

**AST10**

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**Sequence Controller with  
integrated Power Supply**

**Operating Instructions  
Controller**

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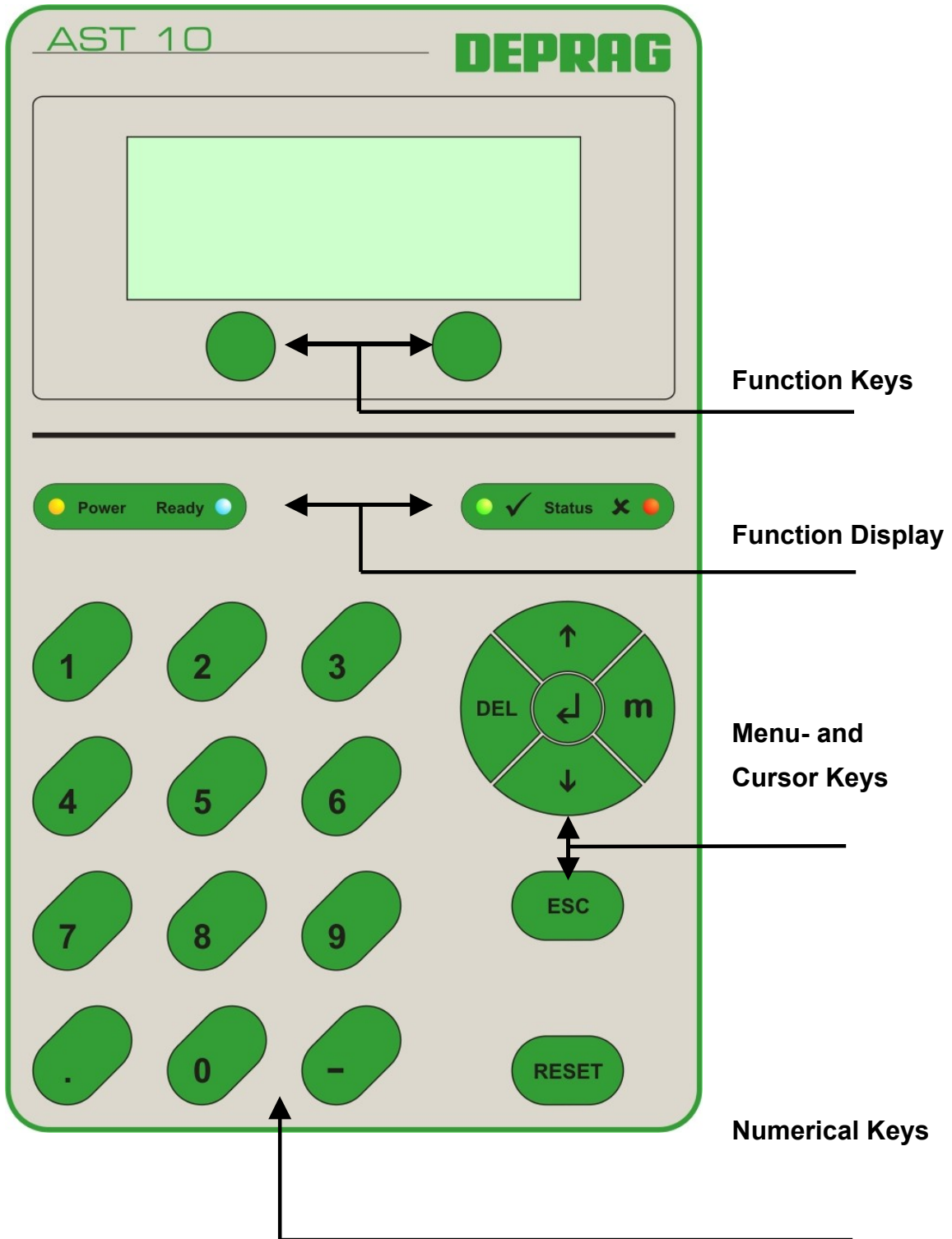
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## **1 General**

The controller can be programmed by using the WEB-Interface or by the integrated numeric keypad, whereby the programming choices on the keypad are more limited.

The controller can be operated as a stand-alone unit or it can be operated by a PLC.

## 2 Operating Elements



## 2.1 Functional Display (LED's)

The LED's located below the display notify the user about the operating status of the controller:

<b>Color</b>	<b>Description</b>	<b>Meaning</b>
yellow	Power	All voltages are O.K.
blue	Ready	The controller is ready
green		Last Assembly was O.K.
red		Last Assembly was NOT O.K.

