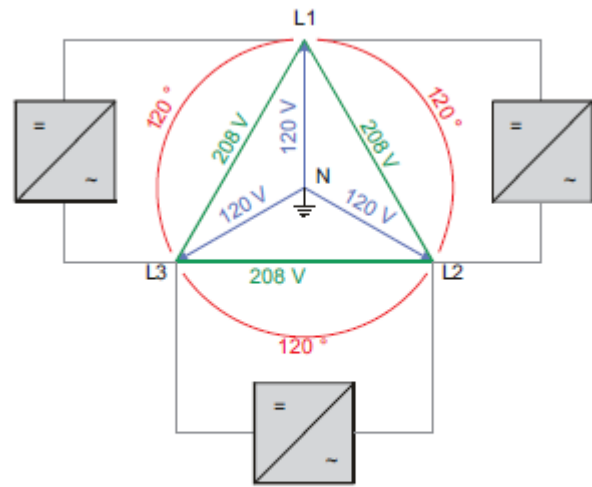


Balancing the MIX™

By Brian Lydic, Fronius Sales Application Engineer

The Fronius IG Plus line contains a wide variety of power levels with single-phase output as well as those with three-phase output. The IG Plus 11.4-3_{delta} and 12.0-3_{wye} inverters are listed for use with three-phase systems. The 11.4-3_{delta} works on 208V and 240V delta systems, while the 12.0-3_{wye} works only on a 277V wye. These units have three separate inverter power stages, one per phase. The inverters come from the factory programmed to operate in what is called 'MIX™-Mode'. In this mode the unit turns on a master power stage first thing in the morning, and then the other slave stages turn on one at a time, as needed for the optimal output power of the PV array. This functionality keeps the inverter's efficiency higher at low output levels than would be obtained with one single, large power stage. (For a detailed explanation of the MIX™ concept, please see "In the MIX" in the January edition of the Fronius USA Newsletter, written by my esteemed colleague Tim McKernan. [Also available on our website.](#)) In a three-phase system, this mode of operation would introduce some imbalance unless all three power stages are running concurrently (at higher output power). If only one inverter is used in the system, then the maximum imbalance would be 3800W for the 11.4-3_{delta} and 4000W for the 12.0-3_{wye}. However, if multiple inverters are used the imbalance could reach values that would exceed acceptable limits.



**IG Plus 11.4-3 on 208V delta -
one power stage per phase**

It is possible to change the inverter in the field to operate in 'Balance Mode,' in which the stages feed power equally to all three phases all the time. Therefore, there would be no imbalance. Once in Balance Mode, if any phase experiences a fault condition (i.e. grid under-voltage or over-voltage), the entire unit ceases production and goes into its startup cycle of grid monitoring before restarting. This will allow the inverter to be used in situations where the introduced imbalance is undesirable or when production must be ceased on all phases because of a fault condition on only one phase.

If a three-phase system with multiple inverters is needed, it could often be a good idea to use multiple single-phase inverters instead of multiple three-phase inverters. For example, let's say you have a ~35kW system with a three-phase 208V electrical hookup and will use multiple Fronius inverters to accomplish the job. One option would be to use three IG Plus 11.4-3_{delta} inverters operating in parallel. If these were all set to run in MIX™-Mode, then you could end up with up to 11.4kW of imbalance. Each power stage

can output 3.8kW, and if all three inverters choose the same master power stage for the day, the three individual stages on a single phase could output 11.4kW total. 11.4kW is quite possibly more imbalance than your power company would like to see, so you'd want to put at least some of the inverters in balance mode. Once in balance mode, the inverter loses the efficiency gain of having three separate power stages, but will still run efficiently as a monolithic power stage.

The same system could effectively be set up with three IG Plus 11.4-1_{uni} single-phase inverters. In this case, each inverter outputs to only one of the three phases. The balance of the three-phase system should remain very close if all the arrays are the same. In this configuration each phase should have the same number of power stages operating on it at any given time. This allows us to take advantage of the MIX™ concept while keeping the system balanced. In addition to this, installation cost would likely be less for the three single-phase inverters. This is because you would be using three two-pole circuit breakers rather than three three-pole breakers, and would only be running two conductors instead of three to each inverter. A possible drawback to this configuration is that the inverters do not talk to each other, and if one shuts down for some reason, the other two inverters could still be running, thus contributing imbalance for that time. However, this is still an accepted practice and most utilities would have no problem with this type of design.

If you have a system which requires a number of inverters which is not a multiple of three and there is a need to keep things balanced, you could use several single phase units and one or two three-phase units running in Balance Mode. Say we need eight inverters. You could use six single-phase units (two per phase) and two three-phase units in Balance Mode. With the wide range of different inverters in the IG Plus line, you should be able to make a well-balanced system no matter how many inverters are needed.

Keeping all this in mind, please give Fronius USA Solar Technical Support a call at (877) 376-6487 if you need to change an IG Plus 11.4-3_{delta} or 12.0-3_{wye} to Balance Mode. The inverter needs to be powered up in order to change this parameter which is accessed through a "back-door" setup menu. We'll walk you through the process.