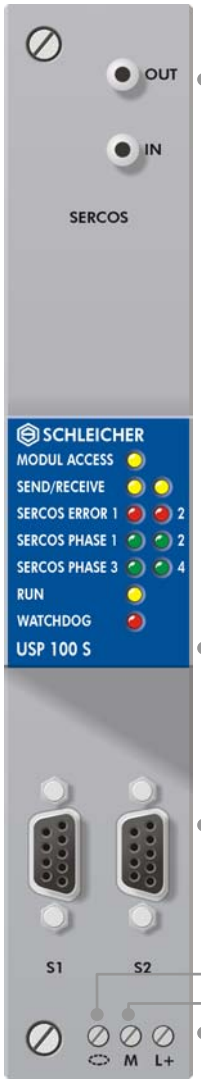
Positioning Processor • Sercos Master • 8 Axes — USP 100 S

Front



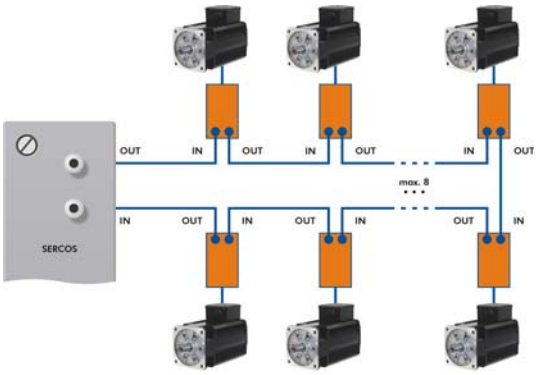
F-SMA screw connections for optical fiber

LED displays (→ Technical Data)

Encoder connections

Shield connection for all cables
Encoder supply voltage (0 V)
Encoder supply voltage

Basic structure of Sercos ring



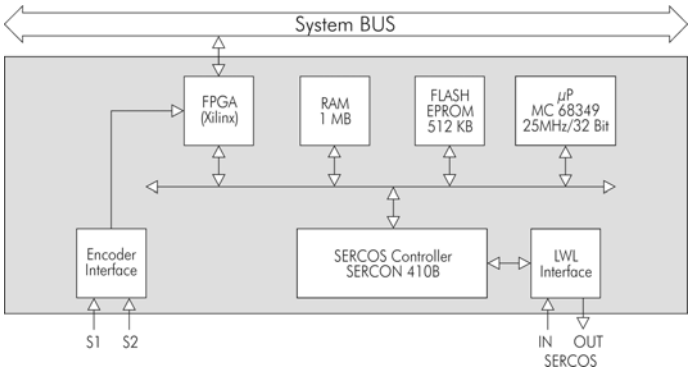
The USP 100 S positioning processor provides the XCN control system with a SERCOS interface. SERCOS is a standardized IEC 1491 field bus for real-time communication in the CNC field. Standardization means that all SERCOS-capable drives from any manufacturer can be operated in a ring. As a master the USP 100 S module can operate up to 8 SERCOS controllers.

Up to 64 NC axes can be driven using a controller configuration with an XCN control unit and 8 USP 100 S modules. Each SERCOS ring is synchronized with the XCN system clock. A communication cycle time can be selected between 0.5 ms and 2 ms, depending on the number of axes and the operating mode. Digital optical fibre connection transmits 2 or 4 Mbit/s, and is insensitive to interference even over long distances.

Synchronized digital data exchange makes the USP 100 S module ideal for manipulators, high-performance CNC machines and robots.

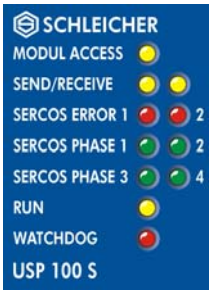
The module has two F-SMA connections for optical fibre (standardized IEC 874-2 connection) and two 9-pin sub-miniature connections for handwheel/encoder.

DriveTop interface
A protocol implemented in the controller allows communication with a Bosch-Rexroth DriveTop interface via the serial PC interface on the XCx 700. Thus the drive parameters can be easily output, optimized and saved.

