Display & Programming.

Mode	LED	Function	Parameter	▼	▲	Display	Default
kW [%] / kW	Red	Measurement in %		Min. Peak	Max. Peak	kW [%]	
kW [%] / kW	Green	Measurement in kW		P2	P1Max	kW	
Locked	Red/Green	Operating lock	On / Off	Decrease	Increase	On / Off	On
Ts	Red	Start timer	0.0 - 999 sec.	Decrease	Increase	Ts[Sec]	2.0
Tr	Red	Respons timers	0.0 - 999 sec.	Decrease	Increase	Tr [Sec]	0.1
Parameter	Red	Parameter access	P00 - P15	Decrease	Increase	Parameter no.	
Limit 1	Red/Green	Setpoint limit 1	6 - 99 %	Decrease	Increase	Setpoint [%]	80
Limit 2	Red/Green	Setpoint limit 2	6 - 99 %	Decrease	Increase	Setpoint [%]	20
Range I/U	Red	Current range	0.5 - 600/5A	Decrease	Increase	Current [A]	10
Range I/U	Green	Voltage range	100 - 575 Vac	Decrease	Increase	Voltage [V]	400*
Relay 1	Red	Rel ay polarity 1	n.inv / inv	Decrease	Increase	n.in / in	n.in
Relay 2	Red	Relay polarity 2	n.inv / inv	Decrease	Increase	n.in / in	n.in

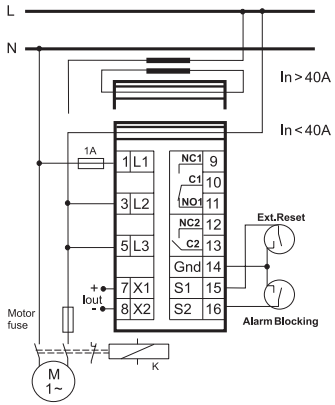
* Depends on order specfications

The HPL500 is programmed by the use of only three keys located on the front panel, see paragraph about programming on page 2. All directly accessible parameters as well as their adjustable range are listed in the table above. Parameters are stored in EEProm. If no key is activated for approx. 30 seconds, the display defaults to kW [%]. Note that the function of the keys is repeated if held down continously.
Access to the parameter list is found under the field „Parameter". The display shows P00, which using the arrow-up key must be changed to the desired number (see table to the right). Upon pressing the „Mode" key the value of the selected parameter is shown. It may now be changed using the arrow keys. To store the new value press the „Mode" key and the unit returns to the parameter list. Pressing the „Reset" key instead of the „Mode" key discards the new value and keeps the old value and the unit returns to showing kW%.
Note: When displaying setpoints a max-limit is displayed with a red LED and a min-limit with a green LED. This only applies to setpoints and not alarms, which are always displayed with a flashing red LED.

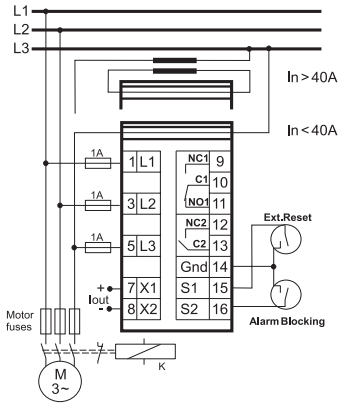
Nr.	Parameter	Range
P01	Type limit 1	Off, Lo, Hi
P02	Type limit 2	Off, Lo, Hi
P03	Auto Shut Down	Off, On
P04	Hysteresis limit 1	Off, 1 - 50%
P05	Hysteresis limit 2	Off, 1 - 50%
P06	Maksimum shaft power	40 - 100% of P*
P07	Motor efficiency	50 - 100%
P08	Iout = P1 or P2	P1, P2
P09	Pmin (Iout = 0(4)mA)	0 - 50%
P10	Pmax (Iout = 20mA)	50 - 100%
P11	Type of Iout	0-20mA, 4-20mA
P12	Iout mode	n.inv, inv.
P13	Damping filter	Off, On
P14	S2 Select	nor, SPC
P15	Factory settings	Par, rSt-dEF

Underlined values are factory settings
* Value is set in kW in the range equivalent to 40 - 100% of the measuring range (P)

Note: Current must be measured in the L3 phase (Terminal 5).
Direction is not important



Single phase - connect phase to both L2 & L3
Connection to a single phased load



Connection to a three phased load

Unipower

HPL500
Version 1.0

Technical information — English edition

Technical Specifications

Mechanical spec.

Housing
Makrolon 8020 (30% GV), UL94V-1 (house).
Makrolon 2800, UL94V-2 (connector + front).

Mounting
Snap-on construction for 35mm DIN-rail or wall mounting.

Protection class
IP40 (house).
IP20 (connector).

Operating Temperature range:
-15 - +50 °C surrounding air.

Weight: Approx. 250g.

Dimensions: D 110 x W 56 x H 75 mm.

Terminal tight. torque: 7lbs/in, 0.79Nm
Use 60/75 copper (CU) wire only

Electrical spec.

