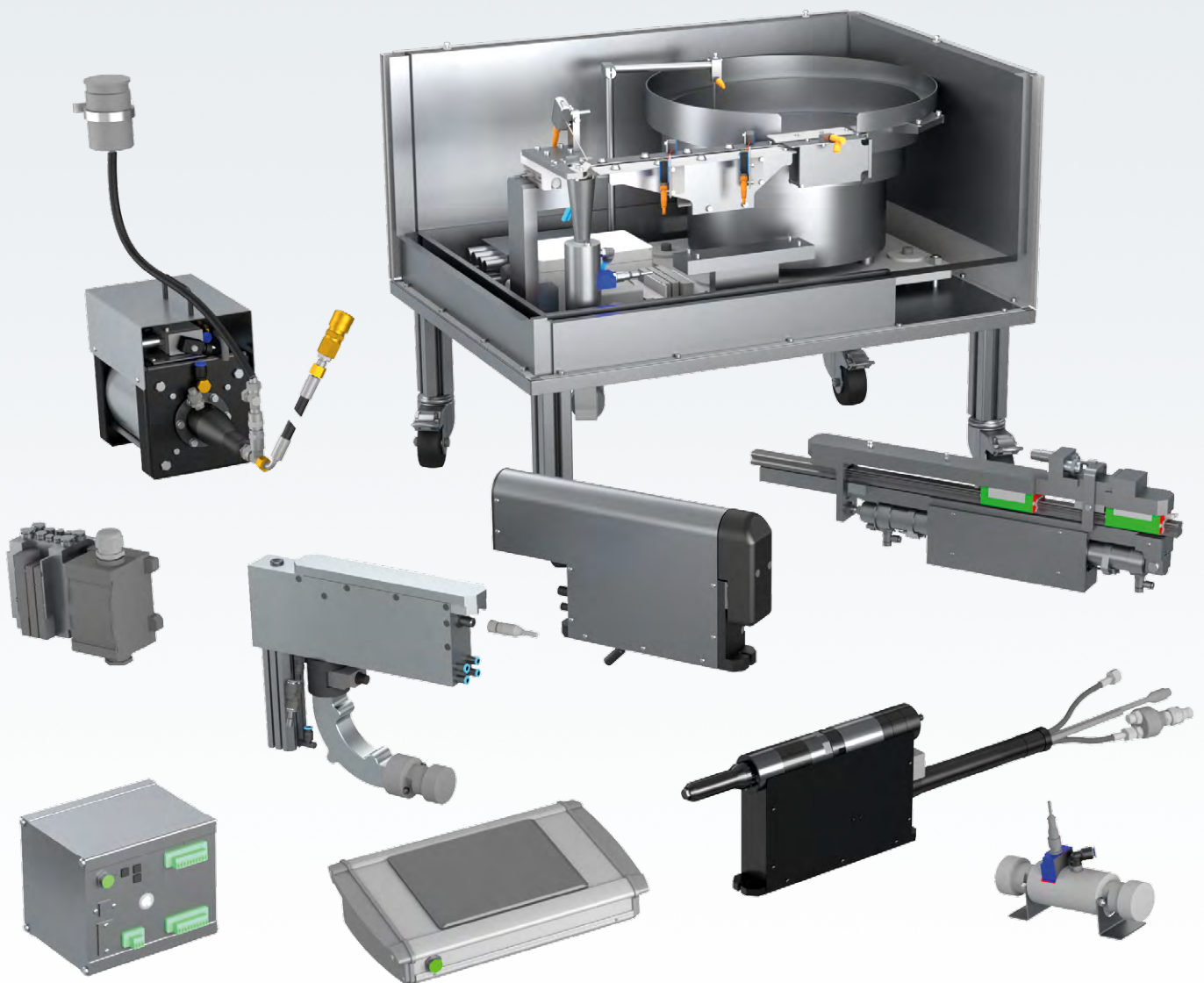# TITGEMEYER

Tools & Automation

Riveting automation

Equipment Installation

Implementation manual for SAN2URCap

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Content

1. Introduction

Process control (TC) riveting head for series production. For standard blind rivets 2.0 - 6.4 mm

Benefits at a glance

Industrial automatization is essential in these days. Importance of the automatization is rapidly growing also in the field of the riveting. SAN2 offers a technology for setting the blind rivets automatically. Together with Universal Robots you can get perfect solution for your project. Moreover, the integration of the SAN2 and UR robots is simple and straightforward due to the provided SAN2URCap. This manual will guide you from the installation of the URCap to creating simple example program together with UR robot.

2. Installation

2.1. System requirements

The URCap is meant for the following SAN2 setup (the setup overview is available in Figure 1):

– Riveting head mounted on the robot
– Charger mounted on the fixed point or on the linear motion
– Vibration bowl may contain the transport booster
– SANK2 control unit

