

Command Reference

Probus V - ADDAT 30/31

Interface – operating instructions
(Translated from German)

Version: 4.1

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1. Overview

The interface system Probus V consists mainly of two parts:

- The ADDAT 30/31 module is an AD/DA interface for controlling power supplies via fibre optics using serial data transmission. The ADDAT extension board is monitor directly to the device electronics.
- The converter for converting the interface signal to a fibre optics signal is mounted at the back panel. The reach highest possible noise immunity, the signal converter can be operated as an external module outside of the power supply. In that case the data transmission outside of the power supply also happens via fibre optics.

1.1. Software Interface

All commands and readback values are transmitted serially as readable ASCII characters over the fiber optic link.

There are different command sets implemented:

- Probus V instruction set for uniform access to all internal functions.
Recommended for new applications!
- Probus IV compatible commands (broadly compatible to IBIG40)
Not recommended for new applications!
- Special commands for communication with IEEE488 interface converter
IBIG50

1.2. Available Standard Interfaces

To connect the ADDAT to different interfaces, interface converters are used.

Some examples for available converters:

1.2.1. RS-232 - Standard Design

An active converter from RS-232 to fiber optics with a 9-pole Sub-D connector is integrated into the interface plate on the rear panel of the power supply.

1.2.2. RS-485 - Standard Design

An active converter from RS-485 to fiber optics with a 9-pole Sub-D connector is integrated into the interface plate on the rear panel of the power supply.

1.2.3. USB-Interface - Standard Design

An active converter from USB to fiber optics is integrated into the interface plate on the rear panel of the power supply.

This converter works together with the PC based driver software as a virtual COM-Port. The power supply can be programmed over USB without special USB knowledge, even with existing software that utilizes a COM-Port for communication.

1.2.4. Ethernet/ LAN/ TCP/IP - Standard Design

An active converter from Ethernet to fiber optics is integrated into the interface plate on the rear panel of the power supply.

This converter works together with the PC based driver software as a virtual COM-Port. The power supply can be programmed over Ethernet without deep going network knowledge, even with existing software that utilizes a COM-Port for communication.

1.2.5. IEEE-488- Standard Design

An active converter from IEEE-488 to fiber optics is integrated into the interface plate on the rear panel of the power supply.

The converter has two modes of operation:

Mode 1 is the compatibility mode for legacy software. It works like the former PROBUS IV with data transmission using Trigger-On-Talk. It offers only a limited set of commands and should therefore not be used for new projects.

Mode 2 offers a unified handshake mode of communication. Only in this mode, the full advantage of the new PROBUS V system can be utilized.

The Address switch for IEEE primary address setting is accessible at the back side of the power supply.

1.2.6. PROFIBUS-DP - Standard Design

An active converter from Profibus-DP to fiber optics is integrated into the interface plate on the rear panel of the power supply.

The converter sends its input data block cyclically to the ADDAT and provides the received data from the ADDAT in the output data block.

(Please refer also to description ">H0")

1.2.7. External Fiber Optics

All of the above-mentioned interface converters can also be placed outside the power supply close the controlling equipment, i.e. a PC or PLC.

The connection between power supply and controlling equipment is made by plastic standard fiber optics up to a distance of 20m. Connection distances up to a few 100m are possible if requested.

Highest possible noise immunity can be achieved!

Fiber optic connections are based on the popular HFBR-0500 Series of Agilent (HP).

1.3. Multiple ADDAT modules in one system

Special power supplies can comprise more than one ADDAT. Please refer also to the documentation of the special unit.

1.3.1. Serial fiber optic ring

Up to 10 ADDAT modules can be connected in a fiber optic ring. Complex power supplies that incorporate more than one ADDAT module can be controlled with only one interface converter. (Except for the Profibus-DP converter).

Each ADDAT has its own address.

NOTE

Do not confuse with the GPIB primary address!

The last ADDAT in the chain has to be set to address "#0".

For most commands it is necessary to add the address as a prefix in the following way "#n"

Particular commands don't need an address prefix, for example the device-clear command "=", this command affects all connected ADDATs.

1.3.2. Parallel Interface

In special applications, up to 256 ADDAT modules can be operated in parallel mode either on a RS-485 bus or special fiber optic distribution units.

Unlike in serial mode (1.3.1), external addresses are being ignored in parallel mode.

Please refer also to calibration register >CPAR.

2. Instruction set

- Each command string must be terminated by at least one of the following termination characters or any combination of them: "CR", "LF" or "0x00"
- Each command string sent to the power supply unit will be answered by a corresponding response string.
- "Empty" command strings, i.e. strings consisting only of termination characters, are rejected and do not return an answer string
- All read data and handshake strings from the power supply unit are terminated with the set terminator (see register ">KT" or ">CKT" and "Y" command)
- **In the following description of all commands, the terminator is omitted.**
Upper case and lower-case characters have the same meaning.
- **Receive timeout:**
If no new character has been received for longer than 5000ms all previously received characters will be discarded. Due to the relatively long timeout, it is possible to transmit commands manually using a terminal program.
- **Command length:**
The maximum command string length is limited to 50 characters
- **Receive buffer:**
The ADDAT has a 255 characters long FIFO Receive Buffer.
- **Checksum:**
For critical applications, the transmission will be protected by a checksum. See Section 0 and the description of the register ">CCS" in Section 4.2.6.

3. Test the connection with the XP terminal

The XP demo terminal program can be used to test the connection to the power supply unit. This can be downloaded under the Resources tab on each XP Power FuG high voltage product page.

4. Register based commands

All settings, status signals, calibration constants, monitor values, set values etc. are accessible in registers.

Access to these registers follows the same syntax for all registers.

There are registers located in RAM, which are set to defined values at power on. These registers can be randomly changed during operation.

For calibration and configuration, some registers are stored in the EEPROM. The names of these special registers start with ">C...". These calibration registers can be read out at any time.

4.1. General

4.1.1. Command format without address

These commands are only applicable if only one ADDAT is implemented in the power supply.

