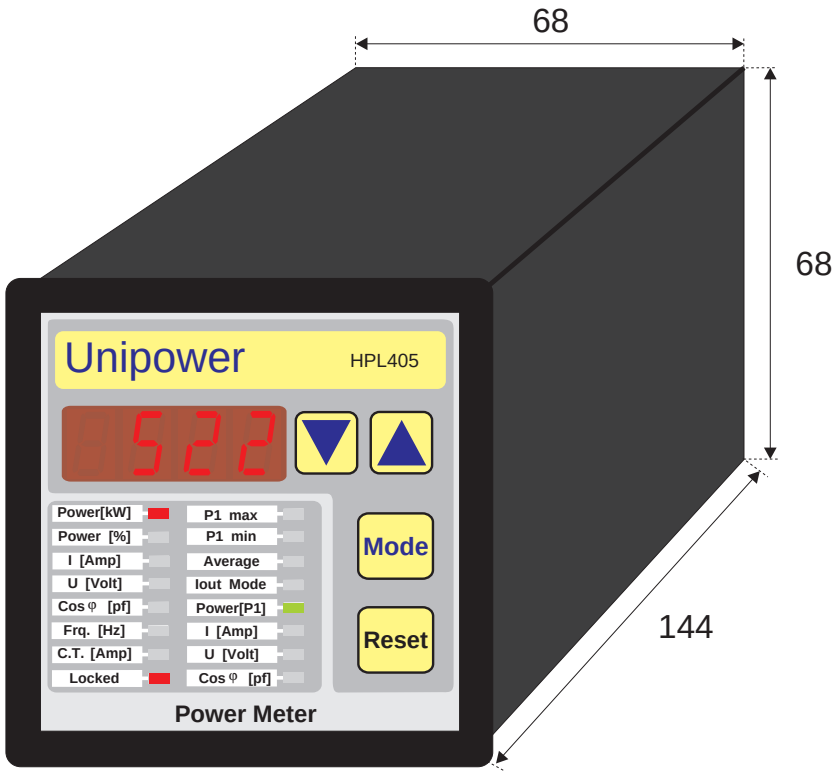
Unipower HPL405A-3P 3 x 400 Volt

Technical information Version 2.4



The Concept

The Unipower HPL405A is a member of a family of ***Intelligent Power-Control Units***, which is base upon the latest advance in the Microcontroller technology. The unit calculates and measures true power consumption from the formula:

$P = \sqrt{3} \times U \times I \times \cos\varphi$.

Besides kW the unit also measures true RMS voltage (U, Volt), RMS current (I, Amp.), power factor and mains frequency (f, Hz). The current and voltage in each phase are digitized (sampled) at a rate of 10kHz. The digitized values are used to calculate all the measurement variables. The unit measures on all three phases, which is necessary when working with asymetric loads.

Features

- Three phase asymetric kW measurement.
- Measurement/Display of
  - Power (kW or kW%) 2 %
  - Voltage (V) 1 %
  - Current (A) 1 %
  - Power factor 3 %
  - Frequency (Hz) 0.5 %
- 2- or 3- phase measurement method.
- Peak detection of all measurement variables (Max & Min)
- Analogue output 4-20mA proportional to either kW,voltage, current or power factor.
- Scaling of analogue output for kW.
- Remote control of analogue output.

Technical Specifications

Mechanical

Housing: Noryl.
Mounting: Panel mounting. DIN 43700
Dimensions: D 143 x B 72 x H 72 mm.
Protection Class: IP54.
Operating Temperature Range: -15 - +55 ℃.
Weight: App. 500g.
CE mark to: EN50081-2, EN50082-2, EN61010-1

Electrical

Power Supply: 3 x 330 - 3 x 450 Volt AC.
Current Range: External N/1 or N/5 current converter.
Power factor Range: 0-1.
Frequency Range: 45 - 65 Hz.
Consumption: Power supplied from measurement curcuit, 3 VA.
Analogue output: 4 -20 mA, max 400 ohm.
The output is electrically isolated from the measurement system.

