YASKAWA

iQpump Drive
Programming Manual

Document Number: TM.iQp.02

◆ Quick Reference for iQpump (P7U) <0033>

Parameter Number	Factory Setting	User Setting
A1-00	0	
A1-01	2	
A1-03	0	
A1-04	0	
A1-05	0	
b1-01	0	
b1-02	1	
b1-03	0	
b1-08	0	
b1-11	0 s	
b2-01	0.5 Hz	
b2-02	50%	
b2-03	0.00 s	
b2-04	0.50 s	
b2-09	0%	
b3-01	2	
b3-02	120%	
b3-03	2.0 s	
b3-05	0.2 s	
b3-14	1	
b4-01	0.0 s	
b4-02	0.0 s	
b5-01	1	
b5-02	2.00	
b5-03	5.0 s	
b5-04	100.0%	
b5-06	100.0%	
b5-07	0.0%	
b5-08	0.00 s	
b5-09	0	
b5-10	1.0	
b5-12	0	
b5-13	0%	
b5-14	1.0 s	
b5-17	0.0 s	
b8-01	0	
b8-04	kVA Dep.	
b8-05	2 0 ms	
b8-06	0%	
C1-01	25.0 s	
C1-02	25.0 s	
C1-03	10.0 s	
C1-04	10.0 s	
C1-05	50.0 s	
C1-06	50.0 s	
C1-09	10.0 s	
C1-11	0.0 Hz	
C2-01	0.20 s	
C2-02	0.20 s	
C4-01	1.00	
C4-02	200 ms	
C6-01	2	
C6-02	kVA Dep	
C6-03	kVA Dep	
C6-04	kVA Dep	

Parameter Number	Factory Setting	User Setting
C6-05	0	
d1-01	00145	
d1-02	00145	
d1-03	00145	
d1-04	00145	
d1-17	0.00 to 6.00 Hz	
d2-01	100.0%	
d2-02	0.0%	
d2-03	0.0%	
d3-01	0.0 Hz	
d3-02	0.0 Hz	
d3-03	0.0 Hz	
d3-04	1.0 Hz	
E1-01	240.0 V 486.0 V	
E1-03	F	
E1-04	60.0 Hz	
E1-05	240.0 V 486.0 V	
E1-06	60.0 Hz	
E1-07	3.0 Hz	
E1-08	17.2 Vac 33.6 Vac	
E1-09	1.5 Hz	
E1-10	10.3 Vac	
E1-11	0.0 Hz	
E1-12	0.0 Vac	
E1-13	0.0 Vac	
E2-01	kVA Dep	
E2-03	kVA Dep	
E2-04	2	
E2-05	kVA Dep	
F6-01	1	
F6-02	0	
F6-03	1	
F6-05	0	
H1-01	24	
H1-02	14	
H1-03	3: 2 - Wire 0: 3 - Wire	
H1-04	80	
H1-05	84	
H2-01	40	
H2-02	41	
H3-02	100.0%	
H3-03	0.0%	
H3-08	2	
H3-09	B*	
H3-10	100.0%	
H3-11	0.0%	
H3-12	0.30 s	
H3-13	0	
H4-01	2	
H4-02	100.0%	
H4-03	0.0%	

Parameter Number	Factory Setting	User Setting
H4-04	8	
H4-05	50.0%	
H4-06	0.0%	
H4-07	0	
H4-08	0	
H5-01	1F	
H5-02	3	
H5-03	0	
H5-04	3	
H5-05	1	
H5-06	5 ms	
H5-07	1	
H5-09	2.0 s	
L1-01	1	
L1-02	8.0 min	
L1-03	3	
L1-04	1	
L1-05	0.20 s	
L2-01	2	
L2-02	kVA Dep	
L2-03	kVA Dep	
L2-04	kVA Dep	
L2-05	Voltage Class Dep.	
L3-01	1	
L3-02	120%	
L3-04	1	
L3-05	1	
L3-06	120%	
L4-01	0.0 Hz	
L4-02	2.0 Hz	
L4-05	0	
L4-06	80%	
L5-01	0	
L5-02	0	
L5-03	180.0 s	
L6-01	0	
L6-02	15%	
L6-03	10.0 s	
L8-01	0	
L8-02	95º C	
L8-03	4	
L8-05	1	
L8-06	5.0%	
L8-07	1	
L8-09	1	
L8-10	0	
L8-11	300 s	
L8-12	45º C	
L8-15	1	
L8-18	1	
L8-19	20.0%	
n1-01	1	
n1-02	1.00	
n3-01	5%	
n3-02	150%	

Parameter Number	Factory Setting	User Setting
n3-03	1.0	
n3-04	40 s	
o1-01	6	
o1-02	1**	
o1-05	3	
o1-06	1**	
o1-07	2**	
o1-08	91**	
o2-01	1**	
o2-02	1	
o2-03	0	
o2-04	kVA Dep.	
o2-05	0	
o2-06	1	
o2-07	0 H	
o2-08	1	
o2-10	0 H	
o2-12	0	
o2-14	0	
o3-01	0	
o3-02	0	
P1-01	0	
P1-02	1	
P1-03	00145	
P1-04	0.0 (system units P1-02)	
P1-05	0 s	
P1-06	35.0 Hz	
P1-07	0.0 (system units P1-02)	
P1-08	5 s	
P1-09	155.0 (system units P1-02)	
P1-10	2 s	
P1-11	0.0 (system units P1-02)	
P1-12	60 s	
P1-13	0.0 (system units P1-02)	
P1-14	0.0 A	
P1-15	0	
P2-01	0	
P2-02	0.0	
P2-03	10 s	
P2-04	0.0 (system units P1-02)	
P2-05	10 s	
P2-06	0	
P2-07	300 s	
P2-08	0	
P2-09	0.0 (system units P1-02)	
P2-10	0.0 (system units P1-02)	
P2-11	0 RPM	

Parameter Number	Factory Setting	User Setting
P2-12	15 RPM	
P2-13	5.0 s	
P2-14	5.0 s	
P2-15	0.0 (system units P1-02)	
P2-16	1.5 (system units P1-02)	
P2-17	2.0 s	
P2-18	2.0 s	
P2-19	0	
P2-20	0.0 Hz	
P3-01	0	
P3-02	59.0 Hz	
P3-03	0.0 (system units P1-02)	
P3-04	59.0 Hz	
P3-05	0.0 (system units P1-02)	
P3-06	5 s	
P3-07	0.0 (system units P1-02)	
P3-08	0.0 (system units P1-02)	
P3-09	35.0 Hz	
P3-10	35.0 Hz	
P3-11	2 s	
P3-12	0.0 (system units P1-02)	
P3-13	0.0 Hz	
P3-14	0.0 (system units P1-02)	
P4-01	0.0 (system units P1-02)	
P4-02	0.0 Hz	
P4-03	0.0 min	
P4-04	2.0 s	
P4-05	0.0 Hz	
P4-06	1.0 s	
P4-07	0	
P4-08	0	
P4-09	0.2 min	
P4-10	0	
P5-01	1	
P5-02	0.0 Hz	
P5-03	1	
P5-04	1	
T1-02	kVA Dep.	
T1-04	kVA Dep.	

* Factory setting changes to "B" when b5-01=1.
** Factory setting changes to "B" when b5-01=1 as follows: o1-06=1, o1-07=38, o1=08=24

Warnings and Cautions

This Section provides warnings and cautions pertinent to this product, that if not heeded, may result in personal injury, fatality, or equipment damage. Yaskawa is not responsible for consequences of ignoring these instructions.

⚠ WARNING

YASKAWA manufactures component parts that can be used in a wide variety of industrial applications. The selection and application of YASKAWA products remain the responsibility of the equipment designer or end user. YASKAWA accepts no responsibility for the way its products are incorporated into the final system design. Under no circumstances should any YASKAWA product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and fail safely under all circumstances. All products designed to incorporate a component part manufactured by YASKAWA must be supplied to the end user with appropriate warnings and instructions as to that part's safe use and operation. Any warnings provided by YASKAWA must be promptly provided to the end user. YASKAWA offers an express warranty only as to the quality of its products in conforming to standards and specifications published in the YASKAWA manual. NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS OFFERED. YASKAWA assumes no liability for any personal injury, property damage, losses, or claims arising from misapplication of its products.

⚠ WARNING

- Read and understand this manual before installing, operating, or servicing this Drive. All warnings, cautions, and instructions must be followed. All activity must be performed by qualified personnel. The iQpump drive must be installed according to this manual and local codes.
- Do not connect or disconnect wiring while the power is on. Do not remove covers or touch circuit boards while the power is on. Do not remove or insert the digital operator while power is on.
- Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. Status indicator LEDs and Digital Operator display will be extinguished when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are OFF and measure DC bus voltage level to confirm safe level.
- Do not perform a withstand voltage test on any part of the unit. This equipment uses sensitive devices and may be damaged by high voltage.
- The iQpump drive is not suitable for circuits capable of delivering more than 100,000 RMS symmetrical amperes. Install adequate branch short circuit protection per applicable codes. Refer to the specification. Failure to do so may result in equipment damage and/or personal injury.
- Do not connect unapproved LC or RC interference suppression filters, capacitors, or overvoltage protection devices to the output of the Drive. These devices may generate peak currents that exceed iQpump drive specifications.
- To avoid unnecessary fault displays caused by contactors or output switches placed between iQpump drive and motor, auxiliary contacts must be properly integrated into the control logic circuit.
- YASKAWA is not responsible for any modification of the product made by the user; doing so will void the warranty. This product must not be modified.
- Verify that the rated voltage of the iQpump drive matches the voltage of the incoming power supply before applying power.
- To meet CE directives, proper line filters and proper installation are required.
- Some drawings in this manual may be shown with protective covers or shields removed, to describe details. These must be replaced before operation.
- Observe electrostatic discharge procedures when handling circuit cards to prevent ESD damage.
- The equipment may start unexpectedly upon application of power. Clear all personnel from the drive, motor, and machine area before applying power. Secure covers, couplings, shaft keys, and machine loads before energizing the Drive.
- Please do not connect or operate any equipment with visible damage or missing parts. The operating company is responsible for any injuries or equipment damage resulting from failure to heed the warnings in this manual.

◆ Intended Use

Drives are intended for installation in electrical systems or machinery.

For use in the European Union, the installation in machinery and systems must conform to the following product standards of the Low Voltage Directive:

- EN 50178, 1997-10, Equipping of Power Systems with Electronic Devices
- EN 60201-1, 1997-12 Machine Safety and Equipping with Electrical Devices
- Part 1: General Requirements (IEC 60204-1:1997)
- EN 61010, 1997-11 Safety Requirements for Information Technology Equipment
- (IEC 950:1991 + A1:1992 + A2:1993 + A3:1995 + A4:1996, modified)

◆ Other

The iQpump (P7U) Drive is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 240 Vac maximum (240 V Class) and 480 Vac maximum (480 V Class).

Introduction

This Section describes the applicability of the Manual

The iQpump (P7U) is a Pulse Width Modulated Drive for 3-Phase AC induction motors. This type of Drive is also known as an Adjustable Frequency Drive, Variable Frequency Drive, AC Drive, AFD, ASD, VFD, and Inverter.

The iQpump (P7U) is a variable torque AC drive, designed specifically for Simplex and Multiplex pumping applications. The pump applications include Booster Systems, Submersible Deep Well, Fluid Storage Tanks, Metering Pumps, Commercial and Residential Irrigation Systems.

The iQpump (P7U) sets a new benchmark for size, cost, performance, ease-of-use benefits, comprehensive pump and motor protection features, and quality. The iQpump includes numerous built-in features such as H/O/A Operation, Selectable Pump Control Engineering Units, PI Control, Pump Basic Control, Pump Protection, Multi-Pump Control (Lead/Lag), and Pump Messaging Terminology.

The LCD keypad/operator is equipped with Hand/Off/Auto functions, copy feature, and 5 lines of display with 16 characters per line.

Built-in PI and pump specific functions and parameters allow the operator to setup specific control values for a wide range of applications. The iQpump (P7U) will optimize the pump performance by automatically adjusting the pump controller based on operating conditions of the pump; such as, process variable changes and pump protection requirements. The P Group programming parameters are dedicated for pumping applications and provide for ease of setup.

The iQpump (P7U) drive offers energy savings by controlling the flow rate and the number of operating pumps on the system. The iQpump (P7U) can be configured using the most popular system control configurations including Simplex, Duplex, and Triplex pumps systems. The iQpump is the master controller with the ability to add additional pumps on-line by controlling the digital I/O to each individual motor starter.

The iQpump (P7U) has an optional feature to replace the motors starters with additional drives for a more precise pump control system.

This manual is applicable to the iQpump (P7U) Drives defined by models CIMR-P7U□□□□□ - 107.

This manual is subject to change as product improvements occur. The latest version of the manual can be obtained from Yaskawa. The date shown on the rear cover is changed when revisions are made.

This manual may describe trademarked equipment, which is the property of other companies. These trademarks are the property of the registered owner companies and may include the following:

- Modbus®, trademark of Schneider Automation, Inc.

Other Documents and Manuals are available to support special use or installation of this product. These documents may be provided with the product or upon request. Contact Yaskawa Electric America, Inc. as required. Documents may include the following:

- TM.iQp.01 Users Manual
- TM.iQp.11 Modbus Manual
- PumpScada Software and Manual included on CD ROM with product
- Option Instructions included on CD ROM with product

0.1 Conventions Used in this Manual

◆ Software Versions

Yaskawa recognizes the need to continuously improve product quality. This drive may receive feature enhancements in the form of software or hardware changes. New functions may be added to the drive. When a new feature or function is added, the software version <####> will be placed next to the feature or function.

■ EXAMPLE: This example shows that settings 2, 3, 4, 5, and 6, are added to a parameter A1-00 for drive software version <3020>

A1-00 Language Selection *Select Language* | Q | Q | Q | Q |

Select the language displayed on the digital operator according to the following table:

Setting	Description
0	English (factory default)
1	Japanese **<3020>**
2	Deutsch **<3020>**
3	Francais **<3020>**
4	Italiano **<3020>**
5	Espanol **<3020>**
6	Portugues **<3020>**

Figure 1 Example

In the example above, the version note <3020> indicates that five additional languages have been added with drive software version 3020. Check the drive nameplate to determine the drive software version.

■ EXAMPLE: Nameplate with PRG software number:

The “PRG:” number on the drive nameplate reflects the software version. The software version normally increases to a higher number with newer versions. Please consult the factory for details.

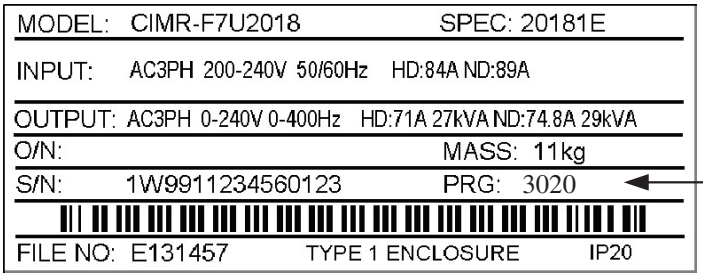


Figure 2 Nameplate

1

Programming

This Manual contains descriptions of all user accessible parameters contained in the Drive. Parameters are listed in alpha-numerical order. Parameter number and name, along with a detailed description and its settings are described on the following pages.

iQpump Basic Programming Parameters

The initialization group contains parameters associated with initial set-up of the Drive. Parameters involving the display language, access levels, initialization and password are located in this group.

◆ A1 Initialization

■ A1-01 Access Level Selection

Setting	Description
0	Operation Only
2	Advanced Level (*factory default)*

If the iQpump drive is programmed for Operation Only (A1-01 = “0: Operation Only”), then only the OPERATION and the PROGRAMMING menus are accessible. Within the PROGRAMMING menu only parameters A1-01 and A1-04 are adjustable.

If A1-01 is configured for Advanced Access (A1-01 = “2: Advanced Level”), then all menus and all parameters are shown. If the Access Level Selection is set to Advanced, all parameters should be adjustable unless:

1. The iQpump drive parameters are password protected (A1-04) which will prevent access to A1-00 through A1-03 and all A2 parameters.
2. A digital input has been configured as a Program Lockout (H1-0X = 1B) is active.
3. During serial communication writing, if a parameter change is also attempted via the digital operator, a “BUSY - WRITE PROTECTED” message will display. Parameter change will not be possible from the digital operator until an Enter command is received via the serial communication to finish the serial writing process.

■ A1-03 Initialize Parameters

Setting	Description
0	No Initialize (*factory default)*
1110	User Initialize
2220	2-Wire Initialize
3330	3-Wire Initialize

The iQpump drive can be set back to one of three default states via the A1-03 parameter.

1. User Initialization – 1110: The modified iQpump drive parameters are returned to the values selected as user settings. User settings are stored when parameter o2-03 = “1: Set Defaults”.
2. 2-Wire Initialization – 2220: The iQpump drive parameters are returned to factory default values with digital inputs S1and S2 configured as Forward Run and Reverse Run, respectively.
3. 3-Wire Initialization – 3330: The iQpump drive parameters are returned to factory default values with digital inputs S1, S2, and S5 configured as Run, Stop, and Forward/Reverse respectively.

After an initialization is performed, parameter A1-03 will automatically be set back to 0.

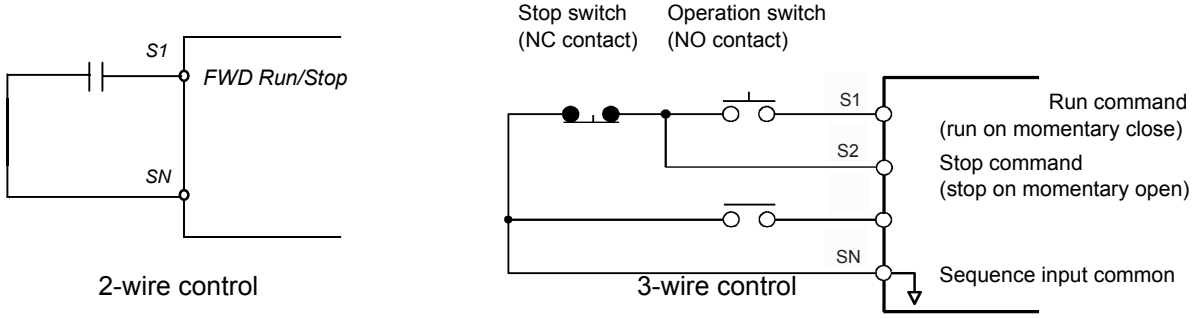


Figure 1 2 & 3-Wire Control Wiring Examples

Important: Some parameters are unaffected by either the 2-Wire or 3-Wire initialization. The following parameters will not be reset when parameter A1-03=2220 or 3330:

A1-00	Language Selection
E1-03	V/f Pattern Selection
o2-04	kVA Selection

■ A1-04 Password Entry

Setting Range: 0 to 9999

Factory Default: 0

If parameters A1-01 through A1-03 are locked (unchangeable), they can be unlocked by entering the correct password number into A1-04.

Once the correct password number is entered and the specified parameters are unlocked, a 2-Wire or 3-Wire initialization will reset the password to 0000.

Note: A1-04 will return to “0000” when the password has been entered.

■ A1-05 Select Password

Setting Range: 0 to 9999

Factory Default: 0

When the value set into A1-04 does NOT match the value set into A1-05, parameters A1-01 thru A1-03 cannot be changed. All other parameters determined by A1-01 can be changed. Parameter A1-05 can be accessed by displaying parameter A1-04, then press and hold the RESET key along with the MENU key simultaneously.

◆ b1 Sequence

The Sequence Group contains parameters associated with starting and stopping the Drive. Parameters involving the Run Command, Speed Reference location, Stopping Method and Hand/Auto changeover are located in this group.

■ b1-01 Reference (Auto Setpoint) Source Selection

Setting	Description
0	Operator - Digital Preset Setpoint d1-01 (*factory default*)
1	Terminals - Analog Input Terminal A1 (or Terminal A2, see Parameter H3-13)
2	Serial Com - RS-485 Terminals R+, R-, S+ and S-
3	Option PCB - Option Board connected at 2CN

In order to run the iQpump drive and motor, the iQpump drive must receive a Run command and a Auto Setpoint command. Parameter b1-01 specifies from where the Auto setpoint is received when in the "Auto" mode. Switching into the "Auto" mode can be done by pressing the AUTO button on the digital operator while the iQpump drive is stopped.

Important: If a Run command is input to the iQpump drive but no corresponding Auto setpoint is input, the Run indicator on the digital operator will turn on and the STOP indicator on the digital operator will blink.

If you want the iQpump drive to follow the "Hand Reference" set by the digital operator: Use the "Hand" mode by pressing the hand key and set P5-01 = "1: Hand Reference (P5-02)". The hand reference can then be entered into the P5-02 parameter.

The iQpump drive offers the ability to provide four types of "Auto Setpoint" reference sources. These Auto Setpoint reference sources are determined by the setting of b1-01 and the drive set to "Auto" mode by pressing the Auto key on the digital operation.

Note: Prior to programming, it is recommended to first select the system units (P1-02) and the feedback device, Scaling (P1-03). P1-03 will automatically scale the iQpump setpoint.

Example:
P1-02 = 1: PSI
P1-03 = 200, feedback range = 200 PSI.

If you want the iQpump drive to follow an "Auto Setpoint" set by the digital operator: Set b1-01 = "0: Operator" (factory default), The Auto setpoint can then be entered into the U1-01 monitor parameter in the "-DRIVE-" menu.

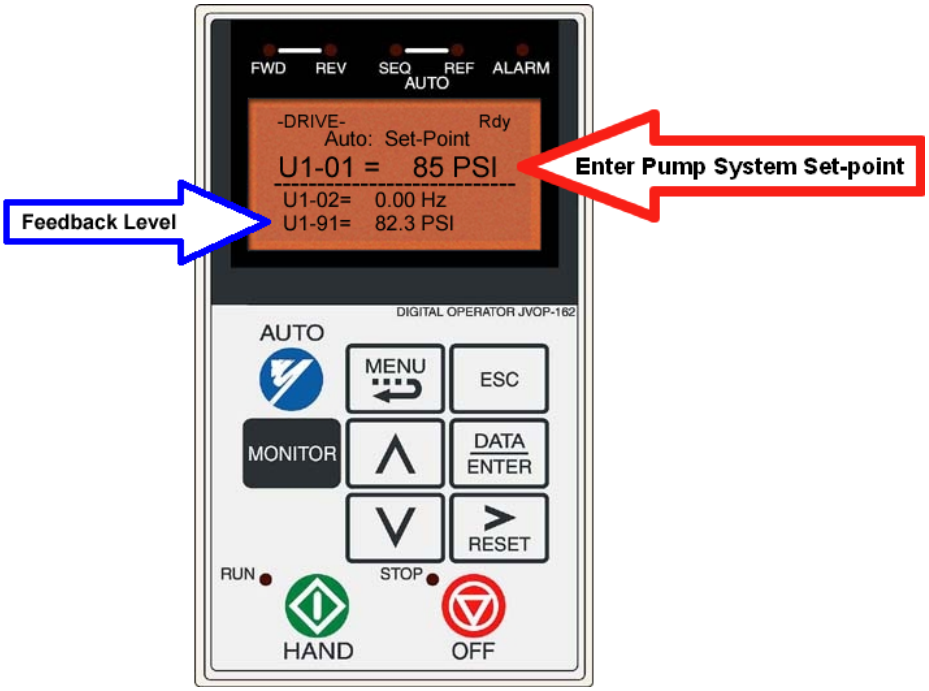


Figure 2 Digital Operator Auto Setpoint

If you want the iQpump drive to follow an "Auto Setpoint" set by the analog input: Set b1-01 = "1: Terminals," and connect a potentiometer or external signal to the iQpump drive. Refer to *Figure 3* for connection diagram for the setpoint potentiometer.

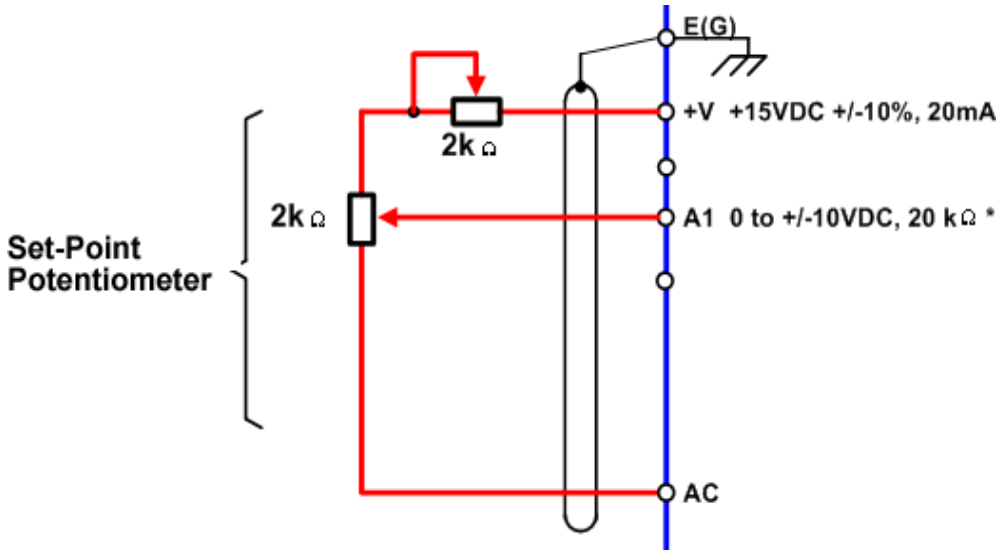


Figure 3 Setpoint Potentiometer Connection Diagram

Refer to *Figure 4* for the connection diagram for an external analog signal setpoint reference.

Note: When b1-01 = 1 (terminals) and P5-01 = 0 (hand mode reference source), the setpoint and the hand reference are determined by the external analog signal.

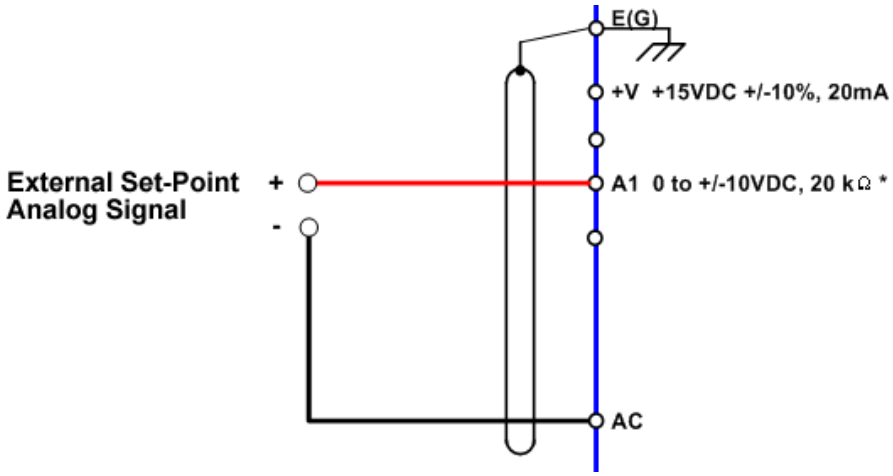


Figure 4 External Analog Signal Setpoint Reference

If you want the iQpump drive to receive the "Auto Setpoint" from serial communication: Set b1-01 = "2: Serial Com," and connect the RS-485/422 serial communications cable to terminals R+, R-, S+, and S- on the control I/O terminal block.

Refer to *Figure 5* for the connection diagram using a PC to provide the auto setpoint reference to the iQpump drive. Further information regarding communication protocols are referenced in *Appendix A*.

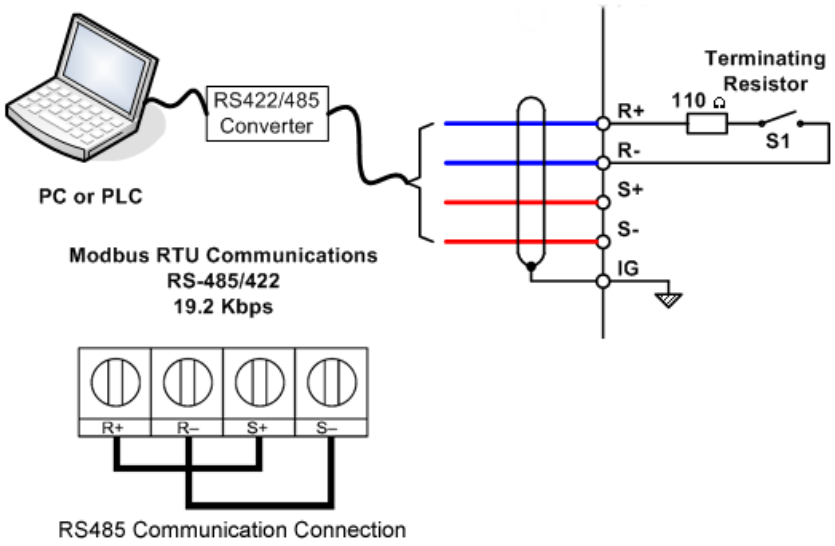


Figure 5 Connection Diagram of PC or PLC

If you want the iQpump drive to receive the "Auto Setpoint" for a network communication option card: Set b1-01= "3: Option PCB," and plug a network option board (p/n SI-J) into the 2CN port on the iQpump drive Control PCB. Consult the manual supplied with the option board for instructions on integrating the iQpump drive into the network system.

The iQpump drive can support the following network communication options. Refer to the appropriate Installation Guide (IG) and Technical Manual (TM) for further details. These network communications documents can be located at http://iQpump.yaskawa.com.

- Profibus DP Option Card CM061 Manual: IG.AFD.12
- DeviceNet Option Card CM05X Manual: IG.AFD.14
- Modbus Plus Option Card CM071 Manual: IG.AFD.17
- Modbus TCP/IP Option Card CM090 Manual: IG.AFD.25
- EtherNet/IP Option Card CM092 Manual: IG.AFD.26

Important: If b1-01 = "3: Option PCB" but a network card is not installed in 2CN, an OPE05 Operator Programming Error will be displayed on the digital operator and the iQpump drive will not run.

■ b1-02 Run Source

Setting	Description
0	Operator (*factory default*)
1	Terminals
2	Serial Com
3	Option PCB

■ Start/Stop from Keypad (Parameter b1-02 = 0)

The iQpump drive comes factory programmed for Start and Stop from the Keypad.

The iQpump drive can be programmed to receiver a Run command from four different inputs: digital operator, terminals, serial communications, or an option PCB.

If the Run command input is determined by the digital operator: Set b1-02 = "0: Operator," and the hand key will be used to provide the Run command to the iQpump drive.

If the Run command input is determined by the external terminals: Set b1-02 = "1: Terminals" and initiate an external Run command by a contact closure between terminals S1 and SN. Refer to *Figure 6* for the connection diagram of the external Run command.

Note: To use the external terminals requires the iQpump drive to be set to "Auto" mode by pressing the Auto key.

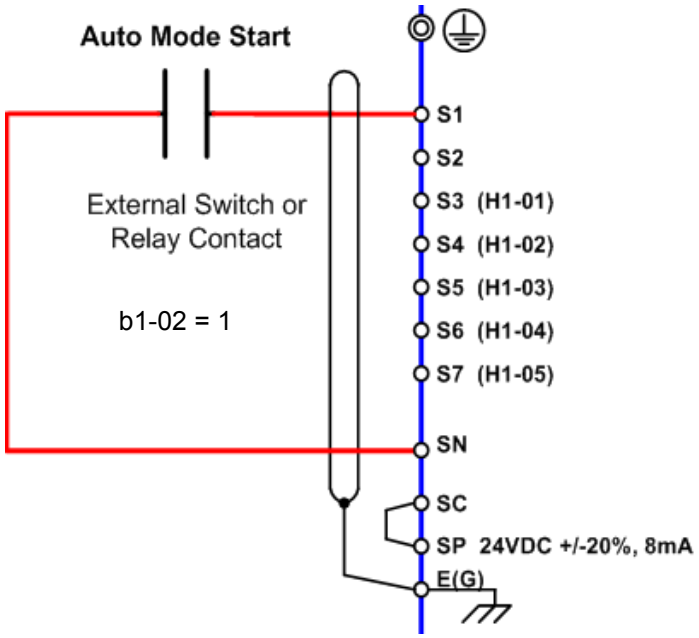


Figure 6 Connection Diagram of External Start/Stop Switch

If the Run command is determined by Serial Communications: b1-02 = "2: Serial Communications," and initiate the Run command through the serial communications. Refer to *Figure 6* (in the previous b1 sequence section) for the connection diagram for serial communications through the RS232/485 terminals. The following is a simple setup procedure for programming the iQpump drive and PC Serial communications to initiate Run and Stop commands through serial communications.

1. Program b1-02 = "2: Serial communications".
2. Program the following H5 parameters:
   H5-01 Serial Communication Address: 31
   H5-02 Serial Baud Rate: 9600 Baud (setting 3).
   H5-03: Serial Communication Parity Selection: None (setting 0)
3. Initiate a Start/Stop command
   iQpump command register number: 0001
   Stop Command: Transmit value of **0000** (16 bit) to iQpump command address.
   Start Command: Transmit value of **0001** (16 bit) to iQpump command address.
   Reset Command: Transmit value of **0008** (16 bit) to iQpump command address.

If the Run command input is determined by a network communications option PCB: b1-02 = "3: Option PCB," and initiate the Run command through the available network communications option PCB listed below. The Installation Guides (IG) and Technical Manuals (TM) are available at http://iQpump.yaskawa.com.

The iQpump Controller allows for monitoring, diagnostics and control using any of the following communication option cards:

- Profibus DP Option Card CM061 Manual: IG.AFD.12
- DeviceNet Option Card CM05X Manual: IG.AFD.14
- Modbus Plus Option Card CM071 Manual: IG.AFD.17
- Modbus TCP/IP Option Card CM090 Manual: IG.AFD.25
- EtherNet/IP Option Card CM092 Manual: IG.AFD.26

Note: Refer to the communication card instruction manual or consult factory for installation and operation instructions.

■ Start/Stop from Comm. Option Card (Parameter b1-01 = 3):

The iQpump Controller allows for the setpoint reference to be set via any of the following communication option cards:

- Profibus DP Option Card CM061 Manual: IG.AFD.12
- DeviceNet Option Card CM05X Manual: IG.AFD.14

- Modbus Plus Option Card CM071 Manual: IG.AFD.17
- Modbus TCP/IP Option Card CM090 Manual: IG.AFD.25
- EtherNet/IP Option Card CM092 Manual: IG.AFD.26

■ Feedback Device

The iQpump Controller requires a feedback device (e.g. Pressure transducer, flow meter, etc.) to perform automatic system regulation. Any analog 0~10 V or 4-20 mA feedback device can be used in combination with the iQpump controller.

Connecting Your Feedback Device to the iQpump Controller

Note: The factory default setting for the iQpump controller is 4~20 mA feedback device connected to analog input A2.

To successfully operate the iQpump drive remotely, an external run command must be received by the Drive. Parameter b1-02 specifies from where the run command will be accepted.

Although the Run Source and the Reference Source (b1-01) are normally taken from the same source (e.g. digital operator, terminals or serial communication), this is not always the case.

To issue a run command from the digital operator: Set b1-02 = "0: Operator," and use the HAND and OFF buttons to start and stop the Drive.

To issue the run command from the terminals: Set b1-02 = "1: Terminals," and select between 2-wire and 3-wire control operation by doing the following:

2-Wire Control The factory default setting is for 2-wire operation. In the 2-wire configuration a closure between S1 and SN will be interpreted as a Forward Run command by the Drive.

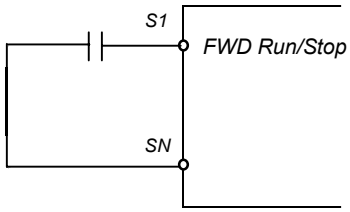


Figure 7 2-Wire Control

3-Wire Control When any of the multi-function digital input parameters, H1-01 through H1-05, is set to 0, terminals S1 and S2 become Run and Stop, respectively. The multi-function digital input that was set to 0 will function as a Forward/Reverse input for the iQpump Drive. When the Forward/Reverse input is open the iQpump drive will run in the Forward direction and when the input is closed, the iQpump drive will run in the Reverse direction.

In 3-wire operation a momentary closure (> 50mS) of S1 will cause the iQpump drive to run provided that S2 is held closed. The iQpump drive will stop anytime the S2-SN connection is broken. If the 3-wire configuration is implemented via a 3-wire Initialization (A1-03 = "3330: 3-Wire Initial"), then terminal S3 becomes the Forward/Reverse input.

Note: Reverse operation is disabled in the iQpump drive; however, in 3-wire control, one of the multi-function digital inputs needs to be programmed to 0. Otherwise, the 3-wire control will not work.

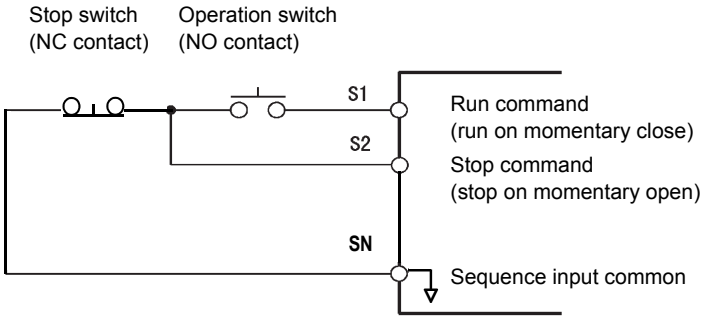


Figure 8 3-Wire Control

To issue a run command via serial communication: Set b1-02 = "2: Serial Com" and connect the RS-485/422 serial communication cable to R+, R-, S+, and S- on the removable terminal block.

To issue the Run command via a network option card: Set b1-02 = "3: Option PCB," and plug a network option board (p/n SI/J) into the 2CN port on the Control PCB. Consult the manual supplied with the option board for instructions on integrating the iQpump drive into your network system.

Important: If b1-01 = "3: Option PCB" but a network card is not installed in 2CN, an "OPE05" operator programming error will be displayed on the digital operator and the iQpump drive will not run.

■ b1-03 Stopping Method

There are four methods of stopping the iQpump drive when the Run command is removed.

Setting	Description
0	Ramp to Stop (*factory default*)
1	Coast to Stop
2	DC Injection to Stop
3	Coast w/Timer

0: Ramp to stop: When the Run command is removed, the iQpump drive will decelerate the motor to 0 rpm. The rate of deceleration is determined by the active deceleration time. The factory default Decel Time is in parameter C1-02.

When the output frequency has dropped below the DC Injection Start Frequency in b2-01 (Default = 0.5 Hz) DC current will be injected in the motor at a level determined by b2-02 (50% Default). The DC Injection condition will occur for the time specified by b2-04 (0.0 Default), to establish the end point of the ramp. DC injection can be used to insure the motor is at zero rpm prior to the iQpump drive shutting off.

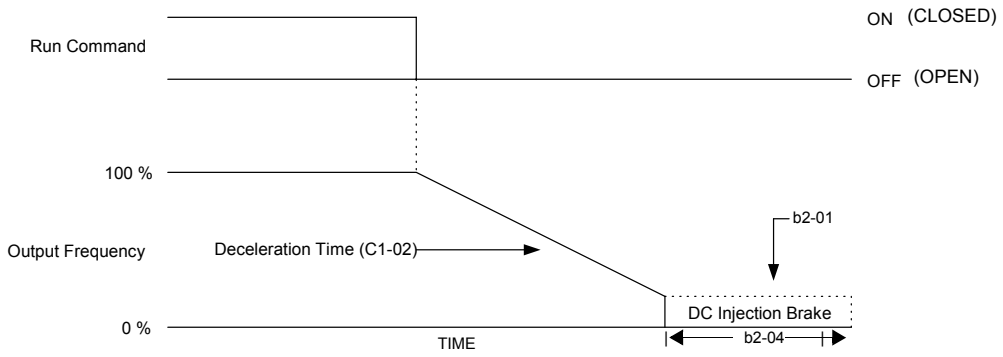


Figure 9 Deceleration to Stop

The actual deceleration time can be determined by the following formula.

$$\text{Time to Stop} = \frac{\text{Output Freq. at time of stop command}}{\text{Maximum Frequency (E1-04)}} \times \text{Setting of active Decel Time (C1-02 or C1-04)}$$

If S-Curve characteristics are specified by the iQpump drive programming, they will add to the total time to stop.

1: Coast to stop: When the Run command is removed, the iQpump drive will turn off its output and the motor will coast (uncontrolled deceleration). The friction of the driven equipment will eventually overcome any residual inertia of the system and the rotation will stop.

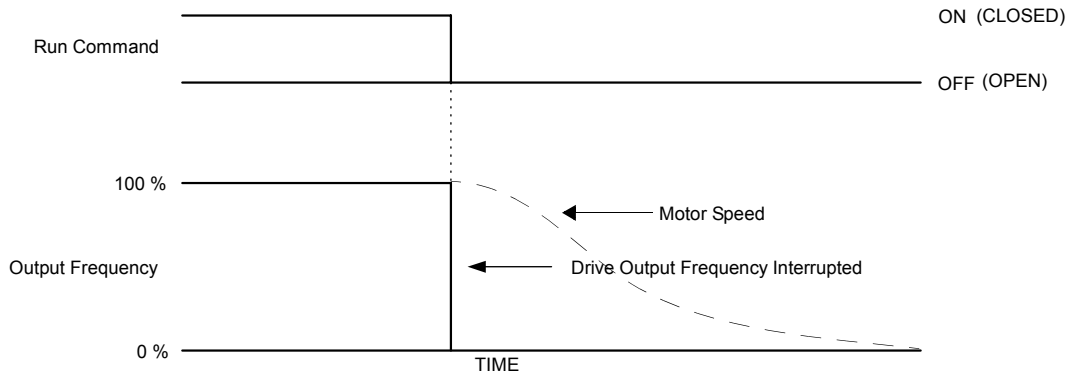


Figure 10 Coast to Stop

Important: After a stop is initiated, a subsequent Run commands input before the Minimum Baseblock Time (L2-03) has expired, will be ignored.

2: DCInj to Stop: When the Run command is removed, the iQpump drive will Baseblock (turn off its output) for the Minimum Baseblock Time (L2-03). Once the Minimum Baseblock Time has expired, the iQpump drive will inject DC current into the motor windings to lock the motor shaft. The stopping time will be reduced as compared to Coast to Stop. The level of DC Injection current is set by parameter b2-02 (50% Default). The DC Injection brake time is determined by the set value in b2-04 and the output frequency at the time the Run command is removed.

$$\text{DC Injection Brake Time} = \frac{(\text{b2 - 04}) \times 10 \times \text{Output Frequency}}{\text{Maximum Frequency (E1 - 04)}}$$

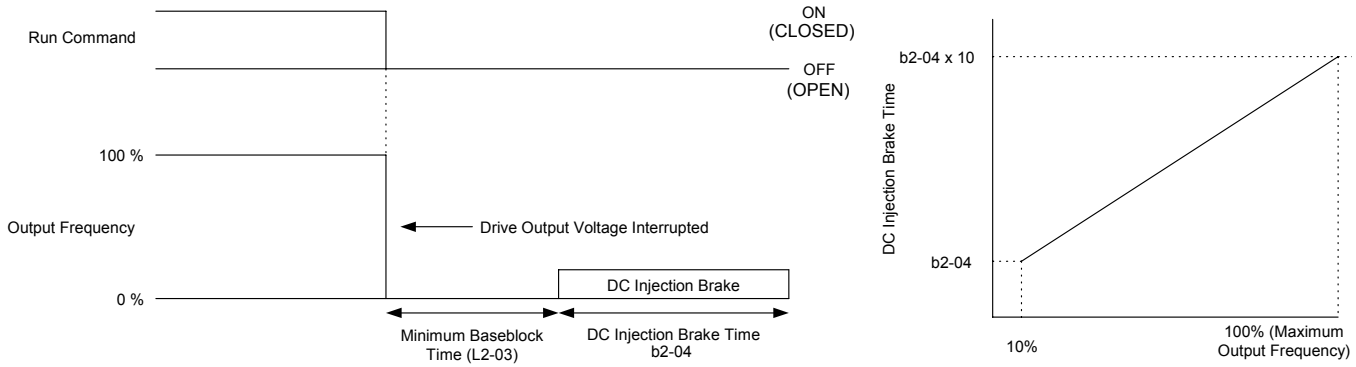


Figure 11 DC Injection Braking to Stop

Important: If an overcurrent (OC) fault occurs during DCInj to Stop, lengthen the Minimum Baseblock Time (L2-03) until the fault no longer occurs.

3: Coast w/Timer: When the Run command is removed, the iQpump drive will turn off its output and the motor will coast to a stop. If a Run command is input before time T (operation wait time) expires, the iQpump drive will not run and the Run command will need to be cycled before operation can occur. The time T (operation wait time) is determined by the output frequency when the Run command is removed and the active deceleration time (C1-02).

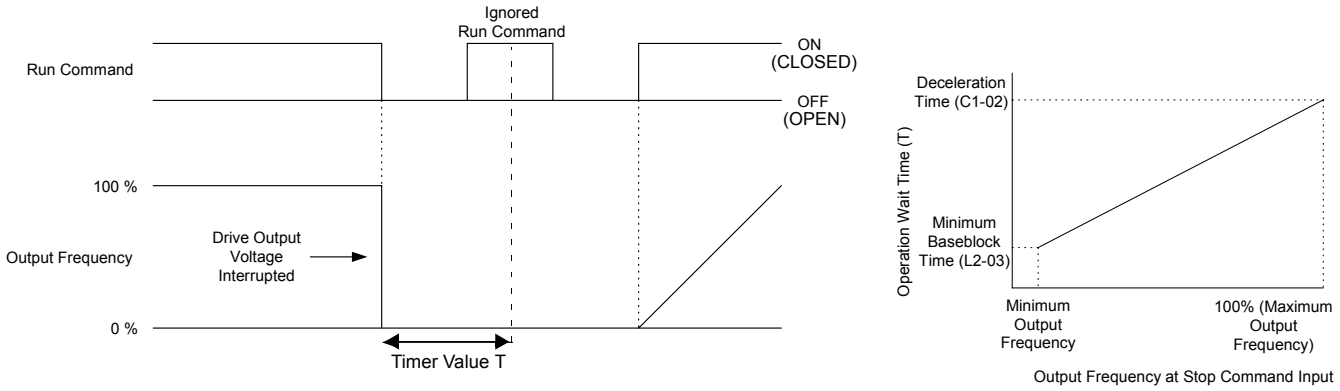


Figure 12 Coast to Stop with Timer

■ b1-08 Run Command Selection During Programming

Setting	Description
0	Disabled (*factory default*)
1	Enabled

As a safety precaution, the iQpump drive will not normally respond to a Run input when the digital operator is being used to adjust parameters. If it is necessary that external Run commands be recognized even while the Drive is being programmed, set b1-08 = "1: Enabled."

■ b1-11 Drive Delay Time Setting

Setting Range: 0 to 600 sec

Factory Default: 0 sec

If a time is set into parameter b1-11, the iQpump drive will delay executing any run command until the b1-11 time has expired. During iQpump drive delay time execution, the digital operator will display:

DDLY
Waiting to RUN

Both the ALARM and Run indicators will blink while the iQpump drive waits to execute the Run command.

◆ b2 DC Braking

The DC Braking Group contains parameters associated with the DC injection braking feature. Parameters involving the starting frequency, current level, braking time, and motor pre heat current level are located here.

■ b2-01 DC Injection Braking Start Frequency

Setting Range: 0.0 to 10.0 Hz

Factory Default: 0.5 Hz

Parameter b2-01 sets the output frequency where the iQpump drive begins DC Injection **during Ramp to stop** in order to lock the rotor of the motor and established the end point of the ramp. If b2-01 < E1-09 (Minimum Frequency), then DC Injection begins at E1-09.

Parameter b2-01 also determines the output frequency that the iQpump drive must be at or below before a Zero Speed condition is considered true. This affects any digital output configured as a Zero Speed signal (H2-0x = "1: Zero Speed").

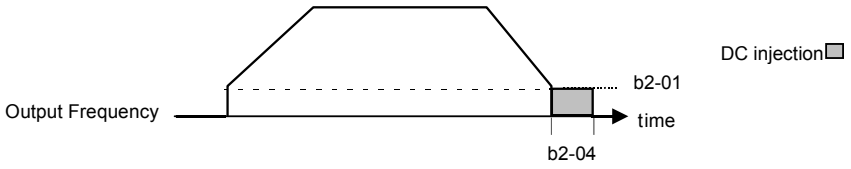


Figure 13 DC Injection Braking During Stopping

■ b2-02 DC Injection Braking Current

Setting Range: 0 to 100%

Factory Default: 50%

The level of DC Injection Braking Current affects the strength of the magnetic field attempting to lock the motor shaft. Increasing the level of current will increase the amount of heat generated by the motor windings and should only be increased to the level necessary to hold the motor shaft. DC Injection current is set in percentage of the iQpump drive rated output current. iQpump drive rated output current is stated on the iQpump drive nameplate.

■ DC Injection Braking Time

Parameter No.	Parameter Name
b2-03	DC Injection Braking Time at Start
b2-04	DC Injection Braking Time at Stop

Setting Range: 0.00 to 10.00 sec

Factory Defaults: b2-03 = 0.00 sec and b2-04 = 0.50 sec

The iQpump drive can be programmed to automatically DC Inject for a predetermined amount of time prior to accelerating to speed (b2-03) and/or at the end of a Ramp to stop (b2-04). Parameter b2-03 can be used to stop a rotating motor prior to attempting acceleration (i.e. a wind milling fan). If DC Injection braking at start or Speed Search is not enabled, attempting to drive a spinning motor may cause nuisance tripping.

Parameter b2-04 can be used to resist any residual motion of the load after the deceleration has finished.

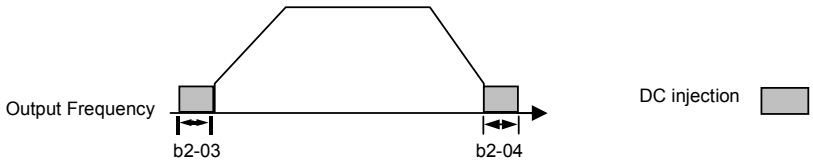


Figure 14 DC Injection Braking During Starting and Stopping

Parameter b2-04 also serves the function of affecting the length of time DC Injection to stop (b1-03 = “2: DC Injection to Stop”) will occur.

■ b2-09 Motor Pre-Heat Current

Setting Range: 0 to 100%

Factory Default: 0%

A DC current can be circulated within the motor windings while the motor is stopped. The current will produce heat within the motor and prevent condensation. Parameter b2-09 determines the percentage of the iQpump drive rated output current that will be used for the motor pre-heat function. This function can be useful in applications where the motor sits for extended periods of time in humid conditions. Motor pre-heating can only be initiated by closing a digital input programmed as a Motor Pre-heat Input (H1-0x = 60). Check with the motor manufacturer to determine the maximum acceptable current level the motor can withstand when stopped. Be sure not to exceed the motor manufacturers recommended level.

◆ b3 Speed Search

The Speed Search function allows the iQpump drive to determine the speed of a motor shaft that is being driven by rotational inertia. Speed Search will allow the iQpump drive to determine the speed of the already rotating motor and begin to ramp the motor to a set speed without first having to bring it to a complete stop. When a momentary loss of supply power is experienced, the iQpump drive output is turned off. This results in a coasting motor. When power returns, the iQpump drive can determine the speed of the coasting motor and start without requiring it to be brought to minimum speed. Speed Search can be programmed to always be active by setting b3-01 or it can be commanded by remote contact closure by setting a digital input.

There are two forms of Speed Search in the Drive, the speed estimation method and the current detection method.

Important: When setting the iQpump drive for remote Speed Search input, via a contact closure, the method of Speed Search is determined by the setting of b3-01. If b3-01 = "0: SpdsrchF Disable" then the remote input will initiate speed estimation method, and if b3-01 = "2: SpdsrchI Disable," then the remote input will start the current detection method.

Parameters L2-03 and L2-04 also affect the current detection method of Speed Search operation.

■ b3-01 Speed Search Selection

This parameter is effective only when the iQpump drive is given a new "RUN" command.

Setting	Description
0	SpdsrchF Disable
1	SpdsrchF Enable
2	SpdsrchI Disable (*factory default*)
3	SpdsrchI Enable

Speed Estimation: Method (b3-01 = 0 or 1) The speed estimation method will calculate the speed using measurements of residual motor fields. The speed estimation version is bi-directional and will determine both the motor speed and direction. To enable speed estimation Speed Search at start, set b3-01 = "1: SpdsrchF Enable".

Important: If the speed estimation method of Speed Search is to be used, then Auto-tuning must be performed prior to using Speed Search. If the length of cable between the iQpump drive and motor is ever changed after Auto-tuning then Auto-tuning should be performed again

Important: The speed estimation mode cannot be used when there are multiple motors operated by one iQpump drive or the motor is two or more frames smaller than the standard size motor per the iQpump drive capacity.

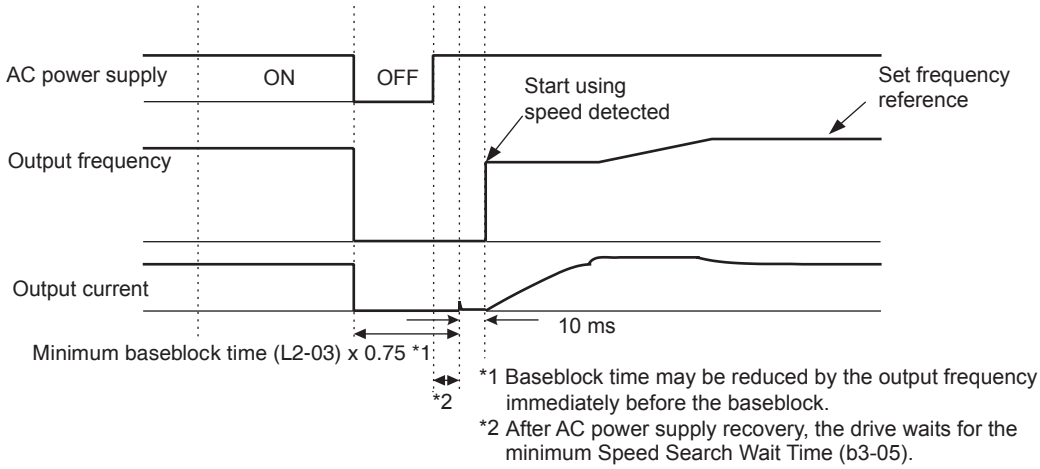
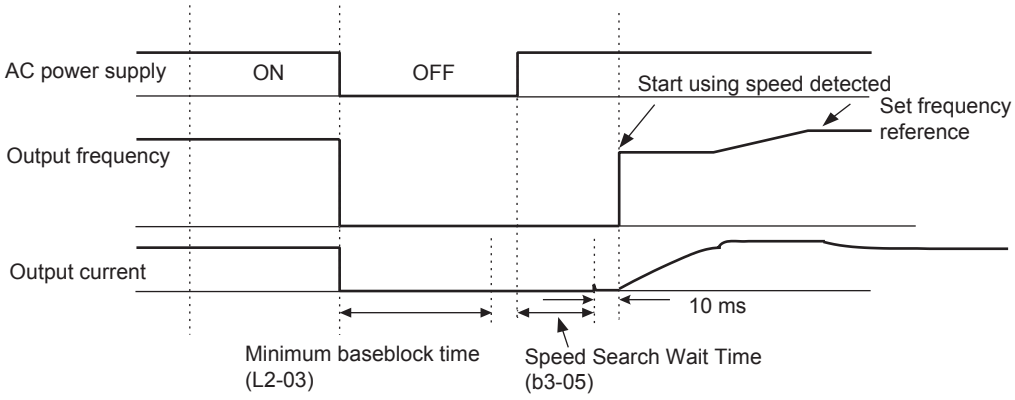


Figure 15 Speed Search (Estimated Speed Method) after momentary power loss where the power loss time is less than the minimum baseblock time



Note: If the frequency immediately before the baseblock is low or the power supply off time is long, operation may be the same as the search in case 1.

Figure 16 Speed Search (Estimated Speed Method) after momentary power loss where the power loss time exceeds the minimum baseblock time

Current Detection Method (b3-01=2 or 3): The current detection method starts searching from a predetermined frequency while monitoring the iQpump drive output current to determine when the rotor speed and the iQpump drive output speed (frequency) match. The current detection version is not bi-directional. To enable current detection Speed Search at start set b3-01 = "3: SpdscrhI enable" and program any digital input equal to Speed Search 1 (H1-0x = 61) or Speed Search 2 (H1-0x = 62). Speed Search 1 will start searching from the max. frequency (E1-04) and ramp down to meet the rotor speed. Speed Search 2 will start searching from the set frequency and ramp down to meet the rotor speed.

Important: If a UV1 fault occurs when current detection Speed Search is attempted, increase the setting of L2-04.

Important: If an OC fault occurs when Speed Search is attempted after power loss recovery, increase the setting of L2-03.

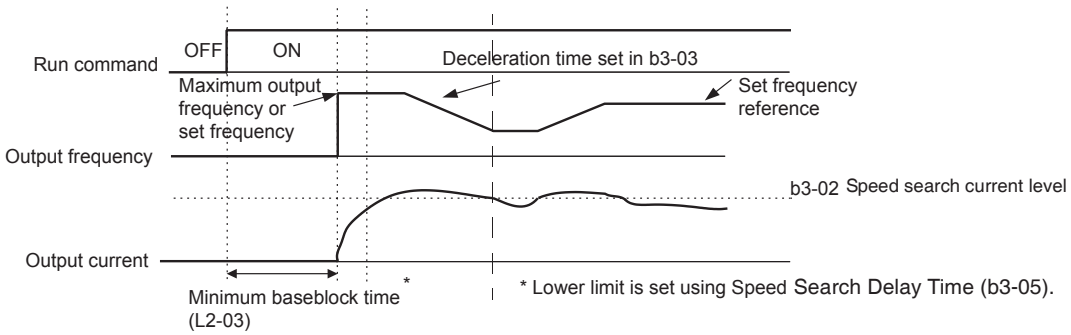


Figure 17 Speed Search (Current Detection Method) at Startup

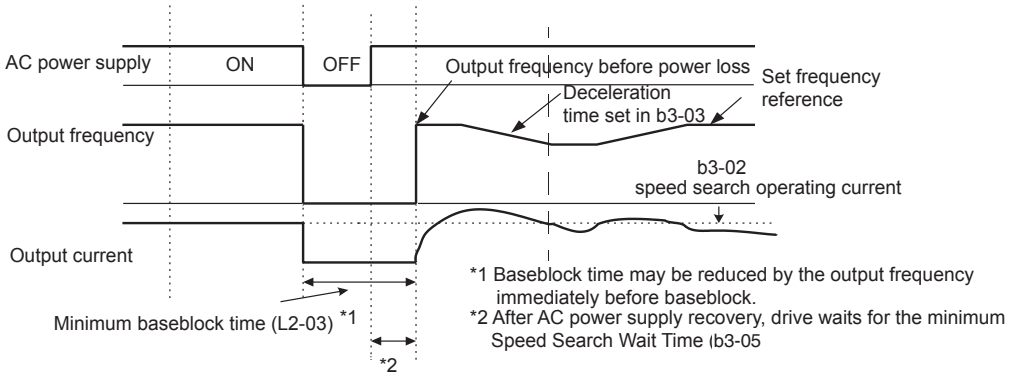


Figure 18 Speed Search (Current Detection Method) after momentary power loss where the power loss time is less than the minimum baseblock time

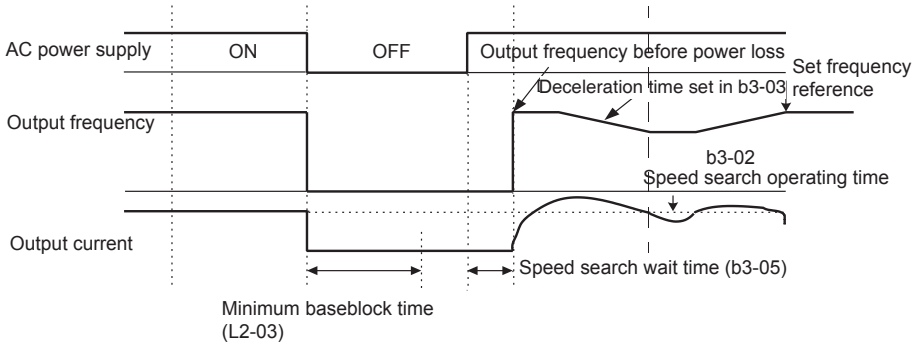


Figure 19 Speed Search (Current Detection Method) after momentary power loss where the power loss time exceeds the minimum baseblock time

Setting of b3-01	Automatic Speed Search for all RUN commands	Automatic Speed Search after momentary power loss and baseblock	Speed Search Used for Run with programmed multi-function input
0	No	Yes - Speed Estimation	Yes - Speed Estimation
1	Yes - Speed Estimation	Yes - Speed Estimation	Yes - Speed Estimation
2	No	Yes - Current Detection	Yes - Current Detection
3	Yes - Current Detection	Yes - Current Detection	Yes - Current Detection

■ b3-02 Speed Search Deactivation Current

Setting Range: 0 to 200% of the iQpump drive rated output current

Factory Default: 120% of the iQpump drive rated output current

When using the current detection method of Speed Search, parameter b3-02 sets the current level that will determine when the search is complete and the rotor and output speeds match. When the output frequency is higher than the actual rotor speed the slip causes the current to be high. As the output frequency is lowered, the closer it comes to the rotor speed, the lower the current draw will be. When the output current drops below the level as set in b3-02 (100% = iQpump drive Rated Current) the output frequency stops decreasing and normal operation resumes.

■ b3-03 Speed Search Deceleration Time

Setting Range: 0.1 to 10.0 sec

Factory Default: 2.0 sec

Parameter b3-03 sets the deceleration ramp used by the current detection method of Speed Search when searching for the motor's rotor speed. Even if Speed Search 2 is selected, for Speed Search at start, the time entered into b3-03 will be the time to decelerate from maximum frequency (E1-04) to minimum frequency (E1-09).

■ b3-05 Speed Search Delay Time

Setting Range: 0.0 to 20.0 sec

Factory Default: 0.2 sec

In cases where an output contactor is used between the iQpump drive and the motor, extra waiting time is provided after power returns and before Speed Search is performed. This extra time allows for the contactor to operate. When Speed Search at start is used, b3-05 will serve as the lower limit of the Minimum Baseblock Time (L2-03).

■ b3-14 Bi-Directional Speed Search Selection

Setting	Description
0	Disabled
1	Enabled *(factory default)*

The b3-14 parameter can be used to turn off the bi-directional capabilities of the Speed Estimation form of Speed Search. By turning off the bi-directional capability, the speed search will only try to match the speed in the last known direction.

◆ b4 Delay Timers

The iQpump drive has an internal timer function that operates independently from the Drive. A digital input must be programmed to be a timer start input by setting H1-0x = 18. A digital output must be programmed as a timer output by setting H2-0x = 12. (Not to be confused with the “Wait to Run Time” in b1-11.)

■ b4-01 Timer Function ON-Delay Time

Setting Range: 0.0 to 3000.0 sec

Factory Default: 0.0 sec

The timer start input (H1-0x = 18) must be held on for at least the time specified in parameter b4-01 before the digital output programmed as the timer output will close. See *Figure 20* for timing details.

■ b4-02 Timer Function OFF-Delay Time

Setting Range: 0.0 to 3000.0 sec

Factory Default: 0.0 sec

The timer start input (H1-0x = 18) must be held off for at least the time specified by b4-02 before the digital output programmed as the timer output will open. See *Figure 20* for timing details.

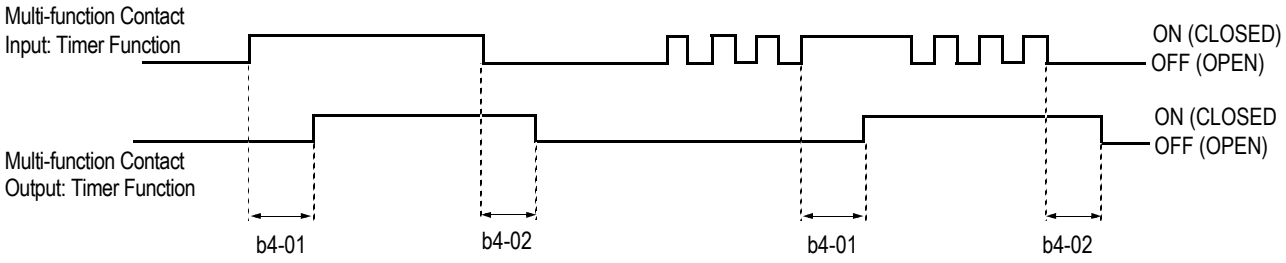


Figure 20 Timing Diagram of Timer Function

◆ b5 PI Function

The capability to accept an analog signal as feedback for a PI (Proportional + Integral) control function is built into the Drive.

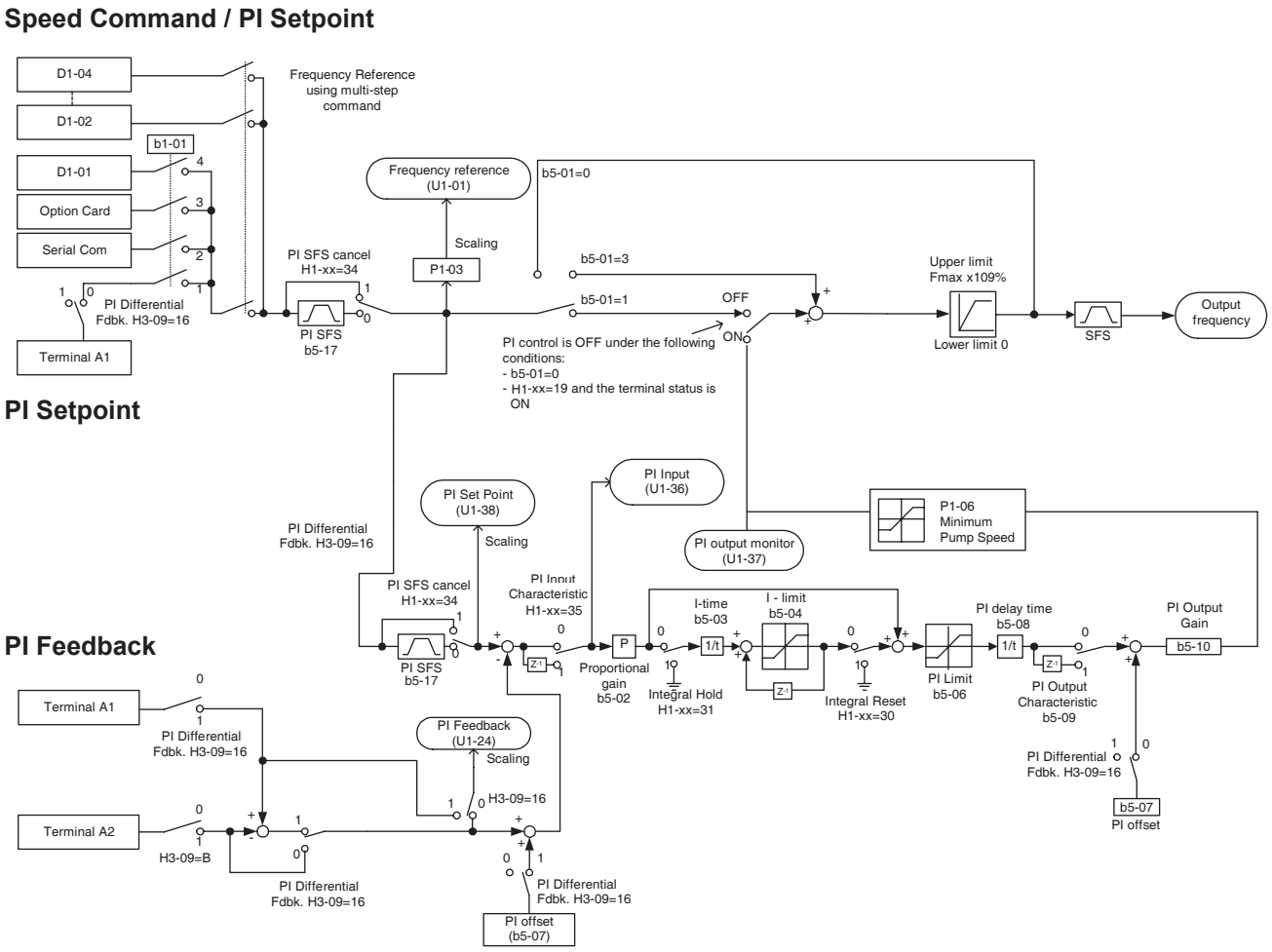


Figure 21 PI Block Diagram

The analog feedback to the iQpump drive for the PI control is via the A2 terminal. The iQpump drive must be programmed (H3-09 = "B: PI Feedback") to use terminal A2 as feedback for the PI functionality of the Drive.

The PI setpoint can be configured to come from one of many different inputs or parameters. *Table 1 on page 25* describes the options for originating the PI setpoint.

Table 1 PI Setpoint Options

The PI Setpoint will be read from:	If these conditions are true		
	Status of b5-18=	Status of Modbus Register 0Fh bit 1	Status of b1-01=
Parameter b5-19	1	N/A	N/A
Modbus Register 06H	0	ON	N/A
D1-01	0	OFF	0
Terminal A1	0	OFF	1
Serial Comm.	0	OFF	2
Option PCB	0	OFF	3

In some situations there are two feedback inputs. The drive can be programmed to maintain a set differential between two analog signals. If input A2 is configured as a “PI Differential Mode” (H3-09 = “16: PI Differential”), then the iQpump drive will maintain a set difference between the measurements read on inputs A1 and A2. This differential setpoint is programmed by parameter (b5-07).

■ b5-01 PI Mode

Setting	Description
0	Disabled (*factory default*)
1	Enabled
2	Fref+PI

The iQpump drive can be used as a stand-alone PI controller. If PI functionality is selected by parameter b5-01, the iQpump drive will adjust its output to cause the feedback from a transmitter to match the PI setpoint (b5-19). The setting of b5-01 will determine whether PI functionality is disabled (b5-01 = “0: Disabled”), enabled (b5-01 = “1: Enabled”), or enable with the output of the PI function used to trim a Speed Command (b5-01 = “3: Fref+PI”).

■ b5-02 Proportional Gain Setting

Setting Range: 0.00 to 25.00

Factory Default: 2.00

The proportional gain will apply a straight multiplier to the calculated difference (error) between the PI Setpoint and the measured transmitter feedback at terminal A2. A large value will tend to reduce the error but may cause instability (oscillations) if too high. A small value may allow to much offset between the setpoint and feedback (See *Figure 22* on following page).

■ b5-03 Integral Time Setting

Setting Range: 0.0 to 360.0 sec

Factory Default: 5.0 sec

The Integral factor of PI functionality is a time-based gain that can be used to eliminate the error (difference between the setpoint and feedback at steady state). The smaller the Integral Time set into b5-03, the more aggressive the Integral factor will be. To turn off the Integral Time, set b5-03 = 0.00.

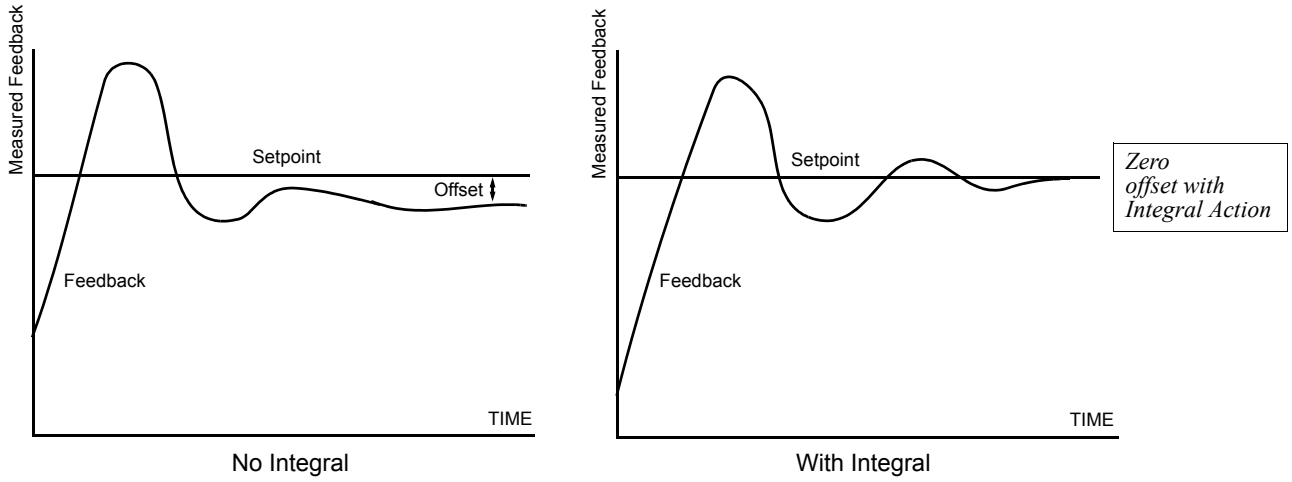


Figure 22 PI Feedback Response Characteristics

■ b5-04 Integral Limit Setting

Setting Range: 0.0 to 100.0%

Factory Default: 100.0%

On some applications, especially those with rapidly varying loads, the output of the PI function may have large oscillations. To suppress these oscillations, a limit can be applied to the integral factor by programming b5-04.

■ b5-06 PI Output Limit

Setting Range: 0.0 to 100.0%

Factory Default: 100.0%

Places a cap on the output of the PI function. Limiting the PI function may help to prevent large overshoots in the Drive's response to error (the difference between the setpoint and the feedback).

■ b5-07 PI Offset Adjustment

Setting Range: -100.0% to +100.0%

Factory Default: 0.0%

The PI Offset Adjustment parameter has two different uses. Parameter b5-07 serves different functions depending on whether it is used on a standard PI loop or a Differential PI loop.

Parameter b5-07 causes an offset to be applied to the output of the PI function in a non-Differential PI loop. Every time the PI output is updated, the offset (b5-07) is summed with the PI output. This can be used to artificially kick-start a slow starting PI loop.

