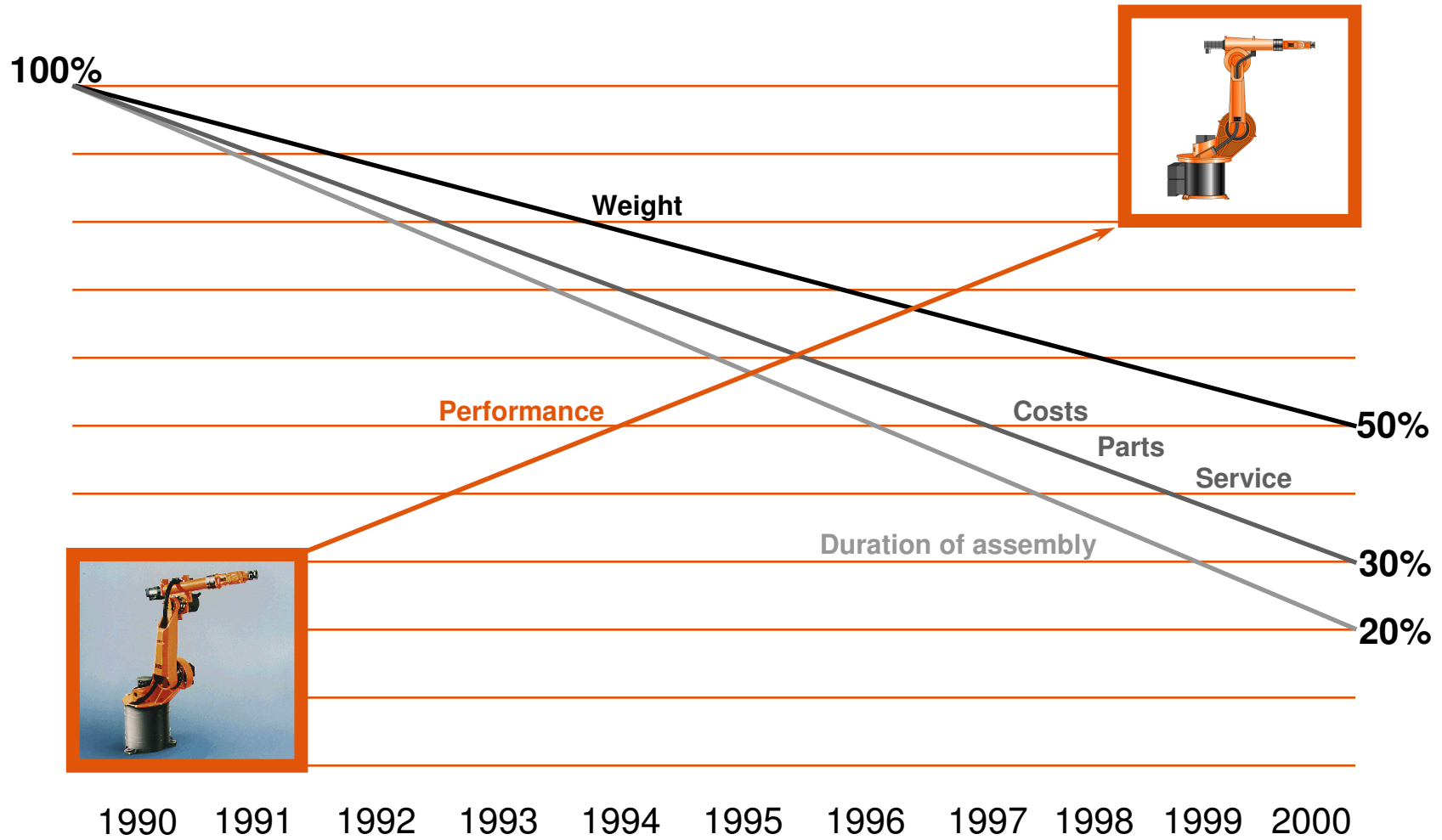


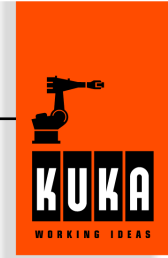
Development of KUKA robots



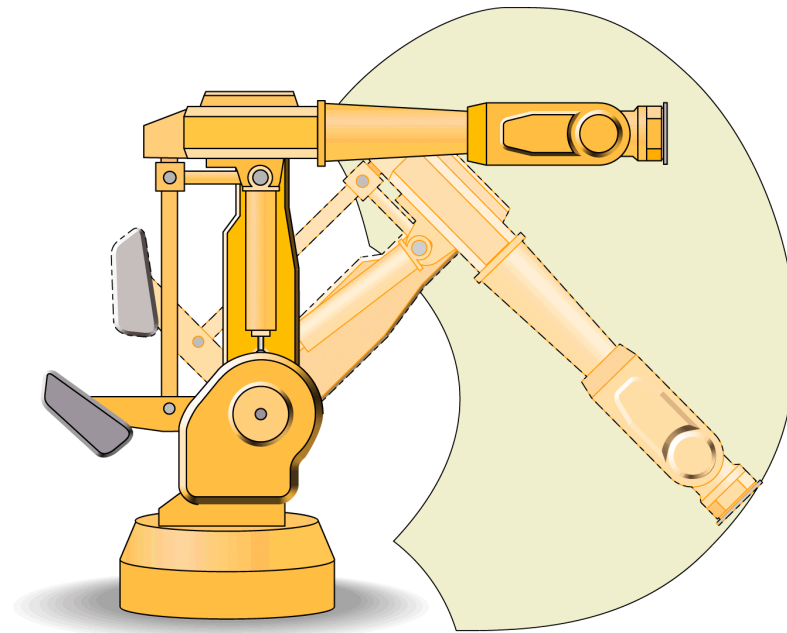
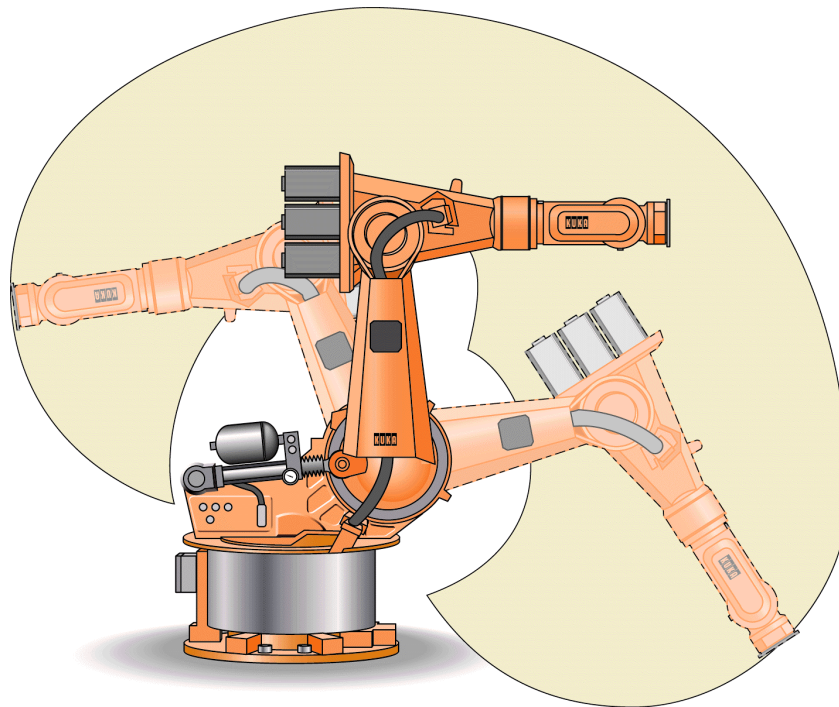
Only the performance increases



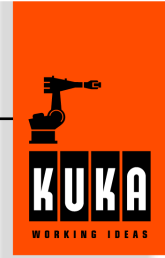
Comparison of different kinematics concepts



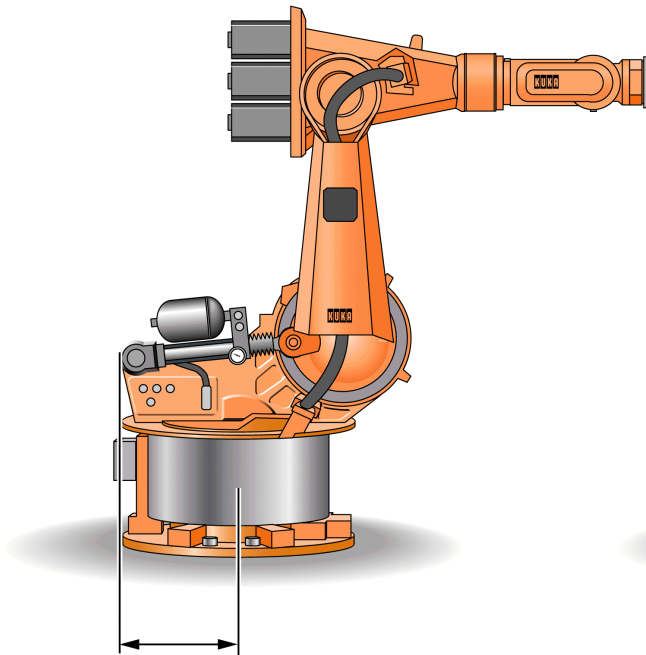
- Overhead motion possible
- Bigger work space



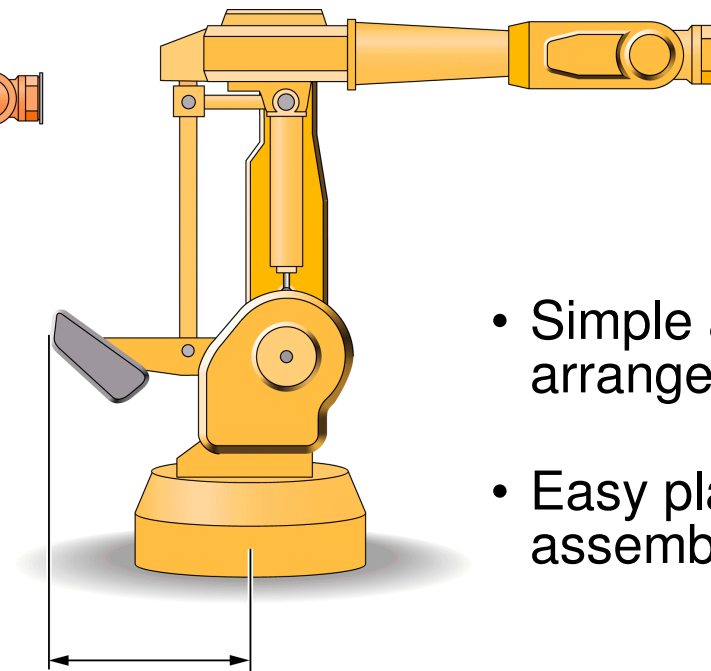
Comparison of jamming edges



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 15/2	(V)KR 30/2 (V)KR 30 L15/2 (V)KR 45/2	(V)KR 125/2 (V)KR 150/2 (V)KR 200/2	(V)KR 350/2 (V)KR 350L280/2 (V)KR 350L240/2	(V)KR 60P/1 (V)KR 100P/1 (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



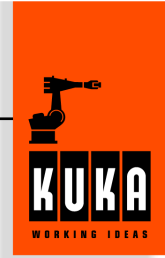
Palettizier KR 180 PA



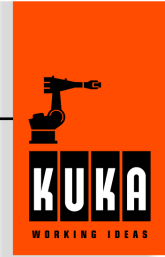
Console robot (V)KR 125 K/1, (V)KR 150 K/1



The new console robot KR 30 K



Wall mounted robot (V)KR 125 W/2



The new mini robot KR 3

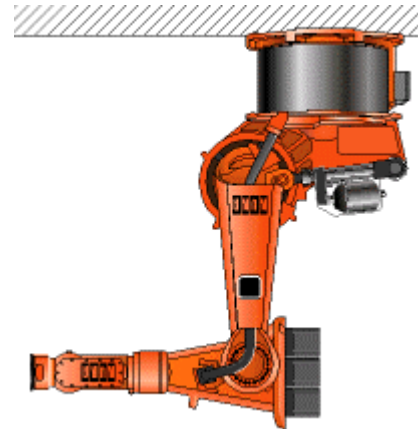
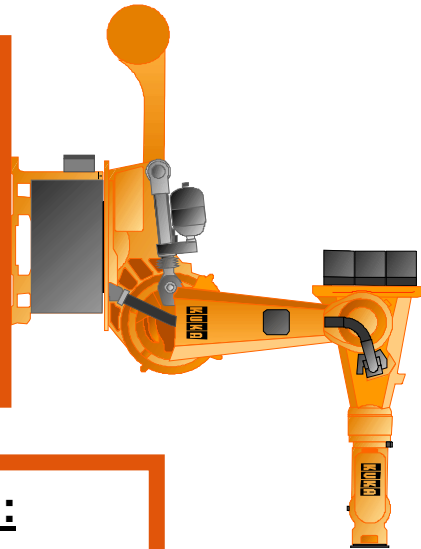


For all situations: flexible mounting positions



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



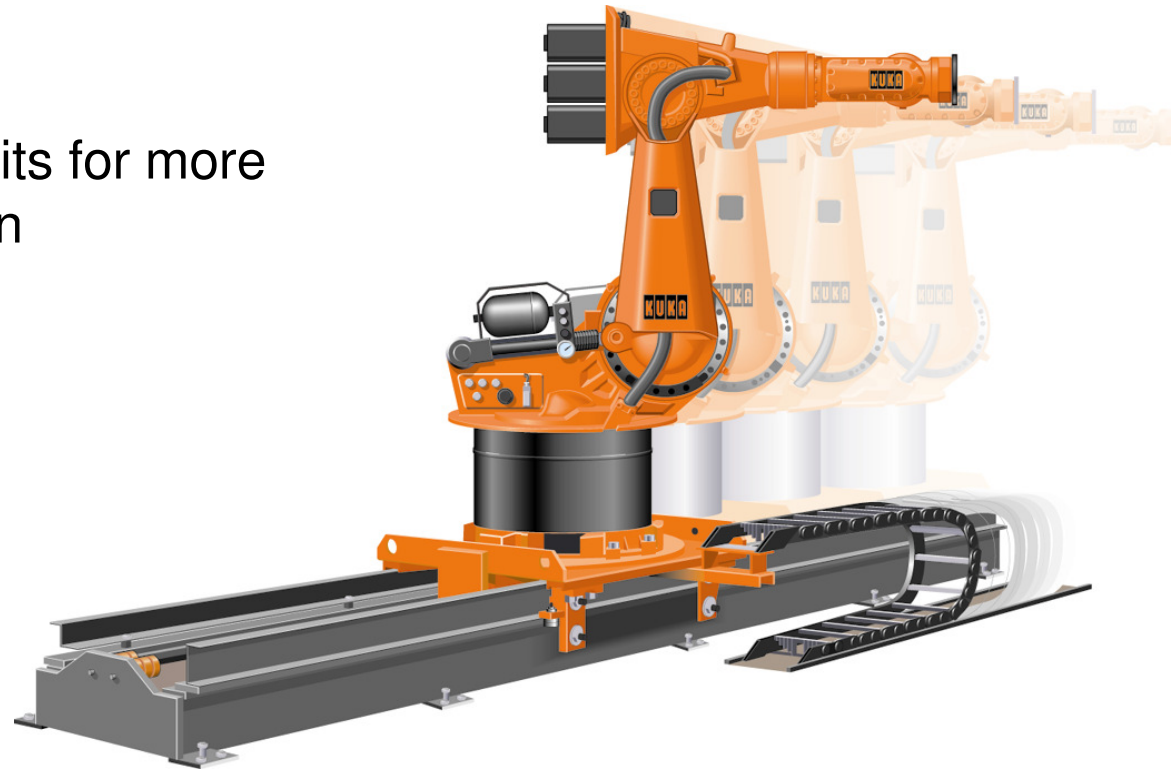
Ceiling mounting:

- 📄 (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)

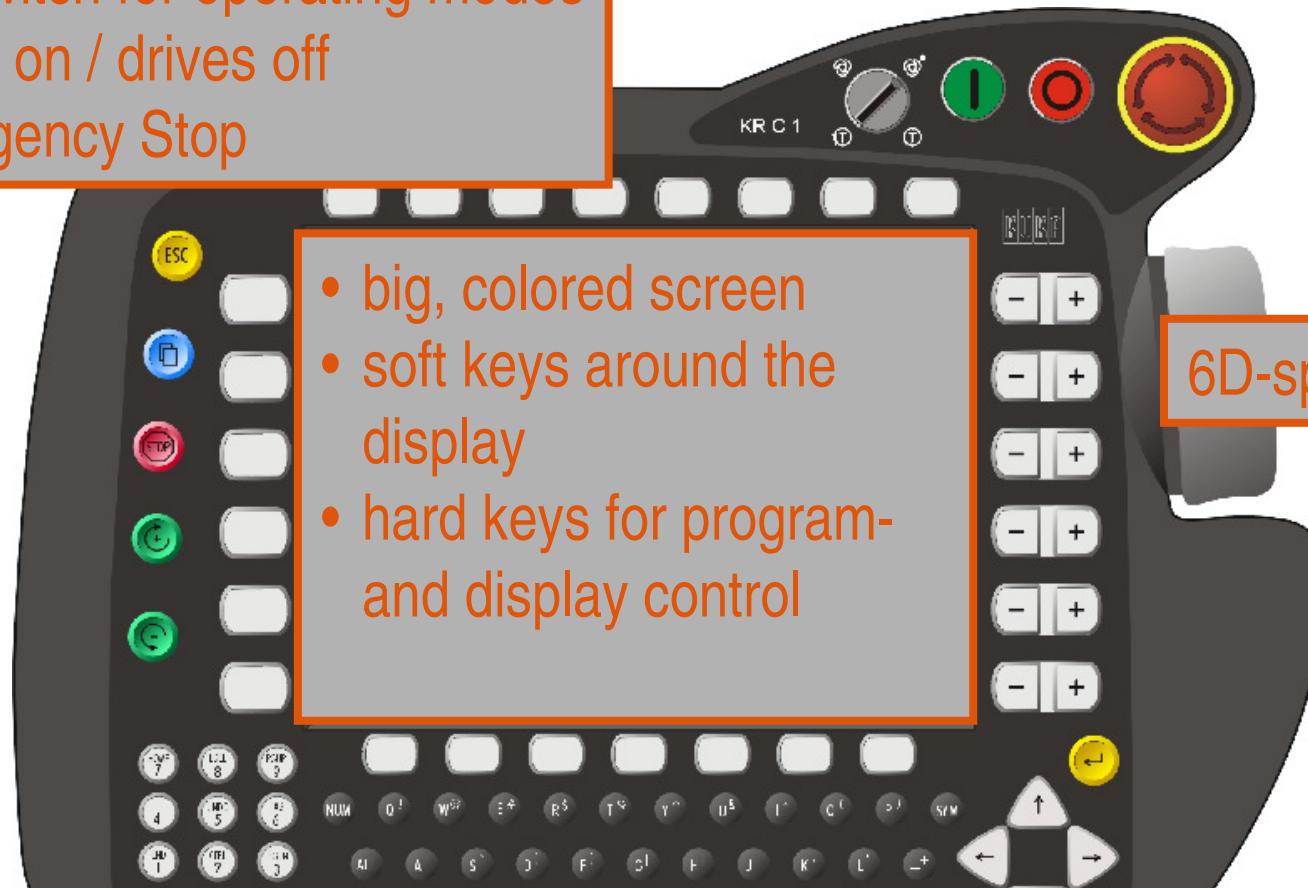


KUKA Control Panel
(KCP)

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

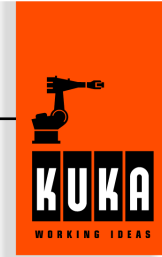
Robot controller KR C1 and KR C1A



KR C1



KR C1A



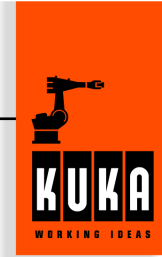
The type code of the KUKA-Industrial robots refers to the payload.

The KUKA type code:



1 kg = 2.2 lbs

Example: KUKA type code



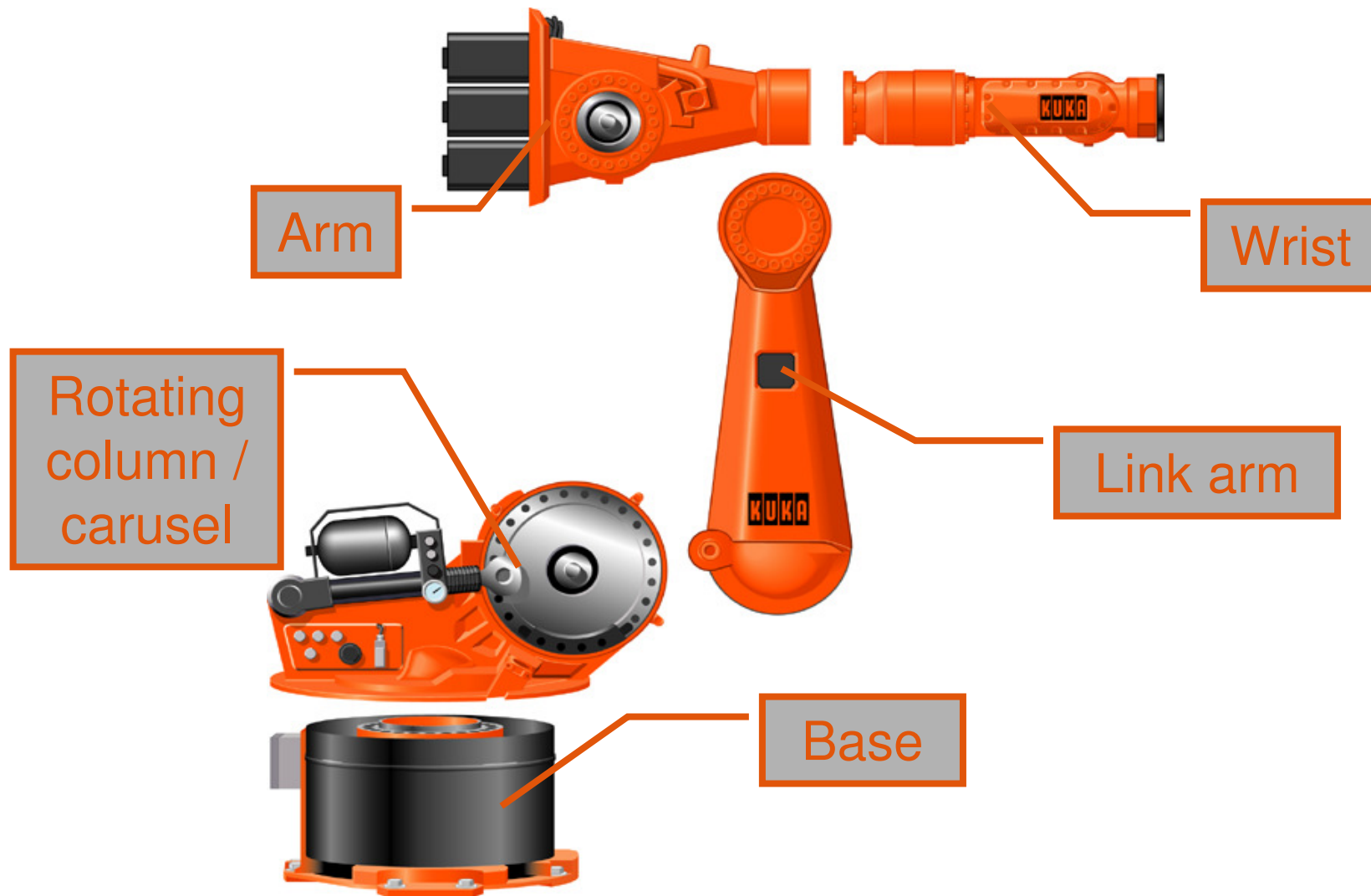
KR 150 / 2

KUKA Industrial **R**obot

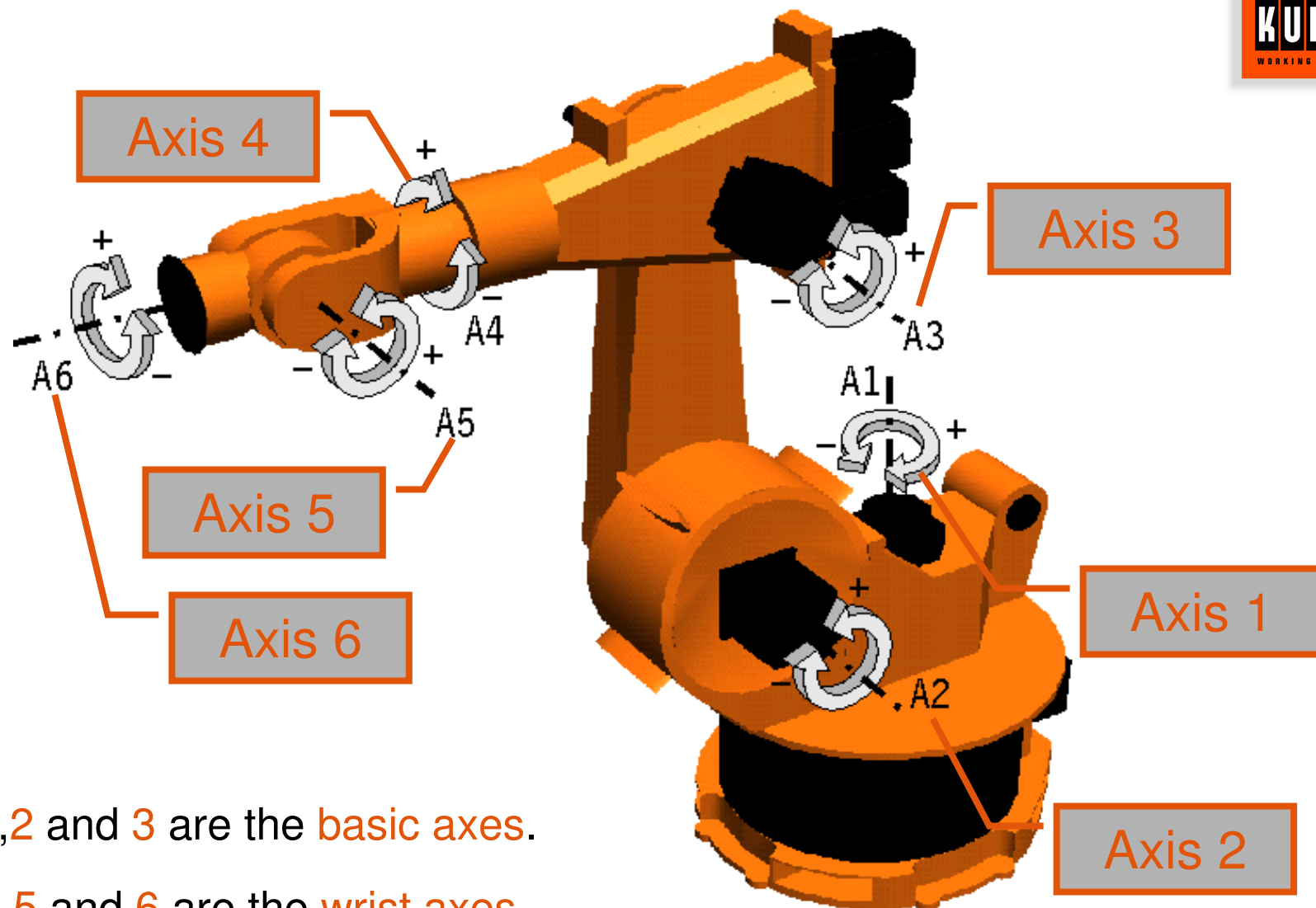
with **150** kg payload

2. Generation

Mechanical construction of a KUKA robot



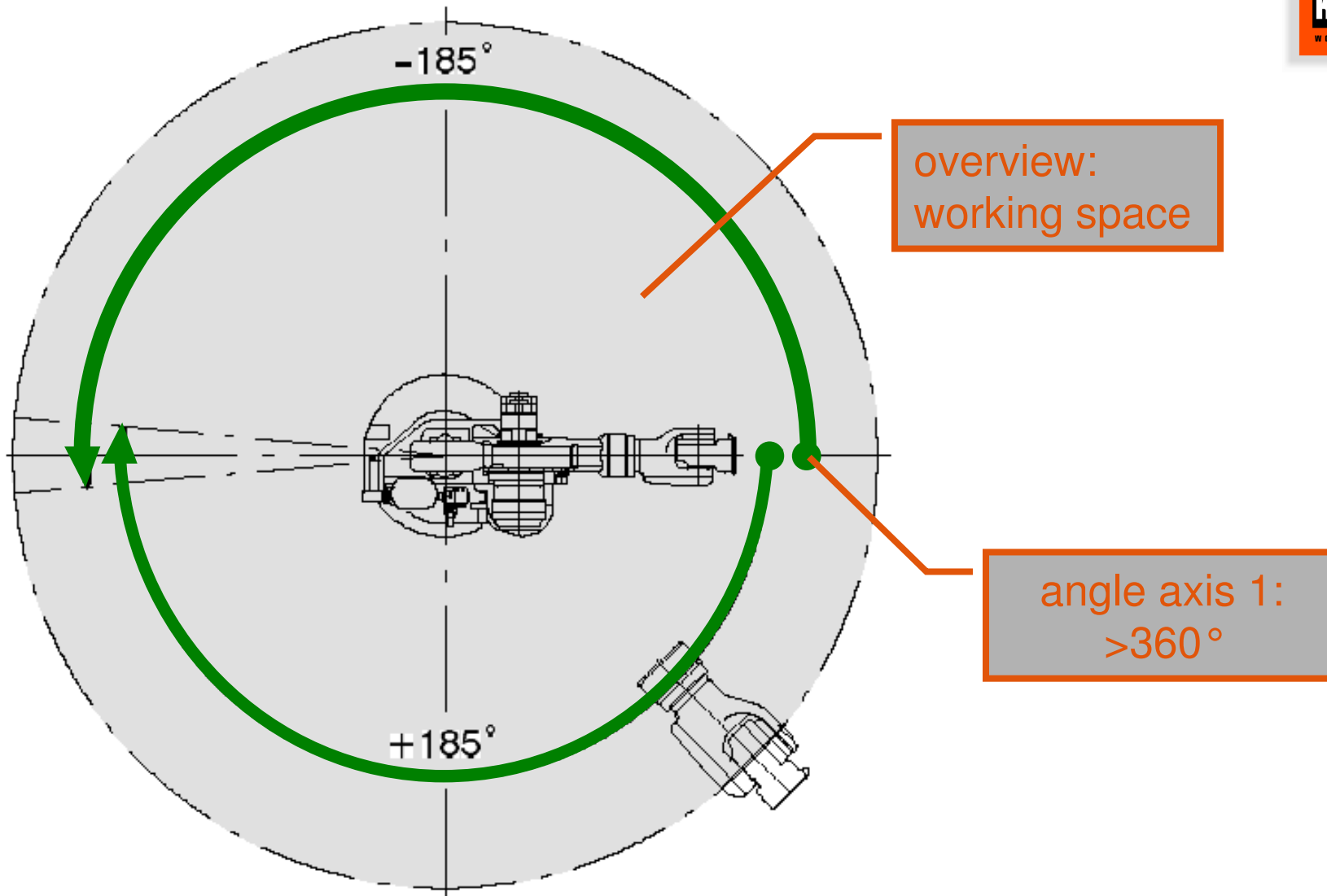
Axes of a KUKA robot



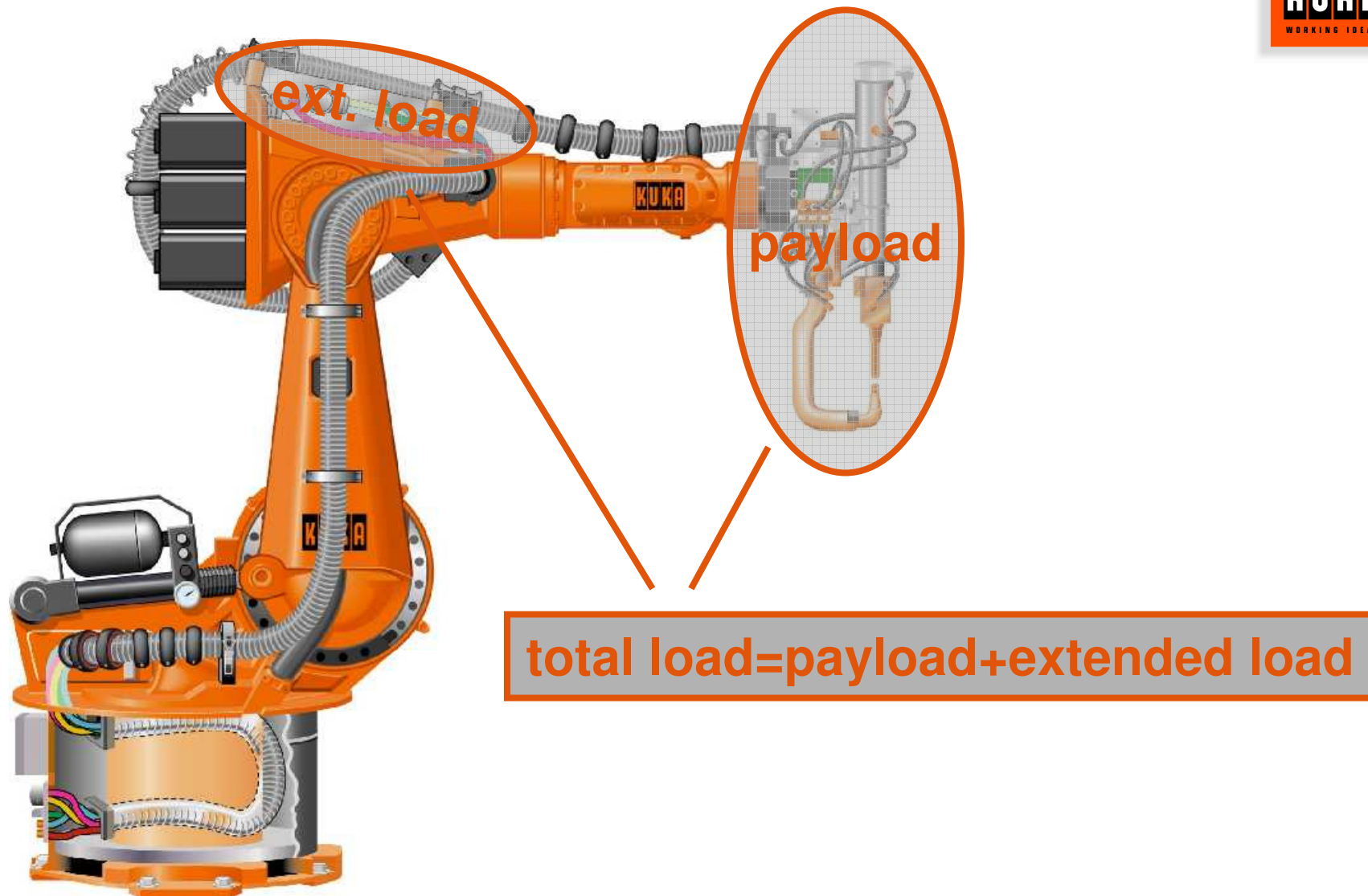
Axes 1, 2 and 3 are the **basic axes**.

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

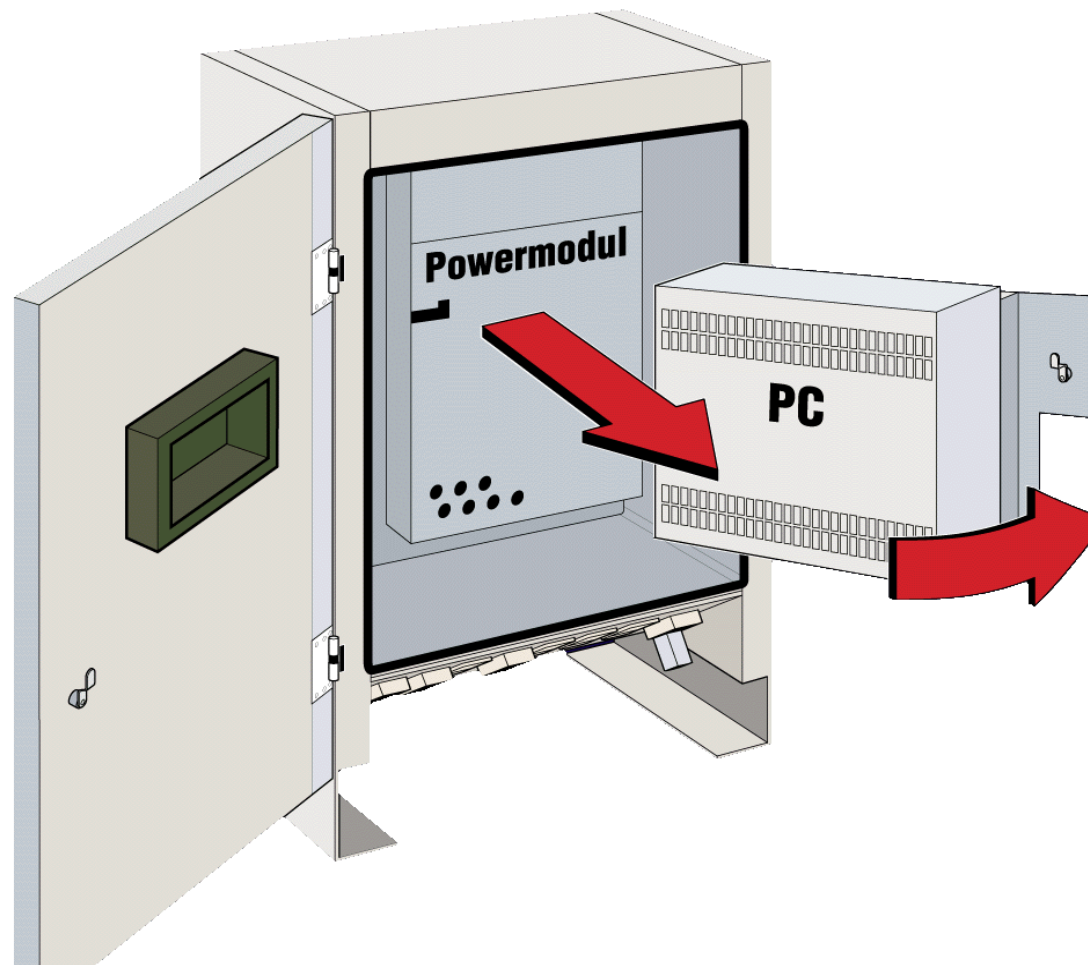
The working space of a KUKA robot (overview)



