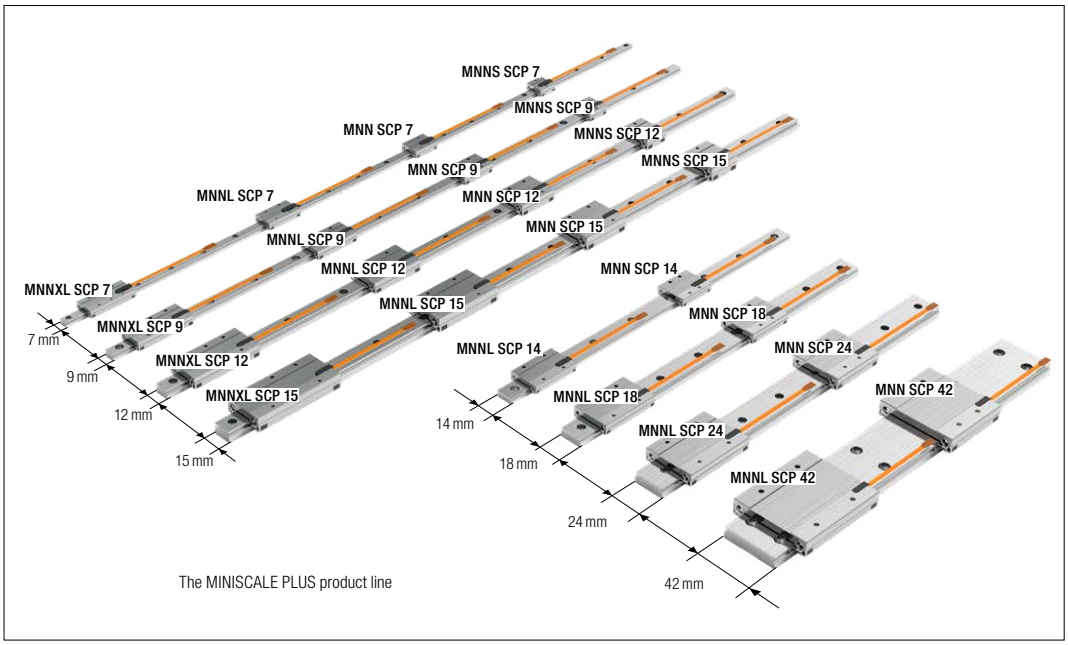
10 MINISCALE PLUS Product Overview

This extraordinary innovation combines «movement» with «measuring» in a highly integrated design. MINISCALE PLUS makes the most compact applications possible and simplifies assembly and installation significantly.

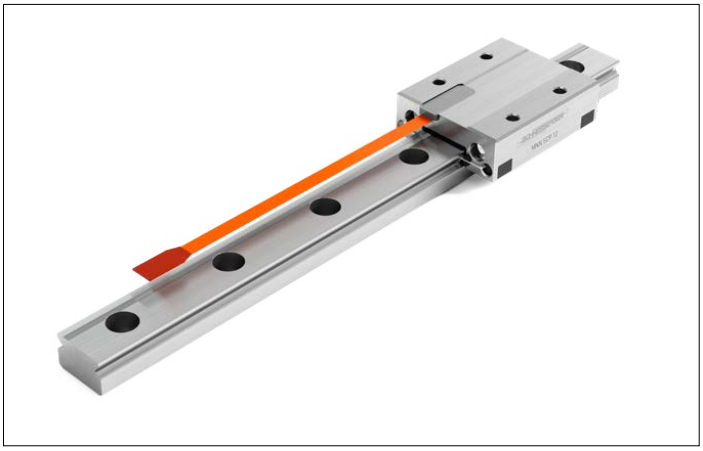
MINISCALE PLUS is based on our MINIRAIL guideways and is available for our entire product range.



The MINISCALE PLUS product line

10 MINISCALE PLUS Product Overview

10.1 Product Characteristics



MINISCALE PLUS

Highly integrated, compact design
- The measuring sensor is integrated into the carriage and requires no additional installation space

Minimal design planning
- The costs of a separate distance measuring system are not required

Quick and easy installation
- MINISCALE PLUS is delivered ready-to-install
- No need for additional components and special mounting (as would be required for a glass scale, for example)
- Distance measurements do not have to be adjusted
- Mounting a measuring scale is not necessary

Consistently high level of accuracy
- Very smooth running with no rolling element pulsation
- The position measurement is performed directly at the point of friction
  This simplifies the controlling of micromovements and dynamic motions
- No hysteresis or positioning errors compared to recirculating ball screws with rotary encoders
- Measurement is carried out directly during the work process
  This reduces Abbe errors
- High Repeatability
- Immune to vibration and shock as a single assembly

High level of reliability and long service life
- MINISCALE PLUS is based on the successful MINIRAIL design.
- The dimensional scale is marked directly on the guideway. The sensor is perfectly integrated into the carriage and sealed

