

Operating Instructions

Communication Module for Nabertherm Series 400/500 Controllers

Communication to superordinate systems via Modbus TCP

M03.0021 ENGLISCH

Original instructions

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■ in
■ Germany

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1 Introduction

As an option, series 400/500 controllers have an Ethernet interface which, in addition to using the VCD software, can also be used to connect to superordinate systems via a Modbus TCP protocol.

These instructions describe the steps required to access the data. Please also observe the instructions and information in your controller manual.



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2 Warranty and Liability



As regards warranty and liability, the normal Nabertherm warranty terms apply, unless individual terms and conditions have been agreed. However, the following conditions also apply:

Warranty and liability claims for personal injury or damage to property shall be excluded if they are attributable to one or more of the following causes:

- All persons involved in operation, installation, maintenance, or repair of the furnace must have read and understood the operating instructions. No liability will be accepted for damage or disruption to operation resulting from non-compliance with the operating instructions.
- Not using the furnace as intended
- Improper installation, start-up, operation, or maintenance of the furnace,
- Operation of the furnace with defective safety equipment or improperly installed or non-functioning safety and protective equipment
- Not observing the information in the operating instructions with respect to transportation, storage, installation, start-up, operation, maintenance, or equipping the furnace
- Making unauthorized changes to the furnace
- Making unauthorized changes to the operating parameters
- Making unauthorized changes to the parameterization, the settings, or the program
- Nabertherm accepts absolutely no liability for damage caused by using parts that are not original Nabertherm parts. Original parts and accessories are designed especially for Nabertherm furnaces. Replace parts only with original Nabertherm parts. Otherwise the warranty will be void.
- Catastrophes due to third-party causes and force majeure
- Errors in the controller cannot be ruled out. Nabertherm does not assume any liability for the absence of errors in the controller. The responsibility for the appropriate selection and the results of using the controller as well as the intended or achieved results is born by the purchaser. No liability is accepted for any loss of data. Furthermore, absolutely no liability is assumed for any damage caused by other inadequate controller performance. Nabertherm never accepts liability for any damages from lost profits, production down-times, data loss, for damages to hardware

or other damages, no matter what the type, which result from using this controller even if Nabertherm or the retailer was made aware of or informed of the possibility of said damage, as long as this is legally permissible.

3 General

Before working on electrical systems, switch the power switch to "0" and disconnect the power cord.

Even with the power switch off, some parts in the furnace may carry voltage.

Work on the electrical system may only be done by a trained person.

The furnace and switching system have been preset by Nabertherm. If required, process-specific optimization must be carried out in order to achieve the best possible control behavior.

The temperature curve must be modified by the user so that the load, furnace or surroundings are not damaged. Nabertherm GmbH assumes no guarantee for the process.



Caution

Before working on the program-controlled grounding receptacle, the connector (optional series L, HTC, N, LH), or the connected device, always turn off the furnace and disconnect the power cord.

Read the operating instructions for the controller carefully to avoid mistakes or malfunctions in the operation of the controller or the furnace.

3.1 Defined Application

The communication module is used only to read and write the described functions and/or addresses. To access data, especially data to control the controller, customers must implement a security concept to prevent unauthorized access to the data.

The communication module may not be modified or converted. It may also not be used to implement security functions.



Note

The applications and processes described in these instructions are exclusively application examples. The responsibility for the selection of suitable processes and the individual application purpose is the responsibility of the operation.

Nabertherm assumes no warranty for the results of processes described in these instructions.

All the applications and processes described are based only on the experience and knowledge of Nabertherm GmbH.

3.2 Symbols Used in this Manual

In these instructions, explanations about how to operate Series 400/500 controllers are supported by symbols. The following symbols are used:



Press the jog dial to select a parameter for adjustment or to confirm the set value.



Turning and pressing the jog dial. Turning changes a selected value or allows you to select a menu item. Press the jog dial to select a parameter for adjustment or to confirm the set value.



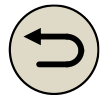
Turning the jog dial. Turning changes a selected value or allows you to select a menu item.



"START" on the jog dial. Starts or stops a heating program. Holding down the button longer stops the heating program.



The MENU operating button. Menu level selection



"BACK" on the jog dial. One menu level up.
Press and hold this button to return directly to the main overview (from V1.06)

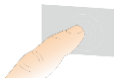


The "INFO" jog dial. Selection of the info-menu.
Press and hold this button in the main overview to go directly to user logon.



Symbol for the user lever that is necessary for operating (Operator, Supervisor oder Admin)

In these instructions, explanations about how to operate Series 500 controllers are supported by symbols. The following symbols are used:



Press the touch panel to select a menu, a parameter to make settings, to change values and to confirm set values. The touch panel is capacitive and cannot be operated with work or safety gloves.



“Settings” is used to access the controller settings.



Icon for the user level required for operation (operator, supervisor or administrator)

4 Safety

The controller has a series of electronic monitoring functions. If a malfunction occurs, the furnace automatically shuts down and an error message appears in the LC display.



Caution

Without additional safety system, this controller is not approved for the monitoring or control of safety-relevant functions.

If the failure of furnace components presents a danger, additional qualified protective measures are necessary.



Note

For more information, please see Chapter "Faults - fault messages"



Note

The behavior of the controller after a grid power outage has been preset as a default setting.

If the grid power outage is shorter than approx. 2 minutes, a running program is continued, otherwise the program is aborted.

