WEISS ROBOTICS

GRIPLINK PLUGIN FOR KUKA

Version 1.0.0

Content

1 Introduction

With the GRIPLINK technology, servo-electric and smart pneumatic gripping modules from WEISS ROBOTICS as well as sensors/actors from selected third-party vendors can be connected to robot systems from leading manufacturers via a network connection. The GRIPLINK plug-in for KUKA is the software link between the GRIPLINK-ET4 interface converter and the robot controller and enables the easy integration of WEISS ROBOTICS' GRIPLINK technology into KUKA robot systems..

> This manual describes the functions of the GRIPLINK plug-in. For information about installation and operation of the GRIPLINK-ET4 interface converter please refer to the GRIPLINK-ET4 user's manual. The manual can be found online on **www.griplink.de/manuals**

Feldfunktion geändert

1.1 Notation and symbols

For a better understanding, the following symbols are used in this manual:

> Functional or safety relevant information. Non-compliance may endanger the safety of personnel and the system, damage the device or impair its function.

> Additional information for a better understanding of the described facts.

> Reference to further information.

1.2 Intended use

The software "GRIPLINK plug-in" is intended for communication between the GRIPLINK-ET4 interface converter from WEISS ROBOTICS and a robot controller. The requirements of the applicable guidelines as well as the installation and operation instructions in this manual must be noted and adhered to. Any other use or use beyond that is considered improper use. The manufacturer is not liable for any damage resulting from this.

1.3 System requirements

One of the following KUKA robot controllers is required to run this software:

- KR C 4 or 5

The following robot option is required to run the software:

- KUKA Ethernet KRL

> Please contact KUKA or your KUKA distributor in order to purchase these products.

The IP addresses of both the robot controller and the GRIPLINK-ET4 interface converter must be located within the same subnet range. Please contact your network administrator if you experience any problems assigning appropriate IP addresses to the devices.

1.4   License terms

The GRIPLINK plug-in is protected by copyright. The software package includes the applicable license terms. By installing and using the GRIPLINK plug-in, the user accepts these license terms.

2 Installation

2.1 Preparation of the robot

Copy the XML file *GripLink.xml* into the folder C:\KRC\ROBOTER\Config\User\Common \EthernetKRL of your robot controller. This file path is only visible if you are acting as an expert (level 3) or higher.
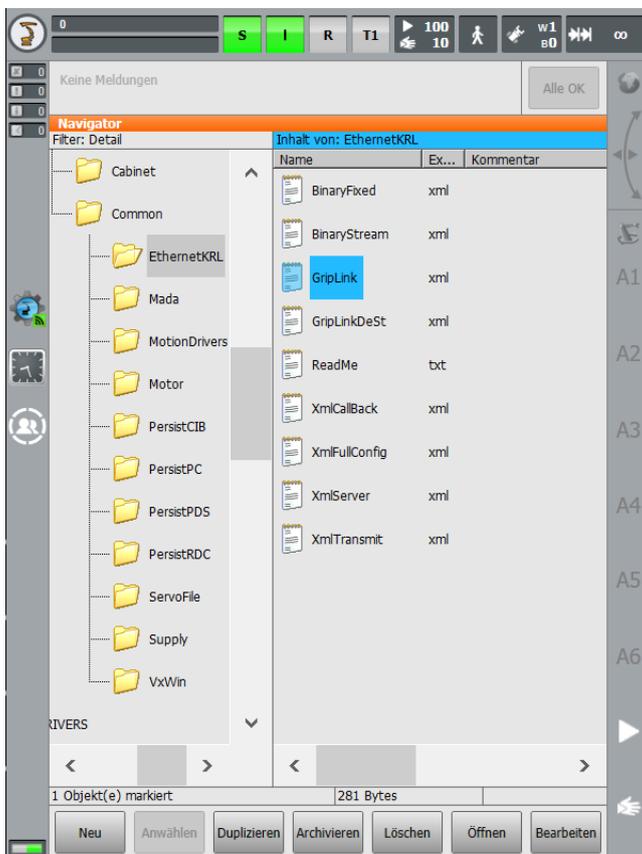
2.2 Configuration of the XML file

