AC Coupling and Frequency Shifting
DC coupling overview
What is a “grid-tie” inverter?

- Grid-tie inverters are AC current sources
- Requires grid voltage/freq to be within specified limits
- Loss of grid means loss of PV
What is AC coupling?

- Battery-based inverter is grid-forming
- Allows grid-tie inverter to stay online when grid goes down
2 main considerations

- AC coupled PV power cannot exceed XW+ rating
- Battery bank must be appropriately sized

Charge amps = PV watts/48V UNREGULATED!
Frequency shift curtailment (off-grid mode)

- Provides 3-stage charging function
- Grid-tie inverter must curtail or shut down when frequency increases
• Frequency shift for non-curtailing
• Grid tie inverter must shut down
• Aux port may be used to drive external AC disconnect relay
- Frequency shift for curtailing
- Grid tie inverter reduces output
- Power continues to flow at load demand
What about changing from grid-tie to off-grid?

- Consider AHJ rules for region (i.e. UL1741, UL1741SA, Rule 14H, PREPA)
- Switching modes requires specific I/O comms
- Consider PG&E Rule 21 requirement

<table>
<thead>
<tr>
<th>System Frequency Default Settings (Hz)</th>
<th>Minimum Range of Adjustability (Hz)</th>
<th>Ride-Through Until</th>
<th>Ride-Through Operational Mode</th>
<th>Maximum Trip Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>f &gt; 62</td>
<td>62 - 64</td>
<td>No Ride Through</td>
<td>Not Applicable</td>
<td>0.16 seconds</td>
</tr>
<tr>
<td>60.5 &lt; f ≤ 62</td>
<td>60.1 - 62</td>
<td>299 seconds</td>
<td>Mandatory Operation</td>
<td>300 seconds</td>
</tr>
<tr>
<td>58.5 ≤ f ≤ 60.5</td>
<td>Not Applicable</td>
<td>Indefinite</td>
<td>Continuous Operation</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>57.0 ≤ f &lt; 58.5</td>
<td>57 - 59.9</td>
<td>299 seconds</td>
<td>Mandatory Operation</td>
<td>300 seconds</td>
</tr>
<tr>
<td>f &lt; 57.0</td>
<td>53 - 57</td>
<td>No Ride Through</td>
<td>Not Applicable</td>
<td>0.16 seconds</td>
</tr>
</tbody>
</table>
XW+ Aux port

- Programmed to trigger on Bulk
- Clear at lower level
AC coupling with generator?

Typically not, unless special application

- Incorporate disconnect relay
- Relay coil activates by generator AC
AC coupling off grid?
Possible with curtailment

- Off grid designs rarely spec AC coupling
- Battery regulation not ideal if non-curtailing
AC coupling off grid

Loads should equal solar production in real time for greatest efficiency
AC coupling off grid
Stored energy should support loads during non-solar hours
AC coupling off grid

Let’s compare losses

- > load means < efficiency
AFC/RSD solution – For MPPT80

- NEC690.11 and NEC690.12 compliant
- Remote shutdown capable
- Contact Kevin Afshar kevina@innovativesolarinc.com
Backplate – For pre-wired systems

- Installer-friendly
- Increase value
- Reduce installation time
- Contact Sue Cole sue@midnitesolar.com
Backplate – For pre-wired systems

- Supports single XW+ with Mini-PDP
- Single MPPT80 or dual MPPT60
Backplate – For pre-wired systems

- One back plate for XW+ or Conext SW platform
- Single Conext SW with AC/DC Switchgear
- Single MPPT80
Backplate – For pre-wired systems

- Or dual MPPT60
Combox Pro – preliminary, subject to change

- Remote monitoring and control
- Firmware updates over the cloud
- USB Port for easy onsite firmware upgrade
- Dual Xanbus networks per Combox for reducing components per installation
- Lithium Ion Support
- Modbus capable for easy integration at system level
- Aux outputs and system level aux relay control for enhanced energy management and control