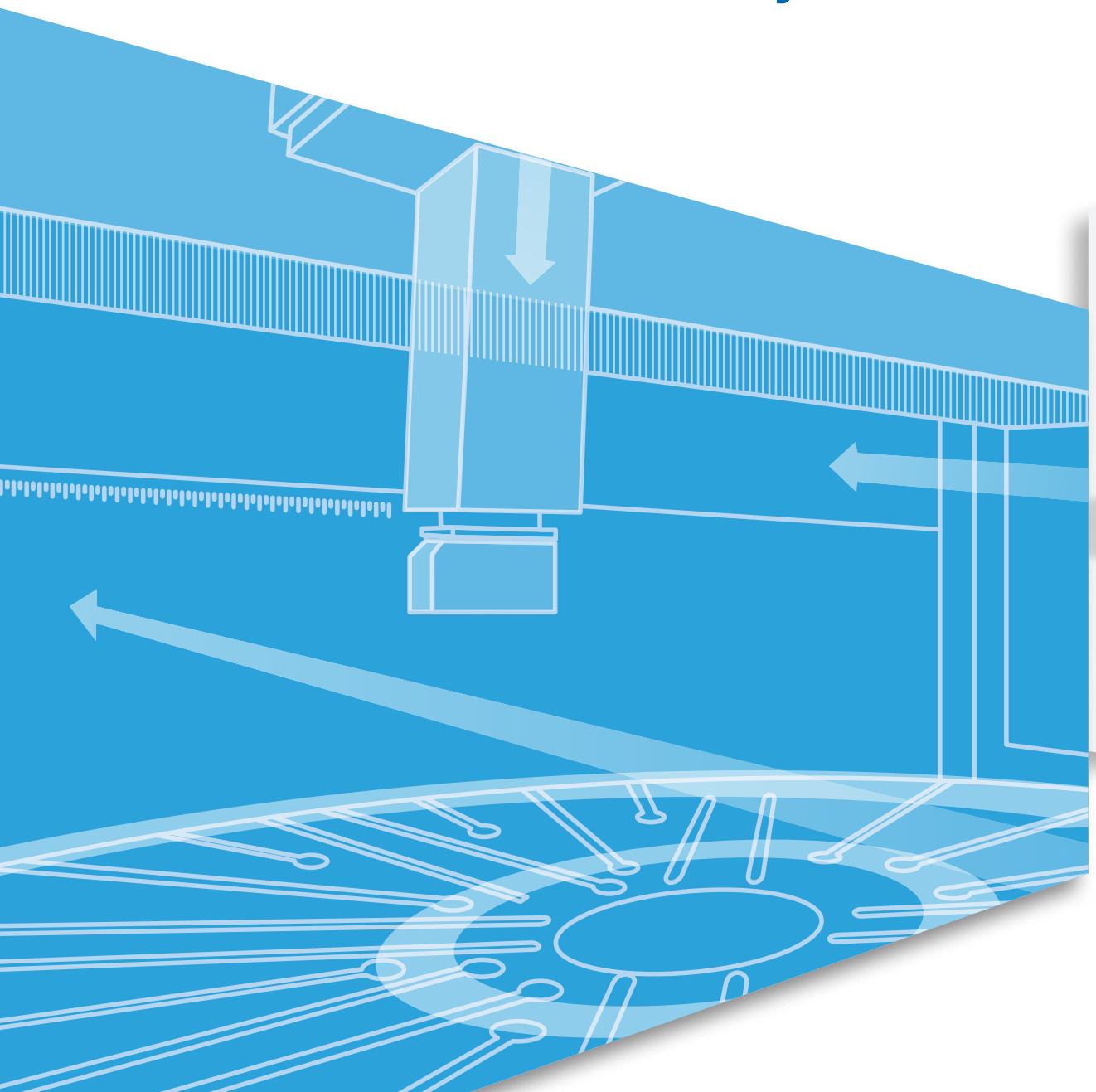
NEWALL
Going to Extremes

DRO Systems and Linear Encoders



A brand of CST
CUSTOM SENSORS & TECHNOLOGIES

Newall Company Profile

Newall Measurement Systems, Ltd. was founded in 1968 in Peterborough, United Kingdom. Since that time, Newall has dedicated itself to providing the machine tool and other machinery and production industries with leading edge technologies that increase productivity and machine tool efficiency.
The need for a reliable and highly accurate linear encoder led Newall, in 1973, to develop its world renowned Spherosyn™ linear encoder. Spherosyn™ incorporates a truly unique design in that none of the electrical or measuring components are exposed to the harsh workshop environment. This allows the encoder to operate under the harshest environmental conditions.
Newall's products also include a wide range of DRO systems, each specifically designed and dedicated to increasing productivity and machine tool efficiency. The digital readout range has developed to include some of the most advanced, market-leading readouts available today.

Over the years, Newall has grown to be a well-respected leader in digital readout systems and linear encoder technology. Over 85% of Newall's products are exported, with distribution and service outlets in over 63 countries. Newall actively supports these markets with a worldwide network of fully trained sales and service personnel. In addition, there are offices located in the USA and Europe.
Newall operates a Quality Management System that complies with the requirements of ISO 9001:2008 for the design, manufacture and service of digital readout systems, interface units, encoders and scales for machine tools and allied equipment.

NEWALL KEY MARKETS

Metal Cutting Conventional

Provide positional data of axis location at OEM and aftermarket (retrofit/rebuilder) level.
Primarily sold through machine tool and industrial distribution networks.

CNC Metal Fabrication

Provide positional feedback in servo loop for press brakes, plasma and water cutting.
Sold directly and through limited industrial distribution.

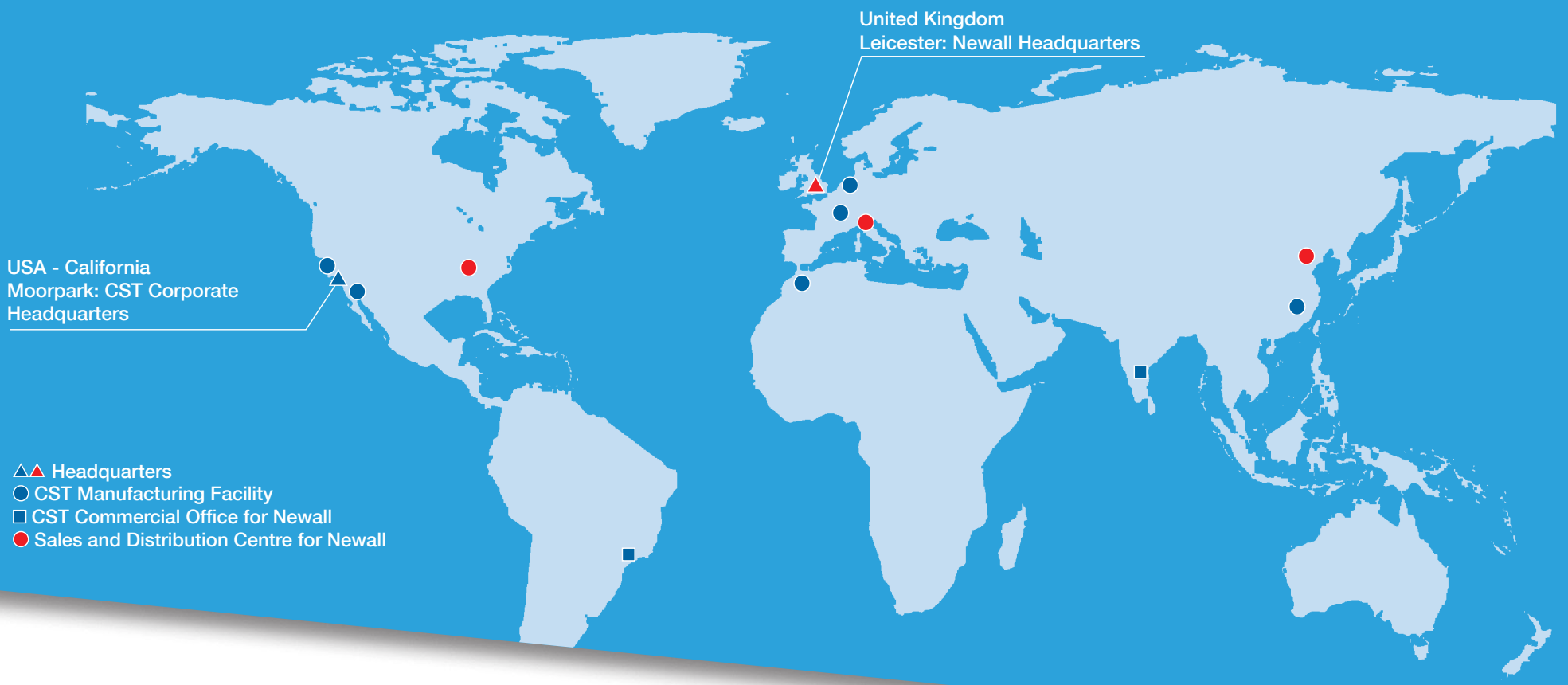
Metal Cutting CNC

Provide linear feedback for servo driven applications.
Primary market: machine tools, OEM and retrofit/rebuilder. Sold directly and through limited industrial distribution.

Industrial Automation

Provide linear positional feedback for PLC and other industrial automation applications. Sold directly and through limited industrial distribution.

Newall and CST Worldwide



Custom Sensors & Technologies (CST) is a specialist in sensing, control and motion products.

Through its brands, BEI Kimco, BEI Sensors, BEI PSSC, Crouzet, Crydom, Kavlico, Newall and Systron Donner Inertial, CST offers customizable, reliable and efficient components for mission-critical systems in Aerospace & Defense, Transportation, Energy & Infrastructures, Commercial & Industrial OEMs, Medical, Food and Beverage and Building Equipment Markets.

Focused on premium value offers and committed to excellence, CST, with 4,700 employees worldwide, is the dependable and adaptable partner for the most demanding customers.
www.cstsensors.com

DP1200 DIGITAL READOUT

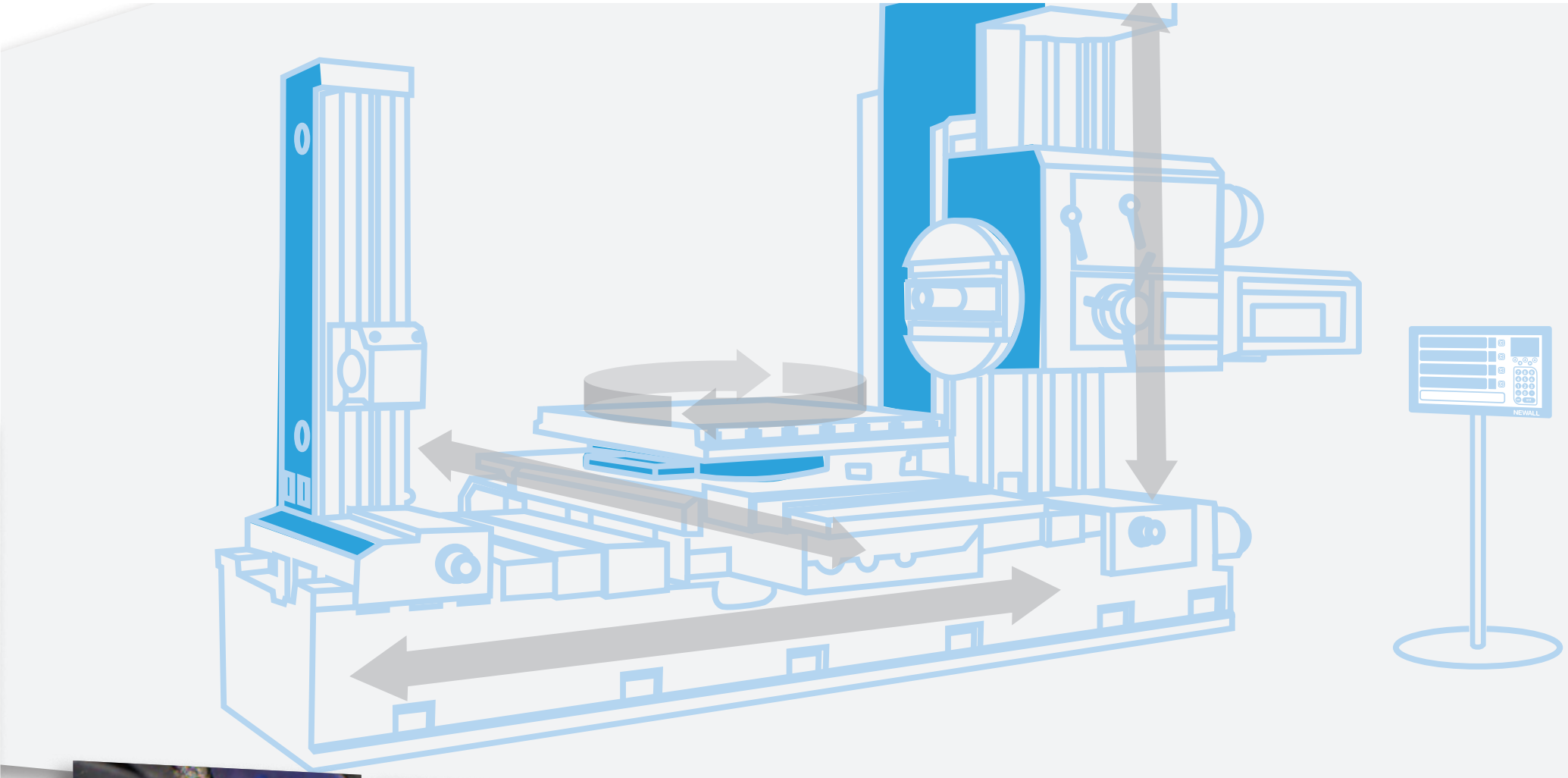
A new dimension of ultimate performance

THE IDEAL DRO SOLUTION FOR LARGE MACHINE TOOLS

Engineered specifically for long travel machine tools, the DP1200 DRO offers features that are essential for increasing productivity of boring mills, planer mills, VTLs, milling machines and long travel lathes.
Built with the operator in mind, the DP1200 includes large, clear numerical displays with a high resolution, 3.5“ TFT screen.
With an intuitive user interface and an optional DSU, the DP1200 is the ideal solution for either retrofit or OEM.

ADVANCED TECHNICAL FEATURES

- Available in 2, 3, or 4 axes (including angular/rotary)
- Real-time tool path graphics with auto-zoom
- Ultra-wide viewing angle
- Arc Contouring: Calculates points along an arc for rough machining
- Polar Co-ordinate Readings: Display radial and angular coordinates
- Line Hole Routine: Calculates points along a line at equal distance
- Programmable Memory/Teach: Store dimensional data into memory while machining the first part
- Tool Offsets: Retain all dimensional data even after tool change
- Feed-Rate Display: Longer tool life and increased cutting tool performance
- Linear and Segmented Error Compensation: Applies a compensation factor for machine geometric and abbey errors



OPTIONAL DIGITAL SENDING UNIT (DSU)

The encoders, along with the incoming power supply, are connected to the DSU. A standard 3.5 metre cable is connected from the DSU to the DP1200. Since the DSU can be mounted anywhere on the machine it reduces the need for extension cables and simplifies cable routing.

DP700 DIGITAL READOUT

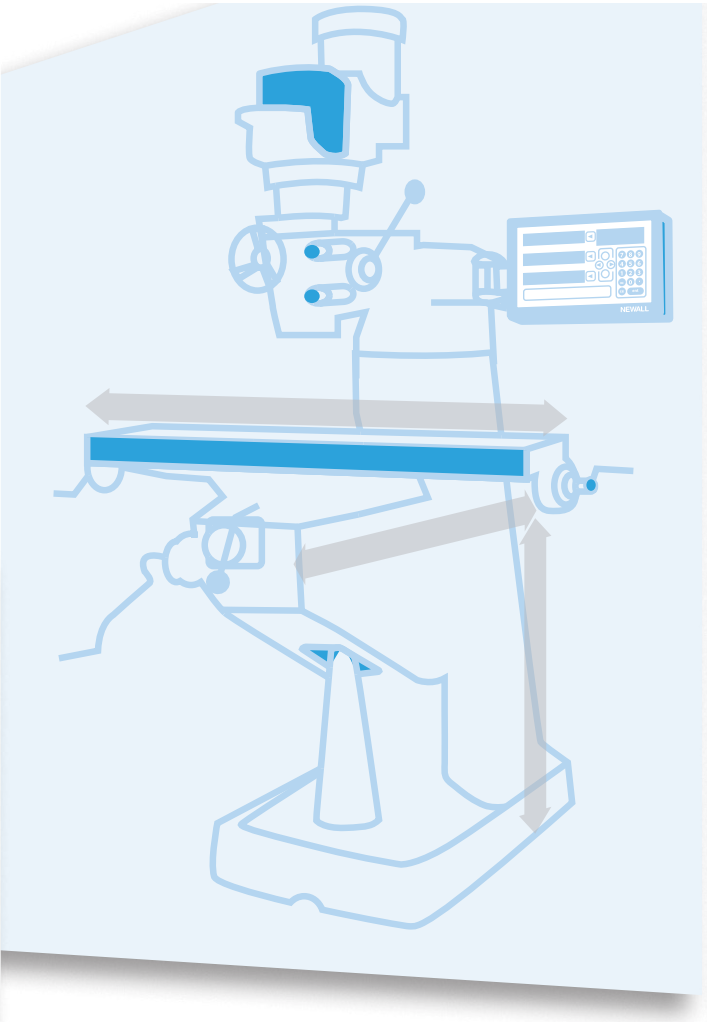
A powerfull and intuitive DRO

FOR ALL TYPES OF METAL CUTTING APPICATIONS

The DP700 is a powerful and intuitive DRO that is housed in a rugged cast aluminum chassis with a wipe clean front panel. The innovative design allows the operator to easily configure the DRO for general machining, milling or turning specific features.