In the XML file, enter the IP address of the GRIPLINK (192.168.1.40 by default) in the <IP> field, and the port number 10001 accordingly in the <PORT> field. If you have changed the IP address of the GRIPLINK Controller, adjust the IP address in the XML file accordingly.

```
 1  <ETHERNETKRL>

 2     <CONFIGURATION>

 3        <EXTERNAL>

 4           <IP>192.168.1.40</IP>

 5           <PORT>10001</PORT>

 6        </EXTERNAL>

 7     </CONFIGURATION>

 8     <RECEIVE>

 9        <RAW>

10           <ELEMENT Tag="Feedback" Type="STREAM"
               Size="128" EOS="10"/>

11        </RAW>

12     </RECEIVE>

13     <SEND/>

14  </ETHERNETKRL>
```

2.3 Software Installation

Make sure that you are using the latest version of the GRIPLINK plugin. The latest version can be downloaded from **www.griplink.de/software.**

The GRIPLINK plug-in for KUKA can be installed via the KUKA WorkVisual software or by using a USB thumb drive to copy the files directly to the robot controller.

2.3.1 Installation via WorkVisual

Copy the *GripLink_Kuka.dat* and *GripLink_Kuka.src* files in WorkVisual to the program folder. Then copy files to your robot using the "Transfer changes" option.

2.3.2 Direct copy to robot controller

Copy the contents of the ZIP archive to a USB thumb drive. Then connect the USB thumb drive to the robot controller or to the smartPAD and copy the *GripLink_Kuka.src* and *GripLink_Kuka.dat* files to the folder *KRC:\R1\Program* of your robot controller.
If your filter setting is not "File" but "Module", you can copy the *GripLink_Kuka* module accordingly.

2.4 Behavior in case of error

If an error occurs within the GRIPLINK plug-in or during communication with the GRIPLINK controller, the running robot program will be stopped by means of an error. This usually interrupts and aborts any running motion of the robot.

In addition, the connection between the robot controller and the GRIPLINK Controller will be closed and the user will be prompted to deselect the running program.

3 Command Reference

The GRIPLINK plugin provides a collection of generic motion and grip functions as well as functions for reading connected sensors. The commands are defined as globally visible subprograms, which receive their parameters as transfer values. To execute a command, the corresponding subroutine must be called.

The basic program flow with the GRIPLINK plugin is always as follows:

1. Establish connection with GRIPLINK_CONNECT
2. Activate gripping module or sensor with GRIPLINK_ENABLE
3. For servo gripping modules without absolute encoder: Reference gripping module with GRIPLINK_HOME
4. Grip or release with GRIPLINK_GRIP or GRIPLINK_RELEASE
5. Disconnect with GRIPLINK_DISCONNECT

The commands available with the GRIPLINK plug-in are described below.

3.1 Establish connection - C ONNECT

This command establishes the connection between the GRIPLINK controller and the robot controller according to the specifications in the file *GripLink.xml.* The command waits until the connection is established or a timeout occurs. If the connected hardware or software is not compatible, an error will be thrown.

If GRIPLINK-ET4 commands are executed before GRIPLINK_CONNECT, this will raise an error.

Syntax

GRIPLINK_CONNCECT()

Parameters

Example

Establish connection between robot and GRIPLINK:

```
GRIPLINK_CONNECT()
```

3.2   Activate device - ENABLE

This command activates the device connected to the specified port.
If a port is addressed before it has been activated, an error will be raised and the program will be stopped.

Syntax

GRIPLINK_ENABLE(< PORT >)

Parameters

< PORT >   Index of the device port (0 to 3)

Example

Activate drive and gripping part monitoring of the gripping module at port 0:

```
GRIPLINK_ENABLE(0)
```

3.3   Query device state - GETSTATE

This command returns the device state of the device connected to the selected port as an integer value. The possible states can be taken from Appendix A. To make the queries easy to read, constants with the corresponding numerical values have been defined, which can be used instead of numbers. Their names can also be seen in Appendix A.

