	416	361	180	144.0
225	625	541	271	217.0
300	833	722	361	289.0
500	1388	1203	601	481.0

Single Phase Motor Chart:
AC, Motor Horsepower Amperage

Horse Power	115 V	208 V	230 V	460 V	575 V	Mini Tfmr. kVA	Std. NEMA kVA Size
1/6	4.4	2.4	2.2	1.1	0.9	0.53	0.75
¼	5.8	3.2	2.9	1.4	1.2	0.7	0.75
1/3	7.2	4	3.6	1.8	1.4	0.87	1
½	9.8	5.4	4.9	2.5	2	1.2	1.5
¾	13.8	7.6	6.9	3.5	2.8	1.7	2
1	16	8.8	8	4	3.2	1.9	2
1½	20	11	10	5	4	2.4	3
2	24	13.2	12	6	4.8	2.9	3
3	34	18.7	17	8.5	6.8	4.1	5
5	56	30.8	28	14	11.2	6.7	7.5
7.5	80	44	40	21	16	9.6	10
10	100	55	50	26	20	12	15

Three Phase Motor Chart:
AC, Motor Horsepower Amperage

Horse Power	208 V	230 V	460 V	575 V	Mini Tfmr. kVA	Std. NEMA kVA Size
½	2.2	2	1	0.8	0.9	3.0
¾	3.1	2.8	1.4	1.1	1.2	3.0
1	4	3.6	1.8	1.4	1.5	3.0
1½	5.7	5.2	2.6	2.1	2.1	3.0
2	7.5	6.8	3.4	2.7	2.7	3.0
3	10.7	9.6	4.8	3.9	3.8	6.0
5	16.7	15.2	7.6	6.1	6.3	9.0
7½	24	22	11	9	9.2	15.0
10	31	28	14	11	11.2	15.0
15	46	42	21	17	16.6	30.0
20	59	54	27	22	21.6	30.0
25	75	68	34	27	26.6	30.0
30	88	80	40	32	32.4	45.0
40	114	104	52	41	43.2	45.0
50	143	130	65	52	52	75.0
60	170	154	77	62	64	75.0
75	211	192	96	77	80	112.5
100	273	248	124	99	103	112.5
125	342	312	156	125	130	150.0
150	396	360	180	144	150	150.0
200	528	480	240	192	200	225.0

Three things to keep in mind:

- A. Motor horsepower charts are based on 1800 RPM squirrel cage induction motors. If using another type of motor, check running amperage against the chart and adjust as necessary.
- B. Increase required transformer kVA by 20% if motors are started more than once per hour.
- C. If your motor service factor is greater than 1, proportionally increase full load amperage. (i.e. – if service factor is 1.10, increase full load amperage by 10%).

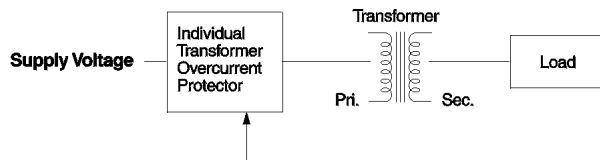
Are there any special application considerations?

- A. **For ambient conditions over 40°C**, derate the transformer nameplate kVA by 8% for each 10°C above 40°C.
- B. **For high altitude applications**, derate the transformer nameplate kVA by 0.3% for every 330 feet over 3300 feet above sea level. This assures proper transformer convection cooling.
- C. Some applications may require a transformer design that limits the BTU output of the unit at full load or a design to withstand and mitigate specific electrical anomalies.

Overcurrent Protection

Fusing and circuit breaker protection. How to overcurrent protect 600 Volt class transformers and associated wiring per NEC 450-3(b) and NEC 240-3.

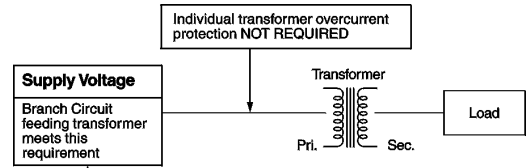
1. Primary protection only is required if the transformer is single-phase and the secondary has only two wires. Overcurrent protection rating and location are shown in Diagram A.



Primary Current	Overcurrent Protection Rating
Less than 2 amps	300% maximum
2 to 9 amps	167% maximum
9 amps or more	125% of rated primary current (or next highest standard rating)

Diagram A

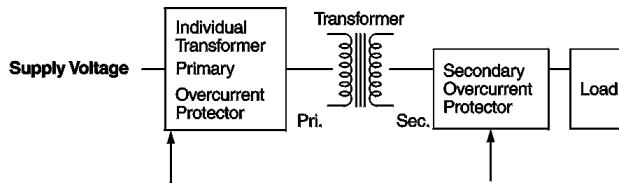
2. If the branch circuit feeding the transformer has overcurrent protection to meet the individual protection requirements in Example 1, then individual transformer protection is **not** required.



