# RSi H2P Series

## Variable Frequency Drive

## With

## Pump Lead Lag Software

## 1.0 to 25 HP - 230V

## 1.0 to 800 HP - 460V

## Instruction Manual

890053-02-00



BENSHAW
Applied Motor Controls

# INDEX

# 1 Introduction

The H2P Series drives with Pump software have an Application Group (AP1) of parameters that includes parameters to program the drive(s) to control multiple motors. Some of the multiple motor control functions included are Lead/Lag (with Fixed Lag or Follow Lead), Alternation (FIFO & FILO settings), Staging and De-staging settings, Run Priority (order) and Jockey Pump control. There is also a Macro Group of parameters (MC2 Group) that includes parameters for quick setup. All Lead/Lag methods described below utilize PI Control requiring as a minimum, the Lead drive to receive a feedback signal of the process variable (pressure, level, etc.). The MC2 Group also includes setup of basic PI control parameters.

There are four (4) methods to control multiple motors. Each is described in more detail below. To view parameters related to Lead/Lag, select “Lead Lag Sel” at the Quick Start menu or at parameter CNF-43. See *Section 5*, *Parameter Setup*. This will open the AP1 Group and create the MC2 Macro Group which includes the majority of Lead/Lag parameters required for quick setup.

The four (4) methods of multi-motor control are:

(1) Contactor Lag
(2) Follow Lead
(3) Fixed Lag
(4) Network Fbk

## 1.1 Lead/Lag Descriptions

- **Contactor Lag** - Utilizes one **Main** drive along with relay logic to control ATL contactors or starters (referred to as **AUX** motors). A single drive can control up to five (5) **AUX** motors (8 with Ext. IO Card) via output relays from the **Main** drive. The relays are programmed to add/remove additional **(AUX)** motors as needed. This is for a single drive only, not multiple drives. Contactor Lag (MMC) operation is covered in a supplemental manual that describes this method in more detail.

- **Follow Lead** - Utilizes one Main drive and Lag drives that **operate at the same frequency (follow)** as the Main PI controlled drive. A Lead drive (designate by “+”) controls all communications to the Lag drives. A Lead/Lag system can incorporate up to five (5) LAG drives (8 with Ext. IO Card). Follow Lead can be operated with a single transducer to the Lead (+) drive or with feedback provided to all drives in the Lead/Lag system.

- **Fixed Lag** - Utilizes one Main drive and Lag drives that ***operate at a set speed (fixed frequency)*****.** A Lead drive (designate by “+”) controls all communications to the Lag drives. A lead/Lag system can incorporate up to five (5) LAG drives (8 with Ext. IO Card). Fixed Lag can also be operated with a single transducer to the Lead drive or with feedback provided to all drives in the Lead/Lag system.

- **Network Feedback** - Setting for Lag drives only that are not receiving a feedback signal. Lag drives operate in accordance with Lead (+) drive setting (Follow Lead or Fixed Lag). Lag drives set to Network Feedback cannot become a Lead (+) drive and thus a transducer connection is not required.

# 2 Lead/Lag Characteristics

## 2.1 Terminology and Definitions

- **Lead (+) Drive** - The drive that controls communications of the entire system. Note the designation of ("+") for the Lead (+) drive. There is only one Lead (+) drive. The Lead (+) drive is a drive that receives transducer feedback. The "+" designation is shown on the LCD display. See *Section 3, LCD Display/Keypad.*
- **Main Drive** - A drive that is performing the PI Control. There is only one Main drive. The Lead (+) drive can be the Main drive, but when a 2nd drive is staged, the 2nd drive now takes over the PI Control and becomes the Main drive. The PI Control is shifted from the Lead (+) to the Main drive. The Lead (+) drive now becomes a Lag drive but still controls communications, but not PI Control.
- **Lag or Aux Drive** - A drive that operates under the control of the Main drive. There can be up to 7 Lag (or AUX) drives as one is a Main drive.

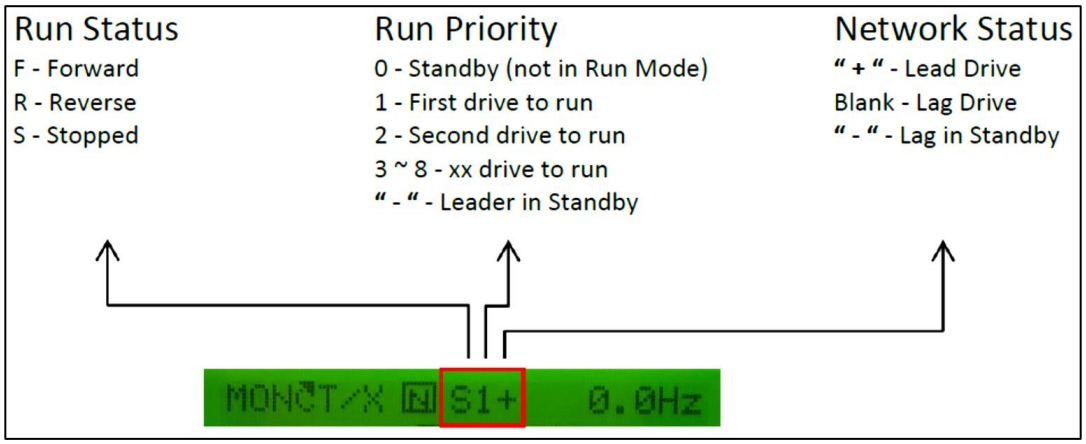
## 2.2 Characteristics of Lead/Lag Operation

- Each drive's ID must be set differently with COM-01 (Int485 St ID).
- Each motor/pump is connected to a drive. The Lead (+) drive controls communications of the entire system. Note the designation of ("+") on the LCD display of the Lead (+) drive.
- Lag (or Aux) drives when staged become the Main PI controlled drive as they take over the PI Control of the system. The PI Control shifts to each Lag (or Aux) drive making it the Main PI controlled drive. The Lead (+) drive now becomes a Lag (or Aux) drive but retains the (+) for communications.
- Lag (or Aux) drives are controlled based on Lead (+) drive operation (Follow Lead or Fixed Lag) and the PI function of the Main drive.
- A Lead/Lag system with only one transducer connected to one drive can only have one Lead (+) drive. Lag drives are set to Network feedback.
- A Lead/Lag system with each drive receiving feedback, the Lead (+) drive can change. Feedback can be from individual transducers to each drive or from one transducer wired to all drives (series 4-20mA loop).
- If the Lead (+) drive is manually stopped, trips or malfunctions, a Lag (or Aux) drive takes over as the Lead (+) drive and continuously controls the system. The Lag (or Aux) drive must be connected with transducer (feedback) to become the Lead (+) drive.
- A Lead/Lag system with each drive receiving feedback, the first drive to be put into AUTO state (button on Keypad) becomes the Lead (+) drive.
- A Lead/Lag system with each drive receiving feedback, when all drives are powered up at the same time, the drive with the lowest ID (COM-01, Drive ID) becomes the Lead (+) drive.
- Drives will power up to their last operating state. If in AUTO, will power up to Auto. If OFF, will power up to Off.
- Alternation (AP1-49) can be set to FILO, FIFO or based on operating time where the operating time of each drive/motor/pump is evenly distributed.

# 3 LCD Display/Keypad

## 3.1 Status

During operation, each drive will display its operating status at the top center of the LCD display.




Examples are: Lead (+) drive running Forward is displayed as "**F1+**".
Lag drive stopped and in standby mode is displayed as "**S0-**".

Other Status indication includes:

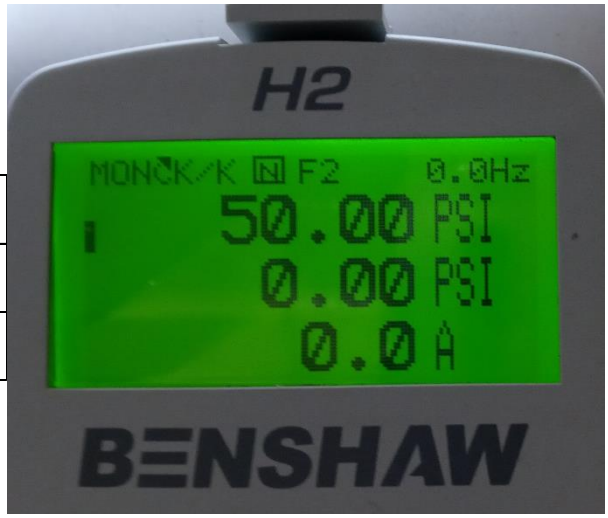
**STP** - Stopped, not in Run Mode
**SLP** - Sleep Mode
**WAN** - Warning of certain setting limits
**TRP** - Tripped

See parameter AP1-47 for additional status indication.

## 3.2 Monitor Screen

The Monitor Screen is set up to display the Reference (Setpoint) and Feedback in PID units. Any of the displayed lines can be changed and set to the user's preference with the parameters listed below.

| | | |
|---|---|---|
| CNF-21 | Monitor Line-1 | PID Ref Value |
| CNF-22 | Monitor Line-2 | PID Fdb Value |
| CNF-23 | Monitor Line-3 | Output Current |



## 3.3 HAND-OFF-AUTO Buttons - Operation

### AUTO Button

**Start-Stop control is from the AUTO button on the LCD display/keypad.** A separate input to the P1 terminal (Fx start command) is not required. **The AUTO button will start and stop each of the drives.**

Press

OFF -> AUTO (green LED blinking) -> AUTO again (green LED ON), drive is in Forward Run Mode.

See Section *3.4, Start/Stop Control* for more details.

### OFF Button

When stopped manually with the OFF button, the drive will decelerate and eventually go into stop mode (STP). If the Lead (+) drive is stopped, Lag drive will become Lead (+) drive (status to F1+) with correct settings. The stopped drive will not auto restart until Auto button is pressed again. The status display will change from STP to F2 (or current priority) and restarts.

### HAND Button

**Caution** - **Pressing the HAND button on the LCD display/keypad will start the drive**. In HAND mode, operating frequency (speed) is set at the Monitor display (MON), Frequency is on Line-1 using the Up, Down, Left and Right arrow buttons. The frequency (speed) displayed at the Monitor display (MON) is duplicating parameter DRV-25, “HAND Cmd Freq”. The default speed is 0 Hz. The drive will ignore a digital input for start/stop and will not be in PI Control Mode. If digital inputs are made for FWD JOG or REV JOG, these override the DRV-25 (Hand Cmd Freq) frequency setting and operate based on DRV-11 (JOG Frequency), DRV-12 (JOG Acc Time) and DRV-13 (JOG Dec Time).

**Note:** When powered is cycled, the drive will reboot to the same status it was in before power was removed. EX: If Stopped (via OFF button), will reboot to off mode. If in AUTO mode (Forward run mode) before power was removed, it will reboot to AUTO, Forward run mode (AUTO LED green, not blinking).

## 3.4 Start/Stop Control

The Lead/Lag software default settings for start/stop are set to automatic. By pressing the Auto button once on each drive, the drives will be in the ready mode (Auto LED blinking). Pressing the Auto button a second time will start the drives. **A separate start command at terminal P1 is not required**.

This is based on the default setting of parameter IN-87 for the P1 Start terminal. Terminal P1 is set to normally closed (first bit set to “1”). This was done to minimize wiring to each drive. Also related to automatic start is parameter ADV-10, Power On Run. With ADV-10 set to “Yes” (default), this permits the drive to automatically start on Power Up. When cycling power to the drives, they will return to the mode (Auto, Stop, Hand) they were in prior to the power being cycled.

**If a separate Start/Stop input at P1 is being used,** change the setting of IN-87 to all zero’s (0).

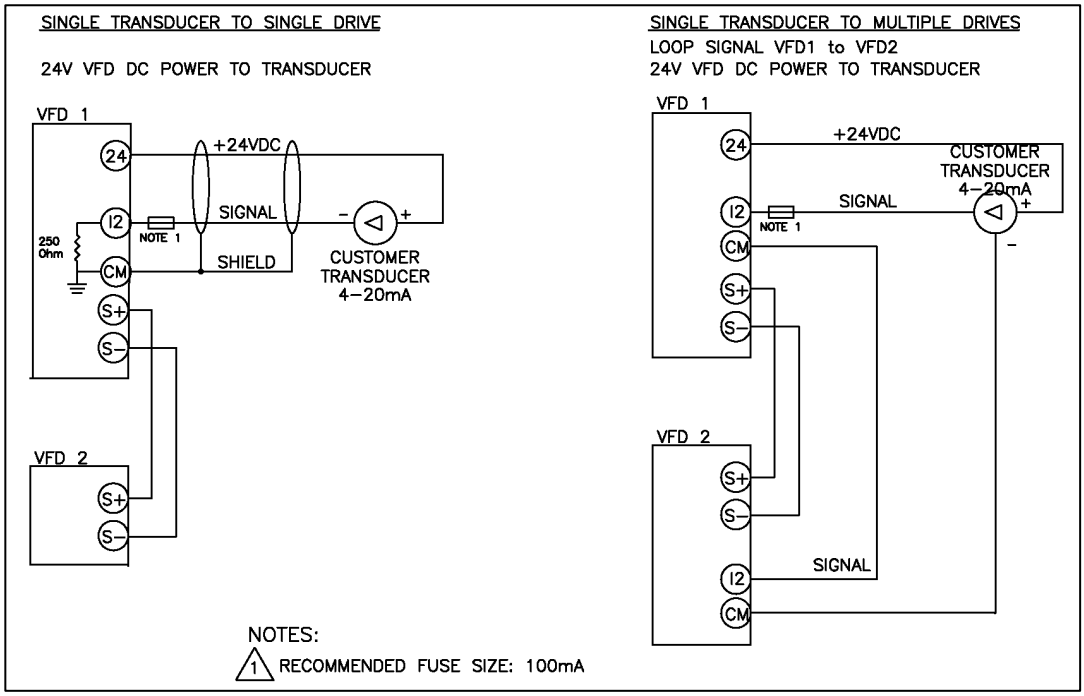
| Parameter | LCD Display | Default | Drive Setting | Notes |
|---|---|---|---|---|
| IN-87 | DI NC/NO Sel | 0 0000 0001 | 0 0000 0000 | With first bit set to "1", the drive is in Run Mode when Powered Up. If using separate Start/Run command for the drive, set first bit back to "0". |
| ADV-10 | Power- on Run | Yes | Yes | Related to IN-87.<br>Yes - Drive will start on Power Up with active start/run command.<br>No - Drive requires start/run command after Power Up. |

# 4 Transducer and Communications Wiring

The below connection diagrams show wiring for a 2 pump (duplex) system using a single transducer connected to a single drive and also a single transducer connected to multiple drives (4-20mA Loop). Alternately, a separate transducer can be connected to each drive.

The difference between the two diagrams is; with a single transducer to a single drive, the Lag drives cannot become a Lead (+) drive if the Lead (+) drive is manually stopped, trips or malfunctions. A Lag drive must receive a feedback signal (4-20mA Loop or separate) to become a Lead (+) drive for continuous control of the system. Depending on transducer wiring, **see Note in *Section 6, Macro 2 Group (MC2)* for parameter MC2-03 setting for Lag drives.**

Utilize the standard H2 Drive Manual for wiring not related to the Lead/Lag operation (any additional I/O for control and monitoring). Note the communications connection among all drives (S+ to S+ and S- to S-) and verify the polarity is correct for communications.