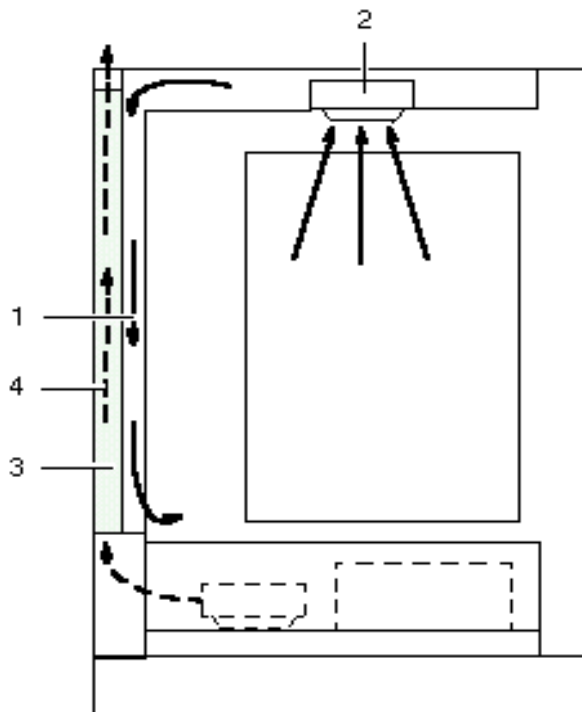
Payload spreading of a KUKA robot



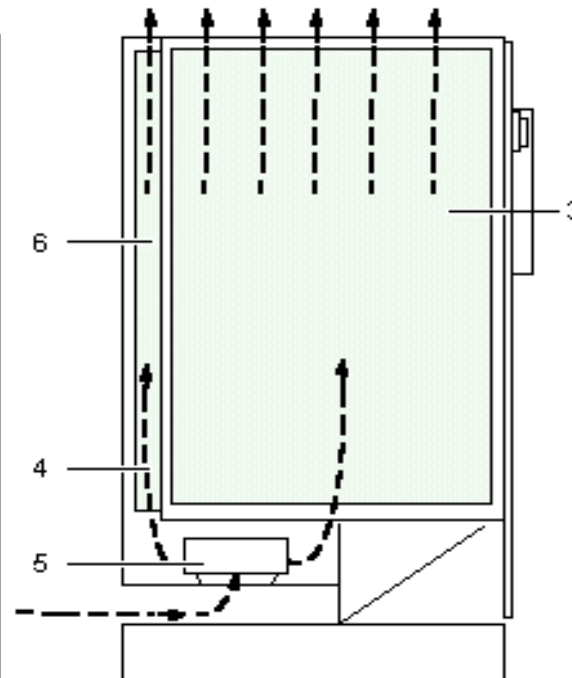
Construction of the controll cabinet



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

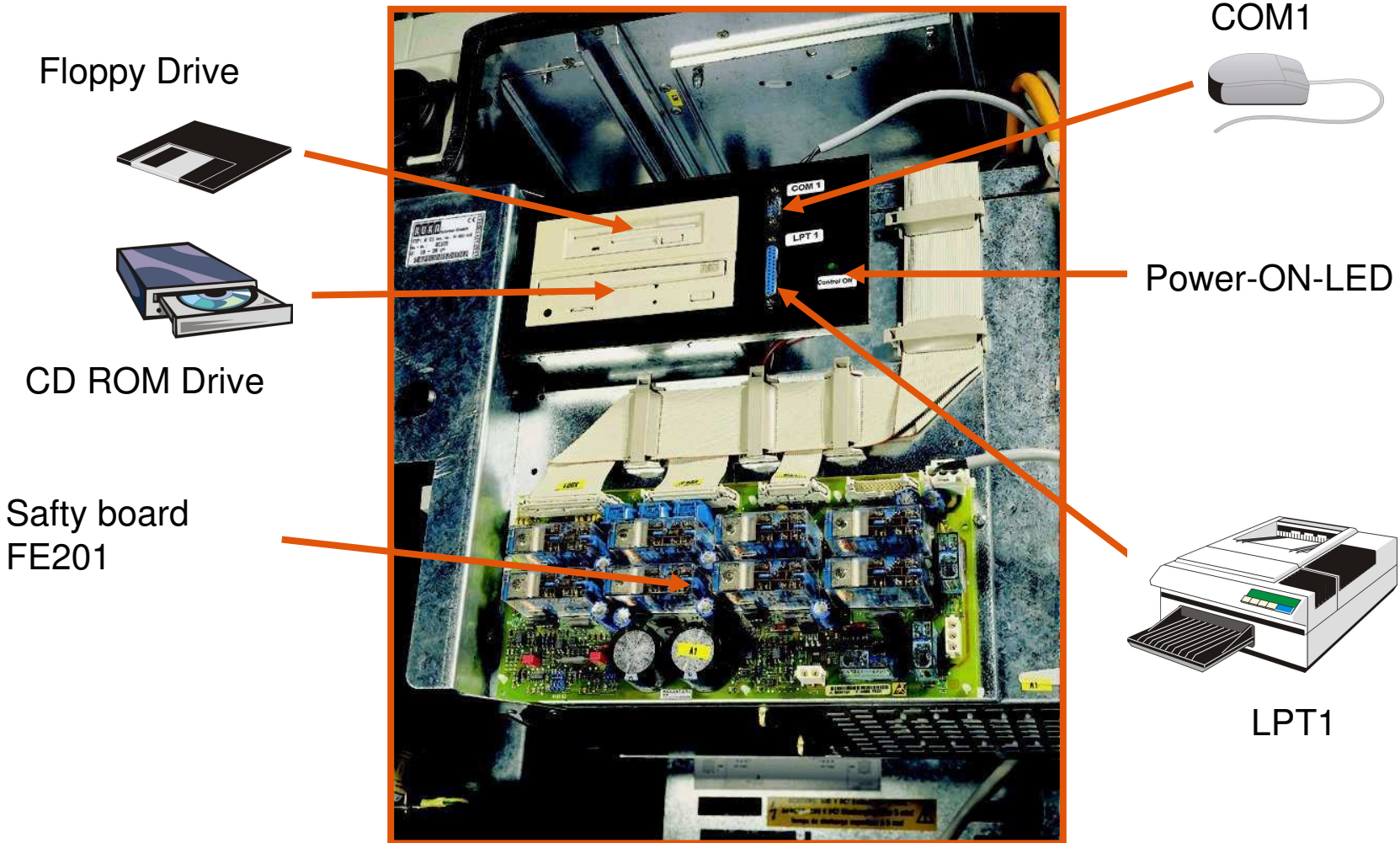
3 Head converter

4 Outer Cooling circuit

5 Fan Inner cooling circuit

6 Head converter

Front view of the PC unit



Overview of the PC unit

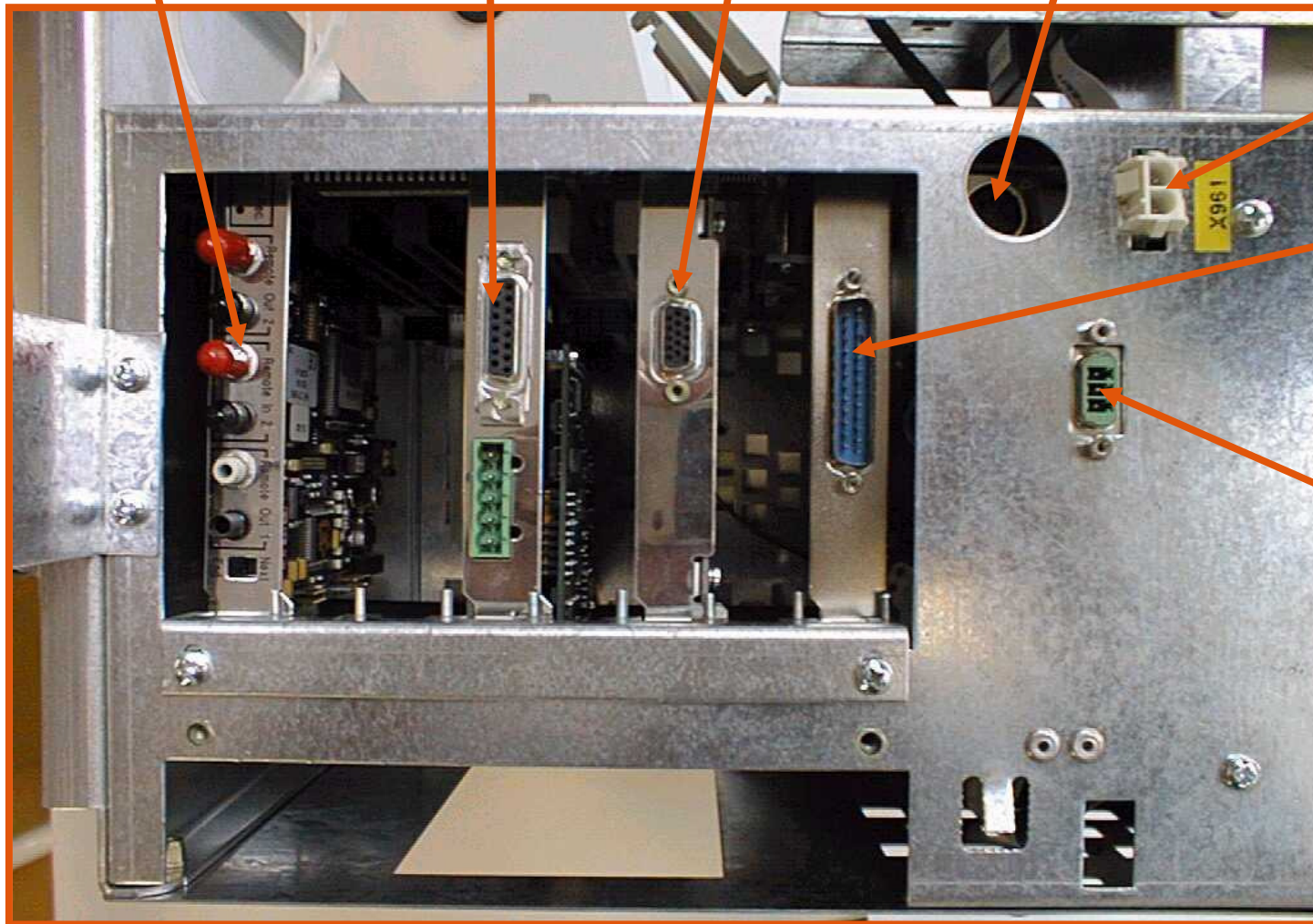


Fieldbus card
(Option)

MFC card

KVGA card

Connector for
A extern keyboard



X961
PC-Power supply

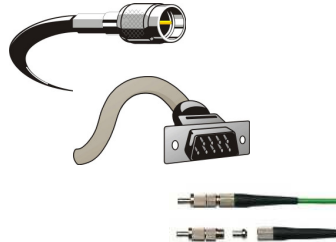
COM2

Extern
Power supply
for Interbus-
card (Option)

User groups

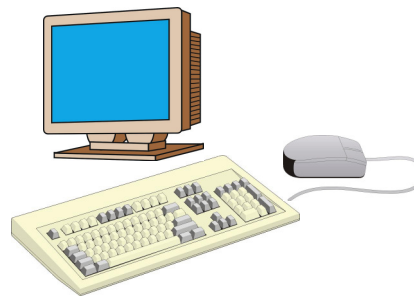


- Configuration of the robot system (External axes, Technology)
- Configuration of the robot system (Fieldbus, Vision-system etc.)
- Own Technology commands via UserTECH



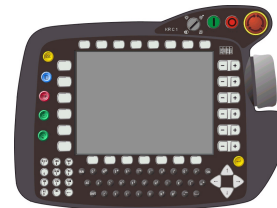
Administrator

Expert



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

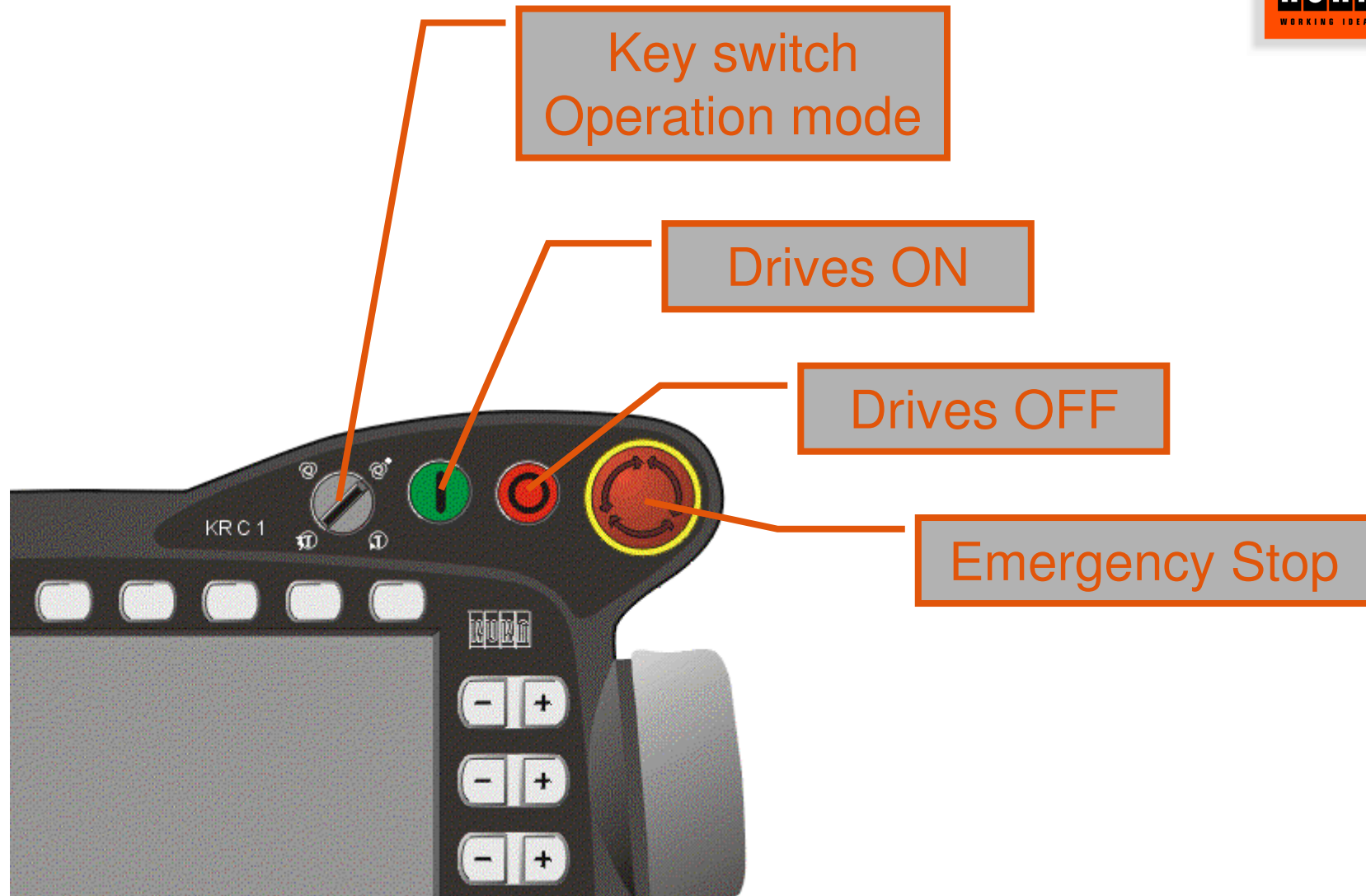
- Start up (Mastering, Tool measuring)
- Simple robot programs (Programming with Inline forms, Motion commands, Technology commands, limit monitoring, no Syntax errors)



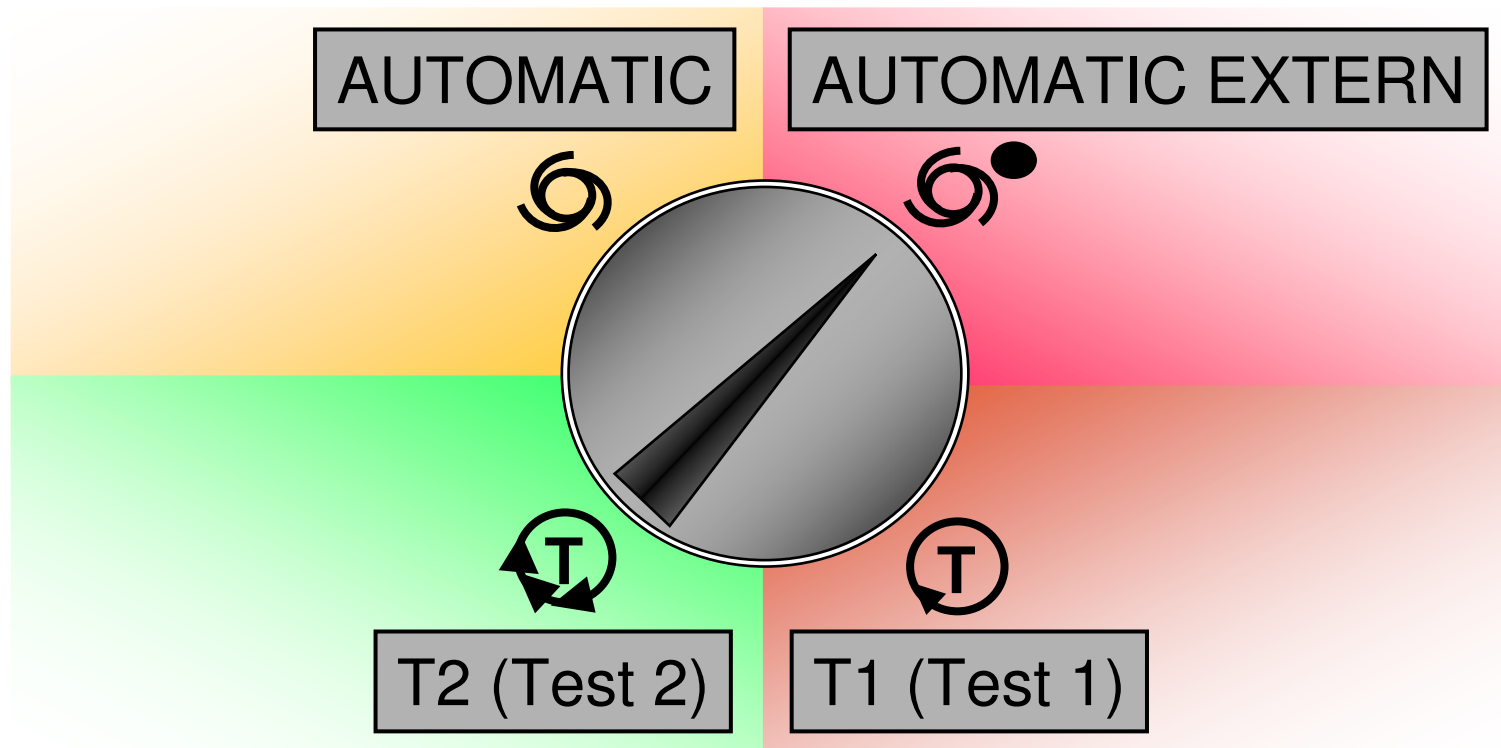
User

KUKA Control Panel (KCP)

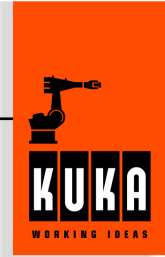




Operation mode switch



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		
9	SET		GDAT1	<input type="radio"/> 9		
10	PTP		GDAT1	<input type="radio"/> 10		
11	PTP		GDAT1	<input type="radio"/> 11		
12	PTP		GDAT1	<input type="radio"/> 12		
13	PTP		GDAT1	<input type="radio"/> 13		
14	PTP	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	12
17	PTP HOME	Vel= 100 %	DEFAULT	<input type="radio"/> 17	Gripper open	
				<input type="radio"/> 18	Gripper close	
				<input checked="" type="radio"/> 19	Ausgang	11

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			

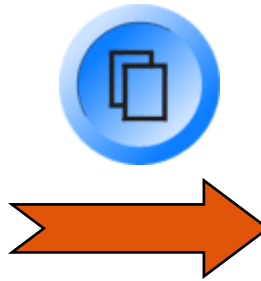
Window selection key



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
Andern	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

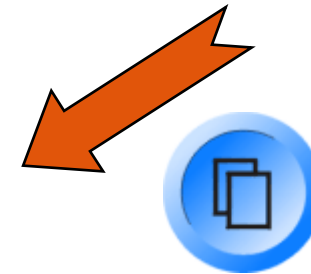
NUM	INS	S	R	QUADRAT2	Satz= 1	T1	POV=100%	Robi 10	14:38
								Eingänge	Schließen



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 text '11'.

The interface includes a menu bar at the top with 'Datei', 'Bearbeiten', 'Konfigurieren', 'Log.', 'Befehle', and 'Hilfe'. On the right side, there are controls for zoom (100%), a light icon (11), and a moon icon (12). At the bottom, there is a status bar with 'NUM', 'INS', 'S', 'I', 'R', 'QUADRAT2', 'Satz= 1', 'AUT', 'POV=100%', 'Robi 10', and '14:34'. Below the status bar are buttons for 'Ändern', 'Bewegung', 'Logik', 'letzter Bef.', 'Satzanwahl', 'Touch Up', and 'DATEI'.

