Quickguide

Electrical Servicing

KUKA Roboter
KR C4

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Verantwortlich für diese Schulungsunterlage: College Development (WSC-IC)

Responsible for this training documentation: College Development (WSC-IC)

Contents – Electrics

Safety for work on the control cabinet

⚠ DANGER

- When the main switch is turned **OFF**, as well as in **"Sleep mode"**, control cabinet components and also motor cables remain **energized**!
- Contact can lead to **death** or **serious physical injuries**!

⚠ WARNING

- Before work is started on live components, the **main switch** must be **turned off**!
- Secure the main switch **to prevent it from being turned on again**!
- Ensure that the system is de-energized!

⚠ WARNING

- The following components may remain energized (50-780 V) up to 5 minutes after the control cabinet has been switched off: KPP, KSP, intermediate circuit connecting cables

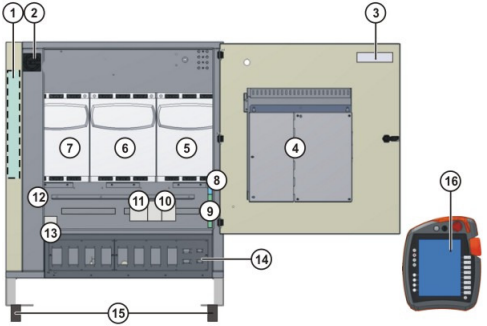
⚠ WARNING

- If power unit components are removed directly after shutdown, the heat sinks are likely to be hot!
- Risk of burns to the skin!

	Always observe ESD guidelines when carrying out work on the control cabinet or other electronic components. All tools must be ESD-compliant!
	Work on the control cabinet may only be performed by a qualified electrician!

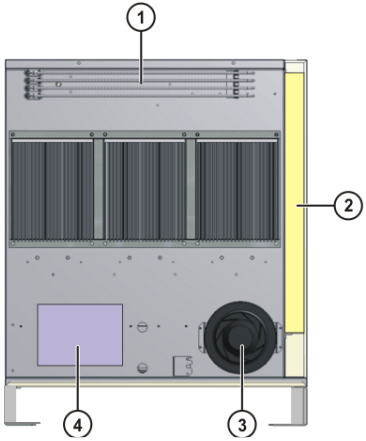
Overview of the robot controller

Front view



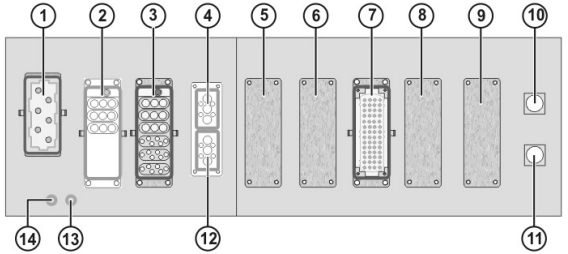
Item	Description
1	Mains filter
2	Main switch
3	CSP (Controller System Panel)
4	Control PC
5	KPP drive power supply (with optional axis servos 7 to 8)
6	KSP drive controller for axes 4 to 6
7	KSP drive controller for axes 1 to 3
8	Brake filter
9	CCU (Cabinet Control Unit)
10	Contactors (optional)
11	Switch (optional)
12	Fuse element
13	Batteries
14	Connection panel
15	Housing
16	smartPAD

Rear view



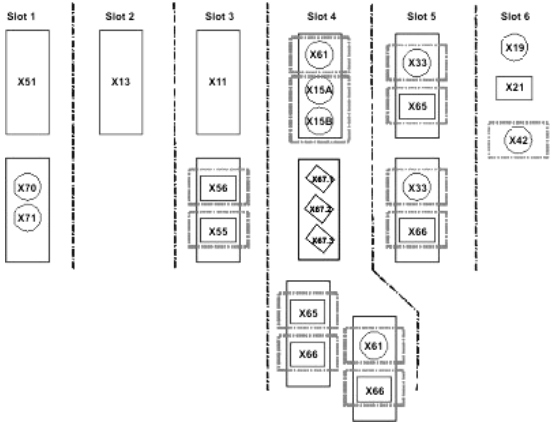
Item	Description
1	Ballast resistors
2	Heat exchanger
3	External fan
4	Low-voltage power supply

Connection panel – standard

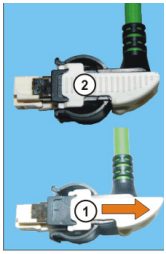


Item	Description
1	XS1 Power supply connection
2	Option
3	XS20 Motor connection, axes 1-6
4	Optional motor connection for external axes 7-8
5	Option
6	Option
7	Optional X11 interface
8	Option
9	Option
10	X19 smartPAD connection
11	X21 RDC connection
12	Option
13	PE1 Ground conductor to the robot
14	PE2 Ground conductor to main infeed

Connection panel – variants



Handling the KUKA network connector

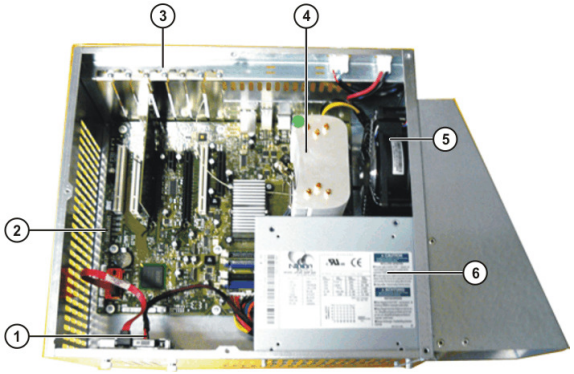


Unplugging the network connector

1. Pull back the plastic lock
2. Press the spring clips together between thumb and forefinger
3. Unplug the connector to the rear

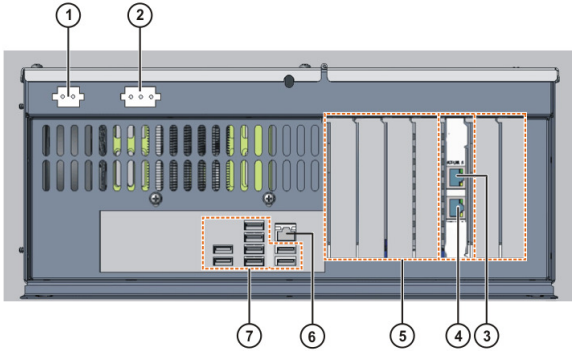
Overview of computer components

Control PC



Item	Description
1	Hard drive
2	Motherboard
3	PC interfaces
4	Processor heat sink
5	PC fan
6	PC power supply unit

