Digital Readouts
Linear Encoders
For Manually Operated Machine Tools
Digital readouts from ACU-RITE make your manually operated machine tools more profitable, improve productivity and raise the quality of the machined workpiece. The 7” TFT color flat panel display shows the actual axis position lucidly and clearly. The context-sensitive graphical user guidance makes working with digital readouts from ACU-RITE a pleasure.

Together with the linear scales from ACU-RITE they form an economic and effective package solution for initial setup or retrofitting on your machine tool.
## Contents

### Digital readouts

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection guide</td>
<td>4</td>
</tr>
<tr>
<td><strong>Functions</strong></td>
<td></td>
</tr>
<tr>
<td>Installation guide (DRO 203, DRO 300)</td>
<td>6</td>
</tr>
<tr>
<td>Probing functions for presets (DRO 300)</td>
<td>6</td>
</tr>
<tr>
<td>Tool compensations (DRO 203, DRO 300)</td>
<td>6</td>
</tr>
<tr>
<td>Distance-to-go display (DRO 100, DRO 203, DRO 300)</td>
<td>7</td>
</tr>
<tr>
<td>Dynamic zoom (DRO 203, DRO 300)</td>
<td>7</td>
</tr>
<tr>
<td>Hole patterns (DRO 203, DRO 300)</td>
<td>8</td>
</tr>
<tr>
<td>Programming of machining steps (DRO 300)</td>
<td>8</td>
</tr>
<tr>
<td>Assistance for working with lathes (DRO 203, DRO 300, DRO 303)</td>
<td>9</td>
</tr>
<tr>
<td><strong>Specifications</strong></td>
<td></td>
</tr>
<tr>
<td>DRO 100 – Simple digital readout for one, two, or three axes</td>
<td>10</td>
</tr>
<tr>
<td>DRO 203 – Versatile digital readout for up to three axes</td>
<td>12</td>
</tr>
<tr>
<td>DRO 300 – Programmable digital readout for three or four axes</td>
<td>14</td>
</tr>
<tr>
<td><strong>Accessories</strong></td>
<td></td>
</tr>
<tr>
<td>Edge finder</td>
<td>16</td>
</tr>
<tr>
<td>Mounting components</td>
<td>17</td>
</tr>
<tr>
<td>IOB 610 external input/output unit for DRO 300</td>
<td>19</td>
</tr>
<tr>
<td><strong>Interfaces</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Linear encoders</strong></td>
<td></td>
</tr>
<tr>
<td>Linear encoders – For manually operated machine tools</td>
<td>22</td>
</tr>
<tr>
<td>Mounting instructions</td>
<td>23</td>
</tr>
<tr>
<td><strong>Specifications</strong></td>
<td></td>
</tr>
<tr>
<td>SENC 50 – Compact linear encoder for limited installation space</td>
<td>24</td>
</tr>
<tr>
<td>SENC 150 – Standard linear encoder</td>
<td>26</td>
</tr>
<tr>
<td><strong>Interfaces</strong></td>
<td></td>
</tr>
<tr>
<td>Incremental signals TTL</td>
<td>28</td>
</tr>
<tr>
<td><strong>Electrical connection</strong></td>
<td></td>
</tr>
<tr>
<td>Cable</td>
<td>29</td>
</tr>
<tr>
<td>General electrical information</td>
<td>30</td>
</tr>
</tbody>
</table>
## Selection guide

<table>
<thead>
<tr>
<th>Model</th>
<th>Number of axes</th>
<th>Reference points/Tool data</th>
<th>Functions</th>
</tr>
</thead>
</table>
| **DRO 100**  
Digital readout for general applications with up to **three axes**  
- 7” TFT color display  
- Splash-proof membrane keyboard | 1, 2 or 3 | 1 datum | General:  
- Absolute/incremental display  
- mm/inch switching  
**Turning:**  
- Radius/diameter display |
| **DRO 203**  
Digital readout for milling, drilling and boring machines, as well as for lathes with **three axes**  
- 7” TFT color display  
- Splash-proof full-travel keyboard | Up to 3 | 10 datums 16 tools | General:  
- Distance-to-go display with graphic positioning aid  
**Milling and drilling:**  
- Probing function using tool  
- Tool radius compensation  
- Hole patterns (circular and linear patterns)  
**Turning:**  
- Radius/diameter display  
- Separate/sum display |
| **DRO 300**  
Digital readout for milling, drilling and boring machines, as well as for lathes with **up to three axes**  
- 7” TFT color display  
- Program memory  
- Splash-proof full-travel keyboard  
- Switching inputs/outputs (via IOB 610) | Up to 4 | 10 datums 99 tools | General:  
- Distance-to-go display with graphic positioning aid  
- Program memory for up to 8 programs with 250 steps each  
**Milling and drilling:**  
- Probing functions for KT edge finder  
- Tool radius compensation  
- Hole patterns (circular and linear patterns)  
**Turning:**  
- Taper calculator  
- Radius/diameter display  
- Separate/sum display |
<table>
<thead>
<tr>
<th>Encoder inputs</th>
<th>Switching inputs/outputs</th>
<th>Data interface</th>
<th>Models</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTL</td>
<td>-</td>
<td>USB Type C</td>
<td>DRO 101, DRO 102, DRO 103</td>
<td>10</td>
</tr>
<tr>
<td>TTL</td>
<td>-</td>
<td>USB Type C</td>
<td>DRO 203</td>
<td>12</td>
</tr>
<tr>
<td>TTL</td>
<td>For KT edge finder; additional ones via IOB 610</td>
<td>USB Type C</td>
<td>DRO 303, DRO 304</td>
<td>14</td>
</tr>
</tbody>
</table>
Functions

– Installation guide (DRO 203, DRO 300)
– Probing functions for presets (DRO 300)
– Tool compensations (DRO 203, DRO 300)

Installation guide
At first switch-on, an installation guide will guide you step by step through the configuration of the unit. During this procedure, you can select the connected encoder directly from a list and thereby adopt all of the encoder parameters. It only takes a few moments to configure the basic functions of the digital readout. You can then separately configure further settings such as scaling factor, error compensation, etc.