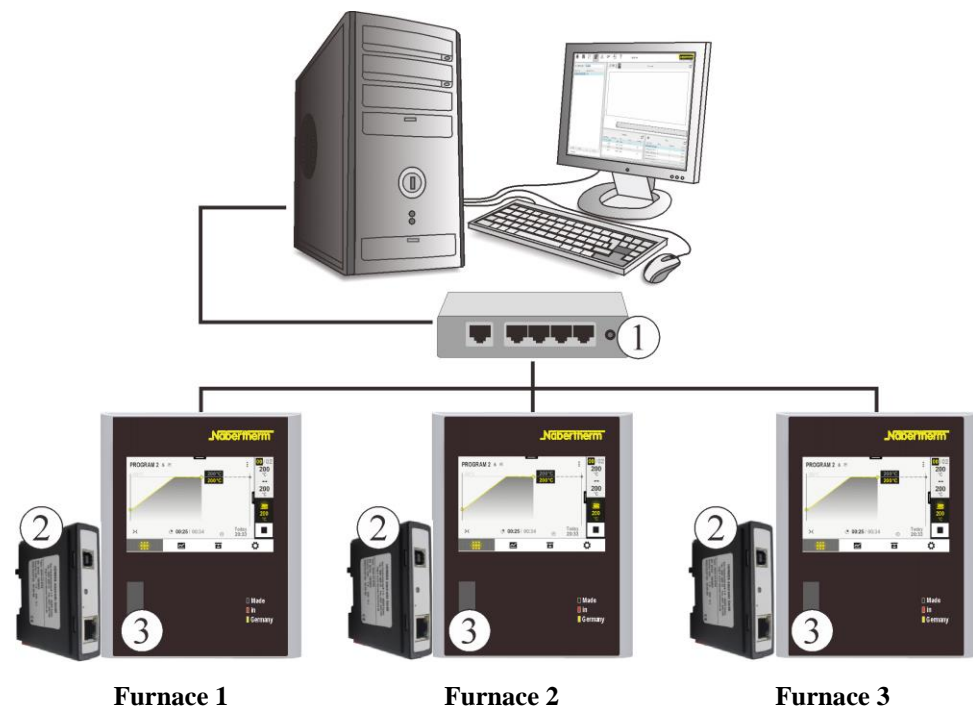
If this setting is not suitable for your process, this setting can, as a rule, be adapted to your process (see the section "Setting the Behavior after Power Outage").



Warning! General Hazards!

The Operating Instructions must be followed prior to switching on the furnace.

5 Setup of Series 400/500 Controllers with Communication Module



No.	Name	Comment
1	Ethernet switch	For more than one furnace or connection >50 m


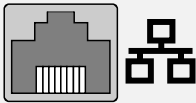
No.	Name	Comment
2	Communication module	Connections >50 m must be supported with a booster (e.g., switch). Depending on conditions at the installation location and the cables used, it may be necessary to use a switch or repeater even for shorter distances.
3	Controller	Series 400/500

5.1 Supported Controllers

Controller model	from software version
B500, C540, P570	1.13
B510, C550, P580	1.06
B400, B410, C440, C450 P470, P480	1.51

6 Configuring the Interface (Ethernet)

The Ethernet communication module offers two modes for accessing controller data:

1. VCD software	
	Recording and controlling with the Nabertherm process data software VCD .
2. Superordinate system	
	Controlling and reading data via the Modbus TCP protocol.

Both modes can be used simultaneously.

The Ethernet interface requires additional settings in the controller so that it can be connected to a network.

These are:

Required settings if an Ethernet interface is used	Explanation
DHCP	Parameter for address assignment
IP address	Address of the Ethernet interface. Network subscribers may not use the same IP address. The first 3 numbers must correspond for communication within a network.
Subnet mask	Mask for describing the address space
DNS server	Server address for name resolution

Required settings if an Ethernet interface is used	Explanation
Host name	Default setting: [N+serial number] 8 characters must be entered. All entries must be in Latin characters or numbers.
Communication port	Port 2905 (VCD) Port 502 (superordinate system)
















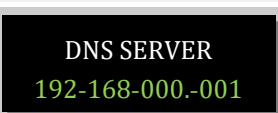
Note



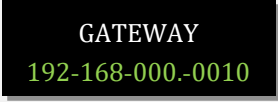

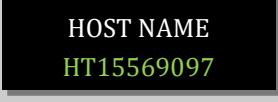

Ask your network administrator for the settings for the use case.

This interface cannot be used in connection with IPv6. Connecting the controller to an existing network without having any knowledge about the network can cause malfunctions in the network.

6.1 Series 400 Controller



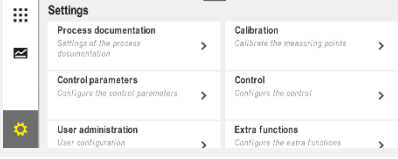

The following steps must be performed to set these parameters:


Setting the data interface (USB/Ethernet)			 ADMIN
Procedure	Operation	Display	Comments
Select the menu level and turn to select the function [SETTINGS]	 		
Select the menu [SYSTEM] and then [DATA INTERFACES]			
Select [DHCP] and then the address assignment mode			DHCP = Yes: The address of the controller is provided via the customer's DHCP server DHCP = No: The address is entered manually
Select [IP ADDRESS] and enter the IP address		 192-168-004.-070 (Example)	If you are unsure, ask your IT department about a network connection.
Select [SUBNET MASK] and enter		 255-255-255-000 (Example)	If you are unsure, ask your IT department about a network connection.
Select [DNS SERVER] and enter the DNS server IP address		 192-168-000.-001 (Example)	If you are unsure, ask your IT department about a network connection.

Setting the data interface (USB/Ethernet)			 ADMIN
Procedure	Operation	Display	Comments
Select [GATEWAY] and enter your gateway		 <p>(Example)</p>	If you are unsure, ask your IT department about a network connection.
Enter [HOST NAME]		 <p>(Example)</p>	<p>If you are unsure, ask your IT department about the host name. 8 characters must always be entered. This name is also used for the data folder on a USB flash drive.</p> <p>Note: Names can be entered only with Latin letters and numbers.</p>
Changes do not have to be saved.			Press the [Back] icon to go back to the overview.

6.2 Series 500 Controller

The following steps must be performed to set these parameters:

Set the data interface (USB/Ethernet)			 ADMINISTRATOR
Procedure	Operation	Display	Comments
Select the [Settings] menu			
Select [SYSTEM] and then [INTERFACES]			
Select [DHCP] and the address assignment mode			<p>DHCP = Yes: The address of the controller is provided via the customer's DHCP server</p> <p>DHCP = No: The address is entered manually</p>
Select [IP ADDRESS] and enter the IP address			If you are unsure, ask your IT department about network integration.
Select [SUBNET MASK] and enter it			If you are unsure, ask your IT department about network integration.
Select [GATEWAY] and enter it			If you are unsure, ask your IT department about network integration.