If the iQpump drive is configured for Differential PI Regulation (H3-09 = "16: PI differential"), then this parameter is the target setpoint for the differential to be maintained between the signal measured on analog input A1 and the signal measured on analog input A2.

■ b5-08 PI Primary Delay Time Constant

Setting Range: 0.00 to 10.00 sec

Factory Default: 0.00 sec

Acts as a time based filter that lowers the responsiveness of the PI function, but also makes the function more stable when the setpoint varies rapidly or when the feedback is noisy.

■ b5-09 PI Output Level Selection

Setting	Description
0	Normal Output (direct acting) (*factory default*)
1	Reverse Output (reverse acting)

Normally, the output of the PI function causes an increase in motor speed whenever the measured feedback is below the setpoint. This is referred to as direct acting response. However, if b5-09 = "1: Reverse Output," the output of the PI function causes the motor to slow down when the feedback is below the setpoint. This is referred to as reverse acting response.

■ b5-10 PI Output Gain Setting

Setting Range: 0.0 to 25.0

Factory Default: 1.0

Applies a multiplier to the output of the PI function. Using the gain can be helpful when the PI function is used to trim the Speed Command. Increasing b5-10 causes the PI function to have a greater regulating affect on the speed command.

■ b5-12 PI Feedback Reference Missing Detection Selection

Setting	Description
0	Disabled (*factory default*)
1	Alarm
2	Fault

Loss of feedback can cause problems to a PI application. The iQpump drive can be programmed to turn on a digital output whenever a loss of feedback occurs. Feedback Loss Detection (FBL) is turned on by b5-12. When b5-12 = "1: Alarm," the iQpump drive acknowledges the loss of feedback without stopping or turning on the fault output (MA-MB). If b5-12 = "2: Fault," the iQpump drive coasts to a stop and turns on the fault output if the feedback is determined to be lost.

The Feedback Loss Detection can be disabled during the following conditions:

- Pre-Charge Level (P4-01) is set to 0.
- Thrust Bearing acceleration or deceleration.

Note: A Feedback Loss Detection (FBL) will occur when the Thrust Bearing function is enabled and a run command given, P1 Feedback Loss Detection Time (b5-14) is set to 0, and P1 Feedback is below Feedback Loss Detection Level (b5-13).

■ b5-13 PI Feedback Loss Detection Level

Setting Range: 0 to 100%

Factory Default: 0%

■ b5-14 PI Feedback Loss Detection Time

Setting Range: 0.0 to 25.0 sec

Factory Default: 1.0 sec

The iQpump drive interprets feedback loss whenever the feedback signal drops below the value of b5-13 and stays below that level for at least the time set into b5-14. See *Figure 23* for timing details.

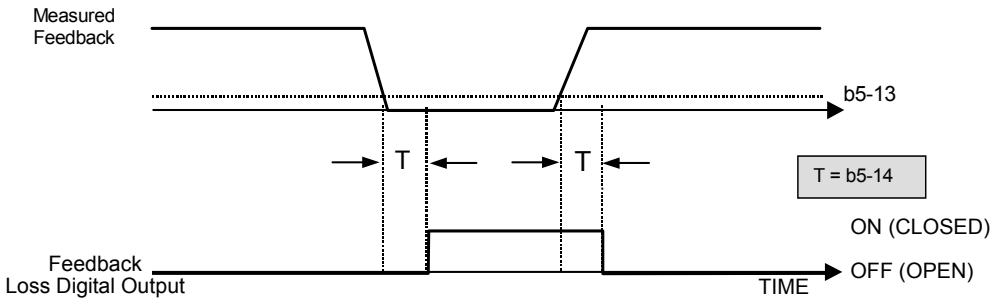


Figure 23 Loss of PI Feedback Feature

■ b5-17 PI Accel/Decel Time

Setting Range: 0.0 to 25.5 sec

Factory Default: 0.0 sec

This is a soft start function that is applied to the PI setpoint analog input. Instead of having nearly instantaneous changes in signal levels, there is a programmed ramp applied to level changes. When changing setpoints the error can be limited by gradually ramping the setpoint through the use of parameter b5-17.

◆ b8 Energy Savings

The energy savings function improves overall system operating efficiency by operating the motor at its highest efficiency. This is accomplished by continuously monitoring the motor load and adjusting the motor terminal voltage so that the motor always operates near its rated slip frequency. A motor is most efficient when operating near rated slip conditions.

■ b8-01 Energy Savings Selection

Setting	Description
0	Disabled (*factory default*)
1	Enabled

When the Energy Savings function is enabled (b8-01 = "1: Enabled"), the iQpump drive reduces the output voltage to the motor below the voltage value specified by the programmed V/f pattern whenever the motor load is light. Since torque is reduced during this voltage reduction, the voltage has to return to normal levels when the load returns. The energy savings is realized through improved motor efficiency. The reduced output voltage causes increased rotor slipping even with a light load. A motor is most efficient when operating fully loaded (i.e. operating at rated slip).

■ b8-04 Energy Saving Coefficient Value

Setting Range: 0.0 to 655.0

Factory Default: Model Dependent

Parameter b8-04 is used in maximizing motor efficiency. The factory setting will be iQpump drive capacity dependant but can be adjusted in small amounts while viewing the kW monitor (U1-08) and running the iQpump drive to minimize the output kW. A larger value typically results in less voltage to the motor and less energy consumption. Too large a value will cause the motor to stall.

■ b8-05 Power Detection Filter Time

Setting Range: 0 to 2000 ms

Factory Default: 20 ms

The Energy Saving function will search out the lowest output voltage in order to achieve minimum output power usage. Parameter b8-05 determines how often the output power (kW) is measured and the output voltage is adjusted.

■ b8-06 Search Operation Voltage Limit

Setting Range: 0 to 100%

Factory Default: 0%

Once Energy Savings is enabled and the optimal energy saving coefficient value has been set, the programmer can have the iQpump drive further search out the proper voltage to achieve the lowest output power by making minute changes to the output voltage and measuring the output power every b8-05 ms. Parameter b8-06 sets limits to the range over which the voltage will be adjusted in order to minimize the power output. Settings too large a value may allow the motor to stall if the load is applied abruptly.

If b8-06 = 0, then the optimum voltage search operation is disabled (but not Energy Savings itself).

◆ C1 Accel/Decel

■ Acceleration Times

Parameter No.	Parameter Name
C1-01	Acceleration Time 1
C1-02	Deceleration Time 1
C1-03	Acceleration Time 2
C1-04	Deceleration Time 2
C1-05	Acceleration Time 3
C1-06	Deceleration Time 3

Setting Range: 0.0 to 6000.0 sec

Factory Defaults: C1-01 and C1-02, 25.0 sec
C1-03 and C1-04, 10.0 sec
C1-05 and C1-06, 50.0 sec

C1-01 (Acceleration Time 1) sets the time to accelerate from zero to maximum speed (E1-04). C1-02 (Deceleration Time 1) sets the time to decelerate from maximum speed to zero. C1-01 and C1-02 are the factory default active accel/decel "pair". Another accel/decel pair (C1-03 and C1-04) exists that can be activated by a multi-function digital input (H1-0x = 7), or specified by a switch over frequency as programmed in parameter C1-11.

C1-05 (Acceleration Time 3) and C1-06 (Deceleration Time 3) are used during the multiple pumping operation. Refer to P3-12 for further description.

■ C1-09 Fast Stop Time

Setting Range: 0.0 to 6000.0 sec

Factory Default: 10.0 sec

A special deceleration parameter is available for use with emergency or fault operations. Parameter C1-09 will set a special deceleration that can be operated by closing a digital input configured as H1-0x = 15 or H1-0x = 17. A digital input configured as H1-0x = 15 will look for a switch closure before initiating the Fast Stop operation. A digital input configured as H1-0x = 17 will look for the switch opening before initiating the Fast Stop operation.

Unlike a standard deceleration time, once the Fast Stop operation is initiated even momentarily, the iQpump drive cannot be re-operated until the deceleration is complete, the Fast Stop input is cleared, and the Run command is cycled.

The C1-05 (Acceleration Time 3) and C1-06 (Deceleration Time 3) are used during the multiplex pumping operation. Refer to P3-12 for further description.

■ C1-11 Accel/Decel Switch Frequency

Setting Range: 0.0 to 200.0 Hz

Factory Default: 0.0 Hz

The iQpump drive can be programmed to automatically switch between the two sets of Accel/Decel parameters on the fly. No digital input is required. If parameter C1-11 is set to a frequency other than zero, the iQpump drive will use Acceleration 1 and Deceleration 1 whenever the output frequency is equal to or above the value of C1-11 and use Acceleration 2 and Deceleration 2 whenever the output frequency is below the value of C1-11.

A multi-function input programmed as "Multi-Acc/Dec 1" will have priority over C1-11. For example, if the output frequency is greater than the value of C1-11 but a digital input configured as "Multi-Acc/Dec 1" is closed then Acceleration 2 and Deceleration2 are active.

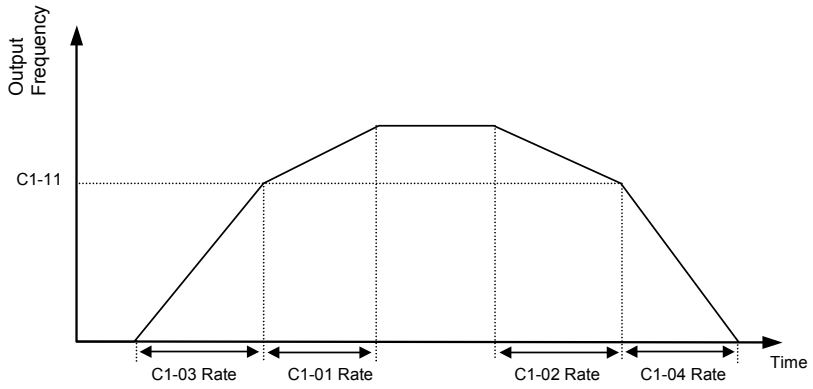


Figure 24 Accel/Decel Switch Frequency Operation

◆ C2 S-Curve Acc

■ S-Curve Characteristics

Parameter No.	Parameter Name
C2-01	S-Curve Characteristic at Start
C2-02	S-Curve Characteristic at Stop

Setting Range: 0.00 to 2.50 sec

Factory Default: 0.20 sec

Parameters C2-01 and C2-02 will affect the acceleration rate of the output frequency in order to reduce shock to the load. The S-curve addition to the acceleration profile can ramp the acceleration rate from a 0 to the rate specified by the active Acceleration Time (C1-01 or C1-03) and back to 0.

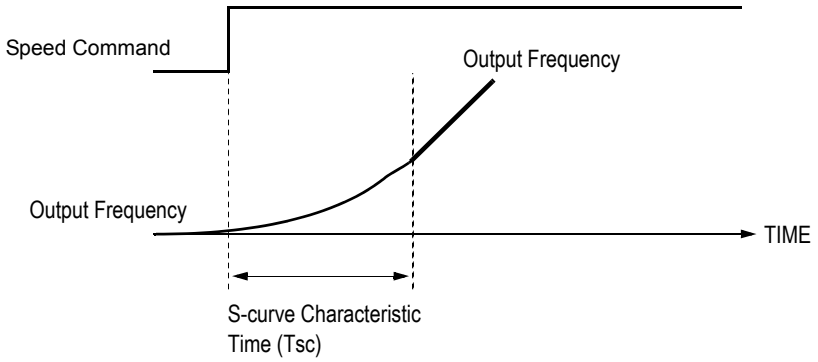


Figure 25 S-curve Characteristic Timing Diagram

The S-Curve transition into and out of the active acceleration rate can be programmed independently. C2-01 will ramp up the acceleration from no acceleration up to the rate of C1-01 or C1-03. C2-02 will ramp the acceleration rate from the rate of C1-01 or C1-03 back down to no acceleration (constant speed). The use of S-Curve characteristics will lengthen the overall acceleration time as follows:

$$\text{Overall Aceleration Time} = \text{Active Acceleration Time} + \frac{(\text{C2-01}) + (\text{C2-02})}{2}$$

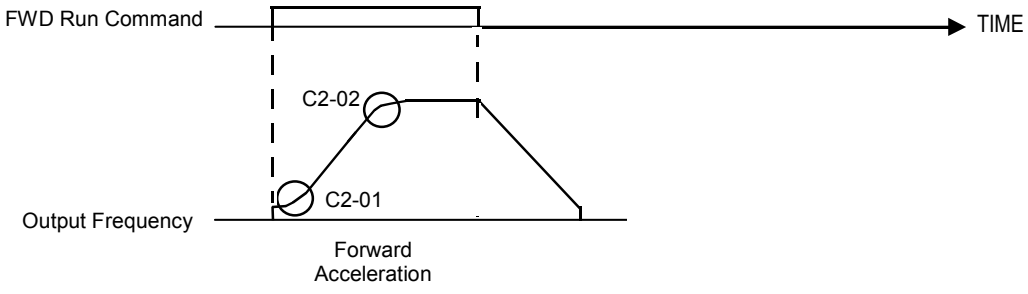


Figure 26 S-Curve Characteristic Timing Diagram

◆ C4 Torque Comp

■ C4-01 Torque Compensation Gain

Setting Range: 0.00 to 2.50

Factory Default: 1.00

■ C4-02 Torque Compensation Primary Delay Time

Setting Range: 0 to 10000 ms

Factory Default: 200 ms

The Torque Compensation function compensates for insufficient torque production at start-up and during low speed operation. The iQpump drive will detect increases in the motor load by monitoring the output current and compensate by increasing the output voltage. The increased output voltage leads to an increase in usable torque.

Parameter C4-01 sets the aggressiveness of the compensation for IR (resistive) and IL (inductive) losses in the motor windings, which are more pronounced at lower speeds. Normally C4-01 does not need to be changed but may require adjustment in the following cases:

- If the iQpump drive to motor cable is long, increase C4-01
- If the motor capacity is smaller than the iQpump drive capacity, increase C4-01
- If the low speed motor performance is unstable, decrease C4-01.
- If the output current level exceeds the Drive's rated current while operating at low speeds, increase C4-01

Parameter C4-02 determines how quickly the Torque Compensation function will react to situations of insufficient torque. Again, C4-02 will not normally require adjustment except for the following situations:

- If the motor vibrates, increase C4-02
- If the motor response is sluggish (and possibly stalls), decrease C4-02

Important: Performing Auto-tuning can enhance low speed performance.

◆ C6 Carrier Frequency

■ C6-01 Normal Duty Selection

Setting	Description
1	Normal Duty 1
2	Normal Duty 2 (*factory default*)

Adjustment of parameter C6-01 will affect the Drive's overload and carrier frequency settings. Generally this parameter does not need adjustment and should be left at the factory default setting.

■ C6-02 Carrier Frequency Selection

Setting	Description
0	Low Noise
1	Fc=2.0 kHz
2	Fc=5.0 kHz
3	Fc=8.0 kHz
4	Fc=10.0 kHz
F	Program
*The factory default setting is model dependent	

Parameter C6-02 sets the switching frequency of the Drive's output transistors. It can be changed in order to reduce audible noise and also reduce leakage current. Cases that may require adjustment to the C6-02 are:

• If the wiring length between the iQpump drive and the motor is long, decrease the carrier frequency

Wiring Length	328 ft or less	Over 328 ft
C6-02 (carrier frequency) setting	1 to 4 (10 kHz max.)	1 to 2 (5 kHz max.)

• If speed and torque are inconsistent at low speeds, decrease the carrier frequency
• If leakage current from the iQpump drive is large, decrease the carrier frequency
• If the audible motor noise is too great, increase the carrier frequency (may require iQpump drive current derating)

When parameter C6-02 is set to "0: Low Noise" the iQpump drive uses a carrier frequency of 2 kHz and reduces the motor audible noise by approximately 5 db. over the conventional 2 kHz setting (C6-02 = 1). The iQpump drive modulates the nominal PWM pattern to achieve the lower noise. This setting is normally used with high starting torque loads that are frequently started and stopped or, applications where leakage current needs to be minimized and motor audible noise is important.

Table 2 Carrier Frequency Parameter Factory Defaults (C6-01=2: Normal Duty 2)

208 V – 240 V Drives 1						480 V Drives 1					
Model CIMR-P7	C6-02 Carrier Frequency (kHz)	C6-03 Carrier Frequency Max. (kHz)	C6-04 Carrier Frequency Min. (kHz)	C6-05 Carrier Frequency Gain	Nominal HP	Model CIMR-P7	C6-02 Carrier Frequency (kHz)	C6-03 Carrier Frequency Max. (kHz)	C6-04 Carrier Frequency Min. (kHz)	C6-05 Carrier Frequency Gain	Nominal HP
20P4	4 (10.0)	4 (10.0)	4 (10.0)	0	0.5/0.75	40P4	6 (15.0)	6 (15.0)	6 (15.0)	0	0.5/0.75
20P7	4 (10.0)	4 (10.0)	4 (10.0)	0	1	40P7	6 (15.0)	6 (15.0)	6 (15.0)	0	1
21P5	4 (10.0)	4 (10.0)	4 (10.0)	0	1.5/2	41P5	6 (15.0)	6 (15.0)	6 (15.0)	0	1.5/2
22P2	3 (8.0)	3 (8.0)	3 (8.0)	0	3	42P2	6 (15.0)	6 (15.0)	6 (15.0)	0	3
23P7	4 (10.0)	4 (10.0)	4 (10.0)	0	5	43P7	6 (15.0)	6 (15.0)	6 (15.0)	0	5
25P5	6 (15.0)	6 (15.0)	6 (15.0)	0	7.5	45P5	6 (15.0)	6 (15.0)	6 (15.0)	0	7.5
27P5	6 (15.0)	6 (15.0)	6 (15.0)	0	10	47P5/49P0	6 (15.0)	6 (15.0)	6 (15.0)	0	10/15
2011	3 (8.0)	3 (8.0)	3 (8.0)	0	15	4011	3 (8.0)	3 (8.0)	3 (8.0)	0	15/20
2015	4 (10.0)	4 (10.0)	4 (10.0)	0	20	4015	4 (10.0)	4 (10.0)	4 (10.0)	0	25
2018	4 (10.0)	4 (10.0)	4 (10.0)	0	25	4018/4024	4 (10.0)	4 (10.0)	4 (10.0)	0	30/40
2022	4 (10.0)	4 (10.0)	4 (10.0)	0	30	4030	3 (8.0)	3 (8.0)	3 (8.0)	0	40/50
2030	4 (10.0)	4 (10.0)	4 (10.0)	0	40	4037	3 (8.0)	3 (8.0)	3 (8.0)	0	60
2037	2 (5.0)	2 (5.0)	2 (5.0)	0	50	4045	3 (8.0)	3 (8.0)	3 (8.0)	0	75
2045	2 (5.0)	2 (5.0)	2 (5.0)	0	60	4055	2 (5.0)	2 (5.0)	2 (5.0)	0	100
2055	3 (8.0)	3 (8.0)	3 (8.0)	0	75	4075	2 (5.0)	2 (5.0)	2 (5.0)	0	125
2075	1 (2.0)	1 (2.0)	1 (2.0)	0	75/100	4090	3 (8.0)	3 (8.0)	3 (8.0)	0	150

208 V – 240 V Drives 1						480 V Drives 1					
Model CIMR-P7	C6-02 Carrier Frequency (kHz)	C6-03 Carrier Frequency Max. (kHz)	C6-04 Carrier Frequency Min. (kHz)	C6-05 Carrier Frequency Gain	Nominal HP	Model CIMR-P7	C6-02 Carrier Frequency (kHz)	C6-03 Carrier Frequency Max. (kHz)	C6-04 Carrier Frequency Min. (kHz)	C6-05 Carrier Frequency Gain	Nominal HP
2090	1 (2.0)	1 (2.0)	1 (2.0)	0	125	4110	2 (5.0)	2 (5.0)	2 (5.0)	0	200
2110	1 (2.0)	1 (2.0)	1 (2.0)	0	150	4160	2 (5.0)	2 (5.0)	2 (5.0)	0	250
						4185	1 (2.0)	1 (2.0)	1 (2.0)	0	300/350
						4220	1 (2.0)	1 (2.0)	1 (2.0)	0	450
						4300	1 (2.0)	1 (2.0)	1 (2.0)	0	500+

■ Carrier Frequency Limits

Parameter No.	Parameter Name
C6-03	Carrier Frequency Upper Limit
C6-04	Carrier Frequency Lower Limit

Setting Range: 0.4 to 10.0 kHz

Factory Default: Model Dependent

■ C6-05 Carrier Frequency Proportional Gain

Setting Range: 0 to 99

Factory Default: 0

It is possible to configure the iQpump drive such that the carrier frequency will automatically increase as the output frequency is raised (synchronous carrier). A synchronous carrier can be used by setting parameter C6-02=F: Program. The profile of the carrier frequency is show below and can be configured to the users specification by setting the carrier frequency upper and lower limits (C6-03 and C6-04 respectively) and a carrier frequency proportional gain (C6-05).

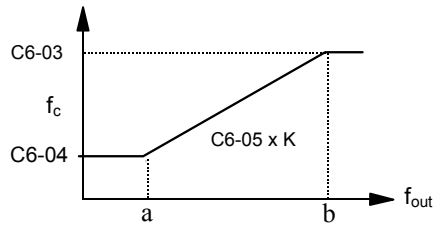


Figure 27 Synchronous Carrier Frequency Characteristics

The frequencies that correspond to the breakpoints a and b will be determined by the value of ***K*** given in the table below and the following formulas:

Conditions	*K* Value
C6-03 > 10.0 kHz	3
10.0 kHz > C6-03 > 5.0 kHz	2
C6-03 < 5.0 kHz	1

$$a = \frac{\text{C6-04}}{\text{C6-05} \times \boldsymbol{K}}$$

$$b = \frac{\text{C6-03}}{\text{C6-05} \times \boldsymbol{K}}$$

Important: If C6-05 > 6 and C6-04 > C6-03 the iQpump drive will fault and display and OPE11 error.

◆ d1 Setpoint and Jog References

■ Setpoint References

Parameter No.	Parameter Name
d1-01	Setpoint Reference 1
d1-02	Setpoint Reference 2
d1-03	Setpoint Reference 3
d1-04	Setpoint Reference 4

Setting Range: 0 to P1-03 Value

Factory Default: 0

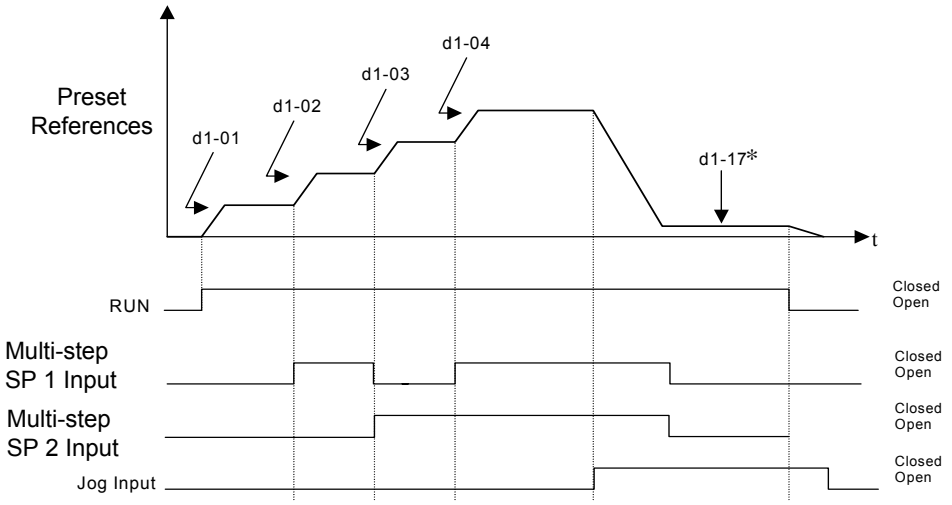


Figure 28 Setpoint and Jog Reference Timing Diagram

* Available only with an LCD operator (JVOP-160).

■ d1-17 Jog Frequency Reference (LCD Operator Function Only JVOP-160)

Setting Range: 0.00 to E1-04 Value

Factory Default: 0.00 to 6.00 Hz

The iQpump drive can be programmed to utilize digital inputs to change between four setpoint and a jog references. It is a two-step process to set the iQpump drive up for setpoint point and jog references. First, d1-01 through d1-04 and d1-17 must be programmed with the desired setpoint references and the desired jog reference, respectively. Next, up to three of the Drive's digital inputs (Terminals S3 through S7) need to be programmed (via parameters H1-01 to H1-05) and wired (to normally open contacts) as Multi-step SP1, Multi-step SP2, and Jog Frequency.

Table 3 Preset Speed Truth Table

Preset Reference	Terminal programmed as Multi-step SP1	Terminal programmed as Multi-step SP2	Details
1	OFF	OFF	Setpoint Reference 1 (d1-01) or analog input A1# (determined by b1-01, see page *36*)
2	ON	OFF	Setpoint Reference 2 (d1-02) or analog input A2# (determined by H3-09, see page *36*)
3	OFF	ON	Setpoint Reference 3 (d1-03)
4	ON	ON	Setpoint Reference 4 (d1-04)
# Shown for H3-13="0: Main Fref TA1"; A1 and A2 are reversed if H3-13="1: Main Fref TA2"			

As shown in the above table, it is possible to use analog inputs in place of Setpoint Reference 1 and Setpoint Reference 2.

- If b1-01 = "1: Terminals" then the analog input A1 will be used instead of Setpoint Reference 1 for the first preset setpoint. If b1-01 = "0: Operator," then Setpoint Reference 1 will be used.
- If H3-09 = "2: Aux Reference" then the analog input A2 will be used instead of Setpoint Reference 2 for the second preset setpoint. If H3-09 = 2 then Setpoint Reference 2 will be used. This is only available when the iQpump drive is operating in the speed mode.

Important: The programming of d1-01 through d1-04 and d1-17 will be affected by the setting of P1-02 and o1-03, respectively. The programming of these parameters will be in the units specified by Display Scaling parameter (P1-02 and o1-03).

Note: This function is only used with the LCD operation, not used with HOA operator.

◆ d2 Reference (Speed Command) Limits

■ d2-01 Frequency Reference Upper Limit

Setting Range: 0.0 to 110.0%

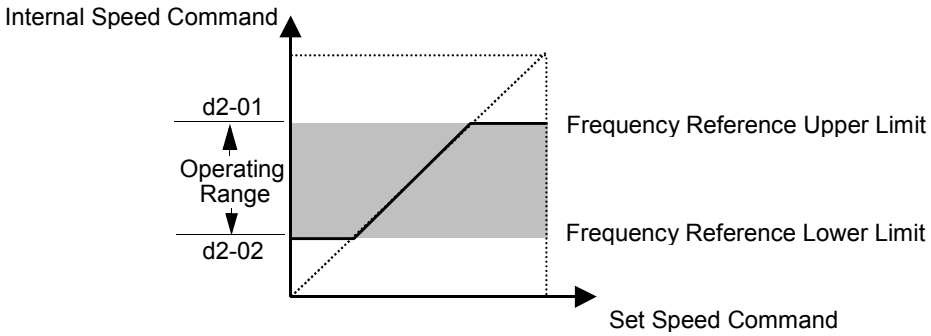
Factory Default: 100.0%

■ d2-02 Frequency Reference Lower Limit

Setting Range: 0.0 to 110.0%

Factory Default: 0.0%

The use of parameters d2-01 and d2-02 places limitations on the speed command that the iQpump drive will accept. The parameters are set in units of percentage of the maximum frequency (E1-04) and provide limits on any remote speed command input. By entering upper or lower frequency limits, the iQpump drive programmer can prevent operation of the iQpump drive above or below levels that may cause resonance, equipment damage or discomfort (see also parameter d3-0X). For example, limits may be needed to prevent low speed operation of: Cooling tower fans with gear boxes, pumps with pressure dependent seals, or AHUs with minimum delivery requirements.



Note: See also the “Sleep” function in Figure 1.19 for alternate “lower limit” implementation.

Figure 29 Frequency Reference Upper and Lower Limit Effects on the Speed Command

■ d2-03 Master Speed Reference Lower Limit

Setting Range: 0.0 to 110.0%

Factory Default: 0.0%

Unlike Frequency Reference Lower Limit (d2-02) which will affect the speed command no matter where it is sourced from (i.e. analog input, preset speed, jog speed, etc.), the Master Speed Reference Lower Limit (d2-03) sets a low speed threshold that will only affect the analog input that is the active master speed frequency (as determined by parameter H3-13 and H3-09). This parameter allows a minimum speed to be programmed for the master reference while allowing a lower speed to be set as a jog reference. If the speed commanded by the active master speed frequency is below the setting of d2-03, then the iQpump drive will operate at the speed specified by d2-03.

◆ d3 Jump Frequencies

■ Jump Frequencies

Parameter No.	Parameter Name
d3-01	Jump Frequency 1
d3-02	Jump Frequency 2
d3-03	Jump Frequency 3

Setting Range: 0.0 to 200.0 Hz

Factory Default: 0.0 Hz

■ d3-04 Jump Frequency Width

Setting Range: 0.0 to 20.0 Hz

Factory Default: 1.0 Hz

In order to avoid continuous operation at a speed that causes resonance in driven machinery, the iQpump drive can be programmed with jump frequencies that will not allow continued operation within specific frequency ranges. If a speed is commanded that falls within a dead band, or Jump Frequency, the iQpump drive will clamp the frequency reference just below the dead band and only accept higher speed commands when the commanded speed rises above the upper end of the dead band, for increasing references. Similarly, the iQpump drive will clamp the frequency reference just above the dead band and only accept lower speed commands when the command speed falls below the lower end of the dead band, for decreasing references.

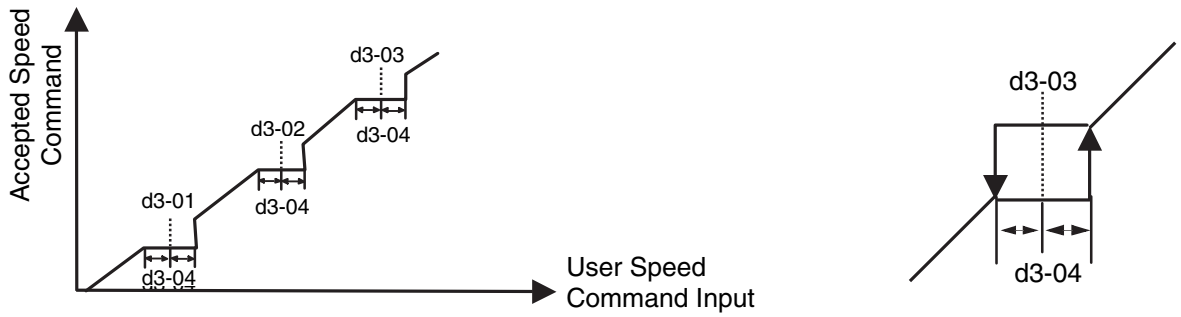


Figure 30 Jump Frequency Characteristics

Setting the center point of the dead band with the d3-01 through d3-03 parameters and setting the width of the dead band with parameter d3-04 determines the dead band characteristics. The programmer can set up to three Jump Frequencies. If multiple Jump Frequencies are programmed the following rule applies:

d3-01< = d3-02< = d3-03

◆ E1 V/f Pattern

■ E1-01 Input Voltage Setting

Setting Ranges: 155.0 V to 255.0 V (208 V/240 V Models)
310.0 V to 510.0 V (480 V Models)

Factory Defaults: 208.0 V (208 V Models)
240.0 V (240 V Models)
480.0 V (480 V Models)

Set the Input Voltage parameter (E1-01) to the nominal voltage of the connected AC power supply. This parameter adjusts the levels of some protective features of the iQpump drive (i.e. Overvoltage, Stall Prevention, etc.). E1-01 also serves as the Maximum/Base Voltage used by the Preset V/Hz curves (E1-03 = 0 to D).

■ E1-03 V/f Pattern Selection

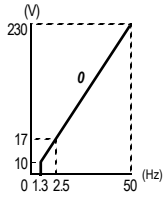
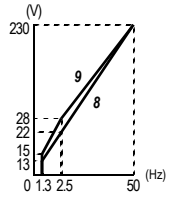
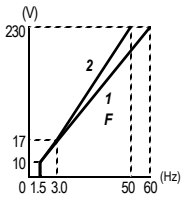
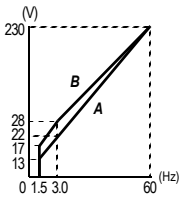
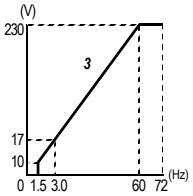
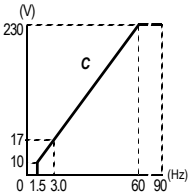
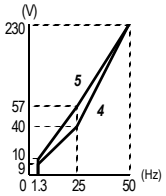
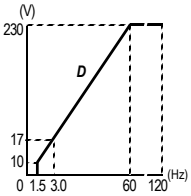
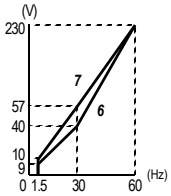
Setting	Description
0	50 Hz
1	60 Hz Saturation
2	50 Hz Saturation
3	72 Hz
4	50 Hz VT1
5	50 Hz VT2
6	60 Hz VT1
7	60 Hz VT2
8	50 Hz HST1
9	50 Hz HST2
A	60 Hz HST1
B	60 Hz HST2
C	90 Hz
D	120 Hz
E	180 Hz (invalid - OPE2 fault will occur)
F	Custom V/f (*factory default, with parameter values per setting 1*)
FF	Custom w/o limit

The iQpump drive operates utilizing a set V/f pattern to determine the appropriate output voltage level for each commanded speed. There are 14 different preset V/f patterns to select from with varying voltage profiles, saturation levels (frequency at which maximum voltage is reached), and maximum frequencies.

There are also settings for Custom V/f patterns that will allow the programmer to manually set (“Customize”) the V/f pattern using parameters E1-04 through E1-13.

Using parameter E1-03, the programmer can select one of the preset V/f patterns or chose between a custom V/f pattern with an upper voltage limit (E1-03 = “F: Custom V/f”) and a custom V/f pattern without a voltage limit (E1-03 = “FF: Custom w/o limit”).

Table 4 Preset V/f Patterns

	Specifications		E1-03	V/f Pattern *1		Specifications		E1-03	V/f Pattern *1
General-purpose	50 Hz		0		High Starting Torque *2	50 Hz	High Starting Torque 1	8	
							High Starting Torque 2	9	
	60 Hz Saturation		1 F			60 Hz	High Starting Torque 1	A	
	50 Hz Saturation		2				High Starting Torque 2	B	
	72 Hz		3			90 Hz		C	
Variable Torque	50 Hz	Variable Torque 1	4		High Speed Operation	120 Hz		D	
		Variable Torque 2	5						
	60 Hz	Variable Torque 1	6						
		Variable Torque 2	7						

If one of the custom V/f patterns is selected, then parameters E1-04 through E1-13 will determine the V/f pattern.

Table 4 is for 240 V class units only. For 480 V class units multiply the voltage value by 2.

Important: When a factory Initialization is performed, the setting of E1-03 is unaffected but the settings of E1-04 through E1-13 are returned to their factory default settings.

■ E1-04 Maximum Output Frequency

Setting Range: 0.0 to 120.0 Hz

Factory Default: 60.0 Hz

■ E1-05 Maximum Output Voltage

Setting Ranges: 0.0 to 255.0 V (240 V Models)
0.0 to 510.0 V (480 V Models)

Factory Defaults: 240.0 V (240 V Models)
480.0 V (480 V Models)

■ E1-06 Base Frequency

Setting Range: 0.0 to 120.0 Hz

Factory Default: 60.0 Hz

■ E1-07 Mid Output Frequency A

Setting Range: 0.0 to 120.0 Hz

Factory Default: 3.0 Hz

■ E1-08 Mid Output Voltage A

Setting Ranges: 0.0 to 255.0 V (240 V Models)
0.0 to 510.0 V (480 V Models)

Factory Defaults: 17.2 V (240 V Models)
34.5 V (480 V Models)

■ E1-09 Minimum Output Frequency

Setting Range: 0.0 to 120.0 Hz

Factory Default: 1.5 Hz

■ E1-10 Mid Output Voltage

Setting Ranges: 0.0 to 255.0 V (240 V Models)
0.0 to 510.0 V (480 V Models)

Factory Defaults: 10.3 V (240 V Models)
20.7 V (480 V Models)

■ E1-11 Mid Output Frequency B

Setting Range: 0.0 to 120.0 Hz

Factory Default: 0.0 Hz

■ E1-12 Mid Output Voltage B

Setting Ranges: 0.0 to 255.0 V (240 V Models)
0.0 to 510.0 V (480 V Models)

Factory Defaults: 0.0 V (240 V Models)
0.0 V (480 V Models)

Top set up custom V/f pattern, program the points shown in the diagram below using parameters E1-04 through E1-13. Be sure that the following condition is true:

E1-09 ≤ E1-07 ≤ E1-06 ≤ E1-11 ≤ E1-04

■ E1-13 Base Voltage

Setting Ranges: 0.0 to 255.0 V (240 V Models)
0.0 to 510.0 V (480 V Models)

Factory Defaults: 0.0 V (240 V Models)
0.0 V (480 V Models)

To set up a custom V/f pattern, program the points shown in the diagram below using parameters E1-04 through E1-13. Be sure that the following condition is true:

E1-09 ≤ E1-07 ≤ E1-06 ≤ E1-11 ≤ E1-04

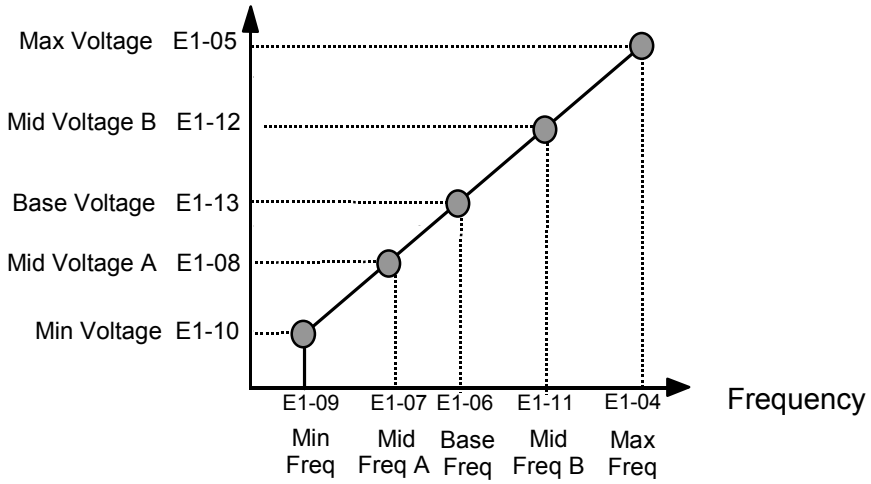


Figure 31 Custom V/f Pattern Programming Curve

Increasing the voltage in the V/f pattern increases the available motor torque. However, when setting a custom V/f pattern, increase the voltage gradually while monitoring the motor current, to prevent:

- Drive faults as a result of motor over-excitation
- Motor overheating or excessive vibration

Tables 5 and 6 are for 240 V class units only. For 480 V class units, multiply the voltage values by 2.

Table 5 V/f Pattern Default Settings for Drive Capacity 0.5 to 2 HP for 240 V Class

Parameter No.	Name	Unit	Factory Setting														
E1-03	V/f Pattern Selection	—	0	1	2	3	4	5	6	7	8	9	A	B	C	D	F
E1-04	Max Output Frequency	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	60.0
E1-05	Max Output Voltage	V	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0
E1-06	Base Frequency	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0
E1-07	Mid Output Frequency A	V	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0
E1-08	Mid Output Voltage A	V	17.2	17.2	17.2	17.2	40.2	57.5	40.2	57.5	21.8	27.6	21.8	27.6	17.2	17.2	17.2
E1-09	Min Output Frequency	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5
E1-10	Mid Output Voltage	V	10.3	10.3	10.3	10.3	9.2	10.3	9.2	10.3	12.6	14.9	12.6	17.2	10.3	10.3	10.3
E1-11	Mid Output Frequency B	Hz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E1-12	Mid Output Voltage B	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E1-13	Base Voltage	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For 480 V class units, the value is twice that of 240 V class units.																	

Table 6 V/f Pattern Default Settings for Drive Capacity 3 to 40 HP for 240 V Class

Parameter No.	Name	Unit	Factory Setting														
E1-03	V/f Pattern Selection	—	0	1	2	3	4	5	6	7	8	9	A	B	C	D	F
E1-04	Max. Output Frequency	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	60.0
E1-05	Max. Output Voltage	V	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0
E1-06	Base Frequency	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0
E1-07	Mid. Output Frequency A	V	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0
E1-08	Mid. Output Voltage A	V	16.1	16.1	16.1	16.1	40.2	57.5	40.2	57.5	20.7	26.4	20.7	26.4	16.1	16.1	16.1
E1-09	Min. Output Frequency	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5
E1-10	Mid. Output Voltage	V	8.0	8.0	8.0	8.0	6.9	8.0	6.9	8.0	10.3	12.6	10.3	14.9	8.0	8.0	8.0
E1-11	Mid Output Frequency B	Hz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E1-12	Mid Output Voltage B	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E1-13	Base Voltage	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For 480 V class units, the value is twice that of 240 V class units.																	

Table 7 V/f Pattern Default Settings for Drive Capacity 50 to 150 HP for 240 V Class

Parameter No.	Name	Unit	Factory Setting														
E1-03	V/f Pattern Selection	–	0	1	2	3	4	5	6	7	8	9	A	B	C	D	F
E1-04	Max. Output Frequency	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	60.0
E1-05	Max. Output Voltage	V	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0
E1-06	Max. Voltage Frequency	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0
E1-07	Mid. Output Frequency A	V	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0
E1-08	Mid. Output Voltage A	V	13.8	13.8	13.8	13.8	40.2	57.5	40.2	57.5	17.2	23.0	17.2	23.0	13.8	13.8	13.8
E1-09	Min. Output Frequency	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5
E1-10	Mid. Output Voltage	V	6.9	6.9	6.9	6.9	5.7	6.9	5.7	6.9	8.0	10.3	8.0	12.6	6.9	6.9	6.9
E1-11	Mid Output Frequency B	Hz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E1-12	Mid Output Voltage B	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E1-13	Base Voltage	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
For 480 V class units, the value is twice that of 240 V class units.																	

◆ E2 Motor Setup

■ E2-01 Motor Rated Current

Setting Range: 10% to 200%

Factory Default: Model Dependent

The Motor Rated Current parameter (E2-01) is necessary information for the iQpump drive motor protection function. The motor overload protection parameter L1-01 is enabled by default. In addition, motor rated current is used by the torque compensation function to insure optimum torque production. Set E2-01 to the full load amps (FLA) value stamped on the motor's nameplate. During Auto-tuning, it is required for the operator to enter the motor rated current in parameter T1-04 on the Auto-Tuning menu. If the Auto-tuning operation completes successfully, the value entered into T1-04 will be also written into E2-01.

For applications employing an iQpump drive that is oversized for the motor, E2-01 may be set as low as 10% of the iQpump drive output current rating. The AMP value in E2-01, however, must always be greater than the "No Load Current" value in parameter E2-03 or an OPE02 error will be displayed.

■ E2-03 No Load Current

Setting Range: Model Dependent (see *Appendix B*)

Factory Default: Model Dependent

Set E2-03 to the motor no-load current at rated voltage and rated frequency. Consult the motor manufacturer for the proper value if the no load current is not stated on the motor nameplate.

■ E2-04 Number of Motor Poles

Setting Range: 2 to 48 poles

Factory Default: 2 pole

This parameter sets the number of motor poles used for no-flow detection function and for the calculation of RPM-related parameters.

■ E2-05 Motor Line-to-Line Resistance

Setting Range: 0.000 to 65.000 Ω

Factory Default: Model Dependent

Sets the line-to-line resistance of the motor's stator winding. Usually determined by performing Auto-tuning. If Auto-tuning cannot be completed without error, then manually set E2-05 to the value as determined by the motor manufacturer. Remember this value must be entered as line-line and not line neutral.

$$\text{E2-05} = \left(\begin{array}{l}\text{Phase-to-phase Resistance at}\\ \text{Insulation Class Temperature}\end{array}\right) \quad X \quad \frac{273 + (25 + \text{insulation class temperature}) /2}{273 + \text{insulation class temperature}}$$

Where: Insulation class temperature is in °C

◆ F6 Com OPT Setup

■ F6-01 Operation Selection After Communication Error

Setting	Description
0	Ramp to Stop
1	Coast to Stop (*factory default*)
2	Fast-Stop
3	Alarm Only

If a serial communication option board is attached to the iQpump drive at the 2CN connector, the iQpump drive will automatically monitor the card for any type of communication errors. F6-01 is applicable no matter whether a run command or speed command is coming via the option board, digital operator, or terminal input. The setting of F6-01 determines whether the communication error is seen as a fault or an alarm. If F6-01 = "3: Alarm Only," then the fault output is not energized upon a communication error. All other settings of F6-01 cause the fault output to energize. The setting of F6-01 does not apply to any of the embedded communication protocols used at the RS-485/422 terminals on the removable terminal board. (See parameters H5-0X.)

■ F6-02 Option PCB External Fault Detection Selection

Setting	Description
0	Always Detected *(factory default*)
1	Detected only during operation

■ F6-03 Option PCB External Fault Stopping Method

Setting	Description
0	Ramp to Stop
1	Coast to Stop (*factory default*)
2	Fast-Stop
3	Alarm Only

If an external fault is received from a communication option card, the settings of F6-02 and F6-03 will determine the iQpump drive operation in reaction to the fault signal. Parameter F6-02 will determine if the external fault is always recognized (F6-02 = "0: Always Detected") or only recognized when the Run command is active (F6-02 = "1: Detected only during operation").

Once the fault is recognized, parameter F6-03 will determine the operation of the Drive. If parameter F6-03 is set to anything other then "3," the iQpump drive will fault and a stopping sequence is begun. If F6-03 = "3: Alarm Only," then the external fault is treated like an alarm. Operation will continue and an EF0 fault will flash on the digital operator.

■ F6-05 Current Scaling via Communication Option PCB

Setting	Description
0	A Display (*factory default*)
1	100%/8192 (Drive Rated Current)

A communication option card can read the Drive's DPRAM to access the current monitor. The format of the current reading in the DPRAM will be determined by parameter F6-05.

F6-05 = "0: A Display" → Current is a decimal number corresponding to actual Amperes
F6-05 = "1: 100%/8192 (Drive Rated Current)" → Current reading is a number where 8192 = 100% of the iQpump drive rated output current

◆ H1 Digital Inputs

■ Terminal Function Selections

Parameter No.	Parameter Name
H1-01	Terminal S3 Function Selection
H1-02	Terminal S4 Function Selection
H1-03	Terminal S5 Function Selection
H1-04	Terminal S6 Function Selection
H1-05	Terminal S7 Function Selection

Setting Range: 0 to 86

Factory Defaults: H1-01 = “24: External Fault”
H1-02 = “14: Fault Reset”
H1-03 = “3: Multi-Step SP1” (2-Wire)
“0: 3-Wire Control” (3-Wire)
H1-04 = “80: Hand Mode”
H1-05 = “84: Pre-Charge”

The iQpump drive has five multi-function contact digital inputs. By programming parameters H1-01 through H1-06, the user can assign specific functions to each input. Below is a table with a complete list of all of the digital input functions. Following the table is a more detailed description of each of the functions.

Table 8 Digital Input Functions

Parameter setting	Function	Parameter setting	Function
0	3-Wire Control	20-2F	External Pump Fault
1	Local/Remote Selection	30	Integral Reset
2	Option/Inv Selection 1	31	Integral Hold
3	Multi-step SP1	34	PI Soft Start Cancel
4	Multi-step SP2	35	PI Input Characteristic
6	Not Used	36	Option/Inv Selection 2
7	Multi-Accel/Decel 1	60	Motor Pre-heat
8	External Baseblock N.O.	61	Speed Search 1
9	External Baseblock N.C.	62	Speed Search 2
A	Accel/Decel Ramp Hold	64	Speed Search 3
C	Terminal A2 Enable	67	Communications Test Mode
F	Terminal Not Used	68	High Slip Braking
10	MOP Increase	6A	Drive Enable
11	MOP Decrease	6B	Comm/Inv Selection
12	Not Used	6C	Com/Inv SEL 2
13	Not Used	6D	Not Used
14	Fault Reset	6E	Not Used
15	Fast Stop N.O.	70	Not Used
17	Fast Stop N.C.	80	Hand Mode
18	Timer Function	81	Disable Sleep Mode
19	PI Disable	82	Sleep Activation
1B	Program Lockout	83	Thermostat Fault
1C	Not Used	84	Disable Pre-Charge
1D	Not Used	85	Low Water Level
1E	Not Used	86	Fixed Speed Auto

Function: 3-Wire Control (Setting: 0)

When one of the digital inputs is programmed for 3-Wire control, that input becomes a Forward/Reverse directional input. Whenever the input is open, the iQpump drive will be set for forward rotation of the motor shaft. If the input it closed, then the motor shaft will rotate in the reverse direction whenever a there is a Run input. The S1 and S2 digital inputs will function as a Run and Stop input respectively.

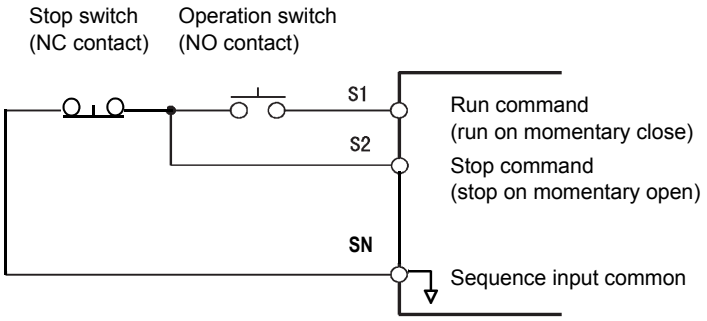


Figure 32 Terminal Configuration for 3-Wire Control

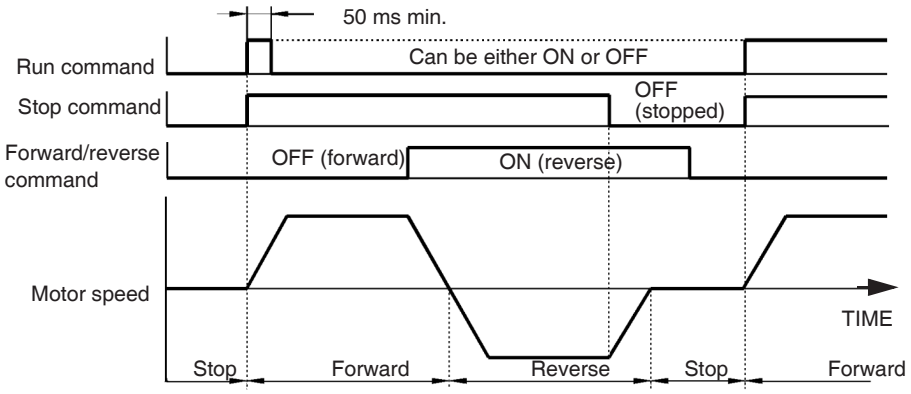


Figure 33 3-Wire Control Timing Diagram

Important: As long as the S1(Run Command) input is applied in for at least 50 ms the Run command will latch internally in the Drive.

Function: Local/Remote Selection (Setting: 1)

This function has been disabled. Please refer to settings “6D” and “6E”.

Function: Option/Inv Selection 1 (Setting: 2)

The Option/Inv Selection function allows the user to select the source for the Run and speed commands between either the Drive’s terminals or an optional communication card. When a digital input is programmed for the Option/Inv Selection function (H1-0x = 2) that input will function as follows:

Table 9 Digital Input Functions

Option/Inv Selection Input Status	Run and Speed Command Source
CLOSED	From the control circuit and analog input terminals
OPEN	From the Communications Option Card

To switch the command source between the option card and the terminals be sure to program the following parameters:

- Set b1-01 (Auto Setpoint Reference Selection) to 1 (Terminals).
- Set b1-02 (Run Command Selection) to 1 (Terminals).
- Set H1-0x (Input Terminal Function Selection) to 2.

Important: Switching between the different Reference and Run sources can only be done while the iQpump drive is stopped.

Function: Multi-step SP1 (Setting: 3)

Function: Multi-step SP2 (Setting: 4)

The iQpump drive can be programmed to step through four preset setpoints and a jog reference. It is also possible to mix in the analog inputs as setpoint references that can be chosen in place of the first and second preset setpoint references. The selection of which preset setpoint will be the active setpoint is determined by the status of the digital inputs set for Multi-step SP1 (H1-0x = 3) and Multi-step SP2 (H1-0x = 4). Changing the active setpoint via the Multi-step Setpoint References can be done while the iQpump drive is running.

The following table details which reference is active based on the status of the Multi-step SP1 and Multi-step SP2 inputs:

Table 10 Digital Input Functions

Preset Reference	Terminal Programmed as Multi-step SP1	Terminal Programmed as Multi-step SP2	Details
1	OFF	OFF	Setpoint Reference 1 (d1-01) or analog input A1# (determined by b1-01)
2	ON	OFF	Setpoint Reference 2 (d1-02) or analog input A2# (determined by H3-09)
3	OFF	ON	Setpoint Reference 3 (d1-03)
4	ON	ON	Setpoint Reference 4 (d1-04)
# Shown for H3-13="0: Main Fref TA1"; A1 and A2 are reversed if H3-13="1: Main Fref TA2"			

The determination of whether the Preset Reference 1 will be the Setpoint Reference 1 (d1-01 or the analog input A1) is determined by the status of b1-01. If b1-01 = "1: Terminals," the value of the input to A1 will determine the commanded setpoint when Preset Reference 1 is selected. If b1-01≠1, the setting of d1-01 will determine the commanded setpoint when Preset Reference 1 is selected.

The determination of Preset Reference 2 is made much the same way as Preset Reference 1 except that the setting of parameter H3-09 decides whether the analog input A2 or d1-02 is Preset Setpoint 2. If H3-09 = "2: Aux Reference," the value of the input to A2 will determine the commanded Aux Reference when Preset Reference 2 is selected. If H3-09 = 2, the setting of d1-02 will determine the commanded setpoint when Preset Reference 2 is selected.

Function: Multi-Acc/Dec 1 (Setting: 7)

When a digital input configured as Multi-Acc/Dec 1 (H1-0x = 7) is OPEN the first set of acceleration/deceleration times (C1-01 and C1-02) are active.

When a digital input configured as Multi-Acc/Dec 1 (H1-0x = 7) is CLOSED the second set of acceleration/deceleration times (C1-03 and C1-04) are active.

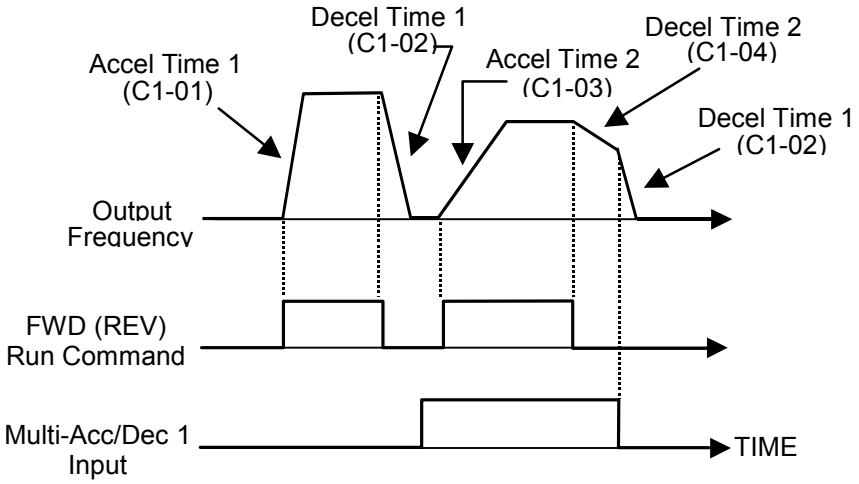


Figure 34 Multi-Accel/Dec Timing Diagram

Function: Ext Baseblk N.O. (Setting: 8)

Function: Ext Baseblk N.C. (Setting: 9)

When the iQpump drive is commanded into baseblock, gating of the output transistor stops and output voltage/frequency drops to zero (motor coasts). The iQpump drive can be forced into a baseblock state by either closing a digital input configured for Ext Baseblk N.O. (H1-0x = 8) or opening a digital input configured for Ext Baseblk N.C. (H1-0x = 9).

When the baseblock state is removed the speed search function is used to catch the coasting motor and ramp it back to the commanded speed.

The method of speed search, Current Detection or Speed Estimation, that is utilized when the baseblock input is removed depends on the setting of parameter b3-01:

If b3-01 = “0: SpdsrchF Disable” or “1: SpdsrchF Enable”; Speed Estimation is used

If b3-01 = “2: SpdsrchI Disable” or “3: SpdsrchF Enable”; Current Detection is used

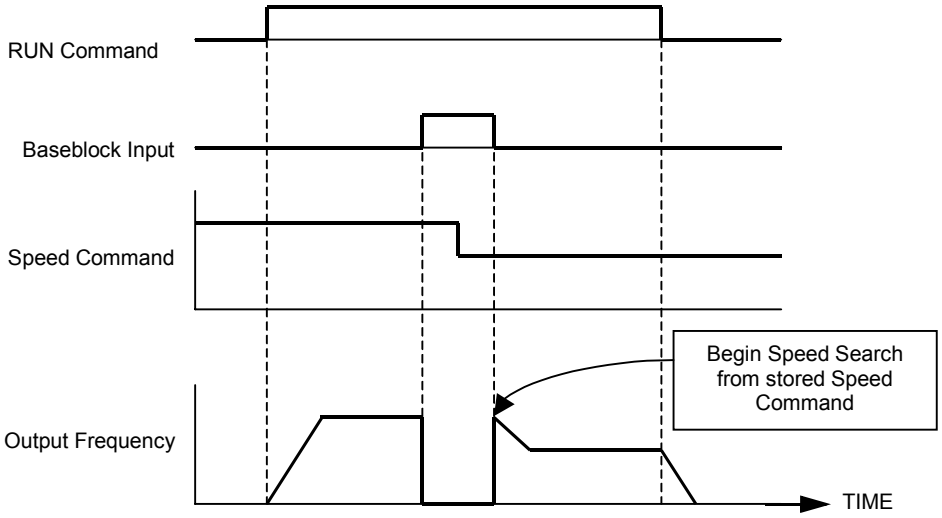


Figure 35 External Baseblock Characteristics

Function: Acc/Dec RampHold (Setting: A)

The Acc/Dec RampHold function will clamp ("hold") the speed of the output frequency whenever a digital input that has been programmed for it (H1-0x = A) is closed. All acceleration or deceleration will stop and the iQpump drive will hold the current speed. Once the input is opened, acceleration or deceleration continues.

The Acc/Dec RampHold function is affected by parameter d4-01. If d4-01 = "1: Enabled" and the Acc/Dec RampHold functions are both being used, whenever the RampHold input is closed the output frequency is memorized. When interrupted power is returned and a Run command is input, the Speed Command will be the last output frequency memorized by the Acc/DecRampHold function, if the Acc/Dec RampHold input is still closed.

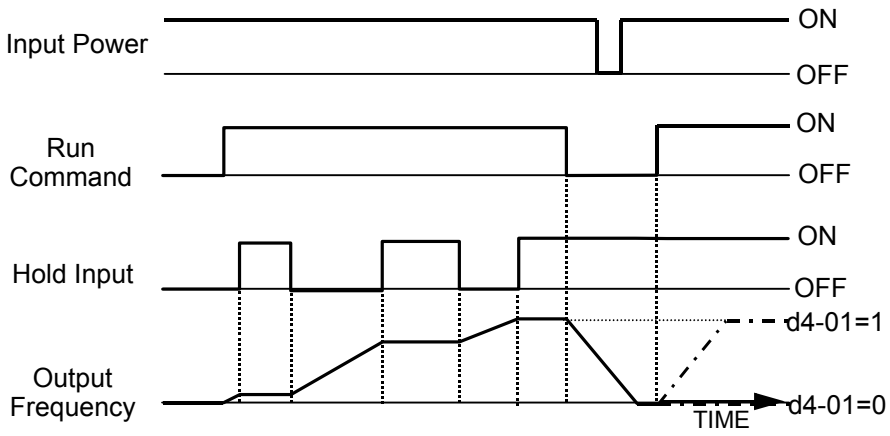


Figure 36 Accel/Dec RampHold Function Timing Diagram

Function: Term A2 Enable (Setting: C)

Any digital input configured as Term A2 Enable (H1-0x = C) when open will cause the input to analog input A2 to be ignored.

If analog input A2 is configured as the Main Reference (H3-13 = "1: Main Fref TA1"), then the Term A2 Enable input will have no effect.

Function: Term Not Used (Setting: F)

Any digital input programmed as Term Not Used (H1-0x = F) will have no function assigned to it and it's OPEN/CLOSED state will not matter to the Drive's operation.

Function: MOP Increase (Setting: 10)

Function: MOP Decrease (Setting: 11)

Using two digital inputs, the iQpump drive can operate with the same type of functionality as a motor operated potentiometer (MOP). One digital input can be programmed as an MOP Increase input (H1-0x = 10) and another digital input can be programmed as an MOP Decrease input (H1-0x = 11). This MOP functionality is also commonly referred to as Floating Point Control, Incremental Control or UP and DOWN Control since closing the MOP Increase input will cause the speed command to increase and closing the MOP Decrease input will cause the speed command to decrease.

If both the MOP Increase and the MOP Decrease are closed or open simultaneously, the speed will command will not change. The speed command will change at the active acceleration or deceleration rate.

MOP Increase cannot be programmed without also programming the MOP Decrease (or vice versa) else an OPE03 fault will occur. Setting the MOP Increase/Decrease function while the Acc/Dec RampHold function is programmed into other digital inputs will also cause an OPE03 fault.

Once the MOP function is programmed the preset speeds are disabled and the analog speed command input becomes a potential frequency reference lower limit. The lower limit of the MOP function is the greater of the analog speed command and the programmed frequency reference lower limit (d2-03). Once a Run command is issued the iQpump drive will accelerate immediately to the lower limit. The upper limit will be the Frequency Reference Upper Limit (d2-01), if used, otherwise the Maximum Frequency (E1-04).

The status of the d4-01 parameter (MOP Reference Memory) will affect the performance of the iQpump drive after power is cycled to the iQpump drive and a fresh Run command is issued. If d4-01 = "0: Disabled," the Run command will cause the iQpump drive to ramp to the frequency reference lower limit. However, if d4-01 = "1: Enabled," the Run command will cause the iQpump drive to ramp to the last speed commanded by the MOP function before the Run command was removed and the power cycled. Even if d4-01 = "1: Enabled," the previous speed command can be reset to the frequency reference lower limit automatically by closing either the UP or Down input without having a Run command active.

Important: Be sure to set b1-01 = “1: Terminals,” (Auto Setpoint =Terminals) if the MOP function is to be used. If b1-01 = “0: Operator,” then the MOP is disabled even if it is programmed. The Jog inputs have priority over the MOP function.

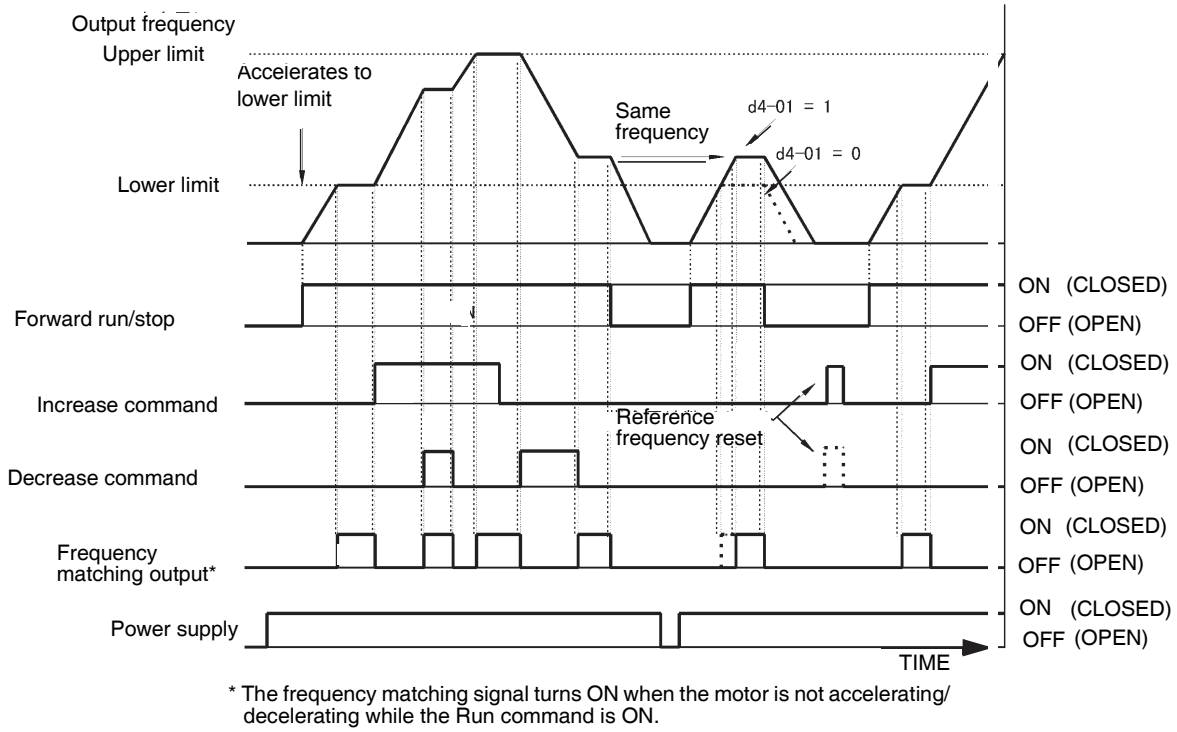


Figure 37 Floating Point Control Time Chart

Function: Fault Reset (Setting: 14)

Whenever the iQpump drive detects a fault condition, the fault output contact will close and the Drive’s output will shut OFF causing the motor to coast (specific stopping methods can be selected for some faults such as L1-04 for motor overheat). Once the Run command is removed, the fault can be reset by either the RESET key on the digital operator or by closing a digital input configured as a Fault Reset (H1-0x = 14).

Function: Fast Stop N.O. (Setting: 15)

Function: Fast Stop N.C. (Setting: 17)

The Fast Stop function operates much like an emergency stop input to the drive. While in the Run mode, if a Fast Stop is input to the iQpump drive (CLOSED for H1-0x = 15 or OPEN for H1-0x = 17), the iQpump drive will decelerate to a stop with the deceleration time determined by C1-09 (Fast Stop Time). The Run command can remain closed during the Fast Stop operation. The iQpump drive will not run, from either the terminals or the digital operator, while the Fast Stop is being input to the Drive. To restart the Drive, the Fast Stop input must be removed and the Run command must be cycled.

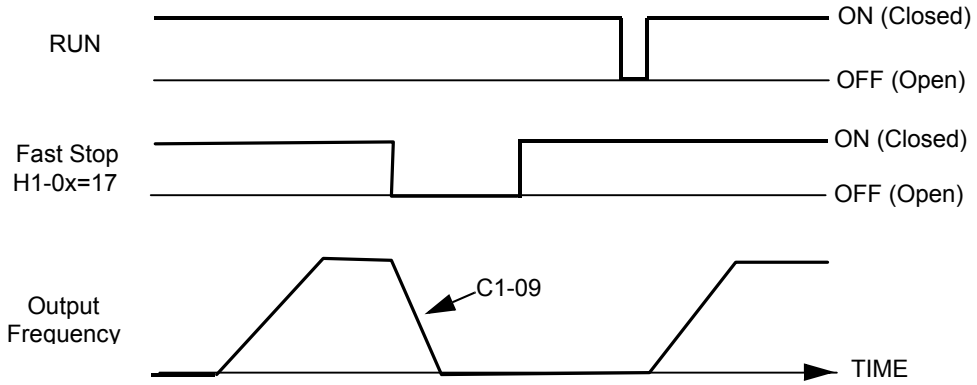


Figure 38 Fast Stop Commands Time Chart

Important: Be aware that during rapid deceleration the iQpump drive may fault on an over voltage condition. When faulted, the iQpump drive output shuts off allowing the motor to coast. The result is an uncontrolled motor state. Therefore, be sure to set an acceptable deceleration time in parameter C1-09 when using the fast stop feature.

Function: Timer Function (Setting: 18)

The Timer Function works independently from the Drive. For Timer operation a digital input must be configured for a Timer Function start (H1-0x = 18), a digital output must be configured as a Timer Function output (H2-0x = 12), and the Timer Function ON-Delay and OFF-Delay parameters (b4-01 and b4-02, respectively) must be programmed.

Once the applicable parameter are programmed the Timer Function start digital input must be closed at least as long as the setting of b4-01 before the Timer Function output will close. The Timer Function input must be open for at least as long as the setting of b4-02 before the Timer Function output will reopen.

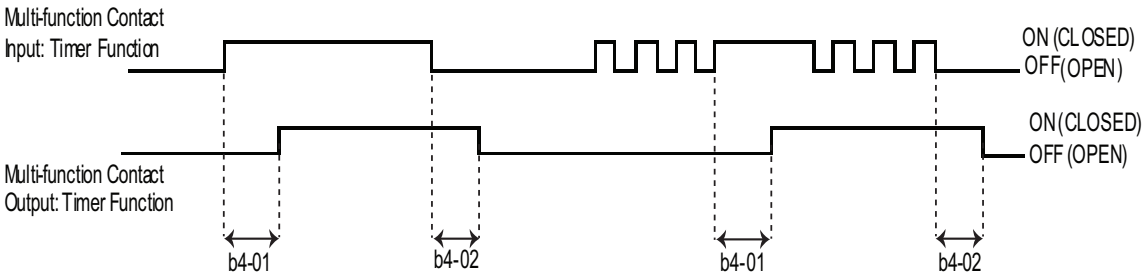


Figure 39 Timer Function Time Chart

Function: PI Disable (Setting: 19)

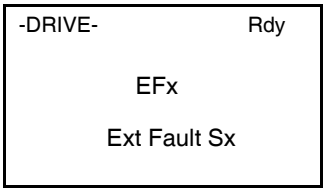
When the PI Function has been enabled by b5-01 (PI Mode Selection), it can be indefinitely disabled by closing a digital input configured as a PI Disable input (H1-0x = 19). When disabled, the iQpump drive operates as a standard drive that does not have PI enabled

Function: Program Lockout (Setting: 1B)

A Program Lockout digital input will allow changing of parameter values when it is open but prevent changing of any iQpump drive parameter value except the Speed Command when it is closed. Parameter values can be viewed even when a Program Lockout is active.

Function: External Fault (Setting: 20 through 2F)

External Fault functionality can be programmed into the digital inputs of the Drive. The External Fault inputs can be used to signal to the iQpump drive that other equipment related to the operation of the iQpump drive has experienced problems. If the External Fault is input to the iQpump drive the digital operator will display:



with the x in EFx and Sx represent the terminal number of the digital input that the fault was received on.

To program an External Fault the value input into the H1-0x parameter will determined by:

- Contact type wired to the terminal (Normally Open or Normally Closed)
- Detection profile (Always Detected or Only Detected while Running)
- Drive operation after fault (Stopping Method or Continue Operation)

The following table shows the programming choices.

Table 11 Programming Choices

Set Value	Input Contact Type		Detection Mode		Stopping Method			
	N.O. contact	N.C. contact	Always Detected	Detected while Running	Decel to stop (major fault)	Coast to stop (major fault)	Fast stop (major fault)	Continue operation (minor fault)
20	X		X		X			
21		X	X		X			
22	X			X	X			
23		X		X	X			
24	X		X			X		
25		X	X			X		
26	X			X		X		
27		X		X		X		
28	X		X				X	
29		X	X				X	
2A	X			X			X	
2B		X		X			X	
2C	X		X					X
2D		X	X					X
2E	X			X				X
2F		X		X				X

Function: PI Integral Reset (Setting: 30)

By configuring one of the digital inputs as an Integral Reset Input, (H1-0x = 30), the value of the integral component of PI control can be reset to zero whenever the configured input is CLOSED. The integral component of PI control will be held at zero as long as the configured digital input is held CLOSED.

Resetting the Integral component of PI control can be useful in cases where an excessively large Integral value prevents the PI control from responding quickly to changes in the system being regulated by the iQpump drive (e.g. duct pressure, water temperature).

Function: PI Integral Hold (Setting: 31)

By configuring a digital input as an Integral Hold input (H1-0X = 31), the value of the Integral component of the PI control can be forced to clamp at the value it was at when the input is CLOSED. The Integral component of the PI control returns to accumulating error when the digital input is OPEN again.

Holding the Integral Value can be useful during periods when the error can build up naturally, such as during long accelerations. Not allowing Integral windup produces a more stable PI control.

Function: PI SFS Cancel (Setting: 34)

SFS means softstart, also referred to as accel/decel in this description.

By configuring a digital input as a PI SFS (softstart) Cancel input (H1-0x = 34), the operator will be able to use a contact closure to remove the acceleration and deceleration times that are applied to changes in the PI setpoint by the b5-17 parameter. If the digital input configured as PI SFS Cancel is closed, the PI setpoint Accel/Decel (Parameter b5-17) will be ignored. Immediate updating of any change to the setpoint will apply.

Function: Input Level Sel (Setting: 35)

When using the PI Function built into the Drive, the chosen setpoint is compared with the measured feedback. The difference is called the Error. The proportional and integral function are applied to this error. For some applications it may be appropriate to invert the input to the PI block. This can be accomplished by setting one of the digital inputs up as an Input Level Sel (H1-0x=35). When an Input Level Sel digital input is closed the Error will be inverted before it is passed to the PI block.