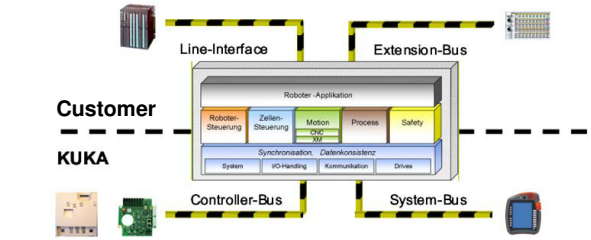
Control PC interfaces



Item	Description
1	Connector X961, power supply 24 V DC
2	Connector X962, PC fan
3	LAN Dual NIC* – KUKA Controller Bus
4	LAN Dual NIC* – KUKA Line Interface
5	Field bus cards, slots 1 to 7
6	LAN Onboard – KUKA System Bus
7	8 USB 2.0 ports

* **NIC** = Network Interface Card

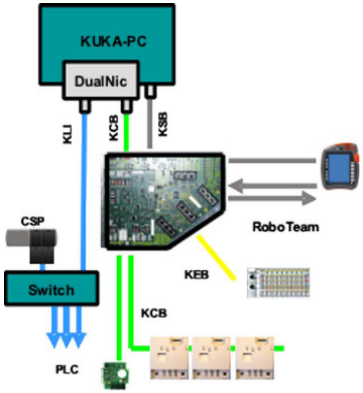
Bus systems



Bus	Description
KCB **K**UKA **C**ontroller **B**us	Connection of the drive circuit devices (RDC, KPP, KSP)
KSB **K**UKA **S**ystem **B**us	Connection of the smartPAD, RoboTeam, SIB
KEB **K**UKA **E**xtension **B**us	Connection of EtherCAT I/Os
KLI **K**UKA **L**ine **I**nterface	Connection of PLC, periphery, data archiving, diagnosis, RDP

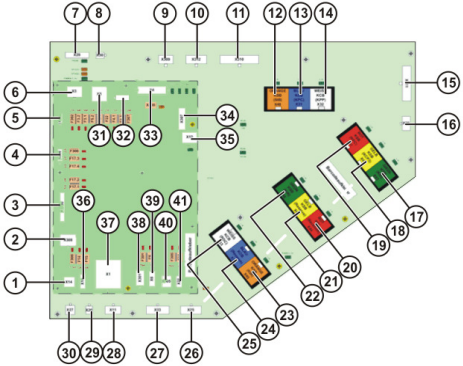
Legend:

RDC = Resolver-Digital Converter
KPP = KUKA Power Pack
KSP = KUKA Servo Pack
PLC = Programmable Logic Controller
NIC = Network Interface Card
SIB = Safety Interface Board



CCU – Cabinet Control Unit

CCU connections



Item	Plug	Description
1	X14	External fan connection
2	X308	External power supply, safety circuit
3	X1700	Board connection
4	X306	smartPAD power supply
5	X302	SIB power supply
6	X3	KPP1 power supply
7	X29	EDS connection, memory card
8	X30	Ballast resistor temperature monitoring
9	X309	Main contactor 1 (HSn, HSRn)
10	X312	Main contactor 2 (HSn, HSRn)
11	X310	Spare (safe input 2/3, safe output 2/3)
12	X48	Safety Interface Board SIB
13	X31	Controller bus, KPC
14	X32	Controller bus, KPP
15	X311	Safe inputs, ZSE1, ZSE2, NHS
16	X28	Mastering test
17	X43	KUKA Service Interface (KSI)
18	X42	KUKA Operator Panel Interface smartPAD
19	X41	KUKA System Bus, KPC
20	X44	EtherCAT Interface (KUKA Extension Bus)
21	X47	Spare

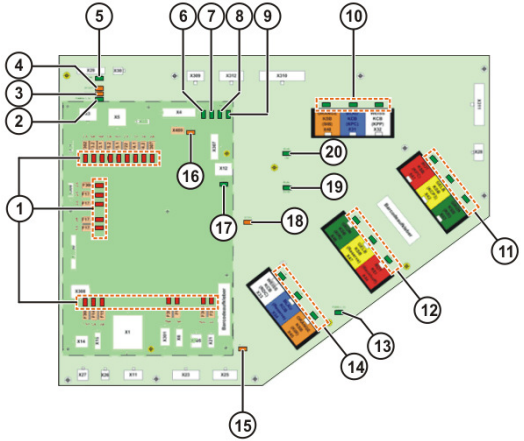
Item	Plug	Description
22	X46	KUKA System Bus, RoboTeam
23	X45	KUKA System Bus, RoboTeam
24	X34	Controller bus, RDC
25	X33	Controller bus, spare
26	X25	Fast Measurement inputs 7-8
27	X23	Fast Measurement inputs 1-6
28	X11	Alarm contact for main switch
29	X26	Thermostatic switch for transformer
30	X27	Alarm contact for cooling unit
31	X5	KPP2 power supply
32	X22	Cabinet lighting
33	X4	KPC power supply
34	X307	CSP power supply
35	X12	USB
36	X15	Internal cabinet fan (optional)
37	X1	Infeed from low-voltage power supply
38	X301	24V without battery backup, spare
39	X6	24V without battery backup, optional
40	X305	Battery
41	X21	RDC power supply

CCU fuses

Item	Designation	Description	Fuse rating
1	F17.1	Contactor outputs 1-4 CCU	5 A
2	F17.2	CCU inputs	2 A
3	F17.3	CCU safe inputs	2 A
4	F17.4	CCU logic	2A
5	F306	smartPAD supply	2 A
6	F302	SIB power supply	5 A
7	F3.2	KPP1 logic without battery backup	7.5 A
8	F3.1	KPP1 brakes without battery backup	15 A
9	F5.2	KPP2 logic without battery backup	7.5 A
10	F5.1	KPP2 brakes without battery backup	15 A
11	F22	Cabinet lighting (optional)	2 A
12	F4.1	KPC with battery backup	10 A
13	F4.2	KPC fan with battery backup	2 A
14	F307	CSP power supply	2 A
15	F21	RDC power supply	2 A
16	F305	Battery infeed	15 A
17	F6	24 V without battery backup (optional)	2 A
18	F301	Without battery backup, spare	10 A 7A cont. load!
19	F15	Internal fan (optional)	2 A
20	F14	External fan	7.5 A
21	F308	Internal power supply External power supply, with battery backup	7.5 A

Do not exchange fuses when energized!
A defective fuse is indicated by a red LED next to the fuse. Once the cause of the fault has been eliminated, defective fuses must be replaced with fuses with the value specified in the operating instructions or printed on the module.

CCU LEDs



Item	Designation	Description	Remedy
1	**Fuse LEDs**	**On** = fuse defective	■ Exchange defective fuse
		Off = fuse OK	
2	**PWRS/3.3V**	**On** = supply OK	
		Off = no power supplied	■ Check fuse F17.3 ■ If the LED PWR/3.3V lights up, exchange the CCU module
3	**STA2** Safety node B	**Off** = no supply	■ Check fuse F17.3 ■ If the LED PWR/3.3 lights up, exchange the CCU module
		Flashing at 1 Hz = normal state	----------
		Flashing at 20 Hz = boot phase	----------
		Flashing = fault code (internal)	■ Check cabling at X309, X310, X312; test by unplugging the cables at X309, X310, X312 and switching the controller off/on. ■ If the fault still occurs, exchange the module.

