AVS47-Serial/USB-W CONVERTER

For Interfacing the AVS-47B with Computers

User Guide

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(for use with firmware version avs47_serial_usb_1r3.ino)

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WARRANTY

Picowatt warrants the **AVS47-Serial/USB-W <u>hardware</u>** to be free from defects in materials and workmanship. Our liability under this warranty is limited to repairing or replacing any instrument or part thereof which, within three (3) years after the shipment to the original purchaser, proves defective. This warranty is void if the instrument has not been used according to the instruction manual, or if it has been used under exceptional environmental conditions.

In need of warranty repair, the instrument must be returned to **Picowatt**, prepaid , and with a detailed description of the fault or malfunction following the instrument.

The name, address and e-mail address of a person who is able to give supplementary information should be included whenever possible. If the repair was covered by warranty, **Picowatt** will return the instrument on our cost using an economical shipping method.

If no fault is found, or if there is a strong indication that the warranty is void, the purchaser is charged for the return freight and costs in addition to the repair. It is recommended that **Picowatt** be contacted prior to shipment. We can possibly give instructions for additional tests or simple component replacements so that unnecessary shipments may be avoided.

The **<u>firmware</u> must not be considered a commercial product**. It is given as is, for free, without any kind of warranties or liability. The program and this user guide may contain errors, and we would be glad to get feedback, corrections and suggestions for improvements.

Important: The AVS-47B uses +/- 5 Volt levels for data communications in its standard configuration, whereas the AVS47-Serial/USB-W can be damaged by applying negative voltages to its 15-pin connector.

Therefore, short circuit piece JP204 INSIDE THE AVS-47, A, B MUST BE CHANGED to position JP203 on circuit board “E” (the board with the power supply unit) before connecting the AVS-47B and the converter together. In case of any uncertainty, please contact factory.

If the AVS-47B is interfaced with model AVS47-IB GPIB box, or directly with a PC computer using its Com port or via a USB-232 adapter, this jumper shall be returned to JP204.

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BACKGROUND

The AVS47-Serial/USB-W is an external protocol converter that creates a galvanically isolated RS232 interface for the model AVS-47, -A and -B AC Resistance Bridges. Until now, **Picowatt** have offered two possibilities for interfacing the AVS-47x with computers: The direct **Picobus** interface and the Model **AVS47-IB** external GPIB (IEEE-488) interface unit. Both alternatives have limitations with respect to computer type, operating system and programming language. The AVS47-Serial/USB-W removes many of these limitations at a low cost, offering new possibilities for computer interfacing. A short comparison of the three available interfacing solutions follows.

Some commands are for the TS-530A Temperature Controller. This product has been discontinued, and those features are only for the instruments still in use.

USB-Picobus

Picobus is a proprietary synchronous, serial protocol that is based on two coming and two leaving signal lines. Suitable four lines are provided by the hardware handshake outputs and inputs of traditional Com: ports of PC-type computers. The asynchronous TXD and RXD signals of the RS232 interface are ***not*** used by Picobus. Today's computers seldom have physical Com: ports, but a virtual Com: port can be easily created by a **USB-232 converter**.

Unfortunately, low-level Picobus communication is complicated, as it requires computer program to write and read states of independent bits of the computer's hardware registers. In order to make programs portable between different platforms, common operating systems do not favour direct hardware access. For this reason, we offer driving programs (**USB-Picobus**), but only for a **Windows-PC** running at least the base version of **LabView2012** or later.

This has been a serious limitation that excludes Mac computers and programming languages other than LabView. The great advantages of Picobus are, that the protocol is almost bullet-proof, it has low EMI noise, and for customers with a suitable computer environment, it is completely free with the exception of a possibly needed USB-232 converter. We do not recommend USB-Picobus for new designs.

The AVS47-IB is a protocol converter between GPIB (IEE-488) and Picobus. It is the heart of the "GPIB-Picobus" interface.

GPIB-Picobus (OBSOLETE!)

This interfacing solution is based on an external converter, AVS47-IB, between IEEE-488 and Picobus protocols.

This very powerful converter offered automatic scanning of sensors, buffering of data and many macro commands. The box is connected to - but galvanically isolated from - the AVS-47x via Picobus and to the computer via GPIB (therefore the name of this option is **GPIB-Picobus**). It has its own mains power supply and it can be located far from the cryostat in order to minimize electromagnetic or ground current problems that the GPIB line may cause. The box can be used with computers having an GPIB controller and suitable software for GPIB communications. It is highly compatible with the IEEE-488.2 standard with its mnemonic and common commands and error reporting. We offer a versatile free (old) **LabView Driver** that was written for LV7.1 and can still be used with today's LabView versions. For the most noise-critical applications, an optical fibre link to the bridge was available (**AVS47IB-PICOLINK**).

The GPIB-Picobus had a much wider range of applications than USB-Picobus, e.g. it can be interfaced also with Mac and Linux computers. Production of the AVS47-IB has been discontinued but some units may still be available.

AVS47-Serial/USB-W

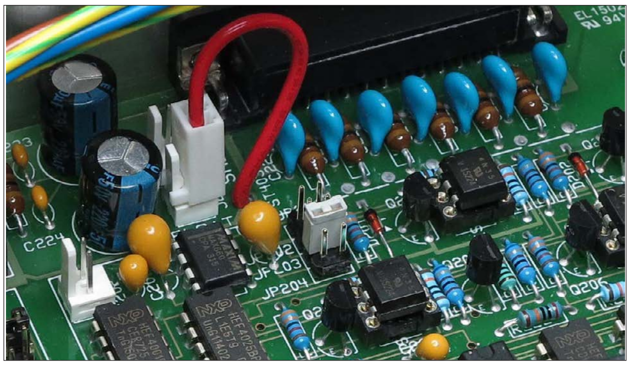
The AVS47-Serial/USB-W is also an external protocol converter box ("CPU box") that is connected to the resistance bridge via galvanically isolated Picobus. It can be connected to the computer's Com: port using a 1:1 cable with 9-pin connectors. More typically, it is connected to a virtual RS232 port using a USB-232 converter which enables RS232 communications between the computer and the box. The *difference* between the old USB-Picobus and AVS47-Serial/USB-W is that the former uses the proprietary synchronous Picobus protocol but the latter is based on the asynchronous RS232.

RS232 is a very old protocol which has disappeared from many instruments because of its low speed and poorly standardized software behaviour. However, asynchronous serial communications is far from dead: Most operating systems, like Windows, Linux and Mac OS, and most common programming languages, like C/C++, Python, versions of Basic etc., LabView and Matlab, support it. The speed is not an issue with slow instruments, like the AVS-47B, which produce only tiny amounts of output data. The AVS47-Serial/USB-W expands computer-interfacing of the AVS-47B beyond a Windows-PC and LabView to almost any application and platform where simple RS232 communications is supported.

Commands and queries to the AVS47-Serial/USB-W are simple and mnemonic, like "RAN3" for the 200Ω range. Communications is based on the most common default format without handshaking. Therefore many low-cost USB-232 converters are likely to perform well in this application.

The AVS47-Serial/USB-W CPU is based on the very popular Arduino Mega2560 unit.

AVS47-Serial/USB-W Unit measures 130x105x60 mm and gets power from the +12V Mains Adapter.



Change short circuit piece JP204 to position JP203 before making any connections in order to avoid damage to the AVS47-Serial/USB-W, which uses 0/+5V voltage levels for communications with the AVS-47B resistance bridge. Otherwise the bridge would supply negative voltages to the CPU wth possibly harmful consequences.

CONNECTING THE AVS47-Serial/USB-W

The AVS47-Serial/USB-W uses 0/+5V voltage levels for communications with the AVS-47B Resistance Bridge, which is set for -5/+5V levels by default. Therefore, open the top cover of the bridge and move short circuit piece JP204 to position JP203 before making any connections ("E" board).

