ASCII-Commands

ATS 400

Automatic testing system

PRÜFTECHNIK

Contents

1 Welcome

This document describes the external remote control of the **ATS 400** variant devices via ASCII commands. The commands required to parameterize a test type, check the start conditions, start the test, retrieve the measured values and result data and stop the test are described here and explained with examples.

This description is valid for **ATS 400** devices for connection to the `serial` interface of the IO-CPU (`RS232`), communication via `LAN` (`TCP/IP`) and `PROFINET`.
There are three connection options for the external remote control of the **ATS 400**, depending on the transport layers used. The remote control options of the operating variants are summarized in the following table:

Function	Refinement/protocols	Serial					LAN					PROFINET				
		X2	X4	X5	X6	X8	X2	X4	X5	X6	X8	X2	X4	X5	X6	X8
External remote control without value display*1	**ASCII**	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✓	✓	✓	✗	✗
External remote control with value display*2	**ASCII** Remote (Viewer or LAN)	✗	✓	✓	✗	✗	✗	✓	✓	✗	✗	✗	✓	✓	✗	✗

*1 **ETL DataView 3** is not running on the remote-controlled device.

*2 **ETL DataView 3** is running on the remote-controlled device. `Serial` and `PROFINET` with the setting "`Remote` -> `Viewer`" and `LAN` with the setting "`Remote` -> `LAN` - > `ASCII`".
More information in chapter External remote control with value display.

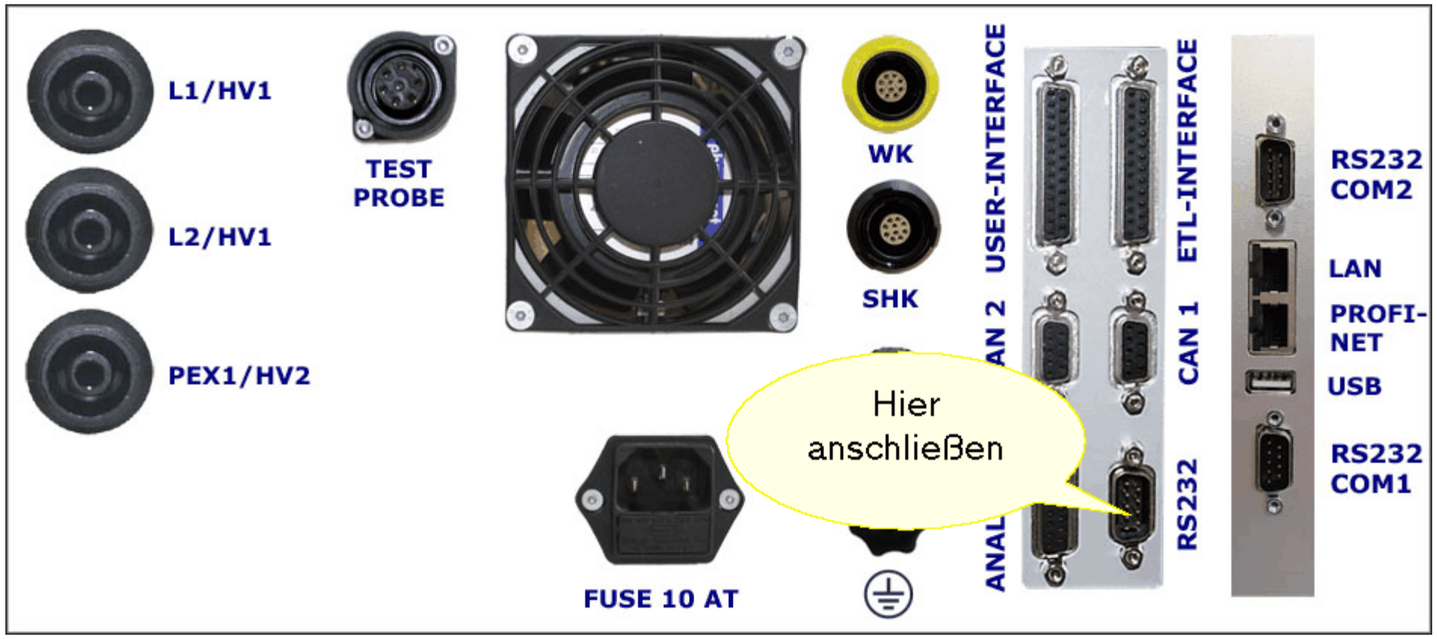
2 General

This chapter describes transport layers and the corresponding connections. It also explains the basics of data exchange and the formats of ASCII commands.

2.1 Connections on the ATS400

- All operating variants have a connection to the serial interface.
- The right-hand connection panel does not exist on the X2 operating variant.
- The X4/X5 operating variants correspond to the image shown (connection to the serial interface).
- On the X6/X8 operating variants, the right-hand connection panel is a PC connection panel.
- The X2 operating variants can also be equipped with a **PROFINET** connection.
- The X4/X5 operating variants also have connection options for **LAN** via the **LAN** interface (**LAN** connection image) and **PROFINET** via the **PROFINET** interface (**PROFINET** connection image).
- The X6/X8 operating variants have a connection option for **LAN** via one of the two **LAN** interfaces.

Connection to the serial interface



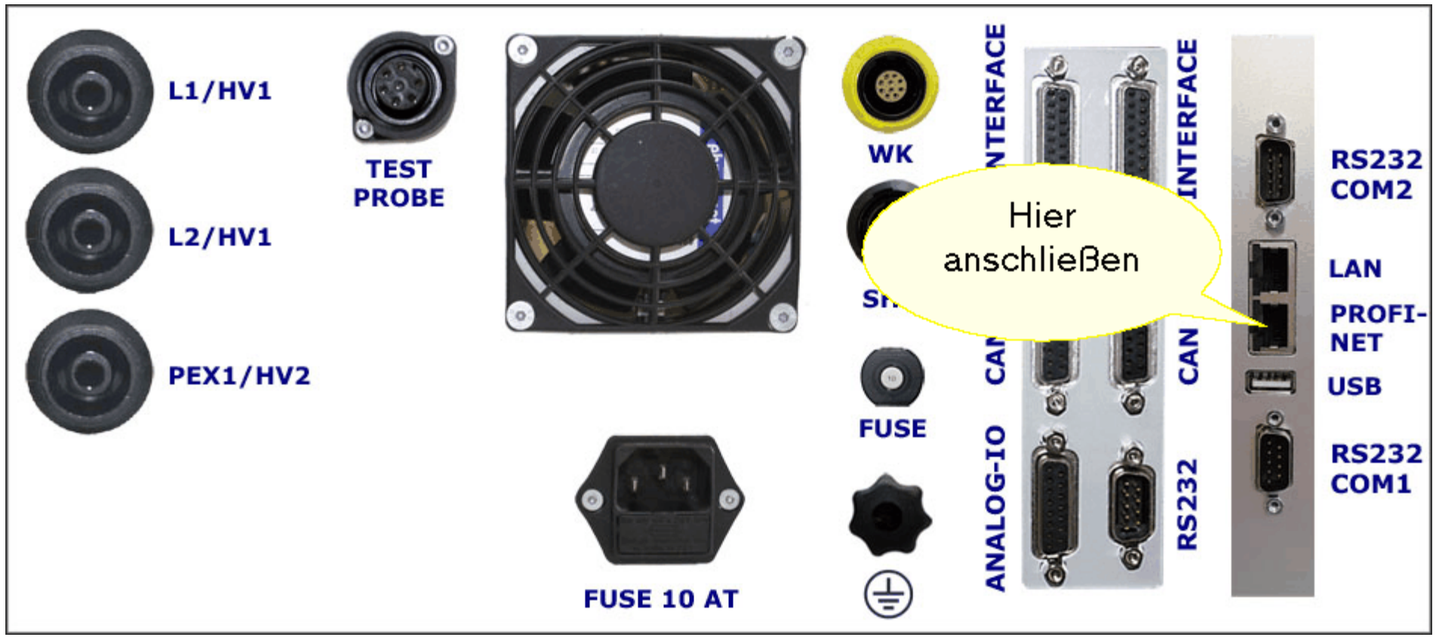
The connection is made via the 9-pin serial socket. The device is a data terminal device. You can find more information on the serial interface in Wikipedia, for example, at http://de.wikipedia.org/wiki/RS-232.
You can usually use a null modem cable.

Use the following connection settings:

Baud rate	9600 (factory setting). From IO-CPU version 33537, the baud rate can be set to a higher value using **ETL DataView 3** or a service program. The baud rates 9600, 19200, 38400, 57600 and 115200 are possible.
Parity	None

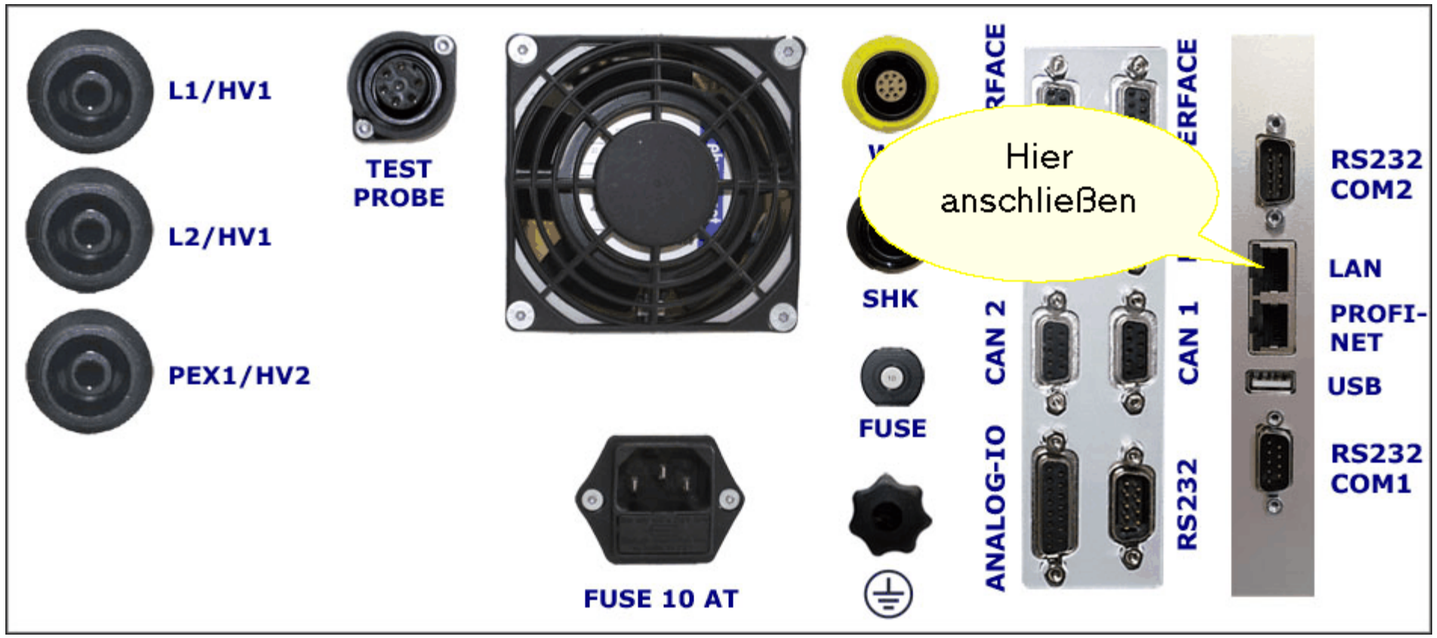
Baud rate	9600 (factory setting). From IO-CPU version 33537, the baud rate can be set to a higher value using **ETL DataView 3** or a service program. The baud rates 9600, 19200, 38400, 57600 and 115200 are possible.
Data bits	8
Stop bits	1
Handshake	none

Connection for PROFINET



The connection is made via the RJ45 socket labeled **PROFINET**.

Connection for LAN



The connection is made via the RJ45 socket labeled `LAN`.

2.2 Licensing

A license must be available for each device in a test stand that is to be remote-controlled via the ASCII protocol. You can obtain this license from the sales department under item number `205060`.

2.3 Data format

Only ASCII characters and control characters are used. You can find more information on ASCII characters in Wikipedia, for example, at https://en.wikipedia.org/wiki/ASCII . Data exchange is line-oriented.

Each line begins with a mnemonic code for the command consisting of 4 capital letters. The mnemonic code is followed by the information associated with the code.

Each line is terminated with the control character <CR> (hex 0D, decimal 13). You can find more information on control characters in Wikipedia, for example, at https://en.wikipedia.org/wiki/Control_character.

2.4 Data exchange

Data is exchanged according to the master/slave principle. The **ATS 400** is the slave.
Each request is acknowledged with a corresponding response. The next command may only be sent once the response has been received. In the case of chained commands, this applies to the entire chain.
If a request is not understood, the device responds by sending the mnemonic code followed by `nok`. In the case of chained commands, this applies to each individual command.

2.5 Scaling of values

Values that represent numbers are transferred with the corresponding scaling. The format follows the following rules:
vxxxxxx**s**

Element	Description
v	Sign; permitted characters: `+`, `–`, `>`, `<` or `space`.
xxxxxx	Value; 6-digit, consisting of digits and '.', invalid measured values are marked with „------“.
s	Scaling; `f`, `p`, `n`, `u`, `m`, `k`, `M`, `G`, `T` or space.

Permitted formatting is, for example:

Formatting	Description
`'+0500.0 '	+500,0.
`'+000100M`	100E+6.
`'-00010.0 '	-10,0.
`' ------ '	For invalid value when querying measured values.
`'>022000 '	For measuring range exceeded, largest value in the measuring range is 22000.

The scaling corresponds to the SI prefixes, whereby the u character is used for micro. Only the SI prefixes mentioned above are used. More information on SI prefixes can be found, for example, in Wikipedia at http://en.wikipedia.org//wiki/Unit_prefix for units of measurement.

2.6 Settings

The protocol used is recognized automatically. No settings are necessary.
From a certain firmware version, the `Remote` LED on the front of the **ATS 400** flashes when an ASCII command is recognized.
From a certain firmware, the `Remote` LED lights up permanently on the front of the **ATS 400** when a KWP-Protocol has been detected.
If communication via the ASCII or KWP-Protocol is detected, the device must be switched off and on again so that a different protocol can be used, e.g. for remote control with **ETL DataView 3**.

2.7 Use of ETL DataView 3

Caution

- Communication via RS232 or PROFINET
  The following rules apply to the external remote control without value display on the tester:

  - Simultaneous use of **ETL DataView 3** is not possible.
  - Simultaneous use of **ETL DataView 3** and commanding via ASCII may result in the device not functioning properly.
  - In the **ATS 400** X4 and **ATS 400** X5 variants, **ETL DataView 3** may be in the main menu or in the debug display, but not in any other menu or display.
  - For the **ATS 400** X6 and **ATS 400** X8 variants, **ETL DataView 3** must be removed from the autostart.

  The following rules apply to the external remote control with value display (Viewer) on the test device:

- **ETL DataView 3** must be in remote control mode. This is set via `Settings` -> `Workstation` -> `Remote`, more on this in the chapter External remote control with value displays.
- To access this mode after switching on the ATS 400, the start must be set to remote control in `Settings` -> `Workstation` -> `Startmode`, more on this in the chapter External remote control with value displays.

Kommunication via LAN

- **ETL DataView 3** must be in remote control mode. This is set via `Settings` -> `Workstation` -> `Remote`, more on this in the chapter External remote control with value displays
- To access this mode after switching on the **ATS 400**, the start must b e set to remote control in `Settings` -> `Workstation` -> `Startmode`, more on this in the chapter External remote control with value displays.

2.8 Chaining of commands

From IO-CPU version 33537 it is possible to chain commands. The responses are also chained.
There is a time advantage when using the chained commands, especially when transmitting the parameters. Also when querying the measured values if more than one channel, e.g. resistance, current and test time, are queried. Commands are concatenated by transmitting several commands separated by the character ';' in a line. The length of the line or the expected response must not exceed 200 characters. A maximum of 15 parameters can therefore be sent in one line.

The commands are processed in the order in which they are received. There is no difference whether the commands are sent individually or concatenated.

Command processing begins as soon as the ';' character is received. The response is then sent immediately. It is possible that the response is already being sent while a concatenated command is being received by the **ATS 400**.

Examples of communication can be found in the folder ***Demo-Programs\ExamplesRS232\03_Combined*** for various test types. The subfolders each contain a program and a log file with the communication between the sample program and the **ATS 400**.

Example:
S: 'UAIM+0000.8m;UAIX+0001.2m;UAUP+001.00k;UAF0+0050.0 ;UATP+0002.0 ;UATU+0002.0 ;UATD+0002.0 ;UAUS+000000 ;UACO+000000 ;UAAD+000002 ;UAC0;UAIR+000000 ;STPA+000001 ;STSC 0002 0000'
R: 'UAIM+0000.8m;UAIX+0001.2m;UAUP+001.00k;UAF0+0050.0 ;UATP+0002.0 ;UATU+0002.0 ;UATD+0002.0 ;UAUS+000000 ;UACO+000000 ;UAAD+000002 ;UAC0;UAIR+000000 ;STPA+000001 ;STSC'

Attention:
The length of the commands between the semicolons must be observed.
'UAC0' is 4 characters long. The semicolon must be inserted directly after the "0" (UAC0;).
The commands for the test parameters are 12 characters long. For commands with scaling, the semicolon is inserted directly after the scaling (UAIM+0001.9m;). For commands without scaling, a space is inserted before the semicolon instead of the scaling (UAIM+0001.9 ;).

3 Device information

Information about the firmware and serial number of the device can be retrieved at any time, regardless of the test type.

3.1 Querying the firmware

Kommand	Answer	Example	From firmware	Description
GFWS?	**GFWSxxxxx yyyyy**	S 'GFWS' R 'GFWS33528 26480'	33222	Queries the version numbers of the firmware. IO-CPU = xxxxx and LT-CPU = yyyyy. IO-CPU = 33528 LT-CPU = 26480

3.2 Query the serial number

Kommand	Answer	Example	From firmware	Description
RQSN?	**GFWSxxxxxxxxxxxxxx**	S 'RQSN' R 'RQSN21191702221535'	33222	Queries the serial number of the device. SN = 21191702221535.

4 Global commands

Global commands are commands that can be used for all test types.

4.1 Setting the test type

Kommand	Answer	Example	From firmware	Description
STPAvxxxxxxxs	**STPAvxxxxxxxs**	S 'STPA+000001 ' R 'STPA+000001 '		This command can be used to set the test type. After setting the test type, it can take up to 200 ms until closed contact monitoring is detected via the status request command. Test type values: 'STPA+000000 ' = No test type 'STPA+000001 ' = High-voltage test 'STPA+000002 ' = Function test 'STPA+000003 ' = Protective earth test 'STPA+000004 ' = Insulation test 'STPA+000005 ' = Leakage current test 'STPA+000006 ' = Resistance test 'STPA+000020 ' = Continuity test with DC4 module 'STPA+000021 ' = Voltage measurement 'STPA+000022 ' = Symmetry test 'STPA+000023 ' = Protective earth test with resistance module

4.2 Setting the test step information

Kommand	Answer	Example	From firmware	Description
STTSvxxxxxxxs	**STTSvxxxxxxxs**	S 'STTS+000005 ' R 'STTS+000005 '	33347	This command is used to transfer the status of the current test step If the value 5 (result IO with buzzer) or 6 (result NOK with buzzer) is transmitted, the tones are activated according to the settings in the **ATS 400**. You make these settings with **ETL DataView 3** under `Settings` -> `I/O interface`. The following values are permitted: 'STTS+000005 '= Result IO with buzzer 'STTS+000006 '= Result NIO with buzzer The command is transmitted at the end of a test step.

4.3 Setting the test plan information

Kommand	Answer	Example	From firmware	Description
STTCvxxxxxxxs	**STTCvxxxxxxxs**	S 'STTC+000002 ' R 'STTC+000002 '	33347	This command is used to transfer the status of the test plan. If the value 2 (overall result IO) or 3 (overall result NIO) is transmitted, the tones are activated according to the settings in the **ATS 400**. You make these settings with **ETL DataView 3** under `Settings` -> `I/O interface`. The following values are permissible: 'STTC+000001 ' = Test plan active 'STTC+000002 ' = Test plan completed IO (result= passed) 'STTC+000003 ' = Test plan completed NIO (result = failed) 'STTC+000005 '= Test plan completed To control only the buzzer and the LED on the front of the ATS 400, it is sufficient to transmit only the value 2 or 3.

4.4 Status query

Kommand	Answer	Example	From firmware	Description
GETS?	**GETSxxxx**	S 'GETS' R 'GETS5887'		The current status of control elements and similar status variables can b e queried via the status query. This query is used to determine whether it is possible to start a check. xxxx= Number in hexadecimal format. 5887 = 0101 1000 1000 0111

The bit sequence is to be evaluated from right to left. Only bits 0, 1, 2, 3, 8, 9, 10, 13, 14 and 15 are evaluated, the others are reserved.

Example:

	Bi15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
5887 ->	0	1	0	1	1	0	0	0	1	0	0	0	0	1	1	1
	Bit 14 will be evaluated	External matrix has relays switched/set or is not available	Parameters have been edited	Not relevant	Not relevant	Fail button not set	Pass button not set	Cancel not set in ETL-Interface	Not relevant	Not relevant	Not relevant	Not relevant	Start button PE Test-probe not actuated	Contact monitoring is Closed	Safety circuit is closed	Start button is pressed

To start a test with the **ATS 400**, Bit 13 must not be set and Bit 14 or Bit 15 must be set. Depending on the test type, further bits must or can be set.
Bit 1 must also be set for all high-voltage tests and the insulation test.

Explanation of the bit sequence: :

Bit	Description
Bit 0	1 = Start button on the front of the device or ETL-Interface is pressed.
Bit 1	1 = Safety circuit is closed.
Bit 2	1 = Contact monitoring is Closed.
Bit 3	1 = Start button on the composite test probe (VPS) is pressed during the protective earth test. (Always set if no PE board is installed).
Bit 8	1 = Cancel in ETL-Interface is set.
Bit 9	1 = Taste Pass an der Front gedrückt / Pass im ETL-Interface gesetzt.
Bit 10	1 = Pass button pressed on the front / Pass set in the ETL-Interface.
Bit 13	1 = Parameters are still being processed. **Important**: If the bit is not removed after more than one second, the diagnostic data must be retrieved.
Bit 14	A valid status is only transmitted when the higher-level control system has sent an RMST command (output relay position) to the matrix for the first time. Prior to this, the value 1 is reported back. 1 = external matrix has switched/set relay or is not present. 0 = CAN cable not plugged in, external matrix not switched on, external matrix is currently switching (transient state), addressed matrix module not present, external matrix defective.
Bit 15	0 = Status according to bit 14 (i.e. bit 14 is evaluated). 1 = Matrix in idle state, i.e. all relays are switched off. (does not apply if the relays are switched off via the '**RM__**' command).

4.5 Status of the test

For a number of queries, the status of the check is also returned. This is indicated by the character string zz in the responses. This status is always a two-digit number with the following values:

Value	Description
zz = 00	Test not started (measured value is invalid).
zz = 01	Test active.
zz = 02	Test completed IO (Result = Passed).
zz = 03	Test completed NIO (Result = Failed).
zz = 04	Error, test could not be started.
zz = 05	Abort due to error (device error).
zz = 06	Abort by user (Cancel ETL-Interface).
zz = 07	Test started, (measured value is invalid).

Query: UAUI?
Answer: UAUIvxxxxxxs **zz**

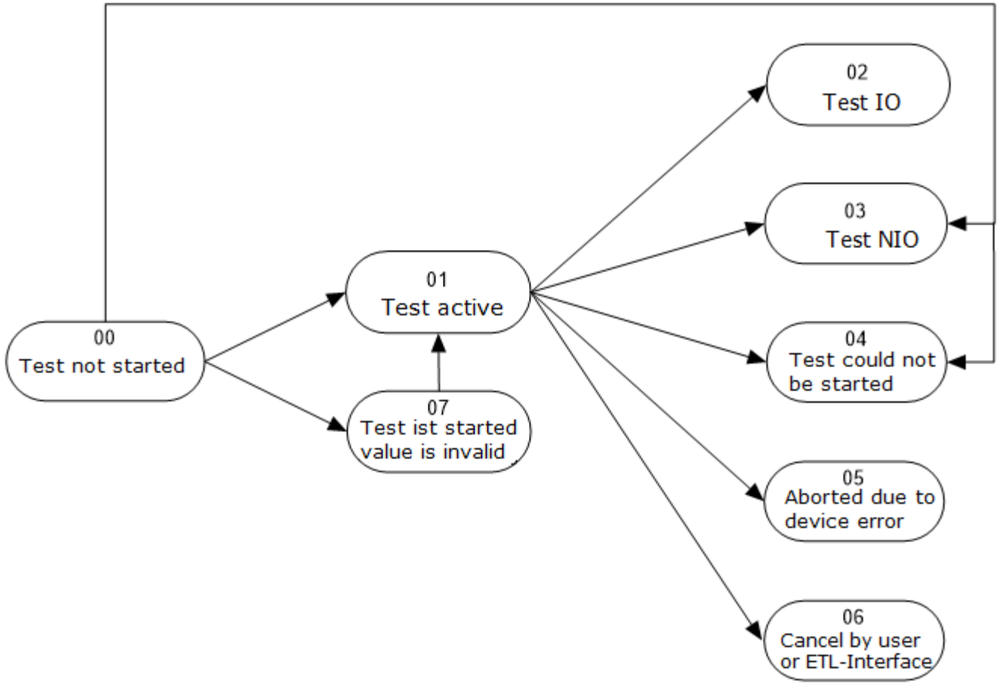
Example:

S 'UAUI?'
R 'UAUI+001001 **01**' (01 = Test active)

After starting the test, the following status transitions are possible:

Act. state	New state	New state	New state
00	03		
00	04		
00	01	02/03/04/05/06	
00	07	01	02/03/04/05/06
01	02/03/04/05/06		
04			
07	01	02/03/04/05/06	

State diagram for the status transitions:



4.6 Query the test time

Kommand	Answer	Example	From firmware	Description
PTI_?	PTI_vxxxxxxs	S 'PTI_?' R 'PTI_+000040m' S 'PTI_?' R 'PTI_+000.04 '	bis 33536 ab 33537	By querying the test time, the current test time or, after completion of the test, the total test time can be determined.

4.7 Dummy

The dummy command is valid for all test devices and all ASCII remote control options.
The 'DUOU' command switches the function test adapter into the measurement path or removes it from the measurement path. The 'DUIN?' command must be used to query the status. After the dummy has been switched on, the individual test steps must be carried out like a normal test.
The function test adapters have a resistance of 1 MOhm for the HVDC and insulation test and 440 Ohm for the resistance measurement.
In this case, the safety circuit must also be closed for the HVDC and insulation test.
A voltage of 1.00 kV is used for the HVDC and insulation test.
The limit values for the current or resistance are specified so that one passed measurement and two failed measurements are obtained.

4.7.1 Set the output

Kommand	Answer	Example	From firmware	Description
DUOUvxxxxxxs	**DUOUvxxxxxxs**	S 'DUOU+000001 ' R 'DUOU+000001 '	33222	Sets the digital output for requesting or starting a dummy check by e.g. a PLC. The following values are permitted: 'DUOU+000000 ' = Dummy is not requested. 'DUOU+000001 ' = Dummy is requested.

After setting the digital output, the tests can be commanded and carried out as described in the examples of the test types.

4.7.2 Read the input

Kommand	Answer	Example	From firmware	Description
DUIN?	**DUINvxxxxxxs**	S 'DUIN?' R 'DUIN+000000 '	33222	Reads the digital input for feedback to the PLC that the dummy test object is ready for testing. The following values are permitted: 'DUIN+000000 ' = Dummy not inserted. 'DUIN+000001 ' = Dummy inserted.

4.8 Setting the start conditions

Kommand	Answer	Example	From firmware	Description
STSC xxxx yyyy	**STSC**	S 'STSC 0003 0000' R 'STSC'	33250	Setzt die Startbedingungen, sodass sie bei Prüfungen ausgewertet werden können. 0003 = 0011 -> Bit0 (Starttaste) und Bit1 (Sicherheitskreis) sind gesetzt. xxxx = Positivmaske yyyy = Negativmaske, wird nicht überwacht Die Positivmaske und die Negativmaske sind Hexadezimalzahlen, die die einzelnen Startbedingungen bitweise kodieren. Sets the start conditions so that they can be evaluated during tests. 0003 = 0011 -> Bit0 (start button) and Bit1 (safety circuit) are set. xxxx = Positive mask yyyy = Negative mask, is not monitored The positive mask and the negative mask are hexadecimal numbers that encode the individual start conditions Bit by Bit.

Wichtig

- This command must be sent before the start command of the test.
- The start conditions for contact monitoring are monitored at the start of the test and during the test if they have been set.
- During the high-voltage tests and the insulation test, the safety circuit is always monitored regardless of whether the start conditions are set.
- If a start condition is set and this is not fulfilled at the start command, the test will not be started.
- If a start condition is set and this is no longer fulfilled during the check, the check is ended with the status 03.

Only bits 0 to 3 are to be set for the **ATS 400**, the others are not to be used.

Bit	Description
Bit 0	1 = Start button on the front of the device or ETL-Interface is pressed.
Bit 1	1 = Safety circuit is closed.
Bit 2	1 = Contact monitoring is Closed.
Bit 3	1 = Start button on the composite test probe (VPS) is pressed

5 Commanding the test types

In this chapter, the commands, queries and error numbers of each test type are described in a separate chapter and explained with examples.

Examples of communication can be found in the folder ***Demo-Programs\ExamplesRs232\ATS400\Standard*** for various test types. The subfolders each contain a program and a log file with the communication between the sample program and the **ATS 400**.
For the communication via LAN are the examples in the folder ***Demo-Programs\ExamplesLan\ATS400\Standard\.***

5.1 High voltage test

This chapter describes the ASCII commands for parameterizing and querying the measured values for the high voltage test.
The parameters of the HVAC and HVDC tests are largely identical. On the high voltage live line tester test system, the switchover is carried out using the commands 'UAC0' for HVAC and 'UAC1' for HVDC.

5.1.1 Set parameter

Attention

- Data is exchanged according to the master/slave principle. The ETL device is the slave.
- Each request is acknowledged with a corresponding response. Only after the response is received can the next command be sent. In the case of chained commands in ATS400, this applies to the entire chain.
- If a request is not understood, the device responds with the mnemonic code followed by `nok`. For chained commands in ATS400, this applies to each individual command.
- If no SI prefix is used for the command, the number is followed by a space.
- The transferred parameters are retained on the device; they are only overwritten when new parameters are transferred.
- The quotation marks in the "Example" column are only there to illustrate the length of the command with and without SI prefix and are not part of the command.

Attention

- The sequence of commands must be observed as shown in the table.
- The commands marked with an asterisk (*) are optional. They only need to be transferred if the functionality is required.

