

NANOMAT-EC torque ranges between 0.02 - 0.12 Nm

MICROMAT-EC torque ranges between 0.03 - 0.8 Nm

MINIMAT-EC torque ranges between 0.15 - 25 Nm

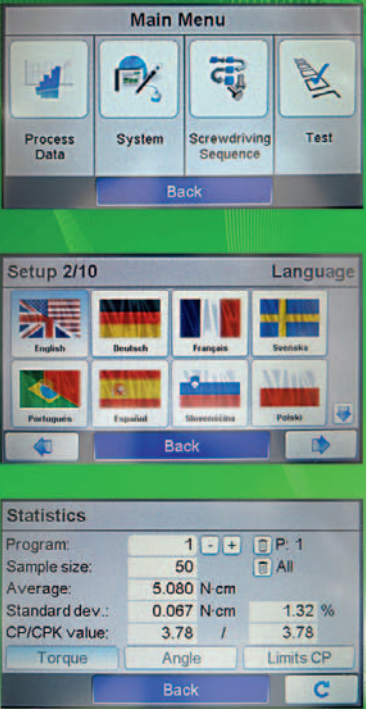
Screwdriver Spindles

The flexible EC screwdriver for the highest standards

- flexible
- documentation features
- high precision

The EC screwdriver spindle with brushless drive technology combined with the AST6 or AST11 screwdriver controller offers maximum flexibility and process control. The integrated torque and angle measurement system enables precise control of the screw assembly process and guarantees the highest accuracy and reliable documentation of important process parameters. Through the combination of different screwdriving strategies with flexible tightening parameters, multi step screw run-down sequences can be realised in one assembly cycle.

Screwdriver Spindles electric



Screwdriving System consisting of the components:

- EC Screwdriver Spindle
- Sequence Controller
- Motor cable
- Power supply cable



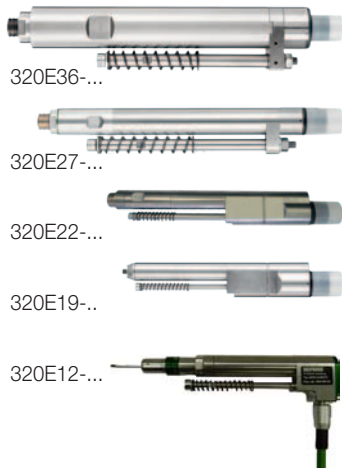
Controller AST6



Controller AST11

ADVANTAGES

DEPRAG EC SCREWDRIVER - the flexible EC screwdriver for the highest demands



The DEPRAG EC screwdrivers allow free programming of the screw tightening process. Within the power range of the selected tool, the torque value, speed, stand-by and direction of rotation can be adjusted individually to the assembly requirement.

Outstanding features of stationary EC screwdrivers are their high torque precision and the large range of control functions – perfect conditions for process security and control on highest level.

The brushless electric motors provide low maintenance operation. They are ideally suited for the tightening of screws due to their outstanding dynamics and an achievement of high peak torque values.

The integrated torque control - based upon precise measurement of the motor current along with the evaluation of other dynamic factors - as well as angle measurement, allows precise control of multistage screw-driving processes and documentation of the resulting values.

The DEPRAG screwdrivers based on EC technology enable a torque accuracy of < 2% standard deviation, which can be relied upon after millions of cycles.

Thus, a Cmk value of ≥ 1.67 with a tolerance requirement of $\pm 10\%$ in reference to 6 Sigma is reached.

A Cmk value of 1.67 means that the error rate is less than 0.6 per one million screw assemblies.

DEPRAG SEQUENCE CONTROLLER AST6 – compact size for torque ranges up to 2 Nm



AST6-1

- highest precision for lowest torque ranges
- small size for confined spaces
- colour touch screen with 4.3" TFT display
- torque control/angle monitoring
- angle control/torque monitoring
- tightening procedure using friction values
- 100 user-tagable sequence programs
- for stationary applications
- available communication ports: field bus, input/output



ASTi6-1 for the installation into a switch cabinet

The DEPRAG sequence controller AST6 is the ideal controller for stationary screw assemblies in combination with the tried and tested DEPRAG EC screwdrivers of the NANOMAT-EC, MICROMAT-EC and MINIMAT-EC (size 22) series within a torque range of 0.02 Nm – 0.2 Nm. When choosing the option ASTi6-1 for integration into the switch cabinet, the software panel DAST is required for operation and visualisation of the controller. In that case the system controller additionally provides the range of functions available on the AST6-1 display.

Operator friendly: The sequence controller already includes standard screwdriving programs for tightening to torque and loosening to angle. Parameters can be directly altered to suit screwdriving tasks using the touch screen. The AST6 allows free programming of your screwdriving sequences. When needed these can be made available from the integrated web server user interface, and efficiently and comfortably created and parameterized.

