

# Microgrid for Alcântara Launch Center in Brazil

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## Abstract

Some microgrid challenges arise when operating isolated from the main grid precisely because the local distribution network becomes an ungrounded delta circuit and the microgrid power sources have low short-circuit capacity. The main problems are the non-detection of ground overcurrent in an earth fault event, the unbalance between voltages measured by voltage transformers connected between phases-to-earth, and black start. These issues were resolved through adjustments in the protection relays of the sources and medium voltage circuit breakers, in addition to the implementation of effective control strategies in the Energy Management System.

## Specifications and field results

The microgrid at the Alcântara Launch Center in São Luís, Brazil, was designed to increase reliability, resilience, and power quality, especially during rocket launch campaigns, when it is essential to guarantee power supply and energy quality. This microgrid was used as a case study and comprises a 1 MW photovoltaic system, a battery energy storage system (BESS) with 1 MW / 1 MWh lithium-ion batteries, a backup system with 1.125 MVA diesel generators, and automatic monitoring and control systems.

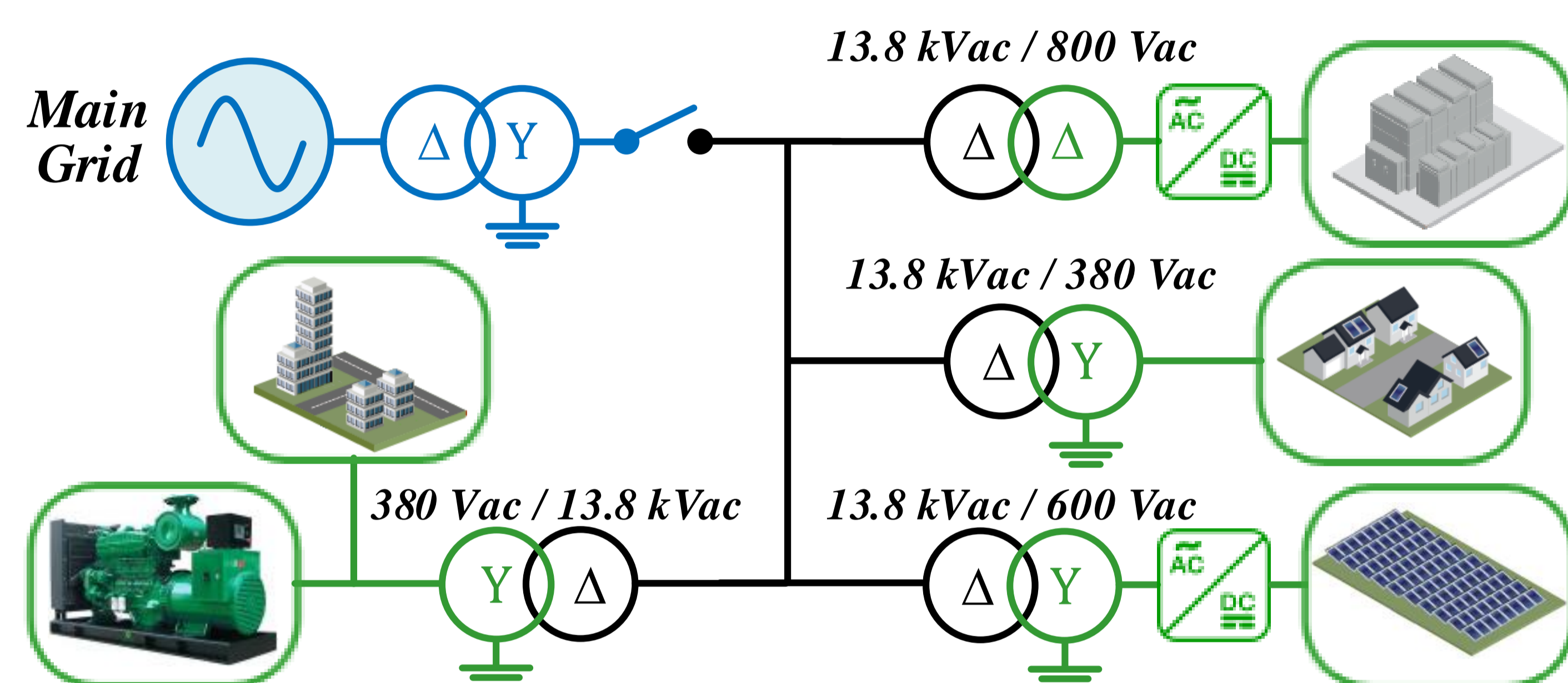


Fig. 1. Simplified diagram of the ALC-μGrid medium voltage network.

