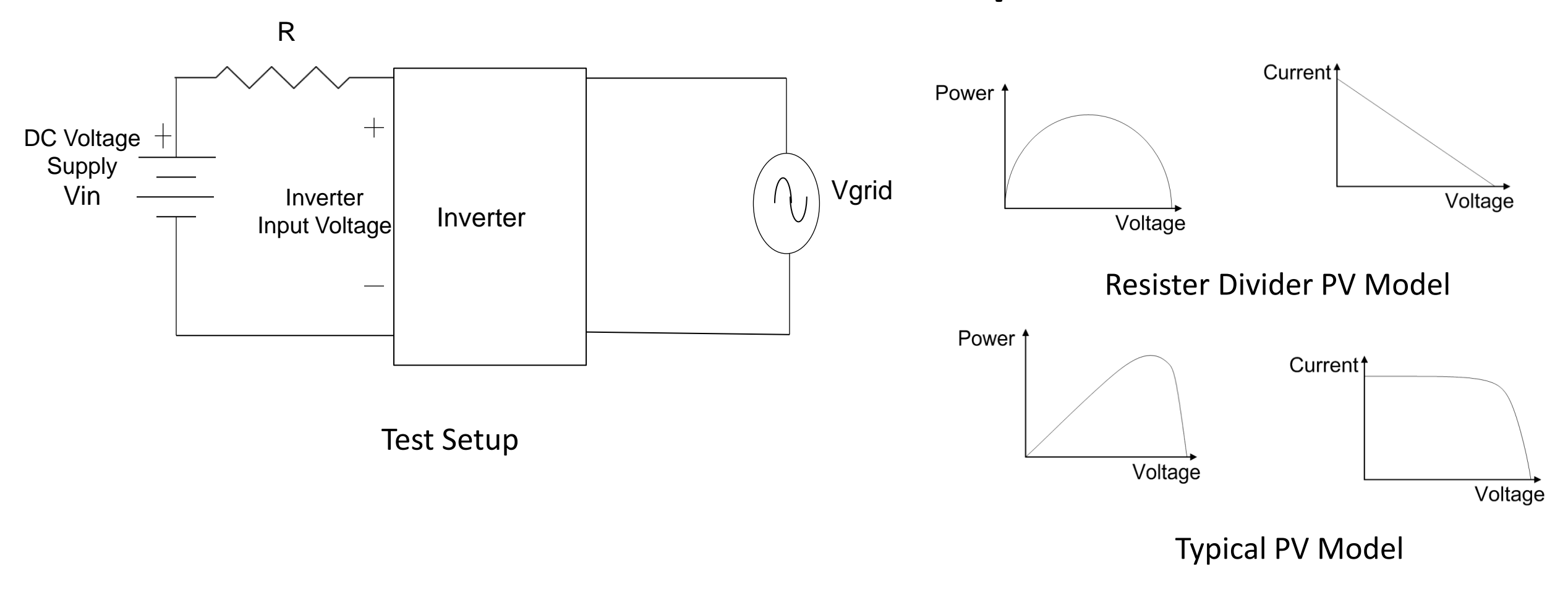


Testing Commercial PV Inverters for Standard Effectiveness