Programming & Display

Mode	Function	Variable	▼	▲	Display	Default
Power(kW)	kW display		Min. kW	Max. kW	kW	
Power(%)	kW (%P1) display		Min. kW (%P1)	Max. kW (%P1)	kW (%P1)	
I (Amp.)	AC-current display		Min. I [Amp]	Max. I [Amp]	I (Amp.)	
U (Volt)	AC-voltage display		Min. U [Volt]	Max. U [Volt]	U (Volt)	
Cosφ (pf)	Cosφ/P.F.display		Min. P.F.	Max. P.F.	Power factor	
Frq. (Hz)	Frequency display		Min. frequency	Max. frequency	Frequency	
C.T.Amp.	Converter size/type	Int./n-1/n-5 (see table)	Decrease	Increase	1 - 5000 Amp.**	int, 1 Amp.
Locked	Programming lock	On, Off			"On/Off"	"On"
P1 max	P1 max define	kW = 20 mA setpunkt	Decrease	Increase	20 mA setpoint	0.658 kW
P1 min	P1 min define	kW = 4(0) mA setpunkt	Decrease	Increase	0 mA setpoint	0 kW
Average	Averaging interval	0.1 - 5.0 Sec.	Decrease	Increase	0.1 - 5.0 sec.	0.5 sec.
Iout Mode	Analog output mode	kW(%)/I(A)/U(V)/P.F.			"Iout"	kW(%)

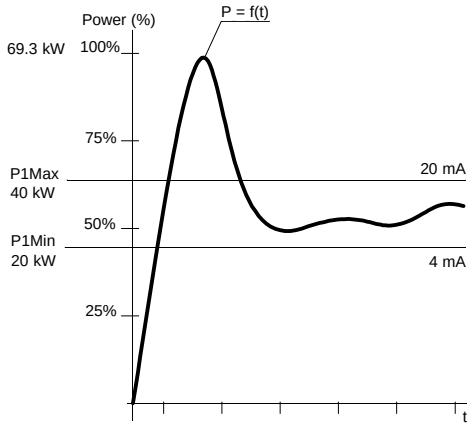
(**) The display changes between converter size and type

The HPL405A is operated by four keys located on the frontpanel. The "mode"-key is used to change the display from showing kW to display/alter one of the other parameters. All the parameters and their programming ranges are shown in the table above. The led on the front shows which parameter is chosen. Before a parameter is changed the unit must be **'unlocked'**. This is done by activating the 'mode'-key until the led **'Locked'** is lit. The display now shows **'On'** and when both 'arrow'-keys are activated continously for 5 seconds the display shows **'off'** and the unit is programmable. The led **'Locked'** flashes when the unit is unlocked. The unit is locked again when the 'reset'-key is activated or when 5 minutes has elapsed. Parameters are saved into EEPROM. For the measurement variables the 'arrow'-keys are used to show **peakvalues** (max./min.). If no key has been activated for 5 seconds the display returns to the position programmed into Iout. The peakvalues are preset to actual values during power-on or by activating the 'reset'-key.

Note: The function of the keys is repeated if the keys are continously activated.

Function.

The drawing shows a possible power consumption curve of an AC-motor immediately after power has been applied to the motor. Current range (C.T. Amp), output function (Iout Mode), P1max, P1min and averaging interval is programmable from the front panel. When current range has been selected from the front panel (**C.T. Amp**) the maximum power range is readable in the mode **P1max**. The mode **P1min** displays zero immedately after current range has been selected. It is now possible to scale **P1max** downwards and **P1min** upwards to create a narrow power band. The analogue output signal (Iout = 4 - 20 mA) is now proportional to the power consumption within the band. The drawing shows the HPL405A programmed to use a 100/1 current converter, which corresponds to a maximum power consumption of 69.3 kW. **P1max** is then set to 40 kW and **P1min** to 20 kW. Now the analogue output signal equals 20 mA at 40 kW and 4 mA at 20 kW. This function is for instance used in the ice-cream industry. The power consumption of the motor, which drives the ice through the freezing tunnel, is more or less proportional to the viscousity of the ice. The power measurement may be used to keep the ice at constant quality. The mode **Power(%)** on the front panel always shows 100%, when the power consumption is equal to or greater than **P1max** and zero when the consumption is equal to or less than **P1min**.



