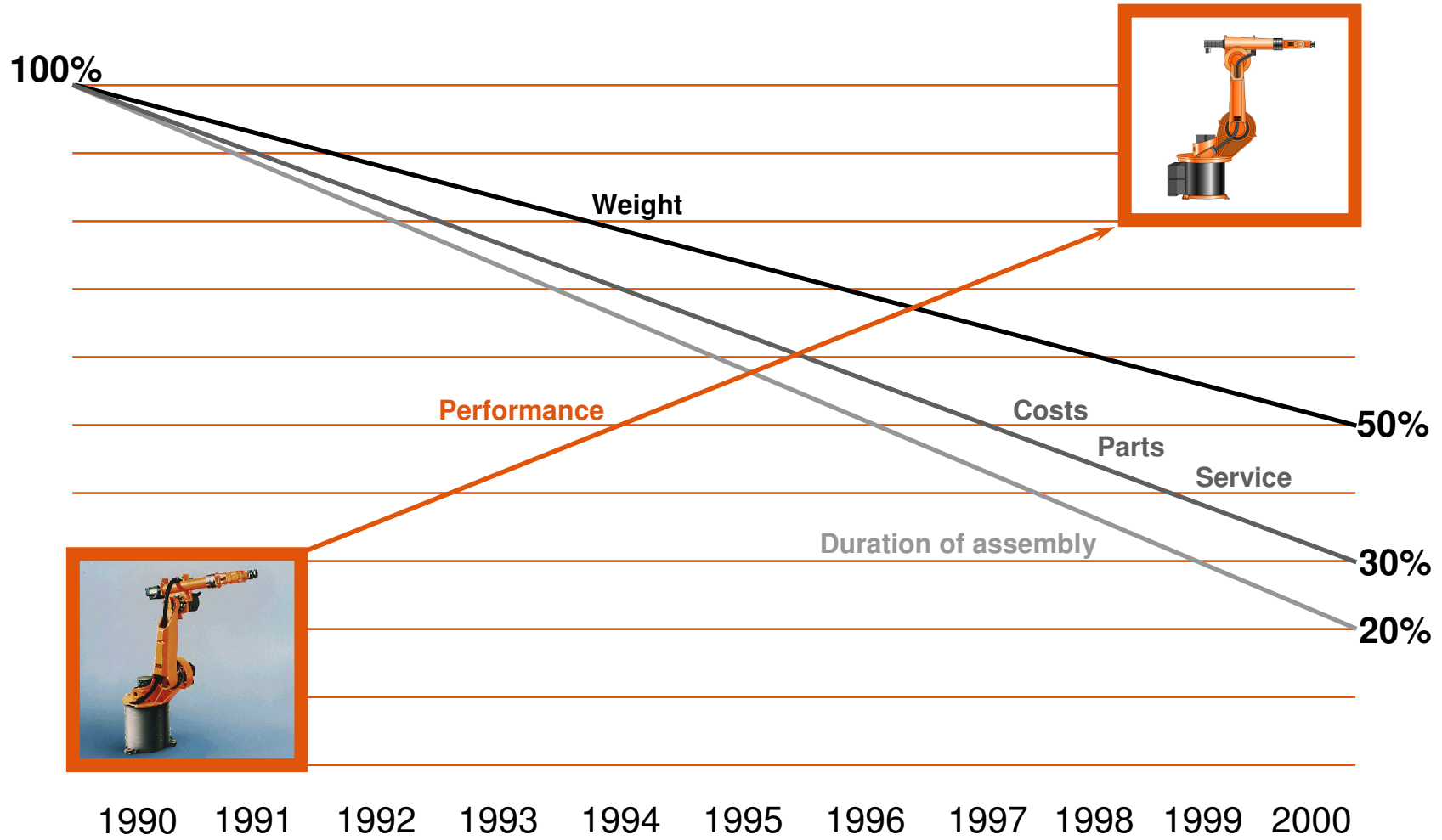


# Development of KUKA robots



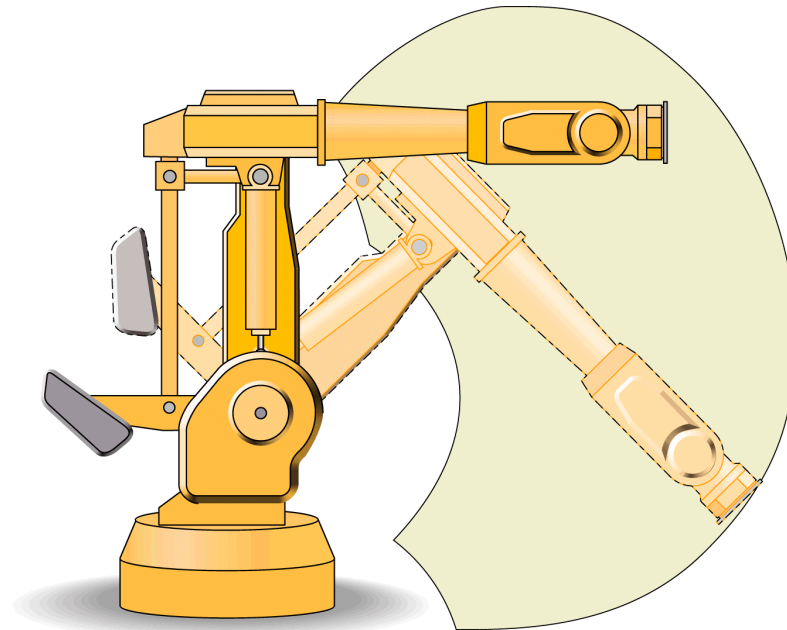
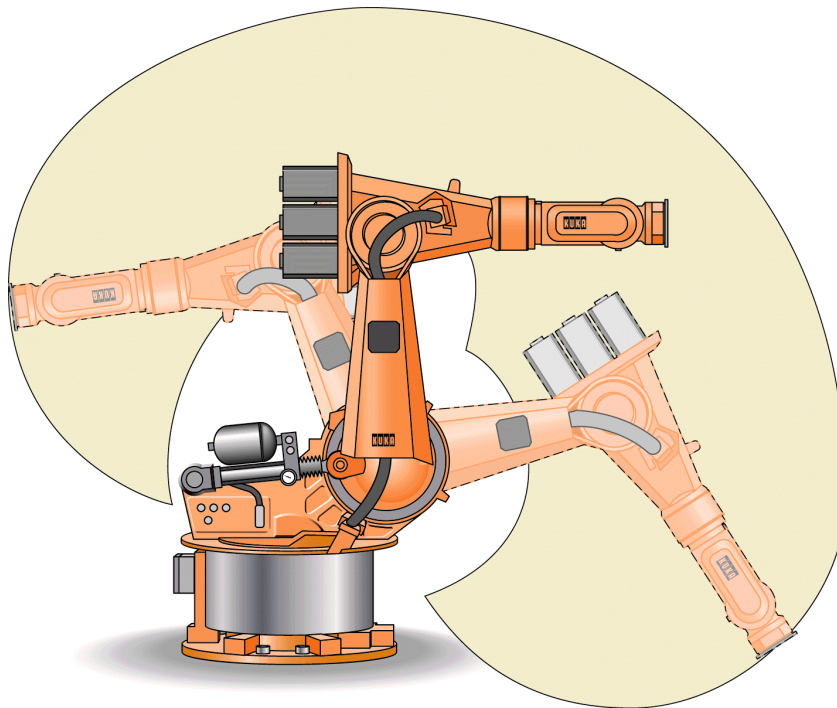
Only the performance increases



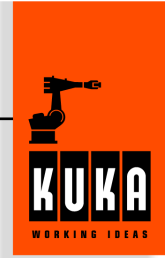
## Comparison of different kinematics concepts



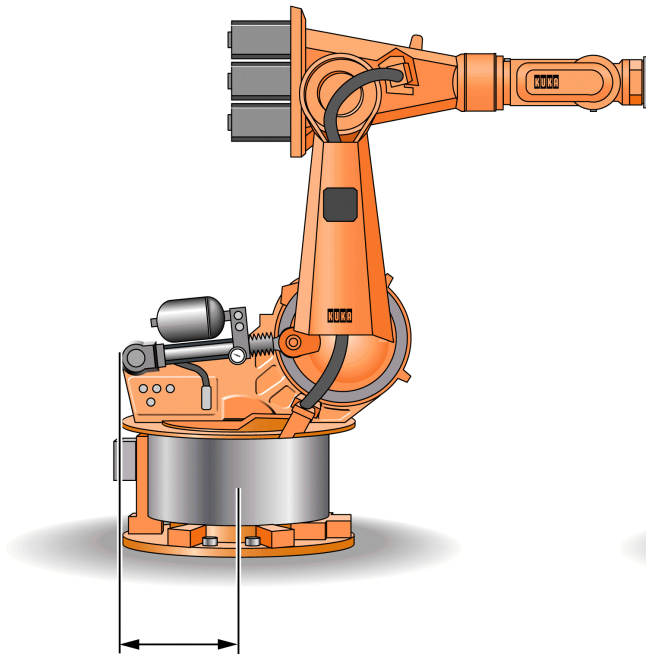
- Overhead motion possible
- Bigger work space



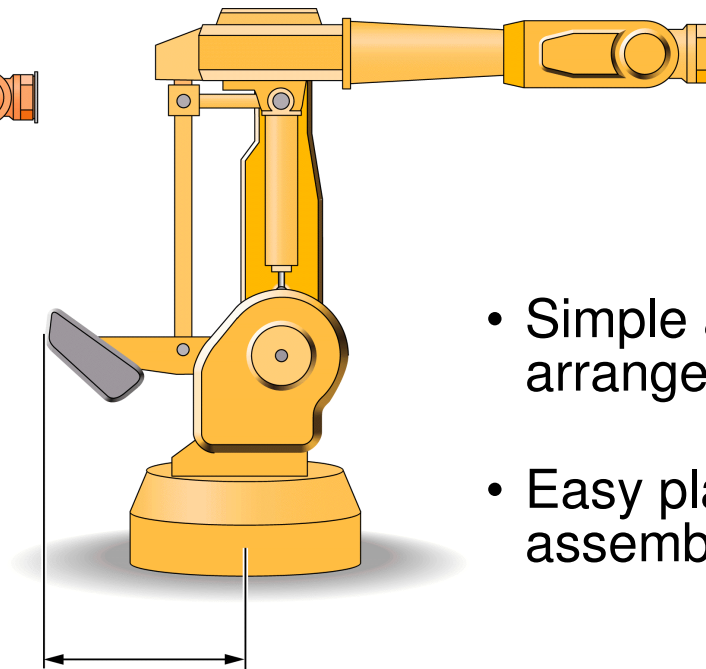
## Comparison of jamming edges



KUKA Robot



Parallelogram Robot



- Simple and clearly arranged configuration
- Easy planning of robot assembly lines and cells

# KUKA robot classes



Lower Payload	Medium Payload	High Payload	Heavy Payload	Special Series
(V)KR 6/2	(V)KR 30/2	(V)KR 125/2	(V)KR 350/2	(V)KR 60P/1
(V)KR 15/2	(V)KR 30 L15/2	(V)KR 150/2	(V)KR 350L280/2	(V)KR 100P/1
	(V)KR 45/2	(V)KR 200/2	(V)KR 350L240/2	(V)KR 100PA/1
				(V)KR 160PA/1

## Heavy duty robot (V)KR 350/2



*Press to Press Linker: (V)KR 60 P/2, (V)KR 100 P/2*



## Palettizier KR 180 PA

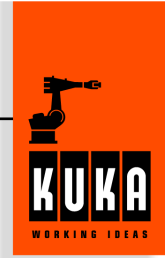


*Console robot (V)KR 125 K/1, (V)KR 150 K/1*





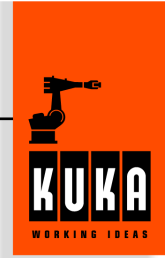
## *The new console robot KR 30 K*



## Wall mounted robot (V)KR 125 W/2



## *The new mini robot KR 3*

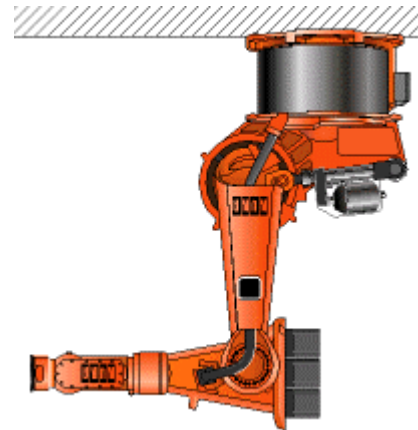


*For all situations: flexible mounting positions*



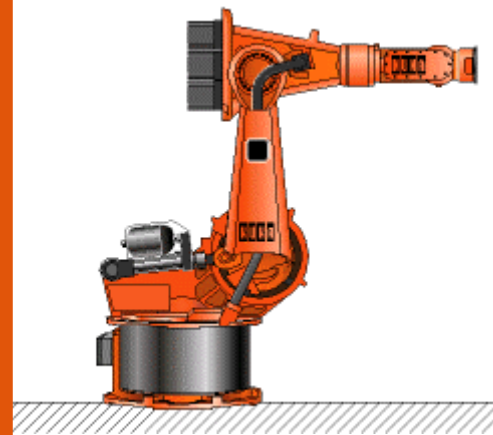
**Wall mounting:**

- 📄 (V)KR 6/2
- 📄 (V)KR 15/2
- 📄 (V)KR 30/2
- 📄 (V)KR 30L15/2
- 📄 (V)KR 125 W/2



**Floor mounting:**

- 📄 (V)KR 6/2
- 📄 (V)KR 15/2
- 📄 (V)KR 15 L2/2
- 📄 (V)KR 30/2
- 📄 (V)KR 30 L15/2
- 📄 (V)KR 45/2
- 📄 (V)KR 125/2
- 📄 (V)KR 150/2, 200/2
- 📄 (V)KR 350/2
- 📄 KL 250, KL 1500



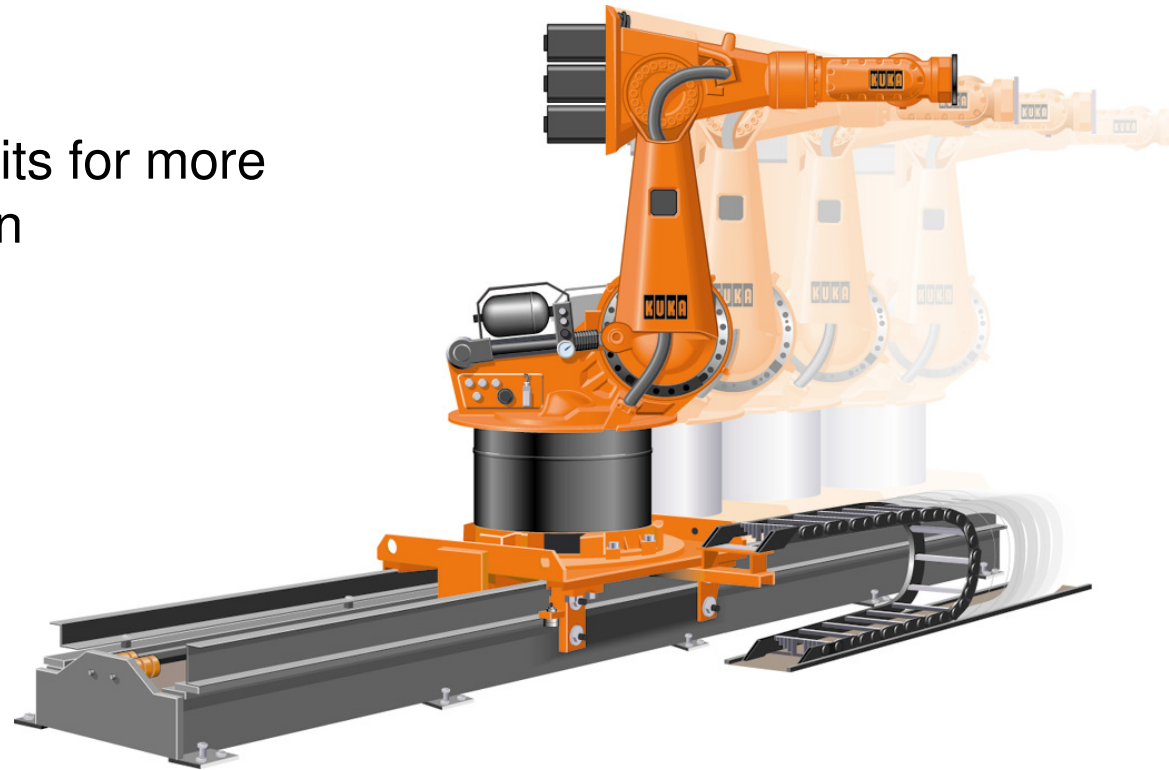
**Ceiling mounting:**

- 📄 (V)KR 6/2
- 📄 (V)KR 15/2
- 📄 (V)KR 15 L2/2
- 📄 (V)KR 30/2
- 📄 (V)KR 30 L15/2
- 📄 (V)KR 45/2
- 📄 (V)KR 125/2
- 📄 (V)KR 150/2, 200/2
- 📄 (V)KR 350/2
- 📄 KL 250, KL 1500

