

Technical Tip: How to Optimize the Anti-No-Flow Feature (ANF)

Product(s): iQpump1000 and iQpump Micro Drives

Doc. No. TN.iQp.02

This Technical Tip assists users in applying Yaskawa iQpump1000 and iQpump Micro products to pump systems and provides useful information on the Anti-No-Flow feature to:

- minimize pump system pressure ripple
- prevent erroneous detection of no-flow conditions
- prevent undesirable sleep mode activation when Using Anti-No-Flow and
- test for proper Anti-No-Flow and Sleep Mode function.

What is the Anti-No-Flow (ANF) feature?

Anti-no-flow continuously monitors and regulates pump system pressure. The drive decelerates and sleeps during no-flow conditions when pressure regulation is not required.

A no-flow condition can occur with closed valves, broken check valves, or a plugged discharge. A pump's bearings or impeller can be damaged by overheated or vaporized liquid cause by prolonged no-flow or dead-head conditions. The feature is designed to protect pumps and also save energy by entering sleep mode to turn off the pump during no-flow conditions.

The Anti-No-Flow feature continuously monitors discharge pressure to insure proper pressure regulation as illustrated in Figure 1: Anti-No-Flow Timing Chart.

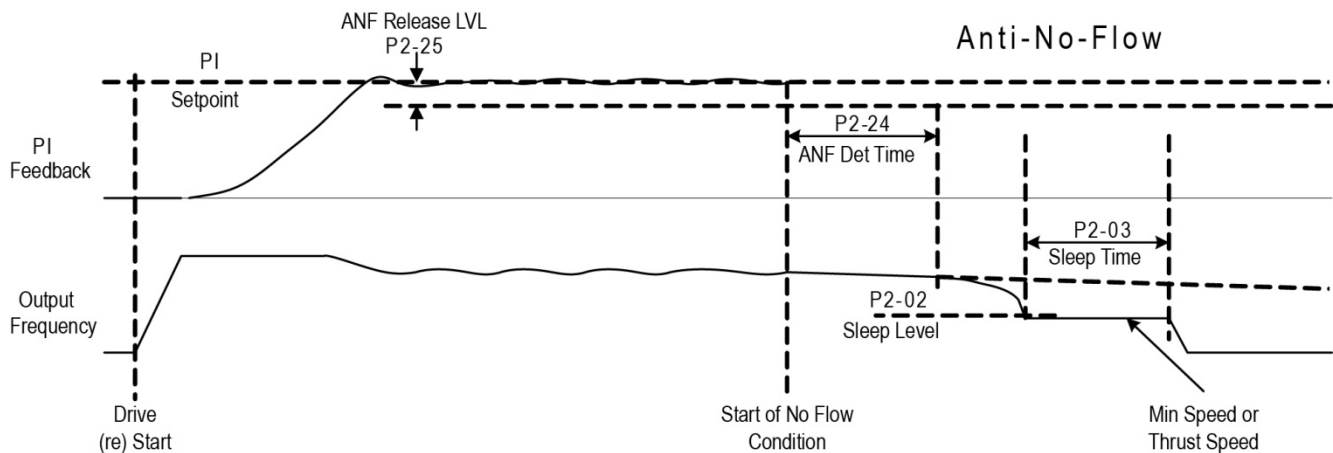


Figure 1: Anti-No-Flow Timing Chart

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What is the Anti-No-Flow (ANF) feature ? (continued)

ANF detects a potential no-flow condition by monitoring for highly stable system pressure that occurs when no liquid is moving.

ANF tests to confirm a no-flow condition by monitoring system pressure after sending a small destabilization output frequency to the pump motor. The ANF feature then performs one of these actions based on the test result:

- return to normal pressure regulation **if the system pressure drops**
- decelerate to minimum pump speed *P1-06* **if the pressure remains at the set point.**

What Causes Pump System Pressure Ripple?

Anti-No-Flow can create periodic system pressure ripple depending on system design.

Periodic pressure ripple is a result of the ANF feature testing for potential no-flow conditions.

It is important to recognize that ANF testing for no-flow conditions is preferable to potential pump damage caused by unresolved no-flow or dead-head conditions. Additionally, a certain amount of pressure ripple is expected and tolerated as the drive adjusts to changes in flow during normal pressure regulation.

