Logix 1400 Version 23/3400IQ Firmware
Manual Appendix B
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Date	Description	Version	Sign Off
04-04-03	Original Draft	0	
10-06-03	V23 code created, requiring the addition of the Jog calibration.	1	
1-12-04	Jog calibration clarified	2	
2-2-04	Generic parms usage clarified	3	
3-2-04	Multiple view statement added	4	
1-13/07	Logix 3400IQ reference added	5	

Introduction

This addendum covers the release of Logix 1400 Controller Firmware v23 and 3400IQ, and Fieldbus code version 2.04.xx. Because the Logix 1400/3400IQ consists of two separate boards, the Fieldbus Interface board and the Logix Controller board, it is possible for the firmware on each board to be updated at different times. Subsequently, new features may be added to the Logix 1400/3400IQ Controller firmware that will not be directly addressable from the Fieldbus DD parameters, until the Fieldbus code is modified to support the new features. However, a generic approach was incorporated into the design of the Logix 1400/3400IQ. to allow expansion of the Controller board functionality, without requiring immediate changes to, and re-registration of, the Fieldbus firmware. This is accomplished through the use of the GENERIC PARMS parameter.

Therefore, this document covers the new features, and outlines the enhancements included, in the new version v23 Controller board firmware.

Verification of Controller code version

You can verify the Logix 1400/3400IQ Controller code version via the REVISION_ARRAY parameter of the Resource block through the Fieldbus communications. This array consists of three elements. The third element of this array reports the version number of the Logix Controller board firmware. This value is a hexadecimal data type. Version 23 would be 0x0023. If your configurator cannot display hex data, the decimal equivalent would be represented as 35.

The first element indicates the Fieldbus code version. Version 2.04.03 would show 0x0204. The tertiary revision number is show in the last element of BLOCK_TEST, (example- 0x03).

Additionally, you can physically check the version number by removing the large cover on the Logix 1400/3400IQ positioner itself.

CAUTION
Proper safety procedures and area permissions must be followed before opening the cover of the Logix 1400 as you will be exposing the electronics to the area atmosphere. De-energize or obtain proper area authorization before removing covers.

The top board containing the three color LEDs of the Logix 1400 positioner is the Logix Controller board. With the positioner in the upright position, pneumatic connections on the left side, you will see a large square IC in the lower right quadrant of the half-moon board with a sticker. The sticker displays the revision number of the firmware programmed into the microprocessor. Example: REV. 23.03.

Use of GENERIC-PARM Parameter

This document assumes the user has a working knowledge of the Logix 1400/3400IQ Fieldbus Positioner, and Host system Configurator. Refer to the Logix 1400or the 3400IQ Startup Guide for an overview of the use of the Configurator and Logix 1400 or 3400IQ. Each feature activation will assume that the positioner is configured correctly – namely: Linear/ Rotary actuator, ATO or ATC, Characterization off, and the gains set to reasonable values. All variables are in the Logix 1400/3400IQ's transducer block unless otherwise specified.

Within the transducer block of the 1400/3400IQ are two parameters named GENERIC_PARM_NUM and GENERIC_PARM_VALUE respectively. All numeric variables (including enumeration and bit maps) can be accessed using these two parameters. All new variables added in the development of the Logix 1400 version 23 firmware can be accessed using these parameters. GENERIC_PARM_NUM as two parts: variable number and variable type.

These must be properly set and written to the device in order for the value of GENERIC_PARM_VALUE to be valid. Many variables in the Logix 1400/3400IQ are scaled by some factor of ten. When the variable being accessed is scaled the value shown by GENERIC_PARM_VALUE will be in its native form (larger), and may need to be scaled down. This document will include the variable name, variable number, variable type, and divide by scaling factor when the GENERIC_PARMS must be used.

1-   The positioner should be set to OOS.
2-   Refer to Table IV 'Transducer Block Parameters' of the Logix 1400 IOM (page 46-24), or the Logix 3400IQ IOM.
3-   In GENERIC_PARM_NUM, First select the VAR_TYPE as indicated in the parameter table under 'Type', then enter the variable number into VAR_NUM for the variable you wish to access.
4-   Write the data to the Logix.
5-   GENERIC_PARM_VALUE will update to display the current value stored in that variable number.
6-   If you wish to change the value in a variable, after selecting the variable in the steps above, enter the desired value into GENERIC_PARM_VAL and then write this value to the Logix.

