



HEIDENHAIN



Preliminary Product
Information

ECI 119 **EBI 135**

Absolute Rotary Encoders,
Multiturn Function via
Battery-Buffered Revolution
Counter

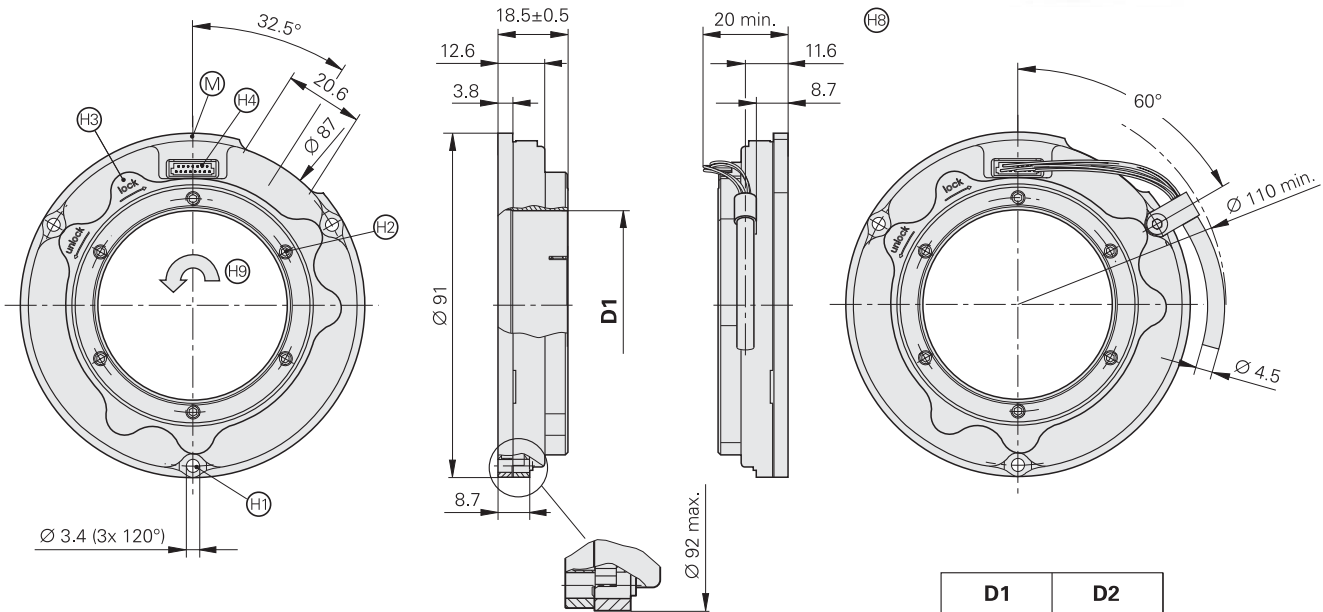
November 2012

ECI 119

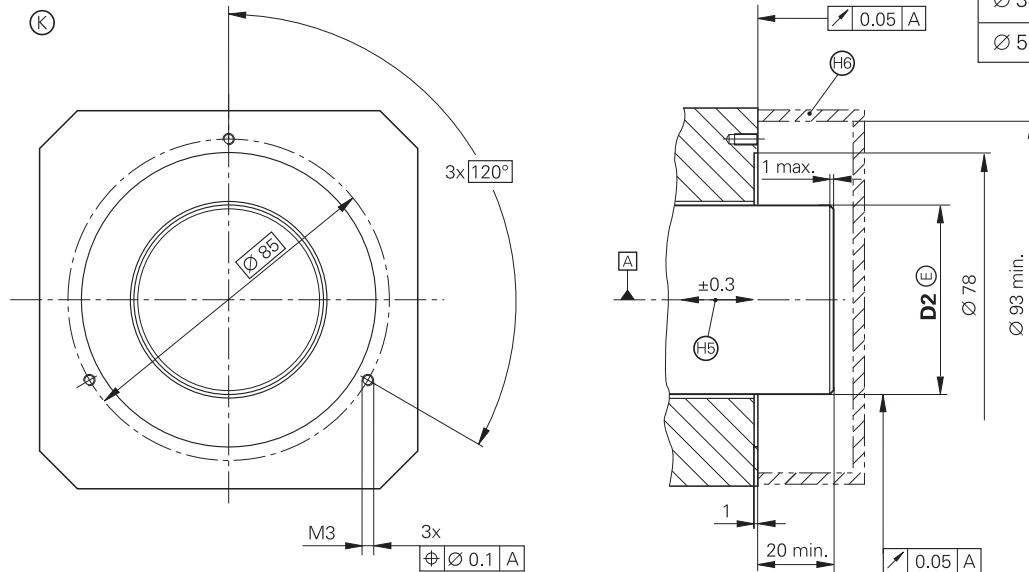
EBI 135

Rotary encoders without integral bearing for integration in motors

- Hollow through shaft
- Inductive scanning principle
- EBI 135: Multiturn function via battery-buffered revolution counter



D1	D2
Ø 30G6	Ø 30h7
Ø 38G6	Ø 38h7
Ø 50G6	Ø 50h7



mm

 Tolerancing ISO 8015
 ISO 2768 - m H
 < 6 mm: ±0.2 mm

- ▣ = Bearing of mating shaft
- ⊗ = Required mating dimensions
- Ⓜ = Measuring point for operating temperature
- Ⓜ = Cylinder head screw ISO 4762-M3 with ISO 7092 (3x) washer. Tightening torque 0.9 ± 0.05 Nm
- Ⓜ = SW2.0 (6x). Evenly tighten crosswise with increasing tightening torque; final tightening torque 0.5 ± 0.05 Nm
- Ⓜ = Shaft detent: For function, see Mounting/Removal
- Ⓜ = PCB connector, 15-pin
- Ⓜ = Compensation of mounting tolerances and thermal expansion, no dynamic motion
- Ⓜ = Protection against contact as per EN 60529
- Ⓜ = Required up to max. Ø 92 mm
- Ⓜ = Required installation space for encoder cable with cable clamp (accessory). Bending radius of connecting wires min. R3
- Ⓜ = Direction of shaft rotation for output signals as per the interface description

	Absolute		
	Singleturn		Multiturn
	ECI 119		EBI 135
Incremental signals	$\sim 1 V_{PP}$	–	–
Line count	32	–	–
Cutoff frequency –3 dB	≥ 6 kHz typical	–	–
Absolute position values	EnDat 2.2	EnDat 2.2	EnDat 2.2
Order designation*	EnDat 01	EnDat 22 ¹⁾	EnDat 22 ¹⁾
Position values/revolution	524288 (19 bits)		
Revolutions	–	65536 (16 bits) ²⁾	
