RESOLUTE™ absolute optical encoder with Yaskawa serial communications

RESOLUTE™ is a true-absolute fine-pitch optical encoder system with excellent metrology performance.

Patented RESOLUTE encoder technology combines 1 nm resolution with exceptionally high speed, up to 100 m/s or 14 600 rev/min, reading from a range of high-accuracy linear tape and spar scales or angle encoder rings.

RESOLUTE encoder systems use a single optical absolute track with a nominal pitch of 30 μm, combined with sophisticated optics. This ensures wide set-up tolerances, very low sub-divisional error of ±40 nm and ultra-low noise (jitter) of less than 10 nm RMS, resulting in better velocity control performance and rock solid positional stability.

The RESOLUTE system ensures reliability with excellent dirt immunity, built-in separate position-checking algorithm and IP64 sealed readhead with wipe-clean recovery.

RESOLUTE encoders are available with a variety of serial protocols. Contact your local Renishaw representative for details.

- True-absolute non-contact optical encoder system: no batteries required
- Wide set-up tolerances for quick and easy installation
- High immunity to dirt, scratches and light oils
- Resolutions to 1 nm linear or 24 bit rotary (rotary servomotors) and 30 bit (fully closed loop control) rotary
- 100 m/s or 14 600 rev/min maximum speed
- ±40 nm sub-divisional error for smooth velocity control
- Less than 10 nm RMS jitter for improved positional stability
- Built-in separate position-checking algorithm provides inherent safety
- IP64 sealed readhead for high reliability in harsh environments
- Integral set-up LED enables easy installation and provides diagnostics at a glance
- Operates up to 80 °C
- Integral over-temperature alarm

Compatible with:
- RELA30 low-expansion, high-stability spar scales
- RSLA30 stainless steel spars
- RTLA30 with FASTRACK™ carrier
- RTLA30-S self-adhesive tape scale
- RESA30 angle encoders
- Ultra-high accuracy REXA30 angle encoders
- Optional Advanced Diagnostic Tool ADTa-100
Data sheet
RESOLUTE absolute optical encoder (Yaskawa)

System features

Unique single-track absolute optical scale
- Absolute position is determined immediately upon switch-on
- No battery back-up
- No yaw de-phasing unlike multiple-track systems
- Fine pitch (30 µm nominal period) optical scale for superior motion control compared to inductive, magnetic or other non-contact optical absolute encoders
- High-accuracy graduations marked directly onto tough engineering materials for outstanding metrology and reliability

High dirt immunity
- Advanced optics and embedded surplus code means the RESOLUTE encoder system even reads dirty scale
- Absolute position can be determined in all three cases shown here; clean scale (left), grease contamination (below-left), particle contamination (below)

Unique detection method
- Readhead acts like an ultra-fast miniature digital camera, taking photos of a coded scale
- Photos are analysed by a high-speed digital signal processor (DSP) to determine absolute position
- Built-in position-check algorithm constantly monitors calculations for ultimate safety and reliability
- Advanced optics and position determination algorithms are designed to provide low noise (jitter < 10 nm RMS) and low sub-divisional error (SDE ±40 nm)

Optional Advanced Diagnostic Tool
The RESOLUTE encoder system is compatible with the Advanced Diagnostic Tool ADTa-100* and ADT View software, which acquire detailed real-time data from the readhead to allow easy set-up, optimisation and in-field fault finding. The intuitive software interface provides:
- Digital readout of encoder position and signal strength
- Graph of signal strength over the entire axis travel
- Ability to set a new zero position for the encoder system
- System configuration information

* ADTa-100 compatible readheads are marked with the symbol ADT
Linear absolute encoder version

Resolutions and scale lengths

The maximum scale length is determined by the readhead resolution and the number of position bits in the serial word. For RESOLUTE readheads with fine resolution and short word length, the maximum scale length will be limited accordingly. Conversely, coarser resolutions or longer word lengths enable the use of longer scale lengths.