Supply / measuring voltage
1x100 - 1x400Vac ±10%.
3x100 - 3x575Vac ±10%

Current range
Internal: 0.5, 1, 2.5, 5, 10, 20, 30 & 40A
External: With N/5A converter (50-600A)

Accuracy: Class 2.

Consumption: 2 VA

Frequency range: 45 - 65 Hz

Relay spec.
250 VAC/5 Amp.

Analogue output
0(4)-20mA, max load 400Ω galvanically isolated from the measuring system.

CE-mark to:
EN61326-1, EN61010-1



Generally

Unipower HPL500 is equipped with a specially developed power supply for use from 100V - 575V - both single phased and three phased. Mains voltages in the whole world is hereby covered with one unit.
HPL500 also measures currents up to 40A without the use of an external current converter.
As all Unipower HPL-modules the HPL500 naturally integrates the functions necessary to establish an efficient and compact supervision or control; Start timer, reaction timer, setpoints etc.
For setup simplicity the HPL500 includes peak detectors on the power measurement.
Additionally also true kW may be displayed as well as the entered kW range.

Generally

The measurement is based on a fast four quadrant multiplication of current and voltage making the HPL500 capable of measuring the exact power consumption also on frequency inverters. Measurement: **$P = \sqrt{3} \times U \times I \times \cos\varphi$.**

Programming:
The HPL500 is programmed by the use of only three keys placed on the front panel. The „Mode"-key is used to select one of the programmable parameters. When a parameter is selected, the value may be changed using the two arrow keys. To store the new value, press the „Mode"-key, and the value is stored in EEProm. If the „Reset"-key is pressed the old value is kept and the unit returns to showing kW%.
Please note: The unit is equipped with a key lock which must be unlocked before a parameter can be changed. This is done by selecting „Locked" and then changing the display value from „On" to „Off" with the arrow keys.

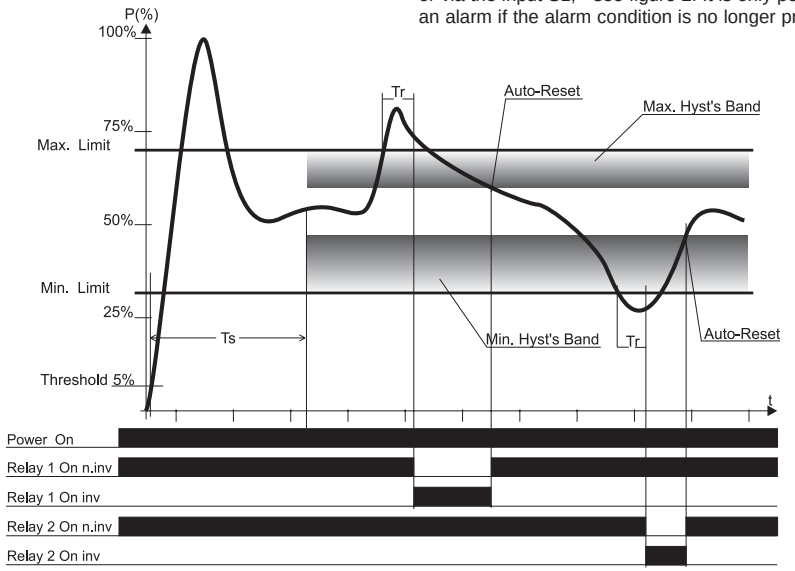
Voltage range:
The HPL500 is equipped with a newly developed power supply unit making the unit applicable for voltages from 100V to 575V - single phased as well as three phased. Simply set up the connected voltage via the front.

Measuring range:
The unit contains a current converter up to 40A. Internally the range may be selected from 0.5A to 40A in 8 steps. If a larger range is required an external N/5A CT must be used. As for the voltage - just select the CT via the front and the HPL500 computes the kw range as **$P = \sqrt{3} \times U \times I$**. The readout as well as the setup of setpoints are relative to this range. Ex:

1A and 400V gives a range of P = 0,69kW = 100%

Functions

The figure below shows a typical consumption curve for an AC-motor (e.g. pump) immediately after power has been applied to the motor. Below the curve a bar shows the state of the relays.



Ts: Start timer
The programmable start timer (Ts) is used to avoid alarms at motor start. When the power consumption exceeds 5%, Ts is activated. After expiration of Ts limits, hysteresis, Tr etc will become active. If the power consumption drops below 5%, the supervision is disabled again.

Setpoints:
The HPL500 includes two independent limits user selectable as max- or min-limits (P01 & P02).
Determining the setpoints may be done in two ways:
1. Theoretically:
Md = P2 x 60 / 2πn, where
Md: Torque where an alarm is required.
P2: Corresponding shaft power.
n: Revolutions in rev./min.
P1 = P2 + Po (or from the efficiency curve for the motor).
Setpoint [%]= 100 x P1/P, where
P: Measuring range for HPL500.
2. Peak detectors:
Run the motor at normal load and read the peak values by activating the arrow keys in the kW[%]-mode. Place the Max. limit suitable above and the Min. limit suitable below. The Peak detectors may be reset by activating the relevant arrow key and at the same time pressing the Reset key. They are also reset by the power rising through the 5% threshold. Therefore after a power down, or motor resstart

Tr: Reaction timer
In the figure to the left it is shown, how the reaction timers (Tr) are activated upon exceeding the setpoints. Tr is used to avoid alarms, unless the setpoint has been exceeded for a certain period of time. If Tr is set to 0, the reaction time equals the time constant in the measuring circuit of approx. 40ms.