Elec. permissible speed/ Deviations ³⁾	$\leq 3750 \text{ min}^{-1}/\pm 128 \text{ LSB}$ $\leq 6000 \text{ min}^{-1}/\pm 512 \text{ LSB}$	$\leq 6000 \text{ min}^{-1}$ (for continuous position value)	
Calculation time t_{cal} Clock frequency	$\leq 8 \mu\text{s}$ $\leq 2 \text{ MHz}$	$\leq 6 \mu\text{s}$ $\leq 16 \text{ MHz}$	
System accuracy	$\pm 90''$		
Power supply	3.6 to 14 V DC		<i>Rotary encoder</i> U_P : 3.6 to 14 V DC <i>Buffer battery</i> U_{BAT} : 3.6 to 5.25 V DC
Power consumption (maximum)	3.6 V: $\leq 580 \text{ mW}$ 14 V: $\leq 700 \text{ mW}$	<i>Normal operation with 3.6 V:</i> 530 mW <i>Normal operation with 14 V:</i> 630 mW	
Current consumption (typical)	5 V: 80 mA (without load)	5 V: 75 mA (without load)	<i>Normal operation with 5 V:</i> 75 mA (without load) <i>Buffer battery</i> ⁴⁾ : 25 μA (with rotating shaft) 12 μA (at standstill)
Electrical connection	Via PCB connector, 15-pin	Via PCB connector (incl. external temperature sensor ⁵⁾), 15-pin	
Shaft*	Hollow through shaft D = 30 mm, 38 mm, 50 mm		
Mech. perm. speed n	$\leq 6000 \text{ min}^{-1}$		
Moment of inertia of rotor	$D = 30 \text{ mm}$: $64 \cdot 10^{-6} \text{ kgm}^2$ $D = 38 \text{ mm}$: $58 \cdot 10^{-6} \text{ kgm}^2$ $D = 50 \text{ mm}$: $64 \cdot 10^{-6} \text{ kgm}^2$		
Permissible axial motion of measured shaft	$\pm 0.3 \text{ mm}$		
Vibration 55 to 2000 Hz ⁶⁾ Shock 6 ms	$\leq 300 \text{ m/s}^2$ (EN 60068-2-6) $\leq 1000 \text{ m/s}^2$ (EN 60068-2-27)		
Max. operating temp.	115 °C		
Min. operating temp.	–20 °C		
Protection EN 60529	IP 20 when mounted ⁷⁾		
Weight	$D = 30 \text{ mm}$: approx. 0.19 kg $D = 38 \text{ mm}$: approx. 0.16 kg $D = 50 \text{ mm}$: approx. 0.14 kg		