High number of programs: Use the colour TFT touch screen for fast access to the 100 programmable standard programs. Individual application profiles are free selectable using the program number or a user defined program name (tag).

Based on web browser: Use an established web browser or the touch screen to set parameters and access controller functions. Additional software is not required.

Small size: Due to its small size the controller is particularly suitable for stationary applications where there are confined spaces.

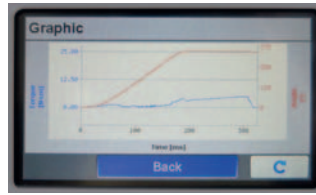
Storage, documentation and evaluation: The AST6 records the screwdriving results for the last 7 production days. Additional features include the graphic display of screwdriving graphs, integrated PLC functions, comprehensive analysis options and the option of combination with an automatic screw feeding machine.

A software update service is optionally available. Also available are comprehensive software packages for screw joint analysis, documentation and process data collection.

Examples of the functions display on the AST6



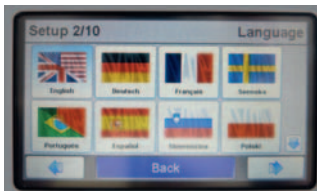
Main menu



Graphic display of screwdriving graphs



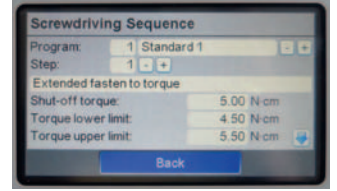
Statistics display



Language selection



Program selection



Program set-up

DEPRAG SEQUENCE CONTROLLER AST11 – flexible EC technology for the highest standards

- highest precision over the entire torque range
- torque control/angle monitoring
- angle control/torque monitoring
- friction-torque testing and friction-controlled fastening to torque
- 16 freely programmable sequence programs
- comprehensive analysis functions
- communication port: Ethernet - for parameterisation of the web server
- PLC: inputs/outputs
- integrated RS232 port with varied options:
 - 4 fieldbuses available: Profibus, Profinet, EtherCat, EthernetIP
 - direct connection of a barcode scanner
 - connection of a serial printer
- integrated functions for process control
- can be used in combination with DEPRAG feeders
- for manual and stationary applications



The DEPRAG controller AST11 is the ideal sequence controller for manual and stationary screw assemblies together with the tried and tested DEPRAG EC screwdrivers MICROMAT-EC and MINIMAT-EC.

Operator friendly: The sequence controller already includes standard screwdriving programs for tightening to torque and loosening to angle. Parameters can be directly altered to suit screwdriving tasks using the controller's keypad. The AST10 allows free programming of your screwdriving sequences for hand-held or stationary screwdriving tools. If required, further screwdriving programs can quickly and easily be set-up using the already existing basic program.

Freely programmable: Fast access to the 16 programmable screwdriving programs is enabled by the integrated display- and operating unit.

Based on web server: To set parameters and access additional control functions, simply use any common web browser or the integrated key pad. Additional software is not required.

Various communication options: Several communication options, especially for stationary use, via PLC and optionally RS232, Profinet, Profibus, EtherCat, Ethernet IP.

Saving, documentation and evaluation: The AST10 displays the screwdriving results of the last 7 production days. Additional software modules offer graphic display of screwdriving graphs, integrated PLC functions, comprehensive analysis options via a PC. Combination with an automated DEPRAG screw feeder is also possible. A software update service is optionally available.

