

TRANSIENT SIGNAL TECHNOLOGIES
ADVANCED SOLUTIONS IN MATERIALS SCIENCE

HALL EFFECT MEASUREMENT SYSTEMS



FEATURES

- four probe van der Pauw measurements
- variable temperature Hall effect and resistivity
- variable magnetic field study
- fully automated measurement systems
- user friendly software, pubs ready results

APPLICATIONS

- conductivity studies of materials
- understanding scattering mechanisms, mobility studies
- magnetoresistance studies
- shallow and mid-states energy spectrum probing

TYPICAL VARIABLE TEMPERATURE HALL EFFECT SETUP

HALL EFFECT AND VAN DER
PAUW CONTROLLER

TEMPERATURE
CONTROLLER

VARIABLE
TEMPERATURE
(80 K - 500 K)
CRYOSTAT



BIPOLEAR ELECTROMAGNET
POWER SUPPLY



DELL DESKTOP COMPUTER



VACUUM ACCESSORIES



VACUUM ROTARY PUMP

0.5 TESLA ELECTROMAGNET

THE VARIABLE TEMPERATURE HALL EFFECT MEASUREMENT SYSTEMS (HMS)

The variable temperature Hall Effect Measurement System is designed to provide complete automatic measurements of the electrical properties of semiconductor materials using the van der Pauw measurement technique.

A TYPICAL VARIABLE TEMPERATURE HALL EFFECT MEASUREMENT SYSTEM

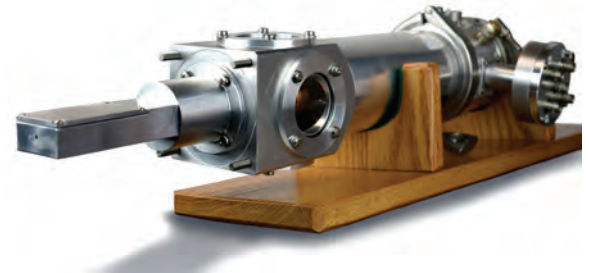
A typical variable temperature Hall Effect Measurement system includes:

- ◆ DC600 Programmable Temperature Controller and H5000 Hall Effect Measurement Controller
- ◆ Liquid nitrogen cryostat equipped with triax cables for signal acquisition
- ◆ Electromagnet or permanent magnet setup
- ◆ Bipolar electromagnet power supply
- ◆ Vacuum pump and vacuum accessories
- ◆ Adjustable probes, soldering pins or Kapton Harness for taking 4-point van der Pauw measurements
- ◆ Dell Optiplex 5090 Tower desktop computer and 22" LCD monitor
- ◆ All electronics mounted in 19" electronic rack

AVAILABLE TEMPERATURE RANGES

Depending on vacuum variable temperature cryostat the HMS systems can operate in different temperature ranges:

- ◆ Room Temperature (VTHS chamber)
- ◆ 80 K to 500 K (VPF cryostat)
- ◆ Room Temperature to 700 K (VTHS chamber)



DC600 TEMPERATURE CONTROLLER

Transient Signal Technologies offers programmable temperature controller that is designed for use with variable temperature systems. This controller provides accurate temperature measurements, precise temperature control, and easy-to-use data acquisition functions over the temperature range from 80 K to 700 K. DC600 temperature controller is designed to operate with Pt RTD temperature sensors and supports 50 Watt heaters. This controller is supplied with VPF cryostats for operation in 80 K - 500 K temperature range.



K2000 TEMPERATURE CONTROLLER

For HMS operating in 300 K - 700 K temperature range we offer low-wattage K2000 programmable temperature controller that is intentionally designed for operation with miniature ceramic hot stages. This controller provides accurate temperature measurements, precise temperature control, and easy-to-use data acquisition functions over the temperature range from 300 K to 700 K. K2000 temperature controller is designed for operation with Pt RTD temperature sensors and supports 10 Watt heaters. This controller is supplied with VTHS chambers.



HALL AND VAN DER PAUW MEASUREMENT CONTROLLER

Transient Signal Technologies offers a turnkey solution for both four-probe resistivity and Hall effect measurements over a wide range of temperatures. The H5000 Hall and van der Pauw measurement controller is an all-in-one solution enabling current source/measure, voltage source/measure, magnetic flux measurements and full bipolar field control. Together with the DC600 or K2000 temperature controllers and Hall Effect Measurement Software, the platform becomes a reliable and trusted materials research tool.



THE SAMPLE HOLDERS AND CONNECTIONS FOR FOUR-PROBE MEASUREMENTS

The variable temperature VPF cryostats (80 K - 500 K) can be supplied with copper cold fingers in two configurations: (i) for use with soldering pins and (ii) with adjustable probes. Additional two electric pins are added for enabling light excitations using mounted LEDs in sample vacuum space or for making gate bias experiments.



The room temperature or variable temperature Hall Effect Systems with VTHS chambers (300 K - 700 K) are offered in two configurations: (i) with Kapton Harness using soldering for sample mounting and (ii) with adjustable probes. Both variable temperature setups (VPF and VTHS) utilize triaxial cables to ensure measurements of extremely low signals with highest signal-to-noise resolution.

MAGNETS AND ELECTROMAGNETS

There are different magnets offered by Transient Signal Technologies. All magnets will work as a part of a turnkey solution with the H5000 Hall Controller and software. These magnets provide both low field and high field options, and offer solutions for a range of budget needs and sample measurement needs.