## *KUKA linear unit (KL)*



KUKA liner units for more  
liberty of action



KL 250 (max. weight 250kg) for KR 15 and smaller  
KL 1500 (max. weight 1500kg ) for KR 30 and higher



Floor mounting

Ceiling mounting



## Components of a complete KUKA robot system



KUKA Robot  
(e.g. KR 200/2)



Robot Controller  
(e.g. KR C1)

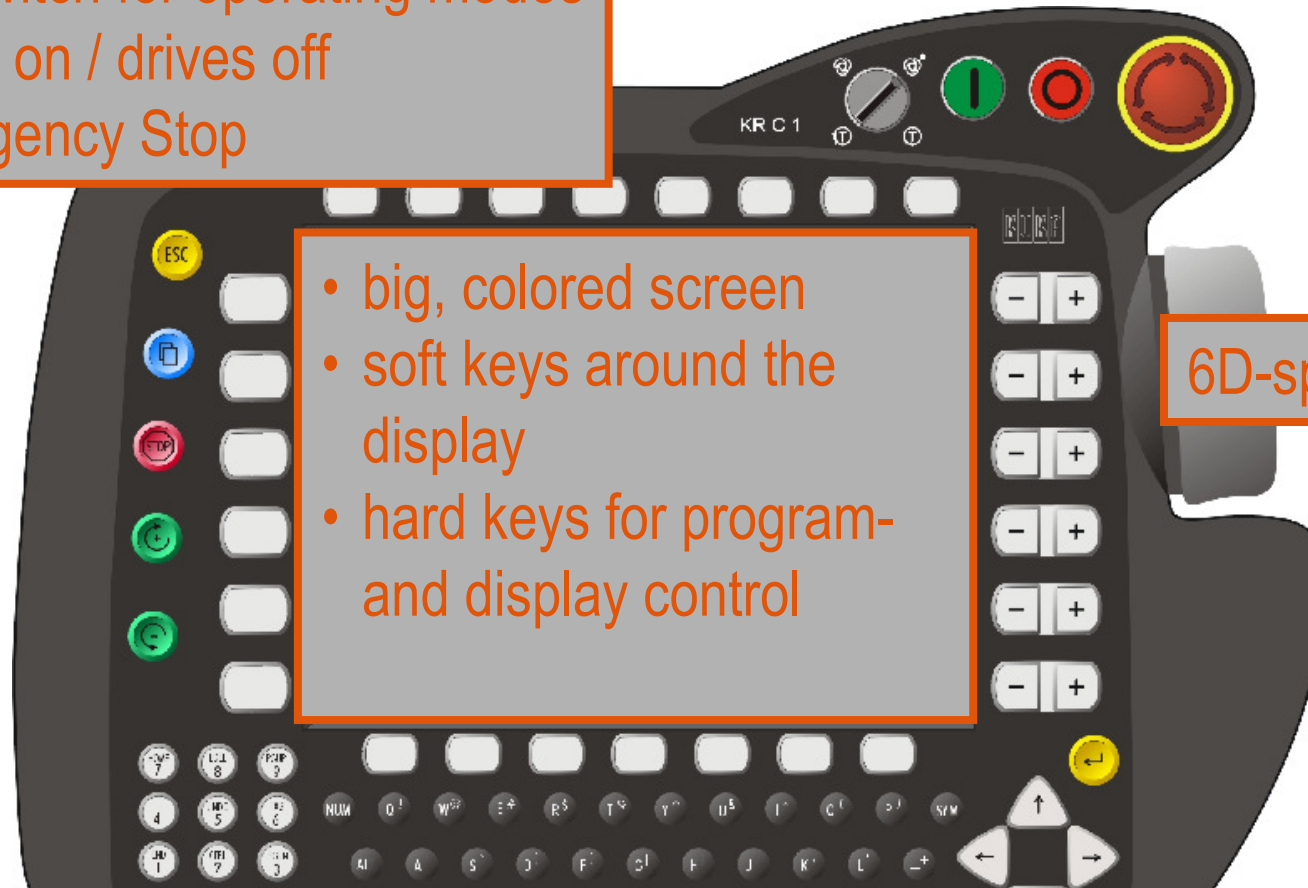


KUKA Control Panel  
(KCP)

## KUKA Control Panel (KCP)



key switch for operating modes  
drives on / drives off  
Emergency Stop



- big, colored screen
- soft keys around the display
- hard keys for program- and display control

6D-spacemouse

numeric block, ASCII block, cursor block with Enter key



## Robot controller KR C1 and KR C1A



KR C1



KR C1A



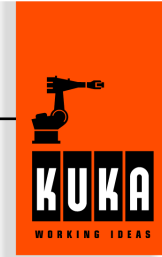
The type code of the KUKA-Industrial robots refers to the payload.

The KUKA type code:



**1 kg = 2.2 lbs**

*Example: KUKA type code*



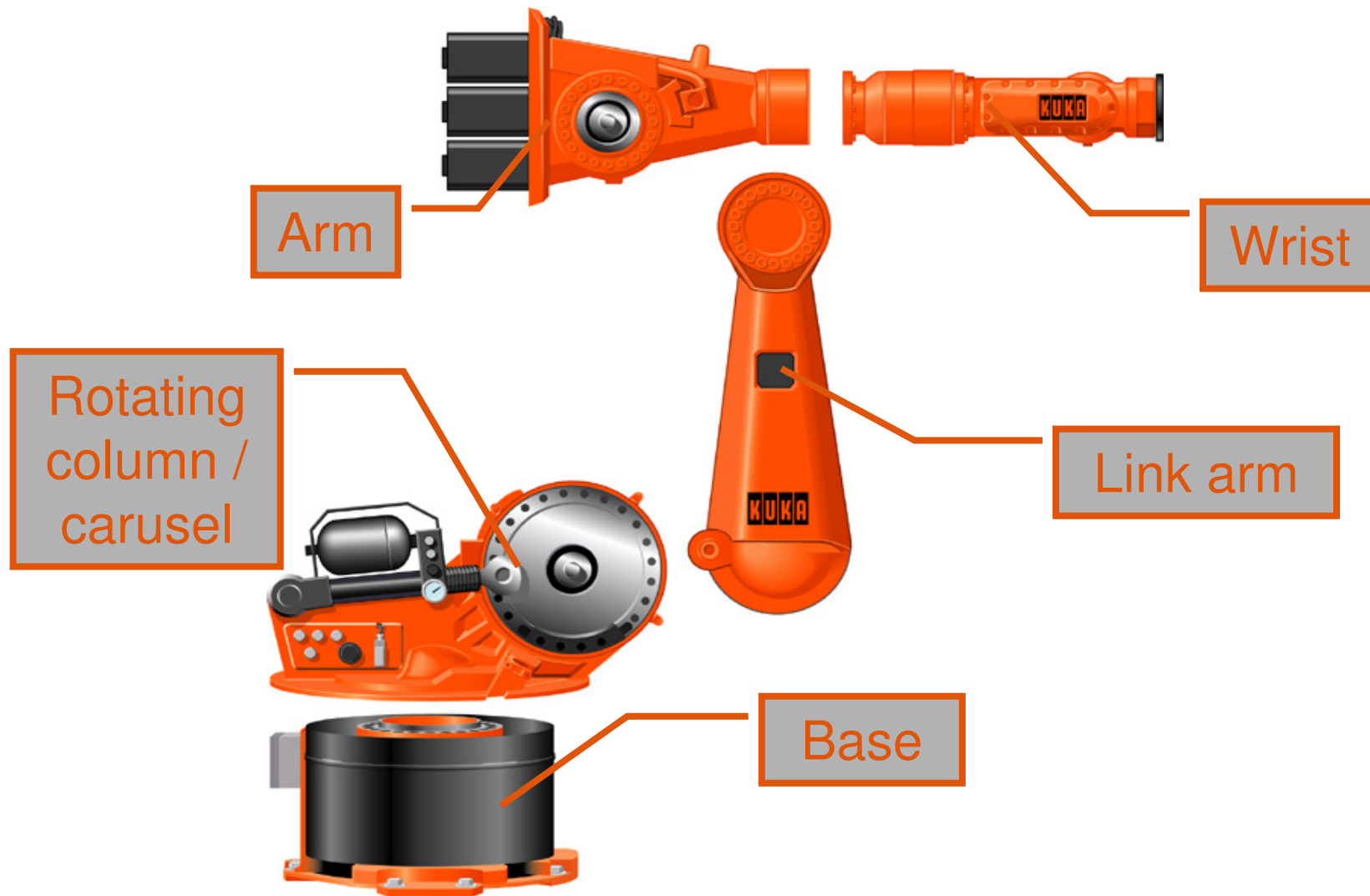
**KR 150 / 2**

**KUKA** Industrial **R**obot

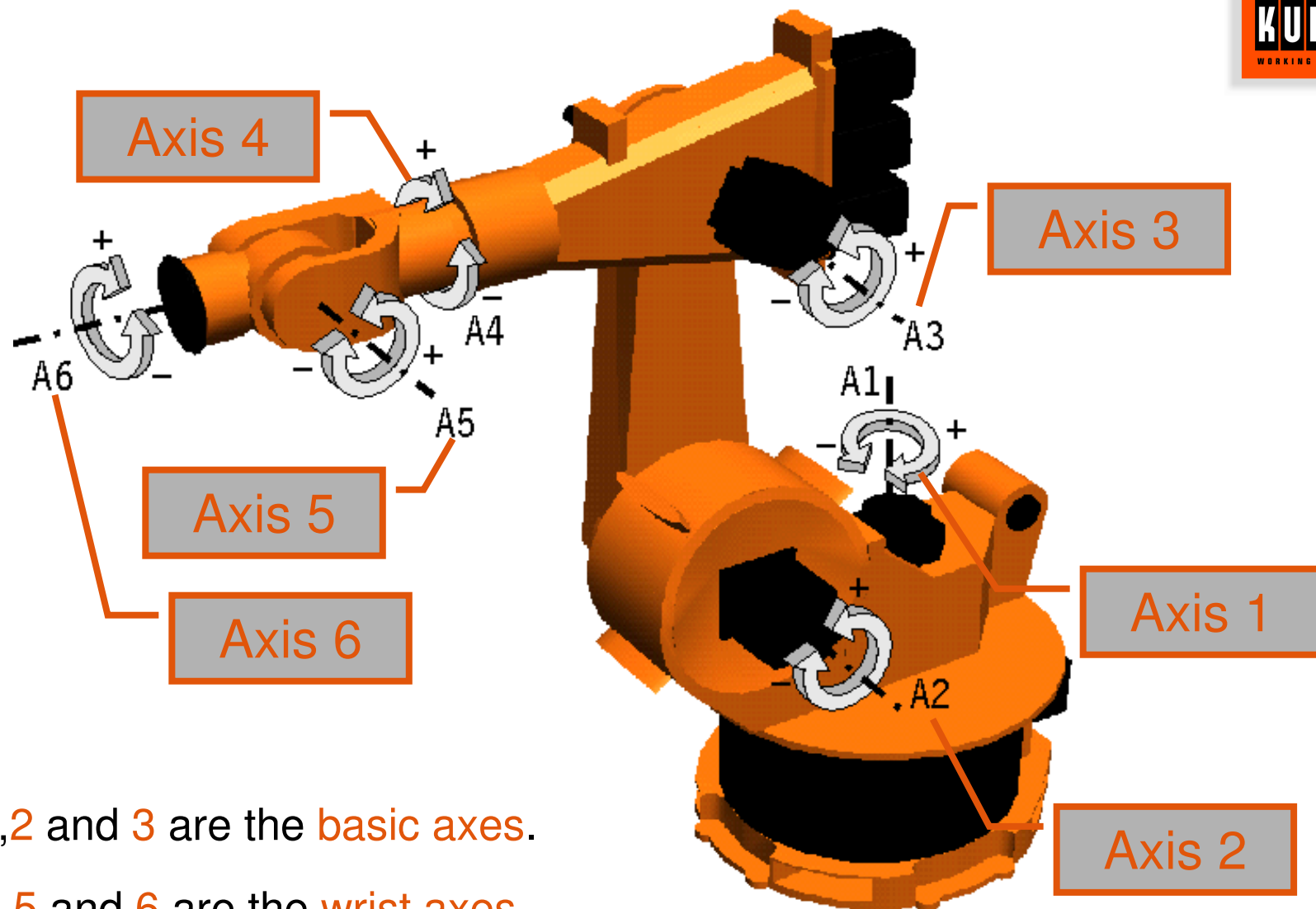
with **150** kg payload

**2.** Generation

## Mechanical construction of a KUKA robot



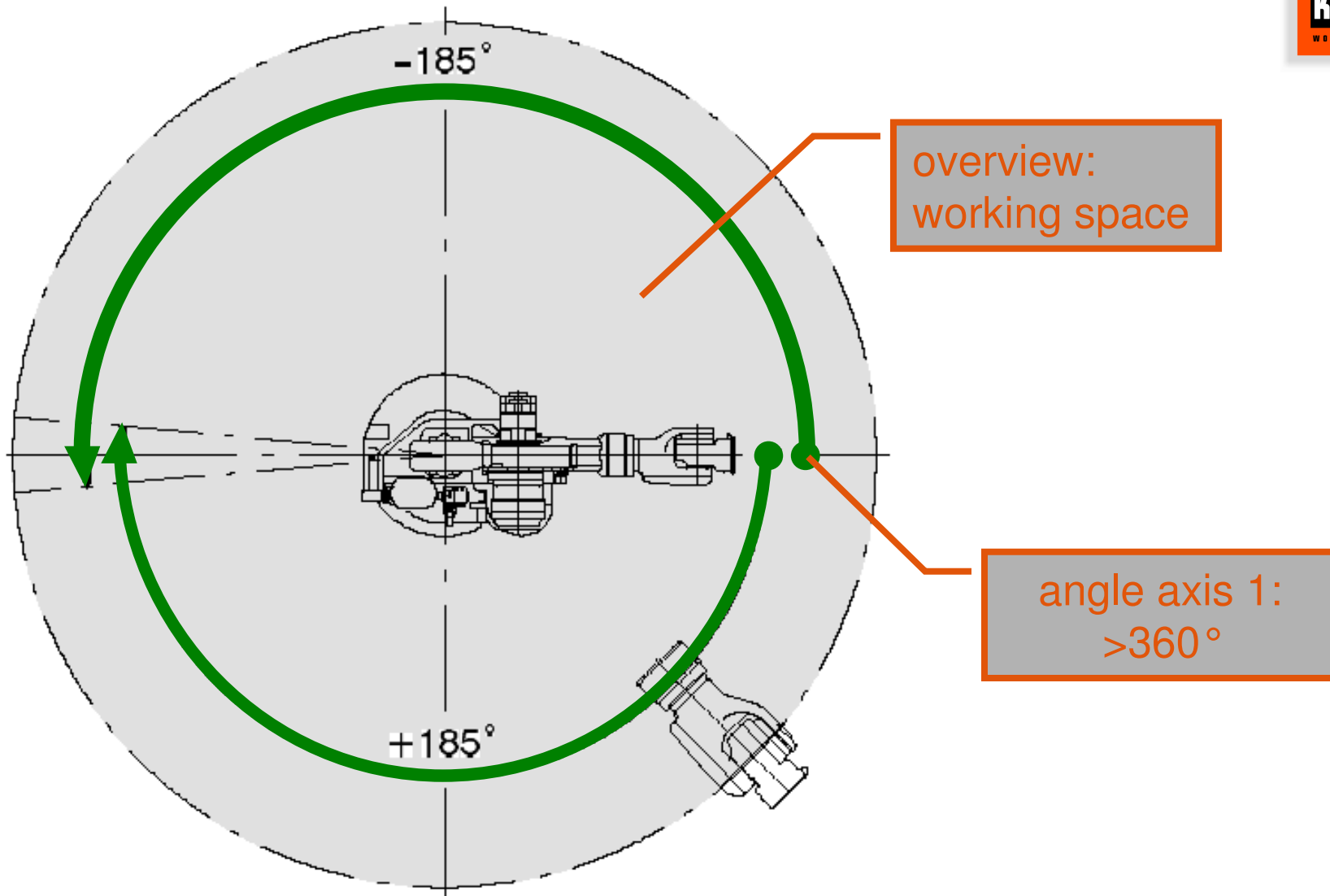
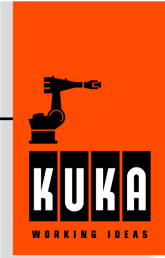
## Axes of a KUKA robot