	Command	Answer	Example	From firmware	Description
1	`UAIMvxxxxxxs`	`UAIMvxxxxxxs`	`S 'UAIM+0000.8m'` `R 'UAIM+0000.8m'`		Sets the minimum current as a test parameter. Imin = 0,8 mA
2	`UAIXvxxxxxxs`	`UAIXvxxxxxxs`	`S 'UAIX+0001.2m'` `R 'UAIX+0001.2m'`		Sets the maximum current as the test parameter. Imax = 1,2mA
3	`UAUPvxxxxxxs`	`UAUPvxxxxxxs`	`S 'UAUP+001.00k'` `R 'UAUP+001.00k'`		Sets the test voltage as a test parameter. U = 1,00 kV
4	`UAF0vxxxxxxs`	`UAF0vxxxxxxs`	`S 'UAF0+0050.0 '` `S 'UAF0+0050.0 '`		Sets the frequency as a test parameter. **The frequency is only valid for an HV AC test. If the parameter is set for an HVDC test, it is ignored for the test**. F = 50,0 Hertz **Attention**: In the UAF0 command, the number **0 (zero)** must be used and not the letter **O**.

	Command	Answer	Example	From firmware	Description
5	**UATPvxxxxxxs**	**UATPvxxxxxxs**	S 'UATP+0002.0 ' R 'UATP+0002.0 '		Sets the test time as a test parameter. t = 2,0 s
6	**UATUvxxxxxxs** *	**UATUvxxxxxxs**	S 'UATU+0002.0 ' R 'UATU+0002.0 '		Sets the ramp time for the rising edge as a test parameter. **If the value 0 is transferred, the rising ramp is not active.** t = 2,0 s
7	**UATDvxxxxxxs** *	**UATDvxxxxxxs**	S 'UATD+0002.0 ' R 'UATD+0002.0 '		Sets the ramp time for the falling edge as a test parameter. **If the value 0 is transferred, the falling ramp is not active.** t = 2,0 s
8	**UAUSvxxxxxxs** *	**UAUSvxxxxxxs**	S 'UAUS+000000 ' R 'UAUS+000000 '		Sets the start voltage of the ramp as a test parameter. U = 0 V
9	**UACOvxxxxxxs**	**UACOvxxxxxxs**	S 'UACO+000000 ' R 'UACO+000000 '	33432	This command is used to set the polarity. The polarity can be used to interconnect the high-voltage test. Attention: **Simultaneous use of the relay matrix and the ETL-Interface is only possible from version 33581 of the IO-CPU. Either a relay matrix or the outputs on the ETL-Interface can be used.** Please refer to the documentation for the device to find out how the wiring is carried out. Polarity values: 'XXXX+00000**0** ' = No relay matrix active and no interconnection active. 'XXXX+00000**1** ' = No relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+00000**2** ' = No relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+00000**3** ' = No relay matrix active and both interconnections active. 'XXXX+0**65280** ' = Relay matrix active and both circuits not active. 'XXXX+0**65281** ' = Relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+0**65282** ' = Relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+0**65283** ' = Relay matrix active and both interconnections active. 'XXXX+0**65535** ' = Relay matrix active and no interconnection active. With **000001** bis **000003,** only the relay outputs of the ETL-interface are switched. With **065280** bis **065283,** the relay outputs of the ETL-interface are also switched and the corresponding switching times are waited for. This is done in parallel with the switching in the matrix modules. With **065535** only the matrix modules are switched. **Attention**: In the command **UACO** , the letter **O** must be used and not the number **0 (zero)**.
10	**UAADvxxxxxxs** *	**UAADvxxxxxxs**	S 'UAAD+000002 ' R 'UAAD+000002 '		This command sets the spark detection. 'UAAD+00000**1** ' = Coarse. 'UAAD+00000**2** ' = Normal (Default value). 'UAAD+00000**3** ' = Fein.
11	**UAC0** or **UAC1**	**UAC0** or **UAC1**	S 'UAC0' R 'UAC0' S 'UAC1' R 'UAC1'		0(Zero): Switches on the HVAC test mode. 1: Switches on the HVDC test mode.
12	**UAHR+xxxxxx** *	**UAHR+xxxxxx**	S 'UAHR+000001 ' R 'UAHR+000001 '	33425	This command can be used to change the current measurement range to 1 µA resolution. **This command is only effective for HVDC test with the HVDC3 module and measurement with the MEP.** 'UAHR+00000**0** ' = Resolution not increased. 'UAHR+00000**1** ' = Resolution increased.
13	**UAIRvxxxxxxs** *	**UAIRvxxxxxxs**	S 'UAIR+000000 ' R 'UAIR+000000 '	33502	This command can be used to activate the current check for exceeding Imax in the ramp. **This command is only effective for HVDC test with the HVDC3 module.** Default setting is '0' not activated. 'UAIR+00000**0** ' = Check not active.

	Command	Answer	Example	From firmware	Description
					'UAIR+00000**1** ' = Check active.
14	**UATCvxxxxxxs** *	**UATCvxxxxxxs**	S 'UATC+000001 ' R 'UATC+000001 '	335xx	This command activates the temperature-compensated test for the HVDC test. To use this mode, it is necessary to transfer the scaling data, the connection of the analog sensor, the base temperature and the material constant beforehand. The following values are permissible: 'XXTC+00000**0** ' = No temperature compensation (factory setting). 'XXTC+00000**1** ' = temperature compensation at > 40 °C 'XXTC+00000**2** ' = temperature compensation at > Basistemperatur 'XXTC+00000**3** ' = temperature compensation at > 10 °C 'XXTC+00000**4** ' = Always perform temperature compensation. Temperaturcompensation, Scaling data
15	**UAMTvxxxxxxs** *	**UAMTvxxxxxxs**	S 'UAMT+000002 ' R 'UAMT+000002 '	33580	This command is used to set the test module for the **HVDC** test. 'UAMT+00000**0** ' = Factory setting. 'UAMT+00000**1** ' = Use HVDC3 module. 'UAMT+00000**2** ' = Use HVDC7 module.
16	**UATSvxxxxxxs**	**UATSvxxxxxxs**	S 'UATS+0000.1 ' R 'UATS+0000.1 '	33700	This command is used to set a start time before the evaluation. This time begins with the test time and during this time the current is not checked against the limits. The value must not be greater than or equal to the test time. The default value is 0 sec. Start time = 0.1 s.
17	**UAUEvxxxxxxs** *	**UAUEvxxxxxxs**	S 'UAUE+000024 ' R 'UAUE+000024 '	33700	This command is used to set the discharge voltage for the **HVDC** test. At the end of the test, the discharge voltage must be lower than this value. The value must not be less than 10 V and greater than 42 V. The default value is 20 V. Discharge voltage = 24 V.
18	**UAILvxxxxxxs** *	**UAILvxxxxxxs**	S 'UAIL+000000 ' R 'UAIL+000000 '	33746 und DHMP 3.94	Sets or clears the use of the current measurement channel with the highest current for evaluation. 'UAIL+000000 ' = Uses the normal current measurement channel for evaluation (default). 'UAIL+000001 ' = Uses the current measurement channel with the highest current for evaluation.
19	**STPAvxxxxxxs**	**STPAvxxxxxxs**	S 'STPA+000001 ' R 'STPA+000001 '		This command can be used to set the test type. After setting the test type, it can take up to 200 ms until closed contact monitoring is detected via the status request command. Test type values: 'STPA+00000**0** ' = No test type 'STPA+00000**1** ' = High-voltage test 'STPA+00000**2** ' = Function test 'STPA+00000**3** ' = Protective earth test 'STPA+00000**4** ' = Insulation test 'STPA+00000**5** ' = Leakage current test 'STPA+00000**6** ' = Resistance test 'STPA+0000**20** ' = Continuity test with DC4 module 'STPA+0000**21** ' = Voltage measurement 'STPA+0000**22** ' = Symmetry test 'STPA+0000**23** ' = Protective earth test with resistance module
20	**STSC xxxx yyyy**	**STSC**	S 'STSC 0003 0000' R 'STSC'		Sets the start conditions of the test so that they can be evaluated before and during the test. The safety circuit is always active during high-voltage tests. hex 3= 0011 (Bit0= Start button, Bit1= Safety circuit)

5.1.2 Perform test

	Query	Answer	Example	From firmware	Description
	GETS?	**GETSxxxx**	S 'GETS?' R 'GETS5887'		This query is used to determine whether it is possible to start a test. 5887 hex = **01**0**1** 1000 1000 0**111** (Bit0 = 1: Start button pressed, Bit1 = 1: Safety circuit closed, Bit2 = 1: Contact monitoring closed, Bit13 = 0 : Parameter download is completed) To start a test with the **ATS 400**, Bit13 must not be set and Bit14 or Bit15 must be set. Depending on the test type, further bits must or can be set. Bit1 must also be set for all high-voltage tests and the insulation test. Status query. **Caution:** If Bit13 is not removed after a timeout of 1s, the diagnostic data must be deleted with the commands SY* and HV* can be retrieved. The commands and descriptions can be found in the chapter Diagnostic data.
	UAST	**UAST**	S 'UAST' R 'UAST'		This command starts the high voltage test. **Attention:** The start command is transmitted after the start conditions have been fulfilled, parameter download is completed (Bit13 not set) and Bit14 (or Bit15) is set. The status query is carried out using the **GETS?** command (more on this in the Examples section).
	UAC_?	**UAC_+xxxxxxs**	S 'UAC_?' R 'UAC_+000000 '	33436	This command can be used to query whether the AC module or the DC module is active. UAC_+00000**0** = AC module is set. UAC_+00000**1** = DC module is set.
	UAII?	**UAIIvxxxxxxs zz**	S 'UAII?' R 'UAII+000009u 01'		Returns the current current as a measured value and the test status. After completion of the test, the max. current. I = 9 uA, 01 = Test active (status of the test)
	UAUI?	**UAUIvxxxxxxs zz**	S 'UAUI?' R 'UAUI+001001 01'		Returns the current voltage during the test and the result value and test status after the test. If a breakdown occurs during the test, the voltage is returned immediately before the breakdown. U = 1001 V, 01 = Test active (status of the test).
	UAUC?	**UAUCvxxxxxxs zz**	S 'UAUC?' R 'UAUC+001001 01'	33453	Always returns the current voltage even after the test and the test status. For HVDC tests, this can be used to check that the discharge has taken place. U = 1001 V, 01 = Test active (status of the test).
	UANC? *	**UANCvxxxxxxs zz**	S 'UANC?' R 'UANC+000009u 01'	335xx	Returns the uncompensated current. **This value is only valid if an HVDC test with temperature compensation is performed**. I = 9uA, 01 = Test active (status of the test).
	UATE? *	**UATEvxxxxxxs zz**	S 'UATE?' R 'UATE+0020.0 01'	335xx	Returns the temperature in °C that is used for the HVDC test with temperature compensation. **This value is only valid if an HVDC test with temperature compensation is performed.** T = 20 °C, 01 = Test active (status of the test).
	UAIV?	**UAIVvxxxxxxs zz**	S 'UAIV?' R 'UAIV+000000 '	33746 und DHMP 3.94	Returns the Largest current within the interval of measured values.
	ERIN?	**ERINvxxxxxxs**	S 'ERIN?' R 'ERIN+000000 '	33297	This command can be used to query the error information. This field is updated at the end of the check. During the check, this field is filled with zeros. In Case of error, the response is a number in the range from 16 to 27 for HVAC or from 23 to 44 for HVDC. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).
	UASP	**UASP**	S 'UASP' R 'UASP'		This command stops the high voltage test. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).

5.1.3 Example

5.1.3.1 Individual commands

	Command	Description
Query device information		
S	'GFWS?'	Firmware
R	'GFWS33624 23529'	IO-CPU = 33624, LT-CPU = 23529
S	'RQSN?'	Serial number
R	'RQSN211917 0222 1534'	SN = 2119170 0222 1534
Transfer test parameters		
S	'UAIM+0000.8m'	Imin = 0,8mA
R	'UAIM+0000.8m'	
S	'UAIX+0001.2m'	Imax = 1,2mA
R	'UAIX+0001.2m'	
S	'UAUP+001.00k'	U = 1kV
R	'UAUP+001.00k'	
S	'UAF0+0050.0 '	F = 50Hz
R	'UAF0+0050.0 '	
S	'UATP+0002.0 '	t = 2s
R	'UATP+0002.0 '	
S	'UATU+0002.0 '	tRamp up = 2s
R	'UATU+0002.0 '	
S	'UATD+0002.0 '	tRamp down = 2s
R	'UATD+0002.0 '	
S	'UAUS+000000 '	URamp = 0V (Start voltage of the ramp)
R	'UAUS+000000 '	
S	'UACO+000000 '	No wiring and no relay matrix active
R	'UACO+000000 '	
S	'UAAD+000002 '	Spark detection Normal
R	'UAAD+000002 '	
S	'UAC0'	HVAC active
R	'UAC0'	
S	'UAIR+000000 '	No Imax test in ramp
R	'UAIR+000000 '	
S	'STPA+000001 '	Activate high voltage test
R	'STPA+000001 '	
S	'STSC 0002 0000'	Set safety circuit as start condition
R	'STSC'	

	Command	Description
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS7086'	011**1** 0000 1000 0**11**0 Bit1 = 1: Safety circuit closed, Bit2 = 1: contact monitoring closed, Bit13 = 1 : Parameters are still being processed
S	'GETS?'	Status query
R	'GETS5086'	01**0**1 0000 1000 0**11**0 Bit13 = 0 : Parameter download is completed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'UAST'	Start test
R	'UAST'	
Measured values query		
S	'UAUI?'	Voltage
R	'UAUI+000000 **00**'	**00** test not yet active
S	'UAII?'	Current
R	'UAII+000000f **00**'	**00** test not yet active
S	'PTI_?'	Test duration
R	'PTI_+000.00 '	t = 0 s
S	'UAUI?'	Voltage
R	'UAUI+001997 **01**'	U = 1997 V, **01** test active
S	'UAII?'	Current
R	'UAII+001971u **01**'	I = 1971 uA, **01** test active
S	'PTI_?'	Test duration
R	'PTI_+000.03 '	t = 0,03 s
S	'UAUI?'	Voltage
R	'UAUI+001999 **02**'	U = 1999 V, **02** test completed IO (passed)
S	'UAII?'	Query the current current
R	'UAII+001974u **02**'	I = 1974 uA, **02** test completed IO (passed)
S	'PTI_?'	Test duration
R	'PTI_+001.01 '	t = 1,01 s
Error query		
S	'ERIN?'	Error query
R	'ERIN+000000 '	No error
Test stop		
S	'UASP'	Test Stop
R	'UASP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000001 ') only needs to be transmitted before starting.

Example:

'STPA+000001 '
'UAST'

5.1.3.2 Chained commands

From IO-CPU version 33537 it is possible to chain commands.

	Command	Description
	Query device information	
S	'GFWS?;RQSN?'	Firmware and serial number
R	'GFWS33624 23529;RQSN211917 0222 1534'	IO-CPU = 33624, LT-CPU = 23529, SN = 2119170 0222 1534
	Transfer test parameters	
S	'UAIM+0000.8m;UAIX+0001.2m;UAUP+001.00k;UAF0+0050.0 ;UATP+0002.0 ;UATU+0002.0 ;UATD+0002.0 ; UAUS+000000 ;UACO+000000 ;UAAD+000002 ;UAC0;UAIR+000000 ;STPA+000001 ;STSC 0002 0000'	Description in "Individual commands"
R	'UAIM+0000.8m;UAIX+0001.2m;UAUP+001.00k;UAF0+0050.0 ;UATP+0002.0 ;UATU+0002.0 ;UATD+0002.0 ; UAUS+000000 ;UACO+000000 ;UAAD+000002 ;UAC0;UAIR+000000 ;STPA+000001 ;STSC'	
S	**Status query before start (parameters download, start conditions, ...)**	
S	'GETS?'	Status query
R	'GETS7086'	011**1** 0000 1000 0**11**0 Bit1 = 1: Safety circuit closed, Bit2 = 1: contact monitoring closed, Bit13 = 1 : Parameters are still being processed
S	'GETS?'	Status query
R	'GETS5086'	010**1** 0000 1000 0**11**0 Bit13 = 0 : Parameter download is completed.
	Parameter Download is completed and the start conditions have been met. Start Test	
S	'UAST'	Test start
R	'UAST'	
	Measured values query	
S	'UAUI?;UAII?;PTI_?'	Voltage; current; test duration
R	'UAUI+000000 **00**;UAII+000000f **00**;PTI_+000.00 '	**00** test not yet active
S	'UAUI?;UAII?;PTI_?'	Voltage; current; test duration
R	'UAUI+001997 **01**;UAII+001971u **01**;PTI_+000.03 '	**01** test active
S	'UAUI?;UAII?;PTI_?'	
R	'UAUI+001999 **02**;UAII+001974u **02**;PTI_+001.01 '	**02** test completed IO (passed)
	Error query	
S	'ERIN?'	Error query
R	'ERIN+000000 '	No error
	Test stop	
S	'UASP'	Test stop
R	'UASP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000001 ') only needs to be transmitted before starting.

Example:
'STPA+000001 '
'UAST'

5.1.4 Error number high voltage

The error information is queried with the command '**ERIN?**'.

Error numbers HVAC:

Value	Meaning
16	Error: Limit Detection I max
	During the static phase, the upper limit was exceeded and the test was aborted.
17	Peak Value Detection.
	A current peak was detected and the test was aborted.
18	Test condition: Test voltage not reached.
	The necessary high voltage could not be generated. The following causes are possible: - There is a short circuit in the test specimen. - The test was started when handling test pistols at the same test point. - There is a defect in the appliance.
19	Test condition: Minimum current not reached.
	During the evaluation time, the current has not reached or exceeded the lower limit value.
20	Error: ARC Detection - Ramp.
	There was a breakdown in the ramp, which was detected via the voltage curve. The threshold for breakdown detection was exceeded.
21	Error: Limit Detection I max - Ramp
	During the ramp, the upper limit was exceeded and the test was aborted.
22	Error: ARC Detection - static phase.
	A breakdown occur red in the static phase, which was detected via the voltage curve. The threshold for breakdown detection was exceeded.
23	Error: Limit Detection I max - static phase.
	During the static phase, the upper limit was exceeded and the test was aborted.
24	Error: ARC Detection Gradient - Ramp
	There was a breakdown in the ramp, which was detected via the voltage curve. The slope for the breakdown detection was exceeded.
25	Error: ARC detection gradient - static phase
	A breakdown occur red in the static phase, which was detected via the voltage curve. The slope for the breakdown detection was exceeded.
26	Short circuit.
	The necessary high voltage could not be generated. The following causes are possible: - There is a short circuit in the test specimen. - The test was started when handling test pistols at the same test point. - There is a defect in the appliance.
27	Voltage exceeded.
	After switching on or after the end of the ramp, the voltage is too high.

Error numbers HVDC:

Value	Meaning
32	Error: Limit Detection I max
	During the static phase, the upper limit was exceeded and the test was aborted.
33	Error: Peak Value Detection
	A current peak was detected and the test was aborted.
34	Test condition: Minimum current not reached.
	During the evaluation time, the current has not reached or exceeded the lower limit value.
35	Error: ARC Detection.
	A breakdown has occurred, which was detected via the voltage curve. The threshold for breakdown detection was exceeded.
36	Test condition: Test voltage not reached.
	The necessary high voltage could not be generated. The following causes are possible: - There is a short circuit in the test specimen. - The test was started when handling test pistols at the same test point. - There is a defect in the appliance.
37	Error: ARC Detection - Ramp.
	There was a breakdown in the ramp, which was detected via the voltage curve. The threshold for breakdown detection was exceeded.
38	Error: Limit Detection I max - Ramp.
	During the ramp, the upper limit value was exceeded and the test was aborted.
39	Error: ARC Detection - static phase.
	A breakdown occur red in the static phase, which was detected via the voltage curve. The threshold for breakdown detection was exceeded.
40	Error: Limit Detection I max - static phase.
	During the static phase, the upper limit was exceeded and the test was aborted.
41	Error: ARC Detection Gradient - Ramp.
	There was a breakdown in the ramp, which was detected via the voltage curve. The slope for the breakdown detection was exceeded.
42	Error: ARC detection gradient - static phase.
	A breakdown occur red in the static phase, which was detected via the voltage curve. The slope for the breakdown detection was exceeded.
43	Discharge time exceeded.
	After the test, the voltage could not be reduced below the discharge voltage within the discharge time.
44	Voltage exceeded.
	After switching on or after the end of the ramp, the voltage is too high.
45	Current not reached in the ramp.
	During the ramp, the current has not reached or exceeded the lower limit value.

5.2 Insulation test

This chapter describes the ASCII commands for parameterizing and querying the measured values for the insulation test.

5.2.1 Set parameter

Attention

- Data is exchanged according to the master/slave principle. The ETL device is the slave.
- Each request is acknowledged with a corresponding response. Only after the response is received can the next command be sent. In the case of chained commands in ATS400, this applies to the entire chain.
- If a request is not understood, the device responds with the mnemonic code followed by **nok**. For chained commands in ATS400, this applies to each individual command.
- If no SI prefix is used for the command, the number is followed by a space.
- The transferred parameters are retained on the device; they are only overwritten when new parameters are transferred.
- The quotation marks in the "Example" column are only there to illustrate the length of the command with and without SI prefix and are not part of the command.

Attention

- The sequence of commands must be observed as shown in the table.
- The commands marked with an asterisk (*) are optional. They only need to be transferred if the functionality is required.

	Command	Answer	Example	From firmware	Description
1	**MRC0**	**MRC0**	S 'MRC0' R 'MRC0'	33341	0(zero): Uses the DC3 module for the insulation test. This value is preset.
	MRC1	**MRC1**	S 'MRC1' R 'MRC1'		1: Uses the DC7 module for the insulation test. The **ATS 400** must be equipped accordingly and the function activated.
2	**MRUPvxxxxxxs**	**MRUPvxxxxxxs**	S 'MRUP+000500 ' R 'MRUP+000500 '		Sets the voltage as a test parameter. U = 500 V
3	**MRRXvxxxxxxs**	**MRRXvxxxxxxs**	S 'MRRX+000950k' R 'MRRX+000950k'		Sets the minimum resistance as a test parameter. Rmin = 950 kOhm
4	**MRTPvxxxxxxs**	**MRTPvxxxxxxs**	S 'MRTP+002.00 ' R 'MRTP+002.00 '		Sets the test time as a test parameter. t = 2,00 s
5	**MRTUvxxxxxxs**	**MRTUvxxxxxxs**	S 'MRTU+000.00 ' S 'MRTU+000.00 '		Sets the ramp time for the rising edge as a test parameter. **If the value 0 is transferred, the ramp is not active.** t = 0 s
6	**MRTDvxxxxxxs**	**MRTDvxxxxxxs**	S 'MRTD+000.00 ' R 'MRTD+000.00 '		Sets the ramp time for the falling edge as a test parameter. **If the value 0 is transferred, the ramp is not active.** t = 0 s
7	**MRUSvxxxxxxs**	**MRUSvxxxxxxs**	S 'MRUS+000.00 ' R 'MRUS+000.00 '		Sets the start voltage of the ramp as a test parameter. U = 0 V
8	**MRUEvxxxxxxs**	**MRUEvxxxxxxs**	S 'MRUE+000025 ' R 'MRUE+000025 '	33341	Sets the discharge voltage as a test parameter (adjustable from 10 to 45V) U = 25 V
9	**MRCOvxxxxxxs**	**MRCOvxxxxxxs**	S 'MRCO+000000 ' R 'MRCO+000000 '	33476	This command is used to set the polarity. The polarity can be used to interconnect the insulation test. Attention: **Simultaneous use of the relay matrix and the ETL-Interface is only possible from version 33581 of the IO-CPU. Either a relay matrix or the outputs on the ETL-Interface can be used.**

	Command	Answer	Example	From firmware	Description
					Please refer to the documentation for the device to find out how the wiring is carried out. Polarity values: 'XXXX+00000**0** ' = No relay matrix active and no interconnection active. 'XXXX+00000**1** ' = No relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+00000**2** ' = No relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+00000**3** ' = No relay matrix active and both interconnections active. 'XXXX+0**65280** ' = Relay matrix active and both circuits not active. 'XXXX+0**65281** ' = Relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+0**65282** ' = Relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+0**65283** ' = Relay matrix active and both interconnections active. 'XXXX+0**65535** ' = Relay matrix active and no interconnection active. With **000001** bis **000003,** only the relay outputs of the ETL-interface are switched. With **065280** bis **065283,** the relay outputs of the ETL-interface are also switched and the corresponding switching times are waited for. This is done in parallel with the switching in the matrix modules. With **065535** only the matrix modules are switched. **Attention:** In the command **MRCO** , the letter **O** must be used and not the number **0 (zero)**.
10	**MRTCvxxxxxxs** *	**MRTCvxxxxxxs**	S 'MRTC+000001 ' R 'MRTC+000001 '	335xx	This command activates the temperature-compensated test for the insulation test. To use this mode, it is necessary to transfer the scaling data, the connection of the analog sensor, the base temperature and the material constant beforehand. The following values are permissible: 'XXTC+00000**0** ' = No temperature compensation (factory setting). 'XXTC+00000**1** ' = temperature compensation at > 40 °C 'XXTC+00000**2** ' = temperature compensation at > Basistemperatur 'XXTC+00000**3** ' = temperature compensation at > 10 °C 'XXTC+00000**4** ' = Always perform temperature compensation. Temperaturcompensation, Scaling data
11	**STPAvxxxxxxs**	**STPAvxxxxxxs**	S 'STPA+000004 ' R 'STPA+000004 '		This command can be used to set the test type. After setting the test type, it can take up to 200 ms until closed contact monitoring is detected via the status request command. Test type values: 'STPA+00000**0** ' = No test type 'STPA+00000**1** ' = High-voltage test 'STPA+00000**2** ' = Function test 'STPA+00000**3** ' = Protective earth test 'STPA+00000**4** ' = Insulation test 'STPA+00000**5** ' = Leakage current test 'STPA+00000**6** ' = Resistance test 'STPA+0000**20** ' = Continuity test with DC4 module 'STPA+0000**21** ' = Voltage measurement 'STPA+0000**22** ' = Symmetry test 'STPA+0000**23** ' = Protective earth test with resistance module
12	**STSC xxxx yyyy**	**STSC**	S 'STSC 0003 0000' R 'STSC'		Sets the start conditions of the test so that they can be evaluated before and during the test. The safety circuit is always active during high-voltage tests. hex 3 = 00**11** (**Bit0 = Start button**, **Bit1 = Safety circuit**)

5.2.2 Perform test

	Query	Answer	Example	From firmware	Description
	GETS?	**GETSxxxx**	S 'GETS?' R 'GETS5086'		This query is used to determine whether it is possible to start a test. 5086 hex = 0101 0000 1000 0110 (Bit0 = 0: Start button not pressed, Bit1 = 1: Safety circuit closed, Bit2 = 1: Contact monitoring closed, Bit13 = 0 : Parameter download is completed) To start a test with the **ATS 400**, Bit13 must not be set and Bit14 or Bit15 must be set. Depending on the test type, further Bits must or can be set. Bit1 must also be set for all high-voltage tests and the insulation test. Status query. **Caution:** If Bit13 is not removed after a timeout of 1s, the diagnostic data must be deleted with the commands SY* and HV* can be retrieved. The commands and descriptions can be found in the chapter Diagnostic data.
	MRST	**MRST**	S 'MRST' R 'MRST'		This command starts the insulation test. **Attention:** The start command is transmitted after the start conditions have been fulfilled, parameter download is completed (Bit13 not set) and Bit14 (or Bit15) is set. The status query is carried out using the **GETS?** command (more on this in the Examples section).
	MRC_?	**MRC_+xxxxxxs**	S 'MRC_?' R 'MRC_+000000 '	33341	Queries which module is configured for the insulation test. MRC+000000 = DC3 module is set. MRC+000001 = DC7 module is set.
	MRIR?	**MRIRvxxxxxxs zz**	S 'MRIR?' R 'MRIR+000989k 01'		Returns the current resistance as a measured value. The measured value is limited to the measuring range. If the value of the range limit is returned as the measured value, the actual value can also be greater. R = 989 kOhm, 01 = test active (status of the test).
	MRIU?	**MRIUvxxxxxxs zz**	S 'MRIU?' R 'MRIU+000500 01'		Returns the current voltage as a measured value and the test status. At the end of the test, the last measured voltage. If a breakdown occurs during the test, the voltage is returned immediately before the breakdown U = 500 V, 01 =test active (status of the test).
	MRRU?	**MRRUvxxxxxxs zz**	S 'MRRU?' R 'UAUC+001001 01'	33528	Returns the current voltage during the test and the voltage valid for the test as a measured value after the test. U = 1001 V, 01 = test active (status of the test).
	MRNR? *	**MRNRvxxxxxxs zz**	S 'MRNR?' R 'MRNR+000989k 01'	335xx	Returns the uncompensated resistance. **This value is only valid if an insulation test with temperature compensation is performed.** R = 989 kOhm, 01 = test active (status of the test).
	MRTE? *	**MRTEvxxxxxxs zz**	S 'MRTE?' R 'MRTE+0020.0 01'	335xx	Returns the temperature used for the insulation test with temperature compensation. **This value is only valid if an insulation test with temperature compensation is performed.** T = 20°C, 01 = test active (status of the test).
	ERIN?	**ERINvxxxxxxs**	S 'ERIN?' R 'ERIN+000000 '	33297	This command can be used to query the error information. This field is updated at the end of the check. During the check, this field is filled with zeros. In Case of error, the response is a number in the range from 48 to 53. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).
	MRSP	**MRSP**	S 'MRSP' R 'MRSP'		This command stops the insulation test. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).