5,000 Gauss (0.5 Tesla) and 7,000 Gauss (0.7 Tesla) Permanent Magnets

The PM-50 and PM-70 dipole permanent magnets are a low cost magnet systems. This compact bench top magnet provides a 5,000 Gauss or 7,000 Gauss field between flat 50 x50 mm square pole pieces with a 20 mm gap. The Hall vacuum cryostat slides into the pole gap of the magnet, and a measurement can be taken in one field direction. The HMS software prompts the user to remove the chamber and to insert it in the opposite direction when a reversed direction magnetic field is required.

5,000 Gauss (0.5 Tesla) and 10,000 Gauss (1 Tesla) Electromagnets and Power Supplies

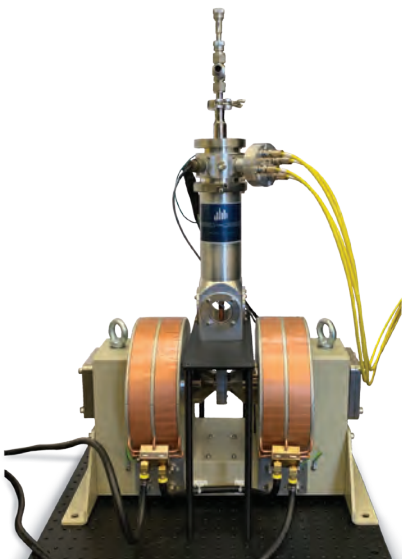
The EM-50 and EM-100 electromagnets are our small footprint magnet systems. These compact, air or water cooled (water cooling is mandatory for EM-100), bipolar bench top systems provides a reversible field of 5,000 Gauss or 10,000 Gauss with a 20 mm face diameter pole pair and 20 mm gap between poles. The size of the gap can be adjusted if necessary to accommodate other chambers or devices.

The EM-50 and EM-100 electromagnets are coupled with the MPS-50 or MPS-100 bipolar power supplies allowing automatic field reversal Hall measurements. It is continuously controllable over both the current and voltage range windows when coupled to the H5000 and monitored by the HMS Software.



14,000 Gauss (1.4 Tesla) and 20,000 Gauss (2 Tesla) C-Frame Electromagnets and Power Supplies

These high field electromagnets EM-150 and EM-200 are supplied with a 38 mm face diameter pole pair to provide the highest possible field versus current values. These are coupled with MPS-150 or MPS-200 bipolar power supplies. Both magnets require water cooling for operation at high currents. Transient Signal Technologies supplies proved recirculating water chillers to ensure proper system operation. The MPS-150 and MPS-200 power supplies are high powered operational amplifiers with full 4-quadrant, bipolar operation. The voltage and current outputs can be made to vary smoothly and linearly through the entire plus and minus ranges, passing smoothly through zero with no polarity switching. These power supplies enable easy software controlled field reversal, and measurements can be done with either sign or at zero field.



SPECIFICATIONS FOR THE VARIABLE TEMPERATURE HALL MEASUREMENT SYSTEM

Vacuum Systems/Cryostats

Operating Temperature Range:	Available for ranges 80 - 500 K or 300 - 700 K (VPF cryostat or VTHS chamber)
Width of the Sample Compartment:	20 mm
Standard Window Material:	Fused silica
Other Window Materials:	UV or IR windows are available
Optical Working Distance:	12 mm
LN2 hold time:	6 hours
LN2 reservoir volume:	0.4 L
Temperature stability:	+/- 0.1 K

Sample Compartment

Sample Mounting Surface Size:	10 mm x 10 mm
Sample Thickness:	0.001-2000 micrometer
Sample Connections:	Adjustable probes or soldering (soldering pins/Kapton Harness)
Electrical Connections:	Triax connectors
Light Excitations:	Optical windows and special magnet poles with axial holes are available. Two additional soldering pins for LED mounting inside vacuum are available
Gate Bias Experiments:	Two additional soldering pins for gate bias are available

Hall and VDP controller:

Current Source Range:	1^{-12} to 0.01 Amps
Voltage Measurement Range:	1^{-6} to 2.4 Volts
Resistance (or Resistivity) Range:	Typical range is 10^{-4} Ohm*cm to 10^{13} Ohm*cm (dependent on sample thickness)
Carrier Concentration Range:	Approximate range is 10^3 cm ⁻³ to 10^{19} cm ⁻³ (dependent on sample thickness)
Mobility Range:	Approximate range is 1 cm ² /volt*sec to 10^7 cm ² /volt*sec

Temperature Controllers:

Temperature Controller Requirements:	DC600 or K2000 Programmable Temperature Controllers
Temperature Accuracy:	< 0.5K at 80K; +/- 0.5K between 80K and 400K; < 1.5K from 400K to 700K
Temperature Stability:	+/- 0.1K
Temperature Resolution:	0.01 K

Magnet Systems:

Permanent magnets:	5,000 Gauss or 7,000 Gauss at 20 mm gap between square poles
Small footprint electromagnets:	5,000 Gauss or 10,000 Gauss at 20 mm gap between poles. Distance between poles is adjustable.
High field electromagnets:	14,000 Gauss or 20,000 Gauss at 20 mm gap between poles. Distance between poles is adjustable.
Recirculating water chiller:	Required for EM-100, EM-150 and EM-200 electromagnets

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