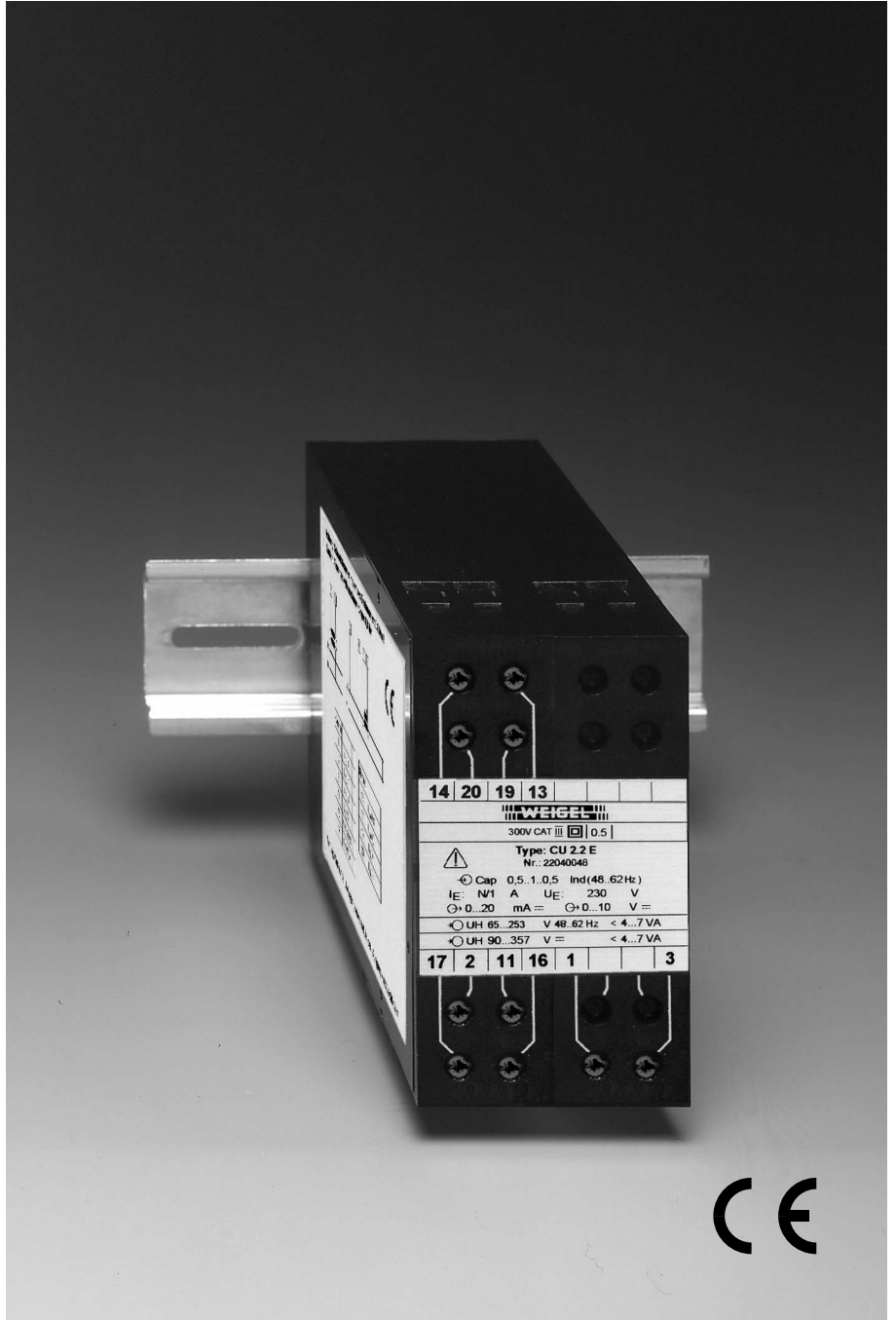


# Data Sheet

063.8e

## Transducers for Phase Angle ( $\cos \varphi$ )

CU 2.2



## Application

The microprocessor controlled transducer **CU 2.2** produce load independent DC current and DC voltage output signals proportional to the **phase angle  $\varphi$**  between the applied AC voltage and AC current. The signal can be transmitted over a considerable distance and fed into indicators, recorders, data loggers and/or control systems.

It is possible to connect more than one measuring, recording or control devices to the output circuit provided the total impedance does not exceed the rating.

The CU 2.2 transducer requires an auxiliary power supply. Inputs, outputs and power supply are **galvanically isolated from each other**. The outputs are **short-circuit proof** and **safe against idling**.

The transducers comply with safety requirements and are tested for interference immunity.

The transducers are designed to be mounted in machines/systems. Regulations for installation of electrical systems and equipment have to be observed.

