Cleco®
Production Tools

Programming Manual
P2280PM-EN
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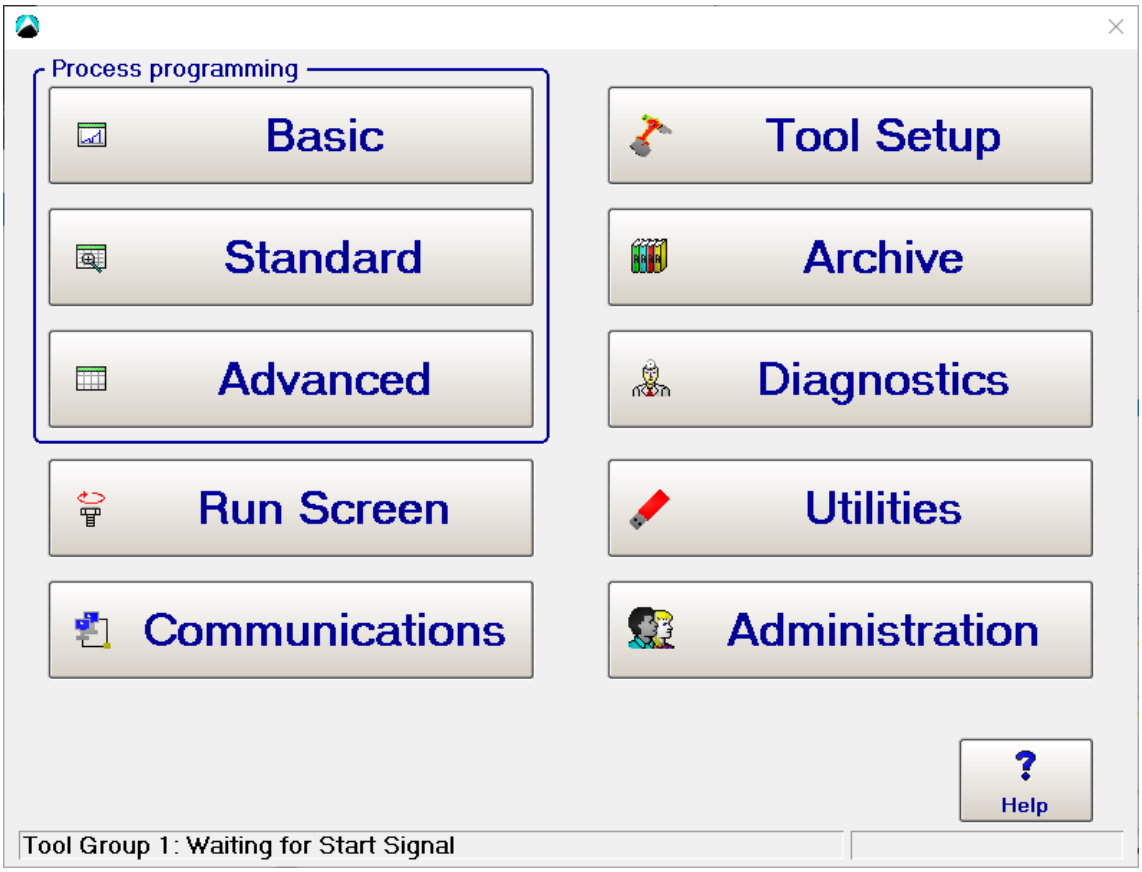
S168813

mPro200GC(-AP) & mPro400GC(D)



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1 About this Document

This document is intended for qualified employees responsible for installation and maintenance (administrators, maintenance technician, service, operator).
It contains information

- for safe and appropriate handling of the product.
- on function.
- for programming the software: S168813-1.14

The original language of this document is German.

Other Documents

Number	Document
P1730PM	Programming Manual – Tightening Sequences
P2170BA	Instruction Manual – 960645-GC, 960646-GC Socket Tray
P2227BA	Instruction Manual – S168171 TorqueNet
P2260JH	Installation Manual – WLAN Data Transmission
P2332BA	Instruction Manual – 943620PT, 943610PT WLAN Socket Tray
P2383BA	Instruction Manual – I-Wrench
P2403HW	Hardware Description – mPro200GC(-AP)
	GMCC Specification
	Open Protocol FEP Specification
	PFCS Vendor Specification
	ToolsNet Documentation
	ToolsNet Open Protocol Specification
	S168691 mProRemote Professional

Symbols in the Text

italic	Menu options (e.g., Diagnostics) input fields, check boxes, radio buttons or dropdown menus.
>	Indicates selection of a menu option from a menu, e.g., *File* > *Print*.
<...>	Specifies switches, pushbuttons or the keys of an external keyboard, e.g., <F5>.
`Courier`	Indicates Filenames and paths, e.g., `setup.exe`.
•	Indicates lists, level 1.
–	Indicates lists, level 2.
a) b)	Indicates options.
➢	Indicates results.
1. (...) 2. (...)	Indicates action steps.
►	Indicates single action steps.

Other documents

► Read all safety warnings and instructions. Failure to follow the directions and safety instructions could result in serious injuries, property or environmental damage.

Warning notes are identified by a signal word and a pictogram:

- The signal word describes the severity and probability of the impending danger.
- The pictogram describes the type of danger.

⚠ 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 injury.

⚠ 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.

Structure Of Warnings

⚠ Caution

Type and source of danger.
Possible consequences of non-observance.
► Measures to avoid danger.

2 General Functions

2.1 Operation

The controls can be operated via the touchscreen or an externally connected keyboard.
During initial operation or frequent use, an external keyboard facilitates parameter setting on the controller.

Touchscreen Operation

1. To enter values during configuration, press the corresponding input field.
2. Use the displayed keyboard to enter values.
3. To finish the input and hide the keyboard, press <Enter>.

Operation with an External Keyboard

1. To activate input fields, press <TAB>. Press <TAB> several times to switch to other input fields.
2. Use the keyboard to enter values. Use the arrow keys to reach individual characters to correct or delete the entry.

With an external keyboard, the following functions can be performed via key combinations:

Keys	Function
<TAB>	Switch to the next object (button, input or confirmation field).
<Alt>	Calls up the drop-down menus. Afterwards, the entries of the drop-down menu can be selected with the arrow keys.
<Enter>	Input confirmation, execute or activate a function.
<Esc>	Close a drop-down menu or clear an input field.
<PgUp>	Go to previous page.
<PgDn>	Go to the following page.
<End>	Cursor jumps to last position in an input field.
<Delete>	Deletes the following character in an input field.
<F1>	Call up the status display for all groups.
<F7>	Display of process data.
<F9>	Program output *Ofmpro* of the relevant system information.
<Shift> <F9>/<10>/<11>	Calls up another console, for system administrators only.
<Caps Lock>	Switches to capital letters. This function is displayed on the displayed keyboard and canceled by pressing <Caps Lock> again.

Combinations with<Shift>, <Alt> or <Ctrl> are possible. Combinations with a numeric key or a combination of three keys are not possible.

2.2 General Buttons

Below is a list of generally valid buttons:

Button	Description
	**Navigator** Press the button to return to the *Navigator* dialog. If changes have been made, a query appears asking whether they should be saved.
	**OK** Press the button to return to the previous dialog box. Changes will not be saved. The changes are only saved by a query. This is displayed before the *Navigator* dialog is called.
	**Cancel** Press the button to return to the previous dialog. Changes will not be saved.
	**Accept** Press the button to return to the previous dialog. Changes will be saved.

Button	Description
	**Discard** Press the button to return to the previous dialog. Changes will not be saved.
	**Back** Press the button to return to the previous dialog.
	**Help** Press the button to display information about the current screen.

2.3 mProRemote

The controller can be accessed and configured via an external PC. For this purpose, the *S168691 mPro-Remote Professional* software is required, see the associated document.

3 Navigator

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

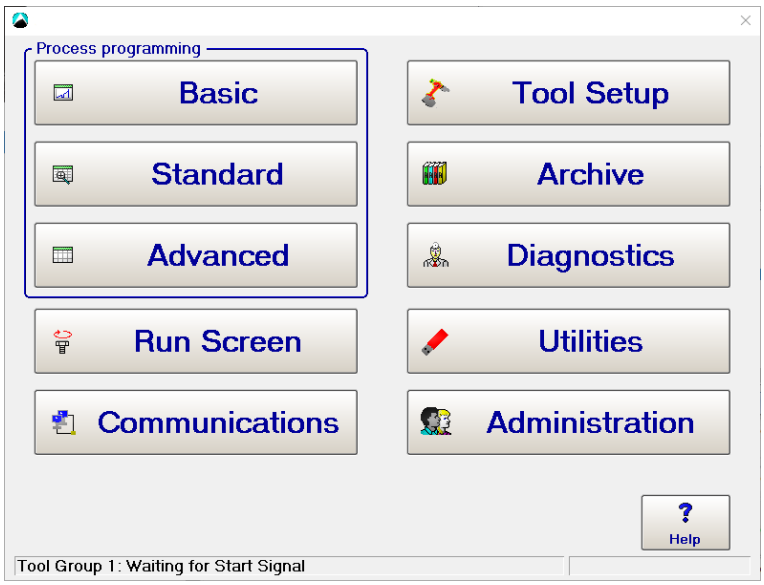
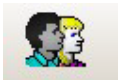


Fig. 3-1: Navigator dialog

Below is a list of all menu items:

Button	Description
	**Basic Application Builder** The *Basic Application Builder* menu enables quick and easy programming of a two-stage fastening strategy. The following fastening strategies are available: • Torque Control/Angle Monitor (SEQ 11 + SEQ 30) • Angle Control/Torque Monitor (SEQ 11 + SEQ 50) Torque, angle and speed values for up to 99 product groups can be entered via a graphic. The remaining parameters of the fastening strategy are calculated automatically.
	**Standard Application Builder** The *Standard Application Builder* allows tightenings to be programmed with up to six levels. For up to 99 product groups all necessary parameters can be parameterized manually.
	**Advanced** The *Advanced* contains an overview of all product groups of a tool and allows the configuration of inputs, outputs and Linking as well as controller- and tool-specific settings..
	**Run Screen** The *Run Screen* displays torque, angle and status of the current rundown. The tightening graph provides functions for analyzing torque curves.
	**Communication** The *Communication* menu allows configuration of data transmission via the serial and Ethernet protocols as well as access to workpiece ID, network and fieldbus settings.
	**Tool Setup** The *Tool Setup* menu allows installing and uninstalling tools and configuring tool groups as well as the programmable I/O level.
	**Archive** The *Archive* menu contains measurements of previous rundowns.
	**Diagnostics** The *Diagnostics* menu provides functions for monitoring, analysis and calibration of components and tools.

Button	Description
	**Utility** The *Utility* menu contains functions for updates of the system or tightening module software and for configuring radio settings on wireless tools, as well as system information.
	**Administration** The *Administration* menu provides general features for the software as well as functions for data backup, user administration and service functions.

4 Basic Application Builder

The *Basic Application Builder* dialog allows a quick and easy programming of a two-stage tightening process. Only a few parameters are required to configure tightening processes for up to 99 applications. For programming more complex tightening processes *see chapter 5 Standard Application Builder, page 18*.

► Select *Navigator* > *Basic*.

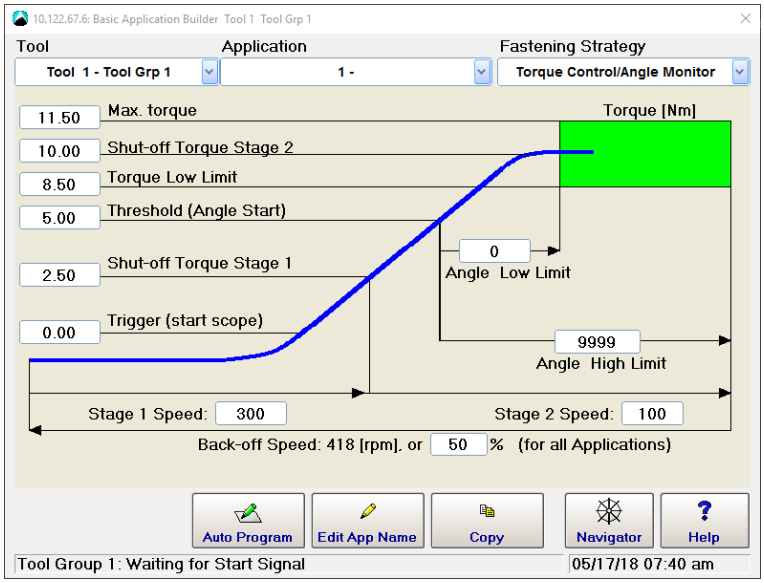


Fig. 4-1: Basic Application Builder dialog with the Torque Control/Angle Monitor fastening strategy selected

Parameters of the tightening process:

Parameter	Description
Fastening Strategy	In following fastening strategies are available in the *Fastening Strategy* drop-down menu: • Torque Control/Angle Monitor (SEQ 11/SEQ30): The screw is tightened until the shut-off torque (stage 2) is reached. The shut-off point must be within the torque and angle limits. • Angle Control/Torque Monitor (SEQ 11/SEQ 50): The screw is tightened until the shut-off angle is reached. The shut-off point must be within the torque and angle limits.
Maximum Torque	Upper limit value of the torque that must not be exceeded for a valid rundown.
Shut-Off Torque Stage 2	Torque where the tool is switched off and the rundown is finished. This parameter is displayed only for the *Torque Control/Angle Monitor* fastening strategy.
Torque Low Limit	Lower limit value of the torque that must be reached for a valid rundown.
Threshold Torque	Torque at which the angle measurement values of stage 2 are saved.
Shut-Off Torque Stage 1	Torque at which stage 1 ends and stage 2 begins.
Trigger Torque	Torque from which the measured values are saved for the graphical representation of the torque graph.
Angle Low Limit	Lower limit of the angle [degrees] that must be reached for a valid rundown.
Shut-Off Angle	Angle [degrees] where the tool is switched off and the rundown is finished. This parameter is displayed only for the *Angle Control/Torque Monitor* fastening strategy.
Angle High Limit	Upper limit of the angle [degrees] that must not be exceeded for a valid rundown.
Stage 1 Speed	Rotation frequency of the tool in stage 1.

Parameter	Description
Stage 2 Speed	Rotational frequency of the tool in stage 2. In order to achieve a higher accuracy at the shut-off point, a slower speed is usually used in stage 2.
Back-Off Speed: (...) [RPM], or(...)% (Applies To All Applications)	The speed specifications for counterclockwise rotation apply to all product groups. The speed is calculated from the percentages, depending on the maximum speed of the tool.

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 extended parameters:

Parameter	Stage 1	Stage 2
Start Delay Time TV (ms)	0	0
Start Pulse Suppression TA (ms)	0	0
Fastening Time Tmax (ms)	10,000	10,000
Dwell Time TN (ms)	0	Automatic setting: 30 Manual setting: 0
Torque Averaging Filter Ff	4	4

4.1 Rundown Programming

There are three options in the *Basic Application Builder* dialog to program a simple fastening sequence.

4.1.1 Auto Program

With the automatic adjustment all further parameters are calculated on the basis of the input.

The <Auto Program> button is only available in the *Basic Application Builder* menu if a tool is connected to the controller and the application has not yet been programmed.

Automatic programming is only possible under the following conditions:

- The application has already been parameterized in the *Basic Application Builder* menu.
- A Fastening program was parameterized for the application, which uses SEQ 11 in stage 1 and SEQ 30 or DIA 50 in stage 2.

Configure fastening strategy with automatic adjustment

1. To open *Basic Application Builder*, select *Navigator* > *Basic*.
2. Select the correct tool and product group in the drop-down menus.
3. Select the fastening sequence from the drop-down menu.
4. To open the *Auto Program* press <Auto Program>.
5. Enter the *Shut-Off Torque Stage 2* or the *Shut-Off Angle* depending on the selected fastening strategy. A virtual keyboard will appear at the controller when the text field is selected.
6. Confirm the entry with <OK>.
   ➢ All other parameters are calculated automatically and displayed in the graphic. They can be adjusted manually. The calculation of the parameters can be found in the table below.
7. To save the changes and exit the dialog click on <Navigator> and <Accept>.

Calculation of the parameters:

Parameter	Torque Control/Angle Monitor		Angle Control/Torque Monitor	
	Stage 1	Stage 2	Stage 1	Stage 2
Shut-Off Torque	Shut-Off Torque Stage 2 × 0,25	Manual input at <Auto Program>	0	-

Parameter	Torque Control/Angle Monitor		Angle Control/Torque Monitor	
	Stage 1	Stage 2	Stage 1	Stage 2
Shut-Off Angle	-	-	-	Manual input at <Auto Program>
Maximum Torque	-	Shut-Off Torque Stage 2 × 1.15	-	Maximum capacity of the tool, if not 0
Torque Low Limit	-	Shut-Off Torque Stage 2 × 0.85	-	0
Threshold Torque	-	Shut-Off Torque Stage 2 × 0.5	-	0
Trigger Torque	0	-	0	-
Angle Low Limit	-	0	-	Shut-Off Angle - 10°
Angle High Limit	-	9999	-	Shut-Off Angle + 10°
Speed	300 or Tool Max Speed if lower	50	300 or Tool Max Speed if lower	50
Speed left rotation	50 % of Tool Max Speed for all applications		50 % of Tool Max Speed for all applications	

4.1.2 Manual Programming

Manual programming of fastening sequences in the *Basic Application Builder*

1. To open the *Basic Application Builder*, select *Navigator* > *Basic*.
2. elect the correct tool and product group in the drop-down menus.
3. Select the fastening sequence from the drop-down menu.
4. Enter values in the input fields. The allowed parameters can be found in the following table. The following applies to the input:
   - Enter negative values with a minus sign "-" in front of the value.
   - No comma needs to be inserted for whole numbers. The decimal places are added automatically.
5. To save the changes and exit the dialog click on <Navigator> and <Accept>.

Allowed parameters:

Parameter	Range	Typical value
Trigger Torque [Nm]	0 – Tool Max	Shut-Off Torque × 0.1
Shut-Off Torque Stage 1 [Nm]	0 – Tool Max	As appropriate
Threshold Torque [Nm]	Shut-Off 1 – Tool Max	Shut-Off Torque × 0.5
Torque Low Limit [Nm]	-Tool Max – Tool Max	Shut-Off Torque × 0.9
Shut-Off Torque Stage 2 [Nm]	Low Limit – To save the changes and exit the dialog	As appropriate
Maximum Torque [Nm]	Shut-Off – 1.2 × TQ calibration value	Shut-Off Torque× 1.1
Angle Low Limit [Deg]	0 – 9999	Shut-Off Angle × 0.9
Shut-Off Angle [Deg]	Low Limit – 9999	As appropriate
Angle High Limit [Deg]	Shut-Off – 9999	Shut-Off Angle × 1.1
Stage 1 Speed [RPM]	0 – Tool Max	Tool Max × 0.8
Stage 2 Speed [RPM]	0 – Tool Max	Tool Max × 0.5
Speed left rotation	0 – Tool Max	Tool Max × 0.5

4.1.3 Copy

Copy parameters of an application to one or more other applications

1. To open the *Basic Application Builder*, select *Navigator* > *Basic*.
2. To select the tools and application for copying, press <Copy>.
3. Enter the source and destination for the respective tool or application.
4. To specify multiple target applications, separate the application numbers with a space or a comma.
5. To specify a range, use a hyphen. Example: 2, 10-15, 99 (the following applications are selected: 2, 10, 11, 12, 13, 14, 15, 99
6. To start the copy process, press <Copy>.
   ➢ All stages of the selected application will be copied.
7. To save the changes and exit the dialog click on <Navigator> and <Accept>.

4.2 Edit App Name

Edit the App name

1. To open the *Basic Application Builder*, select *Navigator* > *Basic*.
2. Select the Application in the drop-down menu.
3. To edit a name, press <Edit App Name>.
4. Enter a name and accept the change with <OK>.

5 Standard Application Builder

In the *Standard Application Builder* allows to program rundowns with up to six stages.

► Select *Navigator* > *Standard*.

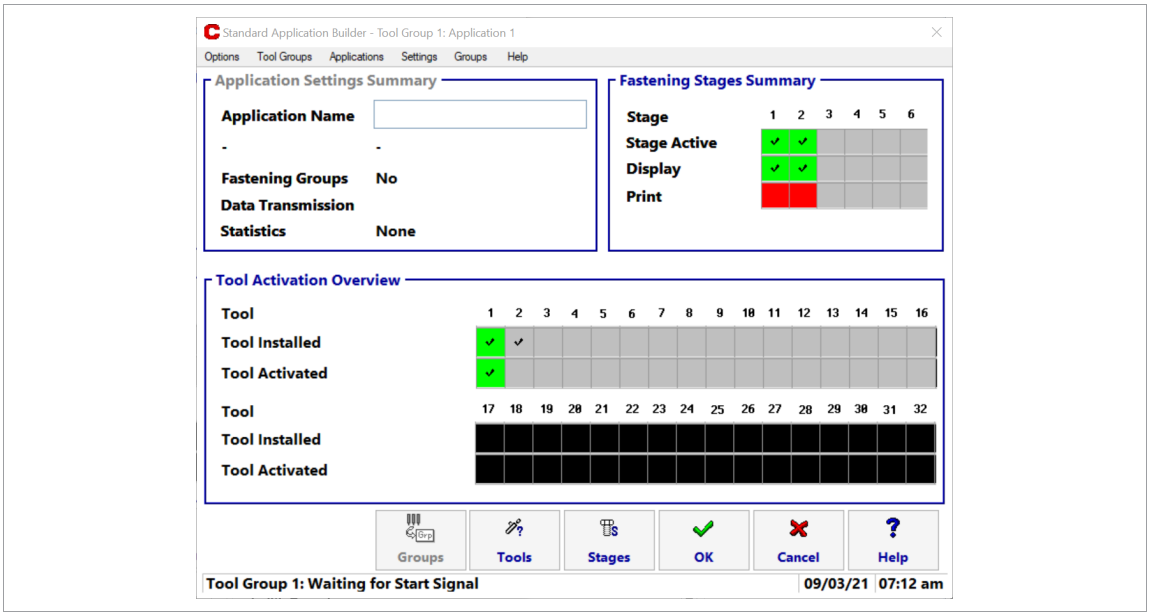


Fig. 5-1: Standard Application Builder dialog

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 5.11 Settings for Speed Left Rotation, page 43*
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 5.12 Fastener IDs, page 44* • Batch program, *see chapter 5.14 Batch Programming, page 45* • Set Input/Output bitmask, *see chapter 5.15 Input/Output Bitmask, page 47* • I-Wrench additional parameters, *see chapter 5.16 Additional I-Wrench Parameters, page 49*
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.

Option	Description
Data Transmission	**– Not available in current software version –** Depends on the software. Indicates which communication protocol is installed.
Statistics	**– 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 (<Tool> 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 Activate Tool

In the *Tool Activation* dialog, the tools can be selected that are to be used in the application. All tools are displayed that are installed in a tool group. A tool is installed if its measuring board is present.

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.

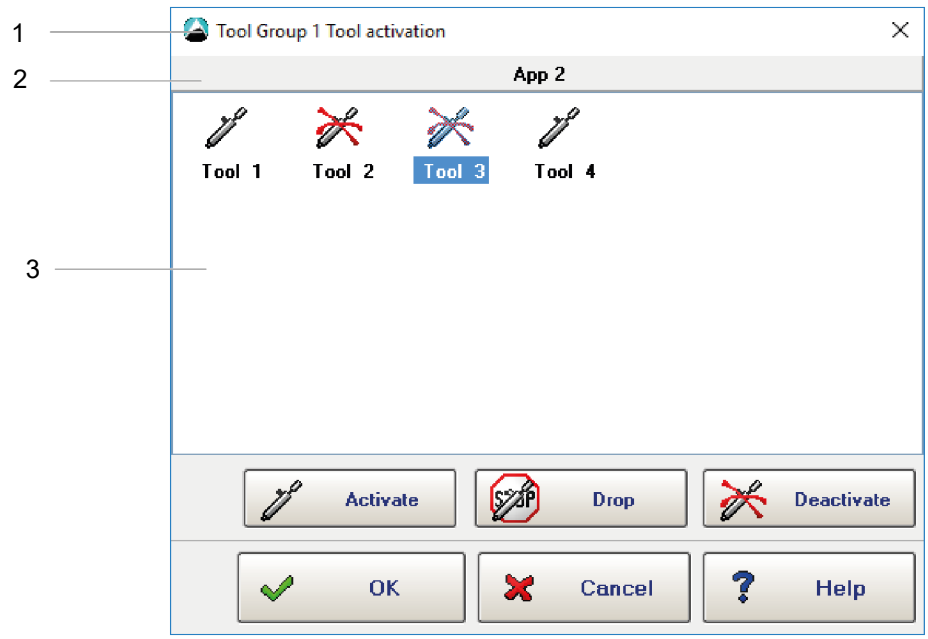


Fig. 5-2: The Tool Activation dialog with the tools of Tool Group 1 used for Application 1. Tools 1 and 4 are activated, Tools 2 and 3 are deactivated. Tool 3 is currently selected.

1	Current Tool Group
2	Application you are programming
3	Installed tools

Assign tool to an application

1. Select *Navigator* > *Standard* > *Tools*.
2. Select the required tool group and application from the *Tool Groups* and *Applications* menu of the *Standard Application Builder*.
3. Press <Tools> to open the *Tool Activation* dialog.
4. Press the tool in the *Installed Tools* field to select it.
   ➢ The selected tool is highlighted in blue.
5. Assign one of the following options to the tool:

Button	Description
	Use tool in the application. The tool result is included in the total result.
	Tool is part of the application, but is not started. This setting is used when a tool is temporarily unusable. The result of the tool is NOK. The error *ABGW* is displayed. The NOK result of the deselected tool is displayed in the archive, but has no influence on the total result.
	Do not use tool in the application.

6. To confirm the selection, press <OK> and then <Change>.
7. Use the <Deactivate> or <Drop> button of the Tool Activation dialog to deactivate or temporarily drop a tool.

5.2 Copy 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.

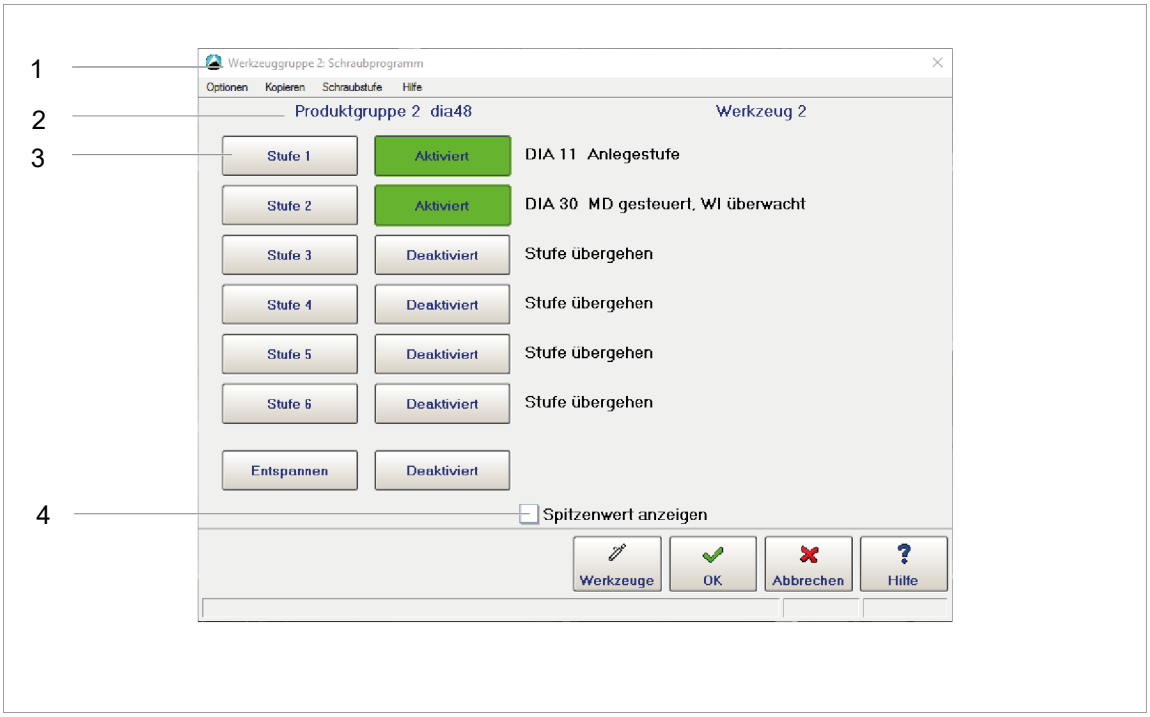


Fig. 5-3: The Fastening Program window set for programming the stages of Tool 2 in Tool Group 2 for Application 2

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. Press <Activated> or <Disabled> 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> 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.

5.4 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* > *Options*.

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.

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

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 *Save 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.

5.5 Fastening Stage Programming

► Select *Navigator* > *Standard* > *Stage* > *Stage n*.

The *Fastening Stage Programming* dialog allows you to:

- Select the fastening strategy
- Enter time parameters
- 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.

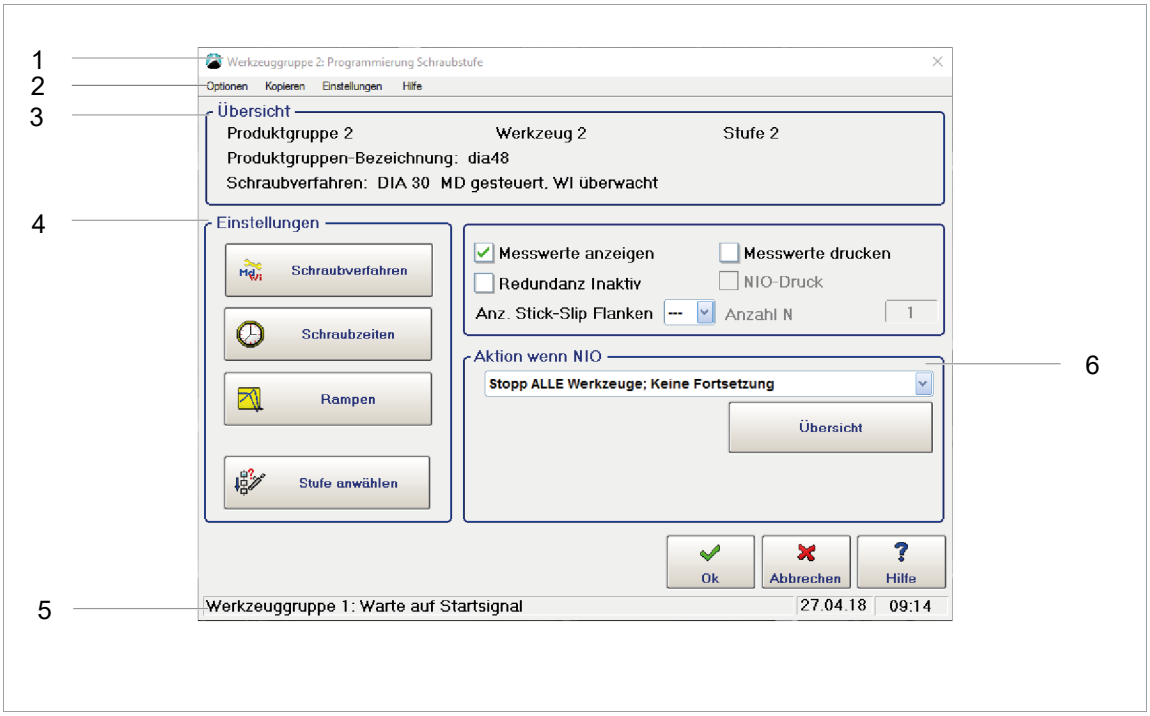


Fig. 5-4: The Fastening Stage Programming dialog set for programming Stage 2 of Tool 2 in Tool Group 2 for Application 2

1	Title bar
2	Menu bar
3	Summary
4	Settings
5	Status bar
6	Action on NOK

- 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 Rundown data table (*Navigator* > *Run Screen* > *Visualization* > *Rundown Data Table*). The Tool monitor (*Navigator* > *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.

5.6 Rundown Programming

The Rundown Programming dialog allows you to enter rundown parameters.

► Select *Navigator* > *Standard* > *Stage* > *Stage n* > *Sequences*.

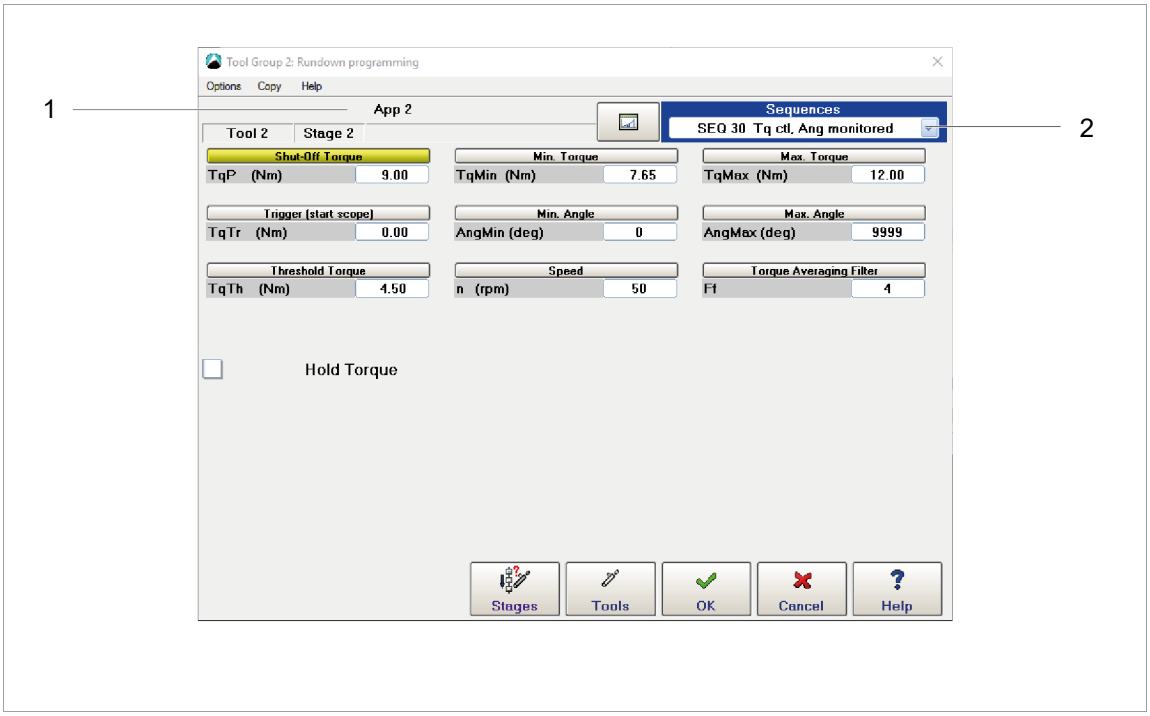


Fig. 5-5: The Rundown Programming dialog set for programming Stage 2 of Tool 2 in Tool Group 2 for Application 2

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.

Select the sequence to be programmed

1. Press *Sequences*.
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 5.5 Fastening Stage Programming, page 23*.

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

► Press the  button to the left of the Sequences drop-down menu to switch views.

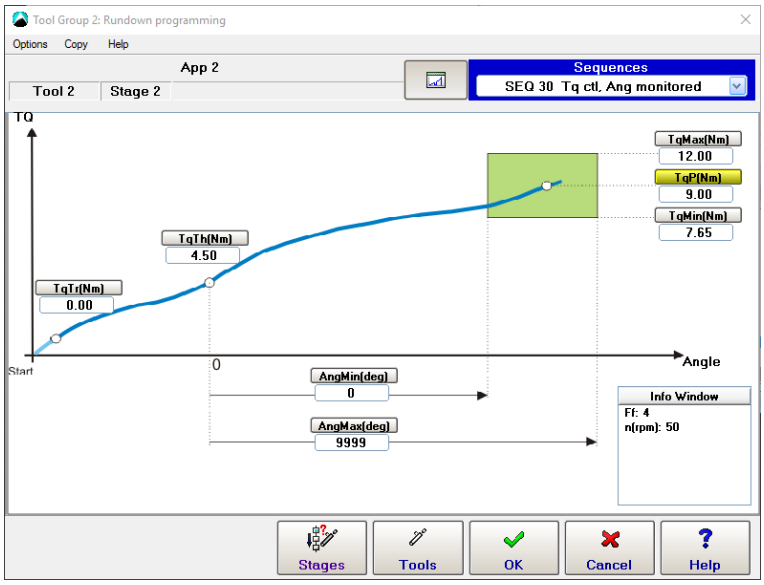


Fig. 5-6: The graphical view of the Rundown programming window

5.6.1 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*, 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* (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*, 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.

5.6.2 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* > *Stage* > *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.

5.6.3 Parametrize I-Wrench Tool Series

When parameterizing the I-Wrench, the Trigger Torque and Threshold Torque must be at least 1% of the I-Wrench capacity. In this case, an error message is displayed when exiting the *Rundown Programming* dialog. The error message depends on the value entered:

Scenario 1: Trigger Torque/Threshold Torque = 0 Nm

➢ Leaving the dialog, an error message appears indicating that the entered value is automatically set to 1% of I-Wrench capacity. After confirming the error message, the dialog can be left.

Scenario 2: Trigger Torque/Threshold Torque is greater than 0, but less than 1% of the I-Wrench capacity

➢ Leaving the dialog, an error message appears indicating that the entered value is less than 1% of the I-Wrench capacity. To leave the dialog, the value must be adjusted.

Scenario 3: Trigger Torque/Threshold Torque is between 1 % and 5 % of the I-Wrench capacity

➢ Leaving the dialog, an error message appears indicating that the accuracy of the torque measurement is not guaranteed in this range. After confirming the error message, the dialog can be left and the parameterization is saved.

5.6.4 Parametrize CellClutch Tool Series

Settings for up to seven stages of a fastening sequence can be parameterized with Sequence 97.
Stages 1 to 5 are used to pre-tighten the screw. They can be activated as required. If the clutch is already released in one of the pre-tightening stages, the rundown is aborted and evaluated with NOK.
The tightening stage (*Tightening*) monitors the clutch and is always set. Shut-off in the tightening stage takes place when the clutch is released. If the parameterized angle or time is reached before the clutch is released, the rundown is aborted and evaluated with NOK.
In the case that the tool is jammed, the *After Clutch Stage* option can be used to remove the tool from the screw. The stage is completed when the parameterized angle, the parameterized time has been reached or the start trigger is released. This also applies if the clutch was released earlier. *After Clutch Stage* is not evaluated and does not send a result to the controller.

1. Select *Navigator* > *Standard* > *Stages*.
2. Activate desired stages.
3. To program the fastening sequence for the respective stage, press the *Stage n*, *Tightening* or *After Clutch Stage* button.
4. Confirm settings with *OK*.

Batch Programming

With the CellClutch tools, several rundowns can be evaluated together. This is parameterized in the batch settings.

1. Select *Navigator* > *Standard* > *Settings* > *Batch*.
2. In the *Batch Counter Mode* drop-down menu, select the *Application* option. For tools of the CellClutch series the batch function is only possible with the application.
3. Enter a number of rundowns belonging to a batch in the *Batch Size* input field.
4. Confirm settings with *OK*.

5.7 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* > *Stage* > *Stage n* > *Timing*.

Copy commands of the *Copy* 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.

Fastening stage timing parameters

Parameter	Description
Fastening Time 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 shutdown) 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 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 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 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 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**

Fastening stage timing for the I-Wrench

When you use an I-Wrench, the *Fastening Stage Programming* dialog displays parameters specific to I-Wrenches.

Long Timeout [ms]

This parameter determines when the fastening cycle ends and allows the operator to finish with a final result even if several tightening steps are needed. Enter a value that is slightly greater than the maximum pauses required for handling the I-Wrench.

The Long Timeout is enabled when the torque increases beyond the lower torque limit (5 % of I-Wrench capacity), but remains below 75 % of the target torque. The I-Wrench starts to measure time when the torque decreases below the 5 % (of I-Wrench capacity) between tightening steps, i.e., during pauses required for handling the I-Wrench. If the pause is greater than the value for Long Timeout, the I-Wrench uses the greatest peak below 75 % of the target torque as the result of the fastening cycle. If the pause is less than the value for Long Timeout and the torque is greater than 75 % of the target torque, the Long Timeout is stopped and the Short Timeout is enabled.

Short Timeout [ms]

This parameter determines when the fastening cycle ends and facilitates rapid completion of the fastening cycle after the last tightening step. Enter a low value, typically 200 ms. The Short Timeout is enabled when the torque increases beyond 75 % of the target torque. The I-Wrench starts to measure time when the torque decreases below the 5 % (of I-Wrench capacity). If the pause is greater than the value for Short Timeout, the I-Wrench uses the greatest peak above 75 % of the target torque as the result of the fastening cycle.

5.8 Ramps

The *Slow Start* dialog provides features that allow you to better control the Speed Ramp-up and Speed Ramp-down of a stage. This function is disabled for CellTek tools.

► Select *Navigator* > *Standard* > *Stage* > *Stage n* > *Slow Start*.

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

Parameter	Activate
Speed Ramp-Up	
Ramp-Up Time	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	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.
Maximum Flex-Time	Maximum permissible time for the Flex-Stop to reduce the torque after a shut-off.

5.9 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:

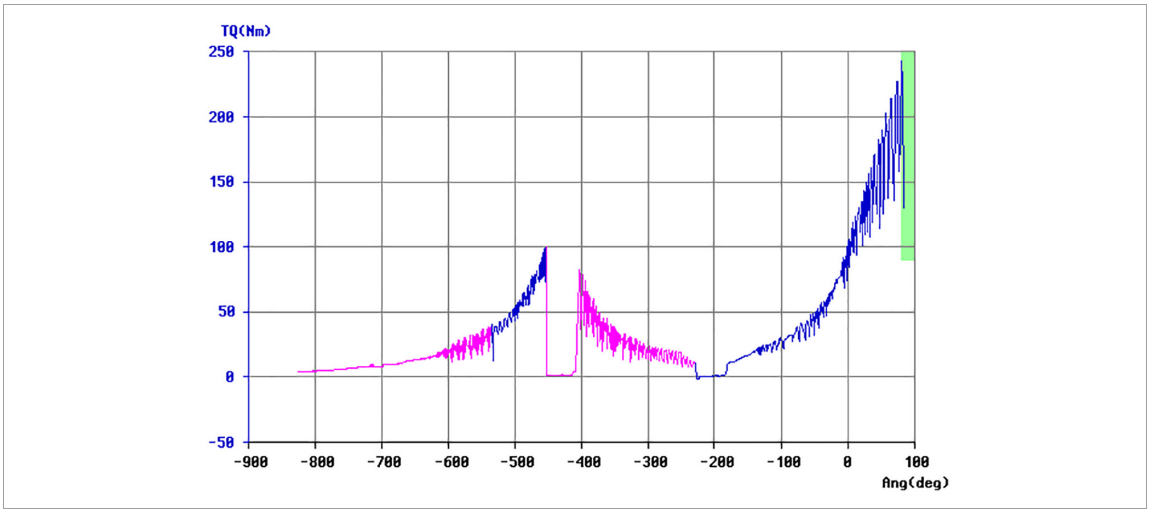


Fig. 5-7: Torque graph showing many stick-slip flanks

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

5. Select *Navigator* > *Standard* > *Stage* > *Stage n* to access the *Stick-Slip Cycles* drop-down menu.
6. 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.

5.10 Action on NOK

The *Fastening 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*.

1. Select *Navigator* > *Standard* > *Stage* > *Stage n* to access the *Action on NOK* drop-down menu.
2. Press the *Action on NOK* drop-down menu and select the required option.

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.

5.10.1 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* > *Stage* > *Stage n*.
2. Tap the *Action on NOK* drop-down menu and select the *Perform Touch Up / Error Handling* dialog.
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 function

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 function:

1. Select *Navigator* > *Standard* > *Stage* > *Stage n*.
2. Tap the *Action on NOK* drop-down menu and select the *Perform Touch Up / Error Handling*.
   - 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 function

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 function:

1. Select *Navigator* > *Standard* > *Stage* > *Stage n*.
2. Tap the *Action on NOK* drop-down menu and select *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* m.

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*

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.

5.10.2 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.

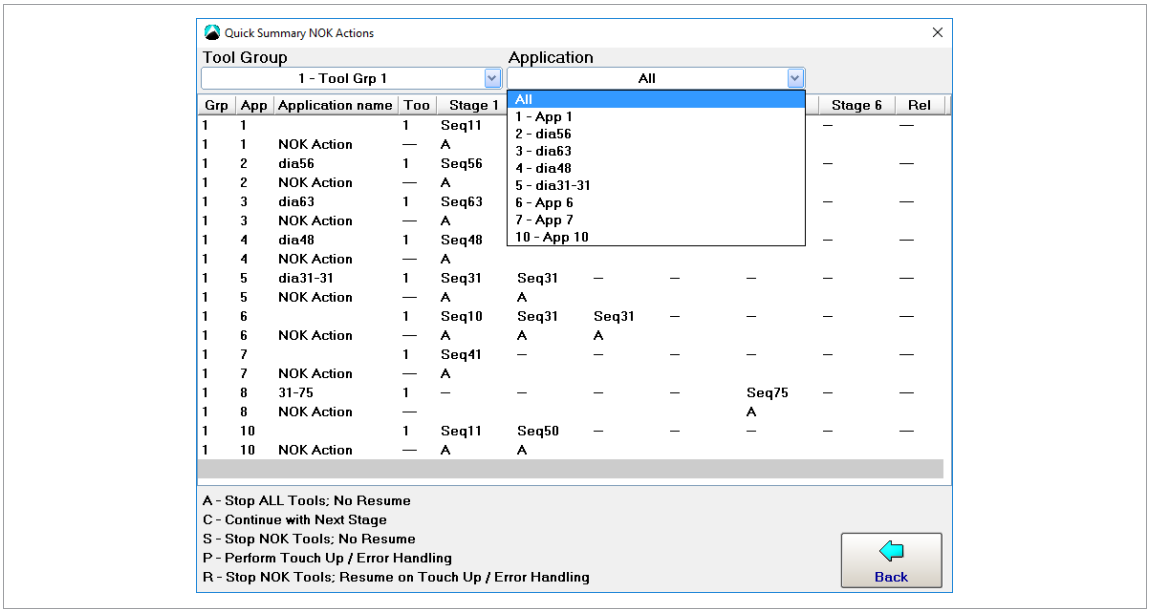


Fig. 5-8: Quick Summary NOK Actions window

To access a Quick Summary Quick Summary NOK Actions list:

1. Select *Navigator* > *Standard* > *Stage* > *Stage n*.
2. In the *Fastening Stage Programming* dialog:
   - Tap the <Quick Summary> button in the *Action on NOK* selection 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.

5.10.3 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* und *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

he 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.

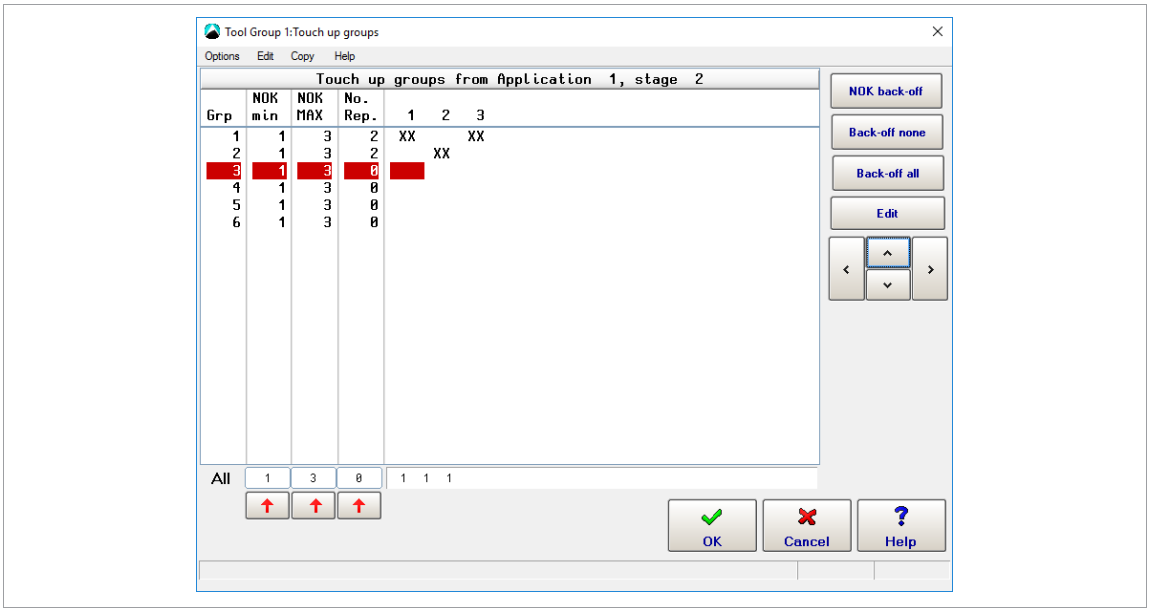


Fig. 5-9: Touch-up groups dialog with six touch-up groups (represented by table rows) and three tools (represented by table columns no. 1-3)

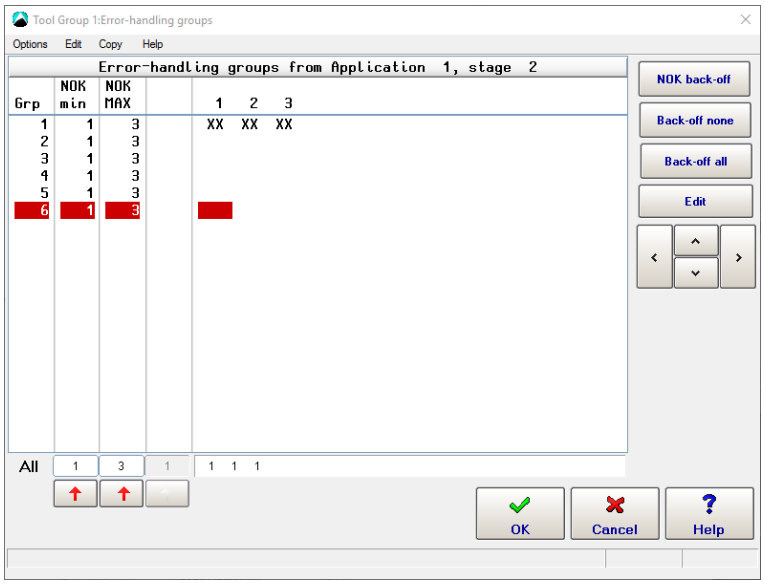


Fig. 5-10: Error Handling groups dialog with six error handling group (represented by table rows) and three tools (represented by table columns no. 1-3)

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

1. Select *Navigator* > *Standard* > *Stage* > *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 *Groups* option from the *Edit* menu.