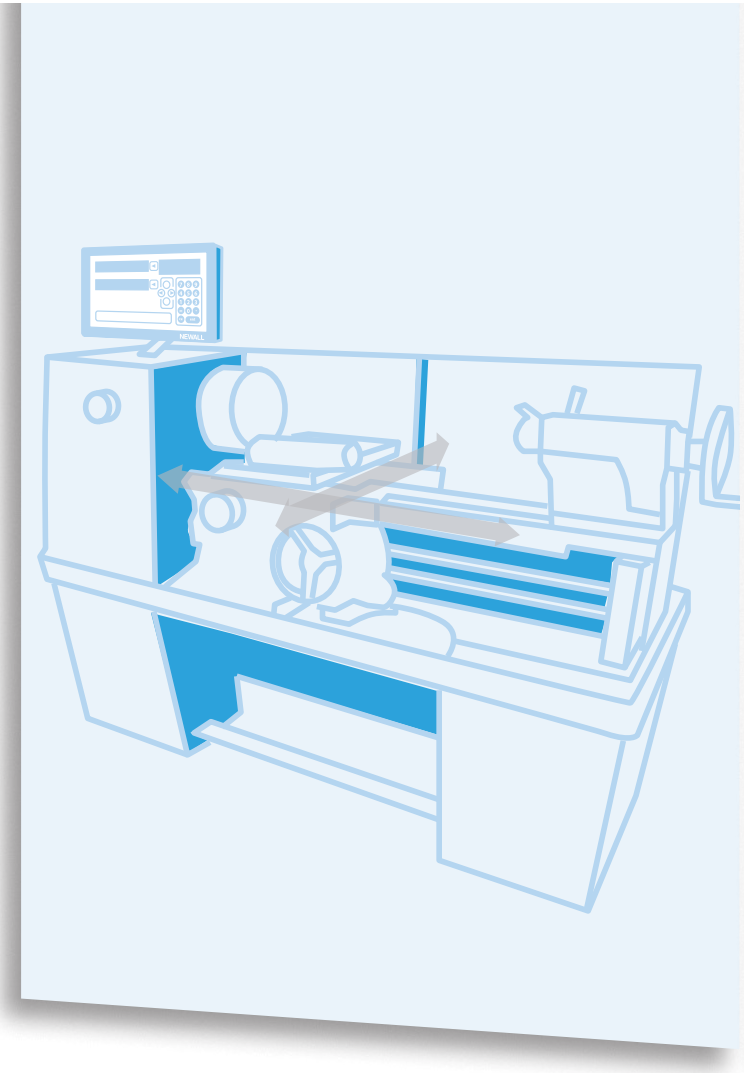
ADVANCED TECHNICAL FEATURES INCLUDE:

- Bolt Hole Circle Routine: Enter parameters via question and answer message prompts
- Arc Contouring: Calculates points along an arc for rough machining
- Polar Co-ordinate Readings: Display radial and angular coordinate
- Line Hole Routine: Calculates points along a line at equal distance
- Programmable Memory/Teach: Store dimensional data into memory while machining the first part
- Tool Offsets: Retain all dimensional data even after tool change
- Axis Summing: Sums two axes within the same plane
- Feed-Rate Display: Longer tool life and increased cutting tool performance
- Linear and Segmented Error Compensation: Applies a compensation factor for machine geometric and abbey errors
- RS-232 Output: Allows for data output



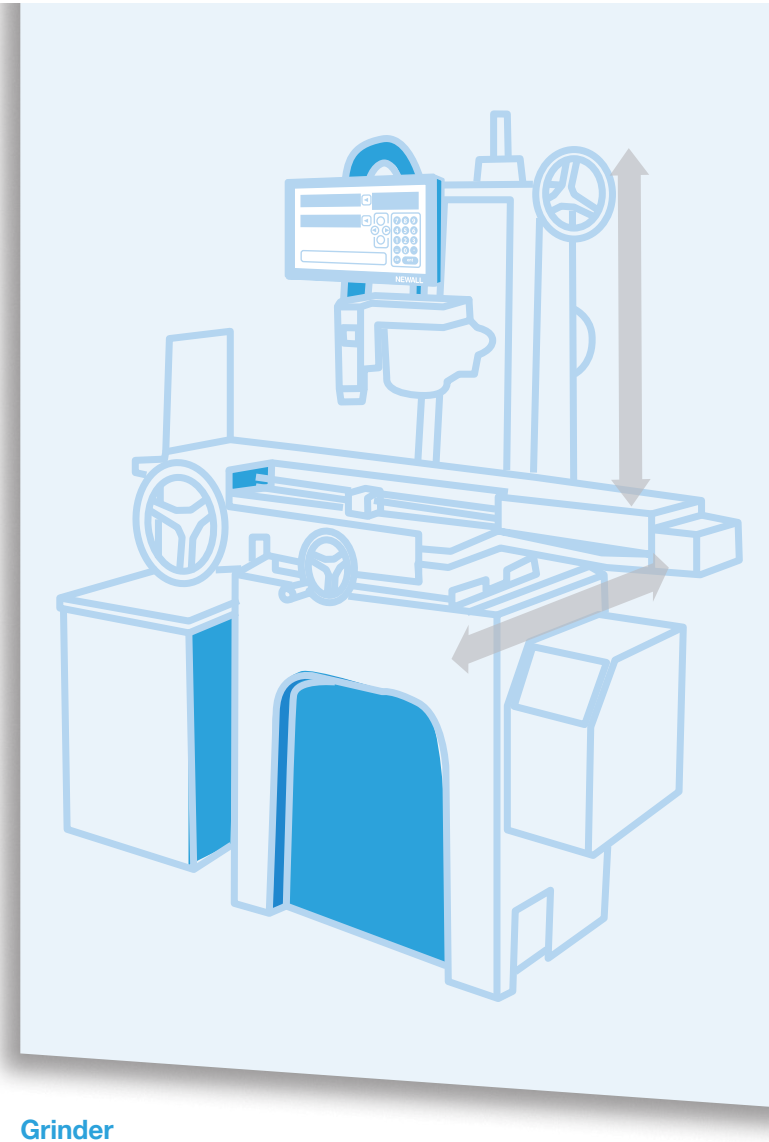
Knee Type Milling Machine

For milling applications, Newall Digital Readouts dramatically increase productivity and machine efficiency. The DP700 includes features such as bolt hole circle, line hole routine and arc contouring which calculates tool position by way of simple message prompts. Axis feed rate is displayed meaning better tool life and surface finish.



Lathe

Adding a Newall DRO to your lathe means you measure the part diameter one time and enter the value into the DRO. Since the DP700 allows you to enter a tool offset library, true diameter will always be displayed even after tool changes. Operators report a 20-40% increase in productivity and less scrap when using a Newall DRO on lathes.



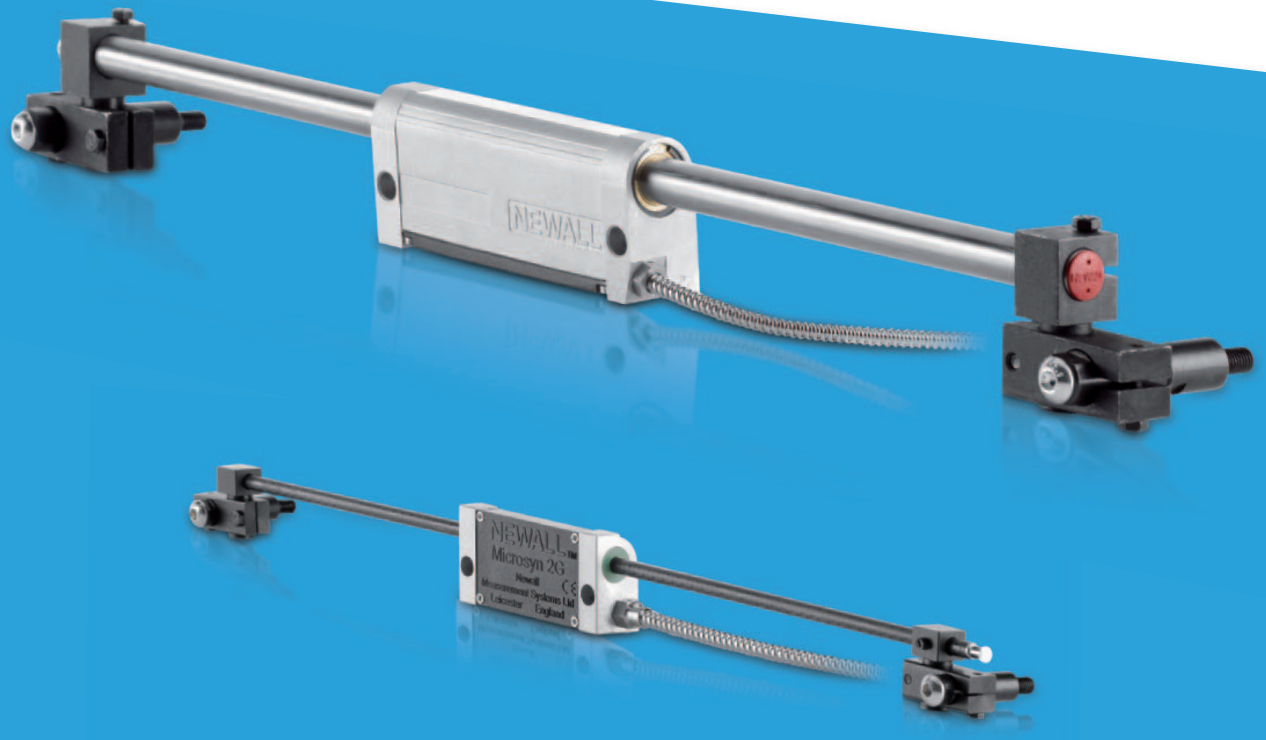
Grinder

Nothing compares to Newall on a surface or cylindrical grinder as the Microsyn encoders will withstand grinding dust, coolant and slurry. With resolutions down to 1µm (0.00005”), the Newall DP700 can guide the operator to the precise location without the worry of miscounting due to scale contamination. Programmable memory along with absolute and incremental features means faster and more accurate grinding.

SPHEROSYN 2G / MICROSYN 2G

Consistent accuracy and reliability even under the harshest environmental conditions

Designed to work exclusively with Newall's Digital Readouts, the Spherosyn 2G and Microsyn 2G encoders embody a truly innovative design in which all of the electronics and measuring components are sealed and protected. Unlike other encoder technologies, Newall encoders carry an IP67 environmental rating and will continue to provide accurate, reliable readings even when fully submersed in water, oil or coolant. No other linear encoder matches the durability and reliability of Newall.



SPHEROSYN 2G
Travel length: Up to 13.5 metres
Accuracy: +/-10µm per any one metre of travel
Resolution: 10µm or 5µm (0.0005" or 0.0002")
Repeatability: Within one resolution count

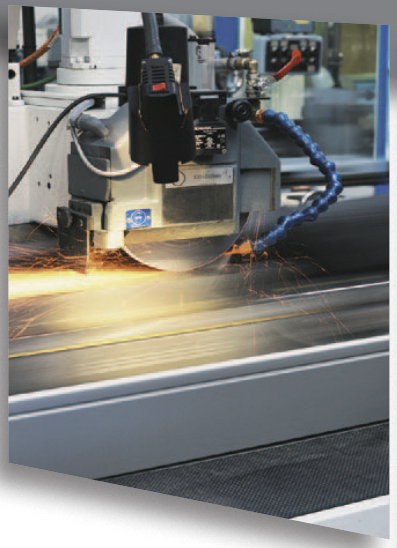
MICROSYN 2G
Travel length: Up to 1 metre
Accuracy: +/-5µm or +/-10µm
Resolution: 10µm, 5µm, 2µm or 1µm (0.0005", 0.0002", 0.0001" or 0.00005")
Repeatability: Within one resolution count

KEY BENEFITS

- IP67 environmental rating. Fully submersible
- Withstands dust, dirt, oil and other harsh environmental conditions
- No mechanical wear characteristics
- No more broken or scratched glass
- Requires no cleaning or regular maintenance
- High tolerance to shock and vibration
- Easy to install – No backer bar or machined surface required

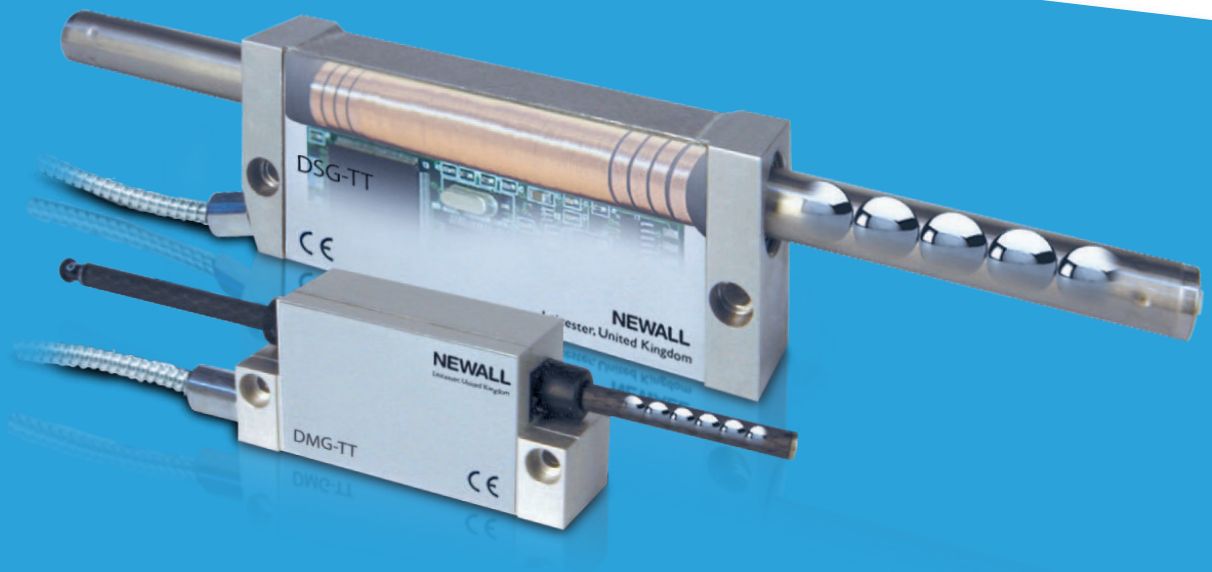
Mechanical Specifications	Spherosyn 2G	Microsyn 2G
Scale Travels	52mm – 13,500mm call for travels > 13.5 metres	50mm – 1000mm
Scale Diameter/Material	15.25mm / stainless steel	6.5mm / carbon fibre
Reader Head Dimensions	52mm x 141mm x 28mm	35mm x 75mm x 18mm
Overall Scale Length	Travel length + 254mm	Travel length x 178mm
Output Cable Length	3.5 metres stainless steel armor (extension cables available)	

To learn more about Newall's unique and innovative Spherosyn technology, visit www.newall.com.



DSG AND DMG ENCODERS

Positional feedback for non-servo applications



Newall's DSG and DMG linear encoders were specifically engineered to be used with competitive brands of DRO displays. The design of the DSG and DMG encoders is based on Newall's Spherosyn 2G and Microsyn 2G encoder technology that carries an IP67 environmental rating and is recognized throughout the world for quality, accuracy and reliability.

