The VON Servisavor® Frequently Asked Questions

Why does the VON Servisavor® not have a 200A Breaker?

The breaker in the Servisavor® has been selected to protect the autotransformer from overload conditions. This results in an 80A breaker for a 15kVA unit, 100A for a 20kVA, and 125A for a 25kVA. Using a 200A breaker with these transformers results in a unit that run until it burns itself up if overloaded.

Why does the VON Servisavor® not come in even larger sizes?

There are two reasons for this. One is the physical size of the unit. Above 20kVA the size and weight of the transformer for a Servisavor® increases dramatically. The unit quickly becomes too large to be safely handled.

The second reason is related to the customer's service. Let us take an example of a house with a 200A service that has a fault on one of their hot legs. Typically this type of service would have a 200A rated cable for each hot leg. If you connected a 20kVA Servisavor® to this house it will restore up to 100A on each hot leg. In order to get this current, it will pull 200A from the remaining good hot leg, and return 200A on the neutral cable. If you were to connect a 200A Servisavor®, you can see that you could quickly be pulling 400A on the 200A rated cable. To make this situation worse, many utilities have used a neutral with a much lower current rating since the neutral rarely carries much current. This would result in the Servisavor® attempting to push more than double the rated current through the cable which will quickly cause the neutral to heat to the point of burning, destroying the remaining good legs of the service and possibly causing property damage.

Why does the VON Servisavor® use a four conductor cable to the adapter head?

Why is the neutral wire in the VON Servisavor® twice the size of the line or "hot" conductors?

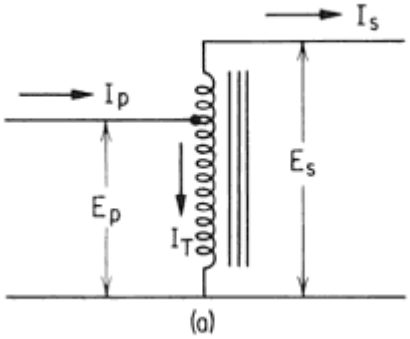
The VON Servisavor® uses an Autotransformer circuit to temporarily restore power to the customer when one of the three wires feeding a 240/120 V service has failed. In the event of a faulted "hot" leg, the Servisavor® takes the 120 V provided by the remaining good utility cables, and generates the second 120 V leg, out of phase with the first providing 240 V to the customer.

In this situation, the neutral wire actually carries two times the current of the "hot" wires feeding the house. The most cost effective method we have found to increase the rating of the neutral circuit has been to use a four conductor cable, and use two of the conductors in parallel for the neutral. You will also notice that the neutral "pigtail" is of twice as large of a gauge as the conductors in the four conductor cable. For example, a 20kVA Servisavor® uses 4 conductor #4 gauge cable, and the neutral pigtail is made of #2 gauge wire.

For those who are interested, a more technical explanation of why the neutral current is double the “hot” current follows.

Some of the following is borrowed from the Handbook of Transformer Design and Application by William Flanagan. For this explanation, the Servisavor® is applied in a faulted hot leg situation, where 120V AC would be supplied to the Servisavor®. Note that E is voltage, I is current, and N is turns.

From page 43 of Handbook of Transformer Design and Application: “*The voltage-current relationships in an autotransformer are the same as in an isolation transformer if the definitions of primary and secondary in Figure are used… As in other transformers, the primary volt-amperes will equal the secondary volt-amperes neglecting losses. Then, for a step-up autotransformer:*



