Cleco®
Production Tools

Programming Manual
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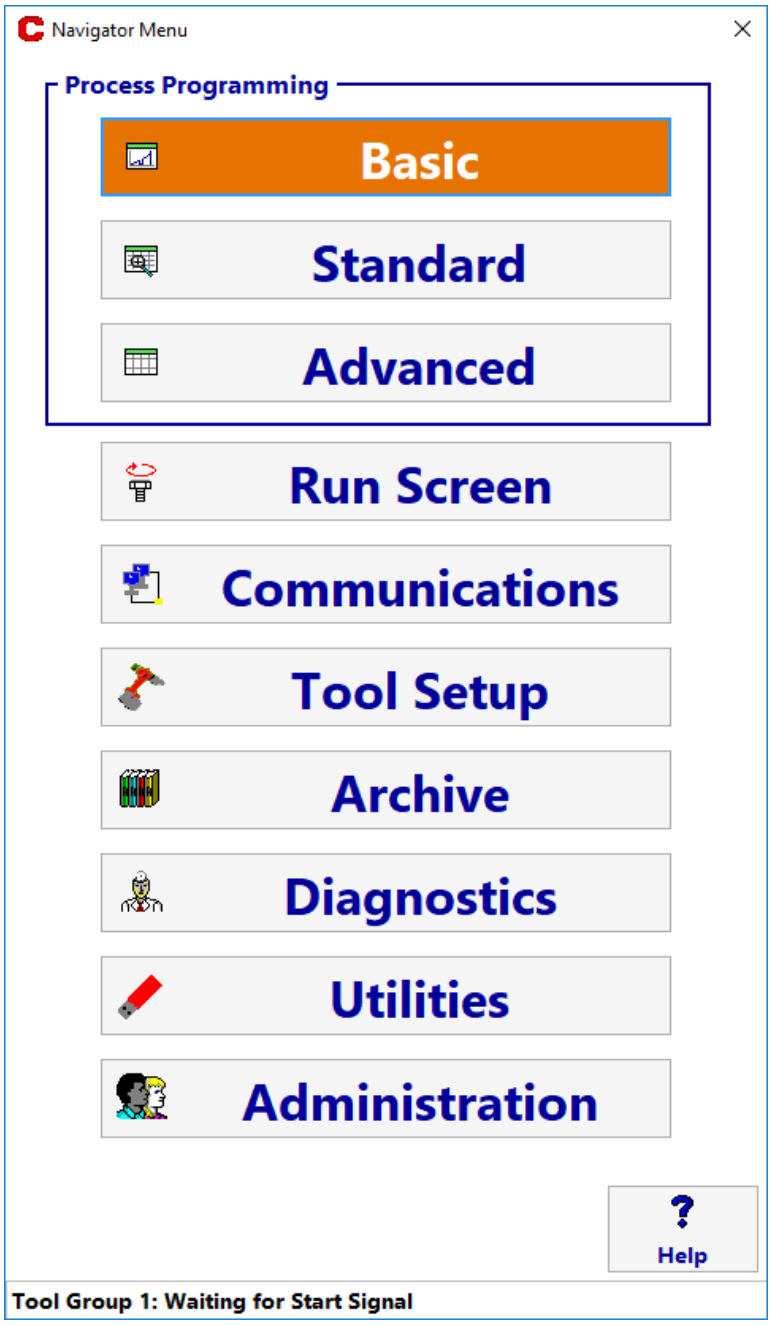
mPro300GCD

Software S168300



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Contents

1 For This Programming Manual 6

2 Navigator 8

3 Basic Application Builder 10
3.1 Programming a Basic Fastening Strategy 10
3.2 Auto Program 11
3.3 Manual Programming 12

4 Run Screen 14
4.1 Part ID display 15
4.2 Data transmission protocol indicators and miscellaneous information 16
4.3 Run Screen configuration 16
4.4 Access to additional features 17
4.5 Oscilloscope 18

5 Standard Application Builder 21
5.1 Tool activation 22
5.2 Copying parameters 23
5.3 Fastening program 24
5.4 Fastening stage programming 25
5.5 Rundown programming 28
5.6 Fastening stage timing 31
5.7 Ramps 32
5.8 Extension of stick-slip behavior (Sequences 31 and 51) 32
5.9 Action on NOK 33
5.10 Settings for speed left rotation 45
5.11 Fastener IDs 46
5.12 Fastening groups 47
5.13 Batch programming 48
5.14 Input / Output bitmask 50

6 Tool Setup 52
6.1 Tool List 52
6.2 Tool Settings 53
6.3 Installing a Primary Corded Tool 54
6.4 Installing a Secondary Tool 54
6.5 Tool maintenance information 55

7 Tool constants 59
7.1 Control unit 60
7.2 Transducer data 60
7.3 Redundancy 61
7.4 Tool data 61
7.5 Transducer data 63
7.6 Current calibration 67

8 Advanced 70
8.1 Application Matrix 70
8.2 Inputs 70
8.3 Outputs 71
8.4 Linking 74
8.5 Controller settings 81
8.6 Tool Group settings 84

9 Enhanced Programming 91
9.1 Programmable I/O Mapping 91
9.2 Modules 93
9.3 Fieldbus configuration 95
9.4 Byte Area 98

10 Communications 117
10.1 Data Transmission 117
10.2 Serial Protocols 118
10.3 Ethernet Protocols 122
10.4 Part ID 146
10.5 Network Settings 152
10.6 Custom fieldbus protocols 153
10.7 Tightening Parameter Server (TPS) 158

11 Diagnostics 165
11.1 System Diagnostics – Controller 165
11.2 System Diagnostics – Network 169
11.3 System Diagnostics – Inputs/Outputs 173
11.4 Tool diagnostics – Test Options 175
11.5 Tool diagnostics – Miscellaneous 178

12 Archive 181
12.1 Monitor tool 182
12.2 Error table 183
12.3 Torque graph 183
12.4 Filtering archive entries 183
12.5 Statistics 185

13 Utilities 190
13.1 Software Update 190
13.2 System Settings 191
13.3 Switch between primary and secondary mode 192

14 Administration 197
14.1 Counters 197
14.2 Print 198
14.3 Date and time 198
14.4 Modification list 198
14.5 Touch Calibration 198

14.6 Data export 199
14.7 Users 202
14.8 Service messages 204
14.9 Load and save parameters 205
14.10 Factory Reset 205
14.11 Save all Data to USB stick 205
14.12 Screen Saver 205
14.13 Language 205

15 Error messages / warnings 206

16 Open Source Software 210

17 Glossary 211

18 Appendix A – Input Signals 214

19 Appendix B – Output Signals 217

1 For This Programming Manual

This manual provides information required to program the mPro300GCD standard controller software.

Software version: S168300-1.0

This version of the standard software runs on the following hardware:
- mPro300GCD

Additional documentation

Document no.	Document type
	PFCS Vendor Specification
	Open Protocol FEP Specification
P2227BA	TorqueNet User Manual
	ToolsNet Open Protocol Specification
	ToolsNet documentation
	GMCC specifications
P1730PM	System description – Fastening Sequences
P2444HW	Hardware Manual – mPro300GCD
2461JH	Quick Installation Guide – mPro300GCD
P2468TS	Troubleshooting mPro300GCD

Symbols in the text

Italic	Identifies menu options (e.g. diagnosis), input fields, control boxes, options fields or dropdown menus.
>	Denotes the selection of a menu option from a menu, e.g. *File* > *Print*
<...>	Denotes switches, pushbuttons or the keys of an external keyboard, e.g. <F5>
`Courier`	Denotes filenames and paths, e.g. **`setup.exe`**
•	Denotes lists, level 1
-	Denotes lists, level 2
a) b)	Denotes options
→	Denotes results
1. (...) 2. (...)	Denotes action steps in sequence
▶	Denotes a single action step

Warnings and notes

Always adhere to safety instructions to avoid situations that could result in personal injury or death or in damage to equipment or the environment.

Danger

A symbol combined with the word **Danger** indicates a hazard with a **high level of risk** which, if not avoided, will result in death or serious injuries.

Warning

A symbol combined with the word **Warning** indicates a hazard with a **medium level of risk** which, if not avoided, could result in death or serious injury.

Caution

A symbol combined with the word **Caution** indicates a hazard with a **low level of risk** which, if not avoided, could result in minor or moderate injury.

Note

A symbol combined with the word **Note** indicates a potentially **harmful situation** which, if not avoided, could result in damage to property or the environment.

General instructions include application tips and useful information, but no warnings against hazards.

2 Navigator

The figures in this document show the display when the controller is accessed via a remote connection.

The actual arrangement of the operating elements on the display of the mPro300GCD controller can therefore differ from the figures shown here. Isolated additional figures in portrait format show the direct display of the controller.

The *Navigator* dialog allows you to access all major features used to program the Global Controller.

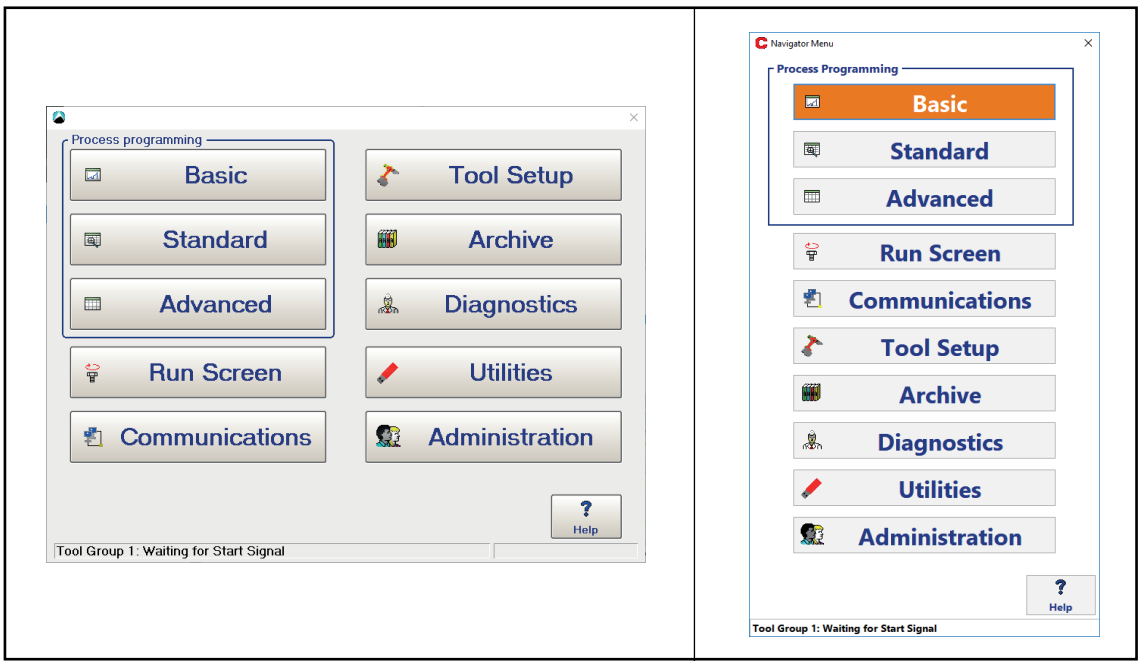


Fig. 2-1: The Navigator dialog

Most dialog windows of the Global Controller display the <Navigator> button, which saves current changes and returns you to the *Navigator* dialog.

Fig. 2-2: The Navigator button

Process programming

The *Process programming* section of the *Navigator* provides access to the <Basic> Application Builder, the <Standard> Application Builder, and <Advanced> process programming.

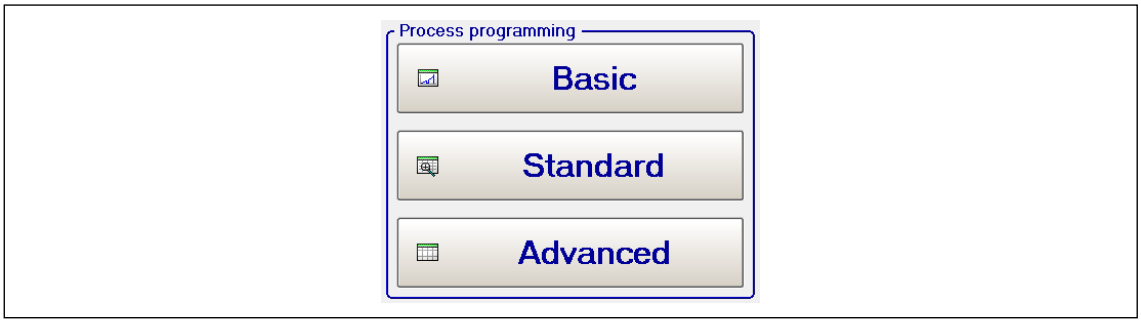


Fig. 2-3: The Process programming section of the Navigator

Basic Application Builder: Allows you to graphically select and program a two-stage rundown for *Torque Control/Angle Monitor* (SEQ 11 + SEQ 30) or *Angle Control/Torque Monitor* (SEQ 11 + SEQ 50) for any of the 99 Applications available. You only enter Torque, Angle, and Speed parameters in one screen. Other parameters, e.g., timers, automatically default to predetermined values.

Standard Application Builder: Allows you to program rundowns with up to 6 stages for any of the 99 Applications available. You first select a fastening sequence for each stage and then program the required Torque, Angle, Speed, and Advanced parameters.

Advanced process programming: Allows you to access a Matrix, which provides an overview of all Applications of a Tool, and to program Inputs, Outputs, Linking, Controller Settings, and Tool Settings.

Run Screen

Displays the Torque, Angle, and Status Indicator Labels of the current rundown. The Torque graph view provides features for analyzing torque traces.

Communications

Allows you to configure Serial and Ethernet protocol data transmission and to access Part ID, Network, and Fieldbus settings.

Tool Setup

Allows you to install and uninstall tools and to configure tool groups and the programmable I/O.

Archive

Provides a chronological history of previous rundowns.

Diagnostics

Provides features to determine if the system is functioning properly.

Utilities

Contains features to upgrade or change the system software. The Utilities allow you to check the currently installed software version and revision, update the mPro300GCD application software, install a new firmware version in the Tightening Module, check system information and load or save parameters from/to a storage device.

Administration

Provides features to configure, load, save, and print system settings. You can manage Users, set password protection, reset Counters, set the Date/Time, set a Screen saver, change the Language of the application software (English, German, Portuguese, Chinese, and Spanish), and create and maintain Modification lists and Service messages.

3 Basic Application Builder

In the *Basic Application Builder*, you can select a typical two-stage rundown where the first stage is a high-speed rundown and the second stage is a different-speed rundown that controls on either torque or angle.

You can select a fastening strategy from the *Fastening Strategy* drop-down menu in the upper right-hand corner of the screen. The available options are *Torque Control/Angle Monitoring* (SEQ 11/SEQ 30) and *Angle Control/Torque Monitoring* (SEQ 11/SEQ 50). Once a strategy is selected, the appropriate parameters are displayed for programming.

Basic Parameters for Torque Control/Angle Monitor:

- Trigger (start scope) [Nm]: torque to start collecting oscilloscope data
- Shut-off Torque Stage 1 [Nm]: torque to change from stage 1 to stage 2
- Threshold (Angle Start) [Nm]: torque to begin counting angle in stage 2
- Torque Low Limit [Nm]: minimum acceptable torque
- Shut-off Torque Stage 2 [Nm]: torque to turn off the tool
- Max. torque [Nm]: maximum acceptable torque
- Angle Low Limit [Deg]: minimum acceptable angle
- Angle High Limit [Deg]: maximum acceptable angle

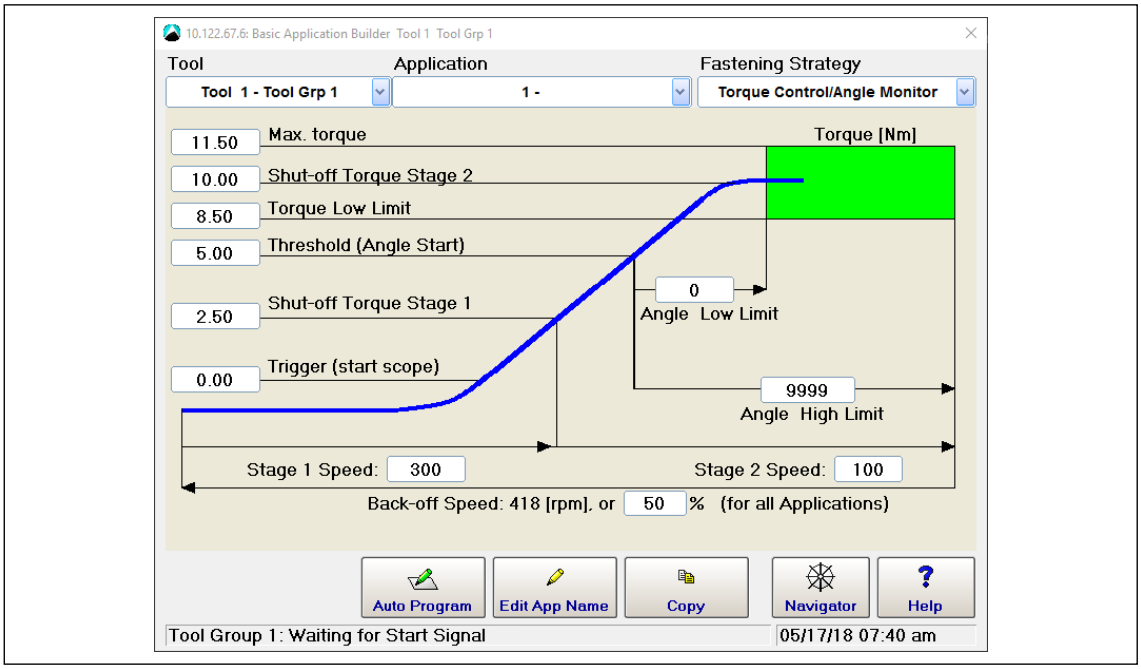


Fig. 3-1: Basic Application Builder window with the Torque Control/Angle Monitor fastening strategy selected

Basic Parameters for Angle Control/Torque Monitor:

- Shut-Off Angle [Deg]: angle to turn off the tool
- The other parameters are the same as for *Torque Control/Angle Monitor* except Shut-off Torque Stage 2, which is not included.

3.1 Programming a Basic Fastening Strategy

You can program a basic fastening strategy in the *Basic Application Builder*. Use the *Auto Program* feature or manually set required parameters.

To program a basic fastening strategy:

1. In the Navigator, tap the <Basic> button to open the *Basic Application Builder*.
2. Verify that the tool and application selected in the *Tool* and *Application* drop-down menus are correct.
3. Select a fastening strategy, i.e., *Torque Control/Angle Monitor* or *Angle Control/Torque Monitor*, from the *Fastening Strategy* drop-down menu.
4. Access the *Auto Program* feature by tapping the <Auto Program> button, or manually set parameters.

3.2 Auto Program

The *Auto Program* feature is only available from the *Basic Application Builder* when a tool is connected to the controller and the application is not programmed yet. If no tool is connected or the application is already programmed, the <Auto Program> button is disabled.

3.2.1 Auto Program in Torque Control/Angle Monitor mode

In the *Torque Control/Angle Monitor* mode, the *Auto Program* feature accepts the *Shut-off Torque Stage 2* parameter.

To use the *Auto Program* feature:

1. In the *Basic Application Builder*, tap the <Auto Program> button to display the *Auto Program* dialog.
2. In the *Auto Program* dialog, tap the *Shut-off Torque Stage 2* text box to display the virtual keyboard.
3. Use the keyboard to enter the required value for *Shut-off Torque Stage 2*
4. Tap the <Enter> key to close the keyboard.
5. Tap the <OK> button of the *Auto Program* dialog to save the value, or tap <Cancel> to discard.
6. The remaining parameters are automatically set and displayed in the *Basic Application Builder* screen. Limits are set to ±15% of the value entered.
7. Manually adjust parameters if needed.
8. Tap the <Navigator> button to display the *Confirm changes* dialog.
9. In the *Confirm changes* dialog, tap:
   - <Accept> to save the parameters, close the *Basic Application Builder*, and return to the *Navigator*,
   - <Cancel> to return to the *Basic Application Builder*, or
   - <Discard> to exit the *Basic Application Builder* without saving changes.

Default parameters in Torque Control/ Angle Monitor mode

Parameter Name	Stage 1	Stage 2
Shut-off Torque Stage 2	–	Value from Auto Program dialog
Max. torque	–	Shut-off Torque Stage 2 * 1.15
Torque Low Limit	–	Shut-off Torque Stage 2 * 0.85
Threshold (Angle Start)	–	Shut-off Torque Stage 2 * 0.5
Shut-off Torque Stage 1	Shut-off Torque Stage 2 * 0.25	–
Trigger (start scope)	0	–
Angle Low Limit	–	0
Angle High Limit	–	9999
Speed	300 or Tool Max Speed if lower	50
Back-off Speed	50% of Tool Max Speed for all applications	

3.2.2 Auto Program in Angle Control/Torque Monitor mode

In the *Angle Control/Torque Monitor* mode, the *Auto Program* feature accepts the *Shut-Off Angle* parameter.

Default parameters in Angle Control/Torque Monitor mode

Parameter Name	Stage 1	Stage 2
Shut-Off Angle	–	Value from Auto Program dialog
Angle Low Limit	–	Shut-off Angle -10°
Angle High Limit	–	Shut-off Angle +10°
Max. torque	–	Tool max capacity if not 0
Torque Low Limit	–	0
Threshold (Angle Start)	–	0
Shut-off Torque Stage 1	0	–
Trigger (start scope)	0	–
Speed	300 or Tool Max Speed if lower	50
Back-off Speed	50% of Tool Max Speed for all applications	

3.3 Manual Programming

You can also manually set parameters in the *Basic Application Builder*:

1. Tap the *Shut-off Torque Stage 2* text box to display the virtual keyboard.
2. Enter the required torque value. You do not have to enter decimal points for whole numbers. They will be added automatically.
3. Use the <Tab> key on the keyboard to move to the next text box.
4. Press the <Enter> key to close the keyboard once you have entered all required parameters.
5. Tap the <Navigator> button to display the *Confirm changes* dialog.
6. In the *Confirm changes* dialog, tap:
   - <Accept> to save the parameters, close the *Basic Application Builder*, and return to the *Navigator*,
   - <Cancel> to return to the *Basic Application Builder*, or
   - <Discard> to exit the *Basic Application Builder* without saving changes.

Acceptable ranges for Basic Application Builder parameters

Parameter Name	Range	Typical
Fastening Strategy	Torque Control/Angle Monitor	Torque Control/Angle Monitor
	Angle Control/Torque Monitor	Angle Control/Torque Monitor
Trigger (start scope) [Nm]	0 to Tool Max	10% of Shut-off Torque
Shut-off Torque Stage 1 [Nm]	0 to Tool Max	as appropriate
Threshold (Angle Start) [Nm]	Shut-off 1 to Tool Max	50% of Shut-off Torque
Torque Low Limit [Nm]	-Tool Max to Tool Max	90% of Shut-off Torque
Shut-off Torque Stage 2 [Nm]	Low Limit to Tool Max	as appropriate
Max. torque [Nm]	Shut-off to 1.2 TQ-Cal. value	110% of Shut-off Torque
Angle Low Limit [Deg]	0 to 9999	90% of Shut-Off Angle
Shut-Off Angle [Deg]	Low Limit to 9999	as appropriate
Angle High Limit [Deg]	Shut-Off to 9999	110% of Shut-Off Angle
Stage 1 Speed [RPM]	0 to Tool Max	80% of Tool Max
Stage 2 Speed [RPM]	0 to Tool Max	50
Back-off Speed	0 to Tool Max	50% of Tool Max

Enter negative values by preceding the value with a hyphen "-".

In the *Basic Application Builder*, some parameters are not programmable, and default values are set instead. You can view and change these settings in the *Standard Application Builder*. If you change them in the *Standard Application Builder*, the *Basic Application Builder* does not revert back to defaults.

Default values of advanced parameters

Parameter Name	Stage 1	Stage 2
Start Delay Time TV [ms]	0	0
Start pulse suppression TA [ms]	0	0
Fastening time Tmax [ms]	10000	10000
Dwell time TN [ms]	0	0 (30 with Auto Program)
Torque Averaging Filter Ff	4	4

If an application with more than two stages is required or if a fastening strategy that differs from those above has been selected for the application, you must use the *Standard Application Builder* rather than the *Basic Application Builder*.

The Copy feature of the *Basic Application Builder* lets you copy the parameters of an application to one or more other applications:

1. Tap the <Copy> button to open the *Copy* dialog.
2. Specify the *Source* and *Dest*. (target) Tool and Application.
   - To specify multiple Dest. (target) Applications, separate Application numbers with a space or comma.
   - To specify ranges, use a hyphen.
   - Example: 2, 10-15, 99

When you use the *Copy* feature in the *Basic Application Builder*, all stages of the selected application are copied.

4 Run Screen

On the *Run Screen*, you see rundown data as it occurs.

- You first select the *Tool/Tool Group* (1–32) and *Application* (1–99) which you want to display.
- The Torque (TQ) and Angle (ANG) readings are displayed on a color-coded background that indicates their status.
- You can display the current tool name, Part ID, and status labels.
- A message field displays information related to the tool, rundown status, and errors.

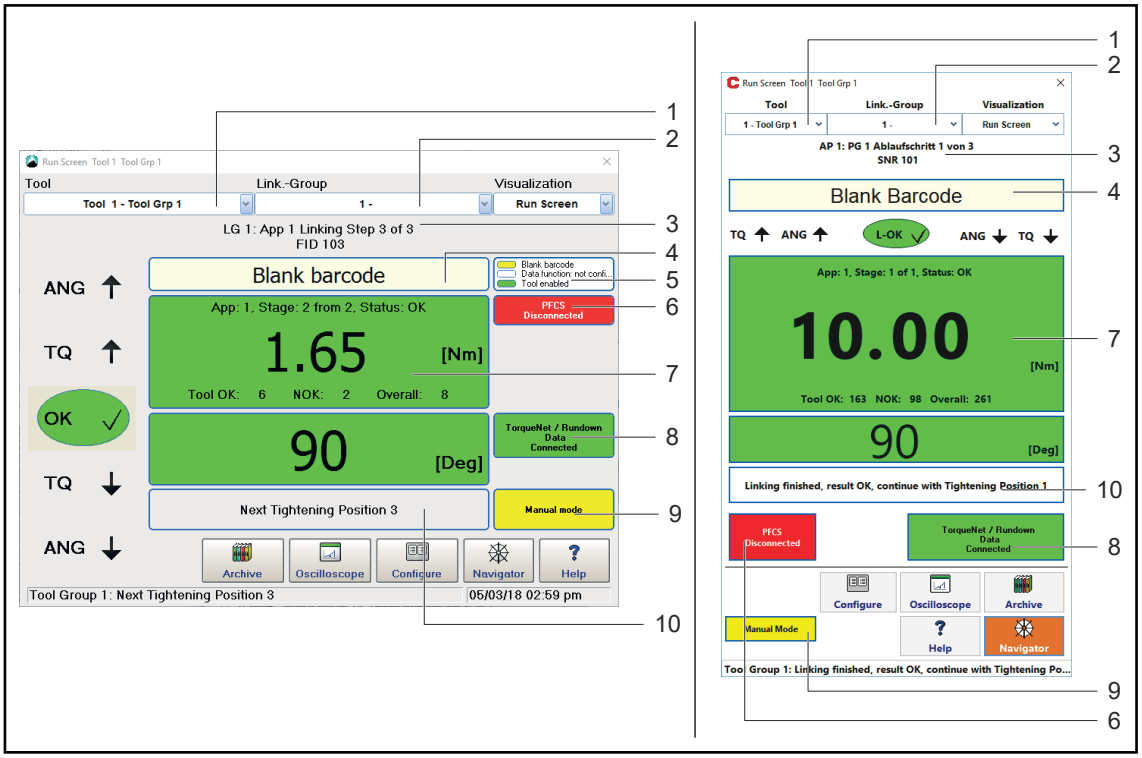


Fig. 4-1: Overview Run Screen – Display left: Remote connection, display right: Controller

Item	Description
1	Tool / Tool Group
2	Application
3	Linking Step
4	Part ID input box
5	Part ID status indicator
6	Plant Floor Comm System disconnected
7	Rundown counter
8	TorqueNet / Rundown Data connected
9	Input mode
10	Message field

Torque (TQ) and Angle (ANG) readings

Background color	Torque and Angle status
Green	Within the required limits
Red	Too high
Yellow	Too low

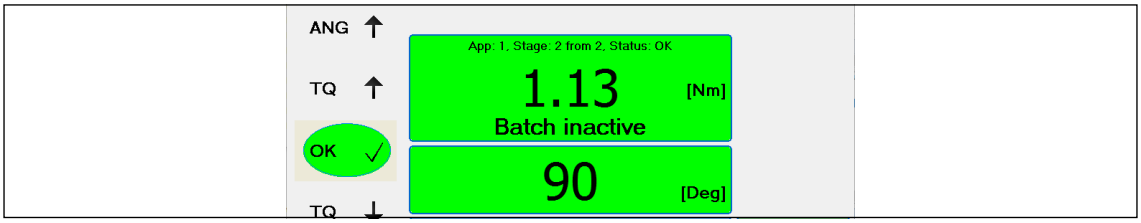


Fig. 4-2: The green background indicates that Tool 1 of Tool Group 1 has run successfully in Application 1

4.1 Part ID display

The *Run Screen* displays the Part ID input box and status indicator if the Part ID is activated.

▶ Select *Navigator* > *Communications* > *Part ID* > *Activated: Yes* to activate the Part ID.

If the *Keypad Entry* option is enabled for the Part ID, you can use the virtual keypad or an attached keyboard to manually enter a Part ID in the input box.

▶ Select *Navigator* > *Communications* > *Part ID* > *Keypad Entry: Allowed* to activate Keypad Entry.

If you manually enter a Part ID, you must press the <Enter> key to confirm.

4.1.1 Part ID status indicators

The Part ID status indicators are displayed on the right margin of the *Run Screen*.

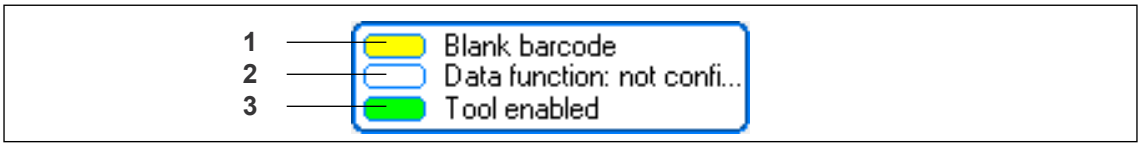


Fig. 4-3: Part ID status indicators

Item	Description
1	Input status indicator
2	Special Function indicator
3	Release indicator

Input status indicator (top indicator):

Indicates whether or not a new Part ID can be entered.

Color	Data function	Status
Green	Barcode valid	A valid Part ID is available.
Red	Barcode invalid	The Part ID is invalid.
Red	Not Accepting Part ID input	A new Part ID may not be entered when the tool trigger is active.
Red	NEW INPUT IGNORED!	This status is displayed if a new Part ID is entered while Not Accepting Part ID input is true.
Yellow	Blank barcode	A new Part ID may be entered.

Special Function indicator (center indicator):

Indicates the status of the Part ID Special Function.

Color	Data function	Status
Green	Function: App 1 (current application or linking group)	The Part ID Special Function is enabled, and the function (application, linking group) associated with the current Part ID in the Workpiece administration (Barcode mask) is used. See chapter *10.4 Part ID, page 177* and *10.4.2 Workpiece administration, page 179*.
Red	Function: Not found	The Part ID Special Function is enabled, but the Part ID is invalid or does not match any entries in the Workpiece administration.
Yellow	Function: None	The Part ID Special Function is enabled, but not configured.
White	Data function: not configured	Part ID Special Function is disabled.

4.2 Data transmission protocol indicators and miscellaneous information

The *Run Screen* displays additional status indicators for data transmission protocols, e. g., Torque Net and Open Protocol, and other information, e.g., Emergency mode.

▶ Select *Navigator* > *Communications* > *Data Transmission* to enable data transmission protocols.

- When data transmission is enabled for a protocol, this protocol is displayed and its color indicates the status.
- The screen also displays status indicators for the Plant Floor Comm System protocol.

Color	Status
Green	Connected
Yellow	Connecting
Red	Disconnected

4.3 Run Screen configuration

The *Run Screen configuration* dialog allows you to control which items are displayed on the *Run Screen*.

▶ Select *Navigator* > *Run Screen* > *Configure*.

Button	Description
	<Configure> provides access to the *Run Screen configuration* dialog.

4.3.1 Additional information section

Enable options of this section to display the following information on the *Run Screen:*

Parameters	Description
None	No additional informations.
Counters	If enabled, the *Run Screen* displays the number of OK, NOK, and Overall rundowns for the current tool. Counter information is available for individual tool groups. ▶ *Navigator > Administration > Counters*.
Batch	If enabled, the *Run Screen* displays additional information on the active batch. ▶ *Navigator > Standard > Settings > Batch*. See chapter *5.13 Batch programming, page 58* on how to enable and configure Batch mode.

4.3.2 Rundown Details section

Enable options of this section to display the following information on the *Run Screen:*

Parameters	Description
Rundown Details	Displays additional details including application number, current stage number, total number of stages in the application, and rundown status summary (OK, A>, Tq<, etc).
Station Name (for all Tools)	**- Not available in current software version -** Displays the station name as entered in *Navigator > Advanced > Controller > General*.
Redundancy	**- Not available in current software version -** Displays redundancy data.
Auto Select (for all Tools)	Causes the *Run Screen* to switch to the actual rundown result and tool.
Show compensated Torque if available	In the fastening sequence Seq. 32, an average torque value is calculated over a defined range. This compensates for the prevailing torque detected. If the checkbox is activated the result is displayed in the *Run screen* as compensated value (result without prevailing torque).

4.4 Access to additional features

The *Run Screen* also provides direct access to the following features.

Button	Description
	<Oscilloscope> displays the Torque graph view, which provides a torque curve after each complete rundown in the tightening direction. (See chapter *4.5.1 Torque graph, page 18* for details.)
	<Archive> displays the *Archive* dialog, which provides information of previous rundowns with automatic update after each new rundown. (See chapter *12 Archive, page 217* for details.)

Visualization menu

Besides the *Run Screen*, the following *Visualization* options are available:

Option	Description
Run Screen	Provides rundown data as it occurs.
Rundown Table	Provides rundown data table with tool summary for all tool groups.
Step view	Provides rundown data table with steps for current tool group.
Tool monitor	See chapter *12.1 Monitor tool, page 218* for details.

4.5 Oscilloscope

The *Oscilloscope* feature provides a torque curve after each complete rundown in tightening direction.

▶ Select *Navigator* > *Run Screen* > *Oscilloscope*.

Button	Description
	<Oscilloscope> displays the Torque graph view.

4.5.1 Torque graph

The *Torque graph* visualizes how the torque increases over the angle during a rundown: **TQ = f(Ang)**. The curve is based on one data point per degree of angle rotation. A green box is displayed on the trace to indicate the torque and angle limits.

For some fastening sequences, a gradient curve is also displayed: **GD = f(Ang)**

If a gradient curve is available:

- the x-axis of the Torque graph shows the angle in degrees, and
- the left and right y-axes show the gradient and the torque in the selected unit of measurement or vice versa.

Scaling of all three axes is automatic and based on the measuring points recorded.

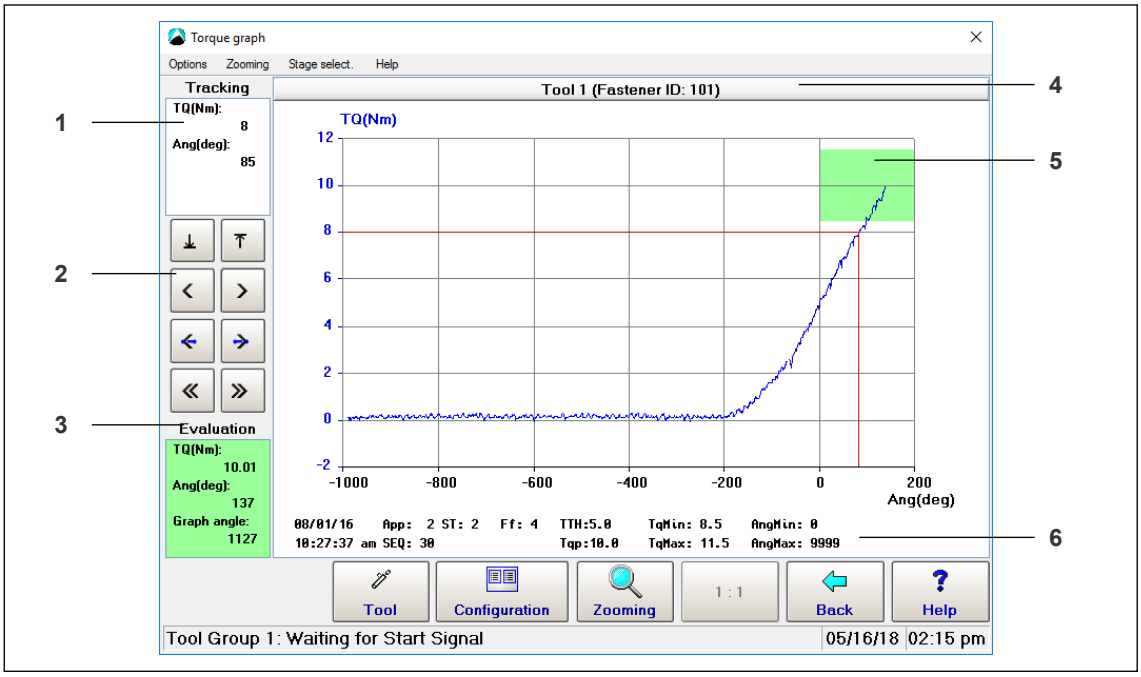


Fig. 4-4: The Torque graph view of a rundown

Item	Description
1	Tracking area displays cursor position
2	Arrow buttons control cursor position
3	Evaluation area indicates rundown status
4	Tool and Fastener ID
5	Green box indicates torque and angle limits
6	Rundown parameters

Positive and negative angle values

Recording of measured points begins when the *Trigger torque* is reached. The *Threshold torque* of the last fastening stage determines the position of the origin on the x-axis (angle = 0). If the Trigger torque is less than this Threshold torque, the angle values are negative until the Threshold torque is reached.

Exception for Fastening Sequence 13, prevailing torque monitoring

In sequence 13, recording starts either at *Trigger torque* or at *Threshold torque On*, depending on which is reached earlier. This is required for correct monitoring of the prevailing torque.

4.5.2 Navigating the Torque graph

Various menu options and control buttons allow you to navigate the *Torque graph*.

Select a stage or the entire rundown

The *Stage select.* menu provides options for viewing the curve of the entire rundown or just the section pertaining to a particular stage.

Magnify or reduce the graph

To magnify or reduce the center of the graph by a factor of 2:

- From the *Zooming* menu, select the <Zoom +> option to magnify or the <Zoom -> option to reduce.
- The <1:1> button allows you to restore the graph to the original size.

To magnify a particular area of the graph:

1. Tap the <Zooming> button.
2. In the graph, tap the left border of the area you want to magnify.
3. Tap the right border of the area you want to magnify.

Shift the magnified graph right or left

- From the *Zooming* menu, select the <Move +> or <Move -> option to shift the graph right or left by one grid or scale unit.
- Use the <Begin> and <End> options to view the beginning or end of the graph.

Display and move the cursor

1. Tap the graph to display the cursor.
   → The angle (Ang) and torque (TQ) values of the current cursor position are now displayed in the *Tracking* field in the upper left corner of the *Torque graph* window.
2. Use the <Arrow> buttons to the left of the graph to move the cursor.

4.5.3 Trace configuration

The *Trace configuration* dialog allows you to control which items are displayed in the *Torque graph*.

▶ Select *Navigator* > *Run Screen* > *Oscilloscope* > *Configuration*.a

Button	Description
	<Configuration> provides access to the *Trace configuration* dialog.

Trace configuration options

Base (x-axis) section

▶ Select the option you want to display on the x-axis.

Traces (y-axis) section

▶ Select the options you want to display on the left and right y-axes.

Enable *Enhanced trace recording* to make additional options, e.g., Time, Speed, Current, and Gradient, available.

▶ Select *Navigator* > *Advanced* > *Tool Group* > *Miscellanous* > *Activate enhanced trace recording if supported by tool (Time, Speed, ...)*.

The options available in the *Show trace* drop-down menus also depend on the tools and fastening sequences used.

Settings section

▶ Show or hide items in Torque graph view.

- View grid (left axis): Display the torque curve on a grid.
- OK zone: Display the green box on the trace that indicates the torque and angle limits.
- Parameters: Display the rundown parameters below the torque curve.
- Update: Disable automatic update.

See chapter *4.5.1 Torque graph, page 18*.

Redundancy curve

With recent TM measuring board versions, you can analyze current values in *Torque graph* view if current redundancy is enabled. The current values are converted to torque values and displayed on the controller.

The current redundancy curve is displayed in a light blue or turquoise color. Display of the redundancy curve is disabled by default. To display the redundancy curve in Torque graph view, you need to set the *Torque Red. (Nm)* option in the *Trace configuration* dialog.

The redundancy curve is only displayed correctly if Redundancy is set to <Current/Resolver> and programmed correctly in the *Tool constants*. The controls of the *Torque graph* view, e.g. <Zooming>, <Stage select.>, etc., work as if only the torque curve was represented.

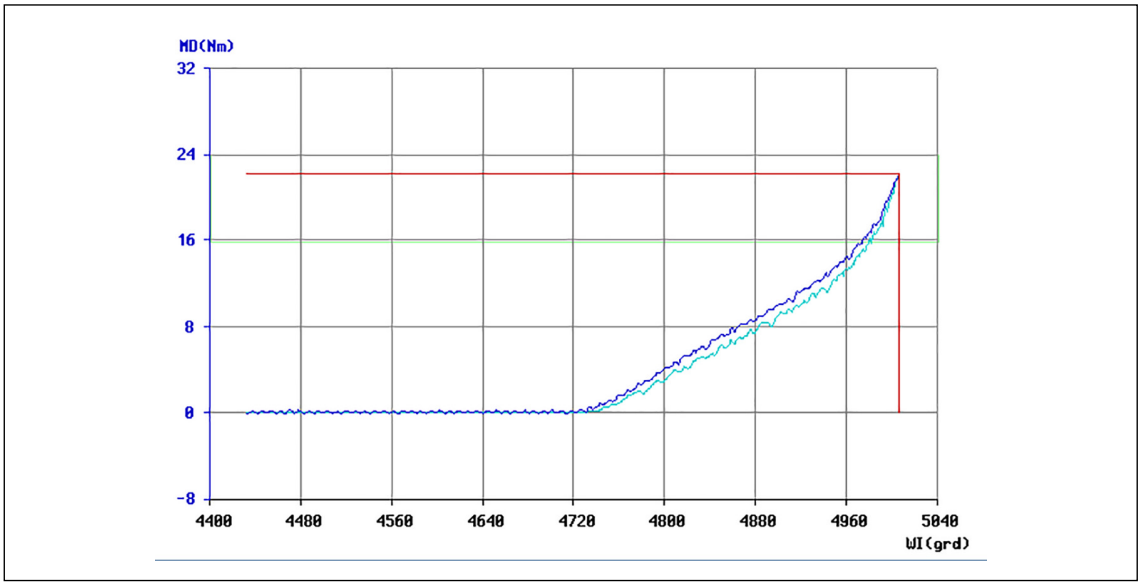


Fig. 4-5: The Torque graph view with the redundancy curve displayed in light blue color

4.5.4 Torque graph for fastening sequences 41 and 46

The *Torque graph* is enabled for fastening sequences 41 and 46. Recording for the graph begins with the start of fastening. No recording occurs during TA time because torque measurements are suppressed during these periods. Special inputs for trigger torque or threshold torque (start of angle count) are not provided. The graph is generated based on the residual torque as in sequence 48.

5 Standard Application Builder

In the *Standard Application Builder*, you can program fastening processes that are not covered in the *Basic Application Builder*.

▶ Select *Navigator* > *Standard*.

You select the tool group and application to be programmed from the *Tool Groups* and *Applications* menus. The selected tool group and application are displayed in the window's title bar. The *Options* menu allows you to copy parameters from other tool groups and applications.

Menus

Option	Description
Options	• Copy existing parameter values between tool groups • Abort
Tool Groups	• Select tool group to be programmed • Set left rotation speed (see chapter *5.10 Settings for speed left rotation, page 45*)
Applications	• Select application to be programmed
Settings	• Activate tools for the selected application • Access fastening stage settings for the selected application • Set fastener IDs (see chapter *5.11 Fastener IDs, page 46*) • Batch program (see chapter *5.13 Batch programming, page 48*) • Set Input/Output bitmask (see chapter *5.14 Input / Output bitmask, page 50*)
Groups	• Set up fastening groups for multi-tool applications

App settings summary

This section displays parameters that are valid for the entire application.

Option	Description
Application name	Enter a text string of your choice in the text box to name your application.
Fastening groups	Indicates if fastening groups are enabled for the current application.
Data Transmission	**- Not available in current software version -** Depends on the software. Indicates which communication protocol is installed.
Statistic	**- Not available in current software version -** Shows if statistics are activated for at least one tool in this application. If so, the first tool with programmed fastening stage is displayed.

Fastening stages summary

This section indicates which stages are scheduled for fastening and display. Items show as active if they are activated for at least one tool.

Display is only indicated if the stage is activated (green = activated, red = deactivated). *Print* is not supported in the current software version.

Tool activation overview

This section indicates what tools are installed and which are activated.

Tools are only displayed if they have previously been entered in the configuration of the Tool List and Programmable I/O.

▶ If installed tools are not displayed, check the settings of the programmable I/O.

Tool activation overview items		
Tool installed	green = available red = selected, but not available	Indicates tool availability, i.e., whether or not a measuring board is present (hardware)
Tool activated	green = activated gray = deactivated yellow = dropped	You activate tools in the *Tool activation* dialog (<Tools> button or *Tool activation* option of *Settings* menu)

Only activated tools participate in the rundown of an application and are considered in the evaluation. Dropped tools are considered in so far as total NOK is evaluated.

5.1 Tool activation

In the *Tool activation* dialog, you select the installed tools to be used in your application. A tool is installed if its measuring board is present.

▶ Select *Navigator* > *Standard* > *Tools*.

For a tool to participate in the rundown sequence of an application and appear in the overall evaluation for the workpiece, it must be activated for that application. This means, that a single fastening station can employ various applications with differing tool activation to handle similar work pieces whose number of fastening points differ.

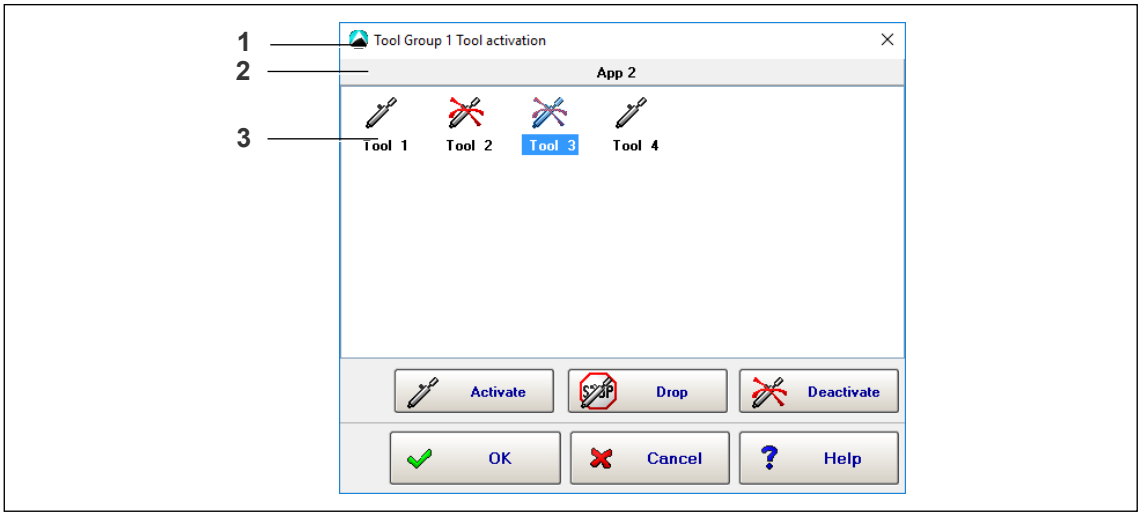


Fig. 5-1: The Tool activation dialog with the tools of Tool Group 1 used for Application 1. Tools 1 and 4 are activated, Tools 2 and 3 are deactivated. Tool 3 is currently selected.

Item	Description
1	Current Tool Group
2	Application you are programming
3	Installed hardware

The tool selected in the installed tools field (highlighted, blue background) can be activated or deactivated for the current application.

To activate a tool:

1. Select the required tool group and application from the *Tool Groups* and *Applications* menus of the *Standard Application Builder*.
2. Tap <Tools> to open the *Tool activation* dialog.
3. Tap the tool in the installed tools field to select it.
4. Tap <Activate>.
5. Tap <OK>.
6. Tap *Change* or *Discard* in the pop-up dialog to confirm or discard your changes.
7. Use the <Deactivate> or <Drop> button of the *Tool activation* dialog to deactivate or temporarily drop a tool.

Although dropped tools do not participate in a rundown, they are evaluated NOK (ABGW error) and linked to the overall evaluation.

5.2 Copying parameters

The Copy commands of the *Options* menu allow you to copy existing parameters.

▶ Select Navigator > Standard > Options

The following two *Copy* options are available:

- *Copy rundown parameters*: Copies parameters that relate to the tool group.
- *Copy fastening parameters*: Copies parameters that relate to the tool.

In the *Copy* dialogs, you can enter single values, lists (e.g.: 1/3/5), ranges (e.g.: 1-5), or combine these (e.g.: 1/3/5-8).

When you copy parameters, plausibility checks are performed. If a plausibility check fails, an error message is displayed.

5.3 Fastening program

The *Fastening program* dialog allows you to program the entire fastening sequences and all relevant fastening parameters in the selected application. In each application, each tool used (activated) must be programmed. Various copy functions support programming and reduce the effort required for entering parameters.

▶ Select *Navigator* > *Standard* > *Stages* to set up and activate fastening stages for the selected application.

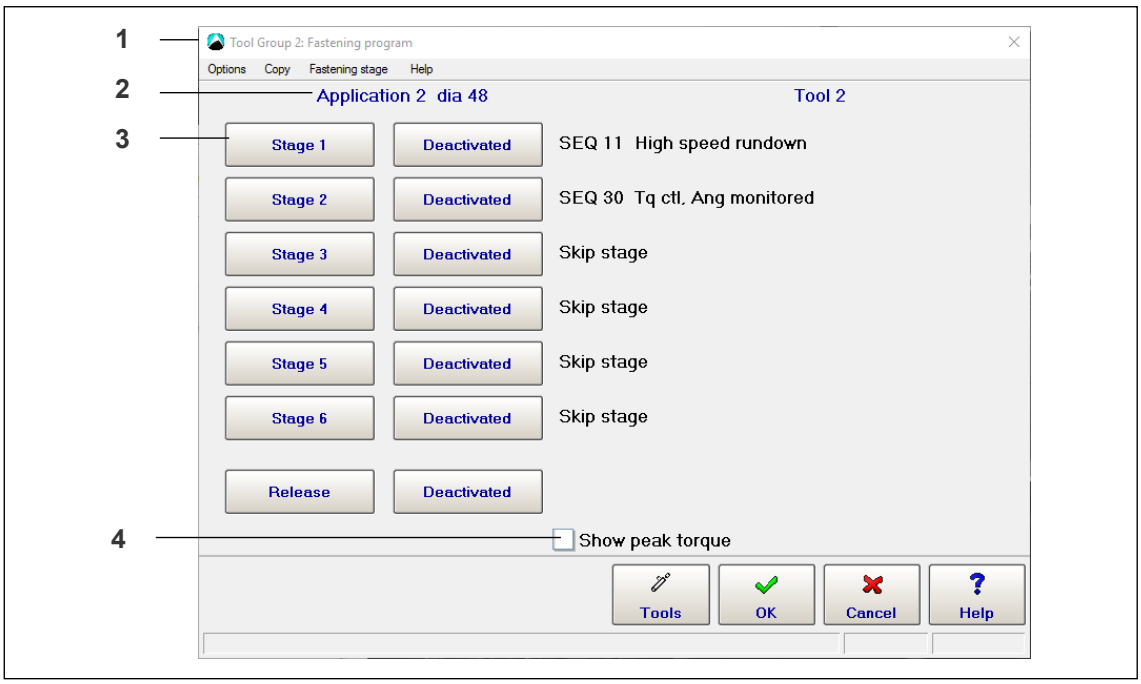


Fig. 5-2: The Fastening program window set for programming the stages of Tool 2 in Tool Group 2 for Application 2

Item	Description
1	Current Tool Group
2	Application and Tool you are programming
3	Stage n button: Opens the *Fastening stage programming* dialog for Stage n
4	Show peak torque option: Displays peak torque on *Run Screen*

This screen shows which stages are activated and, for each stage, which sequences are processed by the selected tool.

1. Tap <Activated> or <Deactivated> to define which stages are processed. This also defines the number of stages of the normal rundown (maximum six stages).
2. You must deactivate stages that are not needed.
3. Use the *Fastening stage* menu options or the <Stage n> buttons to access settings of individual stages.

For a rundown to proceed, it does not matter which stages are processed and which are skipped.

- Therefore switch stages on and off as required during set-up.
- However, the stage number of each programmed stage is included in the rundown data documentation. This is why deactivated fastening stages are also recorded in the documentation.
- We recommend that you copy the stages back-to-back after set-up, to achieve an uninterrupted sequence beginning with stage one.

The activation of stages applies to the selected application including a releasing stage if programmed, i.e., *to all tools*. If you change one tool, the change automatically applies to all tools. Only the display of the programmed sequence is tool-related.

The *Copy* menu allows you to copy an entire fastening program tool by tool.

Copying from this menu includes all parameters to be entered in subordinate screens, i.e., the entire fastening stage program of a tool in this application.

Release

The releasing stage is used at the end of a rundown to prevent mechanic locking of the tool without loosening the joint.

The target values for the releasing stage are stored permanently in the control unit. If <Release> is activated, the tool automatically moves 3 degrees or 1/6 of the min torque of the last activated stage.

The evaluation of the releasing stage is shown in the *Tool monitor* only. The rundown data of the releasing stage cannot be printed, even in the event of an error. An error in the releasing stage increments the NOK rundown counter.

5.3.1 Load/save XMP application in XML

The *Fastening program* dialog provides controls to save the parameters of individual applications as an XML file and to load parameters of applications from an XML file. This allows you to copy an application, e.g., to install it on another controller.

▶ Select *Navigator* > *Standard* > *Stages* > *Options* > *Load application from XML*.

Save an application as an XML file

When you save the parameters of an application to an XML file, you can use them for any application, any tool, and on any Global Controller system.

To generate an XML file with all values saved for the required tool in the current application:

1. Select the *Select Tool* option from the *Options* menu of the *Fastening program* dialog to open the *Select Tool* dialog.
2. Select the required Tool in the *Select Tool* dialog.
3. Press <OK> and confirm to close the dialog.
4. Select the *Save application as XML* option from the *Options* menu of the *Fastening program* dialog to open the *Save XML parameters* dialog.
5. Navigate to the location where you want to save the XML file, enter a name for the file, and confirm to save the file and close the dialog.

Load an application from an XML file

To load an XML file with the parameters required for the current tool in the selected application:

1. Select the required Tool.
2. Select the *Load application from XML* option from the *Options* menu of the *Fastening program* dialog to open the *Load XML parameters* dialog.
3. Navigate to the location of the required XML file, select the required file, and confirm to load the file and close the dialog.

The parameters for error handling, touch-up, counter-clockwise rotation, tool activation, fastening group, and fastener IDs are not saved or loaded.

5.4 Fastening stage programming

▶ Select *Navigator* > *Standard* > *Stages* > *Stage n* to open the *Fastening stage programming* dialog.

The *Fastening stage programming* dialog allows you to:

- Select the fastening strategy,
- Enter time parameters, and
- Specify the sequence control for touch-ups and error handling.

Use the button controls or *Settings* menu options to access these features.

The parameters entered in this screen automatically apply to all tools in the selected stage. If you change one tool, the change automatically applies to all tools.

To select the stage to be programmed, either tap the <Select stage> button or select the *Select stage* option from the *Options* menu.

Use the <Copy> commands (*Copy* menu) to transfer parameters that apply to all tools to other stages.

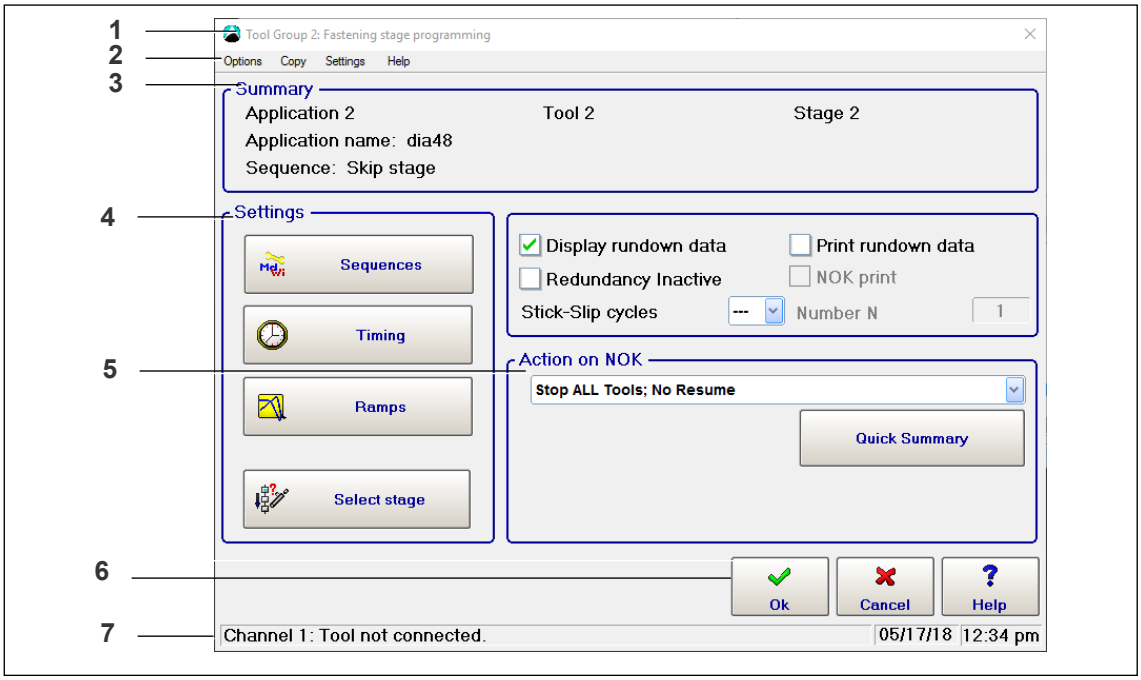


Fig. 5-3: The Fastening stage programming window set for programming Stage 2 of Tool 2 in Tool Group 2 for Application 2

The Fastening stage programming window consists of seven major parts:

Item	Description
1	Title bar
2	Menu bar
3	Summary
4	Settings
5	Action on NOK
6	Command buttons
7	Status bar

- The title bar displays the current tool group.
- The Summary section indicates the current application and its identifier, the current tool, the stage to be programmed, and the sequence currently selected for this stage.

Menus

Option	Description
Options	• Select stage to be programmed • Select tool • Abort
Copy	• Copy existing parameter values between different stages
Settings	• Program sequences and timing • Activate/deactivate error handling and touch-up • Reset NOK actions • Open Quick Summary NOK Actions window

Options

Option	Description
Display rundown data	Displays the current fastening stage in the *Rundo*wn data table (*Run Screen > Visualization > Rundown Table*). The Tool monitor (*Run Screen > Visualization > Tool monitor*) is processed independently of this function.
Redundancy Inactive	Disables redundancy for this stage.
Stick-Slip cycles	Sets number of stick-slip cycles for this stage. Stick-slip monitoring is only available for sequences 31 and 51.
Print features	**- Not supported in the current software version -** • *Print rundown data* prints the results of this stage. • *NOK print* prints tools of this stage that have NOK results. • *Number N* defines the rundown interval at which this stage is to be printed. The results for all tools are printed. ▶ Enter N = 1 if you want to print this stage for every rundown. ▶ Enter N = 0 if you only want to print tools with NOK results.

5.5 Rundown programming

The *Rundown programming* dialog allows you to enter rundown parameters.

▶ Select *Navigator* > *Standard* > *Stages* > *Stage n* > *Sequences*.

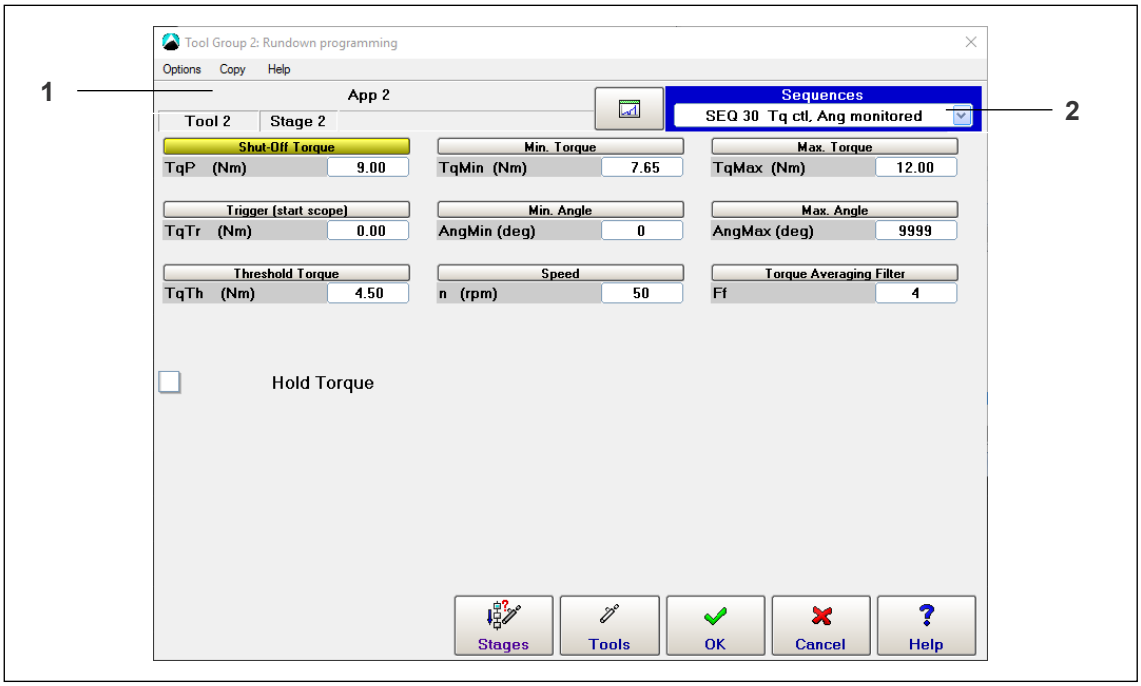


Fig. 5-4: The Rundown programming window set for programming Stage 2 of Tool 2 in Tool Group 2 for Application 2

Item	Description
1	Current Application and its identifier
2	Sequence selected

Since the parameters displayed depend on the selected sequence, you first select the sequence you want to program.

To select the sequence to be programmed:

1. Tap the Sequences drop-down menu.
2. Select the required sequence from the menu.
   Select *Skip stage* from the *Sequences* drop-down menu if you want to program the sequence without a fastening action in this stage for this tool. This option is also needed because stage activation generally applies to tools (see chapter *5.4 Fastening stage programming, page 25*).

The Global Controller also provides a graphical view of Rundown programming:

▶ Tap the  button to the left of the *Sequences* drop-down menu to switch views.

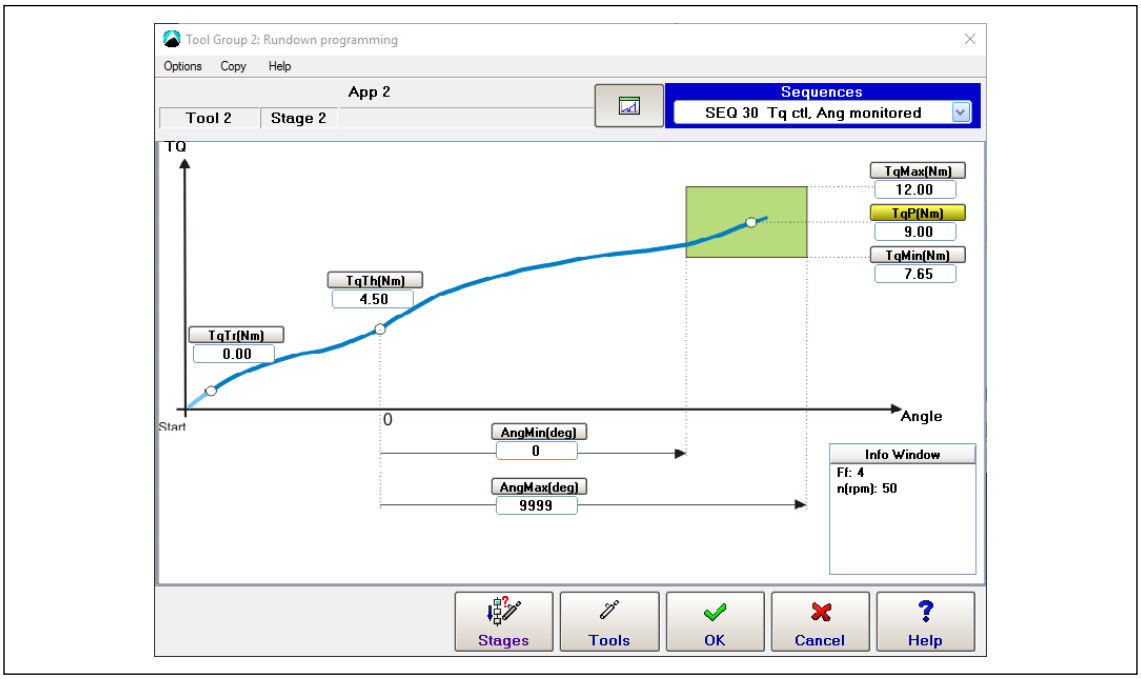


Fig. 5-5: The graphical view of the Rundown programming window

5.5.1 Fastening strategy and related parameters

Target values leading to the completion of a fastening stage are highlighted in yellow.

When a shut-off criterion is reached, the tool stops. The shut-off criterion is usually the target value (e.g., *Shut-off angle ANG*). In the event of an error, shut-off is initiated by a monitoring value (e.g., *Max. Angle AngMax*), the *Fastening time Tmax*, or another error (e.g., in the servo).

The initial torque result is the value TQ reached at shut-off. If the torque continues to rise during *Dwell time TN* (if programmed) due to the kinetic energy of the tool, the highest value reached during dwell time (peak value memory) is displayed and used for min/max evaluation.

The initial angle result is the value ANG reached at shut-off. If, during *Dwell time TN*, further angle pulses occur in the rotation direction programmed for the sequence due to the kinetic energy of the tool, these are counted in and the total result is displayed and used for min/max evaluation. The programmed rotation direction depends on the sequence selected.

Range of values

The value ranges shown in the parameter tables of the rundown sequences (see also the *System description: Fastening technology* manual) represent the general input ranges for the respective parameters. These ranges are checked when you close *Rundown programming*.

If a value is out of range or not plausible, the program displays an error message and returns to *Rundown programming*.

Additional limitations result from process-related interdependencies of the parameters, e.g., Min. Torque TqMin must not be higher than *Max. Torque TqMax*. These interdependencies are also examined in a plausibility check when you close *Rundown programming*.

Detailed information on fastening sequences is available in *System description - Fastening technology* (Manual P1730PM).

Moreover, values entered may be rejected because they exceed the values allowed for the tool as defined in the *Tool constants*.

The Tool constants must be set correctly. Refer to the data sheets of the tools for the correct values.

If value ranges or plausibility are violated, the user is alerted to the cause of the error, e.g.:
Error: Torque TqMax = 9.50 Nm < TqMin = 10.62 Nm

When fastening parameters are copied to **another** tool, a plausibility check against the *Tool constants* of the target tool is made. If an error occurs, the copying is terminated and an error message displayed. To ensure successful copying, you must either change the *Tool constants* of the target tool or the parameters of the tool currently selected.

When fastening parameters are copied to **all** tools, a plausibility check against the *Tool constants* of all these tools is made. If an error occurs, an error message is displayed. If a tool shows values that are not plausible, the program suggests to either stop copying or continue nonetheless. You must subsequently change either the *Tool constants* or the parameters for the target tool. The parameters are copied to all other tools.

5.5.2 Socket slip-off monitoring

In *socket slip-off* or *Nut slip off*, the socket inadvertently slips off the fastener head during a rundown. The torque therefore drops sharply and then rebounds when the tool reengages after some degrees, e.g., 30 or 60 degrees. Actual behavior depends on the fastener or on how much additional force the operator applies to the fastener through the tool.

If the socket slips off after the *Threshold Torque* has been exceeded, the measured angle is not fully applied to fastening and, therefore, correct fastening is not guaranteed.

Socket slip-off monitoring is only available with Sequences 31 and 51. If socket slip-off is detected, the fastening sequence is aborted with NOK.

Programming socket slip-off monitoring

▶ Select *Navigator* > *Standard* > *Stages* > *Stage n* > *Sequences*.

To program socket slip-off monitoring, you enter a minimum torque (*Nut Slip Off TqMin* = *TqMinNS*) and a minimum angle (*Nut Slip Off AngMin* = *AngMinNS*) in the *Rundown programming* dialog for fastening sequence 31 or 51. The software does not run a plausibility check on the values entered for these parameters.

When the detected torque drops below the programmed torque (TqMinNS) during the rundown sequence, the angle is measured. You can distinguish between the following two cases:

- If the torque remains below *TqMinNS* until the programmed angle limit (*AngMinNS*) is reached, fastening is aborted and evaluated NOK.
- If the torque rises again above *TqMinNS* before the programmed angle limit (*AngMinNS*) is reached, fastening continues.

This functionality is activated when the Threshold Torque is reached and other preconditions (*Block Angle*, front Evaluation Angle Offset) are met for fastening sequences 31 and 51.

The angle count for socket slip-off monitoring is independent of the general angle count of the fastening sequence. It only continues as long as the torque remains below *TqMinNS*, and it is reset to zero when the torque rises above this level again.

The measuring board software does not distinguish between socket slip-off and stick-slip based on angle. Since episodes do not cumulate for the fastening sequence, stick-slip does not necessarily cause the fastening sequence to be canceled. It is only canceled for stick-slip if the programmed angle limit is exceeded in a stick-slip pulse.

5.6 Fastening stage timing

The timing programmed in the *Fastening stage timing* dialog automatically applies to all tools in the current stage of the selected application and tool group. If you change the timing of one tool, the changes apply to all tools in the selected application and tool group.

▶ Select *Navigator* > *Standard* > *Stages* > *Stage n* > *Timing*.

Copy commands of the *Copying* menu transfer the timing parameters, which apply to all tools, to other fastening stages or applications.

You cannot copy the timing parameters to other tool groups.

When you close *Fastening stage timing*, the parameters entered are checked for agreement with the permitted value ranges.

If a value is out of range, the program displays an error message and returns to *Fastening stage timing*.

5.6.1 Fastening stage timing parameters

Parameter	Description
Fastening time (Tmax) 0...60,000	• Monitors the maximum duration of a rundown. TV (Start delay time) and TN (Dwell time) are not monitored by Tmax. • Tmax > TA + fastening time + TN • *Fastening time* begins with tool start. If no shut-off criterion is reached at the end of *Fastening time*, the sequence is terminated (safety shut-down) and evaluated NOK (Tmax: Terminated because Fastening time is exceeded). • Tmax must always be set to a value greater than 0. • The shut-off criteria are constantly checked, not only after timeout of Tmax.
Start pulse suppression (TA) 0...999	• Time beginning with tool start during which the torque is not recorded. For safety reasons, the calibration value is continuously monitored to ensure it is not exceeded. • During startup, the inertia moments in the tool generate a torque impulse at the transducer. To avoid misinterpretations in the rundown sequence, this should not be measured and evaluated.
Start delay time (TV) 0...60,000	*Delays tool start.* • Use *Start Delay Time* at the beginning of a stage to program wait time between stages. If grouping is activated, the delay time is not available here because it is defined for the entire group.
Marking time (TF) 0...60,000	• Sets duration of color marking after OK rundown. • At the end of an OK rundown, the output *Color* at the I/O level is set for the marking time programmed in the last stage to be processed. The output is designed for direct control of a color marking system for OK rundowns. The marking times of the other stages will be ignored.
Dwell time (TN) 0...999	• Measuring time after shut-off of the tool. • Due to the kinetic energy of the tool, rotation may briefly continue after shut-off, which causes torque and angle to increase and therefore measurement to continue during *Dwell time*. Only the peak torque and the nominal rotation direction of angle pulses are detected during *Dwell time*!

If a value range is violated, the user is alerted to the cause of the error, e.g.:
Error: Start Delay Time = 9999 ms is larger than max val. 60000

5.7 Ramps

The *Ramps* dialog provides features that allow you to better control the *Speed Ramp-up* and *Speed Ramp-down* of a stage.

▶ Select *Navigator* > *Standard* > *Stages* > *Stage n* > *Ramps*.

Ramp functionality is supported by Tool/Measuring card firmware Version 314 or newer.

Parameter	Description
Speed Ramp-up	
Ramp-up time [ms]	Time to accelerate tool to the speed programmed for a stage (usually Stage 1 or any stage after a stop).
Speed Ramp-down	
Activate	Enables the *Speed Ramp-down*.
Begin Ramp-down [%]	Percentage of *Shut-off Torque* (sequences 11 and 30) or *Max. Torque* (sequence 50) where *Speed Ramp-down* begins.
Use Default for Target Speed	Uses the default value for the *Target Speed*, which is the speed programmed for the next stage or 5% of maximum tool speed if a stop is required.
Target Speed [RPM]	Sets the speed to be reached after the *Speed Ramp-down* at shut-off. From the beginning of the ramp-down, the speed is reduced in 30 steps to the *Target Speed*.
Flex-Stop (after shut-off)	
Activate	Enables the *Flex-Stop* or soft stop. Duration depends on maximum Flex-Time (1s or programmed value) and torque (drop below 2% of calibrated value).
Flex-Stop [%]	Percentage of duration for the *Flex-Stop*. The higher the percentage, the longer it takes to relieve torque after shut-off.
Max Flex-Time [ms]	Maximum permissible time for the *Flex-Stop* to reduce the torque after a shut-off.

5.8 Extension of stick-slip behavior (Sequences 31 and 51)

In stick-slip, slipping and sticking occurs during a rundown due to friction under the fastener head. The torque therefore fluctuates sharply. To avoid errors, current redundancy is turned off for a few ms, and speed is reduced to 4% of maximum speed.

A stick-slip flank is detected during a rundown if the currently measured torque is more than 4 % of the calibrated value below the peak torque of the last 16 torque measurements. Stick-slip monitoring is activated independently of the *Threshold Torque*. The time between two stick-slip flanks must be at least 3 ms. If another event occurs within less than 3 ms, it will not be considered a separate flank.

Depending on underhead friction, material characteristics, etc., periods of many stick-slips rather than just a few may occur as illustrated in the following diagram:

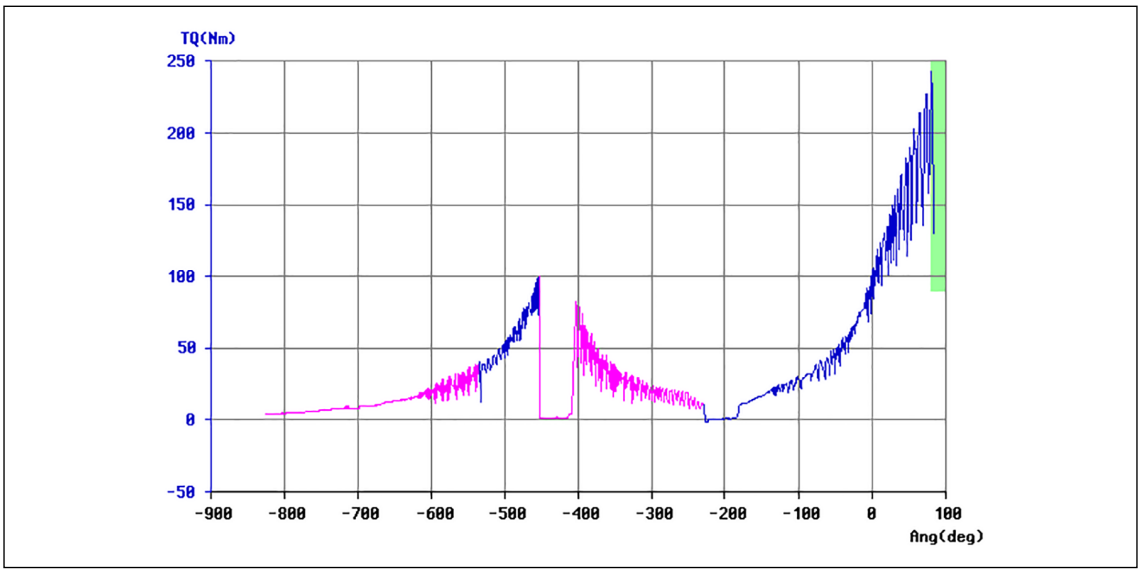


Fig. 5-6: Torque graph showing many stick-slip flanks

When so many torque peaks occur, the tool needs to be stopped because reliable torque and angle measurements are no longer possible. You can therefore set the maximum number of flanks or *Stick-Slip cycles* allowed for a fastening stage. If this number is exceeded, the tool is turned off with NOK and Error SS>.

Programming stick-slip monitoring

1. Select *Navigator* > *Standard* > *Stages* > *Stage n* to access the *Stick-Slip cycles* drop-down menu.
2. Tap the *Stick-Slip cycles* drop-down menu, and select the number of stick-slip flanks allowed for the current stage.
   - You can select a number from 1 to 9.
   - Select the value "---" if you want to disable stick-slip monitoring for the current stage.