Screwdriver spindle, Straight handle design			NANOMAT-EC, size 12		MICROMAT-EC, size 19			
Screwdriver		Type	320E12-00012 1)		320E19-0002	320E19-0005	320E19-0008	
		Part no.	420400B		405024A	405024C	405024B	
Torque	min.	Nm / in.lbs	0.02 / 0.18		0.03 / 0.27	0.08 / 0.7	0.15 / 1.3	
Torque	max. *)	Nm / in.lbs	0.12 / 1.06		0.2 / 1.8	0.5 / 4.4	0.8 / 7.1	
Speed	min.	rpm	120		150	60	100	
Speed	max. *)	rpm	1500		1500	1200	1000	
Diameter		mm / in.	17.5 / 0.68		19 / ¾	19 / ¾	19 / ¾	
Length		mm / in.	150 / 5.85		190 / 7 ³¹ /64	190 / 7 ³¹ /64	190 / 7 ³¹ /64	
Weight		kg / lbs	0.2 / 0.44		0.25 / 0.55	0.25 / 0.55	0.27 / 0.59	
Noise level		dB (A)	56		60	60	60	
Line voltage (DC)		V	24		48	48	48	
Internal hex. drive DIN ISO 1173			B3 (3 mm)		B3 (3 mm)	B3 (3 mm)	B3 (3mm)	
Suitable inserting tools and connection parts with inserting end DIN ISO 1173			A3 (3 mm)		A3 (3 mm)	A3 (3 mm)	A3 (3mm)	
Screwdriver spindle, Straight handle design			MINIMAT-EC, size 22		MINIMAT-EC, size 27			
Screwdriver		Type	320E22-00120	320E22-00200	320E27-0010-D	320E27-0018-D	320E27-0024-D	320E27-0042-D
		Part no.	420988D	420988E	416500B	416500H	416500C	416500D
Torque	min.	Nm / in.lbs	0.24 / 2.12	0.4 / 3.54	0.15 / 1.3	0.4 / 3.5	0.4 / 3.5	0.7 / 6.2
Torque	max. *)	Nm / in.lbs	1.2 / 10.62	2.0 / 17.7	1.0 / 8.85	1.8 / 15.9	2.4 / 21.2	4.2 / 37.2
Speed	min.	rpm	50	30	50	100	50	40
Speed	max. *)	rpm	900	550	1000	1000	700	400
Diameter		mm / in.	22 / 7/8	22 / 7/8	27 / 1 1/16	27 / 1 1/16	27 / 1 1/16	27 / 1 1/16
Length		mm / in.	202 / 7 ⁶¹ /64	202 / 7 ⁶¹ /64	254 / 9.9	251 / 9.8	251 / 9.8	263 / 10.3
Weight		kg / lbs	0.55 / 1.21	0.55 / 1.21	0.75 / 1.65	0.75 / 1.65	0.75 / 1.65	0.75 / 1.65
Noise level		dB (A)	60	60	60	60	60	60
Line voltage (DC)		V	24	24	48	48	48	48
Internal hex. drive DIN ISO 1173			F6.3 (1/4")	F6.3 (1/4")	B3 (3 mm)	F6.3 (1/4")	F6.3 (1/4")	F6.3 (1/4")
Suitable inserting tools and connection parts with inserting end DIN ISO 1173			E6.3 (1/4")	E6.3 (1/4")	A3 (3 mm)	E6.3 (1/4")	E6.3 (1/4")	E6.3 (1/4")
Screwdriver spindle, Straight handle design			MINIMAT-EC, size 36					
Screwdriver		Type	320E36-0040-D	320E36-0060-D	320E36-0090-D	320E36-0120-D	320E36-0180-D	320E36-0250-D
		Part no.	416600E	416600A	416600F	416600B	416600C	416600G
Torque	min.	Nm / in.lbs	0.8 / 7.1	1 / 8.85	2 / 17.7	2 / 17.7	3 / 26.6	5 / 44.25
Torque	max. *)	Nm / in.lbs	4 / 35.4	6 / 53.1	9 / 79.7	12 / 106.2	18 / 159.3	25 / 221.25
Speed	min.	rpm	100	70	50	35	25	20
Speed	max. *)	rpm	1000	740	550	380	280	220
Diameter		mm / in.	36 / 1 ²⁷ /64	36 / 1 ²⁷ /64	36 / 1 ²⁷ /64	36 / 1 ²⁷ /64	36 / 1 ²⁷ /64	36 / 1 ²⁷ /64
Length		mm / in.	298 / 11.6	298 / 11.6	298 / 11.6	298 / 11.6	298 / 11.6	298 / 11.6
Weight		kg / lbs	1.2 / 2.64	1.2 / 2.64	1.2 / 2.64	1.2 / 2.64	1.2 / 2.64	1.2 / 2.64
Noise level		dB (A)	60	60	60	60	60	62
Line voltage (DC)		V	48	48	48	48	48	48
Internal hex. drive DIN ISO 1173			F6.3 (1/4")	F6.3 (1/4")	F6.3 (1/4")	F6.3 (1/4")	F6.3 (1/4")	F6.3 (1/4")
Suitable inserting tools and connection parts with inserting end DIN ISO 1173			E6.3 (1/4")	E6.3 (1/4")	E6.3 (1/4")	E6.3 (1/4")	E6.3 (1/4")	E6.3 (1/4")

*) as per VDI/VDE 2647 Directive

1) The motor cable, 2.5 meters long, is solidly connected to the screwdriver

MOTOR CABLE

Motor cable for screwdrivers, size 19, 22, 27 and 36			straight connection	with 90° angle connection
Length 2.5 m / 8.2 ft. (standard)	Part no.		385442A	385442E
Length 5 m / 16.4 ft.	Part no.		385442B	385442F
Length 8 m / 26.2 ft.	Part no.		385442C	385442G
Length 12 m / 39.4 ft.	Part no.		385442D	385442H

