



AVS-48SI PICOBRIDGE

The **AVS-48SI** is a high-performance cryogenic AC Resistance Bridge with an analog PID Temperature Controller. It is mainly intended for resistance thermometry and control at very low temperatures. PICOBRIDGE offers an unprecedented and breathtakingly long list of features - many of them are not intended for daily routine. However, as experienced scientists know, if the experimental system does not behave as expected, all tools that help in finding out what is happening can be invaluable. That is where the AVS-48SI excels.

Most scientific instruments are used for years, often longer than a decade. They can maintain their accuracy well or not so well, but nothing warns about a possible change in calibration. Sending an instrument to the manufacturer for recalibration is a nuisance and it is usually forgotten. Few laboratories have resources to make calibrations themselves, either. But the PICOBRIDGE offers a nice solution. It can be calibrated without any external standards, without user intervention and without moving it away from its normal operating place and temperature. Only one command is needed to start an automatic process, which measures seven stable wirewound resistors carefully using 128 combinations of range and excitation. It takes about 3.5 hours to restore appr. 5ppm/°C and 35ppm/year accuracy.

The AVS-48SI is a resistance bridge *front end*: its user interface must be provided by the operator's external computer. It has a versatile serial USB/RS232 interface for writing one's own programs on any language and platform that support RS232 communication. For LabView owners, a full-featured resistance bridge+temperature controller "Virtual Instrument" is offered as an alternative that can be used without writing a line of LabView code. This program offers direct temperature readout, automatic scanning, intelligent filtering and more. It requires at least a base version of LabView2012 or later.

Although the AVS-48SI includes a stepless and precise temperature controller, its price is not substantially higher than the price of the older AVS-47B with optional computer interface but without a controller.

PICOBRIDGE is based on world's longest tradition in making resistance bridges: VS-2, VS-3 and VS-4 (Instruments for Technology Oy, Ab 1972-1981), then AVS-45, AVS-46, and three generations of AVS-47 (RV-Elektronikka Oy 1981-).

For a more detailed description, full specifications and operating instructions, download the user guide and other articles from our WEB site.

PICOBRIDGE FEATURES

ANALOG RESISTANCE BRIDGE HARDWARE

- 7 multiplexed inputs for sensors #1-7. Wiring corresponds to sensors #0-6 of the AVS-47, AVS-47A and AVS-47B.
- Sensors can be measured using 4 or 2 wires, selection is made programmatically. The difference between 2- and 4-wire readings is the total current path resistance whose change can reveal a bad contact to sensor or a short circuit between wires.
- 8 resistance ranges from 0-3Ω to 0-30MΩ for measuring both low and very high resistivity sensors and materials using low current and voltage.
- 8 square-wave excitations 3μV...10mVrms. Noise vs. self-heating tradeoff can be optimized.
- Any sensor can float for eliminating ground currents or its I- terminal can be connected to cryostat for improving thermal contact or for reducing number of wires.
- Selectable operating frequency 12.5/13.64(default)/15.0 Hz can help to suppress beating caused by mechanical vibrations. An arbitrary operating frequency is also possible by using an external clock signal.
- Active capacitance compensation improves linearity on the highest ranges by reducing sensitivity to input capacitance. RC filters in sensor leads are possible.
- Very low input leakage current: 5pA.
- Typical input noise voltage $5nV/\sqrt{Hz}$ and noise current $50fA/\sqrt{Hz}$. Optimized performance for both low and high resistivity sensors.
- 7 internal wirewound resistors with excellent long-term and temperature stability. After running the automatic self-calibration, the accuracy of the AVS-48SI is based on only these seven components.
- Amplified AC signal is available for viewing signal quality. Grounded output - no need for a differential connection to the oscilloscope.
- Accurately calibrated stepless analog output (0..+3V) e.g. for an external DVM.
- Accurately calibrated stepless analog control error output (-3...+3V). Can also be used for showing resistance changes.
- Two accurately calibrated DAC outputs 0.005...2.99V. One is used for set point when controlling temperature, the other is free for user's purposes.
- Extremely low RF emissions. Digital intelligence is in an external small box providing physical distance.



ANALOG CONTROLLER HARDWARE

- 18 logarithmically spaced power ranges 1 μ W...1.8W into 100 Ω . Power ratio of ranges is as small as 2.5, which makes it easier to use the middle of a range for control.
- Maximum power is 3W into 50 Ω .
- Short-circuit proof current source output, no high or low limit to heater resistance.
- Heater *power*, not current, depends linearly on error signal. PID gain does not change when heat load and power requirement change. This can improve system stability.
- 14 logarithmically spaced proportional gain settings.
- 12 logarithmically spaced integrator gain settings.
- 11 logarithmically spaced derivator gain settings.
- Set point and control error voltages are available both in digital and analog forms for user's possible own external temperature controller.
- Heater current and voltage are measured for calculating the true heating power. This reveals short circuits and unexpected changes in heater resistance.