	DSG-TT	DMG-TT
Core Technology	Spherosyn	Microsyn
Output Signal	TTL, 1Vpp or 11µApp	
Cable	3.5 metres Armored with 9-pin D Connector	
Resolution	10 or 5 micron (0.0005" or 0.0002")	10, 5, 2, or 1 micron (0.0005", 0.0002", 0.0001" or 0.00005")
Reference Point	none	
Reader Head Dim.	131 x 53.5 x 28.5 (5.15" x 2.10" x 1.12")	75 x 35 x 25 (2.95" x 1.38" x 0.98")

COMPATIBLE WITH MOST BRANDS OF DRO DISPLAYS:

- Acu-Rite
- SWI/Trak
- Anilam/RSF
- Fagor
- Heidenhain
- Mitutoyo
- And Others

LINEAR FEEBACK ENCODERS

Positional feedback for CNC and other servo driven applications

CNC machine tool builders, retro-fitters and system integrators can take advantage of Newall's inductive encoder technology.
The SHG, MHG and HLG line of linear encoders provide a wide range of industrial output protocols.
Newall's inductive encoders offer performance and reliability benefits not found in other linear encoders.

INCREMENTAL OUTPUT PROTOCOLS

- TTL quadrature
- 1Vpp - 20µm signal period
- 11µApp
- 5-28V – Vin Vout quadrature or open collector

Available with periodic or single point reference mark
Resolutions down to 0.1µm available

ABSOLUTE OUTPUT PROTOCOLS

- RS-232
- RS-485
- SSI Gray Code
- SSI Binary
- SSI Gray Code with / Parity + Quad
- Fanuc Serial Absolute Protocol

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NEWALL

DP500 Mill & Lathe DRO Packages

Newall's DP500 Digital Readout Systems set the standard for reliability, value and ease of use for turret mills and tool room lathes. The DP500 DRO system includes Newall's Spherosyn LT or Microsyn LT encoders that are designed to provide accurate readings even under the toughest shop conditions.

FEATURES INCLUDE:

- Bolt Hole Circle Routine
- Tool Offsets
- Absolute/Incremental Readings
- Inch/Metric Instant Conversion
- Radius/Diameter Readings
- Switchable Resolutions
- Datum Preset/Zero Reset
- Reference Point (Digifind)
- Center Find

THE NEWALL ADVANTAGE

- Backed by a company with over 30 years of proven reliability in manufacturing DRO systems
- Encoders carry an IP67 rating – All electronic and measuring components are sealed from the environment.
- Continually provides accurate readings even under the harshest shop conditions
- No cleaning or maintenance required
- Tolerant to shock and vibration
- No glass to break or scratch

Manufactured & Designed in the UNITED KINGDOM

A brand of CST
CUSTOM SENSORS & TECHNOLOGIES

ALL DP500 PACKAGES INCLUDE EVERYTHING REQUIRED FOR A COMPLETE INSTALLATION:

- DP500 DRO (2 or 3 axis)
- Spherosyn LT and/or Microsyn LT Encoder Assemblies with 3.5M armored cable
- Scale Bracket Kit and Hardware
- Reader Head Mounting Brackets and Hardware*
- Display Mounting Arm and Hardware*

*All packages are available with or without mounting brackets for the reader head and mounting arm.

Contact your local authorized Newall distributor for more information on the DP500 Mill and Lathe DRO packages or go to **www.newall.com**

DP500 Lathe Packages	
Travel Lengths	
Inches	Millimeters
6 x 40	152 x 1016
8 x 40	203 x 1016
10 x 40	254 x 1016
6 x 60	152 x 1524
8 x 60	203 x 1524
10 x 60	254 x 1524
12 x 60	305 x 1524
14 x 60	356 x 1524
6 x 72	152 x 1829
8 x 72	203 x 1829
10 x 72	254 x 1829
12 x 72	305 x 1829
14 x 72	356 x 1829
6 x 80	152 x 2032
8 x 80	203 x 2032
10 x 80	254 x 2032
12 x 80	305 x 2032
14 x 80	356 x 2032
Longitudinal travel includes Spherosyn LT encoder. Cross travel axis can be either Microsyn LT or Spherosyn LT encoder (please specify).	

DP500 Mill Packages		
Travel Length		Axes
Inches	Millimeters	
12 x 30	305 x 762	2 Axes
12 x 30 x 6	305 x 762 x 152	3 Axes w/Quill
12 x 30 x 16	305 x 762 x 406	3 Axes w/Knee
12 x 36	305 x 914	2 Axes
12 x 36 x 6	305 x 914 x 152	3 Axes w/Quill
12 x 36 x 16	305 x 914 x 406	3 Axes w/Knee
14 x 36	356 x 914	2 Axes
14 x 36 x 6	356 x 914 x 152	3 Axes w/Quill
14 x 36 x 16	356 x 914 x 406	3 Axes w/Knee
16 x 36	406 x 914	2 Axes
16 x 36 x 6	406 x 914 x 152	3 Axes w/Quill
16 x 36 x 16	406 x 914 x 406	3 Axes w/Knee
All two axis mill packages include Spherosyn LT encoders. Three axis packages for quill axis include Microsyn LT encoder. Knee axis includes Spherosyn LT.		

Worldwide Sales Offices

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Brazil
+55 (11) 2505 7501

China
+86 (21) 8025 7166

India
+91 80 4113 2204/05

East Asia Pacific
+86 (21) 8125 7177

To find your local sales office visit: **www.newall.com/sales**

WHY YOUR LATHE NEEDS A DRO.

EFFICIENCY. ACCURACY. PRODUCTIVITY.

NEWALL

Without a DRO:

Cross-Slides Have Backlash

Lathes utilize a cross-slide to machine critical O.D. and I.D. dimensions.

Tool Pressure Is Exerted On The Cross-Slide

The turning work piece exerts pressure on the tool, which shifts the cross-slide back against the screw. With backlash always a consideration, each lathe requires its own “feel.”

Vernier Dials Are Hard To Read

The lines of the dial are hard to see and can be obscured by oil and debris. Hand wheel revolutions must be counted. Misreading of the dial and scraping the part is easily done if not extremely careful.

Stop And Check Time is Non-Productive

Since the operator cannot rely on the cross-slide dial for finish dimensions, frequent stops to check the part with a scale, caliper, micrometer and dial indicators are required.

I.D. Work Is Even More Difficult To Measure “Blind”

Difficult set-ups of indicators and magnetic base holders are time consuming, and always run the danger of being bumped or moved.

Step Lengths

Since reading the carriage travel is even more difficult with the lathe’s vernier dial, due to its location (some lathes do not even have a dial on this axis), stop-and-measure is a must. Travel-type dial indicators are a small improvement, but are hard to read. They can jump and skip due to chips getting caught under the friction wheel, which must be held under compression against the lathe carriage way to spin the dial.

Why Your Lathe Needs a DRO:

Vastly Reduced Positioning Time

- Digital Readouts (DRO's) utilize linear scales mounted to the cross-slide and carriage axes of the lathe. The scale reads position independent of the lead screw and shows the true tool position, regardless of mechanical wear and backlash. ***Reading lines on vernier dials, counting hand wheel revolutions and lead screw backlash compensation are eliminated.***

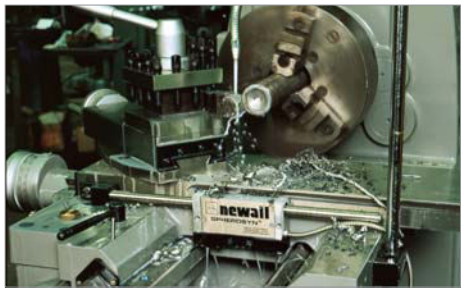
- The accuracy and repeatability of precision linear scales allow the operator to ***position the tool to the print dimensions – just like the print reads. Stop-check-measure steps are all but eliminated***, save for final cuts. Features like Direct Diameter Reading greatly ***reduce mathematics, calculations and scrap*** due to operator error. ***Less time checking and measuring means more time making chips.***

Productivity improvement of 20-40% typically reported using DRO on lathes.

Why Your Lathe DRO Should be Newall

- ***Lathework Is A Harsh Environment***
  Most lathe work is exposed to a high volume of chips, coolant and other potentially hazardous conditions, more so than other machining operations, such as milling.
- ***If The Scale Doesn't Work, Neither Does The DRO***
  DRO display features are helpful, but the main DRO benefit is derived from independence of lead screw wear and backlash, which the linear scales provide.
- ***Glass or Magnetic (Wire or Tape) Scales Can Fail In the Lathe Environment***
  - Glass Scales can scratch, break or misread due to condensation and contamination from chips, coolants and lubricants.
  - Magnetic wire and tape scales fail due to chip build up or loss of polarity.
- ***If the Scale has an Enclosure and Lip Seal – It Needs to Be Protected and is Prone to Damage or Failure***

Newall Spherosyn/Microsyn Scales are Unaffected by Chips, Coolant, Lubricants, Shock and Vibration



- ***Field Proven as the Most Reliable Linear Scale*** for over 30 years
- ***Unique Ball Bearing/Tube Design*** requires no enclosure or seals
- ***Easier and Faster to Install*** than any other linear scale for lathes
- ***Shock and Vibration Resistant*** Holds up to the most extreme conditions
- ***Accuracy to 5 micron***

Others Claim to be Reliable – Newall Proves it with the Industries Best Warranty

• 5 Year Warranty / 3 Year No-Fault • Lifetime Scale Warranty • 30 Day Money-Back Guarantee

Newall – The DRO of Choice For Lathes

Ask about our Free 30-day Trial.

www.newall.com

Quotes from actual lathe DRO owners and operators:

"I don't want to use a lathe without my Newall DRO. The DRO is much more efficient and accurate. I am always having to check and be sure I read the dial correctly, or that my indicator did not bump, without an operational DRO. I believe all lathes should have a DRO - it's too difficult without it. And I know my Newall DRO will keep working. I don't have to worry about keeping the scales clean. With Newall it's just a walk in the park." *- Bill Frontiera /Operations Manager – Stapels Manufacturing/Troy, MI*

"I have seen our lathe operators be much more productive with a DRO on their lathe vs. without. We first bought our most recent engine lathe without a DRO on it, and you could easily see the difference in operator efficiency vs. those operators on lathes with a DRO. We soon purchased a Newall DRO for the new lathe. We have tried several DRO brands on our lathes and found Newall to be the most reliable, by far." *- Bee Amphlett / Shop Supervisor – Dyna-Drill Technologies/Houston, TX*

Productivity improvement of 20-40% typically reported using DRO on lathes.

DRO Cost Justification (Typical Example)

*(*Cost of DRO varies based on size of machine, make and model of DRO.)*

Lathe Use/Hours per Week	20 hrs.
Shop Rate/Hour	$55.00
DRO Productivity Improvement	25%

Lathe Use/Hours per Week	*20 hrs.* ***X*** *DRO* Productivity Improvement *25%*	= 5 Hours /Week
DRO Productivity Improvement	***5 Hours/Week X*** *Shop Rate/Hour $55.00*	= $275 Savings/Week
Cost of DRO*	$2,055/$275 Savings/Week	= ***Return on Investment*** 7.5 Weeks

DRO Cost Justification Worksheet

Lathe Use/Hours per Week	_____
Shop Rate/Hour	$___.___
DRO Productivity Improvement	_____ %

Lathe Use/Hours per Week	___ *hrs.* ***X*** *DRO Productivity Improvement* ___%	=_____ Hours /Week
DRO Productivity Improvement	_____ ***X*** *Shop Rate/Hour $___.___*	=_____ Savings/Week
Cost of DRO*	_____/_____Savings/Week	= ***Return on Investment*** _____

NEWALL
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Product Bulletin: 092509-L

Newall Linear Encoders for CNC Mills with ProtoTrak™ Controls

Get all the benefits of linear encoder accuracy without the frustrating down time of encoder failure.

- Direct replacement of Trak™ sensor or glass scale*
- Featuring Newall's renowned linear encoder reliability:
  - Withstands dust, dirt, chips, coolant and oil
  - IP67 rated (fully submersible)
  - Tolerant to shock and vibration
  - No mechanical wear, cleaning or maintenance
- Easy to install
- No more expensive sensor wheel repairs
- No more broken, scratched or contaminated glass
- Competitively priced

To learn more about Newall's revolutionary linear encoder technology, visit our new Web site at newall.com or call us at 1-800-229-4376.

*Must have Trak™ sensor or glass scale option available on the machine to be compatible.

NOMINAL TRAVEL	NEWALL PART NUMBER
Z Axis (6")	MHG-TT SFMJ00200
12"	SHG-TT SCMJ01200
16"	SHG-TT SCMJ01600
18"	SHG-TT SCMJ01800
20"	SHG-TT SCMJ02000
24"	SHG-TT SCMJ02400
30"	SHG-TT SCMJ03000
32"	SHG-TT SCMJ03200
34"	SHG-TT SCMJ03400
36"	SHG-TT SCMJ03600
40"	SHG-TT SCMJ04000
60"	SHG-TT SCMJ06000

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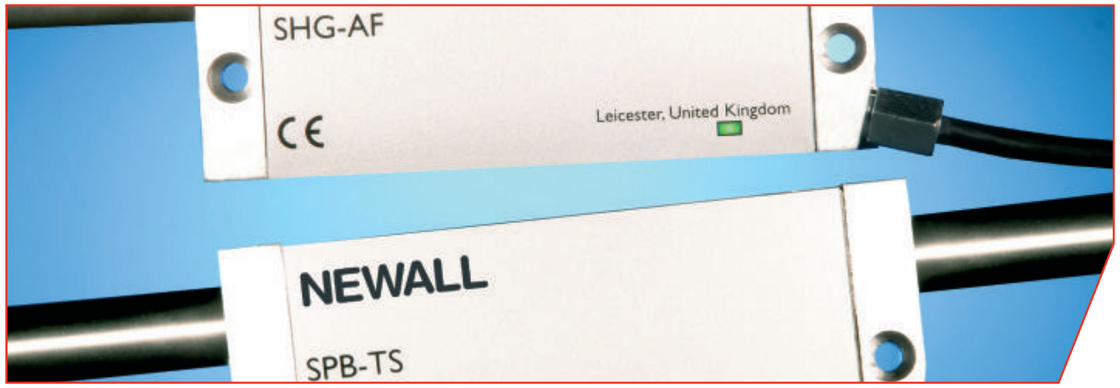
NEWALL

Linear Encoders

a company of Schneider Electric



Company Profile

NEWALL

Newall was founded in Peterborough, England in 1968 and is now a division of CST (Custom Sensors & Technologies), a business unit of Schneider Electric. During this time, Newall has dedicated itself to providing the automation, machine tool and other machinery and production industries with leading edge technologies that increase productivity and machine tool efficiency.

Over the years Newall has grown to be a well respected leader in Digital Readout (DRO) and Linear Encoder technology. Newall's world renowned range of Digital Readout Systems (DROs) are specifically designed and dedicated to increasing machine productivity. Together with the Spherosyn™ and Microsyn™ Linear Encoders, they are some of the most advanced, market-leading readouts available on the market today.

Features

- IP67 rating (NEMA 6)
- Withstands dust, swarf, oil and other harsh environmental conditions
- No mechanical wear characteristics
- Requires no cleaning or maintenance
- High tolerance to shock and vibration
- High reliability

Linear Encoders

The range of Linear Encoders provided by Newall incorporate a truly unique design in that none of the electrical or measuring components are exposed to harsh workshop environments and they will continue to provide accurate and reliable readings even when fully submerged in water, oil and coolant. For this reason all of the Newall Linear Encoder range carry an IP67 (NEMA 6) environmental rating. This means they are dust tight and protected against the effects of total water immersion up to 1m.

The range includes incremental, absolute and distance-coded variants and are available with industry standard output signals which can be interfaced with all major CNC, NC, PLC and PC products.

IP Protection Levels

The chart clearly defines levels of IP ratings and should be used as a guide during the specification and design process.

