

SCAPE Mini-Picker Quick Guide



For Universal Robots

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INTRODUCTION

This Quick Guide is the documentation for SCAPE Mini-Picker products.

Tool Units

The SCAPE Mini-Picker is the easy way to bin-picking. The package includes a complete “Tool Unit” and all the necessary software to perform bin-picking. The Tool Unit includes a 3D sensor and is ready to be mounted directly on the robot.

The SCAPE Mini-Picker Tool Unit also contains two grippers: A suction cup gripper and a finger gripper. PC and all necessary software to get started are included.

Overview of Manual

This manual will guide you through the steps needed to get the system up and running. The manual is divided into the following main topics:

- Contents of package
- Installation of hardware
- Installation and setting up SCAPE URCap
- Calibrating and Measuring the Workcell
- Running bin-picking and teaching place movements with included example parts
- Introduction to training of new parts

Videos

Our videos serve as a helpful tool for installing your SCAPE Mini-Picker. It is recommended to read this document as a PDF on a PC with internet access. This way it is possible to click directly on the links to the videos. However, QR-Codes are also included so it is possible to use a mobile phone to watch the videos in an easy way.

New Versions of the SCAPE Software and this manual can always be found on the Scape Customer Portal under: <https://www.scapetechnologies.com/customer-portal>

2 PREREQUISITES

The following parts are necessary for the Mini-Picker

- Robot: UR10 or UR16.
- Ethernet connector (Modbus is used)
- Compressed air: Min. 3 bar, 25 liter/minute
- Connector between compressed air and $\varnothing 6$ tube

A PC is included with the SCAPE Mini-Picker system. The following must be available:

- Monitor
- Keyboard
- Mouse
- Internet – required for remote assistance

IMPORTANT: PC comes without a Wi-Fi card or dongle, so if only Wi-Fi/WLAN is available, one of these needs to be provided by the customer.

Recommendation: Brackets to mount the included energy chain along the robot arm.

3 CONTENT OF THE SCAPE MINI-PICKER PACKAGE

Below is a complete detailed overview of all included hardware and software contents for the SCAPE Mini-Picker.

3.1 SOFTWARE

The following SCAPE software is installed on the SCAPE Controller PC but also available in the folder "SCAPE Resources" on the desktop:

- OP11-03 SCAPE 3D Orientation Control™ (part of SCAPE Bin-Picking Suite (x64).exe)
- OP13-08 SCAPE Grid Scanner Recognition™ - Compact (part of SCAPE Bin-Picking Suite (x64).exe)
- OP17-03 SCAPE Automatic Self Test™ (part of SCAPE Bin-Picking Suite (x64).exe)
- TC10-01 SCAPE Part Training Studio™ (part of SCAPE Bin-Picking Suite (x64).exe)
- Drivers (in folder "Drivers")
- SCAPE Robot Program (in folder "SCAPE Robot Program")
- SCAPE Workcell - preconfigured (in C:\SCAPE\Workcell)
- Example Product Files (in C:\SCAPE\Products\SmallAngleTube)
- Splashtop (enables remote support)

3.2 HARDWARE

PC10-20 SCAPE Controller PC:

- Intel Core i5-13400 Ten Core processor
- 16 GB DDR4 2666 MHz RAM
- 1 TB NVMe SSD Hard disk
- Gigabit LAN
- HDMI, Display Port, and D-Sub Port
- 3 x USB 3.2 Gen 1 ports, 6 x USB 2.0 ports
- SCAPE USB License Dongle (needed to run the SCAPE software).

Note: the PC specifications may change without notice. The above specifications are the minimum regarding processing power, memory, and storage space.

IMPORTANT: A screen and peripherals are not included but are needed to control the SCAPE software!

3.3 TOOL UNIT

The following is a list of components on the Tool Units included in the product:

- Grid Scanner – Compact
- Ejector to create suction from compressed air.
- A valve to turn on/off the suction.
- Energy chain holder with energy chain (IGUS I-PCLT-36B)
- Interface plate for mounting on the UR robot.
- I/O module (passive)
- TCP Pointer
- All needed cables.
- Suction Cups (round, 2 of each):

Diameters [mm]							
Ø5	Ø 7	Ø 9	Ø12	Ø 14	Ø 17.5	Ø 20	Ø 25

- Suction Cup and finger gripper mounted on pneumatically controlled “sliders” so they can be moved forward automatically when the system needs them. Also works as collision control.
- Tool Unit Controller including a valve manifold, Modbus system, and power supply.