## Functional Principle

A transformer in the current circuit and a multiplier in the voltage circuit adapt the signals and pass them via a multiplexer to an A/D converter.

A microprocessor analyzes the digitalized signal in real time. Via a D/A converter and an optocoupler for galvanic isolation the signal is transferred to the output stages.

These issue the output quantity as a load independent DC current and a synchronous impressed DC voltage proportional to the phase angle  $\varphi$  of the input signal.

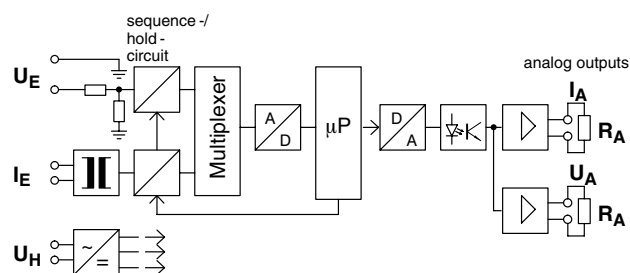
Optionally, the measured value can be inquired via a **serial interface (RS232/RS485)**, also switching signal can be produced.  $\blacktriangleright$

### Notes

The outputs must **not** be connected to each other.

If one or both input signals are not applied, the transducer outputs will show the  $\cos \varphi = 1$  value.

## Block Circuit Diagram



## General Technical Data

case details	projecting case clamping to TH 35 DIN rail according to DIN EN 60 715
material of case	ABS/PC black self-extinguishing to UL rating 94 V-0
terminals	screw-terminals
wire cross-section	4 mm <sup>2</sup> max.
enclosure code	IP 40 case IP 20 terminals

### dielectric test

2210 V all circuits to case	
3536 V measuring circuit and auxiliary voltage to output	
1330 V currents to each other and to voltages	
operating voltage	300 V (rated voltage phase to zero)
class of protection	II
measurement category	CAT III
pollution level	2
dimensions WxHxL	45 mm x 80 mm x 115 mm
weight	approx. 0.27 kg

## Inputs

input rating	sinusoidal AC current and sinusoidal AC voltage
input quantity	phase angle $\varphi$ (power factor)
<b>version</b>	

<b>E</b>	single phase AC
<b>D</b>	3-phase 3-wire balanced load system

### measuring ranges $\blacktriangleright$

-37° ... 0 ... 37°	corresponds to $\cos \varphi$ : cap 0.8 ... 1 ... 0.8 ind
-60° ... 0 ... 60°	corresponds to $\cos \varphi$ : cap 0.5 ... 1 ... 0.5 ind

rated input voltage $U_{EN}$ $\blacktriangleright$	rated input current $I_{EN}$ $\blacktriangleright$
65 V, 100 V, 110 V, 240 V, 400 V, 415 V, 440 V, 500 V	N/1 A N/5 A

operating voltage	519 V max.
modulation range	1.2 $U_{EN}$ or 1.2 $I_{EN}$
overload limits	1.2 $U_{EN}$ , 1.2 $I_{EN}$ continuously 2 $U_{EN}$ , 10 $I_{EN}$ max. 1 s
frequency range	48 ... 62 Hz $\blacktriangleright$
power consumption	approx. 0.25 mA each voltage circuit $I^2 \cdot 0.01 \Omega$ each current circuit

## Outputs

### current output

output current	$I_A$	load independent DC current (0 ... 20 mA) $\blacktriangleright$
rated current	$I_{AN}$	0 ... 20 mA or 4 ... 20 mA
load range	$R_A$	0 ... 10 V / $I_{AN}$
current limitation		to approx. 120% of end value to 100 ... 140% of end value on request $\blacktriangleright$

### voltage output

output voltage	$U_A$	impressed DC voltage (0 ... 10 V) $\blacktriangleright$
rated voltage	$U_{AN}$	0 ... 10 V or 2 ... 10 V
load	$R_A$	$\geq 4 \text{ k}\Omega$

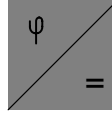
load error	$\leq 0.1\%$ based on 50% load change
residual ripple	$\leq 1\%_{\text{rms}}$
response time	approx. 500 ms
idling voltage	$\leq 15 \text{ V}$

Also, bipolar output quantities are possible using power supply units **H4** and **H5** (e.g. -20 ... 0 ... 20 mA).  $\blacktriangleright$

**If the voltage output only will be used, short-circuit the current output!**

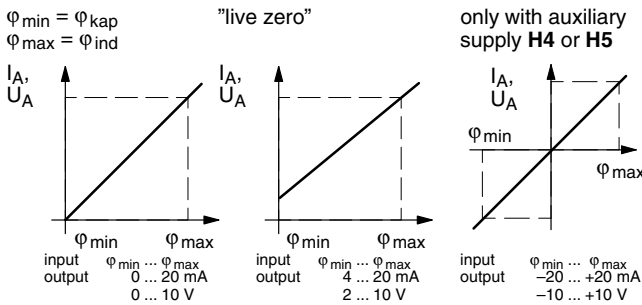
Input and outputs are galvanically isolated.