1st IP#	Degree of protection against access to hazardous parts & ingress of solid objects	2nd IP#	Degree of protection against the ingress of water
0	No protection	0	No protection
1	Protected against solid foreign objects of 50mm Ø and >	1	Protected against vertically falling water drops
2	Protected against solid foreign objects of 12.5mm Ø and >	2	Protected against vertically falling water drops when enclosure titled up 15°
3	Protected against solid foreign objects of 2.5mm Ø and >	3	Protected against spraying water
4	Protected against solid foreign objects of 1.0mm Ø and >	4	Protected against splashing water
5	Dust protected	5	Protected against water jets
6	**Dust tight**	6	Protected against powerful jets from any direction
		7	**Protected against the effects of total water immersion up to 1M**
		8	Protected against the effects of total water immersion beyond 1M

Linear Encoder Overview

Incremental Linear Encoders

Newall's Incremental Linear Encoders comprise of a scale and reader head that contains a coil assembly and supporting electronics, which provide quadrature square wave or sine-cosine feedback signals that allow for direct integration to servo driven applications. These encoders operate on the principle of electromagnetic induction. An electromagnetic field is generated by inducing a 10kHz sinusoidal current through a single drive coil within the reader head. This field interacts with the nickel chrome elements contained in the scale.

A set of four pickup coils detect variations in the induced field which are then combined and processed by the electronic circuitry to generate a signal that varies as the reader head moves along the scale. Depending on the position of the reader head as it passes over each element, the phase shift of this pickup signal relative to the drive signal will vary between 0 and 360 degrees. High speed Digital Signal Processing (DSP) converts the analogue signal to an industry standard signal, which also generates the periodic reference marker pulse.

Absolute Linear Encoders

Newall's Absolute Linear Encoders provide a true absolute position upon power up. The linear encoder does not use batteries or static memory to retain the position data.

Like Incremental Linear Encoders, the scale is comprised of a stainless steel tube that houses a column of precision nickel-chrome elements. For absolute and single point reference mark versions, coded scale inserts are placed between the elements in such a manner as not to interfere with the geometry of the system contact.

The Absolute Linear Encoder reader head also contains a sensor array that detects the target that is embedded in the coded scale inserts.

High speed digital signal processing is utilised in order to process the positional data and to communicate the output protocols.

Distance-Coded Linear Encoders

Newall's Distance-Coded Linear Encoders, using its internal absolute position count, can mimic the distance coded index marks that are generated by glass scales. An index pulse is generated at uniquely spaced intervals in the range of 4 to 10mm, varying by 20 micron increments. As the encoder is not constrained by any hardware limitations, it can calculate and output almost any sequence of marker pulses.

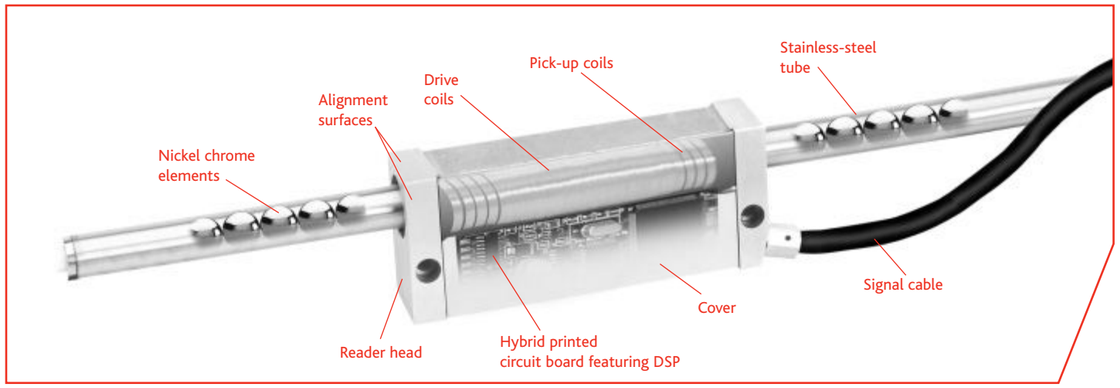
Encoder Selection Guide

	Measuring Length	Measuring Accuracy**	Standard Resolution**	Page	Output Signal	Encoder Model
	Incremental Linear Encoders					
	Single Scale 12m* Modular 30m +	±10µm	1µm	Page 14	TTL RS422 Differential Quadrature	SHG-TT
			20µm via SCC200	Page 14	1Vpp Signal Period	SHG-VP
					1Vpp Single Point Signal Period	SHG-VS
			1µm	Page 14	TTL Single Point RS422 Differential Quadrature	SHG-TS
					5-30V (Vin Vout)	SHG-PV
					5-30V (Open Collector)	SHG-PC
	Up to 1m	±10µm	1, 5, 10µm	Page 24	TTL RS422 Single Point Differential Quadrature	SPB-TS
					TTL RS422 Differential Quadrature Periodic Point	SPB-TT
	Up to 1m	±10µm	1µm	Page 16	TTL RS422 Differential Quadrature	MHG-TT
			20µm via SCC200	Page 16	1Vpp Signal Period	MHG-VP
		±5µm	1µm	Page 18	TTL RS422 Differential Quadrature	MCG-TT
					1Vpp 20µm Signal Period via SCC200 (included)	MCG-VP
	Up to 22m	±25µm +20µm/m	10µm	Page 20	Magnetic Tape System	MAG-TS
	Absolute Linear Encoders					
	Up to 3.5m	±10µm	1µm	Page 22	RS485 + RS422 Differential Quadrature	SHG-A4
					SSI Binary + RS422 Differential Quadrature	SHG-AB
					SSI Gray Code + RS422 Differential Quadrature	SHG-AG
					RS232 + RS422 Differential Quadrature	SHG-A2
					Faunc	SHG-AF
					SSI Gray Code with Even Parity + RS422 Differential Quadrature	SHG-AS
					SSI Gray Code with Even Parity + 1Vpp 20µm signal period via SCC200 (included)	SHG-AV
	Distance-Coded Linear Encoders					
	Up to 3.5m	±5µm	1µm	Page 22	Distance-Coded TTL RS422 Differential Quadrature	SHG-TC

Notes to Selection Guide
All of these encoders can be connected to a wide range of PLC, CNC, NC and PC applications.

The choice of encoder depends on five principal factors:
1. The level of precision required for the application e.g., in general, a saw conveyor requires a lower level of precision than a grinding machine
2. Spatial limitations. The slim-line encoders can be fitted into smaller spaces then the full-sized encoders.
3. The overall measuring length of the application
4. The required resolution
5. The output signal

Accuracy defined as per meter
* For longer modular scale requirements refer to factory
** Further options for resolution and accuracy are available. Please refer to pages above



Sectional view

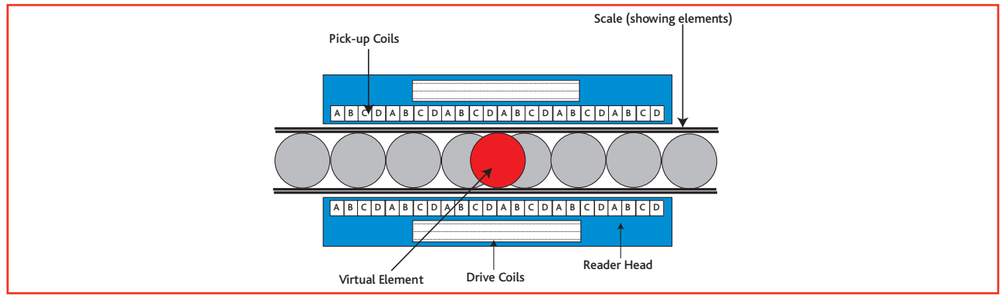
Newall's SHG technology is an inductive linear encoder, made up of two main assemblies; the reader head and the scale.

The scale is a stainless steel tube, housing a column of precision elements. The elements are maintained under compression; the compression load being set during manufacturing to calibrate the scale. The reader head, which fits around the scale, moves in a linear motion along the scale length comprising a rectangular aluminium casting containing a coil assembly and electronics.

Incremental

Figure 1 shows the arrangement of coils in the head. There are six sets of pick-up coils. Each set consists of four identical windings that are spaced at intervals of one pitch. As a result of this spacing each coil in a set is positioned over an identical part of an adjacent element. All the coils of a set are connected together in series. Over the pick-up coils is the drive coil. The elements within the scale cause the permeability of the scale to vary periodically over a pitch. The voltages induced in each of the sets of pick-up coils vary according to the relevant positions of the coils to the underlying elements.

Figure 1 – Arrangement of Coils



The variation of the amplitude of the induced signals with displacement along the scale is shown in Figure 2a. The coils are spaced such that when one set of coils is at a maximum, (e.g. set A) another set spaced one half an element pitch away (set C) will be at a minimum. These coil pairs are combined differentially to produce signals that vary with displacement as shown in Figure 2b.

These combined signals are phase shifted by the electronic circuits in the head. The A-C signal is advanced 45° and the D-B signal is retarded 45°. These signals are added together and filtered. The result is an output signal whose phase varies as the head is displaced along the scale.

Figure 2a

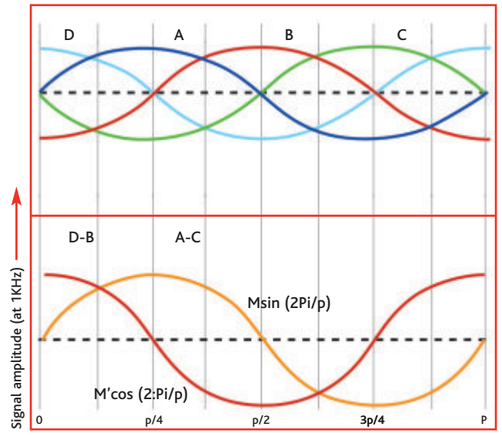


Figure 2b

The phase changes by 360° for each pitch of movement. This output signal is at the fundamental frequency of 10kHz and has a peak to peak amplitude of approximately 5V and a DC level of around 5V. Thus the position measured is absolute over a single element, i.e., for every 12.7mm increment. Figure 3 shows a phase shift of 90° that equates directly to a position of 3.175mm ($^1/_4$ of a pitch) relative to the zero phase position. To achieve linear measurement the total position is constructed by the addition of the absolute measurement value and the sum of the number of elements traversed since the encoder was referenced.

Encoders of position sensors can be broadly categorised into two families, DC operation or AC operation. In the DC operation lie optical and magnetic encoders, both rotary and linear. Devices that use AC operation are either inductive or capacitive. Examples of rotary inductive devices are resolvers and syncros whilst linear devices include LVDTs, Inductosyn and Newall Linear Encoders.

In AC systems, the signals containing the positional data are modulated AC signals at the fundamental operating frequency of the device. In DC systems the signals are modulated DC, i.e., slowly varying DC levels.

DC signals are particularly subject to offset errors, drift and low frequency noise.

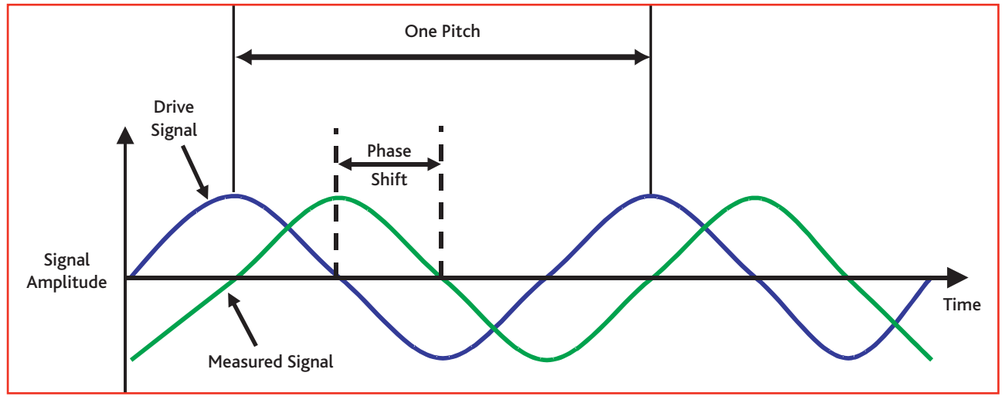
Offset errors can be countered by the use of technique chopper stabilisation which, effectively, converts the signal to AC to eliminate the offset and then converts back. In AC systems the nulling of offset errors is inherent in the AC coupling used and no complex techniques need be applied.

Drift is a problem in DC systems, particularly optical where the lamps, LEDs or solar cells are subject to long term ageing. Inductive systems are inherently stable being based on fixed physical properties such as turn ratios and permeability of the encoder parts. These do not change with time.

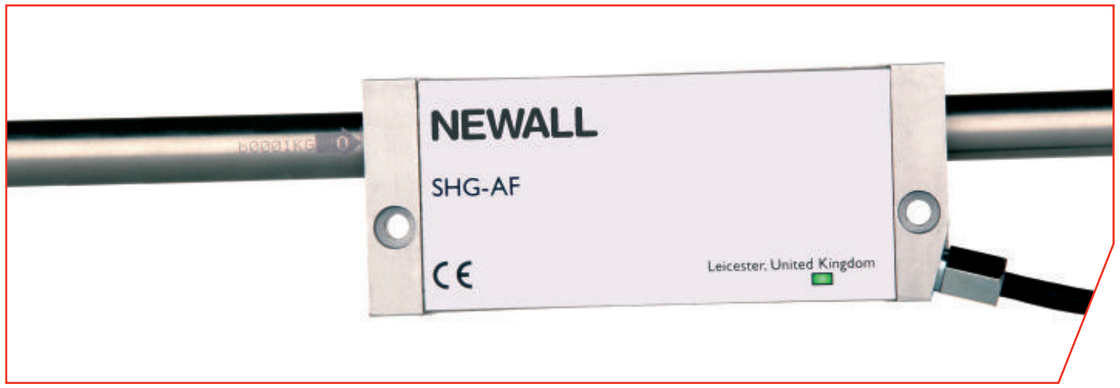
Low frequency noise, particularly mains power frequencies, can interfere with DC signals and cannot be blocked without severely degrading the system's response time. AC systems, working at a precise, fixed frequency, will employ low and high frequency filters without impacting upon response speed.

A criticism often aimed at inductive encoders is that their relatively long pitch length requires a much larger interpolation level for a given resolution than for an optical grating. This is true but, it is not mentioned that accurate interpolation is much more easily achieved, for the reasons given above, on AC systems than DC. The accuracies and resolutions that can be obtained from resolvers match those of their optical rotary counterparts. The same is true for Newall's linear encoders versus its linear optical or magnetic competitors.

Figure 3



Technology Absolute



Absolute

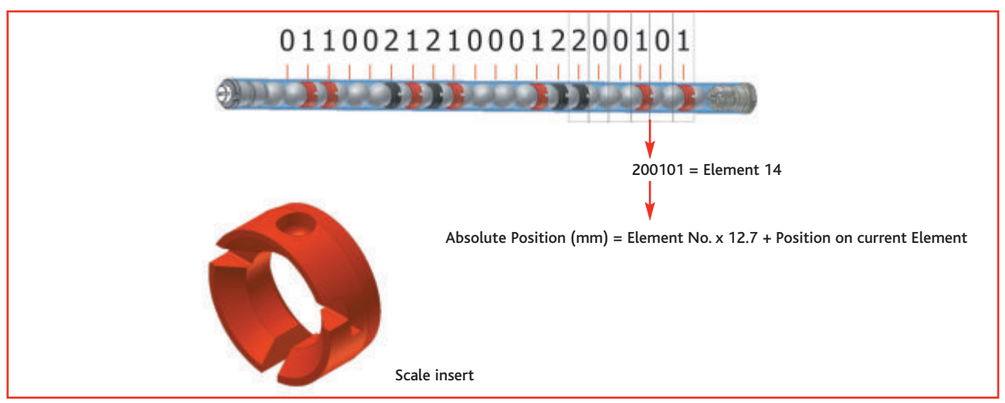
The Newall Absolute Linear Encoder is a breakthrough in linear measurement technology. Uniquely coded inserts are placed between the precision nickel chrome elements in the scale. The inserts are locked in position as part of the manufacturing process and contain a small magnetic target that can be detected by a series of hall sensors contained within the reader head. The density of the inserts and the detectors within the reader head allows the system to determine absolute position on power up.

Once the encoder has internally determined the true absolute position it is then a matter for the DSP processing to handle communications of the positional data to the outside world through the use of communications protocols such as SSI (Synchronous Serial Interface), Fanuc, RS232, RS485 etc. Furthermore, the internal positional information can be used to accurately emulate other forms of Pseudo-Absolute interfaces such as Distance-Coded.

Being a Digital Sound Processor (DSP) based absolute system capable of a high level of processing, the encoders are error mapped during manufacturing against a laser interferometer. This error map is stored in FLASH memory allowing it to be applied in real-time thus resulting in a highly accurate system.

Distance-Coded

Distance-Coded reference markers allow the controller to acquire absolute position by moving the encoder system across two uniquely spaced reference marks. By using its internal absolute position count, a variant of the Absolute can mimic the Distance-Coded index marks that are generated by glass scales.



