

# RISH Ducer C12 Phase Angle Difference Transducer

## Data Sheet

Transducer for measuring  
phase angle difference



Fig. 1. RISH Ducer C12  
transducer in housing **E16**  
clipped onto a top-hat DIN rail.



Fig. 2. RISH Ducer C12  
transducer in housing **E16**  
screw hole mounting brackets  
pulled out.

## Application

The transducer **RISH Ducer C12** (Fig. 1 and 2) converts the phase angle difference of two synchronised supplies into an output signal that can serve several receiving instruments such as indicators, recorder, alarm units etc.

## Features / Benefits

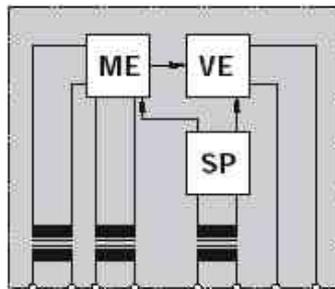
- Measuring inputs: Sine or distorted wave-forms of nominal input voltage

Measured variable	Nominal input voltage	Measuring range limits
Phase Angle difference	10 to 660 V	$\pm 60$ and $\pm 175^\circ$ el

- Measuring output :  
DC current signal (load - independent ) or DC voltage signal
- Measuring principle : Measurement of the zero crossing interval
- Electric isolation between all transducer connection circuits/ Prevents interference voltages and currents being transmitted
- Narrow housing, 70 mm / Saves space and therefore costs
- Snaps onto a DIN rail or screws onto a wall or panel / Adaptable to the circumstances at the place of installation
- The device fulfils the protection requirements of the EMC guidelines (89/336/EWG). The device bears the CE symbol for EMC
- Screw terminals suitable for multistrand or solid wires/ Easy wiring without problems

## Mode of Operation (Fig.3)

The two input variable are matched to the internal instrument level via isolation transformers and led to a RS flip-flop. This bistable element generates constant amplitude rectangular Signals whose length corresponds to the time between the rising zero-axis crossing of the two input variables. Parasitic Zero-axis crossings, due to superimposed ripple control frequency for example, are almost suppressed by a dead time (positive feedback). The arithmetical mean voltage difference and is inherently independent of the input frequency. A following amplifier converts this difference into the desired output signal.



## Technical Data

### General

- Measured quantity : Phase angle between difference of two Single phase balanced networks
- Measuring principle : Measurement of the zero crossing interval

### Measuring input $U_G$ and $U_S$ $\rightarrow$

measuring ranges ①

$\Delta \angle$  :  $\pm 120^\circ$  el

Nominal frequency  $f_N$  ② : 50 or 60 Hz

Nominal input voltage

$U_N$  ③ : For both inputs  
100 $\sqrt{3}$ , 110 $\sqrt{3}$ , 100, 110, 200, 230, 400 or 500 V

Wave form : Sine - Wave

Power consumption: : Approx.  $U_N \cdot 1$  mA per measuring input

Sensitivity: : < 0.05% of measuring range end value

### Overload capacity :

Measured quantity	Number of applications	Duration of one application	Interval between two successive applications
$1.5 \times U_N$	contin.	—	—
$2 \times U_N$	10	10 s	10 s
$4 \times U_N^*$	1	2 s	—

\* But max 1.5 KV

### Measuring output A $\rightarrow$

Output signals : Load-independent DC voltage  $U_A$   
OR  
Load-independent DC current  $I_A$   
 $D \angle (\text{el.}) = \angle U_G - \angle U_S$   
 $U_G$  Generator Voltage  
 $U_S$  Bus Voltage

Standard ranges of  $U_A$

④ to ⑥

: 0...10/ 1...5 / -10...0...10 V

Load Capacity 20 mA

**External Resistance**

$$R_{\text{ext min.}} [\text{k}\Omega] > \frac{U_{AN} [\text{V}]}{20 \text{ mA}}$$

