WELDING SYSTEMS

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SYNCHROWELD

Robot and Welding Machine united

Synchroweld, the innovative method for a constant energy input per unit length, can be applied for the welding of contoured parts, high-strength fine-grained and duplex steels and for the heat-reduced welding of thin sheets.

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Perfect interaction of robot and welding system

A technology partner and **YASKAWA Motoman** collaborated with **SKS Welding Systems** in the development of the innovative system solution Synchroweld. This new control method is the response to the high demands of the automotive industry for a more reliable weld process.

Synchroweld unites robot and welding machine to a procedural entity.

Thanks to Synchroweld the welding machine finally gets the actual welding speed, i.e. the TCP speed from the robot and its external axes. The speed information is now directly processed in the weld controller. Synchroweld opens up new possibilities for a better control of the weld process.

THE ADVANTAGES OF SYNCHROWELD

- **Optimum welding** with constant penetration and identical appearance at each point along the weld seam (even at the torch reorientation points)
- **Constant energy input per unit length** – the energy input per unit length remains constant during welding
- **Process optimisation** – with the visualisation of the actual TCP speed in measurements the process can be optimised
- **Work made easier and time is saved** – even with complicated weld seam geometries only one welding program and one welding speed setting is required
- **Welding data documentation** – the actual values and the actual welding speed are documented as well as the reference values
- **RWDE monitor** – all relevant information (values, measurements) are displayed on the MOTOMAN teach box monitor

Constant energy per unit length

$$\text{Energy} = \frac{\text{Voltage x Current}}{\text{Welding Speed}} \qquad E = \frac{U \times I}{v}$$

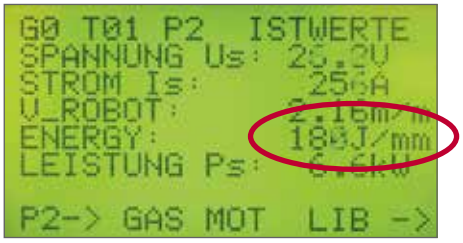
The energy input per unit length has not always been regarded as an important parameter in the majority of supplier industry applications. However, as the amount of fine-grained steel, duplex steel and high tensile steel increases in the axle area or in the high-temperature area of exhaust systems and for thin sheets, energy input per unit length will become an important parameter. Energy input per unit length describes the energy that is applied to a component per unit of length – or to be more specific: the heat input in a component.

Synchroweld allows the energy input per unit length to be kept constant thus ensuring that heat is introduced into the component evenly. The benefits of Synchroweld in general are that it reduces the amount of warping and keeps structural modifications to a minimum, even in the case of standard welding applications.

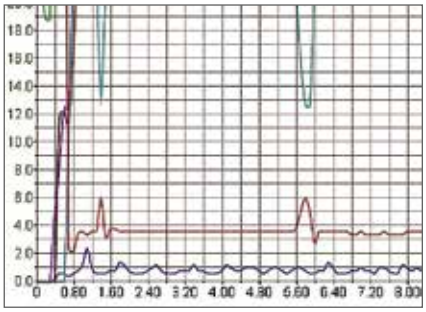
Display of energy input per unit length in the system

1. Continuous display of energy input per unit length on the RWDE monitor of the teach box.
2. Continuous display of energy per unit length on the Q8p weld controller, in Joules per mm or Joules per cm.
3. Display of energy input per unit length in the captured data (i.e. in the actual welding values) of the Q8 Tool Software.

Please note:
Currently the display of the heat-input per unit length on the teach box is supported by YASKAWA Motoman only.



2 *in the SKS weld controller*



3 *in the Q8 Tool Software*

1 *on the RWDE monitor of the teach box*

INFO

Base material = 1.4301
Filler material = 1.4370
Shielding gas = 97,5 % Ar, 2,5 % CO_2
Sheet thickness t = 1,5 mm
Welding speed v = 2,2 m/min

1 2 4 5

Weld seam pictures from the robot's reorientation points

Welding without Synchroweld

Weld seam pictures 1 / 2 / 4 and 5 are of the fillet weld shown above at the robot reorientation points. Penetration is strongest at these four points and it even shows a burn-through right down to the tool. The robot adapts its speed in the torch reorientation area and slows down on sharp curves. However, the welding parameters of the welding system remain constant. Because of this, too much energy is applied to the component at these 4 points, which causes the uneven seam appearance or the burn-through. Previously, welding parameters and the associated welding speeds had to be determined using complicated methods in these problematic locations. These points are exactly where Synchroweld makes use of its optimisation potential (see: weld seam pictures on the right side).