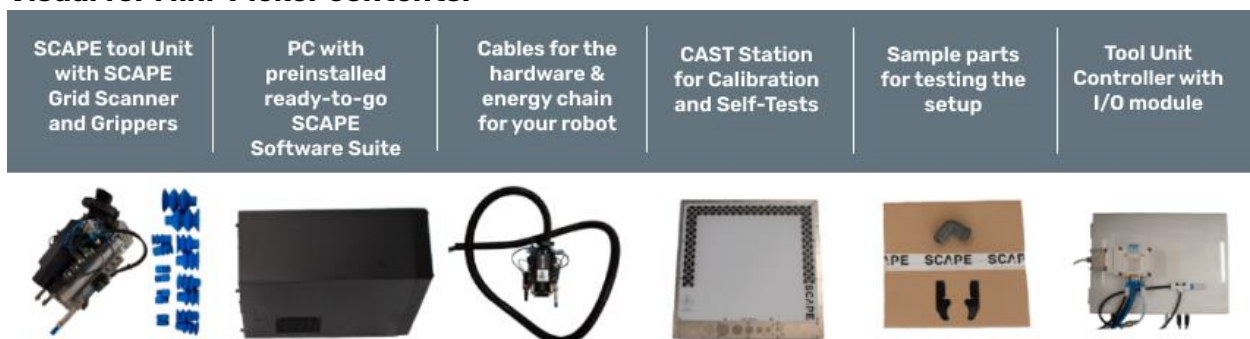
3.4 OP17-03 SCAPE AUTOMATIC SELF TEST

- CAST Station plate

3.5 EXAMPLE PARTS

- 20 pieces of “Angle Tube” example parts. Pretrained product included for testing.
- Precision grip sample fingers for the “Angle Tube” are included.

Visual for Mini-Picker contents:



4 HARDWARE INSTALLATION

4.1 TOOL UNIT - INSTALLATION AND MOUNTING

IMPORTANT: The robot must be mounted in an upright position, where the mounting plate is parallel to the floor.

The Tool Unit is supplied with an interface fitting the flange on the UR robot. The interface plate includes a precision pin which means the Tool Unit can only be mounted with one specific orientation.

To mount the Tool Unit, bring the robot into a position similar to figure 1, so that the mounting screws can be reached better. The screws should be mounted as seen in figure 1.

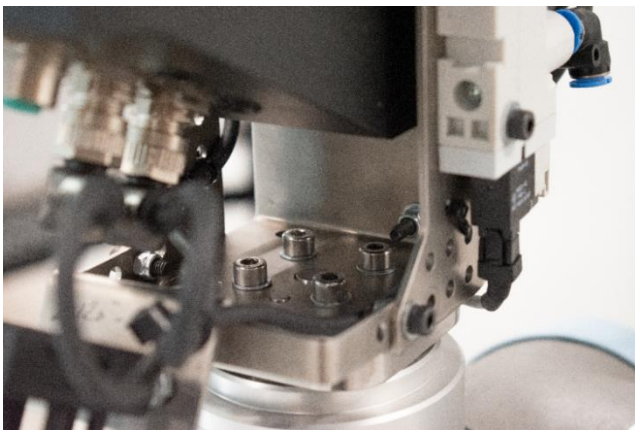


Figure 1: Mounted screws and precision pins

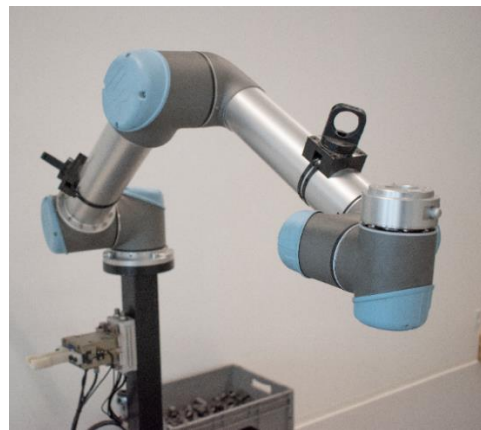


Figure 2: Robot position for mounting of Tool Unit

An energy chain is mounted on the Tool Unit. It is an IGUS PMAFLEX PC chain, configuration "igus i-pclt-36b". Energy chain brackets to mount the chain along the robot arm are not included. The energy chain can be mounted with cable ties; however, it is recommended to use some kind of brackets to minimize the wear and tear of the energy chain. When mounting the energy chain, make sure there is enough slack (about 500-550 mm) for the cables between the end of the chain and the tool unit. Correct mounting can be seen in figure 3 and 4.



Figure 1: Energy Chain mounted on robot arm



Figure 4: Energy chain with 500-550mm slack

4.2 MOUNT THE CAST STATION (OPTIONAL)

The CAST Station plate (OP17-03) can be mounted in a fixed position. The advantage is that it is then possible to perform recalibrations and measure changed grippers faster. Note, this is not strictly necessary.

If mounted in a fixed position, it must be vertically near the robot in a place where the robot has a good work envelope in front of the plate.