UR robot minimum requirements are

– Polyscope versions at least 3.7 for CB-Series and 5.1 for e-Series or newer
– Robot types UR10, UR10e, UR16e (due to the minimum payload)
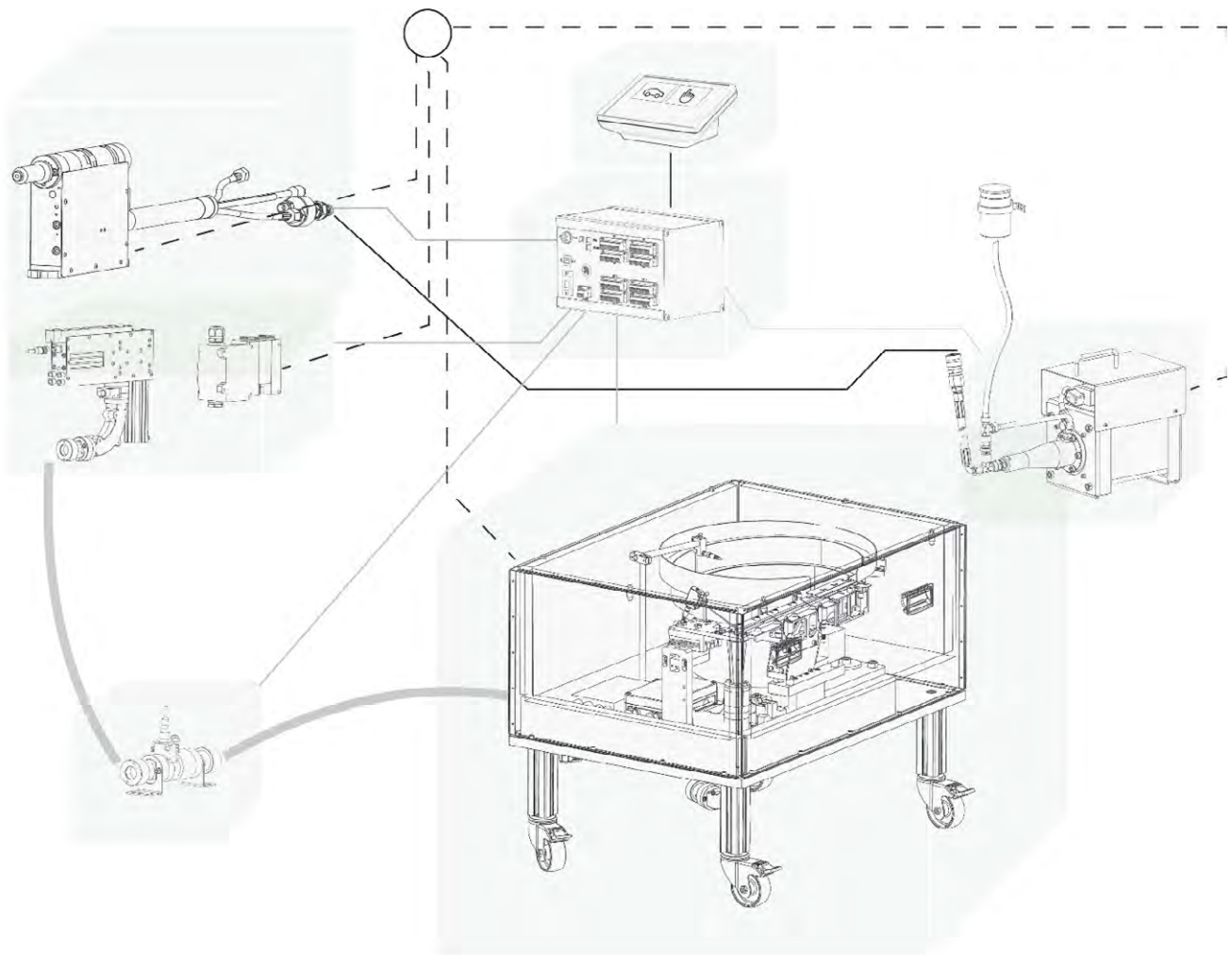
Air supply

Figure 1 Interconnection of the SAN components (Dashed line - pneumatics, solid black - hydraulics, solid gray - electronic connection, bold gray line – rivet transport)

2.2. Hardware assembly

– Mount the UR robot to the required position. For SAN2 application the orientation of the robot may be arbitrary regarding your particular setup. Connect the robot and UR Control box. During this step, please follow Universal Robots instructions delivered together with the robot
– To connect and assemble the SAN2 system, please follow the document **Equipment Installation** for SAN 2.
  – The rivet charger has to be mounted in the fixed position
  – The riveting head has to be mounted on the robot arm. The mounting plate between the robot TCP and riveting head is provided as a special accessory. When mounting the flange if possible, please follow the orientation showed in Figure 2. This orientation is considered when setting the TCP/Tool coordinates and orientation. In case this orientation does not suit your application (e.g. robot violates its working envelope), different orientation is possible. However, the TCP/Tool orientation has to be setup accordingly
  – Note that if the technical support has been requested during the order, our team will help you with assembly and first startup
– Connect the SANK2 control unit and UR Control box with the Ethernet cable
– Install the SAN2 URCap. For this step, you will need a USB storage device. Download the URCap available at https://www.titgemeyer.com/en/tools-automation/service/download-center/ and save it to a USB storage device. Insert the USB storage into the robot panel and install the URCap from Settings – System - URCaps menu. Press the + button and navigate to the URCap file on your USB storage device. After the installation the robot has to be restarted
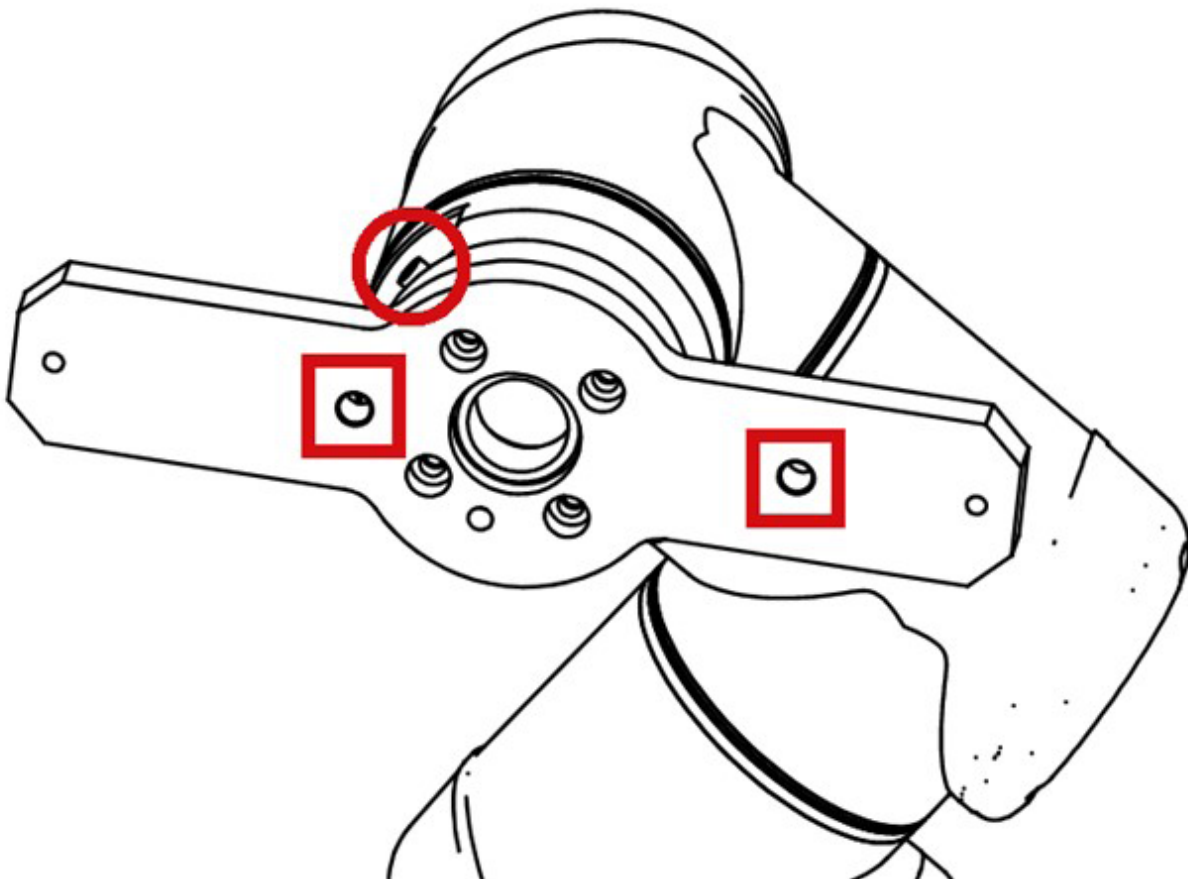