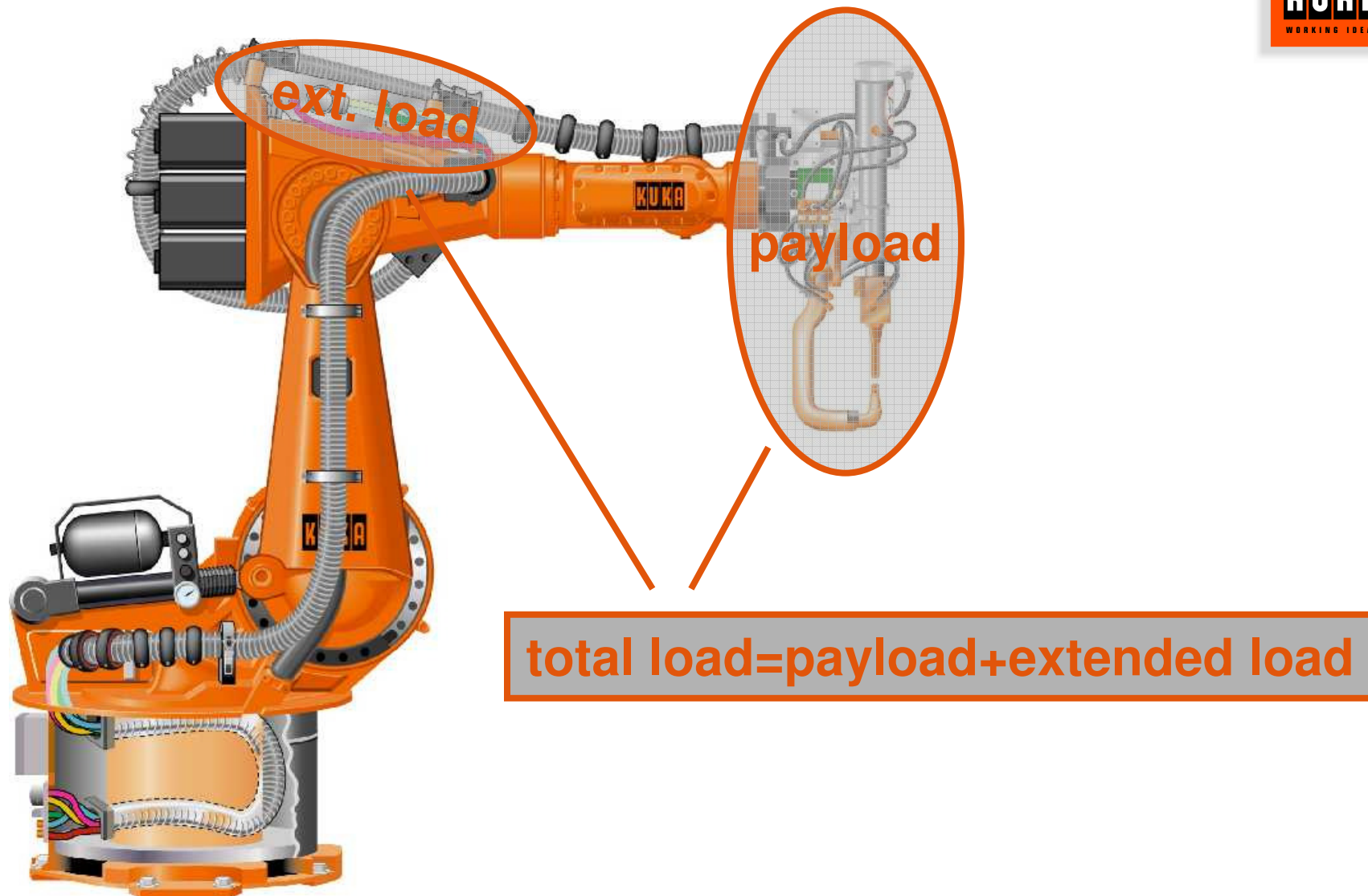
Axes 1, 2 and 3 are the **basic axes**.

Axes 4, 5 and 6 are the **wrist axes**.

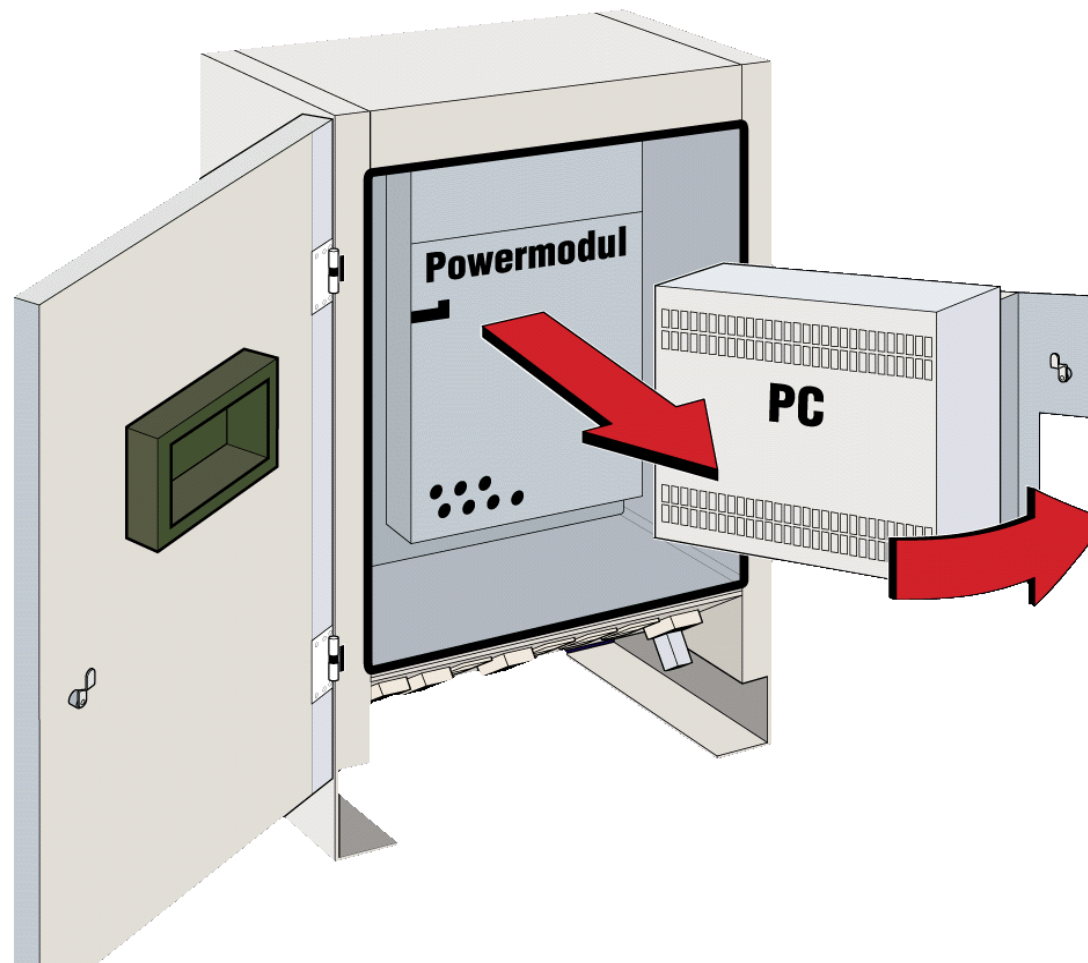
# The working space of a KUKA robot (overview)



## Payload spreading of a KUKA robot

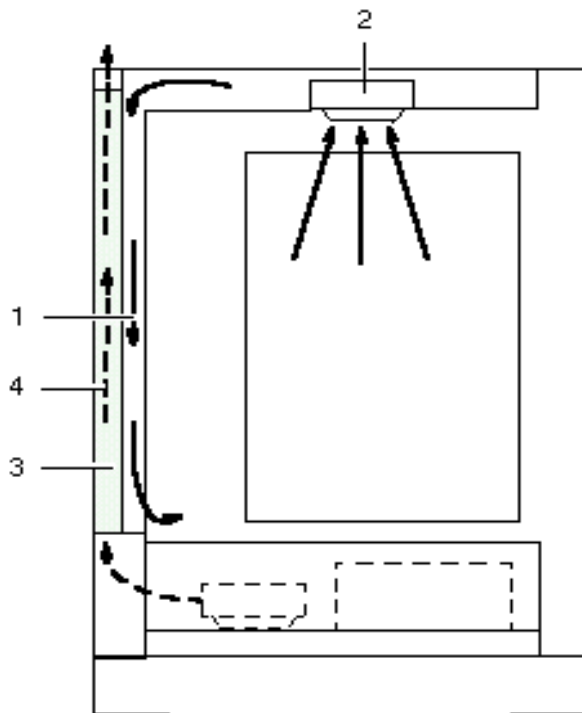


## Construction of the controll cabinet

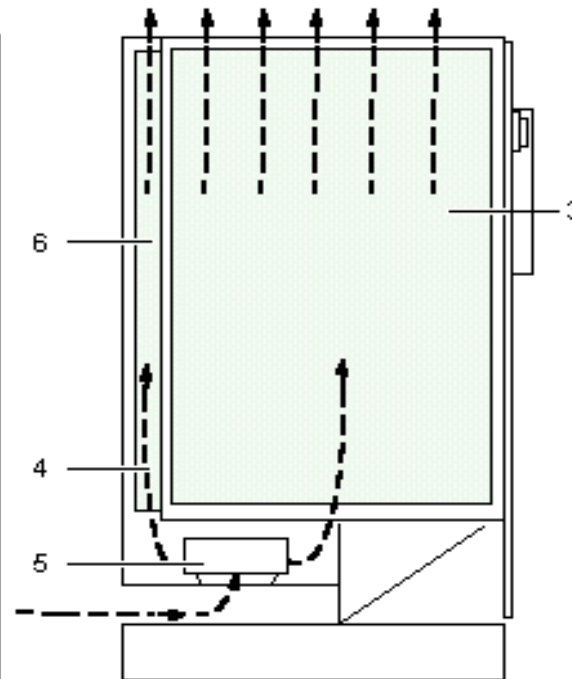




## Cooling of the control cabinet KR C1



Front view of the inner  
and outer Cooling circuit



Side view of the outer  
Cooling circuit

1 Inner Cooling circuit

2 Fan Inner cooling circuit

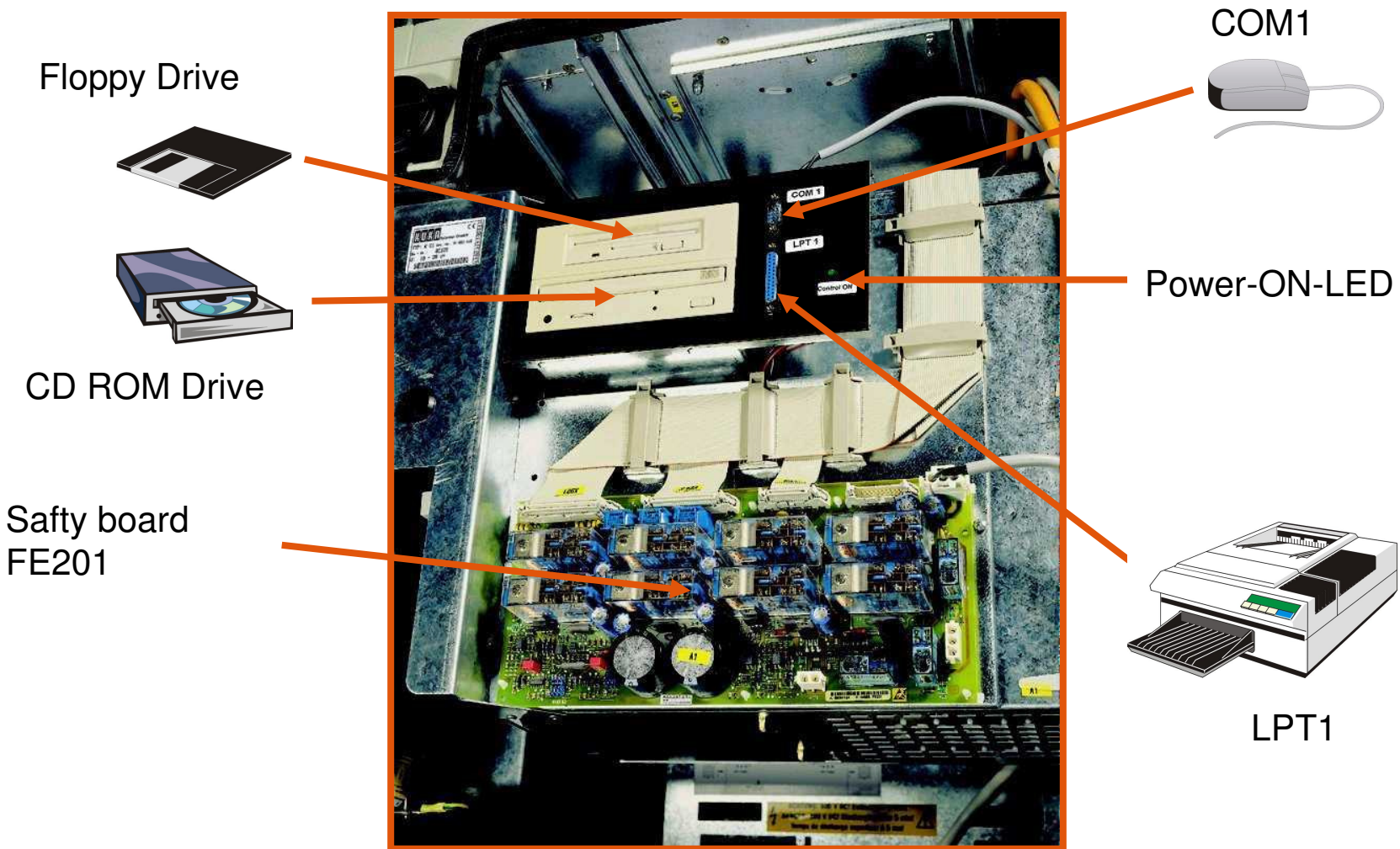
3 Head converter

4 Outer Cooling circuit

5 Fan Inner cooling circuit

6 Head converter

# Front view of the PC unit



## Overview of the PC unit

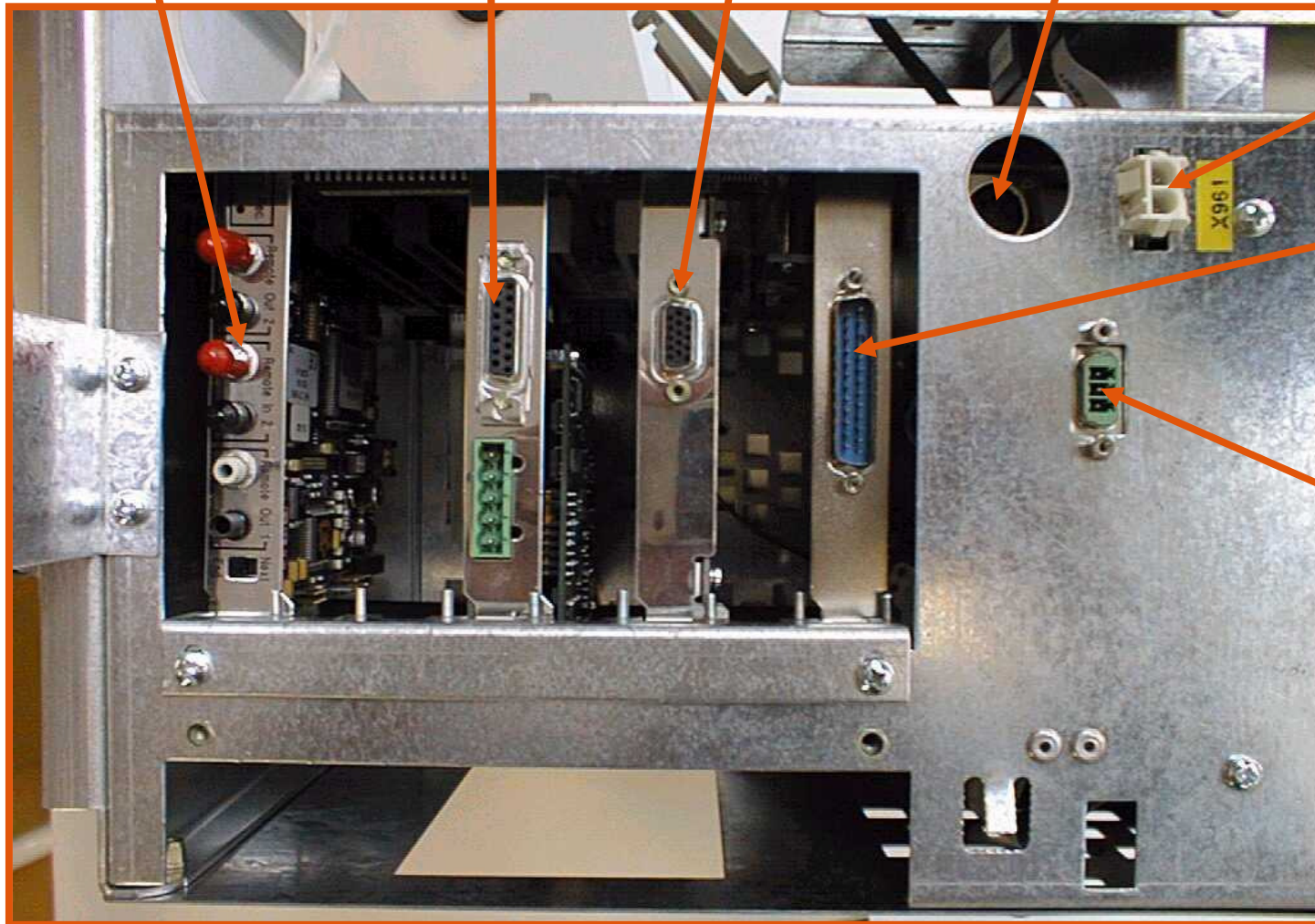


Fieldbus card  
(Option)

