Technical Note 077

ACH580 E-Clipse Underload detection

Underload detection in bypass

Many building automation systems (BAS) require a proof-of-flow detection for certain applications. This indication, also known as broken belt detection, can then be used to verify that a fan or pump is providing flow to the conditioned space. Technical Note 053 has a detailed description for the ACH580 series base drive.

This Technical Note will address proof-of flow when operating in bypass. This E-Clipse feature provides the same functionality often used in the base drive. The underload detection feature creates an alert before a problem becomes a serious issue. In a fan application, early detection of a broken belt can prevent equipment damage (frozen coil) caused by loss of air circulation. In a pump application, this could indicate a broken coupling or a significant leak.

The traditional hardware device of choice is to add a current sensing relay. With this relay installed on one output wire to the motor, a technician from the BAS company can adjust the trip level to indicate when the motor is not loaded, based on the motor FLA. This additional hardware and installation add cost. An obvious, but often overlooked advantage is that this feature is standard in all E-Clipse bypass packages. That means less hardware and associated costs for the customer.

Underload detection

Measuring motor current is the most common method to prove flow in bypass mode. An induction motor running at full speed without any load, only draws magnetizing current. That value is approximately 30% of motor FLA. However, below 66% speed, Figure 1 shows very little difference in motor current between full-load and no-load conditions. Since the motor is always at 100% speed in bypass mode, any trip setting between no-load and full-load can be used.

For the application shown in Figure 1, the differentiation of loaded vs unloaded becomes detectable when the current is approximately 12 to 13 amps. Therefore, 15 amps or 50% of FLA would be a good value for detection. Setting the level to 50% will ensure that an underload is detected. This current-based detection method is fine for motors that always run at full speed across-the-line.

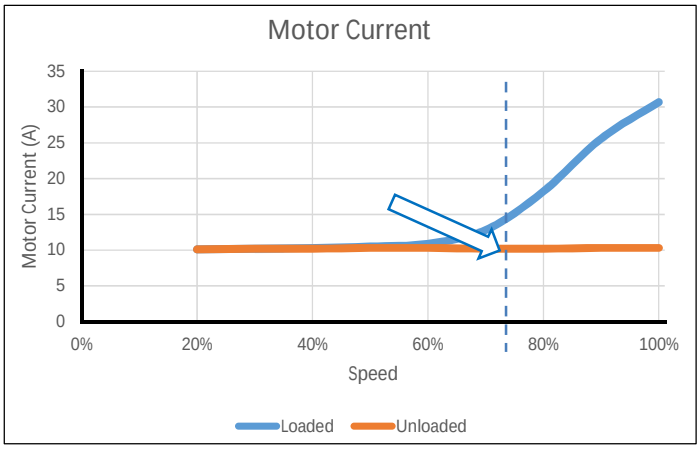

Figure 1: Constant speed current

Advantages with E-Clipse bypass

The ACH580 drive communicates to the E-Clipse module. All motor values stored in the ACH580 drive are shared with the E-Clipse and stored in the bypass module. Even if the drive is off-line, the E-Clipse allows motor operation using bypass. In addition, the E-Clipse includes separate current transformers (CTs) that are only in the circuit during bypass. Those CTs enable the bypass to measure current and operate independently of the drive. The sharing of motor data provides simplified startup and commissioning, independent CTs provide reliable proof-of-flow in bypass.

Startup is simplified

Setting up underload detection in the E-Clipse is accomplished using the bypass keypad shown in Figure 2. Keypad screen captures for each step are pictured to the right of the keypad image.

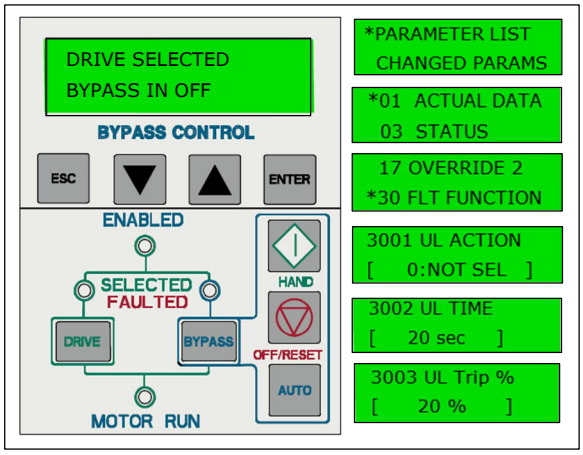

Figure 2: E-Clipse keypad

Below are the programming steps.

1A Press enter and use the ▲ and ▼ arrows to navigate to Parameter list. The asterisk * shows the item selected. Press Enter.

2A Parameter groups are displayed. Navigate to group 30, press Enter. Fault functions are listed starting with underload functions [UL]:

3A 3001 UL ACTION
Select either 1 [Fault] or 2 [Warning].

4A 3002 UL TIME
Default time is 20 seconds: 20 to 40 seconds is common but can be configured to meet application needs.

5A 3003 UL TRIP %
Default value is 20%. Based on the data in Figure 1, 50% of motor FLA was a resonable value for the load profile.

Detection and annuciation

This Technical Note assumes parameter 3001 [underload action] is set to fault. Without any further action, that detection will activate the standard fault and fault-not actions. This can include a relay output or warning for the BAS to monitor. However, this specific fault will be undetectable as different from other faults. Only looking at the E-Clipse keypad will tell the user what fault is detected.

There are several options to differentiate the underload condition from a general fault or warning. One way is to program an output relay to change state when an underload is detected. Those relay contacts can be monitored by the BAS. Another way is to monitor the status over fieldbus, such as BACnet object BV8 in the bypass. Figure 3: BAS connection, shows some of the detailed status information available in the E-Clipse bypass controller.

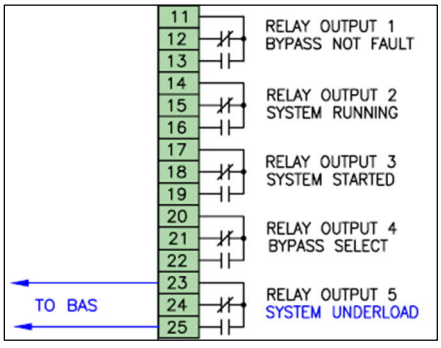

Figure 3: BAS Connection

1B E-Clipse Relay Output 5 was selected to illustrate how to implement this detection. By default, that relay is programmed to bypass-in-auto.

2B RO-5 can be programmed to recognize a bypass underload [20 = BYP UNDERLD]. Or a system underload [22 = SYS UNDERLD] that includes the ACH580 underload detection.

3B The example below configures the E-Clipse relay functions are setup in parameter group 14. Navigate to 1413 [RO5 select], change the value to [22] and press save. Now the underload function will activate relay 5, based on the settings made for parameters 3001, 3002, and 3003.

4B Figure 3 shows connections to RO5 for detection of an underload or broken belt.

Summary:

The underload features built into the ACH580 E-Clipse provide several benefits, at no additional cost.

- No additional hardware is required.
- Customer gets the best of both worlds: ACH580 uses Torque detection (most sensitive for variable speed) bypass uses current detection (OK for full speed applications).
- Easy integration, there is only one connection point: either a single System Underload relay output or monitor a single BACnet object that covers both these topics at once.