



## TEMPERATURE CONTROL SYSTEM

### Microwave Dielectric Measurements in High Temperature

#### Measurement Demonstration

Measurements acquired with *EpsiMu*<sup>®</sup> PE13 from 30° to 80° at 100 MHz and 1 GHz

Ethanol  $\geq 99.8\%$

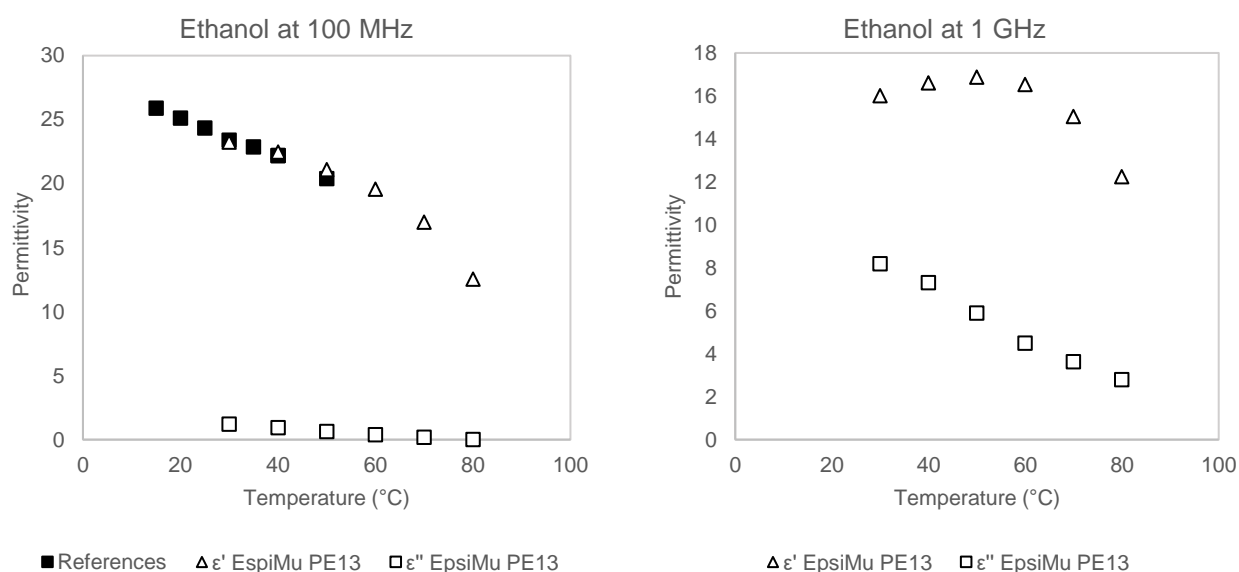


Fig. 4. (left) Real part of permittivity  $\epsilon'$  ( $\Delta$ ) and imaginary part of permittivity  $\epsilon''$  ( $\square$ ) EpsiMu measurement of ethanol as function of temperature, from 30° to 80°, at 100 MHz; comparison with references from Puranik et al, 1993, Khirade et al, 1999 and Checinska-Majak et al, 2012 ( $\blacksquare$ ); (right) Real part of permittivity  $\epsilon'$  ( $\Delta$ ) and imaginary part of permittivity  $\epsilon''$  ( $\square$ ) EpsiMu measurement of ethanol as function of temperature, from 30° to 80°, at 1 GHz. Measurement errors are not displayed for clarity reasons; please see [Technical Properties](#) for measurement errors.

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### APU10 (absorbent magnetic material)

