OPERATING INSTRUCTIONS

Sequence Controller

AST1 822050 A

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SAFETY TIPS

Attention: When using electrical equipment, the following basic safety rules have to be observed, to avoid electrical shocks, injury and fire hazards.

Please read and observe those rules, prior to the use of the tool.
Keep this Booklet (Safety Rules) nearby and easy to access!

1. **Keep your work area organized**
   - Untidy work areas result into injuries!

2. **Consider Work-Environment**
   - Do not use electrical equipment in damp or wet environments. Make sure sufficient lighting is available. Do not use electrical equipment close to flammable liquids or gases.

3. **Protect yourself from electrical shocks**
   - Eliminate direct body contact with grounded parts, such as pipes, radiators, or other connected electrical equipment.

4. **Do not overload device**
   - You work more efficient and safer within the rated power-range. Make sure that the calibration value of the driver is input into the controller.

5. **Use the correct Screwdriving-Tool**
   - Do not use power insufficient drivers or additional parts (i.e. offsets) for non-applicable assemblies. Do not use tools for purposes or assemblies other than what they are designed for.

6. **Wear suitable Work-Clothes**
   - Do not wear loose clothing or jewelry, since they could be caught by moving parts. For long hair, use a hair net.

7. **Do not miss-use cable**
   - **Do not carry the tool by its cable. Do not pull on cable to disconnect plug! Protect the cable from heat, oil and sharp edges.**

8. Maintain your Tools

- check regularly the cable and if damaged, have it replaced. Check also the extension cable on a regular basis and replace it, if damaged. Keep the handles clean, dry and free of oil or grease.

9. Eliminate unintentional Start

- Make sure that the on/off switch is in the “off” position, when connecting the equipment to an electrical outlet.

10. Concentrate on your Work

- Remain alert. Work sensibly and do not use the tool, if you are not focused.

11. Check Device for Damages

- Prior to the use of the equipment, pay attention to the safety features and all other parts, in regards to their correct and designated function. Damaged safety guards and parts should be repaired by a DEPRAG service technician or exchanged, unless otherwise specified in the Operating Instruction. Damaged switches or plugs have to be replaced by DEPRAG. Do not use a device with defective switches or plugs.

12. Attention

- For your own safety use only accessories and equipment, which are listed in the Operating Instructions or which are shown in the associated catalog. The use of any other driver, not shown in the OP-instructions or in our catalog, is not permissible.

13. Repair by DEPRAG only

- This electrical device complies with all relevant safety regulations. Repairs can therefore only be done by a DEPRAG electrician; otherwise injury could be possible, for which DEPRAG is not liable.

14. Vibration-Free Installation

- The electronic equipment (controller and power supply) has to be operated on a compact- and vibration-free surface.

15. Temperature

- The room temperature should not exceed 40^{o} Celsius ($104\,^{o}$F). If temperature exceeds this point, provide sufficient cooling.

General Information

TECHNICAL MODIFICATION SUBJECT TO CHANGE WITHOUT NOTICE.

THIS MANUAL HAS BEEN WRITTEN WITH THE MOST DETAILED CARE. HOWEVER, SHOULD THERE BE AN ERROR, WE WOULD APPRECIATE YOUR NOTIFICATION.

DEPRAG IS NOT BE LIABLE FOR ANY ERRORS OR THEIR SUBSEQUENT RESULTS!

1. ERROR DESCRIPTION

Possible Error Indications on the AST-Display

OFFSET-ERROR

Error:	Error:	Solution:
OFFSET	- defective cable - no transducer	- check cable - connect transducer

TTL-VOLTAGE <4.75V

Error:	Error Source:	Solution:
TTL<	- Supply Voltage of internal parts defective	- Not-Repairable by customer; send equipment to DEPRAG

TTL-VOLTAGE >5.25V

Error:	Error Source:	Solution:
TTL>	- Supply Voltage of internal parts defective	- Not-Repairable by customer; send equipment to DEPRAG

TRANSDUCER VOLTAGE <11.5V

Error:	Error Source:	Solution:
GEB+<	- Supply Voltage of Transducer defective	- Not-Repairable by customer; send equipment to DEPRAG

TRANSDUCER VOLTAGE >12.5V

Error:	Error Source:	Solution:
GEB+>	- Supply Voltage of Transducer defective	- Not-Repairable by customer; send equipment to DEPRAG

TRANSDUCER VOLTAGE <11.0V

Error:	Error Source:	Solution:
GEB-<	- Supply Voltage of Transducer defective	- Not-Repairable by customer; send equipment to DEPRAG

TRANSDUCER VOLTAGE >-13.0V

Error:	Error Source:	Solution:
GEB->	- Supply Voltage of internal parts defective	- Not-Repairable by customer; send equipment to DEPRAG

MD CAL TOO SMALL

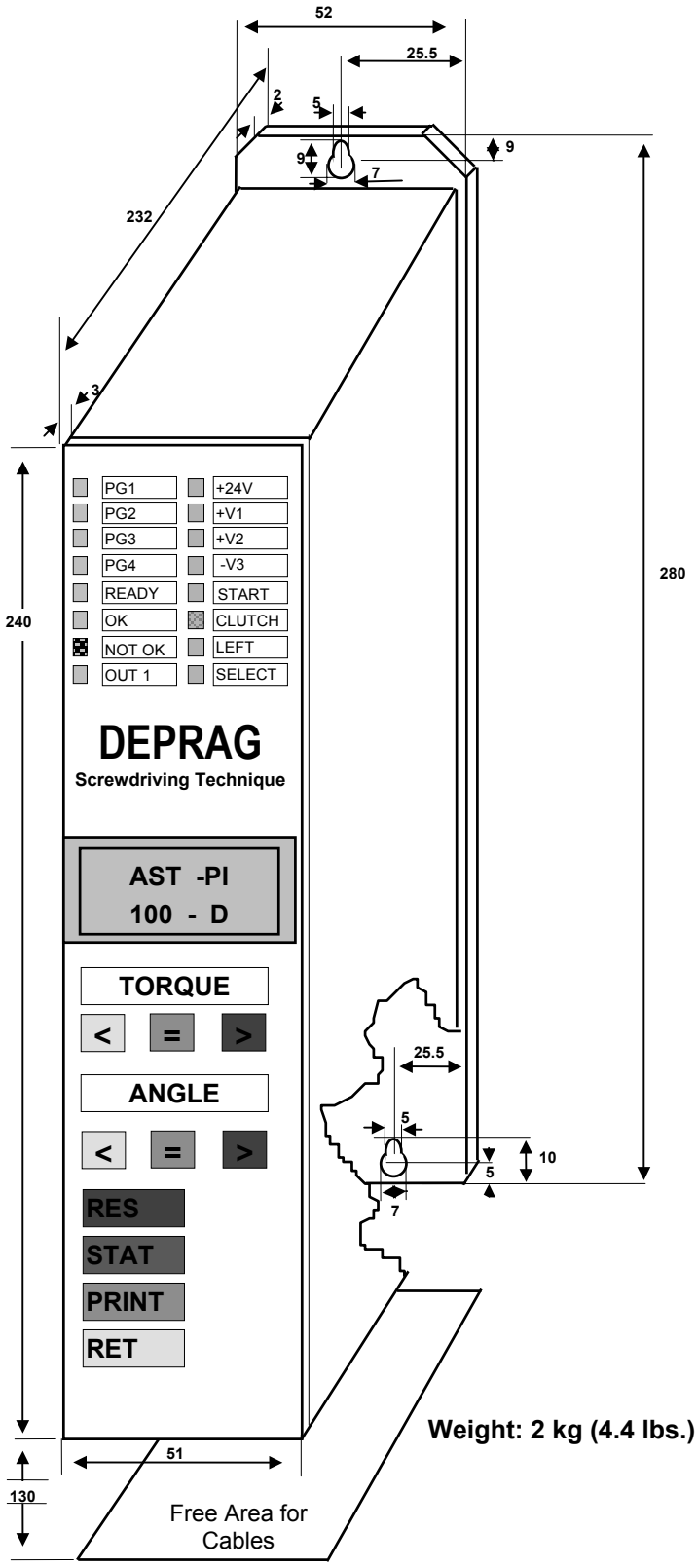
Error:	Error Source:	Solution:
MDKAL<	- Transducer locked - Transducer damaged (overloaded)	- Turn Driver by Hand - Not-Repairable by customer; send equipment to DEPRAG

MD CAL TOO LARGE

Error:	Error Source:	Solution:
MDKAL>	- Transducer locked - Transducer damaged (overloaded)	- Turn Driver by Hand - Not-Repairable by customer; send equipment to DEPRAG

2. EQUIPMENT VIEW

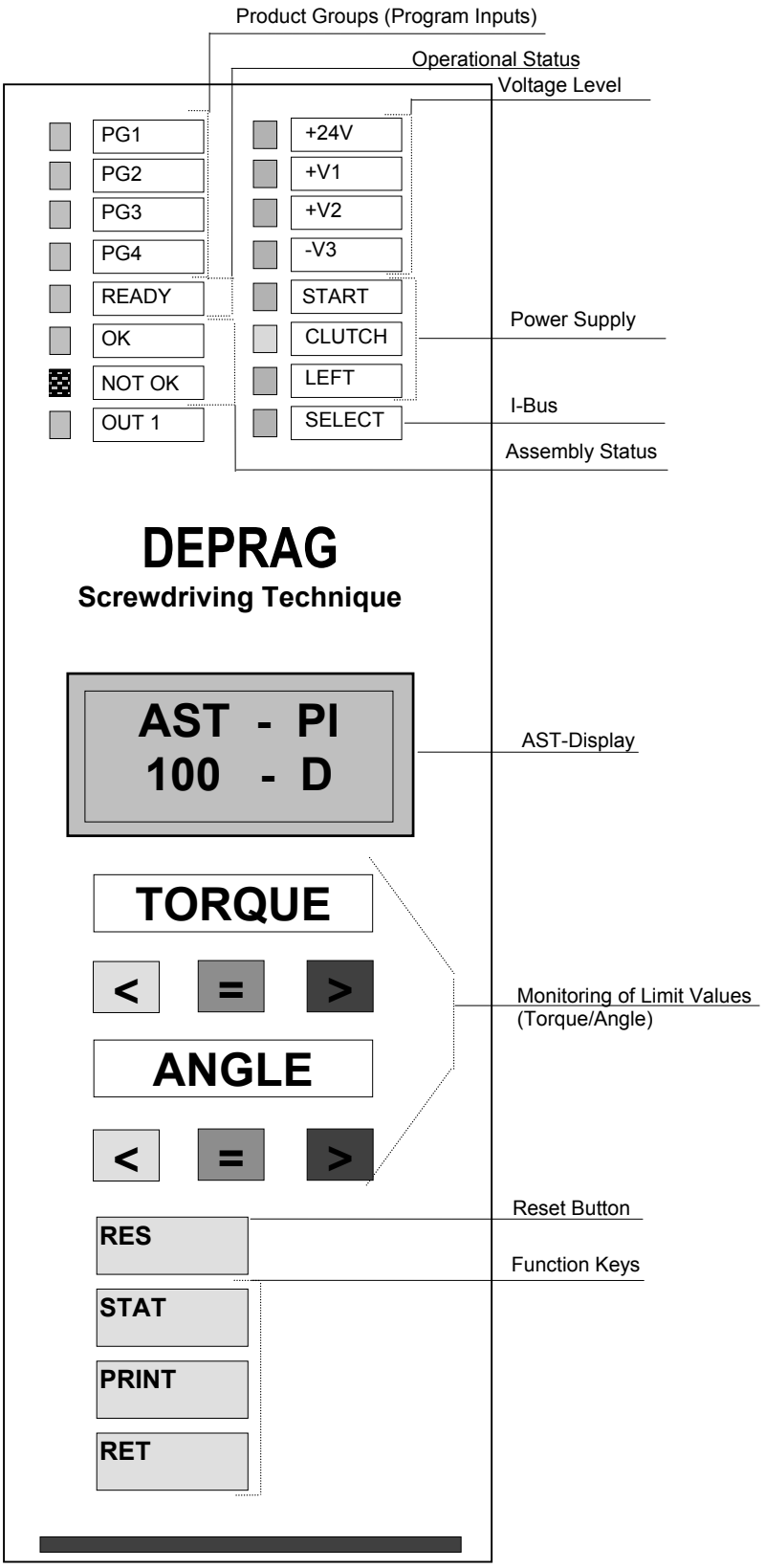
DIMENSIONS



Weight: 2 kg (4.4 lbs.)

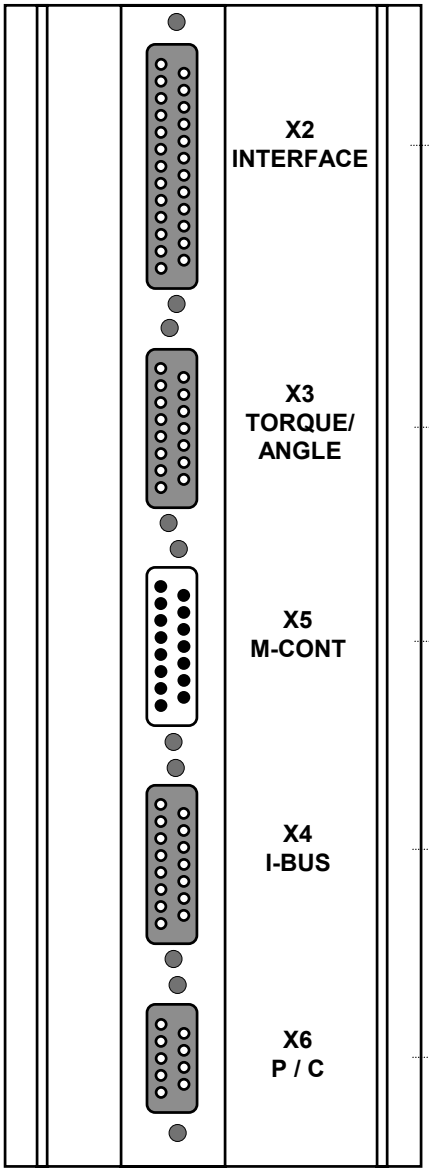
2. EQUIPMENT VIEW

FRONT VIEW



2. EQUIPMENT VIEW

ELECTRICAL CONNECTIONS



Equipment Controller
(Socket)

Torque / Angle
(Socket)

Power Supply
(Plug)

I-Bus
(Socket)

Printer/PC
(Socket)

If the “I-Bus” Port is active, then only the Printer will be available on Port “P / C”.

If the “I-Bus” Port is not active, then the Printer and Computer will be available on Port “P / C”.

3. LAY-OUT

X2 EQUIPMENT CONTROLLER

25-pole MIN-D Socket

PIN	DESTINATION	
1	0V-Programming	Input
2	Program 1	Input
3	Program 3	Input
4	not used	
5	not used	
6	+24V-Programming	Input
7	Ready (Operational)	Output
8	Fault (NIO - Not O.K.)	Output
9	not used	
10	not used	
11	+24V-Supply Voltage	Output
12	0V-Supply Voltage	Output
13	not used	
14	0V-Programming	Input
15	Program 2	Input
16	Program 4	Input
17	not used	
18	not used	
19	+24V-Programming	Input
20	OK (IO / O.K.)	Output
21	Exit 1	Output
22	not used	
23	not used	
24	+24V-Supply Voltage	Output
25	0V-Supply Voltage	Output

All In- and Outputs carry a 0V/24V level and are controlled with the same.

