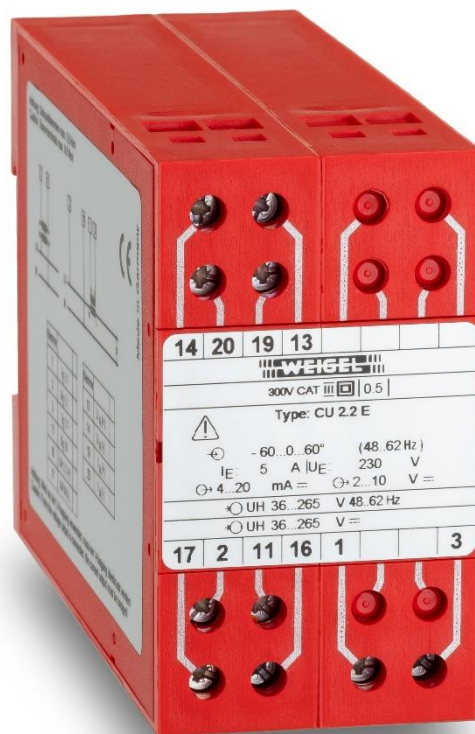


# Measuring transducer for Phase angle ( $\cos \varphi$ )

-for sinusoidal signals-



**CU 2.2 E**  
**CU 2.2 D**



## Application

The microprocessor controlled transducer CU 2.2 produce load independent DC current and DC voltage output signals proportional to the phase angle  $\phi$  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.

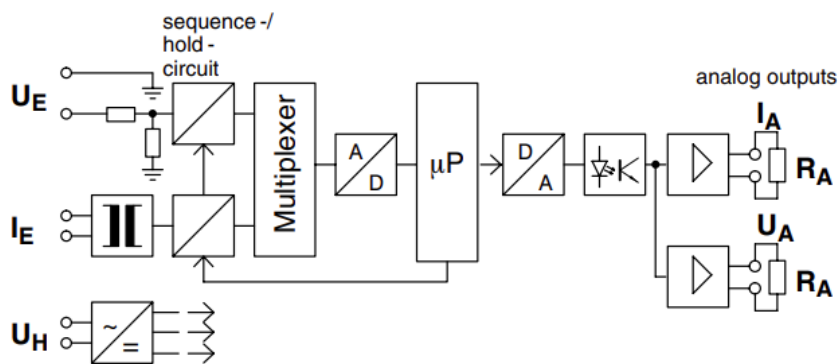
The transducers are designed to be mounted in machines/systems. Regulations for installation of electrical systems and equipment have to be observed.

## Operating 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  $\phi$  of the input signal.

## Block circuit diagram

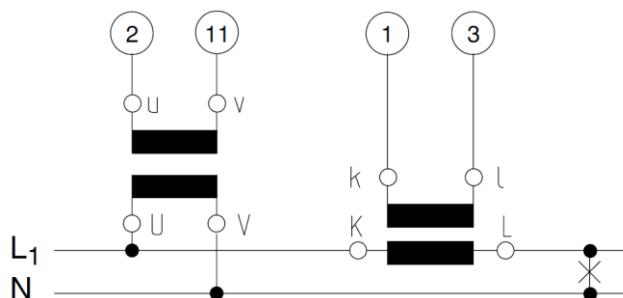


### Notes:

If one or both input variables are missing, the outputs of the transducer show the value for  $\cos \phi = 1$ .  
Input, outputs and auxiliary voltage are galvanically isolated from each other.

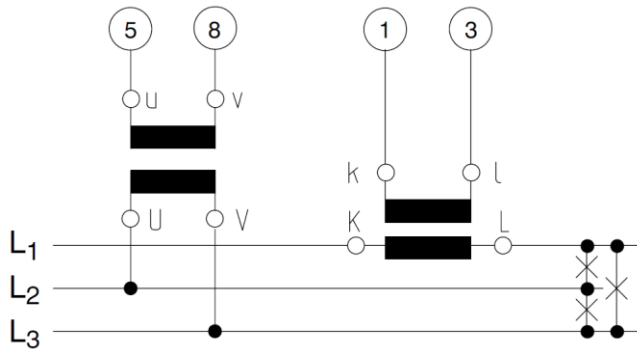
## Connections

### Input CU 2.2 E (single-phase AC network)



## Connections

Input CU 2.2 D (three-wire three-phase system balanced load)