**Important:** Turn ON the terminating resistor on the last drive in the network. SW1=ON

# 5 Parameter Setup

Follow the steps below to setup H2P drives to operate as a Lead/Lag system. The H2 Pump Software (H2P) has a macro group of parameters (MC2 Group) that includes settings for multiple drive / multiple motor control. The MC2 Group includes parameters from other groups, including AP1 Group, PID Group and others. The MC2 Group parameter list and settings are shown in the table in *Section 6, Macro 2 Group (MC2)*.

**Step 1**: Upon Power Up, at Run QuickStart, select “Yes”.

**Step 2**: At 43 Macro Select, select (2) Lead Lag Sel.

**Step 3**: Set the remaining parameters within the Quick Start menu.

**Step 4**: Set a unique communication address at parameter COM-01 (Drive ID) in each drive.

- *VFD#1 - COM-01 to “1”*
- *VFD#2 - COM-01 to “2”*

**Step 5**: Cycle power after setting the above parameters.

**Note:** The default for COM-01 (Drive ID) is “0”. If COM-01 is not set in each drive, the drive will flash a warning “Int485 St ID” as a reminder to set COM-01 when changing other parameters.

The firmware places the Lead/Lag parameters in a Macro group (MC2). To access the Macro group:

**Step 6**: At the first drive with COM-01 set as Drive ID 1, press the MODE button while viewing the upper left corner of the LCD. Stop when U&M MC2 (User & Macro) is displayed. Set parameters in the MC2 Group. The Macro group (MC2) includes parameters for Lead/Lag setup and are listed in the table in *Section 6, Macro 2 Group (MC2)*.

- Data Share: When setting parameters in Drive #1, parameter’s designated as “Yes” in the Data Share column of the parameter table will be changed in all Lag drives in the system. **Note that the Lead (+) drive must be in the Ready Mode (AUTO LED blinking) to Data Share**. See *Section 20, Data Share*. Alternatively, if it is necessary to set or change a specific data shared parameter in a Lag drive, change it within the Lag drive.

# 6 Macro 2 Group (MC2)

This table lists parameters in the macro group (MC2). It includes the MC2 group parameter number cross referenced to the original drive parameter along with default settings for Lead/Lag operation. The Notes provide a brief description of the parameter settings. For detailed descriptions of the parameters, refer to *Section 8, Application Group 1, AP1 Parameter Descriptions.*

**NOTE: For Lag drives only. Parameter MC2-03.**

If using a single transducer to the Lead (+) drive only, set Lag drives to Network Feedback. If all drives are receiving the transducer feedback signal, set Lag drives to same as the Lead (+) drive (Follow Lead or Fixed Lag).

| Macro Parameter | Original Parameter | LCD Display | Setting Range | Default | Unit | Data share | NOTES | |
|---|---|---|---|---|---|---|---|---|
| MC2-01 | COM-01 | Int485 St ID | 1~8 | 0 | - | No | EX: 2 VFD's, VFD#1=1, VFD#2=2, If not changed from "0", will flash a warning (Int485 ST ID). | |
| MC2-02 | PID-01 | PID Sel | 0: No<br>1: Yes | 1: Yes | - | No | PID Enabled - default | |
| MC2-03 | AP1-40 | Lead-Lag Sel | 0: None<br>1: Contactor Lag<br>2: Follow Lead<br>3: Fixed Lag<br>4: Network Fbk | 3: Fixed Lag | - | No | Contactor Lag - MMC Control<br>Follow Lead - The Lag drive will follow the Main when called upon to run.<br>Fixed Lag - The Lag drive will run at a fixed speed (MC2-15 / AP1-60).<br>Network Feedback - One Lead (+) drive, all others Lag | |
| MC2-04 | AP1 49 | ALT Sequence | 0: FILO<br>1: FIFO<br>2: Op Time Order | 0. FILO | - | Yes | FILO - First In Last Out<br>FIFO - First In First Out<br>Op Time - Staging/De-staging based on drive accumulated operating times. | |
| MC2-05 | AP1-56 | Alternate Time | 00:00 – 100:00 | 24:00 | Hr.:Min | Yes | Hr.:Min Set Alternation Time. | |
| MC2-06 | AP1-58 | Alt Timer Disp | View Only | - | Hr.:Min | No | View accumulated time before alternation occurs. | |
| MC2-07 | AP1-42 | * of Pumps | 0~8 | 5 | - | Yes | # of pumps/drives connected in Lead/Lag system. See Standby. | |
| MC2-08 | AP1-94 | * Of Drives | 0~8 | 5 | - | Yes | # of drives running in Lead/Lag system. | |
| MC2-09 | DRV-03 | Acc Time | 0.0~600.0 | 20 | sec | Yes | Acceleration and Deceleration times based on 60 Hz. | |
| MC2-10 | DRV-04 | Dec Time | 0.0~600.0 | 20 | sec | Yes | | |
| MC2-11 | AP1-50 | Stage Pres. Dv | 0.00~300.00 | 5 | PSI | Yes | Difference (deviation) between Setpoint and Feedback to pull in Lag drive. 5 PSI (or more) below setpoint, Lag drive starts. | |
| MC2-12 | AP1-53 | Stage DT | 0.0~3600.0 | 5 | sec | Yes | Delay time after reaching MC2-11 / AP1-50 | |
| MC2-13 | AP1-54 | Destage DT | 0.0~3600.0 | 5 | sec | Yes | Delay time after MC2-14 / AP1-59 | |
| MC2-14 | AP1-59 | Destage Pres. | 0.00~300.00 | 5 | PSI | Yes | Difference between Setpoint and Feedback to drop out Lag drive. 5 PSI (or more) above setpoint, Lag drive stops. | |
| MC2-15 | AP1-60 | Lag Freq | Low Freq~ High Freq | 60 | Hz | Yes | Fixed Lag frequency setting. Only used when MC2-03 / AP1-40 is set to Fixed Lag. | |
| MC2-16 | AP1- 61 | Stage Freq 1 | Low Freq~ High Freq | 45 | Hz | Yes | Frequency setting of Main drive to pull in Lag drives. Set lower to pull in sooner. For Follow Lead and Fixed Lag, only one Staging Freq is used for all Lags. AP1-62~AP1-68 are not used. | |
| MC2-17 | AP1-70 | Destage Freq 1 | Low Freq~ High Freq | 40 | Hz | Yes | Set lower to drop out the Lag drive later. For Follow Lead and Fixed Lag, only one De-staging Freq is used for all Lags. AP1-71~AP1-77 are not used. | |
| MC2-18 | AP1-43 | Run Priority | View Only | - | - | No | LCD will show priority of running order, middle digit. | |
| MC2-19 | AP1-44 | Lag Pump Run | View Only 0~7 | 0 | - | No | This is # of Lag drives (only) running. | |
| MC2-20 | AP1-45 | Curr. Prty 1 | View Only | - | - | No | 4321 | 4 digits representing first 4 drives. If only 2 drives are used, shows 0021 |
| MC2-21 | AP1-46 | Curr. Prty 2 | View Only | - | - | No | 8765 | 4 more, representing drives 5 ~ 8 |

| Macro Parameter | Original Parameter | LCD Display | Setting Range | | Default | Unit | Data share | NOTES |
|---|---|---|---|---|---|---|---|---|
| MC2-22 | AP1-47 | Lead-Lag Status | | Trip | Manual | View Only | No | Shows status of specific drive. |
| | | | | Manual | | | | |
| | | | | Interlock | | | | |
| | | | | Standby | | | | |
| | | | | Sleep | | | | |
| | | | | Stop | | | | |
| | | | | Ready | | | | |
| | | | | Proc PID | | | | |
| | | | | Constant | | | | |
| MC2-23 | AP1-48 | Lag Stop Sel | 0: | No | 0: No | - | Yes | No - When Lead (+) drive run command is removed, the Lead (+) de-stages per MC2-13 Delay Time. A Lag drive can become Lead (+). |
| | | | 1: | Yes | | | | Yes - When Lead (+) drive run command is removed, all Lag drives stop. |
| MC2-24 | AP1-78 | DataShare | 0: | None | 1: Auto | - | Yes | Auto: Changing MC2 group parameters at the Lead (+) drive also changes specified parameters in the Lag drives. |
| | | | 1: | Auto | | | | |
| | | | 2: | Manual | | | | Manual: Writes all DataShare parameters to Lag drive at once, LCD Flashes "DataShare" then returns to Auto. |
| MC2-25 | AP1-79 | All CommErr | 0: | No | 0: No | - | Yes | No - If CommErr occurs, only drive with error trips. |
| | | | 1: | Yes | | | | Yes - If CommErr occurs, all drives trip. |
| MC2-26 | AP1-88 | Jockey Pump | 0: | No | 0: No | - | No | No: Do not use Jockey Pump function. |
| | | | 1: | Yes | | | | Yes: Use Jockey Pump function. |
| MC2-27 | AP1-89 | Jockey Dly T | 0.0 ~ 60.0 | | 20 | sec | No | Jockey Pump Off delay time. |
| MC2-28 | AP1-95 | Run Time Monitor | 0: | Pump1 | 0: Pump1 | - | No | Lead (+) drive can select any drive to view Run Days and Run Time MC2-29, 30 (AP1-96, 97), Lag drives can only view their own. |
| | | | | through | | | | |
| | | | 7: | Pump 8 | | | | |
| MC2-29 | AP1-96 | PmpRunTime Day | | 0 ~ 65535 | 0 | Day | No | Run Time - Days |
| MC2-30 | AP1-97 | PmpRunTime Min | | 0:00 ~ 23:59 | 0:00 | Hr.:min | No | Run Time - Hrs. - mins. |
| MC2-31 | AP1-98 | PmpRunTime Clr | 0: | None | 0: None | - | No | For the Pump selected in MC2-28 (AP1-95), clear the Days/Hrs/Mins in MC2-29, 30 (AP1-96, 97) |
| | | | 1: | All | | | | |
| | | | 2: | Pump1 | | | | |
| | | | | through | | | | |
| | | | 9: | Pump 8 | | | | |
| MC2-32 | PID-11 | PID Ref 1 Set | 0-PID 53 | | 60 | PSI | Yes | Setpoint entered here when PID-10 (Setpoint Source) is set to Keypad. The default setting is 20% (in PID Units) of the MC2-37 (PID-53) maximum transducer rating. |
| MC2-33 | PID-20 | PID Fdb Source | 0 ~ 9 | | (3) I2 | - | Yes | Feedback Source - 4-20mA |
| MC2-34 | PID-26 | PID I-Time 1 | 0.0 ~ 200.0 | | 2 | Sec | Yes | I-Gain (Note: P-Gain at PID-10) |
| MC2-35 | PID-50 | PID Unit Sel | 0 ~ 40 | | (2) PSI | - | Yes | Units of PI Control parameters |
| MC2-36 | PID-51 | PID Unit Scale | 0.01 ~ 100 | | (2) x1 | Msg | Yes | Multiplies all parameters in PID Units by the scale factor. |
| MC2-37 | PID-53 | PID Unit 100% | PID 52 ~ 300.00 | | 300 | PSI | Yes | Set max. value of transducer. Sets 20mA to max. PI Units. |
| MC2-38 | PID-60 | Sleep Bst Set | 0 ~ 6000.0 | | 0 | PSI | Yes | Feedback must reach above setpoint to go into Sleep mode. |
| MC2-39 | PID-61 | Sleep Bst Freq | 0.00, Low Freq~ High Freq | | 0 | Hz | Yes | To build pressure before entering Sleep Mode, frequency to which drive will accelerate to. Setting of 0.00 Hz., disables Sleep Boost. |
| MC2-40 | PID-62 | PID Sleep 0 DT | 0 ~ 6000.0 | | 10 | sec | Yes | Main drive Sleep Delay Time. |
| MC2-41 | PID-63 | PID Sleep0Freq | 0.00, Low Freq~ High Freq | | 0 | Hz | Yes | Main drive Sleep Frequency. Note: If minimum speed (freq) is set at MC2-46 (PID-31), Sleep Freq must be above minimum. |
| MC2-42 | PID-64 | PID WakeUp0 DT | 0 ~ 6000.0 | | 10 | sec | Yes | Main drive Wake Up Delay Time. Set longer than Acceleration time MC2-09 (DRV-03). |

| Macro Parameter | Original Parameter | LCD Display | Setting Range | Default | Unit | Data share | NOTES |
|---|---|---|---|---|---|---|---|
| MC2-43 | PID-65 | PID WakeUp0Dev | 0~Unit Band | 20 | PSI | Yes | Amount (deviation) of feedback below Setpoint MC2-32 (PID-11) to wake up. |
| MC2-44 | AP2-55 | Lost Fdb Mode | 0: None | Free-Run | - | No | None: Disable Lost Feedback monitoring. |
| | | | 1: Warning | | | | Warning to alert of Lost (or Low) Feedback Level. |
| | | | 2: Free-run | | | | Free Run or Decel to trip on Lost Feedback fault. See AP2-55 below. |
| | | | 3: Dec | | | | |
| MC2-45 | ADV-08 | Stop Mode | 0: Dec | 0: Dec | - | Yes | Decelerate to a stop. |
| | | | 1: DC-Brake | | | | Apply DC Injection braking during stop. |
| | | | 2: Free-Run | | | | Coast to stop. |
| | | | 4: Power Braking | | | | Controlled stop for optimum decel rate. |
| MC2-46 | PID-31 | PID Limit Lo | -100.00 ~ PID Limit Hi | 0% | % | Yes | If minimum speed is required, set to xx% (of 60 Hz.) |

## 6.1 Additional Parameters

Parameters related to the feedback signal may need set or adjusted based on user preference. See *Section 19, Lost Feedback and High Feedback Settings* for further details.

| Macro Parameter | Original Parameter | LCD Display | Setting Range | Default | Unit | Data share | NOTES |
|---|---|---|---|---|---|---|---|
| - | AP2-53 | High Fdb Time | 0.0–1200.0 (sec) | 100.00 sec | sec | No | High Feedback delay time. |
| - | AP2-54 | High Fdb Level | -100.00 ~ 100.00 (%) | 90 % of PID-53 (MC2-37) | | No | High Feedback Level. **NOTE:** High Feedback is a fault. May not want drive to fault on high level. To disable, set AP2-54 to 0.00 (PID Units). |
| MC2-44 | AP2-55 | Lost Fdb Mode | 0: None | Free-Run | - | No | None: Disable Lost Feedback monitoring. |
| | | | 1: Warning | | | | Warning: Provide alert of Lost (or Low) Feedback. |
| | | | 2: Free-run | | | | Free Run or Decel: Enables trip on Lost Feedback fault along with stop method. |
| | | | 3: Dec | | | | |
| - | AP2-56 | Lost Fdb Time | 0.1 ~ 120.0 (secs) | 20.0 | | No | Time Delay for Lost Feedback Warning or Fault. |
| - | AP2-57 | Lost Fdb Level | -100% ~ +100% of PID-53 | 1.0 % of PID-53 | | No | Set amount (PID Units) to trigger Lost Feedback Warning or Fault. |

## 6.2 Related Parameters

There are numerous other pump related operation and control parameters (listed below) that are included in the H2P Pump Software but are not addressed in this H2P Pump manual. Refer to the H2 Series Drive Instruction Manual, 890053-00-00 for details on these parameters.