POWER INPUTS

- 90-250V 50-60Hz universal power supply makes the Picobridge easily portable between countries.
- Alternative 18V AC safety voltage input allows your own filtering of input power.
- Alternative 12V DC input for total independence of mains.

CPU UNIT

- Digital intelligence is placed in an external CPU unit for keeping RF emissions outside the shielded cryostat room. Cable length: 5 meters.
- CPU is based on the very popular Arduino Mega2560.
- The connection between the CPU and bridge is galvanically isolated.

OPTIONAL OPTICAL FIBRE CONNECTION

- Wire cable between the bridge and the CPU can be replaced by an optional 5 or 10 meter long optical fibre link. It provides the ultimate safety against EMI and ground currents.

OPERATION USING SERIAL COMMANDS

- The AVS-48SI is for all types of computers, operating systems and programming languages that support serial communications.
- No need for LabView (although it is supported)
- Use a USB-232 converter for creating a Com: port.
- Serial format is standard 9600,8,N,1 . Needs only TxD, RxD and Ground wires. No handshaking.
- Wide command set for bridge and controller (\approx 107 commands/queries).
- Automatic calibration in situ – no external devices or tools are needed.
- Each channel's measuring settings are saved. They can be recalled together with the channel, or same properties can be used for any channel. Saved properties are: range, excitation, 2/4-wire, sensor grounding and autoranging.
- A/D conversion results are averages of 1..1000 samples
- An averaged A/D conversion yields also Min, Max and STandard Deviation (STD \approx rms noise).
- PID parameters can be saved and recalled for each power range.
- Changing power range when system is in balance does not change heating power. In other words, changing does not disrupt control.
- Command for automatically delaying the start of averaging until bridge has achieved good balance after a change in range or channel.
- HOLD mode for keeping heating power constant temporarily. Use for visiting other sensors during control.

CALIBRATION

- Automatic self-calibration program is based on 7 wire-wound resistors. They have excellent temperature stability and the best available long-term stability. The bridge can be calibrated in situ in its real operating place and temperature. Maintaining or checking calibration does not need any tools or standards.
- The analog output signals can be calibrated so that if they are measured with your own DVM, you get correct readings.
- The calibrator resistors can be measured using a high-end 4-wire ohmmeter. If necessary, their new values can be easily entered in the field. This also facilitates easy replacing of a damaged preamplifier.



LABVIEW OPERATION

BRIDGE

- The “avs48si.vi” is a free-running full-function virtual instrument with its sub-VIs.
- All features of the analog bridge and controller are supported.
- Sensors can have short descriptive names.
- Every channel’s measuring and filtering properties are saved and they can be recalled automatically with the channel.
- Temperature readout for sensors that have R/T conversion files. These text files are easy to create.
- Smart filter reduces errors due to settling, autoranging or interference spikes.
- Smart filter has an output mode for eliminating time lag when data has an almost linear trend.
- Automatic scanning of selected sensors. Smart filter takes care of sufficient settling times.
- The large and bright display shows all scanned channel’s names, resistances and temperatures simultaneously at a single glance.
- Any one of the calibrator resistors can be included in a scan sequence for “quality control”.
- The calibrator resistors’ true values are shown for comparison and checking.
- Resolution of the resistance display is 5 $\frac{3}{4}$ digits (1/300000 counts, AVS-47B had 1/20000 counts).

TEMPERATURE CONTROLLER

- Each power range has its own set of PID parameters, which are saved and can be recalled together with the power range.
- Temperature control set point can be given as resistance or temperature (if an R/T file exists).
- HOLD mode for maintaining output constant. When holding, other sensors can be measured or scanned.
- Heater’s output range can be changed without change in output power when the system is in balance.
- Control sensor’s *measuring range and/or excitation* can be changed in hold mode without changing output power.
- Non-linearized animated analog error meter shows trend when error is large but has high sensitivity near to balance.

- Animated heater power meter shows percentage of the range’s maximum output. True heating power in Watts and the range’s maximum are shown as numbers.
- Heating power can be limited by disabling high power ranges.

CALIBRATION

- Similar as with serial operation, but the calibration VIs offer more information that can be easily saved.

SAVING RESULTS

- Measured or scanned results are made available to other LabView VIs by means of a Functional Global Variable (FG).
- Results can be saved to disk with time stamps as a CSV file in two alternative forms: a single line which is rewritten or created by the latest result, or a multiline file where new results are appended as they become available.

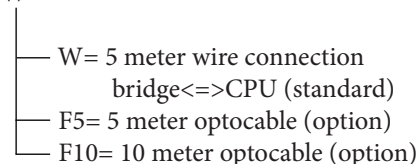
OTHER

- The A/D converter of the bridge can measure 26 different internal voltages. An aid to remote diagnostics.
- Standard deviation of readings in the smart filter is available for quality control.
- LabView source code is not protected (at least the base version LV2012 or later is required).
- Simple installation by just copying the LV programs into one directory.

ORDERING INFORMATION

The AVS-48SI has a universal power supply for 90-250V 50-60Hz. No need to specify mains voltage or frequency.

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