* Please select when ordering.

¹⁾ Online diagnostics not supported.

²⁾ Compliance with the EnDat specification 297403 and the EnDat Application Notes 722024, Chapter 11, "Battery-buffered encoders" is required for correct control of the encoder.

³⁾ Velocity-dependent deviation between the absolute and incremental signals.

⁴⁾ At $T = 25 \text{ °C}$; $U_{BAT} = 3.6 \text{ V}$




⁵⁾ Evaluation optimized for KTY 84; see *Position Encoders for Servo Drives* catalog.

⁶⁾ 10 to 55 Hz constant over distance 4.9 mm peak to peak


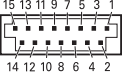


⁷⁾ CE compliance of the complete system must be ensured by taking the correct measures during installation.

Electrical connection

Cables inside the motor housing

ECI 119 EnDat 01	With one connector With PCB connector, 15-pin (female), with cable clamp Length 0.3 m		EPG (16 x AWG30/7) Cable Ø 4.5 mm	ID 640067-N3
ECI 119 EnDat 22 EBI 135	With one connector With PCB connector, 15-pin (female), with cable clamp Length 0.3 m			ID 825855-xx
	Complete With PCB connector, 15-pin (female), and right-angle socket M23 (male), 9-pin; with litz wires for temperature sensor and with cable clamp			ID 824632-xx

Pin layout of ECI 119

15-pin PCB connector														
														
	Power supply				Incremental signals ¹⁾				Absolute position values				Others ²⁾	
	13	11	14	12	1	2	3	4	7	8	9	10	5	6
	U_P	Sensor U_P	0V	Sensor 0V	A+	A-	B+	B-	DATA	DATA	CLOCK	CLOCK	T+	T-
	Brown/ Green	Blue	White/ Green	White	Green/ Black	Yellow/ Black	Blue/ Black	Red/ Black	Gray	Pink	Violet	Yellow	Brown	Green

U_P = Power supply


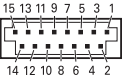


Sensor: The sensor line is connected internally with the corresponding power line.

Vacant pins or wires must not be used!

¹⁾ Only with ordering designation EnDat 01

²⁾ Only with ordering designation EnDat 22 and with encoder cable ID 824632-xx

Pin layout of EBI 135

15-pin PCB connector										
										
	Power supply				Absolute position values				Others ¹⁾	
	13	11	14	12	7	8	9	10	5	6
	U_P	U_{BAT}	0V	Battery 0V	DATA	DATA	CLOCK	CLOCK	T+	T-
	Brown/ Green	Blue	White/ Green	White	Gray	Pink	Violet	Yellow	Brown	Green

U_P = power supply; **U_{BAT}** = external buffer battery

Vacant pins or wires must not be used!

¹⁾ Only with encoder cable ID 824632-xx

EBI 135

Connection of the external buffer battery

The multiturn function of the EBI 135 is realized through a revolution counter. To prevent loss of the absolute position information during power failure, the EBI must be driven with an external buffer battery.