No other parameters are required.

5.9 Action on NOK

The F*astening stage programming* dialog includes features to control Action on NOK. The *Action on NOK* drop-down menu provides five options to control tool functionality if a rundown reaches an NOK condition. The default option is *Stop All Tools； No Resume*.

▶ Select *Navigator* > *Standard* > *Stages* > *Stage n* to access the *Action on NOK* drop-down menu.

Option	Description
Stop All Tools; No Resume	Disables ALL tools in current group if NOK occurs in current stage. Touch-up and error handling ignored in subsequent stages.
Continue with Next Stage	Ignores NOK and continues with next stage of application. Touch-up and error handling ignored in subsequent stages.
Stop NOK Tools; No Resume	Disables tools with NOK status in current stage.
Perform Touch-up / Error Handling	Performs specified touch-up operation if enabled in current stage, then proceeds to next stage if OK rundown occurs during touch-up/error handling operation.
Stop NOK Tools; Resume on Touch-up /Error Handling	Disables tools with NOK status from participating in further stages unless/until touch-up and/or error handling are/is enabled in a subsequent stage.

5.9.1 Touch-up and error Handling

The NOK strategy comprises touch-up and error handling. After touch-up another fastening stage may be started while error handling leads to the end of the process. You can therefore back off joints in a touch-up routine and retighten them during the remainder of the fastening sequence to achieve an OK rundown. Since no additional fastening stage can follow an error handling routine — the rundown is terminated with NOK — it is often used to fully back off the fasteners.

Touch-up and error handling can be programmed separately for each fastening stage, i.e., group assignments and back-off parameters can be entered in each stage for both touch-up and error handling. Touch-up is performed immediately after the end of a fastening stage. Error handling can be initiated by any fastening stage, but is performed after the last fastening stage using the stage-related back-off parameters.

- Groups can be programmed for touch-up and error handling. Subsequent to touch-up, a preset stage may be started. Error handling leads to the end of the process.
- Separate back-off parameters can be programmed for each fastening stage and for both touch-up and error handling.
- Each tool can be assigned to more than one touch-up group.

Perform Touch-up/Error Handling option

The *Perform Touch-up/Error Handling* option of the *Action on NOK* drop-down menu provides access to a touch-up and error handling routine to handle errors. This is the only option of the *Action on NOK* drop-down menu that allows for this touch-up and error handling functionality. With the option selected, you can enable the *Error Handling upon NOK* and *Touch-up upon NOK* features.

To select the *Perform Touch-up/Error Handling* option and access the *Error Handling upon NOK* and *Touch-up upon NOK* features:

1. Select *Navigator* > *Standard* > *Stages* > *Stage n*.
2. Tap the *Action on NOK* drop-down menu and select the *Perform Touch-up/Error Handling* option.
3. To access the *Error Handling upon NOK* dialog or *Touch-up upon NOK* dialog:
   - Tap the <Error handling inactive> or <Touch-up inactive> button, which is now displayed below the *Action on NOK* drop-down menu, or
   - Tap the *Error handling inactive* or *Touch-up inactive* menu option, which is now enabled in the *Settings* menu.

Error Handling upon NOK feature

Option	Description
Not enabled	If an NOK occurs in this fastening stage, the sequence continues with the next stage.
Enabled	If a previously set number of NOK rundowns occurs in the current and previous fastening stages (the number of NOK rundowns can be programmed for groups), error handling with stage-related back-off parameters follows after the last fastening stage.

To enable the *Error Handling upon NOK* feature:

1. Select *Navigator* > *Standard* > *Stages* > *Stage n*.
2. Tap the *Action on NOK* drop-down menu and select the *Perform Touch-up/Error Handling* option.
   - The <Error handling inactive> button is now displayed below the drop-down menu.
   - The *Error handling inactive* option is now enabled in the *Settings* menu.
3. Tap the <Error handling inactive> button or option to display the *Edit error handling* dialog.
4. Tap the *Error Handling upon NOK* checkbox to enable the feature.
5. Tap the <OK> button.

Touch-up upon NOK feature

Option	Description
Not enabled	If an NOK occurs in this fastening stage, the sequence continues with the next stage. NOK tools may participate in error handling if this has been programmed (<Error Handling upon NOK> enabled).
Enabled	If a previously set number of NOK rundowns occurs in the current and previous fastening stages (the number of NOK rundowns can be programmed for groups), the programmed process stops and touch-up starts.

To enable the *Touch-up upon NOK* feature:

1. Select *Navigator* > *Standard* > *Stages* > *Stage n*.
2. Tap the *Action on NOK* drop-down menu and select the *Perform Touch-up/Error Handling* option.
   - The <Touch-up inactive> button is now displayed below the drop-down menu.
   - The *Touch-up inactive* option is now enabled in the *Settings* menu.
3. Tap the <Touch-up inactive> button or option to display the *Edit touch-up* dialog.
4. Tap the *Touch-up upon NOK* checkbox to enable the feature.
5. Tap the <OK> button.

Additional features of the Edit error handling and Edit touch-up dialogs

Option	Description
Display rundown data	The rundown data recorded is shown in the rundown data table during production.
Print rundown data	The rundown data recorded is sent to a printer after production (end of sequence).
NOK print	The measured values are printed only if no OK is reached in this stage.
Number N	This stage is printed for every Nth workpiece. The results of all tools are printed. Enter N =1 if you want to print this stage for every workpiece.
Max. tightening time Tmax (ms)	Enter the maximum tightening time allowed for the error handling/touch-up stage. When this time is exceeded, the sequence is terminated with NOK.
Repeat from stage (can be edited for touch-up only)	Enter the fastening stage from which you want to resume the sequence after touch-up.

5.9.2 Quick Summary NOK Actions

The *Quick Summary NOK Actions* dialog lists all applications with Action on NOK conditions for all installed tools in the current tool group.

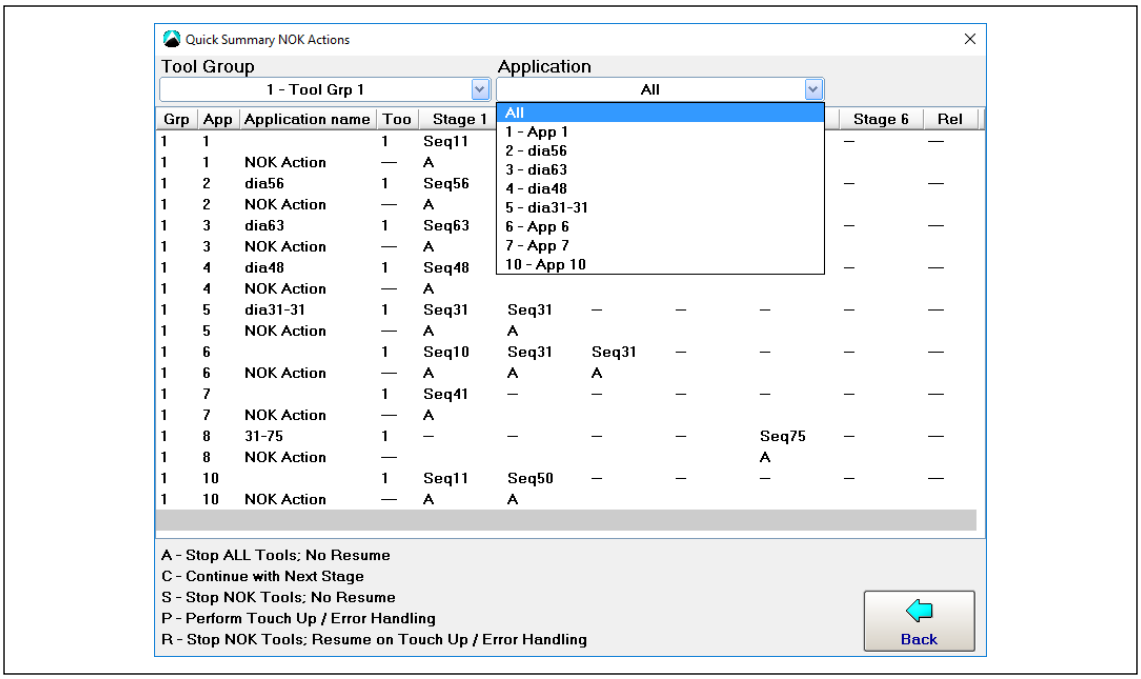


Fig. 5-7: Quick Summary NOK Actions window

To access a Quick Summary NOK Actions list:

1. Select *Navigator* > *Standard* > *Stages* > *Stage n*.
2. In the *Fastening stage programming* dialog:
   - Tap the <Quick Summary> button in the Action on NOK section of the window, or
   - Select the *Quick Summary* option in the Settings menu.
3. Tap the *Tool Group* drop-down menu and select the required tool group.

5.9.3 Touch-up and error handling groups and parameters

To provide maximum flexibility, the touch-up and error handling features allow for extensive programming. The <Groups> and <Parameters> buttons of the *Edit touch-up* and *Edit error handling* dialogs provide access to this functionality:

Button	Description
	The <Groups> buttons of the *Edit touch-up* and *Edit error handling* dialogs open the *Touch-up groups* and *Error Handling groups* dialogs.
	The <Parameters> buttons of the *Edit touch-up* and *Edit error handling* dialogs open the *Touch-up back-off parameters* and *Error handling back-off parameters* dialogs.

Touch-up groups dialog and Error Handling groups dialog

The dialogs display a list of touch-up or error handling groups. In the rightmost field of the list, you assign tools (each represented by a numbered table column) to touch-up or error handling groups (each represented by a table row). You can assign each tool to any number of touch-up or error handling groups. Use the <Edit> button to select or deselect tools.

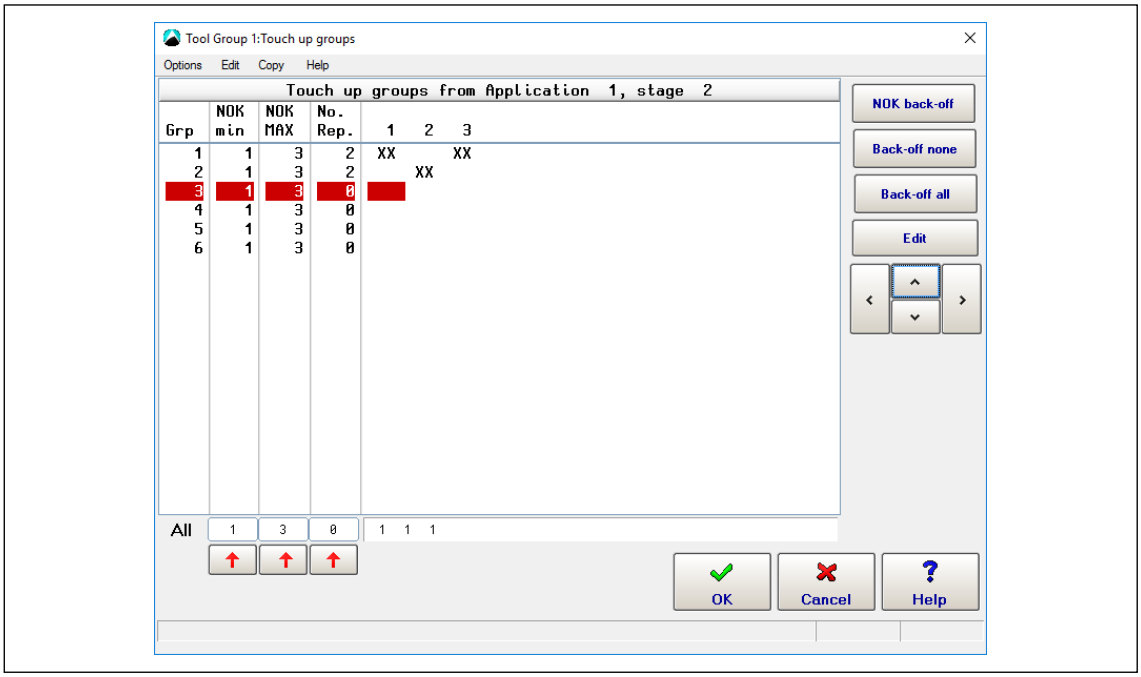


Fig. 5-8: Touch-up groups dialog with six touch-up groups (represented by table rows) and three tools (represented by table columns no. 1-3)

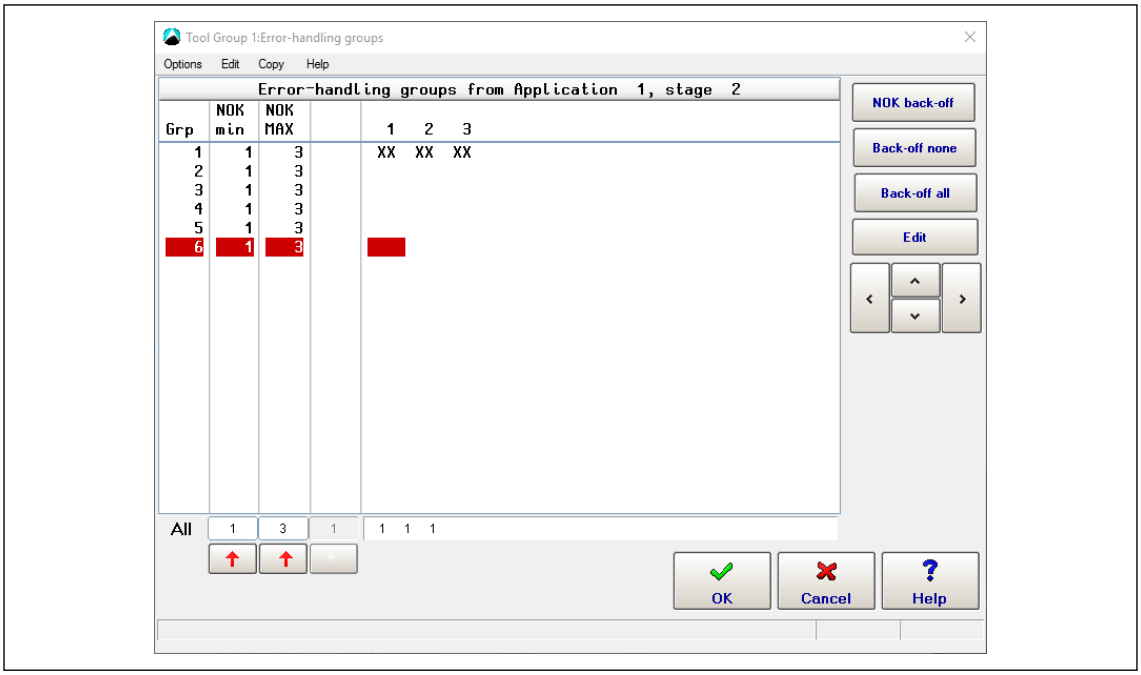


Fig. 5-9: Error Handling groups dialog with six error handling group (represented by table rows) and three tools (represented by table columns no. 1-3)

To access the *Touch-up groups* dialog or *Error Handling groups* dialog:

1. Select *Navigator* > *Standard* > *Stages* > *Stage n*.
2. Tap the <Touch-up active> or <Error handling active> button in the *Action on NOK* section of the Fastening stage programming window to open the *Edit touch-up* or *Edit error handling* dialog.
3. In the *Edit touch-up* or *Edit error handling* dialog:
   - Tap the <Groups> button, or
   - Select the *Edit groups* option from the *Edit* menu.

Features of the *Touch-up groups* and *Error Handling groups* dialogs

Parameter	Description
NOK min, NOK max	Touch-up or error handling is only performed if the number of NOK tools in a touch-up or error handling group is within the range of *NOK min* and *NOK max*.
No. Rep. (number of repeats NOK = number of reruns) (only in Touch-up groups dialog)	During the entire fastening sequence, a counter is updated, which increments for each touch-up routine. If the value set in the No. Rep. column is exceeded for a tool in a touch-up group, the touch-up group no longer participates in the touch-up for this fastening sequence. The counter is reset prior to the next fastening sequence.
<NOK back-off>, <Back-off none>, and <Back-off all> buttons and Edit menu options	These commands adjust group settings for standard strategies. NOK min and NOK max are set accordingly. You must set the No. Rep. counter as required.
Copy menu	Copy data from a stage or to a stage. Only the data of the current screen is transferred.

To enter values in the *Touch-up groups* table or *Error Handling groups* table:

1. Select the required stage: *Options* menu (Select stage option) > Select stage dialog.
2. In the *Touch-up groups* dialog or *Error Handling groups* dialog, use the <Up> and <Down> arrow buttons to highlight the touch-up or error handling group you want to program.
3. For the parameter you want to change, tap the text box at the bottom of the parameter's column.
4. Use the virtual keyboard, which is now displayed, to enter the required value.
5. If you tap the ↑ button at the bottom of the column, the value for the highlighted touch-up or error handling group is copied to all touch-up and error handling groups.

This feature was developed with maximum flexibility in mind. Since it allows for detailed programming, it may seem less intuitive at first. For most purposes, only back-off of either the NOK tools or all tools is needed. The standard programs provide this functionality and can be accessed through buttons and *Edit* menu options for fast and easy programming. Greater familiarity with the subject is only required if you need more elaborate responses to NOK events.

***Touch-up back-off parameters* dialog and *Error handling back-off parameters* dialog**

Parameter	Description
Shut-Off Angle	Back-off angle
Angle Low Limit	Lower limit of angle reached
Angle High Limit	Upper limit of angle reached
Speed	Speed preselection; range of maximum speed specified in the Tool constants

5.9.4 Algorithm of touch-up/error handling

To program complex touch-up and error handling routines, refer to the following internal processing algorithm:

1. Check group assignment for touch-up
   Beginning with group 1, the program checks if the tools in this group will be assigned to touch-up. This is the case if:
   - at least *NOK min* tools in the group are NOK, and
   - no more than *NOK max* tools in the group are NOK, and
   - the *number of reruns* has not been exceeded for any tool in the group.

   The *number of reruns* indicates how often touch-up can be performed with a given tool. The program updates a counter *(No. Rep.*, number of repeats NOK) across all stages for each tool. It is incremented for each touch-up performed.

   Tools are removed from touch-up if *NOK min* and *NOK max* are met, but the value of the *No. Rep.* counter has been reached. This can result in tools being removed from touch-up after they have been assigned to touch-up by groups with higher index numbers. Please pay special attention to examples 3 and 5 below, which illustrate this.
2. Check group assignment for error handling
   Beginning with group 1, the program checks if the tools in this group will be assigned to error handling. This is the case if:
   - at least one NOK tool in the group has not been assigned yet to touch-up, and
   - at least *NOK min* tools in the group are NOK, and
   - no more than *NOK max* tools in the group are NOK.

   As in touch-up, you can assign each tool to several error handling groups, and evaluation and assignment follows the index numbering of the groups.

3. Tools assigned to both touch-up and error handling are removed from touch-up.

   This can happen when a tool that has already been assigned to touch-up is assigned to error handling together with tools that have not been assigned to touch-up.

4. Additional tools may get assigned to error handling during subsequent stages.

   Touch-up is executed right after an episode. Error handling is executed just before the end of the sequence. Subsequent fastening stages can therefore assign additional tools to error handling during the remainder of the fastening sequence.

5.9.5 Examples of touch-up and error handling

This section provides five examples for programming touch-up and error handling groups.

Example 1

- A 3-stage fastening sequence has been programmed.
- In fastening stage 2, touch-up and error handling have been programmed.
- After touch-up, fastening stage 1 is to be repeated.

The group assignment for touch-up and error handling is programmed as follows:

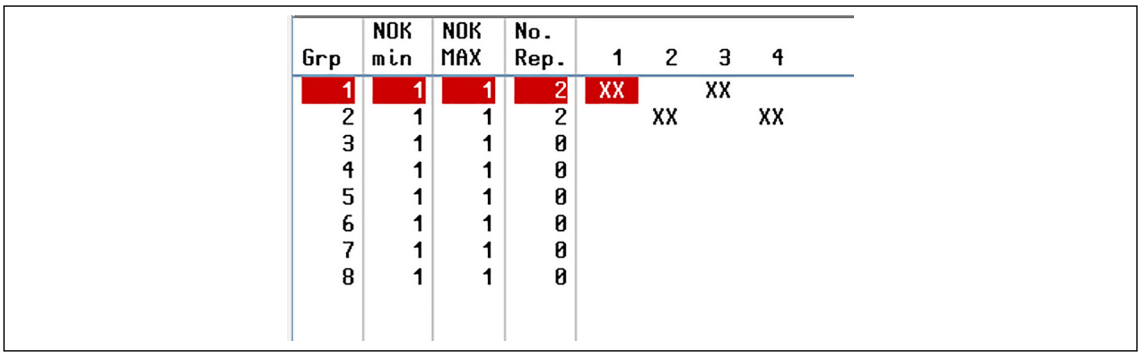


Fig. 5-10: Example 1 has two touch-up groups with two tools each

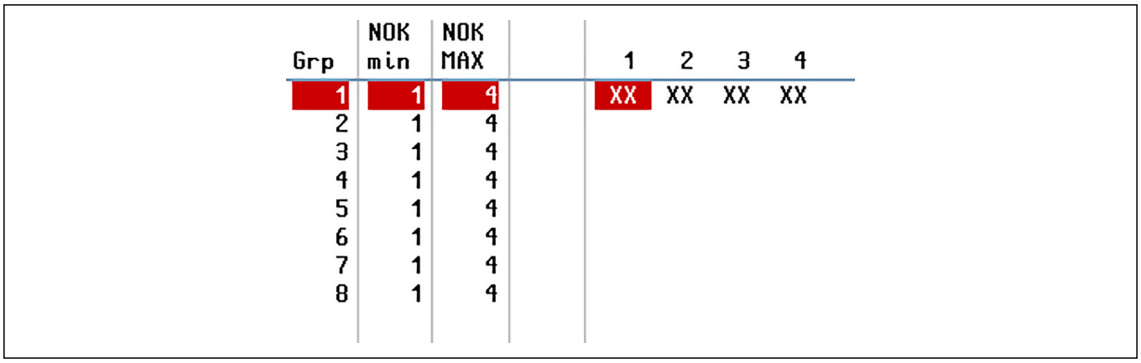


Fig. 5-11: Example 1 has one error handling group with all four tools assigned

Fastening sequence 1

Stage	Tool evaluation				Evaluation total	Remark
	01	02	03	04		
1	OK	OK	OK	OK	OK	Fastening stage 1
2	OK	OK	NOK	OK	NOK	Fastening stage 2, tool 3 - NOK
8[a]	OK	-	OK	-	OK	Touch-up stage 2 tools 1, 3 are backed off
1	OK	-	OK	-	OK	Repeat from stage 1 (as required)
2	OK	-	OK	-	OK	
3	OK	OK	OK	OK	OK	Total OK is reached

a. Stage 8 is used for back-off in touch-up

Fastening sequence 2

Stage	Tool evaluation				Evaluation total	Remark
	01	02	03	04		
1	OK	OK	OK	OK	OK	Fastening stage 1
2	OK	OK	NOK	OK	NOK	Fastening stage 2, tool 3 - NOK
8[a]	OK	-	OK	-	OK	Touch-up stage 2 tools 1, 3 are backed off
1	OK	-	OK	-	OK	Repeat from stage 1 (as required)
2	OK	-	NOK	-	NOK	Fastening stage 2, tool 3 - NOK
8[b]	OK	OK	OK	OK	OK	Touch-up stage 2 tools 1, 3 are backed off
1	OK	-	OK	-	OK	Repeat from stage 1 (as required)
2	OK	-	NOK	-	OK	Fastening stage 2, tool 3 - NOK
9[c]	NOK	NOK	NOK	NOK	NOK	Error handling stage 2 tools 1, 2, 3, 4 are backed off

a. Stage 8 is used for back-off in touch-up

b. Stage 8 is used for back-off in touch-up

c. Stage 9 is used for back-off in error handling

Since separate back-off parameters are entered for touch-up and error handling, you have the option to only loosen fasteners during touch-up and fully back them off during error handling.

Fastening sequence 3

Stage	Tool evaluation				Evaluation total	Remark
	01	02	03	04		
1	OK	OK	OK	OK	OK	Fastening stage 1
2	NOK	OK	NOK	OK	NOK	Fastening stage 2, tool 1, 3 - NOK
9[a]	NOK	NOK	NOK	NOK	NOK	Error handling: Touch-up is not performed since touch-up NOK MAX = 1.

a. Stage 9 is used for back-off in error handling

Example 2

For touch-up and error handling, the following back-off groups have been programmed for all fastening stages (shown for stage 1 here only). After touch-up, the fastening sequence is repeated from stage 1.

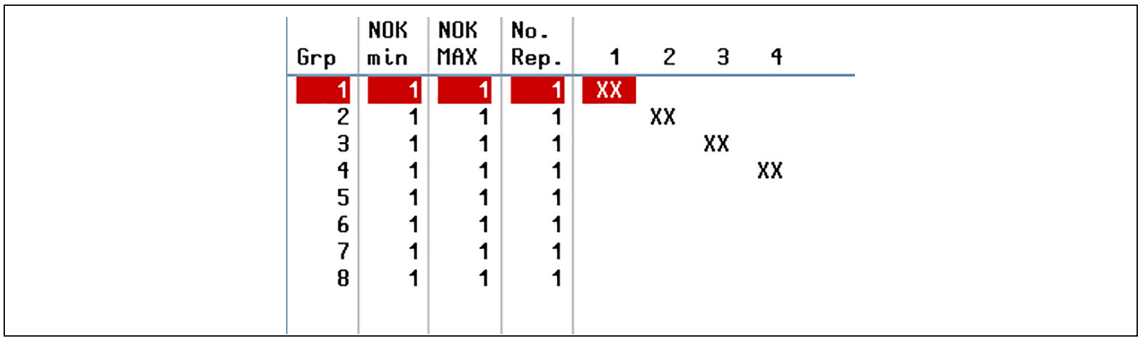


Fig. 5-12: Example 2 has four touch-up groups with one tool each

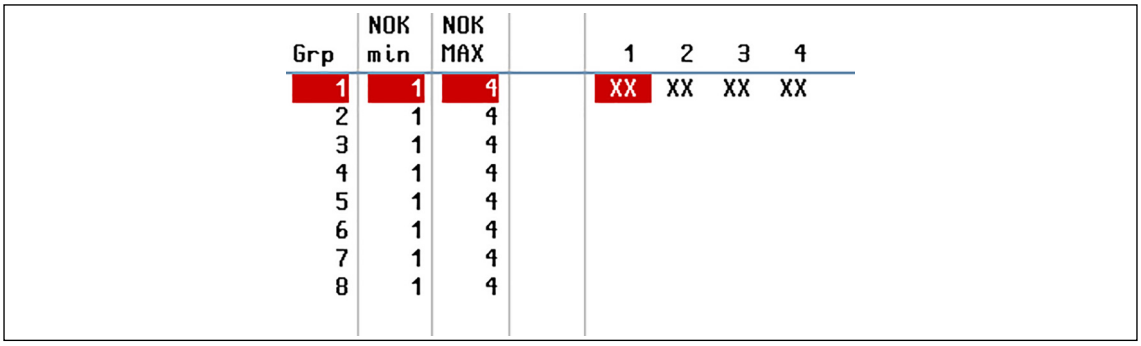


Fig. 5-13: Example 2 has one error handling group with all four tools assigned

- The group assignment for touch-up corresponds to the *NOK back-off* standard process. Each tool forms a separate touch-up group. Since *No. Rep.* (number of repeats/reruns) is set to *1* in each group, touch-up can be performed only once for each group.
- The group assignment for error handling corresponds to the *Back-off all* standard process. All tools are in one error handling group. If one tool is evaluated NOK, all tools are backed off.

The following illustrates this for an actual fastening sequence:

Fastening sequence

Stage	Tool evaluation				Evaluation total	Remark
	01	02	03	04		
1	OK	NOK	OK	OK	NOK	Tool 2 - NOK
8[a]	-	OK	-	-	OK	Touch-up tool 2
1	-	OK	-	-	OK	Repeat from stage 1 (as required)
2	NOK	OK	OK	OK	NOK	Tool 1 - NOK
8*	OK	-	-	-	OK	Touch-up tool 1
1	OK	-	-	-	OK	Repeat from stage 1 (as required)
2	OK	-	-	-	OK	
3	OK	NOK	OK	OK	NOK	Tool 2 - NOK
9[b]	NOK	NOK	NOK	NOK	NOK	Error handling: Touch-up is not performed since touch-up No. Rep. = 1. That is, touch-up is only performed once with this tool. During error handling, all tools are backed off.

a. Stage 8 is used for back-off in touch-up

b. Stage 9 is used for back-off in error handling

Example 3

For touch-up, the following has been programmed in all fastening stages:

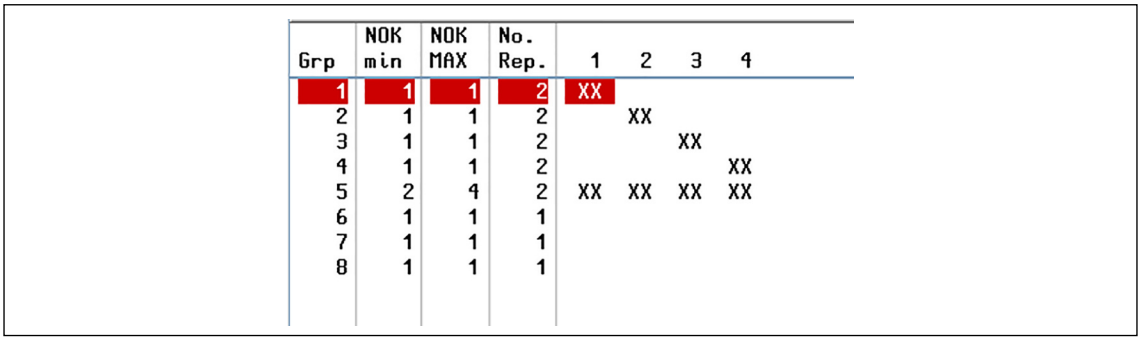


Fig. 5-14: Example 3 has five touch-up groups, i.e., four groups with one tool each and one group with all four tools assigned

Each tool belongs to more than one touch-up group. This achieves the following:

- If only one of the four tools (nos. 1-4) is evaluated NOK during a rundown, this tool performs touch-up. This is so because Group 5 only backs off all four tools if at least two tools are evaluated NOK (*NOK min* = 2).
- If at least two tools are evaluated NOK during a rundown, all four tools (nos. 1-4) participate in touch-up. Groups 1 through 4 assign individual NOK tools to touch-up. If at least two tools are assigned, the *NOK min* and *NOK Max* conditions of Group 5 are met and therefore all four tools assigned to touch-up.

Example 4

For touch-up, the following has been programmed in all fastening stages:

Grp	NOK min	NOK MAX	No. Rep.	1	2	3	4
1	1	2	1	XX	XX		
2	1	1	1				
3	1	1	1				
4	1	1	1				
5	1	1	1				
6	1	1	1				
7	1	1	1				
8	1	1	1				

Fig. 5-15: Example 4 has one touch-up group with two tools

Grp	NOK min	NOK MAX	1	2	3	4
1	1	4	XX	XX	XX	XX
2	1	4				
3	1	4				
4	1	4				
5	1	4				
6	1	4				
7	1	4				
8	1	4				

Fig. 5-16: Example 4 has one error handling group with all four tools assigned

For this application, *Touch-up upon NOK* and *Error Handling upon NOK* are required. The following outcomes are discussed below:

1. Tool 2 is evaluated NOK.
2. Tool 2 and Tool 4 are evaluated NOK.

1. If Tool 2 is NOK, two cases can be distinguished:

a) One of the two tools in the touch-up group (Tools 1 and 2) has already participated in touch-up during the previous fastening stage:
   - In this case, touch-up is not performed. Instead, error handling is performed for all tools (nos. 1-4) because Tool 2 is in one error handling group (Group 1) with Tool 1 and Tools 3-4.
   - This occurs because a counter is internally updated for each tool. Across all stages, the counter is incremented every time a tool participates in touch-up. Since *No. Rep.* (number of repetitions/reruns) is set to *1* for Touch-up Group 1, touch-up can only be performed if none of the tools in this group (Tools 1 and 2) have participated in touch-up during a previous fastening stage.
   - Note that *No. Rep.* may have a different value in another fastening stage, which would cause a different outcome for that stage.

b) None of the two tools (Tools 1 and 2) have participated in touch-up during the previous fastening stage: In this case, touch-up is performed for Tools 1 and 2. Since Tool 2 participates in touch-up, no error handling is performed.

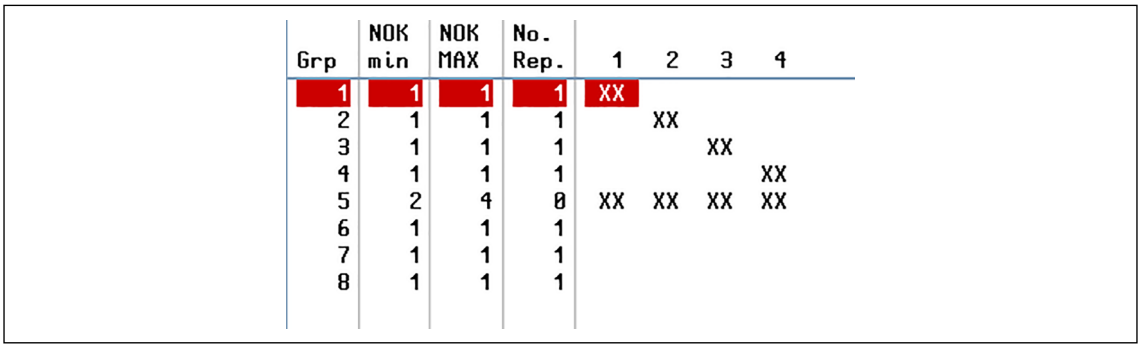
2. If Tool 2 and Tool 4 are NOK, error handling is performed:

Since Tool 2 and Tool 4 are in the same error handling group, this results in error handling for Tool 2. In this case, no touch-up is performed for Tool 2.

Example 5

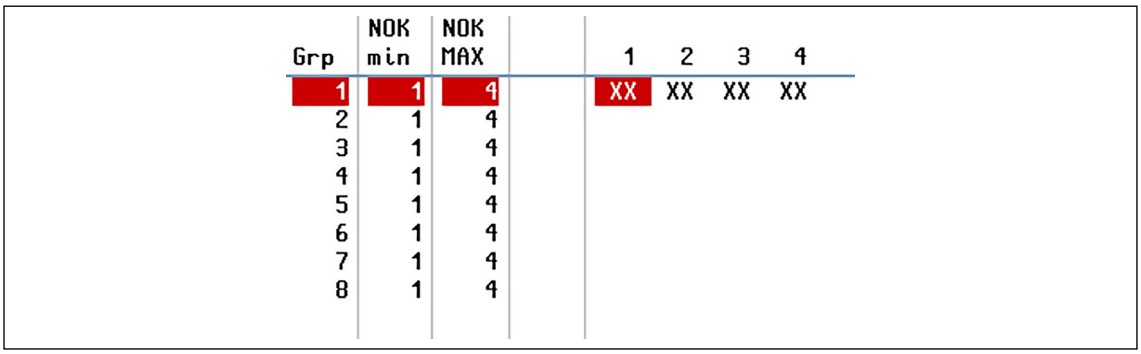
The following outcome is required:

- If only one tool is NOK, touch-up is performed for this tool.
- If two or more tools are NOK, error handling is performed.



Grp	NOK min	NOK MAX	No. Rep.	1	2	3	4
1	1	1	1	XX			
2	1	1	1		XX		
3	1	1	1			XX	
4	1	1	1				XX
5	2	4	0	XX	XX	XX	XX
6	1	1	1				
7	1	1	1				
8	1	1	1				

Fig. 5-17: Example 5 has five touch-up groups, i.e., four groups with one tool each and one group with all four tools assigned



Grp	NOK min	NOK MAX	1	2	3	4
1	1	4	XX	XX	XX	XX
2	1	4				
3	1	4				
4	1	4				
5	1	4				
6	1	4				
7	1	4				
8	1	4				

Fig. 5-18: Example 5 has one error handling group with all four tools assigned

Fastening sequence 1

Stage	Tool evaluation				Evaluation total	Remark
	01	02	03	04		
1	OK	NOK	OK	OK	NOK	Tool 2 NOK; Tool 2 is assigned to touch-up via group 2. There is no assignment to touch-up via group 5 since the NOK min value is not reached.
8	-	OK	-	-	OK	Touch-up tool 2
1	OK	OK	OK	OK	OK	Repeat from stage 1
2	OK	OK	OK	OK	OK	Total OK is reached

Fastening sequence 2

Stage	Tool evaluation				Evaluation total	Remark
	01	02	03	04		
1	OK	NOK	OK	NOK	NOK	Tool 2 NOK, tool 4 NOK. No touch-up is performed. Reason: Tool 2 is assigned to touch-up via group 2. Tool 4 is assigned to touch-up via group 4. In group 5, the *NOK min* and *NOK Max* conditions are met. Since *No. Rep.* is set to *0*, this group is not run in touch-up. The tools 2 and 4, which have already been assigned to touch-up, are removed from touch-up, i.e., these tools are considered in the evaluation for error handling.
9	NOK	NOK	NOK	NOK	NOK	Error handling tools 1–4

Flowchart

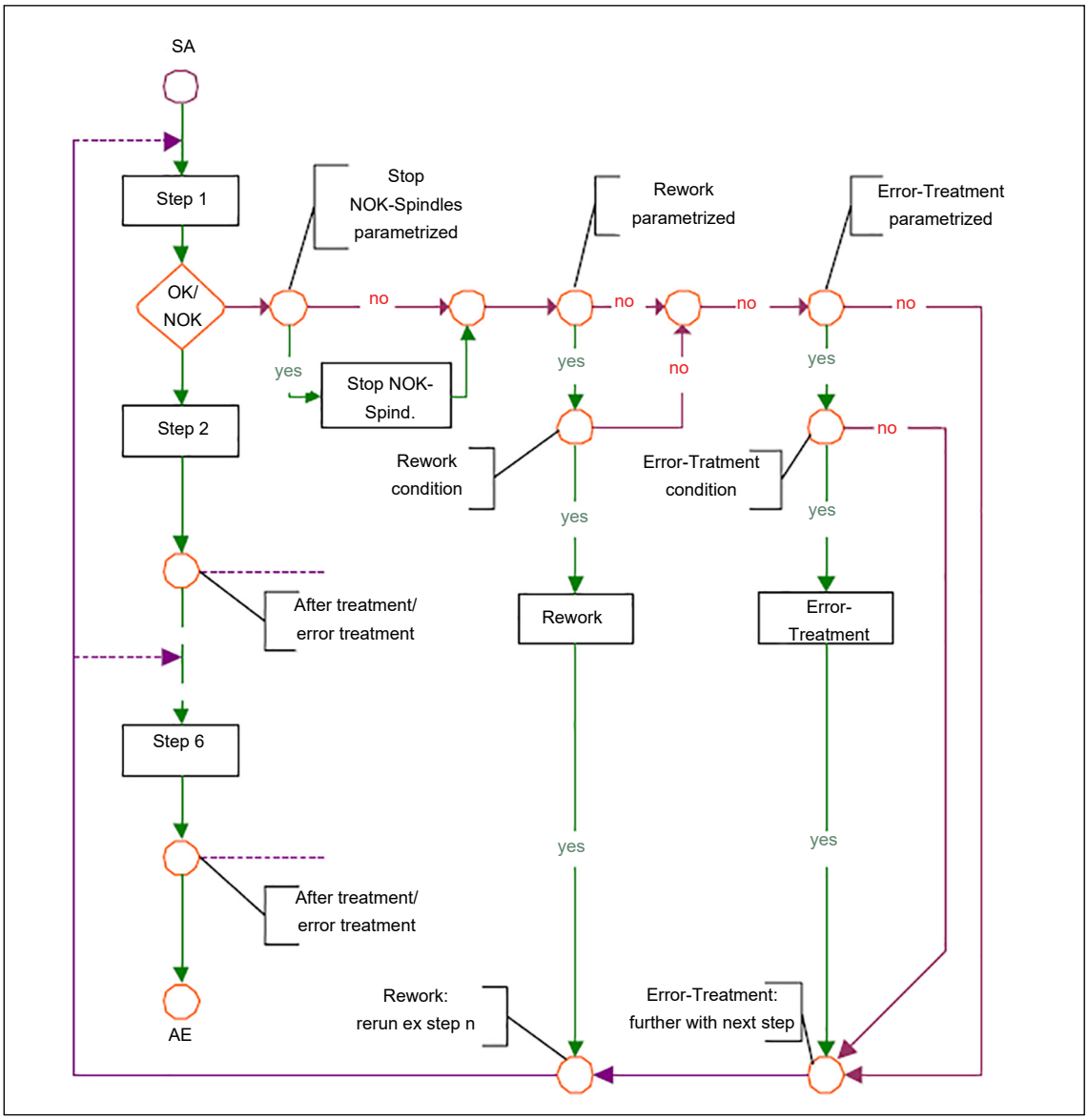


Fig. 5-19: Flowchart for touch-up and error handling

Conditions for touch-up:

Tool assigned to group.
NOK min, NOK Max, and *No. Rep.* (number of reruns) are met.

Conditions for error handling:

Tool assigned to group.
NOK min and *NOK Max* are met.

5.10 Settings for speed left rotation

The left or reverse rotation feature allows you to back off hand-held tools.

Specifications for hand-held tools

Activate the Reverse (TMH_LL) signal by operating the Reverse switch on the hand-held tool.
Provide the Tool Group Enable signal if required.
Press and hold the Start button on the hand-held tool to operate the tool in reverse.

In spindle groups with more than one spindle, all spindles in the group participate in the back-off sequence.
The following applies both to spindles and to hand-held tools:

- The speed set for reverse applies to all applications. Application settings are disregarded.
- No data are transmitted while reverse is executed, i.e., the controller software performs no OK/NOK evaluation of the back-off sequence.

During the back-off sequence, the back-off command is transmitted cyclically between TM/TMH and controller at an interval of ≈ 0.5 s. The existing TSNet connection is used for this purpose. If the TM/TMH does not receive the next back-off command within one second, the TM/TMH terminates the back-off sequence. This ensures that the tool shuts off if the back-off sequence is initiated and the TSNet connection fails.

To set left rotation:

1. Select *Navigator* > *Standard*.
2. In the Standard Application Builder, tap the *Tool Groups* menu to access the menu options.
3. Select the *Settings for speed left rotation* option from the menu to open the dialog of the same name.

Parameters	Value range	Standard setting	Definition	Description
Back-off Speed (as a percentage)	-100 ... 100	0	Percentage of nominal speed at tool output	If a negative value is entered, the tools move in tightening direction.
Back-off speed at beginning (as a percentage)	-100 ... 100	0	Percentage of speed for first time interval (≈ 0.5 s) of back-off	If triggered by the cyclical transmission of the start command, back-off occurs at this initial speed during the first time interval. If a negative value is entered, the tools move in tightening direction.

Parameters	Value range	Standard setting	Definition	Description
Max. Torque (% of max. cal. factor)	1 ... 100	90	Safety shut-off torque	Specifies the torque at which tightening is terminated.
Back-off application	1 ... 99	0	Application number to use for release	0 - Specifies that no back-off application is set. 1-99 - Specifies the application to be used for back-off.

In older TM software versions, the *Max. Torque* parameter may not be processed and the back-off function only works if a value greater than or equal to 90% is entered for *Max. Torque*.

5.11 Fastener IDs

The *Fastener IDs* dialog and table allow you to assign a number to each fastening position. These numbers are used for documentation in the rundown data table, in rundown data printing, and for many types of data transmission. Fastener IDs can have up to four digits.

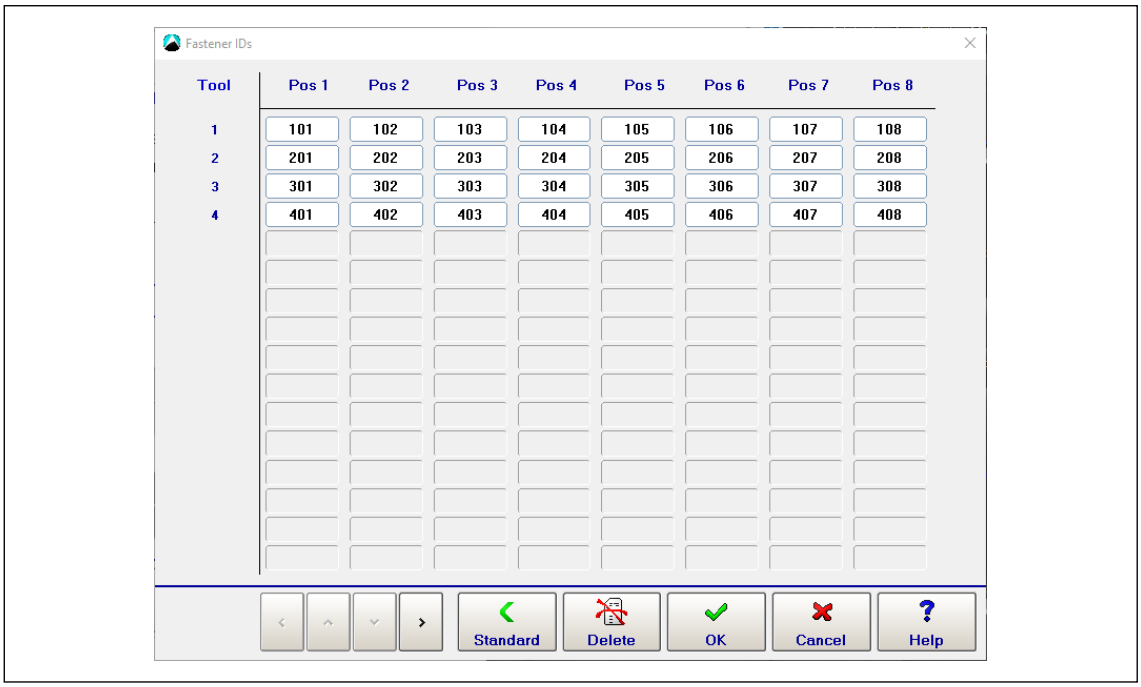


Fig. 5-20: The Fastener IDs dialog with all fastener IDs set to default values

1. Select *Navigator* > *Standard*.
2. In the *Standard Application Builder*, tap the *Settings* menu and select the *Fastener IDs* option to open the dialog of the same name.
3. Enter fastener IDs:
   - Tap <Standard> to set all fastener IDs to default values.
   - Use the <Arrow> buttons to increment all fastener IDs.
   - Tap a fastener ID to display the virtual keyboard and enter a new value.

5.12 Fastening groups

The *Fastening groups* dialog allows you to arrange tools into groups for the purpose of programming a common start delay time for each group (see chapter *5.6 Fastening stage timing, page 31*). This is used, for example, in the assembly of cylinder heads where the grouped delay of tool start helps to control the flow and settling properties of the cylinder head seal.

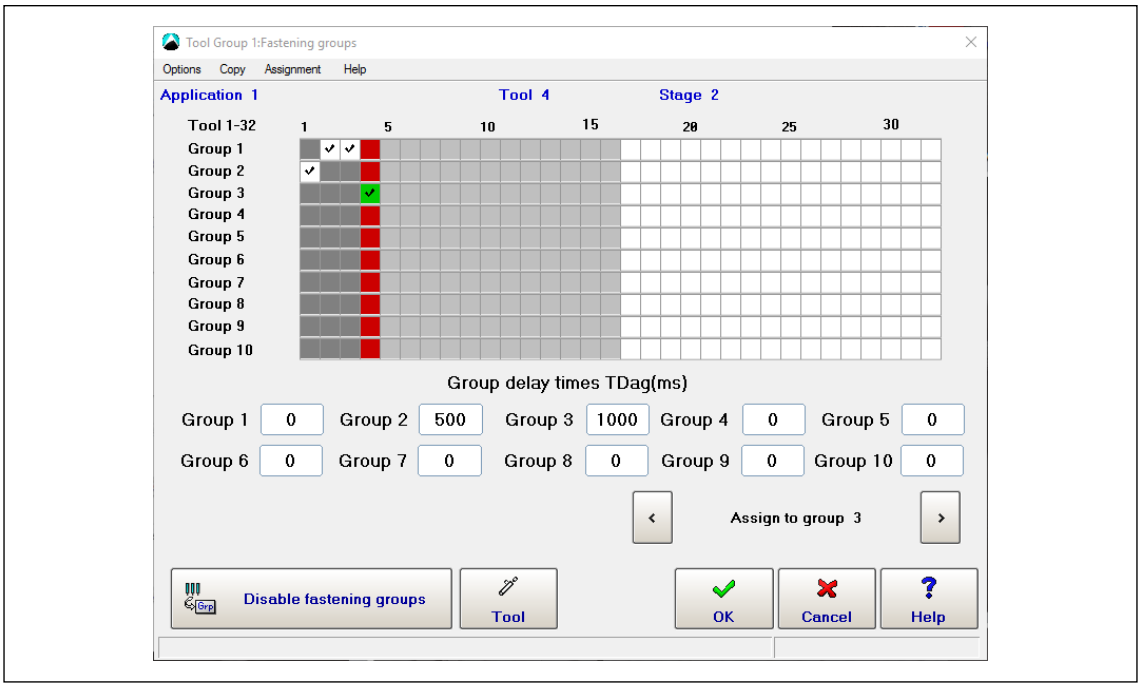


Fig. 5-21: The Fastening groups dialog with four tools assigned to three fastening groups

To open the *Fastening groups* dialog:
1. Select *Navigator* > *Standard*.
2. Select the required *Tool Group* and *Application* in the *Standard Application Builder*.
3. Tap the <Groups> button, or tap the *Groups* menu and select the *Fastening groups* option.
4. Select the required Stage in the pop-up window.

You can program delay times for up to ten fastening groups. These *Group delay times* always apply to whole fastening groups. When you program individual tools, you just assign them to a fastening group. The Group delay times are displayed when you program individual tools. You can change them regardless of the selected tool and its current fastening group assignment. If the fastening groups are disabled, the input boxes for *Group delay times* and the assignment controls are deactivated.

To arrange tools into fastening groups:
1. Tap the <Enable fastening groups> button in the *Fastening groups* dialog.
2. Enter the required delay times in the input boxes of the *Group delay times section* of the dialog.
3. Select a tool you want to assign to one of the fastening groups you just programmed:
   - Open the *Select Tool* dialog: Tap the <Tool> button, or tap the *Options* menu and select the *Select Tool* option.
   - Use the <Arrow> buttons of the *Select Tool* dialog to select a tool.
   - Tap the <OK> button to confirm the selection and close the dialog.
4. Assign the selected tool to a fastening group:
   - Use the <Assign to group n> arrow buttons of the *Fastening groups* dialog, or
   - Select an option from the *Assignment* menu.
5. Repeat steps 3 and 4 to assign all required tools to a fastening group.
6. Tap the <OK> button to confirm all assignments and close the *Fastening groups* dialog.

If tools of this tool group are not assigned to a fastening group, they default to: *Start Delay Time (TV) = 0 ms*. That is, no start delay occurs, and the tool starts immediately on activation of the fastening stage.

If you disable the fastening groups, the *Start Delay Time (TV)* set in *Fastening stage timing* applies to all tools again.

When fastening groups are activated, the *Start Delay Time (TV)* input box in the *Fastening stage timing* dialog is locked for the current stage!

5.13 Batch programming

Batch mode allows you to select a number of rundown positions for similar workpieces.
To enable Batch programming:

1. Select *Navigator* > *Standard*.
2. Select the *Batch* option from the *Settings* menu to open the *Batch* dialog.
3. Select the *Lock at batch done* option if you want to disable further rundowns until either external input (*Unlock Tool*) or Open Protocol MID-0043 unlocks the tool for further rundowns in the next or current workpiece.

Displaying batch information on the Run Screen

The *Run Screen* displays batch information if you enable the *Batch* option in the *Additional information* section of the *Run Screen configuration* dialog (see chapter *4.3.1 Additional information section, page 22*).

To display batch positions on the *Run Screen*:

1. Select *Navigator* > *Run Screen*.
2. Tap the <Configure> button to open the *Run Screen configuration* dialog.
3. Enable the *Batch* option in the *Additional information* section of the dialog.

Batch count modes

In the *Batch* dialog, you can select one of two Batch count modes, i.e., *Application* or *Open Protocol* mode:

Open Protocol option

The Open Protocol mode allows you to dynamically select a number of rundown positions.

To activate Open Protocol:

1. Select *Navigator* > *Communications*.
2. Select the *Data Transmission* tab of the *Communications* dialog.
3. Set the *Open Protocol* option in the *Ethernet* list.

When Open Protocol is connected, but no batch size selected, the Run Screen displays the *Wrong Batch size* message:

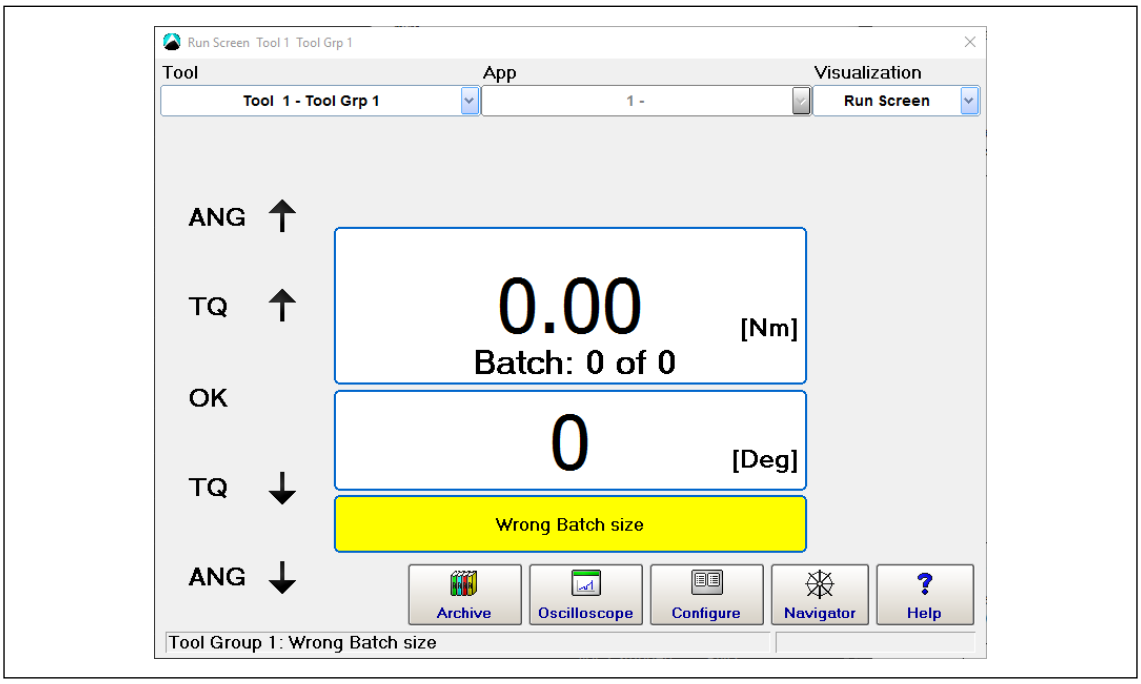


Fig. 5-22: The Run Screen with batch information enabled, but no batch size selected

Use MID-0019 to select the application number and batch size (App Nr. = 2 and Batch size = 3 in this example).
The batch counter of the Run Screen with the correct batch size displayed: **Batch: 0 of 3**

When the controller is ready for rundowns in batch mode, OK rundowns increment the Batch position counter: **Batch: 1 of 3**

When the batch is completed, the tool is locked for the next workpiece.
Use Open Protocol MID-0043 to unlock the tool for further rundowns.

Application option

The Application mode allows you to manually select a batch size.

When you select the *Application* option of the *Batch count mode* menu, the *Batch Size* input box is enabled in the *Batch* dialog. You can manually enter the required batch size. Enable the *Lock at batch done* option if required.
Use the *Unlock Tool* input signal to unlock the tool after the batch is done:

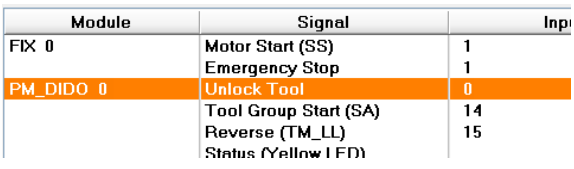


Fig. 5-23: The Unlock Tool signal set in the Programmable I/O Mapping dialog

If you use the PM_DIDO module, you can map the *Unlock Tool* input signal on the *Inputs* tab of the *Advanced* dialog. The *Programmable I/O Mapping* option should be disabled:

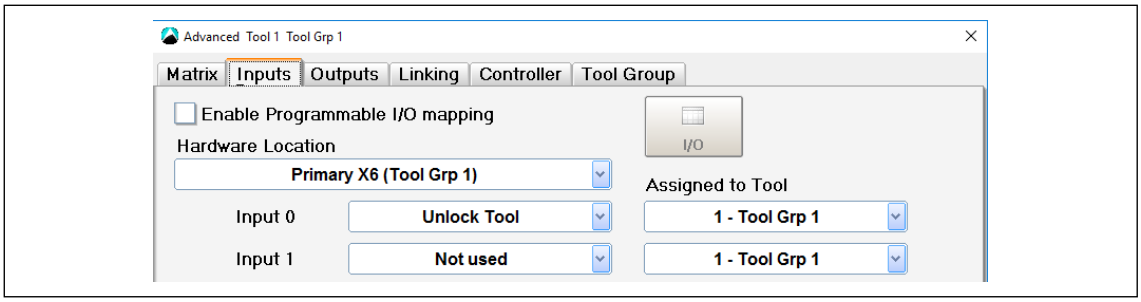


Fig. 5-24: The Inputs tab of the Advanced dialog with the Unlock Tool input signal mapped (Input 0) and the Programmable I/O Mapping option disabled

5.14 Input / Output bitmask

▶ *Navigator > Standard > Settings > Input/ Output bitmask*

The *Input / Output bitmask* allows you to assign additional input and output signals for an application. If you set Inputs in the bitmask, a rundown can proceed in the application when the required inputs are provided. See *Appendix A*, Pos. 28 and *Appendix B*, Pos. 23 for signals and tool compliance.

You set inputs and outputs in the *Input / Output bitmask* dialog.

To edit the *Input / Output bitmask*:

1. Select *Navigator* > *Standard*.
2. Select the required tool group and application in the *Standard Application Builder*.
3. Select the *Input / Output bitmask* option from the *Settings* menu of the *Standard Application Builder* to open the *Input / Output bitmask* dialog.
4. In the *Input / Output bitmask* dialog, tap the boxes that display the values of required Inputs and Outputs to change the values for the selected application.

The following three states are available for input signals:

	Description
1	Rundown can proceed if input position is set.
0	Rundown can proceed if input position is not set.
-	Rundown can proceed with input position set or not set.

Examples of inputs set in the Input / Output bitmask

With the following Inputs defined in the *Input / Output bitmasks* for Applications 1 and 2 of Tool Group 1, a rundown can proceed for:

- Application 1 if Positions 1 and 2 are not set and Position 3 is set, and for
- Application 2 if Position 1 is set and Positions 2 and 3 are not set.

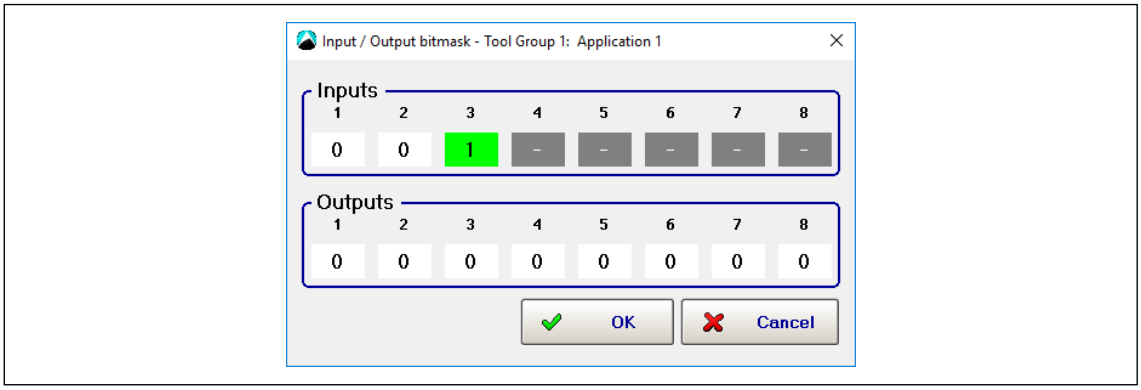


Fig. 5-25: Inputs set for Application 1 of Tool Group 1

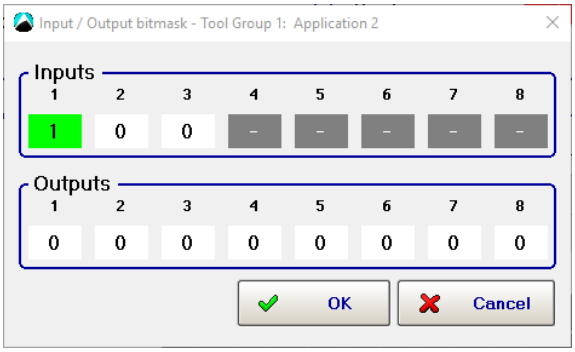


Fig. 5-26: Inputs set for Application 2 of Tool Group 1

If the conditions set for an application in the *Input / Output bitmask* are not met, a message is displayed in the Status bar and also in the Status field of the *Run Screen*.

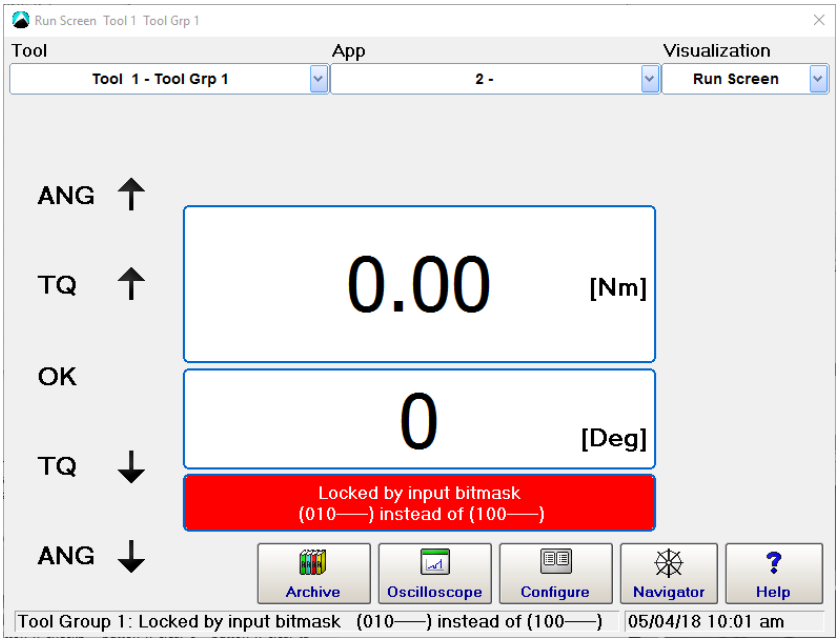


Fig. 5-27: Messages in the Status bar and in the Run Screen's Status field indicate that the Inputs defined for Application 2 in the Input / Output bitmask ('1' for Input 1, '0' for Input 2, '0' for Input 3, and Inputs 4 to 8 not defined) are not matched ('0' for Input 1, '1' for Input 2, '0' for Input 3). The tool is locked.

Example of outputs set in the Input / Output bitmask

In the following example, Outputs 1 and 4 are set for Application 2:

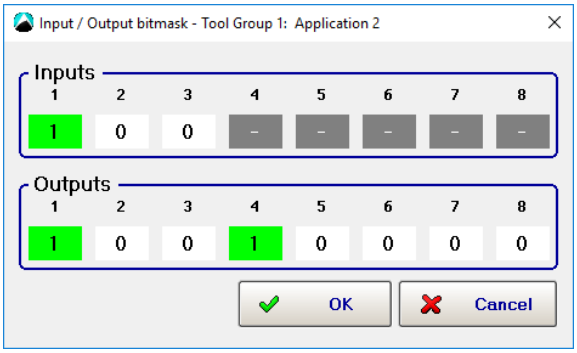


Fig. 5-28: Inputs and Outputs set for Application 2 of Tool Group 1

Note: If Application 2 is selected, Output signals 1 and 4 are set. The status message reports that the wrong Inputs are selected. The tool is locked.

6 Tool Setup

For accepting a tool, see the sections on installing a:
- Corded tool
- Secondary tool

6.1 Tool List

The *Tool List* displays installed tools and allows users to install, edit, and uninstall tools.

▶ Select *Navigator* > *Tool Setup*.

Tool List table

Parameter	Description
Grp	Displays the tool group number associated with the tool in this table row.
Tool Group Name	Displays the name of the tool group associated with the tool.
Tool	Displays the tool number of the tool in this table row. This number is assigned by the user when a tool is installed.
Type	Identifies the type of the tool in this table row: • Primary: the corded tool associated with a Primary controller. • Secondary: the corded tool associated with a Secondary controller paired to either a Master or Primary controller.
Name	Displays the tool name assigned by the user during installation.
Status	Displays the state of the tool in this table row: • Online: the tool is installed and ready for use. • Connection Timed Out: no response from the specific IP address. • Connection Rejected: IP is available, but 4001 is not accessible, i.e., either the tool is already connected to another controller or the specific IP address is another device on the network. • OS Connection error message. Examples: 007:030 (EHOSTUNREACH) No route to host 007:031 (EHOSTDOWN) Host is down • Needs User Acceptance: tool is installed and waiting for user acceptance. • Not Compatible: tool is not supported by the controller. • Servo Not Connected: tool is installed, but the Secondary controller is not attached.
Serial Number	Displays the serial number of the tool.
Tool Model	Displays the model number of the tool. Tube-Nut Tool: the automatic recognition of a tube nut tool results from a 'T' in the tool model number. If a 'T' appears in the model number, a tube nut tool is expected.
Maintenance Counter • Status • Actual • Warning threshold before service • Maintenance limit	These four columns display Maintenance Counter information. See chapter *6.5 Tool maintenance information, page 55* for details.

Button controls of the Tool List dialog

Button	Description
	<I/O> opens the *Programmable I/O Mapping* dialog. See chapter *9.1 Programmable I/O Mapping, page 115*.
	<Tool Settings> opens the *Tool Settings* dialog. See chapter *6.2 Tool Settings, page 53*.
	<Install> installs a corded tool attached to a Secondary controller. Corded tools attached to a Primary controller are installed automatically.
	<Edit> reconfigures setup options for a tool.
	<Uninstall> removes a tool from the controller's Tool List.
	<Reassign> reassigns / confirms assignment of tool to controller.
	<Navigator> returns to the *Navigator* dialog.
	<Help> provides help related to the current dialog.

6.2 Tool Settings

The *Tool Settings* dialog allows you to view the tool's memory, set the Maintenance Counter, and access the *Tool constants* dialog.

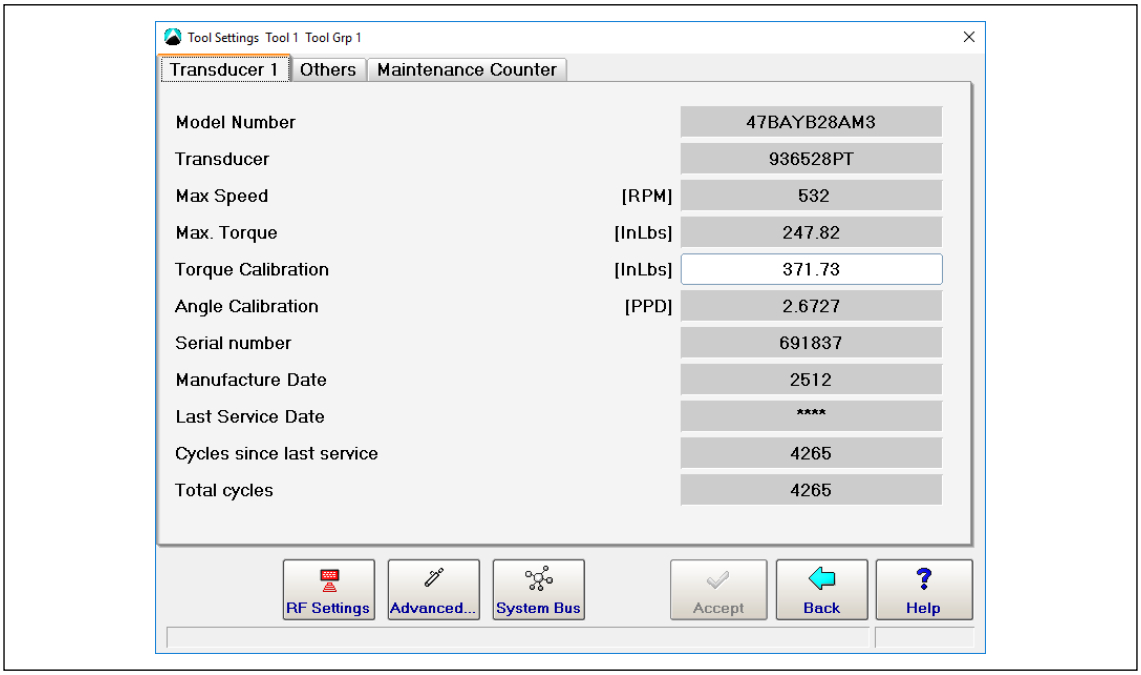


Fig. 6-1: The Transducer 1 tab of the Tool Settings dialog for Tool 5 of Tool Group 5

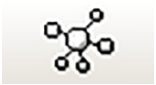
Tool Settings dialog tabs

Transducer 1:
- Allows you to view the memory of the currently selected tool.
- You can edit the Torque Calibration value (±20 % of nominal) to correct the torque calibration of the currently selected tool.

Others:
- Servo PS
- Static Current factor [Nm/A]
- *Battery Low Level [V]* drop-down menu

Maintenance Counter: See chapter *6.5 Tool maintenance information, page 55*.

Button controls of the Tool Settings dialog

Button	Description
	<RF Settings> opens the *RF Settings* dialog. See chapter *13.2 System Settings, page 228*.
	<Advanced> opens the *Tool constants* dialog. See chapter *7 Tool constants, page 77*.
	<System Bus> opens the *System Bus map*. See chapter *11.1.1 System Bus (ARCNet Map), page 198*.

6.3 Installing a Primary Corded Tool

1. Connect the tool and switch the tool on.
2. Select *Navigator* > *Tool Setup*.
   Tool 1 is reserved for a corded tool with Primary controller. Other corded Tools are connected to the Secondary.
3. Tap the line which lists the Primary tool to highlight it.
4. Tap the <Tool Settings> button.
5. Check the *Model number* and *Serial Number* to verify that the tool shown is the connected tool.
6. If the tool identification is correct, tap the <Accept> button and confirm if required.
   → A pop-up message indicates that the settings are being saved.

When the tool is installed for the first time, the controller type must be selected. See chapter *Distinction of Global Controller types, page 240*.

6.4 Installing a Secondary Tool

- You can install a tool as *Secondary* on the controller if:
- The tool is a corded tool.
- The STMD-H module type of measuring card is connected to Controllers System Bus and the Node number is any other than 1.
- The input/output signals are mapped to STMD-H TM_DIDO I/O levels.

1. Select *Navigator* > *Tool Setup*.
2. Tap the <Install> button to open the *Assign Tool n* dialog.
3. Select the required Tool Group, and select the *Secondary* option from the Type drop-down menu.

Parameter	Description
Group Name	Displays the name of the tool group.
Name	Assigns a name to the tool.
Type	• Secondary: the corded tool associated with a Secondary controller paired to either a Master or Primary controller.

1. Ensure that STMD-H module is connected with the selected tool group.
2. Tap <OK> to add the tool as a Secondary tool to the selected Tool Group and return to the Tool List.
3. Tap the line which lists the Secondary tool to highlight it.
4. Tap the <Tool Settings> button.
5. Check the *Model number* and *Serial Number* to verify that the tool shown is the connected tool.
6. If the tool identification is correct, tap the <Accept> button and confirm if required.
   → A pop-up message indicates that the settings are being saved.
7. The Global Controller software automatically sets required I/O signals as default. You can change them in the *Programmable I/O Mapping* dialog.

Installing a connected tool

If a tool is installed, that is already connected to another controller, the <Edit> button is replaced by the <Reassign> button. The following status message is displayed: **Assigned to another controller!**

Tap <Reassign> to accept the tool. Is the tool installed, the button changes back to <Edit> button.

6.5 Tool maintenance information

Tool maintenance information helps you to supply the tool (hand tools and WLAN tools) in regular rotation for maintenance or service. With this maintenance/service offering, the standard wear parts are maintained or replaced. The Global Controller software feature allows you to program maintenance intervals and provide timely messages that are output visually or by email via TorqueNet.

6.5.1 Explanation of terms

The following sections explain the terms relevant to tool maintenance information.

Maintenance limit

The *Maintenance limit* for a tool defines the maximum number of fastening cycles at which maintenance of the tool is required. You can set the *Maintenance limit* on the *Maintenance Counter* tab of the *Tool Settings* dialog. If this value is not set on the controller, the default value of the tool memory is used.

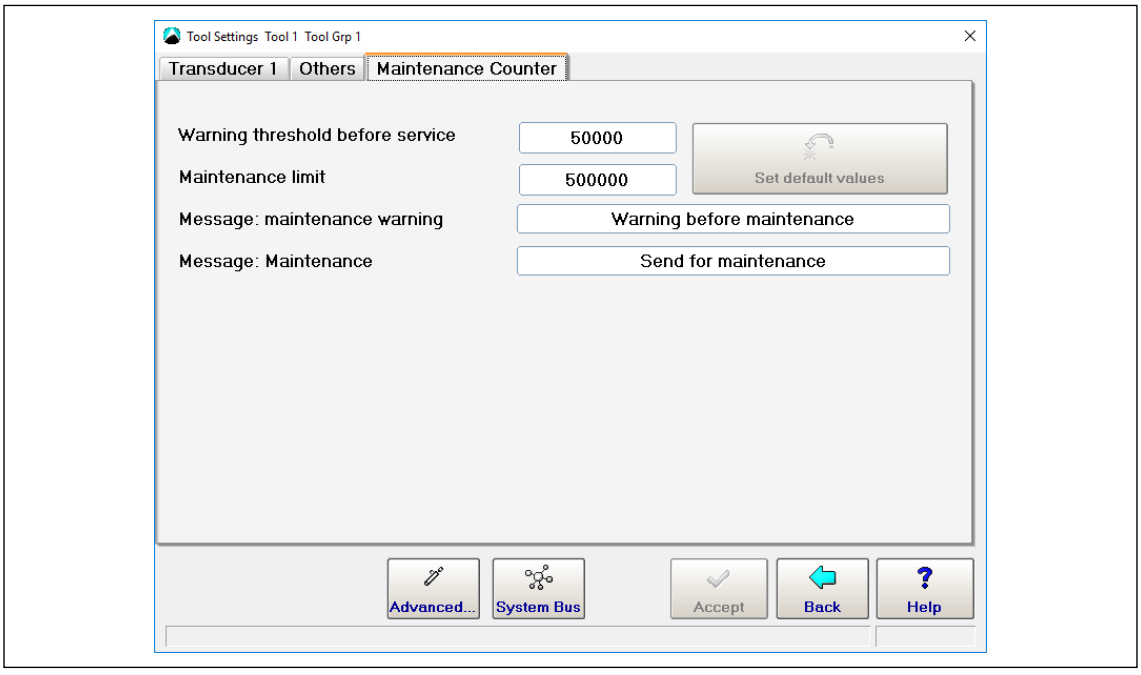


Fig. 6-2: The Maintenance Counter tab of the Tool Settings dialog for Tool 1

To access *Maintenance limit*:

1. Select *Navigator* > *Tool Setup*.
2. Select the required Tool in the *Tool List* dialog.
3. Tap <Tool Settings> to open the *Tool Settings* dialog.
4. Select the *Maintenance Counter* tab of the *Tool Settings* dialog.

Warning threshold before service

The *Warning threshold before service* allows you to generate a maintenance warning message on the Global Controller before the actual *Maintenance limit* is reached. This offset from the *Maintenance limit* is programmed as a numerical value. A default value is permanently stored on the transducer. If a different value is programmed on the Global Controller, the value of the tool memory is disregarded and the value from the Global Controller is used.

You can access the *Warning threshold before service* control on the *Maintenance Counter* tab of the *Tool Settings* dialog.

Default values for Maintenance limit and Warning threshold before service

If a tool is connected but not yet accepted, the values for *Warning threshold before service* and *Maintenance limit* are set to the maximum limit and they are highlighted yellow on the *Maintenance Counter* tab of the Global Controller.

When a tool is accepted, the value for *Warning threshold before service* is set to 20,000. The *Maintenance limit* is set to 500,000. This means that maintenance messages are sent when 480,000 fastening cycles rather than the Maintenance limit of 500,000 is reached (20,000 fastening cycles before the Maintenance limit is reached). This allows for more flexible tool maintenance.

Button	Description
	<Set default values> loads the default values for the currently selected tool.

Maintenance warning messages

If the difference between the *Maintenance limit* and the *Warning threshold before service* for a tool is greater than the *Actual* counter, but less than the *Maintenance limit*, the controller generates a maintenance warning.

To view all values in the *Tool List*:

▶ Select *Navigator* > *Tool Setup*.

In the following example for Tool 1, the *Maintenance limit* is set to 19,000 and the *Warning threshold before service* is set to 1,000. The difference between the two (18,000) is less than the Actual counter value of 18,923 and, therefore, a maintenance warning message is displayed.

