



在 CAN 网络中安全移动

CANopen Safety 安全编码器 – 工程机械设备专用

在绝对位置检测方面 TR Electronic 具有专长，CD_582+FS 系列经验证的 SIL 编码器可与 CANopen 安全接口一起使用了。迄今为止 TR 已推出基于以太网的 PROFINET / Profilesafe、带有 CIP Safety™的 Ethernet/IP、FSoE（通过 EtherCAT 的故障保护）和 Powerlink open SAFETY。

与这些接口不同，CANopen Safety 根据“白色通道原理”工作，即在对整个应用程序的安全评估中，整个信号路径必须证明其可靠性。这是通过重复传输和使用底层 CSMA/CA（防撞）协议来实现的，该协议构成了所有 CAN 实现的基础。

安全编码器的接口连接已经通过广泛的测试证明了其可靠性，扫描技术也经过了无数次测试，与所有 CD_582+FS 一样。该模块化系统基于最新技术，使标准产品组合中的编码器能够完美地适合应用。机械连接可通过实心轴、盲孔轴、空心轴实现。根据安全相关测量系统的要求，驱动轴的正向锁定通过键槽连接固定，或通过由弹簧钢制成的扭矩支架，用于空心轴和盲孔轴固定。

具有 CANopen Safety 的 CD_582+FS 紧凑型安全编码器，可以在轴不静止的情况下预设位置值。这种“动态预设”的工作原理类似于电子参考——根据请求，输出值将调整为

先前存储的预设值。错误检测，如设备故障，通常在 CANopen Safety 中由控制器对缺乏通信协议做出反应来指示。CD_582+FS 也具有主动故障安全状态，即它们可以主动向控制器报告发生的错误。控制器可以更快地做出反应（无需等待监测时间）：例如，如果测量通道仍然可用，控制单元可以使用一个通道上确定的位置值移动到停车位置。

安全编码器扫描技术可供选择，给用户提供了较高的自由度，无论是全磁扫描还是光学位置检测、快速高分辨率扫描。安全编码器都可用于 SIL2/PLd 或 SIL3/PLe 的应用。具有光学扫描选项的设备有一个特殊功能：除了安全总线系统外，位置值还通过 SSI 或增量接口输出（与安全无关）。例如，该附加接口可以用于提供次级控制回路，而不必经过控制系统。同时，编码器通过标准协议中的“灰色”通道提供直接测量值，无需额外保护。

CD_582+FS SIL 安全编码器，尤其是 TR Electronic 新推出的 CANopen Safety，使安全相关编码器的决策变得非常容易：相同的安装空间，相当高的安全性。

TR Electronic General Data

Nominal voltage

- Specific value 24 VDC
- Limit values, min/max 10/30 VDC

Nominal current, typically

- Specific value 60 mA
- Specific value 80 mA with second interface
- Condition unloaded

Supply

- SELV/PELV IEC 60364-4-41

- In case of UL / CSA approval according to NEC Class 2

- Protection class III DIN EN 61140

Polarity protection yes

Short circuit protection yes

internal 1 A fuse

Overvoltage protection yes, up to ≤ 60 V DC

Device design

- Type Multi-Turn

- Redundant scanning system yes, double

TR Electronic General Data continuation

- Design optical/magnetic

Total resolution ≤ 29 Bit

Number of steps per revolution $\leq 8192 = 13$ bit resolution

Number of revolutions ≤ 65536

Accuracy (functional) $\pm 0.045^\circ$

Reproducibility $\pm 0.01^\circ$

CANopen - Interface

- CANopen EN 50325-4 (CiA DS301)

- Bus connection ISO 11898-1, ISO 11898-2

- CAN Specification 2.0 A 11-Bit Identifier

- Device-Profile for Encoder CiA DS406

- Layer Setting Services, LSS CiA DS305

- CANopen Safety EN 50325-5 (CiA DS304)

SSI - Interface

- Equipment Optional interface
- Equipment in preparation
- SSI-Clock input RS-422; 2-wire
- SSI-Data output RS-422, 2-wire
- SSI-Clock frequency $\leq 1\text{MHz}$
- SSI-Mono time, typically $15\ \mu\text{s}$, $20\ \mu\text{s}$, $50\ \mu\text{s}$, $500\ \mu\text{s}$
- Protocol, TR-specific Function information + CRC
- Output code Binary, Gray
- Number of data bits 8...29
- Type of parametrization programmable
- MTTFd, SSI 150 a
- SSI-Refresh time $500\ \mu\text{s}$, asynchronous

Incremental - Interface

- Equipment Optional interface
- Equipment in preparation
- Signal form Square wave
- Signal form, alternative SIN / COS
- Incremental signals, square $K1\pm K2\pm$
- Incremental signals, SIN/COS $SIN\pm COS\pm$, 1 Vss
- Impulses, square wave 1024...5120, in steps of 1024

- Impulses, SIN/COS
- Output driver, TTL RS-422, 5 VDC
- Output driver, HTL Push-Pull, Supply Voltage
- Type of parametrization programmable
- MTTFd, square 180 a
- MTTFd, SIN/COS 190 a
- Duty factor, square 50 %, $\pm \leq 10$ %
- Phase angle, square 90 °, $\pm \leq 20$ ° (electr.)