Functions 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: Select *Navigator* > *Standard*.
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 <red arrow> 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

5.10.4 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 *NIO min* tools in the group are NOK, and
   - no more than *NIO 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 *NIO min* tools in the group are NOK, and
   - no more than *NIO 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.

5.10.5 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:

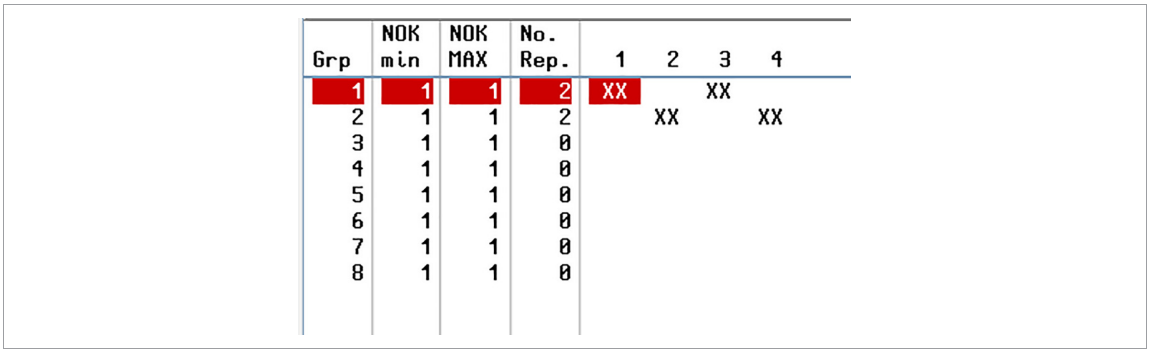


Fig. 5-11: Example 1 has two touch-up groups with two tools each

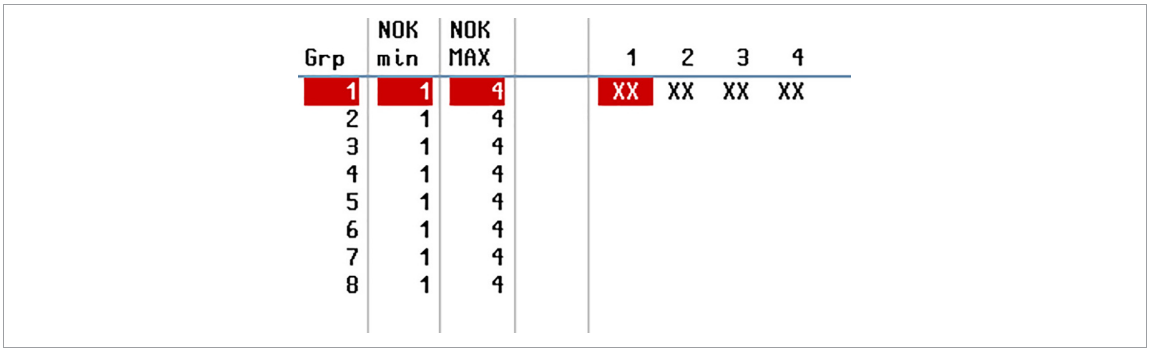


Fig. 5-12: Example 1 has one error handling group with all four tools assigned

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[1]	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

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[2]	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[3]	OK	OK	OK	OK	OK	Touch-up stage 2 tools 1, 3 are backed off

[1] Stage 8 is used for back-off in touch-up
[2] Stage 8 is used for back-off in touch-up
[3] Stage 8 is used for back-off in touch-up

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

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[2]	NOK	NOK	NOK	NOK	NOK	Error handling: Touch-up is not performed since touch-up NOK MAX = 1.

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.

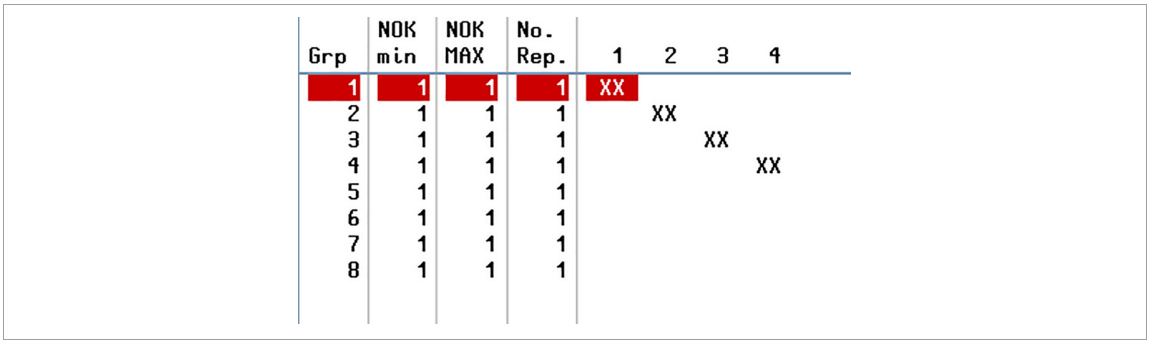


Fig. 5-13: Example 2 has four touch-up groups with one tool each

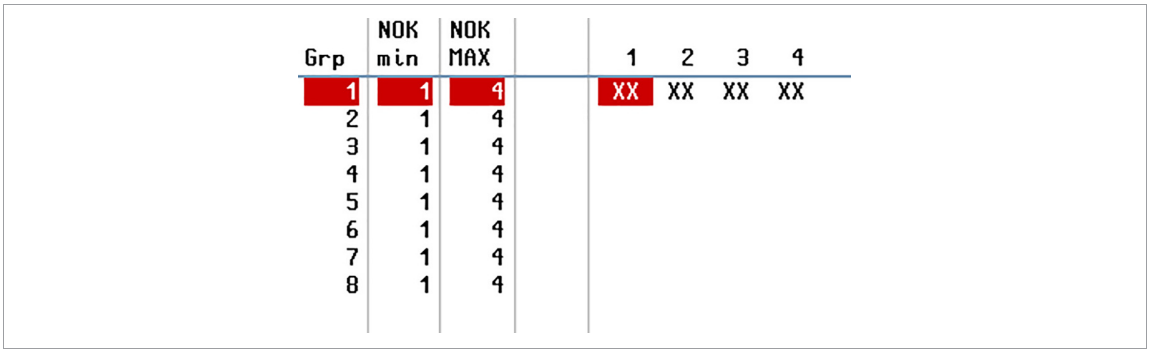


Fig. 5-14: Example 2 has one error handling group with all four tools assigned

[1] Stage 9 is used for back-off in error handling
[2] Stage 9 is used for back-off in error handling

- 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[1]	-	OK	-	-	OK	Touch-up tool 1
1	-	OK	-	-	OK	Repeat from stage 1 (as required)
2	NOK	OK	OK	OK	NOK	Tool 1 - NOK
8[2]	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[3]	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.

Example 3

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

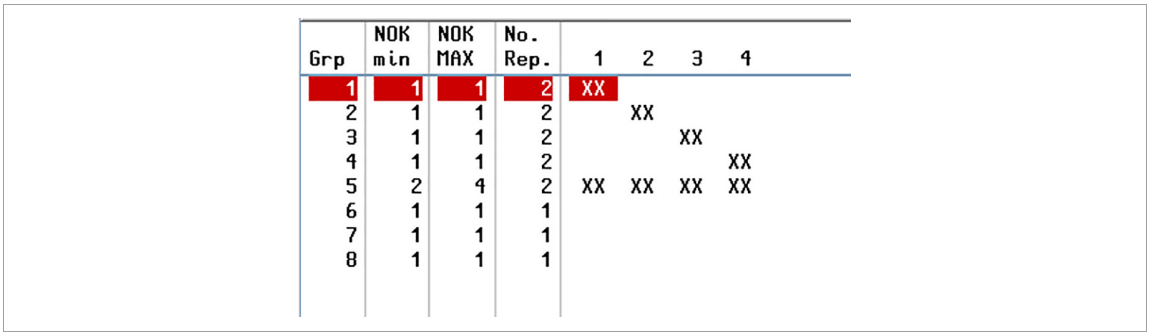


Fig. 5-15: Example 3 has five touch-up groups, i.e., four groups with one tool each and one group with all four tools assigned

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).
- 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.

[1] Stage 8 is used for back-off in touch-up
[2] Stage 8 is used for back-off in touch-up
[3] Stage 9 is used for back-off in error handling

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. 5-16: 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. 5-17: 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/re-runs) 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.

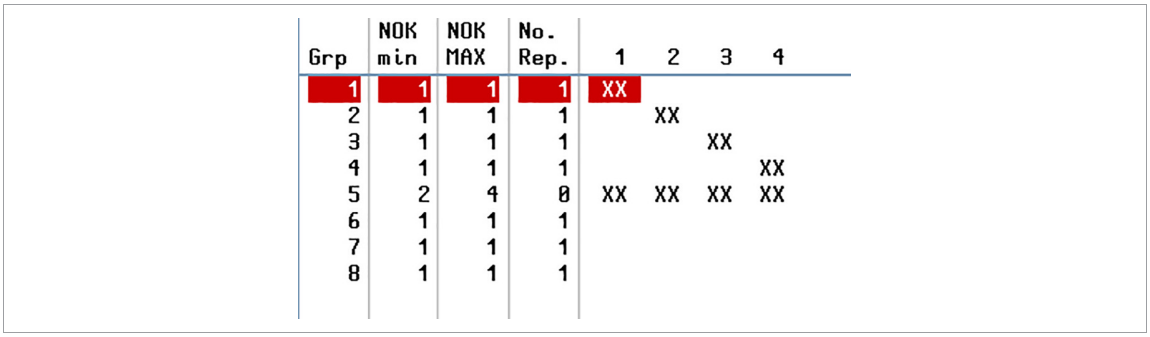
2. If Tool 2 and Tool 4 are NOK, error handling is performed:

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

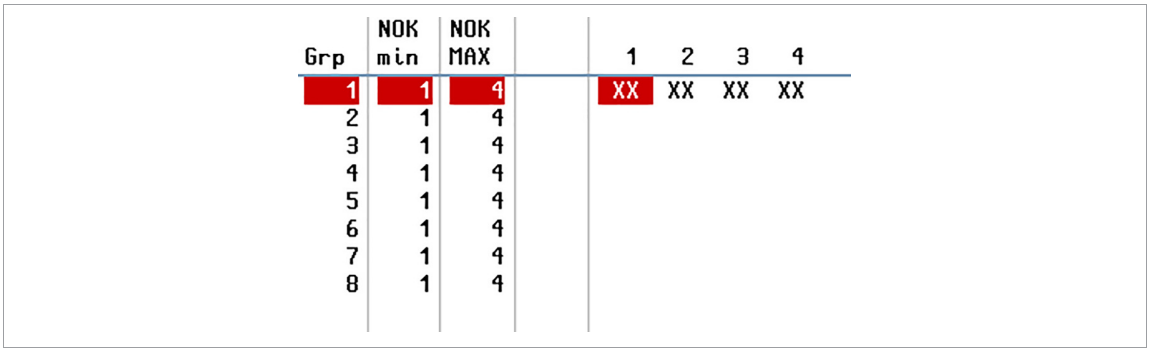
The following outcome is required:

- 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. 5-18: 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. 5-19: 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

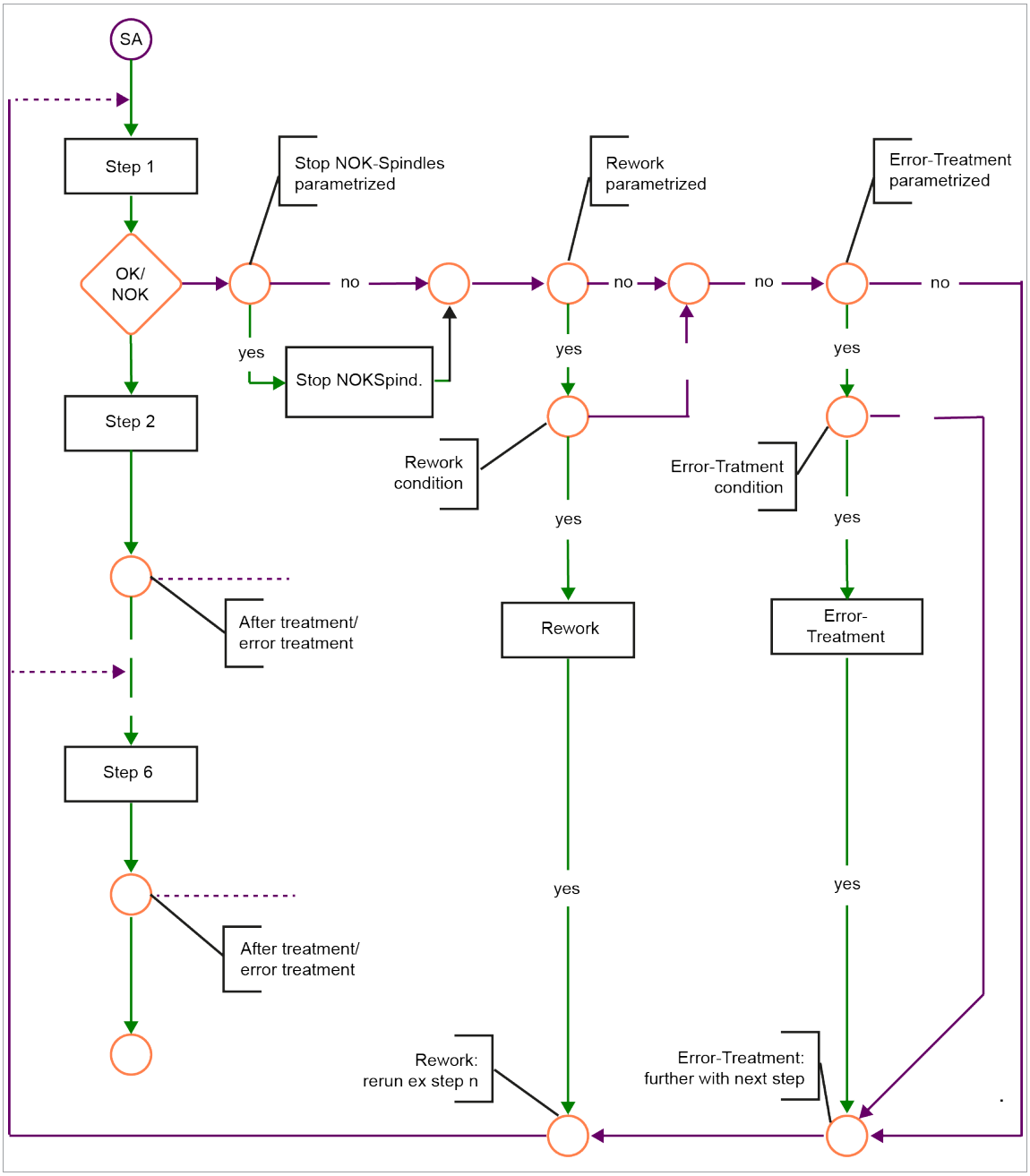


Fig. 5-20: Flowchart for touch-up and error handling

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.

5.11 Settings for Speed Left Rotation

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

Specifications for spindles

Activate the Reverse (TM_LL) input signal.
Provide the Tool Group Enable signal if required.
Set the Tool Group Start (SA) signal to start the back-off process.

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 ARCNET 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 ARCNET connection fails.

Setting left rotation

1. Select *Navigator* > *Standard*.
2. 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 *Settings For Speed Left Rotation* dialog.

Parameter	Value range	Standard setting	Definition	Description
Back-Off Speed (%)	-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 (%)	-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.Back-off speed at beginning
Maximum Torque (% of Maximum Calibration 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 *Maximum Torque (% of Maximum Calibration Factor)* parameter may not be processed and the back-off function only works if a value greater than or equal to 90% is entered for *Maximum Torque (% of Maximum Calibration Factor)*.

5.12 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.

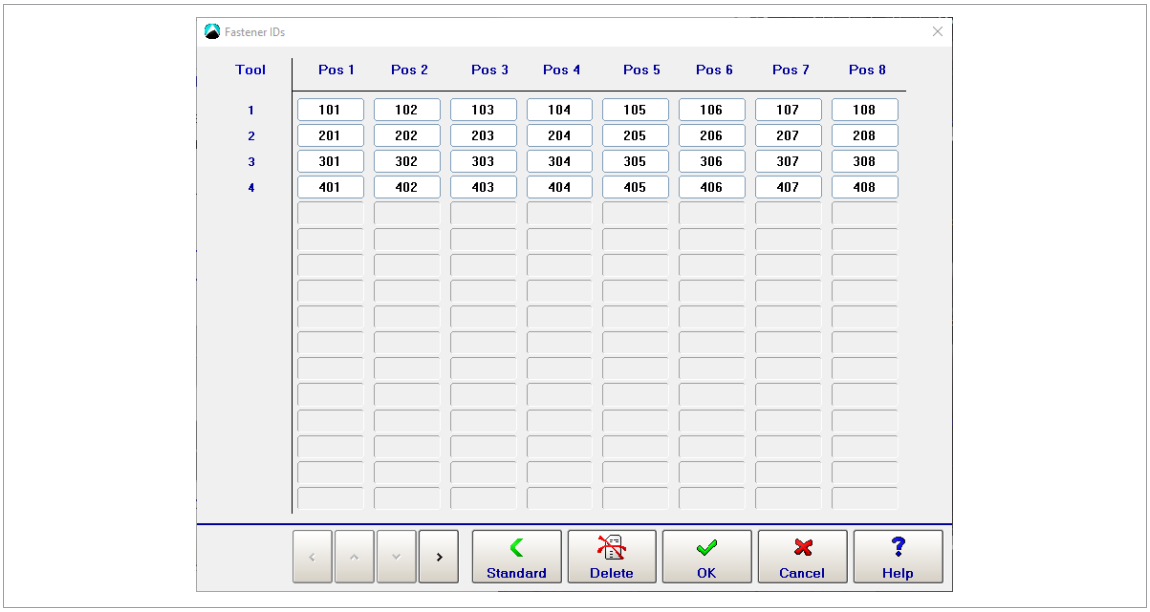


Fig. 5-21: The Fastener IDs dialog with all fastener IDs set to default values

1. Select *Navigator* > *Standard*.
2. Tap the *Settings* menu and select the *Fastener IDs* option to open the *Fastener IDs* dialog.
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.

5.13 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 5.7 Fastening Stage Timing, page 28*. 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.

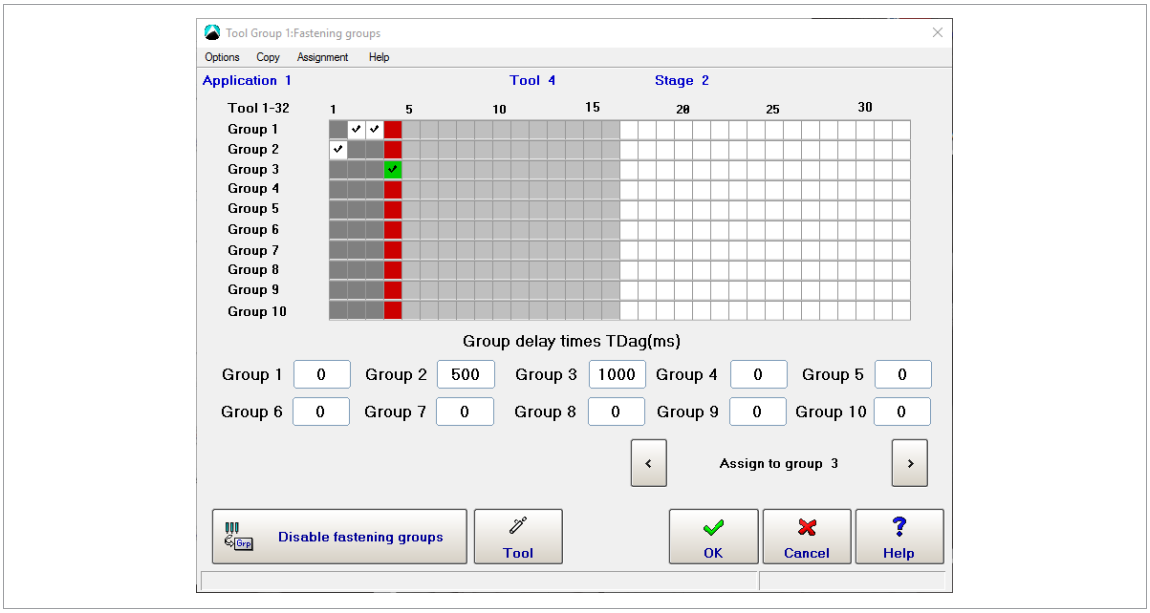


Fig. 5-22: The Fastening Groups *dialog with four tools assigned to three fastening groups*

To open the Fastening groups dialog:

1. Select *Navigator* > *Standard*.
2. Select the required Tool Group and Application.
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 TDag(ms)* 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* input box in the *Fastening Stage Timing* dialog is locked for the current stage!

5.14 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* The Run Screen displays batch information if you enable the *Additional Information* section of the *Run Screen* dialog.

To display batch positions on the Run Screen:

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

Batch count modes

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

Open Protocol option

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

To activate Open Protocol:

1. Select *Navigator* > *Communication*.
2. Select the *Data Transmission* tab of the *Communication* 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:

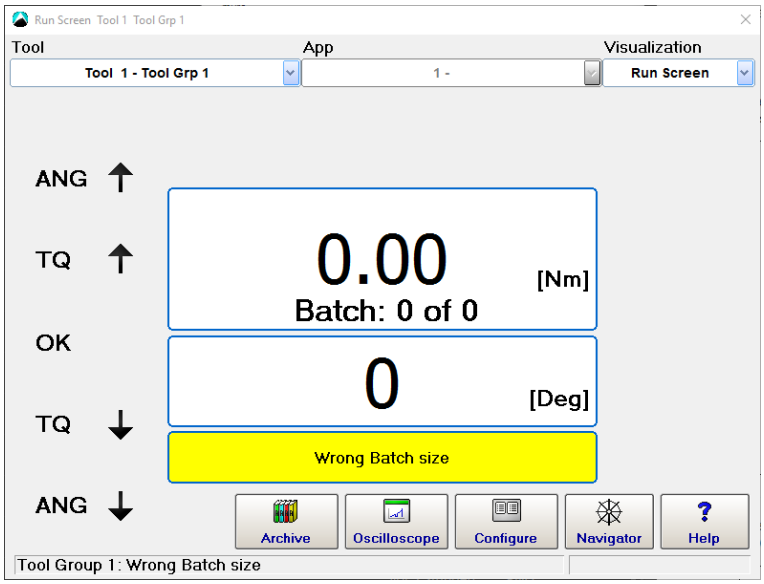


Fig. 5-23: The Run Screen with batch information enabled, but no batch size selected

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 0**

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:

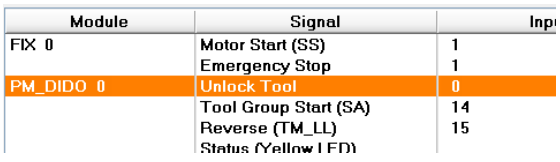


Fig. 5-24: The Unlock Tool signal set in the Programmable I/O Mapping dialog

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:

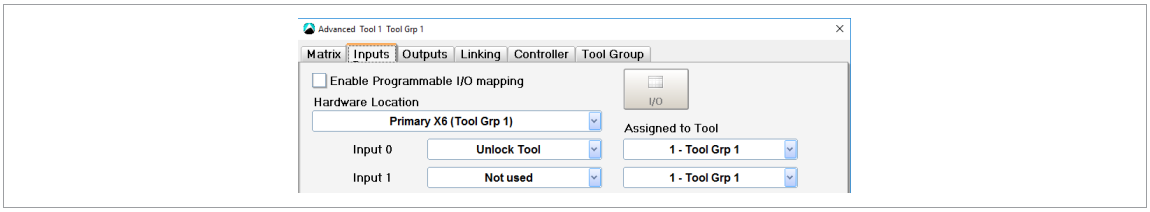


Fig. 5-25: The Inputs tab of the Advanced dialog with the Unlock Tool input signal mapped (Input 0) and the Programmable I/O Mapping option disabled

5.15 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 chapter 19.1 Appendix A – Input Signals, page 245*, pos. 28 and *see chapter 19.2 Appendix B – Output Signals, page 247*, pos. 23.

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.

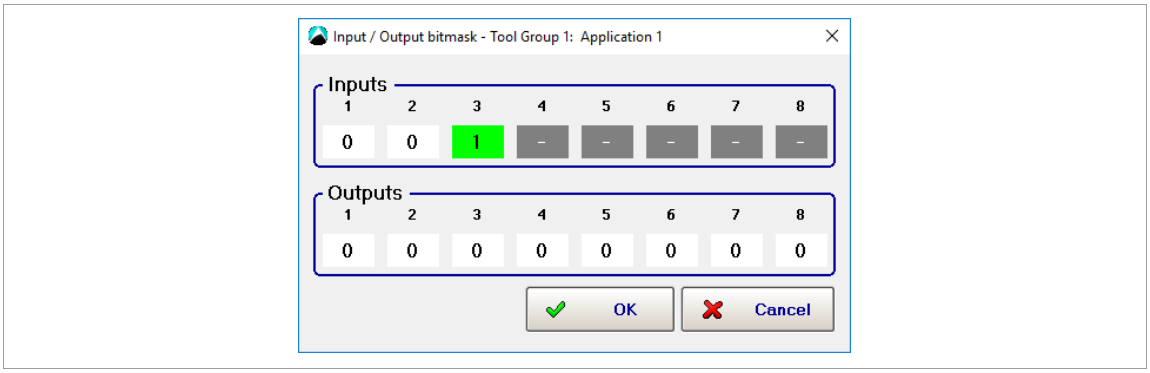


Fig. 5-26: Inputs set for Application 1 of Tool Group 1

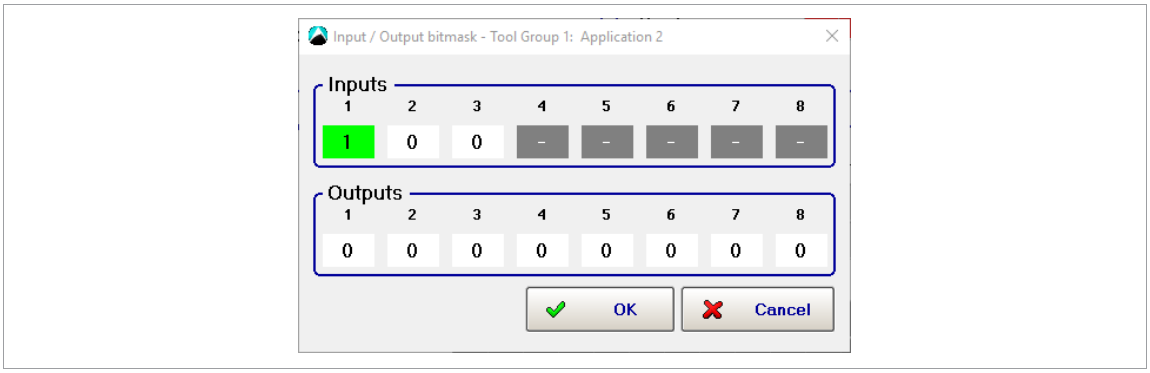


Fig. 5-27: Inputs set for Application 2 of Tool Group 1

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*.

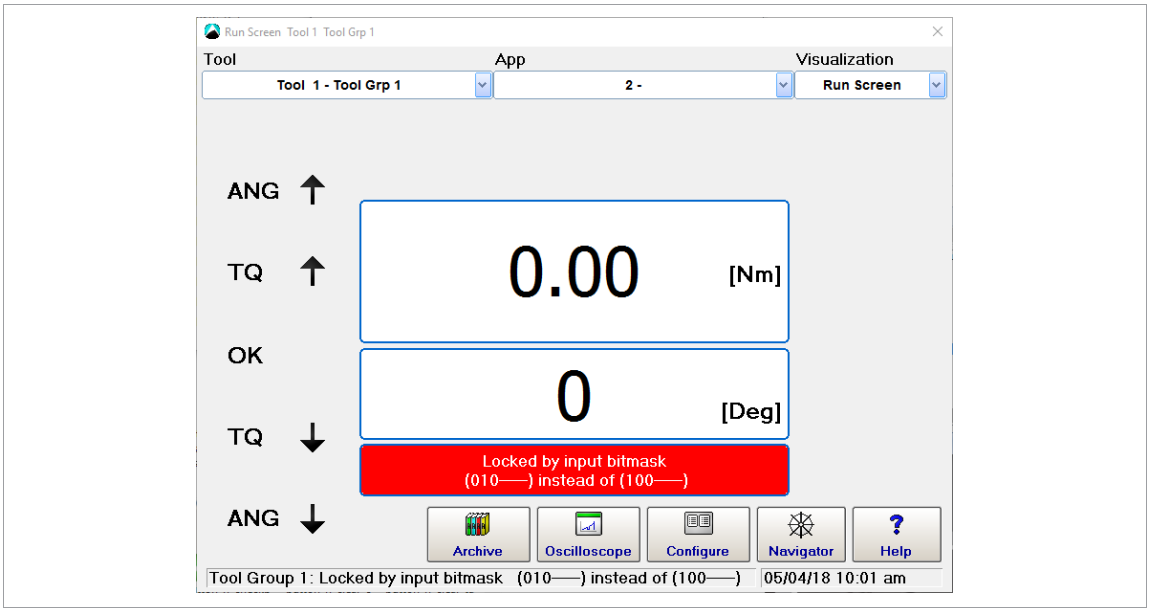


Fig. 5-28: Messages in the Status bar and in the Run Screen's Status field indicate that the Inputs defined for Application 2 in the Input / Output bitmask ('1' for Input 1, '0' for Input 2, '0' for Input 3, and Inputs 4 to 8 not defined) are not matched ('0' for Input 1, '1' for Input 2, '0' for Input 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:

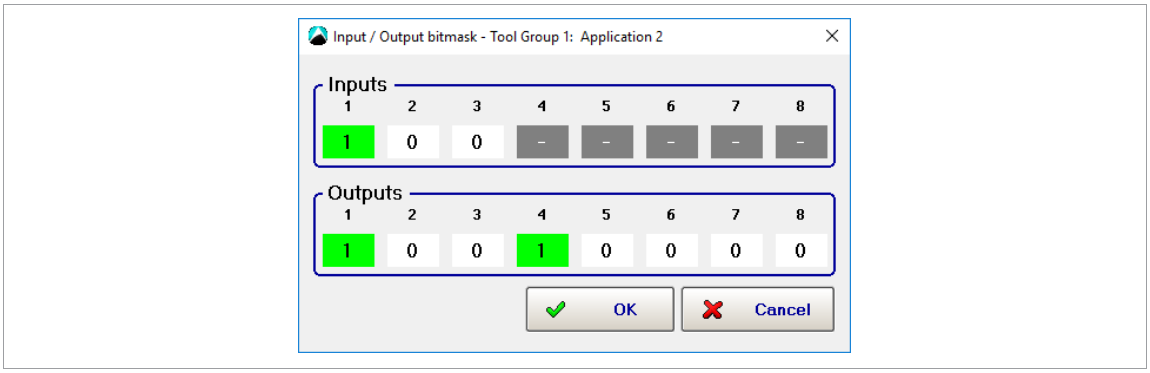


Fig. 5-29: Inputs and Outputs set for Application 2 of Tool Group 1

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.

5.16 Additional I-Wrench Parameters

The *I-Wrench additional parameters* dialog allows you to program tool head and other parameters specific to the I-Wrench.

To open the I-Wrench additional parameters dialog:

1. Select *Navigator* > *Standard*.
2. Select the *I-Wrench additional parameters* option from the *Settings* menu of the Standard Application Builder.

Depending on the tool head model, the I-Wrench supports different heads, i.e., heads with or without memory. For tool heads with memory, the dialog allows you to program a Tool head number for the currently selected application. The I-Wrench is locked if the programmed tool head number does not match the application. For tool heads without memory, the dialog allows you to program torque and angle corrections.

Torque and angle correction for tool heads without memory

Torque correction options:

- Off
- Torque factor
- Elongation [mm]

You must program this parameter if the wrench is connected to an extension that modifies the original calibration length.

Angle correction options:

- Torsion correction factor [°/Nm]
- Gear ratio (for torque multiplier)

This concerns the angular error due to the extension:

- You must determine it using a protractor or a rotary transducer mounted at the end of the extension (close to the joint).
- You then calculate the difference between the angle reading of the wrench and the angle reading of the protractor or rotary transducer.

Example: If the difference is 3° per 100 Nm, you enter '0.03' in the input box because the unit of measurement for the value entered is '°/Nm'.

If an I-Wrench with the PRW firmware version is programmed in SQ-Net, the I-Wrench must have auto-recognition enabled to define Tool head number, Torque correction, and Angle correction. Otherwise, these parameters cannot be sent to the I-Wrench.

6 Advanced Process Programming

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* tab), for linking applications (*Linking* tab), and for programming controller settings (*Controller*) tab), and for programming tool group settings (*Tool Group* tab).

6.1 Application Matrix

► Select *Navigator* > *Advanced* > *Matrix*.

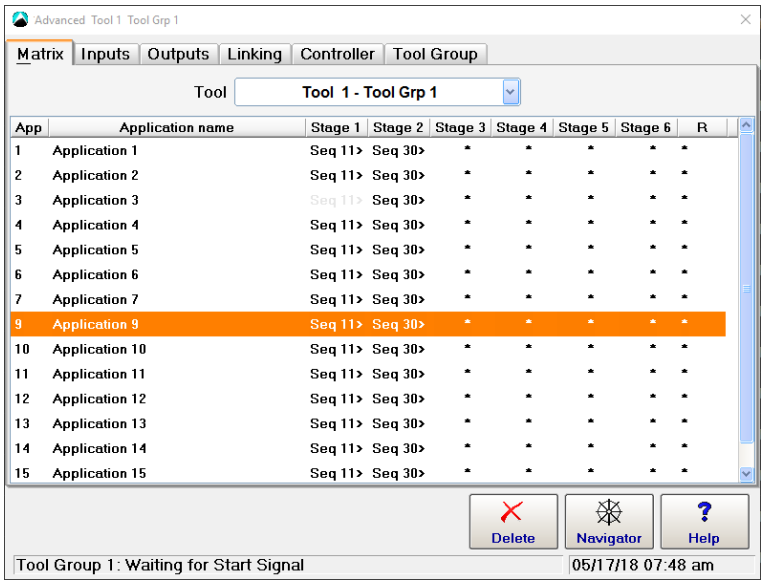


Fig. 6-1: The Application Matrix of the Advanced dialog for Tool 1 of Tool Group 1

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).

6.2 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. This input does not work with LiveWire tools.
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. This input does not work with LiveWire tools.
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	0 = switch to Application mode 1 = activate Linking 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.

6.3 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.
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 1-8	Active if corresponding output is activated via Open Protocol / FEP (MID 0200).
OP Offline	Active if no connection to Open Protocol / FEP Client exists.
Tool Online	Active if LiveWire Tool is online.
Tool Synchronized	Active if LiveWire Tool is synchronized.
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* > *Outputs*.

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 -> active: the tool is locked for the OK/NOK High time [ms]. • Low -> active: the tool is locked for the OK/NOK Low time [ms].

High -> Low

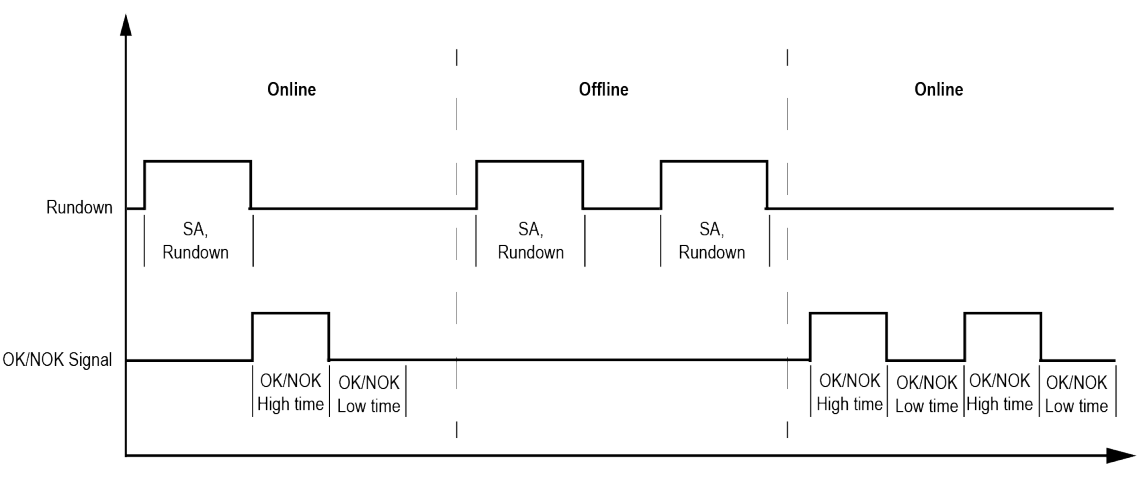


Fig. 6-2: Behavior at High -> Low

Low -> High

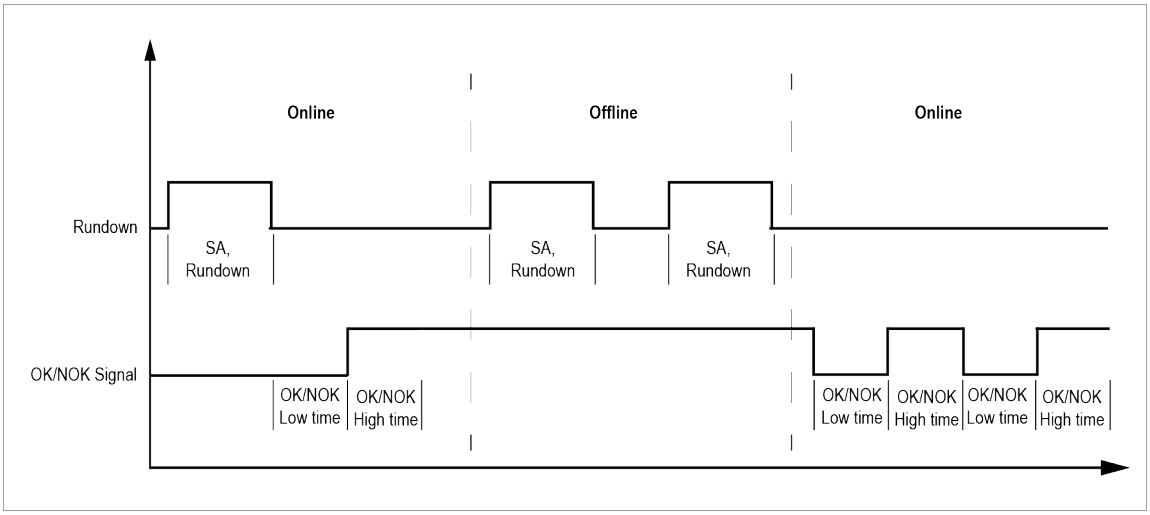


Fig. 6-3: Behavior at Low -> High

6.4 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.

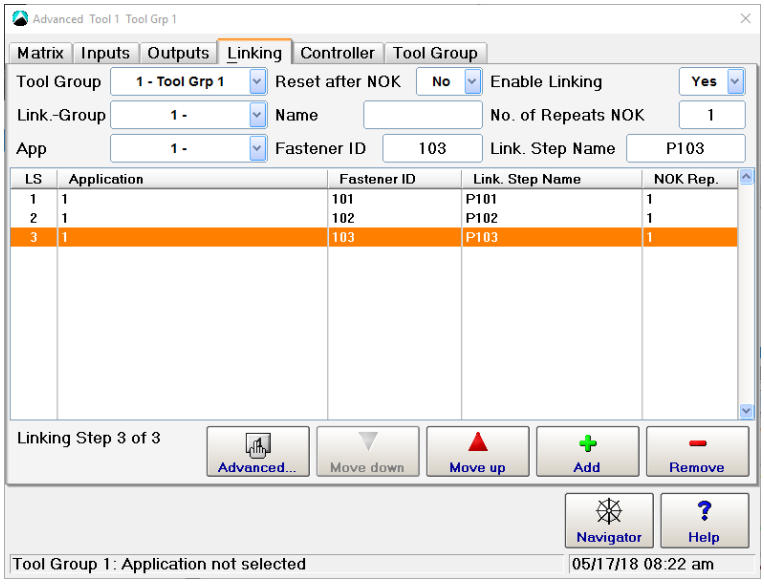


Fig. 6-4: The Linking tab of the Advanced dialog

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. For details *see chapter 6.4.1 Scan Steps in Linking Operations, page 57*.

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.
   - Reset After NOK: Resets the linking group to the first tightening position when an NOK occurs.
   - Number 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.
9. You can enter a Fastener ID and a Linking step name in the *Fastener ID* and *Link. Step Name* boxes.
10. Tap the *Move Up* and *Move Down* buttons to change the position of the currently selected linking step within the linking group.
11. 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.

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* > *Extended...*.

***Overview Linking Steps* Tab**

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.
	<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.

***General* Tab**

Option	Description
Linking Sequence Arbitrary	This option is suitable for position detection systems. If the check box is active, the Linking is assigned to the tightening position based on the movement of the tool. In order to assign the Linking correctly on the basis of their position, the bit mask inputs must be parameterized uniquely.

Linking Step Settings dialog

Das 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 *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 *Programming 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  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  to open the *Settings* dialog for the currently selected linking step.
7. Enter the values required for the linking step.

The *Settings* dialog contains the following controls for defining a new or edit an existing 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.

6.4.1 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. For details on how to set the function Barcode *see chapter 8.4.1 Part ID Settings, page 116* and *see chapter 8.4.2 Workpiece Administration, page 119*.

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* > *Communication* > *Part ID* to open the *Part ID* dialog, and enter the required values. For details *see chapter 8.4.1 Part ID Settings, page 116* and *see chapter 8.4.2 Workpiece Administration, page 119*.
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:

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

Item	Example
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:

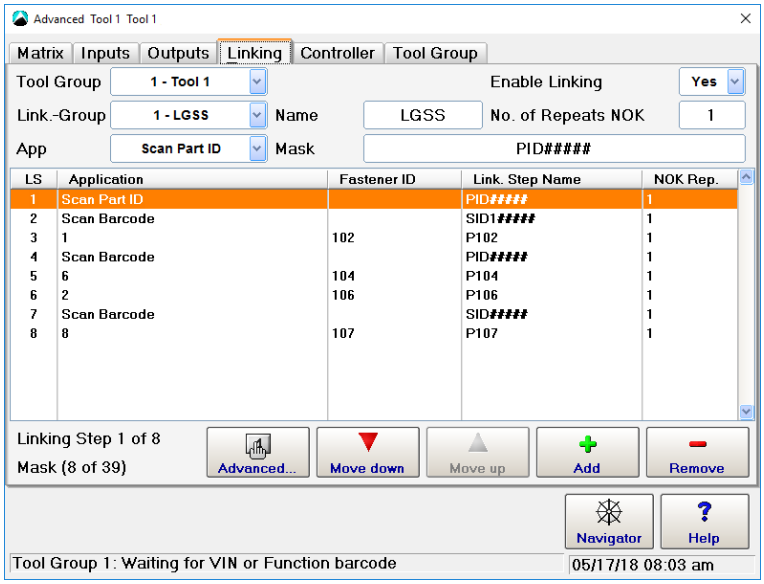


Fig. 6-5: Linking dialog with scan steps programmed

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

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:

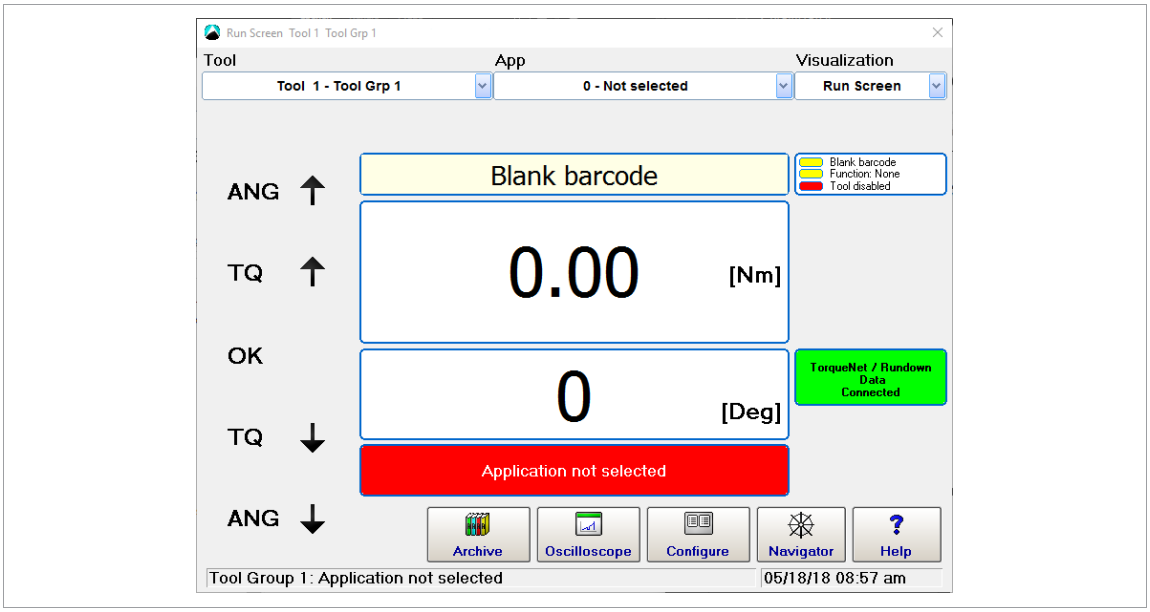


Fig. 6-6: Run screen displays Application not selected message

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:

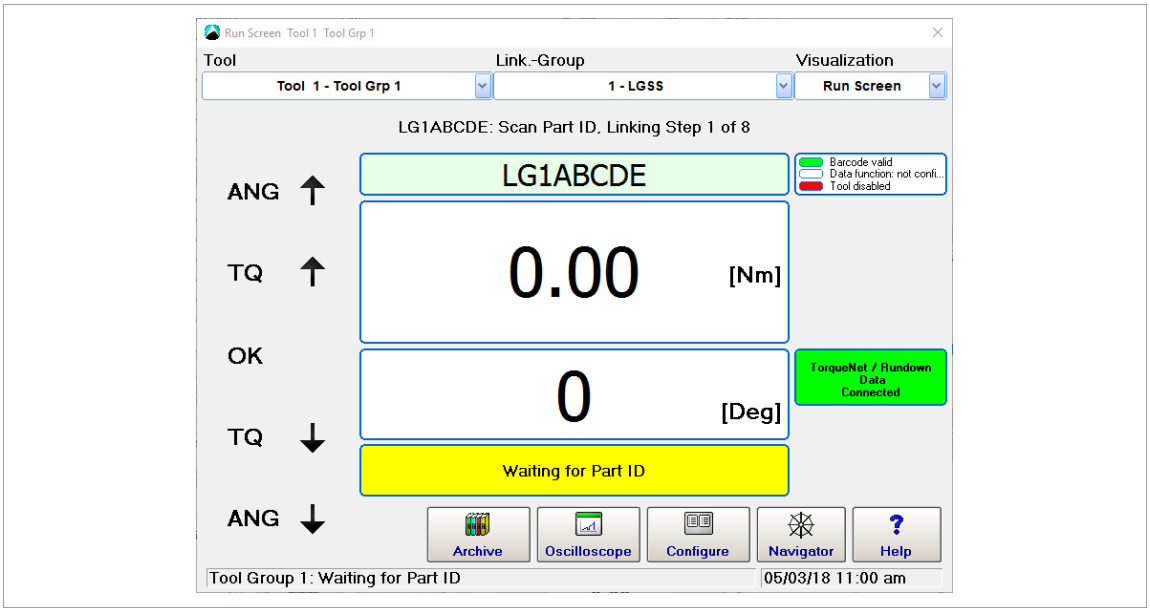


Fig. 6-7: Run screen displays Waiting for Part ID message

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:

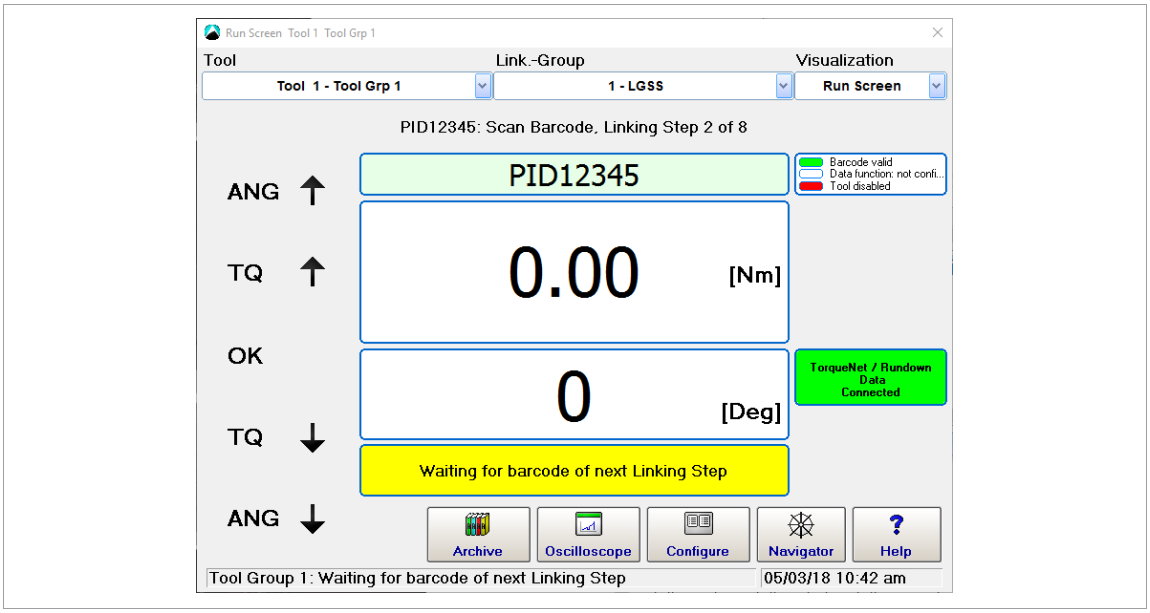


Fig. 6-8: Run screen displays Waiting for barcode of next Linking Step message

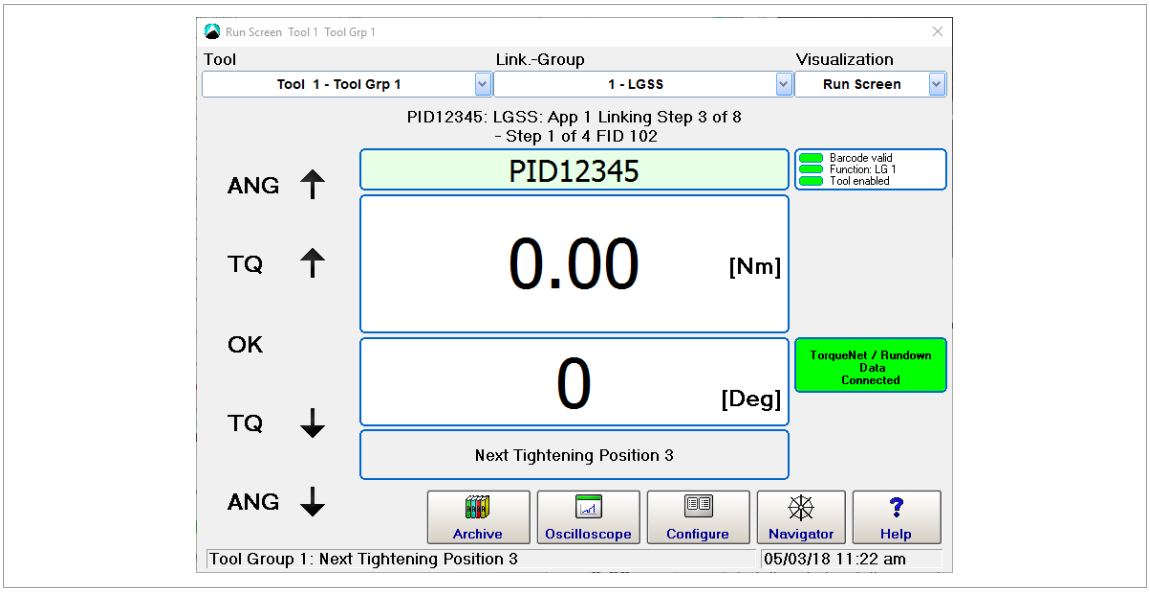


Fig. 6-9: Run screen displays Next Tightening Position 3 message

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.

