

Output Signals

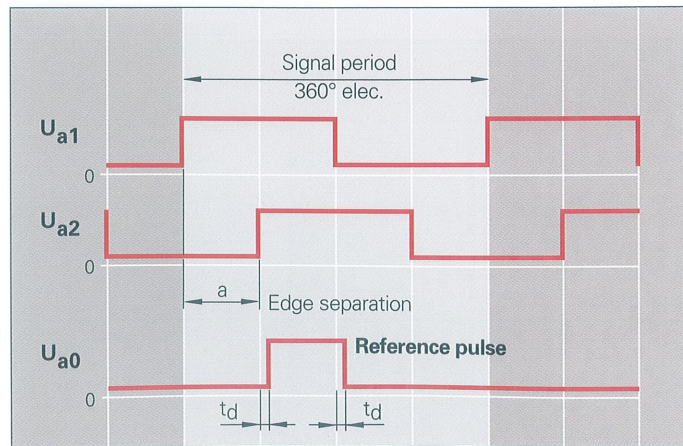


Encoders with TTL square-wave output signals incorporate electronics that digitize non-interpolated or 5 to 10-fold interpolated sinusoidal scanning signals. They provide two 90° (elec.) phase-shifted TTL square-wave pulses U_{a1} and U_{a2} and one or more reference pulses U_{a0} that are gated with the incremental signals. A fault-detection signal U_{aS} indicates fault conditions such as an interruption in the supply lines or light failure. The integrated electronics also output the inverted signals of all square-wave signals.

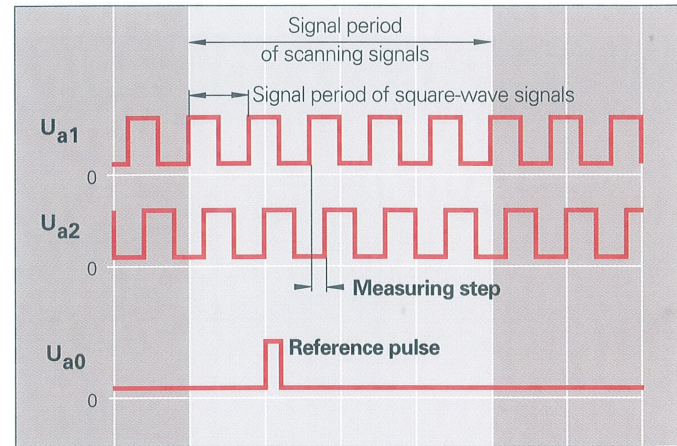
The measuring step results from the distance between two successive edges of the signals U_{a1} and U_{a2} through 1-fold, 2-fold, or 4-fold evaluation.

To ensure reliable operation, the input circuitry of the subsequent electronics must be designed to detect every edge of the square-wave pulses. To avoid errors in counting, the maximum permissible traversing speed for the selected edge separation a must not be exceeded.

	LS 176, LS 476, LS 323, LS 623
Output signals Incremental signals	Square-wave signals \square TTL Two TTL square-wave signals U_{a1} and U_{a2} and their inverse signals $\overline{U_{a1}}$, $\overline{U_{a2}}$
Reference mark signal Pulse width	1 or more square-wave pulses U_{a0} and their inverted pulse $\overline{U_{a0}}$ 90° elec. or 270° elec. (option)
Fault detection signal	1 square-wave pulse $\overline{U_{aS}}$ Improper function: LOW (optional: output U_{a1}/U_{a2} high impedance) Proper function: HIGH
Signal levels	Differential line driver as per EIA standard RS-422 $U_H \geq 2.5$ V at $-I_H = 20$ mA $U_L \leq 0.5$ V at $I_L = 20$ mA
Permissible load	$R \geq 100 \Omega$ (terminating resistor between the associated outputs) $ I_L \leq 20$ mA (max. load per output) $C_{Load} \leq 1000$ pF against 0 V Outputs protected against short circuit to 0 V
Switching times (10% to 90%)	Rise time $t_+ \leq 50$ ns Fall time $t_- \leq 50$ ns With 1 m cable and recommended input circuitry
Connecting cable Cable length	HEIDENHAIN cable with shielding PUR $[4(2 \times 0.14 \text{ mm}^2) + (4 \times 0.5 \text{ mm}^2)]$ Max. 100 m (329 ft) distributed capacitance 90 pF/m