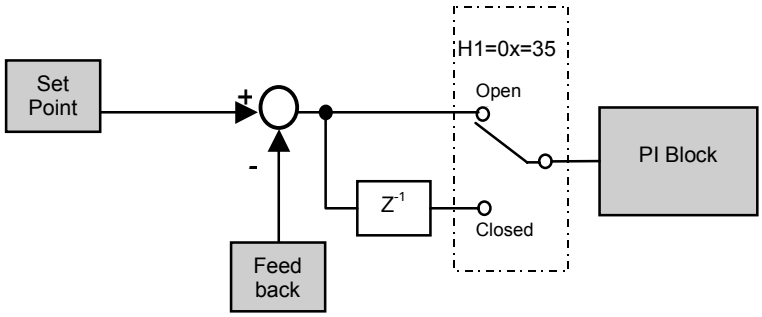


Figure 40 PI Error signal Inversion Block Diagram

Function: Option/Inv Sel 2 (Setting: 36)

The Option/Inv Selection function allows the user to switch the source of the Run and speed command between the Drive's terminals and optional communication card. When a digital input is programmed for the Option/Inv Selection 2 function (H1-0x = 36) that input will function as follows:

Table 12 Programming Choices

Option/Inv Function Input Status	Run and Speed Command Source
CLOSED	From the Communications Option Card
OPEN	From the control circuit and analog input terminals

To switch the command source between the option card and the terminals be sure to program the following parameters:

- Set b1-01 (Frequency Reference Selection) to 1 (Terminals).
- Set b1-02 (Run Command Selection) to 1 (Terminals).
- Set H1-0x (Input Terminal Function Selection) to 36.

Important: Switching the Reference and RUN sources can only be done while the iQpump drive is stopped.

Function: Motor Pre-heat (Setting: 60)

In order to prevent condensation on the motor windings, a DC current can be circulated through the windings. The heat produced by the current in the windings will prevent the moisture from condensation on the wire. Motor pre-heating can only be initiated by closing a digital input programmed as a Motor Pre-heat input (H1-0x = 60). The level of the DC current used by the Motor Pre-heat function is determined by parameter b2-09.

A Run input will be given priority over a Motor Pre-heat input. When the Run command is removed, if the Motor Pre-heat input is still closed, the motor pre-heating will resume.

Function: Speed Search 1 (Setting: 61)

Function: Speed Search 2 (Setting: 62)

Function: Speed Search 3 (Setting: 64)

Table 13 Digital Input Functions

Setting of b3-01	Speed Search Method Used for Multi-function inputs
0	Speed Estimation
1	
2	Current Detection
3	

The Speed Search function can be turned on for all starts with parameter b3-01. If, however, it is beneficial to only use Speed Search at certain starts, a digital input can be programmed to turn on Speed Search only when it is closed.

Speed Search 1 will start searching for the rotor speed from the maximum frequency (E1-04). Speed Search 2 will begin searching for the rotor speed from the existing Speed Command. Speed Search 3 will cause the motor to baseblock when the switch is open and then perform Speed Search when it closes.

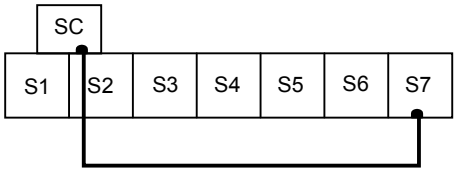
In all cases the form of Speed Search, Speed Estimation or Current Detection, is determined by the setting of b3-01. If b3-01 = “0: SpdsrchF Disable,” then the Speed Estimation form of Speed Search is used. If b3-01 = “2: SpdsrchI Disable,” then the Current Detection form of Speed Search is used.

Function: Comm Test Mode (Setting: 67)

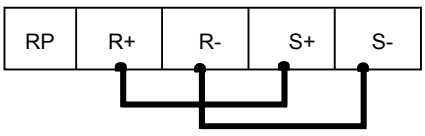
The iQpump drive has a built-in function for self-diagnosing the serial communications operation. The test involves wiring the send and receive terminals of the RS-485/422 port together. The iQpump drive transmits data and then confirms the communications are received normally.

In order to perform the serial communications self-diagnosis, terminal S7 must be programmed as the Comm Test Mode digital input (H1-05 = “67: Com Test Mode”) and then power removed from the iQpump drive and the following steps performed:

1. Wire the S7 and SC terminals of the control circuit terminals together



2. Wire the R+ and S+ terminals of the RS-485/422 port together
3. Wire the R- and S- terminals of the RS-485/422 port together



4. Turn On the terminating resistance (Move Switch 1 of Dip Switch 1 to the ON position).

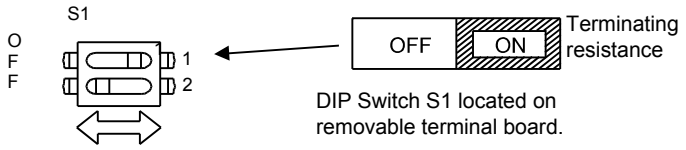


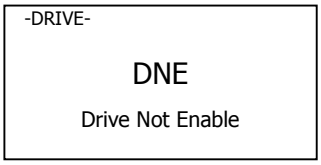
Figure 41 DIP Switch Setting for Terminating Resistor

5. Turn on power to the Drive.

After step 5 above the iQpump drive will either display “Pass” if everything is okay or a CE alarm will be displayed. If the CE alarm occurs, the fault output contact will energize.

Function: Drive Enable (Setting: 6A)

A digital input configured as an iQpump drive Enable input (H1-0x = 6A) will prevent the iQpump drive from executing a Run command until it is closed. When the iQpump drive Enable input is open the digital operator will display:



If a Run command is closed prior to the iQpump drive Enable input being closed the iQpump drive will not run until the Run command is cycled.

If the iQpump drive Enable input is opened while the iQpump drive is running, the iQpump drive will stop, using the method set by parameter b1-03.

Function: Com/Inv Sel (Setting: 6B)

Function: Com/Inv Sel 2 (Setting: 6C)

The Com/Inv Selection function allows the user to switch the origin of the Run and speed command between the Drive’s terminals and the RS-485/422 port (and the embedded communication protocols) on the removable terminal board. When a digital input is programmed for the Com/Inv Selection function (H1-0x = 6B) that input will function as follows:

Table 14 6B, COM/INV SEL

Option/Inv Function Input Status	Run and Speed Command Source
OPEN	From the control circuit and analog input terminals (follows b1-01)
CLOSED	From Serial Comm port (R+,R-,S+, and S-) (embedded protocols)

To switch the command source between the serial communication port and the control circuit terminals be sure to program the following parameters:

- Set b1-01 (Auto Setpoint Reference Selection) to 1 (Terminals).
- Set b1-02 (Run Command Selection) to 1 (Terminals).
- Set H1-0x (Input Terminal Function Selection) to 6B or 6C.

The Com/Inv Sel 2 function will operate the same way except the logic is reversed. When a digital input is programmed for the Com/Inv Selection function (H1-0x = 6C) that input will function as follows:

Table 15 6C, COM/INV SEL 2

Option/Inv Function Input Status	Run and Speed Command Source
OPEN	From Serial Comm port (R+, R-, S+, and S-) (embedded protocols)
CLOSED	From the control circuit and analog input terminals (follows b1-01)

Important: Switching the Reference and Run sources can only be done while the iQpump drive is stopped.

Function: Hand Mode (Setting: 80)

A digital input can be configured to operate the drive in the hand mode from an external contact as a Hand Mode command (H1-0x = 80).

In conjunction with the digital input programmed to hand mode, the run command source has to be programmed to 1 (b1-02 = 1: Terminals).

The multi-function digital input terminal S6 is programmed for Hand Mode as a factory default (H1-04 = 80).

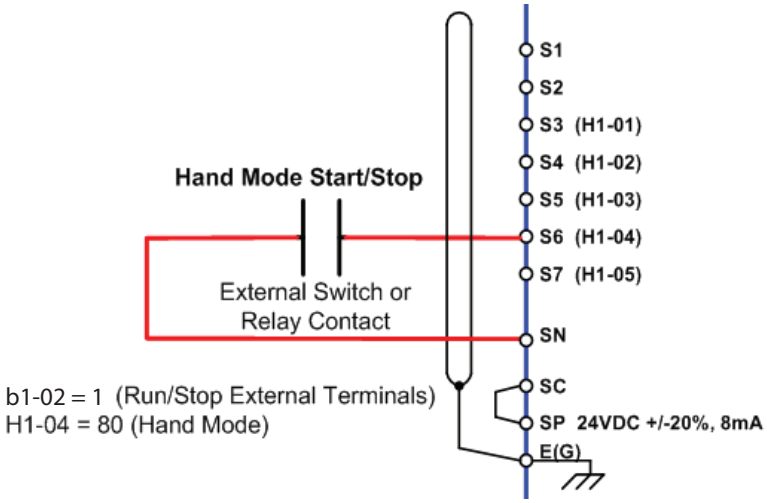


Figure 42 Connection Diagram for External Hand Mode Contact (b1-02 = 1)

Function: Disable Sleep Mode (Setting: 81)

A digital input can be configured to enable or disable the Sleep Mode (H1-0x = 81). The Sleep Mode is only active when the drive is in the Auto Mode. A contact closure into the multi-function digital input will disable the Sleep Mode. Also, the Feedback Drop Detection and Over Cycle Protection will also be disabled. When the digital input is open, the Sleep Mode, Feedback Drop Detection and Over Cycle Protection will be enabled.

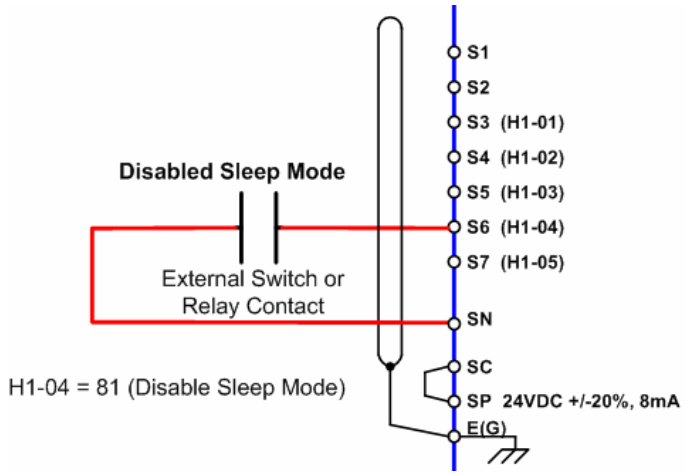


Figure 43 Wiring Diagram

Function: Activate Sleep (Setting: 82)

A digital input can be configured to activate the Sleep Mode (H1-0x = 82) when the drive is operating in the Auto Mode. A contact closure into the multi-function digital input will cause the drive to go to sleep for the time specified by the Sleep Delay Time (P2-03). When the digital input is open, the drive will return to normal operation. Refer to the P2 group for further description of the Sleep function.

Note: Oscillation can occur if Sleep is activated by using the digital input and Sleep Feedback Drop Detection is enabled and detected. It is recommended to disable Sleep Feedback Drop Level (P2-04) or program a long Sleep Delay Time (P2-03) and a large Delta Sleep Feedback Drop Level (P2-04).

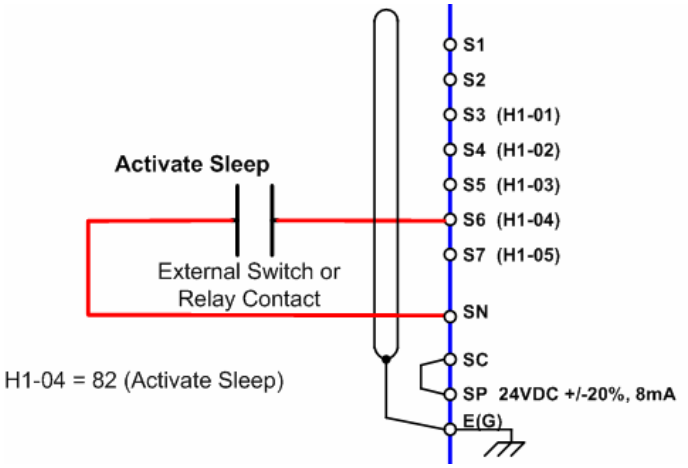


Figure 44 Wiring Diagram

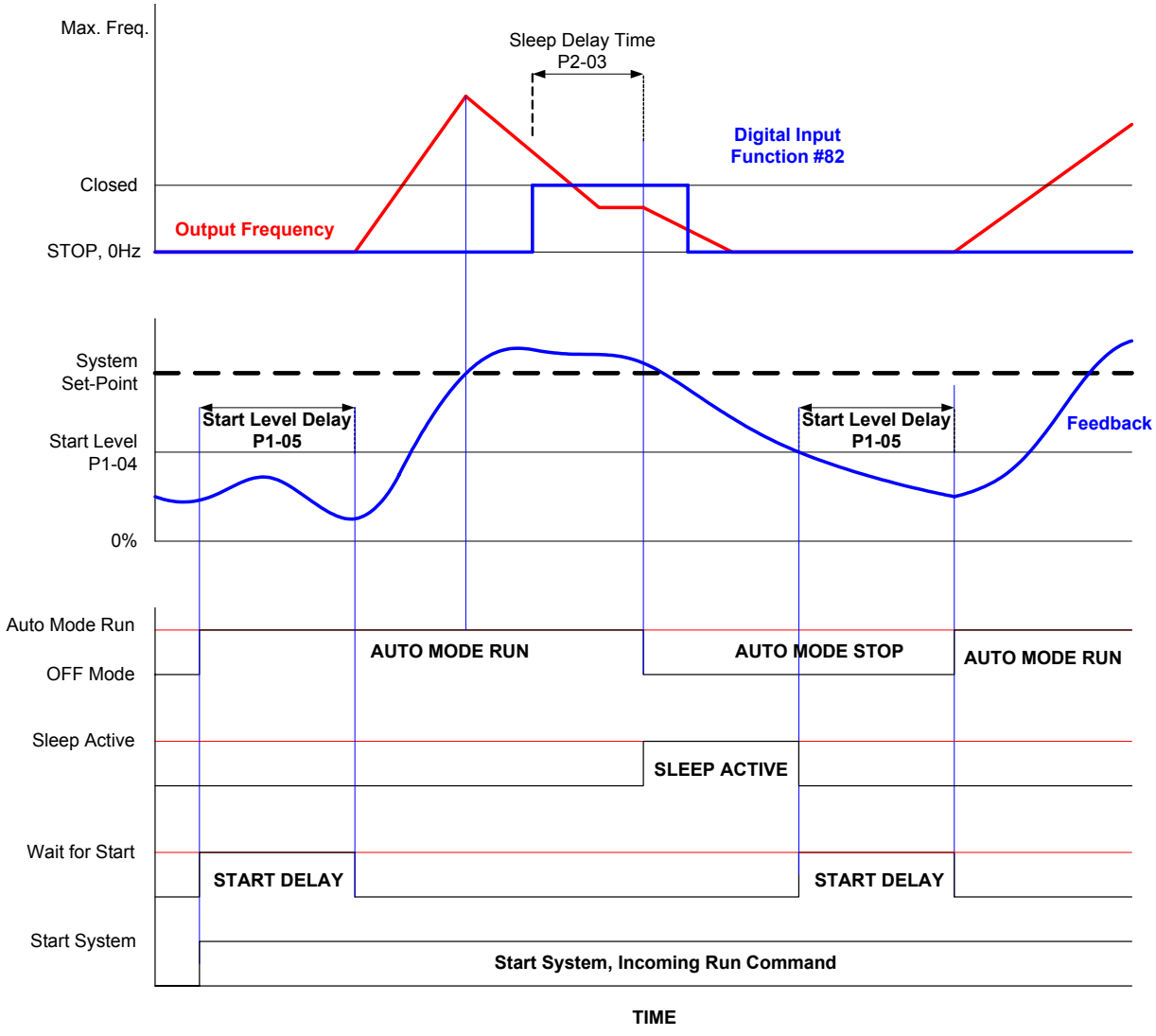


Figure 45 Timing Chart

Function: Thermostat Fault (Setting: 83)

A digital input can be configured to indicate a Thermostat Fault from an external contact (H1-0x = 83). A contact closure into the multi-function input will enable the Thermostat Fault. After an initiation of a Thermostat Fault, to disable the Thermostat Fault requires a open digital input contact, the drive run command to be open and reset the Thermostat Fault via the drive's reset button or fault reset input.

Note: An OPE12 fault will occur if H1-xx = 83 and 87. H1-xx cannot be programmed to “83” and “87” at the same time.

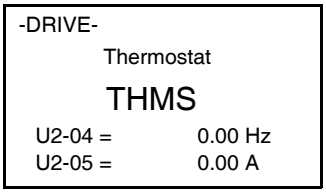


Figure 46 Thermostat Fault on Operator

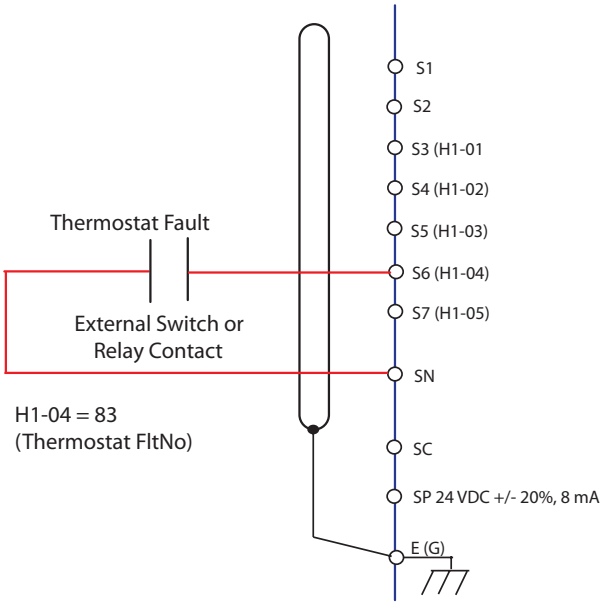


Figure 47 Wiring Diagram

Function: Disable Pre-Charge (Setting: 84)

A digital input can be configured to enable or disable the Pre-Charge function (H1-0x = 84). A contact closure into the multi-function digital input will disable the Pre-Charge function independent of the value programmed into the Pre-Charge Time (P4-03). When the digital input is open, the Pre-Charge function is enabled.

Function: Low Water Level (Setting: 85)

A digital input can be configured to indicate a Low Water Level Fault (H1-0x = 85). The Low Water Level input can be configured as a normally open or normally closed contact by programming the Low Level Input (P1-15). When P1-15 = 0, a Low Water Level Fault will occur when the contact is closed. An open contact will indicate the drive is operating under normal operating conditions.

When P1-15 = 1, a Low Water Level Fault will occur when the contact is open. A closed contact will indicate the drive is operating under normal operating conditions.

If the Pre-Charge function is activated, the Low Water Level will not cause a Low Water Level Fault. The Low Water Level will only indicate that the Pre-Charge function has been completed.

If the drive is operating under normal operating condition and a Low Water Level occurs, the drive will indicate a Low Water Level Fault (LFB/LW) on the digital operator.

To reset the Low Water Level Fault would require the removal of the run command, initiate a fault reset, and restart the drive using the Pre-Charge function.

Note: Low Water Level Fault is only active in the Auto Mode and inactive during the Pre-Charge function.

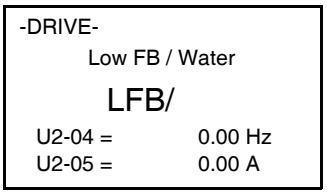


Figure 48 Lower Water Fault on Operator

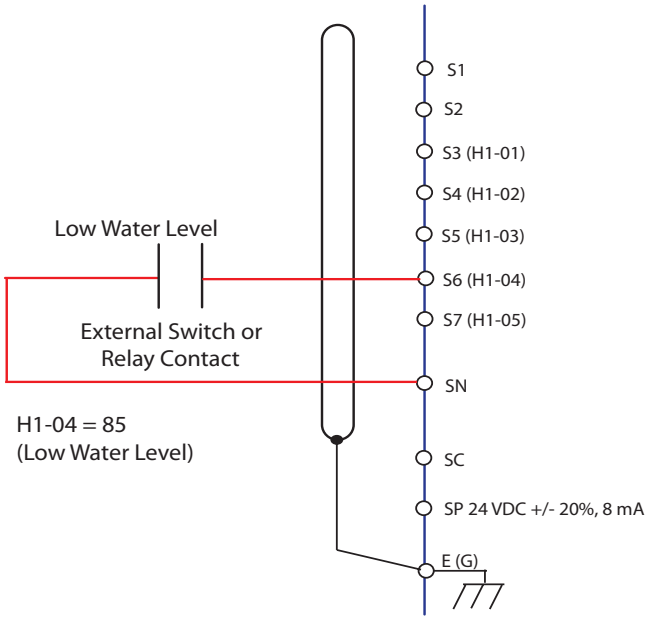


Figure 49 Wiring Diagram

Function: Fixed Speed Auto (Setting: 86)

A digital input can be configured to enable the Fixed Speed Auto (H1-0x = 86) when operating in the Auto Mode. A contact closure into the multi-function input will enable the Fixed Speed Auto function.

The Fixed Speed Auto will cause the drive to run at the iQpump drive Multi/Maximum Level (P3-02) and disable the PI Control, Sleep Mode and Lead/Lag operation.

When the digital input is open, the Fixed Speed Auto is disabled.

Note: Pre-Charge and Thrust Bearing functions have a higher priority than Fixed Speed Auto.

Function: Thermostat Fault (Setting:87) <0032>

A digital input can be configured to indicate a Thermostat Fault from an external contact (H1-0x = 87). An open contact into the multi-function input will enable the Thermostat Fault. After an initiation of a Thermostat Fault to disable the Thermostat Fault requires a closed digital input contact, the drive run command to be open and reset the Thermostat Fault via the drive's reset button or fault reset input.

Note: An OPE12 fault will occur if H1-xx = 83 and 87. H1-xx cannot be programmed to "83" and "87" at the same time.

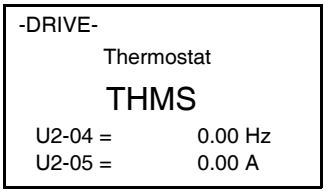


Figure 50 Thermostat Fault on Operator

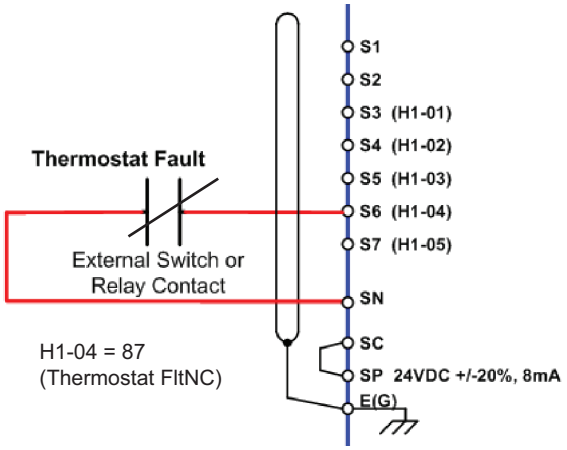


Figure 51 Wiring Diagram

◆ H2 Digital Outputs

■ Terminal Function Selections

Parameter No.	Parameter Name
H2-01	Terminal M1-M2 Function Selection
H2-02	Terminal M3-M4 Function Selection

Setting Range: 0 to 42

Factory Defaults: H2-01 = “40: Pump 2 Control”
H2-02 = “41: Pump 3 Control”

The iQpump drive has two multi-function outputs. By programming parameters H2-01 and H2-02, the user can assign specific functions to each output. Below is a table with a complete list of all of the digital output functions. Because the iQpump drive is a dedicated pump controller, the digital outputs described in this section only relate to the pump specific functions. Following the table is a more detailed description of each of the pump related functions.

Table 16 Digital Output Functions

Parameter setting	Function	Parameter setting	Function
0	During Run1	11	Reset Cmd Active
1	Zero Speed	12	Timer Output
2	FREF/FOUT Agree 1	17	Torque Detect 1 N.C.
3	FREF/Set Agree 1	1A	Reverse Direction
4	Frequency Detect 1	1E	Restart Enabled
5	Frequency Detect 2	1F	Overload (OL1)
6	Drive Ready	20	OH Pre-alarm
7	DC Bus Undervoltage	28	Drive Enable
8	Baseblock 1	39	Drive Waiting
9	Option Reference	3A	Frequency Reduced, OH
A	Remote Operation	3B	Run from Serial Com
B	Torque Detect 1 N.O.	3D	Cooling Fan Err
C	Loss of Reference	40	Pump 2 Control
E	Fault	41	Pump 3 Control
F	Terminal Not Used	42	Pump Fault
10	Minor Fault		

Function: During Run 1 (Setting: 0)

A “During Run 1”output will close whenever the Run command is provided and the iQpump drive is outputting voltage. This will include deceleration and DC Injection.

Function: Zero Speed (Setting: 1)

The “Zero Speed” output will close whenever the output frequency falls below the Minimum Frequency (E1-09).

Function: Fref/Fout Agree 1 (Setting: 2)

The “Fref/Fout Agree 1” output will close whenever the actual output frequency is within the Speed Agree Width (L4-02) of the current Speed Command regardless of the direction.

Function: Fref/Set Agree 1 (Setting: 3)

The “Fref/Set Agree 1” output will close whenever the actual output frequency and the Speed Command are within the Speed Agree Width (L4-02) of the programmed Speed Agree Level (L4-01).

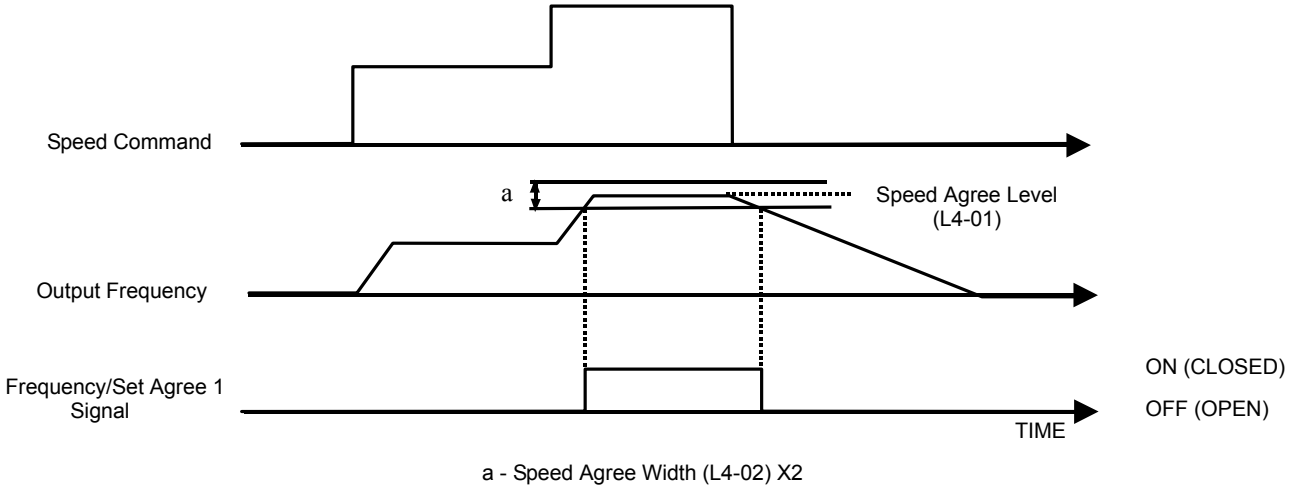


Figure 52 Fref/Set Agree 1 Timing Diagram

Function: Freq Detect 1 (Setting: 4)

A “Freq Detect 1” output will be closed whenever the output frequency is equal to or below the value of the programmed Speed Agree Level (L4-01). The Speed Agree Width (L4-02) is the hysteresis to the Freq Detect 1 function. Whenever the output frequency approaches the Speed Agree Level while accelerating it will need to be equal to or exceed the Speed Agree Level (L4-01) plus the Speed Agree Width (L4-02) before the Freq Detect 1 output will energize.

As the output frequency approaches the Speed Agree Level while decelerating, the Freq Detect 1 output will de-energize exactly at the Speed Agree Level.

The Freq Detect 1 function is effective during both forward and reverse operation.

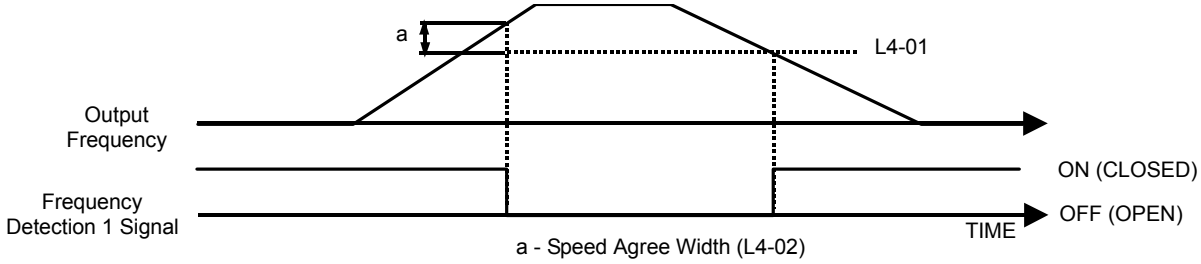


Figure 53 Freq Detect 1 Timing Diagram

Function: Freq Detect 2 (Setting: 5)

A Freq Detect 2 output will be closed whenever the output frequency is equal to or above the value of the programmed Speed Agree Level (L4-01). The Speed Agree Width (L4-02) is the hysteresis to the Freq Detect 2 function. Whenever the output frequency approaches the Speed Agree Level (L4-01) while accelerating it will de-energize exactly at the Speed Agree Level.

As the output frequency approaches the Speed Agree Level while decelerating, the Freq Detect 2 output will de-energize when the output frequency is equal to or below the Speed Agree Level (L4-01) minus the Speed Agree Width (L4-02).

The Freq Detect 2 function is effective during both forward and reverse operation.

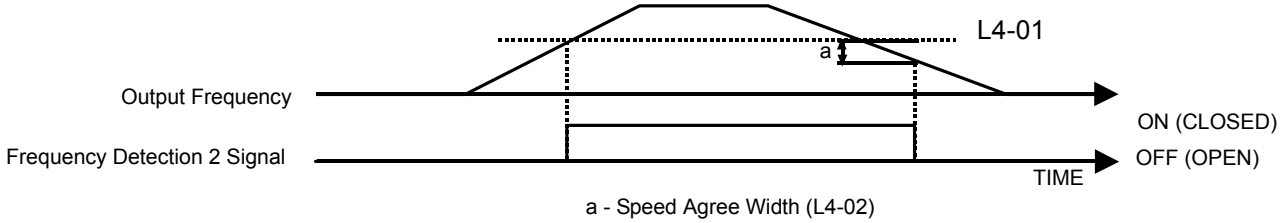


Figure 54 Freq Detect 2 Timing Diagram

Function: Inverter Ready (Setting: 6)

The Inverter Ready output will be closed whenever the iQpump drive is not in a fault state and not being programmed. If b1-08 = "1: Enabled," an iQpump drive that is in an active Run state that is also being programmed will have the Inverter Ready output closed.

Function: DC Bus Undervolt (Setting: 7)

The DC Bus Undervolt output will close whenever the main circuit DC Bus voltage or control circuit power supply drop below their respective trip level. The undervoltage trip level is determined by parameter L2-05. An open soft charge contactor answer back signal will also cause the DC Bus Undervolt output to close.

Function: BaseBlk 1 (Setting: 8)

A BaseBlk 1 programmed output will close to indicate that the iQpump drive is in baseblocked state. While in a baseblock state the Drive's output transistors are prevented from firing. A BaseBlk 1 output contact can also serve as notice that the iQpump drive has a charged DC Bus, no fault and can start at any time.

Function: Option Reference (Setting: 9)

When an output is configured as an Option Reference output, the output will close to show that the speed command is being sourced from the digital operator. If the Option Reference output is open, it indicates the speed command is coming from the control circuit terminals or an optional communications card.

Function: Remote/Auto Operation (Setting: A)

When an output is configured as a Remote Operation output, the output will close to show that the Run command is being sourced from the digital operator. If the Remote Operation output is open, it indicates the Run command is coming from the control circuit terminals or an optional communications card.

Function: Trq Det 1 N.O. (Setting: B)

The Trq Det 1 function ties a digital output to the overtorque/undertorque sensing capabilities of the Drive. If a digital output is configured as Trq Det 1 N.O., whenever the output current differs from the level of L6-02 for at least the length of time set in L6-03, the digital output will close.

The torque detection function has a built-in hysteresis of 10% of the iQpump drive rated output current.

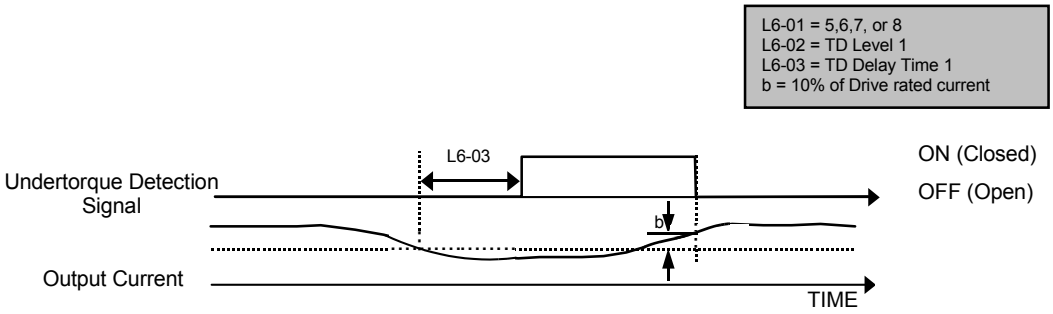


Figure 55 Trq Det 1 N.O. Timing Diagram

Function: Loss of Reference (Setting: C)

The Loss of Reference configured digital output will close when the iQpump drive has detected a loss of the analog speed command. The speed command is considered lost when the voltage level drops 90% in 0.4 seconds. Parameter L4-05 determines the Drive's reaction to a loss of reference state in addition to turning on the Loss of Reference digital output.

The Loss of Reference digital output will only initiate if the iQpump drive is configured for the speed command to be via one of the analog inputs (A1 or A2).

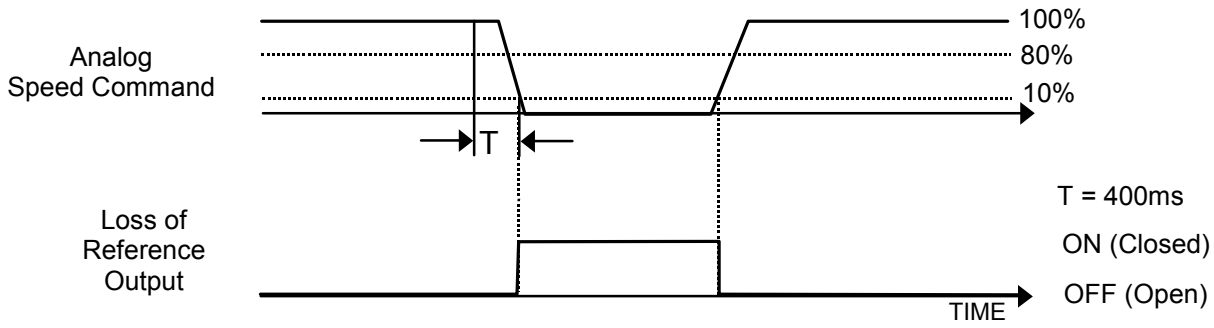


Figure 56 Loss of Reference Function Characteristics

Function: Fault (Setting: E)

The Fault configured digital output will close whenever the iQpump drive experiences a major fault with the exception of the CPF00 and CPF01 (Digital Operator Communications Faults).

Function: Not Used (Setting: F)

The Not Used setting can be used to disable the digital output.

Function: Minor Fault (Setting: 10)

A Minor Fault, also referred to as an alarm, indicates that a condition exists that may be critical to the iQpump drive or application but does not require the iQpump drive to stop. A minor fault will be flashed on the digital operator but neither the Fault output (MA-MB) nor any digital output configured as a Fault output (H2-0x = E) will close. Any digital output configured as Minor Fault will close whenever a minor fault of alarm condition exists.

Function: Reset Cmd Active (Setting: 11)

A Reset Cmd Active digital output will close to signal that a Fault reset is being attempted from terminals or Serial Com.

Function: Timer Output (Setting: 12)

This Timer function, that is built into the Drive, is independent of the rest of the iQpump drive operation, i.e. there is no requirement for a Run command for the timer to operate. A Timer digital output will close b4-01 seconds after a digital input configured as Timer Input (H1-0x = 18) closes and remains closed. The Timer digital output will remain closed for b4-02 seconds after the Timer digital input opens and remains open.

Refer to the descriptions of parameters b4-01 and b4-02 for a timing chart of the Timer function.

Function: Trq Det 1 N.C. (Setting: 17)

The Trq Det 1 function ties a digital output to the overtorque/undertorque sensing capabilities of the Drive. If a digital output is configured as Trq Det 1 N.C., whenever the output current exceeds the level of L6-02 for at least the length of time set in L6-03, the digital output will open.

The torque detection function has a built-in hysteresis of 10% of the iQpump drive rated output current.

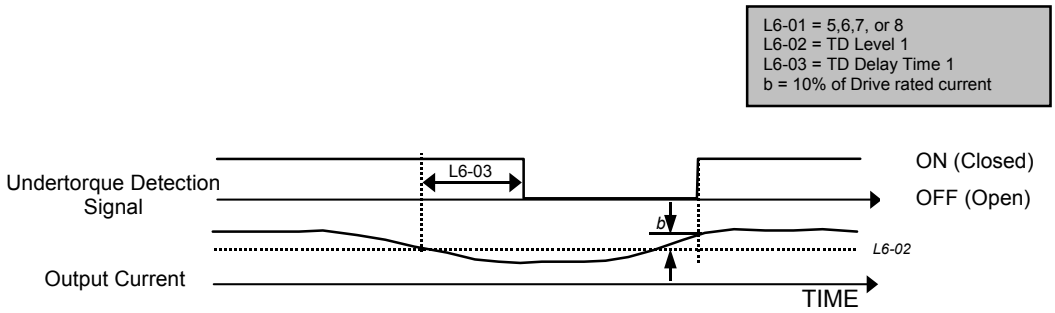


Figure 57 Trq Det 1 N.C. Timing Diagram

Function: Reverse Dir (Setting: 1A)

The Reverse Dir digital output will close whenever the iQpump drive is turning the motor in the direction that corresponds to the reverse direction (CW or CCW). The Reverse Dir digital output will remain closed during deceleration when the rotation is in the reverse direction.

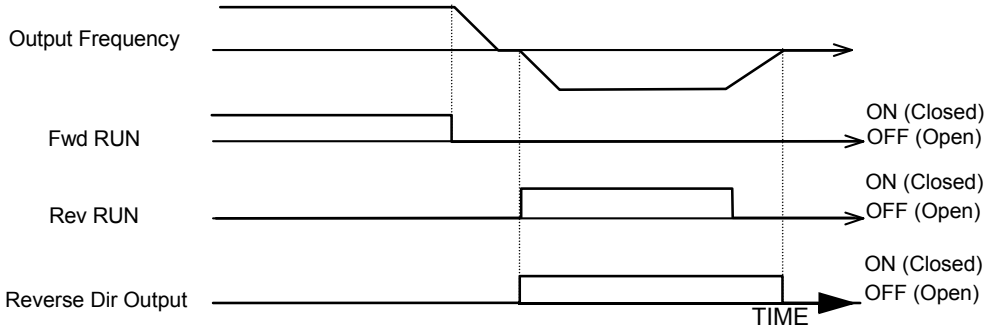


Figure 58 Reverse Direction Timing Diagram

Function: Restart Enabled (Setting: 1E)

Depending on the setting of parameter L5-01, the iQpump drive may be configured to automatically attempt to restart itself after certain faults. The Restart Enabled output will be closed once the restarts begin and will remain closed until a successful restart is accomplished or the number of Auto Restart attempts as specified by L5-01 is reached.

A timing diagram for the Auto Restart function is contained in the parameter L5-01 description.

Function: Overload (OL1) Alarm (Setting: 1F)

The OL1 fault function is designed to protect the motor. It estimates the motor's winding temperature based on the output current, output frequency, and time. The OL1 time is determined by the setting of parameters E2-01, L1-01, and L1-02. An Overload digital output will close whenever 90% of the programmed OL1 time is exceeded.

Function: OH Prealarm (Setting: 20)

The Overheat fault function (OH) is designed to protect the iQpump drive from excessive temperature damage. Thermistors attached to the heatsink of the iQpump drive monitor the temperature near the devices attached to the heatsink (e.g. input diode modules, output transistor modules) and will fault the drive if the temperature reaches 105oC.

An OH Prealarm digital output will close whenever the heatsink temperature reaches the level specified by parameter L8-02. Parameter L8-03 will determine the Drive's response to reaching the OH Prealarm level, in addition to closing the configured digital output.

Function: Drive Enabled (Setting: 38)

A iQpump drive Enable digital output will reflect the status of a digital input configured as an iQpump drive Enable input (H1-0x = 6A). If the iQpump drive Enable digital input is closed then the iQpump drive Enabled digital output will also close.

Function: Drive Waiting (Setting: 39)

A iQpump drive Waiting digital output will close during the time-out period between the input of a Run command and the expiration of the delay time specified by b1-11.

Function: Frequency Reduced, OH (Setting: 3A)

A Frequency Reduced, OH digital output will close when L8-03 = "4:OH Alarm & Reduce" and an overheat pre-alarm is detected.

Function: Run from Serial Com (Setting: 3B)

A Run from Serial Com digital output will close when the drive run command is from embedded serial com or the com option card.

Function: Pump 2 Control (Setting: 40)

The multi-function digital output is configured to enable a second lag pump based on the normal operating conditions of the iQpump, which determines when the second lag pump should be activated or deactivated. The operation of the digital output is determined by the programming of the Pump Mode selection (P1-01).

If P1-01 = 0, the iQpump is programmed for drive only; therefore, the Pump 2 Control output will be deactivated.

If P1-01 = 1 or 2, the iQpump will activate the Pump 2 Control output based on normal operating conditions.

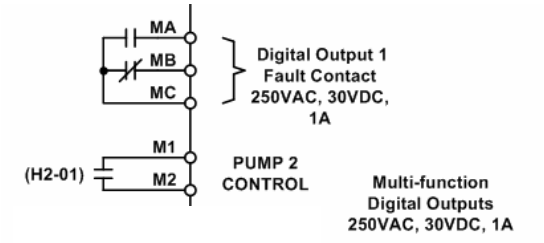


Figure 59

Function: Pump 3 Control (Setting: 41)

The multi-function digital output is configured to enable a third lag pump based on the normal operating conditions of the iQpump, which determines when the third lag pump should be activated or deactivated. The operation of the digital output is determined by the programming of the Pump Mode selection (P1-01).

If P1-01 = 1 or 2, the iQpump is programmed for drive only or drive + 1 pump; therefore, the Pump 3 Control output will be deactivated.

If P1-01 = 2, the iQpump will activate the Pump 3 Control output based on normal operating conditions.

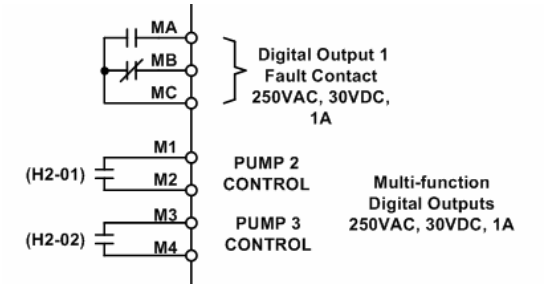


Figure 60

Function: Pump Fault (Setting: 42)

The multi-function digital output can be configured to indicate a Pump Fault (H2-0x = 42). An open contact or output will indicate a normal condition and that no Pump Fault has occurred.

A closed contact or output will indicate a Pump Fault has occurred. The following is a list of dedicated Pump Faults: Low Feedback Fault, High Feedback Fault, Over Cycling Fault, Pump Protection Fault, Thermostat Fault, Low Water Fault, External Pump Fault.

Note: The Pump Fault function is active in Hand, Auto, Pre-Charge and Thrust Bearing Modes. If the Pump Fault function is used, one or both of the Pump Controls (Pump 2, pump 3) will not be available.

◆ H3 Analog Inputs

■ H3-02 Terminal A1 Gain Setting

Setting Range: 0.0 to 1000.0%

Factory Default: 100.0%

■ H3-03 Terminal A1 Bias Setting

Setting Range: -100.0% to +100.0%

Factory Default: 0.0%

In order to have the iQpump drive properly interpret an analog input, it may be necessary to apply a gain and/or a bias to the signal. The analog inputs have a resolution of 10 bits (1024 steps). Using the factory default settings for the analog input's gain and bias, the 0-10 Vdc or 4-20 mA signal at the analog input will yield a 0-100% speed command span.

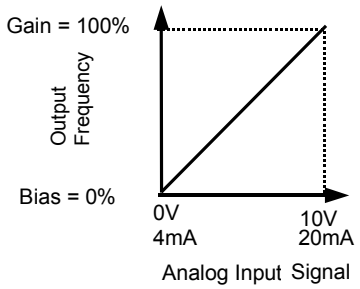


Figure 61 Output Frequency as Commanded Via Analog Input

If a different span of analog input signal is desirable, it will be necessary to adjust the gain, the bias, or both to allow the analog input level to generate the desired frequency command. Adjustment of the gain setting will change the speed command that is equivalent to the maximum analog input (10 Vdc or 20 mA). If, for instance, the gain is increased to 200%, then 10 Vdc or 20 mA will be equivalent to a 200% speed command and 5 VAC or 12 mA will be equivalent to a 100% Speed Command. Since the iQpump drive output is limited by the maximum frequency parameter (E1-04), 0-5 Vdc or 4-12 mA will now be equivalent to 0-100% speed command span.

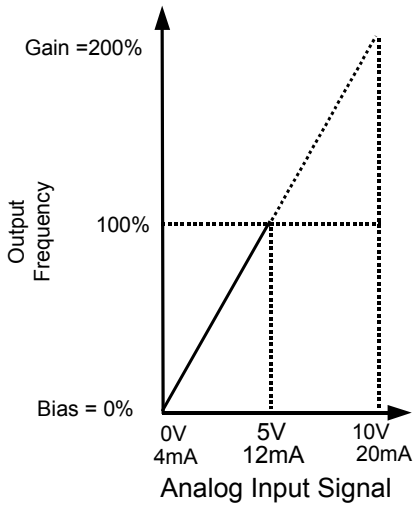


Figure 62 Output Frequency as Commanded via Analog Input with Increased Gain Setting

Adjustment of the bias setting will likewise adjust the speed command that is equivalent to the minimum analog input level (0 Vdc or 4 mA). If, for instance, the bias is set to –25%, then 0 Vdc or 4 mA will be equivalent to a –25% speed command. Since the minimum speed command is 0% an analog input of 2.5 to10 Vdc or 8 to 20 mA will now be equivalent to 0-100% speed command span.

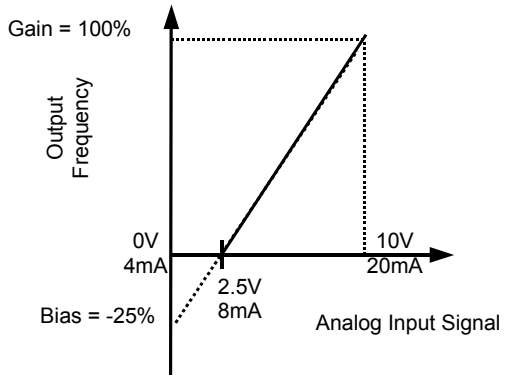


Figure 63 Output Frequency with Reduced Bias Setting

As a further example, for an inverse-acting speed command, set the bias = 100% and the gain = 0%. The minimum analog input level (0 Vdc or 4 mA) will produce a 100% speed command and the maximum analog input level (10 Vdc or 20 mA) will produce a 0% speed command.

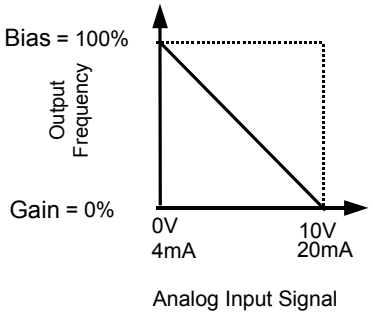
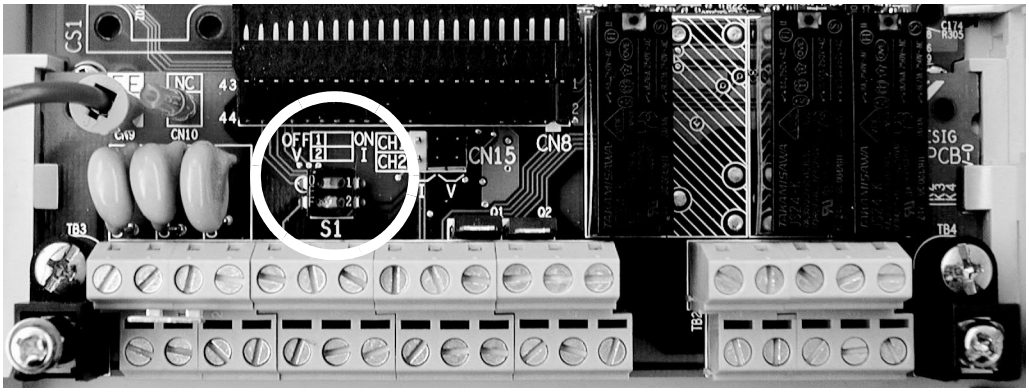


Figure 64 Output Frequency with Inverted Gain and Bias Settings

■ H3-08 Terminal A2 Signal Level

Setting	Description
0	0 - 10 Vdc
2	4 - 20 mA (*factory default*)
3	0 - 20 mA

The H3-08 parameter (Terminal A2 Signal Level) allows the programmer to specify the signal that will be applied to the A2 analog input. The A2 analog input can accept either a 0–10 Vdc or 4-20 mA signal as a reference. The iQpump drive also has a DIP switch (S1) on the removable terminal board that must be set for the proper reference signal into the A2 analog input. The S1-2 dipswitch setting determines the internal resistance of the A2 input while parameter H3-08 determines how the iQpump drive interprets the measured signal.



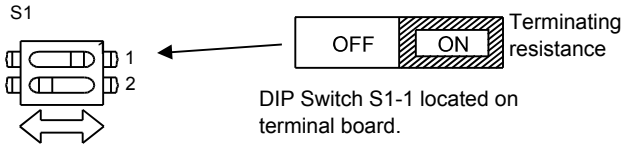


Figure 65 DIP Switch S1

Table 17 DIP Switch S1

Name	Function	Setting
S1-1	RS-485 and RS-422 terminating resistance	OFF: No terminating resistance ON: Terminating resistance of 110 Ω
S1-2	Input method for analog input A2	OFF: 0 to 10 V (internal resistance: 20 kΩ) ON: 4 to 20 mA (internal resistance: 250 Ω) (Default)

■ H3-09 Terminal A2 Function Selection

Setting	Description
0	Frequency Bias
2	Aux Reference
B	PI Feedback (*factory default*)
D	Frequency Bias 2
E	Motor Temperature
16	PI Differential
1F	Not Used

The A2 analog input can be programmed to perform many different functions. The setting of parameter H3-09 determines which of the following functions the A2 analog input will perform.

Function: Frequency Bias (Setting: 0)

By setting H3-09 = "0: Frequency Bias," the A2 analog input will serve as a bias signal to the A1 Speed Command. The effect of using A2 for a frequency bias is that the level of the A2 analog input will be summed with the level of the Speed Command analog input (A1). For example, if H3-02 = 100%, H3-03 = 0%, and the A2 analog input level is 1 Vdc, the Speed Command profile will look like the figure below. If A1 = 0 Vdc the Speed Command would be 10% of the programmed maximum frequency because A1 (0 Vdc) + A2 (1 Vdc) = 1 Vdc.

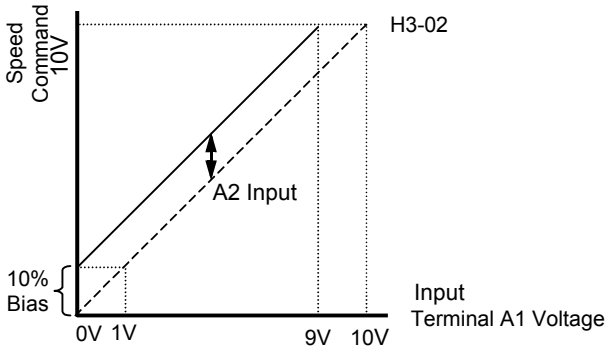


Figure 66 Effect of Frequency Bias Function on Speed Command

It should be noted that the bias applied by the A2 analog input functions differently than the level set by the H3-03. If both biases are used simultaneously they will sum together.

The level of the A1 analog input, as a percentage of the maximum input (either 10 Vdc or 20 mA), can be viewed by the U1-15 monitor. The level of the A2 analog input, as a percentage of the maximum input, can be viewed by the U1-16 monitor.

The bias applied by setting H3-09 = "0: Frequency Bias," can be used in conjunction with the parameter bias H3-03. In that case the H3-03 bias is applied first which changes the slope of the Speed Command vs. Terminal A1 Voltage graph. Then the level of the A2 analog input is summed with the A1 analog input level, which in effect shifts the Speed Command vs. Terminal A1 Voltage graph upwards or downwards but does not change the slope of the line.

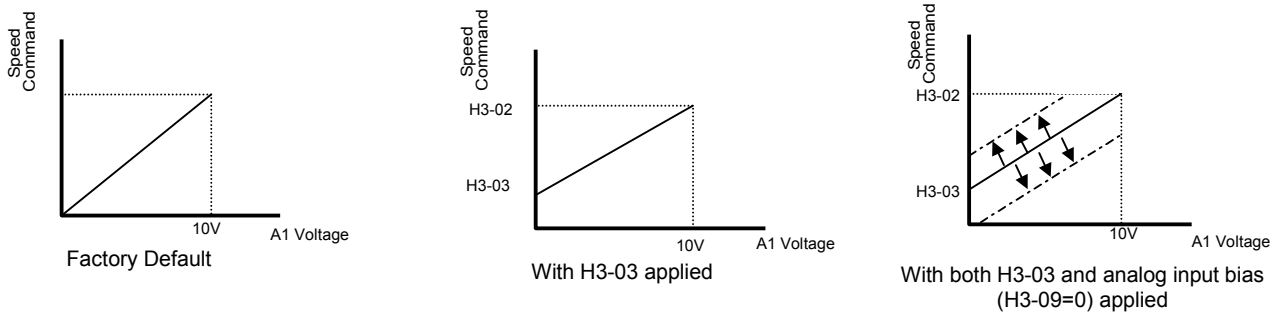


Figure 67 Frequency Bias Applied to Analog Speed Command

Function: Aux Reference (Setting: 2)

In order for the A2 analog input to be used as the master Speed Command, parameter H3-09 must be set for Aux Reference (H3-09 = "2: Aux Reference"). Once A2 is configured as an auxiliary reference, it can be selected as the master Speed Command by setting H3-13 = "1: Main Fref TA2". If H3-09 = 2, terminal A2 analog input will become the speed command when a digital input programmed for Multi-Step Ref 1 (H1-0x = 3) is selected by a contact closure.

Function: PI Feedback (Setting: B)

Configuring the A2 analog input as PI Feedback (H3-09 = "B: PI Feedback") is a requirement of setting the iQpump drive up for PI operation. The A2 analog input is the only source for feedback for PI operation though the setpoint can come from a number of different sources (refer to the section covering the PI parameters for more information regarding specifying the setpoint source. PI parameters are listed in "b5 PI Function" on page 24).

Parameters H3-10 (Terminal A2 Gain) and H3-11 (Terminal A2 Bias) can be used to configure the A2 analog input to match the signal from the Feedback Transmitter.

The U1-24 monitor (PI Feedback) can be used to check the PI Feedback level with the digital operator.

Function: Frequency Bias 2 (Setting: D)

By setting H3-09 = "D: Frequency Bias 2," the A2 analog input will serve as a bias signal to the A1 Speed Command. This setting functions the same as a setting of H3-09=0: Frequency Bias.

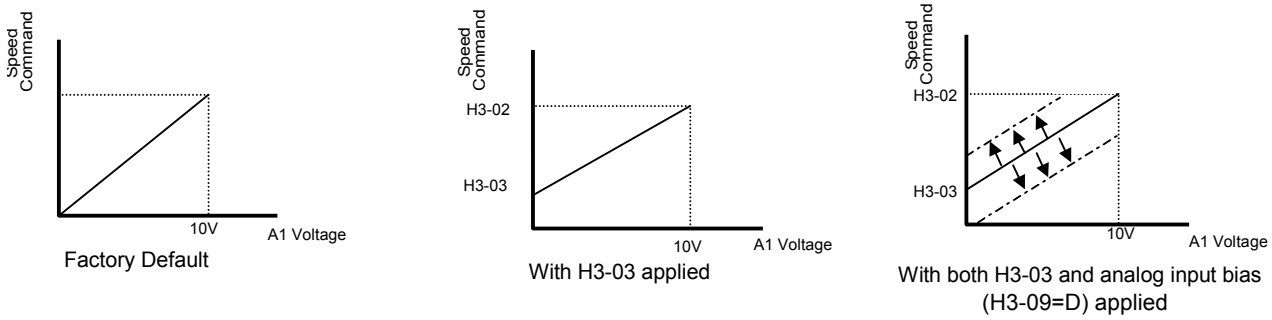


Figure 68 Frequency Bias 2 Applied to Analog Speed Command

Function: Motor Temperature (Setting: E)

In addition to or in place of the OL1 (Motor Overload) fault of the Drive, it is possible to use a PTC (Positive Temperature Coefficient) thermistor for motor insulation protection. The PTC thermistors are built into the windings of some motors and will vary their resistance based on temperature. An example PTC characteristic is show below.

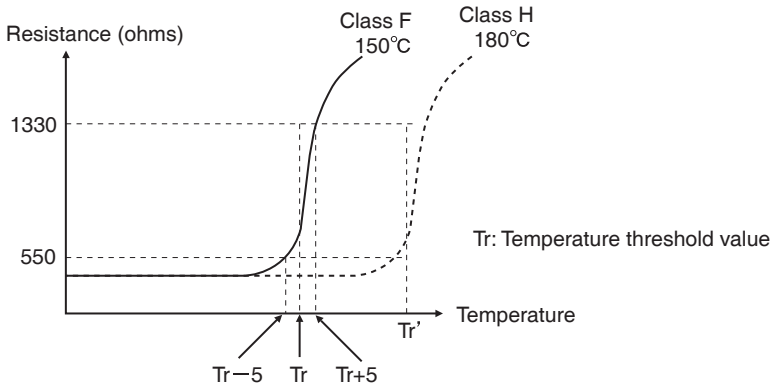
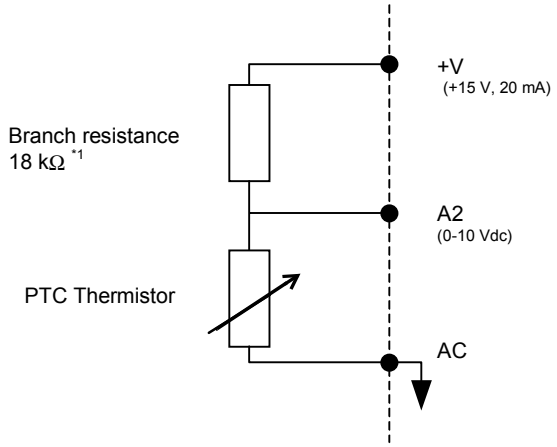


Figure 69 PTC Thermistor Temperature-Resistance Value Characteristics

Connection of the thermistor to the iQpump drive is shown below, in addition make sure Dip Switch S1-2 is in the OFF position, see *Figure 70*.



$$Rbranch = \frac{(R_{ptc@Tr} \text{x} 3) \text{ x } (V_S - V_{ptc@OH3})}{V_{ptc@OH3}}$$

*1 The resistance value of 18 kΩ is only valid for using a 3-phase PTC with the characteristics shown in the figure above.

Figure 70 Thermistor to Drive Connection Diagram

After the connections are made, configure the A2 analog input for motor temperature protection by setting H3-09 = “E: Motor Temperature”. Parameters L1-03, L1-04, and L1-05 set the response to the alarm level being exceeded, response to the fault level being exceeded, and temperature sensing delay time, respectively.

The proper value of the branch resistance is approximated by the formula:

$$Rbranch = \frac{(R_{ptc@Tr}x3) \text{ x } (V_S - V_{ptc@OH3})}{V_{ptc@OH3}}$$

Figure 71

Where: ($R_{ptc@Tr}$ x 3) = The resistance value of the thermistor at either the alarm or fault level adjusted for three phase (three thermistors in series, refer to typical PTC thermistor characteristic in Figure 71).

V_S = The supply voltage (+15 Vdc)

$V_{ptc@OH3}$ = The rated voltage for the over-temperature alarm or fault

Function: PI Differential (Setting: 16)

Normal PI operation will adjust the iQpump drive output in order to match the measured feedback value to a desired setpoint. When PI is operated in the differential mode, however, the iQpump drive output is adjusted in order to maintain a desired differential between two feedback signals. Air handling unit return fan speed control in a “volume snatching” strategy for building pressure control is an example.

When the A2 analog input is configured as a PI Differential (H3-09 = “16: PI Differential”), the A1 analog input becomes the other PI Differential input. The desired differential is set by parameter b5-07 (PI Differential Setpoint) and can be set so that A2 is held less than A1 (b5-07 <0) or A2 is held greater than A1 (b5-07>0).

When PI Differential operation is chosen, the A1 feedback level can be monitored by U1-24 (PI Feedback) and the A2 feedback level can be monitored by U1-53 (PI Feedback2).

Function: Not Used (Setting: 1F)

When H3-09 = “1F: Not Used,” any signal applied to the A2 analog input will be ignored by the Drive.

■ H3-10 Terminal A2 Gain Setting

Setting Range: 0.0 to 1000.0%

Factory Default: 100.0%

■ H3-11 Terminal A2 Bias Setting

Setting Range: -100.0% to +100.0%

Factory Default: 0.0%

Parameters H3-10 and H3-11 perform the same function for the A2 analog input that parameters H3-02 and H3-03 perform for the A1 analog input. Please refer to the parameter description for H3-02 and H3-03 for information about H3-10 and H3-11.

These parameters could be used for final calibration of a factory or field installed pressure to electric transducer input connected to terminal A2 and AC. This field calibration may be needed if there is a job site variation from the typical 3 to 15 PSIG pneumatic signal input range.

■ H3-12 Analog Input Filter Time Constant

Setting Range: 0.00 to 2.00 sec

Factory Default: 0.30 sec

An analog input filter can be used to prevent erratic iQpump drive control when a “noisy” analog reference is used. Parameter H3-12 sets the time constant for a first order filter that will be applied to both the A1 and A2 analog inputs. The iQpump drive operation becomes more stable the longer the time programmed, but it becomes less responsive to rapidly changing analog signals.

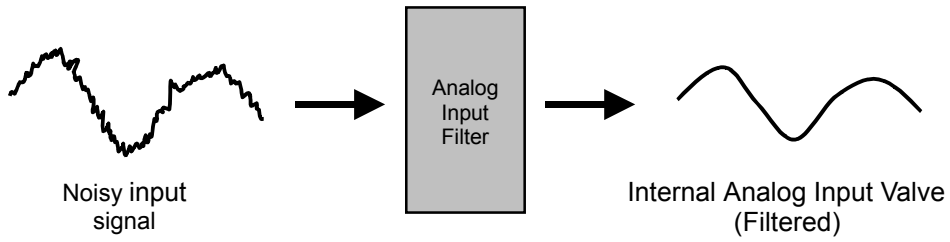


Figure 72 Analog Input Filter Time Constant Effect on “Noisy” Signal

■ H3-13 Master Frequency Reference Terminal Selection

Setting	Description
0	Main Fref = A1 (*factory default*)
1	Main Fref = A2

Parameter H3-13 allows the programmer to select which analog input will serve as the Speed Command input when “Terminals” are selected as the Auto Mode Speed source (b1-01 = “1: Terminals”), or Terminal is selected as the reference source for the Hand mode (b1-12 = “1: Terminals”). For the A2 analog input to be an effective selection for the H3-13 parameter, parameter H3-09 must be configured as Aux Reference (H3-09 = “2: Aux Reference”).

If H3-09≠2, then the A1 analog input will be used regardless of the setting of parameter b1-12.

◆ H4 Analog Outputs

■ H4-01 Terminal FM Monitor Selection

Setting Range: 1 to 53

Factory Default: 2: Output Freq

The FM and AM analog output terminals can be programmed to output a 0-10 Vdc signal proportional to any one of functions detailed in *Table 18 on page 77*.

Table 18

Setting	Description	Setting	Description
1	Frequency Ref	20	SFS Output*
2	Output Freq	24	PI Feedback
3	Output Current	31	Not Used
6	Output Voltage	36	PI Input
7	DC Bus Voltage	37	PI Output
8	Output kWatts	38	PI Setpoint
15	Term A1 Level	51	Auto Mode Fref
16	Term A2 Level	52	Hand Mode Fref
18	Mot SEC Current	53	PI Feedback 2
* SFS is the internal soft starter signal. This signal is generated from the reference and often it passes through the accel/ decel functions.			

When the H4-01 or H4-04 are configured the iQpump drive will output 10 Vdc to represent 100% of the function programmed into them.

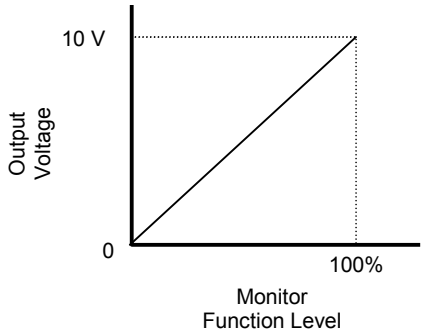


Figure 73 Analog Output Signal Level as a Function of the Monitor Value

Function: Frequency Ref (Setting: 1)

The analog output level will correspond to the chosen Speed Command input whether it is input via the digital operator, analog input, or serial communication. 100% will be equivalent to the maximum output frequency of the iQpump drive (E1-04).

Function: Output Freq (Setting: 2)

The analog output level will correspond to the actual Speed being output by the iQpump drive and will include the acceleration and deceleration ramps. 100% will be equivalent to the maximum output frequency of the iQpump drive (E1-04).

Function: Output Current (Setting: 3)

The analog output level will correspond to the output current level of the Drive. 100% will be equivalent to the Drives rated output current which is based on the kVA Rating of the iQpump drive (o2-04).

Function: Output Voltage (Setting: 6)

The analog output level will correspond to the output voltage level of the Drive. 100% will be equivalent to either 200 Vac or 400 Vac depending on the input voltage rating of the Drive.

Function: DC Bus Voltage (Setting: 7)

The analog output level will correspond to the voltage level of the Drive's DC Bus. 100% will correspond to 400 Vdc for the 240 Vac input iQpump drive and 800 Vdc for the 480 Vac input Drive.

Function: Output kWatts (Setting: 8)

The analog output level will correspond to an internally calculated output power level based on the measured output current and output voltage. 100% will correspond to the kilowatt rating of the iQpump drive as determined by o2-04.

Function: Term A1 Level (Setting: 15)

The analog output level will correspond to the analog input to the Drive's A1 terminal. 100% will be equivalent to 10 Vdc.

Function: Term A2 Level (Setting: 16)

The analog output level will correspond to the analog input to the Drive's A2 terminal. 100% will be equivalent to 10 Vdc.

Function: Mot SEC Current (Setting: 18)

The analog output level will correspond to the calculated secondary (torque producing) current. 100% will be equivalent to motor's full load secondary current as calculated by:

$$I\ sec = \sqrt{I_{Nameplate}^{2} - I_{no\ load}^{2}}$$

$$= \sqrt{(E2\text{-}01)^{2} - (E2\text{-}03)^{2}}$$

Function: SFS (Softstart) Output (Setting: 20)

The analog output level will correspond to the Speed Command after the applicable acceleration and deceleration rates are applied. The SFS (Softstart) Output monitor will not include variations to the Speed Command other than the acceleration and deceleration ramps. 100% will be equivalent to the maximum output frequency of the iQpump drive (E1-04).

Function: PI Feedback (Setting: 24)

The analog output level will correspond to the analog input to the Drive's A2 terminal during normal PI operation but will correspond to the A1 analog input when the A2 analog input is configured as a PI Differential input (H3-09 = "16: PI Differential"). The output will function even if PI operation is not selected (b5-01 = "0: Disabled"). Parameter b5-20 will apply a gain to the measured analog output voltage before the monitor is displayed.
(i.e. with b5-20 = 5 the 2 Vdc feedback signal will generate 10 Vdc on the analog output).

Function: Not Used (Setting: 31)

When H4-01 = "31: Not Used" no voltage is output by the analog output.

Function: PI Input (Setting: 36)

The analog output will correspond to the measured error of the PI function. The measured error of normal PI operation is the setpoint minus the feedback. The measured error of the differential PI is the difference between the A1 and A2 analog inputs summed with the PI differential setpoint). The output will not function unless PI operation is selected (b5-01≠0).

Function: PI Output (Setting: 37)

The analog output will correspond to the output of the PI function. The PI output will be measured after any gains, offsets, or limits are applied to the output of the Proportional and Integral factors. The output will not function unless PI operation is selected (b5-01≠0) and there is an active Run command. 100% will be equivalent to maximum frequency (E1-04).

Function: PI Setpoint (Setting: 38)

The analog output will correspond to the level of the chosen setpoint of the PI function. Please refer to table on page *25* included in the section PI Control (b5 parameters) for more information about selecting the PI setpoint source. The output will not function unless PI operation is selected (b5-01≠0).

■ H4-02 Terminal FM Gain Setting

Setting Range: 0.0 to 1000.0%

Factory Default: 100.0%

Refer to parameter H4-03 for description details.

■ H4-03 Terminal FM Bias Setting

Setting Range: -110.0% to +110.0%

Factory Default: 0.0%

The gain and bias parameters for the analog outputs of the iQpump drive allow the programmer to customize the output signal for the equipment connected to the output. The analog outputs are adjustable over a range of 0-10 Vdc. The gain settings for the analog outputs determine the output voltage level that will be equivalent to 100% of the Monitor Function Level. A gain setting greater than 100% will produce 10 Vdc on the analog output when the monitor function is less than 100%.

For example, if H4-02 = 150%, then the FM analog output will produce 6.7 Vdc when the assigned output function initially reached the 100% level.

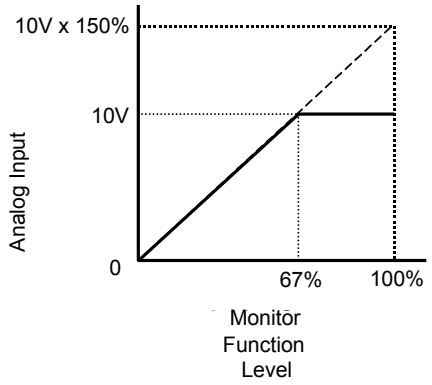


Figure 74 Analog Output gain Setting Adjustment

Like the bias settings for the analog inputs (H3-03 and H3-11), the bias settings for the analog outputs determine the output function level that will be equivalent to 0 Vdc (or 4 mA if the optional terminal board is used).

For example, if H4-03 = -25%, then when the output function level is at 0% the FM analog output will output 2 Vdc.

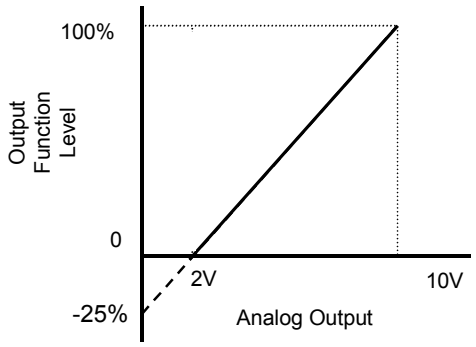


Figure 75

■ H4-04 Terminal AM Monitor Selection

Setting Range: 1 to 53 <0032>

Factory Default: 8: Output kWatts

Refer to parameter H4-01 for description details.

■ H4-05 Terminal AM Gain Setting

Setting Range: 0.0 to 1000.0%

Factory Default: 50.0%

■ H4-06 Terminal AM Bias Setting

Setting Range: -110.0% to +110.0%

Factory Default: 0.0%

Refer to parameters H4-02 & H4-03 for description details.

■ Terminal Signal Level Selections

Parameter No.	Setting	Description
H4-07	0	Terminal FM Signal Level Selection, 0 - 10 Vdc (*factory default*)
H4-08	1	Terminal AM Signal Level Selection, 4 - 20 mA

When the iQpump drive is equipped with the optional, removable terminal board with 4-20 mA outputs (p/n ETC618120), parameters H4-07 and H4-08 determine whether analog outputs are configured as 0-10 Vdc or 4-20 mA. Refer to the documentation for the optional terminal board as the proper jumper settings are required in addition to programming H4-07 and H4-08.

If the standard removable terminal board is being used, the settings of H4-07 and H4-08 have no effect.

◆ H5 Serial Communications Setup

This section explains the individual functions used in special applications involving Modbus Communications.

◆ Using Modbus Communication

Serial communication can be performed with Programmable Logic Controllers (PLC's) or similar devices using the Modbus protocol.

◆ Modbus Communication Configuration

Modbus communication is configured using 1 master (PLC) and a maximum of 31 slaves. Serial communication between master and slave is normally initiated by the master and responded to by the slaves.

The master performs serial communication with one slave at a time. Consequently, the slave address of each slave must be individually set, so that the master can perform serial communication using that address. Slaves receiving commands from the master perform the specified functions, and send a response back to the master.

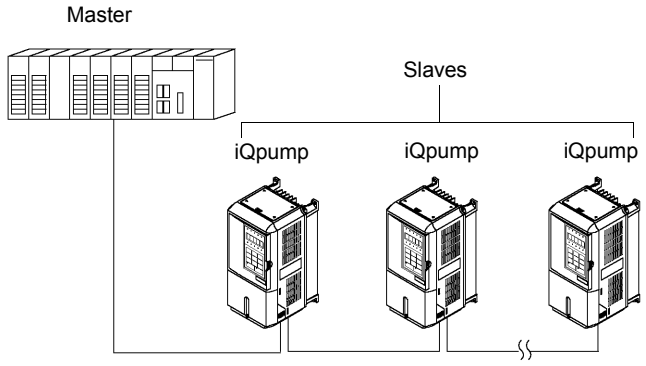


Figure 76 Example of Connections between Master and Drive

◆ Communication Specifications

The Modbus communication specifications are shown below:

Table 19 Modbus Communication Specifications

Item	Specifications	
Interface	RS-422, RS-485	
Communications Cycle	Asynchronous (Start-stop synchronization)	
Communications Parameters	Baud rate:	Select from 1200, 2400, 4800, 9600, and 19200 bps.
	Data length:	8 bits fixed
	Parity:	Select from even, odd, or none.
	Stop bits:	1 bit selected
Communications Protocol	Modbus	
Number of Connectable Units	31 units max.	