In this document the *italicized* sections are for the user interested in using the generic parms feature. Other users should use the standard Fieldbus parameters.

New Features and Enhancements in the v23 code.

These new features and enhancements have been added to the v23 Logix 1400 firmware: (**NOTE:** The Logix 3400IQ incorporates these same features, but with the addition of the switches on the Controller board, some of these outlined features can be directly accessed.)

Supply Pressure:
The new Die Cast housing of the Logix 1400/3400IQ eliminated the supply pressure sensor port. Now the 1400/3400IQ will depend on the top and bottom actuator pressure readings to determine the supply pressure. Due to the fact that the modulator is constantly adjusting pressures, the supply pressure reading tends to move ±5 psi, and requires a couple of minutes to settle to its final value after moving. This should be used only as an indicator of supply available, not as an exact measurement.

Procedure:

In the transducer block set PRESS_CAL to match the air pressure. Under CALIBRATE in the transducer block select "Automatically Calibrate Actuator Pressure Sensors." After the calibration is complete Supply Pressure can be read using GENERIC_PARMS_NUM.

(Previous changes in the Logix 1400 Fieldbus firmware removed the Supply Pressure parameter from the DD list. It was only available using the Generic_Parms feature of the Logix 1400. This parameter is now restored as **SUPPLY_PRESSURE** in the v2.04.xx Fieldbus code.)

To read using GENERIC_PARMS_NUM:
Variable Name: Supply Pressure
Variable Type: Signed Long

Variable Number: 102
Divide by: 100

LED Blink Codes, Re-Cal / LED blinking during IL_OFFSET Adjust:

The new version 23 code blinks two LEDs simultaneously during calibration procedures, and the code that checks the Re-Cal button is more robust. (**NOTE:** The Logix 3400IQ has complete diagnostic blink codes. Refer to the Logix 3400IQ IOM for a list and description.)

Procedure:
 When the calibration procedure is started the Green and Yellow LED blink until the valve has completed the stroke calibration, including the Inner Loop Offset calculation.

The Re-Cal button is ignored during calibration. The Green/Yellow LED will blink during a Re-Calibration also.

During a pressure calibration the Red/Green LED will blink during the entire calibration routine.

During Auto Tuning the Red/Yellow LED will blink.

Hall Sensor Alarm:

The 1400/3400IQ now uses a more robust algorithm to avoid too sensitive of triggers in detecting errors from the Hall Sensor. **Note: A loss of air supply can trigger a Hall Sensor alarm.**

Stroke Speed Limit:

The new version 23 code allows the user to limit the stroking speed of the positioner.

Procedure:
Two new parameters control the stroke speed; these are **STROKE_RATE_OPEN** and **STROKE_RATE_CLOSED**, both are scaled by 100 internally. Each represents the minimum time, in seconds, required to stroke the valve. Simply enter the number of seconds for the valve to stroke.   Writing a 0 to the variables allows the positioner to run at its maximum speed.

Test this feature by watching a clock and the valve stem: First stroke the valve between 0 to 100% and 100 to 0%, and record the time of each stroke. Next set the StrokeRateOpen to 5 seconds + the original stroke open time and the StrokeRateClose to 3 seconds + the original stroke close time. Stroke the valve open and then closed and record the times. The times should have increased by the 5 and 3 second times entered . Disable both by writing 0 to both variables, and stroke the valve again. Stroke time should be back to the original values.

To set using GENERIC_PARMS_NUM:
Variable Name: *StrokeRateOpen*
Variable Type: Unsigned Int
Variable Number: 21
Divide by: 100

Variable Name: *StrokeRateClose*
Variable Type: Unsigned Int
Variable Number: 22
Divide by: 100

This feature is disabled for the corresponding direction when the variable is set to 0.

As a side note: This feature could be use to make a valve very responsive to small steps, by increasing the nominal gain values, and limiting the stroke speed, small steps would be subject to very high gains. When active, the algorithm scales back large step sizes, thus limiting the undesired effects large gains normally demonstrate on large step sizes, such as overshoot.

Disable Re-Cal After a Calibration as Started:

In version 21 of the firmware it was possible to start another Re-Cal before a stroke calibration routine had completed. Now, a Re-Cal can only be started after the completion of the calibration.