Status window



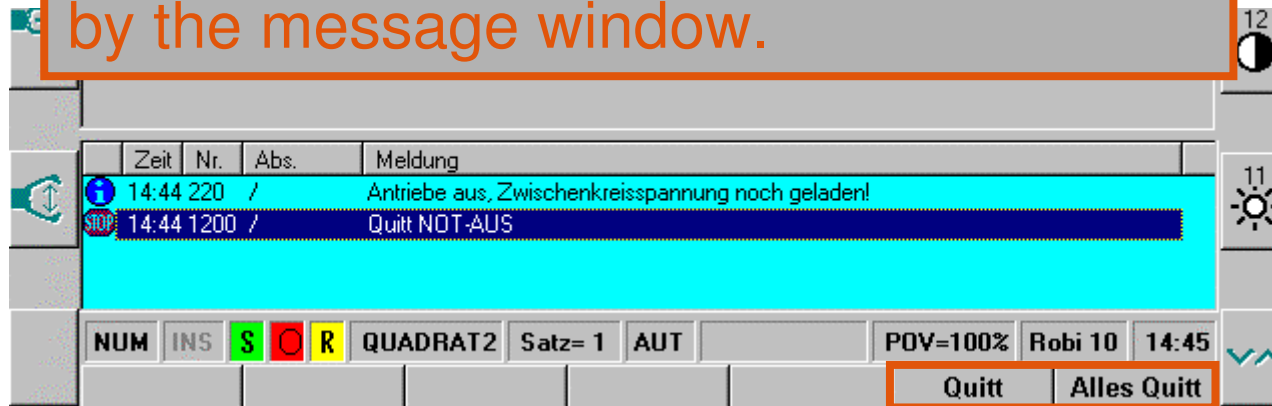
Timer:	Zustand:	Flag:	Wert [in ms]:
t1	Stop	Aus	0
t2	Stop	Aus	0
t3	Stop	Aus	0
t4	Stop	Aus	0
t5	Stop	Aus	0
t6	Stop	Aus	0
t7	Stop	Aus	0
t8	Stop	Aus	0
t9	Stop	Aus	0
t10	Stop	Aus	0

The status window can be opened on demand.

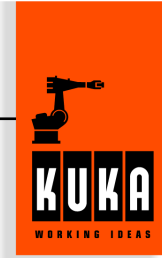
The status window can be closed every time.



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

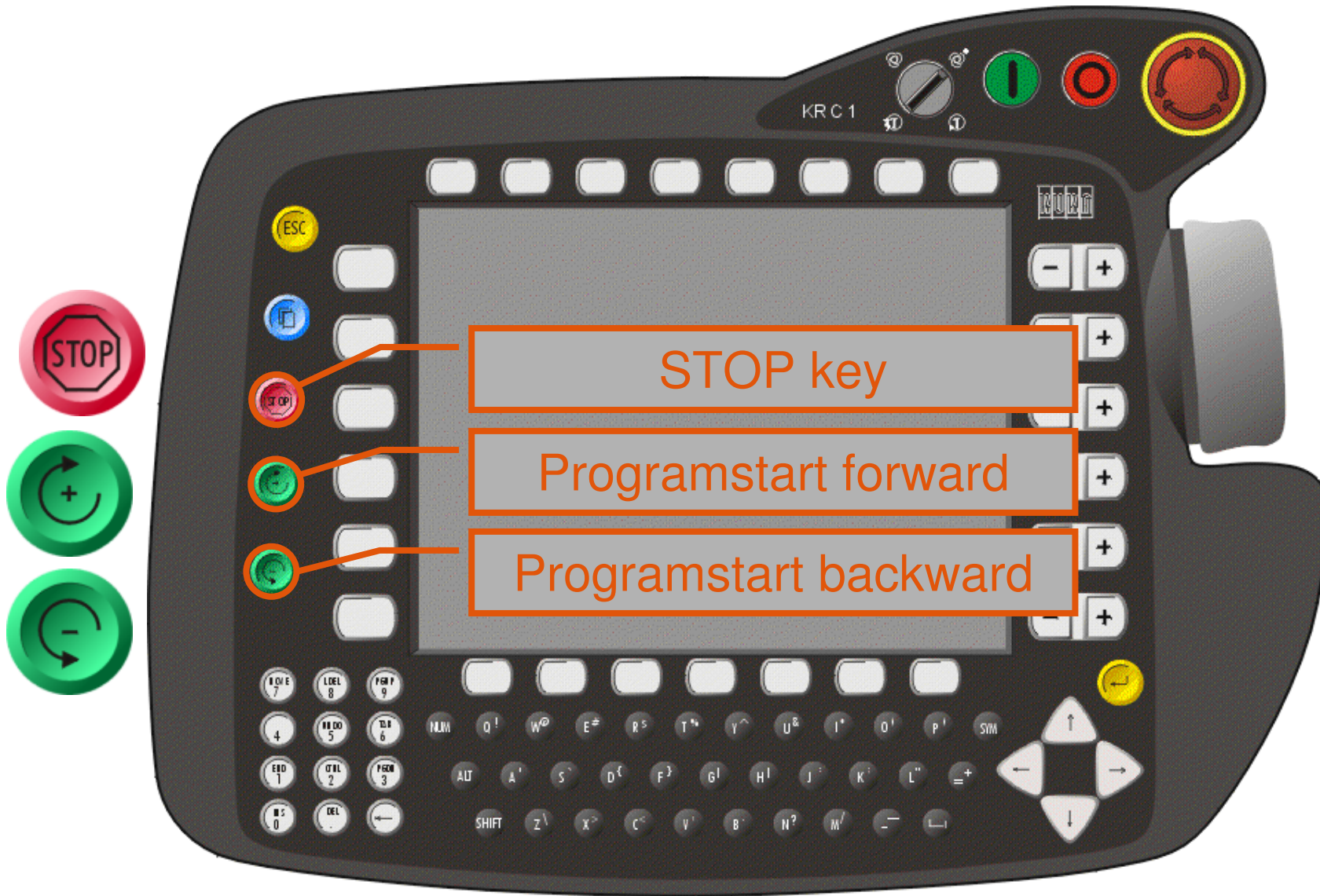
- e.g. „Wait for \$IN[1]==True “



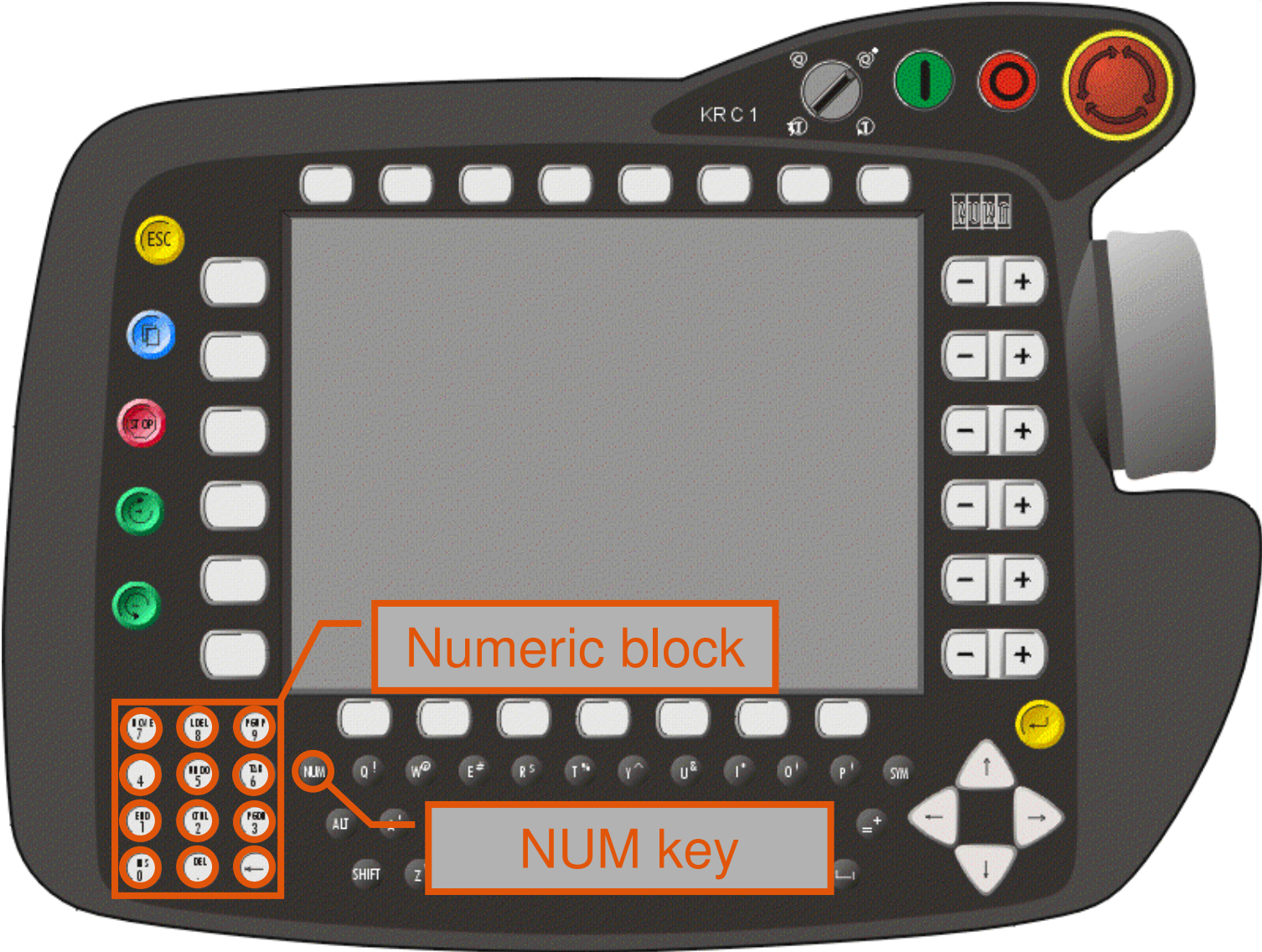
Dialog

- e.g. „Would you teach the point ?“

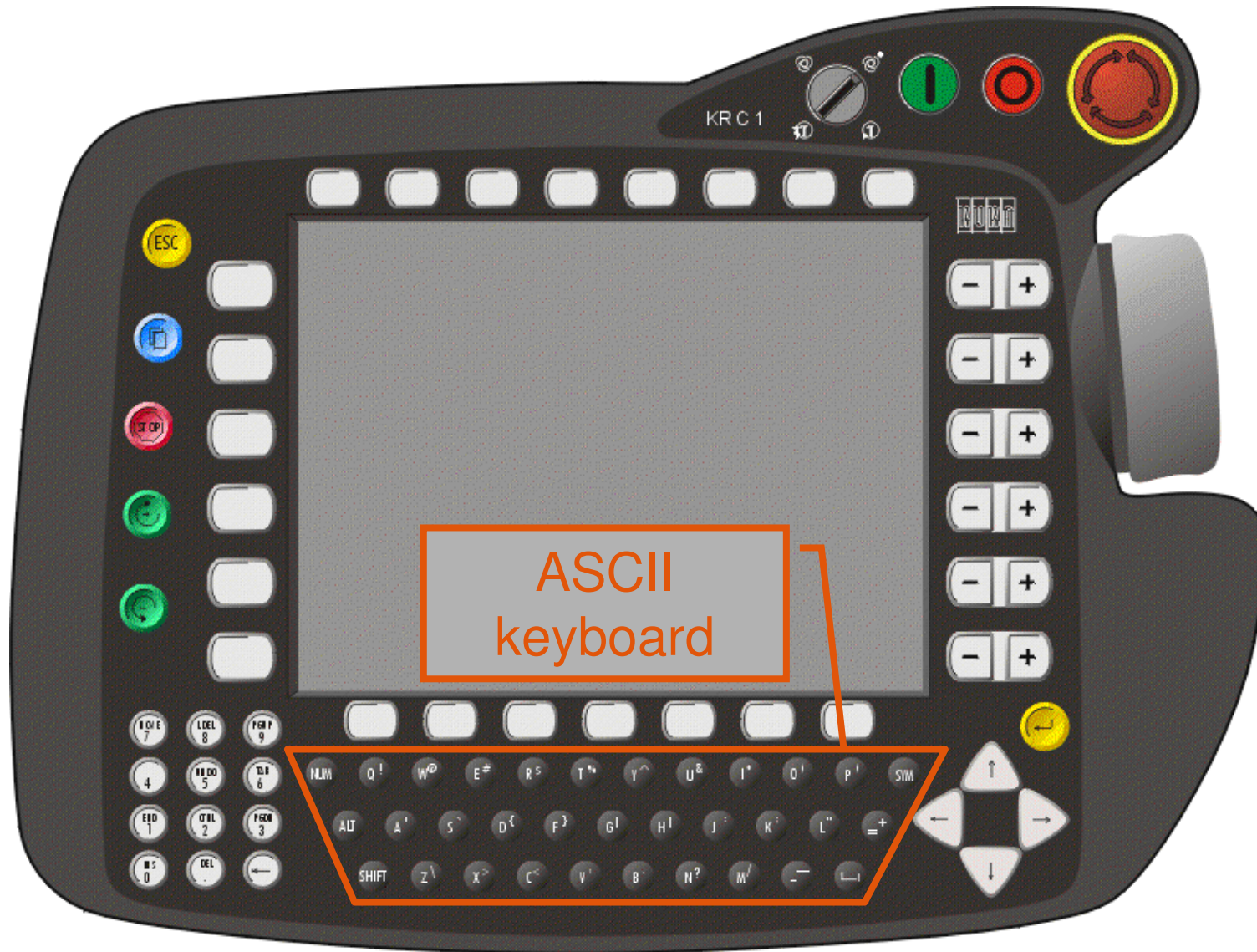
Operation elements with CAN-Bus



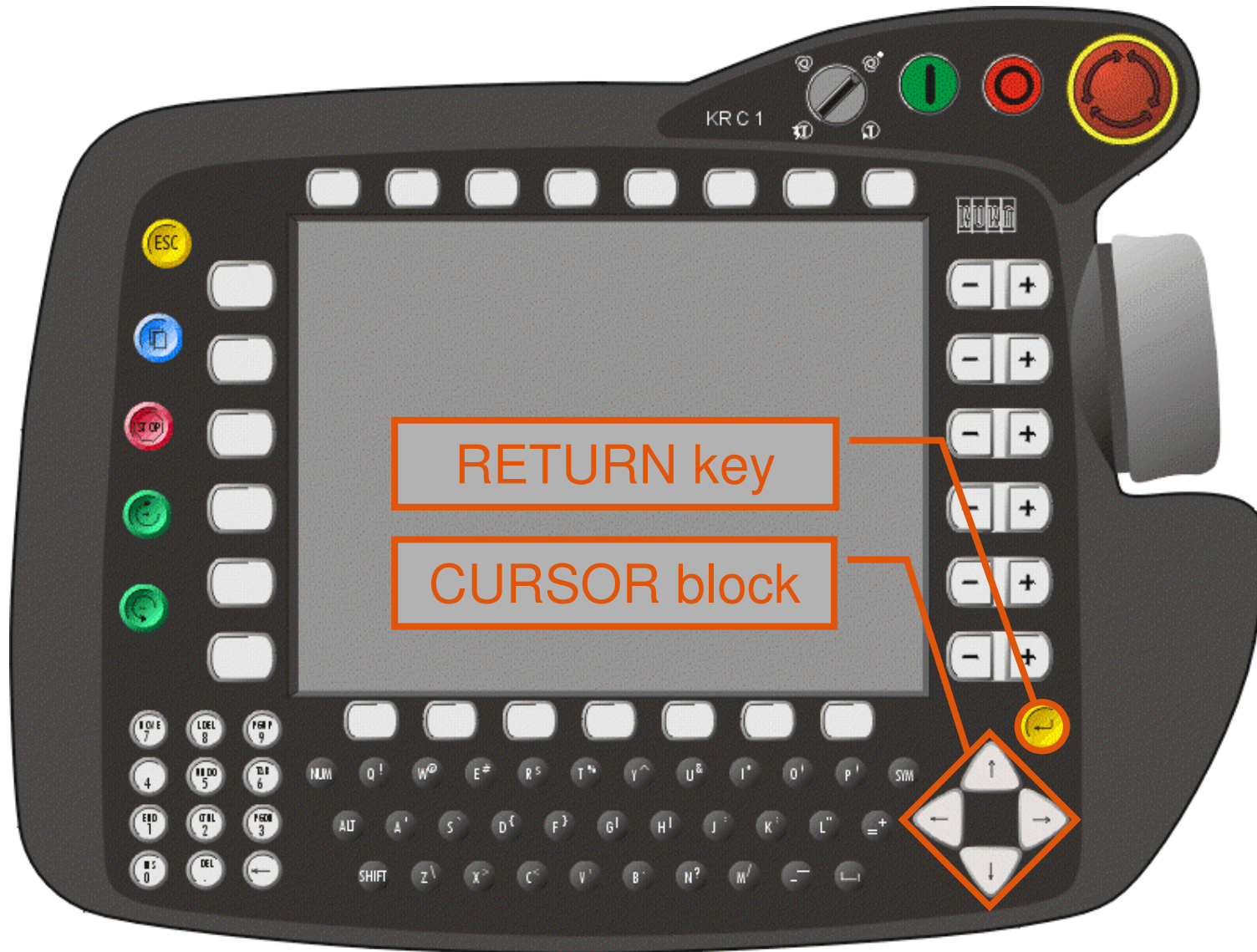
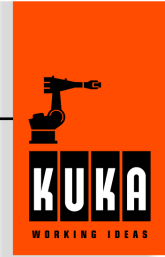
Operation elements with CAN-Bus