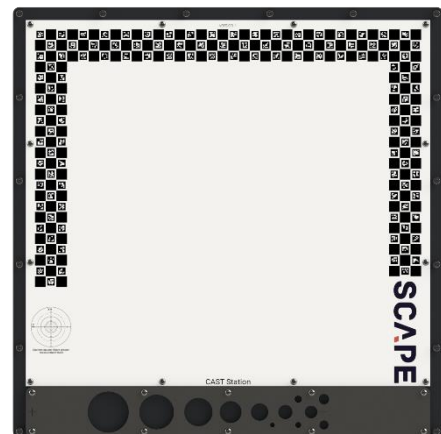


Figure 5: The SCAPE CAST Station

4.3 CONNECTING THE CABLES

Cables and tubes to connect are:

- Ethernet cable for the SCAPE Grid Scanner (going to the SCAPE Controller PC).
- Cable for I/O module with an open end (flying leads). These leads must be connected to the robots I/O's.
- Power cable for the SCAPE Controller PC.
- Ethernet cable between the SCAPE Controller PC and the UR robot.
- Tube (Ø6 mm) for compressed air (min. 3 bar, 25 l/min)
- Ethernet cable for internet connection (optional, needed for remote support)

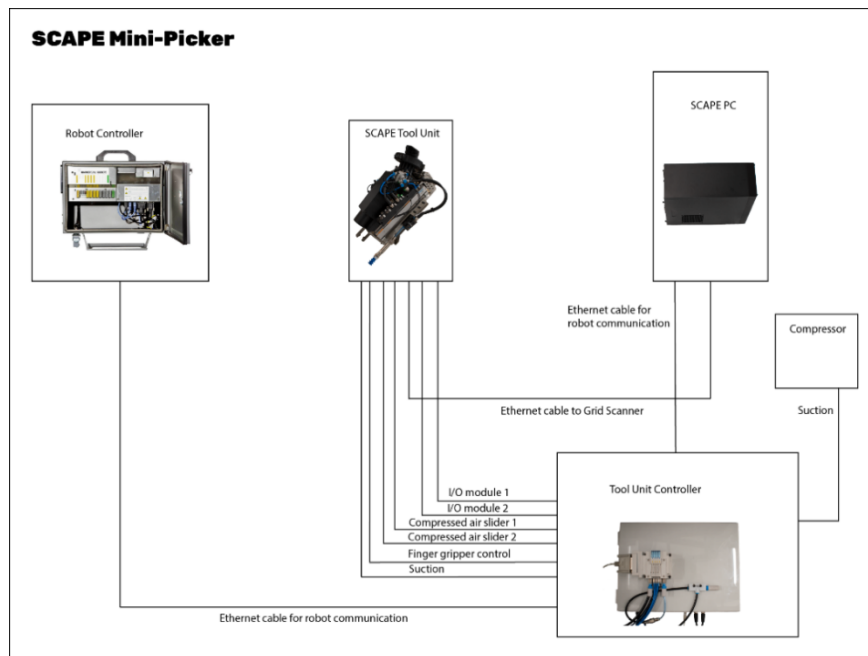
Connecting the flying leads at the end of the cable for the I/O module is done as follows for the SCAPE Mini-Picker:

Left I/O module - is using the Suction Cup

Connection	Wire color	Connector pin no.	Function
+24VDC	Brown	1	Supply voltage (+)
0VDC	Blue	2	Supply voltage (-)
1	White	3	Reserved (input)
3	Green	4	Reserved (input)
2	Yellow	6	Ring Light
4	Gray	8	Projector
5	Pink	5	SC Vacuum
6	Red	9	Slider 1 Forward
7	Black	7	Slider 1 Back
8	Violet	10	Slider 1 Collision
NC	Gray/Pink	11	
NC	Red/Blue	12	

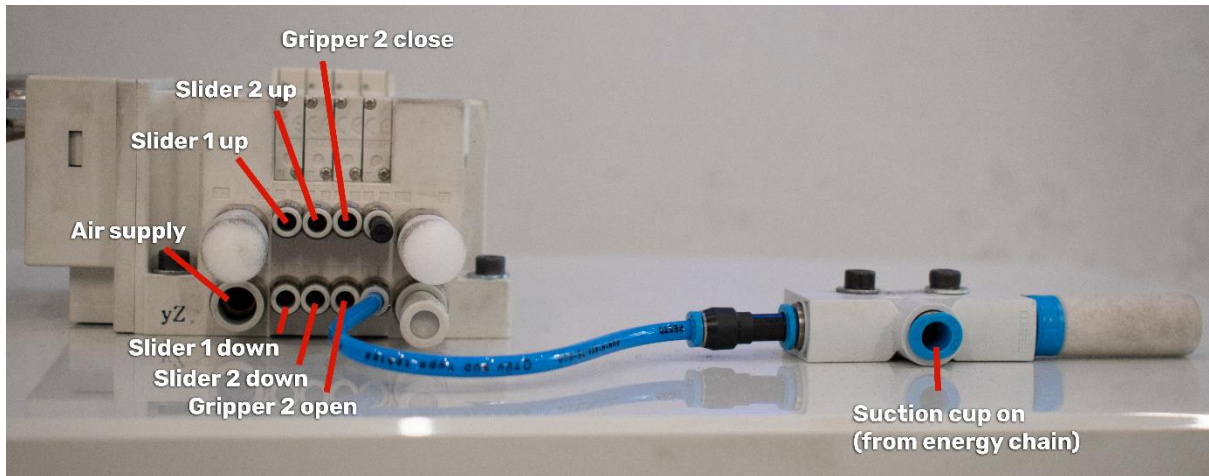
Right I/O module – is using the Finger Gripper