Stroke Calibration Timing Refined:

The routine timing for the stroke calibration has been refined to compensate better for large actuators and slow stroking speed valves so that a better calibration is accomplished. In previous versions the timing delay for each step of the calibration procedure could be too short in some valve design cases to assure an optimal stroke calibration. The new routine adjusts the timing delays based on the actual movement response of the valve. This is especially noticeable during the IL Offset calculation at midstroke.

Feedback Range on Rotary Valves:

Due to the past difficulty in calibrating some rotary actuators, code has been implemented to automatically set the upper (open) position to be in range of the A/D converter, making calibration much easier. The new variable **CAL_FULLSCALE** allows the user to determine the minimum amount of movement (A/D Counts) required to prevent a calibration error.

Procedure: (To be used only if there is a problem during initial setup and calibration.)
First make sure the positioner is configured as a rotary valve in CONTROL_FLAGS. With the air removed from the positioner, carefully loosen the follower arm on the back of the positioner, or the potentiometer screws inside the positioner, so that it can be rotated. Move the arm, or rotate the pot, until just barely in range – the LED that is blinking will change color. Set 'Auto Feedback Gain Enabled' in MISC_FLAGS.   Re-start the calibration. This time the calibration should complete without any problems. Refer to the Logix 1400 IOM for more details on this adjustment.

Normal default for this variable is 1500

To set using GENERIC_PARMS_NUM:
Variable Name: CAL_FULLSCALE
Variable Type: unsigned int
Variable Number: 28
Divide by: -NA

AutoTuning:

Note: Refer to the Logix 3400IQ Quick Start guide for using the autotune feature on the Logix 3400IQ.

Auto Gain Tuning for the positioner has been added to the Logix 1400. This feature is enable by setting the DIP Switch Position 1 (Used as the Logix 1200 ATO/ATC selection switch) in the ON position on the collector board. During Auto Tuning the Red and Yellow LED should blink simultaneously. Auto Tuning can be started in one of two ways. First, if the DIPSwitch is set, the Re-Cal button will cause the positioner to Auto Tune on the completion of a stroke calibration. Second, by choosing "Auto Tune Positioner" under CALIBRATION, with the DIP Switch 1 on. Both methods produce the same result.

If the DIP switch is OFF, normal stroke calibration will be done without the additional auto tuning cycle.

The gains determined by the auto tune calculation can be adjusted by the new parameter, **AUTO_TUNE_MULT**.

Procedure:
Make sure the DIPSwitch is set and press the Re-Cal button. On completion of the IL_Offset calculation of the stroke calibration the valve should again stroke close, open, and closed, and re-calculate the gain values. To read the new gain values change the value of FAIL_MODE and click the write button in the NI Configurator. After a few seconds (up to 5) the new gains will be seen. Don't forget to reset FAIL_MODE back to its desired condition.

To make the positioner more (or less) responsive, change the value of **AUTO_TUNE_MULT**. This parameter will multiply the gains by the value/100. For example to make the positioner less responsive (i.e. lower gains) write a 50 (50/100 = 0.5 and will cut the gains in half) to variable AUTO_TUNE_MULT.

Opening the Dipswitch disables Auto Tuning, so it no longer takes place using either software calibration or Re-Cal.

To set using GENERIC_PARMS_NUM:
Variable Name: AUTO_TUNE
Variable Type: unsigned int
Variable Number: 29
Divide by: 100 (To produce gains that are half the nominal value, you would enter 50)

NOTE: The positioner tuning can still be adjusted by manually changing the normal tuning parameters. However, if auto tuning is enabled, each time you execute a stroke calibration sequence, the tuning values will be recalculated, and may change from your manually input values. If you do not want to have those values changed, disable the auto tuning.

Auto Select Linear/Rotary Actuator Feedback Gains:
This feature was meant to help those who choose to use the 1400/3400IQ on a non-Flowserve actuator. Often the linkage is not properly aligned and Rotary Gains must be used when calibrating to allow for the maximum amount of stem travel. This feature, when enabled by selecting the feature in MISC_FLAGS, will default to linear feedback gains for the highest possible resolution, and switch to lower rotary gains, if the extra travel is needed, automatically during the stroke calibration routine. To ensure enough stroke range is occurring a new variable (**CAL_FULLSCALE**) allows the user to determine the minimum amount of movement (A/D Counts) required to prevent a calibration error.