Set the data interface (USB/Ethernet)			 ADMINISTRATOR
Procedure	Operation	Display	Comments
Select [DNS SERVER] and enter it			If you are unsure, ask your IT department about network integration.
Enter [HOST NAME]			If you are unsure, ask your IT department about the host name. 8 characters must always be entered. This name is also used for the data folder on a USB flash drive. Please note: Names can be entered only with Latin letters.
Save data			Data is saved automatically when it is entered.

6.3 Configuration Examples

Example configuration with DHCP server (only with DHCP server in the network)

DHCP	Yes (with assigned IP address)
IP address	-
Subnet mask	-
DNS server	-
Host name	Default setting: [N+serial number] 8 characters must be entered. All entries must be in Latin characters or numbers.



Note

Configure the DHCP server so that it always allocates the same IP addresses to the controllers. If a controller changes its IP address, it can no longer be found by the VCD software.

Sample Configuration with Fixed IP Address (for example, in small networks)

DHCP	No
IP address	192.168.4.1 (PC with VCD software) 192.168.4.70 (furnace 1) 192.168.4.71 (furnace 2) 192.168.4.72 (furnace 3) ...
Subnet mask	255.255.255.0
DNS server	0.0.0.0 (no DNS server) or 192.168.0.1 (example)

DHCP	No
Host name	Default setting: [N+serial number] The name is user-defined (Latin characters). 8 characters must be entered. All entries must be in Latin characters or numbers.

An active connection is shown on the controller by the “PC Communication” symbol. See the operating instructions for the controller.

7 Controller Datapoints

A superordinate system accesses process data in the controller via the optional communication module (Ethernet).

Note: Simultaneous operation with a superordinate system and the VCD process documentation is possible.

Interface	Ethernet, 10/100Mbaud
Protocol	Modbus/TCP
Port	502

When connecting the superordinate system, pay attention to system-specific settings for communication via Modbus TCP. You will find these in the operating instructions from the respective manufacturer. Examples for connection are described below.



Note

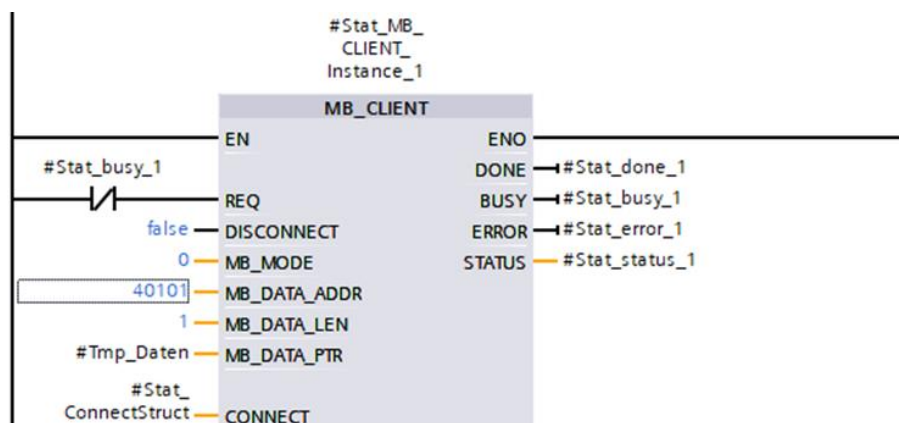
All the examples described here are intended as help for the customer to establish a connection. Check the software when using it and modify it to suit the requirements of the application. We accept no liability for the examples shown here or for the application examples that are provided.



Note

If a data connection is interrupted before it has been closed, there is a 1-minute timeout before you can log on the controller again. Only then can a new data connection be started.

Calling the Modbus TCP module:



The data is written in “#Tmp_Data”; several consecutive registers can be read via “MB_DATA_LEN”. “MB_DATA_ADDR” is the address. “MB_MODE” defines read or write.

This system requires an offset of [40001], as the controller works with “holding” registers. Accordingly, the actual value (control zone) of the controller (address 100) is the address 40101.

MB_MODE	MB_DATA_ADDR	MB_DATA_LEN	Modbus function	Function and data type
0	1 to 9,999	1 to 2,000	01	Read 1 to 2,000 output bits on the remote address 0 to 9,998
0	10,001 to 19,999	1 to 2,000	02	Read 1 to 2,000 input bits on the remote address 0 to 9,998
0	40,001 to 49,999 400,001 to 465,535	1 to 125	03	Read 1 to 125 holding registers on the remote address 0 to 9,998 Read 1 to 125 holding registers on the remote address 0 to 65,534
0	1 to 9,999	1 to 125	04	Read 1 to 125 input words on the remote address 0 to 9,998
1	10,001 to 19,999	1	05	Read 1 output bit on the remote address 0 to 9,998
1	40,001 to 49,999 400,001 to 465,535	1	06	Write 1 holding register on the remote address 0 to 9,998 Write 1 holding register on the remote address 0 to 65,534

7.2 Example 2: Connection with a Eurotherm 61xx Recorder

For data exchange with a Eurotherm 61xx recorder, the recorder must have an Ethernet interface (Modbus Master).