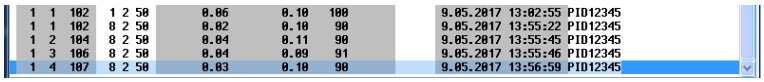


Fig. 6-10: Scan Part ID displayed in the Archive table

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.

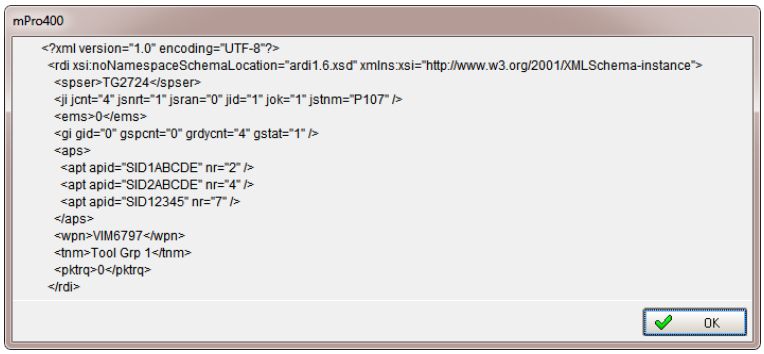


Fig. 6-11: Transmission of Scan barcodes (Linking Step 2, 4, and 7)

6.5 Controller Settings

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

► Select *Navigator* > *Advanced* > *Controller*.

6.5.1 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* menu are Nm, FtLbs, InLbs and dNm. You can also add user-defined units of measurement to the *Torque* menu: 1. Select the *CUSTOM* option from the *Torque* 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 Are 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	Open 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.

6.5.2 Trace Recording

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

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* 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.
NOK Graphs	Records every rundown.
All 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.

6.5.3 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 -

Name	Description
Accept System Bus Map Changes Automatically	No operator intervention necessary to accept changes in the System Bus map.
Use Selected Torque 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 (for details *see chapter 11.5 Current Calibration, page 175*).

6.5.4 Miscellaneous Controller Settings

Controls provided on the *Miscellaneous* tab:

Name	Description
SysLog Messages	These options allow you to set the recording of SysLog messages on the CF 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 The Event Tool Group Becomes 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 (Applies to TPS Server). Save Empty Parameter Sets.	Enable this option if Application parameters are to be saved and edited from TPS (Tightening Parameter Server) only, *see chapter 8.4.5 Tightening Parameter Server (TPS), page 127*.
Show Warnings	With this option enabled, the maintenance warning messages are displayed on the Run Screen. For details *see chapter 9.2.4 Maintenance Counter, page 138*.

6.6 Tool Settings

The *Tool Group* 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 *Tool Group* fastening 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.
Name	Name the selected Tool Group. This name is displayed in all Tool Group drop-down menus.

6.6.1 I/O Tab of the Tool Group Settings

Controls provided on the *I/O* settings 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: • Selector Switch: Selection done by the App / LG select 0-7 signal inputs • Binary + 1 (like TME) • Selector Switch • FEP / OpenProtocol: MID-0018 and MID-0035 are used. • BCD • Ext. PG Anw. +/- • Tool Menu (Cordless Tool) • I-Wrench Socket ID Options of the Mirror drop-down menu: • Binary • Binary + 1 (like TME) • Socket Tray • Selector Switch • 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).

6.6.2 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.

Name	Description
Synchronous Stop	This function is only available for groups with multiple tools. If the check box is activated, all tools in a tool group are stopped synchronously if a NOK result occurs on a tool during the rundown. The time between stopping the first and last tool is less than 500 ms. When the tools are stopped, an SA error is generated for the current stage. The check box can be activated for each tool group and is valid for all product groups of this tool group.

6.6.3 Evaluation and Backoff Settings Tab of the Tool Group Settings

Steuerelemente auf der Registerkarte *Evaluation and Backoff*:

Bezeichnung	Beschreibung
If Trigger Released	Legt den Status von Verschraubungen fest, bei denen der Startschalter vorzeitig losgelassen wurde. • No Evaluation if Torque Below: Diese Option legt den Drehmomentgrenzwert für die Bewertung fest. – 0.00: Die Option ist deaktiviert. – > 0: Die Option ist aktiviert. Es wird ein Ergebnis angezeigt und gesendet, wenn das verschraubte Drehmoment den eingestellten Wert überschreitet. Liegt das verschraubte Drehmoment unter dem eingestellten Wert, wird kein Ergebnis angezeigt. Die Option gilt für das Ergebnis jeder Stufe. • Before Final Stage: Diese Option legt das Verhalten fest, wenn die letzte Stufe einer Verschraubung nicht erreicht wird. Folgende Ergebnisse können gewählt werden: – No Evaluation: es wird kein Ergebnis angezeigt/gesendet, wenn der Startschalter losgelassen wird und die aktuelle Stufe keine Endstufe ist. Ist *No Evaluation if Torque Below* aktiviert, kann die Einstellung *No Evaluation* nicht gewählt werden. Wenn die Auswertung unterdrückt wird, wird kein AE-, OK- und NOK-Signal an den E/A-Ebene gesetzt. – NOK: jede Auslösung führt zu einem Auslösefehler. • in Final Stage: Diese Option legt das Verhalten bei Erreichen der Endstufe fest, wenn der Startschalter vorzeitig losgelassen wurde. Folgende Ergebnisse können gewählt werden: – NOK: jede Auslösung führt zu einem Auslösefehler. – OK if in Limits: das Ergebnis ist IO, wenn das Drehmoment den minimalen Drehmomentwert für diese Stufe erreicht hat, andernfalls ist das Ergebnis ein SA-Fehler.  Die Option *OK if in Limits* ist ohne Funktion, wenn für das Werkzeug die Stromredundanz aktiviert ist.
Ignore BLOC Errors for NOK Counting	Wenn die Schraube bereits verschraubt ist, werden die NIO- und IO-Zähler nicht weiter gezählt. Die Ergebnisse werden ignoriert.
Back-Off Mode for all Applications and Linking Steps	Mit diesem Dropdown-Menü wird definiert, wann ein Lösen erlaubt ist. Die verfügbaren Optionen sind: • Always Allowed • Always Forbidden • Allowed After NOK • Allowed After NOK Except BLOC (Already Tightened) Diese Einstellung ist unabhängig vom verwendeten Arbeitsmodus (Produktgruppen oder Ablaufprogramme).

6.6.4 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. For details *see chapter 6.6.5 Set Up Pictures for Process Visualization, page 66*.
Tool Notification Settings	Opens the Tool Notification Settings dialog. For details *see chapter 6.6.6 Tool Notification Settings, page 68*.

6.6.5 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:

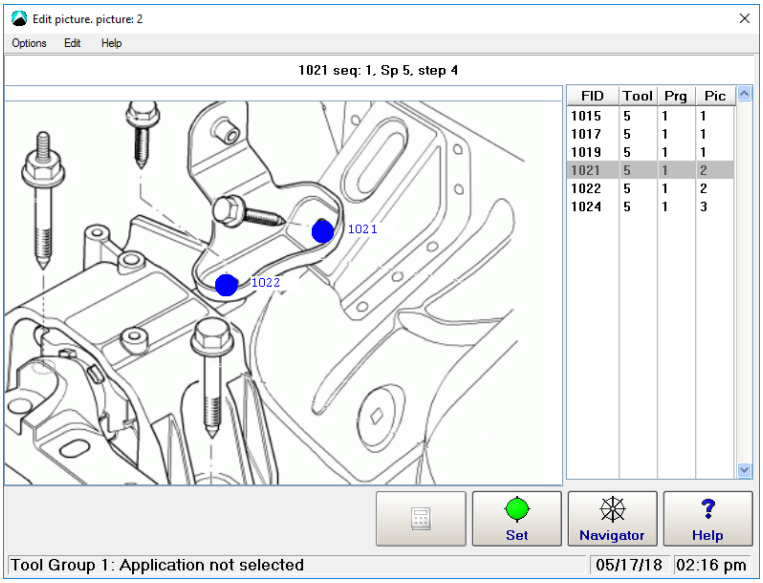


Fig. 6-12: The Edit Picture *dialog displays Picture 2 of Tool 5, which visualizes the positions of Fasteners no. 1021 and no. 1022*

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
Set Up Pictures	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.

The workpiece images used to visualize fastening positions must be bitmap files (bmp) with 579 × 411 pixel pixels and up to 65,535 colors.

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

1. Select *Navigator* > *Advanced* > *Tool Group* > *Miscellaneous*.
2. Tap the <Set Up Pictures> button on the *Tightening* tab to open the *Edit Picture* dialog.
3. Select the required Tool group in the Tool Group pop-up window.
4. Select *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* > *Miscellaneous* > *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* > *Miscellaneous* > *Set Up Pictures*.

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 visualize 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 cursor keys. Finish with ESC.

Visualizing Rundown Data

Process visualization can provide a range of rundown data.

Name	Description
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.

6.6.6 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	Opens the *Tool Notification Settings* dialog.

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

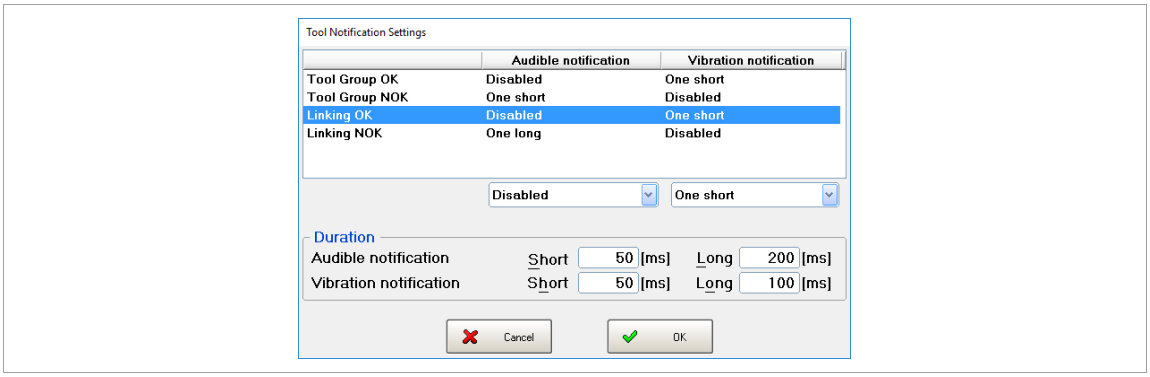


Fig. 6-13: The Tool Notification Settings dialog with notifications for Linking OK status selected

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 *Ton* or *Vibration Notification* notification column.
3. Tap the related text box in the Duration *Duration* section of the *Tool Notification Settings* dialog, and enter the required time in milliseconds.

6.6.7 Extended Tool Settings Tab for Tool Series LiveWire

The *Extended Tool Settings* provides additional settings. The setting options depend on the connected tools.

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

Controls on the *Extended Tool Settings* tab for LiveWire tools:

Parameter	Description
Enable Tool Menu	Lock/Unlock Tool Menu.
Enable Emergency Mode	– Not available in current software version – Define default job for Emergency Operation (offline - without controller).
Enable Tightening Position Settings	– Not available in current software version – Enable Position Settings on Tool.
Synchronization after NOK	– Not available in current software version – Start Tool Synchronization after NOK-Results.
Display Off [min]	Display will turn off when tool is not used. Set a value in minutes.
Servo Off [min]	Servo will turn off when tool is not used. Set a value in minutes.
Power Off [min]	Tool will turn off when it is not used. Set a value in minutes.
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
F1 Button on Tool	Set function for F1 Button on tool. Function can be disabled or force the tool to read bar code. Also by pressing F1 the Tool can be switched to Diagnostic Menu or the user can switch between App. and LG Selection. Options to set F1 Button: • Disabled: F1 Button not used • Read Barcode: activated barcode scanner • Diagnostic Menu: opens the diagnostic menu • App / LG Selection: opens the diagnostic menu
Lock while Offline	Choose after how many milliseconds the tool should be locked when it is offline.
Beeper length after NOK [ms]	Set the length of the beep signal after NOK in ms.
<Remote control & Error acknowledgment settings>	**Remote control** • Activated: If the check box is activated, remote control is enabled. Start packets are sent cyclically to the tool. This ensures that the tool is stopped if no packages can be sent due to an interruption in the network connection. • Timeout until SA error [ms]: Time in milliseconds until an SA (Tool Group Start) error is displayed. • Time interval between start packages [ms]: Defines the time between the transmission intervals of the start packets in milliseconds. If the tool does not receive a start packet within the time Timeout until SA error [ms] and the Time between start packages [ms], the tool stops. Details see Remote control, below.
	Error acknowledgment settings If the tool is operated with the remote control, these parameters can be used to make settings for automatic error acknowledgment. Error messages indicating an error status are automatically acknowledged. These parameters are used to automatically acknowledge error messages: • Activated: Activates the function. If the check box is deactivated, the error is only written in the logbook. • Number of acknowledgments: Enter the number of acknowledgment attempts. Enter 0 to deactivate the function. • Time interval [s]: Time in seconds between the acknowledgment attempts. Details see Error acknowledgment settings, below.

Parameter	Description
<Brake-Rope Adjust Mode>	Used for LiveWire tools only. • Enabled: If the check box is activated, the setting applies only to the selected Tool Group. The settings can be programmed individually for each Tool Group. • Time to restart an aborted rundown [s]: Defines the time frame (in seconds) within which an aborted fastening strategy (releasing the start switch) can be continued. The LCD display of the tool shows a countdown to the final abort. Used for very long fastening sequences with LiveWire Tools only. Allows you to extend the angle parameters (Min. Angle, Shut-Off Angle, Max. Angle) to 24,000 angular degrees (See Basic Application Builder or Run-down programming dialog of Standard Application Builder). When you disable this function, angle parameters with values greater than 9,999 degrees are reset to 9,999. The following message is displayed: **Some values of Shut-off Angle and Maximum Angle use up to 24000 degrees, reset them to 9999 degrees?** When several fastening stages cumulate to a value greater than 24,000 angular degrees, the last 24,000 angular degrees are transferred. If the Threshold Torque of a partly completed stage is not within the last 24,000 angular degrees, the stage is not transferred.

Remote control

LiveWire tools may interrupt the wireless connection or the tool may be in sleep mode. If BB (Tool Group Ready) is present at the controller, the LiveWire tool can accept the order. Only then will the controller attempt to reach the tool. The signal sequence is based on the station solution. If SA (Tool Group Start) is set, SE (Rundown Complete) and AE (Cycle Complete) leave.

As soon as a fastening release is given and an APP is selected, the system tries to reach the tool and load the job. The signal SS (Motor Start) is used to start the tool.

In order to avoid deadlock in the case of a tool that has finally failed, monitoring times are used in the controller. If a communication with the tool is established during the monitoring time, the process runs automatically. The parameterized time from the first active stage + 10 seconds is used for this. Attention, this time must be at least long enough so that all stages can be processed in it.

After this time has elapsed at the latest, the fastening attempt is aborted and the SA shut-off cause is generated. If no result is received from the tool during the monitoring time, the ERG? error is documented (i.e. the controller generates a result). If the tool is online again after the monitoring time, a result is transferred which is registered in the archive with the addition "Job missmatch".

It is still possible to operate the tool using the integrated keys. The start button is also maintained in its function for test purposes. For a start a fastening job must be initiated at the controller (e.g. via the control panel of the controller).

Further differences to the normal procedure:

- If I/Os are parameterized and an I/O device is not ready, the group is set to "not ready".
- The "LL back off" function is not available for LiveWire tools. Back off must be initiated via a valid APP selection.

Error acknowledgment settings

The BATTLOW (low battery) error message is set when the LiveWire tool indicates that the battery voltage is below the undervoltage threshold. The tool remembers when the voltage drops below the undervoltage threshold during a run (under load) and displays this error at the end of the run. It is possible that the battery voltage may be above the undervoltage threshold again after the end of the run (without load). In this case, press the left function key to acknowledge the error message. If the battery voltage remains below the low voltage threshold, the error message is briefly hidden and immediately displayed again. It should

be noted that there is an absolute undervoltage threshold below which the tool switches off. This cannot be shut off. For corded tools this output is always 0.

Errors can always occur in the LiveWire tool because of external influences, which must be acknowledged by the operator. So far, these errors were only displayed on the tool itself. With the error acknowledgment, the errors can be confirmed and recorded in the logbook. As long as the errors are present, no fastening is possible. The following errors can occur:

Error	Description	Error	Description
0	No error	17	Tool counter faulty
2	Servo error 2	18	Tool identification faulty
4	Initialization servo error	19	XRAM error
5	Servo PWM error	20	Start error
6	Servo IIT error	21	Transducer reference voltage error
7	Current offset servo error	22	Transducer offset error
8	Other servo error	23	Transducer calibration error
9	Servo overloaded	24	Warning before maintenance
10	Servo too hot	26	Warning information display (error message is displayed)
11	Motor too hot	27	Information display error (tool is locked until the error is fixed)
12	Voltage servo error	28	Maintenance interval exceeded
13	Servo short circuit	253	Connection state unknown
14	Voltage servo error	254	Connection timeout
15	Resolver error	255	Connection refused
16	Battery low		

The last three error codes are generated by the controller itself to describe why the connection failed if there is no connection.

Output TMAERR1 represents the LSB (least significant bit) and output TMAERR8 the MSB (most significant bit). With these outputs, the error codes can be reported to external points in binary code.

The following is noted in the logbook:

- Occurring errors
- Each automatic acknowledgment attempt
- End of the error state

In addition to the automatic acknowledgment, an external unit can trigger a manual acknowledgment via the "Error Acknowledge" input. This input triggers an acknowledgment exactly when an error state is present and a rising edge is seen at this input. In addition, the input is only effective if no automatic acknowledgment is running.

There is also the output "Ack in Prog" (Acknowledge in Progress). While an acknowledgment is running, this output is set.

If there is an error message, the tool is locked until the error has been corrected. During this time, the error cause is also displayed in the Run Screen. Since there are errors which can be acknowledged for a short time but which return immediately (e.g. "Change battery"), an error is only acknowledged if no error has been reported for one second.

6.6.8 Extended Tool Settings Tab for Tool Series NeoTek

The *Extended Tool Settings* provides additional settings. The setting options depend on the connected tools.

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

Controls 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

6.6.9 Extended Tool Settings Tab for Tool Series CellCore and CellTek

The *Extended Tool Settings* provides additional settings. The setting options depend on the connected tools.

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

Controls on the *Extended Tool Settings* tab for CellCore or CellTek tools:

Parameter	Description
Enable Tool Menu	The tool menu is always enabled. Change not possible.
Power Off [min]	Tool will turn off when it is not used. Set a value in minutes. The default value is 10 minutes.
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
Lock while Offline	Choose after how many milliseconds the tool should be locked when it is offline.

6.6.10 Extended Tool Settings Tab for Tool Series CellClutch

The *Extended Tool Settings* tab enables tool settings. The setting options depend on the connected tools.

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

Controls on the *Extended Tool Settings* tab for CellClutch tools:

Parameter	Description
Enabled Direction	Setting of the direction of rotation. • Both: Default and Back-Off mode are activated. • Default: Default mode is activated. The reverse switch on the tool has to be set to the right. • Back-Off: Back-Off mode is activated. The reverse switch on the tool tool has to be set to the left.
Motor-Startrampe	Setting in which time the motor reaches the parameterized speed. Time for maximum speed: • Normal: The maximum speed is reached after 200 ms. • Medium: The maximum speed is reached after 0.5 s. • Soft: The maximum speed is reached after 1 s. The parameterized speed is reached earlier in percentage.
Work Light	Setting for the brightness of the work light. • Bright: The work light is bright. • Dim: The work light is dim. • Off: The work light is off.
Status Light	Setting for the brightness of the status light. • Bright: The status light is bright. • Dim: The status light is dim. • Off: The status light is off.
Enable Buzzer	If the option is selected, the buzzer gives an acoustic signal to indicate the status.
Enable Motor Brake	Setting of the motor behavior. • On: As soon as the start trigger is released, the motor brakes immediately. • Off: As soon as the start trigger is released, the motor brakes slowly until it comes to a standstill.

Advanced Settings

Parameter	Description
Batch Timeout	The timeout specifies the total time of the batch processing. It starts with the first rundown. If not all rundowns of a batch can be finished within the timeout, the processing is aborted and the batch status is not ok. If 0 s are configured, the timeout is deactivated. If the batch timeout is reached before all rundowns are complete, the batch is aborted and starts again from the beginning. Range of value: 0 s – 32 000 s
Restart Delay	Time in milliseconds between the release of the clutch and the start of a new rundown. This prevents accidentally triggered rundowns. Range of value: 0 ms – 32 000 ms
Double Hit Protection	If the *Double Hit Protection* is activated, a time in milli-seconds can be defined. If the clutch is triggered again within this time, a NOK error is generated. In this way, screws are detected that are already tightened.
Power Off [min]	Enter a value in minutes after which the tool switches off if it is not used.
Lock while Offline	Select a time after which the tool will be locked when offline.

6.6.11 WLAN Socket Tray

The WLAN Socket Tray is used for user guidance and indicates via LED displays which socket has to be removed. Further information can be found in document P2332BA.

1. Select *Navigator* > *Advanced* > *Tool Group* > *WLAN Socket Tray* and enable the *Enable WLAN Socket Tray* checkbox to activate the WLAN Socket Tray for the selected tool group.
2. To configure the WLAN Socket Tray the settings described below are available:

Parameter	Description
Enable WLAN Socket Tray	Select the checkbox to activate the WLAN Socket Tray for the selected tool group. Only one WLAN Socket Tray can be activated per tool group. If the WLAN Socket Tray is activated, the inputs *Bitmask In X (EIN_S_X)* and outputs *Bitmask OUT X (AUS_S_X)* in the I/O level have no influence to the rundown.
Use WLAN Socket Tray for external Application / LG Selection	Activate the checkbox to select the Linking group or the Application of the WLAN Socket Tray externally. As soon as a socket is removed, the corresponding external product group/application is released. To use this function also activate the *External Application / LG Selection* checkbox in the *I/O* tab and select the *WLAN Socket Tray* mode.

3. Select the <WLAN Socket Tray Configuration> button to open the *WLAN Socket Tray Configuration* dialog. 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:

Parameter	Description	Range of values
Hardware type	Select the hardware type. The following options are available: • Off: No hardware type is selected. • WLAN Socket Tray 4-fold: The WLAN Socket Tray has four socket inserts. • WLAN Socket Tray 8-fold: The WLAN Socket Tray has eight socket inserts.	
Address	Enter the IP address of the WLAN Socket Tray.	
Shut off after idle state of	Enter a time in minutes after which the WLAN Socket Tray will shut off if no action is taken (e.g. socket change).	1 min … 999 min
Warning time before shut off	Enter a time in minutes for which a warning message is displayed on the LCD of the WLAN Socket Tray. This warning message indicates how long the WLAN Socket Tray remains switched on without any action. The warning time only starts when the shut-off timeout is running. For this reason, the parameterized time should be less than or equal to the parameter Shut off after idle state of.	1 min … 999 min
Warning when battery voltage under	If the battery voltage falls below the parameterized value, a warning is issued and, if necessary, the WLAN Socket Tray is switched off.	19 V … 22 V
Connection timeout	Enter a time in seconds after which the WLAN Socket Tray is considered to be offline if there is no communication. The Connection Timeout is restarted with every successful communication and only expires if no communication was possible for this time period. The last known status of the WLAN-Socket Tray remains valid until this time has expired. Recommendation: The value should not exceed 20 seconds.	2 s … 99,999 s

Parameter	Description	Range of values
Status timeout	Enter a time in seconds after which the controller sends the next status request to monitor the WLAN connection. The value must be lower than the Conection Timeout to prevent the status from being set to Offline. The status timeout expires again after each successful status check. Recommendation: The value should be less than half of the Conection Timeout to prevent an offline status in case a packet is lost during the state request.	1 s … 99,999 s

4. Confirm the entry with <OK>.

7 Run screen

The *Run Screen* displays the measurement result during a rundown and provides information about the tightening sequence.

Many of the elements shown in the figure below can be turned on and off.

► Select *Navigator* > *Run Screen*.

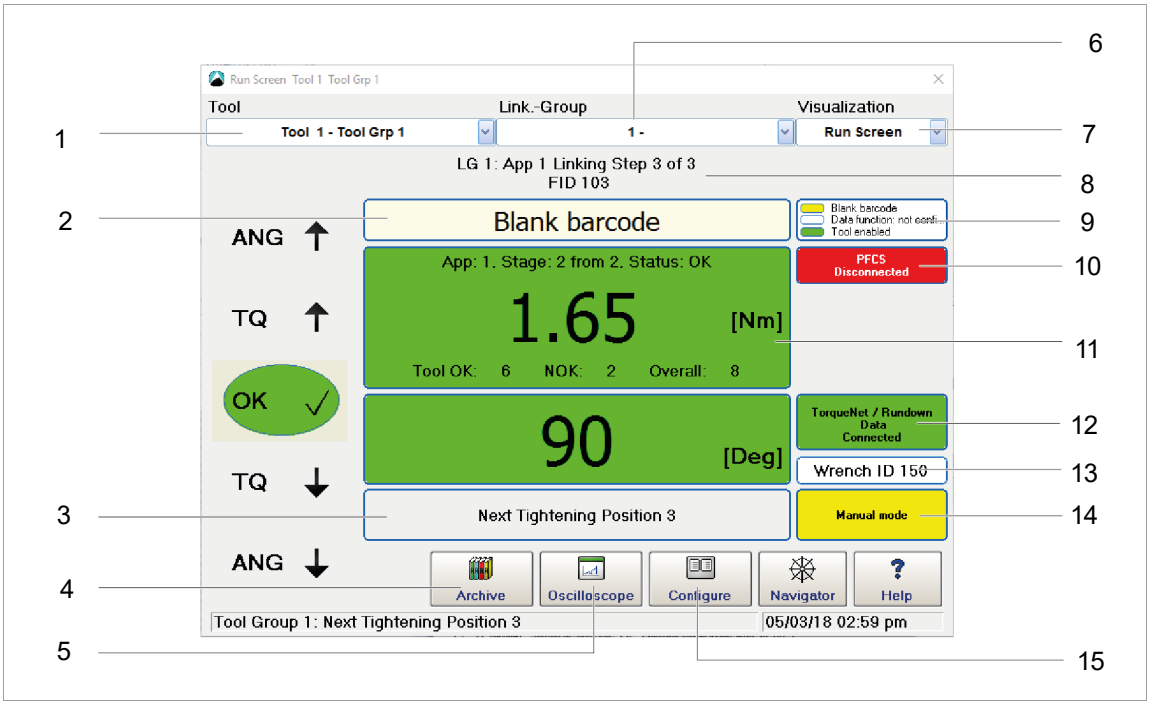


Fig. 7-1: Overview Run Screen

Item	Description
1	Tool/Tool Group ► Select one of 32 tools/tool groups.
2	Part ID input field **To show the display:** 1. Select *Navigator* > *Communication* > *Part ID*. 2. Select option *Yes* or *Yes, interlocked* at *Activated*. 3. To save the input, press *Navigator* > *Accept*.
3	The message field provides information about the tool, Linking status and errors.
4	<Archive> opens the *Archive* dialog, which provides information about the measured values of the last saved rundowns. For details *see chapter 12 Archive, page 178*.
5	<Oscilloscope> displays the Torque graph view, which provides a torque curve after each complete rundown in the tightening direction.
6	Application ► Select one of 99 applications.
7	Visualization ► Select a display type for the measurement results.
8	Display and name of the currently executed Linking step. **To show the display:** 1. Select *Navigator* > *Advanced* > *Linking*. 2. Select option *Yes* at *[Select option (1033)]* and configure a Linking Group. 3. To save the input, press *Navigator* > *Accept*.

Item	Description
9	Part ID status display The display is activated together with the part ID input field.
10	Display of the data transmission protocol PFCS with status. **To show the display:** 1. Select *Navigator* > *Communication* > *Data Transmission*. 2. Select the *PFCS* option at *Ethernet* and activate it with the check box. 3. To save the input, press *Navigator* > *Accept* and restart the controller.
11	Display of torque and angle measurement values. For CellClutch tools, the status of the rundown is displayed with OK or NOK. The background color indicates the status of the result: • Green: Result is OK. Measured values are within the configured limit values. • Red: Result is not OK. Measured values are too high. • Yellow: Result is not OK. Measured values are too high. **To show the display for counter/batch:** 1. Select *Navigator* > *Run Screen* > *Configuration*. 2. Select *Counters* or *Batch*. 3. To save the input, press <OK>.
12	Display of the TorqueNet data transmission protocol with status. **To show the display:** 1. Select *Navigator* > *Communication* > *Data Transmission*. 2. Select the *TorqueNet* option at *Ethernet* and activate it with the check box. 3. To save the input, press *Navigator* > *Accept* and restart the controller.
13	Tool ID (only for I-Wrench)
14	Input mode
15	Configuration of the Run screen

7.1 Visualization

The *Visualization* contains various options for displaying measured values.

Option	Description
Run Screen	Described above.
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	For details *see chapter 12.1 Tool Monitor, page 179*.
Workpiece Picture	For details *see chapter 6.6.5 Set Up Pictures for Process Visualization, page 66*.

7.2 Part ID

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

► Select *Navigator* > *Communication* > *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* > *Communication* > *Part ID* > *Keypad Entry*: Allowed to activate Keypad Entry.

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

Part ID Status Indicators

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

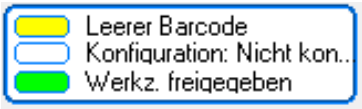


Fig. 7-2: Part ID status indicators

Item	Description
16	Input status indicator
17	Special Function indicator
18	Release indicator

Input status indicator (top indicator)

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

Color	Special function	Status
Green	Barcode valid	A valid Part ID is available.
Red	Barcode invalid	The Part ID is invalid.
	Not Accepting Part ID input	A new Part ID may not be entered when the tool trigger is active.
	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	Special 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 7.2 Part ID, page 78* and *see chapter 8.4.2 Workpiece Administration, page 119*.
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.

7.3 Data Transmission Protocol

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* > *Communication* > *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

7.4 Configure Run Screen

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

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

The Run Screen Configuration dialog has two areas.

Additional information section

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

Parameter	Description
None	No additional information.
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. ► Select *Navigator* > *Administration* > *Counters*.
Batch	If enabled, the Run Screen displays additional information on the active batch. ► Select *Navigator* > *Standard* > *Settings* > *Batch*. See chapter Batch programming on how to enable and configure Batch mode.

Rundown Details section

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

Parameter	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).

7.5 Torque Graph

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

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

The Torque graph visualizes how the torque increases over the angle during a rundown: **MD = 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.

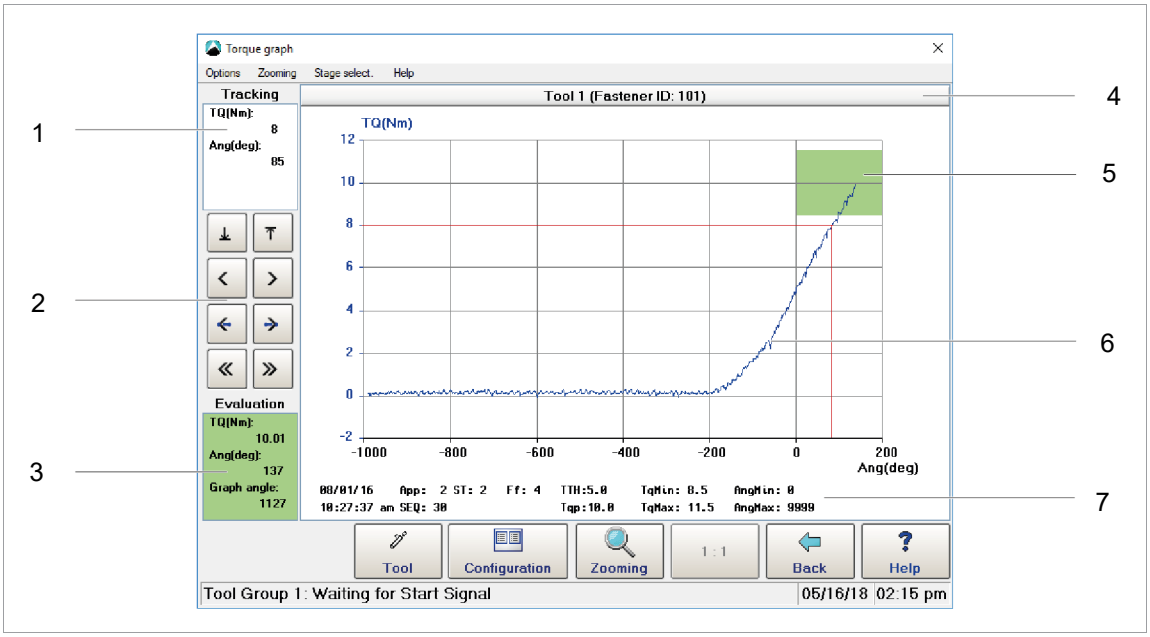


Fig. 7-3: The Torque graph view of a rundown

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	Torque Graph
7	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.

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.

7.5.1 Navigation buttons

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 *Oscilloscope* window.
2. Use the <Arrow> buttons to the left of the graph to move the cursor.

7.5.2 Configuration

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

► Select *Navigator* > *Run Screen* > *Oscilloscope* > *Configuration*.

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

Trace configuration options

Section	Description
Base (X-axis)	► Select the option you want to display on the x-axis.
Traces (Y-axis)	► 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* > *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	► 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.

Redundancy Graph

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.* option in the *Trace configuration* dialog.

The redundancy curve is only displayed correctly if Redundancy is set to <Current/Resolver> or <Transducer 2> 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.

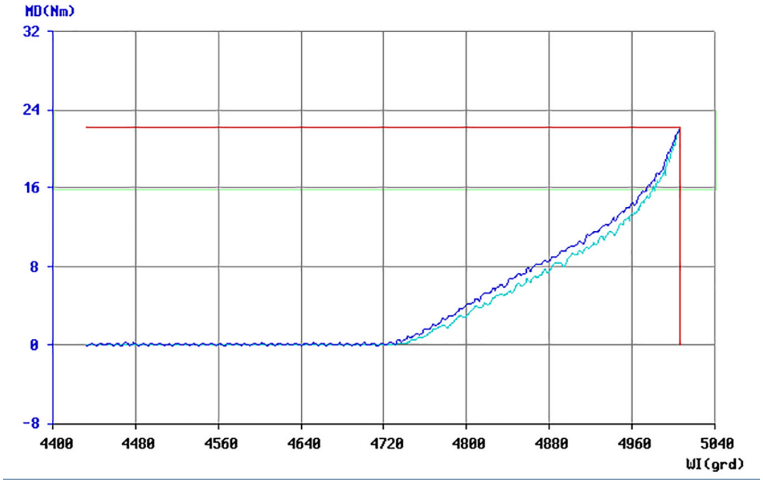


Fig. 7-4: The Torque graph view with the redundancy curve displayed in light blue color

8 Communication

► To open the Open Protocol settings on the controller, select *Navigator* > *Communication* > *Open Protocol* > *Activated* > *Advanced* > *General*. For details see document P2280SW.

8.1 Data Transmission

► Select *Navigator* > *Communication* > *Data Transmission*.

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

The controller software supports the following protocols:

Option	Description	
Drop-down menu *Serial* > *Protocol*	Select a serial data transmission option from the drop-down menu:	
• None	No Protocol is activated on selected COM-Port.	
• Standard	*see chapter 8.2.1 Standard Protocol, page 85*	
• Standard2	*see chapter 8.2.2 Standard2 Protocol, page 86*	
• Standard2PartID	*see chapter 8.2.3 Standard2PartID Protocol, page 87*	
• AVIS	*see chapter 8.2.4 AVIS Protocol, page 89*	
• PFCS	*see chapter 8.2.5 PFCS (Plant Floor Communication System) Protocol, page 89*	
Ethernet > *Protocol* list	Select a supported Ethernet protocol type in the list:	
• Standard	TME Standard	*see chapter 8.3.1 Standard and Standard Plus Protocol, page 89*
• Standard Plus	TME Standard Plus	*see chapter 8.3.1 Standard and Standard Plus Protocol, page 89*
• WinSPC	TME Standard WinSPC	*see chapter 8.3.2 WinSPC Protocol, page 97*
• PFCS	Plant Floor Comm System	*see chapter 8.2.5 PFCS (Plant Floor Communication System) Protocol, page 89*
• Open Protocol	Power Focus Open Protocol	*see chapter 8.3.4 Open Protocol, page 99*
• FEP	Ford Protocol	*see chapter 8.3.5 FEP, page 101*
• TorqueNet	TorqueNet/Rundown Data	*see chapter 8.3.6 TorqueNet / Rundown Data, page 101*
• ToolsNet OP	ToolsNet Open Protocol	*see chapter 8.3.7 ToolsNet Open Protocol, page 102*
• XML/CSV	XML/CSV Result Files	*see chapter 8.3.8 XML/CSV, page 104*
• IPM	IPM Protocol	*see chapter 8.3.9 IPM Protocol, page 110*

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.

8.2 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. Press the <Advanced Serial Settings> button to access additional controls in a pop-up dialog.

Control	Option
Port	COM1, COM2 (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

8.2.1 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 Digit 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
...	...	...	...
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	Ende	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)

8.2.2 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 Status	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)

Start	End	Length or Value	Description
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)

8.2.3 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 Status	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

Start	End	Length or Value	Description
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.

- Part IDs with less than 25 characters are filled with spaces:
  S01ABCDEFG <CR><LF>
- Part IDs with at least 25 and up to 39 characters are transmitted 1:1:
  S01AAAAAAAAAABBBBBBBBBBCCCCCCCCCCDDDDDDDDD<CR><LF>
- 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)

8.2.4 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
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)

8.2.5 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. Details *see chapter 8.2.5 PFCS (Plant Floor Communication System) Protocol, page 89*.

8.3 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.

8.3.1 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.

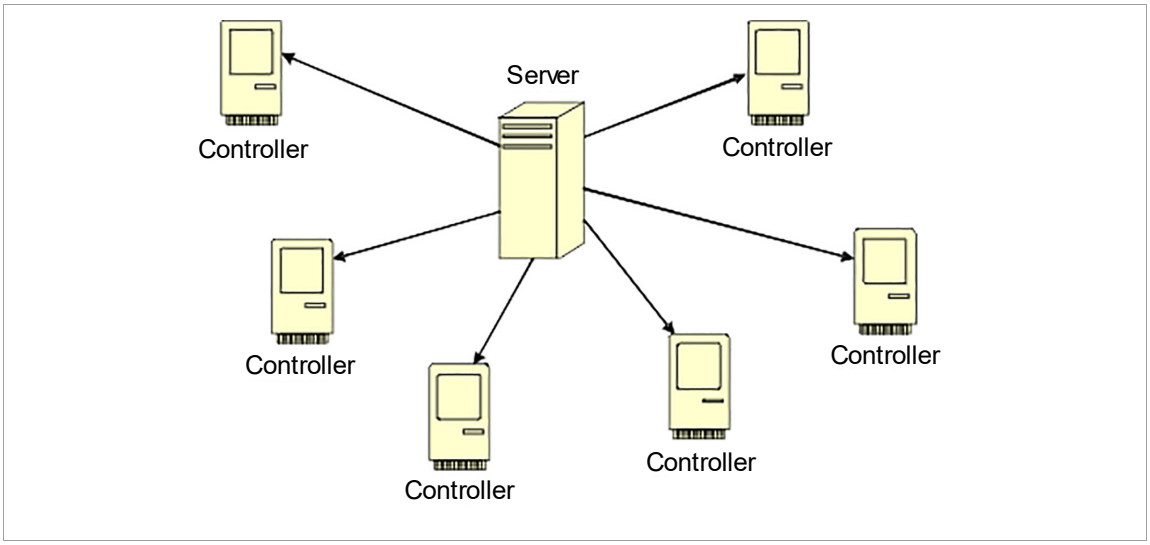


Fig. 8-1: Ethernet architecture

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:

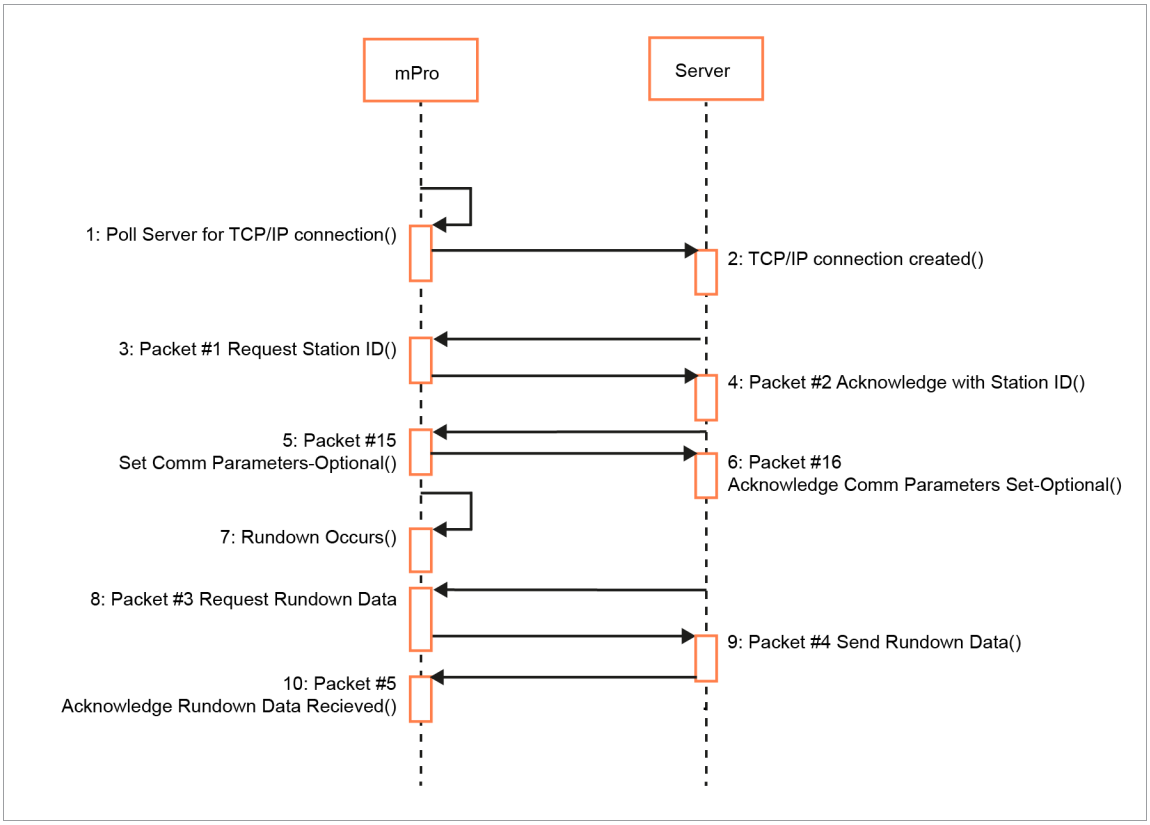


Fig. 8-2: Successful rundown sequence

No rundown data available:

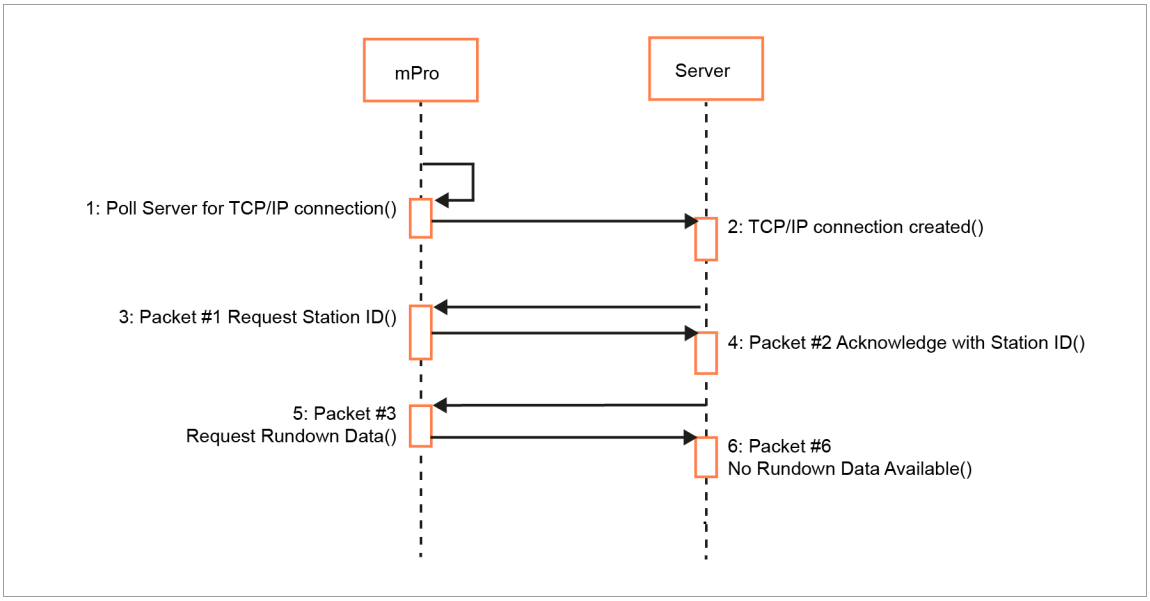


Fig. 8-3: No rundown data available

No server rundown acknowledgment sequence:

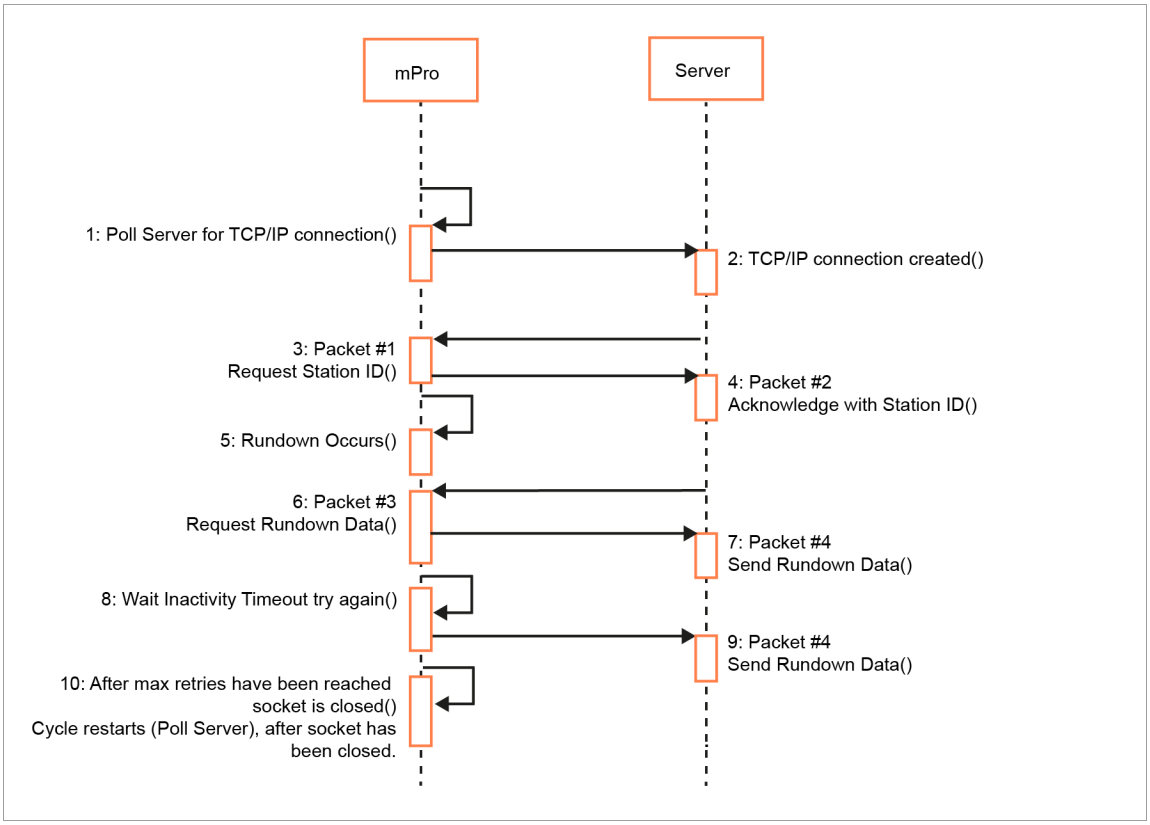


Fig. 8-4: No server rundown acknowledgment sequence

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

1. Server does not send packet #5 within Communication Ack Timeout.
2. Controller resends packet #4.
3. If server does not respond, continue to resend #4 after Communication Ack Timeout has expired until Max Retries is reached.
4. 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.