SEQUENCE CONTROLLER AST6/ASTi6

for screwdriver	NANOMAT-EC MICROMAT-EC MINIMAT-EC	320E12-.. (page 4) 320E19-.. (page 4) 320E22-.. (page 5)	
Sequence controller with integrated performance electronics	Type Part no.	AST6-1 428001A	ASTi6-1 428004A
Sequence controller with fieldbus module Profibus port	Type Part no.	AST6-1 PB 428001B	ASTi6-1 PB 428004B
Sequence controller with fieldbus module Profinet port	Type Part no.	AST6-1 PN 428001C	ASTi6-1 PN 428004C
Sequence controller with fieldbus module EtherCat port	Type Part no.	AST6-1 EC 428001D	ASTi6-1 EC 428004D
Sequence controller with fieldbus module Ethernet IP port	Type Part no.	AST6-1 E/IP 428001E	ASTi6-1 E/IP 428004E
Power supply (DC)	V	24	
Power consumption	W	150	
Display		TFT colour display 4.3"	without display
24V input/output interface		14 inputs / 8 outputs	
Ethernet		yes	
Number of connectable screwdriver		1	
Dimensions (W x H x D)	mm / in.	162 x 143 x 65 / 6 ³ / ₈ x 5 ⁵ / ₈ x 2 ⁹ / ₁₆	
Weight	kg / lbs	1.5 / 3.3	
Power supply unit	Part no.	2041061 (included in delivery)	optional accessories

Required Accessories

Power supply cable 230 V Length 1.8 m / 5.9 ft.	Part no.	812587	—
Power supply cable 115 V Length 1.8 m / 5.9 ft.	Part no.	812295	—

Required Accessories for ASTi6

Control and Operating Unit	Type	DPU100	DPU200
DEPRAG Processing Unit	Part no.	8099722	8134992
Display		touch panel 6.5", colour	15" TFT-display with touch screen, colour
Resolution		VGA (640 x 480 pixels)	VGA (1024 x 768 pixels)
Voltage		24V DC	24V DC
Current consumption	A	0.75	approx. 4.5
Power input	W	18	80 / 110 with USV
Additional functions - Membrane keys - Emergency stop button		12 membrane keys with green and red LED yes	12 membrane keys with green and red LED yes
CPU		Intel Atom, 1.6 GHz	Intel Celeron 2000E 2.2 GHz
Port		1xEthernet, 1xEtherCat, 2xUSB 2.0	1xEthernet, 1xEtherCat, 2xUSB 2.0 Front, 1xUSB 2.0 in rear plate
Working storage		1GB DDR2 RAM	2GB DDR3L-RAM
Mass storage		1GB Compact Flash	Hard disk, 2.5" 320 GB
Operating system		Windows CE	Windows 7 Ultimate
Operating temperature	°C	0 to 55	0 to 45
Housing - protection class		IP65 (splash proof)	IP65 (splash proof)
Dimensions (W x H x D)	mm / in.	290 x 225 x 50 / 11.3 x 8.8 x 1.9	426 x 395 x 95 / 16.6 x 15.4 x 3.7
Weight	kg / lbs	approx. 4.5 / 9.9	approx. 13 / 28.6
Remote maintenance		optional (Ethernet, modem)	optional (Ethernet, modem)
Programming		IEC61131-3 (AWL, KOP, FUP, ST, AS and CFC)	IEC61131-3 (AWL, KOP, FUP, ST, AS and CFC)
Necessary software packages	Type/Part no.	DAST100 / 815641	DAST200 / 815642

Description

DPU100 - This high performance controller can guide axis systems with up to three axes. Complex manual work stations with operator guidance, sequence and screw position visualisation as well as fully automatic machines with several part stations such as rotary indexing machines with up to 4 user stations can be realised. This controller adds the option of connecting a database such as a BDE or ERP system. The DPU100 can be used in combination with all standard DSEC control cabinets.

DPU200 - The DPU200 is the most efficient controller of the DPU series. The controller has a 15" display with XGA resolution (1024 x 768 pixels) for improved image visualisation. It can control complex fully automatic machines such as axis systems with more than three axes. It offers unproblematic connection to databases such as BDE or ERP systems. There are various interfaces and protocols available e.g. OPC, OPC-UA or TCP/IP. The DPU200 can also be used in conjunction with all DSEC control cabinets.

DAST100/200 - The software-panel for EC and EC Servo Systems. DAST is used to supervise the operation and visualisation of the screwdriver sequence controller (AST series) through the system control. The functionality matches the performance capability of the relevant system control.