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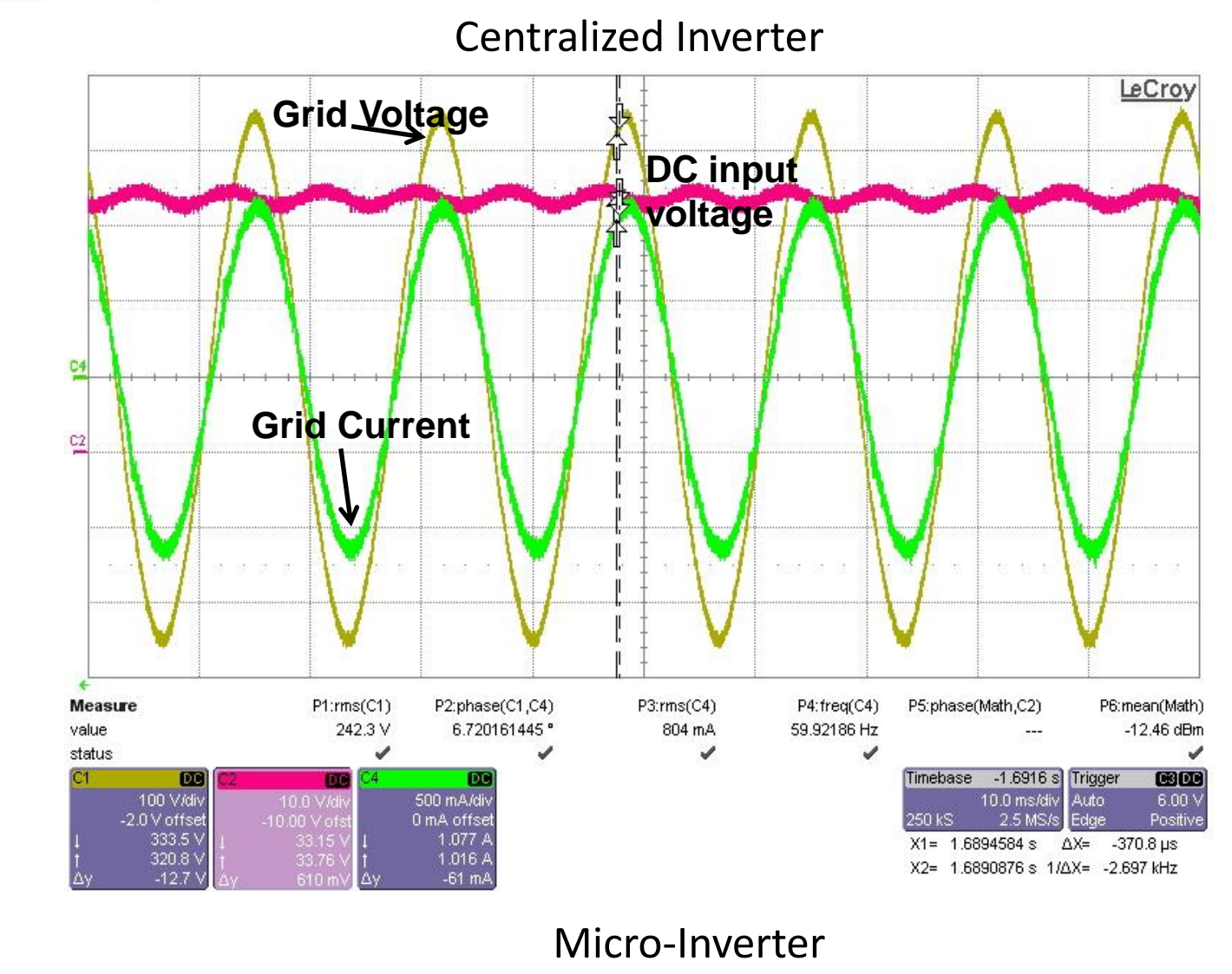
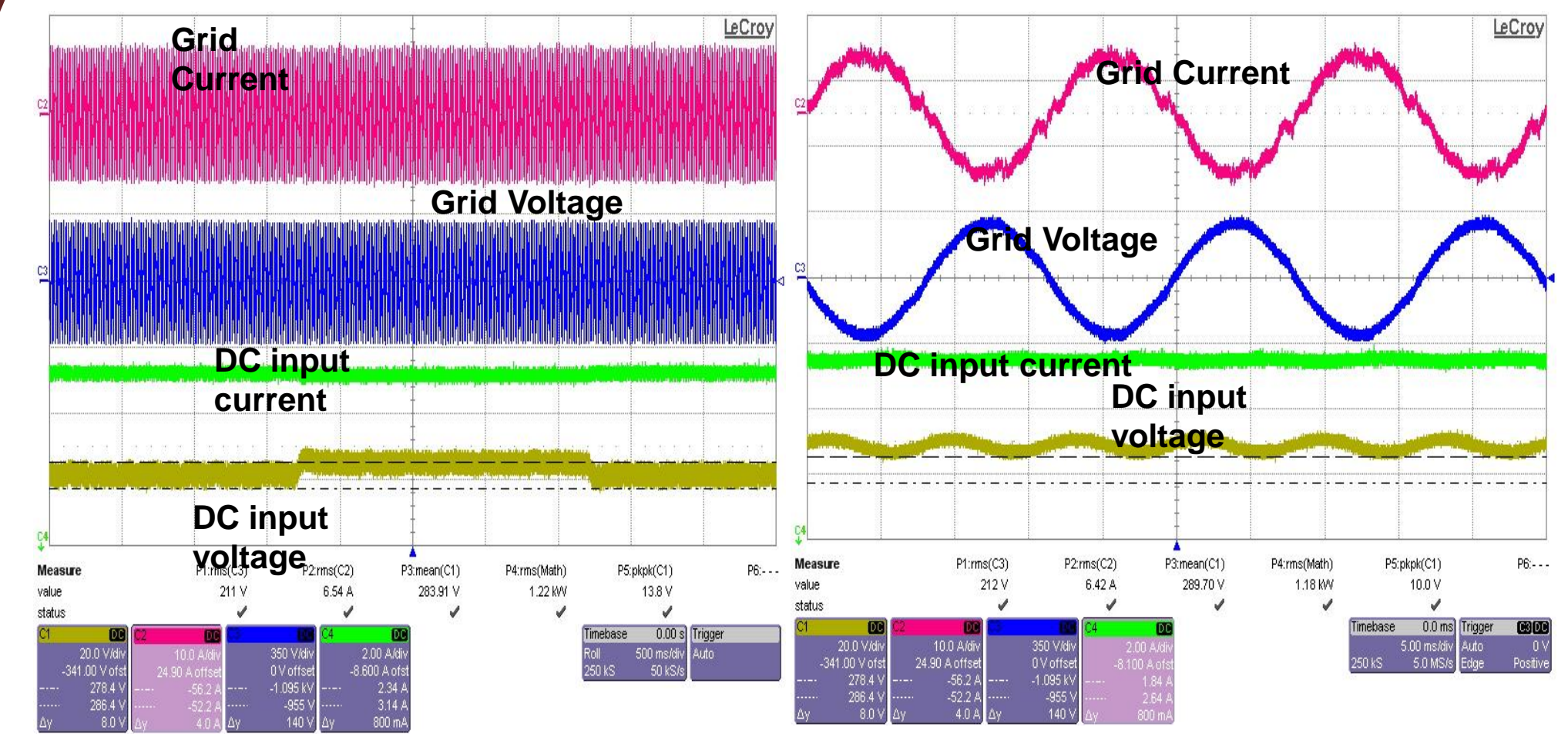