| **Miscellaneous** | |
|---|---|
| V/F Pattern (Linear, Squared, User) | BAS-07 |
| Accel/Decel Pattern (Linear/S-Curve) | ADV-01 ~ 06 |
| Freq Limits | ADV-24 ~ 26 |
| Energy Saving | ADV-50 ~ 52 |
| I2 Analog Input (4 - 20mA) Scaling | IN-50 ~ 58 |
| **PI Control Group (PID)** | |
| P Gain, I Gain | PID-25, 26 |
| PID Output Limits | PID-30, 31 |
| PID Output Inverse | PID-36 |
| PID Units | PID-50 |
| **Application Group 1 (AP1)** | |
| Pre-PID and Soft Fill | AP1-20 ~ AP1-26 |
| Flow Compensation | AP1-30, 31 |

| **Application Group 2 (AP2)** | |
|---|---|
| Load Curve Tuning | AP2-01 ~ 12 |
| Pump Clean Operation | AP2-15 ~ 33 |
| Decel Valve Ramping | AP2-38, 39, ADV-24 |
| Start/End Ramp, Accel/Decel | AP2-40 ~ 42, ADV-24 |
| Damper Control | AP2-45 |
| Lubrication (Oil Pump) | AP2-46 |
| Pre Heat Motor | AP2-48 ~ 50 |
| **Protection Group (PRT)** | |
| Back Spin Timer | PRT-01 |
| Underload | PRT-23 ~ 28 |
| Pipe Broken | PRT-60 ~ 62 |

## 6.3 Control Related Parameters

These parameters have different default settings for Lead/Lag control.

| Control Related Parameters - Defaults for Lead Lag | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Macro Parameter | Original Parameter | LCD Display | Setting Range | | Default | Unit | Data share | NOTES |
| - | IN-87 | DI NC/NO Sel | 0 0000 0000 – 1 1111 1111 | | 0 0000 0001 | bit | No | With first bit set to "1", Drive is in Run Mode when Powered Up. P1 terminal input for Fx (Forward Run) is closed. If using separate Start/Run command, set first bit back to "0". |
| | | | 0 | A Terminal (NO) | | | | |
| | | | 1 | B Terminal (NC) | | | | |
| - | IN-90 | DI Status | 0 0000 0000 – 1 1111 1111 | | 0 0000 0001 | View | No | Status reflects IN-87 settings. |
| | | | 0 | Contact (Off) | | | | |
| | | | 1 | Contact (On) | | | | |
| - | ADV-09 | Run Prevent | 0 | None | 2 | Reverse Prev | No | Prevent Reverse Rotation. |
| | | | 1 | Forward Prev | | | | |
| | | | 2 | Reverse Prev | | | | |
| - | ADV-10 | Power- on Run | 0 | No | 1 | Yes | No | Related to IN-87.<br>Yes - Drive will start on Power Up with active start/run command.<br>No - Drive requires start/run command after Power Up. |
| | | | 1 | Yes | | | | |
| - | ADV-11 | Power- On Delay | 0.0 -6000.0 | | 0.0 | secs | No | |
| - | PRT-08 | RST Restart | Bit | 00–11 | 11 | bit | No | Automatic Fault Resets - This is a 2-bit representation.<br>00 = Off Off, Disable Auto Fault Resets.<br>11 = On On, Enable Auto Fault Resets. |
| | | | Bit 0 | Faults other than LV trip | | | | |
| | | | Bit 1 | LV Trip | | | | |
| - | PRT-09 | Retry Number | 0–10 | | 3 | - | No | Number of Auto Reset attempts. |
| - | PRT-10 | Retry Delay | 0.1–600.0 (sec) | | 5.0 | secs | No | Time between Auto Reset attempts. |
| - | DRV-05 | KDP H.O.A Lock | 0 | Locked | 1 | Unlocked | No | Keypad buttons not locked out. |
| | | | 1 | During Run | | | | |
| | | | 2 | Unlocked | | | | |
| - | OUT-30 | Trip OutMode | bit | 0000-1111 | 1010 | - | Any output relay (OUT-31 ~ OUT-39) that is set to the "Trip" function will change state with the Interlock function. To disable the trip output relay for the Interlock function only, set bit 3 to "0". (0010). | |
| | | | Bit 0 | Low voltage | | | | |
| | | | Bit 1 | Any faults other than low voltage | | | | |
| | | | Bit 2 | Automatic restart final failure | | | | |
| | | | Bit 3 | Operate with Interlock Trip | | | | |

# 7 Application Group 1, AP1 Parameter List

The AP1 Group includes many of the parameters used in the Lead/Lag macro group (MC2). All parameters in the AP1 Group are listed below. Parameter settings and descriptions are provided in *Section 8, Application Group 1, AP1 Parameter Descriptions*.

| Property | Yes / No | Write during operation |
|---|---|---|
| | X | Write disabled |

| Parameter | Name | LCD Display | Setting Range | Default | Property* |
|---|---|---|---|---|---|
| AP1-00 | Jump Code | Jump Code | 1–99 | 20 | Yes |
| AP1-20 | Soft Fill function options | Soft Fill Sel | 0 No<br>1 Yes | 0 No | Yes |
| AP1-21 | Pre- PID operation frequency | Pre-PID Freq | Low Freq– High Freq | 30.00 | Yes |
| AP1-22 | Pre- PID delay time | Pre-PID Delay | 0.0–600.0 (sec) | 60.0 | Yes |
| AP1-23 | Soft Fill escape value | Soft Fill Set | Unit Min–Unit Max | 20.00 | Yes |
| AP1-24 | Soft Fill reference increasing value | Fill Step Set | 0.00–Unit Band | 2.00 | Yes |
| AP1-25 | Soft Fill reference increasing cycle | Fill Step Time | 0–9999 (sec) | 20 | Yes |
| AP1-26 | Soft Fill changing amount | Fill Fdb Diff | 0.00–Unit Band | 0.00 | Yes |
| AP1-30 | Flow Comp function options | Flow Comp Sel | 0 No<br>1 Yes | 0 No | Yes |
| AP1-31 | Max Comp amount | Max Comp Value | 0.00–Unit Band | 0.00 | Yes |
| AP1-40[1] | MMC, Lead-Lag Function Selection | Lead Lag Sel | 0 None<br>1 Contactor Lag<br>2 Follow Lead<br>3 Fixed lag<br>4 Network Fbk | 0 None | No |
| AP1-41[2] | Bypass selection | Regul Bypass | 0 No<br>1 Yes | 0 No | No |
| AP1-42 | Number of auxiliary motors | * of Pumps | 0 ~ 8 | 5 | No |
| AP1-43[3] | First Priority Motor Number (Drive ID) | Run Priority | 1–5 | 1 | No |
| AP1-44 | Display the number of lag motors in operation | Lag Pump Run | - | - | X |
| AP1-45 | Display priority of motors 1– 4 | Curr. Prty 1 | 0000 | 4321 | X |
| AP1-46 | Display priority of motors 5– 8 | Curr. Prty 2 | 0000 | 0005 | X |
| AP1-47 | Lead Lag Operating Status | LeadLag Status | 1 Trip<br>2 Manual<br>3 Interlock<br>4 Standby<br>5 Sleep<br>6 Stop<br>7 Ready<br>8 Proc PID<br>9 Constant | | X |
| AP1-48 | Lag Motor(s) Stop Selection | Lag Stop Sel | 0 No<br>1 Yes | 1 Yes | Yes |
| AP1-49 | Alternating Operation Sequence | ALT Sequence | 0 FILO<br>1 FIFO<br>2 Op time Order | 0 FILO | No |
| AP1-50 | Auxiliary motors staging pressure difference | Stage Pres. Dv | 0–PID Unit 100 (%) | 5 | Yes |
| AP1-51 | Main motor acceleration time when the number of auxiliary motors is reduced | Aux Acc Time | 0.0–600.0 (sec) | 2.0 | Yes |
| AP1-52 | Main motor acceleration time when the number of auxiliary motors is increased | Aux Dec Time | 0.0–600.0 (sec) | 2.0 | Yes |
| AP1-53 | Auxiliary motors start delay time | Stage DT | 0.0–3600.0 (sec) | 5.0 | Yes |

| Parameter | Name | LCD Display | Setting Range | Default | Property* |
|---|---|---|---|---|---|
| AP1-54 | Auxiliary motors stop delay time | Destage DT | 0.0–3600.0 (sec) | 5.0 | Yes |
| AP1-55 | Alternating mode selection | Alternate Mode | 0 None<br>1 AUX Exchange<br>2 Main Exchange | 1 AUX Exchange | No |
| AP1-56 | Alternate time interval | Alternate Time | 00:00–100:00 (hr:min) | 24:00 | Yes |
| AP1-57 | Alternate frequency | AlternateLevel | Low Freq– High Freq | 20.00 | Yes |
| AP1-58 | Alternate timer display | Alt Timer Disp | (hr:min) | 0:00 | X |
| AP1-59 | Auxiliary motor pressure difference | Destage Pres. | 0~PID Unit 100 (%) | 5 | Yes |
| AP1-60[4] | Frequency of Lag motor in Fixed Lag | Lag Freq | Low Freq ~ High Freq | 60.00 | Yes |
| AP1-61 | #1 AUX motor start frequency | Stage Freq 1 | Freq Low Limit– Freq High limit (Hz) | 45.00 | Yes |
| AP1-62 | #2 AUX motor Start frequency | Stage Freq 2 | Low Freq– High Freq | 45.00 | Yes |
| AP1-63 | #3 AUX motor Start frequency | Stage Freq 3 | Low Freq– High Freq | 45.00 | Yes |
| AP1-64 | #4 AUX motor Start frequency | Stage Freq 4 | Low Freq– High Freq | 45.00 | Yes |
| AP1-65 | #5 AUX motor Start frequency | Stage Freq 5 | Low Freq– High Freq | 45.00 | Yes |
| AP1-66[5] | #6 AUX motor Start frequency | Stage Freq 6 | Low Freq– High Freq | 45.00 | Yes |
| AP1-67 | #7 AUX motor Start frequency | Stage Freq 7 | Low Freq– High Freq | 45.00 | Yes |
| AP1-68 | #8 AUX motor Start frequency | Stage Freq 8 | Low Freq– High Freq | 45.00 | Yes |
| AP1-70 | #1 AUX motor stop frequency | Destage Freq 1 | Low Freq– High Freq | 40.00 | Yes |
| AP1-71 | #2 AUX motor stop frequency | Destage Freq 2 | Low Freq– High Freq | 40.00 | Yes |
| AP1-72 | #3 AUX motor stop frequency | Destage Freq 3 | Low Freq– High Freq | 40.00 | Yes |
| AP1-73 | #4 AUX motor stop frequency | Destage Freq 4 | Low Freq– High Freq | 40.00 | Yes |
| AP1-74 | #5 AUX motor stop frequency | Destage Freq 5 | Low Freq– High Freq | 40.00 | Yes |
| AP1-75[5] | #6 AUX motor stop frequency | Destage Freq 6 | Low Freq– High Freq | 40.00 | Yes |
| AP1-76 | #7 AUX motor stop frequency | Destage Freq 7 | Low Freq– High Freq | 40.00 | Yes |
| AP1-77 | #8 AUX motor stop frequency | Destage Freq 8 | Low Freq– High Freq | 40.00 | Yes |
| AP1-78 | PID Parameter Sharing - Lead Drive to Lag (Aux) Drives | DataShare | 0 None<br>1 Auto<br>2 Manual | Auto | No |
| AP1-79 | Communication Error selection | All CommErr | 0 No<br>1 Yes | 0 No | Yes |
| AP1-80 | #1 AUX motor's reference compensation | Aux1 Ref Comp | 0.00–Unit Band (%) | 0.00 | Yes |
| AP1-81 | #2 AUX motor reference compensation | Aux2 Ref Comp | 0.00–Unit Band (%) | 0.00 | Yes |
| AP1-82 | #3 AUX motor reference compensation | Aux3 Ref Comp | 0.00–Unit Band (%) | 0.00 | Yes |
| AP1-83 | #4 AUX motor reference compensation | Aux4 Ref Comp | 0.00–Unit Band (%) | 0.00 | Yes |
| AP1-84 | #5 AUX motor reference compensation | Aux5 Ref Comp | 0.00–Unit Band (%) | 0.00 | Yes |
| AP1-85[5] | #6 AUX motor reference compensation | Aux6 Ref Comp | 0.00–Unit Band (%) | 0.00 | Yes |
| AP1-86 | #7 AUX motor reference compensation | Aux7 Ref Comp | 0.00–Unit Band (%) | 0.00 | Yes |
| AP1-87 | #8 AUX motor reference compensation | Aux8 Ref Comp | 0.00–Unit Band (%) | 0.00 | Yes |
| AP1-88 | Jockey Pump operation selection | Jockey Pump | 0 No<br>1 Yes | 0 No | No |
| AP1-89 | Jockey Pump stop delay time | Jockey Dly T | 0.00 - 60.00 (sec) | 20.00 | Yes |
| AP1-90 | Interlock selection | Interlock (Ext. Mrt OL) | 0 No<br>1 Yes | 0 No | Yes |
| AP1-91 | Delay time before next motor operates when an interlock or an auto change on the main motor occurs. | Interlock DT (Ext. Mrt OL T) | 0.1–360.0 (sec) | 5.0 | Yes |
| AP1-94 | Number of drives operated by the Lead/Lag system. | * of Drives | 0 ~ 8 | 5 | No |
| AP1-95 | Selection of Auxiliary motor to display Run Time at [AP1- 96] [AP1-97] | RunTimeMonitor | 0 Pump 1<br>1 Pump 2<br>2 Pump 3 | 0 Pump 1 | Yes |

| Parameter | Name | LCD Display | Setting Range | | Default | | Property* |
|---|---|---|---|---|---|---|---|
| | | | 3 | Pump 4 | | | |
| | | | 4 | Pump 5 | | | |
| | | | 5 | Pump 6[5] | | | |
| | | | 6 | Pump 7 | | | |
| | | | 7 | Pump 8 | | | |
| AP1-96 | Operation time (Day) of Auxiliary motor selected in [AP1-95] | PmpRunTime Day | 0 – 65535 | | 0 | | Yes |
| AP1-97 | Operation time of Auxiliary motor selected in [AP1-95] (Hour:Minute) | PmpRunTime Min | 00:00 - 23:59 (hr:min) | | 00:00 | | Yes |
| AP1-98 | Pump Run Time Clear selection | PmpRunTime Clr | 0 | None | 0 | None | Yes |
| | | | 1 | All | | | |
| | | | 2 | Pump 1 | | | |
| | | | 3 | Pump 2 | | | |
| | | | 4 | Pump 3 | | | |
| | | | 5 | Pump 4 | | | |
| | | | 6 | Pump 5 | | | |
| | | | 7 | Pump 6[5] | | | |
| | | | 8 | Pump 7 | | | |
| | | | 9 | Pump 8 | | | |

[1] Set PID-01 to 'Yes' to configure AP1-40.

[2] Set AP1-40 to 'Contactor Lag' to configure AP1-41

[3] When AP-01 is set to "1" enter motor number. When set to "2", "3" or "4" enter the Drive ID.

[4] API-60 only appears when AP1-40 is set to '3', Fixed Lag.

[5] Aux motors - Outputs #6, #7 and #8 (AP1-75 ~ AP1-77 and AP1-85 ~ AP1-87) only available with Extended IO Card option installed.