SEQUENCE CONTROLLER AST11

for screwdriver	MICROMAT-EC MINIMAT-EC	320E19-.. (page 4) 320E22-.. and 320E27-.. (page 5)		320E36-..(page 5)	
Sequence controller	Type	AST11-1	AST11-1-S	AST11-2	AST11-2-S
	Part no.	390041A	390041B	390042A	390042B
Module „safety stop“		no	yes	no	yes
Power unit (AC)	V / Hz	100 - 240 / 50 / 60		100 - 240 / 50 / 60	
Power consumption	W	400		400	
Insulation		IP 54		IP 54	
LC-display		4 x 20		4 x 20	
24V input/output interface		12 inputs / 8 outputs		12 inputs / 8 outputs	
Membrane keyboard		yes		yes	
RS 232 Interface		yes		yes	
Ethernet		yes		yes	
Amount of connectable screwdrivers		1		1	
Dimensions (W x H x D)	mm / in.	160x295x200 / 6 ¹⁹ / ₆₄ x 11 ³⁹ / ₆₄ x 7 ⁷ / ₈		160x295x200 / 6 ¹⁹ / ₆₄ x 11 ³⁹ / ₆₄ x 7 ⁷ / ₈	
Weight	kg / lbs	5.8 / 12.76		6 / 13.2	

Required Accessories

Power supply cable Length 1.8 m/5.9 ft. (EU)	Part no.	385443A
Power supply cable Length 1.8 m/5.9 ft. (USA)	Part no.	385443B
Power supply cable Length 2.5 m/8.2 ft. (China)	Part no.	385443C

Optional Accessories		for sequence controller	AST6-1	ASTi6-1	AST11
Patch cable (2m) (connection ASTx -PC)		Part no.	831902 (included in delivery)		831902
Plug RJ45-IP54		Part no.	-		385453A
Part sensor capacitive M18		Part no.	-		354841C
Base		Part no.	416004A		405278A
Cable socket (slide connector voltage supply)		Part no.	-	810122 (included in delivery)	-
ASTi6-1 reset plug		Part no.	-	428005 A (included in delivery)	-
Power supply unit + power supply cable 230 V		Part no.	-	2041061 + 812587	-
Power supply unit + power supply cable 115 V		Part no.	-	2041061 + 812295	-
Touch pen		Part no.	832190		-
Slide connector 26pol. for input/output interface		Part no.	832625		-
Printer Type ND350		Part no.	-		112462A
Field bus module Profibus		Part no.	-		428010A
Field bus module Profinet		Part no.	-		428010B
Field bus module EtherCat		Part no.	-		428010C
Field bus module Ethernet IP		Part no.	-		428010D
Required accessories:					207725A (EU)
Connection cable AST11 to field bus module		Part no.	-		207725B (US)
Motor cable extension for MICROMAT-EC (size 19)					
Length	2.5 m / 8.2 ft.	Part no.	385478A		385478A
Length	5.5 m / 18.0 ft.	Part no.	385478B		385478B
Length	9.5 m / 31.2 ft.	Part no.	385478C		385478C

Optional additional software for sequence controller		AST6-1 und ASTi6-1	AST11
Interface Graph Loader (Hardware and Software)	Part no.	385834A	385834A
Connection cable (ASTxx - Graph Loader)	Part no.	385835B	811420
Software ASTxx Serial Remote (release code) for the simple storage of screwdriving curves and result data to a PC	Part no.	206565	206565
Software Graph 10E (release code)	Part no.	202698	202698
Software Statistics (release code)	Part no.	206081	206081
Software Datalogger (release code)	Part no.	202699	202699
Software Friction value screwdriving (release code)	Part no.	201820	201820
Software GRAPH10 BIN-> CSV	Part no.	201992	201992
Software Graph Viewer for sequence controller AST / activation	Part no.	128900 / 128901	128900 / 128901
Software DEPRAG Data eXchange for sequence controller AST / activation	Part no.	132679 / 132680	132679 / 132680

Interface Graph Loader (hardware and software)

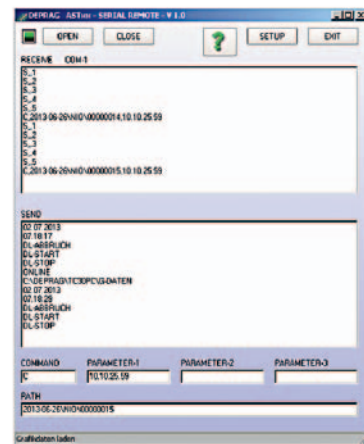
The storage of screwdriving graphs and end value data sets (e.g. torque, angle etc.) for manual work stations and screwdriving stations can be carried out automatically using the Interface Graph-Loader. The corresponding software enables immediate display on the computer screen of the current screwdriving graph, the screw assembly can be evaluated straight after completion and *.csv and *.bin files can be saved in individual directories.