The BMS-Interface requires +24V Voltage. If no external +24V is available, the following bridges can be can be soldered on the 25-pole plug:

PIN		PIN
1	with	12
6	with	11
14	with	25
19	with	24

Output Load:

- with internal supply (bridged plug) 500 mA per output / 1A total load
- with external supply 500 mA per output

3. LAY-OUT

X3 TORQUE/ANGLE

15-pole MIN-D Socket

PIN	DESTINATION
1	Calibrate
2	+MD
3	+12V
4	SC
5	+5V
6	Angle 1
7	Angle 3
8	GND
9	Depth Analog
10	-MD
11	-12V
12	GND
13	+5V
14	Angle 2
15	DI

X4 I-BUS

15-pole MIN-D Socket

PIN	DESTINATION
1	Card Address 0
2	Card Address 1
3	Card Address 2
4	Card Address 3
5	Card Address 4
6	Card Address 5
7	Card Address 6
8	Card Address 7
9	RxD
10	TxD
11	RTS
12	CTS
13	GND
14	GND
15	+5V

3. LAY-OUT

X5 POWER SUPPLY

15-pole MIN-D Plug

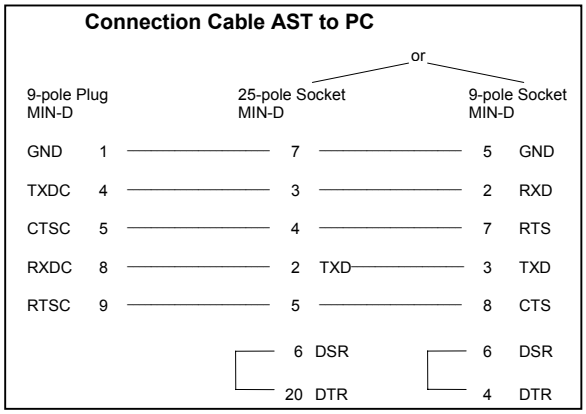
PIN	DESTINATION
1	GND Umbrella
2	Left Rotation
3	N Set-Value
4	N Actual-Value
5	Error
6	Angle V
7	18V AC
8	0V AC
9	Start
10	Clutch (Optional)
11	I Set-Value
12	Ip
13	Angle N
14	18V AC
15	0V AC

X6 P/C

9-pole MIN-D Socket

PIN	DESTINATION
1	GND
2	TxDP
3	CTSP
4	TxDC
5	CTSC
6	RxDP
7	RTSP
8	RxDC
9	RTSC

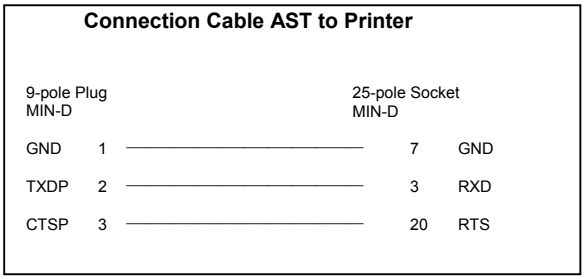
Connection Cable AST to PC



Adjustment on Printer

Baud	**9600**
Data	**8**
Parity	**N**
Stop	**1**

Connection Cable AST to Printer

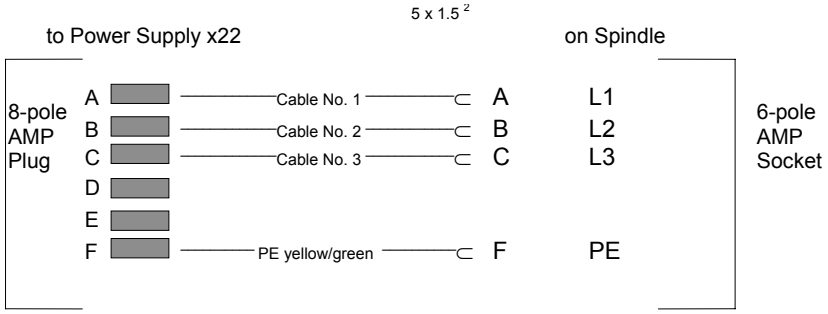


3. LAY-OUT

MOTOR CABLE FOR SPINDLE 300E40-XXX

9-pole Amphenol Plug

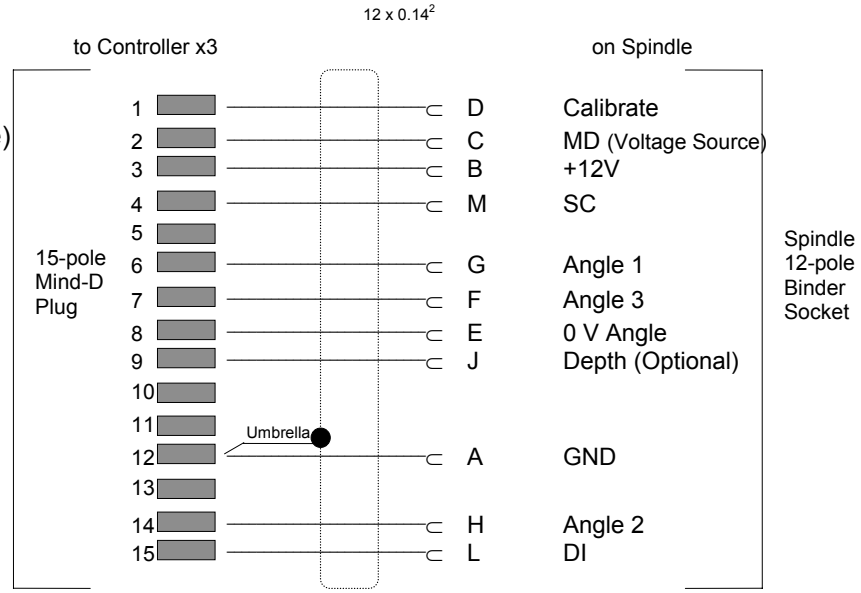
PIN	DESTINATION
A	L1
B	L2
C	L3
D	
E	
F	PE



MD / WI FOR SPINDLE

12-pole Binder Socket

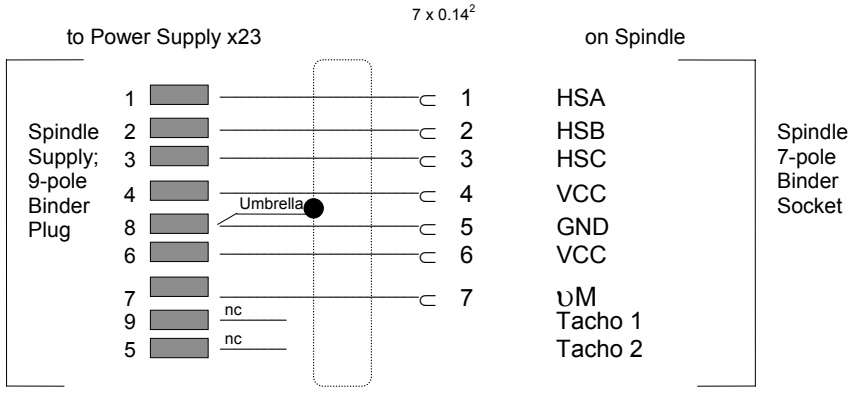
PIN	DESTINATION
D	Calibrate
C	MD (Voltage Source)
B	+12V
M	SC
G	Angle 1
F	Angle 3
E	0 V Angle
J	Depth (Optional)
A	GND
H	Angle 2
L	DI



CONTROL CABLE FOR SPINDLE

7-pole Binder Socket

PIN	DESTINATION
1	HSA
2	HSB
3	HSC
4	VCC
5	GND
6	VCC
7	ϑM

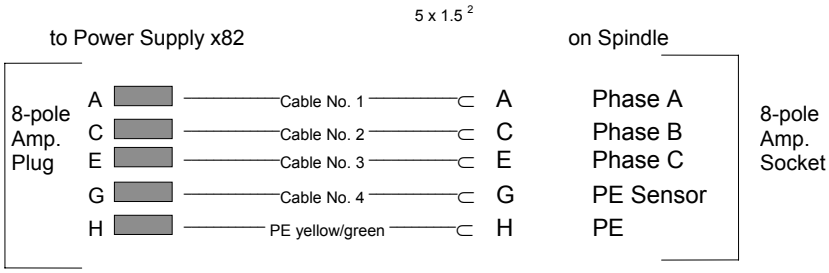


3. LAY-OUT

MOTOR CABLE FOR SPINDLE 300E57-XXX

8-pole Amphenol Plug

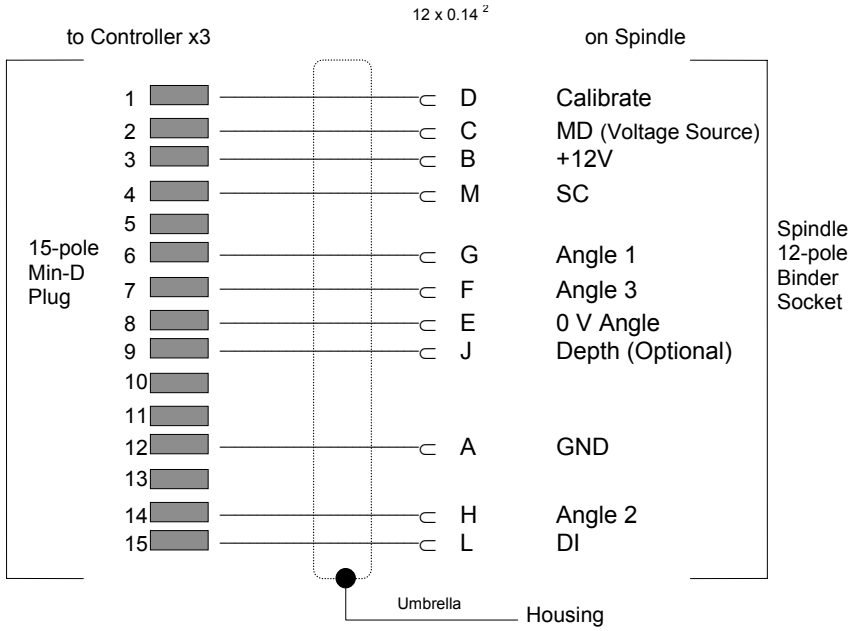
PIN	DESTINATION
A	Phase A
C	Phase B
E	Phase C
G	PE-Sensor
H	PE



MD / WI FOR SPINDLE

12-pole Binder Socket

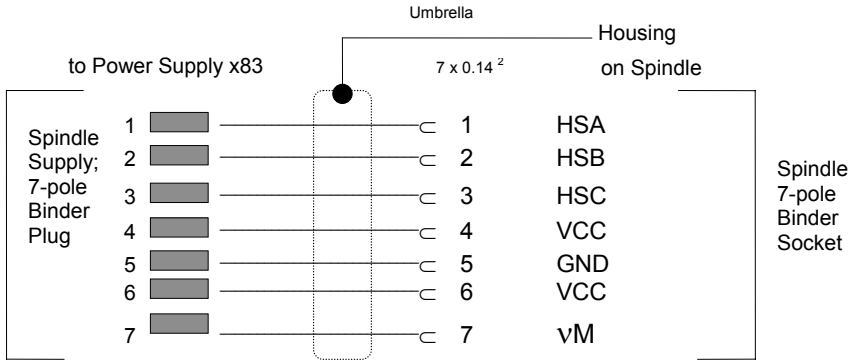
PIN	DESTINATION
D	Calibrate
C	MD (Voltage Source)
B	+12V
M	SC
G	Angle 1
F	Angle 3
E	0 V Angle
J	Depth (Option)
A	GND
H	Angle 2
L	DI



CONTROL CABLE FOR SPINDLE

7-pole Binder Socket

PIN	DESTINATION
1	HSA
2	HSB
3	HSC
4	VCC
5	GND
6	VCC
7	υM

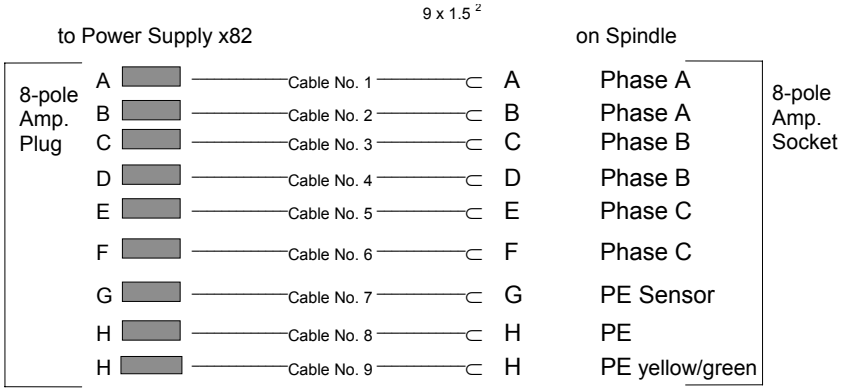


3. LAY-OUT

MOTOR CABLE FOR SPINDLE 300E80-XXX

8-pole Amphenol Plug

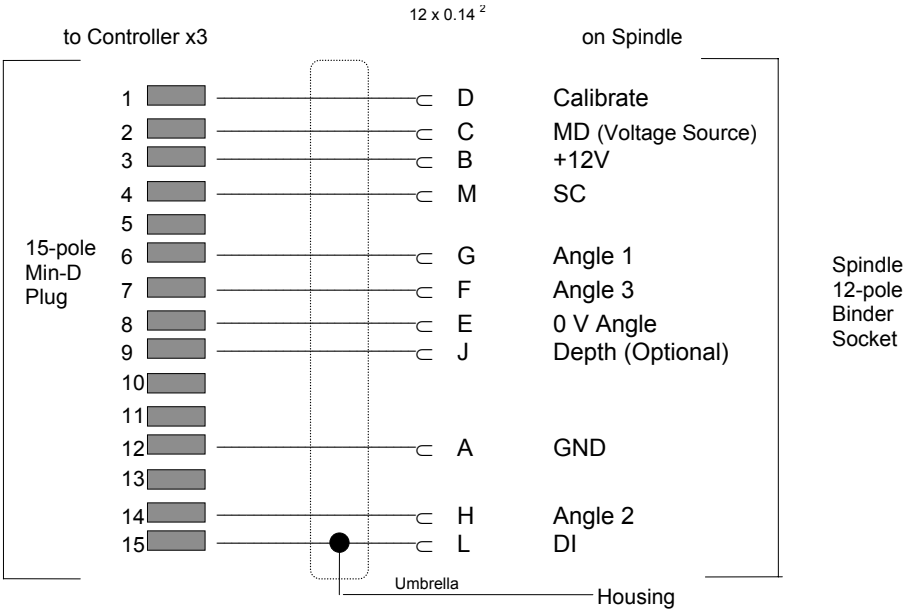
PIN	DESTINATION
A	Phase A
B	Phase A
C	Phase B
D	Phase B
E	Phase C
F	Phase C
G	PE Sensor
H	PE
H	PE yellow/green



MD / WI FOR SPINDLE

12-pole Binder Socket

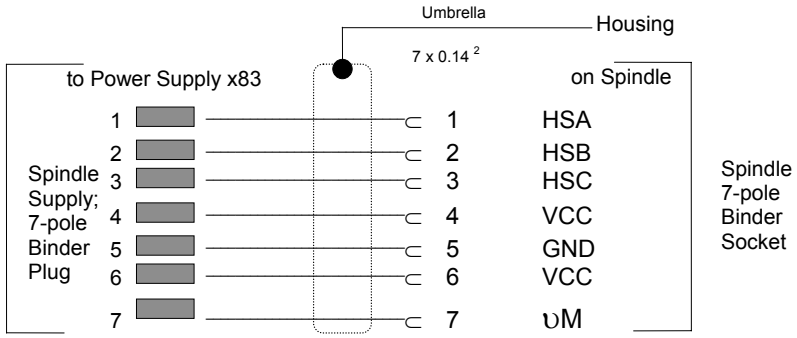
PIN	DESTINATION
D	Calibrate
C	MD (Voltage Source)
B	+12V
M	SC
G	Angle 1
F	Angle 3
E	0 V Angle
J	Depth (Option)
A	GND
H	Angle 2
L	DI



CONTROL CABLE FOR SPINDLE

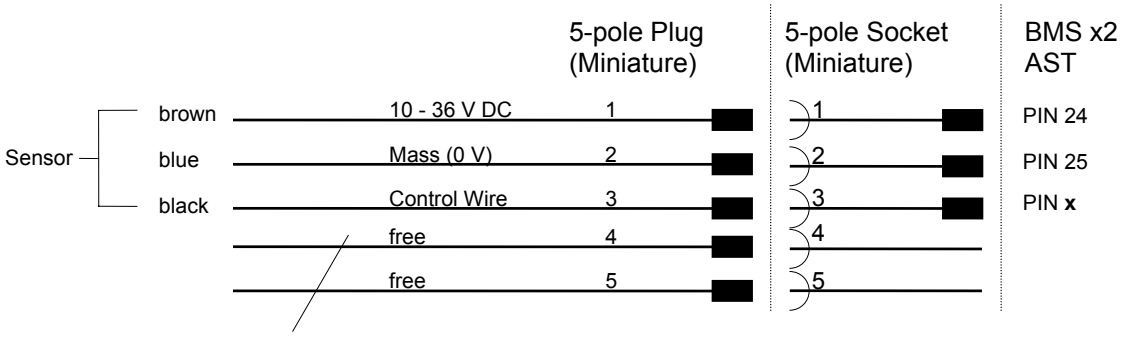
7-pole Binder Socket

PIN	DESTINATION
1	HSA
2	HSB
3	HSC
4	VCC
5	GND
6	VCC
7	υM



3. LAY-OUT

AUTOMATIC START (OPTION) SENSOR PIN LAY-OUT



Sensor Cable (0.8 m) with 5-pole Miniature Plug

Standard Equipment:
Sensor with 0.8 m cable mounted to drive and soldered to 5-pole miniature plug, as well as a 5-pole miniature socket for connection by customer.

Control of each corresponding Program Group

	PG 1	PG 2	PG 3	PG 4
PIN	2	15	3	16

The BMS-Connection requires +24V Voltage. If no external +24V is available, the following bridges can be can be soldered on the 25-pole plug:

PIN		**PIN**
1	with	12
6	with	11
14	with	25
19	with	24

Output Load:

- with internal supply (bridged plug) 500 mA per output / 1A total load
- with external supply 500 mA per output

4. TERMINAL PROGRAM

INSTALLATION

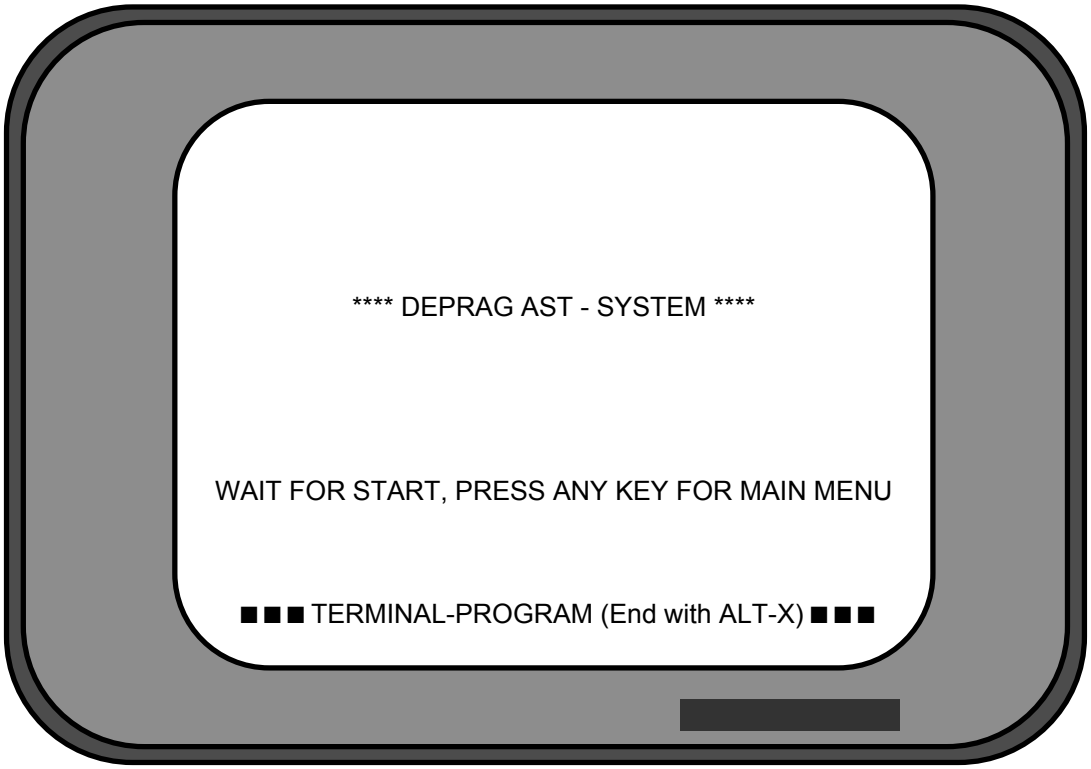
Prior to operating with the Terminal Program, please observe the following

- Establish a connection between AST and PC (lay-out on Page 11)
- Copy the Terminal Program to the Hard Drive of the PC.