The ADDAT is set to standard mode (non-addressable mode).

">name x"

(Upper case and lower-case characters have the same meaning.)

name: name of the register, i.e. **"S0"** for set value 0

NOTE

"name" and argument **"x"** must be separated by at least one space character. The space character can only be omitted if the given argument is **"?"** (query register content).

x: Argument. Typically, a number to be written into the register.

If **"x" = "?"**, character, the register content is the response.

Example:

">S1 33.5e-2"

Sets current set value to 335mA

The ADDAT answers with:

"E0"

"E0" means "no error"

(refer to 6 Error codes)

4.1.2. Command format in addressable mode

The ADDAT is set to addressable mode (DIP switch)

Commands of this form are only applicable in power supplies that contain more than one ADDAT in one fiber optic chain.

"#a>name x"

#a: Address of ADDAT, 0...127

name: Name of the register, i.e. **"S0"** for voltage set value

NOTE

Between address **"a"** and register name **">name"** space characters are allowed but not necessary.

Register name **"name"** and argument **"x"** must be separated by at least one space character. Space can only be omitted if the argument is a **"?"** (query register content).

"x": Argument. Typically, a number to be written into the register.
If "x" = "?", character, the register content is the response.

Example:

"#2 >S0R 1.25e2"

Sets the ramp slope in the ADDAT with address 2 to 125V/sec.

The ADDAT responds with:

"#2 E0"

"#2 E0" means "ADDAT 2, no error "

4.1.3. Readout data without address

Readout of a register is initiated with a command like

">name?"

Output data are returned in the form:

">name:x"

"name": Name of the register, i.e. **"S0"** for voltage set value

"x": Register content, i.e. integer- or float-number, ASCII string etc. (see description of the different registers)

Example 1:

">S1A?"

Queries the valid current set value

The answer string looks like this:

"S1A:+2.33400e+03"

Example 2:

">M0?"

Queries the actual output voltage of the power supply.

The answer string looks like this:

"M0:+2.33400e+03"

4.1.4. Readout format in addressable mode

Readout of a register is initiated with a command like:

"#a>name?"

Output data are returned in the form:

"#a>name:x"

"#a": Address of ADDAT, 0...127

"name": Name of the register, i.e. **"S0"** for voltage set value

NOTE

Between address "a" and register name ">name" space characters are allowed but not necessary.

"x": Register content, i.e. integer- or float-number, ASCII string etc. (see description of the different registers)

Example 1:

"#2>S1?"

Queries the valid current set value of the ADDAT with address 2.

The answer string looks like this:

"#2 S1:3.35000e-01"

Example 2:

"#2 >M0 ?"

Queries the output voltage of ADDAT with address 2.

The answer string looks like this:

"#2 M0:3.35000e-01"

4.2. Register set

4.2.1. Set value control

Set value 0 (Voltage set value)				
Name	Read/Write	Function	Allowed values for x	Value after RESET or DCL
>S0	R/W	Programmed set value	Float number or "?"	0
>S0A	R/W	Actual valid set value (depends on ramp function)	Float number or "?"	0
>S0R	R/W	Ramp rate in V/sec	Float number or "?"	In register ">CS0R"
>S0B	R/W	Control of set value behavior (ramp function): 0: Standard, ">S0A" follows the programmed value in ">S0" immediately. 1: ">S0A" follows the value in ">S0" with the adjusted ramp rate upwards and downwards. 2: ">S0A" follows the value in ">S0" with the adjusted ramp rate only upwards. When programming downwards ">S0A" follows ">S0" immediately. 3: ">S0A" follows the value in ">S0" with a special ramp function only upwards. When programming downwards, ">S0A" follows ">S0" immediately. Ramp between 0...1 with 11.11E-3 per second. Above 1: with ">S0R" 4: Same as 2, but ">S0" as well as ">S0A" are set to zero if ">DON" = "0"	Byte-number (0...255) or "?"	In register ">CS0B"
>S0S	R (Read only)	Status of ramp function: 0: ">S0A" is equal to ">S0" 1: ">S0A" is not equal to ">S0"	"?"	
>S0H	R/W	High Resolution Mode PWM modulated set value +/- 2 Bit, 22Bit resolution	0: Normal operation 1: High Res. Mode	In register ">CS0H"

Register ">S0" can also be set with command U.

If one of the ramp functions 1...4 is selected, ">S0A" is set to 0, if the power supply ON status is not ON. This ensures, that a selected ramp always starts at zero after the power supply was not in ON state.

Set value 1 (Current set value)				
Name	Read/Write	Function	Allowed values for x	Value after RESET or DCL
>S1	R/W	Programmed set value	Float number or "?"	0
>S1A	R/W	Actual valid set value (depends on ramp function)	Float number or "?"	0
>S1R	R/W	Ramp rate in A/sec	Float number or "?"	In register ">CS1R"
>S1B	R/W	Control of set value behavior (ramp function): 0: Standard, ">S1A" follows the programmed value in ">S1" immediately. 1: ">S1A" follows the value in ">S1" with the adjusted ramp rate upwards and downwards. 2: ">S1A" follows the value in ">S1" with the adjusted ramp rate only upwards. When programming downwards ">S1A" follows ">S1" immediately. 3: ">S1A" follows the value in ">S1" with a special ramp function only upwards. When programming downwards ">S1A" follows ">S1" immediately. Ramp between 0...1 with 11.11E-3 per second. Above 1: with ">S1R" 4: Same as 2, but ">S1" as well as ">S1A" are set to zero if ">DON" = "0"	Byte-number (0...255) or "?"	In register ">CS1B"
>S1S	R	Status of ramp function: 0: ">S1A" is equal to ">S1" 1: ">S1A" is not equal to ">S1"	"?"	
>S1H	R/W	High Resolution Mode PWM modulated set value +/- 2 Bit, 22Bit resolution	0: Normal operation 1: High Res. Mode	In register ">CS1H"

Register ">S1" can also be set with command I.