5.2.3 Example

5.2.3.1 Individual commands

	Command	Description
	Query device information	
S	'GFWS?'	Firmware
R	'GFWS33624 23529'	IO-CPU = 33624, LT-CPU = 23529

	Command	Description
S	'RQSN?'	Serial number
R	'RQSN211917 0222 1534'	SN = 2119170 0222 1534
Transfer test parameters		
S	'MRC0'	Uses the DC3 module for the insulation test
R	'MRC0'	
S	'MRUP+000500 '	U = 500 V
R	'MRUP+000500 '	
S	'MRRX+000950k'	Rmin = 950 kOhm
R	'MRRX+000950k'	
S	'MRTP+002.00 '	t = 2,00 s
R	'MRTP+002.00 '	
S	'MRTU+000.00 '	tRampe up = 0 s
R	'MRTU+000.00 '	
S	'MRTD+000.00 '	tRampe down = 0s
R	'MRTD+000.00 '	
S	'MRUS+000.00 '	U = 0 V (Start voltage of the ramp)
R	'MRUS+000.00 '	
S	'MRUE+000025 '	U = 25 V (Discharge voltage)
R	'MRUE+000025 '	
S	'STPA+000004 '	Activate Insulation test
R	'STPA+000004 '	
S	'STSC 0003 0000'	Set safety circuit and start button as start condition
R	'STSC'	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS7082'	011**1** 0000 1000 00**1**0 Bit1 = 1: Safety circuit closed, Bit13 = 1 : Parameters are still being processed
S	'GETS?'	Status query
R	'GETS5887'	01**0**1 1000 1000 0**111** Bit0 = 1: Start button pressed, Bit2 = 1: contact monitoring closed, Bit13 = 0 : Parameter download is completed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'MRST'	Start test
R	'MRST'	
Measured values query		
S	'MRIR?'	Resistance
R	'MRIR+000000 **00**'	**00** test not yet active
S	'MRIU?'	Voltage
R	'MRIU+000000f **00**'	**00** test not yet active
S	'PTI_?'	Test duration

	Command	Description
R	'PTI_ 000000m'	t = 0ms
S	'MRIR?'	Resistance
R	'MRIR+000000 **07**'	**07** test active, but no valid measured values
S	'MRIU?'	Voltage
R	'MRIU+000500 **07**'	**07** test active, but no valid measured values
S	'PTI_?'	Test duration
R	'PTI_ 000010m'	t = 10 ms
S	'MRIR?'	Resistance
R	'MRIR+000993k **01**'	R = 993 kOhm, **01** test active
S	'MRIU?'	Voltage
R	'MRIU+000500 **01**'	U = 500 V, **01** test active
S	'PTI_?'	Test duration
R	'PTI_ 000660m'	t = 660 ms
S	'MRIR?'	Resistance
R	'MRIR+000991k **02**'	R = 991 kOhm, **02** test completed IO (passed)
S	'MRIU?'	Voltage
R	'MRIU+000000 **02**'	**02** test completed IO (passed) (in the ISO test, the voltage is not maintained after the test time has elapsed, the measured value must be taken before the end of the test time)
S	'PTI_?'	Test duration
R	'PTI_ 002000m'	t = 2000 ms
Error query		
S	'ERIN?'	Error query
R	'ERIN+000000 '	No Error
Test stop		
S	'MRSP'	Stop Test
R	'MRSP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000004 ') only needs to be transmitted before starting.

Example:
'STPA+000004 '
'MRST'

5.2.3.2 Chained commands

From IO-CPU version 33537 it is possible to chain commands.

	Command	Description
Query device information		
S	'GFWS?;RQSN?'	Firmware and serial number

	Command	Description
R	'GFWS33624 23529;RQSN211917 0222 1534'	IO-CPU = 33624, LT-CPU = 23529, SN = 2119170 0222 1534
	Transfer test parameters	
S	'MRC0;MRUP+000500 ;MRRX+000950k;MRTP+002.00 ;MRTU+000.00 ;MRTD+000.00 ;MRUS+000.00 ; MRUE+000025 ;STPA+000004 ;STSC 0003 0000'	Description in "Individual commands"
R	'MRC0;MRUP+000500 ;MRRX+000950k;MRTP+002.00 ;MRTU+000.00 ;MRTD+000.00 ;MRUS+000.00 ; MRUE+000025 ;STPA+000004 ;STSC'	
	Status query before start (parameters download, start conditions, ...)	
S	'GETS?'	Status query
R	'GETS7082'	0111 0000 1000 0010 Bit1 = 1: Safety circuit closed, Bit13 = 1 : Parameters are still being processed
S	'GETS?'	Status query
R	'GETS5887'	0101 1000 1000 0111 Bit0 = 1: Start button pressed, Bit2 = 1: contact monitoring closed, Bit13 = 0 : Parameter download is completed.
	Parameter Download is completed and the start conditions have been met. Start Test	
S	'MRST'	Start test
R	'MRST'	
	Measured values query	
S	'MRIR?;MRIU?;PTI_?'	Current resistance; current voltage; current test duration
R	'MRIR+000000 **00**;MRIU+0000.1 **00**;PTI_+000.00 '	**00** test not yet active
S	'MRIR?;MRIU?;PTI_?'	Current resistance; current voltage; current test duration
R	'MRIR+000000f **07**;MRIU+0488.4 **07**;PTI_+000.00 '	**07** test active, but no valid measured values
S	'MRIR?;MRIU?;PTI_?'	Current resistance; current voltage; current test duration
R	'MRIR+001001k **01**;MRIU+0501.4 **01**;PTI_+001.72 '	**01** test active, R = 1001 kOhm, U = 501,4 V, t = 1,72 s
S	'MRIR?;MRIU?;PTI_?'	Current resistance; current voltage; current test duration
R	'MRIR+001001k **02**;MRIU+0020.2 **02**;PTI_+002.00 '	**02** test completed IO (passed), R = 1001 kOhm, t = 2,00 s (in the ISO test, the voltage is not maintained after the test time has elapsed, the measured value must be taken before the end of the test time)
	Error query	
S	'ERIN?'	Error query
R	'ERIN+000000 '	No Error
	Test stop	
S	'MRSP'	Stop test
R	'MRSP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000004 ') only needs to be transmitted before starting.

Example:
'STPA+000004 '
'MRST'

5.2.4 Error number insulation

The error information is queried with the command '**ERIN?**'.

Wert	Bedeutung
48	Test NIO (Failed): Test voltage
	The necessary high voltage could not be generated. The following causes are possible: - There is a short circuit in the test object. - The test was started when handling test pistols at the same test point. - There is a defect in the appliance.
49	Resistance undercut
	The resistance is less than the lower limit value.
50	Resistance exceeded
	The resistance is greater than the upper limit value..
51	Permitted deviation exceeded.
	The difference between two insulation tests is greater than the limit value for the deviation.
52	Discharge time exceeded.
	After the test, the voltage could not be reduced below the discharge voltage within the discharge time.
53	Voltage exceeded.
	After switching on or after the end of the ramp, the voltage is too high.
54	Voltage too high.
	After switching on or after the end of the ramp, the voltage is too high.

5.3 Protective earth test

This chapter describes the ASCII commands for parameterizing and querying the measured values for the protective earth test.

5.3.1 Set parameter

Attention

- Data is exchanged according to the master/slave principle. The ETL device is the slave.
- Each request is acknowledged with a corresponding response. Only after the response is received can the next command be sent. In the case of chained commands in ATS400, this applies to the entire chain.
- If a request is not understood, the device responds with the mnemonic code followed by **nok**. For chained commands in ATS400, this applies to each individual command.
- If no SI prefix is used for the command, the number is followed by a space.
- The transferred parameters are retained on the device; they are only overwritten when new parameters are transferred.
- The quotation marks in the "Example" column are only there to illustrate the length of the command with and without SI prefix and are not part of the command.

Attention

- The sequence of commands must be observed as shown in the table.
- The commands marked with an asterisk (*) are optional. They only need to be transferred if the functionality is required.

	Command	Answer	Example	From firmware	Description
1	**RSIPvxxxxxxs**	**RSIPvxxxxxxs**	S 'RSIP+000010 ' R 'RSIP+000010 '		Sets the test current as a test parameter. I = 10 A
2	**RSUPvxxxxxxs**	**RSUPvxxxxxxs**	S 'RSUP+000012 ' R 'RSUP+000012 '		Sets the open-circuit voltage as the test parameter. U = 12 V
3	**RSRXvxxxxxxs**	**RSRXvxxxxxxs**	S 'RSRX+000100m' R 'RSRX+000100m'		Sets the maximum resistance as a test parameter. Rmax = 100 mOhm
4	**RSTPvxxxxxxs**	**RSTPvxxxxxxs**	S 'RSTP+002.00 ' R 'RSTP+002.00 '		Sets the test time as a test parameter. t = 2,00 s
5	**RSF0vxxxxxxs**	**RSF0vxxxxxxs**	S 'RSF0+0050.0 ' S 'RSF0+0050.0 '		Sets the frequency as a test parameter. F = 50 Hz **Attention**: In the command **RSF0**, the number **0 (zero)** must be used and not the letter **O**.
6	**RSC0** * **RSC1**	**RSC0** **RSC1**	S 'RSC0' R 'RSC0' S 'RSC1' R 'RSC1'	33446	0(zero): Alternating current is used as the current. This is the default setting when the device is switched on. 1: Direct current is used as the current.
7	**RSFLvxxxxxxs** *	**RSFLvxxxxxxs**	S 'RSFL+000000 ' R 'RSFL+000000 '	33614	This command is used to select the source for the current measurement. This command is only required if you have equipment with current clamps. 'RSFL+000000 ' = Current measurement is carried out via the built-in measuring board.

	Command	Answer	Example	From firmware	Description
					'RSFL+000001 ' = Current measurement is carried out via an external current clamp.
8	**RSANvxxxxxxs** *	**RSANvxxxxxxs**	S 'RSAN+000000 ' R 'RSAN+000000 '	33614	This command is used to select the current clamp for the current measurement. **This command is only required if you have equipment with current clamps and have configured these as a current measurement source.** In this case, you must also transfer the Scaling data. Permitted values: 'RSAN+00000**0** ' = Analog input 1 is used. 'RSAN+00000**1** ' = Analog input 2 is used. 'RSAN+00000**2** ' = Analog input 3 is used.. 'RSAN+00000**3** ' = Analog input 4 is used.
9	**RSCOvxxxxxxs**	**RSCOvxxxxxxs**	S 'RSCO+000000 ' R 'RSCO+000000 '	33453	This command is used to set the polarity. The polarity can be used to connect the protective conductor test. Attention: **Simultaneous use of the relay matrix and the ETL-Interface is only possible from version 33581 of the IO-CPU. Either a relay matrix or the outputs on the ETL-Interface can be used.** Please refer to the documentation for the device to find out how the wiring is carried out. Polarity values: 'XXXX+00000**0** ' = No relay matrix active and no interconnection active. 'XXXX+00000**1** ' = No relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+00000**2** ' = No relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+00000**3** ' = No relay matrix active and both interconnections active. 'XXXX+0**65280** ' = Relay matrix active and both circuits not active. 'XXXX+0**65281** ' = Relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+0**65282** ' = Relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+0**65283** ' = Relay matrix active and both interconnections active. 'XXXX+0**65535** ' = Relay matrix active and no interconnection active. With **000001** bis **000003,** only the relay outputs of the ETL-interface are switched. With **065280** bis **065283,** the relay outputs of the ETL-interface are also switched and the corresponding switching times are waited for. This is done in parallel with the switching in the matrix modules. With **065535** only the matrix modules are switched. **Attention:** In the command **RSCO** , the letter **O** must be used and not the number **0 (zero)**.
10	**STPAvxxxxxxs**	**STPAvxxxxxxs**	S 'STPA+000003 ' R 'STPA+000003 '		This command can be used to set the test type. After setting the test type, it can take up to 200 ms until closed contact monitoring is detected via the status request command. Test type values: 'STPA+00000**0** ' = No test type 'STPA+00000**1** ' = High-voltage test 'STPA+00000**2** ' = Function test 'STPA+00000**3** ' = Protective earth test 'STPA+00000**4** ' = Insulation test 'STPA+00000**5** ' = Leakage current test 'STPA+00000**6** ' = Resistance test 'STPA+0000**20** ' = Continuity test with DC4 module 'STPA+0000**21** ' = Voltage measurement 'STPA+0000**22** ' = Symmetry test 'STPA+0000**23** ' = Protective earth test with resistance module
11	**STSC xxxx yyyy**	**STSC**	S 'STSC 0008 0000' R 'STSC'		Sets the start conditions of the test so that they can be evaluated before and during the test. The safety circuit is always active during high-voltage tests. hex 8 = **1**000 (**Bit3 = 1:** start button on the composite test probe is pressed).

5.3.2 Perform test

	Query	Answer	Example	From firmware	Description
	GETS?	**GETSxxxx**	S 'GETS?' R 'GETS5883'		This query is used to determine whether it is possible to start a test. 5883 hex = 0101 0000 1000 0011 (Bit0 = 1: Start button pressed., Bit1 = 1: Safety circuit closed, Bit13 = 0 : Parameter download is completed) To start a test with the **ATS 400**, Bit13 must not be set and Bit14 or Bit15 must be set. Depending on the test type, further Bits must or can be set. Bit1 must also be set for all high-voltage tests and the insulation test. Status query. **Caution**: If Bit13 is not removed after a timeout of 1s, the diagnostic data must be deleted with the commands SY* can be retrieved. The commands and descriptions can be found in the chapter Diagnostic data.
	RSST	**RSST**	S 'RSST' R 'RSST'		This command starts the protective earth test. **Attention:** The start command is transmitted after the start conditions have been fulfilled, parameter download is completed (Bit13 not set) and Bit14 (or Bit15) is set. The status query is carried out using the **GETS?** command (more on this in the Examples section).
	RSIR?	**RSIRvxxxxxxs zz**	S 'RSIR?' R 'MRIR+000102m 01'		Returns the current resistance as a measured value. At the end of the test, the max. resistance. R = 102 mOhm, 01 = test active (status of the test).
	RSII?	**RSIIvxxxxxxs zz**	S 'RSII?' R 'RSII+010023m 01'		Returns the current current as a measured value. I = 10023 mA, 01 = test active (status of the test).
	RSIU?	**RSIUvxxxxxxs zz**	S 'RSIU?' R 'RSIU+001001 01'	33528	Returns the current voltage as a measured value. U = 1001 V, 01 = test active (status of the test).
	ERIN?	**ERINvxxxxxxs**	S 'ERIN?' R 'ERIN+000000 '	33297	This command can be used to query the error information. This field is updated at the end of the test. During the test, this field is filled with zeros. In Case of error, the response is a number in the range from 80 to 83. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).
	RSSP	**RSSP**	S 'RSSP' R 'RSSP'		This command stops the protective earth test. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).

5.3.3 Example

5.3.3.1 Individual commands

	Command	Description
Query device information		
S	'GFWS?'	Firmware
R	'GFWS33624 23529'	IO-CPU = 33624, LT-CPU = 23529
S	'RQSN?'	Serial number
R	'RQSN211917 0222 1534'	SN = 2119170 0222 1534
Transfer test parameters		
S	'RSIP+000010 '	I = 10 A
R	'RSIP+000010 '	
S	'RSUP+000012 '	U = 12 V
R	'RSUP+000012 '	

	Command	Description
S	'RSRX+000130m'	Rmax = 130 mOhm
R	'RSRX+000130m'	
S	'RSTP+002.00 '	t = 2,00 s
R	'RSTP+002.00 '	
S	'RSF0+0050.0 '	F = 50,0 Hz
R	'RSF0+0050.0 '	
S	'RSCO+000000 '	No polarity
R	'RSCO+000000 '	
S	'STPA+000003 '	Activate protective earth test
R	'STPA+000003 '	
S	'STSC 0001 0000'	Start button as start condition
R	'STSC'	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS5082'	0**1**0**1** 0000 1000 00**1**0 Bit1 = 1: Safety circuit closed, Bit13 = 0 : Parameter download is completed.
S	'GETS?'	Status query
R	'GETS5883'	0**1**0**1** 0000 1000 00**11** Bit0 = 1: Start button pressed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'RSST'	Start test
R	'RSST'	
Measured values query		
S	'RSIR?'	Resistance
R	'RSIR+000000 **00**'	**00** test not yet active
S	'RSII?'	Current
R	'RSII+006553k **00**'	**00** test not yet active
S	'PTI_?'	Test duration
R	'PTI_+000.00 '	t = 0,00 s
S	'RSIR?'	Resistance
R	RSIR+000000 **07**'	**07** test active, but no valid measured values
S	'RSII?'	Current
R	RSII+006553k **07**'	**07** test active, but no valid measured values
S	'PTI_?'	Test duration
R	'PTI_+000.00 '	t = 0 s
S	'RSIR?'	Resistance
R	'RSIR+000130m **01**'	R = 130 mOhm, **01** test active
S	'RSII?'	Current
R	'RSII+009952m **01**'	I = 9952 mA, **01** test active

	Command	Description
S	'PTI_?'	Test duration
R	'PTI_+000.54 '	t = 0,54 s
S	'RSIR?'	Resistance
R	'RSIR+000131m **03**'	R = 131 mOhm, **03** test completed NIO (Failed)
S	'RSII?'	Current
R	'RSII+009997m **03**'	I = 9997 mA **03** test completed NIO (Failed)
S	'PTI_?'	Test duration
R	'PTI_+002.00 '	t = 2,00 s
Error query		
S	'ERIN?'	Error query
R	'ERIN+000080 '	Resistance exceeded (measured value = 131 mOhm > Rmax= 130 mOhm)
Test stop		
S	'MRSP'	Stop test
R	'MRSP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000003 ') only needs to be transmitted before starting.

Example:
'STPA+000003 '
'RSST'

5.3.3.2 Chained commands

From IO-CPU version 33537 it is possible to chain commands.

	Command	Description
Geräte Informationen Abfragen		
S	'GFWS?;RQSN?'	Firmware and serial number
R	'GFWS33624 23529;RQSN211917 0222 1534'	IO-CPU = 33624, LT-CPU = 23529, SN = 2119170 0222 1534
Prüfparameter übertragen		
S	'RSIP+000010 ;RSUP+000012 ;RSRX+000110m;RSTP+002.00 ;RSF0+0050.0;RSCO+000000 ;STPA+000003 ;STSC 0000 0000'	Description in "Individual commands"
R	'RSIP+000010 ;RSUP+000012 ;RSRX+000110m;RSTP+002.00 ;RSF0+0050.0 ;RSCO+000000 ;STPA+000003 ;STSC'	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS5082' 0101 0000 1000 0010	0101 0000 1000 0010 Bit1 = 1: Safety circuit closed, Bit13 = 0 : Parameter download is completed.
S	'GETS?'	Status query
R	'GETS5883'	0101 0000 1000 0011 Bit0 = 1: Start button pressed.
Parameter Download is completed and the start conditions have been met. Start Test		

	Command	Description
S	'RSST'	Start test
R	'RSST'	
Measured values query		
S	'RSIR?;RSII?;PTI_?'	Resistance, Current, test duration
R	'RSIR+000000 **00**;RSII+006553k **00**;PTI_+000.00 '	**00** test not yet active
S	'RSIR?;RSII?;PTI_?'	Resistance, Current, test duration
R	'RSIR+000000 **07**;RSII+006553k **07**;PTI_+000.00 '	**07** test active, but no valid measured values
S	'RSIR?;RSII?;PTI_?'	Resistance, Current, test duration
R	'RSIR+000101m **01**;RSII+009872m **01**;PTI_+001.95 '	**01** test active, R = 101 mOhm, I = 9872 mA V, t = 1,95 s
S	'RSIR?;RSII?;PTI_?'	Resistance, Current, test duration
R	'RSIR+000101m **02**;RSII+010.00 **02**;PTI_+002.00 '	**02** test completed IO (passed), R = 101 mOhm, I = 10,00 A, t = 2,00 s
Error query		
S	'ERIN?'	Error query
R	'ERIN+000000 '	No error
Test stop		
S	'MRSP'	Stop test
R	'MRSP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000003 ') only needs to be transmitted before starting.

Example:
'STPA+000003 '
'RSST'

5.3.4 Error number protective earth

The error information is queried with the command '**ERIN?**'.

Wert	Bedeutung
80	Resistance exceeded.
	The measured resistance is greater than the upper limit value.
81	Minimum current not reached.
	The current cannot be set to the configured setpoint. The following causes are possible: - The test specimen is not contacted. - There is a cable break. - The tester has slipped with the test probe. - The tester has inadvertently started the test with the button on the test probe too early. - There is a defect in the appliance.
82	Resistance undercut.
	The measured resistance is less than the lower limit value.

Wert	Bedeutung
83	Scaling data missing.
	No scaling data for the current clamp has been transferred. When using the current clamp, these must be available before starting the test.

5.4 Power consumption test

In diesem Kapilet werden die ASCII-Kommandos für das Parametrieren und Abfragen der Messwerte für die Stromaufnahmeprüfung beschrieben.

5.4.1 Set parameter

Attention

- Data is exchanged according to the master/slave principle. The ETL device is the slave.
- Each request is acknowledged with a corresponding response. Only after the response is received can the next command be sent. In the case of chained commands in ATS400, this applies to the entire chain.
- If a request is not understood, the device responds with the mnemonic code followed by **nok**. For chained commands in ATS400, this applies to each individual command.
- If no SI prefix is used for the command, the number is followed by a space.
- The transferred parameters are retained on the device; they are only overwritten when new parameters are transferred.
- The quotation marks in the "Example" column are only there to illustrate the length of the command with and without SI prefix and are not part of the command.

Attention

- The sequence of commands must be observed as shown in the table.
- The commands marked with an asterisk (*) are optional. They only need to be transferred if the functionality is required.

	Command	Answer	Example	From firmware	Description
1	**SPUPvxxxxxxs**	**SPUPvxxxxxxs**	S 'SPUP+000230 ' R 'SPUP+000230 '		Sets the voltage as a test parameter. U = 230 V
2	**SPF0vxxxxxxs**	**SPF0vxxxxxxs**	S 'RSF0+000050 ' R 'RSF0+000050 '		Sets the frequency as a test parameter. F = 50 Hz **Attention**: In the SPF0 command, the number **0 (zero)** must be used and not the letter **O**.
3	**SPIMvxxxxxxs**	**SPIMvxxxxxxs**	S 'SPIM+000.45 ' R 'SPIM+000.45 '		Sets the lower current limit value as the test parameter. Imin = 0,45 A
4	**SPIXvxxxxxxs**	**SPIXvxxxxxxs**	S 'SPIX+000.55 ' R 'SPIX+000.55 '		Sets the upper current limit value as the test parameter. Imax = 0,55 A
5	**SPTPvxxxxxxs**	**SPTPvxxxxxxs**	S 'SPTP+0002.0 ' R 'SPTP+0002.0 '		Sets the test time as a test parameter. t = 2,0 s
6	**SPQPvxxxxxxs**	**SPQPvxxxxxxs**	S 'SPQP+000001 ' R 'SPQP+000001 '		Sets the test source as test parameter. Hereby the following values are valid: 'SPQP+00000**0** ' = Power supply. 'SPQP+00000**1** ' = Settable from 0 to 270 Volt AC. 'SPQP+00000**2** ' = Externally settable. 'SPQP+00000**3** ' = Settable from 0 to 24 Volt AC. 'SPQP+00000**4** ' = Settable from 0 to 36 Volt AC. 'SPQP+00000**5** ' = External supply. 'SPQP+00000**6** ' = Settable from 0 to 270 Volt DC. 'SPQP+00000**7** ' = External supply with super elevation.

	Command	Answer	Example	From firmware	Description
7	SPMPvxxxxxxs	SPMPvxxxxxxs	S 'SPMP+000000 ' R 'SPMP+000000 '		Sets the voltage management as a test parameter. Hereby the following values are valid: 'SPMP+00000**0** ' = Turn off after test. 'SPMP+00000**1** ' = Leave on after test. 'SPMP+00000**2** ' = Only turn off. 'SPMP+00000**3** ' = Turn off in case of an error, otherwise leave on. 'SPMP+00000**4** ' = Only turn on.
8	SPPPvxxxxxxs	SPPPvxxxxxxs	S 'SPPP+000000 ' R 'SPPP+000000 '		Sets the test mode as a test parameter. 'SPPP+00000**0** ' = Current consumption test. 'SPPP+00000**1** ' = Visual test.
9	SPSSvxxxxxxs	SPSSvxxxxxxs	S 'SPSS+000000 ' R 'SPSS+000000 '		Sets the start scenario as a test parameter. Hereby the following values are valid: 'SPSS+00000**0** ' = After delay. 'SPSS+00000**1** ' = After exceeding the minimum threshold. 'SPSS+00000**2** ' = After exceeding the minimum threshold and subsequent delay. 'SPSS+00000**3** ' = After falling below the gradient. 'SPSS+00000**4** ' = After falling below the maximum threshold 'SPSS+00000**5** ' = After falling below the maximum threshold and subsequent delay
10	SPTSvxxxxxxs	SPTSvxxxxxxs	S 'SPTS+0000.5 ' R 'SPTS+0000.5 '		Sets the start time as a test parameter. The start time defines the delay in the start. t = 0,5 s Only used if SPSS has the value 00000**0** or 00000**2** or 00000**5**.
11	SPTAvxxxxxxs	SPTAvxxxxxxs	S 'SPTA+0010.0 ' R 'SPTA+0010.0 '		Sets the timeout time of the start scenario as a test parameter. This time defines how long it is waited for the reach of the start scenario. t = 10,0 s
12	SPIAvxxxxxxs	SPIAvxxxxxxs	S 'SPIA+010000m' R 'SPIA+010000m'		Sets the release value as a test parameter. When this value is exceeded the tets will be cancelled. I = 10000 mA
13	SPLPvxxxxxxs	SPLPvxxxxxxs	S 'SPLP+000004 ' R 'SPLP+000004 '		Sets the measurement channel as a test parameter. The value always has to be 4. 'SPLP+00000**4** ' = Alternating current effective value.
14	SPISvxxxxxxs	SPISvxxxxxxs	S 'SPIS+000000 ' R 'SPIS+000000 '		Sets the gradient as a test parameter. This parameter is used as a gradient in the start scenario. Only used if SPSS has the value 00000**3**.
15	SPCOvxxxxxxs	RSCOvxxxxxxs	S 'SPCO+000000 ' R 'SPCO+000000 '	33453	This command is used to set the polarity. The polarity can be used to connect the protective conductor test. Attention: **Simultaneous use of the relay matrix and the ETL-Interface is only possible from version 33581 of the IO-CPU. Either a relay matrix or the outputs on the ETL-Interface can be used.** Please refer to the documentation for the device to find out how the wiring is carried out. Polarity values: 'XXXX+00000**0** ' = No relay matrix active and no interconnection active. 'XXXX+00000**1** ' = No relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+00000**2** ' = No relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+00000**3** ' = No relay matrix active and both interconnections active. 'XXXX+0**65280** ' = Relay matrix active and both circuits not active. 'XXXX+0**65281** ' = Relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+0**65282** ' = Relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+0**65283** ' = Relay matrix active and both interconnections active. 'XXXX+0**65535** ' = Relay matrix active and no interconnection active. With **000001** bis **000003,** only the relay outputs of the ETL-interface are switched.

	Command	Answer	Example	From firmware	Description
					With **065280** bis **065283,** the relay outputs of the ETL-interface are also switched and the corresponding switching times are waited for. This is done in parallel with the switching in the matrix modules. With **065535** only the matrix modules are switched. **Attention**: In the command **SPCO** , the letter **O** must be used and not the number **0 (zero)**.
16	**STPAvxxxxxxs**	**STPAvxxxxxxs**	S 'STPA+000002 ' R 'STPA+000002 '		This command can be used to set the test type. After setting the test type, it can take up to 200 ms until closed contact monitoring is detected via the status request command. Test type values: 'STPA+00000**0** ' = No test type 'STPA+00000**1** ' = High-voltage test 'STPA+00000**2** ' = Function test 'STPA+00000**3** ' = Protective earth test 'STPA+00000**4** ' = Insulation test 'STPA+00000**5** ' = Leakage current test 'STPA+00000**6** ' = Resistance test 'STPA+0000**20** ' = Continuity test with DC4 module 'STPA+0000**21** ' = Voltage measurement 'STPA+0000**22** ' = Symmetry test 'STPA+0000**23** ' = Protective earth test with resistance module
17	**STSC xxxx yyyy**	**STSC**	S 'STSC 0003 0000' R 'STSC'		Sets the start conditions of the test so that they can be evaluated before and during the test. The safety circuit is always active during high-voltage tests. hex 3= 0011(Bit0= Start button, Bit1= Safety circuit)

5.4.2 Perform test

	Command	Answer	Example	From firmware	Description
	GETS?	**GETSxxxx**	S 'GETS?' R 'GETS5086'		This query is used to determine whether it is possible to start a test. 5086 hex = 0**1**0**1** 0000 1000 0**11**0 (Bit0 = 0: Start button not pressed, Bit1 = 1: Safety circuit closed, Bit2 = 1: Contact monitoring closed, Bit13 = 0 : Parameter download is completed). To start a test with the **ATS 400**, Bit13 must not be set and Bit14 or Bit15 must be set. Depending on the test type, further Bits must or can be set. Bit1 must also be set for all high-voltage tests and the insulation test. Status query. **Caution**: If Bit13 is not removed after a timeout of 1s, the diagnostic data must be deleted with the commands SY* can be retrieved. The commands and descriptions can be found in the chapter Diagnostic data.
	SPST	**SPST**	S 'SPST' R 'SPST'		This command starts the power consumption test. **Attention:** The start command is transmitted after the start conditions have been fulfilled, parameter download is completed (Bit13 not set) and Bit14 (or Bit15) is set. The status query is carried out using the **GETS?** command (more on this in the Examples section).
	SPIU?	**SPIUvxxxxxxs zz**	S 'SPIU?' R 'SPIU+230000m 01'		Gives back the current voltage as a measured value. U = 230000 mV V, 01 = test active (status of the test).
	SPII?	**SPIIvxxxxxxs zz**	S 'SPII?' R 'SPII+000515m 01'		Gives back the instantaneous current as a measured value. I = 515 mA, 01 = test active (status of the test).
	ERIN?	**ERINvxxxxxxs**	S 'ERIN?' R 'ERIN+000000 '	33297	This command can be used to query the error information. This field is updated at the end of the check. During the check, this field is filled with zeros. In Case of error, the response is a number in the range from 64 to 74. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).
	SPSP	**SPSP**	S 'SPSP' R 'SPSP'		Stops the current consumption test. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error

	Command	Answer	Example	From firmware	Description
					(04) or aborted (06).

