Encoder Products Overview

SICK Sensor Training

Encoders

Encoders Measure Rotary or Linear Position

- Encoders
  - Rotary
    - Incremental
    - Absolute
    - Single-Turn
    - Multi-Turn
  - Linear
    - Absolute
What Do Rotary Encoders Actually Do?

- Encoders convert mechanical movement or positions into electrical signals
- Encoders can provide information about
  - Angle
  - Speed
  - Acceleration
  - Distance
**Incremental Encoders**

Incremental encoders produce a high/low electrical signal per measuring step:
- Output is an electrical pulse, 1 to 200,000+ pulses per revolution – usually referred to as the “A” and “B” channels.
- Plus a reference pulse – usually referred to as a “Z” channel or marker pulse.
  - Marker pulses are typically 90°, 180°, or 270° in length and synchronized with the beginning of “A” or “B” channel pulses.

**Incremental Encoder**

![Incremental Encoder Diagram](image)
Absolute Encoders

- Absolute encoders provide a unique coded value for every position.
- Single and Multi-Turn:
  - Single-turn provides a unique coded value for each position of one turn.
  - Multi-turn provides unique coded value for each position of every turn plus the number of shaft revolutions.
- Position retained after power-off, power-on or power failure, even if the moving element moves or drifts during power-off.

Absolute Encoder

- IR LED Light Source: 1 LED for each Track
- Stationary Mask
- Rotating Encoder Disk
- Photo-Detector: 1 for each Track
- IR LED Light Source: 1 LED for each Track
**Product Overview**

<table>
<thead>
<tr>
<th>INCREMENTAL</th>
<th>ABSOLUTE</th>
<th>LINEAR &amp; Wire Draw</th>
</tr>
</thead>
<tbody>
<tr>
<td>DKS40</td>
<td>ARS60</td>
<td>BTF/PRF</td>
</tr>
<tr>
<td>DKV60</td>
<td>ATM60</td>
<td>KH53</td>
</tr>
<tr>
<td>DGS60</td>
<td>Singleturn Parallel</td>
<td>BCG</td>
</tr>
<tr>
<td>DGS65</td>
<td>Multiturn</td>
<td>BTF/PRF</td>
</tr>
<tr>
<td>DGS66</td>
<td></td>
<td>BKS/PKS</td>
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<tr>
<td>DRS60</td>
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<td></td>
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<tr>
<td>DFS60</td>
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<td></td>
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<tr>
<td></td>
<td>_afs60x-s</td>
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<tr>
<td></td>
<td>_afm60x-s</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>ATM90</td>
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</tbody>
</table>

**DRS 60 and DRS 61**

- **DRS 60**
  - 1 … 8,192 pulse per rev field programmable

- **DRS 61**
  - 1,…8,192 pulse per rev and zero-pulse width field programmable
  - Push button zero-pulse position teach-in
  - Opto-ASIC with chip-on-board technology

- **Mounting**
  - Face mount
  - Servo mount
  - Blind hollow shaft
  - Through hollow shaft

- **Electrical interfaces**
  - TTL / RS 422
  - HTL / push pull
ARS60 Absolute Encoder

- Single turn absolute encoder
- Number of steps from 2 to 32,768
- Push button zero-set or via a signal line
- Opto-ASIC and chip-on-board technology
- Mounting
  - Face mount
  - Servo flange
  - Blind hollow shaft
  - Through hollow shaft
- Electrical interfaces
  - SSI
  - Parallel (push-pull)

ATM60 Multi-Turn Absolute Encoders

- Multiturn Absolute Encoder
  - 8,192 steps per revolution and 8,192 revolutions (max. 25 bit with SSI)
  - Geared mechanism
- Mounting
  - Face mount
  - Servo flange
  - Blind hollow shaft
  - Through hollow shaft
- Electrical interfaces:
  - SSI
  - RS 422 parameter interface
  - Profibus
  - CANopen
  - DeviceNet
DKV60 Conveyor Encoder

- 1 to 2,048 pulses per 200 mm
- IP 65
- Interfaces
  - TTL/RS422, HTL/push-pull interface
- Measuring drum surface: knurled, "O"ring
- 1.5 meter cable