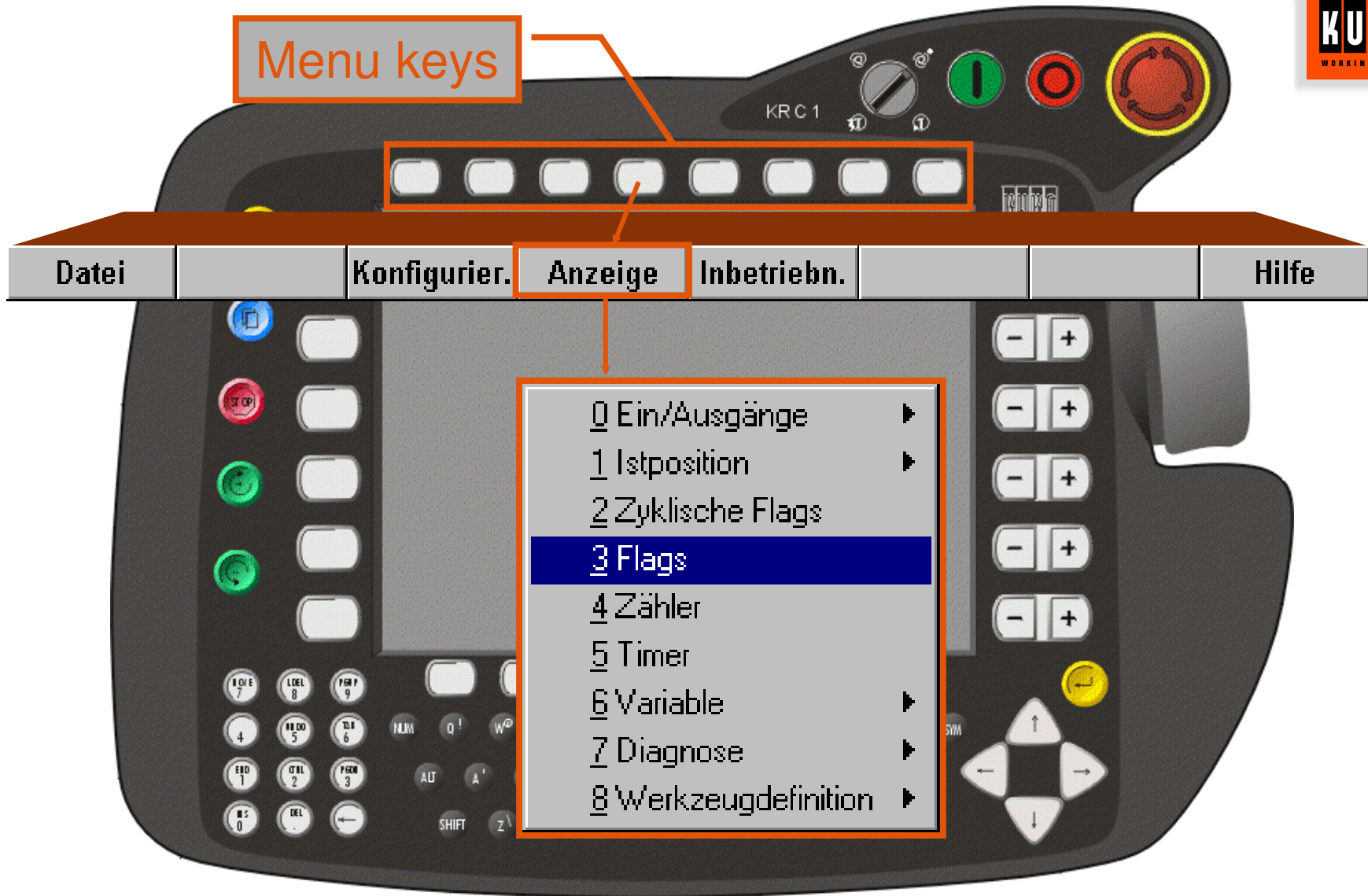
Operation elements with CAN-Bus



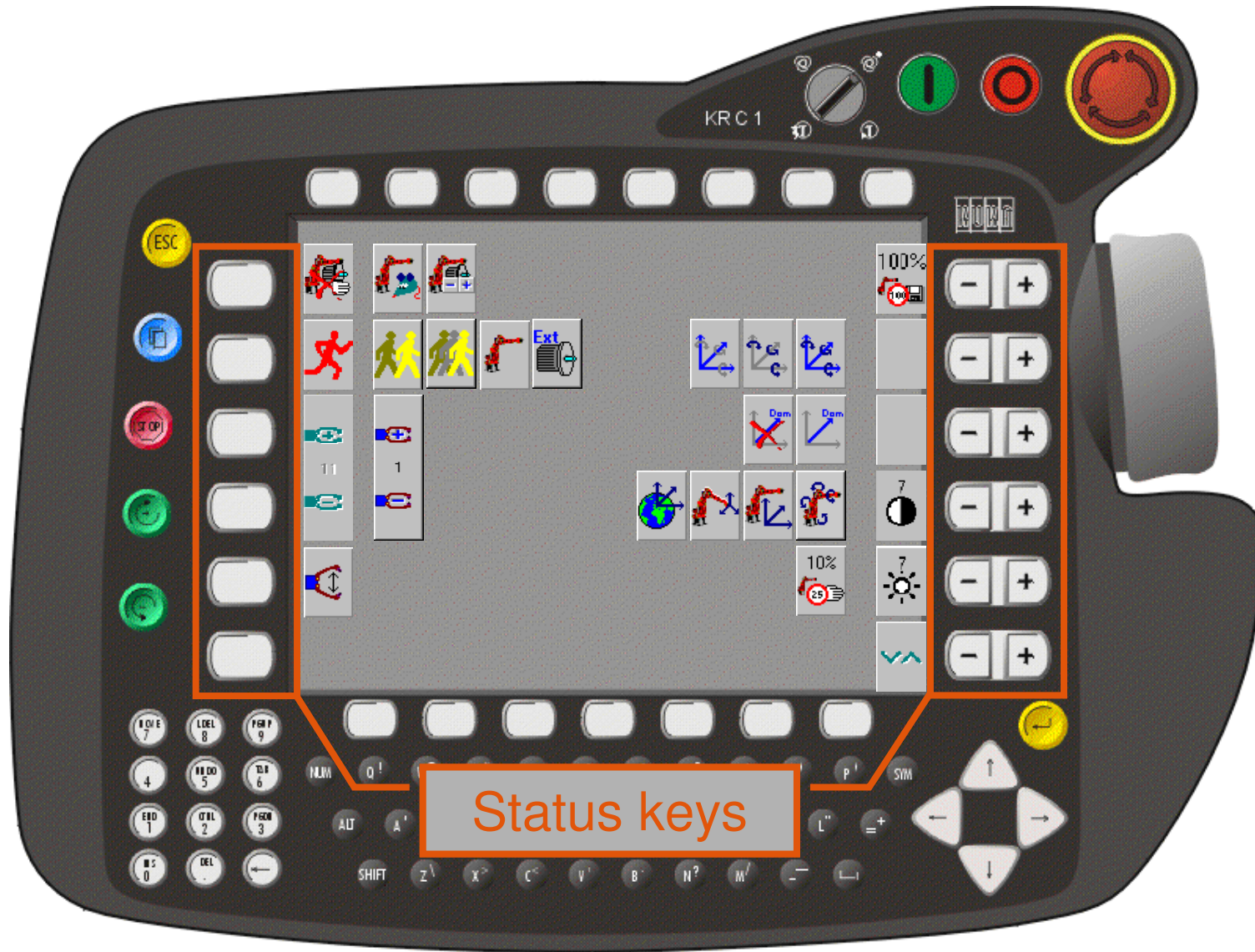
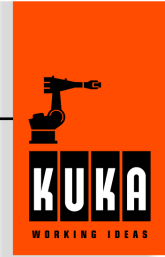
Operation elements with CAN-Bus