Connection	Wire color	Connector pin no.	Function
+24VDC	Brown	1	Supply voltage (+)
0VDC	Blue	2	Supply voltage (-)
1	White	3	Gripper Open
3	Green	4	Gripper Close
2	Yellow	6	Reserved (output)
4	Gray	8	Reserved (output)
5	Pink	5	Reserved (input)
7	Red	9	Slider 2 Forward
7	Black	7	Slider 2 Back
8	Violet	10	Slider 2 Collision
NC	Gray/Pink	11	
NC	Red/Blue	12	



4.4 CONNECTING THE TOOL UNIT CONTROLLER

A separate Tool Unit Controller is included, to handle all the Inputs and Outputs. The connections for the pneumatic fittings can be seen here:



When everything is connected, it should look something like this:



5 INSTALLING AND SETTING UP THE SCAPE ROBOT PROGRAM

The SCAPE robot program is provided as a “URCap” implementation. Files can be found on the supplied PC.

The video:

Installing and setting up SCAPE Robot Program

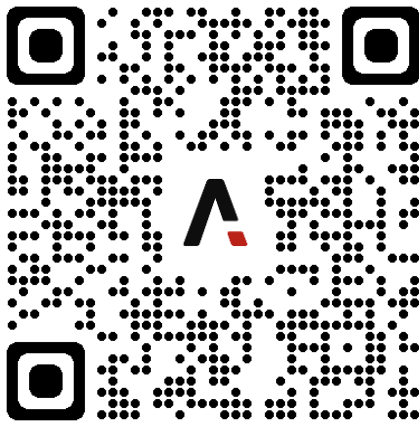
Contains complete instructions on how to:

- Install the program
- Initialize robot
- Configure and test I/O's
- Measure the TCP

URe robots

SCAPE Mini-Picker Documentation

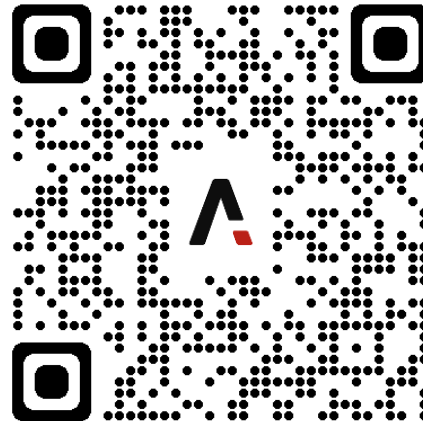
(Playlist)



UR CB-Series robots

SCAPE Mini-Picker Documentation

(Playlist)



Scan the QR-Code or click the images to see the videos for the UR robots

6 SOFTWARE ON THE SCAPE CONTROLLER PC

The supplied SCAPE Controller PC is installed with the following software:

- Windows 10 or Windows 11 (64 bit)
- SCAPE software and drivers (drivers are in the folder “SCAPE Resources/Drivers”)
- Quick Guide documentation (this document) (in the folder “SCAPE Resources/Documentation”)

6.1 SCAPE Bin-Picking Suite™

The installed SCAPE applications found on the desktop are:



SCAPE Calibration Manager™: For configuring all the units in a Workcell, such as the robot, cameras, grippers, light sources, and sensors. This is already done when you open the application. It is also in this application that measuring the locations of units in the cell and calibrating sensors take place.

SCAPE Bin-Picking Manager™: Run-time unit during bin-picking. It controls the starting and stopping of bin-picking system and changing of products (the parts to be picked).

SCAPE Part Training Studio™: For training new parts based on a CAD files or by scanning the parts. It includes the recognition and gripping of the parts.

In addition, there is a service running in the background (started automatically):

SCAPE Communication Server™: For communication between SCAPE and the UR robot. Connection to the UR robot has already been configured.

If the applications need to be re-installed or updated, please refer to the documentation “SCAPE Software Installation & Maintenance Manual”.

6.2 DRIVERS FOR SCAPE GRID SCANNER RECOGNITION™

Necessary drivers are installed:

- FlyCapture_2.11.3.121_x64.exe

For re-installing please refer to “SCAPE Software Installation & Maintenance Manual”.