Additional error messages are shown directly on the Display.

## 2.2 Keypad Layout

### 2.2.1 Function Keys

In automatic mode, the function keys have the following functions:

Left Function Key    manual reloading of a screw when operated with feeder

Right Function Key    release of a part when operated with F-function and if the corresponding menu released the part

### 2.2.2 Numerical Keypad and ESC-key

Use the numerical keypad to input number values (such as nominal speed), to set a parameter or to perform a test. Always confirm any numerical input with RETURN-key.

Use the ESC-key to interrupt your input; the original value remains intact.

### 2.2.3 Menu and Cursor Keys

The menu keys have the following functions:

m:            in automatic mode, the main menu can be called up with this key

DEL:            use the DEL-key to remove incorrect numerical inputs.

ESC:            use the ESC-key to change into the next higher menu-level, to exit the individual menus or to cancel an input.

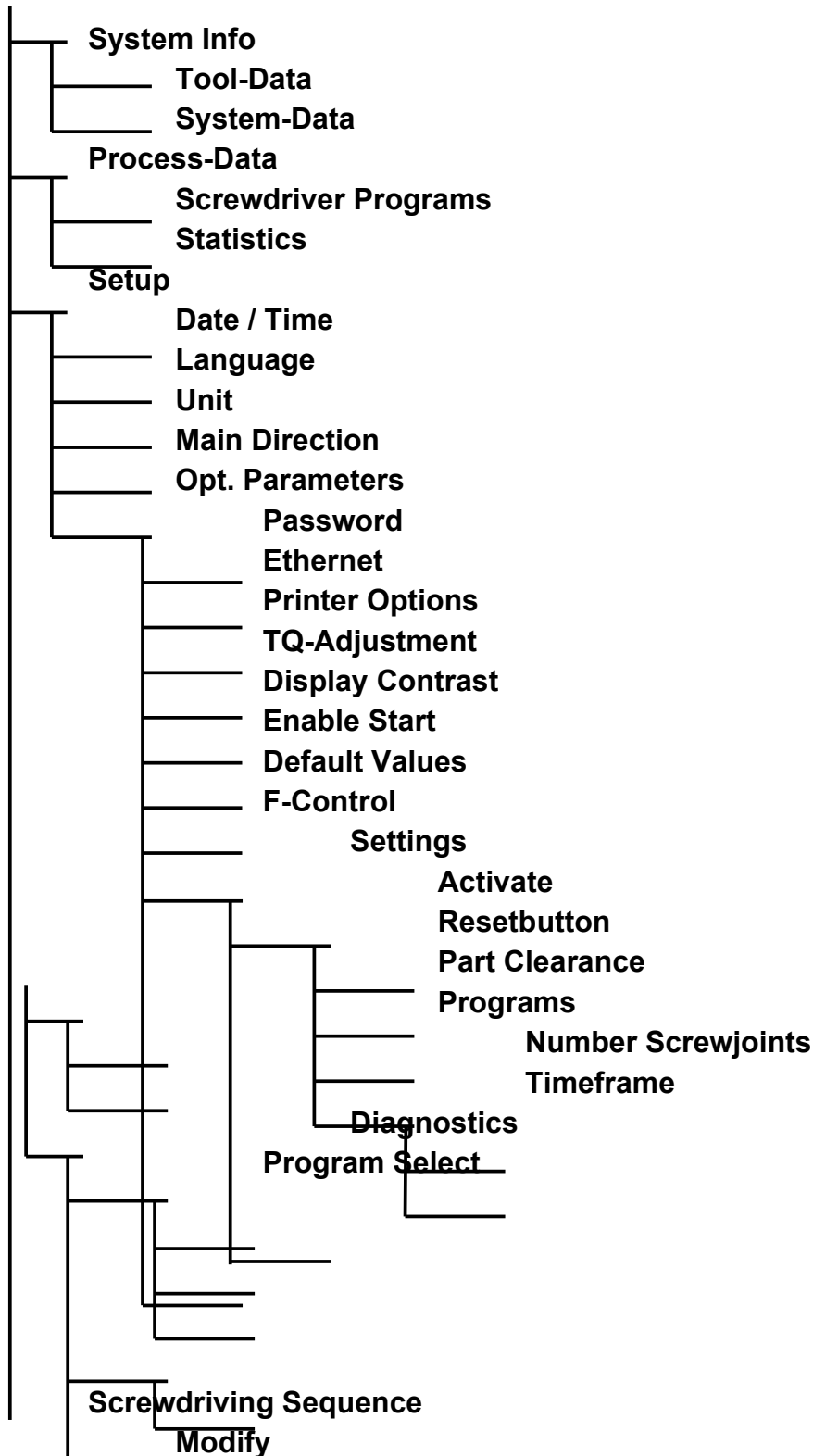
RESET :        use the RESET-key to reset an error, which occurred while operating in the F-function, if the corresponding menu allows such a reset.