INFO

Base material = 1.4301
Filler material = 1.4370
Shielding gas = 97,5 % Ar, 2,5 % CO_2
Sheet thickness t = 1,5 mm
Welding speed v = 2,2 m/min

1 2 3 4 5

Synchroweld weld seam pictures with homogeneous seam appearance and constant penetration

Welding with Synchroweld

The welding parameters are matched automatically to the actual TCP speed of the robot or the complete system, consisting of robot and external axes. If the robot slows down at the reorientation points or on sharp curves, the welding parameters are synchronised at the same time.

Result: A constant energy input per unit length is introduced in the component. The result is homogeneous, constant penetration and identical appearance at all points of the weld seam.

Welding speed management in the weld controller

KF_1,0mm _AUS=>														
KF-Puls Extern														
KU03 1.0 1.0 mm														
Ar<9%CO2 G 00 T 01														
Verfahren	KF-Puls		StartParameter											
Bediener	Experte		Startpuls	5.0	ms									
BetriebsArt	Extern		Startstrom	400	A									
			Draht einfädeln	5.0	m/min									
KU03 1.0														
Durchmesser	1.0	mm	ProgrammParameter											
			KF Dynamik	0										
Ar<9%CO2			DownSlope	10.0	%									
Gasvorzeit	0.20	s												
Gasnachzeit	0.20	s												
GAS-Menge	12.0	l/min	EndParameter											
			Endpulsdauer	2.0	ms									
Diverses			Rückbrand	2.0	mm									
Modus	EinzelDraht		Endkrater (P7)	0										
Motor 1/2	Motor 1													
Anlage	Master													

	Start	P2	AUS					Einheit
Drahtvorschub1	4.0	16.0						m/min
Robotergeschw.	2.20	1.80						m/min
Fensterbreite	0.0							±%
PulsSpannung	31.0	31.0						V
PulsZeit	2.0	2.0						ms
GrundStrom	16	122						A
KorrekturWert	0	0						A
GrundZeit	10.9	1.8						ms
KorrekturWert	0.0	0.6						ms
KennFeld	74.0	74.0						%
Freigabe	Ein	Ein						
ProgrammDauer	0.1							s

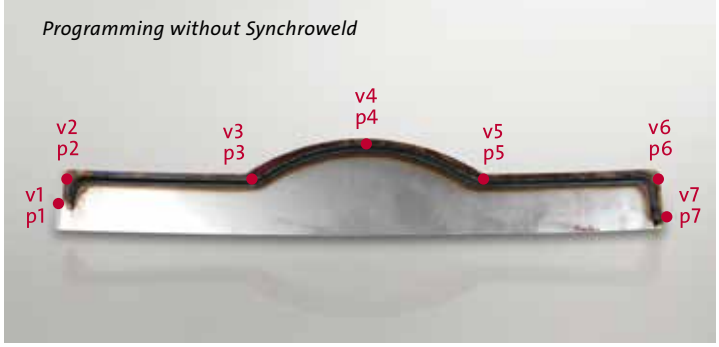
Presets

Welding speed setting from the weld controller

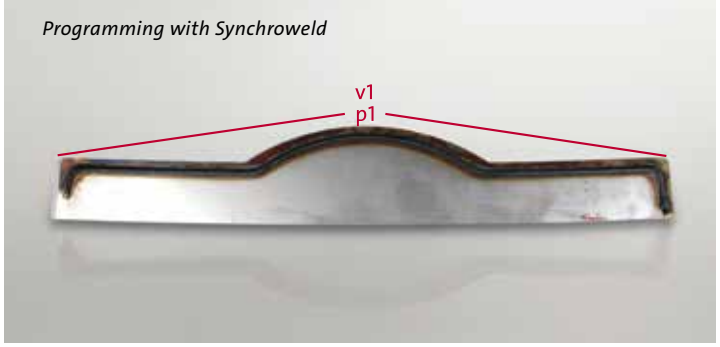
Welding speeds are displayed in the documentation sheet of the Q8 Tool Software and saved. This means that the actual values including the welding speed are documented in addition to the reference values. Until now the welding speed was only ever managed by the robot program. Synchroweld manages the welding speed plus the welding parameters in one single data sheet. In networked SKS welding machines the complete documentation – reference values and actual values – are saved in so-called log files. Part identification can be assigned to the log files using a scanner. This allows non-ambiguous assignment of the data, even for the traceability of the components.

