



SusGrip Smart Gripper
TMFLOW MANUAL



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REVISIONS

REVISION	DATE	CHANGES
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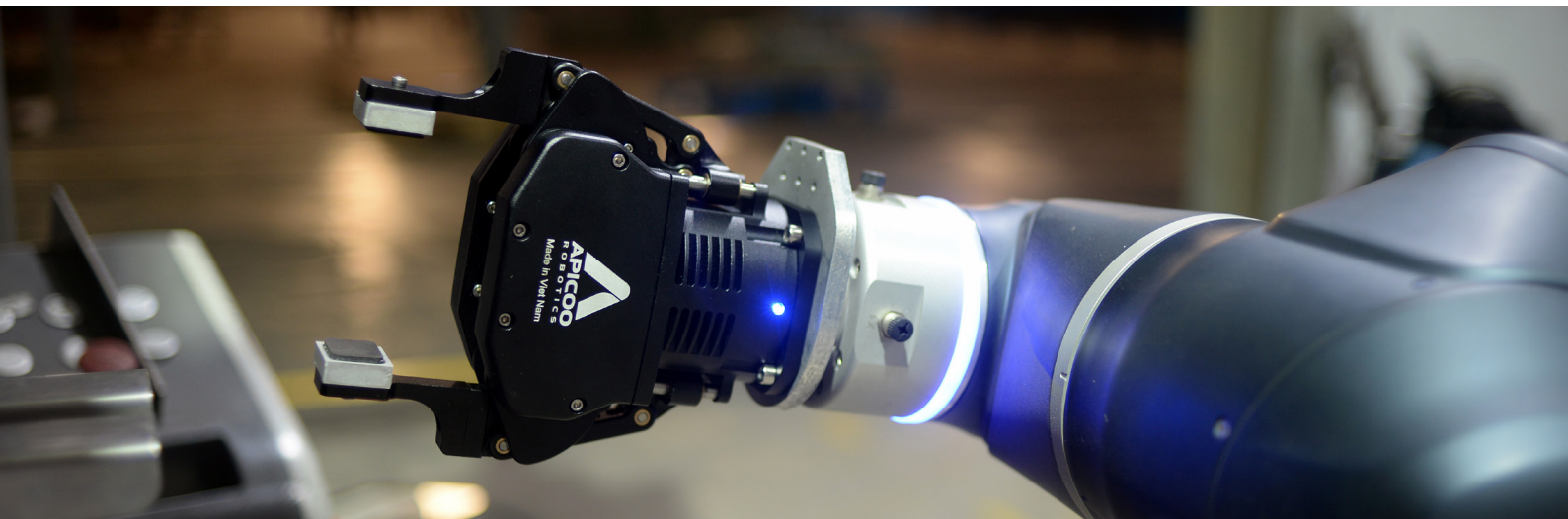
1 - GENERAL INTRODUCTION

1.1. SusGrip Overview

The SusGrip series features cutting-edge grippers with a sophisticated mechanical design that ensures precise parallel motion of the fingers. Powered by high-performance BLDC motors, these grippers deliver efficient and robust operation across a diverse range of applications.

Each gripper in the SusGrip lineup is equipped with a high-precision absolute encoder, enabling continuous monitoring of finger positions. This eliminates the need for pre-operation calibration, significantly enhancing convenience and efficiency. Additionally, SusGrip offers an array of intelligent features, including Object Detection, Gripper Status Notifications, Anti-Backdriving, and Anti-Pinching capabilities.

With a modular design, SusGrip fingers can be easily swapped and exchanged using common bolts, providing users with the flexibility to customize their gripper to meet specific application needs and personal preferences.



1.2. Key Features

The SusGrip lineup is equipped with a comprehensive suite of intelligent features, designed to ensure seamless integration and exceptional versatility across a wide range of applications and industries. Whether users are working in robotics, research, automation, or prototyping, SusGrip adapts effortlessly to users' workflow—minimizing development time while maximizing performance and reliability.

- **Long Stroke:** Large stroke range in a compact package;
- **Parallel Motion:** Height compensation is not in SusGrip's dictionary;
- **Fingers Encoder:** No calibration, wake up and go;
- **Prominent Strength:** Guaranteed 100N grasp force;
- **Ecosystems Infiltrator:** Present in and supports various co-bot ecosystems;
- **Object Detection:** No delay, SusGrip tells you when an object is grasped;
- **Familiar Commission:** Open and close using a single signal line;
- **Deep Manipulation:** Total control of the gripper with Modbus RTU;
- **Any-how Grasping:** Handles objects in both ways, internally or externally;
- **Safety-Oriented Design:** No injuries-causing pinch points whatsoever;
- **Intuitive GUI:** Specific application for easy one-time configuration;
- **Customizable Fingertip:** Effortless finger types swapping and modding.

1.3. Applications

This section outlines the recommended use cases for SusGrip, guiding users in leveraging its full potential while ensuring optimal performance and compatibility with their specific operational requirements:

- Palletizing;
- Pick & Place;
- Handling;
- Assembly;
- Feeding;
- Sorting.

1.4. About this manual

This manual is meant for any devices that are a part of the SusGrip gripper family such as:

- SusGrip-2F Gripper (linear parallel);
- SusGrip-3F Gripper (concentric parallel);
- SusGrip Variants.

This manual is only meant for the SusGrip family and its variants running firmware version 2.4.x where x is from 6 to 255.

2 - SAFETY

2.1. Safety Guidelines

Read This Manual Thoroughly – Before installing, operating, calibrating, programming, decommissioning, inspecting, or maintaining the SusGrip-2F or -3F, ensure you have read and understood this manual in full. Familiarity with the gripper's functions, limitations, and safety protocols is essential for safe and effective use.

Trained and Qualified Personnel Only – Installation, operation, and servicing of the SusGrip should be performed exclusively by trained personnel. Operators must be knowledgeable in collaborative robot safety standards, including but not limited to ISO/TS 15066.

Use as Intended – The SusGrip-2F and -3F are designed solely for gripping tasks within their specified payload capacities. Do not exceed these limits, and do not use the gripper to handle hazardous, flammable, corrosive, or radioactive materials unless explicitly authorized by the manufacturer.

2.2. Warnings and Precautions



ATTENTION:

Any use of the SusGrip Gripper in noncompliance of these warnings is inappropriate and may cause injury or damage.



WARNING:

- When commissioned with a robot, the gripper needs to be properly secure before operation;
- Do not supply the gripper with electrical sources that are above the specified ratings;
- Key position on the cable must align correctly with the gripper's connector;
- Cable must be secured on both ends before operation;
- Do not install or turn on a gripper that is damaged beyond operation or lacking vital parts;
- Attempt not to exceed the gripper's payload for a prolonged period of time;
- Do not use the gripper directly on people or living animals;
- Refer to the mechanical dimensions when customizing fingers.

2.3. Intended Use

SusGrip gripper is designed for grasping and temporarily holding objects. The gripper is intended for installation on a robot, machinery, or special-purpose jig.



ATTENTION:

SusGrip gripper is NOT intended for applying force against objects or surfaces.
SusGrip gripper is NOT intended for actively hold objects for an extended period of time.

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3 - PRODUCT SPECIFICATIONS

3.1. Mechanical Dimensions

The figures below demonstrate the mechanical dimensions of the standard variant of the SusGrip-2F gripper, each dimension is given in millimeters (mm):

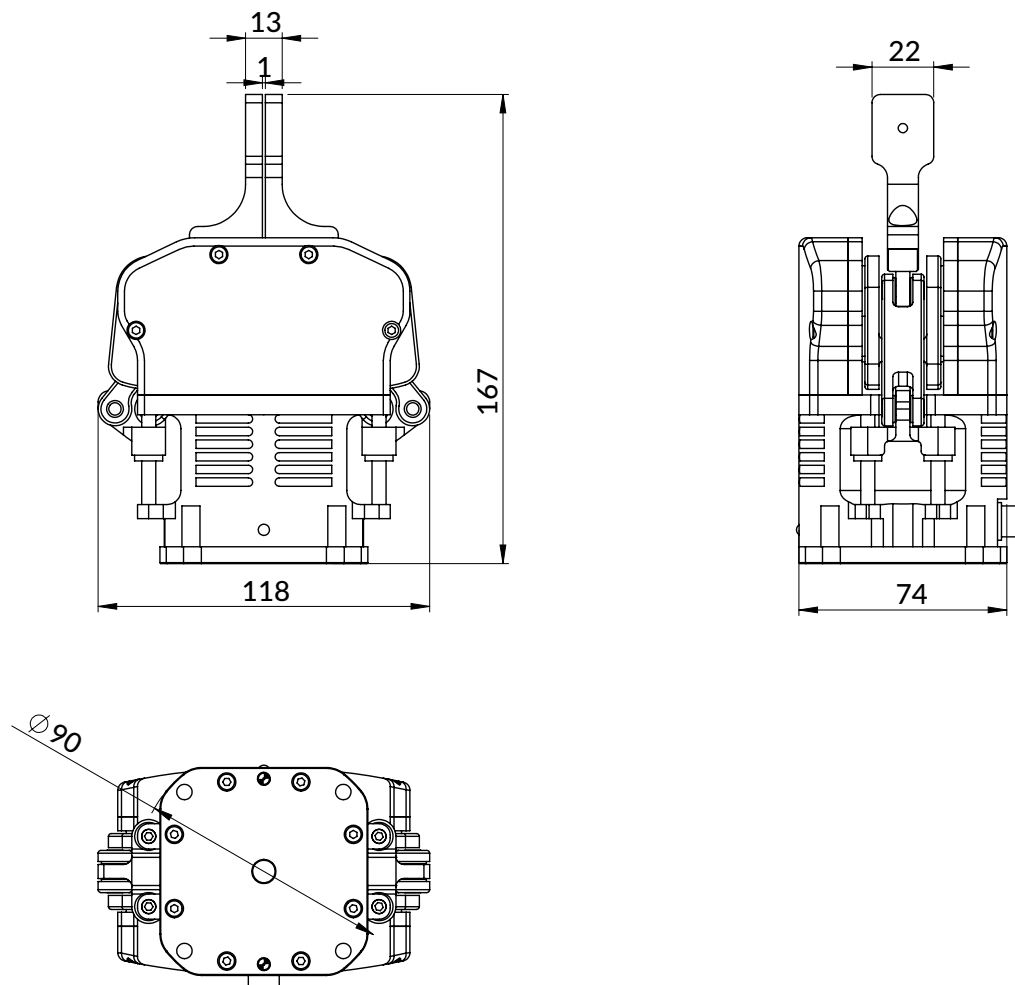


Figure 3.1 - SusGrip-2F Mechanical Dimensions (Closing)

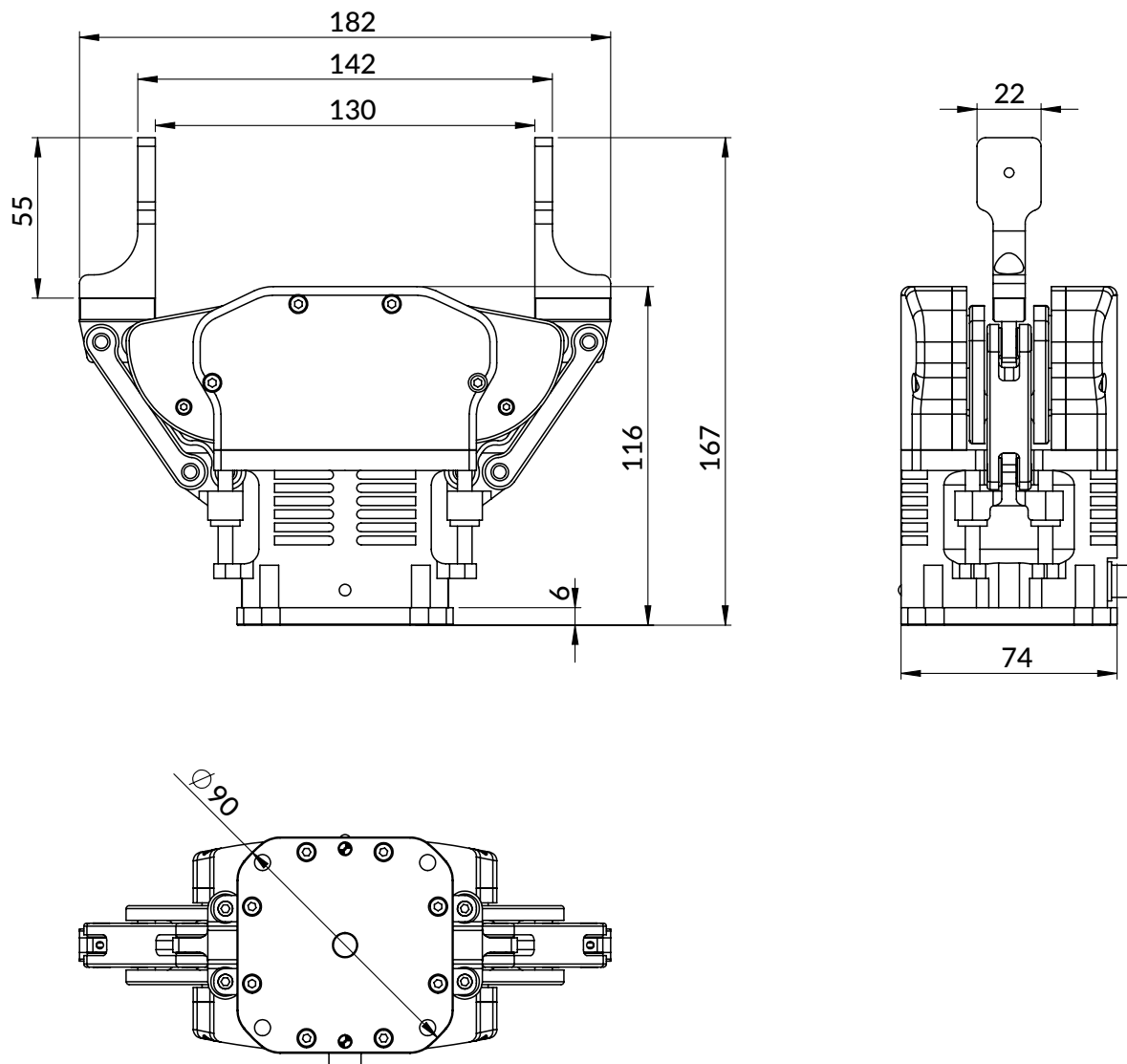


Figure 3.2 - SusGrip-2F Mechanical Dimensions (Opening)

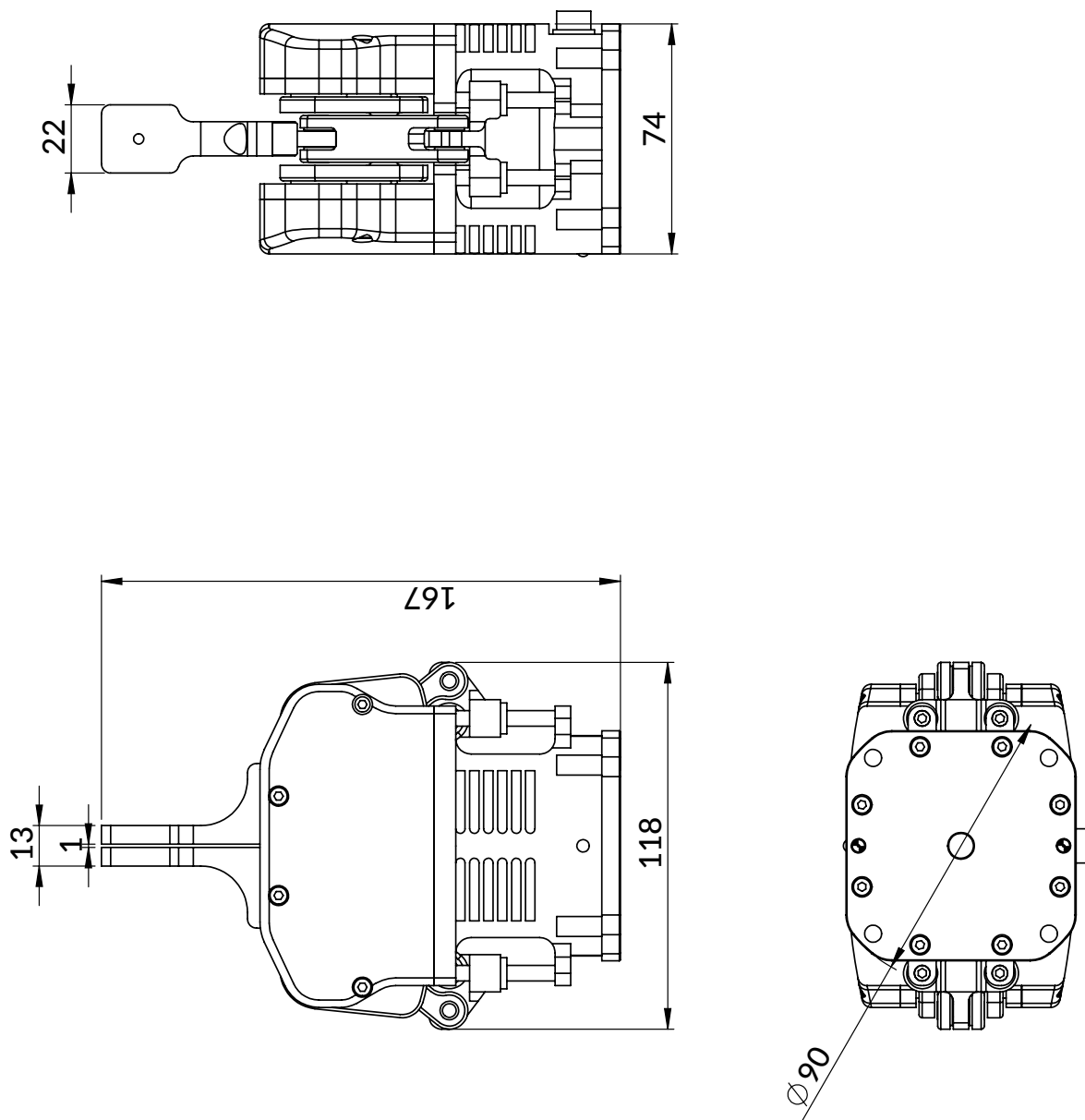


Figure 3.3 - SusGrip-2F Mechanical Dimensions (Closing, Rotated)