Easy setup with probing functions
A very useful accessory for datum setting is the HEIDENHAIN KT edge finder: Simply move the edge finder toward a side of the workpiece until the stylus deflects. The digital readout stores the exact position on its own and automatically takes into account the direction of approach and the radius of the stylus or the tool. For this purpose, the digital readout provides the following probing functions:
• Workpiece edge as reference line
• Workpiece centerline as reference line
• Circle center as datum

Tool compensation for milling machines
The ACU-RITE digital readouts save tool data in a tool table (i.e., diameter and length of the tool used). The data can come from preset tools or be measured on the machine.

When positioning in distance-to-go mode, the readouts take the tool radius (R+ or R–) in the machining plane into account and consider the tool length (ΔL) in the spindle axis.

Determining and storing tool compensation values on lathes
You can store the data for the tools you insert in the turret or quick-change holder in the tool table:
• Enter the tool position directly when turning the first diameter, or
• "freeze" the current axis position value, retract the tool, measure the turned diameter and then enter that value.

Changing the datum
If you change the workpiece or a datum, then you can set a new preset. The tool data are then automatically referenced to the new datum and do not need to be changed.
– Distance-to-go display (DRO 100, DRO 203, DRO 300)
– Dynamic zoom (DRO 203, DRO 300)

Distance-to-go display for turning and milling
The distance-to-go display feature simplifies your work considerably: you enter the next nominal position, and the display shows you the distance remaining to the target position. This means that you simply move to the display value zero.

When you use the distance-to-go feature for milling, the digital readout can compensate for the milling radius. In this way you can directly use the drawing dimensions without having to do any conversions. You no longer have to remember any complicated values.

The distance-to-go display is enhanced by a “near zero” message: As you traverse to zero, a square cursor moves into a target fork. The “near zero” message is configurable for each axis.

Dynamic zoom
The dynamic zoom feature offers a significant improvement in position value readability. Once activated, the display value for the axis currently being moved is maximally enlarged. This occurs in four steps depending on the number of digits in the respective numerical value. For small numbers (i.e., numbers close to zero), the character height can be increased from 17 mm (standard height) to 25 mm. The operator immediately sees which axis is currently moving and can also easily read the numerical value from a greater distance. When the axis stops moving, the display returns to its standard size after a second has elapsed.
Functions
– Hole patterns (DRO 203, DRO 300)
– Programming of machining steps (DRO 300)

Automatic calculation of bolt hole patterns for milling and drilling
In milling machine mode, you can machine **circular hole patterns** (full circle or circle segments) and **linear hole patterns** without much calculation. You simply enter the geometric dimensions and the number of holes from the drawing. The display calculates the coordinates of the individual holes in the working plane. You only need to traverse “to zero” and drill. The display then shows the next position. The **graphic display** is a particularly useful feature: it lets you verify your input for the programmed bolt-hole pattern before machining.

Programming machining steps
The programming functions of the DRO 300 allow you to save repetitive machining steps. For example, you can save all of the machining steps required for a small batch in the form of a program. In the RUN mode of operation, the distance-to-go display will guide you step-by-step to the programmed positions.

You create programs by typing in the positions step by step. The fixed cycles such as Bolt Hole Circle, Linear Hole Pattern, Incline Mill Form or Circular Arc keep your programs short and save you programming time. In the course of your work, the readout presents each nominal position in the proper sequence. You need only move from one position to the next.
Radius/diameter display
In lathe mode, you can see the positions of the transverse axis in either radius or diameter values. You can switch at a keystroke.

Sum display of longitudinal axes
In lathe mode, the positions of the saddle and the top slide are displayed either separately or as the sum of both values.

- If you select separate displays, the position values are referenced to the datum for each individual axis. If only the saddle is moved, the displayed value for the top-slide axis remains unchanged.
- If sum display is selected, the counter adds both values while taking the algebraic sign into account. You can thereby read the absolute position of the tool in relation to the workpiece datum without having to perform calculations.

Vectoring (DRO 203, DRO 300)
The vectoring function breaks down a movement into its longitudinal and crossfeed axis components. If you are turning threads, for example, vectoring lets you see the diameter of the thread in the X axis, even though you are moving the compound axis handwheel.

Taper turning made easy (DRO 203, DRO 303)
If taper dimensions do not include the angle, the integrated taper calculator will help you with the calculation. Simply enter the taper ratio or the two diameters and the length. The correct angle for the top slide will be displayed immediately.

Constant surface speed (DRO 300)
Particularly in taper turning or parting, the surface speed usually changes along with the diameter. But a constant surface speed is better for optimum machining results and long tool life. In conjunction with the IOB 610 output module, the DRO 300 digital readout therefore makes it possible to control a constant surface speed contingent on the current workpiece diameter.
DRO 100
– Simple digital readout for one, two, or three axes

The ACU-RITE DRO 100 digital readouts are well-suited for general applications on milling, drilling, boring, and lathe machines with one, two, or three axes.