◆ Communication Connection Terminal

Modbus communication uses the following terminals: S+, S-, R+, and R-. The terminating resistance must be turned ON only if the iQpump drive is at the very end of the Serial Communication chain. Set the terminating resistance by turning ON pin 1 of switch S1 On the Drives terminal board. Switch S1 is located directly above the left most relay module.

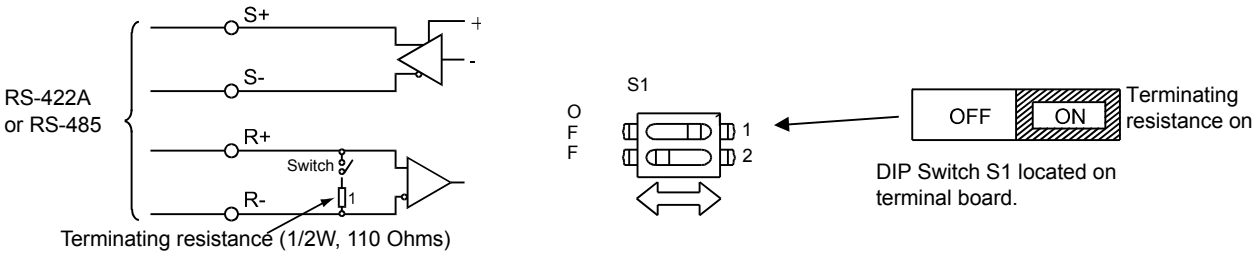


Figure 77 Communication Connection Terminals and Terminating Resistance

Important:

- Separate the communication cables from the main circuit cables and control circuit wiring.
- Use shielded cables for the communication cable, and use proper shield clamps.
- When using RS-485 2 Wire communication, connect S+ to R+, and S- to R-, on the control circuit terminal board. See *Figure 78*.
- Terminate shield at one end only.

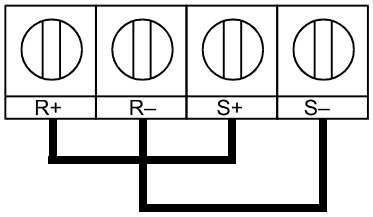


Figure 78

◆ Procedure for Setting Up Communication

Use the following procedure to perform communication with the PLC.

1. Turn OFF the input power to the iQpump drive and connect the communication cable between the PLC and the Drive.
2. Turn ON the input power to the Drive.
3. Set the required communication parameters (H5-01 to H5-09) using the Digital Operator.
4. Turn OFF the input power to the Drive, and check that the Digital Operator display has completely faded.
5. Turn ON the input power to the iQpump drive once again.
6. Perform communication with the PLC.

■ Related Parameters

The following parameters need to be set correctly to insure proper operation of the iQpump drive when using Modbus communication.

Table 20 Serial Communication Related Parameters

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page Number
b1-01	0108H	Frequency Reference Selection **Reference Source**	Selects the speed command (frequency reference) input source. 0: Operator - Digital preset speed d1-01 1: Terminals - Analog Input Terminal A1 (or Terminal A2 see parameter H3-13) 2: Serial Com - RS-485 terminals R+, R-, S+ and S- 3: Option PCB - Option board connected at 2CN	0 to 3	0	Pump Quick Setup	*174*
b1-02	0181H	Run Command Selection **Run Source**	Selects the run command input source. 0: Operator - "Hand" and "Off" keys on digital operator 1: Terminals - Contact Closure on Terminal S1 2: Serial Com - RS-485 terminals R+, R-, S+ and S- 3: Option PCB - Option board connected at 2CN	0 to 3	1	Pump Quick Setup	*174*
H5-01	0425H	Drive Node Address **Serial Com Adr**	Selects Drive station node number (address) for terminals R+, R-, S+, S-.* **Note:** An address of "0" disables serial com.	0 to 20 (H5-08=0) 0 to FF (H5-08=1) 0 to 63 (H5-08=2)	1F	Programming	*185*
H5-02	0426H	Communication Speed Selection **Serial Baud Rate**	Selects the baud rate for terminals R+, R-, S+ and S-.* 0: 1200 Baud 1: 2400 Baud 2: 4800 Baud (APOGEE FLN) 3: 9600 Baud (Metasys N2) 4: 19200 Baud	0 to 4	3	Programming	*185*
H5-03	0427H	Communication Parity Selection **Serial Com Sel**	Selects the communication parity for terminals R+, R-, S+ and S-.* 0: No Parity 1: Even Parity 2: Odd Parity	0 to 2	0	Programming	*185*
H5-04	0428H	Stopping Method after Communication Error **Serial Fault Sel**	Selects the stopping method when a communication error is detected. 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0 to 3	3	Programming	*185*
H5-05	0429H	Communication Error Detection Selection **Serial Flt Dtct**	Enables or disables the communications timeout detection function. 0: Disabled - A communications loss will NOT cause a communications fault. 1: Enabled - If communications are lost for more than the time specified in parameter H5-09, a communications fault will occur.	0 or 1	1	Programming	*185*
H5-06	042AH	Drive Transmit Wait Time **Transmit WaitTIM**	Sets the time from when the Drive receives data to when the Drive sends data.	5 to 65	5 ms	Programming	*185*
H5-07	042BH	RTS Control Selection **RTS Control Sel**	Enables or disables "request to send" (RTS) control: 0: Disabled (RTS is always on) 1: Enabled (RTS turns on only when sending)	0 or 1	1	Programming	*185*
H5-09	0435H	Communication Error Detection Time **CE Detect Time**	Determines how long communications must be lost before a fault is annunciated. Works in conjunction with parameters H5-05 and H5-04.	0 to 10.0 (H5-08=0) 0 to 10.0 (H5-08=1) 0 to 90.0 (H5-08=2)	2.0 sec	Programming	*186*
*Set H5-01 to 0 to disable Drive responses to Modbus communications.							

Modbus communication can perform the following operations regardless of the settings in b1-01 and b1-02:

1. Monitoring operation status of the Drive
2. Setting and reading iQpump drive parameters
3. Resetting faults
4. Input multi-function commands

Important: An OR operation is performed between the multi-function command input from the PLC and the command input from multi-function digital input terminals S3 to S7.

■ Message Format

In Modbus communication, the master sends commands to the slave, and the slave responds. The message format is configured for both sending and receiving as shown below. The length of the data packets is changed by the command (function) contents.

Slave address
Function code
Data
Error check

Figure 79 Message Format

The space between messages must support the following:

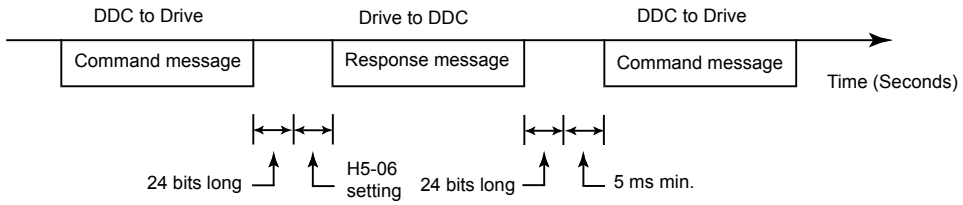


Figure 80 Message Spacing

Slave Address

Set the iQpump drive address from 0 to 32. If 0 is selected, commands from the master will be broadcast (i.e., the iQpump drive will not return responses).

Function Code

The function code specifies commands. There are four function codes supported by the Drive, as shown below.

Table 21 Modbus Function Codes

Function Code (Hexadecimal)	Function	Command Message		Response Message	
		Min. (Bytes)	Max. (Bytes)	Min.* (Bytes)	Max. (Bytes)
03H	Reading/Holding Register Contents	8	8	7	37
06H	Write In Single Holding Register	8	8	8	8
08H	Loopback Test	8	8	8	8
10H	Write In Several Holding Registers	11	41	8	8
* Minimum bytes for a normal Response Message (error response message is always 5 bytes).					

Data

Configure consecutive data by combining the storage register address (test code for a loopback address) and the data the register contains. The data length changes depending on the command details.

Error Check

Errors are detected during communication using CRC-16. Perform calculations using the following method:

1. The factory setting for CRC-16 communication is typically zero, but when using the Modbus system, set the factory setting to one (e.g., set all 16 bits to 1).
2. Calculate CRC-16 using MSB as slave address LSB, and LSB as the MSB of the final data.
3. Calculate CRC-16 for response messages from the slaves and compare them to the CRC-16 in the response messages.

Modbus Function Code Details

◆ Reading/Holding Register Contents (03H)

Read the contents of the storage registers only for the specified number of registers. The addresses must be consecutive, starting from a specified start register. The data content of the storage register are separated into high bytes and low bytes.

The following table shows message examples when reading status signals, error details, data link status, and frequency references from the slave 2 Drive.

Command Message		
Slave Address		02H
Function Code		03H
Start Register	High Byte	00H
	Low Byte	20H
No. of Registers	High Byte	00H
	Low Byte	04H
CRC-16	High Byte	45H
	Low Byte	F0H

Response Message (During Normal Operation)		
Slave Address		02H
Function Code		03H
Data quantity		08H
First Storage Register	High Byte	00H
	Low Byte	65H
Second Storage Register	High Byte	00H
	Low Byte	00H
Third Storage Register	High Byte	00H
	Low Byte	00H
Fourth Storage Register	High Byte	01H
	Low Byte	F4H
CRC-16	High Byte	AFH
	Low Byte	82H

Response Message (During Error)		
Slave Address		02H
Function Code		83H
Error code		03H
CRC-16	High Byte	F1H
	Low Byte	31H

Figure 81 Function Code 03H Message Example

◆ Write In Single Holding Register (06H)

Command Message		
Slave Address		01H
Function Code		06H
Register Address	Upper	00H
	Lower	01H
Setting Data	Upper	00H
	Lower	01H
CRC-16	Upper	98H
	Lower	0BH

Response Message (During Normal Operation)		
Slave Address		01H
Function Code		06H
Register Address	Upper	00H
	Lower	01H
Setting Data	Upper	00H
	Lower	01H
CRC-16	Upper	98H
	Lower	0BH

Response Message (During Error)		
Slave Address		01H
Function Code		86H
Error code		21H
CRC-16	Upper	82H
	Lower	78H

Figure 82 Function Code 06H Message Example

◆ Loopback Test (08H)

The loopback test returns the command message directly as the response message without changing the contents to check the communications between the master and slave. Set user-defined test code and data values.

The following table shows a message example when performing a loopback test with the slave 1 Drive.

Command Message		
Slave address		01H
Function code		08H
Test Code	High Byte	00H
	Low Byte	00H
Data	High Byte	A5H
	Low Byte	37H
CRC-16	High Byte	DAH
	Low Byte	8DH

Response Message (During Normal Operation)		
Slave address		01H
Function code		08H
Test Code	High Byte	00H
	Low Byte	00H
Data	High Byte	A5H
	Low Byte	37H
CRC-16	High Byte	DAH
	Low Byte	8DH

Response Message (During Error)		
Slave address		01H
Function code		88H
Error Code		01H
CRC-16	High Byte	86H
	Low Byte	50H

Figure 83 Function Code 08H Message Example

◆ Write In Several Holding Registers (10H)

Write the specified data to the desired slave indicating the desired starting register. The written data must be consecutive, starting from the specified address in the command message: High Byte (8 bits), then Low Byte 8 bits, in sequential storage register order.

The following table shows an example of a message when a forward Run command has been set at a speed command of 60.0 Hz in the slave 1 iQpump drive by the PLC.

Command Message		
Slave Address		01H
Function Code		10H
Start Register	High Byte	00H
	Low Byte	01H
No. of Registers	High Byte	00H
	Low Byte	02H
No. of Bytes*		04H
First 2 Bytes of data	High Byte	00H
	Low Byte	01H
Second 2 Bytes of data	High Byte	02H
	Low Byte	58H
CRC-16	High Byte	63H
	Low Byte	39H

Response Message (During Normal Operation)		
Slave Address		01H
Function Code		10H
Start Register	High Byte	00H
	Low Byte	01H
No. of Registers	High Byte	00H
	Low Byte	02H
CRC-16	High Byte	10H
	Low Byte	08H

Response Message (During Error)		
Slave Address		01H
Function Code		90H
Error code		02H
CRC-16	High Byte	CDH
	Low Byte	C1H

* No. of bytes = 2 x (# of Registers)

Figure 84 Function Code 08H Message Example

Important: Set the number of bytes as quantity of specified registers x 2. Handle response messages in the same way.

Modbus Data Tables

The data tables are shown below. The types of data are as follows: Reference data, monitor data and broadcast data.

◆ Reference Data

The reference data table is shown below. Reference data can be read and written to.

Table 22 Reference Data

Register No.	Contents	
0000H	Reserved	
0001H	Sequence Control	
	Bit 0	Run Forward 1: Run 0: Stop
	Bit 1	Run Reverse 1: Run 0: Stop
	Bit 2	External fault1: Fault (EFO)
	Bit 3	Fault reset1: Reset command
	Bit 4	ComNet
	Bit 5	ComCtrl
	Bit 6	Multi-function digital input command 3
	Bit 7	Multi-function digital input command 4
	Bit 8	Multi-function digital input command 5
	Bit 9	Multi-function digital input command 6
	Bit A	Multi-function digital input command 7
	Bits B to F	Not used
0002H	Frequency reference (Set units using parameter o1-03)	
0003H to 0005H	Not used	
0006H	PI Setpoint	
0007H	Analog output 1 setting (-11 V = 726 to 11 V = 726) → 10 V = 660	
0008H	Analog output 2 setting (-11 V = 726 to 11 V = 726) → 10 V = 660	
0009H	Multi-function contact output setting	
	Bit 0	Digital output 1 (Terminal M1-M2) 1: ON 0: OFF
	Bit 1	Digital output 2 (Terminal M3-M4) 1: ON 0: OFF
	Bit 2	Not Used
	Bits 3 to 5	Not used
	Bit 6	Set fault contact (terminal MA-MC) output using bit 7. 1: ON 0: OFF
	Bit 7	Fault contact (terminal MA-MC) 1: ON 0: OFF
	Bits 8 to F	Not used
000AH to 000EH	Not used	
000FH	Reference selection settings	
	Bit 0	Not used
	Bit 1	Input PI setpoint 1: Enabled 0: Disabled
	Bits 3 to B	Not used
	C	Broadcast data terminal S5 input 1: Enabled 0: Disabled
	D	Broadcast data terminal S6 input 1: Enabled 0: Disabled
	E	Broadcast data terminal S7 input 1: Enabled 0: Disabled
	F	Not used
Note: Write 0 to all unused bits. Also, do not write data to reserved registers.		

■ Monitor Data

The following table shows the monitor data. Monitor data can only be read.

Table 23 Monitor Data

Register No.	Contents	
0020H	Drive status	
	Bit 0	Running 1: Running 0: Stopped
	Bit 1	Reverse operation 1: Reverse operation 0: Forward operation
	Bit 2	Drive startup complete 1: Completed 0: Not completed
	Bit 3	Fault1: Fault
	Bit 4	Data setting error1: Error
	Bit 5	Multi-function digital output 1 (terminal M1 - M2) 1: ON 0: OFF
	Bit 6	Multi-function digital output 2 (terminal M3 - M4) 1: ON 0: OFF
	Bit 7	Not used
	Bits 8 to F	Not used
0021H	Fault details	
	Bit 0	Overcurrent (OC) Ground fault (GF)
	Bit 1	Main circuit overvoltage (OV)
	Bit 2	Drive overload (OL2)
	Bit 3	Drive overheat (OH1, OH2)
	Bit 4	Not used
	Bit 5	Fuse blown (PUF)
	Bit 6	PI feedback reference lost (FbL)
	Bit 7	External error (EF, EFO)
	Bit 8	Hardware error (CPF)
	Bit 9	Motor overload (OL1) or overtorque 1 (OL3) detected
	Bit A	PG broken wire detected (PGO), Overspeed (OS), Speed deviation (DEV)
	Bit B	Main circuit undervoltage (UV) detected
	Bit C	Main circuit undervoltage (UV1), control power supply error (UV2), inrush prevention circuit error (UV3), power loss
	Bit D	Missing output phase (LF)
	Bit E	Modbus communications error (CE)
	Bit F	Operator disconnected (OPR)
0022H	Data link status	
	Bit 0	Writing data
	Bit 1	Not used
	Bit 2	Not used
	Bit 3	Upper and lower limit errors
	Bit 4	Data integrity error
	Bits 5 to F	Not used
0023H	Frequency reference	U1-01
0024H	Output frequency	U1-02
0025H	Output voltage reference	U1-06
0026H	Output current	U1-03
0027H	Output power	U1-08
0028H	Torque reference	U1-09
0029H	Not used	
002AH	Not used	

Register No.	Contents	
002BH	Sequence input status	
	Bit 0	Input terminal S1 1: ON 0: OFF
	Bit 1	Input terminal S2 1: ON 0: OFF
	Bit 2	Multi-function digital input terminal S3 1: ON 0: OFF
	Bit 3	Multi-function digital input terminal S4 1: ON 0: OFF
	Bit 4	Multi-function digital input terminal S5 1: ON 0: OFF
	Bit 5	Multi-function digital input terminal S6 1: ON 0: OFF
	Bit 6	Multi-function digital input terminal S7 1: ON 0: OFF
	Bits 7 to F	Not used
002CH	Drive status	
	Bit 0	Operation1: Operating
	Bit 1	Zero speed1: Zero speed
	Bit 2	Frequency agree1: Matched
	Bit 3	Desired frequency agree1: Matched
	Bit 4	Frequency detection 11: Output frequency £ L4-01
	Bit 5	Frequency detection 21: Output frequency Š L4-01
	Bit 6	Drive startup completed1: Startup completed
	Bit 7	Low voltage detection 1: Detected
	Bit 8	Baseblock1: Drive output baseblock
	Bit 9	Frequency reference mode1: Not communication 0: Communication
	Bit A	Run command mode1: Not communication 0: Communication
	Bit B	Overtorque detection1: Detected
	Bit C	Frequency reference lost1: Lost
	Bit D	Retrying error1: Retrying
	Bit E	Error (including Modbus communications time-out) 1:Error occurred
	Bit F	Modbus communications time-out 1: Timed out
002DH	Multi-function digital output status	
	Bit 0	Multi-function digital output 1 (terminal M1-M2) 1: ON 0: OFF
	Bit 1	Multi-function digital output 2 (terminal M3-M4): 1: ON 0: OFF
	Bit 2	Not used
	Bits 3 to F	Not used
002EH - 0030H	Not used	
0031H	Main circuit DC voltage	
0032H - 0037H	Not used	
0038H	PI feedback level (Input equivalent to 100%/Max. output frequency; 10/1%; without sign)	
0039H	PI input level (±100%/±Max. output frequency; 10/1%; with sign)	
003AH	PI output level (±100%/±Max. output frequency; 10/1%; with sign)	
003BH	CPU software number	
003CH	Flash software number	
003DH	Communication error details	
	Bit 0	CRC error
	Bit 1	Invalid data length
	Bit 2	Not used
	Bit 3	Parity error
	Bit 4	Overrun error
	Bit 5	Framing error
	Bit 6	Time-out
	Bits 7 to F	Not used
003EH	kVA setting	
003FH	Control method	

Note: Communication error details are stored until an error reset is input (errors can be reset while the Drive is operating).

■ Broadcast Data

The following table shows the broadcast data. Broadcast Data Can Be Written (fuNction Code 06H/10H) only.

Table 24 Broadcast Data

Register Address	Contents	
0001H	Operation signal	
	Bit 0	Run forward 1: Run 0: Stop
	Bit 1	Reverse operation command 1: Run 0: Stop
	Bits 2 and 3	Not used
	Bit 4	External error (1: Fault set using H1-01)
	Bit 5	Error (Fault 1: Reset commandset using H1-02)
	Bits 6 to B	Not used
	Bit C	Multi-function digital input terminal S5 input
	Bit D	Multi-function digital input terminal S6 input
	Bit E	Multi-function digital input terminal S7 input
	Bit F	Not used.
0002H	Frequency reference	30000/100%
Note: Bit signals not defined in the broadcast operation signals use local node data signals continuously.		

■ Enter Command

When writing parameters to the iQpump drive from the PLC using Modbus communication, the parameters are temporarily stored in the constant data area in the Drive. To enable these parameters in the parameter data area, use the Enter command.

There are two types of Enter commands:

1. Enter commands that enable parameter data in RAM
2. Enter commands that write data to EEPROM (non-volatile memory) in the iQpump drive at the same time as enabling data in RAM.

The following table shows the Enter command data. Enter command data can only be written.

The Enter command is enabled by writing 0 to register number 0900H or 0901H.

Table 25 Enter Command

Register No.	Contents
0900H	Write parameter data to EEPROM
0910H	Parameter data is not written to EEPROM, but refreshed in RAM only.

Important: The maximum number of times you can write to EEPROM using the iQpump drive is 100,000. Do not frequently execute Enter commands (0900H) written to EEPROM.
The Enter command registers are write-only. Consequently, if reading these registers, the register address will become invalid (Error code: 02H).

■ Error Codes

The following table shows Modbus communication error codes.

Table 26 Error Codes

Error Code	Contents
01H	Function code error A function code other than 03H, 08H, or 10H has been set by the PLC.
02H	Invalid register number error • The register address you are attempting to access is not recorded anywhere. • With broadcast sending, a start address other than 0000H, 0001H, or 0002H has been set.
03H	Invalid quantity error • The number of data packets being read or written is outside the range of 1 to 16. • In write mode, the number of data packets in the message is not No. of packets x 2.
21H	Data setting error • Upper limit or lower limit error has occurred in the control data or when writing parameters. • When writing parameters, the parameter setting is invalid.
22H	Write mode error • Attempting to write parameters to the Drive during run. • Attempting to write via Enter commands during run. • Attempting to write parameters other than A1-00 to A1-05, E1-03, or 02-04 when a CPF03 (defective EEPROM) fault has occurred. • Attempting to write read-only data.
23H	Writing during main circuit undervoltage (UV) fault • Writing parameters to the Drive during UV (main circuit undervoltage) alarm. • Writing via Enter commands during UV (main circuit undervoltage) alarm.
24H	Writing error during parameters processing Attempting to write parameters while processing parameters in the Drive.

■ Slave Not Responding

In the following cases, the slave will ignore the write function.

- When a communication error (overrun, framing, parity, or CRC-16) is detected in the command message.
- When the slave address in the command message and the slave address in the iQpump drive do not agree.
- When the data that configures the message and the data time length exceed 24 bits.
- When the command message data length is invalid.

Important: If the slave address specified in the command message is 0, all slaves execute the write function, but do not return response messages to the master.

◆ Modbus Self-Diagnosis

The iQpump drive has a built-in function for self-diagnosing the operations of serial communication interface circuits. The self-diagnosis function connects the communication parts of the send and receive terminals, receives the data sent by the Drive, and checks if communication is being performed normally.

Perform the self-diagnosis function using the following procedure.

1. Turn ON the power supply to the Drive, and set parameter H1-05 (Terminal S7 Function Selection) to 67 (Comm Test Mode).
2. Turn OFF the power supply to the Drive.
3. Perform wiring according to the following diagram while the power supply is turned OFF.
4. Turn ON the terminating resistance. (Turn ON pin 1 on DIP switch 1.)
5. Turn ON the power supply to the iQpump drive again.

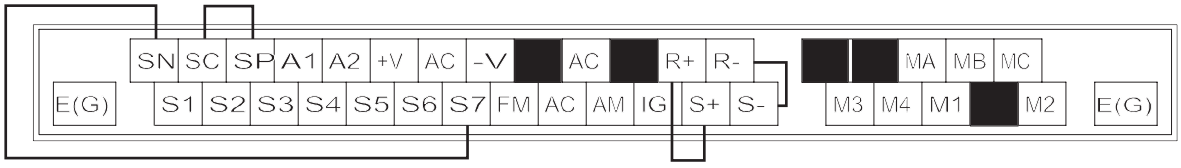


Figure 85 Communication Terminal Connection for Self -Diagnosis Function

6. During normal self-diagnostic operation, the Digital Operator displays the frequency reference value. If an error occurs, a CE (Modbus communication error) alarm will be displayed on the Digital Operator, the fault contact output will be turned ON, and the iQpump drive operation ready signal will be turned OFF.

■ H5-01 Drive Node Address

Setting Range:	0 to 20 (Hex)	} MODBUS	0 to FF	} N2	0 to 63	} P1
Factory Default:	1F		1F		1F	

In order for a master to be able to communicate with the iQpump drive using serial communications, the iQpump drive must have a unique node address. The iQpump drive is given a node address if H5-01¼0. The node addresses do not have to be assigned in sequential order but they must be unique, i.e. no two Drives on the same serial network can be assigned the same address. After setting the iQpump drive address with the H5-01 parameter, the power to the iQpump drive must be cycled for the addressing to take effect.

Leaving H5-01 = 0 will disable responses to MEMOBUS communications.

■ H5-02 Communications Speed Selection

Setting	Description
0	1200 Baud
1	2400 Baud
2	4800 Baud (Standard for APOGEE)
3	9600 Baud (*factory default*) (Standard for Metasys)
4	19200 Baud

■ H5-03 Communications Parity Selection

Setting	Description
0	No Parity (*factory default*)
1	Even Parity
2	Odd Parity

Parameters H5-02 and H5-03 configure the Drives MEMOBUS communications via the RS-485/422 terminals on the removable terminal block. Configure H5-02 and H5-03 to match the settings of the master controller of the serial network. After changing the H5-02 or H5-03 parameter, the power to the iQpump drive must be cycled for the change to take effect.

If either the speed or parity value is changed via the serial communications, the serial communications will cease to operate until the iQpump drive power is cycled.

It may be necessary to avoid the 19.2 K baud setting if frequent serial communications errors occur at that baud rate.

■ H5-04 Stopping Method after Communication Error

Setting	Description
0	Ramp to Stop
1	Coast to Stop
2	Fast-Stop
3	Alarm Only (*factory default*)

The setting of parameter H5-04 will determine the Drive's reaction to a serial communications fault such as the CE fault. The iQpump drive can be programmed to either ramp to a stop in the time specified by C1-02 (H5-04 = "0: Ramp to stop"), coast to a stop (H5-04 = 1), ramp to a stop at the special fast stopping time specified by C1-09 (H5-04 = "2: Fast-Stop"), or continue operating using the commands received before the serial communication fault and flashing an alarm on the digital operator (H5-04 = "3: Alarm Only").

■ H5-05 Communications Error Detection Selection

Setting	Description
0	Disabled
1	Enabled (*factory default*)

The iQpump drive can be configured by parameter H5-05 to recognize a CE fault whenever serial communications time-out. If H5-05 = "1: Enabled," the iQpump drive will fault if serial communication responses are not received within a set period of time determined by parameter H5-09. iQpump drive power should be cycled after a change is made to this parameter.

■ H5-06 Drive Transit Wait Time

Setting Range: 5 to 65 ms

Factory Default: 5 ms

Parameter H5-06 will set the delay time between the receiving of a message from the master and the sending of a response from the iQpump drive back to the master. The iQpump drive power should be cycled after a change is made to this parameter.

■ H5-07 RTS Control Selection

Setting	Description
0	Disabled (RTS is always on)
1	Enabled (RTS turns on only when sending) (*factory default*)

RTS or Request To Send control is a method of flow control applied to messaging in serial communications. Parameter H5-07 configures whether the iQpump drive will implement RTS messaging all the time (H5-07 = "0: Disabled") or only when sending (H5-07 = "1: Enabled"). It is recommended to set H5-07 = "0: Disabled," when using RS-485 and set H5-07 = "1: Enabled," when using RS-422. The iQpump drive power should be cycled after a change is made to this parameter.

■ H5-08 Communication Protocol Selection

Setting	Description
0	Memobus (Modbus) (*factory default*)
1	N2 (Metasys)
2	FLN (APOGEE)

Since the iQpump drive is capable of using MEMOBUS, Metasys N2, or Apogee FLN communications via the RS-485/422 terminals, parameter H5-08 must be programmed to specify to the iQpump drive which format is being used. iQpump drive power should be cycled after a change is made to this parameter.

■ H5-09 Communication Error Detection Time

Setting Range: 0.0 to 10.0 sec

Factory Default: 2.0 sec

The setting of parameter H5-09 determines the length of time that serial communications must be lost before a CE fault occurs. Setting H5-09 = 0 will configure the iQpump drive for the quickest CE fault detection but may cause nuisance faults. The iQpump drive power should be cycled after a change is made to this parameter.

◆ L1 Motor Overload

■ L1-01 Motor Overload Protection Selection

Setting	Description
0	Disabled
1	Std Fan Cooled (Enabled) (*factory default*)

The iQpump drive has an I²t electronic overload protection function, the OL1 fault, for protecting the motor from overheating. The iQpump drive bases the protection on time, output current, and output frequency. The electronic thermal overload function is UL-recognized so an external thermal overload relay is not required.

If the iQpump drive is connected to a single motor, the motor overload protection should be enabled (L1-01 = "1: Std Fan Cooled") unless another means of preventing motor thermal overload is provided.

The time before the OL1 fault will occur changes as the output frequency is reduced. The maximum output current level at which there is no time limit for operation (the OL Start Point) is different depending on the output frequency. For instance, if the iQpump drive is being operated at 60 Hz and the output current level is below 106% of the motor's rated current (E2-01), the iQpump drive will run without an OL1 fault indefinitely. Once the 106% output current level is exceeded, de-rating of the OL1 time starts.

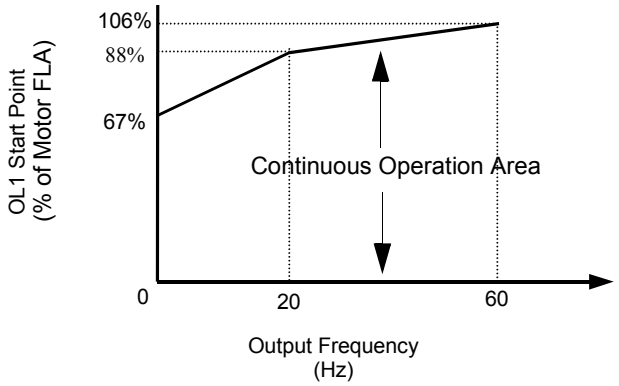


Figure 86 Motor Overload Protection Curve

Important: If the iQpump drive is connected to more than one motor for simultaneous operation, the electronic overload protection should be disabled (L1-01 = "0: Disabled") and each motor should be wired with its own motor thermal overload.

■ L1-02 Motor Overload Protection Time

Setting Range: 0.1 to 20.0 Minutes

Factory Default: 8.0 Minutes

The L1-02 parameter will set the allowed operation time before the OL1 fault will occur when the iQpump drive is running at 60 Hz and 133% of the motor's full load amp rating (E2-01). Adjusting the value of L1-02 can shift the set of OL1 curves up the Y-axis of the diagram below but will not change the shape of the curves.

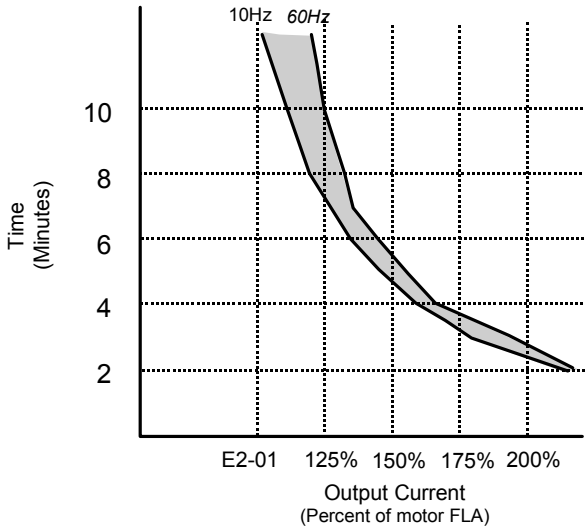


Figure 87 Motor Overload Protection Time based on Output frequency and Load

■ L1-03 Motor Overheat Alarm Operation Selection

Setting	Description
0	Ramp to Stop
1	Coast to Stop
2	Fast-Stop
3	Alarm Only (*factory default*)

■ L1-04 Motor Overheat Fault Operation Selection

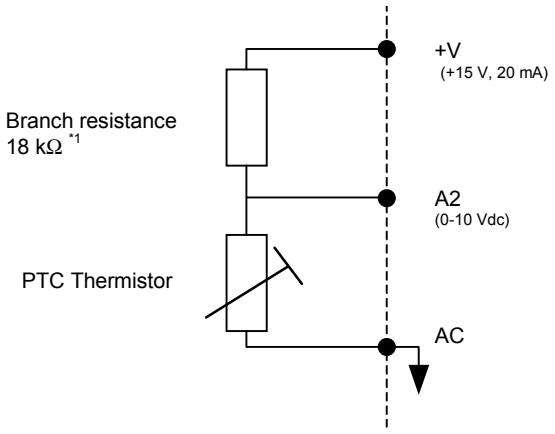
Setting	Description
0	Ramp to Stop
1	Coast to Stop (*factory default*)
2	Fast-Stop

■ L1-05 Motor Temperature Input Filter Time

Setting Range: 0.00 to 10.00 sec

Factory Default: 0.20 sec

The iQpump drive can be programmed to accept a PTC (Positive Temperature Coefficient) Thermistor input for monitoring motor temperature. By setting parameter H3-09 = "E: Motor Temperature," and attaching the PTC thermistor per the figure below, the iQpump drive can react to the increasing motor winding temperature with both an alarm (L1-03) and a fault (L1-04).



*1 The resistance value of 18 kΩ is only valid for using a 3-phase PTC with the characteristics shown in the figure on following page.

Figure 88

A typical PTC Thermistor characteristic shown on the following page.

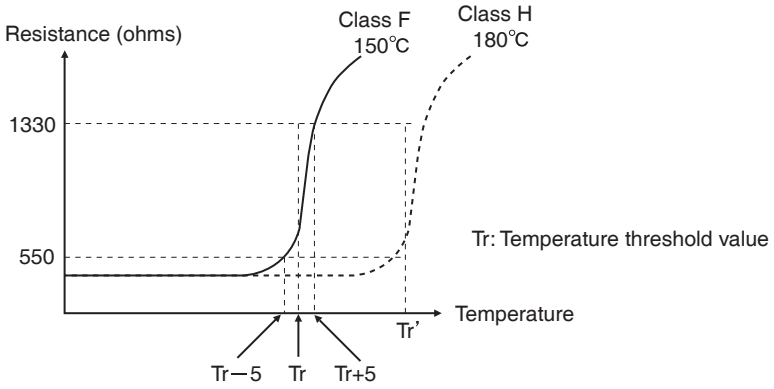


Figure 89 PTC Thermistor Temperature-Resistance Value Characteristics

Using the changing voltage drop across the thermistor the voltage into the A2 analog input will vary according to the motor's winding temperature. If the measured voltage into A2 exceeds 1.17 Vdc the iQpump drive will flash an OH3 alarm on the digital operator and will either ramp to a stop in the time specified by C1-02 (L1-03 = "0: Ramp to Stop"), coast to a stop (L1-03 = "1: Coast to Stop"), ramp to a stop at the special fast stopping time specified by C1-09 (L1-03 = "2: Fast-Stop"), or continue operating using the commands received before the OH3 alarm (L1-03 = "3: Alarm Only"). The Drive's fault contact, MA-MB, will not close.

If the measured voltage into the A2 analog input exceeds 2.34 Vdc the iQpump drive will fault (OH4) and either ramp to a stop in the time specified by C1-02 (L1-04 = "0: Ramp to Stop"), coast to a stop (L1-04 = "1: Coast to Stop"), ramp to a stop at the special fast stopping time specified by C1-09 (L1-04 = "2: Fast-Stop"). The Drive's fault contact, MA-MB, will close.

Parameter L1-05 will apply a time delay filter to the A2 analog input when it is configured as the thermistor input. The greater the time programmed into L1-05 the less responsive the iQpump drive will be to quick changes to the input voltage but the more stable the input will be. A noisy input will benefit from a greater L1-05 time.

◆ L2 Momentary Power Loss Ride-thru Function

When momentary power loss recovery is enabled (L2-01≠0), a speed search is executed to catch the potentially spinning motor shaft. This speed search will occur regardless of the setting of b3-01 “Speed Search Selection”.

■ L2-01 Momentary Power Loss Detection Selection

Setting	Description
0	Disabled
1	PwrL Ride Thru t
2	CPU Power Active (*factory default*)

■ L2-02 Momentary Power Loss Ride-Thru Time

Setting Range: 0.0 to 25.5 sec

Factory Default: Model Dependent

The iQpump drive allows different responses to momentary power losses. The setting of L2-01 determines whether the iQpump drive attempts to restart after a short loss of incoming AC power and for what length of time this capability remains active.

If L2-01 = “0: Disabled,” the iQpump drive detects a UV1 fault 15 ms after power loss and automatic restarting is disabled. The iQpump drive cannot restart until the external run command is removed and the UV1 fault is reset.

If L2-01 = “1: PwrL Ride Thru t,” the iQpump drive restarts without the UV1 fault if power is returned within the time specified in L2-02, the Momentary Power Loss Ride-thru Time. During the power loss but before the fault trip, the digital operator will display a UV alarm. If L2-02 is set for a time longer than the control power supply can be sustained, a UV1 fault will not occur and the iQpump drive restarts upon the return of AC power. The time that the control power supply can be maintained varies with iQpump drive size. The larger the Drive, the greater the potential ride-thru time.

If L2-01 = “2: CPU Power Active,” the iQpump drive ignores L2-02 and attempts a restart as long as the control power supply is still able to maintain a minimal voltage level. In effect, setting L2-01 = “2: CPU Power Active” (factory default) is programming the iQpump drive for maximum Power Loss Ride-thru. An equivalent setting is L2-01 = “1: PwrL Ride Thru t,” with L2-02 set to a time longer than the control power supply can be maintained after power is lost.

Note: The run command must be held during power loss for any power loss ride-thru capability to be possible. It is for this reason that 3-wire control is not recommended for use with the Momentary Power Loss function.

■ L2-03 Momentary Power Loss Minimum Baseblock Time

Setting Range: 0.1 to 5.0 sec

Factory Default: Model Dependent

When momentary power loss recovery is enabled (L2-01¼0) the iQpump drive will baseblock for a period of time specified by the L2-03 parameter. The baseblock time will be executed just prior to the speed search function in order to allow any residual magnetic fields in the motor windings to decay before any new voltage is applied to the motor.

If the motor’s secondary circuit time constant is known, set L2-03 = 0.7x (value of time constant). If an OC or OV fault occurs during momentary power loss recovery, increase the setting of L2-03.

The L2-03 parameter also sets the baseblock time for the DC Injection Braking function (b1-03 = “2: DC Injection to Stop”). If an OC or OV fault occurs during DC Injection Braking to Stop, increase the setting of L2-03.

■ L2-04 Momentary Power Loss Voltage Recovery Ramp Time

Setting Range: 0.0 to 5.0 sec

Factory Default: Model Dependent

When momentary power loss recovery is enabled (L2-01≠0), a speed search is executed to catch the potentially spinning motor shaft. As part of the speed search function full voltage is not immediately applied to the motor but is ramped up. The setting of parameter L2-04 determines the ramp time for increasing the output voltage from zero to maximum voltage (E1-05).

If a UV1 fault occurs during the current detection speed search function, increase the setting of L2-04.

■ L2-05 Undervoltage Detection Level

Setting Range: 150 to 210 Vdc

Factory Default: 190 Vdc

The L2-05 parameter sets the DC Bus undervoltage level. The setting of L2-05 affects the voltage at which a UV alarm or a UV1 fault will occur. If the setting of L2-05 is lowered below the factory default level (190 Vdc for a 240 Vac drive and 380 Vdc for a 480 Vac drive), then an AC Input Reactor must be installed on the input AC line to prevent inrush current from damaging the Drive's input diodes. An AC Line dip and fast voltage recovery can potentially cause a large inrush current.

◆ L3 Stall Prevention

■ L3-01 Stall Prevention Selection During Accel

Setting	Description
0	Disabled
1	General Purpose (*factory default*)
2	Intelligent

■ L3-02 Stall Prevention Level During Accel

Setting Range: 0 to 200% of the iQpump drive rated output current

Factory Default: 120% of the iQpump drive rated output current

The stall prevention during acceleration function adjusts the acceleration time in order to prevent OC fault trips during acceleration. If L3-01 = "0: Disabled," stall prevention is disabled. If the load is large enough and the acceleration time short enough the iQpump drive may fault and stop.

If L3-01 = "1: General Purpose," then the standard stall prevention function is enabled. When the output current exceeds the level set by the L3-02 parameter, the iQpump drive will discontinue accelerating and maintain speed. If, during acceleration, the output current comes within 15% of the level set by parameter L3-02, the acceleration time is lengthened. Once the output current level has dropped below the L3-02 level, acceleration will begin again with the acceleration rate reaching the programmed rate once again 15% below the L3-02 level.

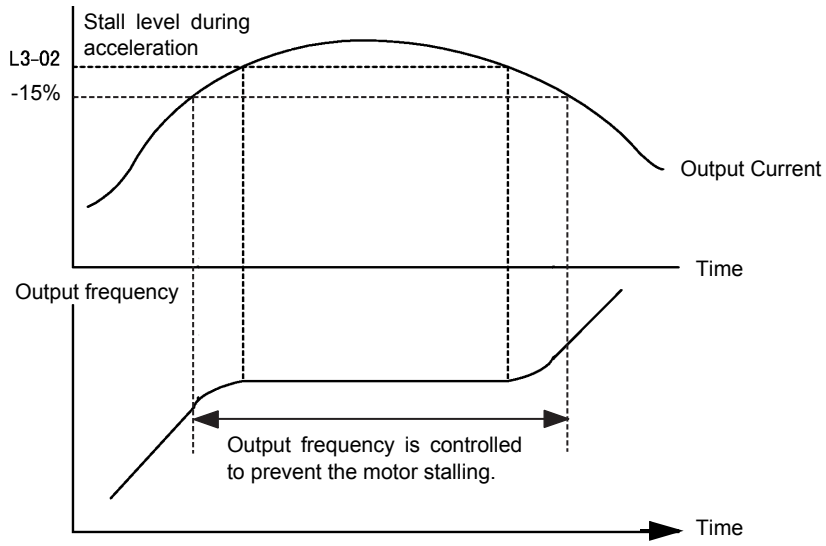


Figure 90 Detailed Time Chart for Stall Prevention During Acceleration

If L3-01 = "2: Intelligent," the intelligent stall prevention is enabled. The active acceleration time is ignored and the iQpump drive will attempt to accelerate as quickly as possible without exceeding the L3-02 output current level.

Important: Stall Prevention during Acceleration is not effective when the output frequency is less than 6 Hz.

The following figure demonstrates acceleration when L3-01 = "1: General Purpose".

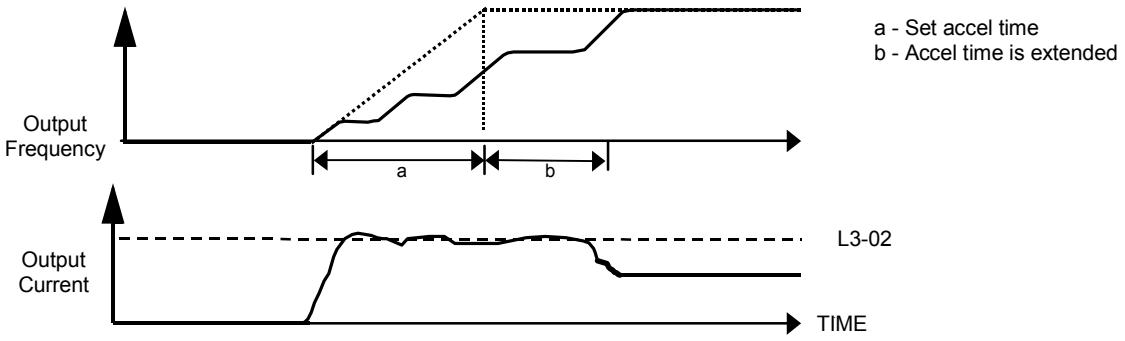


Figure 91 Time Chart for Stall Prevention During Acceleration

The L3-02 parameter is set as a percentage of the iQpump drive rated output current. If the motor capacity is small compared to the Drive's capacity, or if the motor stalls during acceleration, lower the set value of L3-02.

■ L3-04 Stall Prevention Selection During Decel

Setting	Description
0	Disabled
1	General Purpose (*factory default*)
2	Intelligent

The stall prevention during deceleration function adjusts the deceleration time in order to prevent OV fault trips during deceleration. If L3-04 = "0: Disabled," stall prevention is disabled and if the load is large and the deceleration time short enough the iQpump drive may fault and stop.

If L3-04 = "1: General Purpose," then the standard stall prevention function is enabled. If, during deceleration, the DC Bus voltage exceeds the stall prevention level (see *Table 27*), the iQpump drive will discontinue decelerating and maintain speed. Once the DC Bus voltage has dropped below the stall prevention level, the deceleration will continue down to the Speed Command level. See *Figure 92*.

Table 27 Stall Prevention During Decel

Drive Voltage		Stall Prevention Level during Deceleration (V)
240 Vac		380
480 Vac	E1-01 ≥ 400 Vac	760
	E1-01 < 400 Vac	660

If L3-01 = "2: Intelligent," the intelligent stall prevention is enabled. The active deceleration time is ignored and the iQpump drive will attempt to decelerate as quickly as possible without causing the DC Bus voltage to exceed the stall prevention level.

The following figure demonstrates acceleration when L3-04 = "1 General Purpose".

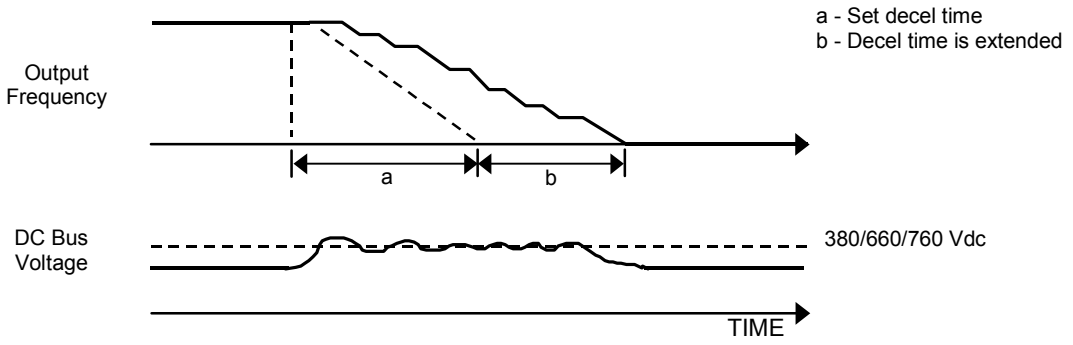


Figure 92 Time Chart for Stall Prevention During Deceleration

■ L3-05 Stall Prevention Selection During Running

Setting	Description
0	Disabled
1	Decel Time 1 (*factory default*)
2	Decel Time 2

■ L3-06 Stall Prevention Level During Running

Setting Range: 30 to 200% of the iQpump drive rated output current

Factory Default: 120% of the iQpump drive rated output current

The Stall Prevention During Running function will attempt to avoid an iQpump drive OC fault occurrence while the iQpump drive is operating at a constant speed. If L3-05 = "0: Disabled," the iQpump drive may fault if the load increases sufficiently to cause the output current to reach the OC fault level (180% of the iQpump drive rated output current).

If L3-05 = "1: General Purpose," the iQpump drive is outputting a constant speed, and the Drive's output current level exceeds the level set by parameter L3-06 for more than 100 ms the iQpump drive will begin to decelerate at the rate specified by parameter C1-02. The iQpump drive will continue to decelerate until the output current level drops below the L3-06 level (less a 2% hysteresis). Once the output current drops below the L3-06 – 2% level the iQpump drive will begin to accelerate at the currently active acceleration rate (either C1-01 or C1-03).

If L3-05 = "2: Decel Time 2," the iQpump drive will function as described above except C1-04 will be used instead of C1-02 as the deceleration rate used when the output current exceeds L3-06 for more than 100 ms.

The following figure demonstrates acceleration when L3-05≠0.

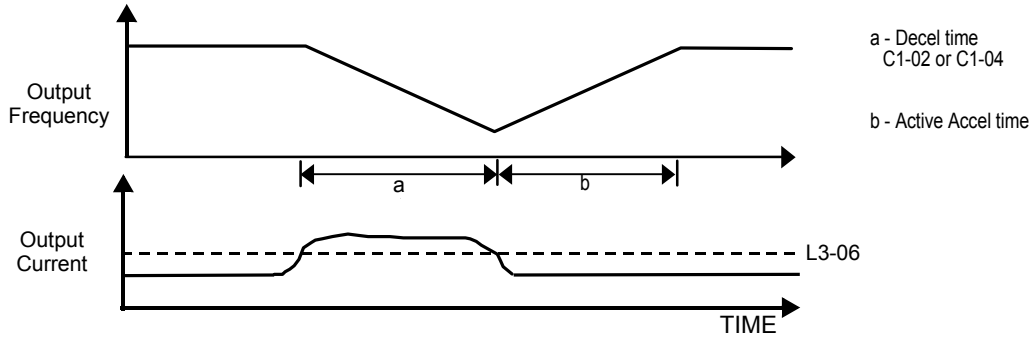


Figure 93 Time Chart for Stall Prevention Level During Running

The L3-06 parameter is set as a percentage of the iQpump drive rated output current. If the iQpump drive still faults when L3-05≠0, then either lower the L3-06 or adjust the C1-02 or C1-04 settings for a quicker deceleration.

◆ L4 Speed Command Loss Detection

■ L4-01 Speed Agreement Detection Level

Setting Range: 0.0 to 200.0 Hz

Factory Default: 0.0 Hz

■ L4-02 Speed Agreement Detection Width

Setting Range: 0.0 to 20.0 Hz

Factory Default: 2.0 Hz

Parameters L4-01 and L4-02 are user specified levels for use with the Fref/Fout Agree 1, Fref/Set Agree 1, and Freq Detect 1 & 2 digital output functions. Please refer to the H2 Digital Output Parameters for more information.

■ L4-05 Frequency Reference Loss Detection Selection

Setting	Description
0	Disabled
1	Enabled @% of PrevRef (*factory default*)

Note: Only available in Hand Mode (P5-01 = 0).

■ L4-06 Frequency Reference at Loss of Frequency Reference

Setting Range: 0.0 to 100% of previous speed command

Factory Default: 80% of previous speed command

The Drive can be configured to compensate for the loss of its external speed command. An external speed command is considered lost if it drops 90% of its value in 400 mS or less.

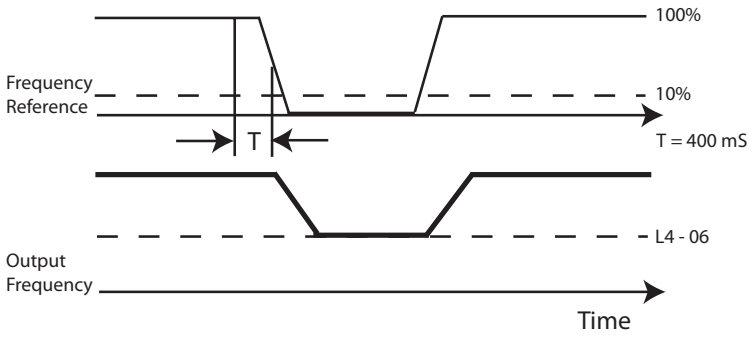


Figure 94 Loss of Frequency Reference Timing Diagram

To enable Frequency loss detection, set L4-05 = "1: Enabled @% of PrevRef". If Frequency Reference Loss Detection is enabled and the reference is lost, the Drive continues to operate at the speed commanded by parameter L4-06. When the speed command returns, the Drive again follows the speed command.

Setting H2-01 / H2-02 = "C: Loss of Ref", configures a digital output as a Frequency Reference Loss indication only when L4-05 = "1" Enabled @% of PrevRef".

Note: Only available in Hand Mode (P5-01 = 0).

◆ L5 Fault Restart

■ L5-01 Number of Auto Restart Attempts

Setting Range: 0 to 10

Factory Default: 0

■ L5-02 Auto Restart Operation Selection

Setting	Description
0	No Flt Relay (*factory default*)
1	Flt Relay Active

■ L5-03 Maximum Restart Time After Fault

Setting Range: 10.0 to 3600.0 sec <0032>

Factory Default: 180.0 sec

All major faults will cause the iQpump drive to stop. For some faults it is possible to configure the iQpump drive to attempt a restart automatically. After the fault occurs, the iQpump drive baseblocks for the Maximum Restart Time After Fault programmed in L5-03. After the baseblock is removed the iQpump drive checks if a fault condition still exists. If no fault condition exists the iQpump drive will attempt to restart the motor. If the restart is successful, the iQpump drive performs a Speed Search (Regardless of the status of b3-01 "Speed Search Selection") from the set speed command and the Auto Restart Attempts count is increased by one. Even if the restart fails the restart count is increased by one as long as the iQpump drive attempted to rotate the motor. The restart count will not be incremented if the restart is not attempted due to a continuing fault condition, (i.e. an OV fault). The iQpump drive waits the Maximum Restart Time After Fault (L5-03) before attempting another restart. This parameter is not applicable to Loss of Prime Fault.

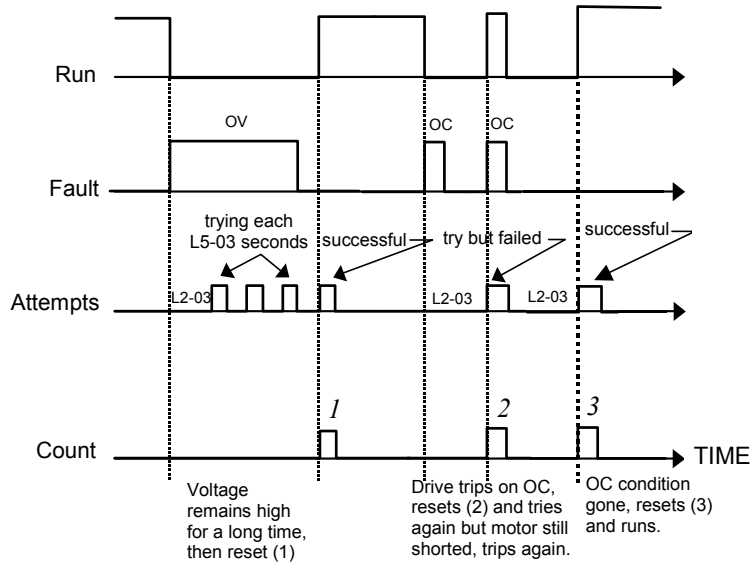


Figure 95 Automatic Restart Timing Diagram

The auto restart count is reset back to 0 if any of the following occur:

- No further faults for ten minutes after the last retry.
- The Drives power is turned off (the iQpump drive must be without power long enough to let control power dissipate).
- The SHIFT/RESET key is pushed after the last reset attempt.

The setting of parameter L5-02 determines whether the fault output (MA-MB) will be closed during an auto restart attempt. The setting of L5-02 can be important when interfacing the iQpump drive with other equipment.

The following faults will allow the Auto Restart function to initiate:

- OC (Overcurrent)
- LF (Output Open Phase)
- PF (Input Phase Loss)
- PUF (DC Bus Fuse)

- OL1 (Motor Overload)
- OL3 (Overtorque)
- OL2 (Drive Overload)
- OV (DC Bus Overvoltage)
- GF (Ground Fault)
- UV1 (DC Bus Undervoltage)
- OH1 (Overheat)

In order for auto restart after a UV1 fault, Momentary Power Loss Ride-thru must be enabled (L2-01 = “1: PwrL Ride Thru t,” or “2: CPU Power Active”). Setting H2-01 or H2-02 equal to “1E” configures a digital output as “Restart Enabled” to signal if an impending auto restart is possible.

◆ L6 Torque Detection

■ L6-01 Torque Detection Selection 1

Setting	Description
0	Disabled (*factory default*)
1	OL@SpdAgree - Alm
2	OL At Run -Alm
3	OL@SpdAgree - Flt
4	OL At Run - Flt
5	UL@SpdAgree - Alm
6	UL at Run - Alm
7	UL@SpdAgree - Flt
8	UL At Run - Flt

■ L6-02 Torque Detection Level 1

Setting Range: 0 to 300% of the iQpump drive rated output current

Factory Default: 15% of the iQpump drive rated output current

■ L6-03 Torque Detection Time 1

Setting Range: 0.0 to 10.0 sec

Factory Default: 10.0 sec

The iQpump drive can be programmed to indicate when either an overtorque or an undertorque conditions exist. A digital output must be programmed for "Torque Detection," (H2-01/H2-02 = "B: Trq Det 1 N.O." or "17: Trq Det 1 N.C.). A warning of an overtorque condition can indicate a jam and an undertorque condition can indicate a broken belt, no water in a pump, or other loss of load.

To configure Torque Detection requires the following decisions:

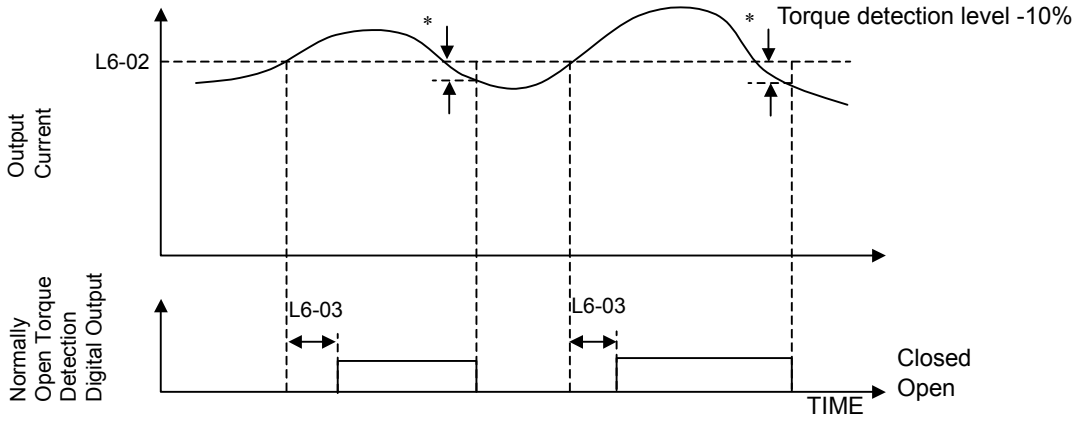
1. Do you wish to check for an overtorque condition or an undertorque condition?
2. Do you wish to check for the torque condition whenever the drive is running or only at speed agree? Nuisance detection during acceleration, when variable torques are normally required, can be avoided.
3. Do you want the drive to fault if the torque condition is detected or only alarm and continue operation?

The following table can help choose the proper setting for Torque Detection Selection 1 to get the wanted results.

Table 28 L6-01 Setting Choices

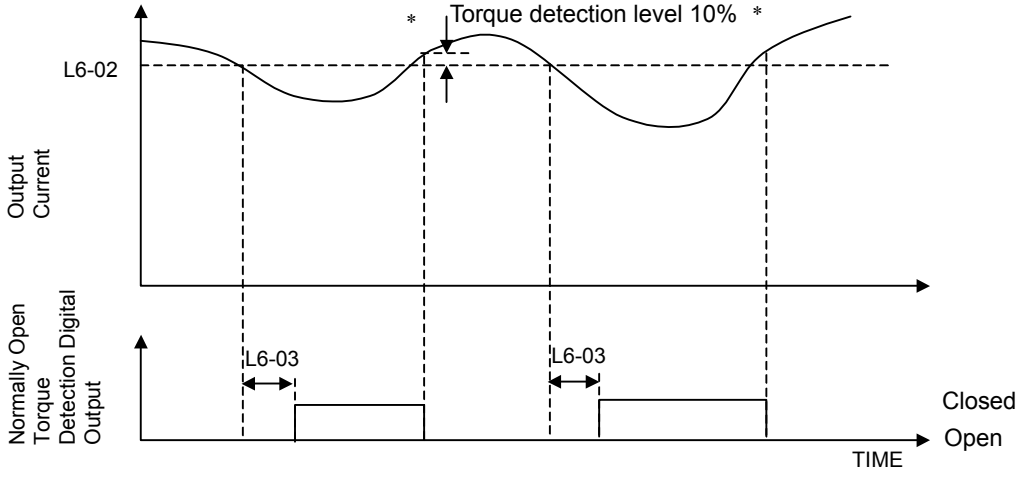
L6-01 Setting	Overtorque	Undertorque	Fault	Alarm	Always Detected	Only Detected @ Spd Agree
0	Torque Detection Disabled					
1	X			X		X
2	X			X	X	
3	X		X			X
4	X		X		X	
5*		X		X		X
6		X		X	X	
7		X				X
8		X			X	
*Suggested settings for Loss of Load indication						

After selecting the proper detection scheme the Torque Detection Level (L6-02) must be specified. If the current level read by the output current transformers rises above (overtorque) or drops below (undertorque) this level, and remains there for at least the Torque Detection Time (L6-03), then the Torque Detection Function will change the state of any digital output configured for Torque Detection (H2-01/ H2-02 = "B: Trq Det 1 N.O.," or "17: Trq Det 1 N.C.").



* When the output current drops below the Torque Detection Level by approximately 10% of the Drive's rated output current the digital output is reset.

Figure 96 Over Torque Detection



* When the output current rises above the Torque Detection Level by approximately 10% of the Drive's rated output current the digital output is reset.

Figure 97 Under Torque Detection

◆ L8 Hardware Protection

■ L8-01 Internal Dynamic Braking Resistor Protection Selection

Setting	Description
0	Not Provided (*factory default)*
1	Provided

This parameter is not applicable for iQpump drive operation.

■ L8-02 Overheat Pre-Alarm Level

Setting Range: 50 to 130°C

Factory Default: 95°C

■ L8-03 Overheat Pre-Alarm Operation Selection

Setting	Description
0	Ramp to Stop (Decel Time C1-02)
1	Coast to Stop
2	Fast-Stop (Decel Time C1-09)
3	Alarm Only
4	OH Alarm and Reduce (*factory default*)

The iQpump drive is capable of warning the operator of an impending heatsink over-temperature fault via an OH pre-alarm. The level at which the pre-alarm will activate is determined by the setting of parameter L8-02. Measurement of the heatsink temperature is done with several strategically mounted thermistors. If any of the heatsink thermistors measure a temperature in excess of the setting of L8-02, the iQpump drive will fault (OH2) and either: ramp to stop using the C1-02 deceleration rate (L8-03 = “0: Ramp to Stop”), coast to stop (L8-03 = “1: Coast to Stop”), ramp to stop using the C1-09 fast stop deceleration rate (L8-03 = “2: Fast-Stop”), alarm (OH) and continue running (L8-03 = “3: Alarm Only”), alarm (OH) and continue running but at a reduced speed (L8-03 = “4: Alarm & Reduce”). If L8-03 = 4: Alarm and Reduce, the iQpump drive will continue to run but will reduce the speed to the level determined by parameter L8-19. Refer to the description for parameter L8-19.

If a digital output is configured for OH Prealarm (H2-01 = “20: OH PreAlarm”), it will close whenever the heatsink temperature is greater than the L8-02 level no matter what the setting is of L8-03.

■ L8-05 Input Phase Loss Protection <0033>

Setting	Description
0	Disabled
1	Enabled *(factory default*)

The input phase loss detection circuit monitors the DC bus current ripple and activates when one of the input phases is lost. The detection circuit calculates the maximum and minimum values of the DC bus voltage in one second intervals, and compares the difference (ΔV) between these values with an internal detection level. If ΔV reaches or exceeds the detection level, after 0.5 second, the input phase loss is detected; a PF fault occurs and the motor coasts to a stop.

Input phase loss detection is disabled in the following cases:

- A Stop command is input
- Magnetic Contactor (MC) shuts OFF
- CPU A / D converter fault (CPF5)
- During deceleration
- Output current $\leq$ 30% of Inverter rated current

■ L8-06 Input Phase Loss Detection Level

Setting Range: 0.0 to 25.0% of Drives O V Trip point

Factory Default: kVA Dependent

The iQpump drive checks for a lost input phase by monitoring the DC Bus voltage ripple. After an initial delay of approximately 12 seconds, the iQpump drive will sample the DC BUS voltage every 1.28 seconds to determine the minimum and maximum voltage readings. The difference between the minimum and maximum voltage is averaged over ten consecutive scans. If this "averaged" value is greater than the trip level as determined by L8-06 (L8-06 x 400 for 200 volt class Drives; L8-06 x 800 for 400 volt class Drives) the iQpump drive shuts down and displays "PF," an input phase loss fault.

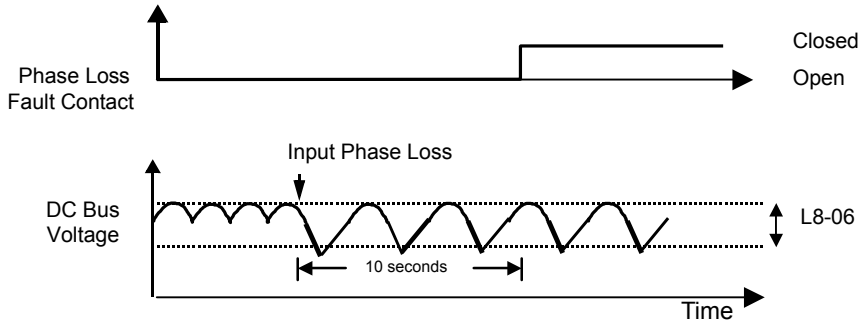


Figure 98 Input Phase Loss Detection Diagram

■ L8-07 Output Phase Loss Protection <0033>

Setting	Description
0	Disabled
1	Enabled (*factory default*)

The output phase loss detection circuit monitors the DCCT and activates when one or more of the output phases are lost. The detection circuit calculates the RMS current value (I_{RMS}) for each of the phases and compares it with an internal output detection level. If I_{RMS} decreases to or below the detection level for 10 seconds, an output phase loss (LF) fault occurs and the motor coasts to a stop

■ L8-09 Output Ground Fault Detection Selection

Setting	Description
0	Disabled
1	Enabled *(factory default*)

The iQpump drive has a ground fault detection circuit that activates when the current to ground exceeds 50% of the Drive's rated output current. The current to ground is determined by comparing the measured current on each of the output phases. If the current to ground is determined to be above 50% of the Drive's rated output current the digital operator will display a GF and the iQpump drive will coast to stop.

■ L8-10 Heatsink Cooling Fan Operation Selection

Setting	Description
0	Fan On-Run Mode (*factory default*)
1	Fan Always On

Refer to L8-11 description.

■ L8-11 Heatsink Cooling Fan Operation Delay Time <0033>

Setting Range: 0 to 300 sec

Factory Default: 300 sec

Parameters L8-10 and L8-11 allow the iQpump drive programmer to customize the heatsink cooling fan operation. Parameter L8-10 determines whether the cooling fans are always ON whenever the iQpump drive is powered (L8-10 = "1: Fan Always On") or if the cooling fans are only ON when the iQpump drive is in a Run condition (L8-10 = "0: Fan On-Run Mode").

Parameter L8-11 is a delayed OFF for the cooling fan if L8-10 = "0: Fan On-Run Mode". When the cooling fans are set to turn OFF is when either the Run command is removed or the drive is in baseblock. The iQpump parameter L8-11 will cause the fans to continue cooling the iQpump drive for the amount of time programmed into L8-11 after the Run command is actually removed or baseblocked enabled. The iQpump drive can be programmed to allow the cooling fan to run for up to 5 minutes (factory default) after the run command is removed or baseblock enabled.

Both parameters are intended to extend fan life while still providing sufficient cooling for proper iQpump drive operation.

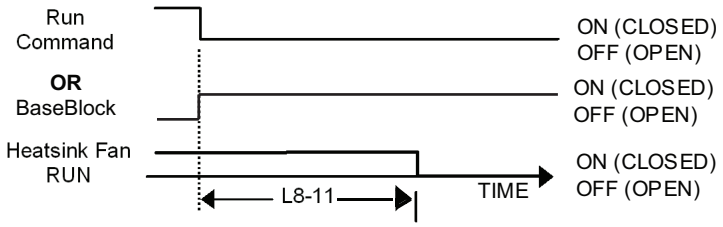


Figure 99 Heatsink Cooling Fan Operation Timing Diagram

■ L8-12 Ambient Temperature Setting

Setting Range: 113 to 140°F (45 to 60°C)

Factory Default: 113°F (45°C)

Set parameter L8-12 to the temperature °F (°C) of the area in which the iQpump drive is mounted. If L8-12 exceeds the actual rated ambient temperature of the iQpump drive 113°F (45°C), the OL2 fault level will be de-rated as shown in the figure below. This will allow the user to trade-off lighter drive loading for operation in a higher ambient temperature.

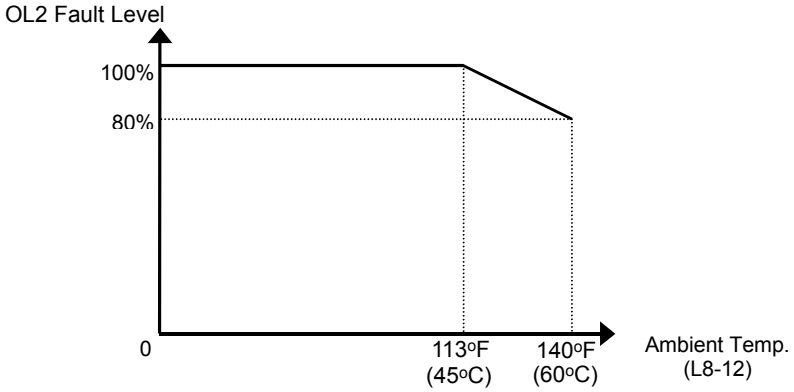


Figure 100 Ambient Temperature Derating Curve

■ L8-15 OL2 Characteristic Selection at Low Speeds

Setting	Description
0	Disabled
1	Enabled (L8-18 is active) (*factory default*)

At very low speeds (6 Hz and below) and very high current levels it can be possible to damage output transistors. Therefore the factory default setting of L8-15 is to shorten the time before an OL2 fault will occur during low speed/high load situations (L8-15 = "1: Enabled").

■ L8-18 Soft CLA Selection

Setting	Description
0	Disabled
1	Enabled (*factory default*)

The Soft CLA (software current limit level) is an iQpump drive protection function that will limit the Drive's output current. The iQpump drive limits the output current by reducing the output frequency whenever the current exceeds 110% of the inverter rated current If the current level drops below the Soft CLA level, then normal operation will continue.

If the software current limit is disabled (L8-18 = "0: Disabled"), the iQpump drive may trip on an OC fault if the load is prohibitively large or the acceleration is too short. For proper iQpump drive protection and operation leave the Soft CLA function enabled.

■ L8-19 Overheat Frequency Reference Reduction Level

Setting Range: 0.0 to 100.0% of maximum frequency

Factory Default: 20.0% of maximum frequency

When the heatsink temperature reaches the OH Pre-alarm level (L8-02) and the Overheat Pre-Alarm Operation Selection parameter is set for Alarm and Reduce (L8-03 = "4: OH Alarm & Reduce"), the L8-19 parameter sets the amount of speed decrease that will be applied to the Speed Command in order to lower the heatsink temperature. The decrease in speed will lower the current being switched and conducted by the heat producing output transistors of the Drive.

Parameter L8-19 is set in percentage of maximum frequency (E1-04).

◆ n1 Hunting Prevention

■ n1-01 Hunting Prevention Selection

Setting	Description
0	Disabled
1	Enabled (*factory default*)

■ n1-02 Hunting Prevention Gain Setting

Setting Range: 0.00 to 2.50

Factory Default: 1.00

Sometimes when the iQpump drive is lightly loaded and the carrier frequency is high, the Drive's output current may vary, or hunt. This varying current can cause the motor to vibrate. The Drive's Hunting Prevention function can stabilize the motor's magnetizing current by adjusting the output voltage (n1-01 = "1: Enabled"). The Hunting Prevention function can eliminate the vibration but at the cost of the iQpump drive response.

Parameter n1-02 can adjust the gain of the Hunting Prevention function if it is enabled by n1-01. Normally there is no need to adjust n1-02 from the factory default setting. Make adjustments in the following cases:

- If vibration occurs with a light load, increase the setting of n1-02.
- If the motor stalls, reduce the setting of n1-02.

An overly large Hunting Prevention Gain (n1-02) may cause the motor to stall.