Item	Designation	Description	Remedy
4	**STAS1** Safety node A	See item 3	See item 3
5	**FSoE** Safety protocol of the EtherCat connection	**Off** = not active	----------
		On = operational	----------
		Flashing = fault code (internal)	----------
6	**27 V** Voltage, main power supply unit, without battery backup	**Off** = no supply	▶ Check infeed at X1 (rated voltage 27.1 V)
		On = supply OK	----------
7	**PS1** Voltage, Power Supply 1 (short battery backup)	**Off** = no supply	▶ Check infeed at X1 (rated voltage 27.1 V) ■ Drive bus switched off (BusPowerOff state)
		On = supply OK	
8	**PS2** Voltage, Power Supply 2 (medium battery backup)	**Off** = no supply	■ Check infeed at X1 ■ Controller in Sleep mode
		On = supply OK	----------
9	**PS3** Voltage, Power Supply 3 (long battery backup)	**Off** = no supply	■ Check infeed at X1
		On = supply OK	----------
10	**L/A KSB (SIB)**	**On** = physical connection	----------
	L/A KCB (KPC)		
	L/A KCB (KPP)		
11	**L/A**	**Off** = no physical connection	----------
	L/A		
	L/A		
12	**L/A**	**Flashing** = data exchange	----------
	L/A		
	L/A		
13	**PWR/3.3V** Power for CIB	**Off** = no supply	■ Check fuse F17.3 ■ Jumper plug X308 present ■ Check fuse F308 ■ With external supply via X308: ▶ Check ext. supply voltage (rated voltage 24 V)
		On = supply OK	----------
14	**L/A**	**On** = physical connection OK	
	L/A	**Off** = no physical connection	----------
	L/A	**Flashing** = data exchange	

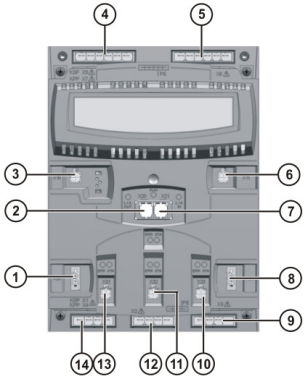
Item	Designation	Description	Remedy
15	**STA1 (CIB)** µC I/O node	**Off** = no supply	■ Check fuse F17.3 ■ If the LED PWR/3.3V lights up ► Exchange CCU
		Flashing at 1 Hz = normal state	----------
		Flashing at 10 Hz = boot phase	----------
		Flashing = fault code (internal)	■ Exchange CCU
16	**STA1 (PMB)** µC USB node	**Off** = no supply	■ Check infeed at X1 ■ If the LED PWR/5V lights up ► Exchange CCU
		Flashing at 1 Hz = normal state	----------
		Flashing at 10 Hz = boot phase	----------
		Flashing = fault code (internal)	■ Exchange CCU
17	**PWR/5V** Supply for PMB	**Off** = no supply	■ Check infeed X1 (rated voltage 27.1 V)
		Flashing at 1 Hz = normal state	----------
		Flashing at 10 Hz = boot phase	----------
		Flashing = fault code (internal)	----------
18	**STA2** FPGA node	**Off** = no supply	■ Check infeed at X1 ■ If the LED PWR/3.3V lights up ► Exchange CCU
		Flashing at 1 Hz = normal state	----------
		Flashing at 10 Hz = boot phase	----------
		Flashing = fault code (internal)	► Exchange CCU
19	**RUN SION** EtherCat Safety nodes	**On** = operational	----------
		Off = Init (after switching on)	----------
		Flashing at 2.5 Hz = Pre-Op (intermediate state on start-up)	----------
		Single signal = Safe Op	----------
		Flashing at 10 Hz = boot (for firmware update)	----------
20	**RUN CIB** EtherCat ATµC I/O node	See item 19	See item 19

Power unit

NOTICE

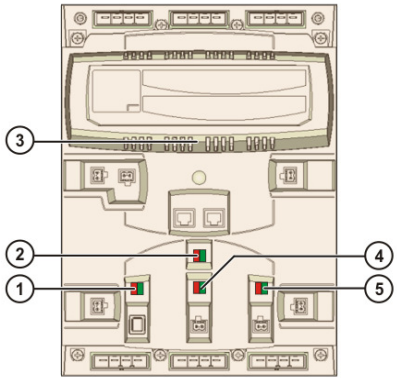
- KPP and KSP modules have a SafetyID!
- Only one module may be exchanged at a time!

KPP KUKA Power Pack connections



Item	Plug	Description
1	X30	Brakes power supply OUT
2	X20	Drive bus OUT
3	X10	Control electronics power supply OUT
4	X7	Ballast resistor
5	X6	DC link OUT
6	X11	Control electronics power supply IN
7	X21	Drive bus IN
8	X34	Brakes power supply IN
9	X3	Motor connection 3, axis 8
10	X33	Brake connection 3, axis 8
11	X32	Brake connection 2, axis 7
12	X2	Motor connection 2, axis 7
13	-	Not used
14	X4	AC power supply connection and PE

KPP KUKA Power Pack diagnostic LEDs



Item	Description		
1	LED group: power supply		
	LED	LED	Meaning
	Off	Off	■ No power supply to the control electronics
	On	Off	■ Fault in the power supply
	Off	Flash-ing	■ Intermediate circuit voltage out of the permitted range
	Off	On	■ Intermediate circuit voltage within the permitted range

2	LED group: KPP device status		
	LED	LED	Meaning
	Off	Off	■ No power supply to the control electronics
	On	Off	■ Fault in the KPP
	Off	Flash-ing	■ No communication with the controller
	Off	On	■ Communication with the controller

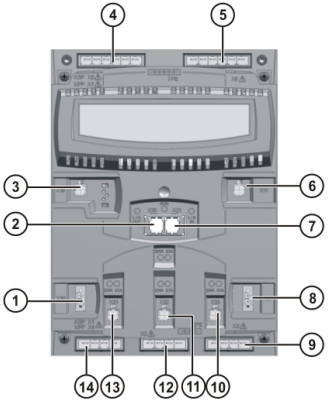
3	LED group: drive bus status		
	LED	LED	Meaning
	Off	Off	■ No power supply to the control electronics
	On	Off	■ Fault in power supply
	Off	Flash-ing	■ Power supply not enabled
	Off	On	■ Power supply enabled

4,5	LED group: axis control		
	LED	LED	Meaning
	Off	Off	■ No power supply to the control electronics ■ Axis not present
	On	Off	■ Fault in the axis
	Off	Flash-ing	■ No servo enable
	Off	On	■ Servo enable