Design
With its sturdy housing and splash-proof membrane keyboard, the DRO 100 is built for the workshop. The DRO 100 displays position values, status information, and additional useful data on a TFT color screen.

Functions
The most important functions are available quickly and directly via function keys. If the DRO 100 is connected to a lathe, then you can simply switch from radius to diameter display. For lathes with a separate top slide, the sum display feature on the 3-axis version of the DRO 100 allows you to display the saddle and top slides either together or separately.

Data Interfaces
A USB port enables the writing and reading out of data and files.
### DRO 100

<table>
<thead>
<tr>
<th><strong>Axes</strong></th>
<th>1, 2 or 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Encoder inputs</strong></td>
<td>TTL</td>
</tr>
</tbody>
</table>
| **Display step** | Adjustable, max. 7 digits  
*Linear axis:* 1 mm to 0.0001 mm  
*Rotary axis:* 1° to 0.001° (00° 00' 01'') |
| **Display** | 7” TFT color screen (15:9); resolution 800 x 400 pixels for position values and dialog |
| **Status display** | Frees rate, ABS/INC, mm/inch |
| **Functions** | • 1 datum  
• REF reference-mark evaluation for distance-coded or single reference marks  
• Distance-to-go mode  
• mm/inch switching  
• Absolute-incremental display  
• Integrated help function  
• Axis coupling  
• Radius/diameter display |
| **Error compensation** | Linear axis error |
| **Data interface** | USB connection, Type C |
| **Optional accessories** | Stand, holder for mounting arm, protective cover |
| **Power connector** | AC 100 V (–10 %) to 240 V (+5 %), 50 Hz to 60 Hz (±5 %), ≤ 33 W |
| **Operating temperature** | 0 °C to 45 °C (storage temperature –20 °C to 70 °C) |
| **Protection** | EN 60529 IP 40; front panel IP 54 |
| **Mass** | 1.6 kg |

* Please select when ordering

1) Depends on the signal period of the connected encoder
**DRO 203**
– Versatile digital readout for up to three axes

The ACU-RITE DRO 203 digital readout is especially well-suited for use on milling, drilling, boring, and lathes machines with up to three axes.

**Design**
The DRO 203 digital readout is designed as a sturdy upright unit with splash-proof full-travel keypad for use in a workshop. It is equipped with a 7” TFT color screen for position values, dialog, input displays, graphic functions, and for a graphic positioning aid.

**Functions**
The DRO 203 digital readout is distinguished by its Klartext dialog guidance. The distance-to-go display facilitates positioning tasks. You approach the next position quickly and reliably by simply traversing until the display reads zero. The functions for the respective application are easy to activate via parameter input. Special functions are available for producing hole patterns (linear patterns and circular patterns).

You can easily switch between radius and diameter display when the position display is configured for turning. The digital readout also offers support for lathes with a separate top slide: the sum display feature allows you to display the saddle and top slides either together or separately. To set presets, simply touch the workpiece and freeze the tool position. Then retract and measure the workpiece with the tool out of the way.

**Data interfaces**
A USB port enables the writing and reading out of data and files.

---

**Tolerancing ISO 8015**
ISO 2768 - m H
± 6 mm: ±0.2 mm
## Axes*
2 or 3 (can be configured); various axis designations

## Encoder inputs
TTL

## Display step
Adjustable, max. 7 digits
- **Linear axis:** 1 mm to 0.0001 mm
- **Rotary axis:** 1° to 0.001° (00° 00’ 01”)

## Display
7” TFT color screen (15:9); resolution 800 x 400 pixels for position values and dialog

## Status display
Tool, reference point, operating function, feed rate, ABS/INC, mm/inch, stopwatch

## Functions
- 10 reference points
- 16 tools
- REF reference-mark evaluation for distance-coded or single reference marks
- Distance-to-go mode
- Scaling factor
- mm/inch switching
- Absolute-incremental display
- Integrated help function
- Graphic positioning aid (“near zero” warning)
- Calculator
- Calculation of positions for hole patterns (bolt circles, linear hole patterns)
- Tool radius and tool length compensation
- Linear hole patterns, bolt hole circles

## For milling/drilling/boring
- Taper calculator
- Radius/diameter switching
- Freezing the tool position for back-off
- Vectoring: X/Y display of the traverse path with inclined top slide
- Sum display for Z and ZO (axis coupling)

## Error compensation
- **Axis error:** Linear and multipoint over up to 200 points
- **Backlash compensation:** for compensation of reversal error

## Data interface
USB connection, Type C

## Accessories
- Stand, holder for mounting arm, protective cover

## Power connector
AC 100 V (–10 %) to 240 V (+5 %), 50 Hz to 60 Hz (±5 %), ≤ 33 W

## Operating temperature
0 °C to 45 °C (storage temperature –20 °C to 70 °C)

## Protection
EN 60529
- IP 40; front panel IP 54

## Mass
1.7 kg

* Please select when ordering

1) Depends on the signal period of the connected encoder
The ACU-RITE DRO 300 is a versatile digital readout designed primarily for milling, drilling, boring, and lathe machines with up to four axes. A separate I/O unit provides switching input/outputs for simple tasks in automation.

**Design**
Thanks to its splash-proof full-travel keyboard, the DRO 300 is exceptionally well-suited for use in a workshop. It supports all operations with intuitive interactive menus on its large, easy-to-read color flat-panel display.

**Functions**
The DRO 300 has the same functions as the DRO 203.

In addition, the DRO 300 offers a connection for the KT 130 edge finder. This allows you to define presets and datums with speed and precision. The DRO 300 digital readout supports you with special probing functions.

