



## **APP NOTE: AUTOMATIC GENERATOR STARTING REV 2**

### **SAFETY WARNING:**

A generator is often viewed as a necessary back up source of electricity for renewable energy systems. Many see generators as a necessary evil. Without taking sides in that discussion, we do warn that providing automatic starting of a generator can be dangerous. There are those who believe that a generator is hazardous enough just when running since the combination of fuel, heat, sparks and exhaust fumes are not friendly to life. So to have a set of preprogrammed electronic parameters that start the generator without requiring a person to be present to make sure it is running safely, is a fire waiting to happen. So, use caution if you need to install automatic generator starting at your home. Please make sure your customer understands the risks if you are asked to install one for someone else. It will probably be at a remote location, which brings some interesting responsibilities with it.

### **THE APOLLO SOLAR CHARGE CONTROLLERS PROVIDE A GREAT SOLUTION:**

A T80 or T80HV in the system provides the means to start a genset based on the battery State of Charge. The terminals on the generator itself are where the AUX Relay in a T80 gets connected. The logic is that if the battery State of Charge goes down to 50% for example, the AUX Relay contacts in the T80 close to start the generator. When the State of Charge is above 80% for example, the AUX Relay contacts open thus stopping the generator. That plan uses the fuel only when there is not enough free solar energy to keep the battery charged, and it stops using fuel when the bulk charge is completed. This allows the PV to complete the long Absorb charge stage bringing the battery up to 100% full.

### **DETERMINING THE GENERATOR START POINT:**

Every site is different, including the amount of sun at the location, the size of the PV array, the cost of fuel and the degree to which the battery power is critical. Apollo Solar is not in a position to make any recommendations as to the exact State of Charge settings. Those settings will be established, fine tuned and supported by the installer / integrator of the system. The Apollo Gateway provides important feedback to help the installer fine tune these settings. By studying the results via the internet, a person with expertise in this area can adjust the settings for the optimum use of fuel while making sure that the batteries are not damaged by deep discharging.

### **USING STATE OF CHARGE (SOC) INSTEAD OF BATTERY VOLTAGE**

Most automatic generating starting products make the decision as to when the batteries need charging based on the battery voltage. Although this is the most common easiest, and sometimes the only method available, it is not the most accurate. The battery voltage will be greatly affected by charging or loads on the battery. Some battery manufacturers state that one should let their batteries sit without charging or connecting a load for several hours before a voltage measurement will provide an accurate way to determine the State of Charge. Certainly a large load can cause the battery voltage to drop giving a false indication of a low battery even though it may be close to full. The Apollo Solar charge controllers have an internal State of Charge meter which is a more accurate method since it based on the Amp-hours drawn from a known full battery.

**USING THE T80 AUX RELAY TO START THE GENSET**

The Apollo Solar charge controllers have 2 separate galvanically isolated relays, which can be programmed to close or open on a variety of parameters within the T80. See the T80 user manual for the details. For this app note, the example is to provide a remote start of a genset when the State of Charge of the battery has dropped below some predetermined level like 30%. The relay contacts are rated for ½ Amp at up to 50 volts DC. The remote starting switch on the genset would be wired to these Aux relay contacts such that a simple contact closure would cause the genset to autostart. When the same relay contacts are opened, the genset should stop.

**APOLLO SOLAR IS NOT IN THE GENERATOR BUSINESS:**

Apollo Solar does not recommend nor discourage any specific brand or type of generator. It follows that we can not provide tech support for generators. Our Charge Controllers and Inverters work with generators, but our expertise and support begins and ends with our products.

**NOT ALL GENERATORS CAN BE STARTED AUTOMATICALLY:**

The smallest size generators (about 2kW or less) don't have a starter motor. They require that a person pulls a cord. This class of generator does not apply to Apollo Solar applications. 5kW or 6kW generators include starter motors and a small battery. Some of them have manual chokes which require a person to monitor the engine after he pushes the start button. These generators are not good candidates for automatic starting either. When you get up to the 8kW to 10kW generators, there is enough money in the genset that wiring is usually provided by the generator manufacturer for a start switch, which has the ability for remote starting and stopping. If these serious machines are of good quality, they have enough smarts so that a simple remote ON and OFF switch will allow it to be started and stopped. Importantly, these gensets also monitor a few critical parameters like oil pressure and some temperatures so they can turn themselves off before self-destructing.

**SMALL SYSTEMS WITH PULL START GENSETS:**

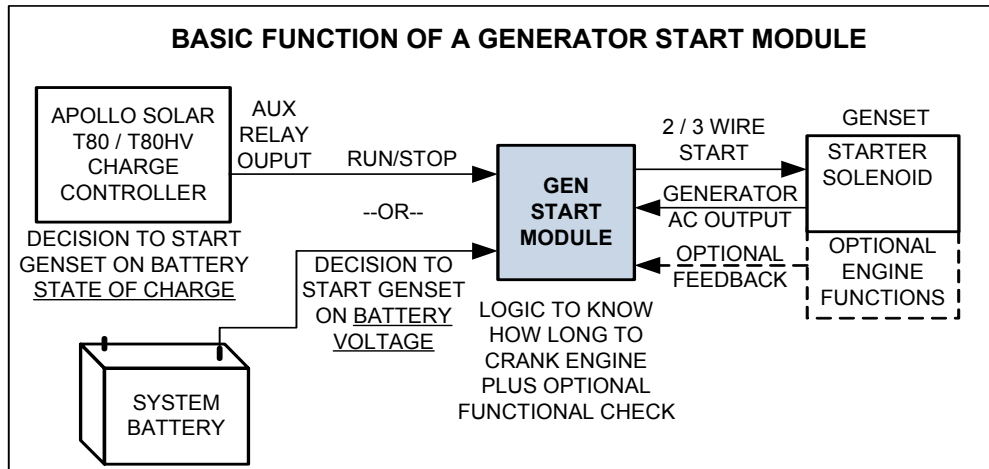
For small (<3kW) systems, where the PV is not sufficient to keep the batteries charged, then the choice is simple. Periodically pull out a small generator, hook it up to the AC Input of the Inverter/Charger and pull the cord to start it. Keep an eye on the generator and turn it off when the batteries go from Bulk into Absorb. They will then be about 80% full.

**LARGE SYSTEMS WITH SMART GENSETS:**

From both the business and system design perspectives, we believe that if an installation requires a large (>10kW) automatic starting genset, it should be a self contained module, which takes care of all its own issues internally. In other words, the external system should tell the generator when to turn on and when to turn off, but it is up to the generator to control everything so it doesn't burden the renewable energy system.

**THE CHALLENGE – GENSETS BETWEEN 3kW AND 10kW:**

The middle ground (between 3kW and 10kW) can pose a problem. There may not be enough money in a mid-sized genset for the manufacturer to make it as smart as you need it to be. You will then have to include a Generator Starting Module, which adds the smarts to know how to deal with the glow-plug on a diesel, how long to crank the starter, how many times to crank it before it is flooded, how long to wait between cranking, etc. There are companies who make these modules for \$300 to \$600. Interfacing them correctly to any specific generator can be complicated and time consuming. We believe that the tech support department at the generator manufacturer of choice should help the installer solve those problems.



In the block diagram above, the Gen Start Module is the device that must be added to make the genset as smart as it has to be for automatic starting. The decision of when to start is still made by the Apollo Solar T80 or TSW True Sine Wave Inverter / Charger. The third party Gen Start Module is connected between the T80 AUX Relay contacts and the generator.