7 WORKCELL SETUP

The following sections and videos describe how to set up a Workcell so that it will be ready for part training.

7.1 TEACHING ROBOT MOVEMENTS

A few fixed robot movements must be taught. They cover the movements between the bin, the Handling Station (if present) and the final place position.

The video:

Teaching Robot Movements

Shows which waypoints to teach and how to do it.

The points to be taught are:

- Waypoints for bin-picking movements and Handling Station movements (optional).
- Teach waypoints towards and from place movements.

Please Note:

Be attentive with the joints' positions at waypoints. Energy chains placed in a restrictive area can block robots' future movements.

7.2 CALIBRATING AND MEASURING THE WORK CELL

The video:

Calibrating and measuring the Workcell

Shows what needs to be calibrated and measured and guides you through the process.

Open the SCAPE Calibration Manager. It is already installed with a Workcell configuration containing all the items in the SCAPE Mini-Picker product.

Now follow the video guide.

Just to give a short overview, here are the topics:

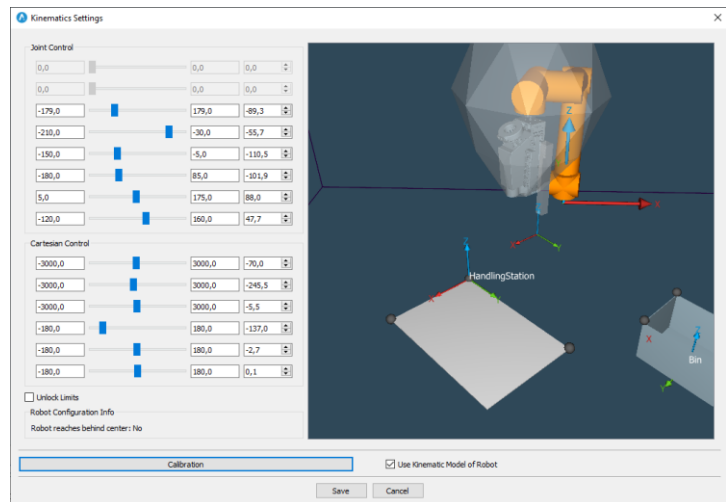
- Calibrating the Kinematics of the robot
- Measuring a new bin (adding bins is explained in more detail in the Appendix)
- Measuring the Handling Station (If needed in the application)
- Defining Workspace (optional)

- Calibrating the Grid Scanner
- Measuring the Suction Cup

Although the suction cups and finger gripper are already measured in the delivered Workcell it is highly recommended to measure them again. They may not be in the exact same position.

Please Note:

Measure two corners alongside the long edge of the handling station, which is closest to the robot. The third corner measured should be the corner, which is on the right side of the robot, when robot is facing the long edge of the Handling Station. Here is how it should look like in the SCAPE Software:



7.3 RUNNING BIN-PICKING AND TEACHING PLACE MOVEMENTS

- Close the SCAPE Calibration Manager and open the SCAPE Bin-Picking Manager.
- The program will load up the example product file for the test parts by default. (named Angle Tubes)
- Choose the 'Teach place position for the part' task and run the program.

The example product is included just to make sure that you can check that the full system is working.

Caution: Ensure that the TCP pointer on the robot is dismantled before start-up!

The video:

Running Bin-Picking and Teaching Place Movements

Shows how to:

- Teach waypoints for place movements (with and without Orientation Control)
- Open SCAPE Part Training Studio for the first time, and select 'MyNewBin'
- Run Bin-Picking

8 TRAINING PARTS

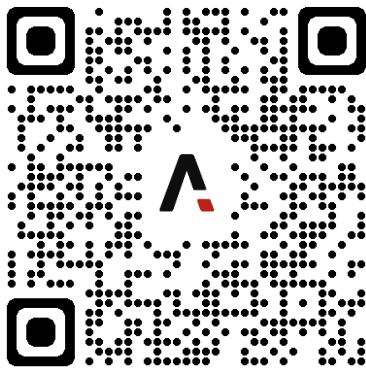
In the following section, you can find information on how to train new parts for Bin-Picking and Orientation Control.

8.1 TRAINING A NEW PART FOR BIN-PICKING

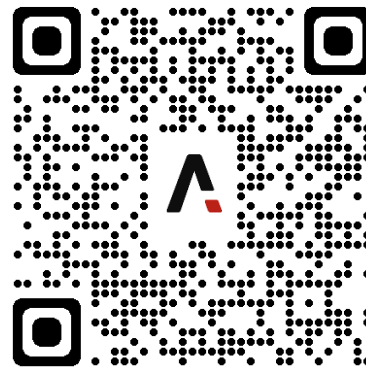
Close the SCAPE Bin-Picking Manager and open the SCAPE Part Training Studio.