MAKING WORK EASIER WITH SYNCHROWELD

Programming without Synchroweld



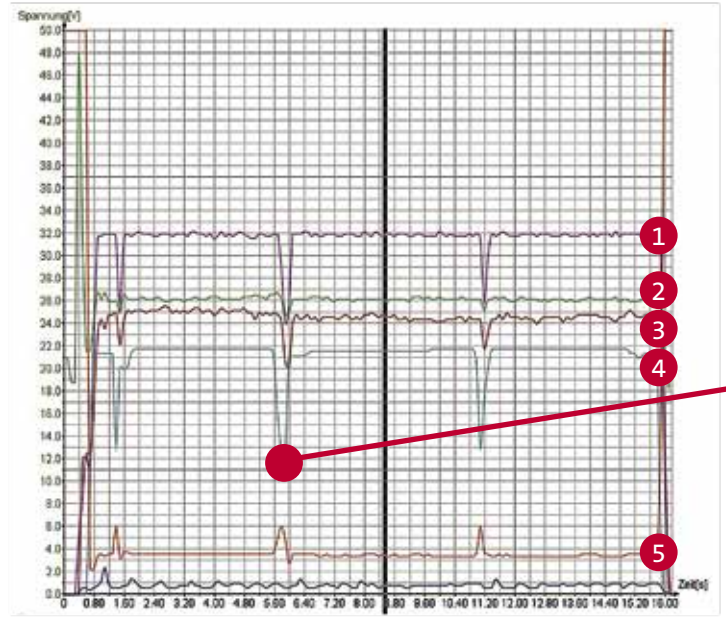
Programming with Synchroweld



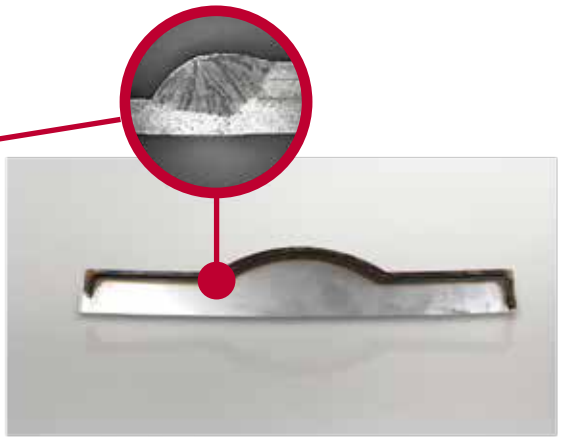
Previously, the user proceeded as follows when programming a welding job: He selected the respective optimum welding speed for each of several points (see above) and then, using several test welding steps, he determined the corresponding welding parameters. This procedure is extremely time-consuming and requires a great deal of user know-how.

Synchroweld makes the user's work much easier: only one welding program and one welding speed setting is required, even with complicated weld seam geometries. This saves a considerable amount of time when programming a welding job.

Process optimisation with Synchroweld



1 *Wire feed speed*
2 *Voltage*
3 *Current*
4 *Welding speed*
5 *Energy input per unit length*