Other faults

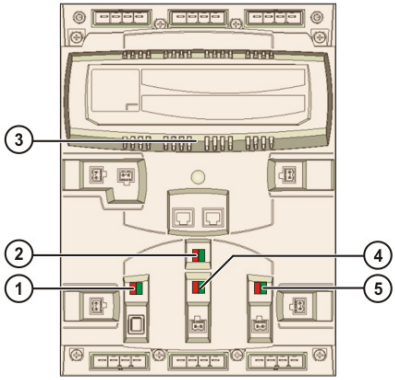
No.	Meaning
1	Fault during the initialization phase
	■ Middle axis control LEDs flashing ■ All other LEDs are off ■ Red axis control LED lit continuously ■ Green axis control LED flashes at 2 to 16 Hz, followed by a pause
2	Firmware fault during the initialization phase
	■ Red device status LED on ■ Green device status LED dimmed

KSP KUKA Servo Pack connections



Item	Plug	Description
1	X30	Brakes power supply OUT
2	X20	Drive bus OUT
3	X10	Control electronics power supply OUT
4	X5	DC link OUT
5	X6	DC link IN
6	X11	Control electronics power supply IN
7	X21	Drive bus IN
8	X34	Brakes power supply IN
9	X3	Motor connection 3
10	X33	Connection, brake 3
11	X32	Connection, brake 2
12	X2	Motor connection 2
13	X31	Connection, brake 1
14	X1	Motor connection 1

KSP KUKA Servo Pack diagnostic LEDs



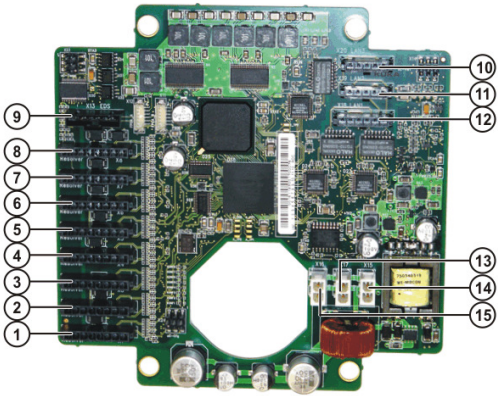
Item	Description		
1,4,5	LED group: axis control		
	LED	LED	Meaning
	Off	Off	■ No power supply to the control electronics ■ Axis not present
	On	Off	■ Fault in the axis
	Off	Flashing	■ No servo enable
	Off	On	■ Servo enable

2	LED group: KSP device status		
	LED	LED	Meaning
	Off	Off	■ No power supply to the control electronics
	On	Off	■ Fault in the KSP
	Off	Flashing	■ No communication with the controller
	Off	On	■ Communication with the controller

3	LED group: drive bus status		
	LED	LED	Meaning
	Off	Off	■ No power supply to the control electronics
	On	Off	■ Fault in power supply
	Off	Flashing	■ Power supply not enabled
	Off	On	■ Power supply enabled

RDC – Resolver Digital Converter

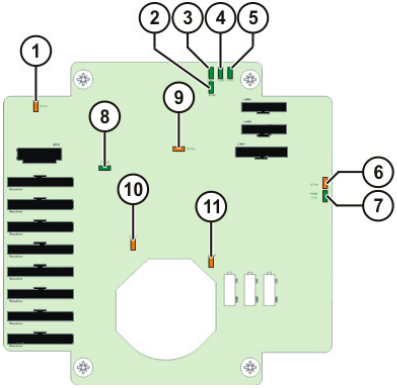
RDC connections



Item	Plug	Description
1 → 8	X1 → X8	Resolver connection, axes 1 → 8
9	X13	EDS connection, memory card, RDC
10	X20	EMD connection
11	X19	KCB OUT
12	X18	KCB IN
13	X17	EMD power supply
14	X15	Power supply infeed
15	X16	Power supply OUT (next KCB device)

* **KCB** = KUKA Controller Bus, **EMD** = Electronic Mastering Device

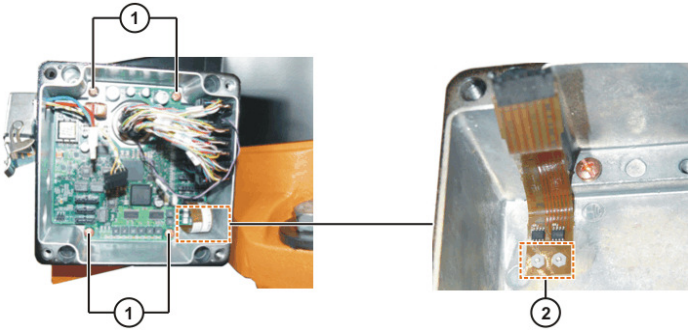
RDC diagnostic LEDs



Item	Plug	Description
1	STA3	Motor temperature microcontroller
	■ Off = fault ■ Flashing = fault code (internal) ■ Flashing at 1 Hz = normal state	
2	RUN	EtherCAT AT bus
	■ Off = Init ■ Flashing at 2.5 Hz = Pre-Op ■ Flashing = fault code (internal) ■ On = normal state ■ Single signal = Safe Op ■ Flashing at 10 Hz = boot	
3	L/A 1	Input of the KCB (X18)
	■ Off = no physical connection ■ Flashing = data exchange active ■ On = physical connection	
4	L/A 2	Output of the KCB (X19)
	■ See item 3	
5	L/A 3	Output of the KCB to the EMD (X20)
	■ See item 3	
6	STA4	VMT µC (voltage monitoring)
	■ Off = fault ■ Flashing = fault code (internal) ■ Flashing at 1 Hz = normal state	

Item	Plug	Description
7	PWR/3.3V	RDC power supply
	■ Off = no voltage ■ Power supply connected	
8	FSOE	Safety protocol of EtherCat connection
	■ Off = not active ■ On = operational ■ Flashing = fault code (internal)	
9	STA2	FPGA B integrated circuit
	■ Off = fault ■ Flashing = fault code (internal) ■ Flashing at 1 Hz = normal state	
10	STA1	FPGA A integrated circuit
	■ See item 9	
11	STA0	Configuration microcontroller
	■ See item 9	

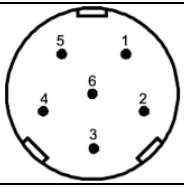
Fastening of RDC and EDS



Item	Fastening	Tightening torque
1 RDC	M6x10	2.0 Nm
2 EDS	M2.5 plastic nuts	0.1 Ncm

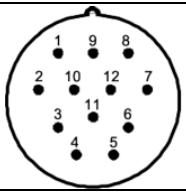
Servomotor

Power connector



Pin-Pin	Resistance value	Designation
1 → 2	0.17 Ω – 14 Ω	Winding U→V
1 → 6	0.17 Ω – 14 Ω	Winding U→W
2 → 6	0.17 Ω – 14 Ω	Winding V→W
4 → 5	24 Ω - 80 Ω	Brake+/Brake-
3		Ground