The videos:

**Quick Guide on
Training Parts for Bin-Picking**



**Quick Guide on
Guaranteed Precision Gripping**

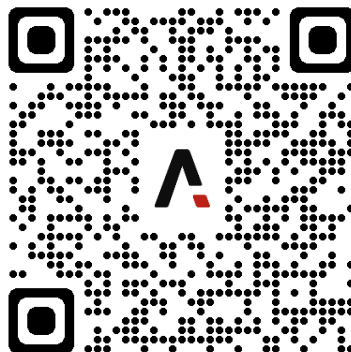


Scan the QR-Code or click the image to see the Quick Guides

Will guide you through how to teach a new part.

To learn about setting up AI Verification view our video:

**SCAPE 3D Orientation Control with
Artificial Intelligence (AI) Verification**



Scan the QR-Code or click the image to see the video on AI Verification

8.2 3D ORIENTATION CONTROL

The Mini-Picker include the module “3D Orientation Control” (OP11-03). With this module it is possible to guarantee a precision grip before final delivery which again can guarantee precision delivery.

Physically this module consists of a white plate called a “Handling Station”. By default, it has the dimensions 400x800 mm. Can be different size per agreement.

The plate is typically installed next to the bin and flush with the top of the bin (to ensure the robot has enough room to perform the grip). If SCAPE is not 100% sure about the recognition of the part on the table, SCAPE will not attempt to grip it but will instead “reject” it, this can be done in two ways:

1. The system stops and waits for the operator to remove the part.
2. Handling Station plate is tipped automatically (typically the part then slides back into the bin, but it can also be into a “reject”-bin).

For the second solution (which is recommended), Scape can deliver the table with this functionality. Please contact Scape for more information.

HOW TO ADD AND MEASURE HANDLING STATION IN SCAPE CALIBRATION MANAGER

1. Right click [Handling station] and select [Add Handling Station].

The Handling Station Properties dialog will be displayed.

2. Type name and description of the Handling Station.
3. [No Camera] is default in [Stationary Camera Used at this Handling Station].

APPENDIX

A HOW TO ADD AND MEASURE BINS

1. Right click [Bins] and select [Add Bin].

The [Bin properties] dialog with two tabs [General] and [Bin surfaces] will be displayed.

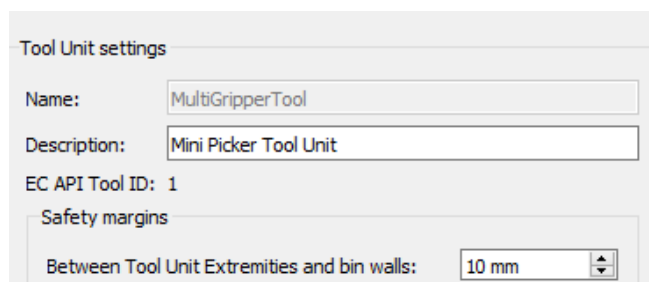
The [Bin properties] Tab [General]

2. Type in name and description in the fields [Name of the Bin] and [Description of the bin].
3. Select [Bin Type]:
 - Bin: Standard bin.
 - Pallet Box: Variable height box built from wooden frames around pallet.
 - Gripping Area Without Sides: No actual bin, but an area in which to pick objects.
4. Select [Inner Height of the Bin] depending on the [Bin Type] chosen:
 - Bin: Type in Inner Height of the Bin.
 - Pallet Box: Type in Number of Pallet Box Frames in use and height of each frame.
 - Gripping Area Without Sides: Type in Maximum Object Height.
5. Click Save to save changes and exit the dialog.

Additional information:

Position of bin and safety margin

The position of the bin must be fixated with a tolerance of ± 5 mm. A safety margin of 5 mm between the Tool Unit Extremities and bin walls is set as default. If it is a possibility that the bins have dented walls exceeding 5 mm and/or the bin fixture has a larger tolerance than ± 5 mm, the safety margin between the Tool Unit Extremities and bin walls should be increased. This is done in the "Tool Unit Properties" tab in SCAPE Calibration Manager.



The [Bin properties] - Tab [Bin surfaces]

The tab [Bin surfaces] dialog can be used to add extra details to the bin model if needed. Features such as rounded corners should be added to the model to avoid collisions. Click Save to save changes and exit the dialog.

B ACQUIRING A POINT CLOUD WITH THE GRID SCANNER

The Grid Scanner may be used as an independent 3D data acquisition sensor. Thus, it includes a functionality that allows the user to acquire point clouds aside from the main bin-picking program.

The point clouds may be visualized in the SCAPE software and saved to disk in a format supported by the Point Cloud Library.