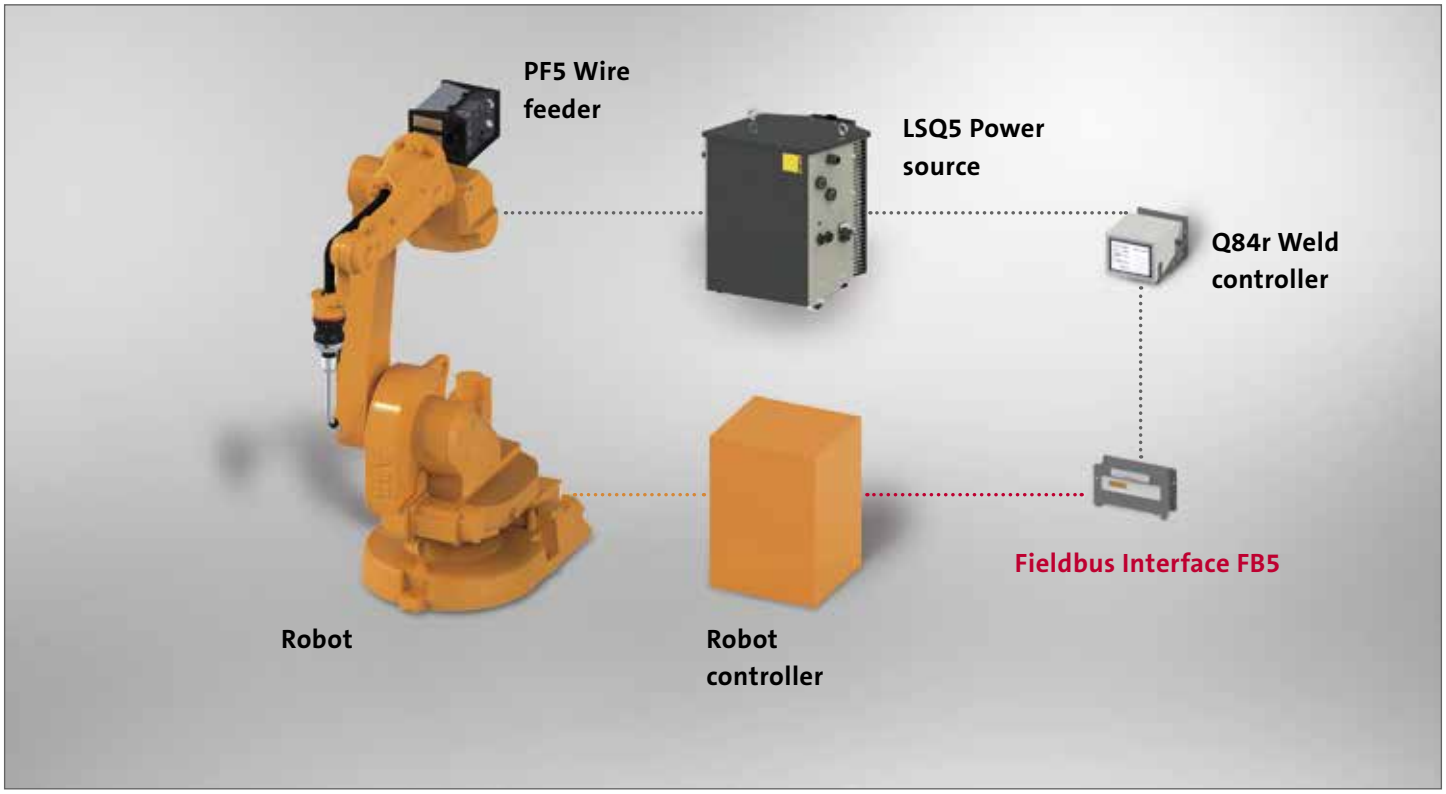
Actual values

Another advantage of Synchroweld is cycle time reduction. The recorded measurements show the user the speed trend. This means that specific reprogramming can be carried out for the locations of a seam at which speed drops are detected, thus increasing the speed.

PROCESS MONITORING

	Controlling functions	Monitoring functions
Power	✓	
Voltage	✓	
Wire feeding speed	✓	
Mains voltage	✓	
Arc length (AutoComp)	✓	
Synergy curve	✓	
Welding current monitoring		✓
Arc monitoring		✓
Ignition current monitoring		✓
Motor current monitoring		✓
Shielding gas monitoring		✓
Welding speed	✓	
Energy per unit length	✓	

Synchroweld system requirements - ABB

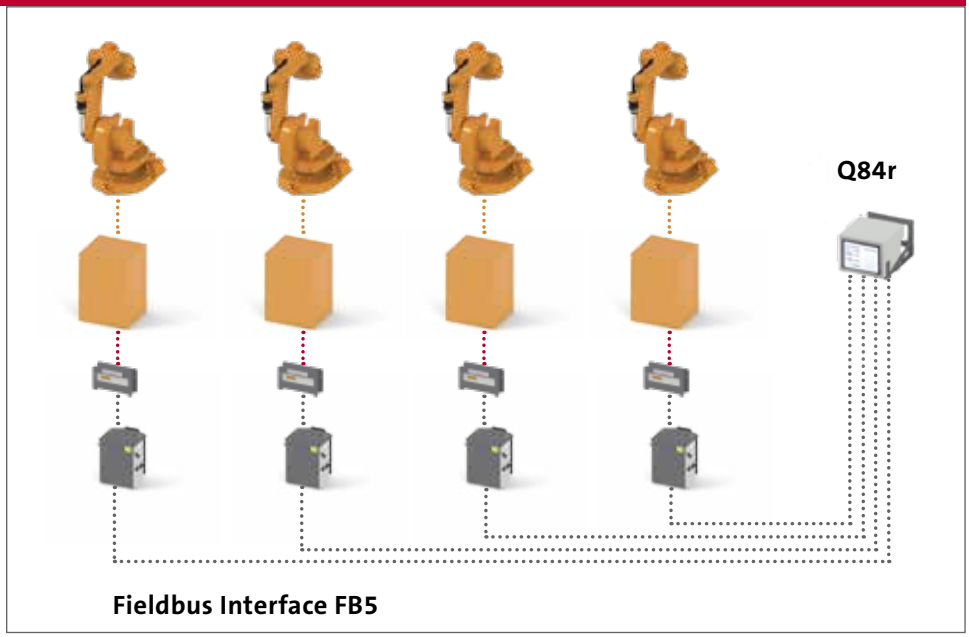


The following system components are needed to use Synchroweld:

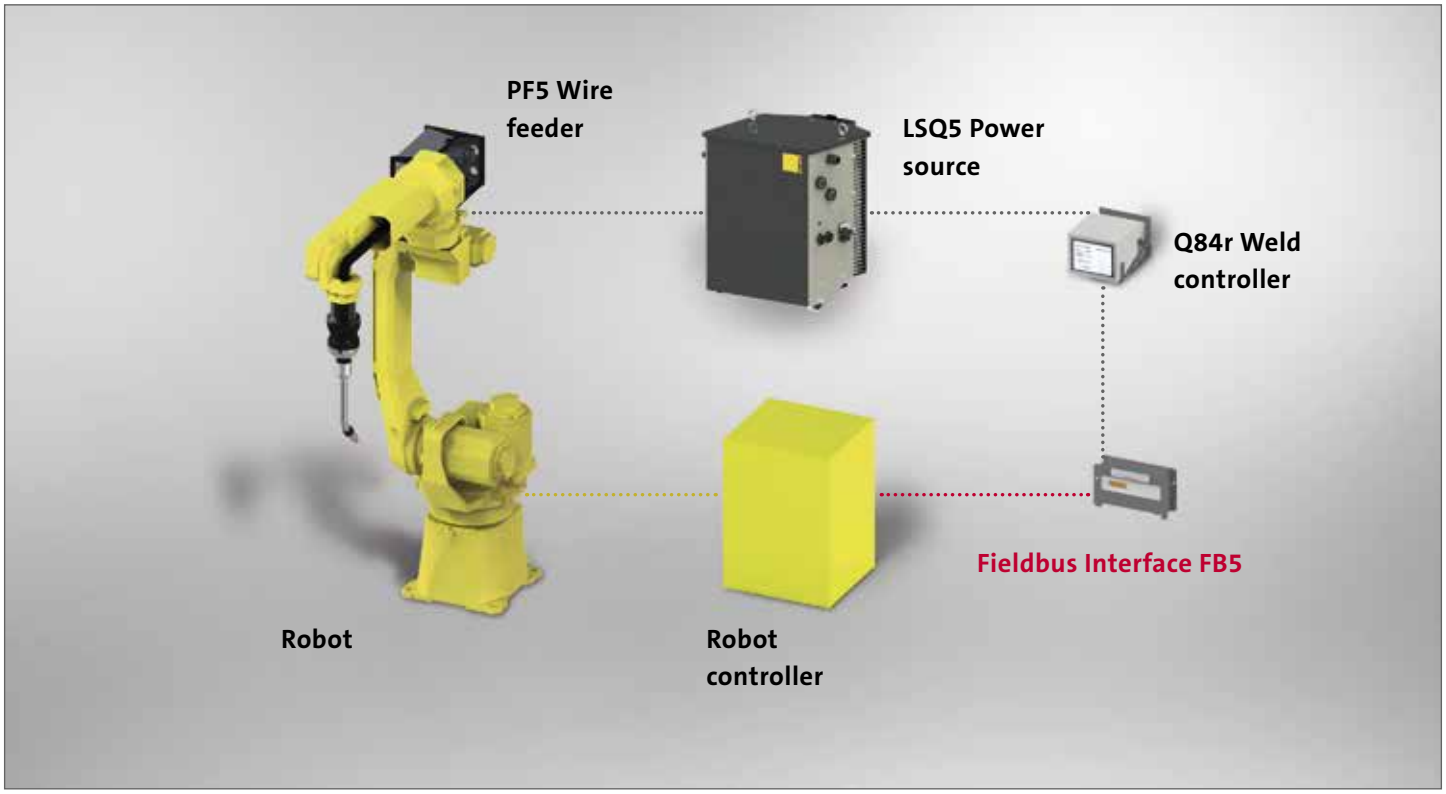
ABB	SKS
Fieldbus connection	Power sources: LSQ3, LSQ5
	Weld controllers: Q6pw, Q8p, Q8pw, Q80, Q84s, Q84r
	Wire feeder: PF5
	Interface: Fieldbus Interface FB5

SYNCHROWELD SYSTEM REQUIREMENTS

In a Fieldbus environment up to four weld machines can be controlled in Synchroweld mode.



