in housing E16 for rail and wall mounting

The transducer **RISH** *Ducer* **C11** (Fig. 1 and 2) measures the phase angle between current and voltage of a single or 3 phase balanced network having a sine wave form. The output signal, in the form of a load independent DC current or voltage, is proportional to the phase angle between the 2 measured quantities current and voltage.

The measuring range scales of the connected instruments, such as indicators, recorders, controllers etc., are calibrated in conj values of the angle.

Features / Benefits

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

Measured	Nominal input	Nominal input	Measuring range
variable	current	voltage	limits
Phase angle	0.01 to 10 A	10 to 660 V	0 to 30 and 0175° el + 15 to < + 175° el

- Measuring output: DC current signal (load-independent) or DC voltage signal (not superimposed)
- *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
- Two isolated outputs (Optional)
- Electrical isolation between output 1 and output 2 is 500V
- Screw terminals suitable for multistoried or solid wires / Easy wiring without problems

Mode of operation (Fig. 2)

The input variables – current and voltage – are matched to the internal instrument Level via isolation transformers and led to an RS flip-flop. This bitable element generates constantamplitude rectangular signals whose length corresponds to the time between the rising zero-axis crossings of the two input variables. Parasitic zero axis crossings, due to superimposed ripple control frequencies for example, are almost suppressed by a dead time (positive feedback). The mean voltage of these rectangular waves is therefore proportional to the phase angle and inherently independent of the input frequency.

Technical data

General

Measured quantity: Measuring principle: Phase angle between current and voltage Measurement of the zero crossing interval



current I_N (4) : 1 Power consumption: <

Sensitivity:

1, 2 or 5 A < 0.1 VA per current path U_N . 1 mA per voltage path < 0.05% of range end value



Fig. 1. RISH Ducer C11 transducer in housing E16 clipped onto a top-hat rail.



Overload capacity:

Measured quantity	Number of applications	Duration of one application	Interval between two successive applications
2 x I _N	continuously		
10 x I _N	5	15 s	5 min
40 x I _N	1	1 s	
1.5 x U _N	continuously		
2 x U _N	10	10 s	10 s
4 x U _N 1	1	2 s	

¹ but max. 1.5 kV Measuring output A ⊖→

Output signals: Standard ranges of U A

Standard ranges of IA

5 to 7

Impressed DC voltage OA OI
Load-independent DC current IA
010 / 15 / –10010 V
for one output
Load capacity 20 mA
External resistance
$R_{ext} [k\Omega] > U_{AN} [V]$
20 mA
U _{AN} = Full scale output
For two outputs
R _{ext.} [kΩ] > 10 kΩ / V
01/05/010/020/420 mA
-101/-2.502.5/-505/
–10010/–20020 mA
Burden voltage: ±15 V for one output
Burden voltage: ± 12V for two
outputs External resistance
R _{ext} max.[kΩ]₌ Burden voltage
I _{AN} [mA]
I _{AN} = Full scale value

Improseed DC voltage LL, or

1 to 11 see section "Special features"