Interface Graph Loader

Software ASTxx Serial Remote (release code)

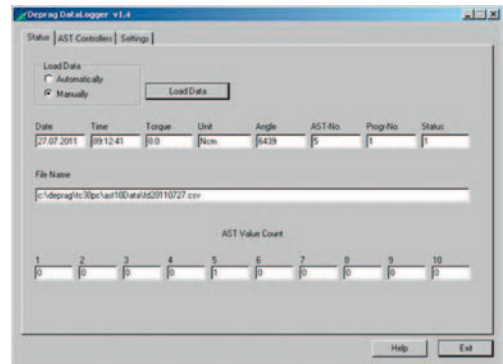
The program ASTxx Serial Remote is started on a PC and is controlled by commands over a serial interface (COM-Port). With this program, screwdriving curves and result-data can be transferred fast and simply onto a PC. The PLC controls when and which data should be stored. The storage place (also the directory) on the PC is determined by the PLC as well. The directory is setup automatically on the PC.



ASTxx Serial Remote

Software Datalogger (release code)

The software „Datalogger“ offers the possibility to record and archive the final-values of up to 10 sequence controllers. This storage format corresponds with the required format of the software „Statistics“, so that the data sets can be analyzed with the software „Statistics“. It can be selected whether the data is collected automatically while the program is running, or whether the data reading should be triggered manually. The connection to the controllers is done by Ethernet and TCP/IP. The software is available in several different languages.



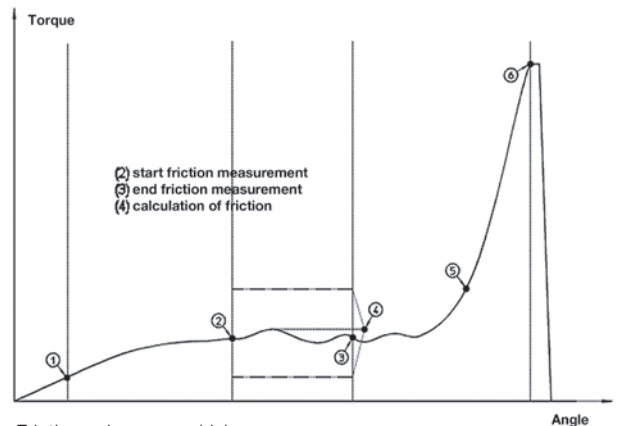
Datalogger

Software Friction value screwdriving (release code)

With the friction-value process, it is possible to measure and compensate varying friction-values (e.g. on self-forming screw-joints). Additionally, this procedure can be used for verification purposes.

Software GRAPH10 BIN-> CSV

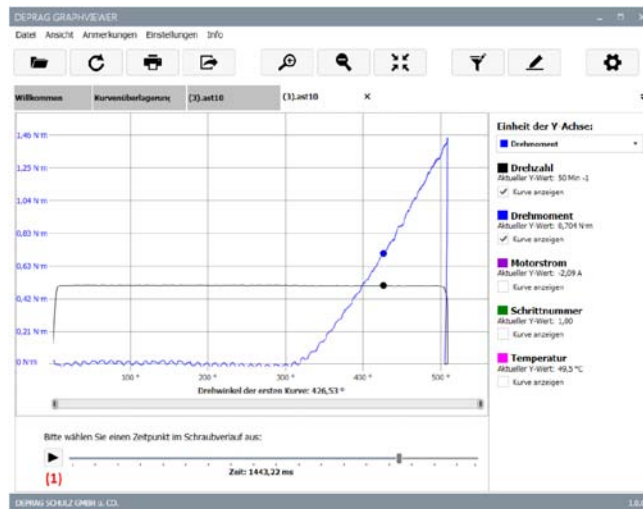
The software converts your binary files into csv files for further processing.



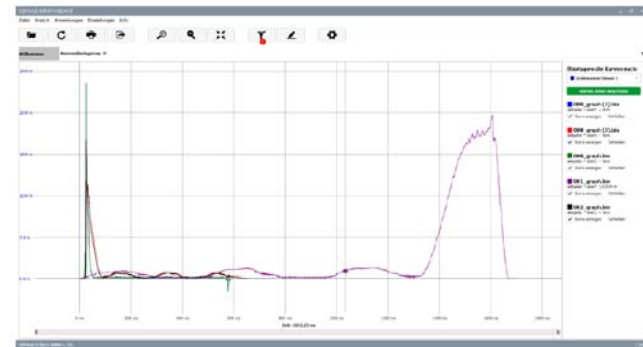
Friction value screwdriving

DESCRIPTION OF THE SOFTWARE

Software Graph Viewer for evaluation of screwdriving curves



Visualisation over angle



Superposition over time

During each screw assembly when using a sequence controller AST, the relevant measurement values are recorded in a file. There is now a new software product: the DEPRAG Graph Viewer, to simply and easily evaluate and analyse these measurement values.

Visualisation of measurement values over time

In this visualisation, various measurement sizes can be shown in relation to the screwdriving procedure. All available measurement values can be displayed in chronological order.