If one of the ramp functions 1...4 is selected, "S1A" is set to 0, if the power supply ON status is not ON. This ensures, that a selected ramp always starts at zero after the power supply was not in ON state.

Example 1: (only one ADDAT in the power supply)

">s0 27.334e3"

sets voltage set value to 27334.

The answer string from the ADDAT is:

"E0"

Example 2: (ramp function, only one ADDAT in the power supply)

In a high voltage power supply, the output voltage shall be ramped up slowly, but in case of a decreasing set value the output voltage shall follow immediately.

Select and set the suitable ramp function:

">S0B 2"

The answer string from the ADDAT is:

"E0"

The ramp rate shall be 250V per second:

">SOR 250"

The answer string from the ADDAT is:

"E0"

Setting the final value to be reached:

">S0 10000" alternative version **"U 10000"**

The answer string from the ADDAT is:

"E0"

The outputs of the power supply will now ramp up to 10000V with a ramp speed of 250V/sec.

Now, the power supply shall be switched to OFF:

">S0 5000" alternative version **"U 5000"**

The answer string from the ADDAT is:

"E0"

The output voltage of the power supply will now fall down to 5000V. Maximum speed depends only on the connected load.

Now, the power supply shall be switched to OFF:

"F0"

The Answer string from the ADDAT is:

"E0"

The programmed set value is still in register **"S0"** and can be read:

">S0?"

The answer string from the ADDAT is:

"S0:5.00000E03"

On the other hand, the actual valid set value in register **">S0A"** is set to zero, because the power supply reports it's OFF-state with the signal **"ON-STAT"**.

Readout of ON-state:

">DON?"

The answer string from the ADDAT is:

"DON:0"

Readout of the actual valid set value:

">S0A?"

The answer string from the ADDAT is:

"S0A:0.00000E00"

Now, the power supply shall be switched to ON again:

"F1"

Answer string from ADDAT is:

"E0"

Now, the actual valid set value in register **">S0A"** ramps up to 5000V with ramp speed 250V/sec.

The actual valid set value can be readout:

">S0A?"

The answer string from the ADDAT is:

"S0A:1.23300E03"

The set value for the power supply has reached 1233V.

4.2.2. Digital outputs

The ADDAT has 5 digital outputs, which can be switched on and off either permanently or pulsed for special purposes.

Name	Read/Write	Function	Allowed values for x	Value after RESET or DCL
>B0	R/W	Switching ON/OFF or pulsing of output bit 0 (output "X0")	"0" or "1" or "?"	0
>B0A	R	Query actual value of output "X0" (Can be different to set value if pulse function ">B0" is used)	"?"	0
>B1	R/W	Switching ON/OFF or pulsing of output bit 1 (output "X1")	"0" or "1" or "?"	0
>B1A	R	Query actual value of output "X1" (Can be different to set value if pulse function ">B1" is used)	"?"	0
>B2	R/W	Switching ON/OFF or pulsing of output bit 2 (output "X2")	"0" or "1" or "?"	0
>B2A	R	Query actual value of output "X2" (Can be different to set value if pulse function ">B2" is used)	"?"	0
>BX	R/W	Polarity reversal Switching ON/OFF or pulsing of output "X-CMD"	"0" or "1" or "?"	0
>BXA	R	Query actual value of output bit "X-CMD" (Can be different to set value if pulse function ">BX" is used)	"?"	0
>BON	R/W	HV-ON Switching ON/OFF or pulsing of output "ON-CMD"	"0" or "1" or "?"	0
>BONA	R	Query actual value of output bit "ON-CMD" (Can be different to set value if pulse function ">BON" is used.)	"?"	0

The behaviour of the digital outputs can be influenced by the calibration values:

i.e. register ">CB0P" defines the polarity of output "X0" and the register ">CB0T" sets the pulse time in 10ms steps. Please refer to description of calibration constants.

If pulsing is enabled, a pulse is triggered on a "0" -> "1" transition of the corresponding ">B0" input register.

Example:

">B0 1"

Switches digital output "X0" to ON

The Answer string from the ADDAT is:

"E0"

4.2.3. Analog monitors

All monitor registers are continuously updated in the background with the latest measured values from the AD converters.

NOTE

The monitor values only represent the actual output voltage if the device is in a static state.

Name	Read/ Write	Function	Allowed values for x
>M0	R	Monitor 0 (V-Monitor)	"?"
>M0R	R	Monitor 0 (V-Monitor), uncalibrated raw value from the AD converter	"?"
>M0I	R/W	Monitor 0 (V-Monitor), resolution and integration time used by the AD converter	"0...7" or "?"
>M1	R	Monitor 1 (I-Monitor)	"?"
>M1R	R	Monitor 1 (I-Monitor), uncalibrated raw value from the AD converter	"?"
>M1I	R/W	Monitor 1 (I-Monitor), resolution and integration time used by the AD converter	"0...7" or "?"

Argument x	Resolution	Integration time
0	14Bit + sign	256µs
1	15Bit + sign	1ms
2	15Bit + sign	4ms
3	17Bit + sign	20ms
4	17Bit + sign	40ms
5	typ. 18Bit + sign	80ms
6	typ. 19Bit + sign	200ms
7	typ. 20Bit + sign	800ms

Note: The range of 0...7 for the argument ensures compatibility to Probus IV

Probus IV compatible command "**Sn**" writes its argument in both registers ">M0I" and ">M1I" simultaneously.

Resolution is defined as effective number of bits (ENOB). Parts of the measured value with lower significance are noise.

Standard integration time = 20ms

Example: (Addressable mode)

"#1 m0?"

Queries the output voltage from the ADDAT with address 1.

The Answer string is the register content:

"#1 M0:+2.33400e+03"

4.2.4. Digital Inputs

These registers are Read Only.