◆ o1 Monitor Configuration

■ o1-01 User Monitor Selection

Setting Range: 6 to 94

Factory Default: 6

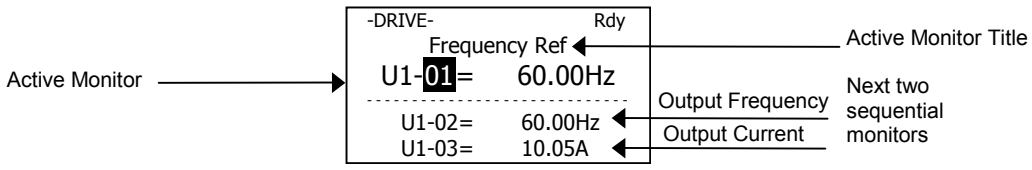
Setting	Description
6	Output Voltage (*factory default*)
7	DC Bus Voltage
8	Output Power
10	Input Terminal Status
11	Output Terminal Status
12	Drive Operation Status
13	Cumulative Operation Time
14	Software Number
15	Terminal A1 Input Voltage
16	Terminal A2 Input Voltage
18	Motor Secondary Current (Iq)
20	Output Frequency After Soft Start
24	PI Feedback Value
28	CPU Number
34	First Parameter Causing an OPE
36	PI Input
37	PI Output
38	PI Setpoint
39	Memobus Communication Error Code
40	Heatsink Cooling Fan Operation Time
51	Auto Mode Frequency Reference Value
52	Hand Mode Frequency Reference Value
53	PI Feedback 2 Value
90	Pump Setpoint
91	Pump Feedback
92	Pump Status
93	Total Setpoint Compensation
94	Motor Speed <0032>

■ o1-02 Power-On Monitor

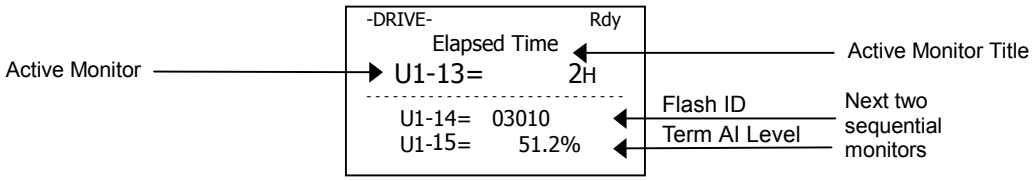
Setting	Description
1	Auto: Setpoint Reference (*factory default*)
2	Output Frequency
3	Output Current
4	User Monitor (set by o1-01)

When the iQpump drive is powered up, three monitors are displayed on the digital operator. The first and largest monitor is the “Power-On” monitor. The factory default “Power-On monitor” is Speed Command (U1-01). Below the Speed Command monitor are the next two sequential monitors, Output Frequency (U1-02) and Output Current (U1-03). Pressing the INCREASE key once scrolls the monitors to show the User Monitor as selected by o1-01. The factory default for o1-01 is the Output Voltage monitor (U1-06).

The active monitor displayed when the iQpump drive is powered on can be changed to either be U1-01 (Speed Command), U1-02 (Output Frequency), U1-03 (Output Current), or the User Monitor. Whichever monitor is selected as the Power-On top monitor, the two monitors displayed below it are the next two sequential monitors. See example below.



For example, if the iQpump drive needs to display the Elapsed Timer as the Power-On monitor, then o1-01 must be set to "13" and o1-02 must be set to "4". The next time iQpump drive power is cycled, the digital operator displays U1-13 (Elapsed Time), U1-14 (Flash ID), and U1-15 (Term AI Level).



■ o1-05 LCD Contrast Adjustment

Setting Range: 1, 3 or 5

Factory Default: 3

The contrast setting of the LCD display of the digital operator can be adjusted by the setting of parameter o1-05. The higher the number programmed into o1-05, the darker the background will become. Set o1-05 to the value that makes the LCD the easiest to view at the normal viewing distance and angle.

■ o1-06 User Monitor Selection Mode

Setting	Description
0	3 Mon Sequential
1	3 Mon Selectable (*factory default*)

■ o1-07 Second Line User Monitor

Setting Range: 1 to 94

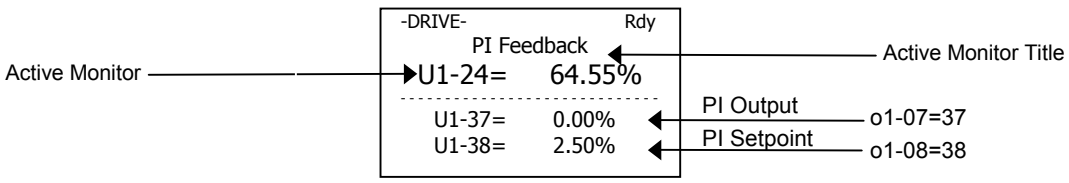
Factory Default: 2

■ o1-08 Third Line User Monitor

Setting Range: 1 to 94

Factory Default: 91

Normally the monitors shown directly below the active monitor are the next two sequential monitors. If o1-06 (User Monitor Selection Mode) is set to "1: 3 Mon Selectable," those two monitors are locked as specified by parameters o1-07 and o1-08 and will not change as the top parameter is scrolled with the INCREASE and DECREASE keys.



◆ o2 Key Selections

■ o2-01 Local/Remote Key Selections

Setting	Description
0	Disabled
1	Enabled (*factory default*)

The o2-01 parameter will have no effect on the operation of the iQpump drive when the HOA (Hand/Off/Auto) keypad is used. If an optional non-HOA keypad is used with the Drive, parameter o2-01 determines whether the Local/Remote switch on the digital operator will be enabled and will switch between keypad operation and the sources specified by the b1-01 and b1-02 parameters when the iQpump drive is stopped.

■ o2-02 OFF Key Function During Auto Run

Setting	Description
0	Disabled
1	Enabled (*factory default*)

The factory default setting of the OFF Key Function During Auto Run parameter (o2-02 = “1: Enabled”) enables the OFF key on the digital operator even if b1-02 specifies the Run command source for the Auto mode as not coming from the digital operator. In effect the OFF key becomes an alternative Stop input. Once the iQpump drive has been stopped by the OFF key it can be restarted either by cycling the external Run command or pressing the Auto key. If o2-02 = “0: Disabled,” pressing the OFF key while in the Auto mode will have no effect.

■ o2-03 User Parameter Default Value

Setting	Description
0	No Change (*factory default*)
1	Set Defaults
2	Clear All

The iQpump drive gives the option of configuring any and all of the programming parameters and then saving the parameters as “User Initialization Values”. After configuring the Drive, set parameter o2-03 = “1: Set Defaults,” to save the parameters to a User Initialization memory location. Once this has been done, the “Initialize Parameters” parameter (A1-03) will offer the choice of “1110:User Initialize”. Choosing A1-03 = “1110: User Initialized,” will reset all modified parameters back to what they were the last time they were saved using o2-03.

The choice of setting A1-03 = “1110: User Initialized,” is unavailable until first setting the User Initialization parameters using o2-03. Once a User Initialization is set (saved), it can be cleared by setting o2-03 = “2: Clear All”. After clearing the User Initialization parameters, the choice of “1110: User Initialize” is no longer a available in A1-03.

■ o2-04 Drive / kVA Selection

Setting Range: 0 to FF

Factory Default: Model Dependent

Parameter o2-04 matches the control board to the iQpump drive hardware. Proper setting of o2-04 is important so that the control board can provide proper protection for the iQpump drive hardware. This parameter is configured at the factory and does not normally require adjustment in the field. It is available primarily to accommodate control board replacement in the event of damage.

Table 29 kVA Settings by iQpump Drive Model Number

208-230/240 Vac		480 Vac	
Model Number	Proper o2-04 Setting	Model Number	Proper o2-04 Setting
20P4	0	40P4	20
20P7	1	40P7	21
21P5	2	41P5	22
22P2	3	42P2	23
23P7	4	43P7	24
27P5	6	45P5	26
2011	7	47P5	27
2015	8	49P0	3C
2018	9	4011	28
2022	A	4015	29
2030	B	4018	2A
2037	C	4022	2B
2045	D	4024	3D
2055	E	4030	2C
2075	F	4037	2D
2090	10	4045	2E
2110	11	4055	2F
		4075	30
		4090	31
		4110	32
		4160	34
		4185	35
		4220	36
		4300	37

The factory defaults of the following parameters may be changed when the setting of o2-04 is changed:

- b8-04 (Energy Saving Coefficient Value)
- C6-02 (Carrier Frequency Selection)
- E2-01 (Motor Rated Current)
- E2-03 (Motor No-Load Current)
- E2-05 (Motor Line-to-Line Resistance)
- L2-02 (MPL Ride-Thru Time)
- L2-03 (MPL Minimum Base Block Time)
- L2-04 (MPL Voltage Recovery Ramp Time)
- L8-02 (Overheat Pre-Alarm Level)
- L8-06 (Input Phase Loss Detection Level)

■ o2-05 Frequency Reference Setting Method Selection

Setting	Description
0	Disabled (*factory default*)
1	Enabled

The factory default setting of the Frequency Reference Setting Method parameter (o2-05 = "1: Enabled") dictates that when setting a Speed Command via the digital operator ("Hand" mode), it is not necessary to press the DATA/ENTER key before the iQpump drive will begin to accelerate or decelerate to the new set speed. This is referred to as MOP (Motor Operated Potentiometer) type functionality. When o2-05 = "1: Enabled," the speed command is stored to memory 5 seconds after the INCREASE or DECREASE keys are released.

When o2-05 = "0: Disabled," the digital operator INCREASE and DECREASE keys will change the speed command but the iQpump drive will not accelerate or decelerate to the new speed command until the DATA/ENTER key is pressed. In order to change the Speed Command in the HAND mode, U1-01 must be the top monitor and then the ENTER key must be pressed in order to access the Speed Command function. This in not to be confused with pressing the ENTER key in order to achieve a change in speed using the INCREASE and DECREASE keys, which is the subject of parameter o2-05.

■ o2-06 Operation Selection when Digital Operator is Disconnected

Setting	Description
0	Disabled
1	Enabled (*factory default*)

Leaving o2-06 enabled will cause the iQpump drive to fault, when the digital operator is removed, even if it's not outputting to the motor. The reset key on the digital operator will need to be pressed after reconnecting the digital operator to reset the fault and continue normal operation.

If o2-06 = "0: Disabled" then the iQpump drive will not fault if the digital operator is disconnected, but the iQpump drive will discontinue motor operation. If full iQpump drive operation is required while the digital operator is removed set o2-06 = "0: Disabled" and o2-15 = "0: Disabled" (Hand Key Function). If both o2-06 and o2-15 are disabled then the digital operator can be disconnected without disturbing iQpump drive operation.

■ o2-07 Cumulative Operating Time Setting

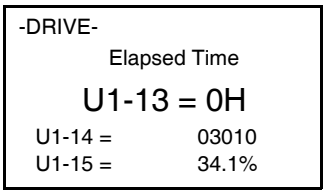
Setting Range: 0 to 65535 Hours

Factory Default: 0 Hours

■ o2-08 Cumulative Operation Time Selection

Setting	Description
0	Power-On Time
1	Running Time (*factory default*)

The iQpump drive features an Elapsed Timer monitor that records in units of hours. The Elapsed Timer monitor is U1-13. Parameter o2-08 programs this function to either accumulate elapsed hours based on time the iQpump drive is powered (o2-08 = "0: Power-On Time") or time the iQpump drive is running (o2-08 = "1: Running Time"). The iQpump drive is considered "running" anytime there is an active run command or when the iQpump drive is outputting voltage (i.e. including during deceleration).



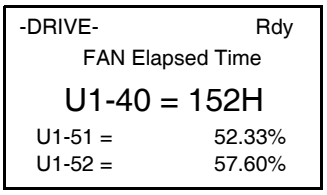
Parameter o2-07 allows manual adjustment of the Elapsed Timer, primarily to accommodate maintenance or control board replacement in the event of damage. To reset the Elapsed Timer back to zero, set o2-07 = 0.

■ o2-10 Cumulative Cooling Fan Operation Time Setting

Setting Range: 0 to 65535 Hours

Factory Default: 0 Hours

The elapsed time of heatsink cooling fan operation is tracked by the U1-40 monitor. Much like the o2-07 parameter can be used to adjust or reset the iQpump drive operation elapsed timer, parameter o2-10 can be used to adjust the time displayed by the U1-40 monitor in the event of fan replacement.



■ o2-12 Fault Trace / Fault History Clear Function

Setting	Description
0	Disabled (No Effect) (*factory default*)
1	Enabled

The operator can clear the Fault Trace (U2) and Fault History logs by setting o2-12 = “1: Enabled”. Clearing the Fault Trace and Fault History logs erases all the information.

■ o2-14 kWh User Monitor Initialization

Setting	Description
0	Disabled (No Change) (*factory default*)
1	Clear All

The kWh monitors (U1-29 and U1-30) track the power usage of the iQpump drive and are not reset by powering down the Drive. To reset the monitors back to zero, set o2-14 = “1: Clear all”.

◆ o3 Digital Operator Copy Function

■ o3-01 Copy Function Selection

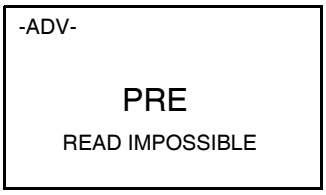
Setting	Description
0	COPY SELECT (*factory default*)
1	INV → OP READ
2	OP → INV WRITE
3	OP ↔ INV VERIFY

Note: The copy function is disabled when serial communication is active.

■ o3-02 Read Allowed Selection

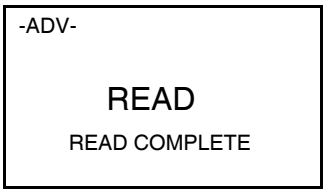
Setting	Description
0	Disabled (*factory default*)
1	Enabled

The digital operator has parameter COPY capabilities via built in non-volatile memory. The digital operator can READ all of the parameters in the iQpump drive and store them for later WRITE back to the iQpump drive or into an iQpump drive with the same product code and software number. In order to read the parameter values and store them in the digital operator, select o3-02 = "1: Enabled". If you attempt to READ the data, which overwrites any previously stored data, without first setting o3-02 = "1: Enabled," you will get the following error:

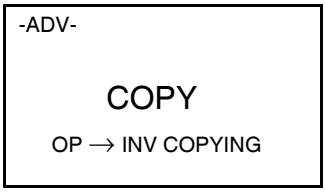


After setting o3-02 = "1: Enabled," it is possible to store parameter values in the digital operator by setting o3-01=1 (INV→ OP READ).

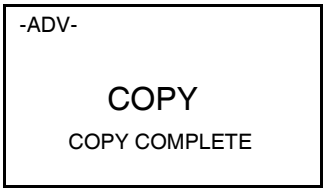
A successful READ of the parameter values will display:



An error may occur while saving the parameter values to the digital operator's memory. If an error is displayed, press any key to cancel the error display and return to parameter o3-01. Error displays and their meanings are covered in Chapter 6: Diagnostics and Troubleshooting of the P7 Users Manual (TM.iQp.01). To COPY parameter values into a Drive, set o3-01 = "2: OP→ INV WRITE". During the writing of the parameter values into the iQpump drive the digital operator will display:

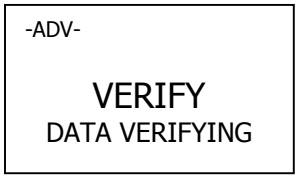


A successful COPY of the parameter values will display:

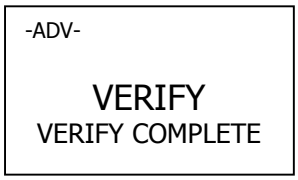


An error may occur while writing the parameter values to the Drive. If an error is displayed, press any key to cancel the error display and return to parameter o3-01. Error displays and their meanings are covered in Chapter 6: Diagnostics and Troubleshooting of the iQpump User Manual (TM.iQp.01).

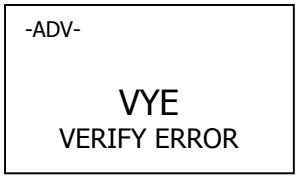
It is possible to compare the parameter values stored in the digital operator with the parameter values currently in the iQpump drive by using the VERIFY function. This VERIFY function should not be confused with the "-VERIFY-" that is displayed on the digital operator when viewing the "Modified Constants" menu. To VERIFY the parameter values in the iQpump drive as compared with those stored in the digital operator, set o3-01 = "3: OP↔INV VERIFY". During the comparing of the parameter values into the iQpump drive the digital operator will display:



A successful VERIFY of the parameter values will display:



If all the parameter values stored in the digital operator do not match those programmed in the Drive, the digital operator displays the following:



The digital operator will not display which parameters did not match, only that the verification found discrepancies in some parameter values.

Note: In order to properly use the COPY or VERIFY functions, the following iQpump drive specifications must be identical between the iQpump drive that the parameters were read from and the iQpump drive that the parameters are to be written to:

- Model Number (e.g. CIMR-P7U2015-107)
- Software Number (e.g. 30030 also known as FLASH ID)

Yaskawa offers DriveWizard™ software that can also READ, COPY, and VERIFY iQpump drive parameter values. DriveWizard™ lists all discrepancies between the iQpump drive and a pre-saved parameter file when verifying is performed.

To use DriveWizard first select o2-15 = "0: Disabled" and select o2-06 = "0: Disabled" then remove the digital operator/keypad and attach the DriveWizard cable in its place.

◆ P1 Pump Basic

■ P1-01 Pump Mode

Setting	Description
0	Drive only (Simplex) (*factory default*)
1	Drive + 1 Pump (Duplex)
2	Drive + 2 Pumps (Triplex)

Lead-Lag Operation

The iQpump drive can be configured to specify the number of pumps to be controlled by programming the Pump Mode (P1-01). The maximum number of pumps that can be controlled is 3 pumps (1 lead and 2 lag). The iQpump can be configured for lead-lag operation where 1 pump is controlled by the iQpump drive's output (lead) and the other two pumps controlled by the drive's digital outputs (M1-M2, M3-M4) or lag operation.

To control the two lag pumps requires the multi-function digital outputs (H2-0x) to be programmed for Pump 2 Control (H2-01 = 40) and Pump 3 Control (H2-01 = 41).

Note: The factory defaults for the digital outputs (H2-0x) are programmed for Pump 2 and Pump 3 Control.

Auxiliary Pump Control

The iQpump drive can be configured to control multiple pumps with multiple iQpump drives by programming the Pump Mode (P1-01). The maximum number of pumps that can be independently controlled is 3 pumps.

To configure an Auxiliary Pump Control system requires the first drive to be programmed for drive + 1 (P1-01 = 1) and the second drive (last) for drive only (P1-01 = 0). The multi-function digital output (M1-M2) needs to be programmed for Pump 2 Control (H2-01 = 40).

The first drive starts to run and brings the second drive online based on the pump system demand. The moment the second drive starts running, the multi-function digital output (M1-M2) closes.

The multi-function digital output provides an input command (Terminal S7 and SN) to the first iQpump drive and initiates a Fixed Speed Auto function on the first drive (H1-05 = 86).

When the Fixed Speed Auto input is closed, the first drive will run at a fixed speed without PID control. When the second drive goes to sleep, the Fixed Speed Auto input opens and the first drive starts operating under normal pump control.

When using the iQpump drive to control 3 pumps, all of the drives need to be daisy chained in a similar configuration. The last drive always has to be programmed for drive only (P1-01 = 0) and the other drives for duplex mode (P1-01=1).

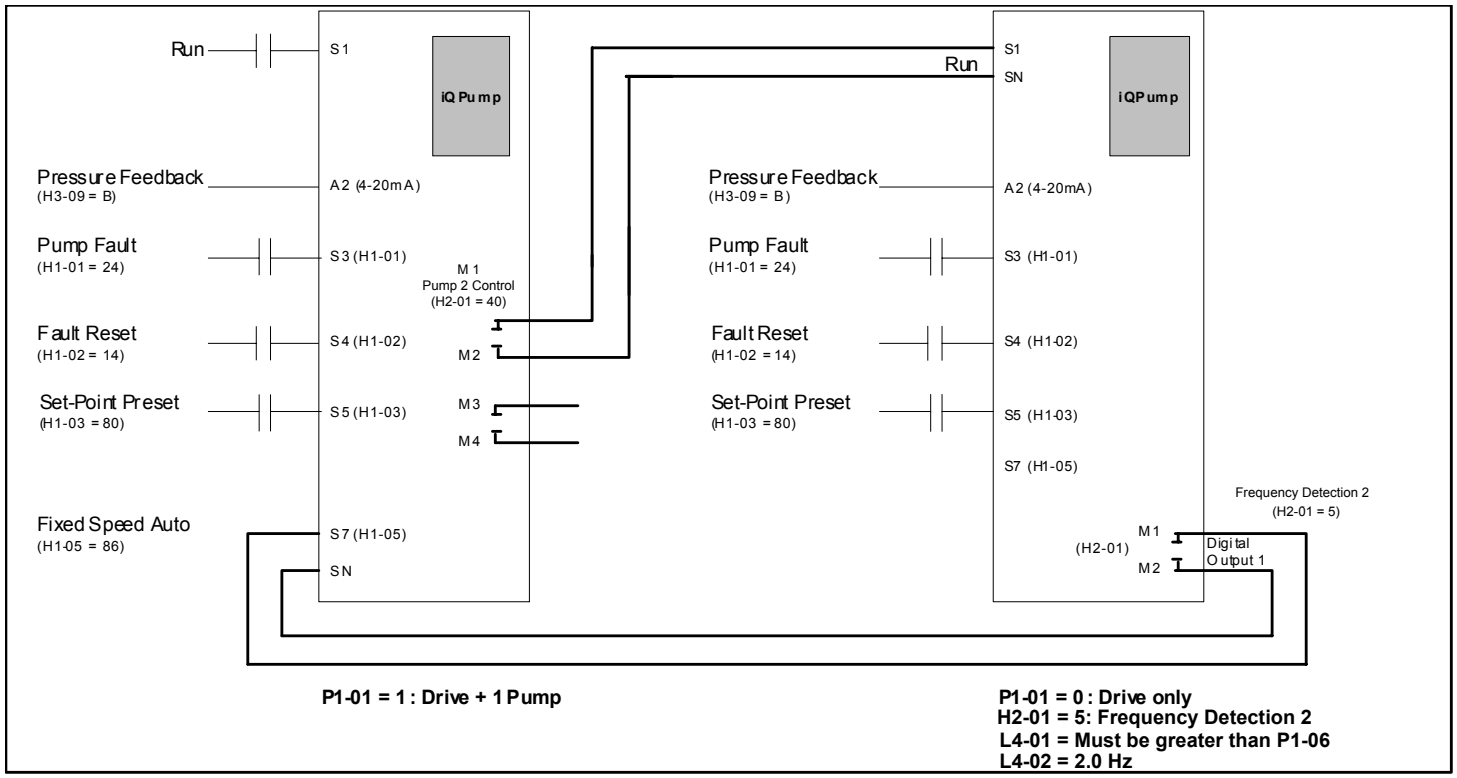


Figure 101

Note: When the Fixed Speed Auto is activated, the sleep and lead-lag functions are disabled. This configuration is only active in Auto Mode.

The L4-01 parameter of the last drive controls the previous drive and activates the Auto Mode (when the frequency level drops below L4-01).

■ P1-02 System Units

Setting	Description
0	WC: Inch of Water
1	PSI: 1b/Sqr Inch (*factory default*)
2	GPM: Gallons/Min
3	F: Degrees Fahrenheit
4	CFM: Cubic ft/Min
5	CMH: Cubic m/Hr
6	LPH: Liters/Hr
7	LPS: Liters/sec
8	Bar: Bar
9	Pa: Pascals
10	C: Degrees Celsius
11	ft: Feet <0032>
12	%: Percent

The iQpump drive can be configured to program the drive using units or scaling that are appropriate for the pumping system by programming the System Units (P1-02). The System Units will affect setpoint references, feedback scaling, pump levels, and display monitors. The following is a list of parameters that are affected by the programming of the System Units (P1-02).

- d1 Group: d1-01 through d1-04.
- o1 Group: o1-07, o1-08.
- P1 Group: P1-03, P1-04, P1-07, P1-09, P1-11, P1-13.
- P2 Group: P2-02, P2-04, P2-09, P2-10, P2-15, P2-16.
- P3 Group: P3-03, P3-05, P3-07, P3-08, P3-12, P3-14.
- P4 Group: P4-01
- U1 Monitor: U1-91

For further description of each parameter, please refer to the appropriate section or Appendix A.

■ P1-03 Feedback Device Scaling

Setting Range: 1 ~ 36000 [based on System Units (P1-02)]

Factory Default: 00145 PSI

The iQpump drive can be configured to scale the feedback signal using the Feedback Device Scaling Parameter (P1-03). The programmed value in P1-03 represents the maximum level when a feedback reference is provided to the drive. An example: If a 4-20 mA signal is provided and P1-03 is set to 145 PSI, then 20 mA would represent the maximum PSI readout level of 145 PSI. This parameter works in conjunction with the System Units (P1-02).

X	**X**	**X**	**X**	**X**
Digit 5	Digit 4	Digit 3	Digit 2	Digit 1

Digits 1 through 4 set the desired number to be displayed at maximum feedback level. Digit 5 determines the number of decimal places in the displayed number.

If Digit 5 = 0 number format is XXXX
If Digit 5 = 1 number format is XXX.X
If Digit 5 = 2 number format is XX.XX
If Digit 5 = 3 number format is X.XXX

Example 1: 00145 (factory default)
P1-02 = 1 (factory default)
P1-03 = 145 PSI (No decimal point)

Example 2: 11000 (one decimal point)
P1-02 = 1
P1-03 = 100.0 PSI (one decimal point)

■ P1-04 Start Level

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The iQpump drive can be configured to program the starting pressure for the system by programming the Start Level (P1-04). The units for this parameter are determined by the System Units (P1-02).

Important: Please refer to the Pump Protection (P2 Group on page 129) and Pump Multiplex section (P3 Group on page 143) for further details and timing diagrams.

■ P1-05 Start Level Delay Time

Setting Range: 0 to 3600 sec

Factory Default: 0 sec

The iQpump drive can be configured to prevent the pump from starting for a set period of time by programming the Start Level Delay Time (P1-05) after an Auto Mode run has been initiated.

Note: The Start Delay Time will function only after a stop command due to the no-flow detection or sleep detection functions. Removing the enable signal does not activate the Start Delay.

Important: Please refer to the Pump Protection (P2 Group on page 129) and Pump Multiplex section (P3 Group on page 143) for further details and timing diagrams.

■ P1-06 Minimum Pump Frequency

Setting Range: 0 to 120 Hz

Factory Default: 35 Hz

The iQpump drive can be configured to operate the pump at a minimum output frequency by programming the Minimum Pump Frequency (P1-06). The minimum value has to be programmed to a value smaller than Pump 2 Frequency Shutdown Level (P3-09) and Pump 3 Frequency Shutdown Level (P3-10), when the drive is operating in the Multiplex Mode (P1-01). The programmed value in P1-06 will also limit the minimum PID output. If the Thrust Bearing Frequency (P4-05) is programmed for a value greater than 0, then the minimum frequency is determined by the Thrust Bearing Frequency (P4-05).

Important: Please refer to the Pump Protection (P2 Group on page 129) and Pump Multiplex section (P3 Group on page 143) for further details and timing diagrams.

■ P1-07 Low Feedback Level

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The iQpump drive can be configured to display a Low Feedback (LFB) alarm when the feedback level falls below the programmed Low Feedback Level (LFB). The “LFB” alarm will turn off when the feedback level rises above P1-07 plus the Hysteresis Level (P1-13). Setting P1-07 to a value of 0 will disable this function. This function is only active during operation in the Auto Mode.

The Low Feedback Level (P1-07) works in conjunction with Low Level Fault Time (P1-08). The units for this parameter are determined by the System Units (P1-02).

■ P1-08 Low Level Fault Delay Time

Setting Range: 0 to 3600 sec

Factory Default: 5 sec

The iQpump drive can be configured to display a Low Feedback (LFB) alarm when the feedback level falls below the programmed Low Feedback Level (P1-07) for the time programmed in the Low Level Fault Delay Time (P1-08).

Setting P1-08 to a value of 0 will disable this function. This function is only active during operation in the Auto Mode.

The Low Level Fault Delay Time (P1-08) works in conjunction with Low Feedback Level (P1-07).

■ P1-09 High Feedback Level

Setting Range: 0.0 to 6000.0

Factory Default: 155.0 (system units P1-02)

The iQpump drive can be configured to display a High Feedback (HFB) alarm when the feedback level rises above the programmed High Feedback Level (P1-09). The “HFB” alarm will turn off when the feedback level falls below P1-09 plus the Hysteresis Level (P1-13). Setting P1-09 to a value of 0 will disable this function. This function is active during operation in the Hand Mode, Auto Mode, Pre-Charge, and Thrust-Bearing Mode.

The High Feedback Level (P1-09) works in conjunction with High Level Fault Time (P1-10). The units for this parameter are determined by the System Units (P1-02).

■ P1-10 High Level Fault Delay Time

Setting Range: 0 to 3600 sec

Factory Default: 2 sec

The iQpump drive can be configured to display a High Feedback (HFB) alarm when the feedback level rises above the programmed High Feedback Level (P1-09) for the time programmed in the High Level Fault Delay Time (P1-10).

Setting P1-10 to a value of 0 will disable this function.

The High Level Fault Delay Time (P1-10) works in conjunction with High Feedback Level (P1-09).

Note: This function is active during operation in the Hand Mode, Auto Mode, Pre-Charge, and Thrust-Bearing Mode.

■ P1-11 Maximum Setpoint Difference <0032>

Setting Range: 0.0 to 6000.0

Factory Default: 0.0 (system units P1-02)

The iQpump drive can be configured to display a Not Maintaining Setpoint (NMS) fault when the difference between the setpoint and the feedback exceeds the Maximum Setpoint Difference (P1-11). When the Maximum Setpoint Difference has been exceeded, the drive will trip on NMS fault and will coast to a stop when the fault occurs.

Setting P1-11 to a value of 0 will disable this function. This function is only active during operation in the Auto Mode.

The Maximum Setpoint Difference (P1-11) works in conjunction with the Not Maintaining Setpoint (P1-12). The units for this parameter are determined by the System Units (P1-02).

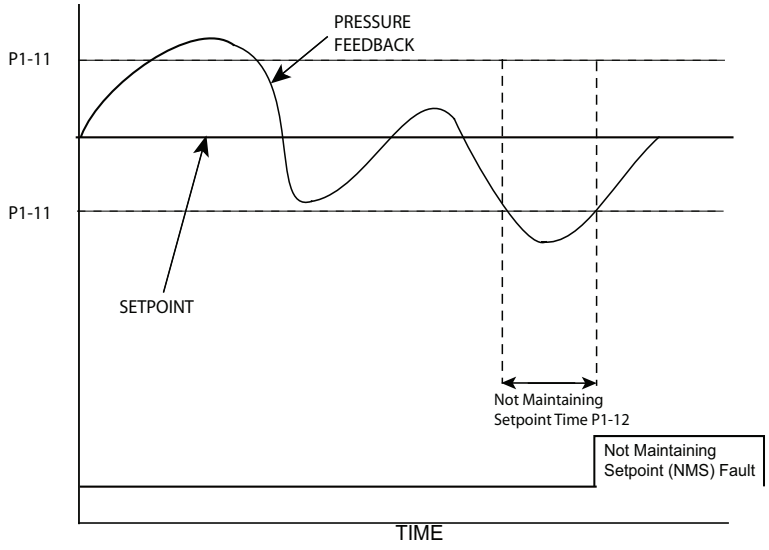


Figure 102 Not Maintaining Setpoint (NMS) Fault

■ P1-12 Not Maintaining Setpoint and Loss of Prime Time <0032>

Setting Range: 0 to 3600 sec

Factory Default: 60 sec

The iQpump drive can be configured to display a Not Maintaining Setpoint (P1-11) fault when the difference between the setpoint and the feedback levels are exceeded for the time programmed in the Not Maintaining Setpoint and Loss of Prime Time (P1-12). The drive will coast to a stop after the level has been exceeded for the specified time programmed in P1-12.

This function is only active during operation in the Auto Mode.

The Not Maintaining Setpoint and Loss of Prime Time (P1-12) is also used for the Prime Loss Level (P1-14) function. Refer to Prime Loss Level (P1-14) for further description.

The Not Maintaining Setpoint and Loss of Prime Time (P1-12) works in conjunction with Maximum Setpoint Difference (P1-11) and Prime Loss Level (P1-14).

Note: The time value programmed into P1-12 is shared by Maximum Setpoint Difference (P1-11) and Prime Loss Level (P1-14) functions. However, independent times are maintained. If one function time; such as P1-11, has elapsed, the other functions time (P1-14) is still maintained until this time has elapsed.

■ P1-13 Hysteresis Level

Setting Range: 0.0 to 100.0

Factory Default: 0.0

The iQpump drive can be configured to detect Low Feedback Level (P1-07) and High Feedback Level (P1-09) alarms. The Hysteresis Level (P1-13) is used to provide a bandwidth before the drive returns to normal operation. The Hysteresis Level is used to prevent rapid cycling between alarm and normal operations.

The Hysteresis Level (P1-13) works in conjunction with the Low Feedback Level (P1-07) and High Feedback Level (P1-09) functions. The units for this parameter are determined by the System Units (P1-02).

■ P1-14 Prime Loss Level

Setting Range: 0.0 to 1000.0 A

Factory Default: 0.0 A

The iQpump drive can be configured to detect a “loss of prime” in the pump. This drive will display a “LOP” fault when the output current drops below the Prime Loss Level (P1-14) for the time programmed in the Not Maintaining Setpoint and Loss of Prime Time (P1-12), and the output frequency is at maximum output frequency. The drive will coast to a stop when a fault occurs.

This function is only active during operation in the Auto Mode.

Note: The Prime Loss Level function is only active when the maximum numbers of pumps defined by P1-01 are running at maximum frequency.

The Prime Loss Level (P1-14) works in conjunction with Not Maintaining Setpoint and Loss of Prime Time (P1-12).

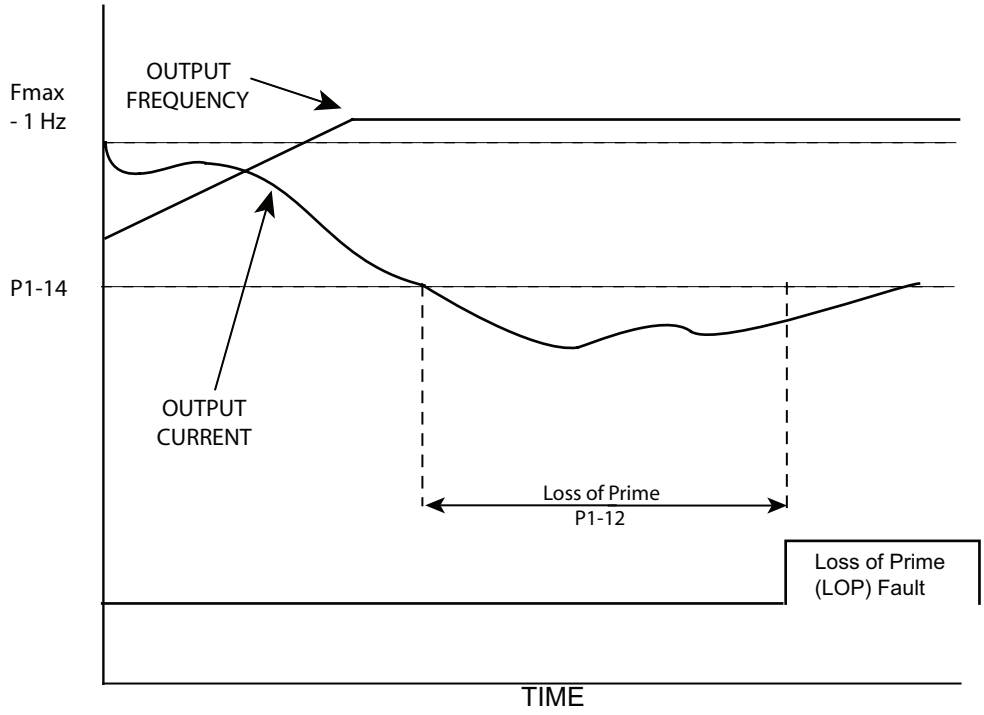


Figure 103 Loss of Prime (LOP)

■ P1-15 Low Water Input

Setting	Description
0	Closed at Low Water (*factory default*)
1	Open at Low Water

The iQpump drive can be configured to detect a low water level condition. To activate the low water level detection requires one of the multi-function digital inputs to be programmed for low water level (H1-xx = 85). The multi-function digital input can be configured to accept a normally closed or normally open contact by programming the Low Water Input (P1-15).

This function is only active during operation in the Auto Mode.

Important: Refer to H1-xx = 85 on page 158 for further description of the low water level function.

◆ P2 Pump Protection

■ P2-01 Sleep Level Type

Setting	Description
0	Output Frequency (*factory default*)
1	Output Current
2	Feedback

If P2-01 = "0: Output Frequency"

The iQpump drive can be configured to enter a "sleep" condition based on output frequency. The drive will enter the sleep mode when the output frequency falls below the programmed Sleep Level (P2-02) for a time specified by the Sleep Delay Time (P2-03).

This function is only active during operation in the Auto Mode. The display will indicate "Sleep" alarm when active.

The Sleep Level Type works in conjunction with the Sleep Level (P2-02), Sleep Delay Time (P2-03), and Alternative Sleep Activate Level (P2-20). A multi-function digital output can be programmed to enable sleep (H1-xx = 82).

Note: If the value programmed into Alternative Sleep Activate Level (P2-20) is greater than 0.0 Hz, the sleep function will become active when the output frequency rises above the programmed Sleep Level (P2-02) and above the programmed Alternative Sleep Activate Level (P2-20). It is recommended that P2-20 be programmed 1 or 2 Hz above the P1-06 value. The sleep level using P2-20 enables the sleep mode; however, the drive still enters sleep based on P2-20. With the normal default sleep level programmed in P2-02, the sleep cycle will not activate until the output frequency is above P2-02.

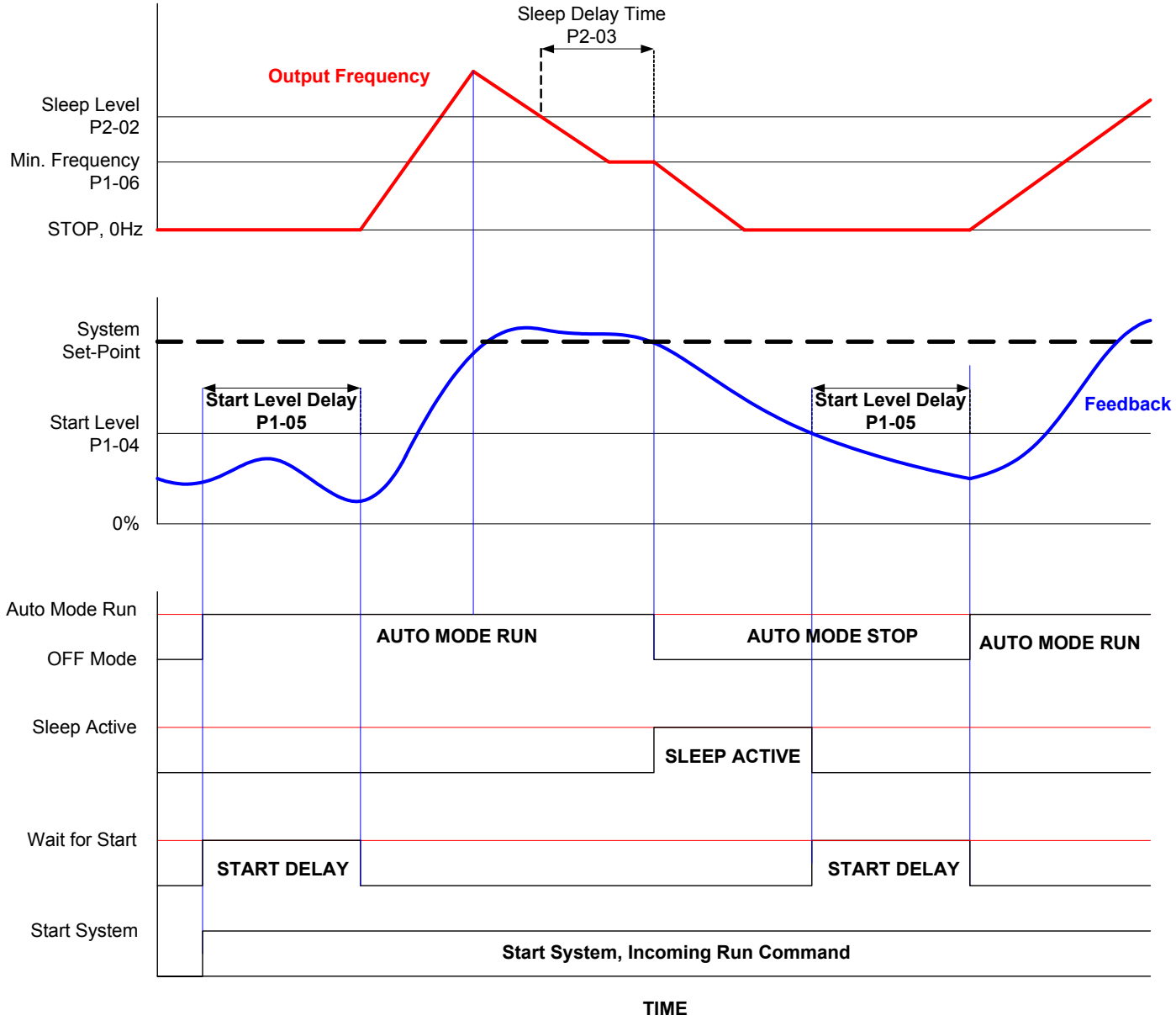


Figure 104 Sleep Function Based on Output Frequency

If P2-01 = "1: Output Current"

The iQpump drive can be configured to enter a "sleep" condition based on output current. The drive will enter the sleep mode when the output current falls below the programmed Sleep Level (P2-02) for a time specified by the Sleep Delay Time (P2-03).

This function is only active during operation in the Auto Mode. The display will indicate "Sleep" alarm when active.

The Sleep Level Type works in conjunction with the Sleep Level (P2-02), Sleep Delay Time (P2-03), and Alternative Sleep Activate Level (P2-20). A multi-function digital output can be programmed to enable sleep (H1-xx = 82).

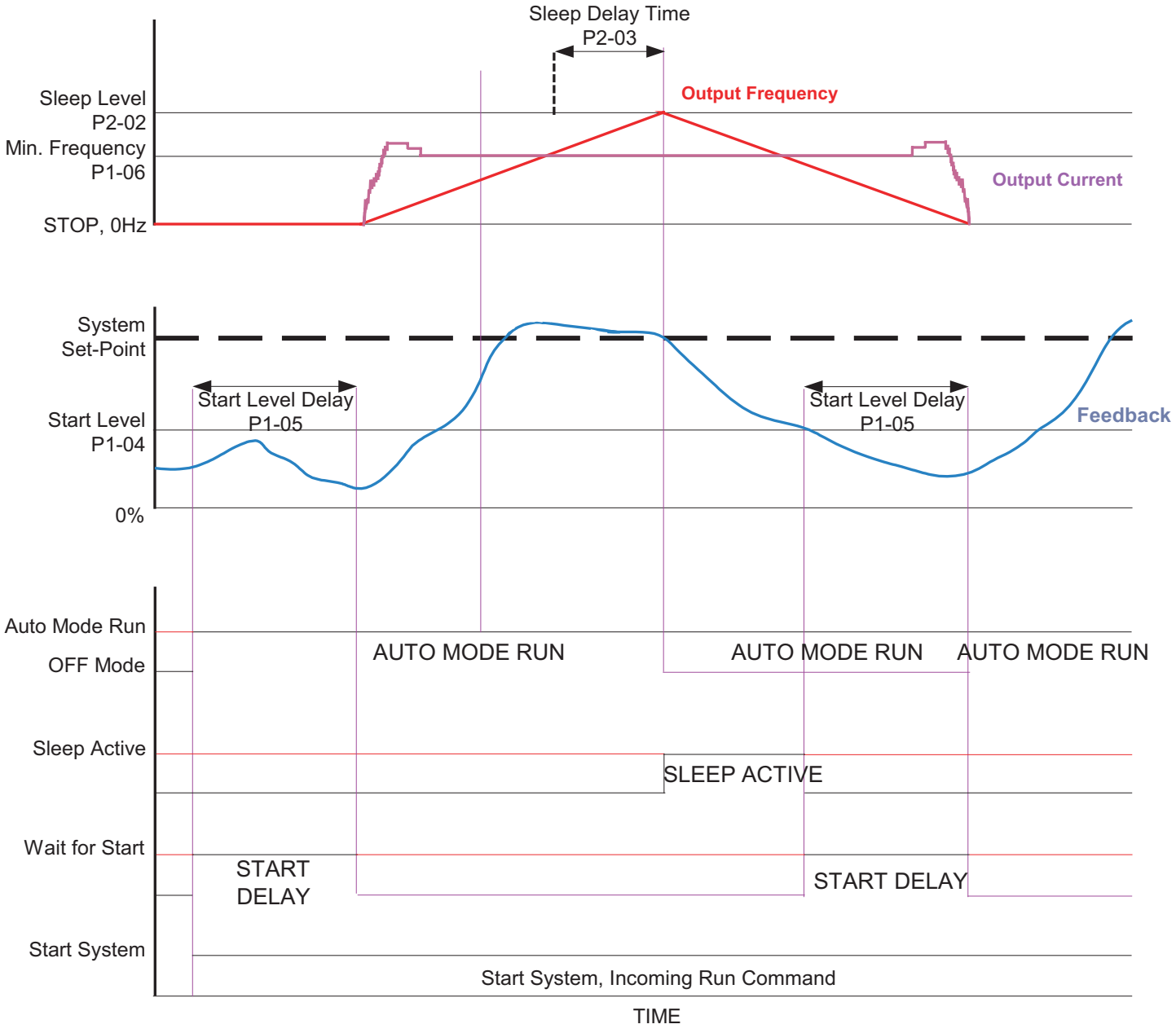


Figure 105 Sleep Function Based on Output Current

If P2-01 = "2: Feedback"

The iQpump drive can be configured to enter a "sleep" condition based on the feedback signal. The drive will enter the sleep mode when the feedback signal rises above the programmed Sleep Level (P2-02) for a time specified by the Sleep Delay Time (P2-03).

This function is only active during operation in the Auto Mode.

The Sleep Level Type works in conjunction with the Sleep Level (P2-02), Sleep Delay Time (P2-03), and Alternative Sleep Activate Level (P2-20).

Note: The feedback signal depends on the PID direction (b5-09). If the PID operation is programmed Reverse Output direction, the sleep mode will activate when the feedback signal falls below the programmed Sleep Level (P2-02). The PID will automatically be reset while sleep mode is active.

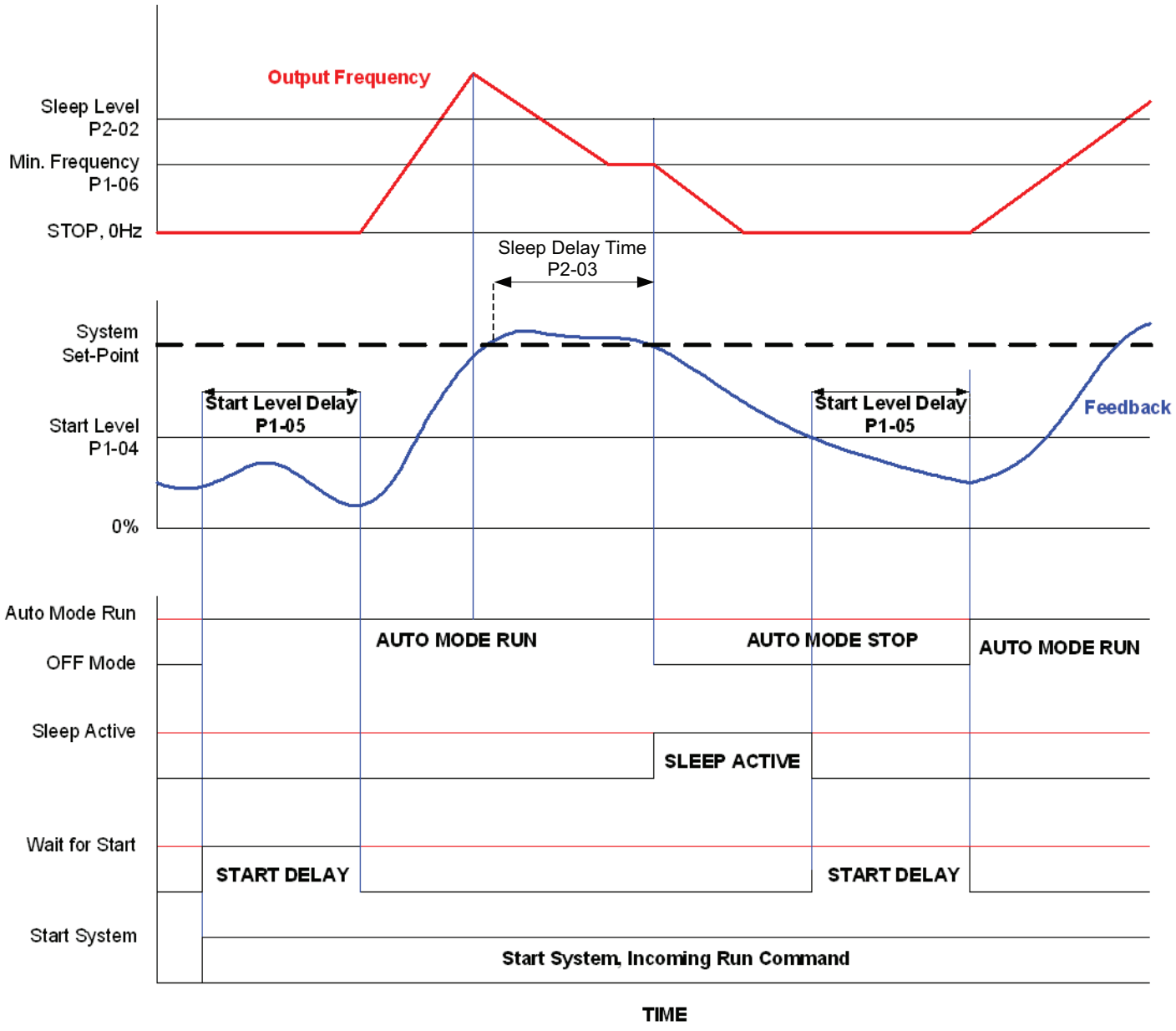


Figure 106 Sleep Function Based on Feedback Level

■ P2-02 Sleep Level

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The iQpump drive can be configured to enter a “sleep” condition based on the programmed Sleep Level Type (P2-01). The drive will enter the sleep mode when the output frequency or current falls below the programmed Sleep Level (P2-02). When the Sleep Level Type (P2-01) is set to Feedback (P2-01 = 2), the drive will enter the sleep mode when the feedback signal rises above the programmed Sleep Level (P2-02).

The display units for the Sleep Level (P2-02) are determined by the setting of P1-02.

Setting	Display Units
0	Hz (Hertz)
1	A (Amps)
2	Determined by System Units P1-02

A value of 0 programmed into the Sleep Level (P2-02) disables the sleep function. This function is only active during operation in the Auto Mode.

Note: The Sleep Level (P2-02) has to be programmed above the Minimum Pump Frequency (P1-06) for the sleep function to operate.

■ P2-03 Sleep Delay Time

Setting Range: 0 to 3600 sec

Factory Default: 10 sec

The iQ Pump drive can be configured to enter a “sleep” condition based on the programmed Sleep Level (P2-02) and Sleep Level Type (P2-01). The drive can be programmed to provide a delay time before the drive enters the sleep mode by programming the Sleep Delay Time (P2-03).

The Sleep Delay Time (P2-03) works in conjunction with the Sleep Level (P2-02).

■ P2-04 Delta Sleep Feedback Drop Level

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The iQpump drive can be configured to detect a no-flow condition when the drive enters the sleep mode. The drive will monitor the incoming feedback signal. If the difference between the system setpoint and the feedback exceeds the Delta Sleep Feedback Drop Level (P2-04) within the programmed Feedback Detection Drop Time (P2-05) and the output frequency is greater than the Minimum Pump Frequency (P1-06), the drive will stop decelerating (sleep deactivate) and return to normal operation (flow detected).

The drive will enter the sleep mode when the difference between the system setpoint and the feedback are smaller than the Delta Sleep Feedback Drop Level (P2-04). This function is only active during operation in the Auto Mode. A value of 0 programmed into Delta Sleep Feedback Drop Level (P2-04) will disable this function.

The Delta Sleep Feedback Drop Level (P2-04) works in conjunction with the Feedback Detection Drop Time (P2-05).

Note: A no-flow detection during deceleration is only active when the output frequency is greater than the Thrust Bearing Frequency (P4-05).

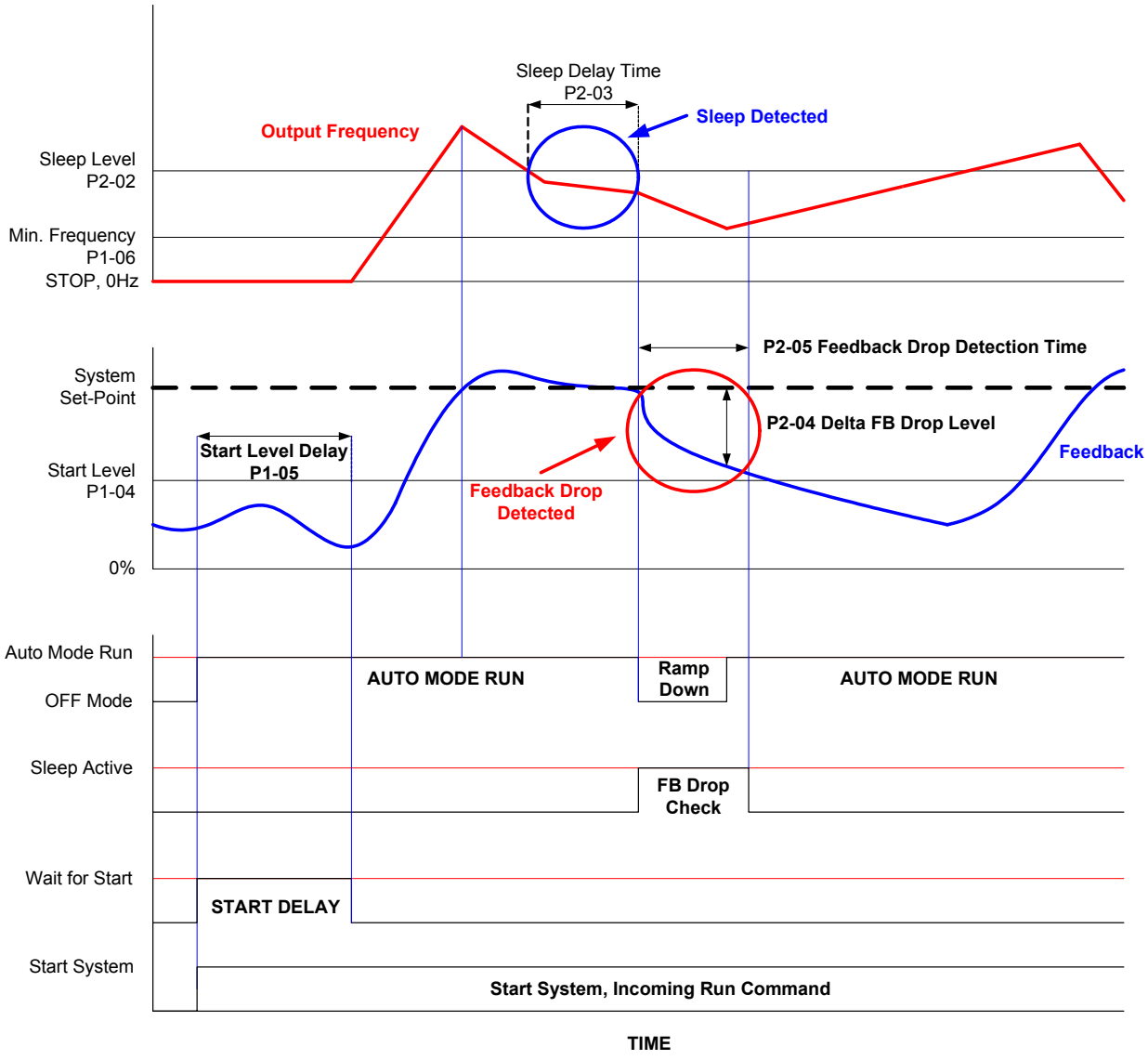


Figure 107 No-Flow Detection During Deceleration

■ P2-05 Feedback Detection Drop Time

Setting Range: 0 to 3600 sec

Factory Default: 10 sec

The iQpump drive can be configured to detect a no-flow condition. The drive can be programmed to monitor the feedback signal during a flow, no-flow condition for a programmed Feedback Detection Drop Time (P2-05).

The Feedback Detection Drop Time (P2-05) works in conjunction with the Delta Sleep Feedback Drop Level (P2-04).

■ P2-06 Sleep Mode: Cycling Protection

Setting Range: 0 to 10

Factory Default: 0

The iQpump drive can be configured to allow a maximum number of cycles before initiating a “Pump Over Cycle Fault (POC).” The drive will determine the maximum number of cycles based on the programmed number in the Sleep Mode: Cycling Protection (P2-06). One cycle is defined by the drive transferring from normal operation to sleep mode when operating in the Auto Mode. A value of 0 programmed into the Sleep Mode: Cycling Protection (P2-06) will disable this function.

The maximum time allowed between cycles can be programmed in the Sleep Mode: Maximum Cycling Protection Time (P2-07).

The Sleep Mode: Cycling Protection (P2-06) works in conjunction with the Sleep Mode: Maximum Cycling Protection Time (P2-07).

■ P2-07 Sleep Mode: Maximum Cycling Protection Time

Setting Range: 0 to 3600 sec

Factory Default: 300 sec

The iQpump drive can be configured to allow a maximum number of cycles before initiating a “Pump Over Cycle Fault (POC).” The number of cycles allowed is determined by programming the Sleep Mode: Cycling Protection (P2-06). The maximum time allowed between cycles can be programmed in the Sleep Mode: Maximum Cycling Protection Time (P2-07). If no cycling occurs within the programmed time, the drive will reset the internal cycle register.

The Sleep Mode: Maximum Cycling Protection Time (P2-07) works in conjunction with the Sleep Mode: Cycling Protection (P2-06).

■ P2-08 Over-Cycling Mode

Setting	Description
0	Disabled (*factory default*)
1	Alarm
2	Pump Over Cycle Fault (POC)
3	Auto Compensation

If P2-08 = “0: Disabled,” the over-cycling mode is disabled.

If P2-08 = “1: Alarm,” then a “Pump Cycling” alarm will occur to indicate a pump over-cycle condition when the maximum number of cycles has been reached as defined by the Sleep Mode: Cycling Protection (P2-06).

If P2-08 = “2: Pump Over Cycle Fault (POC),” then a “Pump Over Cycle (POC)” fault will occur to indicate a pump over-cycle fault condition, when the maximum number of cycles has been reached, as defined by the Sleep Mode: Cycling Protection (P2-06).

If P2-08 = “3: Auto Compensation,” then the drive will automatically increase (compensate) the system setpoint by the value programmed in the Setpoint Compensation (P2-09) parameter.

The compensation will increase each time the maximum number of cycles is reached as defined by the Sleep Mode: Cycling Protection (P2-06) function. When the setpoint is increased (incremented), the internal over-cycle counter will be reset.

The original setpoint will be restored (decreased) in steps defined by Setpoint Compensation (P2-09) when the pump system has been operating without cycling for the time programmed in the Maximum Cycle Protection Time (P2-07) parameter.

Over-cycle protection is only active during operation in the Auto Mode and in combination with no-flow sleep functions P2-05 and P2-07.

Note: Maximum setpoint compensation can be programmed in Maximum Setpoint Compensation (P2-10).

Manually starting and stopping the drive will reset the internal over-cycle counter. Transitioning from Hand to Auto Mode will also reset the internal over-cycle counter.

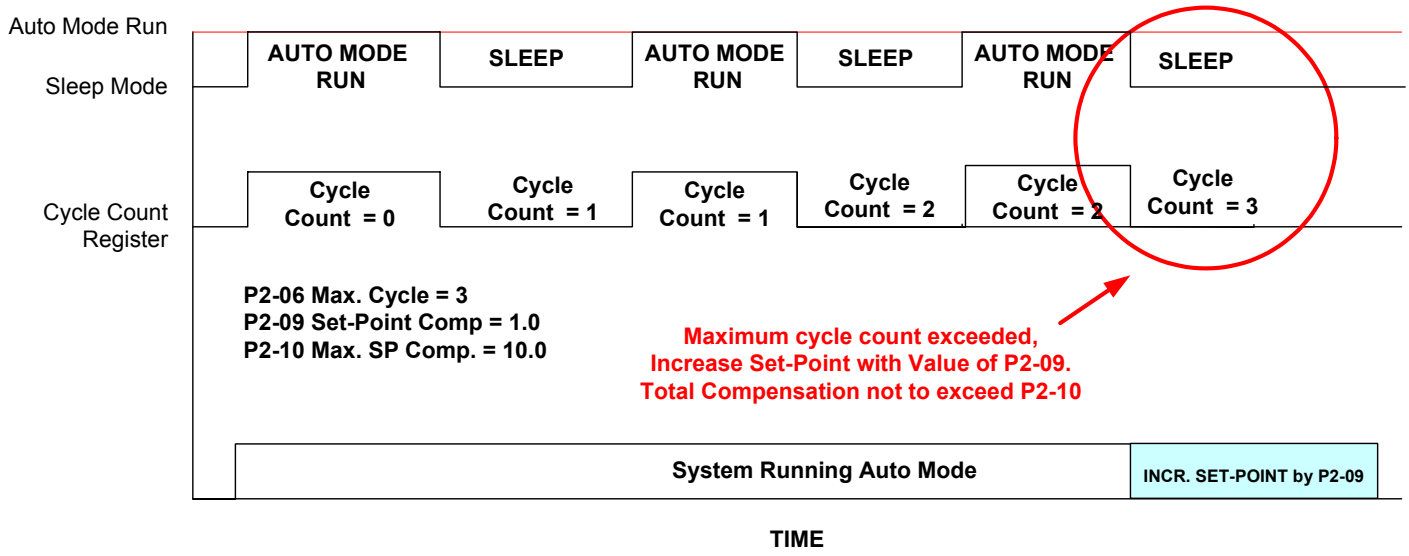


Figure 108

Total setpoint compensation can be monitored with Total Setpoint Compensation (U1-93).

■ P2-09 Setpoint Compensation

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The iQpump drive can automatically increase the setpoint each time the maximum number of cycles programmed in Sleep Mode: Cycling Protection (P2-06). The units for this parameter are determined by the System Units (P1-02).

Refer to Over-Cycling Mode: (P2-08 = 3: Auto Compensation) for further description.

■ P2-10 Maximum Setpoint Compensation

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The iQpump drive can set the maximum allowable setpoint compensation during an over-cycling condition by the value programmed in Maximum Setpoint Compensation (P2-10). The units for this parameter are determined by the System Units (P1-02).

Refer to Over-Cycling Mode: (P2-08 = 3: Auto Compensation) for further description.

■ P2-11 No-Flow Activation Level

Setting Range: 0 to 24000 RPM

Factory Default: 0 RPM

The iQpump drive can be configured to activate a no-flow detection by programming the No-Flow Activation Level (P2-11). The no-flow detection is active when the motor is operating below this No-Flow Activation Level (P2-11) and below the No-Flow Detection Bandwidth (P2-12).

Setting P2-11 to a value of 0 will disable this function. This function is only active during operation in the Auto Mode and when the drive is operating above the Minimum Pump Frequency (P1-06) and below the level programmed in P2-11.

Note: Program Start Level (P1-04) to a value greater than 0.

The No-Flow Activation Level (P2-11) works in conjunction with the No-Flow Detection Bandwidth (P2-12).

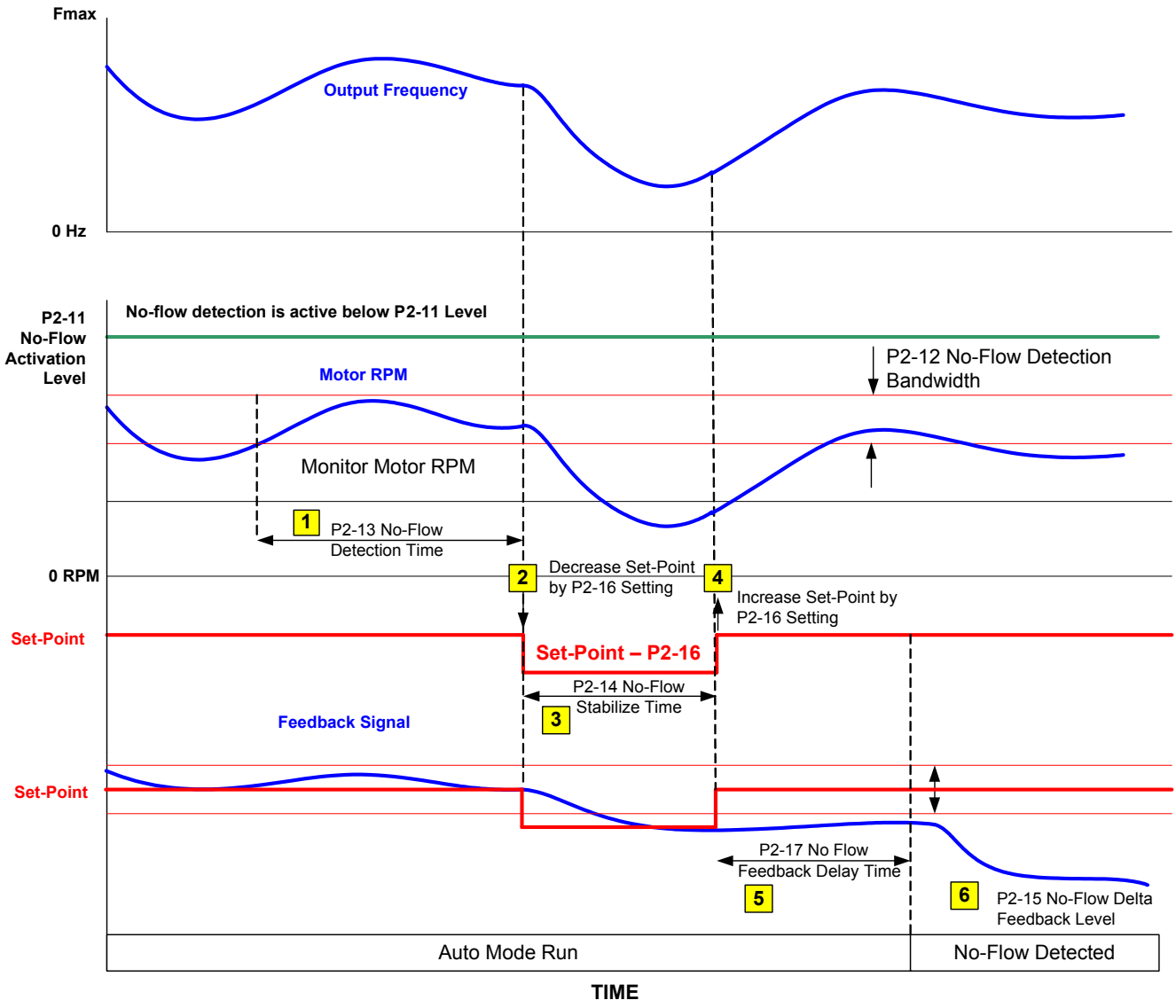
No-Flow Detection Basic Operation

The iQpump drive can be configured for a no-flow detection condition. The no-flow detection function of the iQpump drive is an advanced feature for all pumping applications. The typical applications for this function are submersible and booster station pumps.

The programming of the No-Flow Activation Level (P2-11) will activate the no-flow detection function. The drive will monitor the motor RPM and if the motor RPM falls below the No-Flow Activation Level (P2-11) and the No-Flow Detection Bandwidth (P2-13), the no-flow process is activated.

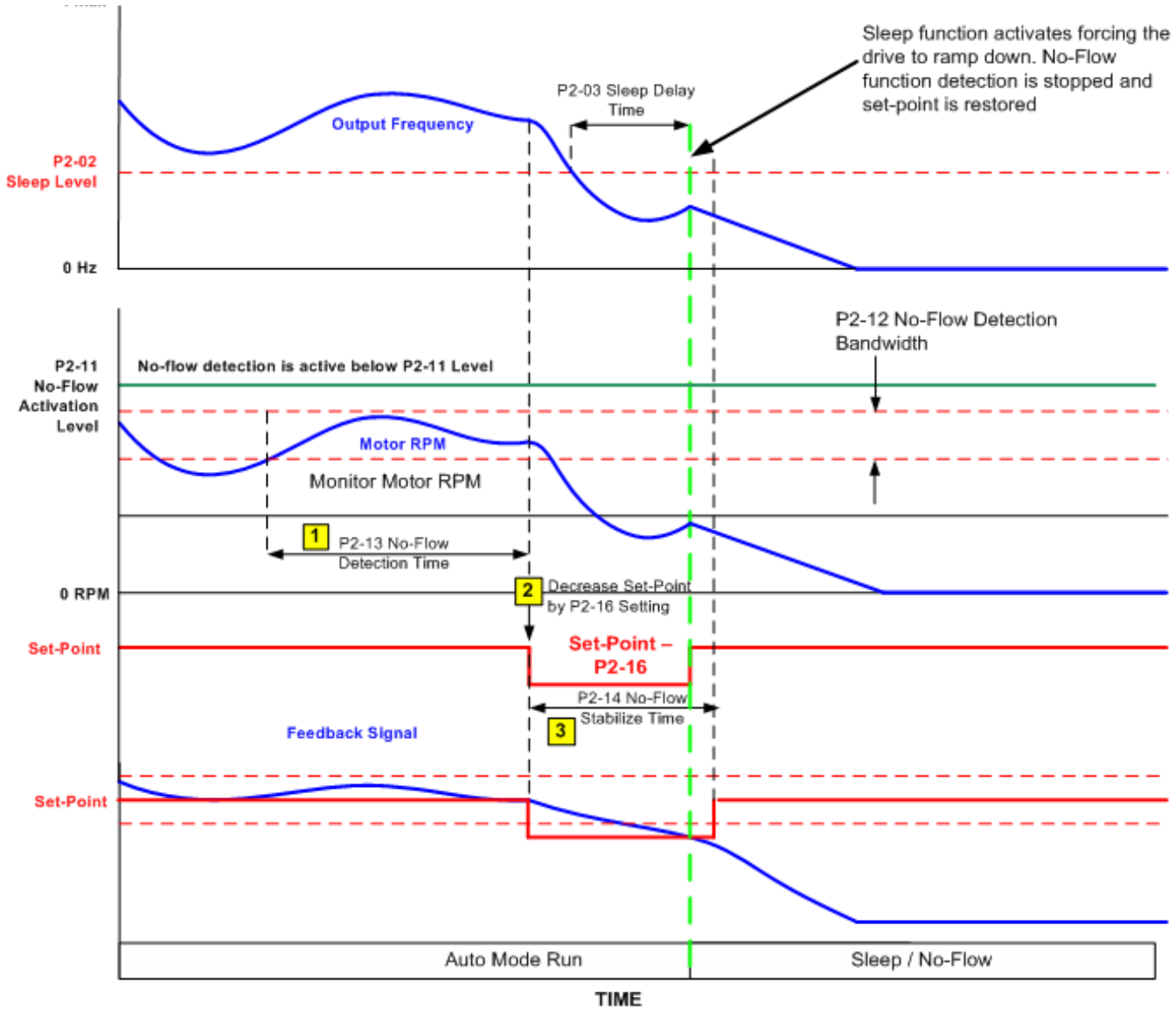
The drive will check for system response by monitoring the motor RPM for a time specified by the No-Flow Detection Time (P2-13). If the motor RPM is within the bandwidth programmed in P2-12 after the time specified by P2-13, the setpoint will be lower by the value programmed in the No-Flow Setpoint Compensation (P2-16). The drive will wait for the system to stabilize for the time programmed in the No-Flow Stabilization Time (P2-14).

After the time programmed in P2-14 has elapsed, the setpoint is returned to the original value. The drive will again wait for the system to stabilize for the time programmed in P2-13. If the time programmed in P2-13 has elapsed, the drive will continue to monitor the feedback level. If the feedback level falls within the No-Flow Delta Feedback Level (P2-15) for a time programmed in No-Flow Feedback Delay Time (P2-17), the drive will enter a “sleep” mode after the P2-13 time elapses.



Note: Sleep function P2-02 is disable (P2-02 = 0)

Figure 109



Note: Sleep function P2-02 is enable (P2-02 > 0)

Figure 110

■ P2-12 No-Flow Detection Bandwidth

Setting Range: 0 to 1000 RPM

Factory Default: 15 RPM

The iQpump drive can be configured to activate a no-flow detection by programming the No-Flow Activation Level (P2-11). The no-flow activation can have a programmed bandwidth before the no-flow condition is activated by programming the No-Flow Detection Bandwidth (P2-12).

The No-Flow Detection Bandwidth (P2-12) sets the motor RPM fluctuation bandwidth. The no-flow detection activates when the motor RPM is below the No-Flow Activation Level (P2-11) and remains within the programmed No-Flow Detection Bandwidth (P2-12) for a time specified by the No-Flow Detection Time (P2-13).

The No-Flow Detection Bandwidth (P2-12) works in conjunction with the No-Flow Activation Level (P2-11).

Refer to the No-Flow Activation Level (P2-11) for further description.

■ P2-13 No-Flow Detection Time

Setting Range: 0.0 to 1000.0 sec

Factory Default: 5.0 sec

The iQpump drive can be configured to activate a no-flow condition by programming the No-Flow Activation Level (P2-11) and No-Flow Detection Bandwidth (P2-12). The no-flow detection activates when the motor RPM remains within the programmed bandwidth (P2-12) for a time programmed in the No-Flow Detection Time (P2-13).

The No-Flow Detection Time (P2-13) works in conjunction with the No-Flow Detection Bandwidth (P2-12) and the No-Flow Feedback Level (P2-15).

Refer to the No-Flow Activation Level (P2-11) for further description.

■ P2-14 No-Flow Stabilization Time

Setting Range: 0.0 to 1000.0 sec

Factory Default: 5.0 sec

The iQpump drive can be configured to activate a no-flow detection by programming the No-Flow Activation Level (P2-11). When the no-flow detection is activated, the system setpoint will be lowered by the value programmed in the No-Flow Setpoint Compensation (P2-16) for a specific time as programmed by the No-Flow Stabilization Time (P2-14). After the time programmed in P2-14 has elapsed, the system setpoint will return to the original setting.

The No-Flow Stabilization Time (P2-14) works in conjunction with the No-Flow Setpoint Compensation (P2-16).

Refer to the No-Flow Activation Level (P2-11) for further description.

■ P2-15 No-Flow Delta Feedback Level

Setting Range: 0.0 to 6000.0

Factory Default: 1.0

The iQpump drive can be configured to activate a no-flow detection by programming the No-Flow Activation Level (P2-11). When the no-flow detection is activated, the feedback level is monitored and compared to the system setpoint. If the difference between the system setpoint and the feedback level exceeds the No-Flow Delta Feedback Level (P2-15) for a time specified by the No-Flow Feedback Delay Time (P2-17), the drive will enter a “sleep” mode.