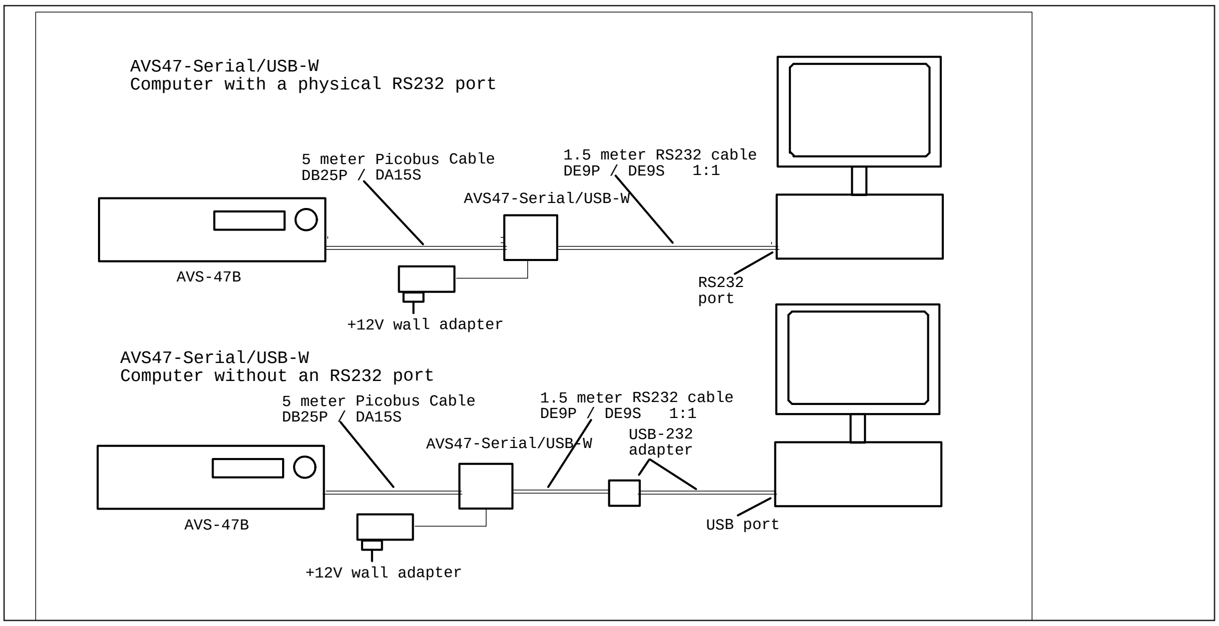
The jumper must be in position JP204 if AVS-47B is interfaced with an AVS47-IB or directly with a PC computer, or with a USB-232 adapter

For use with old AVS-47 and AVS-47A bridges please see the addendum.

The AVS47-Serial/USB-W is connected to the AVS-47B Resistance Bridge using the supplied 5-meter long 25-to-15 way cable PB25P15P6W5M-2. The AVS47-Serial/USB box should be located near to the computer and far from the cryostat. Connection from the CPU box to the computer varies depending on available hardware:

- *Computer has a physical RS232 port:*
Connect the supplied 1.5m cable RS9P9S7W1.5M with male and female 9-pin D-connectors from the AVS47-Serial/USB-W box to the RS232 port of your computer.

- *Computer has only USB ports:*
You need a USB-232 converter and its software installed. Plug the USB connector to your computer



There are two ways to connect the AVS47-Serial/USB-W: Either directly to computer's RS232 port, or via a USB-232 converter to computers USB port. The converter creates a virtual RS232 port that your high-level program will access.

and the above 9-pin cable between the converter and the AVS47-Serial/USB box. The USB-232 converter from National Instruments (NI part number 778472-01) is known to work well, but it is quite expensive. Cheaper converters are available from other manufacturers. Check their compatibility with your platform.

STARTING THE AVS47-Serial/USB-W

The box starts when it gets power from the supplied +12V DC adapter. The "REMOTE" indicator on the AVS-47B front panel is blanked but indicates booting by blinking weakly once. The system starts always in local mode. Change from local to remote or vice versa does not alter the state of the bridge. **With the AVS-47 and AVS-47A, Start first the CPU box and then the bridge.** With the AVS-47B, the bridge can always be on. Then the red "AL" light on the DB15 panel indicates booting by a very short blank state.

Resetting the AVS47-Serial/USB-W

If needed, the CPU can be re-initialized by unplugging and re-inserting the 12V power plug. **With the AVS-47 and AVS-47A, you must first unpower the bridge and turn it on it last**. Resetting does not change either the state of the bridge or the TS-530A controller. Before going to remote mode, re-program the settings of your possible TS-530A with the last used values. Those settings cannot be read from the temperature controller because of its old design..

Before sending any query to the box, refer to command TER on page 10 and use it for instructing the box to send a line terminator that your computer program expects.

The box can be reset by command "RST". It will bring the bridge to a safe setup: input=ZERO, multiplexer channel=0, range=2MΩ, excitation=3µV and display=R. In addition, command separator defaults to ";" (semicolon) and response line terminator to CRLF. Software reset is a less powerful way to initialize the program than the power-off-on method.

RS232 Format

The AVS47-Serial/USB-W uses the most common RS232 format: baud rate 9600, 8 data bits, no parity, 1 stop bit and no flow control. This format can be changed only by changing the Arduino firmware source code and uploading it. Do not change this default format, if there is no compelling reason to do so.

COMMANDS AND COMMAND LINES

It is a good idea to get acquainted with the AVS47-Serial/USB-W by using an RS232 hyperterminal program. It lets you control the bridge by writing commands/queries and reading the responses. Although such a program is no longer included in Windows, many free programs are available from the Internet. For example, we have used a program called “Hype! Terminal”. See also page 9 for a simple “conversation” program in LabView. You can get both programs from us upon request.

Commands to the AVS47-Serial/USB-W are not case sensitive. You may insert blank space(s) between the command and argument part. Commands “ran5”, “RAN5”, “ran 5”, “RAN 5” or “ran   5” are all equivalent.

The first part of a command or query can contain only alphabetic letters. The second, argument part of a *command*, is made of integral numbers. The argument part of a *query* is a question mark “?” like in “RAN ?” or “ran?”.

Several commands can be placed on a single command line. The commands/queries must have a command separator, or delimiter, between them (comma or semicolon, which is the start-up default). Your own computer program can terminate the command line either by carriage return (CR or \r, ASCII 13), by linefeed (LF or \n, ASCII 10) or by CRLF. These are called line terminators and the box recognizes them all. The commands/queries are performed in sequential order, the previous command must be completed before the next one can be handled.

For example: “rem1;inp1;ran3;exc7” (quotation marks are not parts of the actual string) sets the bridge in remote mode, sensor measuring input, 200Ω range and 10mV excitation. After having waited for some seconds (settling time), one can take the reading.

Maximum number of characters on one line, including command separators and possible blanks, is 255. Handling the commands starts after a line terminator has been received. If the command line is not terminated with CR, LF or CRLF, processing will not start.

Do not issue further commands or queries before all the commands/queries on the previous command line have been executed.

Responses

The AVS47-Serial/USB-W obeys the principle, that only a query can produce a response. So your application program needs not poll and read the serial port after commands.

The only exception to this is the REPEAT command. If the repeated line contains queries, the responses are sent automatically, and you must decide how to read them. It is not necessary to read responses, the CPU’s output buffer is emptied after each repeated line.

