Precision in measuring

Measuring Systems

Linear encoders
Rotary encoders
Angle encoders
Digital Position Readouts

Iskra

Iskra TELA d.d.

ISKRA - The History

Iskra Tela is the production company for elements for electronic and automationelements.

The company itself is a member of the Iskra group and in majority ownership of Iskra Corporation.

The history of company begines in 1949 when Iskra Tela was established.
From the first beginning the company has been oriented towards leading edge industrial automation technologies:

Milestones:

1960: First Digital readout
1970: First positioning system
1982: First Linear encoder
1983: First Rotary encoder
1986: First CNC control system
1997: First NC linear encoder
2000: First metal tape linear encoder
2005: First Absolute linear encoder

ISKRA - The Present

Today Iskra TELA's focus is on development, production and marketing of elements for electronic and automation, sensors and systems for automation in industry.

Production programme MEASURING SYSTEMS is one of the more sophisticated in Iskra Group. It has interdisciplinary knowledge of different technologies: Opt-electronics, micro-electronics, precision mechanics, engineering.

The high quality of Iskra products requires special production, measuring and testing equipment.

Iskra has designed and made the special machines required for production and measurement of linear and rotary encoders.

Our high quality standard is confirmed by certification in the ISO 9001 quality system and by authorisation of BvQi.

Summary

Precision measurements, graduations

Linear Encoders for length measurements:
- DRO Incremental Glass Linear Encoders: TGM111, 113, 115, 130, 131, 170, 179
- Long length metal tape Linear Encoder: TGM190,
- NC Incremental Glass Linear Encoders: TGM133, 173,
- ABSOLUTE Linear Encoders: TCM133, TCM173,

Rotary Encoders for angle and position measurements
- Miniature and standard Rotary Encoders
- Angular Encoders

Accessories
- Interpolation Electronics
- Magnet Field Sensor

Digital Position Readouts for conventional manually operated machine tools

Precision measurements, graduations

Precision grating of chrome coated glass is a highly technological process for linear and rotary encoders.

Chrome coated glass precision graduations are composed of an extremely thin layer of chrome on glass.

A small output signals 20ym or 40ym periode ensures high repeatability and accuracy for all kind of applications:
- Optics
- High precision measurements
- Semiconductor technology
- Inspection Devices

Linear Encoders for length measurements:

Linear encoders measure the position of linear axis and are suitable for positioning accuracy on machines. The scales are protected against chip, dust and cooling water and are designed for use on various machine tools and installations such as:

- Lathes,
- Milling machines,
- Drilling and boring machines,
- machining centres,
- grinding machines, EDM machines,
- Bending presses,
- welding machines,
- other positioning devices etc.

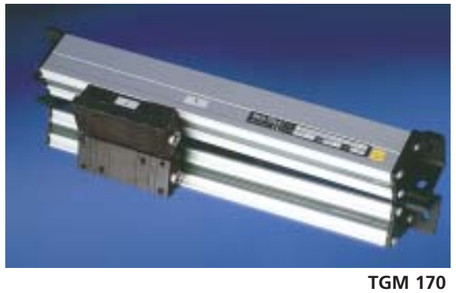
Iskra offers a wide range of linear encoders requiring different types of feedback signals for manufacturer's and end-user's of machine tools.

- DRO Incremental glass linear encoders
- NC Incremental glass linear encoders
- Long lengths linear metal tape encoder
- Absolute Linear encoders

TGM 111

TGM 113

TGM 130



TGM 170

DRO Linear Encoders

DRO Linear encoders are used primarily on conventional metal working machine tools (lathes, milling machine tools, drilling and boring machines, grinding machine tools, machining centres, EDM, press brakes, etc).
Both the scale and reading head are protected against the influence of industrial environment
Available resolutions from 10 to 0,5 microns, output signals 11uA, 5V TTL RS422A, 12V square wave, +/-12V sinusoidal etc, Reference marks: one, two, upon request or distance coded reference marks.

With incremental linear scales current position is determined by starting at reference position and counting measuring steps.

The DRO Linear Encoders family consists of optoelectronic incremental linear encoders types: TGM 111, 113, 115, 130, 131, 170.