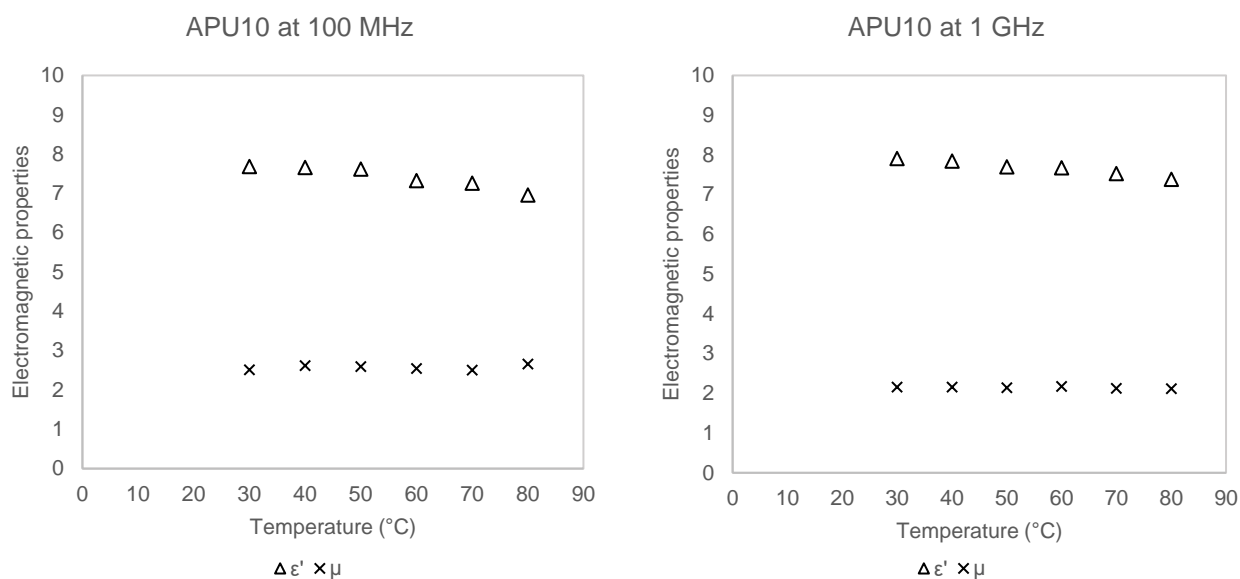


Fig. 5. (left) Real part of permittivity  $\epsilon'$  ( $\Delta$ ) and real part of permeability  $\mu$  (x) EpsiMu measurement of APU10 as function of temperature, from 30° to 80°, at 100 MHz; (right) Real part of permittivity  $\epsilon'$  ( $\Delta$ ) and real part of permeability  $\mu$  (x) EpsiMu measurement of APU10 as function of temperature, from 30° to 80°, at 1 GHz. Measurement errors are not displayed for clarity reasons; please see [Technical Properties](#) for measurement errors.

### Measurements acquired with EpsiMu® 7mm from 30° to 80° at 530 MHz and 12 GHz

#### Air (constant permittivity with temperature)

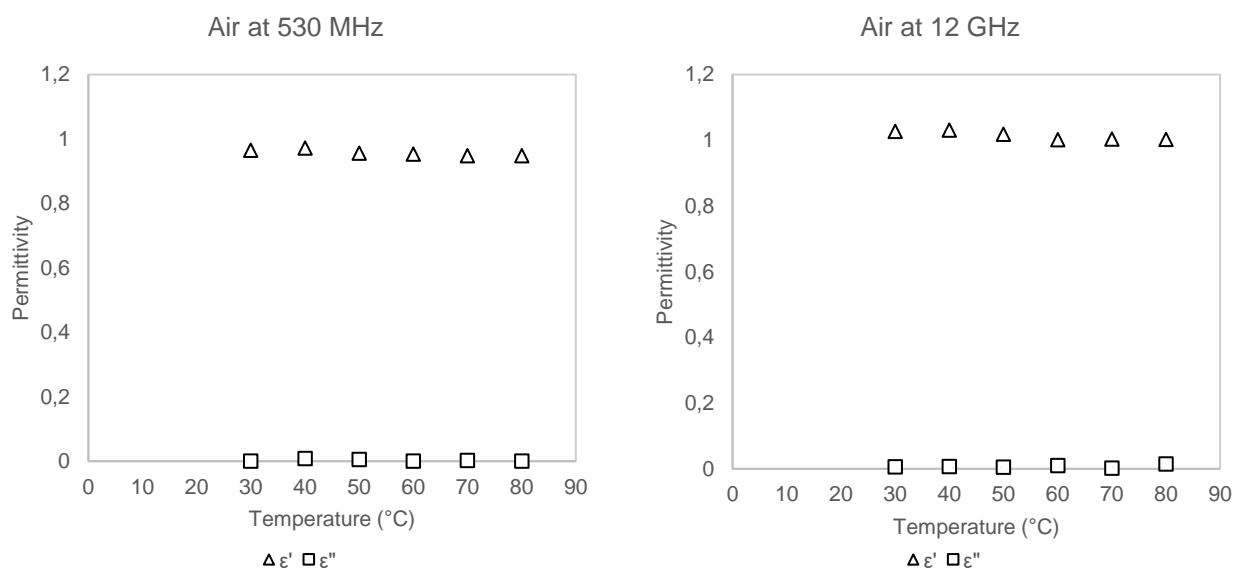


Fig. 6. (left) Real part of permittivity  $\epsilon'$  ( $\Delta$ ) and imaginary part of permittivity  $\epsilon''$  ( $\square$ ) EpsiMu measurement of air as function of temperature, from 30° to 80°, at 530 MHz; (right) Real part of permittivity  $\epsilon'$  ( $\Delta$ ) and imaginary part of permittivity  $\epsilon''$  ( $\square$ ) EpsiMu measurement of air as function of temperature, from 30° to 80°, at 12 GHz.