Technical data	USP 100 S
Article number	R4.315.0270.0
Number of controllable axes	8
Processor	MC 68349 25MHz, 32 Bit
Memory	1 MB RAM, 512 KB FLASH-EPROM
Input signal voltage	Typical 2.6 V ... 4.8 V (5.0 ... 15 mA) Worst case 3.2 V ... 4.6 V (6.3 ... 15 mA)
Internal power consumption DC 5 V	4 W
Sercos ring optical fibre connection IN / OUT	F-SMA screw connections acc. to IEC 874-2
Encoder connection S1 / S2	9-pin subminiature, jack contact
Isolation	Between encoder connection and bus
Weight	0.5 kg
Block diagram	

Position controller data	
Travel range	± 1 m at 0.1 µm resolution ± 10 m at 1 µm resolution ± 100 m at 10 µm resolution
Velocity	1 mm/min ... 300 m/min
Acceleration	1 mm/s² ... 100 m/s²
SERCOS cycle time	0.5 ms ... 4 ms (adjustable in 0.5 ms steps)

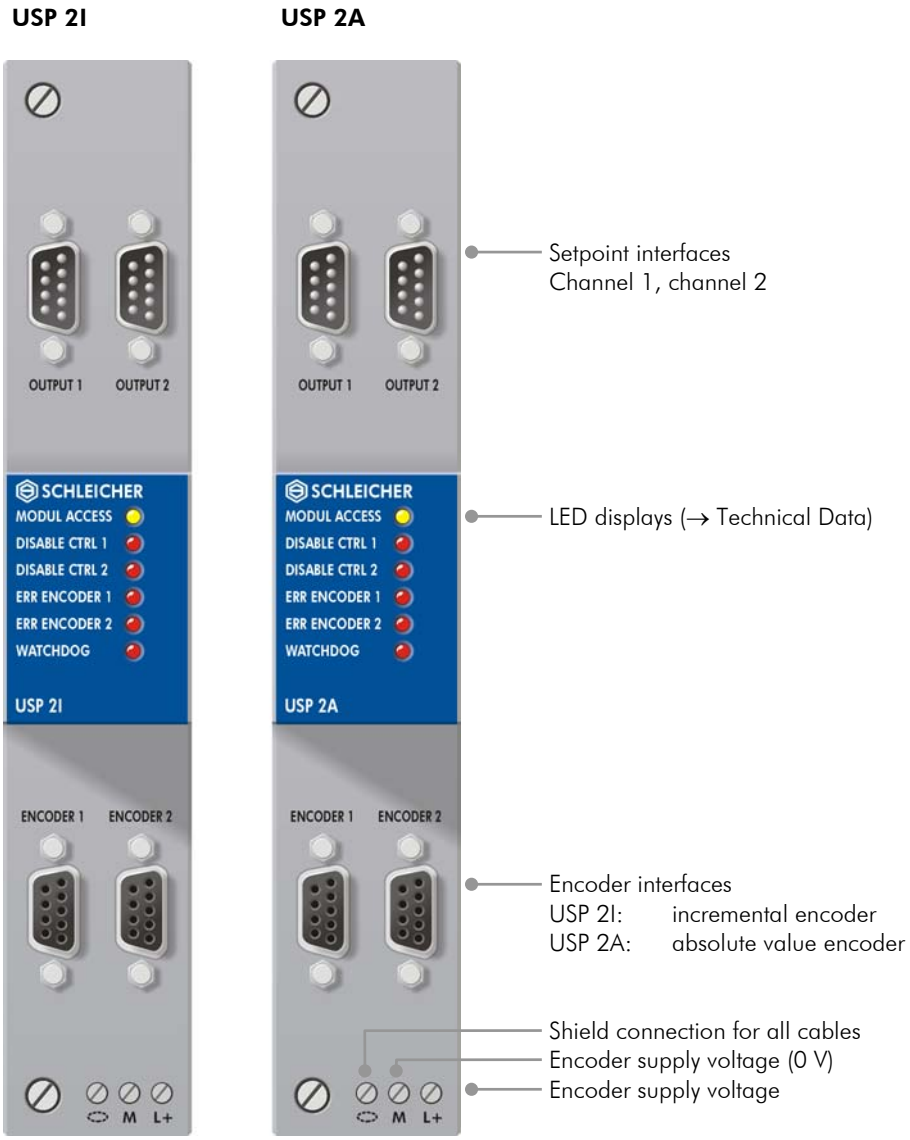
LED displays



MODUL ACCESS	on	Controller access to module OK
	off	Control unit in STOP mode or module not programmed by user program or module defective
SEND / RECEIVE	on	Send / receive active
SERCOS ERROR 1	on	Software error
SERCOS ERROR 2	on	Hardware error; LED indicates distortion of the received optical signal. The brightness gives an indication of the degree of distortion. Causes: Optical fibre bent or broken, connection dirty.
SERCOS PHASE 1/2/3/4	on	SERCOS run-up phase 1/2/3/4
WATCHDOG	on	Error; controller lock activated for all axes, error message sent to control unit
	off	Controller access to module OK within cycle time

For general technical data see page 66.