Transmission rate

- Specific value 10 kbit/s
- Specific value 20 kbit/s
- Specific value 50 kbit/s
- Specific value 100 kbit/s
- Specific value 125 kbit/s (DIP Switch)
- Specific value 250 kbit/s (DIP Switch)
- Specific value 500 kbit/s (DIP Switch)
- Specific value 800 kbit/s
- Specific value 1 MBit/s (DIP Switch)
- Adjustability * by means of DIP-switches
- Adjustability via LSS service
- Adjustability * restricted adjustable

Cycle time

- Not safety related 1.0 ms

- Safety related 3.0 ms

Preset writing cycles $\geq 16\,000\,000$

Speed output safety-related

- Resolution 16/32 Bit

- Accuracy (output value) ± 0.6 1/min (opt./magn.)

- Accuracy (output value) ± 3.6 1/min (magn./magn.)

- Tracking error see Safety Manual

Parameter/Function, changeable Integration time

Preset parameter

Scaling parameter

Monitoring window

Counting direction

Velocity parameter

Type of parametrization programmable

Programming - Tool Fieldbus-Device

TR-SOFT: CANopen-Device Tool

Functional safety

- Safety principle Redundance with cross compare

- SIL-Standardization DIN EN 61508 / DIN EN 62061

- SIL-Standardization DIN EN 61800-5-2

- SIL-Level SIL3 / SIL CL 3

- PL-Standardization DIN EN ISO 13849
- Performance-Level (PL) PLe / Cat. 4
- Service life 20 Years
- PFH / PFH [D] 2.75E-9 1/h
- PFH / PFH [D] PFH: DIN EN 61508-4
- PFH / PFH [D] PFH [D]: DIN EN ISO 13849-1
- PFDav, T = 20 a 8.50E-5
- MTTFd 170 a, high
- DCavg 98 %, high/middle
- Mode High demand, continuous
- Proof-Test-Interval T1 = 20 Years
- Accuracy (safety) $\pm 0.7^\circ$

Safety functions

- DIN EN 61800-5-2 SLP (safely-limited position)
- DIN EN 61800-5-2 SDI (safe direction)
- DIN EN 61800-5-2 SCA (safe cam)
- DIN EN 61800-5-2 SS1 (safe stop 1)
- DIN EN 61800-5-2 SS2 (safe stop 2)
- DIN EN 61800-5-2 SOS (safe operating stop)
- DIN EN 61800-5-2 SLS (safely-limited speed)
- DIN EN 61800-5-2 SSR (safe speed range)
- DIN EN 61800-5-2 SSM (safe speed monitor)

Internal process safety time ≤ 7 ms

Maximum Speed, mechanically ≤ 6000 1/min

Shaft load, axial/radial ≤ 50 N, ≤ 100 N

Bearing life time $\geq 3.9E+10$ revolutions

Bearing life time - Parameter

- Speed 3000 1/min
- Operating temperature 60 °C
- Shaft load, axial/radial = 60 %
- Degree of contamination normal
- Mounting position Shaft horizontal

Point of origin, shaft load Mounting flange + 10 mm

Shaft type

- Shaft diameter [mm] 10
- Shaft diameter [mm] 12
- Shaft diameter [mm] 14
- Shaft forming Parallel key/Groove

Angular acceleration $\leq 10E+4$ rad/s²

Moment of inertia, worst-case $\leq 5.3E-6$ kg m²

at shaft diameter 14 mm

depending from shaft forming

Start-up torque, worst-case ≤ 3.4 Ncm (IP65, -20 °C, +6 °C)

≤ 10 Ncm (IP67, -20 °C, +6 °C)

at shaft diameter 14 mm

depending from shaft forming

Mass, typically 0.3...0.5 kg

Isolation voltage 500 V

TR Electronic Environmental conditions

Vibration DIN EN 60068-2-6

- Specific value $\leq 100 \text{ m/s}^2$

- Sine 50...2000 Hz

Shock DIN EN 60068-2-27

- Specific value $\leq 1000 \text{ m/s}^2$

- Half sine 11 ms

Immunity to disturbance DIN EN 61000-6-2

Transient emissions DIN EN 61000-6-3

Magnetic fields DIN EN 61000-4-8

- Specific value 30 A/m

- Criteria A

- Spatial direction X, Y, Z

Working temperature

- Standard -40...+85 °C

- Derating $T_w = -0.002 * n + 85 \text{ °C}$

- Derating $T_w = -0.004 * n + 85 \text{ °C}$ (IP67)

Storage temperature, dry -40...+90 °C

Relative humidity 98 %, non condensing

Protection class

- Standard IP65
- Optional extended to IP67

Installation height \leq 5000 m, above sea level

Resistance

- against salt (seawater) DIN EN IEC 60068-2-52
- Test method Test method 1
- excluded are Attachment parts