Application note AN540

Task

Automatic recovery of jammed obstacles.

Description

Supervision and control of forward / reverse cycles in applications where a jam may be removed automatically.
The unit single handedly reverses the motor when a certain load is exceeded. Pause and duration is programmable.

Unipower

For this task the Unipower HPL540 is used.

Setup

HPL540 has a limit with a specially developed control algorithm for reversing of motors. The unit has two output relays; One for forward direction (Always Relay 1) and one for reverse (Always Relay 2).

Voltage Range must be set to the nominal voltage for the motor.

Current range should be selected so that the rated motor current is covered.

Start timer (Ts) must be set large enough to filter out the start up current for the motor. If set too small, an alarm will occur at start up. If set too large, damage to equipment might occur if an alarm condition is present at start up. So please set Ts just large enough for the motor to be at nominal speed when Ts expires. This accounts for both forward and reverse.
Note: On every start of the motor – this being forward as well as reverse – the start timer is activated.

Response timer (Tr) must be set according to the need for intervention due to overload. Typically values below 0.5 seconds are applicable for overload protection, but an exact value can not be given here.

Setpoint could be set using the peak detectors; Leave the motor running at maximum acceptable load and read the max-peak. The setpoint should be assigned a value appropriately above.

Reverse time will need to be set high enough for any jammed obstacles to be cleared so that a new attempt can be made to permanently let the obstacle pass – if this is the purpose of the application. In general this timer must be set so that the equipment can make a reasonable attempt to free a jammed obstacle. Setting it too low will lower the possibility of a successful attempt. Setting it too high will probably only waste time.

Reverse count is the number of attempts the HPL540 will try to automatically recover from a jammed obstacle. If the HPL540 continues to measure an overload upon reaching this number it will give up and signal for a technician to check what is causing the jam. This “give up” – alarm is signaled via the analogue output. See **analogue output** below.
The counter is reset after a certain time without reversals according to an implemented algorithm.
An extra feature using this reverse count parameter is to make the HPL540 perform continuous forward / reverse cycles without signaling for “help”. Setting the reverse count to “Inf” (Infinite) will do just this.

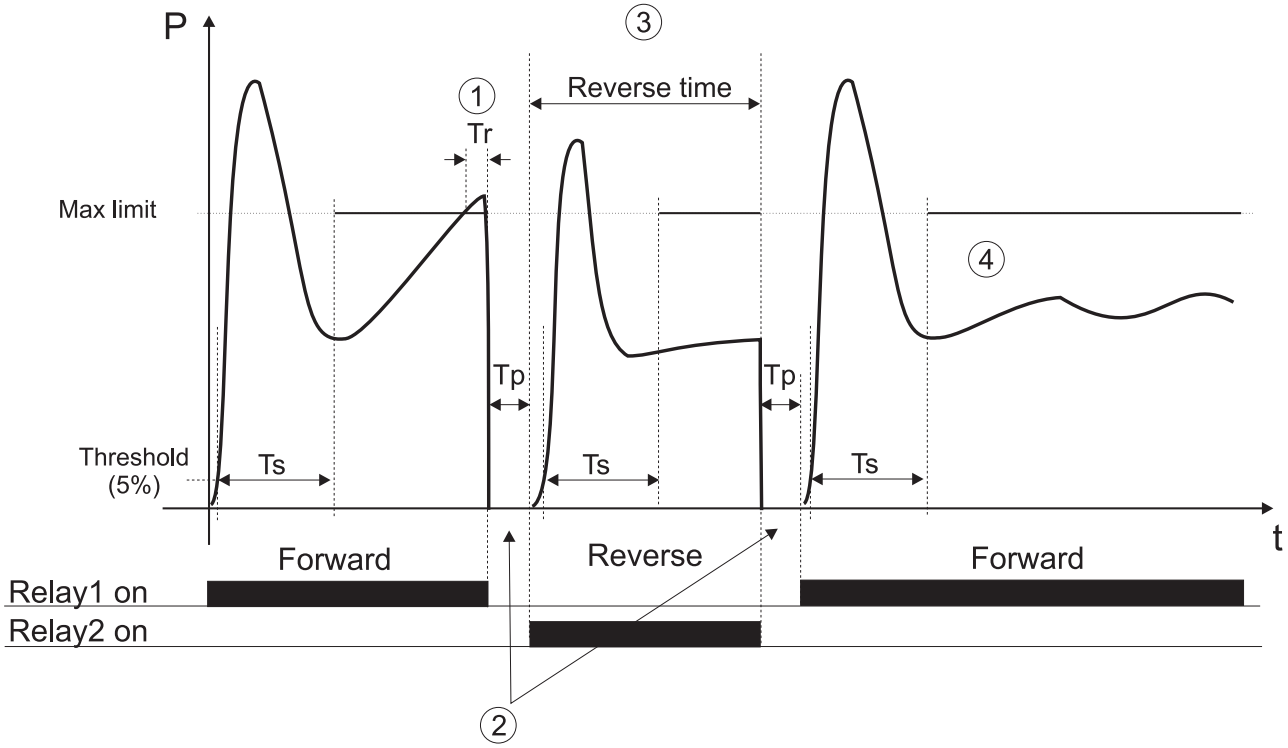
Pause (P02) should be set just long enough for the equipment to be at full stop before direction is changed. Setting this parameter too short will cause damage to the equipment since a direction change will occur while the motor and equipment is still running. This setting is shared for both direction changes.