$U_{AN}$  = Full output Value

Standard ranges of  $I_A$

⑦ to ⑨

: 0...1/0...5/0...10/0...20/4...20 mA

-1...0...1/-2.5...0...2.5/-5...0...5/

-10...0...10/-20...0...20 mA

Burden voltage:  $\pm 15$  V

External Resistance

$$R_{\text{ext max.}} [\text{k}\Omega] \leq \frac{15 \text{ V}}{I_{AN} [\text{mA}]}$$

$I_N$  = Full output value

Voltage limit under

$R_{\text{ext}} = \infty$

Approx. 40 V

Current limit under

overload

Approx.  $1.3 \times I_{AN}$  with current

Approx. 30 mA with voltage output

FSO variation:

Approx.  $\pm 2\%$

Ripple in output

current ⑩

$\leq 2\%$  p.p.

Response time

< 300 ms

Behavior of output Current difference operating States :

Operating Stage <sup>1</sup>		Output	
Generator Voltage	Bus Voltage	Unipolar	Bipolar
Leading ( $f_G = f_S$ )		$> I_{AN} / 2$	Pos.
Missing <sup>2</sup>	Nominal Value	Neg.	$< - I_{AN}$
Nom. Value	Missing <sup>2</sup>	$> I_{AN}$	$> I_{AN}$
Missing <sup>2</sup>	Missing <sup>2</sup>	Indefinite	Indefinite

<sup>1</sup> With Power supply switched on

<sup>2</sup> e.g. switched off or fault condition

## Accuracy (acc. to DIN/IEC 688-1)

Reference value	: Output span
Basic accuracy	: Class 0.5
<b>Reference conditions</b>	
Ambient temperature	: 23°C, ± 5 K
Input voltage	: 0.8...1.2 U <sub>N</sub>
Frequency	: f <sub>N</sub> ±10%
Wave form	: Sine-wave
Power supply	: U <sub>HN</sub> ± 15% (AC), U <sub>HN</sub> -15 / +33% (DC)
Output burden	: 0...R <sub>ext</sub> max. with current output R <sub>ext</sub> min. ...∞ with voltage output

① to ⑩ see section "Special features"

Influence effects (maximum values):  
(included in basic error)

Linearity error	: ± 0.2%
frequency influence f <sub>N</sub> ± 5%	: ± 0.05%
Dependence on external resistance (Δ R <sub>ext</sub> max.)	: ± 0.05%
Power supply influence U <sub>HN</sub> ± 15%	: ± 0.05%

### Additional errors (maximum values)

Temperature influence (-25...+55°C)	: ± 0.2% / 10 K
Voltage influence between 0.5 and 1.5 U <sub>N</sub>	: ± 0.3%
Frequency influence 45 – 200 Hz	: ± 0.5%
External field influence 0.5 mT	: ± 0.2%

Power supply influence U <sub>HN</sub> ± 20%	: ± 0.2%
Influence of common mode voltage 220 V, 50 Hz or 10 V, 1 MHz	: ± 0.2%

### HF surge voltage influence

acc. to IEC 255-4 Class III, 2.5 kV, 1 kV, 200 Ω 1 MHz, 400 Hz	: ± 4.0%
acc. to ANSI/IEEE C 37.90-1978 2.5 kV, 150 Ω 1 MHz, 50 Hz	: ± 1.0%

### Power Supply → ○

AC voltage ⑪ ⑫	: 24, 115, 120, 230 or 240 V, ± 20%, 42 to 70 Hz Power input approx. 4 VA
DC voltage	: 24...90 or 24...90V, -15 / +33%, Power input approx. 4 W

## Environmental conditions

Climate rating ⑬	: Climate class 3Z acc. to VDI/VDE 3540, but temperature continuously - 25 to +55°C. Relative humidity ≤ 75% annual mean (application class HVE acc. to DIN 40 040)
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Storage temperature range	: - 40 to +70°C
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⑪ to ⑬ see section "Special features"

