Practical experience with thermal system Flex TC

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Motivation

- Customer requests for temperature parameters (SGP model)
- Search for heating/cooling equipment for measurements (including temperature parameters in SPICE models)
- Test in April 2015 with loaned equipment from J.P. Kummer (Flex TC)
Short survey

- **Usability**
  Simple and quick possibility to perform measurements at various temperatures

- **Characteristics:**
  Temperature range: -55 bis +175 °C bzw. -60 bis +300 °C (max TC)
  Various plungers available (even custom specific)
  Dimensions: ca. 50 cm x 35 cm x 20 cm
  Weight: ca. 15 kg

- **Technique:**
  Heating/cooling by gas circulation (heating/cooling device in main device) und additional Peltier element inside head („plunger“)
  Temperature sensor placed inside plunger

- **Price:**
  Ca. 20000 € incl. 3 plungers
Control panel

- Temperature setting directly by touchscreen
- Appliance very simple, no previous knowledge necessary.
Test setting (1)

IC-CAP-measuring system:

Measuring of Gummel plots from -50 °C to +150 °C (using 25°C-steps)
Test setting (2)

- DUT mounting by using steel clip and thermal compound
- Adaptor available for complete shielding of measuring setup
Test setting (3)

Test setup at µParset
(Test system for high current/high voltage)
Results (1)

**Temperature behaviour:**

- Heating-/cooling rate: ca. 10 min (0°C to 100°C and 0°C to -50°C)
- Temperature deviation:

<table>
<thead>
<tr>
<th>target temperature (°C)</th>
<th>temp. setting (°C) (including offset)</th>
<th>temp. measured (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>104</td>
<td>99.9 - 100.1</td>
</tr>
<tr>
<td>0</td>
<td>-1</td>
<td>0 - 0.1</td>
</tr>
<tr>
<td>-50</td>
<td>-53</td>
<td>-50.2 - -50.0</td>
</tr>
</tbody>
</table>

- Specification of manufacturer (+/- 0.2°C) is met
- Offset is to be determined dependent on used plunger
Results (2)

- **Current measurement (Gummel plot) -50°C:**

  - Temperature control activated
  - Temperature control deactivated

![Gummel plot graphs](image-url)
Results (3)

- **Current measurement (Gummel plot) at 100°C:**

  Temperature control activated
  
  Temperature control deactivated
Results (4)

- Voltage measurement (VCEsat) bei -50°C:

  Temperature control activated

  Temperature control deactivated
Results (5)

- **Voltage measurement** (VCEsat) bei 100°C:

  **Measurement artefact?**

  Temperature control activated

  Temperature control deactivated
Summary

- **Advantages:**
  - Simple and quick possibility to perform measurements at various temperatures
  - No previous knowledge necessary for using
  - Mobility of temperature system
  - Good temperature stability (+/- 0.2°C)

- **Disadvantages:**
  - Electrical noise when measuring low currents < 10 nA (and possibly low voltages)
  - Noise is appearing in heating and cooling
  - Occurring of humidity/ice in cooling mode (but N₂-purging is possible)
  - Heating and cooling rates lower than specified by manufacturer, but acceptable

- **Possible improvements:**
  - Possibility of deactivating temperature controlling during measurement by software solution (manufacturer is trying to offer a software solution; information of G. Kölz)
Supplier / contact

http://www.jpkummer.com/en/node/93

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Thank you for your attention!