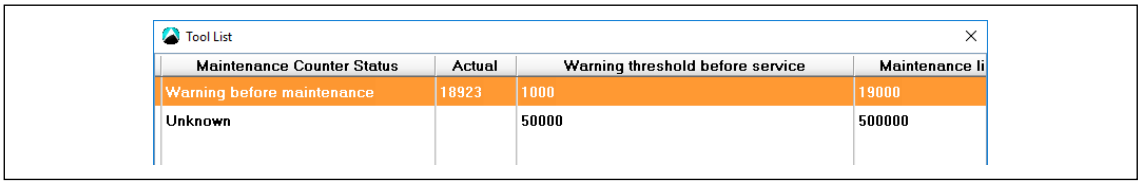


Fig. 6-3: The Maintenance Counter Status column displays a maintenance warning message for Tool 1 because the difference between the Maintenance limit and the Warning threshold before service (19,000-1,000) is less than the Actual counter value (18,923)

You can also display the *Warning before maintenance* message on the *Run Screen*:
Tool 1: Warning before maintenance

When the value of the *Actual* counter is greater than the *Maintenance limit*, the controller generates a different maintenance warning message:
Tool 1: Send for maintenance

To display maintenance warning messages on the *Run Screen*:
1. Select *Navigator* > *Advanced* > *Controller* tab > *Miscellaneous* tab.
2. Enable the *Show Warnings* option in the *Maintenance Counter* section.

You can change the text of both maintenance warning messages on the *Maintenance Counter* tab of the ***Tool Settings*** dialog.

Dynamic Service Counter

The service counter has a dynamic component to accommodate different loading of the tool. Depending on how much the loading of the tool falls off, the service counter is incremented with a higher or lower value.

6.5.2 Maintenance Counter update interval

You can transmit the current state of the *Maintenance Counter* through TorqueNet and specify an update interval. This time interval determines how frequently the current *Maintenance Counter* status is transmitted to TorqueNet. You can enter values from 0.1 hours (6 min) to 24 hours.

The following controls are available in the *Advanced Settings* dialog:

Parameters	Description
Synchronization	
Date/time synchronization	Synchronizes controller time with server time. If this checkbox is enabled, the *Synchronization if difference above (s)* input box is available.
Synchronization if difference above (s)	Limits the time difference between server and controller. Valid entries are from 1 second to 9999 seconds.
Maintenance Counter	
Counter update interval (h)	For detailed information on Maintenance Counters, see chapter *6.5 Tool maintenance information, page 55*. This control sets the interval in hours at which the controller updates Maintenance Counters on the TorqueNet server. Valid entries are in from 0.1 hours to 3445.0 hours.
Enable notification	Sends an E-Mail notification when a maintenance counter threshold is exceeded.

To enable *Maintenance Counter* updates through TorqueNet and set the update interval:
1. Select *Navigator* > *Communications* > *Data Transmission.*
2. Select the *TorqueNet* entry in the *Ethernet* list of the *Data Transmission* tab.
3. Enable the *Activated* checkbox below the *Ethernet* list.
4. The <Advanced> button is now displayed below the <Activated> checkbox.
5. Tap the <Advanced> button to open the *Advanced Settings* dialog.
6. Check the *Enable notification* option in the Maintenance Counter section of the *Advanced Settings* dialog.
7. Enter the required value in the *Counter update interval (h)* input box.

6.5.3 Maintenance Counter current state

You can read out current *Maintenance Counter* states in the *System information* of the Global Controller. This information is only provided in English.

The following information on *Maintenance Counters* is available in the *System information*:
- Maintenance counter total: the current count
- Counter warning threshold: *Warning threshold before service*
- Counter stop border: *Maintenance limit*
- Maintenance counter state: the status of the maintenance counter. The status is bit-coded. Setting of bit 0 marks exceeding of the warning limit; setting of bit 1 marks exceeding of the stop limit.

Maintenance counter state:

Binary	Decimal	Description
00	0	Current count below Warning threshold before service.
01	1	Warning threshold before service reached.
10	2	N/A
11	3	Maintenance limit reached.

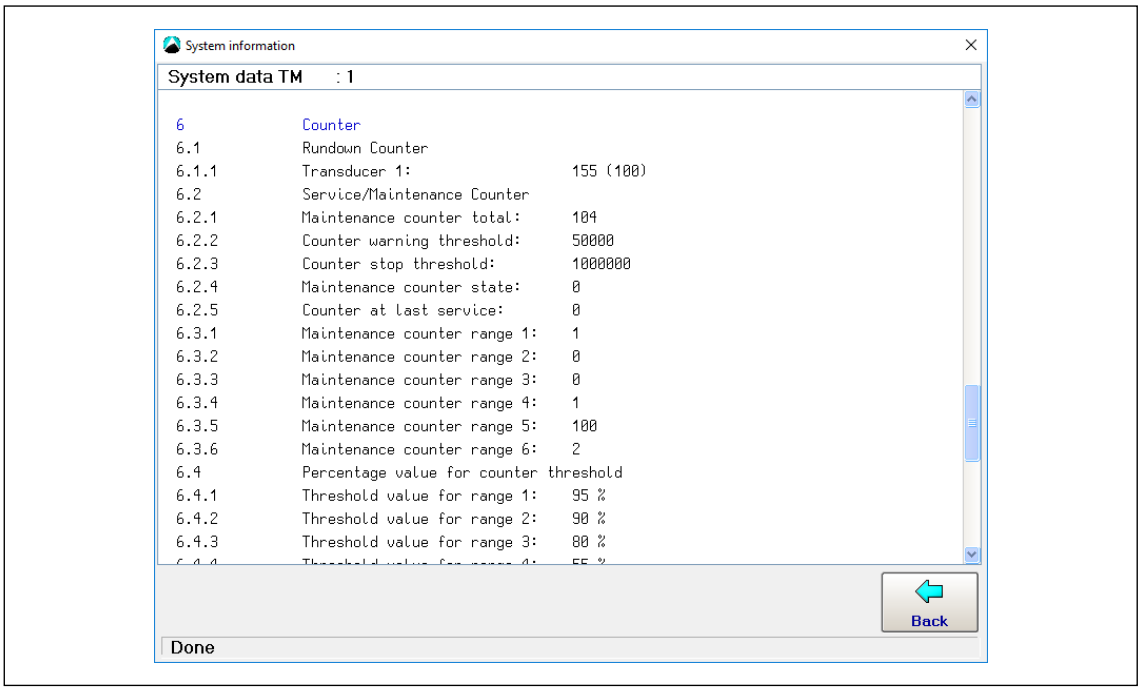


Fig. 6-4: Maintenance Counter states displayed in the System information window

To access current counter states:

1. Select *Navigator* > *Tool Setup.*
2. Select the required *Tool* in the *Tool List* dialog.
3. Tap the <Tool Settings> button to open the *Tool Settings* dialog.
4. Tap the <System Bus> button of the *Tool Settings* dialog to open the *System Bus map* dialog.
5. Select the *Current state* tab of the *System Bus map* dialog.
6. Select the required *Node* in the List of participants.
7. Tap the <System information> button to open the System information window.
8. Scroll to the required section.

7 Tool constants

The tool constants reflect the tool layout, essentially the motor, gearing, and transducer(s). They are typically programmed once during initial setup or for major changes, e.g., tool replacement or modifications (different gearing or transducer). They provide the basis for all other fastening parameters.

If an *intelligent transducer* is connected, certain data is adopted from the transducer and affects the tool constants. These values are highlighted in yellow in the *Tool constants* screen and cannot be modified here.

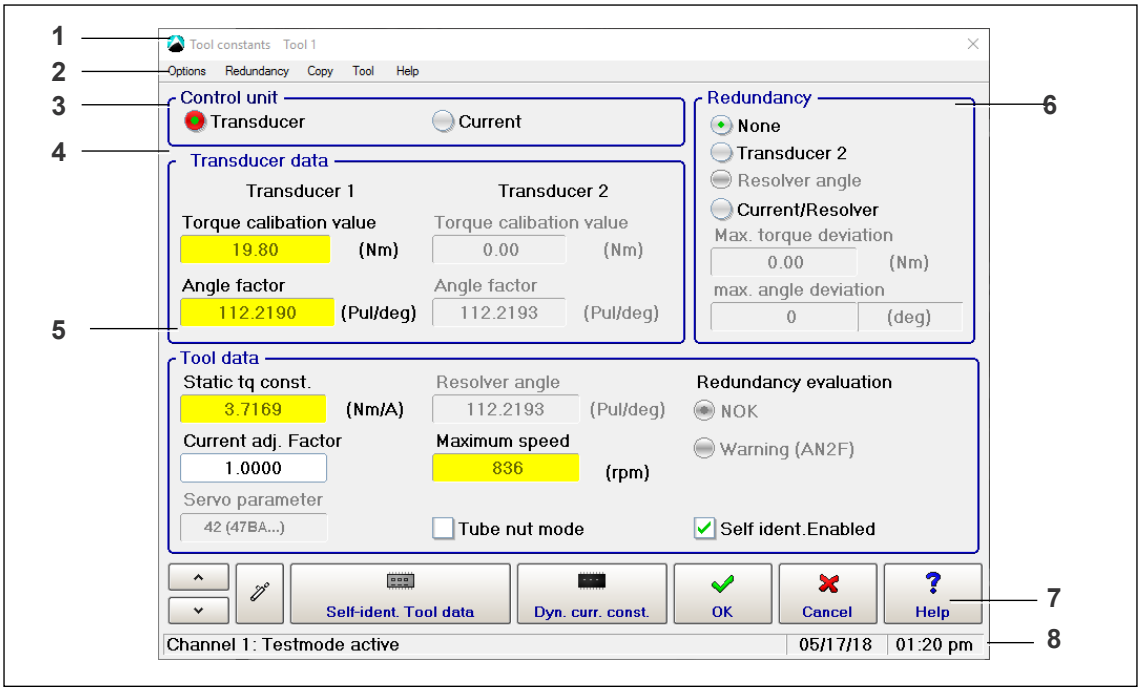


Fig. 7-1: The Tool constants screen

The *Tool constants* screen has the following major parts:

Item	Description
1	Title bar: Displays currently selected tool
2	Menu bar
3	Control unit section
4	Transducer data section
5	Tool data section
6	Redundancy section
7	Command buttons
8	Status bar

To access the *Tool constants* screen:

1. Select *Navigator* > *Tool Setup*.
2. Select the required tool in the *Tool List*.
3. Tap the <Tool Settings> button.
4. Tap the <Advanced> button in the *Tool Settings* screen.

7.1 Control unit

To select the required tool open the *Select Tool* dialog.

1. Select *Options* > *Select Tool*, or
2. Tap the  button.

The following options are available:

- Transducer
- Current

The radio button of the enabled option is highlighted in red.

If *Current* is used, an asterisk (*) is displayed following the value for TqAct in the *Tool monitor* table and in the *Archive* (Details). Current is mostly used with tools that do not have a transducer.

If *Transducer, Current/Resolver* or *Current* is set as control value, you cannot use yield point procedures in the fastening program.

7.2 Transducer data

Torque calibration value

The *Torque calibration value* is the full-scale torque of the transducer.

To set its unit of measurement:

▶ Select *Navigator* > *Advanced* > *Controller* > *General*.

The required value is provided on the name plate of the transducer or its data sheet, or it is entered by the automatic identification of the transducer.

Angle factor

The *Angle factor* is the resolution of the angle pulse encoder in pulses per degree.

The required value is provided on the name plate of the transducer or its data sheet, or it is entered by the automatic identification of the transducer.

Exception: If a BL system without angle encoder is used, the angle pulses are generated by the servo, which therefore also defines the resolution. This also applies to redundancy via resolver angle. The angle factors are provided in a table.

Attachments

The fastening parameters relate to the bolted joint. The calibration values for torque and angle must therefore reflect the actual conditions at the output attachment of the tool. This is automatically given for most applications with standard tools (modular system), e.g., when a straight attachment follows right on a combined transducer. In these cases, you can just enter the data of the combined transducer. But if additional gearing, e.g., of an angle attachment, is installed between transducer and joint, you must take its data into account to receive values that truly relate to the joint.

Torque: A reducing gear increases the torque on the output shaft and, therefore, the Torque calibration value you have to enter. Moreover, you have to multiply the Torque calibration value by the efficiency rate of the gearing (see name plate or data sheet).

Angle: A reducing gear increases the resolution and, therefore, the Angle factor. If the angle pulses are generated by the servo, the angle resolution results from the resolver resolution of the servo and the gearing of the tool.

$$\text{Output attachment resolution [pulses/degree]} = \frac{\text{Resolver res. [pulses/revolution]}}{\text{360 [degrees/revolution]}} \times \text{Gear reduction ratio}$$

Example:
Resolver resolution = 1024 pulses/rev. (pulses per motor revolution)
Gear reduction ratio = 1 : 15.1364

$$\text{Output attachment resolution} = \frac{1024\ [\text{pulses/revolution}]}{360\ [\text{degrees/revolution}]} \times 15.1364 = 43.054\ [\text{pulses/degree}]$$

7.3 Redundancy

The measuring board uses the signals provided by Transducer 1 to control the fastening process. Whenever references to tool constants occur for parameters (e.g., input ranges of fastening sequences) or functions (e.g., gradient calculation: scanning factor), they relate to Transducer 1.

▶ Use the controls in the *Redundancy* section of the *Tool constants* screen to enable redundancy functions.

Redundancy options

- *None*: No redundancy
- *Resolver angle*: Angle redundancy with resolver angle
- *Current/Resolver*: Equivalent torque redundancy derived from motor current and information from resolver

▶ Define the redundancy tolerances:
  - *Max. torque deviation*: Defines the greatest torque deviation allowed for the redundancy measurement between Transducer 1 and current-based equivalent torque that results in an OK evaluation of the fastening process.
  - *Max. angle deviation*: Defines the greatest angle deviation allowed for the redundancy measurement between Transducer 1 and resolver angle that results in an OK evaluation of the fastening process.

7.4 Tool data

Static tq const. (static torque constant)

The *Static tq const.* corresponds to the torque constant of the transducer data. You cannot change its value in the *Tool constants* screen, but limited editing is possible in the *Transducer data* dialog (see below; to access, tap <Self-ident. Tool data> button).

In theory, you can derive the *Static tq const.* from the average current factor of the motor and the gear ratio. The required value is provided in the data sheet of the transducer, or it is available from the self-identification of the tool if applicable.

The value serves as a starting point for further current/torque conversion calculations. If only low accuracy is needed, the *Static tq const.* can be applied directly for current redundancy (e.g., for back-off operations).

Current adj. Factor (current adjustment factor)

The *Current adj. Factor* is preset to 1, and can be changed in all redundancy functions. This factor is not part of self-identification, but it is required for current calibration (see below; to access, tap <Dyn. curr. const.> button). It is therefore not highlighted in yellow and can be edited.

Resolver angle

When an intelligent transducer is connected, the *Resolver angle* corresponds to the *Resolver factor* value in the *Transducer data*. You cannot change its value in the *Tool constants* screen. But the value changes automatically when you change the *Overall gear ratio* value in the *Transducer data* dialog (to access, tap <Self-ident. Tool data> button).

Maximum speed

When an intelligent transducer is connected, the *Maximum speed* corresponds to the *Tool speed* value in the *Transducer data*. You cannot change its value in the *Tool constants* screen. But the value changes automatically when you change the Overall gear ratio value in the *Transducer data* dialog (to access, tap <Self-ident. Tool data> button).

The *Maximum speed* is the maximum rotational speed of the entire tool, i.e., directly at the output shaft. The speeds you set for a rundown in the fastening sequences are internally referenced to this *Maximum speed* parameter. The value is provided on the name plate of the transducer or its data sheet. It can be monitored with an external speed sensor or the integrated revolution counter. For this, the *Angle factor* must be entered correctly because the integrated revolution count is derived from the angle pulses.

Tube nut mode

▶ Enable ☑ the *Tube nut mode* checkbox if you need pipe nut functionality.

In *Tube nut mode*, a special output drive with an *open mouth* for threading the tool onto the pipe is used. After fastening, the output drive must return to this position to back off the tool from the pipe. The tool therefore switches automatically to back-off after fastening, and the SA signal is supplied again to back off the tool.

This simplifies the task for the operator because there is no need to manually switch between fastening and back-off each time.

Self ident. Enabled (disabling self-identification)

If a tool is replaced with the same type while self-identification is enabled, the transducer data are automatically imported. If the tool type differs, the transducer data can be edited as required and written back to the tool memory chip. These values are then also imported into the tool constants.

This means that users who wish to use the Apex Tool Group modular system for the spindle layout are required to modify and overwrite the original data of the memory chips if they want to set up a single spindle from different components. The *Tool constants* screen therefore provides the option to disable self-identification—which is enabled by default—for each spindle.

Self-identification is enabled by default

▶ Clear ☐ the tick mark of the *Self ident. Enabled* checkbox to disable self-identification.

Input boxes that previously had a yellow background now have a white background.

When self-identification is disabled:

- Automatic import of self-identification values into the *Tool constants* is turned off.
- If the transducer is replaced, chip data are read, but the values are not imported into the *Tool constants*.
- If a different type is detected during replacement, the window with the transducer data of the tool is displayed automatically—as with enabled self-identification. But in this case, it is for information only, i.e., there is no option to change or import the data.

The values programmed in *Tool constants* remain unchanged when self-identification is disabled, and you can change them manually if required. This is indicated by the input boxes, which no longer have a yellow background.

▶ As with enabled self-identification, you can open and view detected transducer data (*Transducer data* screen) at any time by tapping the <Self-ident. Tool data> button on the *Tool constants* screen.

With the self-identification feature enabled, you can import transducer data of the chip into *Tool constants* to serve as initial values for customized programming of the tool constants. You then disable self-identification to edit the tool constants and individually adapt them to the client-specific tool layout.

Redundancy error messages

If redundancy is enabled, the error messages listed below may occur in the measured values.

Please keep in mind that it makes a difference if redundancy with *Resolver angle* is selected. See also the resolver angle sections of this documentation.

Error	Explanation
TqRE	Torque redundancy error
ARE	Angle redundancy error
A2D	Angle encoder 2 defective

- The errors result in an NOK evaluation.
- With NOK selected for Redundancy evaluation, these errors result in an NOK evaluation.

Moreover, the following warning messages may occur in the system warnings:

- Offset Torque encoder 2 too high
- Offset Torque encoder 2 too low
- Calibration value Torque encoder 2 too high
- Calibration value Torque encoder 2 too low

7.5 Transducer data

Self-identification requires the TM software 960911v2.7 or newer and transducers and tools with appropriate technology.

In redundancy configurations, you normally install transducers of the same type. When you then connect or disconnect transducers, detected data are immediately recorded and imported. If you install transducers of different types, the *Transducer data* screen opens automatically for the selected tool and displays the new transducer data. You must then explicitly accept the parameters.

7.5.1 Transducer data screen

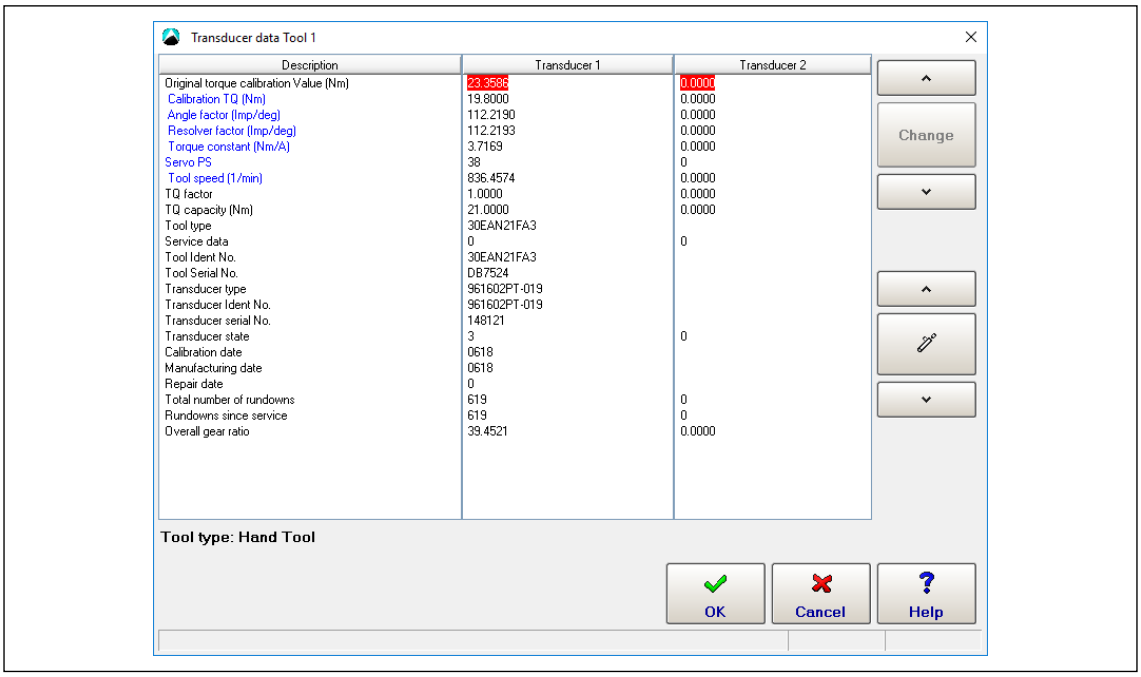


Fig. 7-2: The Transducer data screen for Tool 1

To open the Transducer data screen:

1. Select *Navigator* > *Tool Setup.*
2. Select the required *Tool* in the Tool List.
3. Tap the <Tool Settings> button to open the *Tool Settings* dialog.
4. Tap the <Advanced> button to open the Tool constants screen.
5. Tap the <Self-ident. Tool data> button.

Button	Description
	<Self-ident. Tool data> opens the *Transducer data* dialog.

The Transducer data table consists of the following three columns:

Column name	Content
Description	This column contains the designations of the values displayed in the *Transducer 1* and *Transducer 2* columns.
Transducer 1	This column lists the values for Transducer 1. If no transducer is connected for the selected tool, zeros are displayed.
Transducer 2	Transducer 2 is not available.

When a table row is selected, additional information on the values in this row may be displayed below the table columns:

Column name	Information displayed below column
Description	Tool type: Tool Tool type: Hand Tool
Transducer 1	Conditionally editable
Transducer 2	Transducer 2 is not available.

Individual data can be edited and changed. Changes directly influence the controller and quality of the run-down. Changes should only be made in exceptional cases and by authorized technicians. Changes are made on the user's own responsibility and are registered in the transducer itself.

The following table explains the categories listed in the *Description* column of the *Transducer data* table:

Description column items	Explanation
Original torque calibration Value (Nm)	For information only
Calibration TQ (Nm)	Editable value and used for calculation
Angle factor (Imp/deg)	Editable value and used for calculation
Resolver factor (Imp/deg)	Editable value: changes automatically when you edit the value for *Overall gear ratio*
Torque constant (Nm/A)	Editable value if the equivalent current is used instead of a transducer
Servo PS	Editable value that provides adaptation for the tool and motor in use
Tool speed (^{1}/min)	Not a directly editable value: changes automatically when you edit the value for Overall gear ratio
TQ factor	For information only
TQ capacity (Nm)	Serves as test value for the input of torques in the diagram screens and as a service for information
Tool type	Editable value comprised of the codes for the motor, gearing, transducer, and output drive
Service data	indicates whether changes have been made to the editable tool data in the transducer; can assume the following values: • 0: No change made to editable tool data • 1 or greater: Changes made to editable tool data This value is set to 1 when transducer data is changed for the first time. Additional changes are not indicated. When service work is needed, this alerts you to the fact that relevant transducer data has been altered. The *Tool type* category is an exception. If you change its value, the *Service data* value does not change because transducers do not come with a *Tool type* value when they are supplied by the factory.
Tool Ident No.	For information only
Tool Serial No.	For information only

Description column items	Explanation
Transducer type	This must always be identical with the transducer code in the *Tool type*
Transducer Ident No.	For information only
Transducer serial No.	For information only
Transducer state	Indicates type and state of the transducer; can assume the following values: • 0: No transducer connected • 1: Transducer is connected, but not intelligent • 3: Transducer is connected and intelligent
Calibration date	For information only
Manufacturing date	For information only
Repair date	For information only
Total number of run-downs	For information only
Rundowns since service	For information only
Overall gear ratio	Editable value: changes of the *Overall gear ratio* value automatically result in an adjustment of the values for *Resolver factor* and *Tool speed*

7.5.2 Change transducer data controls and dialog

▶ Use the <Change> button and the related ⌃ and ⌄ arrow buttons of the *Transducer data* screen to open the *Change* dialog and adjust values.

To change a value in the Transducer data table:

1. Use the ⌃ and ⌄ arrow buttons to select the required row of the Transducer data table.
   The currently selected values are highlighted in red.
   If the currently selected values are not editable, the <Change> button is disabled and grayed out. If limited editing of the selected values is allowed, the <Change> button is enabled and the Conditionally editable message is displayed in the comment line below the Transducer data table.
2. Tap the <Change> button to open the *Change* dialog.
3. Enter the required value(s) in the *Transducer 1* input boxes of the *Change* dialog to change the torque (Nm).
4. Tap the <OK> button.

If a new transducer is connected or if you adjust individual values in the *Transducer data* table, the *Tool Memory* and *Accepted values* radio buttons are displayed below the data table. These options allow you to compare values. When you select the *Accepted values* option, the <Change> controls are no longer displayed and the <Accept> button is displayed instead of the <OK> button.

Parameter	Description
Tool Memory option	Displays the values of the currently connected transducer. If you adopt these transducer values and open the dialog again, the option is no longer available in the Transducer data window.
Accepted values option	Displays the values of the previously connected transducer if the two transducers differ. With this option selected, the <Change> button and related <Arrow> controls are no longer displayed. The <OK> button is replaced with the <Accept> button. If you adopt these transducer values and open the dialog again, the option is no longer available in the Transducer data window.
<Accept> button	Replaces the <OK> button when the <Accepted values> option is selected. This button opens a confirmation dialog. If you tap the <Yes> button of the confirmation dialog, the following values are adopted for the current tool • Calibration TQ • Angle factor • Torque constant • Overall gear ratio: Changes of this value also result in adjustments of the Resolver factor and Tool speed values.

7.5.3 Transducer data status messages and Applying transducer data to Tool Constants

When you close the *Transducer data* window, a dialog asks you to accept or reject changes. Current changes are indicated by status messages and require confirmation.

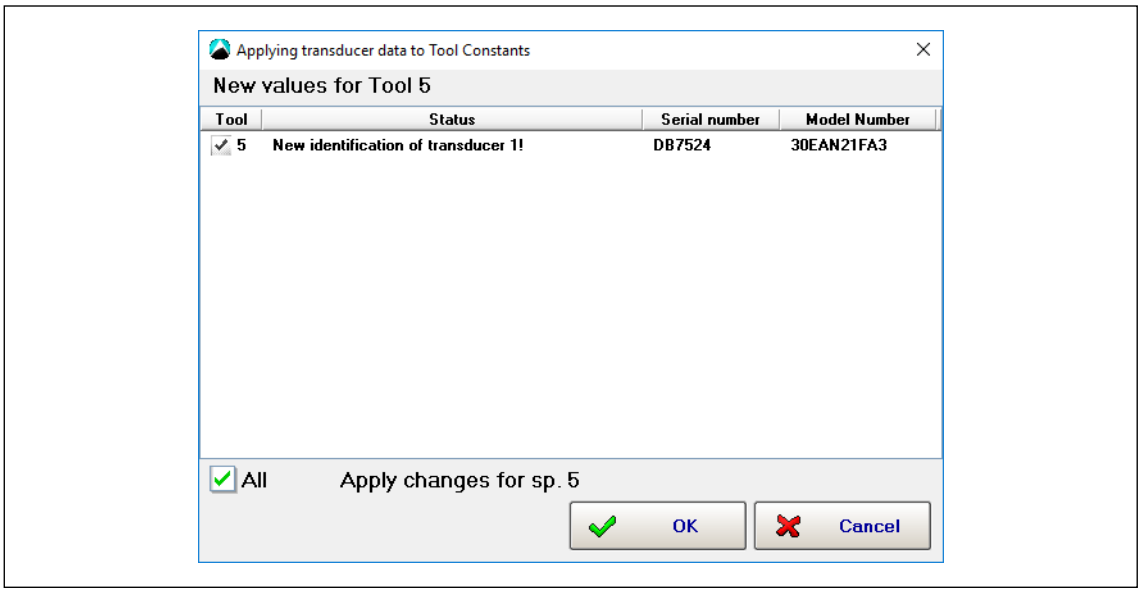


Fig. 7-3: The Applying transducer data to Tool Constants dialog with a status message for Tool 5

The *Applying transducer data to Tool Constants* dialog provides status information when transducer data has changed. The following table explains the available status messages:

Status message	Explanation
New identification of transducer 1!	The transducer has been matched. The new Ident No. differs from the stored transducer Ident No.
Transducer data not realistic	The new tool type differs from the stored tool type.
Manual tool: Transducer 1 does not match the tool type	The transducer type is not contained in the tool type.
Not a standard combination!	The capacity level [Nm] of the two intelligent transducers is not identical. The capacity level is indicated by the second number of the Transducer type.
New transducer type 1	The new type differs from the stored transducer type.
Transducer 1 does not match the tool!	The transducer type is not contained in the tool type.
Transducer parameters are of the same type	The data for the new transducer correspond to the stored data except for the rundown counter.
Transducer parameters are unchanged	The data relevant for the Tool constants correspond to the stored data.
??? Unknown status ???	The new transducer is not recognized as being or not being of the same type.

Once the transducer data is adopted, the status messages are no longer displayed.

7.6 Current calibration

Electric current values are converted into torque values to ensure that users can apply the same unit of measurement (Nm). The dynamic current constants (*Dyn. curr. const.* unit: Nm/A) are the conversion factors required for this purpose. You use the *Current calibration* feature to determine dynamic current constants for your *Tools, Applications* and *Stages*.

The conversion factors depend on various conditions including:
- Tool/motor data
- Data specific to the required joint (speed, dynamics, fastening sequence)

In theory, you can derive the static torque constant (*Static tq const. = Static Current factor*) from the current factor of the motor and the gear ratio. The required value is provided in a table, or it is available from the self-identification of the tool if applicable. This value serves as a basis for current-to-torque conversions. Where only low accuracy is needed, you can apply the *Static tq const.* directly for current redundancy (e.g., in back-off-only operations).

Where higher accuracy is needed, you have to take the specifics of the rundown into account and determine a *Dynamic current constant*. You use the *Current calibration* feature to perform test rundowns and calculate average values for each stage, which are then saved as *Dynamic current constants*. These remain valid until the conditions for the rundown change.

7.6.1 Settings required for current calibration

You can run *Current calibration* if the following requirements are met:
- *Dynamic Current Calibration* is enabled (*Navigator > Advanced > Controller > Advanced*).
- Either current redundancy is enabled or current control with transducer redundancy is enabled.

Enabling Dynamic Current Calibration

The *Dynamic Current Calibration* checkbox of the *Advanced* dialog enables dynamic current calibration for all tools and applications.

Parameters	Description
Enabled	Enables *Dynamic Current Calibration*.
Number of Samples	Displays the number of test rundowns.

To enable the *Dynamic Current Calibration* option:
1. Select *Navigator > Advanced > Controller > Advanced.*
2. Enable the *Dynamic Current Calibration* option.
3. Use the *Number of Samples* input box to enter the number of test rundowns required to determine the Dynamic current constant.

Tool constants settings required for current calibration

You can run *Current calibration* with the following *Tool constants* settings in the *Tool constants* screen:

Control unit	Redundancy	Redundancy evaluation
Transducer	Current/Resolver	NOK or Warning (AN2F)

7.6.2 Changing Dynamic current constants

Use the *Change of calibration values* dialog to initiate calibration and change the *Dynamic current constants* for tools, applications, and stages.

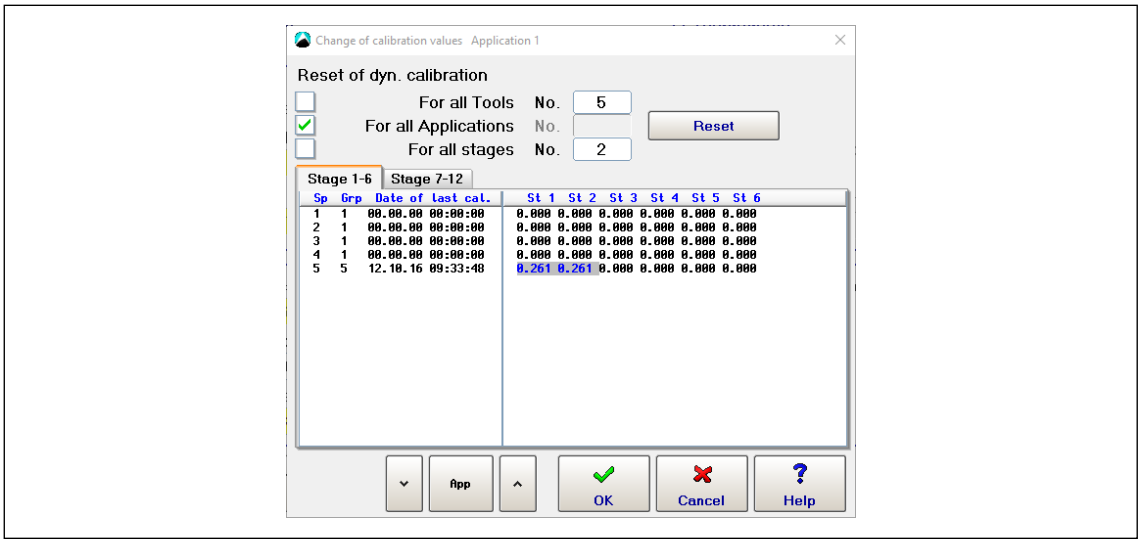


Fig. 7-4: Dynamic current constants calibrated for Stages 1 and 2 (St 1 and St 2) of Application 1, Tool 5 (Sp 5)

To change Dynamic current constants:

1. Tap the <Dyn. curr. const.> button of the *Tool constants* screen to open the *Change of calibration values* dialog.
2. Select the required tools, applications, and stages: Use the checkboxes to select all or enter the numbers of specific items.
3. Tap the <Reset> button to reset the *Dynamic current constants* of the required tools, applications, and stages.
4. Tap the <OK> button to close the dialog.
5. Execute the required test rundowns.
6. Check the outcome of the dynamic current calibration in the *Current calibration* window of the *Tool diagnostics* (Select *Navigator* > *Diagnostics* > *Tool* > *Current Calibration*).

Dialog window item	Explanation
Title bar	Displays the currently selected application. Use the <App> button and the related <Arrow> controls at the bottom of the dialog window to select the required application.
Sp column	Lists all connected tools.
Grp column	Provides the tool group associated with the tool listed in this row.
Date of last cal. column	Lists the dates and times of the last dynamic current calibrations.
St columns	Provide the Dynamic current constants for each stage of a tool in the current application.
0.261 0.261 0.000 0.000	Blue text on gray background indicates values based on completed calibration.

While you run dynamic current calibration, static current redundancy is used.

7.6.3 Actions that automatically discard dynamic current constants

If you make one of the following changes, the dynamic current calibration data are automatically discarded and static calibration data are used:

Change / Parameter	How to access
• Speed (enter different value) • Shut-off Torque (enter different value) • Torque Averaging Filter (enter different value) • Sequence (select different sequence)	Rundown programming dialog: ▶ Select *Navigator* > *Standard (select a tool group)* > *Stages* > *Stage n (select a stage)* > *Sequences*
• Transducer data (change tool when intelligent transducer is used)	Transducer data dialog: ▶ Select *Navigator* > *Diagnostics* > *Tool* > *Tool Memory*
• Torque calibration value (enter different value) • Static tq const. (enter different value) • Current adj. Factor (enter different value) • Maximum speed (enter different value) When parameters are imported into the station, they are checked to see if they affect any of the changes above.	Tool constants dialog: ▶ Select *Navigator* > *Tool Setup* > *Tool n (select a tool)* > *Tool Settings* > *Advanced*

8 Advanced

The *Advanced* dialog provides an overview of existing applications (*Matrix* tab) and additional features for programming the digital 24 V-inputs 0-7 and 24 V-outputs 0-7 of the controller's on-board module (PM-DIDO) (*Inputs* and *Outputs* tabs), for linking applications (*Linking* tab), for programming controller settings (*Controller* tab), and for programming tool group settings (*Tool Group* tab).

▶ Select *Navigator* > *Advanced* > *Matrix*.

8.1 Application Matrix

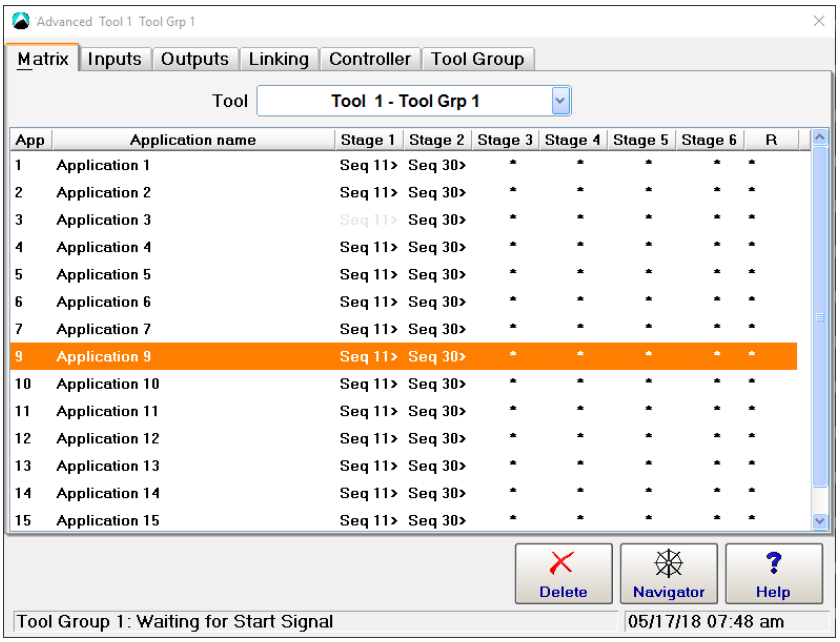


Fig. 8-1: The Application Matrix of the Advanced dialog for Tool 1 of Tool Group 1

The Application Matrix is a display matrix of 99 Applications vs. 6 Stages displaying the selected Sequence number for each stage. It gives the user an overview of controller programming in a single screen. The arrow following the sequence number for a stage indicates the direction of rotation (> for clockwise; < for counterclockwise).

8.2 Inputs

▶ Select *Navigator* > *Advanced* > *Inputs*.

NeoTek tools have two function buttons. First button is currently fixed to reverse. The second function button can be assigned to one of the listed functions in the dropdown menu. No function is assigned to *Function button 2* per default.

The *Inputs* tab provides simple programming for the digital 24 V-inputs 0-7 of the controller's on-board module (Primary, Tool 1 (Tool Grp1), Tool 2 (Tool Grp 2)). For each module, the input signals of the following table can be connected to the physical inputs 0-7.

Signal Name	Description
Not used	No input is set on this position.
Tool Group Enable	When active, allows the tool to run in conjunction with Tool Group Start (SA).
Tool Group Start (SA)	Starts a new rundown. All state outputs of the previous rundown are cleared. Inactive if external tool start is parameterized.
Remote Tool Start	Allows external input to control the start of the tool.
Reverse (TM_LL)	When active, causes the tool to run in counterclockwise direction using the back-off strategy. Inactive if external tool reverse is parameterized.

Signal Name	Description
Remote Tool Reverse	Allows external input to control the tool running in counterclockwise direction.
Unlock Tool	Release tool after locked by completed batch sequence.
App / LG Select 0-7	App / LG Select 0-7 are used to select Applications 1-99 using a binary count of 1-99 where App / LG Select 0 is the least significant bit. When Linking is activated, the Linking Group is selected with these inputs.
Abort Linking	When active, current workpiece is cancelled and Linking Group is reset to start position.
Reject Release	Used when Reject Release is enabled (*Advanced* > *Tool Group* > *Tightening*) and the Release Method is <Input Reject Release>. When the tool is disabled due to the reject limit being reached, it is re-enabled after this input is toggled.
OP Input 1-8	Input is passed through to Open Protocol / FEP (MID 0211).
Tool Group Stop	Stops the current rundown.
Pendant Release	Pendant momentary switch. Used to release one job only. Used with GMCC.
Pendant Bypass	Pendant maintained switch. Used to bypass all jobs regardless of result. Used with GMCC.
Manual Mode	When active, manual operation is used as defined in the Manual mode settings (*Advanced* > *Tool Group* > *Tightening*).
Linking Mode	1 = activate Linking mode, 0 = switch to Application mode.
Reset Signals	Reset output signals rundown state.
Activate Tool Scanner	Barcode scanner is activated with the function key 2. The signal must be present for three seconds before the barcode is active. The function only applies to NeoTek tools.
Used by Programmable IO	Input signal is not available. Signal is parameterized by Programmable I/O.

8.3 Outputs

▶ Select *Navigator* > *Advanced* > *Outputs*.

NeoTek tools have four LEDs, an output signal as shown in the picture can be assigned to any of the LEDs. Default setting is:

LEDs	Definition
Red	Tool NOK
Green	Tool OK
Yellow	Status
Blue	Not assigned

The *Outputs* tab provides simple programming for the digital 24 V-outputs 0-7 of the controller's on-board module (Primary, Tool 1 (Tool Grp1), Tool 2 (Tool Grp 2)). For each module, the output signals of the following table can be connected to the physical outputs 0-7.

Each of the physical outputs 0-7 can be programmed to have one of the following definitions:

Signal Name	Description
Not used	No output is set on this position.
Tool Group OK	Evaluation of Tool Group. Active if Torque/Angle/Yield are within programmed limits and no other error occurred.
Tool Group NOK	Evaluation of Tool Group. Active if Torque/Angle/Yield are outside limits or some other error has occurred.
Cycle Complete (AE)	Active when a rundown has ended and there are status outputs to report.
Linking Completed	Active when rundowns of all Linking Steps of the selected Linking Group are completed.

Signal Name	Description
Linking OK	Work piece is OK. Active if all Linking Steps of Linking Group were OK.
Linking NOK	Work piece is NOK. Active if one or more Linking Steps of Linking Group were NOK.
App / LG Confirm 0-7	App / LG Confirm 0-7 are used to indicate the currently selected applications 1-99 using a binary count where App / LG Confirm 0 is the least significant bit.
OP Out 1-10	Active if corresponding output is activated via Open Protocol / FEP (MID 0200).
OP Offline	Active if no connection to Open Protocol / FEP Client exists.
Status (Yellow LED)	Used to give customized status information. Active (flash) when the *Blink Lights when Tool in Reverse* option is checked (*Advanced* > *Tool Group* > *I/O*) and reverse input is active.
Tool OK (Green LED)	Evaluation of a single Tool. Active if Torque/Angle/Yield are within programmed limits and no other error has occurred.
Tool NOK (Red LED)	Evaluation of a single Tool. Active if Torque/Angle/Yield are outside limits or some other error has occurred.
TQ Low	Active if Torque is too low.
TQ High	Active if Torque is too high.
AN Low	Active if angle is too low.
AN High	Active if angle is too high.
Pass Through (Green)	Allows external input to control a stack light connected to the controller's discrete I/O.
Pass Through (Yellow)	
Pass Through (Red)	
Pass Through (Alarm)	
Tool Running	Tool runs in clockwise (CW) or in counter clockwise (CCW) direction.
Tool Group in Reverse	Active if reverse switch on Tool is active, or if input for reverse is active.
Verification Mode	Active if tool verification is in progress.
Tool Error	Active if any error on Tool exists (e.g., transducer, motor, temperature).
Tool Bypassed	Active if Tool is bypassed. Tool does not participate in rundown.
Tool Enabled	Release of the tool group.
Used by Programmable IO	Output signal is not available. Signal is parameterized by Programmable I/O.

Timer

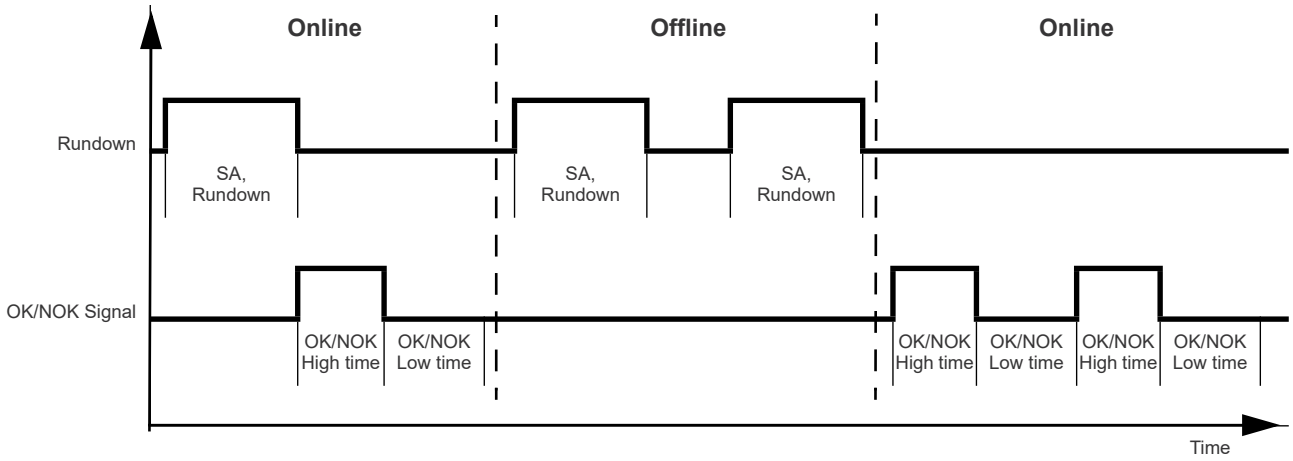
Select *Navigator* > *Advanced* > *Output*.

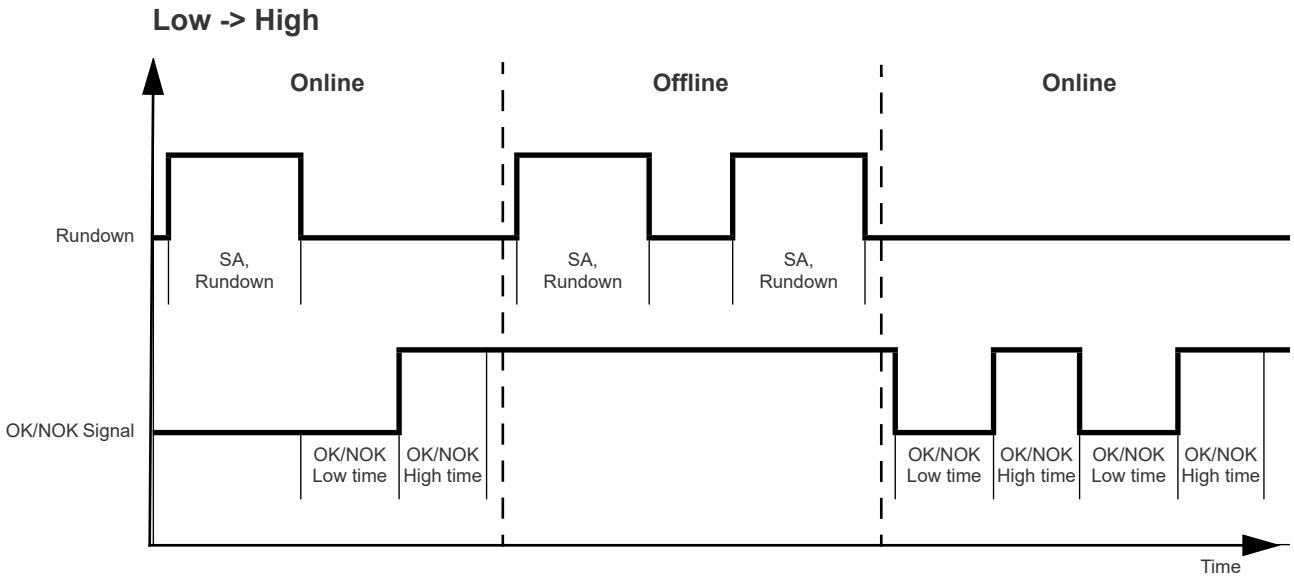
Button	Description
	<Timer> opens a dialog in which settings for the signal properties of the outputs can be defined. This function is used to record tightening signals for offline rundowns of cordless EC tools in order to inform the remote station (PLC) of each result. The settings apply to all tools. The timer applies to the following signals: • OK/NOK group outputs • Cycle Complete (AE) • for NOK: all NOK error outputs (e.g. torque too high, angle too low)

The following settings are available in the *Timer* menu:

Parameter	Description
OK/NOK High time [ms]	Time in milliseconds that the group output signal remains activated at OK/NOK High. This time is independent of the speed of the rundown.
OK/NOK Low time [ms]	Time in milliseconds that the group output signal remains activated at OK/NOK Low. This time is independent of the speed of the rundown.
High -> Low Low -> High	See the graphics below. When changing the setting from *Low -> High* to *High -> Low* it could happen that the tool is locked. In this case, restart the control.
Lock tool while timer active	If the check box is activated, the tool is locked after the fastening process. • *High -> Low* active: the tool is locked for the *OK/NOK High time [ms]*. • *Low -> High* active: the tool is locked for the *OK/NOK Low time [ms]*.

High -> Low





8.4 Linking

The *Linking* feature allows you to program linking groups (also called linking strategies), i.e., sets of linking steps to be processed in succession. Each linking step corresponds to one tightening position specified by a unique Fastener ID, and it executes the application required for this tightening position. The feature allows you to automatically switch between applications. An application is run when the start switch on the related tool is activated and the order of linking steps maintained. On completion of a step cycle, the linking group proceeds to the next linking step. You can program up to 99 different linking groups.

You can use this feature for batch counting if you enter the same application in the required number of linking steps.

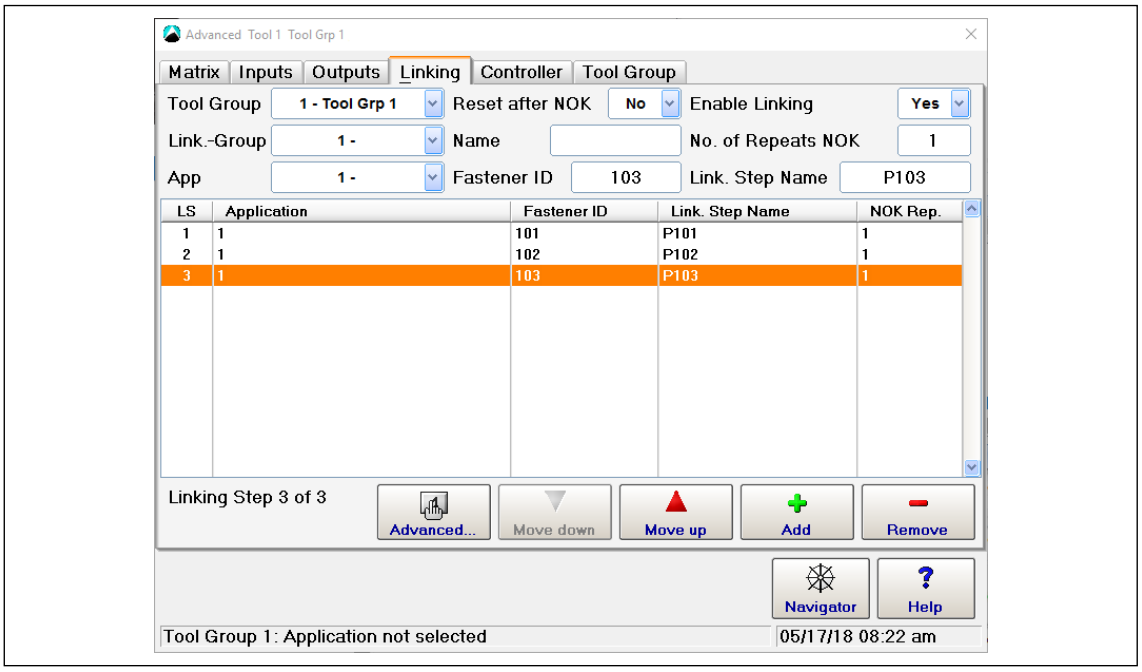


Fig. 8-2: The Linking tab of the Advanced dialog

To set up a linking group and add linking steps:

1. Select *Navigator* > *Advanced* > *Linking*.
2. Select the required tool group from the *Tool Group* drop-down menu of the *Linking* tab.
3. Select a linking group (1-99) from the *Link.-Group* drop-down menu.
4. If you want to name the selected linking group, enter a name in the *Name* text box.
5. Select the required application (1-99) from the *App* drop-down menu to associate it with the current linking step of the linking group.

Instead of associating a linking step with an application, you can associate it with the *Scan Part ID* or the *Scan Barcode* option from the *App* drop-down menu. These options force the operator to perform a scan prior to proceeding with the next programmed linking step. See chapter *8.4.2 Scan steps in linking operations, page 77* for details.

6. Select the *Yes* option from the *Enable Linking* drop-down menu.
7. Tap the *Add* button to place the selected application as a linking step in the current linking group.
8. Select the action to be performed on NOK.
9. *Reset after NOK*: Resets the linking group to the first tightening position when an NOK occurs.
10. *No. of Repeats NOK*: Defines the number of times a fastener can be retightened after NOKs on the same tightening position before advancing to the next linking step.
11. You can enter a Fastener ID and a Linking step name in the *Fastener ID* and *Link. Step Name* boxes.
12. Tap the *Move up* and *Move down* buttons to change the position of the currently selected linking step within the linking group.
13. Tap the *Remove* button to remove the currently selected linking step from the linking group.

When linking is enabled, the controller automatically runs working mode with linking groups rather than single applications. Note that the Tool Start switch or Remote Start input has to be toggled between linking steps. The linking group and current tightening position are displayed on the *Run Screen*.

The following inputs and outputs will also be active when linking is enabled: Linking OK, Linking NOK, Linking Complete, and Reset Linking. Please refer to the Inputs and Outputs sections for more information on these signals.

8.4.1 Programming Linking Steps dialog

The *Programming Linking Steps* dialog allows you to employ several tools in a linking group and work several tightening positions or joints in a linking step.

▶ Select *Navigator* > *Advanced* > *Linking* > *Advanced*.

The *Overview Linking Steps* tab provides the following information on the linking group selected from the drop-down menu:

Item	Description
LS	Linking step number
#TP	Number of tightening positions or joints in this linking step
Start-TP	First tightening position in this linking step
App	Application of this linking step
TS	Tool used in this linking step
Link. Step Name	Linking step name

The *Overview Linking Steps* tab provides the following controls to edit the linking group selected from the drop-down menu:

Button	Description
	<Fastener IDs> opens the *Fastener IDs* dialog.
	<Add> opens the *Settings* dialog to define a new linking step.

Button	Description
	<Up> and <Down> move the currently selected linking step up or down in the table.
	<Delete> deletes the linking step currently selected in the table.
	<Edit> opens the *Settings* dialog to edit the linking step currently selected in the table.
	<Barcode> opens the *Barcode Mask Configuration* dialog.

Linking Step Settings dialog

The *Linking Step Settings* dialog allows you to define new linking steps or edit existing linking steps in the currently selected linking group.

To define a new or edit an existing linking step in the *Linking Step Settings* dialog:

1. Select *Navigator* > *Advanced* > *Linking*.
2. Select the required tool group from the *Tool Group* drop-down menu of the *Linking* tab.
3. Tap the *Advanced* button on the *Linking* tab to open the *Programming Linking Steps* dialog for the selected tool group.
4. Select the *Overview Linking Steps* tab.
5. Select the required linking group from the *Linking Group* drop-down menu.
6. Do one of the following:
   - To define a new linking step: Tap the *Add* button ('plus' icon) to open the *Settings* dialog.
   - To edit an existing linking step: Select the required linking step in the linking steps table displayed for the currently selected linking group, and tap the *Edit* button (pencil icon) to open the *Settings* dialog for the currently selected linking step.
7. Enter the values required for the linking step.

Item	Description
Link. Step Name	Enter a name for this linking step.
Application (App)	Select the application of this linking step.
Number of Tight. Pos.	Set the number of tightening positions or joints required in this linking step.
Start at Tight. Pos.	Set the first tightening position in this linking step.
Tool selection	Enter the tool to be used in this linking step.
No. of NOK repeats	Set the number of NOK repeats allowed.
Target Stage	Select the target stage.
Mandatory Stages	Enter mandatory stages.
Input mask	If required, define an input bitmask, that is, input bits that must be activated (e.g., E1) and/or must not be activated (e.g., EN2-3) to release this linking step.
Outputs	If required, define an output bitmask, that is, output bits to be set (e.g., A1-2/6) when this linking step is activated.
Visual. color after OK	Tap the color box to select the color to be used for OK rundown results.
Visualization text	Enter text to be displayed on the process visualization screen (Workpiece Picture).
Text message (Inputs)	Enter text message.

8.4.2 Scan steps in linking operations

You can define scan steps to release tightening steps. A scan step releases the next linking step when a corresponding barcode is received. The *App* drop-down menu of the *Linking* dialog allows you to choose between two scan step types, i.e., *Scan Part ID* or *Scan Barcode*.

▶ Select: *Navigator* > *Advanced* > *Linking*.

The following two scan step types are available for linking operations:

Item	Description
Scan Part ID	• Can be set only once for a linking operation. • Serves as VIN for the entire workpiece (if Function barcode is not programmed).
Scan Barcode	• Can be set for each tightening position.
1 - 99	• Displays the Applications assigned by the user.

You can program the linking operation with Function barcode or without. The Function barcode serves as VIN if the Special function is enabled. See chapter *10.4.1 Part ID settings, page 178* and *10.4.2 Workpiece administration, page 179* for details on how to set the Function barcode.

Example of setting up Function barcode and scan steps

To set up a Function barcode and scan steps for a linking operation:

1. Select *Navigator* > *Communications* > *Part ID* to open the *Part ID* dialog, and enter the required values. See chapter *10.4.1 Part ID settings, page 178* and *10.4.2 Workpiece administration, page 179* for details.
2. Tap the *Configure* button to open the *Workpiece administration* dialog, and tap the *New* button to open the *Edit workpiece* dialog.
3. Set the required Function barcode as indicated by the following example, and confirm your settings:

Items	Example
Workpiece Description	Test Linking Group
Barcode Mask	LG1#####
Barcode Function	Use Linking Group X (1-99)
Linking group	1

4. Select *Navigator* > *Advanced* > *Linking*.
5. Select the *Scan Part ID* option from the *App* drop-down menu.
6. Enter the required scan mask in the *Mask* input box, e.g., PID#####:
   → The *PID#####* mask enables the next tightening position if the scanned barcode begins with *PID* and consists of 8 ASCII characters.
7. Enter the required value in the *No of retries* input box:
   The number of retries defines the maximum number of scan retries allowed before the current workpiece proceeds to the next step or is aborted.

The option selected from the *Enable Linking* drop-down menu has no effect if the Special function is enabled in the Part ID settings and Workpiece administration. Before the first linking position becomes available for scan steps, the Special function barcode defines whether Linking or Application mode is used and which Linking or Application number is selected.

8. Set the remaining linking positions as indicated by the following example:

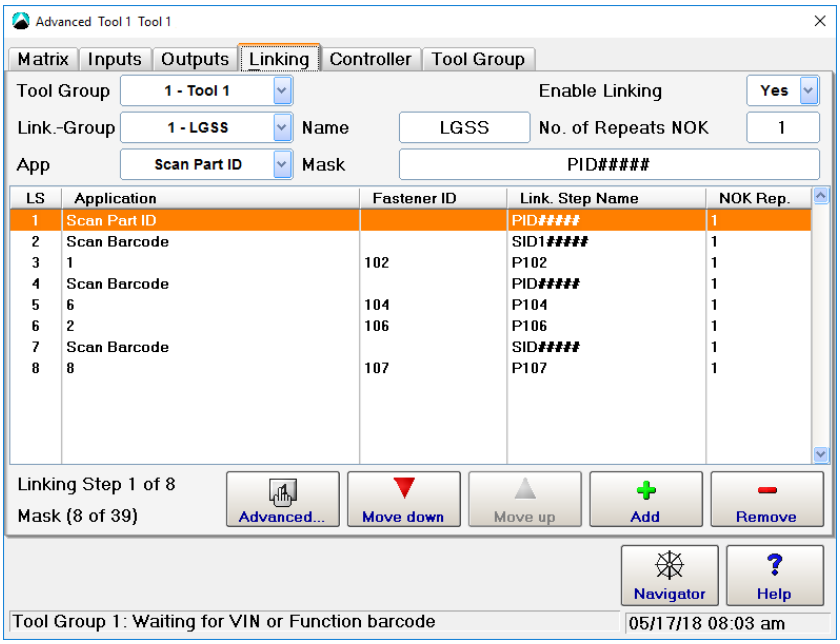


Fig. 8-3: Linking dialog with scan steps programmed

LS	Application	Fastener ID	Link. Step Name	NOK Rep.
1	Scan Part ID		PID#####	1
2	Scan Barcode		SID1#####	1
3	1	102	P102	1
4	Scan Barcode		SID2#####	1
5	6	104	P104	1
6	2	106	P106	1
7	Scan Barcode		SID#####	1
8	48	107	P107	1

For rundowns with linking steps, the <Yes, interlocked> Part ID mode is recommended since rundowns with linking steps were developed for this mode. If you select a linking group with scan steps in the <No> Part ID mode, a related error message is displayed and no rundown can proceed.

Run screen displays error message since a linking group is selected and Part ID mode set to <No>: **Linking Group requires Part ID, but Part ID mode is disabled.**

Example of rundown using linking steps with Function barcode

Once you have set up Function barcode and scan steps, the *Run screen* may initially look as follows, i.e., Linking mode and App or LG number are not yet selected:

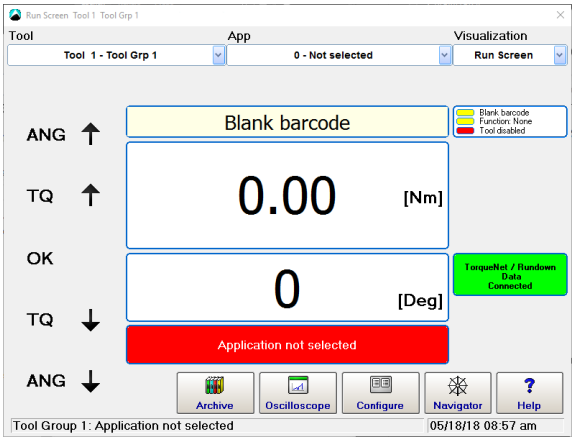


Fig. 8-4: Run screen displays Application not selected message

In our example the eight-character Function barcode *LG1ABCDE* sets the rundown to Linking mode and selects Linking Group 1, which is named LGSS. The first linking step locks the tool group and waits until a matching Part ID barcode is received, i.e., a Part ID barcode that matches the *PID#####* mask:

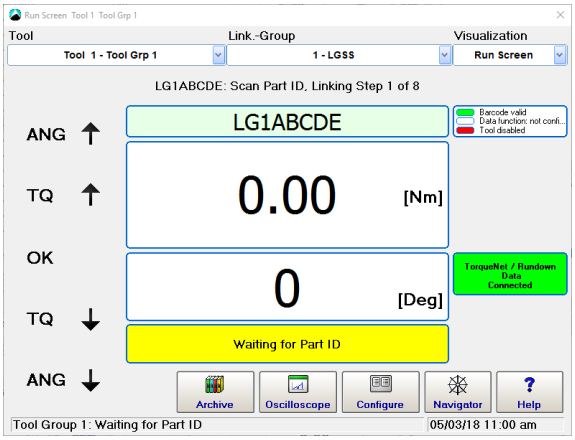


Fig. 8-5: Run screen displays Waiting for Part ID message

The following actions abort the current workpiece and result in linking NOK:

- Any changes in the linking selection
- Rescan of the Part ID barcode with valid result, i.e., the barcode matches the mask

The Scan Part ID barcode activates Position 2 of the Linking table and waits for a position barcode that matches the *SID1#####* mask. This continues until all positions in the Linking table have been processed:

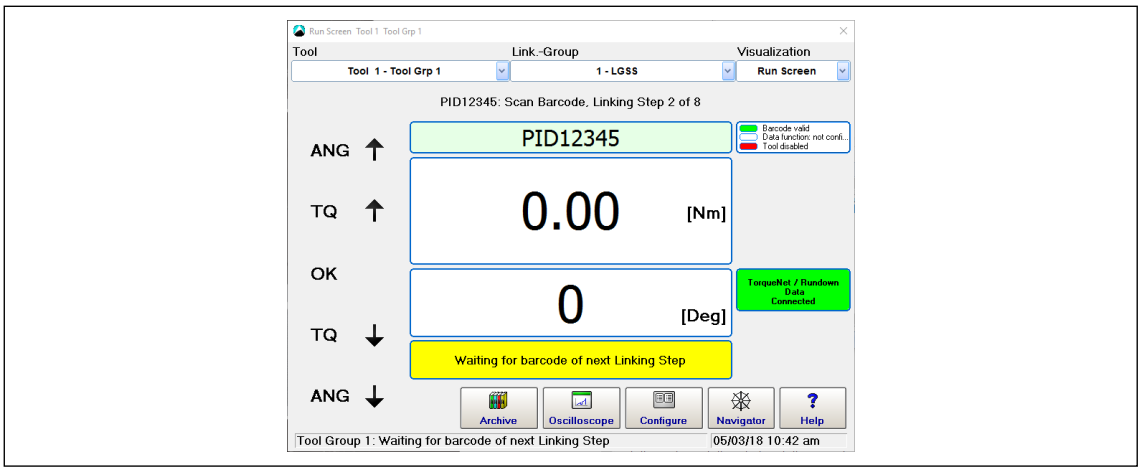


Fig. 8-6: Run screen displays Waiting for barcode of next Linking Step message

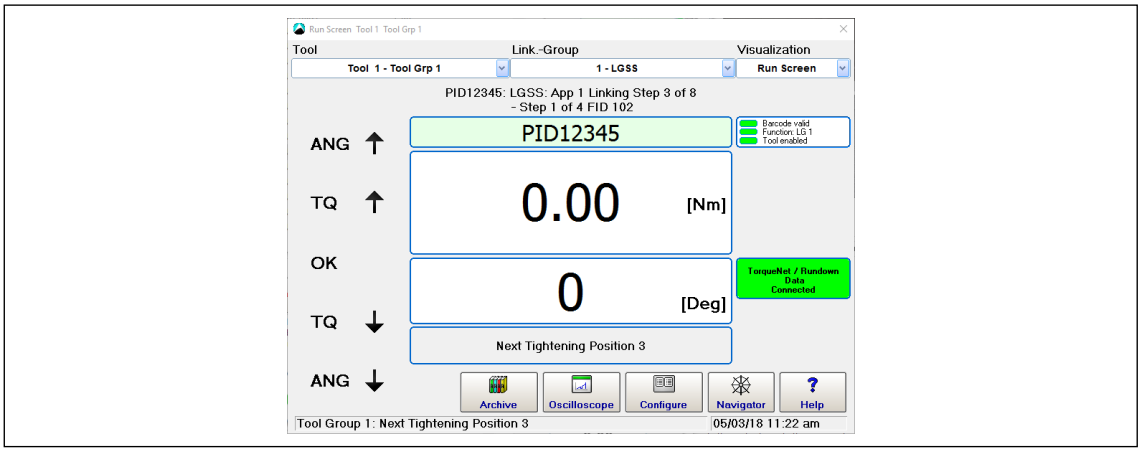


Fig. 8-7: Run screen displays Next Tightening Position 3 message

Rundowns using linking steps without Function barcode

In rundown cycles using linking steps without Function barcode, you can directly change the linking group number after a Function barcode has been scanned as long as the first scan step or rundown has not been started yet.

VIN number in scan steps

- If a Function barcode and Scan Part ID are defined, the Scan Part ID is entered in the Archive table as VIN number.
- If the Scan Part ID is not set in the linking table, the Function barcode is entered in the Archive table as VIN number.

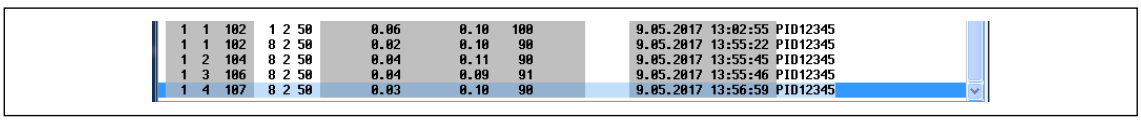


Fig. 8-8: Scan Part ID displayed in the Archive table

Scan barcodes cannot serve as VIN number. They are transmitted with other rundown data as extended Archive data (extended XML-formatted string) to the Archive and active server.

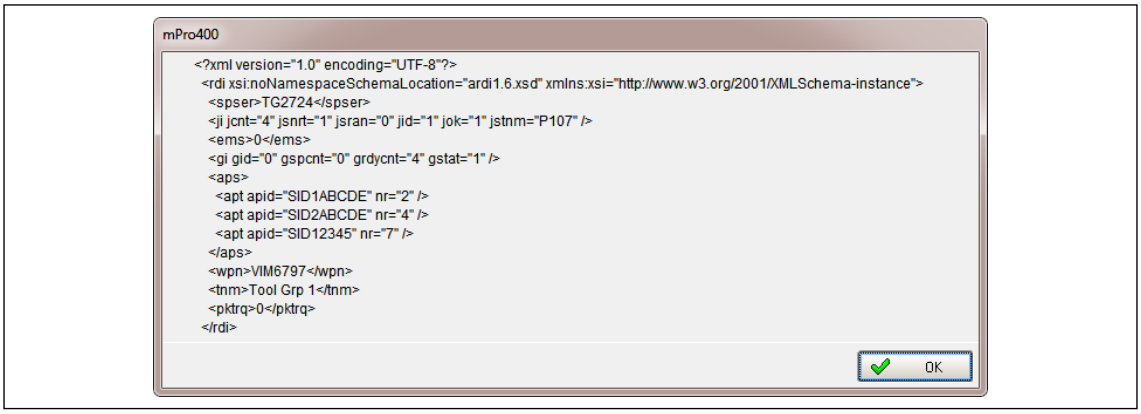


Fig. 8-9: Transmission of Scan barcodes (Linking Step 2, 4, and 7)

8.5 Controller settings

The *Controller* tab provides features to program controller settings on the *General*, *Advanced*, and *Miscellaneous* tabs.

▶ Select *Navigator* > *Advanced* > *Controller*.

8.5.1 General controller settings

Controls provided on the *General* tab:

Name	Description
Name	Allows you to enter a name for the controller.
Number	Allows you to assign a number to the controller.
Custom Torque units	Select the unit of measurement used for torque by the controller. The units available from the *Torque* drop-down menu are *Nm, FtLbs, InLbs*, and *dNm*. You can also add user-defined units of measurement to the *Torque* drop-down menu: 1. Select the *CUSTOM* option from the *Torque* drop-down menu. 2. Enter a Name for the user-defined unit in the *Units* box. 3. Enter the Factor required to convert the unit to Nm in the *Factor (Per Nm)* box. 4. Tap the <Add> button to add the user-defined unit to the Torque list. 5. Select a user-defined unit from the list and tap the <Remove> button to delete it from the list.
Start Tool Setup screen (if warnings active)	Defines the screen to be displayed after controller restart.
Reset Application / Linking Group to zero	Enable to apply after system restart.
Keep operating mode (Application or Linking)	Enable to apply after system restart.
Trace Recording	Opens the *Rundown archive settings* dialog where you can enable or disable the recording of rundown traces for each tool group and application.

▶ Tap the <Navigator> button to commit changes.

8.5.2 Trace Recording

The features of the *Rundown archive settings* dialog allow you to control the recording of Torque graphs in the *Archive*.

▶ Select *Navigator* > *Advanced* > *Controller* > *General* > *Trace Recording*

Button	Description
	<Trace Recording> opens the *Rundown archive settings* dialog.

To set the recording of Torque graphs for an application:

1. Select *Navigator* > *Advanced* > *Controller* > *General* > *Trace Recording* to open the *Rundown archive settings* dialog.
2. Select the required Tool from the *Tools* drop-down menu to display all applications of the tool in the *Rundown archive settings* table.
3. Find the required application in the *App* column of the table and tap the application's table row to select it.
4. Select the *On* option from the drop-down menu below the *Record* column of the table to enable recording for the selected application.
5. Select the required *recording mode* option from the drop-down menu below the *Mode* column. See the Recording mode section below for a description of the options.
6. If you use the *Sample* or *Interval* recording mode options, enter the number of rundowns to be omitted and recorded in the input boxes below the *Pause and Graph* columns.
7. Tap the <OK> button to confirm changes.
8. The <red arrow> buttons below the *Record, Mode, Pause*, and *Graph* columns allow you to transfer the values of the selected application to all applications in the table.

Recording mode

The drop-down menu below the *Mode* column sets the recording mode. The following options are available:

Name	Description
None	Does not record any rundowns.
All graphs	Records every rundown.
NOK Graphs	Records rundowns with NOK result only.
Sample	Records a set of rundowns specified by the *Pause* and *Graph* settings for the currently selected application. *Graph* sets the number of consecutive rundowns to be recorded. *Pause* sets the number of consecutive rundowns to be omitted. For example, if *Pause* is set to *1* and `Graph` is set to *9*, nine rundowns are recorded and the tenth is not recorded. In Sample mode, <Reset counters> triggers a restart of recording.
Interval	Uses the *Pause* and *Graph* settings to define a set of rundowns as in *Sample* mode. While *Sample* recording is just carried out once, *Interval* recording is repeated cyclically.
Redundancy graph options	The *Sample* and *Interval* options are also available with redundancy graphs.

8.5.3 Advanced controller settings

Controls provided on the *Advanced* tab:

Name	Description
Display format on Secondary	Allows the user to change the information on the tightening status displayed at the Secondary display.
Warning factor	Determines the percentage of deviation from the fixed internal limits, from which the system outputs a warning. Example: The supply voltage is 12 V ±0.6 V: • If the Warning factor is set to *100 %*, 11.4 V cause an NOK. • If the Warning factor is set to *50 %*, 11.7 V cause a system warning to be output. When a system warning occurs for the first time, the output '"System Warning" of the I/O level is activated.
Login/Logout Enable	- Not available in current software version - Requires the user to log in at the controller to operate the tool. Logout disables the tool. The *Run Screen* displays *Password Required* until a user logs in. To log in: 1. Select Navigator > Login. 2. Enter a user name and password. The user must have Login rights. See *Navigator* > *Administration* > *Users*.
Accept System Bus map changes automatically	No operator intervention necessary to accept changes in the *System Bus* map.
Use Selected TQ units for Data Transmission	If the system is set to use Custom torque units, they are also used in data transmission, e.g., for Open Protocol.
Generate results with SKIP error for skipped tightening positions	Each Linking Step of a programmed Linking Group that is not processed after a workpiece abort (e.g., change of workpiece by new scanned VIN) is recorded in the Archive. Each of these entries is marked with a SKIP error.
Dynamic Current Calibration	Enables Dynamic Current Calibration for use of dynamic current constants (see chapter *7.6 Current calibration, page 87* for details).

8.5.4 Miscellaneous controller settings

Controls provided on the Miscellaneous tab:

Name	Description
SysLog messages options	These options allow you to set the recording of SysLog messages on the SD card.
Allow Tool Test, Switch board and App/LG selection via mProRemote	If this option is NOT enabled, some safety-critical functions are not active via mProRemote to preclude potential problems, e.g., a tool running by accident.
Finish current tightening in case Tool Group gets disabled	Enable this option if the Tool Group has to finish its rundown when it gets disabled (e.g., Tool Group Enable input gets low) during a rundown. If this option is disabled, the Tool Group stops immediately after a disable signal.
Disable local saving and editing of Application parameters (for TPS)	Enable this option if Application parameters are to be saved and edited from TPS (Tightening Parameter Server) only. See chapter *10.7 Tightening Parameter Server (TPS), page 190*.
Show Warnings (Maintenance Counter)	With this option enabled, the maintenance warning messages are displayed on the *Run Screen*. See chapter *6.7 Tool maintenance information, page 71* for details.

8.6 Tool Group settings

The *Tool Group* tab provides access to settings specific to a tool group. You select the required Tool Group from the *Tool Group* drop-down menu. The *Tool Group* tab provides access to input/output settings (*I/O* tab), fastening settings (*Tightening* tab), and to settings specific to tools (*Extended Tool Settings* tab).

▶ Select *Navigator* > *Advanced* > *Tool Group*.

Controls provided on the *Tool Group* settings tab:

Name	Description
Tool Group	Select the tool group you want to program.
Tool Group Name	Name the selected Tool Group. This name is displayed in all Tool Group drop-down menus.

8.6.1 I/O tab of the Tool Group settings

Controls provided on the *I/O* tab:

Name	Description
External Application / LG Selection	With this option enabled, the application or linking group is selected externally by the source selected from the Mode drop-down menu. **Mode drop-down menu options:** • Binary: Selection done by the *App / LG select 0-7* signal inputs • Binary + 1 (like TME) • Selector Switch • Socket Tray • FEP / Open Protocol: MID-0018 and MID-0035 are used • BCD Ext. App. Sel. +/-**Mirror drop-down menu options:** • Binary • Binary + 1 (like TME) • Selector Switch • Socket Tray • BCD
External Tool enable	Allows the user to require an external signal input for the rundown cycle to begin.
Latched Remote Start	Enables latching of the ext. tool start signal. If unchecked the remote start signal must be maintained for the tool to continue running.
Blink Lights when Tool in Reverse	Causes LEDs on the tool to flash when the tool is in reverse. If this box is unchecked, there is no visual indication when the tool is in reverse.
Blink when Linking is finished	Causes LEDs to flash when the linking group is finished.
Lock if Fieldbus is offline	With this option enabled, the tool group gets locked if there is a problem with the fieldbus connection. *Run Screen* locked by Fieldbus NOK.
External Tool Stop Active Low	Tool stops after indicating the servo module has detected an error (transducer, resolver, etc.).
Enable Remove Fastener Torque	Sets Remove Fastener Torque: a threshold for each application above which a fastener should be replaced (GMCC).

8.6.2 Tightening tab of the Tool Group settings

Controls provided on the *Tightening* tab:

Name	Description
Manual mode	In the absence of a server connection, the operator is allowed to proceed with emergency settings (for the selected Application or Linking Group or by working with Part IDs), which are defined under manual operation. In addition, external Application Selection through input signals (App / LG Select 0-7) can be activated.
Reject Release	Enter the maximum number of rejects (overall NOK results) that are permitted before a release signal is required. If you enter *0*, the function is disabled. Release on Backoff allows the operator to release the tool by running the tool in reverse. Release Input Toggle allows the operator to set a low-high-low pulse of the *Reject Release*-input as a release signal.