Model Name	TGM 111	TGM 113/115	TGM 130/131	TGM 170
Output signals	SO=Sine voltage DI=square wave differential DO=square wave	SO=Sine voltage, DS=square wave differential RS422A DO=square wave	SI = 11µApp, SV = 1Vpp DS=square wave differential RS422A DO=square wave	SI = 11µApp, SV = 1Vpp DS=square wave differential RS422A DO=square wave
Engraving pitch	20µm or 40µm	20µm or 40µm	20µm or 40µm	20µm or 40µm
Resolution	Available: 1µm, 2µm, 5µm, 10µm	Available: 0.5µm, 1µm, 2µm, 5µm, 10µm	Available: 0.5µm, 1µm, 2µm, 5µm, 10µm	Available: 0.5µm, 1µm, 2µm, 5µm, 10µm
Accuracy (at 20µC/68µF)	±3 µm (Lm<520mm), ±5 µm, ±10 µm	±3 µm (Lm<520mm), ±5 µm, ±10 µm	±3 µm, ±5 µm, ±10 µm	±3 µm, ±5 µm, ±10 µm
Light source	IR LED	IR LED	IR LED	IR LED
Photo detector	Photo transistor	Solar Cell		
Cross section	20x32mm (47,6mm)	16,3x29mm (45mm)	18x32mm (46mm)	37x51,5mm (77.5mm)
Measuring length [mm] TGM111: up to 2020mm TGM113: up to 1120mm TGM115: up to 1720mm TGM130: up to 1240mm TGM131: up to 2040mm TGM170: up to 3040mm	70,120,170,220,270,320, 370, 420, 470, 520, 570, 620, 670, 720, 770, 820, 920, 1020, 1120 (max for TGM113), 1220, 1320, 1420, 1520, 1620, 1720 (max for TGM115), 1820, 2020 (max for TGM111)		70,120,170,220,270,320, 370, 420, 470, 520, 570, 620, 670, 720, 770, 820, 920, 1020, 1140, 1240 (max for TGM130 and TGM131 without mounting bar), 1340, 1440, 1540, 1640, 1740, 1840, 2040 (max for TGM131 with mounting bar), 2240, 2440, 2640, 2840, 3040 (max for TGM170)	
Reference Mark	Reference Marks: TGM111: optionally each 100 mm TGM113/115: optionally each 50 mm,		Reference Marks: TGM130: : optionally each 50 mm TGM131/170: optionally each 50 mm or Distance coded: Passing two adjacent reference marks that are max. 20 mm apart from each other reproduces absolute position.	
Operating temperature	0°C to +50°C, (32µF to 122µF)		0°C to +50°C, (32µF to 122µF)	
Storage temperature	-30°C to +70°C, (-22µF to 158µF)		-30°C to +70°C, (-22µF to 158µF)	
Humidity range	30% to 90% (no condensation)		30% to 90% (no condensation)	
Protective design grade (class)	Normal: IP53; with Air Purge: IP64		Normal: IP53; with Air Purge: IP64	
Atmosphere	Corrosive gas should not be contained in the atmosphere		Corrosive gas should not be contained in the atmosphere	
Vibration resistance (max vibration)	30 m/s²		30 m/s²	
Shock resistance (max shock)	100m/s²		100 m/s²	
Max. Response speed	45 m/min		60 m/min	
Power supply Power consumption	+5 V ± 5% 130 mA max.		+5V±5% 130 mA max.	
Cable length:	3m standard, available up to 50m		3m standard, SI: up to 20m DS: DO: up to 50m SV: up to 150m	