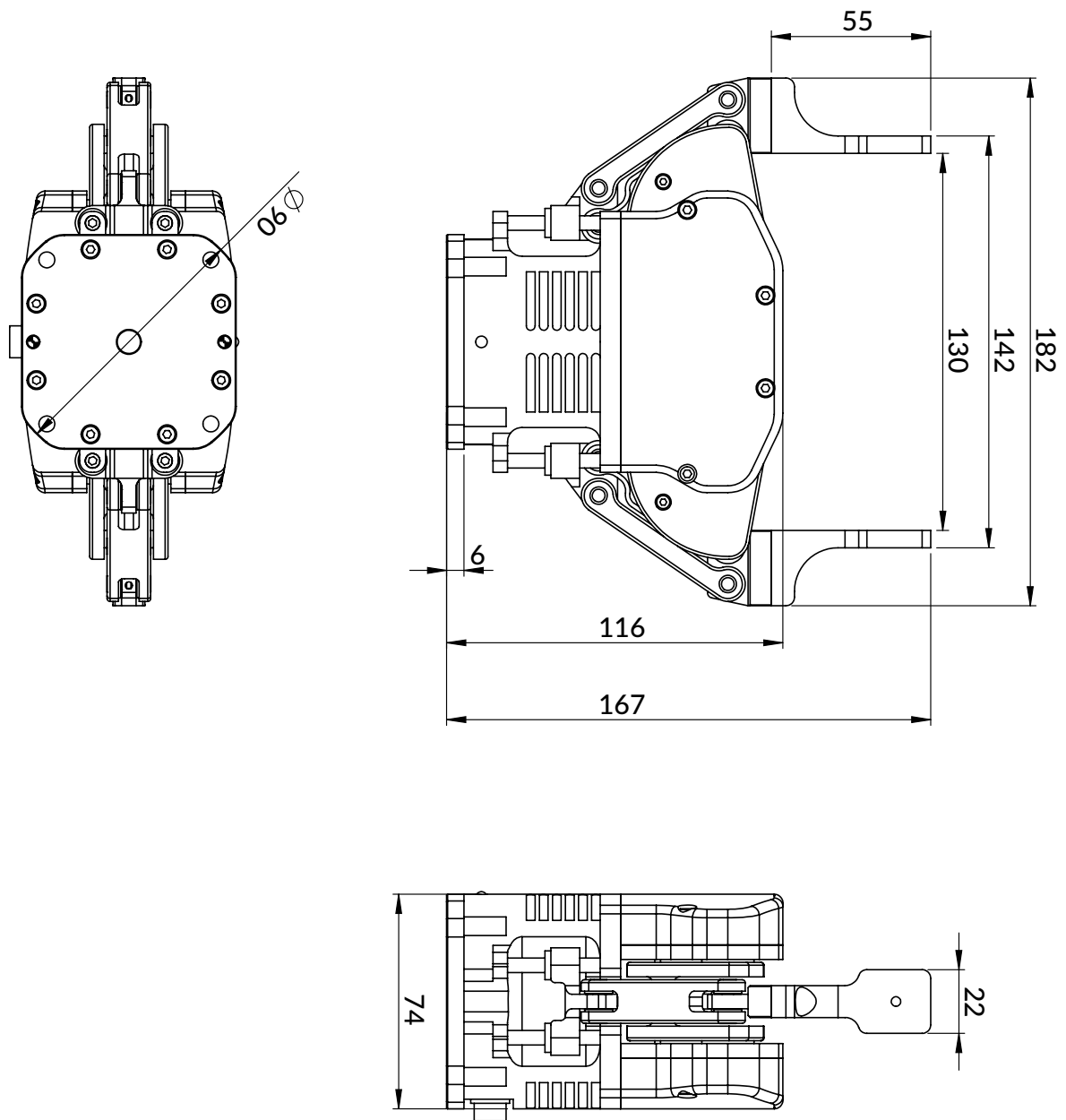


Figure 3.4 - SusGrip-2F Mechanical Dimensions (Opening, Rotated)

The figures below demonstrate the mechanical dimensions of the standard variant of the SusGrip-3F gripper, each dimension is given in millimeters (mm):

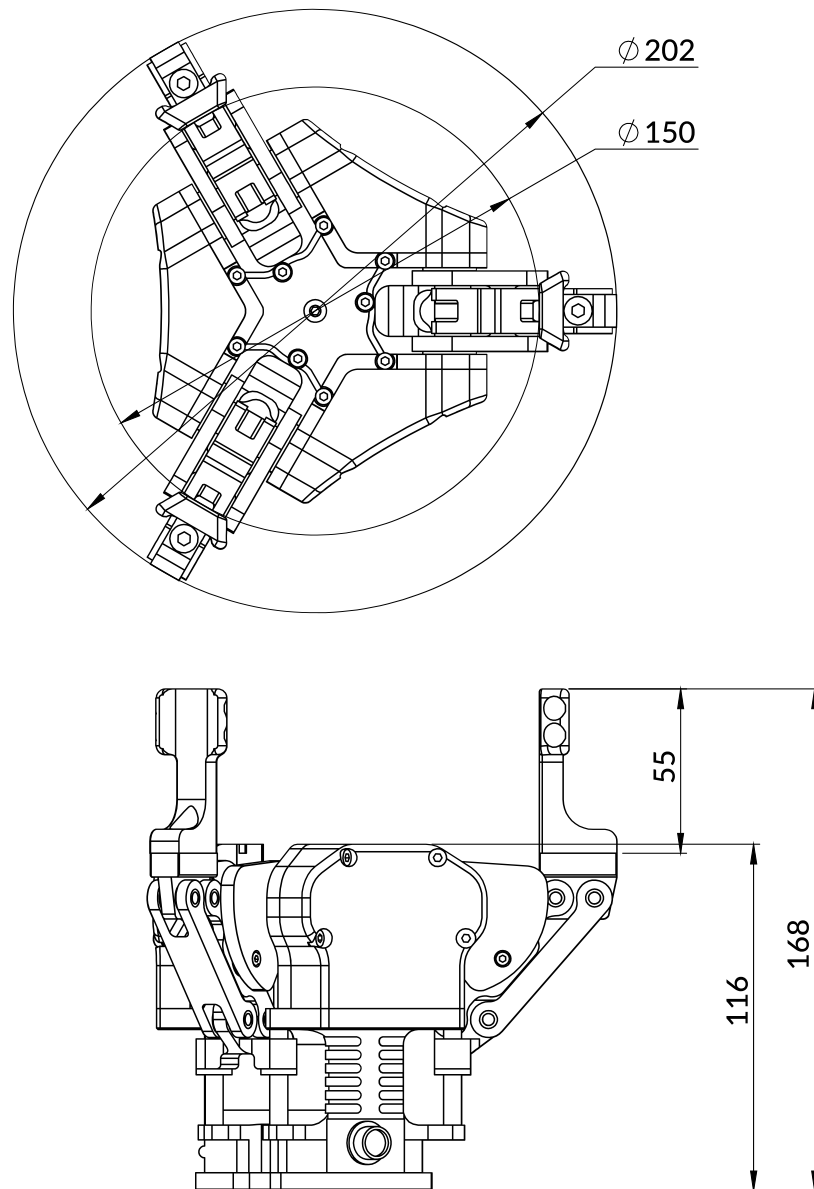


Figure 3.5 - SusGrip-3F Mechanical Dimensions (Opening)

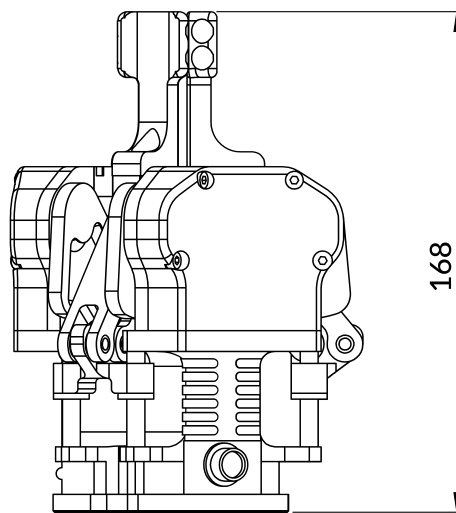
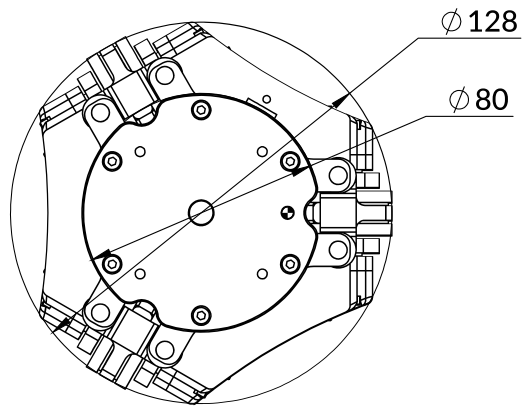


Figure 3.6 - SusGrip-3F Mechanical Dimensions (Closing)

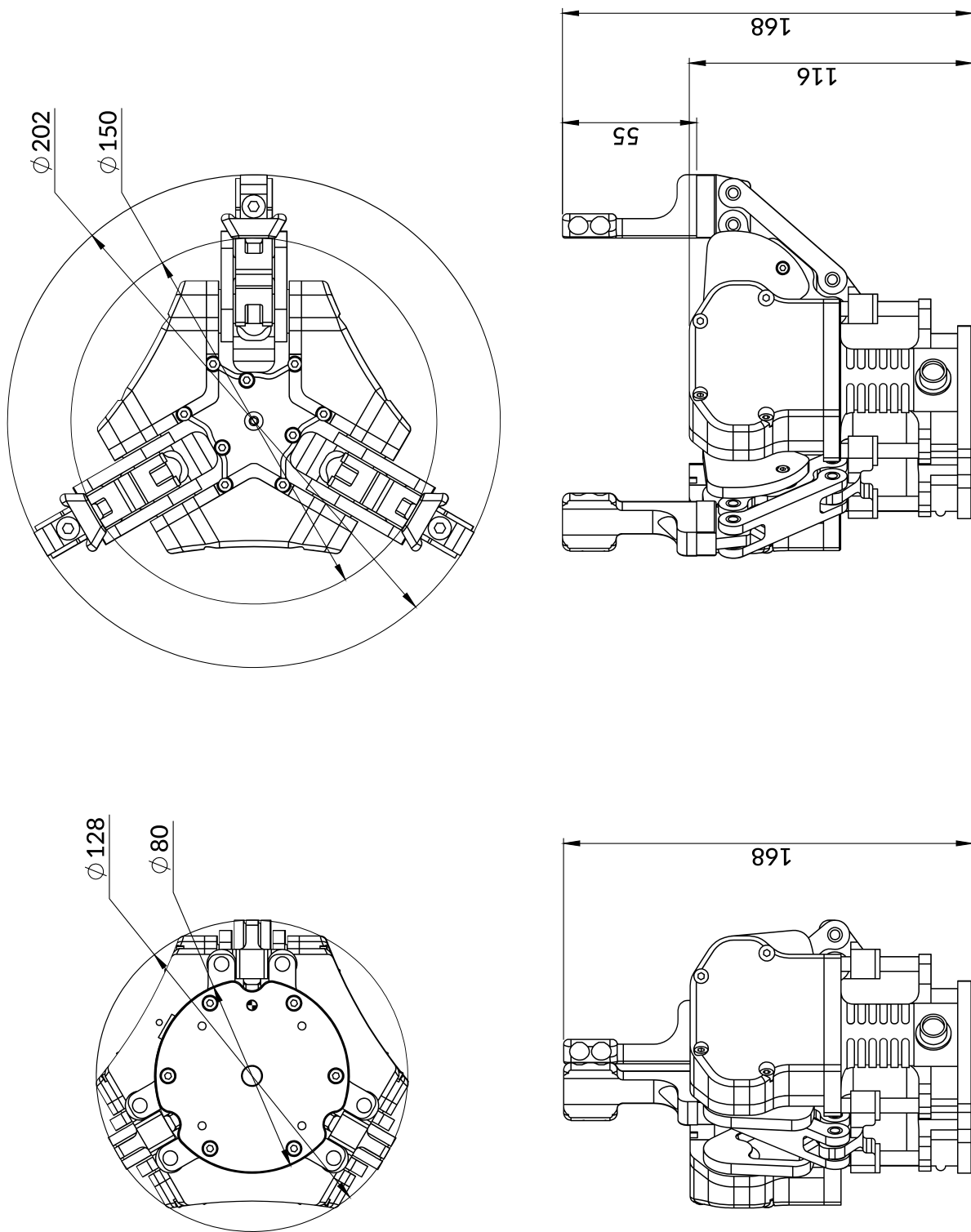


Figure 3.7 - SusGrip-3F Mechanical Dimensions (All, Rotated)

3.2. CoM, TCP, and Moment of Inertia

The table below elaborates the parameters for Center of Mass (CoM) and Tool Centre Point (TCP) of the standard variant of the SusGrip-2F and SusGrip-3F grippers:

Table 3.1 - SusGrip-2F & -3F CoM, TCP (Standard)

TYPE	CENTER OF MASS (mm)			TCP (mm)			MASS (g)
	X	Y	Z	X	Y	Z	
SUSGRIP-2F	0.00	2.00	61.50	0.00	0.00	167.00	1250.00
SUSGRIP-3F	1.00	-2.00	66.00	0.00	0.00	168.00	1540.00

Parameters computed with SusGrip standard fingertips installed.

The Moment of Inertia of the SusGrip-2F gripper when fully opens is as follow:

$$I = \begin{pmatrix} I_{xx} & I_{xy} & I_{xz} \\ I_{yx} & I_{yy} & I_{yz} \\ I_{zx} & I_{zy} & I_{zz} \end{pmatrix} = \begin{pmatrix} 6304 & -5 & 18 \\ -5 & 7313 & 199 \\ 18 & 199 & 1895 \end{pmatrix}$$

The Moment of Inertia of the SusGrip-3F gripper when fully opens is as follow:

$$I = \begin{pmatrix} I_{xx} & I_{xy} & I_{xz} \\ I_{yx} & I_{yy} & I_{yz} \\ I_{zx} & I_{zy} & I_{zz} \end{pmatrix} = \begin{pmatrix} 10313 & 12 & 132 \\ 12 & 10299 & -286 \\ 132 & -286 & 3442 \end{pmatrix}$$

3.3. I/O Interface

3.3.1. On Gripper Body

The SusGrip-2F and SusGrip-3F grippers offer a 9-pin port for power, signals, and Modbus RTU communication via RS485+ and RS485- pins. The figure below demonstrates the pin map of the I/O port on the gripper body:

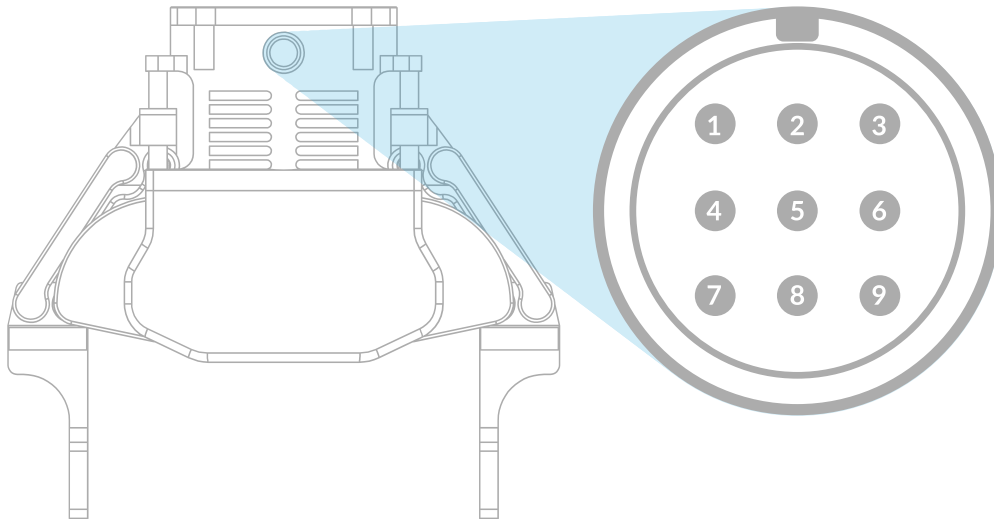


Figure 3.8 - SusGrip-2F & -3F I/O Port Pin Map

Table 3.2 - SusGrip-2F & -3F I/O Port Pin Map

PIN	TYPE	FUNCTIONALITY	NOTE
1	PWR	POWER SUPPLY 0VDC	
2	RS485	RS485 B-	
3	DO	OBJECT DETECTION SIGNAL OUTPUT	PNP 24V Output
4	RS485	RS485 GND	
5	DO	MOTION STATUS SIGNAL OUTPUT	PNP 24V Output
6	DI	GRIPPER OPEN/CLOSE SIGNAL INPUT	PNP 24V Input
7	RS485	RS485 A+	
8		NOT CONNECTED	
9	PWR	POWER SUPPLY 24VDC	

- PWR: Power supply;
- RS485: RS485 data bus;
- DO: Digital output;
- DI: Digital input;

3.3.2. On Standard SusGrip Cable

Each SusGrip gripper comes with a Standard SusGrip Cable out of the box. The figure below demonstrates the pin map of the Standard SusGrip Cable:

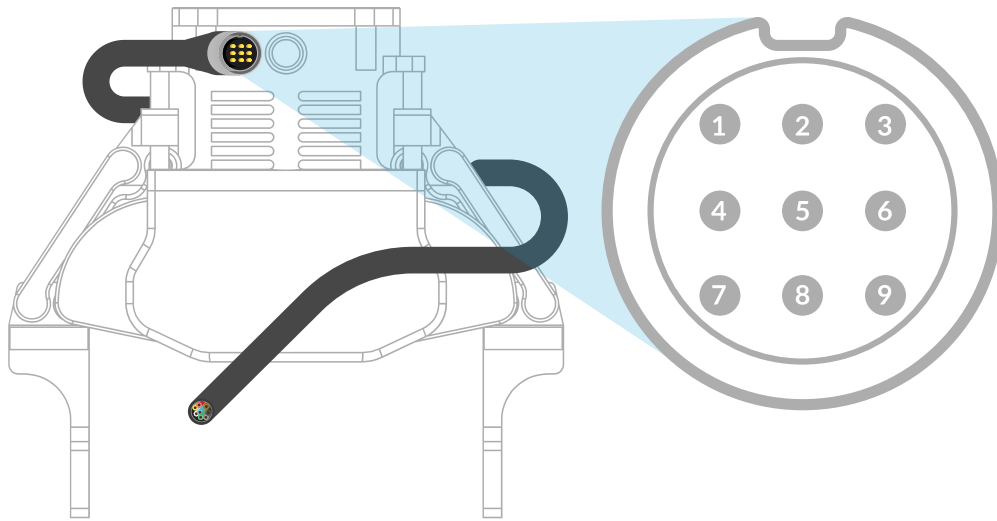


Figure 3.9 - Standard SusGrip Cable Pin Map

Table 3.3 - Standard SusGrip Cable Pin Map

PIN	TYPE	FUNCTIONALITY	WIRE COLOR
1	DO	OBJECT DETECTION SIGNAL OUTPUT	GREY/ ORANGE
2	RS485	RS485 B-	GREEN
3	PWR	POWER SUPPLY 0VDC	BLACK
4	DI	GRIPPER OPEN/CLOSE SIGNAL INPUT	BLUE
5	DO	MOTION STATUS SIGNAL OUTPUT	BROWN
6	RS485	RS485 GND	WHITE
7	PWR	POWER SUPPLY 24VDC	RED
8		NOT CONNECTED	
9	RS485	RS485 A+	YELLOW

- PWR: Power supply;
- RS485: RS485 data bus;
- DO: Digital output;
- DI: Digital input;

3.4. Product Ratings

The specifications of the standard variant of SusGrip-2F and SusGrip-3F are listed in the table below:

Table 3.4 - SusGrip-2F and SusGrip-3F Ratings

PARAMETER	VALUE	UNIT
STROKE ⁽¹⁾	(2F) 1~130 0.04~5.04	mm inches
	(3F) 10~150 0.4~5.90	
HOLDING FORCE ⁽²⁾	(normal) up to 100	N
	(uncaged) up to 180	
FORM-FIT PAYLOAD	5.0	Kg
	11.0	Lbs
WEIGHT	(2F) 1.25 2.75	Kg Lbs
	(3F) 1.54 3.39	Kg Lbs
OPERATIONAL VOLTAGE	20-25	Volts (DC)
ABSOLUTE LIMIT VOLTAGE	15-30	Volts (DC)
MAXIMUM CURRENT DRAW ⁽³⁾	(normal) < 2.0	Amperes (DC)
	(uncaged) up to 10.0	
OPERATIONAL TEMPERATURE	-5.0~55.0	°C
FINGER POSITION RESOLUTION	0.1	mm
FINGER CONTROL RESOLUTION	1.0	mm
FINGER MAXIMUM SPEED ⁽⁴⁾	(2F) 240.0	mm/s
	(3F) 300.0	

(1) Stroke (fingers position) is computed differently between 2F and 3F. On SusGrip-2F, stroke is the distance between the 2 fingers, whereas on SusGrip-3F, stroke is the diameter of concentric grasping.