# 8 Application Group 1, AP1 Parameter Descriptions

| Parameter | Description |
|---|---|
| AP1-20<br>Soft Fill Sel | • No - Disables Pre-PID and Soft Fill<br>• Yes - There are two separate operations. Setting AP1-20 to "Yes" enables both Pre-PID and Soft Fill operations.<br>▪ First: Pre-PID based on AP1-21 (Pre-PID Frequency) and AP1-22 (Pre-PID Delay Time). The drive will simply ramp to the AP1-21 Frequency and remain there for the AP1-22 Time. If the feedback pressure goes above the AP1-23 (Soft Fill Set) amount, drive will exit Pre-PID and go into normal PI operation.<br>▪ Second: Soft Fill operation automatically changes the PI Reference (setpoint) set in PID-10 and PID-11 to a "Soft Fill" PI Reference (setpoint). The Soft Fill PI Reference performs a series of steps that increase over time to slowly fill a piping system. The steps are defined by parameters AP1-23, AP1-24 and AP1-25. |
| AP1-21<br>Pre-PID Freq | • The drive will ramp up to the set Pre-PID frequency. It will remain there for the Delay time AP1-22 (Pre-PID Delay Time) then go into Normal PI Control. If the feedback exceeds the amount set in AP1-23 (Soft Fill Set) before the delay time, the drive will exit Pre-PID and go into Normal PI operation. |
| AP1-22<br>Pre-PID Delay | • Time to operate in Pre-PID mode at frequency set in AP1-21 (Pre-PID Freq). |
| AP1-23<br>Soft Fill Set | • When feedback reaches this PSI amount (or other PID Units) at any time during Pre-PID or Soft Fill, the drive exits the operation and goes into normal PI operation. If drive was in the Soft Fill operation, the PI Ref (setpoint) resorts back to the setpoint value (PID-11) instead of the Steps defined in AP1-24 and AP1-25. |
| AP1-24<br>Fill Step Set | • After Pre-PID operation time, if feedback has not reached the AP1-23 (Soft Fill Set) exit amount, the PI Reference (setpoint) will automatically change to this setpoint AP1-24 (Soft Fill PI Reference) amount and start the Soft Fill operation. The "Soft Fill PI Reference" becomes the new PI setpoint. Soft Fill steps are based on AP1-24 and AP1-25. |
| AP1-25<br>Fill Step Time | • This is the time of each step AP1-24 (Soft Fill Set). The step will increase by the AP1-24 amount when the feedback reaches the Fill Feedback Difference (AP1-26). If the feedback remains below the Soft Fill Set, the drive does not increase to the next step. |
| AP1-26<br>Fill Fdb Diff | • This is the difference between the Soft Fill Set PI Reference (AP1-24) amount and the feedback pressure. When the feedback increases to the AP1-26 amount below the step amount (whichever step it is on), the drive increases the Soft Fill Set PI Ref. to the next step. If the feedback remains below the AP1-26 amount, the Soft Fill PI Ref. does not increase to the next step. |
| AP1-30<br>Flow Comp Sel | • No - Disables Flow Compensation operation.<br>• Yes - Enables Flow Compensation<br>▪ Compensates for pressure loss due to long pipes and/or higher flow rates. The maximum amount of compensation is set in AP1-31. |
| AP1-31<br>Max Comp Value | • The maximum compensation amount (PID Units) that is added to the PID-11 (PID Ref 1 Set) setpoint. The compensation amount varies based on the follow:<br>• $\text{Compensation amount} = \frac{\text{Out Freq} - \text{Start Freq}}{\text{MaxFreq} - \text{Start Freq}} * (\text{PID} - 53) * \frac{(\text{AP1} - 31)}{100\%}$ |
| AP1-40 / MC2-03<br>Lead Lag Sel | • Selecting MMC or Lead/Lag operation.<br>▪ Contactor Lag: MMC operation.<br>▪ Follow Lead: This is a Lead/Lag control method with one PID-controlled Main drive and all of the Lag drives operate at the same frequency as the Main drive. Drives with this setting can become a Lead (+) drive but must also have feedback connected. See *Section 9, Lead/Lag - Follow Lead.* |

| Parameter | Description |
|---|---|
| | ▪ Fixed Lag: This is a Lead/Lag control method with one PID-controlled Main drive and all of the Lag drives operate at a fixed frequency. See parameter AP1-60, Lag Freq. Drives with this setting can become a leader drive but must also have PID feedback connected. See *Section 10, Lead/Lag - Fixed Lag*<br>▪ Network Fbk: For Lag drives only. A method of operation for all Lag drives that operate in accordance with the Lead (+) drive setting of Follow Lead or Fixed Lag. A drive with this setting cannot be a Lead (+) drive and thus a feedback connection is not required. |
| AP1-41<br>Regular Bypass | • For MMC (Contactor Lag) control only.<br>▪ Regular bypass mode is a function that disables the PI Control and drive/motor speed is based on the feedback signal.<br>▪ Not used with Follow Lead, Fixed Lag or Network Feedback. |
| AP1-42 / MC2-07<br>* of Pumps | • For MMC, (Contactor Lag)<br>▪ Sets the number of AUX Motors to operate with MMC<br>• For Follow Lead, Fixed Lag<br>▪ Sets the total number of drives/pumps *connected* to the Lead/Lag system. This number may be higher than the number of drives that are actually *operated* by lead/lag operation. See AP1-94 (* Of Drives). If AP1-42 is set higher the AP1-94, the remaining drives become standby drives. Standby drives can become part of the alternation sequence.<br>See *Section 17, Standby*<br>• For Network Fbk<br>▪ The parameter is not used. |
| AP1-43 / MC2-18<br>Run Priority | ● For MMC (Contactor Lag)<br>■ Set the motor number for the first priority motor. The priority will automatically change based on the setting of the Alternation Sequence AP1-49 (ALT Sequence) during operation.<br>● For Follow Lead, Fixed Lag, Network Fbk<br>■ Set the Drive ID (based on COM-01) for the first priority. The priority will automatically change based on the setting of the Alternation Sequence AP1-49 (ALT Sequence) during operation.<br>● For Jockey Pumps, when AP1-88 (Jockey Pump) is set to “Yes”, and AP1-49 (ALT Sequence) is set to Op Time Order, parameter setting is not possible. |
| AP1-44 / MC2-19<br>Lag Pump Run<br>(View Only) | ● For MMC (Contactor Lag)<br>■ Displays the number of AUX motors in operation, excluding Main Motor.<br>● For Follow Lead, Fixed Lag<br>■ Displays the number of Lag drives/motors in operation, excluding Main drive. |
| AP1-45 / MC2-20<br>Curr Prty 1<br>AP1-46 / MC2-21<br>Curr. Prty 2<br>(View Only) | ● For MMC (Contactor Lag)<br>■ Displays the run priorities of the motors operated by MMC.<br>● For Follow Lead, Fixed Lag, Network Fbk<br>■ Displays the run priorities of the drives operated by Lead/Lag.<br>● Each digit represents the motor number (Drive ID), and the number displayed in each digit represents priority.<br>● Example: When 4321 is displayed, Motor 1 (Drive ID 1) priority is first, and Motor 2 (Drive ID 2) priority is |

| Parameter | Description |
|---|---|
| | second. Operation is in the order of 1-2-3-4. |
| AP1-47 / MC2-22<br>Lead Lag Status<br>(View Only) | • For MMC (Contactor Lag)<br>  ■ The parameter is not used.<br>• For Follow Lead, Fixed Lag, Network Fbk<br>  ■ It displays current Lead/Lag operation status of the specific drive (Trip, Manual, Interlock, Standby, Sleep, Stop, Ready, Proc PID or Constant). |
| AP1-48 / MC2-23<br>Lag Stop Sel | • Sets whether to stop all drives (motors) simultaneously when the start/run command is removed from the Lead (+) drive.<br>• If “No”<br>  ■ When the start/run command is removed from Lead (+) drive, it stops based on delay time AP1- 54 (Destage DT) and becomes standby drive (“F0” status). Lag drive can become Lead (+) drive and operation can continue. With next start of standby drive (showing “F0”), it becomes Lag drive.<br>• If “Yes”<br>  ■ When the start/run command is removed from Lead (+) drive, all drives/motors are stopped simultaneously.<br>• For Network Fbk<br>  ■ The parameter is not used. |
| AP1-49 / MC2-04<br>ALT Sequence | • Sets the operating sequence.<br>• For **MMC** (Contactor Lag), Fixed Lag and Follow Lead<br>• **FILO** (First In Last Out)<br>  ■ Stops in the reverse order in which motors were started. When motors start in the order of 1-2-3-4, they stop in the order of 4-3-2-1.<br>• **FIFO** (First In First Out)<br>  ■ Stops in the same order in which motors were started. When motors start in the order of 1-2-3-4, they stop in the order of 1-2-3-4.<br>• **Op Time Order**<br>  ■ The sequence is automatically determined according to the operation time of each drive/motor.<br>  ■ Example: When Motor 1,2,3,4 (Drive ID’s 1,2,3,4) operation time is 6h, 9h, 8h, 7h, the operating sequence will be Motor (Drive ID) 1-4-3-2, and they will stop in the order of 2-3-4-1.<br>• **For Network Fbk**<br>  ■ The parameter is not used. |
| AP1-50 / MC2-11<br>Stage Pres. Dv | • One of the conditions for Lag drive (or Aux) to operate (stage). It is the difference between the PID feedback and the PID reference (setpoint). Above or below setpoint is based on PID-36 (PID Output Inverse) setting.<br>  ■ For PID-36 set to “No” (normal PID), it is deviation below setpoint.<br>  ■ For PID-36 set to “Yes” (Inverse PID), it is deviation above setpoint.<br>• For Network Fbk<br>  ■ The parameter is not used. |
| AP1-51 | • For MMC (Contactor Lag) |

| Parameter | Description |
|---|---|
| Aux Acc Time | ■ Sets the acc. time of Main drive (motor) when Aux Motor stops.<br>● For Follow Lead, Fixed Lag, Network Fbk<br>■ The parameter is not used. |
| AP1-52<br>Aux Dec Time | ● For MMC (Contactor Lag)<br>■ It sets the decel time of Main drive (motor) when Aux Motor starts.<br>● For Follow Lead, Fixed Lag, Network Fbk<br>■ The parameter is not used. |
| AP1-53 / MC2-12<br>Stage DT | ● Sets the delay time to start Lag drive (or AUX motor) when all the conditions for staging are met.<br>● When the following conditions are met, staging is performed according to priority.<br>■ For MMC (Contactor Lag)<br>◆ The output frequency of Main drive is higher than the next priority AUX's [Stage Freq]. Example: When the priority order is 1,2,3,4, and 1,2 are operating, the next AUX motor to be staged is AUX motor 3, and the Main drive's output frequency has to be higher than AP1-63 (Stage Freq 3).<br>◆ When PID feedback deviation exceeds the PID reference (setpoint) by AP1-50 (Stage Pres. Dv).<br>◆ And the above conditions are maintained for the AP1-53 (Stage DT) delay time.<br>■ For Follow Lead, Fixed Lag<br>◆ The output frequency of the Main drive is higher than AP1-61 (Stage freq1).<br>◆ When PID feedback deviation exceeds the PID reference (setpoint) by AP1-50 (Stage Pres. Dv).<br>◆ And the above conditions are maintained for the AP1-53 (Stage DT) delay time.<br>● For Network Fbk<br>■ The parameter is not used. |
| AP1- 54 / MC2-13<br>Destage DT | ● Sets the delay time to stop Lag drive (or AUX motor) when all the conditions for de-staging are met.<br>● When the following conditions are met, de-staging is performed according to priority.<br>■ For MMC (Contactor Lag)<br>◆ The output frequency of Main drive is less than the next priority AUX's Destage Freq. Example: When the priority order is 1,2,3,4 in FILO mode, and 1,2 are operating, the next AUX motor to be de-staged is AUX motor 2, and the Main drive's output frequency has to be less than AP1-71 (Destage Freq 2).<br>◆ When PID feedback deviation exceeds the PID reference (setpoint) by AP1-59 (Destage Pres).<br>◆ And the above conditions are maintained for AP1-54 (Destage DT) delay time.<br>■ For Follow Lead, Fixed Lag<br>◆ The output frequency of the Main drive is less than AP1-70 (Destage freq1).<br>◆ When PID feedback deviation exceeds the PID reference (setpoint) by AP1-59 (Destage Pres).<br>◆ The above conditions are maintained for AP1-54 (Destage DT) delay time.<br>● For Network Fbk<br>■ The parameter is not used. |

| Parameter | Description |
|---|---|
| AP1-55<br>Alternate Mode | • For MMC (Contactor Lag), it sets alternating operation.<br>▪ None<br>◆ Alternate operation is not activated.<br>▪ Aux Exchange<br>◆ Alternate operation is activated for AUX motors only, excluding the Main motor.<br>▪ Main Exchange<br>◆ Alternate operation is activated for AUX motors and includes the Main motor.<br>• The following conditions must be met for Alternate operation.<br>▪ The Alternating Timer AP1-58 (Alt Timer Disp) is higher than the set value of AP1-56 (Alternate Time).<br>▪ All AUX (auxiliary) motors are off.<br>▪ The output frequency of the Main motor connected to the drive is equal to or less than the alternate level AP1-57 (AlternateLevel).<br>• For Follow Lead, Fixed Lag, Network Fbk<br>▪ The parameter is not used. |
| AP1-56 / MC2-05<br>Alternate Time | • Set the time to alternate drives/motors/pumps. |
| AP1-57<br>Alternate Level | • Sets the Alternate operation frequency.<br>• For Follow Lead, Fixed Lag, Network Fbk<br>▪ The parameter is not used. |
| AP1-58 / MC2-06<br>Alt Timer Disp<br>(View Only) | • Timer display for alternation<br>• For MMC (Contactor Lag)<br>▪ Aux Exchange AP1-55 (Auto Ch Mode)<br>◆ Operating time is counted for AUX motors only, excluding the Main motor connected to the drive.<br>◆ When AP1-58 (Alt Timer Disp) reaches the AP1-56 (Alternate Time), Alternate operation is performed according to AP1-49 (ALT Sequence). The time is initialized to 00:00.<br>See *Section 14, Alternate Time*<br>▪ Main Exchange AP1-55 (Auto Ch Mode<br>◆ Operating time is counted for AUX motors and includes the Main motor.<br>• For Follow Lead, Fixed Lag<br>▪ Operating time is counted while more than one motor is operating including the main motor.<br>• For Network Fbk<br>▪ The parameter is not used. |
| AP1-59 / MC2-14<br>Destage Pres. | • One of the conditions for Lag drive (or Aux) to stop (de-stage). It is the difference between the PID feedback and the PID reference (setpoint). Above or below setpoint is based on PID-36 (PID Output Inverse) setting.<br>▪ For PID-36 set to “No” (normal PID), it is deviation above setpoint. |