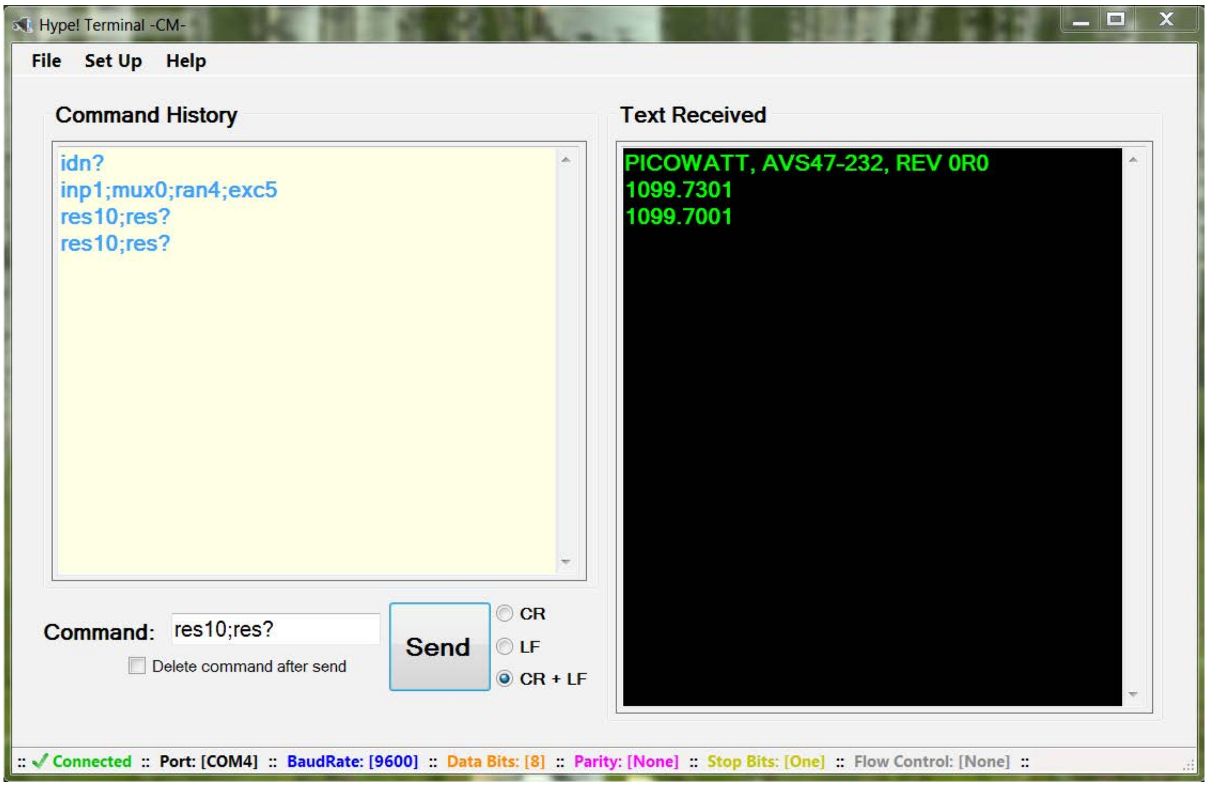
Responses can consist of printable alphanumeric characters, but most queries return only a number. Some values are output as floating point numbers, but exponential format is not supported. The responses do not have headers in order to make them easier to read into a program.

If a command line consists of more than one query, the responses are output in the corresponding order and they are separated by the command separator (delimiter) you have chosen (see above).

For example, command line “ARN10;RES5;RES?;RAN?” instructs the bridge to go to autorange mode, wait for 10 seconds after each automatic change of range (if needed), then take a mean of 5 A/D conversions, and place the result and the range setting (which was possibly altered by autoranging) in the output queue. The result is sent via the RS232 port to the computer, which must detect that data has arrived into the serial buffer and then read it from the buffer. The response could be like “1234.5000;4” (i.e. 1234.5Ω; 2kΩ range).

You may save programming overhead by giving *commands* for a measurement on one line. Responses to *queries* may be easier to read into variables, if queries are made separately for each item. Then one does not need to remove the delimiters and parse the response line.

The response ends by the line terminator specified by the TER command (default is CRLF). The terminator can, but it must not, be the same for both transmitting and receiving. The AVS47-Serial/USB-W will always recognize any of the three line terminators, CR, LF or CRLF.



```
idn?
inp1;mux0;ran4;exc5
res10;res?
res10;res?
```

```
PICOWATT, AVS47-232, REV 0R0
1099.7301
1099.7001
```

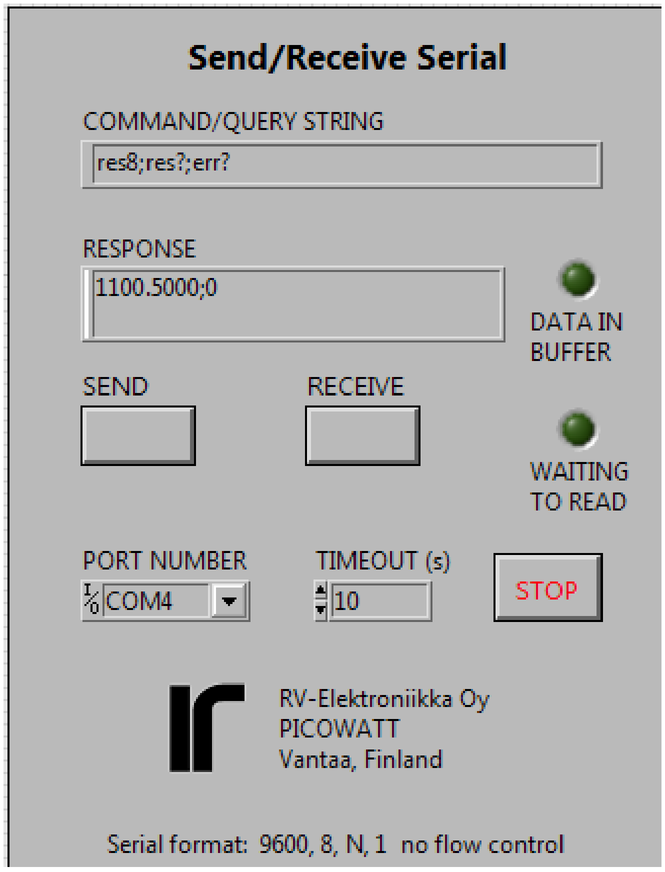
Command: res10;res?

☐ Delete command after send

○ CR
○ LF
● CR + LF

:: ✓ Connected :: Port: [COM4] :: BaudRate: [9600] :: Data Bits: [8] :: Parity: [None] :: Stop Bits: [One] :: Flow Control: [None] ::

The “Hype! Terminal” is easy to use: Just specify the Com port number (SetUp) and it is ready. After identification, the bridge is set for measure input, channel 0, range 2kΩ, and excitation 300µV. Then 10 A/D conversions are taken (RES10) and the output is read by RES?. This RS232 terminal program for a Windows PC does not require LabView.



COMMAND/QUERY STRING: res8;res?;err?

RESPONSE: 1100.5000;0

PORT NUMBER: COM4

TIMEOUT (s): 10

Serial format: 9600, 8, N, 1 no flow control

Send/Receive Serial tool

This handy LabView VI was written for developing programs for the AVS47-Serial/USB-W. It allows one to send commands and queries and to read the response to queries. It requires the base version or better of LabView2012 or later.

Check that jumper JP203=inserted inside the AVS-47B bridge (see page 5) and connect the cables as was instructed earlier. The AVS47-Serial/USB-W starts when it gets power from the +12V mains adapter. Select the correct Com: port. The serial format is fixed to the most common default, 9600,8,N,1 with no flow control. Run the VI and click “SEND” for sending the default IDN? query. DATA IN BUFFER should light. Click “RECEIVE” for reading the response. If this works, make the port number default and save the VI so that you do not need to re-enter the port number when you load the VI next time.

Use this tool for getting acquainted with the behaviour of the software before starting to write your own application in whatever programming language you prefer. Labview programs recognize only `'\n'` (newline) character for terminating the transmitted string, but some other program may expect `'\r'` (carriage return) or \r\n. Define the response line terminator by the command TER.

You can see the non-printing characters in the response if you stop the VI, click the RESPONSE field and select `'\' Codes Display` or `Hex Display` from the context menu. Start the VI again.

If you try to receive before a response is available, the program waits until the input buffer is non-empty or timeout occurs. See the block diagram, how this was done. You can put the OPC? query after a time-taking command like a long average (e.g. `RES100;OPC?).` The “operation complete” query places character ‘1’ in the output queue when averaging is ready. You do not need OPC?, if you have at least one query and put them as the last items on the command line.

This VI can be downloaded from our WEB site at http://www.picowatt.fi/interfacing/computer_interfaces.html (“read and write using LabView”).

FIRST COMMANDS AND QUERIES

All queries work in both remote and local modes, so that you can read bridge settings although it is in local. Commands that control the operation of the AVS47-Serial/USB firmware are also effective in both modes, whereas hardware commands to the AVS-47B can be used only in remote. The following initial commands are for making the AVS47-Serial/USB firmware to correspond to your application program. The commands and responses are same for the -W and -F versions.