Square-wave signals without previous interpolation



Square-wave signals after 5-fold interpolation

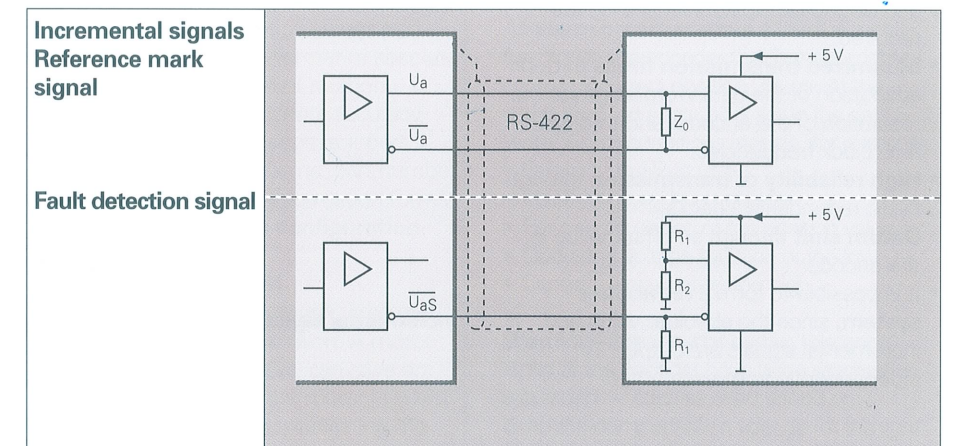
	LS 176 LS 476	LS 623	LS 323	
Interpolation	5-fold ¹⁾	10-fold ¹⁾	None	
Measuring step (after 4-fold evaluation)	1 μ m	0.5 μ m	5 μ m	
Edge separation¹⁾ at max. permissible traversing speed	$\geq 0.25 \mu$ s; 120 m/min ²⁾ $\geq 0.5 \mu$ s; 120 m/min $\geq 1 \mu$ s; 60 m/min	$\geq 0.25 \mu$ s; 120 m/min $\geq 0.5 \mu$ s; 60 m/min $\geq 1 \mu$ s; 30 m/min	$\geq 2.5 \mu$ s; 60 m/min	$\geq 1.25 \mu$ s; 120 m/min
Delay time of reference pulse	$t_{d1} \leq 50$ ns			³⁾
Fault detection signal	Yes	No	No	No

¹⁾Please indicate when ordering
²⁾Mechanical limit
³⁾Reference pulse non-gated

\square TTL: Recommended input circuitry of subsequent electronics

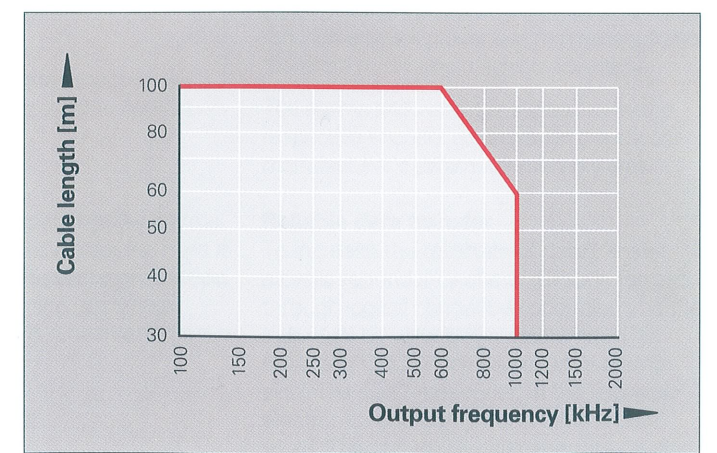
Dimensioning

Recommended differential line receiver
AM 26 LS 32
MC 3486
SN 75 ALS 193
 $R_1 = 4.7$ k Ω
 $R_2 = 1.8$ k Ω
 $Z_0 = 120 \Omega$



Cable lengths

TTL square-wave signals can be transmitted to the subsequent electronics by cable up to 100 m (329 ft), provided that the $5 \text{ V} \pm 5\%$ supply voltage is maintained at the encoder. The voltage received by the encoder can be measured from the subsequent electronics through sensor lines and corrected, if required, by a control system. (See also *Explanations of Specifications.*)



Permissible cable length with respect to output frequency