The Measurement Principle

The power is calculated individually for each phase every half period:

$$P_{lx} = \frac{1}{n} \cdot \sum_{j=1}^{n} U_{lx}(j) \cdot I_{lx}(j)$$

The total power for 3-phase measurement is calculated as:

$$P_T = P_{l1} + P_{l2} + P_{l3}$$

If 2-phase measurement (ARON-connection) is used the power is calculated as:

$$P_T = \frac{(P_{l1} + P_{l2}) \cdot 3}{2}$$

The RMS-voltage for each phase is calculated:

$$U_{lx} = \sqrt{\frac{1}{n} \cdot \sum_{j=1}^{n} U_{lx}(j)^2}$$

The displayed voltage is averaged between the three phases:

$$U_T = \frac{U_{l1} + U_{l2} + U_{l3}}{3}$$

The RMS-current for each phase similar to the voltage. The current is either displayed as the sum or the average of the three phases when working with 3-phase measurement (See function of Dip switch no. 3):

$$I_T = I_{l1} + I_{l2} + I_{l3} \qquad or \qquad I_T = \frac{I_{l1} + I_{l2} + I_{l3}}{3}$$

while working with 2-phase measurement (ARON-connection) the current always reflects the average of the three phases

$$I_T = \frac{I_{l1} + I_{l2}}{2}$$

The power factor is calculated as:

$$P_f = \frac{P_T}{U_T \cdot I_T}$$

Measurement Ranges.

Analogue Output (Iout) 4 - 20 mA:

Power(%P1)

kW = P1min => Iout = 4 mA

kW = P1max => Iout = 20 mA.

P1max = √3 x 400 x N			
N/1, N/5 [Amp]	P1max	N/1, N/5 [Amp]	P1max
5 Amp.	3.46 kW	400 Amp.	277 kW
10 Amp.	6.93 kW	500 Amp.	346 kW
12.5 Amp.	8.66 kW	600 Amp.	416 kW
20 Amp.	13.9 kW	700 Amp.	485 kW
25 Amp.	17.3 kW	750 Amp.	520 kW
30 Amp.	20.8 kW	800 Amp.	554 kW
40 Amp.	27.7 kW	900 Amp.	624 kW
50 Amp.	34.6 kW	1000 Amp.	693 kW
60 Amp.	41.6 kW	1200 Amp.	831 kW
75 Amp.	52.0 kW	1250 Amp.	866 kW
100 Amp.	69.3 kW	1500 Amp.	1040 kW
125 Amp.	86.6 kW	2000 Amp.	1390 kW
150 Amp.	104 kW	2500 Amp.	1730 kW
200 Amp.	139 kW	3000 Amp.	2080 kW
250 Amp.	173 kW	4000 Amp.	2770 kW
300 Amp.	208 kW	5000 Amp.	3460 kW

I (Amp)

I = 0.0 Amp => Iout = 4 mA

3 watt-meter method:

The dip switch 3 selects whether sum or average current is output on the analogue output:

SW3 OFF:

When the sum of the current in the three phases = 3 * C.T. Amp => Iout = 20 mA.

eks: A 100 Amp. current converter is selected.

The sum of the current in all three phases must equal 300 Amp. before the unit outputs 20 mA

SW3 ON:

When the average current in the three phases = C.T. Amp => Iout = 20 mA.

2-wattmeter method (ARON connection):

When the average current on all three phases = C.T. Amp => 20 mA.

U (Volt)

U = Nominal voltage + 10% => Iout = 20 mA

eks. 400 Volt + 10% = 440 Volt

Power Factor

P.F. = 0.0 => Iout = 4 mA

P.F. = 1.0 => Iout = 20 mA.

Bemærk: Hvis strømmen bliver mindre end 10% af strømmåleområdet , viser apparatet "----" for Power Factor.

Dip. switch usage.

In order to acces the dip switch the four screws on the back plane must be removed and pulled out of its housing. The switch is located on the front panel PCB between the two rows of LED's.