| Parameter | Description |
|---|---|
| | ■ For PID-36 set to “Yes” (Inverse PID), it is deviation below setpoint.<br>● For Network Fbk<br>■ The parameter is not used. |
| AP1-60 / MC2-15<br>Lag Freq | ● For Fixed Lag only<br>■ Sets the operating frequency of the Lag motors.<br>● For MMC (Contactor Lag), Follow Lead, Network Fbk<br>■ The parameter is not used. |
| AP1-61 / MC2-16<br>Stage Freq 1<br>through<br>AP1-68<br>Stage Freq 8 | ● For MMC (Contactor Lag)<br>■ Staging frequency for AUX Motor’s 1 ~ 8 based on the output frequency of the Main drive.<br>Example: When priority is 1,2,3,4, and AUX motors 1 and 2 are operating, staging conditions for AUX 3 are met only when the output frequency of the Main drive reaches AP1-63 (Stage Freq 3) or higher.<br>● For Follow Lead, Fixed Lag, Network Fbk<br>■ AP1-61 Stage Freq 1 is the only one used. It is the staging frequency for the Lag motor(s) to start based on the output frequency of the Main drive.<br>■ AP1-62 (Stage Freq 2) ~ AP1-68 (Stage Freq 8) are not used. |
| AP1-70 / MC2-17<br>Destage Freq 1<br>through<br>AP1-77<br>Destage Freq 8 | ● For MMC (Contactor Lag)<br>■ De-staging frequency for AUX Motor’s 1 ~ 8 based on the output frequency of the Main drive.<br>Example: When priority is 1,2,3,4, and AUX motors 1 and 2 are operating, de-staging conditions for AUX 2 are met only when the output frequency of the Main drive reaches AP-71 (Destage freq2) or less.<br>● For Follow Lead, Fixed Lag, Network Fbk<br>■ AP1-70 (Destage Freq 1) is the only one used. It is the de-staging frequency for the Lag drives/motors to stop and is based on the output of the Main drive.<br>■ AP1-71 (Destage Freq 2) ~ AP1-77 (Destage Freq 8) are not used. |
| AP1-78 / MC2-24<br>DataShare | ● For Follow Lead and Fixed Lag<br>■ This function allows certain parameters entered at the Lead (+) drive to be shared automatically with Lag drives.<br>◆ None<br>Parameter data is not shared.<br>◆ Auto<br>When changing parameters designated as DataShare “Yes” in the Lead drive, it is shared with connected Lag drives. Drives must be in the Ready mode (AUTO LED blinking).<br>◆ Manual<br>With parameters set at the Lead (+) drive, all parameters in the shared list are shared with Lag drives. Drives must be in the Ready mode (AUTO LED blinking).<br>◆ See *Section 20, Data Share*<br>● For MMC (Contactor Lag) and Network Fbk<br>■ The parameter is not used. |
| AP1-79 / MC2-25 | ● Sets whether to trigger a fault (CommErr) for Lead/Lag drives in the event of communication error. |

| Parameter | Description |
|---|---|
| All CommErr | ● For MMC (Contactor Lag)<br>■ The parameter is not used.<br>● For Follow Lead and Fixed Lag<br>■ No<br>{Comm Err!!} Trip is triggered only for drive with communication error.<br>■ Yes<br>{Comm Err!!} Trip is triggered for all drives when communication error occurs.<br>● For Network Fbk<br>■ {Comm Err!!} Trip does not occur.<br>■ The parameter is not used.<br>See *Section 21, Troubleshooting Communication Problems in Lead/Lag Operation* |
| AP1-80<br>Aux1 Ref Comp<br>through<br>AP1-87<br>Aux8 Ref Comp | ● For MMC (Contactor Lag)<br>● Set an amount (%) to increase the PID reference value (setpoint) when the corresponding AUX motor (1~8) is staged. This helps with pressure loss when flow rate increases.<br>■ The % value set in AP1-80 through AP1-87 (Aux Ref Comp) is added to the PID reference when the corresponding AUX motor is turned on. Related to the number in AP1-44 (Lag Pump Run).<br>■ Example: When the number in AP1-44 (Lag Pump Run) becomes 1, the % value in AP1-80 (Aux1 Ref Comp) is added to PID reference.<br>See AP1-44 Lag Pump Run Parameter description<br>● AP1-87 (Aux8 Ref Comp) is only used when all the following conditions are met. (If the conditions are not met, the value of AP1-44 (Lag Pump Run) cannot be “8”.)<br>■ AP1-40 (Lead Lag Sel) is set as Contactor Lag<br>■ AP1-55 (Auto Ch Mode) is set as Aux Exchange<br>■ Extended I/O option is connected<br>■ 8 output relays are set to “MMC”<br>■ AP1-42 (* of Pumps) is set to “8”<br>● For Network Fbk<br>■ The parameter is not used. |
| AP1-88 / MC2-26<br>Jockey Pump | ● Sets whether to operate a Jockey Pump.<br>● Only Lead (+) drive can be set.<br>● For Follow Lead and Fixed Lag<br>■ No<br>Do not use the Jockey Pump function.<br>■ Yes<br>Use the Jockey Pump function.<br>See *Section 12, Jockey Pump*<br>● For MMC (Contactor Lag) and Network Fbk<br>■ The parameter is not used. |

| Parameter | Description |
|---|---|
| AP1-89 / MC2-27<br><br>Jockey Dly T | ● Sets the delay time to stop Jokey pump.<br>● For MMC (Contactor Lag) and Network Fbk<br>■ The parameter is not used. |
| AP1-90 (Interlock)<br><br>Ext. Mtr OL | ■ Yes/No |
| AP1-91 (Interlock)<br><br>Ext. Mtr OL T | ● Sets the delay time when exchanging the Main motor.<br>● For MMC (Contactor Lag), when AP1-55 (Auto Ch Mode) is Main Exchange, the delay time is applied in the following events.<br>■ When the Main motor needs to be changed because an interlock was input for the Main motor.<br>■ When the Main motor needs to be changed by the Alternate operation.<br>● For Follow Lead, Fixed Lag, Network Fbk<br>■ The parameter is not used. See *Section 13, Interlock Trip*. |
| AP1-94 / MC2-08<br><br>* Of Drives | ● For Follow Lead, Fixed Lag, Network Fbk<br>● Sets the number of drives that are actually ***operated*** by the Lead/Lag system.<br>■ Sets the number of drives ***operated*** in the Lead/Lag system. Compared to AP1-42 (* of Pumps) which is the number of drives ***connected*** and can be larger than AP1-94. EX: if AP1-42 is set to "8" and AP1-94 is set to "5", only 5 drives are used, and 3 drives are in standby mode. Standby drives can become part of the alternation sequence.<br>See *Section 17, Standby*<br>● For MMC (Contactor Lag)<br>■ The parameter is not used. |
| AP1-95 / MC2-28<br>RunTimeMonitor | ● Shows the Pump number corresponding to the (Drive ID) set at COM-01.<br>■ For the pump number (Drive ID) displayed, view Run Time parameters AP1-96 (PmpRunTime Day) and AP1-97 (PmpRunTime Min).<br>● Lead (+) drive can select all drive ID's to view Run Time parameters.<br>● Lag Drives will show their own ID number and cannot select other drive ID's. |
| AP1-96 / MC2-29<br>PmpRunTime Day | ● Displays the number of operating days of the pump number (Drive ID) selected in AP1-95 (RunTimeMonitor). |
| AP1-97 / MC2-30<br>PmpRunTime Min | ● Displays the accumulated operating time (Hr:Min) of the pump number (Drive ID) selected in AP1-95 (RunTimeMonitor).<br>■ When the operating time becomes 24:00, it changes to 00:00 and AP1-96 (PmpRunTime Day) increases by one day.<br>● NOTE: Parameters AP1-96 and AP1-97 are programmable. The run time can be set for a motor/pump that has been in operation. |
| AP1-98 / MC2-31<br>PmpRunTime Clr | ● Resets the time of the selected pump number (Drive ID) in AP1-95. Resets both AP1-96 (PmpRunTime Day) and AP1-97 (PmpRunTime Min). |

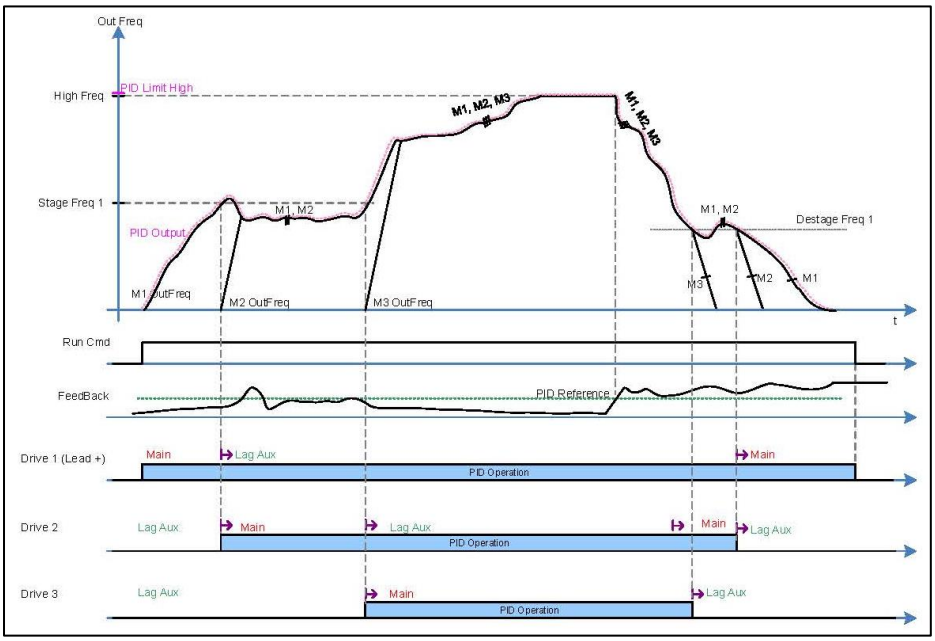
# 9 Lead/Lag - Follow Lead

Control Mode for multiple drives where the Main drive is PI controlled all running Lag (Aux) drives/motors operate at the same PID output frequency as the Main drive. During staging/de-staging, a shift of the Main PI controlled drive occurs. With actual feedback wired to Drive 1 only, Drives 2 and 3 receive the feedback signal through Modbus communications. Note that the Lead (+) drive (controlling communications) does not change, only the Main PI controlled drive changes.

The following figure shows the basic operating sequence for Follow Lead operation for Drives 1, 2 and 3. In this case the alternating sequence AP1-49 (ALT Sequence) is set to FILO (First In Last Out) and the run priority AP1-45 (Curr. Prty 1) is 0321. Run priority means that Drive 1 is the first priority and Drives 2 and 3 are 2nd and 3rd priority. With FILO, the motor starting order is Motor 1 (M1) -> Motor 2 (M2) -> Motor 3 (M3). Motor stopping order is Motor 3 (M3) -> Motor 2 (M2) -> Motor 1 (M1).

## 9.1 Follow Lead - Conditions for Staging Lag Drives

1. Feedback is below the setpoint PID-11 (PID Ref 2 Set) and below the deviation amount AP1-50 (Stage Pres. Dv).
2. Output Frequency of the Main Drive reached stage frequency AP1-61 (Stage Freq 1).
3. The stage delay time AP1-53 (Stage DT) has expired.




**Follow Lead - FIFO**

## 9.2 Follow Lead - Staging Details

With the start of Drive 1 which is the Lead (+) and the Main drive, the speed ramps up. If the three staging conditions are met, (feedback below setpoint, operating frequency reaches staging frequency and the delay time has expired), Drive 2 (M2) starts **and now becomes the Main PI controlled drive. Drive 1 (M1) becomes the Lag (Aux) drive and follows the output of Drive 2. There is a shift in the Main PI controlled drive from Drive 1 to Drive 2.** If feedback still remains below the setpoint, Lag Drive 3 (M3) will start **and now Drive 3 becomes the Main PI controlled drive. There is a shift in the Main PI controlled drive from Drive 2 to Drive 3. Drive 2 becomes another Lag (Aux) drive,** the 2nd Lag drive in operation. Lag Drives 1 and 2 will still follow the Main PI controlled Drive output, which is now Drive 3 (M3).

### 9.3 Follow Lead - Conditions for De-staging Lag Drives

1. Feedback is above the setpoint PID-11 (PID Ref 1 Set).
2. Output Frequency of the Main drive reached the De-stage frequency AP1-70 (Destage Freq 1) for the Lag drive.
3. The De-Stage delay time AP1-54 (Destage DT) has expired.

### 9.4 Follow Lead - De-staging Details

Three drives/motors/pumps are running and Drive 3 is the Main PI controlled drive. The feedback has increased to a level above the setpoint. When the three conditions are met ((feedback above setpoint, operating frequency reaches de-staging frequency and the delay time has expired), the Main drive decelerates and eventually stops. With FILO operation, Drive 3 (M3) is the first to stop. Since Drive 3 (M3) is the Main PI controlled drive, a shift occurs making Drive 2 (M2) the Main drive. As de-staging continues, Drive 2 (M2) decelerates and stops. Since Drive 2 is now the Main PI controlled drive, a shift occurs making Drive 1 (M1) the Main drive. At this time, Drive 1 (M1) is operating as the Main drive and continues PI control. If the feedback continues to be above the setpoint, it will also eventually stop or go into Sleep mode, if set. This is the **Last Out** for the FILO setting.

**Other Conditions**

Priority - The drive priority AP1-45 (Curr. Prty 1) can be viewed as the running order. The 4 digits (0321) represent the first 4 drives. Since only 3 are in the example Lead/Lag system, it shows as 0321. The run priority for each drive is also shown on each drive's LCD at the top center of the display. See *Section 3.1, Status*.

Parameter AP1-44, Lag Pump Run. This is simply the number of Lag drives (only) running and changes as Lag drives are operated.

The actual acceleration/deceleration times of the output frequency will vary based on a combination of PID-25 (PID P-Gain 1) of the drive and DRV-03 (Acc Time), DRV-04 (Dec Time) in each drive.

Lead (+) Change - The Lead (+) drive can change if the Lead (+) drive trips or is manually stopped. Run priority will change on Start/Stops and Sleep mode. See *Section 16, Lead Change.*

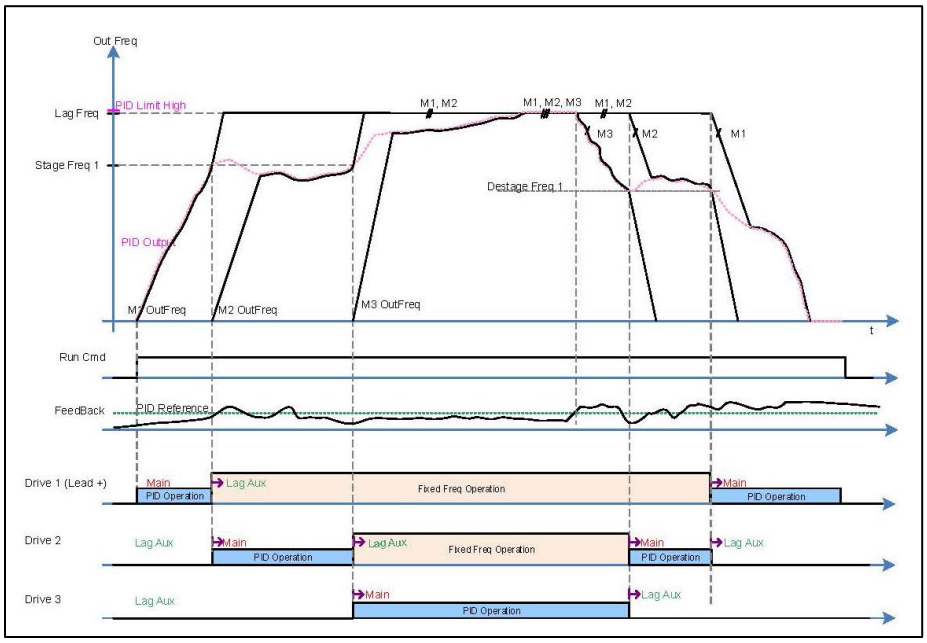
# 10 Lead/Lag - Fixed Lag

Control Mode for multiple drives where the Main drive is PI controlled and all Lag (Aux) drives/motors operate at a fixed frequency, AP1-60 (Lag Freq). During staging/de-staging, a shift of the Main PI controlled drive occurs. With actual feedback wired to Drive 1 only, Drives 2 and 3 receive the feedback signal through Modbus communications. Note that the Lead (+) drive (controlling communications) does not change, only the Main PI controlled drive changes.