Motor resolver connector



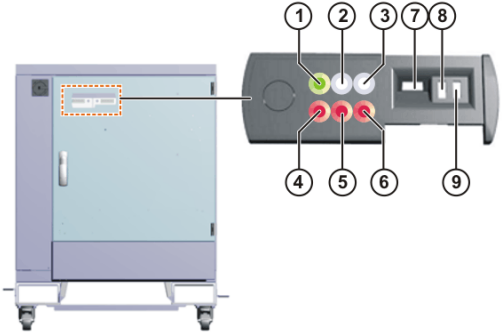
Pin-Pin	Resistance value	Designation
1→2	30 Ω – 200 Ω	Stator winding 1
11→12	30 Ω – 200 Ω	Stator winding 2
10→7	20 Ω – 100 Ω	Rotor coil
8→9	588 Ω at 25 °C 1000 Ω at 100 °C	Temperature sensor

Encoder cable on the RDC

Pin - RDC	Designation
1	Temp. sensor (connection A)
2	Temp. sensor (connection B)
3	Rotor coil
4	Rotor coil
5	Stator winding 1
6	Stator winding 1
7	Stator winding 2
8	Stator winding 2

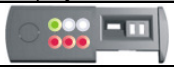
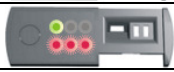
CSP – Controller System Panel

Overview



Item	Part	Color	Meaning
1	LED 1		Operating LED
2	LED 2	White	Sleep LED
3	LED 3	White	Automatic LED
4	LED 6		Error LED
5	LED 5		Error LED
6	LED 4		Error LED
7	USB 1	---	---
8	USB2	---	---
9	RJ45	---	KLI (**K**UKA **L**ine **I**nterface)

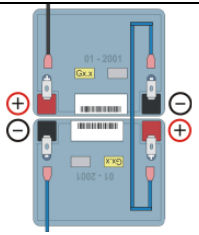
LED diagnosis

Function	Display	Description
CSP test		■ **CSP OK** = after switching on, all the LEDs light up for 3 seconds.
Automatic mode		■ **LED 1** = On ■ **LED 3** = On ► Controller is in Automatic mode
		■ **LED 1** = On ► Controller is **not** in Automatic mode
Sleep mode		■ **LED 2** flashes slowly ► Controller is in Sleep mode
		■ **LED 1** flashes slowly ► Controller is coming out of Sleep mode
ProfiNet Ping		■ **LED 1** = On ■ **LED 5** flashes slowly ■ **LED 4** flashes slowly ■ **LED 6** flashes slowly ► ProfiNet ping is being executed

Display	Description	Remedy
	■ **LED 1** flashes slowly ■ **LED 4** = On ► BIOS error	► Exchange the PC
	■ **LED 1** flashes slowly ■ **LED 5** = On ► Timeout booting Windows or starting the PMS	► Exchange the HDD ► Reload the image
	■ **LED 1** flashes slowly ■ **LED 6** = On ►Timeout waiting for RTS “RUNNING”	► Reload the image ► Run setup
	■ **LED 1** flashes slowly ►Timeout waiting for HMI Ready	-------

Battery

Polarity



⚠ WARNING

A short-circuit or short to ground at the battery poles causes a very high short-circuit current. This short-circuit current can cause severe injury and substantial damage to property. It must be ensured that no short-circuit or short to ground is caused at the battery poles.

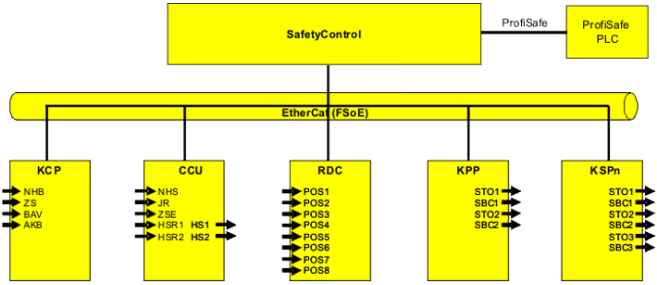
Diagnosis

Menu sequence: **Display → Variable → Single**
System variable (ENUM): **$ACCU_STATE**

Status	Description
■ **#CHARGE_OK**	▶ Battery test was positive
■ **#CHARGE_OK_LOW**	▶ Battery test was positive ▶ The battery was still not fully charged after the maximum charging time
■ **#CHARGE_UNKNOWN**	▶ The battery is being charged ▶ Charging current has not yet dropped sufficiently ▶ Battery test not yet carried out
■ **#CHARGE_TEST_NOK**	▶ Battery test was negative
■ **#CHARGE_NOK**	▶ Battery test is not possible ▶ Battery was still not fully charged after the maximum charging time
■ **#CHARGE_OFF**	▶ No charging current available ▶ Either no battery present or battery defective

System safety

ProfiSafe – safe inputs and outputs



Designation	Meaning
NHB	▶ Emergency Stop
ZS	▶ Enabling
BAV	▶ Mode selection lock
AKB	▶ Disconnect operator panel
NHS	▶ E-Stop on cabinet (optional)
JR	▶ Mastering test (SafeOperation)
ZSE	▶ External enabling (optional)
HSR1	▶ Checkback, main contactor 1 (optional)
HSR2	▶ Checkback, main contactor 2 (optional)
HS1	▶ Main contactor 1
HS2	▶ Main contactor 2
POS[n]	▶ Position value, channel [n]
STO[n]	▶ Safe Torque off n
SBC[n]	▶ Safe Brake Control n