In addition, the DRO 300 is programmable, which makes it ideal for small-batch production on conventional machine tools. The DRO 300 allows you to store up to eight programs, each with up to 250 working steps. Programs are created by either keying them in step by step or by generating them using actual position capture (teach-in programming).

**Data interfaces**
A USB port enables the writing and reading out of data and files.

Tolerancing ISO 8015
ISO 2768 - m H
± 6 mm: ± 0.2 mm
## Axes
3 or 4; various axis designations

## Encoder inputs
TTL

## Display step
Adjustable, max. 7 digits
- Linear axis: 1 mm to 0.0001 mm
- Rotary axis: 1° to 0.001° (00° 00’ 01”)

## Display
7” TFT color screen (15:9); resolution 800 x 400 pixels for position values and dialog

## Status display
Tool, reference point, operating function, feed rate, ABS/INC, mm/inch, stopwatch

## Axis display
Switchable between DRO1 and DRO2

### Functions
- 10 reference points
- 99 tools
- REF reference-mark evaluation for distance-coded or single reference marks
- Distance-to-go mode
- Scaling factor
- mm/inch switching
- Absolute-incremental display
- Integrated help function
- Graphic positioning aid (“near zero” warning)
- Calculator

### For milling/drilling/boring
- Calculation of positions for hole patterns (bolt circles, linear hole patterns)
- Tool radius and tool length compensation
- Probing functions for reference-point acquisition with KT edge finder: “Edge,” “Centerline” and “Circle center”
- Oblique line, circular arc
- Linear hole patterns, bolt hole circles

### For turning
- Taper calculator
- Radius/diameter switching
- Freezing the tool position for back-off
- Vectoring: XY display of the traverse path with inclined top slide
- Sum display for Z and Zo (axis coupling)

### Programming
8 programs with up to 250 steps

### Error compensation
- **Axis error**: Linear and multipoint over up to 200 points
- **Backlash compensation**: for compensation of reversal error

### Data interface
USB connection, Type C

### Switching I/O
- Input for edge finder
- Further inputs/outputs over the IOB 610 external input/output unit

### Accessories
Stand, holder for mounting arm, protective cover, KT 130 edge finder (for milling)

### Power connection
AC 100 V (–10 %) to 240 V (+5 %), 50 Hz to 60 Hz (±5 %), ≤ 33 W

### Operating temperature
0 °C to 45 °C (storage temperature –20 °C to 70 °C)

### Protection
EN 60529 IP 40; front panel IP 54

### Mass
1.7 kg

---

1) Depends on the signal period of the connected encoder
Accessories
– Edge finder

KT 130 edge finder
For any workpiece materials
With spiral cable
ID 283273-S1

The KT 130 is a 3-D triggering edge finder. This means it can also be used for nonconducting materials. The stylus is deflected when it contacts the workpiece, and the edge finder sends a triggering signal over the cable to the DRO 300 digital readout.

The KT 130 edge finder allows you to set reference points quickly and easily, without leaving marks on the workpiece.
– Mounting components

The back panel of the digital displays has a VESA-MIS 100 standard mounting interface. There are several possible mounting configurations:

- Single-Pos stand
- Mounting frame
- Mounting arm with holder

**Accessories:**

- **Stand**
  ID 1197273-01
- **Mounting arms**
  (refer to page 18)
- **Mounting frame**
  (accessory for DRO 203 and DRO 300)
  ID 1197274-01
  For mounting the digital readout in a housing or operating panel.
- **Holder for mounting arm**
  ID 1197273-02
  Is needed if a replacement unit is mounted to an already existing mounting arm.
You can use the mounting arm to easily place the display at a conveniently operable position. It can be attached to the machine either with a mounting bracket or directly. The display can also be swiveled with the holder mounted on the mounting arm.

**Mounting arm A**
- Short version: 300 mm
  - ID 1223631-01
- Long version: 670 mm
  - ID 1223636-01

**Mounting arm B**
- ID 1223632-01

**Mounting arm C**
- ID 1223637-01

**Mounting arm D**
- ID 1223634-01

**U-section beam with holder**
Fits mounting arms A and B
- ID 1223635-01
The DRO 300 provides application-dependent additional functions that can be used when the IOB 610 external input/output unit is connected.

**IOB 610 external input/output unit**
ID 1197271-01
The IOB 610 input/output unit is attached to a standard NS 35 rail (DIN 46 227 or EN 50 022).

It is connected to the DRO 300 using the touch probe input. LEDs show the power supply, the data transmission and the status of the inputs and outputs.

**Accessories:**
- **Connecting cable** complete with connectors, between IOB 610 and DRO 300
  ID 1226509-xx
- **Distribution cable** complete with connectors, for parallel connection of IOB 610 and KT 130 on DRO 300
  ID 1226398-01

The additional functions can be configured on the DRO 300 when the IOB 610 is connected.

### Switching inputs
The switching inputs are active when a HIGH signal (contact or pulse) is present. They are isolated and can be supplied externally or internally.

**Signal level of the switching outputs**
- $0 \leq U_L \leq 1.5 \text{ V}$
- $4.5 \text{ V} \leq U_H \leq 26 \text{ V}$
- $I_L \leq 25 \text{ mA}$
- $t_{\text{min}} \geq 100 \text{ ms}$

**Zero reset**
In the milling mode, each axis can be set to the display value 0 over an external signal.

**Detection of gear ranges**
In turning mode, four switching inputs are available for the recognition of gear stages.
Switching outputs
The IOB 610 features ten floating relay outputs.

Standby
The standby output is at LOW level if the DRO 300 cannot operate the IOB (e.g., not switched on, cable disconnected, etc.).