Positioning Processor • 2 Axes • Incremental Encoder — USP 2I
Positioning Processor • 2 Axes • Absolute Encoder SSI — USP 2A



The USP 2I / USP 2A slave positioning processors are intelligent processing units for position control and positioning of two independent axes.

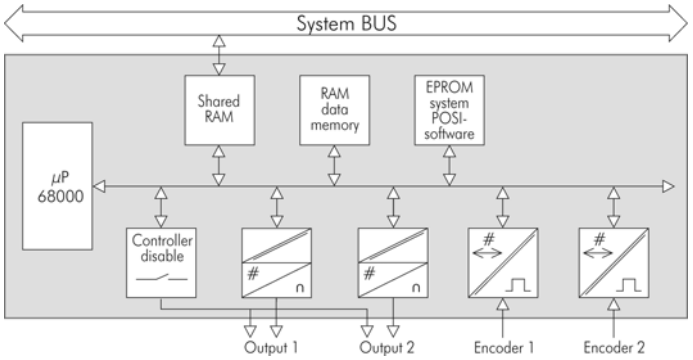
The USP 2I and USP 2A differ only in the type of inputs for the position measuring system. The USP 2I is designed for incremental encoders, the USP 2A for absolute value encoders.

USP 2I / USP 2A operate as remotepage modules on the system bus. Data communication with the control unit is via a dual-port RAM (shared RAM).

In connection with the XCN 700 CNC control unit they allow you to create high-velocity contiouring control. The control unit can control up to 32 USP 2I / USP 2A modules (but if other types of remotepage module are also used, this number is reduced correspondingly).

Position control functions
The modules provide the following position control functions:

- Proportional control with drift compensation
- Precontrol
- Monitoring exact positioning
- Following error
- Tracer function
- Measuring circuit monitoring

Technical data	USP 2I	USP 2A
Article number	R4.315.0020.0	R4.315.0030.0
Number of controllable axes	2 (max. 8 USP per control unit)	
Internal power consumption	DC 24 V: 2.3 W / DC 5 V: 1.5 W	
Connection	Encoder: subminiature 9-pin connector / Outputs: Subminiature, 9-pin connector	
Weight	0.58 kg	
Block diagram		

Encoder inputs		
Position detection	Incremental position encoder 2 sets of pulses offset by 90°, 1 zero pulse	Absolute position encoder Synchronous serial transmission
Pulse frequency / clock pulse freq.	Max. 1 MHz	≤ 190 kHz
Signal inputs	6 (Channel A, B, 0, /A, /B, /0, TTL-level)	2 (data+, data–)
Transmission time	–	Approx. 150 µs
Input load	270 ohms	270 ohms
Isolation	Yes; but not ENCODER 1 / ENCODER 2	Yes for data+ / data–; Not for clock pulse+ / clock pulse–
Input signal voltage	Typical 2.6 V ... 4.8 V (5.0 ... 15 mA) Worst case 3.2 V ... 4.6 V (6.3 ... 15 mA)	
Encoder supply voltage	Depending on encoder 5... 24 V external supply	

Setpoint outputs	
Setpoint output voltage / current	±10 V / ±10 mA
Resolution	16-bit
Shunt	1 kOhm
Isolation	yes; but not OUTPUT 1 / OUTPUT 2

Position controller data	
Travel range	± 1 m at 0,1 µm resolution ± 10 m at 1 µm resolution ± 100 m at 10 µm resolution ±1000 m at 100 µm resolution
Position control cycle	2 ms
Velocity	1 mm/min ... 300 m/min
Acceleration	1 mm/s² ... 100 m/s²