Visualisation of measurement values over angle

In this visualisation, the angle can be analysed in relation to the screwdriving procedure. The y-axis can be freely chosen by the user. This can e.g. enable analysis of angle in relation to torque or angle in relation to motor current, etc. In order to precisely analyse the screw assembly, a video can be played in visualisation over angle. Use the “start” and “pause” buttons in the same way as a video player to visualise the curve sequence of the screwdriving process. Individual sequences can be selected and displayed using the time bar.

Superposition of measurement values over time / over angle

As well as visualisation over angle and visualisation over time, there is also an option to display several curves at the same time in order to draw correlations and recognise trends. Any number of curves can be added. It is also possible to align curves to specific synchronisation points and hide or show screwdriving steps.

- **Simple filtering and synchronisation in search history**
Screwdriving curves can be filtered according to program step or by torque. All displayed curves can be coordinated to one synchronisation point.
- **Easy operation**
The required units, sizes and contents can be flexibly selected by the user.
- **Several display views at one time**
In order to compare several curves, more than one screwdriving curve can be opened at the same time.
- **Usability & “touch first”**
The new software has been developed to be “touch first” and allows easy operation – without mouse or keyboard.

• Additional features

- Add individual texts and reference arrows
- Zoom
- Conversion of units
- Multi-language (German, English)
- Save and load files
- Print curve data
- Export files
- Download directly from controller

• System prerequisites

- Windows 7, 8, 10
- The software is available as a download and requires activation

➤ **Use with current AST software version is recommended.**

Software Deprag Data eXchange for AST sequence controllers enables DEPRAG graphic files to be exported either as csv or Excel files

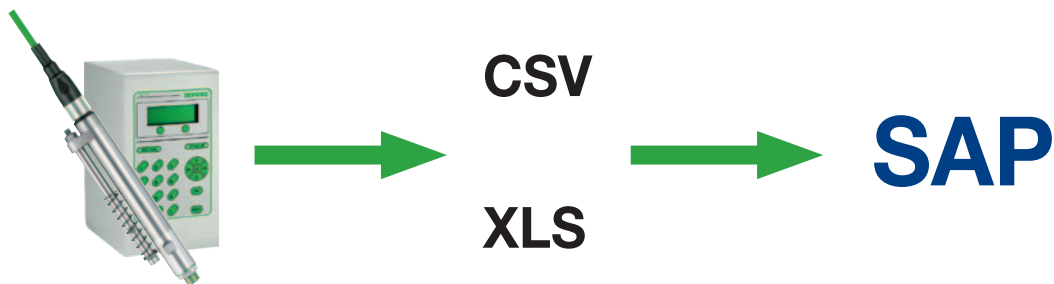
AST sequence controllers, the adaptive screwdriving system ADAPTIVE DFS and the ComCenter document relevant processing data for every screw assembly, which is then saved in a distinctive DEPRAG format. The so-called "graphic files" contain all screw curves, end values and details relating to the screwdriving process and are only readable by DEPRAG's own software solutions.

In order to use and analyse this data in other systems, it is necessary to transform the internal format into a universal machine-readable format. The new software solution DEPRAG Data eXchange enables DEPRAG graphic files to be exported either as csv or Excel files.