Figure 2 Standard orientation of the flange mounted on the robot arm

2.3. Software setup

Before the robot is started together with the riveting system, it is necessary to setup the tool coordinates and orientation and also configure the SAN2URCap for successful communication with the SAN2 system.

First of all, the TCP has to be set. It is recommended to create a new tool and name it e.g. "SAN2RH" or "RivetingHead". Regarding the standard assembly orientation depicted in Figure 2, all TCP values are shown in Figure 3. If the riveting head does not follow the standard orientation, new values has to be entered. Recommended way to compute them is to use the Wizard.

In any case, the proper Payload of 5.55 kg has to be filled in. Also the center of gravity coordinates must be entered. Otherwise the robot may encounter unexpected protective stop and also its hardware may be damaged by calculating with improper weights and forces. This has to be fulfilled even if a new tool is not created and any position in the program is related to the robot base or original TCP.
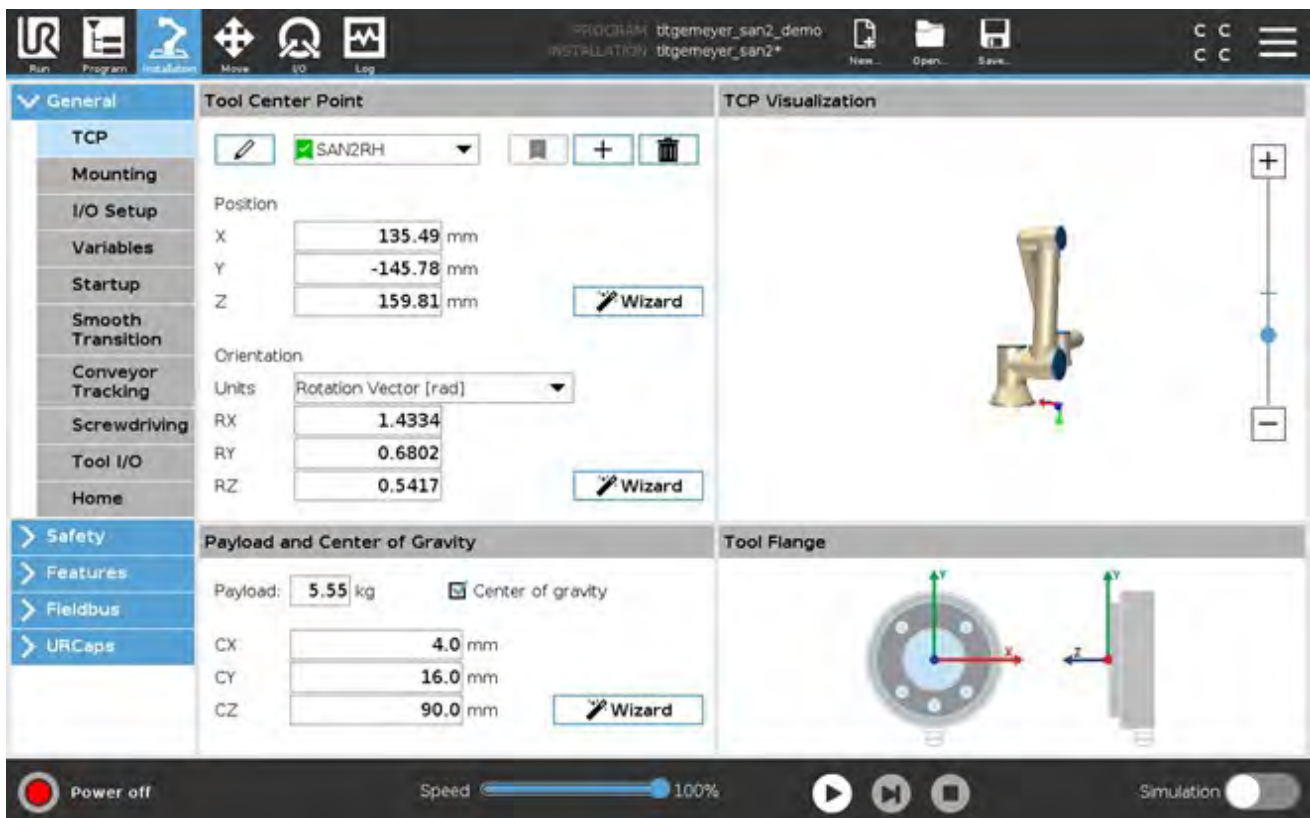

Figure 3 TCP settings for standard SAN2 head orientation

After the TCP is set, SAN2 Setup (URCap installation node) has to be configured.