$\blacktriangleright$  for other ratings refer to **Extras**



## Transducers for Phase Angle (cos φ)

### Conversion Characteristics



### Auxiliary Supply

power supply unit	auxiliary voltage	power consumption
H1 *)	230 V~ (195 ... 253 V), 48 ... 62 Hz	< 7 VA
H2	115 V~ (98 ... 126 V), 48 ... 62 Hz	< 4 VA
H3	24 V= (20 ... 72 V)	< 3 VA
H4	20 ... 100 V= or 20 ... 70 V~	< 3 VA
H5	90 ... 357 V= or 65 ... 253 V~	< 4 ... 7 VA

\*) standard

Galvanic isolation between input, output and auxiliary voltage

### Accuracy at Reference Conditions

**accuracy** class 0.5 ( $\pm 0.5\%$  of end value)  
 temperature coefficient  $\leq 0.01\%/K$   
 valid for standard products and a life-period of 1 year maximum

#### reference conditions

input voltage  $U_{EN} \pm 0.5\%$   
 power factor  $\cos \varphi = 1$   
 frequency 50 ... 60 Hz  
 wave form sine wave, distortion factor  $\leq 0.1\%$   
 auxiliary voltage  $U_{HN} \pm 1\%$ , 50 Hz  
 ambient temperature  $23^\circ\text{C} \pm 1K$   
 warm-up  $\geq 5 \text{ min}$

### Environmental

climatic suitability climatic class 3 to VDE/VDI 3540 sheet 2  
 operating temperature range  $-10 \dots +55^\circ\text{C}$   
 storage temperature range  $-25 \dots +65^\circ\text{C}$   
 relative humidity  $\leq 75\%$  annual average, non-condensing

### Rules and Standards

DIN EN 60 529 Enclosure codes by housings (IP-code)  
 DIN EN 60 688 Electrical measuring transducers converting AC quantities into analog or digital signals  
 DIN EN 60 715 Dimensions of low voltage switching devices: standardized DIN rails for mechanical fixation of electrical devices in switchgears  
 DIN EN 61 010-1 Safety requirements for electrical measuring, control and laboratory equipment Part 1: General requirements

DIN EN 61 326-1 Electrical equipment for measurement, control and laboratory use – EMC requirements Part 1: General requirements  
 VDE/VDI 3540 sheet 2 Reliability of measuring and control equipment (classification of climates for equipment and accessories)

### Extras (on Request)

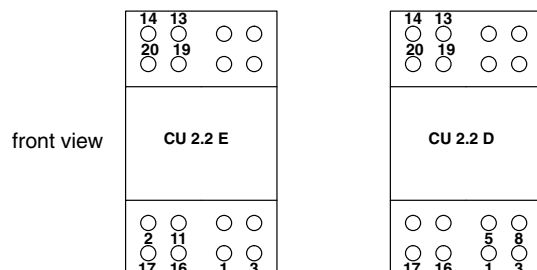
#### input ratings

measuring range to be specified in the range  $-180^\circ \dots 0 \dots 180^\circ$  corresponds to  $\cos \varphi$ :  
 ind. (output)  $-1 \dots 1 \dots -1$  cap. (output) (unique measuring range  $-175^\circ$  to  $+175^\circ$ )  
 rated current  $I_{EN}$  deviating from standard inputs ranging from 0 ... (0.5 A ...  $I_{EN}$  ... 5 A)  
 rated voltage  $U_{EN}$  deviating from standard inputs ranging from 0 ... (50 V ...  $U_{EN}$  ... 519 V)  
 frequency range on request

#### output ratings

output current limitation to 100 ... 140% of end value  
 switching output  
 RS232 and RS485 interface (to be used alternatively) to digitally inquire different measuring values

### Terminals



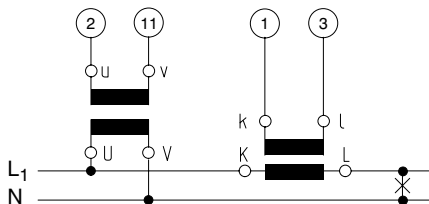
terminal	CU 2.2 E	CU 2.2 D
1	$I_E L_1$	$I_E L_1$
2	$U_E L_1$	-
3	$I_E L_1$	$I_E L_1$
5	-	$U_E L_2$
8	-	$U_E L_3$
11	$U_{EN}$	-
13	$U_A(+)$	$U_A(+)$
14	$U_A(-)$	$U_A(-)$
16	$U_H L_1(+)$	$U_H L_1(+)$
17	$U_H N (-)$	$U_H N (-)$
19	$I_A (+)$	$I_A (+)$
20	$I_A (-)$	$I_A (-)$

$I_E$  current input  
 $U_E$  voltage input  
 The numbers on the terminals conform to details in connection diagrams (refer to DIN 43 807).