The following figure shows the basic operating sequence for Fixed Lag operation with Drives 1, 2 and 3. In this case the alternating sequence AP1-49 (ALT Sequence) is set to FILO (First In Last Out) and the run priority AP1-45 (Curr. Prty 1) is 0321. Run priority means that Drive 1 is the first priority and the Drives 2 and 3 are 2nd and 3rd priority. With FILO, the motor starting order is Motor 1 (M1) -> Motor 2 (M2) -> Motor 3 (M3). Motor stopping order is Motor 3 (M3) -> Motor 2 (M2) -> Motor 1 (M1).

## 10.1 Fixed Lag - Conditions for Staging Lag Drives

1. Feedback is below the setpoint PID-11 (PID Ref 1 Set) and below the deviation amount AP1-50 (Stage Pres. Dv).
2. Output Frequency of the Main Drive reached the stage frequency AP1-61 (Stage Freq 1) of the Lag drive.
3. The stage delay time AP1-53 (Stage DT) has expired.




**Fixed Lag - FILO**

## 10.2 Fixed Lag - Staging Details

With the start of Drive 1 which is the Lead (+) and the Main drive, the speed ramps up. If the three staging conditions are met, (feedback below setpoint, operating frequency reaches staging frequency and the delay time has expired), Drive 2 (M2) starts **and now becomes the Main PI controlled drive. Drive 1 (M1) becomes a Lag (Aux) drive and runs at the Fixed Lag frequency. There is a shift of the Main PI controlled drive from Drive 1 to 2.** If feedback still remains below the setpoint, Drive 3 (M3) will start and **now Drive 3 becomes the Main PI controlled drive. There is a shift of the Main drive from Drive 2 to 3. Drive 2 becomes another Lag (Aux) drive,** the 2nd Lag drive in operation. Drives 1 and 2 run at the Fixed Lag frequency. Drive 3 is operating with PI control as the Main drive.

### 10.3 Fixed Lag - Conditions for De-staging Lag Drives

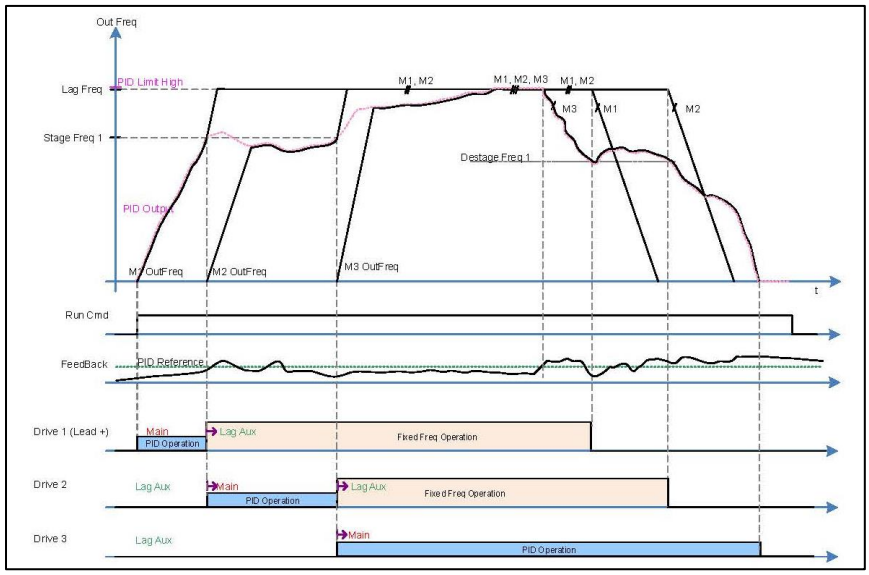
1. Feedback is above the setpoint PID-11 (PID Ref 1 Set).
2. Output Frequency of the Main drive reached the De-stage frequency AP1-70 (Destage Freq 1) for the Lag drive.
3. The De-Stage delay time AP1-54 (Destage DT) has expired.

### 10.4 Fixed Lag - De-staging Details

Three drives/motors/pumps are running and Drive 3 is the Main PI controlled drive. The feedback has increased to a level above the setpoint. When the three conditions are met ((feedback above setpoint, operating frequency reaches de-staging frequency and the delay time has expired), the Main drive decelerates and eventually stops. With FILO operation, Drive 3 (M3) is the first to stop. Since Drive 3 (M3) is the Main PI controlled drive, a shift occurs making Drive 2 (M2) the Main drive. As de-staging continues, Drive 2 (M2) decelerates and stops. Since Drive 2 is now the Main PI controlled drive, a shift occurs making Drive 1 (M1) the Main drive. At this time, Drive 1 (M1) is operating as the Main drive and continues PI control. If the feedback continues to be above the setpoint, it will also eventually stop or go into Sleep mode, if set. This is the **Last Out** for the FILO setting.

### 10.5 Fixed Lag FIFO - First In First Out

The above describes de-staging of the FILO (First In Last Out) setting. Parameter AP1-49 (ALT Sequence) can be set to FIFO (First In First Out). With this setting, de-staging sequence changes. Below shows with Drive 3 (M3) as the Main Drive, First Out is Drive 1 (M1), then Drive 2 (M2).




**Fixed Lag - FIFO**

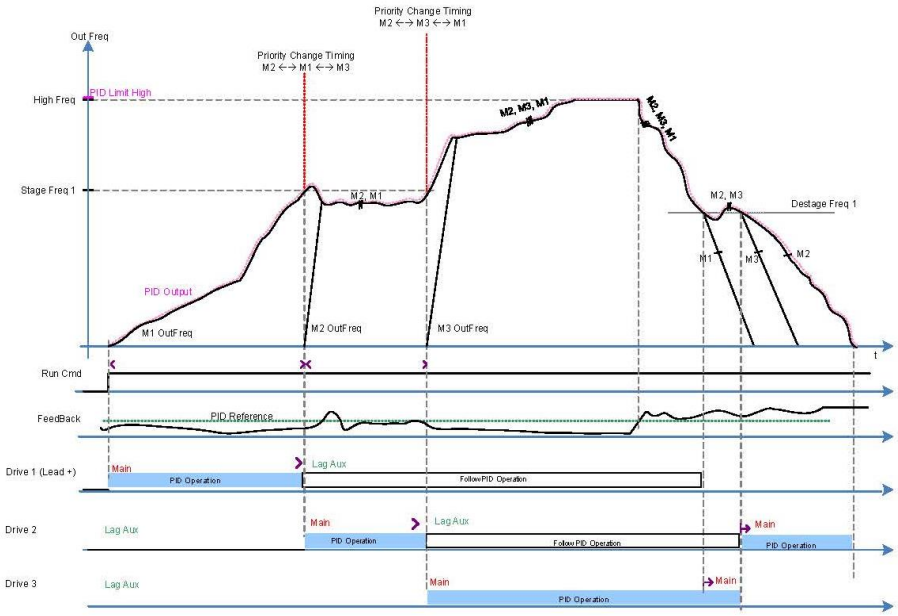
# 11 Priority Change based on Operation Time

When Alternating Sequence, AP1-49 (ALT Sequence) is set to operating time (Op time Order), the run priority of each drive/motor/pump is automatically arranged according to its operating time. Run priority can be viewed at parameters AP1-45 (Curr. Prty 1) and AP1-46 (Curr. Prty 2).

| Macro Parameter | Original Parameter | Display | Setting Range | Default | Unit | NOTES | |
|---|---|---|---|---|---|---|---|
| MC2-20 | AP1-45 | Curr. Prty 1 | View Only | - | - | 4321 | 4 digits representing first 4 drives. If only 2 drives are used, shows 0021 |
| MC2-21 | AP1-46 | Curr. Prty 2 | View Only | - | - | 8765 | 4 more, representing drives 5 ~ 8 |

Each of the four digits represent the motor number (Drive ID), and the number displayed in each position represents run priority from right to left. EX: AP1-45 is shown as 0321, Motor 1 (M1) will start first, then M2, etc. The run priority is also shown on each drive's LCD at the top center of the display. See *Section 3.1, Status*. The drive/motor/pump with the longest operating time among the operating motors is moved to lowest priority (last position). The run priority will change when the number of motors in operation increases or decreases. Priority is also arranged separately for operating motors and stopped motors. See *Section 15, Priority Change based on User Setting Time.*

The below figure shows the case where [AP1-49 ALT Sequence] is set to Op Time Order in Follow Lead mode and Drive 1 (M1) has the longest operating time. The initial run priority is 0321. When Drive 2 (M2) starts, the priority is changed to 0312. This puts Drive 2 ahead of Drive 1 for the next start. Drive 3 (M3) is shown as lowest priority as it is stopped. When Motor 3 (M3) starts, priority changes to 0132. Now run priority is Drive 2, Drive 3 then Drive 1. During the de-staging, Drive 1 is stopped first, Drive 3 is stopped second and lastly Drive 2. The starting order for the next start will be Drive 2 (M2), Drive 3 (M3), Drive1 (M1). Parameter AP1-45 is shown as 0132.




**Follow Lead - Operating Time**

# 12 Jockey Pump

"Jockey Pump" refers to a pump whose purpose is to maintain the pressure in a system at a specific level when there are pressure losses in the pipe system due to light usage or no usage. It prevents frequent starting of the main pumps.

| Macro Parameter | Original Parameter | Name | LCD Display | Setting Range | | Default | |
|---|---|---|---|---|---|---|---|
| MC2-26 | AP1-88 | Jockey Pump operation selection | Jockey Pump | 0<br>1 | No<br>Yes | 0 | No |
| MC2-27 | AP1-89 | Jockey Pump stop delay time | Jockey Dly T | 0.00 - 60.00 (sec) | | 20.00 | |

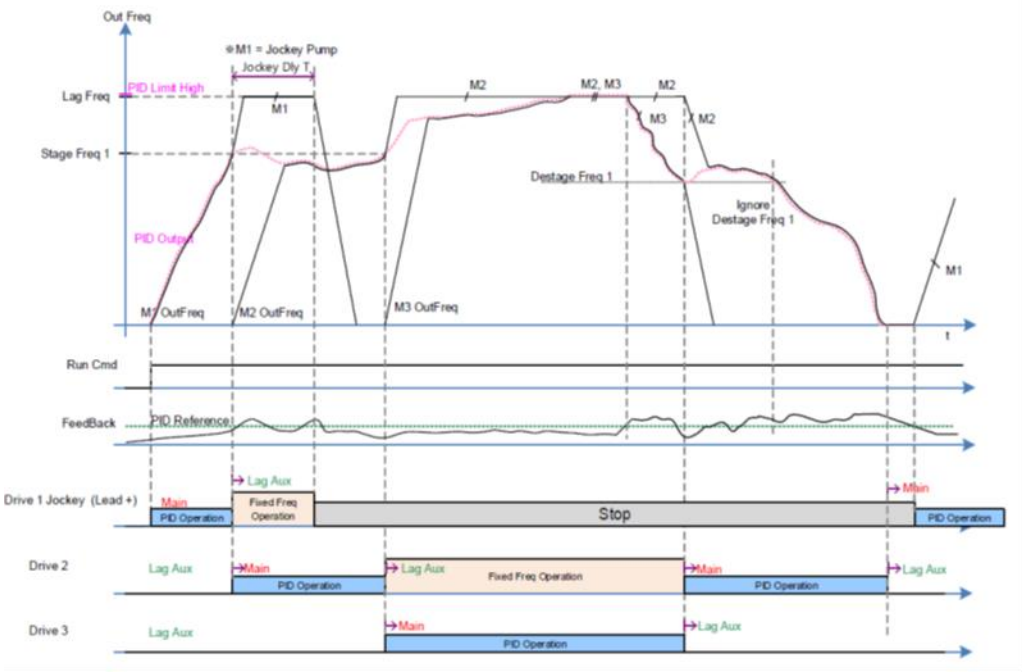
Set the Lead (+) drive as the Jockey Pump drive (MC2-26 to “Yes”). This is typically Drive ID #1. If the Jockey Pump drive can build and maintain pressure, it will be the only one to operate. If it cannot build pressure, a Lag drive will operate. With a Lag drive running, the Jockey Pump drive will run for the stop delay time set in MC2-27 (Jockey Dly T) then stop.

Conditions for Jockey Pump starting.

1. Drive is in Ready mode (with run command applied).
2. Feedback is below the setpoint PID-11 (PID Ref 1 Set) and below the deviation amount AP1-50 (Stage Pres. Dv).
3. If in Sleep mode, the first drive to start (Wake-Up).
4. All other motors are stopped.

Conditions for Jockey Pump stopping.

1. Drive has been stopped manually (run command removed).
2. Feedback went above the setpoint PID-11 (PID Ref 1 Set).
3. When jockey pump delay time AP1-89 (Jockey Dly T) has expired after Lag (Aux) motor has been running.




**Jockey Pump Operation**

**Jockey Pump Operation - Staging Details**

With the start of Drive 1 which is the Jockey Pump Lead (+) drive, the speed ramps up because of the low feedback. If the feedback pressure had increased above the setpoint (not shown), Drive 1 would decelerate to a stop and other motors would not run. Since the pressure did not build up, Drive 2 starts based on the three staging conditions (feedback below setpoint, frequency of Drive 1 reaches staging frequency and the delay time has expired). Drive 2 (M2) starts **and now becomes the Main PI controlled drive. Drive 1 (M1) becomes a Lag (Aux) drive and runs at the Fixed Lag frequency. There is a shift of the Main PI controlled drive from Drive 1 to 2.** After the Jockey pump delay time AP1-89 (Jockey Dly T) has expired, Drive 1 (Jockey) will stop. If feedback still remains below the setpoint, Drive 3 (M3) will start and **now Drive 3 becomes the Main PI controlled drive. There is a shift of the Main drive from Drive 2 to 3. Drive 2 becomes a Lag (Aux) drive** and runs at the Fixed Lag frequency. Drive 3 is operating with PI control as the Main drive.

**Jockey Pump Operation - De-staging Details**

Drive 1 (Jockey) had stopped after Drive 2 started and after the Jockey delay time. With two drives/motors/pumps running, Drive 3 is the Main PI controlled drive. The feedback has increased to a level above the setpoint. When the three conditions for de-staging Lag drives are met (feedback above setpoint, frequency reaches de-staging frequency and the delay time has expired), Drive 3 (Main) decelerates and eventually stops. With FILO operation, Drive 3 (M3) is the first to stop. Since Drive 3 (M3) is the Main PI controlled drive, a shift occurs making Drive 2 (M2) the Main drive. As feedback continues to be above the setpoint, de-staging continues and Drive 2 (M2) decelerates and stops. This is the **Last Out** for the FILO setting as Drive 1 (Jockey) had previously stopped.

**Other Jockey Pump Operating Conditions**

- Only the Lead (+) drive can be set as Jockey pump.
- When the Lead (+) drive is set as Jockey pump, all Lag drives are automatically set to Network Fbk.
- When the Lead (+) drive is set as Jockey pump, the run priority AP1-43 (Run Priority) is fixed to the Drive's ID COM-01 (Int485 St ID) and cannot be changed. The run priority of the Jockey Pump drive is always first.
- The run priority of the rest of the drives follow the setting of the alternating sequence AP1-49 (ALT Sequence).
- When power is removed from the Jockey Pump drive, the system stops.
- Alternation does not apply to the Jockey pump drive.

