Interface system
Probus V

Interface converter
IEEE-488 (GPIB)

Revision of document 1.5

Content

1 Overview

The interface system Probus V consists mainly of two parts:

- The base module of PROBUS V is the board ADDAT30 . This is the AD/DA interface that controls the power supply via a fiber optic serial data link.
  The ADDAT is mounted as an SMT board next to the power supply control circuits.
  For special applications, up to 10 ADDATs can be connected in a fiber optic ring. By sub-addressing, different channels can be controlled independently.

- An interface converter is placed in the back panel of the power supply. It is connected to ADDAT via a fiber optic serial data link. The converter adapts the interface on customer side to the fiber optic link.

Remark:

The position of the assemblies described above applies to most equipment.

The board ADDAT30 is assembled on an auxiliary circuit board (DIN10) at special equipment as well as equipment of the traditional series. Usually, the board is mounted in a rail in the middle area of the power supply.

The interface converter is mounted either on this board or in the rear panel of the power supply.

The interface converter can also be placed outside of the power supply to achieve highest possible noise immunity.

If necessary, the IEEE-488 (GPIB) interface converter can be replaced against other converters of the Probus V system.

Converters for USB, Profibus, Ethernet/LAN, RS232, RS422,... are available.
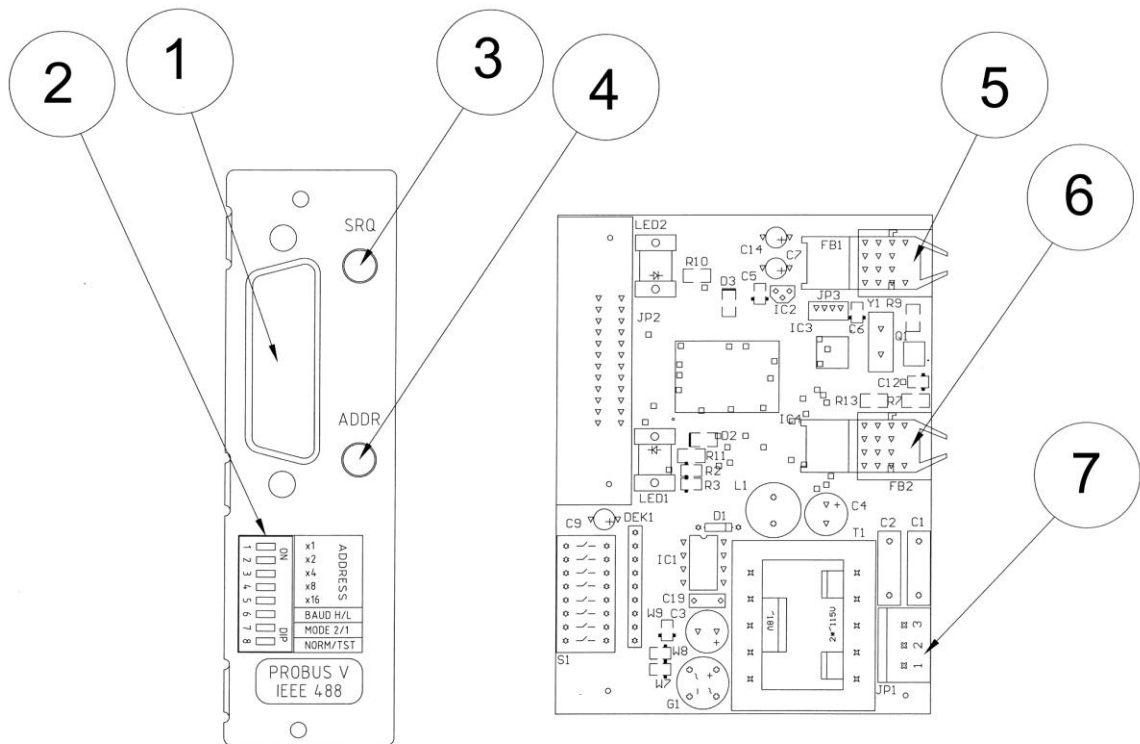
1	IEEE-488 connector	6	Fiber optic input (Rx), Receiver Agilent (HP) HFBR-2521
2	Configuration switch		
3	Service Request LED	7	Power connector, 230V (115V) Typ MLSS156-03-C from Pancon Pin assignment from top to bottom: PE , N , L1 (N and L1 can be exchanged)
4	Interface Addressed LED		
5	Fiber optic output (Tx), Transmitter Agilent (HP) HFBR-1521		

