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 timer	0.0 - 999 sec.	Decrease	Increase	Tr [Sec]	0.1
Parameter	Red	Parameter access	P00 - P13	Decrease	Increase	Parameter no.	
Limit 1	Red/Green	Setpoint limit 1	6 - 99 %	Decrease	Increase	Setpoint [%]	80
Limit dP	Red	Setpoint limit dP	1-50%	Decrease	Increase	Setpoint [%]	10
Limit dP	Green	Setpoint limit dU	1-99V	Decrease	Increase	Setpoint [V]	10
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	Relay 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

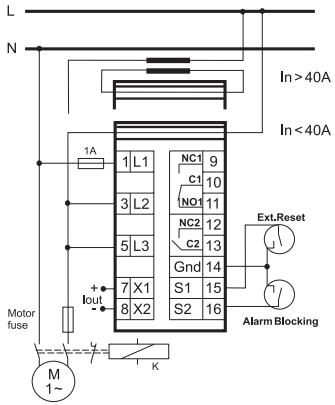
* Depends on order specfications

The HPL530 is programmed by the use of only three keys located on the front panel. 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 [%]. 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 discards the new value and keeps the old value.
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.
Note: The setpoint for a max-limit is displayed with a red LED and a min-limit with a green LED. This only applies to setpoints. Alarms are always displayed by flashing red LED.

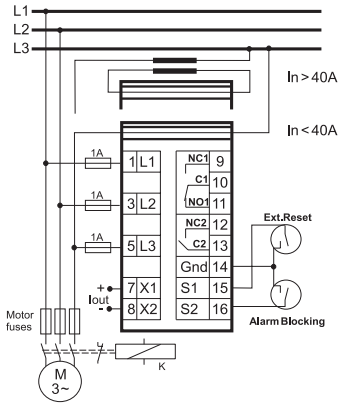
Nr.	Parameter	Range
P01	Type limit 1	Off, Lo, Hi
P02	Type limit dP	Off, +P, ±P
P03	Auto Shut Down	Off, On
P04	Hysteresis limit 1	Off, 1 - 50%
P05	Maksimum shaft power	40 - 100% of P*
P06	Motor efficiency	50 - 100%
P07	Iout = P1 or P2	P1, P2
P08	Pmin (Iout = 0(4)mA)	0 - 50%
P09	Pmax (Iout = 20mA)	50 - 100%
P10	Type of Iout	0-20mA, 4-20mA
P11	Iout mode	n.inv, inv.
P12	Damping filter	Off, On
P13	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 HPL530
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 ranges.
3x100 - 3x575Vac, 17 ranges
Ranges selectable via face plate
Current range
Internal: 0.5, 1, 2.5, 5, 10, 20, 30 & 40A
External: With N/5A converter (50-600A)
Ranges selectable via face plate
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
UL certified:
UL508, File E194022
GOST-R certified

Generally

Unipower HPL530 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. HPL530 also measures currents up to 40A without the use of an external current converter.
As all Unipower HPL-modules the HPL530 naturally integrates the functions necessary to establish an efficient and compact supervision or control; Start timer, reaction timer, setpoints etc.
The HPL530 features a special „shock load" supervision algorithm in addition to a standard Max/min limit.
For setup simplicity the unit includes peak detectors on the power measurement.

Generally

The measurement is based on a fast four quadrant multiplication of current and voltage making the HPL530 capable of measuring the exact power consumption also on frequency inverters. Measurement: **$P = \sqrt{3} \times U \times I \times \cos\varphi$.**

Voltage range:
The HPL530 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 HPL530 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