A configuration example is described below. This must be adjusted depending on the measuring point and unit:

Channel configuration:

Parameter	Value
Channel Number	1) i.e. Master actual value
Value	-
Input Type	Master Comms
Scale Type	Linear
Scale Division - Major	10
Scale Division - Minor	1
Slave	i.e. 3) P470
Digital	-
Function Code	Read holding reg (3)
Register	i.e. 100
Data Type	Integer (16 Bit)
Scaling	Decimal Places
Decimal Places	1
Process Value	Medium Priority
Pv Format	Numeric
Span Low	0 °C
Span High	i.e. 1000 °C
Zone Low	0 %
Zone High	100 %
Max Decimal Digits	1
Colour	i.e. 0 (red)
Units	°C
Descriptor	Master actual value
Alarm Number	1
Enable	off
Job Number	1
Category	No Action

Configuration of the master-comm interface:

Parameter	Value
High Priority Interval	0,125 Seconds
Medium Priority Interval	i.e. 1 Seconds

Parameter	Value
Low Priority Interval	2 Seconds
Store Diagnostics	-
Slave	i.e. 3) P470
Enable	✓
Online	✓
Descriptor	i.e. P470
Network	Ethernet
IP Address	i.e. 192.168.56.71
Modbus Address	i.e. 2
Profile	Third Party
Timeout	3000 ms
Retry	9
Max Block Size	124 Register
Share Socket	✓

7.3 Datapoints for Read Access

The datapoints are listed in the following table:

Datapoint	Data type	Register type	Slave register (address) decimal	Read	Write	Min	Max	Comment
Active actual value (control zone)	Int16	holding	100	x		-	-	[°C/°F], in tenths of a degree
Temperature of charge zone	Int16	holding	101	x		-	-	[°C/°F], in tenths of a degree
Temperature of cooling zone	Int16	holding	102	x		-	-	[°C/°F], in tenths of a degree
Temperature of zone 1	Int16	holding	103	x		-	-	[°C/°F], in tenths of a degree
Temperature of zone 2	Int16	holding	104	x		-	-	[°C/°F], in tenths of a degree
Temperature of zone 3	Int16	holding	105	x		-	-	[°C/°F], in tenths of a degree
Temperature of zone 4	Int16	holding	106	x		-	-	[°C/°F], in tenths of a degree
Temperature of doc. zone 1	Int16	holding	107	x		-	-	[°C/°F], in tenths of a degree
Temperature of doc. zone 2	Int16	holding	108	x		-	-	[°C/°F], in tenths of a degree
Temperature of doc. zone 3	Int16	holding	109	x		-	-	[°C/°F], in tenths of a degree

Datapoint	Data type	Register type	Slave register (address) decimal	Read	Write	Min	Max	Comment
Temperature of doc. zone 4	Int16	holding	110	x		-	-	[°C/°F], in tenths of a degree
Program setpoint	Int16	holding	111	x		-	-	[°C/°F], in tenths of a degree
Spare	Int16	holding	112	x		-	-	[°C/°F], in tenths of a degree
Charge setpoint	Int16	holding	113	x		-	-	[°C/°F], in tenths of a degree
Cooling TC setpoint	Int16	holding	114	x		-	-	[°C/°F], in tenths of a degree
Setpoint of zone 1	Int16	holding	115	x		-	-	[°C/°F], in tenths of a degree
Setpoint of zone 2	Int16	holding	116	x		-	-	[°C/°F], in tenths of a degree
Setpoint of zone 3	Int16	holding	117	x		-	-	[°C/°F], in tenths of a degree
Setpoint of zone 4	Int16	holding	118	x		-	-	[°C/°F], in tenths of a degree
Control zone output	uint16	holding	119	x		-	-	[%], in tenths of a percent
Cooling power	uint16	holding	120	x		-	-	[%], in tenths of a percent
Power of zone 1	uint16	holding	121	x		-	-	[%], in tenths of a percent
Power zone 2	uint16	holding	122	x		-	-	[%], in tenths of a percent
Power zone 3	uint16	holding	123	x		-	-	[%], in tenths of a percent
Power zone 4	uint16	holding	124	x		-	-	[%], in tenths of a percent
Status	uint16	holding	125	x		-	-	0=Off, 1=Wait, 2=Run, 3=Pause, 4=End, 5=Auto-tune, 6=Error, 7=External setpoint operation
Program no.	uint16	holding	126	x		-	-	-
Segment no.	uint16	holding	127	x		-	-	1-39
Remaining time of the program	Uint32	holding	128+129	x		-	-	32Bit, 128=Low Word, 129=High Word
Extra relay	uint16	holding	130	x		-	-	Bit array
Alarm 1 Status	uint16	holding	131	x		-	-	-
Alarm 2 Status	uint16	holding	132	x		-	-	-
Warnings	Uint32	holding	133+134	x		-	-	Bit array, 32Bit, 133=Low Word, 134=High Word
Current malfunction	uint16	holding	135	x		-	-	-
Controller type	uint16	holding	136	x		-	-	0=B400, 1=B410, 2=C440, 3=C450, 4=P470, 5=P480, 6=B500, 7=B510, 8=C540, 9=C550, 10=P570, 11=P580

Datapoint	Data type	Register type	Slave register (address) decimal	Read	Write	Min	Max	Comment
Maximum temperature	Int16	holding	137	x		-	-	[°C/], in tenths of a degree
Serial number	uint16	holding	138-147	x		-	-	ASCII String
Temperature Unit	uint16	holding	151	x		-	-	0=°C, 1=°F
Program transferred completely	uint16	holding	404	x		-	-	0=program transfer not completed 1=program transfer completed Refer also to Section 7.7



Note

“Active current value” is a variable value with different sources that represents the controlling temperature value. This also corresponds to the large temperature value on the main overview page of the controller.

For example, with active charge control, the “active current value” changes from the zone 1 measuring point to the temperature of the charge measuring point.



Note

With controller versions > 2.0, the status (register 125) assumes the value “0” (Off) or “4” (End) after the end of the program. The status “4” is output if extra functions were activated in the program that remain active after the end of the program.

8 Datapoints for Write Access: Program Start and Segment Jump

The program start can be used for a previously transferred program or for a program that is preset on the controller. Also refer to the following section.

The datapoints are listed in the following table:

The Modbus function “MULTIPLE_REGISTER” is used to write.