Synchroweld system requirements - Fanuc

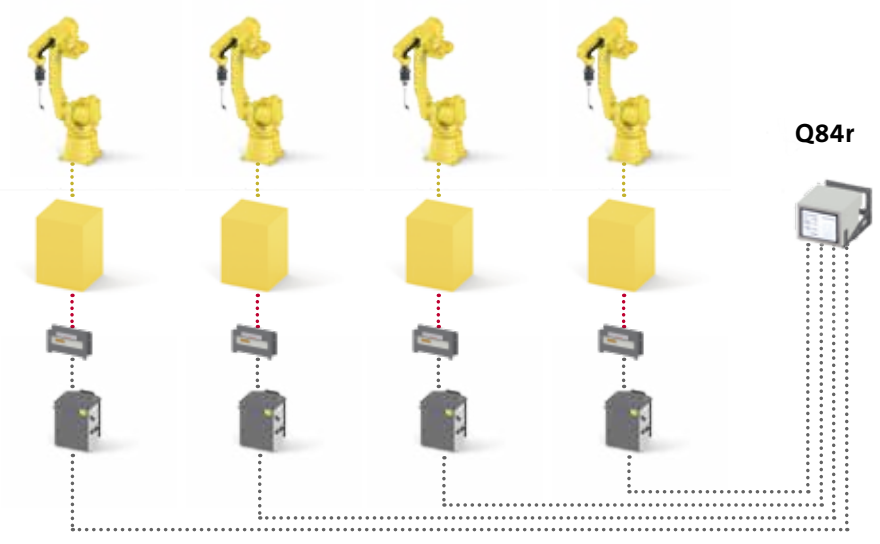


The following system components are needed to use Synchroweld:

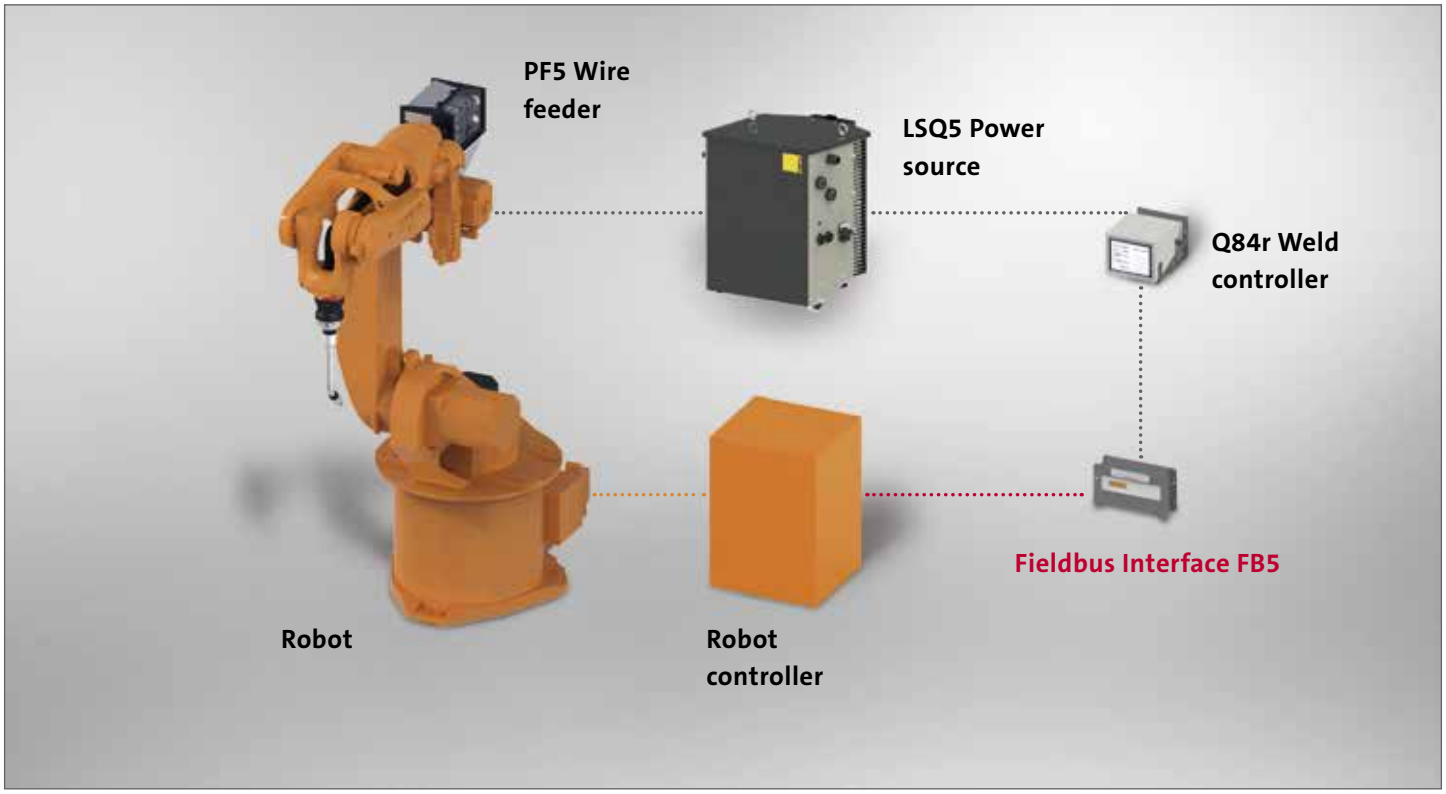
Fanuc	SKS
Fieldbus connection	Power sources: LSQ3, LSQ5
	Weld controllers: Q6pw, Q8p, Q8pw, Q80, Q84s, Q84r
	Wire feeder: PF5
	Interface: Fieldbus Interface FB5