To Start the Terminal:

- Turn Computer ON
- Start Terminal by inputting of program name

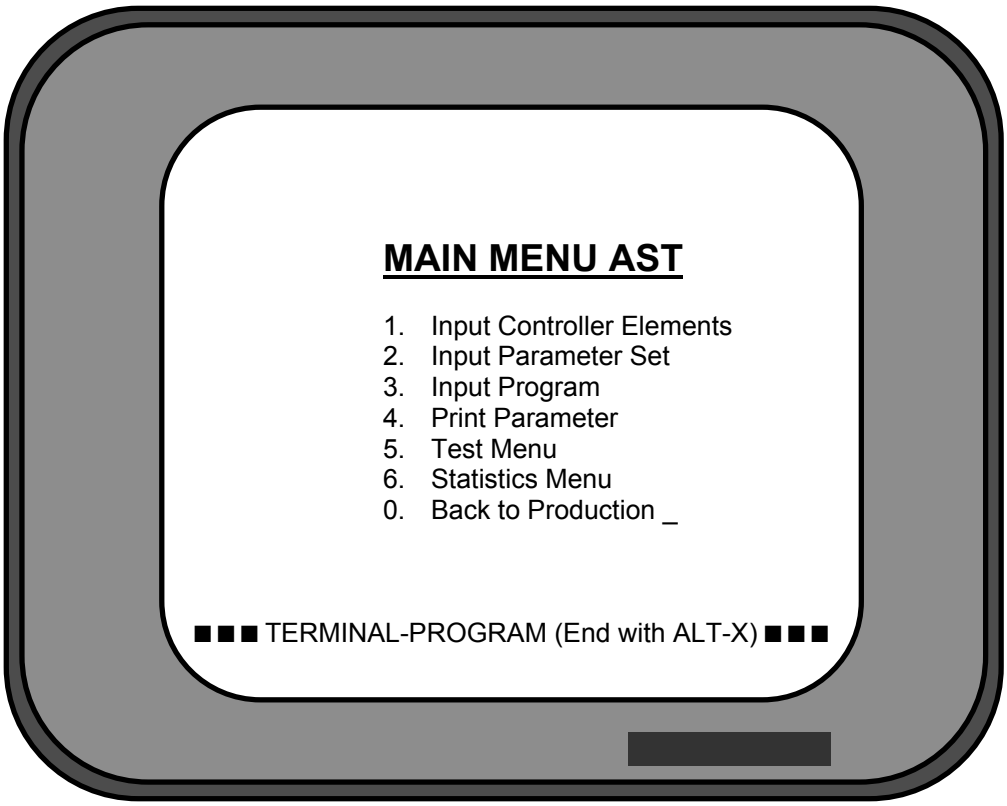
If the Connection of AST ⟶ Computer is done, the following start screen appears:



Press any Key ⟶ Main Menu AST

4. TERMINAL PROGRAM

MAIN MENU



Selection Main Menu

Items can only be selected out of the main menu, if the Sequence Controller is operational; i.e. the START-message was displayed, or if a system error occurs.
Select needed option, input corresponding number and confirm with ENTER-key

Example: **1** Input

confirm by pressing Enter Key

now you are in the “Input” mode

“Input Controller Factors” (see page 18)

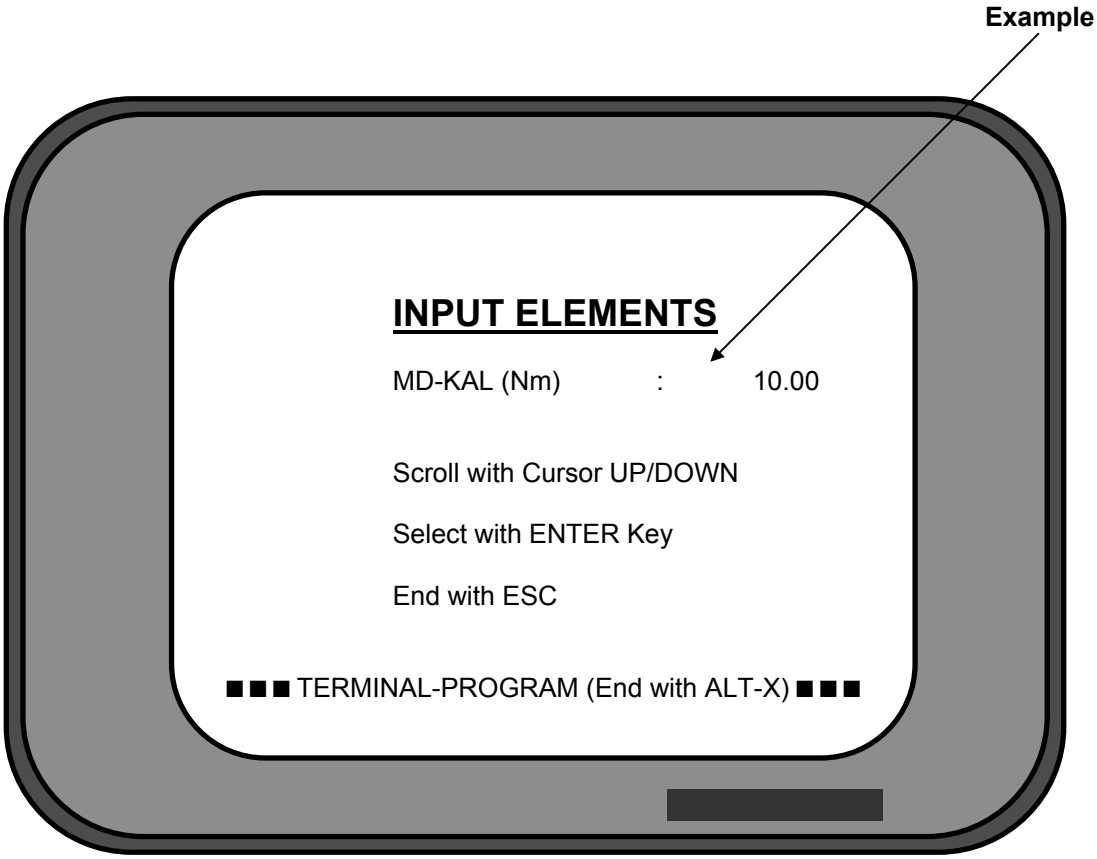
4. TERMINAL PROGRAM

INPUT CONTROLLER FACTORS

- Controller Factors are values that allow the Sequence Controller to adapt to hardware (spindle, printer, PC, etc.) and the operational requirements (access control, AST-display-contrast, etc.)
  All factors are input by the user and subsequently stored. The Sequence Controller will be automatically configured with those factors, every time the system is turned ON.
  A change of those Factors is possible at any time.

- If the access control is activated, the AST-system asks for the access number. Input the access number and press the Enter Key.

- The screen “Input Factors” appears:



For the next factor use Enter-key (factor is being stored)
use CURSOR-keys (factor is **not** stored)

4. TERMINAL PROGRAM

INPUT CONTROLLER FACTORS

MD-KAL

MD-KAL is the calibration value of the transducer in the Spindle. This value indicates for what maximum torque the transducer is designed. The calibration value is imprinted on the serial number tag of the spindles and has to be input in Nm.

MD-FACTOR

The Torque-Factor **MD-FACTOR** has two functions:

- Equalizes the torque-loss on its way from the Transducer to the Assembly (i.e. use of reduction
- gearing).

- Adapts the reduction factor to the measuring electronic when using reduction gears.

Example: An Angle-Head has an efficiency of h = 0.93, which means a torque-loss of 7%. Furthermore it has a reduction factor of i = 1.40.

The MD-Factor is calculated as follows:

$$\text{MD-FACTOR} = = \frac{1}{hxi} = \frac{1}{0.93 \times 1.40} = 0.768$$

WI-FACTOR (IMP/Grd)

Spindles mounted with Angle-Transducers produce per angle degree a certain number of voltage impulses, which are counted by the Sequence Controller.
The amount of impulses by degree (IMP/Grd) has to be input as the Angle-Factor.

SPINDLE TYPE	ANGLE-FACTOR
300E40-XXX	1.00
300E57-XXX	1.00
300E80-XXX	2.00

The indicated Angle-Factors applies to standard spindles only.

The required Angle-Factors for spindle not shown here, can be found in the individual spindle specification sheets.

4. TERMINAL PROGRAM

INPUT CONTROLLER FACTORS

KUPPL.-ZEIT (ms) = Clutch Time

Spindles with a mechanical clutch require for the reverse a certain time period. during this clutch-time, the spindle is at a standstill.
Afterwards, the program sequence continues.
The input is done in ms (Standard Value > 500 ms)

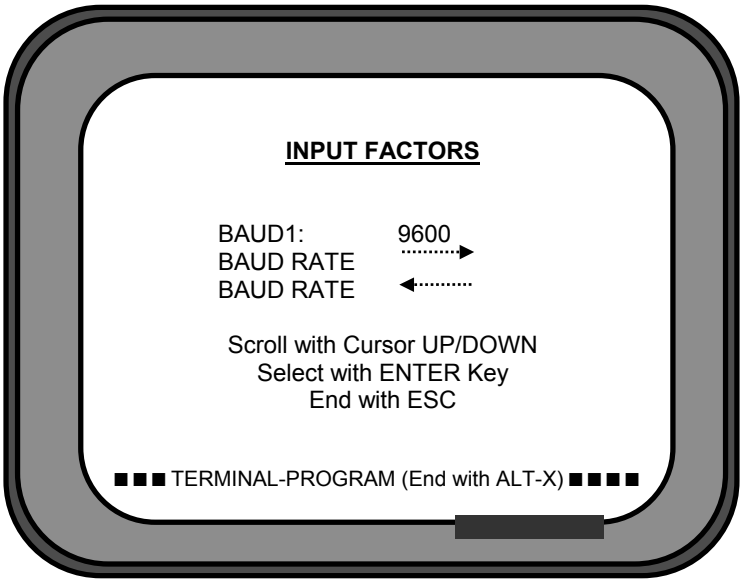
Note: The standard spindle does not have a mechanical clutch. Therefore, input is not necessary.

NIO-DRUCK (PRINTOUT) (O/1)

If NIO-DRUCK is activated (NIO-DRUCK = 1), only the measuring values for assemblies NIO (NOT O.K.) will be printed.

If NIO-DRUCK is not activated (NIO-DRUCK = 0), all measuring values will be printed (NIO and IO) NOT O.K. and O.K.

To have any value printed at all, a CHKM- and PRIM-Command has to be programmed into the screwdriving program.



BAUD1

BAUD1 is the baud rate for the serial port

This Baud rate is adjustable to 2400 / 4800 / 9600 / 19200
by using the Cursor Keys

CONTRAST

The Contrast of the AST-Displays can be adjusted by using the Cursor Keys

4. TERMINAL PROGRAM

INPUT CONTROLLER FACTORS

STATION

When using more than one AST-controllers, it is possible to assign to each System a Station Number to simplify recognition.
The Station Number is being displayed when the System is turned ON and also indicated on each printout.
The station number has no purpose at cross-linked AST-controllers.

ZUTRITT 1/2 (0 = none) ACCESS

If control factors, parameters and programs should only be accessible or changed by certain personnel, it is possible to assign access numbers.

Two access numbers in a range from 1 - 32000 can be input. If at Access 1 and Access 2 a zero (0) is input, this function is not active and no access control is possible.

ROT-DRUCK (0/1) (RED-PRINT)

When using the special printers, it is possible to print the NIO (Not O.K.) assemblies and error messages in Red. This function is activated when a 1 is input and deactivated with a 0.
For Printers any other than the PR-1, a 0 has to be input.

I-BUS (0/1)

If the controller is cross-linked over the I-Bus, input a 1 at this position.
If the controller is used as an individual station, input a 0.

4. TERMINAL PROGRAM

INPUT CONTROLLER FACTORS

FARB-ZEIT (ms) - (COLOR-TIMING)

There is a possibility to integrate a spay-paint system to Output1 (OUT1) of the BMS-port. The paint-spray system is activated (Set Output1), if the assembly is deemed O.K.

- If a paint-spray system is used, the color-timing has to be input in ms (milli-seconds). Output 1 is then reserved for this paint-spray system (OUT1 is no longer free programmable).

- If no paint-spray system is used, input a zero (0). OUT1 is free programmable.

RAMPEN-ZEIT (ms) - (RAMP-TIMING)

The period from the time the driver is at standstill, till the moment when the driver starts at the default speed, is known as Ramp-Time. This Ramp-Timer can be adjusted in a range from 0 - 3000 ms.

WINK.x4 (0/1) = (ANGLE x4)

Spindles mounted with Angle-Transducers produce per angle degree a certain number of voltage impulses. This factor has to be set to 1.

4. TERMINAL PROGRAM

INPUT CONTROLLER FACTORS

SA-MODE (0/1)

The parameter “SA-Mode” influences the behavior of the controller, when removing the Start Signal, “SA” (Abort through Start key)

SA-Mode = 0 The program is exited by use of Start key and the NIO (Not O.K.) output is set (i.e. at Automatic Stations)

SA-Mode = 1-4 The program will not be exited when using the Start key, but continues by renewed Start. (i.e. at Hand-Screwdriver Stations) - nee also NEXT-STEP!

At a renewed Start, the program will continue, independent of the adjustment NEXT-STEP.

This is important for Hand-Drivers, which have a sequenced loop and program should not be interrupted by start removal. However, if the assembly has to be completed, the Input (1-4) which was set to “SA-Mode 1-4”, has to be dampened.

Attention: The selected input cannot be used anymore with the Function WINP!

NEXT-STEP (0/1)

Here it is possible to select how to continue the operation after start was removed.

NEXT-STEP = 0 Assembly will be continued at the precise Step, where it was interrupted.

NEXT-STEP = 1 Assembly will be continued at the subsequent Step, from where it was interrupted.

4. TERMINAL PROGRAM

INPUT CONTROLLER FACTORS

INVERS (0/1)

When Spindles with reverse option (i.e. spindles with integrated off-set drive) are used, the turn-direction of the Motors can be inverted with the INVERS Option.

INVERS = 0 Turn-Direction is followed as specified in the screwdriving diagram.

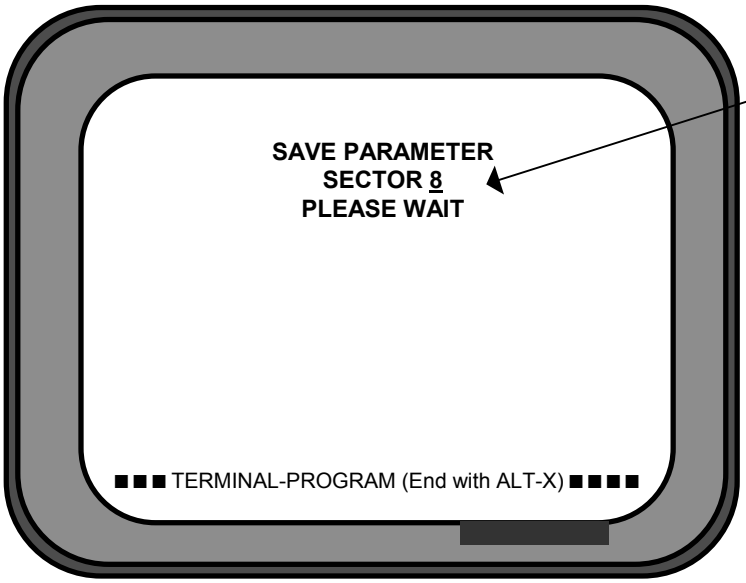
INVERS = 1 Turn-Direction will be inverted.

WINK-LT (0/1) = ANGLE TRANSDUCER

The AST-controller allows that the angle impulses are either taken directly from the angle-transducer on the Spindle or from the sensor of the transducer.

WINK-LT = 0 Angle impulse directly from the angle-transducer

WINK-LT = 1 Angle impulse from the transducer sensor



End with ESC

Controller Factors are stored

If you change a parameter, but do not want to store it, push the RESET Key on the AST-controller.

4. TERMINAL PROGRAM

PARAMETER-SET / GENERAL INFORMATION

What is a Parameter?

During actual assembly it is often necessary to tighten or loosen assemblies in more than one step.
The AST-controller requires for **each** tightening- respectively loosening-step detailed information:

- Does the fastener need tightening or loosening
- Does the Spindle have to shut-off when reaching torque or angle
- Information about the required shut-off values
- Information about the limit values
- Information about the determined speed
- Information about the determined voltage

etc.