8.6.3 Evaluation and Backoff Settings tab of the Tool Group settings

Controls provided on the *Evaluation and Backoff Settings* tab:

Name	Description
If trigger released options	Sets status of fastenings after Trigger is released prematurely. • No evaluation if Torque below [Nm]: sets torque limit for evaluation. • before final stage: sets result to NOK or to No evaluation. • in final stage: sets result to NOK if released prematurely or to OK if requested Torque/Angle is within limits.
Ignore BLOC errors for NOK counting	If the bolt is already fastened, the NOK and OK counters are not incremented. The results are ignored.
Back-off mode for all Applications and Linking steps	This drop-down menu lets you define when a back-off is allowed. The available options are: • Always allowed • Always forbidden • Allowed after NOK • Allowed after NOK except BLOC (already tightened) This setting is independent of the working mode (Applications or Linking Groups) used.

8.6.4 Miscellaneous tab of the Tool Group settings

Controls provided on the *Miscellaneous* tab:

Name	Description
Activate enhanced trace recording if supported by tool (Time, Speed, ...)	In addition to torque and angle traces, some tool types support time, speed, and current traces. This option enables the additional traces for the tool group. Please keep in mind that more data is transferred and stored with this option enabled.
Set up pictures	Opens the *Edit picture* dialog, which provides options for process visualization. See chapter *8.6.5 Set up pictures for process visualization, page 86* for details.
Tool Notification Settings	Opens the *Tool Notification Settings* dialog. See chapter *8.6.6 Tool notification settings, page 88.*

8.6.5 Set up pictures for process visualization

Process visualization provides operators with information required for task management.

▶ Select *Navigator* > *Advanced* > *Tool Group* > *Miscellaneous*.

Button	Description
	<Set up Pictures> opens the *Edit picture* dialog.

The features of the *Edit picture* dialog allow you to set up and manage images of fastening positions for process visualization:

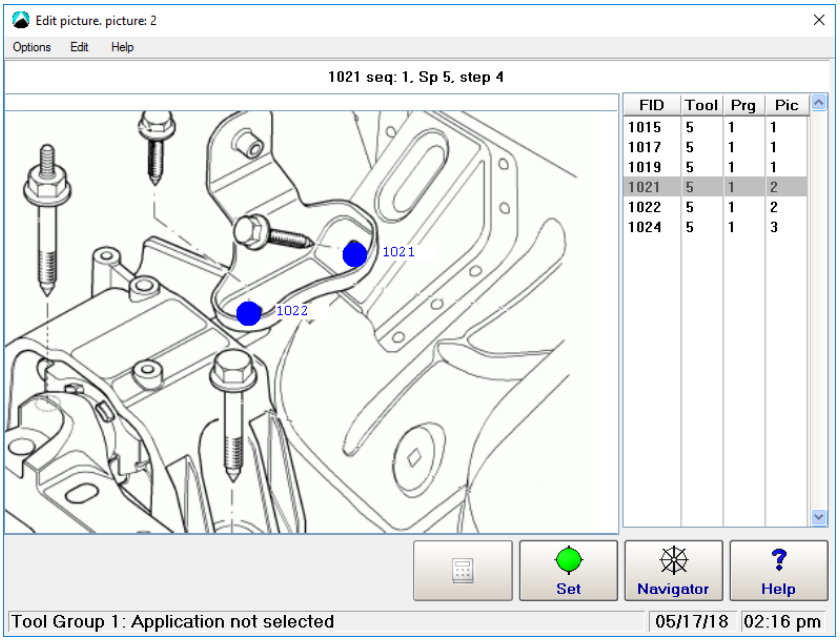


Fig. 8-10: The Edit picture dialog displays Picture 2 of Tool 5, which visualizes the positions of Fasteners no. 1021 and no. 1022

The *Edit picture* dialog window displays an image of a workpiece and a table with the fasteners associated with a particular tool group. You can select a fastener in the table and set the selected fastening position on the workpiece image.

The fastening position table displays the following information:

Column header	Description
FID	Fastener ID
Tool	Tool used for the rundown at the fastening position
Prg	Program (Linking Group) used for the rundown
Pic	Picture displayed during the rundown

Workpiece image (bitmap) management

The *Options* menu of the *Edit picture dialog* provides access to commands that allow you to add new workpiece images to a tool group and select existing images to visualize fastening positions.

▶ Select *Navigator* > *Advanced* > *Tool Group* > *Miscellaneous* > *Options* > *bitmap management*

The workpiece images used to visualize fastening positions must be bitmap files (bmp) with 480 x 800 pixels and up to 65,535 colors.

To add an image (bitmap) of a workpiece to a tool group:

1. Select *Navigator Menu* > *Advanced* > *Tool Group*
2. Tap the <Set up Pictures> button on the *Miscellaneaus* tab to open the *Edit picture* dialog.
3. Select the required Tool group in the *Tool Group* pop-up window.
4. Select the *Select picture* option from the *Options* menu of the *Edit picture* dialog to open the *Select picture* dialog.
5. Select the *Image no.* to which you want to assign a new workpiece image, and tap the <OK> button of the *Select picture* dialog.
6. Select the *bitmap management* option from the *Options* menu of the *Edit picture* dialog.
7. Tap the <load bitmap> button in the *bitmap management* pop-up window and confirm the *Load new picture* pop-up to open the *Load Pict.File* dialog.
8. Navigate to the bitmap file you want to add, select the file, and tap the <OK> button.
9. Tap the <OK> button of the *bitmap management* dialog to return to the *Edit picture* dialog.
   → Result: The new workpiece image is now displayed in the *Edit picture* dialog.
10. Tap the <Navigator> button of the *Edit picture* dialog to confirm or cancel changes and to close the dialog.

When you select a bitmap image from the directory *Geladene Bilder* (loaded pictures), only a link to the image is stored.

Setting fastening positions in a workpiece image

▶ Select *Navigator* > *Advanced* > *Tool Group* > *Miscellaneaus* > *Set up Pictures*.

Button	Description
	The <Set> button of the *Edit picture* dialog allows you to place the currently selected fastening position and its Fastening ID (FID) in the current workpiece image.

To set fastening positions in a workpiece image:

1. Select the *Select picture* option from the *Options* menu of the *Edit picture* dialog to open the *Select picture* dialog.
2. Select the workpiece image (*Image no.*) in which you want to visualize a fastening position, and tap the <OK> button of the *Select picture* dialog.
3. Select the fastener (*FID*) you want to visualize from the table of fastening positions.
4. Tap the <Set> button.
5. Tap the location in the workpiece image where you want to place the currently selected fastener (FID).
   → Result: The fastening position (blue dot) with its fastener ID is now displayed in the workpiece image.
6. Tap the <Navigator> button of the *Edit picture* dialog to confirm or cancel changes and to close the dialog.

Moving or deleting fastening positions and related text in a workpiece image

The *Edit* menu of the *Edit picture* dialog provides access to commands that allow you to move or delete fastening positions and related text in a workpiece image.

▶ Select *Navigator* > *Advanced* > *Tool Group* > *Miscellaneaus* > *Set up Pictures*.

Options of the *Edit* menu of the *Edit picture* dialog:

- Move Tightening Position
- Move Tightening Position text
- Delete Tightening Position
- Delete all Tightening Positions

To move or delete fastening positions and related text in a workpiece image:

1. Select the *Select picture* option from the *Options* menu of the *Edit picture* dialog to open the *Select picture* dialog.
2. Select the workpiece image (*Image no.*) in which you want to move or delete a fastening position, and tap the <OK> button of the *Select picture* dialog.
3. Tap the Fastening position you want to move or delete in the workpiece image of the *Edit picture* dialog.
   → Result: The fastener ID of the selected fastening position is now highlighted yellow.
4. Select the required option from the *Edit* menu, and check the title bar of the *Edit picture* window for instructions.
5. Follow instructions displayed in the title bar to move or delete the fastening position and related text in the workpiece image.
6. Tap the <Navigator> button of the *Edit picture* dialog to confirm or cancel changes and to close the dialog.

When you select the *Move Tightening Position* option from the Edit menu, these instructions are displayed in the title bar of the Edit picture window:
Edit picture - Move Tightening Position. Use cursorkeys. Finish with ESC.

Visualizing rundown data

Process visualization can provide a range of rundown data.

Declaration text	Stores visualization texts for the rundown steps in a work sequence.
Workpiece image area of the Edit picture dialog	Displays the following information. • Workpiece image (bitmap which serves as background and illustrates the workpiece) • Active and inactive fastening positions: - Blue: fastening positions not yet processed - Green: fastening positions processed with OK results - Red: fastening positions processed with NOK results • Text fields (which are highlighted yellow as long as the related fastening position is processed)

In the workpiece image area, you can display and edit a maximum of 512 fastening positions for all fastening programs. The table lists the first 512 programmed fastening positions. Fastener IDs should always be unique.

The details of process visualization features (e.g., of presentation, messages, acknowledgements, operator entries, and of automatic, manual, and setup operating modes) depend on customer requirements and vary considerably. We therefore cannot provide more specific information here. Please refer to the documentation of your specific software solution for greater detail.

8.6.6 Tool notification settings

Use *Audible* or *Vibration notifications* to indicate *Tool Group* and *Linking* status on NeoTek tools.

You can set Audible and Vibration tool notifications for the following four conditions:
- Tool Group OK
- Tool Group NOK
- Linking OK
- Linking NOK

▶ Select *Navigator* > *Advanced* > *Tool Group* > *Miscellaneous*.

Button	**Description**
<Tool Notification Settings>	<Tool Notification Settings> opens the *Tool Notification Settings* dialog.

The *Tool Notification Settings* dialog allows you to select tool notification patterns and enter notification durations in milliseconds:

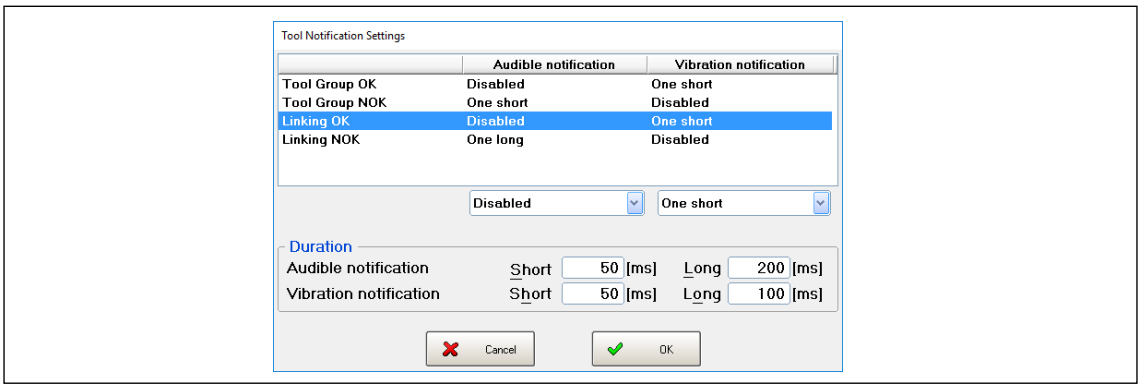


Fig. 8-11: The Tool Notification Settings dialog with notifications for Linking OK status selected

The *Tool Notification Settings* dialog has two sections. The upper section displays a table of all available notifications and allows you to select a pattern for each notification or disable each notification individually. The lower section provides two pairs of text boxes (Audible and Vibration) that allow you to enter a Short and/ or Long signal duration (in ms) to be used in notification patterns.

The following controls and options are available in the *Tool Notification Settings* dialog

Control	Description
Tool Notification Settings table	Select the status for which Audible and Vibration tool notifications are to be set.
Audible notification drop-down menu	*Disabled*: No Audible tool notification set for selected status. *One short, Two short, Three short*: Use one, two, or three Short-duration signals in Audible notifications for the selected status. *One long, Two long, Three long*: Use one, two, or three Long-duration signals in Audible notifications for the selected status.
Vibration notification drop-down menu	*Disabled*: No Vibration tool notification set for selected status. *One short, Two short, Three short*: Use one, two, or three Short-duration signals in Vibration notifications for the selected status. *One long, Two long, Three long*: Use one, two, or three Long-duration signals in Vibration notifications for the selected status.
Audible notification duration text boxes	*Short*: Enter duration [ms] of signals to be used in Short-duration Audible notification patterns. *Long*: Enter duration [ms] of signals to be used in Long-duration Audible notification patterns.
Vibration notification duration text boxes	*Short*: Enter duration [ms] of signals to be used in Short-duration Vibration notification patterns. *Long*: Enter duration [ms] of signals to be used in Long-duration Vibration notification patterns.

To enable an Audible or Vibration notification for a particular status and set its pattern and duration:

1. Tap the table row of the required status in the upper section of the *Tool Notification Settings* dialog.
2. Select the required notification pattern from the drop-down list below the Audible or Vibration notification column.
3. Tap the related text box in the Duration section of the *Tool Notification Settings* dialog, and enter the required time in milliseconds.

8.6.7 Extended Tool Settings tab for NeoTek tools

The *Extended Tool Settings* tab provides additional settings for NeoTek tools.

▶ Select *Navigator* > *Advanced* > *Tool Group* > *Extended Tool Settings*.

Controls provided on the *Extended Tool Settings* tab for NeoTek tools:

Parameter	Description
Brightness LED-Ring	Options to set *Brightness LED-Ring*: • Low • Middle: default value • High
Tool Light	Options to set *Tool Light*: • First Start Switch: on after pressing the start switch to first position • Always Off • 3 Seconds: on for 3 seconds when tool is turning • During Rundown: on during the whole tightening process
Brightness Tool Light	Options to set *Brightness Tool Light*: • Low • Middle: default value • High

In this dialog the WLAN Socket Tray can be assigned to the product group via the hardware type and the IP address and settings for power management can be done:

9 Enhanced Programming

The *Enhanced Programming* chapter includes information on programming I/Os, byte area configuration, and field bus configuration.

9.1 Programmable I/O Mapping

The *Programmable I/O Mapping* dialog provides an overview of all I/O signals that are currently assigned for the selected *Tool Group* or *Tightening Module*.

A list of all signals you can assign to the corresponding hardware in the *Programmable I/O Mapping* dialog is provided in *Appendix A: Input Signals* and *Appendix B: Output Signals*.

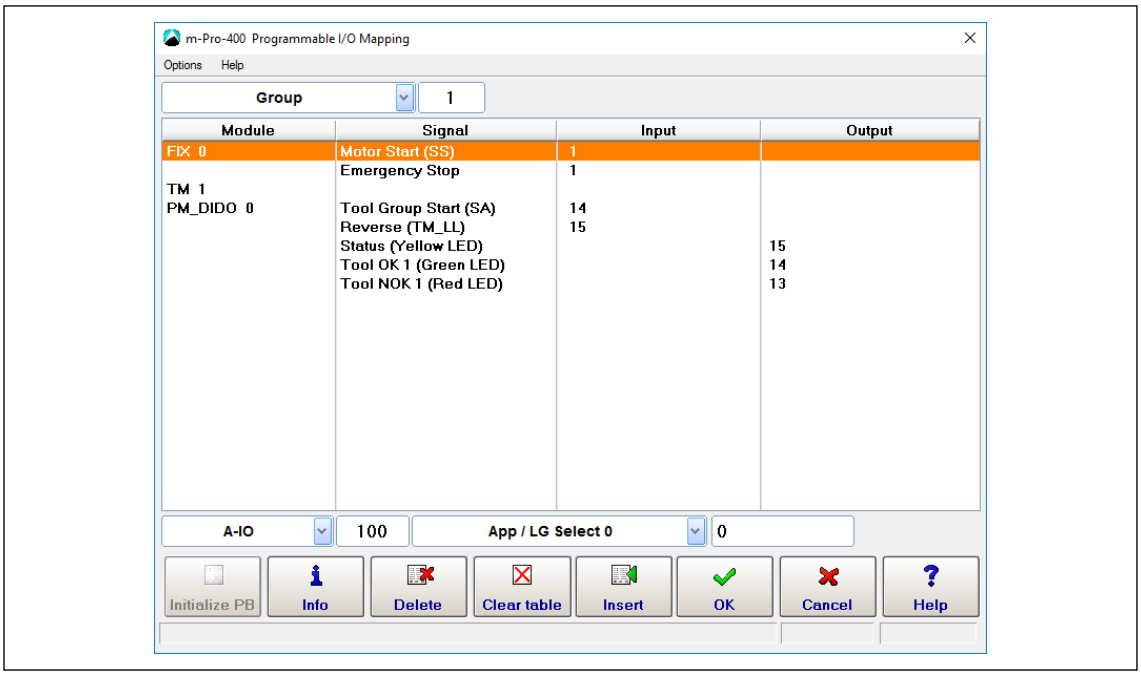


Fig. 9-1: The Programmable I/O Mapping dialog for Tool Group 1

To access the *Programmable I/O Mapping* dialog for a tool group or tightening module:

1. Select *Navigator* > *Advanced* > *Inputs* or *Outputs*.
2. Tap the <I/O> button on the *Inputs* or *Outputs* tab and confirm the pop-up dialogs to open the *Programmable I/O Mapping* dialog.
3. Select the *Group or TM* (tightening module) option from the drop-down menu above the *Module* list of the *Programmable I/O Mapping* dialog.
4. Enter the required tool group or tightening module.

Button	Description
	<OK> saves your changes and returns you to the previous window.
	<Cancel> discards your changes and returns you to the previous window.
	<Help> provides help related to the current dialog.

Button	Description
	<Insert> adds the newly parameterized I/O signal to the current tool group or tightening module.
	<Delete> deletes the currently selected I/O from the tool group or tightening module.
	<Clear table> • Deletes all I/Os of the currently selected tool group. • Reverts to default if no signals are defined for this group.
	<Information> provides an overview of current settings.
	<Initialize PB> opens a settings dialog that is specific to the fieldbus and depends on the configured fieldbus module type. See Fieldbus configuration, page 95.

9.1.1 Programming I/Os

The drop-down menus and input boxes below the Module list of the *Programmable I/O Mapping* dialog are used to program I/Os.

▶ Tab the <Insert> button to add a newly parameterized I/O to the current tool group or tightening module.

The following table describes the drop-down menus and input boxes available in the *Programmable I/O Mapping* dialog:

Drop-down menu/ Input field	Designation	Description
Group	Tool Group / TM (tightening module) selection	• Select the tool group or tightening module for which I/Os are to be parameterized. • For tightening modules, only the Engagement Initiator (FINDINI) and Top Dead Center Initiator (OTINI) signals are available.
A-IO	Module selection	• Select the module and the corresponding node/address for the I/Os.
Ext.App.Sel.0	Signal selection	• Select the signal and the bit where this I/O is to be addressed. • For buses with many I/Os, the bit must be specified with precedent byte and separated by a period, e.g., 2.5 for the sixth bit on the third byte. See Appendix A and B for the available I/Os.

9.2 Modules

You can edit each tool group and tightening module (TM) configuration, and you can assign the signals to specific bits on specific modules. The following table shows which node/address, signal, and bit configurations are programmable on the modules listed.

System bus bridges

This is a bridge between the system bus and digital I/Os or fieldbuses.

Module	Interface	Inputs	Outputs	Address	Signal	Bit
TM_DIDO	Digital I/Os 24 V	16 freely configurable I/Os		1-max. tool groups	See Appendix A and B for all I/O signals.	0–15

For I/O configuration, see also the *Predefined module assignments* section below.

On-board modules

On-board modules are available on the controller.

Module	Interface	Inputs	Outputs	node	Signal	Bit
PM_DIDO	Digital I/Os 24V	16	16	0	See Appendix A and B for all I/O signals.	0–15

Anybus modules

Anybus modules can be installed in the Global Controller's X7 or X8 fieldbus socket. It virtually becomes another device on the system bus.

Module	Interface	Input bytes	Output bytes	Range	Node	Signal	Bit
PM_PROS	Profibus	112	112	0–111	4-5	See Appendix A and B for all I/O-signals.	0.0-111.7
AB_DVN	DeviceNet	255	255	0–254			0.0-255.7
AB_PN	PROF-INET IO	256	256	0–255			
AB_EIP	EtherNet/IP	255	255	0–254			
AB_MBT	Modbus/TCP	256	256	0–255; max. 4 connections			

Fixed Signals

All input signals can be assigned as fixed signals. You can assign a fixed value to a group signal, e.g., to set a signal to logic 1 with FIX if this is not to be done by wiring.

Module	Signal	Bit
FIX	See all input signals in Appendix A.	0-1

Tightening modules

Tightening modules can be assigned in any order to the tool groups. Each tightening module can only be assigned to one tool group.

Module	Node
TMA	1-16
TM	1-32

Initiator signals

To achieve the quickest possible response to initiator signals (position signals in SEQ 15, 16, and 56), these signals are sent directly from the physical input (bridge or on-board module) to a tightening module.

To make the status of these signals viewable, you usually assign them to the tightening group as well, not just to the tightening module. You can then view the signal status in the *I/O process map*.

▶ Select *Navigator* > *Diagnostics* > *System* > *I/O mapping*.

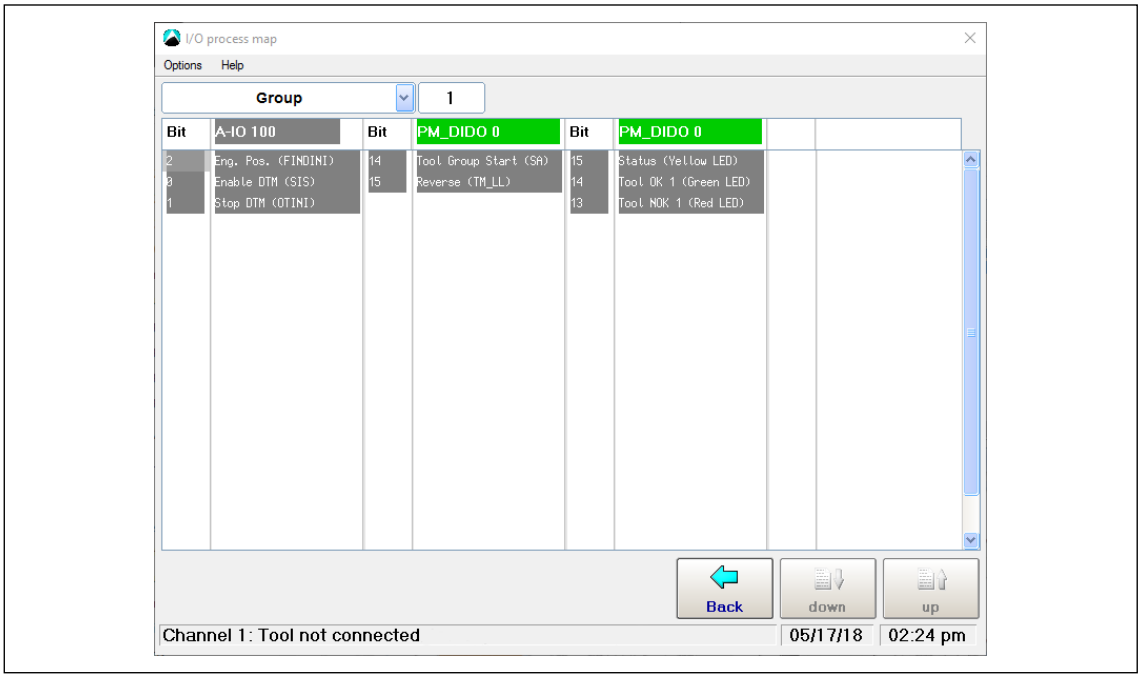


Fig. 9-2: Initiator signal names

Initiator name	Name
FINDINI	Engagement Initiator
SIS	Work-piece out of Position
OTINI	Top Dead Center Initiator

Duplicate assignment of signals

Physical input signals can be assigned to multiple logical input signals (e.g., one key to switch for External Part ID disable and External Application Selection enable).

Physical output signals cannot be assigned to multiple logical outputs.

9.2.1 Predefined module assignments

Primary controller (mPro400GCD-P, Module: TM_DIDO 1)

Inputs		Outputs	
Bit	**Description**	**Bit**	**Description**
0	Start	2	Red LED
1	Tool Reverse	3	Green LED
6	Function buttons 2	4	Yellow LED
		5	Blue LED

Secondary controller (mPro400GCD-S(H), mPro400GCD-S(H)-STO, mPro300GCD, Module: TM_DIDO)

Inputs		Outputs	
Bit	**Description**	**Bit**	**Description**
0	Start	2	Red LED
1	Tool Reverse	3	Green LED
6	Function buttons 2	4	Yellow LED
		5	Blue LED

9.3 Fieldbus configuration

The input/output signals for the field buses (DeviceNet, PROFINET, PROFIBUS, EtherNet/IP, and Modbus TCP) are freely assignable. For the parameterization of the buses, configuration modes are available, which reduce the effort required to configure multichannel systems. The following are available:

- Manual configuration
- Select standard configuration
- Manual tuple configuration (only available with DeviceNet)

You must configure the required tool groups, i.e., you must assign the spindles (TM modules) to tool groups

- To configure fieldbus settings, you must set up a fieldbus-specific signal and select it in the *Programmable I/O Mapping*. Otherwise, the button for fieldbus configuration is not enabled.
- The signal direction is related to the fieldbus master, i.e., Controller output signals are inputs from the fieldbus master perspective and vice versa.

The Fieldbus Configuration is flexible enough to ensure compatibility of the controller fieldbus configuration with the PLC fieldbus configuration. Therefore, I/O signals can be configured independently of order and project planning.

9.3.1 Fieldbus Configuration screen

The following screenshot shows an example for *EtherNet/IP Configuration*. The title displays the actual PLC fieldbus configuration (master) and changes with the new configuration being accepted.

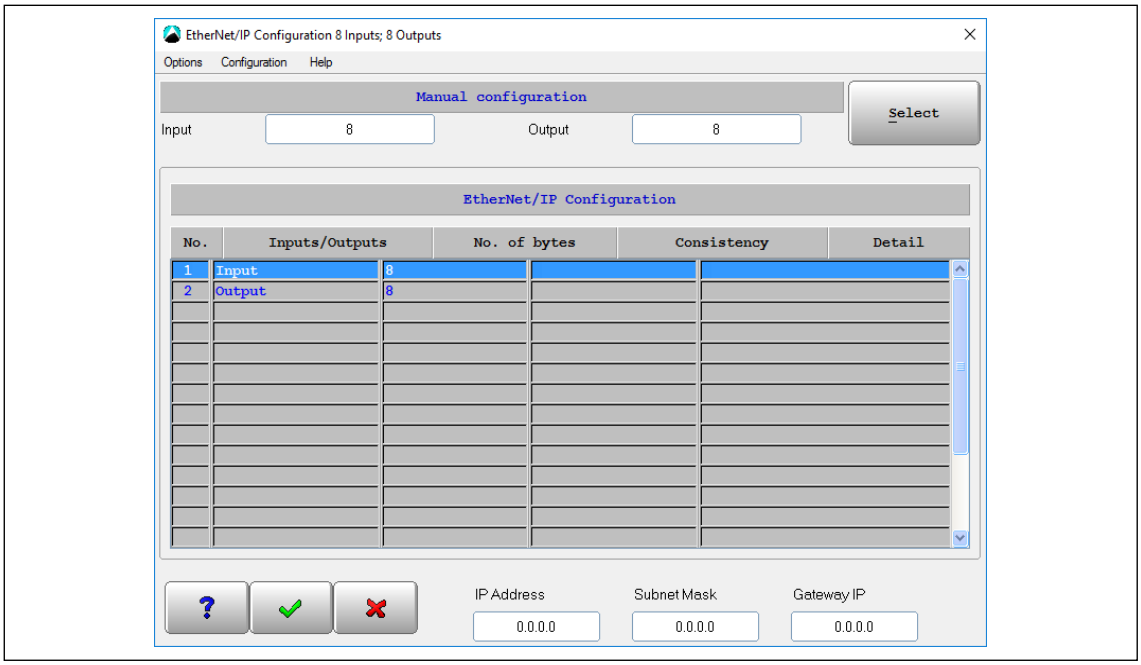


Fig. 9-3: The Fieldbus Configuration dialog for EtherNet/IP configuration

To access the *Fieldbus Configuration* dialog:

1. Tap the <I/O> button, e.g., in *Navigator* > *Advanced* > *Inputs*, to open *Programmable I/O Mapping*.
2. Tap the <Initialize PB> button in the *Programmable I/O Mapping* dialog.

The Fieldbus Configuration screen has the following three sections:

- Configuration mode area
- Fieldbus configuration table
- Additional fieldbus-specific settings area

Configuration modes

Manual Configuration

Enter the number of inputs and outputs of the master device (PLC), and press the <Return> key to confirm.

Manual Configuration (PROFIBUS)

Assign inputs and outputs as part of string (hexadecimal).

Assignment	Consistency	Inputs/Outputs
10 bis 1F	Inaktive	Input
20 bis 2F	Inaktive	Output
A0 bis AF	Aktive	Input
90 bis 9F	Aktive	Output

The second part of the assignment corresponds to the number of bytes to be reserved. This configuration string is usually generated by the PLC programming software if manual configuration is required.

Select standard configuration

A predefined configuration can be selected.

DeviceNet	PROFINET	PROFIBUS	EtherNet/IP	Modbus TCP
8, 16, 32, 48, 64 inputs and outputs				

Manual tuple configuration (only with DeviceNet)
Enter inputs and outputs as configuration strings in tuple edit mode.
You can enter a maximum of 8 tuples. The maximum for input or output tuples is 6.

Configuration String:
In tuple edit mode, the I/O submodules must be entered in tuples.
Each tuple is a string that consists of 4 hexadecimal numbers separated by commas. Byte 1+2 define the first configuration word, byte 3+4 define the second configuration word.
The first word represents the Instance offset. Bit 16 in this word also specifies the direction of the module. So the offset can be 0 – 32767. The second word represents the Instance length.
Example: 80,10,00,0E -> Output 14 bytes with 16 bytes offset.

Fieldbus configuration table

The Fieldbus configuration table shows the current Fieldbus I/O configuration:

No.	Inputs/Outputs	No. of bytes	Offset/Consistency	Part of string/Detail
Submodule number	Direction	Number of bytes reserved	Only DeviceNet Shows the offset of the bytes for this string part. Only PROFIBUS Shows if consistency is active or not.	Only DeviceNet Shows string part as tuple. Only PROFIBUS Shows settings as part of string.

To change values of the DeviceNet or PROFIBUS configuration:

1. Tap a table row of the *Fieldbus configuration* table to open a pop-up dialog.
2. Change the required value in the pop-up dialog.

Fieldbus-specific settings

Depending on the selected fieldbus, these settings are displayed in the configuration:

DeviceNet	
Setting	**Description**
Baud rate	Baud rate for DeviceNet data transmission
MAC ID	MAC ID (0-63)
PROFIBUS	
Setting	**Description**
Init Bridge	Write configuration to System Bus PROFIBUS Bridge
PB Address	PROFIBUS Address
EtherNet/IP and Modbus TCP	
Setting	**Description**
_Network settings	IP Address, Subnet Mask, and Gateway IP of the Ethernet connection

For PROFINET, no additional options are available.

9.4 Byte Area

The programmable byte ranges (Byte Area) facilitate communication with other system components and visualization of tightening results.

9.4.1 Programmable byte ranges (Byte Area)

The *Definitions for byte areas* dialog displays a maximum of 8 byte areas. The dialog is used to add, delete, or change the byte areas.

The dialog and related texts are only available in the English language.

To open the *Definitions for byte areas* dialog:
1. Select *Navigator* > *Advanced* > *Inputs* or *Outputs*.
2. Tap the <I/O> button and confirm the pop-ups to open the *Programmable I/O Mapping* dialog.
3. Enter the required Tool group in the *Group* input box.
4. Select the *Byte Area* option of the *Options* menu.

Button controls of the Definitions for Byte Areas dialog

Button	Description
	<Cancel> returns you to the previous window without saving changes.
	<OK> saves your changes and returns you to the previous window.
	<Delete> deletes the currently selected byte areas.
	<Edit> opens the *Byte Area Input* dialog to make changes to the currently selected byte area.
	<New> opens the *Byte Area Input* dialog to add data for a new byte area.

The byte area table of the Definitions for Byte Areas dialog

The first time you open the *Definitions for Byte Areas* dialog, no byte areas are listed in the table.

Column header	Description
ID	System Bus node/Module ID number
Area	First byte to last byte in an area
Modul	Module in use
Format	Data format
Funct.	Function used for the area

9.4.2 Configuring byte areas

The *Byte Area Input* dialog allows you to enter data for a new byte area or change data of existing byte areas.

To add a new byte area:
1. Tap the <New> button in the *Definitions for byte areas* dialog to open the *Byte Area Input* dialog.
2. Enter the required settings for the *Byte Area*.
3. Tap the <OK> button and confirm the settings to close the *Byte Area Input* dialog.
4. The new byte area is now displayed in the table of the *Definitions for byte areas* dialog.

To edit a byte area:

1. Select a Byte Area in the table of the *Definitions for byte areas* dialog.
2. Tap the <Edit> button to open the *Byte Area Input* dialog for the currently selected byte area.
3. Enter the required changes for the Byte Area.
4. Tap the <OK> button and confirm the changes to close the *Byte Area Input* dialog.

Input error messages

Message		Description
Invalid node number	**ARCNet ID**	If you enter an incorrect value in the ARCNet ID input box, the *Invalid node number* pop-up is displayed. ▶ Tap the <OK> button to return to the *Byte Area Input* dialog and change the value.
Input areas not plausible	**Start/End Input Area**	If you enter an unrealistic byte value in the Start Input Area or End Input Area box (e.g., last byte is smaller than first byte), the *Input areas not plausible* pop-up is displayed. ▶ Tap the <OK> button to return to the *Byte Area Input* dialog and change the value.
Byte Area overlaps with Area in group 5!	**Start/End Output Area**	If you enter an unrealistic byte value in the Start Output Area or End Output Area box (e.g., last byte is smaller than first byte), the *Output areas not plausible* pop-up is displayed. ▶ Tap the <OK> button to return to the *Byte Area Input* dialog and change the value.

9.4.3 Configuration options

The input controls and options available in the *Byte Areas Input* dialog depend on the software version. The input boxes and drop-down menus available in all software versions are explained in this section. The following sections explain data transmission functionality and formats for particular software versions.

Input box/Drop-down menu	Description		
ARCNet ID	Enter the System Bus node number/ slot number.		
Module	▶ Select the module to be used:		
			Order no.
	PM_PROS	Profibus plug-in card	962292PT (DB9) 962291PT (M12)
	PM_IBS	Interbus-S plug-in card; this module is not supported anymore	-
	A_PB	Profibus System Bus bridge	960392 (For backward compatibility only)
	A_IB	System Bus Interbus bridge	For backward compatibility only
	A_IBR	System Bus Interbus bridge (reduced format)	
	AB_DVN	DeviceNet plug-in card	962293PT
	AB_PN	ProfiNet	544357PT (RJ45) 962294PT (M12)
	AB_EIP	EtherNet/IP	962297PT (RJ45)
	AB_MBT	Modbus/TCP	962299PT

Input box/Drop-down menu	Description	
Function (See also sections below.)	Select the function to be used for the area. The options available depend on the software version.	
	EUN read	Set workpiece number
	EUN write	Mirroring of currently active workpiece number
	DFUE read	See sections below.
	DFUE write	See sections below.
	DATA	Only output; controller writes tightening data back
Format (See also Data Transmission sections.)	▶ Select the data format. The options available depend on the software version.	
	ASCII	Workpiece number data are transmitted in both directions in ASCII-encoded form.
	ASCII Byte Swap	Workpiece number data are transmitted in both directions in ASCII-encoded form. The bytes are swapped within pairs in the transmission data. This is sometimes necessary for Interbus-S transmissions. In these cases, please note that the first byte in the bus range is an even number.
	BCD	The transmission of work piece number data is in binary-coded decimal system in both directions.
	SpiBitErg	Bit results (1 Byte per tool) (see also section below)
	SpiByteErg	BCD actual values (6 Byte per tool) (see also section below)
	SpiByteLimits	Actual values along with values of min and max limits in short (Torque, Torque Min, Torque Max, Angle, Angle Min, Angle Max) total 12 bytes/tool (see also section below)
Start Input Area: (first byte)	• Start byte of bus data range to be loaded. • Only active if EUN read or DFUE read is selected. • Counting starts with 0.	
End Input Area: (last byte)	• End byte of bus data range. • Only active if EUN read or DFUE read is selected. • Counting starts with 0.	
Start Output Area: (first byte)	• Start byte of bus data range to be written. • Only active if EUN write or DFUE write of DATA is selected. • Counting starts with 0.	
End Output Area: (last byte)	• End byte of bus data range to be written. • Only active if EUN write or DFUE write of DATA is selected. • Counting starts with 0.	

9.4.4 Example of a data transmission: EUN read/write

This section explains generally valid data transmission using EUN (Engine Unit Number; workpiece number) to provide an example of data transmission.

Function		Format	Data transmitted
EUN	Read Write	ASCII ASCII byte swap BCD	Workpiece number

The numbering of bytes described in this example always starts with 0. This is a relative value and always refers to the beginning, i.e., the first parameterized byte of the parameterized byte range.

Example: Transmission of an 8-digit workpiece number

EUN read/write - ASCII								
Byte	0	1	2	3	4	5	6	7
Value in ASCII	A	B	C	D	1	2	3	4
Hex	0x41	0x42	0x43	0x44	0x31	0x32	0x33	0x34

Read number: ABCD1234

EUN read/write - ASCII byte swap								
Byte	0	1	2	3	4	5	6	7
Example value in ASCII	A	B	C	D	1	2	3	4
Example value in ASCII Swap	B	A	D	C	2	1	4	3
Hex	0x42	0x41	0x44	0x43	0x32	0x31	0x34	0x33

Read number: BADC2143

EUN read/write - BCD			
Byte	**Contents**	**Meaning**	**Comment**
0	0x12	MSB EUN	EUN (e.g., 12345679) bytes 1+2+3
1	0x34	MSB	
2	0x56	MSB	
3	0x79	LSB EUN	

MSB = most significant byte
LSB = least significant byte

9.4.5 Example of da ta transmission: DFUE read/write

This section explains generally valid data transmission using DFUE to provide an example of data transmission.

The following data transmission combinations are possible for DFUE for the programmable byte areas:

Function		Format	Transmitted data
DFUE	read	Telegram	Workpiece number
	write	Telegram	Rundown data

Both byte areas use telegram-based data areas. Data is sent in multiple blocks if it does not fit in a single block. The blocks are embedded in Synchronization Bytes to ensure consistency of data. Synchronization Bytes are also used for handshakes and flow control. Moreover, *DFUE read* uses two Function Bytes, which can contain various control bits.

The numbering of bytes described in this example always starts with 0. This is a relative value and always refers to the beginning, i.e., the first parameterized byte of the parameterized byte range.

DFUE read					
Byte areas					
Byte	**Bit**	**Signal**	**Meaning**	**Remark**	
0			Function byte 1		BYTE AREA
1			Function byte 2		
2	0	Block counter	Synchronization Byte Read		
	...				
	5				
	6	Last block			
	7	Toggle			
3	0	Block counter	Synchronization Byte 1 Send		
	...				
	5				
	6	Last block			
	7	Toggle			
4			Telegram data area (see table: Telegram data read)		
5					
...					
n-1	0	see Byte 3	Synchronization Byte 2 Send		
	...				
	7				

DFUE write					
Byte areas					
Byte	**Bit**	**Signal**	**Meaning**	**Remark**	
0	0	Block counter	Synchronization Byte Read		BYTE AREA
	...				
	5				
	6	Last block			
	7	Toggle			
1	0	Block counter	Synchronization Byte 1 Send		
	...				
	5				
	6	Last block			
	7	Toggle			
2			Telegram data area (see table: Telegram data write)		
3					
...					
n-1	0	see Byte 1	Synchronization Byte 2 Send		
	...				
	7				

Depending on data size, the telegram data area is divided into blocks for transmission via DFUE read or write.

Function Bytes

Bit	Function Byte 1	Function Byte 2
	Meaning	Meaning
0	Request measuring values (step-based - chronological order)	
1	Request measuring values (sorting within a step)	
2		
3	Transmission only for the last rundown data	Selection Telegram 6
4	Reserve	
5	Reserve	
6	Reserve	
7		Selection Telegram 2

9.4.6 Workflow of data transmission in multiple blocks

The size of the telegram data area is based on the size of the programmed byte areas. If the data cannot be transmitted in one block, the data is sent in multiple blocks. A maximum of 63 blocks can be transmitted.

Receiving Data

The receive routine is initiated when:

- Synchronization Byte 1 is equal to Synchronization Byte 2,
- Synchronization Byte 1 is not equal to 0, and
- Synchronization Byte 1 is not equal to Synchronization Byte Read.

If these criteria are met, data (telegram data) is read.

When the Last block has been read, i.e., Bit 6 (Last block) = 1, the process waits until Synchronization Byte 2 is set to 0. Subsequently, Synchronization Byte Read is set to 0. At this point, all data blocks have been transferred, and the receiver waits again until additional data is available.

Sending Data

The transmission starts with the entry of the first data block in the data transmission area. Initially, Synchronization Byte 1 Write (Byte 10) is set. Like the other Synchronization Bytes, this byte consists of:

- a Block counter (Bit 0 to 5; 31 blocks maximum),
- a Last block bit, which is set by transmission of the last block, and
- a Toggle bit.

The Toggle bit is inverted after each read of the data block to make sure that the content of the Synchronization Bytes always changes. This ensures that data transmissions that only consist of one block are handled correctly.

Once the Synchronization Byte is set, Telegram data are set. The size of the Telegram data block depends on parameters of the byte area in the configuration.

Once all telegram data are set, Synchronization Byte 2 Write (Byte n-1) is set equal to Synchronization Byte 1 Write (Byte 10). This is how the receiver knows that the data in the input area are valid and can be accepted.

To acknowledge data receipt, the receiver sets Synchronization Byte Read in the output area equal to Synchronization Bytes 1 und 2 in the input area. Transmission continues with the next block unless the Last Block bit is set.

To confirm, the sender sets Synchronization Byte 2 to 0. Therefore, Synchronization Byte 1 is not equal to Synchronization Byte 2.

When the last block is reached (Last Block bit is set), Synchronization Byte 2 is set to 0. After cycling through these states, new data can be sent again.

Flow chart: Receive routine (DFUE read)

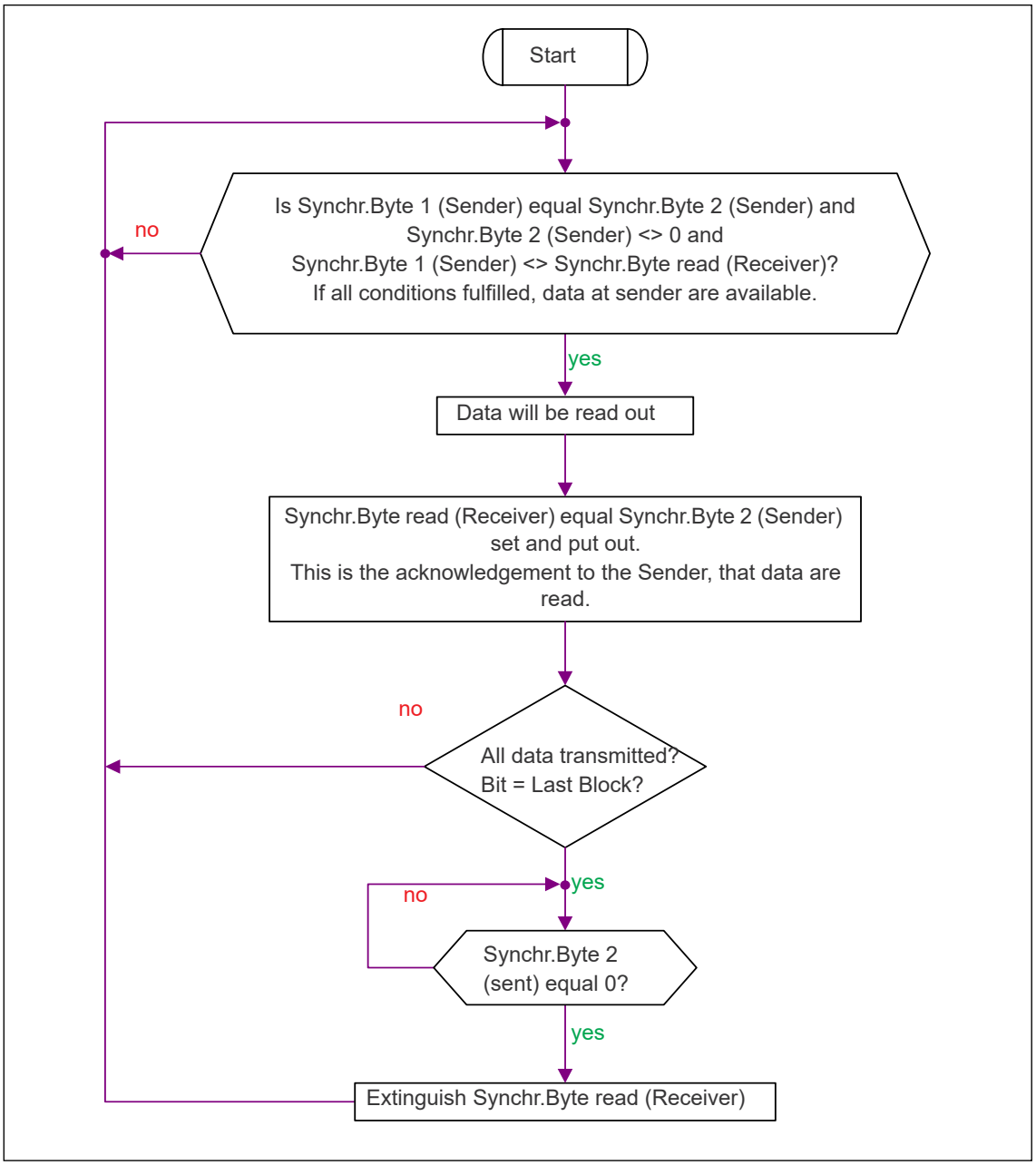


Fig. 9-4: DFUE read

Flow chart: Send routine (DFUE write)

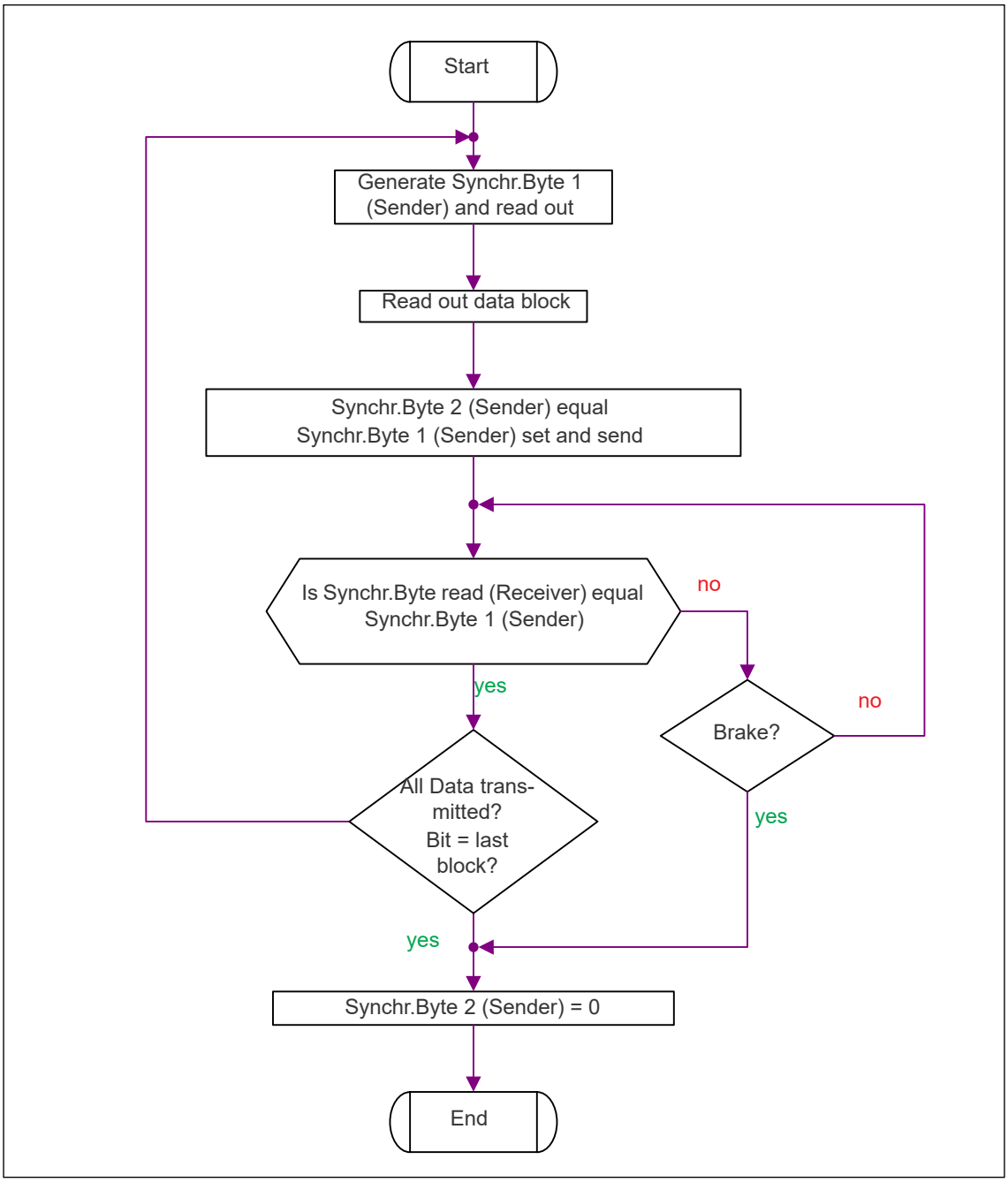


Fig. 9-5: DFUE write

9.4.7 Telegram data area layout

The following tables provide examples of Telegram blocks for reading and writing telegram data.

Example 1: Transmission of an 8-digit workpiece number

DFUE read telegram data				
Byte	**Format**	**Content**	**Meaning**	
0	ASCII	0x41	A	DATENBLOCK
1	ASCII	0x42	B	
2	ASCII	0x43	C	
3	ASCII	0x44	D	
4	ASCII	0x31	1	
5	ASCII	0x32	2	
6	ASCII	0x33	3	
7	ASCII	0x34	4	

Example 2: Transmission of the tightening results from 3 tools

DFUE write telegram data							
Byte	**Format**	**Bit**	**Contents**	**Meaning**	**Tool**		
0	Integer		0x02	Telegram number		Telegram header	DATENBLOCK
1	Integer		0x03	Number of joints			
2	Integer		0x01	Joint number	Data set Tool 1	Tool data sets x Number of joints (see byte 1) (14 bytes per tool)	
3	Bit	0		Not handled			
		1		Torque OK			
		2		Angle OK			
		3					
		4		Torque too high			
		5		Torque too low			
		6		Angle too high			
		7		Angle too low			
4	BCD, HB		0x01	Torque actual			
5	BCD, LB		0x54				
6	BCD, HB		0x01	Angle actual			
7	BCD, LB		0x54				
8	Float HB			Torque actual			
9	Float						
10	Float						
11	Float LB						
12	Float HB			Angle actual			
13	Float						
14	Float						
15	Float LB						
16	Integer		0x01	Joint number	Data set Tool 2		
…							
29	Float LB			Angle actual			

DFUE write telegram data							
Byte	**Format**	**Bit**	**Contents**	**Meaning**	**Tool**		
30	Integer		0x01	Joint number	Data set Tool 3		
…							
43	Float			Angle actual			

If, due to the size of the programmed byte area, the telegram area is smaller than the data block to be transmitted, transmission proceeds in several blocks as described in the Sending Data section and Send routine flowchart above.

9.4.8 DFUE read/write telegrams: ASCII Telegram 2

DATA Byte Area (ASCII) Controller -> PLC				
Byte	**Format**	**Content**	**Explanation**	**Tool[a]**
0	Integer	0x38	Joint number[b] (example: 0x38 = 56)	1st Tool group feedback
	bit	0x01	Not done	
		0x02	Torque OK	
		0x04	Angle OK	
		0x80	Reserve	
		0x10	Torque too high[c]	
		0x20	Torque too low[d]	
		0x40	Angle too high	
		0x80	Angle too low	
2	BCD, HB	0x06	Actual torque * factor 10 (BCD)[e] (example: 0x06 0x73 = 67.3 Nm)	
3	BCD, LB	0x73		
4	BCD, HB	0x18	Actual angle (BCD) (example: 0x18 0x73 = 1873°)	
5	BCD, LB	0x73		
6	Float, HB	0x42	Actual torque (float) (example: 0x18 0x 86 0xC2 0x8F = 67.38 Nm)	
7	Float	0x86		
8	Float	0xC2		
9	Float, LB	0x8F		
10	Float, HB	0x44	Actual angle (float) (example: 0x44 0xEA 0x20 0x00 = 1873°)	
11	Float	0cEA		
12	Float	0x20		
13	Float, LB	0x00		
14	Integer	0x01	Joint number	2nd Tool group feedback
…				
27	Float, LB		Actual angle (float)	
…n				nth Tool of group

a. 14 bytes per tool.

b. With the system variants [AV1] and [AV2], the joint number is always zero. With the system variants [AV3] and [AV4], the joint numbers are part of rundown sequence programming.

c. Sequence 15: Torque or breakaway torque too high.

d. Sequence 15: Torque or breakaway torque too low.

e. Sequence 15: Maximum torque for evaluation or, in case of 'TQ too low', minimum torque for evaluation.

Range of Values	
Actual torque (BCD)	0…999.9 Nm (if actual torque lower than zero, transmitted as zero)
Actual angle (BCD)	0…9999°

If a range is exceeded or undercut, 0xFFFF (hex) is entered instead of a BCD value.

Data transmission

The rundown data of the last fastening stage is transmitted.

If no fastening stage can be determined, the following values are explicitly set:
- Torque too low
- Angle too low
- Actual torque = 0 Nm
- Actual angle = 0°

Rundown data of a fastening stage with Sequence 41 (back-off, angle controlled) or Sequence 46 (back-off, torque & angle controlled) are not transmitted if the back-off angle is <= 8°. This is evaluated as backing off, and the rundown data of the previous fastening stage are transmitted instead. If the back-off angle is > 8°, this is evaluated as back-off procedure, and the following values are explicitly set:
- Torque too low
- Angle too low
- Actual torque = 0 Nm
- Actual angle = 0°

If back-off occurred in the final stage with Sequence 48 (back-off adv. monitoring), the following values are explicitly set:
- Torque too low
- Angle too low
- Actual angle = 0°

If the final target fastening stage has not been reached, the following values are explicitly set:
- Torque too low
- Angle too low
- Actual angle = 0°

9.4.9 Byte Area DATA

The data is transmitted for each tool without synchronization. Since each tool uses its own byte area, the source can be identified by the configured offset. Updating of the data is done with the 0/1-edge at the AE output (cycle complete).

SpiBitErg - Bit results

DATA Byte Area (SpiBitErg) Controller -> PLC			
Byte	**Bit**	**Error Content**	**Tool[a]**
0	0x01	Not done	1st Tool group feedback
	0x02	OK	
	0x04	NOK	
	0x08	Hardware failure	
	0x10	Torque too high	
	0x20	Torque too low	
	0x40	Angle too high	
	0x80	Angle too low	

DATA Byte Area (SpiBitErg) Controller -> PLC			
Byte	**Bit**	**Error Content**	**Tool[a]**
1	0x01	Not done	2nd Tool group feedback
	0x02	OK	
	0x04	NOK	
	0x08	Hardware failure	
	0x10	Torque too high	
	0x20	Torque too low	
	0x40	Angle too high	
	0x80	Angle too low	
…n			nth Tool of group

a. 1 byte per tool

Data transmission

Tightening results are transmitted from the last parameterized tightening stage.

If this stage was not executed because of an NOK, these values are sent:
- NOK
- Torque too low
- Angle too low

Rundown data of a fastening stage with Sequence 41 (back-off, angle controlled) or Sequence 46 (back-off, torque & angle controlled) are not transmitted if the back-off angle is <= 8°. This is evaluated as backing off, and the rundown data of the previous fastening stage are transmitted instead. If the back-off angle is > 8°, this is evaluated as back-off procedure, and the following values are explicitly set:
- NOK
- Torque too low
- Angle too low

If back-off occurred in the final stage with sequence 48 (back-off adv. monitoring), the following values are explicitly set:
- NOK
- Torque too low
- Angle too low

If the final target fastening stage has not been reached, the following values are explicitly set:
- NOK
- Torque too low
- Angle too low

SpiByteErg – Actual values in BCD format

DATA byte area (SpiByteErg) Controller -> PLC				
Byte	**Format**	**Content**	**Explanation**	**Tool[a]**
0	BCD, HB	0x06	Actual torque * factor 10 (BCD) (example: 0x06 0x73 = 67.3 Nm)	1st Tool of Tool group
1	BCD, LB	0x73		
2	BCD, HB	0x18	Actual angle (BCD) (example: 0x18 0x73 = 1873°)	
3	BCD, LB	0x73		
4	BCD, HB	0x01	Actual gradient * factor 100 (BCD) (example: 0x01 0x65 = 1.65 Nm/°)	
5	BCD, LB	0x65		
6-7	BCD		Actual torque * factor 10 (BCD)	2nd Tool of Tool group
8-9	BCD		Actual angle (BCD)	
10-11	BCD		Actual gradient * factor 100 (BCD)	
…n				nth Tool of Tool group

a. 14 bytes per tool

Range of values

If a range is exceeded or undercut, 0xFFFF (hex) is entered instead of a BCD value.

Data transmission

The rundown data of the last fastening stage is transmitted.

If no fastening stage can be determined, the following values are explicitly set:
- Actual torque = 0 Nm
- Actual angle = 0°
- Gradient = 0 Nm/°

Rundown data of a fastening stage with Sequence 41 (back-off, angle controlled) or Sequence 46 (back-off, torque & angle controlled) are not transmitted if the back-off angle is <= 8°. This is evaluated as backing off, and the rundown data of the previous fastening stage are transmitted instead. If the back-off angle is > 8°, this is evaluated as a back-off procedure, and the following values are explicitly set:
- Actual torque = 0 Nm
- Actual angle = 0°
- Gradient = 0 Nm/°

If back-off occurred in the final stage with Sequence 48 (back-off adv. monitoring), the following values are explicitly set:
- Actual torque = 0 Nm
- Actual angle = 0°
- Gradient = 0 Nm/°

If the final target fastening stage has not been reached, the following values are explicitly set:
- Actual torque = 0 Nm
- Actual angle = 0°
- Gradient = 0 Nm/°

SpiByteLimits

DATA byte area (SpiByteLimits) Controller -> PLC				
Byte	**Format**	**Content**	**Explanation**	**Tool[a]**
0-1	Integer	0x019F	Actual Torque * factor 10 (example: 0x019F= 415/10 = 41.5 Nm)	1st Tool of Tool group
2-3	Integer	0x0100	Torque Low limit * factor 10 (example: 0x0231= 256/10 = 25.6 Nm)	
4-5	Integer	0x0231	Torque High limit * factor 10 (example: 0x0231= 561/10 = 56.1 Nm)	
6-7	Integer	0x1234	Actual angle (example: 0x1234 = 4660°)	
8-9	Integer	0x1000	Angle Low limit (example: 0x1000 = 4096°)	
10-11	Integer	0x1273	Angle High limit (example: 0x1273 = 4723°)	
12-13	Integer		Actual Torque * factor 10	2nd Tool of Tool group
…	…	…	…	
22-23	Integer		Actual Torque * factor 10	
…n				nth Tool of Tool group

a. 14 bytes per tool

9.4.10 Check byte areas in the Bus monitor

The *Bus monitor* of the *Diagnostics* dialog allows you to view the input/output data for the programmable byte areas of your tool groups. The monitor always displays current data.

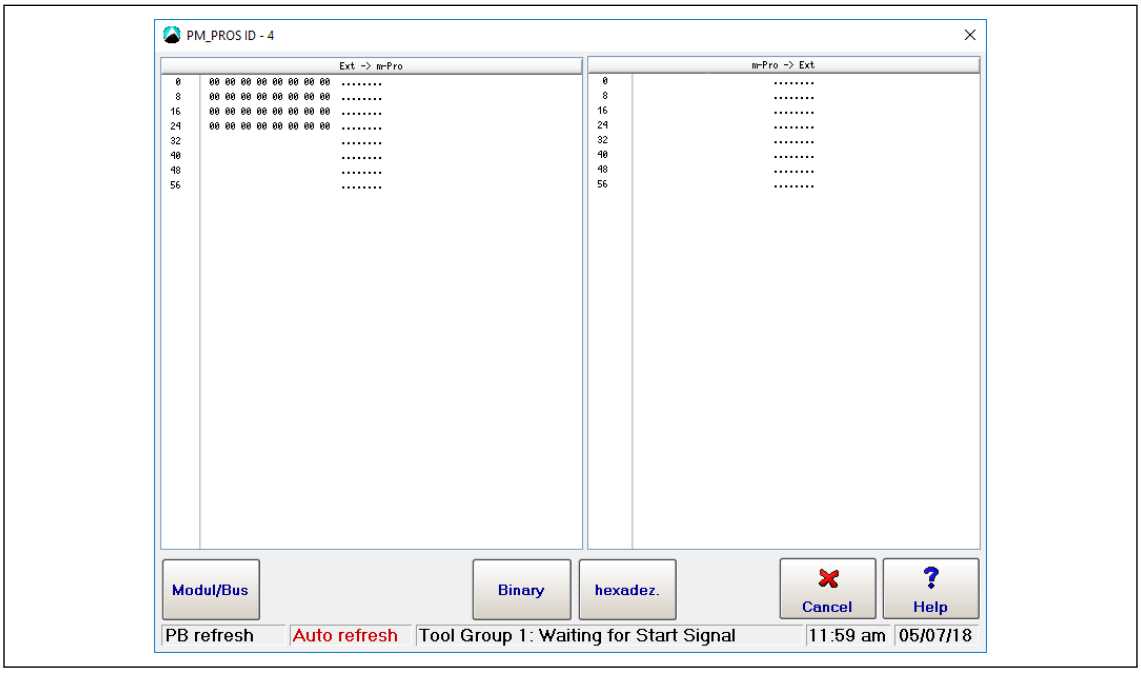


Fig. 9-6: Assigned input byte areas displayed in the Bus monitor

To check the byte areas assigned for a module:

1. Select *Navigator* > *Diagnostics* > *System*
2. Tap the <Bus monitor> button on the *System* tab of the *Diagnostics* dialog to open the *Bus monitor* dialog.
3. Tap the <Modul/Bus> button of the *Bus monitor* dialog to open the *Module* list.
4. Select the required module in the *Module* list to display the byte areas assigned for this module.
5. Use the <Binary> and <hexadez.> buttons to switch between binary and hexadecimal views.
6. Check the assigned input areas in the left half of the list and the assigned output areas in the right half.

When the Bus monitor opens, the byte areas are displayed in hexadecimal form. You can view the parameters in binary form by pressing the <Binary> button.

Auto refresh display

PB refresh	
PB refresh PB refresh PB refresh	• Automatic display. • If there is no connection to the bus, the display is black. When a connection to the bus has been established, the display is green or red and does not change back to black even if the connection is interrupted. • When a connection to the bus exists, the display changes from red to green and back each time the bus is activated.

Auto refresh	
Auto refresh Auto refresh	• Automatic display. • Alternates continuously between red and green. • Indicates that the programming of the byte areas is constantly monitored. • When parameters are changed, matching is performed automatically by the Byte Area monitor. • It is always the current parameters that are displayed on the monitor screen.

9.4.11 Data format of telegrams

The following sections describe the data formats of telegrams/data blocks transmitted via fieldbus byte areas DFUE read and DFUE write.

Telegram 1 – Transmission of workpiece identification

Telegram No. 001 – PLC -> Controller			
Byte	**Format**	**Content**	**Signification**
0	Binary	0x01	Telegram number
1	Binary	0x0C	Number N of (ASCII) characters of the workpiece identification
2	Bit 0		Tool group 1 accept identification
	Bit 1		Tool group 2 accept identification
	Bit 2		Tool group 3 accept identification
	Bit 3		Tool group 4 accept identification
	Bit 4		Tool group 5 accept identification
	Bit 5		Tool group 6 accept identification
	Bit 6		Tool group 7 accept identification
	Bit 7		Tool group 8 accept identification
3	Bit 0		Tool group 9 accept identification
	Bit 1		Tool group 10 accept identification
	Bit 2		Tool group 11 accept identification
	Bit 3		Tool group 12 accept identification
	Bit 4		Tool group 13 accept identification
	Bit 5		Tool group 14 accept identification
	Bit 6		Tool group 15 accept identification
	Bit 7		Tool group 16 accept identification
4	ASCII	0x41	Workpiece identification (39 characters maximum) (here, e.g., 'ABCD12345678')
5	ASCII	0x42	
...		....	
n+3		0x38	

The length of the telegram is based on the quoted length in byte 1 of the workpiece identification. The telegram length is N+4 bytes.

When a new workpiece number is received, all collected measuring values of a group are canceled.

Telegram 2 – Transmission of all rundowns

Telegram No. 002 – Controller -> PLC				
Byte	**Format**	**Content**	**Meaning**	**Tool**
0	Integer	0x02	Telegram number	
1	Integer	0x03	Number of joints	
2	Integer	0x01	Joint number	Data set Tool 1
3	Bit		Not processed	
			Torque OK	
			Angle OK	
			Torque too high	
			Torque too low	
			Angle too high	
			Angle too low	
4	BCD, HB	0x01	Torque actual	
5	BCD, LB	0x54		
6	BCD, HB	0x01	Angle actual	
7	BCD, LB	0x54		
8	Float HB		Torque actual	
9	Float			
10	Float			
11	Float LB			
12	Float HB		Angle actual	
13	Float			
14	Float			
15	Float LB			
16	Integer	0x01	Joint number	Data set Tool 2
...				
29	Float LB		Angle actual	
30	Integer	0x01	Joint number	Data set Tool 3
...				
43	Float		Angle actual	

Bytes 2...15 (13 bytes) are repeated for each tool.

Telegram 6 – Transmission of all rundowns

The following tables describe Telegram 6 without Sequence 56 and Telegram 6 with Sequence 56.

Telegram 6 without Sequence 56

Telegram No. 006 – Controller -> PLC			
Byte	**Format**	**Content**	**Meaning**
0	Binary	0x06	Telegram number
1	Binary	0x13	Number of tools whose values are transferred (is set by controller)
2	Binary	0x0F	Tool number (here 15)
3	Binary	0x03	PS (here 3)
4	Binary	0x02	Step (here 2)
5	Bit oriented		Fastening fault 1
6	Bit oriented		Fastening fault 2

Telegram No. 006 – Controller -> PLC			
Byte	**Format**	**Content**	**Meaning**
7	Binary		Target bit (is set by PLC)
8	Binary HB	0x01	Joint number with factor 1 (here, e.g.: 0x0165 = 357 dec.)
9	Binary LB	0x65	
10	Binary	0x03	TQ act - with factor 10 (signed) (here, e.g.: 0x03A5 = 93.3)
11		0xA5	
12	Binary	0x03	TQ min - with factor 10 (signed) (here, e.g.: 0x032A = 81.0)
13		0x2A	
14	Binary	0x04	TQ max - with factor 10 (signed) (here, e.g.: 0x0400 = 102.4)
15		0x00	
16	Binary	0x00	AN act - with factor 1 (here, e.g.: 0x002E = 46)
17		0x2E	
18	Binary	0x00	AN min - with factor 1 (here, e.g.: 0x002D = 45)
19		0x2D	
20	Binary	0x00	AN max - with factor 1 (here, e.g.: 0x0078 = 120)
21		0x78	
22	Binary	0x02	Threshold torque act - with factor 10 (here, e.g.: 0x0258 = 60.0)
23		0x58	
24	Binary	0x02	Threshold torque min (-10%) with factor 10 (here, e.g.: 0x021C = 54.0)
25		0x1C	
26	Binary	0x02	Threshold torque max (+10%) with factor 10 (here, e.g.: 0x0294 = 66.0)
27		0x94	
28	Binary	0x00	Grad act - with factor 100 (signed) (here, e.g.: 0x0069 = 1.05)
29		0x69	
30	Binary	0x00	Grad min - with factor 100 (signed) (here, e.g.: 0x0032 = 0.50)
31		0x32	
32	Binary	0x00	Grad max - with factor 100 (signed) (here, e.g.: 0x00E6 = 2.30)
33		0xE6	

Bytes 2...33 (32 bytes) are repeated for each tool.

Telegram 6 with Sequence 56

Telegram No. 006 – Controller -> PLC			
Byte	**Format**	**Content**	**Meaning**
0	Binary	0x06	Telegram number
1	Binary	0x13	Number of tools whose values are transferred (here 19) (is set by Controller)
2	Binary	0x0F	Tool number (here 15)
3	Binary	0x03	PS (here 3)
4	Binary	0x02	Step (here 2)
5	Bit oriented		Fastening fault 1
6	Bit oriented		Fastening fault 2
7	Binary		Target bit (is set by PLC)
8	Binary HB	0x01	Joint number with factor 1 (here, e.g.: 0x0165 = 357 dec.)
9	Binary LB	0x65	
10	Binary	0x02	TQ act max Phase 2 with factor 10 (here, e.g.: 0x27B = 63.5 Nm)
11		0x7B	

Telegram No. 006 – Controller -> PLC			
Byte	**Format**	**Content**	**Meaning**
12	Binary	0x01	TQ act max Phase 3 with factor 10 (here, e.g.: 0x190A = 40.0 Nm)
13		0x90	
14	Binary	0x00	TQ target min Phase 3 with factor 10 (here, e.g.: 0x005 = 0.5 Nm)
15		0x05	
16	Binary	0x01	TQ target max Phase 3 with factor 10 (here, e.g.: 0x1F4 = 50 Nm)
17		0xF4	
18	Binary	0x01	TQ act min Phase 4 with factor 10 here, e.g.: 0x01AE = 43.0 Nm)
19		0xAE	
20	Binary	0x02	TQ act. max. Phase 4 with factor 10 (here, e.g.: 0x0264 = 61.2 Nm)
21		0x64	
22	Binary	0x02	TQ target min Phase 4 with factor 10 (here, e.g.: 0x0258 = 60.0 Nm)
23		0x58	
24	Binary	0x02	TQ target max Phase 4 with factor 10 (here, e.g.: 0x021C = 54.0 Nm)
25		0x1C	
26	Binary	0x01	Angle act - shut-off angle (here, e.g.: 0x0125 = 293 deg)
27		0x25	
28	Binary	0x00	Angle target min (here, e.g.: 0x00FA = 250 deg)
29		0xFA	
30	Binary	0x01	Angle target max (here, e.g.: 0x012C = 300 deg)
31		0x2C	
32	Binary	0x00	Not busy 0x0000
33		0x00	

Bytes 2...33 (32 bytes) are repeated for each tool.

Content error bytes (Tightening fault 1 and 2)

The following tables describe error bytes without Sequence 56 and error bytes with Sequence 56.

Error bytes without Sequence 56

Byte	Bit	Content fault
1	0	OK
	1	NOK
	2	Torque too low
	3	Torque too high
	4	Angle too low
	5	Angle too high
	6	GD too low
	7	GD too high
2	0	Timeout (TMAX)
	1	Start break off (SA)
	2	Emergency stop activated
	3	Prevailing torque fault
	4	Redundancy fault
	5	Last Step not reached
	6	Hardware fault internal
	7	Hardware fault external

Error bytes with Sequence 56

Byte	Bit	Content fault
1	0	OK
	1	NOK
	2	Torque too low
	3	Torque too high
	4	Angle too low
	5	Angle too high
	6	Bearing fault
	7	Gear wheel fault
2	0	Timeout (TMAX)
	1	Start break off (SA)
	2	Emergency stop activated
	3	Seq. 56 generally fault
	4	Redundancy fault
	5	Last Step not reached
	6	Hardware fault internal
	7	Hardware fault external

10 Communications

10.1 Data Transmission

▶ Select *Navigator* > *Communications* > *Data Transmission*.

Serial and Ethernet data transmissions can be configured. For each enabled protocol, the status in the *Activated/Enabled* column changes from *No* to **Yes**.

The controller software supports the following protocols:

Option	Description	
Serial > *Protocol* drop-down menu	Select a serial data transmission option from the drop-down menu:	
• None	No Protocol is activated on selected COM-Port.	
• Standard	See: 10.2.1 Standard Protocol, page 118.	
• Standard2	See: 10.2.2 Standard2 Protocol, page 119.	
• Standard2PartID	See: 10.2.3 Standard2PartID Protocol, page 120.	
• AVIS	See: 10.2.4 AVIS Protocol, page 121.	
• PFCS	See: 10.2.5 PFCS (Plant Floor Communication System) Protocol, page 122.	
Ethernet > *Protocol* list	Select a supported Ethernet protocol type in the list:	
• Standard	TME Standard	See: 10.3.1 Standard and Standard Plus Protocol, page 122.
• Standard Plus	TME Standard Plus	See: 10.3.1 Standard and Standard Plus Protocol, page 122.
• WinSPC	TME Standard WinSPC	See: 10.3.2 WinSPC Protocol, page 129.
• PFCS	Plant Floor Comm System	See: 10.3.3 PFCS Protocol, page 130.
• Open Protocol	Power Focus Open Protocol	See: 10.3.4 Open Protocol, page 131.
• FEP	Ford Protocol	See: 10.3.5 FEP, page 134.
• TorqueNet	TorqueNet/Rundown Data	See: 10.3.6 TorqueNet / Rundown Data, page 134.
• ToolsNet OP	ToolsNet Open Protocol	See: The following controls are available on the *Miscellaneous* tab:, page 135.
• XML/CSV	XML/CSV Result Files	See: 10.3.8 XML/CSV protocol, page 136.
• IPM	IPM Protocol	See: 10.3.9 IPM Protocol, page 141.
Server	Enter the IP adress of the server	
Port	Enter the correct port number	
Activated	Provides acess to additional controls.	

Rundown data transmission with back-off sequence in last stage:

- If the shut-off value is <= 8°, the result of the last stage is not transmitted because the stage is considered a release stage.
- If the shut-off value is > 8°, the result of the last stage is transmitted.

This applies to all data transmission protocols except TorqueNet. With TorqueNet, the result of the last stage is always transmitted.

10.2 Serial Protocols

To enable a serial protocol:

1. Tap the required COM Port entry in the table to select it.
2. Select the required serial protocol from the *Protocol* drop-down menu.
   - The <Advanced Serial Settings> button and additional options are displayed. The *Advanced Serial Settings* are basic serial COM Port settings.
   - Activate the *No data transmission for back-off stages* option to prevent back-off stages being sent to SEQ 41, SEQ 46 and SEQ 48.
3. Tap the <Advanced Serial Settings> button to access additional controls in a pop-up dialog.

Control	Options
Port	COM1 (set in *Serial Port* selection table)
Baudrate	2400, 4800, 9600, 14400, 19200, 38400, 57600, 115200
Data Bits	7, 8
Parity	None, Odd, Even
Stop Bits	1, 2
Flow Control	None, Hardware

10.2.1 Standard Protocol

A single serial port is shared between the tools.

Transmission data – Part ID not activated

Start	End	Length or Value	Description
1	1	42 HEX	B
2	3	2 Digit ASCII	Tool Number
4	5	2 Digit ASCII	Parameter Set
6	17	12 Char ASCII	Date and Time (YYMMDDHHMMSS)
18	24	7 Digit ASCII	Final Torque (Seq 32: value includes press-in Tq)
25	31	7 Digit ASCII	Low Torque Limit (Seq 32: adds press-in Tq)
32	38	7 Digit ASCII	High Torque Limit (Seq 32: adds press-in Tq)
39	39	1 Char ASCII Status	Torque Status Flag L = low A = accept H = high
40	46	7 Digit ASCII	Final Angle
47	53	7 Digit ASCII	Low Angle Limit
54	60	7 Digit ASCII	High Angle Limit
61	61	1 Char ASCII Status	Angle Status Flag L = low A = accept H = high
62	62	1 Char ASCII Status	Overall Status Flag A = accept R = reject
63	64	2 Digit ASCII	Link/Position (Only for Linking)
65	66	2 Digit ASCII	Number of linked positions (only for Linking)
67	67	0D hex	CR (carriage return)
68	68	0A hex	LF (line feed)

Transmission data – Part ID activated

Length ≤ 25

Start	End	Length or Value	Description
...	...	...	...
67	91	25 Digit ASCII	Part ID
92	92	0D hex	CR (carriage return)
93	93	0A hex	LF (line feed)

Transmission data – Part ID activated

Length > 25, in this example 30

Start	End	Length or Value	Description
...	...	...	...
67	96	30 Digit ASCII	Part ID
97	97	0D hex	CR (carriage return)
98	98	0A hex	LF (line feed)

10.2.2 Standard2 Protocol

A single serial port is shared between the tools.

Transmission data – Part ID not activated

Start	End	Length or Value	Description
1	1	42 HEX	B
2	3	2 Digit ASCII	Tool Number
4	6	3 Digit ASCII	Parameter Set
7	18	12 Char ASCII	Date and Time (YYMMDDHHMMSS)
19	25	7 Digit ASCII	Final Torque (Seq 32: value includes Prevailing Tq)
26	32	7 Digit ASCII	Low Torque Limit (Seq 32: adds Prevailing Tq)
33	39	7 Digit ASCII	High Torque Limit (Seq 32: adds Prevailing Tq)
40	40	1 Char ASCII Status	Torque Status Flag L = low A = accept H = high
41	47	7 Digit ASCII	Final Angle
48	54	7 Digit ASCII	Low Angle Limit
55	61	7 Digit ASCII	High Angle Limit
62	62	1 Char ASCII Status	Angle Status Flag L = low A = accept H = high
63	63	1 Char ASCII Status	Overall Status Flag A = accept R = reject
64	65	2 Digit ASCII	Link/Position (only for Linking)
66	67	2 Digit ASCII	Number of linked positions (only for Linking)
68	68	0D hex	CR (carriage return)
69	69	0A hex	LF (line feed)

Transmission data – Part ID activated

Length ≤ 25

Start	End	Length or Value	Description
...	...	...	...
68	92	25 Digit ASCII	Part ID
93	93	0D hex	CR (carriage return)
94	94	0A hex	LF (line feed)

Transmission data – Part ID activated

Length > 25, in this example 30

Start	End	Length or Value	Description
...	...	...	...
68	92	30 Digit ASCII	Part ID
93	93	0D hex	CR (carriage return)
94	94	0A hex	LF (line feed)

10.2.3 Standard2PartID Protocol

A single serial port is shared between the tools.