MFC card

KVGA card

Connector for  
A extern keyboard



X961  
PC-Power supply

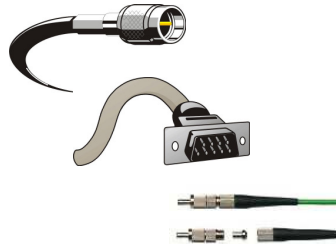
COM2

Extern  
Power supply  
for Interbus-  
card (Option)

## User groups



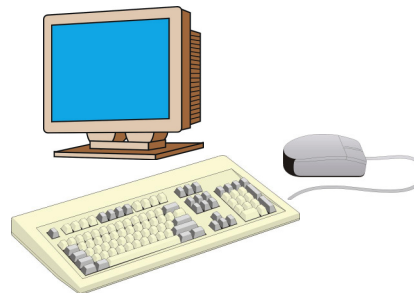
- Configuration of the robot system (External axes, Technology)
- Configuration of the robot system (Fieldbus, Vision-system etc.)
- Own Technology commands via UserTECH



Administrator

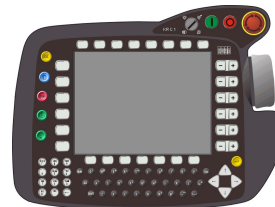
- Advanced programming with program language KRL
- Complex robot programs (Subprograms, Interrupt programming, Loops, Program junction)
- Numeric Motion commands

Expert



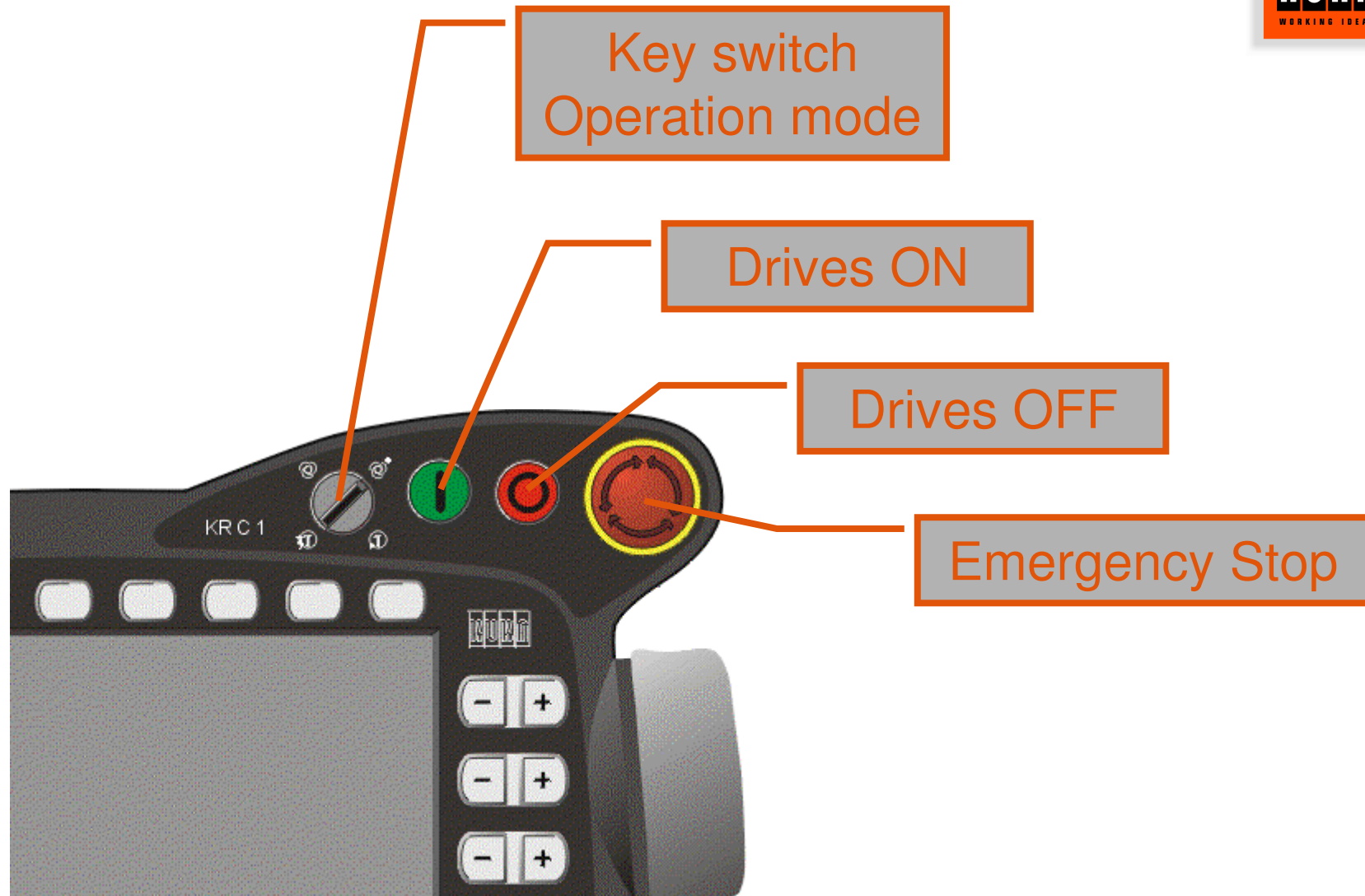
- Start up (Mastering, Tool measuring)
- Simple robot programs (Programming with Inline forms, Motion commands, Technology commands, limit monitoring, no Syntax errors)

User

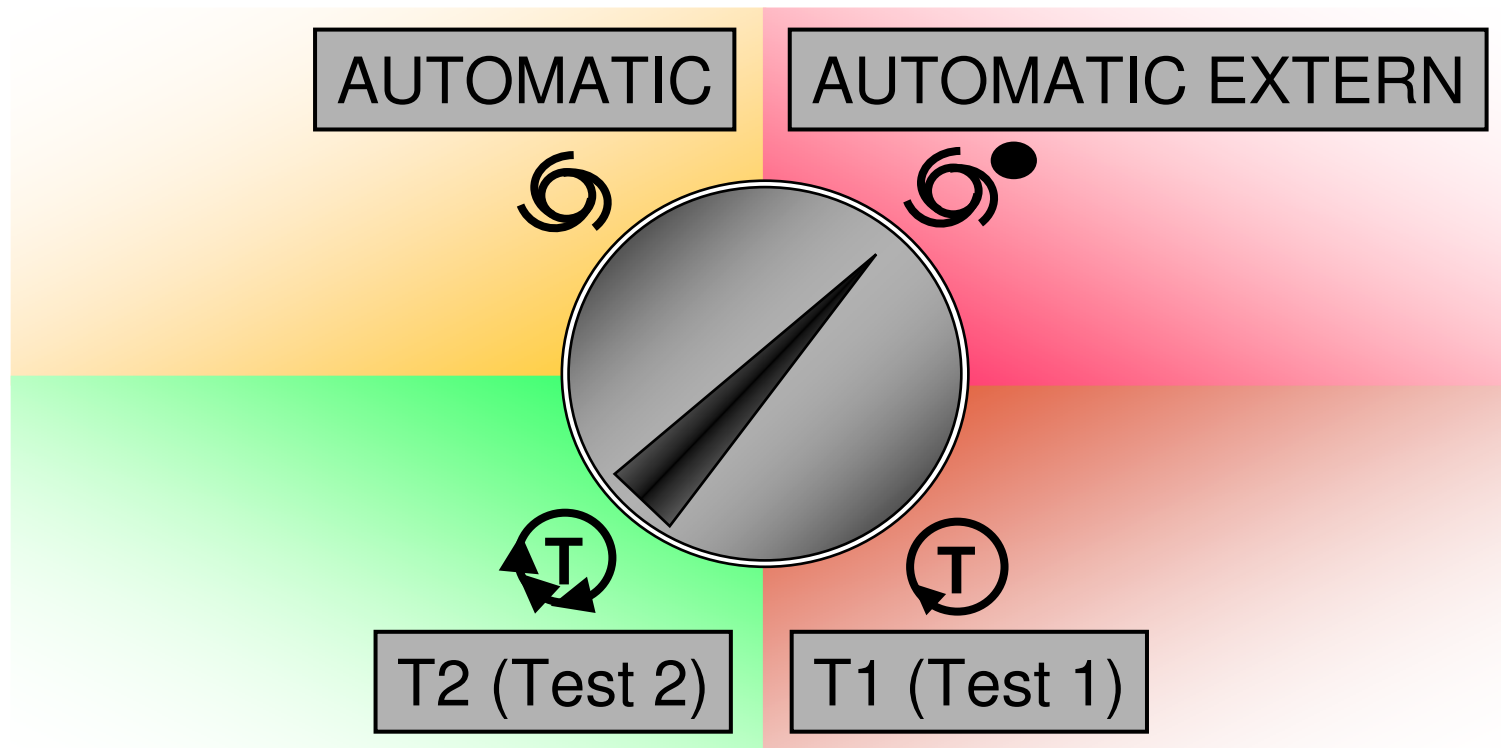


# KUKA Control Panel (KCP)





# Operation mode switch



# Operation mode elements with CAN-Bus





# Display windows



Datei	Bearbeiten	Konfigurier.	Anzeige	Technolog.	Befehle	Hilfe
1	INI			<input type="radio"/> 1 Ausgang		100%
2	PTP HOME	Vel= 100 %	DEFAULT	<input type="radio"/> 2 Ausgang		
3				<input type="radio"/> 3 Ausgang		
4	PTP P1	Vel= 100 %	PDAT1	<input type="radio"/> 4 Ausgang		
5	PTP P2	Vel= 100 %	PDAT2	<input type="radio"/> 5 Ausgang		
6	PTP P3	Vel= 100 %	PDAT3	<input type="radio"/> 6 Ausgang		
7	PTP P4	Vel= 100 %	PDAT4	<input type="radio"/> 7 Ausgang		
8	LIN		GDAT1	<input type="radio"/> 8 Ausgang		
9	SET		GDAT1	<input type="radio"/> 9 Ausgang		
10				<input type="radio"/> 10 Ausgang		
11	PTP		IT5	<input type="radio"/> 11 Ausgang		
12	PTP		IT6	<input type="radio"/> 12 Ausgang		
13	PTP		IT7	<input type="radio"/> 13 Ausgang		
14	PTP	Vel= 100 %	PDAT8	<input type="radio"/> 14 Ausgang		
15	SET GRP 1	State= OPN	GDAT2	<input type="radio"/> 15 Ausgang		12
16	PTP P9	Vel= 100 %	PDAT9	<input type="radio"/> 16 Ausgang		
17	PTP HOME	Vel= 100 %	DEFAULT	<input type="radio"/> 17 Gripper open		11
				<input type="radio"/> 18 Gripper close		
				<input checked="" type="radio"/> 19 Ausgang		

Zeit	Nr.	Abs.	Meldung
14:37	200	/	A
14:37	1	/	N

NUM	INS	S	R	QUADRAT2	Satz= 1	T1	POV=100%	Robi 10	14:37
Ändern	Bewegung	Logik	letzter Bef.	Satzanwahl	Touch Up	DATEI			

# Window selection key



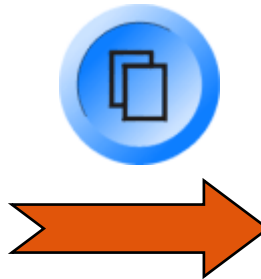
Datei	Bearbeiten	Konfigurier.	Anzeige	Technolog.	Befehle	Hilfe
1	INI			<input type="radio"/>	1 Ausgang	100%
2	PTP HOME	Vel= 100 %	DEFAULT	<input type="radio"/>	2 Ausgang	
3				<input type="radio"/>	3 Ausgang	
4	PTP P1	Vel= 100 %	PDAT1	<input type="radio"/>	4 Ausgang	
5	PTP P2	Vel= 100 %	PDAT2	<input type="radio"/>	5 Ausgang	
6	PTP P3	Vel= 100 %	PDAT3	<input type="radio"/>	6 Ausgang	
7	PTP P4	Vel= 100 %	PDAT4	<input type="radio"/>	7 Ausgang	
8	LIN P5	Vel= 2 m/s	CPDAT1	<input type="radio"/>	8 Ausgang	
9	SET GRP 1	State= CLO	GDAT1	<input type="radio"/>	9 Ausgang	
10				<input type="radio"/>	10 Ausgang	
11	PTP P4	Vel= 100 %	PDAT5	<input type="radio"/>	11 Ausgang	
12	PTP P6	Vel= 100 %	PDAT6	<input type="radio"/>	12 Ausgang	
13	PTP P7	Vel= 100 %	PDAT7	<input type="radio"/>	13 Ausgang	
14	PTP P8	Vel= 100 %	PDAT8	<input type="radio"/>	14 Ausgang	
15	SET GRP 1	State= OPN	GDAT2	<input type="radio"/>	15 Ausgang	
16	PTP P9	Vel= 100 %	PDAT9	<input type="radio"/>	16 Ausgang	
17	PTP HOME	Vel= 100 %	DEFAULT	<input type="radio"/>	17 Gripper open	
				<input type="radio"/>	18 Gripper close	
				<input checked="" type="radio"/>	19 Ausgang	

Zeit	Nr.	Abs.	Meldung
14:37:200	/		Antriebe nicht bereit
14:37:1	/		NOT-AUS

NUM	INS	S	R	QUADRAT2	Satz= 1	T1	POV=100%	Robi 10	14:37
Ändern	Bewegung	Logik	letzter Bef.	Satzwahl	Touch Up	DATEI			



Datei	Bearbeiten	Konfigurier.	Anzeige	Technolog.	Befehle	Hilfe
1	INI			<input checked="" type="radio"/>	1 Ausgang	100%
2	PTP HOME	Vel= 100 %	DEFAULT	<input type="radio"/>	2 Ausgang	
3				<input type="radio"/>	3 Ausgang	
4	PTP P1	Vel= 100 %	PDAT1	<input type="radio"/>	4 Ausgang	
5	PTP P2	Vel= 100 %	PDAT2	<input type="radio"/>	5 Ausgang	
6	PTP P3	Vel= 100 %	PDAT3	<input type="radio"/>	6 Ausgang	
7	PTP P4	Vel= 100 %	PDAT4	<input type="radio"/>	7 Ausgang	
8	LIN P5	Vel= 2 m/s	CPDAT1	<input type="radio"/>	8 Ausgang	
9	SET GRP 1	State= CLO	GDAT1	<input type="radio"/>	9 Ausgang	
10				<input type="radio"/>	10 Ausgang	
11	PTP P4	Vel= 100 %	PDAT5	<input type="radio"/>	11 Ausgang	
12	PTP P6	Vel= 100 %	PDAT6	<input type="radio"/>	12 Ausgang	
13	PTP P7	Vel= 100 %	PDAT7	<input type="radio"/>	13 Ausgang	
14	PTP P8	Vel= 100 %	PDAT8	<input type="radio"/>	14 Ausgang	
15	SET GRP 1	State= OPN	GDAT2	<input type="radio"/>	15 Ausgang	
16	PTP P9	Vel= 100 %	PDAT9	<input type="radio"/>	16 Ausgang	
17	PTP HOME	Vel= 100 %	DEFAULT	<input type="radio"/>	17 Gripper open	
				<input type="radio"/>	18 Gripper close	
				<input checked="" type="radio"/>	19 Ausgang	