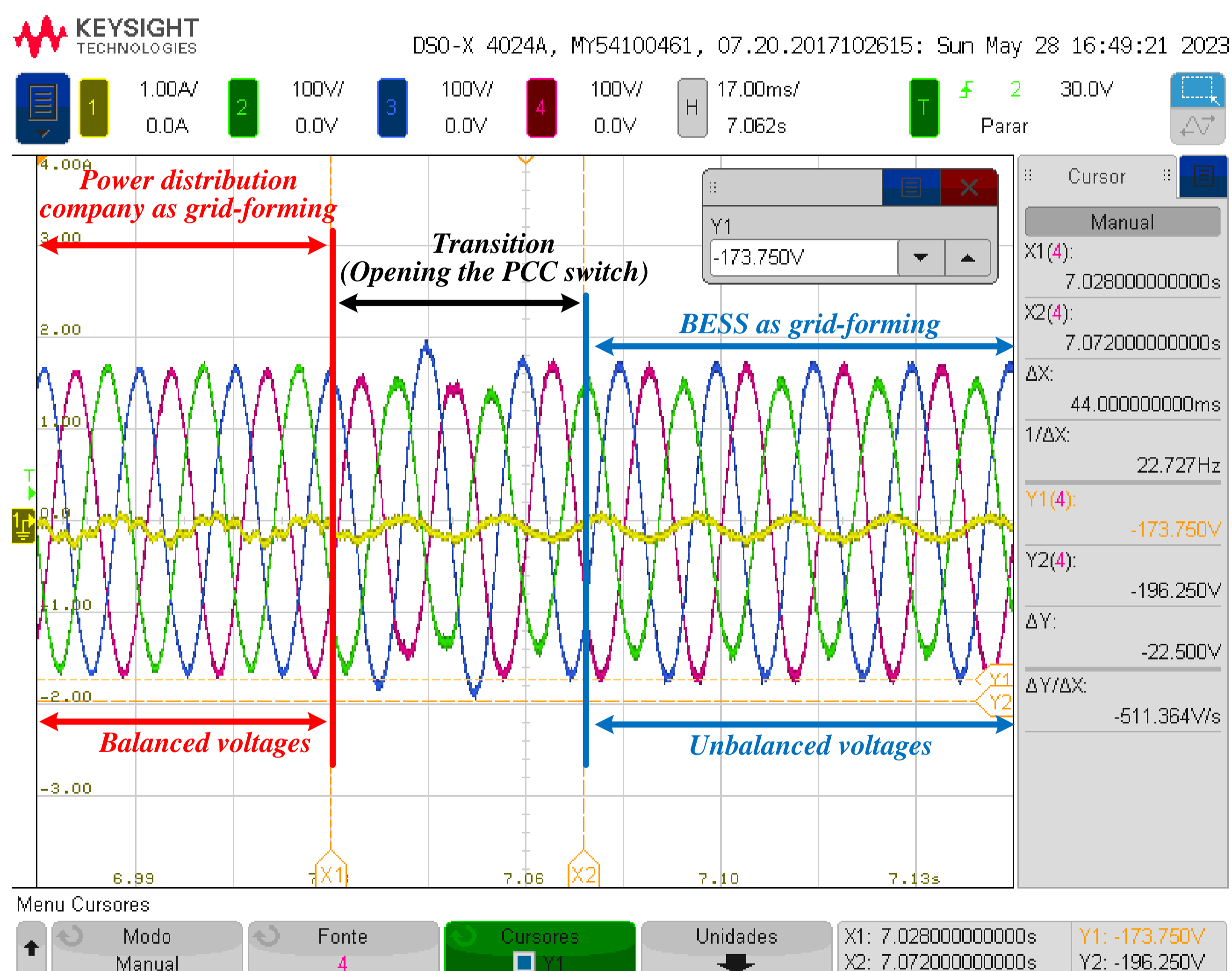


Fig. 2. Voltages in transition from on-grid to off-grid