(2) Uncaged mode is a feature that allows the gripper to bypass most constraints and operate with much greater strength and power.

(3) Under normal operation (Uncaged mode disabled), current draw by the gripper is affected by the force setting set by users. Normally this value is < 2.0A but can spike above this level for a brief moment when collision with the objects first occurs.

(4) The achievable speed is dependent of acceleration settings and the total distance they have to travel.

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4 - INSTALLATION GUIDE

4.1. Setup Overview

This section discusses the components in the SusGrip package and ways of setting up the gripper for OMRON Techman robot arms.

4.1.1. What's Included in the Box

The SusGrip gripper physical package arrives at users with the following components:

- 01 SusGrip gripper;
- 02 default SusGrip fingers for 2F, or 03 fingers for 3F;
- 02 dowel pins + 01 M5 bolt for each finger;
- 04 M5 bolts for robot end-effector;
- 01 4-meter SusGrip cable;
- 01 USB-to-RS485 device.

When OMRON Techman is specified by users to be their application robot, the following additional components are provided:

- 01 Phoenix M8 to SG M10 cable, with variable length;
- 01 special USB-to-RS485 converter device based off the FT232 chip.

If requested by users at purchase, the following components can be included:

- Customized fingers for specific applications;
- Customized tool flanges for specific robot models;
- Customized cables for specific I/O ports;
- USB drive for document and softwares.

4.1.2. Implementation Types on OMRON Techman Robots

There are various ways SusGrip grippers can be installed and operated with Techman robot arms:

- Single gripper connecting to Techman arm's End module IO (M8 IO port);
- Single gripper connecting to DB9 ports on control box;
- Multi-grippers connecting to DB9 ports on control box;
- Single gripper connecting to control box via special USB-to-RS485;
- Multi-grippers connecting to control box via special USB-to-RS485;

4.2. Mechanical Setup

4.2.1. Fingertips Installation

The required tools to install fingertips onto SusGrip grippers:

- An M4 hex screw (or Allen key);
- Low strength threadlocker (such as Loctite 243).

The required parts (provided in the package) to install fingertips:

- 02x M5x8 bolts for SusGrip-2F | 03x M5x8 bolts for SusGrip-2F;
- 02x Fingertips for SusGrip-2F | 03x Fingertips for SusGrip-3F;
- 04x Dowel pins Ø3x8 for SusGrip-2F | 06x Dowel pins Ø3x8 for SusGrip-3F;

To install the fingertips onto the gripper base:

- Align the Fingertip indexing pins with the finger dowel holes;
- Insert the dowel pins and mount the fingertips on top;
- Apply low strength threadlocker onto the bolts;
- Insert the M5x8 SHCS bolts;
- Use up to 3N.m of torque to tighten the M5x8 bolts.

The figure below demonstrates the fingertips installation process:

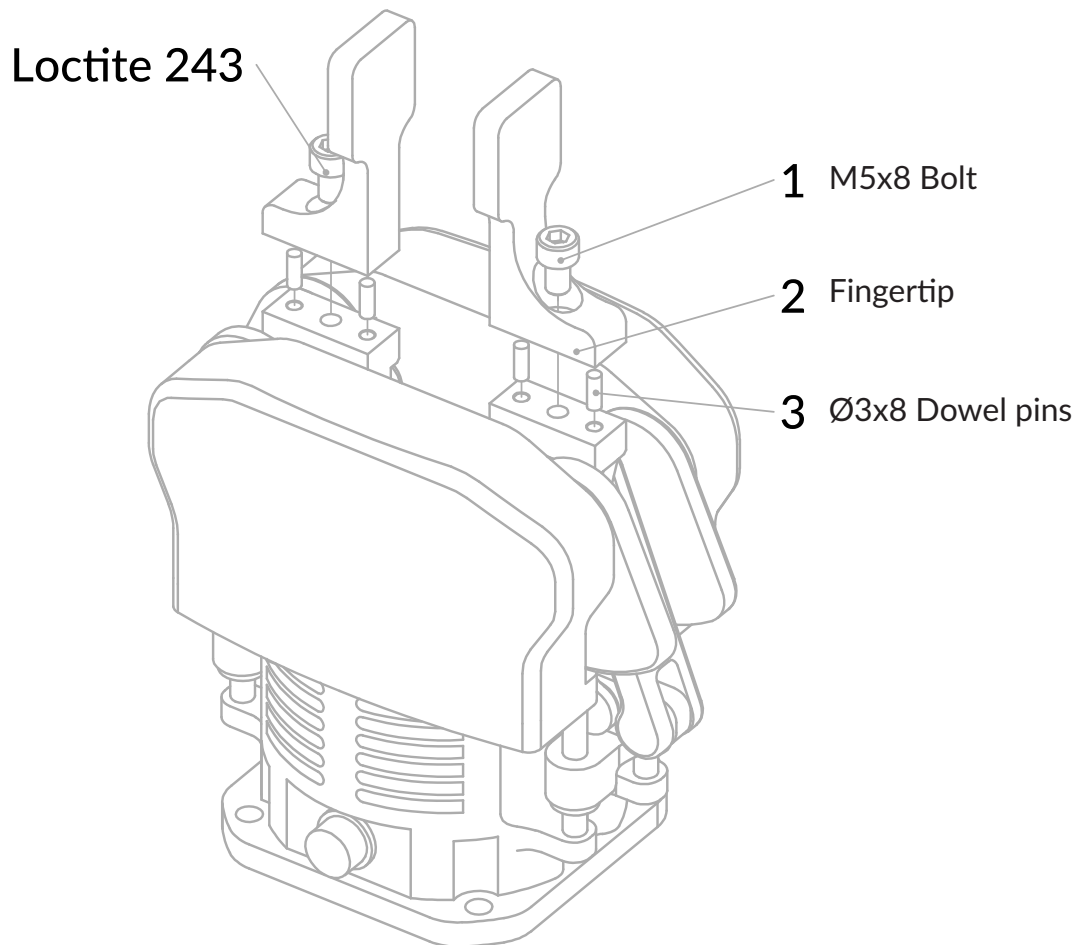


Figure 4.1 - Fingertips Installation onto SusGrip Grippers

4.2.2. Gripper Installation onto Techman Robot

The required tools to install SusGrip grippers onto Techman robot arms:

- An M5 hex screw (or Allen key);

A special adaptive flange is required to mount SusGrip-2F gripper onto the End Module of Techman robot arms. It can be requested at purchase or self-fabricated by customers. The following figure shows example installation of SusGrip-2F:

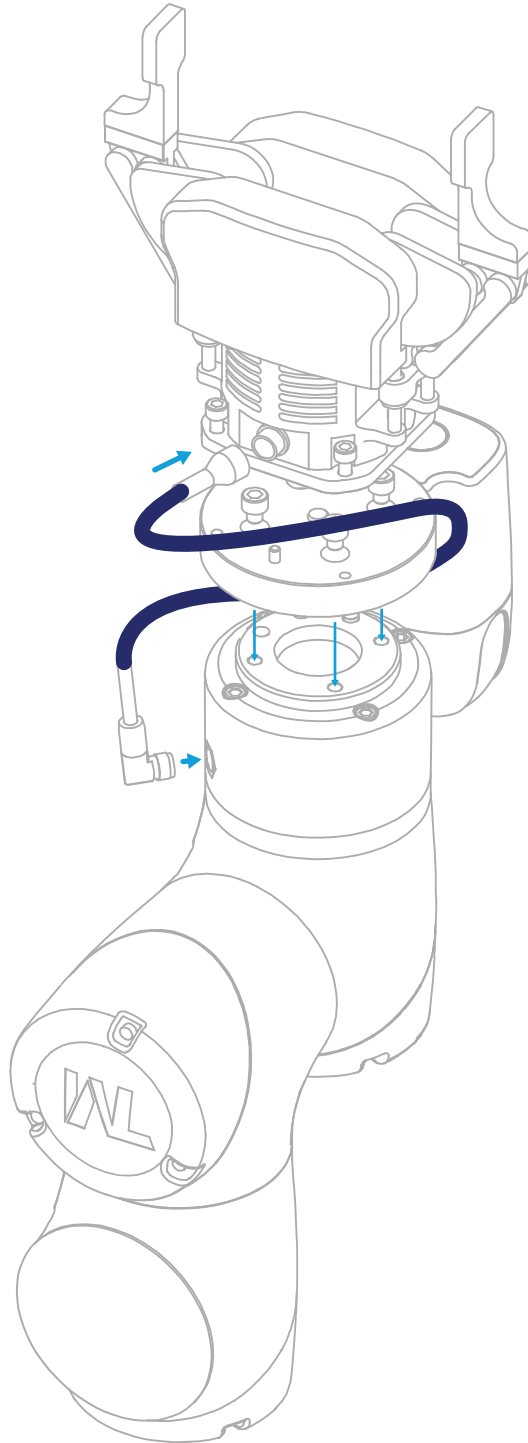


Figure 4.2 - SusGrip Gripper Installation on Techman Robot Arm

An additional special adaptive flange is required (total 2 flanges) to mount SusGrip-3F gripper onto the End Module of Techman robot arms. It can be requested at purchase or self-fabricated by customers. The following figure shows example installation of SusGrip-3F:

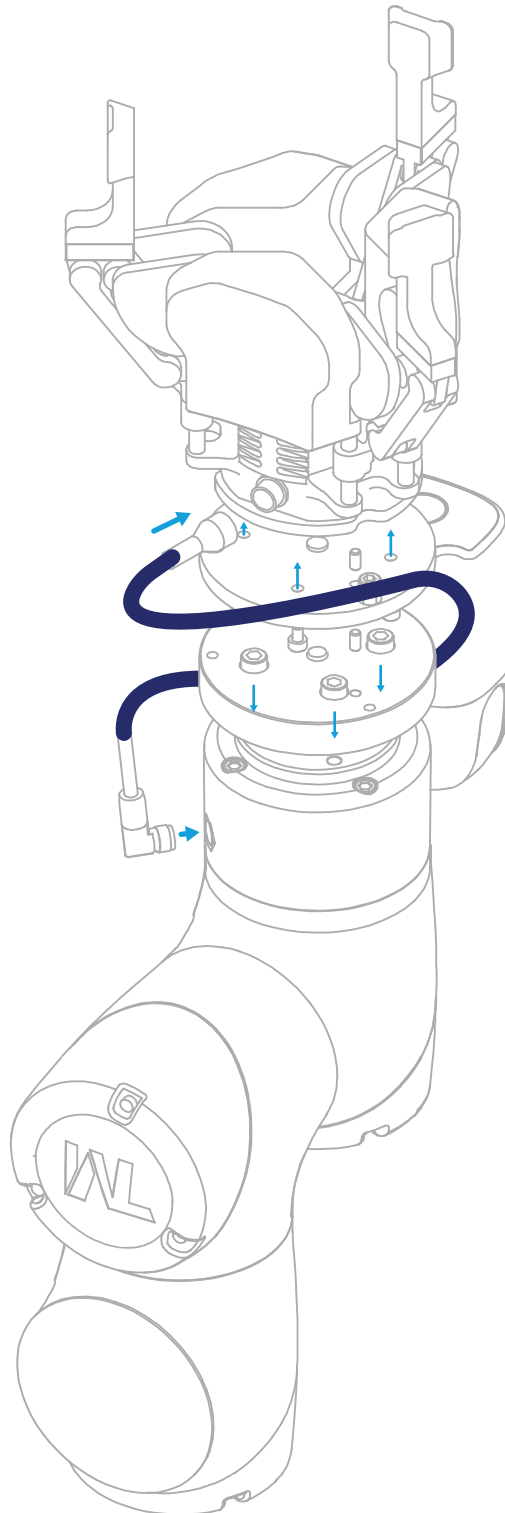


Figure 4.3 - SusGrip Gripper Installation on Techman Robot Arm with Additional Flanges

4.3. Flange Dimensions

Refer to this section if users wish to self-fabricate customized adaptive flange for SusGrip grippers.

The figure below shows the flange cap dimensions of the standard variant of the SusGrip-2F gripper:

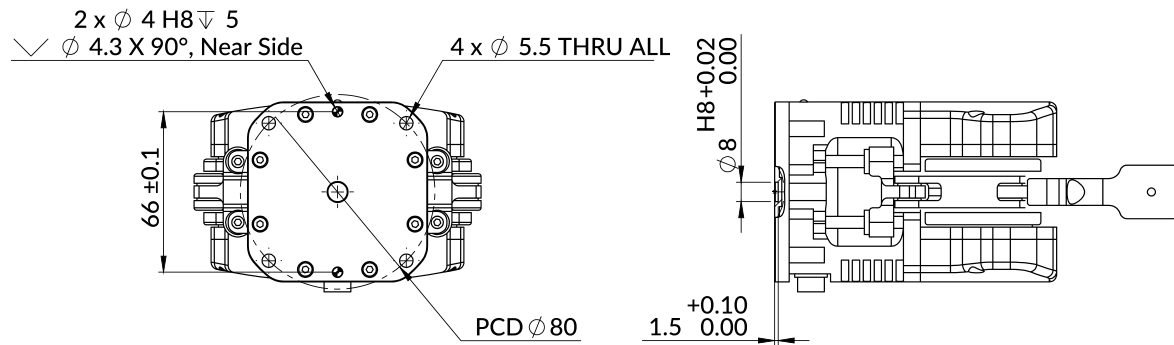


Figure 4.4 - Standard SusGrip-2F Gripper Flange Cap

The figure below shows the flange cap dimensions of the standard variant of the SusGrip-3F gripper:

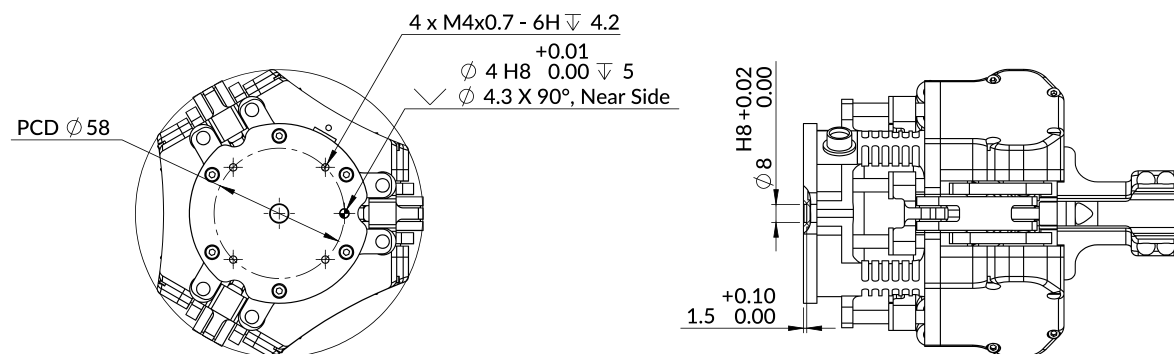
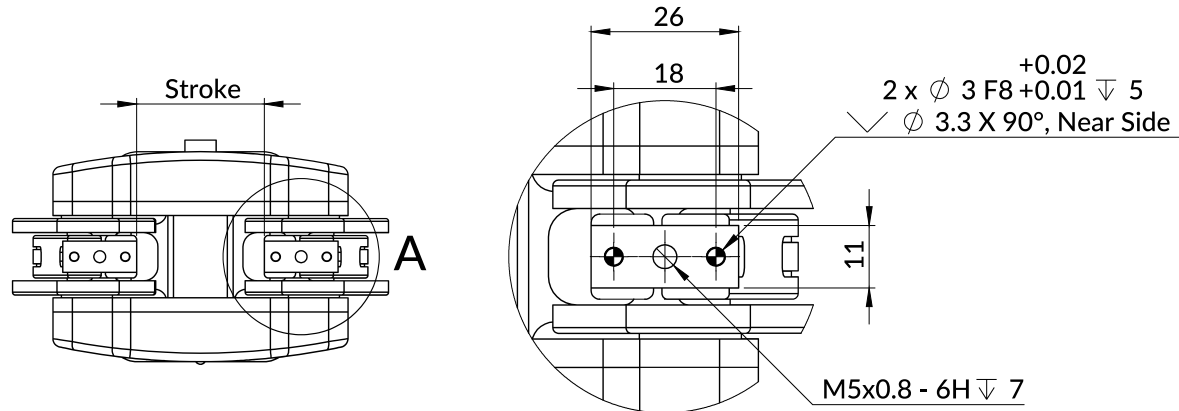


Figure 4.5 - Standard SusGrip-3F Gripper Flange Cap

Next, fingerbase dimensions are described.