Zeit	Nr.	Abs.	Meldung
14:37:200	/		Antriebe nicht bereit
14:37:1	/		NOT-AUS

NUM	INS	S	R	QUADRAT2	Satz= 1	T1	POV=100%	Robi 10	14:38
								Eingänge	Schließen



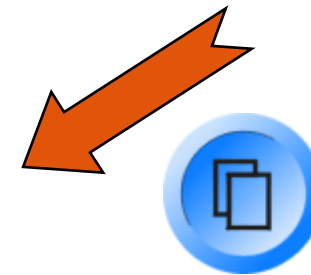
Datei	Bearbeiten	Konfigurier.	Anzeige	Technolog.	Befehle	Hilfe
1	INI			<input type="radio"/>	1 Ausgang	100%
2	PTP HOME	Vel= 100 %	DEFAULT	<input type="radio"/>	2 Ausgang	
3				<input type="radio"/>	3 Ausgang	
4	PTP P1	Vel= 100 %	PDAT1	<input type="radio"/>	4 Ausgang	
5	PTP P2	Vel= 100 %	PDAT2	<input type="radio"/>	5 Ausgang	
6	PTP P3	Vel= 100 %	PDAT3	<input type="radio"/>	6 Ausgang	
7	PTP P4	Vel= 100 %	PDAT4	<input type="radio"/>	7 Ausgang	
8	LIN P5	Vel= 2 m/s	CPDAT1	<input type="radio"/>	8 Ausgang	
9	SET GRP 1	State= CLO	GDAT1	<input type="radio"/>	9 Ausgang	
10				<input type="radio"/>	10 Ausgang	
11	PTP P4	Vel= 100 %	PDAT5	<input type="radio"/>	11 Ausgang	
12	PTP P6	Vel= 100 %	PDAT6	<input type="radio"/>	12 Ausgang	
13	PTP P7	Vel= 100 %	PDAT7	<input type="radio"/>	13 Ausgang	
14	PTP P8	Vel= 100 %	PDAT8	<input type="radio"/>	14 Ausgang	
15	SET GRP 1	State= OPN	GDAT2	<input type="radio"/>	15 Ausgang	
16	PTP P9	Vel= 100 %	PDAT9	<input type="radio"/>	16 Ausgang	
17	PTP HOME	Vel= 100 %	DEFAULT	<input type="radio"/>	17 Gripper open	
				<input type="radio"/>	18 Gripper close	
				<input checked="" type="radio"/>	19 Ausgang	

Zeit	Nr.	Abs.	Meldung
14:37:200	/		Antriebe nicht bereit
14:37:1	/		NOT-AUS

NUM	INS	S	R	QUADRAT2	Satz= 1	T1	POV=100%	Robi 10	14:38
								Quitt	Alles Quitt



# Program window



The screenshot displays the KUKA robot programming interface. The main window shows a list of program lines with the following text:

```
1  INI
2  PTP HOME Vel= 1
3
4  PTP P1 Vel= 100 % PDAT1
5  PTP P2 Vel= 100
6  PTP P3 Vel= 100
7  PTP P4 Vel= 100
8  LIN P5 Vel= 2 m/s CPDAT1
9  SET GRP 1 State= CLO GDAT1
10
11 PTP P4 Vel= 100
12 PTP P6 Vel= 100
13 PTP P7 Vel= 100
14 PTP P8 Vel= 100 % PDAT8
15 SET GRP 1 State= OPN GDAT2
16 PTP P9 Vel= 100 % PDAT9
17 PTP HOME Vel= 100 % DEFAULT
```

Annotations in the image include:

- Linepointer**: Points to the line number '1'.
- Programpointer**: Points to the text 'INI'.
- Cursor**: Points to the vertical bar on line 5.
- Line number**: Points to the line number '11'.

The interface also features a menu bar at the top with 'Datei', 'Bearbeiten', 'Konfigurieren', 'Log.', 'Befehle', and 'Hilfe'. A status bar at the bottom shows 'NUM INS S I R QUADRAT2 Satz= 1 AUT', 'POV=100% Robi 10 14:34', and buttons for 'Ändern', 'Bewegung', 'Logik', 'letzter Bef.', 'Satzanwahl', 'Touch Up', and 'DATEI'.

# Status window



Timer:	Zustand:	Flag:	Wert [in ms]:
t1	Stop	Aus	0
t2	Stop	Aus	0
t3	Stop	Aus	0
t4	Stop	Aus	0
t5	Stop	Aus	0
t6	Stop	Aus	0
t7	Stop	Aus	0
t8	Stop	Aus	0
t9	Stop	Aus	0
t10	Stop	Aus	0

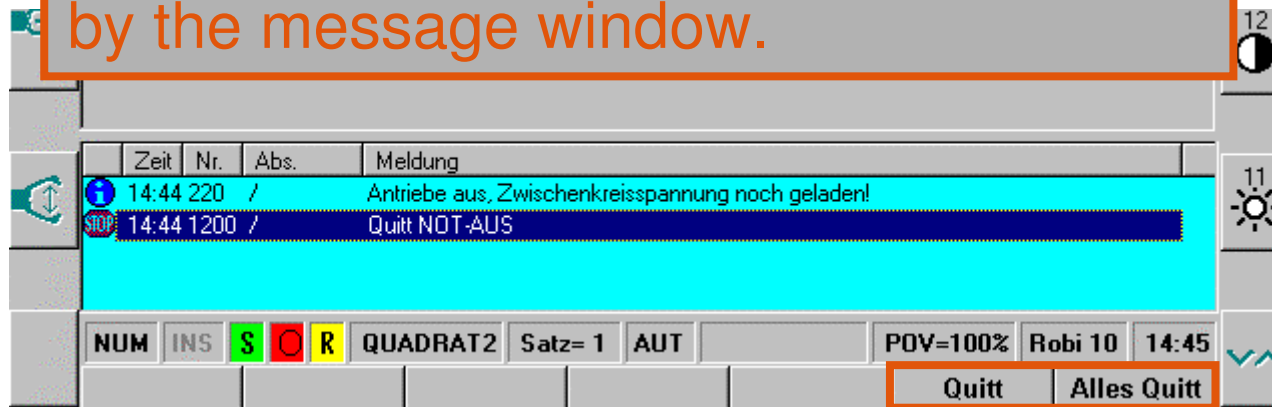
The status window can be opened on demand.

The status window can be closed every time.

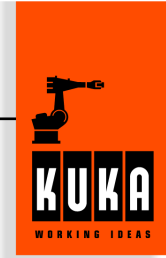
## Message window



The system communicates with the user by the message window.