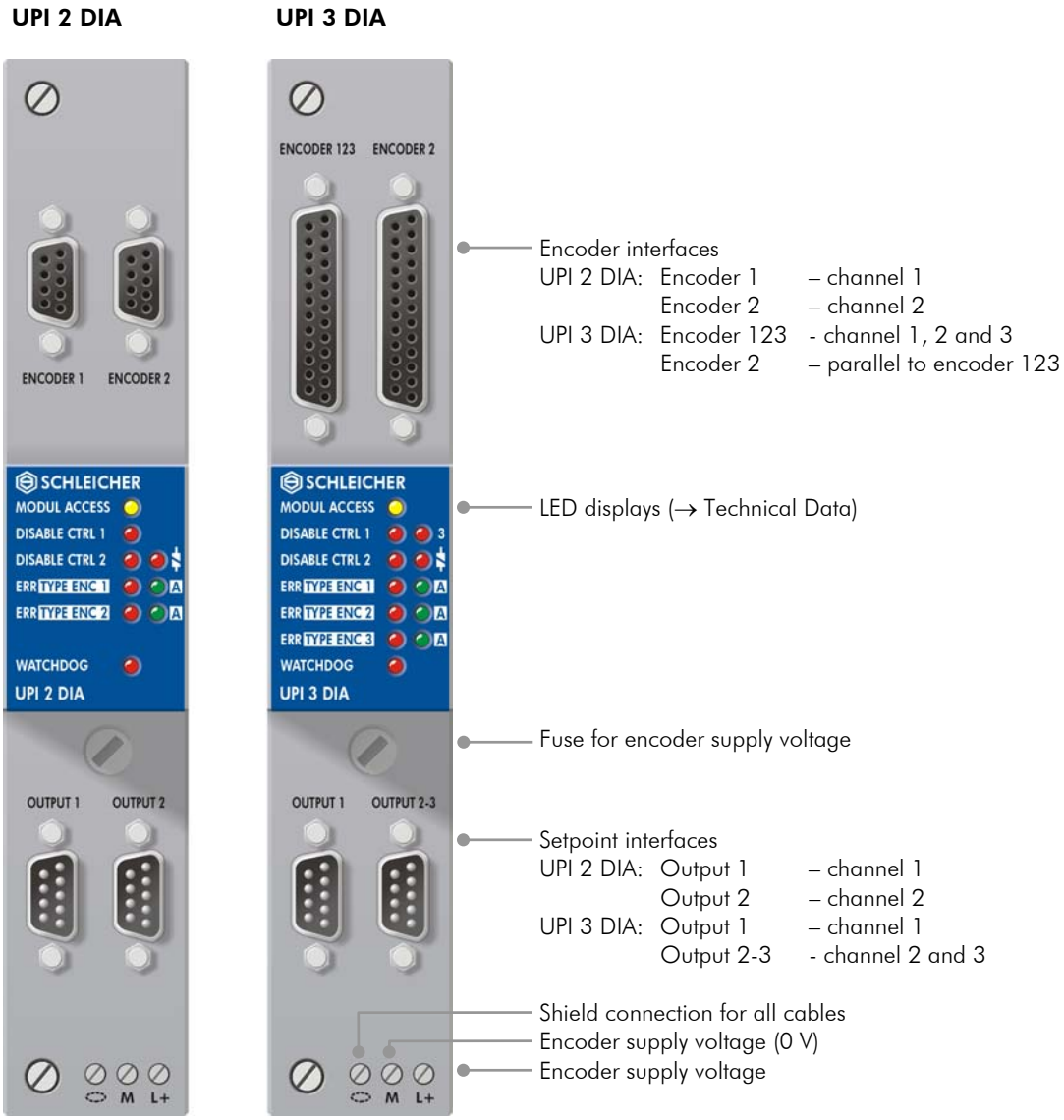
LED displays identical for USP 2I and USP 2A



MODULE ACCESS	on	Controller access to module OK
	off	Control unit in STOP mode or module not programmed or module defective
DISABLE CTRL x	on	Controller disable on and desired speed = 0 V for axis 1 and 2
	off	Controller disable off for axis 1 and 2
ERR ENCODER x	on	Interruption (cable break) of one or more encoder signals for axis 1/2
WATCHDOG	on	Microprocessor monitoring activated; control unit outputs error message and controller disable is activated on axes 1 and 2.

For general technical data see page 66.