10 MINISCALE PLUS Product Overview

10.2 Technical Information and Modifications

10.2.1 Performance Parameters of MINISCALE PLUS

Max. acceleration	300 m/s²		
Max. speed	5 m/s analog, 3.2 m/s digital		
Preload classes	V1 Preload 0 to 0.03 C		(C = dynamic load capacity)
Accuracy classes	G1		
Materials - guideways, carriages, ball bearings - ball recirculation	Stainless, through-hardened steel POM		
Areas of application - temperature range [1] - vacuum - humidity - cleanroom	-40 °C to +80 °C (-40 °F to +176 °F) On request 10 % to 70 % (non-condensing) Cleanroom class ISO 7 or ISO 6 (in accordance with ISO 14644-1)		
Resolution	TTL output	0.1 µm [3]	(optional: 1 µm / 10 µm)
Accuracy [2]	1000 mm	+/- 5 µm [4]	
Repeatability [2]	Unidirectional Bidirectional	+/- 0.1 µm +/- 0.2 µm	(with resolution of 0.1 µm)
Dimensional scale	Pitch Max. length Coefficient of expansion	100 µm 1000 mm 11.7 x 10-6K-1	
Supply voltage	5 V DC +/- 5 %		
Current consumption (typical)	60 mA (analog) / 90 mA (digital)		
Output signal	Analog: 1 Vpp (at 120 Ω) Digital: TTL in accordance with RS 422 standard		
Source format	Differential sin/cos analog signals with reference pulse or Differential, interpolated digital signals (A, B, R) The reference signal is synchronised with the incremental signals		

[1] The standard lubrication covers a temperature range from -20 °C to +80 °C. Lubricants for other temperatures are available upon request from SCHNEEBERGER.

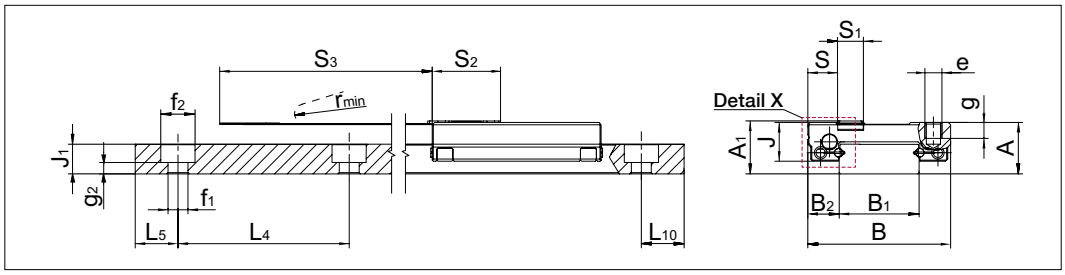
[2] The values apply to a room temperature of 20 °C (68 °F).

[3] Note the high signal frequencies at high resolution and high speed.

[4] Linearity protocol available on request

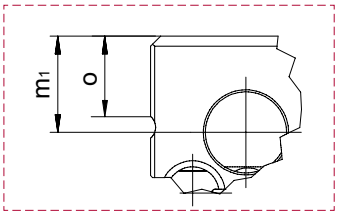
10 MINISCALE PLUS Product Overview

10.2.2 Dimension Tables, Load Capacities, and Moment Loads for Standard Width MINISCALE PLUS



Please contact SCHNEEBERGER for applications with a single MINISCALE PLUS carriage type MNNS 7, 9, 12 or 15.