Linear Encoder for press brakes

Model Name	TGM 179
Output signals	SI = 11µApp, SV = 1Vpp DS=square wave differential RS422A
Engraving pitch	20mm or 40mm
Resolution	Available: 0.5µm, 1µm, 2µm, 5µm, 10µm
Accuracy (at 20°C/68°F)	±3 µm, ±5 µm, ±10 µm
Light source	IR LED
Photo detector	Solar Cell
Cross section	55.2 x 51.5 mm (182 mm)
Measuring length [mm]	70,120,170,220,270,320, 370, 420, 470, 520, 570, 620, 670, 720, 770, 820, 920,
Reference Mark	Reference Marks: Optionally each 50 mm or Distance coded: Passing two adjacent reference marks that are max. 20 mm apart from each other reproduces absolute position.
Operating temperature	0°C to +50°C, (32°F to 122°F)
Storage temperature	-30°C to +70°C, (-22°F to 158°F)
Humidity range	30% to 90% (no condensation)
Protective design grade (class)	Normal: IP53; with Air Purge: IP64
Atmosphere	Corrosive gas should not be contained in the atmosphere
Vibration resistance (max. vibration)	30 m/s²
Shock resistance (max shock)	100 m/s²
Max. Response speed	60 m/min
Power supply	+5 V ± 5%
Power consumption	130 mA max.
Cable length:	3m standard, SI: up to 20m DS: DO: up to 50m SV: up to 150m

Long length metal tape Linear Encoder: TGM190

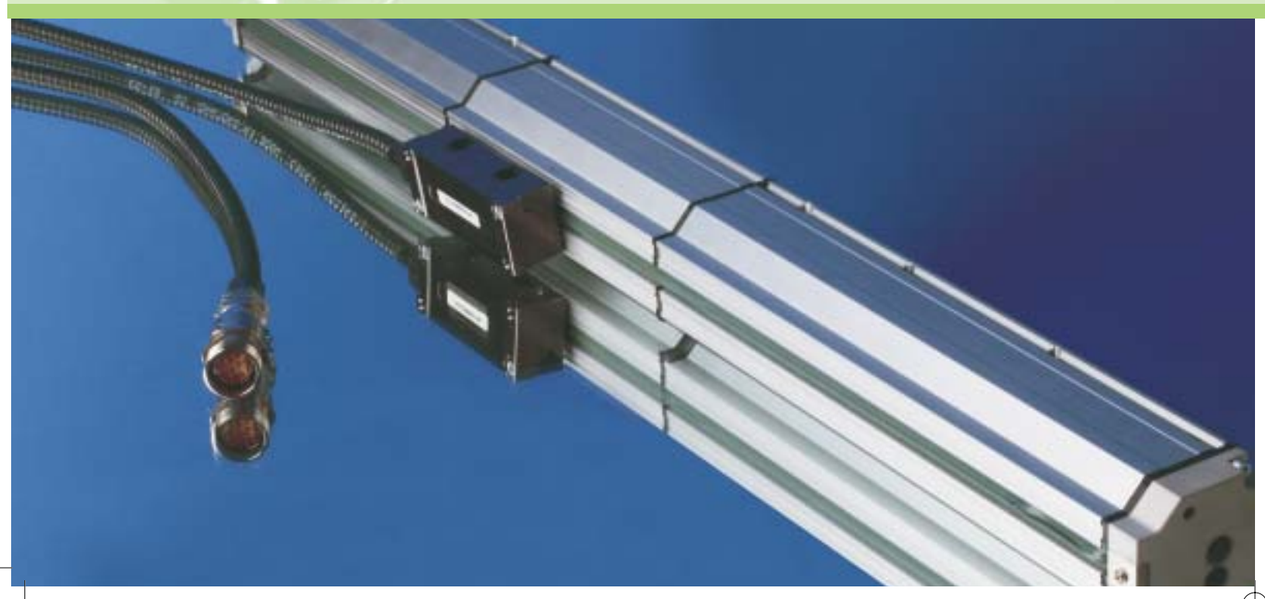
The linear encoders type are designed for measuring ranges from 3m to 30m with recommended resolutions from 10ym to1 microns.

Available output signals 11uA, 1Vpp, 5V TTL RS422A.

Reference marks: selectable via magnet selector or distance coded.