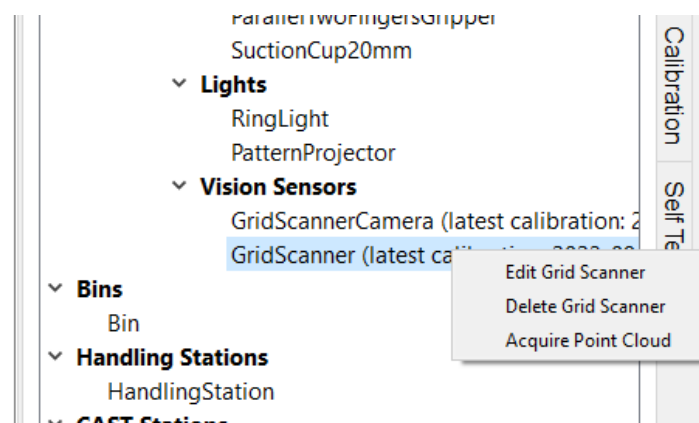
The widespread use of the PCL format allows the user to import the data collected with the SCAPE Grid Scanner in third party software or employ the data for custom made applications.

Individual Point Cloud Acquisition with SCAPE Calibration Manager

SCAPE Calibration Manager allows you to acquire, visualize, and save point clouds individually, one at a time.

It also provides the settings that the user needs to tune for the correct operation of the Grid Scanner, both for the individual as well as the automated point cloud Acquisition.

The point cloud acquisition functionality may be found under the menu options of the Grid Scanner. This section assumes that the Grid Scanner has already been calibrated. In the tree panel on the right side of the main SCAPE Calibration Manager window, right click on Grid Scanner and select "Acquire Point Cloud".

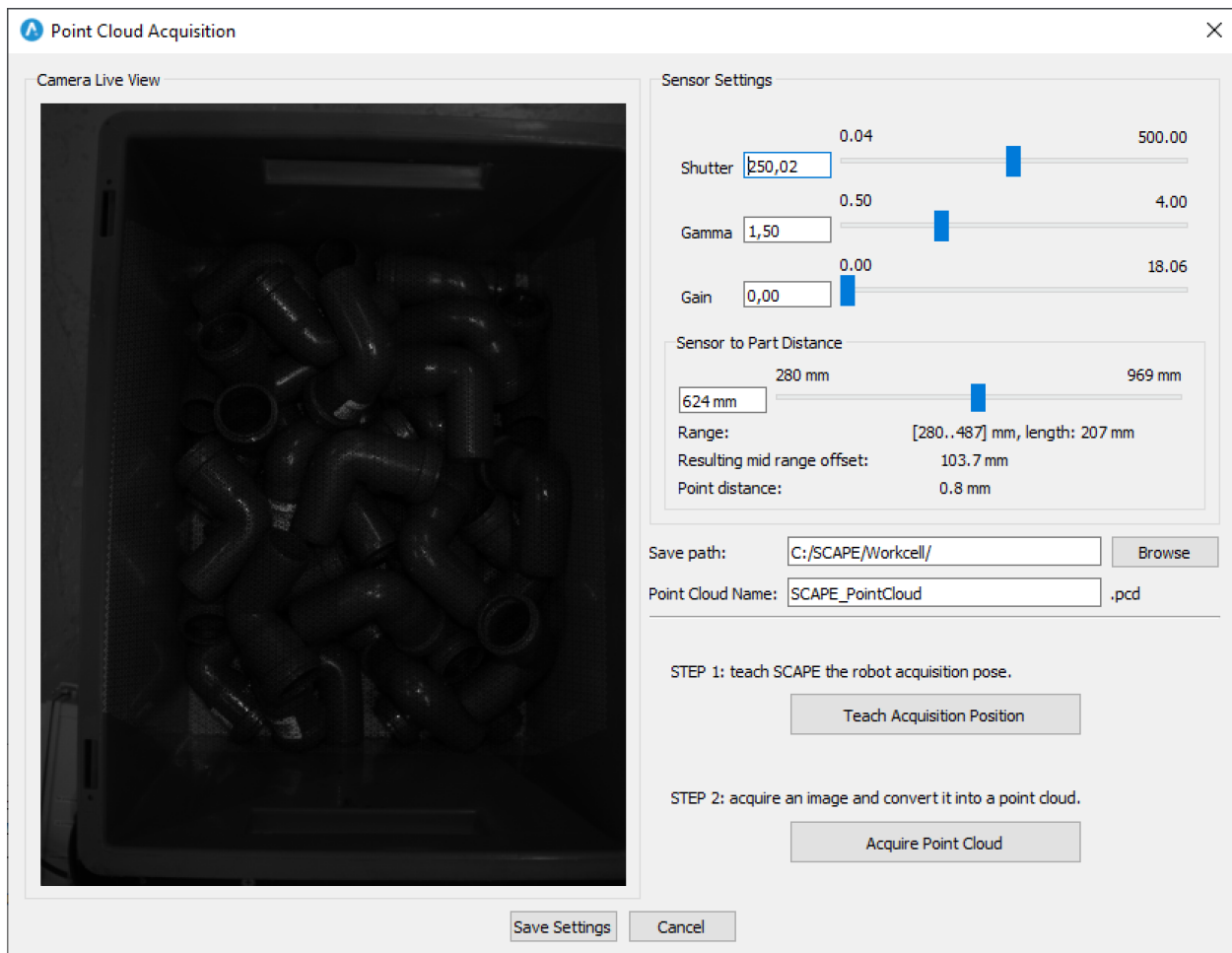


The point cloud acquisition requires that the calibration robot program is running. If the calibration program is not running a small dialog will be shown asking the user to run the program.