IDN?, *IDN? Identification query. You can check succesful starting and firmware version of the AVS47-Serial/USB by this query. The response has four comma-separated fields and is like "PICOWATT, AVS47-Serial/USB,0,1R3". The serial number field is identically "0".

HW? Hardware version query. Returns the version of the AVS47-Serial/USB hardware. The response is like "PICOWATT, RS232PB_A2". The latter item is the version of the mother board.

AL? Alarm line query. This query transacts with the AVS-47B bridge and checks the state of the "AL" Picobus signal line (AL is used for preventing multiple reads of a single A/D conversion). Response should be 1 if the bridge is powered, if the 25/15 pin cable is in place and everything is OK. If the response is 0, check that the cable is plugged and OK. Re-start the box by re-connecting its +12V power. The bridge should end up in local mode. If AL? still returns zero, refer to the trouble-shooting procedure (page 20) or contact factory.

LIM [0..1] Select the command delimiter (or command separator).

0 = semicolon (dec ASCII 59). This is the start-up default, which is used also by the IEE-488.2 standard.

1 = comma (dec ASCII 44). May be useful if a comma-separated format (CSV) is preferred.

TER [0..3] Select the response line terminator that the box uses for indicating the end of its response. Depending on your computer software, you may need to modify the default value of CRLF. When *reading* the serial port, the AVS47-Serial/USB firmware looks for both CR and LF, and when either of them is encountered, the line is considered as ended. The possibly remaining terminator is neglected. You can modify the response line terminator by sending the TERx command:

0 = nothing
1 = linefeed (LF, \n, dec ASCII 10)
2 = carriage return (CR, \r, dec ASCII 13)
3 = CRLF (start-up default)
LabView requires TER=1.

REM [0..1 | ?] Remote mode command/query. The change from local to remote does not change the state of the bridge: the program first reads the setup in local mode and then sends this setup back to the bridge in remote mode. Any hardware commands sent before the REM1 command are forgotten. The AVS-47B shows remote mode by a yellow light on the front panel.

0 = local
1 = remote
REM? returns 0 or 1

HARDWARE COMMANDS

INP [0..2 | ?] Input selector command/query.

0 = Grounded input (zero resistance)
1 = Measure the selected sensor channel
2 = Calibrate (bridge measures internal 100Ω)
INP? returns 0..2

MUX [0..7 | ?] Multiplexer channel command/query. The bridge will need a settling time after channel has been changed. The required time is longer if excitation is low. Use the DLY or SCK command after setup commands like MUX, RAN and EXC, before starting to take readings.

0..7 = sensor channel
MUX? returns 0..7

RAN [0..7 | ?] Range command/query

0 = no range is connected. No excitation can run into the sensor, and output is random. Do not use this value in order to avoid accidental heating of the sensor when another range is later selected. If you do not know the proper range, start from 2MΩ.

1..7 = ranges from 2Ω to 2MΩ
RAN? returns 0..7

EXC [0..7 | ?] Excitation command/query. Excitation voltage, as the term is used in the context of the AVS-47B, means the RMS voltage across a sensor whose value is half of the selected range. Excitation is symmetrical square wave -shaped current at about 13.7Hz.

0 = no excitation
1..7 = 3µV, 10µV, 30µV...3mV
EXC? returns 0..7.

REF [0..20000] Reference command for deviation (ΔR) measurements. For example, REF10000 sets the AVS-47B's reference DAC to 1 Volt, which corresponds to the middle of any currently selected resistance range.

The resulting DAC voltage can be measured by switching the ADC input to DIS3 (the internal reference). Then issue ADCx for measuring the output voltage of the DAC.

The programmed reference DAC has only 12 bits (0..4095), whereas the 0..20000 output of the bridge corresponds to about 14 bits.The reference value is therefore divided internally by 5 for scaling it to range 0..4000. The DAC output changes in steps of 5 digits (500µV) and has a typical accuracy of a low-cost 12-bit D/A converter.

NULDEV [1..100] Null deviation command.

This is a macro command that measures whatever was previously selected by the DIS command and then sends this value to the reference DAC. The argument determines, how many A/D conversions are averaged for the measurement. .

This command is intended to be used only with DIS0. The REF POT / REF MEM front panel switch must be in REF MEM position. After the NULDEV command, the rear panel DIFFERENCE BNC output is near to zero. Select then DIS1 for viewing the difference.

RFS? Reference source query.

The deviation signal V_{dR}, is the difference between measured resistance value (analog voltage from the self-balancing circuitry) and the reference voltage. The reference voltage, in turn, can be either the output voltage from the reference DAC or the voltage of the front panel potentiometer. This selection is made by the front panel REF POT/REF MEM -switch. There is no remote command for changing the switch position.

The reference DAC is programmed remotely by sending the REFx command (see above). It can also be programmed manually by lifting the SET REF switch momentarily. Then the DAC takes the *displayed reading* as input. Deviation can be nulled this way manually. The NULDEV command is for making it remotely.

In remote-controlled applications, the reference-source switch should be in REF MEM position. You can verify this by quering RFS?. The response is:

0 = reference DAC (reference memory)
1 = front panel potentiometer

MAG? Magnifier query

The deviation voltage V_{dR} can be amplified by a factor of 10. Amplification is made by a simple circuit and is therefore not very accurate. The ΔRx10 mode is suitable for recording only small changes, not for measuring absolute values. It is best when excitation is high and readings therefore less noisy. Magnification can be selected only manually. MAG? returns

0 = 1xΔR
1 = 10xΔR

MEASUREMENT AND READOUT COMMANDS/QUERIES

These commands are for determining the A/D converter input, for making single or averaged A/D conversions, and for reading the result. There is also a command for detecting the possible ADC overrange.

DIS [0..7 | ?] Display selector command

This command selects one of 8 possible voltages to be measured. The current selection can be queried by DIS?.

Use the RES command and query only when

displaying DIS0 and DIS1. The RES? query can also be used for reading item 7 (Set point of the old TS-530A temperature controller). Then you get the set point in resistance, scaled correctly by the currently selected measuring range. However, because of the very old design, the TS-530A set point cannot be given in resistance but it must be given as an integer. Refer to the "SPT" command below.

Use the ADC command and query for all other display items than 0,1 and 7 because the RES values are scaled by the currently selected measuring range. The ADC? query returns integers -19999..19999 corresponding to ADC input voltages from -2V to +2V. Refer to the AVS-47B manual for how to use the various display items.

0= Voltage proportional to the sensor value R
1= Deviation ΔR between R and the reference
2= Adjust reference. This is the voltage from the front panel potentiometer
3= Reference. This is output voltage from the reference D/A converter
4= Excitation voltage. This is the approximate excitation voltage across the sensor. Useful only on the lowest resistance ranges and high excitation. Can be used for estimating current lead resistance.
5= 530A heater voltage, (amplified inside TS-530A, negative reading)
6= TS-530A heater current (actually, voltage across current sense resistor in volts)
7= TS-530A set point voltage (V).

ADC [1..1000] A/D conversion command

The A/D conversion is made from voltage that has been previously selected for measurement by using the DISn command. The ADC command can be used both in local and remote modes.

ADC1 makes one single measurement, ADCn makes n successive measurements and calculates their average. Conversions take 0.4 seconds each, rate is 2.5 conversions/second.

If the result is an exact zero, the conversion is automatically repeated for detecting possible overrange (because the ICL7135 ADC yields a blinking zero in case of an overload.

The red "AL" light on the DA15 panel blinks when conversions are made. Otherwise it will light constantly if the AVS-47B is turned on. When the bridge is on and connected, this light will also show booting of the CPU by blanking shortly.

ADC? A/D conversion query

This query returns the mean value of n conversions (see above). The conversion result is given as an integer -19999 to 19999 for ADC input voltages -2V..+2V. Polarity is indicated by minus sign and it is also returned by the POL? query. Use ADCn and ADC? at least for measuring items 4..6, which are not directly dependent on range. Use RESn and RES? for measuring items 0, 1 or 7. Items 2 and 3 can be measured using either command. If the ADC's range is exceeded the result is an exact zero, which can be distinguished from a real zero by checking OVR? See also OVR? and ARN.