Primary Current	Overcurrent Protection Rating
Less than 2 amps	300% maximum
2 to 9 amps	167% maximum
9 amps or more	125% of rated primary current (or next highest standard rating)

Diagram B

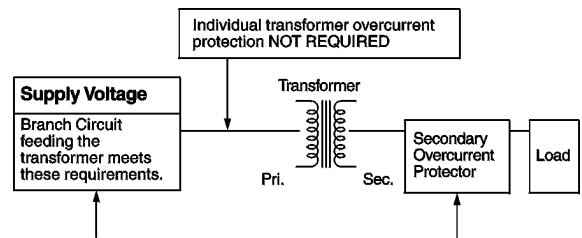
3. Primary and secondary protection is required if the transformer has more than two wires on the secondary circuit.



Primary Current	Secondary Current	Overcurrent Protection Rating
250% primary current	Less than 9 amps	167% maximum
Not more than 250%	9 amps or more	125% (or next higher standard rating)

Diagram C

4. If the branch circuit feeding the transformer has overcurrent protection to meet the individual primary overcurrent protection requirements in Example 3, then individual primary protection is **not** required. Secondary OCP is required as shown below.



Primary Current	Secondary Current	Overcurrent Protection Rating
250% primary current	Less than 9 amps	167% maximum
Not more than 250%	9 amps or more	125% (or next higher standard rating)

Diagram D

Section 240.6 (a) of the 2008 National Electrical Code*

The standard ampere ratings for fuses and inverse time circuit breakers shall be considered 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110, 125, 150, 175, 200, 225, 250, 300, 350, 400, 450, 500, 600, 700, 800, 1000, 1200, 1600, 2000, 2500, 3000, 4000, 5000 and 6000 amperes. Additional standard ratings for fuses shall be considered 1, 3, 6, 10 and 601. The use of fuses and inverse time circuit breakers with nonstandard ampere ratings shall be permitted.

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Primary Fuse Recommendations

V _{in}	Primary Voltage												
	120	200	208	220	230	240	277	440	460	480	550	575	600
VA													
50	1.25 (2)	.75 (1.25)	.6 (1.13)	.6 (1.13)	.6 (1)	.6 (1)	.5 (.8)	.3 (.5)	.3 (.5)	.3 (.5)	.25 (.4)	.25 (.4)	.25 (.4)
75	1.8 (3)	1.13 (1.8)	1 (1.8)	1 (1.6)	.8 (1.6)	.8 (1.5)	.8 (1.25)	.5 (.8)	.4 (.8)	.4 (.75)	.4 (.6)	.3 (.6)	.3 (.6)
100	2.5 (4)	1.5 (2.5)	1.4 (2.25)	1.25 (2.25)	1.25 (2)	1.25 (2)	1 (1.8)	.6 (1.13)	.6 (1)	.6 (1)	.5 (.8)	.5 (.8)	.5 (.8)
150	3.5 (6.25)	2.25 (3.5)	2 (3.5)	2 (3.2)	1.8 (3.2)	1.8 (3)	1.6 (2.5)	1 (1.6)	.8 (1.6)	.8 (1.5)	.8 (1.25)	.75 (1.25)	.75 (1.25)
200	5 (8)	3 (5)	2.8 (4.5)	2.5 (4.5)	2.5 (4)	2.5 (4)	2 (3.5)	1.25 (2.25)	1.25 (2)	1.25 (2)	1 (1.8)	1 (1.5)	1 (1.6)
250	3 (5)	3.5 (6.25)	3.5 (6)	3.2 (5.6)	3.2 (5)	3 (5)	2.5 (4.5)	1.6 (2.8)	1.6 (2.5)	1.5 (2.5)	1.25 (2.25)	1.25 (2)	1.25 (2)
300	4 (6.25)	4.5 (7.5)	4 (7)	4 (6.25)	3.5 (6.25)	3.5 (6.25)	3.2 (5)	2 (3.2)	1.8 (3.2)	1.8 (3)	1.6 (2.5)	1.5 (2.5)	1.5 (2.5)
350	4.5 (7)	5 (8)	5 (8)	4.5 (7.5)	4.5 (7.5)	4 (7)	3.5 (6.25)	2.25 (3.5)	2.25 (3.5)	2 (3.5)	1.8 (3)	1.8 (3)	1.75 (2.5)
500	6.25 (10)	4 (6.25)	4 (6)	3.5 (5.6)	3.5 (5)	3 (5)	5 (9)	3.2 (5.6)	3.2 (5)	3 (5)	2.5 (4.5)	2.5 (4)	2.5 (4)
750	10 (15)	6.25 (9)	6 (9)	5.6 (8)	5 (8)	5 (7.5)	8 (12)	5 (8)	4.5 (8)	4.5 (7.5)	4 (6.25)	3.5 (6.25)	3.5 (6.25)
1000	12 (20)	8 (12)	8 (12)	7.5 (10)	7 (10)	6.25 (10)	10 (17.5)	3.5 (5.6)	3.6 (5)	3 (5)	5 (9)	5 (8)	5 (8)
1500	17.5 (30)	12 (15)	12 (15)	10 (15)	10 (15)	10 (15)	15 (25)	5.6 (8)	5 (8)	5 (7.5)	4.5 (6.25)	4.5 (6.25)	4.5 (6.25)
2000	25 (40)	15 (25)	15 (20)	15 (20)	12 (20)	12 (20)	20 (35)	7.5 (10)	7 (10)	6.25 (10)	6 (9)	5.6 (8)	5 (8)
3000	35 (60)	20 (35)	20 (35)	17.5 (30)	17.5 (30)	20 (30)	35 (50)	10 (15)	10 (15)	10 (15)	9 (12)	8 (12)	8 (12)
5000	60 (100)	35 (60)	30 (60)	30 (50)	30 (50)	30 (50)	60 (90)	15 (25)	15 (25)	15 (25)	12 (20)	12 (20)	12 (20)
7500	80 (150)	50 (90)	45 (90)	45 (80)	45 (80)	40 (70)	90 (125)	25 (40)	25 (40)	20 (35)	20 (30)		
10K	110 (200)	70 (125)	60 (110)	60 (110)	60 (110)	60 (100)	110 (175)	30 (50)	30 (50)	30 (50)	25 (45)		
15K	175 (300)	100 (175)	90 (175)	90 (150)	90 (150)	80 (150)	175 (250)	45 (80)	45 (80)	40 (70)	35 (60)		
25K	300 (500)	175 (300)	150 (300)	150 (250)	150 (250)	150 (250)	90 (250)	60 (70)	70 (125)	70 (125)	60 (110)		
37K						200 (350)				100 (175)			80 (150)
50K						300 (500)				150 (250)			110 (200)
75K						400 (750)				200 (350)			175 (300)
100K						600 (1000)				300 (500)			225 (400)
167K						900 (1600)				450 (850)			350 (650)