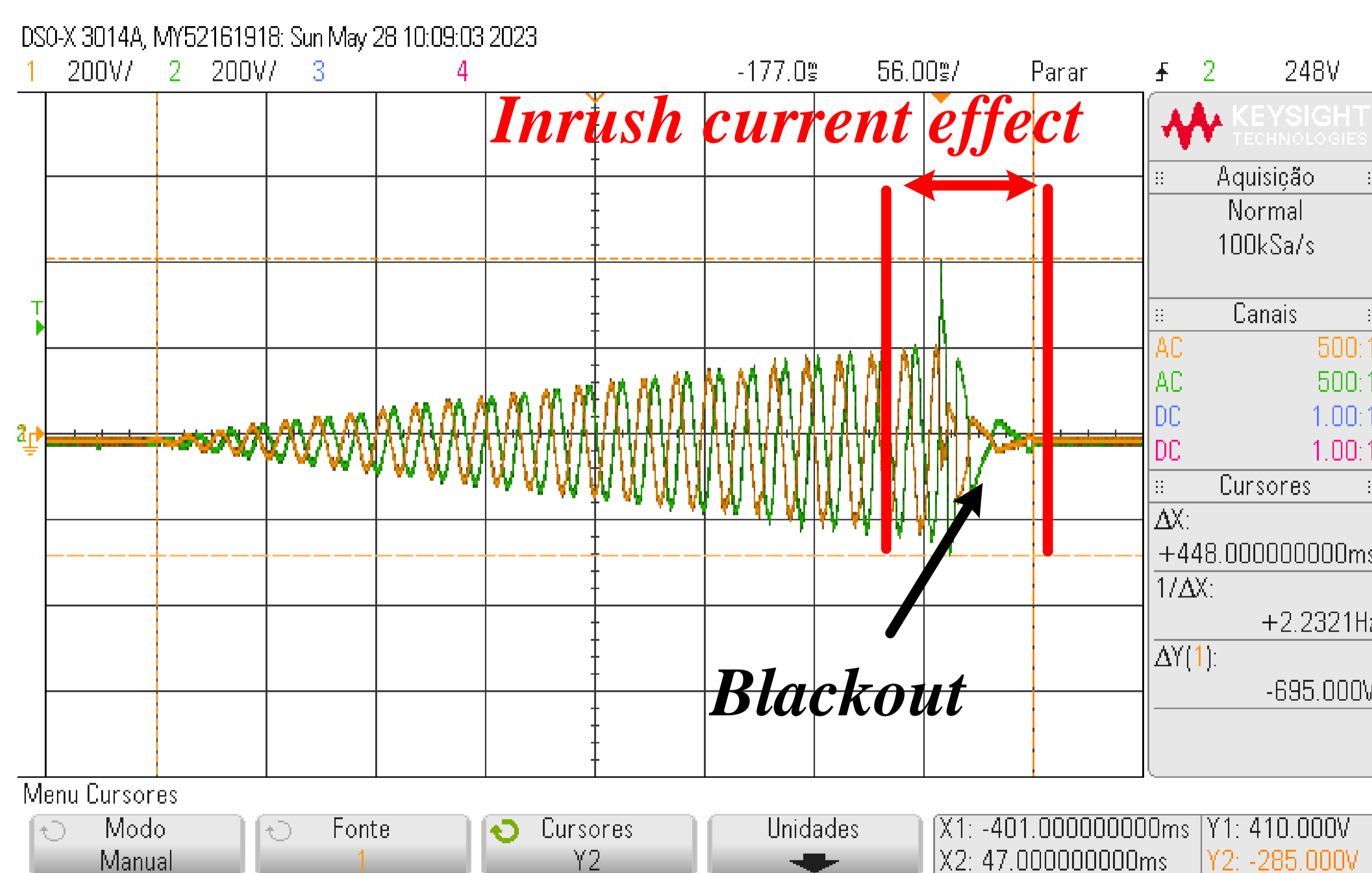


Fig. 4. Black start: protection tripping due to inrush current