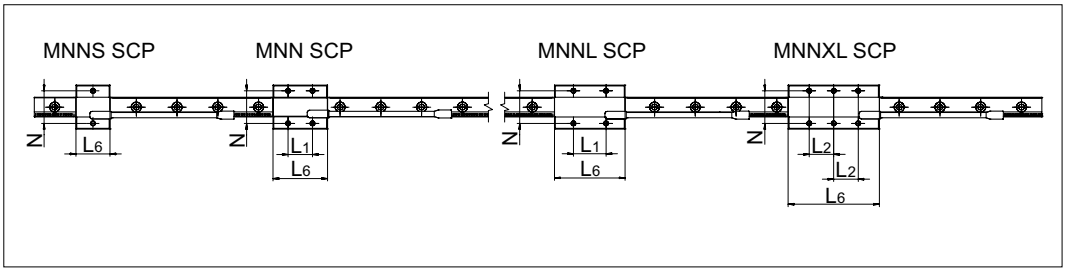
Detail X

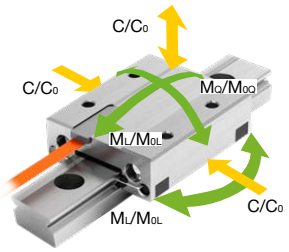


		Name	Standard size 7					Standard size 9				
			Guideway	MNNS SCP	MNN SCP	MNNL SCP	MNNXL SCP	Guideway	MNNS SCP	MNN SCP	MNNL SCP	MNNXL SCP
Dimensions (mm)	A	System height		8					10			
	A_1	System height with sensor		9.2								
	B	System width		17					20			
	B_1	Rail width	7					9				
	B_2	Distance between reference surfaces		5					5.5			
	J	Carriage height		6.5					8			
	J_1	Rail height	4.5					5.5				
	L_1	Longitudinal spacing of attachment holes		-	8	13	20		-	10	16	26
	L_2	Longitudinal spacing of attachment holes		-	-	-	10		-	-	-	13
	L_4	Spacing of attachment holes	15					20				
	L_5/L_{10}	Position of first and last attachment hole	5					7.5				
	L_6	Carriage length (steel body)		16.1	22.1	29.6	38.6		19	29	37	47
	N	Lateral attachment hole spacing		12					15			
	e	Thread		M2					M3			
	f_1	Hole diameter	2.4					3.5				
	f_2	Countersink diameter	4.2					6				
	g	Thread depth		2.5					3			
	g_2	Step drilling height	2.2					2				
	m_1	Position of lubrication holes		3.1					3.8			
	o	Reference face height		2.5					3.1			
	s	Distance from sensor		3.6					4.2			
	s_1	Sensor width		5.5					5.5			
	s_2	Sensor length		13.5					13.5			
	s_3	Length of the flexible printed circuit board		75					75			
	r_{min}	Permitted radius		2					2			
Load capacity (N)	C_0	Static load capacity		935	1560	2340	3275		1385	2770	3880	5270
	C	Dynamic load capacity (≙ C_{100})		645	925	1230	1550		1040	1690	2140	2645
Torque (Nm)	M_{0Q}	Permissible lateral static torque		3.4	5.6	8.4	11.8		6.5	12.9	18.1	24.5
	M_{0L}	Permissible longitudinal static torque		1.6	4.3	9.3	18		2.8	10.2	19.4	35.1
	M_Q	Permissible lateral dynamic torque		2.3	3.3	4.4	5.6		4.8	7.9	9.9	12.3
	M_L	Permissible longitudinal dynamic torque		1.1	2.5	4.9	8.5		2.1	6.2	10.7	17.6
Weights guideway (g/m), carriage (g)			216	9	13	18	23	309	16	24	31	40

SCHNEEBERGER LINEAR TECHNOLOGY

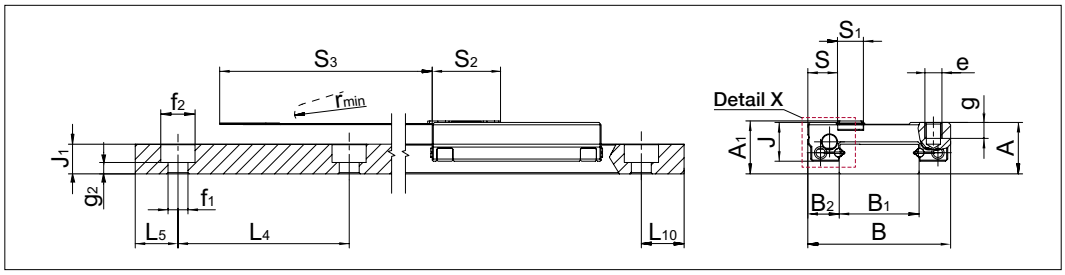
10 MINISCALE PLUS Product Overview



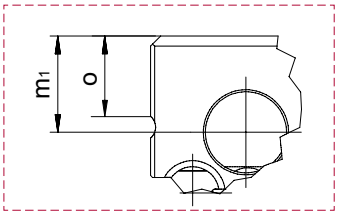


		Name	Standard size 12					Standard size 15				
			Guideway	MNNS SCP	MNN SCP	MNNL SCP	MNNXL SCP	Guideway	MNNS SCP	MNN SCP	MNNL SCP	MNNXL SCP
Dimensions (mm)	A	System height		13					16			
	A_1	System height with sensor										
	B	System width		27					32			
	B_1	Rail width	12					15				
	B_2	Distance between reference surfaces		7.5					8.5			
	J	Carriage height		10					12			
	J_1	Rail height	7.5					9.5				
	L_1	Longitudinal spacing of attachment holes		-	15	20	30		-	20	25	40
	L_2	Longitudinal spacing of attachment holes		-	-	-	15		-	-	-	20
	L_4	Spacing of attachment holes	25					40				
	L_5/L_{10}	Position of first and last attachment hole	10					15				
	L_6	Carriage length (steel body)		20.9	33.4	43.4	55.9		28.7	40.7	55.7	70.7
	N	Lateral attachment hole spacing		20					25			
	e	Thread		M3					M3			
	f_1	Hole diameter	3.5					3.5				
	f_2	Countersink diameter	6					6				
	g	Thread depth		3.5					4			
	g_2	Step drilling height	3					5				
	m_1	Position of lubrication holes		4.75					5.55			
	o	Reference face height		3.9					4.9			
	s	Distance from sensor		6.7					8.3			
	s_1	Sensor width		5.5					5.5			
	s_2	Sensor length		13.5					13.5			
	s_3	Length of the flexible printed circuit board		75					75			
	r_{min}	Permitted radius		2					2			
Load capacity (N)	C_0	Static load capacity		1735	3900	5630	7800		3120	5620	8740	11855
	C	Dynamic load capacity (≙ C_{100})		1420	2510	3240	4070		2435	3680	5000	6200
Torque (Nm)	M_{00}	Permissible lateral static torque		10.6	23.8	34.4	47.6		23.7	42.7	66.4	90.1
	M_{0L}	Permissible longitudinal static torque		3.6	16.3	32.9	61.8		9.4	28.1	65.5	118.6
	M_Q	Permissible lateral dynamic torque		8.7	15.3	19.8	24.8		18.5	27.9	38.1	47.1
	M_L	Permissible longitudinal dynamic torque		3	10.4	18.9	32.2		7.3	18.4	37.6	62
Weights guideway (g/m), carriage (g)			598	29	47	63	81	996	56	81	114	146