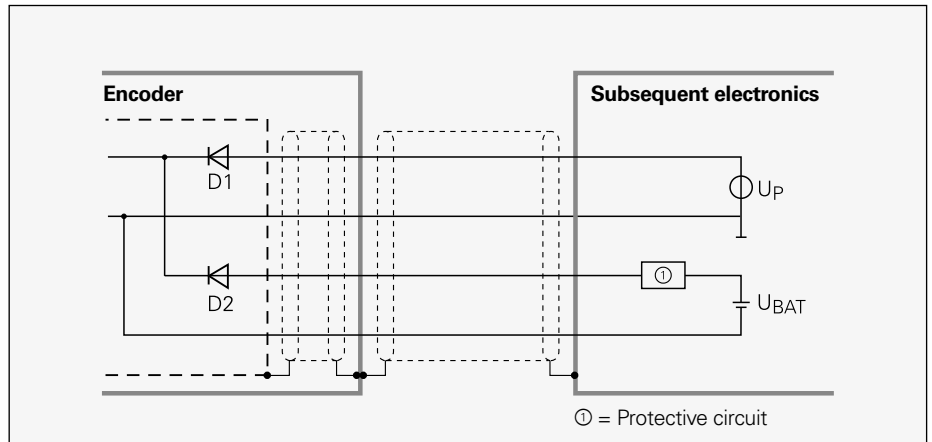
A lithium thionyl chloride battery with 3.6 V and 1 500 mAh is recommended as buffer battery. A service life of over 10 years in appropriate conditions (one EBI per battery; ambient temperature 25 °C; shaft at standstill, self-discharge < 1 % per year) can be expected. To achieve this, the main power supply (U_P) must be connected to the encoder while connecting the buffer battery, or directly thereafter, in order for the encoder to become fully initialized after having been completely powerless. Otherwise the encoder will consume a significantly higher amount of battery current until main power is supplied the first time.

If the application requires compliance with DIN EN 60086-4 or UL 1642, an appropriate protective circuit is required for protection from wiring errors.

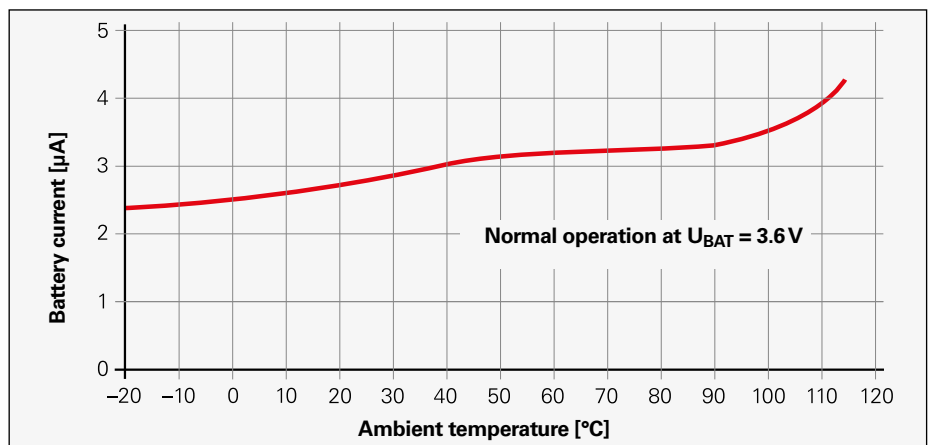
If the battery voltage falls below certain limits, the EBI issues warnings or error messages over the EnDat interface:

- **"M Battery" warning**
2.8 to 3.2 V (typically 2.9 V)
- **"M All Power Down" error message**
2.0 to 2.4 V (typically 2.2 V): the encoder has to find a new reference.

The EBI uses low battery current even during normal operation. The amount of current depends on the ambient temperature.



Connection of the buffer battery



Typical discharge current in normal operation

Mounting information

The ECI 119/EBI 135 are encoders without integral bearing. This means that mounting and operating conditions influence the functional reserves of the encoder. It is essential to ensure that the specified mating dimensions and tolerances are maintained in all operating conditions.