Switching functions (for milling applications)
One or more switching ranges or switching points can be defined for an axis. The switch-off ranges are located symmetrically around the display value 0. If switching points are used, the relay activates when the position display reaches a specific value. The direction function switches when the algebraic sign is changed.

You can set whether
• the switching function should apply to the actual value or distance-to-go mode,
• the relay will open or close when the condition is met
• or the relay remains activated as long as the switching condition is met (continuous mode) or for a specified duration (pulsed mode).

Analog output
Constant surface cutting speed CSS
(only in turning applications)
CSS provides spindle speed control as the diameter of the workpiece changes. A speed command signal is sent to the inverter of the spindle motor via the analog interface (DAC 0 V to 10 V) of the IOB 610. The maximum and minimum permissible spindle speeds can be specified. In addition, a maximum of three operating gears can be taken into account. The DRO 300 recognizes the current gear stage by means of the switching inputs of the IOB 610. CSS control can also be started remotely (via an input to the CSS board) with an external switch.

Controlling the spindle speed
(only in milling applications)
With the analog outputs, the speed of the spindle on milling machines can be controlled in an open controlled loop. A spindle speed can be assigned to each tool defined in the tool table. The speed can be manually adapted during machining.
Interfaces
– Digital readouts

Pin layout of encoders $\text{TTL}$

Mating connector:
9-pin D-sub connector (male)

<table>
<thead>
<tr>
<th>Voltage supply</th>
<th>Incremental signals</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 $\text{U}_p$</td>
<td>6 $0\text{ V}$</td>
<td>2 $\text{U}_{a1}$</td>
</tr>
</tbody>
</table>

Shield on housing; $\text{U}_p =$ Power supply voltage

KT 130 edge finder and IOB 610 (only DRO 300)
A 15-pin D-sub connection is provided for connecting the KT 130 and the IOB 610.

The trigger signal from the edge finder can also start data output (adjustable by parameter).

USB
The digital readouts have a USB interface with a Type C port.
Linear Encoders
– For manually operated machine tools

For typical applications on manually operated machine tools, such as milling machines or lathes, **display steps of 10 µm** are sufficient. This is provided by the linear encoder of the SENC 50 and SENC 150 series without interpolation.

Jig boring machines, grinding machines, and measuring and inspection tasks normally require **display steps of 1 µm** and better. The SENC 50 and SENC 150 with integral 5-fold or 10-fold interpolation are suitable for these higher requirements.

For **limited installation space**, for example on the slide of a lathe, the SENC 50 linear encoder may be the best solution.

The SENC 150 linear encoders are used as universal linear encoders under **normal mounting conditions**.
Mounting instructions

SENC 50
This linear encoder with small cross section is fastened at points on a machined surface. With a back-up spar, only two points, one at each end, are sufficient.

For mounting without back-up spar, an intermediate support is required in addition. The encoder is mounted so that the sealing lips are directed downward or away from splash water.

Assembly
When mounting, the scale unit must be aligned at several points along the machine guideway. Stop surfaces or stop pins can also be used to align the scale.

The proper gap between the scale housing and scanning unit is ensured by the shipping brace. You must also ensure that the lateral tolerance is maintained.

Accessories
Back-up spar for SENC 50
ID 680803-xx

The SENC 50 can be mounted on a back-up spar to increase stability.

SENC 150
The SENC 150 is fastened at its ends by their mounting blocks to a machined surface. A support bracket is provided for measuring lengths above 625 mm.

If the SENC 150 is mounted with a back-up spar, there is no need for the support bracket. At measuring lengths of 1675 mm or more, the back-up spar is absolutely necessary. The encoder is mounted so that the sealing lips are directed downward or away from splash water.

Assembly
When the SENC 150 is mounted, the shipping brace already ensures the proper gap between the scale unit and the scanning unit. You need only align the scale unit at several points along the machine guideway.

Accessories
Back-up spar for SENC 150
ID 680116-xx

The SENC 150 can be mounted on a back-up spar to increase stability. At measuring lengths of 1675 mm or more, the back-up spar is absolutely necessary and is already included in delivery.
SENC 50

Incremental linear encoder
- Extremely compact dimensions
- Measuring steps 5 µm to 0.5 µm

<table>
<thead>
<tr>
<th>ML (mm)</th>
<th>LL (inch)</th>
<th>L1</th>
<th>Qty. B</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1</td>
<td>143.5/5.65&quot;</td>
<td>20.960.825&quot;</td>
</tr>
<tr>
<td>75</td>
<td>2</td>
<td>168.0/6.65&quot;</td>
<td>20.960.825&quot;</td>
</tr>
<tr>
<td>100</td>
<td>3</td>
<td>194.3/7.65&quot;</td>
<td>33.661.325&quot;</td>
</tr>
<tr>
<td>125</td>
<td>4</td>
<td>219.7/8.65&quot;</td>
<td>46.361.825&quot;</td>
</tr>
<tr>
<td>150</td>
<td>5</td>
<td>245.1/9.65&quot;</td>
<td>59.062.325&quot;</td>
</tr>
<tr>
<td>175</td>
<td>6</td>
<td>270.5/10.65&quot;</td>
<td>71.762.825&quot;</td>
</tr>
<tr>
<td>200</td>
<td>7</td>
<td>295.9/11.65&quot;</td>
<td>84.463.325&quot;</td>
</tr>
<tr>
<td>225</td>
<td>8</td>
<td>321.3/12.65&quot;</td>
<td>97.163.825&quot;</td>
</tr>
<tr>
<td>250</td>
<td>9</td>
<td>346.7/13.65&quot;</td>
<td>59.062.325&quot;</td>
</tr>
<tr>
<td>275</td>
<td>10</td>
<td>372.1/14.65&quot;</td>
<td>69.062.825&quot;</td>
</tr>
<tr>
<td>300</td>
<td>11</td>
<td>397.5/15.65&quot;</td>
<td>71.762.825&quot;</td>
</tr>
<tr>
<td>325</td>
<td>12</td>
<td>422.9/16.65&quot;</td>
<td>84.463.325&quot;</td>
</tr>
<tr>
<td>350</td>
<td>13</td>
<td>448.3/17.65&quot;</td>
<td>97.163.825&quot;</td>
</tr>
<tr>
<td>375</td>
<td>14</td>
<td>473.7/18.65&quot;</td>
<td>46.361.825&quot;</td>
</tr>
<tr>
<td>425</td>
<td>16</td>
<td>524.9/20.65&quot;</td>
<td>71.762.825&quot;</td>
</tr>
<tr>
<td>475</td>
<td>18</td>
<td>575.2/22.65&quot;</td>
<td>33.661.325&quot;</td>
</tr>
<tr>
<td>525</td>
<td>20</td>
<td>626.1/24.65&quot;</td>
<td>59.062.325&quot;</td>
</tr>
</tbody>
</table>