Yaskawa sets the ANF factory defaults to suite most pump systems. However some systems with stable flow dynamics, such as drip line irrigation or high flow volumes, generally 300+ HP, may require the user to perform additional ANF tuning.

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How to Minimize Pump System Pressure Ripple

1. Determine if the pressure ripple is caused by ANF.
2. Disable ANF by setting parameter *P2-23 Anti-No-Flow Bandwidth* to 0.
3. Observe for pump system pressure ripple;
 - a. If ripple **persists** go to step 4.
 - b. If ripple **stops** go to step 5.
4. Probable cause: Pressure regulator tuning. Adjust PI parameters (*B5 group*) or acceleration and deceleration parameters (*C1 group*) to resolve persistent ripple.
5. Probable cause: ANF fine-tuning required.
6. Fine-tune the ANF feature. Return parameter *P2-23* to the factory default value of 0.40%.
7. Monitor the value displayed in *U1-99 Anti-No-Flow Timer*
8. Double the value of *P2-24* then recheck the *U1-99* timer under these conditions:
 - a. The *U1-99* timer reaches the value set in *P2-24 Anti-No-Flow Detection Time*, 10 seconds by default and,
 - b. the pressure dips under normal operating conditions.

Note: A pressure dip caused by ANF will be slightly larger than 3 PSI, which is the factory default for the *P2-25 Anti-No-Flow Release Level*. The timer should reset before a pressure dip occurs, now set to 20 seconds. It is common for large systems to require a *P2-24 Anti-No-Flow Detection Time* setting of 30 to 45 seconds.

How to Prevent Erroneous Detection of No-flow Conditions

Decrease the value of parameter *P2-23 Anti-No-Flow Bandwidth* to prevent the drive from erroneously detecting a possible no-flow condition. A value of 0.20% is common in applications with stable flow rates

How to Prevent Undesirable Sleep Mode Activation when Using Anti-No-Flow

1. Improve the pressure regulation responsiveness:
 - a. increase parameter *b5-02 Proportional Gain Setting (P)* and
 - b. decrease parameter *b5-03 Integral Time Setting (I)*.
2. Alternately, decrease parameter *C1-01 Acceleration Time 1*, and *C1-02 Deceleration Time* values to create faster ripples preventing Anti-No-Flow from entering sleep mode.

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How to Test for Proper ANF and Sleep Mode Function

1. Slowly close the discharge gate valve. **CAUTION:** It is important to slowly close the valves to prevent abnormal system behavior or damage.
2. Verify the drive enters sleep mode when the pump is in a true no-flow/dead-head condition.

Contact Yaskawa America, Inc. technical support at 800-YASKAWA (927-5292) for questions regarding the Anti-No-Flow feature.

Table of Related Parameters

No.	Name	Description	Values
P1-06	Minimum Pump Speed	Minimum frequency at which the drive will run. Applies to both HAND and Automatic modes.	Default: 40.0 Hz Min.: 0.0 Max.: [E1-04] Unit range and resolution determined by P1-07.
P2-03	Sleep Delay Time	Sets the delay time before the drive enters Sleep Mode when the sleep level set in P2-02 is reached.	Default: 0 s Min.: 0 Max.: 3600
P2-23	Anti-No-Flow Bandwidth	Sets the amount of PI error bandwidth used to detect the Anti-No-Flow condition. Setting this parameter to 0.00 will disable the function.	Default: 0.40% Min.: 0.00 Max.: 2.00
P2-24	Anti-No-Flow Detection Time	Sets the time delay before the drive starts the increased deceleration rate after Anti-No-Flow is detected.	Default: 10.0 s Min.: 1.0 Max.: 60.0
P2-25	Anti-No-Flow Release Level	Sets the amount below the setpoint which the feedback must drop to disengage the Anti-No-Flow and return to normal PI operation.	Default: 3.0 PSI Min.: 0.0 Max.: 100.0 Units determined by P1-02.
U1-91	Pump Feedback	Displays the PID Feedback.	Displayed units depend on parameter P1-02.
U1-99	Anti-No-Flow Timer	The Anti-No-Flow reduces the output frequency when this value reaches the P2-24 setting.	0.1 s