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 - 99.9 sec.	Decrease	Increase	Ts[Sec]	2.0
Setpoint	Red	Setpoint	6 - 99 %	Decrease	Increase	Setpoint [%]	80
Parameter	Red	Parameter access	P00 - P15	Decrease	Increase	Parameter no.	
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*
Reverse time	Red	Reverse cycle duration	0.1-25.0sec.	Decrease	Increase	Time [sec]	10.0
Reverse count	Red	Allowed attempts	OFF, 1-25	Decrease	Increase	Attempts[]	5

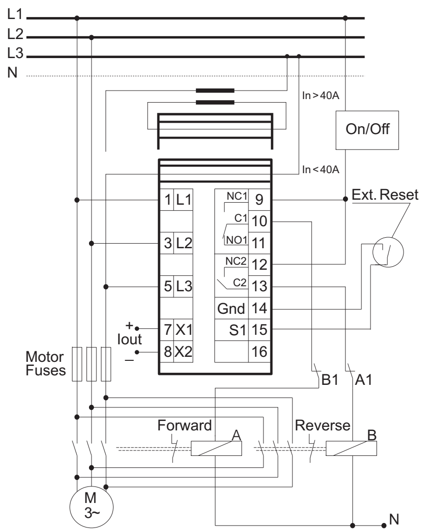
* Depends on order specifications

The HPL540 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: The direction LEDs will light green when active. A flashing green LED indicates either pause or not active (Measurement below threshold). An active response timer is indicated with a lit red LED. Alarms are always displayed with a flashing red LED. An alarm detected in the reverse direction is shown with a falshing red reverse LED and an alarm caused by exceeding the allowed number of attempts is indicated with a flashing red forward LED.

Nr.	Parameter	Range
P01	Respons time (Tr)	0.0 - 25.0s (0.1)
P02	Pause	1.0 - 25.0s
P03	Maksimum shaft power	40 - 100% of P*
P04	Motor efficiency	50 - 100%
P05	Iout = P1, P2 or Alert	P1, P2, Alt
P06	Pmin (Iout = 0(4)mA)	0 - 50%
P07	Pmax (Iout = 20mA)	50 - 100%
P08	Type of Iout	0-20mA, 4-20mA
P09	Damping filter	Off, On
P10	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



The schematic to the left shows a typical wiring for a conveyor protection with automatic reversal.

The relay contacts A1 and B1 are used for improved security only to avoid simultaneous start of both forward and reverse contactor.

The On/Off switch must be implemented according to usual design rules so as to prevent accidental start of machinery by a reset of the HPL540. With this in mind - please **note:** If the On/Off switch is left in the „On“ position the machinery will run forward immediately after resetting the HPL540. For security reasons the main supply should be removed from the machinery until the fault is cleared.

The analogue output (Iout) may be used as an alarm output in which case it may be connected directly to an external 12V low power relay (ex. Finder 34.51.7.012.0010 or Schrack V23092-A1012-A301).

When measuring currents above 40A an external CT is needed and should be connected as shown in the schematic - i.e. the secondary of the CT wired through the HPL540.

Unipower HPL540
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 HPL540 is equipped with a specially developed and patented power supply for use from 100V - 575V - both single phased and three phased (Patent no. PR177225). Mains voltages in the whole world is hereby covered with one unit. HPL540 also measures currents up to 40A without the use of an external current converter.
The Unipower HPL540 is specifically developed for load protection of conveyance machinery; when a conveyor transport is blocked the HPL540 reverses the transport direction in order to automatically recover the fault. The number of reversals as well as the reverse time are programmable.
For setup simplicity the HPL540 includes peak detectors on the power measurement.

Generally

The measurement is based on a fast four quadrant multiplication of current and voltage making the HPL540 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 HPL540 is equipped with a newly developed and patented 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 HPL540 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 driving a conveyour machine. The curve illustrates the behavior of the HPL540 during a blocking sequence. 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 HPL540 includes one max-limit common to both the forward and reverse direction.

Determining the setpoint 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 HPL540.

2. Peak detectors:

Run the motor in forward mode at normal load and read the max peak value by activating the arrow up key in the kW[%]-mode. Place the setpoint suitable above. 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

Tr: Reaction timer

In the figure below it is shown, how the reaction timer (Tr) is activated upon exceeding the setpoint. 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.

Reverse time:

After a blockage the HPL540 automatically reverses for a certain time (see figure below).