5.4.3 Example

5.4.3.1 Individual commands

	Command	Descriprtion
Query device information		
S	'GFWS?'	Firmware
R	'GFWS33624 23529'	IO-CPU = 33624, LT-CPU = 23529
S	'RQSN?'	Serial number
R	'RQSN211917 0222 1534'	SN = 2119170 0222 1534
Transfer test parameters		
S	'SPUP+000230 '	U = 230 V
R	'SPUP+000230 '	
S	'SPF0+000050 '	F = 50 Hz
R	'SPF0+000050 '	
S	'SPIM+000.45 '	I min = 0,45 A
R	'SPIM+000.45 '	
S	'SPIX+000.55 '	Imax = 0,55 A
R	'SPIX+000.55 '	
S	'SPTP+0002.0 '	t = 2,0 s
R	'SPTP+0002.0 '	
S	'SPQP+000001 '	Test source adjustable from 0 bis 270 Volt AC
R	'SPQP+000001 '	
S	'SPMP+000000 '	Voltage management: Turn off after test
R	'SPMP+000000 '	
S	'SPPP+000000 '	Power consumption test.
R	'SPPP+000000 '	
S	'SPSS+000000 '	Start scenario: After delay.
R	'SPSS+000000 '	
S	'SPTS+0000.5 '	Determines the delay in the start scenario, t = 0,5 s
R	'SPTS+0000.5 '	
S	'SPTA+0010.0 '	Timeout time for the start scenario, t = 10,0 s
R	'SPTA+0010.0 '	
S	'SPIA+010000m'	Release value I = 10000 mA
R	'SPIA+010000m'	
S	'SPLP+000004 '	The value always has to be 4
R	'SPLP+000004 '	

	Command	Descriprtion
S	'SPCO+000000 '	No polarity
R	'SPCO+000000 '	
S	'STPA+000002 '	Activate Power consumption test
R	'STPA+000002 '	
S	'STSC 0003 0000'	Set safety circuit and start button as start condition
R	'STSC'	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS6082'	0**11**0 0000 1000 00**1**0 Bit1 = 1: Safety circuit closed, Bit13 = 1 : Parameters are still being processed.
S	'GETS?'	Status query
R	'GETS4083'	0**10**0 0000 1000 00**11** Bit0 = 1: Start button pressed, Bit13 = 0 : Parameter download is completed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'SPST'	Start test
R	'SPST'	
Measured values query		
S	'SPIU?'	Voltage
R	'SPIU+000000 **00**'	**00** test not yet active
S	'SPII?'	Current
R	'SPII+000000 **00**'	**00** test not yet active
S	'PTI_?'	Test duration
R	'PTI_ 000000m'	t = 0ms
S	'SPIU?'	Voltage
R	'SPIU+230000m **01**'	**01** test active, U = 230000 mV
S	'SPII?'	Current
R	'SPII+000515m **01**'	**01** test active, I = 515 mA
S	'PTI_?'	Test duration
R	'PTI_+000180m'	t = 180 ms
S	'SPIU?'	Voltage
R	'SPIU+229900m **02**'	U = 22990 mV, **02** test completed IO (Passed)
S	'SPII?'	Current
R	'SPII+000515m **02**'	I = 515 mA, **02** test completed IO (Passed)
S	'PTI_?'	Test duration
R	'PTI_+002670m'	t = 2670 ms
Error query		
S	'ERIN?'	Error query
R	'ERIN+000000 '	error
Test stop		

	Command	Descriprtion
S	'SPSP'	Stop test
R	'SPSP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000002 ') only needs to be transmitted before starting.

Example:
'STPA+000002 '
'SPST'

5.4.3.2 Chained commands

From IO-CPU version 33537 it is possible to chain commands.

	Command	Descriprtion
Query device information		
S	'GFWS?;RQSN?'	Firmware and serial number
R	'GFWS33624 23529;RQSN211917 0222 1534'	IO-CPU = 33624, LT-CPU = 23529, SN = 2119170 0222 1534
Transfer test parameters		
S	'SPUP+000230 ;SPF0+000050 ;SPIM+000.45 ;SPIX+000.55 ;SPTP+0002.0 ;SPQP+000001 ;SPMP+000000; SPPP+000000 ;SPSS+000000 ;SPTS+0000.5 ;SPTA+0010.0 ;SPIA+010000m;SPLP+000004 ;SPCO+000000 ; STPA+000002 ;STSC 0003 0000'	Description in "Individual commands"
R	'SPUP+000230 ;SPF0+000050 ;SPIM+000.45 ;SPIX+000.55 ;SPTP+0002.0 ;SPQP+000001 ;SPMP+000000; SPPP+000000 ;SPSS+000000 ;SPTS+0000.5 ;SPTA+0010.0 ;SPIA+010000m;SPLP+000004 ;SPCO+000000 ; STPA+000002 ;STSC'	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS6082'	0110 0000 1000 0010 Bit1 = 1: Safety circuit closed, Bit13 = 1 : Parameters are still being processed.
S	'GETS?'	Status query
R	'GETS4083'	0100 0000 1000 0011 Bit0 = 1: Start button pressed, Bit13 = 0 : Parameter download is completed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'SPST'	Start test
R	'SPST'	
Measured values query		
S	'SPIU?;SPII?;PTI_?'	Voltage, current, test duration
R	'SPIU+000000 **00**;SPII+000000 **00**;PTI_ 000000m'	**00** test not yet active
S	'SPIU?;SPII?;PTI_?'	Voltage, current, test duration
R	'SPIU+230000m **01**;SPII+000515m **01**;PTI_+000180m'	**01** test active, U = 230000 mV, I = 515 mA, t = 180 ms
S	'SPIU?;SPII?;PTI_?'	Voltage, current, test duration
R	'SPIU+229900m **02**;SPII+000515m **02**;PTI_+002670m'	**02** test completed IO (Passed), U = 229900 mV,I = 515 mA, t = 2,00 s
Error query		

	Command	Descriprtion
S	'ERIN?'	Error query
R	'ERIN+000000 '	No error
	Test stop	
S	'SPSP'	Stop test
	'SPSP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000002 ') only needs to be transmitted before starting.

Example:
'STPA+000002 '
'RSST'

5.4.4 Error number power consumption

The error information is queried with the command '**ERIN?**'.

Wert	Bedeutung
64	Current limit for turn off exceeded.
	The measured current is greater than the switch-off current.
65	Upper limit exceeded.
	The measured value has exceeded the upper limit.
66	Lower limit not reached.
	Lower limit of current not reached for current consumption test.
67	Short circuit.
	A short circuit was detected at the start of the test.
68	Timeout start scenario.
	A start scenario with time monitoring is used and the configured time limit has been exceeded.
69	Reserved
70	Reserved
71	Error with external source.
	An error occurred during communication with the external source.
72	External voltage too low.
	The voltage supplied by the external voltage source is too low.
73	Voltage exceeded.
	The configured voltage has been exceeded.
74	Voltage too low.
	The voltage is too low.

5.5 Resistance test

In diesem Kapilet werden die ASCII-Kommandos für das Parametrieren und Abfragen der Messwerte für die Widerstandsprüfung beschrieben.

5.5.1 Set parameter

Attention

- Data is exchanged according to the master/slave principle. The ETL device is the slave.
- Each request is acknowledged with a corresponding response. Only after the response is received can the next command be sent. In the case of chained commands in ATS400, this applies to the entire chain.
- If a request is not understood, the device responds with the mnemonic code followed by **nok**. For chained commands in ATS400, this applies to each individual command.
- If no SI prefix is used for the command, the number is followed by a space.
- The transferred parameters are retained on the device; they are only overwritten when new parameters are transferred.
- The quotation marks in the "Example" column are only there to illustrate the length of the command with and without SI prefix and are not part of the command.

Attention

- The sequence of commands must be observed as shown in the table.
- The commands marked with an asterisk (*) are optional. They only need to be transferred if the functionality is required.

	Command	Answer	Example	From firmware	Description
1	**WITPvxxxxxxs**	**WITPvxxxxxxs**	S 'WITP+0001.0 ' R 'WITP+0001.0 '		Sets the test time as a test parameter. t = 1,0 s
2	**WITOvxxxxxxs**	**WITOvxxxxxxs**	S 'WITO+0000.8 ' R 'WITO+0000.8 '	33296	Sets the timeout value as a test parameter. If this command is not used, the measurement time is u s e d as the timeout time. t timeout = 0,8 s **Attention**: In the command **WITO** , the letter **O** must be used and not the number **0 (zero)**.
3	**WIRMvxxxxxxs**	**WIRMvxxxxxxs**	S 'WIRM+000010 ' R 'WIRM+000010 '		Sets the lower limit value as a test parameter. Rmin = 10 Ohm
4	**WIRXvxxxxxxs**	**WIRXvxxxxxxs**	S 'WIRX+000011 ' R 'WIRX+000011 '		Sets the upper limit value as a test parameter. Rmax = 11 Ohm
5	**WIROvxxxxxxs**	**WIROvxxxxxxs**	S 'WIRO+000000 ' R 'WIRO+000000 '		Sets the offset value as a test parameter. Roffset = 0 Ohm **Attention**: In the command **WIRO** , the letter **O** must be used and not the number **0 (zero)**.
6	**WIMBvxxxxxxs**	**WIMBvxxxxxxs**	S 'WIMB+000006 ' R 'WIMB+000006 '	33297	Sets the range as testparameter. In the case this parameter is not set the range Automatic will be used. Range = 6 (see measuring range by article below the table)
7	**WIMMvxxxxxxs**	**WIMMvxxxxxxs**	S 'WIMM+000000 ' R 'WIMM+000000 '	33459	Sets the measurement method. The following values are valid: 'WIMM+00000**0** ' = Resistance measurement. 'WIMM+00000**1** ' = Only temperature measurement. 'WIMM+00000**2** ' = Not compensated Resistance and temperature. 'WIMM+00000**3** ' = Compensated Resistance and temperature. 'WIMM+00000**4** ' = Continuity check.

	Command	Answer	Example	From firmware	Description
8	**WISRvxxxxxxs**	**WISRvxxxxxxs**	S 'WISR+000000 ' R 'WISR+000000 '	33459	Sets the type of the temperature sensor. The following values are valid: 'WISR+00000**0** ' = No temperature sensor. 'WISR+00000**1** ' = PT100. 'WISR+00000**2** ' = PT1000. 'WISR+00000**3** ' = NTC.
9	**WITRvxxxxxxs** *	**WITRvxxxxxxs**	S 'WITR+000000 ' R 'WITR+000000 '	33459	Sets the value of the resistance of the sensor at reference temperature. This value is used only for NTC type sensor and need not be set with other types.
10	**WITTvxxxxxxs** *	**WITTvxxxxxxs**	S 'WITT+000000 ' R 'WITT+000000 '	33459	Sets the value of the reference temperature of the sensor. This value is used only for NTC type sensor and need not be set with other types.
11	**WITBvxxxxxxs** *	**WITBvxxxxxxs**	S 'WITB+000000 ' R 'WITB+000000 '	33459	With this command the factor B of the sensor is set. This value is used only for NTC type sensor and need not be set with other types.
12	**WITMvxxxxxxs** *	**WITMvxxxxxxs**	S 'WITM+000000 ' R 'WITM+000000 '	33459	With this command the temperature coefficient of the tested material is set. The unit is 1/Kelvin.
13	**WIFSvxxxxxxs** *	**WIFSvxxxxxxs**	S 'WIFS+000000 ' R 'WIFS+000000 '	335xx	This command switches the stability criterion on or off as an end condition. The following values are permissible: 'WIFS+00000**0** ' = Stability criterion is not used. 'WIFS+00000**1** ' = Stability criterion is used. Is required when measuring the winding resistance of a motor which rotates as a result of the measurement and therefore induces a voltage.
14	**WITSvxxxxxxs** *	**WITSvxxxxxxs**	S 'WITS+000000 ' R 'WITS+000000 '	335xx	This command is used to transmit the time in which the stability criterion must be fulfilled. The maximum permissible time is 10 seconds.
15	**WIDSvxxxxxxs** *	**WIDSvxxxxxxs**	S 'WIDS+000000 ' R 'WIDS+000000 '	335xx	This command is used to transfer the permissible deviation in %.
16	**WICOvxxxxxxs**	**WICOvxxxxxxs**	S 'WICO+000000 ' R 'WICO+000000 '	33453	This command is used to set the polarity. The polarity can be used to connect the protective conductor test. Attention: **Simultaneous use of the relay matrix and the ETL-Interface is only possible from version 33581 of the IO-CPU. Either a relay matrix or the outputs on the ETL-Interface can be used.** Please refer to the documentation for the device to find out how the wiring is carried out. Polarity values: 'XXXX+00000**0** ' = No relay matrix active and no interconnection active. 'XXXX+00000**1** ' = No relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+00000**2** ' = No relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+00000**3** ' = No relay matrix active and both interconnections active. 'XXXX+0**65280** ' = Relay matrix active and both circuits not active. 'XXXX+0**65281** ' = Relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+0**65282** ' = Relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+0**65283** ' = Relay matrix active and both interconnections active. 'XXXX+0**65535** ' = Relay matrix active and no interconnection active. With **000001** bis **000003,** only the relay outputs of the ETL-interface are switched. With **065280** bis **065283,** the relay outputs of the ETL-interface are also switched and the corresponding switching times are waited for. This is done in parallel with the switching in the matrix modules. With **065535** only the matrix modules are switched. **Attention**: In the command **WICO** , the letter **O** must be used and not the number **0 (zero)**.

	Command	Answer	Example	From firmware	Description
17	STPAvxxxxxxs	STPAvxxxxxxs	S 'STPA+000006 ' R 'STPA+000006 '		This command can be used to set the test type. After setting the test type, it can take up to 200 ms until closed contact monitoring is detected via the status request command. Test type values: 'STPA+00000**0** ' = No test type 'STPA+00000**1** ' = High-voltage test 'STPA+00000**2** ' = Function test 'STPA+00000**3** ' = Protective earth test 'STPA+00000**4** ' = Insulation test 'STPA+00000**5** ' = Leakage current test 'STPA+00000**6** ' = Resistance test 'STPA+0000**20** ' = Continuity test with DC4 module 'STPA+0000**21** ' = Voltage measurement 'STPA+0000**22** ' = Symmetry test 'STPA+0000**23** ' = Protective earth test with resistance module
18	STSC xxxx yyyy	STSC	S 'STSC 0003 0000' R 'STSC 0003 0000'		Sets the start conditions of the test so that they can be evaluated before and during the test. The safety circuit is always active during high-voltage tests. hex 3= 0011(Bit0= Start button, Bit1= Safety circuit)

Measuring range Article number **205785**:

Value	Description
0	Automatic
1	4 Ω
2	8 Ω
3	16 Ω
4	32 Ω
5	64 Ω
6	128 Ω
7	256 Ω
8	512 Ω
9	1024 Ω
10	2048 Ω
11	4096 Ω
12	8192 Ω
13	100 kΩ

Measuring range Article number **209219**:

Value	Description
0	Automatic
1	0,2000 - 2,0000 MΩ
2	20,00 - 199,99 kΩ

Value	Description
3	2,000 - 19,999 kΩ
4	0,2000 - 1,9999 kΩ
5	20,00 - 199,99 Ω
6	2,000 - 19,999 Ω
7	0,2000 - 1,9999 Ω
8	20,00 - 199,99 mΩ
9	2,000 - 19,999 mΩ
10	0,2000 - 1,9999 mΩ
11	0 - 199,99 µΩ

5.5.2 Perform test

	Command	Answer	Example	From firmware	Description
	GETS?	**GETSxxxx**	S 'GETS?' R 'GETS5001'		This query is used to determine whether it is possible to start a test. 5001 hex = 0101 0000 0000 0001 (Bit0 = 1: Start button pressed, Bit13 = 0 : Parameter download is completed). To start a test with the **ATS 400**, Bit13 must not be set and Bit14 or Bit15 must be set. Depending on the test type, further Bits must or can be set. Bit1 must also be set for all high-voltage tests and the insulation test. Status query. **Caution**: If Bit13 is not removed after a timeout of 1s, the diagnostic data must be deleted with the commands SY* can be retrieved. The commands and descriptions can be found in the chapter Diagnostic data.
	WIST	**WIST**	S 'WIST' R 'WIST'		This command starts the resistance test. **Attention:** The start command is transmitted after the start conditions have been fulfilled, parameter download is completed (Bit13 not set) and Bit14 (or Bit15) is set. The status query is carried out using the **GETS?** command (more on this in the Examples section).
	WIIR?	**WIIRvxxxxxxs zz**	S 'WIIR?' R 'WIIR+017372u 01'		Gives back the current resistance as a measured value. R = 17372 uOhm, 01 = test active (status of the test).
	WIIT?	**WIITvxxxxxxs zz**	S 'WIIT?' R 'WIIT+000000 01'		Gives back the current temperature as a measured value.
	WIXR?	**WIXRvxxxxxxs zz**	S 'WIXR?' R 'WIXR+000000 01'		Gives back the current resistance of the temperature sensor as a measured value.
	WIR1?	**WIR1vxxxxxxs zz**	S 'WIR1?' R 'WIR1+000896m'		Gives back the loop resistance of wire L1 as a measured value. Rcc1 = 896 mOhm.
	WIR2?	**WIR2vxxxxxxs zz**	S 'WIR2?' R 'WIR2+001245m'		Gives back the loop resistance of wire L2 as a measured value. Rcc2 = 1245 mOhm.
	WIXI?	**WIXIvxxxxxxs zz**	S 'WIXI?' R 'WIXI+885800u'		Gives back the measurement current as a measured value. I = 885800 uA.
	WIXS?	**WIXSvxxxxxxs zz**	S 'WIXS?' R 'WIXS+000003 '		Gives back the current module state as a value. Such as measuring the RCC1 and RCC2.
	WIXE?	**WIXEvxxxxxxs zz**	S 'WIXE?' R 'WIXE+000005 '		Gives back the error code as a value.
	WIEF?	**WIEFxxxx**	S 'WIEF?' R 'WIEF0000'		Returns the execution flags. The value is in hexadecimal formatting. Bit 0 indicates whether the result value corresponds to the stability criterion. If the bit is set this is the case otherwise it is the last measured value. The other bits are not used and always 0.

	Command	Answer	Example	From firmware	Description
	ERIN?	**ERINvxxxxxxs**	S 'ERIN?' R 'ERIN+000000 '	33297	This command can be used to query the error information. This field is updated at the end of the check. During the check, this field is filled with zeros. In Case of error, the response is a number in the range from 112 to 116. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).
	WISP	**WISP**	S 'WISP' R 'WISP'		Stops the resistance test. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).

5.5.3 Example

5.5.3.1 individual commands

	Command	Description
	Query device information	
S	'GFWS?'	Firmware
R	'GFWS33624 23529'	IO-CPU = 33624, LT-CPU = 23529
S	'RQSN?'	Serial number
R	'RQSN211917 0222 1534'	SN = 2119170 0222 1534
	Transfer test parameters	
S	'WITP+0001.0 '	t = 1 s
R	'WITP+0001.0 '	
S	'WITO+0000.5 '	Timeout = 0,5 s
R	'WITO+0000.5 '	
S	'WIRM+000000 '	Rmin = 10 mOhm
R	'WIRM+000000 '	
S	'WIRX+000011 '	Rmax = 11 mOhm
R	'WIRX+000011 '	
S	'WIRO+000000 '	R offset = 0 Ohm
R	'WIRO+000000 '	
S	'WIMB+000009 '	Measuring range = 9 (2,000 - 19,999 mΩ)
R	'WIMB+000009 '	
S	'WIMM+00000**0** '	Measuring method **0** = Resistance measurement
R	'WIMM+000000 '	
S	'WISR+00000**0** '	Temperature sensor **0** = No temperature sensor
R	'WISR+00000**0** '	
S	'WITM+0.0000 '	Temperature coefficient
R	'WITM+0.0000 '	
S	'WIFS+00000**1** '	Stability criterion is used
R	'WIFS+00000**1** '	
S	'WITS+0002.0 '	Time for the stability criterion t= 2.0 s (maximum time 10.0 s)

	Command	Description
R	'WITS+0002.0 '	
S	'WIDS+0001.0 '	Permissible deviation in %= 1,0%
R	'WIDS+0001.0 '	
S	'WICO+000000 '	No polarity
R	'WICO+000000 '	
S	'STPA+000006 '	Activate resistance test
R	'STPA+000006 '	
S	'STSC 0001 0000'	Set start button as start condition
R	'STSC'	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS5000'	0**1**0**1** 0000 0000 0000 Bit13 = 0 : Parameter download is completed.
S	'GETS?'	Status query
R	'GETS5001'	0**1**0**1** 0000 0000 000**1** Bit0 = 1: Start button pressed
Parameter Download is completed and the start conditions have been met. Start Test		
S	'WIST'	Start test
R	'WIST'	
Measured values query		
S	'WIIR?'	Resistance
R	'WIIR+017361u **00**'	**00** test not yet active
S	'WIXS?'	Module status
R	'WIXS+000003 '	Module status = 3
S	'PTI_?'	Test duration
R	'PTI_ 000000 '	t = 0 s
S	'WIIR?'	Resistance
R	'WIIR+017363u **01**'	**01** test active, R = 17363 uOhm
S	'WIXS?'	Module status
R	'WIXS+000027 '	Module status = 27
S	'PTI_?'	Test duration
R	'PTI_+000920m'	t = 920 ms
S	'WIIR?'	Resistance
R	'WIIR+017360u **02**'	R = 17360 uOhm, **02** test completed IO (Passed)
S	'WIXS?'	Module status
R	'WIXS+000027 '	Module status = 27
S	'PTI_?'	Test duration
R	'PTI_+001000m'	t = 1000 ms
Error query		

	Command	Description
S	'ERIN?'	Error query
R	'ERIN+000000 '	No Error
Test stop		
S	'WISP'	Stop test
R	'WISP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000006 ') only needs to be transmitted before starting.

Example:
'STPA+000006 '
'WIST'

5.5.3.2 Chainend commands

	Command	Description
Query device information		
S	'GFWS?;RQSN?'	Firmware and serial number
R	'GFWS33624 23529;RQSN211917 0222 1534'	IO-CPU = 33624, LT-CPU = 23529, SN = 2119170 0222 1534
Transfer test parameters		
S	'WITP+0001.0 ;WITO+0000.5 ;WIRM+000000 ;WIRX+000011 ;WIRO+000000 ;WIMB+000009 ;WIMM+000000 ;WISR+000000 ;WITM+0.0000 ;WIFS+000001 ;WITS+0002.0 ;WIDS+0001.0 ;WICO+000000 ;STPA+000006 ;STSC 0001 0000'	Description in "Individual commands"
R	'WITP+0001.0 ;WITO+0000.5 ;WIRM+000000 ;WIRX+000011 ;WIRO+000000 ;WIMB+000009 ;WIMM+000000 ;WISR+000000 ;WITM+0.0000 ;WIFS+000001 ;WITS+0002.0 ;WIDS+0001.0 ;WICO+000000 ;STPA+000006 ;STSC'	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS5000'	0**1**0**1** 0000 0000 0000 Bit13 = 0 : Parameter download is completed.
S	'GETS?'	Status query
R	'GETS5001'	0**1**0**1** 0000 0000 000**1** Bit0 = 1: Start button pressed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'WIST'	Start test
R	'WIST'	
Measured values query		
S	"WIIR?';WIXS?;PTI_?'	Resistance, Module status, Test duration
R	'WIIR+017361u **00**;WIXS+000003 ;PTI_ 000000 '	**00** test not yet active
S	"WIIR?';WIXS?;PTI_?'	Resistance, Module status, Test duration
R	'WIIR+017363u **01**;WIXS+000027 ;PTI_+000920m'	**01**test active, R = 17363 uOhm, Module status = 27, t = 920 ms
S	"WIIR?';WIXS?;PTI_?'	Resistance, Module status, Test duration
R	'WIIR+017360u **02**;WIXS+000027 ;PTI_+001000m'	**02** test completed IO (Passed), R = 17360 uOhm, Module status = 27, t = 1000 ms

	Command	Description
Error query		
S	'ERIN?'	Error query
R	'ERIN+000000 '	No error
Test stop		
S	'WISP'	Stop test
	'WISP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000006 ') only needs to be transmitted before starting.

Example:
'STPA+000006 '
'WIST'

5.5.4 Error number resistance

The error information is queried with the command '**ERIN?**'.

Wert	Bedeutung
112	Upper limit exceeded
	The measured resistance value has exceeded the upper limit value.
113	Lower limit not reached.
	The measured resistance value has fallen below the lower limit value.
114	Resistance invalid.
	No resistance value could be determined.
115	Resistance timeout.
	The resistance could not be determined within the configured time limit.
116	Contacting error.
	The resistance to be measured is not contacted.

Measuring module error code: is queried with the command '**WIXE?**'.

Wert	Beschreibung
0	No Error.
1	Contact Check Plus Timeout.
2	Contact Check Plus R to high.
3	Contact Check Plus I to low.
4	Contact Check Plus Icc status.
5	Contact Check Plus Ucc status.
6	Contact Check Minus Timeout.

Wert	Beschreibung
7	Contact Check Minus R to high.
8	Contact Check Minus I to low.
9	Contact Check Minus Icc status.
10	Contact Check Minus Ucc status.
11	CS0 Timeout.
12	Overvoltage Plus.
13	Overvoltage Minus.
14	Measured value too small for measuring range.
15	Measured value too large for measuring range.
16	ADC Status.
17	Current source, set current does not match measured current. Actual current less than 0.5 * set current.
18	Current source, set current does not match measured current. Actual current greater than 1.5 * set current.
19	Negative polarity in sense lines.
20	Temperature too low.
21	Temperature too high.
22	Temperature measuring current too low.
23	Temperature measuring current too high.
24	Temperature negative polarity in sense lines.

5.6 Continuity test

This chapter describes the ASCII commands for parameterizing and querying the measured values for the continuity test.
This continuity test is carried out with the **DC4-LM** resistance module (4-wire measuring method) and belongs to **article 209219**.
The measurement is valid from **firmware 33589**.

5.6.1 Set parameter

Attention

- Data is exchanged according to the master/slave principle. The ETL device is the slave.
- Each request is acknowledged with a corresponding response. Only after the response is received can the next command be sent. In the case of chained commands in ATS400, this applies to the entire chain.
- If a request is not understood, the device responds with the mnemonic code followed by **nok**. For chained commands in ATS400, this applies to each individual command.
- If no SI prefix is used for the command, the number is followed by a space.
- The transferred parameters are retained on the device; they are only overwritten when new parameters are transferred.
- The quotation marks in the "Example" column are only there to illustrate the length of the command with and without SI prefix and are not part of the command.

Attention

- The sequence of commands must be observed as shown in the table.
- The commands marked with an asterisk (*) are optional. They only need to be transferred if the functionality is required.

	Command	Answer	Example	From firmware	Description
1	**CRTTvxxxxxxs**	**CRTTvxxxxxxs**	S 'CRTT+0002.0 ' R 'CRTT+0002.0 '		Test time for the test in seconds. t = 2,0 s
2	**CRRSvxxxxxxs**	**CRRSvxxxxxxs**	S 'CRRS+0010.0 ' R 'CRRS+0010.0 '		Resistance that is used as the threshold. Values in the range 0.2 Ohm to 2.2 MOhm are permissible. Rmax = 10,0 Ohm with continuity test Rmin = 10,0 Ohm with interruption test
4	**CRRAvxxxxxxs**	**CRRAvxxxxxxs**	S 'CRRA+000006 ' R 'CRRA+000006 '		Measuring range with which to measure. The following values are permissible: 'CRRA+00000**1** ' = 0,2000 - 2,0000 MΩ. 'CRRA+00000**2** ' = 20,00 - 199,99 kΩ. 'CRRA+00000**3** ' = 2,000 - 19,999 kΩ. 'CRRA+00000**4** ' = 0,2000 - 1,9999 kΩ. 'CRRA+00000**5** ' = 20,00 - 199,99 Ω. 'CRRA+00000**6** ' = 2,000 - 19,999 Ω. 'CRRA+00000**7** ' = 0,2000 - 1,9999 Ω.
1	**CRMOvxxxxxxs**	**CRMOvxxxxxxs**	S 'CRMO+000000 ' R 'CRMO+000000 '		This determines whether to check for continuity or interruption. The following values are permissible: 'CRMO+00000**0** ' = For continuity test. 'CRMO+00000**1** ' = For interruption test. **Attention**: In the command **CRMO** , the letter **O** must be used and not the number **0 (zero)**.

	Command	Answer	Example	From firmware	Description
5	**CRCOvxxxxxxs**	**CRCOvxxxxxxs**	S 'CRCO+000000 ' R 'CRCO+000000 '		This command is used to set the polarity. The polarity can be used to connect the continuity test with the DC4-LM R module (4-wire measuring method). Attention: **Simultaneous use of the relay matrix and the ETL-Interface is only possible from version 33581 of the IO-CPU. Either a relay matrix or the outputs on the ETL-Interface can be used.** Please refer to the documentation for the device to find out how the wiring is carried out. Polarity values: 'XXXX+00000**0** ' = No relay matrix active and no interconnection active. 'XXXX+00000**1** ' = No relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+00000**2** ' = No relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+00000**3** ' = No relay matrix active and both interconnections active. 'XXXX+0**65280** ' = Relay matrix active and both circuits not active. 'XXXX+0**65281** ' = Relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+0**65282** ' = Relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+0**65283** ' = Relay matrix active and both interconnections active. 'XXXX+0**65535** ' = Relay matrix active and no interconnection active. With **000001** bis **000003,** only the relay outputs of the ETL-interface are switched. With **065280** bis **065283,** the relay outputs of the ETL-interface are also switched and the corresponding switching times are waited for. This is done in parallel with the switching in the matrix modules. With **065535** only the matrix modules are switched. **Attention**: In the command **CRCO** , the letter **O** must be used and not the number **0 (zero)**.
6	**STPAvxxxxxxs**	**STPAvxxxxxxs**	S 'STPA+000020 ' R 'STPA+000020 '		This command can be used to set the test type. After setting the test type, it can take up to 200 ms until closed contact monitoring is detected via the status request command. Test type values: 'STPA+00000**0** ' = No test type 'STPA+00000**1** ' = High-voltage test 'STPA+00000**2** ' = Function test 'STPA+00000**3** ' = Protective earth test 'STPA+00000**4** ' = Insulation test 'STPA+00000**5** ' = Leakage current test 'STPA+00000**6** ' = Resistance test 'STPA+0000**20** ' = Continuity test with DC4 module 'STPA+0000**21** ' = Voltage measurement 'STPA+0000**22** ' = Symmetry test 'STPA+0000**23** ' = Protective earth test with resistance module
7	**STSC xxxx yyyy**	**STSC**	S 'STSC 0003 0000' R 'STSC'		Sets the start conditions of the test so that they can be evaluated before and during the test. The safety circuit is always active during high-voltage tests. hex 3= 0011 (Bit0= Start button, Bit1= Safety circuit).

5.6.2 Perform test

	Command	Answer	Example	From firmware	Description
	GETS?	**GETSxxxx**	S 'GETS?' R 'GETS5001'		This query is used to determine whether it is possible to start a test. 5001 hex = 0**1**0**1** 0000 0000 000**1** Bit0 = 1: Start button pressed, Bit13 = 0 : Parameter download is completed. To start a test with the **ATS 400**, Bit13 must not be set and Bit14 or Bit15 must be set. Depending on the test type, further Bits must or can be set. Bit1 must also be set for all high-voltage tests and the insulation test. Status query.

	Command	Answer	Example	From firmware	Description
					Caution: If Bit13 is not removed after a timeout of 1s, the diagnostic data must be deleted with the commands SY* can be retrieved. The commands and descriptions can be found in the chapter Diagnostic data.
	CRST	**CRST**	S 'CRST' R 'CRST'		This command starts the continuity test with the DC4-LM (4-wire measuring method) module. **Attention:** The start command is transmitted after the start conditions have been fulfilled, parameter download is completed (Bit13 not set) and Bit14 (or Bit15) is set. The status query is carried out using the **GETS?** command (more on this in the Examples section).
	CRIR?	**CRIRvxxxxxxs zz**	S 'CRIR?' R 'CRIR+002.20M 01'		Gives back the last measured resistance as the measured value. R = 2,20 MOhm, 01 = test active (status of the test).
	CRCU?	**CRCUvxxxxxxs zz**	S 'CRCU?' R 'CRCU+0089,9m 01'		Gives back the measured current as a measured value. I = 89,9 mA, 01 = test active (status of the test).
	ERIN?	**ERINvxxxxxxs**	S 'ERIN?' R 'ERIN+000000 '	33297	This command can be used to query the error information. This field is updated at the end of the check. During the check, this field is filled with zeros. In Case of error, the response is a number 96, 97, 115 or 116. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).
	CRSP	**CRSP**	S 'CRSP' R 'CRSP'		Stops the continuity test with the DC4-LM (4-wire measuring method) module. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).