Analogue output (P05) may be configured to alert for help if automatic recovery cannot be performed (see **reverse count** above). If this parameter is set to "Alt" the HPL540 will set the analogue output to 20mA during alert. Under normal conditions the analogue output will be 0mA.

Mode of operation

The following figure shows the capabilities of the HPL540.

At the bottom of the figure the state of the relays is shown above which the course of the power measurement can be seen.



At point (1) a blockage in the forward direction is detected – the set point is exceeded. This causes the HPL540 to deactivate Relay 1 and hereby shut down the motor. Before changing direction the pause timer is started – shown at points (2). Upon expiration of the pause timer Relay 2 is activated and the reverse cycle is initiated. Point (3) shows the duration of the reverse timer. When it expires Relay 2 is deactivated and the pause timer is started followed by activation of Relay 1. Now the forward direction is active again and at point (4) it is clear that the obstacle causing the jam has been removed, since no overload is detected at this point.

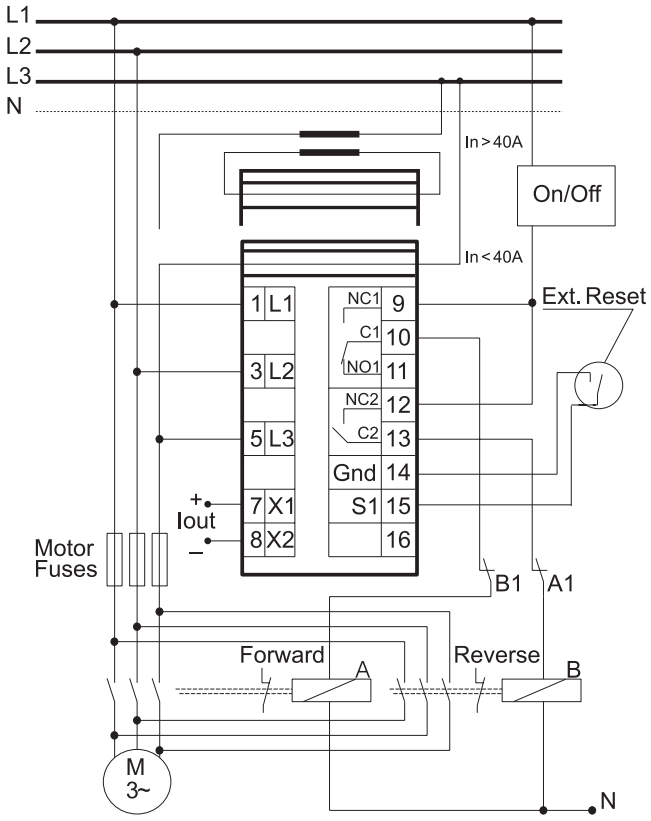
Should the overload remain during reversal the motor is stopped immediately and an alarm is signaled. Now the HPL540 is unable to clear the obstacle automatically and intervention from a technician is needed. The generated alarm may be reset by pressing the reset key or by activating the external input S1.

Explanation of the symbols:
Max limit: Setpoint at which an overload is detected
Reverse time: Duration of the reverse cycle
Threshold: Point where control / supervision is started. Automatically initiates the start timer upon motor start
Tp: Pause timer – duration of the pause before direction change
Tr: Response timer – makes the HPL540 ignore possible spikes in the measurement
Ts: Start timer – used to filter out the start up current from the control cycle

Connection

The schematic below shows how the HPL540 may be connected to solve the task. It is important that the required safety precautions are taken when wiring the reversal control.

Be sure to connect relay 1 for forward control and relay 2 for reverse.



The following explanation of the precautions taken is not exhaustive and should only be taken as guidelines.

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.