

Application Note

High-precision Current Sensors for Measuring Large Currents in Solar Power Generation Systems

Market: Renewable energy, grid connection, power conditioners
DL950 ScopeCorder, CT1000S AC/DC Split Core Current Sensor



1. Introduction

The introduction of renewable energy is rapidly advancing as a response to global environmental issues, and solar power generation systems play a particularly significant role in this context. A solar power generation system is a technology that uses solar panels to convert solar energy into electricity, which is then connected and supplied to the grid. This technology is gaining attention as a clean energy source that does not rely on fossil fuels, helping to curb global warming and achieve a sustainable society.

2. Challenges

In completed facilities, removing high-current cables may not be possible, or doing so may require considerable time and effort. So depending on the situation, you may need to choose open-close type current sensors.

Split core (clamp type) current sensors generally present disadvantages such as significant variability and large measurement errors. In other words, even when employing a high-precision measuring instrument, measurement values that fluctuate too much will compromise the reliability of the evaluation itself.

Improving the reproducibility of measurement data to reduce variations in measured values is also important for accurate evaluation. Moreover, the measuring instruments and sensors used must have excellent noise resistance, as the measurements take place in a high-noise environment.

3. Solutions provided by DL950 and CT1000S

- CT1000S Current accuracy (50/60 Hz):
 $\pm(0.2\% \text{ of reading} + 0.01\% \text{ of range})$
- User-friendly, high-precision current sensors that do not require cable removal
- Can measure large currents up to AC 1000 A/DC 1500 A*
*DC 1500 A (continuous operation) at the max. operating temperature plus 40°C
- Carrier frequency measurement at a high bandwidth of 300 kHz (–3 dB) (CT1000S)
- Accurate measurement in noisy environments due to outstanding Common Mode Rejection Ratio (CMRR) characteristics
- Real time waveform math and power math (DL950)
- Synchronized measurement with WT5000 based on IEEE 1588 (DL950)



4. Waveform measurement with a large-current sensor

4.1 A high-accuracy AC/DC current sensor that is easy to connect to waveform measuring instruments for measurement

The CT1000S AC/DC split core current sensor can measure large currents up to AC 1000 A/DC 1500 A*, with current accuracy (50/60 Hz) of $\pm(0.2\%$ of rdg + 0.01% of rng). Its open/close structure means you can measure large currents without having to remove the cables being measured. Moreover, you can directly connect the current sensor not only to waveform measuring instruments but also to power meters, making it ideal for power measurement.

*DC 1500 A (continuous operation) at the max. operating temperature plus 40°C

4.2 Reduces the impact on the axial position of the cable being measured

The principle of a current sensor makes it ideal for the cable being measured to pass through the center of the sensor's primary current hole. But in actual measuring situations passing the cable through the center of the hole is often difficult to do, and in any case the cable position affects the measurement values. This product uses a conductor position adjuster to restrict the axial position of the cable being checked, which reduces the impact of misalignment in the axial position when sensing the current with the AC/DC split core current sensor.



Figure 1. Sensor appearance (left) and conductor position adjuster (right)

4.3 Real time math and power math by the DL950

The DL950's real time math function (/G03 option) performs various calculations on captured signals and displays the results in real time as trend graphs. This function enables you to set triggers on calculation results or perform automatic waveform parameter measurements as well as cursor measurements. You can also apply filters to both the input signals and calculation results. In addition, since the real time math function is independent of the input channels, real time calculation results for 32 input channels and additional 16 channels can be displayed and analyzed simultaneously. The power math function (/G05 option) calculates up to 118 types of power parameters for each cycle in real time, including the RMS value, effective power, integrated power, and harmonics. It simultaneously displays both the voltage and current signals being measured, as well as the trend waveform of the computed power parameters in real time. You can also set triggers on trend waveforms for the power parameters.

*The power math option includes the real time math option.

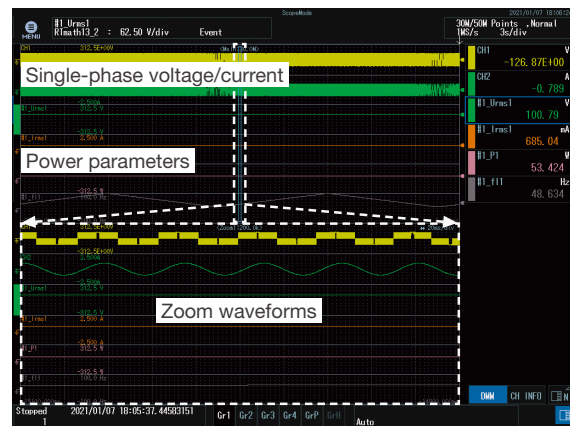


Figure 2. Example of single-phase voltage/current waveforms and power parameter math

Moreover, when you need to measure signals even faster, you can measure the waveforms of three-phase voltages and currents of large currents using the DLM5000 Mixed Signal Oscilloscope.



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