Reset of alarms:
Alarms may be reset with the „Reset" key on the front plate or via the input S1, - see figure 2. It is only possible to reset an alarm if the alarm condition is no longer present.

Inhibit of alarms (Input S2):
Input S2 has two functions: *1.* Just as Ts blocks for alarms during startup, an alarm can be inhibited by connecting S2 to Gnd. *2.* Limit select - see special functions.

Auto Shut Down:
If the motor is stopped deliberately a min limit will give an alarm unless Auto Shut Down is activated (P03). Exceeding the min limit is hereby ignored as long as the measurement drops below Threshold before Tr expires.

Hysteresis:
From the figure to the left it is evident how possible Maximum- and Minimum- hysteresis bands are placed relative to the limits; The hysteresis band always lies above a Min. limit and below a Max. limit. Hysteresis is activated, when an alarm is generated and hysteresis is enabled in the HPL500 setup (P04 & P05).

Analogue output
The HPL500 features a current output configurable as either 0-20mA or 4-20mA (P11). If the output is in a control loop it can be inverted (P12). Using the shaft power settings (P06 & P07), the analogue output may reflect the shaft power P2 (P08).

Zoom:
The analogue output may be scaled to represent a limited range of the power consumption (P09 & P10). This only affects the analogue output - and not the % readout or the setpoints.

Filter:
When dealing with fluctuating power signals a built-in damping filter (P13) may be used to advantage. It has a time constant of approx. 250ms.

Relays:
The unit is equipped with two relays; Relay 1 is a change-over switch which always is related to limit 1. Relay 2 is a close / break - switch, which always is related to limit 2. The polarity of the relays may be inverted independently of each other.

Readout:
The HPL500 displays - like all other HPL units - percentage of the power range. In addition kW may be displayed as well as the power range. If the shaft power settings are used HPL500 displays computed shaft power percentage of the rated shaft power.

Factory settings:
The unit may always return to the factory settings (P15), if a „fresh start" parameters set up is desirable.

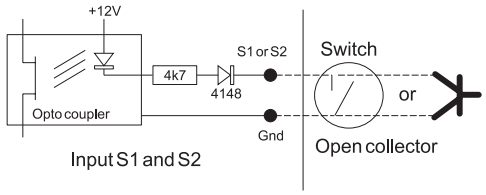


Figure 2

Special functions

1. Limit select by input S2
In some applications it can be useful to have two selectable limits. Examples: Supervising two speed motors used in cranes, Dalandermotors etc.

To change the function of S2 from normal [nor] (Alarm inhibit) to special [SPC] (Limit select) select (P14) and [SPC]. This causes both limits to become max.-limits (Hi) with setpoints of 80% for limit 1 and 60% for limit 2. Settings may of course be changed if desired. Now the unit works as follows:

With S2 open Limit 2 is used and with S2 closed Limit 1 is used. To avoid false alarms a new Ts is activated each time the S2 input changes state from open to closed or from closed to open.

In this mode (Limit select) it is also possible to select separate current range for each limit. Both current ranges may be set independently of the selected limit.

2. Shaft power P2:
HPL500 can compute shaft output power P2 as input power (P1) minus motor losses (P0) (heat, friction, copper losses, windage etc)
Therefore; P2 = P1 – P0

If you wish to use this feature, during the setup procedure you have to enter two parameters P06 (max shaft power P2max [kW]) and P07 (efficiency η at full load [%]).
Note! Please do not confuse efficiency η with Cosφ. In some motors they may be similar but in others there are big differences.

P2max is the kW rating on the motor plate or in the manufacturers' data, which may also state Motor efficiency η. If not then you will have to calculate it. To do this first calculate P1max using the formula;

$P1Max = \sqrt{3} \times U \times I(max) \times \cos\varphi$.

Example:
400V Motor rated 3.5kW, 7A full load current, Cosφ 0.85
So; P1Max = √3 x 400V x 7A x 0.85 = 4122W = 4.122kW

Motor efficiency $\eta = P2max/P1max$.

From the example above we know the motor is rated at 3.5kW (P2max) and that P1max = 4.122kW. Therefore 3.5 /4.122 = 84.9%, say 85%, and this is parameter P07.

This is the motor efficiency AT FULL LOAD. However Motor losses decrease as the motor load decreases, therefore η changes. To calculate accurate and meaningful Shaft Output Power from Idle to full load power it is necessary to regulate η according to the actual motor load in real time. HPL500 does this by using data modelled from typical motors across their entire power range. Your motor's data may differ slightly from the model used in HPL500 but the resulting Shaft Output Power calculation will still be useful to you.

Note! If these settings are used all setpoints are related to the shaft power (P2) and not to the input power (P).