The No-Flow Delta Feedback Level (P2-15) works in conjunction with the No-Flow Feedback Delay Time (P2-17). The units for this parameter are determined by the System Units (P1-02).

Refer to the No-Flow Activation Level (P2-11) for further description.

Note: The feedback detection direction can be selected by programming No-Flow Feedback Detection Direction (P2-19).

■ P2-16 No-Flow Setpoint Compensation

Setting Range: 0.0 to 6000.0

Factory Default: 1.5

The iQpump drive can be configured to activate a no-flow detection by programming the No-Flow Activation Level (P2-11). When the no-flow detection is activated and the No-Flow Detection Time (P2-13) has elapsed, the system setpoint will be lowered by the value programmed in the No-Flow Setpoint Compensation (P2-16) for the time programmed in No-Flow Stabilization Time (P2-14).

The No-Flow Setpoint Compensation (P2-16) works in conjunction with the No-Flow Stabilization Time (P2-14). The units for this parameter are determined by the System Units (P1-02).

Refer to the No-Flow Activation Level (P2-11) for further description.

■ P2-17 No-Flow Feedback Delay Time

Setting Range: 0.0 to 1000.0 sec

Factory Default: 2.0 sec

The iQpump drive can be configured to activate a no-flow detection by programming the No-Flow Activation Level (P2-11). When the no-flow detection process is activated, and the system setpoint has returned to the original value, the feedback will be monitored. If the feedback level is within the No-Flow Delta Feedback Level (P2-15), a specific delay time can be programmed in the No-Flow Feedback Delay Time (P2-17) before the drive enters a “sleep” mode.

The No-Flow Feedback Delay Time (P2-17) works in conjunction with the No-Flow Delta Feedback Level (P2-15).

Refer to the No-Flow Activation Level (P2-11) for further description.

■ P2-18 No-Flow Motor RPM Sample Time

Setting Range: 0.0 to 1000.0 sec

Factory Default: 2.0 sec

The iQpump drive can be configured to activate a no-flow detection by programming the No-Flow Activation Level (P2-11). The no-flow detection function monitors the motor RPM. The motor RPM monitor sample rate can be programmed in the No-Flow Motor RPM Sample Time (P2-18).

Refer to the No-Flow Activation Level (P2-11) for further description.

■ P2-19 No-Flow Feedback Detection Direction

Setting	Description
0	Outside Bandwidth (P2-15) (*factory default*)
1	Inside Bandwidth (P2-15)

The iQpump drive can be configured to activate a no-flow detection by programming the No-Flow Activation Level (P2-11). When the no-flow detection process is activated, and the system setpoint has returned to the original value, the feedback will be monitored. The direction of the feedback upon return of the no-flow detection can be selected by programming the No-Flow Feedback Detection Direction (P2-19).

The No-Flow Feedback Detection Direction (P2-19) works in conjunction with the No-Flow Delta Feedback Level (P2-15).

Refer to the No-Flow Activation Level (P2-11) for further description.

■ P2-20 Alternative Sleep Activation Level

Setting Range: 0.0 to 120.0 Hz

Factory Default: 0.0 Hz

The iQpump drive can be configured to activate a “sleep” mode. In addition, the iQpump drive can be configured to activate an alternative “sleep” mode. When the Sleep Level Type (P2-01) is set for a value of 0 (P2-01 = 0: Output Frequency), the alternative sleep activation level is set when a value greater than 0 is programmed in the Alternative Sleep Activation Level (P2-20).

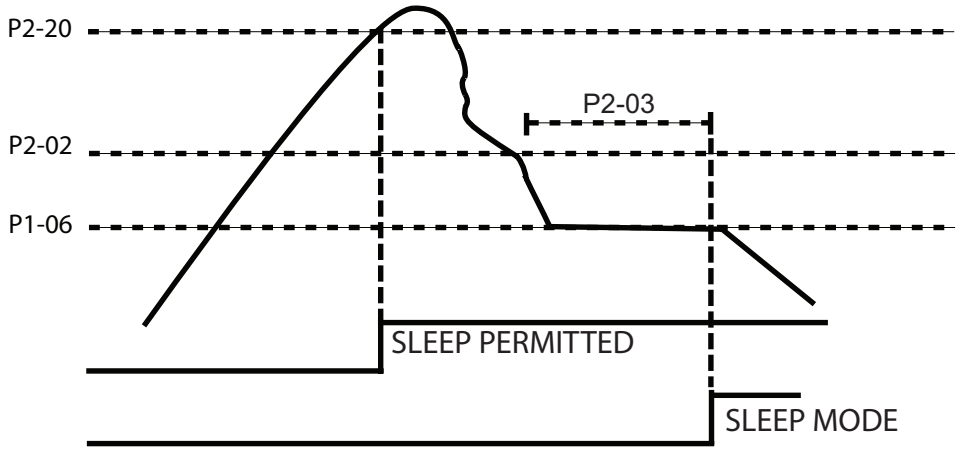


Figure 111

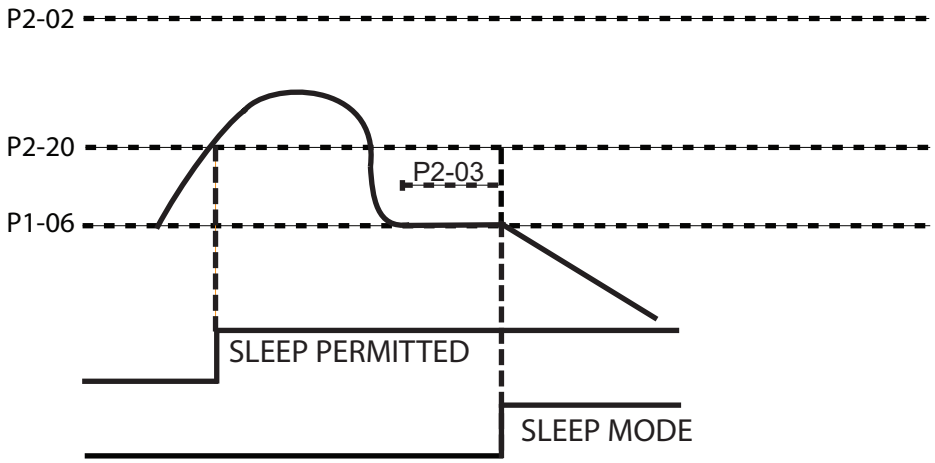


Figure 112

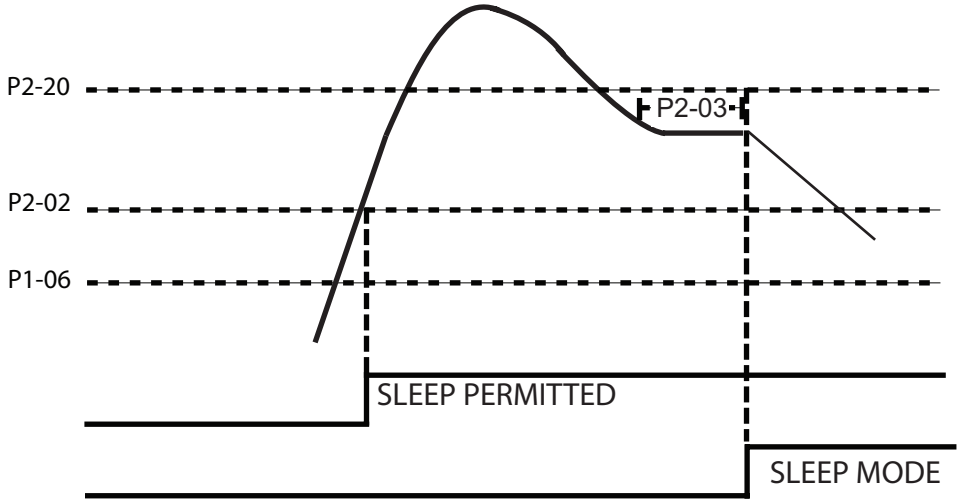


Figure 113

The sleep function can be active during the following conditions:

- When P2-20 is set to 0 (disabled), the output frequency must be greater than the Sleep Level (P2-02).
- When P2-20 is greater than P2-02, the output frequency must be greater than Alternative Sleep Activation Level (P2-20). See *Figure 111*.
- When P2-20 is greater than 0 and less than P2-02, the output frequency must be greater than Alternative Sleep Activation Level (P2-20). See Figure 112.
- When P2-20 is greater than 0 and less than P2-02, the output frequency must be greater than Alternative Sleep Activation Level (P2-20) and Sleep Level (P2-02). See Figure 113.

A value of 0 programmed in P2-20 will disable this function.

The Alternative Sleep Activation Level (P2-20) works in conjunction with the Start Level (P1-04) and the Sleep Level Type (P2-01).

Note: It is recommended that P2-20 be programmed 1 or 2 Hz above the P1-06 value. The sleep level using P2-20 enables the sleep mode; however, the drive still enters sleep based on P2-20. With the normal default sleep level programmed in P2-02, the sleep cycle will not activate until the output frequency is above P2-02.

◆ P3 Pump Protection

■ P3-01 Lead-Lag Control

Setting	Description	Parameters Used
0	Output Frequency (*factory default*)	P3-02, P3-04, P3-09, P3-10
1	Feedback Level	P3-03, P3-04, P3-05, P3-06
2	Output Frequency + Feedback Level	P3-02, P3-03, P3-05, P3-06, P3-07, P3-08, P3-10

The iQpump drive can be configured for lead-lag control. The lead-lag control refers to the drive (lead) controlling a pump and turning on auxiliary pumps (lag) by the drive's output contacts. The controlling of the auxiliary pumps is referred to staging and de-staging. Up to three (3) total pumps can be operated, one lead (drive control) and two auxiliary pumps. The pump control staging and de-staging can be controlled by three (3) different lead-lag control methods.

0: Output Frequency

1: Feedback Level

2: Output Frequency + Feedback Level

P3-01 = 0: Output Frequency

The "output frequency" control method monitors the drive's output frequency and determines if the auxiliary pumps need to be staged (turned ON) to maintain the programmed system's setpoint. The output frequency also determines when the auxiliary pumps are to be de-staged (turned OFF). Refer to *Figure 114* and *Figure 115* for the staging and de-staging of the auxiliary pumps using the "output frequency" control method.

Auxiliary Pump Staging (ON)

The staging of auxiliary pump 2 occurs when the output frequency remains above the iQpump drive Multi/Maximum Level (P3-02) for the time programmed in Add Pump Delay Time (P3-04).

The staging of auxiliary pump 3 occurs when the auxiliary pump 2 is staged and the output frequency remains above the iQpump drive Multi/Maximum Level (P3-02) for the time programmed in Add Pump Delay Time (P3-04). Refer to *Figure 114* for the staging of the auxiliary pump 2 and 3 using the "output frequency" control method.

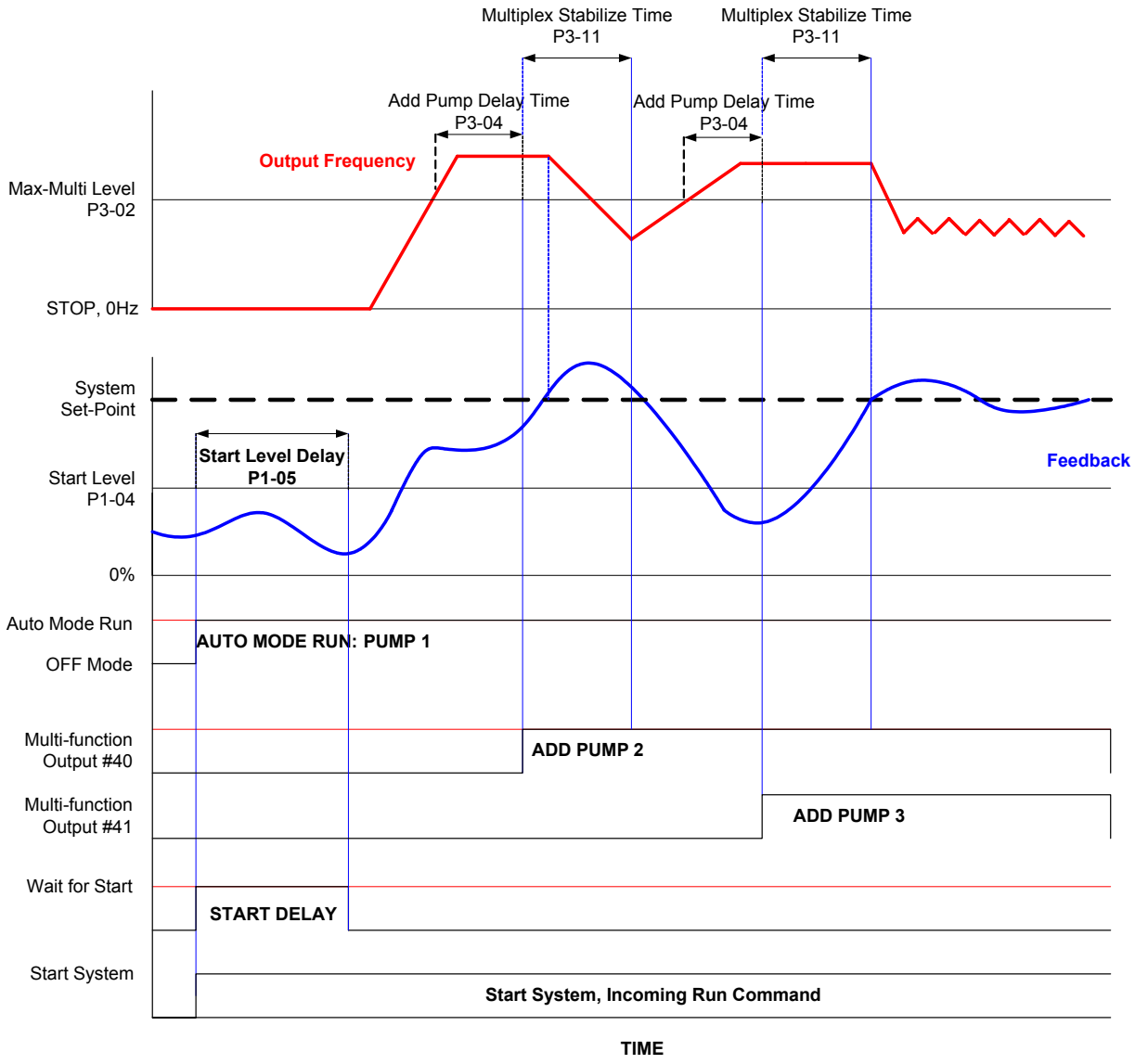


Figure 114

Auxiliary Pump De-Staging (OFF)

The de-staging of the auxiliary pumps 2 and 3 will occur in the reverse order of the staging process described previously.

The de-staging of auxiliary pump 3 occurs when the output frequency falls below the Pump 3 Frequency Shutdown Level (P3-10) for the time programmed in the Shutdown Pump Delay Time (P3-06).

The de-staging of pump 2 occurs when the auxiliary pump 3 is de-staged and the output frequency falls below the Pump 2 Frequency Shutdown Level (P3-09) for the time programmed in the Shutdown Pump Delay Time (P3-06). Refer to *Figure 115* for the de-staging of the auxiliary pumps 2 and 3 using the “output frequency” control method.

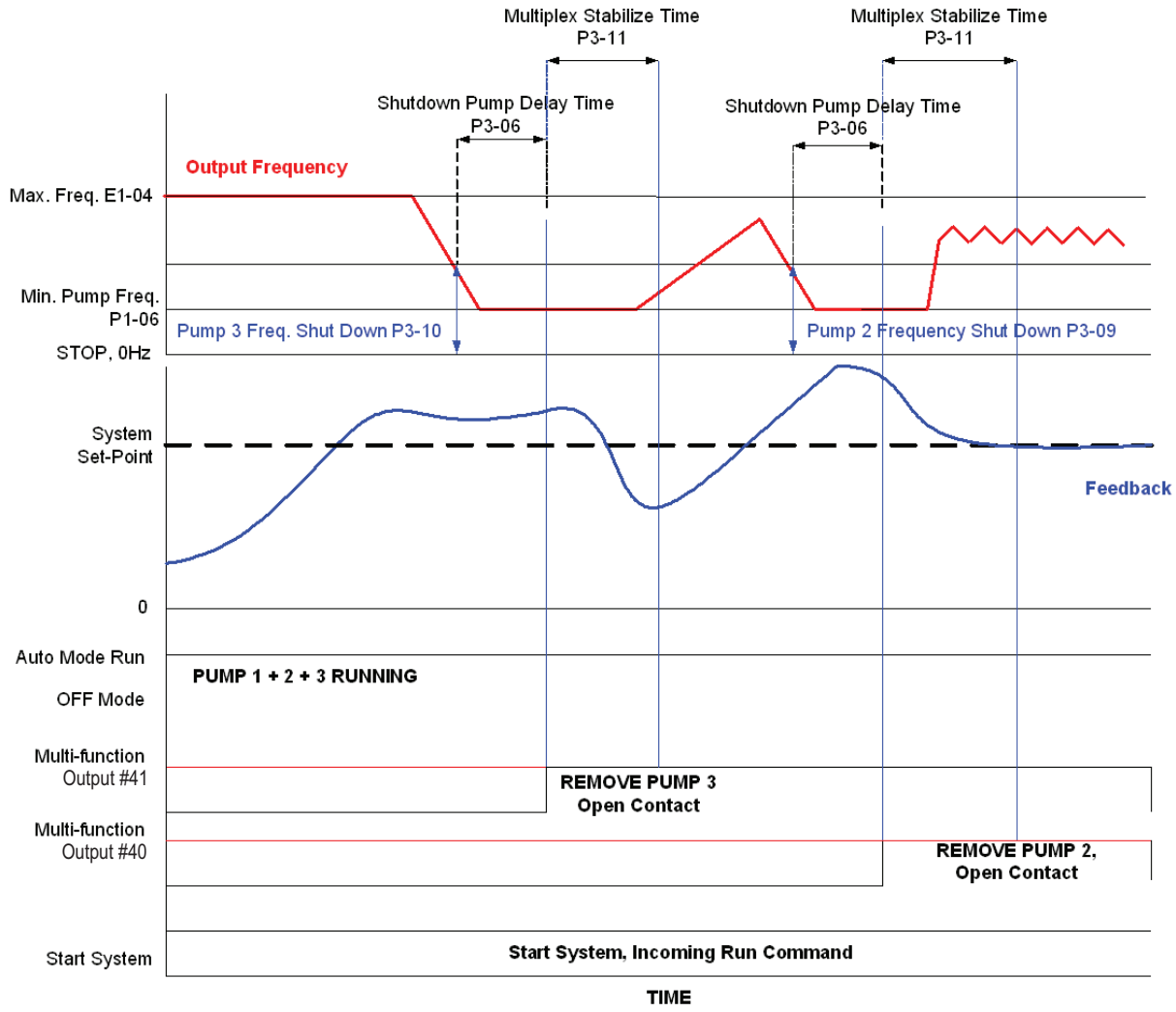


Figure 115

The pump system can be allowed to stabilize by programming a time into the Multiplex Stabilization Time (P3-11). The Multiplex Stabilization Time (P3-11) becomes active after an auxiliary pump is staged or de-staged.

Note: The pump protection function is disabled during auxiliary pump staging and de-staging.

The No-Flow and Sleep functions are only active when the lead pump controlled by the drive is the only pump operating the pump system.

P3-01 = 1: Feedback Level

The “feedback level” control method monitors the drive’s output frequency and the system’s feedback level to determine if the auxiliary pumps need to be staged (turned ON) to maintain the programmed system’s setpoint. The output frequency and the system’s feedback also determine when the auxiliary pumps are to be de-staged (turned OFF). Refer to *Figure 116* and *Figure 117* for the staging and de-staging of the auxiliary pumps using the “feedback level” control method.

Auxiliary Pump Staging (ON)

The staging of auxiliary pump 2 occurs when the difference between the system setpoint minus the feedback level exceeds the value programmed in the Add Pump Delta Level (P3-03) for the time programmed in Add Pump Delay Time (P3-04).

The staging of auxiliary pump 3 occurs when the auxiliary pump 2 is staged and when the difference between the system setpoint minus the feedback level exceeds the value programmed in the Add Pump Delta Level (P3-03) for the time programmed in Add Pump Delay Time (P3-04). Refer to *Figure 116* for the staging of the auxiliary pumps using the “feedback level” control method.

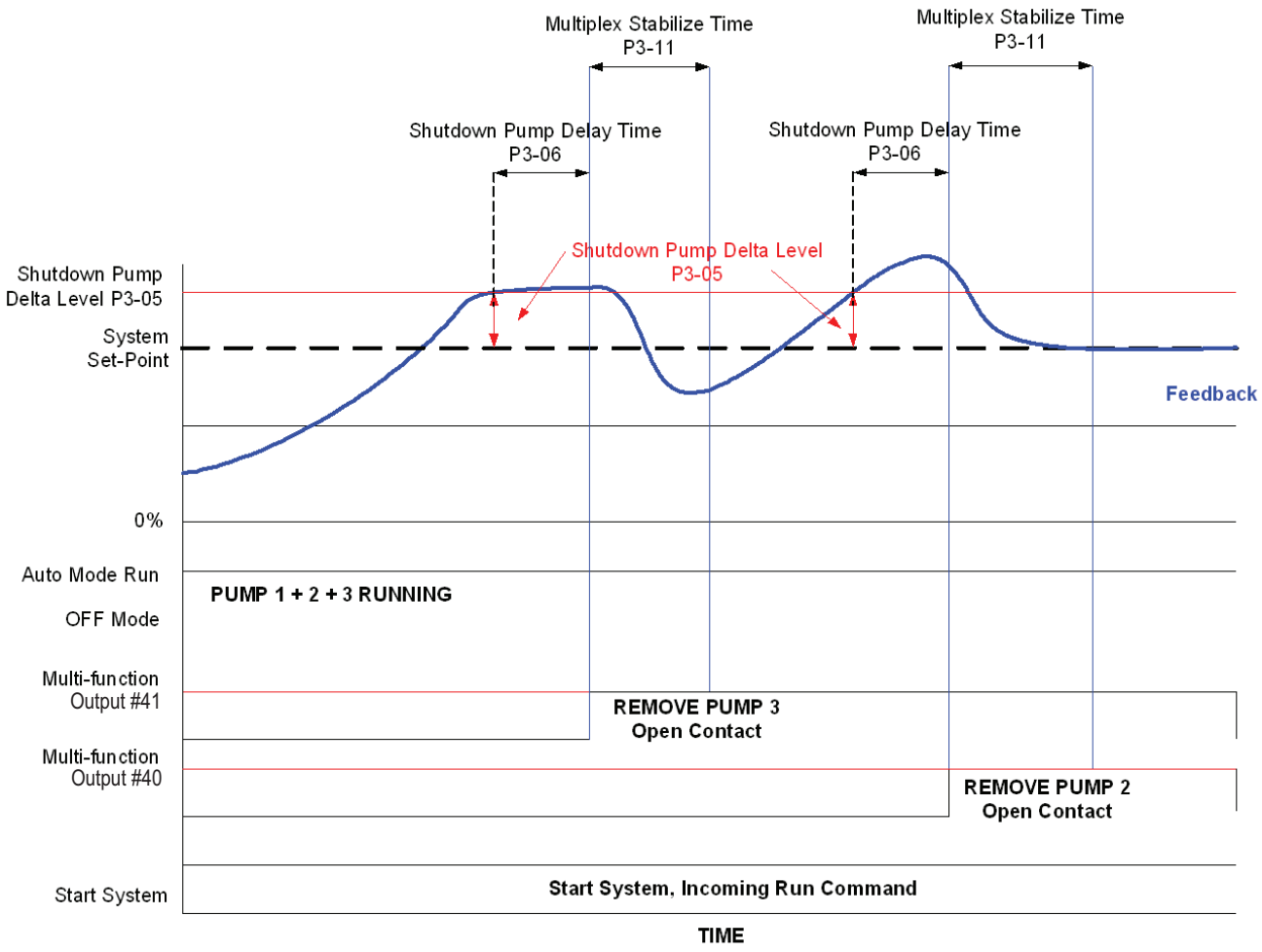


Figure 116

Auxiliary Pump De-Staging (OFF)

The de-staging of the auxiliary pumps 2 and 3 will occur in the reverse order of the staging process described previously.

The de-staging of auxiliary pump 3 occurs when the difference between the system's feedback level minus the setpoint exceeds the value programmed in the Shutdown Pump Delta Level (P3-05) for the time programmed in the Add Pump Delay Time (P3-04).

The de-staging of auxiliary pump 2 occurs when the auxiliary pump 3 is de-staged and the difference between the system's feedback level and setpoint exceeds the value programmed in the Shutdown Pump Delta Level (P3-05) for the time programmed in Add Pump Delay Time (P3-04). Refer to *Figure 117* for the de-staging of the auxiliary pumps 2 and 3 using the "feedback level" control method.

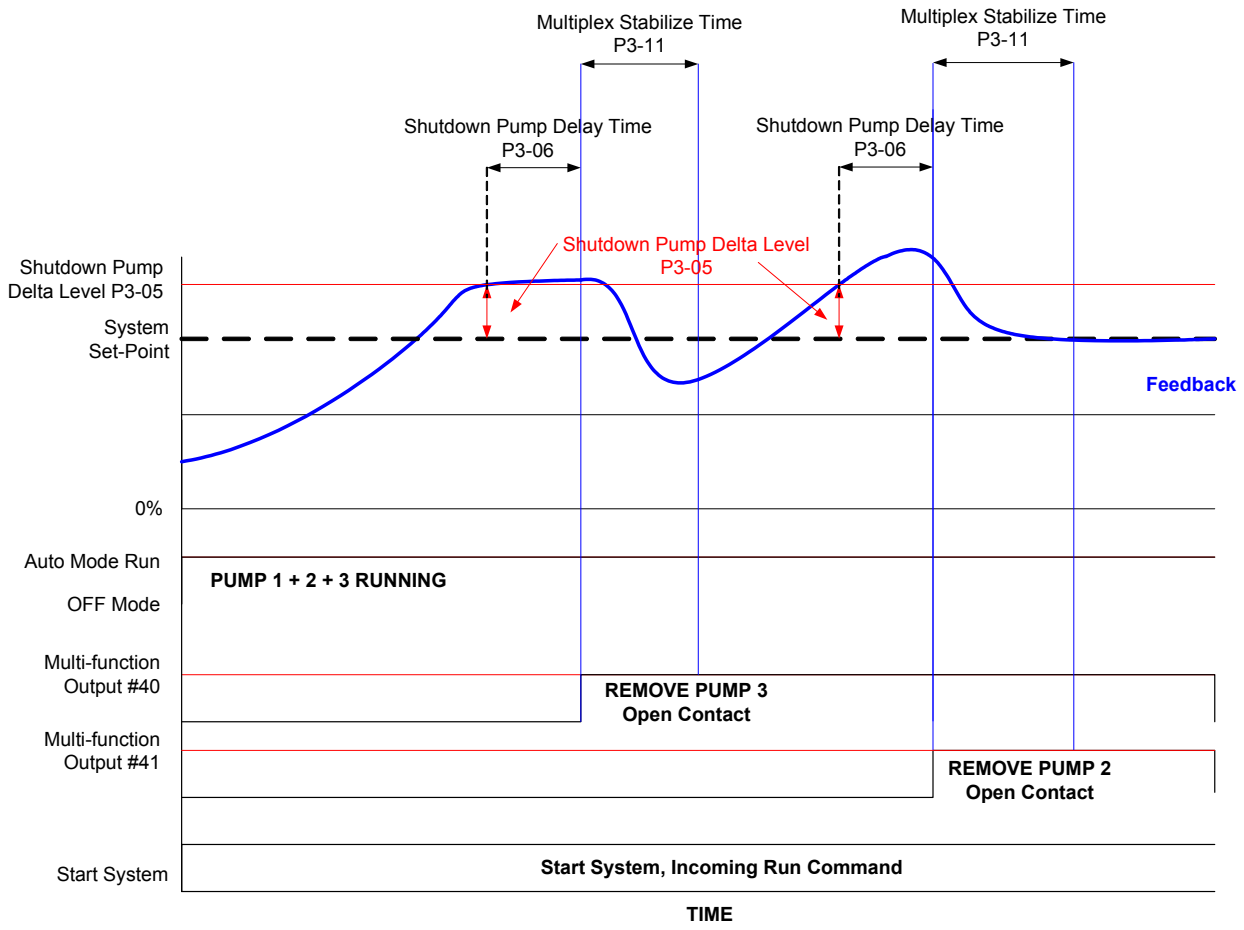


Figure 117

The pump system can be allowed to stabilize by programming a time into the Multiplex Stabilization Time (P3-11). The Multiplex Stabilization Time (P3-11) becomes active after an auxiliary pump is staged or de-staged.

Note: The pump protection function is disabled during auxiliary pump staging and de-staging.

The No-Flow and Sleep functions are only active when the lead pump controlled by the drive is the only pump operating the pump system.

P3-01 = 2: Output Frequency + Feedback Level

The “output frequency + feedback level” control method monitors the drive’s output frequency and the difference between the system’s setpoint and feedback level to determine if the auxiliary pumps need to be staged (turned ON) to maintain the programmed system’s setpoint. The output frequency and the difference between the system’s setpoint and feedback level also determine when the auxiliary pumps are to be de-staged (turned OFF). Refer to *Figure 118* and *Figure 119* for the staging and de-staging of the auxiliary pumps using the “output frequency + feedback level” control method.

Auxiliary Pump Staging (ON)

The staging of auxiliary pump 2 occurs when the output frequency remains above the iQpump drive Multi/Maximum Level (P3-02) and the difference between the system’s setpoint and the feedback level exceeds the value programmed in the Add Pump Delta Level (P3-03) for the time programmed in Add Pump Delay Time (P3-04).

The staging of auxiliary pump 3 occurs when the auxiliary pump 2 is staged and when the output frequency remains above the iQpump drive Multi/Maximum Level (P3-02) and the difference between the system’s setpoint and feedback level exceeds the value programmed in the Add Pump Delta Level (P3-03) for the time programmed in Add Pump Delay Time (P3-04). Refer to *Figure 118* for the staging of the auxiliary pumps using the “output frequency + feedback level” control method.

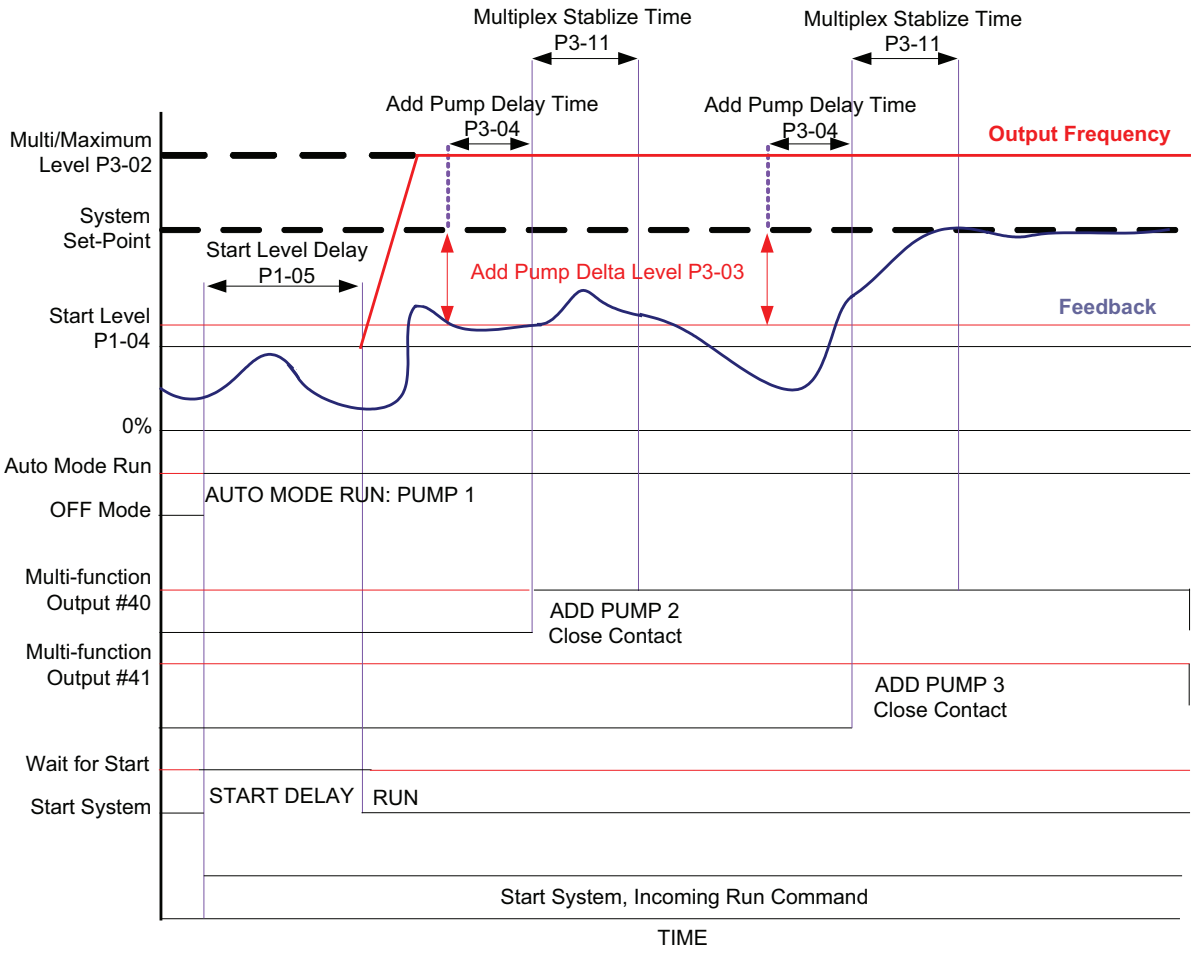


Figure 118

Auxiliary Pump De-Staging (OFF)

The de-staging of the auxiliary pumps 2 and 3 will occur in the reverse order of the staging process described previously.

The de-staging of auxiliary pump 3 occurs when the output frequency falls below the Pump 3 Frequency Shutdown Level (P3-10) and the difference between the system's feedback minus the setpoint exceeds the value programmed in the Shutdown Pump Delta Level (P3-05) for the time programmed in the Add Pump Delay Time (P3-04).

The de-staging of auxiliary pump 2 occurs when the auxiliary pump 3 is de-staged and the output frequency falls below the Pump 2 Frequency Shutdown Level (P3-09) and the difference between the system's feedback level minus the setpoint exceeds the value programmed in the Shutdown Pump Delta Level (P3-05) for the time programmed in Shutdown Pump Delay Time (P3-06). Refer to *Figure 119* for the de-staging of the auxiliary pumps using the "output frequency + feedback level" control method.

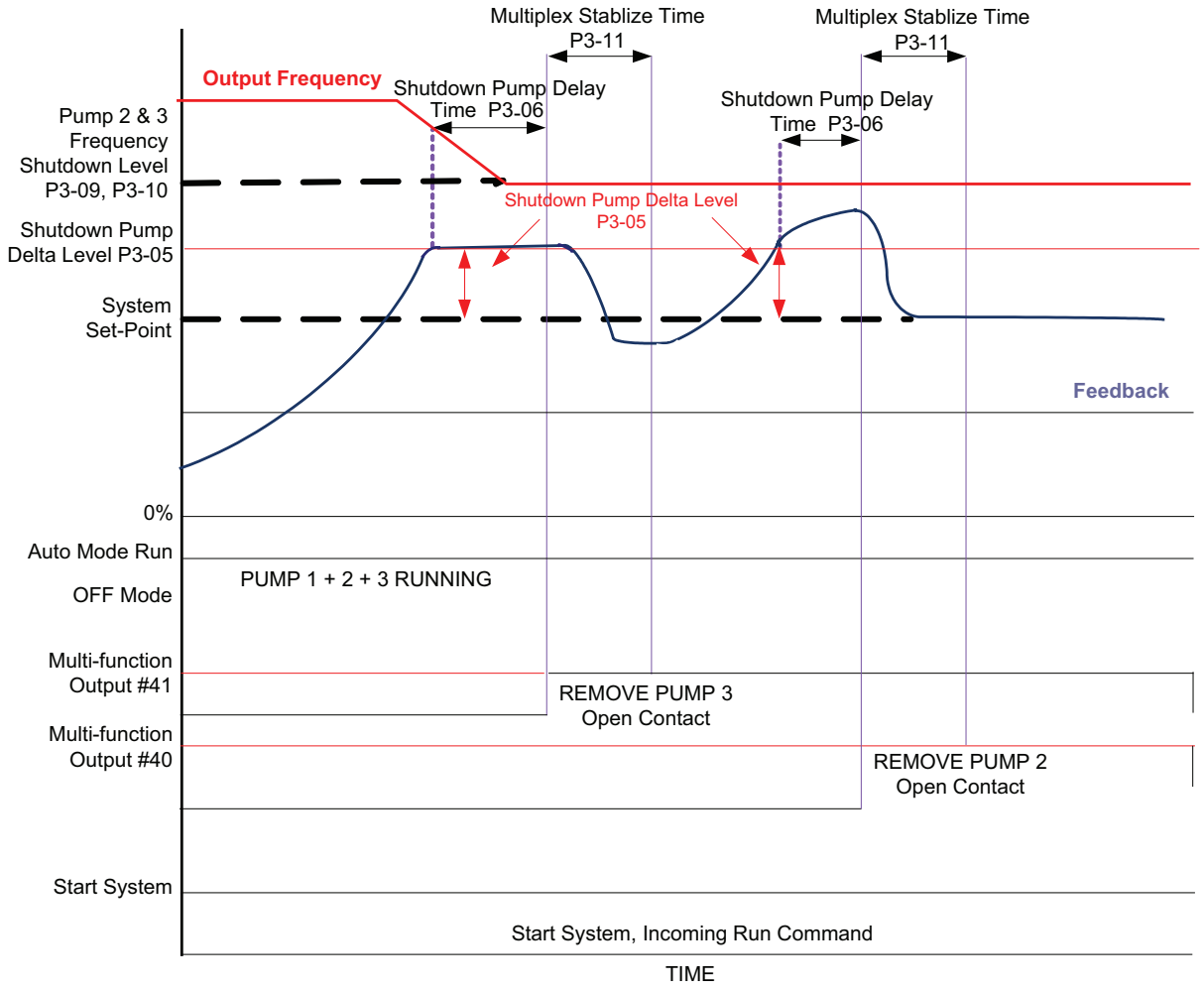


Figure 119

■ P3-02 Drive Multi/Maximum Level

Setting Range: 0.0 to 120.0 Hz

Factory Default: 59.0 Hz

The maximum frequency level used for the multiplex pumping operation (staging) is programmed in the iQpump drive Multi/Maximum Level (P3-02) is active when the Lead-Lag Control (P3-01) is set to 0 or 2. The multiplex pumping operation (staging) is determined by the programmed setting of P3-01 as described below.

If P3-01 = 0: Output Frequency

The staging (turning ON) of the auxiliary pump occurs when the output frequency rises above the iQpump drive Multi/Maximum Level (P3-02) for the time programmed in the Add Pump Delay Time (P3-04). The auxiliary pumps will be added by the control of the multi-function digital output contact closure (H2-xx = 40 and 41).

If P3-01 = 1: Feedback Level (P3-02: Not Used)

The iQpump drive Multi/Maximum Level (P3-02) is not used when Lead-Lag Control (P3-01) is set to 1.

If P3-01 = 2: Output Frequency + Feedback Level

The staging (turning ON) of the auxiliary pump occurs when the output frequency rises above the iQpump drive Multi/Maximum Level (P3-02) and the difference between the system's setpoint minus the feedback level has exceeded the Add Pump Delta Level (P3-03) for the time programmed in the Add Pump Delay Time (P3-04).

The auxiliary pumps will be added by the control of the multi-function digital output contact closure (H2-xx = 40 and 41).

Refer to Lead-Lag Control (P3-01) for further description of the staging of the pump system.

■ P3-03 Add Pump Delta Level

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The delta level used for the staging of the multiplex pumping operation is programmed in the Add Pump Delta Level (P3-03). The staging of the multiplex pumping operation is determined by the programmed setting of P3-01 as described below.

If P3-01 = 0: Output Frequency (P3-03: Not used)

The Add Pump Delta Level (P3-03) is not used when Lead-Lag Control (P3-01) is set to 0.

If P3-01 = 1: Feedback Level

The staging (turning ON) of the auxiliary pump occurs when the difference (delta) between the system's setpoint minus the feedback level has exceeded the Add Pump Delta Level (P3-03) for the time programmed in the Add Pump Delta Time (P3-04).

The auxiliary pumps will be added by the control of the multi-function digital output contact closure (H2-xx = 40 and 41).

If P3-01 = 2: Output Frequency + Feedback Level

The staging (turning ON) of the auxiliary pump occurs when the output frequency rises above the level programmed in the iQpump drive Multi/Maximum Level (P3-02) and the difference (delta) between the system's setpoint minus the feedback level has exceeded the Add Pump Delta Level (P3-03) for the time programmed in the Add Pump Delta Time (P3-04).

The auxiliary pumps will be added by the control of the multi-function digital output contact closure (H2-xx = 40 and 41).

The units for this parameter are based on P1-02. Refer to Lead-Lag Control (P3-01) for further description of the staging of the pump system.

⚠ CAUTION

Do not program this level too close to the system's setpoint.

If the level is too close to the setpoint, excessive cycling of the pump system may occur.

■ P3-04 Add Pump Delay Time

Setting Range: 0 to 3600 sec

Factory Default: 2 sec

The staging (turning ON) of the auxiliary pumps will occur after the time delay programmed in the Add Pump Delay Time (P3-04) has elapsed. The time delay will occur prior to the staging of the auxiliary pumps.

The Add Pump Delay Time (P3-04) works in conjunction with iQpump drive Multi/Maximum Level (P3-02), Add Pump Delta Level (P3-03), No-Flow Activation Level (P2-11) and No-Flow Feedback Detection Direction (P2-19).

Refer to Lead-Lag Control (P3-01) for further description of the staging of the pump system.

■ P3-05 Shutdown Pump Delta Level

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The delta level used for the de-staging of the multiplex pumping operation is programmed in the Shutdown Pump Delta Level (P3-05). The de-staging of the multiplex pumping operation is determined by the programmed setting of P3-01 as described below.

If P3-01 = 0: Output Frequency (P3-05: Not used)

The Shutdown Pump Delta Level (P3-05) is not used when Lead-Lag Control (P3-01) is set to 0.

If P3-01 = 1: Feedback Level

The de-staging (turning OFF) of the auxiliary pump occurs when the difference (delta) between the system's feedback level minus the setpoint has exceeded the Shutdown Pump Delta Level (P3-05) for the time programmed in the Shutdown Pump Delay Time (P3-06).

The auxiliary pumps will be added by the control of the multi-function digital output contact closure (H2-xx = 40 and 41).

If P3-01 = 2: Output Frequency + Feedback Level

The de-staging (turning OFF) of the auxiliary pump occurs when the output frequency drops below the level programmed in the Pump 3 Frequency Shutdown Level (P3-10) or Pump 2 Frequency Shutdown Level (P3-09) and the difference (delta) between the system's feedback level minus setpoint has exceeded the level programmed in the Shutdown Pump Delta Level (P3-05) for the time programmed in the Shutdown Pump Delay Time (P3-06).

The auxiliary pumps will be added by the control of the multi-function digital output contact closure (H2-xx = 40 and 41).

⚠ CAUTION

Do not program this level too close to the system's setpoint.

If the level is too close to the setpoint, excessive cycling of the pump system may occur.

■ P3-06 Shutdown Pump Delay Time

Setting Range: 0 to 3600 sec

Factory Default: 5 sec

The de-staging (turning OFF) of the auxiliary pumps will occur after the time delay programmed in the Shutdown Pump Delay Time (P3-06) has elapsed. The time delay will occur prior to de-staging of the auxiliary pumps.

The Shutdown Pump Delay Time (P3-06) works in conjunction with iQpump drive Multi/Maximum Level (P3-02) and Add Pump Delta Level (P3-03).

Refer to Lead-Lag Control (P3-01) for further description of de-staging of the pump system.

■ P3-07 Multi Pump Setpoint Increase

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The iQpump drive can be configured for multiplex pumping operation. The multiplex pumping operation can have the system setpoint increased each time a pump is staged (turned ON) by programming the amount to be increased into the Multi Pump Setpoint Increase (P3-07). The system's setpoint will be lowered by this amount when each pump is de-staged (turned OFF). Refer to *Figure 120* below.

The units for this parameter are determined by the System Units (P1-02).

Example: Constant Pressure System

System Setpoint: 80PSI

Pressure Transducer: 150PSI

Multi Pump Setpoint Increase: 4PSI

Pump 1 (Running) Setpoint = 80PSI

Pump 1 + Pump 2 (Running) Setpoint = 84PSI (80PSI + 4PSI)

Pump 1 + Pump 2 + Pump 3 (Running) Setpoint = 88PSI (80PSI + 4PSI + 4PSI)

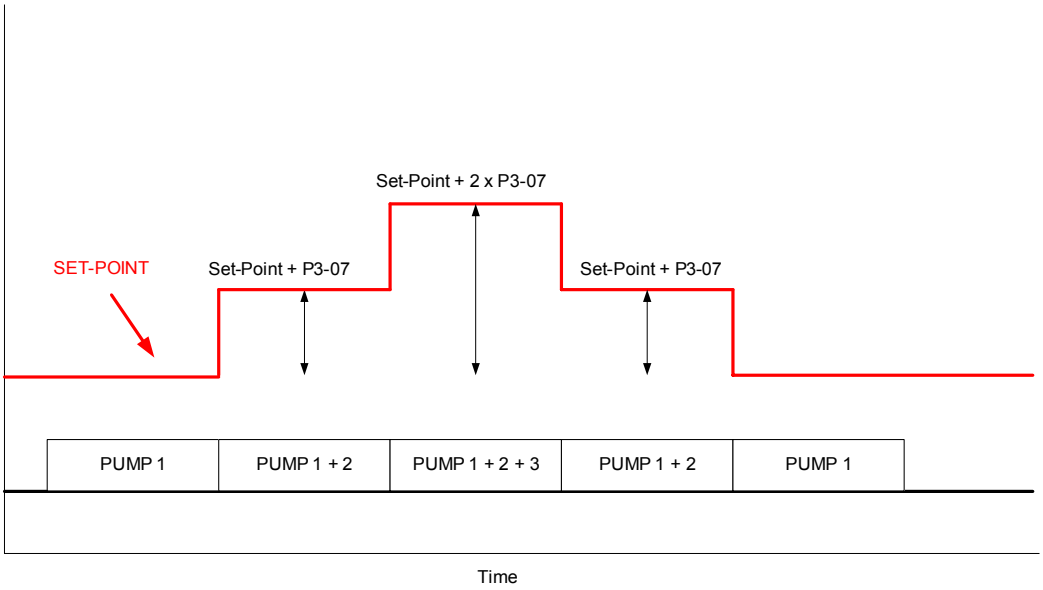


Figure 120

■ P3-08 Multi Pump Setpoint Decrease

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The iQpump drive can be configured for multiplex pumping operation. The multiplex pumping operation can have the system setpoint decreased each time a pump is staged (turned ON) by programming the amount to be decreased into the Multi Pump Setpoint Decrease (P3-08). The system's setpoint will be raised by this amount when each pump is de-staged (turned OFF). Refer to *Figure 121* below.

The units for this parameter are determined by the System Units (P1-02).

Example: Constant Pressure System

System Setpoint: 80 PSI

Pressure Transducer: 150 PSI

Multi Pump Setpoint Increase: 4 PSI

Pump 1 (Running) Setpoint = 80 PSI

Pump 1 + Pump 2 (Running) Setpoint = 76 PSI (80 PSI - 4 PSI)

Pump 1 + Pump 2 + Pump 3 (Running) Setpoint = 72 PSI (80 PSI - 4 PSI - 4 PSI)

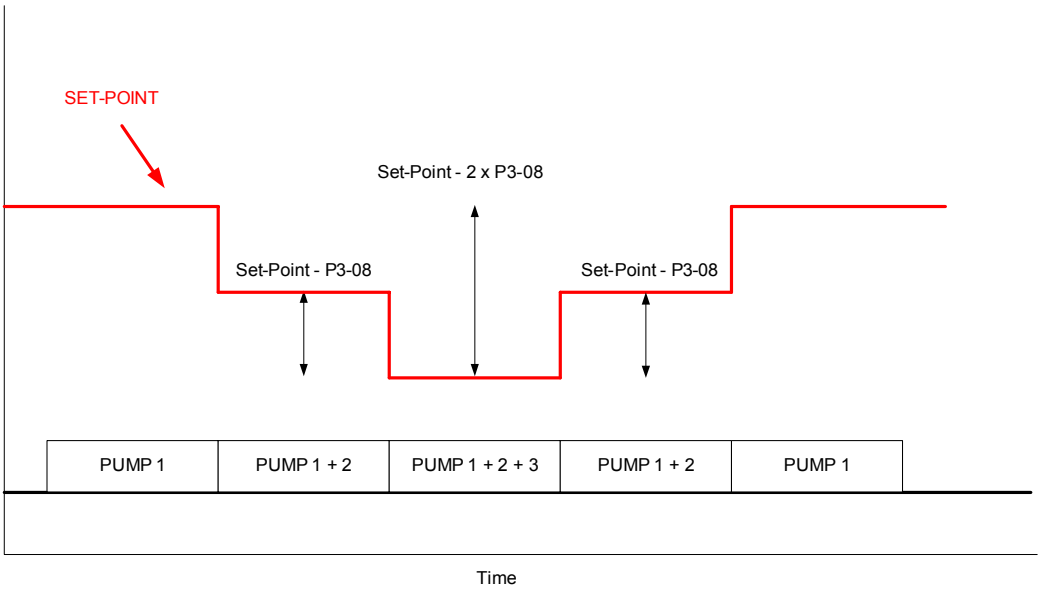


Figure 121

■ P3-09 Pump 2 Frequency Shutdown Level

Setting Range: 0.0 to 120.0 Hz

Factory Default: 35.0 Hz

The Pump 2 shutdown frequency level used for the multiplex pumping operation (de-staging) is programmed in the Pump 2 Frequency Shutdown Level (P3-09). The Pump 2 Frequency Shutdown Level (P3-09) is active when the Lead-Lag Control (P3-01) is set to 0 or 2. The multiplex pumping operation (de-staging) is determined by the programmed setting of P3-01 as described below.

If P3-01 = 0: Output Frequency

The de-staging (turning OFF) of the auxiliary pump occurs when the output frequency falls below the Pump 2 Frequency Shutdown Level (P3-09) for the time programmed in the Shutdown Pump Delay Time (P3-06).

The auxiliary pumps will be removed by the control of the multi-function digital output contact opening (H2-xx = 40 and 41).

If P3-01 = 1: Feedback Level (P3-02: Not Used)

The Pump 2 Frequency Shutdown Level (P3-09) is not used when Lead-Lag Control (P3-01) is set to 1.

If P3-01 = 2: Output Frequency + Feedback Level

The de-staging (turning OFF) of the auxiliary pump occurs when the output frequency falls below the Pump 2 Frequency Shutdown Level (P3-09) and the difference between the feedback minus the system's setpoint has exceeded the Shutdown Pump Delta Level (P3-05) for the time programmed in the Shutdown Pump Delay Time (P3-06).

The auxiliary pumps will be removed by the control of the multi-function digital output contact opening (H2-xx = 40 and 41).

Refer to Lead-Lag Control (P3-01) for further description of the de-staging of the pump system.

■ P3-10 Pump 3 Frequency Shutdown Level

Setting Range: 0.0 to 120.0 Hz

Factory Default: 35.0 Hz

The Pump 3 shutdown frequency level used for the multiplex pumping operation (de-staging) is programmed in the Pump 3 Frequency Shutdown Level (P3-10). The Pump 3 Frequency Shutdown Level (P3-10) is active when the Lead-Lag Control (P3-01) is set to 0 or 2. The multiplex pumping operation (de-staging) is determined by the programmed setting of P3-01 as described below.

If P3-01 = 0: Output Frequency

The de-staging (turning OFF) of the auxiliary pump occurs when the output frequency falls below the Pump 3 Frequency Shutdown Level (P3-10) for the time programmed in the Shutdown Pump Delay Time (P3-06).

The auxiliary pumps will be removed by the control of the multi-function digital output contact opening (H2-xx = 40 and 41).

If P3-01 = 1: Feedback Level (P3-02: Not Used)

The Pump 3 Frequency Shutdown Level (P3-10) is not used when Lead-Lag Control (P3-01) is set to 1.

If P3-01 = 2: Output Frequency + Feedback Level

The de-staging (turning OFF) of the auxiliary pump occurs when the output frequency falls below the Pump 3 Frequency Shutdown Level (P3-10) and the difference between the feedback minus the system's setpoint has exceeded the Shutdown Pump Delta Level (P3-05) for the time programmed in the Shutdown Pump Delay Time (P3-06).

The auxiliary pumps will be removed by the control of the multi-function digital output contact opening (H2-xx = 40 and 41).

Refer to Lead-Lag Control (P3-01) for further description of the de-staging of the pump system.

■ P3-11 Multiplex Stabilization Time

Setting Range: 0 to 3600 sec

Factory Default: 2 sec

The iQpump drive can be configured for multiplex pumping operation. A time delay can be programmed to allow the system to stabilize when a pump is staged (turned ON) or de-staged (turned OFF). The time used for system stabilization is programmed into the Multiplex Stabilization Time (P3-11). When a pump is staged (turned ON), the stabilization time (P3-11) temporarily disables the lead/lag functionality during this time period to prevent pump cycling.

This function is only active when the Pump Mode (P1-01 > 0) is greater than 0.

Refer to Lead-Lag Control (P3-01) for further description.

Note: The pump protection and lead-lag control are suspended during this time period.

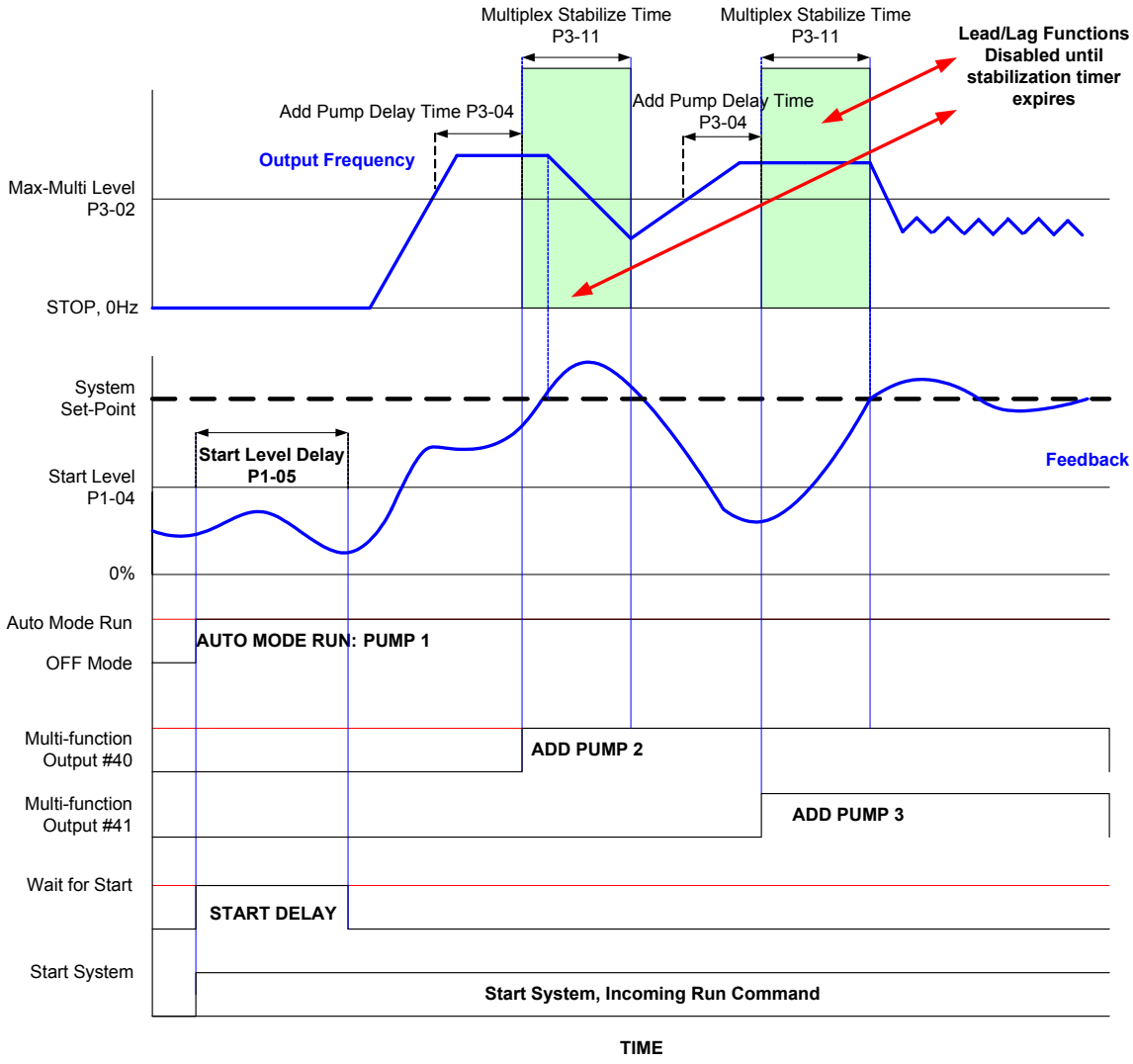


Figure 122

■ P3-12 Delta Setpoint Feedback Acc/Dec Changeover

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The iQpump drive can be configured for multiplex pumping operation. The acceleration (Acc) and deceleration (Dec) times can be changed when the difference between the delta setpoint and feedback are within the programmed level in the Delta Setpoint Feedback Acc/Dec Changeover (P3-12).

The acceleration and deceleration times during this changeover are programmed into C1-05 and C1-06, respectively.

This function is used to improve the pump regulation.

Setting P2-12 to a value of 0 will disable this function.

■ P3-13 Friction Compensation Start Frequency

Setting Range: 0.0 to 120.0 Hz

Factory Default: 0.0 Hz

The iQpump drive can be configured for multiplex pumping operation. The pump system may experience an increase of friction when additional pumps are staged (turned ON). The level when the additional compensation for friction losses can be programmed into the Friction Compensation Start Frequency (P3-13). This function will activate when the output frequency rises above the Friction Compensation Start Frequency (P3-13). The maximum compensation at Maximum Output Frequency (E1-04) is specified by the Maximum Friction Increase at Maximum Frequency (P3-14).

The Friction Compensation Start Frequency (P3-13) works in conjunction with the Maximum Friction Increase at Maximum Frequency (P3-14).

Note: This function is only active when the Pump Mode (P1-01) is set to 0.

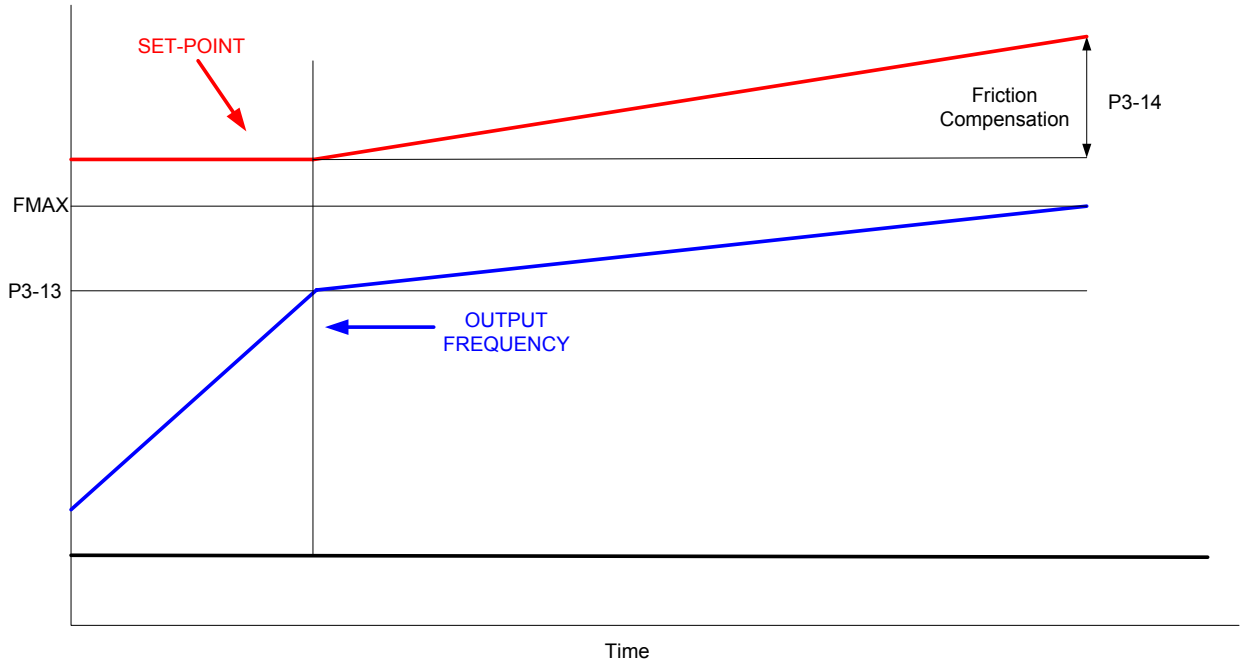


Figure 123

■ P3-14 Maximum Friction Increase at Maximum Frequency

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The iQpump drive can be configured for multiplex pumping operation. The pump system may experience an increase of friction when additional pumps are staged (turned ON). The level when the additional compensation for friction losses can be programmed into the Maximum Friction Increase at Maximum Frequency (P3-14). This function will activate when the output frequency rises above the Friction Compensation Start Frequency (P3-13). The maximum compensation at Maximum Output Frequency (E1-04) is specified by the Maximum Friction Increase at Maximum Frequency (P3-14).

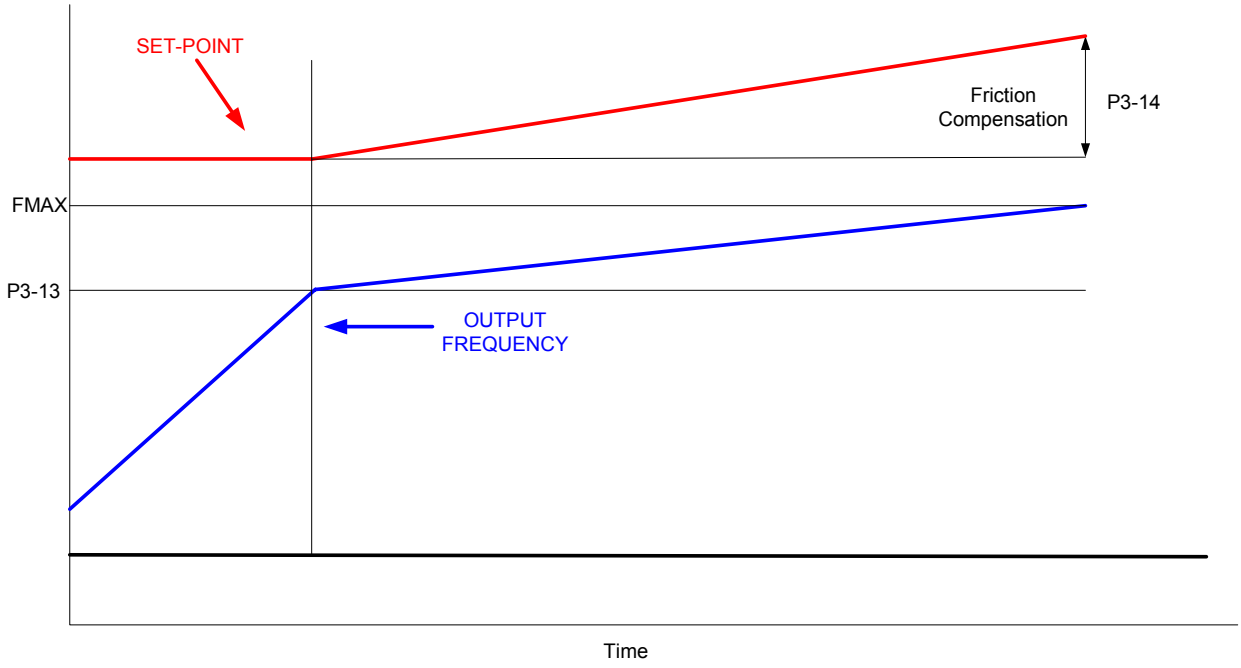


Figure 124

The maximum compensation at Maximum Output Frequency (E1-04) is specified by programming the Maximum Friction Increase at Maximum Frequency (P3-14).

The Maximum Friction Increase at Maximum Frequency (P3-14) works in conjunction with the Friction Compensation Start Frequency (P3-13). The units for this parameter are determined by the System Units (P1-02).

Note: This function is only active when the Pump Mode (P1-01) is set to 0.

Example:

If P3-13 = 30.0 Hz, P3-14 = 10.0 PSI, Output Frequency = 45.0 Hz, and Maximum Frequency = 60 Hz, then:

Setpoint Increase = 5.0 PSI

(45.0 - 30.0 Hz) x (10 PSI / (60.0-30.0 Hz)) = 5.0 PSI

◆ P4 Pump Protection

■ P4-01 Pre-Charge Level

Setting Range: 0.0 to 6000.0

Factory Default: 0.0

The iQpump drive can be configured for special functions for dedicated pumping applications. These functions are: Pre-Charge Level (P4-01) and Thrust Bearing Frequency (P4-05). Refer to the Thrust Bearing Frequency (P4-05) for further description about the thrust bearing function. There are two pre-charge operation methods: (1) Pre-charge with Thrust Bearing function disabled. (2) Precharge and Thrust Bearing functions both enabled.

Some pump systems require the system to be "pre-charged" before normal operation can occur. The built-in pre-charge function allows the pump system to run at a fixed motor speed for a programmed time. This function also operates in conjunction with a programmable feedback level and/or an external contact to indicate that the desired level has been reached.

Pre-Charge with Thrust Bearing Function Disabled.

The pre-charge level that the iQpump drive will operate at is determined by programming the Pre-Charge Level (P4-01). The drive will monitor the Feedback Level (U1-91) and compare the feedback level with the level programmed in the Pre-Charge Level (P4-01). When the feedback level reaches the Pre-Charge Level (P4-01), the drive will disable the pre-charge mode and switch to Auto Mode or automatic regulation.

The frequency reference used during the pre-charge mode is determined by programming Pre-Charge Frequency (P4-02) for a maximum allowable time set in the Pre-Charge Time (P4-03).

A multi-function digital input can be programmed to indicate the pre-charge has been completed, "Low Water Level" (H1-xx = 85), with Low Water Input (P1-15) determining if the low water detection is a normally-open or normally-closed contact.

The pre-charge can also be disabled by programming the multi-function digital input for Pre-Charge Disabled (H1-xx = 84).

The pre-charge is only active in Auto Mode. The Pre-Charge Level (P4-01) works in conjunction with the Pre-Charge Frequency (P4-02) and the Pre-Charge Time (P4-03). The units for this parameter are determined by the System Units (P1-02).

Note: The drive will stop when one of the following conditions occur:

- The feedback level rises above the Pre-Charge Level (P4-01)
- The Pre-Charge Time (P4-03) elapses, or
- The Low Water Level input (H1-xx = 85) is deactivated

The acceleration time used during pre-charge mode is determined by Acceleration Time 1 (C1-01).

If the Pre-Charge Frequency (P4-02) is less than the Minimum Pump Frequency (P1-06), the drive will internally use a Pre-Charge Frequency equal to the Minimum Pump Frequency (P1-06) value.

The pre-charge function can only be activated while the drive is in "stop" condition. To enable the pre-charge function requires the Pre-Charge Time (P4-03) and Pre-Charge Level (P4-01) to be set to a value greater than 0. When the pre-charge function is activated, a "Pre-Charge" alarm will be displayed on the digital operator.

Chart: Pre-Charge, Turn Off Feedback Level

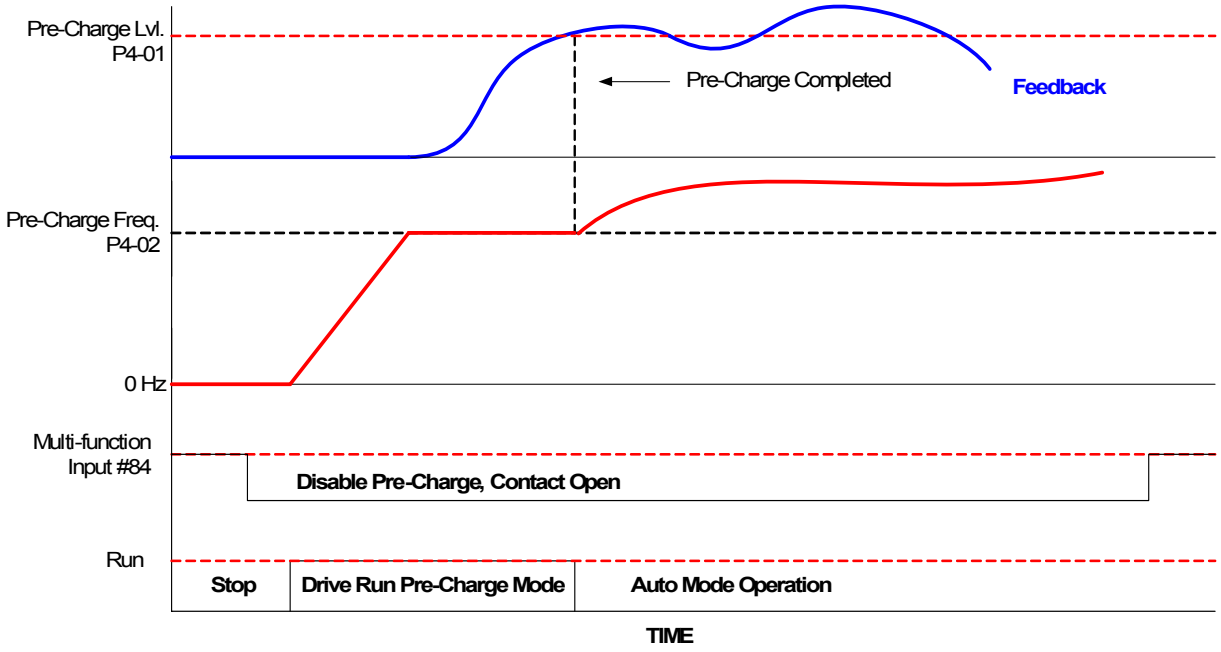


Figure 125

Chart: Pre-Charge, Turn Off Low Water Input

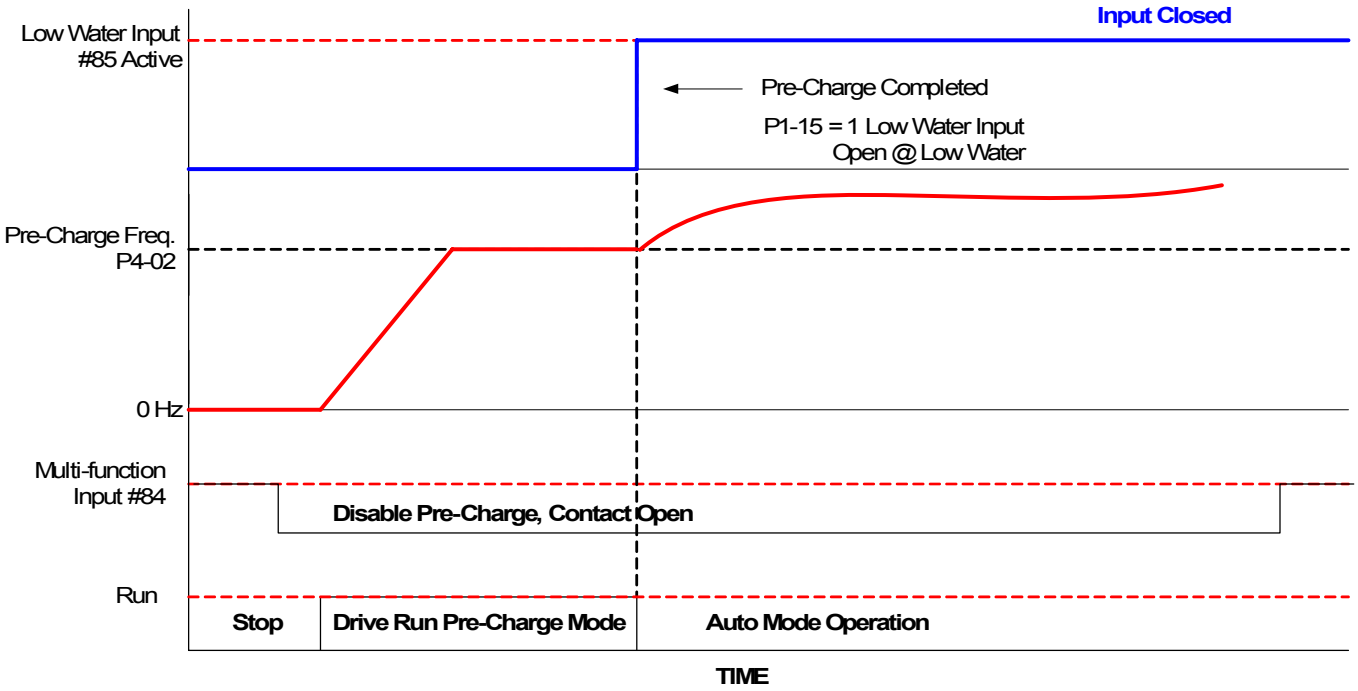


Figure 126

**Chart: Pre-Charge,
Turn Off Pre-Charge Timer**

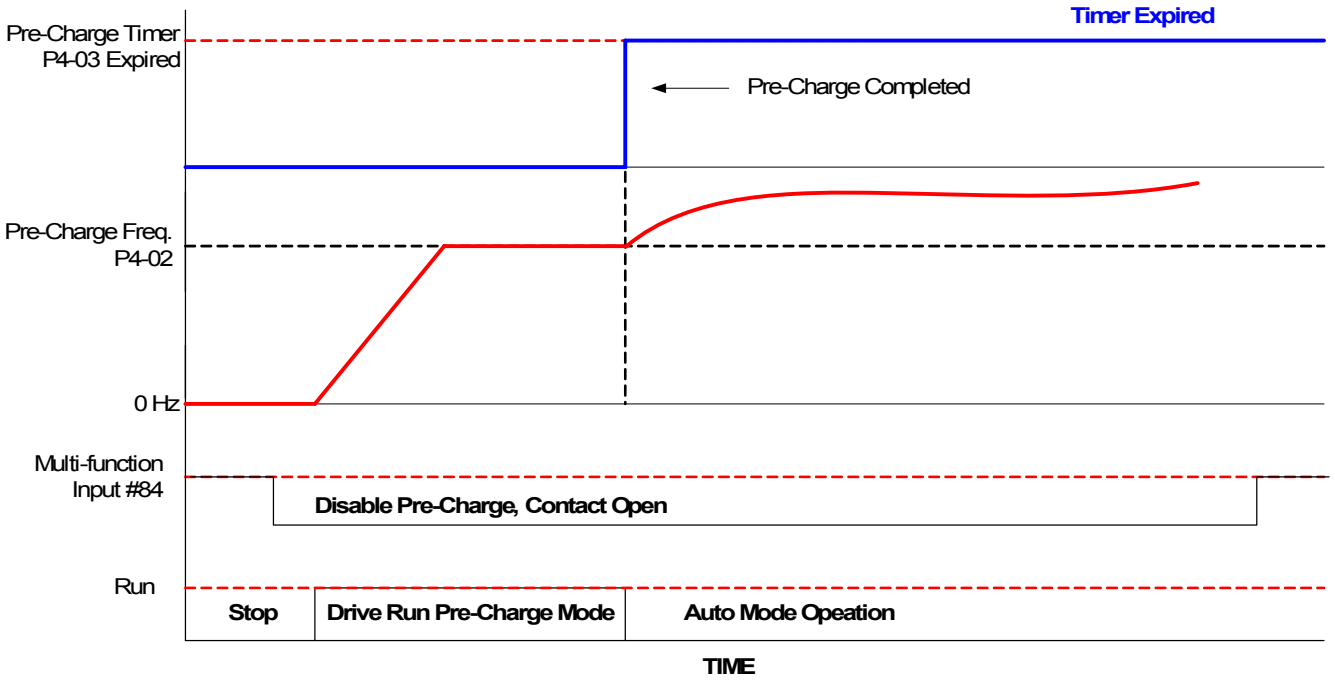


Figure 127

**Chart: Pre-Charge,
Turn Off Pre-Charge Disable Input**

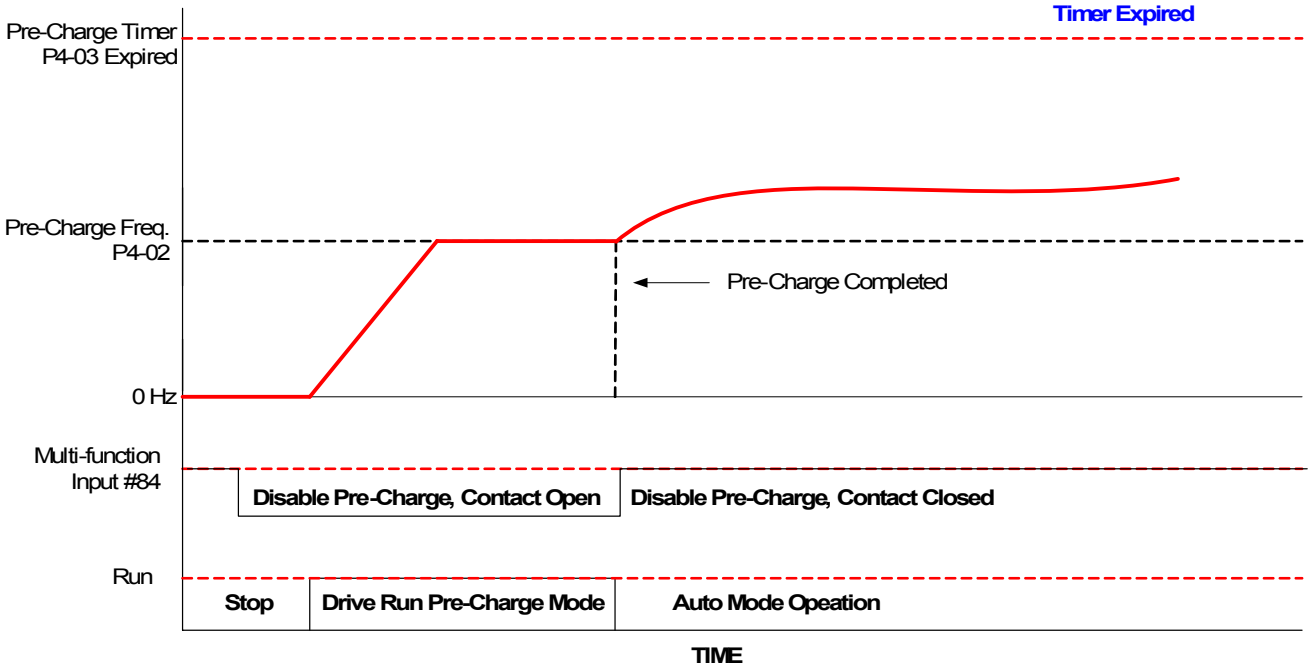


Figure 128

Pre-Charge with Thrust Bearing Function Both Enabled. *<0032>*

When both Pre-Charge and Thrust Bearing modes are enabled, the system will function as follows: Upon receiving a run command, the drive will ramp up to the Thrust Bearing Frequency (P4-05) using the Thrust Bearing Acceleration Time (P4-04). After reaching the Thrust Bearing Frequency (P4-05), the Pre-Charge becomes active and P4-05 becomes the new minimum frequency. The drive will ramp up to the Pre-Charge Frequency (P4-02) and will remain at this frequency until the Pre-Charge has been completed. This can occur when the P4-03 time has expired, P4-01 level has been reached, or the Low Water digital input has been deactivated.