Test Setup



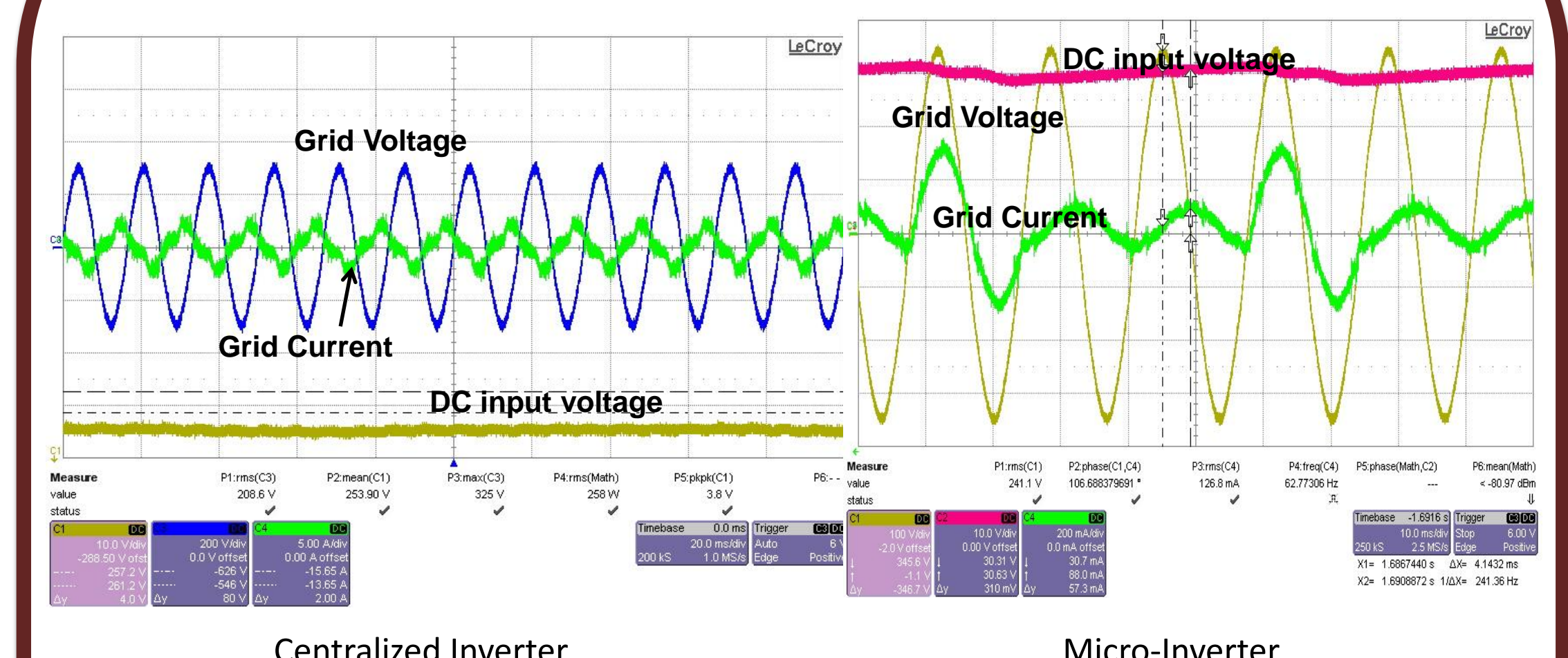
The test setup was slightly different than using an actual PV panel; but, because energy harvesting was not tested the setup was similar enough to a real PV panel that it did not have an effect on the results.