This information is called parameters.
Parameters, which contain **one** tightening- or **one** loosening-step, are input by the user into the AST-controller in form of **one** parameter-set.

Since the AST-controller has 10 parameter sets available, it is possible to input and store 10 different tightening- or loosening steps.

CONSTRUCTION OF A PARAMETER SET

The most important parameter is the screwdriving diagram (short: DIA).
The AST-controller has four Screwdriving Diagrams available as a standard, specifically DIA2 to DIA5.

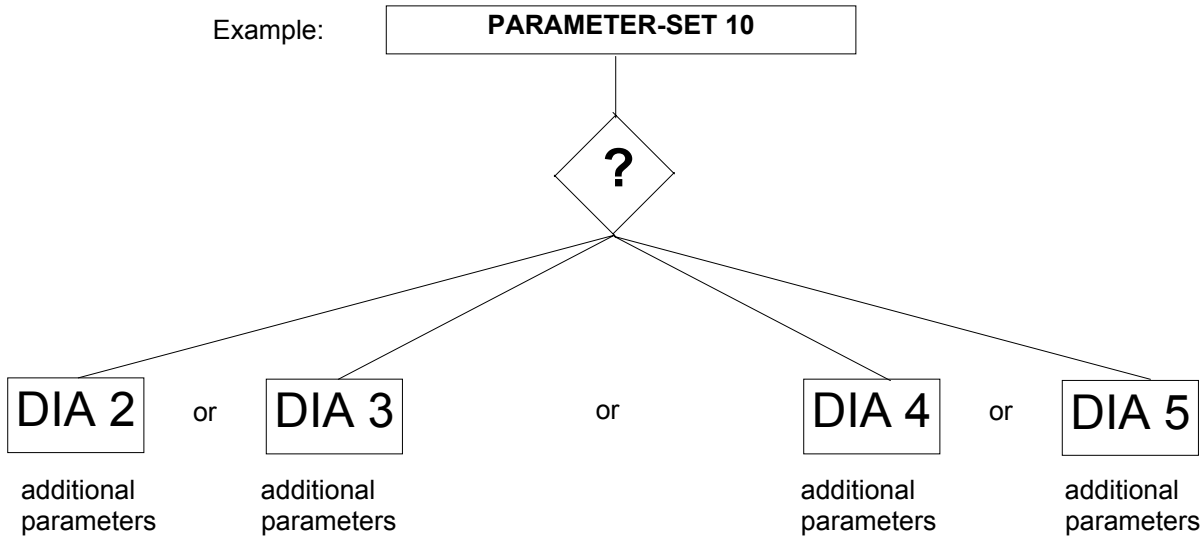
Each diagram is an independent tightening process, respectively loosening process.

	DIA 2	DIA 3	DIA 4	DIA5
Loosening			●	
Tightening	●	●		●
Shut-Off at Torque	●	●		
Shut-Off at Angle			●	●
Check Torque			○	○
Check Angle		○		

4. TERMINAL PROGRAM

PARAMETER-SET / GENERAL INFORMATION

For each Parameter-Set only one Screwdriving Diagram can be selected. All subsequent parameters depend on the selected screwdriving diagram.



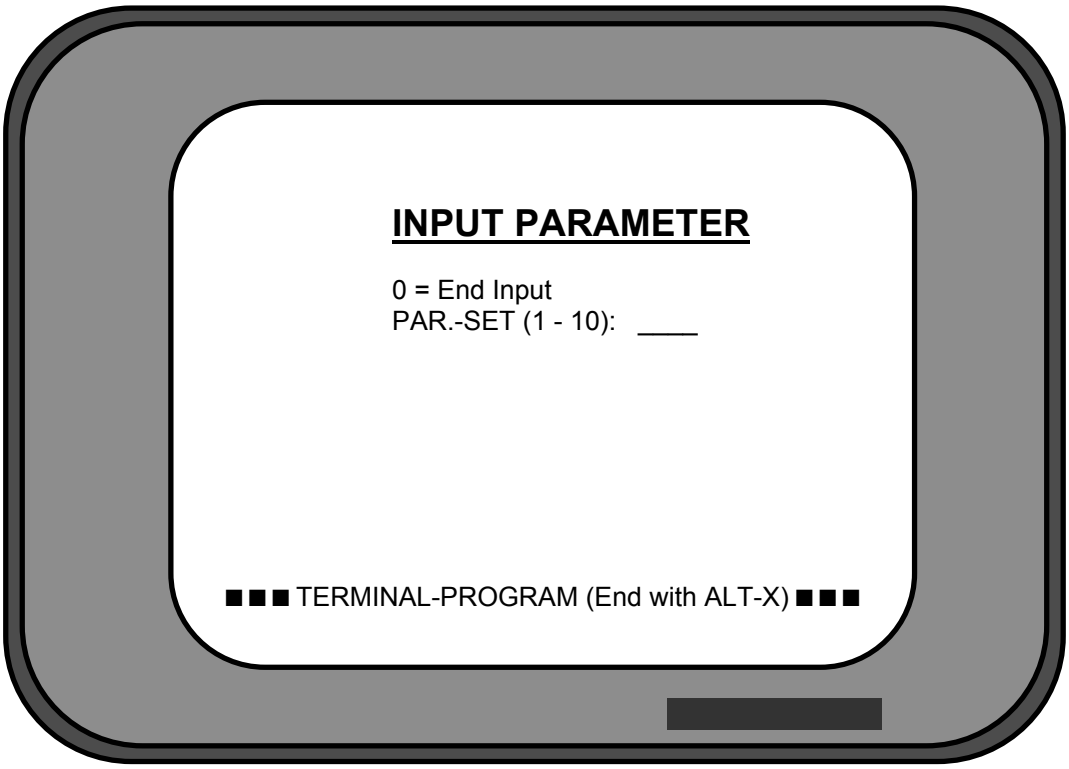
Please find on the next pages a description of how to input a parameter and the individual screwdriving diagrams.

4. TERMINAL PROGRAM

PARAMETER-SET / GENERAL INFORMATION

Selection of a Parameter

- Parameter Sets can be only selected, if the AST-controller is operational, i.e. the START-message is displayed.
- If the access control is activated, the AST-controller asks for an access number. Input the access number and press the Enter key.

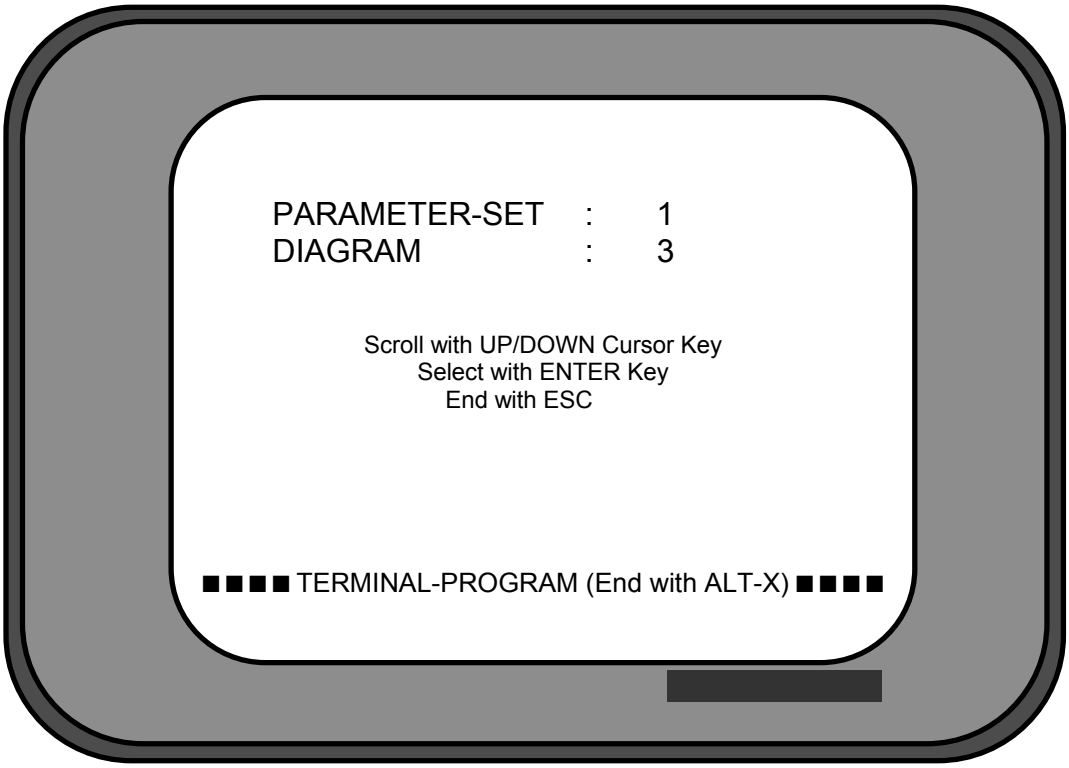


Input a Parameter-Set

- Input the required parameter number (1 to 12) and press the Enter key.
- The screen displays the screwdriving diagram (DIA) of the selected parameter set.
- Scroll to the needed parameter, using the Cursor keys.
- Input the required value.
- The previous value is overwritten.
- Confirm input value using the Enter key

4. TERMINAL PROGRAM

PARAMETER-SET / GENERAL INFORMATION



If a different screwdriving diagram is selected, recheck all values of the parameter-set!

To exit a Parameter-Set

- Check all parameter, if they are correct.
- Press ESC key.
- System exits the parameter set.
- Another parameter set can be selected.
- Input 0 and press Enter key.
- All 12 parameter set are being saved.
- System exits the menu “input parameter”.
- If you do not want to save the entered parameters, push the RESET Key on the AST-controller.

4. TERMINAL PROGRAM

DESCRIPTION OF PARAMETER

MP (Nm)

MP is the torque value, at which the spindle shuts-off.
Input Range: 0 Nm **up to** Calibration Value (MD-KAL) of the Spindle (Factor)

WP (Grd) / Degree

WP is the angle degree, at which the spindle shuts-off.
Input Range: 0 Degree **up to** 32000 Degree

MS (Nm)

When the spindle reaches the threshold torque MS, the angle measurement starts.
Input Range: 0 Nm **up to** shut-off torque (MP)

MD-MIN (Nm)

MD-MIN is the minimum torque value, at which the screwdriving step is assessed as IO (O.K.).
(lower limit of the IO-window = O.K.-window)
Input Range: 0 Nm **up to** shut-off torque (MP)

MD-MAX (Nm)

MD-MAX is the maximum torque value, at which the screwdriving step is assessed as IO (O.K.).
(upper limit of the IO-window = O.K.-window)
Input Range: shut-off torque (MP) **up to** 110% of calibration value (MD-KAL) of the Spindle (Factor)

WI-MIN (Grd) / Degree

MD-MIN is the minimum angle degree, at which the screwdriving step is assessed as IO (O.K.).
(lower limit of the IO-window = O.K.-window)
Input Range: 0 (Grd) Degree **up to** 32000 (Grd) Degree

WI-MAX (Grd) / Degree

MD-MAX is the maximum angle degree, at which the screwdriving step is assessed as IO (O.K.).
(upper limit of the IO-window = O.K.-window)
Input Range: minimum angle (WI-MIN) (MP) **up to** 32000 (Grd) Degree

4. TERMINAL PROGRAM

DESCRIPTION OF PARAMETER

DREHZAHL = SPEED (%)

With the parameter SPEED, the spindle speed for the tightening step can be input.
Since the speed depends on the spindle type, this input is not done in absolute-values, but rather as a percentage.
Input-Range: 0% (no speed) up to 100% (maximum speed) in 1% increments

Determination of Value: For the determination of the best speed, the following 2 items have to be considered:

- The harder a screw joint, the lower a speed should be selected.
- The softer a screw joint, the higher a speed can be selected.

STROM (%) / VOLTAGE

With the parameter STROM (Voltage), the maximum motor voltage for the spindle can be programmed.
If the motor requires during the assembly more voltage than predetermined by STROM (Voltage), the spindle will shut-off. This will eliminate damage to the spindle.
Since the motor voltage depends on the spindle type, this input is not done in absolute-values, but rather as a percentage.

Input-Range: 0% (no voltage) up to 100% (maximum voltage) in 1% increments

Determination of Value: Input at STROM (Voltage) a low value (i.e. 10%) and proceed with the assembly. If the spindle halts the assembly because of too high motor voltage (Control Indicator I-MAX lights up), increase the voltage step-by-step, until the assembly is indicated as IO (O.K.).

4. TERMINAL PROGRAM

DESCRIPTION OF PARAMETER

T-SCHRAUB (ms) = Screwdriving Time

With the parameter T-SCHRAUB, the maximum allowable assembly time can be programmed.
If the AST-controller does not reach the required torque within the screwdriving-time, (i.e. missing screw) the tightening step will be stopped after expiration of screwdriving time, and a NIO (Not O.K.) assembly will be indicated.
Input-Range: 1 ms up to 32000 ms in 1 ms increments

Determination of Value: Input a relative long Screwdriving-Time (i.e. 20000 ms) and proceed with the assembly. Use the actual assembly time, add a buffer of about 2000 ms and input the resulting value as the T-SCHRAUB value.

T-NACHLAUF (ms) = Lag Time

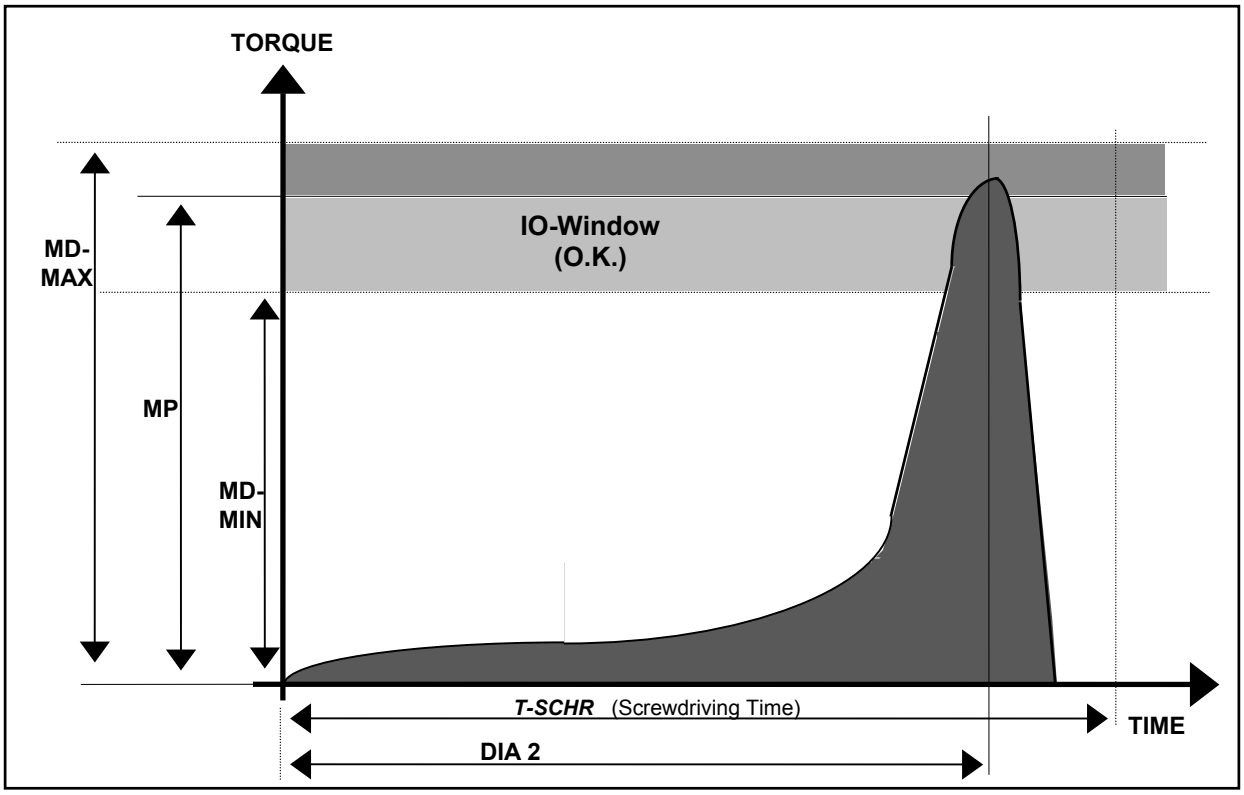
Because of the spindle mass inertia, the spindle does not come to an absolute standstill at shut-off, but rather has some lag.
With the Lag-Time (T-Nachlauf) it is possible to input a time interval, for how much longer the torque and angle will be measured, after the spindle shuts-off.
Input-Range: 1 ms up to 32000 ms in 1 ms increments

Determination of Value: To determine the actual assembly values, the lag-time has to be fully considered. Basic Rule: the larger the spindle, the larger the lag-time needs to be selected. (approx. 100 ms - 500 ms).