Wire Draw Encoders

- BCG/PMRA-F
  - Basic line
  - 0-5 m
  - Very Compact size
  - Very Low cost
  - 4-20 mA
- BKS/PKS
  - Basic line
  - Only 2m and 5m
  - Compact size
  - Low cost
- BTF/PRF
  - Advanced line
  - 2, 3, 5, 10, 20, 30, 50m
  - Standard size
  - Higher performance
**KH53 Linear Encoder**

- Max. measuring length 1,700 m
- Resolution 0.1 mm
- Friction-free through non-contact measurements
- Ideal for harsh environmental conditions
- Absolute position detection, no reference traverse necessary
- Various interfaces:
  - SSI
  - Profibus

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**F Technology Encoders**

*Complete Encoder Family DFS60, AFS60, AFM60*

- DFS60 16 Bit Incremental
- AFS60 18 Bit Absolute Singleturn
- AFM60 30 Bit (18 Single, 12 Multi) Absolute Multiturn

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30 mm instead 45 mm
DFS 60

Mounting
- Face mount
- Servo mount
- Through hollow shaft
- Blind hollow shaft

Programmable in field
- Number of lines 1...65,536
- Zero-pulse width and position
- Interface voltage level

M12 or M23 connectors, or cable outlet
- Cable exit either axial or radial

IP 65
Rugged metal encoder disc
- -30 to +100°C operating temperature

DFS60 Mechanical Interfaces

Complete Incremental Encoder family with common mechanical interfaces

- Face mounting flange
  - Solid shaft: Ø 10 x 19 mm

- Servo flange
  - Solid shaft: Ø 6 x 10 mm

- Blind hollow shaft
  - Hollow shaft: Ø 8 to 15 mm

- Through hollow shaft
  - Hollow shaft: Ø 8 to 15 mm
DFS60 Metal Code Disk

- Extremely Robust
- Large Temperature Range
  - -30 to 100 C

![DFS60 Metal Code Disk Diagram]

Nickel code disc

Scanning system and scanning manipulator

DFS60 Increased Lifetime

- 30 mm Between Robust Ball Bearings
  - Excellent runout
  - Reduced vibration
    - Speeds > 6,000 rpm
  - Increased lifetime of Encoder

![DFS60 Increased Lifetime Diagram]
DFS60 Shaft Mounting

- Plastic hollow shaft clamping
  - Simple Encoder Assembly
  - Excellent shaft runout
  - Electrical isolation between motor shaft and electronics

DFS60 Mounting to Structure

- Integrated stator coupling made of spring steel to allow radial and axial movement of the motor shaft
  - Simple mounting
  - Flexible for increased life
Pluggable Cable Outlet

- Pluggable cable outlet
  - Radial or axial
- Customized cable solutions
  - Different cable length
  - Connector at the cable end possible
- Simple wiring
- Reduced installation depth

DFS60 Programming Software Tool

- Programming via USB or COM interfaces
- External power supply not necessary
DFS60 Programming Tool PGT-08-S

- PGT-08-S Programming Tool for F-technology Encoders

- DFS60, VFS60, AFS60 and AFM60 Series all use the same connection/programming interface to connect computer
  - PN 1036616

- Also need cable from PN 1036616 Sub-D to encoder connector
  - For DFS w/ M12: PN 2046579
  - For DFS w/ M23: PN 2046580
  - For AFS/AFM w/ M12: PN 2048439
  - For AFS/AFM w/ M23: PN 2048440

PGT-08-S Programming Interface

- PGT-08-S establishes communication and provides information regarding the encoder attached and the current configuration

<table>
<thead>
<tr>
<th>Type Label</th>
<th>DFS60 and VFS60</th>
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<tbody>
<tr>
<td>Part number</td>
<td>1036616</td>
</tr>
<tr>
<td>Type</td>
<td>DFS60A.EDPC5555</td>
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<tr>
<td>Datencode</td>
<td>0850</td>
</tr>
<tr>
<td>Power supply</td>
<td>4.5...32V</td>
</tr>
<tr>
<td>Mechanical interface</td>
<td>Blind hollow shaft metal 10 mm</td>
</tr>
<tr>
<td>Connection type</td>
<td>Connector M12, 8 pin, radial</td>
</tr>
<tr>
<td>Number of lines</td>
<td>12</td>
</tr>
<tr>
<td>Electrical interface</td>
<td>TTL / RS422</td>
</tr>
<tr>
<td>Zero pulse width</td>
<td>90°, gated with channel A and B</td>
</tr>
</tbody>
</table>
Set Pulses and Output Signal Level