The following in particular must be kept in mind:

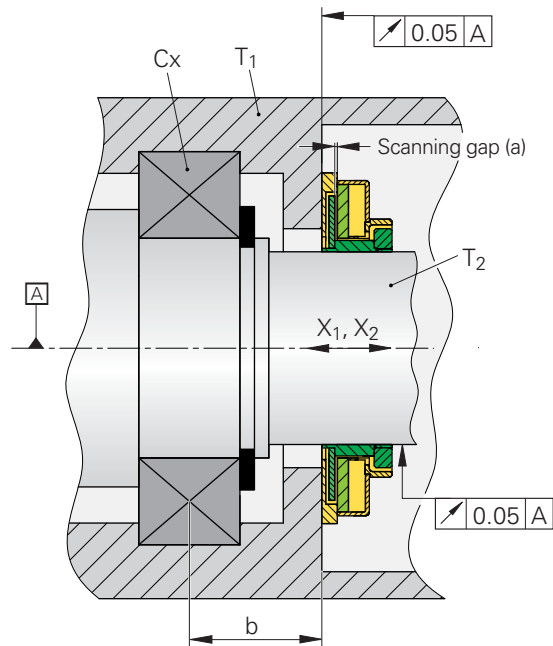
- Axial runout of flange mounting surface
- Radial runout of the motor shaft
- Maintaining the scanning gap (a), while taking into account the superimposition of motions, such as:
 - The length relation of the motor shaft and housing under temperature influence (T_1 ; T_2 ; α_1 ; α_2) depending on the position of the fixed bearing (b)
 - The bearing play (Cx)
 - Nondynamic shaft offsets due to load (X_1)
 - The effect of engaging motor brakes (X_2)

The application analysis must result in values within specification under all operating conditions (particularly under max. load and at minimum and maximum operating temperature) for the measured

- max. radial runout of the motor shaft
- max. axial runout of the motor shaft with respect to the mounting surface
- max. scanning gap (a)
- minimum scanning gap (a)

and under consideration of the signal amplitude (by inspecting the scanning gap at room temperature) using the ATS software.

Furthermore, the general mechanical and electrical information in the current "Position Encoders for Servo Drives" brochure must be kept in mind!



Mounting/Removal

Preparing installation

Align

Place the rotary encoder flat with the flange side on a clean, even surface (e.g. a granite plate). The shaft detent (arrow) must be disabled, i.e. the encoder shaft must move freely within the encoder housing.



Lock

Press the encoder housing (stator) against the supporting surface and tighten the locking ring by turning it clockwise until it is **finger tight**.



Ready for mounting

The rated scanning gap is set now. The encoder shaft is locked and the connector is blocked.



Check

Ensure the correct position of the locking ring. The ring ends must lie between the encoder shaft and the clamping ring (no overhang permitted).



Mounting/Removing the rotary encoder

Slide on the encoder

Slide the encoder onto the mating shaft; do not jam it. Apply pressure only on the encoder shaft (clamping ring).



Screw on

Fasten the encoder housing with three screws and washers.

- M3 screws; head $\varnothing \leq 5.5$ mm
- Washers as per ISO 7092
- Tightening torque 0.9 ± 0.05 Nm (with torque wrench)

If required, fasten the clamp of the encoder cable. Appropriate tools are available from HEIDENHAIN.



Clamp the shaft

Evenly tighten crosswise the clamping screws (SW 2.0, 6x60°) with increasing tightening torque. Do not exert additional axial pressure; final tightening torque = 0.5 ± 0.05 Nm.



Release the lock

Turn the locking ring counterclockwise up to the stop (snap-in point). The locking ring is now in its operating position: the connector is accessible.

Removing the rotary encoder

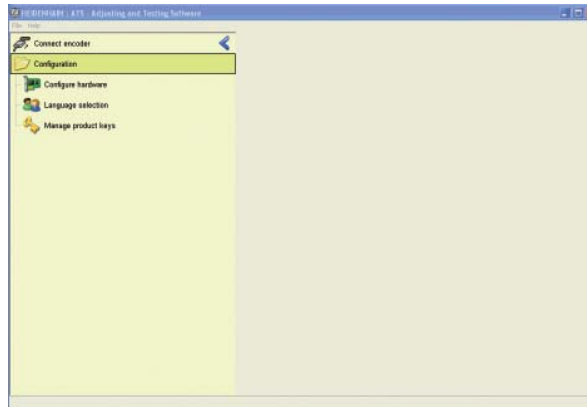
The encoder is removed in the opposite sequence with a loosened shaft lock. Remount only if the encoder and mounting parts are in faultless condition.