## Table 1 : Electromagnetic compatibility

The basic standards EN 50 081-2 and EN 50 082-2 were taken in account

Conducted interference from the instrument	EN 55 011	Group 1, Class A
HF radiation from complete instrument	EN 55 011	Group 1, Class A
Electrostatic discharge	IEC 801-2	± 4 kV contact, ± 8 kV air
HF field influence on instrument	IEC 801-3	80 to 1000 MHz, 10 V/m, 80 % AM 1 kHz
Transient burst via connections	IEC 801-4	± 2 kV, 5/50 ns, 5 kHz, > 1 min. capacitively coupled
Transient surge on power supply	IEC 801-5	± 2 kV, 1.2/50 ms, symmetrical ± 4 kV, 1.2/50 ms, asymmetrical
HF interference via connections	IEC 801-6	0.15 to 80 MHz: 10 V, 80% AM 1 kHz, source 150 Ω

The limits given in the standards mentioned are observed. During the interference test, occasional impairment of operating behaviour was permitted, but no change of operating mode and no loss of data. The device fulfils the protection requirements of the EMS guidelines (89/336/EWG). **The device bears the CE symbol for EMS.**

## Regulations

HF surge compatibility	: 2.5/1 kV, 1 MHz, 400 surges/s acc. to IEC 255-4 Cl. III
Electrical standards	: Acc. to IEC 348
Housing protection	: IP 40 acc. to IEC 529 Terminals IP 20
Test voltage	: Input versus Output : 4KV, 50Hz, 1min Input versus Housing : 4KV, 50Hz, 1min Output versus Housing : 4KV, 50Hz, 1min Output1 versus Output2 : 500V, 50Hz, 1min

## Installation Data

Mechanical design	: Housing type E16 Dimensions see section "Dimensional drawings"
Material of Housing	: Lexan 940 (polycarbonate), Flammability Class V-0 according to UL 94, self-extinguishing, nondripping, free of halogen

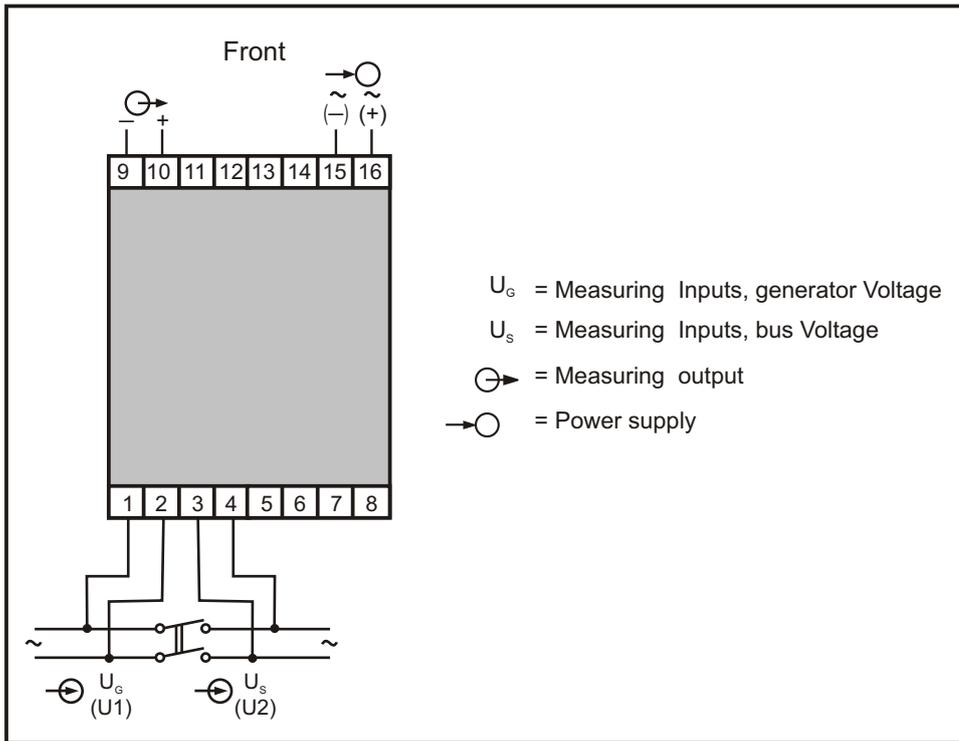
Mounting	: For snapping onto top-hat rail (35 × 15 mm or 35 × 7.5 mm) acc. to EN 50 022 OR directly onto a wall or panel using the pull-out screw hole brackets
Mounting Position	: Any
Electrical connections	: Screw - type terminals with indirect wire pressure, for max. 2 × 2.5 mm <sup>2</sup> or 1 × 6 mm <sup>2</sup>
Weight	: Approx. 0.6 kg.