4.4. Fingers Customization

The SusGrip-2F and SusGrip-3F grippers offer effortless swapping of a wide variety of finger designs. Users can create customized finger types that are best suited to their specific applications and install onto SusGrip's finger base following the dimensions specified:

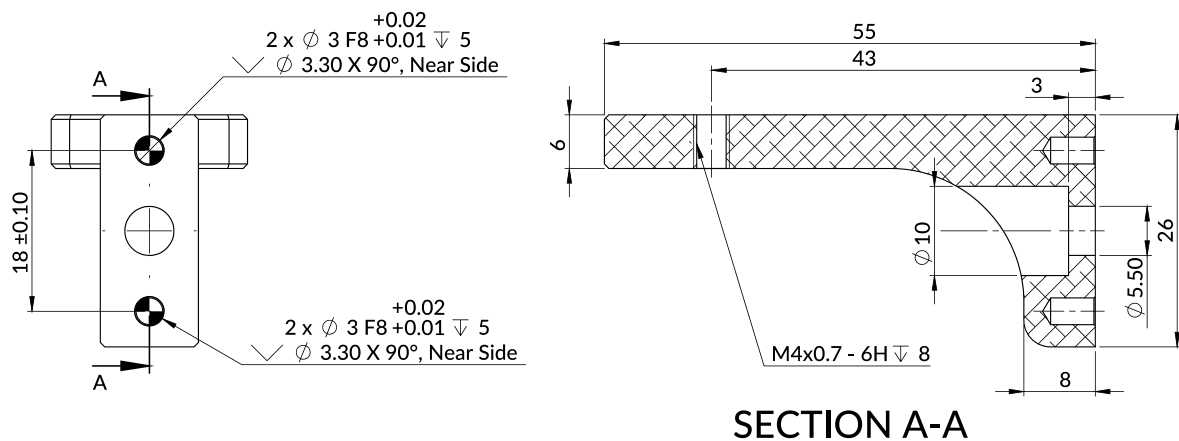


DETAIL A

Figure 4.6 - Standard SusGrip Finger Base

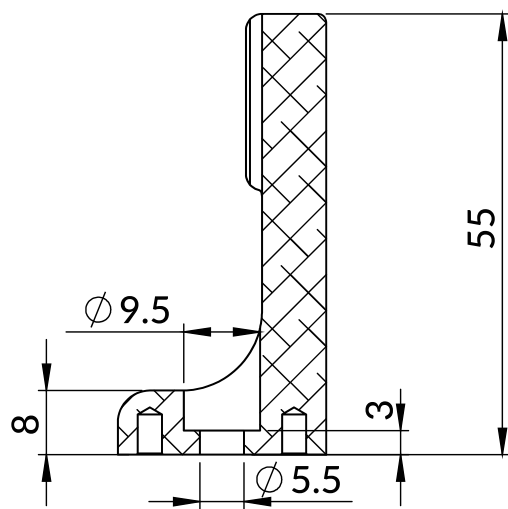
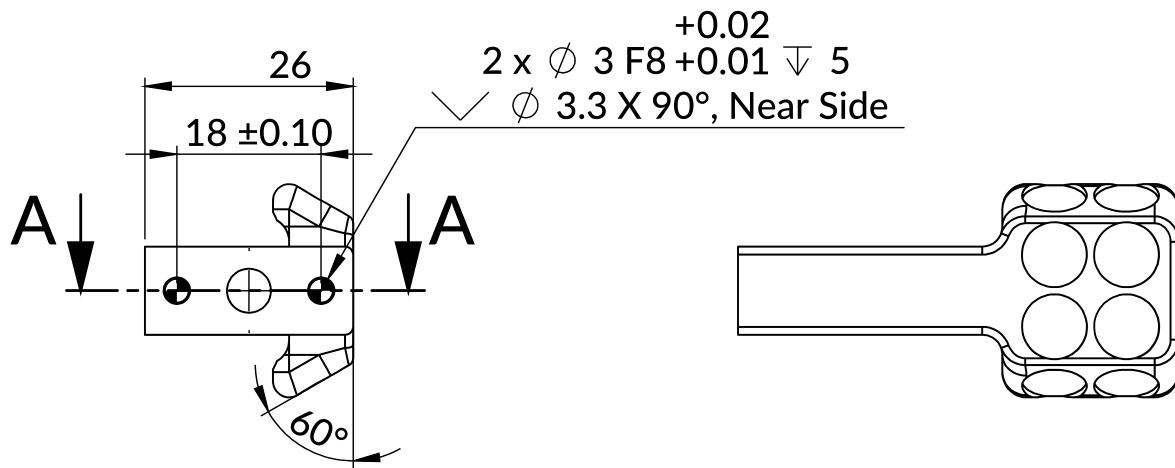
The standard variant of SusGrip-2F and SusGrip-3F grippers has the same finger base design.

For design reference, the following figures shows the standard finger design of SusGrip-2F and SusGrip-3F grippers:



SECTION A-A

Figure 4.7 - Standard SusGrip-2F Finger Design



SECTION A-A

Figure 4.8 - Standard SusGrip-3F Finger Design

4.5. Electrical Setup

First, connect the gripper with the provided SusGrip cable with the key properly aligned:

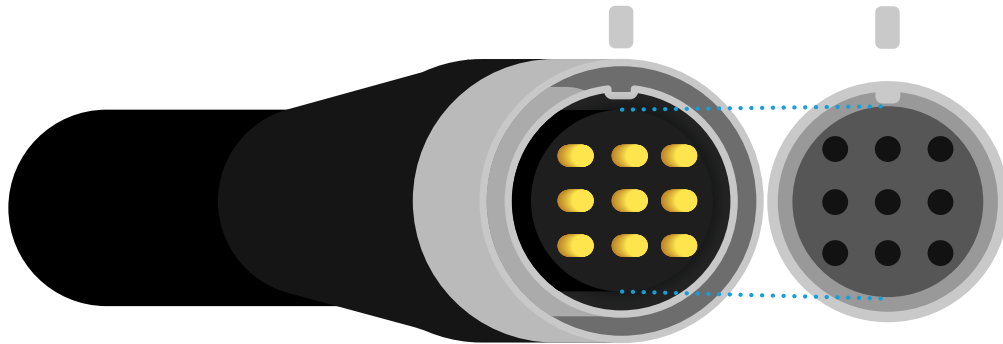


Figure 4.9 - Connect SusGrip Cable to the Gripper

4.5.1. RS485 Connection to End Module IO Port

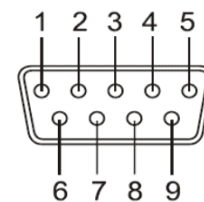
Simply connect the provided Phoenix M8 to SG M10 cable to the IO port on the End Module of the robot arm.

4.5.2. RS485 Connection to Control Box DB9 Ports

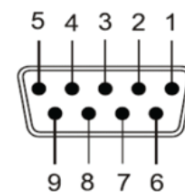
SusGrip grippers **MUST** be operated via Modbus RTU over RS485 with the TMFlow components. Users can connect SusGrip gripper to the robot by using the provided standard SusGrip cable and a DB9 connector. Connect to the DB9 ports on the robot control box.

The pin map of the DB9 ports on the robot control box is derived from the **Omron TM Collaborative Robot S Series: TM25S and TM30S Hardware Installation Manual** as follow:

Type: DB9			
BAUD: 300 to 921600			
Pin Number	RS-232	RS-485/422 Full Duplex	RS-485 Half Duplex
1	DCD	TX-	Data-
2	RXD	TX+	Data+
3	TXD	RX+	
4	DTR	RX-	
5	GND	GND	GND
6	DSR		
7	RTS		
8	CTS		
9	RI		



Pin definition of DB9 male connector (for Control Box)



Pin definition of DB9 female connector (from the cable or device)

On the open end of the standard SusGrip cable, connect the RS485 wires to the DB9 connector (preferably soldered) as follow:

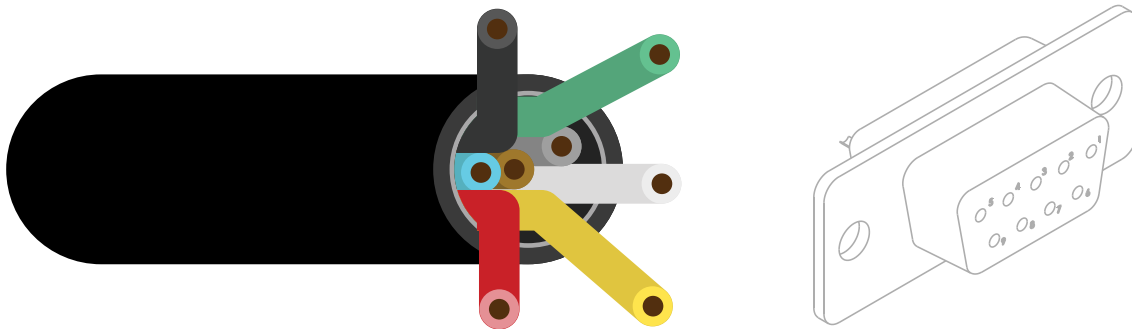
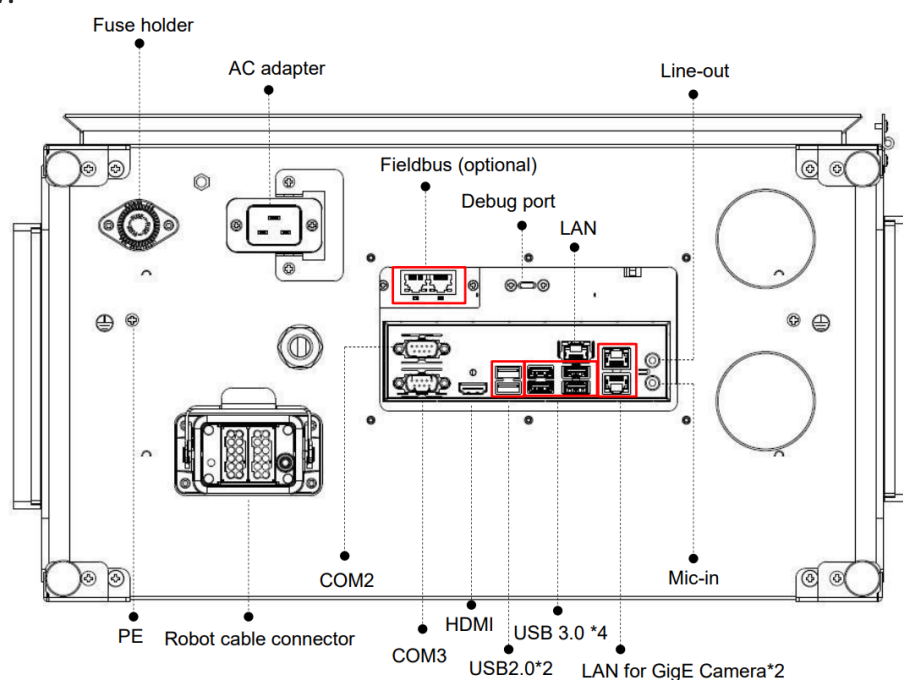


Figure 4.10 - Standard SusGrip Cable RS485 and Power Wires with DB9 Connector

Table 4.1 - SusGrip Cable Connection Guide with Control Box DB9 Ports

WIRE	TYPE	ON GRIPPER	CONNECT TO
RED	PWR	POWER SUPPLY 24VDC	24VDC POWER SUPPLY
BLACK	PWR	POWER SUPPLY 0VDC	0VDC POWER SUPPLY
YELLOW	RS485	RS485 A+	PIN 2 OF DB9 PORT
GREEN	RS485	RS485 B-	PIN 1 OF DB9 PORT
WHITE	RS485	RS485 GND (shorted with 0VDC)	(OPTIONAL) PIN 5 OF DB9 PORT

The location of the DB9 ports on the robot control box is derived from the **Omron TM Collaborative Robot S Series: TM25S and TM30S Hardware Installation Manual** as follow:



4.5.3. RS485 Connection to Control Box via USB

SusGrip grippers can also be connected to the Control Box using a special USB-to-RS485 converter device. This converter device is provided at purchase if requested by customers.



This method of connectivity, though viable, is **DISCOURAGED** by OMRON as specified in their official manual:

"The USB port of the control box is used for connecting the keyboard, mouse and external storage devices. External storage devices should only be used for the import/export functions of TMflow. No other device than those listed above should be connected. Be noted that the external storage device should be labelled TMROBOT."

On the open end of the provided SusGrip cable, connect as follow:

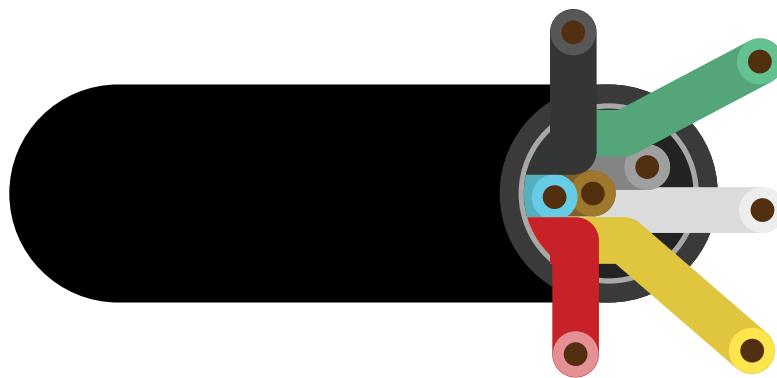


Figure 4.11 - SusGrip Cable Connection with RS485

Table 4.2 - SusGrip Cable Connection Guide with RS485

WIRE	TYPE	ON GRIPPER	CONNECT TO
RED	PWR	POWER SUPPLY 24VDC	24VDC POWER SUPPLY
BLACK	PWR	POWER SUPPLY 0VDC	0VDC POWER SUPPLY
YELLOW	RS485	RS485 A+	RS485-to-USB A+
GREEN	RS485	RS485 B-	RS485-to-USB B-
WHITE	RS485	RS485 GND (shorted with 0VDC)	(OPTIONAL) RS485 BUS GND REF

Then connect the USB-to-RS485 converter device to any USB port on the control box of the robot.



If the special USB-to-RS485 converter device was **NOT** obtained at purchase, users may substitute with any USB-to-RS485 converter devices that are based off the chip FT232. Devices based of the chip CH34x family will **NOT** work.

4.5.4. Digital Input/Output (DIO) Connection

Digital IO connection is not a part of the TMFlow package and is not discussed in this manual. Refer to the original manual for description of this section.

4.5.5. Example Connection to Computer

Additionally, users might need to connect SusGrip gripper to a computer and perform configuration tasks beforehand. In such case, follow the RS485 Connection with the USB-to-RS485 converter device:

- Connect the gripper using the standard SusGrip cable;
- On the open end of the cable, connect the RS485 wires to the USB device;
- Plug the USB device into the computer;
- Provide SusGrip gripper with the appropriate power supply.

The figure below demonstrates such connection:

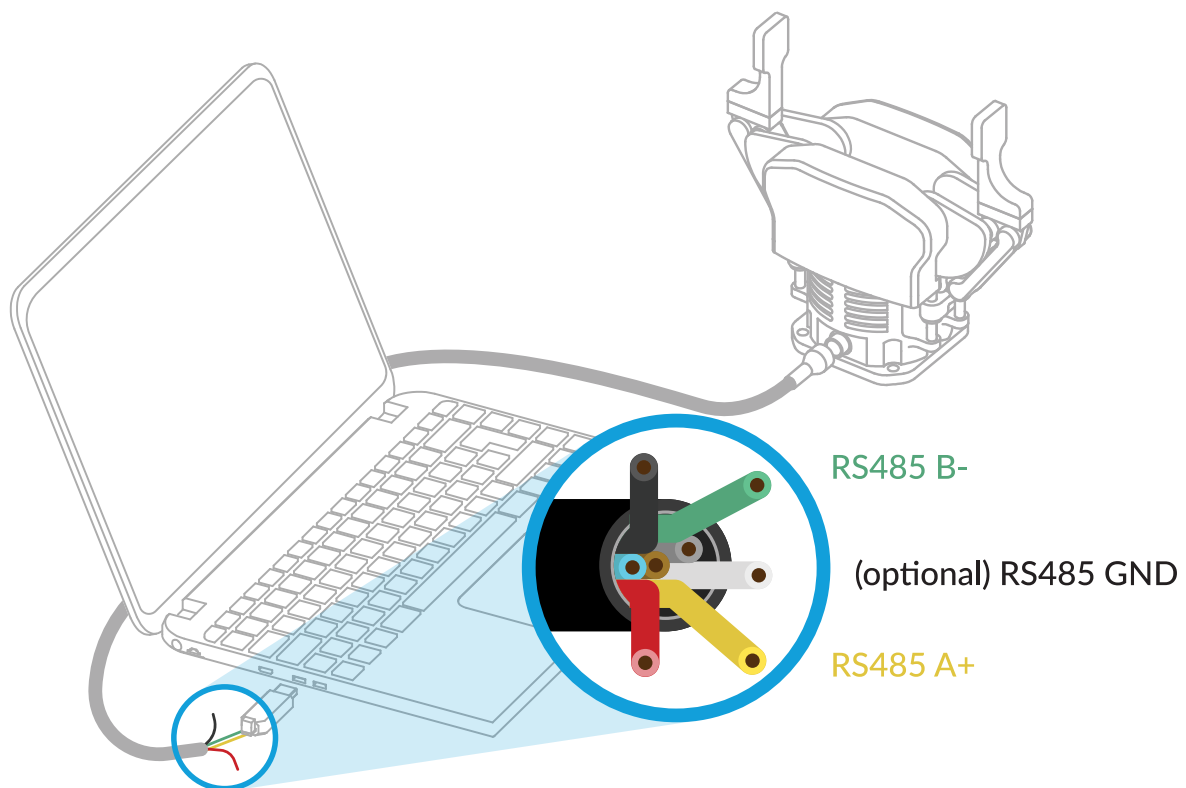


Figure 4.12 - Example Connection to Computer

Continued on the next page.

4.6. Software Setup

4.6.1. OMRON TMFlow Setup

To download and install OMRON TMFlow, please refer to OMRON's or Techman Robot's official website and documentation. Apicoo Robotics will NOT cover installation of this software, nor will Apicoo Robotics be responsible for any problems arising during the installation process.

4.6.2. Robot Serial Port Configuration

Serial ports on the robot must be configured properly to support communication with SusGrip grippers.