Model Name	Special long lengths linear encoder TGM 190
Output signals	SI = 11µApp, SV = 1Vpp DS=square wave differential RS422A
Engraving pitch	40mm
Resolution	Available: 1µm, 2µm, 5µm, 10µm
Accuracy (at 20°C/68°F)	±10 µm
Light source	IR LED
Photo detector	Solar Cell
Cross section	50x58.5 mm (85 mm)
Measuring length [mm]	Single Section Housing: 440, 640, 840, 1040, 1240, 1440, 1640, 1840, 2040, 2240, 2440, 2640, 2840, 3040, 3240, 3440 Multi Section Housing: 3640, 3840 … 29840, 30040
Reference Mark	Optionally each 100 mm selectable by magnet selector or Distance coded: Passing two adjacent reference marks that are max. 80 mm apart from each other reproduces absolute position.
Operating temperature	0°C to +50°C, (32°F to 122°F)
Storage temperature	-30°C to +70°C, (-22°F to 158°F)
Humidity range	30% to 90% (no condensation)
Protective design grade (class)	Normal: IP53; with Air Purge: IP64
Atmosphere	Corrosive gas should not be contained in the atmosphere
Vibration resistance (max vibration)	100 m/s²
Shock resistance (max shock)	100 m/s²
Max. Response speed	120 m/min
Power supply	+5 V ± 5%
Power consumption	130 mA max
Cable length:	3m standard, SI: up to 20m DS: DO: up to 50m SV: up to 150m

TGM 190

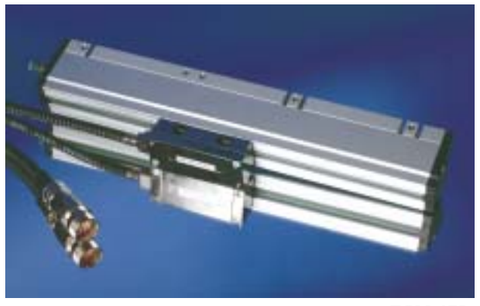


NC Incremental Glass Linear Encoders: TGM133, 173

The NC linear encoders types TGM133, 173 are primarily used for NC machine tools applications (CNC lathes, Machining centres, CNC EDM, etc). They may also be used for measuring and positioning in the semiconductor industry. Recommended resolutions from 1ym to 0,1 microns.
Available output signals 11uA, 1Vpp, 5V TTL RS422A. The scales are with defined thermal behaviour. Reference marks: one, two, upon request or distance coded. The NC Linear Encoders family consists of optoelectronic incremental linear encoders types: TGM 133 (slim size), TGM173 (medium size).

Model Name	TGM 133 (Slim size)	TGM 173 (Medium size)
Output signals	SI=11µApp, SV=1Vpp, DS=square wave differential RS422A	SI=11µApp, SV=1Vpp, DS=square wave differential RS422A
Engraving pitch	20µm	20µm
Resolution	for SI and SV output signals: Recommended: 0.1µm, 0.5µm, 1µm For DS output signals: Available: 0.1µm, 0.5µm, 1µm	for SI and SV output signals: Recommended: 0.1µm, 0.5µm, 1µm For DS output signals: Available: 0.1µm, 0.5µm, 1µm
Accuracy (at 20°C/68°F)	±3 µm, ±5 µm, ±10 µm	±3 µm, ±5 µm, ±10 µm
Light source	IR LED	IR LED
Photo detector	Solar Cell	Solar Cell
Cross section	18 x 32 mm (46 mm)	37 x 58,5 mm (85 mm)
Measuring length [mm] TGM133: max length up to 2040mm TGM173: max length up to 3040mm	70,140,170,240,270,340, 370, 440, 470, 540, 570, 640, 670, 740, 770, 840, 940, 1040, 1140 (max for TGM133 without mounting bar), 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040 (max for TGM133 with mounting bar), 2240, 2440, 2640, 2840, 3040 (max for TGM173)	
Measuring length [inch]	5.5, 7.5, 9.4, 13.4, 17.3, 21.3, 25.2, 29.1, 33.1, 37.0, 40.9, 44.9, 48.8, 52.8, 56.7, 60.6, 64.6, 68.5, 72.4, 80.3, 88.2, 96.1, 103.9, 111.8, 119,7	
Reference Mark	Distance coded: Passing two adjacent reference marks that are max. 20 mm apart from each other reproduces absolute position.	
Operating temperature	0°C to +50°C, (32°F to 122°F)	
Storage temperature	-30°C to +70°C, (-22°F to 158°F)	
Humidity range	30% to 90% (no condensation)	
Protective design grade (class)	Normal: IP53; with Air Purge: IP64	
Atmosphere	Corrosive gas should not be contained in the atmosphere	
Vibration resistance (max vibration)	100 m/s²	
Shock resistance (max shock)	100 m/s²	
Max. Response speed	120 m/min	
Power supply	+5V±5%	
Power consumption	130 mA max.	
Cable length:	3m standard, SI: up to 20m DS: up to 50m SV: up to 150m	