If there are high demands on fiber optic cable length or radiation resistance, the transmitter and receiver can be exchanged against the HFBR-x4xx series (SMA connector and 62.5/125µm glass fiber)

2   Interface setup information

If you have no time: In normal case, only the GPIB primary address has to be adjusted on switches 1...5. The other switches 6...8 remain in OFF position.
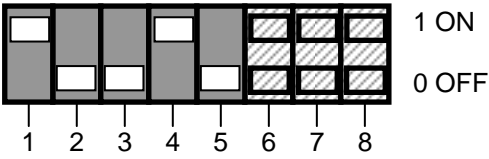
2.1   GPIB primary address (PA)

The GPIB primary address (PA) enables identification of all units connected to an IEEE-488 bus system.

Therefore, each unit on the bus must be assigned a unique PA.

The controlling PC usually has PA=0 and the connected units usually have addresses from 4 upwards. In general, the delivery state of FuG power supplies is PA=8.

Adjustment of the PA is done on the back panel of the device on the IEEE-488 interface converter module. It is not necessary to open the power supply.
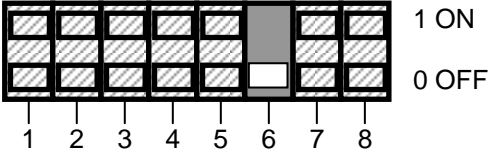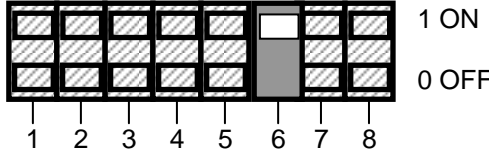
After changing a configuration switch, the power supply must be switched off for 5 seconds and switched on again.

Adjustment of primary address	
Example address = 9 (1*1 + 0*2 + 0*4 + 1*8 + 0*16 = 9)	Setting of the switches follows the binary system: Switch 1 has value 1 Switch 2 has value 2 Switch 3 has value 4 Switch 4 has value 8 Switch 5 has value 16 The addition of the values of the switches in ON position givs the address.

2.2   Baudrate adjustment

The IEEE-488 interface converter communicates with ADDAT over a serial fiber optic link. In Standard configuration, the baudrate is set to 625kBd on both sides.

For special applications (i.e. long fiber connections), the baudrate can be changed to 38400Bd. In this case, the baudrate has to be set to 38400Bd also on ADDAT.

625 kBd **Standard setting**	38400 Bd (only for special applications)

2.3 Compatibility mode Probus IV

If compatibility to a former Probus IV system has priority, the interface converter can be set to a special compatibility mode (Mode 1).
This mode is not recommended for new designs.

The full efficiency of the new Probus V system can only be achieved in standard mode.

Probus V Modus **Standard setting**	Compatibility mode (behave of system like Probus IV)
Switches 1–8, switch 7 ON, others OFF 1 ON 0 OFF 1 2 3 4 5 6 7 8	Switches 1–8, switch 7 OFF, others OFF 1 ON 0 OFF 1 2 3 4 5 6 7 8
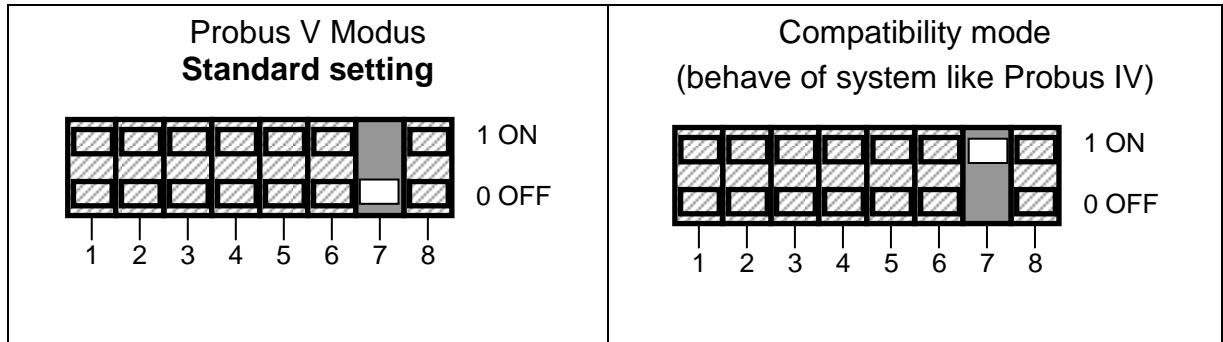
2.4 Test mode

Switch 8 sets the converter to test mode. The switch must stay in OFF position.