10.2.3 Dimension Tables, Load Capacities and Moment Loads for Wider Width MINISCALE PLUS



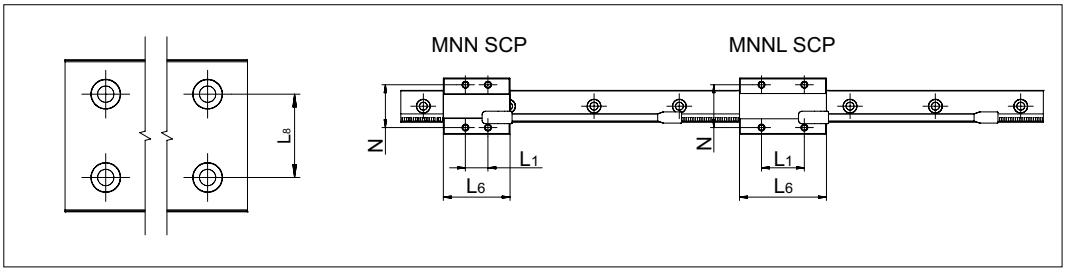
Detail X

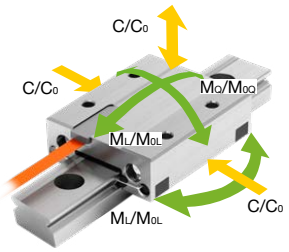


		Name	Wide size 14			Wide size 18		
			Guideway	MNN SCP	MNNL SCP	Guideway	MNN SCP	MNNL SCP
Dimensions (mm)	A	System height		9			12	
	A_1	System height with sensor		10				
	B	System width		25			30	
	B_1	Rail width	14			18		
	B_2	Distance between reference surfaces		5.5			6	
	J	Carriage height		6.8			8.5	
	J_1	Rail height	5.2			7		
	L_1	Longitudinal spacing of attachment holes		10	19		12	24
	L_2	Longitudinal spacing of attachment holes		-	-		-	-
	L_4	Spacing of attachment holes	30			30		
	L_5/L_{10}	Position of first and last attachment hole	10			10		
	L_6	Carriage length (steel body)		29.6	38.6		37	47
	L_8	Lateral attachment hole spacing	-			-		
	N	Lateral attachment hole spacing		19			21	
	e	Thread		M3			M3	
	f_1	Hole diameter	3.5			3.5		
	f_2	Countersink diameter	6			6		
	g	Thread depth		2.8			3	
	g_2	Step drilling height	2			2.5		
	m_1	Position of lubrication holes		3.3			4.3	
	o	Reference face height		2.2			3.1	
	s	Distance from sensor		5.2			5.8	
	s_1	Sensor width		5.5			5.5	
	s_2	Sensor length		13.5			13.5	
	s_3	Length of the flexible printed circuit board		75			75	
	r_{min}	Permitted radius		2			2	
Load capacity (N)	C_0	Static load capacity		2340	3275		3880	5270
	C	Dynamic load capacity (≙ C_{100})		1230	1550		2140	2645
Torque (Nm)	M_{0Q}	Permissible lateral static torque		16.6	23.3		35.5	48.2
	M_{0L}	Permissible longitudinal static torque		9.3	18		19.4	35.1
	M_Q	Permissible lateral dynamic torque		8.7	11		19.6	24.2
	M_L	Permissible longitudinal dynamic torque		4.9	8.5		10.7	17.6
Weights guideway (g/m), carriage (g)			518	25	33	915	47	60

SCHNEEBERGER LINEAR TECHNOLOGY

10 MINISCALE PLUS Product Overview





		Name	Wide size 24			Wide size 42		
			Guideway	MNN SCP	MNNL SCP	Guideway	MNN SCP	MNNL SCP
Dimensions (mm)	A	System height		14			16	
	A_1	System height with sensor						
	B	System width		40			60	
	B_1	Rail width	24			42		
	B_2	Distance between reference surfaces		8			9	
	J	Carriage height		10			12	
	J_1	Rail height	8.5			9.5		
	L_1	Longitudinal spacing of attachment holes		15	28		20	35
	L_2	Longitudinal spacing of attachment holes		-	-		-	-
	L_4	Spacing of attachment holes	40			40		
	L_5/L_{10}	Position of first and last attachment hole	15			15		
	L_6	Carriage length (steel body)		43.4	55.9		52.7	70.7
	L_8	Lateral attachment hole spacing	-			23		
	N	Lateral attachment hole spacing		28			45	
	e	Thread		M3			M4	
	f_1	Hole diameter	4.5			4.5		
	f_2	Countersink diameter	8			8		
	g	Thread depth		3.5			4.5	
	g_2	Step drilling height	4			5		
	m_1	Position of lubrication holes		4.75			5.5	
	o	Reference face height		3.9			4.9	
	s	Distance from sensor		7.8			8.8	
	s_1	Sensor width		5.5			5.5	
	s_2	Sensor length		13.5			13.5	
	s_3	Length of the flexible printed circuit board		75			75	
	r_{min}	Permitted radius		2			2	
Load capacity (N)	C_0	Static load capacity		5630	7800		8110	11855
	C	Dynamic load capacity (≙ C_{100})		3240	4070		4750	6200
Torque (Nm)	M_{QQ}	Permissible lateral static torque		68.2	94.4		171.2	250.2
	M_{QL}	Permissible longitudinal static torque		32.9	61.8		56.8	118.6
	M_Q	Permissible lateral dynamic torque		39.2	49.3		100.3	130.8
	M_L	Permissible longitudinal dynamic torque		18.9	32.2		33.3	62
Weights guideway (g/m), carriage (g)			1476	84	109	2828	169	231

