Anti-Islanding Testing of PV Inverters

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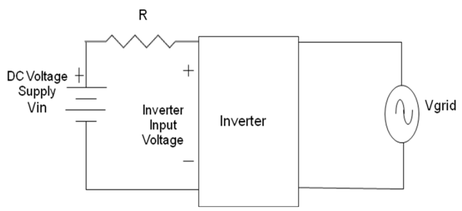
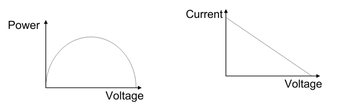
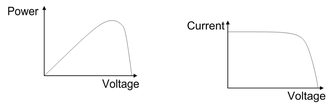
Test Setup



Test Setup



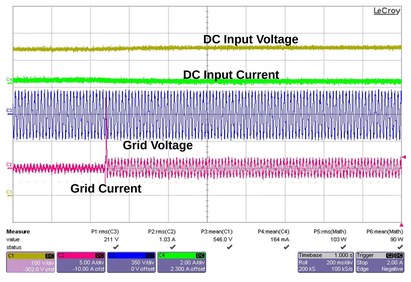
Resister Divider PV Model



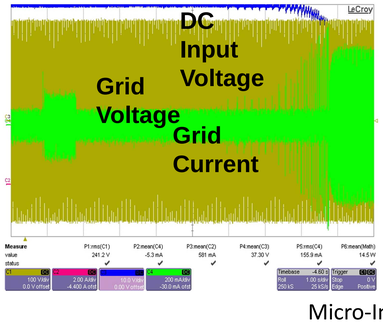
Typical PV Model

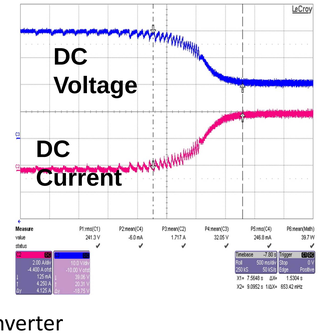
- Test setup utilizes the DC power supply as the source.
- Maximum power point tracking function can be tested with series resistor.

Start Up



Centralized Inverter

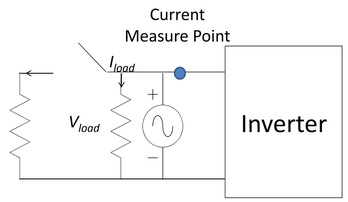




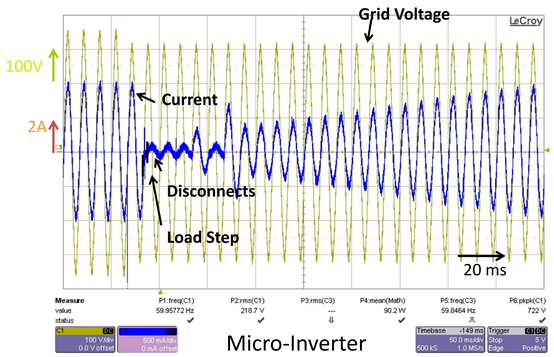
Micro-Inverter

- Inverter has an overshoot current when it first turns on due to the energy stored in the output filter.
- The centralized inverter uses a much larger inductor so its overshoot is much larger than the micro-inverter.
- This condition has not been considered in the IEEE 1547 standard.

Load Step Test



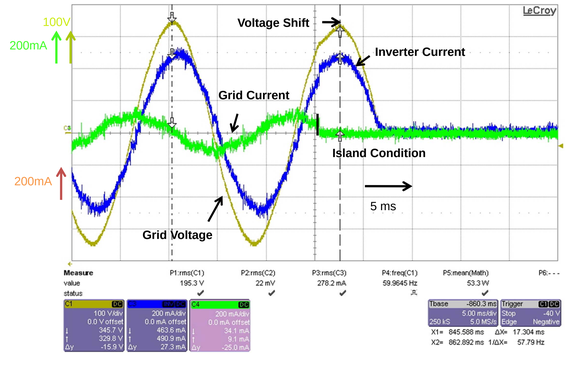
Test Setup



Micro-Inverter

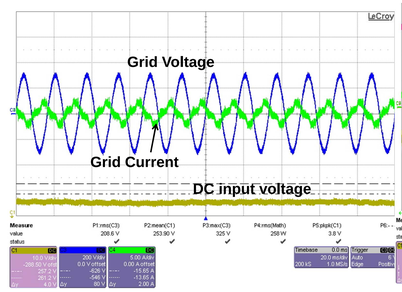
- Inverter output is connected in parallel with a 300 Ω resistor (160 W).
- Resistor is connected to a switch and a 6 Ω resistor (9.6 kW). When the switch connects, there is a load change of 9.6 kW. The inverter voltage stays within 88% of voltage (211 V_{rms} or 298.7 V_{peak}); but, it trips and reduces the energy harvest. This is likely because of the sensitivity of the inverter design. Currently, this condition is not considered in IEEE 1547 standards.

Anti-Islanding

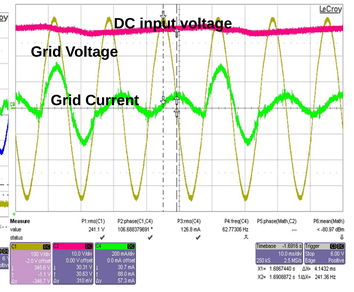


When an island forms, the distributed generation must turn off. Many different methods are used. The micro-inverter detects an island and trips at the next zero crossing.

Low Power Operation



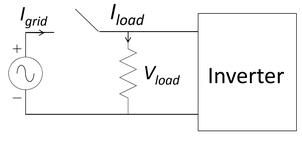
Centralized Inverter



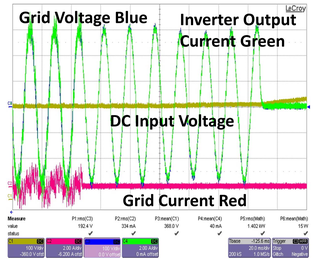
Micro-Inverter

- The low power operation is shown at about 5% nominal for the centralized inverter and 20% of the nominal for the micro-inverter.
- Under low-power operation, the centralized inverter tends to have high harmonics and the micro inverter operates in burst mode.
- The power grid will have to compensate for the current during the cycles the micro-inverter turns off. Currently the low power condition is not considered in the IEEE 1547 standard.

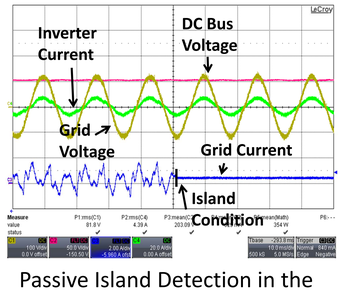
Anti-Islanding II



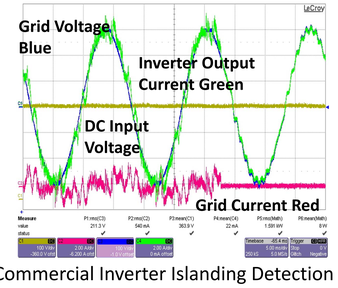
Island Test Set Up



Commercial Inverter Islanding Detection



Passive Island Detection in the Non-Detection Zone



Commercial Inverter Islanding Detection

- Non-detection zone occurs when the grid current goes to zero while the inverter output current equals to the load current.
- Under this case, a passive method cannot detect the island. An active method is required. The active method should not cause false trips.