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
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	Network ID – Set to IP Address of Controller

Start	Bytes	Data Type	Required Fields
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	Required Fields
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	Required Fields
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

Start	Bytes	Data Type	Required Fields
	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		Angle Spec – 1 if High, 0 if Low, X if OK
	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 tool being sent in the packet.

Packet No. 5 – Server Rundown Packet Acknowledge

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 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	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 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	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 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	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.

Start	Bytes	Data Type	Required Fields
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

Start	Bytes	Data Type	Required Fields
10	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.

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

8.3.2 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
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)

8.3.3 PFCS (Plant Floor Communication System) Protocol

For more information, see the current version of the "PFCS Supplier Specification" and *see chapter 8.2.5 PFCS (Plant Floor Communication System) Protocol, page 89*

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.
   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 • AVI Barcode • Vin/Track	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. The AVI (Automatic Vehicle Identification) Barcode corresponds to the identifier scanned by the Part ID or Barcode step on the controller. 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.
Discard Zeroed Rundown 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

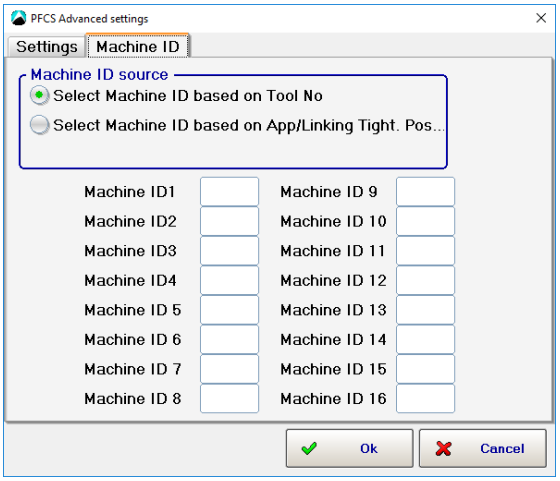


Fig. 8-5: PFCS Advanced settings – Machine ID tab

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 6.4 Linking, page 54*.

8.3.4 Open Protocol

For detailed information on Open Protocol telegrams, see the current version of the Open Protocol FEP Specification.

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*> check box.
   ➢ The <Advanced> button is displayed, which provides access to additional controls.
4. Tap the <Advanced> button to open the *Advanced Settings* dialog for Open Protocol. Contact your network administrator for required settings.

Open Protocol Advanced Settings – Communication Ports tab

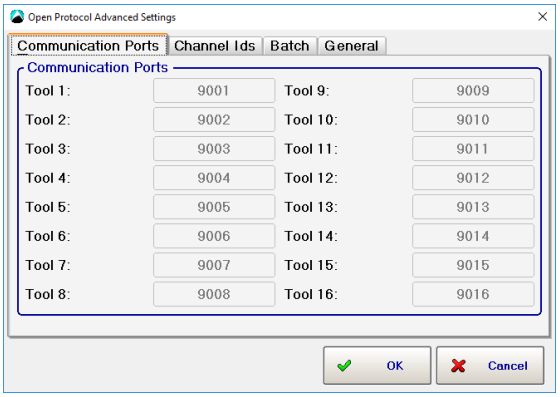


Fig. 8-6: Open Protocol Advanced Settings – Communication Ports tab

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 ID's tab

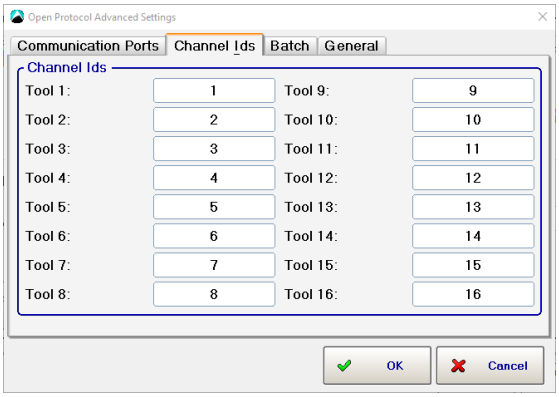


Fig. 8-7: Open Protocol Advanced Settings – Channel ID's tab

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 • OK+NOK	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. 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 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 0019.
MID 0061 Batch Information (Linking Mode)	In the Open Protocol result telegram MID 0061, the batch information (position, size, status) for the sequence program is filled in with the current values.

Control	Description
• 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 Linking 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 0254.
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 Open Protocol 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.

8.3.5 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.

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.

8.3.6 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.

The following two standard port numbers are available:

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 on the *Advanced Settings* tab:

Control	Description
Date/Time Synchronization	Synchronizes controller time and server time with each other. If this check box is activated, the input field *Synchronization if Difference Above (Seconds)* is available.
Synchronization if Difference Above (Seconds)	Limits the time difference between server and controller. Valid entries range from 1 to 9999 seconds.
Counter update interval (h)	For detailed information on maintenance counters, see the *Maintenance Information Tool* section. This controller sets the interval in hours at which the controller updates the maintenance counters on the TorqueNet server. Valid entries range from 0.1 to 3445.0 hours.
Enable notification	Sends an e-mail notification when the threshold value of a maintenance counter is exceeded.

8.3.7 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*> check box.
   ➢ 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 Timeout (Seconds)	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.

Control	Description
Result Ack Timeout (Seconds)	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 (Seconds)	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 (Seconds)* input box.
All Multi Spindle Results as Spindle 1 \n(Workaround for a Bug in Some TN4000 Versions)	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 concerning 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 tab

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 Tools-Net 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.

8.3.8 XML/CSV

The XML/CSV Ethernet protocol is used to transmit data between an FTP or SAMBA server and a controller. The data is saved as a **.xml* or **.csv* file.

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:
Prefix_TNR_YYYYMMDDHHMMSS.xml or *Prefix_TNR_YYYYMMDDHHMMSS.csv*
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: *PREFIX_____20160131122045.csv*

With prefix and VIN/Part ID: *PREFIX_abcdefghijklmnopq20160131122045.csv*

Same with different date/time format: *PREFIX_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.
- For part numbers up to 14 characters, a prefix with up to 8 digits can be used. If the prefix has less than 8 or the part number less than 14 characters, the remaining characters are filled with "_". If the part number has more than 14 characters, the prefix is automatically reduced by the corresponding number.

To configure XML/CSV data transmission:

1. Select *Navigator* > *Communication* > *Data Transmission* wählen.
2. Tap the *XML/CSV* entry in the *Ethernet* table to select it.
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 Open *Protocol Advanced Settings* dialog.
5. Contact your network administrator for required settings.

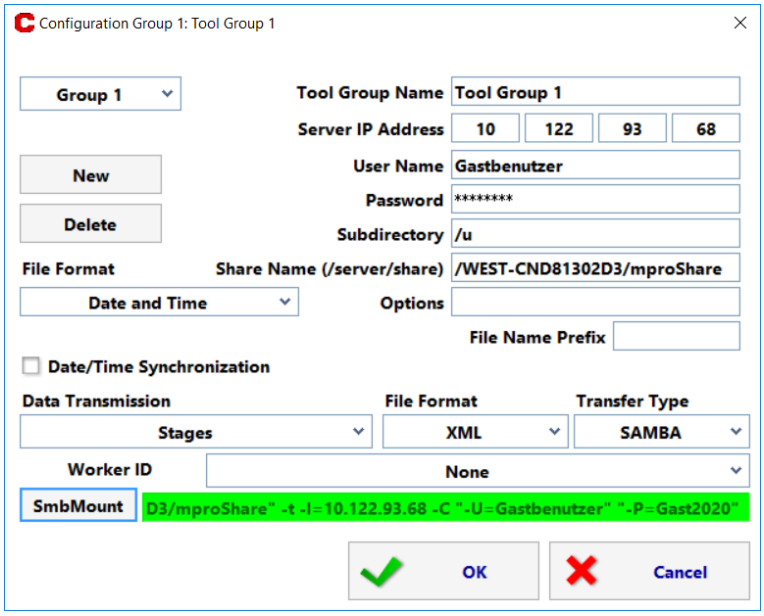


Fig. 8-8: SAMBA settings

The following controls are available on the XML/CSV Network settings tab:

Control	Description
Group	Displays the network settings for the selected tool group. There are only tool groups displayed that have already been defined. If no network settings have been defined yet, None is displayed.
<New>	Creates a new set of Network settings with empty fields. ► Select the new tool group and assign a name.
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.
Server IP Address	Enter the IP address of the server host to establish a connection between the controller and the server.
User Name	Name of the user who owns the share folder for the files.
Password	User password.
Subdirectory	Subdirectory in the share folder where the files will be saved (optional).
Options	The following options are possible (optional): • -C: No conversion to capital letters • -W: Domain
File Format	Applies format to the date and time used as the last part of file names. • Complete date and time: _YYYYMMDDHHMMSS.xml • Year without century: ___YYMMDDHHMMSS.xml • Date and time in ticks (10 ms) converted to hexadecimal value: _____00EA14F8.csv • 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

Control	Description
Transfer Workpiece OK/NOK	Provides additional column in CSV files with information on whether a workpiece was tightened OK or NOK.
Date/Time Synchronization	If the check box is enabled, the date and time will be synchronized with the server. If the check box is deactivated, the settings of the controller are used.
File Name Prefix	Adds a filename prefix to result filenames. 1 to 9 characters can be entered.
Data Transmission	Defines which result data are transmitted: • Final tightening: The results of the last tightening step are transmitted. • Steps: The results of all tightening stages are transmitted.
File Format	Selection of supported file formats, *see chapter Data Transfer CSV File, page 109* • XML: XML file format • CSV_STD: CSV Standard: The first version of CSV files was developed with German phrases in the header. • CSV_FR: French phrases in header. • CSV_EN: English phrases in header.
Transfer Type	Select transmission type: • FTP: Data is transmitted using the File Transport Protocol (FTP). • SAMBA: Data is transmitted to a file server using the Server Message Block Protocol (SMB).
Worker ID	Specifies whether the first scanned barcode is saved in the result file: • None: The scanned barcode is not displayed. • 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 server type SAMBA is selected, this button can be used to check if a connection with the server is established.

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: • 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 Uebernahme (Abort by new file on transfer) • Abbruch durch gescannten Abbruchcode (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* (Nm/degree), 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

<table>
<tr><th>Tag</th><th>Description</th></tr>
<tr><td><UG></td><td>Lower limit of the set point</td></tr>
<tr><td><OG></td><td>Upper limit of the set point</td></tr>
<tr><td><IST_NUM></td><td>Actual value, measured result</td></tr>
<tr><td><SOLLWERT></td><td>Specification of the set point value, depends on the characteristic type</td></tr>
<tr><td><STATUS></td><td>Status of a characteristic, does not refer to overall result.
0: OK rundown
Number that is not 0: NOK rundown, see below <FEHLER></td></tr>
<tr><td><FEHLER></td><td>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:
<table>
<tr><th><STATUS></th><th><FEHLER></th><th>Description</th></tr>
<tr><td>5</td><td>???</td><td>All causes not defined here</td></tr>
<tr><td>11</td><td>MD zu Gross</td><td>Torque too high</td></tr>
<tr><td>12</td><td>MD zu Klein</td><td>Torque too low</td></tr>
<tr><td>13</td><td>WI zu Gross</td><td>Angle too high</td></tr>
<tr><td>14</td><td>WI zu Klein</td><td>Angle too low</td></tr>
<tr><td>15</td><td>TMAX</td><td>Terminated by Max. time exceeded</td></tr>
<tr><td>33</td><td>Abbruch</td><td>Measuring card: other abort by master</td></tr>
<tr><td>121</td><td>NOT-AUS</td><td>Rundown aborted by emergency stop</td></tr>
<tr><td>122</td><td>SA</td><td>Canceled by removal of the start signal</td></tr>
<tr><td>123</td><td>FHW</td><td>Measuring board hardware fault</td></tr>
</table></td></tr>
<tr><td><KFN></td><td>Tightening Position
The content consists of three parts: Tightening position: XXX_X
• Tightening Position: fixed designation which cannot be changed
• XXX: Fastener ID, can be specified under Navigator > Advanced > Linking > Fastener ID
• _X: consecutive number, is assigned automatically.</td></tr>
<tr><td><STUFE></td><td>Fastening stage
The required level can be selected during export.</td></tr>
<tr><td><TOOL></td><td>Serial number of the tool</td></tr>
<tr><td><SPNR></td><td>Spindle number</td></tr>
<tr><td><PGNR></td><td>Application number</td></tr>
</table>

Data Transfer 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>.

Column			Description
CSV-STD	CSV-FR	CSV-EN	
Ident	N°VAN	Ident	Depending on the setting at Worker ID, the following is displayed: • At *Worker ID* > *None* the vehicle number (VIN) is displayed. • At *Worker ID* > *1. Barcode in Linking Sequence* the vehicle number and worker ID is displayed.
Grp	Grp	Grp	Tool group number

Column			Description
CSV-STD	CSV-FR	CSV-EN	
SNR	Nom Position	SNR	Fastener ID that uniquely assigns the tightening position.
Bearbeitet	Date	TimeStamp	Date and time of rundown
Status	Statut Vissage	Status	Status of the rundown result (OK/NOK)
MdIst	Couple	TQAct	Shut-off torque reached during rundown
WiIst	Angle	ANAct	Shut-off angle reached during rundown
GdIst	Gradient	GCAct	Gradient reached during rundown
MdMin	Couple Min	TqMin	Minimum Torque
MdMax	Couple Max	TqMax	Maximum Torque
WiMin	Angle Min	AngMin	Minimum Angle
WiMax	Angle Max	AngMax	Maximum Angel
GdMin	Gradient Min	GdMin	Minimum Gradient
GdMax	Gradient Max	GdMax	Maximum Gradient
Sp	N° d'outil	Sp	Tool Number
Ta	N° de Position	Pos	Linking step, several steps can occur if Linking groups are configured.
Pg	Programme	App	Used application/Linking group
Stufe	Etape	Stage	The last stage used for tightening
Dia	Diagramme	Seq	The fastening sequence used in the final tightening stage

Example CSV-STD with setting *Worker ID* > *1. Barcode in Linking Sequence*

```
Ident;Grp;SNR;Bearbeitet;Status;MdIst;WiIst;GdIst;MdMin;MdMax;WiMin;WiMax;GdMin;GdMax;Sp;Ta;Pg;Stufe;Dia;¶
VIN2/OperatorA;1;101;20-12-2021 14:13:20;IO;2,02;0;0,00;0,0;0,0;0;0;0,00;0,00;1;1;1;1;11¶
VIN2/OperatorA;1;101;20-12-2021 14:13:20;IO;12,08;35;0,00;10,20;13,80;20;90;0,00;0,00;1;1;1;2;30¶
VIN2/OperatorA;1;102;20-12-2021 14:13:29;IO;2,02;0;0,00;0,0;0,0;0;0;0,00;0,00;1;2;1;1;11¶
VIN2/OperatorA;1;102;20-12-2021 14:13:29;IO;12,10;37;0,00;10,20;13,80;20;90;0,00;0,00;1;2;1;2;30¶
VIN2/OperatorA;1;103;20-12-2021 14:13:36;IO;2,01;0;0,00;0,0;0,0;0;0;0,00;0,00;1;3;1;1;11¶
VIN2/OperatorA;1;103;20-12-2021 14:13:36;IO;12,06;37;0,00;10,20;13,80;20;90;0,00;0,00;1;3;1;2;30§
```

Example CSV-STD with setting *Worker ID* > *None*

```
Ident;Grp;SNR;Bearbeitet;Status;MdIst;WiIst;GdIst;MdMin;MdMax;WiMin;WiMax;GdMin;GdMax;Sp;Ta;Pg;Stufe;Dia;¶
VIN1;1;101;20-12-2021 14:08:01;IO;2,01;0;0,00;0,0;0,0;0;0;0,00;0,00;1;1;1;1;11¶
VIN1;1;101;20-12-2021 14:08:01;IO;12,03;44;0,00;10,20;13,80;20;90;0,00;0,00;1;1;1;2;30¶
VIN1;1;102;20-12-2021 14:08:15;IO;2,01;0;0,00;0,0;0,0;0;0;0,00;0,00;1;2;1;1;11¶
VIN1;1;102;20-12-2021 14:08:15;IO;12,04;39;0,00;10,20;13,80;20;90;0,00;0,00;1;2;1;2;30¶
VIN1;1;103;20-12-2021 14:08:29;IO;2,01;0;0,00;0,0;0,0;0;0;0,00;0,00;1;3;1;1;11¶
VIN1;1;103;20-12-2021 14:08:29;IO;12,08;39;0,00;10,20;13,80;20;90;0,00;0,00;1;3;1;2;30§
```

8.3.9 IPM Protocol

IPM (Integrated Process data 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:

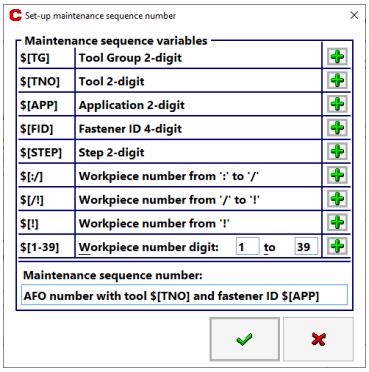
1. Tap the *IPM* entry in the *Ethernet* table to select it.
2. Tap the <*Activated*> check box.
   ➢ The <Advanced> button is displayed, which provides access to additional controls.
3. Tap the <Advanced> button to open the IPM advanced settings dialog.
   Contact your network administrator for required settings.

IPM Advanced Settings – General Tab

The following controls are available on the General tab:

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 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.
Date/Time Synchronization	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 acknowledgment 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.

<table>
<tr><th>Control</th><th>Description</th></tr>
<tr><td>Error Codes</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 customer-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 measurement 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 warnings</td><td>Offset+20</td><td>Without evaluation</td></tr>
<tr><td>Offset+3</td><td>Tool incorrectly configured</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 transducer 1</td><td>Offset+23</td><td>Shutoff by depth sensor</td></tr>
<tr><td>Offset+6</td><td>Problem with transducer 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 lowering 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 measuring 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 (Independent of Transmission Settings)</td><td>If the checkbox is activated, the data from the last executed stage is transmitted 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	Select the data of which the AFO number should be composed. • Default: Tool No. and App in appendix The following types are available: – 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 (in the Maintenance sequence tab) 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. 8-9: 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.
Event Number	Configures the event number field in IPM telegrams.
Workpiece number-filter	If this is active, the workpiece number is only transmitted in the set character range.

IPM advanced settings – Transmission Settings Tab

This *Transmission Settings* dialog allows you to configure whether execution of particular stages is sent.

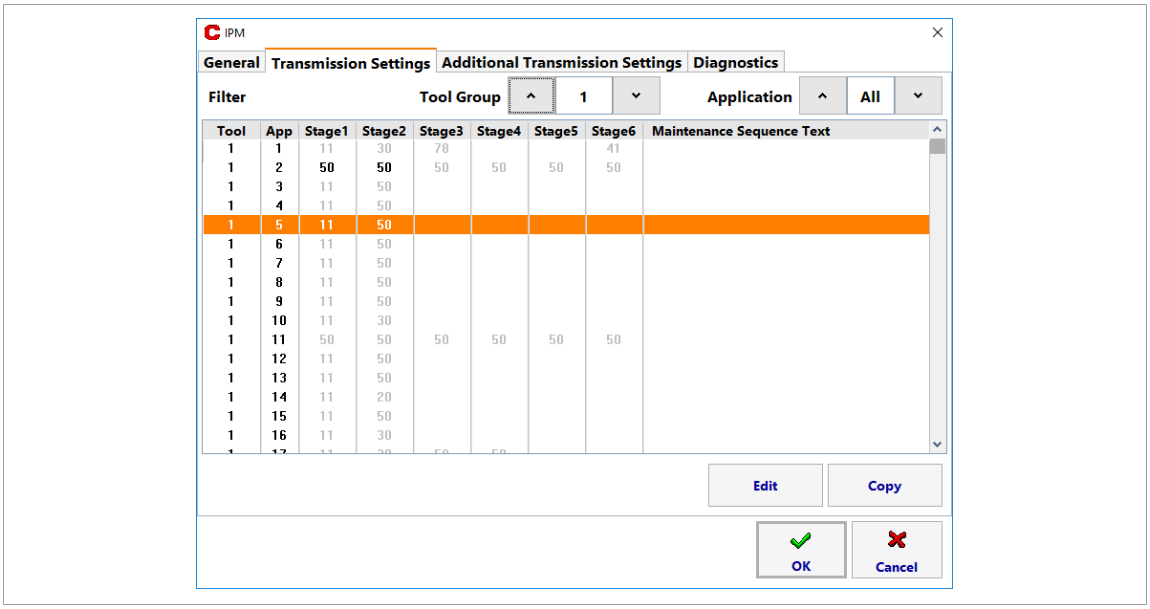


Fig. 8-10: IPM advanced settings – Transmission Settings tab

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.

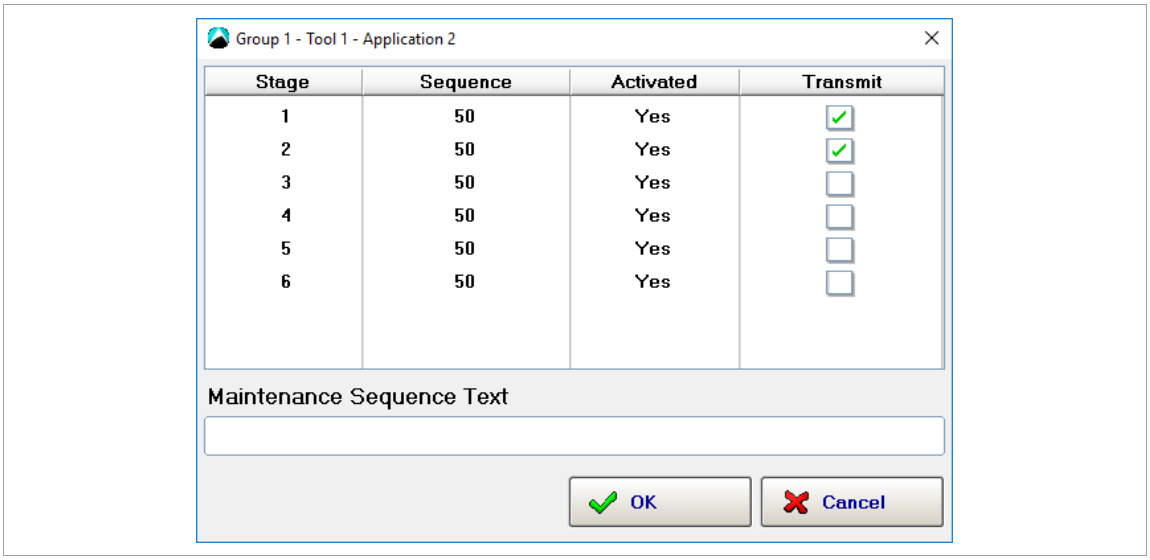


Fig. 8-11: IPM advanced settings – Transmission Settings tab – Filter *dialog*

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 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 <Copy> to select a tool and a application for the copy operation.

3. Ensure that the correct Source Tool and Application are displayed.
4. Enter the Target Tool and Application.
5. Tap the <OK> button to confirm your settings and close the dialog.

IPM Advanced Settings – Additional Transmission Settings tab

The settings on the *Additional Transmission Settings* tab apply to all stages. The following controls are available:

Control	Description
Use AFO text from TPS comment	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 application* option is selected in the *General* tab, the *Maintenance sequence number type* 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* 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 CF 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*. The telegrams are usually saved to the `Pfad/x0/ipm-save`CF card.
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 (CF 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.

8.4 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.

8.4.1 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.
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.

Control	Description
# of Characters	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. • Disabled: 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 Activated 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 chapter 8.2 Serial Protocols, page 84*. 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. This button is only displayed when Serial is selected as the port.
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* 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 chapter 8.4.2 Workpiece Administration, page 119*) to release the associated job. The following selection options are available: • None: There is no restriction on the bar codes used. • Range: 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.

Control	Description
<Configure>	Opens the dialog *Select Area* or *Select position* to define a barcode area or positions.

Barcode – 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.
4. The *Select Area* controls are displayed in the lower right corner.
5. Select the *Range* under Selection.
6. Tap the <Configure> button to open the *Select Area* dialog.
7. 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.

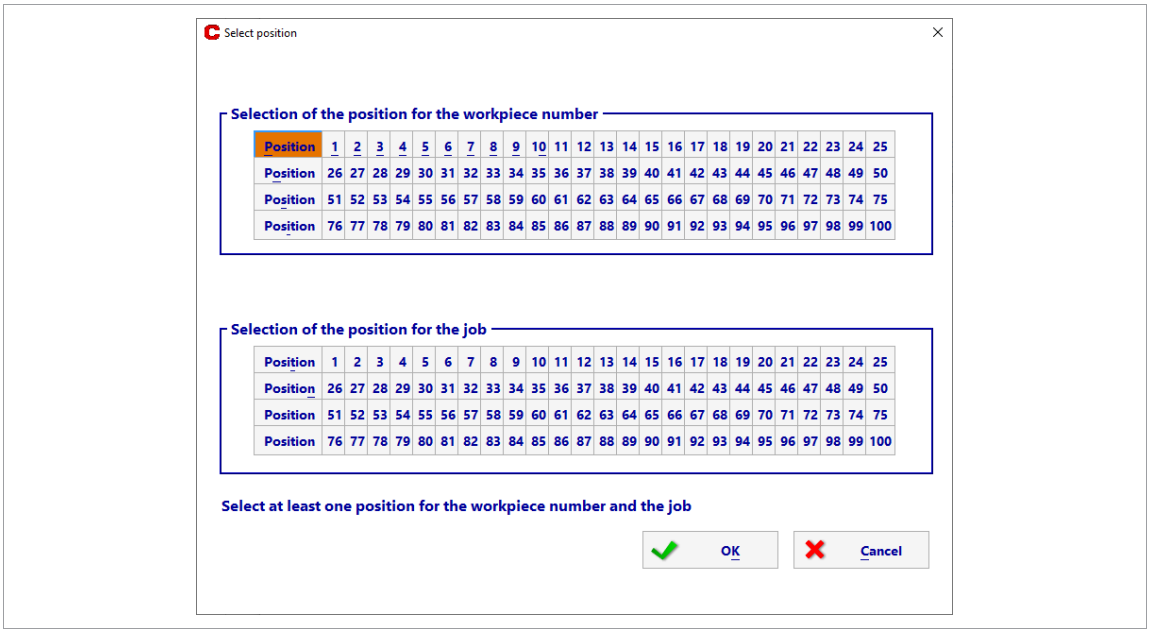


Fig. 8-12: Option to select the positions for the workpiece number and the job

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.

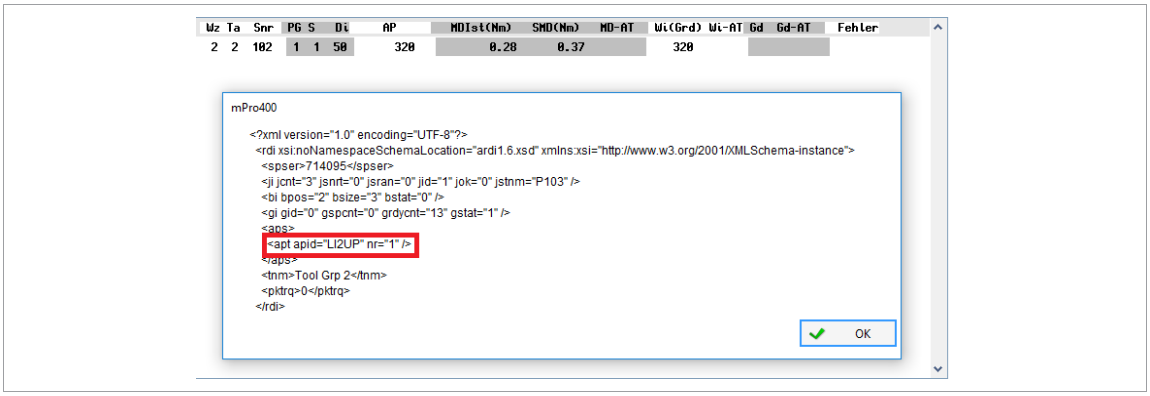


Fig. 8-13: Job number in XML format

8. Confirm the entry with <OK> to leave the dialog.
   The dialog can only be exited if at least one position is selected for the workpiece number and for the job number.

8.4.2 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.

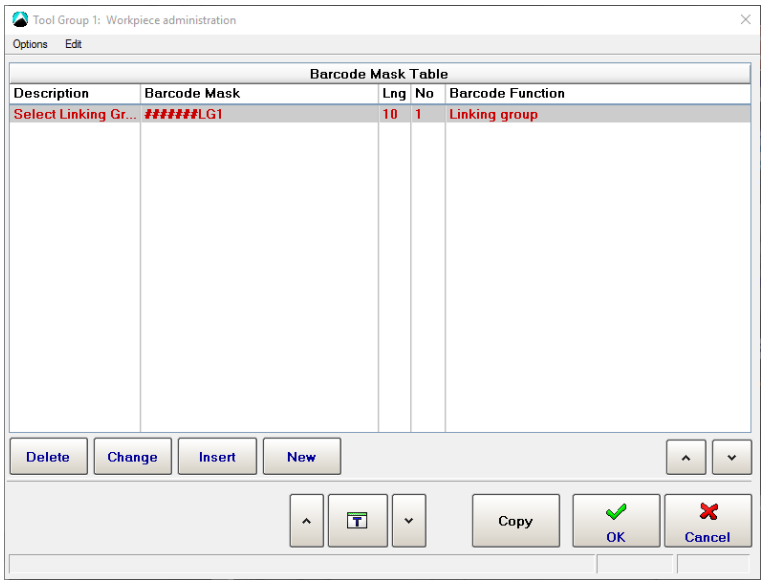


Fig. 8-14: Workpiece Administration

To access Workpiece administration:

1. Select *Communication* > *Part ID*.
2. Select the required Tool Group from the drop-down menu, and enable Part IDs for this Tool Group.
3. Select the Activated 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.

Button	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.
<Copy>	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	Selects the action triggered when an actual barcode matches the barcode mask. The following options are available in the drop-down menu:

Control	Description
• Use Application X (1-99)	Automatically select the application specified in the *Application* input box below the *Barcode Function* drop-down menu.
• Use Linking Group X (1-99)	Automatically select the linking group specified in the *Linking Group* input box below the *Barcode Function* drop-down menu. The CellClutch tool series does not support this function. If a Linking Group is programmed, the tool loses the connection to the controller.
• Tool enable	Enable the selected tool when barcode is scanned.
• Disable Tool	Disable the selected tool when barcode is scanned.

8.4.3 Network Settings

The *Network Settings* tab allows you to configure how the controller communicates over a network.

Contact your network administrator for required settings.

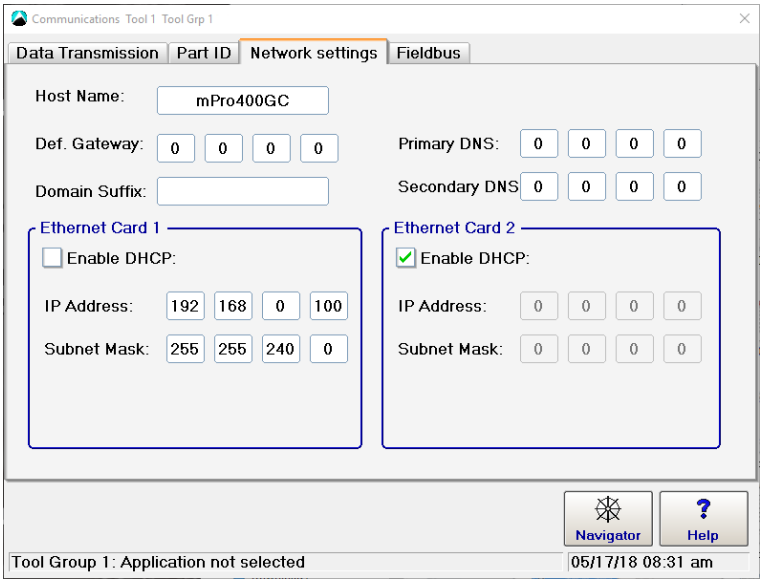


Fig. 8-15: Network Settings

By default, the controller is equipped with two Ethernet cards.

In the factory setting of mPro200GC(-AP), the IP address and the subnet mask of the controller are specified with a default value (Ethernet 1):

Parameter	Default value
IP address	192.168.100.200
Subnet mask	255.255.255.0

8.4.4 Fieldbus Protocols

The *Fieldbus* tab of the *Communication* 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	Details *see chapter 8.4.4.1 GMCC Protocol, page 122*.
Trasys	Details *see chapter 8.4.4.2 Trasys Protocol, page 124*.

8.4.4.1 GMCC Protocol

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* > *Communication* > *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.
Part ID 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.
Node Address	Enter a valid fieldbus node address. The valid address range is 1 to 63.
Slot	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.

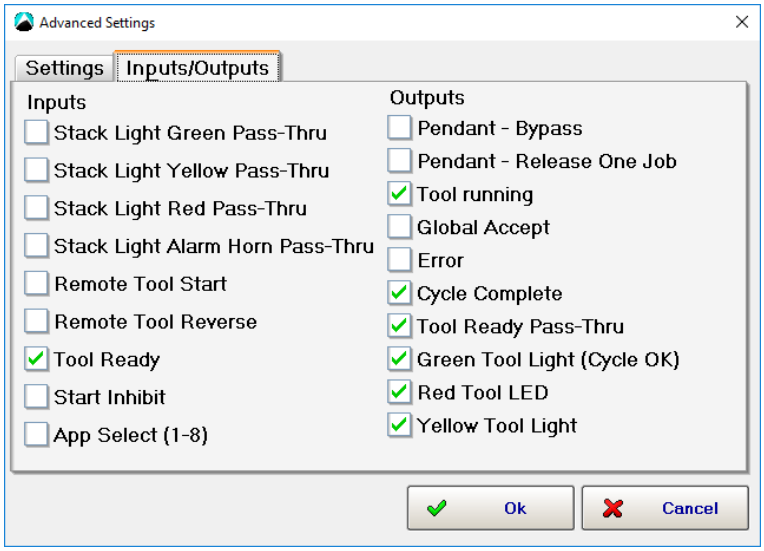


Fig. 8-16: GMCC Input/Output signals

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.

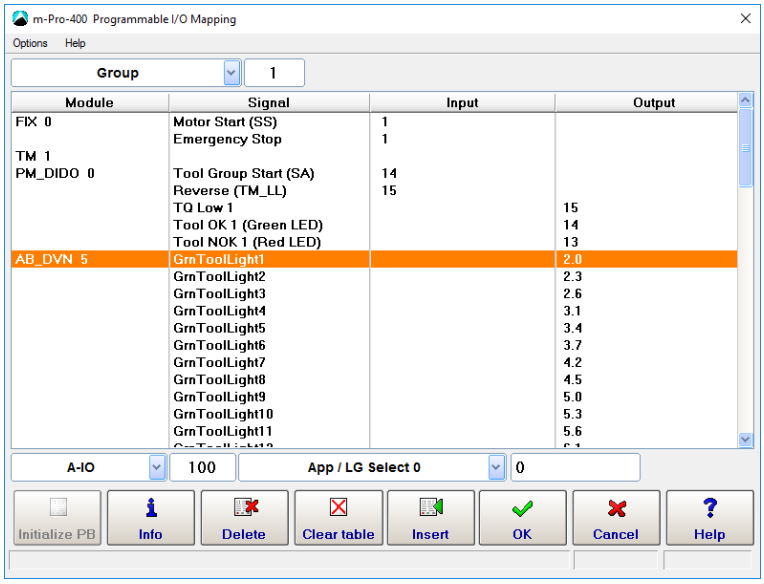


Fig. 8-17: GMCC – Programmable I/O Mapping

Note that all I/Os remain active when you disable GMCC. You have to remove obsolete I/Os manually.

8.4.4.2 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* > *Communication* > *Fieldbus*.
2. Select the *Trasys* option from the *Protocol* drop-down menu to display the *Timeout (s)*.
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.

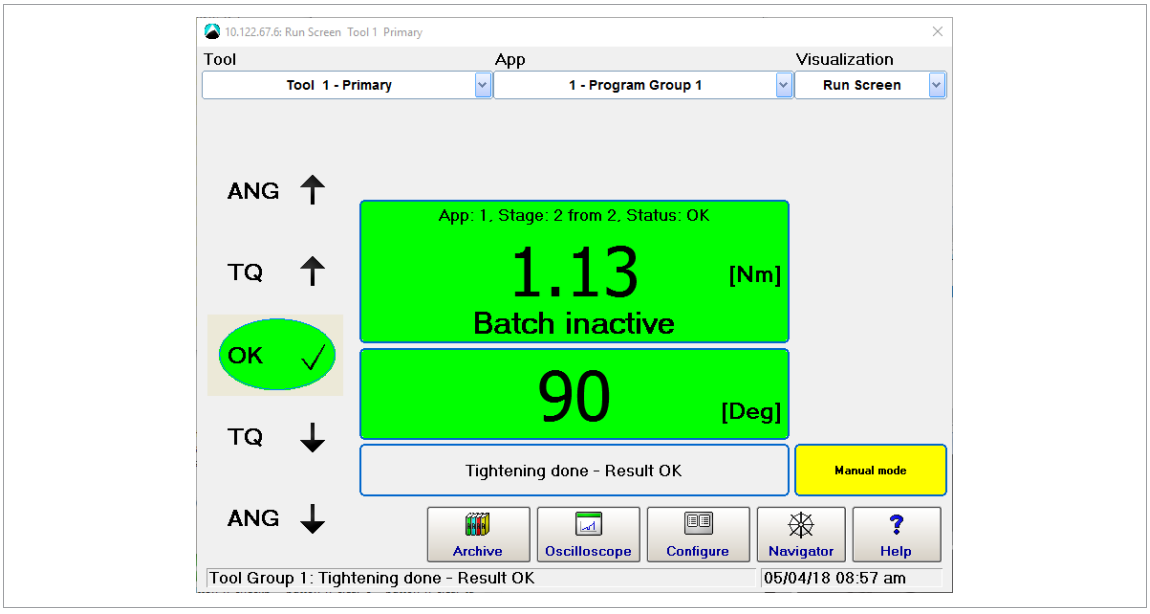


Fig. 8-18: Trasys keep-alive timed out

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).

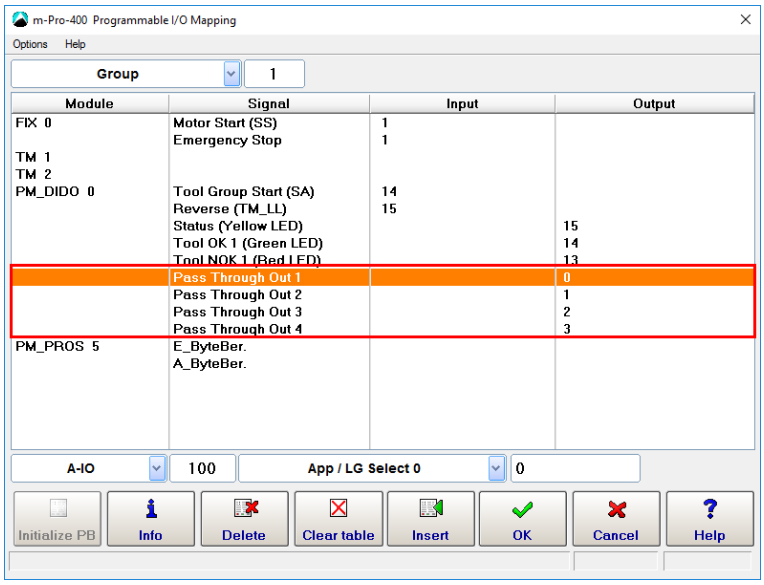


Fig. 8-19: Trasys – Set up Programmable I/O's

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.

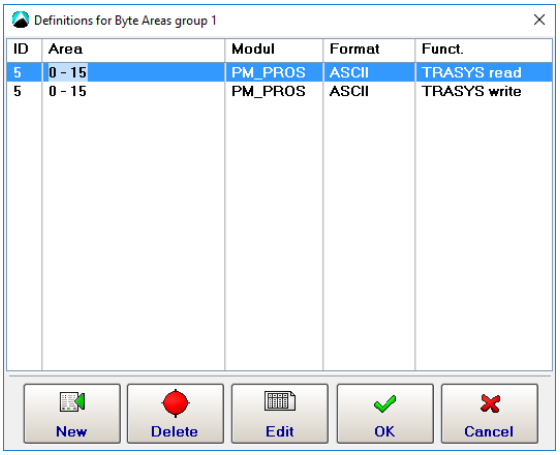


Fig. 8-20: Trasys – Set up byte area

3. Initialize the Profibus with the correct Profibus address and with 16 inputs and 16 outputs with consistency active.

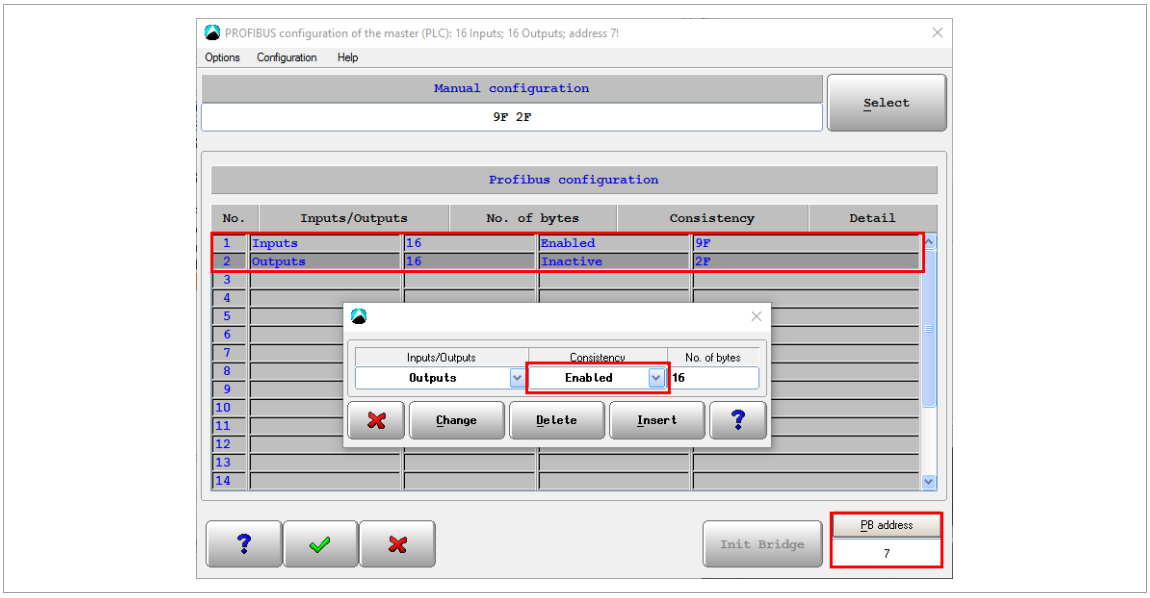


Fig. 8-21: Trasys – Profibus configuration

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*.

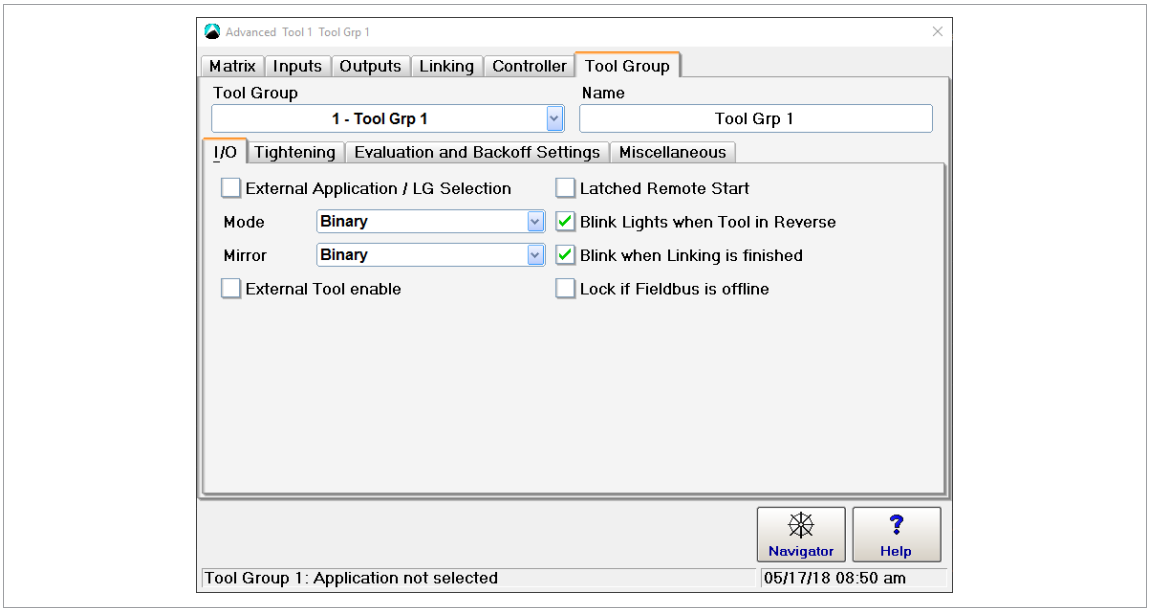


Fig. 8-22: Trasys – Advanced Tool I/O settings

- 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*.

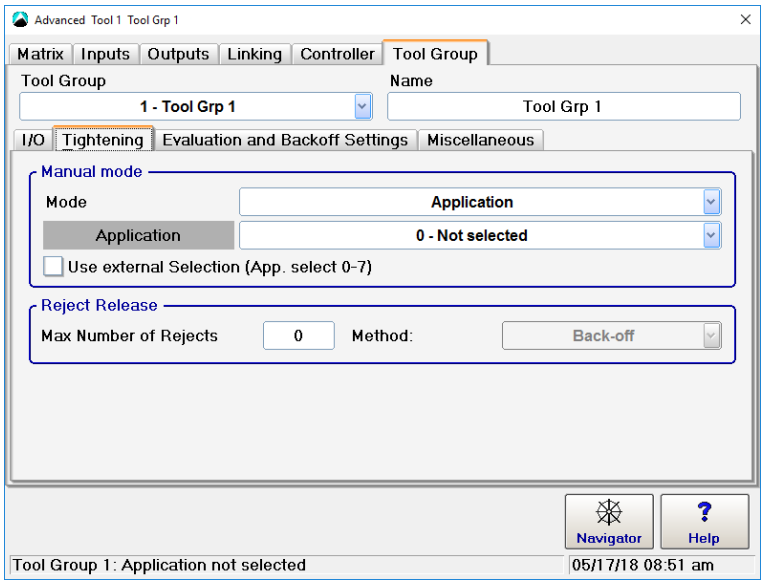


Fig. 8-23: Trasys – Advanced Tool Tightening settings

To use the emergency application:

► Activate the *Use External Selection (Application 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 (Application Select 0-7)* option.
2. Select the required application.
3. Activate the *Use External Selection (Application 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* 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.

8.4.5 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 or tool group ready for rundowns.

TPS communication uses the following Open Protocol MIDs:

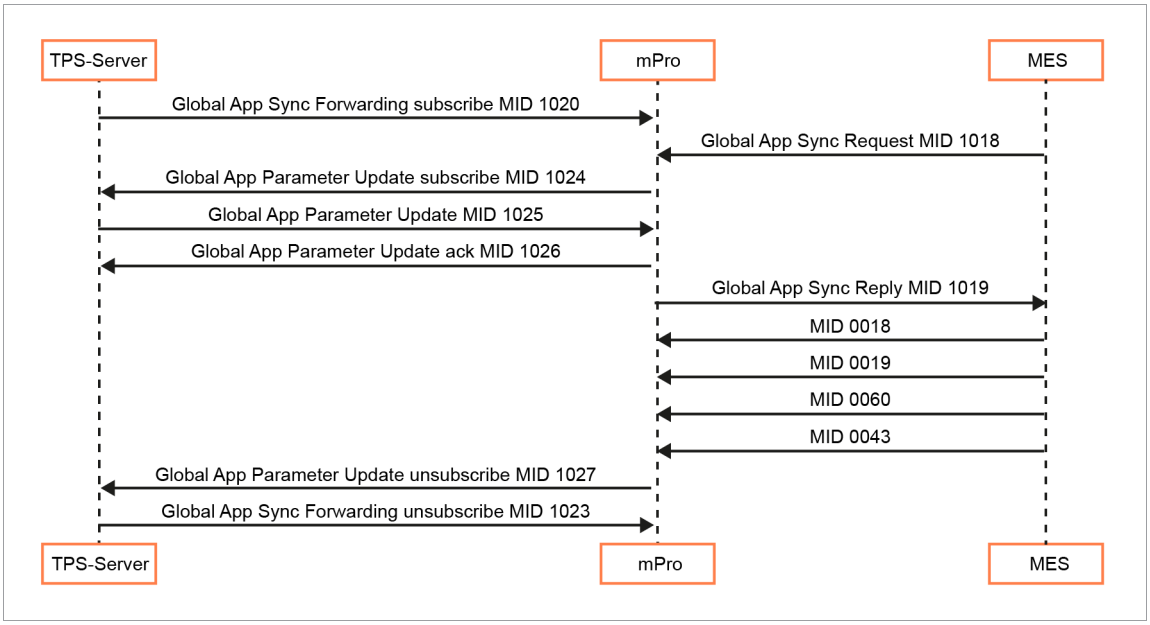


Fig. 8-24: Open Protocol MIDs required for TPS communication

8.4.5.1 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, or I-Wrench 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* > *Communication* > *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. Check the *General* box.
11. Tap *Allow Parameter Update via Open Protocol MID 25*.
12. Auf <OK> to confirm your changes and close the *Open Protocol Advanced Settings* dialog.
13. Tap <Navigator> to confirm your changes and close the *Communication* dialog.