10.2.4 MINISCALE PLUS Components and Working Method

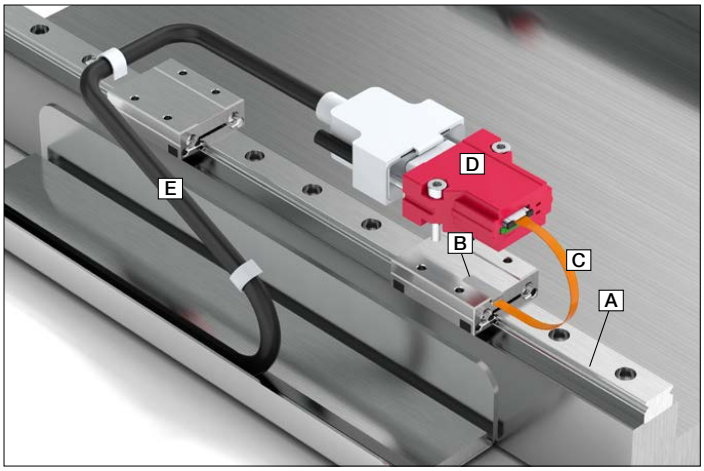
MINISCALE PLUS is an optical, incremental measuring system that consists of the MINIRAIL guide system and the following additional components:

A Dimensional scale on the guide rail
B Optical sensor on the carriage
C Flexible Sensor Print (must not be exposed to dynamic loads)
D Interface module

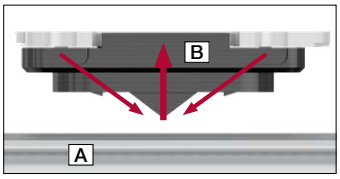
The control cable **E** with D-Sub 9 connector must be supplied by the customer and be a flexible cable where necessary.

There are various structural types of interface modules available. These are described in section „Interface module“.

With a flexible flat cable (Flat Flex Cable, abbreviated: FFC), which is inserted between the flexible sensor print and the interface module, the interface module can be positioned flexibly. The FFC cables are suitable for dynamic loads. (You can find more information about this in section 10.2.8)



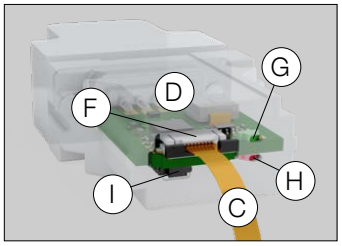
Axis with MINIRAIL, MINISCALE PLUS and interface module



Sensor principle
A Dimensional scale on guideway
B Sensor in carriage

Dimensional scale and optical sensor
The high-precision dimensional scale is part of the hardened guideway's surface with a scale increment of 100 µm. Two LEDs in the sensor illuminate the dimensional scale. Light-dark fields form because of the illumination of the various structured areas on the dimensional scale. These optical signals are detected by the sensor and converted into electrical signals. The raw signals supplied by the sensor are processed by the interface module.

The level of illumination provided by the LEDs is actively controlled. This can counteract the aging of the system and impurities on the dimensional scale are also compensated for.



Components of the interface module

Interface module
The raw signals are processed by the interface module and converted to standard output signals. Analog or digital interface modules are available.

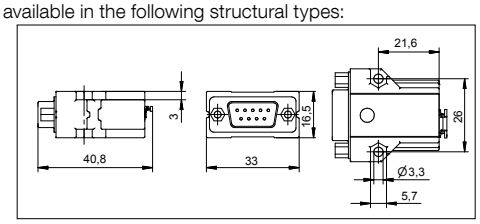
Ensure the ZIF connector **F** is accessible and the LED displays (**G** and **H**) on the interface module are clearly visible. Unlike the analog interface, the digital interface includes a compensation key **I**, which must also be accessible.