SYNCHROWELD SYSTEM REQUIREMENTS

In a Fieldbus environment up to four weld machines can be controlled in Synchroweld mode.



Synchroweld system requirements - KUKA

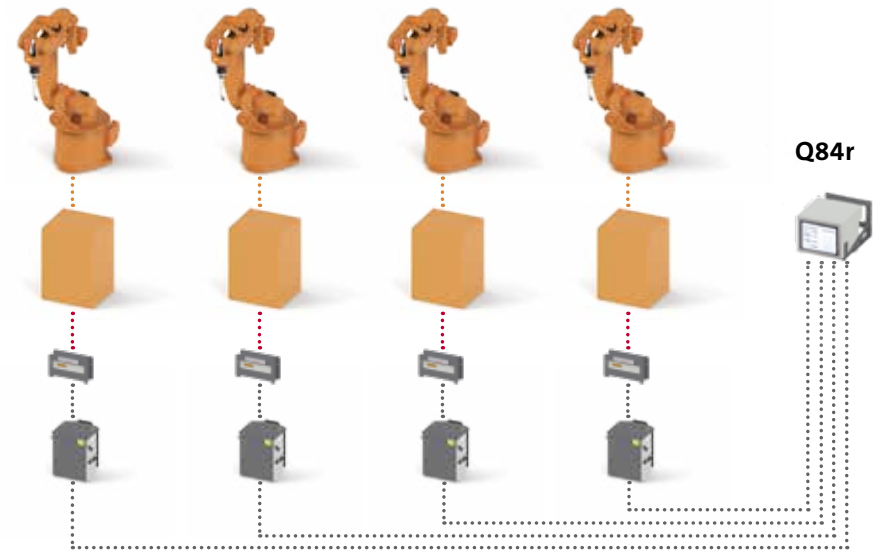


The following system components are needed to use Synchroweld:

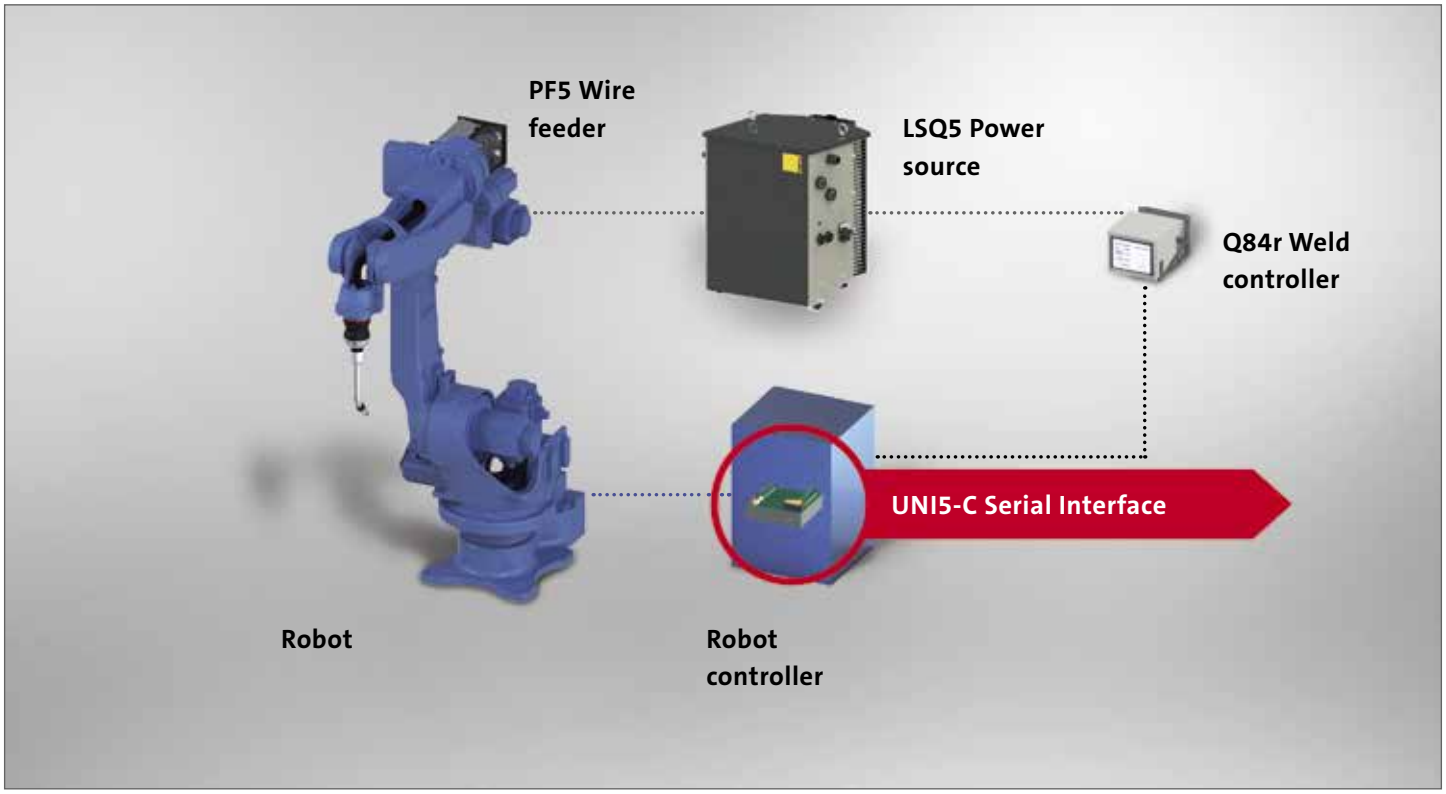
KUKA	SKS
Fieldbus connection	Power sources: LSQ3, LSQ5
	Weld controllers: Q6pw, Q8p, Q8pw, Q80, Q84s, Q84r
	Wire feeder: PF5
	Interface: Fieldbus Interface FB5