Technology Magnetic

Magnetic Tape

The Newall MAG-TS encoder comprises of a flexible tape scale which is mounted on a fixed surface of the machine, with or without an optional twin track backing bar, and a reader head which is fastened to the moving part to be measured; arranged such that it travels in alignment with the scale.

The flexible nature of the tape scale makes the encoder ideal for rotary as well as linear applications.

For ease of installation, the adhesive side of the tape is attached directly to a machined surface. For applications where the mounting surface is uneven, the tape scale can be attached to an optional twin track backing bar, supported by stand-offs.

A stainless steel cover strip is supplied to protect the encoded tape. The cover strip is attached to the encoded tape by way of adhesive backing.

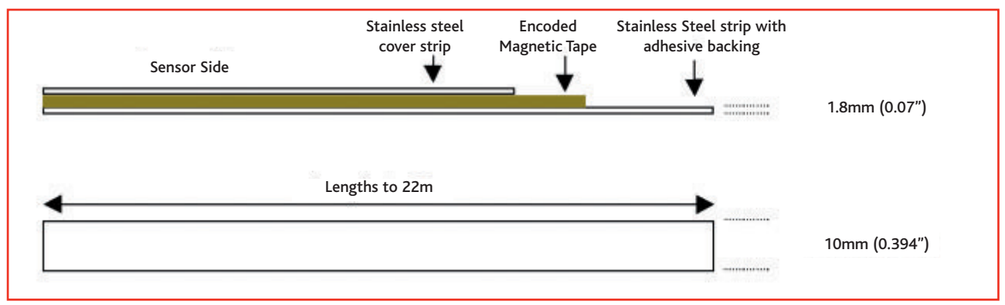
Principal of Operation

The tape scale is made up of a flexible magnetic rubber strip, sandwiched between a backing strip and a cover strip made from thin stainless steel. The encoded tape contains magnetic markers that are placed at intervals along the length of the tape.

As the incremental sensor in the reader head passes over the tape, the magnetic field is converted to an electrical signal, which is sampled by a micro controller. The field between the markers varies sinusoidally, with which the micro controller determines the position of the sensor in relation to each marker.

Reference Mark (RM)

One index marker (short lengths of tape containing just one magnetic pole pair) can be fitted in the second track of the optional backing bar. This is detected by the index sensor in the reader head and output as the RM signal. More then one reference mark can be supplied on request.



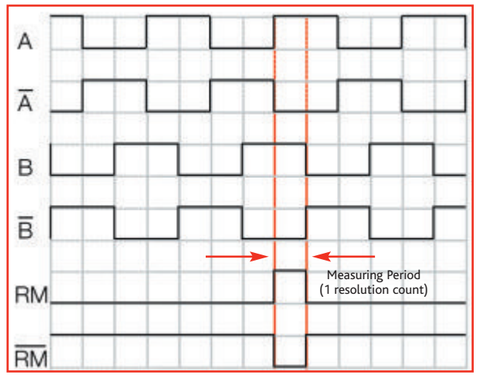
TTL Differential Quadrature (ordering code TT)

Newall TT Series Linear Encoders provide a differential quadrature output at TTL RS422 levels. The output signals are transmitted via a 9-core cable in accordance with the pin-out table below.

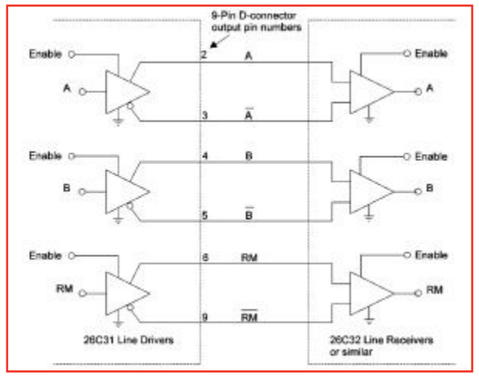
The periodic Reference Mark (RM) is synchronised with the A and B signals as shown in the diagram.

The distance between two successive edges of the combined pulse trains A and B is one measuring step (resolution).

TT - TTL - Differential Quadrature



Encoder Connections



Connector D type 9 pin	- TT Incremental Output Core	Function	Colour
1	7/0.15mm	Reserved, Do Not Connect	Orange
2	7/0.15mm	Channel A	Green
3	Twisted Pair	Channel $\overline{A}$	Yellow
4	7/0.15mm	Channel B	Blue
5	Twisted Pair	Channel $\overline{B}$	Red
6	7/0.25mm	0V	White
7	7/0.25mm	5V	Black
8	7/0.15mm	Channel RM	Violet
9	Twisted Pair	Channel $\overline{RM}$	Grey
GND	Screen	GND	---

Single Point TTL RS422 Differential Quadrature (ordering code TS) and Single Point 1Vpp (ordering code VS)

The SHG-TS and SHG-VS linear encoder scales have a series of up to eight selectable reference markers spaced every 25.4mm, starting 78.5 from the end of the scale. The reference point selected is dependent on the rotational alignment of the scale relative to the reader head on installation. An installation LED, bio-colour green and red, is mounted on the reader head encoder face. Available with TTL output (TS) or 1Vpp output when used with the SCC 200 converter (VS).

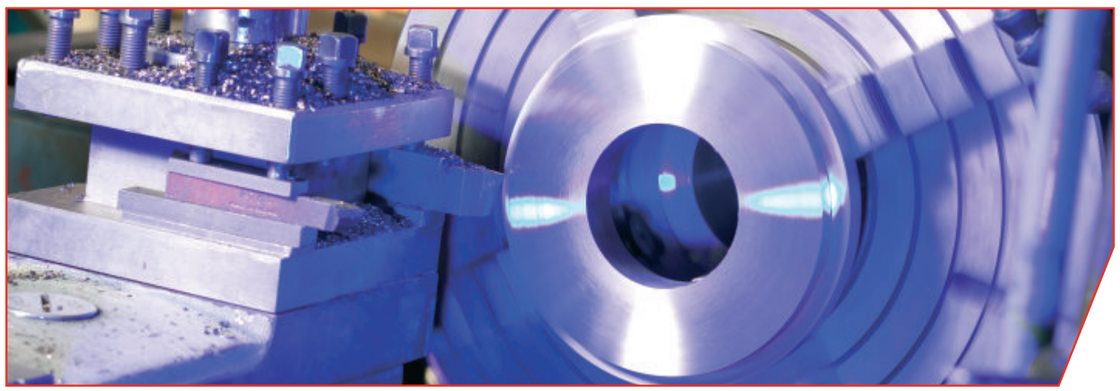
Distance-Coded TTL RS422 Differential Quadrature (ordering code TC)

The SHG-TC Linear Encoders provide a unique output reference marker every 10mm of movement along the length of the scale. This allows the absolute position value to be captured by the controller having moved over a maximum distance of 20mm. this removes the requirement to traverse the full length of the scale to pick up the single point index and establish the alignment position.

1Vpp via SCC200 Signal Converter (included) (ordering code VP)

Refer to section entitled Sine-Cosine Converter

Newall Signal Codes	Signal Type	Description	Available on
TT	Incremental TTL	TTL, RS422 Differential Quadrature output	SHG, MHG, SPB, MCG, MAG
TC	Incremental TTL-DC	TTL, Distance Coded	SHG
TS	Incremental TTL-SP	TTL Single Point	SHG, MHG, SPB
VP	Incremental ~1Vpp	1 Volt Peak to Peak	SHG, MHG, MCG
VS	Incremental ~1Vpp-SP	1 Volt Peak to Peak - Single Point	SHG
A2	Absolute - RS232	RS232	SHG
A4	Absolute - RS485	RS485	SHG
AB	Absolute - SSI-Binary	Synchronous Serial Interface - Binary Code	SHG
AF	Absolute - Fanuc	Fanuc Interface Protocol	SHG
AG	Absolute - SSI-Gray	Synchronous Serial Interface - Gray Code	SHG
AS	Absolute - Gray & Parity	Synchronous Serial Interface - Gray Code plus Even Parity Checksum	SHG



RS232 + RS422 Differential Quadrature (ordering code A2)

RS232 is a serial communication typically used to interface with PC control systems 'COM' port. This Electronics Industry Association (EIA) standard allows for data transmission from one transmitter to one receiver at data rates up to 20K bits/second and distances up to approximately 15m at the maximum data rate. A USB to serial converter (Newall part number 307-82340) is available to allow serial interface via a USB port.

RS485 + RS422 Differential Quadrature (Ordering code A4)

The RS485 standard is a multipoint communication network, which specifies up to 32 drivers and 32 receivers on a single 2-wire Bus. A key feature is the ability to address individual devices. Newall's Linear Encoders are capable of being given and remembering a unique address tag which means multiple devices can be hung off the RS485 Bus. (Please specify address tag when ordering).

Absolute Fanuc (ordering code AF)

This protocol is proprietary to Fanuc and available on all of their control systems. The controller makes a request for positional data and the encoder has to respond correctly with data within a strictly controlled time state.

SSI Output Format

The SSI (Synchronous Serial Interface) is a patented absolute interface by Max Stegmann GmbH. Newall's absolute encoders offer this interface implementing the 24 bit Gray code or Binary positional encoding. An even parity checksum is available on the AS & AV version. The Most Significant Bit (MSB) is transmitted first (D23).

The following absolute encoders are available with an SSI output:

- Absolute SSI Binary, 24 Bit (ordering code AB)
- Absolute SSI Gray, 24 Bit (ordering code AG)
- Absolute SSI Gray, 24 Bit with Even Parity (ordering code AS or AV)
  (Parity is transmitted last and is Even Parity)

SSI is a serial protocol that provides absolute positional feedback for encoder applications. The SSI is a synchronous standard, meaning that the clock signals for the data exchange are provided by the controller and are typically limited to 1.5MHz. Transfer rates (baud) are also dependent on cable lengths. The following table is recommended.

Cable Length (m)	Baud Rate (KHz)
< 50	≥ 400
< 100	≥ 300
<200	≥ 200
<400	≥ 100

Binary is the position in decimal converted to its binary equivalent and then expanded with additional zero's to fill the required data packet. For example:

123456 (Decimal) = 11110001001000000 (Binary)

If this is shown in a 24 bit data packet it will equal:
000000011110001001000000

Gray is a binary code that only varies by one bit per transition.

Example:
0000
0001
0011
0010
0110 etc.

So the position in decimal is converted to pure binary and the converted to its Gray code equivalent. This has the advantage over binary in that the maximum reading error is a single step.

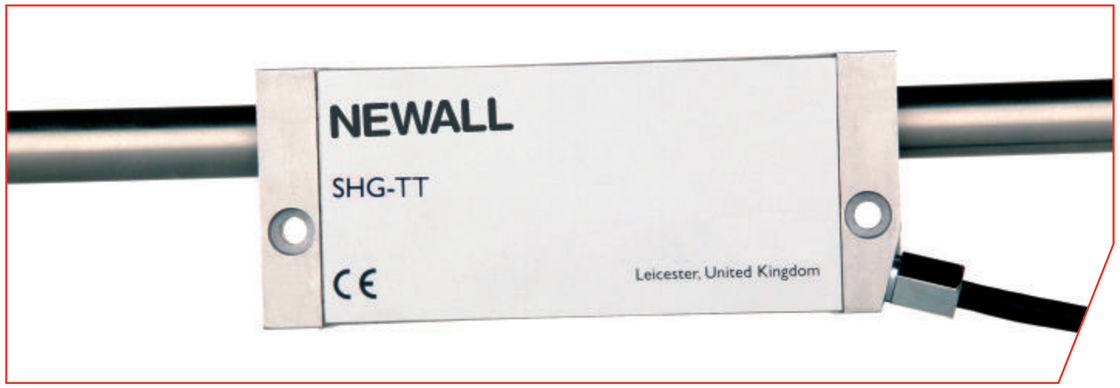
Signal Connection Table

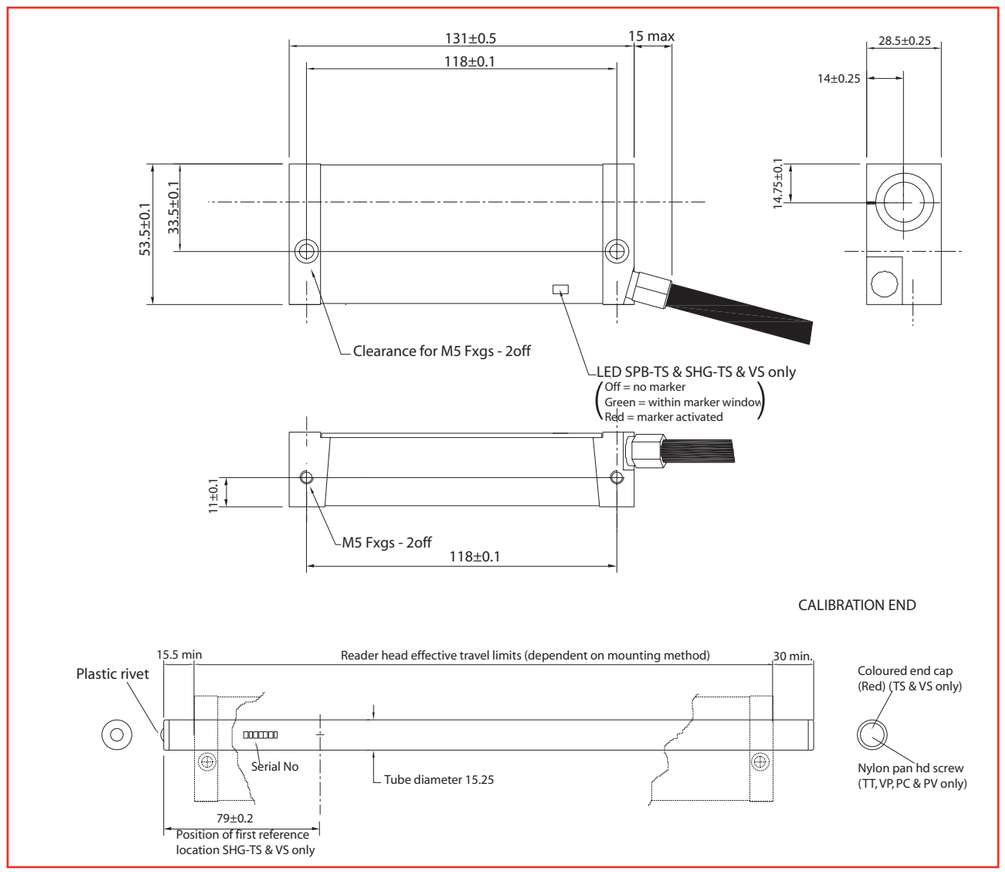
Connector	Absolute Output				
D Type 15 Pin	-A2 RS232	-A4 RS485	-AB & -AG SSI-Gray / SSI Binary	-AS Gray & Parity	-AV SSI & ~1Vpp
1			SSI CLK	SSI CLK	Details on page 27 Connection details via SCC200
2	Reserved, do not connect	Reserved, do not connect	Reserved, do not connect	Reserved, do not connect	
3	RS232 TX	RS232 TX			
4	$\overline{RM}$	$\overline{RM}$	$\overline{RM}$	$\overline{RM}$	
5	$\overline{B}$	$\overline{B}$	$\overline{B}$	$\overline{B}$	
6	$\overline{A}$	$\overline{A}$	$\overline{A}$	$\overline{A}$	
7	RS232 RX	RS232 RX			
8	+5VDC	+5VDC	+5VDC	+5VDC	
9			SSI $\overline{CLK}$	SSI CLK	
10		RS485	SSI DATA	SSI DATA	
11		$\overline{RS485}$	SSI $\overline{DATA}$	SSI $\overline{DATA}$	
12	RM	RM	RM	RM	
13	B	B	B	B	
14	A	A	A	A	
15	0V		0V	0V	