Voltage limit under $R_{ext} = \infty$: Current limit under overload: FSO variation: Ripple in output current 11 : Response time: Accuracy (acc. to DIN/IEC 688-1)	Approx. 40 V Approx. 1.3 x I_{AN} with current Approx. 30 mA with voltage output Approx. $\pm 2\%$ $\leq 2\%$ p.p. < 300 ms	Power supply → AC voltage: (12) (13) DC voltage:	24, 115, 120, 230 or 240 V, \pm 20%, 42 to 70 Hz Power input approx. 4 VA for one output Power input approx. 8 VA for two outputs 2490 (2460V for two outputs) or 90240 V, -15 / +33%, Power input approx. 4 W for one output Power input approx. 8 W for two outputs
Reference value:	Output span	Installation data	
Basic accuracy:	Class 0.5	Mechanical design:	Housing type E16
Reference conditions:		-	Dimensions see section
Ambient temperature	23°C, ± 5 K		Dimensional drawings"
Input current	0.81.2 I _N	Material of housing:	Lean 940 (polycarbonate),
Input voltage	0.81.2 UN		Flammability Class V-0 according
Frequency	$f_{\rm N} \pm 10\%$		to UL 94, self-extinguishing, no dripping,
wave form		••	free of halogen
Power supply	$U_{HN} \pm 15\%$ (AC), $U_{HN} - 157 + 33\%$ (DC)	Mounting:	For snapping onto top-hat rail (35x15 mm
Output burden	DRext max. with current output		or 35X7.5 mm) acc. to EN 50 022 ro
Influence effects (maximum values):	Rext IIIII ~ With Voltage Output		out scrow hole brackets
Included in basic error		Mounting position	
Linearity error	+ 0.2% for one output	Fleetrical connections:	Screw-type terminals with indirect
	$\pm 0.2\%$ for two outputs	Electrical connections.	wire pressure for max 2'2 5 mm ²
Frequency influence			or 1'6 mm ²
f _N + 5%	+ 0.05%	Weight:	
Dependence on		Weight.	hippion: oto ng
external resistance			
$(\Delta R_{ext} max.)$	± 0.05%		
Power supply influence		Regulations	
U _{HN} ± 15%	± 0.05%	HF surge	
Additional errors (maximum values)		compatibility:	2.5/1 kV, 1 MHz, 400 surges/s
Temperature influence	± 0.2% / 10 K for one output	. ,	acc. to IEC 255-4 Cl. III
(–25+55°C)	± 0.3% / 10 K for two outputs	Electrical standards:	acc. to IEC 348
Voltage influence between	± 0.3% for one output	Housing protection:	IP 40 acc. to IEC 529
0.5 and 1.5 U _N	± 0.5% for two outputs		Terminals IP 20
Current influence between	± 0.3% for one output	Test voltage:	4 kV / 50 Hz / 1 min.
0.4 and 1.5 I _N between	± 0.5% for two outputs	-	between electrically isolated circuits
0.1 and 1.5 I _N	± 0.7% for two outputs		and versus housing500V / 50 Hz / 1min.
Frequency influence			between output 1 versus output 2.
45 – 200 Hz	± 0.5% for one output		(for two outputs)
External field influence	\pm 0.7% for two outputs		
0.5 mT	± 0.2%		
Power supply influence		Environmental conditions	
U _{HN} ± 20%	± 0.2%	Climatic rating (14):	Climate class 32 acc. to VDI/VDE
Influence of common mode voltage			3540, but temperature continuously
220 V, 50 Hz or 10 V, 1 MHz	± 0.2%		-20 10 + 30 C.
HF surge voltage influence			Relative number $\geq 75\%$ annual mean (application class \downarrow)/E acc
acc. to IEC 255-4 Class III,			to DIN 40.040)
2.5 kV, 1 kV, 200 Ω 1 MHz, 400 Hz	± 4.0%	Storage tomperature	
acc. to ANSI/IEEE		Siorage temperature	-40 to +70°C
C 37.90-1978	4.0%	range.	
2.5 κV, 150 Ω 1 MHZ, 50 HZ	± 1.0%		

(12) to (14) 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. capacitive 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 behavior was permitted, but no change of operating mode and no loss of data.