Standard setting	Test mode
1 ON 0 OFF 1 2 3 4 5 6 7 8	1 ON 0 OFF 1 2 3 4 5 8 7 6
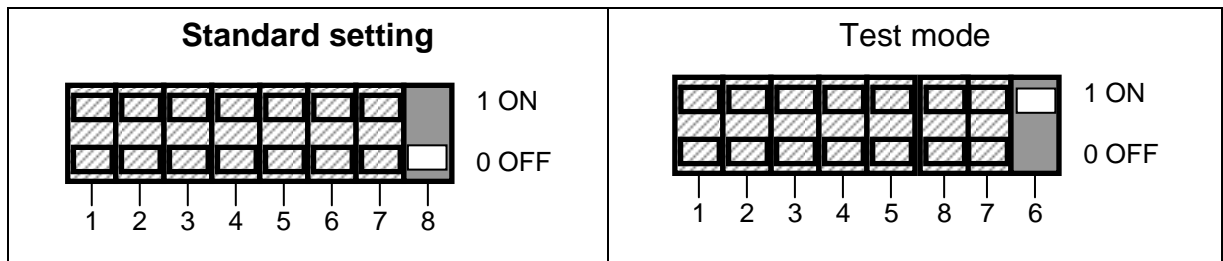
3 Test of connection

If you use in your PC a National Instruments IEEE-488 plug in card, the connection can be tested very easily.

Together with the card a program comes: the "National Instruments Measurement And Automation Explorer". shortform: "**MAX**"

Other manufacturers of IEEE-488 boards should have similar programs. Please refer to the manufacturer of your card.

Example for MAX, Version 3.1

Start MAX and click on "Geräte und Schnittstellen" and GPIB0.

Click now on "Scan For Instruments". The power supply will respond with "FuG", Type and serial number
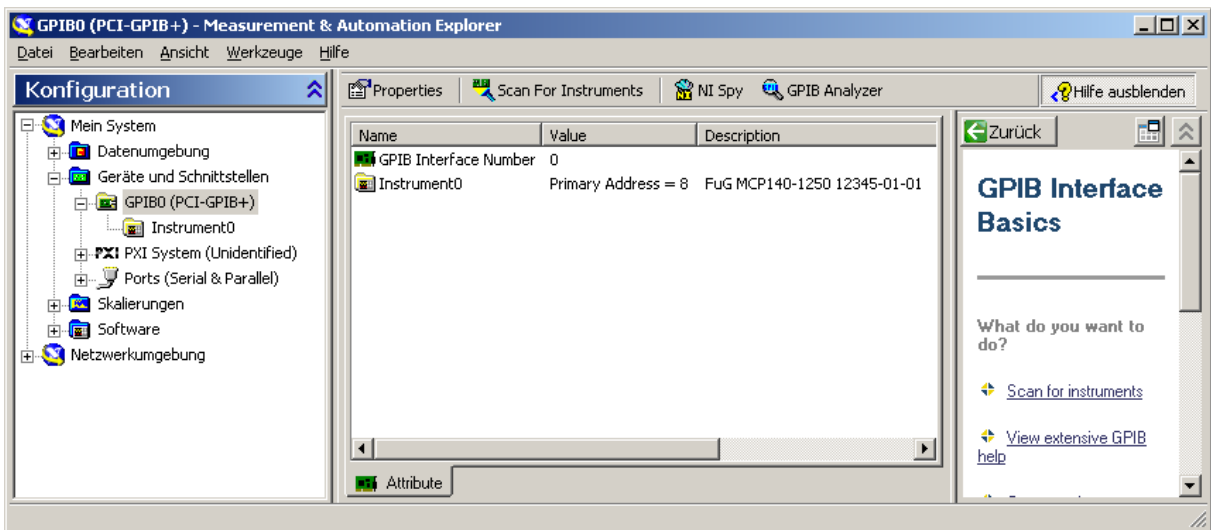
A double click on "Instrument 0" opens a window:

Click on "Communicate with Instrument":
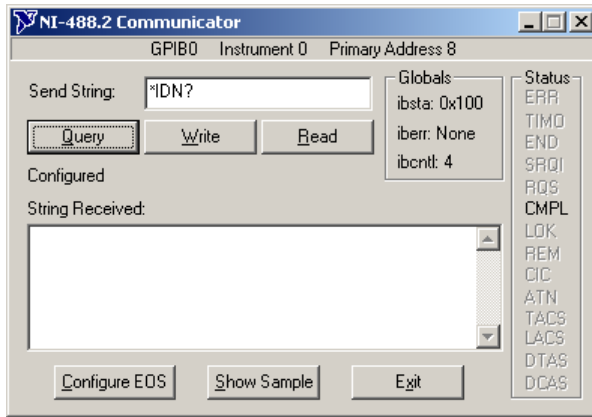
Now you can type a command into the send string field:

After starting the communicator, the string *IDN? is already placed in the input field. This is the standard query for the identification string of the device.

If you click on Query, the Send String is transmitted to the power supply and the answer string is displayed in the String Received field.
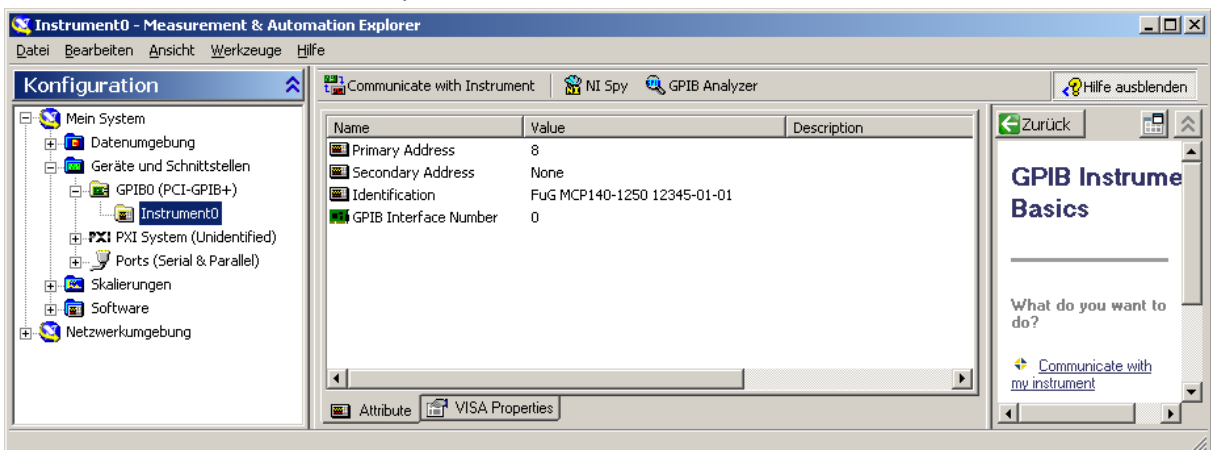
If you click on Write, the command string is sent to the power supply, but the answer string is not collected from the power supply.

A click on read collects and displays the answer string.

(QUERY is just a combination of WRITE and READ.)

Click on "QUERY":
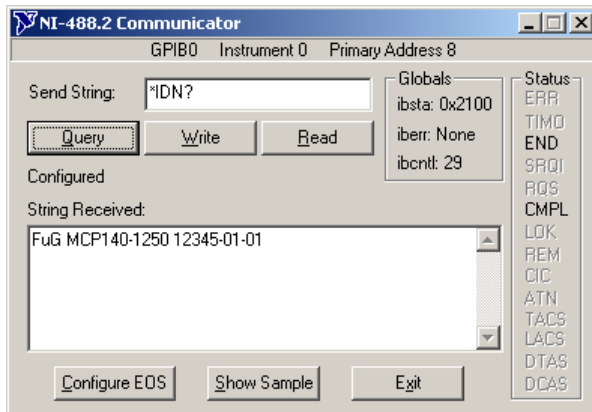
The power supply outputs type and serial number.