Blank connections are not implemented and are to be left unconnected

Signal Connection Table for Fanuc Serial Absolute

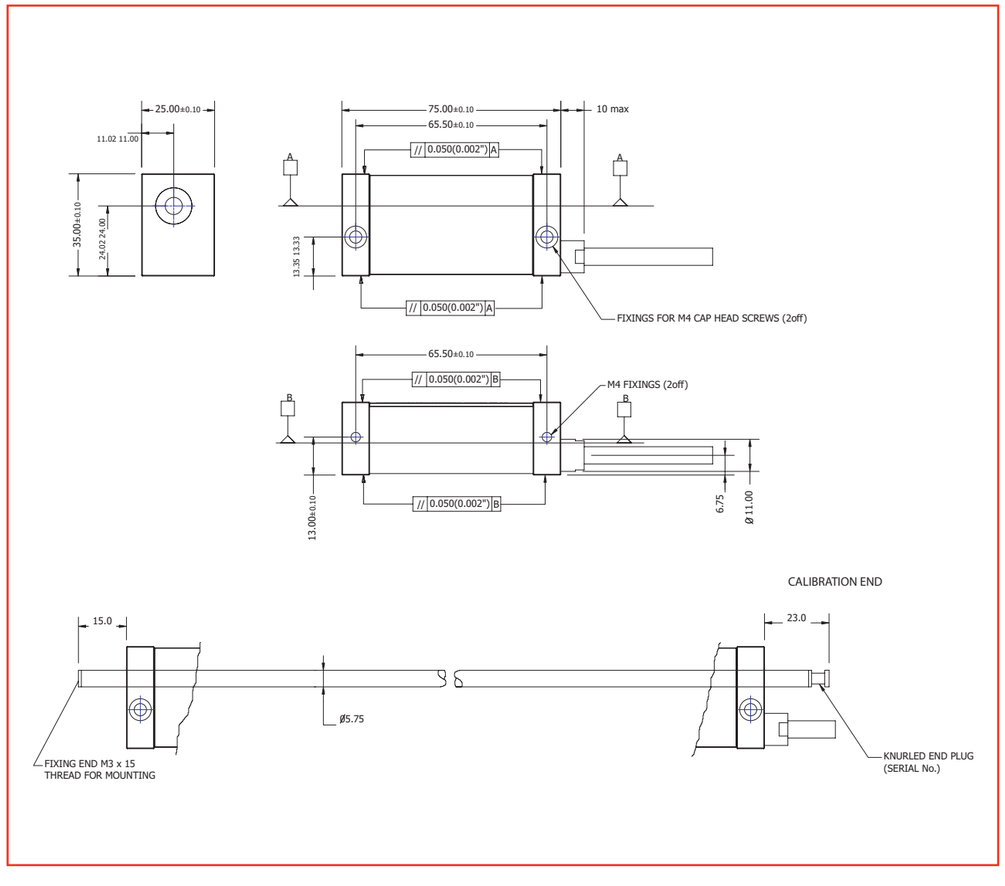
Connector PCE - E20FS HONDA	-AF Fanuc
5	Fanuc RQ
9, 18, 20	+5VDC
6	Fanuc $\overline{RQ}$
1	Fanuc Data
2	Fanuc $\overline{Data}$
12, 14, 16	0V



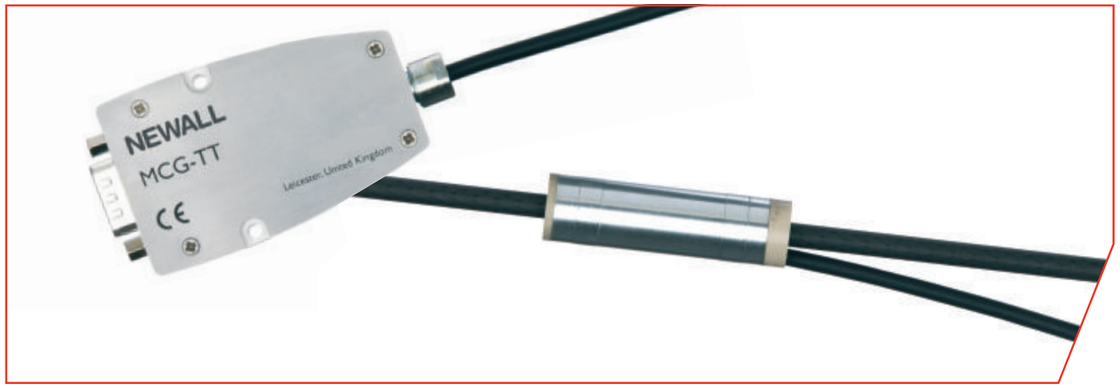


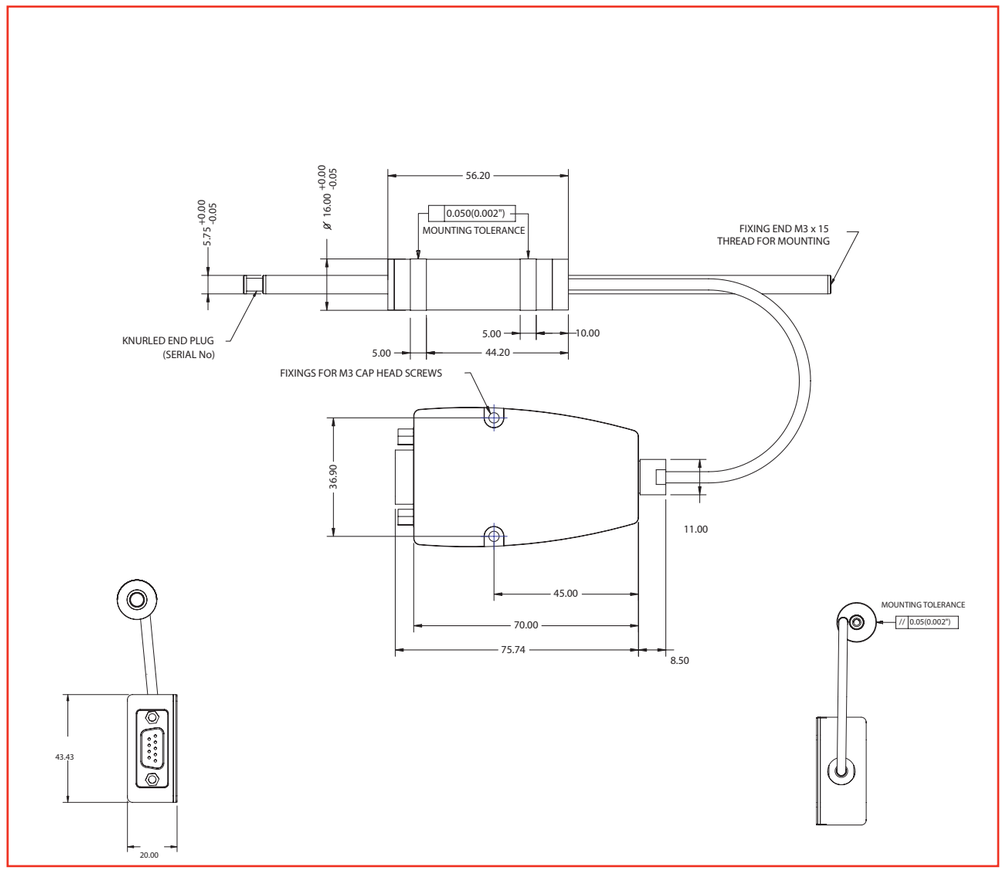
Specification	SHG-TT, SHG-VP, SHG-PC, SHG-PV	SHG-TS, SHG-VS	Options
Type	Inductive	Inductive	
Accuracy Grade	±10µm (±0.0004in)	±10µm (±0.0004in)	
Resolutions (µm/m)	1µm	TS = 1µm VS = 20µm via SCC200	0.5, 2, 5 & 10µm
Resolutions (in)	0.00005in	0.0005in	0.00002in 0.0001in 0.0002in 0.0005in
Reference Type	Periodic	Single Point	
Reference Location	Every 12.7mm (0.5in)	User select from 1 to 8 every 50.8mm (where scale travel permits)	
Maximum Traverse Rate	SHG-TT = 2m/s at 1µm resolution SHG-VP = 4m/s at 1µm resolution SHG-PC = 2m/s at 1µm resolution SHG-PV = 2m/s at 1µm resolution	SHG-TS = 2m/s at 1µm resolution SHG-VS = 4m/s 20µm Signal Period with SCC200	
Maximum Acc. / Dec.	100g / 98m/s (head moving)	100g / 98m/s (head moving)	
Power Supply	5VDC ± 5% <80mA	5VDC ± 5% <80mA	
Shock (11ms)	100g / 980m/s2 (IEC 69-2-6)	100g / 980m/s2 (IEC 69-2-6)	
Vibration (55-2000Hz)	30g / 294m/s2 (IEC 68-2-27)	30g / 294m/s2 (IEC 68-2-27)	
Ingress Protection (IP) Level	IP67, fully submersible (IEC 529) - Exceeds NEMA 6	IP67, fully submersible (IEC 529) - Exceeds NEMA 6	
Operating Temperature Range	0 to 55°C (32 to 131°F)	0 to 55°C (32 to 131°F)	
Storage Temperature Range	-20 to 70°C (-4 to 158°F)	-20 to 70°C (-4 to 158°F)	
Magnetic Field Susceptibility	100mT (1000 Gauss)	100mT (1000 Gauss)	
Radiated Magnetic Field	Less then 1mT	Less then 1mT	
Overall Cross-Section	53.5 x 28.5mm (2 x 1in)	53.5 x 28.5mm (2 x 1in)	
Scale Material	Stainless Steel	Stainless Steel	
Co-efficient of Expansion	12ppm/°C	12ppm/°C	
Scale OD	15.25mm (0.6in)	15.25mm (0.6in)	
Maximum Scale Travel	12,000mm (472in)*	12,000mm (472in)*	
Maximum Single End Mount Measuring Length	350mm (14in)	350mm (14in)	
Maximum Length between Supports	1500mm (59in)**	1500mm (59in)**	
Scale Over-Travel Requirements	254mm (10in)	254mm (10in)	
Standard Cable	9 core screened cable with PUR (polyurethane) cover with no armour	9 core screened cable with PUR (polyurethane) cover with no armour	Fully interlocked stainless steel armour
Cable Length	0.5m (20in)	0.5m (20in)	
Minimum Bend Radius with PUR	25mm (1in)	25mm (1in)	With Armour 50.8mm (2in)
Maximum Cable Length	22m (866in)	22m (866in)	
Connector	SHG-TT, SHG-VP, SHG-VV, SHG-VM = D type 9 pin (IP54, NEMA 3) SHG-PC, SHG-PV = 15 Pin D Type (IP54, NEMA 3)	D type 9 pin (IP54, NEMA 3)	SHG-TT, SHG-VP, SHG-TS, SHG-VS = 12 pin (IP67, NEMA 6), SHG-PC, SHG-PV = 19 Pin (IP67, NEMA 6)
EMC Compliance	BS EN 50081-2 & BS EN 50082-2	BS EN 50081-2 & BS EN 50082-2	

* Longer scale travels are available on request
** Only applies for travels over 2540mm (100 in)

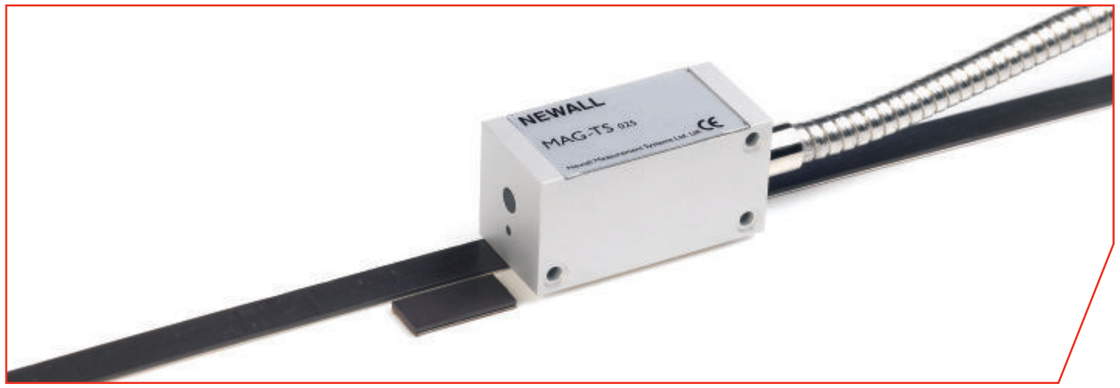


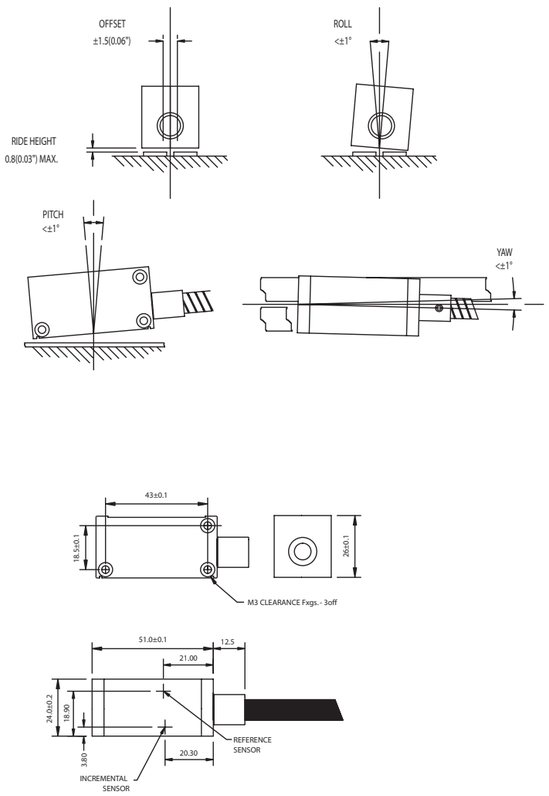
Specification	MHG-TT, MHG-VP	Options
Type	Inductive	
Accuracy Grade	±10µm	±5µm
Resolutions (µm/m)	TT = 1µm VP = 20µm via SCC200	0.1, 0.2, 0.5, 2, 5 & 10µm
Resolutions (in)	TT = 0.0005in	0.000005in 0.000001in 0.00002in 0.0001in 0.0002in 0.0005in
Reference Type	Periodic	
Reference Location	Every 5mm (0.2in)	
Maximum Traverse Rate	MHG-TT = 2m/s at 1µm resolution MHG-VP = 4m/s at 1µm resolution	
Maximum Acc. / Dec.	10g / 98m/s (head moving)	
Power Supply	5VDC ± 5% <80mA	
Shock (11ms)	100g / 980m/s2 (IEC 69-2-6)	
Vibration (55-2000Hz)	30g / 294m/s2 (IEC 68-2-27)	
Ingress Protection (IP) Level	IP67, fully submersible (IEC 529) - Exceeds NEMA 6	
Operating Temperature Range	0 to 55°C (32 to 131°F)	
Storage Temperature Range	-20 to 70°C (-4 to 158°F)	
Magnetic Field Susceptibility	100mT (1000 Gauss)	
Radiated Magnetic Field	Less then 1mT	
Overall Cross-Section	35 x 25mm (1.5 x 1in)	
Scale Material	Carbon Fibre	Stainless steel
Co-efficient of Expansion	12ppm/°C	
Scale OD	5.75mm (0.2in)	
Maximum Scale Travel	1000mm (39in)	
Maximum Single End Mount Measuring Length	250mm (10in)	
Scale Over-Travel Requirements	178mm (7in)	
Standard Cable	9 core screened cable with PUR (polyurethane) cover with no armour	Fully interlocked stainless steel armour
Cable Length	0.5m (20in)	
Minimum Bend Radius with PUR	25mm (1in)	With Armour 50.8mm (2in)
Maximum Cable Length	22m (866in)	
Connector	D type 9 pin (IP54, NEMA 3)	12 pin (IP67, NEMA 6), Round type
EMC Compliance	BS EN 50081-2 & BS EN 50082-2	