ADC? query can be preceded either by an ADCn or RESn command. They are one and the same function. The result is valid until the next ADC/RES command.

RES [1..1000] A/D conversion command for resistance.

The ADC reading is scaled by the currently selected resistance range, therefore measurement of display items 4-6 can produce misleading results.

RES1 makes a single conversion, RESn makes n successive measurements at 0.4 second intervals and their mean value is calculated.

If the A/D converter outputs an exact zero, the conversion is automatically repeated for detecting a possible overload. *The OVR? check should be a routine part of your application program.*

RES? Query for resistance

Resistance is output as a floating point number with four decimal places for R and ΔR displays, and with five decimal places for 10xΔR display. It is scaled by the currently selected resistance range. The reading may include a preceding minus sign. Arduino Mega2560 does not support output in exponential form.

RES? query can be preceded either by an ADCn or RESn command, they are actually one and the same function. The result is valid until the next ADC/RES command.

POL? Polarity query

The ADC? and RES? return values are preceded by a minus-sign if the reading is negative. You will probably not need this query, it is used by the firmware. POL? returns
0= negative
1= positive

OVR?, OVL? Overrange query.

An overrange-reading from the ICL7135 ADC is an exact zero, which can be distinquished from a true zero by repeating once each measurement that yields an exact zero. A BUSY bit from the A/D converter alternates if overrange, which separates these two cases. The AVS47-Serial/USB does this check automatically.

If a *single* A/D conversion is made by using ADC or RES command and the result is overrange, the ADC? reading is coerced to 20001 and the RES? reading is coerced to 2000100.0 which both are impossible readings in normal operation. In addition, the OVR? bit is 1 and ERR? returns “ADC overload”.

If n in ADCn or RESn is greater than 1, the average may contain one or more overrange- readings. No coercion is made, as the average can still be useful. Overrange detections are internally OR’ed together. OVR?=1 then indicates that the final average contains at least one overrange reading (which is 0). Such an average is distorted and perhaps it should not be used.

If there is any possibility for such a situation, use autoranging. It will react to the first overranged conversion and, after autoranging and autoranging delay, averaging is re-started. This quarantees a correct mean value.

OVR? returns:

0= no overrange

1= reading was overrange, or at least one sample in the average was overrange.

OVR? gets information from the A/D conversions. Do not use OVR? alone without a preceding ADCx conversion command. Instead, *reading* the conversion result is not necessary for asking OVR?.

MIN?, MAX? These queries return the minimum and maximum resistance values (in ohms) of conversions averaged for one RESn or ADCn command.

STD? Standard deviation of the averaged A/D conversions as resistance in ohms. Use a long average for getting a reliable STD. If noise is purely random and white, STD is proportional to the noise at the bridge input. If data has a trend, STD is not useful.

QRATIO? This is simply (MAX-MIN)/STD. For a purely random white noise, QRATIO is about 5. A much higher figure may tell about external interference in data, whereas a much lower figure can tell about insufficient number of samples. QRATIO is also affected by the digitising step if excitation is high. It is most useful at low excitations.

REPEAT This command repeats one command line continuously. The commands and queries behave excactly similarly as if only one line were sent. If the line includes queries, the CPU sends responses automatically and your program can read them as they come. *This is an exception to the rule that the CPU does not send anything by itself, without an explicit query*. Repeating is stopped by sending anything via the RS232 line. An example using a hyperterminal program:

```
ADC5;ADC?;REPEAT
response:
12345
12346
12344 etc.
```

The REPEAT command must be the last item on a command line. In the repeating state, the bridge gives new readings 2.5 times/second. Your application program can read all responses as they come, or you can read only when readings are needed. There is no buffer for saving old results in the CPU.

Stop continuous repeating by sending first any character to the CPU and give then new instructions on a new command line.

ARN [0..30] Autorange mode command.

In autorange mode, the absolute value of each A/D conversion result is compared against two limits:

• If lower than 1800 (out of 19999), range is changed downwards, provided that it is not already 2Ω.

• If the reading is higher than 19900, the range is changed upwards, provided that it is not already 2MΩ.

• If the argument in ADCn or RESn is greater than 1 (average of many conversions), the first encountered overloaded or underranged conversion causes an autoranging operation, and after a delay, averaging is started from the beginning. This guarantees a correct average.

The ICL7135 ADC circuit is overloaded, if reading exceeds 19999. Then the AVS-47B front panel display shows blinking zeros and an internal overload indicator blinks between true and false. During overload, a measurement like ADC;ADC? returns an exact zero, which cannot be distinguished from a real exact zero.

Because of this uncertainty, the AVS47-Serial/USB repeats once any conversion that returned zero, which enables detection of overload. The overload indicator is set to 1 (queried by OVR?).

ARN 0 means manual ranging. Argument higher than 0 enables autoranging. A value between 1 and 30 determines, in seconds, how long the system waits after having changed the range until a new autorange operation can take place or until any command can be performed. A time like 5 seconds may suffice at high excitations, when the bridge settles quickly. A longer time, up to 15-20 seconds, should be used at the lowest excitation in order to guarantee good balance before readings are taken.

If the resistance changes several decades, which is typical when switching channel, the settling delay time of x seconds is applied after each change of range. This can make scanning unnecessarily slow or too fast for good settling, but you can avoid it by using the SCK[1..10] command. Refer to description of SCK.

Use the RAN? query if you want to check the range that was possibly changed by ARN.

Autoranging is especially useful in scanning. If you do not use autoranging, you MUST check with OVR? whether the single conversion or the average contained overload.

NOTE: The AVS-47B's hardware autoranging must not be enabled when the bridge is under remote control. This would cause a rival condition.

OTHER COMMANDS AND QUERIES

OPC? Operation complete query

This query can be placed after slow operations, like long averaging. When encountered, it places a “1” into the output queue. It should be the last item on a command row.

DLY [0..30] Delay command

The argument is delay time in seconds. Use DLY for giving the AVS-47B time to settle after a change in channel, range or excitation.

Note that autorange has its own settling delay after each change of range before starting to make A/D conversions. This delay is determined by n in ARNn (see ARN).

SCK[1..10] This “sign-check” function is an alternative to the fixed DLY delay. It is useful after a change in range or input channel. When the command interpreter encounters SCKn, the function starts to make A/D conversions at maximum speed and calculates differences between successive readings. This continues until two successive differences have had opposite signs n times, or the function has found n sets of 3 *successive* equal readings. Then the function concludes that data is either within the peak-to-peak noise or it has settled to within display resolution. The function exits and operation continues with the next command, which is typically ADCn.

The SCK function cannot prevent the A/D converter from being overloaded. In such a case, the ADC outputs only zeros. SCK behaves as if it had received three equal readings (zeros in this case) and exits without any additional delay.

The described method does not work if the data has a trend that is large enough to prevent differences from changing their sign. If there is such a trend, the function exits after a timeout of about 30 seconds.

The function is faster if n is small, but then the data may not have settled properly. A large n guarantees better settling but is slower.

Some examples on how SCK could be used:

RAN3;SCK4;RES10;RES?

MUX4;RAN5;EXC2;SCK5;RES10;RES?

SCK works nicely if the measured resistance is within the selected range. SCK cannot change range automatically, an overloaded ADC reading will be 20001. Therefore, use autoranging with sufficient autorange delay. For example:

ARN10 (plus excitation, channel etc.)
RES1;SCK5;RES10;RES?

Now RES1 forces autoranging to find a valid range, but on low excitation, this reading can still be far from correct. SCK5 waits until difference between successive ADC readings has changed sign 5 times. Then an average of ten samples is measured. The delay *must be long enough* so that range-changing has no overshoot.

Scanning is a situation where a good tradeoff between speed and settling accuracy is difficult to find. Following is just an idea of how automatic scanning could be programmed.

Use autoranging when scanning. Enable it by e.g. ARN10. Create variable RAN[CH] and also for any other parameters that you want to use with individual channels, for example EXC[CH]. The command line for a scan-enabled channel CH could be like

MUX[CH];RAN[CH];EXC[CH];DLY2;
RES1;SCK5;RES20;RES?