## Input

Input rating	sinusoidal alternating current and alternating voltage	
Input quantity	Phase angle $\cos \varphi$ (power factor)	
Types	<b>CU E:</b> Single-phase AC network <b>CU D:</b> Three-wire three-phase network with the same load	
Measuring ranges	$-37^\circ \dots 0 \dots 37^\circ$ corresponds to $\cos \varphi$ : kap 0.8 ... 1 ... 0.8 ind $-60^\circ \dots 0 \dots 60^\circ$ corresponds to $\cos \varphi$ : kap 0.5 ... 1 ... 0.5 ind	
Rated input voltage $U_{EN}$	63.5 V, 100 V, 110 V, 240 V, 400 V, 415 V, 440 V, 500 V	
Rated input current $I_{EN}$	1 A, 5 A	
Operating voltage	max. 519 V (300 V CAT III)	
Overloads	current	voltage
Modulation range	1.2 $I_{EN}$	<b>or</b> 1.2 $U_{EN}$
Overload limits	1.2 $I_{EN}$ continuous	1.2 $U_{EN}$ continuous
	10 $I_{EN}$ max. 1s, 2 $U_{EN}$ max. 1s	
Frequency range	48 ... 62 Hz	
Power consumption	approx. 0.25 mA per voltage path $I^2$ : 0.01 $\Omega$ per current path	

## Outputs

### Current output

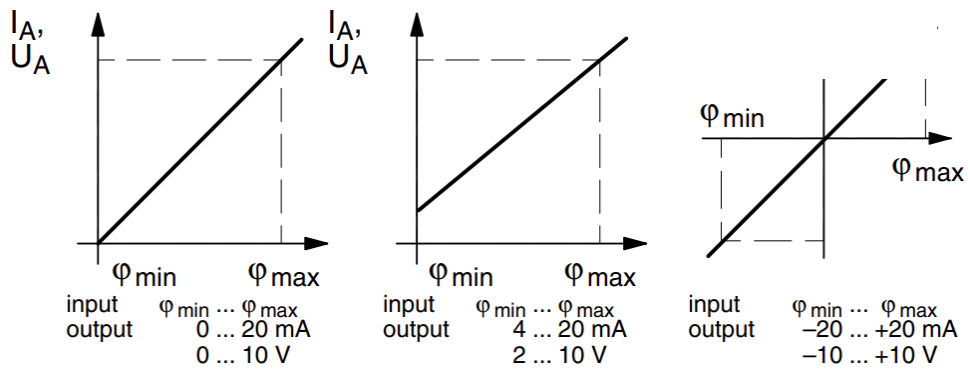
Output current $I_A$	impressed direct current
Rated current $I_{AN}$	0 ... 20 mA or 4 ... 20 mA
Burden area RA	0...10V / $I_{AN}$
Current limitation	approx. 120 % of end value

### Voltage output

Output voltage $U_A$	impressed direct voltage
Rated voltage $U_{AN}$	0...10 V or 2...10 V
Load RA	$\geq 4 \text{ k}\Omega$
Load error	$\leq 0.1 \%$ based on 50 % load change

residual ripple	$\leq 1\%$ eff
response time	approx. 500 ms
idling voltage	$\leq 15 \text{ V}$

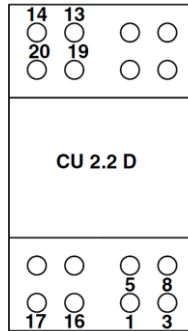
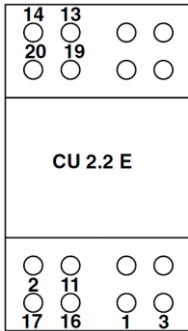
## Conversion Characteristics



## Auxiliary supply

Power supply	auxiliary voltage	power consumption
	20 ... 100 V= or 20 ... 70 V~	< 3 VA
	36 ... 265 V= or 36 ... 265 V~	< 7 VA

## Terminals



Klemme	CU 2.2 E	CU 2.2 D
1	$I_E L_1$	$I_E L_1$
2	$U_{EL1}$	–
3	$I_E L_1$	$I_E L_1$
5	–	$U_{EL2}$
8	–	$U_{EL3}$
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 correspond to the information in the connection diagrams (according to DIN 43 807).