Datapoint	Data type	Register type	Slave register (address) decimal	Read	Write	Min	Max	Comment
Controller command	uint16	holding	148		x	1	3	1=Start, 2=Stop, 3=Pause, after a program has been loaded
Select and load program number (command)	uint16	holding	149		x	1	50	-
Segment jump (command)	uint16	holding	150		x	-40	40	A jump forward/back by [number] segments is carried out

8.1 SampleProcess: Program Selection and Program Start

Selection and start of program number 2

Modbus address	Read	Write	Value	Controller behavior
125	X		0 or 4	Controller is ready to load a selected program.
149		X	0 → 2	Program number (here no. 2) is loaded
126	X		1..50 → 2	Program in cache is changed to "2"
148		X	0 → 1	Start program
125	X		0 → 2 or 4 → 2	Program running
148		X	1 → 0	Start command is reset
149		X	2 → 0	Reset program number
125	X		2 → 4 or 2 → 0	Program finished

8.2 Sample Process: Segment Jump

Example: In the active program, a hold time segment is repeated, since the furnace is loaded with a double charge.

Modbus address	Read	Write	Value	Controller behavior
125	X		2	Program is active
127	X		3	Segment 3 (hold time) is active
127	X		3 → 4	Controller changes from hold time to the next segment.
150		X	-1	Execute segment jump, one segment back
127	X		3	Controller is once again in segment 3
150		X	-1 → 0	Reset segment jump
...
125	X		2 → 4 or 2 → 0	Program finished

8.3 Datapoints for Write Access: Program Input

The data points for Series 500 controllers are summarized in the following table:

The "MULTIPLE_REGISTER" Modbus function is used to write.



Note

The time until the transferred program is acknowledged may vary depending on the size of the transferred program as well as the controller model.

If there is no response after max. 20 seconds, it can be assumed that the input is incorrect.

**Note**

The operator is responsible for the plausibility of the transferred values. There is no complete check as to whether the transferred data is correct.

Example: Segments with 0°C as the target temperature are invalid for the controller, but return the successful transfer of the program (= 1).

During program transfer, the parameter checks the following among other things:

1. Correct transfer of the sent data
2. No invalid program flags set
3. The number of segments correspond to the controller type

**Note**

Once a program that was written and transferred via Modbus has ended, the program data must be transferred again before a new (or the same) program is started.

**Please note:**

Active and past segments may not be changed. Otherwise, this may result in implausible processes.

**Note**

To set extra functions in the end segment of the program, which remain active once the program has finished, remember the following:

- The chosen number of segments is filled as described below
- The next segment number that is no longer captured by address 402 is filled exclusively with extra functions – no temperatures, rates, flags, etc. may be set.
- If a program has 39 segments, extra functions that are to be active once the program has finished, are set in address 319 (analogous to addresses 280 – 318).

Datapoint	Data type	Register type	Slave register (address) decimal	Read	Write	Min	Max	Comment
Target temperature segment 1	uint16	holding	200	X	X	0	Max. furnace temperature	[°C/°F], in degrees
Target temperature segment 2	uint16	holding	201	X	X	0	Max. furnace temperature	[°C/°F], in degrees
...
Target temperature segment 39	uint16	holding	238	X	X	0	Max. furnace temperature	[°C/°F], in degrees
Time / rate segment 1	uint16	holding	240	X	X	0	29999 / 9999	[Min] or [°C/h] Pay attention to address 360.
Time / rate segment 2	uint16	holding	241	X	X	0	29999 / 9999	[Min] or [°C/h] Pay attention to address 361.
...

Datapoint	Data type	Register type	Slave register (address) decimal	Read	Write	Min	Max	Comment
Time / rate segment 36	uint16	holding	278	X	X	0	29999 / 9999	[Min] or [°C/h] Pay attention to address 399.
Extra function segment 1	uint16	holding	280	X	X	0000 0000 0000 0000	0000 0000 0011 1111	16-bit array
Extra functions segment 2	uint16	holding	281	X	X	0000 0000 0000 0000	0000 0000 0011 1111	16-bit array
...
Extra functions segment 39	uint16	holding	318	X	X	0000 0000 0000 0000	0000 0000 0011 1111	16-bit array
Holdback value segment 1	uint16	holding	320	X	X	0	99	[°C/°F], in degrees (manual holdback) or tenths of a degree (extended holdback)
Holdback value segment 2	uint16	holding	321	X	X	0	99	[°C/°F], in degrees (manual holdback) or tenths of a degree (extended holdback)
...
Holdback value segment 39	uint16	holding	358	X	X	0	99	[°C/°F], in degrees (manual holdback) or tenths of a degree (extended holdback)
Flags segment 1	uint16	holding	360	X	X	0000 0000 0000 0000	0000 0000 0000 0011	16-bit array Bit 0=activate controlled cooling Bit 1=use rate instead of time
Flags segment 2	uint16	holding	361	X	X			16-bit array Bit 0=activate controlled cooling Bit 1=use rate instead of time
...
Flags segment 39	uint16	holding	398	X	X			16-bit array Bit 0=activate controlled cooling Bit 1=use rate instead of time
Start temperature	uint16	holding	400	X	X	0	Max. furnace temperature	[°C/°F], in degrees

Datapoint	Data type	Register type	Slave register (address) decimal	Read	Write	Min	Max	Comment
Program flags	uint16	holding	401	X	X	0000 0000 0000 0000	0000 0000 0001 1111	16-bit array Bit 0=repeat once program has finished Bit 1=transfer temperatures in °F Bit 2=manual holdback active Bit 3=charge control active Bits 2+4=extended holdback active
Number of segments	uint16	holding	402	X	X	1	40	Maximum number of segments depends on controller type.
Release write command	uint16	holding	403	X	X	0	1	0=no release, 1=release

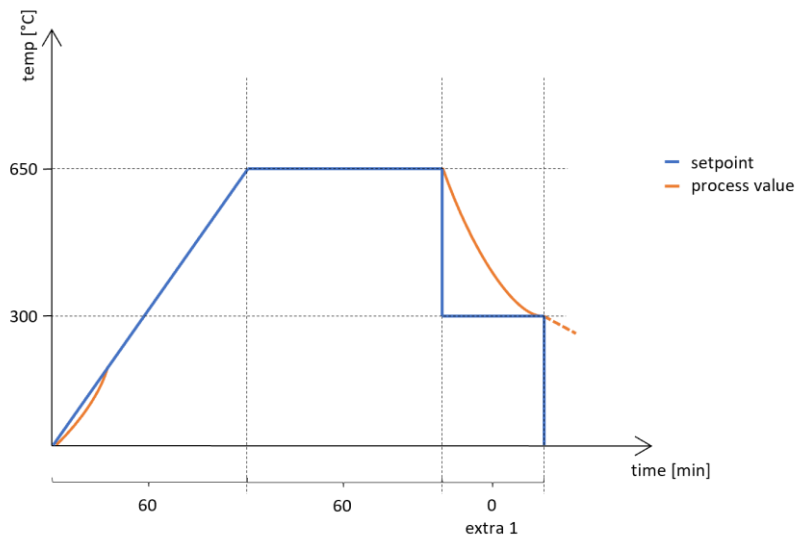
8.3.1 Sample Process: Program Transfer (Simple)