The setup screen is shown in Figure 4. It contains following options:

– Setup SAN2 – this checkbox allows generation of the URScript code with SAN2 setup functions. When checked, the setup script is generated. In case the setup is not enabled, the program nodes become undefined and warning will be displayed in each program node, see Figure 5 for illustration.

– SAN2 online status – next to the Setup SAN2 checkbox a connection status is shown.
This indication shows availability of the device at IP address specified below

– Select log level – Level of the messages written to the robot Date Log

– SAN2 IP Address – IP address of the riveting system control unit SANK2 (SAN2 IP address can be set using SANLCD, see the SAN instruction manual). If the IP address is set and the robot has been launched for the first time after the boot, it is necessary to restart the daemon (or the whole robot) – IP address is passed to the daemon. The daemon then creates the connection and keeps it. Therefore, if the IP address is changed during the duty, a robot restart may be required to continue

– Inputs update frequency [Hz] – Modbus messages rate. This rate determines, how often per second the robot asks SAN2 for input states. Possible values are 1 – 125. Reasonable values are, however, between 10 and 25. These values provide fast performance and do not overload the communication channels.

– Timeout of ready [s] – When the SAN2 is switched to the AUTO mode, it is also commanded to get to the home position. When in AUTO mode and in home position, the SAN2 reports READY signal. Timeout of ready determines how long does the URCap wait for the ready signal before the error is reported.

– Daemon is running – information checkbox about the current running state of the daemon.
If the daemon is running, the box is checked. Beside the additional state information is displayed.

– Reset daemon – button to reset the daemon for any case of trouble.
The button blocks the UI for a while, but at most for 14 seconds.

– Hint – at the bottom of the screen, there is a legend available for all the settings of SAN2 Setup node.
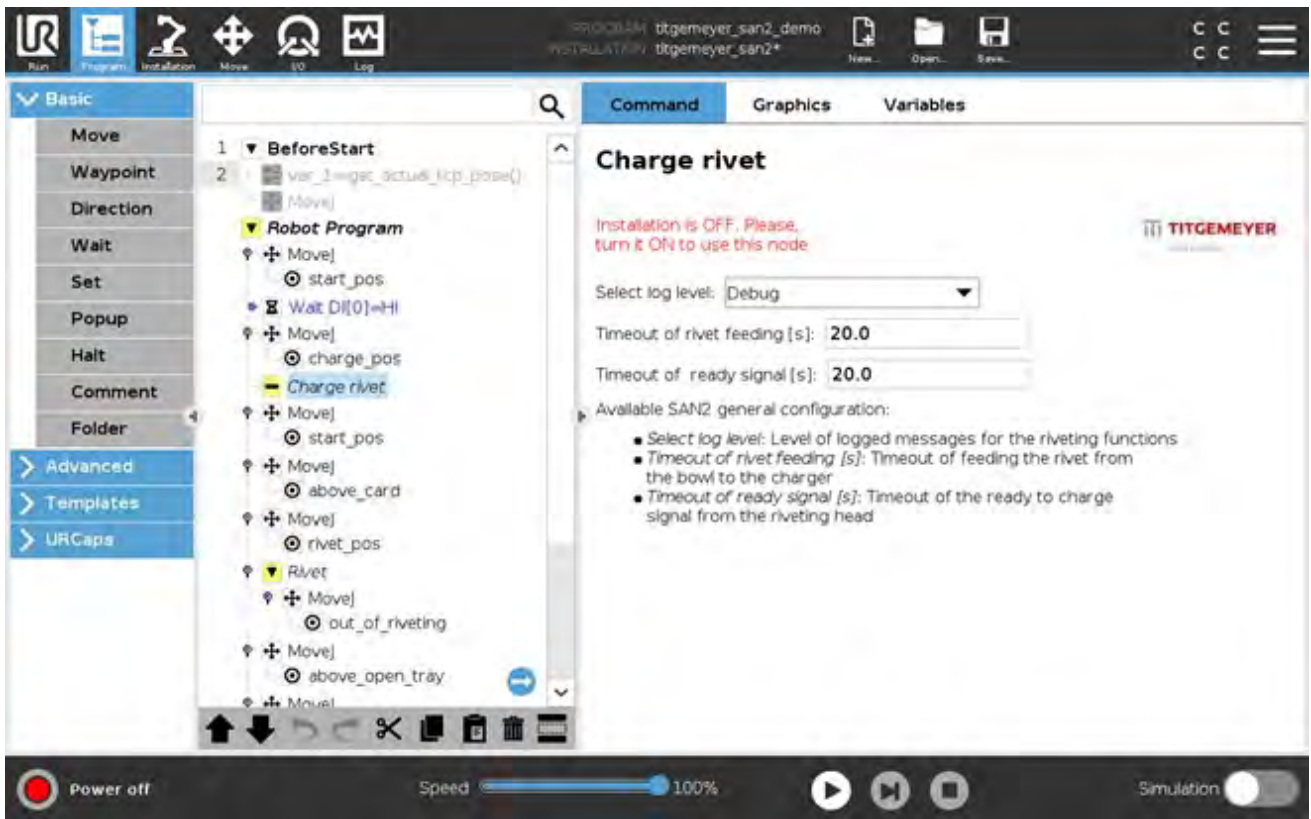