8.4.5.2 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.

8.4.5.3 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.

8.4.5.4 Additional Settings on the Global Controller

Set Part ID mode:

1. Select *Communication* > *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.

8.4.5.5 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 *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	Select the Global Controller that has the local application to be uploaded.
Channel	Select the required Open Protocol communication port.
Application	Select the required local application. The numbers provided in this drop-down menu are the local Application numbers assigned on the Global Controller.

Item	Description
Global App #	Enter the global application number under which this local application is to be saved on TPS.
Global App Name	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>	Uploads the local application defined in the dialog, and saves it as a global application under the number and name specified.
<Cancel>	Discards all data entered in the dialog.

8.4.5.6 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.

8.4.5.7 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:

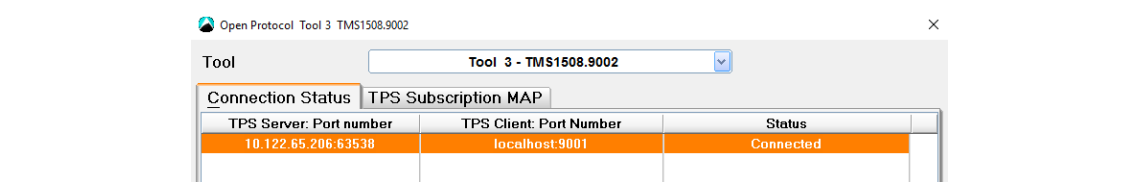


Fig. 8-25: TPS is connected to the Global Controller using Port 9002 for Tool 3

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:

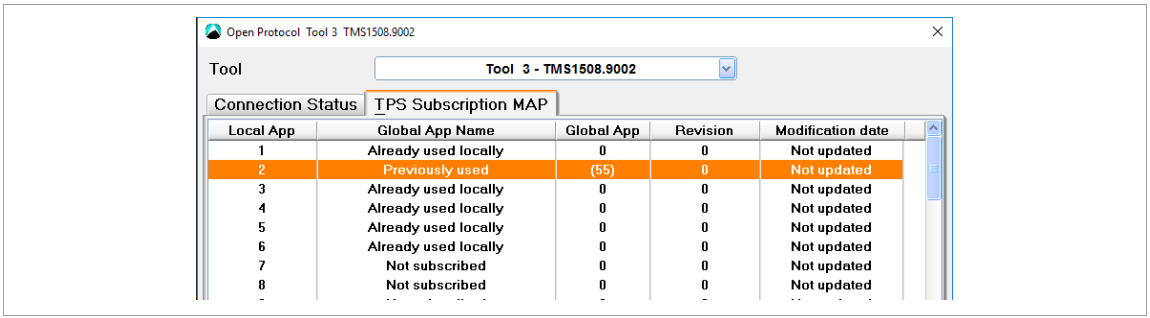


Fig. 8-26: Applications of Tool 3 viewed in the TPS Subscription MAP of the controller

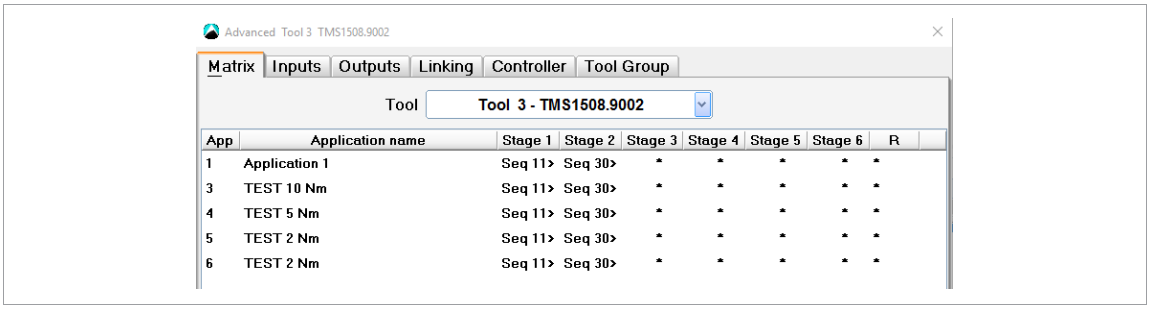


Fig. 8-27: Applications of Tool 3 viewed on the Matrix tab of the Advanced dialog

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:

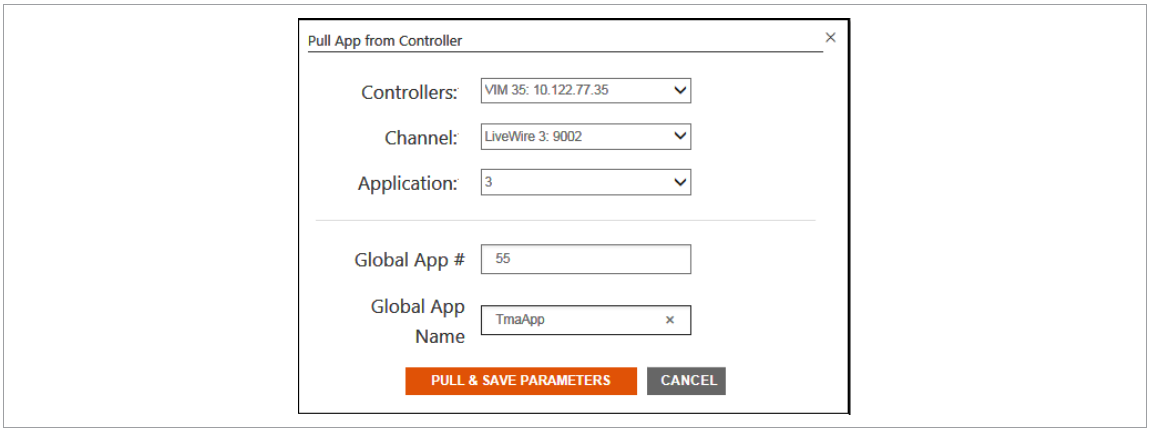


Fig. 8-28: Pull App from Controller dialog with local Application 3 selected for upload as Global Application 55

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:

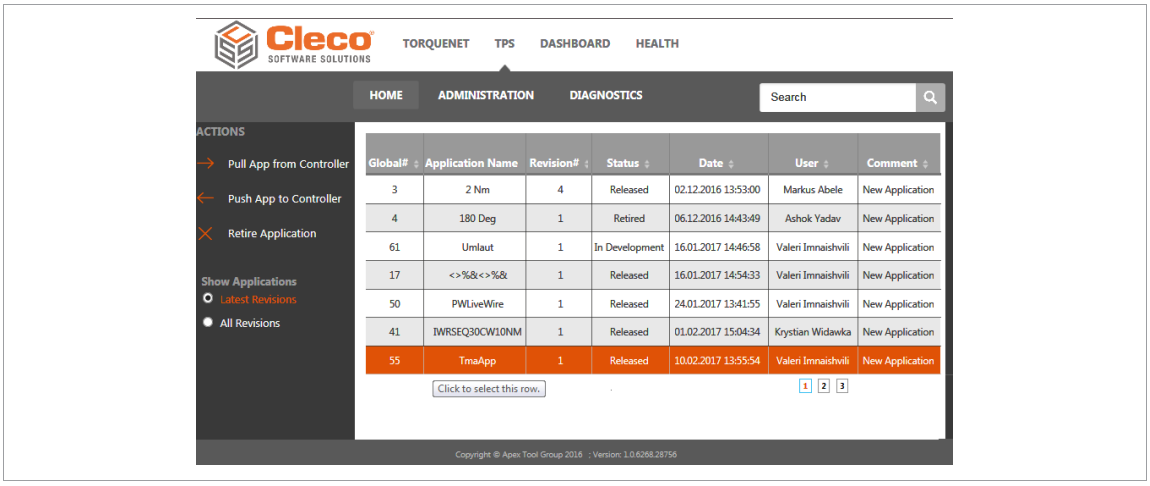


Fig. 8-29: Global Application 55 displayed with Released status

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:

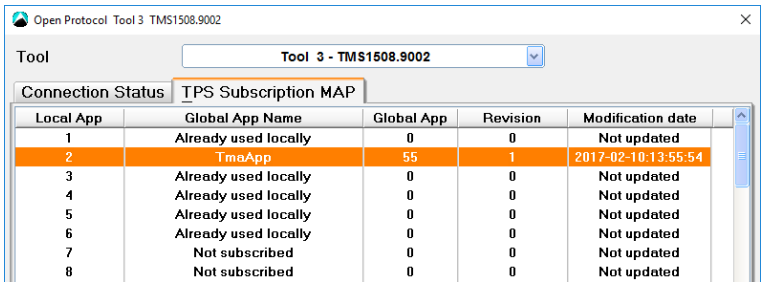


Fig. 8-30: Global Application 55 (TmaApp) viewed in the TPS Subscription MAP of the controller

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:

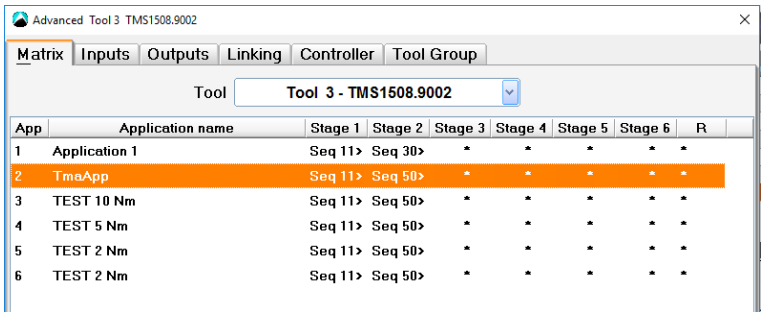


Fig. 8-31: Global Application 55 (TmaApp) viewed on the Matrix tab of the Advanced dialog

The Open Protocol client sets Application 2 (MID 0008) and Part ID (MID 0050 or MID 0150):

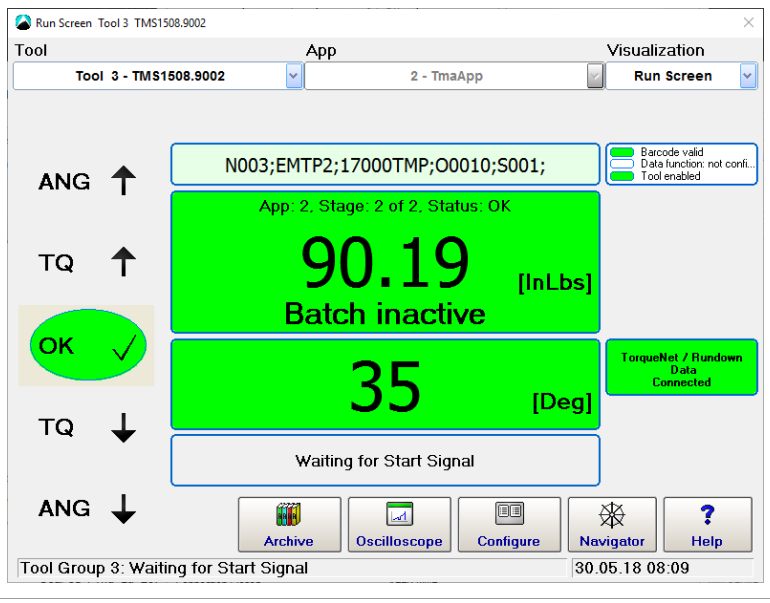


Fig. 8-32:

9 Tool Setup

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

► Select *Navigator* > *Tool Setup*.

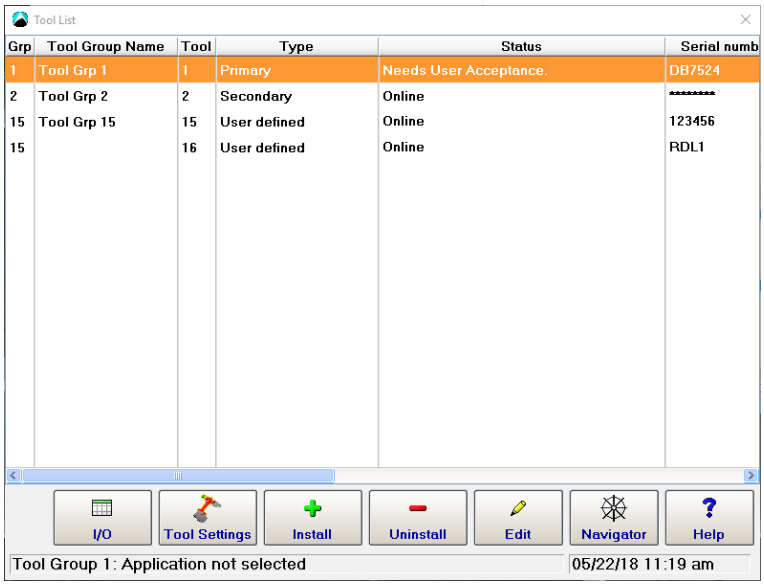


Fig. 9-1: Tool Setup tab

Parameter	Description
Grp	Display of the tool group number.
Tool Group Name	Display of the name associated with the tool group.
Tool	Display of the tool number associated with the tool during installation.
Type	Display of the tool type: • Primary: A corded tool connected to a Primary controller. • Secondary: A corded tool connected to a Secondary controller paired to either a Master or Primary controller. • Cleco Cordless Tool: A cordless tool installed with a unique IP address on a Master or Primary controller. • GWK: A corded tool that is associated with a Secondary controller. • LiveWire I-Wrench: A corded and/or cordless tool associated with a Secondary controller. For more information see the P2383BA manual. • CellClutch: A cordless CellClutch tool installed with a unique IP address on a Master or Primary controller.
Status	Display of the tool status: • 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 under <Tool Settings>. • Not Compatible: tool is not supported by the controller. • Servo Not Connected: tool is installed, but the Secondary controller is not attached.
Serial Number	Display of the serial number of the tool.
Tool Model	Displays the model number of the tool.

Parameter	Description
Maintenance counter • Maintenance Counter Status • Actual • Warning Threshold Before Service • Maintenance Limit	These four columns show information about the maintenance counter, *see chapter 9.2.4 Maintenance Counter, page 138*.

Button	Description
	<I/O> opens the *Programmable I/O Mapping* dialog. Here, input and output signals can be manually configured.
	<Tool Settings> opens the *Tool Settings* dialog.
	<Install> installs either a cordless tool or a corded tool attached to a Secondary controller. Corded tools attached to a Primary controller are installed automatically.
	<Uninstall> removes a tool from the controller's Tool List.
	<Edit> reconfigures setup options for a tool. Name and IP address/hostname of a tool can be adjusted.

9.1 Tool Settings

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

► Select *Navigator* > *Tool Setup*.

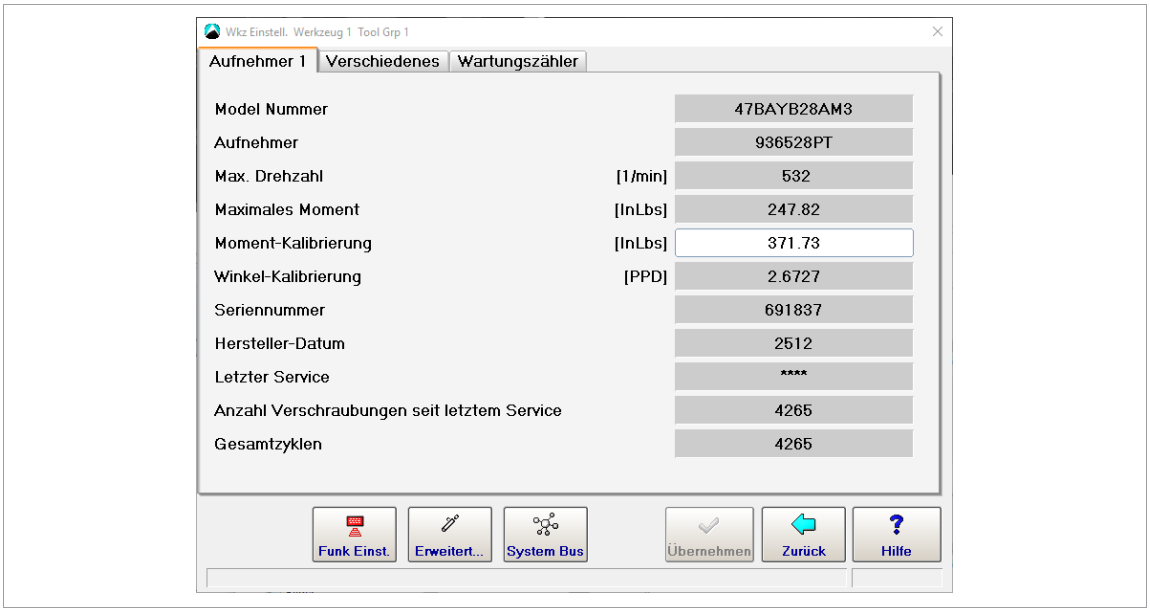
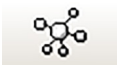


Abb. 9-2: The Transducer 1 tab of the Tool Settings *dialog*

Button	Description
	<RF Settings> opens the *RF Settings* dialog, *see chapter 14.2 System Settings, page 204*.

Button	Description
	<Advanced> opens the *Tool Constants* dialog, *see chapter 11 Tool Constants, page 169*.
	<System Bus> opens the *System Bus Map* dialog, *see chapter 13.1.1 System Bus (ARCNet Map), page 187*.
	<Accept> completes the installation of the tool and accepts the tool data. Afterwards, the tool is available.

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 Torque Constant
- Battery

Service counter:
Details *see chapter 9.2.4 Maintenance Counter, page 138*.

Low Level [V]

Cordless tools switch off when the battery voltage is too low. This can lead to a rundown no longer being completed properly. To prevent this, the battery voltage is monitored. If the battery voltage falls below the defined undervoltage threshold, a warning message is shown on the display. The current job can be completed.

► After this warning message occurs, change the battery pack to avoid the tool switching off.

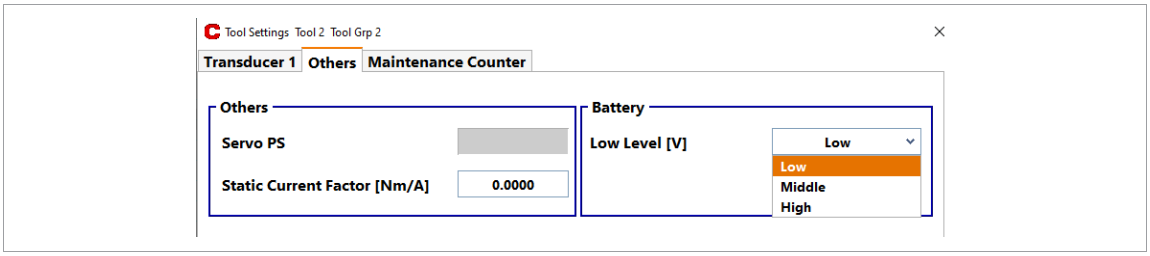


Fig. 9-3: Setting the undervoltage threshold

The undervoltage threshold defines the time of the warning message and depends on the application. The following options are available:

- High: The warning message is displayed when the battery voltage reaches the upper limit. This ensures that some rundowns can still be performed after the warning message occurs.
- Middle: The warning message is displayed when the battery voltage is between *Low* and *High*.
- Low: The warning message is only displayed when the battery voltage is already low. With this setting, more rundowns can be performed with one battery charge. After the warning message is displayed, the battery voltage is only sufficient for a few more rundowns before the tool switches off.

9.2 Installing the Tool

16 tools can be connected to one Primary controller:

- 1 Corded tool
- Up to 16 cordless tools
- Up to 16 Secondary controllers, each connected to another corded tool.

9.2.1 Installing Corded Tools

Installing a Corded Tool to a Primary Controller

1. Connect the tool and switch the tool on.
2. Select *Navigator* > *Tool Setup*.
3. Press the line which lists the Primary tool to highlight it. Tool 1 is reserved for a corded tool with Primary controller. Other corded Tools are connected to the Secondary.
4. Press 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.
   ➢ After the settings have been accepted, the status of the tool is *Online*.

When the tool is installed for the first time, the controller type must be selected, *see chapter 15.9 Factory Reset, page 222*.

Installing a Secondary Tool

You can install a tool as Secondary on the controller if:

- The tool is a corded tool.
- The STMHE 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 STMHE TM_DIDO I/O levels.

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

Parameter	Description
Tool 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. • Cleco Cordless Tool: a cordless tool associated with a Secondary controller. • GWK: a corded tool associated with a Secondary controller. • LiveWire I-Wrench: a corded and/or wireless tool associated with a Secondary controller. For more information, see manual P2383BA.

1. Ensure that STMHE module is connected with the selected tool group.
2. Press <OK> to add the tool as a Secondary tool to the selected Tool Group and return to the Tool List.
3. Press the line which lists the Secondary tool to highlight it.
4. Press 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.

9.2.2 Installing Cordless Tools

Installing a cordless tool to a Primary controller

1. Install the tool in the local or existing network. See document P2260JH or the Quick Start Guide of the corresponding tool.
2. Select *Navigator* > *Tool Setup*.
3. To add a new tool, press <Install>.
4. Select *Tool Group Name*, enter *Name* and select *Cleco Cordless Tool* at *Type*.
5. Enter the IP address or the host name of the tool at *IP address / hostname*.
6. Confirm input with <OK>.
7. Press <Tool Settings>.
8. Check the *Model Number* and the *Serial Number* to verify that the tool shown is the connected tool.
9. If the tool identification is correct, tap the <Accept> button and confirm if required.
   ➢ After the settings have been accepted, the status of the tool is *Online*.

Installing an I-Wrench to a Primary Controller

For a detailed description of an installation in a Local network or an Existing network see:

- Installation Instructions: WLAN data transmission / Cordless EC tool
- Instruction Manual / I-Wrench

9.2.3 Installing Tool Groups with Multiple Tools

1. Select *Navigator* > *Diagnostics* > *System* > *System Bus*.
2. Make sure that the tools you want to use in the Tool Group are usable on the System Bus.
   In the following example, Nodes 15 and 16 are used as BTS.
3. Select *Navigator* > *Tool Setup*.
4. Press the <Install> button to open the *Assign Tool* dialog.
5. Select the required Tool Group, and select the <Secondary> option from the *Type* drop-down menu.
6. Press <OK> to add the tool as a Secondary tool to the selected Tool Group and return to the Tool List.
7. Tap the line which lists the tool to highlight it.
8. Press the <Tool Settings> button.
9. Check the *Model Number* and *Serial Number* to verify that the tool shown is the connected tool.
10. 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 process is complete, the Tool List is displayed again.
11. Press the <I/O> button to open the *Programmable I/O Mapping* dialog.
12. Select the Tool Group and add the next TM (tightening module) you want to use (TM 16 in this example).

You also have to add required I/O signals. For details *see chapter 10.1 Programmable I/O Mapping, page 141*.

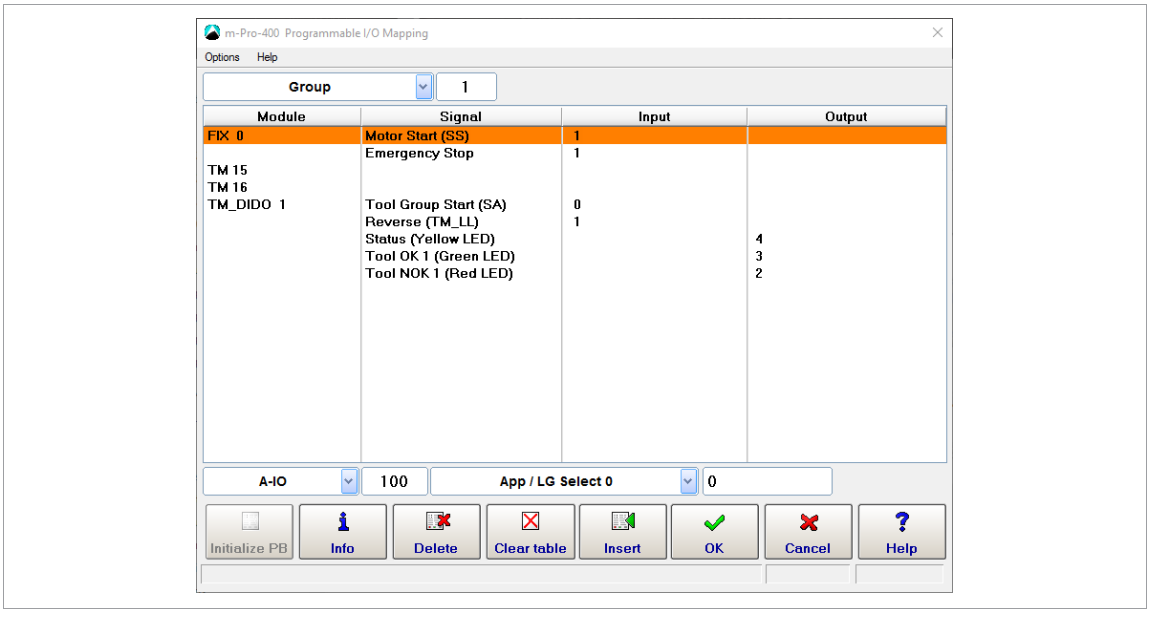


Fig. 9-4: Programmable I/O Mapping

13. Press <OK> and leave *Programmable I/O Mapping*.
    - ➢ The next TM is added to the same Tool Group.

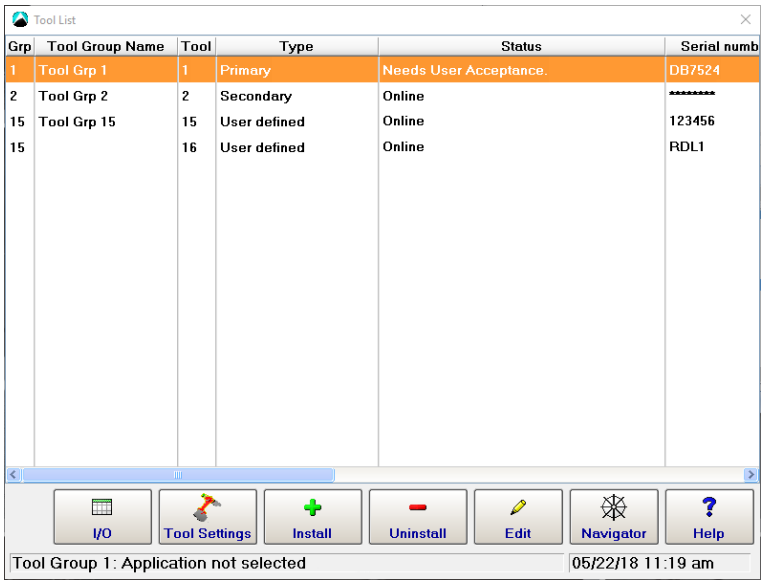


Fig. 9-5: Tool List with Tools 15 and 16 (both Tool Group 15) listed

You still have to verify tool identification data for the second TM:

14. Tap the line which lists the second tool (Tool 16 in this example) to highlight it.
15. Press the <Tool Settings> button.
16. Check the *Model Number* and *Serial Number* to verify that the tool shown is the second connected tool.
17. If the tool identification is correct, press the <Accept> button and confirm if required.

9.2.4 Maintenance Counter

Tool maintenance information helps to keep the tool in regular circulation for maintenance and service. With this maintenance/service offering, common 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.

Configuring warning threshold and warning messages for maintenance

1. Select *Navigator* > *Tool Setup*.
2. Select the required Tool in the Tool List dialog.
3. To open the settings of the maintenance counter, press <*Tool Settings*> and select the *Maintenance Counter* tab.
4. Change settings and save with *Accept* > *Accept*.

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.

Parameter	Description
Warning Threshold Before Service	The *Warning Threshold Before Service* function allows to generate a maintenance warning message on the controller before the actual maintenance limit is reached. This displacement from the maintenance limit is programmed as a numerical value. A default value is permanently stored on the transducer. If another value is programmed on the controller, the value of the tool memory is ignored and the value from the controller is used.
Maintenance Limit	The *Maintenance Limit* for a tool defines the maximum number of rundowns after which maintenance of the tool is required. If this value is not set in the controller, the default value of the tool memory is used.
Message: Maintenance Warning	If the difference between the *Maintenance Limit* and *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 message.. Example: For tool 1, the *Maintenance Limit* is set to 19,000 and *Warning Threshold Before Service* is set to 1,000. The difference between these two (18,000) is lower than the actual counter value of 18,923, so a maintenance warning message is shown in the Run screen: **Tool 1: Warning before maintenance**
Message: Maintenance	If the value of the actual counter is greater than the maintenance limit, the controller generates another maintenance warning message: **Tool 1: Send for maintenance**

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

Display maintenance warning messages in the Run screen

1. Select *Navigator* > *Advanced* > *Controller* > *Miscellaneous*.
2. Activate the *Show Warnings* check box in the *Maintenance Counter* section.
   ➢ When *Warning Threshold Before Service* or *Maintenance Limit* is reached, the Run screen shows the messages that are configured under *Navigator* > *Tool Setup* > *Tool Settings* > *Maintenance Counter*.

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.

Enable Maintenance Counter updates through TorqueNet and set the update interval:

1. Select *Navigator* > *Communication* > *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.
   ➢ The <Advanced> button is now displayed below the *Activated* checkbox.
4. Tap the <Advanced> button to open the *Advanced Settings* dialog.
5. Check the *Enable notification* option in the *Maintenance Counter* section of the *Advanced Settings* dialog.
6. Enter the required value in the *Counter update interval (h)* input box.

You can read out current Maintenance Counter states in the *System Information* window 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.

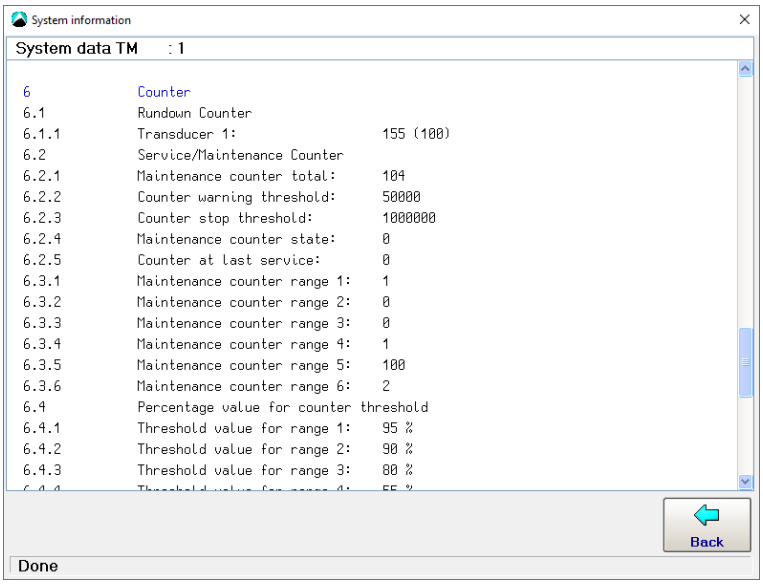


Fig. 9-6: Maintenance Counter states displayed in the System information window

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 on 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.

Dynamic Service Counter

The service counter has a dynamic component that takes into account the different loads on the tool. Depending on the load of the tool, the dynamic service counter is increased with different factors.

10 Enhanced Programming

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

10.1 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".

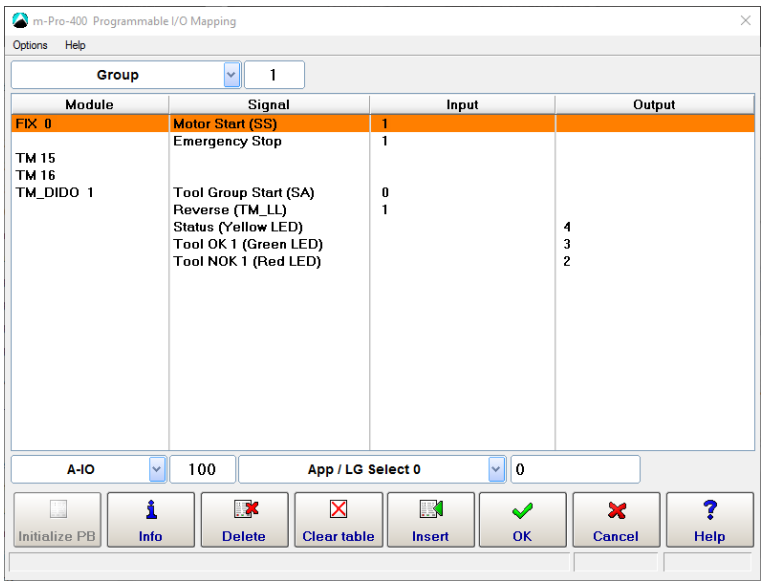


Fig. 10-1: The Programmable I/O Mapping *dialog for Tool Group 1*

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.
	<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.
	<Info> 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 chapter 10.3 Fieldbus Configuration, page 146*.

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:

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.

10.2 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
A-IO	Digital I/Os 24 V	32 freely configurable I/Os		100 – 131	See Appendix A and B for all I/O signals.	0 – 31
A-IOS	Digital I/Os 24 V	16 freely configurable I/Os				0 – 15
A-IBR	INTERBUS-S	64	64			0.00 – 3.15
A-IB	INTERBUS-S	160	160			0.00 – 9.15
A-PB	Profibus DP	896	896			0.0 – 111.7
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 24 V	16	16	0	See Appendix A and B for all I/O signals.	0 – 15
PM_IBS (deprecated)	INTERBUS-S	64	64	4 – 5		0.00 – 3.15

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	PROFINET 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*.

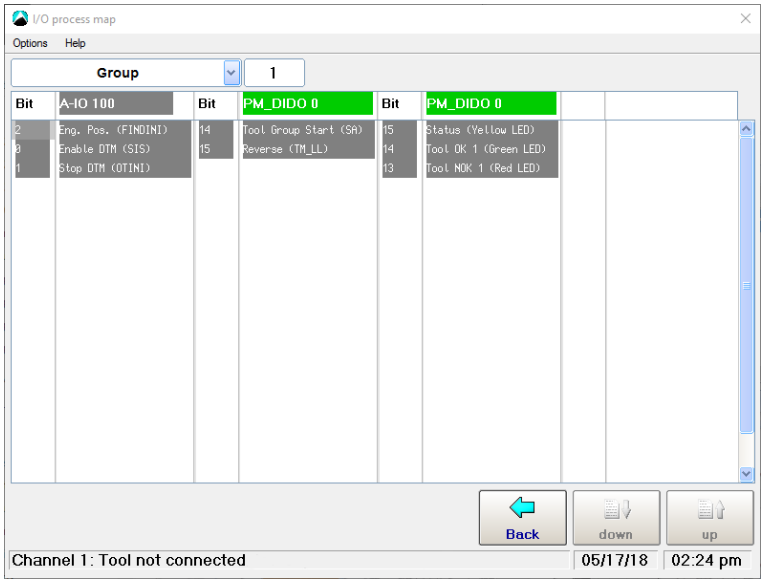


Fig. 10-2: Initiator signal names

Initiator name	Description
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.

Predefined module assignments

Primary controller (mPro400GC-P, Module: PM_DIDO 0):

Inputs		Outputs	
Bit	**Description**	**Bit**	**Description**
14	Start	13	NIO
15	Tool Reverse	14	IO
		15	Status

Primary-(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 button 2	4	Yellow LED
		5	Blue LED

Secondary controller (mPro400GC-S, Module: TM_DIDO):

Inputs		Outputs	
Bit	Description	Bit	Description
0	Start	2	NIO
1	Tool Reverse	3	IO
		4	Status

Secondary controller (mPro400GCD-S(H), mPro400GCD-S(H)-STO, 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

Socket Tray (S133410: 4 positions):

Inputs		Outputs	
Bit	**Description**	**Bit**	**Description**
0	Nut 1	8	LED 1
1	Nut 2	9	LED 2
2	Nut 3	10	LED 3
3	Nut 4	11	LED 4

For more information, see Instruction Manual P2170BA (960645-GC for 4 position, 960646-GC for 8 position).

Stack light with / without buzzer (S133420 / S133405):

Inputs		Outputs	
Bit	**Description**	**Bit**	**Description**
8	Yellow LED	0	Pushbutton on the controller box
9	Blue LED	1	Key switch on the controller box
10	Red LED		
11	Green LED		
12	Summer (only for S133420)		

10.3 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.

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.

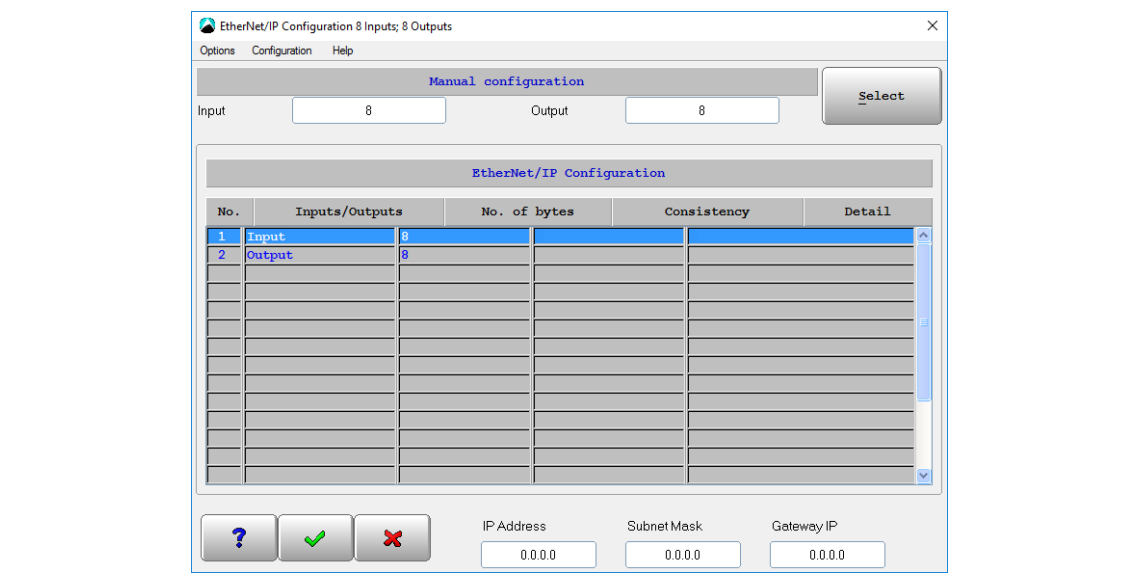


Fig. 10-3: The Fieldbus Configuration dialog for EtherNet/IP configuration

To access the Fieldbus Configuration dialog:

1. Tap the <I/O> button, e.g., *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 to 1F	Inactive	Input
20 to 2F	Inactive	Output
A0 to AF	Enabled	Input
90 to 9F	Enabled	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:

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

For PROFINET, no additional options are available.

10.4 Byte Area

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

10.4.1 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 in 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

10.4.2 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* dia.
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.
   ➢ 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.

10.4.3 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		Order no.
ARCNet ID	Enter the System Bus node number/ slot number.		
Module	• Select the module to be used:		
	PM_PROS	Profibus plug-in card	544173PT (DB9) S133173 (M12)
	PM_IBS	Interbus-S plug-in card; this module is not supported anymore	-
	A_PB	Profibus System Bus bridge	960392
	A_IB	System Bus Interbus bridge	For backward compatibility only
	A_IBR	System Bus Interbus bridge (reduced format)	
	AB_DVN	DeviceNet plug-in card	544171PT
	AB_PN	ProfiNet	544174PT (RJ45) S133174 (M12)

Input box/Drop-down menu	Description		Order no.
	AB_EIP	EtherNet/IP	544172PT (RJ45), 544278PT (M12), 544354PT (M12, BB-DLR)
	AB_MBT	Modbus/TCP	544211PT
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.	
	SpiBi-tErg	Bit results (1 Byte per tool) (see also section below)	
	SpiByteErg	BCD actual values (6 Byte per tool) (see also section below)	
	SpiBy-teLimits	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.		

Input box/Drop-down menu	Description	Order no.
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.	

10.4.4 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.

The following data transmission combinations for EUN are possible for the programmable byte ranges:

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

10.4.5 Example of Data 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**
0			Function byte 1
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**
0	0	Block counter	Synchronization Byte Read
	...		
	5		
	6	Last block	
	7	Toggle	

DFUE write			
Byte areas			
Byte	**Bit**	**Signal**	**Meaning**
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

	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

10.4.6 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)

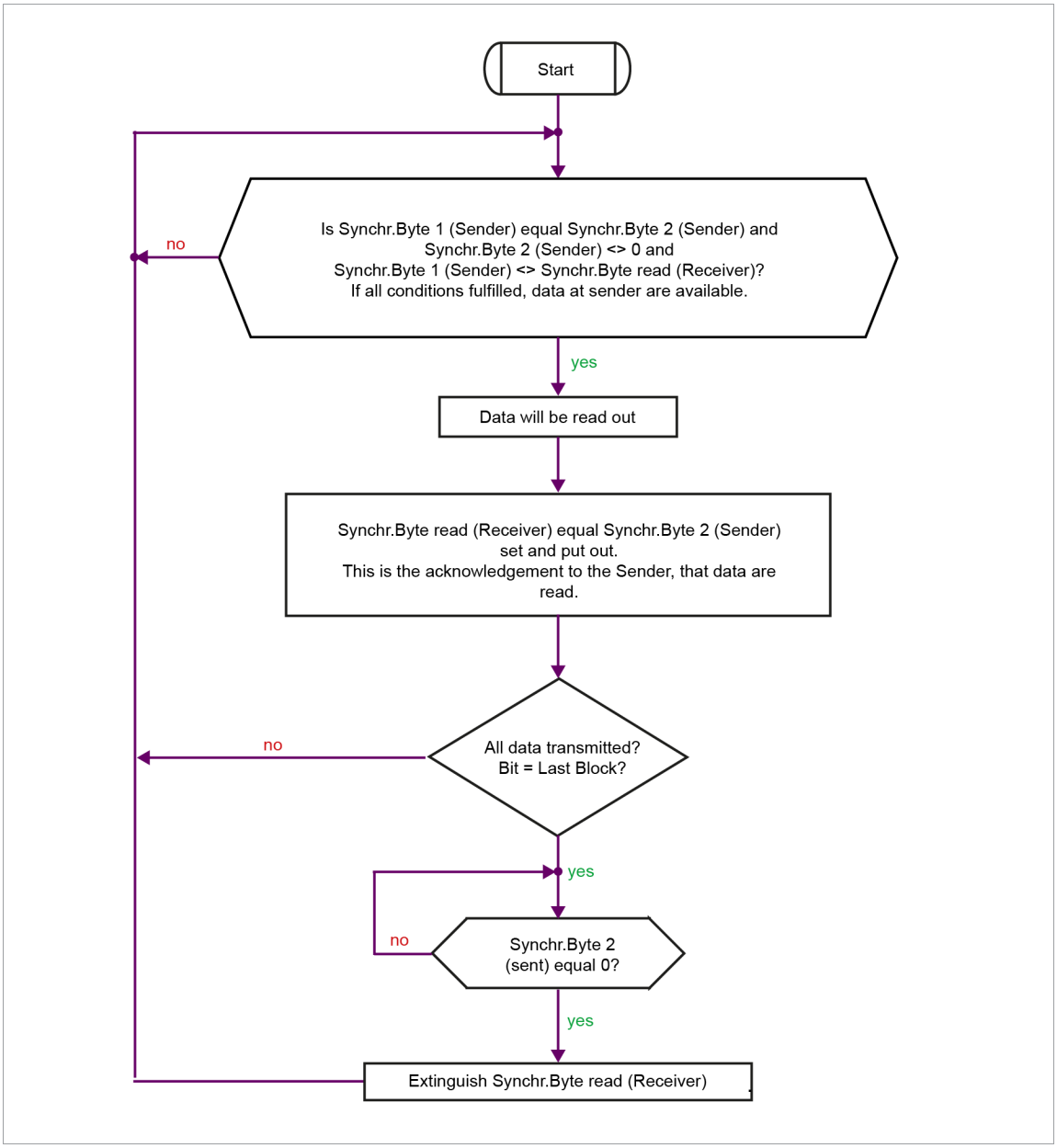


Fig. 10-4: DFUE read

Flow Chart: Send Routine (DFUE write)

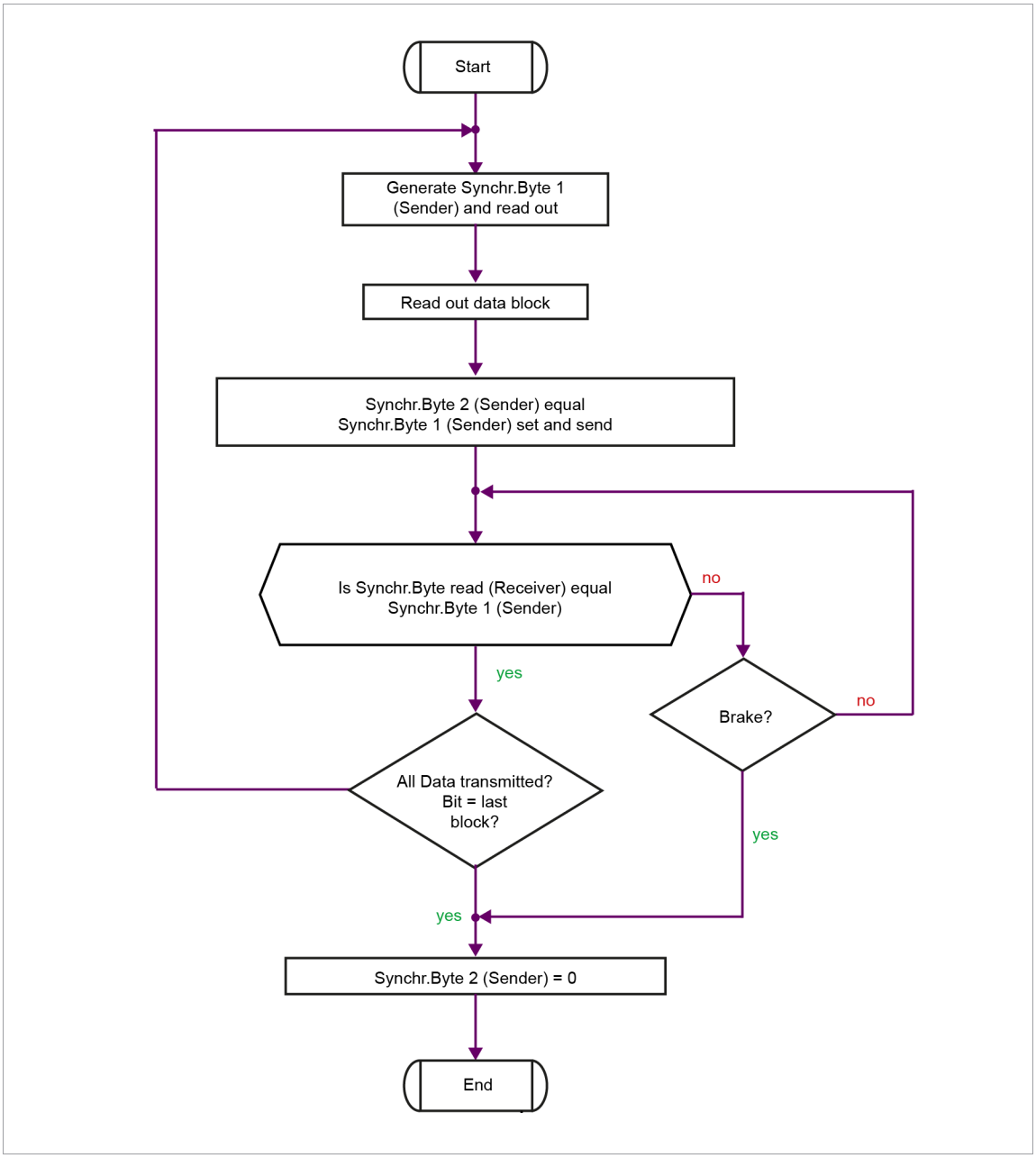


Fig. 10-5: DFUE write

10.4.7 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	DATA BLOCK
1	ASCII	0x42	B	
2	ASCII	0x43	C	
3	ASCII	0x44	D	
4	ASCII	0x31	1	

DFUE read telegram data				
Byte	**Format**	**Content**	**Meaning**	
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**	**Content**	**Meaning**	**Too**	
0	Integer		0x02	Telegram number		Telegram header
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		
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.

10.4.8 DFUE read/write Telegrams: ASCII Telegram 2

DATA Byte Area (ASCII) Controller -> PLC				
Byte	**Format**	**Content**	**Meaning**	**Tool[1]**
0	Integer	0x38	Joint number[2] (example: 0x38 = 56)	1st Tool group feedback
1	Bit	0x01	Not done	
		0x02	Torque OK	
		0x04	Angle OK	
		0x80	Reserve	
		0x10	Torque too high[3]	
		0x20	Torque too low[4]	
		0x40	Angle too high	
		0x80	Angle too low	
2	BCD, HB	0x06	Actual torque * factor 10 (BCD)[5] (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

Range of Values	
Actual torque (BCD)	0…999,9 Nm (if actual torque lower than zero, transmitted as zero)
Actual angle(BCD)	0…9999°

[1] 14 byte per tool
[2] 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.
[3] Sequence 15: Torque or breakaway torque too high.
[4] Sequence 15: Torque or breakaway torque too low.
[5] Sequence 15: Maximum torque for evaluation or, in case of 'TQ too low', minimum torque for evaluation.