Application note	Application note												
For phase angle or po loaded three- or four- data are needed for c	– Curr – Volta	 Current connection Voltage connection 			(e.g. in phase L1) (e.g. between phases L1 – L3)								
Current connection in phase	L1	L2	L3		L1			L2				∟3	
Voltage connection between phases	L1 – L2	L2 – L3	L3 – L1		L1 - l	_3	L2	2 – L1			L3	– L2	
Vector diagrams			U ₃₁ L3	L 2 L		I1	L3		U ₂₁	L3	₁₃	L1 U ₃₂	
Connection diagram	Fig. 4	Fig. 5	Fig. 6		Fig.	7	F	ig. 8			F	ig.9	
Limitation*: Max. meas. range	205 0 145° el current lagging			14 cu	5 0 20 rrent leadir	05° el 1g							
* Limitation: With lagg in the case of leading	ing current the max. posi current.	tive measuring range si	de is 175° – F, with F	the angle	between la	agging curre	ent and vol	tage. 1	he sar	ne app	olies ar	nalogou	isly
Table 2: Specifica	tion and ordering inf	ormation											
Order Code C11 –													
Features, Selection				*SCOD	E no	o-go	≜	ł	ł	A			
1. Mechanical o 3) Housing E1	design I6			В			3			•			
2. Measuring m	node						-						
1) For phase a	angle			С				1					
3. Application													
A) Single-pha	se AC						•	•	A	•			•
B) 3- or 4-wire	e 3/4-phase balanced U: I	_1-L2/I: L1					•	·	В	•		·	·
C) 3- or 4-wire	e 3/4-phase balanced U: I	L2-L3/I: L2					•	·	С	•		·	·
D) 3- or 4-wire	e 3/4-phase balanced U: I	L3-L1/I: L3					•	•	D	•			•
E) 3- or 4-wire	e 3/4-phase balanced U: I	_1-L3/I: L1					•	•	E	•			•
F) 3- or 4-wire 3/4-phase balanced U: L2-L1/I: L2							•		F	•			
G) 3- or 4-wire 3/4-phase balanced U: L3-L2/I: L3									G				
This feature sel "Electrical conne	lection "3. Application" ar ections" must be checked	nd the later sections "A I and specified with one	pplication note" and another.										
4. Nominal free	uency ²												
1) 50 Hz										1.			
2) 60 Hz									·	2			
9) Non-standa ≥16 to 400	rđ	[Hz]						•		9			
Watch for restrictions/additional errors!													

Order Code C11 –		
Features, Selection	*SCOI	DE no-go
5. Nominal input voltage (measuring input)		
A) 100/ 3 V;		
B) 110/ 3 V;		
C) 100 V;		
D) 110 V;		
E) 200 V;		
F) 230 V;		
G) 400 V;		
H) 500 V;		
Z) Non-standard ≥10.00; to 660;	[V;V]:	
With a 3 phase system show the input nomin for transformer connection add semicolon wit e.g. 6600/110 (in line D) or 120 ;14400/120 (places	voltage as a phase to phase voltage. primary / secondary voltage in V, line Z, non-standard) show 2 decimal	

Insert code figure In the 1 st field on the next page!

Î А В С D

Е F G Н Ζ

.

Order Code C11 –										
Features, Selection		no-go		1	1	Insert o	code figu In the 1 on the n	re st field ext		
6. Nominal input current (measuring input) 4							page!			
1) 1 A;			·	I	•	,	•	•	·	·
2) 2 A;				2						
3) 5 A;				3						
9) Non-standard [A;A]:				0						
≥0.01; to 10;			·	9	•	·	·	•		·
For transformer connection add semicolon with primary / secondary current in A, e.g.500/1 (in line 1) or 6.67;1600/6.67 (in line 9, non-standard) show 2 decimal places										
7. Measuring range 1										
2) 0.9-cap-1-ind-0.5					2					
3) 0.8-cap-1-ind-0					3					
4) 0.5-cap-1-ind-0.5					4					
5) 0.5-ind-0-cap-1-ind-0-cap-0.5					5					
Z) Non-standard [° el]										
e.g. 0.5-cap-1-ind-0 or 030 to 0175, – 15015 to – 1750175 Watch for restrictions/additional errors!										
8. Output signal (measuring output) output 1	п									
1) 010 V,	В		•			1		•		•
2) 1 5 V,						2				
3) – 10 010 V,			•			3		•	•	
9) Non-standard [V]						9			·	
01.00 to 015 ⁵										
0.21 to 315 ⁶ $-1.0001.00$ to -1515										