Open TMFlow software and connect to the robot. Then, open **Settings**, under **Configuration**, select **I/O Setup, Serial Port**:

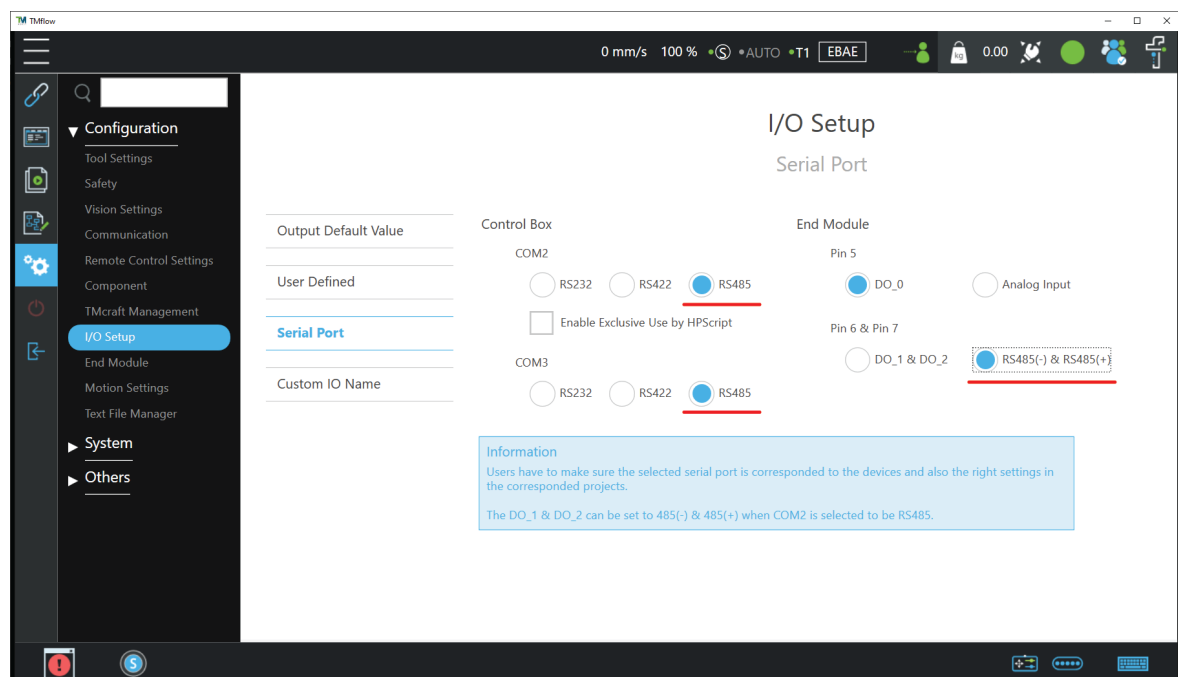


Figure 4.13 - Serial Port Setup on TMFlow

If the DB9 ports on the robot control box are to be used, users must switch them to RS485 mode.

If the port on the robot End Module is to be used, users must first switch COM2 of the control box to RS485 mode, then the End Module will allow Pin 6 & Pin 7 to be switched to RS485(-) & RS485(+) mode, as seen in the figure above.

Continued on the next page.

4.6.3. TMFlow Package Installation

To install and use the SusGrip TMFlow package, a USB storage device is required. The USB storage device must satisfy the following requirements:

- The USB storage device must be named exactly **TMROBOT**
- There must be a folder named exactly **TM_Export** in the root directory

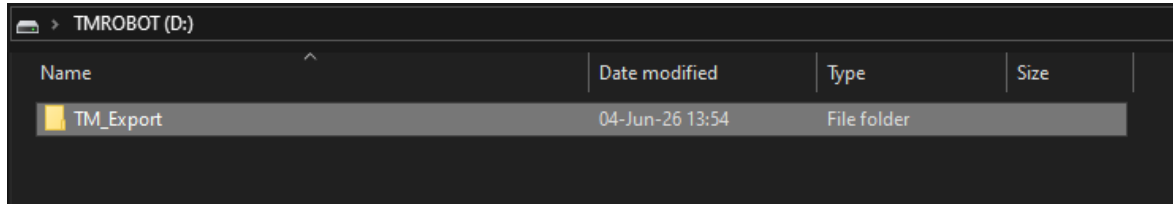


Figure 4.14 - The USB Storage Device TMROBOT with TM_Export Folder

Download the SusGrip TMFlow package and copy the entire folder into the **TM_Export** folder on the **TMROBOT** USB storage device:

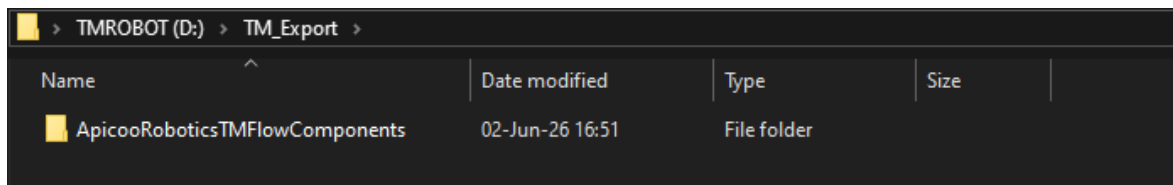


Figure 4.15 - The Folder ApicooRoboticsTMFlowComponents inside TM_Export

Insert the USB storage device into the robot control box via any USB port. Go to Settings, under System, select Import/Export:

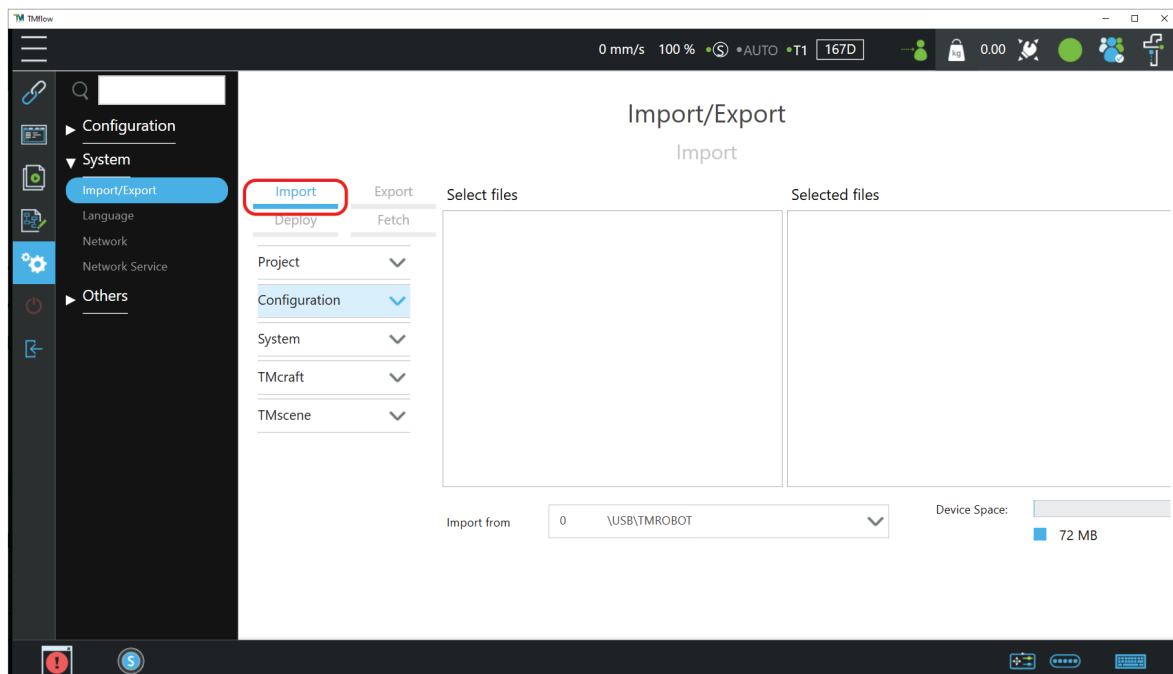


Figure 4.16 - Import/Export Screen in TMFlow Software

Then choose Import and select **ApicooRoboticsTMFlowComponents** from the Robot List:

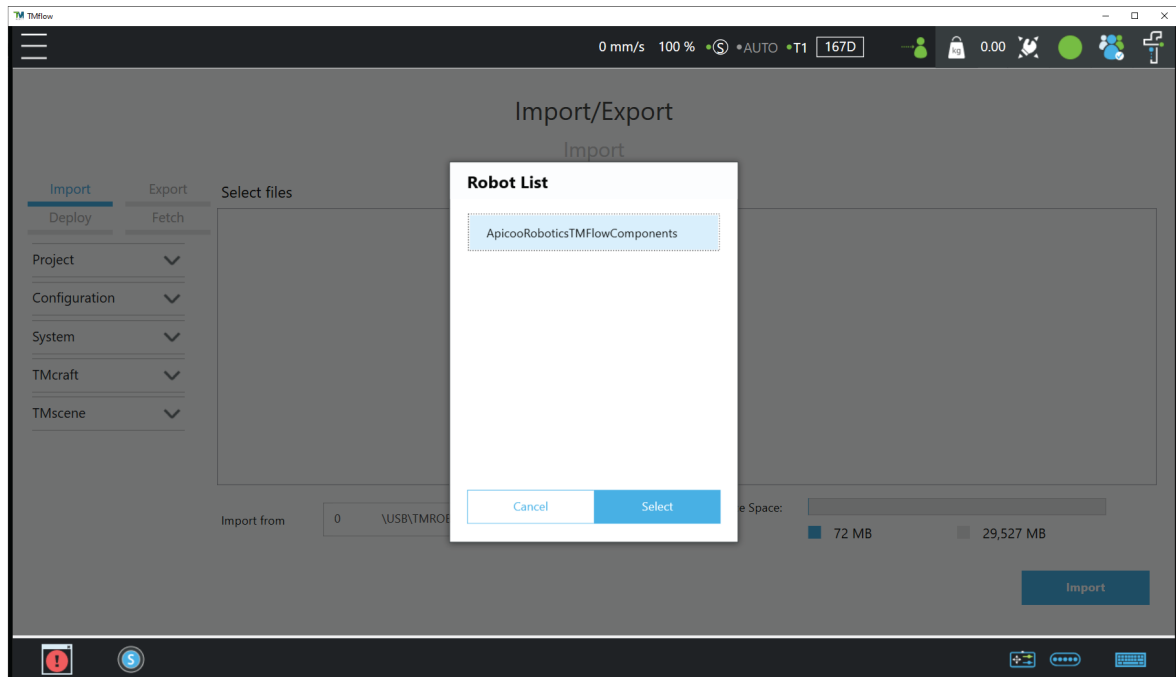


Figure 4.17 - Select ApicooRoboticsTMFlowComponents

Under **Configuration**, select **Component**. The right-hand side panel will show all component packages as zip files. Select all the zip files that starts with GRIPPER_APICOO then hit the **Import** button:

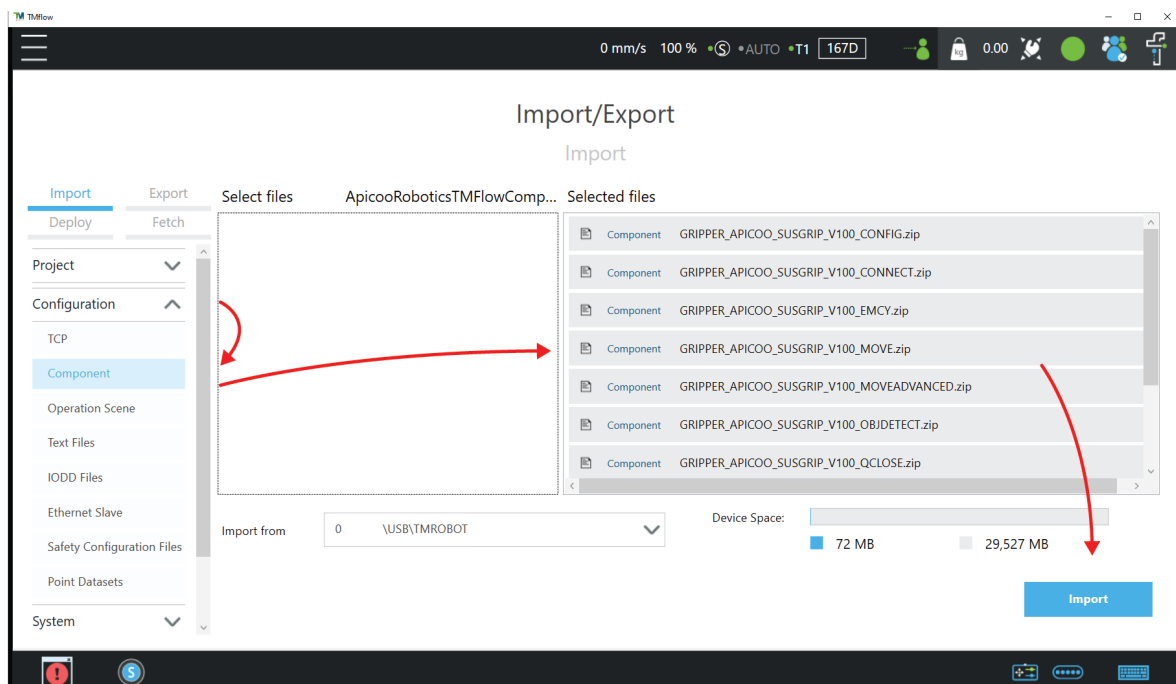


Figure 4.18 - Select and Import All GRIPPER_APICOO Zip Files

Once import is complete, return to **Settings, Configuration**, select **Component** to open the Component List screen:

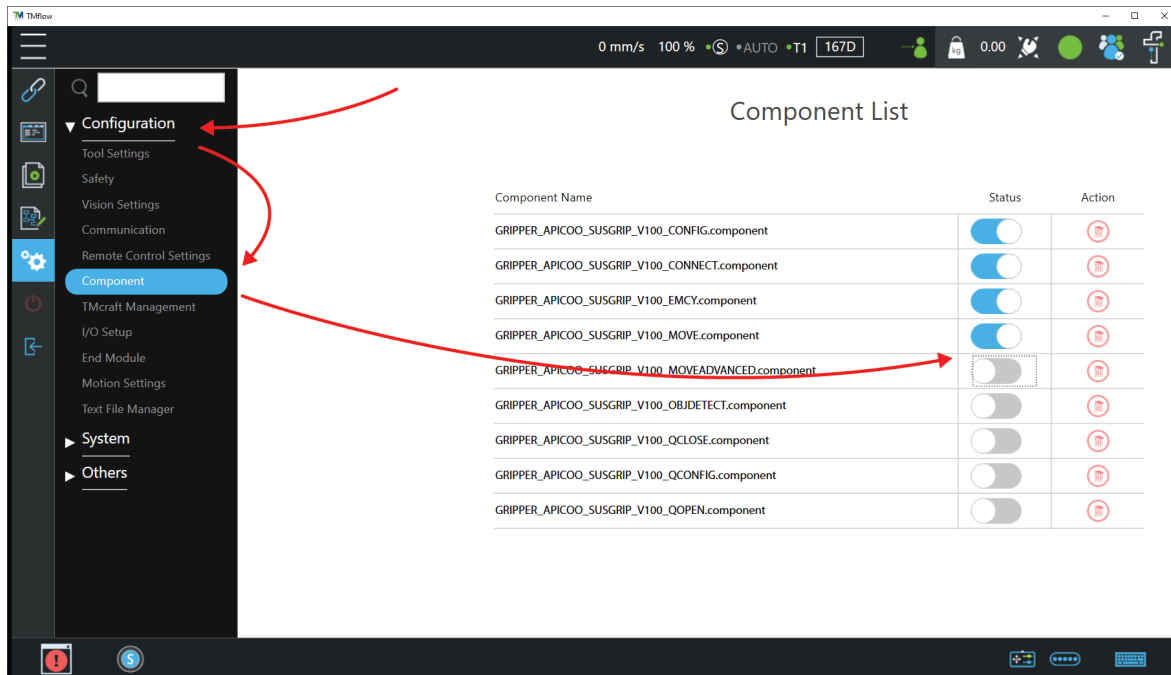


Figure 4.19 - Enable The Imported Components

Enable the components by toggling the switch button on the Status column. After this, the components are ready to be used in programming a robot flow.

To see the components, create a new Flow project. On the left-hand side action panel, expand **Components**:

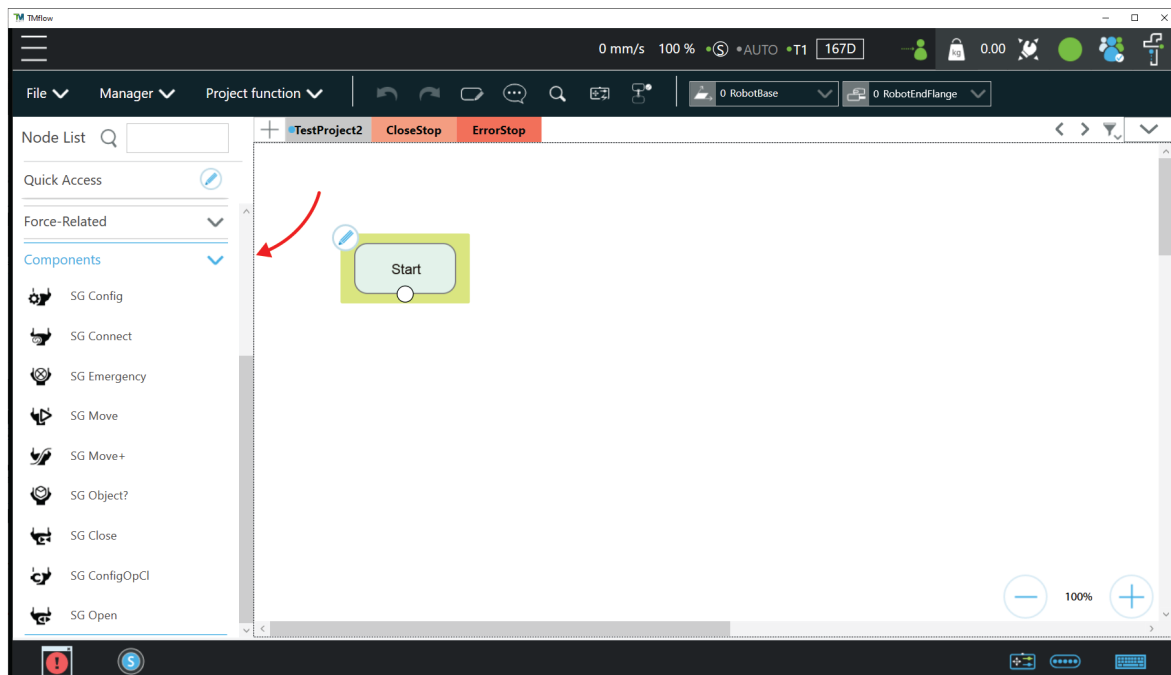


Figure 4.20 - SusGrip TMFlow Components in Flow Programming

4.6.4. TM Robot Gripper Button

There exists a button on TM robot arms called Gripper Button. This button allows users to quickly grip and release the gripper without having to run a program. This button is supported by SusGrip TMFlow package.