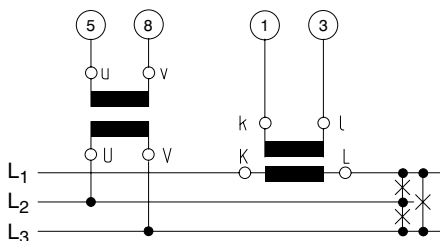
$I_A$  current output  
 $U_A$  voltage output  
 $U_H$  auxiliary voltage input

## Connections

input CU 2.2 E single phase AC



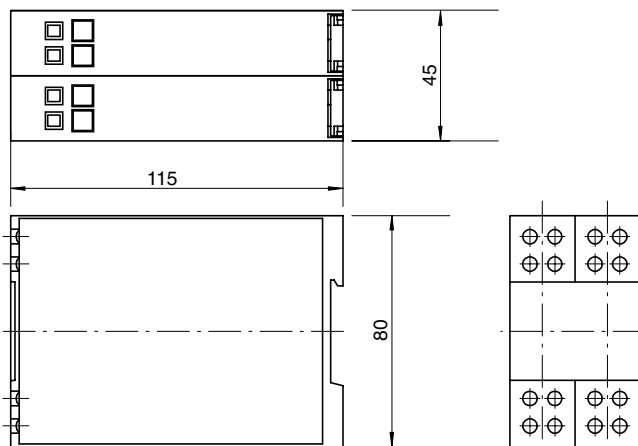
input CU 2.2 D 3-phase 3-wire balanced load



## Dimensions

side view

front view



(dimensions in mm)

ordering example

CU 2.2 D 250/5 400 2 F50 11 H1

phase angle transducer for 3-phase 3-wire balanced load system, input current 250/5 A, input voltage 400 V, measuring range  $-60^\circ \dots 0 \dots 60^\circ$ , frequency 50/60 Hz, output 0 ... 20 mA and 0 ... 10 V, auxiliary supply 230 V AC

## Ordering Guide

type	transducer
	<b>physical quantity</b>
CU 2.2	phase angle (power factor)
	<b>version</b>
E	single-phase AC
D	3-phase 3-wire system balanced load
	<b>current input</b>
N/1	1 A
N/5	5 A
xx	special current input **)
	<b>voltage input</b>
65	65 V
100	100 V
110	110 V
240	240 V
400	400 V
415	415 V
440	440 V
500	500 V
xxx	special voltage input **)
	<b>measuring range</b>
1	$-37^\circ \dots 0 \dots 37^\circ$ (corresponds to $\cos \varphi$ : cap 0.8 ... 1 ... 0.8 ind)
2	$-60^\circ \dots 0 \dots 60^\circ$ (corresponds to $\cos \varphi$ : cap 0.5 ... 1 ... 0.5 ind)
0	to be specified in the range $-180^\circ \dots 0 \dots 180^\circ$ **) (corresp. to $\cos \varphi$ (output): ind. $-1 \dots 1 \dots -1$ cap.) (unique measuring range $-175^\circ$ to $+175^\circ$ )
	<b>input frequency range</b>
F50	48 ... 62 Hz (50/60 Hz) *)
Fxxx	special frequency **)
	<b>output</b>
11	0 ... 20 mA and 0 ... 10 V
12	0 ... 10 mA and 0 ... 10 V
13	0 ... 5 mA and 0 ... 10 V
14	4 ... 20 mA and 2 ... 10 V
15	$-20 \dots 0 \dots 20$ mA and $-10 \dots 0 \dots 10$ V ***)
10	special output **)
	<b>auxiliary supply</b>
H1	AC 230 V (195 ... 253 V), 48 ... 62 Hz *)
H2	AC 115 V (85 ... 126 V), 48 ... 62 Hz
H3	DC 24 V (20 ... 72 V)
H4	DC 20 ... 100 V / AC 20 ... 70 V
H5	DC 90 ... 357 V / AC 65 ... 253 V

\*) standard

\*\*) on request, please clearly add the desired specifications.

\*\*\*) only available with H4 or H5

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– specifications subject to change without notice; date of issue 12/10 –