Reverse count:

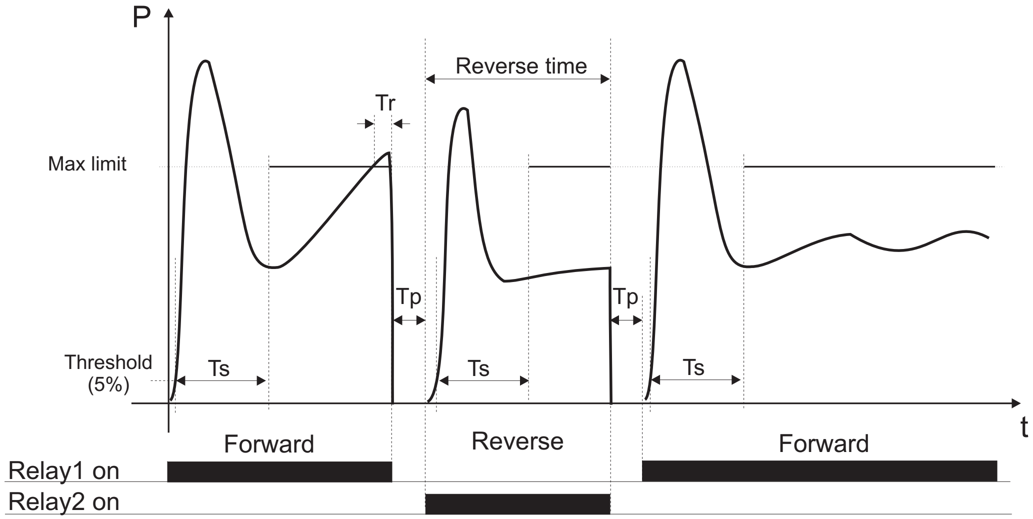
If the recovery attempts should be limited it is possible to programme how many times the HPL540 should try before giving up and signal for a technician to check the equipment (P05). Possible settings are up to 25 - or indefinitely (OFF) if HPL540 should perform continous forward / reverse.

Tp: Pause

To avoid damage to the equipment when changing direction the HPL540 includes a programmable pause timer. It is common for both directions.

Reset of alarm:

An alarm 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.



Analogue output

The HPL540 features a current output configurable as either 0-20mA or 4-20mA (P08). The output may reflect either power or act as an alarm output (P05). Using the shaft power settings (P03 & P04), the analogue output may reflect the shaft power P2 (P05). If used as alarm output the output is 0mA under normal conditions and 20mA during alarms.

Zoom:

The analogue output - if reflecting power - may be scaled to represent a limited range of the power consumption (P06 & P07). 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 (P09) 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 forward. Relay 2 is a close / break - switch, which always is related to reverse. The polarity of the relays is fixed to non-inverted.

Readout:

The HPL540 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 HPL540 displays computed shaft power percentage of the rated shaft power.

Factory settings:

The unit may always return to the factory settings (P10), if a „fresh start“ parameters set up is desirable.

Special functions

1. Automatic fault recovery cycle

The following description refers to the figure to the left. All symbols and references are shown on the figure.

After a power on the unit is in the forward mode - i.e. Relay 1 is on and Relay 2 is off. Upon starting the motor the power consumption exceeds the Threshold (5%) and the start timer (Ts) is activated. After expiration of Ts the supervision becomes active.

As seen from the figure the machine is blocked by some material (a piece of wood etc.) causing the power consumption to rise and eventually exceed the setpoint (Max limit). This starts a response timer (Tr). After Tr has expired the automatic fault recovery cycle is initiated starting with stopping the machine by deactivating the forward relay (Relay 1) as seen in the figure.

To avoid damage to the equipment a pause timer (Tp) is inserted. Expiration of the pause starts the reverse cycle by activating the reverse relay (Relay 2). This mode is active for the duration of the reverse time, provided the machinery isn’t blocked in the reverse direction as well. Should this occur (Not depicted in the figure) the HPL540 will detect it by an excess of the setpoint and deactivate the reverse relay immediately. After the reverse timer has expired the reverse relay is deactivated and a new pause is inserted (Tp).

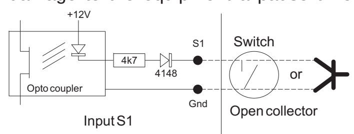


Figure 2

Now it is tested if the allowed number of trials has been exceeded (Reverse count). If this is the case no forward mode is activated, but an external signal is given (if enabled P05) to signal that help is needed.

Upon a succesful completion of the reverse cycle (No excess of the allowed number of reverse trials) the HPL540 commences a new forward action by activating the forward relay.

The number of reverse trials will be automatically reset after a certain time dependent on Ts, Reverse time and Pause.

2. Shaft power P2:

HPL540 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 P03 (max shaft power P2max [kW]) and P04 (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 = $\sqrt{3}$ x 400V x 7A x 0.85 = 4122W = 4.122kW

Motor efficiency η = P2max/P1max.

From the example above we know the motor is rated at 3.3kW (P2max) and that P1max = 4.122kW. Therefore 3.3 /4.122 = 80% and this is parameter P04.

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. HPL540 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 HPL540 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).