Program with:

- Ramp
- Hold time
- Cooling segment with extra function

Modbus address	Read	Write	Value	Controller behavior
125	X		0 or 4	Controller is ready to receive a program.
125	X		0 or 4	Controller is ready to receive a program.
137	X		8500	Maximum temperature of the furnace in tenths of a degree
151	X		0	Temperature unit = °C
402		X	0 → 3	Set number of segments to 3
200		X	0 → 650	Set target temperature of the first segment to 650°C.
240		X	0 → 60	Heat to target temperature 1 in 60 min (standard = length of time)
320		X	0	No holdback values, since no holdback is used
201		X	0 → 650	Set target temperature of the second segment to 650°C → hold time
241		X	0 → 60	Hold target temperature 2 for 60 min
202		X	0 → 300	Cool to target temperature 3
242		X	0	Cool as fast as possible

Modbus address	Read	Write	Value	Controller behavior
282		X	0000 0000 0000 0000 → 0000 0000 0000 0001	Activate extra function 1 while cooling to target temperature 3
403		X	0 → 1	Write access is enabled
404	X		0 → 1	Program transferred completely. The process may take a few seconds.
403		X	1 → 0	Write access is reset
148		X	0 → 1	Start the program
125	X		0 → 2 or 4 → 2	Program running
126	X		51	Modbus TCP program is running
148		X	1 → 0	Start command is reset
125	X		2 → 4 or 2 → 0	Program finished



8.4 Sample Process: Program Transfer (Complex)

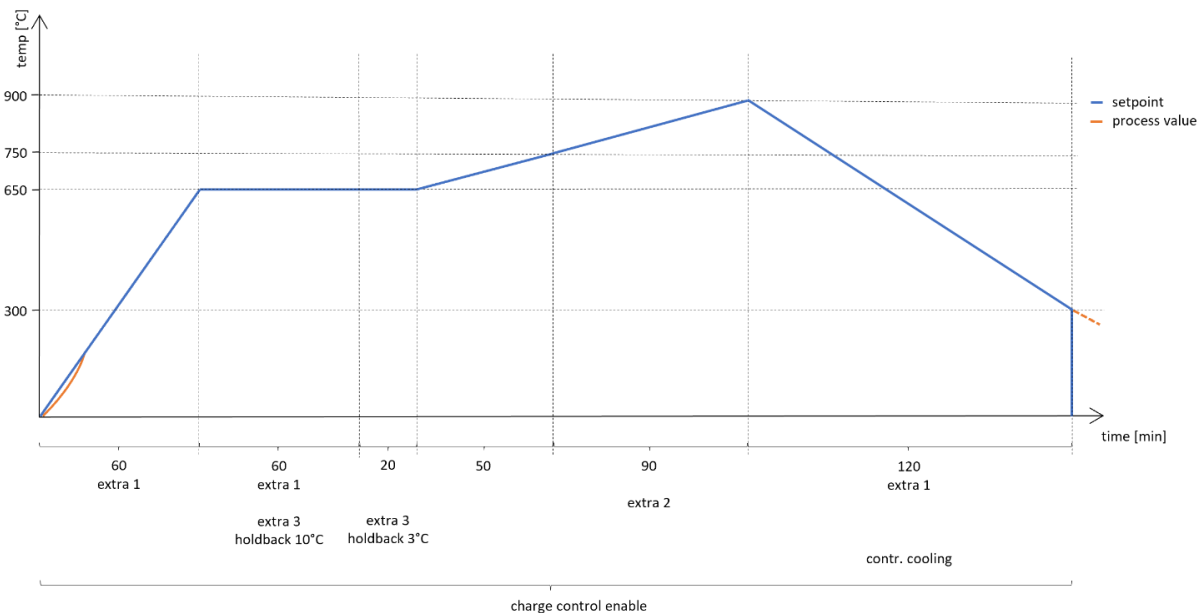
Program with:

- different ramps
- a hold time
- active charge control
- controlled cooling
- different extra functions
- manual holdback

Modbus address	Read	Write	Value	Controller behavior
125	X		0 or 4	Controller is ready to receive a program.

Modbus address	Read	Write	Value	Controller behavior
137	X		9000	Maximum temperature of the furnace in tenths of a degree
151	X		0	Temperature unit = °C
401		X	0000 0000 0000 0000 → 0000 0000 0000 1100	Charge control and manual holdback active
402		X	0 → 6	Set number of segments to 6
200		X	0 → 650	Set target temperature of the first segment to 650°C.
240		X	0 → 650	Heat to target temperature 1 at 650°C/h
280		X	0000 0000 0000 0000 → 0000 0000 0000 0001	Extra function 1 activated in segment 1
360		X	0000 0000 0000 0000 → 0000 0000 0000 0010	Use rate instead of time
201		X	0 → 650	Set target temperature of the second segment to 650°C → hold time
241		X	0 → 60	Hold target temperature 2 for 60 min
281		X	0000 0000 0000 0000 → 0000 0000 0000 0101	Extra functions 1 and 3 activated in segment 2
321		X	0 → 10	Holdback band in which the hold time elapses
202		X	0 → 650	Set target temperature of the third segment to 650°C → hold time
242		X	0 → 20	Hold target temperature 3 for 20 min
282		X	0000 0000 0000 0000 → 0000 0000 0000 0100	Extra function 3 activated in segment 3
322		X	0 → 3	Holdback band in which the hold time elapses
203		X	0 → 750	Set target temperature of the fourth segment to 750°C
243		X	0 → 50	Heat up within 50 min
204		X	0 → 900	Set target temperature of the fifth segment to 900°C
244		X	0 → 100	Heat to target temperature 5 at 100°C/h
284		X	0000 0000 0000 0000 → 0000 0000 0000 0010	Extra function 2 activated in segment 5
364		X	0000 0000 0000 0000 → 0000 0000 0000 0010	Use rate instead of time