ML = Measuring length
P = Gauging points for alignment
\( \sigma \) = Beginning of measuring length
\( \varnothing \) = Required mating dimensions
\( \mathbb{M} \) = M4 nut usable
\( \varnothing \) = For aligning the back-up spar
\( \mathbb{B} \) = Direction of scanning head motion for output signals in accordance with interface description

Tolerancing ISO 8015
Dimensions without tolerance ±0.2 mm
(±.008 inches)
## Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>SENC 50</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measuring standard</strong></td>
<td>Glass scale with incremental graduation</td>
</tr>
<tr>
<td><strong>Accuracy grade</strong></td>
<td>±3 µm</td>
</tr>
<tr>
<td><strong>Measuring length ML</strong></td>
<td>Mounting spar* optional</td>
</tr>
<tr>
<td></td>
<td>50  75  100  125  150  175  200  225  250  275  300  325  350  375  425 475 525</td>
</tr>
<tr>
<td><strong>Incremental signals</strong></td>
<td>TTL</td>
</tr>
<tr>
<td><strong>Grating period</strong></td>
<td>20 µm</td>
</tr>
<tr>
<td><strong>Integrated interpolation</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Signal period</strong></td>
<td>4 µm</td>
</tr>
<tr>
<td><strong>Measuring step</strong></td>
<td>5 µm</td>
</tr>
<tr>
<td><strong>Reference marks</strong></td>
<td>Distance-coded</td>
</tr>
<tr>
<td><strong>Voltage supply</strong></td>
<td>DC 5.1 V ±0.1 V/≤ 180 mA</td>
</tr>
<tr>
<td><strong>Without load</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Electrical connection</strong></td>
<td>Cable in metal armor, with 9-pin D-sub connector; length: 3 m</td>
</tr>
<tr>
<td><strong>Cable length</strong></td>
<td>≤ 6 m (total length with ACU-RITE cable)</td>
</tr>
<tr>
<td><strong>Traversing speed</strong></td>
<td>≤ 60 m/min</td>
</tr>
<tr>
<td><strong>Required moving force</strong></td>
<td>≤ 2.2 N</td>
</tr>
<tr>
<td><strong>Operating conditions</strong></td>
<td>Temperature 0 °C to 50 °C; humidity 25 % to 95 % (non-condensing)</td>
</tr>
<tr>
<td><strong>Conditions for storage</strong></td>
<td>Temperature –20 °C to 70 °C; humidity 20 % to 95 % (non-condensing)</td>
</tr>
<tr>
<td><strong>Protection</strong></td>
<td>EN 60529</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>0.5 kg + 0.3 kg/m measuring length</td>
</tr>
</tbody>
</table>

* Please indicate when ordering  
1) After 4-fold evaluation in the subsequent electronics
SENC 150

Incremental linear encoder
- Sturdy design
- Measuring lengths up to 3 m
- Measuring steps 5 µm to 0.5 µm

Dimensions without tolerance ±0.2 mm
(±.008 inches)

F = Machine guideway
G = Beginning of measuring length
ML = Measuring length
P = Required mating dimensions
LL = Measuring length
B = Direction of scanning head motion for output signals in accordance with interface description