To assign the Gripper Button functions, go to **Settings** on TMFlow software, under **Configuration**, select **End Module**, then **Gripper Button**:

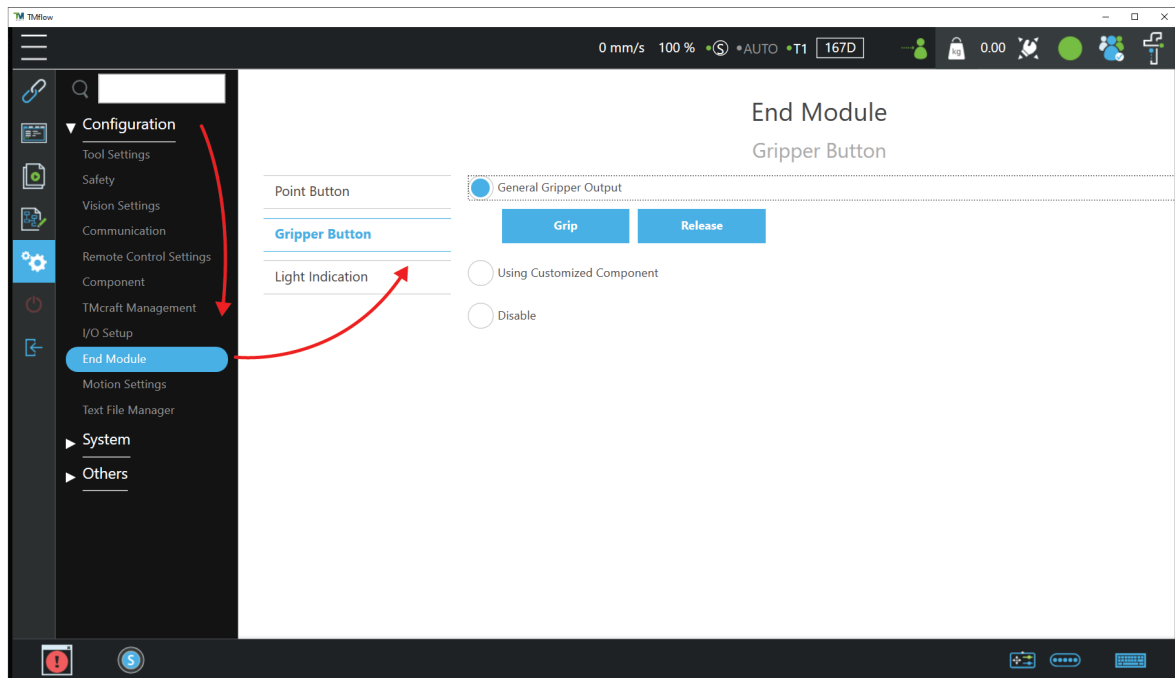


Figure 4.21 - TMFlow End Module Settings

Put the tick on **Using Customized Component**. Select the components from the SusGrip TMFlow package for **Grip** and **Release** as follow:

- Grip: GRIPPER_APICOO_SUSGRIP_VXXX_QCLOSE
- Release: GRIPPER_APICOO_SUSGRIP_VXXX_QOPEN

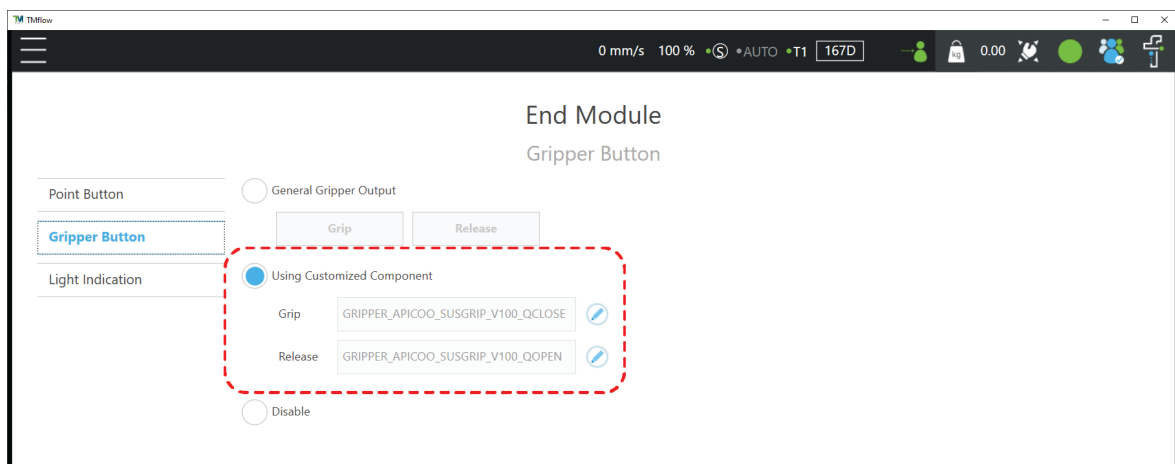


Figure 4.22 - Using SusGrip Components for TM Gripper Button

4.6.5. Global Variable Prerequisites

Before communication between SusGrip grippers and the robot could be made, there must exist the 02 following global variables with the exact name:

Table 4.3 - Required Global Variables for SusGrip Grippers in TMFlow

TYPE	PREFIX	VARIABLE NAME	DEFAULT VALUE
string	g_	GRIPPER_APICOO_comPort	"COM2"
int	g_	GRIPPER_APICOO_deviceID	1

If the global variables do not exist, users must manually create them. Start by creating a new Flow project, or opening an existing one. Open **Manager** and select **Variables**:

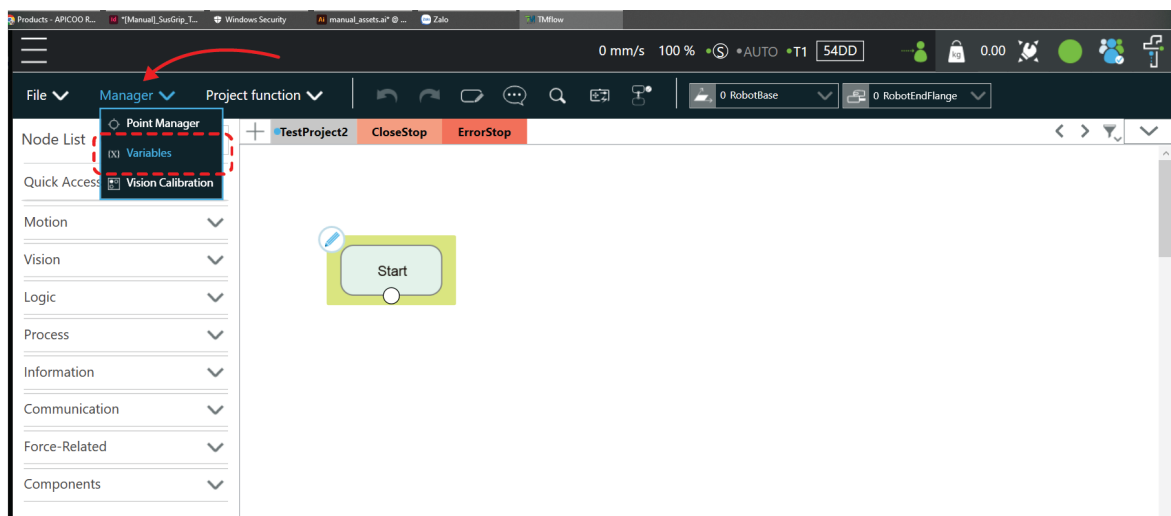


Figure 4.23 - Open Variables Manager in TMFlow

In the Variable manager screen, select **Global Variables**, **Variable**, and add the 02 variables with the exact name as above:

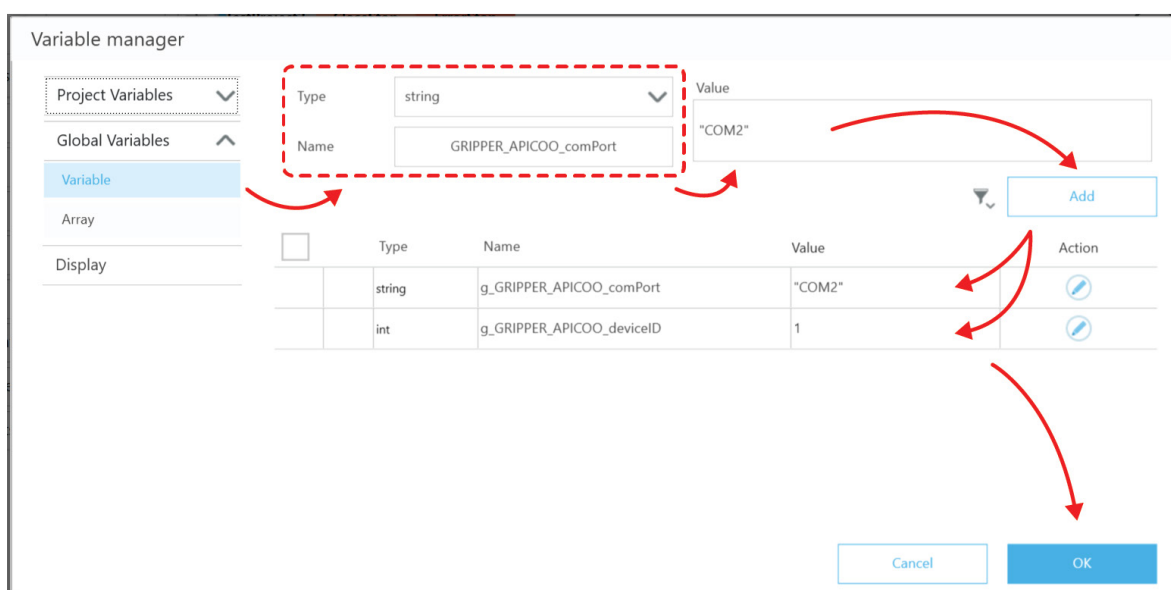


Figure 4.24 - Add the Required Global Variables to the Robot

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5 - TMFLOW OPERATION GUIDE

SusGrip grippers offer two control modes: Normal mode and IO-only mode. In Normal mode, commands are sent to the gripper by accessing its Modbus registers over RS485, and signals on the input pin are ignored. In IO Only mode, commands can still be received over RS485, but will be overridden by signal on the input pin.

When operating SusGrip grippers with the SusGrip TMFlow package for OMRON TM robot arms, the device **MUST** be configured to Normal operation mode. This can be done in TMFlow software or by using Apicoo Universal Console (AUC).

Refer to the main manual for guidance on AUC. Refer to the Components Description in this manual for guidance on using SusGrip flow nodes.

5.1. Features Description

SusGrip-2F and SusGrip-3F offer various operational features and customizations. Refer to the main manual for detailed features description.

5.2. Modbus RTU Communication

Refer to the main manual for detailed description of Modbus RTU communication.

When operating SusGrip grippers with SusGrip TMFlow package for OMRON TM robot arms, the device **MUST** be configured to the following serial communication properties:

Refer to the main manual for registers map and detailed description.

Table 5.1 - SusGrip Modbus RTU Properties for OMRON TM Robots

PARAMETER	VALUE				UNIT
MODBUS SERVER ID	1~247				
SUPPORTED MODBUS FUNCTIONS	FC03	FC04	FC06	FC16	
THROWABLE EXCEPTIONS	01 - Illegal Function		02 - Illegal Data Address		
INTERFACE	RS485 half-duplex				
SUPPORTED SERIAL BAUD RATES	115200				bits/s
SERIAL DATA BITS	8				bits
SUPPORTED SERIAL PARITIES	None				
SUPPORTED SERIAL STOP BITS	1				bit

5.3. Creating a Simple Open/Close Program Flow

Start by creating a new file, select new Flow. Right after the Start node, drag the **SG Connect** node from the list of Components into the flow:

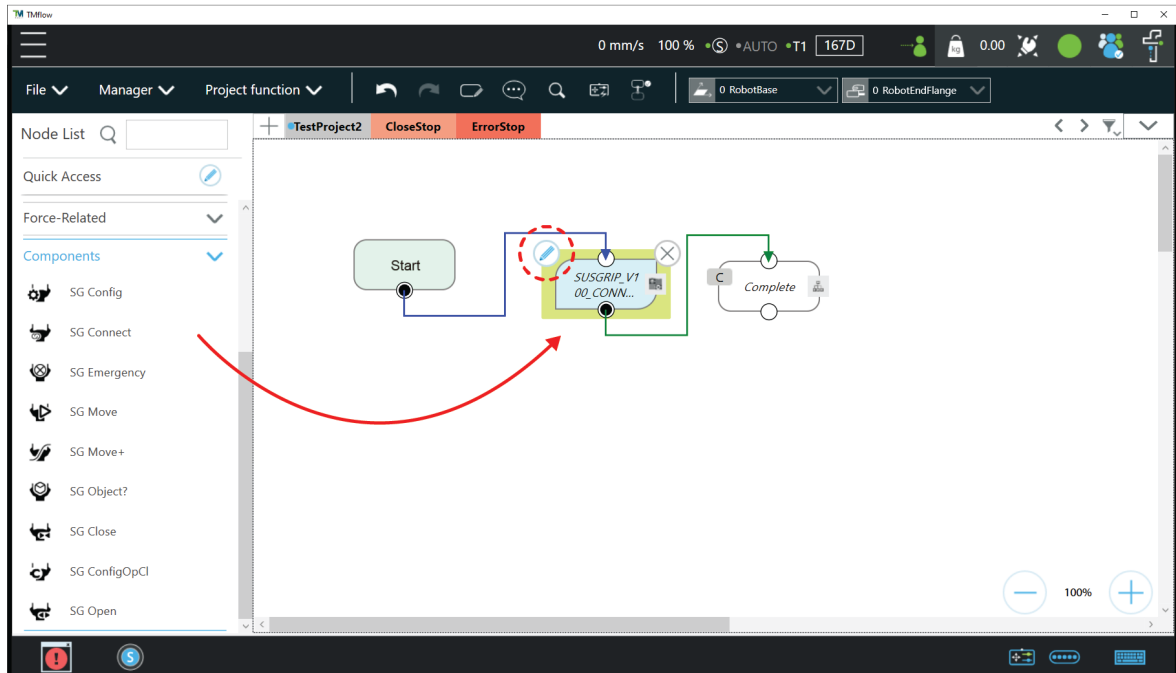


Figure 5.1 - Drag and Drop SG Connect Node into the Flow

Open the editing screen for that node, select and edit **Set_COM_port_and_device_**

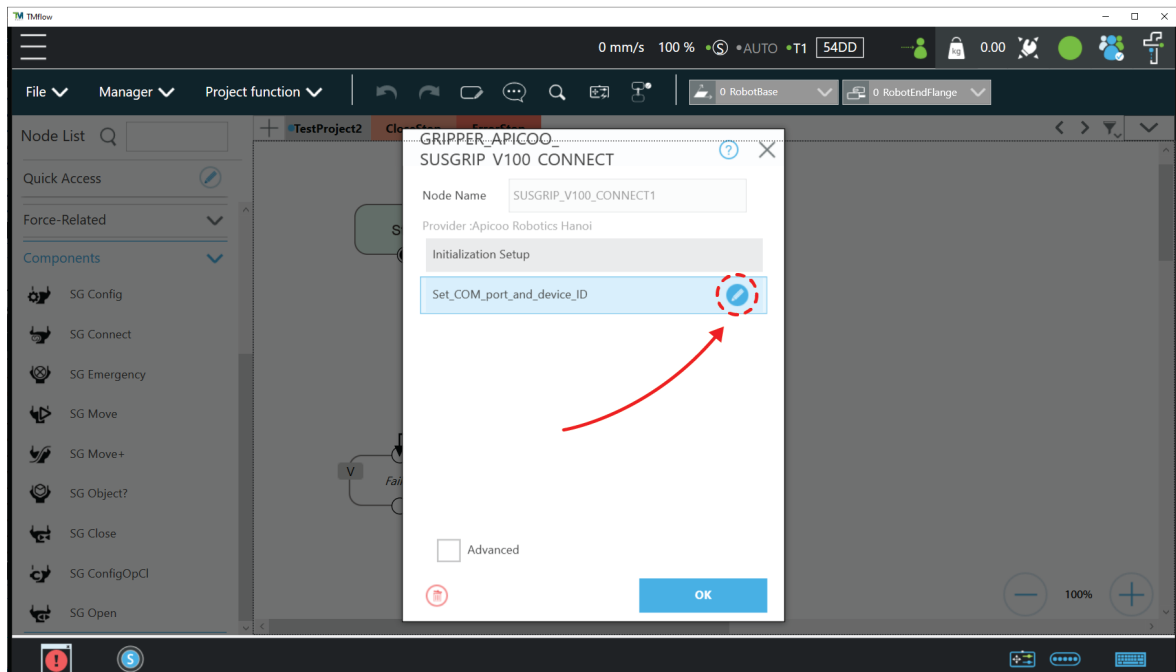


Figure 5.2 - Edit the SG Connect Node

ID:

Select the editable Variables, which are the 02 prerequisite global variables added to the robot:

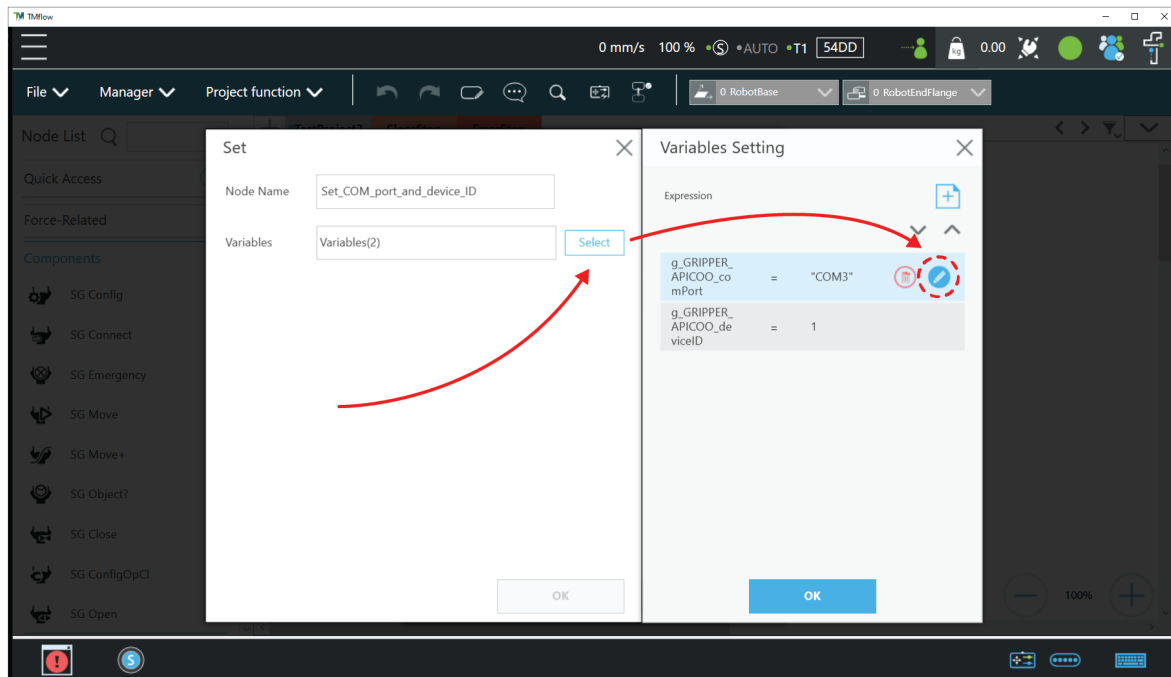


Figure 5.3 - Edit the Global Variables

Change the global variable **g_GRIPPER_APICOO_comPort** to:
"COMx"

where x is a number depending on the serial port SusGrip is connected to. For example, the IO port on the End Module of the robot arm is typically "COM2".