SYNCHROWELD SYSTEM REQUIREMENTS

In a Fieldbus environment up to four weld machines can be controlled in Synchroweld mode.



Systemvoraussetzungen Synchroweld - YASKAWA Motoman

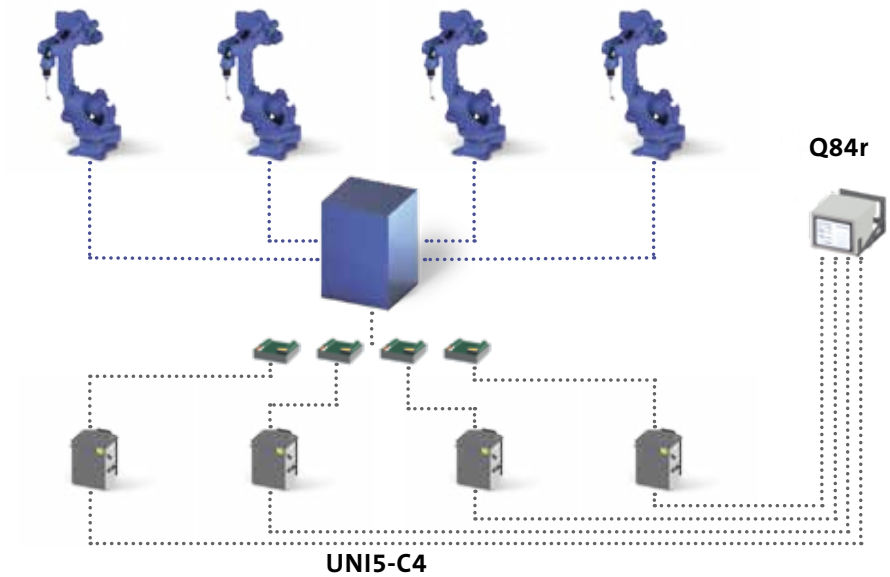


The following system components are needed to use Synchroweld:

YASKAWA Motoman	SKS
Robot controller: NX/DX 100/DX 200	Power sources: LSQ3, LSQ5
	Weld controllers: Q6pw, Q8p, Q8pw, Q80, Q84s, Q84r
	Wire feeder: PF5
	Interface: UNI5-C (RWDE Protocol)

SYNCHROWELD SYSTEM REQUIREMENTS

The RWDE Protocol supports up to four weld machines with the use of a single NX/DX100 robot controller.



WELDING SYSTEMS

www.sks-welding.com

Synchroweld summary

Optimum welding result

Constant energy input per unit length

Makes work easier/Saves time

Process optimisation/Cycle time reductions

Documentation of the actual TCP speed

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