Syntax

    GRIPLINK_GETSTATE(< PORT >)

Parameters

    < PORT >   Index of the device port (0 to 3)

Return value

    INT

Example

As long as the gripper connected to port 1 has not gripped a part, it should try again:

```
WHILE NOT (GRIPLINK_GETSTATE(1) == GS_HOLDING)
    GRIPLINK_RELEASE(1,0)
    GRIPLINK_GRIP(1,0)
ENDWHILE
```

3.4 Deactivate device - DISABLE

This command deactivates the device connected to the selected port. This command can be used, for example, to change tools. The device can be reactivated via GRIPLINK_ENABLE.

Syntax

GRIPLINK_DISABLE(< PORT >)

Parameters

< PORT >   Index of the device port (0 to 3)

Example

Change the gripping module at port 0:

```
; Connect to GRIPLINK
GRIPLINK_CONNECT()
Activate gripper 0
GRIPLINK_ENABLE(0)
; DO something
; ...
; Prepare tool change:
; Disable gripper 0:
GRIPLINK_DISABLE(0)
; Now, the gripper can be changed
;
; - OPERATE THE TOOL CHANGER HERE -
;
; Activate the new gripper:
GRIPLINK_ENABLE(0)
```

3.5   Referencing gripping module - HOME

This command references the selected servo gripper. The command executes a reference run of the gripping module and waits until this is completed. After the Home command has been executed, the fingers of the gripping module are powerless and must be moved to a defined position with a Grip/MGrip or Release/MRelease command.

☞   The reference run can be configured via the web interface of the GRIPLINK controller.

Syntax

> GRIPLINK_HOME(< PORT >)

Parameters

> < PORT >   Index of the device port (0 to 3)

Example

> Reference the gripping module to port 2:

```
GRIPLINK_HOME(2)
```

3.6   Grip workpiece - GRIP

This command causes the selected gripping module to grip a workpiece using the selected grip configuration. The command is executed until the gripping state corresponds to HOLDING or to NO PART. However, if the device state corresponds to FAULT or a timeout occurs, the running program is stopped.

☞   The gripping parameters can be configured via the web interface of the GRIPLINK controller.

Syntax

GRIPLINK_GRIP(< PORT >,< INDEX >)

Parameters

| < PORT > | Index of the device port (0 to 3) |
| < INDEX > | Selected handle (range depends on gripper model) |

Example

The gripping module at port 0 is to grip with grip configuration 2.

```
GRIPLINK_GRIP(0,2)
```

3.7 Simultaneous gripping of workpieces - MGRIP

This command causes the selected gripping modules to execute a grip. The command waits until all gripping modules addressed have each reached one of the states HOLDING or NO PART. If one of the devices reaches the FAULT state or a timeout occurs, the program will be stopped.

The gripping parameters can be configured via the web interface of the GRIPLINK controller.

Syntax

GRIPLINK_MGRIP(< INDEX >,< PORT0 > ,< PORT1 >,< PORT2 >,< PORT3 >)

Parameters

< INDEX >	Selected handle (range depends on gripper model)
< PORT0 >	Select port 0: 1 = selected, 0 = not selected
< PORT1 >	Select port 1: 1 = selected, 0 = not selected
< PORT2 >	Select port 2: 1 = selected, 0 = not selected
< PORT3 >	Select port 3: 1 = selected, 0 = not selected

Example

The gripping modules at ports 0 and 1 grip with grip configuration 2:

```
GRIPLINK_MGRIP(2,1,1,0,0)
```

3.8   Release workpiece - RELEASE

This command causes the selected gripping module to release a gripped workpiece. The command waits until the workpiece has been released. If the device state corresponds to FAULT, the further program will be stopped.