TGM 133



TGM 173

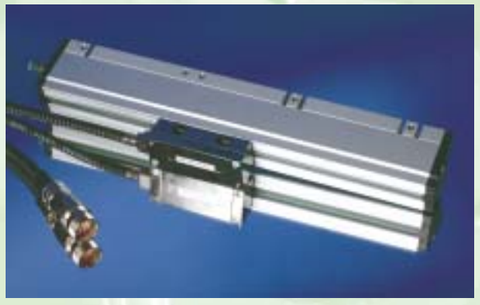
ABSOLUTE Linear Encoders: TCM133, TCM173

The ABSOLUTE linear encoders types TCM133, 173 are primarily used for CNC machine tools, positioning systems, robotics, production lines, semiconductor equipment etc.

The absolute position value is accertained By evaluating a pseudo-random code. Next to this code is an incremental track with grating periode of 32ym. Available resolutions from 1ym to 0,1 microns. Available output signals 1Vpp, 5V TTL RS422A. Type of absolute code interface: SSI or BiSS. The scales are with defined thermal behaviour.

The ABSOLUTE Linear Encoders family consists of linear encoders types: TCM 133 (slim size), TCM173 (medium size).

Model Name	TCM 133 (Slim size)	TCM 173 (Medium size)
Incremental output signals	SV=1Vpp, DS=square wave differential RS422A	SV=1Vpp, DS=square wave differential RS422A
Engraving pitch	32µm	32µm
Resolution	for SV (1Vpp) output signals: Recommended: 0.1µm, 0.2µm, 0.5µm, 1µm, 2µm For DS (5V TTL RS422A) output signals: Available: 0.1µm, 0.2µm, 0.5µm, 1µm, 2µm	for SV (1Vpp) output signals: Recommended: 0.1µm, 0.2µm, 0.5µm, 1µm, 2µm For DS (5V TTL RS422A) output signals: Available: 0.1µm, 0.2µm, 0.5vm, 1µm, 2µm
Absolute code Interface	SSI or BISS	SSI or BISS
Accuracy (at 20°C/68°F)	±3 µm, ±5 µm	±3 µm, ±5 µm
Light source	IR LED	IR LED
Photo detector	Integrated light to voltage converter	Integrated light to voltage converter
Cross section	18 x 32 mm (62 mm)	37 x 58,5 mm (85 mm)
Measuring length [mm]	70,140,170,240,270,340, 370, 440, 470, 540, 570, 640, 670, 740, 770, 840, 940, 1040, 1140, 1240 (for TCM133 mounting bar recommended), 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040 (max for TCM133, mounting bar required), 2240, 2440, 2640, 2840, 3040 (max for TCM173)	
Operating temperature	0°C to +50°C, (32°F to 122°F)	
Storage temperature	-30°C to +70°C, (-22°F to 158°F)	
Humidity range	30% to 90% (no condensation)	
Protective design grade (class)	Normal: IP53; with Air Purge: IP64	
Atmosphere	Corrosive gas should not be contained in the atmosphere	
Vibration resistance (max vibration)	100 m/s²	
Shock resistance (max shock)	100 m/s²	
Max. Response speed	120 m/min	
Power supply	+5V±5%	
Power consumption	150 mA max.	
Cable length:	3m standard: max for DS: up to 50m; max for SV: up to 150m	



TCM 173

TCM 133

Rotary Encoders for angle and position measurements

Rotary Encoders

Rotary encoders transform mechanical rotation into a series of electrical pulses. The operating principle is based on an optoelectronic technique. They are used in various industrial fields for accurate angle, positionand rotation speed measurements. Rotary encoders can be divided into two groups

Used for rotary motion applications, angular velocity, and linear position measurements when used in conjunction: with mechanical measuring standards like lead screw's.