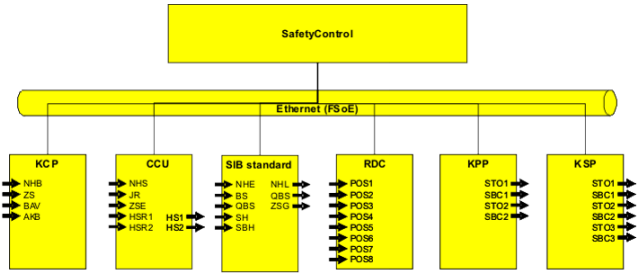
Safe inputs – robot safety

Input byte 0		
Bit	Signal	Description
0	RES	■ Reserved 1 ▶ The value **1** must be assigned to the input
1	NHE	■ Input for external E-Stop ▶ **0** = external E-Stop is active ▶ **1** = external E-Stop is not active
2	BS	■ Operator safety ▶ **0** = operator safety is not active, e.g. safety gate open ▶ **1** = operator safety is active
3	QBS	■ Acknowledgement of operator safety ▶ **0** = operator safety has not been acknowledged ▶ Edge 0 ▶ 1 = operator safety has been acknowledged
4	SHS1	■ Safety stop 1 (all axes) ▶ **0** = safety stop is active ▶ **1** = safety stop is not active
5	SHS2	■ Safety stop 2 (all axes) ▶ **0** = safety stop is active ▶ **1** = safety stop is not active
6	E2	■ E2 keyswitch (customer-specific signal for mode selection) ▶ **0** = E2 keyswitch is not active ▶ **1** = E2 keyswitch is active
7	E7	■ E7 keyswitch (customer-specific signal for mode selection) ▶ **0** = E2 keyswitch is not active ▶ **1** = E2 keyswitch is active
Input byte 1		
0	US2	■ US2 supply voltage ■ Precondition: “by ProfiSafe” must be set under “Hardware options” – “Peripheral contactor” in the safety configuration ▶ **0** = switch off US2 ▶ **1** = switch off US2
1	SBH	■ Safe operational stop (all axes) ▶ **0** = safe operational stop is active ▶ **1** = safe operational stop is not active
2	RES	■ Reserved 11 ▶ The value **1** must be assigned to the input
3	RES	■ Reserved 12 ▶ The value **1** must be assigned to the input
4	RES	■ Reserved 13 ▶ The value **1** must be assigned to the input
5	RES	■ Reserved 14 ▶ The value **1** must be assigned to the input
6	RES	■ Reserved 15 ▶ The value **1** must be assigned to the input
7	SPA	■ Shutdown PROFIsafe Acknowledge ▶ **0** = confirmation is not active ▶ **1** = confirmation is active

Safe outputs – robot safety

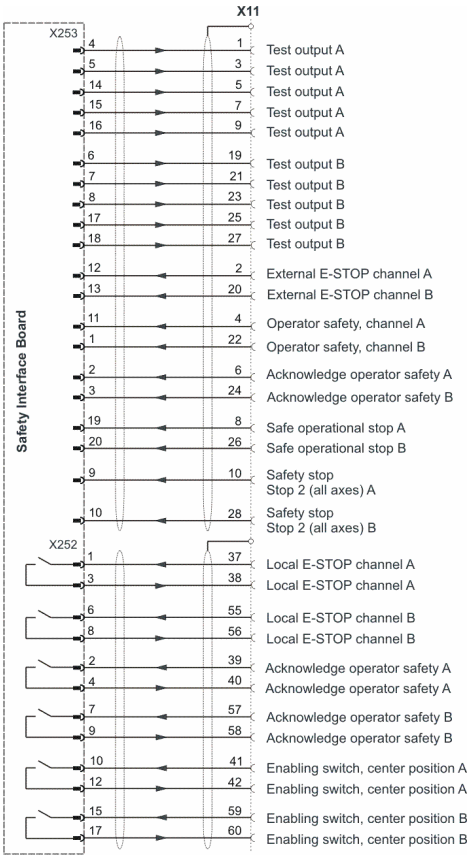
Output byte 0		
Bit	Signal	Description
0	NHL	■ Local E-Stop (local E-Stop triggered) ▶ **0** = local E-Stop is active ▶ **1** = local E-Stop is not active
1	AF	■ Drives enable ▶ **0** = drives enable is not active ▶ **1** = drives enable is active
2	FF	■ Motion enable ▶ **0** = motion enable is not active ▶ **1** = motion enable is active
3	ZS	■ One of the enabling switches is in the center position ▶ **0** = enabling is not active ▶ **1** = enabling is active
4	RES	■ Reserved 5
5	EXT	■ The robot is in **External mode** ▶ **0** = External mode is not active ▶ **1** = External mode is active
6	T1	■ The robot is in **Manual Reduced Velocity mode** ▶ **0** = T1 mode is not active ▶ **1** = T1 mode is active
7	T2	■ The robot is in **Manual High Velocity mode** ▶ **0** = T2 mode is not active ▶ **1** = T2 mode is active
Output byte 1		
0	NHE	■ External E-Stop has been triggered ▶ **0** = external E-Stop is active ▶ **1** = external E-Stop is not active
1	BS	■ Operator safety ▶ **0** = operator safety is not assured ▶ **1** = operator safety is assured (input BS = 1 and, if configured, input QBS acknowledged)
2	SHS1	■ Safety stop 1 (all axes) ▶ **0** = safety stop 2 is not active ▶ **1** = safety stop 1 is active (safe state reached)
3	SHS2	■ Safety stop 2 (all axes) ▶ **0** = safety stop 2 is not active ▶ **1** = safety stop 1 is active (safe state reached)
4	RES	■ Reserved 13
5	RES	■ Reserved 14
6	PSA	■ PROFIsafe active ▶ **0** = robot controller on PROFIsafe bus is not active ▶ **1** = robot controller on PROFIsafe bus is active
7	SP	■ Shutdown PROFIsafe ▶ **0** = announcement of termination of connection is not active ▶ **1** = announcement of termination of connection is active

SIB – safe inputs and outputs

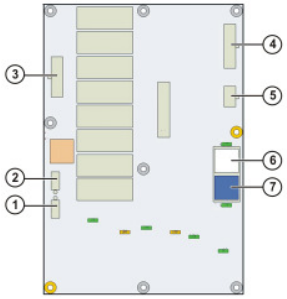


Desig.	Meaning
NHB	▶ E-Stop on operator panel
ZS	▶ Enabling
BAV	▶ Mode selection lock
AKB	▶ Disconnect operator panel
NHS	▶ E-Stop on cabinet (optional)
JR	▶ Mastering test (SafeOperation)
ZSE	▶ External enabling (optional)
HSR1	▶ Checkback, main contactor 1 (optional)
HSR2	▶ Checkback, main contactor 2 (optional)
HS1	▶ Main contactor 1
HS2	▶ Main contactor 2
NHE	▶ External E-Stop
BS	▶ Operator safety
QBS	▶ Ackn. operator safety
SH	▶ Safety stop SH, robot axes
SBH	▶ Safe operational stop
NHL	▶ Internal E-STOP
ZSG	▶ Enabling switch pressed
POS[n]	▶ Position value, channel [n]
STO[n]	▶ Safe Torque off [n]
SBC[n]	▶ Safe Brake Control [n]

Interface X11, connector pin allocation

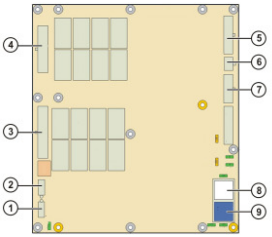


Standard SIB connections



P	Plug	Description
1	X250	SIB power supply
2	X251	Power supply for other components
3	X252	Safe outputs
4	X253	Safe inputs
5	X254	Safe inputs
6	X259	KUKA System Bus
7	X258	KUKA System Bus