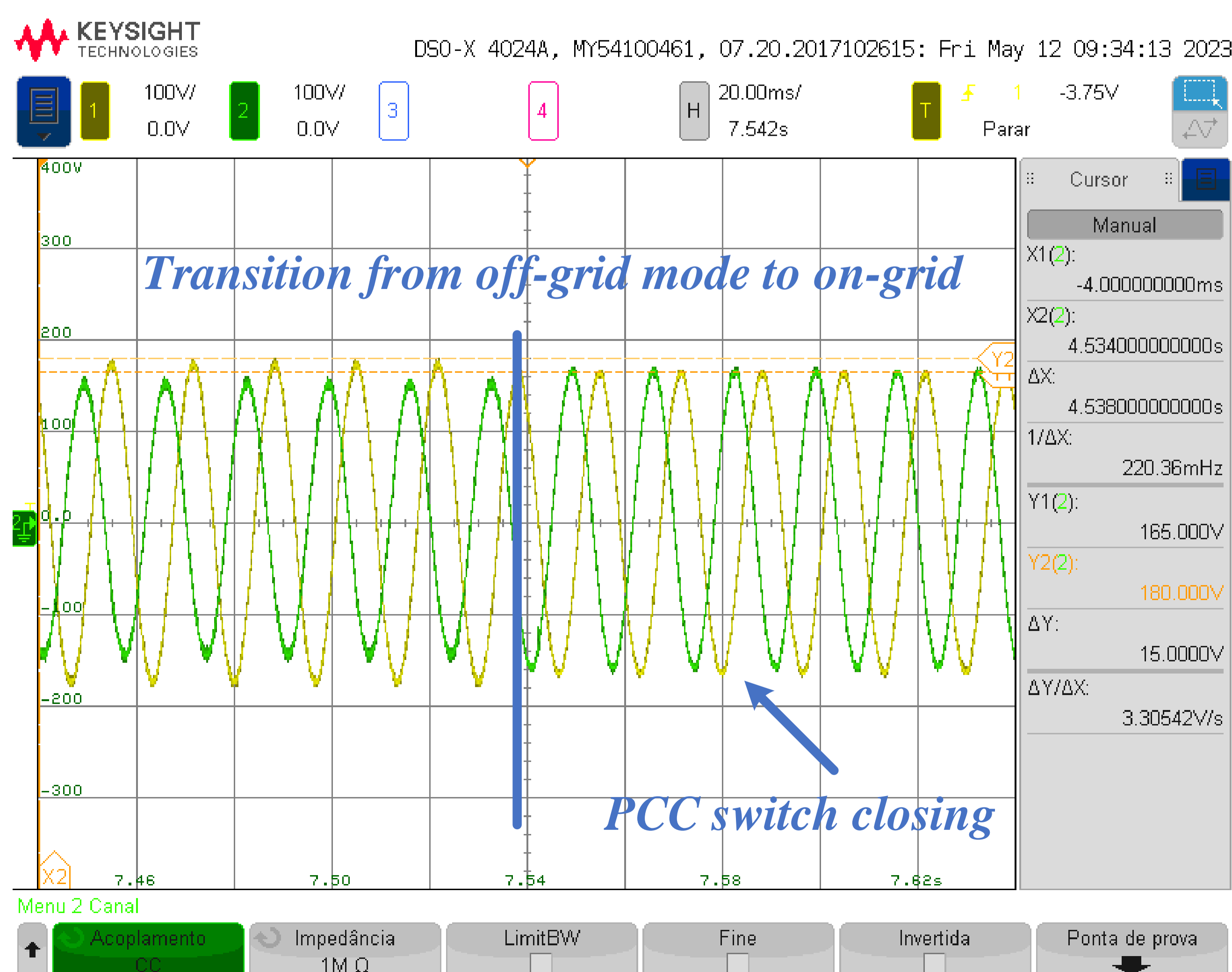


Fig. 3. Voltages in transition from off-grid to on-grid