Cursor:        Use the cursor keys to navigate between the different menus.

The Up- and Down- keys move the cursor either up or down and the ENTER- key confirms the selected menu item.

### 3 Operation

#### 3.1 Menu-Structure



- Default Programs**
- Test**
  - Tool Test**
    - Speed Test**
    - Angle Test**
    - Torque Test**
  - System Test**
    - Ready Criteria**
  - Process Test**
  - Interface Test**
    - I/O-Port**
  - Display Test**
  - Key Test**
  - Control LED Test**
  - Special Tests**

## 3.2 Menu-Functions

All sub-menus, where values can be changed or which causes the interruption of the automatic operation, are protected by a password.

If the password is set to 0000, then all menus are freely accessible! The password may be changed in the menu item SETUP.



### **INFO:**

**The following settings are implemented at delivery:**

**Password: 0000**



### **ATTENTION:**

**Some menu points will interrupt the automatic cycle, which means the screw assembly cycle cannot be continued!**

The following menus interrupt the automatic cycle:

- **Setup**
- **Screwdriving Sequence**
- **Test**

**Please assure by setting passwords that only authorized personnel can make changes.**

---

### 3.2.1 Menu System Info

The menu system info displays general data of the controller and the connected screwdriver. The data can be displayed during equipment operation, without interrupting the automatic sequence.

#### 3.2.1.1 Tool Data

The tool data include all important information about the connected driver, such as screwdriver model, serial number, torque limits, etc.

#### 3.2.1.2 System Data

The system data contain basic controller settings, such as language, IP Address, main direction, etc.

### 3.2.2 Menu Process Data

The menu process data supplies data for the screwdriving process. The data can only be displayed, but not changed. **The data can be displayed during equipment operation, without interrupting the automatic sequence.**

#### 3.2.2.1 Screwdriving Programs

The menu item Screwdriver Programs displays the parameters of the individual screwdriving programs. After inputting the required program number, use the cursor keys to switch between the individual parameters within the programs.

Use the function keys to directly change from and to the individual programming steps.

#### 3.2.2.2 Statistics

To use the statistics display, make sure to include the command STATISTICS in the screwdriver program.

##### 3.2.2.2.1 Show

First, input the program number to display the statistics. Then you can select between display of torque or angle. The last 100 values are used to calculate the statistics. The following values are shown:

- Number of Data Sets
- Average
- Standard Deviation Actual
- Standard Deviation in Percentage
- CP-Value
- CPK-Value

Use the cursor keys to switch between the individual display values.

The left function key allows the deletion of the statistics of an individual program.

The right function key allows the inputting of limit values for the CP- and CPK-Value calculation.

### **3.2.2.2.2 Delete**

It is possible to either delete the complete statistics for all programs (left cursor key) or only the statistics for individual programs (right cursor key).

### 3.2.3 Menu Setup

Use the setup menu to input general controller adjustments.

#### 3.2.3.1 Date / Time

The current system time as well as system date will be displayed.

Use the left function key to change time and date. Proceed using the following steps:

- Press key CHANGE, a blinking cursor appears over the date
- Input the current day, confirm with ENTER key, the current day will be displayed and the blinking cursor appears over the month.
- Input current month, confirm with ENTER key, the current month will be displayed and the blinking cursor appears over the year.
- Input current year, confirm with ENTER key, the current year will be displayed and the blinking cursor appears over the hour area of the time.
- Input current time (hour), confirm with ENTER key, the current time (hour) will be displayed and the blinking cursor appears over the minute area of the time
- Input current time (minute), confirm with ENTER key, the current time (minute) will be displayed and the blinking cursor appears over the seconds area of the time
- Input current time (seconds), confirm with ENTER key, the current time (minute) will be displayed
- Use the left function key to accept the changes

#### 3.2.3.2 Language

The system allows the selection between different languages.