Order Code C11 –										
Features, Selection	*SCODE	no-go	↓	4	4	4	4			
8. Output signal (measuring output) output1 (continuation)			- 1							
A) 0 1 mA			Å							
B) 0 5 mA			В							
C) 010 mA			С							
D) 020 mA			D							
E) 420 mA			E							
F) – 1 0 1 mA			F							
G) – 2.5 0 2.5 mA			G							
H) – 5 0 5 mA			Н							
J) – 10 010 mA			J							
K) – 20 020 mA			К							
Z) Non-standard [mA]			Z							
0> 1.00 to 0< 20 (8) 15 to < (420) (9)										
> (-1.0001.00) to < (-20020) (10)										
9. Power supply										
0) Internal from voltage measuring input (≥24 to 500 V AC) ⁽¹²⁾				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 [V]				9						
> 24 to 500 (13)										
A) 24 90 V DC, –15 / +33%		E		Α						
B) 90240 V DC, –15 / +33%				В						
C) 2460 V DC, -15 / +33%		D		С						
10. Special features	v									
0) Without	T									
1) With										
Without special features (line 0): Order code complete With special feature (line										
1): The features to be omitted must be marked with / (slant line) in the order code										
until reaching the required feature.										
11. Smaller residual ripple in measuring output (11)		Y				А				
A) \leq 0.5% p.p. instead of \leq 2% p.p.Watch for response time and mutual			· ·	•	•	/ `	•	•	·	•
dependence of residual ripple/response time!										
12. Improved climatic rating (DIN 40 040) (14)							А			
A) Application class HVR instead of HVE (standard)		Y								
13. Output signal (measuring output) output 2	^		7							
Same as Output signal (measuring output) output 1 in sr.no. 8	A									
*1 inos with lotter (s) under "no as" cannot be combined with preceding lines having the same letter under "SCODE"										

Spe	ecial features
Nat	ure of special features
Mea	asuring range
1	for power factor measurement deviating from standard measuring ranges (e.g. 0.8cap, 1ind0.1)or measuring range between 030 and 060°el resp. ± 15 to < ± 60°el
	Liniduois. Measuring ranges < 60°el:
	Additional error 0.5%
	Nominal frequency \geq 50 Hz
	Residual ripple $\leq 2\%$ p.p.
	Response time < 1 s
Nor	minal frequency f _N
0	between 16 and 400 Hz
e	apart from the standard ranges 50 or 60 Hz
	Limitation at $f_N > 100$ Hz:
	Additional error 0.2%
	Limitations at 16 \leq f _N < 50 Hz:
	possible only with measuring ranges
	$\ge 060 \text{ or } > \pm 60^{\circ} \text{el}$
	Additional error 0.3%
	Residual ripple $\leq 2\%$ p.p.
	Response time < 2 s
Nor	minal input voltage U _N
3	between 10 and 660 V, other than the standard
_	values 100/ 3 , 110/ 3 , 100, 110, 200, 230, 400
	01 500 V.
	at $L_{\rm V} > 500$ V overload canacity 2000 V 2 s
Nor	at ON > 500 V Overload capacity 2000 V, 2 S
4	between 0.01 and 10 A other than the standard
	values 1, 2 or 5 A
	Limitations at $I_N > 5$ A:
	Power consumption < 0.3 VA per current circuit
	Overload capacity of current circuit
	2 x I _N continuous
	10 x I _N for 10 s
	maximum 5 times at 5 minute intervals
	40'I _N for 1 s
	max. 250 A, once only
	$t_N \ge 40 \text{ Hz}$
1	Limitations at $I_N > 8.3 \text{ A}$
	Reference conditions $I_E \leq 10 \text{ A}$
Out	Uninglar load independent DC voltage*
э	Unipolar load-independent DC voltage
1	Ranges between 0 I and 0 IS v,other than the standard range 0 IU V





	Measuring inputs									
Application	Terminal allocation	Application	Terminal allocation							
Phase angle measurement in single-phase AC network	L1/L2/L3	Phase angle measurement in 3- or 4-wire 3-phase network balanced U: L1 – L2 I: L1	L1 L2 L3 N							
Phase angle measurement in 3- or 4-wire 3-phase network U: L2 – L3 I: L2	L1 X L2 X L3 X	Phase angle measurement in 3- or 4-wire 3-phase network U: L3 – L1 I: L3	L1 2 5 6 L1 L2 L3 N							
Phase angle measurement in 3- or 4-wire 3-phase network U: L1 – L3 I: L1	L1 2 5 6 L1 2 5 6 L2 L3 L3 N	Phase angle measurement in 3- or 4-wire 3-phase network U: L2 – L1 I: L2	L1 L2 L3 N							
Phase angle measurement in 3- or 4-wire 3-phase network U: L3 – L2 I: L3	L1 2 5 6 L1 L2 L3 N									