If the drive is to stop at any time after the Thrust Bearing Frequency has been reached, the drive will ramp down to the P4-05 frequency at the rate programmed in Deceleration Time (C1-02). This condition can occur due to loss of run command, auto mode, or drive is in the sleep mode. The drive will then ramp down from a frequency (P4-05) to 0 using Deceleration Time programmed in P4-06. The Thrust Bearing Acceleration is active when working from sleep while the Pre-Charge is not.

The Pre-Charge Frequency (P4-02) should be set to a value greater than the Thrust Bearing Frequency (P4-05). If the Pre-Charge Frequency (P4-02) is less than the Thrust Bearing Frequency (P4-05), the drive will internally use a Pre-Charge Frequency equal to the P4-05 value.

If the Pre-Charge Frequency (P4-02) is less than the Minimum Pump Frequency (P1-06), the drive will internally use a Pre-Charge Frequency equal to the Minimum Pump Frequency (P1-06) value.

Thrust Bearing Mode and Pre-Charge Function in Auto Mode

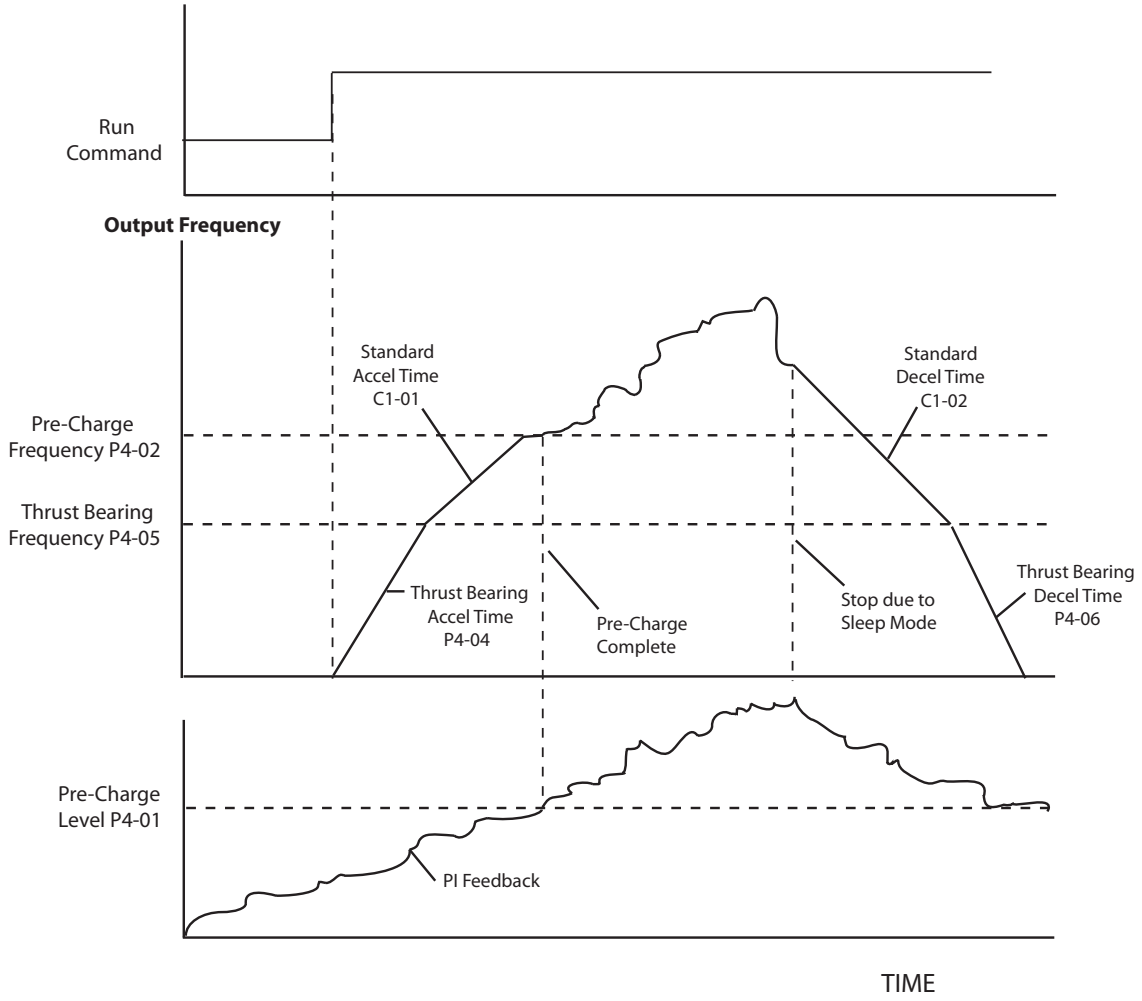


Figure 129

Thrust Bearing Mode and Pre-Charge Function in Auto Mode (Pre-Charge Time Expired)

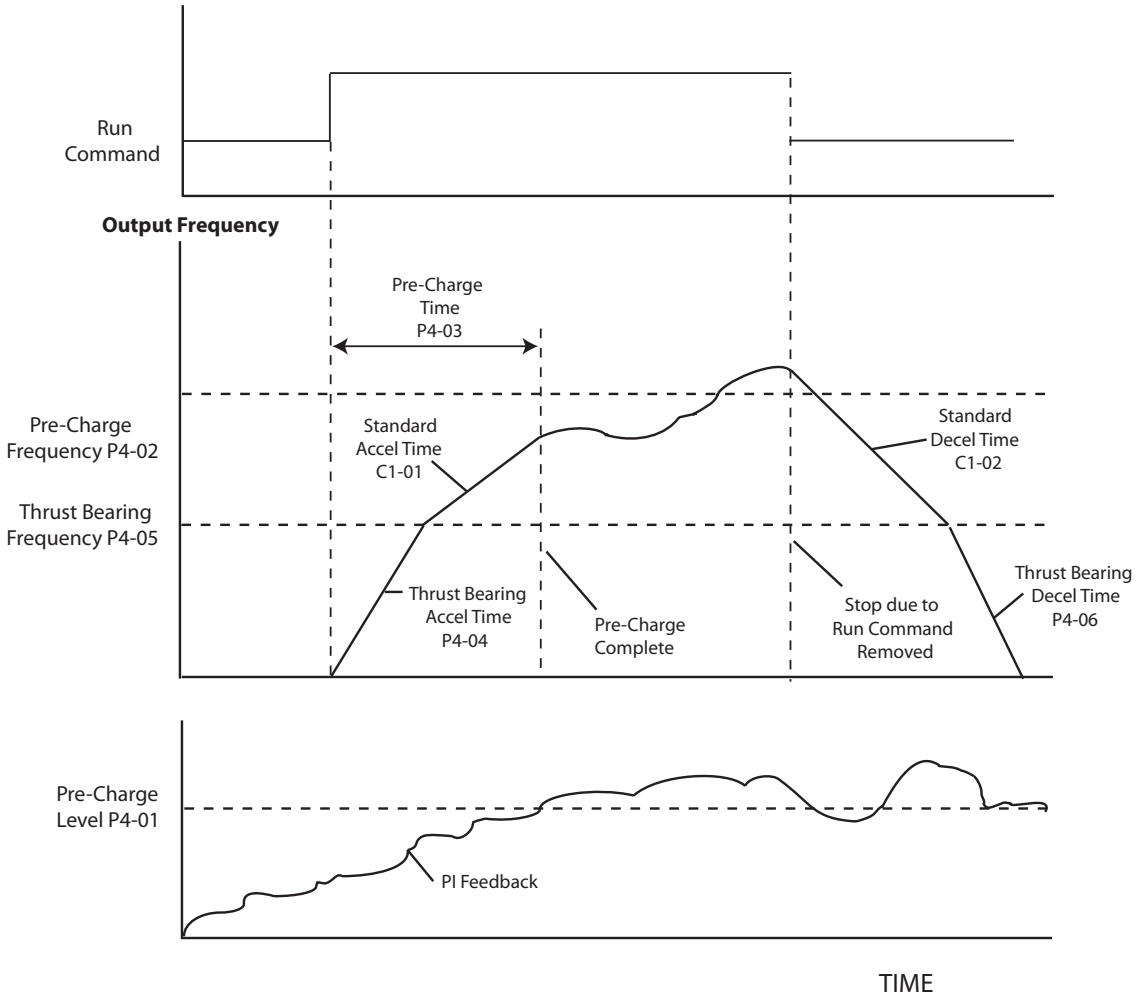


Figure 130

Thrust Bearing Mode and Pre-Charge Function with Alternating Auto and Hand Mode.

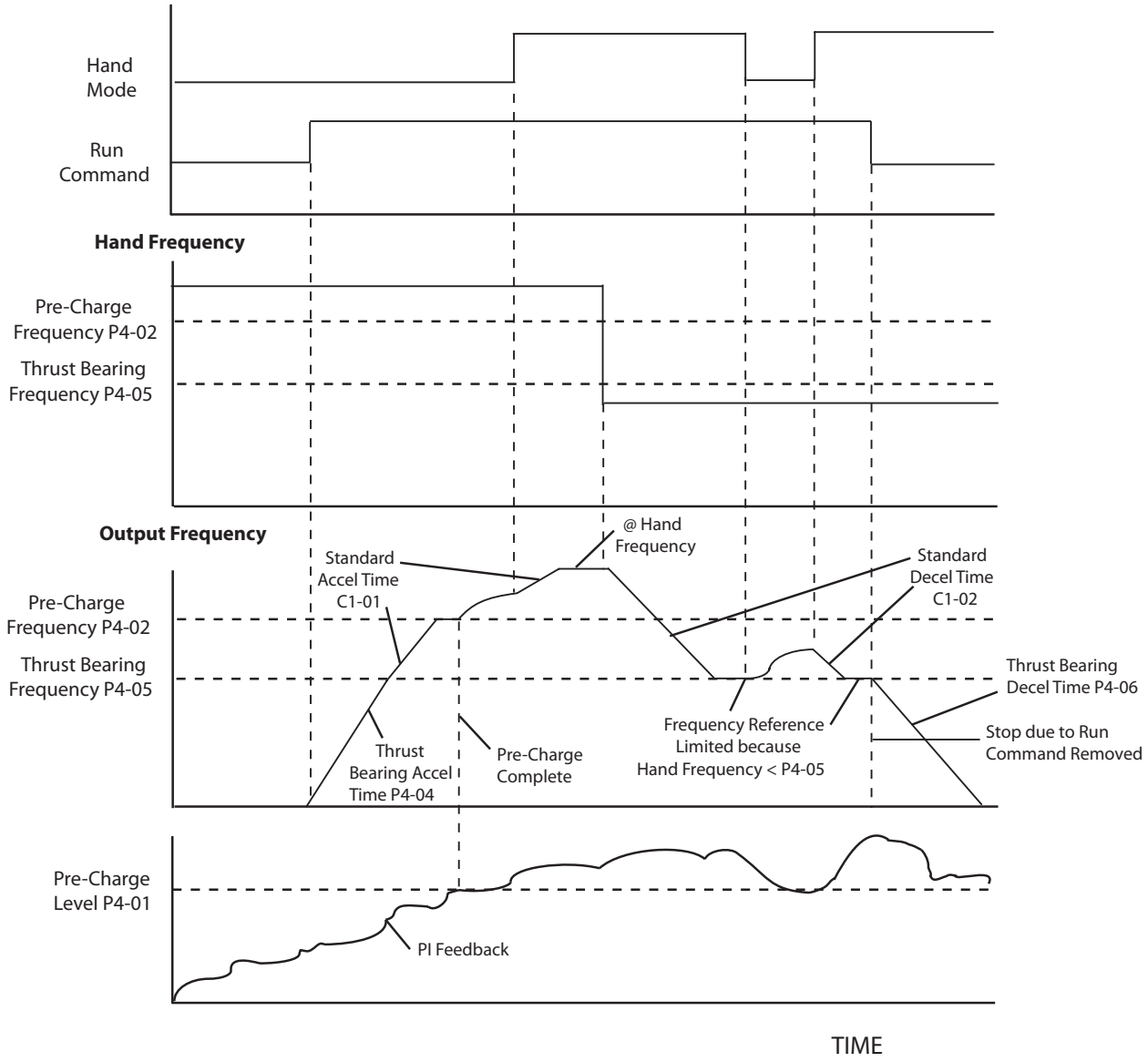


Figure 131

■ P4-02 Pre-Charge Frequency

Setting Range: 0.0 to 120.0 Hz

Factory Default: 0.0 Hz

The iQpump drive can be configured for a pre-charge function. The frequency reference used by the pre-charge function is programmed in the Pre-Charge Frequency (P4-02).

Refer to Pre-Charge Level (P4-01) for further description.

The Pre-Charge Frequency (P4-02) works in conjunction with the Pre-Change Level (P4-01).

■ P4-03 Pre-Charge Time

Setting Range: 0.0 to 3600.0 min

Factory Default: 0.0 min

The iQpump drive can be configured for a pre-charge function. The maximum allowable time for the pre-charge function is programmed in the Pre-Charge Time (P4-03). Setting P4-03 to a value of 0 will disable the pre-charge function.

Refer to Pre-Charge Level (P4-01) for further description.

The Pre-Charge Time (P4-03) works in conjunction with the Pre-Change Level (P4-01).

■ P4-04 Thrust Bearing Acceleration Time <0032>

Setting Range: 0.0 to 6000.0 sec

Factory Default: 1.0 sec

The iQpump drive can be configured for a thrust bearing function. The acceleration time, when the thrust bearing function is enabled (P4-05 > 0), is programmed in the Thrust Bearing Acceleration Time (P4-04).

Refer to Thrust Bearing Frequency (P4-05) for further description.

The Thrust Bearing Acceleration Time (P4-04) works in conjunction with the Thrust Bearing Frequency (P4-05).

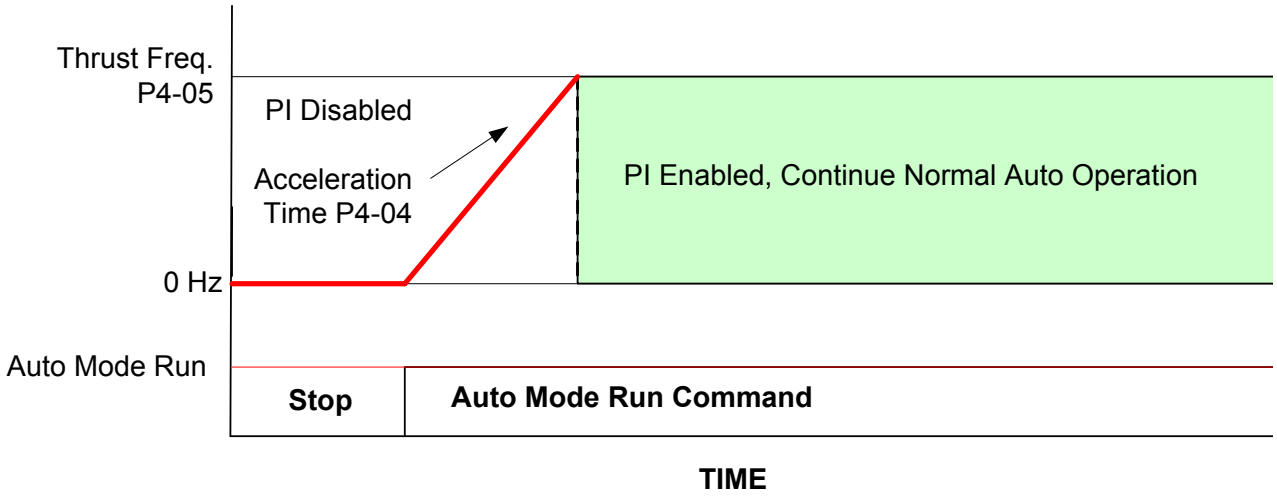


Figure 132

■ P4-05 Thrust Bearing Frequency

Setting Range: 0.0 to 120.0 Hz

Factory Default: 0.0 Hz

The iQpump drive can be configured for special functions for dedicated pumping applications. These functions are: Pre-Charge Level (P4-01) and Thrust Bearing Frequency (P4-05).

Refer to the Pre-Charge Level (P4-01) for further description about the pre-charge function.

The thrust bearing function will be activated when the frequency value is greater than 0 for the Thrust Bearing Frequency (P4-05) parameter and the pre-charge function is de-activated. The pre-charge function will de-activate the thrust bearing function.

The thrust bearing frequency of the iQpump drive will operate as determined by programming the Thrust Bearing Frequency (P4-05). The drive's output will ramp up or accelerate up to the thrust bearing frequency based on the acceleration time programmed in the Thrust Bearing Acceleration Time (P4-04).

The PI mode is automatically disabled during the thrust bearing operation. Once the output frequency reaches the thrust bearing frequency programmed in the Thrust Bearing Frequency (P4-05), the drive will automatically switch to the Auto Mode or automatic regulation. The thrust bearing function is available in Hand and Auto Modes.

The Thrust Bearing and Pre-Charge functions will work in tandem, if both are enabled.

Setting Thrust Bearing Frequency (P4-05) to a value of 0 will disable this function.

The Thrust Bearing Frequency (P4-05) works in conjunction with the Thrust Bearing Acceleration Time (P4-04).

When the thrust bearing function is activated, a "Thrust Bearing" alarm will be displayed on the digital operator.

Note:

- In Auto Mode, the Minimum Pump Frequency (P1-06) will become the thrust bearing frequency if the minimum pump frequency is less than the Thrust Bearing Frequency (P4-05).
- In Hand Mode, the minimum frequency will be the Thrust Bearing Frequency (P4-05).
- The thrust bearing function is required when using Electric Submersible Motors. See "CAUTION" statement that follows.

⚠ CAUTION

The following procedures are necessary for proper protection and setup of a submersible pump, for example Franklin Electric Submersible Pumps.

The Franklin Electric Submersible Pump (motor) requires an acceleration and deceleration time of one second when accelerating up from 0 - 30 Hz, or decelerating down from 30 - 0 Hz. The frequency reference of 30 Hz is the minimum allowable speed of the Franklin Electric motors. Please verify that the pump (motor) running at 30 Hz does not produce too much pressure for the pump application. Shut-off pressure at 30 Hz is 25% of shut-off pressure at 60 Hz.

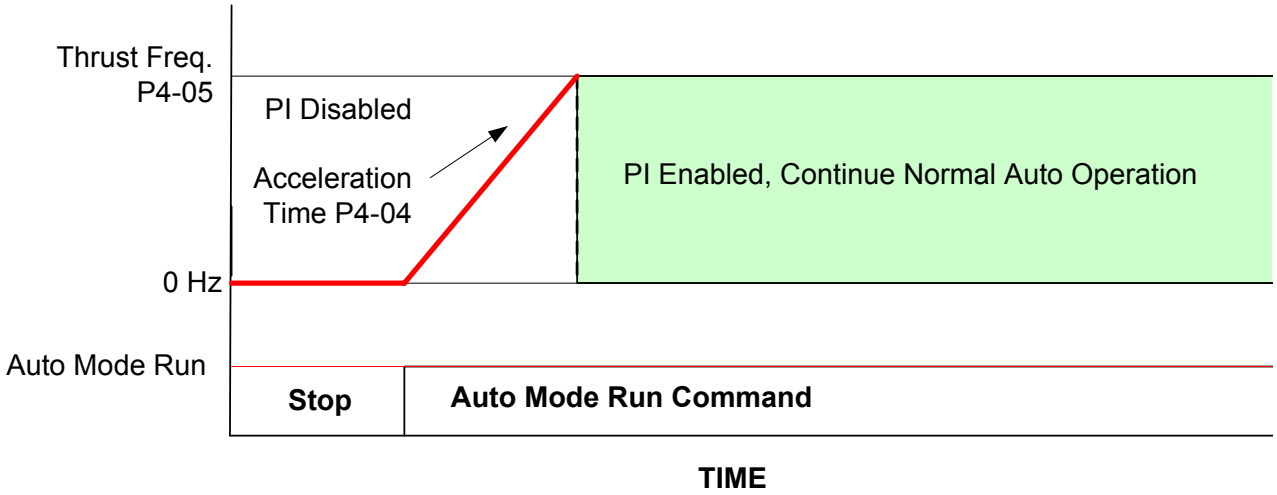


Figure 133

■ P4-06 Thrust Bearing Deceleration Time <0032>

Setting Range: 0.0 to 6000.0 sec

Factory Default: 1.0 sec

This deceleration time will be used to bring the Drive from Thrust Frequency (P4-05) to a stop when the Thrust Mode is active. Any time the Run Command is removed while the drive is operating in the Thrust Mode above the Thrust Frequency, this deceleration time will be used once the frequency reference is at or below the Thrust Frequency.

Note: In the Auto Mode, the Minimum Pump Frequency (P1-06) will become the Thrust Frequency if smaller than the Thrust Frequency (P4-05).
In the Hand Mode, the Minimum Pump Frequency (P1-06) will become the Thrust Frequency if smaller than the Thrust Frequency (P4-05).

■ P4-07 Feedback Fault Auto Restart Enable <0032>

Setting Range: 0 to 7

Factory Default: 0

Setting to enable / disable Auto Restart for the following iQpump transducer / feedback faults:

LL: Low Level Feedback (P1-07)
HL: High Level Feedback (P1-09)
TL: Transducer Loss (b5-12)

Setting	TL	HL	LL
0:	Disable	Disable	Disable
1:	Disable	Disable	Enable
2:	Disable	Enable	Disable
3:	Disable	Enable	Enable
4:	Enable	Disable	Disable
5:	Enable	Disable	Enable
6:	Enable	Enable	Disable
7:	Enable	Enable	Enable

Note: Parameter L5-01 needs to be set to “1” and program L5-03 needs to be set to the applicable time.

■ P4-08 Protection Fault Auto Restart Enable <0032>

Setting Range: 0 to 7

Factory Default: 0

Setting to enable / disable Auto Restart for the following iQpump protection faults:

SP: Not Maintaining Set-Point (P1-11)
LOP: Loss of Prime (P1-12)
POC: Pump Over Cycling (P2-08)

Setting	POC	LOP	SP
0:	Disable	Disable	Disable
1:	Disable	Disable	Enable
2:	Disable	Enable	Disable
3:	Disable	Enable	Enable
4:	Enable	Disable	Disable
5:	Enable	Disable	Enable
6:	Enable	Enable	Disable
7:	Enable	Enable	Enable

Note: Parameter L5-01 needs to be set to “1” and program L5-03 needs to be set to the applicable time.

■ P4-09 Loss of Prime Maximum Restart Time After Restart <0032>

Setting Range: 0.2 to 6000.0 min

Factory Default: 0.2 min

If the restart fails (or is not attempted due to a continuing fault condition) the Drive waits this many minutes before attempting another restart.

Note: This parameter will take the place of L5-03 during a Loss of Prime Fault restart attempt.

■ P4-10 Auto Mode Operator Run Power Down Storage

Setting	Description
0	Disabled *(factory default)*
1	Enabled

⚠ WARNING

When the drive is powered down while running, and upon the return of power, the drive will automatically initiate an internal “Run” command. Take extreme caution when using this function.

- Make sure it is safe to use this function in combination with the application requirements.
- This function is the sole responsibility of the user when activated (enabled) and the user accepts application liability.

This “Run” status can be stored when operating from the digital operator (b1-02 = 0) and in the Auto Mode. To enable this function, program the Auto Mode Operator Run Power Down Storage (P4-10) to a value of 1.

The primary use of this function is to automatically restart the pump system after a long period of power loss.

Note: This function does not work if the system is left in the Hand Mode and power is removed.

◆ P5 Pump Protection

■ P5-01 Hand Mode Reference

Setting	Description
0	Analog Input A1 (0~10 V)
1	Hand Reference (P5-02) *(factory default)*

The iQpump drive can be operated manually or in the “Hand” mode. The frequency for the hand mode can be an analog input (0 ~ 10 Vdc) or from the digital operator (P5-02).

The hand mode operation is useful when testing the system during initial start-up without the automated regulation functions of the iQpump drive.

The selection to determine the hand mode reference is determined by programming the Hand Mode Reference Source (P5-01). If P5-01 = 1, then the hand reference frequency is set by programming the Hand Reference (P5-02).

The Hand Mode Reference Source (P5-01) works in conjunction with the Hand Reference (P5-02) if P5-01 = 1.

The Hand Mode can be activated from the digital operator or by programming a multi-function digital input for “Hand Mode” (H1-xx = 80).

Note: To change the hand reference requires the P5-02 parameter to be programmed also. U1-01 will be the only monitor available and the Up/Down arrow keys will not operate like a digital MOP.

■ Hand Mode Operation from Keypad (Factory Default)

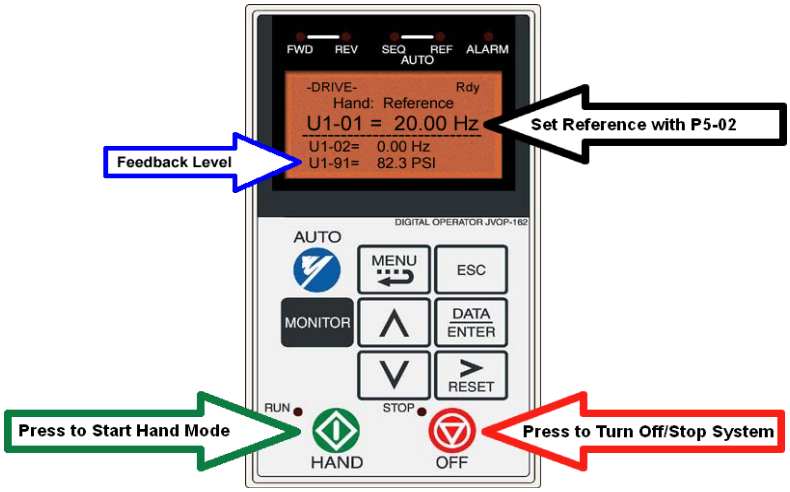


Figure 134

■ Hand Mode Operation from External Signal (P5-01 = 0)

Connection Diagram of Potentiometer

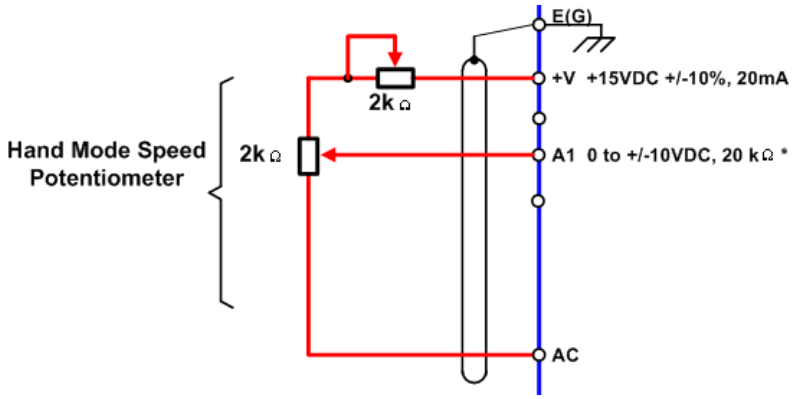


Figure 135

Connection Diagram of External Signal

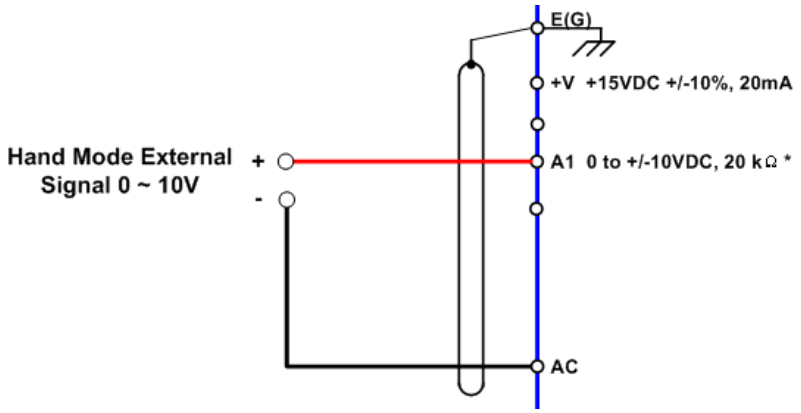


Figure 136

■ P5-02 Hand Reference

Setting Range: 0.0 to 120.0 Hz

Factory Default: 0.0 Hz

The iQpump drive can be operated manually or in the “Hand” mode. The frequency reference for the hand mode is programmed in the Hand Reference (P5-02).

The Hand Reference (P5-02) is used when the hand mode is active and the Hand Mode Reference Source (P5-01) is set to 1.

Refer to Hand Mode Reference Source (P5-01) for further description.

The Hand Reference (P5-02) works in conjunction with the Hand Mode Reference Source (P5-01).

Note: If the thrust bearing function is enabled, P4-05 determines the minimum Hand Reference allowed.

■ P5-03 HAND / AUTO During Run Selection <0032>

Setting Range: 0 to 1

Factory Default: 0

Selects if the drive will permit switching between HAND and AUTO modes while running.
0: Disabled
1: Enabled

Switching from HAND to AUTO is not permitted when the Drive output frequency is less than the PID minimum speed.

Switching from AUTO to HAND is not permitted when the Drive is running in the multiplex mode with auxiliary drives enabled.

■ P5-04 Hand Key Function Selection <0032>

Setting Range: 0 to 1

Factory Default: 1

Enables or disables the “Hand” key on the digital operator.
0: Disabled
1: Enabled

◆ Pump Tuning

■ PI Control Tuning (b5 Group)

The built-in PI controller in the iQpump is used to control process variables such as pressure, flow or fluid level. PI control is designed to eliminate the need for continuous operator attention. The drive has the capability to accept an analog signal 0-10 Vdc or 4-20 mA as feedback for a PI (Proportional + Integral) control function. A process reference setpoint is connected to the iQpump drive or set via the digital operator and an actual process value feedback is also brought back to the iQpump drive.

Examples:

Weather the iQpump is used in either Simplex (P1-03 = 0) or Multiplex mode (P1-01 = 1 or 2); the PI settings will need to be adjusted based on individual system applications. The three parameters below should be the only adjustments required. If control becomes unstable, please refer to the PI Control (b5-xx) for more details.

Note: These parameters are also programmed through the quick start menu.

Step 1. Make sure that PI is enabled (factory default is enabled b5-01 = 1).

■ b5-01 PI Mode

Setting	Description
0	Disabled
1	Enabled (*factory default*)
2	Fref + PI

The iQpump drive can be used as a stand-alone PI controller. If PI functionality is selected by parameter b5-01, the iQpump drive will adjust its output to cause the feedback from a transmitter to match the PI setpoint (b5-19). The setting of b5-01 will determine whether PI functionality is disabled (b5-01 = “0: Disabled”), enabled (b5-01 = “1: Enabled”), or enabled with the output of the PI function used to trim a Speed Command (b5-01 = “3: Fref+PI”).

Step 2. Adjust Proportional Gain Setting.

■ b5-02 Proportional Gain Setting

Setting Range: 0.00 to 25.00

Factory Default: 2.00

The proportional gain will apply a straight multiplier to the calculated difference (error) between the PI setpoint and the measured transmitter feedback at terminal A2. A large value will tend to reduce the error but may cause instability (oscillations) if too high. A small value may allow too much offset between the setpoint and feedback (see *Figure 137*).

Step 3. Adjust Integral Time

■ b5-03 Integral Time Setting

Setting Range: 0.0 to 360.0 sec

Factory Default: 5.0 sec

The Integral factor of PI functionality is a time-based gain that can be used to eliminate the error (difference between the setpoint and feedback at steady state). The smaller the Integral Time set into b5-03, the more aggressive the Integral factor will be. To turn off the Integral Time, set b5-03 = 0.0 seconds.

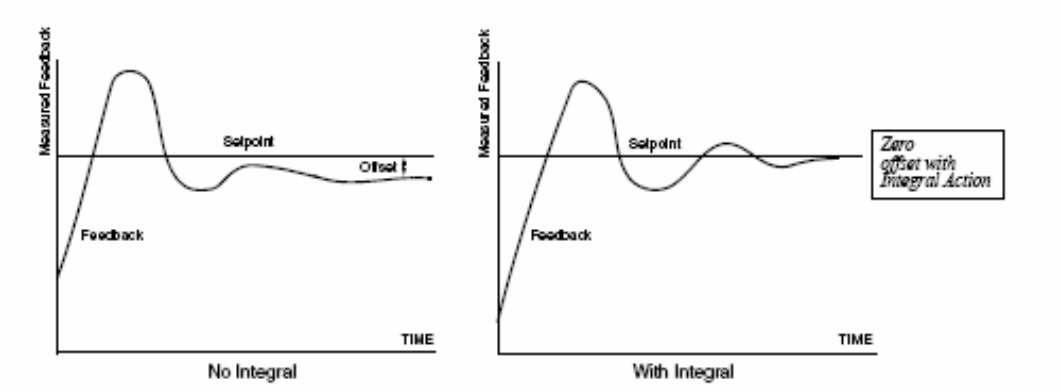


Figure 137 PI Feedback Response Characteristics

The iQpump offers programmable acceleration and deceleration ramps. Each parameter has a setting range of 0.0 to 6000.0 seconds.

Acceleration Time: This is the time it takes to accelerate from 0 Hz to Maximum Output Frequency defined by parameter E1-04.

Deceleration Time: This is the time it takes to decelerate from Maximum Output Frequency defined by parameter E1-04 to 0 Hz.

Example: C1-01 Acceleration Time 1 programmed for 30 seconds, E1-04 Maximum Output Frequency set to 60 Hz. It will take the iQpump Controller 20 seconds to accelerate from 0 to 40 Hz (40 Hz ÷ 60 Hz x 30 sec = 20 sec).

Example: C1-02 Deceleration Time 1 programmed for 50 seconds, E1-04 Maximum Output Frequency set to 60 Hz. It will take the iQpump Controller 10 seconds to decelerate from 60 to 30 Hz (30 Hz ÷ 60 Hz x 50 sec = 25 sec).

■ Factory Default Settings for C1-01 Acceleration Time and C1-02 Deceleration Time is 25.0 Seconds

Thrust Bearing Operation (see *"P4-04 Thrust Bearing Acceleration Time: on page 156*) uses a separate acceleration time defined by parameter P4-04. Once Thrust frequency is reached, the iQpump drive returns to its normal acceleration time set by C1-01.
Pre-Charge mode uses C1-01 as its acceleration time.
Hand Mode Operation uses C1-01 and C1-02 for acceleration and deceleration time.

Auto Mode can use acceleration time C1-05 and deceleration time C1-06, depending on parameter P3-12 setting (see section. *P3-12 Delta Setpoint Feedback Acc/Dec Changeover on page 155*.)

◆ System Response During Normal Automatic Operation (P3-12)

Acceleration and Deceleration times can automatically be adjusted during Automatic Setpoint regulation to improve system stability.

■ Enable Alternate Acceleration / Deceleration Ramps based on Set-Point and Feedback Level

To enabled the alternate acceleration and deceleration time, parameter P3-12 has to be programmed to a value greater than 0.

Please refer to section *P3-12 Delta Setpoint Feedback Acc/Dec Changeover on page 155* for a detailed explanation.

◆ Friction Compensation for Single Pump Systems (P3-13, P3-14)

Please refer to section *P3-13 Friction Compensation Start Frequency on page 156* and *P3-14 Maximum Friction Increase at Maximum Frequency on page 156* for a detailed explanation.

◆ Friction Compensation for Multi-Pump Systems (P3-07, P3-08)

Please refer to section *P3-07 Multi Pump Setpoint Increase on page 151* and *P3-08 Multi Pump Setpoint Decrease on page 152* for a detailed explanation.

◆ T1 Auto-Tuning

■ T1-02 Motor Rated Power

Setting Range: 0.00 to 650.00 kW

Factory Default: Model Dependent

■ T1-04 Motor Rated Current

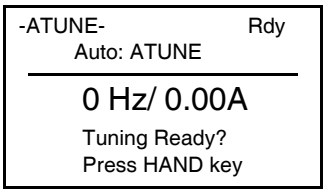
Setting Range: Model Dependent

Factory Default: Model Dependent

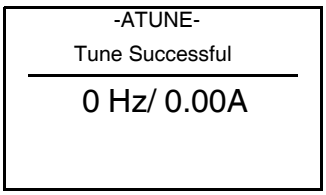
Auto tuning is recommended to achieve optimum performance. In addition, the iQpump drive requires Line-To-Line Resistance auto-tuning before it can properly perform the Estimated Speed Search method. This method of speed search allows for bi-directional speed search. The T1 parameters are found under the Auto-Tuning menu.

To perform auto-tuning follow these steps:

1. T1-02 should be left at the default value (the last 3 digits of the iQpump drive model number).
2. In T1-04, enter the Full Load Amps (FLA) as stamped on the motor's nameplate.
3. Press the INCREASE key once to display this:



4. If ready, press the HAND key once to start auto-tuning. This process will last for approximately 15 seconds. Once auto-tuning is finished, the digital operator will display this:



5. To exit the Auto-Tuning menu, press the MENU key once.

Note: It is possible to a get a "Data Invalid" error if the either T1-02 or T1-04 fall outside the range of what the iQpump drive will accept as reasonable levels for the programmed size of the iQpump drive (o2-04).

Appendix: A

Parameters

This appendix lists all the parameter numbers and names, along with a description of each. Also, below the parameter name in bold type is the abbreviated name as it appears on the digital operator display/keypad.

Parameter List

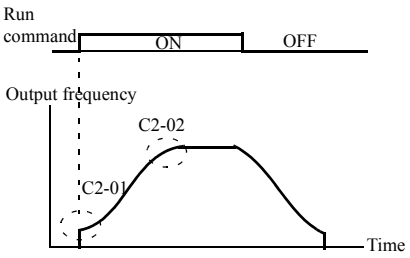
Table 1 Parameter List

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
			Initialization				
A1-00 ♦	0100H	Language Selection **Select Language**	Language selection for digital operator display. 0: English 2: Deutsch 3: Francais 4: Italiano 5: Espanol 6: Portugues *Not returned to factory setting by initialization	0 to 6	0	Programming	*8*
A1-01 ♦	0101H	Access Level Selection **Access Level**	This setting determines which parameters are accessible. 0: Operation Only 2: Advanced Level	0 or 2	2	Programming	*8*
A1-03	0103H	Initialize Parameters **Init Parameters**	Used to return all parameters to their factory or user setting. 0: No Initialize 1110: User Initialize (The user must set their own parameter default values and then parameter o2-03 must be set to "1" to save them. If the parameter values are changed after o2-03 is set to "1," the user default values can be restored by setting A1-03 to 1110.) 2220: 2-Wire Initial 3330: 3-Wire Initial	0 to 3330	0	Programming	*8*
A1-04	0104H	Password 1 **Enter Password**	When the value set into A1-04 does NOT match the value set into A1-05, parameters A1-01 thru A1-03 cannot be changed. All other parameters as determined by A1-01 can be changed. Parameter A1-05 can be accessed by pressing the MENU key while holding the RESET key.	0 to 9999	0	Programming	*99*
A1-05	0105H	Password 2 **Select Password**		0 to 9999	0	Programming	*9*
♦ Denotes that parameter can be changed when the drive is running. * Menu location is Pump Quick Setup when b5-01=1, and Programming when b5-01=0.							
			Sequence				
b1-01	0180H	Frequency Reference Selection **Reference Source**	Selects the speed command (frequency reference) input source. 0: Operator - Digital preset speed d1-01 1: Terminals - Analog Input Terminal A1 (or Terminal A2 see parameter H3-13) 2: Serial Com - RS-485 terminals R+, R-, S+ and S- 3: Option PCB - Option board connected at 2CN	0 to 3	0	Pump Quick Setup	*10*
b1-02	0181H	Run Command Selection **Run Source**	Selects the run command input source. 0: Operator - "Hand" and "Off" keys on digital operator 1: Terminals - Contact Closure on Terminal S1 2: Serial Com - RS-485 terminals R+, R-, S+ and S- 3: Option PCB - Option board connected at 2CN	0 to 3	0	Pump Quick Setup	*12*
b1-03	0182H	Stopping Method Selection **Stopping Method**	Selects the stopping method when the run command is removed. 0: Ramp to Stop 1: Coast to Stop 2: DC Injection to Stop 3: Coast w/Timer (A new run command is ignored if input before the time in C1-02 expires.)	0 to 3	0	Programming	*15*
b1-07	0186H	Local/Remote Run Selection **LOC/REM RUN Sel**	0: Cycle External RUN - If the run command is closed when switching from hand (local) mode to auto (remote) mode, the Drive will not run. 1: Accept External RUN - If the run command is closed when switching from hand (local) mode to auto (remote) mode, the Drive WILL run. **Note:** Used with LCD Operator only.	0 or 1	0	Programming	—
b1-08	0187H	Run Command Selection During Program **RUN CMD at PRG**	0: Disabled - Run command accepted only in the operation menu. 1: Enabled - Run command accepted in all menus (except when b1-02 = 0).	0 or 1	0	Programming	—
b1-11	010FH	Drive Delay Time Setting **Wait to Run Time**	After a run command, Drive output will start after this delay time.	0 to 600	0 sec	Programming	*17*
			DC Braking				
b2-01	0189H	DC Injection Braking Start Frequency **DCInj Start Freq**	Sets the frequency at which DC injection braking starts when ramp to stop (b1-03 = 0) is selected. If b2-01< E1-09, DC injection braking starts at E1-09.	0.0 to 10.0	0.5 Hz	Programming	*18*
b2-02	018AH	DC Injection Braking Current **DCInj Current**	Selects the DC injection braking current as a percentage of the Drive rated current.	0 to 100	50%	Programming	*18*

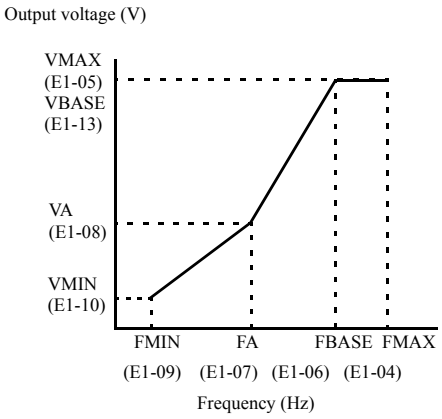
Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
b2-03	018BH	DC Injection Braking Time at Start **DCInj Time @ Start**	Sets the time length of DC injection braking at start in units of 1 second.	0.00 to 10.00	0.00 sec	Programming	*18*
b2-04	018CH	DC Injection Braking Time at Stop **DCInj Time @ Stop**	When b1-03 = 2 actual DC Injection time is calculated as follows: b2-04 * 10 * Output Frequency / E1-04. When b1-03 = 0, this parameter determines the amount of time DC Injection is applied to the motor at the end of the decel ramp. This should be set to a minimum of 0.50 seconds when using HSB. This will activate DC injection during the final portion of HSB and help ensure that the motor stops completely.	0.00 to 10.00	0.5 sec	Programming	*18*
b2-09	01E1H	Motor Pre-Heat Current **Preheat Current**	Motor Pre-heat current in% of Drive rated current. This is used to keep the motor warm to prevent condensation and is used in conjunction with a digital input (data = 60).	0 to 100	0%	Programming	*19*
			Speed Search				
b3-01	0191H	Speed Search Selection **SpdSrch at Start**	Enables/disables and selects the speed search function at start. 0: SpdsrchF Disable - Speed search at start is disabled (estimated speed method is used at other times) 1: SpdsrchF Enable - Speed search is enabled (estimated speed method) 2: SpdsrchI Disable - Speed search at start is disabled (current detection method is used at other times) 3: SpdscrhI Enable - Speed search is enabled (current detection method) Estimated Speed Method: Actual motor speed and direction is estimated, then the motor is ramped from that speed to the commanded speed. Current Detection Method: Current level is monitored while output frequency is ramped down.	0 to 3	2	Programming	*20*
b3-02	0192H	Speed Search Deactivation Current **SpdSrch Current**	Used only when b3-01 = 3. Sets the speed search operation current as a percentage of Drive rated current.	0 to 200	120%	Programming	*22*
b3-03	0193H	Speed Search Deceleration Time **SpdSrch Dec Time**	Used only when b3-01 = 3. Sets the deceleration time during speed search.	0.1 to 10.0	2.0 sec	Programming	*22*
b3-05	0195H	Speed Search Delay Time **Search Delay**	Delays the speed search operation after a momentary power loss to allow time for an external output contactor to re-energize.	0.0 to 20.0 sec	0.2 sec	Programming	*22*
b3-14	019EH	Bidirectional Speed Search Selection **Bidir Search Sel**	0: Disabled 1: Enabled	0 or 1	1	Programming	*22*
			Delay Timers				
b4-01	01A3H	Timer Function ON-Delay Time **Delay-ON Timer**	Used in conjunction with a multi-function digital input and a multi-function digital output. This sets the amount of time between when the digital input is closed, and the digital output is energized.	0.0 to 3000.0	0.0 sec	Programming	*23*
b4-02	01A4H	Timer Function OFF-Delay Time **Delay-OFF Timer**	Used in conjunction with a multi-function digital input and a multi-function digital output. This sets the amount of time the output stays energized after the digital input is opened.	0.0 to 3000.0	0.0 sec	Programming	*23*
			PI Control				
b5-01	01A5H	PI Mode Setting **PI Mode**	This parameter enables / disables the closed loop (PI) controller. 0: Disabled 1: Enabled (commanded speed becomes PI setpoint) 3: Fref+PI	0, 1, 3	1	Programming	*25*, *170*
b5-02 ♦	01A6H	Proportional Gain Setting **P Gain**	Sets the proportional gain of the PI controller.	0.00 to 25.00	2.00	Programming	*25*, *170*
b5-03 ♦	01A7H	Integral Time Setting **PI I Time**	Sets the integral time for the PI controller. A setting of zero disables integral control.	0.0 to 360.0	5.0 sec	Programming	*25*, *170*
b5-04 ♦	01A8H	Integral Limit Setting **PI I Limit**	Sets the maximum output possible from the integrator. Set as a% of fmax.	0.0 to 100.0	100.0%	Programming	*26*
b5-06 ♦	01AAH	PI Output Limit **PI Limit**	Sets the maximum output possible from the entire PI controller. Set as a% of fmax.	0.00 to 100.0	100.0%	Programming	*26*

♦ Denotes that parameter can be changed when the drive is running. * Menu location is Quick Setting when b5-01=1, and Programming when b5-01=0.

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
b5-07 ♦	01ABH	PI Offset Adjustment **PI Offset**	Sets the amount of offset of the output of the PI controller. Set as a% of fmax. The PI Offset Adjustment parameter has two different uses. Parameter b5-07 serves different functions depending on whether it is used on a standard PI loop or a Differential PI loop. 1: Parameter b5-07 causes an offset to be applied to the output of the PI function in a non-Differential PI loop. Every time the PI output is updated, the offset is summed with the PI output. This can be used to artificially kick-start a slow starting PI loop. 2: If the Drive is configured for Differential PI Regulation (H3-09=16), then the PI Offset is the targeted maintained differential between the signal measured on analog input A1 and the signal measured on analog input A2.	–100.0 to +100.0	0.0%	Programming	*26*
b5-08 ♦	01ACH	PI Primary Delay Time Constant **PI Delay Time**	Sets the amount of time for a filter on the output of the PI controller.	0.00 to 10.00	0.00 sec	Programming	*26*
b5-09	01ADH	PI Output Level Selection **Output Level Sel**	Determines whether the PI controller will be direct or reverse acting. 0: Normal Output (direct acting) 1: Reverse Output (reverse acting)	0 or 1	0	Programming	*27*
b5-10	01AEH	PI Output Gain Setting **Output Gain**	Sets the output gain of the PI controller.	0.0 to 25.0	1.0	Programming	*27*
b5-12	01B0H	PI Feedback Reference Missing Detection Selection **PFb los Det Sel**	0: Disabled 1: Alarm 2: Fault	0 to 2	0	Pump Quick Setup	—
b5-13	01B1H	PI Feedback Loss Detection Level **Fb los Det Lvl**	Sets the PI feedback loss detection level as a percentage of maximum frequency (E1-04).	0 to 100	0%	Pump Quick Setup	*27*
b5-14	01B2H	PI Feedback Loss Detection Time **Fb los Det Time**	Sets the PI feedback loss detection delay time in terms of seconds.	0.0 to 25.5	1.0 sec	Pump Quick Setup	*27*
b5-17	01B5H	PI Accel/Decel Time **Acc/Dec Time**	Applies an accel/decel time to the PI setpoint reference.	0.0 to 25.5	0.0 sec	Programming	*28*
♦ Denotes that parameter can be changed when the drive is running.							
			Energy Saving				
b8-01	01CCH	Energy Saving Control Selection **Energy Save Sel**	Energy Savings function enable/disable selection 0: Disabled 1: Enabled	0 or 1	0	Programming	*29*
b8-04	01CFH	Energy Saving Coefficient Value **Energy Save COEF**	Used to fine-tune the energy savings function.	0.0 to 655.00	kVA Dependent	Programming	*29*
b8-05	01D0H	Power Detection Filter Time **kW Filter Time**		0 to 2000	20 ms	Programming	*29*
b8-06	01D1H	Search Operation Voltage Limit **Search V Limit**		0 to 100	0%	Programming	*29*
			Accel / Decel				
C1-01 ♦	0200H	Acceleration Time 1 **Accel Time 1**	Sets the time to accelerate from zero to maximum frequency.	0.0 to 6000.0	25.0 sec	Pump Quick Setup	*30*
C1-02 ♦	0201H	Deceleration Time 1 **Decel Time 1**	Sets the time to decelerate from maximum frequency to zero.		25.0 sec	Pump Quick Setup	*30*
C1-03 ♦	0202H	Acceleration Time 2 **Accel Time 2**	Sets the time to accelerate from zero to maximum frequency when selected via a multi-function input.		10.0 sec	Programming	*30*
C1-04 ♦	0203H	Deceleration Time 2 **Decel Time 2**	Sets the time to decelerate from maximum frequency to zero when selected via a multi-function input.		10.0 sec	Programming	*30*
C1-05 ♦	0204H	Acceleration Time 3 **Accel Time 3**	Sets the time to accelerate from zero to maximum frequency when activated by P3-12. Used for system response stabilization.		50.0 sec	Programming	*30*
C1-06 ♦	0205H	Deceleration Time 3 **Decel Time 3**	Sets the time to decelerate from maximum frequency to zero when activated by P3-12. Used for system response stabilization.		50.0 sec	Programming	*30*
C1-09	0208H	Fast Stop Time **Fast Stop Time**	Sets the time to decelerate from maximum frequency to zero for the "Fast Stop" function.	0.0 to 6000.0	10.0 sec	Programming	*30*
♦ Denotes that parameter can be changed when the drive is running.							

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
C1-11	020AH	Accel/Decel Switch Frequency **Acc/Dec SW Freq**	Sets the frequency for automatic switching of accel / decel times. Fout < C1-11: Accel/Decel Time 2 Fout >= C1-11: Accel/Decel Time 1 Multi-function input “Multi-Acc/Dec 1" has priority over C1-11.	0.0 to 200.0	0.0 Hz	Programming	*30*
			S-Curve Acc/Dec				
C2-01	020BH	S-Curve Characteristic at Accel Start **SCrv Acc @ Start**	S-curve is used to further soften the starting ramp. The longer the S-curve time, the softer the starting ramp.  	0.00 to 2.50	0.20 sec	Programming	*32*
C2-02	020CH	S-Curve Characteristic at Accel End **SCrv Acc @ End**		0.00 to 2.50	0.20 sec	Programming	*32*
			Torque Comp				
C4-01 ♦	0215H	Torque Compensation Gain **Torq Comp Gain**	This parameter helps to produce better starting torque. It determines the amount of torque or voltage boost based upon motor current and motor resistance.	0.00 to 2.50	1.00	Programming	*33*
C4-02	0216H	Torque Compensation Primary Delay Time **Torq Comp Time**	This parameter adjusts a filter on the output of the torque compensation function. Increase to add torque stability, decrease to improve torque response.	0 to 10000	200 ms	Programming	*33*
♦ Denotes that parameter can be changed when the drive is running.							
			Carrier Freq				
C6-01	0223H	Normal Duty Selection **Normal Duty Sel**	1: Normal Duty 1 2: Normal Duty 2	1 or 2	2	Programming	*34*
C6-02	0224H	Carrier Frequency Selection **CarrierFreq Sel**	Carrier frequency sets the number of pulses per second of the output voltage waveform. 0: Low Noise (Carrier frequency is randomly moduled for lower audible noise) 1: Fc = 2.0 kHz 2: Fc = 5.0 kHz 3: Fc = 8.0 kHz 4: Fc = 10.0 kHz 5: Fc = 12.5 kHz 6: Fc = 15.0 kHz F: Program (Determined by the settings of C6-03 thru C6-05)	0 to F	kVA Dependent	Programming	*34*
C6-03	0225H	Carrier Frequency Upper Limit **CarrierFreq Max**	Maximum carrier frequency allowed when C6-02 = F.	0.4 to 15.0 kHz	kVA Dependent	Programming	*34*
C6-04	0226H	Carrier Frequency Lower Limit **CarrierFreq Min**	Minimum carrier frequency allowed when C6-02 = F.	0.4 to 15.0 kHz	kVA Dependent	Programming	*34*
C6-05	0227H	Carrier Frequency Proportional Gain **CarrierFreq Gain**	Sets the relationship of output frequency to carrier frequency when C6-02 = F.	0 to 99	0	Programming	*34*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
			Preset Reference				
d1-01 ♦	0280H	Setpoint Reference 1 **Setpoint 1**	Digital preset setpoint reference 1. Used when b1-01 = 0 and when in "hand" mode. Setting units are affected by P1-02.	1 to P1-03 Value	0	Programming	*36*
d1-02 ♦	0281H	Setpoint Reference 2 **Setpoint 2**	Digital preset setpoint reference 2. Selected via multi-function input terminals. Setting units are affected by P1-02.		0	Programming	*36*
d1-03 ♦	0282H	Setpoint Reference 3 **Setpoint 3**	Digital preset setpoint reference 3. Selected via multi-function input terminals. Setting units are affected by P1-02.		0	Programming	*36*
d1-04 ♦	0283H	Setpoint Reference 4 **Setpoint 4**	Digital preset setpoint reference 4. Selected via multi-function input terminals. Setting units are affected by P1-02.		0	Programming	*36*
d1-17 ♦	0292H	Jog Frequency Reference **Jog Reference**	Jog reference used when a jog is selected via the LCD operator keypad. This parameter is not available with the HOA operator. Setting units are affected by o1-03.		0	Programming	*37*
♦ Denotes that parameter can be changed when the drive is running.							
			Reference Limits				
d2-01	0289H	Frequency Reference Upper Limit **Ref Upper Limit**	Determines maximum speed command, set as a percentage of parameter E1-04. If speed command is above this value, actual Drive speed will be limited to this value. This parameter applies to all speed command sources.	0.0 to 110.0	100.0%	Programming	*38*
d2-02	028AH	Frequency Reference Lower Limit **Ref Lower Limit**	Determines minimum speed command, set as a percentage of parameter E1-04. If speed command is below this value, actual Drive speed will be set to this value. This parameter applies to all speed command sources.	0.0 to 110.0	0.0%	Programming	*38*
d2-03	0293H	Master Speed Reference Lower Limit **Ref1 Lower Limit**	Determines the minimum speed command, set as a percentage of parameter E1-04. If speed command is below this value, actual Drive speed will be set to this value. This parameter only applies to analog inputs A1 and A2.	0.0 to 110.0	0.0%	Programming	*38*
			Jump Frequencies				
d3-01	0294H	Jump Frequency 1 **Jump Freq 1**	These parameters allow programming of up to three prohibited frequency points for eliminating problems with resonant vibration of the motor / machine. This feature does not actually eliminate the selected frequency values, but will accelerate and decelerate the motor through the prohibited bandwidth.	0.0 to 200.0	0.0 Hz	Programming	*39*
d3-02	0295H	Jump Frequency 2 **Jump Freq 2**			0.0 Hz	Programming	*39*
d3-03	0296H	Jump Frequency 3 **Jump Freq 3**			0.0 Hz	Programming	*39*
d3-04	0297H	Jump Frequency Width **Jump Bandwidth**	This parameter determines the width of the deadband around each selected prohibited frequency point. A setting of "1.0" will result in a deadband of +/- 1.0 Hz.	0.0 to 20.0	1.0 Hz	Programming	*39*
			V/F Pattern				
E1-01	0300H	Input Voltage Setting **Input Voltage**	Set to the nominal voltage of the incoming line.	155 to 255.0 (240V) 310 to 510.0 (480V)	240 V 480 V	Programming	*40*
E1-03	0302H	V/F Pattern Selection **V/F Selection**	0: 50 Hz 1: 60 Hz Saturation 2: 50 Hz Saturation 3: 72 Hz 4: 50 Hz VT1 5: 50 Hz VT2 6: 60 Hz VT1 7: 60 Hz VT2 8: 50 Hz HST1 9: 50 Hz HST2 A: 60 Hz HST1 B: 60 Hz HST2 C: 90 Hz D: 120 Hz F: Custom V/F FF: Custom w/o limit	0 to FF	F	Programming	*40*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
E1-04	0303H	Maximum Output Frequency **Max Frequency**	 To set V/f characteristics in a straight line, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Always ensure that the four frequencies are set in the following manner: E1-04 (FMAX) ¤ E1-06 (FA) > E1-07 (FB) ¤ E1-09 (FMIN)	0.0 to 120.0 Hz	60.0 Hz	Programming	*41*
E1-05	0304H	Maximum Output Voltage **Max Voltage**		0.0 to 255.0 (240V) 0.0 to 510.0 (480V)	230.0 V 460.0 V	Programming	*41*
E1-06	0305H	Base Frequency **Base Frequency**		0.0 to 200.0	60.0 Hz	Programming	*42*
E1-07	0306H	Mid Output Frequency A **Mid Frequency A**		0.0 to 200.0	3.0 Hz	Programming	*42*
E1-08	0307H	Mid Output Voltage A **Mid Voltage A**		0.0 to 255.0 (240V) 0.0 to 510.0 (480V)	17.2 VAC 34.5 VAC	Programming	*42*
E1-09	0308H	Minimum Output Frequency **Min Frequency**		0.0 to 200.0	1.5 Hz	Programming	*42*
E1-10	0309H	Mid Output Voltage **Min Voltage**		0.0 to 255.0 (240V) 0.0 to 510.0 (480V)	10.3 VAC 20.7 VAC	Programming	*42*
E1-11	030AH	Mid Output Frequency B **Mid Frequency B**	Set only when V/f is finely adjusted at rated output range. Adjustment is not normally required.	0.0 to 200.0	0.0 Hz	Programming	*42*
E1-12	030BH	Mid Output Voltage B **Mid Voltage B**		0.0 to 255.0 (240V) 0.0 to 510.0 (480V)	0.0 VAC	Programming	*42*
E1-13	030CH	Base Voltage **Base Voltage**		0.0 to 255.0 (240V) 0.0 to 510.0 (480V)	0.0 VAC	Programming	*42*
			Motor Setup				
E2-01	030EH	Motor Rated Current **Motor Rated FLA**	Set to the motor nameplate full load amps.	10% to 200%	kVA Dependent	Pump Quick Setup	*45*
E2-03	030FH	**No-Load Current**	Sets the magnetizing current of the motor.	kVA Dependent	kVA Dependent	Programming	*45*
E2-04	0311H	Number of Motor Poles **Number of Poles**	Set to the number of poles. Used for no-flow detection function and for the calculation of RPM related parameters.	2 to 48	2	Pump Quick Setup	*45*
E2-05	0312H	Motor Line-to-Line Resistance **Term Resistance**	Phase to phase motor resistance, normally set by the autotuning routine.	0.000 to 65.000	kVA Dependent	Programming	*45*
			Com OPT Setup				
F6-01	03A2H	Operation Selection after Communication Error **Com Bus Flt Sel**	Sets the stopping method for option PCB communications error (BUS fault). Active only when a communications option PCB is installed and when b1-01 or b1-02 = 3. 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0 to 3	1	Programming	*46*
F6-02	03A3H	Input Level of External Fault from Communication Option Card **EF0 Detection**	0: Always detected 1: Detected only during run	0 or 1	0	Programming	*46*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
F6-03	03A4H	Stopping Method for External Fault from Communication Option Card **EF0 Fault Action**	0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0 to 3	1	Programming	*46*
F6-05	03A6H	Current Monitor Display Unit Selection **Current Unit Sel**	0: A Display 1: 100%/8192 (Drive Rated Current)	0 or 1	0	Programming	*46*
			Digital Inputs				
H1-01	0400H	Terminal S3 Function Selection **Terminal S3 Sel**	0: 3-wire control FWD/REV selection for 3-wire sequence 1: Local/Remote Sel Hand/Auto Selection - Closed = Hand, Open = Auto. 2: Option/Inv Sel Selects source of speed command and sequence. Closed = b1-01 & b1-02, Open = Option Card 3: Multi-Step SP1 Closed = speed command from d1-02 or Aux Terminal. Open = speed command determined by b1-01. 4: Multi-Step SP2 Closed = speed command from d1-03 or d1-04. Open = speed command determined by b1-01. 7: Multi-Acc/Dec 1 Closed = Accel & Decel Ramps determined by C1-03 & C1-04. Open = Accel & Decel Ramps determined by C1-01 & C1-02. 8: Ext BaseBlk N.O. Closed = Output transistors forced off, Open = Normal operation. 9: Ext BaseBlk N.C. Closed = Normal Operation, Open = Output transistors forced off. A: Acc/Dec RampHold Closed = Acceleration suspended and speed held, Open = Normal Operation. C: Term A2 Enable Closed = Terminal A2 is active, Open = Terminal A2 is disabled. F: Term Not Used Terminal has no effect. 10: MOP Increase Closed = Speed Command Increases, Open = Speed Command Held. Must be set in conjunction with MOP Decrease and b1-02 must be set to 1. 11: MOP Decrease Closed = Speed Command Decreases, Open = Speed Command Held. Must be set in conjunction with MOP Increase and b1-02 must be set to 1. 14: Fault Reset Closed = Resets the Drive after the fault and the run command have been removed. 15: Fast-Stop N.O. Closed = Drive decelerates using C1-09, regardless of run command status. 17: Fast-Stop N.C. Closed = Normal operation. Open = Drive decelerates using C1-09, regardless of run command status. 18: Timer Function Input for independent timer, controlled by b4-01 and b4-02. Used in conjunction with a multi-function digital output. 19: PI Disable Turns off the PI controller, and PI setpoint becomes speed command. 1B: Program Lockout Closed =All parameter settings can be changed. Open = Only speed command at U1-01 can be changed.	0 to 87	24	Programming	*47*
H1-02	0401H	Terminal S4 Function Selection **Terminal S4 Sel**		0 to 87	14	Programming	*47*
H1-03	0402H	Terminal S5 Function Selection **Terminal S5 Sel**		0 to 87	3: 2-wire 0: 3-wire	Programming	*47*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
H1-04	0403H	Terminal S6 Function Selection **Terminal S6 Sel**	20: External Pump Fault, Normally Open, Always Detected, Ramp To Stop 21: External Pump Fault, Normally Closed, Always Detected, Ramp To Stop 22: External Pump Fault, Normally Open, During Run, Ramp To Stop 23: External Pump Fault, Normally Closed, During Run, Ramp To Stop 24: External Pump Fault, Normally Open, Always Detected, Coast To Stop 25: External Pump Fault, Normally Closed, Always Detected, Coast To Stop 26: External Pump Fault, Normally Open, During Run, Coast To Stop 27: External Pump Fault, Normally Closed, During Run, Coast To Stop 28: External Pump Fault, Normally Open, Always Detected, Fast-Stop 29: External Pump Fault, Normally Open, Always Detected, Fast-Stop 2A: External Pump Fault, Normally Open, During Run, Fast-Stop 2B: External Pump Fault, Normally Closed, During Run, Fast-Stop 2C: External Pump Fault, Normally Open, Always Detected, Alarm Only 2D: External Pump Fault, Normally Closed, Always Detected, Alarm Only 2E: External Pump Fault, Normally Open, During Run, Alarm Only 2F: External Pump Fault, Normally Closed, During Run, Alarm Only 30: PID Integral Reset 31: PID Integral Hold 34: PI SFS Cancel. 35: Input Level Sel 36: Option/Inv Sel 2 Selects source of speed command and sequence. Closed = Option Card, Open = b1-01 & b1-02. 60: Motor Preheat Applies current to create heat to avoid condensation. Closed = Apply amount of current as set in parameter b2-09. 61: Speed Search 1 When closed as a run command is given, Drive does a speed search starting at maximum frequency (E1-04). (Current detection.) 62: Speed Search 2 When closed as a run command is given, Drive does a speed search starting at speed command. (Current detection.) 64: Speed Search 3 67: Com Test Mode - Used to test RS-485/422 interface. Direction determined by fwd/rev input. 3-wire control Only. 6A: Drive Enable - Closed = Drive will accept run command. Open = Drive will not run. If running, Drive will stop per b1-03. 6B: Com/Inv Sel - Selects source of speed command and sequence Closed = Serial Communication (R+,R-,S+,S-), Open = b1-01 & b1-02 6C: Com/Inv Sel 2 80: Hand Mode Function Active in Stopped and Auto Mode. Closed: Hand mode operation as defined in P1-14. Open: Stop Mode when with no incoming run command. **Note:** Input not active when b1-02 is set for 0 – Operator. 81: Disable Sleep Mode Function Active in Auto Mode. Closed: Disables sleep function, Feedback Drop Detection and Over cycle protection. Open: Sleep function, Feedback Drop Detection and Over cycle protection enabled. 82: Sleep Activation Active in Auto Mode. Closed: Drive will go to sleep (External Digital Input). Open: No function.	0 to 87	80	Programming	*47*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
H1-05	0404H	Terminal S7 Function Selection **Terminal S7 Sel**	83: Thermostat Fault, Function Active in Auto Mode. Closed: Drive will trip on “Thermostat Fault”. Open: Thermostat fault not active. Open: Low Water Level Fault. 84: Pre-charge Closed: Disables pre-charge function. Open: Pre-charge function enabled. 85: Low Water Level Function Active in Auto Mode during normal operation, also used with pre-charge function. Function logic depends on parameter P1-15 (Low Water Input). P1-15 = 0 (Closed @ Low Water). Closed: Low Water Level Fault. Open: Reservoir/Tank is filled to normal level. P1-15 = 1 (Open @ Low Water). Closed: Reservoir/Tank is filled to normal level. Pre-charge function: Function uses low water level input as “Tank/Reservoir” feedback to indicate water level reached. 86: Fixed Speed Auto Function Active in Auto Mode Only, Pre-Charge and Thrust Bearing function have a higher priority. When fixed speed auto is active (closed) drive disabled Sleep Mode and Lead/Lag operation. Closed: Drive runs at P3-02 frequency, PI Control disabled Open: Drive runs normal operation auto mode. 87: Thermostat Fault, Normally Closed <0032> Function Active in Auto Mode. Closed: Thermostat fault not active. Open: Drive will trip on “Thermostat Fault”.	0 to 87	84	Programming	*47*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
			Digital Outputs				
H2-01	040BH	Terminal M1-M2 Function Selection **Term M1-M2 Se**l	0: During RUN 1 = Closed when a run command is input or the Drive is outputting voltage. 1: Zero Speed = Closed when Drive output frequency is less than Fmin (E1-09). 2: Fref/Fout Agree 1 = Closed when Drive output speed equals the speed command within the bandwidth of L4-02. 3: Fref/Set Agree 1 = Closed when the Drive output speed and the speed command are equal to the value in L4-01 within the bandwidth of L4-02. 4: Freq Detect 1 = Closed when the Drive output speed is less than or equal to the value in L4-01, with hysteresis determined by L4-02. 5: Freq Detect 2 = Closed when the Drive output speed is greater than or equal to the value in L4-01, with hysteresis determined by L4-02. 6: Inverter Ready = Closed when the Drive is not in a fault state, and not in program mode. 7: DC Bus Undervolt = Closed when the DC bus voltage falls below the UV trip level (L2-05). 8: Base Blk 1 = Closed when the Drive is not outputting voltage. 9: Operator Reference = Closed when the speed command is coming from the digital operator. A: Remote/Auto Oper = Closed when the run command is coming from the digital operator. B: Trq Det 1 N.O. - Closes when the output current exceeds the value set in parameter L6-02 for more time than is set in parameter L6-03. C: Loss of Ref - Closes when the Drive has detected a loss of analog speed command. Speed command is considered lost when it drops 90% in 0.4 seconds. Parameter L4-05 determines Drive reaction to a loss of speed command. D: DB Overheat. E: Fault - Closes when the Drive experiences a major fault. F: Not Used 10: Minor Fault - Closes when Drive experiences a minor fault or alarm. 11: Reset Cmd Active - Closes when the Drive receives a reset command from terminals or serial comms. 12: Timer Output - Output for independent timer, controlled by b4-01 and b4-02. Used in conjunction with a multi-function digital input. 17: Trq. Det 1 N.C. - Opens when the output current exceeds the value set in parameter. L6-02 for more time than is set in parameter L6-03. 1A: Reverse Dir - Closes when the Drive is running in the reverse direction. 1E: Restart Enabled - Closes when the Drive is performing an automatic restart. Automatic restart is configured by parameter L5-01. 1F: Overload (OL1) - Closes before a motor overload occurs. (90% of OL1 time). 20: OH Prealarm - Closes when the Drive's heatsink temperature exceeds the setting of parameter L8-02. 38: Drive Enable - Closes when the Drive enable input is active. 39: Waiting to Run - Closes during the time after a run command is issued, but the Drive is not running due to the time set in parameter b1-10. 3A: OH Freq Reduce 3B: Run Src Com/Opt 3D: Cooling Fan Err = Closed during internal cooling fan failure. 40: Pump 2 Control Open: Shutdown Additional Pump 2. Closed: Start Additional Pump 2. Function Active in multiplex mode. Contactor control for second pump. 41: Pump 3 Control Open: Shutdown Additional Pump 3. Closed: Start Additional Pump 3. Function Active in multiplex mode. Contactor control for second pump.	0 to 42	40	Programming	*63*
H2-02 (continued on next page)	040CH	Terminal M3-M4 Function Selection **Term M3-M4 Sel**		0 to 42	41	Programming	*63*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
H2-02 (continued)	040CH	Terminal M3-M4 Function Selection **Term M3-M4 Sel**	42: Pump Fault Function Active in hand, auto, pre-charge and thrust mode Open: No Dedicated Pump Faults are active. Closed: Dedicated pump fault active (Low Feedback Fault, High Feedback Fault, Over Cycling Fault, Pump Protection Fault, Thermostat Fault, Low Water Fault, Ext. Pump Fault).	0 to 42	41	Programming	*63*
			Analog Inputs				
H3-02 ♦	0411H	Terminal A1 Gain Setting **Terminal A1 Gain**	Sets the speed command when 10 V is input, as a percentage of the maximum output frequency (E1-04).	0.0 to 1000.0	100.0%	Programming	*70*
H3-03 ♦	0412H	Terminal A1 Bias Setting **Terminal A1 Bias**	Sets the speed command when 0 V is input, as a percentage of the maximum output frequency (E1-04).	–100.0 to +100.0	0.0%	Programming	*70*
H3-08	0417H	Terminal A2 Signal Level Selection **Term A2 Signal**	Selects the signal level of terminal A2. 0: 0 - 10 Vdc (switch S1-2 must be in the off position) 2: 4 - 20 mA (switch S1-2 must be in the on position)	0 or 2	2	Programming	*71*
H3-09	0418H	Aux Terminal Function Selection **Terminal A2 Sel**	Selects what effect the aux terminal has on the Drive. 0: Frequency Bias - 0 - 100% bias 2: Aux Reference B: PI Feedback D: Frequency Bias 2 - 0 - 100% bias E: Motor Temperature - See parameters L1-03 & L1-04 16: PI Differential 1F: Not Used	0 to 1F	B**	Programming	*72*
H3-10 ♦	0419H	Terminal A2 Gain Setting **Terminal A2 Gain**	Sets the percentage when 10 V (20 mA) is input.	0.0 to 1000.0	100.0%	Programming	*76*
H3-11 ♦	041AH	Terminal A2 Bias Setting **Terminal A2 Bias**	Sets the percentage when 0 V (4 mA) is input.	–100.0 to +100.0	0.0%	Programming	*76*
H3-12	041BH	Analog Input Filter Time Constant Filter Avg Time	Used to “smooth” out erratic or noisy analog input signals.	0.00 to 2.00	0.30 sec	Programming	*76*
H3-13	041CH	Master Frequency Reference **Terminal SelectionTA1/ A2 Select**	Determines which terminal will be the main reference source. 0: Main Fref TA1 - Terminal TA1 is the main speed command and Terminal TA2 is the Aux speed command. 1: Main Fref TA2 - Terminal TA2 is the main speed command and Terminal TA1 is the Aux speed command. Only effective when H3-09 is set to 2 “Aux Reference”.	0 or 1	0	Programming	*76*

♦ Denotes that parameter can be changed when the drive is running.
** Factory setting changes to “B” when b5-01 = 1.