- Choose pulses per revolution
  - 1 … 65,536 pulses per rotation
- Choose Output signal level
  - TTL or HTL
  - Only one electrical interface to replace 3 common interfaces

Select Zero Pulse Width

- Zero pulse width 90, 180, 270

90, gated with channel A ⊕ B
180, gated with channel B
180, gated with channel A
270, gated with rising A and
PGT-08-S Read Position Meter

- Rotate shaft and see the results
- Re-zero shaft position

Positive Feedback for DFS60

- Customers have provided positive feedback regarding the concept and construction of the DFS60

  Especially:
  - Robust construction
  - Large ball bearing distance
  - Usage of large diameter ball bearings
  - New plastic hollow shaft clamping
  - Pluggable cable outlet
  - Programmability
  - Very good signal quality
AFM60 and AFS60 Absolute Encoders

- Complete Absolute Encoder Single- and Multi-turn Product Family with common mechanical interfaces

**Face mount flange**
- Solid shaft: 10 x 19 mm

**Servo flange**
- Solid shaft: 6 x 10 mm

**Blind hollow shaft**
- Blind hollow shaft: 8 to 15 mm, 3/8", 1/2", 5/8"

**Through hollow shaft**
- Through hollow shaft: 8 to 15 mm, 3/8", 1/2", 5/8"

AFM60 and AFS60 Bearing Separation

- Similar Construction to DFS60
- Excellent run out
  - Reduced vibration
    - > 6,000 rpm
- Increased life
AFM/AFS60 - Field Replaceable Cable

- Pluggable cable outlet
- Customized cable solutions with different cable length and connector at the cable end possible
- Radial or axial direction

AFM60 and AFS60

- Metal code disc with 1024 sin/cos periods
- 8 Bit Interpolation
- 18 Bit Absolute Position Single-turn
- 30 Bit Absolute Position Multi-turn
  - Max 262,144 steps/turn
AFM/AFS60 – Field Programmable

- AFM60 and AFS60 are field programmable
- No external power supply necessary need if using Type 2.0 USB
- Programming via Standard data line

AFS60/AFM60 – Programmable Parameters

- Configure Resolution
  - Single-turn is configurable 8-18 bit
    - 256 – 32,768 steps per rotation
  - Multi-turn is fixed at 4096 turns
- Configure Zero point or Offset
- Configure counting direction
  - CW
  - CCW
AFM60 and AFS60 Summary

- High resolution
  - 18 Bit in Single-turn
  - Max. 30 Bit in Multi-turn
- Programmable
- Big ball bearing distance of 30 mm
- M12 or M23 plug
- Pluggable cable outlet useable in axial or radial direction
- Temperature range -30…+ 100 °C
- IP Protection up to IP65
- Max. operating speed 9,000 RPM

Encoder Positioning

<table>
<thead>
<tr>
<th>Name</th>
<th>Price</th>
<th>Performance defined by resolution, signal quality and features</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFS60 – Solid shaft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DFS60 – Blind hollow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DFS60 – Through hollow</td>
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<td></td>
</tr>
<tr>
<td>Programable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS36 – Solid shaft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS36 – Blind hollow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS50 – Solid shaft</td>
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</tbody>
</table>
Encoder Applications

- Packaging
  - Case packers & Palletizers
  - Bag forming, filling and sealing machines
  - Box folding machines
  - Labeling machines
- Logistic
  - High bay warehouse, feed racker, roll conveyor
  - Forklift, SUVs
- Wood industry
  - Joining machines
- Energy
  - Solar tracker
  - Windmills
- Machine building
  - Machine tools
  - CNC-machines

Packaging Applications
Motion Feedback

Press Position
Robotics Applications

Conveyor Speed Feedback
Elevator Application

- Position of car
- Feedback for speed regulation of the drive for smooth movement of the car
- Hollow Shaft Incremental Encoder

Crane Hoist Motor Feedback

Incremental Hollow Shaft Encoder
Gantry Absolute Position Feedback

Welding Robot Position Feedback

Absolute Shaft Encoders
**Container Crane Position**

- SICK offers multiple solutions
  - Laser Distance Measurement
  - Linear Encoders (most accurate, but most expensive)

**Unmanned Rack Vehicle**

- 35 Meter Travel
- Measuring element is mounted on the girders due to aggressive environment