Transmission data – Part ID not activated

Start	End	Length or Value	Description
1	1	42 HEX	B
2	3	2 Digit ASCII	Tool Number
4	6	3 Digit ASCII	Parameter Set
7	18	12 Char ASCII	Date and Time (YYMMDDHHMMSS)
19	25	7 Digit ASCII	Final Torque (Seq 32: value includes Prevailing Tq)
26	32	7 Digit ASCII	Low Torque Limit (Seq 32: adds Prevailing Tq)
33	39	7 Digit ASCII	High Torque Limit (Seq 32: adds Prevailing Tq)
40	40	1 Char ASCII Status	Torque Status Flag L = low A = accept H = high
41	47	7 Digit ASCII	Final Angle
48	54	7 Digit ASCII	Low Angle Limit
55	61	7 Digit ASCII	High Angle Limit
62	62	1 Char ASCII Status	Angle Status Flag L = low A = accept H = high
63	63	1 Char ASCII Status	Overall Status Flag A = accept R = reject
64	65	2 Digit ASCII	Link/Position (only for Linking)
66	67	2 Digit ASCII	Number of linked positions (only for Linking)
68	68	0D hex	CR (carriage return)
69	69	0A hex	LF (line feed)

Transmission data – Part ID activated

Length ≤ 25

Start	End	Length or Value	Description
...	...	...	...
68	92	25 Digit ASCII	Part ID
93	93	0D hex	CR (carriage return)
94	94	0A hex	LF (line feed)

Transmission data – Part ID activated

Length > 25, in this example 30

Start	End	Length or Value	Description
...	...	...	...
68	97	30 Digit ASCII	Part ID
98	98	0D hex	CR (carriage return)
99	99	0A hex	LF (line feed)

Part ID length

Standard, Standard2, and StandardPart2ID protocol data transmissions are extended to include the scanned Part ID/Bar code number. For the Part ID, at least 25 characters ASCII are transmitted prior to CR/LF. The Part ID length can be up to 39 characters.

1. Part IDs with less than 25 characters are filled with spaces:
   `S01ABCDEFG <CR><LF>`
2. Part IDs with at least 25 and up to 39 characters are transmitted 1:1:
   `S01AAAAAAAAAABBBBBBBBBBCCCCCCCCCCDDDDDDDDD<CR><LF>`
3. Part IDs with more than 39 characters are cut off by the controller.

Start	End	Length or Value	Description
1	1	53 hex	S
2	3	2 digit ASCII	Tool Number
4	28	25 digit ASCII	Part ID/Bar code number
29	29	0D hex	CR (carriage return)
30	30	0A hex	LF (line feed)

10.2.4 AVIS Protocol

A single serial port is shared between the tools.

Start	End	Length or Value	Description
1	1	42 HEX	B
2	3	2 Digit ASCII	Tool Number
4	5	2 Digit ASCII	Parameter Set
6	17	12 Digit ASCII	Date and Time (YYMMDDHHMMSS)
18	24	7 Digit ASCII	Final Torque
25	31	7 Digit ASCII	Low Torque Limit
32	38	7 Digit ASCII	High Torque Limit
39	39	1 Digit ASCII	Torque Status Flag L = low A = accept H = high
40	46	7 Digit ASCII	Final Angle
47	53	7 Digit ASCII	Low Angle Limit
54	60	7 Digit ASCII	High Angle Limit

Start	End	Length or Value	Description
61	61	1 Digit ASCII	Angle Status Flag L = low A = accept H = high
62	62	1 Digit ASCII	Overall Status Flag A = accept R = reject
63	64	2 Digit ASCII	Link / Position (Only for Linking)
65	66	2 Digit ASCII	Number of Linked Positions (Only for Linking)
67	91	25 Digit ASCII	Linking position name
92	92	0D HEX	CR (carriage return)
93	93	0A HEX	LF (line feed)

10.2.5 PFCS (Plant Floor Communication System) Protocol

The basic functionality of the PFCS protocol is to send the rundown data from the PFD (Plant Floor Device, this is our controller) to the PFCS server and to send the keep-alive messages if idle. Two communication interfaces are available for PFCS, i.e., Serial RS232 and Ethernet (TCP/IP TCP sockets).

When you enable PFCS for the Serial or Ethernet interface, an <Advanced Settings> or <Advanced> button is displayed and provides access to additional controls which allow you to configure PFCS.

▶ See chapter *10.3.3 PFCS Protocol, page 130*.

10.3 Ethernet Protocols

To enable an Ethernet protocol:

1. Tap the required protocol in the *Ethernet* table to select it.
2. Enter the required values in the *Server* and *Port* input boxes below the table.
3. Tap the <Activated> checkbox.
   → For some protocols, the <Advanced> button is displayed, which provides access to additional controls. See the sections below for details.

10.3.1 Standard and Standard Plus Protocol

The main purpose of the Ethernet Protocol Standard is to communicate rundown data (packet 4) from a Controller to an external server on the local network. Other packets in the protocol support additional data, e.g., Station ID, Communication parameters, and Date/Time parameters. Data is transmitted in TCP/IP network byte order (big-endian) to and from the server.

The Standard Plus Ethernet Protocol is a superset of the Standard. It adds Application #, Linking step, Total # of Linking steps, Tightening Group, and a 25-character Part ID to the rundown data.

A server running *Protocol Standard*-compatible software can create TCP/IP connections to multiple controllers.

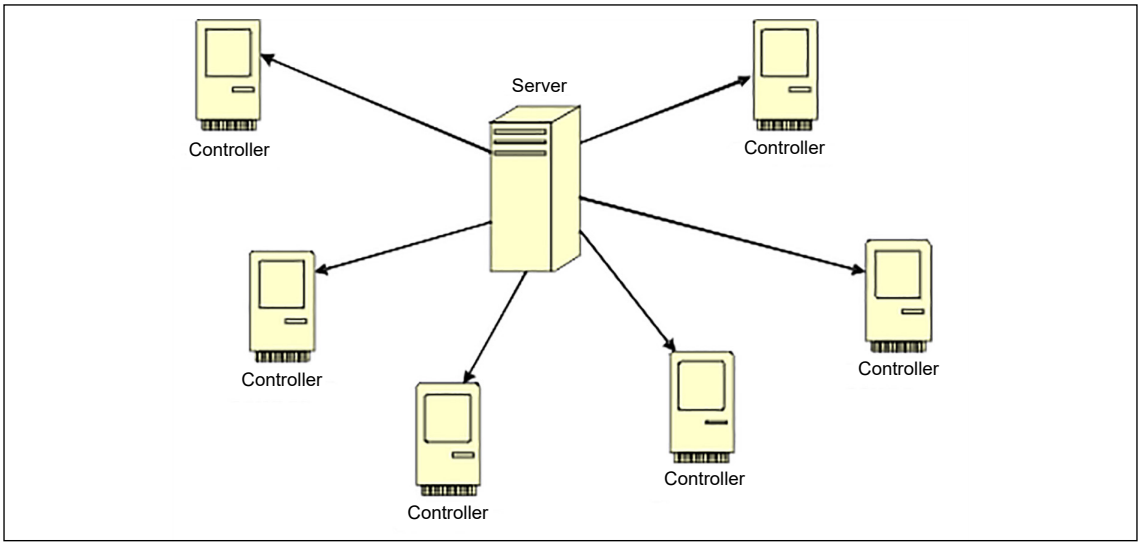


Fig. 10-1: Ethernet architecture

Additional Features

- Download, upload, file, and print parameters.
- Upload and file rundown data from any unit on the network (10,000 per controller).
- Export rundown data in standard database formats (i.e., Microsoft Access, SQL, or Oracle).
- English, German, Spanish, and Portuguese languages.

Sequence Diagrams

Successful rundown sequence:

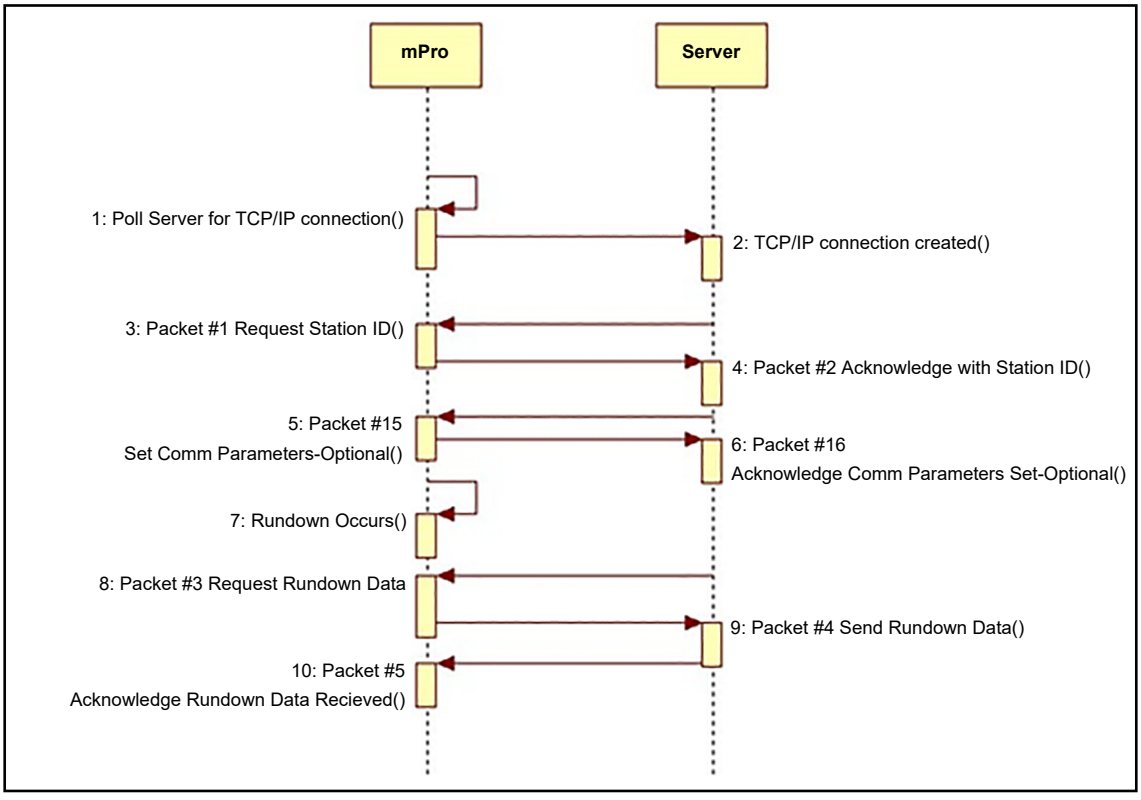


Fig. 10-2: Successful rundown sequence

No rundown data available:

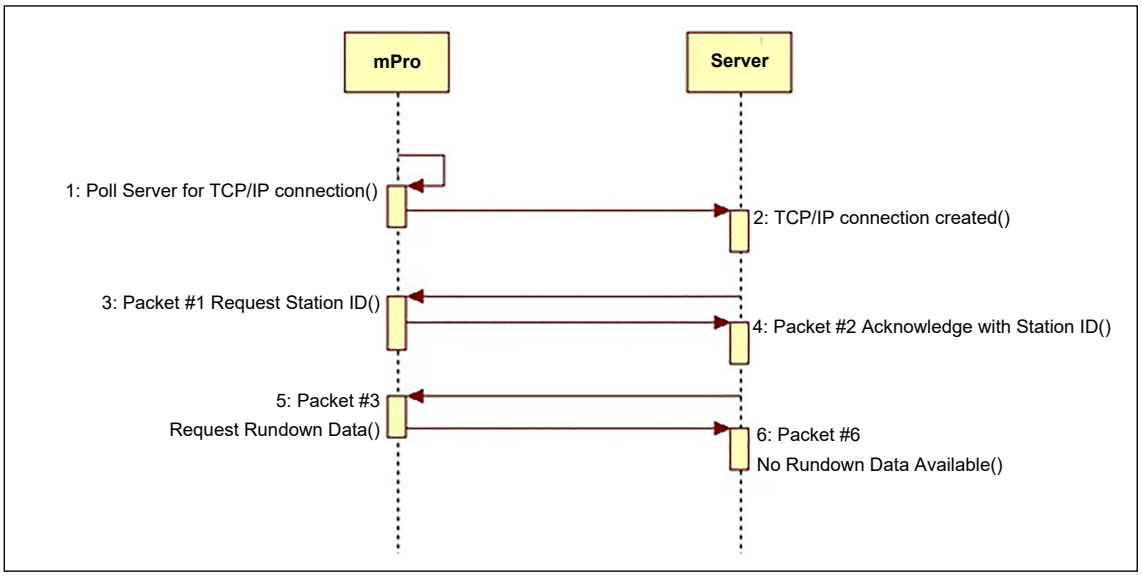


Fig. 10-3: No rundown data available

No server rundown acknowledgment sequence:

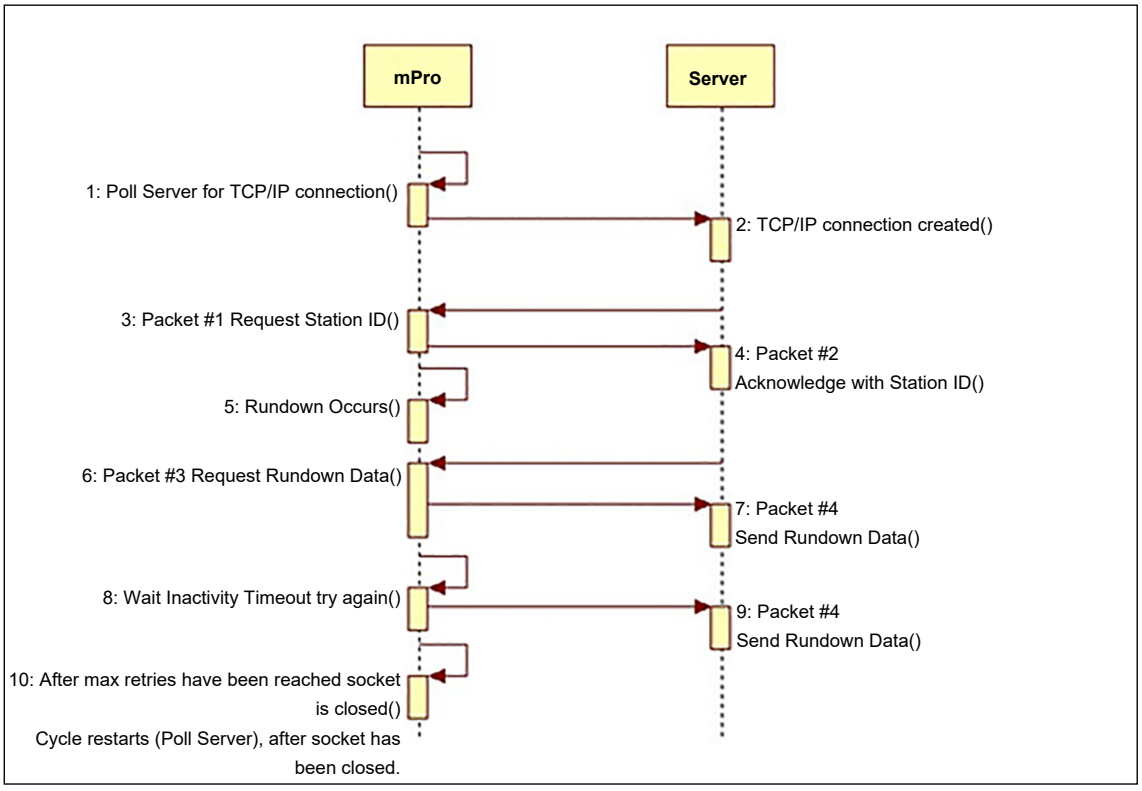


Fig. 10-4: No server rundown acknowledgment sequence

Commands

You can also use the following commands:
Clear Buffer

Packet	Description
Packet #7 (Server to Controller) Clear Buffer	Packets #7 and #8 can be used to reset the controller's buffer. After the acknowledgment, the cycle count will be reset to 1. The cycle count is incremented every time a rundown occurs (any tool) on a controller.
Packet #8 (Controller to Server) ACK Cleared Buffer	

Communication parameters:

Packet	Description
Packet #15 (Server to Controller) Set Comm Parameters	Communication Inactivity Timeout Communication Acknowledgment Timeout Communication Acknowledgment Retries
Packet #16 (Controller to Server) ACK Set Comm Parameters	

Date and Time settings:

Packet	Description
Packet #17 (Server to Controller) Set Date/Time Parameters	
Packet #18 (Controller to Server) ACK Set Date/Time Parameters	

Acknowledgment Conditions

Rundown acknowledgment scenario

- Server does not send packet #5 within Communication Ack Timeout.
- Controller resends packet #4.
- If server does not respond, continue to resend #4 after Communication Ack Timeout has expired until Max Retries is reached.
- TCP/IP connection is dropped and reconnection is attempted. Same procedure as ideal Packet sequence.

There is no scenario where the server would send a NAK.

If the server receives *bad/invalid* packet #4, it waits for the controller to time out and resend packet #4. Then the server will send packet #5.

Message formats

No.	Packet Definition
1	Server Station ID # Request
2	Controller Station ID # Acknowledge
3	Server Rundown Packet Request
4	Controller Rundown Packet
5	Server Rundown Packet Acknowledge
6	Controller No Rundown Packet

No.	Packet Definition
7	Server Reset Buffer Request
8	Controller Reset Buffer Acknowledge
15	Server Communication Parameters Packet
16	Controller Communication Parameters Packet Acknowledge
17	Server Set Date and Time Packet
18	Controller Set Date and Time Packet Acknowledge

Data type definitions

Data Type	Description
A	Alphanumeric - ASCII character format
B	Binary data
D	Double – 64-bit signed floating point
I	16-bit unsigned integer
S	16-bit signed integer
W	32-bit unsigned integer

The first 8 bytes (the header) of every packet contains the same information:

- Message length
- Controller IP address
- Station number

Packet No. 1 – Server Station ID Request

Start	Bytes	Data Type	Required Fields
0	2	I	Message Length in Bytes – Set to 10 for this packet
2	4	W	Network ID – Set to IP Address of Controller
6	2	I	Station Number – Set to 0 for this packet type
8	2	I	Packet Number – Set to 1 for this type

Packet No. 2 – with Acknowledgment

Start	Bytes	Data Type	Required Fields
0	2	I	Message Length in Bytes – Set to 11 for this packet
2	4	W	Network ID – Set to IP Address of Controller
6	2	I	Station Number – Set to Controller Station No.
8	2	I	Packet Number – Set to 2 for this type
10	1	A	Acknowledge – 06hex, NAK – 15hex

Packet No. 3 – Server Rundown Packet Request

Start	Bytes	Data Type	Required Fields
0	2	I	Message Length in Bytes – Set to 12 for this packet
2	4	W	Network ID – Set to IP Address of Controller
6	2	I	Station Number – Set to Controller Station No.
8	2	I	Packet Number – Set to 3 for this type
10	2	I	Cycle Number – 0 to 65535

Packet No. 4 – Rundown Data

Start	Bytes	Data Type	Required Fields
0	2	I	Message Length in Bytes – Set to 12 for this packet
2	4	W	Network ID – Set to IP Address of Controller
6	2	I	Station Number – Set to Station No.
8	2	I	Packet Number – Set to 4 for this type
10	2	I	Cycle Number – 0 to 65535
12	2	I	Number of tools being sent
14	2	I	Parameter Set
16	3	A	'C', 'T', 'S' (Cooper Tools System)
19	1	A	Spare
20	8	D	Date/Time: Integer portion equals the number of days since Jan 01, 1900. The fractional portion is the fraction of the 24-hour day that has elapsed.
28	4	W	Vehicle ID Number (VIN)
32	2	I	Tool Number
34	8	D	Final Torque (Nm)
42	8	D	Torque Low Limit
50	8	D	Torque High Limit
58	2	I	Final Angle
60	2	I	Angle Low Limit
62	2	I	Angle High Limit
64	2	I	Status Byte
	Bit 0		Cycle Complete – 1 if the rundown was completed successfully
	Bit 1		Torque Status – 1 if the torque was within specs
	Bit 2		Torque Spec – 1 if High, 0 if Low, X if OK
	Bit 3		Angle Status – 1 if the angle was within specs
	Bit 4		Angle Spec – 1 if High, 0 if Low, X if OK
	Bit 5		Time Status – 1 if Time is within specs for the complete rundown
	Bit 6		Time Spec – 1 if High, 0 if Low, X if OK
	Bit 7 – 15		Spare
66	10	A	Tool Serial Number

Bytes 32 through 75 are repeated for each tools being sent in the packet.

Packet No. 5 – Server Rundown Packet Acknowledge

Start	Bytes	Data Type	Required Fields
0	2	I	Messsage Length in Bytes - Set to 11 for this packet
2	4	W	Network ID - Set to IP Address of Controller
6	2	I	Station Number - Set to Controller Station No.
8	2	I	Packet Number - Set to 5 for this type
10	1	A	Acknowledge - 06hex, NAK - 15hex

Packet No. 6 – Controller No Rundown Packet

Start	Bytes	Data Type	Required Fields
0	2	I	Messsage Length in Bytes - Set to 11 for this packet
2	4	W	Network ID - Set to IP Address of Controller
6	2	I	Station Number - Set to Controller Station No.
8	2	I	Packet Number - Set to 6 for this type
10	1	A	Null character - Set to 00 hex

Packet No. 7 – Server Reset Buffer Request

Start	Bytes	Data Type	Required Fields
0	2	I	Messsage Length in Bytes - Set to 10 for this packet
2	4	W	Network ID - Set to IP Address of Controller
6	2	I	Station Number - Set to Controller Station No.
8	2	I	Packet Number - Set to 7 for this type

Packet No. 8 – Controller Reset Buffer Acknowledge

Start	Bytes	Data Type	Required Fields
0	2	I	Messsage Length in Bytes - Set to 11 for this packet
2	4	W	Network ID - Set to IP Address of Controller
6	2	I	Station Number - Set to Controller Station No.
8	2	I	Packet Number - Set to 8 for this type
10	1	A	Acknowledge - 06hex, NAK - 15hex

Bytes 76 through 109 are added to the Standard Ethernet Protocol to create the Standard Plus

Start	Bytes	Data Type	Required Fields
76	2	I	Application
78	2	I	Step/Position in Linking Sequence
80	2	I	Total Number of Linked Positions
82	2	I	Tightening Group
84	25	A	Part ID String

In Standard Plus, the Part ID is used and VIN is defaulted to 0. The Part ID can be input using the virtual keypad of the Run Screen or the Serial Barcode Reader.

Packet No. 15 – Server Communication Parameters

Start	Bytes	Data Type	Required Fields
0	2	I	Message Length in Bytes – Set to 24 for this packet
2	4	W	Network ID – Set to IP Address of Controller
6	2	I	Station Number – Set to Station No.
8	2	I	Packet Number – Set to 15 for this type
10	2	I	Communication Acknowledge Timeout (Default = 60 sec)
12	2	I	Communication Inactivity Timeout (Default = 60 sec)
14	2	I	Communication Acknowledgment Retries (Default = 3)
16	8	I	Spare

Packet No. 16 – Server Communications Acknowledgment

Start	Bytes	Data Type	Required Fields
0	2	I	Message Length in Bytes – Set to 11 for this packet
2	4	W	Network ID – Set to IP Address of Controller
6	2	I	Station Number – Set to Station No.
8	2	I	Packet Number – Set to 16 for this type
10	2	A	Acknowledge – 06hex, NAK – 15hex

Packet No. 17 – Server Set Date and Time

Start	Bytes	Data Type	Required Fields
0	2	I	Message Length in Bytes – Set to 18 for this packet
2	4	W	Network ID – Set to IP Address of Controller
6	2	I	Station Number – Set to Station No.
8	2	I	Packet Number – Set to 17 for this type
10	8	D	Date/Time: Integer portion equals the number of days since Jan 01, 1900. The fractional portion is the fraction of 24-hour day that has elapsed.

Packet No. 18 – Server Set Date and Time Acknowledgment

Start	Bytes	Data Type	Required Fields
0	2	I	Message Length in Bytes – Set to 11 for this packet
2	4	W	Network ID – Set to IP Address of Controller
6	2	I	Station Number – Set to Station No.
8	2	I	Packet Number – Set to 18 for this type
10	1	A	Acknowledge – 06hex, NAK – 15hex

10.3.2 WinSPC Protocol

This Ethernet protocol is same as protocol Ethernet-Standard except Packet No. 4.

Start	End	Length or Value	Description
1	1	42 HEX	B
2	3	2 Digit ASCII	Tool Number
4	5	2 Digit ASCII	Parameter Set
6	17	12 Digit ASCII	Date and Time (YYMMDDHHMMSS)
18	24	7 Digit ASCII	Final Torque
25	31	7 Digit ASCII	Low Torque Limit
32	38	7 Digit ASCII	High Torque Limit
39	39	1 Digit ASCII	Torque Status Flag L = low A = accept H = high
40	46	7 Digit ASCII	Final Angle
47	53	7 Digit ASCII	Low Angle Limit
54	60	7 Digit ASCII	High Angle Limit
61	61	1 Digit ASCII	Angle Status Flag L = low A = accept H = high

Start	End	Length or Value	Description
62	62	1 Digit ASCII	Overall Status Flag A = accept R = reject
63	64	2 Digit ASCII	Link / Position (Only for Linking)
65	66	2 Digit ASCII	Number of Linked Positions (Only for Linking)
67	91	25 Digit ASCII	Linking position name
92	92	0D HEX	CR (carriage return)
93	93	0A HEX	LF (line feed)

10.3.3 PFCS Protocol

See also chapter *10.2.5 PFCS (Plant Floor Communication System) Protocol*, page 122. For detailed information, see the current version of the *PFCS Vendor Specification*.

To configure PFCS:

1. Tap the PFCS entry in the Ethernet table to select it.
2. Enter the required values in the input boxes below the table.
3. Tap the <Activated> check box.
   → The <Advanced> button is displayed, which provides access to additional controls.
4. Tap the <Advanced> button to open the *PFCS Advanced settings* dialog.
5. Contact your network administrator for required settings.

PFCS Advanced settings – Settings tab

The following controls are available on the *Settings* tab:

Control	Description
Timeout (s)	Controller must time out in N seconds (typically N = 5) while waiting for a response to a request.
Keep Alive Timer (s)	This can be simply called Reconnect Timer. The controller tries to connect to a port on the PFCS server and, if connection from the controller to the PFCS port is not successful, the controller must wait N seconds (typically N = 20) before trying to connect to PFCS again. The time to connect depends, e.g., on the architecture of the controller's communications to PFCS and on how it responds to the PFCS server closing the connection.
Retries	Number of retries allowed for sending messages from PFD to PFCS. The connection is disconnected if no acknowledgment message from PFCS is received after all allowed retries are made.
Format	Defines which vehicle identifier is included in the results data sent from controller to PFCS. The Plant Integrator selects one of two options as applicable for the process.
AVI Barcode	The AVI (Automatic Vehicle Identification) Barcode corresponds to the identifier scanned by the Part ID or Barcode step on the controller.
VIN/Track	Scanned VIN on the controller if Part ID enabled or Part ID Interlocked modes are active.
Request Vehicle Build	Enable or disable request of Vehicle Build Data from PFCS. If enabled, the controller must request a VIN or AVI Barcode by sending a type *0001* request to PFCS.
Enable Individual Vehicle Build Data Request for each Tool	Provides for each tool in a multi-spindle Tool Group to use its individual Vehicle Build Data Request.

Control	Description
Discard Zeroed Run-down Results	Prevents sending of rundown results terminated by take away start signal (SA).
Enable Unsolicited Build Data	The PFCS Protocol provides the mechanism for receiving or retrieving information either as an unsolicited build information message or as a response to a solicited request. If operation requires unsolicited data download from PFCS (type *0003*), it must receive this download on a separate *Port* and with a separate *Machine ID*.

PFCS Advanced settings – Machine ID tab

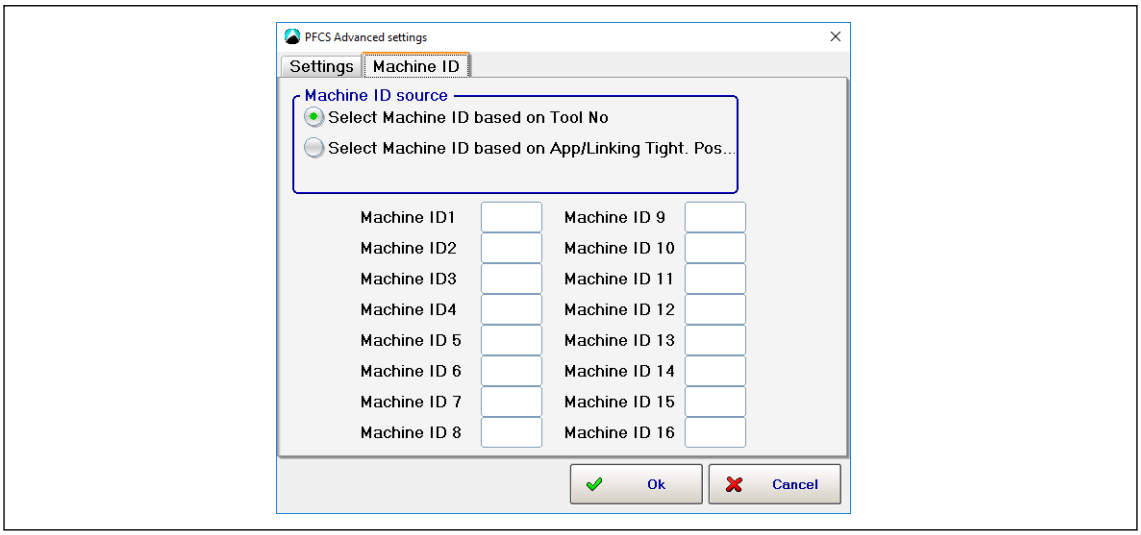


Fig. 10-5: PFCS Advanced settings – Machine ID tab

The Machine IDs are unique 4-character IDs used by the controller for all PFCS communications. These IDs must be a configurable option on the controller. To correctly assign each connection for PFCS, each tool's Machine ID is either parameterized or automatically forwarded by the defined Linking Step Name. (The latter only applies in *Linking* mode. See chapter *8.4 Linking, page 95*.)

10.3.4 Open Protocol

For detailed information on Open Protocol telegrams, see the current version of the *Open Protocol FEP Specification*.

To configure Open Protocol:

1. Tap the *Open Protocol* entry in the *Ethernet* table to select it.
2. Enter the required values in the input boxes below the table.
3. Tap the <Activated> checkbox.
   → The <Advanced> button is displayed, which provides access to additional controls.
4. Tap the <Advanced> button to open the *Open Protocol Advanced Settings* dialog.

Contact your network administrator for required settings.

Open Protocol Advanced Settings – Communication Ports tab

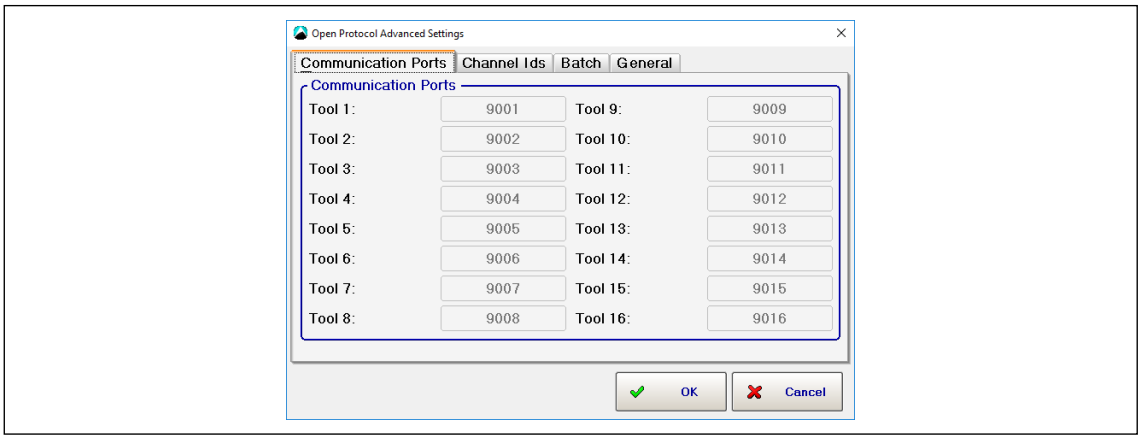


Fig. 10-6: Open Protocol Advanced Settings – Communication Ports tab

Each tool uses a separate TCP Port for communication. The communication ports used are not completely user-definable. But you can define a range (1 to number of tools supported by controller software) by setting the first port number. The ports selected begin with the number entered in the **`Port`** input box on the main *Data Transmission* tab.

Open Protocol Advanced Settings – Channel IDs tab

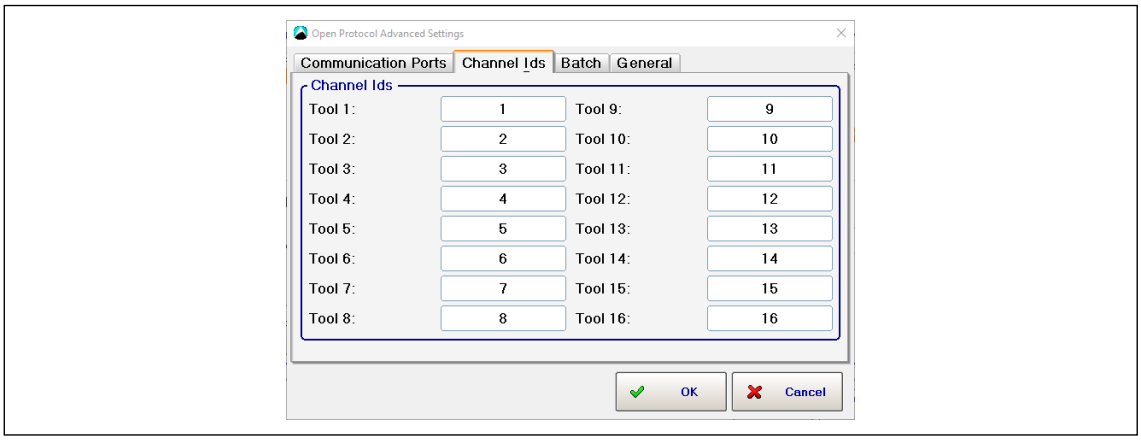


Fig. 10-7: Open Protocol Advanced Settings – Channel IDs tab

In several Open Protocol MIDs, the Channel ID is used as an identifier for the tool used on this controller. The Channel IDs are user-definable and can be specified by two ASCII digits to range from 0 to 99.

Open Protocol Advanced Settings – Batch tab

The Batch tab provides access to global settings for Batch mode. For detailed information on Batch mode, see the *Batch programming* section.

The following controls are available on the Batch tab:

Control	Description
Batch status at increment/bypass	When the batch position counter is incremented or a batch position is bypassed, the batch status of this position is set automatically to the status selected in this drop-down menu.
• NOK	The status of bypassed batch positions is set to NOK.
• OK	The status of bypassed batch positions is set to OK.
Increase batch counter at tightening	The current batch is moved to the next batch position when the tightening status set in this drop-down menu is reached.
• OK	The batch group is moved to the next position when tightening is OK. With a NOK tightening, the operator has to rework the current position until tightening is OK.

Control	Description
• OK+NOK	The batch group is moved to the next position after each evaluated tightening, i.e., after each OK or NOK tightening.
Job Batch Mode	- Not available in current software version - Use Job Batch Mode to combine Applications with different batch sizes into one tightening job (similar to a Linking Group). The overall tightening status of each batch group used is included in the overall tightening status of the Job Batch.
• Off	Job Batch Mode is deactivated.
• OK	Each batch group is moved to the next position when tightening is OK. With a NOK tightening, the operator has to rework the current position until tightening is OK.
• OK+NOK	Each batch group is moved to the next position after each evaluated tightening, i.e., after each OK or NOK tightening.
Reset Batch size on connection loss	If this checkbox is enabled and the Open Protocol connection lost, the current batch size is set to zero. When the connection is established again, the batch size needs to get set again with MID 19.
MID 0061 Batch Information (Linking mode)	In the Open Protocol result telegram MID0061, the batch information (position, size, status) for the sequence program is filled in with the current values.
• per Linking Group	The batch information is filled in for each Linking Group (default setting).
• per Linking Step	The batch information is filled in for each Linking Step. This is useful, for example, for Linking Groups with several tightening positions in one Linking Step.

Open Protocol Advanced Settings – General tab

The following controls are available on the General tab:

Control	Description
Timeout (s)	Defines time in seconds until connection on port is closed if no answer is received on current port. Valid settings are from 5 seconds to 99 seconds.
Terminate Linking Group with MID 38	Allows to abort the currently running Linking Group.
Lock tool on connection loss	Tool gets automatically locked whenever Open Protocol connection is lost.
Abort Job on Connection Loss	If all active Open Protocol connections of a tool group are interrupted, the started job is aborted as soon as the timeout has expired. A NIO result is reported. This function is only possible in Linkging Group mode. The job is not aborted if the connection has been properly terminated (MID 0003).
Control socket tray outputs using MID 254	For the *Selector Control green light* message (MID 254) to function correctly using the programmed I/O signals bitmask In X (EIN_S_X), the *Control Socket Tray Outputs using MID 254* option must be enabled. If socket tray outputs are activated in the Application parameters, this is overwritten by MID 254.
Clear outputs on connection loss	Set all by Open Protocol externally controlled relays to zero if a connection is lost (Open Protocol Port Closure or disconnection).
Disable OpenProtocol communication while in Manual Mode	Whenever the Tool Group is switched to Manual Mode (see *Tightening tab of the Tool Group settings*), the complete Port connection is closed. The port listener gets disabled and no further connection on the port is possible during Manual Mode. It has to be reestablished once Manual Mode is deactivated.

10.3.5 FEP

For detailed information on FEP (Ford Protocol) telegrams, see the current version of the *Open Protocol FEP Specification*.

The options available for FEP are the same as described in the *Open Protocol* section.

To configure FEP:
1. Tap the FEP entry in the Ethernet table to select it.
2. Enter the required values in the input boxes below the table.
3. Tap the <Activated> checkbox.
   → The <Advanced> button is displayed, which provides access to additional controls.
4. Tap the <Advanced> button to open the *FEP Advanced Settings* dialog.

Contact your network administrator for required settings.

See the *Open Protocol Advanced Settings* sections for detailed information on the options available in the *FEP Advanced Settings* dialog.

10.3.6 TorqueNet / Rundown Data

TorqueNet is a data acquisition system that directly collects and stores all fastening process data from intelligent fastening systems and tools.

See the *TorqueNet User Manual* for detailed information on the database and installed web application.

To configure parameters for proper communication between the TorqueNet server and the controller:
1. Tap the *TorqueNet* entry in the *Ethernet* table to select it.
2. Enter the IP address of the TorqueNet server in the *Server* input boxes below the table.
   Contact your network administrator for required settings.
3. Enter the correct port number in the *Port* input box.

Port no.	Description
12345	Default port number for TorqueNet
11222	Default number for ATG Rundown Data

4. Tap the <Activated> checkbox.
   → The <Advanced> button is displayed, which provides access to additional controls.
5. Tap the <Advanced> button to open the *Advanced Settings* dialog.

The following controls are available in the *Advanced Settings* dialog: See chapter *6.7.2 Maintenance Counter update interval, page 73*.

10.3.7 ToolsNet Open Protocol

ToolsNet Open Protocol is a system to control, report, and analyze rundown data produced with the controller.

For detailed information on ToolsNet Open Protocol and its telegrams, see the current version of the *ToolsNet Open Protocol Specification*.

To configure parameters for proper communication between the ToolsNet server and the controller:
1. Tap the ToolsNet OP entry in the Ethernet table to select it.
2. Enter the IP address of the ToolsNet server in the Server input field below the table.
   Contact your network administrator for required settings.
3. Tap the <Activated> checkbox.
   → The <Advanced> button is displayed, which provides access to additional controls.
4. Tap the <Advanced> button to open the *Advanced ToolsNet settings* dialog.

Advanced ToolsNet settings – Miscellaneous tab

The following controls are available on the *Miscellaneous* tab:

Control	Description
Server Connection Time-out (sec)	When the controller powers up and is enabled to communicate with ToolsNet on the network, it attempts to open a TCP/IP connection with ToolsNet (PIM module). If the connection attempt fails, the controller waits a defined time period before making another attempt to connect. The ToolsNet manual suggests to set it to 60 seconds.
Result Ack Timeout (sec)	The controller sets a unique ID number in each telegram (message) sent to ToolsNet. ToolsNet verifies receipt of the telegram by replying with an acknowledge telegram. If a telegram is not acknowledged in the time period defined in this parameter, the controller retransmits the telegram twice. If the telegram is still not acknowledged, the controller closes the connection and tries to reestablish the connection. The ToolsNet manual suggests to set it to 5 seconds.
Keep Alive Interval (sec)	If this time period expires with no information being transmitted, the controller transmits a Keep-Alive telegram to keep the network connection active. ToolsNet replies to these Keep-Alive telegrams. The ToolsNet manual suggests to set it to 30 seconds.
Date/Time synchronization	Limits the difference between the time stamp of the controller and the ToolsNet OP server. Synchronization occurs when the time stamps differ by the number of seconds entered in the *Synchronization if difference above (s)* input box.
Send all multi spindle results as spindle 1	If the ToolsNet server rejects spindle results with the *Index out of bounds* error message, you can use this option as a workaround to send all results as Spindle 1.

See the ToolsNet documentation if you have additional questions con#cerning timeout settings.

Advanced ToolsNet settings – Station numbers

The ToolsNet logical structure defines the controller and tool(s) by a specific System Type, System Number, Station Number, Spindle Number, and Program Number. It also identifies a Station Name and Spindle Name.

In the controller's *ToolsNet settings*, the following designations apply:

- Station means Tool Group
- Spindle means Tool
- Program means Application

ToolsNet uses a System Type number to define controllers. This is a hidden value predefined in the ToolsNet server. It cannot be changed in the controller. For Apex Tool Group controllers, the System Type number is *16*. Each controller that reports to a ToolsNet server must have a System Number unique on that server. And each Tool Group on a controller must have a unique Station Number/Tool Group name.

The following controls are available on the *Station numbers* tab:

Control	Description
Controller System Number	This parameter is the same as ToolsNet's System Number. Each controller must have a unique System Number. It should not duplicate an existing System Number that is already defined in another controller reporting to the same ToolsNet server.
Station	This parameter is the same as ToolsNet's Station Number. Each Tool Group assigned to the controller must have a unique Station Number. It should not duplicate an existing Station Number that is already defined in this controller.

The Ethernet port number used for communications between the controller and the ToolsNet server is automatically set to 6575. This cannot be changed in the controller.

Advanced ToolsNet settings – Tool Group names

You can assign a unique name to each Tool Group on a controller. This is the same as ToolsNet's Station Name. It provides ToolsNet with additional detail for tracking and display purposes.

The following controls are available on the *Tool Group names* tab:

Control	Description
Group	These entries allow ToolsNet to track an assigned *Station Name* for the Tool Group. A maximum 25 characters are allowed.

Advanced ToolsNet settings – Tool names

Each tool assigned to this specific controller can be given a unique name. This is the value that ToolsNet refers to as *Spindle Name*. This provides ToolsNet additional detail for tracking and display purposes.

The following controls are available on the *Tool names* tab:

Control	Description
Tool	This entries allow ToolsNet to track an assigned *Spindle Name* for the Tool. A maximum 25 characters are allowed.

Various parameters defined in the Application Builder screens of the controller are also sent to the ToolsNet server for tracking and display purposes. The *Application Names* defined in the controller are referred to as *Program Names* in ToolsNet database tables. Application Names, torque/angle min/max limits are among the parameters sent for storage.

Finally, once configured, rundown data generated by the tools assigned to the controller are transmitted and archived in the ToolsNet database.

10.3.8 XML/CSV protocol

The XML/CSV Ethernet protocol is used to transmit data via XML file or CSV file from/to the controller to/from an FTP or SAMBA server.

For each rundown result in Application mode or each workpiece in Linking mode, a result file is generated and stored on the server's destination. Each generated result file has a unique file name. The file name is composed of a user-defined file name prefix, the scanned VIN or Part ID (if available), and a time stamp (available in various formats).

The Part ID has priority over the VIN. If both are activated, the Part ID is used in the file name and is part of the *ident* in the file.

Examples of file names:

Without prefix and VIN/Part ID:	`_____20160131120530.xml`
With VIN/Part ID:	`_ABCDEFGHIJKLMNOPQRSTUVW20160131122045.csv`
With prefix:	`PRÄFIX_____20160131122045.csv`
With prefix and VIN/Part ID:	`PRÄFIX_abcdefghijklmnopq20160131122045.csv`
Same with different date/time format:	`PRÄFIX_abcdefghijklmnopq_____00EA14F8.csv`

The following restrictions apply:

- The overall file name length is limited to 38 characters.
- An underscore occurs between Prefix and VIN/Part ID, even if no prefix is defined.
- In the file name, the VIN/Part ID is limited to 23 characters minus the number of characters defined for the prefix.

To configure XML/CSV data transmission:

1. Tap the *XML/CSV* entry in the Ethernet table to select it.
2. Tap the <Activated> checkbox.
   → The <Advanced> button is displayed, which provides access to additional controls.
3. Tap the <Advanced> button to open the *Open Protocol Advanced Settings* dialog.
4. Contact your network administrator for required settings.

The following controls are available on the *XML/CSV Network settings* tab:

Control	Description	
None	Displays the currently selected Network settings. *None* means that no Network settings are available. Otherwise, a list of already defined Tool Group Names is displayed for selection.	
New	Creates a new set of Network settings with empty fields.	
Delete	Deletes the currently selected Network settings.	
Tool Group Name	Allows the XML/CSV protocol to track an assigned *Tool Group Name* for the Tool Group. A maximum 31 characters are allowed.	
File format	Applies format to the date and time used as the last part of file names.	
Date and time	Complete date and time:	_YYYYMMDDHHMMSS.xml
Filename without century	Year without century:	___YYMMDDHHMMSS.xml
Date and Time as HEX	Date and time in ticks (10 ms) converted to hexadecimal value:	_____00EA14F8.csv
Counter instead of Seconds	The same format as `Date and time`, but the seconds are replaced with a rundown counter that ranges from 01 to 99 and starts at 01 every minute. This is useful if more than one file is created during one second.	_YYYYMMDDHHMMCC.xml
Transfer workpiece OK/NOK	Provides additional column in CSV files with information on whether a workpiece was tightened OK or NOK.	
Date/Time synchronization	Synchronizes date and time with the server.	
Data Transmission	Defines result files to contain all tightened *Stages* or only *Final* stage results.	
File format	Selects supported file formats:	
XML	XML file format: See Data transfer as XML file, page 138.	
CSV_STD	CSV standard: The first CSV file version was developed with German expressions in the header. See: CSV-STD, page 140.	
CSV_FR	French expressions in the header: See CSV-FR, page 141.	
CSV_EN	English expressions in the header: See CSV-EN, page 141.	
SAMBA	Toggles server type between *FTP* and *SAMBA*.	
Worker ID 1. barcode in linking sequence.	Adds the first scanned barcode step of the Linking Group to the *ident* information in the XML/CSV file. This scanned string is separated from the scanned VIN/Part ID by a forward slash (/).	
SmbMount	If the *SAMBA* server type is selected, you can use this button to establish the connection to the server. The field to the right shows the connection status.	
Server IP Address, User name, Password, Subdirectory...	Establishes connection to the server and defines the destination where result files are stored. Contact your network administrator for required settings.	
File name prefix	Adds a file name prefix to result file names. You can enter 1 to 9 characters.	

Data transfer as XML file

Example of an XML result file:

OK result

```
<?xml version="1.0" encoding="ISO-8859-1"?>
  <HEADER>
    <QUELLE>CPT: Ventil mit Sensor </QUELLE>
    <SENDETERMIN>08-04-2019 08:42:46</
    SENDETER-MIN>
  </HEADER>
  <PLA>
    <MONTAGE>
      <ID>2000002369R00457530003</ID>
      <STATION>RR</STATION>
      <SCHRITT>RR-Team</SCHRITT>
      <MON_TYP>CPT</MON_TYP>
      <VERSION>S168813</VERSION>
      <GES_STATUS>IO</GES_STATUS>
      <STATION_DATUM_START>08-04-2019
      08:42:24 </STATION_DATUM_START>
      <STATION_DATUM_ENDE>08-04-2019 08:42:44
      </STATION_DATUM_ENDE>
      <MERKMAL>
        <MM>Drehmoment</MM>
        <DIM>Nm</DIM>
        <SCALE>1</SCALE>
        <SCHWELLENWERT>0.0</SCHWELLENWERT>
        <UG>0.00</UG>
        <OG>13.50</OG>
        <IST_NUM>0.00</IST_NUM>
        <STATUS>0</STATUS>
        <KFN>Schraubstelle: 101_1</KFN>
        <STUFE>2</STUFE>
        <TOOL>687980</TOOL>
        <SPNR>1</SPNR>
        <PGNR>1</PGNR>
      </MERKMAL>
      <MERKMAL>
        <MM>Winkel</MM>
        <DIM>Grad</DIM>
        <SCALE>0</SCALE>
        <UG>300</UG>
        <OG>700</OG>
        <IST_NUM>600</IST_NUM>
        <SOLLWERT>600</SOLLWERT>
        <STATUS>0</STATUS>
        <KFN>Schraubstelle: 101_1</KFN>
        <STUFE>2</STUFE>
        <TOOL>687980</TOOL>
        <SPNR>1</SPNR>
        <PGNR>1</PGNR>
      </MERKMAL>
    </MONTAGE>
  </PLA>
</DOCUMENT>
```

NOK result

```
<?xml version="1.0" encoding="ISO-8859-1"?>
  <HEADER>
    <QUELLE>CPT: </QUELLE>
    <SENDETERMIN>06-06-2018 09:01:01</
    SENDETER-MIN>
  </HEADER>
  <PLA>
    <MONTAGE>
      <ID/>
      <STATION>Primary</STATION>
      <SCHRITT/>
      <MON_TYP>CPT</MON_TYP>
      <VERSION>S168813</VERSION>
      <GES_STATUS>NIO</GES_STATUS>
      <FEHLER>NIO in Einzelverschraubung</FEHLER>
      <STATION_DATUM_START>06-06-2018 09:00:59 </
      STATION_DATUM_START>
      <STATION_DATUM_ENDE>06-06-2018 09:01:01 </
      STATION_DATUM_ENDE>
      <MERKMAL>
        <MM>Drehmoment</MM>
        <DIM>Nm</DIM>
        <SCALE>1</SCALE>
        <UG>0.00</UG>
        <OG>13.50</OG>
        <IST_NUM>0.00</IST_NUM>
        <SOLLWERT>0.0</SOLLWERT>
        <STATUS>0</STATUS>
        <KFN>Schraubstelle: 101_1</KFN>
        <STUFE>1</STUFE>
        <TOOL>Duowei-01</TOOL>
        <SPNR>1</SPNR>
        <PGNR>1</PGNR>
      </MERKMAL>
      <MERKMAL>
        <MM>Drehmoment</MM>
        <DIM>Nm</DIM>
        <SCALE>1</SCALE>
        <SCHWELLENWERT>0.0</SCHWELLENWERT>
        <UG>-5.00</UG>
        <OG>11.0</OG>
        <IST_NUM>0.60</IST_NUM>
        <STATUS>122</STATUS>
        <FEHLER>SA</FEHLER>
        <KFN>Schraubstelle: 101_2</KFN>
        <STUFE>2</STUFE>
        <TOOL>Duowei-01</TOOL>
        <SPNR>1</SPNR>
        <PGNR>1</PGNR>
      </MERKMAL>
      <MERKMAL>
        <MM>Winkel</MM>
        <DIM>Grad</DIM>
        <SCALE>0</SCALE>
        <UG>300</UG>
        <OG>500</OG>
        <IST_NUM>299</IST_NUM>
        <SOLLWERT>360</SOLLWERT>
        <STATUS>122</STATUS>
        <FEHLER>SA</FEHLER>
        <KFN>Schraubstelle: 101_2</KFN>
        <STUFE>2</STUFE>
        <TOOL>Duowei-01</TOOL>
        <SPNR>1</SPNR>
        <PGNR>1</PGNR>
      </MERKMAL>
    </MONTAGE>
  </PLA>
</DOCUMENT>
```

Tag	Description
<DOCUMENT>	Contains all data of the file.
<HEADER>	Contains information about the created file.
<QUELLE>	Controller number The content consists of two parts: CPT: XXXX • CPT: fixed designation which cannot be changed • XXXX: Controller number, can be specified under *Navigator* > *Advanced* > *Controller* > *General* > *Number*.
<SENDETERMIN>	Date and time when the file was sent. Format: Day-Month-Year Hour:Minute:Second
<PLA>	Contains all result data.
<MONTAGE>	Sub group
<ID>	Workpiece number
<STATION>	Name of the tool group, can be defined under *Navigator* > *Communication* > *Data Transmission* > *Ethernet* > *XML/CSV* > *Activated*.
<SCHRITT>	Controller name, can be specified under *Navigator* > *Advanced* > *Controller* > *General* > *Name*.
<MON_TYP>	CPT: fixed designation which cannot be changed
<VERSION>	Software version
<GES_STATUS>	Overall result of all fastenings performed on a workpiece. The value is either OK or NOK.
<FEHLER>	Error reason for NOK rundown on the workpiece. This is only displayed if <GES_STATUS> is NOK. Possible errors:

<FEHLER>	Description
Abbruch durch TIMEOUT	Abort by TIMEOUT
Abbruch durch neues File	Abort by new file
Abbruch durch Werker	Abort by worker
Abbruch durch Handbetrieb	Abort by manual operation
NIO in Einzelverschraubung	NOK in single rundown
Abbruch durch APROG-Wechsel	Abort by APROG change
Abbruch durch Handeingabe	Abort by manual input
Abbruch durch neues File bei Ueber-nahme	Abort by new file on transfer
Abbruch durch gescannten Abbruch-code	Abort by scanned abort code
Unbekannter Fehler	Unknown error

<STATION_DATUM _ START>	Date and time when the rundown of the workpiece was started. Format: Day-Month-Year Hour:Minute:Second
<STATION_ DATUM_ENDE >	Date and time when the rundown of the workpiece was completed/cancelled. Format: Day-Month-Year Hour:Minute:Second
<Merkmal>	Contains the result of a rundown. There are separate characteristics for torque and angle results.
<MM>	Characteristic Type: Drehmoment (torque), Winkel (angle) or Gradient (gradient)
<DIM>	Dimension: Unit *Nm*, *Grad* (degree) or *Nm/Grad*, depends on the selected characteristic type.
<SCALE>	Specifies how many decimal places are displayed. This specification depends on the characteristic type: • Angle: 0 • Torque: 1 • Gradient: 2
<SCHWELLENWERT>	Threshold torque MS, start of angle counting

Tag	Description
<UG>	Lower limit of the set point
<OG>	Upper limit of the set point
<IST_NUM>	Actual value, measured result
<SOLLWERT>	Specification of the set point value, depends on the characteristic type
<STATUS>	Status of a characteristic, does not refer to overall result. 0: OK rundown Number that is not 0: NOK rundown, see below < FEHLER>
<FEHLER>	Error reason for NOK single rundown. This is only displayed if the <STATUS> is not 0. Dependent on the <STATUS> there are the following errors:

<STATUS>	<FEHLER>	Description
5	???	All causes not defined here
11	MD zu Gross	Torque too high
12	MD zu Klein	Torque too low
13	WI zu Gross	Angle too high
14	WI zu Klein	Angle too low
15	TMAX	Terminated by Max. time exceeded
33	Abbruch	Measuring card: other abort by master
121	NOT-AUS	Rundown aborted by emergency stop
122	SA	Terminated by take away start signal
123	FHW	Measuring board hardware fault

<KFN>	Tightening Position The content consists of three parts: Screw position: XXX_X • Tightening Position: fixed designation which cannot be changed • XXX: Fastener ID, can be specified under *Navigator* > *Advanced* > *Cycles* > *Fastener ID* • _X: consecutive number, is assigned automatically.
<STUFE>	Fastening stage The required level can be selected during export.
<TOOL>	Serial number of the tool
<SPNR>	Spindle number
<PGNR>	PG number

Data transfer as CSV file

- The file name (**.csv*) is generated from the file prefix defined in the network settings, the part number, and the current time stamp of the transmission.
- Individual values are separated by a semicolon (;).
- Each line of data is arranged in the sequence defined in the first line (header).
- The end of each line is marked by the character sequence <CR><LF>.

CSV-STD

Example file generated with the following settings:

- *transfer workpiece OK/NOK*,
- all *Stages* data transmission, and
- *1. barcode in linking sequence*.

```
Ident;Grp;SNR;Bearbeitet;Status;Werkstück;MdIst;WiIst;GdIst;MdMin;MdMax;WiMin;WiMax;GdMin;GdMax;Sp;Ta;Pg;Stufe;Dia;CRLF
MyVIN/MyFirstScanBarcodeStep;8;801;11-05-2016 14:46:12;IO;IO;0,10;0;0,00;0,0;0,0;0;0;0,00;0,00;8;1;4;1;11CRLF
MyVIN/MyFirstScanBarcodeStep;8;801;11-05-2016 14:46:12;IO;IO;0,10;180;0,00;-1,00;1,00;10;200;0,00;0,00;8;1;4;2;50CRLF
MyVIN/MyFirstScanBarcodeStep;8;802;11-05-2016 14:46:13;IO;IO;0,10;0;0,00;0,0;0,0;0;0;0,00;0,00;8;2;4;1;11CRLF
MyVIN/MyFirstScanBarcodeStep;8;802;11-05-2016 14:46:13;IO;IO;0,00;180;0,00;-1,00;1,00;10;200;0,00;0,00;8;2;4;2;50CRLF
MyVIN/MyFirstScanBarcodeStep;8;804;11-05-2016 14:47:17;IO;IO;0,10;0;0,00;0,0;0,0;0;0;0,00;0,00;8;3;4;1;11CRLF
MyVIN/MyFirstScanBarcodeStep;8;804;11-05-2016 14:47:17;IO;IO;0,00;180;0,00;-1,00;1,00;10;200;0,00;0,00;8;3;4;2;50CRLF
```

CSV-FR

Example file generated with the following settings:

- *Final* stage data transmission and
- *1. barcode in linking sequence*

```
1 N°VAN;Grp;Nom Position;Date;Statut Vissage;Couple;Angle;Gradient;Couple Min;Couple Max;Angle Min;Angle Max;Gradient Min;Gradie
2 xxVINxx/xxBARCODEx;8;801;11-05-2016 14:56:37;OK;0,00;180;0,00;-1,00;1,00;10;200;0,00;0,00;8;1;4;2;50CRLF
3 xxVINxx/xxBARCODEx;8;802;11-05-2016 14:56:48;OK;0,10;180;0,00;-1,00;1,00;10;200;0,00;0,00;8;2;4;2;50CRLF
4 xxVINxx/xxBARCODEx;8;804;11-05-2016 14:57:06;OK;0,00;180;0,00;-1,00;1,00;10;200;0,00;0,00;8;3;4;2;50CRLF
```

CSV-EN

Example file generated with the following settings:

- *Final* stage data transmission.

```
1 Ident;Grp;SNR;TimeStamp;Status;TQAct;ANAct;GDAact;TqMin;TqMax;AngMin;AngMax;GdMin;GdMax;Sp;Pos;App;Stage;Seq;CRLF
2 ABCdefGHIjkl;8;801;11-05-2016 15:03:02;IO;0,10;180;0,00;-1,00;1,00;10;200;0,00;0,00;8;1;4;2;50CRLF
3 ABCdefGHIjkl;8;802;11-05-2016 15:03:04;IO;0,00;180;0,00;-1,00;1,00;10;200;0,00;0,00;8;2;4;2;50CRLF
4 ABCdefGHIjkl;8;804;11-05-2016 15:03:22;IO;0,00;180;0,00;-1,00;1,00;10;200;0,00;0,00;8;3;4;2;50CRLF
```

10.3.9 IPM Protocol

IPM (Integrated Processdata Management) is a system to control, report, and analyze rundown data produced with the controller.

For detailed information on IPM Protocol and its telegrams, see the current version of the *IPM Specification*.

To configure IPM:

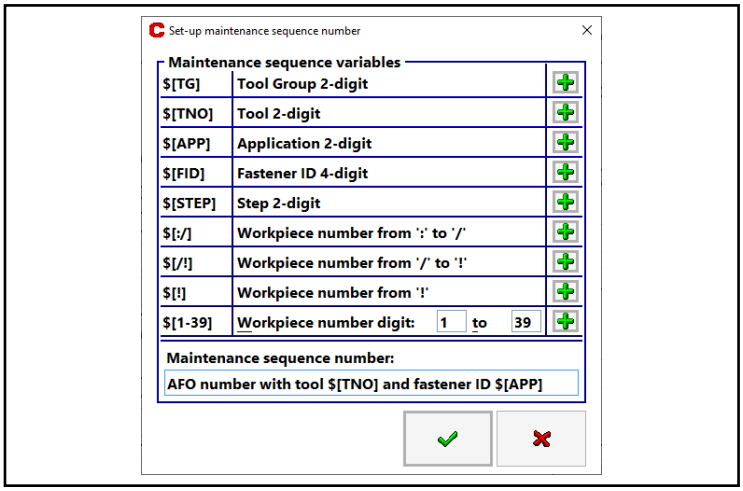
1. Tap the IPM entry in the Ethernet table to select it.
2. Tap the <Activated> checkbox.
   → The <Advanced> button is displayed, which provides access to additional controls.
3. Tap the <Advanced> button to open the *IPM advanced settings* dialog.
4. Contact your network administrator for required settings.

IPM advanced settings – General tab

Auf der Registerkarte Allgemein stehen folgende Steuerelemente zur Verfügung:

Control	Description
Protocol	Select an IPM version if the IPM server does not support the existing version. The controller supports the following versions: • 2.1 • 4.2.2 • 5.2.0
IP address, Port	Enter a valid IP address and the port number.
Send timeout (ms)	The waiting time indicates how many milliseconds elapse before the next IPM telegram is sent to the server. Large amounts of data (e.g. curve points) must be split into several packets when sending to avoid overloading the server. The minimum value is 10 ms (*Quick send*). If too much data for the server accumulates in the RAM archive of the controller, the controller automatically switches to *Quick send* mode. As soon as the amount of data in the RAM archive has decreased, the parameterized value is used again.
Ack Timeout (ms)	Defines the maximum time the controller takes to read out an incoming packet (live telegrams or acknowledgment from the server). After three timeouts, the controller is disconnected and tries to establish a connection again. Please contact your network administrator for the correct settings.
Source and Destination	Configures these fields in the IPM header. They can remain empty, if you do not need them. But IPM version 5.2.0 makes them mandatory, i.e., the server throws exceptions if these fields are empty.

<table>
<tr><th>Control</th><th>Description</th></tr>
<tr><td>Date/Time Snychroniza-tion</td><td>If the check box is activated, the IPM client synchronizes the system time of the controller with the system time of the IPM server based on IPM acknowl-edgment messages.
If there are other options available for automatic setting of the system time (e.g. NTP client or TorqueNet client), it is recommended to select one method and disable all others.</td></tr>
<tr><td>Error codes
Offset</td><td>To distinguish between general and provider-specific error codes. General error codes range from zero to 499, where 499 is the "unspecified" error code. If the error code is set to zero and an error occurs which cannot be described by a general error code, the value 499 is output.
If the offset is set to at least 500, the Apex-specific error codes that provide detailed error information start there.
The error code range for Apex-specific error codes must be defined cus-tomer-specifically. If no offset is defined for this, error 499 will occur for these errors. The apex-specific error codes are:
<table>
<tr><th>Error code</th><th>Description</th><th>Error code</th><th>Description</th></tr>
<tr><td>Offset + 0</td><td>Redundant measure-ment NOK</td><td>Offset + 18</td><td>Torque M1 error</td></tr>
<tr><td>Offset + 1</td><td>Error communicating with the tool</td><td>Offset + 19</td><td>Torque M2 error</td></tr>
<tr><td>Offset + 2</td><td>Servo error</td><td>Offset + 20</td><td>Without evaluation</td></tr>
<tr><td>Offset + 3</td><td>Tool incorrectly con-figured</td><td>Offset + 21</td><td>Tool not ready</td></tr>
<tr><td>Offset + 4</td><td>External abort</td><td>Offset + 22</td><td>Screw or nut broke</td></tr>
<tr><td>Offset + 5</td><td>Problem with trans-ducer 1</td><td>Offset + 23</td><td>Shut off by depth sen-sor</td></tr>
<tr><td>Offset + 6</td><td>Problem with trans-ducer 2</td><td>Offset + 24</td><td>Time since threshold error</td></tr>
<tr><td>Offset + 7</td><td>RAM overflow or emergency off</td><td>Offset + 25</td><td>Nut slid from bolt</td></tr>
<tr><td>Offset + 8</td><td>Too few values in RAM</td><td>Offset + 26</td><td>"GARE" – Gyroscope acceleration exceeded</td></tr>
<tr><td>Offset + 9</td><td>Error communicating with measuring board</td><td>Offset + 27</td><td>"GAL1" – Gyroscope Alarm 1</td></tr>
<tr><td>Offset + 10</td><td>Error in torque/angle processor</td><td>Offset + 28</td><td>"GAL2" – Gyroscope Alarm 2</td></tr>
<tr><td>Offset + 11</td><td>No results</td><td>Offset + 29</td><td>"DTF " – Error lower-ing torque</td></tr>
<tr><td>Offset + 12</td><td>Error in rundown</td><td>Offset + 30</td><td>Clamping force too small</td></tr>
<tr><td>Offset + 13</td><td>Error on the measur-ing board</td><td>Offset + 31</td><td>Clamping force too high</td></tr>
<tr><td>Offset + 14</td><td>FRTM error</td><td>Offset + 32</td><td>"DBL " – rundown within dead time (GWK, I-Wrench)</td></tr>
<tr><td>Offset + 15</td><td>Snug point detection error</td><td>Offset + 33</td><td>"AR> " – angle rate too high (I-Wrench)</td></tr>
<tr><td>Offset + 16</td><td>DTM error</td><td>Offset + 34</td><td>"WREX" – Wrong tool head used (I-Wrench)</td></tr>
<tr><td>Offset + 17</td><td>Evaluation moment error</td><td>Offset + 35</td><td>"ZNIO" – Forced NIO</td></tr>
</table></td></tr>
<tr><td>Always transmit shut-off stage on NOK (indepen-dent of Transmission Set-tings)</td><td>If the checkbox is activated, the data from the last executed stage is trans-mitted if an action is NIO. The transmission always takes place, regardless of the cause of the NOK and regardless of whether this stage has been set for transmission in the Transmission Settings tab.</td></tr>
</table>

Control	Description
Send Gradient target value	If the checkbox is activated, the configured gradient set point is sent. This only applies to IPM telegrams that describe diagrams with gradient switch-off value. Select from which data the AFO number is to be composed.
Maintenance sequence number type	Select the data of which the AFO number should be composed. The following types are available: • **Default: Tool No. And App in appendix** The AFO number consists of: - the parameterized text of the field *Equipment Identifier for Maintenance Sequence* - the screwed tool number (2 digits) - the screwed application (2 digits) The tool number and product group are sent during transmission, separated from the system ID and from each other by a hyphen • **AFO programmable per application** If execution AFO programmable per application is activated, the Maintenance sequence tab is displayed. Here, maintenance sequences and AFO texts can be assigned to each application group with the button <Edit>. As soon as at least one stage in a application is selected for transmission, the corresponding maintenance sequence must be parameterized. If version *AFO programmable per application* is not activated, the AFO text can be defined per application in the *Transmission Settings* tab. • **Text and Variables combination** In this type, the AFO number can be configured dynamically throughout the entire system with a text and additional variables. 1. To configure the AFO number, press the button <Set-up maintenance sequence number>. → The following dialog opens, with which the AFO number is dynamically composed via fixed text and additional variables after each rundown  *Fig. 10-8: Set-up maintenance sequence number* 2. Enter a text in the *Maintenance sequence number* input field or insert variables with the buttons <+>. The existing variables ($[fixed text]) are replaced by corresponding values of the rundown when the AFO user data is transmitted. It is possible to transmit the separators ':', '/' or '!' as well as character ranges in the workpiece number, e.g. in the variant scan.
Equipment Identifier for Maintenance Sequence	Configures the first part of the AFO number.

Control	Description
Event Number	Configures the event number field in IPM telegrams.
Workpiece number filter from digit x to y	If this is active, the workpiece number is only transmitted in the set character range.

IPM advanced settings – Transmission Settings tab

This dialog allows you to configure whether execution of particular stages is sent.

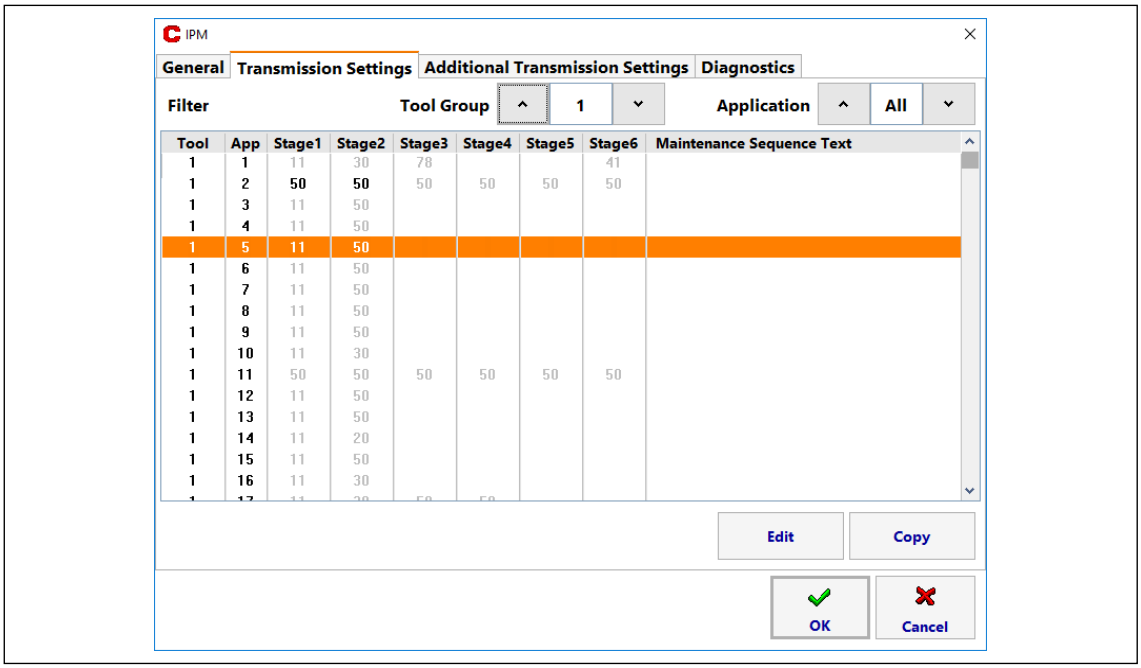


Fig. 10-9: IPM advanced settings – Transmission Settings tab

To select the stages to be sent:

1. Select the Tool Group and Application for which you want to send stages.
2. Tap the entry for the required Tool and Application in the *Filter* table to select it.
3. Tap the <Edit> button to open the *Filter* dialog.

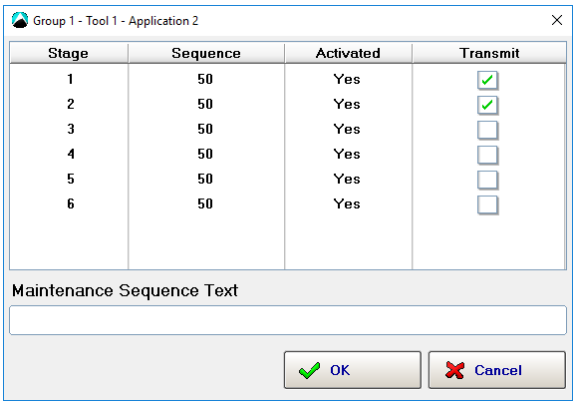


Fig. 10-10: IPM advanced settings – Transmission Settings tab – Filter dialog

4. Tap the *Transmit* checkbox for the stages you want to transmit.
   In the *Stage* table of the *Filter* dialog, each table entry lists the fastening sequence and activation status set for this stage in the *Standard Application Builder*. If you used the *Basic Application Builder*, two stages are activated. You typically just want to transmit data on the final stage, but you can also select multiple stages.
5. Tap the *Maintenance Sequence Text* input box to display the virtual keypad
6. Enter the text to be sent when the application is run.

7. Tap the <OK> button to confirm your settings and close the *Filter* dialog.

To transfer your Transmission Settings to another Tool and Application:

1. On the Transmission Settings tab, tap the Filter table entry of the settings you want to transfer.
2. Tap the <Copy> button to open the *Copy* dialog.
3. Ensure that the correct Source Tool and Application are displayed, and enter the Target Tool and Application.
4. Tap the <OK> button to confirm your settings and close the *Copy* dialog.

IPM advanced settings – Additional Transmission Settings

The settings on the *Additional Transmission Settings* tab apply to all stages. The following controls are available:

Control	Description
AFO parameters from TPS	There is a comment field for each global Linking group of the TPS Server. If the check box is activated, the AFO texts of the IPM are filled in with the comments from the TPS server after a rundown. If a comment contains special characters that occupy several bytes (e.g. ä, ö, ü, ß, or Chinese characters), it is possible that the AFO text is not completely displayed in the IPM. Exception: If the *AFO programmable per apllication* option is selected in the *General* tab, the AFO text is filled with the global Linking group name of the TPS if this check box is activated.
Transmit All Stages	If the checkbox is activated, all Linking groups of all tool groups are transferred to the IPM.

IPM advanced settings – Diagnostics tab

The following controls are available on the *Diagnostics* tab:

Control	Description
SysLog messages	Enables a syslog server configured in *Navigator* > *Advanced* > *Controller* > *Miscellaneous* to receive messages regarding IPM. Note that no message buffering occurs. If this option is not active, no log messages are generated. Activating it will not let you see past messages, only future ones.
Log telegrams	Makes the IPM client save all telegrams to be sent to the SD card, irrespective of whether they were actually sent. If you only want to see the telegrams that were actually sent, check *Navigator* > *Diagnostics* > *System* > *Data Transmission* > *IPM_TCP*. The telegrams are usually saved to the SD card *path /x0/ipmsave*.
Export SysLog and telegrams	Allows you to save the syslog, the traces saved with *Log telegrams*, and the packets waiting to be sent to a USB stick.
Records in buffer	The buffer counters reflect the state for the RAM archive. If the IPM connection is disrupted, the archive entry is buffered. If there is no disruption, these buffer counters should always be equal. This process runs entirely in the background. Once the HD archive is full (SD card full), new entries overwrite old ones. The two buttons below the <Reset buffer counter> button are only enabled when the buffer counters are equal: • <Send buffered data> preserves it. But since it is a ring buffer, the proper order of these packets is not guaranteed. • <Delete buffered data> may be needed when storage is full. In a typical setup, the packets waiting to be sent are on the same drive as the system log files, the traced IPM packets, and the HD archive.

10.4 Part ID

The Part ID tab allows you to specify the interface and functionality of the scan function on the controller and tools. You can set a separate scanner source for each tool group or completely disable the scan function.

The following three barcode types are supported by the controller software:

Barcode type	Description
VIN	The VIN is the superior barcode used in most cases as the Vehicle identifier. The other barcode types cannot be used if VIN is not active. The VIN can be used with Linking or Application mode and can be defined as a 'Function barcode'. Scanning of a Function barcode causes some action on the controller to be executed, e.g., automatic selection of Linking Group or Application or unlocking of the Tool Group.
Part ID	The Part ID can be set as the first scan step in a Linking Group and as a subordinate barcode of the VIN for starting a workpiece. Correct scanning causes the Linking Group to proceed with the next Linking Step. In most cases, the Part ID is used as a Part identifier.
Barcode	The Barcode is also a subordinate barcode of the VIN and can be set as a scan step several times in a Linking Group, e.g., for using scans to separate Applications used on a workpiece. Correct scanning causes the Linking Group to proceed with the next Linking Step.

In a single Tool Group, only one scanner source can be set as a barcode reader and is activated for all barcode types used.

The following options to enter Part IDs are available:
- enter manually on the *Run Screen* by using the virtual keypad or a keyboard,
- scan using a barcode reader attached to a serial port,
- using the barcode reader on the tool, or
- transmitted through a fieldbus.

A Part ID may consist of any sequence of alphanumeric characters, including spaces.

10.4.1 Part ID settings

In the *Settings* section, the following options are available for the part ID:

Control	Description
Tool Group	Allows you to select the required Tool Group from a drop-down menu.
Activated	Defines the level of functionality of the Part ID. • *No*: The Part ID interface is completely disabled. No VIN information is present on the *Run Screen*. • *Yes*: The Part ID interface is enabled and is present on the *Run Screen*. A valid VIN is not required to run the tool. Following a rundown, the VIN is archived with the rundown data. The entered VIN will not be automatically cleared. • *Yes, interlocked*: The Part ID interface is enabled and is present on the *Run Screen*. A valid VIN is required to run the tool. Following a rundown, the VIN is archived with the rundown data. Following either a good rundown (linking disabled) or good linking sequence (linking enabled), the VIN is invalidated and the tool is disabled.