	ON	OFF
SW4	Calibrate	
SW3	Average	Sum
SW2	Aron connection	3-Wattmeter
SW1	Remote control	

Note! SW3 has no function if SW2 is ON
SW4 must always be OFF

Default setting

Pulse width.

The user is able to set the pulse width for the kWh-pulse. Factory settings are 100ms, but may be set between 30ms and 1000ms in 10ms steps.

After having unlocked the unit (Se paragraph on page 2) activate the "mode" key until the Frequency-LED is lit. Press both arrow-keys simultaneously until a number is flashing on the display. This number is the pulse width in ms and may be altered by activating the arrow-keys. When finished press the Reset-key and the unit returns to showing kW.

Remote control.

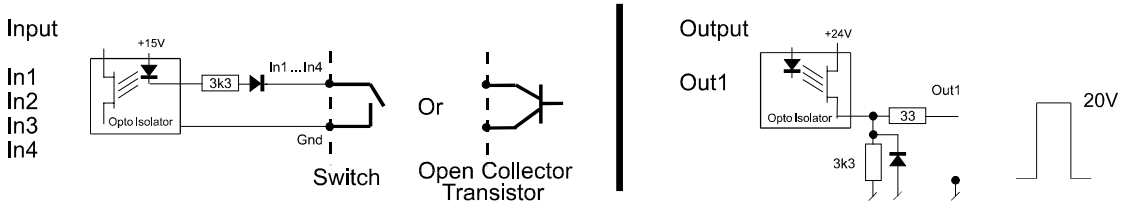
If dip switch SW1 is switched 'On' the HPL405A may be remote controlled from a PLC as shown in the table to the right. The Iout function is not programmable from the front panel in this mode. When the signals In1 to In4 changes the PLC must wait 50ms before the new measurement variable is valid.

Display handling during remote control:

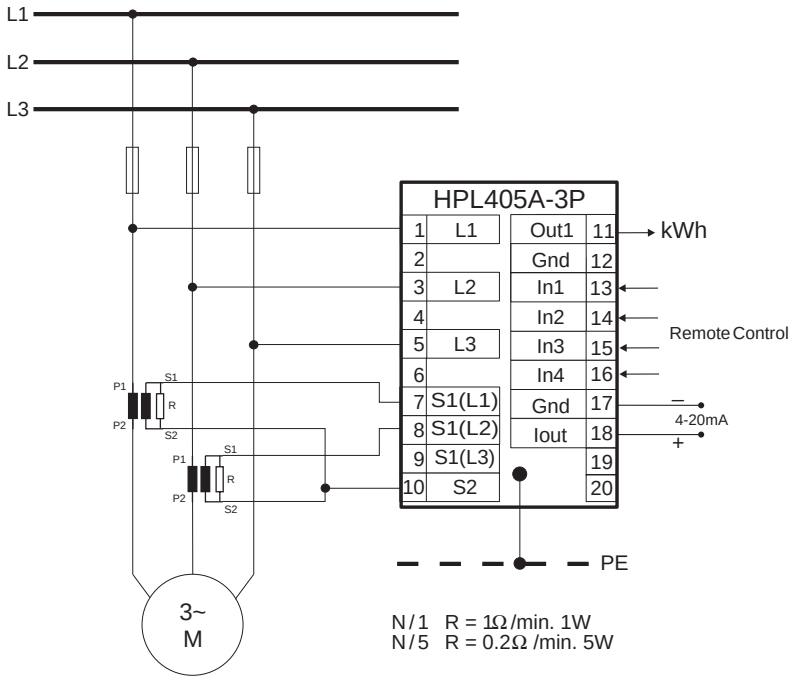
When remote control is selected the display reflects the remote selection. If the input is 4_{HEX} the display shows the power consumption of L1 alone. This is the only way possible to display power, current, voltage and power factor individually for the three phases. The display may be overridden by the use of the 'Mode' key. When no key has been activated for app. 5 seconds, the display returns to reflect the remote input.