Positioning Interface • 2 Axes — UPI 2 DIA
Positioning Interface • 3 Axes — UPI 3 DIA



The UPI 2 DIA and UPI 3 DIA are positioning interfaces for position detection and set value output for 2 or 3 independent NC axes. You can use incremental or absolute positioning transducers (encoders). Set value output ±10 V is provided for analog servo amplifiers. The positioning interfaces can be used on PLC and CNC control units.

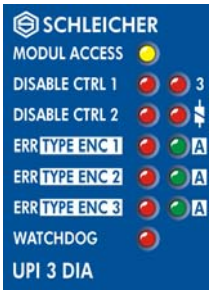
The integrity of the encoder signals is monitored. Only those signals whose inverse is also present will be used (interference blanking). Errors, cable break and skew (temporal displacement of signal and inverse) are displayed, and stop the axis. This means that encoder problems do not cause unknown incorrect positioning. The encoder signal monitoring circuit can detect cable break and insufficient encoder signal quality at input frequencies up to 100 kHz.

Axis positioning
The incremental or absolute position actual value is detected by a position encoder and evaluated as actual value in the control unit. The position setpoint is calculated in the control unit from the entered set coordinates, taking the acceleration and deceleration value and the speed. This calculated value (set speed) is output via a 12-bit D/A converter as the speed setpoint (±10 V). The set speed controls the power converter of the axis drive with speed control.

Controller enable and controller disable
If a fault occurs (e.g. cable break) the relay contacts assigned to the axes are activated.

Technical data	UPI 2 DIA	UPI 3 DIA
Article number	R4.318.0180.B	R4.318.0160.B
Number of controllable axes	2	3
Input signal voltage	Typical 2.25 V ... 3.75 V (5.0 ... 15 mA) Worst case 2.75 V ... 3.55 V (6.3 ... 15 mA)	
Setpoint output voltage / current	±10 V / ±10 mA	
Internal power consumption DC 24 V DC 5 V	5.5 W (when switched on max. 9.7 W for approx. 50 ms) 1 W	
Encoder supply voltage	Depending on encoder 5.3... 24 V external supply	
Fuse	T1,6 A (for encoder supply voltage)	
Connection Encoder Setpoints, enabling outputs	Subminiature 9-pin connector Subminiature 9-pin connector	Subminiature 25-pin connector Subminiature 9-pin connector
Connecting lines Encoder Setpoints, enabling outputs	Cable to Heidenhain rules 5-core, shielded, 0.25 mm²	
Isolation Encoder Setpoints Enabling	connected to one another; isolated from bus, enabling outputs, setpoint outputs connected to one another; isolated from bus, enabling outputs and encoders connected to one another; isolated from bus, encoders and setpoint outputs	
Weight	0.48 kg	
Encoder inputs incremental		
Encoder inputs	A, /A, B, /B, zero, /zero (/ = inverted signal)	
Max. encoder frequency / counting frequency	150 kHz / 600 kHz (after internal pulse quadrupling)	
Max. travel velocity	36 m/min at 1 µm resolution, 10 ms positioning cycle	
Encoder inputs absolute		
Encoder inputs	Measured value, /measured value	
Output to encoder	Clock pulse, /clock pulse (similar to RS422)	
Clock rate	Programmable: 156, 312 or 624 kHz	
Encoder code	Programmable: grey, binary	
Data format	Programmable: 21 / 25 bit	
Setpoint outputs		
Resolution	12-bit	
Enabling outputs	Potential-free relay contacts, switching voltage DC 24 V / 100 mA, permanently short-circuit-proof	

LED displays for UPI 3 DIA (where data for UPI 2 DIA differs it is given in *italics*)