ML  LL  L  L1  L1 ±0.15  L2 ±0.005  B
50    1  185.5 / 7.303  29.25 / 1.152  127 / 5  2x
75    2  215.3 / 8.461  42.25 / 1.663  127 / 5  2x
100   3  236.5 / 9.311  54.75 / 2.159  127 / 5  2x
125   4  261.5 / 10.295  67.25 / 2.648  127 / 5  2x
150   5  287.5 / 11.319  80.25 / 3.159  127 / 5  2x
175   6  312.5 / 12.293  92.75 / 3.662  254 / 10  2x
200   7  338.5 / 13.312  105.76 / 4.163  254 / 10  2x
225   8  363.5 / 14.311  118.76 / 4.663  254 / 10  2x
275  10  414.5 / 16.319  147.25 / 5.812  254 / 10  2x
300  11  439.5 / 17.303  160.25 / 6.302  254 / 10  2x
325  12  465.5 / 18.327  173.76 / 6.832  254 / 10  2x
350  13  490.5 / 19.311  187.25 / 7.383  254 / 10  2x
375  14  515.5 / 20.295  200.75 / 7.894  254 / 10  2x
400  15  541.5 / 21.319  214.25 / 8.449  254 / 10  3x
425  16  566.5 / 22.303  227.76 / 8.959  254 / 10  3x
475  18  612.5 / 24.311  274.25 / 10.805  254 / 10  3x
525  20  668.5 / 26.319  320.76 / 12.632  254 / 10  3x
575  22  714.5 / 28.327  367.26 / 14.463  254 / 10  3x
600  23  744.5 / 29.311  397.76 / 15.632  254 / 10  3x
625  24  769.5 / 30.295  418.25 / 16.463  254 / 10  3x
675  26  820.5 / 32.303  472.75 / 18.632  254 / 10  4x
725  28  871.5 / 34.311  524.25 / 20.763  254 / 10  4x
775  30  922.5 / 36.319  575.75 / 22.894  254 / 10  4x
875  33  998.5 / 39.311  672.75 / 26.563  254 / 10  4x
925  35  1049.5 / 41.319  724.25 / 28.763  254 / 10  5x
950  36  1074.5 / 42.303  749.25 / 29.706  254 / 10  5x
1000 38  1125.5 / 44.311  804.75 / 31.763  254 / 10  5x
1050 40  1176.5 / 46.319  855.25 / 33.826  254 / 10  5x
1100 42  1227.5 / 48.327  905.75 / 35.883  254 / 10  5x
1250 48  1379.5 / 54.319  972.75 / 38.563  254 / 10  5x
1350 52  1481.5 / 58.327  1057.75 / 41.632  254 / 10  5x
1400 54  1531.5 / 60.296  1107.75 / 44.163  254 / 10  5x
1550 60  1684.5 / 66.319  1262.75 / 49.632  254 / 10  7x
1675 65  1811.5 / 71.319  1393.75 / 53.663  254 / 10  7x
1850 72  1989.5 / 78.327  1570.75 / 61.632  254 / 10  8x
2000 78  2141.5 / 84.311  1694.75 / 65.812  254 / 10  8x
2150 84  2293.5 / 90.295  1817.75 / 70.449  254 / 10  9x
2300 90  2446.5 / 96.319  2042.75 / 79.063  254 / 10  10x
2625 110  2954.5 / 116.319  2925.25 / 119.632  254 / 11  12x
3075 120  3208.5 / 126.319  3125.75 / 126.412  254 / 13  13x
<table>
<thead>
<tr>
<th>Table: SENC 150</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measuring standard</strong></td>
</tr>
<tr>
<td><strong>Accuracy grade</strong></td>
</tr>
<tr>
<td><strong>Measuring length ML</strong>*</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>625</td>
</tr>
<tr>
<td>Back-up spar included in items supplied</td>
</tr>
<tr>
<td>1675</td>
</tr>
<tr>
<td><strong>Incremental signals</strong>*</td>
</tr>
<tr>
<td><strong>Grating period</strong></td>
</tr>
<tr>
<td><strong>Integrated interpolation</strong></td>
</tr>
<tr>
<td><strong>Signal period</strong></td>
</tr>
<tr>
<td><strong>Signal period</strong></td>
</tr>
<tr>
<td><strong>Signal period</strong></td>
</tr>
<tr>
<td><strong>Measuring step</strong></td>
</tr>
<tr>
<td><strong>Reference marks</strong></td>
</tr>
<tr>
<td><strong>Voltage supply</strong></td>
</tr>
<tr>
<td><strong>Without load</strong></td>
</tr>
<tr>
<td><strong>Electrical connection</strong></td>
</tr>
<tr>
<td><strong>Cable length</strong></td>
</tr>
<tr>
<td><strong>Traversing speed</strong></td>
</tr>
<tr>
<td><strong>Required moving force</strong></td>
</tr>
<tr>
<td><strong>Operating conditions</strong></td>
</tr>
<tr>
<td><strong>Conditions for storage</strong></td>
</tr>
<tr>
<td><strong>Protection</strong></td>
</tr>
<tr>
<td><strong>Mass</strong></td>
</tr>
<tr>
<td><strong>IP53 when mounted as per Mounting Instructions</strong></td>
</tr>
<tr>
<td><strong>Mass</strong></td>
</tr>
</tbody>
</table>

* Please indicate when ordering  
1 After 4-fold evaluation in the subsequent electronics
ACU-RITE encoders with TTL interface incorporate electronics that digitize sinusoidal scanning signals with or without interpolation.

The **incremental signals** are transmitted as the square-wave pulse trains $U_{a1}$ and $U_{a2}$, phase-shifted by 90° elec. The **reference mark signal** consists of one or more reference pulses $U_{a0}$, which are gated with the incremental signals. In addition, the integrated electronics produce their **inverse signals** $U_{a1}'$ and $U_{a2}'$ for noise-proof transmission. The illustrated sequence of output signals—with $U_{a2}$ lagging $U_{a1}$—applies to the direction of motion shown in the dimension drawing.

The distance between two successive edges of the incremental signals $U_{a1}$ and $U_{a2}$ through 1-fold, 2-fold or 4-fold evaluation is one **measuring step**. The subsequent electronics must be designed to detect each edge of the square-wave pulse.