Normal Operation



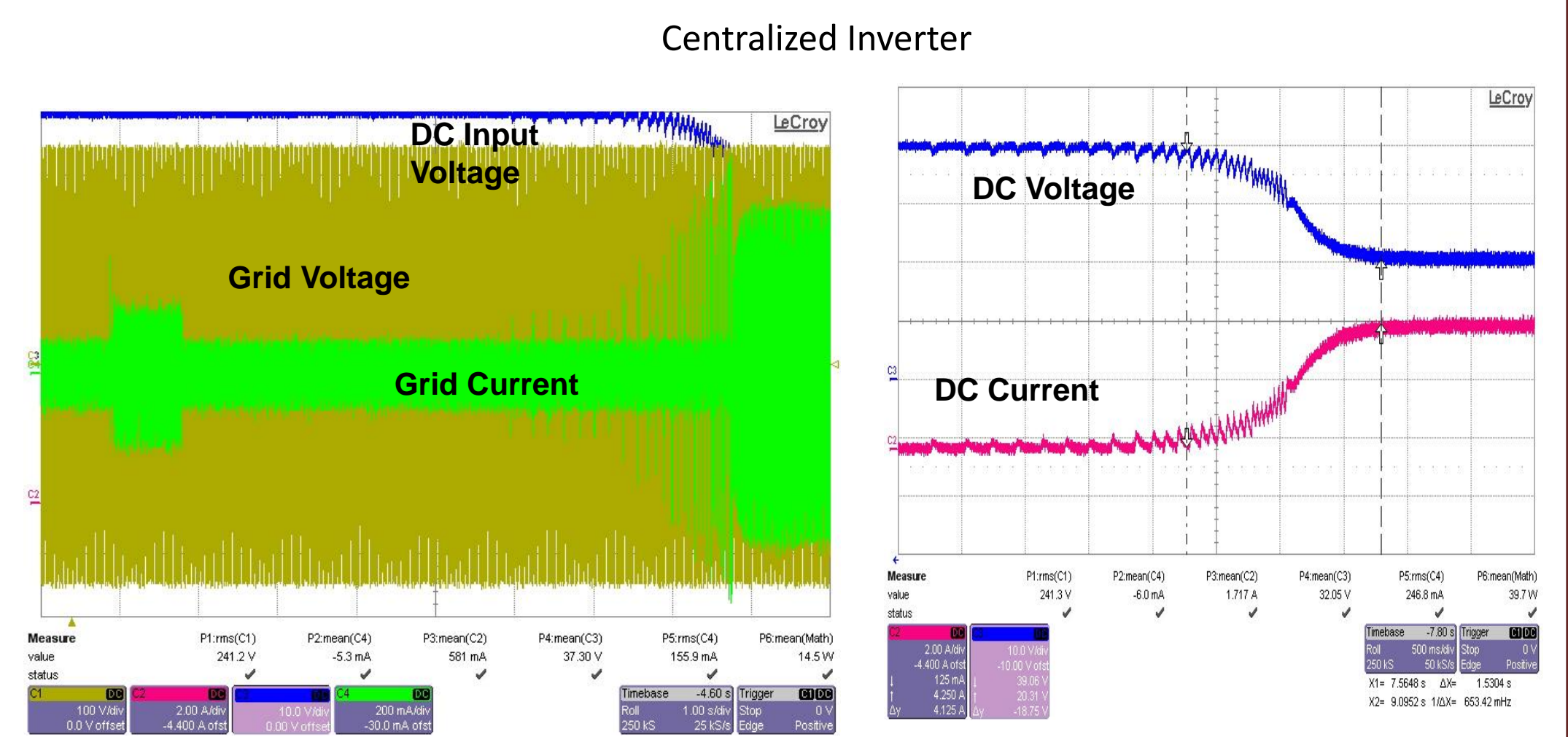
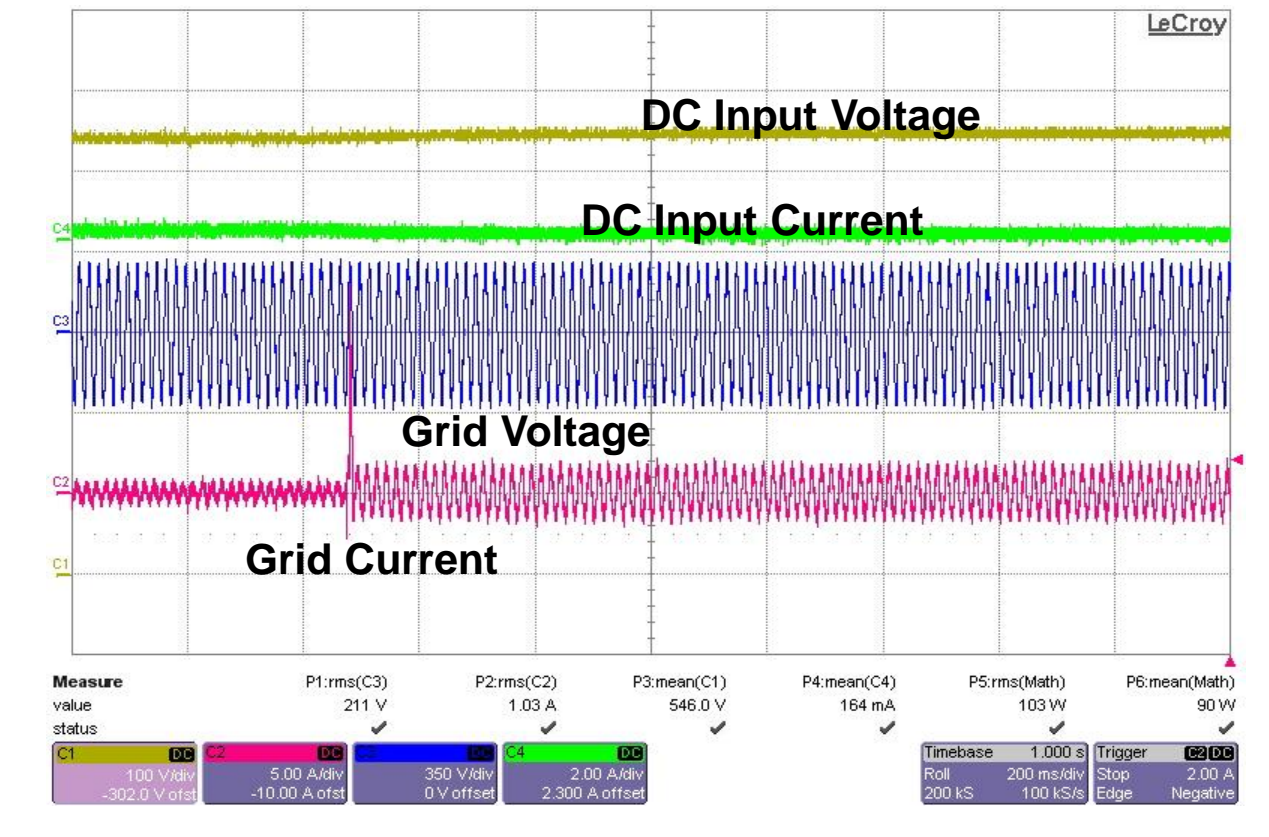
In normal operation, the maximum power point tracking method will perturb the DC voltage for maximum power out. The output sine wave has little harmonics and a power factor of 1.