It is necessary to wait (DLY2) few seconds after having changed the channel so that one can see whether the measured sensor stays within the selected range. The program tries to make one conversion (RES1). In case of under- or overrange, one or more autoranging operations will take place. Sufficient autoranging delay is necessary so that the system does not oscillate if it must make several steps upwards. Such a situation must be strictly avoided - one has to reboot the CPU in the worst case. Final settling is sensed by SCK5 whereafter the resistance is measured.

Before proceeding to the next channel, the range is queried by RAN? and this value is copied to RAN[CH]. When channel CH is measured next time, program will use the correct initial range, which saves time.

The actual switching sequence can also contain steps for preventing accidental heating of the new sensor. For simplicity, this was not shown.

SCK is especially useful in a scanning application where the required settling times may vary a lot.

RST Reset command

This command works only when the program is idling, i.e.it is not executing previously receivcd commands or queries. *RST cannot be used for stopping long averaging or any other pending operation.* Either wait or reboot the interface.

The RST command sets the AVS-47B into a known safe state: input 200Ω, channel 0, range 2M, excitation 3µV and display to R (resistance). Response line terminator is

CRLF and command separator is semicolon. The AVS-47B is left in local mode, which is shown by the blanked REMOTE light.

RST works differently than initial power-on start: both leave the bridge in local mode, but start-up does no alter the previous local-mode settings of the bridge whereas RST changes settings to these “safe values”.

ERR? Error query

The AVS47-Serial/USB has limited error reporting capability. Errors are not reported automatically, they must be queried using the ERR? query. Possible responses:

`0:` No error

`command XXXyyy not recognized:` The letter part of a command has been misspelled or is non-existent

`query XXX? not recognized:` The letter part of a query has been misspelled or is non-existent.

`argument in XXXyyy exceeds maximum:`
`argument in XXXyyy less than minimum:`
Every command has upper and lower limits for its argument. If the given argument is outside these limits, it is coerced to the nearest limit and an error message is available.

`AL input line (No 4 black in -F version) stays at 0:`
This input line from the bridge to the CPU is used for synchronising the operation so that each A/D conversion is read only once. The error message is for trouble-shooting in a case where communication fails.

`ADC overload:` The input voltage to the ADC has exceeded 1.9999 Volts, which is equivalent to the upper limit of each resistance measuring range.

`timeout in SCK:` The sign-checking delay function has not found expected criteria. Reasons can be abnormally slow settling or a trend in data. The function will exit after a timeout. Then this error message becomes available.

Error messages from one command line are chained. The messages are verbal instead of being numerical codes because they are intended to be only programming aids. The application program should minimise the possibility of error situations.

Error register is cleared by ERR?

COMMANDS FOR THE TS-530A TEMPERATURE CONTROLLER

The **TS-530A** is a very old design, and it has been discontinued. It is replaced by the controller that is an integral part of the **AVS-48SI** Resistance Bridge. However, the AVS47-Serial/USB includes also commands for the TS-530A. It is for customers, who already own this controller. These commands have no corresponding queries. The analog setpoint voltage, the heater output voltage and the heater current can be *measured* by the A/D converter of the AVS-47B bridge (see the DIS command and refer also to the TS-530A and AVS-47B manuals).

The TS-530A must be connected to the AVS-47B with the supplied 37-way ribbon cable for data and with the supplied short BNC-BNC coaxial cable for the analog output from the bridge.

The TS-530A does not have a separate “remote” mode. Neither can the front panel settings be read remotely. This means that one can -but should not- change the remotely programmed PID settings by using the TS-530A front panel switches, and the firmware has no way to detect it. If this appears to be a problem, write your program so that the settings of the TS-530A are updated frequently. Re-programming existing settings without changing them will not disturb the analog control circuitry in any way.

SPT [10..42000] Set point command

Set point is given as a long integer from 10 to 42000. One digit corresponds to 100µV and the range is from 1mV to 4.2 Volts although only voltages up to 2V are meaningful when using 530 with the AVS-47B. The slow integrating D/A converter of the TS-530A is very accurate and linear, but it does not go to exact zero, therefore 1mV is the minimum. Arguments less than 10 are coerced to 10.

If you want to give the set point in resistance, you must scale and convert it yourself to a long or unsigned integer suitable for this converter. For example, SPT10000 produces a 1 Volt setpoint. If the AVS-47B measures on range RAN (=1..7), calculate the set point integer from set point resistance R_S as follows:

```
SPT =  RS / (10 ^ (RAN-1)) * 10000
where RS=setpoint in ohms
```

```
If desired set point is e.g. 110
ohms and range=200R,  (RAN=3)
SPT = 110/(10^(3-1)) * 10000 =
11000
```

PRO [0..11] Proportional gain command

Gain increases in steps of five decibels. Values are very approximate.

0..14: 5-10-15-20...60dB

15: no gain. Input of the proportional amplifier is connected to ground.

ITC [0..15] Integrator time constant command.

Values are very approximate.

0: integrator is reset to zero. P and PD mode control

1-10: 1-2-5-10-20..1000s. Higher number means weaker integration

11: analog integrator is latched by leaving its input open

12..15: integrator is reset to zero. Same as ITC=0.

DTC [0..7] Derivator time constant command.

Values are very approximate.

0: No derivation. P and PI mode control.

1..7: 1-2-5-10-20-50-100s

Higher number means stronger derivation. High proportional gain with strong derivation leads easily to oscillation of the control system.

BIA [0..5] Power bias command

Power bias can be used to reduce control error in P and PD modes. It is not useful in PI or PID modes.

0..5: 0-20-40-60-80-100% of maximum heater power. The highest setting is sufficient for maximum output on the selected heater range when proportional input is zero and integrator is reset.

POW [0..7] Heater power range command

Power ranges are calculated for a 100Ω heater. If heater resistance is higher, output voltage compliance (about 10V) will reduce the maximum power. If heater resistance is lower, the available output current (100mA) will reduce the maximum possible output.

0: Heater output is disabled

1..7: 1µW-10µW-100µW...1W

The heater output stage has seven current sensing resistors 10kΩ, 3.16kΩ, 1kΩ, 316Ω, 100Ω, 31.6Ω and 10Ω corresponding to heater ranges 1µW..1W. One volt across a sensing resistor means full output of the range. Based on the above figures, you can calculate correct ranges for heaters other than 100Ω. Similarly, you can measure the output current using DIS6 and calculate the heating power from R_H*I^2.

CABLE SPECIFICATIONS

The AVS47-Serial/USB comes with two cables, Picobus Cable and Serial Cable. The 5 meter Picobus cable connects the converter to the AVS-47B and the 1.5 meter Serial cable connects the box to the computer directly or via an USB-232 converter. This Picobus cable is distinguished from the Picobus cable that is supplied with the AVS-47B by its male 25- and 15 pin D-connectors. The resistance bridge is supplied with a cable that has male and female 25-way D-connectors.

Picobus Cable (PB25P15P6W5M-2)

The male DB25P and male DA15P are connected by a braided (shielded) cable with 6 conductors (e.g. Tasker C6015). Length: 5 meters.

DB25P	DA15P	Description
1	-	braid grounded only in DB25P
4	4	CP clock from box to bridge
5	5	DI data from bridge to box
6	6	AL alarm line from bridge to box
7	7	Isolated ground
20	15	DC data from box to bridge
9	9	Isolated +5V (referred to pin 7)
9,11	-	+5V connection for older bridge versions
Other pins are unused.		

Note that the shielding braid must remain isolated from everything inside the 15-pin connector shell. A 100nF ceramic capacitor with shortest possible leads connects the braid to the connector shell. The braid ***is*** connected to the shell of the 25-way connector at the AVS-47B end.

This arrangement prevents the cable from acting as an antenna at high frequencies while not providing a path for ground currents at the mains frequency. Inside the AVS-47B, Picobus signals and its power supply are galvanically isolated from the bridge ground .

Serial Cable (RS9P9S7W1.5M)

The male DE9P and female DE9S are connected by a braided 1:1 cable of 6 conductors (e.g. Tasker C6015). Length: 1.5 meters.