To set using GENERIC_PARMS_NUM:
Variable Name:CAL_FULLSCALE

Variable Type: Unsigned int
Variable Number: 28
Units: A/D Counts
Scale Factor: N/A

By default this feature is disabled. It is used primarily when the Logix 1400/3400IQ is mounted on a third party valves where the stroke length is not known, or exceeds the nominal 60º follower arm rotation.

Procedure:
First set Auto Feedback Gain Enabled (bit 4 (0x10)) in MISC_FLAGS. This bit enables the Auto Select FB Gains. Then initiate a Stroke Calibration routine.

To set using GENERIC_PARMS_NUM:
Variable Name: MISC_FLAGS*
Variable Type: unsigned char (hex format)
Variable Number: 173
Input: 10 hex (if this is the only bit you wish to set, else calculate the equivalent bit value as a binary to hex number HINT: These binary numbers are set from right to left, or MSB to the left)
Note: MISC_FLAGS is bit mapped so care must be taken not to change any of the other bits when writing to MISC_FLAGS, which could result in unusual positioner responses.

Robust Position Deviation Alarm Trigger:

The triggering algorithm for sensing a position deviation alarm was improved to compensate for Soft limit and Final Value Cutoff usage versus a loss of air supply. In the previous code it was possible to have a change of the status condition of the FINAL_POSITION_VALUE from 'Bad' to 'Uncertain' after an approximately 6 minute cycle on a loss of air condition. In some host systems this would cause a momentary change of status to be indicated. The new algorithm assures that a 'Bad' status is given whenever the positioner cannot maintain the desired position.

Pressure Control Tuning:
(Note: This is the 'Hi-Friction' setting dip switch on the Logix 3400IQ)

A feature that was originally added in the v21 code is Pressure Control Tuning. This is a similar feature that exists in the Logix 1200 and 500 series positioners. The benefit of the option is that its use may smooth out positioner oscillations due to low 'stiction' in the valve with large actuator size thrust. This option is enabled through MISC_FLAGS

Instead of constantly trying to correct the valve position based on the position feedback, Pressure Control Tuning changes the positioner control algorithm into a pressure controller once the position tolerance value set in the PRESS_WINDOW parameter is reached. As long as the valve position remains within the hysterisis tolerance of the value set in the PRESS_HYST parameter, the controller controls the delta pressure in the actuator to maintain stability. The gain of this control is set by the value in PRESS_GAIN. (NOTE: It is very rare that the value of PRESS_GAIN should be changed. Please consult with the factory before attempting to change this variable.)

When the valve position exceeds the tolerance of PRESS_HYST, control returns to position feedback and the controller adjusts the position accordingly until it again locks into the pressure control mode.

This option may also prove useful in reducing oscillations due to high friction packing or pressure balance seals in the valve. In this case the value of PRESS_HYST is increased to be slightly larger than the normal stroke oscillation amplitude created by the high stiction of the valve.   You can determine this by observing the amplitude of position 'jumps', or square wave steps, induced by the high stiction.

Procedure:
Set Bit 3 in MISC_FLAGS. This bit enables the Pressure Control Tuning.

To set using GENERIC_PARMS_NUM:
Variable Name: MISC_FLAGS*
Variable Type: unsigned char (hex format)
Variable Number: 173
Input: 8 hex (if this is the only bit you wish to set, else calculate the equivalent bit value as a binary to hex number. HINT: MSB is to the left in bit map.)
Note: MISC_FLAGS is bit mapped so care must be taken not to change any of the other bits when writing to MISC_FLAGS, which could result in unusual positioner responses.

NVRAM WRITE CYCLE COUNTER:

A new diagnostic parameter, **NVRAM_WRITE_CYCLES** has been added to the transducer block of the Logix 1400/3400IQ. This parameter allows the user to monitor the number of times the NVRAM is written to. This can be a useful diagnostic for checking if the host system is writing to the Fieldbus board memory too often. This is often a configuration error in the host system setup.