> The gripping parameters can be configured via the web interface of the GRIPLINK controller.

Syntax

GRIPLINK_RELEASE(< PORT >,< INDEX >)

Parameters

< PORT >	Index of the device port (0 to 3)
< INDEX >	Selected handle (range depends on gripper model)

Example

Release the workpiece gripped with the gripping module at port 0 with the gripping configuration 2:

```
GRIPLINK_RELEASE(0,2)
```

3.9   Simultaneous release of workpieces - MRELEASE

This command causes the selected gripping modules to release a gripped workpiece at the same time. The command waits until all addressed gripping modules have each reached the RELEASED state. If one of the devices reaches the FAULT state or a timeout occurs, the program will be stopped.

Syntax

> GRIPLINK_MRELEASE(< INDEX >,< PORT0 >,< PORT1 >,< PORT2 >,< PORT3 >)

Parameters

< INDEX >	Selected handle (range depends on gripper model)
< PORT0 >	Select port 0: 1 = selected, 0 = not selected
< PORT1 >	Select port 1: 1 = selected, 0 = not selected
< PORT2 >	Select port 2: 1 = selected, 0 = not selected
< PORT3 >	Select port 3: 1 = selected, 0 = not selected

Example

> Gripping modules at ports 1, 2 and 3 release a workpiece with grip configuration 3:

```
GRIPLINK_MRELEASE(3,0,1,1)
```

3.10   Parameterize gripping recipes - SETGRIPCFG

This command parameterizes a grip preset directly from the robot program. This way, the desired grip settings can be saved within the robot program to be transmitted to the GRIPLINK Controller each time the robot program will be started.

> The parameters set with this command will not be saved permanently. They will be lost when power-cycling the GRIPLINK Controller. Please use the configuration board on the GRIPLINK's web interface to fully parameterize and permanently save grip presets.

Syntax

GRIPLINK_SETGRIPCFG(< PORT >,< INDEX >,< PARAM0...7 >)

Parameter

< PORT >	Index of the device port (0 to 3)
< INDEX >	Index of the grip preset to be configured. The number of available presets depends on the device type.
< PARAM0...7 >	Device specific gripping parameters
	Which parameters are available depends on the device. If one or more are not used, they should be specified as 0.

For grippers from Weiss Robotics, for example:
-   Parameter 0:   No-part limit (in micrometers)
-   Parameter 1:   Release limit (in micrometers)
-   Parameter 2:   Gripping force (in thousandths of a percent)
-   Parameters 3 - 7: not used

Example

Configure the grip configuration 2 of the Weiss Robotics IEG 55-020 gripping module at port 0 as follows:

- No part limit: 3 mm
- Release limit: 10 mm
- Gripping force: 80%

```
GRIPLINK_SETGRIPCFG(0,2,3000,10000,80000,0,0,0,0,0)
```

3.11 Verify device types - DEVASSERT

This command checks whether the device connected to the specified port corresponds to the expected device. If this is not the case, an error will be raised and the program will be stopped. The check is performed via the IO-Link Vendor and Product ID.

Syntax

GRIPLINK_DEVASSERT(< PORT >,< VID > ,< PID >)

Parameter

< PORT >	Index of the device port (0 to 3)
< VID >	Expected Vendor ID number. This is assigned to the manufacturer by the IO-Link user association.
< PID >	Expected Product ID number. Identification number of the device assigned by the manufacturer.

Example

Make sure that a gripping module of type IEG 55-020 (Product ID: 20) from Weiss Robotics (Vendor ID: 815) is connected to port 0:

```
GRIPLINK_DEVASSERT(0,815,20)
```

3.12 Query of position and sensor values - VALUE

This command reads a measured value from the connected device and returns it as an integer value. Depending on the device, one or more measured values are available, which can be selected via the index to be specified.