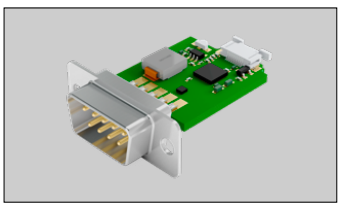
C Flexible Sensor Print
D Electronics (in various structural types)
F ZIF connector
G Green LED (operating voltage)
H Red LED (error indicator)
I Compensation key (only on digital interface module)

The interface modules are available in the following structural types:

With housing
With D-Sub 9 connector

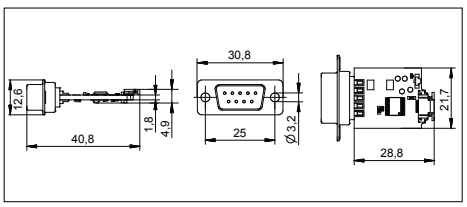
Order designation: MG
(Standard)

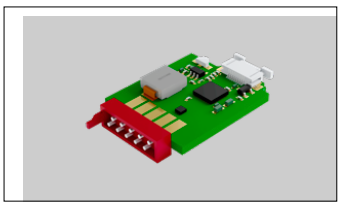




Without housing
With D-Sub 9 connector

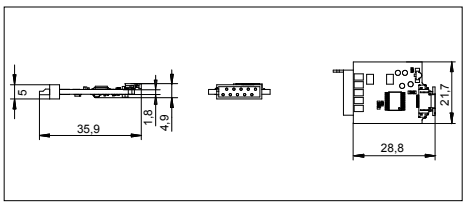
Order designation: OG

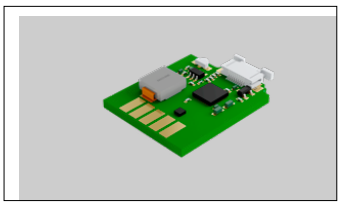




Without housing
With Micro Match connector
(for plug-in assembly on
an electronics board)

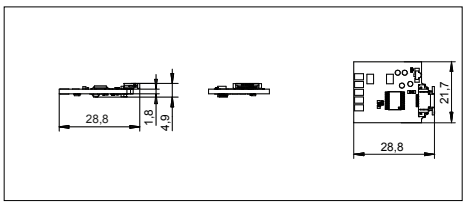
Order designation: MM





Without housing
Without connector
With solder terminals

Order designation: NL



For customers with expertise in electronics, it is also possible to assemble their own digital interface module and integrate it into their own electronics, in consultation with SCHNEEBERGER.
Order designation: KI

10.2.5 Signal Processing

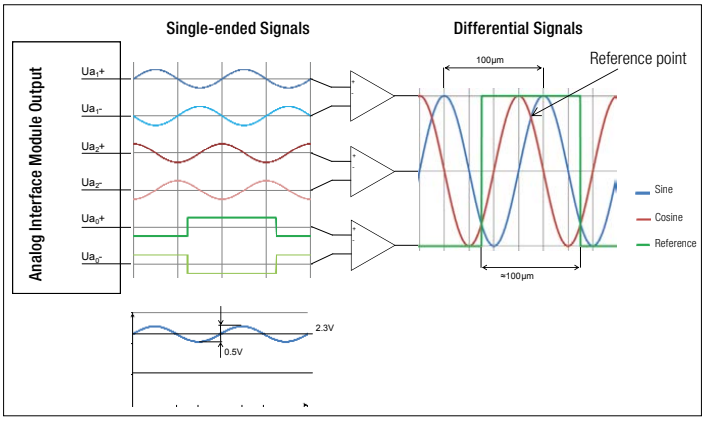
Further information about signal processing is available from the download section of our website www.schneeberger.com.

Analog output format:
Differential, sin/cos analog signals with reference pulse 1 Vpp (at 120 Ω).

The incremental signals sine and cosine are shifted 90° and correlated with the markings on the encoded scale. An electrical signal period (360°) corresponds precisely to the scale increment of the dimensional scale, which is 100 µm.

The reference pulse always marks electronically the same section of the path of the sine and cosine signals. The point of intersection of the two signals within the reference pulse therefore marks a precisely defined position on the dimensional scale.

The sine signal either lags behind the cosine signal or occurs before it, depending on the direction of movement.



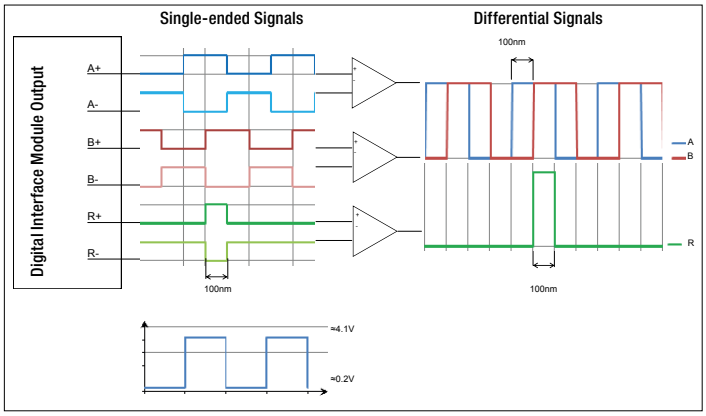
Digital output format:
Differentially interpolated digital signals with reference pulse (A, B, R) TTL signal (RS422).

The digital interface module both processes the raw signal and interpolates the processed analog signal. The interpolation achieves a resolution of 100 nm.

The digital signal waveform consists of an A and B signal. The spacing between the two edges of signals A and B correspond exactly to a distance of 100 nm. The 100 µm increments of the encoder scale are consequently divided into 1000 sections of 100 nm by means of interpolation. The A signal either lags behind the B signal or occurs before it, depending on the direction of movement.