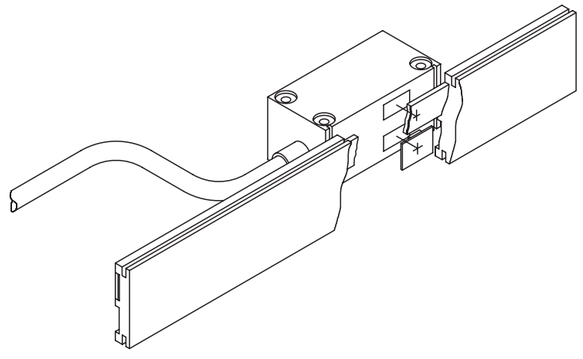
Specification	MCG-TT	Options
Type	Inductive	
Accuracy Grade	±5µm (± 0.0002in)	
Resolutions (µm/m)	1µm	0.1, 0.2, 0.5, 2, 5 & 10µm
Resolutions (in)	0.0005in	0.000005in 0.000001in 0.00002in 0.0001in 0.0002in 0.0005in
Reference Type	Periodic	
Reference Location	Every 5mm (0.2in)	
Maximum Traverse Rate	2m/s at 1µm resolution	
Maximum Acc. / Dec.	10g / 98m/s (head moving)	
Power Supply	5VDC ± 5% <80mA	
Shock (11ms)	100g / 980m/s2 (IEC 69-2-6)	
Vibration (55-2000Hz)	30g / 294m/s2 (IEC 68-2-27)	
Ingress Protection (IP) Level	IP67, fully submersible (IEC 529) - Exceeds NEMA 6	
Operating Temperature Range	0 to 55°C (32 to 131°F)	
Storage Temperature Range	-20 to 70°C (-4 to 158°F)	
Magnetic Field Susceptibility	100mT (1000 Gauss)	
Radiated Magnetic Field	Less then 1mT	
Overall Cross-Section	56.2mm x 16.0mm/OD (2.21in x 0.63in/OD)	
Scale Material	Carbon Fibre	Stainless steel
Co-efficient of Expansion	12ppm/°C	
Scale OD	5.75mm (0.2in)	
Maximum Scale Travel	1000mm (39in)	
Maximum Single End Mount Measuring Length	250mm (10in)	
Scale Over-Travel Requirements	178mm (7in)	
Standard Cable	9 core screened cable with PUR (polyurethane) cover with no armour	
Cable Length	0.5m (20in)	
Minimum Bend Radius with PUR	25mm (1in)	
Maximum Cable Length	22m (866in)	
Connector	D type 9 pin (IP54, NEMA 3)	12 pin (IP67, NEMA 6)
EMC Compliance	BS EN 50081-2 & BS EN 50082-2	



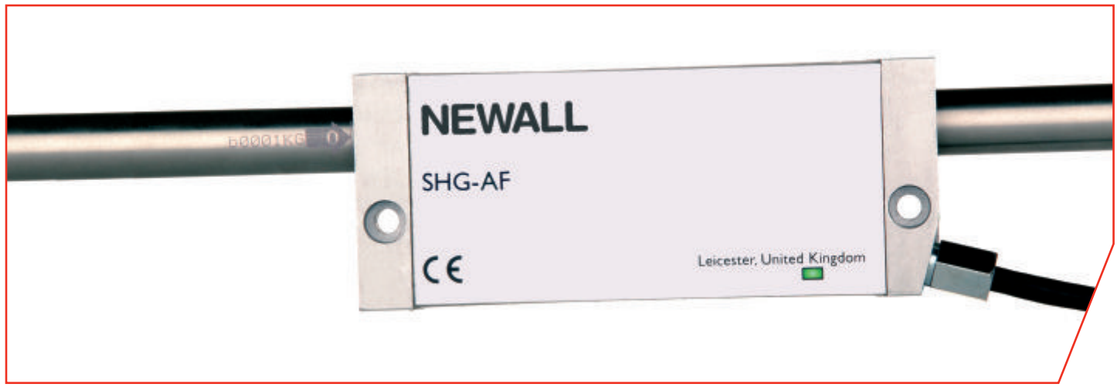


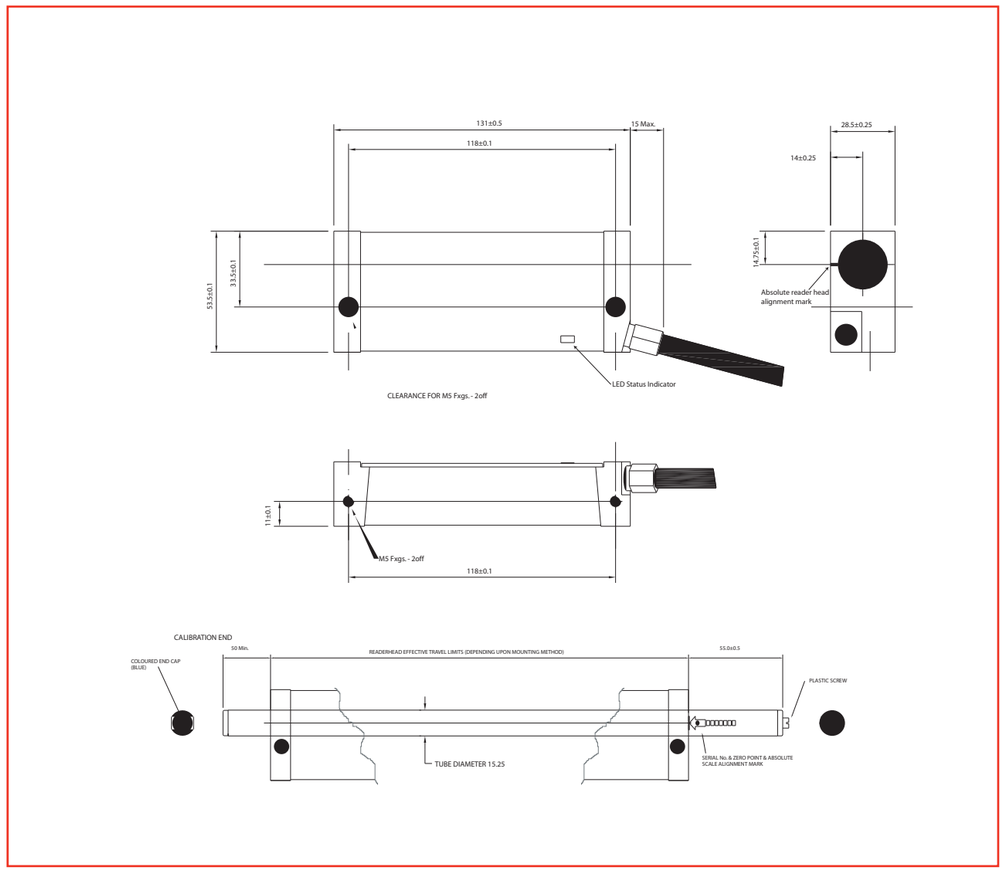
Product Incremental Linear Encoders - MAG-TS Magnetic Tape System

Specification	MAG-TS	Options
Type	Magnetic Tape	
Accuracy Grade	±25µm +20µm (0.001in)	
Resolutions (µm/m)	10µm	5µm
Resolutions (in)	0.0005in	0.0002in
Reference Type	Single	Additional RM available
Reference Location	User Select	
Maximum Traverse Rate	4m/s at 10µm resolution	4m/s at 5µm resolution
Maximum Acc. / Dec.	100g / 980m/s (head moving)	
Power Supply	5VDC ± 5% <80mA	
Shock (11ms)	100g / 980m/s2 (IEC 69-2-6)	
Vibration (55-2000Hz)	30g / 294m/s2 (IEC 68-2-27)	
Ingress Protection (IP) Level	IP67, fully submersible (IEC 529) - Exceeds NEMA 6	
Operating Temperature Range	0 to 55°C (32 to 131°F)	
Storage Temperature Range	-20 to 70°C (-4 to 158°F)	
Magnetic Field Susceptibility	5mT (50 Gauss)	
Radiated Magnetic Field	9mT (90 Gauss @ 0.6mm)	
Overall Cross-Section	24 x 26mm (1 x 1in)	
Scale Material	Rubber and Stainless Steel	
Co-efficient of Expansion	16ppm/°C	
Scale Section	10 x 1.8mm (0.4 x 0.07in)	
Maximum Scale Travel	20m (787in)	
Standard Cable	9 core screened cable with PUR (polyurethane) cover with fully interlocked stainless steel armour	
Cable Length	3.5m (138in)	
Minimum Bend Radius with PUR	With Armour 50.8mm (2in)	
Maximum Cable Length	22m (866in)	
Connector	D type 9 pin (IP54, NEMA 3)	
EMC Compliance	BS EN 50081-2 & BS EN 50082-2	



Optional Backing Bar





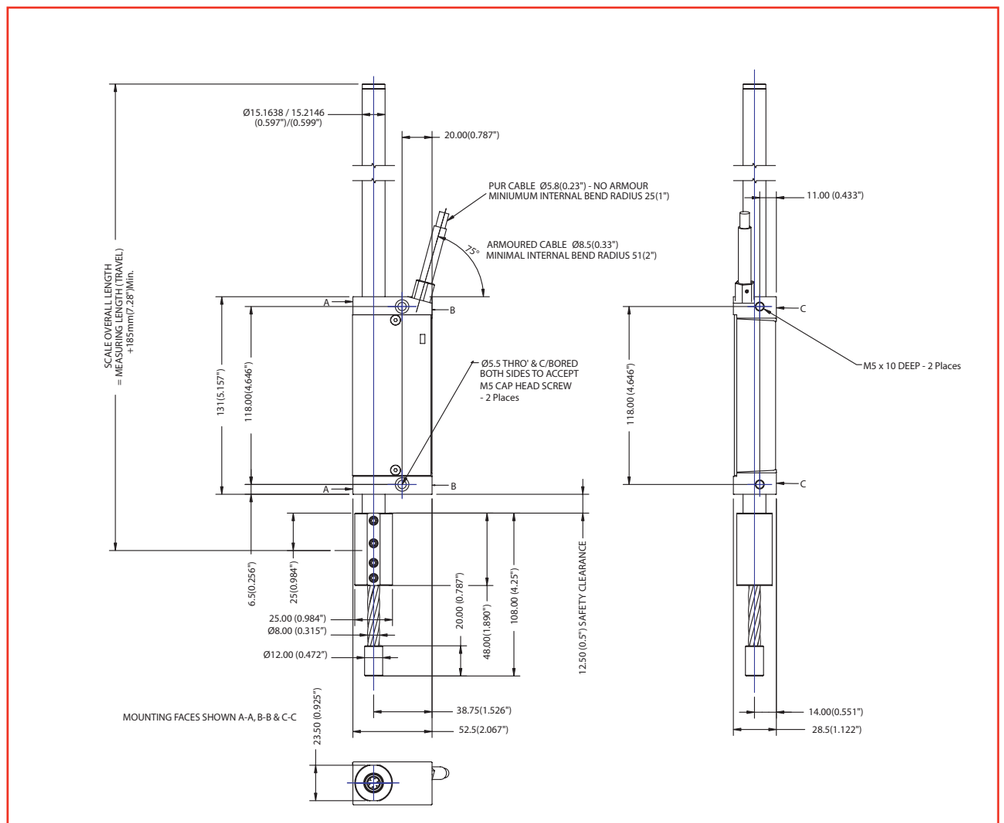
Product Absolute and Distance-Coded Linear Encoders

Specification	SHG-A2, SHG-A4, SHG-AB, SHG-AF, SHG-AG, SHG-AS, SHG-AV	SHG-TC	Options
Type	Inductive	Inductive	
Accuracy Grade	±10µm (0.0004in)	±5µm (0.0002in)	3 & 5µm (0.002in, 0.0002in)
Resolutions (µm/m)	1µm	1µm	0.5, 5, 10µm
Resolutions (in)	0.00005in	0.00005in	0.00002in, 0.0002in, 0.004in
Reference Type	None	Distance-Coded	
Reference Location	Every 10mm via RS422 interface Except SHG-AF & SHG-AV = None	Max 20mm movement (0.8in)	
Maximum Traverse Rate	SHG-A2 = 6m/s SHG-A4 = 6m/s SHG-AB = 6m/s SHG-AF = 4m/s SHG-AG = 6m/s SHG-AS = 6m/s SHG-AV = 4m/s limited by SCC200	4m/s at 1µm resolution	
Maximum Acc. / Dec.	10g / 980m/s (head moving)	10g / 980m/s (head moving)	
Power Supply	5VDC ± 5% <80mA	5VDC ± 5% <80mA	
Shock (11ms)	100g / 980m/s2 (IEC 69-2-6)	100g / 980m/s2 (IEC 69-2-6)	
Vibration (55-2000Hz)	30g / 294m/s2 (IEC 68-2-27)	30g / 294m/s2 (IEC 68-2-27)	
Ingress Protection (IP) Level	IP67, fully submersible (IEC 529) - Exceeds NEMA 6	IP67, fully submersible (IEC 529) - Exceeds NEMA 6	
Operating Temperature Range	0 to 55°C (32 to 131°F)	0 to 55°C (32 to 131°F)	
Storage Temperature Range	-20 to 70°C (-4 to 158°F)	-20 to 70°C (-4 to 158°F)	
Magnetic Field Susceptibility	3mT (30 Gauss)	3mT (30 Gauss)	
Radiated Magnetic Field	10mT (100 Gauss)	10mT (100 Gauss)	
Overall Cross-Section	53.5 x 28.5mm (2 x 1in)	53.5 x 28.5mm (2 x 1in)	
Scale Material	Stainless Steel	Stainless Steel	
Co-efficient of Expansion	12ppm/°C	12ppm/°C	
Scale OD	15.25mm (0.6in)	15.25mm (0.6in)	
Maximum Scale Travel	3500mm (138in)	3500mm (138in)	
Maximum Single End Mount Measuring Length	350mm (14in)	350mm (14in)	
Maximum Length between Supports*	1000mm (39in)	1000mm (39in)	
Scale Over-Travel Requirements	254mm (10in)	254mm (10in)	
Standard Cable	9 core screened cable with PUR (polyurethane) cover with no armour	9 core screened cable with PUR (polyurethane) cover with no armour	Fully interlocked stainless steel armour
Cable Length	0.5m (20in)	0.5m (20in)	
Minimum Bend Radius with PUR	25mm (1in)	25mm (1in)	With Armour 50.8mm (2in)
Maximum Cable Length	18m (708in)	18m (708in)	
Connector	D Type 15 Pin (IP54, NEMA 6)	D Type 15 Pin (IP54, NEMA 6)	19 Pin (IP67, NEMA 6)
EMC Compliance	BS EN 50081-2 & BS EN 50082-2	BS EN 50081-2 & BS EN 50082-2	

*Only applies for travels over 2540mm (100 in)

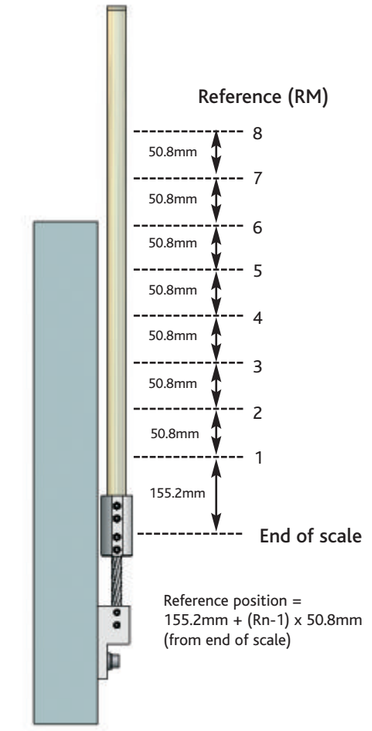
Product Linear Encoder with Flexible Mounting System

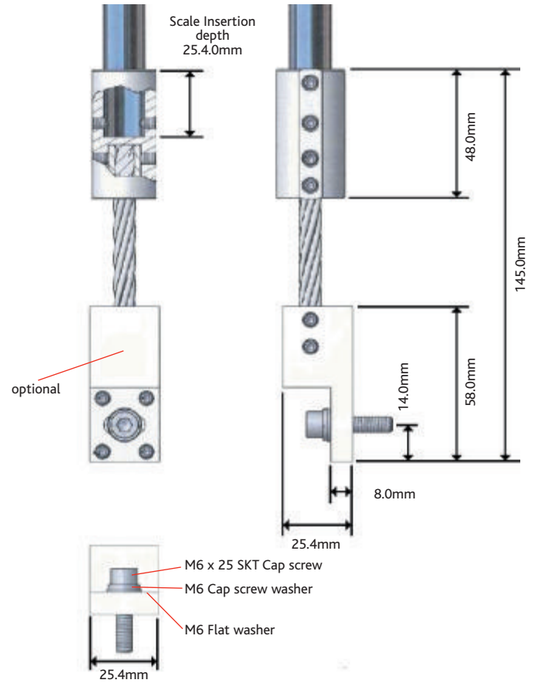
Suitable for press brake applications



Product Linear Encoder with Flexible Mounting System

Suitable for press brake applications





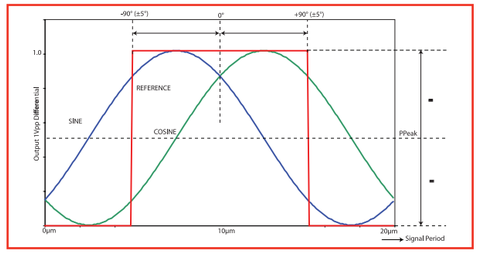
Specification	SPB-TS, SPB-TT
Type	Inductive
Accuracy Grade	±10µm (0.0004in)
Resolutions (µm/m)	1, 5, 10µm
Resolutions (in)	0.00005in, 0.0002in, 0.0004in
Maximum Traverse Rate	1m/s at 1µm resolution
Maximum Acc. / Dec.	10g / 100m/s
Power Supply	5VDC ± 5% <85mA
Reference Mark	SPB-TS = User selectable from 1-8 (50.8mm apart) SPB-TT = Periodic (12.7mm)
Shock (11ms)	100g / 980m/s2 (IEC 69-2-6)
Vibration (55-2000Hz)	30g / 294m/s2 (IEC 68-2-27)
Ingress Protection (IP) Level	IP67, fully submersible (IEC 529) - Exceeds NEMA 6
Moving Force	<5N
EMC Compliance	BS EN 50081-2 & BS EN 50082-2
Operating Temperature Range	0 to 55°C (32 to 131°F)
Storage Temperature Range	-20 to 70°C (-4 to 158°F)
Overall Length	Travel + 277.5mm (10.93in)
Mounting Alignment Tolerance	±3mm at opposite end to flexible mounting system

SCC200 High Performance Converter for servo applications

Incremental sinusoidal signals - 1Vpp (Vss)

The sinusoidal incremental signals are produced by advanced processing of both the A and B signal channels. These channels are phase shifted by 90° and have a signal level of 1Vpp differential when terminated using the recommended circuitry with a common mode voltage of 2.5V. The signal levels are maintained at all speed levels providing no loss of signal integrity with increasing scanning frequency.