Checking the mounting (example: EBI 135)

Examination with the ATS software

(At room temperature, $U_P = 5\text{ V}$)
Start the ATS software.



Rotary encoder inspection is supported as of ATS version 2.6.04. The software version can be checked via "Help" in the menu bar.

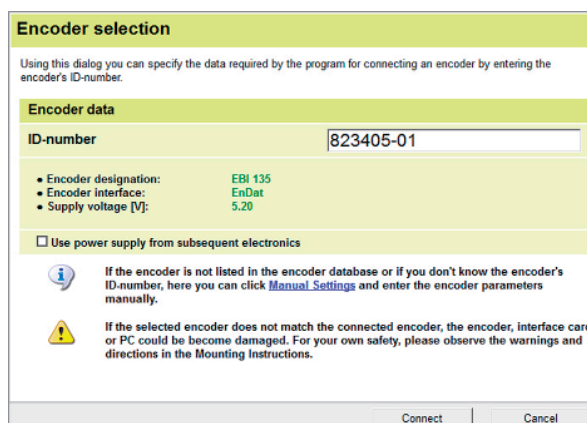


Connect the testing cable

(JAE 15-pin plug connector; ensure proper polarization). Check the mounting quality by means of the ATS software.



Establish the connection: Select "Connect encoder" and enter the ID number. Then select "Connect."



Select **Exl check** under **Mounting**.



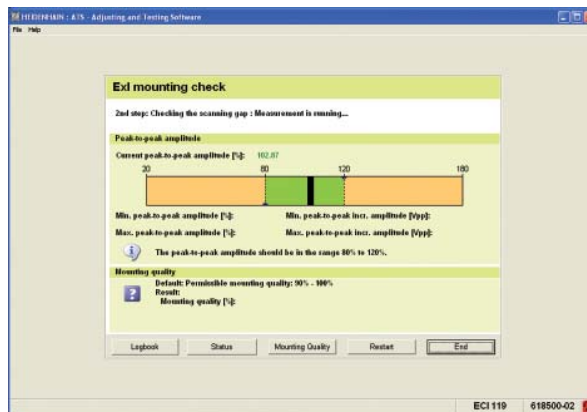
Press "Next."



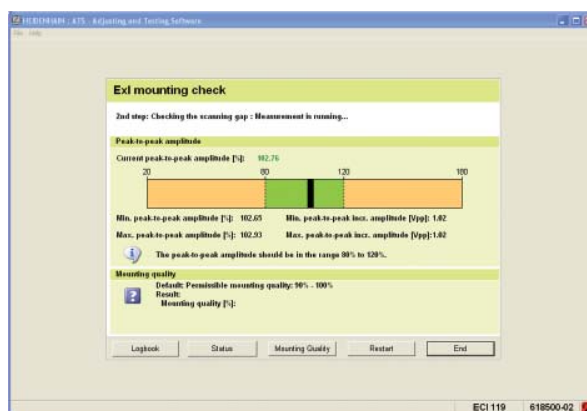
Check "scanning gap."

Important note

A signal amplitude deviating from 100 % limits the permissible axial motion for operation. 5 % deviation means a reduction of 0.03 mm of the permissible axial motion for operation.



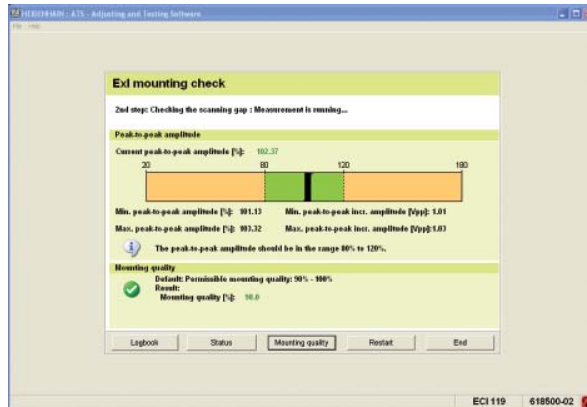
"Scanning gap" check is finished. Then select "Mounting quality." To do so, rotate the motor slowly.