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°

10.4.9 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			
Bye	**Bit**	**Error Content**	**Tool[1]**
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	
1	0x01	Not done	2nd Tool group feedback
	0x02	OK	
	0x04	NIO	

[1] 1 byte per tool

DATA Byte Area (SpiBitErg) Controller -> PLC			
Bye	**Bit**	**Error Content**	**Tool[1]**
	0x08	Hardware failure	
	0x10	Torque too high	
	0x20	Torque too low	
	0x40	Angle too high	
	0x80	Angle too low	
…n			nth Tool of group

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**	**Meaning**	**Tool[1]**
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)	

[1] 14 bytes per tool

DATA byte area (SpiByteErg) Controller -> PLC				
Byte	**Format**	**Content**	**Meaning**	**Tool[1]**
…n				nth Tool of Tool group

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**	**Meaning**	**Tool[1]**
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
…	…	…	…	

[1] 14 bytes per tool

DATA byte area (SpiByteLimits) Controller -> PLC				
Byte	**Format**	**Content**	**Meaning**	**Tool[1]**
22-23	Integer		Actual Torque * factor 10	
…n				nth Tool of Tool group

SpiFloatErg

Byte	Format	Content	Meaning	Tool
0	Float	0x66	Actual torque 0x4640E666 = 12345.6 Nm	1st Tool of Tool group
1	Float	0xE6		
2	Float	0x40		
3	Float	0x46		
4	Float	0x00	Actual angle 0x43960000 = 300 Degree	
5	Float	0x00		
6	Float	0x96		
7	Float	0x43		
8	Float	0x33	Actual gradient 0x3FD33333 = 1.65 Nm/Degree	
9	Float	0x33		
10	Float	0xD3		
11	Float	0x3F		
12-15	Float		Actual torque	2nd Tool of Tool group
16-19	Float		Actual angle	
20-23	Float		Actual gradient	
...	...	...	...	...
...n	...		...	nth Tool of Tool group

SpiFloatErgLimits

Byte	Format	Content	Meaning	Tool
0	Float	0x66	Actual torque 0x4640E666 = 12345.6 Nm	1st Tool of Tool group
1	Float	0xE6		
2	Float	0x40		
3	Float	0x46		
4	Float	0x00	Minimum torque 0x43960000 = 300 Nm	
5	Float	0x00		
6	Float	0x96		
7	Float	0x43		
8	Float	0x00	Maximum torque 0x46C35000 = 25000 Nm	
9	Float	0x50		
10	Float	0xC3		
11	Float	0x46		
12	Float	0x00	Actual angle 0x42700000 = 60 Degree	
13	Float	0x00		
14	Float	0x70		
15	Float	0x42		

Byte	Format	Content	Meaning	Tool
16	Float	0x00	Minimum angle 0x40A00000 = 5 Degree	
17	Float	0x00		
18	Float	0xA0		
19	Float	0x40		
20	Float	0x00	Maximum angle 0x44268000 = 666 Degree	
21	Float	0x80		
22	Float	0x26		
23	Float	0x44		
24-27	Float		Actual torque	2nd Tool of Tool group
28-31	Float		Minimum torque	
32-35	Float		Maximum torque	
36-39	Float		Actual angle	
40-43	Float		Minimum angle	
44-47	Float		Maximum angle	
...	...	...	...	...
...n	...		...	nth Tool of Tool group

10.4.10 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.

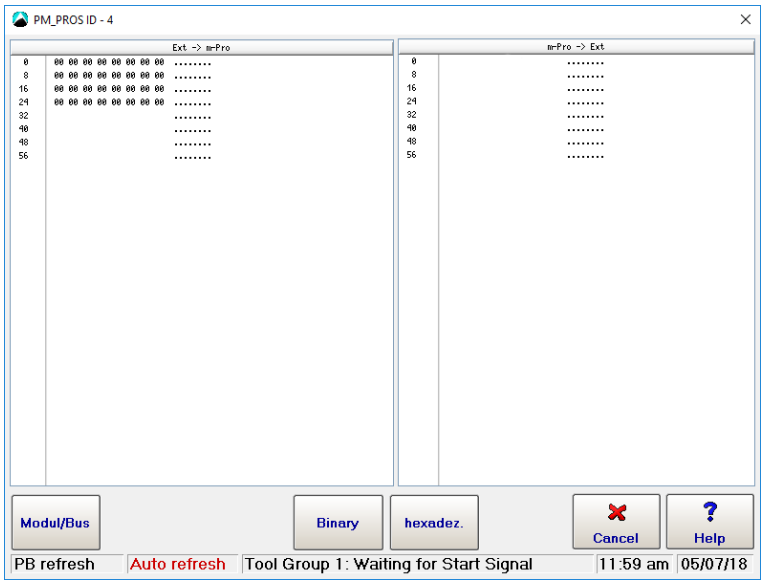


Fig. 10-6: Assigned input byte areas displayed in the Bus monitor

To check the byte areas assigned for a module:

1. Select *Navigator* > *Diagnostics* > *System*.
2. Tap the <Bus Monitor> button to open the *Bus Monitor* dialog.
3. Tap the <Module/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	• 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	• 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.

10.4.11 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**	**Meaning**
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	
...		....	

Telegram No. 001 – PLC -> Controller			
Byte	**Format**	**Content**	**Meaning**
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	
			Reserve	
			Torque too low	
			Angle too high	
			Angle too low	
4	BCD, HB	0x01	Actual torque	
5	BCD, LB	0x54		
6	BCD, HB	0x01	Actual Angle	
7	BCD, LB	0x54		
8	Float HB		Actual torque	
9	Float			
10	Float			
11	Float LB			
12	Float HB		Actual angle	
13	Float			
14	Float			
15	Float LB			
16	Integer	0x01	Joint number	Data set Tool 2
...				
29	Float LB		Actual angle	
30	Integer	0x01	Joint number	Data set Tool 3
...				
43	Float		Actual angle	

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
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	
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	MTQ 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	

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

11 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.

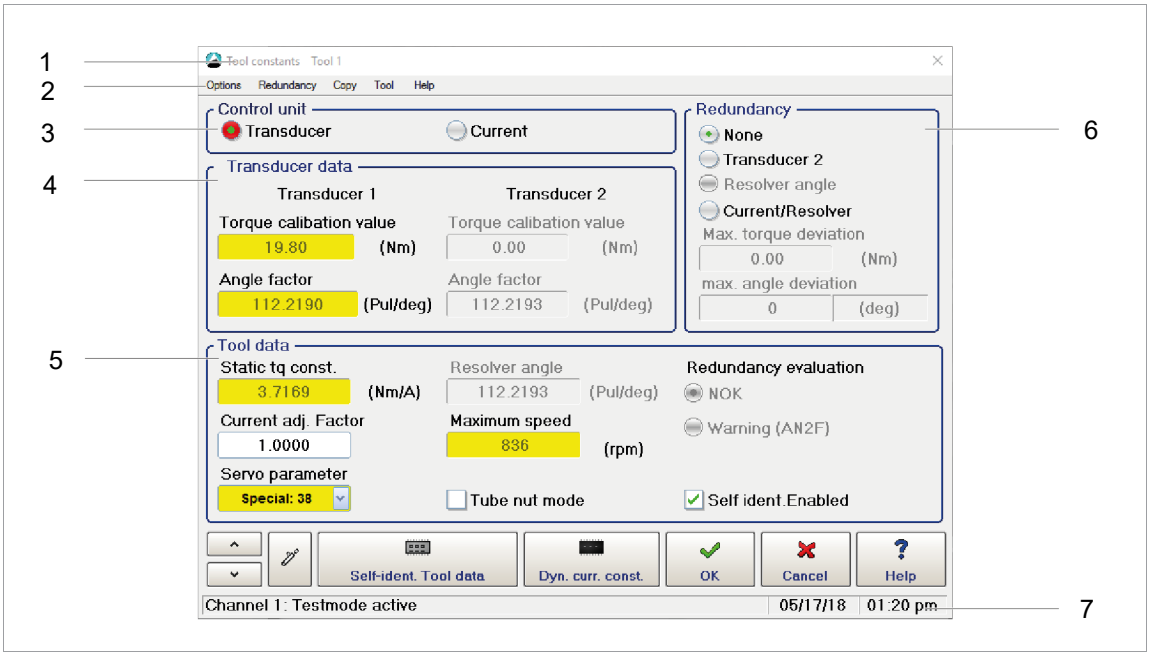


Fig. 11-1: The Tool constants screen

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	Status bar

To access the *Tool Constants* screen:

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

11.1 Control Unit

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

► Select *Options* > *Select Tool* or press the button.

The following options are available:

- Transducer
- Current

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

If *Current* 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.

11.2 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

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

11.3 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.
If a redundancy function is enabled, plausibility checks are also performed for Transducer 2 during programming.

► Use the controls in the *Redundancy* section of the *Tool Constants* screen to enable redundancy functions.

Redundancy options

- None: No redundancy
- Transducer 2: Torque and angle redundancy with Transducer 2
- 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 Transducer 2 or 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 Transducer 2 or between Transducer 1 and resolver angle that results in an OK evaluation of the fastening process.

Transducer 2

Connection of a second transducer for torque and angle (e.g., a second combined transducer in a modular spindle) allows for redundant measurement. When redundancy is active, the controls for *Transducer 2* and for *Maximum Torque Deviation* (torque and angle) are enabled.

Transducer 2 is the redundant or cross-checking transducer. For the input values, the same conditions apply as for Transducer 1.

Maximum Torque Deviation (torque and angle) defines the admissible difference in torque and angle between the two transducers. If one of these values is exceeded, an NOK evaluation results regardless of whether the second transducer is within or out of the torque or angle range of the fastening sequence.

Resolver Angle

With BL spindles, you can use redundancy without a second transducer because the servo can generate angle pulses from the resolver signals and send them to the measuring board. But the redundancy function is limited to the angle encoder in this case. The methods employed are the same as for redundancy with Transducer 2.

The resolver angle factor is provided on the name plate of the spindle or in a table of all angle factors.

Current/Resolver

Based on the motor current, equivalent torque information is generated. The resolver supplies additional angle information.

11.4 Transducer Data

Self-identification requires the TM software 960911-2.7 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.

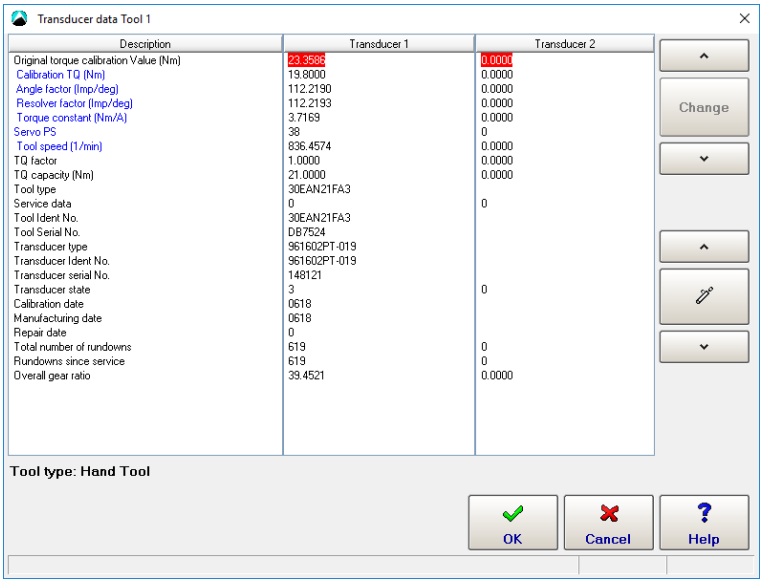
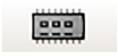


Fig. 11-2: The Transducer data screen for Tool 1

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 <Extended...> button to open the *Tool Constants* screen.
5. Tap the <Self-Identification Tool Data>.

Button	Description
	<Self-Identification Tool Data> opens the *Transducer Data* dialog.
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	This column lists the values for Transducer 2. If no second transducer is connected for the selected tool, zeros are displayed.

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	Conditionally editable

Individual data can be edited and changed. Changes directly influence the controller and quality of the rundown. 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 Torque (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 (rpm)	Not a directly editable value: changes automatically when you edit the value for Overall gear ratio
Torque Factor	For information only
Torque Capacity (Nm)	Serves as test value for the input of torques in the diagram screens and as a service for information
Tool Model	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 spindle 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 Identification Number	For information only
Tool Serial Number	For information only
Transducer Type	This must always be identical with the transducer code in the Tool type.
Transducer Identification Number	For information only
Transducer Serial Number	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 Rundowns	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

Change transducer data controls and dialog

► Use the <Change> button and the related ^ and v 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 v 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 and Transducer 2 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 button <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.

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.

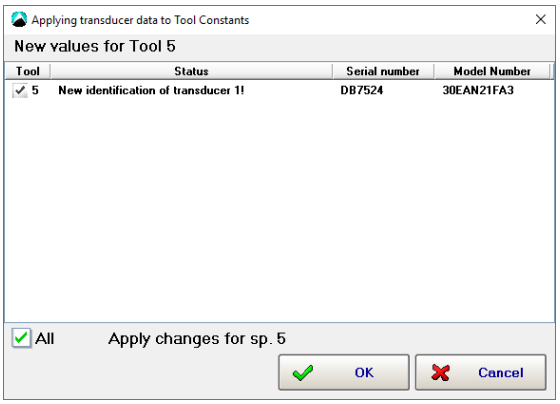


Fig. 11-3: The Applying transducer data to Tool Constants dialog with a status message for Tool 5

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

Explanation	Description
New identification of transducer 1! New identification of transducer 2!	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 Manual tool: Transducer 2 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 New transducer type 2	The new type differs from the stored transducer type.
Transducer 1 does not match the tool! 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??? 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.

11.5 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.

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.

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)
Transducer	Transducer 2	NOK or Warning (AN2F)
Current	Transducer 2	NOK or Warning (AN2F)

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.

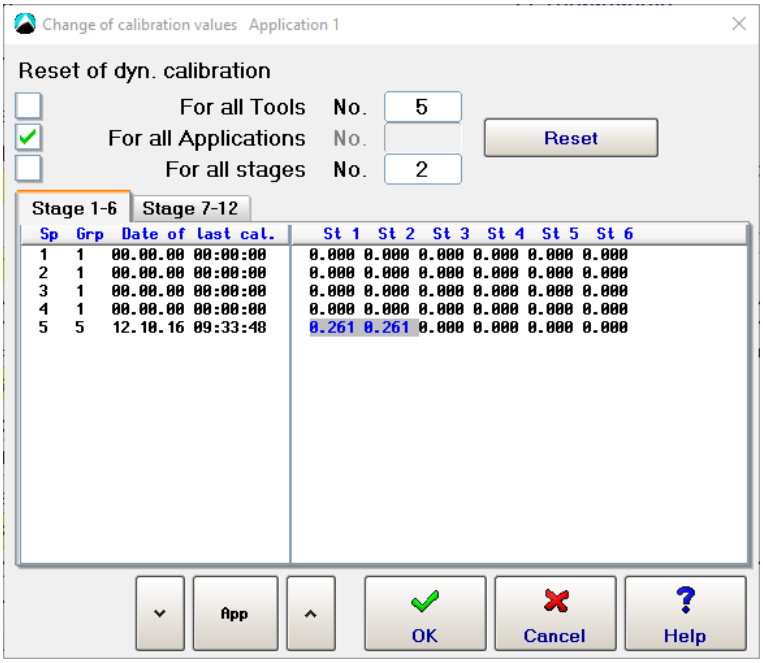


Fig. 11-4: Dynamic current constants calibrated for Stages 1 and 2 (St 1 and St 2) of Application 1, Tool 5 (Sp 5) To change Dynamic current constants:

Changing 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. Execute the required test rundowns.
5. Execute the required test rundowns.
6. Check the outcome of the dynamic current calibration in the *Current Calibration* window of the (select *Navigator > Diagnostics > Tool > Current Calibration*).

The following table explains how information is displayed in the *Change of Calibration Values* dialog:

Dialog window item	Description
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.
1.536 1.535	Blue text on gray background indicates values based on completed calibration.

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

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 X* > *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: ► *Navigator* > *Tool Setup* > *select a tool* > *Tool Settings* > *Advanced*.

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. For CellClutch tools, the status of the rundown is displayed with OK or NOK.
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 CF 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. For more information *see chapter 12.5 Statistics, page 182*.
	<Details> opens the *Tool Monitor* dialog, which provides additional details on the currently selected rundown. For more information *see chapter 12.1 Tool Monitor, page 179*.
	<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. For more information *see chapter 12.4 Filtering Archive Entries, page 180*.
	<Freeze> is displayed in the RAM Archive, which is updated after each rundown. 1. Press <Freeze> to prevent refreshing. 2. Press <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 Tool Monitor

The *Tool Monitor* 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	Description
Tl	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.

Column	Description
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. For more information *see chapter 12.2 Error Table, page 180*.
	<Oscilloscope> displays the *Oscilloscope*, which provides a torque curve for each rundown. For more information *see chapter 7.5 Torque Graph, page 80*.

12.2 Error Table

► Press 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.
A description of the errors *see chapter 16 Troubleshooting, page 224*.

Column	Description
SP	The tool which produced this rundown.
S	This fastening stage.
Error	Reason for shut-off in this stage if stage is NOK (error code).
Explanation	Reason for shut-off in this stage if stage is NOK (error message).

12.3 Torque Graph

Details *see chapter 7.5 Torque Graph, page 80*.

12.4 Filtering Archive Entries

► Tap the <Filter> button of the *Archive* dialog.

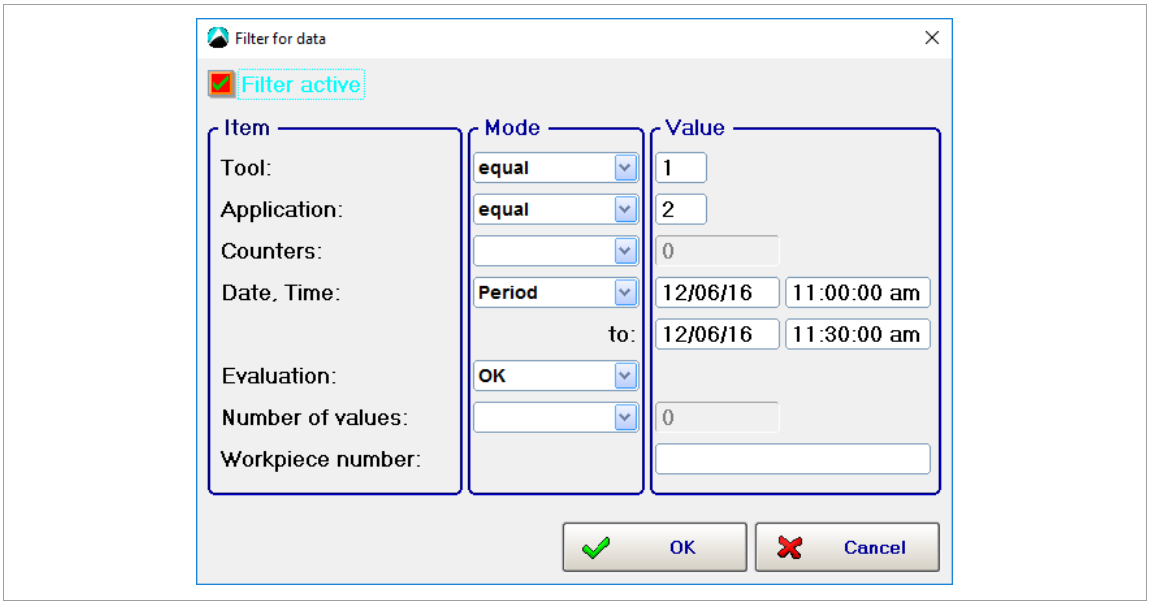


Fig. 12-1: Rundown Filter

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 • Value 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	Displays all rundowns whose application number is greater than that entered.
	less	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.
	Range	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.
Result		OK or NOK filter • If no option is selected, all rundowns are displayed.
	OK	Displays all OK rundowns.
	NOK	Displays all NOK rundowns.

Filter criteria		Description
Item	**Mode**	**Value**
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* > *Statistics*.

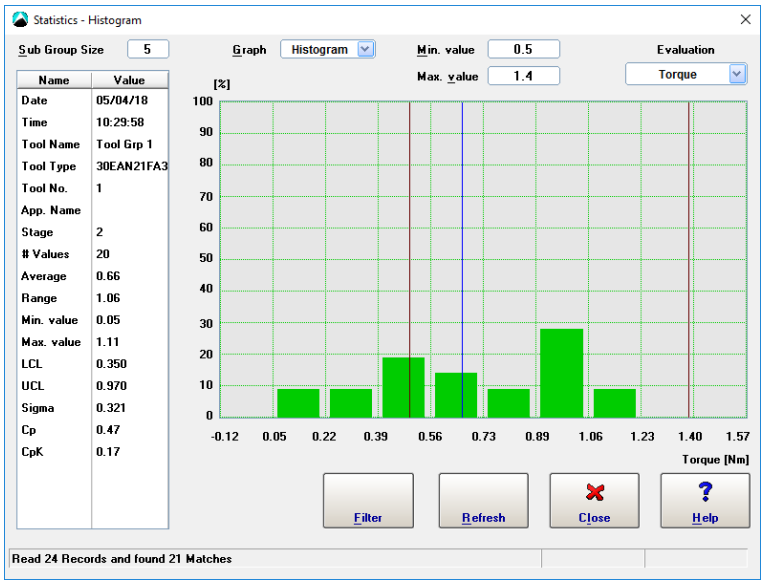


Fig. 12-2: Statistics dialog with a Histogram displayed

12.5.1 Defining Data Sets

The *Statistics Filter* dialog allows you to define rundown data sets for statistical analysis.

► Select *Navigator* > *Archive* > *Statistics* > *Statistics*.

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.
Minimum value Maximum 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.
Minimum value	The minimum value (torque, angle, or gradient) of all values considered.
Maximum 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 are used. Additionally, a control limits factor (A2 or D3) 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 are used. Additionally, a control limits factor (A2 or D4) 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: $LCL_{\bar{X}} = \bar{X} - (A2 \times \bar{R})$ 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: $S = \sqrt{\frac{1}{n-1}} \quad \frac{\Sigma}{i=1} \quad (X_i - \bar{X}^2)$
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. $C_{pK} = min \frac{(\bar{X} - USL, LSL - \bar{X})}{3 \times S}$

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

Control limits factors			
Subgroup size	**A_2**	**D_3**	**D_4**
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.

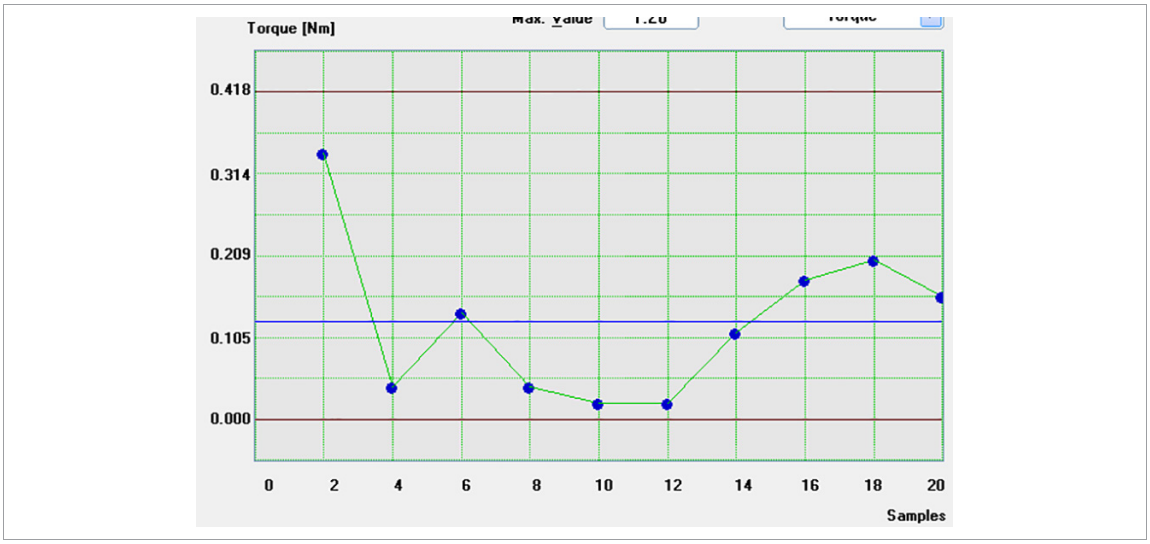


Fig. 12-3: Statistics – Range chart

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.

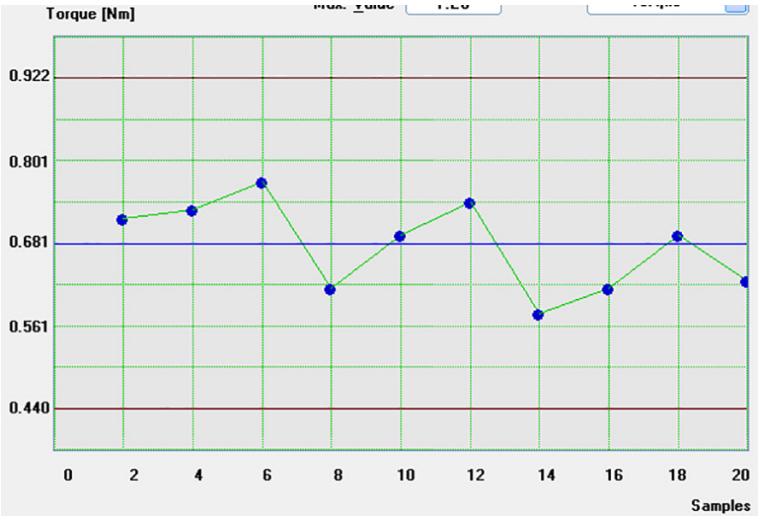


Fig. 12-4: Statistics – X-Bar chart

The center line is defined as $CL = \bar{X}$.

13 Diagnostics

The *Diagnostics* dialog provides access to features for monitoring, analyzing, and calibrating system components and tools used on the controller

► Select *Navigator* > *Diagnostics*.

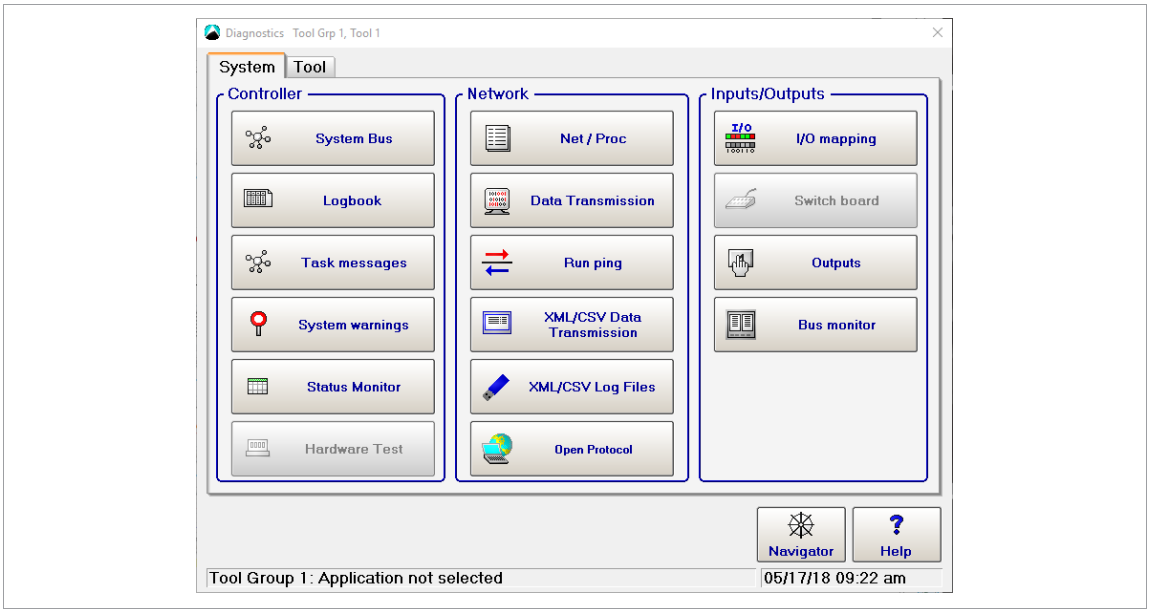


Fig. 13-1: Diagnostics

The *Diagnostics* dialog has *System* and *Tool* diagnostics features arranged on two tabs:

- The *System* tab has three sections: *Controller*, *Network* and *Inputs/Outputs*.
- The *Tool* tab has two sections: *Test Options* and *Miscellaneous*.

13.1 System Diagnostics – Controller

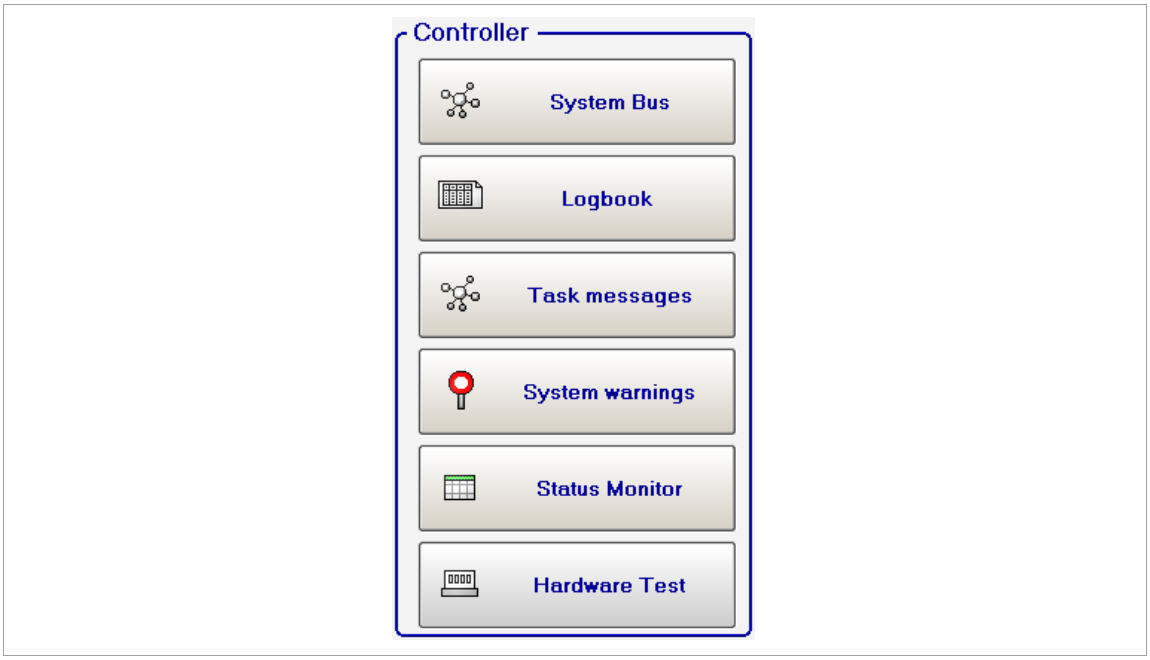


Fig. 13-2: Controller

13.1.1 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 *Navigator* > *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*). 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 (*Node*).

In addition to the current state of the System Bus map, a view of the programmed state of the System Bus map (*Program State*) and statistics of the communications on some System Bus participants are available (*System Bus Statistics*).

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 communication statistics of the current participant.

13.1.2 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*.

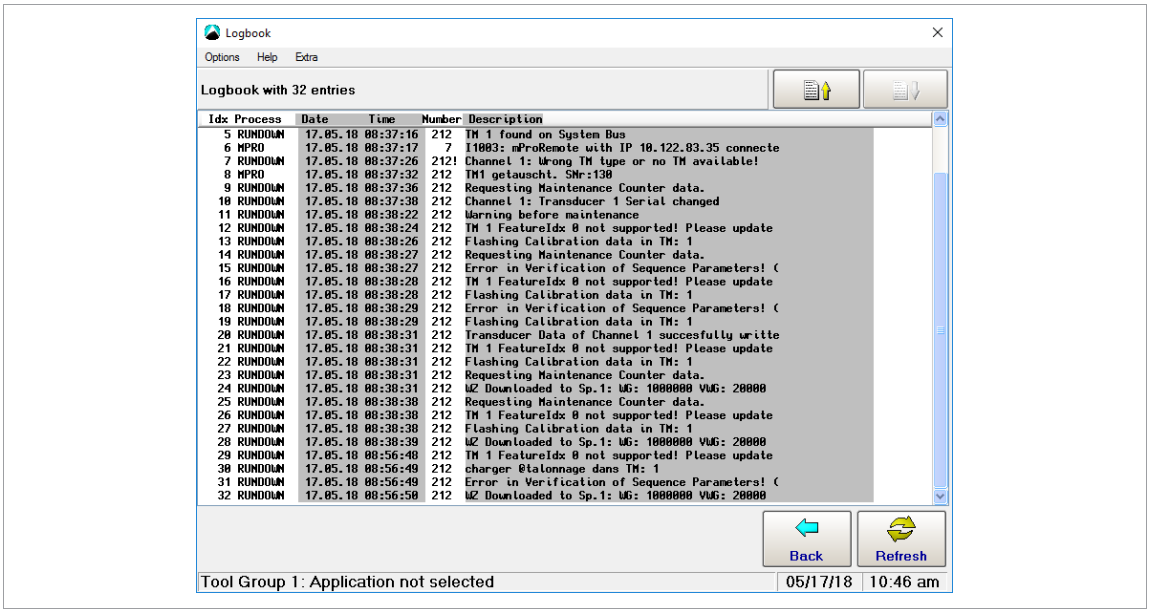


Fig. 13-3: Logbook

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.

13.1.3 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.

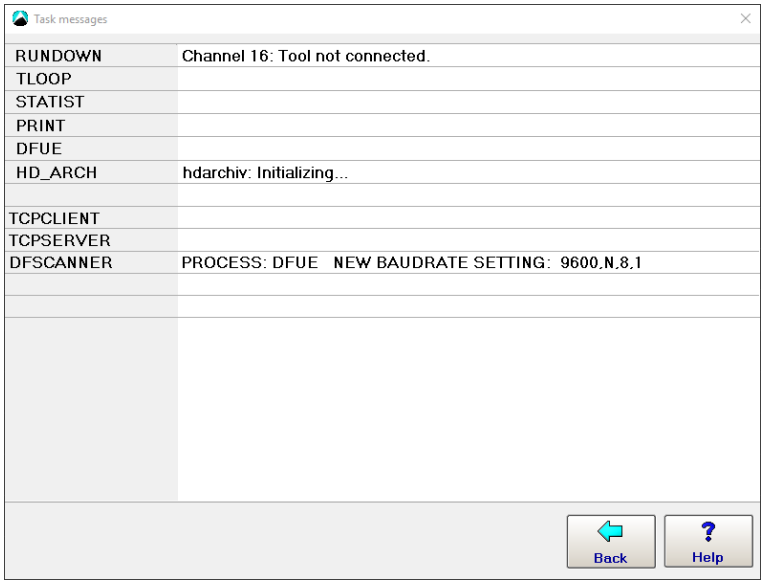


Fig. 13-4: Task Messages

13.1.4 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.

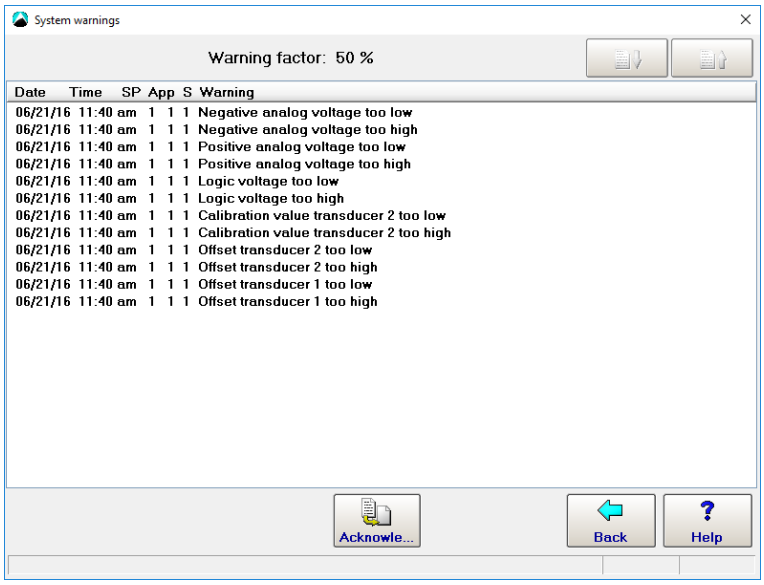


Fig. 13-5: System Warnings

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.

13.1.5 Status Indication

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.

13.1.6 Hardware Test

The Hardware Test features verify the functionality of various hardware components of the controller.

► Select *Navigator* > *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.

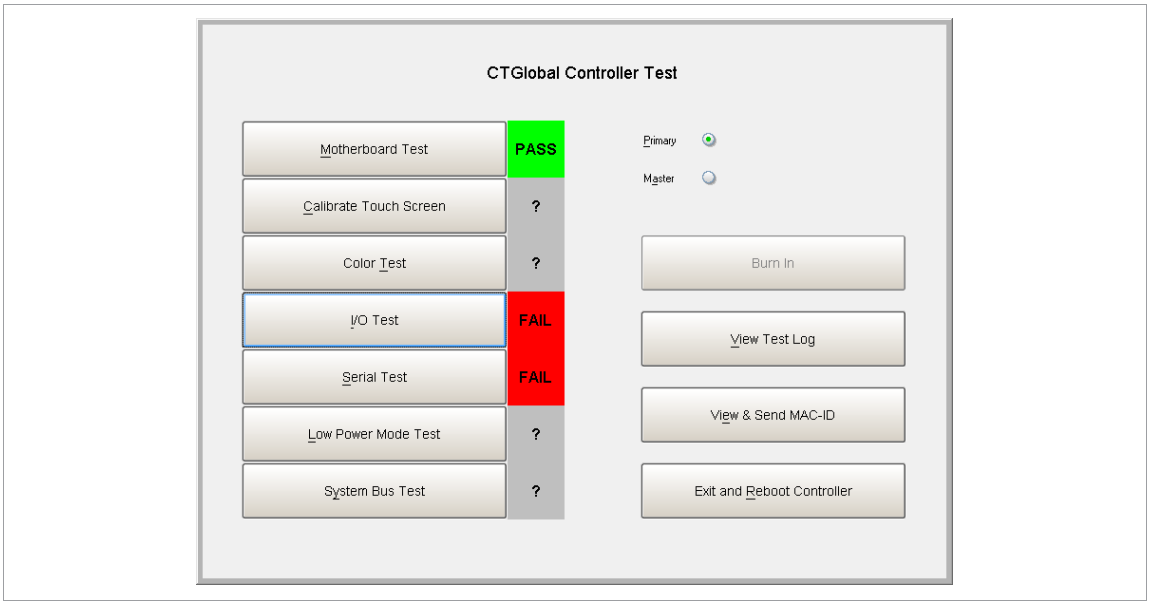


Fig. 13-6: Hardware Test

► 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 CF card.

13.2 System Diagnostics – Network

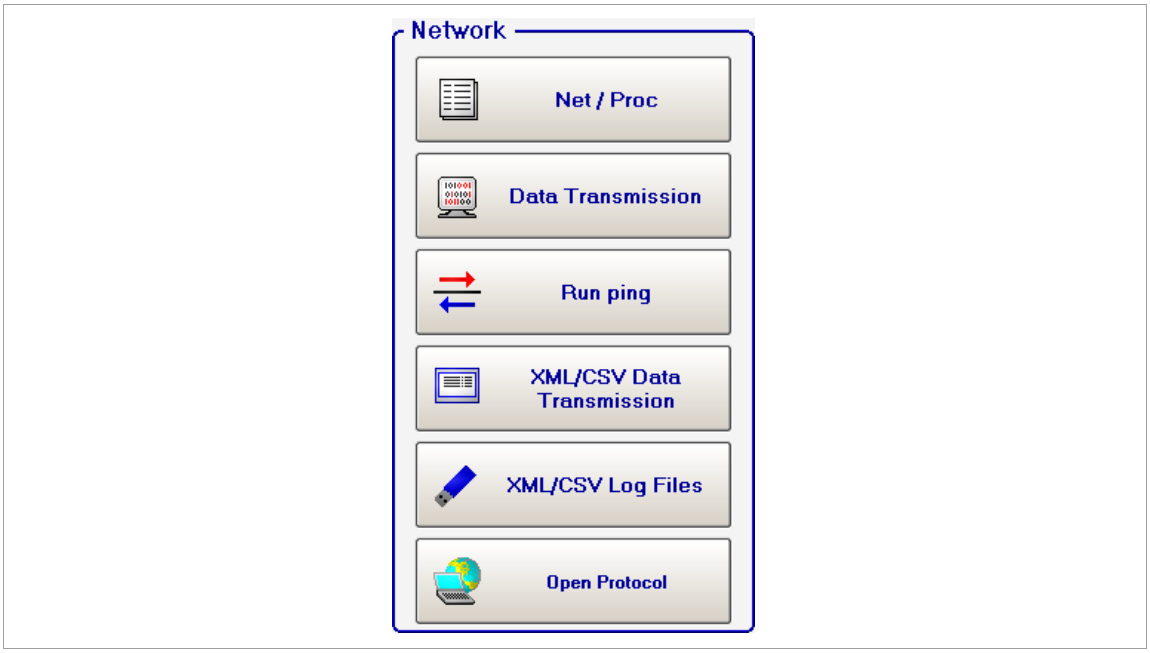


Fig. 13-7: Network

13.2.1 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* to display information on the disk space available on the CF card.
3. Select *XiLink Connections* tab to display remote connection information.

13.2.2 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*.

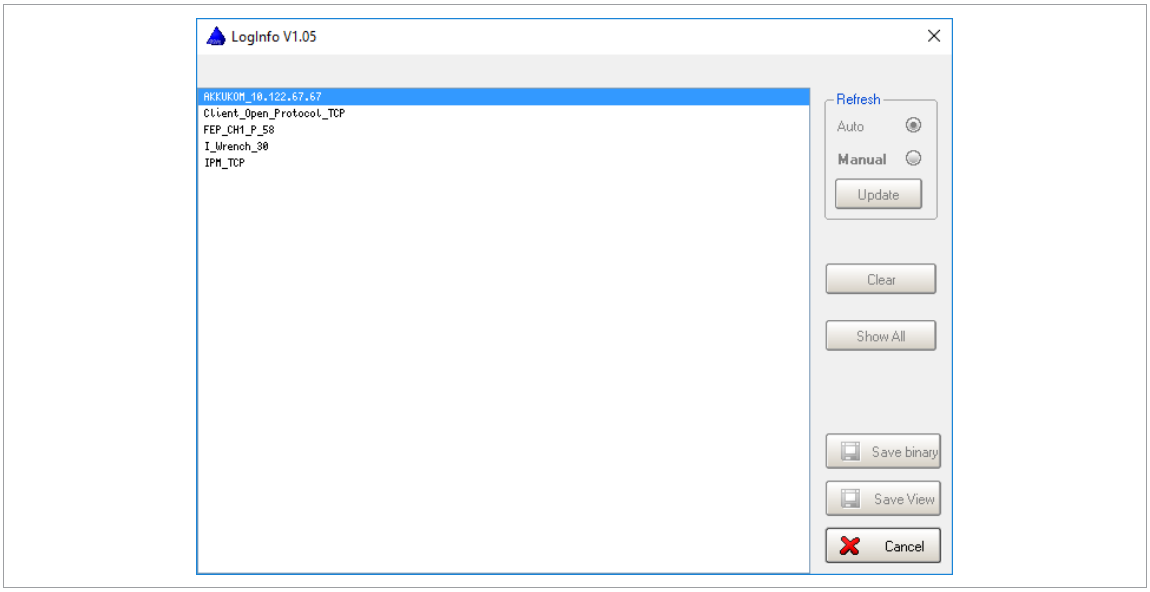


Fig. 13-8: Data Transmission

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.

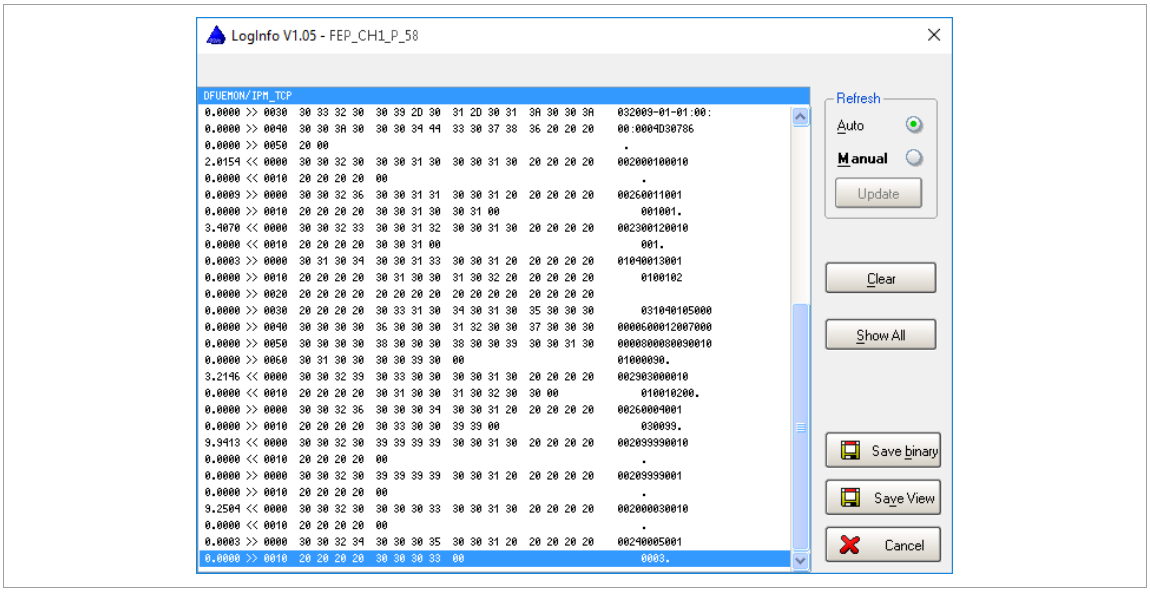


Fig. 13-9: LogInfo

2. Tap the <Manual> radio button to freeze the screen and read the current data record.
3. Tap the <Refresh> button to refresh the screen.

13.2.3 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* 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* dialog.
	<Back> closes the *Test Ethernet Connection* dialog.

13.2.4 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* > *Communication* > *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* ion from the drop-down menu.

The *Results* option displays detailed data and the stored file names:

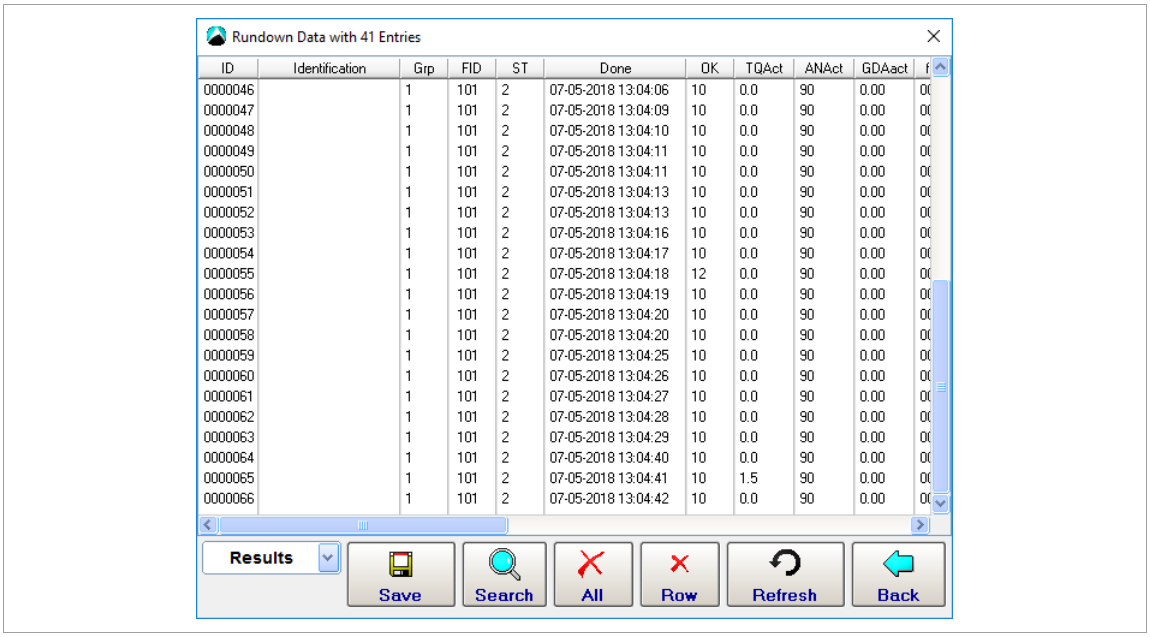


Fig. 13-10: Results

The *Lookup table* option displays fewer details and does not list stages:

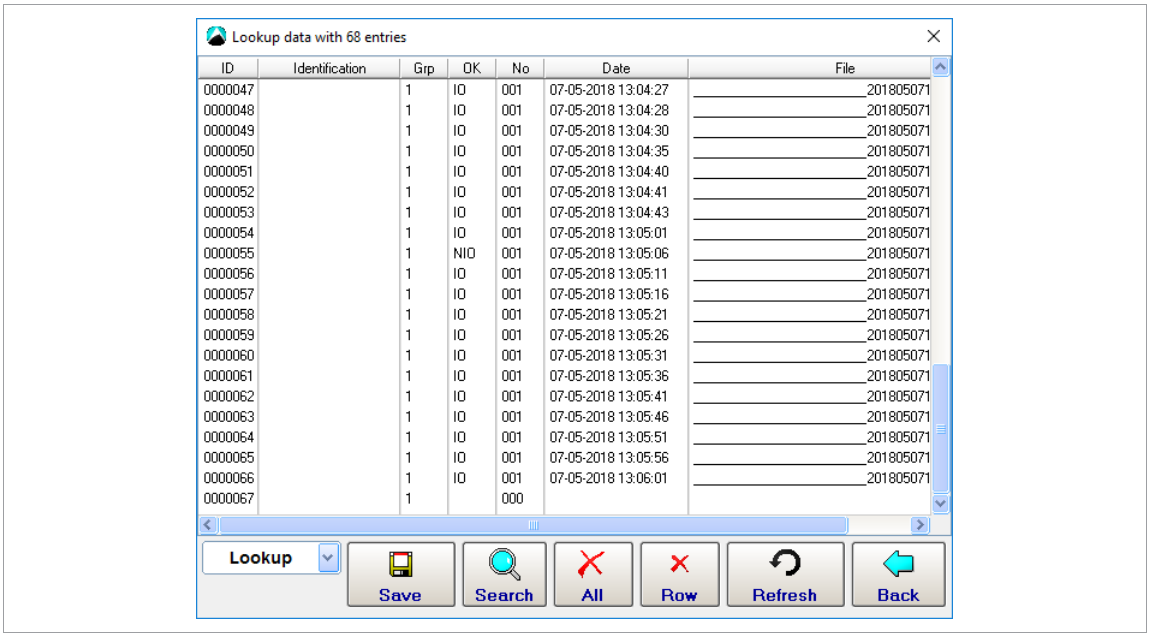


Fig. 13-11: Lookup table

13.2.5 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*.