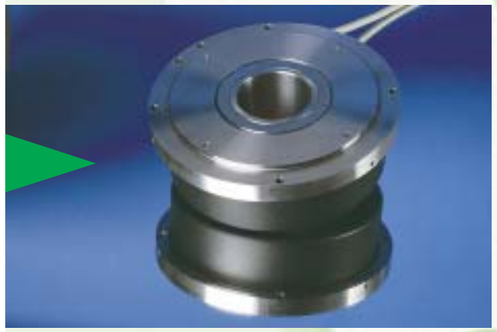
Miniature TGR22, 23, 24 (diameter 22mm) and standard TGR10, 11 12, (diameter 58mm) rotary encoders types: up to 5000 lin/rev, while TGR30 is a handwheel for manual positioning. Line numbers: 50-5.000 lin/rev. Output signals: square waves or sinusoidal. Sinusoidal signals can be interpolated by 5, 10, 25 and 50.

Model Name	Miniature versions, Diameter 22mm			Standard versions, Diameter 58mm			Hand wheel
	TGR22	TGR23	TGR24	TGR10	TGR11	TGR12	TGR30
Cable axial version	22.5	23,5	24.5	10.5	11.5	12.5	TGR3000
Cable radial version	22.4	23.4	24.4	10.6	11.6	12.6	TGR3001
Connector axial version				10.3	11.3	12.3	TGR3002
Connector axial version				10.4	11.4	12.4	(see data sheet)
Flange diameter	22	30	24	58	58	58	58
Shaft diameter	F6f7	F5f7	F4f7	F10f8	F6f8	F8h7	-
Mechanical protection	IP50	IP64, IP65	IP64, IP65	IP64, IP65	IP50		
Output signals: DO(square waves), DS (square waves differential with line driver), SI(11uA sine), SV(1Vpp sine)	DO, DS			DO, DS SI (11uA sine), SV (1Vpp sine)	DO, DS SI (11uA sine), SV (1Vpp sine)	DO, DS SI (11uA sine), SV (1Vpp sine)	DO, DS SI (11uA sine), SV (1Vpp sine)
Output levels: C (OC), T: 5V TTL, S: sine current, L: C-MOS, P: Push-Pull	C, T, P			C, T, L, S, P	C, T, L, S, P	C, T, L, S, P	C, T, L, S, P
Supply voltage	5V, 12V, 15-30V			5V, 12V, 15-30V	5V, 12V, 15-30V	5V, 12V, 15-30V	5V, 12V, 15-30V
Max frequency	50kHz			T,L: 300kHz, C: 150kHz, S: 85kHz	T,L: 300kHz, 150kHz, S: 85kHz	T,L: 300kHz, 150kHz, S: 85kHz	T,L: 300kHz, 150kHz, S: 85kHz
No. lines/rev.	standard: 100, 250, 360, 1024 other on special request			standard: 50, 60, 100, 125, 127, 150, 180, 200, 250, 360, 500, 600, 900, 1000, 1024, 1250, 1500, 1800, 2000, 2500, 3600, 5000 also available with integrated interpolation electronic x10			100
Accessories	Couplings K, M, H; Fastening plates			Couplings K, M, H; fastening plates, connectors, mounting flanges			no

TGR 11

TGR 12

TGR 62



TGR 72

TGR 72

Angular Encoders

Are used in various applications like NC rotary tables, high precision angle measuring tables, machining heads, telescopes, etc.

TGR61, 62 (diameter 90mm); TGRT71-72 (diameter (170mm) are primarily used for high - precision angle measurement for rotary tables; 6000, 9000, 18.000 and 36.000 lines/rev..

Output signals: square waves or sinusoidal. Sinusoidal signals can be interpolated by 5, 10, 25 and 50.