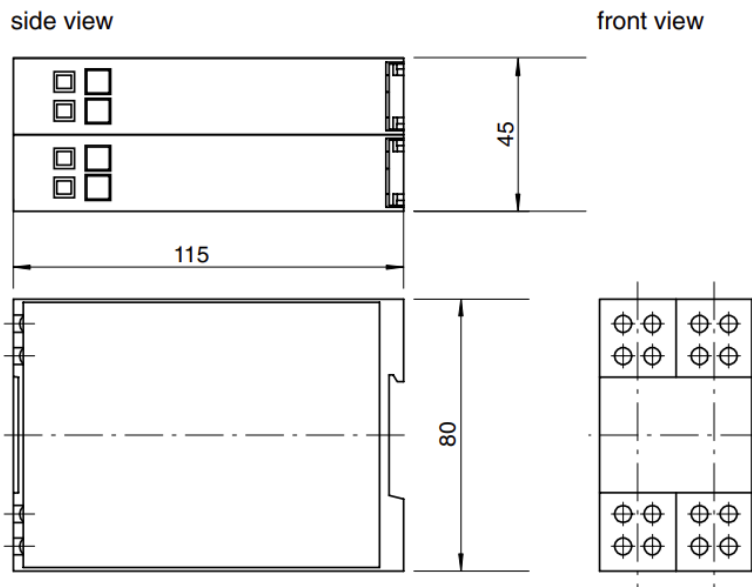
$I_A$  current output  
 $U_A$  voltage output  
 $U_H$  auxiliary voltage input

### Danger:

The two outputs must not be connected to each other!

If only the voltage output is connected, terminals 19 and 20 (current output) must be bridged!

## Dimensions



(dimensions in mm)

(symbolic illustration)

## General technical data

Design	Surface-mounted housing for snap mounting on DIN rail TH 35 according to DIN EN 60 715
Case material	ABS/PC red self-extinguishing according to UL 94 V-0
Connections	Screw terminals, max. torque 0.8 Nm
Wire cross section	max. 4 mm <sup>2</sup>
Protection class	IP 30 housing IP 20 terminals
Test voltages	Measuring circuit and auxiliary voltage against output: 3510 Vrms 5 sec Measuring circuit and auxiliary voltage against housing: 3510 Vrms 5 sec Output against housing: 2210 Vrms 5 sec
Working voltage	300 V (nominal line voltage phase-zero)
Protection class	II
Measurement category	CAT III
Pollution level	2
Sealevel of the place of use	max. 2000 m above sea level

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## Special versions (on request)

Measuring ranges	-37 ° ... 0 ... 37 ° (corresponds to $\cos\varphi$ : cap 0.8 ... 1 ... 0.8 ind)  or to be specified in the range of -180 ° ... 0 ... 180 ° (corresponds to $\cos\varphi$ : Ind -1 ... 1 ... -1 cap, unique measuring range -175 ° up to +175 °)
Rated current	different from standard inputs in the range of 0.5 A ... IEN ... 5 A
Rated voltage	different from standard inputs in the range of 50 V ... UEN ... 519 V

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## Accuracy at reference conditions

<b>Accuracy class</b>	0.5 ( $\pm 0.5$ % of end value)
Temperature drift	$\leq 0.02$ % / K, valid for standard version and max. 1 year

### Reference conditions

Input voltage	UEN $\pm 0.5$ %
Power factor	$\cos\varphi = 1.0$
frequency	50...60 Hz, sine wave, total harmonic distortion $\leq 0.1$ %
Auxiliary voltage	UHN $\pm 2$ %, 48...62 Hz
Ambient temperature	23 °C $\pm 1$ K
Warm-up time	$\leq 5$ min

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## Environmental

Climate suitability	Climate class 3 according to VDE/VDI 3540 sheet 2
Working temperature range	-10...+55 °C
Storage temperature range	-25...+65 °C
Relative humidity	$\leq 75$ % annual average, no condensation Only use the device indoors