Use the cursor keys to select the required language and confirm your selection with the ENTER-key. To leave the menu without making any changes, use the ESC-key.

#### 3.2.3.3 Unit

Several different measuring units are available. Use the function keys for selection and the ENTER key to accept the selection. Use the ESC-key to exit the menu without making any changes.

### 3.2.3.4 Main Direction

Use this area and the cursor keys to select between “Right” or “Left” main direction. The basic setting is RIGHT. Use the ENTER key to accept the selection. Use the ESC-key to exit the menu without making any changes.

### 3.2.3.5 Optional Parameters

#### 3.2.3.5.1 Password

The password can be changed using the left cursor key or even deleted, using the right cursor key.

**ATTENTION:** If a password is deleted, then all menus are freely available!

The following menus interrupt the automatic cycle:

- Setup
- Screwdriving Sequence
- Test

Please assure by setting passwords that only authorized personnel can make changes to the corresponding menus.

To change the password, input a four-digit password and confirm entry with the ENTER-key. It is necessary to input the password twice and if both entries are identical, then the password will be accepted. The password may be any combination of digits between 0000 to 9999.

#### 3.2.3.5.2 Ethernet

When the IP-Address is changed, the system starts-up new! To change the IP-Address, use the function key “Modify?” and the input the four numerical blocks individually. Confirm your entry with the ENTER-key. Thereafter, input the four numerical blocks for the net mask and also confirm this entry with the ENTER-key.

The right function key accepts the input. Immediately thereafter, the system will be automatically rebooted and the display shows “AST10 Reboot System”.

### 3.2.3.5.3 Printer Options

There is a selection possibility for different print options. Use the cursor key to make the selection and the ENTER-key to confirm the selection. Use the ESC-key to exit the menu without making any changes.

### 3.2.3.5.4 Torque Correction Factor (TQ-Adjustment)

Use this area to input an individual value, which adapts the torque to an external measurement.

ATTENTION: When inputting a correction factor, the factory-made calibration will be changed. (the torque established by this factor is only valid for the torque, which was obtained by the input factor).

To change the value, proceed as follows:

Use the left function key "Modify?", input value and confirm entry with ENTER-key. Use the right function key "SET?" to save your entry.

### 3.2.3.5.5 Display Contrast

Use the two function keys to change the contrast of the display. Confirm changes with the ENTER-key.

### 3.2.3.5.6 Enable Start

The enable start allows, if activated, that the screwdriving cycle only starts after the input Enable Start

(PLC-port GX6, Pin 8) has received a "Ready" signal. If no ready signal was given then the controller is not ready.

The enable start may be activated or deactivated. The basic setting is "deactivated".

Make a selection with the cursor-keys and use the ENTER-key to confirm your selection.

Use the ESC-key to exit the menu without making any changes.

### 3.2.3.5.7 Default Values

Use this menu area to reset the setup-adjustments of the controller to the Original values. The Following values will be set:

Parameter		Value
Language		English
Measuring Unit		Nm
Print Options		O.K. and NOT O.K.
Password		0000
Main Turn Direction		right
Program Selection		1
Reload		Only if O.K.
Offset Gearing	Gear Ration	1
	Effect	100%
	Direction Change	no
Enable Start		inactive
Display Contrast		195
F-Control	active	no
	Reset by Button	no
	Part Release by Button	no
	Number of Cycles	0
	Minimum Time	0
	Maximum Time	0
Statistics	Limits for CMK-Value	+/- 15%

### 3.2.3.5.8 F-Function (only visible with handheld Screwdrivers)

see separate documentation F-Function

### 3.2.3.5.9 Program Select (only visible with handheld Screwdrivers)

This area lets you input a value for the program number, which determines which program is used for a standard screwdriver start (programs 1 through 15 are available).

To change the program number:

Use left function key “Modify?”, input value and confirm using the ENTER-key.

Then, use the right Function key to save the change.

## 3.2.4 Menu Screwdriving Sequence

### 3.2.4.1 Modify

Use the menu item “Screwdriving Sequence -> Modify?” to adjust the parameters of the individual screwdriving program.

At first, the system asks for the program number to be input. Thereafter, the cursor allows to select between the individual parameters within one program.

Use the function-key to switch from one to the next program step.

To input a numerical value, use the ENTER-key, then input the value and again press the ENTER-key. Only numbers, which are within an allowable range of the driver, are accepted.