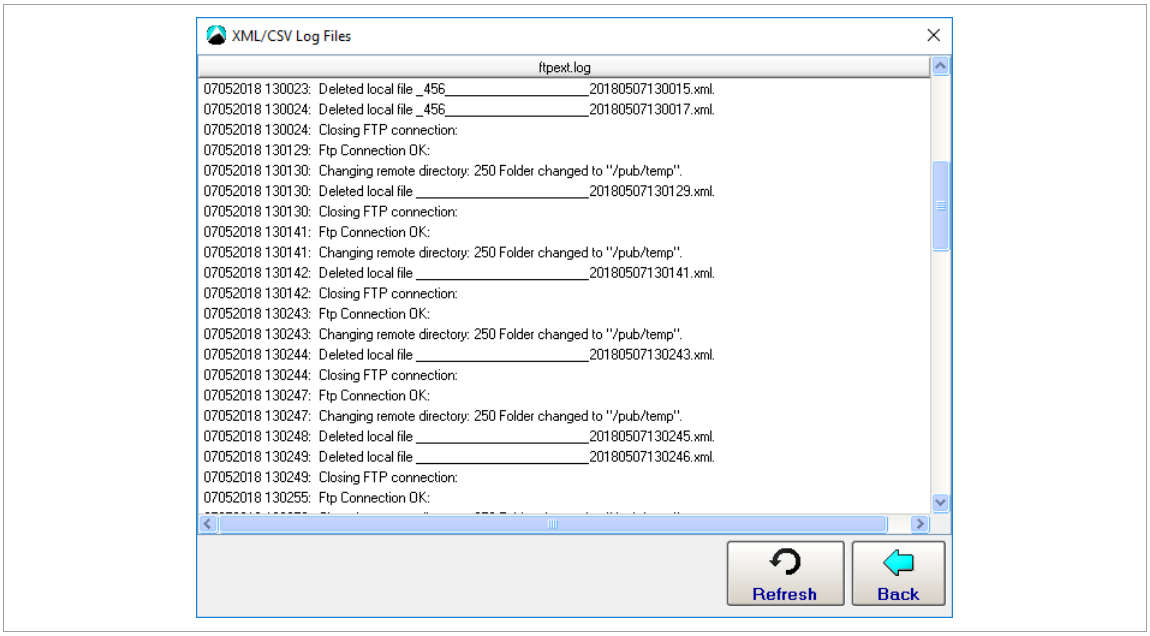


Fig. 13-12: XML/CSV Log Files

13.2.6 Open Protocol

The Open Protocol button provides access to the Tightening Parameter Server (TPS) Connection Status and Subscription Map. For additional information *see chapter 8.4.5 Tightening Parameter Server (TPS), page 127*.

13.3 System Diagnostics – Inputs/Outputs

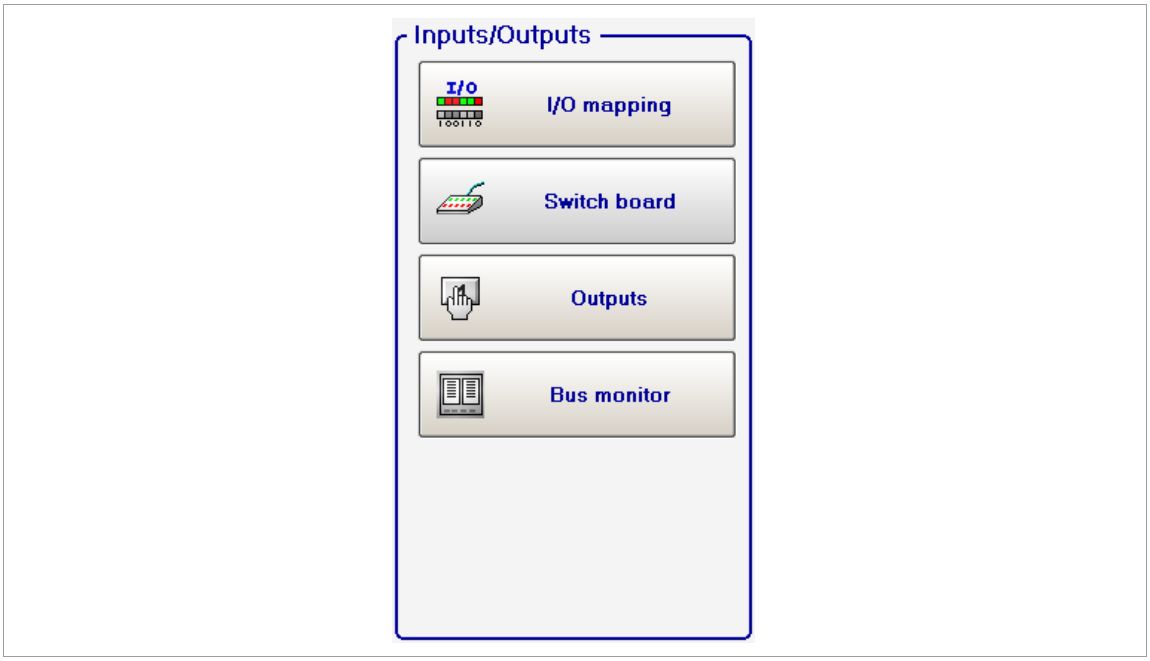


Fig. 13-13: Inputs/Outputs

13.3.1 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.

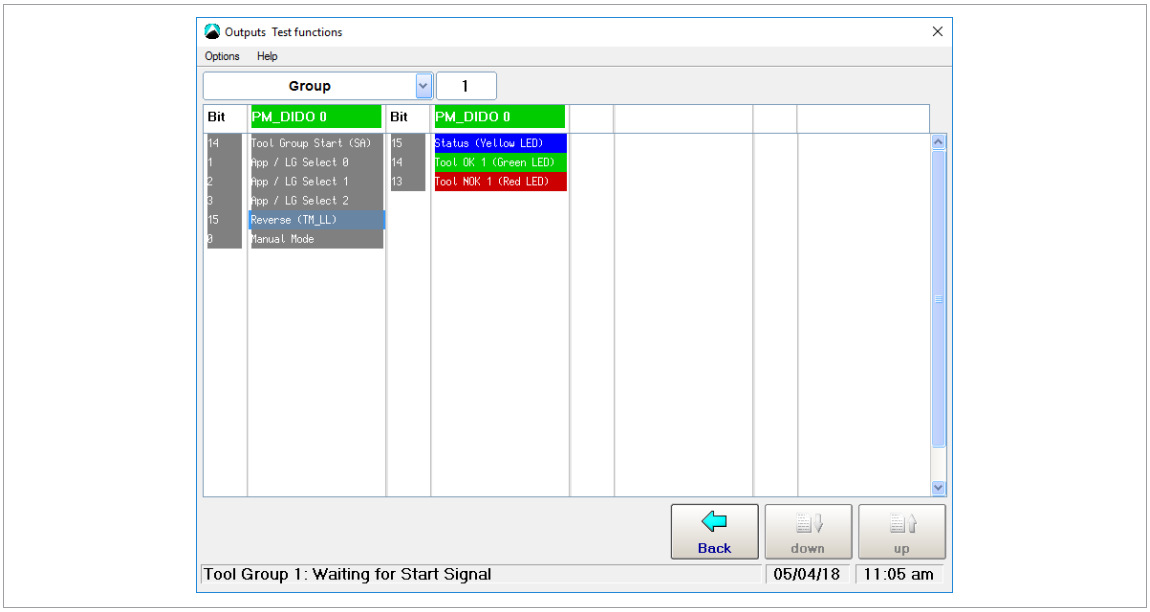


Fig. 13-14: I/O Process Map

13.3.2 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 *Switch Board* menu is used to assist during system setup and/or for troubleshooting and fault correction.

⚠ Caution

Mowing 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.

Note

Changed hardware outputs

Hardware outputs may change status after this function is terminated.

► Check status of hardware outputs.

► 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 *Navigator* > *Diagnostics* > *System* > *Switch Board*.
  ➢ 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.

13.3.3 Outputs

Outputs is used to assist during system setup and/or for troubleshooting and fault correction.

⚠ Caution

Mowing 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.

Note

Changed hardware outputs

Hardware outputs may change status after this function is terminated.

► Check status of hardware outputs.

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.

13.3.4 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 10.4.10 Check Byte Areas in the Bus Monitor, page 163*.

► Select *Navigator* > *Diagnostics* > *System* > *Bus Monitor*.

13.3.5 WLAN Socket Tray

The *Socket Tray Visualization* of displays the status of the WLAN connection, the battery voltage and the sockets and LEDs.

► Select *Navigator* > *Diagnostics* > *System* > *WLAN Socket Tray*.

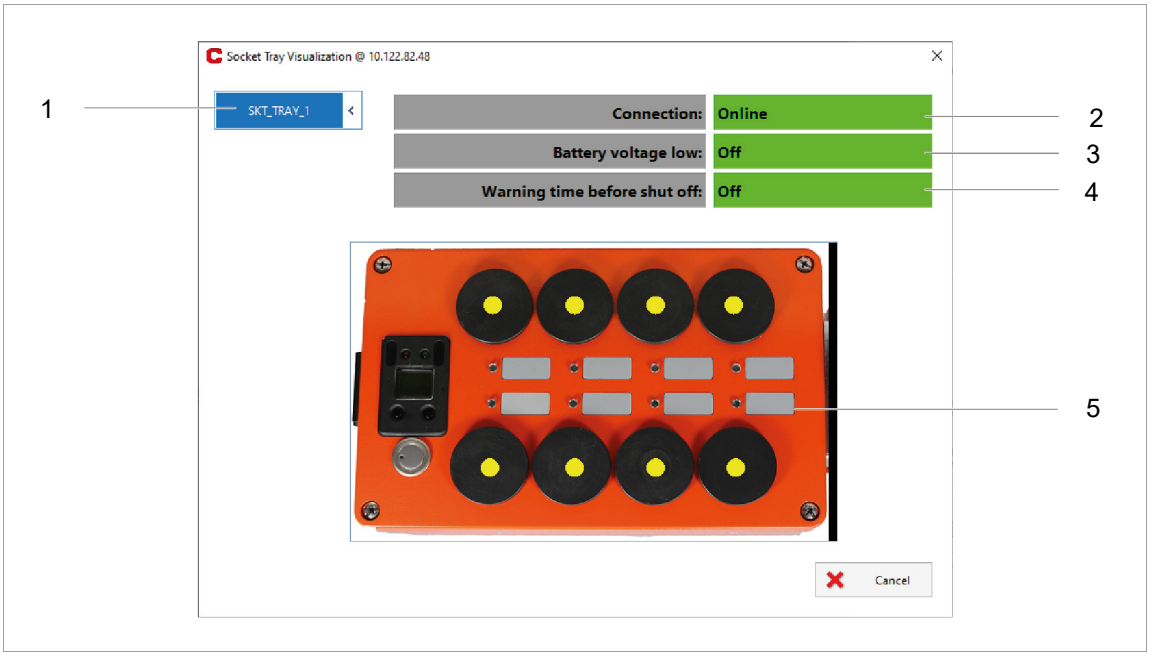


Fig. 13-15: WLAN Socket Tray Visualization

Item	Description
1	Up to 32 WLAN Socket Trays can be selected from the drop-down menu.
2	Shows the status of the connection between the WLAN Socket Tray and the controller: • Online: The WLAN Socket Tray communicates with the controller. • Not assigned: There is no connection. • Connection Timed Out: The connection was interrupted, e.g. because of the parameterized time period of Shut off after idle state of ... parameter (*see chapter 6.6.11 WLAN Socket Tray, page 75*). • Connected: The WLAN Socket Tray is connected but do not communicate with the controller.
3	Shows the status of the battery voltage of the WLAN Socket Tray: • On: If the battery voltage falls below the parameterized value, a warning is displayed. • Off: The battery voltage is above the parameterized value.
4	Shows whether the parameterized Warning time before shut off has been reached. The warning time begins when no socket change is carried out on the WLAN Socket Tray for more than the set time period. • On: The Warning time before shut off has been reached. If no change of socket is executed, the WLAN Socket Tray shuts off. • Off: The Warning time before shut off has not been reached and the WLAN Socket Tray remains switched on.
5	The status of the socket inserts and LEDs is shown on the figure of the WLAN socket tableau. Each insert that contains a socket is shown with a yellow dot. The LED display shows the respective operating and connection status, see document P2332BA.

13.4 Tool Diagnostics – Test Options

The Test Options are only active for corded tools. With cordless tools, the Test Options can be selected from the tool menu.

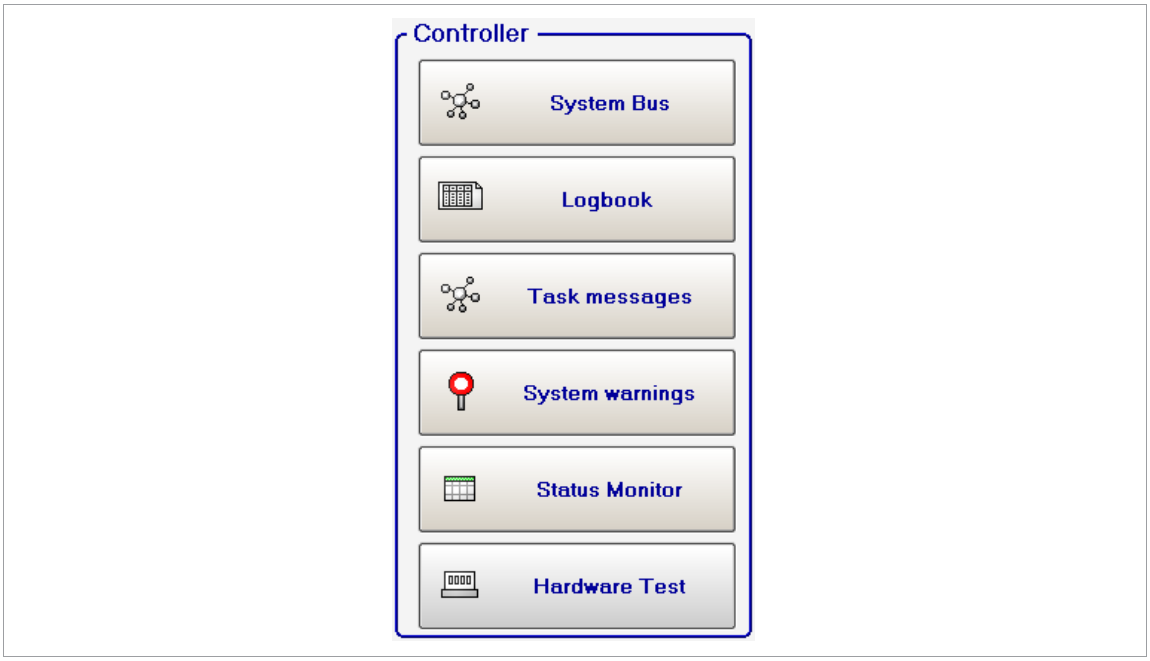


Fig. 13-16: Test Options

13.4.1 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 redundancy is active, it also displays the values of the second 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

13.4.2 Angle Encoder

This test function allows you to assess angle encoding.

► 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.

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.

If redundancy is active, the values of Transducer 2 are also displayed.
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. Example: Transducer 1 may show 360 degrees, while Transducer 2 shows 359 degrees.
- 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.

13.4.3 Voltage

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
Hand-held tools + BB spindles	Rated value	+5 V	+12 V	-12 V
	Tolerance	±0.3 V	±0.6 V	±0.9 V
BTS spindles	Rated value	+3.3 V	+12 V	+24 V
	Tolerance	+0.23 V/-0.06 V	±0.6 V	±3.6 V
NeoTek tools	Rated value	+3.3 V	+12 V	0 V
	Tolerance	±0.3 V	±0.6 V	±0.9 V
Cordless tools	Rated value	+3.3 V	–	–
	Tolerance	±0.17 V	–	–

13.4.4 TQ measurement

This test function allows you to assess torque measurements.

► Select *Navigator* > *Diagnostics* > *Tool* > *TQ Measurement*.

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.

13.4.5 Speed test

This test function allows you to assess tool speed.

► 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.

13.5 Tool Diagnostics – Miscellaneous

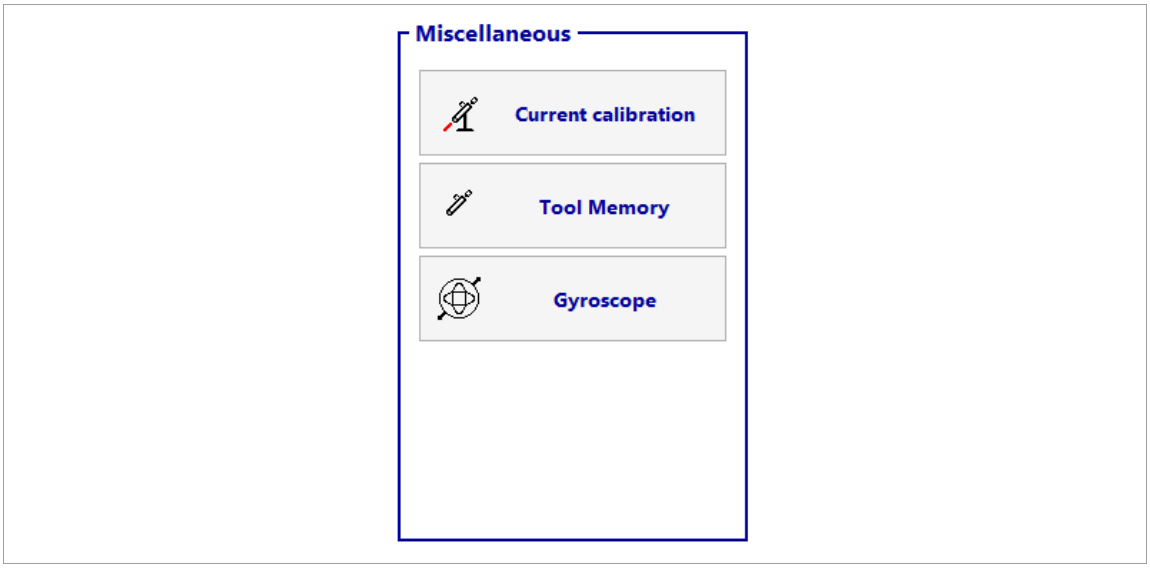


Fig. 13-17: Miscellaneous

13.5.1 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.
For more information on dynamic current constants and calibration, *see chapter 11.5 Current Calibration, page 175.*

Calibration Requirements

Conditions required for dynamic current calibration per application:

- The torque shut-off value is greater than 35 % of the transducer calibration value (the tool capacity with LiveWire tools).
- 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

Activate dynamic current calibration, *see chapter 11.5 Current Calibration, page 175*.

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:

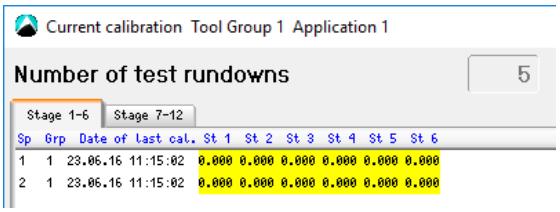


Fig. 13-18: Current calibration started

The dynamic calibration values are highlighted blue when the calibration has completed successfully:

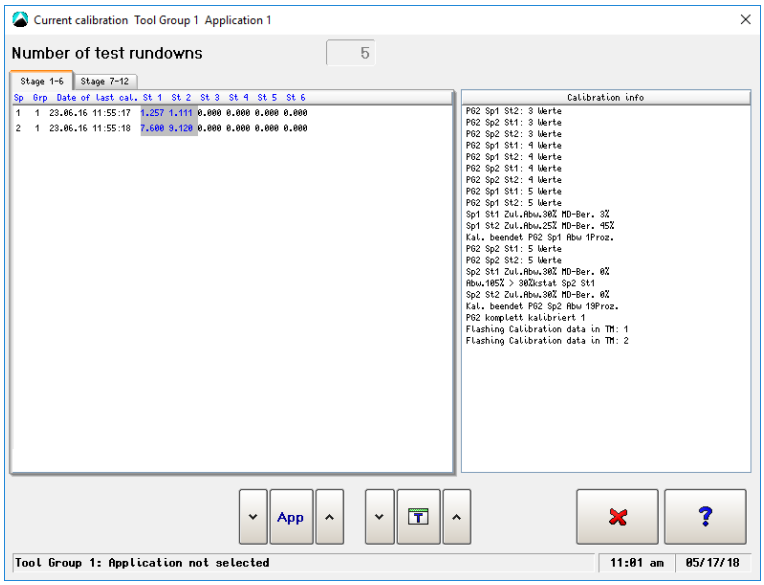


Fig. 13-19: Current calibration completed

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).

13.5.2 Tool Memory

The <Tool Memory> button opens the *Tool Memory* dialog. For more information *see chapter 11.2 Transducer Data, page 170*.

13.5.3 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.
Grad	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.

14 Utility

The *Utility* 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. Configure radio frequency (RF) LiveWire data communication.
Offline	Load and save parameters.

14.1 Carry Out a 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.

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.apextoolgroup.com/current-software-packages/mpro400gcd/*.

The storage device you access may contain any packages for different products, but only valid packages intended for the target unit are listed.

Software update

1. Select *Navigator* > *Utility* > *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. As soon as the following message is displayed, the installation process is complete.

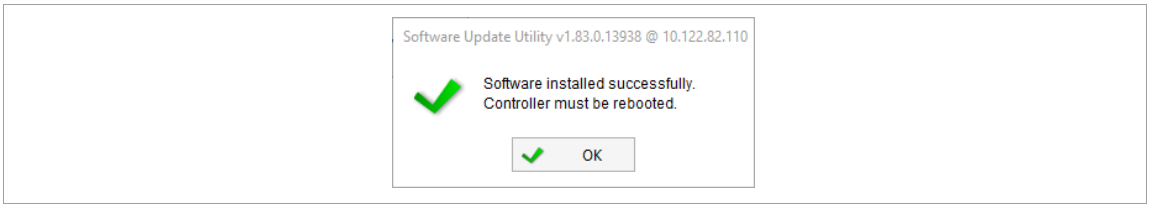


Fig. 14-1: Software update is completed

5. Restart the controller to adopt the software.

Package date/time information indicates when the package was created and its contents were collected and stored.

14.1.1 Software Update for Secondaries

The following applies to a software update of a secondary:

1. Perform a software update on all Secondaries belonging to a Primary, *see chapter 14.2.2 STMD-H Software Update, page 209*.

All Secondaries must have the same software version to ensure the compatibility and functionality with the Primary.

2. Perform a software update of the Primary.

14.1.2 Update Measuring Card Firmware of the Tightening Module (TM)

This procedure applies to firmware updates of tightening modules that are performed with a mPro400GC controller. For the procedure with a mPro400GCD controller *see chapter 14.2.2 STMD-H Software Update, page 209*.

Button	Description
<TM Measuring Card Firmware>	<TM Measuring Card Firmware> opens the *Software-Download* dialog, which allows you to select the tool(s) for which you want to install firmware.

Update measuring card firmware of the tightening module (TM)

1. Select *Navigator* > *Utility* > *Software Update*.
2. Press the <TM Measuring Card Firmware> button on the *Software Update* tab to open the *Software-Download* dialog.
3. Select the <Download to one Tool> button and enter the required *Tool No.*, or select the *Download to all Tools* radio button if you want to install firmware for all tools.
4. Press the <Read Disk> button to open the next dialog which allows you to navigate to the firmware you want to install. If you use the mPro-Remote program, the drives of remote computers are displayed in addition to the drives of the controller.
5. Select the correct file type to display the required files in the dialog, select the files, and press the <OK> button.
6. Before you start the download, make sure that the correct tool is selected.
7. Confirm the dialogs to install the firmware for the selected tool(s).

14.2 System Settings

The *System Settings* tab allows you to view system settings and to configure radio frequency (RF) data communication.

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.
Cordless Tools	<Cordless Tools> opens the *RF Settings* dialog, which allows you to configure the cordless tools.

14.2.1 Cordless Tools

Configuring RF settings

WLAN settings can be configured in the *Communication with tool* tab.

1. Configure WLAN settings. The possible settings are described below.

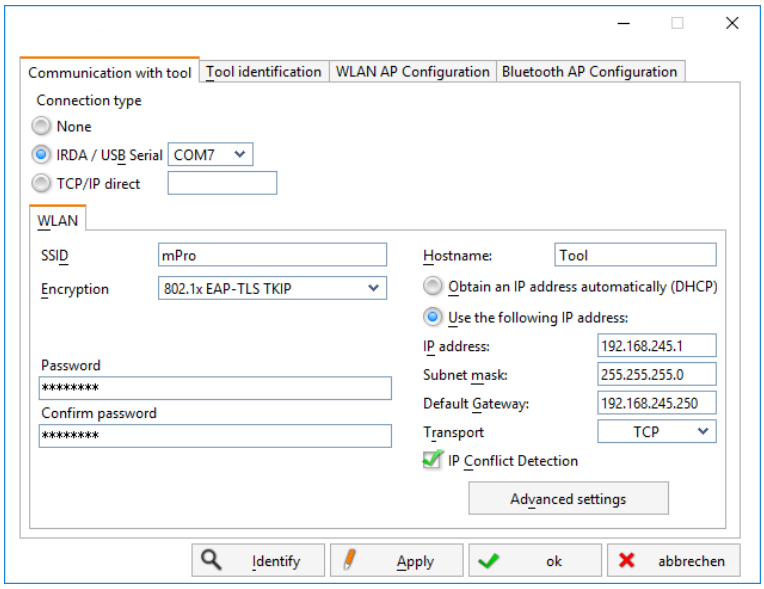


Fig. 14-2: Communication with tool tab

Parameter	Description
SSID	Enter SSID. SSID must be identical to the access point.
Encryption	Select security. *Encryption* must be identical with access point.
Network key	Enter the network key. The network key must be identical to the access point.
Confirm network key	Confirm network key.
Hostname	Optionally, a hostname can be entered.
Obtain an IP address automatically (DHCP)	Do not select this option. IP address is assigned automatically.
Use the following IP address	Enter IP address manually with the following parameters.
IP address	Enter the IP address. Using the mPro200GC-AP, the first three blocks of the IP address are permanently assigned and may not be changed: 192.168.245.xxx In the last block, numbers between 1 and 49 can be assigned as a static address.
Subnet mask	Enter the subnet mask. For the mPro200GC-AP, the default value is: 255.255.255.0
Default Gateway	IP address that is assigned by the access point. For the mPro200GC-AP, the default value is: 192.168.245.250
Transport	Select TCP.
IP conflict Detection	This setting is only available for LiveWire tools with the C2 or C3 measuring card. If the check box is selected, duplicate IP addresses are detected.

2. To set the radio channel, select <Advanced settings>.
   ➢ The *WLAN Advanced settings* window opens.

Parameter	Description
Wireless mode	Select WLAN mode: • Select 802.11b/g/n if a frequency band of 2.4 GHz is used. • Select 802.11a if a frequency band of 5 GHz is used.
5.2 GHz radio band (802.11a)	Select a frequency band. This setting is only possible if the 5 GHz frequency band has been selected.
Wireless channel	There are two setting options: • *Auto* The corresponding channel is automatically searched for. • The channels are unlocked and can be selected manually.
<Scan channels>	Scan radio channel. The button is not active if a channel is selected at *Wireless channel*. This function is not required when using the mPro200GC-AP, since only one channel can be selected.
Transmit power	Set transmission power.
Roaming Aggressiveness	Setting option, from which signal strength the tool connects with another access point. Select *Low* because the mPro200GC-AP has an integrated access point in the controller..
<OK>	Exit the input window, the settings are saved.
<Cancel>	Exit input window, the settings are not saved.

Read Tool Data

Tool data of the connected tool can be displayed in the *Tool identification* tab. If this tab is opened, the tool data is updated automatically.

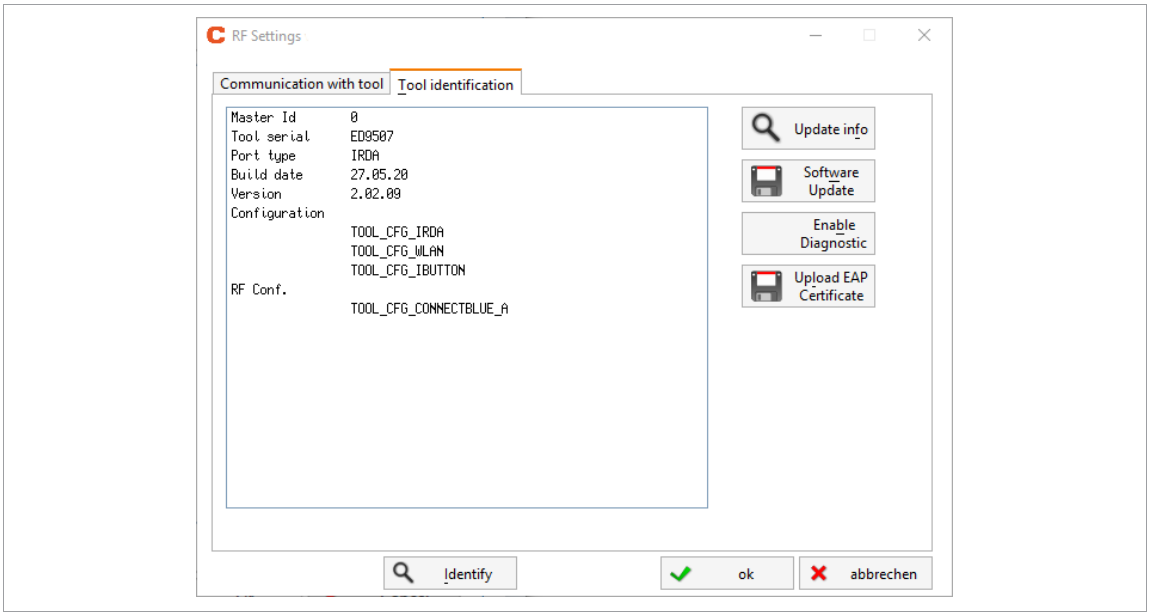


Fig. 14-3: Tool identification

Parameter	Description
Master Id	ID of the controller.
Tool serial	Serial number of the tool.
Port type	Currently used port.
Build date	Build date of the tightening module software (TMA software).
Version	Version of the TMA software.
Configuration	In the tool integrated hardware.

Parameter	Description
RF Conf.	Designation of the radio module hardware in the tool.
<Identify>	Updates the view of the tool data in the tab *Tool identification*.
<Update info>	Updates the view of the tool data.
<Software Update>	Change the software on the tool.
<Enable Diagnostic>	Activate the tool-menu. To activate the tool-menu following the instructions: 1. Press <Enable Diagnostic>. 2. Confirm the following message with <ja>. 3. Confirm the messages **Configuration done!** with <ok>.
<Upload EAP Certificate>	Download an EAP-certificate to the tool.
<ok>	Finish the `Cordless RF Settings`. The settings are saved.
<abbrechen>	Finish the `Cordless RF Settings`. The settings are not saved.

Configuring the access point

In the factory setting, the IP address and the subnet mask of the controller are specified with a default value (Ethernet 1):

Parameter	Default value
IP address	192.168.100.200
Subnet mask	255.255.255.0

Note

IP address conflict

The 200 Series controllers have a factory default IP address of 192.168.100.200. If multiple controllers are connected to the same network without changing the original IP address, an IP conflict occurs.

► Assign a new, unique IP address to each controller.

Configuring the access point

1. Connect laptop/PC directly to the controller via an Ethernet cable.
2. Start `mProRemote Professional` on the Laptop/PC.
3. Enter the IP address 192.168.100.200 in the *Remote Control* tab in the *Target* input field.
4. Press *Remote (TCP/IP)*.
   - ➢ A connection to the controller is established.
   - ➢ The user interface of the controller opens on the laptop/PC.
5. Select *Navigator* > *Utility* > *System Settings* > *Cordless Tools*.
6. Open the *WLAN AP Configuration*.
7. Carry out the desired settings for the configuration of the access point.
8. Press <Apply> to save the changes.

This tab is only displayed for the series mPro200GC(-AP) controller.

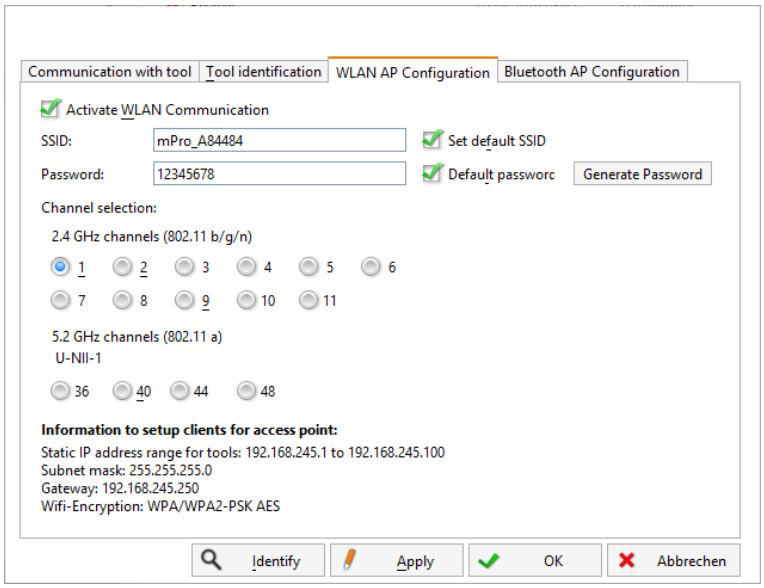


Fig. 14-4: WLAN AP Configuration tab

Parameter	Description
Activate WLAN Communication	If the checkbox is activated, WLAN is enabled on the controller. ➢ The bluetooth function is deactivated.
SSID	Enter the SSID for the WLAN name (access point) to which a connection is to be established.
Set default SSID	If the *Set default SSID* checkbox is activated, then a default value for the SSID is assigned.
Password	Enter the password for the access point. The default password is visible. As soon as a new password is assigned, asterisks * are displayed instead of numbers.
<Generate Password>	Press <Generate Password> to generate any eight-digit password.
Default Password	If the *Default Password* checkbox is activated, then the default password is displayed.
Channel bands	Select the frequency band. Only one channel can be selected. The following may be selected: • 2.4 GHz • 5.2 GHz
2.4 GHz channels (802.11 b/g/n)	Select channel. Only one channel can be selected. Only active if the 2.4 GHz frequency band has been selected.
5.2 GHz channels (802.11 a)	Select channel. Only one channel can be selected. Only active if the 5.2 GHz frequency band has been selected.
Information to setup clients for access point	Access point information: • Range of IP addresses for tools • Subnet mask • Gateway • WLAN encryption
<Identify>	Update the view of the WLAN settings.
<Apply>	Save the settings.
<OK>	Exit software, the settings are saved.
<Cancel>	Exit software, the settings are not saved.

Configuring Bluetooth settings

This tab is only displayed for the series mPro200GC(-AP) controller.

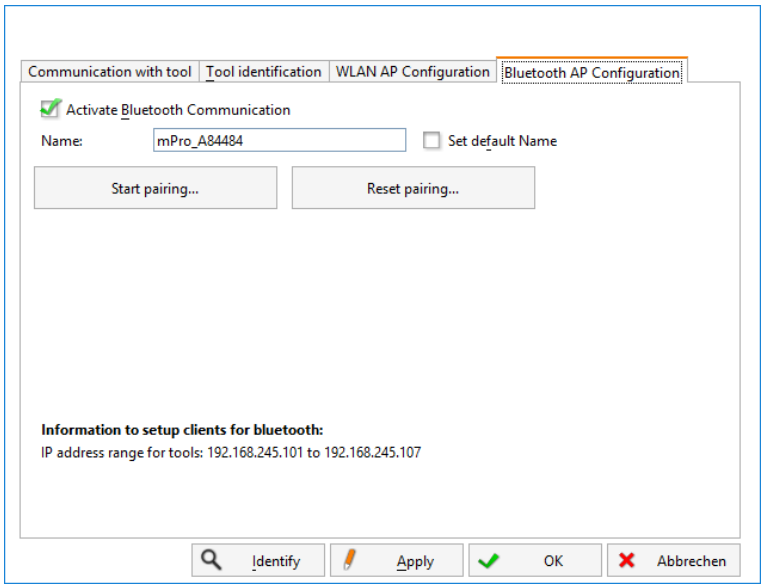


Fig. 14-5: Bluetooth AP Configuration tab

In the *Bluetooth AP Configuration* tab are the following adjustment possibilities:

Parameter	Description
Activate Bluetooth Communication	If the checkbox is activated, bluetooth is enabled on the controller. ➢ The WLAN function is deactivated. If WLAN was previously activated, the message **WLAN will be disabled** appears.
Name	Enter the name by which the control is displayed on the tool.
Set default Name	the checkbox *Set default Name* activated, a default value is assigned for the name.
Start pairing...	Press to visualize the controller for a bluetooth connection to the tool. ➢ The following message indicates if the operation was successful.
Reset pairing...	Press to disconnect the bluetooth connection between the controller and the tool. ➢ The following message indicates if the operation was successful.
Information to setup clients for bluetooth	Information about possible IP addresses for tools. To establish a bluetooth connection, the IP address of the tool must be within the specified range.
<Identify>	Update the view of the WLAN settings.
<Apply>	Save the settings.
<OK>	Exit software, the settings are saved.
<Cancel>	Exit software, the settings are not saved.

14.2.2 STMD-H Software Update

This procedure applies to software updates of tightening modules (STMD-H) that are performed with a mPro400GCD controller.

1. Copy the STMD-H software to an USB flash drive and insert it to the controller.
2. Select *Navigator* > *Diagnostics* > *System Bus* to display an overview of all System Bus participants.
3. In the *Node* column, determine the channel number of the STMD-H for which a software update is to be performed.

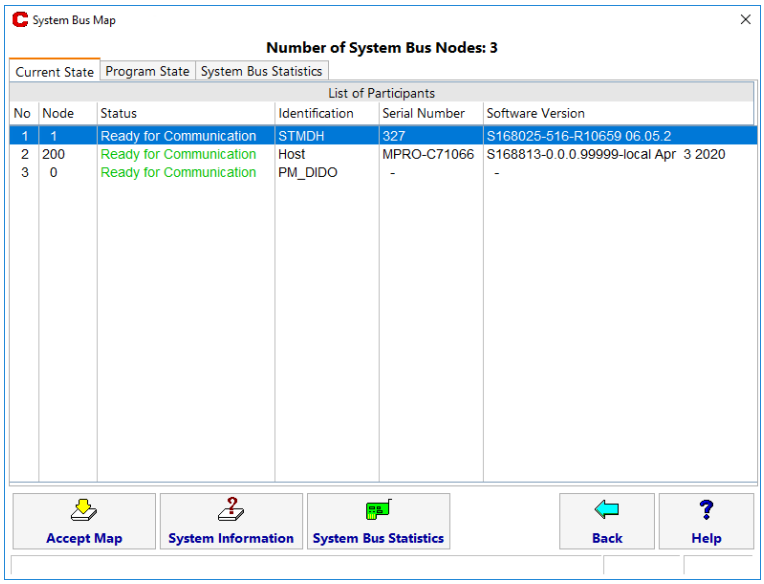


Fig. 14-6: System Bus Map

4. Select *Navigator* > *Utility* > *System Settings* > *Cordless Tools* to open the *RF Settings* dialog.

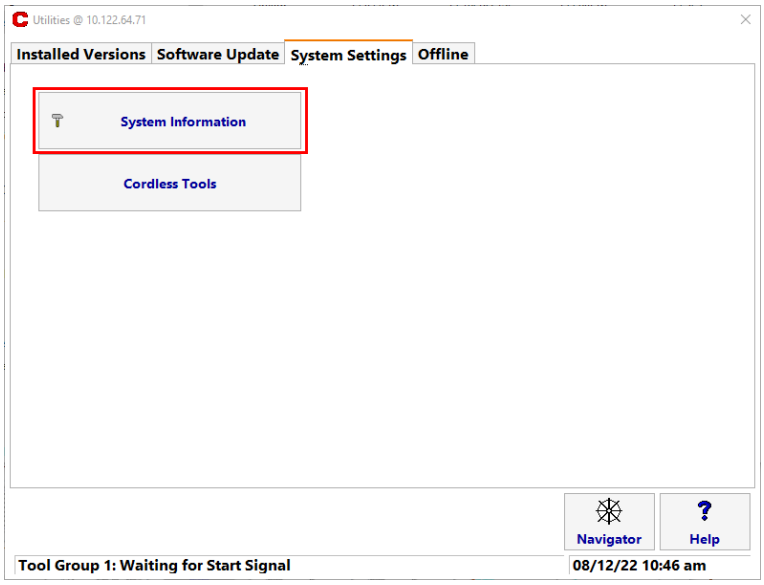


Abb. 14-7: Button to open RF Settings

5. Take the following settings on the *Communication with tool* tab:

Parameter	Setting
Communication type	Select *None*.
RF Connection	Set *RF Gateway IP* to the required STMD-H channel number (192.168.245.XXX). Example: a) Channel 1 = 192.168.245.1 b) Channel 4 = 192.168.245.4
RF Mode	Select *LAN*.

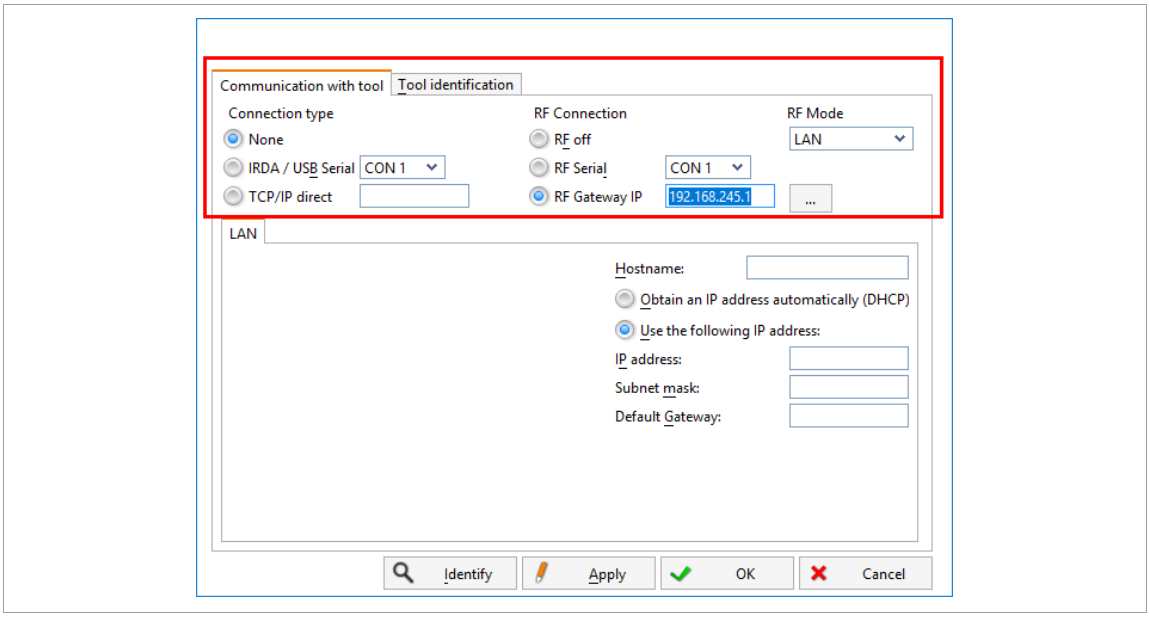


Abb. 14-8: Communication with tool

6. Open the *Tool identification* tab.
   ➢ The version and build date of the currently installed software is displayed.
7. Press <Software Update> and confirm the following messages with <Yes>.

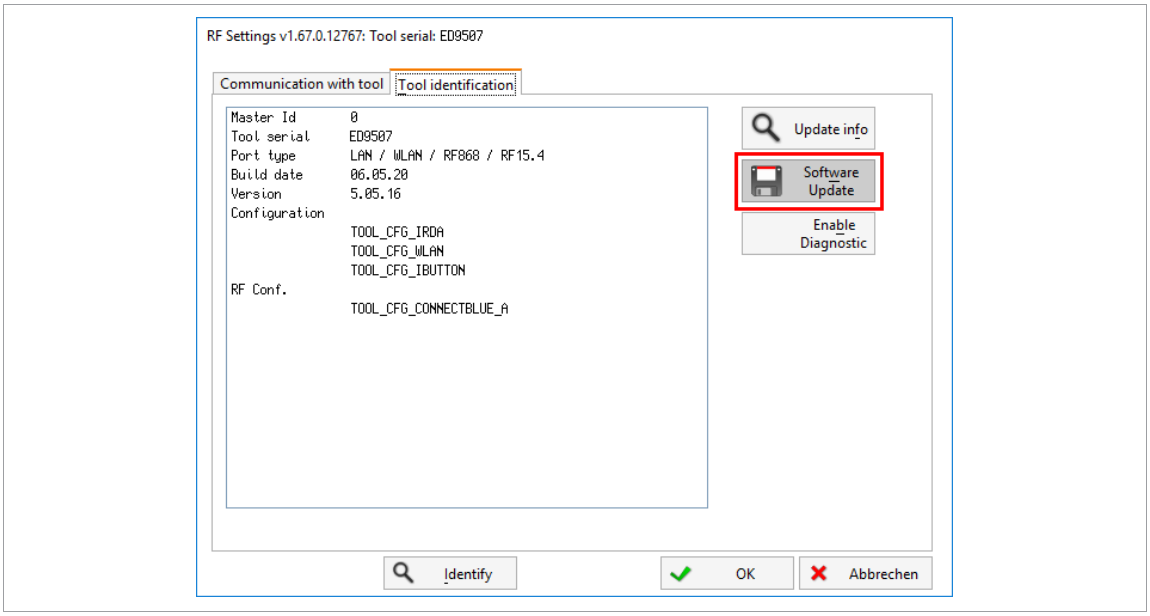


Fig. 14-9: Tool identification

8. Select the `*.tma` software file and confirm with <OK> to start the update process.
   ➢ The *Tool identification* tab displays the version and build date of the new software and the status of the update.

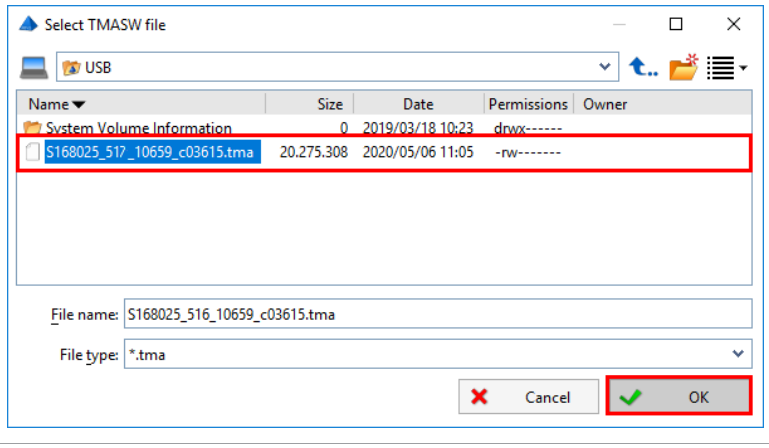


*Fig. 14-10: Select *.tma software file*

Note

Do not switch off the system after software update is completed.
The software update of STMD-H with versions older than S168025-515 or newer than S168025-516 the software update takes up to two and a half minutes.
The software update of a STMD-H from version S168025-515/S168025-516 to S168025-517 (or newer) takes about ten minutes.

► Wait until the software update is completely finished. This can take several minutes.
As soon as **SW update done!** is displayed, the STMD-H starts performing the software update in background. **Do not switch off the system!** The updated STMD-H restarts automatically. To check the completion of the software update, go to *Navigator* > *Diagnostics* > *System* > *System Bus* and wait up to ten minutes until the STMD-H has restarted and displayed in the System Bus Map.

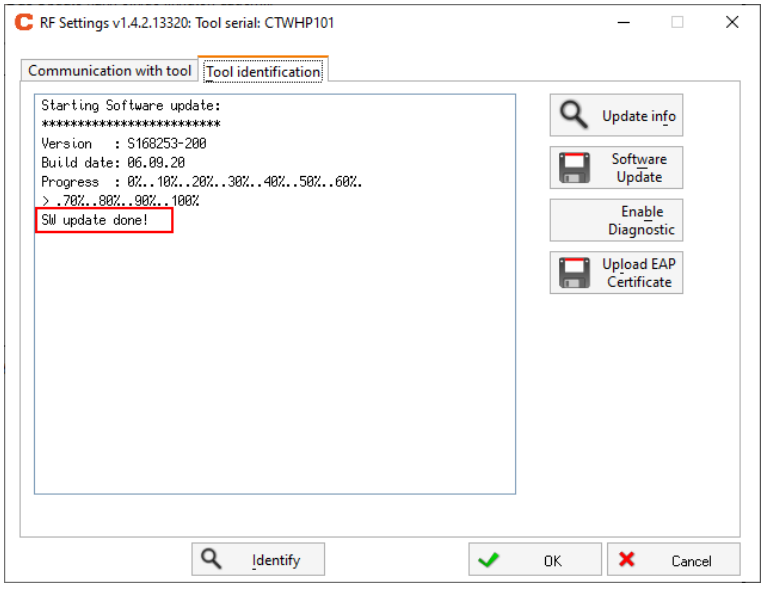


Fig. 14-11: Message „Software update done!“

If the transmission of the software fails, you will need to retry the update. If the transmission continues to fail, contact a *Sales & Service Center* see backside.