Name	Read/ Write	Function	Allowed values for x
>DVR	R	Query input bit " V-REG " (Shows 1, if power supply is in CV mode)	"?"
>DIR	R	Query input bit " I-REG " (Shows 1, if power supply is in CC mode)	"?"
>D3R	R	Query input bit " 3-REG " (For special applications)	"?"
>DX	R	Feedback polarity Query input bit " X-STAT " (For special applications) [0 = positive – 1 = negative]	"?"
>DON	R	Feedback HV-ON/OFF Query input bit " ON-STAT " (Shows 1, if power supply ON)	"?"
>DSD	R	Query input bit " SEL-D " (Shows 1, if power supply is digitally controlled)	"?"
>DSA	R	Query input bit " SEL-A " (Shows 1, if power supply is controlled by the analog interface)	"?"
>DCAL	R	Query input bit " CAL " (Shows 1, if power supply is in calibration mode)	"?"

Example: (Addressable mode)

"#1 >DVR ?"

Queries voltage regulation status "**V-REG**" of the ADDAT with address 1.

The answer string from the ADDAT is:

"#1 DVR:1"

4.2.5. Configuration and Status values

Name	Read/ Write	Function	Allowed values for x	Value after RESET or DCL
>KT	R/W	Terminator character for answer strings from ADDAT (Refer to command "Y")	"0...3" or "?" "0": "CR+LF" "1": "LF+CR" "2": "LF" "3": "CR"	In calibration register ">CKT"
>KS	R	Status byte combined Status (compatible to Probus IV), output as 0/1 string, MSB first Bit 7: " I-REG " Bit 6: " V-REG " Bit 5: " ON-Status " Bit 4: " 3-Reg " Bit 3: " X-Stat " (polarity)	"?"	Depends on actual state of the power supply

		Bit 2: "Cal-Mode" Bit 1: "SEL-A" Bit 0: "SEL-D"		
>KQS	R	"SRQ" -Status byte Output as a decimal number Bit 1: PS is in CC mode Bit 2: PS is in CV mode	"?"	0
>KQM	R/W	"SRQ" -Mask (Service-Request, refer also to command M)	"0...255" bzw. "?" Enable status bits for "SRQ" "0": no "SRQ" (Standard after RESET) Bit 1: "SRQ" on change of status to CC Bit 2: "SRQ" on change of status to CV	0
>KX	R	Controls Execute-on-X	"0": Immediate execution "1": Execution pending until X-command	0
>KN	R/W	Preselection of readout data for Trigger-on-Talk. (can also be set by N command)	"0...6" or "?" "0": Register ">M0" (V-Monitor) "1": Register ">M1" (I-Monitor) "2": Register ">KS" (Status byte as 0/1 string) "3": Register ">CS0T" (rated-voltage of voltage set value) "4": Register ">CS1T" (rated current of current set value) "5": Register ">CFV" (Firmware Version) "6": Register ">CFN" (serial number of power supply)	In calibration register ">CKN"
>KE	R	Error-Code of the most recent command	"?"	0

4.2.6 Calibration values

Calibration values are stored in a non-volatile memory (EEPROM).

All calibration values are organized in registers, which can be read to randomly.

If a register is written, the previous register value will stay unchanged and the ADDAT returns an error code.

Calibration values for analog set values				
Name	Read/Write	Function		Allowed values for x
>CS0T	R/W	Analog output 0 (V-Set)	Type value	Float-number or "?"
>CS0GP	R/W		Gain positive	Float-number or "?"
>CS0GN	R/W		Gain negative	Float-number or "?"
>CS0OP	R/W		Offset positive (in Bits)	Integer-number or "?"
>CS0ON	R/W		Offset negative (in Bits)	Integer-number or "?"
>CS0R	R/W		Default ramp speed	Float-number or "?"

>CS0B	R/W	Analog output 1 (I-Set)	Default set value behavior	"0...4" or "?"
>CS0H	R/W		Default High Res. Mode	"0" or "1" or "?"
>CS1T	R/W		Type value	Float-number or "?"
>CS1GP	R/W		Gain positive	Float-number or "?"
>CS1GN	R/W		Gain negative	Float-number or "?"
>CS1OP	R/W		Offset positive (in Bits)	Integer-number or "?"
>CS1ON	R/W		Offset negative (in Bits)	Integer-number or "?"
>CS1R	R/W		Default ramp speed	Float-number or "?"
>CS1B	R/W		Default set value behavior	"0...4" or "?"
>CS1H	R/W		Default High Res. Mode	"0" or "1" or "?"

Calibration values for analog monitors				
Name	Read/Write	Function		Allowed values for x
>CM0T	R/W	ADC 0 (V-Monitor)	Type value	Float-number or "?"
>CM0GP	R/W		Gain positive	Float-number or "?"
>CM0GN	R/W		Gain negative	Float-number or "?"
>CM0O	R/W		Offset (in Bits)	Integer-number or "?"
>CM0I	R/W		Default integration time	"0...7" or "?"
>CM1T	R/W	ADC 1 (I-Monitor)	Type value	Float-number or "?"
>CM1GP	R/W		Gain positive	Float-number or "?"
>CM1GN	R/W		Gain negative	Float-number or "?"
>CM1O	R/W		Offset (in Bits)	Integer-number or "?"
>CM1I	R/W		Default integration time	"0...7" or "?"
Calibration values for digital outputs				
Name	Read/Write	Function		Allowed values for x
>CB0P	R/W	Output "X0"	Polarity (0=pos, 1=inverted)	"0" or "1" or "?"
>CB0T	R/W		Pulse time in 10ms (0=no pulse)	Byte-number or "?"
>CB1P	R/W	Output "X1"	Polarity (0=pos, 1=inverted)	"0" or "1" or "?"
>CB1T	R/W		Pulse time in 10ms (0= no pulse)	Byte-number or "?"
>CB2P	R/W	Output "X2"	Polarity (0=pos, 1=inverted)	"0" or "1" or "?"
>CB2T	R/W		Pulse time in 10ms (0= no pulse)	Byte-number or "?"
>CBXP	R/W	Output "X-CMD"	Polarity (0=pos, 1=inverted)	"0" or "1" or "?"
>CBXT	R/W		Pulse time in 10ms (0= no pulse)	Byte-number or "?"
>CBONP	R/W	Output "ON-CMD"	Polarity (0=pos, 1=inverted)	"0" or "1" or "?"
>CBONT	R/W		Pulse time in 10ms (0= no pulse)	Byte-number or "?"
Calibration values for digital inputs				