5.6.3 Example

5.6.3.1 Individual commands

	Command	Description
Query device information		
S	'GFWS?'	Firmware
R	'GFWS33624 23529'	IO-CPU = 33624, LT-CPU = 23529
S	'RQSN?'	Serial number
R	'RQSN211917 0222 1534'	SN = 2119170 0222 1534
Transfer test parameters		
S	'CRTT+0001.0 '	t = 1 s
R	'CRTT+0001.0 '	
S	'CRRS+0420.0 '	Resistance used as a threshold (for continuity Rmax= 420 Ohm, for interruption Rmin= 420 Ohm)
R	'CRRS+0420.0 '	
S	'CRRA+000004 '	Measuring range = 6
R	'CRRA+000004 '	
S	'CRMO+000001 '	00000**1** = Check for interruption.
R	'CRMO+000001 '	
S	'CRCO+000000 '	No Polarity
R	'CRCO+000000 '	
S	'STPA+000020 '	Activate continuity test.
R	'STPA+000020 '	

	Command	Description
S	'STSC 0003 0000'	Set safety circuit and start button as start condition
R	'STSC'	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS5082'	0**1**0**1** 0000 1000 00**1**0 Bit1 = 1: Safety circuit closed, Bit13 = 0 : Parameter download is completed.
S	'GETS?'	Status query
R	'GETS5883'	0**1**0**1** 1000 1000 00**11** Bit0 = 1: Start button pressed
Parameter Download is completed and the start conditions have been met. Start Test		
S	'CRST'	Start test
R	'CRST'	
Measured values query		
S	'CRIR?'	Resistance
R	'CRIR+000444 **00**'	**00** test not yet active
S	'WIXS?'	Module status
R	'WIXS+000039 '	Module status = 39
S	'PTI_?'	Test duration
R	'PTI_ 000.00 '	t = 0 s
S	'CRIR?'	Resistance
R	'CRIR+000444 **01**'	**01 test** active, R = 444 Ohm
S	'WIXS?'	Module status
R	'WIXS+000046 '	Module status = 27
S	'PTI_?'	Test duration
R	'PTI_+000.82 '	t = 0,82 s
S	'CRIR?'	Resistance
R	'CRIR+000444 **02**'	R = 444 Ohm, **02** test completed IO (Passed)
S	'WIXS?'	Module status
R	'WIXS+000046 '	Module status = 27
S	'PTI_?'	Test duration
R	'PTI_+001.00 '	t = 1,00 s
Error query		
S	'ERIN?'	Error query
R	'ERIN+000000 '	No Error
Test stop		
S	'CRSP'	Stop test
R	'CRSP'	

Attention:

The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000020 ') only needs to be transmitted before starting.

Example:
'STPA+000020 '
'CRST'

5.6.3.2 Chained commands

	Command	Description
	Query device information	
S	'GFWS?;RQSN?'	Firmware and serial number
R	'GFWS33624 23529;RQSN211917 0222 1534'	IO-CPU = 33624, LT-CPU = 23529, SN = 2119170 0222 1534
	Transfer test parameters	
S	'CRTT+0001.0 ;CRRS+0420.0 ;CRRA+000004 ;CRMO+000001 ;CRCO+000000 ;STPA+000020 ;STSC 0003 0000'	Description in "Individual commands"
R	'CRTT+0001.0 ;CRRS+0420.0 ;CRRA+000004 ;CRMO+000001 ;CRCO+000000 ;STPA+000020 ;STSC'	
	Status query before start (parameters download, start conditions, ...)	
S	'GETS?'	Status query
R	'GETS5082'	0**1**0**1** 0000 1000 00**1**0 Bit1 = 1: Safety circuit closed, Bit13 = 0 : Parameter download is completed.
S	'GETS?'	Status query
R	'GETS5883'	0**1**0**1** 1000 1000 00**11** Bit0 = 1: Start button pressed.
	Parameter Download is completed and the start conditions have been met. Start Test	
S	'CRST'	Start test
R	'CRST'	
	Measured values query	
S	'CRIR?;WIXS?;PTI_?'	Resistance, Module status, Test duration
R	'CRIR+000444 **00**;WIXS+000039 ;PTI_ 000.00 '	**00** test not yet active
S	'CRIR?;WIXS?;PTI_?'	Resistance, Module status, Test duration
R	'CRIR+000444 **01**;WIXS+000039 ;PTI_+000.82 '	**01** test active, R = 444 Ohm, Module status = 39, t = 0,82 s
S	'CRIR?;WIXS?;PTI_?'	Resistance, Module status, Test duration
R	'CRIR+000444 **02**;WIXS+000039 ;PTI_+001.00 '	**02** test completed IO (Passed), R = 444 Ohm, Module status = 39, t = 1,00 s
	Error query	
S	'ERIN?'	Error query
R	'ERIN+000000 '	No Error
	Test stop	
S	'CRSP'	Stop test
	'CRSP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000020 ') only needs to be transmitted before starting.

Example:

'STPA+000020 '
'CRST'

5.6.4 Error number continuity

The error information is queried with the command '**ERIN?**'.

Wert	Bedeutung
96	Resistance exceeded.
	The measured resistance value has exceeded the upper limit value.
97	Resistance undercut.
	The measured resistance value has fallen below the lower limit value.
115	Resistance timeout.
	The resistance could not be determined within the configured time limit.
116	Contacting error.
	The resistance to be measured is not contacted.

5.7 Voltage measurement

This chapter describes the ASCII commands for parameterizing and querying the measured values for voltage measurement. This voltage measurement is carried out via an additional **DHMP measurement board** and belongs to **article 211441**.
Depending on how the circuit board is installed, it can be used either for voltage measurement or for current measurement. Only voltage measurement is currently supported.
The measurement is valid from **firmware 33569**.

5.7.1 Set parameter

Attention

- Data is exchanged according to the master/slave principle. The ETL device is the slave.
- Each request is acknowledged with a corresponding response. Only after the response is received can the next command be sent. In the case of chained commands in ATS400, this applies to the entire chain.
- If a request is not understood, the device responds with the mnemonic code followed by `nok`. For chained commands in ATS400, this applies to each individual command.
- If no SI prefix is used for the command, the number is followed by a space.
- The transferred parameters are retained on the device; they are only overwritten when new parameters are transferred.
- The quotation marks in the "Example" column are only there to illustrate the length of the command with and without SI prefix and are not part of the command.

Attention

- The sequence of commands must be observed as shown in the table.
- The commands marked with an asterisk (*) are optional. They only need to be transferred if the functionality is required.

	Command	Answer	Example	From firmware	Description
1	`VMTTvxxxxxxs`	`VMTTvxxxxxxs`	S 'VMTT+002.00 ' R 'VMTT+002.00 '		Test time for measuring the voltage in seconds. t = 2,00 s
2	`VMULvxxxxxxs`	`VMULvxxxxxxs`	S 'VMUL+000100 ' R 'VMUL+000100 '		Maximum permissible value for the voltage in volts. Umax = 100 V
3	`VMLLvxxxxxxs`	`VMLLvxxxxxxs`	S 'VMLL+000025 ' R 'VMLL+000025 '		Minimum permissible value for the voltage in volts. Umin = 25 V
4	`VMVTvxxxxxxs`	`VMVTvxxxxxxs`	S 'VMVT+000001 ' R 'VMVT+000001 '		Setting whether an AC or DC voltage is to be measured. The following values are permitted: 'VMVT+00000**1** ' = DC voltage is measured. 'VMVT+00000**2** ' = AC voltage is measured.
5	`VMCOvxxxxxxs`	`VMCOvxxxxxxs`	S 'VMCO+000000 ' R 'VMCO+000000 '		This command is used to set the polarity. The polarity can be used to interconnect the voltage measurement. Attention: **Simultaneous use of the relay matrix and the ETL-Interface is only possible from version 33581 of the IO-CPU. Either a relay matrix or the outputs on the ETL-Interface can be used.** Please refer to the documentation for the device to find out how the wiring is carried out. Polarity values: 'XXXX+00000**0** ' = No relay matrix active and no interconnection active. 'XXXX+00000**1** ' = No relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-

	Command	Answer	Example	From firmware	Description
					Interface). 'XXXX+00000**2** ' = No relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+00000**3** ' = No relay matrix active and both interconnections active. 'XXXX+0**65280** ' = Relay matrix active and both circuits not active. 'XXXX+0**65281** ' = Relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+0**65282** ' = Relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+0**65283** ' = Relay matrix active and both interconnections active. 'XXXX+0**65535** ' = Relay matrix active and no interconnection active. With **000001** bis **000003,** only the relay outputs of the ETL-interface are switched. With **065280** bis **065283,** the relay outputs of the ETL-interface are also switched and the corresponding switching times are waited for. This is done in parallel with the switching in the matrix modules. With **065535** only the matrix modules are switched. **Attention**: In the command **VMCO** , the letter **O** must be used and not the number **0 (zero)**.
6	**STPAvxxxxxxs**	**STPAvxxxxxxs**	S 'STPA+000021 ' R 'STPA+000021 '		This command can be used to set the test type. After setting the test type, it can take up to 200 ms until closed contact monitoring is detected via the status request command. Test type values: 'STPA+00000**0** ' = No test type 'STPA+00000**1** ' = High-voltage test 'STPA+00000**2** ' = Function test 'STPA+00000**3** ' = Protective earth test 'STPA+00000**4** ' = Insulation test 'STPA+00000**5** ' = Leakage current test 'STPA+00000**6** ' = Resistance test 'STPA+0000**20** ' = Continuity test with DC4 module 'STPA+0000**21** ' = Voltage measurement 'STPA+0000**22** ' = Symmetry test 'STPA+0000**23** ' = Protective earth test with resistance module
7	**STSC xxxx yyyy**	**STSC**	S 'STSC 0003 0000' R 'STSC 0003 0000'		Sets the start conditions of the test so that they can be evaluated before and during the test. The safety circuit is always active during high-voltage tests. hex 3= 0011 (Bit0= Start button, Bit1= Safety circuit)

5.7.2 Perform test

	Command	Answer	Example	From firmware	Description
	GETS?	**GETSxxxx**	S 'GETS?' R 'GETS5887'		This query is used to determine whether it is possible to start a test. 5887 hex = 0101 1000 1000 0**111** (Bit0 = 1: Start button pressed, Bit1 = 1: Safety circuit closed, Bit2 = 1: Contact monitoring closed, Bit13 = 0 : Parameter download is completed) To start a test with the **ATS 400**, Bit13 must not be set and Bit14 or Bit15 must be set. Depending on the test type, further bits must or can be set. Bit1 must also be set for all high-voltage tests and the insulation test. Status query. **Caution:** If Bit13 is not removed after a timeout of 1s, the diagnostic data must be deleted with the commands SY* and HV* can be retrieved. The commands and descriptions can be found in the chapter Diagnostic data.
	VMST	**VMST**	S 'VMST' R 'VMST'		Starts the voltage measurement. **Attention:** The start command is transmitted after the start conditions have been fulfilled, parameter download is completed (Bit13 not set) and Bit14 (or Bit15) is set. The status query is carried out using the **GETS?** command (more on this in the Examples section).

	Command	Answer	Example	From firmware	Description
	VMCV?	VMCVvxxxxxxs zz	S 'VMCV?' R 'VMCV+064.00 01'		Gives back the current voltage as a measured value. U = 64,00 V, 01 = test active (status of the test).
	VMCC?	VMCCvxxxxxxs zz	S 'VMCC?' R 'VMCC+000009u 01'		Gives back the current current as a measured value. I = 9 uA, 01 = test active (status of the test).
	VMRV?	VMRVvxxxxxxs zz	S 'VMRV?' R 'VMRV+064.00 02'		Gives back the voltage containing the measurement result as a measured value. U = 64,00 V, 02 = test ended IO (passed) (status of the test).
	VMRC?	VMRCvxxxxxxs zz	S 'VMRC?' R 'VMRC+000009u 02'		Gives back the current containing the measurement result as a measured value I = 9 uA, 02 = test ended IO (passed) (status of the test).
	ERIN?	ERINvxxxxxxs	S 'ERIN?' R 'ERIN+000000 '	33297	This command can be used to query the error information. This field is updated at the end of the check. During the check, this field is filled with zeros. In Case of error, the response is a number 14 or 15. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).
	VMSP	VMSP	S 'VMSP' R 'VMSP'		Stops the voltage measurement. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).

5.7.3 Example

5.7.3.1 Individual commands

	Command	Description
	Query device information	
S	'GFWS?'	Firmware
R	'GFWS33624 23529'	IO-CPU = 33624, LT-CPU = 23529.
S	'RQSN?'	Serial number
R	'RQSN211917 0222 1534'	SN = 2119170 0222 1534.
	Transfer test parameters	
S	'VMTT+002.00 '	t = 2,00 s
R	'VMTT+002.00 '	
S	'VMUL+000100 '	Umax = 100 V
R	'VMUL+000100 '	
S	'VMLL+000025 '	Umin = 25 V
R	'VMLL+000025 '	
S	'VMVT+000001 '	00000**1** = DC voltage is measured.
R	'VMVT+000001 '	
S	'VMCO+000000 '	No polarity
R	'VMCO+000000 '	
S	'STPA+000021 '	Activate voltage measurement.
R	'STPA+000021 '	
S	'STSC 0003 0000'	Set safety circuit and start button as start condition.
R	'STSC'	

	Command	Description
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS7082'	0**11**1 0000 1000 00**1**0 Bit1 = 1: Safety circuit closed, Bit13 = 1 : Parameters are still being processed.
S	'GETS?'	Status query
R	'GETS5883'	0**10**1 1000 1000 00**11** Bit0 = 1: Start button pressed, Bit13 = 0 : Parameter download is completed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'VMST'	Start test
R	'VMST'	
Measured values query		
S	'VMCV?'	Voltage
R	'VMCV+000000f **00**'	**00** test not yet active
S	'PTI_?'	Test duration
R	'PTI_ 000.00 '	t = 0,00 s
S	'VMCV?'	Voltage
R	'VMCV+064.00 **01**'	**01 test active**, U = 64,00 V
S	'PTI_?'	Test duration
R	'PTI_+000.25 '	t = 0,25 s
S	'VMCV?'	Voltage
R	'VMCV+064.00 **02**'	**02** test completed IO (Passed), U = 64,00 V,
S	'PTI_?'	Test duration
R	'PTI_+002.01 '	t = 2,01 s
Error query		
S	'ERIN?'	Error query
R	'ERIN+000000 '	No error
Test stop		
S	'VMSP'	Stop test
R	'VMSP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000021 ') only needs to be transmitted before starting.

Example:
'STPA+000021 '
'VMST'

5.7.3.2 Chained commands

	Command	Description
Query device information		
S	'GFWS?;RQSN?'	Firmware and serial number

	Command	Description
R	'GFWS33624 23529;RQSN211917 0222 1534'	IO-CPU = 33624, LT-CPU = 23529, SN = 2119170 0222 1534
Transfer test parameters		
S	'VMTT+002.00 ;VMUL+000100 ;VMLL+000025 ;VMVT+000001 ;VMCO+000000 ;STPA+000021 ;STSC 0003 0000'	Description in "Individual commands"
R	'VMTT+002.00 ;VMUL+000100 ;VMLL+000025 ;VMVT+000001 ;VMCO+000000 ;STPA+000021 ;STSC'	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS7082'	0**11**1 0000 1000 00**1**0 Bit1 = 1: Safety circuit closed, Bit13 = 1 : Parameters are still being processed.
S	'GETS?'	Status query
R	'GETS5883'	0**10**1 1000 1000 00**11** Bit0 = 1: Start button pressed, Bit13 = 0 : Parameter download is completed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'VMST'	Start test
R	'VMST'	
Measured values query		
S	'VMCV?;PTI_?'	Voltage, Test duration
R	'VMCV+000000f **00**;PTI_ 000.00 '	**00** test not yet active
S	'VMCV?;PTI_?'	Voltage, Test duration
R	'VMCV+064.00 **01**;PTI_+000.25 '	**01** test active, U = 64,00 V, t = 0,25 s
S	'VMCV?;PTI_?'	Voltage, Test duration
R	'VMCV+064.00 **02**;PTI_+002.01 '	**02** test completed IO (Passed), U = 64,00 V, t = 2,01 s
Error query		
S	'ERIN?'	Error query
R	'ERIN+000000 '	No Error
Test stop		
S	'VMSP'	Stop test
	'VMSP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000021 ') only needs to be transmitted before starting.

Example:
'STPA+000021 '
'VMST'

5.7.4 Error number voltage measurement

The error information is queried with the command '**ERIN?**'.

Wert	Bedeutung
14	Limit value exceeded.

Wert	Bedeutung
	The measured value exceeds the upper limit value.
15	limit value undercut.
	The measured value falls below the lower limit value.

5.8 User-Interface

The User-interface is designed as a 25-pin SUB-D socket (female). It contains digital inputs and outputs for querying limit switches and for setting outputs and actuators.
The exact specification of the pins is described in the following table:

PIN	IN/OUT	Designation	Explanation
1	Out	Output 24 V	
2		GND	
3	Out 1	Digital output 1	Freely configurable digital output, e.g. for actuating cylinders or similar.
4	Out 2	Digital output 2	d.t.o.
5	Out 3	Digital output 3	d.t.o.
6	Out 4	Digital output 4	d.t.o.
7	Out 5	Digital output 5	d.t.o.
8	Out 6	Digital output 6	d.t.o.
9	Out 7	Digital output 7	d.t.o.
10	Out 8	Digital output 8	d.t.o.
11	In 1	Digital input 1	Freely configurable digital input, e.g. for querying limit switches or similar.
12	In 2	Digital input 2	d.t.o.
13		GND	
14	Out	Output 24 V	
15	In 3	Digital input 3	d.t.o.
16	In 4	Digital input 4	d.t.o.
17	In 5	Digital input 5	d.t.o.
18	In 6	Digital input 6	d.t.o.
19	In 7	Digital input 7	d.t.o.
20	In 8	Digital input 8	d.t.o.
21	In 9	Digital input 9	d.t.o.
22	In 10	Digital input 10	d.t.o.
23	In 11	Digital input 11	d.t.o.
24	In 12	Digital input 12	d.t.o.
25		GND	

5.8.1 Set outputs

Attention

- Data is exchanged according to the master/slave principle. The ETL device is the slave.
- Each request is acknowledged with a corresponding response. Only after the response is received can the next command be sent. In the case of chained commands in ATS400, this applies to the entire chain.

Attention

- If a request is not understood, the device responds with the mnemonic code followed by **nok**. For chained commands in ATS400, this applies to each individual command.
- If no SI prefix is used for the command, the number is followed by a space.
- The transferred parameters are retained on the device; they are only overwritten when new parameters are transferred.
- The quotation marks in the "Example" column are only there to illustrate the length of the command with and without SI prefix and are not part of the command.

Attention

- The sequence of commands must be observed as shown in the table.
- The commands marked with an asterisk (*) are optional. They only need to be transferred if the functionality is required.

Sets the outputs according to the output and the mask.

	Command	Answer	Example	From firmware	Description
1	IUO0vxxxxxxs	IUO0vxxxxxxs	S 'IUO0+021524 ' R 'IUO0+021524 '		For the User-Interface built into the **ATS 400** (internal interface). **Attention**: In the **IUO0** command, the third character is the letter **O** and the fourth character is the number **0**.
2	IUO1vxxxxxxs	IUO1vxxxxxxs	S 'IUO1+000770 ' R 'IUO0+000770 '	33507	For the first external User-Interface. Extension box **article number 205533** User-Interface connector. **Attention**: In the **IUO1** command, the third character is the letter **O.**
3	IUO2vxxxxxxs	IUO2vxxxxxxs	S 'IUO2+001540 ' R 'IUO2+001540 '	33507	For the second external User-Interface. Extension box **article number 205533** User-Interface connector. **Attention**: In the **IUO2** command, the third character is the letter **O.**

The specification of the bits is defined with a count starting with 0. Bit 0 corresponds to output Out 1 and bit 7 corresponds to output Out 8.
The value of the output and the mask is calculated by forming the sum of all values of the set bits. The value of a bit results from 2 to the power of n, where n is the bit to be set.

Bits	Dec. Value
Out1 = Bit0	$2^0 = 1$
Out2 = Bit1	$2^1 = 2$
Out3 = Bit2	$2^2 = 4$
Out4 = Bit3	$2^3 = 8$
Out5 = Bit4	$2^4 = 16$
Out6 = Bit5	$2^5 = 32$
Out7 = Bit6	$2^6 = 64$
Out8 = Bit7	$2^7 = 128$

Only the outputs for which the corresponding bit is set in the mask are changed. All other outputs remain unchanged. This means that individual outputs can be set or reset in a command. The values of the output and the mask are added according to the following formula:
Command = Output + Mask * 256.

Example:
Outputs Out 3 and Out 5 are to be set and output Out 7 is to be reset. Bits 2, 4 and 6 are therefore involved.

Calculation of the output:
Bits 2 and 4 must be set.
Output = 2 high 2 + 2 high 4 = 4 + 16 = 20

Calculation of the mask:
Bits 2, 4 and 6 are changed.
Mask = 2 high 2 + 2 high 4 + 2 high 6 = 84
Command = 20 + 256 * 84 = 21524

5.8.2 Get inputs

	Command	Answer	Example	From firmware	Description
1	IUI0?	IUI0vxxxxxxs	S 'IUI0?' R 'IUI0+003083 '		Reads the states of the inputs for the User-Interface connection on the internal interface. 3083 Dec = 1100 0000 1011 -> Inputs 1, 2, 4, 11 and 12 are set. **Attention**: In the **IUI0** command, the number **0** (zero) must be used and not the letter **O**.
2	IUI1?	IUI1vxxxxxxs	S 'IUI1?' R 'IUI0+000770 '	33507	Reads the states of the inputs when the User-Interface is connected to the first external interface. 770 Dec = 0011 0000 0010 -> inputs 2, 9 and 10 are set.
3	IUI2?	IUI2vxxxxxxs	S 'IUI2?' R 'IUI2+001540 '	33507	Reads the states of the inputs when the User-Interface is connected to the second external interface. 1540 Dec= 0110 0000 0100 -> inputs 3, 10 and 11 are set.

The specification of the bits is defined with a count starting with 0. Bit 0 corresponds to input In 1 and bit 11 corresponds to input In 12.
The value of the input is calculated by forming the sum of all values of the set bits. The value of a bit results from 2 to the power of n, where n is the bit read.

Bits	Dec Werte
In1 = Bit0	2^0 = 1
In2 = Bit1	2^1 = 2
In3 = Bit2	2^2 = 4
In4 = Bit3	2^3 = 8
In5 = Bit4	2^4 = 16
In6 = Bit5	2^5 = 32
In7 = Bit6	2^6 = 64
In8 = Bit7	2^7 = 128
In9 = Bit8	2^8 = 256
In10 = Bit9	2^9 = 512
In11 = Bit10	2^{10} = 1024
In12 = Bit11	2^{11} = 2048

Example:
The inputs In3, In6 and In11 are set. This means that bits 2, 5 and 10 are involved.

Calculation of the inputs:
Value = 2 high 2 + 2 high 5 + 2 high 10 = 4 + 32 + 1024 = 1060

5.9 Relay matrix

The relay matrix easily multiplies the measurement outputs to the desired number of test points and can be expanded as required. It enables automated testing of all measuring points according to a predefined relay command.
The relay matrix is suitable for all types of testing and enables both high voltages and high currents to be connected. It is available as a single-pole or two-pole version for four-wire measurement technology and contact monitoring.

5.9.1 General commands

Attention:
Either a relay matrix or the outputs on the ETL-Interface can b e used.
Simultaneous use of the relay matrix and the ETL-Interface is only possible from version 33581 of the IO-CPU.

These commands can be used to switch the relay matrix, which is available as a separate module. Before using it for the first time, the basic configuration of the relay matrix must be transferred with the commands Set number of boards and Set board type.

	Command	Answer	Example	From firmware	Description
1	RMNRvxxxxxxs	RMNRvxxxxxxs	S 'RMNR+000001 ' R 'RMNR+000001 '		Sets the board type. You will receive the type of circuit board installed with the description of the relay module. The following values are permitted: 'RMNR+000000 ' = No relay matrix. 'RMNR+000001 ' = Relay matrix with 24 relays. 'RMNR+000002 ' = Relay matrix with 8 relays. 'RMNR+000003 ' = Relay matrix with 16 relays. 'RMNR+000004 ' = Relay matrix with 32 relays.
2	RMNBvxxxxxxs	RMNBvxxxxxxs	S 'RMNB+000002 ' R 'RMNB+000002 '		Sets the number of boards installed. You will receive the number of boards with the description of the relay module.
3	RM00vxxxxxxs	RM00vxxxxxxs	S 'RM00+032844 ' R 'RM00+032844 '		Sets the relays K1...K16. 032844 = 1000 0000 0100 1100 -> Set K3, K4, K7 and K16.
4	RMST	RMST	S 'RMST' R 'RMST'		Activates the output of the commanded relay positions to the relay matrix. The relays are switched with this command. **Attention:** The command GETS? Status query can be used to check whether the relay position has been switched or whether other errors are present.
5	RMSP	RMSP	S 'RMSP' R 'RMSP'		This command enables the output of the relay position again. A new relay position can then be transmitted. If no new relay position is transmitted after this command, the matrix switches to idle status after 2 minutes.
3	RM__	RM__	S 'RM__' R 'RM__'		Switches off all relays. The RMST command for the relay position must be sent after this command.

5.9.2 Set outputs

The relays in the matrix are commanded as described in the table.
With the command RM00vxxxxxxs relays K1 to K16 will be commanded.

With the command RM15vxxxxxxs relays K241 to K256 will be commanded.

Relays	Command	Firmware IO-CPU
K1 ... K16	RM00vxxxxxxs	
K17 ... K32	RM01vxxxxxxs	

Relays	Command	Firmware IO-CPU
K33 ... K48	RM02vxxxxxxs	
K49 ... K64	RM03vxxxxxxs	
K65 ... K80	RM04vxxxxxxs	33456 or newer
K81 ... K96	RM05vxxxxxxs	33456 or newer
K97 ... K112	RM06vxxxxxxs	33456 or newer
K113 ... K128	RM07vxxxxxxs	33456 or newer
K129 ... K144	RM08vxxxxxxs	33456 or newer
K145 ... K160	RM09vxxxxxxs	33456 or newer
K161 ... K176	RM10vxxxxxxs	33456 or newer
K177 ... K192	RM11vxxxxxxs	33456 or newer
K193 ... K208	RM12vxxxxxxs	33456 or newer
K209 ... K224	RM13vxxxxxxs	33456 or newer
K225 ... K240	RM14vxxxxxxs	33456 or newer
K241 ... K256	RM15vxxxxxxs	33456 or newer

The specification of the bits is defined with a count starting with 0.
Bit 0 corresponds to the relay K1/K17/ ... /K241.
Bit 15 corresponds to the relay K16/K32/ ... /K256.
The value of the output and the mask is calculated by forming the sum of all Dec. values of the set bits. The value of a bit results from 2 to the power of n, where n is the bit to be set.

Example:
Outputs K3 and K5 are to be set. Bits 2 and 4 are therefore involved.
Calculation of the output:
Bits 2 and 4 must be set.
Output = 2 high 2 + 2 high 4 = 4 + 16 = 20.

Bits	Dec. value	RM00	RM01	RM02	RM03	RM04	RM05	RM06	RM07	RM08	RM09	RM10	RM11	RM12	RM13	RM14	RM15
0	2^0 = 1	K1	K17	K33	K49	K65	K81	K97	K113	K129	K145	K161	K177	K193	K209	K225	K241
1	2^1 = 2	K2	K18	K34	K50	K66	K82	K98	K114	K130	K146	K162	K178	K194	K210	K226	K242
2	2^2 = 4	K3	K19	K35	K51	K67	K83	K99	K115	K131	K147	K163	K179	K195	K211	K227	K243
3	2^3 = 8	K4	K20	K36	K52	K68	K84	K100	K116	K132	K148	K164	K180	K196	K212	K228	K244
4	2^4 = 16	K5	K21	K37	K53	K69	K85	K101	K117	K133	K149	K165	K181	K197	K213	K229	K245
5	2^5 = 32	K6	K22	K38	K54	K70	K86	K102	K118	K134	K150	K166	K182	K198	K214	K230	K246
6	2^6 = 64	K7	K23	K39	K55	K71	K87	K103	K119	K135	K151	K167	K183	K199	K215	K231	K247
7	2^7 = 128	K8	K24	K40	K56	K72	K88	K104	K120	K136	K152	K168	K184	K200	K216	K232	K248
8	2^8 = 256	K9	K25	K41	K57	K73	K89	K105	K121	K137	K153	K169	K185	K201	K217	K233	K249
9	2^9 = 512	K10	K26	K42	K58	K74	K90	K106	K122	K138	K154	K170	K186	K202	K218	K234	K250
10	2^{10} = 1024	K11	K27	K43	K59	K75	K91	K107	K123	K139	K155	K171	K187	K203	K219	K235	K251
11	2^{11} = 2048	K12	K28	K44	K60	K76	K92	K108	K124	K140	K156	K172	K188	K204	K220	K236	K252

Bits	Dec. value	RM00	RM01	RM02	RM03	RM04	RM05	RM06	RM07	RM08	RM09	RM10	RM11	RM12	RM13	RM14	RM15
12	2^{12} = 4096	K13	K29	K45	K61	K77	K93	K109	K125	K141	K157	K173	K189	K205	K221	K237	K253
13	2^{13} = 8192	K14	K30	K46	K62	K78	K94	K110	K126	K142	K158	K174	K190	K206	K222	K238	K254
14	2^{14} = 16384	K15	K31	K47	K63	K79	K95	K111	K127	K143	K159	K175	K191	K207	K223	K239	K255
15	2^{15} = 32768	K16	K32	K48	K64	K80	K96	K112	K128	K144	K160	K176	K192	K208	K224	K240	K256

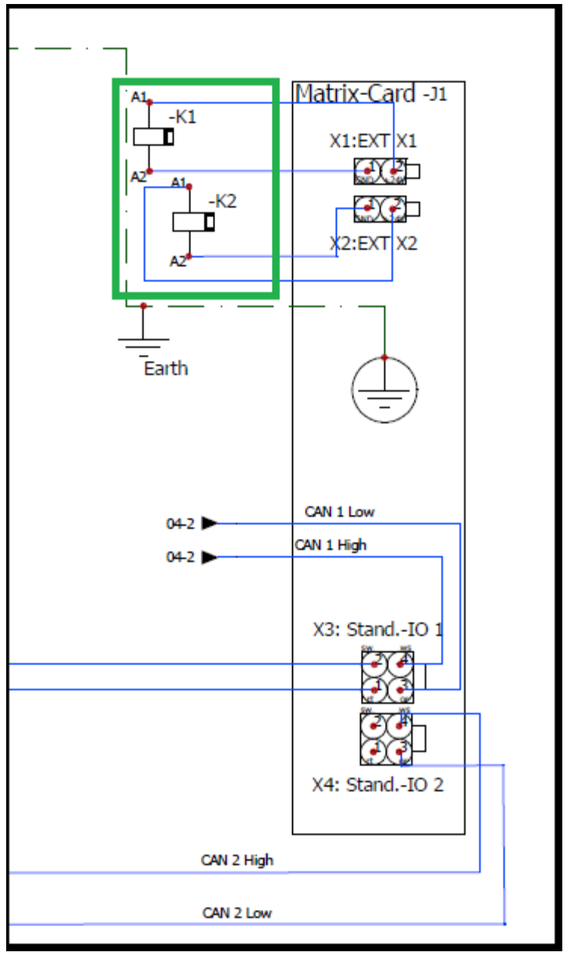
5.9.3 Set additional relay

For matrix types 3 (16 relays) and type 4 (32 relays), it is necessary to set the additional relays if:
- Current consumption test is used..
- Resistance test is used.
- Protective earth test is carried out via the matrix.

