HDL HIGHTECH DEVELOPMENT LEIDEN

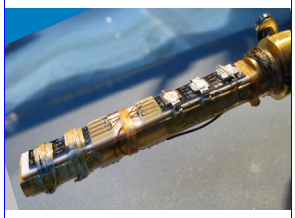
SRD1000 measurement systems *for precision thermometry on the PLTS-2000 and ITS-90*

SRD1000 measurement system

The SRD1000 system is an easy to use, modular, all-in-one measurement system for precision thermometry below 8 K. It comprises a calibrated SRD1000 superconductive reference device, a CMN1000 thermometer, the MIDS-20x series sensor electronics and optional tools to establish low magnetic field conditions in the reference sensor. The user can select a dedicated system configuration that will match the temperature range and other specific conditions of a measurement set-up.

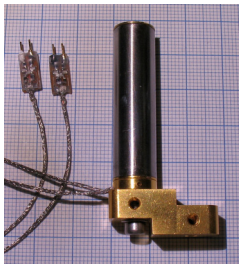
SRD1000 superconductive reference device

- sensor supporting up to 13 stable, calibrated reference points for precision thermometry between 15 mK and 8 K provided by the superconductive transitions of samples of various materials
- lesser points may be included in a specific device to cover only the main temperature range of a measurement set-up
- a Cryoperm / niobium shielding reduces ambient magnetic fields by a factor of 400 to minimise shifts of the superconducting transition temperatures
- an optional compensation coil allows the analysis of residual file conditions near the reference materials
- sensor leads are equipped with filters to suppress the effects of rf-interference



CMN1000 thermometer

- precision thermometer for the range of < 10 mK to 2 K using the temperature dependence of the susceptibility of Cerium Magnesium Nitrate (CMN)
- signal performance is optimised by using a niobium shielding and sensor leads equipped with rf-filters
- simple, 3 parameter function A + B / (*T* - d) suffices to describe the temperature dependence of the sensor signal (error < 0.5 % below 1 K)
- thermal relaxation time is < 5 s at 10 mK and less at higher temperatures
- sensor resolution: about 4 mK at 2 K, 0.2 mK at 500 mK and 10^{-4} mK at 10 mK



MIDS-20X mutual inductance detection system

- series of ultra low-noise detection systems for measuring mutual inductances
- 2-channel model MIDS-202 provides simultaneous measurement of SRD1000 and CMN1000 sensor signals
- MIDS-201 model supports a 1-channel measurement; an optional multiplexer (SSB-01) allows selection between 2 inputs
- 'plug-and-play': no adjustments are required for the entire temperature range of a specific sensor
- system outputs are DC voltages proportional to the signal levels of the sensors
- 24-bit ADC's with optical USB computer interface provide precision logging of the sensor signals
- software tools (DLL interface and LabView VI's) are available for data acquisition and processing

DCS-20 degauss tool

- tool required for demagnetising the shielding of the SRD1000 sensor to optimise its magnetic properties
- supply unit provides a current of 1.7 A, 50 / 60 Hz to drive the degauss coil

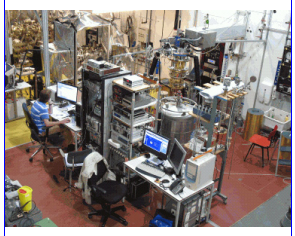
ACS-20 adjustable current source

- battery-powered precison current source used for compensating residual magnetic fields in the SRD1000 sensor
- output current is adjustable between 0 - ±2000 µA using a 10-turn potentiometer and switches for polarity and field orientation

Calibrations

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

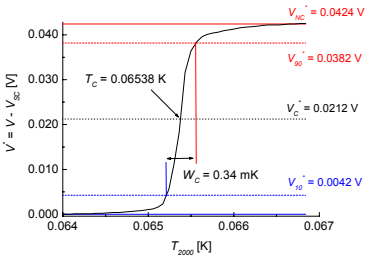
- level A: a calibration with a certificate by PTB (web site: http://www.ptb.de); PTB (the Physikalisch-Technische Bundesanstalt) is the national metrology institute of Germany that measures with the highest accuracy and reliability
- level B: a calibration by HDL performed with an uncertainty level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



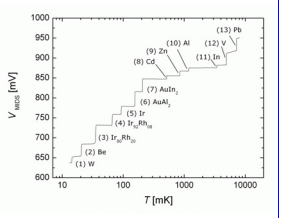
Typical values of the SRD1000 reference points

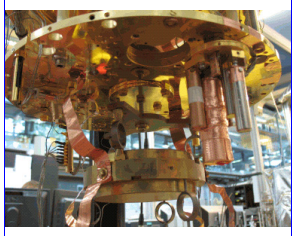
#	material	T_C [mK]	W_C [mK]	U_C [%]
1	W	15	< 0.2	< 0.3
2	Be	21	< 0.3	< 0.3
3	$Ir_{80}Rh_{20}$	30	< 0.5	< 0.3
4	$Ir_{92}Rh_{08}$	65	< 0.5	< 0.2
5	Ir	98	< 0.5	< 0.1
6	$AuAl_2$	145	< 0.5	< 0.1
7	$AuIn_2$	208	< 1	< 0.1
8	Cd	520	< 1	< 0.1
9	Zn	850	< 2	< 0.1
10	Al	1180	< 4	< 0.1
11	In	3400	< 4	< 0.1
12	V	4900	< 20	< 0.1
13	Pb	7200	< 6	< 0.1

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*W_C)*



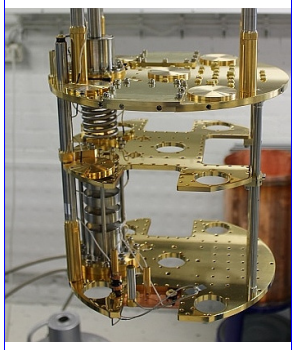
Example of the $Ir_{92}Rh_{08}$ transition and its V, T calibration parameters; calibration by PTB





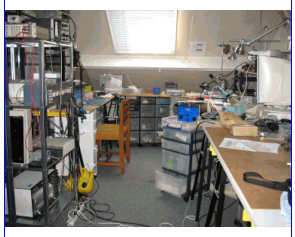
Examples of system configurations

	A	B	C	basic
SRD1000 (up to 13 points)	√	√	√	√
compensation coil	√	√		
CMN1000	√	√	√	
MIDS-202	√	√		
MIDS-201			√	√
SSB-01			√	
DCS-20	√	√	√	√
ACS-20	√	√		
HDL calibration		√		√
PTB calibration	√			
software / manuals / support	√	√	√	√



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 35 years of experience in low temperature physics and related instrumentation



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