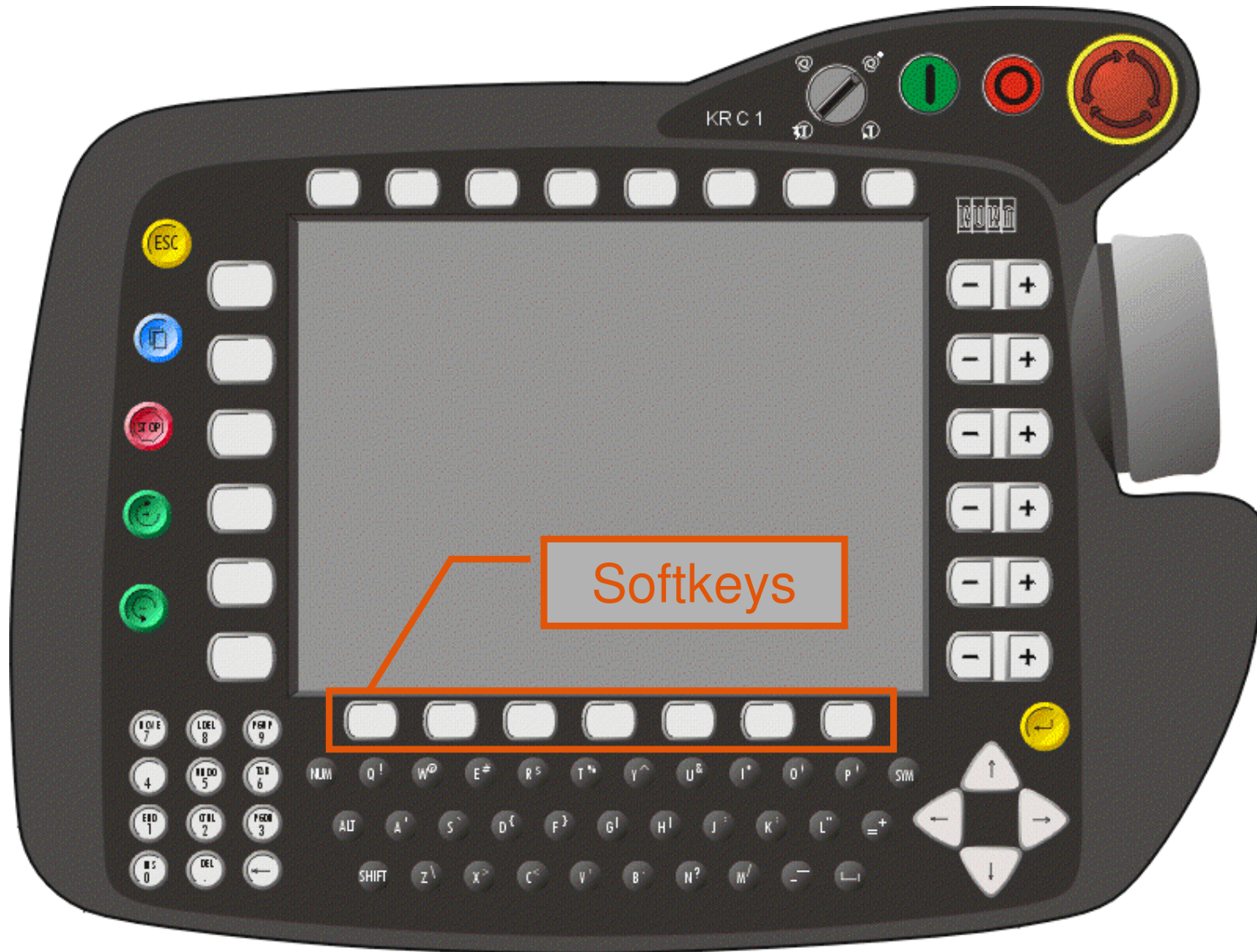
Menu keys



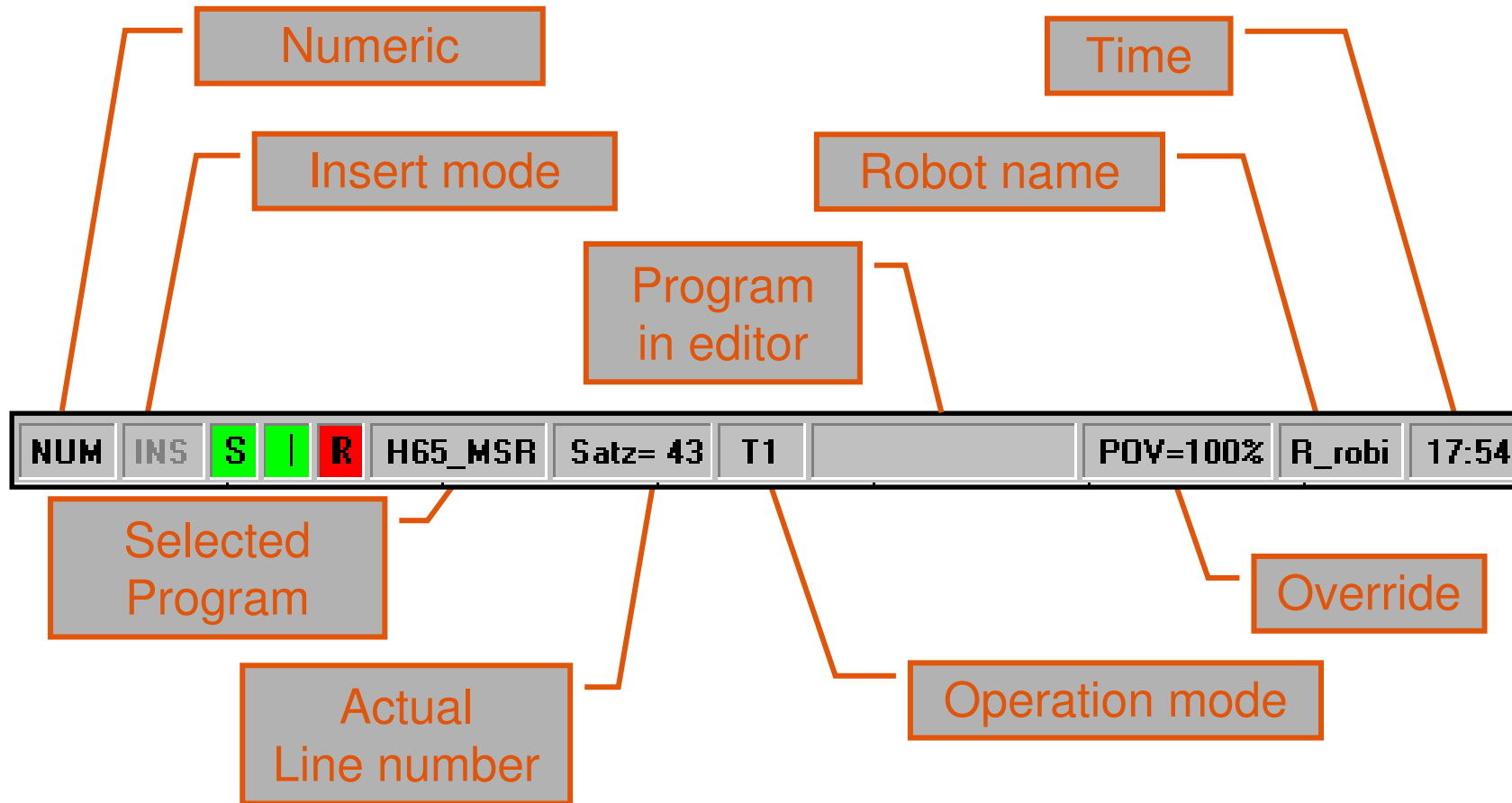
Status keys



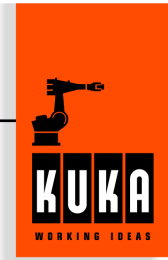
Softkeys



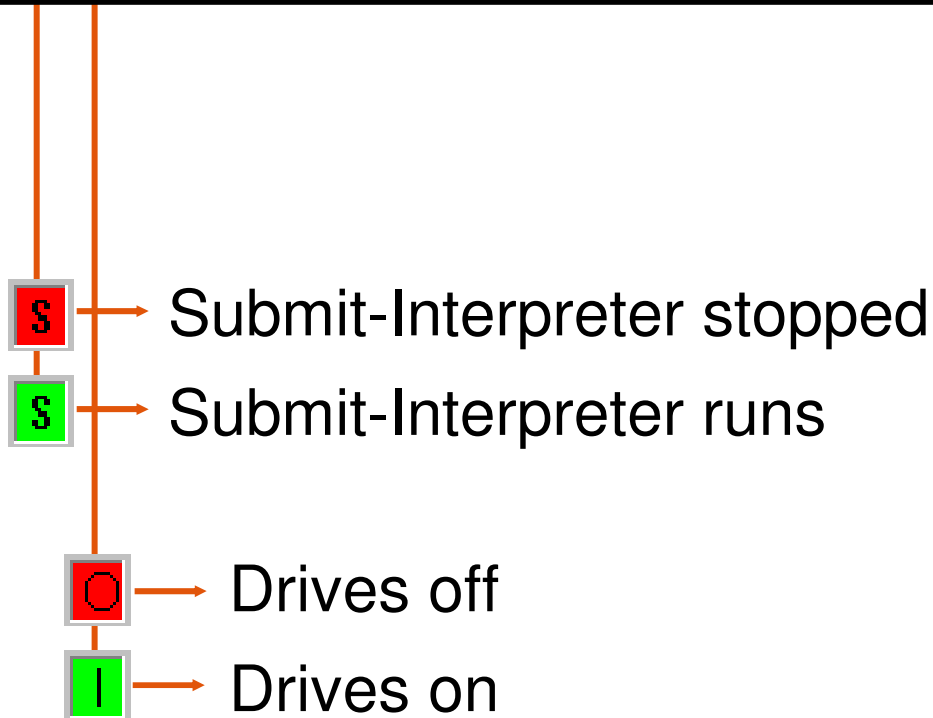
Status line








Status line



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





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



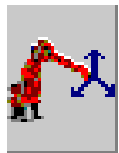
- **Joint jogging**

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.

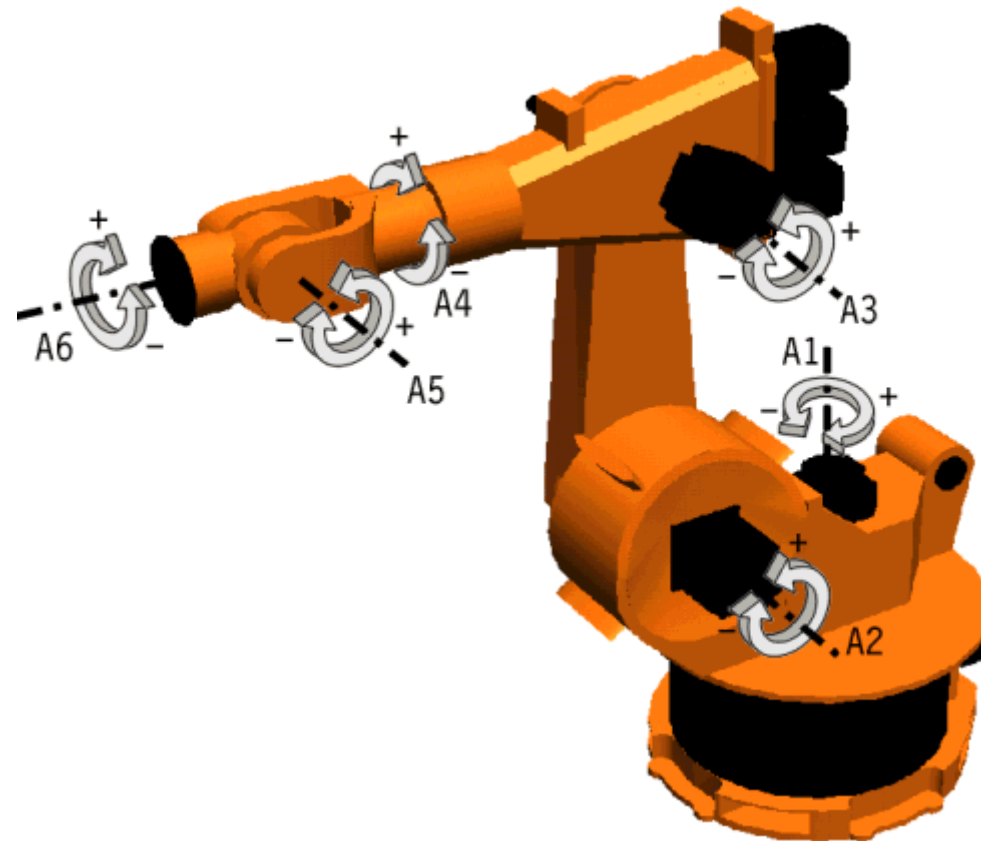


- **BASE coordinate system**

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



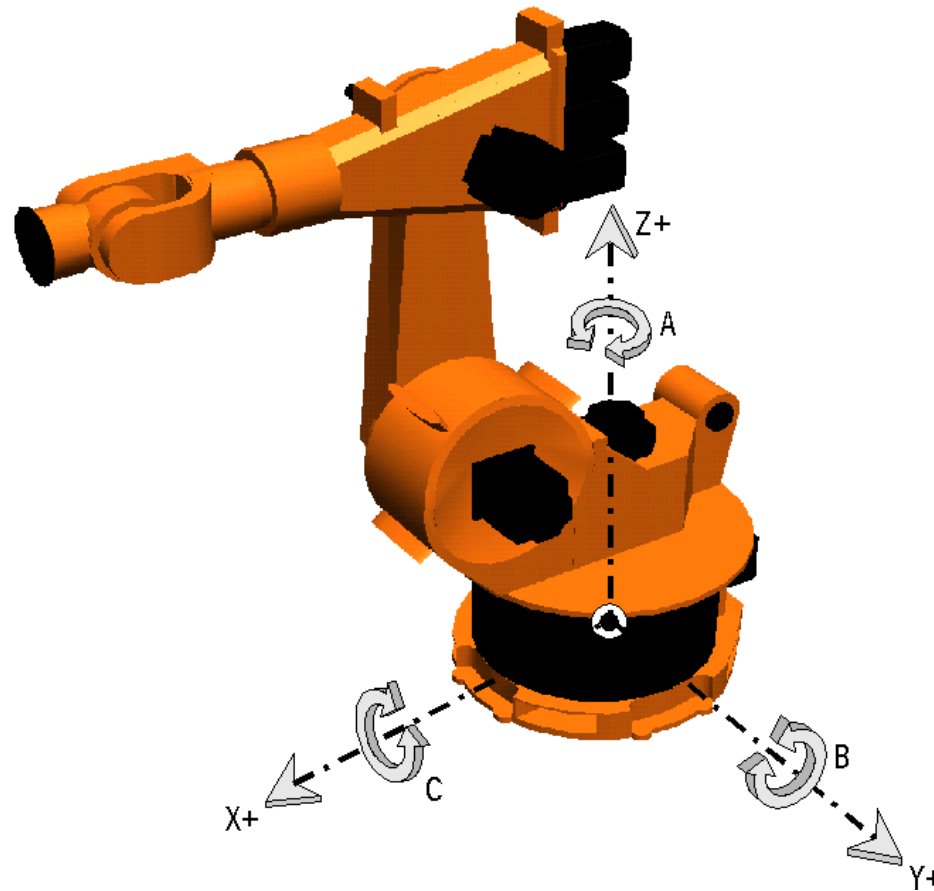
Every robot axis can be moved on it's own in positive and negative direction.



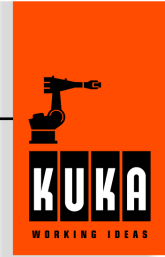
WORLD coordinate system



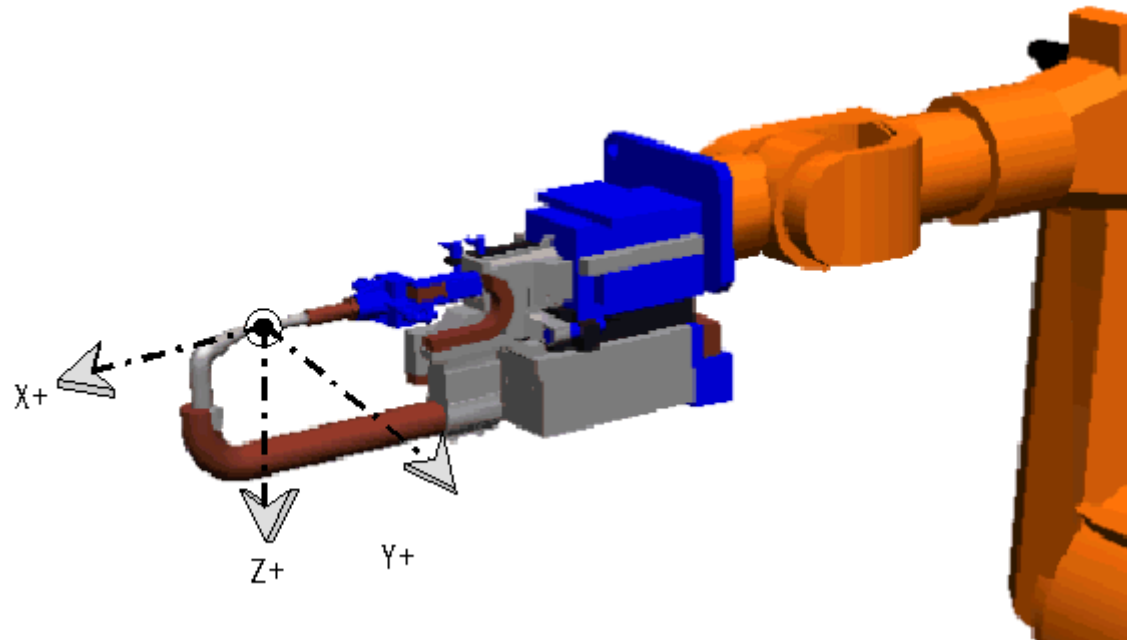
A stationary, rectangle coordinate system, with the origin in the robot basement.



TOOL coordinate system



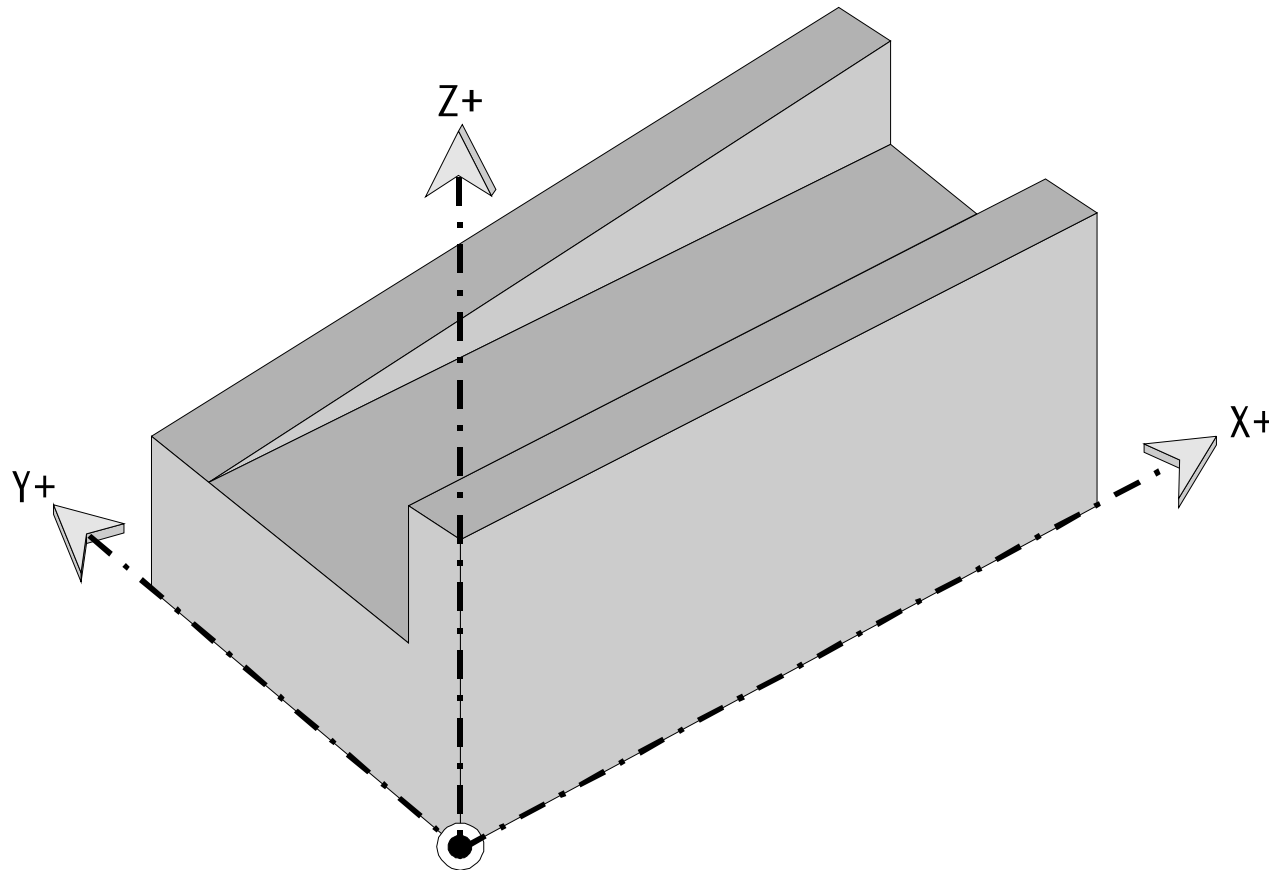
A stationary, rectangle coordinate system, with the origin in the robot basement.