Name	Read/Write	Function		Allowed values for x
>CDVRP	R/W	Input " V-REG "	Polarity (0=pos, 1=inverted)	"0" or "1" or "?"
>CDIRP	R/W	Input " I-REG "	Polarity (0=pos, 1=inverted)	"0" or "1" or "?"
>CD3RP	R/W	Input " 3-REG "	Polarity (0=pos, 1=inverted)	"0" or "1" or "?"
>CDXP	R/W	Input " X-STAT "	Polarity (0=pos, 1=inverted)	"0" or "1" or "?"
>CDONP	R/W	Input " ON-STAT "	Polarity (0=pos, 1=inverted)	"0" or "1" or "?"

General calibration values				
Name	Read/Write	Function		Allowed values for x
>CFN	R/W	Serial number string		String with max. 50 characters or "?"
>CFNNUM	R/W	Numeric serial number (for Profibus)		"0...2147483647"
>CFV	R	Firmware-Version		"?"
>CADR	R/W	Address for addressable mode		Byte-number or "?"
>CKT	R/W	Default Terminator		"0...3" or "?"
>CBAUD	R/W	Special baud rate		"?" "0": 4800Bd "1": 9600Bd "2": 19200Bd "3": 38400Bd "4": 115kBd "5": 230kBd (Factory default) "6": 500kBd "7": 625kBd
>CASM	R/W	Auto-send Master Mode (Used with fiber optic analog programming, ADDAT set to ">CASM=1" sends ">HAXx" commands to remote ADDAT) Profibus: ">CASM 3"		"0": Without any remote ADDAT "1": This ADDAT controls remote ADDAT "2": This ADDAT is controlled by remote ADDAT "3": ADDAT expects a new ">H0" command every 5s/500ms
>CONBR	R/W	Definition of " ON-STAT " message in register ">DON" and status byte ">KS": 0: ">DON" shows the true power supply status (only implemented in the HCP and MCP power supply series) 1: ">DON" shows the copied value from register ">BONA" (Probus IV compatible)		"0" or "1" or "?"

>CKN	R/W	Default N-value for readback preselection	Byte-number or "?"
>CCS	R/W	Type of communication checksum for command and answer strings Refer also to 0.	"0": No checksum "1": 2 Byte Hex checksum
>CPAR	R/W	Parallel operation (i.e. RS-485) Register affects ADDAT in addressable mode only (DIP-switch)	"0": Normal operation, external addresses are forwarded to the next ADDAT "1": Parallel operation: external addresses are being ignored

Example 1: (Calibrating type voltage)

">CS0T 12500"

Type voltage is set to 12500

If write protection is disabled, the value will be written to the EEPROM immediately. After some milliseconds, the answer string is output from the ADDAT:

"E0"

If write protection was active, the previous value in the EEPROM stays unchanged. An error message is output:

"E8"

EEPROM Write Protect Error

Example 2: (Read type voltage)

">CS0T?"

queries type voltage

The answer string from the ADDAT:

"CS0T:+1.25000e+04"

NOTE

Attention: Due to binary based arithmetic inside the ADDAT, rounding errors of typically +/- 1 Digit can occur.

4.2.7. Virtual Registers

These registers can be used for an automatic adoption of a calibration program to the actual version of the ADDAT firmware.

Name	Read/Write	Function	Allowed values for x
>CLIST	W	Reset of the calibration constants readout pointer to the first constant. Outputs also the column headings.	No argument
	R	With each read operation, the next calibration constant will be output with a ">" prefix (the output can be saved for documentation purposes or for cloning calibration constants)	"?"
>RLIST	W	Reset of the register readout pointer to the first register. Outputs also the column headings.	No argument
	R	Consecutive reads output all implemented register:	"?"

		Name, help-text, data type, R/W type, content i.e.: "CS0T"; "U Soll Typenwert"; "2"; "0"; "1.00000E01"	
--	--	--	--

Data types at "RLIST": (column data type)

- "0": Floating point number
- "1": 32Bit signed integer number (long)
- "2": 16Bit signed integer number (int)
- "3": 8Bit unsigned number (unsigned char)
- "4": 8Bit value, output as 0/1 string with MSB first (unsigned char)
- "5": 8Bit signed number (signed char)
- "6": 1Bit
- "7": String
- "8": String
- "9": Hexadecimal Input block
- "10": Hexadecimal Output block

R/W properties at "RLIST": (column Rd/Wr/Cal)

- "0": Read Only
- "1": Write Only
- "2": Read/Write
- "3": Read always / Write only in calibration mode possible

4.2.8. Simultaneous Setting

H-Registers are implemented for cyclic communication with special interface converters, (i.e. Profibus).

One single string sets most of the important registers in the ADDAT.

The answer string from the ADDAT contains most of the important status and monitor values.