Change the global variable **g_GRIPPER_APICOO_deviceID** to the correct ID of the gripper. To find the ID of the gripper, users may use the Apicoo Universal Console software. The factory default ID is typically 1.



When 2 or more SusGrip grippers are connected at the same time, each must have unique device ID. To change device ID of the gripper, users may use the Apicoo Universal Console (AUC) software.

Please refer to the main manual for further guidance on using AUC.

Continued on the next page.

Add the **SG Move** node after the **Complete** output of the previous node:

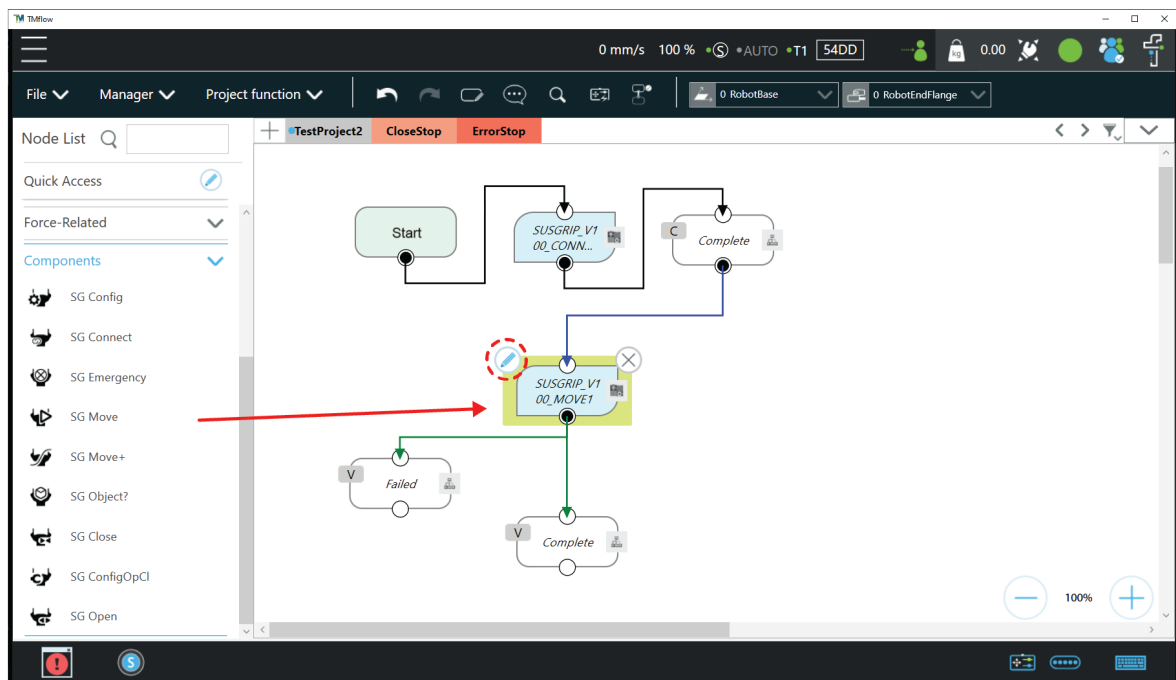


Figure 5.4 - The SG Move Node Added to the Flow

Open the edit screen for that node to set the target fingers position, for example set a position of 120mm (gripper opens to 120mm):

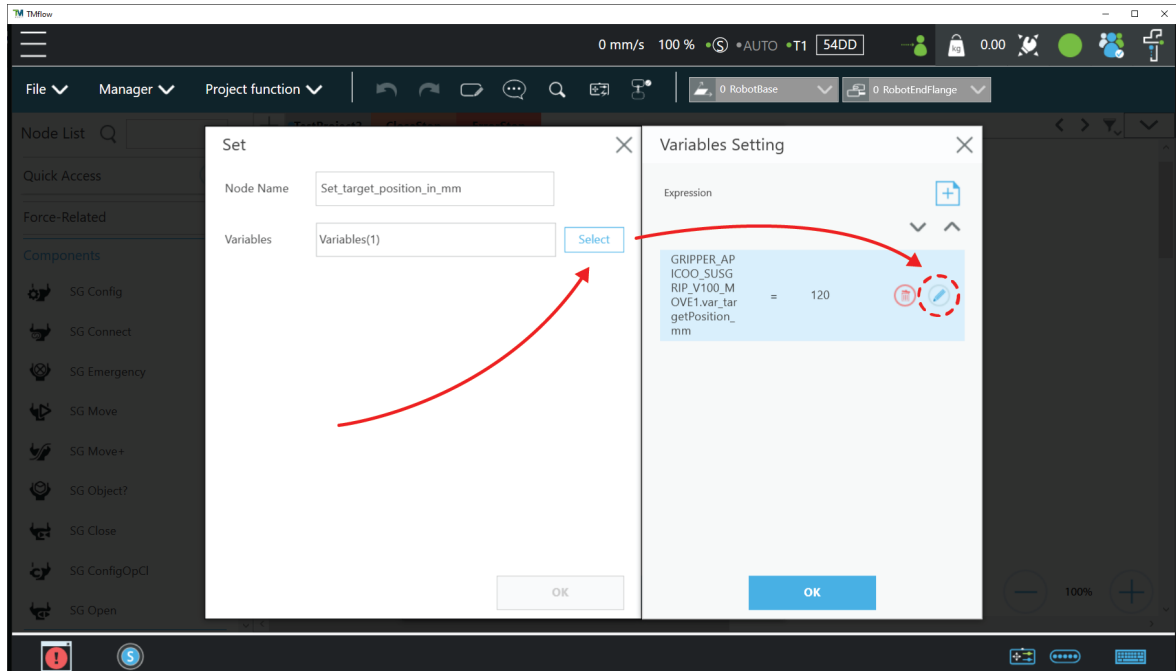


Figure 5.5 - Set Target Position in Millimeters in SG Move Node Edit

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Add another **SG Move** node after the **Complete** gateway output of the previous node and set it to a different target position, for example 10mm (gripper closes to 10mm):

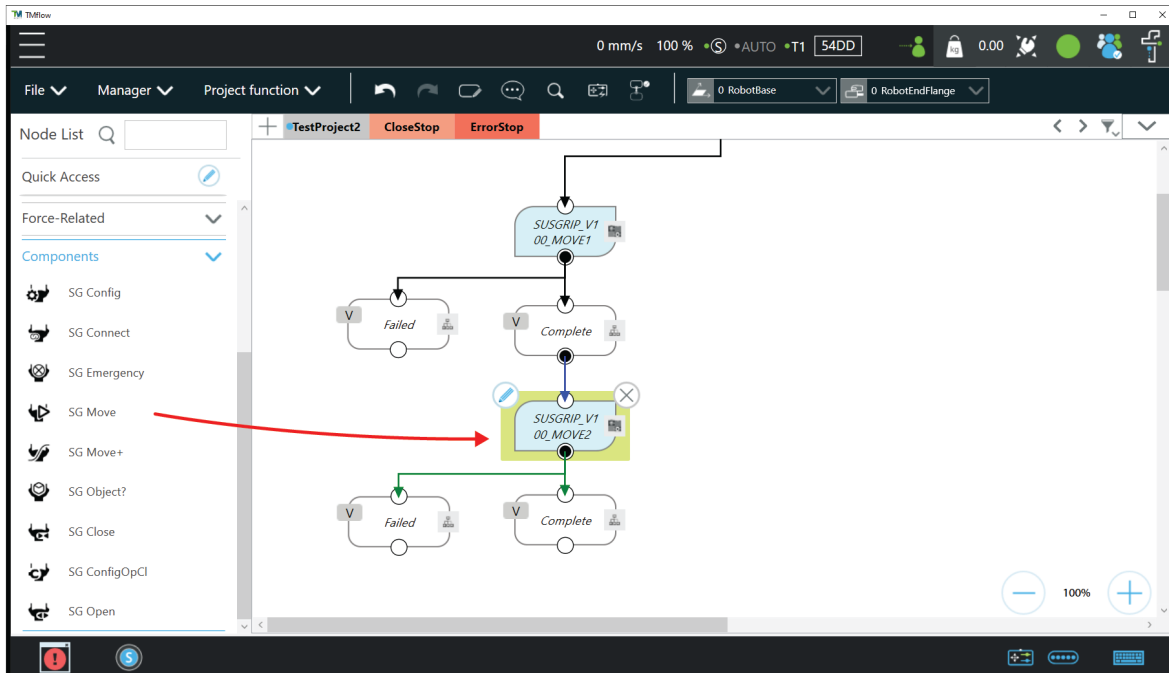


Figure 5.6 - Add New SG Move Node After the Previous Node Complete Output

A warning might appear stating that the component already exists in the Flow Editor. Simply select **Make it as a new component**:

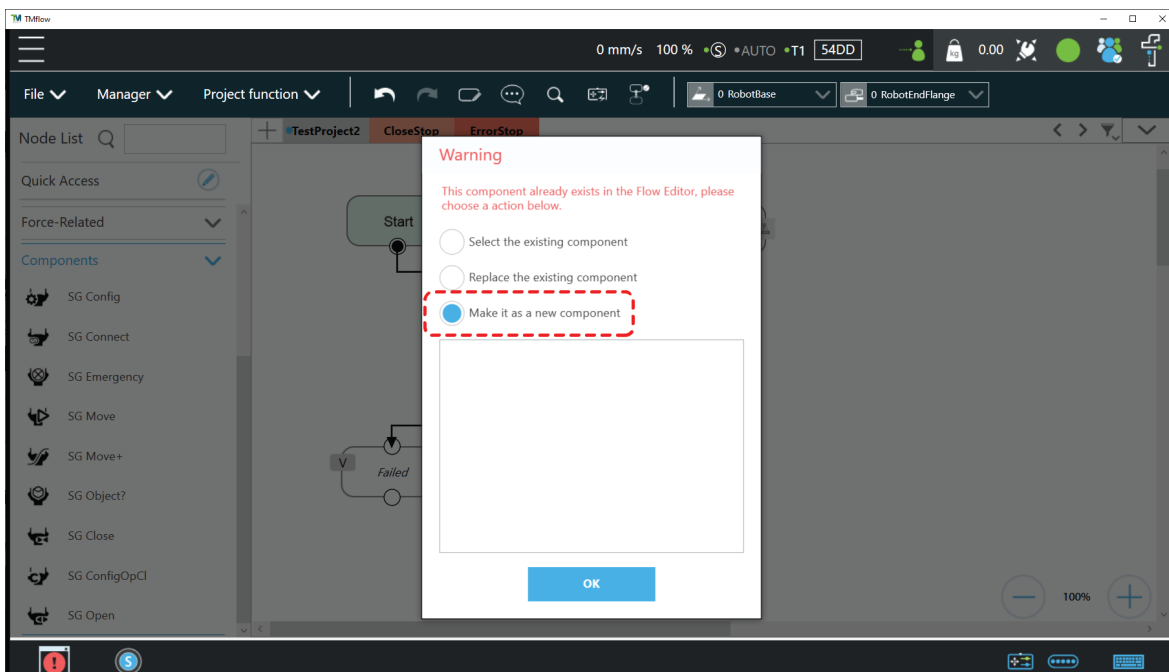


Figure 5.7 - Component Already Exists Warning

Continued on the next page.

Make the program loop forever by connecting the **Complete** output of the second **SG Move** node to the input of the first SG Move node. Then, a program that makes the gripper open and close from 120mm to 10mm continuously is complete:

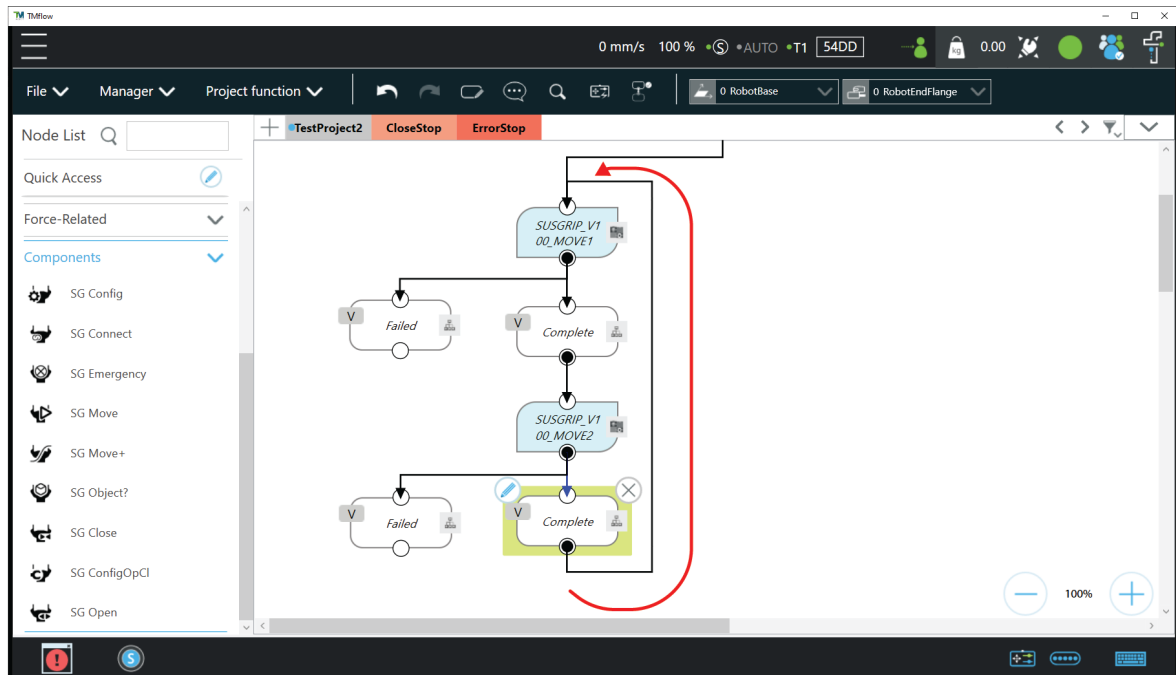


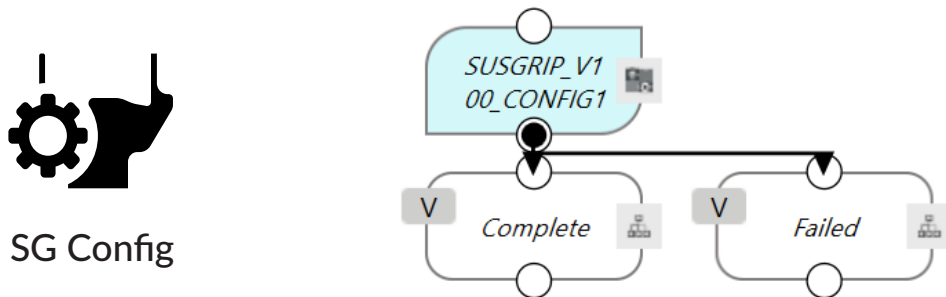
Figure 5.8 - Complete Simple Program with Loop

5.4. Components Description

This section provides detailed description for the components in the SusGrip TM-Flow package.

5.4.1. SusGrip Component: SG Config

The SG Config component sends the configuration parameters to SusGrip gripper:



The settings and variables of this component are:

SETTING	VARIABLE	TYPE	DEF	DESCRIPTION
Set_operation_mode	var_modeNormal	bool	True	Set operation mode for SusGrip gripper: Normal mode = True False = IO Only SusGrip gripper MUST be set to operate in Normal mode when working with TMFlow.
Set_fingers_offset_in_mm	var_offsetFinger_mm	int	0	Set finger offset compensation for SusGrip gripper. Please refer to the main manual for detailed elaboration of this feature.
Set_Over_Current_Protection_OCP_in_mA	var_ocpThreshold_mA	int	2000	Set the threshold for the Over-Current Protection (OCP) feature in milli-Amps. When SusGrip is powered by the End Module of the robot, it is recommended to set the level at 1500mA.
Set_device_ID_from_1_to_247	var_modbusID	int	1	Set the device ID (Modbus slave ID) of the device from 1 to 247. Note that after the device ID is changed, the SG Connect node has to be run to re-declare the ID so that the robot can re-establish communication with the gripper.

Continued on the next page.

The advanced settings and variables of this component are:

SETTING	VARIABLE	TYPE	DEF	DESCRIPTION
Set_expert_parameters	var_enableUncaged	bool	False	Enable or disable Uncaged mode for SusGrip gripper: Disable = False True = Enable. Uncaged mode is NOT recommended for non-expert users. Please refer to the main manual for detailed description of this feature.
	var_forceTime_ms	int	3000	Set the force holding duration when grasping an object in milliseconds. It is typically set from 1000 to 3000 ms. Please refer to the main manual for detailed description of this parameter.
	var_forceDecay_percent	int	30	Set the force strength after the holding period elapsed in percent from 0 to 100. If this is set to 0, force will be decayed completely after the holding duration has passed.
	var_forceSpeed	int	2	Set the force rise and decay speed in 4 levels: 0 = Slow 1 = Moderate 2 = Fast 3 = Very fast. If the level is set outside these values, the gripper will automatically constrain to the allowable range when received.
Save_to_memory	var_saveToMemory	bool	False	Trigger the memory save operation on SusGrip gripper if set to True. It is NOT RECOMMENDED to perform multiple memory save actions in a short period of time.