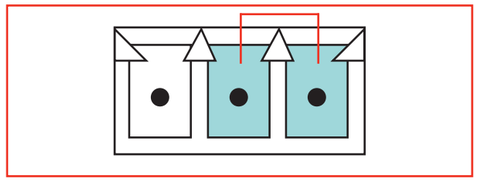
Note: The SCC200 is designed for DIN rail mount. (European DIN rail standards: EN50022 & EN50035)



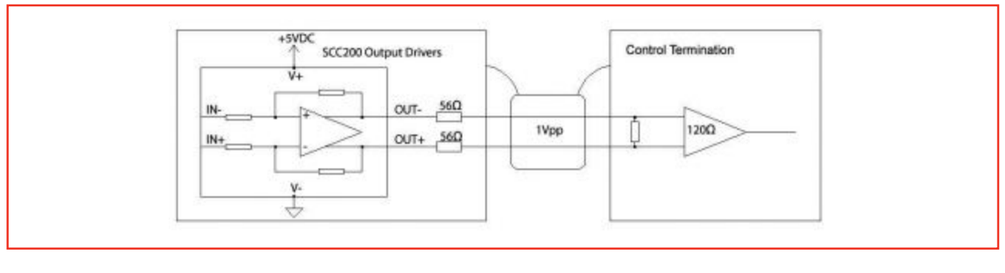
Input Power Connection

If the control **cannot** provide the required power, an external supply can be connected.

If the control **can** supply the required power, insert the link provided as shown below.

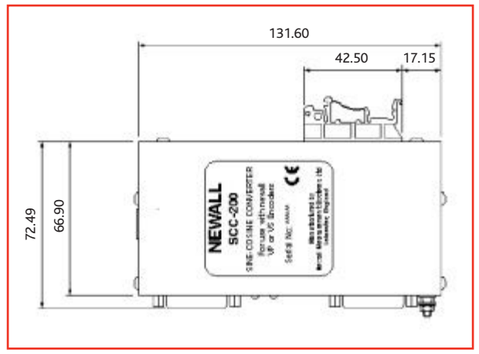


Recommended Input Circuitry at Terminating Electronics



SCC200 High Performance Converter

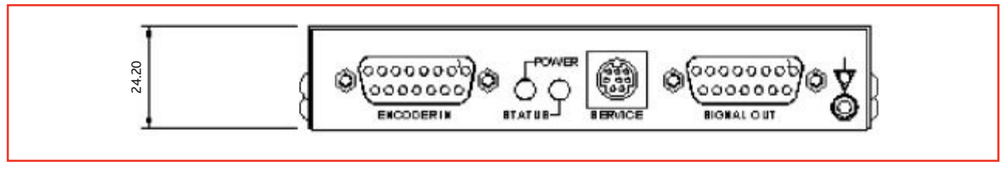
Dimensions



SCC200 Connections (Signal Out Connector 15 pin male D type)

Pin Number	VS, VP Function	AV Function
1	Reserved	SSI CLK +
2	Reserved	Reserved
3	Reserved	Reserved
4	RM-	Reserved
5	B-	B-
6	A-	A-
7	Reserved	Reserved
8	5V	5V
9	Reserved	SSI CLK +
10	Reserved	SSI DATA+
11	Reserved	SSI DATA+
12	RM	Reserved
13	B+	B+
14	A+	A+
15	0V	0V
Shell	Ground	Ground

Connections marked as reserved DO NOT CONNECT

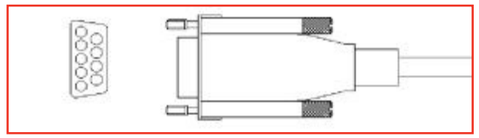


Specification	
Power Supply	5VDC ±5% <300mA
Operating Temperature	0° to 55°C
Storage Temperature	-20° to 70°C
Ingress Protection Level	IP54
EMC Compliance	BS EN 50081-2 BS EN 50082-2
Sinusoidal Voltage Output Signal	~ 1Vpp differential
Sinusoidal Signals A & B* Signal Levels	0.8 to 1.2Vpp*, typically 1Vpp
Amplitude Ratio (A to B)	0.95 to 1.05
Phase Angle	90°C ± 5° elec
Ref. Mark Zero Crossover Point	± 90°C ± 5° elec
Dimensions	131mm x 67mm x 24mm**
Weight	0.5lbs (0.23kg)**
Part Number (for encoder):	SHG-VP SHG-VS 600-82875 SHG-AV
	MHG-VP MCG-VP 600-82870

* With recommended input circuitry at terminating electronics
** Dimensions and weight do not include optional link or DIN rail mount

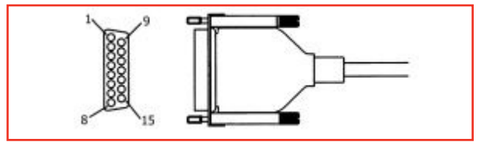
Connectors & Cables

Standard Connectors (IP54, NEMA 3)
9 Pin D Connector



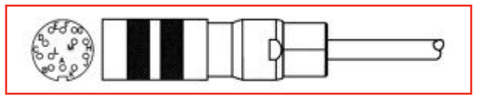
Colour	Pin	Function
Orange	1	Reserved, Do Not Connect
Green	2	Channel A
Yellow	3	Channel $\overline{A}$
Blue	4	Channel B
Red	5	Channel $\overline{B}$
White	6	0V
Black	7	5V
Violet	8	Channel RM
Grey	9	Channel $\overline{RM}$
Screen	SHELL	GND

15 Pin D Connector



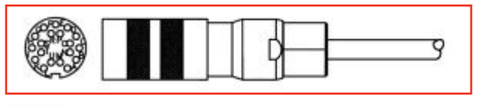
Colour	Pin	Function
Light Green	1	Fanuc RQ / SSI CLK
Orange	2	Reserved, Do Not Connect
Pink & White	3	RS232 TX
Grey	4	$\overline{RM}$
Red	5	$\overline{B}$
Yellow	6	$\overline{A}$
Pink	7	RS232 RX
Black	8	+5VDC
Light Green & White	9	Fanuc RQ/SSI $\overline{CLK}$
Brown	10	Fanuc Data / SSI Data / RS485
Brown & White	11	Fanuc $\overline{Data}$ / SSI $\overline{Data}$ / RS485
Violet	12	RM
Blue	13	B
Dark Green	14	A
White	15	0V
Screen	SHELL	GND

Optional Connector (IP67, NEMA 6)
12 Pin Connector



Colour	Pin	Function
Orange	A	Reserved, Do Not Connect
White	B	0V
White	C	0V
Yellow	D	Channel $\overline{A}$
Green	E	Channel A
Red	F	Channel $\overline{B}$
Blue	G	Channel B
Violet	H	Channel RM
Black	J	5V
Black	K	5V
	L	
Grey	M	Channel $\overline{RM}$
Screen	SHELL	GND

Optional Connector (IP67, NEMA 6)
19 Pin Connector



Colour	Pin	Function
Pink & White	A	RS232 TX
Black	B	+ 5VDC
Black	C	+ 5VDC
Black	D	+ 5VDC
Grey	E	$\overline{RM}$
Violet	F	RM
Orange	G	Reserved, Do Not Connect
White	I	0V
White	K	0V
Pink	L	RS232 RX
Light Green & White	M	Fanuc $\overline{RQ}$ / SSI $\overline{CLK}$
Brown	N	Fanuc Data / SSI Data / RS485
Brown & White	O	Fanuc $\overline{Data}$ / SSI $\overline{Data}$ / RS485
Red	P	B
Yellow	S	A
Dark Green	T	A
Light Green	U	Fanuc RQ / SSI CLK
Screen	SHELL	GND

Extension Cables

There are a selection of extension cables available for the range of encoders. Therefore a cable selection guide has been devised to ensure you can purchase the product you require.

Select one option per section as required. The options in turn make up the part number.

Section 1	Option	Option Description
Extension Cable Digital	ELD	Prefix applicable for all digital extension cables
Section 2	**Option**	**Option Description**
Connector reader head end	09D0	9 pin D (IP54, NEMA 3)
	15D0	15 pin D (IP54, NEMA 3)
	09B0	12 pin round (IP67, NEMA 6)
	15B0	19 pin round
Section 3	**Option**	**Option Description**
Cable Length	035	3.5m cable
	050	5m cable
	070	7m cable
	100	10m cable
Section 4	**Option**	**Option Description**
Termination output end	0D	9 pin D (IP54, NEMA 3)
	1D	15 pin D (IP54, NEMA 3)
	FL	Flying leads (tails)
	FA	Fanuc (Honda)
	AM	Amp
Section 5	**Option**	**Option Description**
Armour	0	Armoured
	1	Non-armoured

Extension cable for SCC200 to CNC/PLC/Motion Control/Drive Encoder Interface

Select one option per section as required. The options in turn make up the part number.

Section 1	Option	Option Description
Extension Cable Digital	ELD	Prefix applicable for all digital extension cables
Section 2	**Option**	**Option Description**
Connector SCC200 output	15DS	15 pin D (IP54, NEMA 3)
Section 3	**Option**	**Option Description**
Cable length	005	0.5m cable
	010	1m cable
	015	1.5m cable
	035	3.5m cable
Section 4	**Option**	**Option Description**
Termination output end*	2D	15 pin D (IP54, NEMA 3), Siemens 611D Drive or 840D CNC
	FL	Flying leads (tails)
Section 5	**Option**	**Option Description**
Armour	0	Armoured
	1	Non-armoured

* Other termination outputs available on request

General Information

The Spherosyn™ Technology Advantage

Environmental Protection

All variants of Newall encoders carry an Ingress Protection (IP) rating of 67 (NEMA 6). The encoders are fully submersible and will continue to provide accurate and dependable readings under the harshest conditions. Unlike most glass based systems, no air purging is required. Dirt, swarf, cast iron dust, graphite dust and other common contaminates will not effect the performance of the system.

Shock and Vibration

In comparison to other linear displacement technologies, Newall's Linear Encoders are tolerant to high degrees of vibration and shock.

- Shock and Impact (11ms IEC 69-2-6): Spherosyn™ technology = 1000m/s2 (100g)
- Vibration (55 - 2000Hz IEC 68-2-27): Spherosyn™ technology = 300m/s2 (30g)

Reliability

Newall encoders require no regular cleaning or maintenance. Unlike optical/glass-based systems, Newall encoders have no general wear characteristics. There are no LEDs to burn out or glass to get scratched or broken. There are no roller bearings, leaf springs or other moving parts to wear out or fail.

Ease of Installation

Installation can be accomplished in a fraction of the time as compared to other linear systems. Even with scale lengths up to 12 metres, machined surfaces or backing bars are not needed. For more compact installations, single end mounting options exist, where the scale need only be supported on one end. These are designed for direct integration into OEM design or optional Newall mounting brackets can be selected.

Accuracy, Repeatability and Resolution

The laser measurement system used to calibrate all of Newall scales have been calibrated by accredited laboratories providing traceability to UK national standards. The procedures comply with the requirements of British Standard Specification BS5781/International Standard ISO10012-1. The National Physical Laboratory (NPL) calibrates the master standard, certificate number 08A014/9501. All Newall Calibration rigs are traceable back to this NPL standard. The calibration of the Newall scales and reader heads is conducted in a temperature controlled (21°C) environment.

Thermal Expansion

The thermal behaviour of the linear encoder is an essential criterion for the working accuracy of a machine tool. And thus it is common knowledge that the thermal behaviour of the encoder should match that of the workpiece.

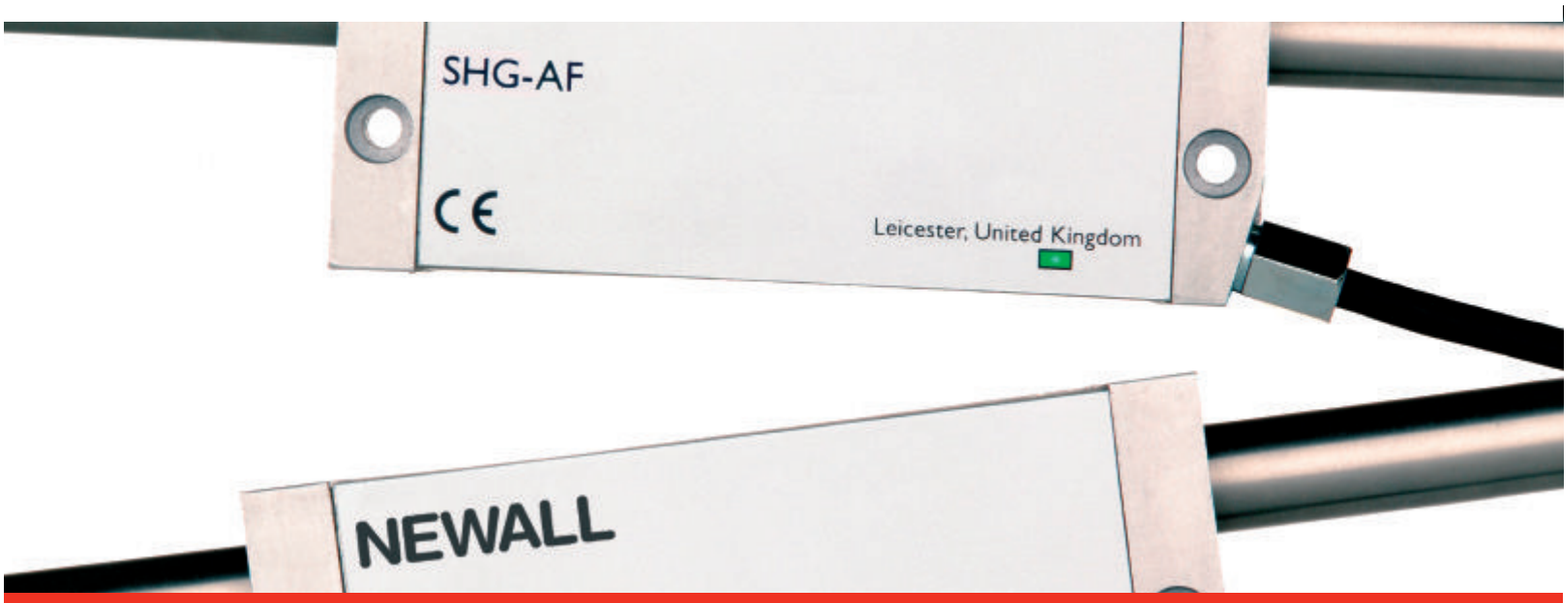
Consequently, a 10°C temperature rise can result in a thermal expansion error for glass in the order of 40µm over 1m of travel. In practice, it is rare that thermal stability will be achieved within the machine, workpiece or encoder during normal operation due to rates of thermal behaviour and environmental conditions. As a result, errors due to thermal effects are impossible to quantify and may be greater or lower than those theoretically calculated. Such errors are minimised by ensuring that the encoder is as matched as possible to both the machine and workpiece.

Product Group	PPM	Steel/Iron (12ppm)	Differential
Glass	8	12	4
Aluminium	23	12	-11
Spherosyn™*	12	12	0

* Spherosyn™ results measured by the Department of Physics University of Hull using strain gauge dilometery with temperature compensation

Newall reserves to change specifications to the products without notification and the company accept no liability for claims from any changes.

NEWALL



Linear Encoders

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