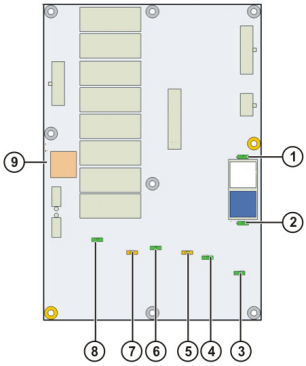
Extended SIB connections



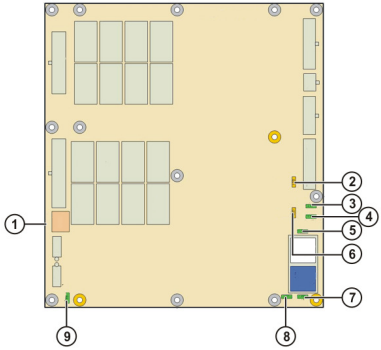
P	Plug	Description
1	X260	Extended SIB power supply
2	X261	Power supply for other components
3	X265	Safe outputs 1 and 2
4	X264	Safe outputs 3 and 4
5	X266	Safe outputs 5 to 8
6	X262	Safe inputs
7	X263	Safe inputs
8	X268	KSB – KUKA System Bus
9	X269	KSB – KUKA System Bus

SIB LED diagnosis

Standard SIB LED overview



Extended SIB LED overview



S	E	Designation	Description	Remedy
1	5	**L/A**	■ **On** = physical connection ■ **Off** = **no** physical connection ■ **Flashing** = data exchange	----------
2	7	**L/A**	■ See item 1	----------
3	9	**PWR_3V3** Power for the SIB	■ **Off** = **no** power supply available	▶ Check fuse F301 ▶ Jumper plug X308 present
			■ **On** = supply present	----------
4	8	**RUN** EtherCat Safety node	■ **On** = operational (normal state) ■ **Off** = Init (after switching on) ■ **Flashing at 2.5 Hz** = Pre-Op (intermediate state on start-up) ■ **Single signal** = Safe Op ■ **Flashing at 10 Hz** = boot for firmware update	----------
5	6	**STAS2** Safety node B	■ **Off** = **no** power supply available	▶ Check fuse F302 ▶ If the LED PWR_3V3 lights up, then exchange the SBI module
			■ **Flashing at 1 Hz** = normal state ■ **Flashing at 10 Hz** = boot phase ■ **Flashing** = fault code (internal)	----------
6	3	**FSOE** EtherCat Safety	■ **Off** = not active ■ **On** = operational ■ **Flashing** = fault code (internal)	----------
7	2	**STAS1** Safety node A	■ see STAS2	▶ see STAS2
8	4	**PWR 3.3V**	■ **On** = power supply present	----------
			■ **Off** = **no** power supply available	▶ Check fuse F302 ▶ If the LED PWR_3V3 lights up, then exchange the SBI module
9	1	**Fuse LED**	■ **On** = fuse defective	▶ Exchange defective fuse
			■ **Off** = fuse OK	----------

S= SIB Standard **E**= SIB Extended

Start-up / diagnosis

Start-up mode

⚠ WARNING

- In start-up mode, the safety equipment is deactivated!
- Start-up mode must only be used for troubleshooting or for testing!

Procedure

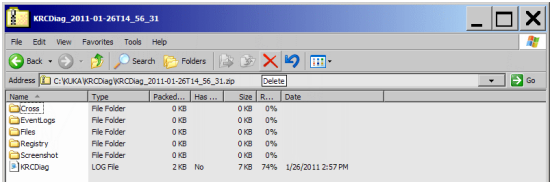
- Log on as Expert: Menu sequence: **Configuration > User group > Log on > Expert**
- Start-up mode: Menu sequence: **Start-up > Service > Start-up mode**

KRCDiag

- is a diagnostic tool for bundling and saving fault profiles in a file
- Evaluation by the KUKA Hotline
- Additional generation of a screenshot of the current display on the HMI

Procedure

- Select the menu sequence: **File > Archive > USB or Network > KrcDiag**.
- Alternative menu sequence: **Diagnosis > KrcDiag**
- Gathering the information incl. file generation takes 5 minutes
  Message: *Do you really want to archive the selected file(s)* > confirm with **Yes**
- File path: **C:\KUKA\KRCDiag\ KRCDIAG_[date]T[time].zip**



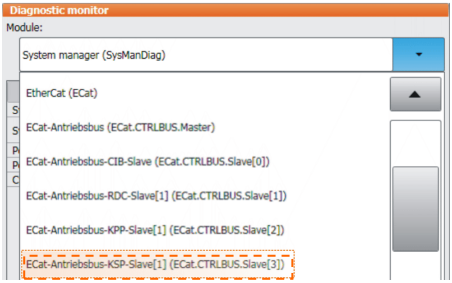
Diagnostic monitor

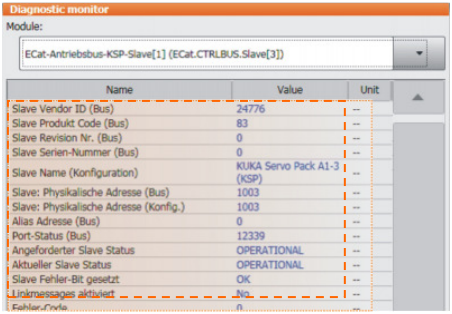
- is used to analyze bus devices, bus components and networks.

Procedure

- Log on as Expert. Menu sequence:
  Robot key > Configuration > User group > Log on > Expert
- Call the diagnostic monitor: Menu sequence:
  Robot key > Diagnosis > Diagnostic monitor
- Select the device / bus device / network configuration to be analyzed
  Pulldown menu (module) > select corresponding diagnosis

▶ Example: KSP module





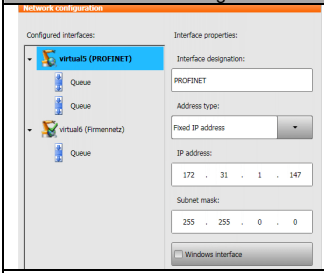
KLI network configuration

- In the standard version, the **KLI** is prepared for the **static** IP address **172.31.1.147** in **virtual 5** (virtual VLAN network 5)
- If **ProfiNet** is used in addition, **virtual 5** can be reserved for this
- WV, Windows, RDP, etc., are allocated to a separate, newly created **virtual 6** (DHCP)

Procedure (HMI):