Model name	TGR 61	TGR 62
Cable axial version	61.5	-
Cable radial version	61.6	62.6
Flange dimension [mm]	90	90
Shaft diameter [mm]	F10H6	Hole F20H6
Mechanical protection	IP64	IP64
Output signals: DS: RS422A SI: (11mA sine), SV(1Vpp sine)	DS (square waves differential with line driver), SV, SI	DS (square waves differential with line driver), SV, SI
Supply voltage	5V±5%	5V±5%
No. lines/rev.	5000, 6000, 9000, 18000	5000, 6000, 9000, 18000
Reference marks	1 or DCR (Distance coded) only for 18000 lines	1 or DCR (Distance coded) only for 18000 lines
Accuracy	±2.5'', ±7.5''	±5'', ±7.5''
Accessories	Couplings	Couplings

Model name	TGR 71	TGR 72
Cable axial version	-	-
Cable radial version	71.6	72.6
Diameter [mm]	F170	F170
Shaft diameter [mm]	F14H6	Hole F50H7
Mechanical protection	IP64	IP64
Output signals: DS: RS422A SI: (11mA sine), SV(1Vpp sine)	DS (square waves differential with line driver), SV, SI	DS (square waves differential with line driver), SV, SI
Supply voltage	5V±5%	5V±5%
No. lines/rev.	16384, 18000, 36000	16384, 18000, 36000
Reference marks	1 or DCR (Distance coded) only for 18000 and 36000 lines	1 or DCR (Distance coded) only for 18000 and 36000 lines
Accuracy	±1.5'', ±2.5''	±2.5'', ±5''
Accessories	Couplings	Couplings

SIM 110

TMS 120

Accessories

Interpolation Electronics

Digitizing and interpolation single - axis units. They convert the sine wave current (11uA) or voltage signals (1Vpp) from the measuring transducers (linear encoders or rotary encoders) into TTL compatible square wave signals for digital up-down counter (e.g. digital position readouts, numerical CNC controllers etc.).

Model name	SIM110	SIM125/150
Interpolations factor	5, 10	25, 50
Input signals	Sine current 11uA or 1Vpp	Sine current 11uA or 1Vpp
Output signals	Square waves with line driver (A, Ainv, B, Binv, RI, Riinv, ERRinv)	Square waves with line driver (A, Ainv, B, Binv, RI, Riinv, ERRinv)
Power supply	5V	5V
Input frequency	50kHz	50kHz
Dimensions	100x65x35mm	100x65x35mm

Magnet Field Sensor

The TMS magnet field sensor is designed for measuring gear wheel speeds and for measuring the relative angle of gear wheel rotation. Its output signals are square wave A and B. Phase shift between signals depends on the gear wheel module. There are 4 nominal modules: 0.5, 1, 1.5 and 2).

Digital Position Readouts for conventional manually - operated machine tools

A family of NP (NP10, 20, 20Z, 21, 22, 30, 31) and ENP (ENP 20, 30) based on sophisticated technology (microprocessor structure) with wide selection of standard and special functions.

Family of one, two, three or four - axis digital position readouts for applications on different kinds of machine tools (lathes, lathes with analogue main spindle drive, milling machine tools, drilling and boring machines, grinding machine tools, machining centres, EDM, tool presetters, etc)

A digital position readout system consists of one, two, three or four linear encoders or rotary encoders for position measuring and of digital position readout unit for showing position values.

The NP system offer a great advantage over conventional measuring systems and provide's considerable improvement to new and used machine tools, substantially increasing productivity as well as profitability. They save a time, increase the dimensional accuracy of machine parts and enable operating easy.