Name	Read/Write	Function	Allowed values for x
>H0	W (Write only)	Set all set values and digital outputs. Answer string is the same as the read result of register ">H1"	String of 32 Hex-characters, is equivalent to 16 Bytes
>H1	R	Outputs all monitors and status signals in one single string.	"?"
>HA	W	Short form of ">H0" for direct communication between two ADDATs for analog fiber optic programming.	String of 20 Hex-characters = 10 Bytes

Example:

">H0 000F4240000003E80000000000000001"

Answer from the ADDAT (example):

"000F4201000500000000010102030001"

Data format input data block ">H0"		
Byte		
0	LSB	Set value "0" (Voltage set value), unsigned integer,
1	MSB	"0...65535" represents 0V to nominal voltage in ">CS0T", ">S0" is set
2	LSB	Set value "1" (Current set value), unsigned integer
3	MSB	"0...65535" represents 0A to nominal current in ">CS1T", ">S1" is set
4	Bit 0	Sign for "0" ("0" = pos., "1" = neg.)
	Bit 1	Sign for "1" ("0" = pos., "1" = neg.)
	Bit 2	Not used
	Bit 3	Not used
	Bit 4	Not used
	Bit 5	Not used
	Bit 6	Not used
	Bit 7	"0": ">CASM 3" Timeout 5sec. "1": ">CASM 3" Timeout 500msec.
5	Bit 0...3	Behavior of the set value "0", value is copied to register ">S0B"
	Bit 4...7	Behavior of the set value "1", value is copied to register ">S1B"
6	Bit 0...3	Not used
	Bit 4...7	Not used
7	Bit 0	Unit ON command, value is copied to register ">BON"
	Bit 1	Output "X-CMD" (polarity reversal), value is copied to register ">BX"
	Bit 2	Output "X0", value is copied to register ">B0"
	Bit 3	Output "X1", value is copied to register ">B1"
	Bit 4	Output "X2", value is copied to register ">B2"
	Bit 5	Not used
	Bit 6	Not used
	Bit 7	Not used
8	LSB	Set value "0" ramp rate, unsigned integer,
9	MSB	"0...65535" represents 0...1x nominal value per second, ">S0R" is set
10	LSB	Set value "1" ramp rate, unsigned integer,
11	MSB	"0...65535" represents 0...1x nominal value per second, ">S1R" is set
12		Not used
13		Not used
14		Not used
15		SYNC Byte, value is transferred to output data block, no further function

Data format output data block ">H1"		
Byte		
0	LSB	Monitor " 0 " (voltage monitor), unsigned integer, (Value from register ">M0"), " 0...65535 " represents 0V to nominal voltage in ">CM0T"
1	MSB	
2	LSB	Monitor " 1 " (current monitor), unsigned integer (Value from register ">M1"), " 0...65535 " represents 0A to nominal current in ">CM1T"
3	MSB	
4	Bit 0	Sign of Monitor " 0 " (" 0 " = pos., " 1 " = neg.)
	Bit 1	Sign of Monitor " 1 " (" 0 " = pos., " 1 " = neg.)
	Bit 2	Not used
	Bit 3	Not used
	Bit 4	Not used
	Bit 5	Not used
	Bit 6	Not used
	Bit 7	Not used
5	Bit 0	Input signal " SEL-D " (" 1 " = power supply is digitally controlled)
	Bit 1	Input signal " SEL-A " (" 1 " = power supply is analogously controlled)
	Bit 2	" CAL-Mode " (" 1 " = power supply is in calibration mode)
	Bit 3	Input signal " X-STAT " (polarity of HVPS with polarity reversal)
	Bit 4	Input signal " 3-REG " (for special applications)
	Bit 5	Input signal " ON-STAT " (" 1 " = power supply ON)
	Bit 6	Input signal " V-REG " (" 1 " = power supply is in constant-voltage regulation)
	Bit 7	Input signal " I-REG " (" 1 " = power supply is in constant-current regulation)
6		Not used
7		Not used
8		Not used
9		Not used
10	LSB	Serial number, long integer
11		
12		
13	MSB	
14		Error code of the most recent command
15		SYNC Byte, value is copied from input data block

4.3. Service Request, automatic transmission on status change

This function is provided for communication with IEEE-488 Interface converters.

NOTE

This function is provided for communication with IEEE-488 Interface converters.

Configuration register ">KQM" (SRQ-Mask) controls the **immediate** and **asynchronous** transmission of an SRQ string if the selected digital status signals change.

Register ">KQM" can also be changed by the Probus IV compatible command "M" or the special command "~M".

All data produced by the SRQ function have a leading "~Q" as identifier.

"~Q2" power supply entered status CC since last transmission of "~Qn"

"~Q4" power supply entered status CV since last transmission of "~Qn"

"~Q6" power supply entered status CC or CV since last transmission of "~Qn"

To avoid a communication overload, the minimum time between two "~Qn" strings is 100ms.

If one IEEE-488 interface converter (IBIG50) controls more than one ADDAT, the ">KQM" registers in each ADDAT must be set separately by addressed commands.

In this case, a non-addressed M command sets only the common SRQ mask in the IEEE-488 interface converter.

Example:

"M2"

Enables automatic transmission of message "~Q2", if the power supply goes into CC mode.

The Answer string from the ADDAT:

"E0"

If control mode changes now to constant voltage (CC-mode), the SRQ string is transmitted immediately.

"~Q2"

The automatic transmission can be stopped by writing 0 into register ">KQM":

"M0" or ">KQM 0"

4.4. Checksum

For critical applications, commands and answer strings can be transmitted with a checksum attached.

Please refer to description of register ">CCS" in 4.2.6.

Special cases:

In Calibration Mode no checksum is used.

command **"*IDN"** and special commands ("**~T1**", "**~T2**", "**~M**") are accepted without a Checksum

In addressable mode, the checksum is only verified for commands proceeded by the local address.

4.4.1. Checksum type 1

Register ">CCS" is set to 1.

Checksum algorithm:

A space character is attached to the command string (without terminator) as a separator for the following checksum.

All ASCII codes of the whole string up to and including the space character are added. 16bit wide addition without sign.

The derived checksum is attached as a four characters hex string after the space character.

After the checksum, one or more terminator character closes the string ("**CR**", "**LF**", "**0x00**" or any combination of these characters).

All answer strings are treated in the same way.

Example 1:

The output voltage shall be set to 15.3V:

Original command string:

"U 15.3"

With attached space character:

"U 15.3 "

Addition of the ASCII Code:

$85+32+49+53+46+51+32 = 348,$

in hex representation **"0x015C"**

The checksum in hex representation is attached to the command string.

Command string including checksum:

"U 15.3 015C"

The following terminator characters are not part of the checksum!