**Table 2 : Special features**

Nature of special features
<b>Measuring range <math>\Delta \angle</math></b> ① between $\pm 60^\circ$ el. and $\pm 175^\circ$ el. buffer angle $< \pm 120^\circ$ el. Additional error 0.5%
<b>Nominal frequency <math>f_N</math></b> ② between 16 and 400 Hz apart from the standard ranges 50 or 60 Hz Limitation at $f_N > 100$ Hz: Additional error 0.2% <hr/> Limitations at $16 \leq f_N < 50$ Hz: possible only with measuring ranges $> \pm 60^\circ$ el Additional error 0.3% Response time $< 2$ s Power Supply derived from measuring input not possible
<b>Nominal input voltage <math>U_N</math></b> ③ between 10 and 660 V, other than the standard values $100/\sqrt{3}$ , $110/\sqrt{3}$ , 100, 110, 200, 230, 400 or 500 V. <b>Limitation:</b> at $U_N > 500$ V overload capacity 2000 V, 2 s
<b>Output signal A</b> ④ Unipolar load-independent DC voltage* Ranges between 0...1 and 0...15 V, other than the standard range 0...10 V
⑤ Live-zero* Ranges between 0.2...1 and 3...15 V, other than the standard range 1...5 V * Limitation at $U_{AN} < 4$ V <b>Additional error:</b> Dependence on external resistance ( $\Delta R_{ext}$ max). = 0.2%, reference conditions: External resistance $2 \times R_{ext}$ min. $\pm 20\%$
⑥ Bipolar symmetrical load-independent DC voltage* Ranges between $-1...0...1$ and $-15...0...15$ V, other than the standard range $-10...0...10$ V
⑦ Unipolar load-independent DC current Ranges between 0...1 and 0...20 mA, other than the standard range 0...1 / 0...5 / 0...10 and 0...20 mA
⑧ Live-zero Ranges between 1...5 and 4...20 mA, other than the standard range 4...20 mA
⑨ Bipolar symmetrical load-independent DC current Ranges between $-1...0...1$ and $-20...0...20$ mA, other than the standard ranges $-1...0...1$ / $-2.5...0...2.5$ / $-5...0...5$ / $-10...0...10$ and $-20...0...20$ mA

Nature of special features
<b>Residual ripple in output current</b> ⑩ $\leq 0.5\%$ p.p. instead of $\leq 2\%$ p.p. Limitations: possible only with nominal frequency $\geq 50$ Hz Response time $< 1$ s (not suitable for synchronising operations )
<b>Power supply</b> ⑪ without separate power supply connection Power supply from voltage input signal ( $\geq 24$ V to 500 V, $f_N \geq 50$ or 60 Hz) <b>Limitation:</b> Reference conditions: Input voltage $U_N \pm 15\%$ With $U_N \geq 170$ V Impulse withstand voltage acc. to IEC 255-4, Cl. II: 1 kV, 1.2/50 $\mu$ s, 0.5 Ws or overload capacity of the voltage input max. 680 V~, 2 s The additional power taken from the input voltage signal is approx. 4 VA
⑫ with AC voltage any voltage between 24 and 500 V, $\pm 20\%$ , 42 to 70 Hz. Power consumption approx. 4 VA apart from the standard voltages 24, 115, 120, 230 & 240 V
<b>Climatic rating</b> ⑬ Climate class 3Z acc. to VDI/VDE 3540, but temperature continuously $-25$ to $+55^\circ$ C. Relative humidity $\leq 90\%$ annual mean (application class HVR acc. to DIN 40 040)