Low Power Operation



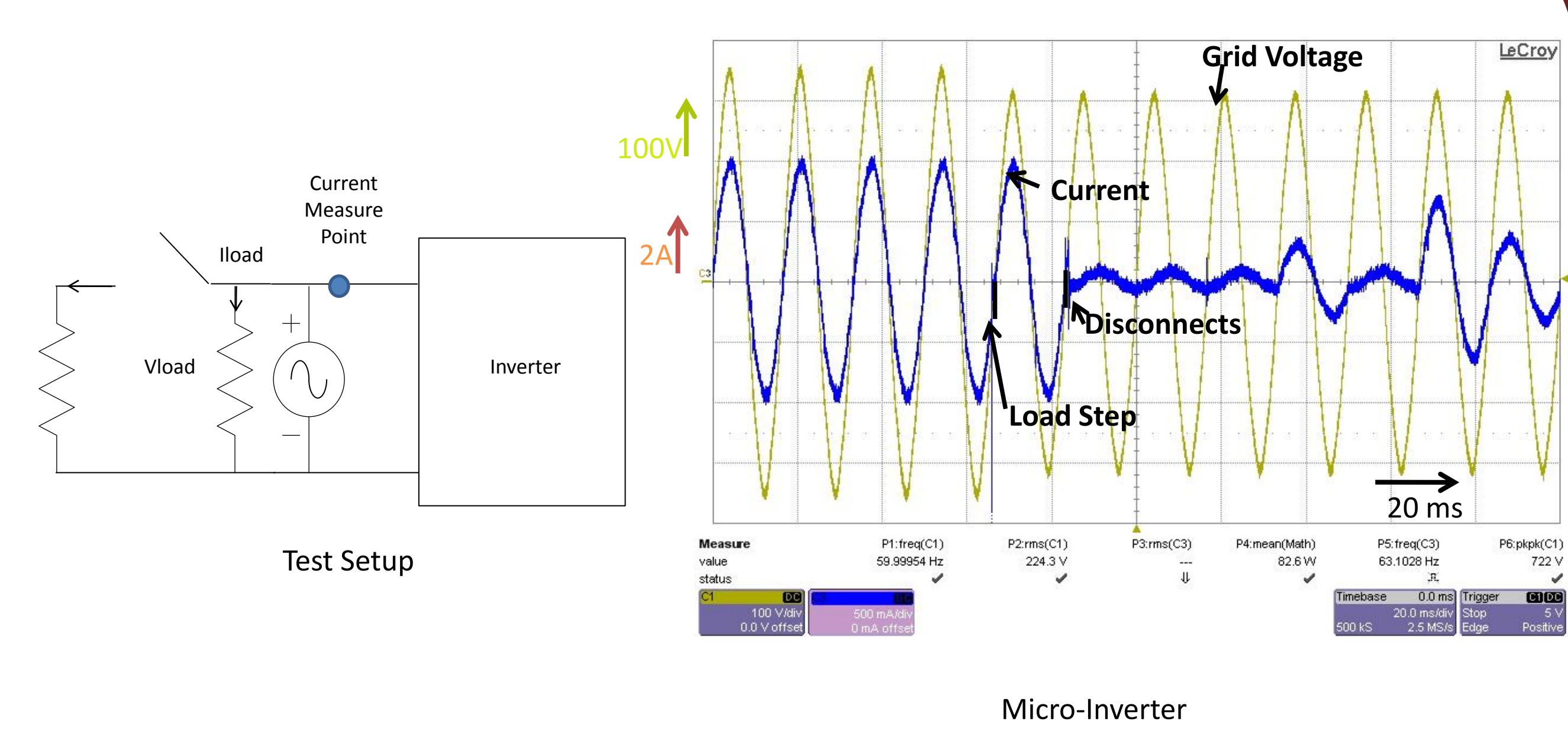
The low power operation is shown at about 5% nominal for the centralized inverter and 20% of the nominal for the micro-inverter. This condition occurs in the early morning, at night, and when there are clouds. Typically solar panels are rated at 1000 W/m². Depending on the location of the solar cell, may rarely occur. So, the inverter is typically operating below the rated power level at normal sunlight condition. At night, in the morning, or during a cloud condition, the centralized inverter will have high harmonics and the micro inverter will operate 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.