To change the selection values, use the ENTER-key, then use the cursor key to select the required value and again use the ENTER-key to confirm the change.

Use the ESC-key to interrupt an input; the previous valid values remain. Again, use the ESC-key to exit the menu.

Now, use the two function keys to save or not save the changes!

Left Function key: the changes will be saved, the values will be reconfirmed and if necessary, the system will return to the menu to adjust the parameter

Right Function key: all changes will be disregarded, the program remains unchanged.

### 3.2.4.2 Default Programs

Use the menu item “Default Program” to generate the programs 1 and 16 as standard programs.

The programs will be generated as follows:

Program 1: one-step tightening to torque with driver-dependent standard values

Program 16: one-step loosening to angle with driver-dependent standard values.

ATTENTION:

Generating default programs will overwrite programs 1 and 16. All other programs will be invalid.

### 3.2.5 Menu Test

#### 3.2.5.1 Tool Test

##### 3.2.5.1.1 Speed Test

The mode “speed test” allows the testing of the speed outside of the program sequence.

The two function keys can control the speed test.

Proceed as follows:

- input nominal speed:
- use left function key „Nominal Value“; a blinking Cursor occurs
- input nominal speed and confirm entry with the ENTER key
- To run driver, use right function key “START“; Driver rotates at specified speed
- To stop driver, use right function key “STOP“; Driver stops

Exit the menu item „Speed Test“ with the ESC-key.

### 3.2.5.1.2 Angle Test

To verify the angle measurement, simply rotate the screwdriver. The current angle is displayed. Use the right function key “RESET” to reset the angle value to “0”. Exit the menu item „Angle Test“ with the ESC-key.

### 3.2.5.1.3 Torque Test

To menu item “Torque Test” allows the verification of the torque measurement, even outside of of program sequences. A one-step standard program will be created using the input torque value, which in turn can be verified through a tightening process on a measuring platform. The two function keys may control the torque test.

Proceed as follows:

- Insert the nominal torque:
- Press the left function key “Nominal Value”; a blinking Cursor occurs.
- Input nominal torque and confirm entry with the ENTER-key.
- To activate the driver, press the function key “START”; the driver starts the tightening program.
- Press the STOP-key to turn the driver off

To exit the torque-test menu at any time, simply press the ESC-key.

### 3.2.5.1.4 Tool I/O Test (only visible with handheld Screwdrivers)

Use the menu item “Driver I/O Test” to test the LED’s and buttons on the Driver. Use the cursor-keys to switch between the individual LED’s and buttons. The status of the button will be displayed; the LED’s may be turned on or off by the ENTER-key.

To exit the Driver I/O Test menu at any time, simply press the ESC-key

## 3.2.5.2 System Test

### 3.2.5.2.1 Ready-Criteria

The menu item „Ready-Criteria“ displays all parameter, which influence the ready status of the controller.

Use the cursor-keys to switch between the individual values.

### 3.2.5.3 Process Test

Use the „Sequence Test“ to check the function of each step in a Screwdriver Program.

To control this test, use the two function keys and proceed as follows:

- Input program number
- Press the Key „PROG“, a **blinking Cursor occurs**
- Input program number and confirm input with the ENTER-key
- Start the sequence with the key „START“, the first step of the program is

processed

- Use the key „NEXT“ to start the next step
- Use the key „STOP“ to stop the process at any time

The current programming step is displayed on the upper right corner

To exit the process-test menu at any time, simply press the ESC-key.

### 3.2.5.4 Interface Test

#### 3.2.5.4.1 I/O-Port

Use the menu item I/O–Port to verify the I/O-conditions.

Use the numerical keys 0 to 7 to activate or deactivate each individual output.

Exit the I/O–Test mode with the ESC-key.

Description of each step in the display:

Inputs:

000000000000

└─	Input 1:	Start
	Input 2:	--
	Input 3:	Program Selection
	Input 4:	Program Selection
	Input 5:	Program Selection
	Input 6:	Program Selection
	Input 7:	Reload
	Input 8:	Start Release
	Input 9:	External Stop
	Input 10:	Part Sensor
	Input 11:	Reset Error
	Input 12:	Release Part

Outputs:

00000000

Output 1:	System O.K.
Output 2:	Assembly O.K.
Output 3:	Assembly NOT O.K.
Output 4:	Ready
Output 5:	Reload
Output 6:	Magnetic Valve
Output 7:	Change Part
Output 8:	--

### 3.2.5.5 Display-Test

In the menu item „Display-Test“, all test areas will be completely dark. This allows the operator to see whether all pixels of the displays are functional!