Figure 4 SAN2 Setup

Figure 5 Example of a program node when Setup SAN2 has not been enabled

3. Programming the robot

The provided solution offers two program nodes that may be used in the robot program:

– Node Charge rivet
– Node Rivet

Both can be found in the URCaps pallet when creating a robot program. General rules for using the node are:

– To use either of the nodes, Setup SAN2 has to be enabled. Otherwise, the program nodes will be undefined (indicated by a yellow icon in the program tree and red warning in the charge or rivet nodes).
  For example see Figure 5.
– Any charge node has to precede the rivet node
– There cannot be two same succeeding nodes (e.g. two riveting nodes, when no changing node has been used)
– When a node is used, it has to follow requirements and recommendations listed at the node

Please note, that the riveting head is a heavy end effector. To prevent a damage to the robot in power-off mode, move the robot to a suitable home position. A suitable position may vary depending on your application. Generally a safe home position is a position, where the joint brakes are stressed with as low force as possible. For a vertical installation of the robot is the best home position the one recommended by Universal Robots.

3.1. Charging Node

The charge rivet node performs rivet charging from the charger to the head. Therefore, before this node is invoked in the UR program, the robot has to be in the charging position. The charging position is considered when the head in front of the charger, riveting axis in the axis of the charger ejector. Also the distance of the riveting head from the charger has to be adjusted according to the utilized rivet (height of the rivet head + 3 to 5 mm from the ejected ejector). When the riveting position is reached, charge rivet can be called. Further information about the charging can be found in document **Equipment Installation**.

In case the rivet mandrels are bended and cause problems during the charging, please consider using Charge rivet node in the Force mode. The Force mode then may allow the head to adjust the head position according to the rivet.

Available options are:

– Select log level – Level of the messages written to the robot Date Log
– Timeout of rivet feeding [s] – At the beginning of the riveting process, the rivet has to be transported from the vibration bowl to the charger. Timeout of rivet feeding determines a timeout of this action. If the rivet is not ready in the charger until this timeout runs out, the error is thrown. Reasonable values are between 10 and 20.
– Timeout of ready signal [s] – Before the charging starts, the SAN2 system has to report READY state (e.g. after home position command or after the previous riveting cycle). Timeout of ready signal defines how long the robot wait for the READY signal until the error is reported. Reasonable values are between 10 and 20.
– Hint – at the bottom of the screen, there is a legend available for all the settings of SAN2 Charge rivet node.
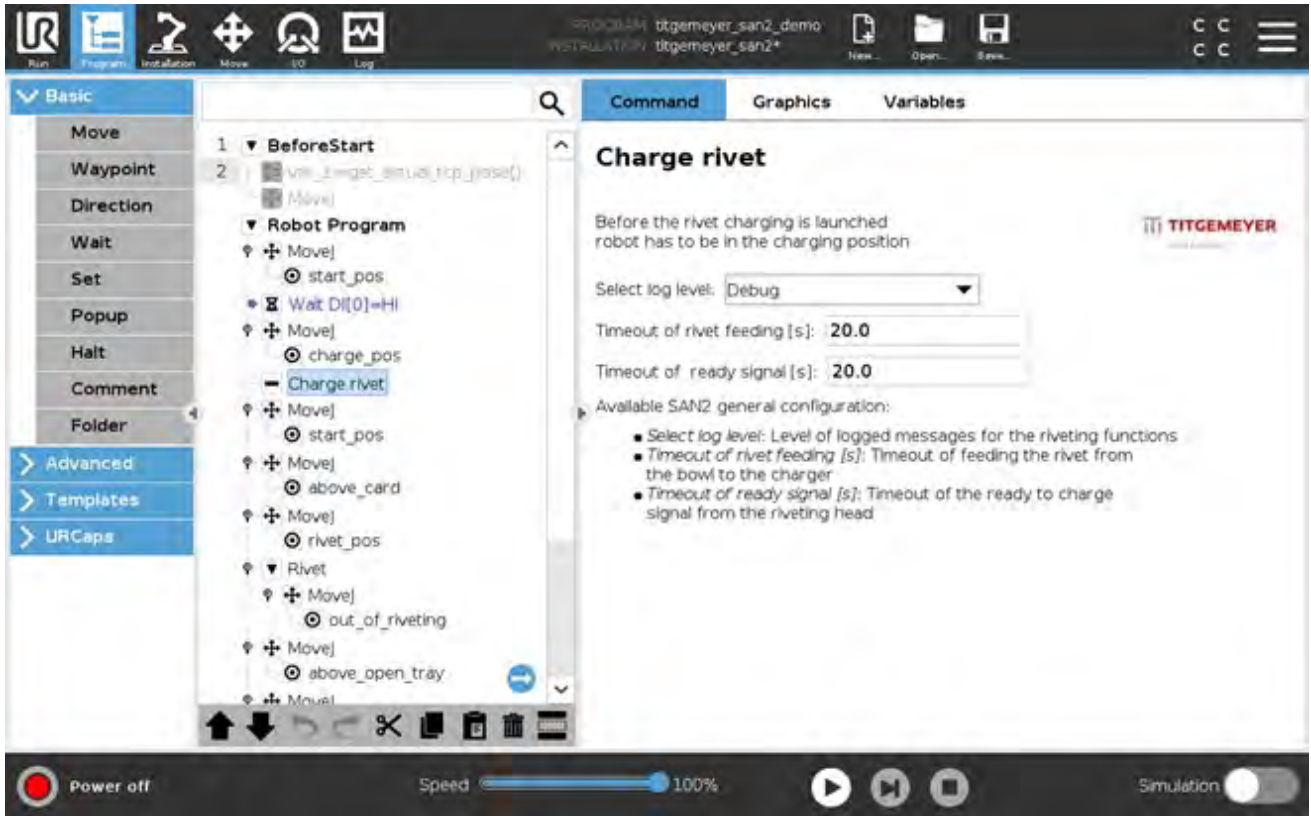
Figure 6 Charge rivet - program node

3.2. Riveting Node

Before the rivet node is call in the UR program, the robot has to be ready in the riveting position – i.e. the rivet has to be inserted into the hole. It is recommended to place the rivet node in the Force sequence to assure sufficient pressure of the riveting head to the material and also to prevent robot damage or protective stop.