---

### Interfaces

#### Incremental signals

<table>
<thead>
<tr>
<th>Interface</th>
<th>Square-wave signals TTL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incremental signals</strong></td>
<td>Two TTL square-wave signals $U_{a1}$, $U_{a2}$ and their inverted signals $U_{a1}'$, $U_{a2}'$</td>
</tr>
<tr>
<td><strong>Reference mark signal</strong></td>
<td>One or more square-wave pulses $U_{a0}$ and their inverted pulses $U_{a0}'$</td>
</tr>
<tr>
<td>Pulse width</td>
<td>90° elec.</td>
</tr>
<tr>
<td>Signal level</td>
<td>Differential line driver as per EIA standard RS-422</td>
</tr>
</tbody>
</table>

$U_H \geq 2.5 \text{ V at } -I_H = 20 \text{ mA}$

$U_L \leq 0.5 \text{ V at } I_L = 20 \text{ mA}$

---

**Diagram:**

- $U_{a1}$
- $U_{a2}$
- $U_{a0}$

**Signal period 360° elec.**

**Measuring step after 4-fold evaluation**
Electrical connection

Cables

Extension cables for SENC
ACU-RITE linear encoders feature cables with D-sub connector for direct connection to ACU-RITE digital readouts. The exact length of the cable can be found in the Specifications. If the cable length is insufficient, extension cables are offered complete with connectors.

Upon request you can also order adapter cables for connection to discontinued ACU-RITE products.

<table>
<thead>
<tr>
<th>Extension cable</th>
<th>Length</th>
<th>In metal armor</th>
<th>Without metal armor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete with D-sub connector (female) and D-sub connector (male)</td>
<td>1.5 m</td>
<td>683276-05</td>
<td>683277-05</td>
</tr>
<tr>
<td></td>
<td>3.0 m</td>
<td>683276-10</td>
<td>683277-10</td>
</tr>
<tr>
<td></td>
<td>4.5 m</td>
<td>683276-15</td>
<td>683277-15</td>
</tr>
<tr>
<td></td>
<td>6.0 m</td>
<td>683276-20</td>
<td>683277-20</td>
</tr>
<tr>
<td></td>
<td>7.5 m</td>
<td>683276-25</td>
<td>683277-25</td>
</tr>
</tbody>
</table>

Pin layout

9-pin D-sub connector
On linear encoder or mating connector to digital readout

<table>
<thead>
<tr>
<th>PIN</th>
<th>Voltage supply</th>
<th>Incremental signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>$U_p$ (VCC)</td>
<td>0 V</td>
</tr>
<tr>
<td>6</td>
<td>$U_{a1}$ (A+)</td>
<td>$U_{b1}$ (A–)</td>
</tr>
<tr>
<td>2</td>
<td>$U_{a2}$ (B+)</td>
<td>$U_{b2}$ (B–)</td>
</tr>
<tr>
<td>3</td>
<td>$U_{a0}$ (R–)</td>
<td>$U_{a0}$ (R+)</td>
</tr>
<tr>
<td>4</td>
<td>$U_{a0}$ (R–)</td>
<td>$U_{a0}$ (R+)</td>
</tr>
<tr>
<td>5</td>
<td>$U_{a0}$ (R–)</td>
<td>$U_{a0}$ (R+)</td>
</tr>
<tr>
<td>9</td>
<td>$U_{a0}$ (R–)</td>
<td>$U_{a0}$ (R+)</td>
</tr>
<tr>
<td>8</td>
<td>$U_{a0}$ (R–)</td>
<td>$U_{a0}$ (R+)</td>
</tr>
<tr>
<td>1</td>
<td>$U_{a0}$ (R–)</td>
<td>$U_{a0}$ (R+)</td>
</tr>
</tbody>
</table>

Cable shield on housing; $U_p =$ Voltage supply
Unused pins or wires must not be assigned!
Color assignment applies only to cable.
General electrical information

Transmission of measuring signals—electrical noise immunity
Noise voltages arise mainly through capacitive or inductive transfer. Electrical noise can be introduced into the system over signal lines and input or output terminals.
Possible sources of noise include:
• Strong magnetic fields from transformers and electric motors
• Relays, contactors and solenoid valves
• High-frequency equipment, pulse devices, and stray magnetic fields from switch-mode power supplies
• AC power lines and supply lines to the above devices

Protection against electrical noise
The following measures must be taken to ensure disturbance-free operation:
• Use only original ACU-RITE cables. Consider the voltage drop on supply lines
• Use connecting elements (such as connectors or terminal boxes) with metal housings. Only the signals and power supply of the connected encoder may be routed through these elements. Deviating applications with additional signals in the connecting element require specific measures with regard to electrical safety and EMC.
• Connect the housings of the encoder, connecting elements and subsequent electronics through the shield of the cable. Connect the shield over a large area and in all directions (360°). For encoders with more than one electrical connection, refer to the documentation for the respective product
• For cables with multiple shields, the inner shields must be routed separately from the outer shield. Connect the inner shield to 0 V of the subsequent electronics. Do not connect the inner shields with the outer shield, neither in the encoder nor in the cable
• Connect the shield to protective ground as per the mounting instructions
• Prevent contact of the shield (e.g. connector housing) with other metal surfaces. Pay attention to this when installing cables.
• Do not install signal cable in the direct vicinity of interference sources (inductive consumers such as contactors, motors, frequency inverters, solenoid valves, etc.)

– Sufficient decoupling from interference-signal-conducting cables can usually be achieved by an air clearance of 100 mm or, when cables are in metal ducts, by a grounded partition.
– A minimum spacing of 200 mm to inductors in switch-mode power supplies is required.
• If compensating currents are to be expected within the overall system, a separate equipotential bonding conductor must be provided. The shielding does not have the function of an equipotential bonding conductor
• Provide power only from PELV systems (EN 50178) to the position encoders. Provide high-frequency grounding with low impedance (EN 60204-1 Chap. EMV).