Softkeys to acknowledge the messages



Hint

- e.g. „Startkey requiered“



State

- e.g. „Emergency Stop“



acknowledge

- e.g. „acknowledge E.-Stop“



Wait

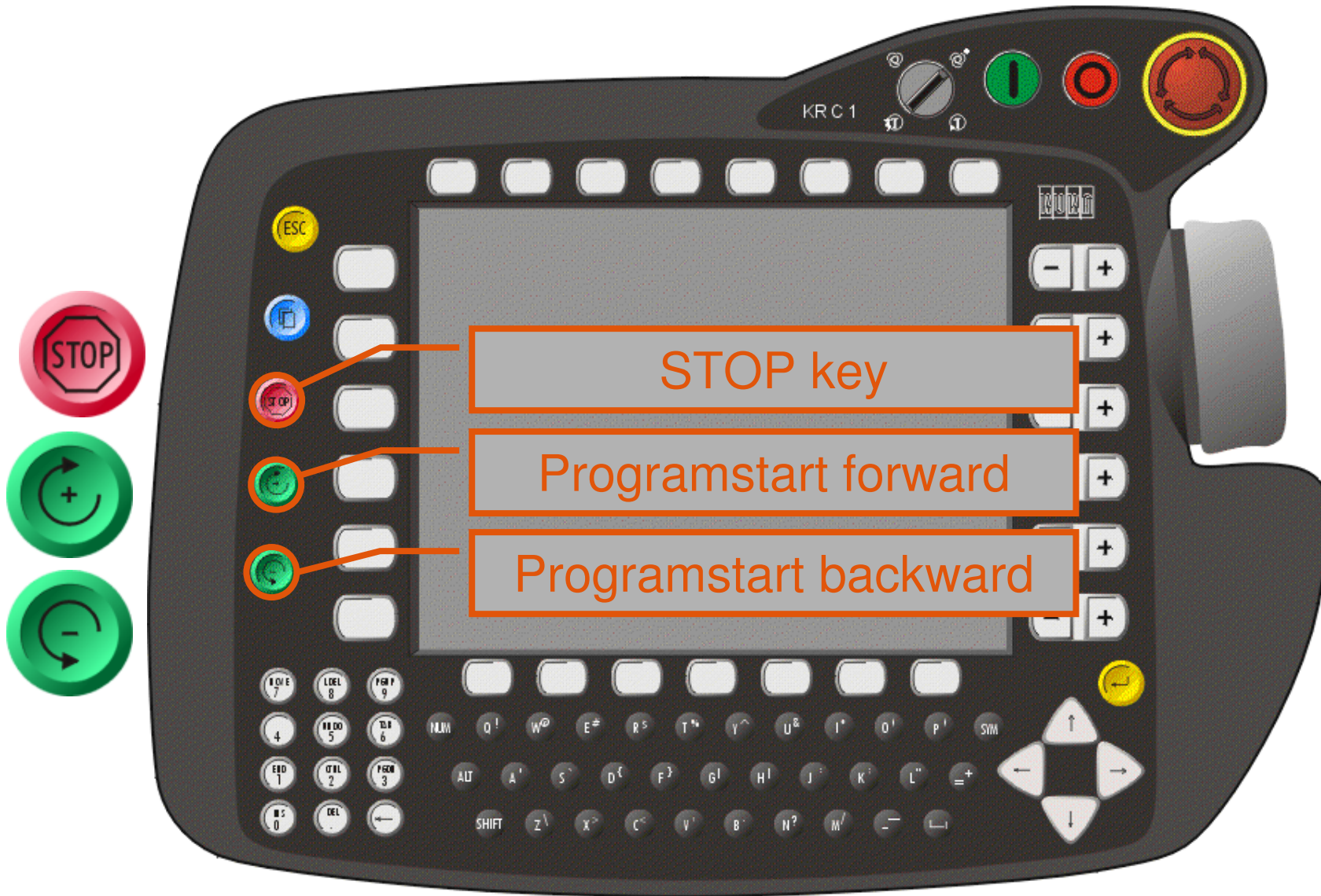
- e.g. „Wait for \$IN[1]==True “



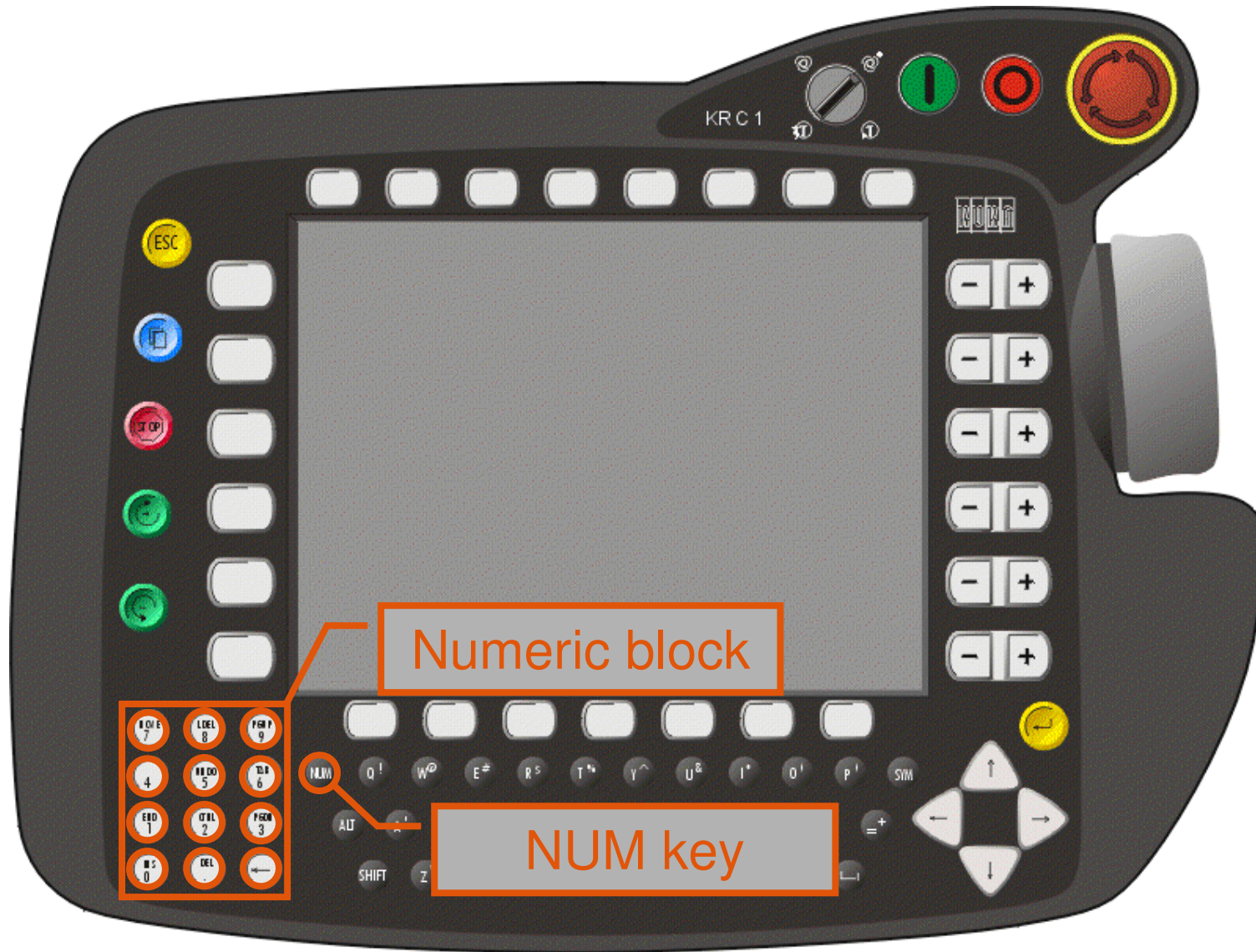
Dialog

- e.g. „Would you teach the point ?“

# Operation elements with CAN-Bus

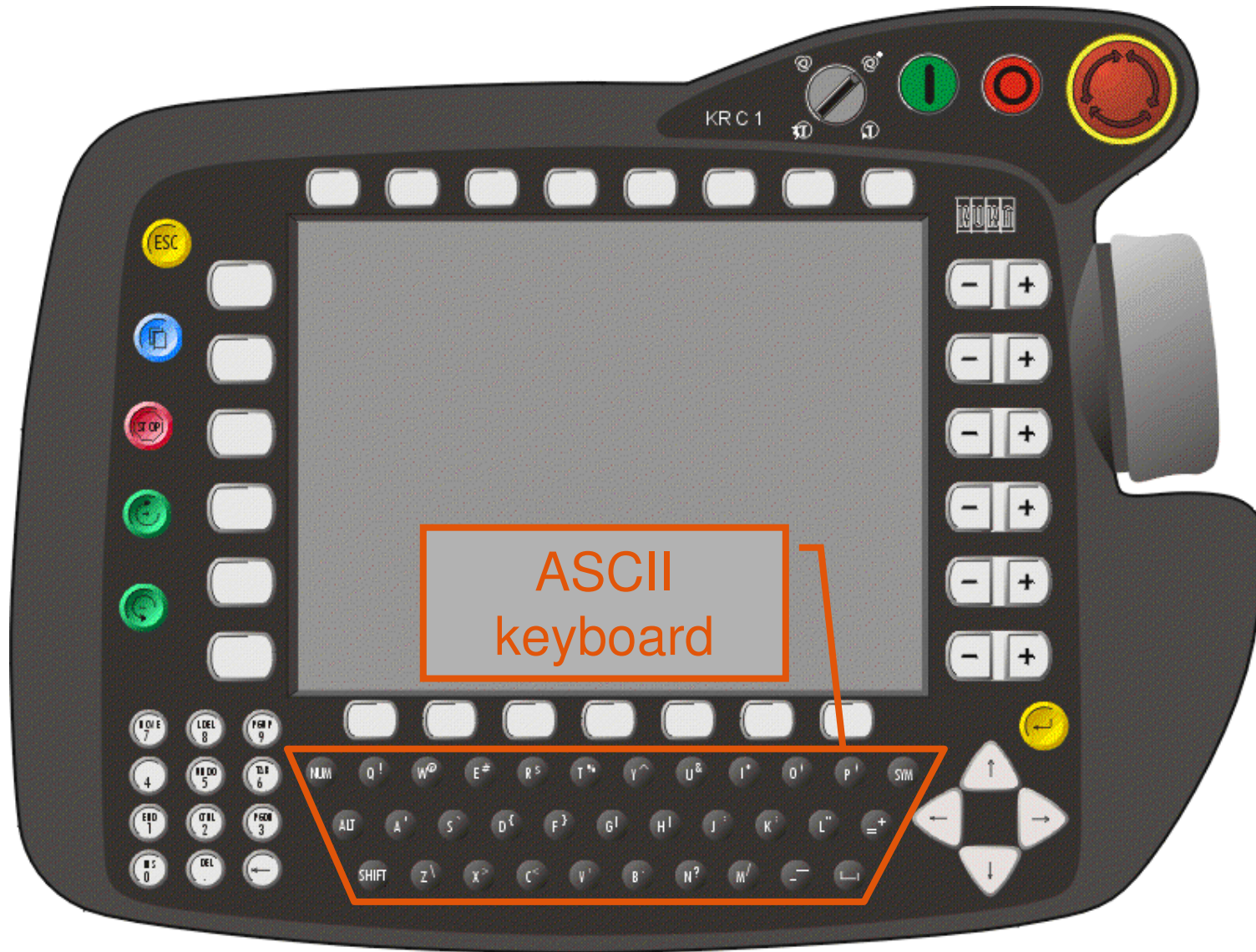


# Operation elements with CAN-Bus

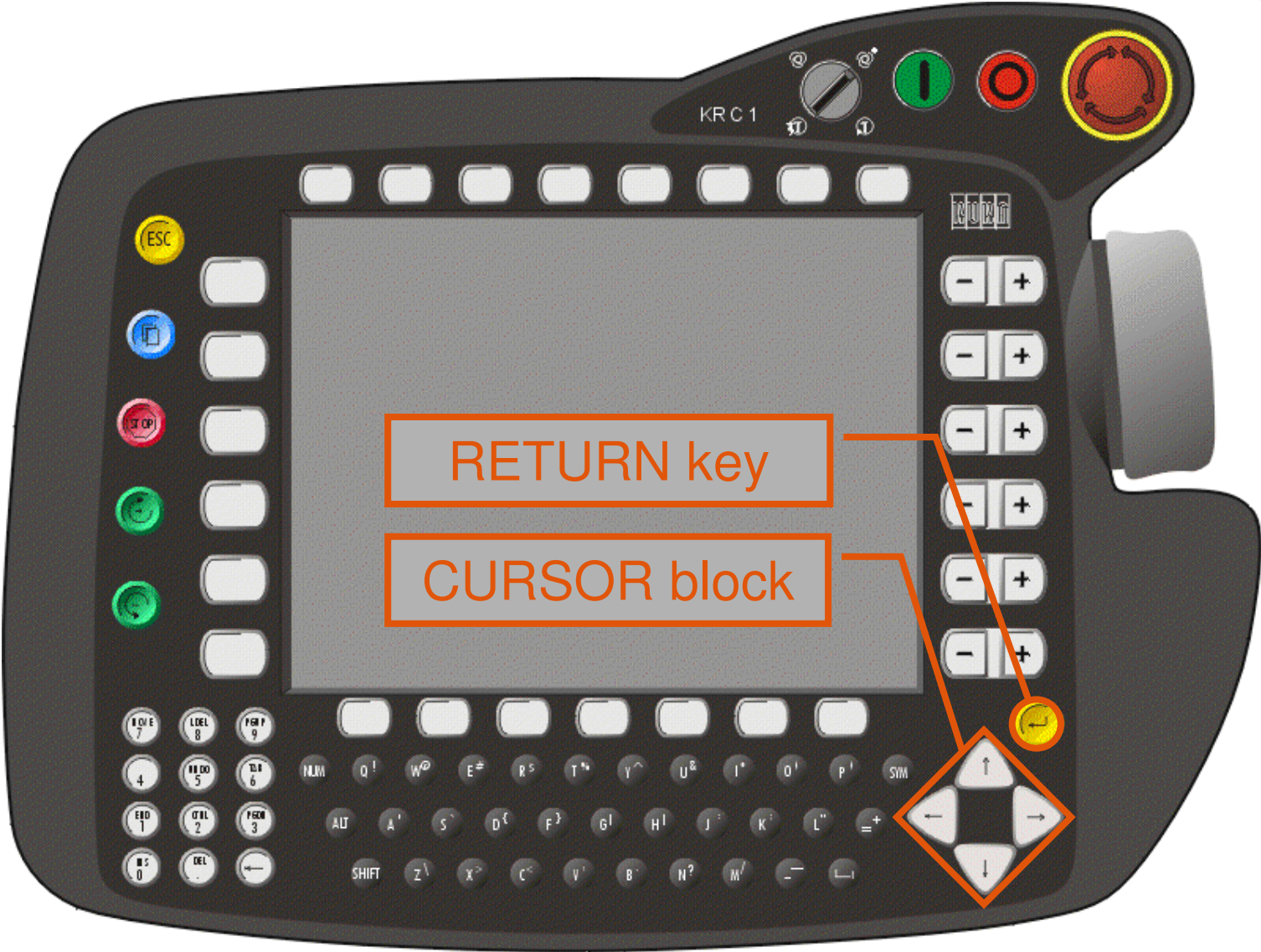




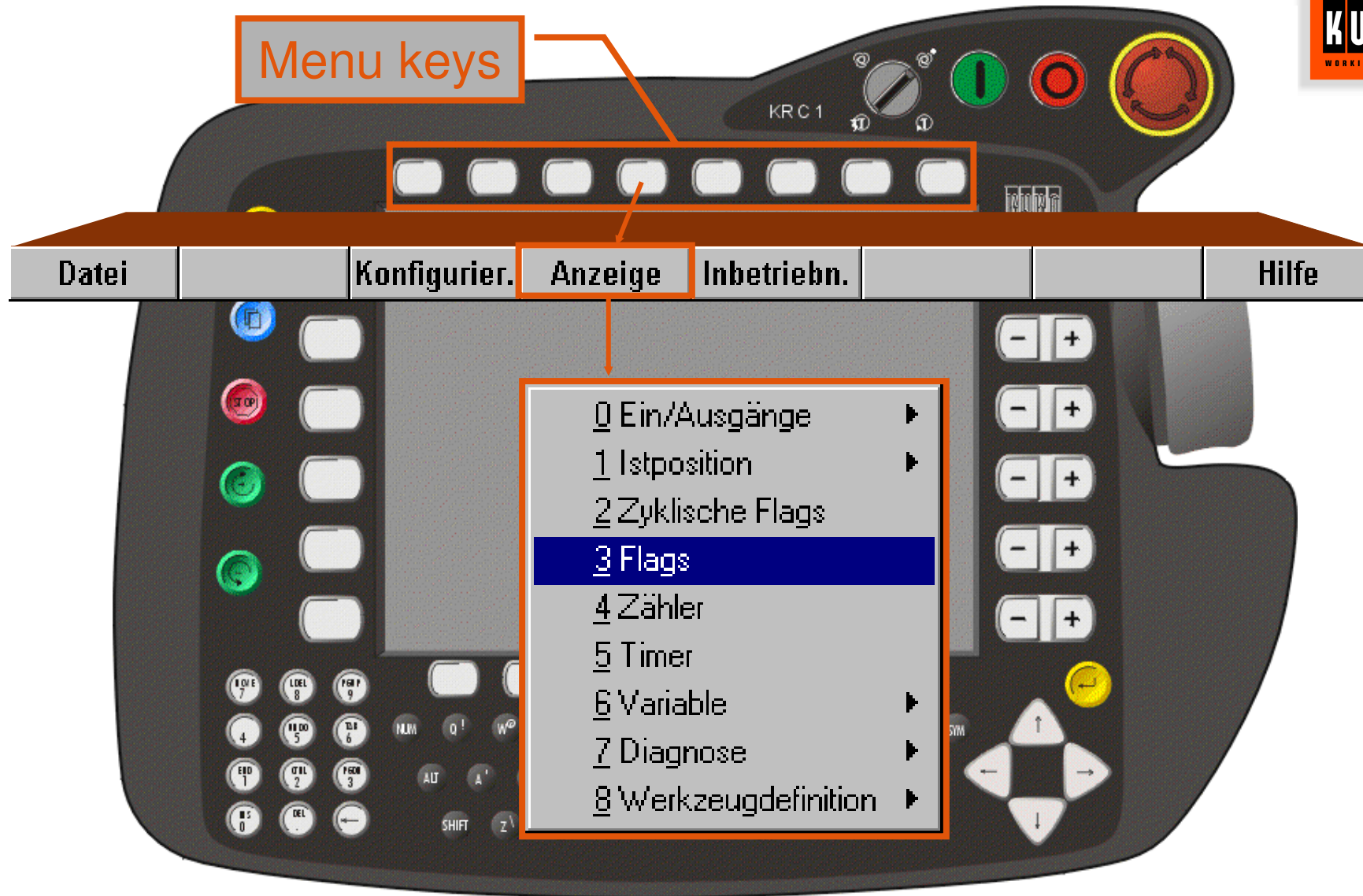
# Operation elements with CAN-Bus



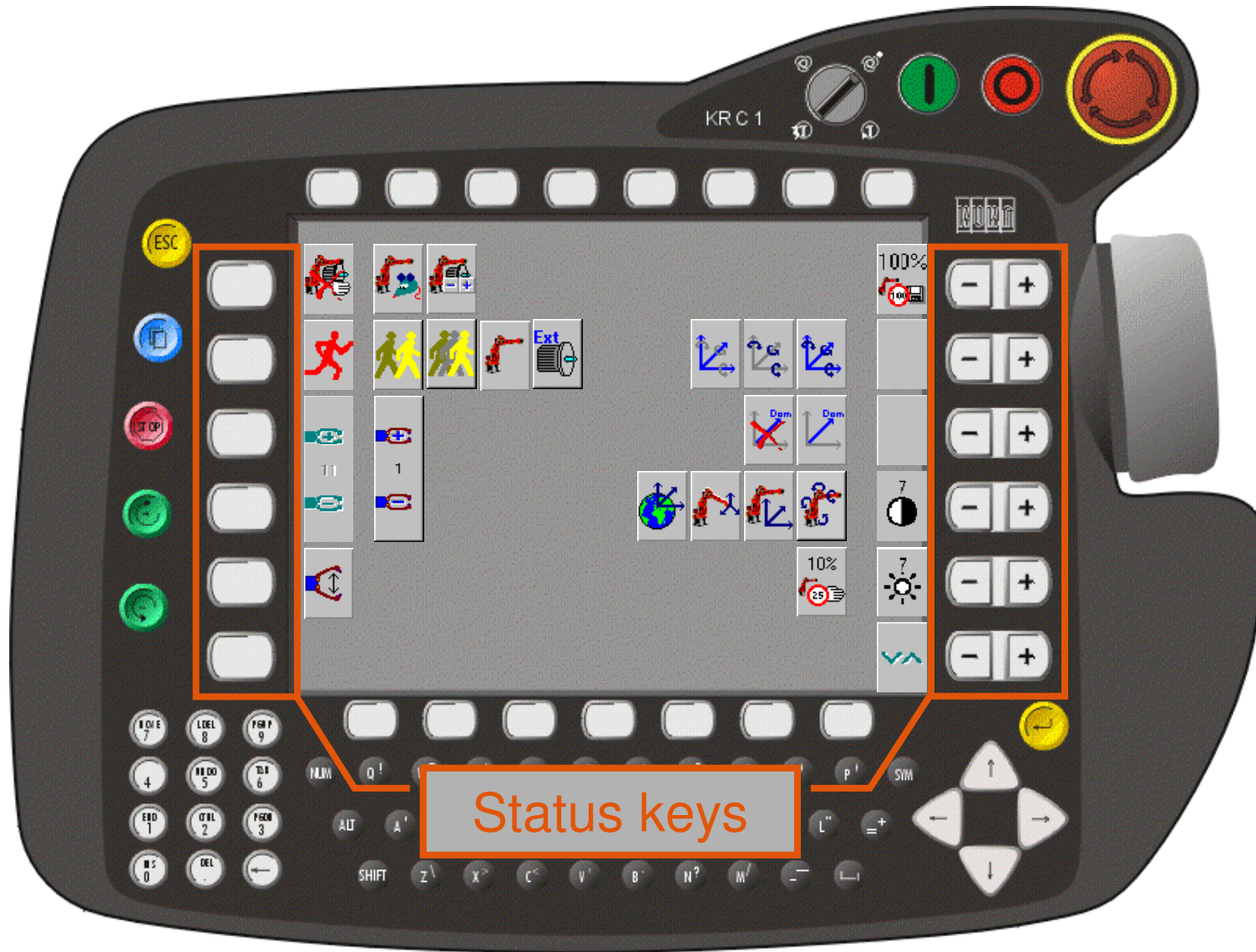
Operation elements with CAN-Bus



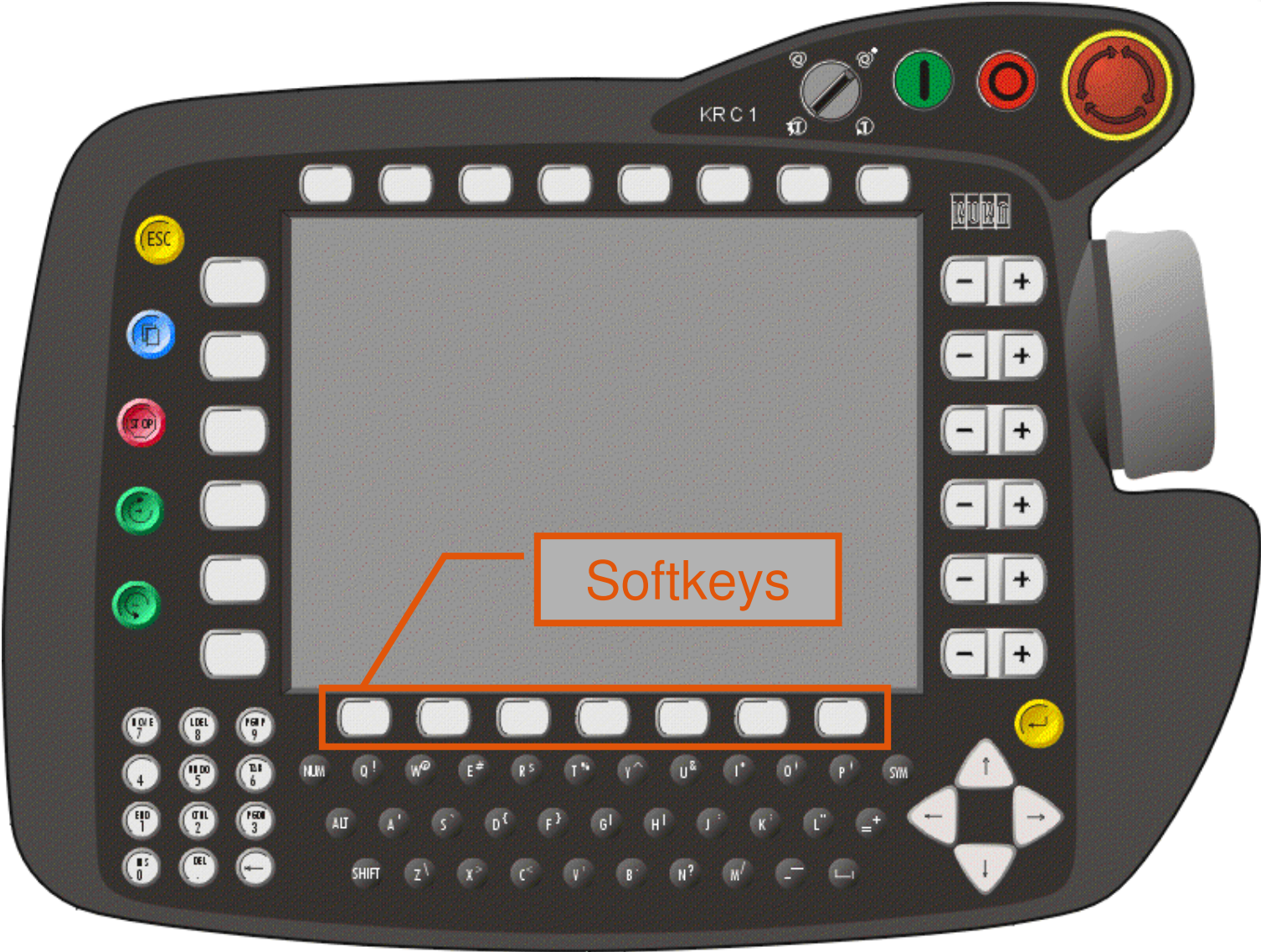
# Menu keys



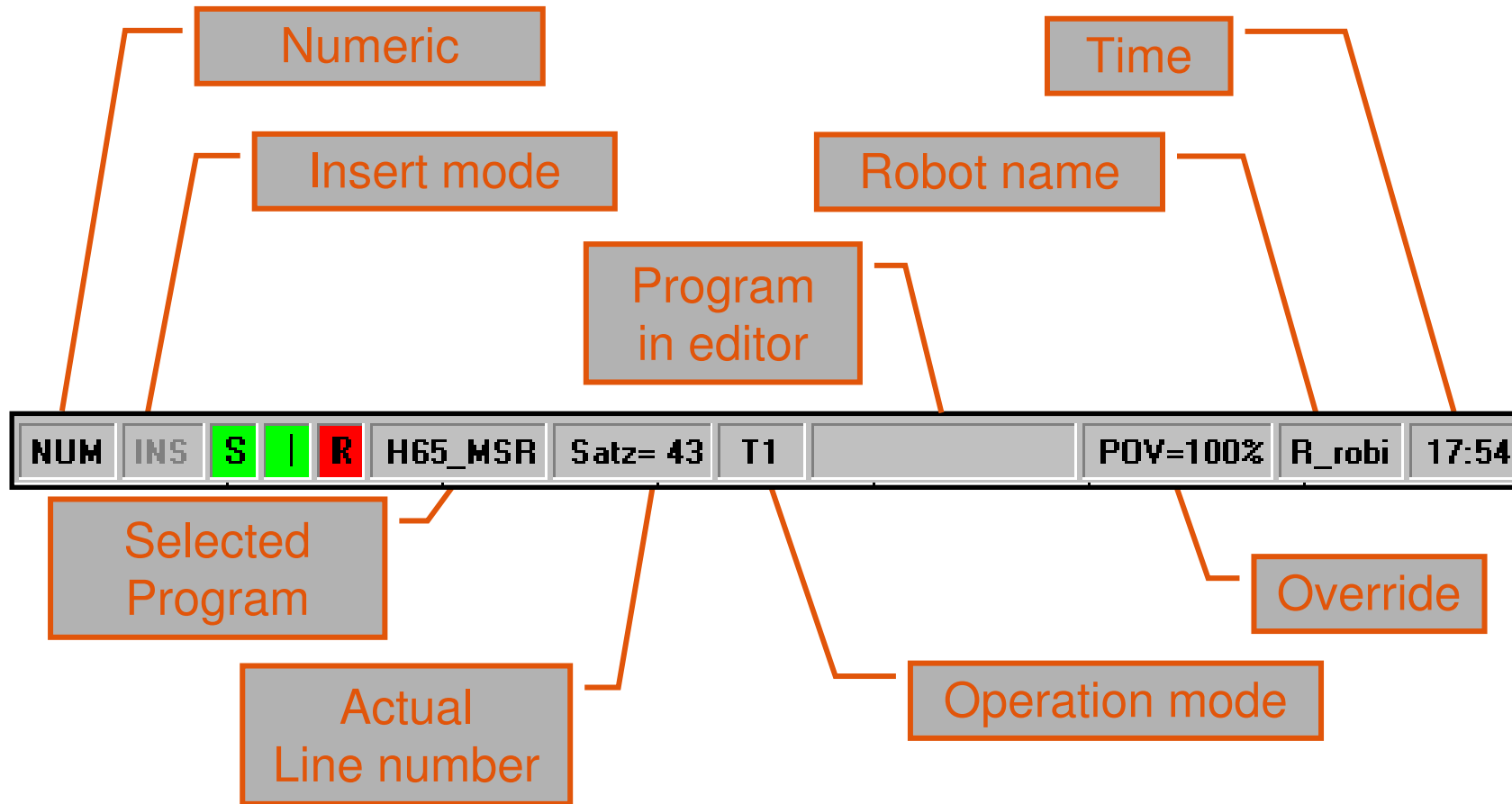
# Status keys



# Softkeys



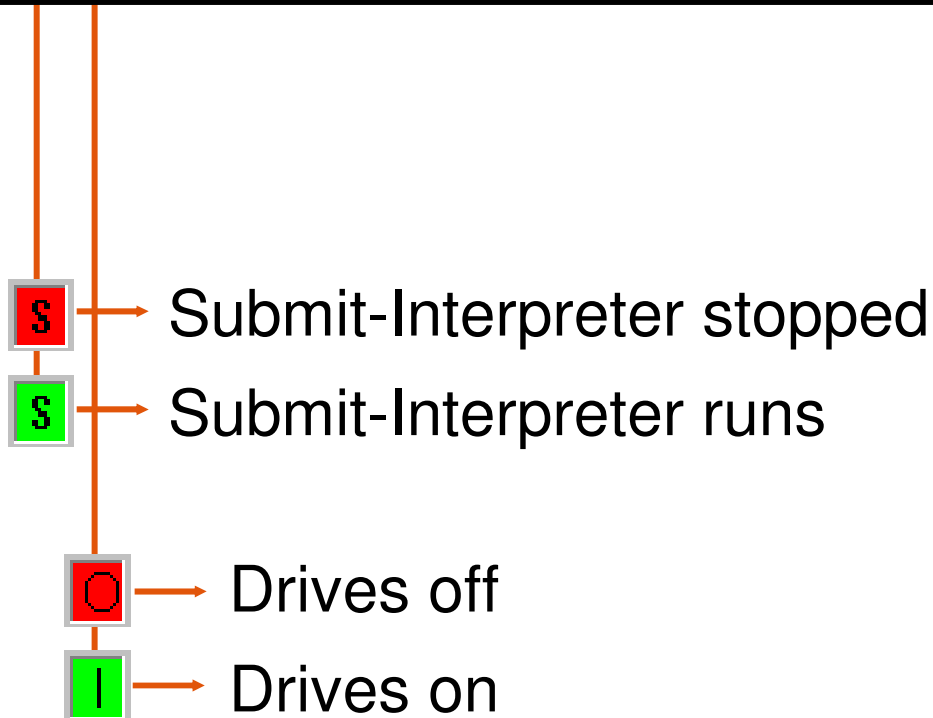
# Status line



# Status line








NUM	INS	S	I	R	H65_MSR	Satz= 43	T1		POV=100%	R_robi	17:54
-----	-----	---	---	---	---------	----------	----	--	----------	--------	-------



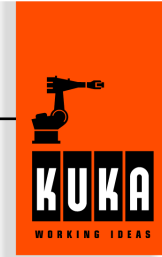