4 Interface converter displays

LED   *ADDR*
This LED is on, while the converter is either in listener addressed state or talker addressed state.

LED1 *SRQ*
This LED is on, while the converter asserts the SRQ line. After a serial poll the LED goes out.

5 Some basic commands

This section describes only some of the most important commands necessary to control basic functions of the power supply.

The configuration switch 7 (compatibility mode) must be in OFF position.

To become familiar with the commands, it is also possible to use MAX to input the commands.

A full reference to all commands is provided in the document **"Probus V - ADDAT30 command reference"**

5.1 Release output voltage

Syntax	Answer String	Function	Remark
Fx *or* **fx** **i.e. F1**	**E0**	writes x in Register ">BON"	ADDAT is in Standard Mode

With commands F1 and F0, the output of the power supply is electronically released and switched off..

For special models, this command is occasional used for different functions.

5.2 Voltage Setvalue

Syntax	Answer String	Function	Remark
Ux *or* **ux** **i.e. U3.47E2**	**E0**	writes voltage setvalue into register ">S0"	ADDAT is in Standard Mode

5.3 Current Setvalue

Syntax	Answer-String	Function	Remark
Ix **i.e. I7.78**	**E0**	writes current setvalue into register ">S0"	ADDAT is in Standard Mode

5.4 Readback of monitor values

Syntax	Answer String	Function	Remark
>M0?	**i.e.** **M0:+1.00000E+01**	reads voltage monitor	
>M1?	**i.e.** **M1:+1.00000E+01**	reads current monitor	

5.5 Device Clear

Syntax	Answer String	Function
=	**E0**	Resets interface to power on state

5.6 Output identification string

Syntax	Answer String	Function
*IDN?	**FuG....**	Output of type and serial number

Output string is the content of register ">FN"

5.7 Set output polarity

Syntax	Answer-String	Function	Remark
Px *or* **px** **i.e. F1**	**E0**	writes value x into register ">BX"	ADDAT is in Standard Mode
#nPx *or* **#npx** **i.e. #1P0**	**#nE0**	writes value x into register ">BX" of ADDAT n	ADDAT is in addressable mode

P0 sets polarity to positive,
P1 sets polarity to negative

Command is only valid in power supplies equipped with remote controlled polarity reversal switch.

For special applications, this command may be used to implement other functions.

6 Examples

The examples make use of some commands described in detail in document **"Probus V - ADDAT30 Command Reference"**

The examples refer to a standard power supply without further options with a nominal output voltage of +2000V and a nominal output current of +150mA.

Depending of the nominal values of your power supply, you have to change some commands.

The power supply is operated in no load condition.

Every command must be terminated with CR, LF, EOI or any combination of this.

6.1 Release output, set voltage and current

The power supply is operated in no load condition.

Set the programming selector on the frontpanel to REMOTE and DIGITAL.

LED *DIGITAL* is now on.

Release output:

Send the command **F1**

(LED *BUSY* on the frontpanel lights for a short moment to indicate data traffic)

The unit sends back answer string **E0**

LED *ON* on the frontpanel lights now.

With command **F0** the unit can be switched off.

Set output voltage

Send the command **U500**

The unit sends back answer string **E0**

Voltage setvalue is now set to 500V.

To check the setvalue, just press the DISPLAY SETVALUES button on the frontpanel.

The output voltage will not begin to rise, because the current setvalue is still set to zero.

Set output current

Send the command **I70e-3**

The unit sends back answer string **E0**

Current setvalue is now set to 70mA.

To check the setvalue, just press the DISPLAY SETVALUES button on the frontpanel.

The output voltage will now rise to 500V.

6.2 Readback of voltage and current

Output voltage and current are continuously measured in the background. The result is stored in registers and therefore immediately available. Resolution and measuring speed can be adjusted depending on the demands of the application.

Setting of resolution and measuring speed:

Send the command **S7**

The unit sends back answer string **E0**

Resolution is now set to maximum with slowest measuring speed (long integration time).

Readback of actual voltage:

The actual voltage monitor is in register >M0

Query monitor register with command **>M0?**

In ideal case, the unit sends back the answer string **M0:+5.00000E+02**

Actual voltage is 500.000V.