## Electrical connections



## Dimensional Drawings

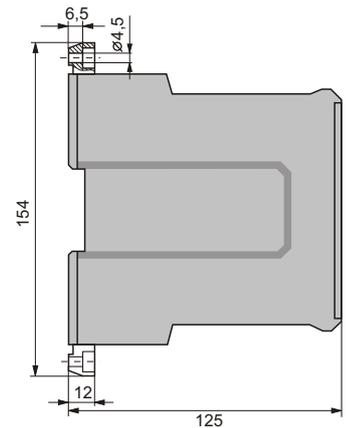
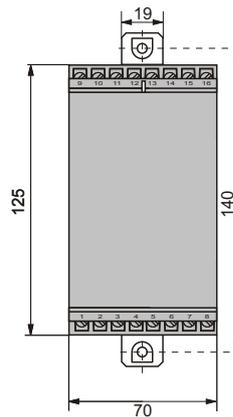
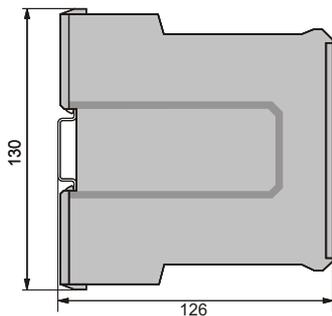
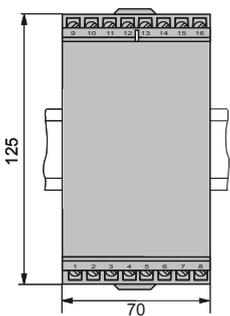


Fig. 5. *RISH Ducer* C12 in housing **E16** clipped onto a top hat rail (35 × 15 mm or 35 × 7.5 mm, acc. to EN 50 022).

Fig. 6. *RISH Ducer* C12 in housing **E16** with the screw hole brackets pulled out for wall mounting.

## Specification and ordering information

Order Code C12 —			
Features, Selection	*SCODE	no-go	
<b>1. Mechanical Design</b> 3) Housing E16			
<b>2. Measuring Mode</b> 2) Phase angle difference			
<b>3. Application</b> A) Single-Phase Connection			
<b>4. Nominal frequency</b> (2) 1) 50 Hz 2) 60 Hz			

## Specification and ordering information

Order Code C12 —			
Features, Selection	*SCODE	no-go	
9) Non-standard [Hz] <span style="background-color: black; color: black;">██████████</span> $\geq 16$ to 400 Restriction : When $F_N > 100$ Hz, additional error 0.2% $16 \leq f_N < 50$ Hz Possible only with measuring range $> \pm 60^\circ$ el additional error 0.3%, response time $< 2$ S			 . . . . . 9 . . . . .
<b>5. Nominal input voltage</b> (measuring input) ③ Generator and bus bar			
A) $100/\sqrt{3}$ V;			. . . . . A . . . . .
B) $110/\sqrt{3}$ V;			. . . . . B . . . . .
C) 100 V;			. . . . . C . . . . .
D) 110 V;			. . . . . D . . . . .
E) 200 V;			. . . . . E . . . . .
F) 230 V;			. . . . . F . . . . .
G) 400 V;			. . . . . G . . . . .
H) 500 V;			. . . . . H . . . . .
Z) Non-standard [V; V]: <span style="background-color: black; color: black;">██████████</span> $\geq 10.00$ to 660;			. . . . . Z . . . . .
With a 3 phase system show the input nominal voltage as a phase to phase voltage. For transformer connection add semicolon with primary / secondary voltage in V, e.g. 6600/110 (in line D) or 120 ;14400/120 (in line Z, non-standard) show 2 decimal places			
<b>6. Nominal input current</b> 0) Ommited			. . . . . 0 . . . . .
<b>7. Measuring range</b> ①			
1) Phase angle difference $\pm 120^\circ$ el.			. . . . . 1 . . . . .
9) Non-standard [°el] <span style="background-color: black; color: black;">██████████</span> $-60 \dots 0 \dots 60$ to $-175 \dots 0 \dots 175$ Watch for restrictions / additional errors!			. . . . . 9 . . . . .