Control	Description
Part ID Source	Defines the source of the barcode reader. • *None*: No source is selected. • *Serial*: One serial port is used for a serial scanner. • *Fieldbus*: The input source for the barcode is set to a byte area reserved by the currently installed fieldbus. • *Protocol*: The barcode is updated by a protocol message, e.g., Open Protocol. • *Key Input Only*: The barcode has to be input manually via keyboard on the *Run Screen*. • *Tool scanner*: This option is only available if a tool scanner is installed on the tool. If a barcode is required to start a rundown, the barcode scanner is activated when the start button is pressed. Once the barcode has been read successfully, pressing the start button again starts the fastening sequence.
Number of Chars	Defines the length of the VIN, not including any termination characters which may be sent by the barcode reader. • 0: All barcodes are accepted without bounds checking. • 1 to 40 are valid values: Only barcodes of this length are accepted.
Keypad Entry	Defines whether a barcode can be entered manually or not. • *Allowed*: The barcode can be entered manually by tapping the Part ID input box on the *Run Screen* and using the virtual keypad or an attached keyboard. • *Disallowed*: The barcode cannot be entered manually from the *Run Screen.*
Special Function	Allows automatic control of tool functionality based on the VIN. You can program special functions in the *Workpiece administration* dialog. • *Deactivated*: Disables *Workpiece administration*. The VIN has no control over tool functionality. When you select the *Disabled* option, you do not lose programmed functions. • *Activated*: Enables *Workpiece administration*. All programmed functions are used for the current Tool Group. When you select the *Enabled* option, the <Configure> button is displayed at the bottom of the Part ID tab and provides access to the *Workpiece administration* dialog.
<Advanced Serial Settings>	Defines the serial COM port to be used and its settings. Changes affect serial data transmission settings. See the *Serial Protocols* section. This button is only displayed when *Serial* is selected as *Part ID Source*.
<Configure>	Opens the *Workpiece administration* dialog. This button is only available if *Special Function* (see above) is enabled.
Scanner prefix	Allows you to program a 4-digit prefix for the Tool Group selected. This prefix has to be part of the scanned barcode and is applicable to this Tool Group. You may need this option if multiple Tool Groups use the same scanner source.
Ignore unexpected barcodes	Prevents cancellation of the current workpiece when another barcode is scanned while the workpiece is being processed.

The *Barcode History* section provides the following options for saving scanned barcodes:

Control	Description
Count	Saves the scanned barcodes. You can set a `Count` that defines how many scans have to occur before the same barcode is accepted again. Set the *Count* to zero to disable this option.
Accept same barcode after NOK	Always accepts a scanned barcode for an NOK workpiece even if *Barcode History Count* is set.

In the *Define Barcode* section, the following options are available for setting barcodes for release:

Control	Description
Selection	The selection defines barcode areas or positions that must match the workpiece type in the *Workpiece administration* dialog (see 10.4.3 Workpiece administration, page 150) to release the associated job. The following selection options are available: • *None*: There is no restriction on the bar codes used. • *Area*: The scanned bar code must match the workpiece type within a defined range. See *Select Area*. • *Position*: Der The scanned barcode must match the workpiece type at defined positions. See *Barcode – Select Position*.
<Configure>	Opens the dialog *Select area* or *Select position* to define a barcode area or positions.

10.4.2 Select Area

The *Select Area* feature allows you to split an incoming barcode into up to 10 parts. If an incoming barcode matches a user-defined pattern, the data is automatically split into corresponding parts. The first part is always named No. 1 and used as workpiece identifier (ID). The other parts are named consecutively starting with No. 2. Each part may have up to 39 characters. The entire barcode may have up to 104 characters.

Scan steps are not supported with the *Select Area* feature.

To enable *Select Area* and define a pattern:

1. Select *Navigator* > *Communication* > *Part-ID*.
2. Select the required *Tool Group* from the drop-down menu.
3. Select the *Yes* or *Yes, interlocked* option from the *Activated* drop-down menu.
   → The *Define Barcode* controls are displayed in the lower right corner.
4. Select the *Area* entry under *Selection*..
5. Tab the <Configure> button to open the *Select Area* dialog.
6. Enter the required pattern in the table.

The table lists all parts to be split off the barcode. Each table row represents one barcode part. The parts are numbered consecutively. The *Split barcode* table has the following columns:

Column	Description
No.	Displays the consecutive number assigned to the barcode part represented by this table row. ▶ -No. 1 is used as workpiece identifier.
Start	Defines the beginning of this barcode part. The number indicates where the first character of this part is located within the barcode. Example: If you enter '10', this barcode part begins with the 10th character of the barcode.
Length	Sets the number of characters to be read into this barcode part.
Scan code mask	• Defines characters to be matched at specific positions of this barcode part. • The hash character (#) matches any character.

The *Select Area* dialog has the following button controls:

Button	Description
	<Add> adds an empty row at the end of the table.
	<Move up> moves the currently selected table row up one position.
	<Move down> moves the currently selected table row down one position.
	<Remove> deletes the currently selected table row/ barcode part.

Barcode – Select Position

1. Select *Navigator* > *Communication* > *Part-ID.*
2. Select the required *Tool Group* from the drop-down menu.
3. Select the *Yes* or *Yes, interlocked* option from the *Activated* drop-down menu.
   → The *Define Barcode* controls are displayed in the lower right corner.
4. Select the *Position* entry under *Selection*.
5. Select <Configure> to open the *Select position* dialog.
   In the selection fields the character positions of the barcode are displayed. The barcode may only have as many characters as there are positions available. The number of available positions depends on the setting under *Communication* > *Part ID* > *Part ID Source*. If *Protocol* is selected, 100 positions are available for selecting the workpiece number and the job. For all other part ID sources, there are only 39 choices.

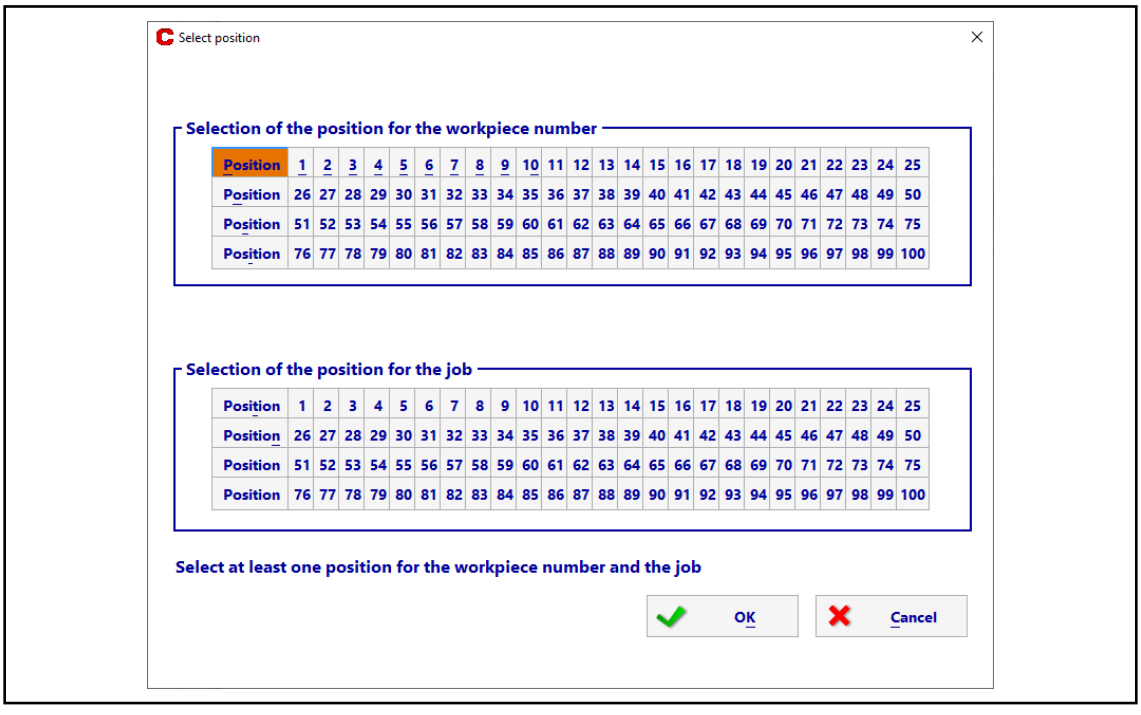


Fig. 10-11: Option to select the positions for the workpiece number and the job

6. In area *Selection of the position for the workpiece number*, select the character positions that are relevant for the part number. Up to 39 positions can be selected. The selected positions are displayed in green.
   The workpiece number is stored in the archive.

7. In area *Selection of the position for the job*, select the character positions that are relevant for the job number. Up to 32 positions can be selected. The selected positions are displayed in green.
   The job number can be displayed in the archive. Under *Archive* > *Details* > *F6 key* it is possible to call up the job number in XML format.

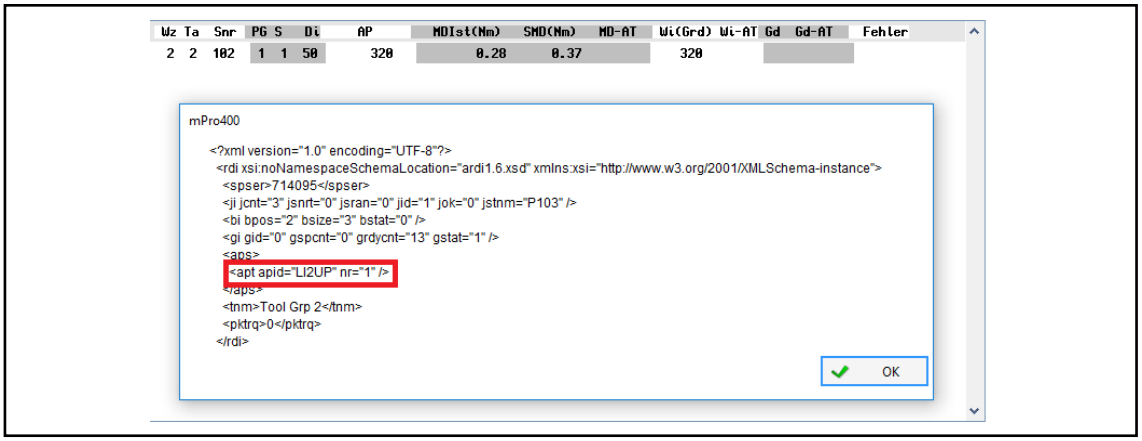


Fig. 10-12: Job number in XML format

10.4.3 Workpiece administration

The Workpiece administration allows you to program barcode masks that control Tool Groups, e.g., a barcode mask that selects a particular Linking Group when the scanned barcode matches the mask.

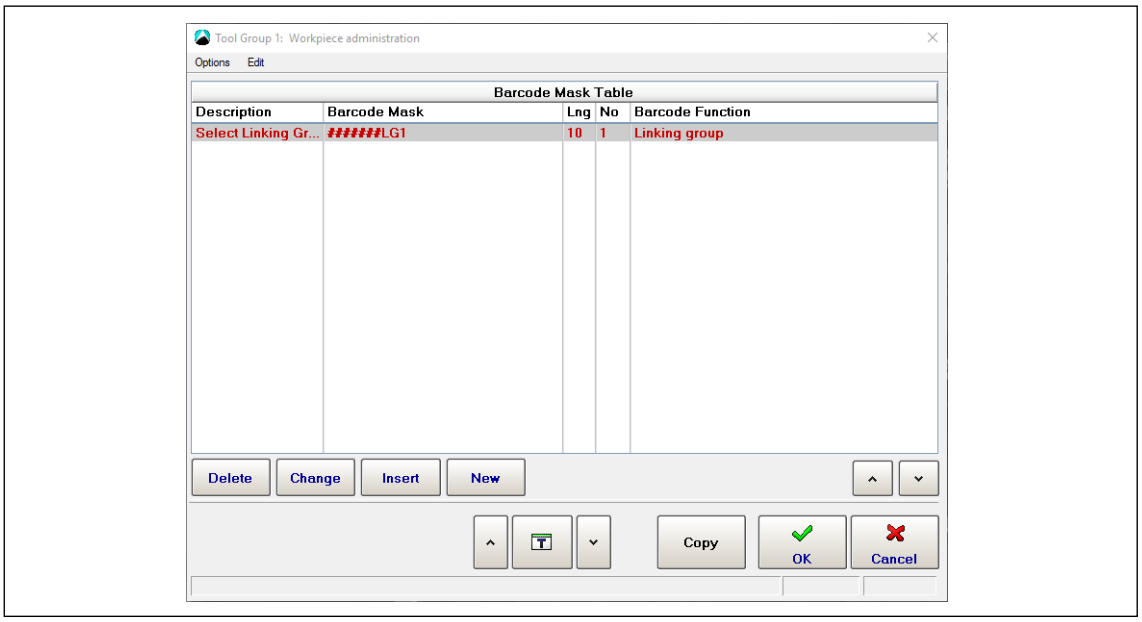


Fig. 10-13: Workpiece administration

To access Workpiece administration:

1. Select *Communications* > *Part ID*.
2. Select the required Tool Group from the drop-down menu, and enable Part IDs for this Tool Group.
3. Select the *Enabled* option from the *Special Function* drop-down menu.
   → The <Configure> button is displayed.
4. Tap the <Configure> button to open the *Workpiece administration* dialog.

The <Delete> and <Change> buttons (and *Edit* menu options) of the *Workpiece administration* dialog only affect the *Barcode Mask* which is highlighted red in the *Barcode Mask Table*.

The following controls allow you to navigate Workpiece administration:

Control	Description
	The <Up> and <Down> arrow buttons just below the *Barcode Mask Table* allow you to step through the table and select a barcode mask.
	The <Up> and <Down> arrow buttons at the bottom of the dialog allow you to select a different Tool Group and display its barcode masks in the *Barcode Mask Table*.
	The <Copy> button opens the *Copy* dialog, which allows you to copy the current barcode mask to a different Tool Group.

Programming a Barcode Function

To program a new Barcode Function:

▶ Tap the <Insert> button to open the *Edit workpiece* dialog.

The *Edit workpiece* dialog provides access to the following controls:

Control	Description
Workpiece Description	Defines an identifier for the programmed barcode mask. Tap the input box to display the virtual keypad. The identifier is limited to 32 characters.
Barcode Mask	Defines the barcode mask for which you want to program the data function. Tap the input box to display the virtual keypad. The mask is limited to 32 alphanumeric characters. Use hash characters (#) to define don't-care terms. When the software compares an actual barcode to a barcode mask, the sections of the barcode that are represented by hash characters in the mask are not considered.
Barcode Function • Use Application X (1-99) • Use Linking Group X (1-99) • Tool Enable	Selects the action triggered when an actual barcode matches the barcode mask. The following options are available in the drop-down menu: Automatically select the application specified in the *Application* input box below the *Barcode Function* drop-down menu. Automatically select the linking group specified in the *Linking group* input box below the *Barcode Function* drop-down menu. Enable the selected tool when barcode is scanned.
• Tool Disable	Disable the selected tool when barcode is scanned.

10.5 Network Settings

The Network settings tab allows you to configure how the controller communicates over a network.

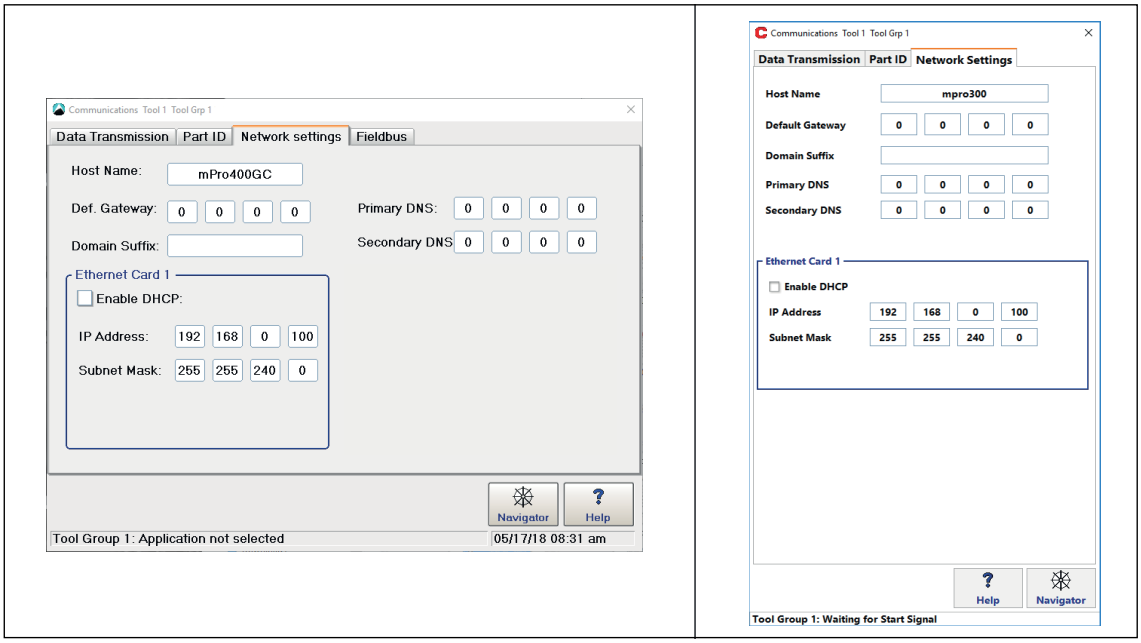


Fig. 10-14: Network settings

The controller is equipped with one Ethernet card.

Contact your network administrator for required settings.

10.6 Custom fieldbus protocols

The *Fieldbus* tab of the *Communications* dialog provides predefined controller configurations for custom fieldbus protocols.

Note that activation of a predefined configuration causes changes in software settings, e.g., Byte Area, Programmable I/0 Level, Advanced Controller, and Tool settings.

Deactivation will not restore previous settings that existed prior to activation!

The following pre-configurations for fieldbus protocols are available:

Fieldbus Protocols	Description
None	No pre-configuration active (default)
GMCC	See chapter 10.6.1 GMCC Protocol (GM Common Controller: GM Final Assembly Plants only), page 153.
Trasys	See chapter 10.6.2 Trasys Protocol, page 155.

10.6.1 GMCC Protocol (GM Common Controller: GM Final Assembly Plants only)

See the GMCC specifications for detailed information on the GMCC protocol. This document only covers the controller settings required for communication with the GMCC protocol.

To access GMCC controller settings:

1. Select *Navigator* > *Communications* > *Fieldbus*.
2. Select the *GMCC* option from the *Protocol* drop-down menu to display the *Module* drop-down menu. GMCC is operable with the following fieldbus options:
   - DeviceNet
   - Ethernet IP
   - Modbus TCP/IP
3. Select the required fieldbus *Module* option to display the <Advanced Settings> button.
4. Tap the <Advanced Settings> button to open the GMCC *Advanced Settings* dialog.

GMCC Advanced Settings

The *GMCC Advanced Settings* tab provides access to the following controls:

Control	Description
Baudrate	Select the baud rate for DeviceNet. The *Baudrate* drop-down menu is only enabled if the DeviceNet fieldbus module is selected. Current baud rates are available: • 125K • 250K • 500K
Input Packet Size	Set the size of the controller's input telegram format. GMCC supports 4- and 8-byte data packets from PLC Outputs to mPro Inputs.
Output Packet Size	Set the size of the controller's outgoing telegram format. GMCC supports 4- and 8-byte data packets from mPro Outputs to PLC Inputs.
PartID Mode	The PLC sends a 32-bit field at the end of the telegram for interpreting GMCC to the controller, either a 9-digit or a 8 long hexadecimal bar code.
Mode	The transfer mode of the GMCC outputs status can be configured as acknowledgment or dwell-based:
• ACKNOWLEDGED	GMCC status outputs drop and have to wait for a new status update when a status acknowledgment is received.
• DWELL	GMCC status outputs drop and have to wait for a new status update when a set dwell time has expired.
Dwell time	Outputs must have a 500-ms transition from ON/OFF states to allow for sufficient dwell time for PLCs to scan/read the change of state of all inputs. The default value is 500 ms. Programmable from 500 ms to 999 ms.

Control	Description
Node Adress	Enter a valid fieldbus node address. The valid address range is 1 to 63.
Slot Address	Enter a valid fieldbus slot address. Valid addresses are either 4 or 5.

GMCC Input/Output signals

The GMCC Inputs/Outputs tab allows you to program GMCC input and output signals. When you enable signals on this tab, they are applied to *Programmable I/O Mapping*.

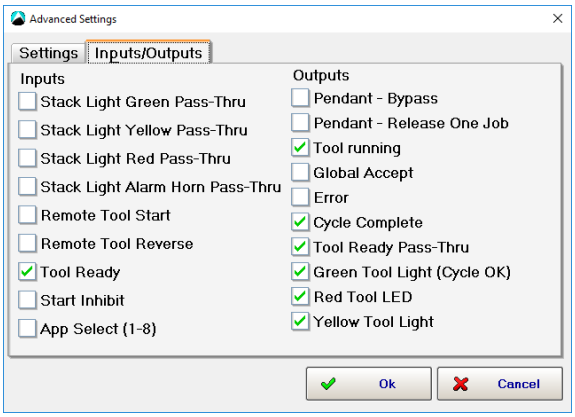


Fig. 10-15: GMCC Input/Output signals

GMCC Fieldbus Network settings

▶ Enter a valid *IP Address*, *SubNet Mask*, and *Gateway* to connect to an Ethernet IP or Modbus TCP/IP fieldbus module.

GMCC default settings on activation

When you enable GMCC, the available configuration of fieldbus, input, and output settings is automatically applied to *Programmable I/O Mapping*.

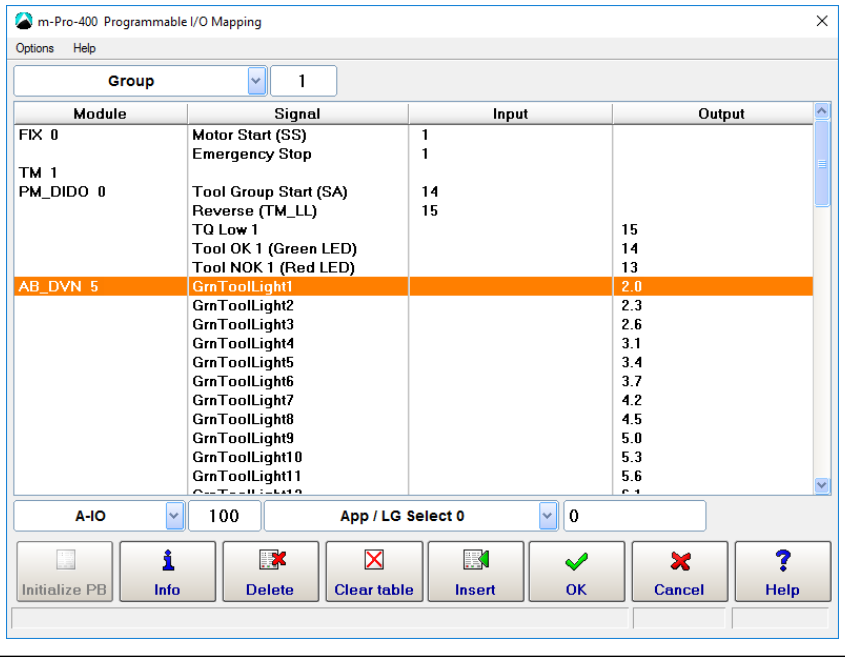


Fig. 10-16: GMCC – Programmable I/O Mapping

Note that all I/Os remain active when you disable GMCC. You have to remove obsolete I/Os manually.

10.6.2 Trasys Protocol

See the Trasys specifications for detailed information on the Trasys protocol. This document only covers the controller settings required for communication with the Trasys protocol.

To access Trasys controller settings:

1. Select *Navigator* > *Communications* > *Fieldbus*.
2. Select the *Trasys* option from the Protocol drop-down menu to display the *Timeout (s)* control.
3. Set the *Timeout* period for the live signal to the PLC (1 s to 20 s).

The PLC sends Trasys protocol telegrams that contain data for commands (e.g., tool enable, select application, new keep alive) to the controller. If the controller receives an invalid keep-alive from the PLC or if keep-alive times out, it automatically switches to *Manual mode* with Application 1 selected, Tool Group unlocked, and the two output signals *Pass Through Out 1* and *Pass Through Out 2* clocking. When keep-alive gets synchronized again, the controller switches back, out of Manual mode and waits for further commands from the PLC.

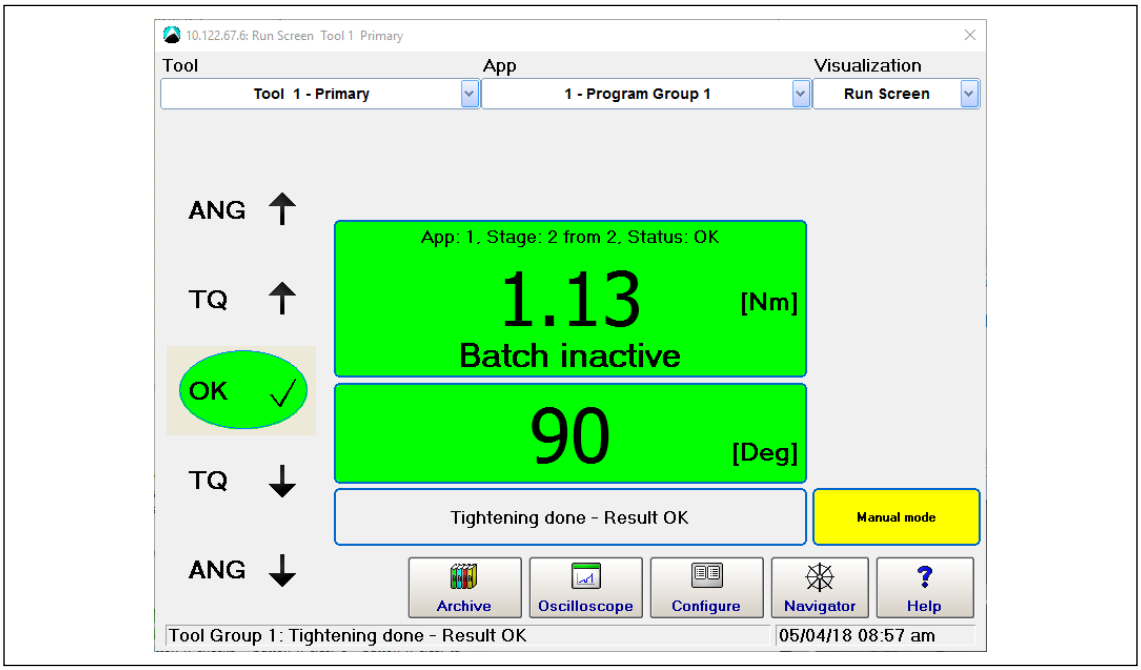


Fig. 10-17: Trasys keep-alive timed out

Trasys protocol fieldbus configuration

To set up Trasys protocol on the controller:

1. Select *Navigator* > *Tool Setup* > *I/O*.
2. Password required?
3. Set the signals *Pass Through Out 1-4* in the *Programmable I/O Mapping*.
   These outputs can be freely configured. The most common application is to map them to the 24 V I/Os on the controller (PM_DIDO 0).

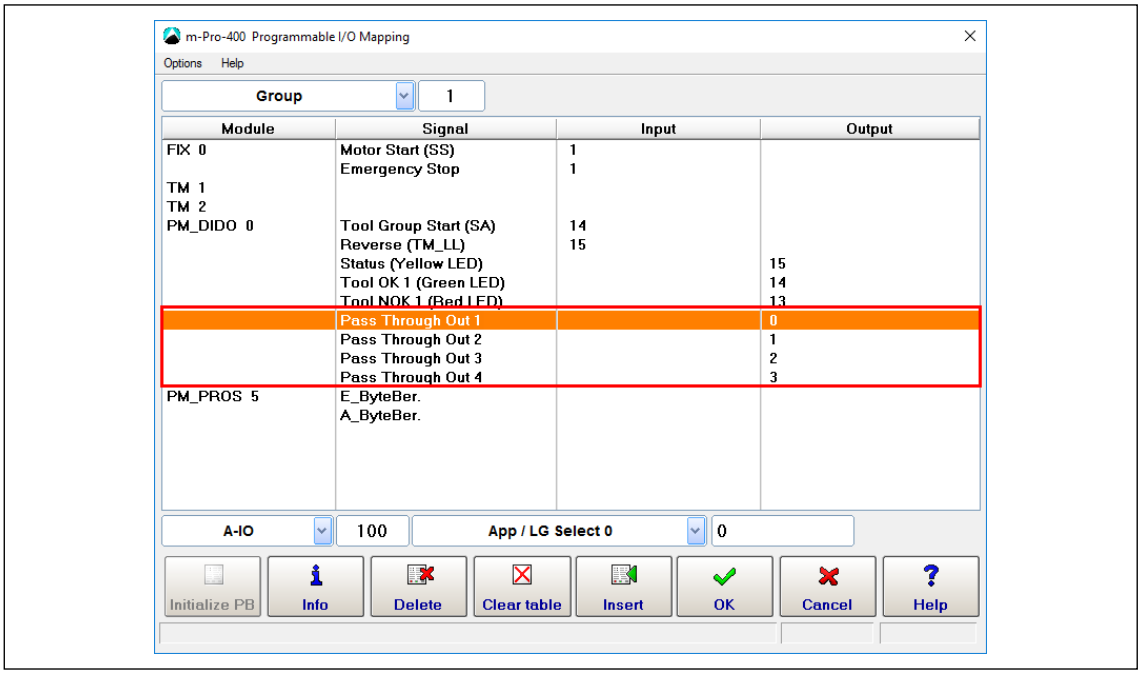


Fig. 10-18: Trasys - Set up Programmable I/O's

Setting up the Profibus communication area

To define byte areas:

1. Select the *Byte Area* option from the *Options* menu of the *Programmable I/O Mapping* dialog to open the *Definitions for Byte Areas* dialog.
   The ARCNet ID is the slot number in which the module is installed.
2. Set up the *Trasys read* and *Trasys write* functions.

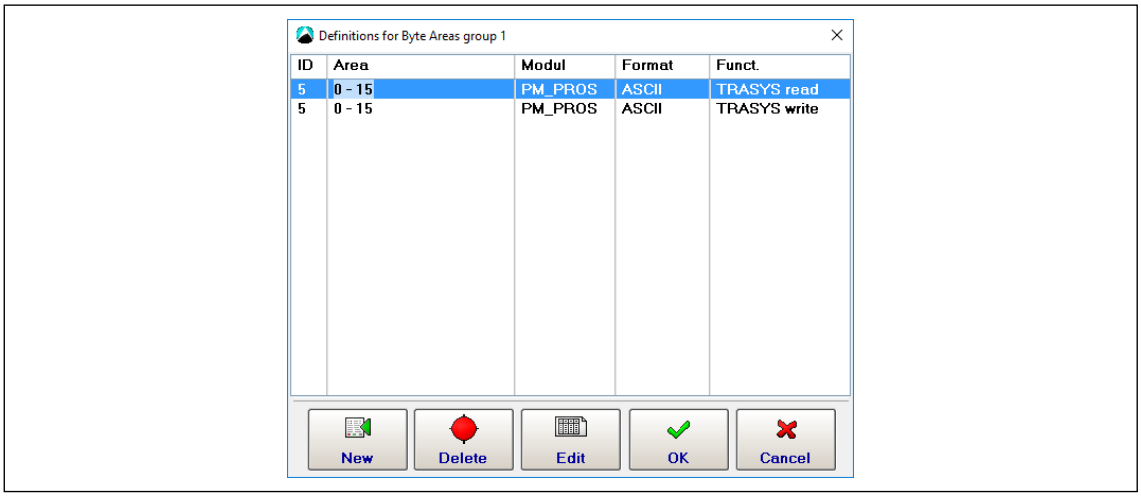


Fig. 10-19: Trasys - Set up byte area

3. Initialize the Profibus with the correct Profibus address and with 16 inputs and 16 outputs with consistency active.

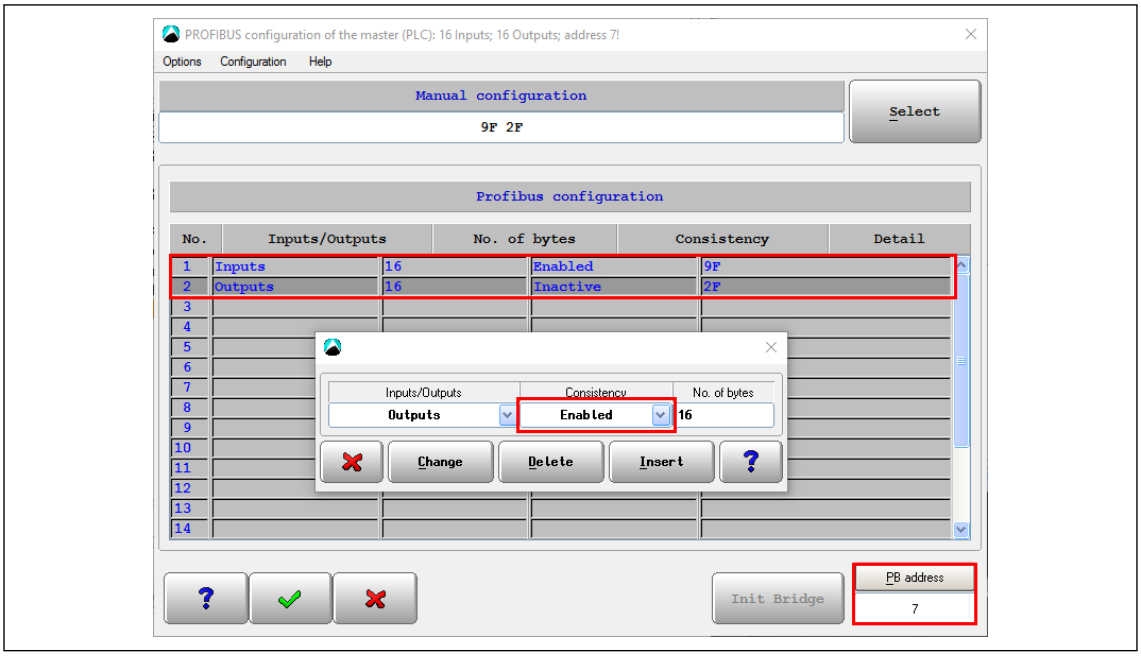


Fig. 10-20: Trasys - Profibus configuration

Trasys protocol default settings

Some settings are required for accepting the external signals from the Trasys protocol. These are set automatically when the Trasys protocol is activated.

The following Advanced Tool I/O options are automatically set:

▶ Select *Navigator* > *Advanced* > *Tool Group* > *I/O*.

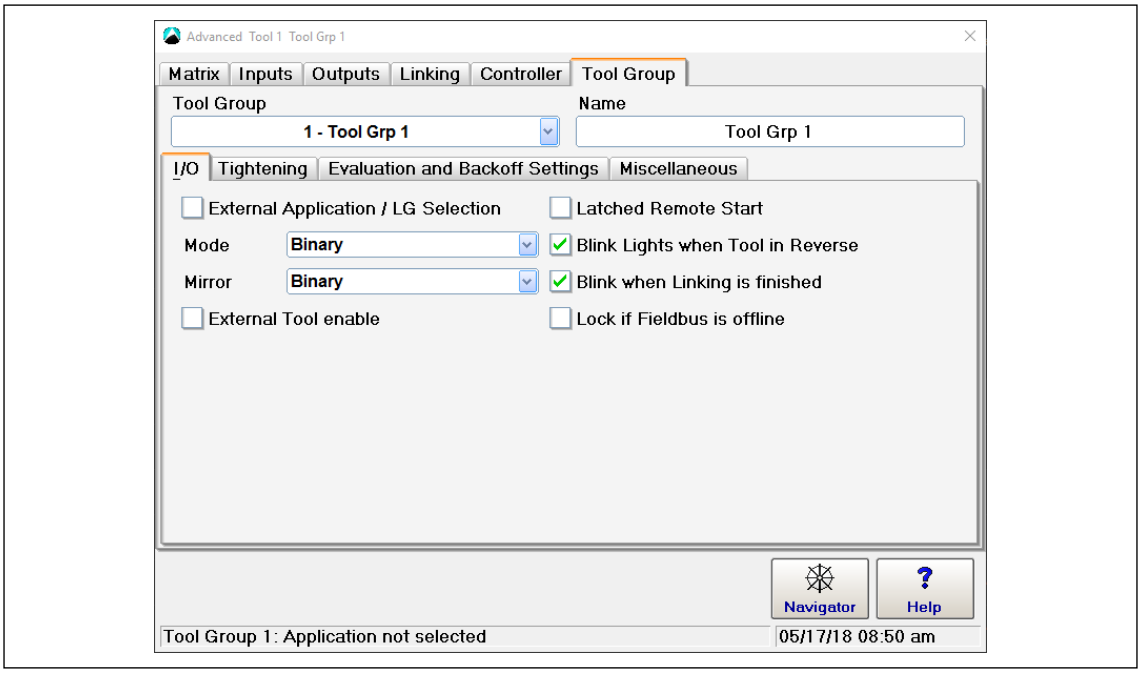


Fig. 10-21: Trasys - Advanced Tool I/O settings

- The *External Application / LG Selection* option is active with both Mode and Mirror set to *Binary*.
  - This must be enabled for the controller to read the application from Trasys.
  - This must be disabled to make changes.
- The *External Tool enable* option is active.
  - This must be enabled for the tool to be locked/unlocked via Trasys.
  - This must be disabled to make changes.

The following Advanced Tool Tightening options are automatically set:

▶ Select *Navigator* > *Advanced* > *Tool Group* > *Tightening*.

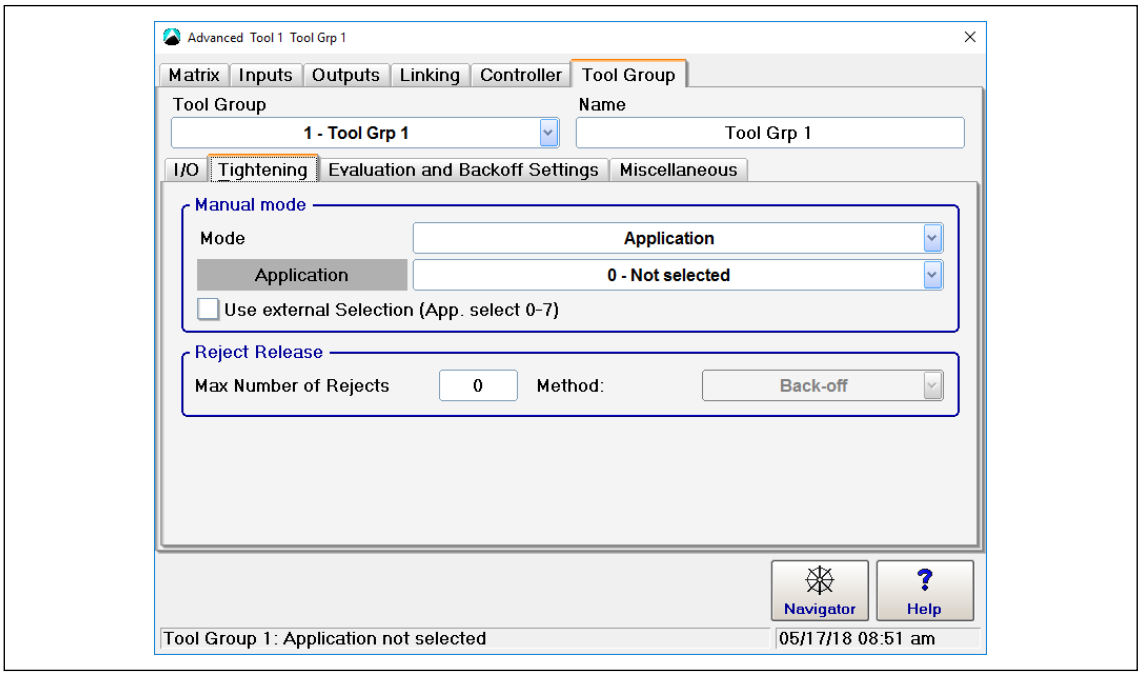


Fig. 10-22: Trasys - Advanced Tool Tightening settings

To use the emergency application:

▶ Activate the *Use external Selection (App. select 0-7)* option in the *Manual mode* section of the Tightening tab.
→ *Application Nr. 1* is automatically active.

To set a different Application Nr.:

1. Deactivate the *Use external Selection (App. select 0-7)* option.
2. Select the required application.
3. Activate the *Use external Selection (App. select 0-7)*option again once the required application is selected.
   You can only change the application if the controller is not in Manual mode. To change the application, the PLC must be connected to the controller.

To suppress results with SA error, you can set a threshold torque:

▶ Select the *No evaluation* option in the *If trigger released before final stage* drop-down menu.
Keep in mind that at least 2 stages must be configured for an application for this option to take effect.

All these options remain active when the Trasys protocol is deactivated. You can then edit disabled options.

10.7 Tightening Parameter Server (TPS)

TPS allows you to manage fastening applications on a remote server and use an Open Protocol client (MES) to control fastening processes. TPS communicates with the Global Controller using Open Protocol telegram exchange.

This section describes how to activate TPS on the Global Controller. The *TPS 1.0 Web Application* manual provides additional information on how to work with TPS and the TPS web application.

The main tasks of the MES are to:

- Download the global application from the TPS server.
- Select the application on the Global Controller.
- Make the current tool vor tool group ready for rundowns.

TPS communication uses the following Open Protocol MIDs:

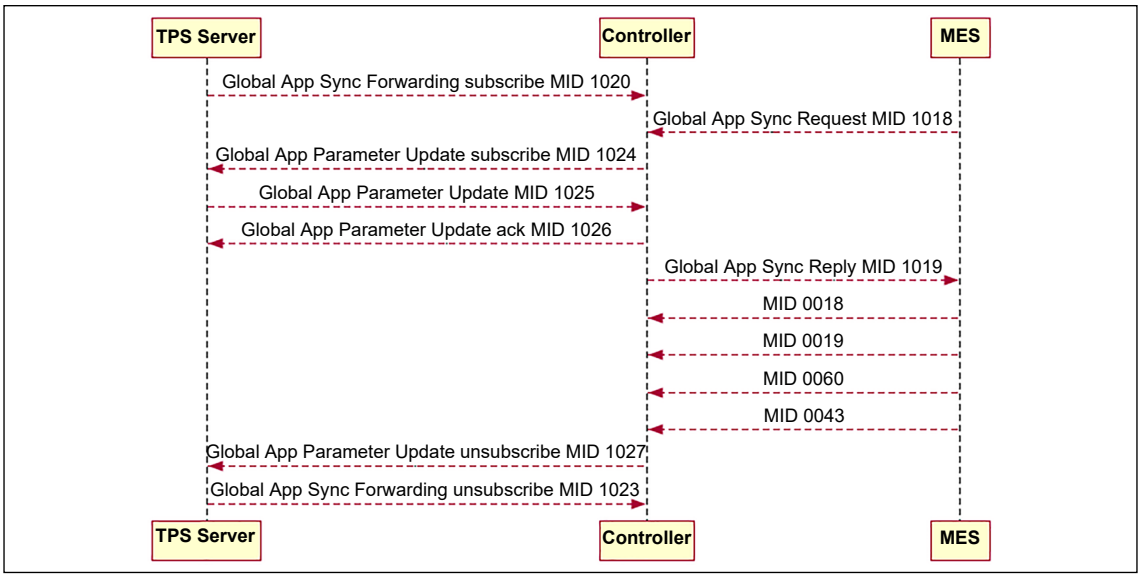


Fig. 10-23: Open Protocol MIDs required for TPS communication

10.7.1 Activating TPS on the Global Controller

To enable parameter update via Open Protocol:

1. Perform a factory reset.
2. Accept the default Primary tool or install a Secondary tool, DC tool in one of the free tool groups.
3. Set up local applications as required.
   If you mostly use the Global Controller to run global applications from TPS, you can still use it to run local applications.
4. Make the controller ready for rundowns.

The Global Controller Version 1.6.0 or newer supports multiple tools in the same tool if at least one of the installed tool numbers matches the tool group number.

5. Select *Navigator* > *Communications* > *Data Transmission*.
6. Select the <Open Protocol> entry in the *Ethernet* list.
7. Enter the required port number, e.g., 9000, in the *Port* input box.
8. Check the *Activated* box.
   → The <Advanced> button is displayed.
9. Tap <Advanced> to display the *Open Protocol Advanced Settings* dialog.
10. Select the *General* tab.
11. Check the *Allow Parameter update via Open Protocol MID 25* box.
12. Tap <OK> to confirm your changes and close the *Open Protocol Advanced Settings* dialog.
13. Tap <Navigator> to confirm your changes and close the *Communications* dialog.

10.7.2 Viewing TPS connection status and subscriptions

To view the TPS connection status and subscriptions:

1. Select *Navigator* > *Diagnostics* > *System*.
2. Tap the <Open Protocol> button in the *Network* section to open the *Open Protocol* dialog.
3. Select the required tool from the *Tool* drop-down menu.
4. Select the *Connection Status* tab or the *TPS Subscription MAP* tab.

The *Connection Status* tab provides the following information:
- TPS Server: Port number
- TPS Client: Port number
- Status

The *TPS Subscription MAP* tab provides the following information:
- Local App: Local application number assigned on Global Controller
- Global App Name: Global application name
- Global App: Global application number assigned on TPS
- Revision
- Modification date

If an application has not been set up as a global application, the *Global App Name* column of the TPS *Subscription Map* provides the following information:
- Not subscribed: Application has not been set up yet.
- Already used locally: Application has been set up locally using the *Basic* or *Standard Application Builder*.
- Previously used: Application has previously been used as a global application.

Local Applications displayed in the Application Matrix of the *Advanced* dialog.

For every parameter transfer the TPS connection is closed and the subscriptions are unsubscribed.

10.7.3 Disabling local saving and editing of applications

You can prevent local saving and editing of global and local applications.

If you use this option, all other controller parameters can still be edited and saved.

To disable local saving and editing of applications:
1. Select *Navigator* > *Advanced* > *Controller* > *Miscellaneous*.
2. Check the *Disable local saving and editing of Application parameters (for TPS Server)* box.

10.7.4 Additional settings on the Global Controller

Set Part ID mode:
1. Select *Communications* > *Part ID*.
2. Select the required option from the *Activated* drop-down menu.

Set <FEP / Open Protocol> mode:
1. Select *Advanced* > *Tool Group* > *I/O*.
2. Enable the *External Application / LG Selection* option.
3. Select the required option from the *Mode* drop-down menu.

10.7.5 Setting up global applications on TPS

From the Home screen of the TPS web application, you can create new global applications or revisions of existing global applications by uploading local applications from a Global Controller.

The Global Controller has to be registered on TPS. Administrator privileges are required to register controllers on TPS. The *TPS 1.0 Web Application* manual provides additional information.

To upload an application from a Global Controller:

1. Tap the <Home> button in the TPS web application.
2. Tap the <Pull App from Controller> button in the *Actions* section to display the *Pull App from Controller* pop-up dialog.
3. Select the local application to be uploaded to TPS.
4. Enter a global application number and name.
5. Tap the <Pull & Save Parameters> button to upload the local application and save it as a global application, or tap the <Cancel> button to discard.

When you confirm the *Pull App from Controller* dialog, the new global application is created on the server. The status of the application is *In Development* by default.

- To enable the application for production, a TPS administrator needs to change the status to *Released*.
- To disable an application on TPS Server, a TPS administrator needs to change the status to *Retired*.

The following controls are available in the *Pull App from Controller* dialog:

Item	Description
Controllers drop-down menu	Select the Global Controller that has the local application to be uploaded.
Channel drop-down menu	Select the required Open Protocol communication port.
Application drop-down menu	Select the required local application. The numbers provided in this drop-down menu are the local Application numbers assigned on the Global Controller.
Global App # input box	Enter the global application number under which this local application is to be saved on TPS.
Global App Name input box	Enter a global application name for this application. • You can use the existing local name as global application name. • Special characters, such as <, >, %, &, are permitted in the application name.
<Pull & Save Parameters> button	Uploads the local application defined in the dialog, and saves it as a global application under the number and name specified.
<Cancel> button	Discards all data entered in the dialog.

10.7.6 Working with TPS Server and Open Protocol client (MES)

To work with a new global application, you have to transfer it to the Global Controller:

- Connect the MES at the same Port number to the Global Controller and request the application using MID-1018.
- After successful transfer, the next available local application number is assigned to the application. The Open Protocol client sets the local application (MID-0008) and Part ID (MID-0050 or MID-0150).
- If a global application has batch positions, you can process batch steps.
- TPS uses MID-1025 to update parameters.

The *Open Protocol* manuals provide additional information on how the Open Protocol client (MES) communicates with the Global Controller.

At reboot of the controller, previously transmitted global applications are automatically unsubscribed. They are displayed as *Previously used* in the TPS Subscription Map.

If a global application whose TPS Status is *In Development* or *Retired* is transferred to the Global Controller, this application is listed in the TPS Subscription Map, but its *Revision* attribute is set to '0' and the *Modification date* is left blank.

10.7.7 Example for setting up a TPS global application

Once you have activated TPS on the Global Controller, you can view the TPS *Connection Status* on the Global Controller. The following screenshot shows the *Connection Status* for Tool 3 installed on the Global Controller:

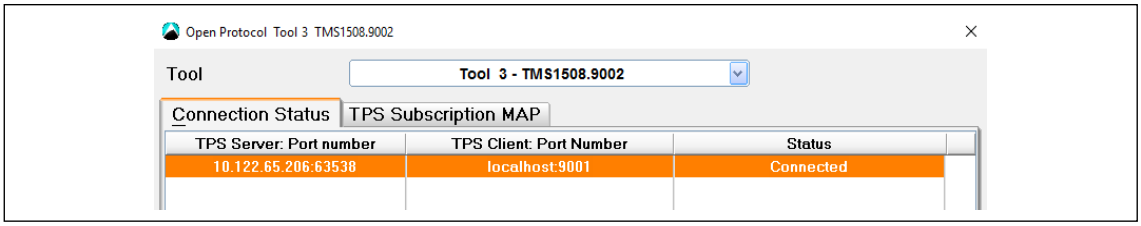


Fig. 10-24: TPS is connected to the Global Controller using Port 9002 for Tool 3

The TPS Subscription MAP provides an overview of all applications. In our example, several applications (1, 3-6) have been set up locally on the Global Controller. Application 2 has previously been used as a global application:

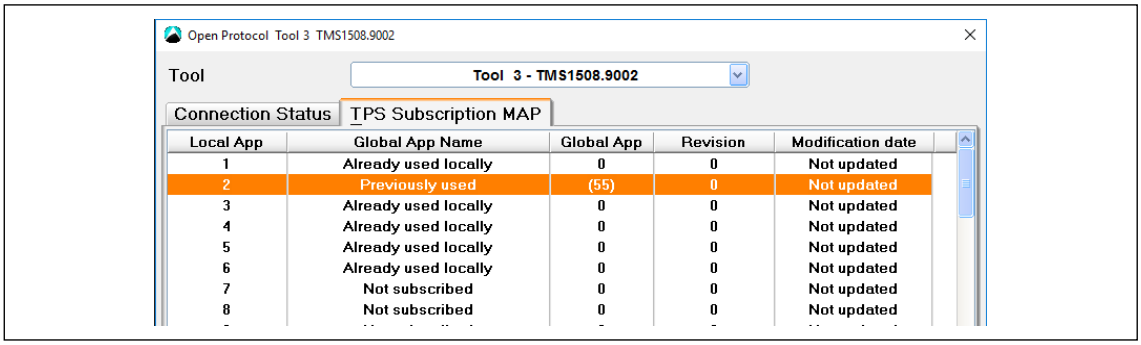


Fig. 10-25: Applications of Tool 3 viewed in the TPS Subscription MAP of the controller

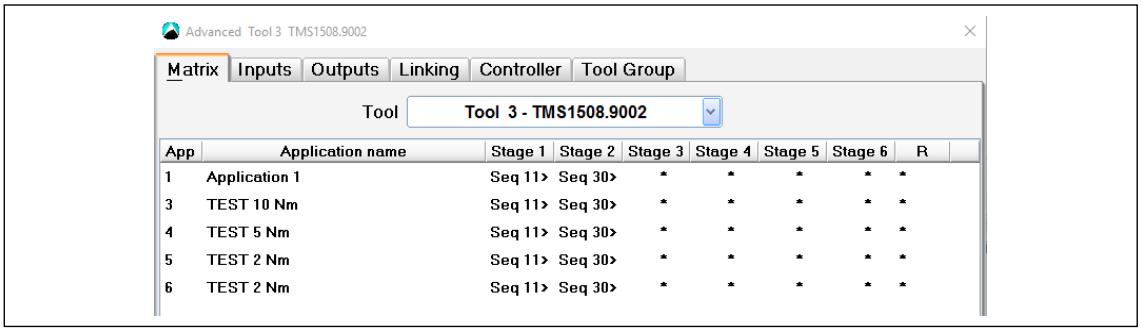


Fig. 10-26: Applications of Tool 3 viewed on the Matrix tab of the Advanced dialog

In the TPS web application, the *Pull App from Controller* command and dialog allow you to upload local applications from the Global Controller to TPS. In the following screenshot, local Application 3 (local name: TEST 10 Nm) of Tool 3 on the VIM 35 controller is selected for upload as Global Application 55 named TmaApp:

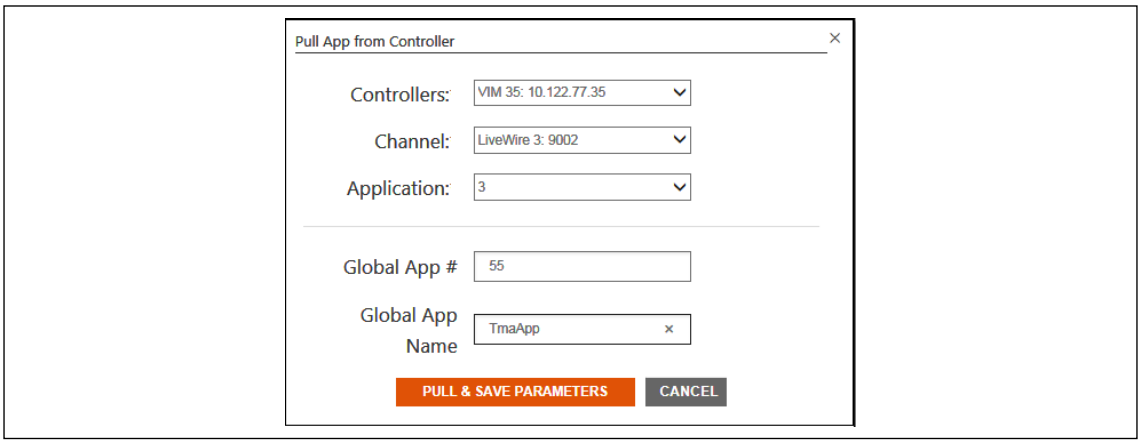


Fig. 10-27: Pull App from Controller dialog with local Application 3 selected for upload as Global Application 55

Once local Application 3 is uploaded, it is displayed as Global Application 55 (global name: TmaApp) on the Home tab of the TPS web application. The initial *Status* of the new global application is *In Development*. In the following screenshot, the *Status* of Global Application 55 is *Released* because the application has been released by a TPS administrator:

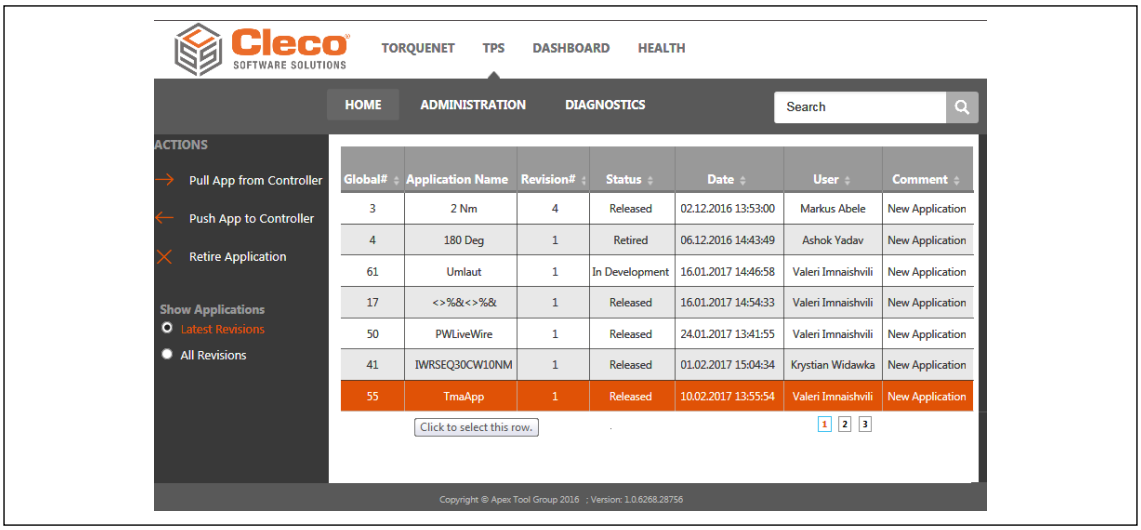


Fig. 10-28: Global Application 55 displayed with Released status

To transfer the new Global Application 55 (TmaApp) to the Global Controller, connect the MES at the same port number to the Global Controller and request the application using MID-1018. After successful transfer, the application is displayed in the TPS Subscription Map of the controller:

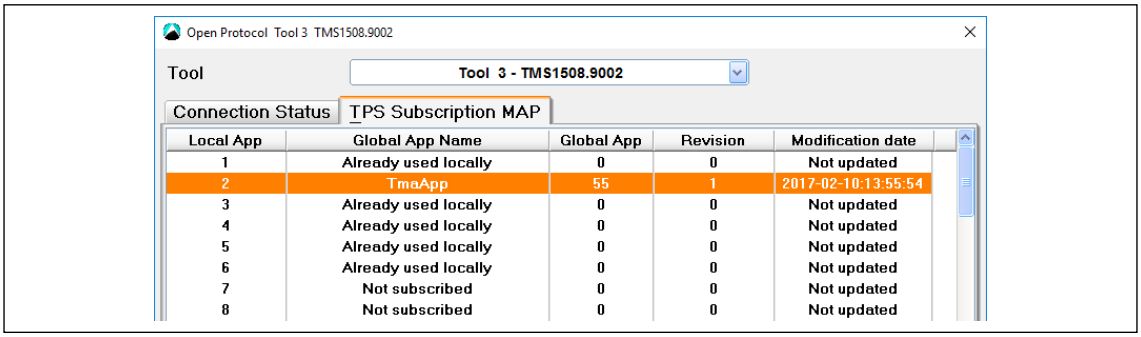


Fig. 10-29: Global Application 55 (TmaApp) viewed in the TPS Subscription MAP of the controller

Global Application 55 (TmaApp) received the local application number '2' because this was the first available local application number on the controller. The next global application would receive local application number '7' because numbers 3 through 6 are already occupied.

Global Application 55 is also displayed on the *Matrix* tab of the *Advanced* dialog. You can use a global application for fastening processes like any application that has been set up locally:

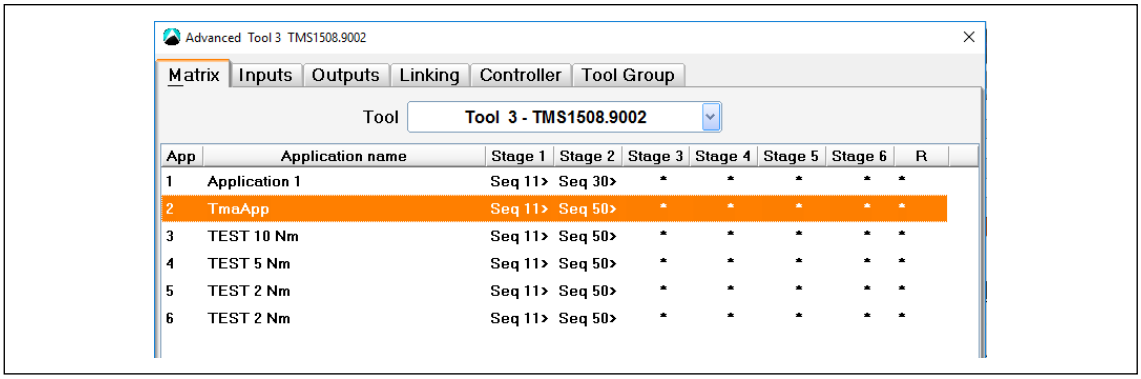
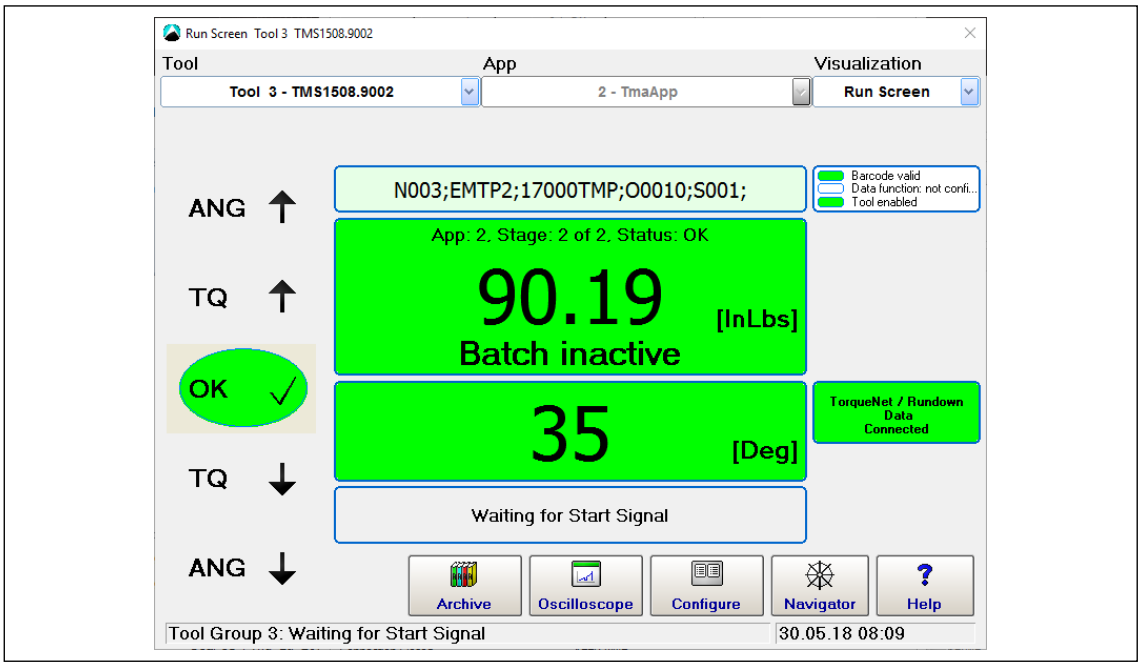


Fig. 10-30: Global Application 55 (TmaApp) viewed on the Matrix tab of the Advanced dialog

The Open Protocol client sets Application 2 (MID-0008) and Part ID (MID-0050 or MID-0150):



11 Diagnostics

The *Diagnostics* dialog provides access to features for monitoring, analyzing, and calibrating system components and tools used on the controller.

▶ Select *Navigator* > *Diagnostics*.

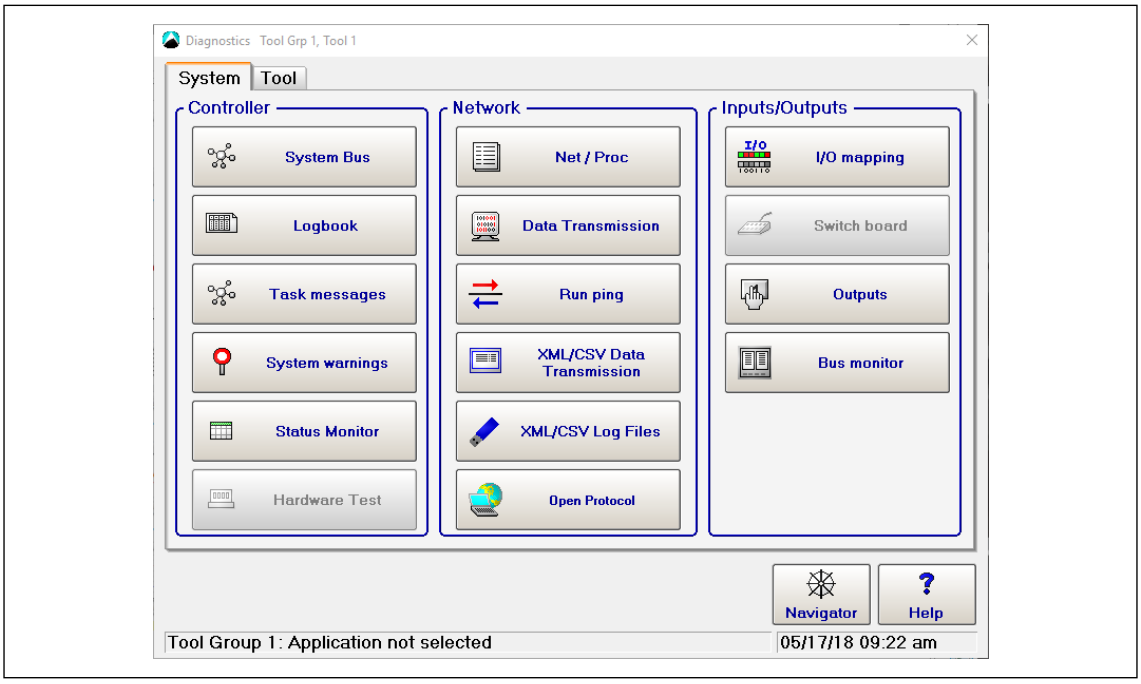


Fig. 11-1: Diagnostics

The *Diagnostics* dialog has *System* and *Tool* diagnostics features arranged on two tabs:
- The *System* diagnostics tab has three sections: *Controller*, *Network*, and *Inputs/Outputs*.
- The *Tool* diagnostics tab has two sections: *Test Options* and *Miscellaneous*.

11.1 System Diagnostics – Controller

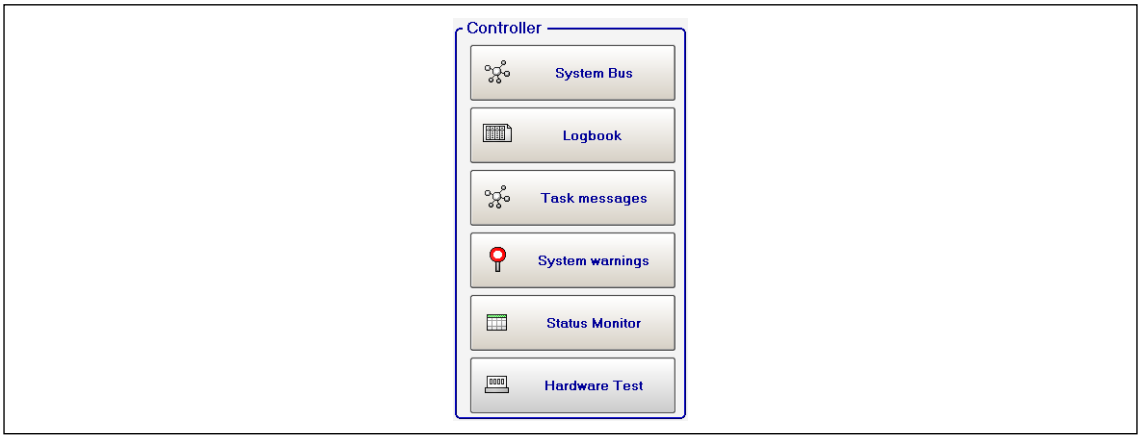


Fig. 11-2: Controller

11.1.1 System Bus (ARCNet Map)

The System Bus map provides detailed information on current participants on the system bus, e.g., tightening modules, bridges, computer units, station controllers, and PMs as well as their ARCNet ID, status, serial number, software version, and identification.

▶ Select *Navigation* > *Diagnostics* > *System* > *System Bus*.

The screen is continuously updated, i.e., if the connection to a participant is interrupted, the participant is removed from the current state table (*Current state* tab). If a new participant is added, the new participant is included in the table. The participant is included even if the associated parameters have not yet been set. The table displays the participants sorted by their ARCNet addresses (*Nodes*).

In addition to the current state of the System Bus map, a view of the programmed state of the System Bus map (*Progr. state* tab) and statistics of the communications on some System Bus participants are available (*System Bus statistics* tab).

System Bus map controls

Button	Description
	<Accept map> accepts the System Bus map manually when: • Hardware components, e.g., TM or bridge, are changed. • Different parameters are loaded and different TMs were used on the nodes. You can check if the correct TM software is used.
	<System information> displays information on hardware/software of the participant selected in the table, e.g., Rundown Counter, Maintenance Counter, Temperature, Voltage, and MfU Data.
	<System Bus statistics> provides communcation statistics of the current participant.

11.1.2 Logbook

Significant events and errors are recorded in the battery buffered RAM. You can display these in the Logbook table.

▶ Select *Navigator* > *Diagnostics* > *System* > *Logbook*.

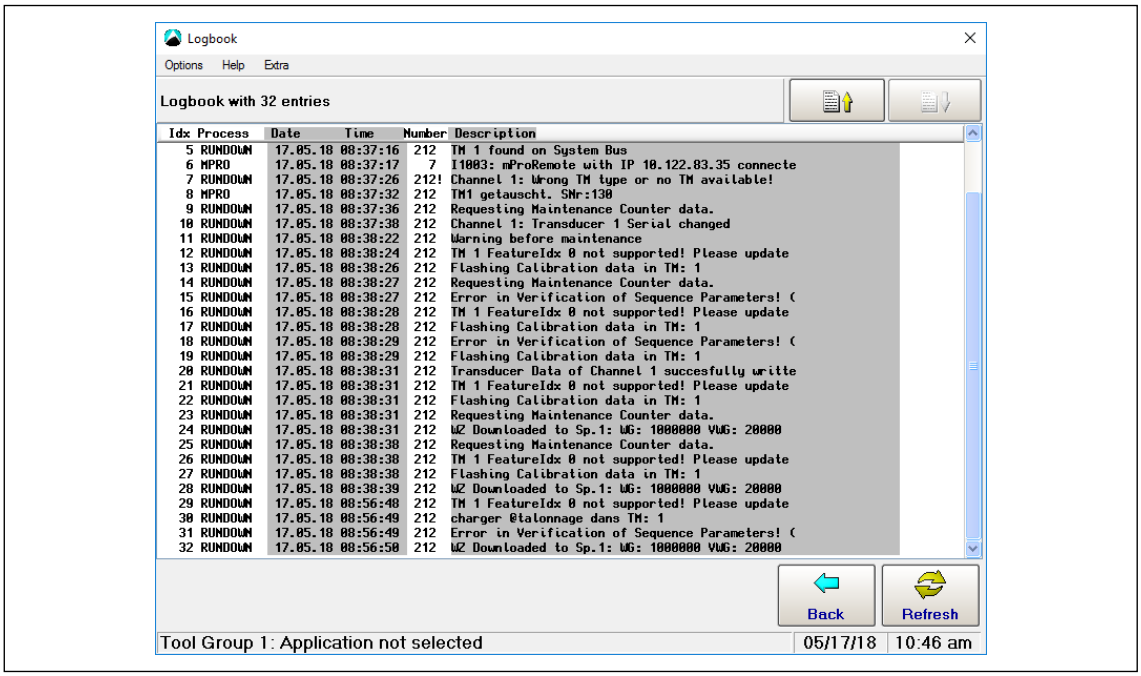


Fig. 11-3: Logbook

1. Tap the <Refresh> button to view the most recent messages. The Logbook is not automatically updated.
2. Use the *Extra* menu options to *Save* or *Delete* entries.
   → When you save, the data is output to the `CPTLOGB.TXT` file in ASCII format. Individual entries are separated by tab characters. The file can therefore be read by any standard database program.
3. The *Options* menu provides access to the *Abort* command.

11.1.3 Task messages

Task messages indicate the status of the control system and diagnose errors.

▶ Select *Navigator* > *Diagnostics* > *System* > *Task messages*.

Each program part (task) can add messages to a status line when the task is processed. As a result, messages are continuously overwritten by other tasks. A line displays the current message output by a task for which the line is reserved.

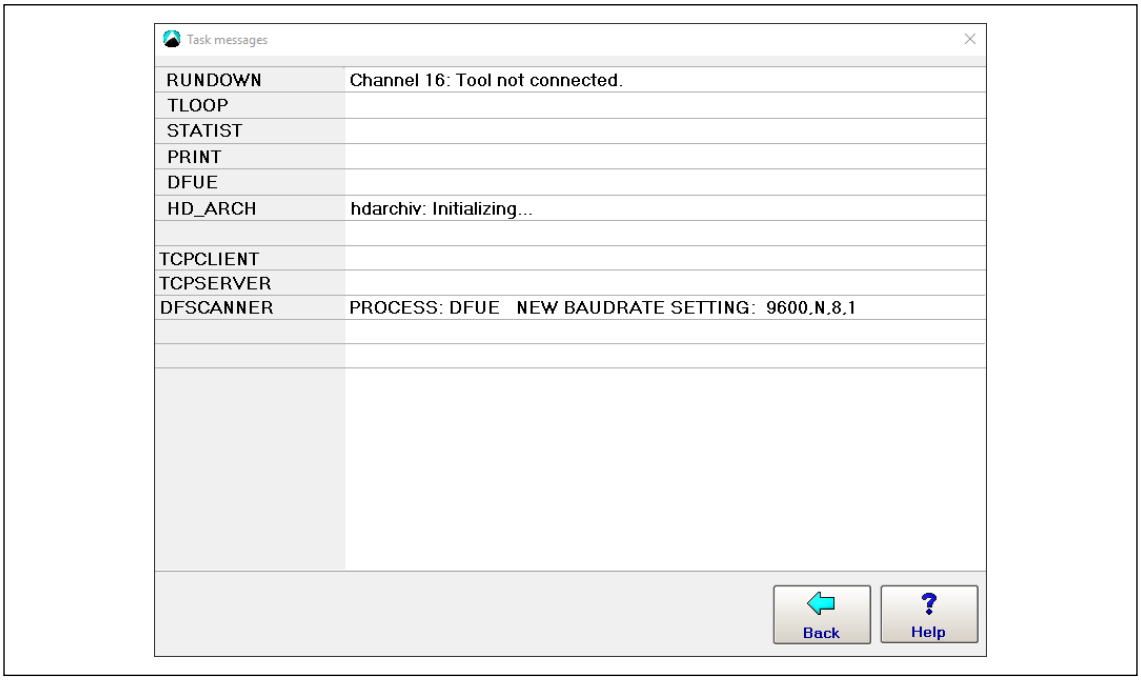


Fig. 11-4: Task messages

11.1.4 System warnings

System warnings help you detect changes in the system at an early stage, before the *Not ready* status is reached. You can therefore take corrective measures on time, which extends the service life of the system.

▶ Select *Navigator* > *Diagnostics* > *System* > *System warnings*.

The following screenshot is intended to show how System warnings are displayed. In normal operation, the System warnings displayed do not contradict each other, e.g., *…voltage too low* and *…voltage too high* are not displayed at the same time.

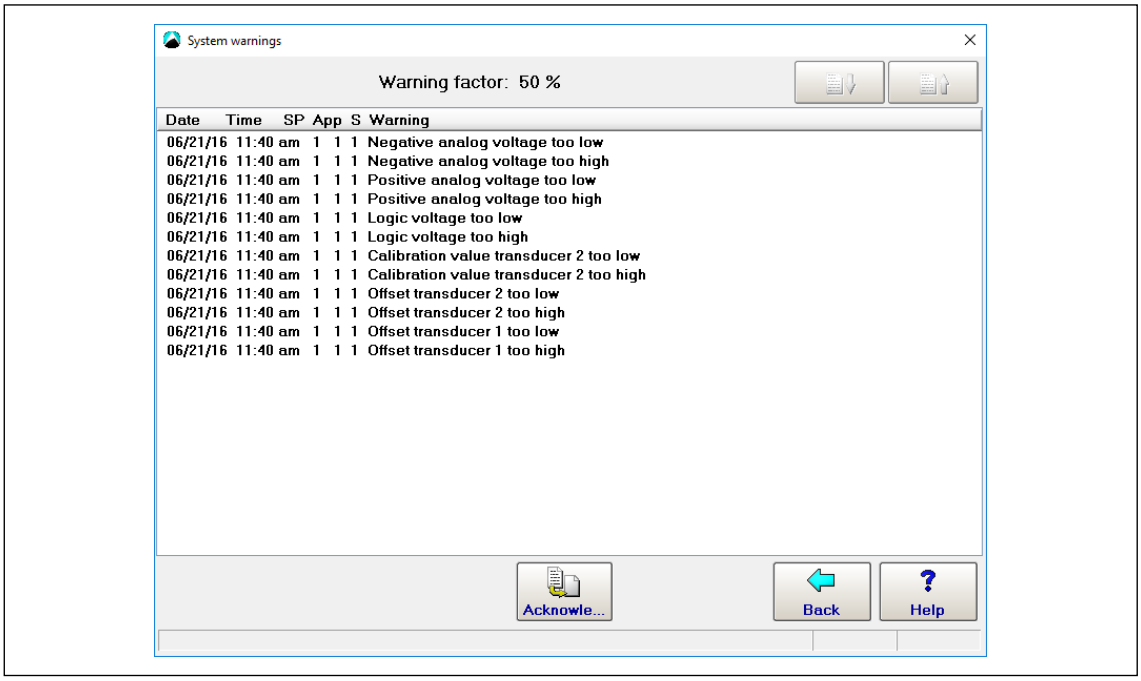


Fig. 11-5: System Warnings

When a system warning occurs for the first time, the *System warning* output of the I/O mapping is activated. When you tap the <Acknowledge> button, all System warnings are deleted and *System warning* output of the I/O mapping is reset.

The *Warning factor* displayed above the *System warnings* list determines the percentage of deviation from the fixed internal limit values, at which a system warning is issued or added to the list.

To set the Warning factor:

1. Select *Navigator* > *Advanced* > *Controller* > *Advanced*.
2. Enter the required percentage in the *Warning factor* input box.
   - If the Warning factor is set to 100 %, no system warning is issued because this corresponds to an *NOK* or *Not ready* state.

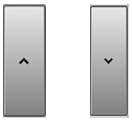
100 warnings can be added to the *System warnings* list. The same message may appear several times. When the maximum number of warnings is reached, the oldest messages are overwritten.

System warnings do not influence the fastening process.

11.1.5 Status Monitor

The *Status Monitor* displays current Tool Group status messages.

