

## SRD1000 measurement systems for precision thermometry on the PLTS-2000

### SRD1000 measurement system

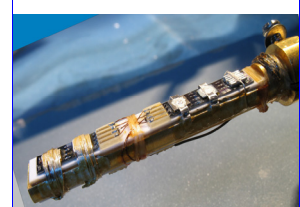
The SRD1000 system is an easy to use, modular and all-in-one measurement system for precision thermometry below 4 K, comprising several items:

- an SRD1000 device that supports up to 10 reference points for thermometry between 10 mK and 1.2 K
- an optional CMN (Cerium Magnesium Nitrate) paramagnetic susceptibility thermometer that - once calibrated with the reference points - allows accurate and continuous thermometry below 4 K
- the MIDS-20X series of mutual inductance detection electronics: a 2-channel MIDS-202 for simultaneous reading of both an SRD1000 device and a CMN thermometer, or a 1-channel MIDS-201 for single sensor use
- a DCS-10 degauss tool and an ACS-10 current source to establish low magnetic field conditions in the SRD sensor unit and thus ensuring accurate reproduction of the reference points
- a calibration of the reference points

Product bundles of the individual system components are obtainable as standard items  
Special system configurations are possible upon request

### SRD1000 superconductive reference device

- The device supports 10 reference temperatures  $T_C$  between 10 mK and 1.2 K provided by the superconductive transitions of samples of various materials
- A compact array of planar micro-coils detects the transitions
- A Cryoperm / niobium shield and a compensation coil reduces ambient magnetic fields by a factor of 400
- Filters suppress the effects of RF-interference
- Evaluation by various metrological institutes in Europe has proven that the SRD1000 concept is reliable for transferring the PLTS-2000
- The typical uncertainty levels of determining the  $T_C$  's range from about 0.04 mK at 15 mK to about 0.8 mK at 1.2 K



Detector array with reference samples



Combined SRD and CMN sensor block

### CMN thermometer option

- The optional CMN thermometer fully integrates with the SRD sensor unit and the MIDS-202 detection electronics
- It provides continuous thermometry in the range of <10 mK to 4 K
- Reading are reliable due to the 'on board' calibration points of the SRD sensor unit
- The resolution is better than 0.5 mK for  $T < 0.5$  K and better than 0.5 % for  $0.5$  K  $< T < 1$  K

### MIDS-20X series of mutual inductance detection systems

- The MIDS-202 is a 2-channel detection system for simultaneously reading an SRD1000 device and a CMN thermometer
- The electronics is essential for reliable realisation of the calibrated reference points
- 'Plug-and-play', no adjustments are required during the measurements
- The system outputs are DC voltages proportional to the signal levels of the sensors
- It includes two 24-bit ADC's with optical USB computer interface for precision readings of the sensor signals.
- The system comes with software tools (a DLL interface and a LabVIEW VI) for data acquisition and processing
- The MIDS-201 model is a 1-channel version of the MIDS-202



### DCS-10 degauss tool

- The tool is used for demagnetising the shielding of the SRD sensor unit to optimise the magnetic properties
- The supply unit provides a current of 1.7 A, 50 / 60 Hz to drive the degauss coil



### ACS-10 current source

- The battery-powered precision current source is used for compensating residual magnetic fields in the SRD sensor unit
- The output current is adjustable between 0 -  $\pm 2000$   $\mu$ A using a 10-turn potentiometer and a polarity selection switch



**Calibrations**

SRD1000 devices combined with the MIDS-20X series of electronics can be supplied with a calibration of the reference points

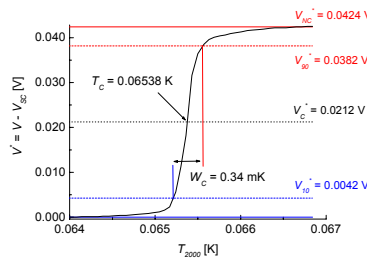
- level A : a calibration with a certificate by PTB (web site: <http://www.ptb.de>); PTB (the Physikalisch-Technische Bundesanstalt) is the national metrology institute of Germany that measures with the highest accuracy and reliability
- level B : a calibration performed with an uncertainty level of about 2% or less



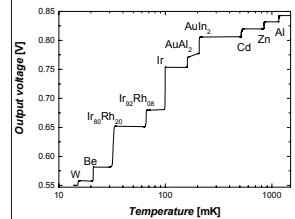
**Typical values of the SRD1000 reference points**

#	material	$T_c$ [mK]	$W_c$ [mK]	$U_c$ [%]
1	W	15	< 0.2	< 0.26
2	Be	21	< 0.3	< 0.28
3	Ir <sub>80</sub> Rh <sub>20</sub>	30	< 0.5	< 0.34
4	Ir <sub>92</sub> Rh <sub>08</sub>	65	< 0.5	< 0.16
5	Ir	98	< 0.5	< 0.10
6	AuAl <sub>2</sub>	145	< 0.5	< 0.06
7	AuIn <sub>2</sub>	208	< 1	< 0.10
8	Cd	520	< 4	< 0.16
9	Zn	850	< 3	< 0.08
10	Al	1180	< 4	< 0.06

with:  
 $T_c$  = transition temperature reference material  
 $W_c$  = transition width (temperature interval in which the signal of the transition changes by 80%)  
 $U_c$  = relative uncertainty in determining  $T_c$  (related to an uncertainty component of  $0.1 \cdot W_c$ )



Example of the Ir<sub>92</sub>Rh<sub>08</sub> transition and its  $V_c$ ,  $T$  calibration parameters; calibration by PTB



Output of the electronics versus sensor temperature showing the 10 transitions of the device

**Product bundles**

	SRD1000 device 10 points	CMN sensor option	DCS-10	ACS-10	MIDS-202	MIDS-201	calibration level A	calibration level B
<b>CONTINUOUS</b>								
high end	✓	✓	✓	✓	✓		✓	
economy	✓	✓	✓		✓			✓
basic	✓	✓	✓					
<b>REFERENCE</b>								
high end	✓		✓	✓		✓	✓	
economy	✓		✓			✓		✓
basic	✓		✓					

**HDL, the company**

- HDL is a one-man business founded by Wim Bosch in 1996
- Core business is the development and sales of cryogenic special products in cooperation with other companies and institutes
- More than 30 years of experience in low temperature physics and related instrumentation

**Further information**

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