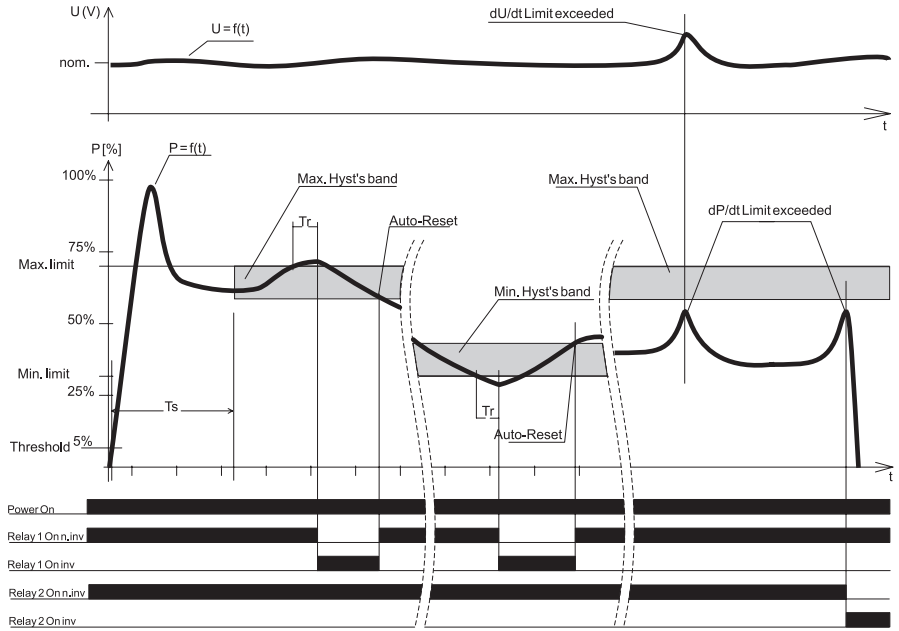
The figure below shows a typical consumption curve for an AC-motor (e.g. pump) immediately after power has been applied to the motor. Below the curve a bar shows the state of the relays.

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 HPL530 includes two independent limits - a normal max or min limit and a special „shock load" limit (dP/dt).
The limit type is set with parameter P01 for the max/min limit and parameter P02 for the dP/dt limit (See paragraph to the right for details).
Determining the setpoint for the max / min limit 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 HPL530.
2. Peak detectors:
Run the motor at normal load and read the peak values by activating the arrow keys in the kW[%]-mode. Place a Max. limit suitable above and a 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 restart.

The setpoint for the dP/dt limit will have to be set with the peak detectors - a theoretical approach is not possible here. The dP/dt peak may be read by pressing both arrow keys in the main kW% display mode. The setpoint should then be placed appropriately above.

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 when connected to Gnd will inhibit all alarms. Connecting S1 to Gnd will inhibit any dP/dt alarms - but will not have effect on max- or min-alarms.

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- or Minimum- hysteresis band is placed relative to the limit;
The 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 HPL530 setup (P04).

Analogue output
The HPL530 features a current output configurable as either 0-20mA or 4-20mA (P10). If the output is in a control loop it can be inverted (P11). Using the shaft power settings (P05 & P06), the output may reflect the shaft power P2 (P07).

Zoom:
The analogue output may be scaled to represent a limited range of the power consumption (P08 & P09). 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 (P12) 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 dP. The polarity of the relays may be inverted independently of each other.

Readout:
The HPL530 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 HPL530 displays computed shaft power percentage of the rated shaft power.

Factory settings:
The unit may always return to the factory settings (P13), if a „fresh start" parameters set up is desirable.

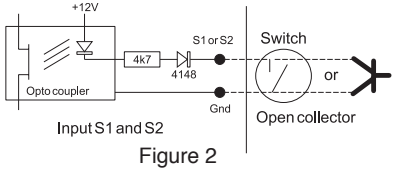


Figure 2

Special functions

1. Shock load supervision (dP/dt):
The principle in shock load supervision is to monitor changes rather than the actual measurement - i.e. compare to previous measurements. The unit uses a „window" of 160ms as basis of comparison against the actual power measurement.

Supervision may be done on either positive changes alone (+dP) or both positive and negative changes (±dP). This is set up with parameter P02.

Before a useful supervision can be performed monitoring the motor voltage is required; A voltage increase/decrease typically results in a square idle power increase/decrease. To take this into account the unit measures the voltage (dU/dt) in parallel with the power. The impact on the power is application specific and must be set up via a dU setpoint.

The dU setpoint must be set so that under normal conditions the setpoint is not exceeded. A detected dU/dt is displayed by lighting the dP limit LED green. For a detailed description please refer to our application note AN530.

2. Shaft power P2:
HPL530 can compute shaft output power P2 as input power (P1) minus motor losses (Po) (heat, friction, copper losses, windage etc)
Therefore; P2 = P1 – Po

If you wish to use this feature, during the setup procedure you have to enter two parameters P05 (max shaft power P2max [kW]) and P06 (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 3.3kW, 7A full load current, Cosφ 0.85
So; P1Max = √3 x 400V x 7A x 0.85 = 4122W = 4.122kW

Motor efficiency η = P2max/P1max.

From the example we know the motor is rated at 3.3kW (P2max) and that P1max = 4.122kW. Therefore η = 3.3 / 4.122 = 80.0%, and this is parameter P06.

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 it is necessary to regulate η according to the actual motor load in real time. HPL530 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 HPL530 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).