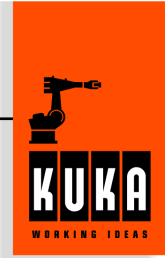
BASE coordinate system



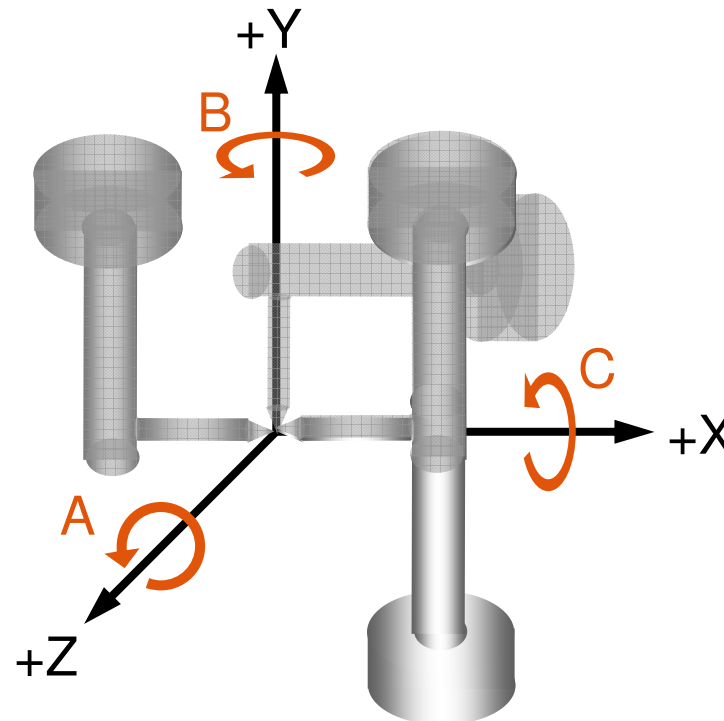
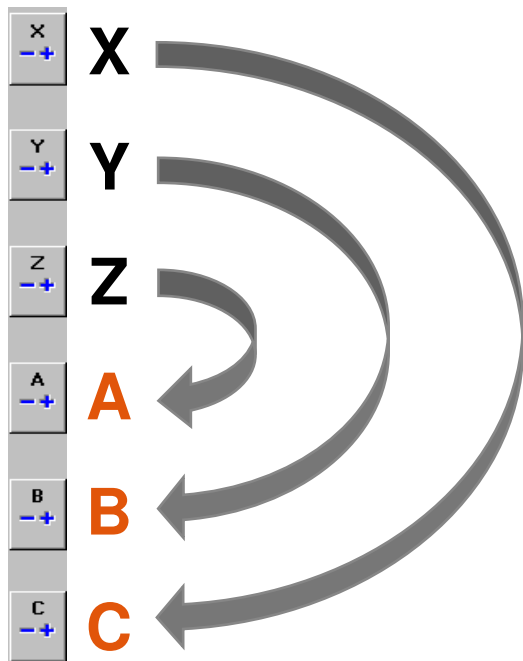
A rectangle coordinate system, with the origin at the workpiece.



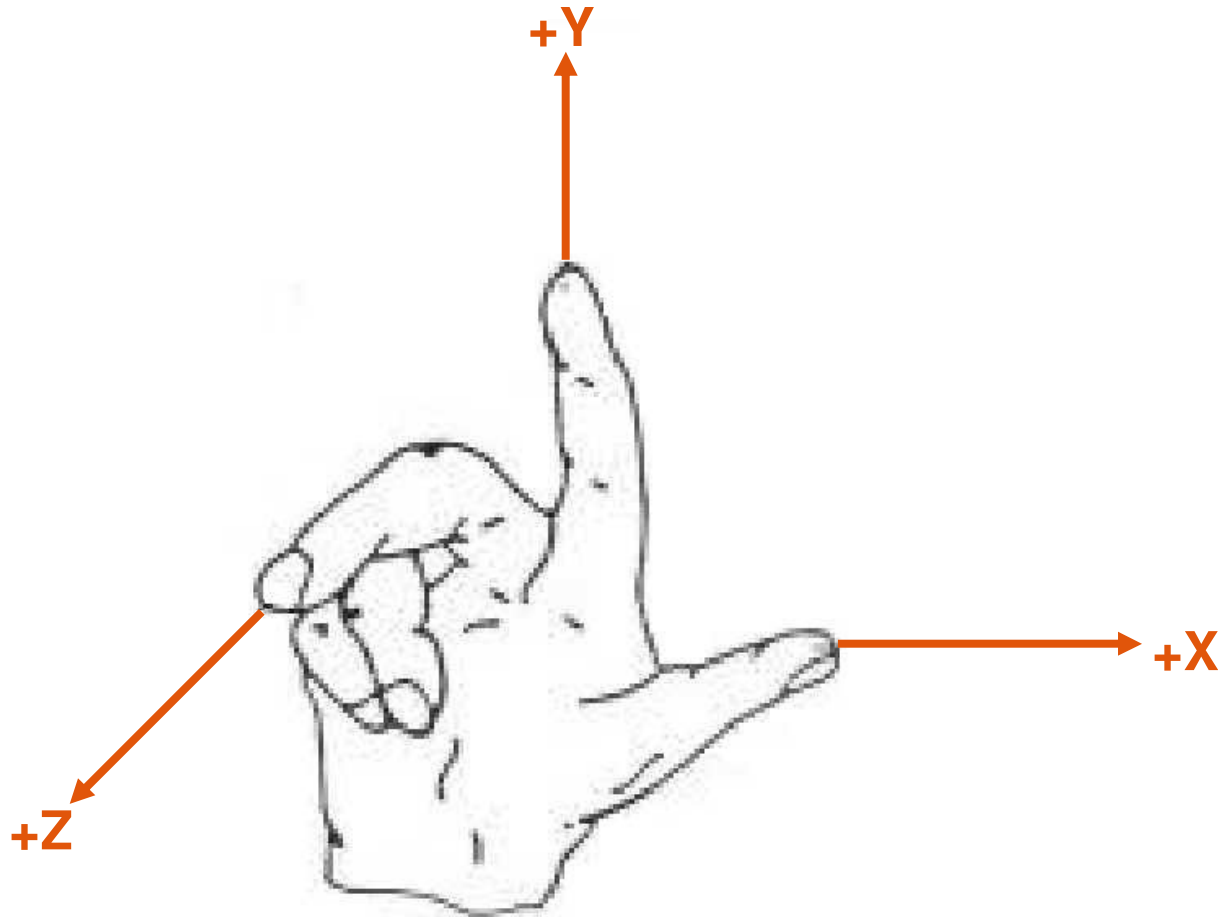
Rotation angle at cartesian coordinates



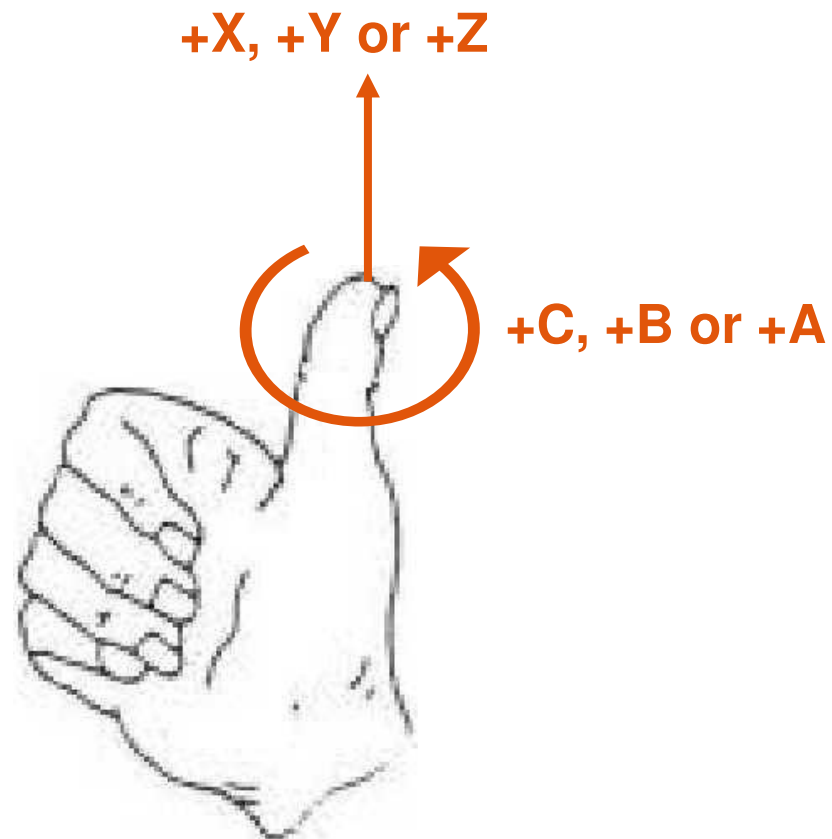
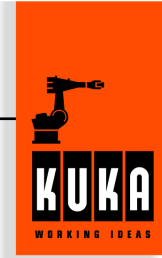
- Angle **A** \Rightarrow Rotation around the **Z**-axis
- Angle **B** \Rightarrow Rotation around the **Y**-axis
- Angle **C** \Rightarrow Rotation around the **X**-axis



Right Hand Rule (Coordinate directions)



Right Hand Rule (Rotation direction)



Select a coordinate system



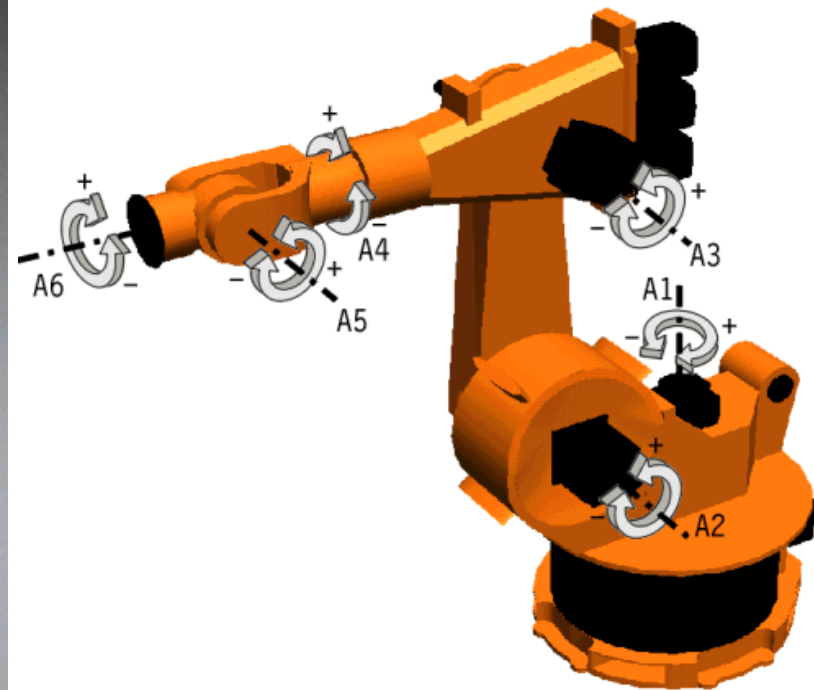
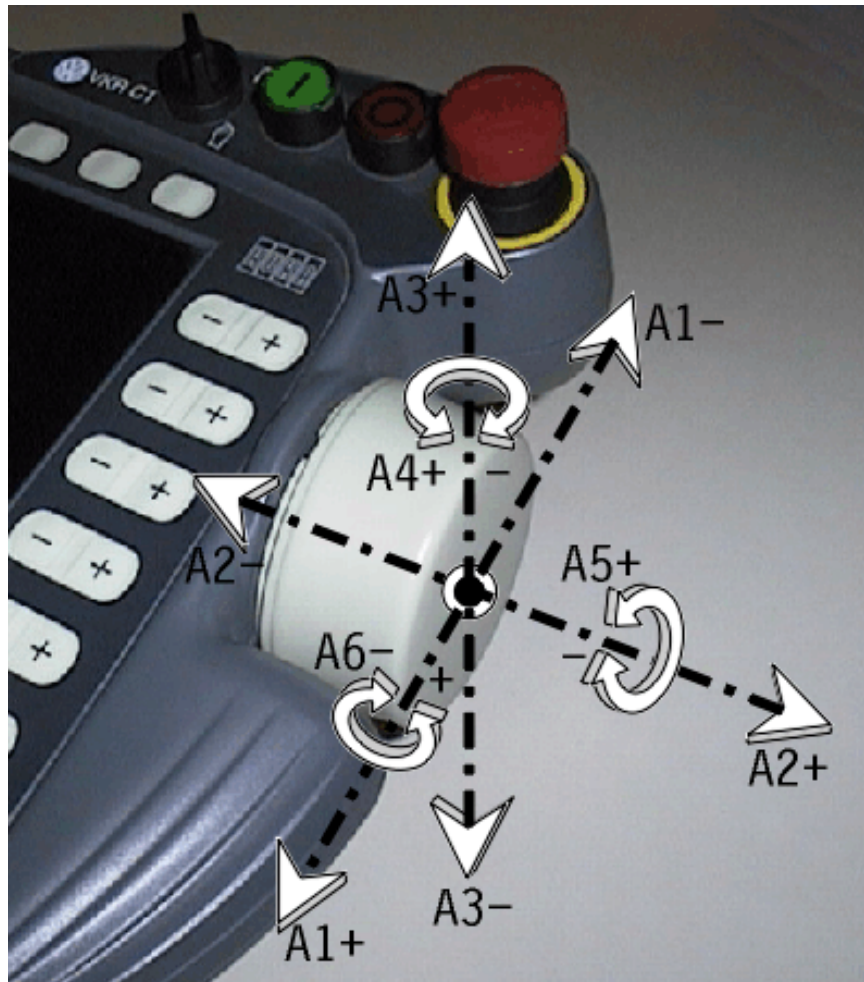
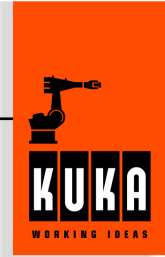
• Select jogging

- 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