In this case SCAPE requests to run the program to send a command to the robot to turn on the pattern projector embedded in the Grid Scanner.

As a general note, consider that several of the instructions in this section require the robot calibration program to be running and similar message boxes will be shown asking the user to run it.

Once the robot calibration program is run, the main menu for point cloud acquisition will be shown.



The main items to take into consideration in this menu are the following:

[Camera Live View]

Shows a live feedback from the Grid Scanner camera. As it may be appreciated the pattern is projected over the content of the bin.

[Sensor Settings]

Group-Box: contains the adjustment tools for the acquisition settings.

[Shutter]

adjusts the shutter speed, which regulates the exposition time of the camera to the incoming light.

The shutter needs to be adjusted such that the content of the bin is visible while avoiding blooming in bright regions.

[Sensor to Part Distance]

Defines the distance at which the Grid Scanner expects the content of the bin to be. This setting needs not be accurate.

It is recommended that the parts lie somewhat within the center of the interval shown in "Range". Having parts outside the range will result in false interpretation of the distance, i.e., the point cloud will not be correct.

[Save Path]

Disk location to save the point clouds.

[Point Cloud Name]

Name to be given to the point cloud file name. The name is automatically updated to avoid overwriting existing point cloud files. However, if the user manually alters this name, overwriting an existing point cloud, this behavior will be suspended.

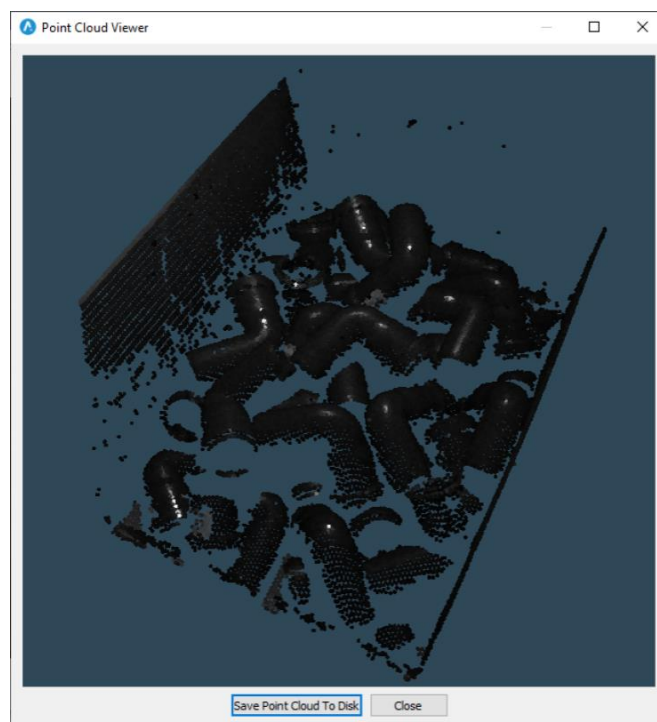
[Acquire Point Cloud]

Click this button to transform the image shown in the [Camera Live View] into a point cloud.

[Save Settings Button]

Click the button to save the current settings (Shutter, Sensor to Part Distance and Save Path). Next time the dialog in Fig 3 is opened, the saved settings will be loaded.

Clicking on [Acquire Point Cloud] shows a new dialog containing the point cloud view.



This 3D view allows rotating, translation and zooming of the perspective. The point cloud may be saved in the previously defined location by clicking on [Save Point Cloud to Disk] or discarded if this dialog is simply closed.

1. The point cloud acquisition general procedure is as follows:
2. Jog the robot to the desired position and ensure that the projected pattern covers the scene.
3. Adjust the settings.
4. Save the settings if they were not saved before or they needed to be modified.
5. Click on [Acquire Point Cloud].
6. Click [Save Point Cloud to Disk] to save or [Close] to discard the point cloud.
7. Repeat from Step 1 if desired.

Note: *Settings are saved in the Workcell file.*

Support & Contact

Opening Hours: 08:00-15:00 CET/CEST
E-mail: support@scapetechnologies.com

Support Terms:

Scape Technologies A/S normally only provide support during regular business hours.

Scape Technologies A/S will provide support for initial configuration and setup of SCAPE Mini-Picker via Splashtop Remote Access.

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SCAPE

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