▶ Select *Navigator* > *Diagnostics* > *System* > *Status Monitor.*

Button	Description
	The <Up> and <Down> arrow buttons allow you to select a different Tool Group.

11.1.6 Hardware Test

The *Hardware Test* features verify the functionality of various hardware components of the controller.

▶ Select *Navigation* > *Diagnostics* > *System* > *Hardware Test*.

When you access *Hardware Test*, all tools will be disabled. After the tests, a reboot of the controller is required and follows automatically on exiting the tests.

Some tests require stable connection of an interface, e.g., for the I/O Test, an I/O dongle has to be connected.

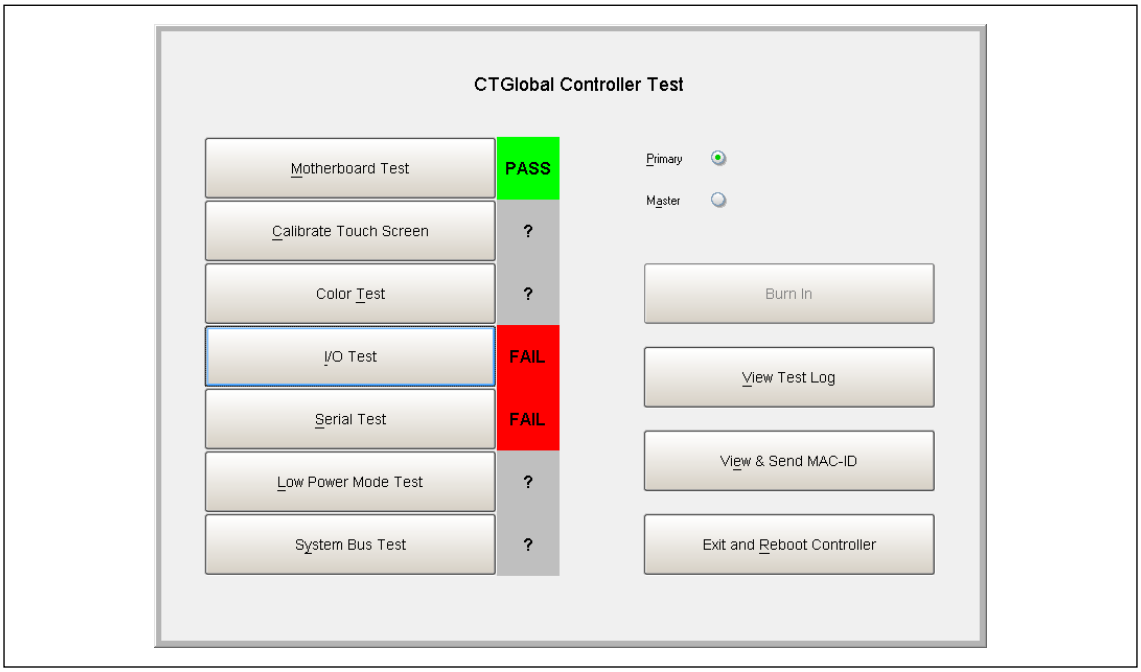


Fig. 11-6: Hardware Test

▶ Select the *Primary* or *Master* radio button to define the controller.

All tests can be executed and run fully automated with results being output to the screen and written to a log file on the SD card.

11.2 System Diagnostics – Network

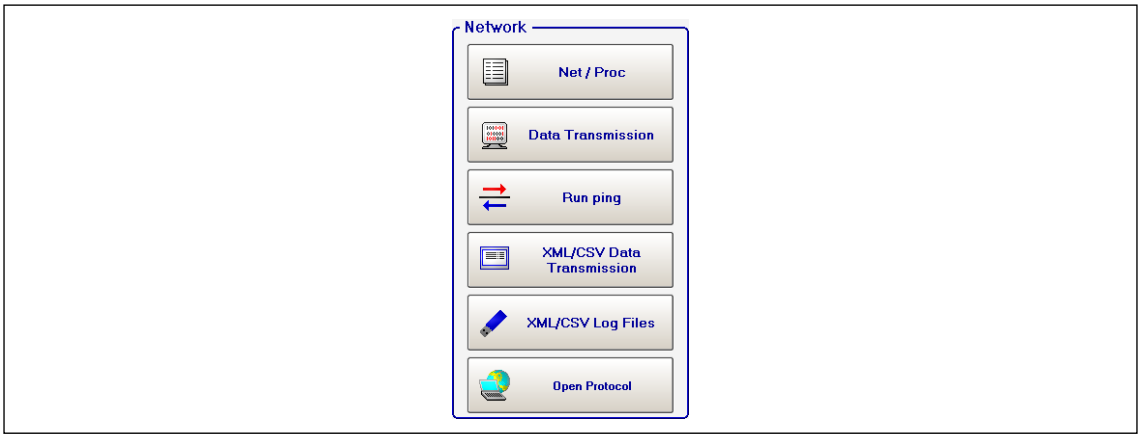


Fig. 11-7: Netzwork

11.2.1 Net/Proc

Net/Proc helps service technicians analyze controller software malfunction and network installation failure. Detailed operating system information is displayed on this screen.

1. Select *Navigator* > *Diagnostics* > *System* > *Net/Proc*.
2. Select the *Environment Variables* tab to display information on the disk space available on the SD card.
3. Select *XiLink connections* tab to display remote connection information.

11.2.2 Data Transmission

Data Transmission monitors Serial and Ethernet data transmission. Incoming and outgoing data are displayed. You need to know the type and protocols to read and interpret data.

▶ Select *Navigator* > *Diagnostics* > *System* > *Data Transmission.*

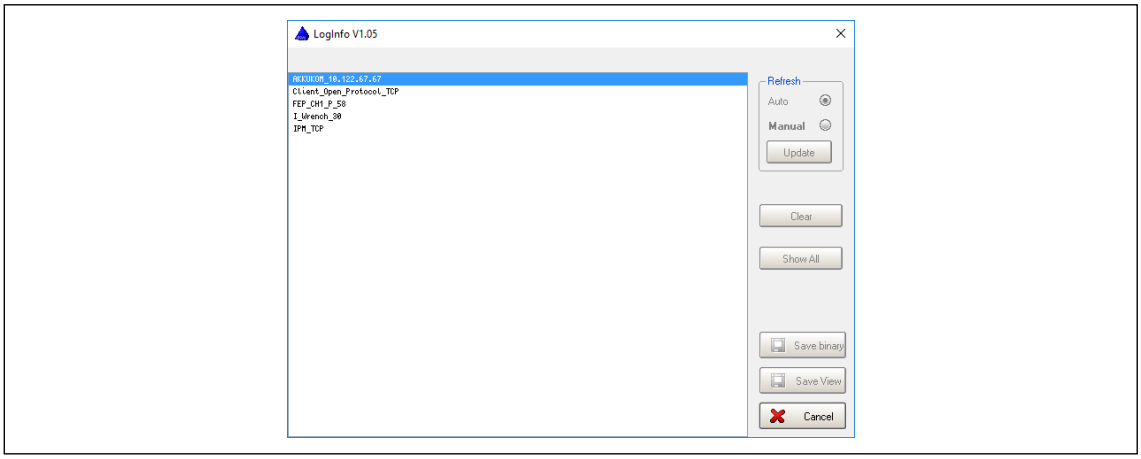


Fig. 11-8: Data Transmission

To display more information on data transmission:

1. Tap a list entry.
   → Incoming and outgoing data is displayed on the screen.
   → The screen is continuously updated.

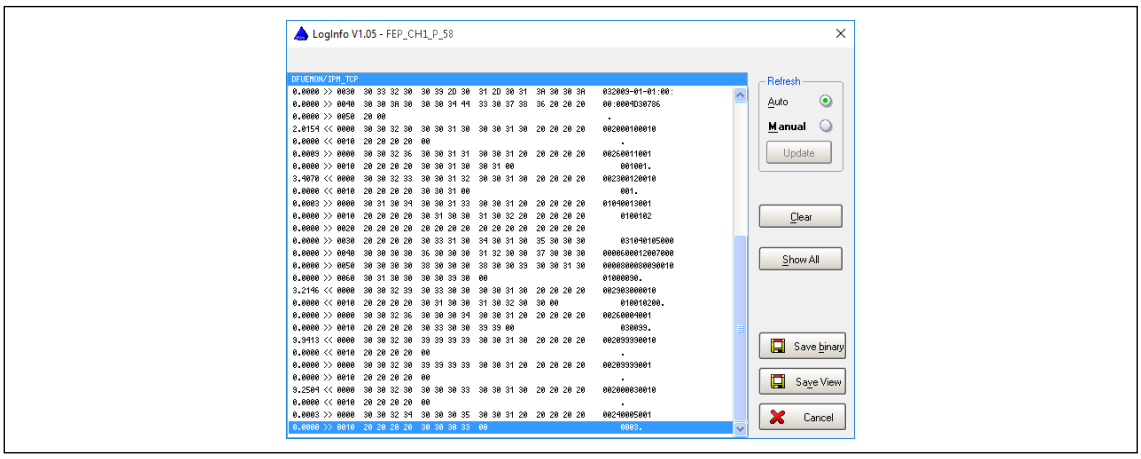


Fig. 11-9: LogInfo

2. Tap the <Manual> radio button to freeze the screen and read the current data record.
3. Tap the <Upadate> button to refresh the screen.

11.2.3 Run ping

The *Test Ethernet connection* dialog allows you to send a ping to a known network address to check if the physical network connection works.

To open the *Test Ethernet connection* dialog and send a ping:

1. Select *Navigator* > *Diagnostics* > *System* > *Run ping*.
2. Tap the <Ping> button to open the *Run ping* pop-up dialog.
3. Enter a known network address in the *IP Address* input box and confirm.
   → If the connection works, the remote station responds to the ping and the response is displayed in the *Test Ethernet connection* dialog.

Button	Description
	<Ping> opens the *Run ping* pop-up dialog.
	<Back> closes the *Test Ethernet connection* dialog.

11.2.4 XML/CSV Data Transmission

The *XML/CSV Data Transmission* feature provides Results and Lookup tables for data transmission via XML/CSV on FTP or SAMBA servers.

To access *XML/CSV Data Transmission*:

1. Enable XML/CSV data transmission:
   - Select *Navigator* > *Communications* > *Data Transmission*.
   - Select the XML/CSV entry in the *Ethernet* list and enable.
2. Select *Navigator* > *Diagnostics* > *System* > *XML/CSV Data Transmission*.
3. Select the *Results* or *Lookup table* option from the drop-down menu.

The *Results* option displays detailed data and the stored file names:

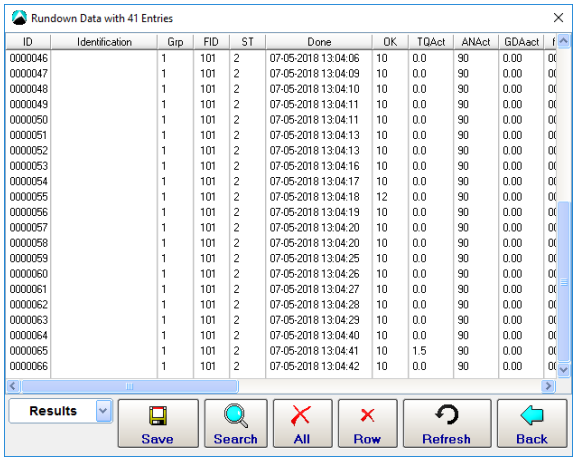


Fig. 11-10: Results

The *Lookup table* option displays fewer details and does not list stages:

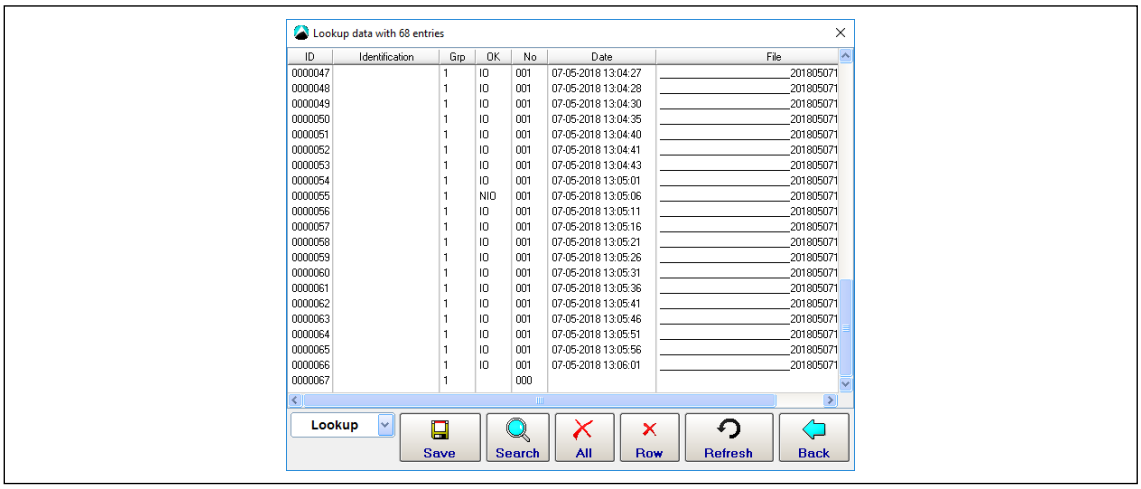


Fig. 11-11: Lookup table

11.2.5 XML/CSV Log Files

The *XML/CSV Log Files* feature displays log messages with status information on XML/CSV Data Transmission. If data transmission does not work properly, the messages may indicate causes.

▶ Select *Navigator* > *Diagnostics* > *System* > *XML/CSV Log Files*.

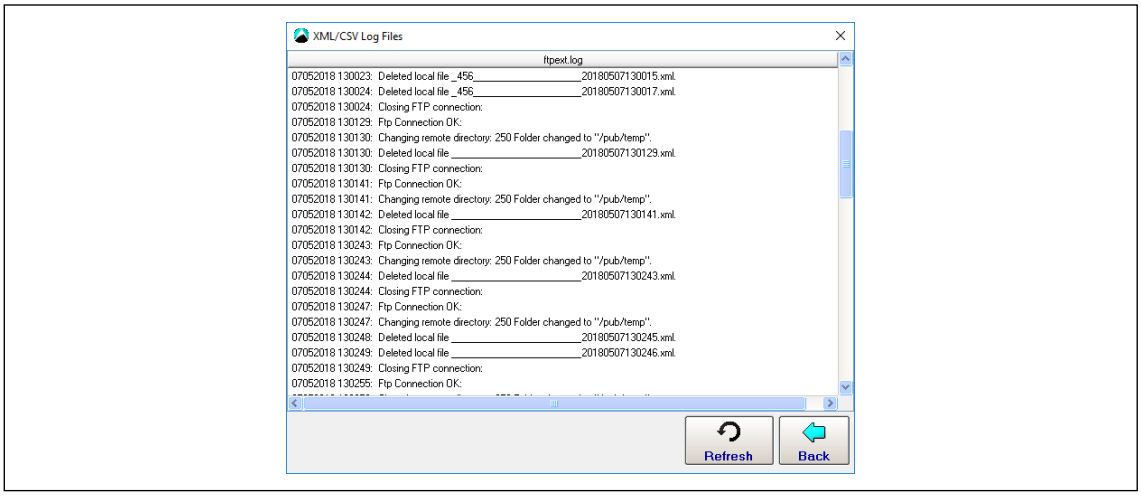


Fig. 11-12: XML/CSV Log Files

11.2.6 Open Protocol

The Open Protocol button provides access to the Tightening Parameter Server (TPS) Connection Status and Subscription Map. See chapter *10.7 Tightening Parameter Server (TPS), page 190* for additional information.

11.3 System Diagnostics – Inputs/Outputs

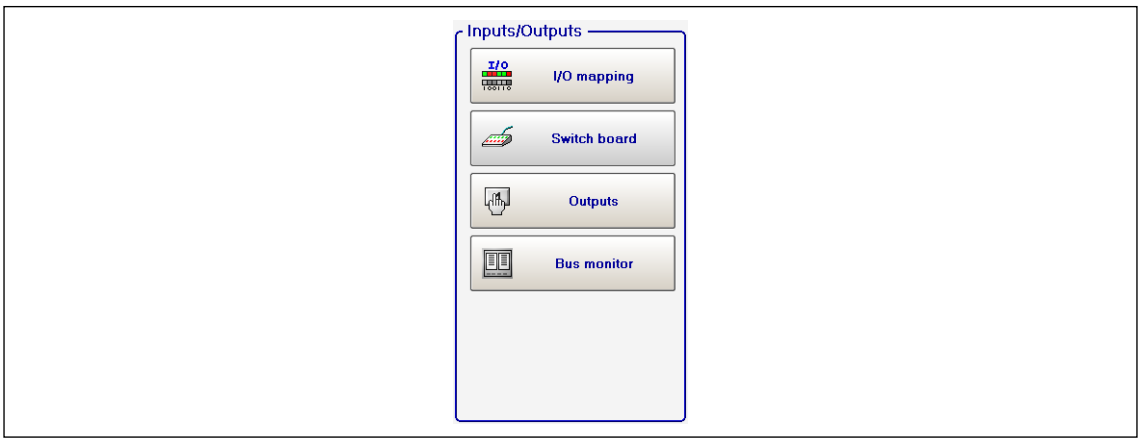


Fig. 11-13: Inputs/Outputs

11.3.1 I/O mapping

The *I/O process map* shows the current status of each available input and output. Active input and output signals are highlighted.

For a detailed description of these signals see *Navigator > Advanced > Inputs/Outputs*.

To access the *I/O process map*:

▶ Select *Navigator > Diagnostics > System > I/O mapping*.

The logic status of the I/O process map represents all setups in the *Programmable I/O Mapping*. You can view the signal exchange with the partner (PLC). In particular, it allows you to check all signals sent by the partner. Inputs and outputs are shown separately, in separate columns of the respective connector. Signals that have not been configured are not shown. The individual bits of a channel are shown with a color background if the bits are active. Inactive bits are shown with a gray background.

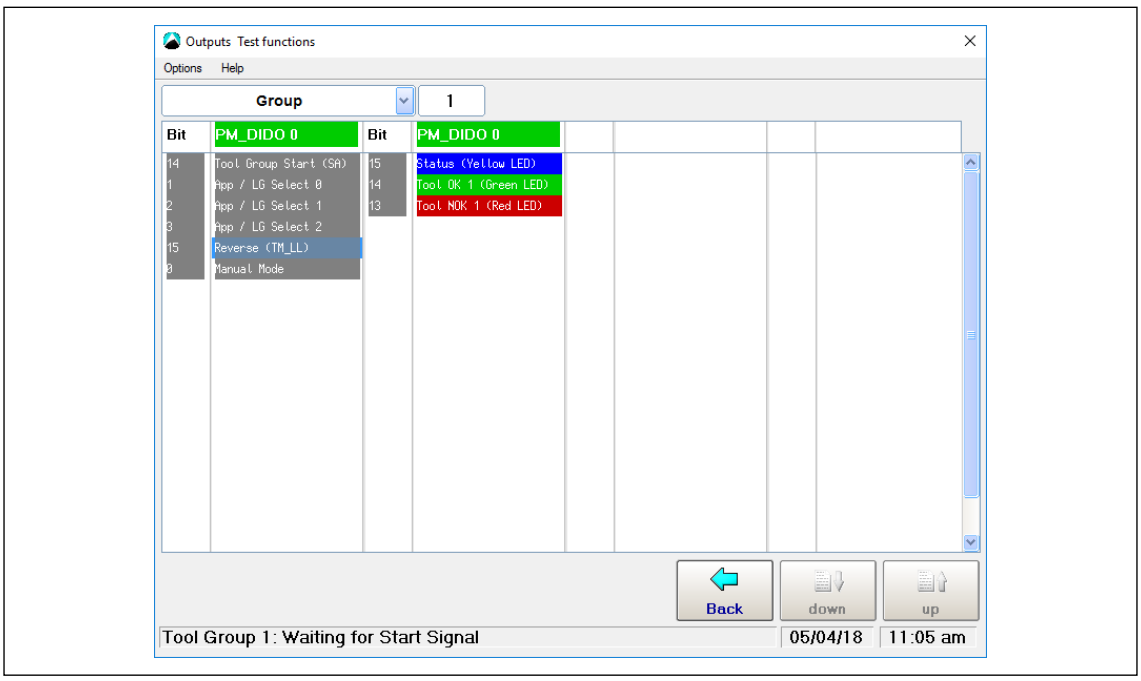


Fig. 11-14: I/O process map

11.3.2 Switch board

Switch board is a test function of the input level. It displays all I/O signals which are configured in the software and for which hardware is installed. The *Operator console* menu is used to assist during system setup and/or for troubleshooting and fault correction.

Warning

Moving parts!

Before you use this feature, make absolutely sure that reconfiguration of controller outputs (usually correspond to PLC inputs) does not cause unintentional configuration of subsequent switching criteria.

Warning

Moving parts!

Do not reach into rotating parts of hand-held tools or machines that are switched on.

Note

Hardware outputs may change status after *Switch board* is terminated.

▶ Select *Navigator* > *Diagnostics* > *System* > *Switch board*.

The Switch board shows the same table as the I/O mapping. However, the operator console allows operation of the input bits by touch.

To change the settings for the inputs and outputs see *Navigator* > *Tool Setup* > *I/O*.

The representation is subdivided by fastening group assignment.

▶ Select the *Group*.
→ The screen shows the signal exchange with the partner (SPC) as a result.
- It allows all signals sent by the partner to be checked.
- All input signals used in the *Programmable I/O Mapping* can be influenced.
- Inputs are listed in the left column, outputs in the right of the corresponding connector columns.

11.3.3 Outputs

Outputs is used to assist during system setup and/or for troubleshooting and fault correction.

Warning

Moving parts!

Before you use this feature, make absolutely sure that reconfiguration of controller outputs (usually correspond to SPC inputs) does not cause unintentional configuration of subsequent switching criteria.

Warning

Moving parts!

Do not reach into rotating parts of hand-held tools or machines that are switched on.

Note

Hardware outputs may change status after *Outputs* is terminated.

1. Select *Navigator* > *Diagnostics* > *System* > *Outputs*.
   In *Outputs* the status of output signals can be set manually. If you activate a function and confirm the safety prompt, all outputs of the system are reset.
2. Tap the required signal output to either set or reset the output bit of the controller hardware.
   → When you quit the function, the system returns to its initial status.

11.3.4 Bus monitor

The *Bus monitor* allows you to view data traffic between the controller and fieldbus masters. You can display In-/Output data in a hexadecimal or binary view (See chapter *9.4.10 Check byte areas in the Bus monitor, page 140*).

▶ Select *Navigator* > *Diagnostics* > *System* > *Bus monitor*.

11.4 Tool diagnostics – Test Options

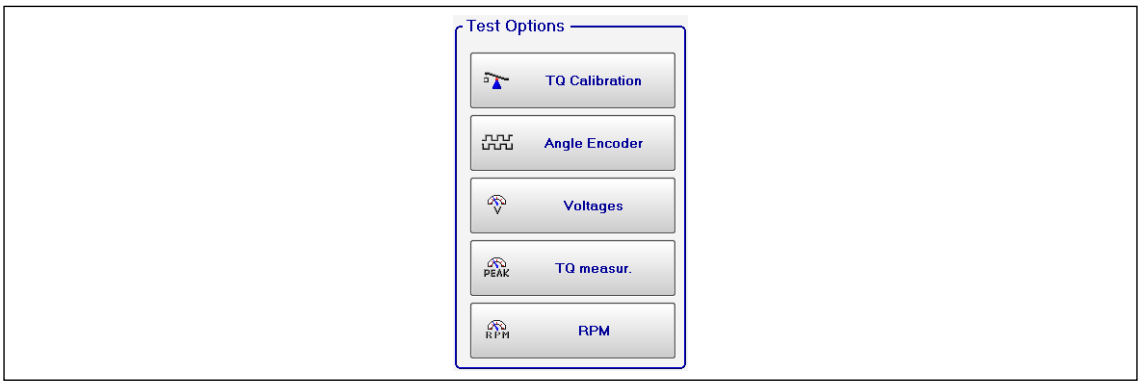


Fig. 11-15: Test Options

The Test Options are only active for corded tools. With cordless tools, the Test Options can be selected from the tool menu.

11.4.1 TQ Calibration

This test function allows you to assess calibration voltages.

▶ Select *Navigator* > *Diagnostics* > *Tool* > *TQ Calibration*.

You must release the tool prior to starting this test!

The test displays the Calibration offset and Calibration voltage of the torque transducer. If a value is out of tolerance, it is displayed in red.

When a rundown starts, the test function is internally terminated even though the display remains. To continue testing, you must activate the test function again after the rundown.

Rated values and tolerances

Item	Rated Value	Tolerance
Calibration offset	0 V	±200 mV
Calibration voltage	5 V	±150 mV

11.4.2 Angle Encoder

This test function allows you to assess angle encoding.

Warning

Moving parts!

Do not reach into rotating parts of hand-held tools or machines that are switched on.

Warning

Moving parts!

Prior to using this function, ensure that no hazard can result from tool rotation.

▶ Select *Navigator* > *Diagnostics* > *Tool* > *Angle Encoder*.

The <Start> button starts the spindle at a speed of 50 rpm. After one revolution of the output shaft (*Target angle* = 360 degrees), which is determined by the angle encoder of Transducer 1, the tool is stopped. During a preset *Dwell time* of 200 ms, any further angle pulses are traced. The total result is displayed as the *Actual Angle*. The *Shut-off Torque* displayed is either the torque applied at shut-off or the maximum torque reached during *Dwell time*, whichever is greater.

An OK evaluation occurs and is displayed if the test run is not terminated by a monitoring criterion and if the total result is equal to or greater than 360 degrees. Monitoring criteria are the torque of Transducer 1 and a monitoring time. The test run is terminated with NOK if the torque of Transducer 1 exceeds 15 % of its calibration value (even during Dwell time) or if the monitoring time of 5 seconds expires.

You must ascertain that the output shaft actually rotated the number of degrees displayed (e.g., by marking its position). If the angle reached by the output shaft does not agree with the value displayed, either an incorrect angle factor is set or the angle encoder does not work properly.

But control and shut-off are only effected by Transducer 1 and the monitoring time.

- Due to the measuring principles employed by pulse counters, a systematic angle difference of ±1 may occur. If the transducers have different angle factors, the larger pulse value (in degrees) is used.
- OK/NOK evaluation depends on the angle reached by Transducer 1 plus/minus a tolerance programmed in the Tool constants.

When a rundown starts, the test function is internally terminated even though the display remains. To continue testing, you must activate the test function again after the rundown.

11.4.3 Voltages

This table displays supply voltages measured for each tool.

▶ Select *Navigator* > *Diagnostics* > *Tool* > *Voltages*.

These are the most important supply voltages on the measuring card. They are required for proper torque and angle measurement and must therefore be monitored continuously. If a voltage is out of tolerance, it is displayed in red.

Voltage designation		Logic	Pos. analog	Neg. analog / Pos. supply
NeoTek tools	Rated value	+3,3 V	+12 V	0 V
	Tolerance	±0,3 V	±0,6 V	±0,9 V

11.4.4 TQ measurement

This test function allows you to assess torque measurements.

▶ Select *Navigator* > *Diagnostics* > *Tool* > *TQ measur*.

You must release the tool prior to starting this test!

The tool is started at zero speed and the torque is continuously measured and displayed.

Parameter	Description
Current torque	Displays the current torque
Peak Torque	Displays the greatest value measured since the function was started

If redundancy is active, the values of Transducer 2 are also displayed.

When a rundown starts, the test function is internally terminated even though the display remains. To continue testing, you must activate the test function again after the rundown.

11.4.5 RPM (Speed measurement)

This test function allows you to assess tool speed.

Warning

Moving parts!

Do not reach into rotating parts of hand-held tools or machines that are switched on.

Warning

Moving parts!

Prior to using this function, ensure that no hazard can result from tool rotation.

▶ Select *Navigator* > *Diagnostics* > *Tool* > *RPM*.

- When you tap the <Start> button, the tool starts with maximum speed. The dialog displays the current speed of the output shaft.
  To achieve exact results, the angle factor must be set correctly since the integrated speed measurement is derived from the resolver signals.
- When you release the <Start> button the tool stops.

As a safety precaution, the torque is monitored by the tool transducer. If the torque exceeds 15% of its calibration value, the speed test is terminated.

When a rundown starts, the test function is internally terminated even though the display remains. To continue testing, you must activate the test function again after the rundown.

11.5 Tool diagnostics – Miscellaneous

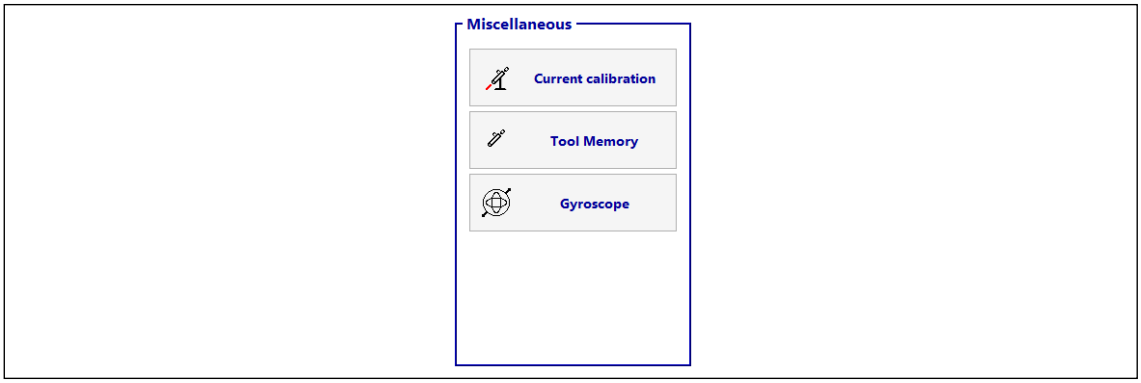


Fig. 11-16: Miscellaneous

11.5.1 Test rundowns for Current calibration

The *Current calibration* feature allows you to determine dynamic current constants (*Dyn. curr. const.* unit: Nm/A). You perform test rundowns that are used to calculate average values for each fastening stage. The resulting dynamic current constants remain valid until the conditions for the rundown change.

See chapter *7.6 Current calibration, page 87* for more information on dynamic current constants and calibration.

Calibration requirements

Conditions required for dynamic current calibration per application:

- The torque shut-off value is greater than 35 % of the transducer calibration value.
- Only the results of OK rundowns are used to calculate dynamic current constants. Results of NOK rundowns are not considered in the calculation. The calculated values are only used when calibration has been completed successfully.
- With the exception of Sequence 48, only torque tightening sequences are used. In all fastening sequences, the torque and current values measured at shut-off are used. This is not possible in back-off strategies because they use angle control and the torque or current values at shut-off move toward zero. For this reason, the maximum torque that occurs is determined to calculate the dynamic value in Sequence 48.

Test rundowns and calibration information

To enable dynamic current calibration: See the *Enabling Dynamic Current Calibration* section for more information.

To access the *Current calibration* dialog:

▶ Select *Navigator* > *Diagnostics* > *Tool* > *Current calibration*.

When all conditions are met, current calibration starts with the incoming number of test rundowns. The values for individual fastening stages are highlighted yellow during calibration for the selected application and tools:

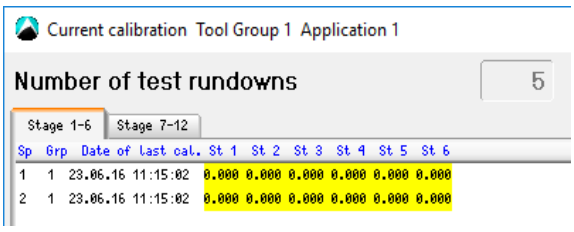


Fig. 11-17: Current calibration started

The dynamic calibration values are highlighted blue when the calibration has completed successfully:

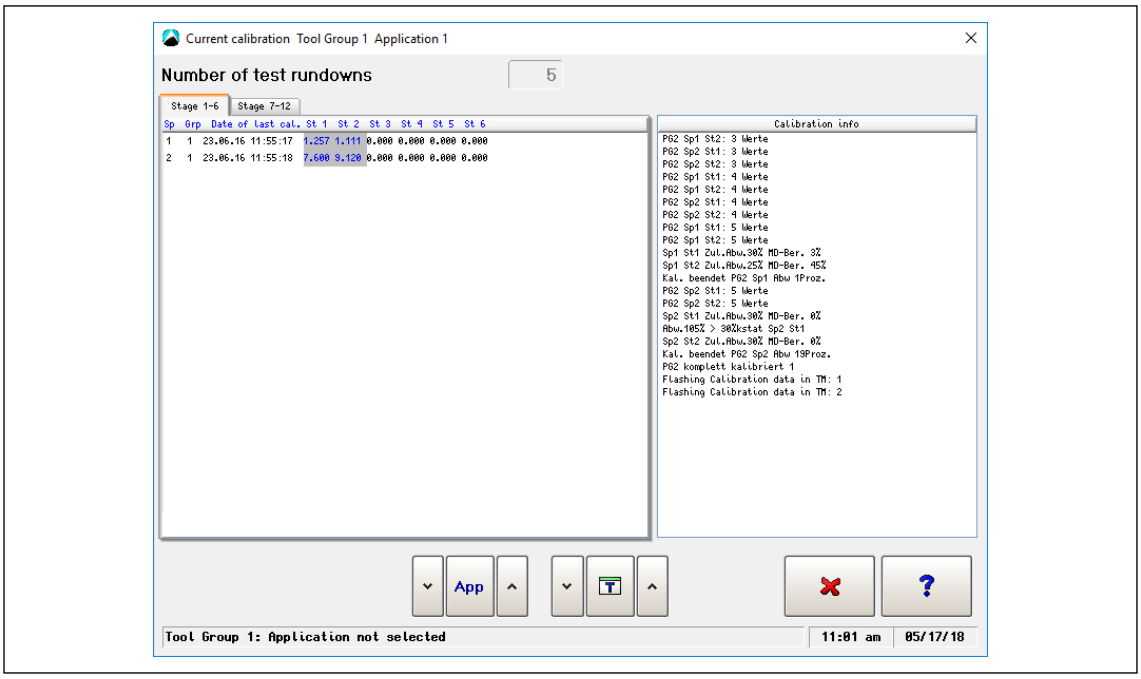


Fig. 11-18: Current calibration completed

The *Calibration info* section indicates the current status of calibration. It provides a sequence analysis of the calibration and displays comments for individual steps:

Comment	Description
Start current cal. Grp n	When you tap the <Start> button, all tools are set for dynamic current calibration. The fastening sequence is started by the inputs of the I/O mapping.
Fastening sequence 1 to n	The programmed number of test rundowns is executed and the individual rundowns are displayed as they occur. The test rundowns are performed with Transducer 1 as control value. Current is not used as control value even if the control value is set to current.
Calculate data, Grp n	Controller prompt instructs the TM to calculate the data.
Accept data, Grp n	Controller prompt instructs the TM to accept the data.
Data req., Sp. n	The controller requests the newly calculated data from spindle n.
Data rec., Sp. n	The controller confirms receipt of the data from spindle n. The left table shows the corresponding values in blue.
Cal. data flashed, Sp n	The calibration data has again been reset from dynamic to static. The calibration data has been stored.

Dynamic current calibration must be performed under the same conditions as actual rundowns, i.e., the fastening rundowns must be fully programmed. The screen only shows the data for the specified parameter set. The comments listed in the *Calibration info* table remain on display unchanged even if another fastening group or parameter set is selected.

The calculations of dynamic current calibrations are based on OK results only. The calculated values that result from a successful calibration run are not used until they are adopted with the closing of the dialog window.

When, after successful calibration, a rundown with the calibrated stage is performed, the *Tool monitor* displays the calculated value with an asterisk (*) (if the final value is ≥ 35 % of the calibration value).

11.5.2 Tool Memory

The <Tool Memory> button opens the *Transducer data* dialog. See chapter *7.5.1 Transducer data screen, page 83*.

11.5.3 Gyroscope

This button is only displayed if a tool with a gyroscope is connected.

The Gyroscope module allows angle correction for hand-held tightening equipment without support. The potential influence of an operator to the absolute angle is compensated by the module.

The *Gyroscope* function can be used to determine the reference angle.

Parameters and buttons in the *Gyroscope* window*:*

Parameter/Button	Description
Status	Display of error messages, see below.
Deg	Displays the angle that the tool has moved since the angle measurement was started.
<Start>	Starts the angle measurement. The position of the tool when <Start> is pressed is set as the zero point.
	Exit the view and return to the previous window.

Possible error messages in the *Gyroscope* window*:*

Error message	Possible cause	Measure
GAE	Invalid angle value returned from gyroscope	▶ Contact *Sales & Service Centers*.
GAEX	Tool rotated more than ±180°	▶ Don‘t rotate tool not more than ±180°.
GARE	Tool moved too fast	▶ Move the tool slower while tightening.
GCOM	Internal communication error	▶ Contact *Sales & Service Centers*.
GVE	Supply voltage too high or too low	▶ Check accessory cable connection. If error occurs again contact *Sales & Service Centers*.

12 Archive

The *Archive* dialog displays a list of the most recent, completed rundowns with an overview of rundown data. You can use the Tool monitor and, if graphic data has been recorded, the Torque graph to further analyze rundowns.

The archive saves all rundown data in a ring buffer. The number of entries it can hold depends on the number and scope of archived rundown sequences. The required memory depends on the length of plotted curves (plotting begins at trigger torque).

▶ Select *Navigator* > *Archive*.

The Archive dialog provides the following information:

Each row of the Archive table lists a rundown. To help you find rundowns, the file name and number of the currently selected rundown are displayed above the Archive table. Files are saved daily, and the file name indicates the date (YYYYMMDD.idx). The following table describes the data displayed for each rundown.

Archive table columns

Column header	Description
TI	The tool which produced this rundown.
St	Current step: More than one step can occur, e.g., if linking groups are programmed.
FID	Fastener ID: A unique ID for the tightened fastening position.
Ap	Application/Linking Group used.
S	The last stage used in tightening.
Se	Fastening Sequence used in last tightening stage.
TqAct	Shut-off torque reached in this rundown.
PTq	Peak torque reached in this rundown.
An	Angle value reached in this rundown. Angle counting begins from threshold torque.
Gd	Gradient value reached in current rundown if available for rundown sequence.
Err	Reason for shut-off of this rundown if rundown is NOK.
Date	Tightening date.
Time	Tightening time.
Workpiece	VIN or Part ID used for this rundown. If both are parameterized, the Part ID has priority.

Two archives are available

- The HD Archive stores the rundowns on the SD card and does not get refreshed after each rundown. The HD Archive is refreshed when the screen is accessed.
- The RAM Archive stores the rundowns in flash memory and is updated after each rundown.

The HD and RAM Archive dialogs provide access to the following features

Button	Description
	<Statistics> provides access to the *Statistics* dialog. See chapter *12.5 Statistics, page 185* for more information.
	<Details> opens the *Tool monitor* dialog, which provides additional details on the currently selected rundown. See the Tool monitor section for more information.
	<RAM> and <HD> toggle between the HD Archive and the RAM Archive.
	<Filter> provides access to the *Filter* dialog, which allows you to filter Archive entries using various criteria. See the Filtering archive entries section for more information.

Button	Description
	<Freeze> is displayed in the RAM Archive, which is updated after each rundown. 1. Tap <Freeze> to prevent refreshing. 2. Tap <Freeze> again to refresh archived data.
	The <Up> and <Down> arrow buttons allow you to scroll to older/newer data. In the HD Archive, only 50 entries are displayed in the Archive table. ▶ Use the <Up> or <Down> button to move to the previous or next 50 entries.

12.1 Monitor tool

The *Monitor Tool* dialog displays additional rundown details.

To access the *Monitor Tool* for a rundown:

▶ Select the required rundown in the Archive table, and tap the <Details> button.

The Monitor Tool dialog provides the following information:

- *Workpiece*: Provides the Part ID or Barcode of the workpiece if available.
- *Process time*: Displays the time stamp of the rundown.
- Rundown counters: Provides the number of *OK, NOK*, and *Total* rundowns archived for the tool.
- Tool monitor table: Each Tool monitor table row lists a fastening stage. The following table describes the data displayed for each fastening stage.

Monitor Tool table columns

Column header	Description
TI	The tool which produced this rundown.
St	Current step: More than one step can occur, e.g., if linking groups are programmed.
FID	Fastener ID: A unique ID for the tightened fastening position.
Ap	Application/Linking Group used.
S	This fastening stage.
Se	Fastening Sequence used in this fastening stage.
TP	Shut-off value programmed (torque or angle, depends on fastening sequence).
TqAct	Shut-off torque reached in this rundown.
PTq	Peak torque reached in this rundown.
Tq-OT	This value is provided if the torque reached does not agree with min. torque and max. torque tolerance. A negative value indicates less than min. torque. A positive value indicates greater than max. torque.
An	Angle value reached in this rundown. Angle counting begins from threshold torque.
An-OT	This value is provided if the angle reached does not agree with min. angle and max. angle tolerance. A negative value indicates less than min. angle. A positive value indicates greater than max. angle.
Gd	Gradient value reached in current rundown if available for rundown sequence.
Gd-OT	This value is provided if the gradient reached does not agree with min. gradient and max. gradient tolerance. A negative value indicates less than min. gradient. A positive value indicates greater than max. gradient.
Error	Reason for shut-off in this stage if stage is NOK.

The Tool monitor dialog provides access to the following features

Button	Description
	<Info> opens the Error table. This button is only displayed if an NOK rundown is selected in the Tool monitor. See chapter *12.2 Error table, page 183* for more information.
	<Oscilloscope> displays the Torque graph view, which provides a torque curve for each rundown. See chapter *4.5 Oscilloscope, page 23* for more information.

12.2 Error table

▶ Tap the <Info> button of the *Tool monitor* dialog.

The Error table lists all errors that occurred during a rundown. Various errors other than the actual reason for shut-off may be listed. The application and parameters used for a rundown determine which error is the reason for shut-off and which errors are listed in this table.

Column header	Description
SP	Spindle
s	Stage in which error occurs.
Error	Occurring error. For a description of errors, see chapter *15 Error messages / warnings, page 243.*
Explanation	Reason for shut-off in this stage.

12.3 Torque graph

See chapter 4.5 Oscilloscope, page 23.

12.4 Filtering archive entries

▶ Tap the <Filter> button of the *Archive* dialog.

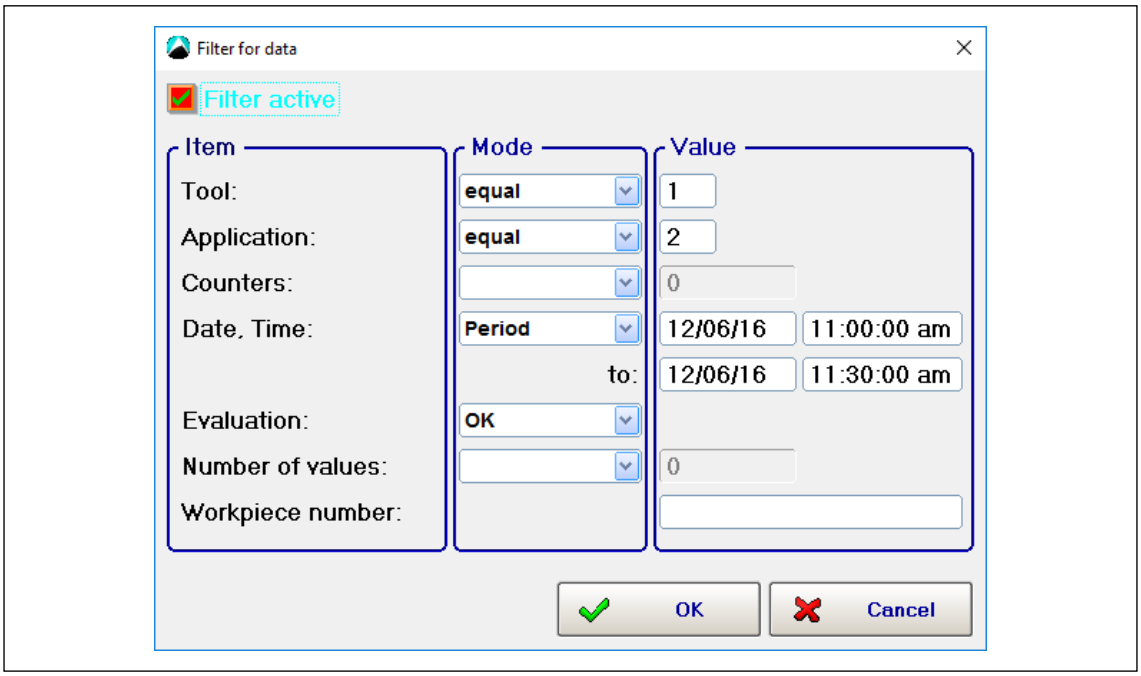


Fig. 12-1: Rundown Filter

1. If you enter filter criteria and tap <OK>.
   → The criteria are saved, but the filter is not applied to the Archive table.
2. Enable the <Filter active> checkbox to apply the filter.

The following filter options are available in the Filter dialog

Filter criteria		Description
Item	**Mode**	**Value**
Tool		Tool number filter • Vaue range: 1 to maximum number of tools • If no number is entered, data for all tools are displayed.
	equal	Displays all rundowns whose tool number is equal to the number entered.
	more	Displays all rundowns whose tool number is greater than that entered.
	less	Displays all rundowns whose tool number is less than that entered.
Application		Application number filter • Value range: 1 to maximum number of applications • If no number is entered, data for all applications are displayed.
	equal	Displays all rundowns whose application number is equal to the number entered.
	more/greater than	Displays all rundowns whose application number is greater than that entered.
	less than	Displays all rundowns whose application number is less than that entered.
Counters		Rundown counter filter • Value range: As large as rundown counter of the controller • If the value entered exceeds the rundown counter of the controller, the program uses the maximum value of the `Total` rundown counter. • If no number is entered, all rundowns are displayed.
	equal	Displays rundowns whose counter value is equal to the number entered.
	more	Displays rundowns whose counter value is greater than that entered.
	less	Displays rundowns whose counter value is less than that entered.
Date, Time		Date and time filter • The entry format for the date is MM.DD.YY. (The date format depends on the language set in: Navigator > Administration > Language.) • The entry format for the time is: HH:MM:SS. • If you enter values that do not fit the specified formats, an error message is displayed. • If no values are entered, all rundowns are displayed.
	equal	Displays rundowns whose date/time value is equal to the value entered.
	more	Displays rundowns whose date/time value is greater than that entered.
	less	Displays rundowns whose date/time value is smaller than that entered.
	Period	Displays rundowns whose date/time value is within the specified period. ▶ When you select the *Period* option, the second date/time line gets enabled. Enter a start date/time and an end date/time to define the period.

Filter criteria		Description
Item	**Mode**	**Value**
Evaluation		OK or NOK filter • If no option is selected, all rundowns are displayed.
	OK	Displays all OK rundowns.
	NOK	Displays all NOK rundowns.
Number of values		Number of data sets to be displayed • The maximum number of data sets displayed is 50. • If no number is entered, all rundowns are displayed.
	equal	Displays the number of rundowns specified by the value entered.
Workpiece number		Workpiece number filter Displays rundowns whose workpiece number is the same as the value entered. • The workpiece number is a sequence of alphanumeric characters. Any characters that the virtual keyboard or an external keyboard can generate are permitted. • The ? character acts as a wild card to represent unknown characters. • A maximum of 35 characters can be filtered.

12.5 Statistics

The *Statistics* dialog allows you to analyze rundown data. You can visualize results as Histogram, Range, and X-Bar graphs.

▶ Select *Navigator* > *Archive* > *Statistic.*

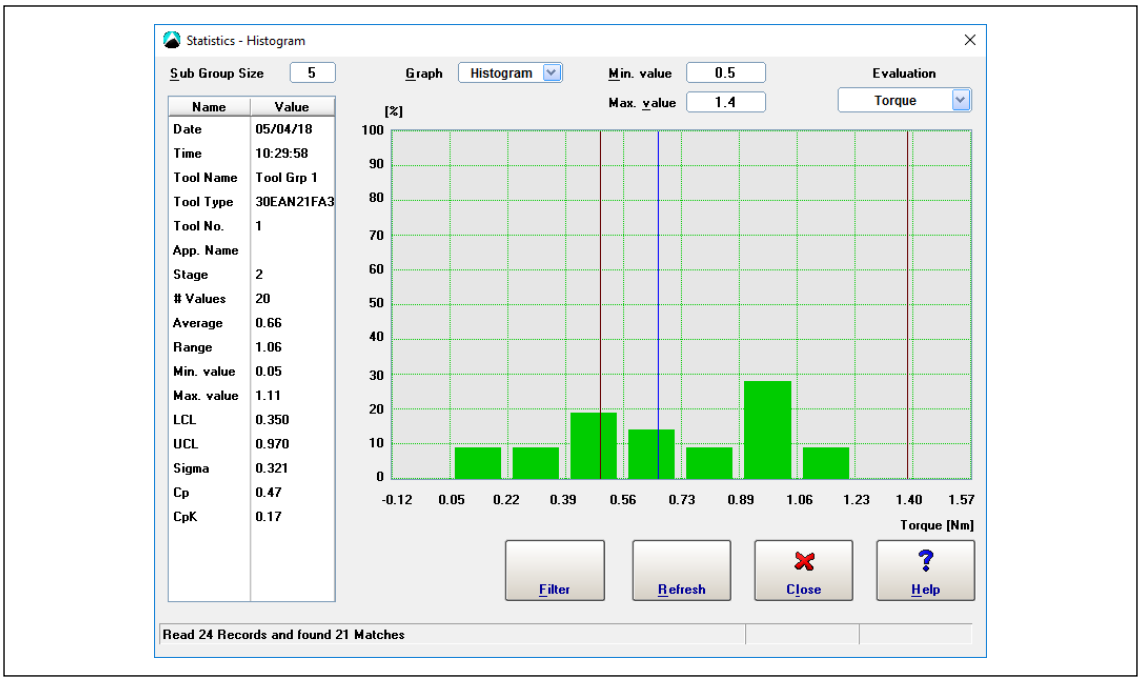


Fig. 12-2: Statistics dialog with a Histogram displayed

12.5.1 Defining data sets

The *Statistics Filter* dialog allows you to define rundown data sets for statistical analysis.

▶ Select *Navigator* > *Archive* > *Statistic* > *Filter*

The following options are available to define rundown data sets:

Option	Description
Tool, Application, Stage	Select the tool/tool group, application, and fastening stage to be included in the rundown data set.
Time Interval	Enter a *Start Date* and an *End Date* to define a time period for rundowns to be included.
Sample size	Define the number of rundowns to be included. • The maximum is 5,000 rundowns. • The most recent records are used.
Result Status	Include *OK*, *NOK*, or *ALL* rundowns in your data set.
Fastener ID	Confine your data set to rundowns associated with a specific *Fastener ID*.

12.5.2 Statistics settings

The *Statistics* dialog allows you to define how your rundown data is analyzed and visualized. The following options are available:

Option	Description
Sub Group Size	Enter a whole number from 2 to 25 to set the required subgroup size. • Serves to determine the lower and upper control limits. • Defines how many values are incorporated in scattering and X-bar calculation.
Graph	Select the required graph type to view statistics as Histogram, Range control chart (R chart), or X-Bar control chart.
Min. value Max. value	Enter values to set the lower specification limit (LSL) and upper specification limit (USL) for calculation of process capability indexes (cp and cpk).
Evaluation	Select the parameter (torque, angle, or gradient) to be analyzed.
<Refresh> button	Include new rundown data in the calculation.

On the left side of the *Statistics* dialog, a table displays an overview of the data analyzed and quality achieved:

Name	Description
# Values	The total number of records (torque, angle, or gradient) used across all subgroups in calculation and visualization. Example: If 43 records meet the criteria defined in the *Statistics Filter* and *Sub Group Size* is set to 25, only 25 values are used.
Average	The arithmetic mean of all values (torque, angle, or gradient) used. This is also the overall average (average of all subgroup averages).
Range	The spread (range between the min. and max. value) of all values (torque, angle, or gradient) used. Not the average of all subgroup ranges.
Min. value	The minimum value (torque, angle, or gradient) of all values considered.
Max. value	The maximum value (torque, angle, or gradient) of all values considered.

Name	Description
LCL	In quality control, the Lower control limit (LCL) is the lower limit for data points below the control (average) line in a control chart. For calculation, the overall average (average of all subgroup averages) and average of all subgroup ranges $\bar{R}$ are used. Additionally, a control limits factor (A_2 or D_3) is needed. This factor depends on the subgroup size and on the chart used. See the table below for applicable factors. For the Histogram and X-Bar chart, `LCL` is calculated using the following formula: $LCL_{\bar{x}} = \bar{X} - (A2 \times \bar{R})$ For the Range chart, *LCL* is calculated using the following formula: $LCL_{\bar{R}} = D_3 \times \bar{R}$
UCL	In quality control, the Upper control limit (UCL) is the upper limit for data points above the control (average) line in a control chart. For calculation, the overall average (average of all subgroup averages) and average of all subgroup ranges $\bar{R}$ are used. Additionally, a control limits factor (A_2 or D_4) is needed. This factor depends on the subgroup size and on the chart used. See the table below for applicable factors: For the Histogram and X-Bar chart, *UCL* is calculated using the following formula: $UCL_{\bar{x}} = \bar{X} - (A2 \times \bar{R})$ For the Range chart, *UCL* is calculated using the following formula: $UCL_{\bar{R}} = D_4 \times \bar{R}$
Sigma	The standard deviation is a measure of variability in a process. It indicates scatter around the mean. In the Statistics dialog (as in a random inspection), it is calculated for the applicable # *Values* (n) and *Average* (X-bar) and with each single value considered by the following formula: $\sigma = \sqrt{\frac{1}{n-1}} \quad \frac{\Sigma}{(i=1)} \quad (X_i - \bar{X})^2$
Cp	The *Cp* index is a measure of process capability. It is the ratio of the process tolerance (defined by the control limits) to 6 standard deviations: $C_p = \frac{USL - LSL}{6 \times S}$
CpK	The *CpK* index combines process potential and a measure of the difference between process and specification mean. *CpK* equals *Cp* if the process mean (X-bar) is centered on the target (nominal) specification value. If *CpK* is negative, the process mean is outside specification limits. If *CpK* is between 0 and 1, part of the 6 sigma spread is outside specifications. If *CpK* is greater than 1, the 6 sigma spread is completely within specifications. $C_{pK} = min\frac{(\bar{X} - LSL, USL - \bar{X})}{3 \times S}$

Control limits factors			
Subgroup size	**A_2**	**D_3**	**D_4**
2	1,880	0,000	3,267
3	1,023	0,000	2,574
4	0,729	0,000	2,282
5	0,577	0,000	2,114
6	0,483	0,000	2,004
7	0,419	0,076	1,924
8	0,373	0,136	1,864
9	0,337	0,184	1,816
10	0,308	0,223	1,777
11	0,285	0,256	1,744
12	0,266	0,283	1,717
13	0,249	0,307	1,693
14	0,235	0,328	1,672
15	0,223	0,347	1,653
16	0,212	0,363	1,637
17	0,203	0,378	1,622
18	0,194	0,391	1,608
19	0,187	0,403	1,597
20	0,180	0,415	1,585
21	0,173	0,425	1,575
22	0,167	0,434	1,566
23	0,162	0,443	1,557
24	0,157	0,451	1,548
25	0,153	0,459	1,541

12.5.3 Range chart

The Range chart is used to monitor the process standard deviation.

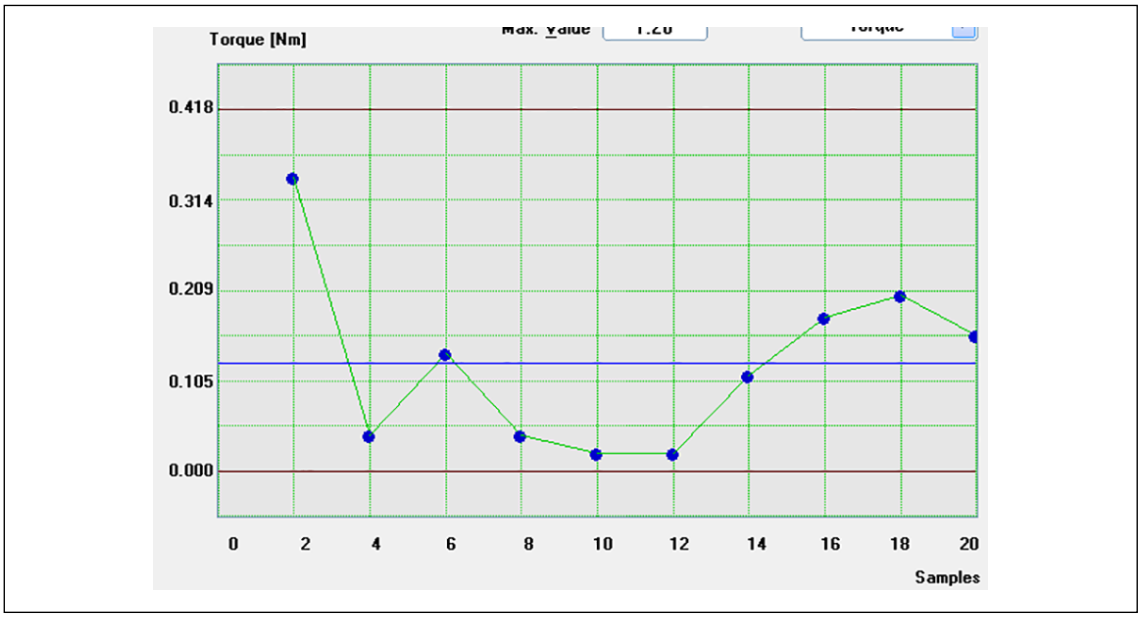


Fig. 12-3: Statistics - Range chart

The center line is defined as $CL = \bar{R}$.

12.5.4 X-Bar chart

The X-Bar chart is used to monitor the process mean.

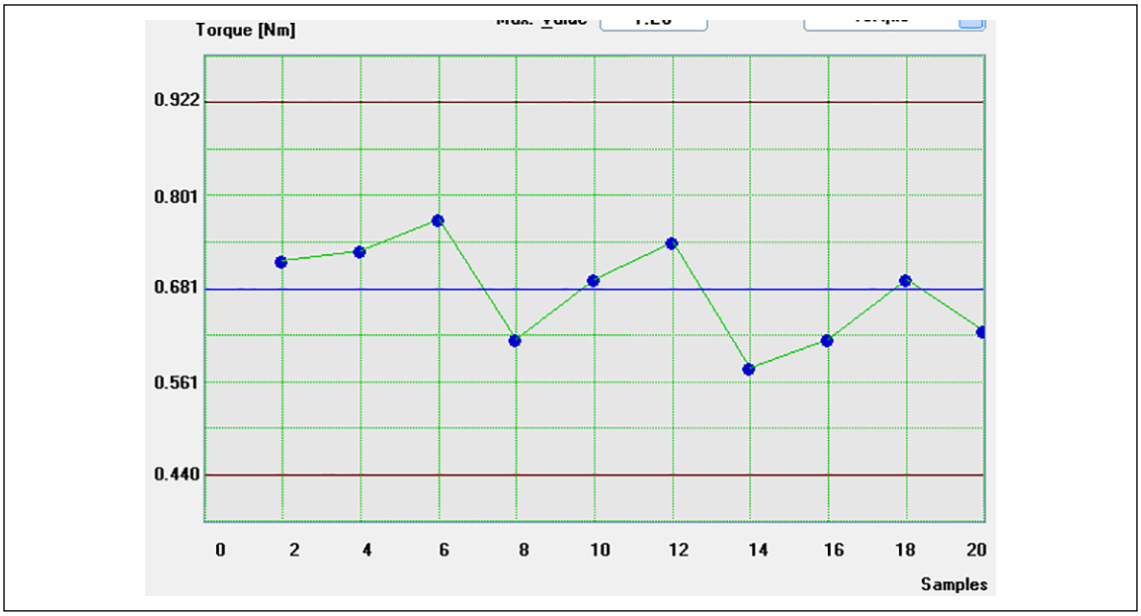


Fig. 12-4: Statistics - X-Bar chart

The center line is defined as $CL = \overline{X}$.

13 Utilities

The *Utilities* dialog is organized into four tabs, which provide access to the following functionality:

Tab	Features
Installed Versions	Access information on the installed controller software version and revision.
Software Update	Update software and measuring card firmware of the tightening module (TM).
System Settings	• Access information on system settings and configuration.
Offline	Load and save parameters.

13.1 Software Update

The *Software Update* tab allows you to install a software update packages. With a software update the system, servo firmware, help files and other functions can be actualized.

The *Active Software Package* field indicates the package from which the currently running software was loaded when the controller was started. After an update.

13.1.1 Update software

Button	Description
<Software Update>	<Software Update> opens the *Software Update Utility* dialog, which allows you to navigate to the software packages you want to install. The software package can be found under `https://software.apex-toolgroup.com/current-software-packages/mpro300gc/`.

The storage device you access may contain any packages for different products, but only valid packages intended for the target unit are listed.

To update software:

1. Select *Navigator* > *Utilities* > *Software Update*.
2. Tap the <Software Update> button on the *Software Update* tab to open the *Software Update Utility* dialog.
3. Navigate and select to the software package you want to install, and tap the <OK> button to execute the software update.
   Note:
   - If you use the mProRemote program, the drives of remote computers are displayed in addition to the drives of the controller.
   - If you use an USB stick, make sure that only the file for the software update is stored on the USB stick.

Note

During ANY update, the system power must not be switched off!

4. Wait until the installation process is finished and follow the instructions on the screen.
   While the software update is running, the <OK> button is grayed out. As soon as the <OK> button is activated, the installation process is completed.

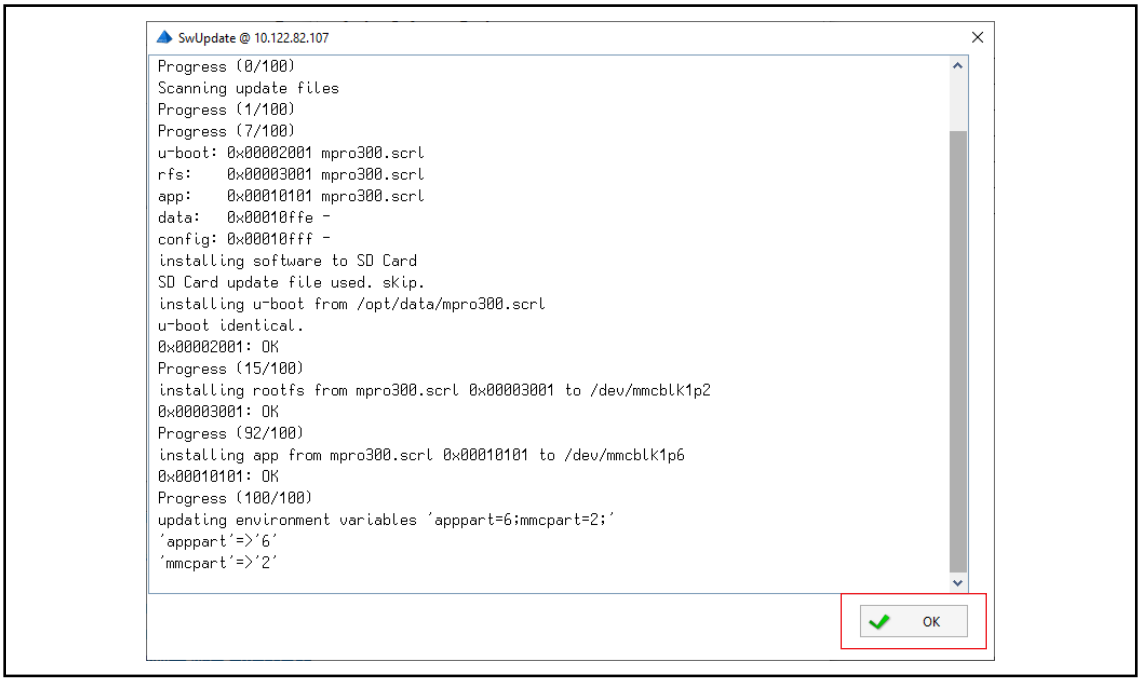


Fig. 13-1: Software update is completed

5. Tap the <OK> button to restart the controller and adopt the software.

Package date/time information indicates when the package was created and its contents were collected and stored.

13.1.2 Software update for mPro300GCD running in a secondary mode

The following applies to a software update of a secondary:

1. Select *Setup* > *Primary mode*, enter the password **0736381254** and confirm the following message to change the secondary mode to a primary mode.
   → After the restart, the controller is in secondary mode.
2. Perform the software update instructions, see chapter 13.1.1 Update software, page 190.
3. Select *Navigator* > *Utility* > *System Settings* > *Switch to secondary mode* and confirm the following messages to change the primary mode back to the secondary mode.
   → After the restart, the controller is in secondary mode.

13.2 System Settings

The *System Settings* tab allows you to view system settings.

Button	Description
	<System information> opens the *System information* dialog, which allows you to view information pertaining to the controller. Use the button controls in the dialog to display specific information.
<Switch to secondary mode>	Press <Switch to secondary mode> to switch from primary to secondary mode.

13.3 Switch between primary and secondary mode

The mPro300GCD controller can be used as a primary or secondary controller.

13.3.1 Primary mode

The controller is primarily used as a control and monitoring unit for one or more tools at a workstation.

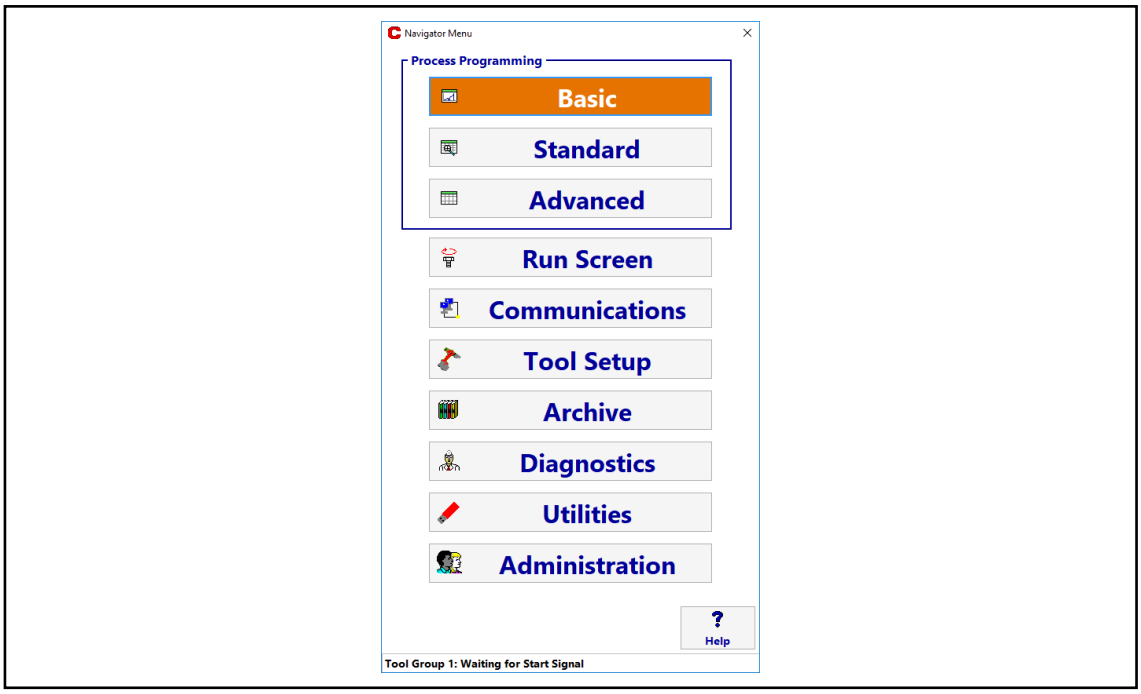


Fig. 13-2: Main screen in primary mode

To switch from primary to secondary mode:

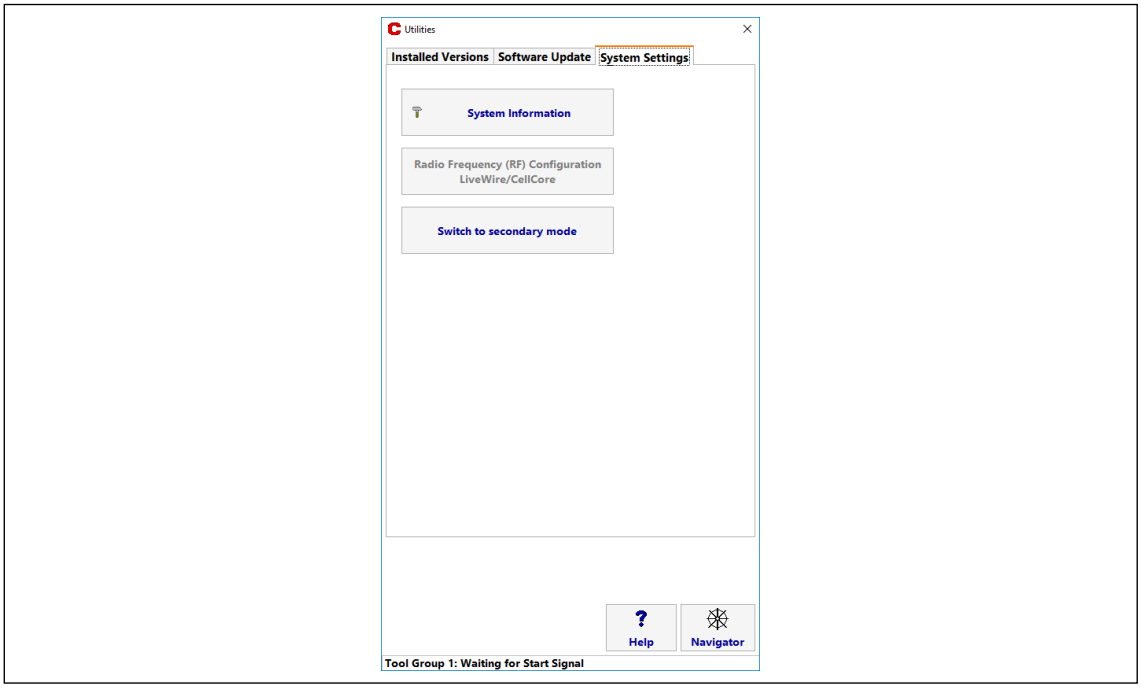


Fig. 13-3: Switch to secondary mode

1. Select *Navigator* > *Utility* > *System Settings* > *Switch to secondary mode*.
2. Confirm the following messages.
   → The controller restarts. After the restart, the controller is in secondary mode.

13.3.2 Secondary mode

The secondary controller is an extension module to the master or primary controller and is needed to operate another corded tool. It features I/Os for local error checking, peripherals and an LCD for user feedback and fault elimination.

The software interface of the secondary controller is only displayed in English.

The main screen of the secondary controller displays the data for the rundown performed.

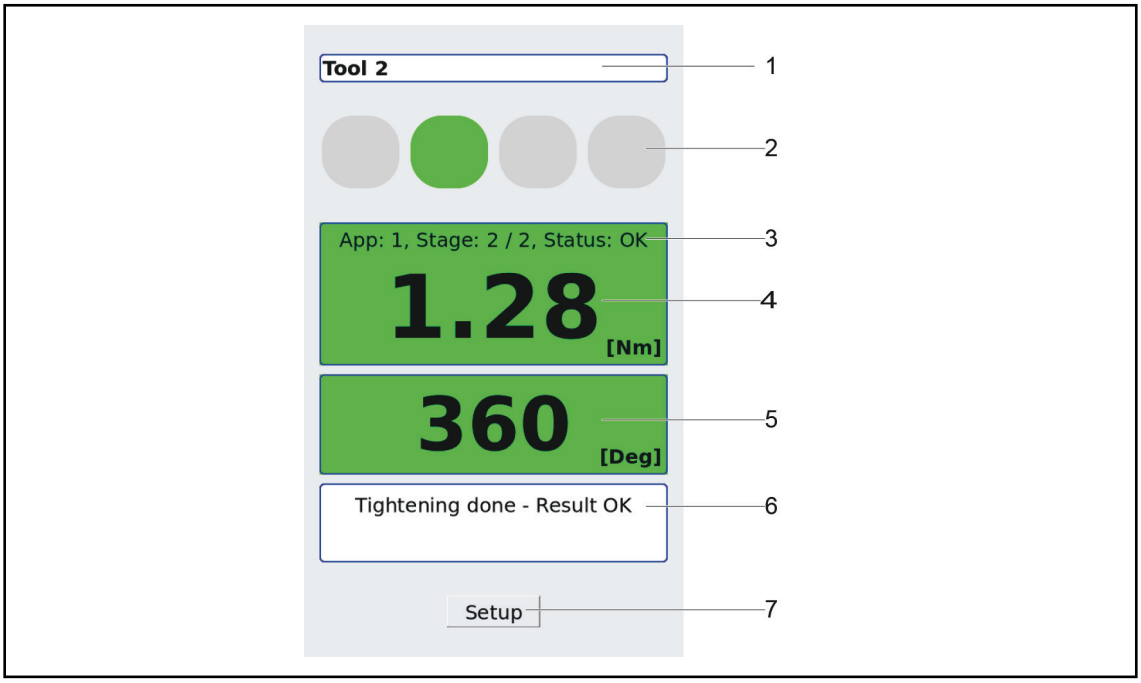


Fig. 13-4: Main screen in secondary mode

Item	Description
1	Tool number
2	LED strip
3	Status result
4	Torque result
5	Angle result
6	Status strip
7	Node address device

Tool number

The current tool number is displayed in the header. The number corresponds to the set node address.

LED strip

The four fields in the LED strip correspond to the configurable LED light rings on the NeoTek tool and light up in the colors red, green, yellow and blue.

Color	Explanation
Red	Rundown NOK
Green	Rundown OK
Yellow	Status
Blue	Not connected as standard, can be programmed at will

Status result

The status result displayed is made up of:

- **the application (App)**
  The application can be selected on the primary. Up to 99 applications are possible whose settings can be individually programmed.
- **the stage**
  The stage shows the stage currently reached and the total number of stages to the end of a rundown.
  Example: Stage 2 / 3 (current stage: 2, total number of stages: 3)
- **the status**
  The status indicates whether the rundown performed was correct (OK) or not (NOK). NOK occurs when the measured rundown values for torque or angle of rotation are not within the programmed tolerance.

Torque result

This field is made up of the torque for the rundown and its unit.

Background color

The background color to the field indicates whether the result is OK.

Background color	Explanation
Red	The torque for the rundown is higher than the defined torque (NOK)
Green	The torque for the rundown corresponds to the defined parameters (OK)
Yellow	The torque for the rundown is lower than the defined torque (NOK)

Unit

The unit can be changed in the primary:

1. *Navigator > Advanced > Controller > General*
2. Under *Custom Torque units* there is a dropdown menu *Torque* in which one of the following units can be selected: Nm, FtLbs, InLbs, dNm or CUSTOM

Peak torque

If a peak torque is set in the primary, the peak torque is marked with a leading "P".

The peak torque can be activated in the primary:

1. *Navigator > Standard > Select application > Stages*
2. Activate the control box *Show peak torque*.

Angle result

This field shows the angle result and its unit.

Background color

The background color to the field indicates whether the result is OK.

Background color	Explanation
Red	The angle for the rundown is higher than the defined angle (NOK)
Green	The angle for the rundown corresponds to the defined parameters (OK)
Yellow	The angle for the rundown is higher than the defined angle

Status strip

The current rundown status is displayed in the top two lines of the status strip.

Status message	Explanation
No communication with master	No connection to primary
Rundown in progress	Status during rundown
Tightening done - Result NOK	Rundown complete, result NOK
Tightening done - Result OK	Rundown complete, result OK

Errors are displayed in the bottom lines of the status strip (e.g. Ems error [1000]: Tool disconnected).

Node address device

The node is used by the primary controller for unambiguous assignment of the tools and secondary controllers. Every secondary controller requires a separate node address to make unambiguous communication with the primary controller possible and to guarantee functionality.

1. To display or edit the node address, click on <Setup>.
   → A window with the following options opens:

Option	Description
Node address	Current node address
<Setup node adress>	Set up the node address
<Primary mode>	Switch to Primary mode
<Back>	Back to main menu

2. To edit the node address, click on <Setup node address>.
3. Enter the password. The password is predefined: **0736381254**
4. Increase the number of the node address with the ▲ key or reduce it with ▼ and confirm with <OK>.

Numbers between 1 and 32 can be selected for the node address.
Node address 1 should only be used if the secondary controller is connected to a master controller as this has no tightening module. The primary controller contains a tightening module assigned as standard to the first node address.

5. Confirm the following message **Save and Reboot?** with <Yes>.
   → The secondary controller executes a reboot. The node address is then changed.

Duplicate node addresses

After the node address has been changed, the secondary controller checks whether the selected address has already been assigned to another device. If this is the case, the message **Duplicate node detected!!!** appears after the node address has been changed.

To duplicate a node address:
1. Confirm the message **Duplicate node detected!!!** with <OK>.
2. Confirm the message **Save and Reboot?** with <Yes>.
3. Confirm the message **Are you sure to accept duplicate node?** with <Yes>.

If a node address is duplicated, the secondary controller will no longer communicate with the primary controller.