For changes to device ID (Modbus slave ID) to take effect, emergency stop (EMCY) has to be engaged first.

Gateway:

- Complete: when all configuration parameters were sent successfully;
- Failed: when 1 or more parameters failed to send.

5.4.2. SusGrip Component: SG Connect

The SG Connect component declares the COM port and device ID for the communication between the robot and SusGrip grippers:



The settings and variables of this component are:

SETTING	VARIABLE	TYPE	DEF	DESCRIPTION
Set_COM_port_and_device_ID	g_GRIPPER_API-COO_comPort	string	"COM2"	Declare the COM port to which SusGrip grippers are connected: - End Module: "COM2" - Control Box: "COM2" or "COM3" - USB-to-RS485: "COMx".
	g_GRIPPER_API-COO_deviceID	int	1	Declare the device ID of the SusGrip gripper to be controlled from 1-247. Only 1 SusGrip gripper can be controlled at a time. When multiple grippers are present on the RS485 bus, this node must be called each time to switch between the IDs of the devices. Note that this component does not change the ID in the configuration on the device. It is used only to declare the ID for the robot to establish communication and control.

This component has no advanced settings and variables.

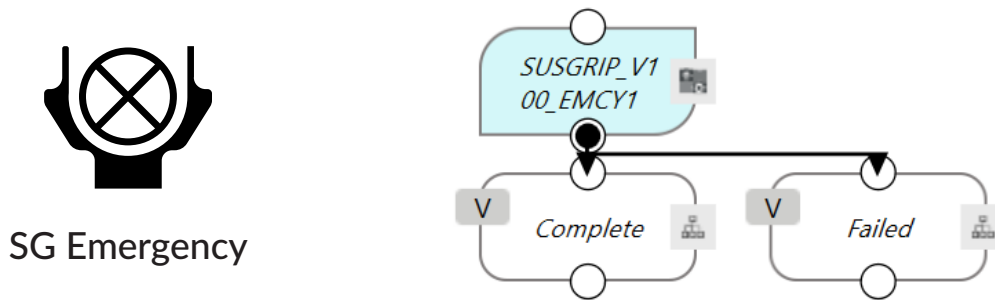
The SG Connect component node **MUST** be called at least once before any other components could be used with SusGrip gripper.

The SG Connect component effectively changes the 02 prerequisite global variables **g_GRIPPER_APICOO_comPort** and **g_GRIPPER_APICOO_deviceID**. Users can change these variables in the Variable Manager directly, in which case it will no longer be necessary to call this component in a program flow.

Gateway: always Complete.

5.4.3. SusGrip Component: SG Emergency

The SG Emergency component engages or releases emergency stop (EMCY) on the target SusGrip gripper:



The settings and variables of this component are:

SETTING	VARIABLE	TYPE	DEF	DESCRIPTION
Engage_True_or_disengage_False_EMKY	var_engageEMKY	bool	True	Engage or release emergency stop (EMKY) on the gripper: Release = False True = Engage. When EMKY is released, all non-persisting errors are cleared.

This component has no advanced settings and variables.

Engaging EMKY is required for changes to device ID (Modbus slave ID) in configuration to take effect.

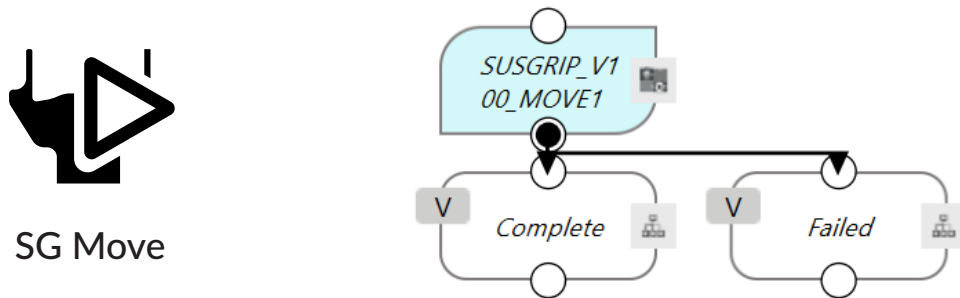
When a Memory save operation is triggered, EMKY is automatically engaged for the duration of the process.

Gateway:

- Complete: when EMKY command was successfully sent to the gripper;
- Failed: when communication with the gripper could not be established.

5.4.4. SusGrip Component: SG Move

The SG Move component sends target fingers position in millimeters to SusGrip gripper to be executed:



The settings and variables of this component are:

SETTING	VARIABLE	TYPE	DEF	DESCRIPTION
Set_target_position_in_mm	var_targetPosition_mm	int	70	Set target fingers position for the SusGrip gripper in millimeters. The value MUST be within the allowable range of the gripper: - SusGrip-2F (Std): from 1 to 130 mm - SusGrip-3F (Std): from 10 to 150 mm The value can be 0 or negative if finger offset configuration is introduced. For example, with finger offset setting of -40mm: - SusGrip-2F (Std): from -39 to 90 mm - SusGrip-3F (Std): from -30 to 110 mm Any value set outside of the allowable range will raise an Invalid Command error and engage EMCY automatically.

This component has no advanced settings and variables.

This component also releases EMCY and clears all errors before executing motion.

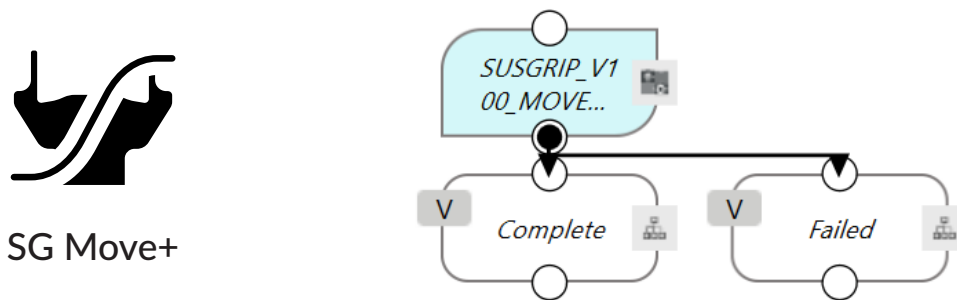
This component always waits until the fingers motion is complete. Users DO NOT need any additional **Wait for** nodes when programming the flow with SG Move.

Gateway:

- Complete: when fingers motion was complete, fingers stationary;
- Failed: when communication with the gripper could not be established.

5.4.5. SusGrip Component: SG Move+

The SG Move+ (Move plus) component sends target fingers motion to SusGrip gripper to be executed:



The settings and variables of this component are:

SETTING	VARIABLE	TYPE	DEF	DESCRIPTION
Set_target_position_in_mm	var_targetPosition_mm	int	70	Set target fingers position for the SusGrip gripper in millimeters. Similar to SG Move.
Set_speed_and_acceleration	var_speed_mm_s	int	120	Set the target fingers speed in mm/s. The minimum is 10 mm/s and is automatically constrained by the gripper when received. Speed determines how fast the fingers travel. For example when moving fingers from 10mm to 130mm (distance = 120mm), set speed to 120mm/s to achieve a travel time of approx. 1s. Whether the fingers can reach this speed is dependent on the acceleration setting and the total distance to travel.
	var_accel_mm_s_s	int	240	Set the target fingers acceleration in mm/s/s (or mm/s ²). The minimum is 10mm/s ² and is automatically constrained by the gripper when received. Acceleration affects how quickly the fingers get into motion. Higher value ensures the target speed is reached, while lower value yields smoother motion.

Continued on the next page.

The settings and variables of SG Move+, continued:

SETTING	VARIABLE	TYPE	DEF	DESCRIPTION
Set_force_strength	var_force_percent	int	30	Set target force strength used to grasp and hold an object: - From 0% to 100% when Uncaged disabled - From 0% up to 160% when Uncaged enabled (not recommended). This strength is only applied for the duration of the force hold time (changeable in configuration, typically 3000ms). After the holding period elapsed, force is decayed to a lower value, which is also set by the configuration parameters (typically reduced to 10-30%). If force strength is set to 0%, no force will be used, and object holding is done purely by residual mechanical force.

The advanced settings and variables of this component are:

SETTING	VARIABLE	TYPE	DEF	DESCRIPTION
Set_advanced_parameters	var_deform_mm	int	5	Please refer to the main manual for detailed description of this parameter. Typically set based on object type: - Fragile: 1-3mm - Rigid: 4-7mm - Elastic: 8-15mm.
	var_OBJThreshold_mArms	int	1600	Please refer to the main manual for detailed description of this parameter. Typically set based on object type: - Fragile: 1000-1300mArms - Hard: 1300-2000mArms - Heavy: >=2000mArms.

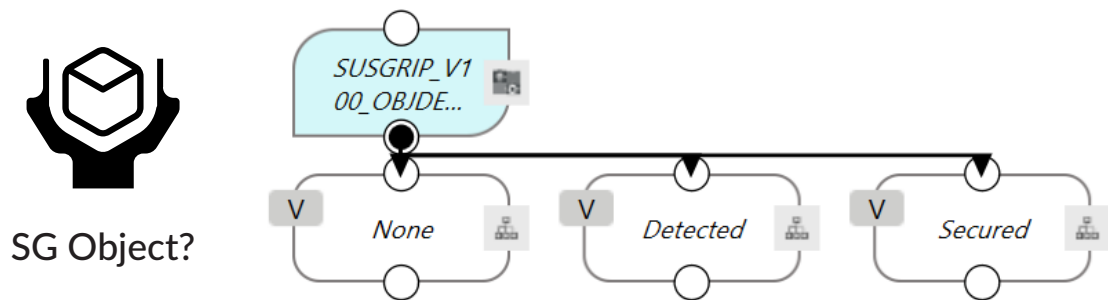
Similar to SG Move, this component releases EMCY and clears all errors before executing motion and waits until the fingers motion is complete. Users DO NOT need any additional **Wait for** nodes when programming the flow with SG Move+.

Gateway:

- Complete: when fingers motion was complete, fingers stationary;
- Failed: when communication with the gripper could not be established.

5.4.6. SusGrip Component: SG Object?

The SG Object? component inquires the target SusGrip gripper about its object detection and grasping status:



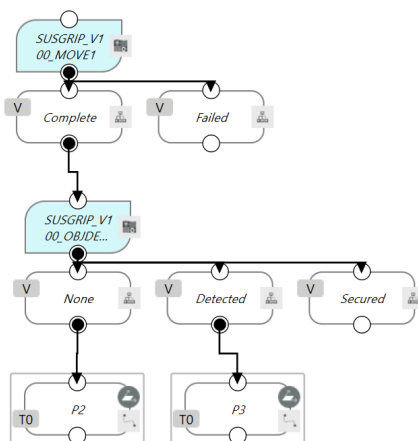
This component has no settings and variables.

SG Object? reads the object status of the target SusGrip gripper the very moment it is executed by the program flow. This component reads only once and does not poll continuously.

Gateway:

GATEWAY CASE	CASE DESCRIPTION
None	Gateway case None can infer one of the following situations: - When SusGrip gripper responded that no objects were detected - When SusGrip gripper responded that an object was lost from grip - When communication with the gripper could not be established
Detected	Gateway case Detected infers that SusGrip gripper has detected an object either while opening or while closing its fingers, but the object was not secured grasped, yet.
Secured	Gateway case Secured infers that SusGrip gripper has detected an object and has securely grasped the object.

Example usage 1:

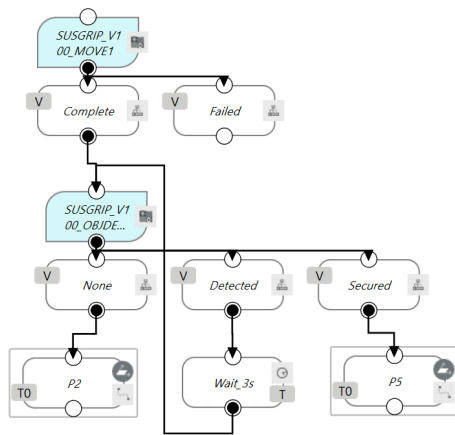


Use **SG Object?** after a **SG Move** node to check whether the gripper detected an object.

If no objects were detected (Gateway case **None**), move the robot to point **P2**.

If an object was detected (Gateway case **Detected**), move the robot to point **P3**.

Example usage 2:



Extended from example usage 1.

Use **SG Object?** after a **SG Move** node to check whether the gripper detected an object.

If no objects were detected (Gateway case **None**), move the robot to point **P2**.

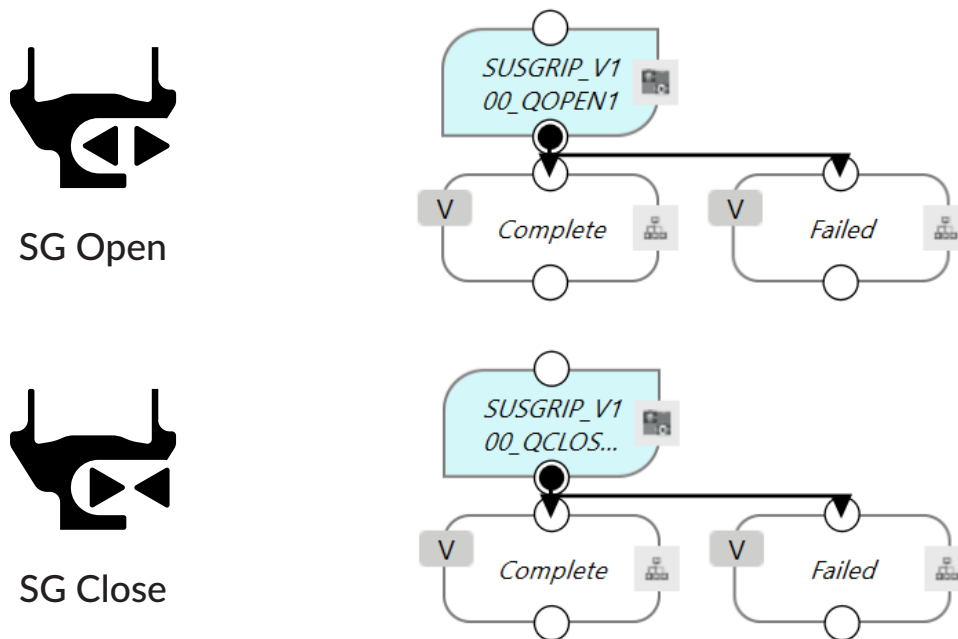
If an object was detected (Gateway case **Detected**), wait 3s then check the object status again.

This creates a mini-loop that checks the object status of the gripper every 3 seconds until it is securely grasped.

When the object was secured grasped (Gateway case **Secured**), move to point **P5**.

5.4.7. SusGrip Component: SG Open and SG Close

The SG Open and SG Close components send motion commands to quickly open and close the target SusGrip gripper:



These components has no settings and variables.

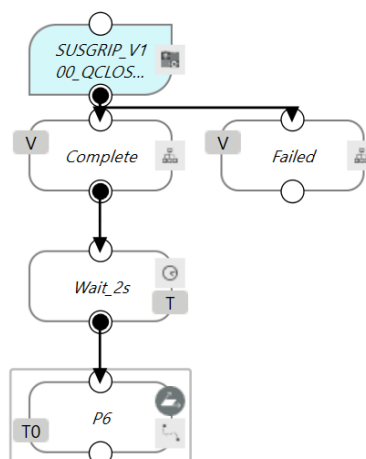
These components are meant to be used with the robot's Gripper Button for Grip and Release action. They can also be used in a program flow.

These components behave similar to **SG Move** and **SG Move+** but DO NOT wait until fingers motion has finished. When using these components in a program flow, users might need additional **Wait for** nodes to allow the fingers motion to complete before proceeding to the next command.

Gateway:

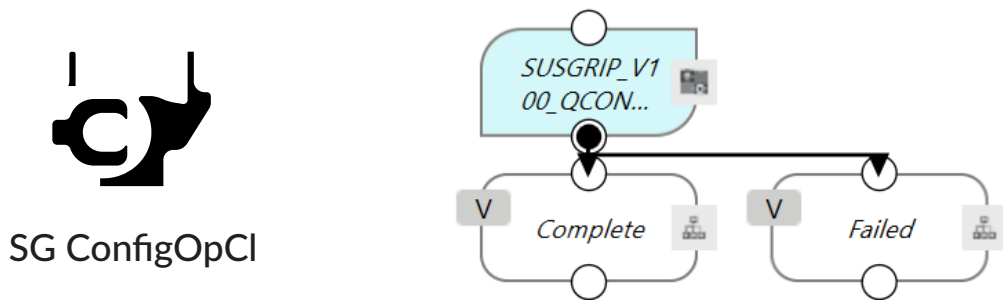
- Complete: when open/close command was sent successfully to the gripper;
- Failed: when communication with the gripper could not be established.

Example usage in a program flow:
An additional **Wait for** node was added after **SG Close** to wait for fingers motion execution before moving to point **P6**.



5.4.8. SusGrip Component: SG ConfigOpCl

The SG ConfigOpCl component sets the fingers position in mm, fingers speed in mm/s, and fingers acceleration in mm/s² for the motion of the components SG Open and SG Close on the target SusGrip gripper:



The settings and variables of this component are:

SETTING	VARIABLE	TYPE	DEF	DESCRIPTION
Set_open_close_position_in_mm	var_openPosition_mm	int	120	Set target fingers position for the SG Open component in millimeters.
	var_closePosition_mm	int	10	Set target fingers position for the SG Close component in millimeters.

The advanced settings and variables of this component are:

SETTING	VARIABLE	TYPE	DEF	DESCRIPTION
Set_open_close_speed_and_accel	var_openSpeed_mm_s	int	120	Set the target fingers speed for the SG Open component in mm/s.
	var_openAccel_mm_s2	int	240	Set the target fingers acceleration for the SG Open component in mm/s ² .
	var_closeSpeed_mm_s	int	120	Set the target fingers speed for the SG Close component in mm/s.
	var_closeAccel_mm_s2	int	240	Set the target fingers acceleration for the SG Close component in mm/s ² .

Continued on the next page.

Setting the position, speed, and acceleration for open and close is similar to setting for the SG Move and SG Move+ components.

When the SG Config component triggers Memory save on the target SusGrip gripper, the parameters of this component also get saved.

Gateway:

- Complete: when all configuration parameters were sent successfully;
- Failed: when 1 or more parameters failed to send.

This is the end of SusGrip TMFlow Components Description.

6 - MAINTENANCE AND TROUBLESHOOTING

Refer to the main manual for Maintenance and Troubleshooting guidance.

This is the end of the Manual for SusGrip TMFlow