In this case, the additional relays must also be reset for the other test types.
The additional relays are available if one of the extension modules with article numbers **206639** or **206748** has been purchased.

	Command	Answer	Example	From firmware	Description
1	**RM64vxxxxxxs**	**RM64vxxxxxxs**	S 'RM64+000000 ' R 'RM64+000000 '		Sets the additional relays on the first board. The following values are permitted: 'RM**64**+00000**0** ' = Both additional relays switched off. 'RM**64**+00000**1** ' = First additional relay will be switched (**K1**). 'RM**64**+00000**2** ' = Second additional relay will be switched (**K2**) 'RM**64**+00000**3** ' = Both additional relays will be switched.
2	**RM65vxxxxxxs**	**RM65vxxxxxxs**	S 'RM65+000001 ' R 'RM65+000001 '		Sets the additional relays on the second board. The following values are permitted: 'RM**65**+00000**0** ' = Both additional relays switched off. 'RM**65**+00000**1** ' = First additional relay will be switched (**K1**). 'RM**65**+00000**2** ' = Second additional relay will be switched (**K2**). 'RM**65**+00000**3** ' = Both additional relays will be switched.
3	**RM66vxxxxxxs**	**RM66vxxxxxxs**	S 'RM66+000002 ' R 'RM66+000002 '	33456	Sets the additional relays on the third board. The following values are permitted: 'RM**66**+00000**0** ' = Both additional relays switched off. 'RM**66**+00000**1** ' = First additional relay will be switched (**K1**). 'RM**66**+00000**2** ' = Second additional relay will be switched (**K2**). 'RM**66**+00000**3** ' = Both additional relays will be switched.

Example:



5.9.4 Query inputs

The commands in the table are used to query the states of the set relays.

Command	Answer	Description	Firmware IO-CPU
RM00?	RM00vxxxxxxs	Reads the last command sent to the relays K1 ... K16	
RM01?	RM01vxxxxxxs	Reads the last command sent to the relays K17 ... K32	
RM02?	RM02vxxxxxxs	Reads the last command sent to the relays K33 ... K48	
RM03?	RM03vxxxxxxs	Reads the last command sent to the relays K49 ... K64	

Command	Answer	Description	Firmware IO-CPU
RM04?	RM04vxxxxxxs	Reads the last command sent to the relays K65 ... K80	33456 or newer
RM05?	RM05vxxxxxxs	Reads the last command sent to the relays K81 ... K96	33456 or newer
RM06?	RM06vxxxxxxs	Reads the last command sent to the relays K97 ... K112	33456 or newer
RM07?	RM07vxxxxxxs	Reads the last command sent to the relays K113 ... K128	33456 or newer
RM08?	RM08vxxxxxxs	Reads the last command sent to the relays K129 ... K144	33456 or newer
RM09?	RM09vxxxxxxs	Reads the last command sent to the relays K145 ... K160	33456 or newer
RM10?	RM10vxxxxxxs	Reads the last command sent to the relays K161 ... K176	33456 or newer
RM11?	RM11vxxxxxxs	Reads the last command sent to the relays K177 ... K192	33456 or newer
RM12?	RM12vxxxxxxs	Reads the last command sent to the relays K193 ... K208	33456 or newer
RM13?	RM13vxxxxxxs	Reads the last command sent to the relays K209 ... K224	33456 or newer
RM14?	RM14vxxxxxxs	Reads the last command sent to the relays K225 ... K240	33456 or newer
RM15?	RM15vxxxxxxs	Reads the last command sent to the relays K241 ... K256	33456 or newer

5.9.5 Example

5.9.5.1 Individual commands

Example resistance test with matrix.

	Command	Description
Query device information		
S	'GFWS?'	Firmware
R	'GFWS33624 23529'	IO-CPU = 33624, LT-CPU = 23529
S	'RQSN?'	Serial number
R	'RQSN211917 0222 1534'	SN = 2119170 0222 1534
Transfer matrix parameters		
S	'RMNR+000004 '	Board type 4: Relay matrix with 32 relays
R	'RMNR+000004 '	
S	'RMNB+000003 '	Number of boards = 3
R	'RMNB+000003 '	
S	'RM00+004608 '	Set K10 and K13
R	'RM00+004608 '	
S	'RM01+004608 '	Set K26 and K29
R	'RM01+004608 '	
S	'RMST'	Matrix Start
R	'RMST'	
Transfer test parameters		
S	'WIRX+000036 '	Rmax = 36 Ohm

	Command	Description
R	'WIRX+000036 '	
S	'WIRM+000000 '	Rmin = 0 Ohm
R	'WIRM+000000 '	
S	'WITP+0001.0 '	t = 1,0 s
R	'WITP+0001.0 '	
S	'WIRO+0000.0 '	R offset = 0,0 Ohm
R	'WIRO+0000.0 '	
S	'WICO+065535 '	Set Polarity: Matrix module will be switched
R	'WICO+065535 '	
S	'WITO+0010.0 '	Timeout = 10,0 s
R	'WITO+0010.0 '	
S	'STSC 0002 0000'	Set Safety circuit as start condition
R	'STSC'	
S	'STPA+000006 '	Activate resistance test
R	'STPA+000006 '	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS7082'	0**1**1**1** 0000 1000 00**1**0 Bit1= 1: Safety circuit closed, Bit13= 1 : Parameters are still being processed, Bit14 = 1 : external matrix has switched/set relay or is not present. For matrix if Bit15 = 0, Bit14 is evaluated.
S	'GETS?'	Status query
R	'GETS5082'	0**1**0**1** 0000 1000 00**1**0 Bit13 = 0 : Parameter download is completed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'WIST'	Start test
R	'WIST'	
Measured values query		
S	'WIIR?'	Resistance
R	'WIIR+017361u **00**'	**00** test not yet active
S	'PTI_?'	Test duration
R	'PTI_ 000000 '	t = 0 s
S	'WIIR?'	Resistance
R	'WIIR+017363u **01**'	**01** test active, R = 17363 uOhm
S	'PTI_?'	Test duration
R	'PTI_+000920m'	t = 920 ms
S	'WIIR?'	Resistance
R	'WIIR+017360u **02**'	R = 17360 uOhm, **02** test completed IO (Passed)
S	'PTI_?'	Test duration
R	'PTI_+001000m'	t = 1000 ms

	Command	Description
Error query		
S	'ERIN?'	Error query
R	'ERIN+000000 '	No error
Test stop		
S	'WISP'	Stop test
R	'WISP'	

5.9.5.2 Chained commands

Example resistance test with matrix.

	Command	Description
Query device information		
S	'GFWS?;RQSN?'	Firmware and serial number
R	'GFWS33624 23529;RQSN211917 0222 1534'	IO-CPU = 33624, LT-CPU = 23529, SN = 2119170 0222 1534
Transfer matrix parameters		
S	'RMNR+000004 ;RMNB+000003 ;RM00+004608 ;RM01+004608 ;RMST'	Description in "Individual commands"
R	'RMNR+000004 ;RMNB+000003 ;RM00+004608 ;RM01+004608 ;RMST'	
Transfer test parameters		
S	'WIRX+000036 ;WIRM+000000 ;WITP+0001.0 ;WIRO+0000.0 ;WICO+065535 ;WITO+0010.0 ;STSC 0002 0000;STPA+000006 '	Description in "Individual commands"
R	'WIRX+000036 ;WIRM+000000 ;WITP+0001.0 ;WIRO+0000.0 ;WICO+065535 ;WITO+0010.0 ;STSC;STPA+000006 '	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS7082'	0**11**1 0000 1000 00**1**0 Bit1= 1: Safety circuit closed, Bit13= 1 : Parameters are still being processed, Bit14 = 1 : external matrix has switched/set relay or is not present. For matrix if Bit15 = 0, Bit14 is evaluated.
S	'GETS?'	Status query
R	'GETS5082'	0**10**1 0000 1000 00**1**0 Bit13 = 0 : Parameter download is completed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'WIST'	Start test
R	'WIST'	
Measured values query		
S	'WIIR?;PTI_?'	Resistance, test duration
R	'WIIR+017361u **00**;PTI_ 000000 '	**00** test not yet active
S	'WIIR?;PTI_?'	Resistance, test duration
R	'WIIR+017363u **01**;PTI_+000920m'	**01** test active, R = 17363 uOhm, t = 920 ms
S	'WIIR?;PTI_?'	Resistance, test duration

	Command	Description
R	'WIIR+017360u **02**;PTI_+001000m'	R = 17360 uOhm, t = 1000 ms, **02** test completed IO (Passed),
Error query		
S	'ERIN?'	Query error
R	'ERIN+000000 '	No error
Test stop		
S	'WISP'	Stop test
	'WISP'	

5.10 Symmetry test

This test can be carried out from firmware 33593.
In the symmetry test, 3 current channels are measured via one current clamp each. The current values of the three measuring channels are evaluated against the limit values. If only one channel is to be evaluated, the limit values of the other channels must be transmitted in such a way that no error is detected. The connection is made via the Test probe and HV2/PEX sockets. A direct current is generated.
To recalculate the currents from the voltages, the conversions must be transferred for the measuring channels with the scaling data. This transfer must take place once beforehand as long as the scaling values do not change.

5.10.1 Set parameter

Attention

- Data is exchanged according to the master/slave principle. The ETL device is the slave.
- Each request is acknowledged with a corresponding response. Only after the response is received can the next command be sent. In the case of chained commands in ATS400, this applies to the entire chain.
- If a request is not understood, the device responds with the mnemonic code followed by **nok**. For chained commands in ATS400, this applies to each individual command.
- If no SI prefix is used for the command, the number is followed by a space.
- The transferred parameters are retained on the device; they are only overwritten when new parameters are transferred.
- The quotation marks in the "Example" column are only there to illustrate the length of the command with and without SI prefix and are not part of the command.

Attention

- The sequence of commands must be observed as shown in the table.
- The commands marked with an asterisk (*) are optional. They only need to be transferred if the functionality is required.

	Command	Answer	Example	From firmware	Description
1	**SYCUvxxxxxxs**	**SYCUvxxxxxxs**	S 'SYCU+000025 ' R 'SYCU+000025 '		Test current in A, which is generated as a total current. I = 25 A
2	**SYVOvxxxxxxs**	**SYVOvxxxxxxs**	S 'SYVO+000012 ' R 'SYVO+000012 '		Open-circuit voltage in V that is generated at maximum if no current flows. U = 12 V **Attention**: In the command **SYVO** , the letter **O** must be used and not the number **0 (zero)**.
3	**SYTTvxxxxxxs**	**SYTTvxxxxxxs**	S 'SYTT+003.00 ' R 'SYTT+003.00 '		Test time in s in which the evaluation of the limits takes place. t = 3,00 s
4	**SYCOvxxxxxxs**	**SYCOvxxxxxxs**	S 'SYCO+000000 ' R 'SYCO+000000 '		This command is used to set the polarity. The polarity can be used to interconnect the symmetry check. Attention: **Simultaneous use of the relay matrix and the ETL-Interface is only possible from version 33581 of the IO-CPU. Either a relay matrix or the outputs on the ETL-Interface can be used.** Please refer to the documentation for the device to find out how the wiring is carried out. Polarity values: 'XXXX+00000**0** ' = No relay matrix active and no interconnection active. 'XXXX+00000**1** ' = No relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+00000**2** ' = No relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+00000**3** ' = No relay matrix active and both interconnections active. 'XXXX+0**65280** ' = Relay matrix active and both circuits not active.

	Command	Answer	Example	From firmware	Description
					'XXXX+0**65281** ' = Relay matrix active and interconnection 1 active (output external relay1: **Pin9 = Out7** in ETL-Interface). 'XXXX+0**65282** ' = Relay matrix active and interconnection 2 active (output external relay2: **Pin10 = Out8** in ETL-Interface). 'XXXX+0**65283** ' = Relay matrix active and both interconnections active. 'XXXX+0**65535** ' = Relay matrix active and no interconnection active. With **000001** bis **000003,** only the relay outputs of the ETL-interface are switched. With **065280** bis **065283,** the relay outputs of the ETL-interface are also switched and the corresponding switching times are waited for. This is done in parallel with the switching in the matrix modules. With **065535** only the matrix modules are switched. **Attention**: In the command **SYCO** , the letter **O** must be used and not the number **0 (zero)**.
5	**SYL1vxxxxxxs**	**SYL1vxxxxxxs**	S 'SYL1+000000 ' R 'SYL1+000000 '		Lower limit value in A, for the measurement on channel AD1. Imin = 0 A
6	**SYU1vxxxxxxs**	**SYU1vxxxxxxs**	S 'SYU1+000010 ' R 'SYU1+000010 '		Upper limit value in A, for the measurement on channel AD1. Imax = 10 A
7	**SYL2vxxxxxxs**	**SYL2vxxxxxxs**	S 'SYL2+000000 ' R 'SYL2+000000 '		Lower limit value in A, for the measurement on channel AD2. Imin = 0 A
8	**SYU2vxxxxxxs**	**SYU2vxxxxxxs**	S 'SYU2+000010 ' R 'SYU2+000010 '		Upper limit value in A, for the measurement on channel AD2. Imax = 10 A
9	**SYL3vxxxxxxs**	**SYL3vxxxxxxs**	S 'SYL3+000000 ' R 'SYL3+000000 '		Lower limit value in A, for the measurement on channel AD3. Imin = 0 A
10	**SYU3vxxxxxxs**	**SYU3vxxxxxxs**	S 'SYU3+000010 ' R 'SYU3+000010 '		Upper limit value in A, for the measurement on channel AD3. Imax = 10 A
11	**SYFLvxxxxxxs**	**SYFLvxxxxxxs**	S 'SYFL+000001 ' R 'SYFL+000001 '		Controls which measurement is used to record the voltage. The standard is to record the PE voltage with MEP-PE. This function is only available in the firmware IO-CPU 35598 / LT-CPU 25521. The following values are permissible: 'SYFL+00000**0** ' = Use of the PE voltage with MEP-PE. 'SYFL+00000**1** ' = Use of the resistor module.
12	**STPAvxxxxxxs**	**STPAvxxxxxxs**	S 'STPA+000022 ' R 'STPA+000022 '		This command can be used to set the test type. After setting the test type, it can take up to 200 ms until closed contact monitoring is detected via the status request command. Test type values: 'STPA+00000**0** ' = No test type 'STPA+00000**1** ' = High-voltage test 'STPA+00000**2** ' = Function test 'STPA+00000**3** ' = Protective earth test 'STPA+00000**4** ' = Insulation test 'STPA+00000**5** ' = Leakage current test 'STPA+00000**6** ' = Resistance test 'STPA+0000**20** ' = Continuity test with DC4 module 'STPA+0000**21** ' = Voltage measurement 'STPA+0000**22** ' = Symmetry test 'STPA+0000**23** ' = Protective earth test with resistance module
13	**STSC xxxx yyyy**	**STSC**	S 'STSC 0003 0000' R 'STSC'		Sets the start conditions of the test so that they can be evaluated before and during the test. The safety circuit is always active during high-voltage tests. hex 3= 0011(Bit0= Start button, Bit1= Safety circuit)

5.10.2 Perform test

	Command	Answer	Example	From firmware	Description
	GETS?	**GETSxxxx**	S 'GETS?' R 'GETS5883'		This query is used to determine whether it is possible to start a test. 5883 hex = 0**10**1 0000 1000 00**11** (Bit0 = 1: Start button pressed., Bit1 = 1: Safety circuit closed, Bit13 = 0 : Parameter download is completed) To start a test with the **ATS 400**, Bit13 must not be set and Bit14 or Bit15 must be set. Depending on the test type, further Bits must or can be set. Bit1 must also be set for all high-voltage tests and the insulation test. Status query. **Caution**: If Bit13 is not removed after a timeout of 1s, the diagnostic data must be deleted with the commands SY* can be retrieved. The commands and descriptions can be found in the chapter Diagnostic data.
	SYST	**SYST**	S 'SYST' R 'SYST'		Starts the die Symmety test. **Attention:** The start command is transmitted after the start conditions have been fulfilled, parameter download is completed (Bit13 not set) and Bit14 (or Bit15) is set. The status query is carried out using the **GETS?** command (more on this in the Examples section).
	SYC1?	**SYC1vxxxxxxs zz**	S 'SYC1?' R 'SYC1+011.75 01'		Gives the current of channel AD1 as a measured value. I = 11,75 A, 01 = test active (status of the test).
	SYC2?	**SYC2vxxxxxxs zz**	S 'SYC2?' R 'SYC2+011.80 01'		Gives the current of channel AD2 as a measured value. I = 11,80 A, 01 = test active (status of the test).
	SYC3?	**SYC3vxxxxxxs zz**	S 'SYC3?' R 'SYC3+011.85 01'		Gives the current of channel AD3 as a measured value. I = 11,85 A, 01 = test active (status of the test).
	SYUC?	**SYUCvxxxxxxs zz**	S 'SYUC?' R 'SYUC+001226m 01'		Gives the voltage as a measured value.. U = 1226 mV, 01 = test active (status of the test).
	SYR1?	**SYR1vxxxxxxs zz**	S 'SYR1?' R 'SYR1+0102.6m 01'		Gives the resistance of channel AD1 as a measured value. R = 102,6 mOhm
	SYR2?	**SYR2vxxxxxxs zz**	S 'SYR2?' R 'SYR2+0103.4m 01'		Gives the resistance of channel AD2 as a measured value. R = 103,4 mOhm
	SYR3?	**SYR3vxxxxxxs zz**	S 'SYR3?' R 'SYR3+0103.0m 01'		Gives the resistance of channel AD3 as a measured value. R = 103,0 mOhm
	ERIN?	**ERINvxxxxxxs**	S 'ERIN?' R 'ERIN+000000 '	33297	This command can be used to query the error information. This field is updated at the end of the check. During the check, this field is filled with zeros. In Case of error, the response is a number 192 or 217. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).
	SYSP	**SYSP**	S 'SYSP' R 'SYSP'		Stops the Symmety test. **Attention**: The command is transmitted when the check status changes from active (01) to passed (02), failed (03), error (04) or aborted (06).

5.10.3 Example

Geben Sie hier den Text ein.

5.10.3.1 individual commands

	Command	Description
Query device information		
S	'GFWS?'	Firmware
R	'GFWS34597 27520'	IO-CPU = 34597, LT-CPU = 27520

	Command	Description
S	'RQSN?'	Serial number
R	'2112200621127 '	SN = 21122 0062 1127
Transfer Skaling data		
S	'ASV1+0000.0 '	Voltage in volts for point 1 in channel 1. U = 0,0 V
R	'ASV1+0000.0 '	
S	'ASP1+0000.0 '	Physical value for point 1 in channel 1.
R	'ASP1+0000.0 '	
S	'ASV2+0010.0 '	Voltage in volts for point 2 in channel 1. U = 10,0 V
R	'ASV2+0010.0 '	
S	'ASP2+0010.0 '	Physical value for point 2 in channel 1.
R	'ASP2+0010.0 '	
S	'ASV3+0000.0 '	Voltage in volts for point 1 in channel 2. U = 0,0 V
R	'ASV3+0000.0 '	
S	'ASP3+0000.0 '	Physical value for point 1 in channel 2.
R	'ASP3+0000.0 '	
S	'ASV4+0010.0 '	Voltage in volts for point 2 in channel 2. U = 10,0 V
R	'ASV4+0010.0 '	
S	'ASP4+0010.0 '	Physical value for point 2 in channel 2.
R	'ASP4+0010.0 '	
S	'ASV5+0000.0 '	Voltage in volts for point 1 in channel 3. U = 0,0 V
R	'ASV5+0000.0 '	
S	'ASP5+0000.0 '	Physical value for point 1 in channel 3.
R	'ASP5+0000.0 '	
S	'ASV6+0010.0 '	Voltage in volts for point 2 in channel 3. U = 10,0 V
R	'ASV6+0010.0 '	
S	'ASP6+0010.0 '	Physical value for point 2 in channel 3.
R	'ASP6+0010.0 '	
Transfer test parameters		
S	'SYCU+0012.0 '	Test current in A, which is generated as a total current, I = 12,0 A
R	'SYCU+0012.0 '	
S	'SYVO+012.00 '	Open-circuit voltage in V that is generated at maximum if no current flows. U = 12,00 V
R	'SYVO+012.00 '	
S	'SYTT+020.00 '	Test time in s in which the evaluation of the limits takes place. t = 20,00 s
R	'SYTT+020.00 '	
S	'SYFL+000001 '	Controls which measurement is used to record the voltage. 1 = Use of the resistance module
R	'SYFL+000001 '	
S	'SYCO+000000 '	No Polarity

	Command	Description
R	'SYCO+000000 '	
S	'SYL1+0001.0 '	Lower limit value in A, for the measurement on channel AD1. Imin = 1,0 A
R	'SYL1+0001.0 '	
S	'SYU1+0025.0 '	Upper limit value in A, for the measurement on channel AD1. Imax = 25,0 A
R	'SYU1+0025.0 '	
S	'SYL2+0000.0 '	Lower limit value in A, for the measurement on channel AD2. Imin = 0,0 A
R	'SYL2+0000.0 '	
S	'SYU2+0025.0 '	Upper limit value in A, for the measurement on channel AD2. Imax = 25,0 A
R	'SYU2+0025.0 '	
S	'SYL3+0000.0 '	Lower limit value in A, for the measurement on channel AD3. Imin = 0,0 A
R	'SYL3+0000.0 '	
S	SYU3+0025.0 '	Upper limit value in A, for the measurement on channel AD3. Imax = 25,0 A
R	SYU3+0025.0 '	
R	'STPA+000022 '	Activate symmety test
S	'STPA+000022 '	
R	'STSC 0001 0000'	Set safety start button as start condition.
R	'STSC'	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS5600'	010**1** 0110 0000 0000 Bit13 = 0 : Parameter download is completed.
S	'GETS?'	Status query
R	'GETS5601'	010**1** 0110 1000 000**1** Bit0 = 1: Start button pressed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'SPST'	Start test
R	'SPST'	
Measured values query		
S	'SYC1?''	Current of channel AD1.
R	'SYC1+000000f **00**'	**00** test not yet active
S	'SYC2?'	Current of channel AD2.
R	'SYC2+000000f **00**'	**00** test not yet active
S	'SYC3?'	Current of channel AD3.
R	'SYC3+000000f **00**'	**00** test not yet active
S	'SYUC?'	Voltage
R	'SYUC+000000f **00**'	**00** test not yet active
S	'SYR1?'	Resistance of channel AD1
R	'SYR1+000000f **00**'	**00** test not yet active
S	'SYR2?'	Resistance of channel AD2

	Command	Description
R	'SYR2+000000f **00**'	**00** test not yet active
S	'SYR3?'	Resistance of channel AD3
R	'SYR3+000000f **00**'	**00** test not yet active
S	'PTI_?'	Test duration
R	'PTI_+000.00 '	t = 0,00 s
S	'SYC1?''	Current of channel AD1
R	'SYC1+0000.0 **01**'	**01** test active, I1 = 10,0 A
S	'SYC2?'	Current of channel AD2
R	'SYC2+0000.0 **01**'	**01** test active, I2 = 0,0 A
S	'SYC3?'	Current of channel AD3
R	'SYC3-0000.1 **01**'	**01** test active, I3 = 0,1 A
S	'SYUC?'	Voltage
R	'SYUC+1467.5m **01**'	**01** test active, U 1467,5 mV
S	'SYR1?'	Resistance of channel AD1
R	'SYR1+0000.1P **01**'	**01** test active, R1 = 1172 uOhm
S	'SYR2?'	Resistance of channel AD2
R	'SYR2+0000.1P **01**'	**01** test active, R2 = 0,1 pOhm
S	'SYR3?'	Resistance of channel AD3
R	'SYR3+014.67 **01**'	**01** test active, R3 = 14,67 Ohm
S	'PTI_?'	Test duration
R	'PTI_+017.22 '	t = 17,22 s
S	'SYC1?''	Current of channel AD1.
R	'SYC1+0000.0 **03**'	**03** test completed NIO (failed), , I1 = 0,0 A
S	'SYC2?'	Current of channel AD2.
R	'SYC2+0000.0 **03**'	**03** test completed NIO (failed), I2 = 0,0A
S	'SYC3?'	Current of channel AD3.
R	'SYC3+0000.0 **03**'	**03** test completed NIO (failed), I3 = 0,0 A
S	'SYUC?'	Voltage
R	'SYUC+1468.6m **03**'	**03** test completed NIO (failed), U = 1468,6 mV
S	'SYR1?'	Resistance of channel AD1
R	'SYR1+0000.1P **03**'	**03** test completed NIO (failed), R1 = 0,1 pOhm
S	'SYR2?'	Resistance of channel AD2
R	'SYR2+0000.1P **03**'	**03** test completed NIO (failed), R2 = 0,1 pOhm
S	'SYR3?'	Resistance of channel AD3
R	'SYR3+0000.1P **03**'	**03** test completed NIO (failed), R3 = 0,1 pOhm
S	'PTI_?'	Prüfdauer
R	'PTI_+020.00 '	t = 20,00 s

	Command	Description
Error query		
S	'ERIN?'	Query error
R	ERIN+000192 '	192 dec. = Current channel 1 lower limit undershot.
Test stop		
S	'SPSP'	Stop test
R	'SPSP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000022 ') only needs to be transmitted before starting.

Example:
'STPA+000022 '
'SYST'

5.10.3.2 Chained commands

	Command	Description
Query device information		
S	'GFWS?;RQSN?'	Firmware and serialnumber
R	'GFWS33608 23527;RQSN201937908221758 '	IO-CPU = 33527, LT-CPU = 27520, SN = 2019379 0822 1758
Transfer Skaling data		
S	'ASV1+0000.0 ;ASP1+0000.0 ;ASV2+0010.0 ;ASP2+0010.0 ;ASV3+0000.0 ;ASP3+0000.0 ;ASV4+0010.0 ;ASP4+0010.0 ;ASV5+0000.0 ;ASP5+0000.0 ;ASV6+0010.0 ;ASP6+0010.0 '	Description in "Individual commands"
R	'ASV1+0000.0 ;ASP1+0000.0 ;ASV2+0010.0 ;ASP2+0010.0 ;ASV3+0000.0 ;ASP3+0000.0 ;ASV4+0010.0 ;ASP4+0010.0 ;ASV5+0000.0 ;ASP5+0000.0 ;ASV6+0010.0 ;ASP6+0010.0 '	
Transfer test parameters		
S	'SYCU+0012.0 ;SYVO+012.00 ;SYTT+020.00 ;SYFL+000001 ;SYCO+000000 ;SYL1+0001.0 ;SYU1+0025.0 ;SYL2+0000.0 :SYU2+0025.0 ;SYL3+0000.0 ;SYU3+0025.0 ;SYFL+000001 ;STPA+000022 ;STSC 0001 0000'	Description in "Individual commands"
R	'SYCU+0012.0 ;SYVO+012.00 ;SYTT+020.00 ;SYFL+000001 ;SYCO+000000 ;SYL1+0001.0 ;SYU1+0025.0 ;SYL2+0000.0 :SYU2+0025.0 ;SYL3+0000.0 ;SYU3+0025.0 ;SYFL+000001 ;STPA+000022 ;STSC'	
Status query before start (parameters download, start conditions, ...)		
S	'GETS?'	Status query
R	'GETS5600'	0**10**1 0110 0000 0000 Bit13 = 0 : Parameter download is completed.
S	'GETS?'	Status query
R	'GETS5601'	0**10**1 0110 1000 000**1** Bit0 = 1: Start button pressed.
Parameter Download is completed and the start conditions have been met. Start Test		
S	'SYST'	Start test
R	'SYST'	
Measured values query		
S	'SYC1?;SYC2?;SYC3?;SYUC?;SYR1?;SYR2?;SYR3?;PTI_?'	Current of channel AD1, current of channel AD2, current of channel AD3, voltage, resistance of channel AD1, resistance of channel AD2, resistance of channel AD3, test duration.

	Command	Description
R	'SYC1+000000f **00**;SYC2+000000f **00**;SYC3+000000f **00**;SYUC+599.26m 00;SYR1+000000f 00;SYR2+000000f 00;SYR3+000000f 00;PTI_+000.00 '	**00** test not yet active
S	'SYC1?;SYC2?;SYC3?;SYUC?;SYR1?;SYR2?;SYR3?;PTI_?'	Current of channel AD1, current of channel AD2, current of channel AD3, voltage, resistance of channel AD1, resistance of channel AD2, resistance of channel AD3, test duration.
R	'SYC1+0000.0 **01**;SYC2+0000.0 **01**;SYC3+0000.0 **01**;SYUC+1471.8m **01**;SYR1+0000.1P **01**;SYR2+0000.1P **01**;SYR3+0000.1P **01**;PTI_+000.31 '	**01** test active, IAD1 = 0 A, IAD2 = 0 A, IAD3 = 0 A, U = 1471,8 mV, RAD1 = 0,1 pOhm, RAD2 = 0,1 POhm, RAD3 = 0,1 pOhm, t = 0,31 s.
S	'SYC1?;SYC2?;SYC3?;SYUC?;SYR1?;SYR2?;SYR3?;PTI_?'	Current of channel AD1, current of channel AD2, current of channel AD3, voltage, resistance of channel AD1, resistance of channel AD2, resistance of channel AD3, test duration.
R	'SYC1+0000.0 **01**;SYC2+0000.0 **01**;SYC3+0000.1 **01**;SYUC+1467.5m **01**;SYR1+0000.1P **01**;SYR2+0000.1P **01**;SYR3+014.67 **01**;PTI_+017.22 '	**01** test active, IAD1 = 0 A, IAD2 = 0 A, IAD3 = 0,1 A, U = 1467,5 mV, RAD1 = 0,1 pOhm, RAD2 = 0,1 POhm, RAD3 = 14,67 Ohm, t = 17,22 s.
S	'SYC1?;SYC2?;SYC3?;SYUC?;SYR1?;SYR2?;SYR3?;PTI_?'	Current of channel AD1, current of channel AD2, current of channel AD3, voltage, resistance of channel AD1, resistance of channel AD2, resistance of channel AD3, test duration.
R	'SYC1+0000.0 **03**;SYC2+0000.0 **03**;SYC3+0000.0 **03**;SYUC+1468.6m **03**;SYR1+0000.1P **03**;SYR2+0000.1P **03**;SYR3+0000.1P **03**;PTI_+020.00 '	**03** test ended NIO (failed), IAD1 = 0 A, IAD2 = 0 A, IAD3 = 0 A, U = 1468,6 mV, RAD1 = 0,1 pOhm, RAD2 = 0,1 pOhm, RAD3 = 0,1 POhm, t = 20,00 s.
Error query		
S	'ERIN?'	Query error
R	ERIN+000192 '	192 dec. = Current channel 1 lower limit undershot.
Test stop		
S	'SPSP'	Stop test
	'SPSP'	

Attention:
The parameters do not always have to be transmitted. If testing is to be carried out with the same values, the command for the test type ('STPA+000022 ') only needs to be transmitted before starting.