The answer string is:

"E0 0095"

Example 2:

The Checksum is switched on and shall be switched off. (Register ">CCS" is "**1**" and shall be set to "**0**")

Calibration lock (DIP switch) must be disabled before performing this operation:

Original command string

">CCS 0"

With attached space character:

">CCS 0 "

Addition of the ASCII Codes:

$62+67+67+83+32+48+32 = 391$

In hex representation **"0x0187"**

The checksum in hex representation is attached to the command string.

Command string including checksum:

">CCS 0 0187"

In hex representation **"0x0187"**

The checksum in hex representation is attached to the command string.

Command string including checksum:

">CCS 0 0187"

The following terminator characters are not part of the checksum!

The answer string is:

"E0 0095"

5. Special commands and Probus IV commands

The Probus IV instruction set is obsolete and is no longer recommended for new applications.

In this case the Probus V instruction set is recommended.

5.1. Send Identify String

Syntax	Answer-String	Function
*IDN?	"#n FuG..." ADDAT is in addressable mode	Outputs serial number of the power supply and sets in the 1. ADDAT in the fiber optic ring monitor selection to "N6"
	"FuG..." ADDAT is in standard Mode	Outputs serial number of the power supply and sets monitor selection to "N6"

The answer string is the serial number string from register ">CFN". If there are more than one ADDAT in a fiber optic ring connected, only the first ADDAT in the chain reports its factory number.

In interaction with the IBIG50 in Probus IV compatibility mode 1, the IBIG50 answer string is suppressed.

Therefore "*IDN?" also sets "N6", so that the following talker addressing followed by a data query via "~T1" will output the device number.

5.2. Device Clear

Syntax	Answer-String	Function
=	"="	Reset of the ADDAT
	ADDAT is in addressable mode and not set to address 0 (Answer string is used as command to reset following ADDAs in the ring)	
	"E0"	
	ADDAT is in standard mode or in addressable mode with address set to 0	

Effects of Device Clear:

- All set values are set to zero
- Set value ramp-function is reset to the calibrated default value from EEPROM
- Set value ramp-speed is reset to the calibrated default value stored in the EEPROM
- All digital outputs are reset
- Monitor selector is reset to the calibrated value stored in the EEPROM
- Service Request Mask is set to zero
- Service Request Register is set to zero
- ADC integration times are reset to its calibrated values stored in the EEPROM
- Terminator character for answer strings is reset to its calibrated value stored in the EEPROM

5.3. Output Release ON/OFF

Syntax	Answer-String	Function	Remark
Fx or fx i.e. F1	"E0"	Writes " x " in register ">BON"	ADDAT is in Standard Mode
#nFx or #nfx i.e. #1F0	"#nE0"	Writes " x " in register ">BON" in ADDAT " n "	ADDAT is in addressable mode

With commands F1 and F0, the output of the power supply is electronically released and switched off. For certain XP Power FuG devices, this command is occasionally used for different functions.

5.4. Voltage set value

Syntax	Answer-String	Function	Remark
Ux or ux i.e. U3.47E2	"E0"	Writes voltage set value into register ">S0"	ADDAT is in Standard Mode
#nUx or #nux i.e. #2U5.23	"#nE0"	Writes voltage set value into register ">S0" in ADDAT " n "	ADDAT in in addressable mode

5.5. Current set value

Syntax	Answer-String	Function	Remark
Ix i.e. I7.78	"E0"	Writes current set value into register ">S1"	ADDAT is in standard mode
#nIx i.e. #3I5	"#nE0"	Writes current set value into register ">S1" in ADDAT " n "	ADDAT is in addressable mode

5.6. Select readback channel for triggered data query

Syntax	Answer-String	Function	Remark
Nx or nx i.e. N1	"E0"	Writes value " x " into register ">KN"	ADDAT is in standard mode
#nNx or #nnx i.e. #1n6	"#nE0"	Writes value " x " into register ">KN" of ADDAT " n "	ADDAT is in addressable mode

Command selects readback data channel for GPIB trigger-on-talk (special command **"~T1"**) and data query ("**?**"-command). Ensures compatibility with Probus IV.)

See also description of register **">KN"**

5.7. Query data, triggered

Syntax	Answer-String	Function	Remark
?	i.e.: "1.2345E01VN"	Returns the preselected data value. See register ">KN" and command "N"	ADDAT is in standard mode
#n? i.e. #3?	"#3 1.2345E01VN"	Returns the preselected data value of ADDAT "#n" See register ">KN" and command "N"	ADDAT is in addressable mode

Ensures compatibility with Probus IV.

Function can also be used together with IEEE-488 Interface (IBIG50) in Mode 2.

5.8. Set AD conversion rate and resolution

The conversion rate of each AD channel can be controlled independently. The resolution of the AD converter depends on the selected conversion rate.

Syntax	Answer-String	Function	Remark
Sx or sx i.e. S1	"E0"	Writes value "x" simultaneously into registers ">M0I" and ">M1I"	ADDAT is in standard mode
#nSx or #nsx i.e. #1S2	"#nE0"	Writes value "x" simultaneously into registers ">M0I" and ">M1I" in ADDAT "n"	ADDAT is in addressable mode

Please refer to the description of analog monitor registers in section 4.2.3. "S" command sets both monitors to the same resolution and conversion rate.

Compatibility to Probus IV.

5.9. Set output polarity

Syntax	Answer-String	Function	Remark
Px or px i.e. P1	"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 functionalities.

5.10. X-outputs setting

Syntax	Answer-String	Function	Remark
Rx or rx i.e. R1	"E0"	Influences register ">B0" , ">B1" and ">B2"	ADDAT is in standard mode
#nRx or #nrx i.e. #1R2	"#nE0"	Influences register ">B0" , ">B1" and ">B2" in ADDAT "n"	ADDAT is in addressable mode

The expansion outputs **"X0"**, **"X1"** and **"X2"** of the ADDAT can be used to control functionalities in special power supplies. These outputs are directly controlled by the registers **">B0"**, **">B1"** and **">B2"**. (see also 4.2.2)

The registers **">B0"**, **">B1"** and **">B2"** can also be influenced by the command **"R"**, which is compatible to Probus IV.