As the value comes from a true analog output voltage measurement, small deviations from the mathematically exact value are normal.

Readback of actual current:

The actual current monitor is in register >M1

Query monitor register with command **>M1?**

In ideal case, the unit sends back the answer string **M1:+0.00000E+00**

Actual current is zero, because of output open circuit condition.

As the value comes from a true analog output voltage measurement, small deviations from the mathematically exact value are normal.

6.3 Readback of power supply status

There are two ways to read back the status:

Read back of combined status byte:

The combined status byte is in register >KS

Query status register with command **>KS?**

The unit sends back an answer string like **KS: 01100000**

Power supply is switched on and runs in constant voltage mode.

Please refer to ADDAT30 command reference where the meaning of the bits is described.

Read back of a single status bit:

All status bits are available in D-registers:

Query one status register with command **>DON?**

Answer string will be **DON:1** if unit is switched on and output is released

6.4 Using the ramp function

Example: The output voltage is set to 500V and should be ramped up to 1000V within 20 seconds.
The ramp rate is 25V/sec.

Choose the type of ramp function:

Send the command **>S0B 2**

The unit sends back answer string **E0**

Ramp function type 2 means, the voltage shall ramp up slowly but go down as fast as possible.

Setting of the ramp rate:

Send the command **>S0R 25**

The unit sends back answer string **E0**

Ramp rate is now set to 25 V per second.

Set the new setvalue:

Send the command **U 1000**

The unit sends back answer string **E0**

The output voltage will start to ramp up from 500V to 1000V with a ramp rate of 25V/s.

7 Glossary

HPIB: **H**ewlett **P**ackard **I**nterface **B**us
            Bus-system developed by HP in the seventies.

GPIB: **G**eneral **P**urpose **I**nterface **B**us
            like HPIB, but independent of manufacturer

IEEE-488
            Standard for the GPIB Bus-system. Typical are the stackable connectors.

IEC-625
            Hardly used different standard for GPIB. Electrically compatible, but uses a different style of connector.

PA   Primary Address or Unit Address.
            Used to distinguish the different units on one bus. Every unit must have its own unique PA.
            The PA is assigned with small switches on the back panel of the unit.

ADDAT30
            Fiber optic controlled module within the power supply that parses and executes the commands and controls the power supply by AD and DA converters.

IBIG50   Interface converter module IEEE-488 to fiber optic.

POF   Plastic Optic Fiber that can be easily processed. Maximum link distance is 20...50m. For longer distance true glass fibers are used.

8 Errorcodes

In standard mode (non addressable mode), the error messages are exactly like described below.
In addressable mode, the error code is sent with preceding address. (i.e. "#1 E0").

Code	Bezeichnung	mögliche Ursache
E0	no error	standard response on each command
E1	no data available	Customer tried to read data from GPIB but there were no data prepared. (IBIG50 sent command ~T2 to ADDAT)
E2	unknown register type	No valid register type after '>'
E4	invalid argument	The argument of the command was rejected. i.e. malformed number
E5	argument out of range	i.e. setvalue higher than type value
E6	register is read only	Some registers can only be read but not written to. (i.e. monitor registers)
E7	Receive Overflow	Command string was longer than 50 characters.
E8	EEPROM is write protected	Write attempt to calibration data while the write protection switch was set to write protected.
E9	address error	A non addressed command was sent to ADDAT while it was in addressable mode (and vice versa).
E10	unknown SCPI command	This SCPI command is not implemented
E11	not allowed Trigger-on-Talk	Not allowed attempt to Trigger-on-Talk (~T1) while ADDAT was in addressable mode.
E12	invalid argument in ~Tn command	Only ~T1 and ~T2 is implemented.
E13	invalid N-value	Register >K8 contained an invalid value. Error code is output on an attempt to query data with ? or ~T1
E14	register is write only	Some registers can only be written to (i.e. >H0)
E15	string too long	i.e. serial number string too long during calibration
E16	wrong checksum	checksum over command string was not correct
E101 E102 E103	Timeout-Error	Problem with communication between IEEE-488 interface converter and ADDAT. (i.e. wrong Baudrates, fiber optic connections mismatched)