RESOLUTE encoders are available with a variety of serial protocols. The table shows a RESOLUTE system using Yaskawa protocol with 36 bit position word length.

<table>
<thead>
<tr>
<th>Resolution</th>
<th>1 nm</th>
<th>50 nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum scale length (L) with 36 bit position word</td>
<td>1.8 m</td>
<td>21 m</td>
</tr>
<tr>
<td>Maximum reading speed</td>
<td>3.6 m/s</td>
<td>100 m/s</td>
</tr>
</tbody>
</table>

Contact your local Renishaw representative for details of other serial protocols.

Scale specifications

For more detailed scale information, refer to the relevant scale data sheet.

**Description**

<table>
<thead>
<tr>
<th>RELA30</th>
<th>High-performance low-expansion spar scale for very high-accuracy applications.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lengths up to 1.5 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RSLA30</th>
<th>High-performance stainless steel spar scale for very high-accuracy applications with longer axis lengths.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lengths up to 5 m*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RTLA30/FASTRACK</th>
<th>Track-mounted hardened stainless steel tape scale for high-performance motion control systems requiring easier and faster scale installation and field replacement.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RTLA30 lengths up to 21 m*</td>
</tr>
<tr>
<td></td>
<td>FASTRACK lengths up to 25 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RTLA30-S</th>
<th>Self-adhesive hardened stainless steel tape scale for high-performance motion control systems requiring simple installation.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lengths up to 21 m*</td>
</tr>
</tbody>
</table>

**Accuracy (at 20 °C)**

<table>
<thead>
<tr>
<th>RELA30</th>
<th>±1 µm up to 1 m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>±1 µm/m for lengths from 1 m to 1.5 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RSLA30</th>
<th>±1.5 µm up to 1 m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>±2.25 µm for lengths from 1 m to 2 m</td>
</tr>
<tr>
<td></td>
<td>±3 µm for lengths from 2 m to 3 m</td>
</tr>
<tr>
<td></td>
<td>±4 µm for lengths from 3 m to 5 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RTLA30/FASTRACK</th>
<th>±5 µm/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTLA30-S</td>
<td>±5 µm/m</td>
</tr>
</tbody>
</table>

**Coefficient of thermal expansion (at 20 °C)**

<table>
<thead>
<tr>
<th>RELA30</th>
<th>0.75 ±0.35 µm/m°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSLA30</td>
<td>10.1 ±0.2 µm/m°C</td>
</tr>
</tbody>
</table>

| RTLA30/FASTRACK | 10.1 ±0.2 µm/m°C |
| RTLA30-S        | 10.1 ±0.2 µm/m°C |

* Limited to 1.8 m when using RESOLUTE Yaskawa readhead with 1 nm resolution
Angle absolute encoder version

Resolution

RESOLUTE encoders are available with a variety of resolutions, to meet the needs of a wide range of applications.

The choice of resolutions depends on the serial protocol being used, but there are no limitations due to ring size; for example Yaskawa 24 bit resolution is available on all ring sizes.

RESOLUTE encoders with Yaskawa serial comms are available with the following resolution options:

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Counts per revolution</th>
<th>Arc second</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 bit</td>
<td>16 777 216</td>
<td>±0.077</td>
</tr>
<tr>
<td>23 bit</td>
<td>8 388 608</td>
<td>±0.154</td>
</tr>
<tr>
<td>26 bit</td>
<td>67 108 864</td>
<td>±0.019</td>
</tr>
<tr>
<td>30 bit</td>
<td>1 073 741 824</td>
<td>±0.0012</td>
</tr>
</tbody>
</table>

For resolution options on other protocols, contact your local Renishaw representative.

Speed and accuracy

RESOLUTE encoders are available with a variety of resolutions, to meet the needs of a wide range of applications.

The choice of resolutions depends on the serial protocol being used, but there are no limitations due to ring size; for example Yaskawa 24 bit resolution is available on all ring sizes.