The rivet node contains one MoveJ command. Position of this move shall be at least 1 cm above the riveted material to prevent the rivet mandrel to get stuck in the set rivet (the mandrel may come out of the nose piece when being released).

Available options of the node are:

– Select log level – Level of the messages written to the robot Date Log
– Timeout of riveting [s] – This timeout watches the riveting process in a case of any trouble. The time is measured from the moment the riveting is enabled. If there is any problem and the timeout runs out, the error is reported.
– Timeout of parameter set [s] – For each riveting a different parameter set can be selected. Therefore in each riveting node the parameter set is setup. If there is no response from the SAN2 system with confirmation of the selected parameter set, the timeout runs out and an error is reported. Reasonable value is between 3 and 20.
– Timeout of rivet charging [s] – This timeout watches the process of the charging the rivet from the charger to the riveting head. If the timeout is exceeded, an error is reported. Reasonable value is between 5 and 20.
– Select parameter set – Specified parameter set for the particular riveting. Up to 4 sets can be configured and used for e.g. different material thickness. The parameter set can be configured in SanAssist application supplied together with the SAN2 system. In case the evaluation module of the SAN system is disabled, please select arbitrary parameter set (other than None) – this does not affect the riveting function.
– OK/NOK indicators – next to the Select parameter set combo box, two indicators are available. These indicators show the last result of the rivet evaluation – OK (active green) and NOK (active RED). In case an error occurred or the machine has not set the rivet yet, both OK and NOK are painted gray, see Figure 7, Figure 8 and Figure 9 **Chyba! Nenalezen zdroj odkazů.**. The results of the evaluation are also available as global variables for further use. The variables' resolvable names are tta_rivet_evaluation_ok and tta_rivet_evaluation_nok. Example of variable further use is shown in Figure 10. In this example, the tta_rivet_evaluation_nok variable is checked in the IF condition and in case the rivet has been NOK, the program is paused and operator is informed by a popup message. Note, that the variables will not be updated if the evaluation module is not enabled.
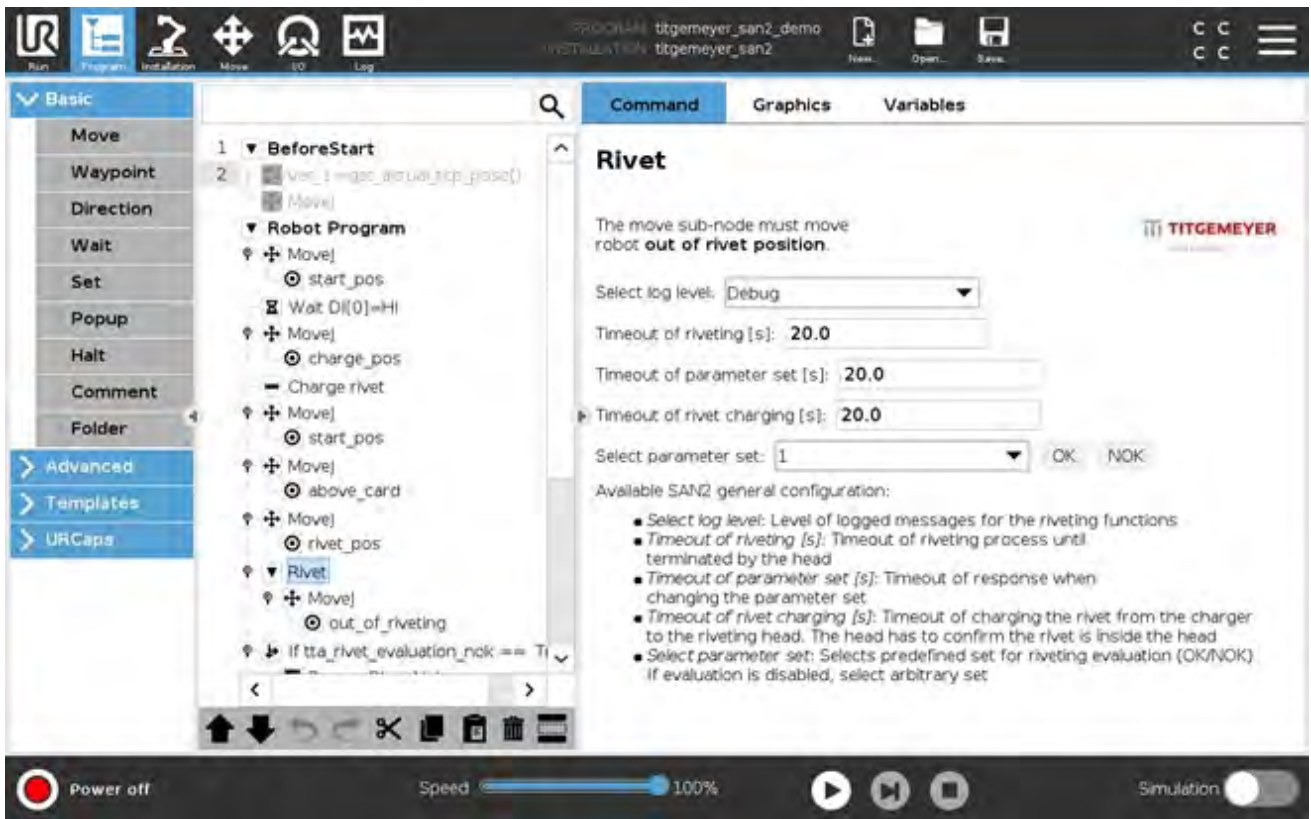– Hint – at the bottom of the screen, there is a legend available for all the settings of SAN2 Rivet node.
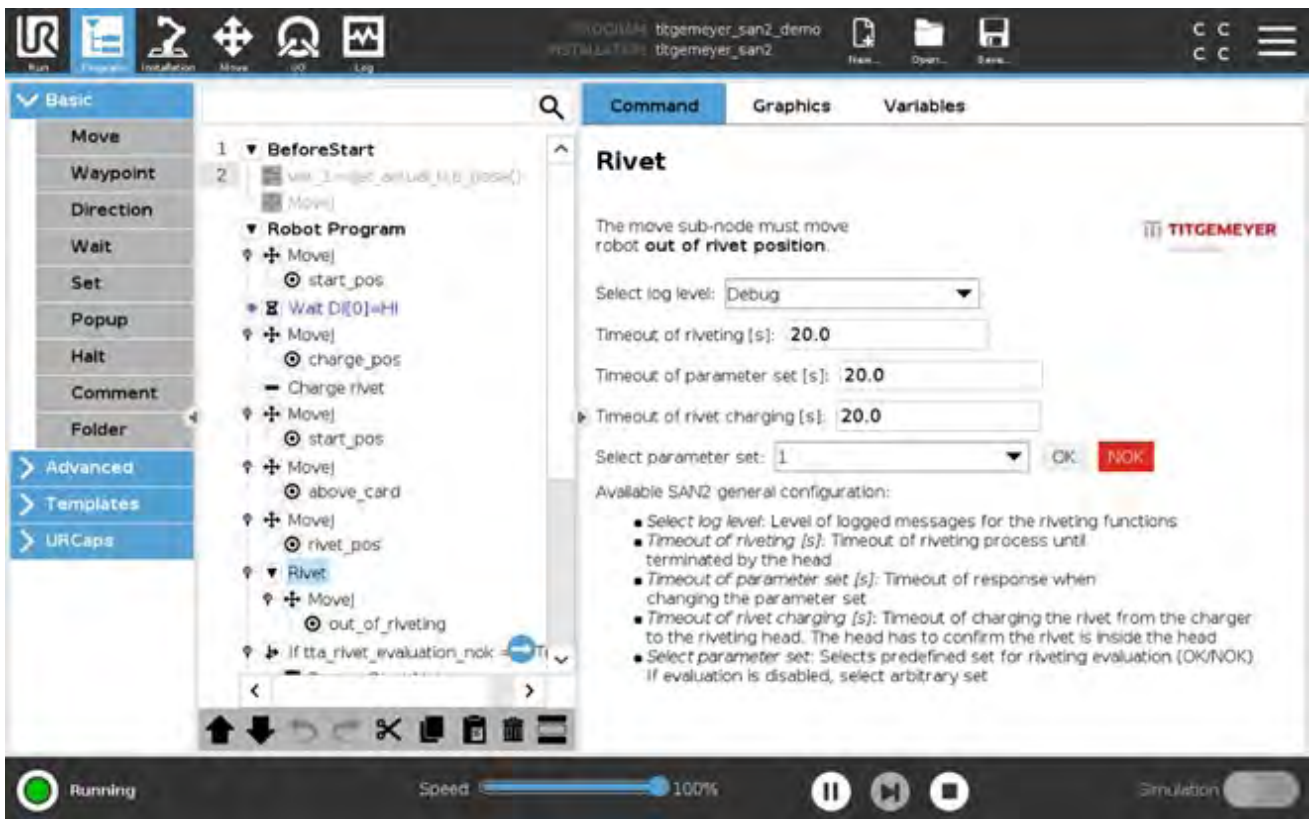
Figure 7 Rivet - program node (Polyscope 5)