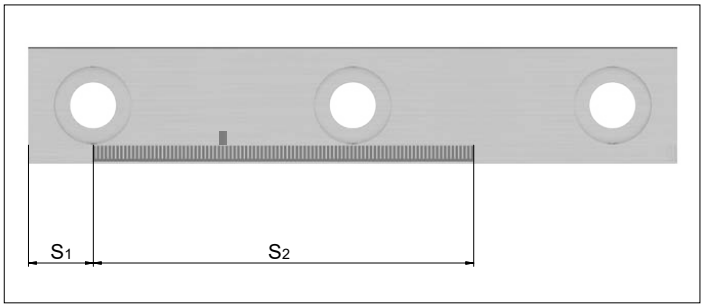
The reference pulse is as wide as the spacing between the two signal edges of signals A and B (100 nm).

The edges of the incremental and reference signals are synchronised.



10.2.6 Incremental track

In standard versions, the incremental track is continued over the entire guideway length.
The position and length can be adapted as per the customer's request.



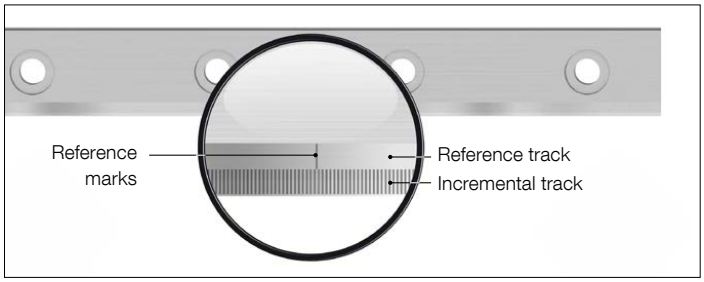
S1 = Start of incremental track
S2 = Length of incremental track

Restrictions:

- For analog MINISCALE PLUS guideways, the length of the incremental track (S_2) must be at least 30 mm

10.2.6 Reference Marks

Incremental measuring systems cannot determine the exact position when switched on. For this reason the reference track is added alongside the incremental track. One or multiple reference points can be marked on the reference track.

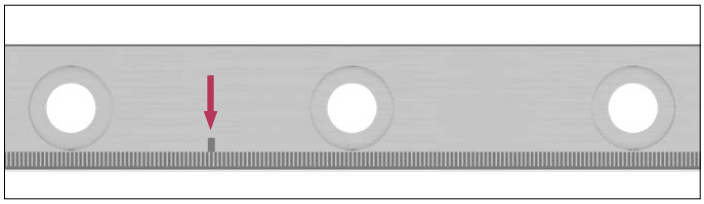


MINISCALE PLUS guideway with dimensional scale

Standard version

The following reference position is defined as standard for all sizes:

- Referencing in the centre of the first and second fixing hole



Standard position of the reference marks for all sizes

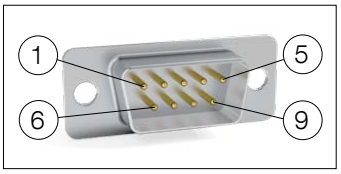
Special versions

Any number of reference marks can be chosen at any position along the reference track. It is necessary for the reference marks to be synchronised with the dimensional scale. Specifically this means that the reference marks can only be placed in multiples of 0.1 mm, since the pitch of the dimensional scale is 0.1 mm. A minimum distance of 1.5 mm between the reference marks should be maintained. Aditionally, the distance between the end of the incremental track and the reference mark must be at least 2 mm.

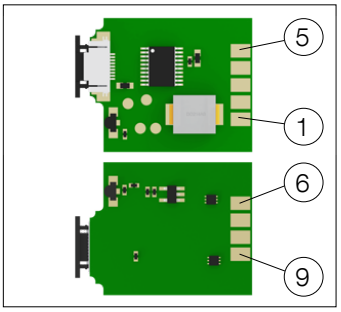
Restrictions:

- The attachment holes on guideways of type 7 and 9 are located on the reference track. The reference marks must therefore be BETWEEN the attachment holes for both of these sizes.
- When specifying the reference mark(s), ensure they can be seen by the carriage's sensor.

10.2.7 Analog (1VSS) and Digital (TTL) Interface Module Pin Connections



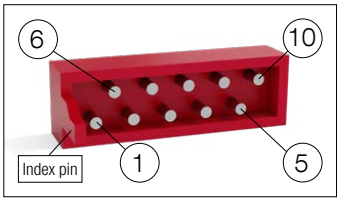
Pin connections of D-Sub 9 connector at the interface module



Pin connections at the interface module with solder terminals

Male 9-pin D-Sub connector or solder terminals:

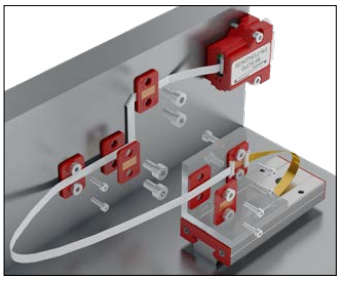
Pin	Analog Signal	Digital Signal	Description
1	Ua1-	A -	Quadrature signal
2	0V	0V	Ground
3	Ua2-	B -	Quadrature signal
4	ERR NOT	ERR NOT	Error signal (Low = Error)
5	Ua0 -	R -	Reference signal
6	Ua1 +	A +	Quadrature signal
7	+ 5V DC	+ 5V DC	Supply voltage
8	Ua2 +	B +	Quadrature signal
9	Ua0 +	R +	Reference signal