# Status line



NUM	INS	S	I	R	H65_MSR	Satz= 43	T1		POV=100%	R_robi	17:54
-----	-----	---	---	---	---------	----------	----	--	----------	--------	-------

-  → No programm selected
-  → Linepointer on the first line
-  → Program runs
-  → Program stopped
-  → Linepointer on the last line





- **Joint jogging**  
Every robot axis can be moved on it's own in positive and negative direction.



- **WORLD coordinate system**  
A stationary, rectangle coordinate system, with the origin in the robot basement.



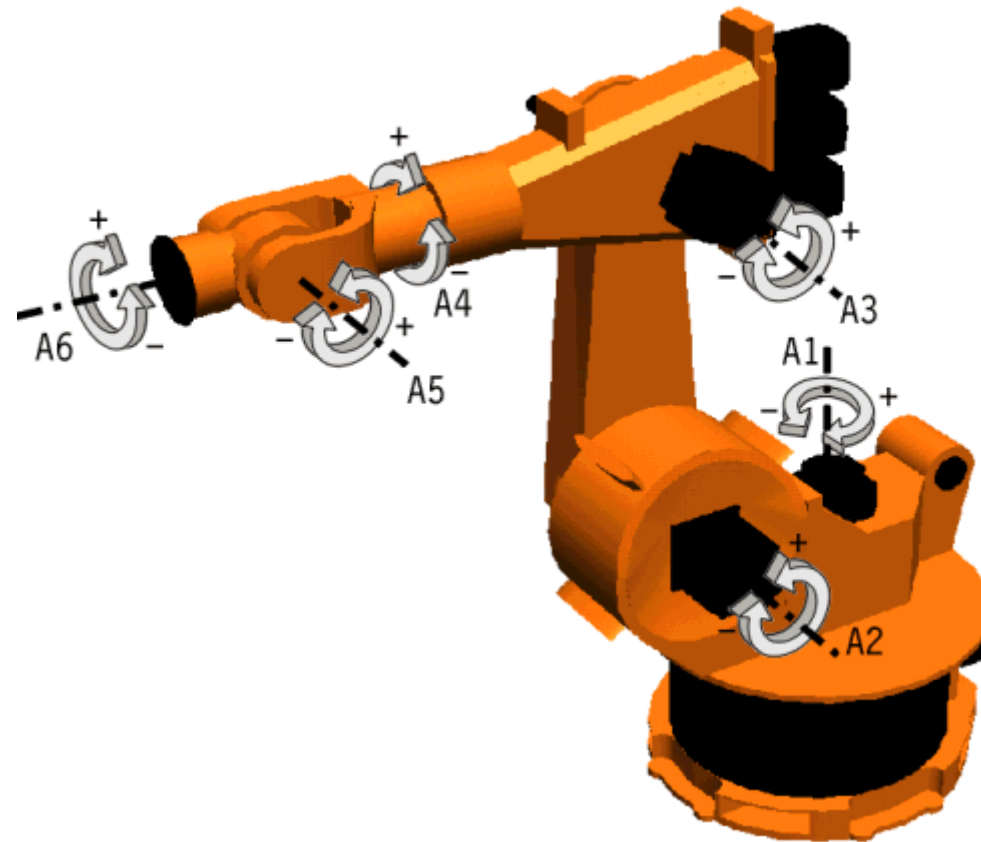
- **TOOL coordinate system**  
A stationary, rectangle coordinate system, with the origin in the robot basement.



- **BASE coordinate system**  
A rectangle coordinate system, with the origin at the workpiece.



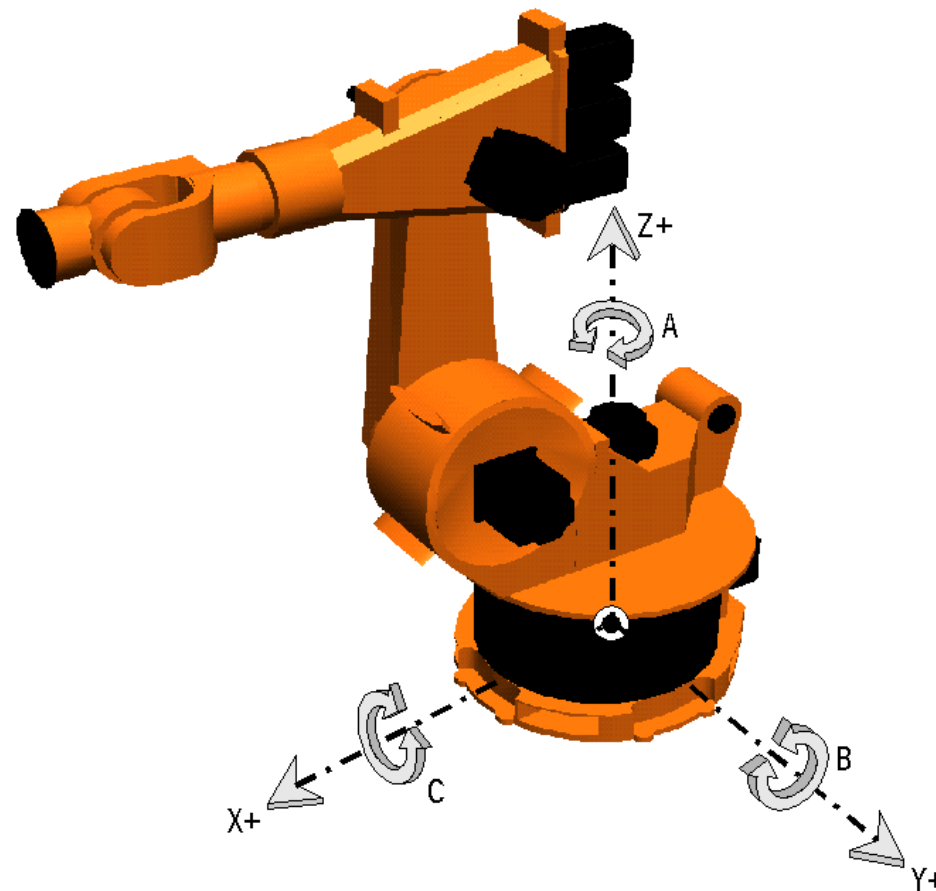
Every robot axis can be moved on it's own in positive and negative direction.



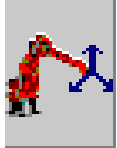
## WORLD coordinate system



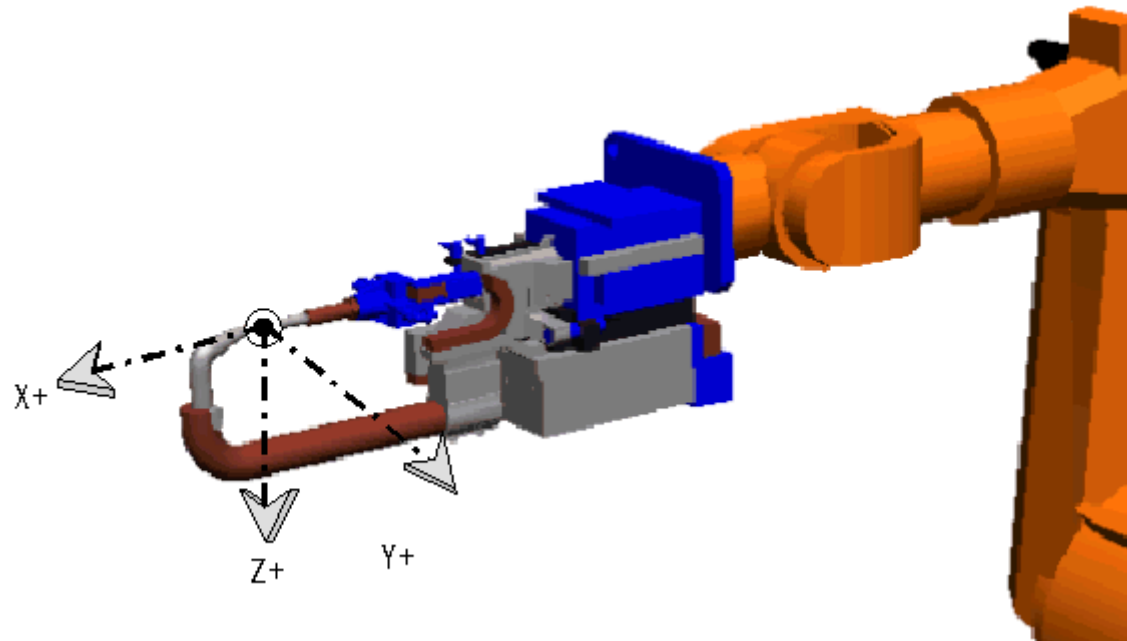
A stationary, rectangle coordinate system, with the origin in the robot basement.