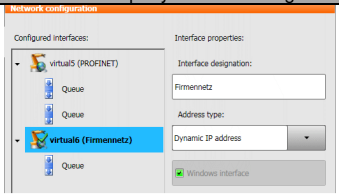
- Log on as Expert. Menu sequence:
  Robot key > **Configuration** > **User group** > **Log on** > **Expert**
- Menu sequence:
  Start-up > **Network configuration**

virtual 5 – ProfiNet configuration



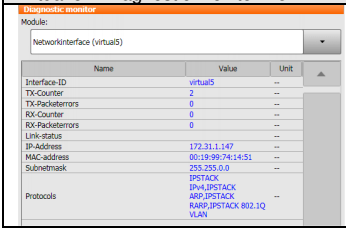
- **Fixed IP**
  - ► Unique, fixed ProfiNet address

virtual 6 – Company network configuration

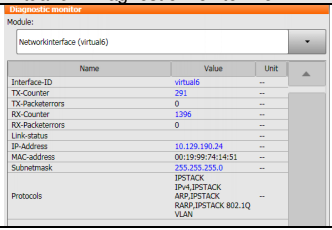


- **DHCP**
  - ► Assignment of IP address via DHCP

virtual 5 – Diagnostic monitor view



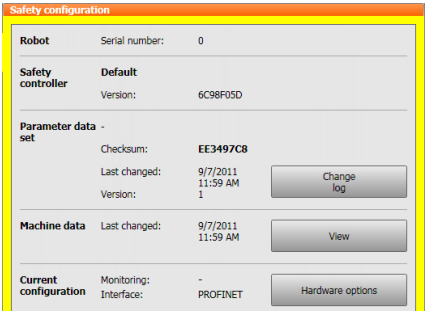
virtual 6 – Diagnostic monitor view

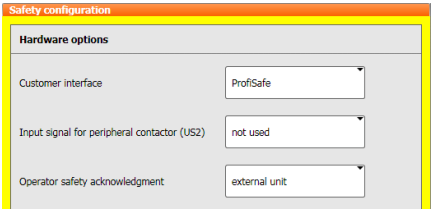


Configuring the system safety

- Selection of the robot safety during start-up.
- Shown here on the**HMI**

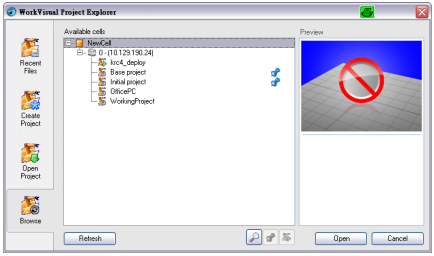
- **Precondition:**
  - ▶ User group **Safety maintenance**
- **Procedure:**
  - ▶ Menu sequence: **Configuration** > **Safety configuration**
  - ▶ Menu sequence: **Hardware options**
  - ▶ Selection of the customer interface **SIB** or **ProfiSafe**





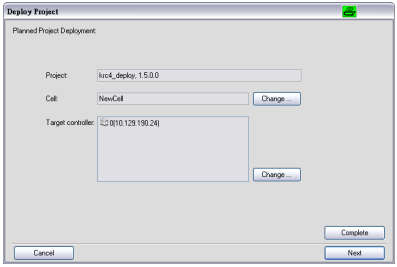
Loading a WorkVisual project

- **Precondition:**
  - **KR C4** and notebook with **WorkVisual** are within the same network
- **Procedure:**
  - Start **WorkVisual**
  - Menu sequence: **File > Open project**
  - Menu sequence: **Browse** tab **> Refresh** button
  - Select **Online project** and load it using the **Open** button



Deploying a WorkVisual project

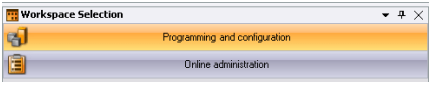
- **Precondition:**
  - **KR C4** and notebook with **WorkVisual** are within the same network
  - The user profile **Expert** is activated on the KR C4
- **Procedure:**
  - The project to be deployed is open in **WorkVisual**
  - Menu sequence: **Extras** tab **> Install**
  - The **Project deployment** window is opened



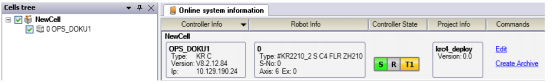
- Check the **Cell** and **Target controller** via the “Change” buttons
- Click on the **Next** button
- Another window opens, and the project is complemented
- Click on the **Activate** button **>** project is deployed
- Additionally, the project must be confirmed on the **KR C4 HMI**

Calling the WorkVisual diagnosis

- **Precondition:** ▶ **KR C4** and notebook with **WorkVisual** are within the same network
- **Procedure:** ▶ Window **Workspaces > Programming and configuration**

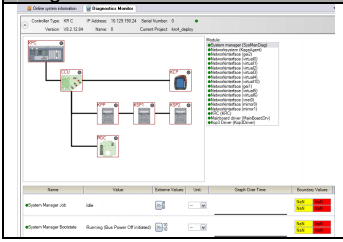


▶ Window **Cell view >** Cell selection – activate check box(es)
▶ **Online system information** is shown for the selected cells

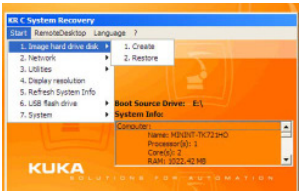


▶ Toggle via the **Editors** tab between **System information editor, Diagnostic monitor, Trace configuration** and **Trace evaluation**
Alternatively, directly via the icons displayed:

- **Examples:**

Diagnostic monitor	Trace evaluation
	

KUKA Recovery Tool (Option)



■ **Precondition:**

- ▶ A bootable **KUKA USB stick** is required
- ▶ **KUKA Recovery Tool** is installed on this USB stick
- ▶ The following settings must be made first:

Path: **MODE > Controller.ini**

[KRCType]
Version=silent
Mode=0
Persistent=0

[HDDSize]
Partition_1=10000
Partition_2=5000

[DEBUG]
Debug=0

Variable	Description
Version	■ GUI mode is executed if the program line is commented out ■ Silent mode is executed if the program line is activated Default: **silent**
Mode	■ **0**: Create hard drive image on the USB stick ■ **1**: Restore hard drive image from the USB stick ■ **2**: Restore master image from the hidden partition Default: **0**
Persistent	■ **0**: Following program execution, the value set for **Mode** is reset to the default value ■ **1**: Following program execution, the value set for **Mode** is retained, e.g. Mode=1 Default: **0**

Path: **NET > NetCon.ini**
[NetUNC] 1=\\backup1\transfer\
Description
■ Only UNC network paths may be used. Drive letters are assigned automatically by the system
■ Format: \\ Server_name\ Share_name

Path: **NET > SetIPAdress.ini**	
[StaticIPAddress] IPAddress=xxx.xxx.xxx.xxx Subnetmask=xxx.xxx.xxx.xxx ;Gateway=xxx.xxx.xxx.xxx	
Value	Description
IP address	■ Enter a permanent, static IP address if no DHCP address assignment is available
Subnet mask	■ Enter the subnet mask for the IP address
Gateway	■ IP address of a gateway, if present
	Default: xxx.xxx.xxx.xxx = no static IP address / gateway

Path: **Image**
ImageName_C.wim ImageName_D.wim
Description
■ Folder for the KRC4 images ■ In Silent mode, the most recent image is always restored.