9. To leave the dialog press <Cancel> and confirm the message **Do you really want to leave the configuration?** with <Yes>. The dialog can be left as soon as the message **SW update done!** is displayed.
10. Select *Navigator* > *Diagnostics* > *System* > *System Bus* and wait until the updated STMD-H with the correct software version is visible in the table. This can take several minutes!

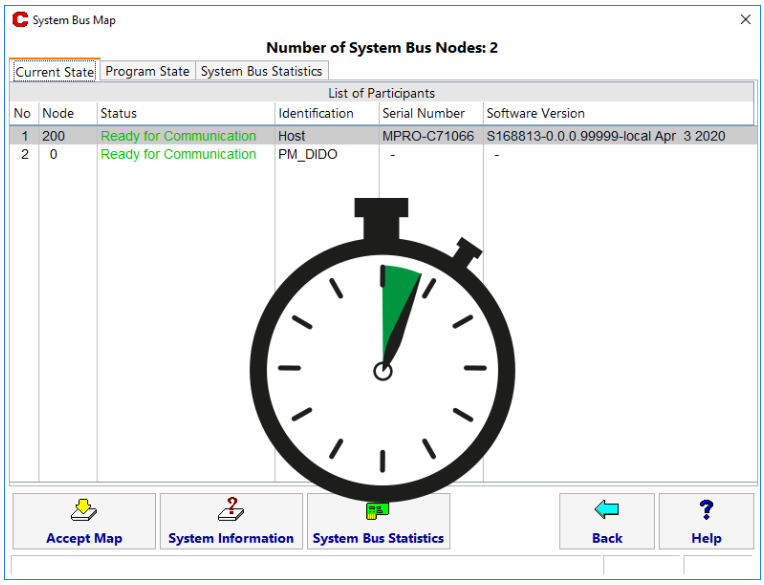


Fig. 14-12: Waiting time until the updated STMD-H appears in the System Bus Map

11. Select the entry and press <Accept Map> to add the STMD-H to the *System Bus Map* again.

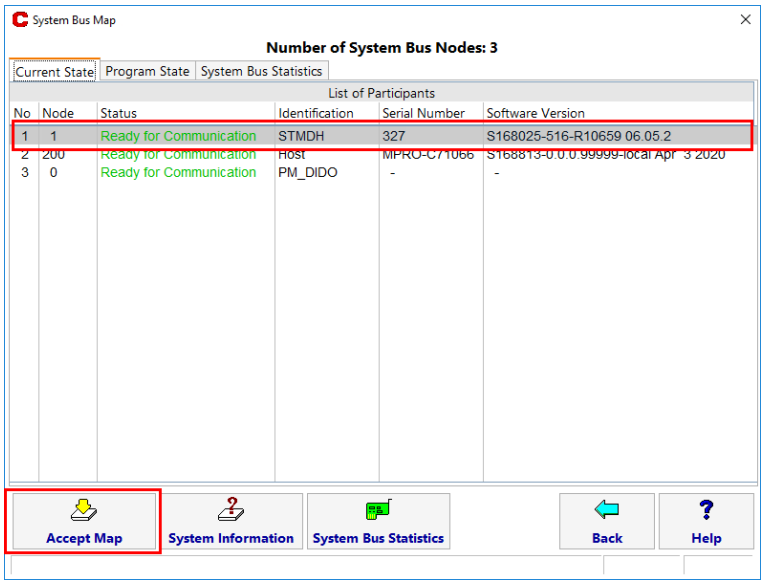


Fig. 14-13: System Bus Map with the updated STMD-H

12. Go back to the main screen.
    - ➢ The software update is now completed.

15 Administration

The *Administration* dialog includes system settings, user administration, data backup and service functions.

► Select *Navigator* > *Administration*.

Fig. 15-1: Administration dialog

15.1 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. There is a separate counter status for each tool group, which can be reset individually or together.

The counter for tightening and results is incremented at the end of a rundown.

► Select *Navigator* > *Administration* > *Counters*.

Button	Description
Number of Run-downs	The number of all tightenings and the number of tightenings with an OK and NOK result that were performed with the selected tool group are displayed.
Reset All Counters	**Resetting the counters status of all tool groups** 1. Select *Navigator* > *Administration* > *Counters*. 2. Press <Reset All Counters>. 3. To reset the counter, press <Accept> and confirm the following message with <OK>.
Reset Displayed Counter	**Resetting the counters status of a tool groups** 1. Select *Navigator* > *Administration* > *Counters*. 2. To select a tool group to reset its counters, press . 3. Select a tool group with the arrow keys and confirm with <OK>. 4. Press <Reset Displayed Counter>. 5. To reset the counter, press <Accept> and confirm the following message with <OK>.
	The button opens a dialog to select a tool group. This is only possible if at least two tool groups are configured.

15.2 Print

The dialog enables setting options for printing parameters.

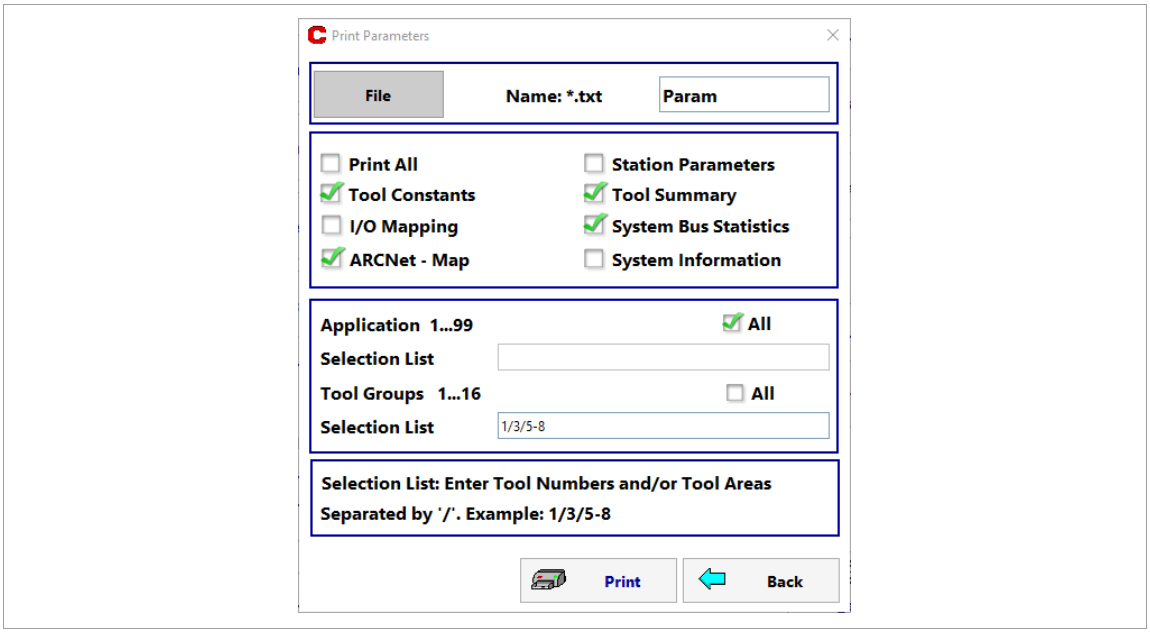


Fig. 15-2: Print Parameters

Print parameters

1. Select *Navigator* > *Administration* > *Print*.
2. Select the parameters to be saved.
3. Select product and tool groups whose parameters are to be printed.
   Individual groups are separated by a " / " and group areas by " - ".
   Example: "1/3/5-8" means that groups 1, 3, 5, 6, 7 and 8 are selected.
4. To open the input field for the file name, select <File>.
5. Select <Print> and confirm the following message with <OK>.
6. Enter the file name with a maximum of eight characters without the file extension.
7. Select a location and start the printing process with <OK> .
   ➢ The print data is written to a `*.txt` file. Depending on the parameter settings, the print job can become very large (> 100 pages) and last a long time.

15.3 Setting the 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.

Set date and time

1. Select *Navigator* > *Administration* > *Date/Time*.
2. Enter the date and time in the required format. The format is in parentheses above the input fields and is dependent on the language.
3. Press the ✔ button to adopte it in the controller real time clock.

15.4 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.
The modification list contains all registered users and shows who has made the last parameter modification and at what time.

15.5 Touch Calibration

This function allows to recalibrate the touchscreen. The touchscreen is optimally set at delivery, but it can deteriorate due to improper handling. This function can be improved again by performing a touch calibration. This function can only be started at the controller, not via the mProRemote connection.

Calibrate touchscreen

1. Select *Navigator* > *Administration* > *Touch Calibration*.
   ➢ A black screen appears with items that are displayed one by one.
2. Follow instructions on the screen and press the items displayed until they are highlighted green.
   ➢ Calibration is performed.
3. Confirm the message **Save new calibration data?** with <YES>. With<NO> the new calibration can be discarded.

If next to the calibration point is pressed, the calibration is canceled.
If the controller can no longer be operated correctly after the touch calibration:

► Restart controller.
► Contact a *Sales & Service Center*.

15.6 Data Backup

15.6.1 Data Export

The *Data Export* feature allows you to export rundown data to a file.

Generate a dBase file

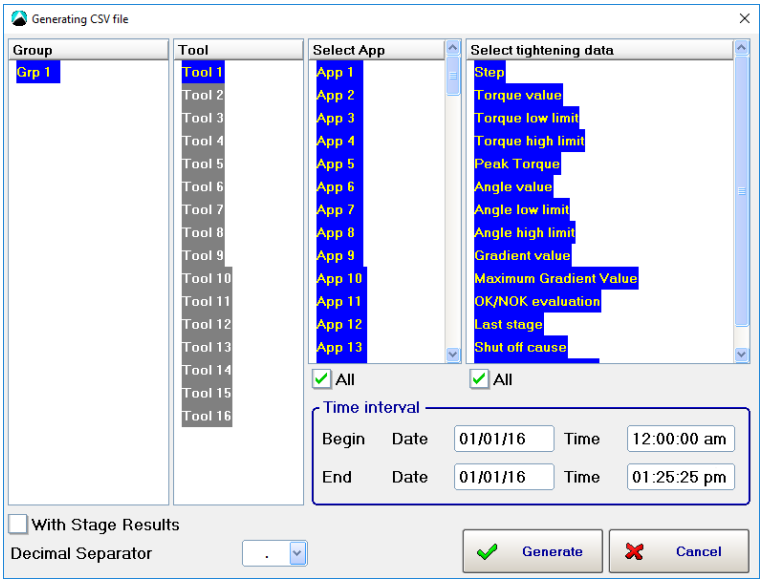


Fig. 15-3: Generating a dBase file

1. Tap *Group*, *Tool* 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. Select the target folder.
   ➢ The dBase file is generated in the archive folder and then copied to a target folder of your choice.
7. You can import the generated dBase file in any statistics, spreadsheet, or database program with the appropriate filter.

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
n+1		End mark for table header	0D	
n+2		1st data record		See example in Example: Data record
...		Next data record		
…		Fiel 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.)

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

Editing with FoxPro C2.6

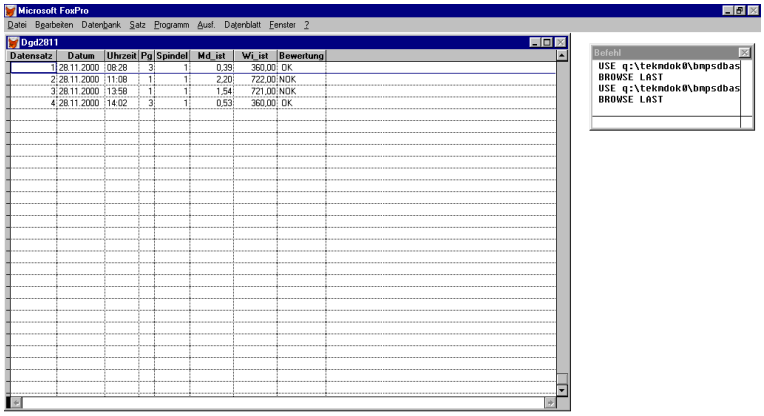


Fig. 15-4: FoxPro

Editing with Access

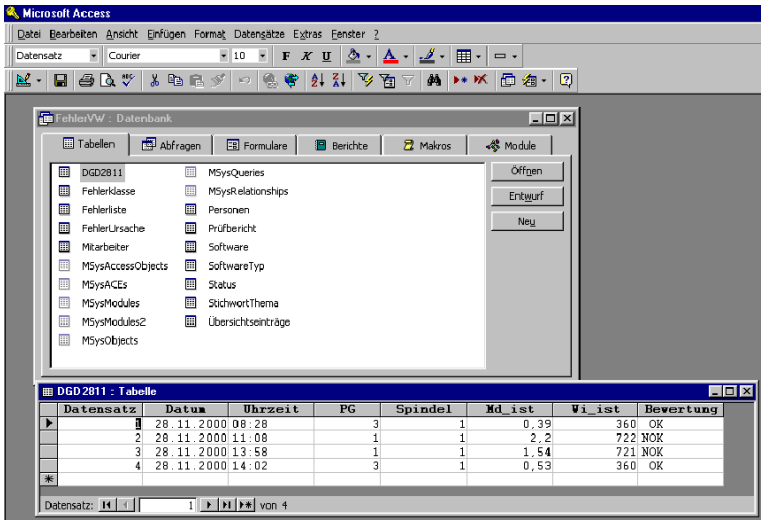


Fig. 15-5: Access

15.6.2 Loading parameters

Load parameters from an internal storage device CF 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.

15.6.3 Saving 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 CF card or a connected USB drive.

15.7 Users

Benutzer registrieren und Zugriffsrechte zur Steuerung des Zugriffs auf Funktionen und Parameter zuweisen. Es können zehn Benutzer registriert werden.

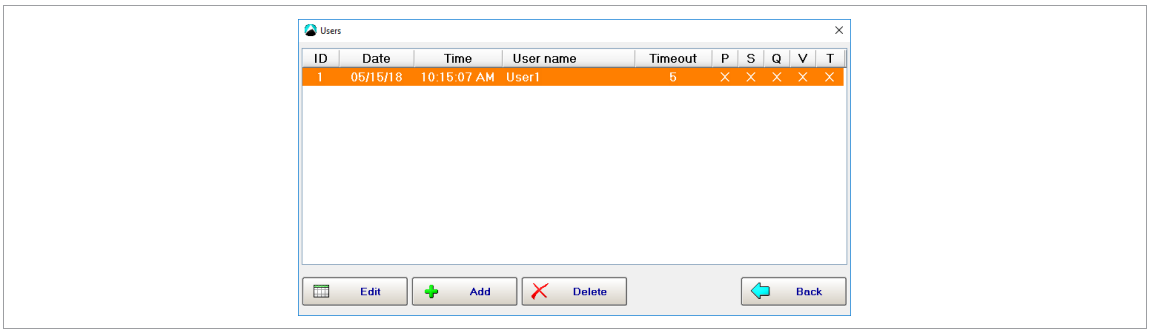


Abb. 15-6: Users

- Der Passwortschutz wird erst aktiviert, wenn ein Benutzer registriert wird.
- Für Servicefunktionen ist ein Benutzername erforderlich.
- Wenn keine Benutzer registriert sind, ist der Passwortschutz deaktiviert. In diesem Fall wird für keine der Funktionen eine Passwort-Eingabeaufforderung angezeigt.

Benutzerrechte

P – Prozessprogrammierung
S – Systemprogrammierung
Q – Statistik
V – Verwaltung
T – Systemtest

Bildschirm	Lesen	Schreiben
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		

Bildschirm			Lesen	Schreiben
	Configure		–	–
Communication				
	Data Transmission			S
	Part ID			S
	Network Settings			S
	Fieldbus			S
Tool Setup			S	
	Install		S	
	Edit		S	
	Uninstall		S	
	I/O		S	
		IO		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	
		Run 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 Measurement	T	
		RPM	T	

Bildschirm				Lesen	Schreiben
		Current Calibration		T	
		Tool Memory		–	–
Utility					
	Installed Versions			–	–
	Software Update				
		Software Update		V	
		TM Measuring Card Firmware		V	
	System Settings				
		System Information		–	–
		Cordless Tools		S	
	Offline				
		Load Parameters		V	
		Save Parameters		V	
Administration					
	Counters				
		Zähler nullen		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			–	–

15.8 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 the enter kay on the virtual keyboard or select the *Select message* option from the *Select 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.

15.9 Factory Reset

The factory reset deletes all configuration data and resets to factory defaults.

After a factory reset, the controller type must be reassigned.

15.10 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. Press <Save All Data to USB Stick>.
3. Navigate to the folder on the USB stick where you want to save the data.
4. Press <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.

15.11 Screen Saver

Der Bildschirmschoner setzt den Bildschirm in den Standby-Modus und verlängert somit die Lebensdauer der Hintergrundbeleuchtung. Der Schraubablauf wird dadurch nicht beeinflusst.
Wenn sich die Steuerung im Ruhezustand befindet, bleibt die Hintergrundbeleuchtung des Bildschirms für die im Wartezeit-Timer einprogrammierte Anzahl von Minuten eingeschaltet. Nach Ablauf der einprogrammierten Zeit wird sie abgeschaltet. Sie wird wieder eingeschaltet, wenn eine Taste gedrückt wird, ein externes Eingangssignal sich ändert oder ein Werkzeug gestartet wird. Wenn der Wartezeit-Timer auf 0 Minuten gestellt ist, bleibt die Hintergrundbeleuchtung unbegrenzt lange eingeschaltet.

1. *Navigator* > *Administration* wählen.
2. Einstellungen im Abschnitt *Screen Saver* vornehmen.

Parameter	Beschreibung
Disabled	Der Bildschirmschoner ist deaktiert, wenn in dem Eingabefeld "0" eingegeben wird. Der Bildschirm ist immer eingeschaltet.
Timeout (Minutes)	Der Bildschirmschoner ist aktiviert, wenn in dem Eingabefeld ein Wert zwischen 1 – 999 eingegeben wird. Dieser Wert gibt den Timeout in Minuten an, nach denen sich der Bildschirm ausschaltet, wenn keine Aktion ausgeführt wird.
Wake Up Run Screen on Update	Ist das Kontrollkästchen aktiviert, wird der Bildschirm bei jeder Änderung der externen Ein-/Ausgänge (z. B. Freigabe, Werkzeug Start) eingeschaltet und der Timeout zurückgesetzt. Ist das Kontrollkästchen deaktiviert, wird die Bildschirm-Hintergrundbeleuchtung nur eingeschaltet, wenn eine Taste gedrückt wird.

15.12 Select Language

Select the language for the user interface. Available languages are:
German, English, Polish, Spanish, Italian, French, Portuguese, Russian and Chinese.

16 Troubleshooting

If an error cannot be rectified with the specified measures, or if the error occurs repeatedly, send the tool or the controller to a *Sales & Service Center* for repair, see reverse.

16.1 Error messages

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.

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
?!?	Unknown software error.	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
???	Wrong/not available application or stage is selected (software error).	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
?S?	Abort due to other errors (software error).	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
48V	48 V from power supply is missing.	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
TERM	Controller aborts the rundown.	▶ Search in the logbook/syslog for the trigger of the abort. ▶ Check tightening system.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
ABGW	Tool was deselected.	▶ Check tool selection in the PLC or application parameterization.	Tightening technician	BD BB BTS	NeoTek 18/48	–
ABL	Another tool in the tool group has an NOK result (sequence error).	▶ Determine and check NOK tool.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore CellClutch LiveWire SCS F4
ADU	Error in the A/D converter. Hardware is defective.	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BB BTS	18/48	–
AN1F	Transducer 1 does not exist: • Transducer 1 is defective. • Transducer cable is defective.	▶ Replace transducer. ▶ Replace transducer cable.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
AN2F	Transducer 2 does not exist: • Transducer 2 is defective. • Transducer cable is defective. • Transducer 2 is parameterized although it is not present.	▶ Replace transducer. ▶ Replace transducer cable. ▶ Check parametrization.	Maintenance technician Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
AR>	Tool moved too fast, angular speed is too high.	▶ Loosen rundown and tighten again. ▶ Move tool more slowly during rundown.	Operator	–	–	SCS F4
ARC?	Error in system bus interface. Open ArcNet Interface.	▶ Check ArcNet cable. ▶ Check terminology.	Maintenance technician	BD BB BTS	18/48	–
AUF?	Job to the tightening module is incorrect (software error).	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
AW<	Not enough graphic values were recorded for the evaluation.	▶ Check parametrization. ▶ Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
BLOC	Bolted on block.	▶ Do not retighten screws that have already been tightened.	Operator	BD BB BTS	NeoTek 18/48	CellTek CellCore CellClutch LiveWire SCS F4
CLU?	Clutch was released in a pre-tightening stage. • Parameterization does not match the joint. • Mechanical clutch is incorrectly adjusted. • Material properties do not match the parameterization.	▶ Check parametrization. ▶ Check the adjustment of the clutch. ▶ Check material.	Tightening technician	–	–	CellClutch
COM?	Error of the serial interface COM1/COM2 at the tightening module (software error).	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	18/48	–
CRC	Checksum error (CRC). Data transmission does not match.	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
DBL	Internal error.	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	–	–	CellClutch SCS F4

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
DF?	Invalid torque averaging filter in the sequence (software error).	▶ Perform software update of the controller. ▶ Perform software update of the measuring card.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
SEQ?	No sequence activated (software error).	▶ Perform software update of the controller. ▶ Perform software update of the measuring card.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
DPR?	DPR error (Dual Ported RAM) on the measuring card (software/hardware error).	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
RES?	No valid measured values available (software error).	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
F<	Force is too low (SEQ 35).	▶ Check joint.	Tightening technician	BB BTS	18/48	–
F>	Force is too high (SEQ 35).	▶ Check joint.	Tightening technician	BB BTS	18/48	–
FHW	Hardware error on the measuring card.	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore CellClutch LiveWire
FK<	Clamping force is too low (SEQ 35).	▶ Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	–
FLT	Error in the power section. Collective error for DC link, resolver, servo and motor.	▶ Note additional error message.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
FMK	Collective error of the measuring card.	▶ Check FMK error, see document P2381TS.	Maintenance technician	BD	NeoTek 18/48	CellTek CellCore LiveWire
FPEF	Snug point could not be determined.	▶ Check joint. ▶ Check parametrization.	Tightening technician	BB BTS	18/48	–
FRK<	Residual clamping force is too low.	▶ Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	–
FRK>	Residual clamping force is too high.	▶ Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	–
FSMW	Not enough measured values to perform phase 2.	▶ Check parametrization. ▶ Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
GAE	Invalid angle value returned from gyroscope.	► Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	–	NeoTek	CellTek LiveWire SCS F4
GAEX	Safety shutdown by the gyroscope. Tool moved more than ±180°.	► Don't rotate tool not more than ±180°. ► Check parametrization.	Operator Tightening technician	BD	NeoTek	CellTek LiveWire SCS F4
GARE	Gyroscope reports that the tool was moved too fast. Angular speed is too high.	► Move tool more slowly during rundown.	Operator	BD	NeoTek	CellTek LiveWire SCS F4
GCOM	Internal communication to gyroscope is incorrect.	► Check contact to the gyroscope. ► In case of recurrence contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD	NeoTek	CellTek LiveWire SCS F4
GD<	Gradient is too low.	► Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
GD>	Gradient is too high.	► Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
GEB?	Torque/angle error of the transducer. • Offset error • Encoder error • Calibration error	► Contact a Sales & Service Center.	Apex Sales & Service Center	BB	–	–
GUT	No error. Rundown result is ok.			BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
GVE	Power supply voltage of the gyroscope is too high or too low.	► Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD	NeoTek	CellTek LiveWire
I2T	Motor is overloaded and too warm (servo error).	► Cool down the tool. ► Make a longer break between rundowns. ► Reduce tightening time, tighten faster.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore CellClutch LiveWire
INI?	No signal from the deep sensor. Depth sensor is defective.	► Replace depth sensor.	Maintenance technician	BD BB BTS	NeoTek 18/48	–
IP	Tool is overloaded: • Torque is too high. • Speed is too low. • Cycle is too high.	► Check parametrization.	Tightening technician Maintenance technician	BD BTS	NeoTek 18/48	CellTek CellCore CellClutch LiveWire

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
IRED	Current/torque redundancy error: • Joint does not match the parameterization. • Motor/gearbox is defective.	▶ Check parametrization. ▶ Check tool. ▶ Check joint. ▶ Contact a *Sales & Service Center*.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
JUM	Tool has slipped off the socket.	▶ Ensure that the tool is correctly seated on the socket.	Operator	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
KAL1	After the end of the rundown, there is still tension on the screw.	▶ Perform calibration only if the output can rotate freely.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
	Calibration error transducer 1.	▶ Replace transducer.	Maintenance technician	BB BTS	–	–
		▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD	NeoTek 18/48	CellTek CellCore LiveWire
KAL2	Calibration error transducer 2.	▶ Replace transducer.	Maintenance technician	BD BB BTS	–	–
KOMM	Communication error between controller and tightening module: • Wrong software versions used. • Implausibility detected.	▶ Perform software update.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore CellClutch LiveWire SCS F4
LFF	Bearing error (SEQ 56), e.g. there is dirt in the bearing.	▶ Check joint.	Tightening technician Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
LOCK	Internal error.	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	–	–	SCS F4
M1<	Torque at M1 (gate 1) is too low (SEQ 48).	▶ Check joint. ▶ Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
M1>	Torque at M1 (gate 1) is too high (SEQ 48).	▶ Check joint. ▶ Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
M2<	Torque at M2 (gate 2) is too low (SEQ 48).	▶ Check joint. ▶ Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
M2>	Torque at M2 (gate 2) is too high (SEQ 48).	▶ Check joint. ▶ Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
MBO>	High evaluation torque is exceeded: • Changed material properties. • Changed paint thickness.	▶ Check material. ▶ Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
MBU<	Low evaluation torque threshold not reached: • Changed material properties. • Changed paint thickness.	▶ Check material. ▶ Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
TQ<	Torque is too low due to changed material properties.	▶ Check material. ▶ Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore CellClutch LiveWire SCS F4
TQ>	Torque is too high: • Parameterization does not match the joint. • Material properties do not match the parameterization.	▶ Reduce final speed. ▶ Check material. ▶ Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
TQRE	First and second transducer provide different torque results (redundancy error).	▶ Check transducer.	Maintenance technician	BB BTS	–	–
	First transducer and current redundancy provide different torque results (redundancy error).	▶ Contact a Sales & Service Center.	Apex Sales & Service Center	BD	NeoTek 18/48	CellTek CellCore LiveWire
TqP<	Breakaway torque not reached. Friction in the bearing of the workpiece is too low.	▶ Check the bearing of the workpiece. ▶ Check parametrization.	Maintenance technician Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
MDS>	Breakaway torque too high. Friction in the bearing of the workpiece is too low.	▶ Clean the bearing of the workpiece. ▶ Check parametrization.	Maintenance technician Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
MDSI	Safety torque is exceeded: • Torque is too high when cutting (self-tapping screw). • Thread is defective.	▶ Check joint.	Tightening technician	BD BTS	NeoTek 18/48	CellTek CellCore LiveWire

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
TqOV	Number of torque overruns is too high. Maximum tool capacity is exceeded.	► Check the bearing of the workpiece.	Maintenance technician Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
TqUN	Number of torque undershoots is too high.	► Check the bearing of the workpiece.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
ME>	Press-in torque is too high.	► Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
MFP<	Torque at juncture too low. Parameterization does not match the joint.	► Check parametrization. ► Check material.	Tightening technician Maintenance technician	BD	NeoTek 18/48	CellTek CellCore LiveWire
MFP>	Torque at juncture is too high. Parameterization does not match the joint.	► Check parametrization. ► Check joint.	Tightening technician Maintenance technician	BD	NeoTek 18/48	CellTek CellCore LiveWire
MST>	Maximum evaluation torque range is exceeded.	► Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
n/e	The rundown was aborted before the next phase was reached: • Torque is too high. • Bolted on block. • Thread is defective.	► Check parametrization. ► Do not retighten a screw that has already been tightened.	Tightening technician Operator	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
NBB	Tool is not ready for use. Internal error in the tool.	► Check tool.	Maintenance technician	BD BB BTS	NeoTek 18/48	–
NBBR	Socket or screw is broken: • Changed material properties. • End of the socket life is reached.	► Check material. ► Replace socket regularly.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
NECK	Socket or tool is broken (anti-necking error).	► Check joint.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
NEG	Screw was loosened and no longer tightened: • Negative torque is detected during pull-off. • In the Linking Group, a loosening is detected which is no longer revised by a positive tightening. • Screw is tightened in the wrong direction. • Parameterization does not match the joint.	▶ Check rundown. ▶ Rework rundown. ▶ Check parametrization.	Operator Tightening technician	–	–	SCS F4
NOEN	Enable signal is missing.	▶ Check system cable.	Maintenance technician	BTS	–	–
		▶ Check WLAN/Bluetooth connection.	Maintenance technician	–	–	CellClutch
EMER	Terminated by emergency stop.	▶ Fix emergency stop. ▶ Do not enter the work area during rundown.	Maintenance technician	BD BB BTS	NeoTek 18/48	–
OFF1	Offset error transducer 1.	▶ Replace transducer.	Maintenance technician	BB BTS	–	–
		▶ Send tool to a *Sales & Service Center*.	Apex *Sales & Service Center*	BD	NeoTek 18/48	CellTek CellCore LiveWire
OFF2	Offset error transducer 2.	▶ Replace transducer.	Maintenance technician	BD BB BTS	–	–
P1M>	Maximum torque in phase 1 is too high: • Parameterization does not match the joint. • Bolted on block.	▶ Check parametrization. ▶ Do not retighten a screw that has already been tightened.	Tightening technician Operator	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
P2M<	Minimum torque in phase 2 is too low: • Parameterization does not match the joint. • Friction torque too low (for self-tapping screws).	▶ Check parametrization. ▶ Replace workpiece.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
P2OV	Maximum torque was exceeded too often in phase 2: • Parameterization does not match the joint. • Thread is defective.	▶ Check parametrization. ▶ Do not screw the tightened screw again. ▶ Replace screw. ▶ Thread recutting.	Tightening technician Operator	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
P2UN	Minimum torque was undershot too often in phase 2: • Parameterization does not match the joint. • Workpiece is defective (e.g. thread is too large).	▶ Check parametrization. ▶ Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
P2OU	Minimum and maximum torque were undershot and overshot too often in phase 2.	▶ Check parametrization. ▶ Check joint. ▶ Do not screw the tightened screw again.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
P3M<	Minimum torque in phase 3 is too low: • Parameterization does not match the joint. • Friction torque too low (for self-tapping screws).	▶ Check parametrization. ▶ Replace workpiece.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
P3M>	Maximum torque in phase 3 is too high: • Parameterization does not match the joint. • Thread is defective. • Bolted on block.	▶ Check parametrization. ▶ Do not retighten a screw that has already been tightened.	Tightening technician Operator	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
P4M<	Minimum torque in phase 4 is too low: • Parameterization does not match the joint. • Friction torque too low (for self-tapping screws).	▶ Check parametrization. ▶ Replace workpiece.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
P4M>	Maximum torque in phase 4 is too high: • Parameterization does not match the joint. • Thread is defective. • Bolted on block.	▶ Check parametrization. ▶ Do not retighten a screw that has already been tightened.	Tightening technician Operator	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
PAR	Wrong parameter.	► Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
App?	The wrong application is selected on the tightening module (software error).	► Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
POWR	Power supply unit is not ready/supplies no voltage.	► Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD	NeoTek 18/48	CellTek CellCore LiveWire
PTA<	Pretightening angle is too low because it was screwed on block.	► Do not retighten a screw that has already been tightened.	Operator Tightening technician	–	–	SCS F4
PTR	Error at PTR (Pulse Torque Recovery), because the torque is too high.	► Check joint. ► Check parametrization.	Maintenance technician Tightening technician	BB BTS	18/48	–
RAM	Graphics memory is full.	► Check joint. ► Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
SA	Rundown was aborted because the start signal was removed: • Operator has slipped off the start switch. • Termination by PLC.	► Keep start switch pressed until the end of the rundown. ► Check PLC.	Operator Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore CellClutch LiveWire SCS F4
SeBB	Ready signal for the servo is not present. Collective error for DC link, resolver, servo and motor.	► Note additional error message.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
SePS	Parameterized servo parameter set does not match the selected servo parameter set.	► Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BB BTS	18/48	–
SERV	Invalid servo type was detected (software error).	► Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BB BTS	–	–
SKIP	Tightening position was skipped. SKIP is displayed as a placeholder for a non-existent result.	► Check operator/control sequence. ► If it is a conscious decision in the process, no action is required.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
Spg?	Voltages are incorrect (hardware error).	► Observe additional error messages.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore CellClutch LiveWire
SPC1	Transducer 1 has no channel settings. Parameter changes to the controller were not adopted.	► Accepting parameter changes/tool data at the controller.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
SPC2	Transducer 2 has no channel settings. Parameter changes to the controller were not adopted.	► Accepting parameter changes/tool data at the controller.	Maintenance technician	BD BB BTS	18/48	–
SS>	Too many stick-slip cycles. The paint coating does not match the parameterization.	► Check material. ► Check parametrization.	Tightening technician	BD BTS	NeoTek 18/48	CellTek CellCore LiveWire
SST>	Stick-slip time has been exceeded. The paint coating of the workpiece does not match the parameterization.	► Reduce speed. ► Check material.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
STTH	No error. *Stop at TTH* is parameterized. The rundown is stopped at the threshold torque.			BB BTS	18/48	–
STO	STO signal (Safe Torque OFF) is incorrect, e.g. due to a wire is broken.	► Check hardware.	Maintenance technician	BD	NeoTek 18/48	–
STRT	Rundown was aborted due to start problems (software error).	► Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BB BTS	18/48	–
StuF	Sequence error of the stage monitoring (system error).	► Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BB BTS	18/48	–
T1?	Error in the intelligent transducer 1. Transducer 1 is defective.	► Replace transducer.	Maintenance technician	BB BTS	–	–
T2?	Error in the intelligent transducer 2. Transducer 2 is defective.	► Replace transducer.	Maintenance technician	BB BTS	–	–
TCNA	Measurement of torsion compensation is not possible.	► Check joint.	Maintenance technician	BB BTS	–	–

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
TDS	No error. Shut-off by depth sensor. Defined screw-in depth is reached.			BB BTS	18/48	–
TMAX	Monitoring time has been exceeded: • Parameterization does not match the joint. • Changed material properties.	▶ Check workpiece and screw. ▶ Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore CellClutch LiveWire SCS F4
TMS<	Time after threshold torque is too low: • Bolted on block. • Joint does not match the parameterization.	▶ Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
TMS>	Time after threshold torque is too high. Joint does not match the parameterization.	▶ Check joint.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
TqOL	Torque is more than 110% higher than the calibration value (torque overload).	▶ Sent the tool to a *Sales & Service Center*.	Apex *Sales & Service Center*	–	–	SCS F4
TRD?	Transducer does not exist or is defective: • Tool cable is defective. • Transducer cable is not connected or defective (applies to spindle). • Transducer is defective.	▶ Check transducer cable (only for spindles). ▶ Replace tool cable. ▶ Replace controller.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
TSD	Start switch is defective.	▶ Check hardware. ▶ Check start switch.	Maintenance technician	–	–	LiveWire
VAN	Negative analog voltage is incorrect. Hardware defective.	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
VAP	Positive analog voltage is not ok. Hardware defective.	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
VLP	Logic voltage is not ok. Hardware defective.	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
A1D	Angle encoder 1 is defective.	▶ Check transducer and replace if necessary.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
A2D	Angle encoder 2 is defective.	▶ Check transducer and replace if necessary.	Maintenance technician	BD BB BTS	–	–

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
ANG<	Angle is too low.	▶ Check joint. ▶ Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire SCS F4
ANG>	Angle is too high.	▶ Check material. ▶ Check parametrization.	Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore CellClutch LiveWire SCS F4
WIG<	Total angle is too low. Initiator was triggered too early.	▶ Check initiator position.	Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
WIG>	Total angle is too high. Initiator signal missing.	▶ Check initator. ▶ Check parametrization.	Maintenance technician Tightening technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire
WiPr	Error in angle processor. Angle processor is defective.	▶ Contact a *Sales & Service Center*.	Apex *Sales & Service Center*	BB BTS	–	–
	Rundown result is implausible Nicht genügend Messwerte vorhanden. Es wurde weniger als 2° geschraubt.	▶ Check rundown. ▶ Check parametrization.	Tightening technician	–	–	SCS F4
ARE	First and second transducer have different angular results (angular redundancy error).	▶ Check transducer. ▶ Send resolver to a Sales & Service Center.	Maintenance technician	BD BB BTS	–	–
WL<	Back-off angle is too low.	▶ Check joint. ▶ Check parametrization.	Maintenance technician Tightening technician	BB BTS	18/48	–
WL>	Back-off angle is too high.	▶ Check joint. ▶ Check parametrization.	Maintenance technician Tightening technician	BB BTS	14/48	–
WREX	The wrong tool insert was used during rundown.	▶ Rework rundown. ▶ Execute the tightening sequence according to the specifications. Job and tool usage are displayed on the tool.	Operator	–	–	SCS F4

Code	Possible cause	Measure	Responsible	Tool Series		
				Fixtured Spindle	Corded	Cordless
ZRF	Gear wheel error (SEQ 56).	► Check joint.	Tightening technician Maintenance technician	BD BB BTS	NeoTek 18/48	CellTek CellCore LiveWire

16.2 Data Transmission

Problem	Possible cause	Measure
No Ethernet communication possible.	Ethernet cable is not plugged in correctly.	► Check wiring.
	Incorrect configuration of the network settings.	► Check network settings.
	Conflict of IP addresses.	► Check network settings.
	Short or broken cable on the Ethernet cable.	► Replace Ethernet cable.
Device does not communicate serially.	Data transmission is not active.	► Check system parameterization.
	RS232 cable is not plugged in correctly.	► Check wiring.
	Short or broken cable on RS232 cable.	► Replace RS232 cable.
	RS232 is incorrectly configured.	► Check serial interface (COM1/COM2). ► Check interface configuration (baud rate, parity, etc.)

16.3 Controller

Problem	Possible cause	Measure
Controller does not switch on.	Power supply is not available.	► Insert the power supply cable. ► Check mains voltage. ► Check mains input fuse (X 23).
	Display is defective.	► Send the controller to a *Sales & Service Center* for repair.
	CPU does not boot. ➢ Backlight is easily visible.	► Send the controller to a *Sales & Service Center* for repair.
	The Cleco logo remains displayed for over one minute after switching on. ➢ Internal flash memory is not initialized.	► Use recovery USB stick.
Touch function of the display does not work.	Touch calibration is faulty.	► Perform touch calibration, use an external keyboard if necessary.
I/Os do not work.	Incorrect parameterization.	► Check I/O parameterization.
	I/O connector is not plugged in correctly or the connector position (X9/X10) is incorrect.	► Check plug connection.
	A short on input/output.	► Check I/O wiring.
	Outputs are overloaded.	► Check power consumption.

Problem	Possible cause	Measure
	Reference potential missing. Internal 24 V without PE reference.	► Check I/O wiring, if necessary use internal power supply or establish reference potential.
	Controller is defective.	► Send the controller to a *Sales & Service Center* for repair.
Anybus module is not recognized.	Anybus module is not mounted correctly.	► Check that the Anybus module is mounted correctly.
	Anybus module is not supported.	► Only use supported modules (see operating instructions, catalogue).
	Anybus module incorrectly parameterized.	► Check parameterization.
	Controller is defective.	► Send the controller to a *Sales & Service Center* for repair.
	Anybus module is defective.	► Replace Anybus module.
USB port does not work.	Unsupported USB device connected.	► Only connect USB stick or keyboard. ► Request software adjustments if necessary.
	USB cable is defective.	► Replace USB cable.
	USB port is overloaded due to a defective USB device.	► Check USB device.
	Controller is defective.	► Replace the controller.

16.4 Software

Problem	Possible cause	Measure
Software is not recognized. ➢ Controller is in Cleco screen.	Software is damaged or not available.	► Perform recovery.
Software does not start.	Internal flash memory defective.	► Check power supply. ► Use a recovery USB stick.
	CF card is damaged.	► Replace CF card.
Software update does not work.	Software package is too new or too large.	► Use recovery USB stick and reformat CF card.

16.5 Tool

Problem	Possible cause	Measure
Tool not recognized.	Tool/tool cable is not connected correctly.	► Check whether the tool cable is correctly inserted and locked on both sides.
	Tool is defective.	► Replace tool.
	Tool cable is defective.	► Tool cable is defective.
	Replace tool cable.	► Send the controller to a *Sales & Service Center* for repair.
Tool does not start.	Incorrect parameterization.	► Check parameterization of the controller (start switch signal in the parameterizable I/O level). ► Check notes in the run screen.
	Tool is defective.	► Replace tool.
Tool cannot be installed.	CellClutch tool is installed with type *Cordless Tools*.	► Install CellClutch tool with type *CellClutch*.

Problem	Possible cause	Measure
Illuminated ring (optical feedback) does not work.	Incorrect parameterization.	► Check parameterization of the controller (LED parameterization in the parameterizable I/O level).
	Tool is defective.	► Replace tool.
Haptic and acoustic feedback does not work (only applies to NeoTek).	Wrong parameterization.	► Check the parameterization of the controller.
	Tool is defective.	► Replace tool.
Function keys F1 and F2 do not work (only applies to NeoTek).	Wrong parameterization.	► Check the parameterization of the controller (CCW rotation and function key in the Programmable I/O Mapping).
	Tool is defective.	► Replace tool.
Accessories are not recognized (only applies to NeoTek).	Measuring card software is too old.	► Update the measuring card software.
	TIM software is too old.	► Update the TIM software.
	Accessory is not connected correctly.	► Check that the accessory is correctly mounted.
Arcnet accessories do not work.	System parameterization is not available/incomplete/incorrect.	► Check system parameterization (see documentation of the accessory).
	24 V power output of the controller is overloaded.	► Reduce the number of accessories. ► Use external supply of the 24 V line if necessary.
	Cable length is over 100 m.	► Use cable length less than 100 m.
	Upstream accessory is defective.	► Disconnect and bridge Arcnet cable on upstream accessories. ► Replace previous accessory.
	A short in the Arcnet data line.	► Disconnect TSnet cable and replace if necessary.
	A short in the power line.	► Replace cable.
	Accessory is defective.	► Replace accessory.

17 Open Source Software

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18 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.

Term	Description
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
Mean (X-bar)	Average of all readings taken in a sample, the sum divided by the count
mPro400GC(D) & mPro200GC(-AP)	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
Redundant Transducer	Secondary transducer used to read torque
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
Second Transducer	See Redundant Transducer
Sequence 11	High-speed rundown
Sequence 16	Depth sensor, Angle control with Angle and Torque monitoring

Term	Description
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 tool 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
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

Term	Description
Variance	Statistical measure, the average of the squared differences from the mean

19 Appendix

19.1 Appendix A – Input Signals

Signal name	Description	Supported with		GMCC activated
		Corded tools	Cordless tools	
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
Disable Part ID	When active, allows the tool to run without part ID.	Yes	Yes	
Enable App / LG Select X	When active, allows inputs "App / LG Select 0-7" to select an application or Linking Group.	Yes	Yes	
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	
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	
Emergency Stop	Input is required for rundowns. Falling edge aborts the fastening procedure.	Yes	No	
Manual Mode	When active, manual operation as in Advanced/Tool Settings defined used.	Yes	Yes	
Motor Start (SS)	Starts the motor. Input could set fix to 1. That means input could be all the time high.	Yes	No	
Pendant Bypass	Pendant momentary switch. Used to release one job only. Used with GMCC.	Yes	No	Yes
Bypass Transducer 2	Input for cross-checking the rundown at the second transducer with an external measuring device.	Yes	No	
Pendant Release	Pendant momentary switch. Used to release one job only. sed with GMCC.	Yes	No	Yes
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	
Reverse (TM_LL)	When active, causes the tool to run in the counter-clockwise direction using the Backoff strategy. Inactive if external tool reverse is parameterized.	Yes	No	

Signal name	Description	Supported with		GMCC activated
		Corded tools	Cordless tools	
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	
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
Tool Group Start (SA)	Starts a new rundown. All state outputs of previous rundown are cleared. Starts a new rundown. All state outputs of previous rundown are cleared. Inactive if external tool start is parameterized.	Yes	No	
Tool Group Stop	Stops the current rundown. +24 VDC must be present for the tool to run.	Yes	No	Yes
Linking Mode	Enable Linking mode.	Yes	Yes	
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	
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	
Abort Linking	When active, Linking (batch counting) is reset to position one.	Yes	Yes	
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	
CPS Ready	Not supported.	No	No	
Reset Signals	Reset output signals rundown state	Yes	Yes	
Manual Part ID input	Opens manual input.	Yes	Yes	
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	
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
Skip Linking Step	When active, skip current step in Linking Group.	Yes	Yes	
Clear DFUE Results	Clear results for DFUE data transmission	Yes	Yes	
Send DFUE Data	Send rundown results via DFUE data transmission	Yes	Yes	

Signal name	Description	Supported with		GMCC activated
		Corded tools	Cordless tools	
Send DFUE Data Inv.	Send with falling edge rundown results via DFUE data transmission.	Yes	Yes	
OP Input X	Input is passed through to Open Protocol / FEP (MID 0211). Input 1-8 can be used.	Yes	Yes	
Pass Through In X	Input is used to activate corresponding output "Pass Through Out 1 – 16"	Yes	Yes	
App / LG Select +	Rising edge increments selected Linking Group number or Application number.	Yes	Yes	
App / LG Select -	Rising edge decrements selected Linking Group number or Application number.	Yes	Yes	
Error Acknowledge	Only applies to LiveWire tools. Input for acknowledging errors, reference for Remote control & Error acknowledgment.	No	Yes	
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	
Heart Beat	Verifies live communications between controller and PLC (hand-shaking). Not selectable. Automatically active when GMCC is selected.	Yes	No	Yes
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	
Bypass Tool X	Deactivate a single tool.	Yes	No	

19.2 Appendix B – Output Signals

Signal name	Description	Supported with		GMCC activated
		Corded tools	Cordless tools	
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
Tool Group NOK	Active if Torque/Angle/Yield are outside limits or some other error has occurred.	Yes	Yes	
Tool Group Ready (BB)	Indicates the status of the fastening control system. 1 = kcan accept start signal. 0 = unable to start, in-situ check necessary (e.g. at a retainer fault, system fault).	Yes	Yes	
Rundown Complete (SE)	Set after all rotation has ended, before evaluation; earliest point to initiate a mech. movement via the PLC.	Yes	Yes	
Cycle Complete (AE)	Active when a rundown has ended and there are status outputs to report.	Yes	Yes	Yes
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	

Signal name	Description	Supported with		GMCC activated
		Corded tools	Cordless tools	
System Warning	The signal becomes active when a system warning is present. This can be viewed or acknowledged under *Diagnostics* > *System Warnings*. The warning factor can be parameterized under *Advanced* > *Controller* > *Advanced*. Used with GMCC. Transmits fault condition to PLC.	Yes	Yes	Yes
Touch Up Active	Indicates if program has entered touch-up mode.	Yes	No	
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
Tool Group in Reverse	Active if reverse switch on Tool is active, or input for reverse is active.	Yes	Yes	
Verification Mode	NNot supported.			
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	
Linking OK	Workpiece is OK. Active if all positions of Linking were OK.	Yes	Yes	
Linking NOK	Workpiece is NOK. Active if one or more positions of Linking were NOK.	Yes	Yes	
Linking Completed	Active when rundowns of all positions of the selected Linking group are completed.	Yes	Yes	
Archive Full	Indicates that the storage space available on the archive drive is below the threshold.	Yes	Yes	
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
Linking in Process	Output is active, as long as the workpiece is processed.	Yes	Yes	
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	
App / LG Confirm X	Confirm application Selects 0–7. App / LG Confirm 0-2 when GMCC is selected. Automatically enabled.	Yes	Yes	Yes
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	
Tool Online	Active if LiveWire Tool is online.	No	Yes	
Tool Synchronized	Active if LiveWire Tool is synchronized.	No	Yes	
---	Not supported.	No	No	

Signal name	Description	Supported with		GMCC activated
		Corded tools	Cordless tools	
Heart Beat	Verifies live communications between controller and PLC. (hand-shaking). UUsed with GMCC. Automatically active when GMCC is selected.	Yes	No	Yes
Pass Through (Green)	Allows external input to control a stack light connected to the controller's discrete I/O.	Yes	No	Yes
Pass Through (Yellow)		Yes	No	Yes
Pass Through (Red)		Yes	No	Yes
Pass Through (Alarm)		Yes	No	Yes
OP Out X	Active if via Open Protocol / FEP (MID 0200) corresponding output is activate.	Yes	Yes	
OP Offline	Active if no connection to Open Protocol / FEP Client exists.	Yes	Yes	
DFUE Active	Active if data transmission DFUE transfer data.			
Pass Through Out X	Outputs have same state as Pass through inputs.	Yes	Yes	
TMA Error Bit X	Only applies to LiveWire tools. Output bits for error acknowledgement, refer- ence for Remote control & Error acknowledgment.	No	Yes	
Ack in Prog	Only applies to LiveWire tools. Output bits for Acknowledge in Progress, reference for Remote control & Error acknowledgment.	No	Yes	
Battery low	Only applies to LiveWire tools. Error „Battery low“, reference for Remote control & Error acknowledgment.	No	Yes	
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	
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	
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	
TQ High X	Active if Torque is too high.	Yes	Yes	
AN Low X	Active if angle is too low.	Yes	Yes	
AN High X	Active if angle is too high.	Yes	Yes	
Tool Running X	Active if Tool runs.	Yes	No	

Signal name	Description	Supported with		GMCC acti-vated
		Corded tools	Cord-less tools	
Tool Error X	Active if any error on Tool exists (e.g. transducer, motor, temperature). Always active with SEQ 41, 46, 48 (back-off) even if angle within range.	Yes	No	
Tool Bypassed X	Active is Tool is bypassed. Tool does not participate rundown.	Yes	No	
Tool Enabled	Release of the tool group.	Yes	Yes	
Solenoid Power	Solenoid Power. Used with GMCC.	Yes	No	Yes
Grn Tool Light X	(Tool) Good rundown (Green Light). Used with GMCC.	Yes	No	Yes
Red Tool Light X	(Tool) Remove, Inspect & Repair fastener (Red Light). Used with GMCC.	Yes	No	Yes
YTool Light X	(Tool) Low Torque (Yellow Light) Used with GMCC.	Yes	No	Yes

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