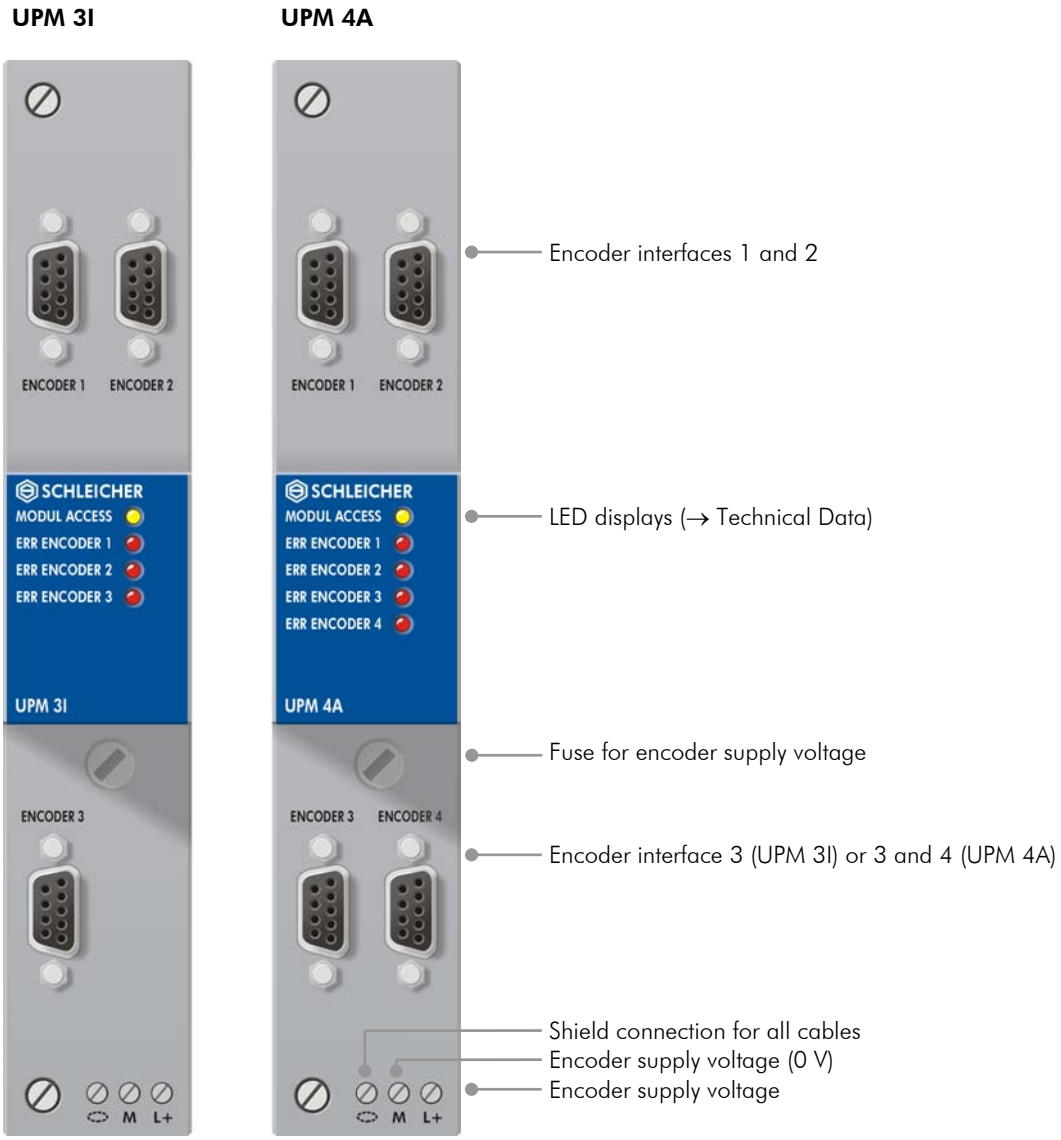




MODULE ACCESS	on	Controller access to module OK
	off	Control unit in STOP mode or module not programmed by user program or module defective
DISABLE CTRL x	on	Controller disable on and desired speed = 0 V for axis 1/2/3 *(Axis 1/2)*
	off	Controller disable off for axis 1/2/3 *(Axis 1/2)*
RELAY OFF		As LED DISABLE CTRL x
ERR TYPE ENC x	on	Interruption (cable break) of one or more encoder signals for axis 1/2/3 *(Axis 1/2)*
	off	Processing OK for the six encoder signals or the absolute encoder signals for axis 1/2/3 *(Axis 1/2)*
A	on	Absolute Encoder or Digital Servo mode for the corresponding axis
	off	Incremental Encoder mode
WATCHDOG	on	No control unit access to UPI 3DIA within cycle time; control unit outputs error message and controller disable is activated on axis 1/2/3 *(Axis 1/2)*.
	off	Controller access to module OK within cycle time

For general technical data see page 66.