Switch to primary mode

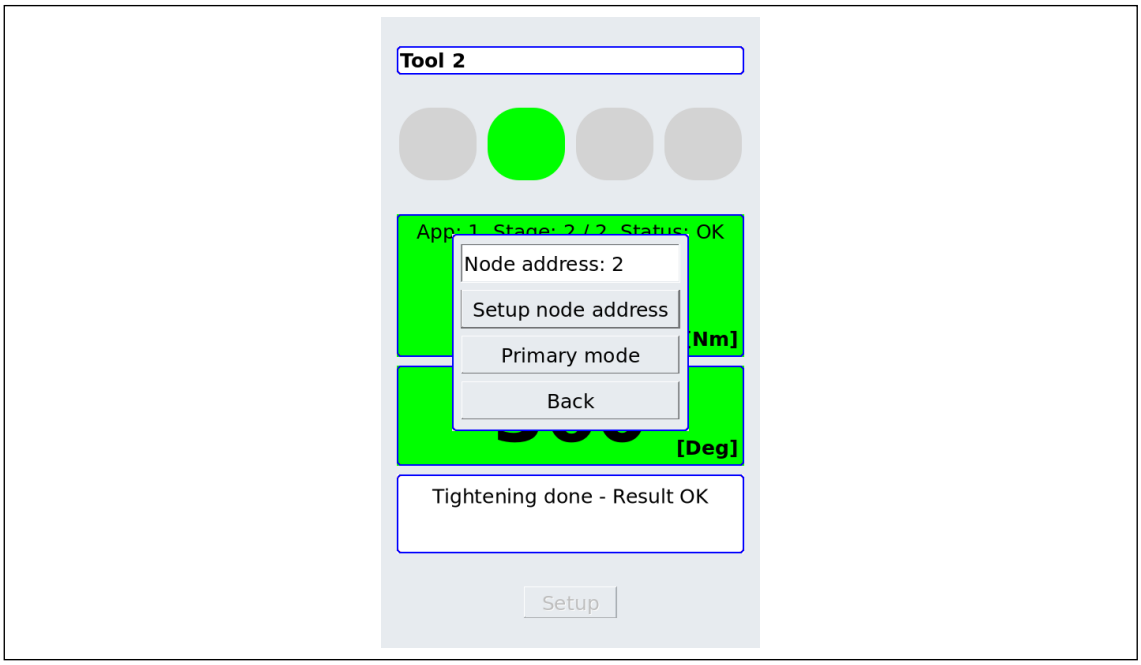


Fig. 13-5: Switch to primary mode

To switch from secondary to primary mode:

1. Press <Setup>.
2. Press <Primary mode>.
3. Enter the password. The password is predefined: **0736381254**
4. Confirm the following message **Save and Reboot?** with <Yes>.
   → The controller restarts. After the restart, the controller is in primary mode.

14 Administration

The *Administration* dialog allows you to select the language of the user interface, set date and time, view and reset counters, set password protection, and load, save, and print system configuration information.

▶ Select *Navigatior* > *Administration*.

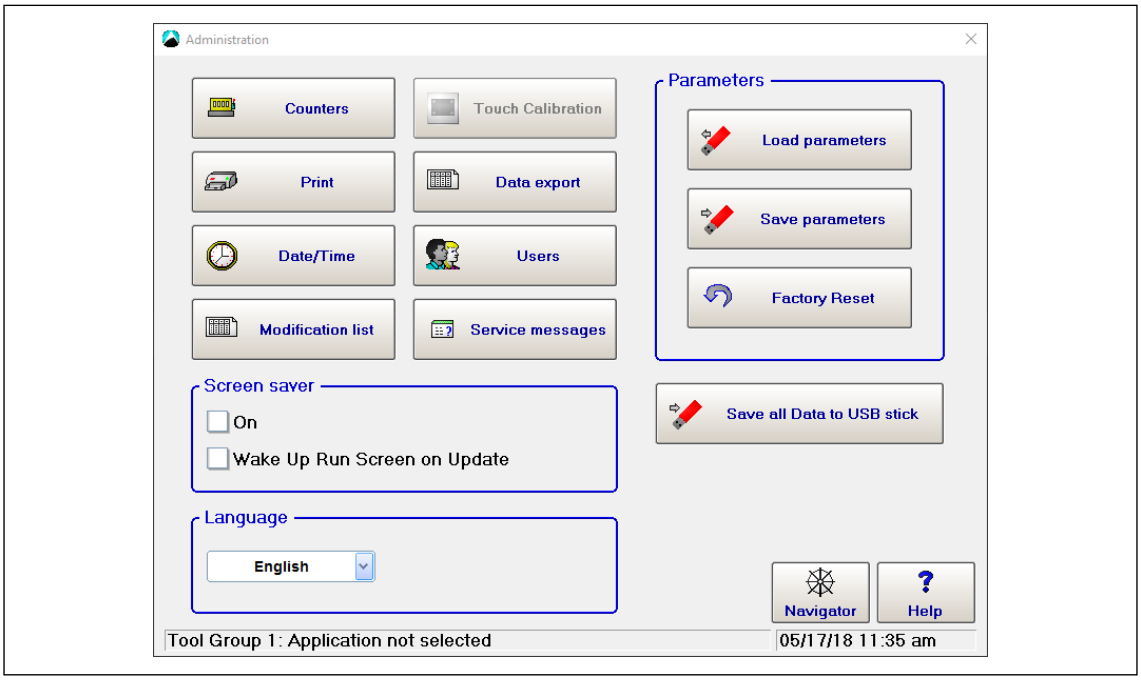


Fig. 14-1: Administration

14.1 Counters

The *Counters status* dialog allows you to reset the counters of OK, NOK, and total rundowns, which you can display on the *Run Screen*.

▶ Select *Navigatior* > *Administration* > *Counters*.

Button	Description
<Reset all counters>	<Reset all counters> resets all counters.
<Reset displayed counter>	<Reset displayed counter> resets the displayed counters.
	This button opens the *Select Tool Group* dialog to choose a Tool Group.

14.2 Print

▶ Select *Navigation* > *Administration* > *Print*.

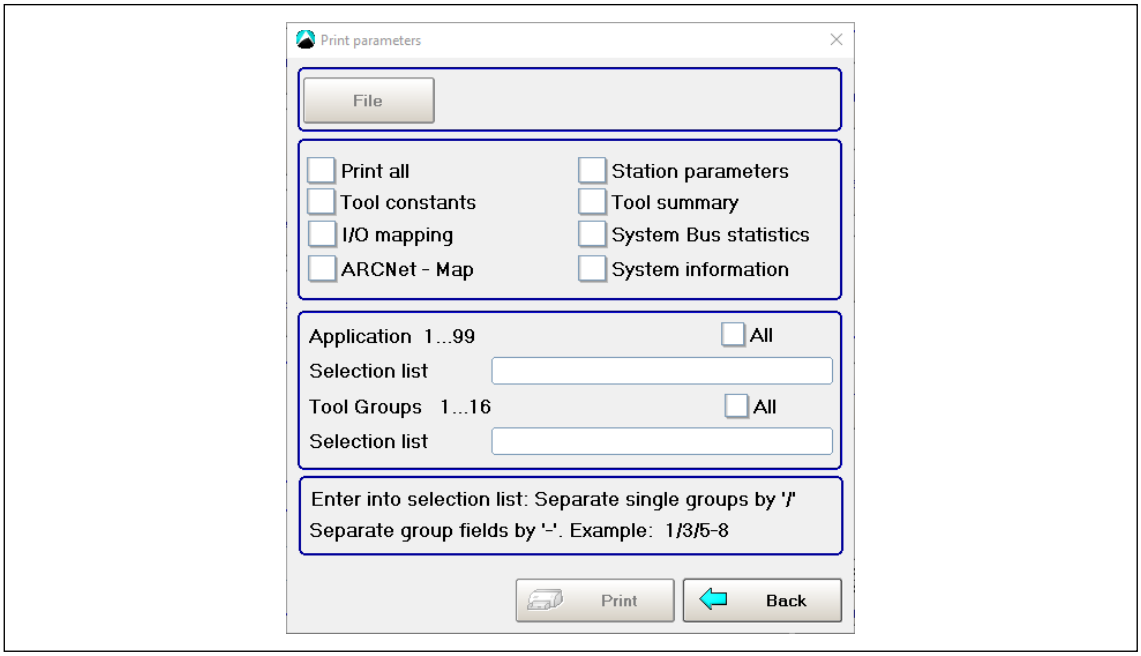


Fig. 14-2: Counters status

To save data to a file:

→ Select the data you want to save and tap the <File> button.

- The file name should have a maximum of 8 characters not including the file extension.
- You can select data of specific applications or tool groups by entering the application and tool group numbers in the *Application* and *Tool Groups Selection list* text boxes.

14.3 Date and time

Each parameter that the controller saves with the date or time refers to the real time clock. This also applies to the rundown process time. The setting must therefore be checked regularly.

1. Enter the date and time in the required format:
   - The format depends on the language selected.
2. Tap the button to confirm the values in the input boxes, which are then adopted by the controller real time clock.

14.4 Modification list

The Modification list indicates who has last changed parameters. It lists all registered, admitted users with ID, User name, and Rights. The Date and Time columns indicate when the user has made the last changes. This information is entered when parameters are accepted into the station (safety prompt). For users who have not made any changes, the date and time of their registration is listed.

14.5 Touch Calibration

1. Tap the <Touch Calibration> button to recalibrate the touch-screen.
2. Follow instructions on the screen:
   - Tap the items displayed until they are highlighted green. This redefines coordinates and completes calibration.
   - You can test, save, or discard calibration settings.

14.6 Data export

The Data export feature allows you to export rundown data to a file.

14.6.1 Generate a dBase file

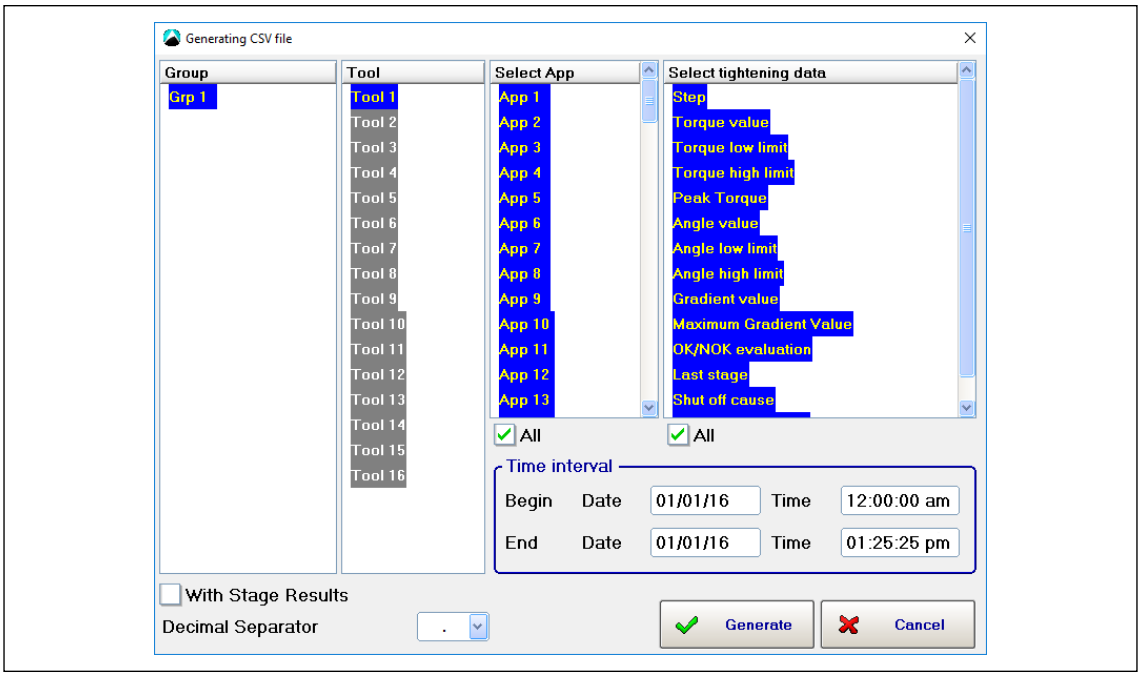


Fig. 14-3: Generating a dBase file

1. Tap groups, tools, and applications in the table to select or deselect them.
2. Select tightening data in the table.
3. Enter dates and times in the *Begin* and *End* input boxes to define the beginning and end of the required time period.
   - The default *Time interval* is midnight to current time. That is, the current date (system date), the time '00:00:00' for *Begin*, and the current time (system time) for *End* are entered by default.
4. Enter a name for the dBase file in the *File name* input box.
   - The file name '*dgd*' is entered by default.
   - You cannot change the file extension (.DBF).
5. Tap the <Generate> button to confirm entries and generate the dBase file.
   - A progress indicator is displayed.
6. The dBase file is generated in the archive folder and then copied to a target folder of your choice. Select the target folder.
7. You can import the generated dBase file in any statistics, spreadsheet, or database program with the appropriate filter.

14.6.2 File structure of a dBase file

Bytes	Addr.	Description	Example	Remarks
0	0x00	Table file type	03	dBase IV without memo
01-03	0x01	Last revision	61 02 0B	970211 (YY MM DD)
04-07	0x04	Number of data records	3D 01 00 00	LB...HB, here 317 (dec)
08-09	0x08	Position of first data record	A3 01	LB...HB, here addr. 0x01A3
10-11	0x0A	Length of data record	2B 03	LB...HB, here 811 (dec)
12-13	0x0C	Reserved	-	-
23-n	0x20	Lower-order records for field description, each 32 bytes		See example in Example: Lower-order records for field description

Bytes	Addr.	Description	Example	Remarks
n+1		End mark for table header	0D	
n+2		1st data record		See example in Example: Data record
…		Next data record		
…		File end	1A	

Example: Lower-order records for field description

(Address offset n = number of field description * 32)

Addr.	Description	Example	Remarks
n+0	Field name max. 10 ASCII		
Characters + final byte 0x00	4D 44 00 00 00 00		
00			
00 00 00 00 00	Here TQ		
n+11	Data type	46	N = Numerical (4E)
D = Date (44)			
F = Floating point (46: here)			
C = Characters (43)			
n+12	Position of field in data		
record	01 00 00 00	10 (dec.)	
n+16	Length of field	0x0A	10 (dec.)
n+17	Number of decimal places	0x02	
n+18 to n+32	Reserved		

Example: Data record

Description	Example	Remarks
Byte for delete marker	0x20	20 = No delete marker
2A = Delete marker		
Data in ASCII	20 20 20 20 31 32 33 2E 38 39	123.89 (dec.)

14.6.3 Editing with Excel

Data record	Date	Time	App	Tool	TQ_ACT	AN_ACT	Result
1	28.11.2000	08:28	3	1	0,39	360,00	OK
2	28.11.2000	11:08	1	1	2,20	722,00	NOK
3	28.11.2000	13:58	1	1	1,54	721,00	NOK
4	28.11.2000	14:02	3	1	0,53	360,00	OK

14.6.4 Editing with FoxPro C2.6

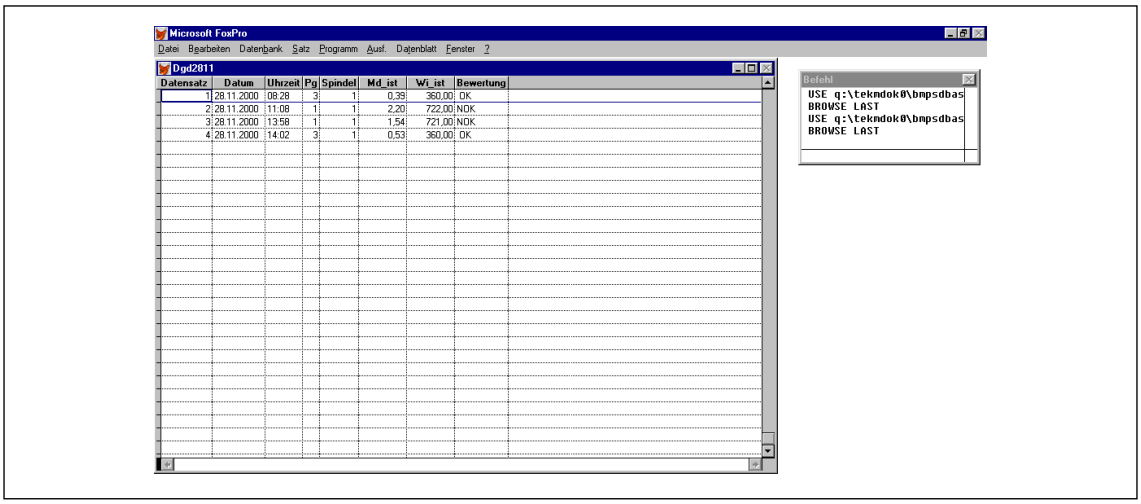


Fig. 14-4: FoxPro

14.6.5 Editing with Access

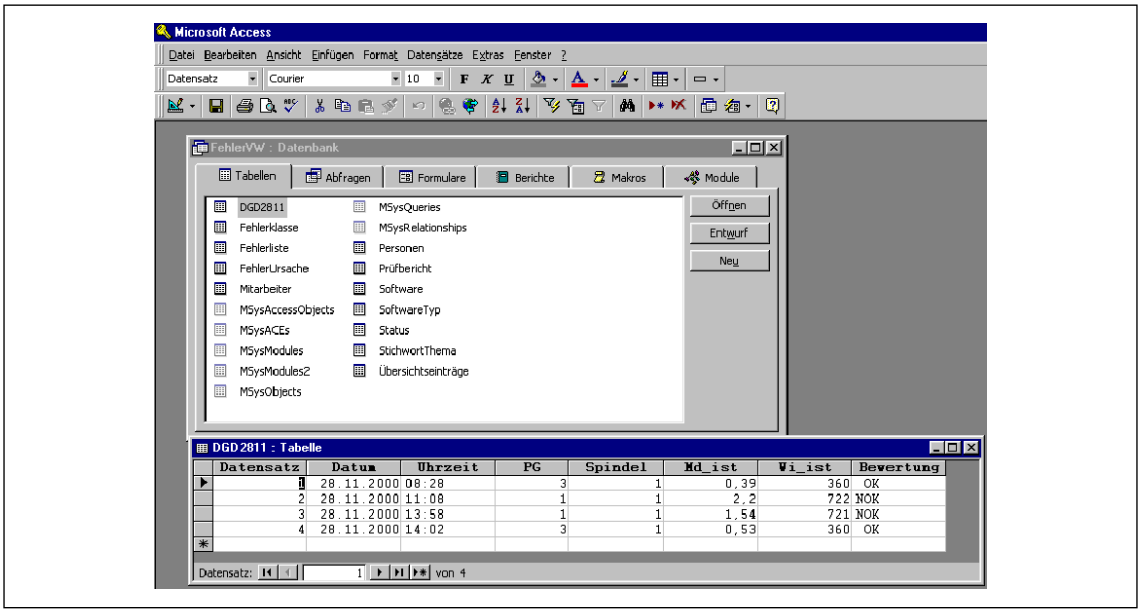


Fig. 14-5: Access

14.7 Users

Register users and assign access rights to control access to features and parameters. You can register 10 users.

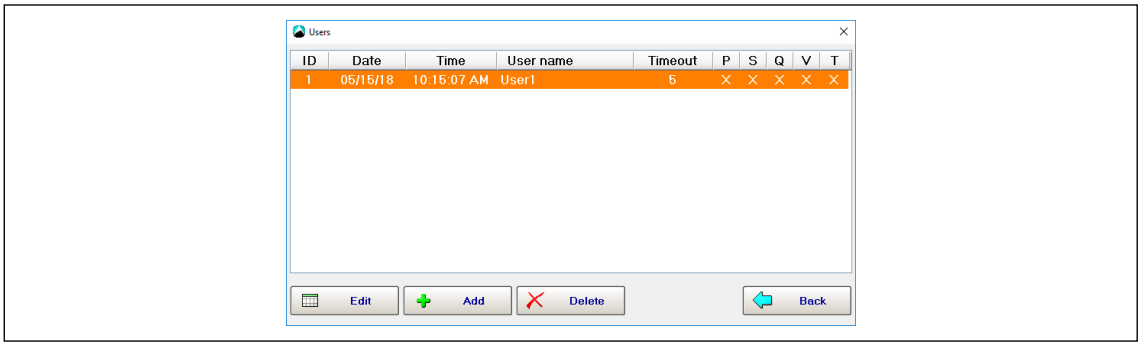


Fig. 14-6: User

- Password protection is only activated when a user is registered.
- A user name is required for service functions.
- Password protection is deactivated if no users are registered. In this case, no password prompt is displayed for any of the functions.

User rights

P – Process programming
S – System programming
Q – Statistics
V - Administration

Screen	Read	Write
Navigator		
Basic Application Builder		P
Standard Application Builder		P
Advanced		S
Matrix		
Delete		S
Inputs		
Outputs		
Timer		
Linking		S
Advanced	T	
Controller		S
Tool Group		S
Run Screen		
Archive		
Delete	V	
Export	–	–
Oscilloscope	–	–
Configuration		
Configure	–	–
Communications		
Data transmission		S
Part ID		S
Network Settings		S
Field Bus		S

Screen				Read	Write
Tool Setup				S	
	Install			S	
	Edit			S	
	Uninstall			S	
	I/O			S	
		OK			P
Archive					
	Export			V	
	Delete			–	–
Diagnostics					
	System				
		I/O Mapping		–	–
		System Bus			
		Accept Map		S	
		System Information		–	–
			Delete	S	
		Logbook			
			Delete	T	
		Task Messages		–	–
		System warnings		–	–
		Status Monitor		–	–
		Hardware Test		–	–
		Net / Proc		–	–
		Data Transmission		T	
		Ping		–	–
		XML/CSV Data transmission		–	–
		XML/CSV Log Files		–	–
		Switch board		T	–
		Outputs		T	–
		Bus monitor		–	–
	Tool				
		TQ Calibration		T	
		Angle Encoder		T	
		Voltages		T	
		TQ measur.		T	
		RPM		T	
		Current calibratopn		T	
		Tool memory		–	–
Utilities					
	Installed Versions			–	–
	Software Update				
		Software update		V	
		TM Measuring Card Firmware		V	
	System settings				
		System information		–	–
	Offline				
		Load Parameters		V	

Screen				Read	Write
		Save Parameters		V	
Administration					
	Counters				
		Reset Counters		V	
		Touch Calibration		V	
		Print		V	
		Date/Time		V	
		Modification List		–	–
		Data Export		V	
		Users			
			Add	V	
			Edit	V	
			Delete	V	
	Load Parameters			V	
	Save Parameters			V	
	Factory Reset			V	
	Save all data to USB stick			–	–
	Language			–	–

14.8 Service messages

Service messages are displayed after a programmed number of rundowns. They do not influence the OK/NOK evaluation of a rundown and do not depend on it. Ten different messages can be output at different intervals. Output is made to the status line and also to the task messages as soon as an interval counter has reached the programmed status. The output remains on screen or is continuously repeated until it is acknowledged by resetting the interval counter for this message. Then interval counting for this message resumes. The interval counters can be reset individually or all at the same time. You can enter any text for the messages. Since the *Service messages* function is mainly designed for periodic maintenance work, typical messages are suggested for selection.

Interval for service messages

▶ Tap the *Interval* text box in the required table row to display the virtual keyboard and enter the interval (number of rundowns) after which the message is to be displayed.

Message text

1. Enter your own message text: Tap the *Message* text box in the required table row to display the virtual keyboard.
2. Select an available message: Tap <Enter> on the virtual keyboard or select the *Select message* option from the *Message* menu to display the *Select message* dialog.

Reset intervals for service messages

1. Reset all intervals: Select the *Reset all* option from the *Interval counters* menu
2. Reset a specific interval: Select the *Reset* option to open the *Reset interval counter* dialog, select the required message number, and tap <OK> to confirm.

Number of rundowns

This is an overall counter, which is incremented for every fastening sequence at a station. You cannot change the counter. Its status is therefore suitable for documentation of maintenance work performed. If the battery RAM is erased, all counter states are reset. Service messages are separately available for each fastening group.

14.9 Load and save parameters

Load parameters from an internal storage device (SD card) or a connected USB drive

1. Select a file and confirm to load the parameters.
   → Parameters loaded from file are transferred to the main memory of the station and are available as current fastening parameters.

Note

Do not load new parameters during a rundown.

2. Confirm the *Transfer to station* once the parameters have been loaded from the file.
   - Two safety prompts are displayed. After this, the same message as during programming is displayed.

Save parameters

You can perform a backup of either all or just selected parameters and settings. You can save the data on an internal storage device (SD card) or a connected USB drive.

14.10 Factory Reset

The Factory Reset deletes all configuration data and resets to factory defaults!

14.11 Save all Data to USB stick

This feature allows you to save current parameters and all archived data, messages, and information on controller exceptions.

To save all data to a USB stick:
1. Insert a memory stick into a USB port on the controller.
2. Tap <Save all Data to USB stick>.
3. Navigate to the folder on the USB stick where you want to save the data.
4. Tap <OK> to save all data.
   → Two files, **`Parameters.tar.z`** and **`Archive.tar.z`**, are automatically created in the selected folder on the USB stick.

14.12 Screen Saver

When the controller is idle, the screen backlight stays on for the number of minutes programmed in the screen-off timer. It is turned off when the programmed time expires. It is turned on again when a keypad key is pressed, an external input signal is changed, or the tool is started. When you set the screen-off timer to 0 minutes, the backlight stays on indefinitely.

To extend service life of the screen backlight:
- Set the timer to an appropriate value.
- Uncheck the *Wake Up Run Screen on Update* option if applicable:
  - With this option unchecked, the backlight is only turned on when a keypad key is pressed.
  - With this option checked, any change in external I/O (e.g., tool enable, tool start) turns on the screen and resets the screen-off timer.

14.13 Language

Select the language for the user interface. Available languages are:
German, English, Polnish, Spanish, Italian, French, Portuguese, Russian and Chinese.

15 Error messages / warnings

The error messages and warnings relating to the tightening sequences are only a small fraction of the numerous error messages and warnings that may be output by the controller.

Error messages from the sequences:

Error Message	Description
?!?	Unknown error
???	Wrong App (Application) or ST (stage)
A1D	Angle encoder 1 defective
A2D	Angle encoder 2 defective
ABGW	Tool was de-selected
ADU	Fault in AD converter
AN1F	Transducer 1 absent
ANG<	Angle too low
ANG>	Angle too high
App?	Wrong App selected on TM
ARC?	Fault in System Bus interface
ARE	Angle redundant check error
AUF?	Fault in order to TM (Measuring board)
AW<	Not enough measured val. for eval.
BLOC	Bolted on block
CAL1	Calibration error transducer 1
COM?	Fault, ser. interface COM1 of TM (Measuring board)
CRC	CRC error
DF?	Invalid damping factor in diagram
DPR?	Fault, DPR (Dual Ported RAM) on TM (Measuring board)
EMER	Terminated by emergency stop
EMS	Error by tool
FHW	Measuring board hardware fault
FLT	Servo fault
FMK	Error measuring board
FPEF	Joint Detection error
FSMW	FRTM: Not enough measured values
GD<	Gradient too low
GD>	Gradient too high
GEB?	Encoder fault MD/WI
GeWi	Total angle reached
I<	Current too low
I>	Current exceeded
I2T	I^2T error
INI?	No signal from initiator
IP	Error output section, excess current
IRED	Current/MD redund.
JUM	Error by socket jump
KOMM	Communication fault Host <--> TM
KVF	Critical screw fastening fault
LFF	LFF: Bearing error SEQ56
M1<	Torque M1 threshold not reached

Error Message	Description
M1>	Torque M1 exceeded
M2<	Torque M2 threshold not reached
M2>	Torque M2 exceeded
MBO>	High evaluation torque exceeded
MBU<	Low evaluation torque threshold not reached
MDSI	Safety Torque exceeded
ME>	Press-in moment too large
MST>	Max. distribution moment exceeded
NBB	Tool not ready
NBBR	Nut or Bolt broken
NECK	Socket or fastener breakage
NOEN	Enable Signal missing
OBew	Without evaluation
OFF1	Offset error transducer 1
P1M>	FRTM: Torque in phase 1 too high
P2M<	FRTM: Torque in phase 2 too low
P2M<	P2M<: Phase2: TQ too low
P2M>	FRTM: Torque in phase 2 too high
P2M>	P2M>: Phase2: TQ too high
P2OU	FRTM: Too much overstep and under-step in phase 2
P3M<	P3M<: Phase3: TQ too low
P3M>	P3M>: Phase3: TQ too high
P4M<	P4M<: Phase4: TQ too low
P4M>	P4M>: Phase4: TQ too high
PAR	Wrong parameter
PS?	Wrong parameter set
PTR	PTR (Pulse Torque Recovery) fault
RAM	Memory error measuring board
RES?	Valid results not available
S?	Terminated by another error
SA	Terminated by take away start signal
SeBB	No ready signal for servo
SePS	Defective servo Parameter Set
Seq	Sequence number not correct
SEQ?	No sequence activated
SERV	Servo type not correct
SP?	Tool not in Tool Group
SPC1	No channel settings transducer 1
Spg?	Voltages faulty
SS>	Max. stick-slip cycle count exceeded
SST>	Max. stick-slip time exceeded
STRT	Start problems
STTH	Stop at threshold
StuF	Rundown fault in stage monitor
SVF	Screw fastening fault
T1?	Fault, intell. sensor 1
T2?	Fault, in intell. sensor 2

Error Message	Description
TDS	Shut off by depth sensor
TERM	Other termination
TEST	MD fault in test
THCF	Fault, TorqueHoldControl
TMAX	Terminated by Max. time exceeded
TMS<	Angle redundancy by time below min Value
TMS>	Angle redundancy by time exceeded
TQ<	Torque too low
Tq<	Torque fallen below
TQ>	Torque too high
Tq>	Torque exceeded
TqOV	DTM: Torque too high
TqP<	DTM: Breakaway torque not reached
TqP>	DTM: Breakaway torque too high
TQRE	Torque redundant check error
TqUN	MRT: Torque too low
TRD?	Sensor not present or defective
TSD	Trigger Switch defective
WIG<	WIG<: Total angle too low
WIG>	WIG>: Total angle too high
WiPr	Fault in angle processor
ZRF	ZRF: Gear wheel faulty SEQ56

Error messages and notes displayed on the screen:

Error	Cause	Measure
SD card is not recognized. 	No SD card available.	▶ Insert Cleco SD card.
	SD card not inserted correctly.	▶ Insert Cleco SD card correctly.
	No signed SD card. → SD card is invalid.	▶ Use Cleco SD card.
	Data on the SD card is damaged.	▶ Replace Cleco SD card.

Error	Cause	Measure
Software is not recognized. 	Software is damaged or not available.	▶ Perform recovery. If the software is still not recognized: ▶ Replace Cleco SD card. ▶ Replace the controller.

Note	Cause	Measure
Booting  	The software is written to the new SD card. This screen is only displayed after inserting a new SD card.	Wait until the controller is booted. → The loading bar indicates when the process is finished.

16 Open Source Software

This product contains various open source software packages that are distributed under various open source licenses. Further information regarding the open source packages and licenses can be found at: http://software.apextoolgroup.com/oss-legal/.

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17 Glossary

Term	Description
Accepted Data	Data within the acceptable limits of a fastening strategy
Angle	Angle to be reached at the end of a fastening process (also final angle, rated angle, or nominal angle)
Angle Capability Indexes	Measure of acceptable variation in final angle values for a fastening process
Angle Control	Fastening strategy that controls a tool based on angle limits
Angle Encoder	Device that measures the angle of rotation
Angle High	Active if final angle > angle high limit
Angle High Limit (AHL)	Maximum angle of rotation that may be reached during a cycle
Angle Limits	Range between the maximum and minimum acceptable angle for one cycle
Angle Low	Active if final angle < angle low limit
Angle Low Limit (ALL)	Minimum angle of rotation that must be reached during a cycle
Angle Monitoring	Fastening strategy that monitors a tool based on angle limits
Angle Reject	Cycle rejected if no acceptable angle is reached
Application	Programmed setting of the tool for a specific fastening process of up to 6 stages
Application Select 0-7	Application selects 0-7 are used to select applications 1-99 using a binary count of 0-7 where app. sel. 0 is the least significant bit.
Baud Rate	Frequency at which the unit communicates
Cycle Complete	Active whenever tool is not running
Cycle OK	Run cycle within limits
Default Parameters	Parameters automatically selected by the unit
Desired Final Torque	Final torque desired in a fastening process (referred to as torque set point)
End Delay Time (ms)	Delay from the time the tool is switched off until measurement stops
Engineering Units	Units of torque measurement
External Transducer	Transducer physically located outside the tool
Fastener Rotation	Direction in which a fastener rotates
Fastening Group	The *Fastening groups* dialog allows you to arrange a maximum of 32 tools into groups for the purpose of programming a common start delay time for each group (Fastening stage timing).
Fastening Strategy	Strategy used to control or monitor a fastening process
Final Angle	Final angle desired in a fastening process
Histogram	Printout generated from statistical data output
If NOK go to stage	Gives the control system direction if the stage is NOK
Internal Transducer	Transducer physically located inside the tool
LCD Screen	Screen on the unit that provides directions for programming the unit
LED Screen	Screen on the unit that provides the readout data from a run cycle
Linking	The Linking feature allows you to automatically change from application to application for a predefined number of Linking Steps (programmed positions for which an application can be programmed). Each Linking Step refers to one tightening position specified by a unique Fastener ID. You can program up to 99 different linking strategies, which are also referred to as Linking Groups.
Load	Refers to the amount of torque applied to a device or tool
Main Menu	First menu that appears on LCD screen
Master Transducer	Transducer used as a benchmark to calibrate another transducer
Max. Fastening Time (mS)	Maximum time for the tool to run during the stage
Maximum Tool Speed	Maximum admissible speed of tool

Term	Description
Mean (X-bar)	Average of all readings taken in a sample, the sum divided by the count
mPro400GC(D)	stands for all versions of the controller described here.
NOK	Active if Torque/Angle/Yield Point are outside the programmed limits or some other fault has occurred
NOK After Reverse	If yes, the controller reports an NOK when the tool is run in reverse.
Number of Repeats NOK (linking)	Sets the number of times a fastener can be retightened after an NOK on the same tightening position before advancing to the next Linking Step.
OK	Active if Torque/Angle/Yield Point are within the programmed limits
Peak Torque	Maximum torque achieved in a run cycle
Port	Socket used for connecting a cable or peripheral equipment
Position (linking)	A number between 1 and 96 which defines the rundown position during linking
Power Supply	Unit used to supply power to an electrical device
Process Capability (Cp)	Measures variation in a process. Is equal to quotient of process tolerance (difference between upper and lower specification limit) divided by six standard deviations. Is always greater than zero with larger values indicating a more capable process. Also referred to as Process Potential Index or Inherent Capability Index.
Process Capability Index (Cpk)	Measures how close a process runs to specification limits. Combines process potential and the difference between process and specification mean. Cpk is equal to Cp if the process mean (X-bar) is centered on the target (nominal) specification value. If Cpk is negative, the process mean is outside specification limits. If Cpk is between 0 and 1, part of the Six Sigma spread is outside specification tolerance. If Cpk is greater than 1, the Six Sigma spread is completely within specification.
Pulses per Degree	Number of encoder pulses generated by the tool while rotating the head exactly 1 degree or 1/360 of a revolution
Range	Statistical measure, the difference between the lowest and highest values in a sample
Reject Release	Stopping of further operation of the system when a predefined number of rejected cycles has occurred
Rejected Data	Data generated by unacceptable rundowns
Rejected Rundown	Rundown that has not met the criteria of the fastening strategy
Remote Parameter Select	Remote device for application selection
Reset After NOK (linking)	Causes the controller to reset to linking position 1 after an NOK
Resolver (angle encoder)	Sensor for measuring rotation angle
Run Number	Number of accepted and rejected rundowns
Rundown Printout	Defines which rundowns the control system prints
Sequence 11	High-speed rundown
Sequence 16	Depth sensor, Angle control with Angle and Torque monitoring
Sequence 30	Torque control/angle monitor
Sequence 41	Angle-controlled back-off
Sequence 50	Angle control/torque monitor
Shut-Off Angle	Angle at which a tool is shut off
Shut-Off Torque	Torque at which a tool is shut off
Speed	Nominal speed of nutrunner during a stage
Standard Deviation (s)	Statistical measure, the square root of the Variance
Start Delay Time (ms)	Time delay before the stage starts
Start Spike Time (ms)	Time delay before the control system starts measuring torque when the stage has started
Statistical Data	Data used to measure the performance and accuracy of the unit and tool

Term	Description
Status Light	Lights (located on the unit or tool) that indicate accepted and rejected cycles
Sub Group Size (Sub Sz)	Size of data subgroup used for statistical analysis, the smallest subgroup size is 5
Synchronization Input	When active, allows the tool to start from stage to stage in conjunction with tool start.
Synchronization Output	Active at the end of each stage to signal a stage is complete
Threshold Torque (Nm)	Torque at which angle counting starts
TM	Tightening Module
Tool	
Tool Enable	Input to enable or disable the tool
Tool Group	
Tool Reverse	When active prior to tool start, the tool will run counterclockwise using the back-off strategy.
Tool Start (LCD and outputs also clear)	Starts the tool
Tool Stop	Stops the tool
Torque Capability Indexes	Measure of acceptable variation of final torque values in a fastening process
Torque Control	Fastening strategy that controls a tool based on torque limits
Torque Filter Factor	Used for calculating torque mean value
Torque High	Active if peak torque > torque high limit
Torque High Limit (THL)	Maximum torque that may be reached during a cycle
Torque Low	Active if peak torque < torque low limit
Torque Low Limit (TLL)	Minimum torque that must be reached during a cycle
Torque Monitoring	Fastening strategy that monitors a tool based on torque limits
Torque Reject	Cycle rejected if no acceptable torque is reached
Torque Threshold (TTH)	Point at which angle counting starts
Torque Transducer	Sensor for measuring torque
Transducer	Device used to read torque
Transducer Rated Torque (torque calibration)	Torque calibration value that must be set at rated torque of the transducer
Trigger Torque (Nm)	Torque at which collection of oscilloscope data starts
Variance	Statistical measure, the average of the squared differences from the mean

18 Appendix A – Input Signals

Pos.	Signal name	Description	Supported with		GMCC acti-vated
			Corded tools	Cord-less tools	
1	Tool Group Start (SA)	Starts a new rundown. All state outputs of previous rundown are cleared. Signal-edge controlled, i.e. a 0/1 change must take place. Inactive if external tool start is parameterized.	Yes	No	
2	Motor Start (SS)	Starts the motor. Input could set fix to 1. That means input could be all the time high.	Yes	No	
3	Emergency Stop	Input is required for rundowns. Falling edge aborts the fastening procedure.	Yes	No	
4	App / LG Select X	Application Selects 0–7 are used to select Applications 1–99 using a binary count of 1–99. When Linking is activated, the Tightening Group is selected with these inputs. GMCC - App / LG Select 0-2 are used to select Applications 1-8 using a binary + 1 count of 0-7. The mode of selection depends on parameters in screen Advanced/Tool Settings. When GMCC is active, the matching "App / LG Select 0-2" are automatically enabled.	Yes	Yes	Yes
5	Tool Group Stop	Stops the actual rundown. +24 VDC must be present for the tool to run.	Yes	No	Yes
6	Pendant Bypass	Pendant maintained switch. Used to bypass all jobs regardless of result. Used with GMCC.	Yes	No	Yes
7	Pendant Release	Pendant momentary switch. Used to release one job only. Used with GMCC.	Yes	No	Yes
8	Reject Release	Used when Reject Release is enabled in Advanced/Tool Settings, and the Release Method is "Input Reject Release". When the tool is disabled due to the reject limit being reached, it is re-enabled after this input is toggled.	Yes	Yes	
10	Eng. Pos. (FINDINI)	Initiator signal for DTM sequences (Seq. 15, 56), or positioning sequence (Seq. 16): start position found. If used must same input additionally assigned to TM.	Yes	No	
11	Enable DTM (SIS)	The initiator signal is present when the sledge has been removed from the interference area; for DTM sequence. If used must same input additionally assigned to TM.	Yes	No	

Pos.	Signal name	Description	Supported with		GMCC acti-vated
			Corded tools	Cord-less tools	
12	Stop DTM (OTINI)	Initiator for position of top dead center in conjunction with DTM sequence. If used must same input additionally assigned to TM.	Yes	No	
13	Tool Group Enable	When active, allows the tool to run in conjunction with Tool Start. Must be active the entire rundown. Special features for GMCC: Green tool light and OK background on controller, blink at 750 ms interval. Signifies Error Proofing Ready. Clears outputs, Ready to run.	Yes	Yes (No, if GMCC and Tool Ready is active.)	Yes
14	Reverse (TM_LL)	When active, causes the tool to run in the counterclockwise direction using the Backoff strategy. Inactive if external tool reverse is parameterized	Yes	No	
15	Manual Mode	When active, manual operation as in Advanced/ Tool Settings defined used.	Yes	Yes	
16	Remote Tool Start	Allows external input to control the start of the tool.	Yes	No	Yes
17	Remote Tool Reverse	Allows external input to control tool running in the counterclockwise direction.	Yes	No	Yes
18	Disable Part ID	When active, allows the tool to run without part ID.	Yes	Yes	
19	Enable App / LG Select X	When active, allows inputs "App / LG Select 0-7" to select an application or Linking Group.	Yes	Yes	
20	Linking Mode	Enable Linking mode.	Yes	Yes	
21	Unlock Tool	Release tool after locked by completed batch sequence. Only used if in Standard Application Builder parameter "Lock at batch done" is checked.	Yes	Yes	
22	Start Linking	When there is a new work piece, the program selection is evaluated and the visualization system initialized. Active only if programmed. Must be active the entire Linking sequence.	Yes	Yes	
23	Abort Linking	When active, Linking (batch counting) is reset to position one.	Yes	Yes	
24	Start Linking Inverted	Negation of Start Linking as a park position. Overwrites the input Start Linking. Active only if programmed. Must be active the entire Linking sequence.	Yes	Yes	
25	CPS Ready	Not supported.			
26	Reset Signals	Reset output signals rundown state	Yes	Yes	
27	Manual Part ID input	Not supported.	No	No	
28	Bitmask In X (EIN_S_X)	Programmable inputs per work step. Inputs can be used, e.g., to check if the correct socket is used. Inputs 1-8 can be set.	Yes	Yes	

Pos.	Signal name	Description	Supported with		GMCC activated
			Corded tools	Cordless tools	
29	Ack Data X	PLC sends ACK to the controller for each spindle in the group, Acknowledging the data transmission. Input 1-10 can be set. Not selectable. Automatically active when GMCC is selected in Acknowledgment mode.	Yes	No	Yes
30	Skip Linking Step	When active, skip current step in Linking Group.	Yes	Yes	
31	Clear DFUE Results	Clear results for DFUE data transmission.	Yes	Yes	
32	Send DFUE Data	Send rundown results via DFUE data transmission.	Yes	Yes	
33	Send DFUE Data Inv.	Send with falling edge rundown results via DFUE data transmission.	Yes	Yes	
34	OP Input X	Input is passed through to Open Protocol / FEP (MID 0211). Input 1-8 can be used.	Yes	Yes	
35	Pass Through In X	Input is used to activate corresponding output "Pass Through Out 1-16".	Yes	Yes	
36	App / LG Select +	Rising edge increments selected Linking Group number or Application number.	Yes	Yes	
37	App / LG Select -	Rising edge decrements selected Linking Group number or Application number.	Yes	Yes	
39	Activate Tool Scanner	Barcode scanner is activated with the function key 2. The signal must be present for three seconds before the barcode is active.	Yes	No	
40	Heart Beat	Verifies live communications between controller and PLC (hand-shaking). Not selectable. Automatically active when GMCC is selected.	Yes	No	Yes
41	CPS Ready	CPS module (power supply of the BTS spindle) is ready for operation. Input is used to lock the tool group when the CPS module is not ready.	Yes	Yes	
42	Bypass Tool X	Deactivate a single tool.	Yes	No	

19 Appendix B – Output Signals

Pos.	Signal name	Description	Supported with		GMCC acti-vated
			Corded tools	Cord-less tools	
1	Tool Group OK	Active if Torque/Angle/Yield are within programmed limits and no other error has occurred. Global Accept when used with GMCC as an overall accept for all tools.	Yes	Yes	Yes
2	Tool Group NOK	Active if Torque/Angle/Yield are outside limits or some other error has occurred.	Yes	Yes	
3	Tool Group Ready (BB)	Indicates the status of the fastening control system. 1 = can accept start signal. 0 = unable to start, in-situ check necessary (e.g. at a retainer fault, system fault).	Yes	Yes	
4	Rundown Com-plete (SE)	Set after all rotation has ended, before evaluation; earliest point to initiate a mech. movement via the PLC.	Yes	Yes	
5	Cycle Com-plete (AE)	Active when a rundown has ended and there are status outputs to report.	Yes	Yes	Yes
6	Paint Mark	Activated at the end of a fastening sequence to effect color marking. Cleared after the programmed color marking time TF has expired.	Yes	Yes	
7	System Warn-ing	Displays the change in a monitored value in the fastening control system as per the parameter, before output BB is set to low. Used with GMCC. Transmits fault condition to PLC.	Yes	Yes	Yes
8	Touch Up Active	Indicates if program has entered touch-up mode.	Yes	No	
9	Tool Group Running	Tool runs in clockwise (CW) or in counter clockwise (CCW) direction. If the WLAN connection of a LiveWire/CellCore tool is interrupted during rundown, the signal stays active until the tool is online again. The signal is only updated online. To abort the signal, a time can be defined for the *Lock while Offline* parameter after which the fastening is aborted as soon as the tool is offline.	Yes	Yes	Yes
10	Tool Group in Reverse	Active if reverse switch on Tool is active, or input for reverse is active.	Yes	Yes	
11	Verification Mode	Not supported.			
12	Barcode Scanned	Barcode has been scanned. Is active for 500 ms after the barcode to accept new workpieces or scan steps has been received.	Yes	Yes	
13	...	Not supported.	No	No	
14	Linking OK	Workpiece is OK. Active if all positions of Linking were OK.	Yes	Yes	
15	Linking NOK	Workpiece is NOK. Active if one or more positions of Linking were NOK.	Yes	Yes	

Pos.	Signal name	Description	Supported with		GMCC activated
			Corded tools	Cordless tools	
16	Linking Completed	Active when rundowns of all positions of the selected Linking group are completed.	Yes	Yes	
17	Archive Full	Indicates that the storage space available on the archive drive is below the threshold.	Yes	Yes	
18	Tool Group Enabled	Tool is enabled. Next active start input starts Tool. Used with GMCC. When the controller is given the Tool Ready Input, it is passed through if activated.	Yes	Yes	Yes
19	---	Not supported.	No	No	
20	Linking in Process	Output is active, as long as the workpiece is processed.	Yes	Yes	
21	Status (Yellow LED)	Active (flash) when parameter "Blinking lights in reverse" is checked and reverse input is active. Usually connect to yellow Tool light.	Yes	No	
22	App / LG Confirm X	Confirm application Selects 0–7. App / LG Confirm 0-2 when GMCC is selected. Automatically enabled.	Yes	Yes	Yes
23	Bitmask Out X (AUS_S_X)	Programmable outputs per work step. Outputs can be used, e.g., to activate corresponding lights on a socket tray.	Yes	Yes	
26	---	Not supported.	No	No	
27	Heart Beat	Verifies live communications between controller and PLC. (hand-shaking). Used with GMCC. Automatically active when GMCC is selected.	Yes	No	Yes
28	Pass Through (Green)	Allows external input to control a stack light connected to the controller's discrete I/O.	Yes	No	Yes
29	Pass Through (Yellow)		Yes	No	Yes
30	Pass Through (Red)		Yes	No	Yes
31	Pass Through (Alarm)		Yes	No	Yes
32	OP Out X	Active if via Open Protocol / FEP (MID 0200) corresponding output is activate.	Yes	Yes	
33	OP Offline	Active if no connection to Open Protocol / FEP Client exists.	Yes	Yes	
34	DFUE Active	Active if data transmission DFUE transfer data.			
35	Pass Through Out X	Outputs have same state as Pass through inputs. Used with GMCC.	Yes	Yes	
39	Tool OK (Green LED)	Evaluation of a single Tool. Active if Torque/Angle/Yield are within programmed limits and no other error has occurred. Flash when parameter "Blinking lights in reverse" is checked and reverse input is active.	Yes	Yes	

Pos.	Signal name	Description	Supported with		GMCC acti-vated
			Corded tools	Cord-less tools	
40	Tool NOK (Red LED)	Evaluation of a single Tool. Active if Torque/Angle/Yield are outside limits or some other error has occurred. Flash when parameter "Blinking lights in reverse" is checked and reverse input is active.	Yes	Yes	
41	TQ Low X	Active if Torque is too low. Always active with SEQ 41, 46, 48 (back-off) even if angle within range.	Yes	Yes	
42	TQ High X	Active if Torque is too high.	Yes	Yes	
43	AN Low X	Active if angle is too low.	Yes	Yes	
44	AN High X	Active if angle is too high.	Yes	Yes	
45	Tool Running X	Active if Tool runs. Used with GMCC.	Yes	No	
46	Tool Error X	Active if any error on Tool exists (e.g. trans-ducer, motor, temperature). Always active with SEQ 41, 46, 48 (back-off) even if angle within range.	Yes	No	
47	Tool Bypassed X	Active is Tool is bypassed. Tool does not partici-pate rundown.	Yes	No	
48	Tool Enabled	Release of the tool group.	Yes	Yes	
49	Solenoid Power	Solenoid Power. Used with GMCC.	Yes	No	Yes
50	GrnToolLight X	(Tool) Good rundown (Green Light). Used with GMCC.	Yes	No	Yes
51	RedToolLight X	(Tool) Remove, Inspect & Repair fastener (Red Light).	Yes	No	Yes
52	YToolLight X	(Tool) Low Torque (Yellow Light)	Yes	No	Yes

Index

Symbols

. . . . . 11, 66

A

Abort Job on Connection Loss . 133
Abort Linking 71
Accept 11
Accept button 65
Accept data, Grp n 179
Accept map 166
Accept same barcode after NOK 148
Accept System Bus map changes automatically 83
Accepted values option 65
Ack Timeout 141
Action on NOK 33
  Continue with Next Stage . . . 33
  Perform Touch-up / Error Handling 33
  Stop All Tools,No Resume . . . 33
  Stop NOK Tools, No Resume . 33
  Stop NOK Tools, Resume on Touch-up /Error Handling . . 33
Activate 32
Activate enhanced trace recording if supported by tool 85
Activate Tool Scanner 71
Add 75, 149
Administration 9, 150, 197
Advanced 9, 70
  Accept System Bus map changes automatically 83
  Controller 83
  Display format on Secondary . 83
  Dynamic Current Calibration . 83
  Generate results with SKIP error for skipped tightening positions . 83
  Login/Logout Enable 83
  Tool I/O 157
  Tool Tightening 158
  Use Selected TQ units for Data Transmission 83
  Warning factor 83
Advanced process programming . 9
Advanced Serial Settings . 118, 147
  Baudrate 118
  Data Bits 118
  Flow Control 118
  Parity 118
  Port 118
  Stop Bits 118
Advanced ToolsNet settings
  Miscellaneous 135
  Station numbers 135
  Tool Group names 136
  Tool names 136
Advanced´ 54
AFO parameters from TPS . . . 145
A-IO 92
All graphs 82
Allow Tool Test, Switch board and App/LG selection via mProRemote 83
Always transmit shut-off stage on NOK 142
AN High 72
AN Low 72
ANG 14
Angle (ANG) readings 14
Angle Control/Torque Monitor 10, 11
  default parameter 11
Angle Encoder 176
Angle factor 60, 64
Angle High Limit . . 10, 11, 12, 38
Angle Low Limit . . . 10, 11, 12, 38
Angle values 19
Anybus module 93
App / LG Confirm 0-7 72
App / LG Select 0-7 71
Application 49, 76, 161
Application Matrix 70
Application name 21
Application setting 21
  Application name 21
  Data Transmission 21
  Fastening groups 21
  Statistic 21
Applications 21
Archive 9, 17, 181
  filtering 183
ARCNet ID 99
ARCNet Map 166
Attachments 60
Audible notification 89
Audible notification duration . . . 89
Auto Program 11
  Angle Control/Torque Monitor 11
  Torque Control/Angle Monitor 11
Auto refresh 111
Auto Select 17
Average 186
AVI Barcode 130
AVIS Protocol 121

B

Back 171
Background color
  green 14
  red 14
  yellow 14
Back-off all 37
Back-off application 46
Back-off mode for all Applications and Linking steps 85
Back-off none 37
Back-off Speed 11, 12, 45
Back-off speed at beginning . . . 45
Barcode 76, 146
  Define 148
  function 152
  green 15
  History 148
  Part ID 146
  Postition auswählen 149
  red 15
  VIN 146
  Workpiece Description 152
  yellow 15
Barcode Function 152
Barcode Mask 152
Base (x-axis) section 19
Basic 9, 10
  Parameter Angle Control/Torque Monitor 10
  Parameter Torque Control/Angle Monitor 10
Basic Application Builder . . . 9, 10
  parameter 12
Basic Fastening Strategy 10
Batch 17
Batch programming 48
Batch status at increment/bypass . 132
Baudrate 118
Begin Ramp-down 32
Binary 111
Blink Lights when Tool in Reverse 84
Blink when Linking is finished . . 84
Blue
  LED 71
Bus monitor 175
Button
  197
  Accept 11
  Accept map 166
  Add 75, 149
  Advanced 54
  Archive 17

Auto Program 11
Back 171
Barcode 76
Basic 10
Binary 111
Cancel 91
Clear table 92
Configuration 19
Configure 16
Copy 13
Delete 76, 92, 98
Details 181
Discard 11
Down 76, 168, 182
Dyn. curr. const 68
Edit 36, 53, 76, 98
Fastener IDs 75
Filter 181
Freeze 182
Groups 36
HD 181
Help 53, 91
hexadez. 111
I/O 53
Information 92
Initialize PB 92
Insert 92
Install 53
Modul/Bus 111
Move down 149
Move up 149
Navigator 8, 53
New 98
OK 91
Oscilloscope 17, 18
Parameters 36
Ping 171
RAM 181
Reassign 53
Remove 149
Reset all counters 197
Reset displayed counter . . . 197
RF Settings 54
Self-ident. Tool data 63
Set 87
Set default values 56
Software Update 190
Stage 24
Statistics 181
System Bus 54, 58
System Bus statistics 166
System information 58, 166, 191
Timer 72
Tool Notification Settings 88
Tool Settings 53, 56
Uninstall 53
Up 76, 168, 182

button
Cancel 11

Byte Area 98
DATA 108

Byte area
configuration 98

Byte areas
Check 111

Byte Areas Input 99
ARCNet ID 99
End Input Area 100
End Output Area 100
Format 100
Function 100
Module 99
Start Input Area 100
Start Output Area 100

C

Cal. data flashed, Sp n 179
Calculate data, Grp n 179
Calibration
Accept data, Grp n 179
Cal. data flashed, Sp n 179
Calculate data, Grp n 179
Data rec., Sp. n 179
Data req., Sp. n 179
Fastening sequence 1 to n . 179
information 178
requirement 178
Start current cal. Grp n 179
Calibration date 65
Calibration offset 175
Calibration TQ 64
Calibration voltage 175
Cancel 11, 91
Change of calibration values . . . 68
Date of last cal. column 68
Grp column 68
Sp column 68
St columns 68
Title bar 68
Channel 161
Clear outputs on connection loss 133
Clear table 92
Communication 9
Communications 117
Configuration 19, 99
Configure 16, 147
Continue with Next Stage 33
Control 133
Control socket tray outputs using MID 254 133
Control unit 60
Controller 165
Controller settings 81
Allow Tool Test, Switch board and App/LG selection via mProRemote 83
Custom Torque units 81
Disable local saving and editing of Application parameters . . . 83
Finish current tightening in case Tool Group gets disabled . . 83
General 81
Keep operating mode 81
Miscellaneous 83
Name 81
Number 81
Reset Application / Linking Group to zero 81
Show Warnings 83
Start Tool Setup screen 81
SysLog messages options . . 83
Trace Recording 81
Controller System Number . . . 135
Controllers 161
Copy 13, 27
Copy menu 37
Copying parameter 23
Count 148
Counter update interval 57
Counters 17, 197
Cp 187
CpK 187
CSV_EN 137
CSV_FR 137
CSV_STD 137
CSV-EN 141
CSV-FR 141
CSV-STD 140
Current adj. Factor 61, 69
Current calibration setting 67
Current/Resolver 61
Custom fieldbus protocols 153
Custom Torque units 81
Cycle Complete 71

D

Data
receiving 103
save to USB stick 205
sending 103
telegram 106, 112
transmission 108, 109
Data Bits 118
Data export 199
Data rec., Sp. n 179
Data req., Sp. n 179
Data Transmission . . 21, 117, 137, 170
XML/CSV 171
Data transmission
multiple blocks 103
protocol indicators 16
Data transmission protocol indicators and miscellaneous information . 16
Date 198
Date of last cal. column 68
Date/Time snychronization . . . 142

Date/Time synchronization 135, 137
Date/time synchronization 57
dBase file
generate 199
structure 199
Default parameter 11
Angle Control/Torque Monitor .11
Default values
advanced parameter 12
Definitions for byte areas 98
Delete 76, 92, 98
Destination 141
Details 181
Diagnostics 9, 165
Controller 165
Export SysLog and telegrams 145
Inputs/Outputs 173
Log telegrams 145
Network 169
Records in buffer 145
SysLog messages 145
Disable local saving and editing of Application parameters 83
Disable OpenProtocol communication while in Manual Mode 133
Discard 11
Discard Zeroed Rundown Results .. 131
Display format on Secondary ...83
Display rundown data 27, 35
Down 76, 168, 182
Dwell time 31
Dwell time TN 12
Dyn. curr. const 68
Dynamic Current Calibration 67, 83
Dynamic current constants
changing 68
discard 69

E

Edit 36, 53, 76, 98
Edit error handling 35
Display rundown data 35
Max. tightening time Tmax ...35
NOK print 35
Number N 35
Print rundown data 35
Repeat from stage 35
Edit touch-up 35
Display rundown data 35
Max. tightening time Tmax ...35
NOK print 35
Number N 35
Print rundown data 35
Repeat from stage 35
Editing 160
Access 201
Excel 200
FoxPro C2.6 201
Enable Individual Vehicle Build Data Request for each Tool 130
Enable notification 57
Enable Remove Fastener Torque 84
Enable Unsolicited Build Data . 131
Enabled 34
End Input Area 100
End Output Area 100
Enhanced Programming 91
Equipment Identifier for Maintenance Sequence 143
Error codes 142
Error Handling 34
Enabled 34
Groups 36
Not enabled 34
Parameters 36
Error Handling groups 36
example 39
Error messages 99
Error messages / warnings ... 206
Error table 183
Ethernet Protocol 122
Evaluation 186
Evaluation and Backoff Settings
Back-off mode for all Applications and Linking steps 85
If trigger released options ... 85
Ignore BLOC errors for NOK counting 85
Export SysLog and telegrams . 145
Ext.App.Sel.0 92
Extended Tool Settings
CellCore 90
LiveWire 90
NeoTek 90
External Application / LG Selection 84
External Tool enable 84
External Tool Stop Active Low . 84

F

Factory Reset 205
Fastener ID 186
Fastener IDs 46, 75
Fastening groups 21, 47
Fastening program 24
Fastening sequence 1 to n ... 179
Fastening stage programming .. 25
Copy 27
Display rundown data 27
Options 27
Print features 27
Redundancy Inactive 27
Settings 27
Stick-Slip cycles 27
Fastening stage timing 31
I-Wrench 32
parameter 31
Fastening stages 21
Fastening Strategy 12
Fastening strategy 29
Fastening time 31
Fastening time Tmax 12
Fieldbus 153
GMCC 153
None 153
Trasys 153
Fieldbus Configuration screen .. 96
File format 137
File name prefix 137
Filter 181
Filtering 183
Finish current tightening in case Tool Group gets disabled 83
Fixed Signal 93
Flex-Stop 32
Flow Control 118
Format 100, 130
Freeze 182
Function 100
green 16
red 16
white 16
yellow 16

G

General
Ack Timeout 141
Always transmit shut-off stage on NOK 142
Clear outputs on connection loss 133
Control socket tray outputs using MID 254 133
Date/Time snychronization . 142
Disable OpenProtocol communication while in Manual Mode 133
Error codes 142
IP address 141
Lock tool on connection loss 133
Protocol 141
Send Gradient target value . 143
Send timeout 141
Terminate Linking Group with MID 38 133
Timeout 133
Generate results with SKIP error for skipped tightening positions ... 83
Global App 161
Global App Name 161
Global Controller 160

GM Common Controller 153
GMCC 153
default settings 154
default settings on activation 154
Fieldbus Network settings . . 154
Input/Output signals 154
GMCC Protocol 153
Graph 186
Green
barcode 15
function 16
LED 71
status 16
Group 92
Groups 21, 36
Grp 52
Grp column 68
Gyroscope 180

H

Hardware Test 169
HD 181
Help 53, 91
hexadez. 111
High -> Low 73

I

I/O 53
Blink Lights when Tool in Reverse 84
Blink when Linking is finished . 84
Enable Remove Fastener Torque 84
External Application / LG Selection 84
External Tool enable 84
External Tool Stop Active Low 84
Latched Remote Start 84
Lock if Fieldbus is offline 84
I/O mapping 173
If trigger released options 85
Ignore BLOC errors for NOK counting 85
Ignore unexpected barcodes . . 147
Image 86
Increase batch counter at tightening 132
Information 92
Initialize PB 92
Initiator signal 93
Input 173
Input / Output bitmask 50
Input mask 76
Input status 15
Inputs 70
Insert 92
Install 53
Installed Versions 190
Installieren
Primary corded Tool 54
Installing
I-Wrench 55
LiveWire Tool 55
Tool Groups 55
Installing a Secondary Tool 54
Integrated Processdata Management 141
Interval 82
IP address 141
IPM 141
IPM advanced settings
Additional Transmission Settings 145
Diagnostics 145
General 141
Transmission Settings 144
IPM Protocol 141
I-Wrench 32
installing 55

J

Job Batch Mode 133

K

Keep Alive Interval 135
Keep Alive Timer 130
Keep operating mode 81
Keypad Entry 147

L

Language 205
Latched Remote Start 84
LCL 187
LED
blue 71
green 71
red 71
yellow 71
Link. Step Name 76
Linking
Scan Barcode 77
Scan Part ID 77
scan steps 77
Linking Completed 71
Linking Mode 71
Linking NOK 72
Linking OK 72
Linking Step Settings 76
Application 76
Input mask 76
Link. Step Name 76
Mandatory Stages 76
No. of NOK repeats 76
Number of Tight. Pos 76
Outputs 76
Start at Tight. Pos. 76
Target Stage 76
Text message 76
Tool selection 76
Visual. color after OK 76
Visualization text 76
LiveWire Settings
Tool Light 90
LiveWire Tool
installing 55
Lock if Fieldbus is offline 84
Lock tool on connection loss . . 133
Lock tool while timer active 73
Log Files
XML/CSV 172
Log telegrams 145
Logbook 166
Logic 176
Login/Logout Enable 83
Low -> High 73

M

Maintenance 55
Maintenance Counter 52, 57
Current state 57
Update interval 57
Maintenance limit 55
Maintenance sequence number type 143
Mandatory Stages 76
Manual Mode 71
Manual mode 85
Manual Programming 12
Manufacturing date 65
Repair date 65
Marking time 31
Max Flex-Zeit 32
Max. angle deviation 61
Max. tightening time Tmax 35
Max. Torque 46
Max. torque 10, 11, 12
Max. torque deviation 61
Max. value 186
Maximum speed 61, 69
MES 161
Min. value 186
Miscellaneous 178
Activate enhanced trace recording

if supported by tool 85
Set up pictures 85
Modification list 198
Modul/Bus 111
Module 99
Modules 93
Monitor tool 182
Move down 149
Move up 149
OK/NOK High time 73
OK/NOK Low time 73
Parameter
OK/NOK High time 73
OK/NOK Low time 73

N

Name 52
Navigator 8, 53
Neg. analog / Pos. supply 176
Net/Proc 170
Network 152, 169
New 98
No Resume 33
No. of NOK repeats 76
No. Rep. 37
NOK back-off 37
NOK Graphs 82
NOK max 37
NOK min 37
NOK print 35
None 17
Not enabled 34
Number N 35
Number of Chars 147
Number of Tight. Pos 76

O

Offline 190
OK 91
On-board module 93
OP Input 1-8 71
OP Offline 72
OP Out 1-10 72
Open Protocol 131, 172
Open Protocol Advanced Settings
Batch 132
Channel IDs 132
Communication Ports 132
General 133
Open Protocol client 161
Options 21, 27
Original torque calibration Value 64
Oscilloscope 17, 18
Output 173, 174
Outputs 71, 76
Overall gear ratio 65

P

Parameter 69
Accept button 65
Accepted values option 65
Activate 32
Angle High Limit 10, 11, 12, 38
Angle Low Limit . 10, 11, 12, 38
Back-off all 37
Back-off application 46
Back-off none 37
Back-off Speed 11, 12, 45
Back-off speed at beginning . 45
Batch 17
Begin Ramp-down 32
copy 23
Copy menu 37
Counters 17
Current adj. Factor 69
Dwell time 31
Dwell time TN 12
Fastening Strategy 12
Fastening time 31
Fastening time Tmax 12
Flex-Stop 32
Grp 52
High -> Low 73
load 205
Lock tool while timer active . . 73
Low -> High 73
Maintenance Counter 52
Marking time 31
Max Flex-Zeit 32
Max. Torque 46
Max. torque 10, 11, 12
Maximum speed 69
Name 52
No. Rep. 37
NOK back-off 37
NOK min 37
None 17
Ramp-up time 32
save 205
Serial Number 52
Show compensated Tourqe if available 17
Shut-Off Angle . 10, 11, 12, 38
Shut-off Torque 69
Shut-off Torque Stage 1 . 10, 11, 12
Shut-off Torque Stage 2 . 10, 12
Speed 11, 38, 69
Stage 1 Speed 12
Stage 2 Speed 12
Start delay time 31
Start Delay Time TV 12
Start pulse suppression 31
Start pulse suppression TA . . 12
Static tq const. 69
Status 52
Target Speed 32
Threshold 11, 12
Threshold (Angle Start) 10
Tool 52
Tool Group Name 52
Tool Memory option 65
Tool Model 52
Torque Averaging Filter 69
Torque Averaging Filter Ff . . 12
Torque calibration value 69
Torque Low Limit . . . 10, 11, 12
Transducer data 69
Trigger 11, 12
Trigger (start scope) 10
Type 52
Use Default for Target Speed 32
Parameters 36
Parity 118
Part ID 146
Accept same barcode after NOK 148
Activated 146
Advanced Serial Settings . . 147
Configure 147
display 15
Ignore unexpected barcodes 147
Keypad Entry 147
Number of Chars 147
Part ID Source 147
Scanner prefix 147
Special Function 147
status indicators 15
Tool Group 146
Part-ID
Barcode History 148
Define Barcode 148
Pass Through (Alarm) 72
Pass Through (Green) 72
Pass Through (Red) 72
Pass Through (Yellow) 72
Pendant Bypass 71
Pendant Release 71
Perform Touch-up / Error Handling 33
PFCS Advanced settings 130
AVI Barcode 130
Discard Zeroed Rundown Results 131
Enable Individual Vehicle Build Data Request for each Tool 130
Enable Unsolicited Build Data 131
Format 130
Keep Alive Timer 130
Machine ID 131
Request Vehicle Build 130
Retries 130
Timeout 130
VIN/Track 130
PFCS Protocol 122, 130
Ping 171

Plant Floor Communication System 122
Port 118
Pos. analog 176
Prarmeter
Auto Select 17
Redundancy 17
Station Name 17
Prarmeters
Rundown Details 17
Primary Corded Tool
installing 54
Primary mode 192
Switch to Secondary mode . . 192
Print 198
Print features 27
Print rundown data 35
Process programming 8
Profibus communication area . . 156
Programmable I/O Mapping 91
A-IO 92
Ext.App.Sel.0 92
Group 92
Programming
Barcode 152
Basic Fastening Strategy 10
Batch 48
I/O 92
manual 12
process 8
Programming Linking Steps 75
Protocol 141
AVIS 121
Ethernet 122
IPM 141
PFCS 122, 130
seial 118
Standard 118
Standard2 119
WinSPC 129
Pull App from Controller 161
Application 161
Channel 161
Controllers 161
Global App 161
Global App Name 161

Q

Quick Summary NOK Actions . . . 35

R

RAM 181
Ramps 32
Ramp-up time 32
Range 186
Range chart 188
Range of values 29
rasys Protocol 155
Reassign 53
Recording mode 82
All graphs 82
Interval 82
NOK Graphs 82
None 82
Redundancy graph options . . 82
Sample 82
Records in buffer 145
Red
barcode 15
function 16
LED 71
status 16
Redundancy 17, 61
Current/Resolver 61
Max. angle deviation 61
Max. torque deviation 61
None 61
Resolver angle 61
Transducer 2 61
Redundancy curve 20
Redundancy graph options 82
Redundancy Inactive 27
Reject Release 71, 85
Release 25
Remote Tool Reverse 71
Remote Tool Start 70
Remove 149
Repair date 65
Repeat from stage 35
Request Vehicle Build 130
Reset all counters 197
Reset Application / Linking Group to zero 81
Reset Batch size on connection loss 133
Reset displayed counter 197
Reset Signals 71
Resolver angle 61
Resolver factor 64
Result Ack Timeout 135
Result Status 186
Retries 130
Reverse 70
RF Setting 192
RF Settings 54
RPM (Speed measurement) . . 177
Run ping 171
Run Screen 9, 14, 17
configuration 16
Rundown
details 17
Rundown data
visualisation 88
Rundown Details 17
Rundown programming 28
Rundown Table 17
Rundowns since service 65

S

Sample 82
Sample size 186
Saving 160
Scan Barcode 77
Scan Part ID 77
Scanner 147
Scanner prefix 147
Screen Saver 205
Secondary mode 193
Secondary-Mode
Switch to Primary mode . . . 196
Self ident. Enabled 62
Self-ident. Tool data 63
Self-identification 62
Send all multi spindle results as spindle 1 135
Send Gradient target value . . . 143
Send timeout 141
Sequence 69
Serial Number 52
Serial Protocol 118
Server Connection Timeout . . . 135
Server IP Address 137
Service data 64
Service messages 204
Servo PS 64
Set 87
Set default values 56
Set up Pictures 86
Set up pictures 85, 86
Settings 21, 27
Show compensated Tourqe if available 17
Show Warnings 83
Shut-Off Angle 10, 11, 12, 38
Shut-off Torque 69
Shut-off Torque Stage 1 10, 11, 12
Shut-off Torque Stage 2 10, 11, 12
Sigma 187
Signal Name
Abort Linking 71
AN High 72
AN Low 72
App / LG Confirm 0-7 72
App / LG Select 0-7 71
Cycle Complete 71
Linking Completed 71
Linking Mode 71

Linking NOK 72
Linking OK 72
Manual Mode 71
Not used 70, 71
OP Input 1-8 71
OP Offline 72
OP Out 1-10 72
Pass Through (Alarm) 72
Pass Through (Green) 72
Pass Through (Red) 72
Pass Through (Yellow) 72
Pendant Bypass 71
Pendant Release 71
Reject Release 71
Remote Tool Reverse 71
Remote Tool Start 70
Reset Signals 71
Reverse 70
Status (Yellow LED) 72
Tool Bypassed 72
Tool Enabled 72
Tool Error 72
Tool Group Enable 70
Tool Group in Reverse 72
Tool Group NOK 71
Tool Group OK 71
Tool Group Start 70
Tool Group Stop 71
Tool NOK (Red LED) 72
Tool OK (Green LED) 72
Tool Running 72
TQ High 72
TQ Low 72
Unlock Tool 71
Used by Programmable IO 71, 72
Verification Mode 72

Signal name
Activate Tool Scanner 71

SmbMount 137
Socket slip-off 30
Software Update 190
Source 141
Sp column 68
Special Function 147
Special function indicator 16
Speed 11, 38, 69
Speed left rotation 45
Speed measurement 177
SpiBitErg 108
SpiByteErg 109
Split barcode 152
St columns 68
Stage 24
Stage 1 Speed 12
Stage 2 Speed 12
Standard 9, 21
Standard Application Builder . 9, 21
Applications 21
Groups 21
Options 21
Settings 21
Tool Groups 21

Standard Protocol 118
Standard2 Protocol 119
Start at Tight. Pos. 76
Start current cal. Grp n 179
Start delay time 31
Start Delay Time TV 12
Start Input Area 100
Start Output Area 100
Start pulse suppression 31
Start pulse suppression TA 12
Start Tool Setup screen 81
Static tq const. 61, 69
Station 135
Station Name 17

Station numbers
Controller System Number . 135
Station 135

Statistic 21
Statistics 181, 185, 186
Average 186
Cp 187
CpK 187
Evaluation 186
Graph 186
LCL 187
Max. value 186
Min. value 186
Range 186
Sigma 187
Sub Group Size 186
UCL 187
Values 186

Statistics Filter 186
Application 186
Fastener ID 186
Result Status 186
Sample size 186
Stage 186
Time Interval 186
Tool 186

Status 52
green 16
red 16
yellow 16

Status (Yellow LED) 72
Status Monitor 168
Stick-slip 32
Stick-Slip cycles 27
STMD-H Firmware Update . . . 192
Stop All Tools 33
Stop All Tools,No Resume 33
Stop Bits 118
Stop NOK Tools 33
Stop NOK Tools, Resume on Touch-up /Error Handling 33
Sub Group Size 186
Switch board 174
Switch to Primary mode 196
Switch to Secondary Mode . . . 191
Synchronization 57
Synchronization if difference above 57
SysLog messages 145
SysLog messages options 83
System Bus 54, 58, 166
System Bus (ARCNet Map) . . . 166
System bus bridge 93
System Bus statistics 166
System information . 58, 166, 191
System Settings 190, 191
System warnings 167

T

Target Speed 32
Target Stage 76
Task messages 167
Terminate Linking Group with MID 38 133
Test rundowns for Current calibration 178
Text message 76
Threshold 11, 12
Threshold (Angle Start) 10

Tightening
Manual mode 85
Reject Release 85

Tightening module 93
Tightening Parameter Server . . 158
Time 198
Time Interval 186
Timeout 130, 133
Timer 72
Title bar 68
TM 191

Tool 52
activated 22
activation 22
installed 22

Tool activation 22
Tool Bypassed 72
Tool data 61
Tool diagnostics 175
Miscellaneous 178
Test Options 175

Tool Enabled 72
Tool Error 72
Tool Group 84
Evaluation and Backoff Settings 85

I/O 84
Miscellaneous 85
Tightening 85
Tool Group Name 84
Tool Group Enable 70
Tool Group in Reverse 72
Tool Group Name 52, 84, 137
Tool Group NOK 71
Tool Group OK 71
Tool Group Start 70
Tool Group Stop 71
Tool Groups 21
installing 55
Tool Ident No 64
Tool Light 90
Tool List 52
Tool Memory 179
Tool Memory option 65
Tool Model 52
Tool monitor 17
Tool NOK (Red LED) 72
Tool Notification Settings . . . 88, 89
Audible notification 89
Audible notification duration . . 89
Vibration notification 89
Vibration notification duration . 89
Tool OK (Green LED) 72
Tool Running 72
Tool selection 76
Tool Serial No 64
Tool Settings 53, 56
Tool Setup 9, 52
Tool speed 64
Tool type 64
ToolsNet Open Protocol 135
Torque (TQ) readings 14
Torque Averaging Filter 69
Torque Averaging Filter Ff 12
Torque calibration value 60, 69
Torque constant 64
Torque Control/ Angle Monitor
default parameter 11
Torque Control/Angle Monitor 10, 11
Torque graph 18, 19, 183
fastening sequences 41 and 46 20
navigating 19
settings 20
Torque Low Limit 10, 11, 12
Total number of rundowns 65
Touch Calibration 198
Touch-up 34
Enabled 34
Groups 36
Not enabled 34
Parameters 36
Touch-up groups 36
example 39
Touch-up/Error Handling 34
algorithm 38
TPS 158
activating 159
connection status 159
Server 161
TQ 14
TQ Calibration 175
TQ capacity 64
TQ factor 64
TQ High 72
TQ Low 72
TQ measurement 177
Trace configuration 19
Base (x-axis) section 19
Traces (y-axis) section 19
Trace Recording 81, 82
Traces (y-axis) section 19
Transducer 2 61
Transducer data 60, 63, 69
Angle factor 64
Calibration date 65
Calibration TQ 64
change 65
Manufacturing date 65
Original torque calibration Value
64
Overall gear ratio 65
Resolver factor 64
Rundowns since service 65
screen 63
Service data 64
Servo PS 64
status messages 66
Tool Ident No 64
Tool Serial No 64
Tool speed 64
Tool type 64
Torque constant 64
Total number of rundowns . . 65
TQ capacity 64
TQ factor 64
Transducer Ident No 65
Transducer serial No 65
Transducer state 65
Transducer type 65
Transducer Ident No 65
Transducer serial No 65
Transducer state 65
Transducer type 65
Transfer workpiece OK/NOK . . 137
Transmit All Stages 145
Trasys 153
Trigger 11, 12
Trigger (start scope) 10
Tube nut mode 62
Type 52

U

UCL 187
Uninstall 53
Unlock Tool 71
Up 76, 168, 182
Update
measuring card firmware) . . 191
software 190
Update software 190
Use Default for Target Speed . . 32
Use Selected TQ units for Data Transmission 83
Used by Programmable IO . 71, 72
User 202
Utilities 9, 190
Installed Versions 190
Offline 190
Software Update 190
System Settings 190

V

Values 186
Verification Mode 72
Vibration notification 89
Vibration notification duration . . 89
VIN 146
VIN/Track 130
Visual. color after OK 76
Visualization menu 17
Run Screen 17
Rundown Table 17
Step view 17
Tool monitor 17
Visualization text 76
Visualizing
rundown data 88
Voltage
Logic 176
Neg. analog / Pos. supply . . 176
Pos. analog 176
Voltages 176

W

Warning factor 83
Warning threshold before service 56
WinSPC Protocol 129
WLAN Socket Tray 175
Worker ID 137
Workpiece Description 152
Workpiece number filter from digit x to
y 144

X

X-Bar chart 189
XML 137
load 25
save 25
XML/CSV
Data transmission 171
protocol 136
XML/CSV Log Files 172
XML/CSV Network settings
CSV_EN 137
CSV_FR 137
CSV_STD 137
Data Transmission 137
Date/Time synchronization . . 137
Delete 137
File format 137
File name prefix 137
New 137
None 137
Server IP Address 137
SmbMount 137
Tool Group Name 137
Transfer workpiece OK/NOK 137
Worker ID 137
XML 137
XMP application
Load/save 25

Y

Yellow
Barcode 15
function 16
LED 71
status 16

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