## *TOOL coordinate system*



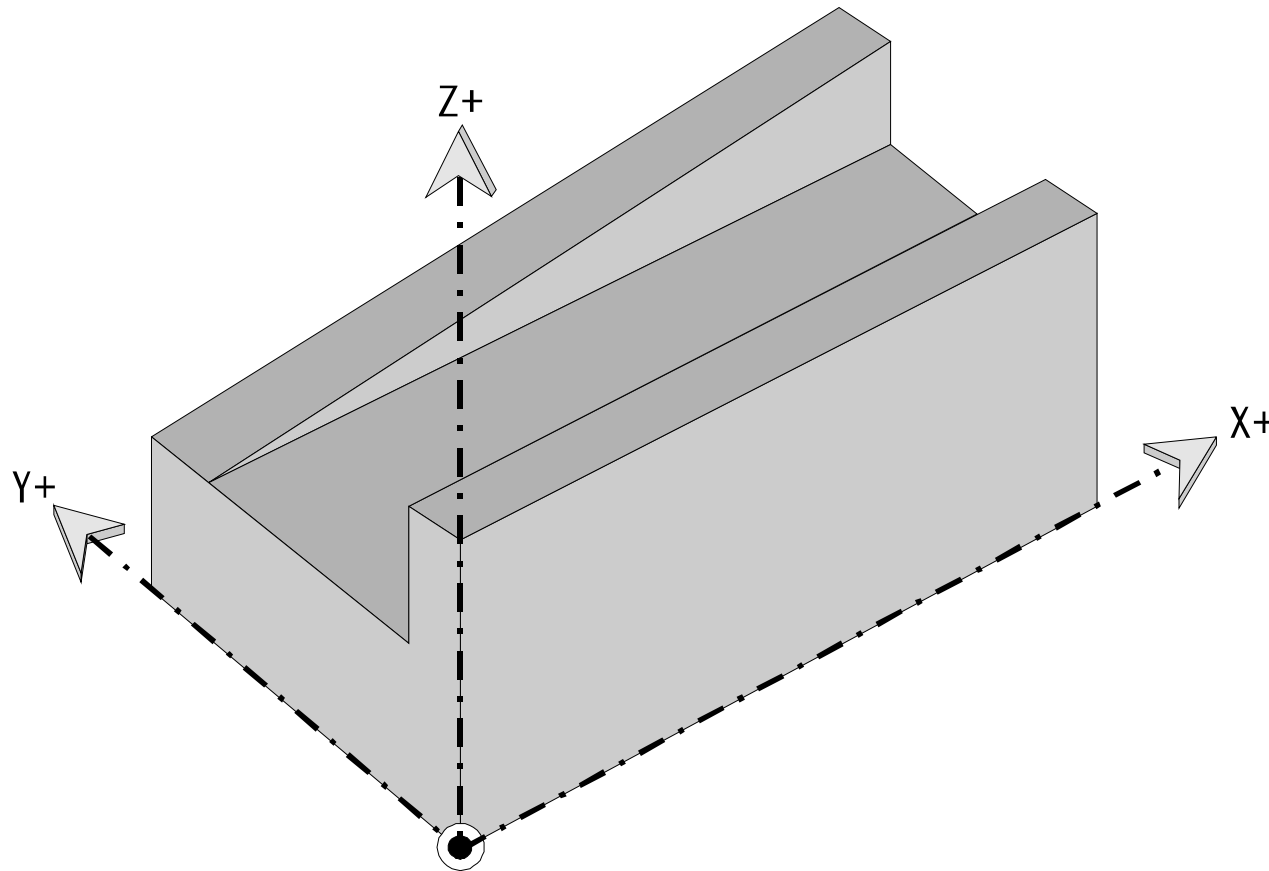
A stationary, rectangle coordinate system, with the origin in the robot basement.



## BASE coordinate system



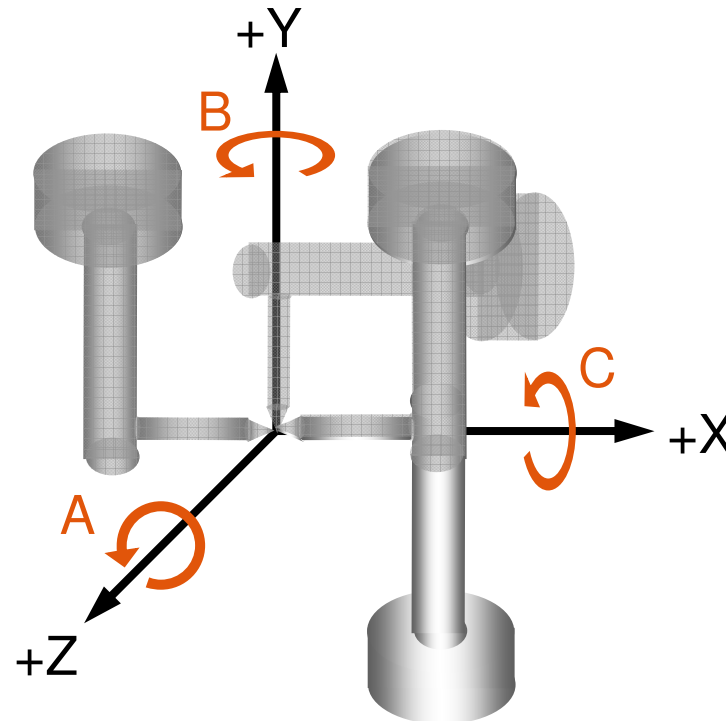
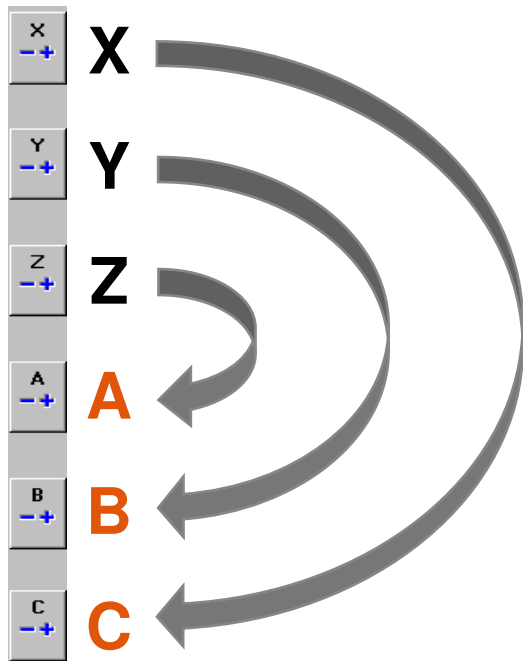
A rectangle coordinate system, with the origin at the workpiece.



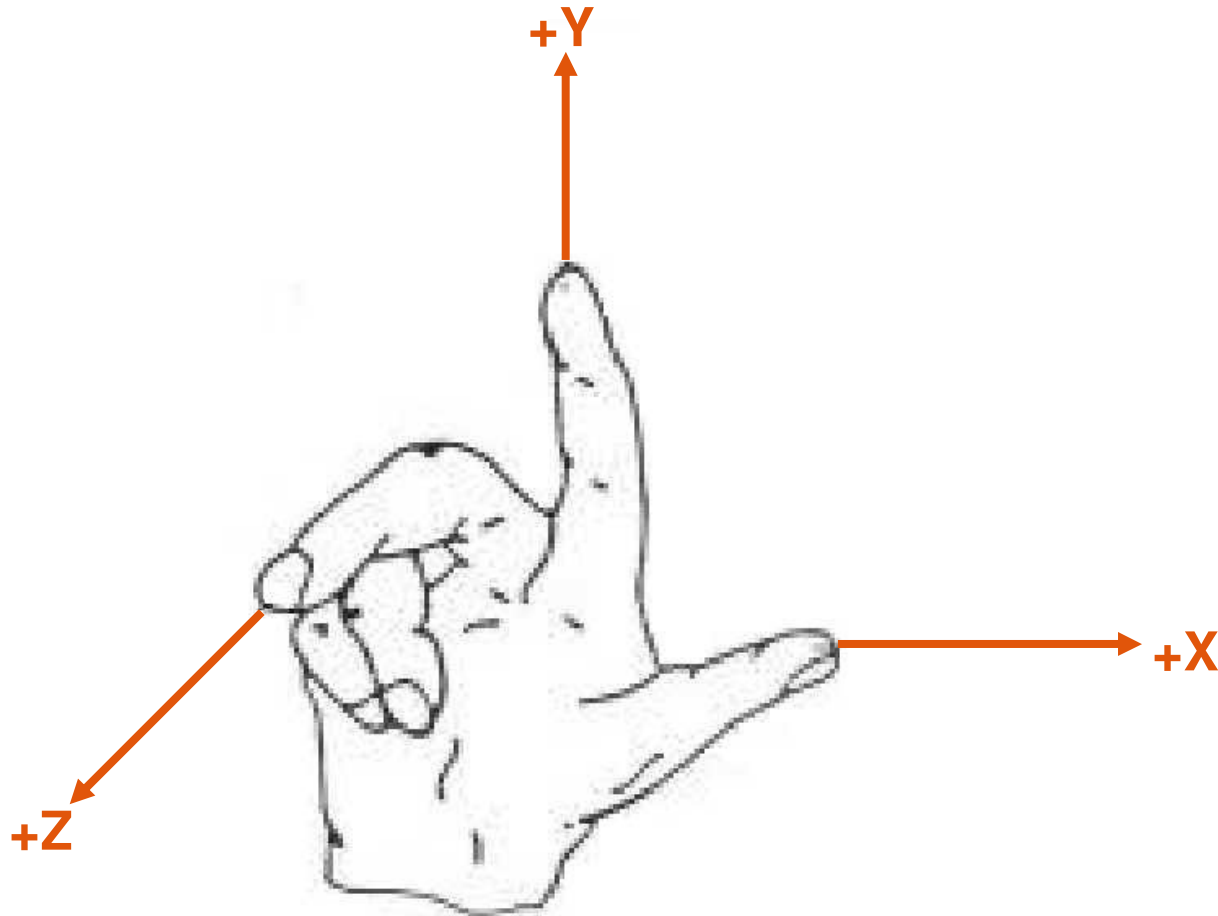
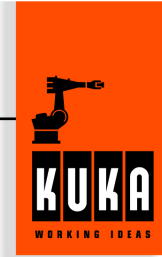
## Rotation angle at cartesian coordinates



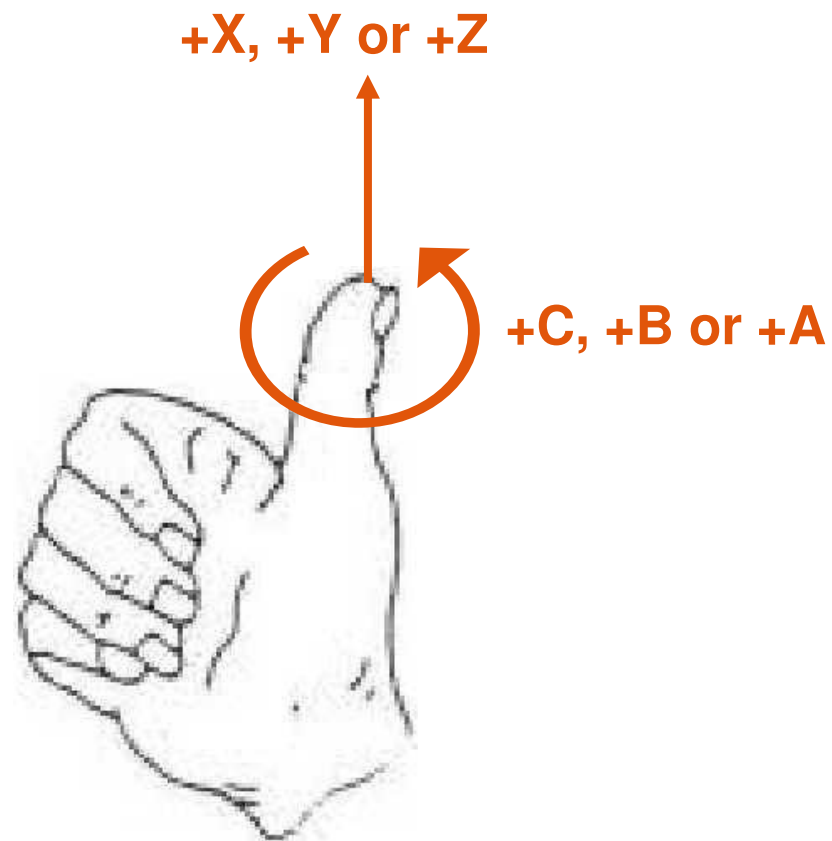
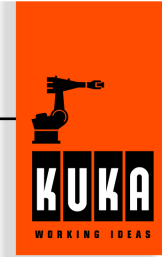
- Angle **A**    ➔ Rotation around the **Z**-axis
- Angle **B**    ➔ Rotation around the **Y**-axis
- Angle **C**    ➔ Rotation around the **X**-axis



## Right Hand Rule (Coordinate directions)



## Right Hand Rule (Rotation direction)





## Select a coordinate system



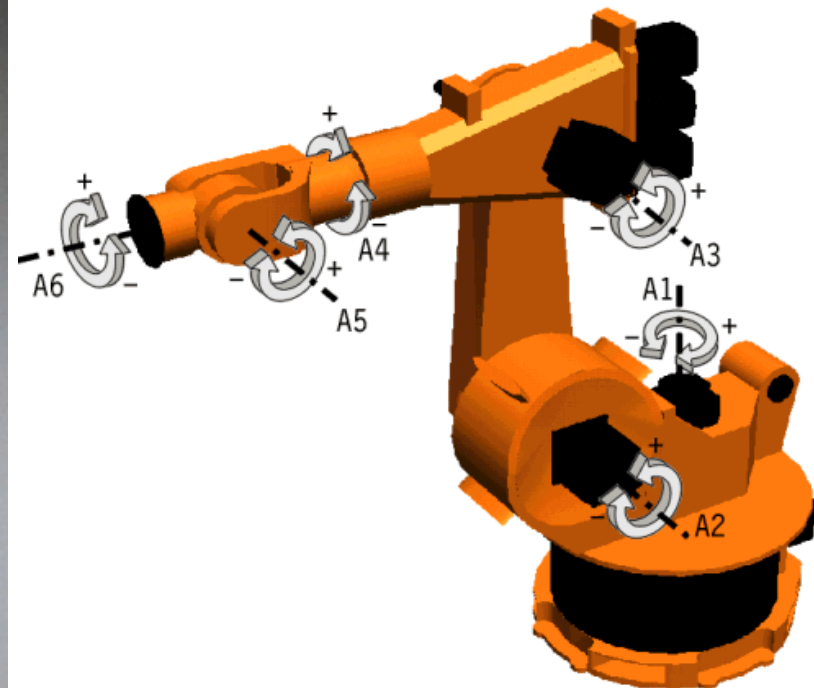
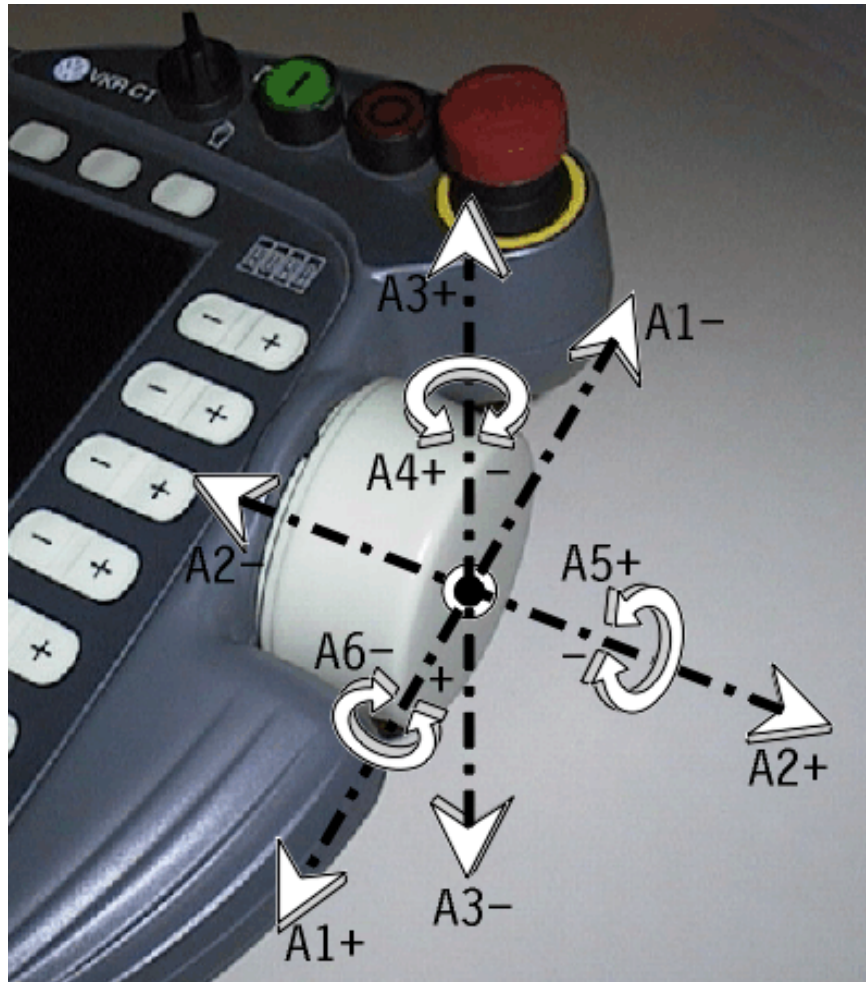
• Select jogging

- Traversing keys
- Spacemouse

• Select coordinate system

- Joint jogging
- WORLD coordinate system
- TOOL coordinate system
- BASE coordinate system

## Joint jogging with 6D mouse



## Cartesian jogging with 6D mouse