$$E_s = \frac{N_s}{N_p} E_p$$

$$E_p I_p = E_s I_s$$

$$I_T = I_p - I_s$$

$$I_T N_p = I_s (N_s - N_p)$$

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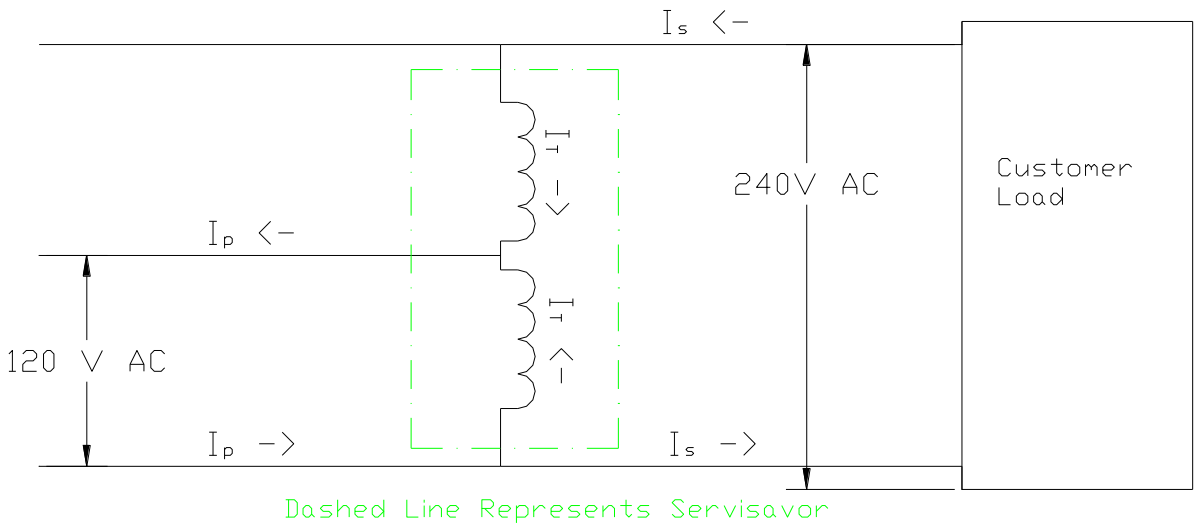
In the Servisavor, $N_S = 2*N_P$.. Using this fact, you can simplify the fourth equation, resulting in $I_T = I_S$. You can also substitute the voltages E_P=120V and E_S=240V into the second equation to get the relationship $I_P=2* I_S$. Again, using substitution, you can determine that the current through both windings is the same, $I_P=2* I_T$.

Based on $I_T = I_S$, the current through the windings of the transformer, and thus the “hot” wires of the connection lead equals the current supplied at 240V, I_S. The current through the neutral wire, still equals I_P, which is two times the current through the hot legs due to $I_P=2* I_S$ (also $I_P=2* I_T$ since $I_T = I_S$)

Using these formulas, and an Autotransformer rating of 20kVA, you can see that for 20kVA I_T = 83.3A. The Servisavor® uses a 100A circuit breaker to allow a short term overload to accommodate inrush on large appliances in a customer’s house.

To aid in visualization, see the following diagram, with a dashed box around the part of the circuit that makes up the Servisavor®. This diagram assumes a balance load. While more complicated, the mathematics works out the same for an unbalanced load.


Is <-
240V AC
Customer Load
Ip <-
120 V AC
Ip ->
Is ->
Dashed Line Represents Servisavor

Can I use the VON Servisavor® on a customer with Distributed Generation?

Yes, you can use the VON Servisavor® on a customer with "DG", within the limitation of the power rating of the Servisavor®. However, users should note that other problems may be generated within the utility system when used with "DG" in a faulted hot leg situation that should be considered.

Fundamentally the Servisavor® does not care about the direction of power flow through it. In a faulted hot leg situation, the Servisavor® is normally taking 120 V AC Power, and generating 240 V AC power. It can do this up to the circuit breaker rating of the unit. In a "DG" situation, this power flow is simply reversed. The customer's net power being returned to the system is being converted from 240 V AC to 120 V AC power. The Servisavor® can do this conversion up to the circuit breaker rating of the unit. If the customer's "DG" system can return more power than the Servisavor® is rated, then the breaker will trip, returning the customer to the faulted hot leg situation.

The faulted neutral situation is much simpler, assuming the "DG" system is returning balanced 240 V power. In this case, the "DG" system is not generating any unbalance current for the Servisavor® to correct for. Therefore the Servisavor® still only has to compensate for the unbalance in the customer's load, and is not effected by the "DG" system.

The one system consideration that must be made is the effects of "DG" power being returned as 120 V current, when the Servisavor® is applied in a faulted hot leg situation. Take for instance, that the "DG" is returning to the utility a net of ~12 kVA, or 50 Amps of 240 V AC power. The Servisavor® is going to convert that 50 Amps of 240 V AC into 100 Amps of 120 V AC. This is well within the capabilities of the Servisavor®, but we (The VON Corporation) do not have the information about you, our customer's system to predict what if any ill effect this type of current might have.

We have more than one service fed from a single transformer. There is a single run of cable to a distributing junction (i.e. Handhold, multi-way splice), and the services are fed from there. The fault is between the transformer and the junction. Can I use the VON Servisavor® in this case?

Yes, you can use the VON Servisavor® in this case. There are several things to note.

If you leave the faulted leg connected at each service, and connect a VON Servisavor® to one of the services, all of the connected services will have power restored by the one VON Servisavor®. This is because the restored voltage will be "backfed" through the cable to the junction, and then out to the other connected services. It should be note that in this case all of the connected services are sharing this one VON Servisavor®. In the case of a faulted hot leg, the available power for each service will be more limited than normal, and customers may need to be informed of this. You can also connect multiple VON Servisavor®'s in this case, i.e. one at each service. Unless the faulted leg is

disconnected at each house, the houses will still share the available restored power, but will have the sum of the VON Servisavor®'s attached available to share, rather than just one.