Check the mounting quality.

Important note

The mounting quality should lie within 95 % to 100 %. A mounting quality of < 95 % indicates an inadequate mounting situation. If necessary, check the mating dimensions and repeat the mounting procedure.

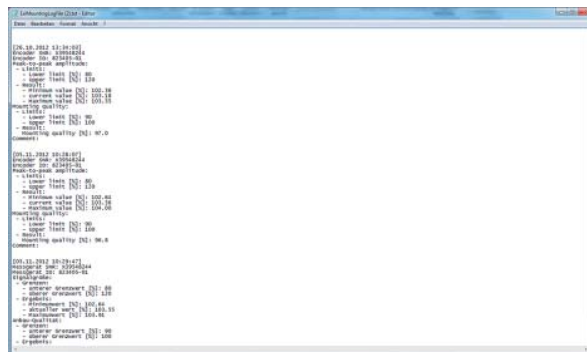


The detailed results of all measurements are saved in the log file through the **logbook**. Comments can be entered.



Note

The measurement results (amplitude, mounting quality, etc.) can be called over the **log file**. The log file is in the ATS program folder and has to be opened using the Explorer.



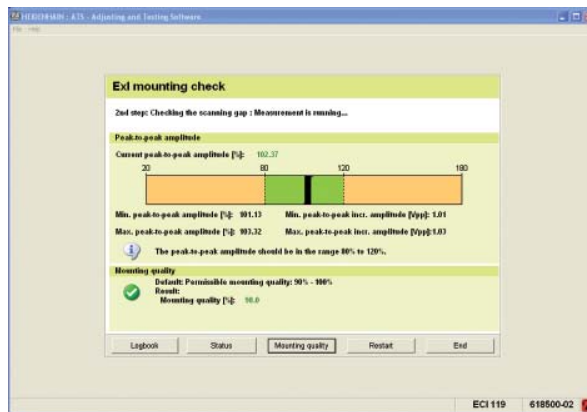
Active warnings and alarms can be displayed through "Status."



Inspection complete. Select "End" or "Restart."

Remove the test cable.

Mount the connecting cable.



Adjusting and testing accessories

PWM 20

The PWM 20 phase angle measuring unit serves together with the provided ATS adjusting and testing software for diagnosis and adjustment of HEIDENHAIN encoders.



	PWM 20
Encoder input	<ul style="list-style-type: none"> • EnDat 2.1 or EnDat 2.2 (absolute value with/without incremental signals) • DRIVE-CLiQ • Fanuc Serial Interface • Mitsubishi High Speed Serial Interface • SSI • 1 V_{PP}/TTL/11 μApp
Interface	USB 2.0
Power supply	100 to 240 V AC or 24 V DC
Dimensions	258 mm x 154 mm x 55 mm

	ATS
Languages	Choice between English or German
Functions	<ul style="list-style-type: none"> • Position display • Connection dialog • Diagnostics • Mounting wizard for EBI/ECI/EQI, LIP 200, LIC 4000 and others • Additional functions (if supported by the encoder) • Memory contents
System requirements	PC (dual-core processor; > 2 GHz) Main memory > 1 GB Windows XP, Vista, 7 (32-bit/64-bit) operating system 100 MB free space on hard disk

DRIVE-CLiQ is a registered trademark of the Siemens Aktiengesellschaft

Cable for PWM 20

Encoder cable

For IK 215, PWM 20, incl. three 12-pin adapter connectors and three 15-pin adapter connectors
ID 621742-01

15-pin adapter connectors

Three connectors for replacement
ID 528694-02

Mounting accessories

Aid for connecting or disconnecting the PCB connector
ID 592818-01

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For more information

- Brochure: *Position Encoders for Servo Drives*