DE9S DE9P	RS232	Description
1	-	-
6	DSR	AL for Picobus applications
2	RXD	RS232 output box=>computer
7	RTS	CP for Picobus applications
3	TXD	RS232 input computer=>box
8	CTS	DI for Picobus applications
4	DTR	DC for Picobus applications
9	-	
5	Computer ground = shielding braid	

Shielding braid is connected, in addition to pins 5, also to **both** connector shells.

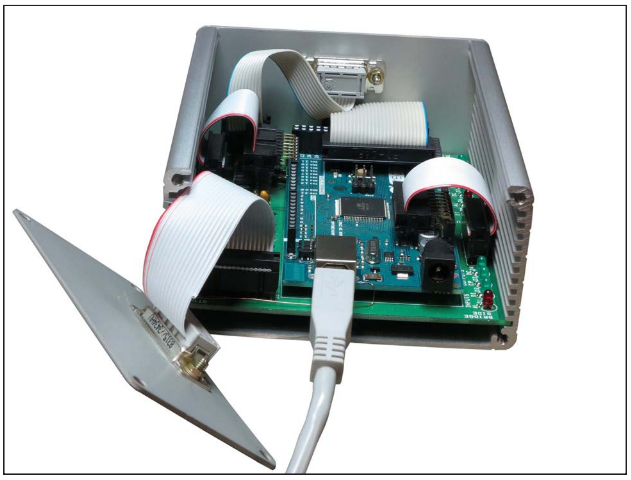
If you use the AVS47-Serial/USB with either the original AVS-47 or its successor, the AVS-47A, please check that the 5-meter Picobus Cable is marked PB25P15P6W5M-2. If the last number 2 is missing, the DB25P connector might not have the connection between pins 9 and 11. Open the connector and verify this. If needed, solder a wire link between these pins. The modified cable can be used with all bridge versions.

RE-PROGRAMMING THE AVS47-Serial/USB-W

The firmware can be updated by reprogramming the Arduino Mega2560 board. In order to do this, you need

- a USB cable (type A/B)
- Arduino development software for Mega2560. It is recommended to use the version that was current when our firmware was created. It is available from us.
- The new firmware version. It is available from us.

1. Install the Arduino programming environment software from the ZIP file.
2. Open the four screws holding the “front” panel of the AVS47-Serial/USB, the panel with the DA15 connector. There must be no cable from this connector to the AVS-47B. Plug the “A” type connector into the USB connector of your computer and the “B” end into the “hidden” USB connector inside the AVS47-Serial/USB. The box will now start, because it gets power from the USB.
3. Make on your hard disk a directory that has the same name as the new firmware file, but without extension, e.g. “avs47_serial_usb_1r2” . Arduino saves source codes into directories that have the same basename as the source code file. It creates such directories automatically, so it is best to create the directory yourself in a place where you want it be.
4. Place the new version of the firmware (e.g. “avs47_serial_usb_1r2.ino” in the new directory (Arduino calls the source code a “sketch”).
5. Start the Arduino environment. Under Tools, select Arduino Mega2560 board type. Select also the USB port that your computer has assigned to the CPU box.
6. Under the File menu, navigate to the new firmware version and open it into the environment.



7. Under the Sketch menu, select UPLOAD. If you do not get any error messages, updating has been done in a few seconds. You can now detach the USB cable, fix the rear panel and connect the 25/15 Picobus cable to the resistance bridge and the -12V power plug. Then test the new firmware using an RS232 terminal program or your own software. Suggestion: start conversation always by issuing the IDN? query.

Before we email an updated version to you, please check and tell us your old firmware version so, that we can send also the old version for backup.

AVS47-Serial/USB-W TROUBLE SHOOTING IDEAS

If you have difficulties in getting the AVS47-Serial/USB-W protocol converter to work, you can try the following trouble-shooting procedure. The problem might not be found this way, but it at least gives us valuable knowledge of where in the system the problem probably is. For making these tests, you need a hyperterminal program, or any other program that allows you to send serial commands to the AVS47-Serial/USB-W and read the responses. Typically, today’s computers have only USB ports and then you need a USB-232 adapter between the computer and the protocol converter box.

Communication between the bridge and the box uses four signals, two from the box to the bridge and two from the bridge to the box. They are

AL: “alarm” line telling that an A/D conversion is ready to be read from the bridge

DI: data bits from the bridge (“instrument”) to the box

CP: clock pulses from the box to the bridge

DC: data bits from the box (seen as the “computer” by the AVS) to the bridge.

The sent and received data bits are synchronized to the clock. Communication *between the box and the bridge* is based on our proprietary synchronous, serial “Picobus” protocol. Although this communication is serial, *it is NOT RS232*. Please do not mix synchronous and asynchronous serial formats. In synchronous Picobus communication, a 48 bits long string contains the **complete state** of the bridge, which is sent in every transaction. While sending the string, the CPU reads a response from the bridge using the same clock pulses for synchronisation. The response contains the state of the bridge just before the transaction. Asynchronous serial communication *between the CPU box and the computer*, on the other hand, uses short mnemonic **commands** for controlling individual bridge settings and **queries** for reading conversion results and settings that are currently in effect.

The expression “protocol converter” means that the complicated synchronous protocol of the bridge is programmatically turned to understandable commands and arguments which are sent and received in serial format that uses the legacy RS232 hardware standard. Because of the slow speed of the AVS-47B and tiny amounts of data, the simplest possible protocol can be used (9600 bauds, 8 data bits, no parity and one stop bit. No handshaking). It is based on signals called TxD, RxD and ground. TxD transfers data from the external computer to the box, and RxD from the box back to the computer.

Signal lines between the CPU box and the computer are not galvanically isolated, whereas communication between the CPU and the bridge is optically isolated.

PROCEDURE

1) Remove the four cross-head screws that hold the rear panel of the box (the panel with the 15-way connector). Then pull of the top cover lid. If it will not come, loosen also two topmost screws on the opposite side. Place the box, so that the rear panel is to the left. You can see a row of several green and two red LEDs. They are for trouble shooting. LEDs on the left (“bridge side”) show signals to an from the primary interface of the AVS-47B. They are marked with AL, DI, CP and DC. At right are the two asynchronous signals, TxD and RxD. The DI, AL, CP and DC signals on the right have no meaning in this AVS47-Serial/USB-W application.

2) Connect the serial cable (RS9P9S7W1.5M) from the box to the USB-232 converter or to your computer, if it has a physical COM: port (RS232 port). Do not yet connect the cable to the resistance bridge.

3) Connect the +12V DC power plug. The green “ON” light and one yellow LED on the Arduino board should turn on. All trouble-shooting LEDs (except possibly TxD, CP or DC on the right) should be off.

4) Send command RST (“reset”) from the computer. You should see very short activity of the TxD LED. It is not dependent on the Arduino board. If you do not see any activity although power is ON, your computer program may be configured wrong, or the cable is not in condition. *If you are not using our original cable, please check that it is wired 1:1.* Pins 2 of both connectors must have been connected together, and also pins 3. Pins number 5 are ground. (The so-called “null modem cable” has cross-connected pins 2 and 3. It is not suitable, because the cross-connection is made inside the CPU box).

5) Send command IDN?. This should return “PICOWATT,AVS47-SERIAL/USB,0,1R3” (or a later revision). You should now see activity also at the RxD light. The firmware program has started succesfully. Much of the Arduino board seems to be in order.

6) Send command RTS1. The green CP light on the left “bridge side” turns on.

7) Send command DTR1. The DC light should turn on. If this and 6) work, the CPU can send data to the bridge.

8) Send commands CTS? and DSR? in turn. Both queries should return 0 to the computer. These signals have not yet been asserted by the bridge.

9) Using a short piece of wire, connect pin 4 to adjacent pin 5 in upper row of the 15-way connector. The pins are counted 1..8 from top right to left and then 9..15 from low right to left. The “DI“ LED should turn on and query CTS? from the computer should return 1. Data can be received from CPU to computer.

10) Move the wire between pins 4 and 6. The “AL” LED should turn on and query DSR? should return 1. The Alarm signal can be received.

11) Remove the piece of wire. Send the RST command again and the lighted LEDs should go off.

