

## Model 74035 Single-Stage Variable Temperature Option

The single stage variable temperature assembly allows you to take measurements from 100 K to 950 K using nitrogen, LN<sub>2</sub>, and argon gas. A single point measurement can be taken at 78 K. Only one hardware device is required to go from high to low temperatures, eliminating the need to remove or resaddle your sample. This ensures accurate measurements throughout the full scale temperature range. Rapid cool down from 950 K to room temperature and from room temperature to 100 K provides efficiency and high throughput. Like our full suite of variable temperature options, the single stage variable temperature assembly is mechanically isolated from the magnetometer head and sample, minimizing noise floor. Designed to deliver superior thermal performance, the unit's vacuum insulation prevents freeze over at low temperatures and can operate safely at high temperatures without the risk of damaging neighboring components.

### Included equipment:

1. Single-stage variable temperature insert with mount
2. 25 liter LN<sub>2</sub> Dewar with condenser stand
3. Gas handling box
4. LN<sub>2</sub> transfer line
5. Condenser assembly
6. Instrument cable
7. Sample rods and holders
  - a. With 7404 and 7407 VSM: 740928 sample tail and holder kit
  - b. With 7410 VSM: 740941 sample tail and holder kit



### Supplemental Equipment Requirements

1. Lake Shore Model 741-VTA variable temperature option kit including a temperature controller and thermocouple card, vacuum handling kit, flanges, hoses, connectors, and accessories.
2. Argon gas cylinder with 344 kPa (50 psi) gas regulator and 3 mm hose barb (can also be a 1/4 NPT female fitting)
3. Nitrogen gas cylinder with a 344 kPa (50 psi) gas regulator and 3 mm hose barb (can also be a 1/4 NPT female fitting)
4. LN<sub>2</sub> source to fill the provided Dewar
5. Clean compressed air (276 kPa [40 psi])
6. Mechanical vacuum pump (E2M or equivalent) kit providing sample space blank off pressure of <math>0.67 \text{ Pa}</math> ( $5 \times 10^{-3}$  torr) for routine operation
7. Turbomolecular vacuum pump (Lake Shore TPS-FRG or equivalent) kit for cryogen transfer line maintenance — can also be used in place of the E2M rotary vacuum pump
8. A Pirani or thermocouple vacuum gauge capable of measuring pressures from 0.1 – 100 Pa ( $10^{-3}$  – 1 torr)

### Specifications

Temperature range	78 K (base), 100 K to 950 K (control)	
Temperature stability	±0.1 K (5 min)	
Temperature accuracy	5 K below 500 K; 1% above 500 K	
Temperature resolution	0.001 K	
Cool-down time	15 min from room temp to 100 K, 40 min from 950 K to room temp	
Nominal ramp rate (in the domain)	5 K/min	
Temperature sensors	Type K thermocouples	
Gasses	LN <sub>2</sub> and nitrogen gas for T < 350 K, argon for T > 350 K	
Nitrogen gas usage	3.2 L/min from >100 K to 350 K	
LN <sub>2</sub> usage	<0.75 L/h from 100 K to 350 K	
Argon gas usage	3.6 L/min	
Gas operating pressure	240 kPa (35 psi)	
Vacuum requirement	0.67 Pa ( $5 \times 10^{-3}$ torr)	
Noise, room temperature	1 µemu RMS	
Magnet gap with 740EMSC 1-inch pick-up coils	3.3 cm (1.3 in)	
Sample zone dimensions	Bore size	7.62 mm (0.30 in)
	Outside diameter	15.9 mm (0.625 in)
Max outer surface temperature	75 °C	
Uncrated weight	4 kg (8.8 lb)	

### Ordering Information

- 74035** Single stage variable temperature option  
**741-VTA** Variable temperature option kit  
**E2M** Rotary vacuum pump with KF-16 inlet for evacuating option vacuum space to 0.13 Pa ( $1 \times 10^{-3}$  torr)  
**TPS-FRG** Compact turbo pumping system for cryogen transfer line maintenance usage — can also be used in place of the E2M rotary vacuum pump

## Model 74046 Magnetoresistance (MR) Probe Option

The MR probe option performs fast and reliable measurements of MR, GMR spin-valve, CMR and other magnetoresistive materials as a function of both in-plane magnetic field and temperature. This measurement option includes data acquisition, control, and analysis software to automatically extract pertinent parameters for the device under test. These include free and pinned layer parameters of both simple and synthetic spin-valve sensors.

The MR probe features four in-line pins for solder-less connection to the sample and is interchangeable with the VSM sample rod for compatibility with variable temperature and autorotation options. The temperature range of use extends from 20 K to 450 K when used with the 74018 LHe/LN<sub>2</sub> cryostat, 325 K to 673 K with the 74034 oven, and 100 K to 673 K with the 74035 single-stage variable temperature assembly. Angular dependent MR measurements are possible when used in combination with the 74033 autorotation option. Contact pins maintain their position on the sample while the entire assembly rotates with respect to the magnet field.



The fully automated MR software is an intuitive yet powerful user interface providing automatic control of all experimental parameters for unattended operation. Experiment recipes can be saved, retrieved, and edited, and measurement data can be displayed and exported in graphical or tabular format. Multiple step profiles can also be defined to allow for flexibility in the preparation steps and for developing annealing step process methodologies.

The MR probe option is composed of several user-replaceable parts, including contact pins, ceramic pin guides, a ceramic sample holder, a contact pressure spring, and a printed circuit board, providing the convenience of in-field service.

### Included Equipment

1. MR hardware insert
2. Lake Shore Model 776 matrix switch
3. Model 2400 Keithley sourcemeter
4. 4-wire I-V cable and MR adapter box
5. MR spare kit (2 PCBs, 1 contact pressure spring, 8 points, 1 pin guide, 1 lower holder — user-replaceable)

### Specifications

Number of probes	4
Probe pin to pin spacing	0.9 mm
Total 4-pin spacing	2.7 mm
Nominal sample cross-section	4.5 mm × 4.5 mm
Maximum sample height	3 mm
Temperature range	20 K to 673 K
Current ranges	7 ranges, 1 $\mu$ A to 100 mA
Current direction	In-plane
Resistance ranges	8 ranges: 2 $\Omega$ , 20 $\Omega$ , 200 $\Omega$ , 2 k $\Omega$ , 20 k $\Omega$ , 200 k $\Omega$ , 2 M $\Omega$ , up to 10 M $\Omega$
Probe tip compliance voltage	0 V to 5 V up to 1 A sourced

### Ordering Information

- 74046** Magnetoresistance option—can be used with variable temperature options (741-VTA not included)
- 74035** Single stage variable temperature option
- 74018** LHe/LN<sub>2</sub> variable temperature cryostat option
- 74034** High temperature oven option
- 74033** Autorotation option
- 741-VTA** Variable temperature option kit (required for use with variable temperature options only)
- E2M** Rotary vacuum pump with KF-16 inlet for evacuating oven vacuum space to 0.13 Pa ( $1 \times 10^{-3}$  torr) — only required for use with variable temperature options
- TPS-FRG** Compact turbo pumping system for cryogen transfer line maintenance usage (can also be used in place of the E2M rotary vacuum pump) — only required for use with variable temperature options