## Ordering Guide

Order number	Measuring transducer for phase angle ( $\cos \varphi$ )
GMU09-1	CU 2.2 E single-phase AC network
GMU09-2	CU 2.2 D three-phase – three-wire system, balanced load
	<b>Current input</b>
1	1 A
5	5 A
9	special current input
	<b>Voltage input</b>
1	57,5 V
2	63,5 V
3	100 V
4	110 V
5	115 V
6	120 V
7	230 V
8	240 V
9	special voltage input
A	380 V (max. 300 V nominal mains voltage phase-zero)
B	400 V (max. 300 V nominal mains voltage phase-zero)
C	415 V (max. 300 V nominal mains voltage phase-zero)
D	440 V (max. 300 V nominal mains voltage phase-zero)
E	500 V (max. 300 V nominal mains voltage phase-zero)
	<b>Measuring ranges</b>
A	-37 °...0...37 °
B	-60 °...0...60 °
C	according to specification in the range from -180 °...0...180 °
	<b>Frequency range input</b>
2	48...62 Hz
9	special frequency
	<b>Output</b>
1	0...20 mA and 0...10 V
2	0...10 mA and 0...10 V
3	0...5 mA and 0...10 V
4	4...20 mA and 2...10 V
5	-20...0...20 mA and -10...0...10 V
9	special output
	<b>Auxiliary supply</b>
4	DC 20...100 V / AC 20...70 V
5	DC 36...265 V / AC 36...265 V
	<b>Manufacturing certificate</b>
0	without
1	with

\*) standard

Order example:

Transmitter for Sinusoidal AC and AC Voltage CU2.2 E, Current Input: 1 A, Voltage Input: 120 V, Measurement Range: -37 °... 0...37 °, frequency range: 50/60 Hz, output: 4-20 mA, auxiliary power: 24 V, without test protocol.

Item number according to number code: GMU09-116A2440



## Guidelines and standards

Directive 2014/30/EU	EMC Directive
Directive 2014/35/EU	Low Voltage Directive
Directive 2011/65/EU	RoHS Directive
DIN EN 60529	Protection types through housing
DIN EN 60688	measuring transducer for converting alternating current variables into analog or digital signals
DIN EN 60715	Dimensions of low-voltage switching devices
DIN EN 61010-1	Standardized mounting rails for the mechanical fastening of electrical devices in switchgear
	Safety regulations for electrical measuring, control, regulation and laboratory devices
	Part 1: General requirements
DIN EN 61326-1	Electrical measuring, control, regulating and laboratory devices - EMC requirements -
	Part 1: General requirements
	61000-4-3 Evaluation criterion B

## Safety regulations and general information



- Check the relevant details for installation of the Measuring transducer against the nameplate and the terminal connections to ensure that they are suitable for your area of application.
- The Measuring transducer may only be installed by qualified electricians.
- The Measuring transducer must be checked for transport damage before commissioning and may only be put into operation if it is in perfect condition. In case of safety-relevant damages the device may not be put into operation.



- Ensure that the connections match the terminal connections.
- Circuits must be fused for the maximum permissible currents.
- When commissioning and using the Measuring transducer, the applicable laws, regulations and provisions for the respective area of use and application must be observed.
- The Measuring transducer is not suitable for use in environments with explosive gases or explosive substances.
- The Measuring transducer may only be operated in the environmental and ambient conditions specified in the data sheet. Direct sunlight must be avoided.



- The Measuring transducer may only be installed on non-flammable materials. The applicable fire protection regulations in the area of use and application must be observed.
- Due to the operating voltage, the distance or insulation from other devices must be observed in accordance with the applicable regulations.



- Stranded cables are only permitted if they are fitted with wire end sleeves.
- Connecting cables must be laid away from electromagnetic interference fields.
- Dangerous electrical voltage (more than 75 V DC or more than 50 V AC) can lead to electric shock and burns.
- The Measuring transducer must always be disconnected when fitting, removing, installing, uninstalling or troubleshooting.
- The Measuring transducer is maintenance-free when used as intended.
- Improper use and non-compliance with these safety instructions can lead to serious injury or even death.

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