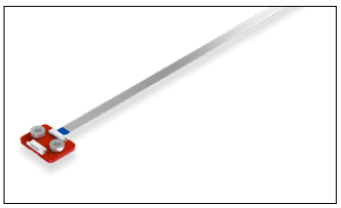
Pin connections of Micro Match connector at the interface module

Male 10-pin Micro Match connector:

Pin	Analog Signal	Digital Signal	Description
1	nc	nc	
2	Ua1 +	A +	Quadrature signal
3	+ 5V DC	+ 5V DC	Supply voltage
4	Ua2 +	B +	Quadrature signal
5	Ua0 +	R +	Reference signal
6	Ua1 -	A -	Quadrature signal
7	0V	0V	Ground
8	Ua2 -	B -	Quadrature signal
9	ERR NOT	ERR NOT	Error signal (Low = Error)
10	Ua0 -	R -	Reference signal



Installation example with FFC extension



FFC cable with adapter

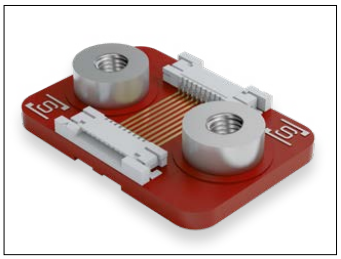
10.2.8 Extensions

Wherever the interface module cannot be mounted directly at the sensor, the extension kit can be used. A flexible flat cable (Flat Flex Cable, abbreviated: FFC) is used between the sensor print and the interface module.

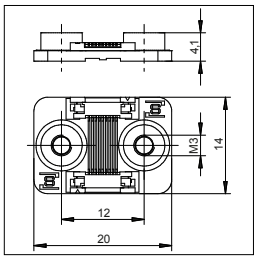
This offers the following benefits:

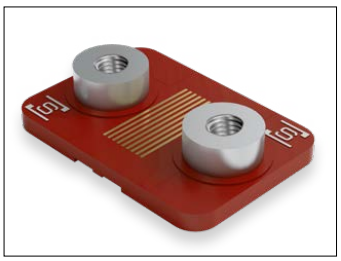
- By moving the interface module, the mass of the moving system can be reduced by moving the interface module to a non-moving location.
- The shielded FFC cable included in the extension set is also designed to be dynamically loaded. The minimum recommended bending radius is 10 mm. In contrast, the flexible sensor print can only be installed statically.
- The FFC cable provides a low push force. This can be a benefit wherever a cable that can be used in a cable carrier is too rigid.
- The FFC cable can also be folded once during installation.

FFC cables are available in three lengths: 250 mm, 400 mm and 600 mm.
An adapter board is delivered with the FFC extension cable.

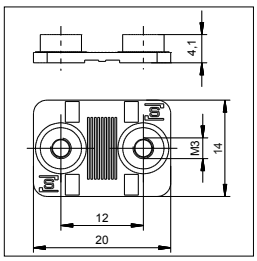


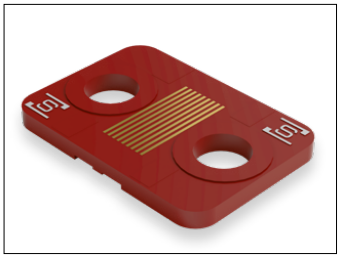
Adapter
It is used for the electrical connection between the sensor print and the extension cable. Two ZIF connectors are available on the adapter for this purpose.



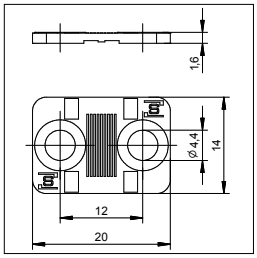


Clamp plate
Can be used for stress relief or to guide the FFC cable. Two M3 spacer sleeves are installed on the board.





Base plate
Can be used as a base or for clamping the cable.



10.2.9 Lubrication

General
Lubrication is a design element and must therefore be defined during the development phase of a machine or application. If the lubrication is specified after design and construction is complete, this is likely to lead to operational difficulties. A carefully thought out lubrication concept is therefore a sign of a state-of-the-art and well devised design.

Parameters to be taken into account in selecting the lubricant include:

- Operating conditions (speed, acceleration, stroke, load, installation orientation)
- External influences (temperature, aggressive media or radiation, contamination, humidity, vacuum, cleanroom)
- Relubrication (Period of time, amount, compatibility)
- Compatibility (with other lubricants, with corrosion protection and with integrated materials such as plastic)

Technical and economic considerations determine the lubricant used.

The guideways should be kept free of cutting oils or water-soluble coolants as they thin or wash off the lubricant. In addition, coolants tend to stick when drying out. Lubricants with solid additives are not suitable.

Additional important information on lubrication is given in chapter 16.3.4.