Fuse = I*300% next size smaller if primary current is less than 2 amp. No secondary fusing required.

(Fuse) = (I*500%) next size smaller if used for a motor control circuit per NEC 430-72[C] exception No. 4

Fuse = I*167% next size smaller if primary current is less than 9 amp. No secondary fusing required.

(Fuse) = (I*250%) next size smaller if primary current is less than 9 Amps. Secondary fusing is required see chart for size.

Fuse = I*125% next size higher if primary current is 9 amp. or higher. No secondary fusing required.

(Fuse) = (I*250%) next size smaller if primary current is 9 Amps. or higher. Secondary fusing is required see chart for size.

Recommended fuse sizes per UL 508 and NEC450-3 (B) (1), NED 430-72 and commercially available type fuses.

Primary Overcurrent Protection

A transformer has all the same component parts as a motor, and like a motor, exhibits an inrush when energized. This inrush current is dependent upon where in the sine wave the transformer was last turned off in relation to the point of the sinewave you are when you energize the transformer. Although transformer inrush could run up to 30 to 35 times full load current under no load, it typically is the same as a motor...about 6 to 8 times normal running current. For this reason it is important to use a dual element slow blow type fuse - the same type of fuse you would use with a motor. If using a circuit breaker, select a breaker with a time delay - again the same type you would use with a motor. If the time delay is not sufficient, you may experience "nuisance tripping" - a condition where the breaker trips when energizing the transformer but when you try it again, it works fine.

Secondary Overcurrent Protection

Overcurrent devices are used between the output terminals of the transformer and the load for three reasons:

1. Protect the transformer from load electrical anomalies.
2. Since short circuit current is minimized, a smaller gauge wire may be used between the transformer and the load.
3. Per NEC, a larger primary fuse may be used to reduce nuisance tripping.