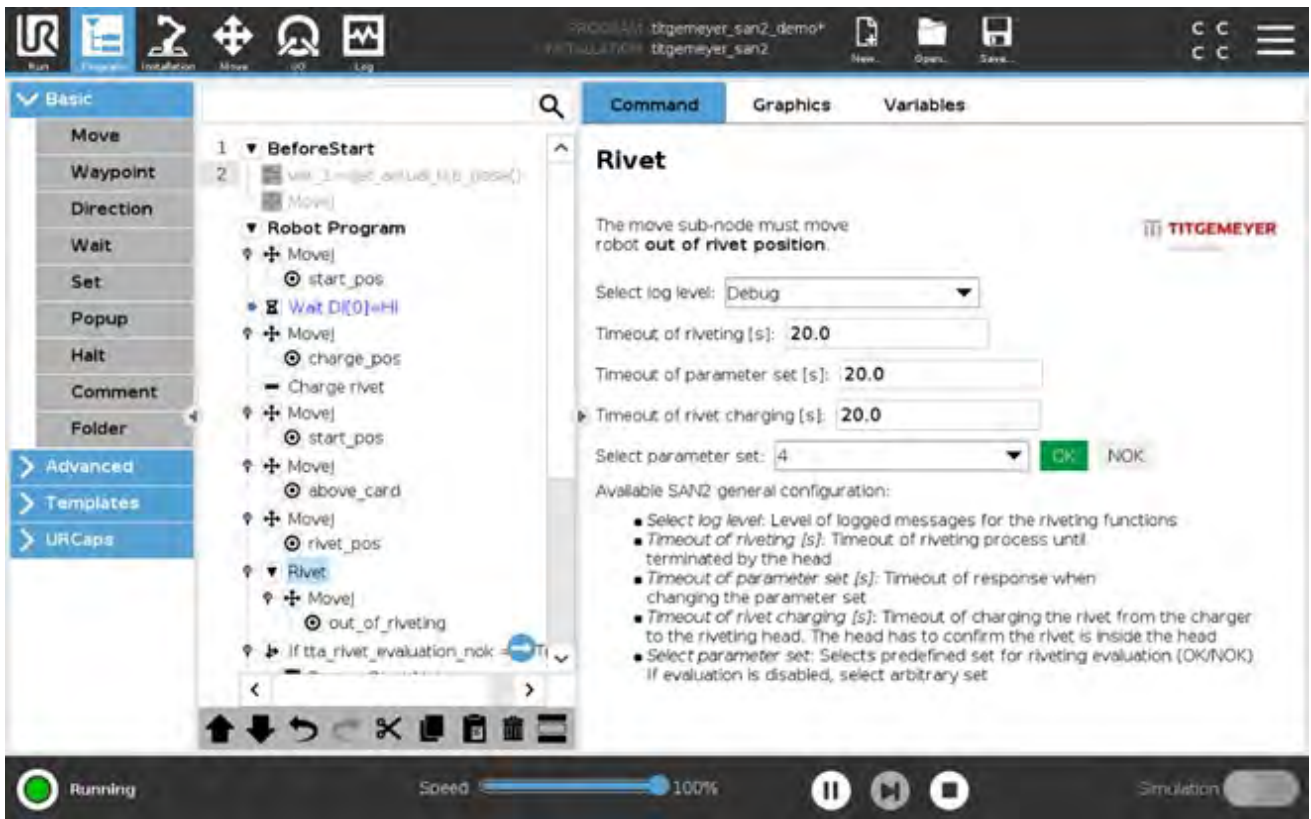Figure 8 Rivet node with NOK result active
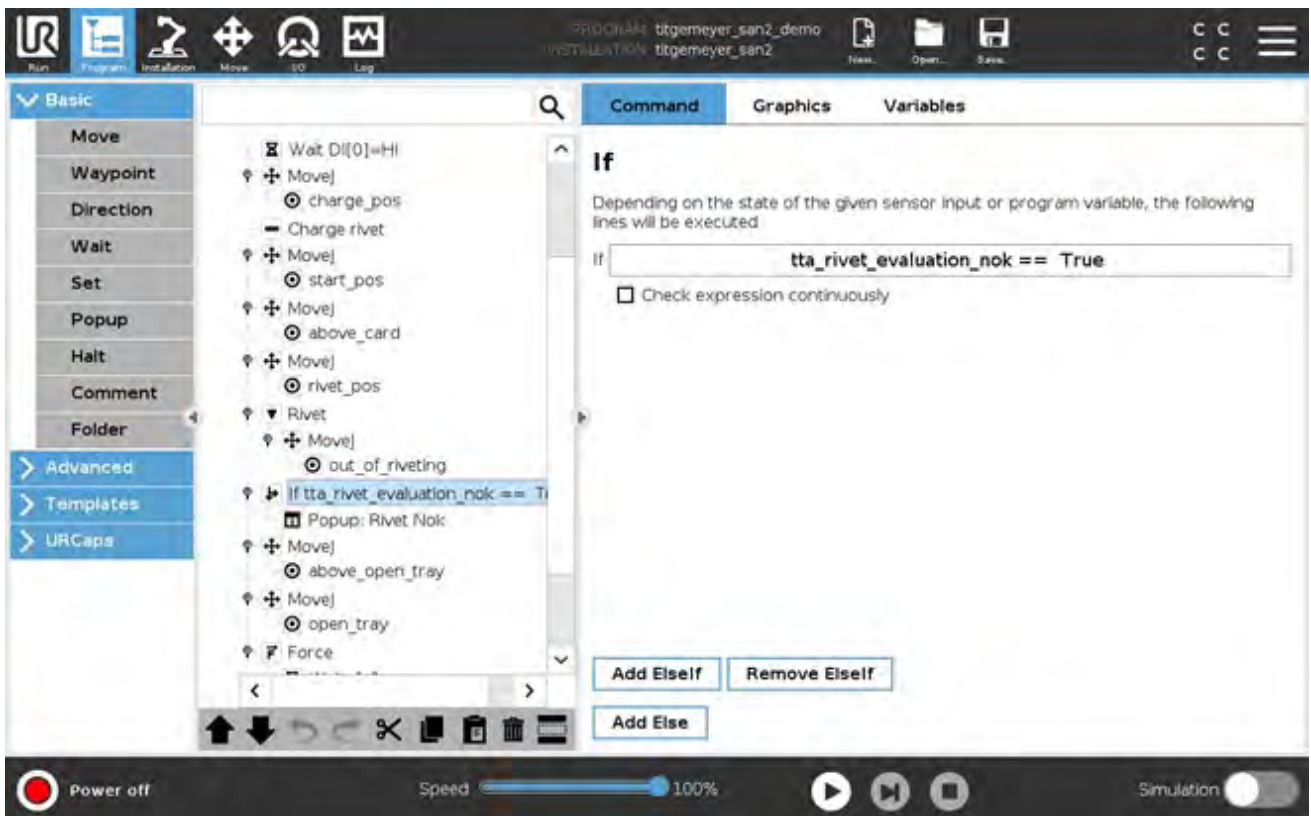
Figure 9 Rivet node with OK result active

Figure 10 Further use of the provided global variable

4. Example UR robot program

As a simple startup program for the UR robot the following sequence may be used:

– MoveJ – move the robot to the starting position
– Wait – wait for digital input that indicates presence of the product to be riveted
– MoveJ – move to the charging position
– Charge rivet – charge the prepared rivet to the riveting head
– MoveJ – move to the riveting position
– Rivet – set the rivet to the product
    – Do not forget to setup a proper "Out of rivet position" at least 1 cm above the riveted material
– If condition – check the result of the riveting. If NOK, pause the process and inform the operator
    – Popup subnode – information about NOK riveting result
– Go to start