To exit the display-test menu at any time, simply press the ESC-key.

### 3.2.5.6 Key Test

The „Key Test“ displays the last actuated key. This menu item allows that all keys are tested in regard to their functionality.

To exit the key-test menu at any time, simply press the ESC-key.

### 3.2.5.7 LED-Test

Use this „LED-Test“ function to verify that all LED's on the controller are functional.

Use the cursor keys to select between the individual LED's.

Use the ENTER-key to turn the individual LED's on or off.

To exit the LED-test menu at any time, simply press the ESC-key.

### 3.2.5.8 Special Tests

These test functions are exclusively for internal use and only accessible to service personnel.

## **4 Functionality**

### **4.1 Interface Ports**

A detailed description of the interface ports can be found in the handbook ControllerAST10\_Hardware\_Description.

### **4.2 Operation as a Stand-Alone Unit with a handheld Screwdriver**

The start of an assembly sequence is actuated – according to screwdriver model – either through push-to-start or by trigger. The selected program from the menu item „program selection“ will be activated. If the program-change is activated (key or reverse-slide), then program 16 will always be activated.

### **4.3 Operation with PLC and a handheld Screwdriver**

The start of an assembly sequence is actuated – according to screwdriver model – either through push-to-start or by button. If a program was selected by the input of the PLD-port (see item 4.4.1), then this program will be activated. If no program was selected for the PLC-port, then the program, which was selected in the menu item “program selection”, will be activated. If the program-switch is activated (key or reverse-slide), then program 16 will always be activated.

## 4.4 Operation with PLC and a stationary Screwdriver

### 4.4.1 Selection and Start of a Screwdriving Program

Use the inputs 3 to 6 of the PLC-port to select programs in accordance with the following table:

Program	Input 6	Input 5	Input 4	Input 3
<b>1</b>	0	0	0	1
<b>2</b>	0	0	1	0
<b>3</b>	0	0	1	1
<b>4</b>	0	1	0	0
<b>5</b>	0	1	0	1
<b>6</b>	0	1	1	0
<b>7</b>	0	1	1	1
<b>8</b>	1	0	0	0
<b>9</b>	1	0	0	1
<b>10</b>	1	0	1	0
<b>11</b>	1	0	1	1
<b>12</b>	1	1	0	0
<b>13</b>	1	1	0	1
<b>14</b>	1	1	1	0
<b>15</b>	1	1	1	1

The signal high on the input “program-start” – pin 1 causes the execution of the respective program.

#### 4.4.2 Standard Communication PLC – AST10

1. Signal high to input **Emergency-Stop** – Pin 23
2. Set the bit pattern for program selection – Pins 3 through 6
3. Request a **Ready** signal – Pin 15 high?
4. Signal high to input **Program-Start** – Pin 1
5. Request **OK** and **NOT OK** response – Pins 13 and 14
6. Signal low to input **Program-Start**, if needed change bit sample for program selection
7. Continue according to item 3 – new screwdriving cycle

#### 4.4.3 Serial Printer Port

Use the serial printer port of the AST10 to output data in ASCII-Format.

The data output can be selected as follows:

- Data output is possible depending on status of the screw joint, adjustment is possible over the web-interface and directly on the terminal of the controller.

The following settings are possible:

- Output O.K. and NOT O.K. screw joints
  - Output only O.K. screw joints
  - Output only NOT O.K. screw jointsassemblies
- Combination of the required values by setting a string-format:

It is possible to set a string-format using any text and commands, where texts are directed to the printer and commands are replaced by each valid value (see table).

The string has to be set, so that each command is preceded by an “@” and has to end with a “space”.

Changes to the string-format are only possible on the Web-Interface.

Example:

**String Format:**

@date\_euro @time Program: @prog Step: @step Error: @error

Runtime:@runtime Torque: @torque Angle: @angle

Output:

24.04.2006 07:13:37 Program: 16 Step: 3 Error: 0 Runtime:0.5 s Torque:

0.215 Nm Angle: 1080 Grad

The unit is shipped with the following standard format:

@date\_iso @time PG: @prog ST: @step TQ: @torque AN: @angle @errortext

Output:

2006-04-24 07:13:37 PG: 16 ST: 3 TQ: 0.215 Nm AN: 1080 Degree IO

Port Rate: 9600 bd, 8 data bits, 1 stop bit, no parity, no Protocol.