① to ③ see section "Special features"

Order Code C12 —			
Features, Selection	*SCODE	no-go	
<b>8. Output signal</b> (measuring output)			
1) 0...10 V, $R_{ext} \geq 500 \Omega$			1 . . . . .
2) 1... 5 V, $R_{ext} \geq 250 \Omega$			2 . . . . .
3) - 10... 0...10 V, $R_{ext} \geq 500 \Omega$			3 . . . . .
9) Non-standard [V] <span style="background-color: black; color: black;">██████████</span> $0 \dots 1.00$ to $0 \dots 15$ ④ $0.2 \dots 1$ to $3 \dots 15$ ⑤ $-1.00 \dots 0 \dots 1.00$ to $-15 \dots 15$ ⑥			9 . . . . .
A) 0... 1 mA, $R_{ext} \leq 15 k\Omega$			A . . . . .
B) 0... 5 mA, $R_{ext} \leq 3 k\Omega$			B . . . . .
C) 0...10 mA, $R_{ext} \leq 1.5 k\Omega$			C . . . . .
D) 0...20 mA, $R_{ext} \leq 750 \Omega$			D . . . . .
E) 4...20 mA, $R_{ext} \leq 750 \Omega$			E . . . . .
F) - 1...0...1 mA, $R_{ext} \leq 15 k\Omega$			F . . . . .
G) - 2.5...0...2.5 mA, $R_{ext} \leq 6 k\Omega$			G . . . . .
H) - 5...0...5 mA, $R_{ext} \leq 3 k\Omega$			H . . . . .
J) - 10...0...10 mA, $R_{ext} \leq 1.5 k\Omega$			J . . . . .
K) - 20...0...20 mA, $R_{ext} \leq 750 \Omega$			K . . . . .
			Z . . . . .

Order Code C12 —			
Features, Selection	*SCODE	no-go	
Z) Non-standard 0...> 1.00 to 0...< 20 (7) 1...5 to < (4...20) (8) > (-1.00...0...1.00) to < (-20...0...20) (9)	[mA]		
<b>9. Power supply</b>			
0) Internal from voltage measuring input (≥ 24 to 500 V AC) (11)			. 0 . . . . .
1) 24 V, 50/60 Hz			. 1 . . . . .
3) 115 V, 50/60 Hz			. 3 . . . . .
4) 120 V, 50/60 Hz			. 4 . . . . .
6) 230 V, 50/60 Hz			. 6 . . . . .
7) 240 V, 50/60 Hz			. 7 . . . . .
9) Non-standard 50/60 Hz ≥ 24 to 500 (12)	[V]		. 9 . . . . .
A) 24... 90 V DC, -15 / +33%			. A . . . . .
B) 90...240 V DC, -15 / +33%			. B . . . . .
<b>10. Special features</b>			
0) Without	Y		. . 0 . . . . .
1) With			. . 1 . . . . .
Without special features (line 0): Order code complete. With special feature (line 1): The features to be omitted must be marked hereafter with / (slant line) in the order code until reaching the required feature.			
<b>11. Smaller residual ripple in measuring output</b> (10)			
A) ≤ 0.5% p.p. instead of ≤ 2% p.p. Restrictions: Possible only with nominal frequency 50 Hz, response time < 1 S (Not Suitable for synchronising operations)		Y	. . . A . . . . .
<b>12. Improved climatic rating</b> (DIN 40 040) (13)			
A) Application class HVR instead of HVE (standard)		Y	. . . . A . . . .

\* Lines with letter(s) under “no-go” cannot be combined with preceding lines having the same letter under “SCODE”.

(4) to (13) see section “Special features”



**RISHABH INSTRUMENTS**  
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