Example:
'STPA+000022 '
'SYST'

5.10.4 Error number symmetry test

The error information is queried with the command '`ERIN?`'.

Wert	Bedeutung
192	`SYP_IUMIN:` Current channel 1 lower limit undershot
193	`SYP_IUMAX:` Current channel 1 upper limit exceeded
194	`SYP_IVMIN:` Current channel 2 lower limit undershot
195	`SYP_IVMAX:` Current channel 2 upper limit exceeded
196	`SYP_IWMIN:` Current channel 3 lower limit undershot

Wert	Bedeutung
197	SYP_IWMAX: Current channel 3 upper limit exceeded
198	SYP_IUMIN_IVMIN: Current channel 1 lower limit undershot and current channel 2 lower limit undershot
199	SYP_IUMIN_IVMAX: Current channel 1 lower limit undershot and current channel 2 upper limit exceeded
200	SYP_IUMAX_IVMIN: Current channel 1 upper limit exceeded and current channel 2 lower limit undershot
201	SYP_IUMAX_IVMAX: Current channel 1 upper limit exceeded and current channel 2 upper limit exceeded
202	SYP_IUMIN_IWMIN: Current channel 1 lower limit undershot and current channel 3 lower limit undershot
203	SYP_IUMIN_IWMAX: Current channel 1 lower limit undershot and current channel 3 upper limit exceeded
204	SYP_IUMAX_IWMIN: Current channel 1 upper limit exceeded and current channel 3 lower limit undershot
205	SYP_IUMAX_IWMAX: Current channel 1 upper limit exceeded and current channel 3 upper limit exceeded
206	SYP_IVMIN_IWMIN: Channel AD2 undershot lower limit and current channel 3 undershot lower limit
207	SYP_IVMIN_IWMAX: Channel AD2 lower limit undershot and current channel 3 upper limit exceeded
208	SYP_IVMAX_IWMIN: Channel AD2 upper limit exceeded and current channel 3 lower limit undershot
209	SYP_IVMAX_IWMAX: Channel AD2 upper limit exceeded and current channel 3 upper limit exceeded
210	SYP_IUMIN_IVMIN_IWMIN: Current channel 1 lower limit undershot and current channel 2 lower limit undershot and current channel 3 lower limit undershot
211	SYP_IUMIN_IVMAX_IWMIN: Current channel 1 lower limit undershot and current channel 2 upper limit exceeded and current channel 3 lower limit undershot
212	SYP_IUMAX_IVMIN_IWMIN: Current channel 1 upper limit exceeded and current channel 2 lower limit undershot and current channel 3 lower limit undershot
213	SYP_IUMAX_IVMAX_IWMIN: Current channel 1 upper limit exceeded and current channel 2 upper limit exceeded and current channel 3 lower limit undershot
214	SYP_IUMIN_IVMIN_IWMAX: Current channel 1 lower limit undershot and current channel 2 lower limit undershot and current channel 3 upper limit exceeded

Wert	Bedeutung
215	SYP_IUMIN_IVMAX_IWMAX: Current channel 1 lower limit undershot and current channel 2 upper limit exceeded and current channel 3 upper limit exceeded
216	SYP_IUMAX_IVMIN_IWMAX: Current channel 1 upper limit exceeded and current channel 2 lower limit undershot and current channel 3 upper limit exceeded
217	SYP_IUMAX_IVMAX_IWMAX: Current channel 1 upper limit exceeded and current channel 2 upper limit exceeded and current channel 3 upper limit exceeded

5.11 Temperature compensation

To use the temperature-compensated HVDC test or insulation test, parameters that are necessary for the calculation must be transferred.

	Command	Answer	Example	From firmware	Description
1	TCBTvxxxxxxs	TCBTvxxxxxxs	S 'TCBT+0020.0 ' R 'TCBT+0020.0 '	335xx	Sets the base temperature in °C to which the measurement is related. T = 20,0 °C
2	TCMCvxxxxxxs	TCMCvxxxxxxs	S 'TCMC+0010.0 ' R 'TCMC+0010.0 '	335xx	Sets the material constant for the calculation, referred to as X in DIN EN 60034-27-4. M = 10,0
3	TCCHvxxxxxxs	TCCHvxxxxxxs	S 'TCCH+000000 ' R 'TCCH+000000 '	335xx	Measuring channel to which the temperature sensor is connected. Permissible values are 0 ... 3.

5.12 Scaling data

The scaling data is used to convert a voltage at the analog interface into a physical quantity. The conversion is based on the interpolation of a straight line, which is specified in two-point form.
The scaling data is required for protective earth test with current clamps, temperature-compensated HVDC test, temperature-compensated insulation test and symmetry test.
The voltage must always be specified with 2 decimal places.
The number of decimal places of the physical value also determines the number of decimal places when reading the values during the symmetry test.
It is sufficient to only transmit scaling data for the channels used.

	Command	Answer	Example	From firmware	Description
	ASV1vxxxxxxs	ASV1vxxxxxxs	S 'ASV1+000.00 ' R 'ASV1+000.00 '	335xx	Voltage in volt for point 1 in channel 1. U = 0,00 V
	ASP1vxxxxxxs	ASP1vxxxxxxs	S 'ASP1+000.00 ' R 'ASP1+000.00 '		Physical value for point 1 in channel 1.
	ASV2vxxxxxxs	ASV2vxxxxxxs	S 'ASV2+010.00 ' R 'ASV2+010.00 '		Voltage in volt for point 2 in channel 1. U = 10,00 V
	ASP2vxxxxxxs	ASP2vxxxxxxs	S 'ASP2+050.00 ' R 'ASP2+050.00 '		Physical value for point 2 in channel 1.
	ASV3vxxxxxxs	ASV3vxxxxxxs	S 'ASV3+000.00 ' R 'ASV3+000.00 '		Voltage in volt for point 1 in channel 2. U = 0,00 V
	ASP3vxxxxxxs	ASP3vxxxxxxs	S 'ASP3+000.00 ' R 'ASP3+000.00 '		Physical value for point 1 in channel 2.
	ASV4vxxxxxxs	ASV4vxxxxxxs	S 'ASV4+010.00 ' R 'ASV4+010.00 '		Voltage in volt for point 2 in channel 2. U = 10,00 V
	ASP4vxxxxxxs	ASP4vxxxxxxs	S 'ASP4+050.00 ' R 'ASP4+050.00 '		Physical value for point 2 in channel 2.
	ASV5vxxxxxxs	ASV5vxxxxxxs	S 'ASV5+000.00 ' R 'ASV5+000.00 '	335xx	Voltage in volt for point 1 in channel 3. U = 0,00 V
	ASP5vxxxxxxs	ASP5vxxxxxxs	S 'ASP5+000.00 ' R 'ASP5+000.00 '		Physical value for point 1 in channel 3.
	ASV6vxxxxxxs	ASV6vxxxxxxs	S 'ASV6+010.00 ' R 'ASV6+010.00 '		Voltage in volt for point 2 in channel 3. U = 10,00 V
	ASP6vxxxxxxs	ASP6vxxxxxxs	S 'ASP6+050.00 ' R 'ASP6+050.00 '		Physical value for point 2 in channel 3.

	Command	Answer	Example	From firmware	Description
	ASV7vxxxxxxs	**ASV7vxxxxxxs**	S 'ASV7+000.00 ' R 'ASV7+000.00 '	335xx	Voltage in volt for point 1 in channel 4. U = 0,00 V
	ASP7vxxxxxxs	**ASP7vxxxxxxs**	S 'ASP7+000.00 ' R 'ASP7+000.00 '		Physical value for point 1 in channel 4.
	ASV8vxxxxxxs	**ASV8vxxxxxxs**	S 'ASV8+010.00 ' R 'ASV8+010.00 '		Voltage in volt for point 2 in channel 4. U = 10,00 V
	ASP8vxxxxxxs	**ASP8vxxxxxxs**	S 'ASP8+050.00 ' R 'ASP8+050.00 '		Physical value for point 2 in channel 4.

5.13 Breakdown detection NG

This chapter explains the parameters that can be transferred to adjust the evaluation of the breakdown detection.

5.13.1 Intrusion detection

Two parameters must be transferred for intrusion detection: Factor and Offset.
These parameters are transferred with the following commands.

Command	Answer	Example	From firmware	Description
BDFCvxxxxxxs	**BDFCvxxxxxxs**	S 'BDFC+000.95 ' R 'BDFC+000.95 '	337xx	Factor for intrusion detection. If the value is not transferred, the default value of 0.95 applies. The value range is from 0.75 to 0.98.
BDOFvxxxxxxs	**BDOFvxxxxxxs**	S 'BDOF+0015.0 ' R 'BDOF+0015.0 '	337xx	Offset for intrusion detection. If the value is not transmitted, the default value of 15.0 applies. The value range is 12.0 to 100.0. **Attention**: In the command **BDOF** , the letter **O** must be used and not the number **0 (zero)**.

During intrusion detection, two voltage values are compared with each other. The absolute values of the voltages are considered. A intrusion detection is detected when the following condition occurs:
U(n) < U(n-1) * factor - offset.
Here is:
U(n): the current voltage.
U(n-1): the previous voltage.
The time difference for recording the voltages is for:
HVAC: 1 / frequency.
HVDC3: 5 ms.
HVDC7: 12.5 ms.

5.13.2 Edge detection

The sensitivity of the edge detection can be set with a factor.
The spark detection values (1, 2 and 3) correspond to the factors:

Value	Factor
1 (Coarse)	3.0
2 (Normal)	2.5 (Default value)
3 (Fine)	2.0

Attention: the following command is not yet effective.
To set other factors, the following command must be transmitted:

Command	Answer	Example	From firmware	Description
BDSLvxxxxxxs	**BDSLvxxxxxxs**	S 'BDSL+0002.5 ' R 'BDSL+0002.5 '	337xx	For this factor to be effective, the value 4 must be transmitted for spark detection with the **UAAD** command. The value range of the factor is from 1.5 to 10.0.

5.13.3 Overcurrent detection

Only the current is considered for over current detection. The following commands are required.

Command	Answer	Example	From firmware	Description
BDINvxxxxxxs	**BDINvxxxxxxs**	S 'BDIN+000002 ' R 'BDIN+000002 '	337xx	Number of over current detections that must be detected in succession. If the value is not transmitted, the default value is 1. The value range is from 1 to 10.
BDCRvxxxxxxs	**BDCRvxxxxxxs**	S 'BDCR+000.15 ' R 'BDCR+000.15 '	337xx	Limit value for the current at which an over current is detected. If the value is not transmitted, the default value is 0.15. The value range is from 0.1 to 2.

5.14 Diagnostic data NG

This chapter describes commands that are transmitted in the event of unexpected behavior in order to read out diagnostic data.

5.14.1 Parameter check

Monitoring commands are explained in this chapter. These commands are used to check whether all the necessary parameters were transmitted without errors during the high voltage and insulation test and whether these values are within the permissible range.

5.14.1.1 Parameters for signal generation

The following command is transmitted to check whether all parameters for signal generation have been transmitted without errors.

Command	Answer	Example	From firmware	Description
HVSP?	**HVSPxxxxxxxx**	S 'HVSP?' R 'HVSP00000000'	337xx	The value is transferred in hexadecimal and must then be evaluated with the individual bits. If the value is 0, then all parameters are OK. The number can comprise 32 bits. Not all bits are currently assigned.

Bit	Cause
0	Test voltage parameter is missing.
1	Parameter flags missing. (A parameter was lost on the CAN-BUS).
2	Test time parameter is missing.
3	Parameter time rising ramp is missing.
4	Parameter time falling ramp is missing.
5	The ramp start voltage parameter is missing.
6	Parameter control flags missing. (A parameter was lost on the CAN-BUS).
7	Parameter Test voltage for the HVAC test is greater than the max. permissible test voltage.
8	Parameter Test voltage for the HVAC test is greater than the max. permissible test voltage with matrix module. (Information about this in the order/quotation).
9	Parameter Test voltage for the HVAC test is too low.
10	Parameter Test voltage for the HVDC or insulation test is greater than the max. permissible test voltage. (Information about this in the order/quotation).
11	Parameter Test voltage for the HVDC or insulation test is greater than the max. permissible test voltage with matrix module. (Information about this in the order/quotation).
12	Parameter Test voltage for HVDC or insulation test is too low.
13	The ramp start voltage parameter is not lower than the test voltage.
14	Discharge voltage parameter is missing.
15	Discharge voltage parameter is not in the range of 10 to 42 volts.
16	Hardware configuration parameter is missing. (A parameter was lost on the CAN-BUS).
17	Parameter time of the rising ramp is not 0.2 sec or greater.
18	Parameter time of the falling ramp is not 0.2 sec or greater.
19	Ramp start voltage parameter is too low.
20	Parameter time of the rising edge is not less than 60 sec.
21	Parameter time of the falling edge is not less than 60 sec.

5.14.1.2 Parameters for the measurement

The following command is transmitted to check whether all the necessary measurement parameters have been transmitted without errors.

Command	Answer	Example	From firmware	Description
HVMP?	**HVMPxxxxxxxx**	S 'HVMP?' R 'HVMP00000000'	337xx	One bit is set for each check. The value is transferred in hexadecimal and must then be evaluated with the individual bits. If the value is 0, then all parameters are OK. The number can comprise 32 bits. Not all bits are currently assigned.

Bit	Cause
0	Frequency parameter is missing.
1	Parameter Frequency is less than 45 Hz.
2	Parameter Frequency is greater than 65 Hz.
3	Parameter control flags missing. (A parameter was lost on the CAN-BUS).
4	Parameter arc detection is missing.
5	Hardware configuration parameter is missing. (A parameter was lost on the CAN-BUS).

5.14.1.3 Parameters for the evaluation

The following command is transmitted to check whether all the necessary test parameters have been transmitted without errors.

Command	Answer	Example	From firmware	Description
HVEP?	**HVEPxxxxxxxx**	S 'HVEP?' R 'HVEP00000000'	337xx	One bit is set for each check. The value is transferred in hexadecimal and must then be evaluated with the individual bits. If the value is 0, then all parameters are OK. The number can comprise 32 bits. Not all bits are currently assigned.

Bit	Cause
0	Parameter control flags missing. (A parameter was lost on the CAN-BUS).
1	Parameter flags missing. (A parameter was lost on the CAN-BUS).
2	Test time parameter is missing.
3	Delay parameter is missing.
4	Temperature compensation mode parameter is missing.
5	Lower current limit parameter is missing.
6	Parameter upper current limit is missing.
7	Lower resistance limit parameter is missing.
8	Parameter upper resistance limit is missing.
9	Parameter Delay time is greater than the test time.
10	The value of the lower current limit is not less than the value of the upper current limit.
11	The value of the lower resistance limit is not less than the value of the upper resistance limit.
12	Hardware configuration parameter is missing. (A parameter was lost on the CAN-BUS).

5.14.2 Start conditions check

This chapter explains commands that fulfill the conditions for a test start.

5.14.2.1 General starting conditions

The following command is transmitted to check the general start conditions.

Command	Answer	Example	From firmware	Description
SYTS?	**SYTSxxxxxxxx**	S 'SYTS?' R 'SYTS00000000'	337xx	One bit is set for each check. The value is transferred in hexadecimal and must then be evaluated with the individual bits. If the value is 0, then all parameters are OK. The number can comprise 32 bits. Not all bits are currently assigned.

Bit	Cause
0	Safety circuit open.
1	LT-CPU carries out wiring.
2	Matrix performs interconnection.
3	ATM 400 performs interconnection.
4	HMP or DHMP no longer sends data.
5	External ATS 400 not ready as source.
6	Variable transformer not yet positioned.
7	Serially controlled source not yet ready.
8	Additional source for leakage current test not yet ready.
9	Additional switches for leakage current test not yet ready.
10	No contacting data is received.

5.14.2.2 IO-CPU check

The following command is transmitted to read the errors from the IO-CPU.

Command	Answer	Example	From firmware	Description
SYIG?	**SYIGxxxxxxxx**	S 'SYIG?' R 'SYIG00000000'	337xx	One bit is set for each check. The value is transferred in hexadecimal and must then be evaluated with the individual bits. If the value is 0, then all parameters are OK. The number can be 32 bit include. Not all bits are currently occupied.

Bit	Cause
0	HMP or DHMP no longer sends data.
1	HMP or DHMP sends an incorrect data stream.
2	Measurement of the function test no longer sends data.
3	Measurement of the function test sends an incorrect data stream.
4	Measurement of the MEP-ISO test no longer sends data.
5	Measurement of the MEP_ISO check sends an incorrect data stream.
6	Measurement of the protective conductor test no longer sends data.
7	Measurement of the protective conductor test sends an incorrect data stream.
8	Safety circuit no longer sends data.

Bit	Cause
9	Safety circuit sends an incorrect data stream.
10	The front panel no longer sends any data.
11	The front panel is sending an incorrect data stream.
12	The ATS 400 no longer sends data as a source.
13	The ATS 400 as the source is sending an incorrect data stream.
14	The external user interface no longer sends any data.
15	The external user interface is sending an incorrect data stream.
16	The external source is no longer sending data.
17	The external source is sending an incorrect data stream.
18	The F3000 source is no longer transmitting data.
19	The F3000 source is sending an incorrect data stream.
20	The LT-CPU no longer sends data.
21	The LT-CPU is sending an incorrect data stream.
22	At least 1 matrix module is no longer sending data.
23	At least 1 matrix module is sending an incorrect data stream.
24	The additional source for the leakage current test no longer sends data.
25	The additional source for the leakage current test sends an incorrect data stream.
26	The voltage measurement board is no longer sending data.
27	The voltage measurement board is sending an incorrect data stream.

5.14.2.3 Matrix module check

The following command is transmitted to read out the timeout error of the matrix modules.

Command	Answer	Example	From firmware	Description
SYMG?	**SYMGxxxxxxxx**	S 'SYMG?' R 'SYMG00000000'	337xx	One bit is set for each check. The value is transferred in hexadecimal and must then be evaluated with the individual bits. If the value is 0, then all parameters are OK. The number can comprise 32 bits. Not all bits are currently assigned. Each bit is the matrix module at which a timeout has occurred.

5.14.2.4 LT-CPU check

The following command is transmitted to read out the LT-CPU error.

Command	Answer	Example	From firmware	Description
SYLG?	**SYLGxxxxxxxx**	S 'SYLG?' R 'SYLG00000000'	337xx	One bit is set for each check. The value is transferred in hexadecimal and must then be evaluated with the individual bits. If the value is 0, then all parameters are OK. The number can comprise 32 bits. Not all bits are currently assigned.

Bit	Cause
0	HMP or DHMP no longer sends data.
1	HMP or DHMP sends an incorrect data stream.
2	Measurement of the function test no longer sends data.

Bit	Cause
3	Measurement of the function test sends an incorrect data stream.
4	Measurement of the MEP-ISO test no longer sends data.
5	Measurement of the MEP_ISO check sends an incorrect data stream.
6	Measurement of the protective conductor test no longer sends data.
7	Measurement of the protective conductor test sends an incorrect data stream.
8	Safety circuit no longer sends data.
9	Safety circuit sends an incorrect data stream.

6 Safety circuit new generation

The new generation safety circuit is installed in devices from July 2019. The following commands can b e used for this safety circuit.
All commands begin with ***SC*** .
The **ATS 400** must have an IO-CPU with version 33505 or newer.
Further information on configurations and messages can be found in the **ATS 400** manual.

6.1 Command safety circuit

Command	Answer	Example	From firmware	Description
SCOP	**SCOP**	S 'SCOP' R 'SCOP'	33505	This command opens the safety circuit. For this command, the safety circuit must be wired for the ***Test with test probe*** configuration. **Attention**: In the command **SCOP** , the letter **O** must be used and not the number **0 (zero)**.
SCCL	**SCCL**	S 'SCCL' R 'SCCL'	33505	This command closes the safety circuit. For this command, the safety circuit must be wired for the ***Test with test probe*** configuration.
SCLK+xxxxxxs	**SCLK+000001**	S 'SCLK+00000**1** ' R 'SCLK+00000**1** ' S 'SCLK+00000**0** ' R 'SCLK+00000**0** '	33505	This command is used to open the locked cage. For this command, the safety circuit must be wired for the configuration ***safety door with guard locking.*** This command is used to lock a locked cage. For this command, the safety circuit must be wired for the configuration ***safety door with guard locking.***
SCDG+xxxxxxs	**SCDG+xxxxxxs**	S 'SCDG+00000**1** ' R 'SCDG+00000**1** ' S 'SCDG+00000**0** ' R 'SCDG+00000**0** '	33505	This command starts the sending of debug data. Sending debug data is necessary in order to be able to to obtain further information in the event of an error. This command ends the sending of debug data.
SCRS	**SCRS**	S 'SCRS' R 'SCRS'	33505	This command is used to restart the safety circuit. This is necessary if the safety circuit is rewired or goes into the safe state (FailSafe) for another reason.

6.2 Query safety circuit

Command	Answer	Example	From firmware	Description
SCST?	**SCSTxxxxxx**	S 'SCST' R 'SCST000110'	33505	The current status of the safety circuit can b e queried via the status query. The number is displayed in hexadecimal format.

Bit	Description
Bit 0	1 = Contact relay 1 closed.
Bit 1	1 = Contact relay 2 closed.
Bit 2	1 = Contact relay 1 closed.
Bit 3	1 = Contact relay 2 closed.
Bit 4	1 = SHK Modul sendet Daten
Bit 5	1 = Lock is open
Bit 8 Bit 15	Status of the SHKBB400
Bit 16	1 = Boot timeout, no data is received from the SHK module within a certain time after the start.
Bit 17	1 = SHKDataTimeout, no more data is received from the SHK module.
Bit 18	1 = CANDataTimeout, no more data is received via CAN.

<table>
<tr><th>Command</th><th>Answer</th><th>Example</th><th>From firmware</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>Bit 19</td><td>1 = FailSafe, the SHK module has switched to the safe state.</td></tr>
<tr><td>Bit 20</td><td>1 = BootError, no data is received after the SHK module has been started several times.</td></tr>
</table>
All other bits must not be evaluated.
</td></tr>
<tr><td>SCBV?</td><td>SCBVxxxxxxxx</td><td>S 'SCBV'
R 'SCBV010032CE'</td><td>33505</td><td>The software and hardware version of the baseboard can be determined via this query. The number is displayed in hexadecimal format.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>Bit 0 bis Bit 23</td><td>Version of the software, value > 13006</td></tr>
<tr><td>Bit 24 bis Bit 31</td><td>Version of the hardware, value > 0</td></tr>
</table>
</td></tr>
<tr><td>SCCM?</td><td>SCCMxxxx</td><td>S 'SCCM'
R 'SCCM0106'</td><td>33505</td><td>The query can be used to determine the command of the safety circuit. The number is displayed in hexadecimal notation.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>Bit 0</td><td>1 = Switch on yellow lamp, bit will be ignored.</td></tr>
<tr><td>Bit 1</td><td>1 = Switch on safety circuit, bit will is ignored.</td></tr>
<tr><td>Bit 2</td><td>1 = Switch on automatic mode, Bit wird ignoriert.</td></tr>
<tr><td>Bit 3</td><td>1 = Output 1 set, bit will is ignored..</td></tr>
<tr><td>Bit 4</td><td>1 = Output 2 set, bit will is ignored..</td></tr>
<tr><td>Bit 5</td><td>1 = Switch on manual mode, bit will is ignored..</td></tr>
<tr><td>Bit 6 Bit 7</td><td>1 or 3 = Warning light flashing.</td></tr>
<tr><td>Bit 8</td><td>1 = Send debug data, is set by the SCDG command.</td></tr>
<tr><td>Bit 9</td><td>1 = Restart safety circuit, is set by the SCRS command.</td></tr>
<tr><td>Bit 10</td><td>1 = Open locked cage, is set by the SCLK command.</td></tr>
</table>
All other bits must not be evaluated.
</td></tr>
<tr><td>SCMS?</td><td>SCMSxxxxxxxx</td><td>S 'SCMS'
R 'SCMS208140A0'</td><td>33505</td><td>This query can be used to determine the status of the safety circuit module. The number is displayed in hexadecimal format.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>Bit 0</td><td>1 = Relay 1 on the baseboard is switched.</td></tr>
<tr><td>Bit 1</td><td>1 = Relay 2 on the baseboard is switched.</td></tr>
<tr><td>Bit 2</td><td>1 = Relay 1 on external board is switched.</td></tr>
<tr><td>Bit 3</td><td>1 = Relay 2 on external board is switched.</td></tr>
<tr><td>Bit 4</td><td>1 = Red warning light is on.</td></tr>
<tr><td>Bit 5</td><td>1 = Green warning light is on.</td></tr>
<tr><td>Bit 6</td><td>1 = XVP is available.</td></tr>
<tr><td>Bit 7</td><td>1 = XVP is configured.</td></tr>
<tr><td>Bit 8 - Bit 15</td><td>Status of the state machine, see the instructions for the ATS 400.</td></tr>
<tr><td>Bit 16 - Bit 19</td><td>Detected configuration, see the instructions for ATS 400.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Command</th><th>Answer</th><th>Example</th><th>From firmware</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>Bit 20</td><td>1 = External board is available.</td></tr>
<tr><td>Bit 21</td><td>1 = Monitored red warning lamp is on.</td></tr>
<tr><td>Bit 22</td><td>1 = Monitored green warning lamp is on.</td></tr>
<tr><td>Bit 23</td><td>1 = Warning lamps configuration complete.</td></tr>
<tr><td>Bit 24</td><td>1 = Input E4 is set.</td></tr>
<tr><td>Bit 25</td><td>1 = Input E5 is set.</td></tr>
<tr><td>Bit 26</td><td>1 = Input E6 is set.</td></tr>
<tr><td>Bit 27</td><td>1 = Input E7 is set.</td></tr>
<tr><td>Bit 28</td><td>1 = Input E8 is set.</td></tr>
<tr><td>Bit 29</td><td>1 = Process OK.</td></tr>
<tr><td>Bit 30</td><td>1 = XVP signal available.</td></tr>
<tr><td>Bit 31</td><td>1 = Locked cage is open.</td></tr>
</table>
All other bits must not be evaluated.
</td></tr>
<tr><td>SCMV?</td><td>SCMVxx</td><td>S 'SCMV'
R 'SCMV15'</td><td>33505</td><td>
The version of the safety circuit module can be determined via this query. The number is displayed in hexadecimal format.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>Bit 0 bis Bit 3</td><td>Low-value version part.</td></tr>
<tr><td>Bit 4 bis Bit 7</td><td>High-value version part.</td></tr>
</table>
The version is made up of two parts. As text, this is to be displayed as the higher-value version part.the lower-value version part.
For example, a received value of 0x15 is displayed as 1.5.
</td></tr>
<tr><td>SCMC?</td><td>SCMCxx</td><td>S 'SCMC'
R 'SCMC00'</td><td>33505</td><td>
The query can be used to determine the command that is sent to the safety circuit module. The number is in hexadecimal format.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>Bit 0</td><td>1 = Close safety circuit. This bit can only be set with the configuration test with test probe.</td></tr>
<tr><td>Bit 1</td><td>1 = Open locked cage. This bit can only be set with the configuration safety door with guard locking.</td></tr>
<tr><td>Bit 2</td><td>1 = Warning lamp flashing.</td></tr>
</table>
All other bits must not be evaluated.
</td></tr>
<tr><td>SCBC?</td><td>SCBCxxxx</td><td>S 'SCBC'
R 'SCBC0002'</td><td>33505</td><td>
The query can be used to determine the transition conditions in the state machine of the SHKBB software. The number is displayed in hexadecimal format.
<table>
<tr><th>Bit</th><th>Description</th></tr>
<tr><td>Bit 0</td><td>1 = Boot timeout event has occurred.</td></tr>
<tr><td>Bit 1</td><td>1 = Restart of the safety circuit module is complete.</td></tr>
<tr><td>Bit 2</td><td>1 = Data was received from the safety circuit module.</td></tr>
<tr><td>Bit 3</td><td>1 = No more data is received from the safety circuit module.</td></tr>
</table>
</td></tr>
</table>

Command	Answer	Example	From firmware	Description
				<table><tr><th>Bit</th><th>Description</th></tr><tr><td>Bit 4</td><td>1 = No more data is received via CAN.</td></tr><tr><td>Bit 5</td><td>1 = An error has occurred in configuration 1.</td></tr><tr><td>Bit 6</td><td>1 = A restart of the safety circuit module has been started.</td></tr><tr><td>Bit 7</td><td>1 = A request to restart the safety circuit module was received..</td></tr><tr><td>Bit 8</td><td>1 = No data is permanently received from the safety circuit module.</td></tr></table> All other bits must not be evaluated.

7 General error information

The general error information is generally valid and not related to the test types.
The error information is queried with the command '**ERIN?**'.

Wert	Bedeutung
0	No error.
	No error has occurred.
1	Failure of power inverter.
	The power inverter is no longer ready for operation. This can have the following causes: - Short or long-term overload, this condition disappears after a few seconds when the overload is no longer present. - Defect in the power inverter. This condition is permanent and requires repair.
2	Over temperature of power inverter.
	The temperature of the inverter has been exceeded. This error disappears when the temperature drops.
3	A state bit has changed during test.
	The state of the contact monitoring or the safety circuit has changed during the test.
4	Abort: user.
	Aborted by user via ETL-Interface.
5	Performance limit reached
	The maximum power limit of the inverter has been reached.
6	External communication
7	Stop received from controlling application.
	The controlling application ETL DataView 3 or the client application has canceled the test
8	Abort: safety circuit.
	The safety circuit was opened during the test or the test was started with the safety circuit open.
9	Abort: Contact monitoring
	The contact was opened during the test or the test was started with the contact open.
10	Communication error.
	Communication in the device or to an external module is disturbed.
11	Communication error.
	Communication to an external device is disturbed.
12	Measuring range exceeded.
	The measured value exceeds the upper limit of the set measuring range.
13	Measuring range undershot.
	The measured value falls below the lower limit of the set measuring range.
14	Limit value exceeded.
	The measured value exceeds the upper limit.
15	Limit value undershot.