4. TERMINAL PROGRAM

INPUT PARAMETER-SET OF SCREWDRIVING DIAGRAM 2 (DIA2)

Tightening Process with: ● Shut-Off at Torque



This illustration shows a one-step tightening of a EC-Servo-Spindle

4. TERMINAL PROGRAM

INPUT PARAMETER-SET OF SCREWDRIVING DIAGRAM 2 (DIA2)

SEQUENCE:

- At the beginning of the tightening process, the Screwdriving Time T-SCHR starts. During the
- assembly, the AST-controller carries out cyclical torque measurements

- The Spindle shuts-off when:
  - The shut-off torque **MP** is reached or
  - The screwdriving time **T-SCHR** expires

The assembly process is considered **IO (O.K.)** if:

- The actual shut-off torque is within the IO (O.K.)-Window, which means:
  - torque is in-between MD-MIN and MD-MAX and within the screwdriving time T-SCHR

The assembly process is considered **NIO (Not O.K.)** if:

- The actual shut-off torque is outside the IO (O.K.)-Window, which means:
  - outside the MD-MIN and MD-MAX or outside the Screw-Assembly Time T-SCHR

Parameters used in Screwdriving Diagram 2 (DIA2):

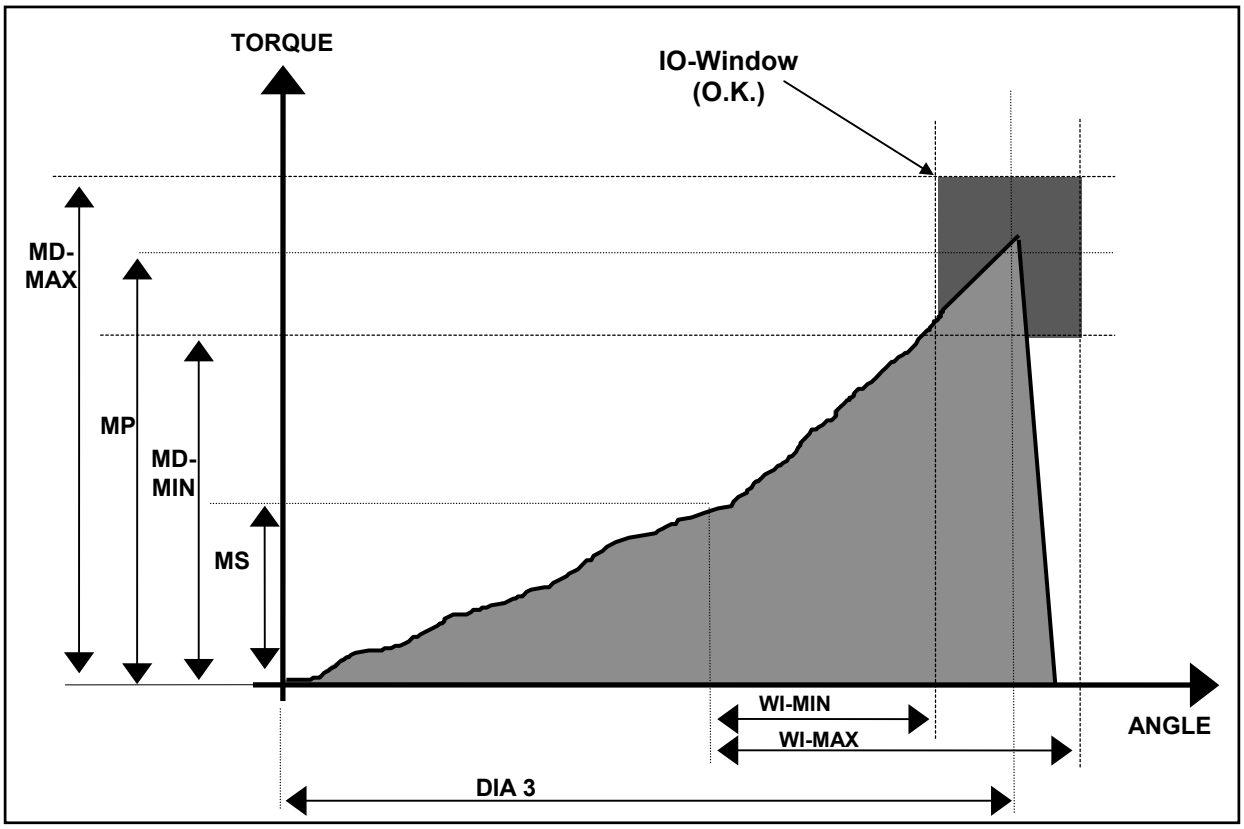
MP, MD-MIN, MD-MAX, Drehzahl (Speed), Strom (Voltage), T-Schraub (Screwdriving Time), T-Nachlauf (Lag Time)

4. TERMINAL PROGRAM

INPUT PARAMETER-SET OF SCREWDRIVING DIAGRAM 3 (DIA3)

Screwdriving Diagram 3	(DIA3)	Tightening in Right-Rotation
Screwdriving Diagram 31	(DIA31)	same as DIA3, however the tightening is done in left-rotation.

Tightening Process with:
- Shut-Off at Torque
- Check Angle



This illustration shows a two-step tightening.

4. TERMINAL PROGRAM

INPUT PARAMETER-SET OF SCREWDRIVING DIAGRAM 3 (DIA3)

Screwdriving Diagram 3	(DIA3)	Tightening in Right-Rotation
Screwdriving Diagram 31	(DIA31)	same as DIA3, however the tightening is done in left-rotation.

Tightening Process with:
- Shut-Off at Torque
- Check Angle

SEQUENCE:

- At the beginning of the tightening process, the screwdriving time T-SCHR starts.
- During the assembly, the AST-controller carries out cyclical torque measurements.
- Starting at the threshold torque MS, the system carries out angle measurements.
- The Spindle shuts-off when:
  - The shut-off torque MP is reached or
  - The maximum angle WI-MAX is reached or
  - The screwdriving time T-SCHR expires

The assembly process is considered **IO (O.K.)** if:

- The actual shut-off torque is within the IO (O.K.)-Window, which means:
  - torque is in-between MD-MIN and MD-MAX and
  - angle is in-between WI-MIN and WI-MAX and the screwdriving time T-SCHR has not expired

The assembly process is considered **NIO (Not O.K.)** if:

- The actual shut-off torque is outside the IO (O.K.)-Window, which means:
  - outside the MD-MIN and MD-MAX or
  - outside the WI-MIN and WI-MAX or the screwdriving time T-SCHR has expired

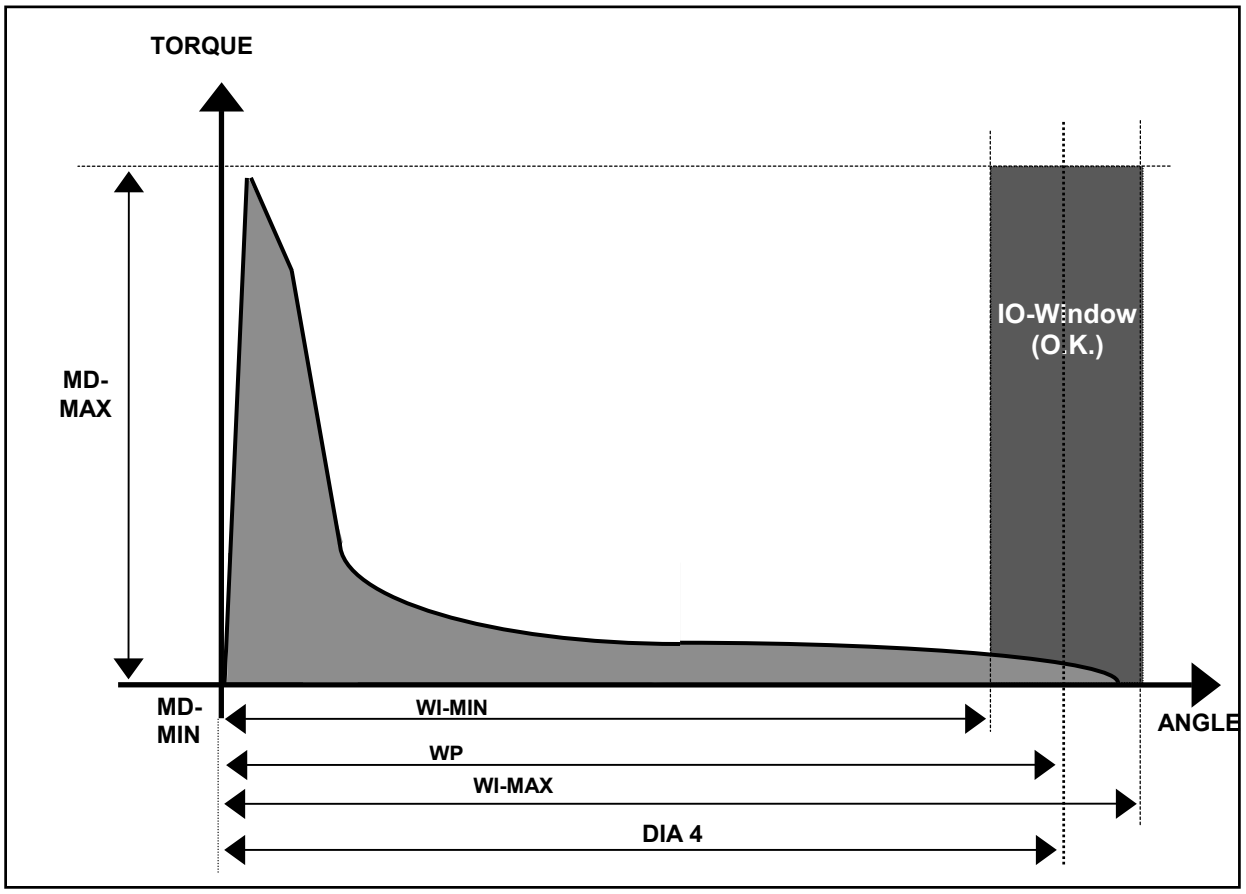
Parameters used in Screwdriving Diagram 3 (DIA3):

MS, MP, MD-MIN, MD-MAX, WI-MIN, WI-MAX, Drehzahl (Speed), Strom (Voltage), T-Schraub (Screwdriving Time), T-Nachlauf (Lag Time)

4. TERMINAL PROGRAM

INPUT PARAMETER-SET OF SCREWDRIVING DIAGRAM 4 (DIA4)

Loosening Process with:
- Shut-Off at Angle
- Check Torque



This illustration shows the loosening of an assembly.

4. TERMINAL PROGRAM

INPUT PARAMETER-SET OF SCREWDRIVING DIAGRAM 4 (DIA4)

Loosening Process with:
- Shut-Off at Angle
- Check Torque

SEQUENCE:

- At the beginning of the loosening process, the screwdriving time T-SCHR starts.
- During the loosening process, the AST-controller carries out cyclical torque and angle
- measurements.
- The Spindle shuts-off when:
  - The shut-off angle WP is reached or
  - The maximum torque MD-MAX is reached or
  - The screwdriving time T-SCHR expires

The assembly process is considered **IO (O.K.)** if:

- The actual shut-off angle is within the IO (O.K.)-Window, which means:
  - between WI-MIN and WI-MAX and
  - below the MD-MAX and
    within the screwdriving time T-SCHR

The assembly process is considered **NIO (Not O.K.)** if:

- The actual shut-off angle is outside the IO (O.K.)-Window, which means:
  - outside WI-MIN and WI-MAX or
  - over the MD-MAX or
    outside the screwdriving time T-SCHR

Parameters used in Screwdriving Diagram 4 (DIA4):

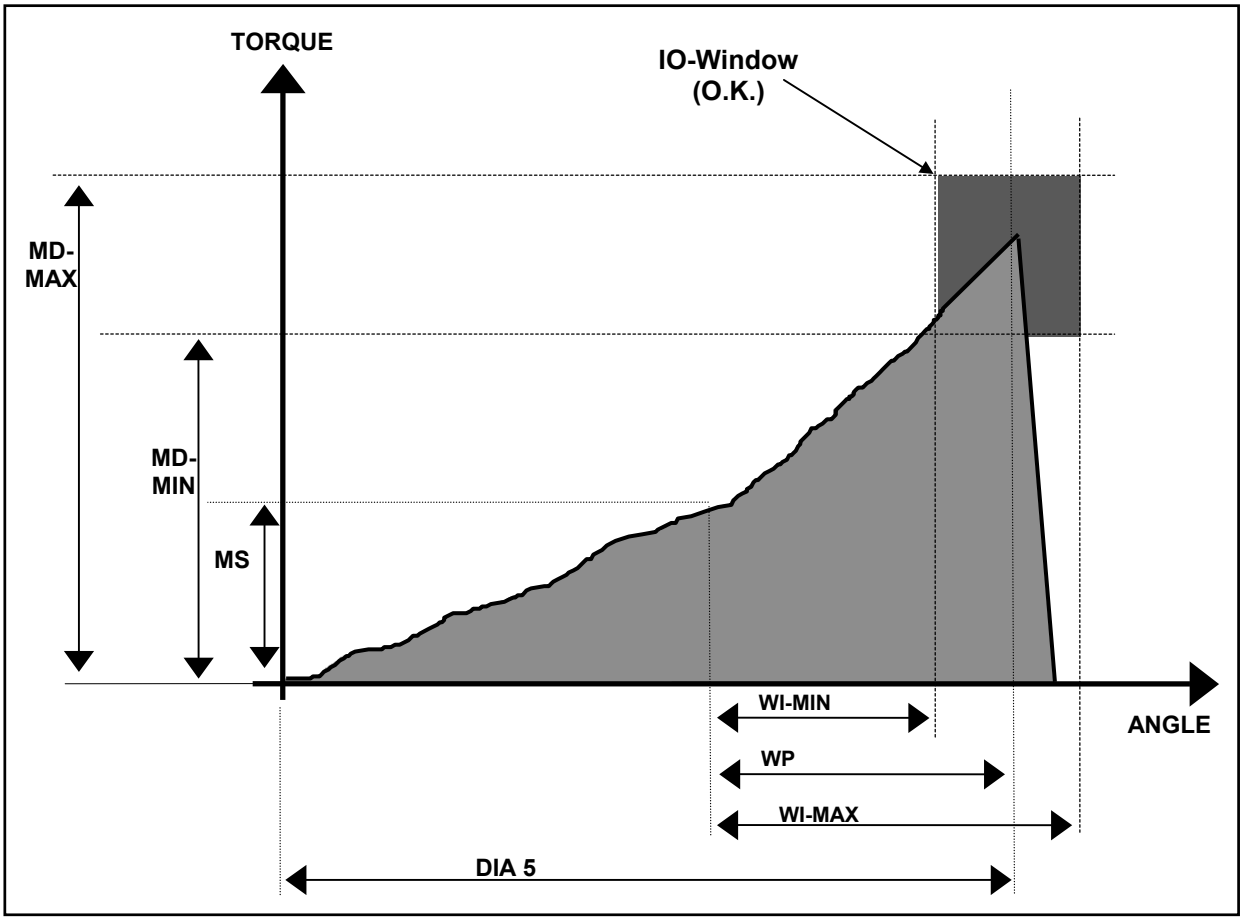
MD-MIN, MD-MAX, WP, WI-MIN, WI-MAX, Drehzahl (Speed), Strom (Voltage), T-Schraub (Screwdriving Time), T-Nachlauf (Lag Time)

4. TERMINAL PROGRAM

INPUT PARAMETER-SET OF SCREWDRIVING DIAGRAM 5 (DIA5)

Screwdriving Diagram 5	(DIA5)	Tightening in Right-Rotation
Screwdriving Diagram 51	(DIA51)	same as DIA5, however the tightening is done in left-rotation.

Tightening Process with:
- Shut-Off at Angle
- Check Torque



This illustration shows the a one-step tightening process.

4. TERMINAL PROGRAM

INPUT PARAMETER-SET OF SCREWDRIVING DIAGRAM 5 (DIA5)

Screwdriving Diagram 5	(DIA5)	Tightening in Right-Rotation
Screwdriving Diagram 51	(DIA51)	same as DIA5, however the tightening is done in left-rotation.

Tightening Process with:
- Shut-Off at Angle
- Check Torque

SEQUENCE:

- At the beginning of the tightening step, the screwdriving time T-SCHR starts.
- During the assembly, the AST-controller carries out cyclical torque measurements
- Starting at the threshold torque MS, the AST-controller carries out angle measurements
- The Spindle shuts-off when:
  - The shut-off angle WP is reached or
  - The maximum torque MD-MAX is reached or
  - The Screwdriving Time T-SCHR expires.

The assembly process is considered **IO (O.K.)** if:

- The actual shut-off angle is within the IO (O.K.)-Window, which means:
  - between WI-MIN and WI-MAX and
  - between MD-MIN and MD-MAX and
    the screwdriving time T-SCHR has not expired.

The assembly process is considered **NIO (Not O.K.)** if:

- The actual shut-off angle is outside the IO (O.K.)-Window, which means:
  - outside WI-MIN and WI-MAX or
  - over the MD-MIN and MD-MAX or
    the screwdriving time T-SCHR has expired.