			Analog Outputs				
H4-01	041DH	Terminal FM Monitor Selection **Terminal FM Sel**	Selects which monitor will be output on terminals FM and AC. 1: Frequency Ref (100% = max. output frequency) 2: Output Freq (100% = max. output frequency) 3: Output Current (100% = Drive rated current) 6: Output Voltage (100% = 230 V or 100% = 460 V) 7: DC Bus Voltage (100% = 400 V or 100% = 800 V) 8: Output kWatts (100% = Drive rated power) 15: Term A1 Level 16: Term A2 Level 18: Mot SEC Current (100% = Motor rated secondary current) 20: SFS Output (100% = max. output frequency) 24: PI Feedback 31: Not Used 36: PI Input 37: PI Output (100% = max. output frequency) 38: PI Setpoint **Note:** 100% = 10 V DC output * FM gain setting (H4-02).	1 to 38 <0032>	2	Programming	*77*
H4-02 ♦	041EH	Terminal FM Gain Setting **Terminal FM Gain**	Sets terminal FM output voltage (in percent of 10 V) when selected monitor is at 100% output.	0.0 to 1000.0	100.0%	Programming	*78*
H4-03 ♦	041FH	Terminal FM Bias Setting **Terminal FM Bias**	Sets terminal FM output voltage (in percent of 10 V) when selected monitor is at 0% output.	–110.0 to 110.0	0.0%	Programming	*78*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
H4-04	0420H	Terminal AM Monitor Selection **Terminal AM Sel**	Selects which monitor will be output on terminals AM and AC. 1: Frequency Ref (100% = max. output frequency) 2: Output Freq (100% = max. output frequency) 3: Output Current (100% = Drive rated current) 6: Output Voltage (100% = 230 V or 100% = 460 V) 7: DC Bus Voltage (100% = 400 V or 100% = 800 V) 8: Output kWatts (100% = Drive rated power) 15: Term A1 Level 16: Term A2 Level 18: Mot SEC Current (100% = Motor rated secondary current) 20: SFS Output (100% = max. output frequency) 24: PI Feedback 31: Not Used 36: PI Input 37: PI Output (100% = max. output frequency) 38: PI Setpoint **Note:** 100% = 10 V DC output * AM gain setting (H4-05).	1 to 38 <0032>	8	Programming	*79*
H4-05 ♦	0421H	Terminal AM Gain Setting **Terminal AM Gain**	Sets terminal AM output voltage (in percent of 10 V) when selected monitor is at 100% output.	0.0 to 1000.0	50.0%	Programming	*79*
H4-06 ♦	0422H	Terminal AM Bias Setting **Terminal AM Bias**	Sets terminal AM output voltage (in percent of 10 V) when selected monitor is at 0% output.	–110.0 to 110.0	0.0%	Programming	*79*
H4-07	0423H	Terminal FM Signal Level Selection **AO Level Select1**	0: 0 - 10 Vdc 2: 4-20 mA*	0 or 2	0	Programming	*80*
H4-08	0424H	Terminal AM Signal Level Selection **AO Level Select2**	0: 0 - 10 Vdc 2: 4-20 mA* * An analog output of 4 - 20 mA cannot be used with the standard terminal board. Therefore an optional terminal board (with shunt connector CN15) is needed.	0 or 2	0	Programming	*80*
♦ Denotes that parameter can be changed when the drive is running.							
			Serial Com Setup				
H5-01	0425H	Drive Node Address **Serial Com Adr**	Selects Drive station node number (address) for terminals R+, R-, S+, S-.* **Note:** An address of "0" disables serial com.	0 to 20 (H5-08=0) 0 to FF (H5-08=1) 0 to 63 (H5-08=2)	1F	Programming	*93*
H5-02	0426H	Communication Speed Selection **Serial Baud Rate**	Selects the baud rate for terminals R+, R-, S+ and S-.* 0: 1200 Baud 1: 2400 Baud 2: 4800 Baud (APOGEE FLN) 3: 9600 Baud (Metasys N2) 4: 19200 Baud	0 to 4	3	Programming	*93*
H5-03	0427H	Communication Parity Selection **Serial Com Sel**	Selects the communication parity for terminals R+, R-, S+ and S-.* 0: No Parity 1: Even Parity 2: Odd Parity	0 to 2	0	Programming	*93*
H5-04	0428H	Stopping Method after Communication Error **Serial Fault Sel**	Selects the stopping method when a communication error is detected. 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0 to 3	3	Programming	*94*
H5-05	0429H	Communication Error Detection Selection **Serial Flt Dtct**	Enables or disables the communications timeout detection function. 0: Disabled - A communications loss will NOT cause a communications fault. 1: Enabled - If communications are lost for more than the time specified in parameter H5-09, a communications fault will occur.	0 or 1	1	Programming	*94*
H5-06	042AH	Drive Transmit Wait Time **Transmit WaitTIM**	Sets the time from when the Drive receives data to when the Drive sends data.	5 to 65	5 ms	Programming	*94*
H5-07	042BH	RTS Control Selection **RTS Control Sel**	Enables or disables "request to send" (RTS) control: 0: Disabled (RTS is always on) 1: Enabled (RTS turns on only when sending)	0 or 1	1	Programming	*94*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
H5-09	0435H	Communication Error Detection Time **CE Detect Time**	Determines how long communications must be lost before a fault is annunciated. Works in conjunction with parameters H5-05 and H5-04.	0.0 to 10.0 (H5-08=0) 0.0 to 10.0 (H5-08=1) 0.0 to 90.0 (H5-08=2)	2.0 sec	Programming	*94*
			Motor Overload				
L1-01	0480H	Motor Overload Protection Selection **MOL Fault Select**	Enables or disables the motor thermal overload protection. 0: Disabled 1: Std Fan Cooled (Enabled) 2: Std Blower Cooled 3: Vector Motor	0 to 1	1	Programming	*96*
L1-02	0481H	Motor Overload Protection Time **MOL Time Const**	Determines how much time will elapse prior to a motor overload fault (OL1), when motor amps exceed the value set in parameter E2-01 by 10%. Actual (OL1) trip time will vary depending on severity of overload.	0.1 to 20.0	8.0min	Programming	*96*
L1-03	0482H	Motor Overheat Alarm Operation Selection **Mtr OH Alarm Sel**	Operation selection when the motor temperature analog input (H3-09 = E) exceeds the OH3 alarm level (1.17 V) 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0 to 3	3	Programming	*97*
L1-04	0483H	Motor Overheat Fault Operation Selection **Mtr OH Fault Sel**	Stopping method when the motor temperature analog input (H3-09 = E) exceeds the OH4 level (2.34 V). 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop	0 to 2	1	Programming	*97*
L1-05	0484H	Motor Temperature Input Filter Time **Mtr Temp Filter**	Delay Time applied to motor temperature analog input (H3-09 = E) for filtering purposes.	0.00 to 10.00	0.20 sec	Programming	*97*
			PwrLoss Ridethru				
L2-01	0485H	Momentary Power Loss Detection Selection **PwrL Selection**	Enables and disables the momentary power loss function. 0: Disabled - Drive trips on (UV1) fault when power is lost. 1: PwrL Ride Thru t - Drive will restart if power returns within the time set in L2-02.* 2: CPU Power Active - Drive will restart if power returns prior to internal power supply shut down.* * In order for a restart to occur, the run command must be maintained throughout the ride thru period.	0 to 2	2	Programming	*99*
L2-02	0486H	Momentary Power Loss Ride-thru Time **PwrL Ridethru t**	Determines the power loss ride-thru time. This value is dependent on the capacity of the Drive. Only effective when L2-01 = 1.	0.0 to 25.5 sec	kVA Dependent	Programming	*99*
L2-03	0487H	Momentary Power Loss Minimum Base Block Time **PwrL Baseblock t**	Used to allow the residual motor voltage to decay before the Drive output turns back on. After a power loss, if L2-03 is greater than L2-02, operation resumes after the time set in L2-03.	0.1 to 5.0 sec	kVA Dependent	Programming	*99*
L2-04	0488H	Momentary Power Loss Voltage Recovery Ramp Time **PwrL V/F Ramp t**	The time it takes the output voltage to return to the preset V/f pattern after speed search (current detection mode) is complete.	0.0 to 5.0 sec	kVA Dependent	Programming	*100*
L2-05	0489H	Undervoltage Detection Level **PUV Det Level**	Sets the Drive's DC Bus undervoltage trip level. If this is set lower than the factory setting, additional AC input reactance or DC bus reactance may be necessary.	Voltage Class Dependent	Voltage Class Dependent	Programming	*100*
			Stall Prevention				
L3-01	048FH	Stall Prevention Selection During Accel **StallP Accel Sel**	0: Disabled (Motor accelerates at active acceleration, C1-01 or C1-03. The motor may stall if load is too heavy or accel time is too short.) 1: General Purpose (When output current exceeds L3-02 level, acceleration stops. It starts to accelerate at current value recovery.) 2: Intelligent (The active acceleration rate, C1-01 or C1-02, is ignored. Acceleration is completed in the shortest amount of time w/o exceeding the current value set in L3-02.	0 to 2	1	Programming	*101*
L3-02	0490H	Stall Prevention Level During Accel **StallP Accel Lvl**	This function is enabled when L3-01 is “1” or “2”. Drive rated current is 100%. Decrease the set value if stalling occurs at factory setting.	0 to 200	120%	Programming	*101*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
L3-04	0492H	Stall Prevention Selection During Decel **StallP Decel Sel**	0: Disabled (The Drive decelerates at the active deceleration rate, C1-02 or C1-04. If the load is too large or the deceleration time is too short, an OV fault may occur.) 1: General Purpose (The Drive decelerates at the active deceleration rate, C1-02 or C1-04, but if the main circuit DC bus voltage reaches the stall prevention level the output frequency will clamp. Deceleration will continue once the DC bus level drops below the stall prevention level.) 2: Intelligent (The active deceleration rate is ignored and the Drive decelerates as fast as possible w/o hitting OV fault level.)	0 to 3	1	Programming	*102*
L3-05	0493H	Stall Prevention Level During Decel **StallP Run Sel**	0: Disabled (Drive runs a set frequency.) A heavy load may cause the Drive to trip on an OC fault. 1: Decel Time 1 (In order to avoid stalling during heavy loading, the Drive will start to decelerate at Decel time 1 (C1-02) if the output current exceeds the level set by L3-06. Once the current level drops below the L3-06 level the Drive will accelerate back to its set frequency at the active acceleration rate.) 2: Decel Time 2 (Same as setting 1 except the Drive decelerates at Decel Time 2 (C1-04).) For 6 Hz or less frequency, stall prevention function during run is disabled regardless of L3-05 set.	0 to 2	1	Programming	*103*
L3-06	0494H	Stall Prevention Level During Running **StallP Run Level**	This function is enabled when L3-05 is "1" or "2". Drive rated current is set as 100%. Normally, changing the setting is not required. Decrease the set value if stalling occurs at factory setting.	30 to 200	120%	Programming	*103*
			Ref Detection				
L4-01	0499H	Speed Agreement Detection Level **Spd Agree Level**	L4-01 and L4-02 are used in conjunction with the multi-function outputs, (H2-01and H2-02) as a setpoint and hysteresis for a contact closure.	0.0 to 200.0	0.0 Hz	Programming	*104*
L4-02	049AH	Speed Agreement Detection Width **Spd Agree Width**		0.0 to 20.0	2.0 Hz	Programming	*104*
L4-05	049DH	Frequency Reference Loss Detection Selection **Ref Loss Sel**	Determines how the Drive will react when the frequency reference is lost. 0: Stop (Disabled) - Drive will not run at the frequency reference. 1: Enabled @ % of PrevRef - Drive will run at a percentage (L4-06) of the frequency reference level at the time frequency reference was lost. **Note:** Only available in the Hand Mode (P5-01 = 0).	0 or 1	0	Programming	*105*
L4-06	04C2H	Frequency Reference Level at Loss Frequency **Fref at Floss**	If Frequency Reference loss function is enabled (L4-05 = 1) and Frequency Reference is lost, then the Drive will run at reduced frequency reference determined by L4-06. New Fref=Fref at time of loss x L4-06. **Note:** Only available in the Hand Mode (P5-01 = 0)	0 or 1	0	Programming	*105*
			Fault Restart				
L5-01	049EH	Number of Auto Restart Attempts **Num of Restarts**	Determines the number of times the Drive will perform an automatic restart.	0 to 10	0	Pump Quick Setup	*105*
L5-02	049FH	Auto Restart Operation Selection **Restart Sel**	Determines if the fault contact activates during an automatic restart attempt. 0: No Flt Relay - fault contact will not activate during an automatic restart. 1: Flt Relay Active - fault contact will activate during an automatic restart.	0 or 1	0	Programming	*105*
L5-03	04A0H	Maximum Restart Time After Fault **Max Restart Time**	If the restart fails (or is not attempted due to a continuing fault condition, e.g. an OV fault) the Drive waits the Maximum Restart Time After Fault (L5-03) before attempting another restart. This parameter is not applicable to Loss of Prime Fault.	10.0 to 3600.0 <0032>	180.0 sec	Pump Quick Setup	*105*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
			Torque Detection				
L6-01	04A1H	Torque Detection Selection 1 **Load Detection**	Determines the Drive's response to an overtorque / undertorque condition. Overtorque and Undertorque are determined by the settings in parameters L6-02 and L6-03. 0: Disabled 1: OL@SpdAgree - Alm (Overtorque Detection only active during Speed Agree and Operation continues after detection) 2: OL At RUN - Alm (Overtorque Detection is always active and operation continues after detection) 3: OL@SpdAgree - Flt (Overtorque Detection only active during Speed Agree and Drive output will shut down on an OL3 fault.) 4: OL At RUN - Flt (Overtorque Detection is always active and Drive output will shut down on an OL3 fault.) 5: LL@SpdAgree - Alm (Undertorque Detection is only active during Speed Agree and operation continues after detection.) 6: LL at RUN - Alm (Undertorque Detection is always active and operation continues after detection.) 7: LL @ SpdAgree - Flt (Undertorque Detection only active during Speed Agree and Drive output will shut down on an OL3 fault.) 8: LL At RUN - Flt (Undertorque Detection is always active and Drive output will shut down on an OL3 fault.)	0 to 8	0	Programming	*107*
L6-02	04A2H	Torque Detection Level 1 **Load Det Lvl**	Sets the overtorque/undertorque detection level as a percentage of Drive rated current.	0 to 300	15%	Programming	*107*
L6-03	04A3H	Torque Detection Time 1 **Loss Det Time**	Sets the length of time an overtorque / undertorque condition must exist before being recognized by the Drive. OL3 is then displayed.	0.0 to 10.0	10.0 sec	Programming	*107*
			Hdwe Protection				
L8-01	04ADH	Internal Dynamic Braking Resistor Protection Selection **DB Resistor Prot**	0: Not Provided 1: Provided	0 or 1	0	Programming	*109*
L8-02	04AEH	Overheat Pre-Alarm Level **OH Pre-Alarm Lvl**	When the cooling fin temperature exceeds the value set in this parameter, an overheat pre-alarm (OH) will occur.	50 to 130	95°C	Programming	*109*
L8-03	04AFH	Overheat Pre-Alarm Operation Selection **OH Pre-Alarm Sel**	Drive Operation upon OH Pre Alarm Detection. 0: Ramp to Stop (Decel Time C1-02). 1: Coast to Stop 2: Fast-Stop (Decel Time = C1-09). 3: Alarm Only *0 to 2 is recognized as fault detection, and 3 is recognized as alarm. (For the fault detection, the fault contact operates.) 4: OH Alarm & Reduce (Continue operation and reduce output frequency by L8-19)	0 to 4	4	Programming	*109*
L8-05 <0033>	04B1H	Input Phase Loss Protection Selection **Ph Loss In Sel**	Selects the detection of input current phase loss, power supply voltage imbalance, or main circuit electrostatic capacitor deterioration. 0: Disabled 1: Enabled	0 to 1	1	Programming	*110*
L8-06	04B2H	Input Phase Loss Detection Level **Ph Loss In Lvl**	Monitors the DC Bus current ripple and activates when one of the input phases is lost (PF).	0.0 to 25.0	0.5%	Programming	*110*
L8-07 <0033>	04B3H	Output Phase Loss Protection Selection **Ph Loss Out Sel**	Selects the detection of output current open-phase. When applied motor capacity is too small for Drive capacity, output phase loss may be detected inadvertently. In this case, set to 0. 0: Disabled 1: Enabled	0 to 1	1	Programming	*110*
L8-09	04B5H	Output Ground Fault Detection Selection **Ground Fault Sel**	Enables and disables Drive output ground fault detection. 0: Disabled 1: Enabled	0 or 1	1	Programming	*110*
L8-10	04B6H	Heatsink Cooling Fan Operation Selection **Fan On/Off Sel**	Controls the Heatsink Cooling Fan Operation. 0: Fan On-Run Mode (Fan will operate only when Drive is running and for L8-11 seconds after RUN is removed). 1: Fan Always On (Cooling fan operates whenever Drive is powered up.)	0 or 1	0	Programming	*110*
L8-11 <0032>	04B7H	Heatsink Cooling Fan Operation Delay Time **Fan Delay Time**	When L8-10=0 this parameter sets a delay time for Cooling Fan de-energization after the run command is removed or baseblock enabled.	0 to 300	300 sec	Programming	*111*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
L8-12	04B8H	Ambient Temperature Setting **Ambient Temp**	When the Drive is installed in an ambient temperature exceeding its rating, Drive overload (OL2) protection level is reduced.	45 to 60°C	45°C	Programming	*111*
L8-15	04BBH	OL2 Characteristic Selection at Low Speeds **OL2 Sel @ L-Spd**	This parameter assists in protecting the output transistor junctions from overheating when output current is high and output frequency is low. 0: Disabled 1: Enabled (L8-18 is active)	0 or 1	1	Programming	*111*
L8-18	04BEH	Soft CLA Selection **Soft CLA Sel**	Enables and disables current limit "A". 0: Disabled 1: Enabled.	0 or 1	1	Programming	*112*
L8-19	04BFH	OH Frequency Reference Reduction Level **Fref During OH**	Sets the amount of frequency reference reduction when an Overheat Pre-alarm (OH) is detected.	0.0 to 100.0	20.0%	Programming	*112*
			Hunting Prev				
n1-01	0580H	Hunting Prevention Selection **Hunt Prev Select**	0: Disabled (Hunting prevention function disabled.) 1: Enabled (Hunting prevention function enabled.) If the motor vibrates while lightly loaded, hunting prevention may reduce the vibration. There is a loss of responsiveness if hunting prevention is enabled.	0 or 1	1	Programming	*113*
n1-02	0581H	Hunting Prevention Gain Setting **Hunt Prev Gain**	Gain setting for the Hunting Prevention Function. If the motor vibrates while lightly loaded and n1-01=1, increase the gain by 0.1 until vibration ceases. If the motor stalls while n1-01=1 decrease the gain by 0.1 until the stalling ceases.	0.00 to 2.50	1.00	Programming	*113*
			High Slip				
n3-01	0588H	High-Slip Braking Deceleration Frequency Width **HSB Decel Width**	Sets how aggressively the Drive decreases the output frequency as it stops the motor. If overvoltage (OV) faults occur during HSB, this parameter may need to be increased. **Note:** Function Deactivated	1.0 to 20.0	5%	Programming	*113*
n3-02	0589H	High-Slip Braking Current Limit **HSB Current Ref**	Sets the maximum current to be drawn during a HSB stop. Higher n3-02 settings will shorten motor stopping times but cause increased motor current, and therefore increased motor heating. .**Note:** Function Deactivated	100.0 to 200.0	150%	Programming	*113*
n3-03	058AH	High-Slip Braking Dwell Time at Stop **HSB DwelTim@ Stp**	Sets the amount of time the Drive will dwell at E1-09 (Minimum Frequency). If this time is set too low, the machine inertia can cause the motor to rotate slightly after the HSB stop is complete and Drive output is shut off. .**Note:** Function Deactivated	0.00 to 10.0	1.0 sec	Programming	*113*
n3-04	058BH	High-Slip Braking Overload Time **HSB OL Time**	Sets the time required for a HSB Overload Fault to occur when the Drive output frequency does not change for some reason during a HSB stop. Normally this does not need to be adjusted. **Note:** Function Deactivated	30.0 to 1200.0	40 sec	Programming	*113*
			Monitor Select				
o1-01 ♦	0500H	User Monitor Selection **User Monitor Sel**	Selects which monitor will be displayed upon power-up when o1-02 = 4.	6 to 94	6	Programming	*114*
o1-02	0501H	User Monitor Selection After Power-Up **Power-On Monitor**	Selects which monitor will be displayed upon power-up. 1: Auto: Setpoint 2: Output Freq 3: Output Current 4: User Monitor (set by o1-01)	1 to 4	1**	Programming	*114*
o1-05	0504H	LCD Brightness Adjustment **LCD Contrast**	<table><tr><th>Set Value</th><th>Description</th></tr><tr><td>5</td><td>LCD display becomes dark</td></tr><tr><td>3</td><td>Standard setting</td></tr><tr><td>1</td><td>LCD display becomes light</td></tr></table>	0 to 5	3	Programming	*115*
o1-06	0517H	User Monitor Selection Mode **Monitor Mode Sel**	Selects the "U1" monitors displayed on the 4th and 5th lines of the digital operator display. 0: 3 Mon Sequential (Displays the next 2 sequential U1 monitors.) 1: 3 Mon Selectable (Displays U1 monitors set by o1-07 and o1-08.)	0 or 1	1**	Programming	*115*

♦ Denotes that parameter can be changed when the drive is running.

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
o1-07	0518H	Second Line User Monitor Selection **2nd Monitor Sel**	Sets the "U1" monitor always displayed on the 4th line of the digital operator display. Effective only when o1-06 = 1.	1 to 94	2**	Programming	*115*
o1-08	0519H	Third Line User Monitor Selection **3rd Monitor Sel**	Sets the "U1" monitor always displayed on the 5th line of the digital operator display. Effective only when o1-06 = 1.	1 to 94	91**	Programming	*115*
			Key Selections				
o2-01	0505H	Local/Remote Key Function Selection **Local/Remote Key**	Has no function when HOA operator is connected. 0: Disabled 1: Enabled	0 or 1	1	Programming	*116*
o2-02	0506H	OFF Key Function During Auto Run **Oper OFF Key**	Determines if the off key on the digital operator will stop the Drive when Drive is operating from external terminals or serial communications. 0: Disabled 1: Enabled	0 or 1	1	Programming	*116*
o2-03	0507H	User Parameter Default Value **User Defaults**	Allows storing of current parameter values as a User Initialization Selection at parameter A1-03. 0: No Change (No user parameter set active). 1: Set Defaults (Saves current parameter settings as user initialization. A1-03 now allows selecting <1110> for user initialization. 2: Clear All (Clears the currently saved user initialization. A1-03 no longer allows selecting <1110>.	0 to 2	0	Programming	*116*
o2-04	0508H	Drive/kVA Selection **Inverter Model #**	Sets the kVA of the Drive. Enter the number based on Drive Model #. Use the □□□□ portion of the CIMR-P7□□□□-107 Model Number.	0 to FF	kVA Dependent	Programming	*117*
o2-05	0509H	Frequency Reference Setting Method Selection **Operator M.O.P.**	Determines if the Data/Enter key must be used to input a frequency reference from the digital operator. 0: Disabled - Data/Enter key must be pressed to enter a frequency reference. 1: Enabled: -Data/Enter key is not required. The frequency reference is adjusted by the up and down arrow keys on the digital operator without having to press the data/enter key.	0 or 1	0	Programming	*118*
o2-06	050AH	Operation Selection when Digital Operator is Disconnected **Oper Detection**	Determines if the Drive will stop when the digital operator is removed. 0: Disabled - The Drive will not stop when the digital operator is removed. 1: Enabled - The Drive will fault (OPR) and coast to stop when the operator is removed.	0 or 1	1	Programming	*118*
o2-07	050BH	Cumulative Operation Time Setting **Elapsed Time Set**	Sets the initial value of the elapsed operation timer.	0 to 65535	0 H	Programming	*118*
o2-08	050CH	Cumulative Operation Time Selection **Elapsed Time Run**	Sets how time is accumulated for the elapsed timer (o2-07). 0: Power-On Time (Time accumulates whenever Drive is powered). 1: Running Time (Time accumulates only when Drive is running)	0 or 1	1	Programming	*118*
o2-10	050EH	Cumulative Cooling Fan Operation Time Setting **Fan ON Time Set**	Sets the initial value of the heatsink fan operation time.	0 to 65535	0 H	Programming	*119*
o2-12	0510H	Fault Trace/Fault History Clear Function **FLT Trace Init**	Clears the fault memory contained in the U2 and U3 monitors. 0: Disabled (no effect). 1: Enabled - resets U2 and U3 monitors, and returns o2-12 to zero.	0 or 1	0	Programming	*119*
o2-14	0512H	kWh User Monitor (U1-29) Initialization **kWh MonitorClear**	Used to reset the kilowatt Hour monitor to zero 0: Disabled (no change). 1: Clear all - Resets U1-29 to zero and returns o2-14 to zero.	0 or 1	0	Programming	*119*
			COPY Function				
o3-01	0515H	Copy Function Selection **Copy Function Sel**	This parameter controls the copying of parameters to and from the digital operator. 0: COPY SELECT (no function) 1: INV -> OP READ - All parameters are copied from the Drive to the digital operator. 2: OP -> INV WRITE - All parameters are copied from the digital operator into the Drive. 3: OP<-->INV VERIFY - Parameter settings in the Drive are compared to those in the digital operator. **Note:** When using the copy function, the Drive model number and software number (U1-14) must match or an error will occur.	0 to 3	0	Programming	*120*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
o3-02	0516H	Read Allowed Selection **Read Allowable**	Enables and disables all digital operator copy functions. 0: Disabled - No digital operator copy functions are allowed. 1: Enabled - Copying allowed	0 to 1	0	Programming	*120*
			Pump Basic				
P1-01	0600H	Pump Mode **Pump Mode**	Select type of control operation. 0: Drive Only (Simplex) 1: Drive + 1 Pump 2: Drive + 2 Pumps	0 to 2	0	Programming	*122*
P1-02	0601H	System Units **System Units**	0: WC:InchOfWater 1: PSI:lb/SqrInch 2: GPM:Gallons/Min 3: F:DegFarenheit 4: CFM:Cubic ft/Min 5: CMH:Cubic m/Hr 6: LPH:Liters/Hr 7: LPS:Liters/sec 8: Bar:Bar 9: Pa:Pascals 10: C:DegCelsius 11: Ft: Feet <0032> 12:%: Percent	0 to 12	1	Pump Quick Setup	*124*
P1-03	0602H	Feedback Device Scaling **Fb Dev Scaling**	Scaling of feedback device in user units (P1-02=1, e.g. 150PSI). Digits 1 through 4 set the maximum feedback number. Digit 5 determines the number of decimal places. Digit 5 = 0: Number format is XXXX Digit 5 = 1: Number format is XXX.X Digit 5 = 2: Number format is XX.XX Digit 5 = 3: Number format is X.XXX **Examples:** 01000 = 1000 13000 = 300.0 25000 = 50.00 32000 = 2.000	1 to 36000 (system units P1-02)	00145	Pump Quick Setup	*124*
P1-04 ♦	0603H	Start Level **Start Level**	Drive starts when the feedback level drops below the start level for a time specified in P1-05. This level also specifies the wake up level when the drive is in Sleep Mode. **Note:** When PID operates in the reverse mode, the feedback value has to rise above the start level for the time programmed in P1-05 for the system to start. A value of 0 disables this function.	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Pump Quick Setup	*125*
P1-05 ♦	0604H	Start Level Delay Time **S-Lvl Delay Time**	Drive starts when the feedback level drops below the start level for a time specified in P1-05.	0 to 3600	0 sec	Pump Quick Setup	*125*
P1-06 ♦	0605H	Minimum Pump Frequency **Min. Pump Freq.**	Minimum drive frequency when operated in the auto mode. Programmed value will limit minimum PID output. Minimum value has to be programmed to a value smaller than P3-09 and P3-10 when Drive is operating in the multiplex mode (P1-01).	0.0 to 120.0 Hz	35.0 Hz	Pump Quick Setup	*125*
P1-07 ♦	0606H	Low Feedback Level **Low FB Level**	The Drive will display a “Low Feedback (LFB)” alarm when the feedback level falls below the programmed level. The alarm will turn off when the feedback level rises above the programmed Low Feedback Level plus the Hysteresis Level (P1-13). A value of 0 disables this function. This function is only active during running while operating in the auto mode.	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Pump Quick Setup	*125*
P1-08 ♦	0607H	Low Feedback Level Fault Delay Time **Low Lvl FLT Time**	The Drive will display a “Low Feedback/Water (LFB/LW)” alarm when the feedback level falls below the programmed level for a time specified in P1-08. The Drive will coast to a stop when a fault occurs. A value of 0 disables this function. This function is only active during running while operating in the auto mode.	0 to 3600 sec	5 sec	Pump Quick Setup	*125*
P1-09 ♦	0608H	High Feedback Level **High FB Level**	The Drive will display a “High Feedback Level (HFB)” alarm when the feedback level rises above the programmed level. The alarm will turn off when the feedback level falls below the programmed High Feedback Level minus the Hysteresis Level (P1-13). This function is active during running in the hand mode, auto mode, pre-charge and thrust-bearing mode.	0.0 to 6000.0 (system units P1-02)	155.0 (system units P1-02)	Pump Quick Setup	*126*
P1-10 ♦	0609H	High Feedback Level Fault Delay Time **Hgh Lvl FLT Time**	The Drive will initiate a “High Feedback Fault (HFB)” when the feedback level rises above the programmed level for a time specified in P1-10. The Drive will coast to a stop when a fault occurs. This function is active during running in all operation modes.	0 to 3600	2 sec	Pump Quick Setup	*126*

♦ Denotes that parameter can be changed when the drive is running.

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
P1-11 ♦ <0032>	0106H	Maximum SetPoint Difference **Max Setpoint Diff**	When the Drive is running and the difference between the setpoint and the feedback exceeds the level in P1-11 for the time specified in P1-12, the Drive will trip on a "Not Maintaining Setpoint (NMS)". The Drive will coast to a stop when a fault occurs. A value of 0 disables this function. This function is only active during running while operating in auto mode.	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Pump Quick Setup	*126*
P1-12 ♦ <0032>	0107H	Not Maintaining Setpoint and Loss of Prime Time **Setpoint-LOP Tim**	Delay time before a Not Maintaining Setpoint or Loss of Prime Time fault occurs. Pump protection criteria specified in P1-11 or P1-14 must be met for the Drive to fault. The Drive will coast to a stop when a fault occurs. A value of 0 disables both Loss of Prime and Not Maintaining Setpoint faults.	0 to 3600	60 sec	Pump Quick Setup	*127*
P1-13 ♦	0108H	Hysteresis Level **Hysteresis Level**	Hysteresis Level used for low and high feedback alarm detection. See function P1-07 and P1-09.	0.0 to 100.0 (system units P1-02)	0.0 (system units P1-02)	Programming	*127*
P1-14 ♦	0109H	Prime Loss Level **Prime Loss Level**	Used to detect loss of prime in the pump. If output current drops below this level for the time specified in P1-12 and the output frequency is at fmax, a "Loss Of Prime" fault occurs. The Drive will coast to a stop when a fault occurs.	0.0 to 1000.0	0.0 A	Pump Quick Setup	*127*
P1-15 ♦	010AH	Low Water Input **Low Water Input**	Sets the type of control operation 0: Closed at Low Water, (Closed indicates low water condition) 1: Open at Low Water, (Open indicates low water condition) To use the low water function one of the digital inputs (H1-XX=85) needs to be programmed. The low water input can be used for a low water condition or in combination with the pre-charge function to indicate the reservoir is filled. The low water input fault is only active during running while operating in auto mode.	0 or 1	0	Programming	*128*
			Pump Protection				
P2-01	060AH	Sleep Level Type **Sleep Lvl Type**	Sets the sleep type. 0: Output Frequency 1: Output Current 2: Feedback **Note:** Feedback depends on PID direction operation. Displays a "Sleep" Alarm when active.	0 to 2	0	Pump Quick Setup	*129*
P2-02 ♦	060BH	Sleep Level **Sleep Level**	Sleep activates when selected level (P2-01) reaches programmed sleep level for time specified in P2-03. The level type is determined by P2-01. A value of 0 disables this function. This function is only active during running while operating in auto mode. Display Units for Sleep Level P2-02 when P2-01 is programmed for the following: P2-01=0: >Display based on "Hz" P2-01=1: >Display based on "A" P2-01=2: >Display based on P1-02 Selection **Note:** When P2-01 is set for a value of 2, display units will be dependent on P1-02 setting.	0.0 to 6000.0	0.0	Pump Quick Setup	*133*
P2-03 ♦	060CH	Sleep Delay Time **Sleep Delay Time**	Delay time before Drive enters sleep mode when criteria is met as defined by parameter P2-02.	0 to 3600	10 sec	Pump Quick Setup	*133*
P2-04 ♦	060DH	Delta Sleep Feedback Drop Level **D Fb Drop Level**	When the Drive enters sleep mode, the software monitors the feedback to detect a flow-no flow condition. If the PID Error (setpoint minus feedback) exceeds the programmed level P2-04 within the programmed time (P2-05) and the output frequency is greater than the minimum frequency (P1-06), the sleep operation deactivates and the Drive returns to normal operation. A value of 0 disables this function.	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Programming	*133*
P2-05 ♦	060EH	Feedback detection drop time. **FB Drop DetTime**	Defines the time window in which the software monitors the feedback to detect a flow-no flow condition. Works in conjunction with parameter P2-04.	0 to 3600	10 sec	Programming	*134*
P2-06 ♦	060FH	Sleep Mode: Cycling Protection **Cycle Protection**	Maximum number of cycles allowed within the time specified in P2-07 before the Drive initiates a "Pump Cycle Fault (PCF)". One Cycle is defined when the Drive transfers from normal operation in auto mode to sleep mode. A value of 0 disables this function.	0 to 10	0	Programming	*134*
P2-07 ♦	0610H	Sleep Mode: Maximum Cycling Protection Time **Max. Cycle Time**	Maximum time allowed between cycles. When no cycling occurs within the programmed time, the Drive will reset the internal cycle register. Works in conjunction with P2-06.	0 to 3600	300 sec	Programming	*135*

♦ Denotes that parameter can be changed when the Drive is running.

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
P2-08	0611H	Over Cycling Mode **Over Cycle Mode**	Sets the Over Cycle Mode: 0: Disabled 1: Alarm 2: Pump Over Cycle Fault (POC) 3: Auto Compensation	0 to 3	0	Programming	*135*
P2-09	0612H	Setpoint compensation **Setpoint Comp.**	Allows for the software to automatically compensate the setpoint in case of excessive cycling.	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Programming	*136*
P2-10	0613H	Maximum Setpoint compensation **Max. SP Comp.**	Maximum allowable setpoint compensation for the over-cycling function.	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Pump Quick Setup	*136*
P2-11	010BH	No-Flow Activation Level **NF Act. Level**	When the motor RPM falls below the programmed level in P2-12, the no-flow detection will activate. A value of 0 disables this function.	0 to 24000	0 RPM	Programming	*136*
P2-12	010CH	No-Flow Detection Bandwidth **NF Det.Bandwidth**	Sets the motor RPM fluctuation bandwidth. No-flow activates when the motor RPM remains within the programmed bandwidth in P2-12 for a time specified in parameter P2-13.	0 to 1000	15 RPM	Programming	*139*
P2-13	010DH	No-Flow Detection Time **NF Detect Time**	No-flow activates when the motor RPM remains within the programmed bandwidth (P2-12) for a time specified in parameter P2-13.	0.0 to 1000.0	5.0 sec	Programming	*139*
P2-14	010EH	No-Flow Stabilization Time **NF StabilizeTime**	Time delay when setpoint returns to the original setting after being changed for no-flow detection.	0.0 to 1000.0	5.0 sec	Programming	*139*
P2-15	010FH	No-Flow Delta Feedback Level **NF FB Level**	No-flow feedback (PID-Error: setpoint minus feedback) level used to detect no-flow condition based on feedback value. Delta feedback (setpoint minus feedback) has to exceed the programmed level for the time programmed in P2-17 to detect a no-flow condition.	0.0 to 6000.0 (system units P1-02)	1.0 (system units P1-02)	Programming	*139*
P2-16	011FH	No-Flow Setpoint Compensation **NF SP Comp.**	Setpoint compensation used in the no-flow detection function.	0.0 to 6000.0 (system units P1-02)	1.5 (system units P1-02)	Programming	*140*
P2-17	0120H	No-Flow Feedback Delay Time **NF FB.Delay Time**	Delay timer used in combination with the no-flow feedback (PID-Error: setpoint minus feedback) level (P2-15) used to detect the no-flow condition based on the feedback value. Delta feedback (Setpoint minus feedback) has to exceed the programmed level (P2-15) for the time programmed to detect a no-flow condition.	0.0 to 1000.0	2.0 sec	Programming	*140*
P2-18	0121H	No-Flow Motor RPM Sample Time **NF RPM Sample Tm**	No-flow detection motor RPM sample rate.	0.1 to 1000.0	2.0 sec	Programming	*140*
P2-19	0122H	No-Flow Feedback Detection Direction **NF FB Det.Direct**	Direction of feedback detection upon return of no-flow detection. 0: Outside Bandwidth (P2-15) 1: Inside Bandwidth (P2-15)	0 or 1	0	Programming	*140*
P2-20 ♦	0123H	Alternative Sleep Activate Level **SLP Act. Level**	When P2-01 Sleep Level Type is set for 0 (Output Frequency), the sleep function becomes active when the output frequency is greater or equal to the level in P2-20. When programmed to 0, the sleep function will become active above the P2-02 Sleep Level. A value of 0 disables this function.	0.0 to 120.0	0.0 Hz	Programming	*141*
♦ Denotes that parameter can be changed when the Drive is running.							
			Pump Multiplex				
P3-01	0614H	Lead-Lag Control **Lead-Lag Control**	Selects lead-lag detection operation. 0: Output Frequency (Output Frequency). 0: Uses P3-02, P3-04, P3-06, P3-09, P3-10. 1: Feedback (Feedback Level). 1: Uses P3-03,P3-04,P3-05,P3-06. 2: Feedback + Fout (Feedback Level and Output Frequency). 2: Uses P3-02,P3-03,P3-05,P3-06,P3-07, P3-08,P3-10. Works in conjunction with parameters P2-11 to P2-19.	0 to 2	0	Programming	*143*

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
P3-02 ♦	0615H	Drive Multi/Maximum Level **Max-Multi Level**	Sets the maximum level used for multiplex pumping operation. Parameter is active when P3-01 = 0 or P3-01 = 2 is selected. **P3-01=0:** When the output frequency rises above the level programmed in P3-02 for a time specified in P3-04, the next available pump will be added to the system by means of a multi-function digital output closure (H2-XX = 40, 41). **P3-01=1:** Not Used. **P3-01=2:** When the output frequency rises above level programmed in P3-02 and the delta feedback (setpoint minus feedback) has exceeded the level programmed in P3-03 for a time specified in P3-04, the next available pump will be added to the system by means of a multi-function digital output closure (H2-XX = 40, 41).	0.0 to 120.00	59.0 Hz	Programming	*149*
P3-03 ♦	0616H	Add Pump Delta Level **Add Pump D-Lvl**	Sets the level used for multiplex pumping operation. The parameter is active when P3-01 =1 or P3-01 = 2 is selected. **P3-01=0:** Not Used. **P3-01=1:** When the delta feedback (setpoint minus feedback) has exceeded the level programmed in P3-03 for a time specified in P3-04, the next available pump will be added to the system by means of a multi-function digital output closure. (H2-XX = 40, 41). **P3-01=2:** When the output frequency rises above level programmed in P3-02 and the delta feedback (Setpoint minus feedback) has exceeded the level programmed in P3-03 for a time specified in P3-04, the next available pump will be added to the system by means of a multi-function digital output closure. (H2-XX = 40, 41). **Note:** Do not program this level too close to the system setpoint or excessive cycling of the pump system may occur.	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Programming	*150*
P3-04 ♦	0617H	Add Pump Delay Time **Add Pump Dly Tm**	Sets the delay time before a pump is added to the system. Works in conjunction with parameters P3-02, P3-03, and P2-11 to P2-19.	0 to 3600	2 sec	Programming	*150*
P3-05 ♦	0618H	Shutdown Pump Delta Level **Shdn Pump D-Lvl**	Sets the level used for multiplex pumping operation. Parameter is active when P3-01 = 1 or P3-01 = 2 is selected. **P3-01=0:** Not Used. **P3-01=1:** When the delta feedback (feedback minus setpoint) has exceeded the level programmed in P3-05 for a time specified in P3-06,the last pump that was brought online will be shutdown by means of a multi-function digital output opening. (H2-XX = 40, 41). **P3-01=2:** When the output frequency drops below level programmed in P3-09 or P3-10 (depends on last pump running) and the delta feedback (feedback minus setpoint) has exceeded the level programmed in P3-05 for a time specified in P3-06, the last pump that was brought online will be shutdown by means of a multi-function digital output opening. (H2-XX = 40, 41). **Note:** Do not program this level too close to the system setpoint or excessive cycling of the pump system may occur.	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Programming	*150*
P3-06 ♦	0619H	Shutdown Pump Delay Time **Shdn Pump Dly Tm**	Sets the delay time before one of the additional across the line pumps is shutdown.Works in conjunction with parameters P3-02 and P3-03.	0 to 3600	5 sec	Programming	*151*
P3-07 ♦	061AH	Multi Pump Setpoint Increase **MP Setpoint Inc.**	Sets the amount the Drive's setpoint will decrease for each time a new pump is brought offline. Pump 1: Setpoint. Pump 1+2: Setpoint + P3-07. Pump 1+2+3: Setpoint + (2 x P3-07).	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Programming	*151*
P3-08 ♦	061BH	Multi Pump Setpoint Decrease **MP Setpoint Dec.**	Sets the amount the Drive's setpoint will increase for each time a new pump is brought online. Pump 1: Setpoint. Pump 1+2: Setpoint - P3-08. Pump 1+2+3: Setpoint - (2 x P3-08).	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Programming	*152*

♦ Denotes that parameter can be changed when the Drive is running.

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
P3-09 ♦	061CH	Pump 2 Frequency Shutdown Level **P2 Freq. Shd Lvl**	Sets the level used for multiplex pumping operation. Parameter is active when P3-01 = 0 or P3-01 = 2 is selected. **P3-01=0:** When the output frequency falls below the level programmed in P3-09 for a time specified in P3-06 and a total of 2 pumps are running, the last pump (Pump 2) that was brought online will be shutdown by means of a multi-function digital output opening (H2-XX = 40, 41). **P3-01=1:** Not Used. **P3-01=2:** When the output frequency falls below the level programmed in P3-09 and a total of 2 pumps are running and the delta feedback (feedback minus setpoint) has exceeded the level programmed in P3-05 for a time specified in P3-06, the last pump (Pump 2) that was brought online will be shutdown by means of a multi-function digital output opening (H2-XX = 40, 41).	0.0 to 120.0	35.0 Hz	Programming	*153*
P3-10 ♦	061DH	Pump 3 Frequency Shutdown Level **P3 Freq. Shd Lvl**	Sets the level used for multiplex pumping operation. Parameter is active when P3-01 = 0 or P3-01 = 2 is selected. **PE-01=0:** When the output frequency falls below the level programmed in P3-10 for a time specified in P3-06 and a total of 3 pumps are running, the last pump (Pump 3) that was brought online will be shutdown by means of a multi-function digital output opening (H2-XX = 40, 41). **P3-01=1:** Not Used. **P3-01=2:** When the output frequency falls below the level programmed in P3-10 and a total of 3pumps are running and the delta feedback (feedback minus setpoint) has exceeded the level programmed in P3-05 for a time specified in P3-06, the last pump (Pump 3) that was brought online will be shutdown by means of a multi-function digital output opening (H2-XX = 40, 41).	0.0 to 120.00	35.0 Hz	Programming	*153*
P3-11 ♦	0110H	Multiplex Stabilization Time **M-Stabilize Time**	Sets the time used to stabilize system when a pump is added (brought online) or shutdown during multiplex operation. When a pump is added, the stabilize timer temporarily disables the lead/lag functionality for the programmed time to prevent pump cycling. **Note:** This function only active in the multiplex mode when P1-01 is greater than 0. During the stabilization time, the pump protection and lead-lag control is suspended.	0 to 3600	2 sec	Programming	*154*
P3-12 ♦	0111H	Delta Setpoint Feedback Acc/Dec Changeover **SP ACC/DEC Hyst.**	Sets the level when the acceleration and deceleration times change over to the values programmed in C1-05 and C1-06 respectively. This function will activate when the difference between the delta setpoint and feedback are within the level programmed in P3-12. This function is used to improve the pump regulation.A value of 0 disables this function.	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Programming	*155*
P3-13 ♦	0112H	Friction compensation start Frequency **Fric. Comp. Lvl**	Sets the level when the setpoint will be adjusted to compensate for the friction losses. This function will activate when the output frequency rises above the level programmed in P3-13. The maximum compensation at maximum output frequency (E1-04) is specified by maximum setpoint frequency (P2-10). **Note:** This function is only active in simplex mode when P1-01 = 0.	0.0 to 120.0	0.0 Hz	Programming	*156*
P3-14 ♦	0113H	Maximum Friction Increase at Maximum Frequency **Friction Inc.**	Sets the maximum setpoint friction compensation at maximum output frequency (E1-04). This function is a linear calculation with P3-13 as its starting frequency. Example: P3-13 = 30.0 Hz, P3-14 = 10.0 PSI, output frequency = 45.0 Hz and maximum frequency = 60.0 Hz Setpoint Increase = (45-30 Hz) x 10 PSI / (60 Hz – 30 Hz) ≥ 5.0PSI **Note:** This function is only active in simplex mode when P1-01 = 0.	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Programming	*156*
♦ Denotes that parameter can be changed when the Drive is running.							

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
			Pump Advanced				
P4-01 ♦	0115H	Pre-Charge Level **Pre-Charge Level**	Sets the level when the drive will run at the pre-charge frequency (P4-02). The Drive will stop when one of the following conditions occurs: Feedback signal rises above P4-01 level, pre-charge timer P4-03 expires, or low water digital input is deactivated (H1-XX = 85). The pre-charge function can only be activated while in a stop condition. The function is enabled by setting P4-03 to a value greater than 0. When the function is activated, the drive's operator display indicates a "Pre-charge" alarm. **Note:** This function is only active in the stopped mode. **Thrust Mode:** The pre-charge level is used when the thrust mode is active for the feedback check. The thrust mode is deactivated when the feedback exceeds the programmed level in P4-01. A value of 0 disables the thrust mode feedback check function.	0.0 to 6000.0 (system units P1-02)	0.0 (system units P1-02)	Pump Quick Setup	*158*
P4-02 ♦	0116H	Pre-Charge Frequency **Pre-Charge Freq.**	Sets the frequency reference used when the pre-charge function is active.	0.0 to 120.0	0.0 Hz	Pump Quick Setup	*163*
P4-03 ♦	0117H	Pre-Charge Time **Pre-Charge Time**	Sets the maximum allowed pre-charge time. A value of 0 disables this function.	0.0 to 3600.0	0.0 min	Pump Quick Setup	*164*
P4-04 ♦	0118H	Thrust Bearing Acceleration Time **Thrust Acc. Time**	Sets the thrust bearing acceleration time. When enabled (P4-05>0), the Drive output frequency will ramp up to the specified thrust bearing frequency reference in P4-05 using an acceleration time as specified in P4-04. The PI mode is automatically disabled. Once the output frequency reaches the programmed thrust bearing frequency, the Drive automatically switches to PI control and the original acceleration time (C1-01), and will continue in the normal operation (auto) mode, unless Pre-Charge is enabled, in which case Pre-Charge mode occurs. This function active in the Hand Mode and Auto Mode. .**Note:** In **Auto Mode**, the Minimum Pump Frequency will become the thrust bearing frequency if smaller than the thrust bearing frequency in P4-05. In **Hand Mode**, the minimum frequency is P4-05 when the thrust mode is enabled. The Pre-Charge level is not active in the hand mode.	0.0 to 6000.0	1.0 sec	Pump Quick Setup	*164*
P4-05 ♦	0119H	Thrust Bearing Frequency **Thrust Freq.**	Sets the frequency reference used when the thrust bearing function is active. A value of 0 disables this function.	0.0 to 120.0	0.0 Hz	Pump Quick Setup	*165*
P4-06 ♦ <0032>	011AH	Thrust Bearing Deceleration Time **Thrust Dec Time.**	This deceleration time will be used to bring the Drive from Thrust Frequency (P4-05) to stop when Thrust Mode is active. Any time the Run Command is removed while the drive is operating in the Thrust Mode above the Thrust Frequency, this deceleration time will be used once the frequency reference is at or below the Thrust Frequency. **Note:** In **Auto Mode**, the Minimum Pump Frequency (P1-06) will become the thrust bearing frequency if smaller than the thrust bearing frequency in P4-05. In **Hand Mode**, the minimum frequency is P4-05 when the thrust mode is enabled. The Pre-Charge level is not active in the hand mode.	0.0 to 6000.0	1.0 sec	Pump Quick Setup	*165*
P4-07 <0032>	011BH	Feedback Fault Auto Restart Enable **Fdback Flt Rstrt**	Setting to enable / disable Auto Restart for the following iQpump transducer / feedback faults (N = disable / Y = enable): LL: Low Level Feedback (P1-07) HL: High Level Feedback (P1-09) TL: Transducer Loss (b5-12) 0: TL = N HL = N LL = N 1: TL = N HL = N LL = Y 2: TL = N HL = Y LL = N 3: TL = N HL = Y LL = Y 4: TL = Y HL = N LL = N 5: TL = Y HL = N LL = Y 6: TL = Y HL = Y LL = N 7: TL = Y HL = Y LL = Y Note: Parameter L5-01 needs to be set to "1" and program L5-03 needs to be set to the applicable time.	0 to 7	0	Pump Quick Setup	*165*

♦ Denotes that parameter can be changed when the Drive is running.

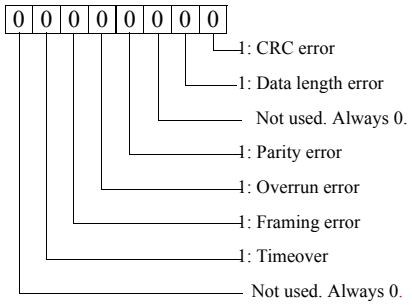
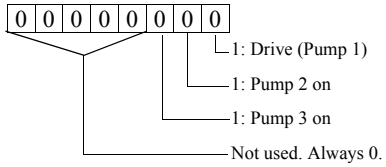
Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description	Setting Range	Factory Setting	Menu Location	Page No.
P4-08 <0032>	011CH	Protection Fault Auto Restart Enable **Prot Flt Restrt**	Setting to enable / disable Auto Restart for the following iQpump protection faults (N = disable / Y = enable): SP: Not Maintaining SetPoint (P1-11) LOP: Loss of Prime (P1-12) POC: Pump Over Cycling (P2-08)) 0: POC = N LOP = N SP = N 1: POC = N LOP = N SP = Y 2: POC = N LOP = Y SP = N 3: POC = N LOP = Y SP = Y 4: POC = Y LOP = N SP = N 5: POC = Y LOP = N SP = Y 6: POC = Y LOP = Y SP = N 7: POC = Y LOP = Y SP = Y **Note:** Parameter L5-01 needs to be set to "1" and program L5-03 needs to be set to the applicable time.	0 to 7	0	Pump Quick Setup	*165*
P4-09 <0032>	011DH	Loss of Prime Maximum Restart Time After Fault **LOP Max Rstrt T**	If the restart fails (or is not attempted due to a continuing fault condition) the Drive waits this many minutes before attempting another restart. **Note:** This parameter will take the place of L5-03 during a Loss of Prime Fault restart attempt.	0.2 to 6000.0	0.2 min	Pump Quick Setup	*165*
P4-10 ♦	011EH	Auto Mode Operator Run Power Down Storage. **AMO PwDn-Storage**	Stores the run status in the Auto mode when operating from digital operator (b1-02=0). 0: Disabled. 1: Enabled. **⚠ WARNING** **When the drive is powered down while running, then upon power-up it will automatically initiate an internal run command.**	0 or 1	0	Pump Quick Setup	*167*
			Hand Mode				
P5-01 ♦	0124H	Hand Mode Reference Source **Hand Mode Ref.**	Sets the hand mode reference source. 0: Analog Input A1 (0-10 V). 1: Hand reference (P5-02).	0 or 1	1	Pump Quick Setup	*168*
P5-02 ♦	0125H	Hand Reference **Hand Reference**	Sets the frequency reference used when the hand mode is active and P5-01 is programmed to 1.	0.0 to 120.0	0.0 Hz	Pump Quick Setup	*169*
P5-03 <0032>	0114H	HAND/AUTO During Run Selection **HAND/AUTO @Run**	Selects if the Drive will permit switching between HAND and AUTO modes while running. 0: Disabled. 1: Enabled. Switching from HAND to AUTO is not permitted when the Drive output frequency is less than the PID minimum speed. Switching from AUTO to HAND is not permitted when the Drive is running in the multiplex mode with auxiliary drives enabled.	0 to 1	0	Programming	*169*
P5-04 <0032>	0513H	Hand Key Function Selection **Oper HAND Key**	Enables or disables the "HAND" key on the digital operator. 0: Disabled. 1: Enabled.	0 to 1	1	Programming	*169*
			Auto-Tuning				
T1-02	0702H	Motor Rated Power **Mtr Rated Power**	Sets the motor rated power in kW. **Note:** T1-02 should be left at the default value (last 3 digits of the Drive model number).	0.00 to 650.0	kVA Dependent	Auto-Tuning	*172*
T1-04	0704H	Motor Rated Current **Rated Current**	Sets the motor rated current. (Used only during an auto-tune.)	kVA Dependent	kVA Dependent	Auto-Tuning	*172*

♦ Denotes that parameter can be changed when the Drive is running.

Monitor List

Table 2 Monitor List

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description
			Monitor
U1-01	0040H	Auto Setpoint Reference **Auto: Setpoint**	Auto Setpoint Reference (speed command) monitor when in auto mode, frequency reference (speed command) setting location when in hand mode. Units changeable via P1-02.
U1-02	0041H	Output Frequency **Output Freq**	Output frequency monitor in Hz.
U1-03	0042H	Output Current **Output Current**	Output current monitor.
U1-06	0045H	Output Voltage **Output Voltage**	Displays Drive output voltage.
U1-07	0046H	DC Bus Voltage **DC Bus Voltage**	Displays DC bus voltage.
U1-08	0047H	Output Power **Output kWatts**	Displays Drive output power.
U1-10	0049H	Input Terminal Status **Input Term Sts**	Displays Drive input terminal status. 0 0 0 0 0 0 0 0 1: FWD. run (Terminal S1) is ON. 1: REV. run (Terminal S2) is ON. 1: Multi-function input 1 (Terminal S3) is ON. 1: Multi-function input 2 (Terminal S4) is ON. 1: Multi-function input 3 (Terminal S5) is ON. 1: Multi-function input 4 (Terminal S6) is ON. 1: Multi-function input 5 (Terminal S7) is ON.
U1-11	004AH	Output Terminal Status **Output Term Sts**	Output terminal ON/OFF check. 0 0 0 0 0 0 0 0 1: Multi-function Contact 1 output 1 (Terminal M1-M2) is ON. 1:Multi-function Contact 2 output 1 (Terminal M3-M4) is ON. Not used Not used 1:Fault output (Terminal MA/MB-MC) is ON.
U1-12	004BH	Drive Operation Status **Int Ctl Sts 1**	0 0 0 0 0 0 0 0 1: During running 1: During zero speed 1: During reverse 1: During reset signal input 1: During speed agree 1: Drive operation ready 1: During fault detection (Minor fault) 1: During fault detection (Major fault)
U1-13	004CH	Cumulative Operation Time **Elapsed Time**	Displays total operating or power-on time of the Drive.
U1-14	004DH	Software Number **FLASH ID**	Displays Drive's software number.
U1-15	004EH	Terminal A1 Input Voltage **Term A1 Leve**l	Displays the input voltage on Terminal A1, as a percentage of 10 Vdc.

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description
			Monitor
U1-16	004FH	Terminal A2 Input Voltage **Term A2 level**	Displays the input current (or voltage) on Terminal A2, as a percentage of 20 mA (or 10 Vdc).
U1-18	0051H	Motor Secondary Current (Iq) **Mot SEC Current**	Displays the amount of current being used by the motor to produce torque (Iq).
U1-20	0053H	Output Frequency After Soft Start **SFS Output**	Displays the frequency reference (speed command) after the accel and decel ramps.
U1-24	0057H	PI Feedback Value **PI Feedback**	Displays the feedback signal when PI control is used.
U1-28	005BH	CPU Number **CPU ID**	Displays control board hardware revision.
U1-29	005CH	kWh **kWh Lo 4 Digits**	Displays the accumulated kWh.
U1-30	005DH	MWh **kWh Hi 5 Digits**	Displays the accumulated MWh.
U1-34	0061H	First Parameter Causing an OPE **OPE Detected**	Displays the parameter number causing an “OPE” fault.
U1-36	0063H	PI Input **PI Input**	Displays the “error” in the PI regulator. (U1-36 = PI Setpoint - PI Feedback).
U1-37	0064H	PI Output **PI Output**	Displays the output of the PI as a percentage of maximum frequency (E1-04).
U1-38	0065H	PI Setpoint **PI Setpoint**	Displays the setpoint of the PI regulator (U1-38 = PI reference + PI bias).
U1-39	0066H	Memobus Communication Error Code **Transmit Err**	
U1-40	0067H	Heatsink Cooling Fan Operation Time **FAN Elapsed Time**	Displays total operating time of the heatsink cooling fan.
U1-90	0720H	Pump Setpoint **Pump Setpoint**	Displays drive setpoint. Resolution 0.1 **Note:** Does not include setpoint compensation (U1-93).
U1-91	0721H	Pump Feedback **Pump Feedback**	Displays scaled feedback. Resolution 0.1
U1-92	0722H	Pump Status **Pump Status**	Display pump running status. 

Parameter No.	Modbus Address	Parameter Name Digital Operator Display	Description
			Monitor
U1-93	723H	Total Setpoint Compensation **Total SP Comp.**	Displays total absolute setpoint compensation. resolution 1
U1-94	724H	Motor Speed **Motor Speed**	Displays motor speed (RPM). Used for no-flow detection (P2 Group).

Fault Trace List

Table 3 Fault Trace List

Parameter No.	Modbus Address	Fault Trace
U2-01	0080H	Current Fault **Current Fault**
U2-02	0081H	Previous Fault **Last Fault**
U2-03	0082H	Frequency Reference at Most Recent Fault **Frequency Ref**
U2-04	0083H	Output Frequency at Most Recent Fault **Output Freq**
U2-05	0084H	Output Current at Most Recent Fault **Output Current**
U2-07	0086H	Output Voltage at Most Recent Fault **Output Voltage**
U2-08	0087H	DC Bus Voltage at Most Recent Fault **DC Bus Voltage**
U2-09	0088H	Output Power at Most Recent Fault **Output kWatts**
U2-11	008AH	Input Terminal Status at Most Recent Fault. The format is the same as for U1-10. **Input Term Sts**
U2-12	008BH	Output Terminal Status at Most Recent Fault. The format is the same as for U1-11. **Output Term Sts**
U2-13	008CH	Drive Operation Status at Most Recent Fault. The format is the same as for U1-12. **Inverter Status**
U2-14	008DH	Cumulative Operation Time at Most Recent Fault **Elapsed time**
Note: Fault trace is not executed at CPF00, CPF01, CPF03, UVI and UV2.		

Fault History List

Table 4 Fault History List

Parameter No.	Modbus Address	Fault History
U3-01	0090H	Most Recent Fault **Last Fault**
U3-02	0091H	2nd Most Recent Fault **Fault Message 2**
U3-03	0092H	3rd Most Recent Fault **Fault Message 3**
U3-04	0093H	4th Most Recent Fault **Fault Message 4**
U3-05	0094H	Cumulative Operation Time at Most Recent Fault **Elapsed Time 1**
U3-06	0095H	Cumulative Operation Time at 2nd Most Recent Fault **Elapsed Time 2**
U3-07	009BH	Cumulative Operation Time at 3rd Most Recent Fault **Elapsed Time 3**
U3-08	0097H	Cumulative Operation Time at 4th Most Recent Fault **Elapsed Time 4**
U3-09	0804H	5th Most Recent Fault **Fault Message 5**
U3-10	0805H	6th Most Recent Fault **Fault Message 6**
U3-11	0806H	7th Most Recent Fault **Fault Message 7**
U3-12	0807H	8th Most Recent Fault **Fault Message 8**
U3-13	0808H	9th Most Recent Fault **Fault Message 9**
U3-14	0809H	10th Most Recent Fault **Fault Message 10**
U3-15	080EH	Cumulative Operation Time at 5th Most Recent Fault **Elapsed Time 5**
U3-16	080FH	Cumulative Operation Time at 6th Most Recent Fault **Elapsed Time 6**
U3-17	0810H	Cumulative Operation Time at 7th Most Recent Fault **Elapsed Time 7**
U3-18	0811H	Cumulative Operation Time at 8th Most Recent Fault **Elapsed Time 8**
U3-19	0812H	Cumulative Operation Time at 9th Most Recent Fault **Elapsed Time 9**
U3-20	0813H	Cumulative Operation Time at 10th Most Recent Fault **Elapsed Time 10**
Note: Faults such as CPF00, CPF01, CPF02, CPF03, UV1, and UV02 are not stored in fault history.		

Table 5 Decimal to Hex Conversion

Decimal	Hex	Decimal	Hex
1	1	51	33
2	2	52	34
3	3	53	35
4	4	54	36
5	5	55	37
6	6	56	38
7	7	57	39
8	8	58	3A
9	9	59	3B
10	A	60	3C
11	B	61	3D
12	C	62	3E
13	D	63	3F
14	E	64	40
15	F	65	41
16	10	66	42
17	11	67	43
18	12	68	44
19	13	69	45
20	14	70	46
21	15	71	47
22	16	72	48
23	17	73	49
24	18	74	4A
25	19	75	4B
26	1A	76	4C
27	1B	77	4D
28	1C	78	4E
29	1D	79	4F
30	1E	80	50
31	1F	81	51
32	20	82	52
33	21	83	53
34	22	84	54
35	23	85	55
36	24	86	56
37	25	87	57
38	26	88	58
39	27	89	59
40	28	90	5A
41	29	91	5B
42	2A	92	5C
43	2B	93	5D
44	2C	94	5E
45	2D	95	5F
46	2E	96	60
47	2F	97	61
48	30	98	62
49	31	99	63
50	32	100	64

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Appendix: B

Factory Default Settings

This appendix lists the factory default settings for the parameters affected by setting of o2-04.

Factory Default Settings

The following tables detail the factory default settings for the parameters that are affected by the setting of parameter o2-04.

Table 35 208/240 VAC Drives

Drive Model CIMR-P7U-☐-107	Nominal Hp	Factory Default for b8-04	Factory Default for C6-02 <0032>	Factory Default for E2-01	Factory Default for E2-03	Factory Default for E2-05	Factory Default for L2-02	Factory Default for L2-03	Factory Default for L2-04	Factory Default for L8-02	Factory Default for L8-06
20P4	0.5/0.75	288.2	10 kHz	1.9	1.2	9.842	0.1	0.1	0.3	95× C	5
20P7	2	223.7	10 kHz	3.3	1.8	5.156	0.1	0.2	0.3	95× C	7.5
21P5	1.5/2	169.4	10 kHz	6.2	2.8	1.997	0.2	0.3	0.3	95× C	10
22P2	3	156.8	8 kHz	8.5	3.0	1.601	0.3	0.4	0.3	100 × C	12
23P7	5	122.9	10 kHz	14.0	4.5	0.771	0.5	0.5	0.3	95× C	12
25P5	7.5	94.75	15 kHz	19.6	5.1	0.399	1.0	0.6	0.3	95× C	10
27P5	10	72.69	15 kHz	26.6	8.0	0.288	1.0	0.7	0.3	95× C	17
2011	15	70.44	8 kHz	39.7	11.2	0.230	1.0	0.8	0.3	95× C	21
2015	20	63.13	10 kHz	53.0	15.2	0.138	2.0	0.9	0.3	90× C	17
2018	25	57.87	10 kHz	65.8	15.7	0.101	2.0	1.0	0.6	100× C	15
2022	30	51.79	10 kHz	77.2	18.5	0.079	2.0	1.0	0.6	90× C	24
2030	40	46.27	10 kHz	105.0	21.9	0.064	2.0	1.1	0.6	90× C	20
2037	50	38.16	5 kHz	131.0	38.2	0.039	2.0	1.1	0.6	95× C	18
2045	60	35.78	5 kHz	160.0	44.0	0.030	2.0	1.2	0.6	100× C	20
2055	75	31.35	8 kHz	190.0	45.6	0.022	2.0	1.2	0.1	105× C	17
2075	75/100	23.10	2 kHz	260.0	72.0	0.023	2.0	1.3	0.1	110× C	16
2090	125	20.65	2 kHz	260.0	72.0	0.023	2.0	1.5	0.1	100× C	18
2110	150	18.12	2 kHz	260.0	72.0	0.023	2.0	1.7	0.1	95× C	20

Note: b8-04 = Energy Savings Coefficient
C6-02 = Carrier Frequency
E2-01 = Motor Rated Current
E2-03 = Motor No-Load Current
E2-05 = Motor Line-to-Line Resistance
L2-02 = Momentary Power Loss Ride-Thru Time
L2-03 = Momentary Power Loss Minimum Base Block Time
L2-04 = Momentary Power Loss Voltage Recovery Ramp Time
L8-02 = Overheat Pre-Alarm Level
L8-06 = Input Phase Loss Detection Level

Table 36 480 VAC Drives

Drive Model CIMR-P7U-☐-107	Nominal Hp	Factory Default for b8-04	Factory Default for C6-02 <0032>	Factory Default for E2-01	Factory Default for E2-03	Factory Default for E2-05	Factory Default for L2-02	Factory Default for L2-03	Factory Default for L2-04	Factory Default for L8-02	Factory Default for L8-06
40P4	0.5/0.75	576.40	15 kHz	1.0	0.6	38.198	0.1	0.1	0.3	95×C	5
40P7	1	447.40	15 kHz	1.6	0.8	22.459	0.1	0.2	0.3	95×C	7.5
41P5	1.5/2	338.80	15 kHz	3.1	1.4	10.100	0.2	0.3	0.3	95×C	10
42P2	3	313.60	15 kHz	4.2	1.5	6.495	0.3	0.4	0.3	90 ×C	10
43P7	5	245.80	15 kHz	7.0	2.3	3.333	0.5	0.5	0.3	95×C	12
45P5	7.5	189.50	15 kHz	13.3	2.6	1.595	1.0	0.6	0.3	95×C	10
47P5	10	145.38	15 kHz	19.9	4.0	1.152	1.0	0.7	0.3	90×C	20
49P0	15	145.46	15 kHz	21.0	4.4	0.922	1.0	0.8	0.3	95°C	23
4011	15/20	140.88	8 kHz	26.5	5.6	0.922	2.0	0.8	0.3	95×C	23
4015	25	126.26	10 kHz	32.9	7.6	0.550	2.0	0.9	0.3	95×C	17
4018	30	115.74	10 kHz	52.3	7.8	0.403	2.0	1.0	0.6	98×C	17
4024	40	89.08	10 kHz	52.0	8.6	0.269	2.0	1.1	0.6	85°C	20
4030	40/50	92.54	8 kHz	65.6	10.9	0.269	2.0	1.1	0.6	85×C	20
4037	60	76.32	8 kHz	79.7	19.1	0.155	2.0	1.1	0.6	85×C	20
4045	75	71.56	8 kHz	95.0	22.0	0.122	2.0	1.2	0.6	90×C	20
4055	100	67.20	5 kHz	130.0	24.0	0.088	2.0	1.2	1.0	90×C	20
4075	125	46.20	5 kHz	130.0	36.0	0.092	2.0	1.3	1.0	98×C	16
4090	150	38.91	8 kHz	156.0	40.0	0.056	2.0	1.5	1.0	108×C	16
4110	200	36.23	5 kHz	190.0	49.0	0.046	2.0	1.7	1.0	100×C	16
4160	250	30.13	5 kHz	270.0	70.0	0.029	2.0	1.8	1.0	108×C	14
4185	300/350	30.57	2 kHz	310.0	81.0	0.025	2.0	0.7	1.0	95×C	15
4220	400/450	27.13	2 kHz	370.0	96.0	0.020	2.0	0.8	1.0	100×C	15
4300	500+	21.76	2 kHz	500.0	130.0	0.014	2.1	0.9	1.0	95×C	15

Note: b8-04 = Energy Savings Coefficient
C6-02 = Carrier Frequency
E2-01 = Motor Rated Current
E2-03 = Motor No-Load Current
E2-05 = Motor Line-to-Line Resistance
L2-02 = Momentary Power Loss Ride-Thru Time
L2-03 = Momentary Power Loss Minimum Base Block Time
L2-04 = Momentary Power Loss Voltage Recovery Ramp Time
L8-02 = Overheat Pre-Alarm Level
L8-06 = Input Phase Loss Detection Level

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