Start Up



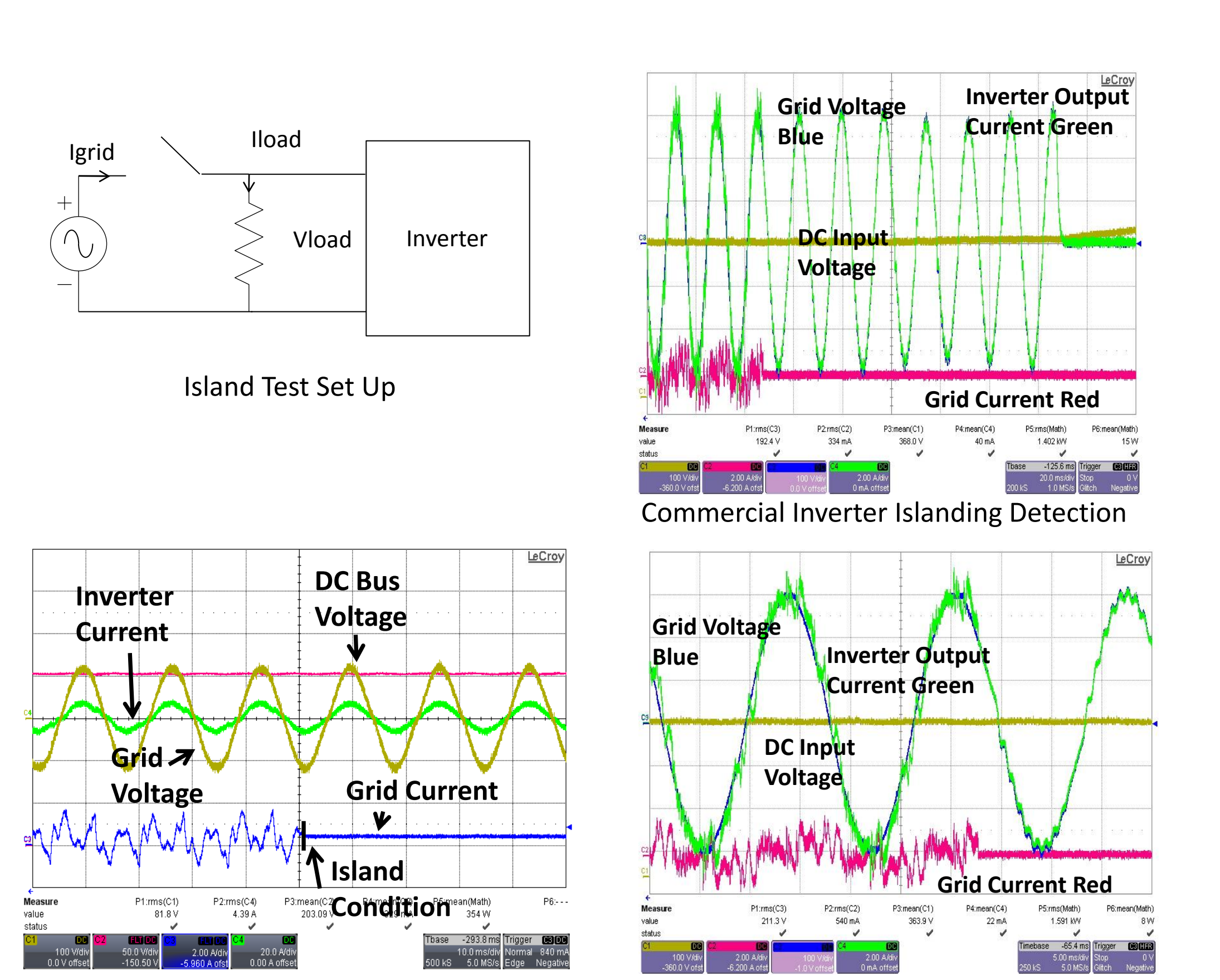
Each inverter will have an overshoot when it first turns on due to the energy stored in the output filter. The centralized inverter uses a much larger inductor so its overshoot is much larger than the micro-inverter. Currently this condition is not considered in the IEEE 1547 standard.

Load Step



The inverter output is 240 V_{rms} connected to a 240 V_{rms} to 208 V_{rms} transformer to the grid. The output is also connected in parallel to a 300 Ω resistor (160 W). This 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. This is likely to be because of the sensitive anti-islanding method. Currently, this condition is not considered in IEEE 1547 standards.

Anti-Islanding Detection



Passive Island Detection in the Non-Detection Zone Commercial Inverter Islanding Detection
When an island forms, the distributed generation must turn off. Many different methods are used. We plan to do more research in this area. We hope to educate the utilities on how the distributed generation detects an island and conditions where the islanding method may not detect.