Modbus address	Read	Write	Value	Controller behavior
205		X	0 → 300	Set target temperature of the sixth segment to 300°C
245		X	0 → 300	Cool to target temperature 6 at 300°C/h
285		X	0000 0000 0000 0000 → 0000 0000 0000 0001	Extra function 1 activated in segment 6
365		X	0000 0000 0000 0000 → 0000 0000 0000 0011	Use rate instead of time Activate controlled cooling
403		X	0 → 1	Write access is enabled
404	X		0 → 1	Program transferred completely. The process may take a few seconds.
403		X	1 → 0	Write access is reset
148		X	0 → 1	Start the program
125	X		0 → 2 or 4 → 2	Program running
126	X		51	Modbus TCP program is running
148		X	1 → 0	Start command is reset
125	X		2 → 4 or 2 → 0	Program finished



8.5 Sample Process: Change Active Program

The program from the “Program transfer (simple)” example run has been started. The furnace should hold the temperature for longer, since, for this example, more charge than usual is being processed.

Modbus address	Read	Write	Value	Controller behavior
125	X		2	Program is active
127	X		1	Segment 1 is active – segment 2 may still be changed.
241		X	60 → 70	Change the duration of the hold time in segment 2 from 60 min to 70 min.
241		X	60 → 70	Change the duration of the hold time in segment 2 from 60 min to 70 min.
403		X	0 → 1	Write access is enabled
404	X		0 → 1	Program transferred completely. The process may take a few seconds.
403		X	1 → 0	Write access is reset
125	X		2 → 4 or 2 → 0	Program finished



Please note:

Active and past segments may not be changed. Otherwise, this may result in implausible processes.

8.6 Datapoints for Setpoint Control

The controller can also be operated with external setpoint control. In this case, a superordinate system continuously specifies a setpoint for the controller. The necessary datapoints are summarized in the table below:

The Modbus function “MULTIPLE_REGISTER” is used to write.

Datapoint	Data type	Register type	Slave register (address) decimal	Read	Write	Min	Max	Comment
Ext. setpoint control Release	uint16	holding	405	X	X	-	-	0=Stop, 1=Start
External program setpoint	uint16	holding	406	X	X	0	Max. furnace temperature	[°C/°F], in degrees
External release of controlled cooling	uint16	holding	407	X	X	-	-	0=no release, 1=release
External release for charge control	uint16	holding	408	X	X	-	-	0=no release, 1=release
External extra relays	uint16	holding	409	X	X	0000 0000 0000 0000	0000 0000 0011 1111	16-bit array
Status	uint16	holding	125	X				0=Off, 1=Wait, 2=Run, 3=Pause, 4=End, 5= Auto-tune, 6=Error, 7=External setpoint control

Note: The controller does not take over setpoints that were changed during a power outage when power is restored. Setpoint control can be changed only when communication is

active. If the program is actively stopped, the setpoint is changed, or other changes are made, you must check or read back whether the change was implemented.

The “External setpoint control” function requires the following firmware versions:

B400, C440, P470 controller	from V1.51
B500, C540, P570 controller	from V1.13
B510, C550, P580 controller	from V1.06
Communication module:	from V1.8
Power module:	independent
Simultaneous use of the <u>VCD software</u> :	from V1.63

The “program transfer” function is possible only with the P-Controller and requires the following firmware versions:

Communication module:	from V1.14
Operating unit:	from V1.79

If the controller is remotely controlled via Modbus TCP, the extra functions in the program are activated and the manual functions (manual activation of the extra function) are deactivated. If an extra function that is deactivated in the controller is reset, the controller sets this function back to *Auto*.

Control of functions that are not available in the furnace is not permissible and can have unforeseeable effects. Therefore, check in advance that the correct signals are being used and check the furnace equipment.

Use controlled cooling so that the cooling time and rate are specified (generated) by the superordinate system. During controlled cooling, the extra function “exhaust air flap” must always be set, otherwise cooling would be delayed.

Note: The controller only checks the setpoint of the superordinate system with regard to exceeding the maximum furnace temperature. Therefore, read back to check for plausibility.



Note

With Series 500 controllers, remember that if a communication module has firmware 1.8, the hostname of the controller must be shortened by two digits (compared to the status on delivery).

For communication modules with firmware 1.9 or higher, you can choose any hostname.

Example: Shorten hostname “N22080075L1” to “N22080075”

Refer to the controller operating manual for how to change the hostname.

8.7 Description of the External Setpoint Control Process

8.8 Example of Process: Heating

Requirements for this example: The furnace is idle. Control voltage is switched on, no program is running and external setpoint mode is not yet activated.

Modbus address	Read	Write	Value	Controller behavior
125	X		0 or 4	Controller is ready to change to external setpoint operation
137	X		8500	Maximum temperature of the furnace in tenths of a degree
151	X		0	Temperature unit = °C
406		X	0 → 650	Target temperature of the controller is changed to 650 °C
408		X	0 → 1	Control is via the “Charge” measuring point (optional accessory)
409		X	0000 0000 0000 0000 → 0000 0000 0000 0010	Activate extra function 2
405		X	0 → 1	External setpoint control is started. Start only when all other variables have been defined.
100	X		0...6500 (≅ 0.0-650.0 °C)	Read / document the actual temperature (control zone)
101	X		0...6500 (≅ 0.0-650.0 °C)	Read / document the actual temperature of the “Charge” measuring point
111	X		6500 (≅ 650.0°C)	Read / document the target temperature of the controller
125	X		7	External setpoint operation is active
133	X		0	Read / document occurring warnings (low bit)
134	X		0	Read / document occurring warnings (high bit)
135	X		0	Read / document occurring malfunctions
405		X	1 → 0	External setpoint control is terminated
125	X		7 → 0	Operation terminated

8.9 Example of Process: Controlled Cooling

Requirements for this example: The furnace has been heated to 650 °C and is to be cooled to 450 °C at a rate of 1 °C/h. External setpoint control is active.