Wert	Bedeutung
	The measured value falls below the lower limit value.
255	Error info not valid.

8 External remote control with value display

For external remote control of the ATS400 with value display, the ATS400 is parameterized via the RS232, PROFINET or LAN interfaces. **ETL DataView 3** runs on the remote-controlled device where the test parameters, test status and result values are displayed as individual test steps.
The external remote control with value display can only be carried out on an **ATS 400** of operating variant X4 or X5.
The following options are availible for remote control:

Protocol	Serial (RS232 external)	PROFINET	LAN
ASCII	✓	✓	✓

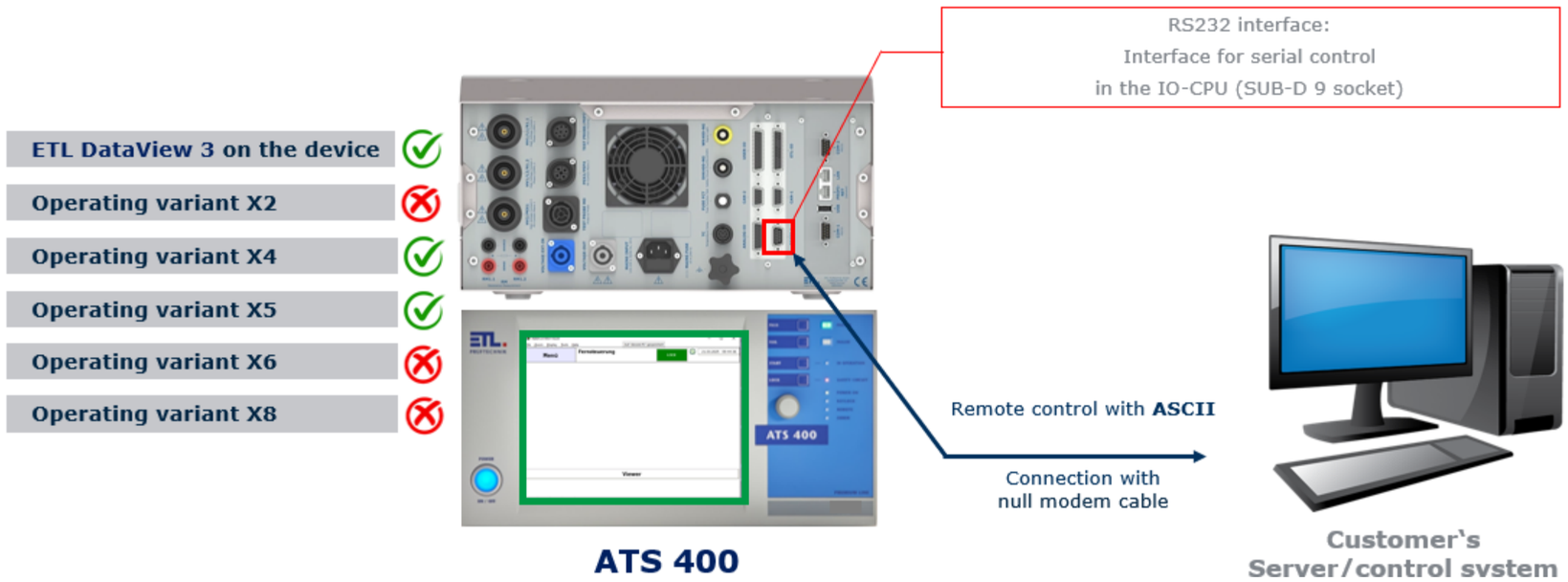
The following program versions or newer must be used:

Interface	ETL DataView 3 new generation	ETL DataView 3 classic	IO-CPU new generation	IO-CPU classic
RS232 (Remote -> Viewer)	3.49.128.463 NG	3.48.117.436	33739	33657
PROFINET (Remote -> Viewer)	3.49.128.463 NG	3.48.117.436	33739	33657
LAN (Remote -> LAN -> ASCII)	3.46.120.450 NG	3.37.73.264	xxxxx	xxxxx

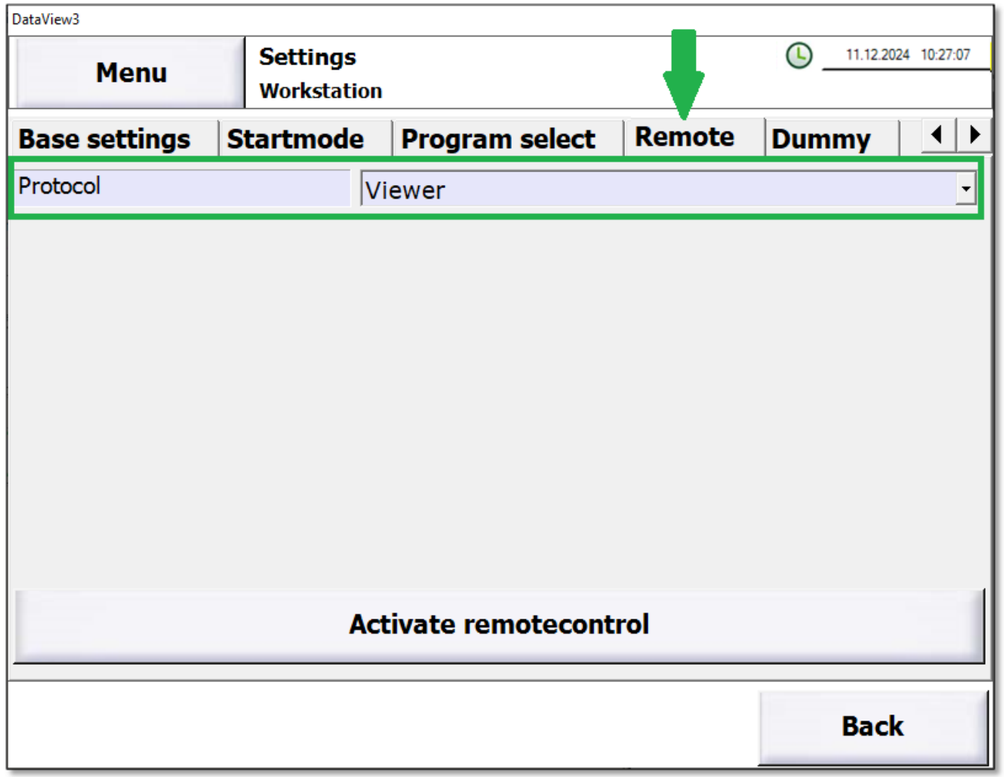
8.1 RS232-Interface

When using the viewer, **ETL DataView 3** must be started on the device in viewer mode.

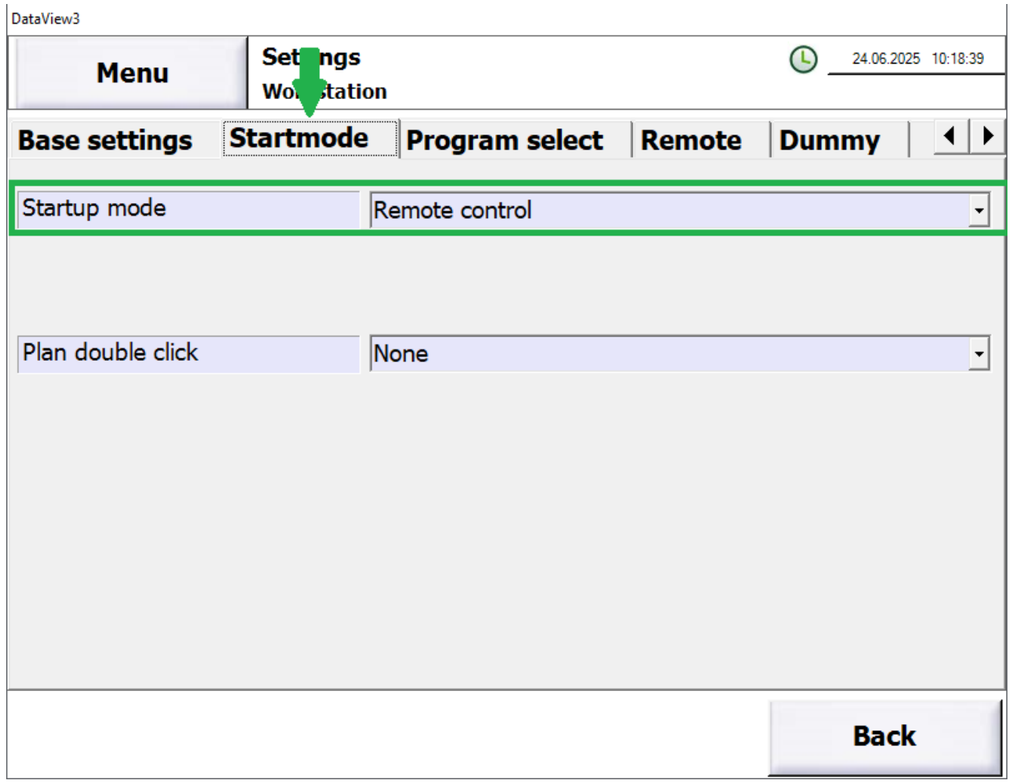
The following image shows the test setup and the possible operating variants.



Starting from the factory settings, the following settings must be made in **ETL DataView 3**:
In `Settings` -> `Workstation` -> `Remote` -> `Viewer`



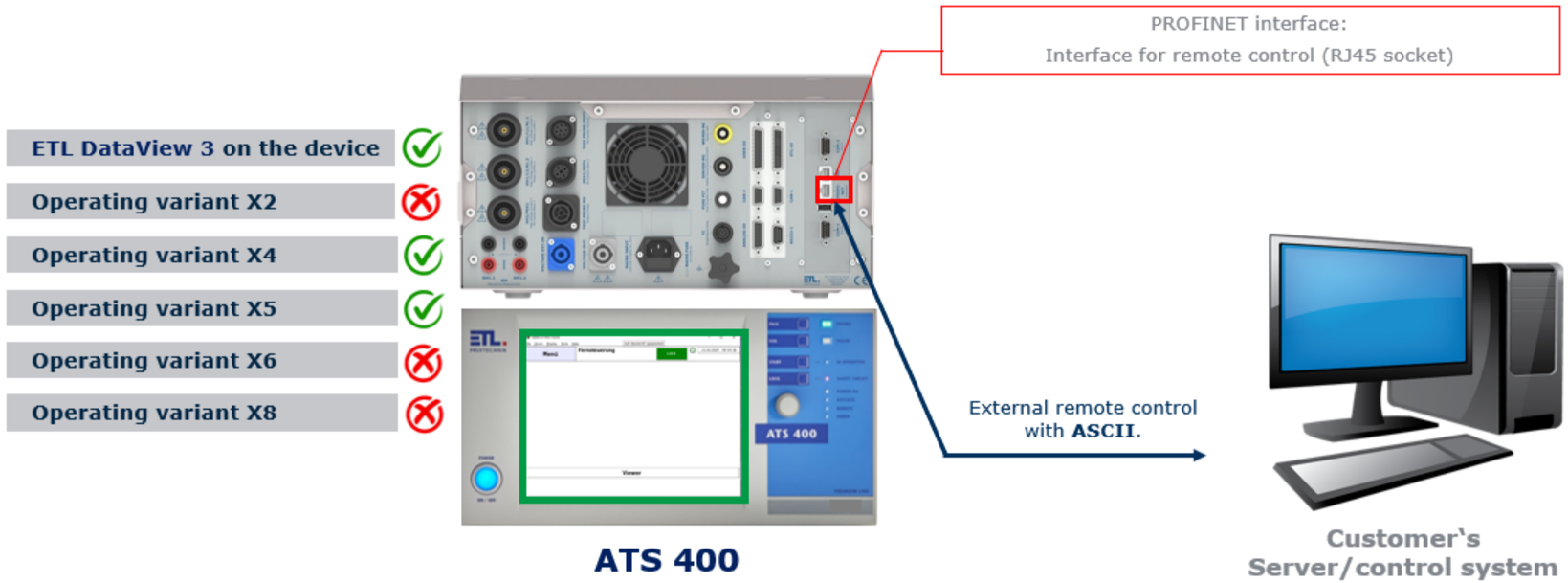
The following settings must be made so that **ETL DataView 3** starts automatically in viewer mode:
In `Settings` -> `Workstation` -> `Startmode` -> `Remote control`


DataView3
Menu
Settings
Workstation
24.06.2025 10:18:39
Base settings
Startmode
Program select
Remote
Dummy
Startup mode
Remote control
Plan double click
None
Back

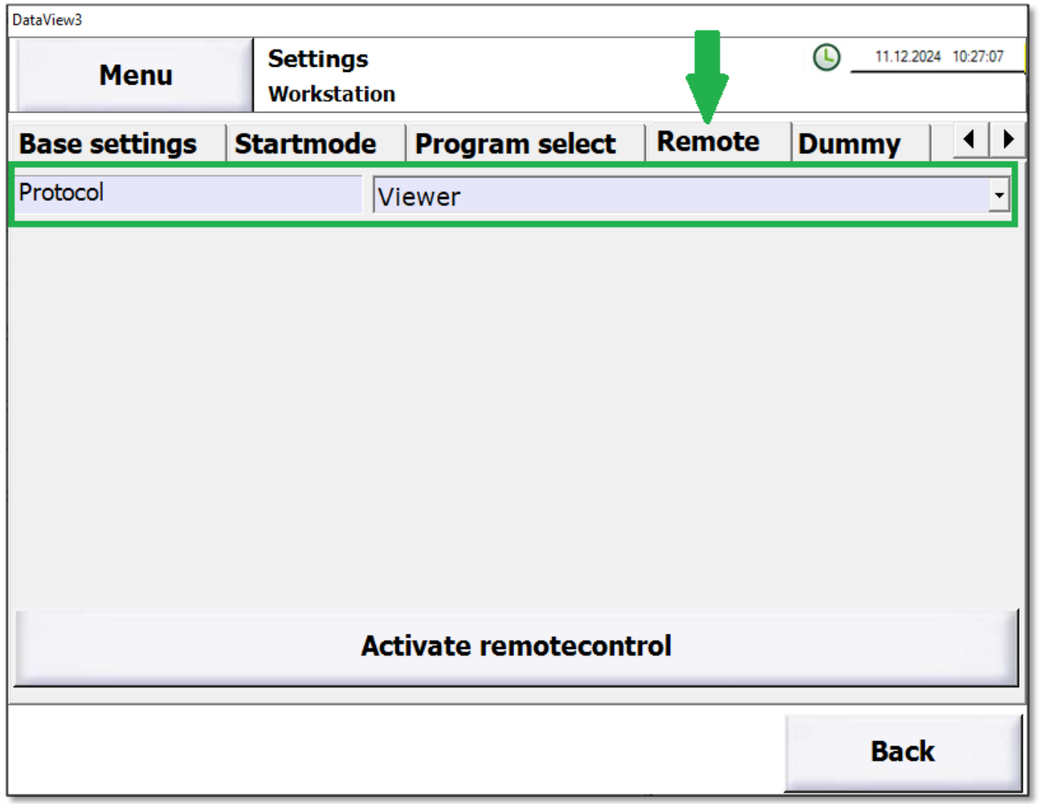
8.2 PROFINET-Interface

When using the viewer, **ETL DataView 3** must be started on the device in viewer mode.

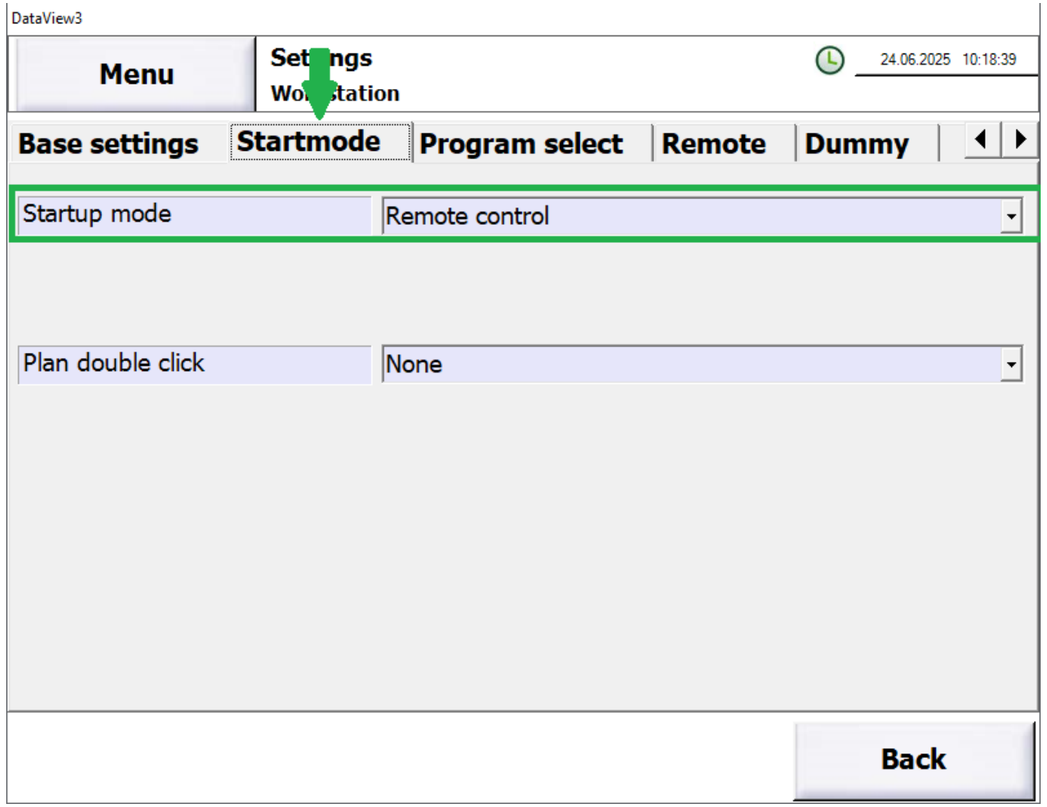
The following image shows the test setup and the possible operating variants.



Starting from the factory settings, the following settings must be made in **ETL DataView 3**:
In `Settings` -> `Workstation` -> `Remote` -> `Viewer`



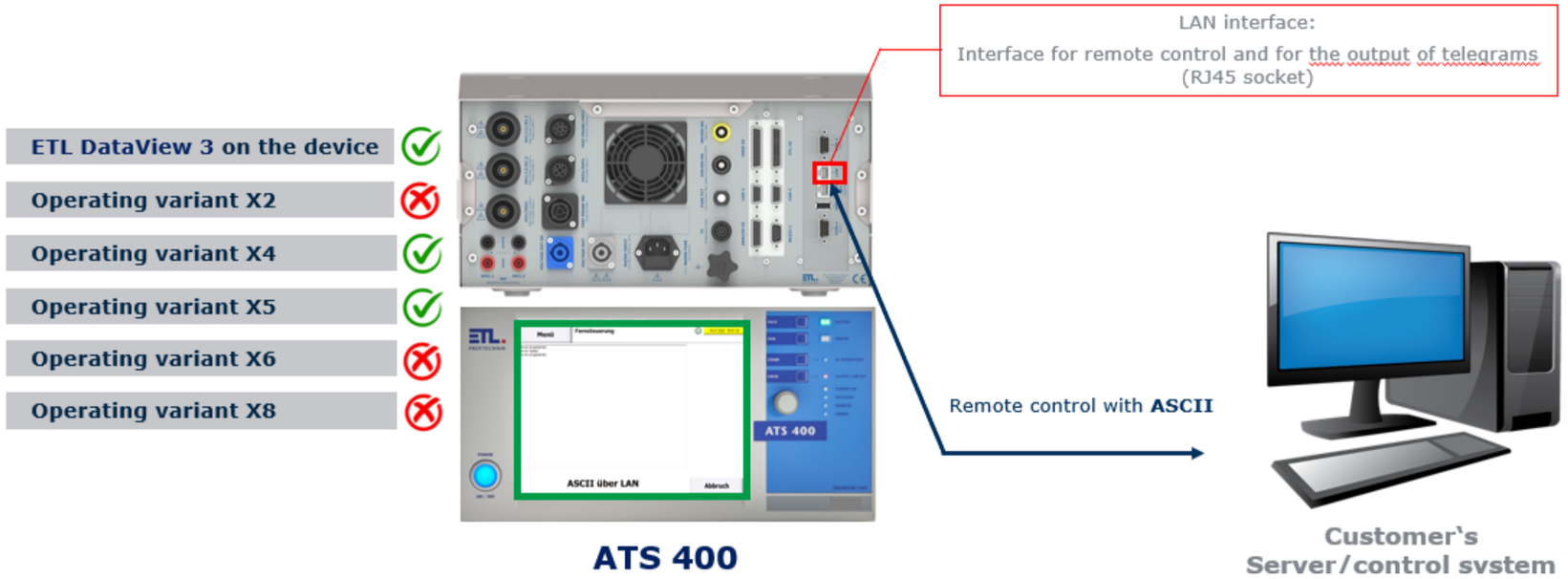
The following settings must be made so that **ETL DataView 3** starts automatically in viewer mode:
In `Settings` -> `Workstation` -> `Startmode` -> `Remote control`



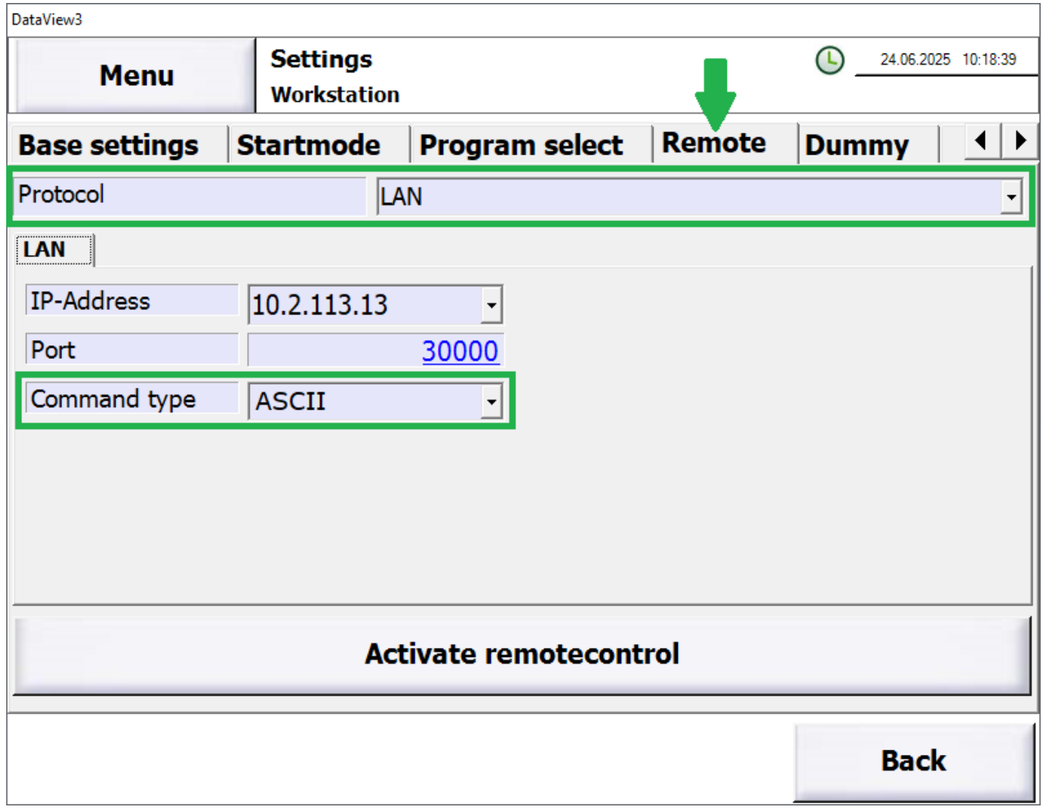
8.3 LAN-Interface

For remote control via the LAN-Interface, **ETL DataView 3** must be started on the device in remote mode.

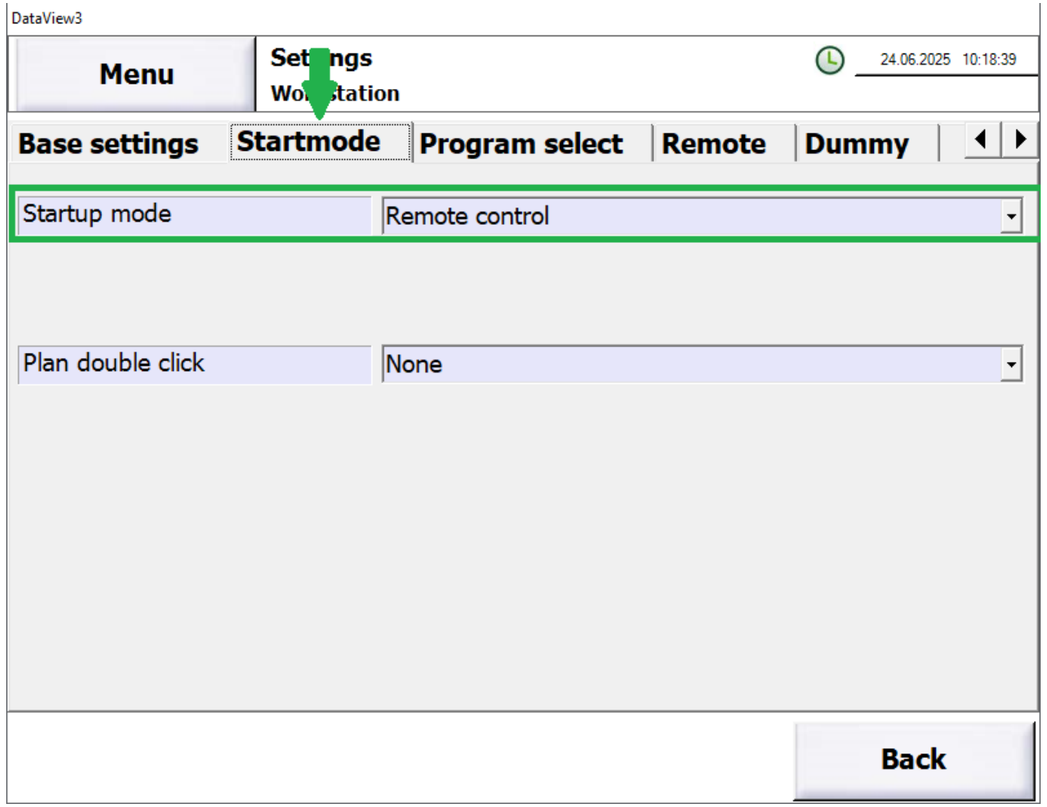
The following figure shows the test setup and the possible operating variants.



Starting from the factory settings, the following settings must be made in **ETL DataView 3**:
In `Settings` -> `Workstation` -> `Remote` -> `LAN`

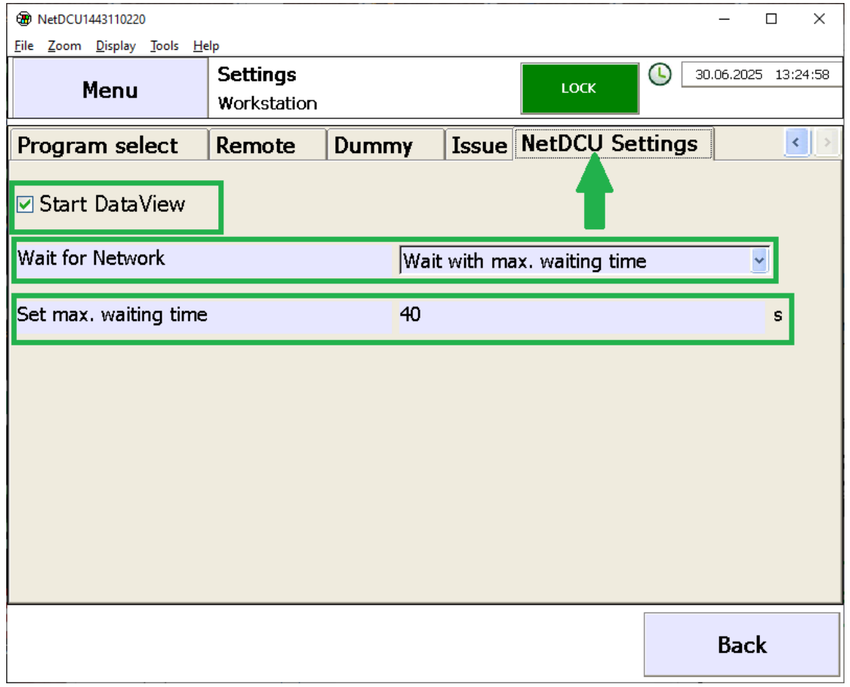


The following settings must be made so that **ETL DataView 3** starts automatically in viewer mode:
In `Settings` -> `Workstation` -> `Startmode` -> `Remote control`



8.3.1 NetDCU_Loader Network settings

In the case of a complete test bench that is switched on via a main switch, the **ATS 400** loads the **ETL DataView 3** before an Ethernet connection is established via the switch. In this case, Windows CE transmits the IP address 127.0.0.1 to **ETL DataView 3**. To prevent this problem, a waiting time must be set in **ETL DataView 3**. This delays the **ETL DataView 3** start via the NETDCU accordingly. During this delay, the system checks whether an IP address other than 127.0.0.1 is present; only then is **ETL DataView 3** started.



8.3.2 Troubleshooting IP-Iddress

Here you will find further information if something does not work as expected.

- On the Windows CE desktop, select `Start` -> `Settings` -> `Network and Dial-up connections.`
- Double-click on the `ETHNETA1` icon to open the configuration dialog.
- Set up the configuration as desired.
- Close the dialog with `OK` and close the `Network and Dial-up connections` window.
- On the Windows CE desktop, select `Start` -> `Programs` -> `Command Prompt.`
- Enter `ndcucfg` and start the command with the Enter key.
- Enter `reg save` and start the command with the Enter key. You will receive `OK` in response.
- Enter `quit` and start the command with the Enter key to close the window.
- Enter `exit` and start the command with the Enter key to close the window.
- **ETL DataView 3** will automatically use the only available IP-Iddress.
- If no cable is connected, **ETL DataView 3** always receives 127.0.0.1 as the IP-Address, regardless of whether DHCP or a fixed IP-Address is configured.
- If you use a fixed IP address, **ETL DataView 3** receives the configured IP-Iddress, e.g. 168.178.196.10.
- If you use DHCP and no DHCP server is available, **ETL DataView 3** receives a predefined IP-Address, e.g. 169.254.205.254.
- If you are using DHCP and a DHCP server is available, **ETL DataView 3** obtains the IP-Address from the DHCP server, for example, 10.2.1.195.

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