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</tr>
</tbody>
</table>

For resolution options on other protocols, contact your local Renishaw representative.

System accuracy is graduation accuracy plus SDE. Effects such as eccentricity influence installed accuracy; for application advice, contact your local Renishaw representative.

CAUTION: Very high speed motion axes require additional design consideration.
For applications that will exceed 50% of the rated maximum reading speed of the ring, contact your local Renishaw representative.

For REXA30 speed and accuracy figures, refer to the REXA30 ultra-high accuracy absolute angle encoder data sheet (Renishaw part no. L-9517-9405).

Rotary scale specifications

For more detailed scale information, refer to the relevant scale data sheet.

<table>
<thead>
<tr>
<th>Material</th>
<th>303/304 stainless steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient of thermal expansion (at 20 °C)</td>
<td>15 ±0.5 µm/m/°C</td>
</tr>
</tbody>
</table>
## General specifications (angle and linear)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power supply</strong></td>
<td>5 V ±10% 1.25 W maximum (250 mA @ 5 V)</td>
</tr>
<tr>
<td><strong>Ripple</strong></td>
<td>200 mVpp maximum @ frequency up to 500 kHz maximum</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>−20 °C to +80 °C</td>
</tr>
<tr>
<td>Operating</td>
<td>0 °C to +80 °C</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td>95% relative humidity (non-condensing) to IEC 60068-2-78</td>
</tr>
<tr>
<td><strong>Sealing</strong></td>
<td>IP64</td>
</tr>
<tr>
<td><strong>Acceleration (readhead)</strong></td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>500 m/s², 3 axes</td>
</tr>
<tr>
<td>Non-operating</td>
<td>1000 m/s², 6 ms, ½ sine, 3 axes</td>
</tr>
<tr>
<td><strong>Maximum acceleration of scale with respect to readhead</strong></td>
<td>2000 m/s²</td>
</tr>
<tr>
<td><strong>Vibration</strong></td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>300 m/s² max @ 55 Hz to 2000 Hz, 3 axes</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td></td>
</tr>
<tr>
<td>Readhead</td>
<td>18 g</td>
</tr>
<tr>
<td>Cable</td>
<td>32 g/m</td>
</tr>
<tr>
<td><strong>Cable</strong></td>
<td></td>
</tr>
<tr>
<td>7 core, tinned and annealed copper, 28 AWG</td>
<td></td>
</tr>
<tr>
<td>Single-shielded, outside diameter 4.7 ±0.2 mm</td>
<td></td>
</tr>
<tr>
<td>Flex life &gt; 40 × 10⁶ cycles at 20 mm bend radius</td>
<td></td>
</tr>
<tr>
<td>UL recognised component</td>
<td></td>
</tr>
</tbody>
</table>
RESOLUTE readhead installation drawing (on RSLA30/RELA30 scale)

Dimensions and tolerances in mm

- Set-up LED
- Optical centreline
- Scale centreline

For detailed drawings, refer to the RESOLUTE linear or rotary encoder installation guides at www.renishaw.com/encoderinstallationguides

**Notes:**
- Extent of mounting face.
- Thread depth from mounting face. Recommended thread engagement 5 mm (8 including counterbore). Recommended tightening torque 0.5 to 0.7 Nm.
- R> 20 Dynamic bend radius
- R> 10 Static bend radius
- 2 mounting holes M3 through, counterbored each side, 3 deep
- Ride height 0.8 ± 0.15
- Pitch tol. ±0.05
- Thread depth from mounting face. Recommended thread engagement 5 mm (8 including counterbore). Recommended tightening torque 0.5 to 0.7 Nm.
- Extent of mounting face.
- Thread depth from mounting face. Recommended thread engagement 5 mm (8 including counterbore). Recommended tightening torque 0.5 to 0.7 Nm.

