**Introduction**

High-performance low-temperature polymer electrolyte membrane fuel cells (PEMFCs) are susceptible to self-heating and undesirable cell temperature rise at high current. Cell self-heating is driven by ohmic (IR) heating, the heat generated when a large current $I$ (A) passes through a resistor $R_{ohmic}$ (Ω):

$$\text{Thermal Power (W)} = I^2 \times R_{ohmic}$$

Passive convective heat loss maybe insufficient to prevent a rise in the cell temperature at high current. Active cooling with small fans located on either side of the fuel cell end-plates (Figure 1) is a cost-effective approach to eliminating or significantly decreasing IR-heating during polarization (V-I) testing (Figure 2 and Figure 3) and voltage or current cycling (Figure 4).

![Figure 1. Active cell cooling with a pair of small fans positioned ~ 20 cm (8 in.) from either side of the cell. The cell heaters are forced to work against the increased convective cooling provided by the fans.](image-url)
**Figure 2.** Without active cooling, the cell temperature can increase, particularly at high current, during a simple polarization scan. Without cell cooling (open symbols), with cell cooling (filled symbols).

**Figure 3.** Active cell cooling maintains the cell temperature at the desired operating condition. Without active cooling, the cell temperature rapidly rose 10 °C.
Figure 4. Active cooling with fans during voltage cycling significantly decreased the ohmic-heating driven temperature fluctuations and limits overall cell heating to ~ 1 °C above target cell temperature. Conditions: 25 cm² Gore PRIMEA® 57 Series MEA, 1.5x H₂ / 2.5x O₂ (as Air), T_{cell} = 65 °C, 65 °C anode and cathode inlet dew point (100% RH). 250 kPa_{in} / 250 kPa_{in}. V-cycling between OCV and 0.3 V, 0.05 V/step, 10 sec/step.