

Questions and Answers about Buck-Boost Transformers

1. What is a buck-boost transformer?

Buck-boost transformers are small single phase transformers designed to reduce (buck) or raise (boost) line voltage from 5-20%. The most common example is boosting 208 volts to 230 volts, usually to operate a 230 volt motor such as an air-conditioner compressor, from a 208 volt supply line.

Buck-boosts are a standard type of single phase distribution transformers, with primary voltages of 120, 240 or 480 volts and secondaries typically of 12, 16, 24, 32 or 48 volts. They are available in sizes ranging from 50 volt amperes to 10 kilo-volt amperes.

Buck-boost transformers are shipped ready to be connected for a number of possible voltage combinations.

2. How does a buck-boost transformer differ from an insulating transformer?

A buck-boost transformer **IS** an insulating type transformer when it is shipped from the factory. When it is connected at the job site, a lead wire on the primary is connected to a lead wire on the secondary—thereby changing the transformer’s electrical characteristics to those of an autotransformer. The primary and secondary windings are no longer “insulated” and secondary windings are no longer “insulated” and its KVA capacity is greatly increased. Refer to figures 1, 2 and 3.

3. What is the difference between a buck-boost transformer and an autotransformer?

When a primary lead wire and secondary lead wire of a buck-boost transformer are connected together electrically, in a recommended voltage bucking or boosting connection, **the transformer is in all respects, an autotransformer. However, if the interconnection between the primary and secondary winding is not made, then the unit is an insulating type transformer.**

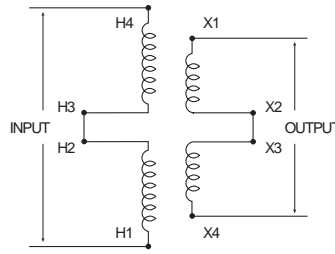


Figure 1. Buck-boost transformer connected as a low voltage insulating transformer (primary and secondary windings shown series connected).

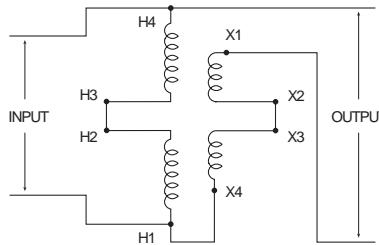


Figure 2. Same buck-boost transformer connected as a boosting autotransformer. The connection from H1 to X4 “converted” the unit to an autotransformer.

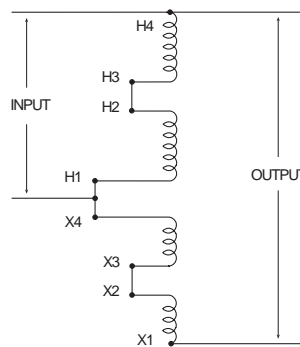


Figure 3. Illustration No. 2 shown with the primary and secondary windings “straightened”.

Applications

4. Why are they used?

Electrical and electronic equipment is designed to operate on standard supply voltage. When the supply voltage is constantly too high or too low, (usually more than 55%), the equipment fails to operate at maximum efficiency. A buck and boost transformer is a simple and **ECONOMICAL** means of correcting this off-standard voltage.

5. What are the most common applications for buck-boost transformers?

Boosting 208V to 230V or 240V and vice versa for commercial and industrial air conditioning systems; boosting 110V to 120V and 240V to 277V for lighting systems; voltage correction for heating systems and induction motors of all types. Many applications exist where supply voltages are constantly above or below normal.

6. Can buck-boost transformers be used to power low voltage circuits?

Yes, low voltage control, lighting circuits, or other low voltage applications requiring either 12V, 16V, 24V, 32V or 48V. The unit is connected as an insulating transformer and the nameplate KVA rating is the transformer’s capacity.



(1 KVA) T-1-11683 (7.5 KVA) T-2-53515-3S

The above pictures illustrate the difference in physical size between the autotransformer of 1 KVA, capable of handling a 9.58 KVA load, and an isolation transformer capable of handling a 7.5 KVA load.

To cite an example . . . a model T-1-11683 buck-boost transformer has a nameplate KVA rating of 1 KVA, but when it’s connected as an autotransformer boosting 208V to 230V, its KVA capacity increases to 9.58 KVA. The key to understanding the operation of buck-boost transformers lies in the fact that the secondary windings are the only parts of the transformer that do the work of transforming voltage and current. In the example above, only 22 volts are being transformed (boosted) — i.e. 208V + 22V = 230V. This 22V transformation is carried out by the secondary windings which are designed to operate at a maximum current of 41.67 amps (determined by wire size of windings).

$$\text{Maximum Secondary Amps} = \frac{\text{nameplate KVA} \times 1000}{\text{secondary volts}}$$

$$\text{Maximum Secondary Amps} = \frac{1.0 \text{ KVA} \times 1000}{24 \text{ V}} = \frac{1000 \text{ VA}}{24 \text{ V}} = 41.67 \text{ amps}$$