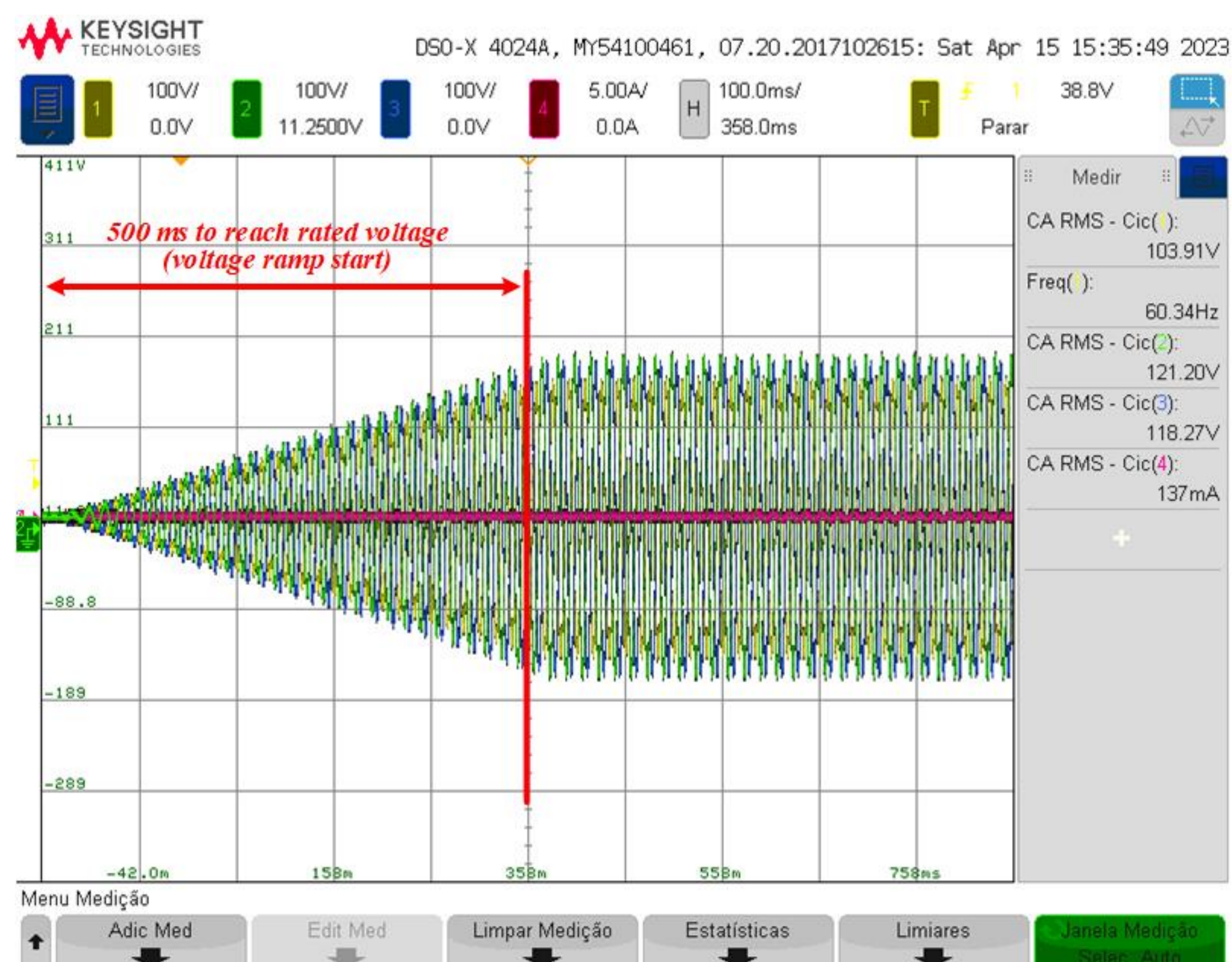


Fig. 5. Black start: without protection tripping