Parameters used in Screwdriving Diagram 5 (DIA5):

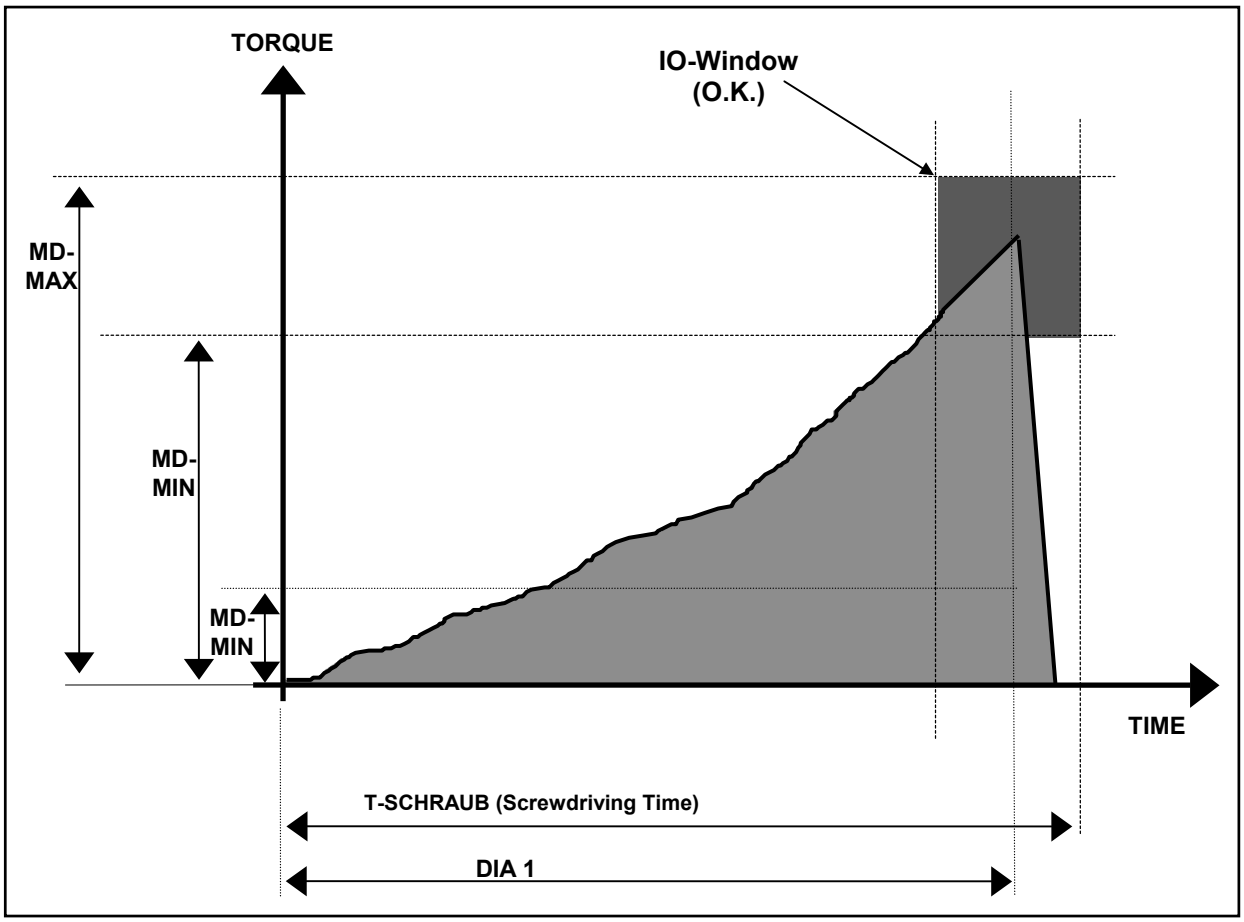
MS, MD-MIN, MD-MAX, WP, WI-MIN, WI-MAX, Drehzahl (Speed), Strom (Voltage), T-Schraub (Screwdriving Time), T-Nachlauf (Lag Time)

4. TERMINAL PROGRAM

INPUT PARAMETER-SET OF SCREWDRIVING DIAGRAM 1 (DIA1)

Screwdriving Diagram 1 (DIA1) Tightening in Right-Rotation

Tightening Process with:
- Shut-Off over Input 4
- Check Torque
- Emergency Shut-Off at MD-MAX



This illustration shows the a one-step tightening process.

4. TERMINAL PROGRAM

INPUT PARAMETER-SET OF SCREWDRIVING DIAGRAM 1 (DIA1) - OPTIONAL

SEQUENCE:

- At the beginning of the tightening step, the screwdriving time T-SCHR starts.
- During the assembly, the AST-controller carries out cyclical torque measurements
- The Spindle shuts-off when:
  - A signal is set at input 4
  - The Screwdriving Time T-SCHR expires.

The assembly process is considered **IO (O.K.)** if:

- The actual shut-off torque is within the IO (O.K.)-Window, which means:
  - between MD-MIN and MD-MAX and within the screwdriving time T-SCHR.

The assembly process is considered **NIO (Not O.K.)** if:

- The actual shut-off torque is outside the IO (O.K.)-Window, which means:
  - outside MD-MIN and MD-MAX or
  - outside screwdriving time T-SCHR.

Parameters used in Screwdriving Diagram 1 (DIA1):

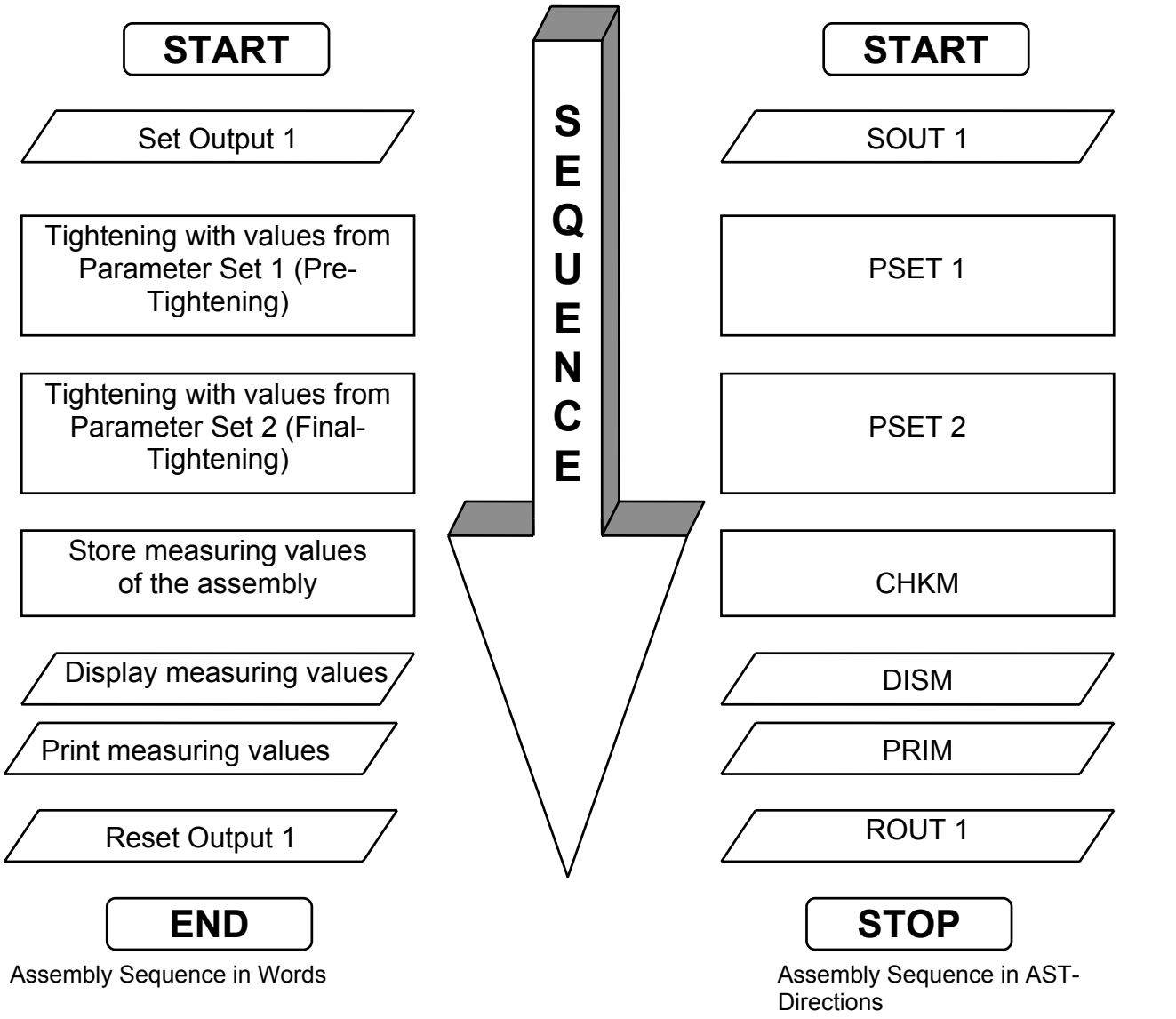
MD-MIN, MD-MAX, Drehzahl (Speed), Strom (Voltage), T-Schraub (Screwdriving Time), T-Nachlauf (Lag Time)

4. TERMINAL PROGRAM

PROGRAMS - GENERAL INFORMATION

What is a Program?

A program is a list of instructions to determine how the assembly process should run.
If a program is started, the instructions are being followed in sequence.
If a tightening- or loosening process is necessary, input the number of the parameter-set, with which the spindle should run.
Because of this, multiple screwdriving-steps are possible, with up to 10 different tightening- or loosening steps, as shown below:



Assembly Sequence in Words

Assembly Sequence in AST-Directions

4. TERMINAL PROGRAM

PROGRAMS - GENERAL INFORMATION

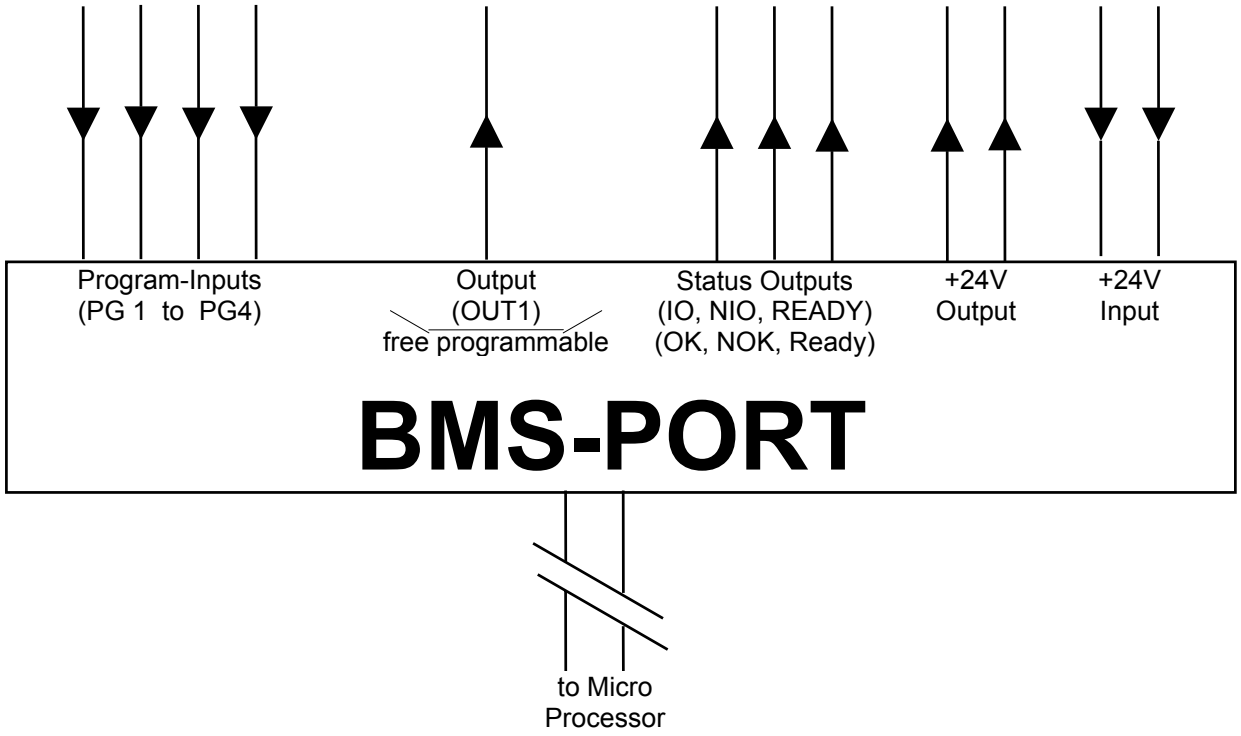
A program is not just limited to the recall of parameter sets. It offers the user the possibility to arrange the assembly process in the best practical way.
This is possible because of the following functions:

- Set/Reset Output
- Read Input Conditions
- Time Interval
- Branching into other Programming Sentences
- Repeating Loops
- Intermediate Storage of Measuring Values
- Statistics of Measuring Values
- Display Measuring Values
- Print Measuring Values

The output OUT1 (24V; 0.5 A) can be customized for other purposes.

THE BMS-PORT

The connection between the AST-controller and the “Outside” (i.e. PLC) is possible through the BMS-Port (BMS = Operational-Control Port)



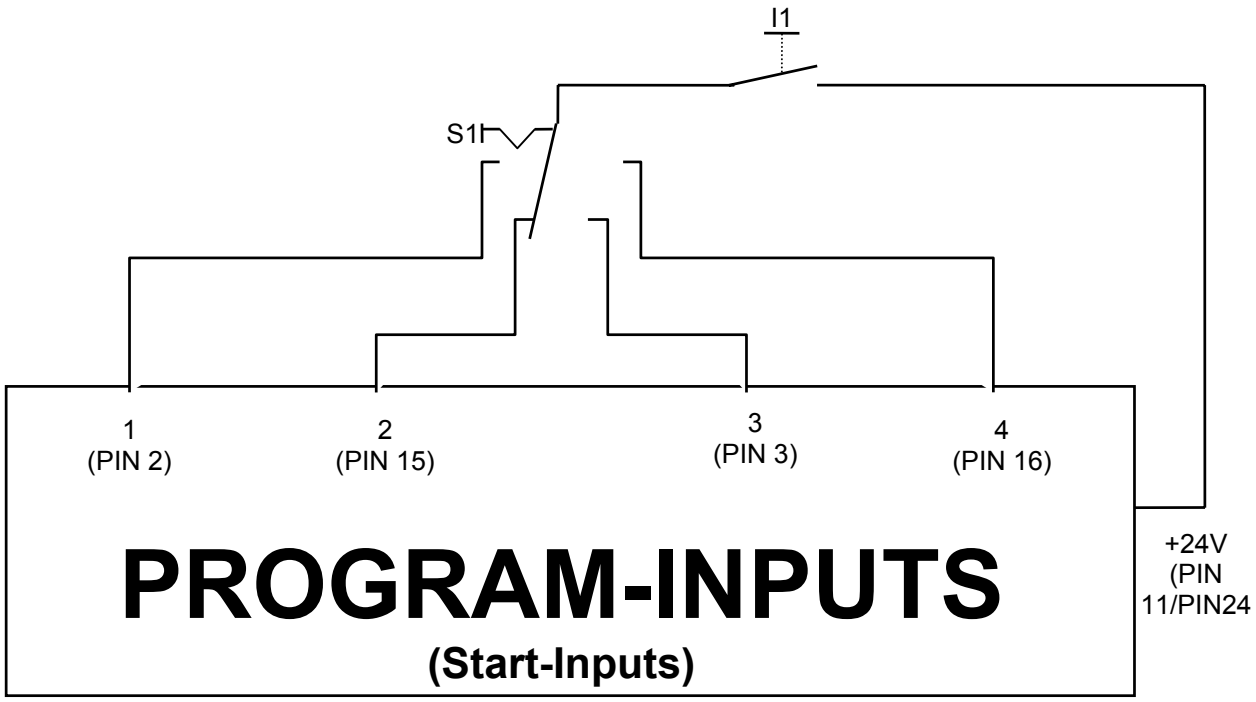
4. TERMINAL PROGRAM

PROGRAMS - GENERAL INFORMATION

Program-Inputs

The 4 programs are started, by means of program-inputs PG 1 to PG 4.

If program 2 has to be started, a +24V signal has to be given to program-input 2. This signal can be provided by the internal voltage source or from an external voltage source, such as an output of a PLC.



If the internal +24V voltage is used (as shown in above diagram), for the controlling of the program inputs, the 0V of the supply voltage (PIN12/PIN25) has to be bridged with the 0V of the program inputs (PIN1/PIN14)
Note: The complete pin-layout of the BMS-port can be found under paragraph “Lay-Out”.

The above illustration shows a simple circuit of the program-inputs.

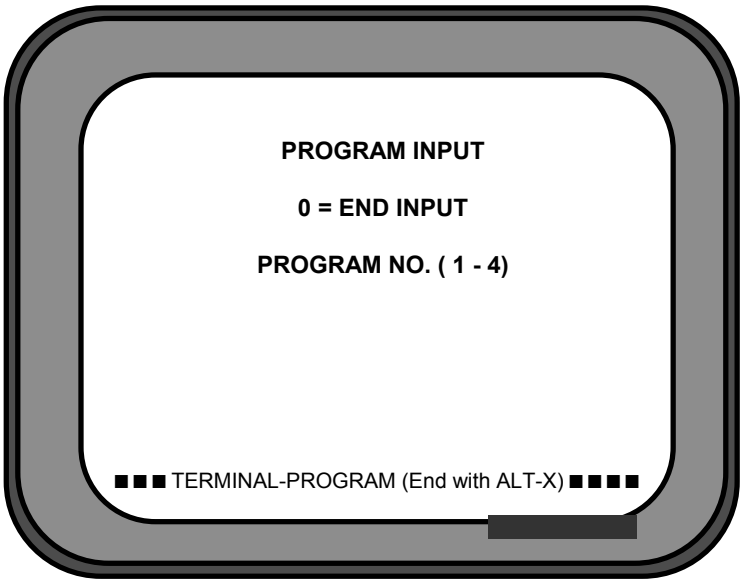
With the selector switch S1, one of the 4 programs can be selected. If solely the button T1 is activated, the AST-controller starts with the process of the selected program.
T1 has to remain activated, until the program is completed. If T1 is released prior to program completion, the AST-controller stops and indicates an error.

On the next Pages we explain the program structure and the individual programming commands.

4. TERMINAL PROGRAM

INPUT PROGRAM

Prior to creating a program, the exact screwdriving sequence has to be clarified. The next step is the inputting of factors and the needed parameter-sets. Then input the program.



PROGRAM SELECTION

- Programs can only be selected, when the AST-controller is operational, i.e. the START-Message is being displayed, or a system error occurs.