R0...R7: **">B0"**, **">B1"** and **">B2"** are simultaneously set to the binary value of **"x"**
(B0 = LSB)

R8: Sets only **">B0"** to 0

R9: Sets only **">B0"** to 1

R10: Sets only **">B1"** to 0

R11: Sets only **">B1"** to 1

R12: Sets only **">B2"** to 0

R13: Sets only **">B2"** to 1

5.11. Execute on X mode

Execute-on-X mode prevents some commands from being executed immediately. These commands are stored in a buffer and will be executed on reception of the command **"X"**.

This function is implemented to ensure compatibility to Probus IV command set.

Due to the much faster command processing speed of the Probus V system, Execute-on-X mode should not be used for new software projects.

Syntax	Answer-String	Function	Remark
Gx or gx i.e. G1	"E0"	Writes value "x" into register ">KX"	ADDAT is in standard mode
#nGx or #ngx i.e. #1G1	"#nE0"	Writes value "x" into register ">KX" in ADDAT "n"	ADDAT is in addressable mode

G0: All commands are executed immediately

G1: Special commands are latched and will be executed on reception of command **"X"**

(please refer to description of **"X"**-command in section 4.2.2)

5.12. Execute-on-X

Syntax	Answer-String	Function
X or x	<p>"X"</p> <p>ADDAT is in addressable mode and not set to address 0 (Answer string functions as command for following ADDAs in the fiber optic ring)</p>	<p>Ensures compatibility to Probus IV command set. The pending commands U, I, F, N, P are executed at once.</p>
	<p>"E0"</p> <p>ADDAT is in standard mode or in addressable mode with address set to zero.</p>	

5.13. Set Terminator

Syntax	Answer-String	Function
<p>Yn or yn</p> <p>(Command must always be sent without address)</p>	<p>"Yn"</p> <p>ADDAT is in addressable mode and not set to address 0 (Answer string functions as command for following ADDAs in the fiber optic ring)</p>	<p>Y0: "CR+LF" Y1: "LF+CR" Y2: "LF" Y3: "CR"</p> <p>Default value in register ">CKT" (typically set to 2)</p>
	<p>"E0"</p> <p>ADDAT is in standard mode or in addressable mode with address set to zero.</p>	

Adjusts the terminator character for answer strings sent by the ADDAT. The command writes its argument value "n" into register ">KT".

In addressable mode, this command must be transmitted without preceding address. The Y command sets the ">KT" registers in all ADDATs.

Please refer also to the description of registers ">KT" and ">CKT"

5.14. SRQ-mask

Syntax	Answer-String	Function	Remark
<p>Mx or mx</p> <p>i.e. m6</p>	"E0"	Sets SRQ mask in register ">KQM"	ADDAT is in standard mode
<p>#nMx or #nmX</p> <p>i.e. #1m6</p>	"#nE0"	Sets SRQ mask in register ">KQM" in ADDAT "n"	ADDAT is in addressable mode

Description of argument see register ">KQM" (0).

The addressable form must be used, if an IEEE-488 interface converter IBIG50 is used together with more than one ADDAT.

Applicable only for IEEE-488: If a non-addressed M-command is used together with addressable ADDATs, the M-command only sets the SRQ-mask in IBIG50.

5.15. Special commands

The commands described here are provided only for communication between an ADDAT and particular interface converters. They should NOT be used for general software development.

These commands are accepted without a checksum in any case.

5.15.1. Special command: Set SRQ mask

Syntax	Answer-String	Function	Remark
~Mn i.e. ~M4	"E0"	Sets SRQ mark	ADDAT is in standard mode
	"#n E0"	No Function	ADDAT is in addressable mode

The function depends on whether the ADDAT is in addressable or standard mode:

If the ADDAT is in standard mode, the "~Mn" command sets the SRQ mask in register ">KQM" (to ensure compatibility with Probus IV in IEEE-488).

If the ADDAT is in addressable mode, only the "E0" answer string is sent back. The SRQ mask will not be changed.

The original M-command only sets the IBIG50 SRQ-Mask which will process the M-command.

5.15.2. Special command Query Data

Syntax	Answer-String	Function
~T2	"Datastring" or "E1"	Triggers ADDAT to send a probably pending answer string.

If the IBIG50 is addressed as a talker, it sends "~T2" to the ADDAT to query data.

In the current firmware revision, the ADDAT does not store any pending data and sends back the error code "E1" (no data available).

5.15.3. Special command Trigger-on-Talk

Syntax	Answer-String	Function	Remark
~T1	i.e.: "1.2345E01VN"	Queries data depending of setting of register ">KN" or N command.	ADDAT ist im Standard Modus
	"#n E11"	Command not allowed	ADDAT ist im adressierbaren Modus

The IBIG50 sends this command in Probus IV compatibility mode1 to the ADDAT to query data.

The ADDAT returns the preselected value (see register ">KN" and N command).

6. Error codes

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	Description	Possible reason
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. set value 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 was too long during calibration
E16	Wrong checksum	Checksum over command string was not correct, refer also to 0.

7. Technical Data

Command processing time:

<1ms, typ. 300-600us

(from terminator of command string to first character of the answer string)

Supported baud rates:

4800Bd, 9600Bd, 19200Bd, 38400Bd, 115kBd

230kBd, 500kBd, 625kBd

Resolution of set values:

Normal operation: 16Bit + sign

in high resolution mode: 22Bit + sign (PWM bit interpolation)

TC of set values: <10ppm/K, typ. 2-3ppm/K

Jitter of ramp function:

<1ms

Effective resolution of monitors:

Effective number of bits, ENOB:

14 - 20Bit + sign, depending on integration time and data of the power supply

TC of monitors: <10ppm/K, typ. 2-3ppm/K