Type	NP10	NP20	NP20Z	NP21	NP22	NP30	NP31	ENP20	ENP30
Housing versions availible	Box Console 'V' Panel mounting (special request)	Box Console 'V' Panel mounting (special request)	Box Console 'V' Panel mounting (special request)	Box Console 'V' Panel mounting (special request)	Box Console 'V' Panel mounting (special request)	Box Console 'V' Panel mounting (special request)	Box Console 'V' Panel mounting (special request)	Console 'V' Panel mounting (special request)	Console 'V' Panel mounting (special request)
Input signals versions	RS 422 (DS) 11uA (SI)	RS 422 (DS) 11uA (SI)	RS 422 (DS) 11uA (SI)	RS 422 (DS) 11uA (SI)	RS 422 (DS) 11uA (SI)	RS 422 (DS) 11uA (SI)	RS 422 (DS) 11uA (SI)	RS 422 (DS) 11uA (SI)	RS 422 (DS) 11uA (SI)
Axis number	1 1+1 (option)	2 2+1 (option)	3	2 2+1 (option)	2 2+1 (option)	3 3+1 (option)	3	3 3+1 (option)	3 3+1 (option)
Axis designation Application	X X, X' One axis	X, Z X, Z, Z' Lathes	X, Zo, Z Lathes	X, Y X,Y + X' or Y' Two coordinate machine tools	X, Z X, Z, Z' Tool Preseters	X, Y, Z X, Y, Z,+X' or Y' or Z' Milling machines, Horizontal milling machines with parallel 4th axis	X, Y, Z EDM	X, Y, Z X, Y, Z, + X' or Y' or Z' Lathes	X, Y, Z X, Y, Z, + X' or Y' o rZ' Milling machines, Horizontal milling machines with parallel 4th axis
Reset	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Preset	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reference Point Standard and DCRM	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ABS/REL	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Inch/mm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R/D	No	Yes	Yes	No	Yes	No	No	Yes	Yes
Datum Points	9	9	99	9	99	9	9	99	99
Conicity calculation	No	Yes	Yes	No	No	No	No	Yes	No
Bolt holes	No	No	No	No	No	Yes	Yes	No	Yes
Linear packet of holes	No	No	No	No	No	No	No	No	Yes
Rectangular packet of holes	No	No	No	No	No	No	No	No	Yes
Angle measuring	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Linear error compensation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Halving of the positioning values	Yes	Yes In Z axes	Yes In Z axes	Yes	Yes In Z axes	Yes	Yes	Yes In Z axes	Yes
Tool dimension compensation	No	Yes - 9	Yes - 99	No	Yes - 99	No	No	Yes - 99	Yes 1
Feedrate display	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Scalling factor	No	No	No	No	No	No	No	Yes	Yes
Electronic rotation - SKEW	No	No	No	No	No	No	No	No	Yes
RPM calculator	No	No	No	No	No	No	No	Yes	Yes
EDM machining mode	No	No	No	No	No	No	Yes	No	No
Analog output for main spindle drive	No	Option	Option	No	No	No	No	Option	Option
Constant surface speed	No	Option	Option	No	No	No	No	Option	Option
RS232C	Option	Option	Option	Option	Yes	Option	Option	Option	Option
Built in interpolator	Option	Option	Option	Option	Option	Option	Option	Option	Option
Touch sensor	Option	Option	Option	Option	Option	Option	Option	Option	Option
Battery back up	Option	Option	Option	Option	Option	Option	Option	Option	Option

NP 10

NP 20

NP 21

NP 31

ENP 20

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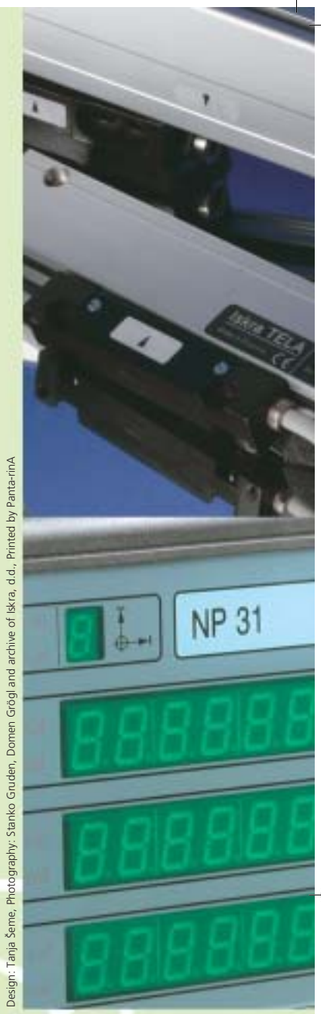

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