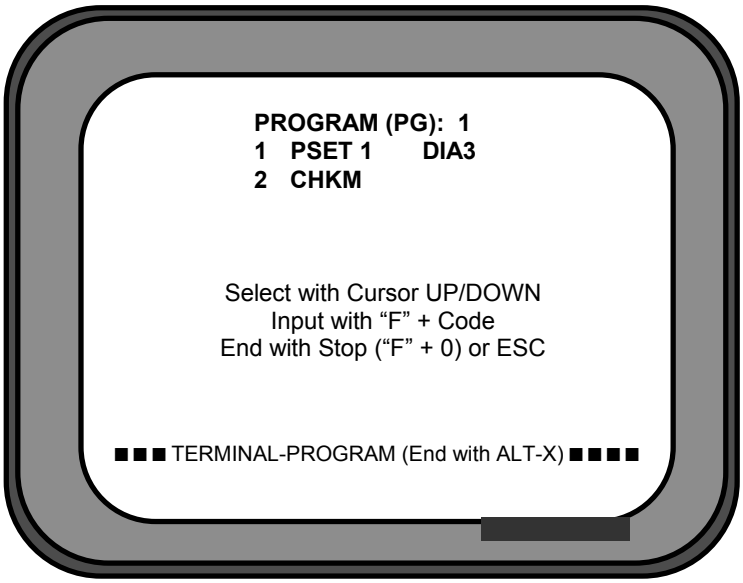
- If the access-control is activated, the AST-controller asks for an access number. This access number has to be input and confirmed by pressing the Enter key.

- Insert into the Selection Menu 'PROGRAM INPUT" the number of the required program (1 - 4), and confirm by pressing the Enter key.

- The Program is being displayed (see Page 46)

4. TERMINAL PROGRAM

INPUT PROGRAM



Input/Change a Programming Command

- Scroll to the needed program sentence, using the Cursor-Keys
- Each programming command has a certain number, the so-called **Command Number** attached. On Page 49, all commands and their corresponding **Command Number** are listed. To input a command:
    - Press Key **F**
    - The screen displays the message FUNC?.
    - Input the Command-Number of the required command and press the Enter Key.
    - The command is being displayed.

* Some program commands consist of the actual command and a number value, for example: the delay time command TIME 500.

  If only the number-value has to be changed and not the command itself, proceed as follows:

    - Input the new number-value and press the Enter key.
    - The old number-value will be overwritten by the new one.

4. TERMINAL PROGRAM

INPUT PROGRAM

Delete a Program-Sentence

- Scroll to the program sentence to be deleted, using the Cursor-Keys UP/DOWN
- Press Key **F**
- The screen displays the message FUNC?.
- Use the Cursor-Key UP
- The program sentence was deleted, all other program sentences move back one spot.

Please refer to the **"NOTE"** shown below!

Insert a Program-Sentence

- Scroll to the program sentence where one sentence has to be inserted, using the Cursor-Keys UP/DOWN
- Press Key **F**
- The screen displays the message FUNC?.
- Use the Cursor-Key DOWN
- A program sentence is inserted, all other program sentences move back one spot.

Please refer to the **"NOTE"** shown below!

Search for a Program-Sentence x

- Press Key **F**
- The screen displays the message FUNC?.
- Use the Cursor-Key RIGHT
- The screen displays the message ZEILE????
- Input the line number of the required program sentence and confirm by pressing the Enter Key. The desired program sentence is being displayed.

"NOTE" **When inserting or deleting a program sentence, any Jump-Command with sentence number indicated, will not be accepted. Those Jump-Commands have to be implemented later "manually".**

4. TERMINAL PROGRAM

INPUT PROGRAM

Delete an actual Program

- Press Key **F**
- The screen displays the message FUNC?.
- Use the Cursor-Key LEFT
- The message PROG.LOESCHEN???? (PROGRAM DELETE???)
  1 = JA (=YES) is displayed

NOTE: If a 1 is input, the program is deleted and cannot be restored.

- If the Program should not be deleted, press Enter Key.

Exit the Program

- Check all commands if they are correct.
- Press **ESC** Key
- You will exit the program.
- Another program can be selected.
- Insert 0 and confirm by pressing the Enter Key.
- All 4 Programs will be stored.
- If the inserted Program should not be stored, press the Reset-Key on the AST-controller.

The screen displays the START-Message. You can now continue with the Operation of the AST-Controller.

4. TERMINAL PROGRAM

LISTING OF PROGRAMMING COMMANDS

COMMAND	COMMAND-NUMBER	EXPLANATION
STOP	**0**	End Program
PSET x	**1**	Assemble with Parameter-Set x
SOUT1	**3**	Set Output 1
ROUT1	**4**	Reset Output 1
TIME x	**5**	Wait x Milli-Seconds (x = 1 to 30000)
Jump x	**6**	Jump to Sentence x
JNOK x	**7**	If Not O.K. (NIO), jump to Sentence x
JOK x	**8**	If O.K. (IO), jump to Sentence x
CHKM	**9**	Store the Measuring Values of the last assembly stage
STAT	**10**	Record the Measuring Values of the last assembly stage and process them statistically
REPT x	**11**	Repeat this part of the program x-times (after REPT a jump-command is necessary!)
NOP	**12**	Reserve space for a command
HALT	**13**	Pause until the input of the active program is reset and then once more set
DISM	**14**	Display the Measuring Values, which were stored with the CHKM command
PRIM	**16**	Print the Measuring Values, which were stored with the CHKM command
CLON	**17**	Activate the Clutch
CLOF	**18**	De-activate the Clutch
CONT x	**19**	The cycle counter will be reduced by 1 for each assembly (Optional)
OFFT	**20**	Offset-Test and equalization

4. TERMINAL PROGRAM

LISTING OF PROGRAMMING COMMANDS

STOP **Program-End**
COMMAND-Number: 0

The STOP-command determines the program end.
The following functions are processed:

- The AST-controller evaluates the measuring values of the last assembly process, which have been stored with the last CHKM command.
  If the Assembly is evaluated as IO (O.K.), the IO-Output of the BMS-Port will be set and the OK-LED on the AST-controller lights up. Accordingly, if the Assembly is NIO (Not O.K.), the BMS-port will be set and the NIO (Not O.K.) LED lights up.

- If a spray paint-timer is input, the Output 1 is set for this time

Each Program has to be ended with the STOP-Command.

PSET x **Assemble with Parameter-Set x**
COMMAND-Number: 1

The PSET-Command initiates one Assembly-Step.
The Spindle is controlled by the values of the indicated parameter-sentence x.
If the PSET-Command and a Parameter-Set-Number is input, the actual screwdriving diagram will be displayed automatically.
Prior to inputting a PSET-Command, confirm that the selected parameter-set has the correct data.

4. TERMINAL PROGRAM

LISTING OF PROGRAMMING COMMANDS

SOUT1 **Set Output 1**
COMMAND-Number: 3

With this Command, the output 1 will be activated.

Output 1 will remain activated, until reset by a ROUT- or STOP-Command.

ROUT1 **Re-Set Output 1**
COMMAND-Number: 4

With this Command, the output 1 will be re-set.

TIME x **Wait x Milli-Seconds**
COMMAND-Number: 5

With this Command, the AST-controller will wait for a required time period x.
When the time period has expired, the program operation will continue.
Input Range from 1 ms to 32000 ms

JUMP x **Jump to Program Sentence x**
COMMAND-Number: 6

With this Command, a jump to a program sentence x is made.
The program operation will continue from this point forward.
Jumps are only possible within the programs, i.e. jumps past the STOP-Command are not possible.

JNOK x **If NIO (Not O.K.), jump to Sentence x**
COMMAND-Number: 7

With this Command, a jump to a program sentence x is made, provided that the previous assembly process was NIO (Not O.K.).
Prior to initiating the JNOK-Command, it is not necessary to store the measuring values with the CHKM-Command.

4. TERMINAL PROGRAM

LISTING OF PROGRAMMING COMMANDS

JOK x **If OK (IO), jump to Sentence x**
COMMAND-Number: 8

With this command, a jump to a program sentence x is made, provided that the previous assembly process was IO (O.K.).
Prior to initiating the JOK-command, it is not necessary to store the measuring values with the CHKM-Command.

CHKM **Store the Measuring Values of the last Assembly**
COMMAND-Number: 9

With this Command, the measuring values of the preceding assembly process are stored.
At program end, the IO/NIO (O.K./Not O.K.) values of the last, by the CHKM-Command, stored assembly process will be evaluated.
A CHKM-Command is also necessary, if the measuring values of an assembly-process need to be displayed by the DISM-command or printed by the PRIM-command.

STAT **Record the Measuring Values of the last Assembly-Step and process them statistically**
COMMAND-Number: 10

With this Command, the measuring values of the last assembly step are added to the current values in the statistics storage.
A comparison is made if the actual measuring value is larger than the current one or smaller.
If one of those two cases apply, the actual (minimum or maximum) measuring value will be stored as the new value.
The result of this evaluation can be either printed or deleted in the statistical menu after program end.
Prior to initiating the STAT-Command, it is not necessary to store the measuring values with the CHKM-Command.

4. TERMINAL PROGRAM

LISTING OF PROGRAMMING COMMANDS

REPT x **Repeat part of the program x-times**
COMMAND-Number: 11

If part of a program has to be repeated x-times, a REPT-Command has to be programmed. This REPT-Command has to be inserted at the end of the program to be repeated. "x" has to be the number of repetitions. After the REPT-Command, it is necessary, to insert a JUMP-Command with program sentence-number, to indicate at which program part the repetition has to start.

NOP **Reserve Space for a Command**
COMMAND-Number: 12

The NOP-Command functions as a space-reservoir, which can be replaced with a different command, if needed. The NOP-Command has no function in the actual program operation.

HALT **Pause until the input of the active program group is reset and then once more set**

COMMAND-Number: 13
(when SA-MODE 0)

With the HALT-Command, the AST-System "delays" the program operation until such a time when the +24V-Signal (Start) on the input of the active program is removed and then set once more.

HALT
COMMAND-Number: 13
(when SA-MODE 1)

With this HALT mode, an additional evaluation of the screwdriving results occurs. The min - max LED's are being set according to the last assembly and the IO (O.K.) / NIO (Not O.K.) display light blinks in a 500 ms rhythm.

DISM **Display the Measuring Values, which were stored with the CHKM command**

COMMAND-Number: 14

The DISM-Command shows the measuring values of the last assembly on the display, which were stored with the CHKM-Command.

4. TERMINAL PROGRAM

LISTING OF PROGRAMMING COMMANDS

PRIM **Print the Measuring Values, which were stored with the CHKM command**

COMMAND-Number: 16

The PRIM-Command prints the measuring values of the last assembly, which were stored with the CHKM-Command.

CONT x **Cycle Counter (n = 1 ..... 32000) Optional**

COMMAND-Number: 19

With this command, a cycle counter is activated. For each run through this command, the counter will be reduced by 1 and the system will jump into the next program sentence. When the count goes down to 0, the counter will be re-loaded and the system jumps to the 2nd next program sentence.

Example:

1	PSET1 DIA3	Assembly with PSET1 (for example)
3	CHKM	Store the Measuring Values of the Assembly
4	DISM	Display the Measuring Values on the Display
5	CONT10	Set Cycle Counter (n = 10)
6	JUMP1	Jump to Program Sentence i.e. 1
7	STOP	End Program

OFFT **Offset-Test and Equalization**

COMMAND-Number: 20

The OFFT-Command initiates an Offset-Test and an equalization of the Spindle. It is recommended to insert the OFFT-Command at the beginning of a program.

4. TERMINAL PROGRAM

PROGRAMMING EXAMPLES

The following program examples should help to learn the programming of the AST-System in an simple and fast way. They also show Solutions for complex programs.

1. Example: One-Step Tightening with IO/NIO (O.K./Not O.K.) Evaluation

A fastener has to be tightened to a certain torque and then evaluated whether this assembly was IO (O.K.) or NIO (Not O.K.).

Note: It is assumed that the AST-controller, Power Supply, Spindle and Printer is connected and operational. More details to this subject can be found in the paragraph (Equipment View)

Procedure: First, determine how many parameter sets and what screwdriving diagrams are required for the assembly.
Since this example shows a one-step assembly, only one parameter set is required.
The Screwdriving diagram DIA2 is best, since the shut-off has to be when torque is reached.
Now, select a parameter set which is "free", which means the set is not needed by another program. Input into this parameter set the screwdriving diagram number and all other values, i.e. shut-off torque-, voltage- and speed, etc. As soon as this is done, store the parameter set.

Now, the actual programming can start. Select out of the 4 programs an "empty" one, respectively one that is no longer needed and input the following commands:

1	PSET*x DIA2
2	CHKM
3	STOP

* x is the number of the inserted parameter set

4. TERMINAL PROGRAM

PROGRAMMING EXAMPLES

Explanation to Program:

Sentence 1:	The Spindle starts and is controlled by the values of parameter set x. When the shut-off torque is reached, the spindle will shut-off.
Sentence 2:	The Measuring Value of the Assembly is stored into a buffer.
Sentence 3:	The stored measuring values are compared to the limit values of the parameter set. If the measuring value is within both limit values, the assembly is deemed IO (O.K.), otherwise as NIO (Not O.K.) The corresponding status-outputs and -displays are set. The program finishes and the AST-controller is again ready.

To start a program, give a +24V Signal to the corresponding program input on the BMS-port. This signal needs to stay on, until the program has completely finished and the AST-controller is again ready.

4. TERMINAL PROGRAM

PROGRAMMING EXAMPLES

2. Example: Two-Step Tightening with IO/NIO (O.K./Not O.K.) evaluation and display of measuring values to AST-Display and Printer

During the first assembly stage, a fastener is tightened with high speed to a certain torque, without checking angle.
During the 2nd assembly stage, the fastener is tightened with slow speed to the final torque with simultaneously checking angle. Afterwards, the measuring results are displayed on the AST-display and printed. An IO (O.K.) and NIO (Not O.K.) evaluation will be done.

Program 1	
1	PSET x DIA2
2	TIME 500
3	PSET y DIA3
4	CHKM
5	DISM
6	PRIM
7	STOP

Program 2	
1	PSET x DIA4
2	TIME 500
3	PSET y DIA5
4	CHKM
5	DISM
6	PRIM
7	STOP

Explanation to Program:

This example requires 2 parameter sets, namely PSETx with screwdriving diagram 2 for the first assembly stage and PSETy with screwdriving diagram 3 for the 2nd assembly stage.

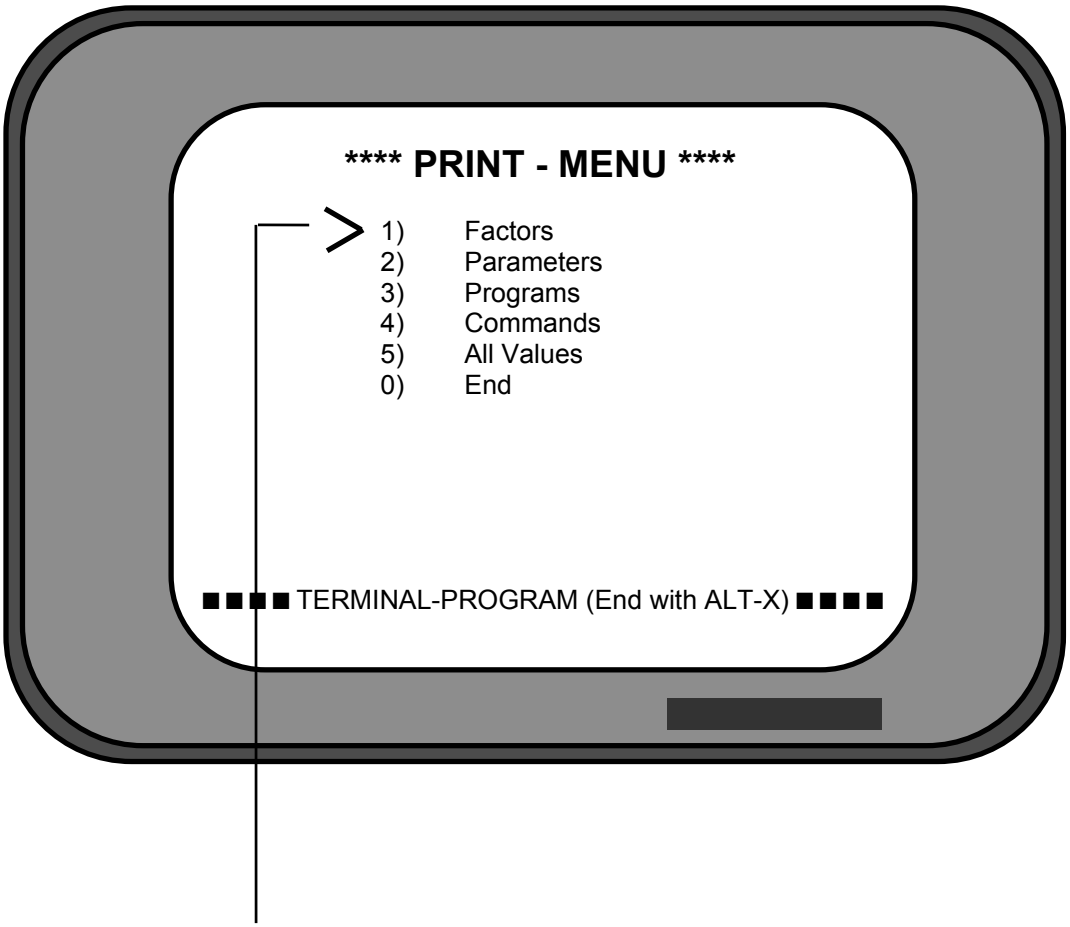
Sentence 1:	The Spindle starts and is controlled with the values from parameter set x. (1st Assembly Stage)
Sentence 2:	Wait for 500 ms. (This waiting period is only needed if a mechanical clutch in the spindle has to be reversed, in-between the two assembly steps.)
Sentence 3:	The Spindle starts and is controlled with the values from parameter set y. (2nd Assembly Stage)
Sentence 4:	The Measuring Value of the 2nd Assembly is stored.
Sentence 5:	The Measuring Values of the 2nd Assembly are shown on the AST-Display.
Sentence 6:	The Measuring Values of the 2nd Assembly are printed
Sentence 7:	IO (O.K.) and NIO (Not O.K.) evaluation of the 2nd assembly step; setting of status-outputs and status-displays; end of program.