12) With the AVS-47B off, connect it to the box using the 25-to-15 pin cable (PB25P15P6W5M). Turn on the bridge. The “AL” LED should light.

If this did not happen, the problem may be in the cable or optoisolator ISO204 (AL) in the bridge. Set the bridge manually for CAL, 200Ω range, 3mV excitation and R display.

13) Send command REM1. This should set the bridge in remote mode, shown by the yellow REMOTE led on the front panel. The bridge state should have remained unchanged.

If the bridge remained in local mode, the problem may be in the cable or in optoisolators ISO201 or ISO202 in the bridge. The cable specification is elsewhere in this manual.

14) Send command RAN4. The range should advance from 200Ω to 2kΩ. There should be no problems with this command, if the previous ones have worked. This verifies that bridge settings can be remotely controlled. You may also want to test commands MUX, EXC and DIS.

15) Send command ADC10. Ten A/D conversions are made at 0.4 second intervals. All four LEDs on the bridge section should show activity. The firmware resets the AL signal and then waits max 0.4 seconds until the next conversion turns AL on. A reading is taken and AL is reset again. The cycle repeats 10 times. Query ADC? returns the average of the 10 conversions.

If the response is zero or something strange, or if the DI led does not blink, optoisolator ISO203 in the bridge may be defective.

If all these tests ended up succesfully, your problem may be in the application program.

If the test stops to a failure, please let us know your results so that we can try to help.

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DECLARATION OF CONFORMITY

Manufacturer:	**RV-Elektroniikka Oy Picowatt**
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declares that under our sole responsibility

Product Name:	AVS47-Serial/USB-W Converter
Product Description:	Protocol Converter between the Picobus Primary interface of the AVS-47B Resistance Bridge and RS232 or USB port of an external computer.

is in conformity with the following Directives:

2004/108/EC:	Electromagnetic Compatibility
2011/65/EU:	ROHS Directive

and that the following harmonized standards have been applied:

EN 50 081-1:	Generic emission standard, Part 1: Residential, commercial and light industry
EN 50 082-1:	Generic immunity standard, Part 1: Residential, commercial and light industry
EN 50 581:	ROHS

Additional information: This product uses +12V power from an external mains adapter.

Vantaa, 14 March 2016

RV-Elektroniikka Oy Picowatt

Reijo Voutilainen

Reijo Voutilainen
President

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ADDENDUM

Using the AVS47-Serial/USB-W with bridge versions AVS-47 and AVS-47A

This protocol converter was designed for the recent AVS-47B version. Among some other improvements, this bridge version differs from previous versions in that it contains an isolated power source for the Picobus primary interface. The new +5V supply facilitates complete galvanic isolation between the bridge and the external computer. With the earlier bridges, this required an external power source. The -now obsolete- GPIB interface was the only practical way to obtain isolation easily.

The AVS47-Serial/USB-W can also be used with the two earlier bridge versions, but one has to check a few points . Depending on when and for which bridge versions the converter was purchased, some changes may be necessary.

1. Check the 5-meter cable PB25P15P6W5M between the bridge and the converter. In its 25-way connector, pins 9 and 11 must be connected together. Verify this connection with an ohmmeter, and if it exists, you do not need to open the connector shell. Otherwise, open the shell and solder a jumper wire from 9 to 11. When re-assembling, note that the shielding harness must be in touch with the shell body.

   This connection exists in cables marked with -2 at the end of the cable part number.

2. Because the old bridges do not have an isolated power supply for Picobus, the AVS47-Serial/USB-W must be set to provide the +5V power. Measure the voltage between pins 9 and 1 (+5V and 0V, respectively) of the female DA15S panel connector when the box is powered by the +12V mains adapter. If there is no power, open the box (see instructions on page 19) and insert a short circuit piece in pin header J7 on the mother board. +5V should now exist between 9 and 1.

3. Open the top cover of your AVS-47 or AVS-47A. Locate short-circuit places JP201-JP204 near to the right rear corner of the instrument. There must be only one short-circuit piece in JP203 for this application. Change the piece from JP204 to JP203 and remove all other pieces if such exist.

4. After having fixed panels and covers, insert the 25-to-15 pin cable and, without any other connections between or from the units, measure the resistance between the enclosures of the two units (note: anodized surfaces are not conducting). The resistance should be infinite while the capacitance should be about 0.1µF, if your DMM can measure capacitance.

After these checks/changes you can use the AVS47-Serial/USB-W with both new and old bridges. With all bridge versions, there shall be only one short circuit piece, JP203. The 9-11 jumper lead is not necessary with AVS-47B, but it does not do any harm either.

REVISION HISTORY

1R0 => 1R1 2016-07-15

New DTR and RTS commands

New DSR? and CTS? queries

Timeout if AL is not set within 1 sec

1R1 => 1R2 2018-03-25

Correction in ADC function

New queries MIN?, MAX?, STD?, QRATIO?

Correction in operation of OVR query

Correction in operation of ERR? query

New sign checking delay function SCK

Multiple error messages are chained

1R2 => 1R3   2018-06-03

Added missing field for serial number (=0) in the IDN? response and removed spaces.

Both OVR? and OVL? can be used for check-ign overrange

Overrange of a single A/D conversion is now decoded additionally into readings ADC?=20001 and RES?=2000100.0000

Maximum length of the input string added from 60 to 255 characters and length of a command or query from 6 to 20 characters

Added new REPEAT command

1R33 => 1R34 2020-11-02

Corrected typing errors and some unclear descriptions.

ADDENDUM

Using the AVS47-Serial/USB-W with bridge versions AVS-47 and AVS-47A

This protocol converter was designed for the recent AVS-47B version. Among some other improvements, this version differs from previous bridges in that it contains an isolated power source for the Picobus primary interface. This +5V supply makes it easy to obtain complete galvanic isolation between the bridge and the external computer. With the earlier AVS-47 bridges, the -now obsolete- GPIB interface was the only practical way to obtain isolation.

The AVS47-Serial/USB-W can also be used with the two earlier bridge versions, AVS-47 and AVS-47A, although one has to check a few points . Depending on when and for which bridge versions the converter was purchased, some changes may be necessary.

1. Check the 5-meter cable PB25P15P6W5M between the bridge and the converter. In its 25-way connector, pins 9 and 11 must be connected together. Verify this connection with an ohmmeter, and if it exists, you do not need to open the connector shell. Otherwise, open the shell and solder a jumper wire from 9 to 11. When re-assembling, note that the shielding harness must be in touch with the shell body.

   This connection may already exist in new cables. If the cable number is PB25P15P6W5M-2 it should have the 9-11 jumper.

2. Because the old bridges do not have an isolated power supply for Picobus, the AVS47-Serial/USB-W must be set to provide the +5V power. Measure the voltage between pins 9 and 1 (+5V and 0V, respectively) of the 15-pin DA15S panel connector when the box is powered by the +12V mains adapter. If there is no power, open the box (see instructions on page 19) and insert a short circuit piece in header J7 on the mother board. +5V should now exist between 9 and 1.

3. Open the top cover of your AVS-47 or AVS-47A. Locate short-circuit places JP201-JP204 near to the right rear corner of the instrument. There must be only one short-circuit piece in JP203 for this application. Change the piece in JP204 to JP203 and remove other pieces if such exist.

4. After having fixed panels and covers, insert the 25-to-15 pin cable between the bridge and the CPU box and, without any other connections between or from them, measure the resistance between the enclosures of the two units (please note that anodized surfaces are not conducting). The resistance should be infinite while the capacitance should be about 0.1µF (if your DMM can measure capacitance).

After these checks/changes you can use the AVS47-Serial/USB-W with both new and old bridges. But there is **then** one important change in behaviour with the “B” version bridges.

With the AVS-47B, the jumper J7/CPU connects the +5V sources of the bridge and of the CPU in parallel. This will not cause any harm to either unit. However, because of the resistance of a transient-suppressing choke inside the AVS-47B, its supply alone cannot deliver the full specified operating voltage to the CPU. This voltage (≈4.8V) may be high enough for booting and running the CPU, but do not expect operation to be reliable. Use always the +12V mains adapter. If re-booting of the CPU is required, you must switch off both units. Start always first the CPU and then the bridge.