# 13 Interlock Trip

The Interlock feature can be used to enable and disable each drive. A digital input can be set to Interlock 1 ~ 8 based on drive ID (COM-01). Connect a normally closed interlock (switch or other trip mechanism) between the digital input and CM.

| Parameter | Name | LCD Display |
|---|---|---|
| IN-65 ~ IN-73 | P1 ~ P9 Define | Interlock 1 ~ 8 |

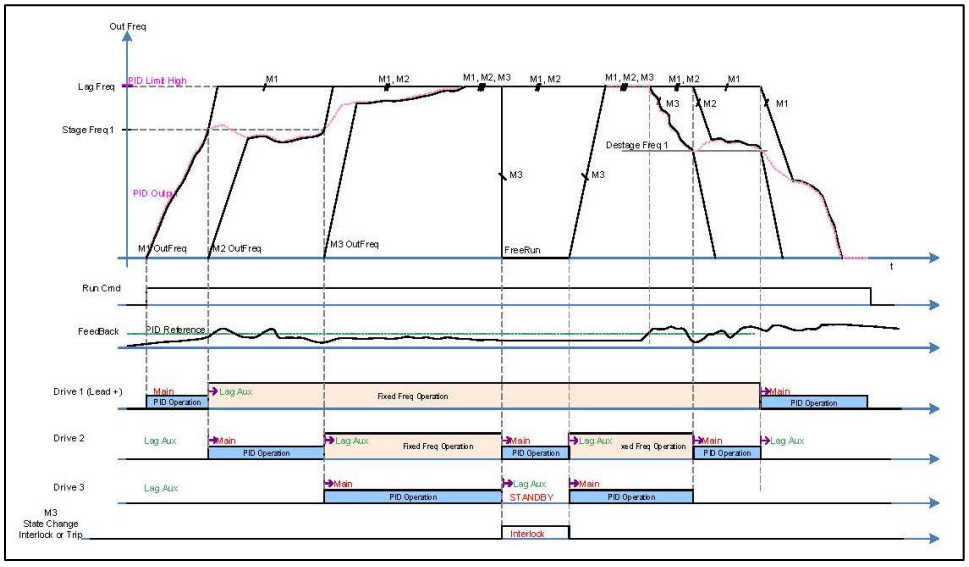
“Interlock” is displayed when the digital input (normally closed) is opened. The drive will go into “Standby” mode and stop operating (LCD Display **“S0”)**. Interlock is a Level Type trip (non-latched) and when cleared (re-closed), the drive will return to operation. Trip is also indicated by the blinking red LED on the keypad.

When an interlock trip occurs, the drive is switched to standby mode. The status in the Lead/Lag system is maintained with other drives, such as "F1+" and "S2". PID control and overall system control are continued by the Lead (+) Drive. If the Lead (+) drive is disabled by Interlock trip, it transfers control of the Lead/Lag system to the next priority drive. If other trips occur, Lead/Lag operation also continues except for the drive that tripped.

If Pipe Broken occurs in the Lead (+) Drive, it is considered to be a trip for entire system, so the entire system operation is stopped.

When the run priority is (M1 ↔ M2 ↔ M3↔ M4 ↔ M5 ↔ M6 ↔ M7 ↔ M8), if Interlock 3 (or any trip) occurs in Drive 3, the priority is changed to (M1 ↔ M2 ↔ M4 ↔ M5 ↔ M6 ↔ M7 ↔ M8), skipping Lag drive 3.

The following figure shows the operation when [AP1-49 ALT Sequence] is set to FILO in the Fixed Lag mode and when M3 becomes disabled by interlock.




**Fixed Lag - FILO and Interlock M3**

At the time of the Interlock trip, Drive 3 (M3) goes into Standby Mode. M3 was the Main PID drive. The Lead/Lag system transfers the Main PI controlled Drive to Drive 2 (M2) for the period of time that M3 is in Standby. When the Interlock is cleared, M3 resumes the Main PID operation.

Any output relay (OUT-31 ~ OUT-39) that is set to the “Trip” function will change state with the Interlock function. To disable the output relay for the Interlock function only, see parameter OUT-30 (Trip OutMode). Set bit 3 to “0”. (0010).

# 14 Alternate Time

This function changes (alternates) the running order (priority) of the drives/motors based on the time set in parameter AP1-56 (Alternate Time). The amount of time (before alternation occurs), can be viewed at AP1-58 (Alt Timer Disp). When the AP1-58 time reaches the set time AP1-56, run priority is changed and the drives are alternated.

| Parameter | Name | LCD Display | Setting Range | Default |
|---|---|---|---|---|
| AP1-56 | Alternate time interval | Alternate Time | 00:00–100:00 (hr:min) | 24:00 |
| AP1-58 | Alternate timer display | Alt Timer Disp | (hr:min) | 0:00 |
| AP1-45 | Priority of motors 1– 4 | Curr. Prty 1 | View Only | 4321 |

Time is counted by the Lead (+) drive when one or more motors are in operation including the Lead (+) drive. If all drives are running, alternation does not occur. At least one drive must be idle (not running) and cannot be in standby mode (Priority “0”). If priority of any drive is “0”, the drive is not included in the alternating sequence. Additionally, alternation is performed after each Stop or Sleep of the system (when all drives are stopped).

When the alternating sequence AP1-49 (ALT Sequence) is set to either “**FILO or FIFO”**, priority is changed by one step.

- Example: When priority is 1,2,3,4 (shown as 4321 at AP1-45), Drive ID 1 is the first priority, first to run. After alternating, the priority is changed to 3,2,1,4 making Drive ID 1 the second priority and making Drive ID the first priority.

When the alternating sequence AP1-49 (ALT Sequence) is set to “**Op Time Order**”, priority is based on the operating time of each drive. The drive with the lowest operating time is set to the first priority and the drive with the highest operating time is set to the last priority. If the operating time of each drive is the same when alternation occurs, priority is not arranged.

- The following is an example of alternating and how priority is arranged.
  - When priority is 1,2,3,4, (shown as 4321 at AP1-45) and only Drive ID 1 is operating, it has the longest operating time. Drive ID’s 2, 3 and 4 are in stopped state. After alternating, the new priority will be 2,3,4,1 (shown as 1432). Drive ID 1 was set to last priority and remains stopped. Drive ID 2 starts operating as it is now the first priority.

# 15 Priority Change based on User Setting Time

Parameter AP1-98 (PumpRunTime Clr) can be used to clear operating times of individual drives/motors or all drives/motors.

| Macro Parameter | Original Parameter | Name | LCD Display | Setting Range | | Default | |
|---|---|---|---|---|---|---|---|
| MC2-29 | AP1-96 | Operation time (Day) of Auxiliary motor selected in [AP1-95] | PmpRunTime Day | 0 – 65535 | | 0 | |
| MC2-30 | AP1-97 | Operation time of Auxiliary motor selected in AP1-95 (Hour:Minute) | PmpRunTime Min | 00:00 - 23:59 (hr:min) | | 00:00 | |
| MC2-31 | AP1-98 | Pump Run Time Clear selection | PmpRunTime Clr | 0 | None | 0 | None |
| | | | | 1 | All | | |
| | | | | 2 ~ 9 | Pump 1 ~ Pump 8 | | |

When clearing the operating time of all motors with AP1-98 (PmpRunTime Clr) at the Lead (+) Drive, the run priority AP1-43 (Run Priority) is arranged based on lowest Drive ID (COM-01, Int485 St ID) among all drives The new run priority does not include drives that are interlocked (in standby mode).

Priority is arranged when

1) the operating time is cleared at the Lead (+) Drive for individual motors/pumps at AP1-98 (PmpRunTime Clr) by selecting Pump1 ~ Pump8.

2) the operating time for individual motors is changed at AP1-96 (PmpRunTime Day) or AP1-97 (PmpRunTime Min).

3) Priority is arranged separately for operating motors vs. stopped motors.

**Priority for operating motors/pumps** - The table below shows a case where the operating time of Drive ID 2 was cleared at Step 2 and priority changed to Priority 1 (lowest operating time). Then, at Step 3, the pump run time for Drive ID 2 was set to 2:00 minutes and priority changed to Priority 3.

| Step | Aux Motor | Aux Motor | Main Motor | Aux Motor | Aux Motor |
|---|---|---|---|---|---|
| | Priority 1 | Priority 2 | Priority 3 | Priority 4 | Priority 5 |
| 1 | Drive ID 3<br>Op time: 00:30<br><Operating> | Drive ID 2<br>Op time: 00:40<br><Operating> | Drive ID 1<br>Op time: 00:50<br><Operating> | Drive ID 4<br>Op time: 01:30<br><Stopped> | Drive ID 5<br>Op time: 01:50<br><Stopped> |
| Select <3: Aux2> in AP1-98 (PmpRunTime Cl)] | | | | | |
| 2 | Drive ID 2<br>Op time: 00:00<br><Operating> | Drive ID 3<br>Op time: 00:30<br><Operating> | Drive ID 1<br>Op time: 00:50<br><Operating> | Drive ID 4<br>Op time: 01:30<br><Stopped> | Drive ID 5<br>Op time: 01:50<br><Stopped> |
| Change Aux2 time to 2:00 through AP1-97 (PmpRunTime Min) | | | | | |
| 3 | Drive ID 3<br>Op time: 00:30<br><Operating> | Drive ID 1<br>Op time: 00:50<br><Operating> | Drive ID 2<br>Op time: 02:00<br><Operating> | Drive ID 4<br>Op time: 01:30<br><Stopped> | Drive ID 5<br>Op time: 01:50<br><Stopped> |

**Priority for Stopped motors/pumps** - The table below shows a case where the operating time of Drive ID 5 was cleared at Step 2 and priority changed to Priority 4 (lowest among stopped drives). Then at Step 3 the run time was set to 2:00 minutes and priority changed to Priority 5.

| Step | Aux Motor | Aux Motor | Main Motor | Aux Motor | Aux Motor |
|---|---|---|---|---|---|
| | Priority 1 | Priority 2 | Priority 3 | Priority 4 | Priority 5 |
| 1 | Drive ID 3<br>Op time: 00:30<br><Operating> | Drive ID 2<br>Op time: 00:40<br><Operating> | Drive ID 1<br>Op time: 00:50<br><Operating> | Drive ID 4<br>Op time: 01:30<br><Stopped> | Drive ID 5<br>Op time: 01:50<br><Stopped> |
| Select <6: Aux5> in AP1-98 (PmpRunTime Clr) | | | | | |
| 2 | Drive ID 3<br>Op time: 00:30<br><Operating> | Drive ID 2<br>Op time: 00:40<br><Operating> | Drive ID 1<br>Op time: 00:50<br><Operating> | Drive ID 5<br>Op time: 00:00<br><Stopped> | Drive ID 4<br>Op time: 01:30<br><Stopped> |
| Change Aux5 time to 2:00 through AP1-97 (PmpRunTime Min) | | | | | |
| 3 | Drive ID 3<br>Op time: 00:30<br><Operating> | Drive ID 2<br>Op time: 00:40<br><Operating> | Drive ID 1<br>Op time: 00:50<br><Operating> | Drive ID 4<br>Op time: 01:30<br><Stopped> | Drive ID 5<br>Op time: 02:00<br><Stopped> |

# 16 Lead Change

- Below describe the conditions when the Lead (+) Drive will change. Lead (+) drive is designated by a "+" on the LCD display (F1+) and controls communications among all drives. **Also, for Lag drives to become the Lead (+) drive, they must be connected with the feedback signal from the transducer**. Also, a Lead change is different from the alternating function described in *Section 14, Alternate Time.* The alternating function changes the run priority (F2) but does not change the Lead (+) drive.
  - If the Lead (+) drive trips on any of the following faults, the drive with the lowest communication address (Drive ID) among other drives becomes the Lead (+) drive.
    - IO Board Trip (Communication error Trip)
    - TB Board Trip (Communication error Trip)
    - Comm Err Trip
    - LV Trip
    - Lost Feedback Trip
    - High Feedback Trip
  - If the operating state of the Lead (+) drive changes, the drive with the lowest Drive ID becomes the Lead (+) drive.
    - When the HAND or OFF button is pressed making the Lead (+) drive operate in Manual Mode.
    - When digital Inputs set to FWD JOG or REV JOG are activated.
    - When changes are made to the following parameters
      - the Drive ID (COM-01)
      - Lead Lag Sel (AP1-40)
      - * of Pumps (AP1-42)
  - If the Lead (+) drive trips on a Broken Pipe fault, the entire system is stopped without switching the Lead (+) drive as the fault cannot be resolved with a Lead drive change.
- When power is turned off to the Lead (+) drive, the Lead drive changes. When power is reapplied to the drive, even if its drive ID is the lowest, the drive powers up as a Lag drive.
  - Example, Drive ID 1 is the Lead Drive (F1+). If power is removed to Drive ID 1, Drive ID 2 becomes the Lead Drive (F2+). When power is reapplied to Drive ID 1, it becomes a Lag drive (F1).
- When the Lead (+) drive is changed due to any of the above, the operating status of the new Lead (+) drive is maintained. If the new Lead (+) drive was in a stopped condition, it remains stopped. If it was running, it continues to run.

# 17 Standby

- Standby drives are definitely part of the Lead/Lag system but are not required to operate for normal Lead/Lag system operation. Example: A Lead/Lag system requires 3 drives for normal operation. There are 5 drives connected in the system. Two of the drives are designated as Standby drives. Standby drives will be operated when certain conditions occur within the Lead/Lag system.
- Standby Drive display.
  - A Lead (+) Drive can be a Standby Drive. Display shows S-+, F-+ or R-+.
  - When a Lag Drive is a Standby Drive, display shows S4-.
- The number of Standby Drives is determined based on the following parameters.

| Parameter | Name | LCD Display | Setting Range | Default |
|---|---|---|---|---|
| AP1-42 | Number of Pumps | * of Pumps | 0 ~ 8 | 5 |
| AP1-94 | Number of drives operated by Lead/Lag | * of Drives | 0 ~ 8 | 5 |

- When the number of Pumps AP1-42 (* of pumps) is set to a larger number than the number of drives operated AP1-94 (* of drives), the difference (AP1-42 - AP1-94) become standby drives.
  - Example: If [AP1-42 * of Pumps] is set to 5 and [AP1-94 * of Drives] is set to 3, 3 drives operate under normal Lead/Lag system operation. The other 2 drives become Standby drives.
- Below are conditions in which a Standby drive is brought into the normal Lead//Lag system operation.
  - When the alternating sequence AP1-49 (ALT Sequence) is set to **FILO or FIFO**, alternation occurs:
    - When all drives are stopped due to high feedback and brings in a standby drive.
    - When any drive is put into manual mode (HAND or OFF button pressed)
    - When any drive trips
    - When any drive is interlocked
    - Example: Normal operation, alternating

| Lead/Lag operating Drives | | | Standby Drive | |
|---|---|---|---|---|
| Priority 1 | 2 | 3 | 4 | 5 |
| Drive ID1 | Drive ID2 | Drive ID3 | Drive ID4 | Drive ID5 |
| F1+ | F2 | F3 | S4- | S5- |
| When operation starts, only Drive ID's 1, 2 and 3 are operated. | | | | |
| When all drives are stopped due to increased PID feedback, alternation occurs, the priority is changed. | | | | |
| Drive ID5 | Drive ID1 | Drive ID2 | Drive ID3 | Drive ID4 |
| F5 | F1+ | F2 | S3- | S4- |
| When operation restarts, Drive ID's 5, 1 and 2 are operated. | | | | |
| When all drives are stopped again due to increased PID feedback, alternation occurs, the priority is changed again. | | | | |
| Drive ID4 | Drive ID5 | Drive ID1 | Drive ID2 | Drive ID3 |
| F4 | F5 | F1+ | S2- | S3- |

    - Note: When all drives are stopped due to the removal of run command from the Lead (+) Drive, the above changes do not occur.