Position Detection • 3 Channels • Incremental Encoder — UPM 3I
Position Detection • 4 Channels • Absolute Encoder — UPM 4A



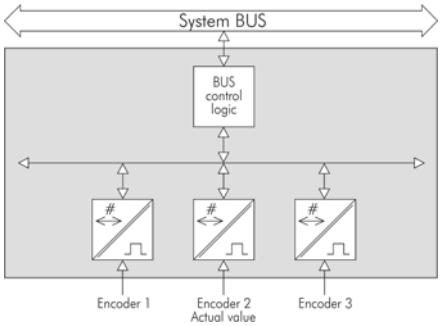
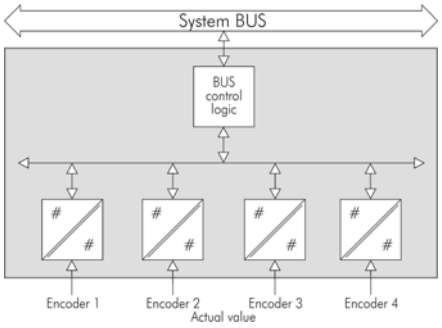
UPM 3I and UPM 4A position detection modules provide position detection with incremental or serial/absolute encoders.

UPM 3I
The UPM 3I provides three independent channels for incremental position encoders. The signals are isolated from the control electronics by optocouplers. The direction of rotation of the three position encoders are detected and sent to three fast counters. The axes are monitored for cable break and short-circuit.

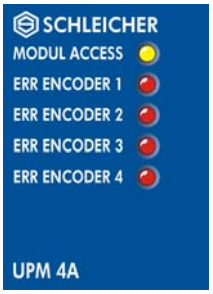
UPM 4A
The UPM 4A provides position encoding for four independent channels with synchronous serial/absolute position encoders. The signals are isolated from the control electronics by means of optocouplers.

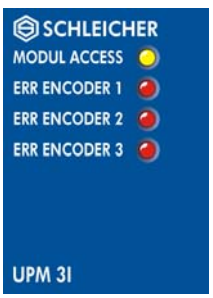
The position encoder actual values are processed and made available in words, which are used for data traffic between the control unit and the UPM 4A position detection module.

The axes are monitored for cable break and short-circuit. The clock rate of the interface and code switching (binary/grey) can be set by the user program.

Technical data	UPM 3I	UPM 4A
Article number	R4.315.0080.B	R4.315.0060.C
Number of axes	3 (max. 2 UPM per control unit)	4 (max. 2 UPM per control unit)
Internal power consumption	DC 24 V: 1.1 W	DC 24 V: 0.5 W / DC 5 V: 1.1 W
Connection	3 subminiature 9-pin connectors	4 subminiature 9-pin connectors
Weight	0.47 kg	0.43 kg
Block diagram		
Encoder inputs		
Position detection	Incremental position encoder 2 sets of pulses offset by 90°, 1 zero pulse	Absolute position encoder Synchronous serial transmission
Pulse frequency / clock pulse freq.	Max. 250 kHz	156 ... 624 kHz, set by software
Connection between clock pulse frequency, conversion time and cable length		156 kHz / 160 µs / 300 m 312 kHz / 80 µs / 100 m 624 kHz / 40 µs / 50 m
Range	+32767 ... –32768, can be extended by software to double word (32 Bit)	25-bit
Signal inputs	6 (channel A, B, 0, /A, /B, /0, TTL-level)	2 (data+, data–)
Transmission time	–	40 ... 160 µs (see above)
Input load	200 ohms	270 ohms
Signal outputs	–	2 (clock pulse+, clock pulse-)
Isolation	By optocouplers	Yes for data+ / data– Not for clock pulse+ / clock pulse– Yes for control electronics / encoder
Encoder supply voltage	Encoder-dependent (DC 5 ... 24 V external supply	
Fuse	F1,6/250C fuse	F2/250C fuse

LED displays for UPM 4A (where data for UPM 3I differs it is given in *italics*)





MODULE ACCESS	on	Controller access to module OK
	off	Control unit in STOP mode or module not programmed by user program or module defective
ERR ENCODER x	on	Interruption (cable break) of one or more encoder signals for axis 1/2/3/4 *(Axis 1/2/3)*
	off	Processing OK for encoder signals for axis 1/2/3/4 *(Axis 1/2/3)*

For general technical data see page 66.