The following commands are available:

Command	Output Value	Output Format	Example
date_euro	Date Euro-Format	Day.Month.Year	24.04.2006
date_usa	Date US-Format	Month/Day/Year	04/24/2006
date_iso	Date ISO-Format	Year-Month-Day	2006-04-24
time	Time	Hour:Minute:Second	07:13:37
step	Step Number	Value	3
torque	Torque	Value Unit	0.215 Nm
angle	Angle	Value Unit	1080 Grad
prog	Program Number	Value	1
errornum	Status / Error Number	Value	0
errortext	Status / Error Text	Error Text	TORUQE SMALL
runtime	Run Time	Value Unit	0.5 s
torqueLL	Torque Lower Limit	Value Unit	0.000 Nm
torqueUL	Torque Upper Limit	Value Unit	0.350 Nm
angleLL	Angle Lower Limit	Value Unit	1000 Grad
angleUL	Angle Upper Limit	Value Unit	1150 Grad
screwdriver	Screwdriver Model	Value	320EGA27-0100
calibration	Calibration Value	Value	1.000
StatAngleAv	Statistics Angle Average	Value Unit	1081 Grad
StatAngleStddev %	Statistics Angle Standard Deviation %	Value Unit	1.36 %
StatAngleStddevAbs	Statistics Angle Standard Deviation absolute	Value Unit	14.70
StatAngleCPK	Statistics Angle CPK	Value	2.16
StatAngleCP	Statistics Angle CP	Value	2.03
StatAngleCPKmin	Statistics Angle CMK Lower Limit	Value Unit	1000 Grad
StatAngleCPKmax	Statistics Angle CMK Upper Limit	Value Unit	1150 Grad
StatAngleNum	Statistics Angle Number of Values	Value	96
StatTorqueAv	Statistics Torque Average	Value Unit	0.213 Nm
StatTorqueStddev %	Statistics Torque Standard Deviation %	Value	
StatTorqueStddevAbs	Statistics Torque Standard Deviation absolute	Value Unit	
StatTorqueCPK	Statistics Torque CPK	Value	
StatTorqueCP	Statistics Torque CP	Value	
StatTorqueCPKmin	Statistics Torque CMK Lower Limit	Value Unit	
StatTorqueCPKmax	Statistics Torque CMK Upper Limit	Value Unit	

Command	Output Value	Output Format	Example
StatTorqueNum	Statistics Torque Number of Values	Value	

## 5 Error Messages and Trouble Shooting

### 5.1 System Errors

Number	Design Group	Cause
0	Driver	No Error
1	Driver	Temperature Error (too hot)
2	Driver	Temperature Sensor defective
3	Driver	Test Sum Error in EEPROM (recovered through main controller)
4	Driver	EEPROM cannot write (irrecoverable)
5	Driver	Test Sum Error in EEPROM (irrecoverable)
6	Driver	Test Sum Error in RAM
7	Driver	Test Sum Error in FLASH
8	Driver	EEPROM-Error: Maximum number of screwdriving cycles reached
...		
100	Power Unit	No Error
101	Power Unit	Encoder index not found!
102	Power Unit	Qep position sensor signal absent or wrong
103	Power Unit	Initialising problem: spindle clear?
104	Power Unit	Error capacitor power unit
105	Power Unit	External watchdog or overcurrent error
...		

## 5.2 Errors of the screwdriving cycle

Number	Displayed Text	Cause
0	OK	No Error
1	TIME LIMIT!	The predetermined time of the screwdriving step was exceeded.
2	ANGLE LOW	The predetermined minimum angle of the screwdriving step was not reached
3	ANGLE HIGH	The predetermined maximum angle of the screwdriving step was exceeded
4	TORQUE LOW	The predetermined minimum torque of the screwdriving step was not reached
5	TORQUE HIGH	The predetermined maximum torque of the screwdriving step was exceeded
6	PU: PROG?	An invalid program was submitted to the power unit
7	DRIVER IO	A program contains too many I/O commands (such as: Waiting for Input)
8	START ?	Invalid or too many start signals
9	INVALID PROG	Program is not valid (does not exist, or was established for a different driver)
10	INTERRUPT	The start signal was reset prior to the regular end of the assembly
11	GENERAL FAULT	General error
...		