- Standby Operation when alternating sequence AP1-49 (ALT Sequence) is set to **Op Time Order**. Standby drives with lower operating times than the running drives, are brought into the Lead/Lag operation. The new priority order is based on the operating time.
  - When all drives are stopped due to high feedback, alternation occurs and brings in a standby drive(s).
  - When all drives are stopped due to removal of run command from Lead (+) drive, alternation occurs.
  - When any drive is put into manual mode (HAND or OFF button pressed)
  - When any drive trips
  - When any drive is interlocked

# 18 Sleep & Wake-Up

## 18.1 Sleep Mode

When the system pressure is high enough (feedback is above setpoint) and the Main drive output frequency is decreasing, the Lag drives will stop based on the alternating sequence AP1-49 (ALT Sequence). With only the Main drive running, it will eventually go into Sleep mode.

| Macro Parameter | Original Parameter | LCD Display | Setting Range | Default | Unit | NOTES |
|---|---|---|---|---|---|---|
| MC2-40 | PID-62 | PID Sleep 0 DT | 0 ~ 6000.0 | 10 | sec | Main drive Sleep Delay Time. |
| MC2-41 | PID-63 | PID Sleep0Freq | 0.00,<br>Low Freq~ High Freq | 0 | Hz | Main drive Sleep Frequency. Note: If minimum speed (freq) is set at MC2-46 (PID-31), Sleep Freq must be above minimum. |

When the Main drive output frequency goes below the sleep frequency MC2-41 (PID Sleep0Freq) and the delay time MC2-40 (PID Sleep 0 DT) has expired, the Main drive will go into Sleep mode.

## 18.2 Sleep Boost

Sleep Boost can be used to increase the pressure before going into Sleep mode which will extend Sleep mode time.

| Macro Parameter | Original Parameter | Display | Setting Range | Default | Unit | NOTES |
|---|---|---|---|---|---|---|
| MC2-38 | PID-60 | Sleep Bst Set | 0 ~ 6000.0 | 0 | PSI | Feedback must reach above setpoint to go into Sleep mode. |
| MC2-39 | PID-61 | Sleep Bst Freq | 0.00,<br>Low Freq~ High Freq | 0 | Hz | To build pressure before entering Sleep Mode, frequency to which drive will accelerate to. Setting of 0.00 Hz., disables Sleep Boost. |

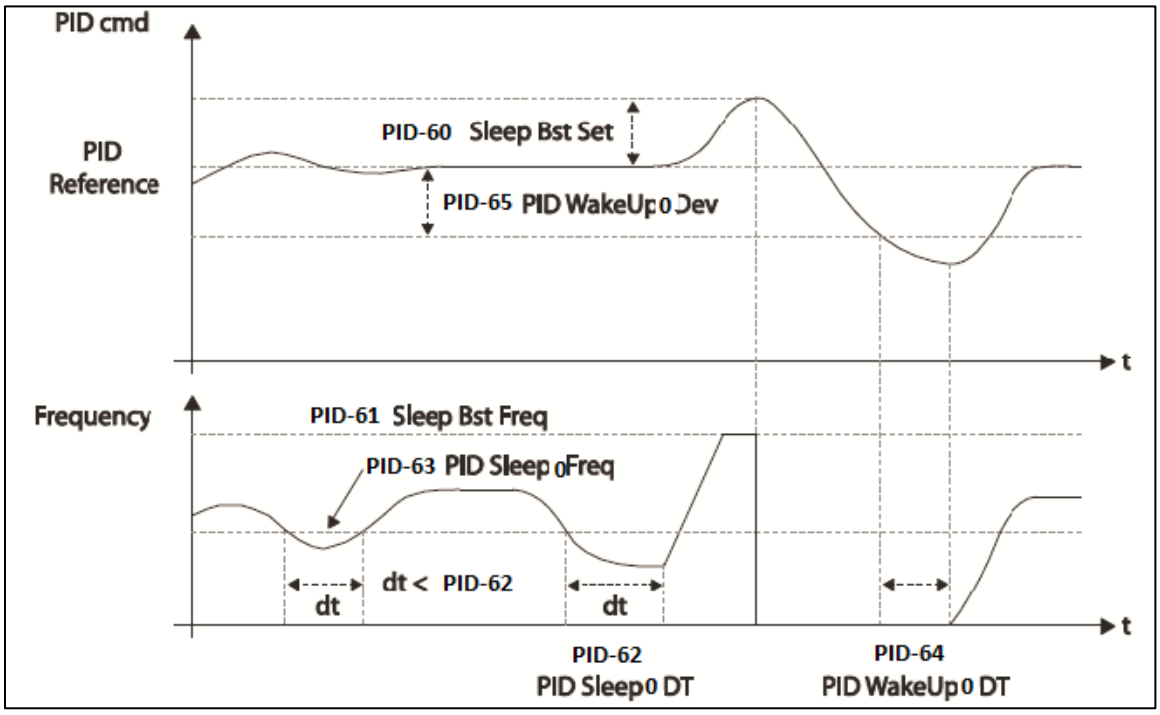
When Sleep mode conditions of Sleep Freq (PID-62) and Delay Time (PID-63) are met, before entering Sleep mode, the output frequency is accelerated to the Sleep Boost Freq PID-61 (Sleep Bst Freq). When the pressure (feedback) exceeds the sleep boost amount PID-60 (Sleep Bst Set) above the setpoint, the Sleep Boost operation is stopped, and the drive enters Sleep mode.

## 18.3 Wake Up

During Sleep mode, when the system pressure (feedback) decreases, the Main drive will resume operation.

| Macro Parameter | Original Parameter | LCD Display | Setting Range | Default | Unit | NOTES |
|---|---|---|---|---|---|---|
| MC2-42 | PID-64 | PID WakeUp0 DT | 0 ~ 6000.0 | 10 | sec | Main drive Wake Up Delay Time. Set longer than Acceleration time MC2-09 (DRV-03). |
| MC2-43 | PID-65 | PID WakeUp0Dev | 0~Unit Band | 20 | PSI | Amount (deviation) of feedback below Setpoint MC2-32 (PID-11) to wake up. |

When the pressure (feedback) falls below the setpoint by the amount set in the wake up level PID-65 (PID WakeUp0Dev) and for the delay time set in PID-64 (PID WakeUp0 DT), the Main drive will Wake Up and resume operation.




**Sleep Mode - Sleep Boost - Wake Up**

Symptom: If Drives/pumps cycle on and off and do not get up to speed.

Cause: Sleep and Wake Up settings.

Solution: 1. Extend Sleep Delay Time (MC2-40 / PID-62) longer than Accel Time (MC2-09 / DRV-03).

Solution 2: Increase PID-25 (Proportional gain %) to improve response.

# 19 Lost Feedback and High Feedback Settings

The Lead/Lag macro includes functions to monitor the feedback signal and detect both a lost (or low) feedback signal and a high feedback signal. The default settings for both when exceeded cause a latched fault which may not be appropriate for all applications. Both can be set to disable the fault. Also, both if faulted, can be auto reset with protection parameters PRT-09 and PRT-10.

## 19.1 Lost Feedback

| Parameter | Name | LCD Display | Setting Range | | Default | |
|---|---|---|---|---|---|---|
| AP2-55 | Lost Feedback Mode | Lost Fdb Mode | 0 | None | 2 | Free-Run |
| | | | 1 | Warning | | |
| | | | 2 | Free-Run | | |
| | | | 3 | Dec | | |
| AP2-56 | Lost Feedback Time | Lost Fdb Time | 0.1 ~ 120.0 (secs) | | 20.0 | |
| AP2-57 | Lost Feedback Level | Lost Fdb Level | -100% ~ +100% of PID-53 | | 1.0 % of PID-53 | |

The Lost Feedback Mode (AP2-55) can be set to None, (disabled) or to provide a Warning or to Trip when the feedback falls below the Lost Feedback Level (AP2-57) for the Lost Feedback Time (AP2-56). When set to Warning, the LCD will flash “Lost Fdb Level” but will not trip the drive. When set to Free-Run or Decel, the drive will trip and stop (coast or decelerate). “Lost Fdb Level” also flashes on the LCD display. The Lost Feedback Level (AP2-57) is in PID Units (PSI) and the default setting is 1.0 % of the maximum transducer value set in MC2-37 (PID-53).

Example: MC2-37 (PID-53) maximum value of transducer is 100 PSI. AP2-57 defaults to 1.0 PSI for Lost Feedback Level detection.

When a trip occurs (setting of Free-Run or Decel), the drive will stay in a faulted condition if the feedback signal remains below the Lost Feedback Level (AP2-57). If the feedback signal increases above the Lost Feedback Level (AP2-57), the drive will perform Auto fault resets/restarts based on the settings of PRT-09 (Retry Number) and PRT-10 (Retry Delay) time. The default settings for PRT-09 and PRT-10 are Retry 3 times every 5 seconds. If the fault is reset, the drive resumes operation. Also, when a trip occurs, any output relay set to the “Trip” function will activate.

## 19.2 High Feedback

The High Feedback default settings cause a trip when the feedback signal exceeds the High Feedback Level AP2-54 (High Fdb Level) for the High Feedback Time AP2-53 (High Fdb Time). “High Fdb Level” flashes on the LCD. The High Feedback Level (AP2-54) is in PID Units (PSI) and the default setting is 90 % of the maximum transducer value set in MC2-37 (PID-53).

| Parameter | Name | LCD Display | Setting Range | Default |
|---|---|---|---|---|
| AP2-53 | High Feedback Time | High Fdb Time | 0.0–1200.0 (sec) | 100.0 |
| AP2-54 | High Feedback Level | High Fdb Level | -100% ~ +100% of PID-53 | 90% of PID-53 |

When a trip occurs, the drive will stay in a faulted condition if the feedback signal remains above the High Feedback Level (AP2-54). If the feedback signal decreases below the High Feedback Level (AP2-54), the drive will perform Auto fault resets/restarts based on the settings of PRT-09 (Retry Number) and PRT-10 (Retry Delay) time. The default settings for PRT-09 and PRT-10 are Retry 3 times every 5 seconds. If the fault is reset, the drive will resume operation when the feedback level decreases below the setpoint. Also, when a trip occurs, any output relay set to the “Trip” function will activate.

To disable the High Feedback Level fault, set AP2-54 to 0.00 (PID Units).

# 20 Data Share

The Data Share function saves time when entering parameter settings. Set parameters in the Macro Group (MC2) at the Lead (+) drive and the same parameters will be changed in all the Lag drives connected via communications in the Lead/Lag system. **Note that the Lead (+) drive must be in the Ready Mode (AUTO LED blinking) to Data Share**. Alternatively, if it is necessary to set or change a specific data shared parameter in a Lag drive, change it within the Lag drive.

**Below is a list of the Data Shared parameters**.

| | | | | | |
|---|---|---|---|---|---|
| MC2-04 | ALT Sequence | MC2-15 | Lag Freq | MC2-36 | PID Unit Scale |
| MC2-05 | Alternate Time | MC2-16 | Stage freq 1 | MC2-37 | PID Unit 100% |
| MC2-07 | * of Pumps | MC2-17 | Destage freq 1 | MC2-38 | Sleep Bst Set |
| MC2-08 | * Of Drives | MC2-23 | Lag Stop Sel | MC2-39 | Sleep Bst Freq |
| MC2-09 | Acc Time | MC2-24 | DataShare | MC2-40 | PID Sleep 0 DT |
| MC2-10 | Dec Time | MC2-25 | All CommErr | MC2-41 | PID Sleep0 Freq |
| MC2-11 | Stage Pres. Dv | MC2-32 | PID Ref 1 Set | MC2-42 | PID WakeUp0 DT |
| MC2-12 | Stage DT | MC2-33 | PID Fdb Source | MC2-43 | PID WakeUp0Dev |
| MC2-13 | Destage DT | MC2-34 | PID I-Time 1 | MC2-45 | Stop Mode |
| MC2-14 | Destage Pres. | MC2-35 | PID Unit Sel | | |

| Macro Parameter | Original Parameter | Name | LCD Display | Setting Range | | Default |
|---|---|---|---|---|---|---|
| MC2-24 | AP1-78 | Parameter Sharing - Lead Drive to Lag (Aux) Drives | DataShare | 0 | None | Auto |
| | | | | 1 | Auto | |
| | | | | 2 | Manual | |

- When AP1-78 (DataShare) is set to AUTO (default);
  - If the above parameters are changed at the Lead (+) drive, the changes are shared with all the Lag (Aux) drives automatically. The Lead (+) drive must be in the Ready Mode (AUTO LED blinking).
- When AP1-78 (DataShare) is set to Manual;
  - All parameters in the above list are shared with the Lag (Aux) drives at once and {DataShare} warning flashes on the LCD display while sharing.
  - Once the changes are shared, parameter AP1-78 returns to the default value of “Auto”.

# 21 Troubleshooting Communication Problems in Lead/Lag Operation

- Communication problems may occur with the following conditions:
  - Power Disconnection or Short Circuit.
  - IO Board Trip.
  - When the alternating sequence AP1-40 (Lead Lag Sel) is changed.
  - When changing the Drive ID COM-01 (Int485 St ID).
  - When the Drive ID COM-01 (Int485 St ID) is duplicated.
  - When there is more than one Lead (+) drive (setting error).
    - Example: when more drives are connected via communications than the setting in AP1-42 (* of Pumps). If 8 drives are connected and AP1-42 is set to 5, Drive ID 6 can become a Lead drive creating more than one Lead drive resulting in communication conflicts. Ensure AP1-42 is correct for the number of drives connected in the Lead/Lag system.
- When AP1-79 (All CommErr) is Yes
  - When communication problems occur, all Drives trip with Comm Err !! and stop.
  - The first drive to clear the Comm Err !! becomes Lead (+) drive.
- When AP1-79 (All CommErr) is No
  - When communication problems occur, only the drive having the problem trips on Comm Err !! and stops.
  - The remaining drives are automatically sorted in the accordance with their Drive ID and normal Lead/Lag operation continues.
- **Other conditions**
  - Comm Err !! is only generated after normal communication is established between Lead and Lag drives (Lead to Lag and Lag to Lead) and when there is no response from Lag drives.
  - Drives with AP1-40 (Lead Lag Sel) set to Network Fbk do not generate CommErr !!.
  - When power is removed from all drives except one during normal Lead/Lag operation.
    - The remaining one becomes the Lead (+) drive. Even though there is no response from Lag drives (not powered), a Comm Err !! is not triggered.
    - Comm Err !! is not triggered during normal power off.
  - If only one drive is turned on, there will be no response from Lag drives (not powered), a Comm Err !! is not triggered.

# 22 Revision History

| Manual | | | | Software | | | |
|---|---|---|---|---|---|---|---|
| **Rev.** | **Date** | **Edition** | **Changes** | **Version** | | **Date** | **View Parameter** |
| 00 | 11/2021 | Pump Lead Lag | Initial Release | 202.00 | Main | 11/26/2020 | DRV-96<br>CNF-10 |
| | | | | 201.00 | IO | 9/16/2020 | DRV-98<br>CNF-12 |
| | | | | | | | |
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