4. TERMINAL PROGRAM

PRINT PARAMETERS

With the AST-System's Menu "PRINT PARAMETER", it is possible to print parameters, programs or commands.
To change into the Print-Menu, input 4 into the main menu and press the Enter key.

The following menu appears:



Select the required menu point, using the UP/DOWN cursor keys and confirm with Enter key.

It is also possible to directly input the number of the required menu point. Then press the Enter key.

4. TERMINAL PROGRAM

PRINT PARAMETERS

to 1: All Factors of the AST System are being printed

to 2: The parameter set, that needs be printed, can be selected. However, a printout is only possible, if parameter set contains a correct screwdriving number (DIA2, DIA3, DIA4, DIA5 or other Options)

to 3: The program, that needs be printed, can be selected. However, a printout is only possible, if the first program sentence does not contains a STOP-Command.

to 4: All commands with corresponding COMMAND-Numbers and a short-description is printed out.

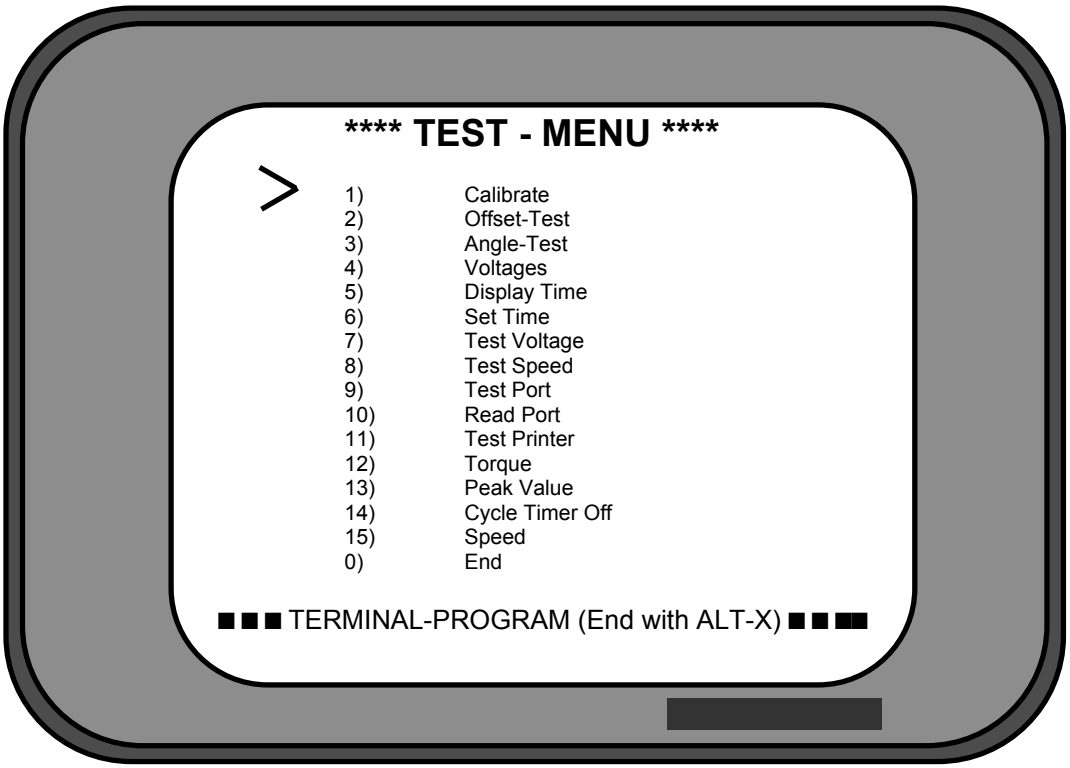
to 5: All items (factors, parameter-sets, programs and commands) are printed in sequence.

to 0: Exit the PRINT-MENU; the AST-System is again operational.

4. TERMINAL PROGRAM

TEST MENU

The Test-Menu offers the possibility to check the AST-controller and the hardware (spindle, power supply, printer...), in regards to their function and accuracy. Operational errors can be analyzed or at least recognized, by the user.



Selection of Test Menu

The Test-Menu can only be selected, if the AST-system is operational, i.e. the Start-Message has been displayed or a system-error occurs.

- **Select Point 5 (TEST-MENU) in the Main Menu and press Enter Key**
- **All Menu-Points 1 - 15 are displayed, together with a Selection Arrow.**

Selection of Menu Point

- **Select the required menu point (arrow) , using the UP/DOWN cursor keys and confirm setting with the Enter key.**

- **It is also possible to directly input the number of the required menu point. Then press the Enter key.**

- **The selected Menu-Point is shown on the screen.**

4. TERMINAL PROGRAM

TEST MENU

Exit Text-Menu

- **Move the arrow to 0 , using the UP/DOWN cursor keys and confirm setting with the Enter key.**
- **It is also possible to directly input directly the number 0. Then press the Enter key.**
- **The Test-Menu will be exited and the screen displays the START-message. The AST-controller is ready.**

4. TERMINAL PROGRAM

TEST MENU

With the following two Menu-Points, the function of the Spindle can be checked. To receive correct results, spindle should not be under load.

1) Calibration

The calibration value of the Transducer will be detected by the AST-controller and displayed on the screen.
This value should not differentiate by more than +/- 5% from the loaded calibration factor.

2) Off-Set Test

The right and the left Off-Set value will be received by the AST-controller and displayed on the screen.
Those values should be within the range of 100 and 120.
A small difference within this range is allowable.

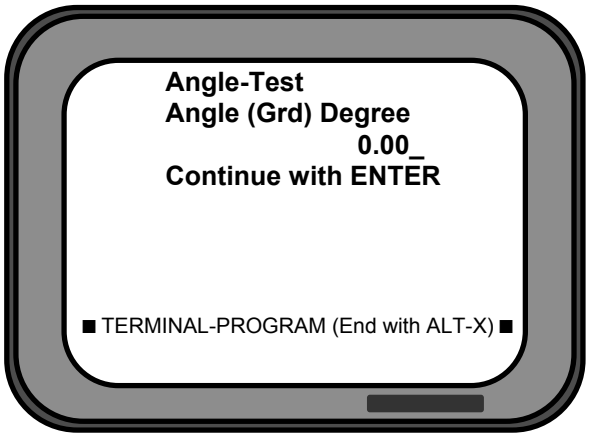
With the following test only the Spindle Angle-Transducer can be tested

3) Angle-Test

The degree counter will be reset to 0, when this option is selected.
When the drive shaft of the spindle is turned, the degree counter has to count the received angle impulses. After a full rotation of the shaft, the screen has to show a value of 360 Degree.

The degree counter has to display the degree value with a " - ", for left-rotation.

The Spindle starts when LEFT/RIGHT cursor keys are pressed.



4. TERMINAL PROGRAM

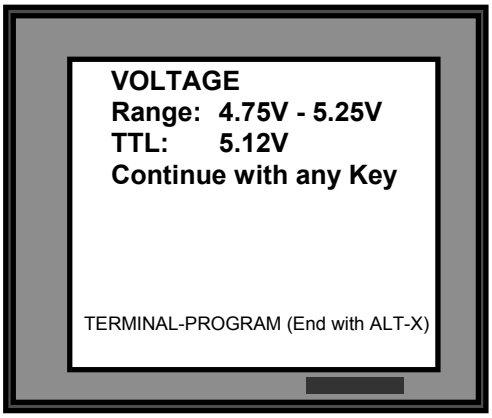
TEST MENU

With the following Option, the internal TTL=Supply voltage as well as the voltage for the transducer can be checked.

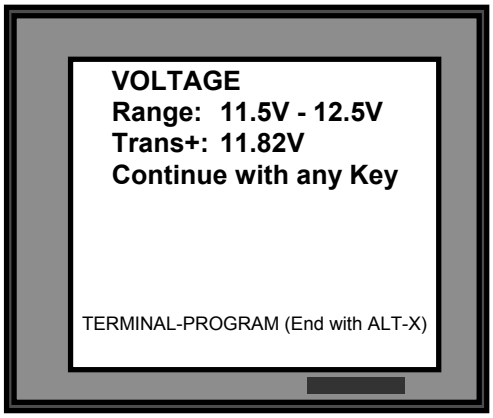
4) Voltage

The actual voltage values, as well as the corresponding tolerance ranges, are displayed:

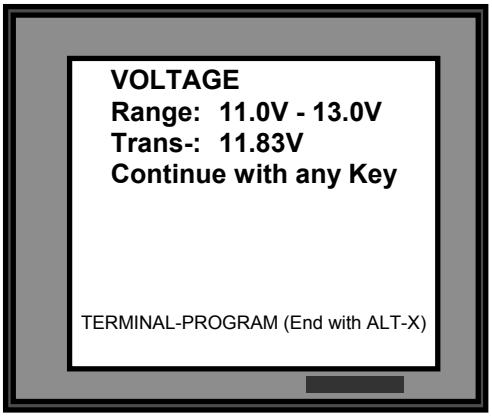
TTL-Supply Voltage	**(+ 4.75 V - - + 5.25V)**	**Picture 1**
Positive Transducer Voltage	**(+11.50 V - - +12.50V)**	**Picture 2**
Negative Transducer Voltage	**(-11.00 V - - -13.00V)**	**Picture 3**



Picture 1



Picture 2



Picture 3

4. TERMINAL PROGRAM

TEST MENU

5) Display Time

The actual Date and Time is displayed

6) Set Time

**To input Date (i.e. 25.07.1995 = July 25th) and Time (i.e. 07.45), continue as follows:
(always input two-digits)**

- **Day (25)**
- **Month (07)**
- **Year (95)**
- **Hour (07)**
- **Minute (45)**

When an error occurs during inputting data, re-start the whole entry!

The Current Test and the Speed Test allow a partial testing of the Power Supply and Spindle.

7) Current Test

**Provide Current I for the Spindle Motor in 1%-increments.
The adjustment is done with the LEFT/RIGHT cursor keys, whereby 0% corresponds with no current and 100% with the maximum current.**

When using the CW- or CCW-Button on the Power Supply and the motor does not start due to low current, the LED "I-MAX" has to light up on the power supply. (on newer design Power Supplies, the buttons CW and CCW are no longer active)

8) Speed Test

**Provide Speed N for the Spindle Motor in 1%- increments.
The adjustment is done with the LEFT/RIGHT cursor keys, whereby 0% corresponds with no speed and 100% with maximum speed.**

When using the CW- or CCW-Button on the Power Supply, the spindle can be tested in its entire speed range.

The default values of the current test apply also for the speed test. Furthermore, the default values of the speed test are valid for the current test.

4. TERMINAL PROGRAM

TEST MENU

With this Menu Option, the output-ports, as well as the LED's of the AST-System, can be checked.

9) Set Port

In sequence the following outputs can be set or re-set. To set the output, use RIGHT cursor key, to reset output, use The LEFT cursor key. To continue to the next output, use the DOWN cursor key

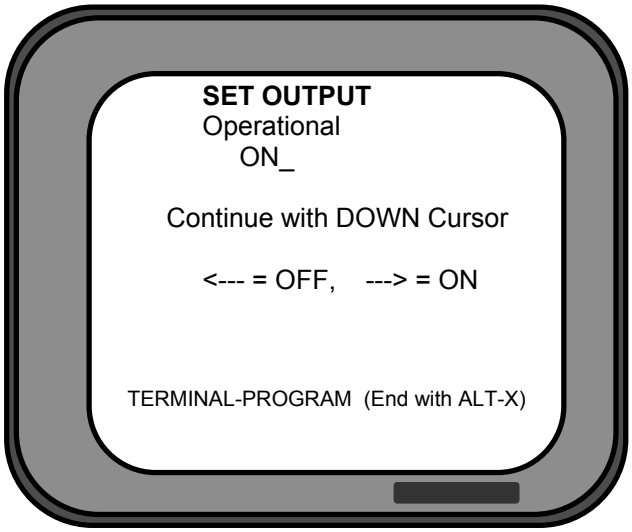
The corresponding BMS-port will be set/reset and the corresponding LED lights up/does not light up

READY	(Operational)
IO	(O.K.)
NIO	(Not O.K. / Error)
OUT1	(Output 1)

the corresponding LED lights up/does not light up

MD<	(Torque too small)
MD=	(Torque O.K.)
MD>	(Torque too large)
WI<	(Angle too small)
WI=	(Angle O.K.)
WI>	(Angle too large)

On the screen the corresponding output and its status (ON/OFF) is indicated.



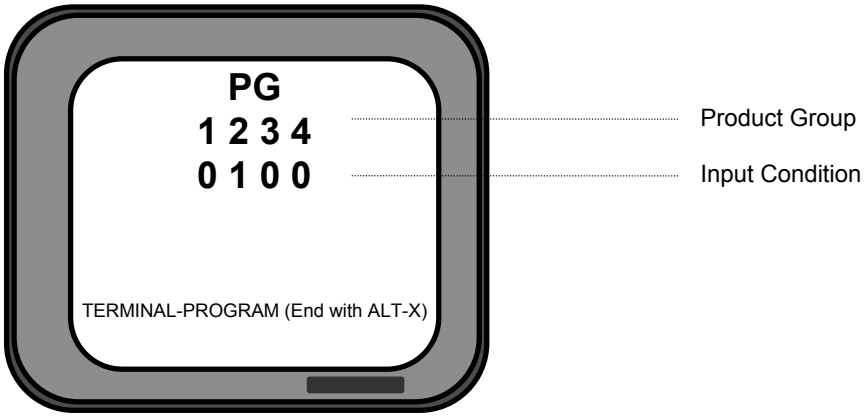
4. TERMINAL PROGRAM

TEST MENU

With this Menu Option, the INPUT-modules, as well as the LED's of the AST-System, can be checked.

10) Read Port

The Input-Ports (Product Group PG 1 - 4) of the AST-Controller are displayed on the screen.



If a +24V Signal is given to an input, then
- the corresponding Input-LED should light up on the AST-controller
- a "1" should be indicated on the screen for this input

If a 0V Signal is given to an input, or if the input is open, then
- the corresponding Input-LED should not light up on the AST-controller
- a "0" should be indicated on the screen for this input

11) Printer Test

A test print-out will be done by the connected printer.
If the printer is OFFLINE, which means not ready to receive, a jump back into the test menu occurs.

4. TERMINAL PROGRAM

TEST MENU

12) Torque

The AST-controller takes cyclical torque-measurements. The actual value is displayed. By pressing the RIGHT cursor-key or LEFT cursor key, the spindle starts.

13) Peak Value

The AST-controller takes cyclical torque-measurements. The highest torque value (peak value) is displayed.

14) Cycle Time On/Off

The cycle time is the time period requried by the AST-controller to complete one screwdriving program.
The On/Off is done with the Enter key

Cycle Time:

- ON → The cycle time will be printed after program end.

- OFF → The cycle time will not be printed.

This adjustment is being stored.

15) Speed

The actual Speed (100%) is displayed in rotations per minute.

Input = 1: Spindle Starts (End with Enter Key)
Input = 0: End (Return to Test-Menu)

0) End

Exit the TEST-MENU; the screen displays the START-message and the AST-controller is again ready.

4. TERMINAL PROGRAM

TEST MENU

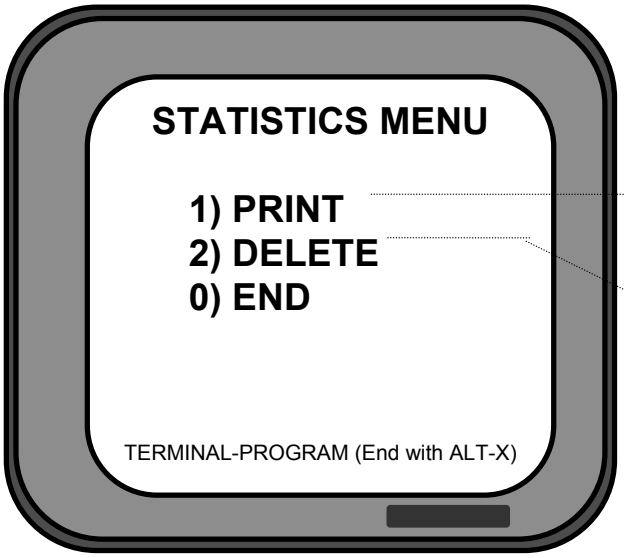
The AST-controller offer the possibility to statistically process an assembly-stage.
For example, the controller calculates an arithmetic average value plus a standard deviation, and stores the largest and smallest measuring values.
For each of the 4 programs, a statistics storage area is reserved. This storage area is permanent, which means the storage content does not get lost when the AST-controller is turned off.
A screwdriving stage can be processed statistically up to 32000-times.

The following Example shows, how a statistical process of a screwdriving stage is obtained:
.
.
In Program 4, the following two-step tightening process is input:

1	**PSET 5 DIA 2**
2	**PSET 9 DIA 3**
3	**CHKM**
4	**DISM**
5	**STOP**

A statistics for the measuring values of the 2nd tightening step has to be obtained.
After sentence 4, the STAT-Command has to be input:

1	**PSET 5 DIA 2**
2	**PSET 9 DIA 3**
3	**CHKM**
4	**DISM**
5	**STAT**
6	**STOP**



After several assemblies, the statistical data can be printed from the Statistics Menu.

The statistics menu allow the possibility to delete the statistical data storage of the corresponding program.

4. TERMINAL PROGRAM

TEST MENU

Example Printout of the Statistical Data