In4	In3	In2	In1	Hex	Iout
Off	Off	Off	Off	0	Σ%P1
Off	Off	Off	**On**	1	ΣI[A]
Off	Off	**On**	Off	2	ΣU[V]
Off	Off	**On**	**On**	3	ΣP.F.
Off	**On**	Off	Off	4	L1-%P1
Off	**On**	Off	**On**	5	L1-I[A]
Off	**On**	**On**	Off	6	L1-U[V]
Off	**On**	**On**	**On**	7	L1-P.F.
On	Off	Off	Off	8	L2-%P1
On	Off	Off	**On**	9	L2-I[A]
On	Off	**On**	Off	A	L2-U[V]
On	Off	**On**	**On**	B	L2-P.F.
On	**On**	Off	Off	C	L3-%P1
On	**On**	Off	**On**	D	L3-I[A]
On	**On**	**On**	Off	E	L3-U[V]
On	**On**	**On**	**On**	F	L3-P.F.

Iout remote-kontrol via In1 ... In4

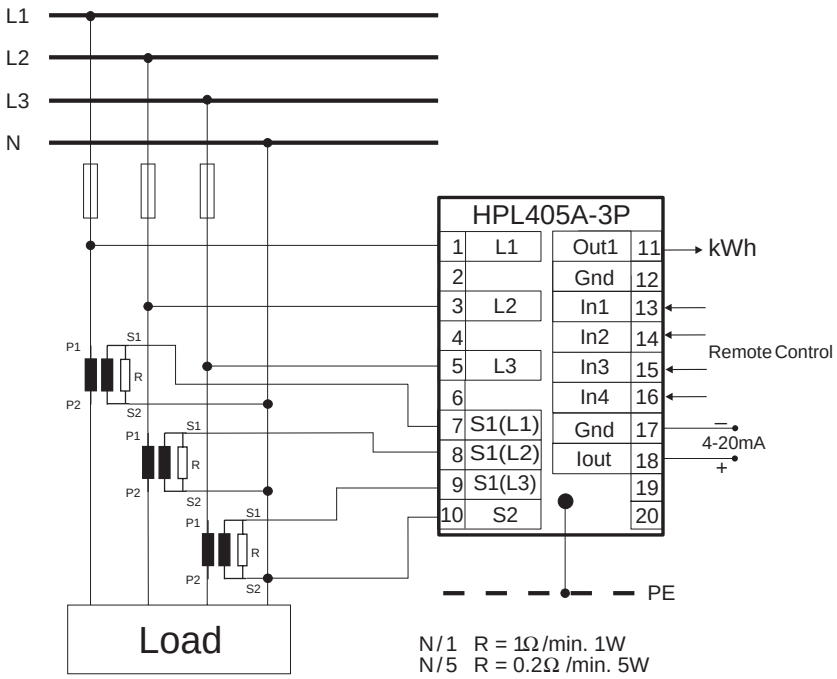


Aron connection (2 watt-meter method)



N/1 R = 1Ω/min. 1W
N/5 R = 0.2Ω /min. 5W

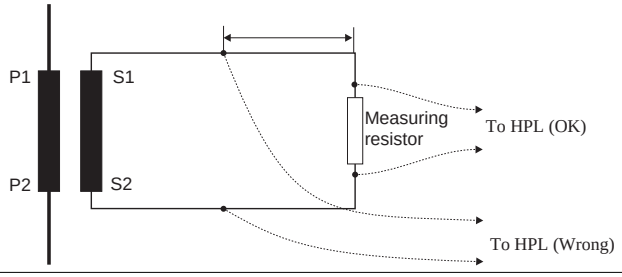
3 watt-meter method



N/1 R = 1Ω/min. 1W
N/5 R = 0.2Ω /min. 5W

Mounting of measuring resistors.

To avoid error in the kW signal due to resistance in the wires to the measuring resistors (1Ω or 0.2Ω), please keep these wires as short as possible. The drawing to the right shows the correct way of mounting the measuring resistors.



If you need further information about the HPL-family of ***Intelligent Power-Control Units*** and its ability to solve your problems, please do not hesitate to contact us.

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