Grid tie inverter not syncing

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I have a growatt sph6000 tl bl-us which is a split-phase hybrid solar inverter. I purchased this with the assumption that my grid was split-phase, with the two lines offset by 180 degrees. But it turns out I actually have 2 legs of a 3 phase system, so the lines are offset by 120 degrees. This is in Mexico and apparently normal.

From what I can see from various schematics on grid tie sync, the inverter creates one phase synched to one line of the grid, and it creates another phase that"s the inverse of the first one. This means that my second phase will be off by 60 degrees. (180-120).

Typically the way a grid-tie inverter works is that you have an IGBT push-pull bank per phase, with the gates being individually driven by the controller. The controller monitors the grid voltage, frequency, and phase, and aligns each inverter phase"s output phase perfectly to the grid by separately controlling the IGBT push-pull drivers.

However, when the mains goes down, you don"t have any phases to reference your generated waveform to, so you have to generate your own. In this case, generating a single reference clock and then phase-shifting it by 180? to drive the second leg of the split-phase output makes sense.

When the grid comes back online, the inverter must then increase or decrease the output frequency of the inverter output in order to catch up or slow down to the phase of the grid. Once it locks phase, it then frequency-matches back to the grid so that the inverter output tracks the grid frequency in phase. It can then finally adjust the voltages. The exact mechanism for doing all of this is implementation-specific.

Your inverter will either work just fine, refuse to tie onto the grid, act temperamentally and trip phase error or undervoltage alarms, or trip an internal breaker. I cannot foresee a situation in which a UL approved and IEEE1547-compliant grid tie inverter would catastrophically fail due to phase imbalance, because such a product is guaranteed to contain safety features that will disconnect and shut down the inverter in the event of improper connection.

Such a system would work by phase-locking to the first phase, matching that phase"s frequency, then generating the second phase 180? shifted from the first. There is no need to account for phase sequencing - swapping L1 and L2 makes no difference, so that doesn"t matter. However, there"s a pretty major design flaw here: the phase angle tolerance of the grid is not zero.

The grid does not have an absolutely perfect guarantee of the angles between phases. I couldn"t find the official spec for North America, but the UK specifies ?1% phase angle for three phase. On a North American system this phase angle error would result in as much as a ?3.26V 60Hz AC voltage delta between an artificially generated 180?-shifted waveform and the real second leg of the grid. That varying voltage delta is a catastrophic problem if it isn"t accounted for - the tracking accuracy needs to be more like 100mV or less, and 3V is far too wide a margin.

It is possible that this could be corrected for by allowing for a certain margin of current imbalance and then adjusting the inverter voltages in realtime using a control loop based on the per-phase current sensors. This would cause the inverter to constantly re-adjust its output voltage to match the offset caused by the phase mismatch, essentially generating a 3V "wobble" on top of the artificially generated 180? shifted output so that the voltage is closely matched to the real signal.

However, I find it hard to believe that this would work in practice. For one, you"d need to match the output voltages to the grid before you connected to it, which means you can"t sense the current imbalance ahead of time as part of the control loop. It"d also be very difficult to keep the control loop stable. On top of all that, it doesn"t make any sense from a control standpoint.

Most of this isn"t actually a question of the hardware design. Two split-phase inverters that worked with 120? and 180? phase angles could use identical hardware, and just have a different nominal phase shift programmed into the controller firmware.

Given the documentation and spec sheets, I don"t think there"s enough information to say whether or not it will actually work. All I can say is that it isn"t impossible, even though it"s unusual. You should contact the manufacturer and ask.