Syntax

GRIPLINK_VALUE(< PORT >,< INDEX >)

Parameter

< PORT >   Index of the device port (0 to 3)
< INDEX >   Index of the measured value to be queried

The following applies to grippers from Weiss Robotics:
- Index = 0: Finger position of the gripper (In micrometers)
- Index = 1: temperature of the gripper (in tenths of a degree Celsius)

Return value

INT

Example

Store the finger position of the gripper connected to port 0 in the variable value:

```
value = GRIPLINK_VALUE(0,0)
```

3.13 Control gripping force retention - CLAMP

The innovative gripping force retention developed by Weiss Robotics keeps up the gripping force on the workpiece even if the power supply to the gripping module is unexpectedly interrupted. Thanks to the integrated absolute sensor technology, production can be continued immediately when the power supply is restored, even without referencing. Furthermore, CLAMP enables permanent gripping without the gripping module overheating.

This command activates or deactivates the gripping force retention for the selected gripping module.

CLAMP is not available with all gripping modules.

Syntax

GRIPLINK_CLAMP(< PORT >,< ENABLE >)

Parameter

| < PORT > | Index of the device port (0 to 3) |
| < ENABLE > | Force retention: 1 = on, 0 = off |

Example

Activates the gripping force safety device on the gripping module at port 2

```
GRIPLINK_CLAMP(2,1)
```

3.14 Control of the LED display - LED

This command changes the color and pattern of the light ring of a selected CRG gripping module from Weiss Robotics.

This function is only available for gripping modules of the Weiss Robotics CRG series.

Light patterns can be configured via the web interface of the GRIPLINK controller.

A controllable LED display is not available for all gripping modules.

Syntax

GRIPLINK_LED(< PORT >,< PATTERN >)

Parameter

< PORT >	Index of the device port (0 to 3)
< PATTERN >	Index of the predefined light pattern (0 to 7)

Example

Activates the light pattern 3 on the gripper connected to port 2:

```
GRIPLINK_LED(2,3)
```

3.15 Close the connection between GRIPLINK and robot - DISCONNECT

This command closes the active connection between the GRIPLINK controller and the robot controller according to the specifications in the *GripLink.xml.*

Syntax

GRIPLINK_DISCONNCECT()

Parameter

Example

Disconnect the connection between the robot and the GRIPLINK:

```
GRIPLINK_DISCONNECT()
```

Anhang A   Gripping state

Gripping state	Code	Constant
NOT CONNECTED	0	GS_NOT_CONNECTED
NOT INITIALIZED	1	GS_NOT_INIZIALIZED
IDLE	2	GS_IDLE
RELEASED	3	GS_RELEASED
NO PART	4	GS_NO_PART
HOLDING	5	GS_HOLDING
PART LOST	6	GS_PART_LOST
FAULT	7	GS_FAULT

Anhang B   Error numbers and ways to fix them

1:      Check connection

2:      Check GRIPLINK controller and replace if necessary.

3:      Check the firmware of the GRIPLINK controller and update if necessary.

4:      Check ENABLE statement and connection of the addressed port

5:      Check whether addressed port was previously activated by an ENABLE instruction.

6:      Check DISABLE statement and connection of the addressed port

7:      Check HOME statement and connection of the addressed port

8:      Check GRIP statement and connection of the addressed port

9:      Check connection of the addressed port(s) as well as the speed of the used gripper parameterization.

10:Check RELEASE statement and connection of the addressed port.

11:     Verify that the multitool statements address each port with 0 or 1 and no other number

12:     Check MGRIP statement and connection of the addressed ports

13:     Check MRELEASE statement and connection of the addressed ports

14:     Check value statement and variable as well as connection of the addressed port

15:     Check DEVASSERT instruction, gripper model and connection of the addressed port.

16:     Do not use CLAMP instruction with addressed gripper model

17:     Check CLAMP statement and connection of the addressed port

18:     Do not use LED instruction with gripper model addressed

19:     Check LED instruction and connection of the addressed port

20:     Check gripper condition

GRIP SMARTER.

WEISS ROBOTICS