**Dimensions:**
- Set-up LED: 36
- 18
- 12
- 14
- 2 mounting holes M3 through, counterbored each side, 3 deep
- 0.31
- R> 20 Dynamic bend radius
- R> 10 Static bend radius
- 0.05
- Ride height 0.8 ± 0.15
- Pitch tol. ±0.05
- Set-up LED: 36
RESOLUTE readhead side exit cable installation drawing (on RSLA30/RELA30 scale)

Dimensions and tolerances in mm

For detailed drawings, refer to the RESOLUTE linear or rotary encoder installation guides at www.renishaw.com/encoderinstallationguides

* Extent of mounting boss. Recommended thread engagement 5 mm (8 including counterbore). Recommended tightening torque 0.5 to 0.7 Nm.
RESOLUTE absolute optical encoder (Yaskawa)

RESOLUTE angle readhead nomenclature

Series
R = RESOLUTE

Scale form
A = Angular

Protocol
23Y = Yaskawa 23 bit*
24Y = Yaskawa 24 bit†
26Y = Yaskawa 26 bit*
30Y = Yaskawa 30 bit†

Mechanical option
B = Standard IP64
R = Side cable outlet

Gain option
A = Standard

Ring diameter
052 = 52 mm ring
057 = 57 mm ring
075 = 75 mm ring
100 = 100 mm ring
103 = 103 mm ring
104 = 104 mm ring
115 = 115 mm ring
150 = 150 mm ring
183 = 183 mm ring (REXA30 only)
200 = 200 mm ring
206 = 206 mm ring
209 = 209 mm ring
229 = 229 mm ring
255 = 255 mm ring
300 = 300 mm ring
350 = 350 mm ring
413 = 413 mm ring (RESA30 only)
417 = 417 mm ring
489 = 489 mm ring (RESA30 only)
550 = 550 mm ring (RESA30 only)

Scale code option
B = Standard scale code

Cable length
02 = 0.2 m
05 = 0.5 m
10 = 1 m
15 = 1.5 m
30 = 3 m
50 = 5 m
90 = 9 m
99 = 10 m

Termination
A = 9-way D-type connector
F = Flying lead (unterminated)
S = M12 (sealed) connector
L = Lemo in-line connector

* For fully-closed loop control
† For rotary servomotors

RESOLUTE linear readhead nomenclature

Series
R = RESOLUTE

Scale form
L = Linear

Protocol
36Y = Yaskawa 36 bit

Mechanical option
B = Standard IP64
R = Side cable outlet

Gain option
T = RTLA30/RTLA30-S
S = RSLA30
E = RELA30

Resolution
001 = 1 nm
050 = 50 nm

Scale code option
B = RTLA30/RTLA30-S (20 mm to 10 m)
C = RSLA30 (20 mm to 5 m)/RELA30 (> 1.13 m to 1.5 m)
D = RELA30 (20 mm to 1.13 m)
E = RTLA30/RTLA30-S (> 10 m to 21 m)

Cable length
02 = 0.2 m
05 = 0.5 m
10 = 1 m
15 = 1.5 m
30 = 3 m
50 = 5 m
90 = 9 m
99 = 10 m

Termination
A = 9-way D-type connector
F = Flying lead (unterminated)
S = M12 (sealed) connector
L = Lemo in-line connector

NOTE: Not all combinations are valid. Check valid options online at
www.renishaw.com/epc
RESOLUTE series compatible products:

- RESA30 stainless steel ring
- REXA30 high-accuracy stainless steel ring
- Advanced Diagnostic Tool ADTa-100 (A-6525-0100)
- RELA30 self-adhesive or clip/clamp mounted ZeroMet™ spar scale
- RSLA30 self-adhesive or clip/clamp mounted stainless steel spar scale
- RTLA30 tape scale and FASTRACK carrier
- RTLA30-S self-adhesive tape scale

For more information about the ADTa-100 and the scale, refer to the relevant data sheets and installation guides which can be downloaded from www.renishaw.com/opticalencoders.