Secondary Fuse Recommendations

V _{OUT}	Secondary Voltage						
	24	110	115	120	220	230	240
VA	Secondary Time Delay Dual Element Slow-Blow Fuse						
50	3.2	0.75	0.6	0.6	0.3	0.3	0.3
75	5	1.125	1	1	0.5	0.5	0.5
100	6.25	1.5	1.4	1.25	0.75	0.6	0.6
150	10	2.25	2	2	1.13	1	1
200	12	3	2.8	2.5	1.5	1.4	1.25
250	15	3.5	3.5	3.2	1.8	1.8	1.6
300	20	4.5	4	4	2.25	2	2
350	20	5	5	4.5	2.5	2.5	2.25
500	30	7.5	7	6.25	3.5	3.5	3.2
750	40	10	10	10	5.6	5	5
1000		12	12	12	7	7	6.25
1500		17.5	17.5	17.5	10	10	10
2000		25	25	25	12	12	12
3000		35	35	35	17.5	17.5	17.5
5000		60	60	60	30	30	30
7500		90	90	80	45	45	40
10K		125	110	110	60	60	60
15K		175	175	175	90	90	80
25K		300	300	300	150	150	150
37.5K				400			200
50K				600			300
75K				800			400
100K				1200			600
167K				1800			900

- Fuse = I*167% next size smaller if secondary current is less than 9 amp.
- Fuse = I*125% next size smaller if secondary current is 9 amp. or higher.

The Energy Policy Act of 2005 (H.R. 6) requires Distribution Transformers manufactured after January 1, 2007 to meet specific energy efficiency requirements. EPCRA 2005 defines the term "distribution transformers" as any transformer which:

- Has an input voltage of 34.5 kVA or less
- Has an output voltage of 600 V or less
- Is rated for operation at a frequency of 60 Hz
- Has a capacity of 10 kVA to 2500 kVA for liquid-immersed units and 15 kVA to 2500 kVA for dry-type units

The following special purpose transformers are excluded from the definition of "distribution transformers" and are, therefore, not required to meet the energy efficiency standards at this time:

- Autotransformers
- Drive (isolation) transformers
- Grounding transformers
- Machine-tool (control) transformers
- Non-ventilated transformers
- Rectifier and Regulating transformers
- Sealed transformers
- Special-impedance transformers
- Testing transformers
- Transformer with tap range of 20% or more
- Uninterruptible power supply transformers
- Welding transformers

Benefiting from Higher Energy Efficiencies

Increasing the energy efficiency of a transformer allows the unit to operate at the same level of power with less energy being wasted in the process. Decreasing usage through reduced waste by just .03% over the next 20 years cuts the need for new power generation in the United States by 60 to 66 million kw.

SolaHD has been engineering and producing energy efficient transformers for the past six years. The SolaHD E version transformers are optimized to meet NEMA's TP-1 limits for load losses calculated to 35% of the name plate rating, yet are the same compact size and footprint as its' conventional 150°C rise units.

The example pictured in Figure 1 shows the differences in efficiency for the old standard model compared to the compliant model. At 35% load, the absolute difference in efficiency is only 1.7%. However, that represents a 52% reduction in wasted energy. Taking that 52% reduction in wasted energy and multiplying it across all the energy consumed results in substantial savings.

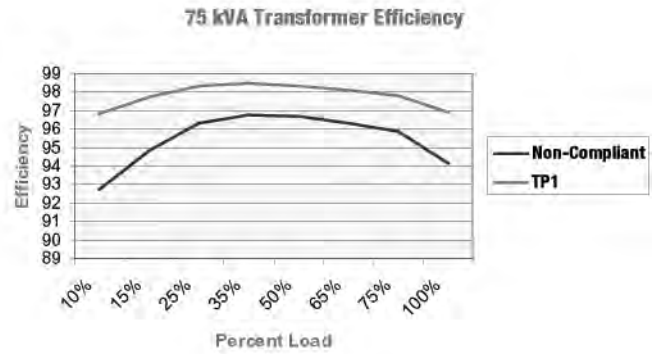


Figure 1

SolaHD offers the following family of transformers that meet the strict efficiency standards. The efficiencies of these transformers are optimized for the load losses calculated at 35% of the name plate rating. This 35% represents an industry average load of most LVGP transformers.

Applications

Any situation where the available voltage must be changed to accommodate the voltage required by the specific electrical circuit or connected equipment. For many electrical circuits, the National Electrical Code (NEC) requires a separately derived neutral secondary connection provided by Delta-Wye connected transformers.

Distribution transformers can be located close to the load. No vaults are required for installation and no long, expensive feeder lines are needed. Common applications include inductive and resistive loads such as motors, lighting and heating.

General Purpose Transformers

Transformers designed to meet the high energy efficiencies required by NEMA Standard TP-1.

Low Temperature Rise Transformers

Transformers designed to limit the temperature rise of the core and coil assembly to either 80°C or 115°C above a 40°C ambient. Reduction in temperature rise increases reliability.

K-Factor Transformers

Transformers designed to withstand the electrical anomalies associated with solid state equipment and DC power supplies (excluding SCR variable speed motor drives) without derating the nameplate kVA.

Copper Wound Transformers

SolaHD general purpose transformers have standard aluminum coil windings. As an option, we offer a selection with copper windings.