Modbus address	Read	Write	Value	Controller behavior
125	X		7	External setpoint operation is active
137	X		8500	Maximum temperature of the furnace in tenths of a degree
151	X		0	Temperature unit = °C
407		X	1	Release “controlled cooling”
406		X	650 → 450 At 1°C/h	Target temperature of the controller is adjusted to 450 °C. The temperature must be reduced in steps (e.g., 1°C/min)

Modbus address	Read	Write	Value	Controller behavior
409		X	0000 0000 0000 0000 → 0000 0000 0000 0001	Activate extra function 1 or associated extra function for "Open exhaust air flap"
100	X		6500...4500 (≅ 650.0-450.0°C)	Read / document the actual temperature inside the furnace
102	X		6500...4500 (≅ 650.0-450.0°C)	Read / document the actual temperature of the "Cooling" measuring point (if present)
111	X		6500 (≅ 650.0°C)	Read / document the target temperature of the controller
133	X		0	Read / document occurring warnings (low bit)
134	X		0	Read / document occurring warnings (high bit)
135	X		0	Read / document occurring malfunctions
405		X	1 → 0	External setpoint control is terminated
125	X		7 → 0	Operation terminated

8.10 Example of Process: Uncontrolled Cooling

Requirements for this example: the furnace has been heated to 650 °C and is to be cooled to 450 °C with a set quantity of fresh air. External setpoint control is active. The setting of the "fresh air" potentiometer determines the volume of fresh air to be introduced.

Modbus address	Read	Write	Value	Controller behavior
125	X		7	External setpoint operation is active
137	X		8500	Maximum temperature of the furnace in tenths of a degree
151	X		0	Temperature unit = °C
407		X	0	No release of "controlled cooling"
406		X	650 → 450	Target temperature of the controller is adjusted to 450 °C.
409		X	0000 0000 0000 0000 → 0000 0000 0000 0101	Activate extra functions 1 and 3 or the associated extra functions for "exhaust air flap" and "fresh air"
100	X		6500...4500 (≅ 650.0-450.0°C)	Read / document the actual temperature (control zone)
102	X		6500...4500 (≅ 650.0-450.0°C)	Read / document the actual temperature of the "Cooling" measuring point (if present)
111	X		6500 (≅ 650.0°C)	Read / document the target temperature of the controller
133	X		0	Read / document occurring warnings (low bit)
134	X		0	Read / document occurring warnings (high bit)

Modbus address	Read	Write	Value	Controller behavior
135	X		0	Read / document occurring malfunctions
405		X	1 → 0	External setpoint control is terminated
125	X		7 → 0	Operation terminated

8.11 Malfunctions and Warnings

The warning and malfunction values are itemized below.

Warnings (ParaID 161) are transferred in a 32Bit array to the Modbus TCP addresses 133 (low word) and 134 (high word).

Example:

133: [0000 0000 0000 0000]

134: [0000 0000 0000 0000] = no warning

133: [0000 0000 0000 0100]

134: [0000 0000 0000 0000] = warning 4 = Charge sensor defective

Warnings		
Bit	Value	Description
0	1	Gradient monitoring
1	2	No control parameters
2	4	Charge sensor defective
3	8	Cooling sensor defective
4	16	Doc sensor defective
5	32	Restart after power outage
6	64	Alarm 1 band alarm
7	128	Alarm 1 Min
8	256	Alarm 1 Max
9	512	Alarm 2 band alarm
10	1024	Alarm 2 Min
11	2048	Alarm 2 Max
12	4096	Alarm 1 E1
13	8192	Alarm 1 E2
14	16384	Alarm 2 E1
15	32768	Alarm 2 E2
16	65536	No USB inserted
17	131072	Import failed

Malfunctions (ParaID 170) are transferred as integer values.

Example:

[0] = No malfunction

[513] = Thermocouple inside furnace defective

Current malfunction		
Integer value	ID+Sub-ID (malfunction in controller)	Text (malfunction in controller)
257	01-01	Bus zone
258	01-02	Bus communications module
513	02-01	TC open
514	02-02	TC Connection
515	02-03	Compare point error
516	02-04	Compare point too hot
517	02-05	Compare point too cold
518	02-06	Encoder separated
519	02-07	Sensor element defective
769	03-01	System memory
770	03-02	ADC error
771	03-03	File system defective
772	03-04	System monitoring
773	03-05	System monitoring zones
774	03-06	Self-test error
1025	04-01	No heater power
1026	04-02	Excess temperature
1027	04-03	Power failure
1028	04-04	Alarm
1029	04-05	Auto-tune failed

9 Nabertherm Service

The Nabertherm Service team is available at all times for furnace maintenance and repair.

If you have any questions, problems, or requirements, contact Nabertherm GmbH. By mail, phone, or the Internet.

Mail

Nabertherm GmbH
Bahnhofstrasse 20
28865 Lilienthal
Germany

Phone or fax


Phone: +49 (4298) 922-333
Fax: +49 (4298) 922-129

Web or e-mail

www.nabertherm.com
contact@nabertherm.de

When you contact us, please have the type plate details of the furnace or controller at hand.

Provide the following details from the type plate:

Nabertherm GmbH Bahnhofstr. 20, 28865 Lilienthal/Bremen, Germany Tel +49 (04298) 922-0, Fax +49 (04298) 922-129 contact@nabertherm.de www.nabertherm.com		 <small>MORE THAN HEAT 33-3000 °C</small> Made in Germany
①	②	④
③		④

- ① Furnace model
- ② Serial number
- ③ Article number
- ④ Year of construction

Fig. 1: Example (type plate)

10 For Your Notes

For Your Notes

For Your Notes