Excessive write cycles can cause configuration upsets and possible communications slow down and errors. It also will shorten the operational life of a Fieldbus device by exceeding the finite number of write cycles NVRAM chips can be used reliably to. These devices typically have a minimum 1,000,000 write cycle endurance. Even though this is a very high number that would typically never be reached during the operational life of the device, a misbehaving host configuration routine could drive up the number of write cycles very quickly, and should be corrected as all devices in the configuration will be adversely affected by this continuous download.

READBACK OUT LINKABLE PARAMETER

The user now has the ability to use Readback in the AO block as a linkable output parameter. Readback is typically configured to track FINAL_POSITION_VALUE, the position feedback of the Logix 1400/3400IQ. This linkable parameter is called **READBACK_OUT** on the AO block. This feature now allows the user to link the position feedback value of the Logix 1400/3400IQ to another block or display block for user viewing of valve position.

Quality, Substatus and Limits track the values of AO Readback. Refer to section 8.6 of the Logix 1400 Reference manual for more explanation of using Readback.

Note: For Readback to be actively tracking the position feedback of the controller board, FEATURE_SEL in the Resource block must have 'Out Readback' selected.

MULTIPLE VIEW OBJECTS AVAILABLE IN TRANSDUCER BLOCK

In previous Fieldbus code versions, the view objects for the Transducer block was limited to the standard Fieldbus parameters only. In the v2.04.xx version these objects have been expanded to encompass all of the parameters in the transducer block. This can make accessing the various parameters much more efficient in host systems that support Views. The Logix 1400/3400IQ now contains multiple View 3 and View 4 lists. This allows all parameters, except for TAG_DESC, UPDATE_EVT, and BLOCK_ALM, to be accessible through views.

Logix 1400- JOG CALIBRATION PROCEDURE
(version v23 controller board required)

Jog calibration is a feature that allows the user to manually calibrate the stroke of the valve. It is especially useful with older diaphragm operated actuators that do not have mechanical limit stops, or require a 'bench set' type of calibration. It can also be used to manually open or close the valve in an emergency situation. Jog calibration can only be done at the valve.

WARNING: Make sure area is safe and all safety procedures are followed before opening the main cover of the positioner to access the switches.

The details of how this is implemented is as follows:
- We now use the remaining two DIP Switches on the collector board for this function. The bottom switch (switch 3, currently Linear/Custom) will be the Direction switch. The middle switch (switch 2, Lin Vlv/Rot Vlv) becomes the Jog Calibration Completed (Stop)/Enable (Start). (The third switch, switch 1 (top), is the AutoTune Disable/Enable switch).
- MISC_FLAGS (bit 7) is the Jog Calibration Set flag. This tells CALIBRATE if the jog calibration is enabled. If the Jog Calibration flag is not set, then the regular calibration can be initiated as it is now in CALIBRATE, or with the Re-Cal button.
- If the Jog Calibration Flag is set, the user begins the routine by switching the Jog Cal switch to the Start position (center DIP switch (2) moves to the right). This will cause the valve to go closed and read the closed A/D value. Then the valve will be positioned to approximately 70% DAC value. The CALIBRATE parameter will indicate "Jog Cal- waiting for user to set 100% Point". The same diagnostic flags as in CALIBRATE_FLAGS will be active during the procedure to test the A/D integrity.
- The user will then select the 'Open'(to the left) Direction switch (3), and the first press of the Re-Cal button will move the valve from the mid DAC value. The user then continues to press the Re-Cal button to open the valve until the desired position is reached. If he overshoots the desired position, he switches the Direction switch (3) (Close(to the right)) and presses Re-Cal to go in the opposite direction. The user continues this process until the desired position is obtained.
- Once the desired position is reached, the user moves the Jog Cal switch (2) to the Completed (Stop) position. This signals the processor that the desired 100% position has been reached. The valve will now be stroked to the mid range and the IL_Offset calculation acquired. The command will then return to the pre-calibration value, and 'Normal Operation' would be displayed in CALIBRATE. At this point the Auto Tuning Switch (1) will be checked. If it is set, the positioner autotune routine will be ran. Upon completion, CALIBRATE will return to Normal and the user can perform other functions. If the AutoTune switch is not set, CALIBRATE immediately returns to the normal condition.

The valve is now ready for operation and remains this way until the Jog Cal switch is set to Start once again. As long as Jog Calibration Enabled is set in MISC_FLAGS, the Logix 1400 will expect the user to perform a jog calibration.