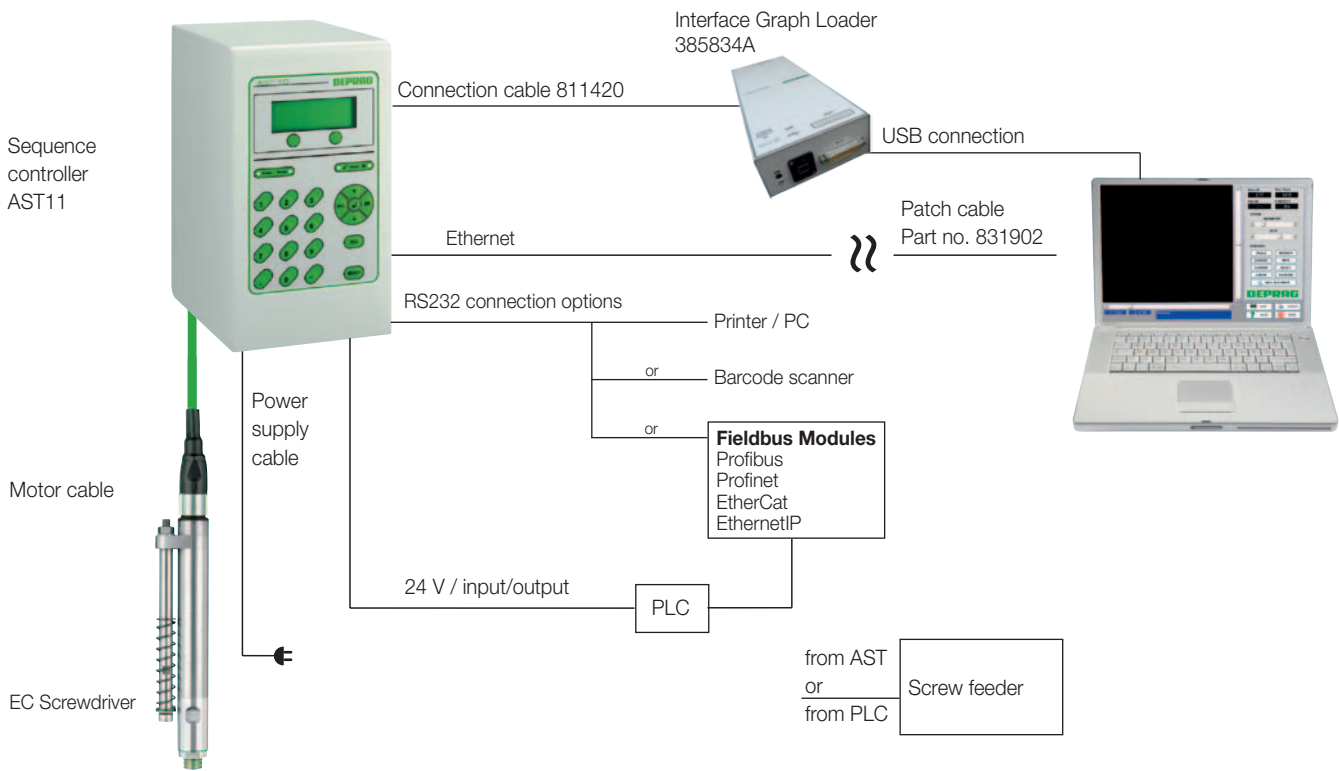
This data can now be used in other software solutions. Optional areas of application include:

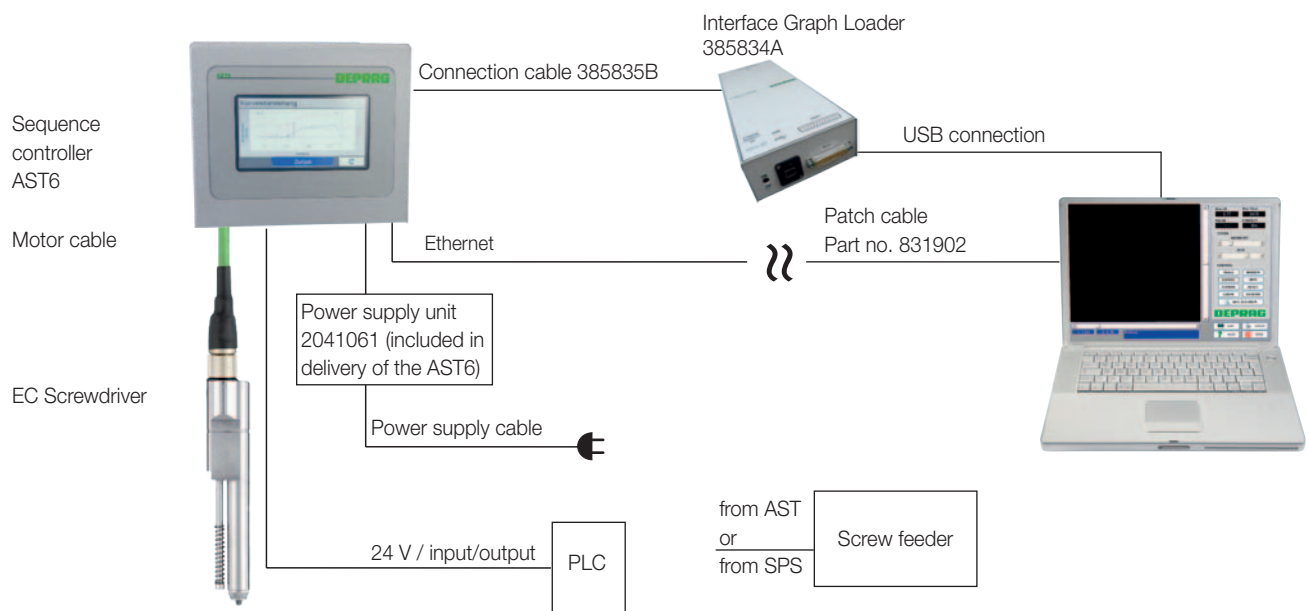
- integration in a databank
- analysis in Matlab
- SAP integration
- filing in customer-specific processing software

Compatibility: all Windows systems (7, 8, 10) without any need for configuration. The software configures itself and is ready to run with just one click.



EXAMPLE





DEPRAG

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