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### **APU10 (absorbent magnetic material)**

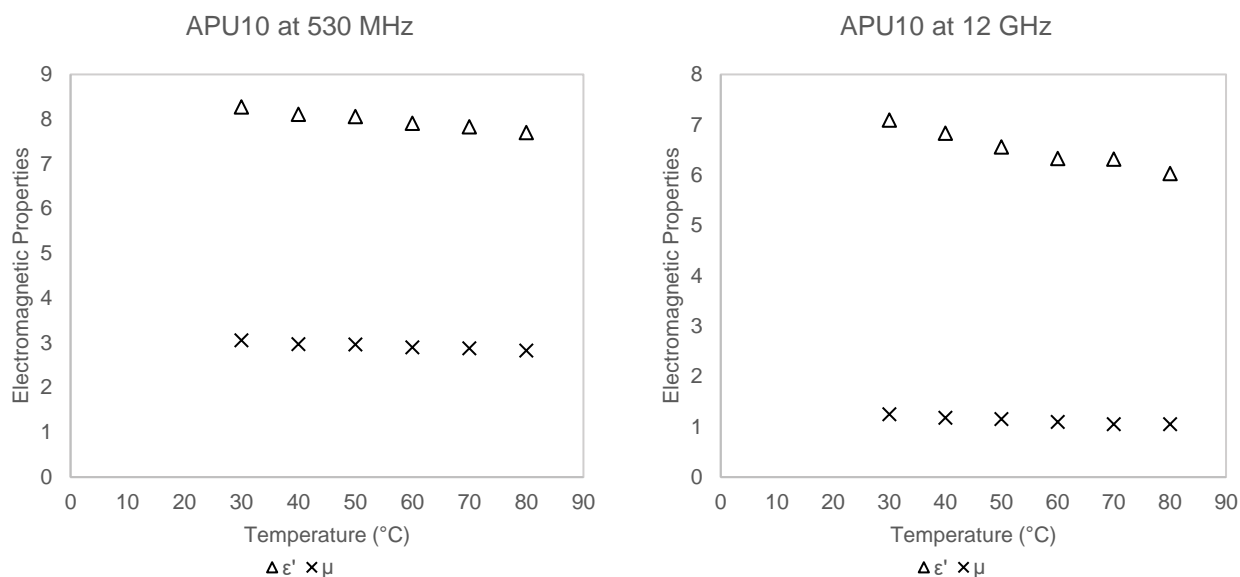


Fig. 7. (left) Real part of permittivity  $\epsilon'$  ( $\Delta$ ) and real part of permeability  $\mu$  ( $\times$ ) EpsiMu measurement of APU10 as function of temperature, from 30° to 80°, at 530 MHz; (right) Real part of permittivity  $\epsilon'$  ( $\Delta$ ) and real part of permeability  $\mu$  ( $\times$ ) EpsiMu measurement of APU10 as function of temperature, from 30° to 80°, at 12 GHz. Measurement errors are not displayed for clarity reasons; please see [Technical Properties](#) for measurement errors.

## Technical Properties

	<b>EpsiMu® 7mm</b>	<b>EpsiMu® PE13</b>
<b>Temperature Range</b>	Room temperature to 85°C	
<b>Temperature Precision</b>	1°C	
<b>Frequency Range</b>	10 KHz to 8 GHz	10 KHz to 18 GHz
<b>Heating delay time</b>	No time restrictions (seconds)	
<b>Number of T°C points</b>	70 points (starting at 15°C)	
<b>Sample type</b>	Washer-shaped solids	Solids, powders, liquids, etc.
<b>Sample length range (mm)</b>	0.2 to a few mm ( $< \frac{\lambda}{2}$ )	1 to sample holder length
<b>Measurement Accuracy</b>	$\frac{\Delta\epsilon'}{\epsilon'} < 5\%$ ; $\frac{\Delta\epsilon''}{\epsilon''} < 10\%$	$\frac{\Delta\epsilon'}{\epsilon'} < 5\%$ ; $\frac{\Delta\epsilon''}{\epsilon''} < 10\%$
<b>Length of Sample-Holder</b>	-	24mm or higher

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