

## Setting Up F4-16PID Using DirectSoft

### Introduction

The F4-16PID CoProcessor module executes up to 16 PID loops independent of the DL405 PLC CPU (D4-430, D4-440, or D4-450). The F4-16PID is setup using V-memory in the PLC. This document will show an example F4-16PID configuration and DirectSoft screen captures to describe how to setup a F4-16PID.

This document should be used in addition to the F4-16PID-M user manual. Here is a direct link to that manual:

<http://www.facts-eng.com/manuals/f416pidm.pdf>

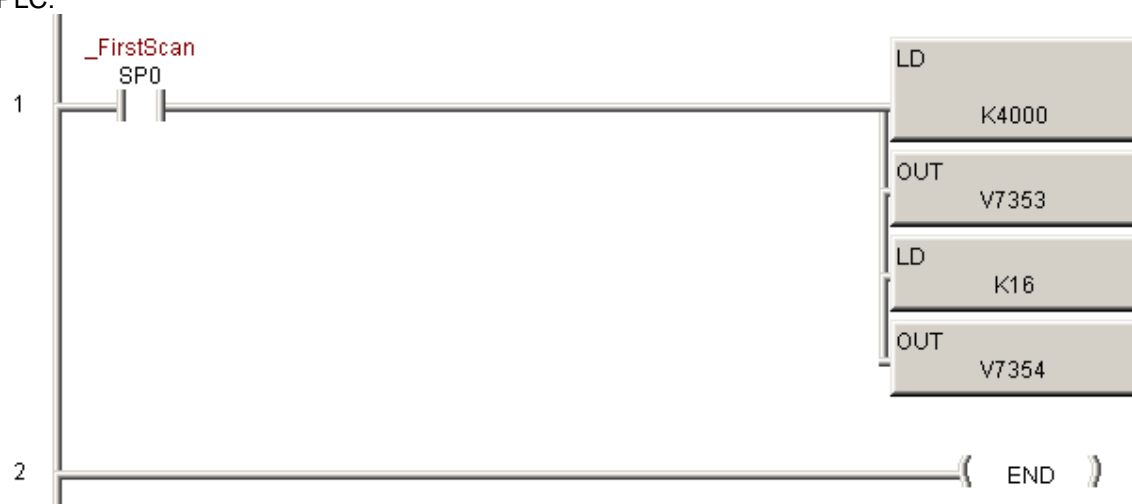
Appendix A starting at page 5.1 (31 of 41) will be the most important information for initial F4-16PID setup.

### Configure Slot Dependent V-memory

You need to write value to the 'Table Beginning Address' and the 'Number of Loops Enabled' at a minimum for F4-16PID operation. Find the slot your F4-16PID is installed in and write one rung of ladder logic to set the two values.

PIDCOP Configuration Memory Map			
Slot Number	Table Beginning Address	Number of Loops Enabled	Error Code
0	V7350	V7351	V7352
1	V7353	V7354	V7355
2	V7356	V7357	V7360
3	V7361	V7362	V7363
4	V7364	V7365	V7366
5	V7367	V7370	V7371
6	V7372	V7373	V7374
7	V7375	V7376	V7377

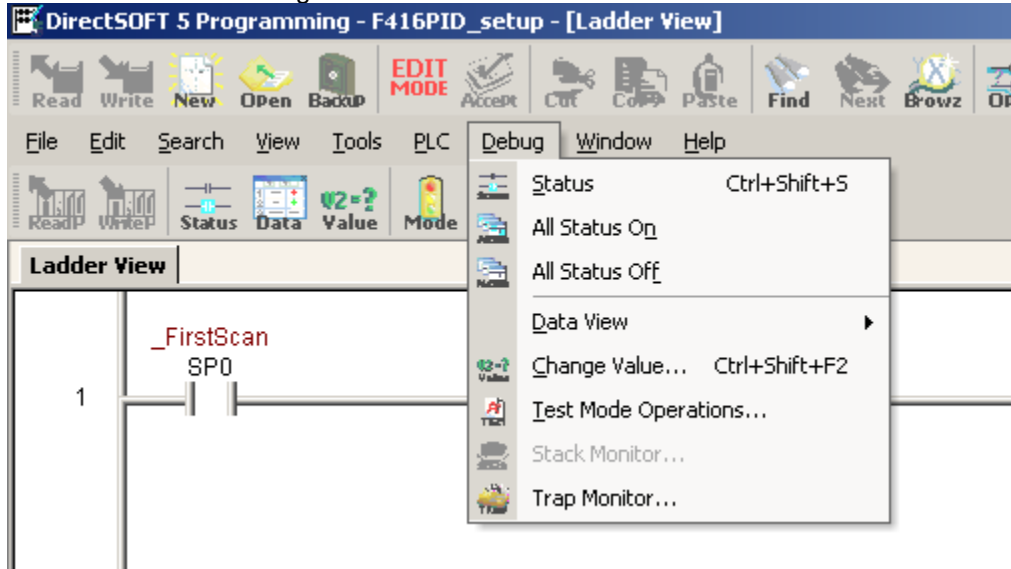
In this example the F4-16PID is installed in Slot 1 (note that slot 0 is the first I/O slot beside the PLC CPU). Write this ladder logic to your PLC, put the PLC in Run mode, then power cycle the PLC:



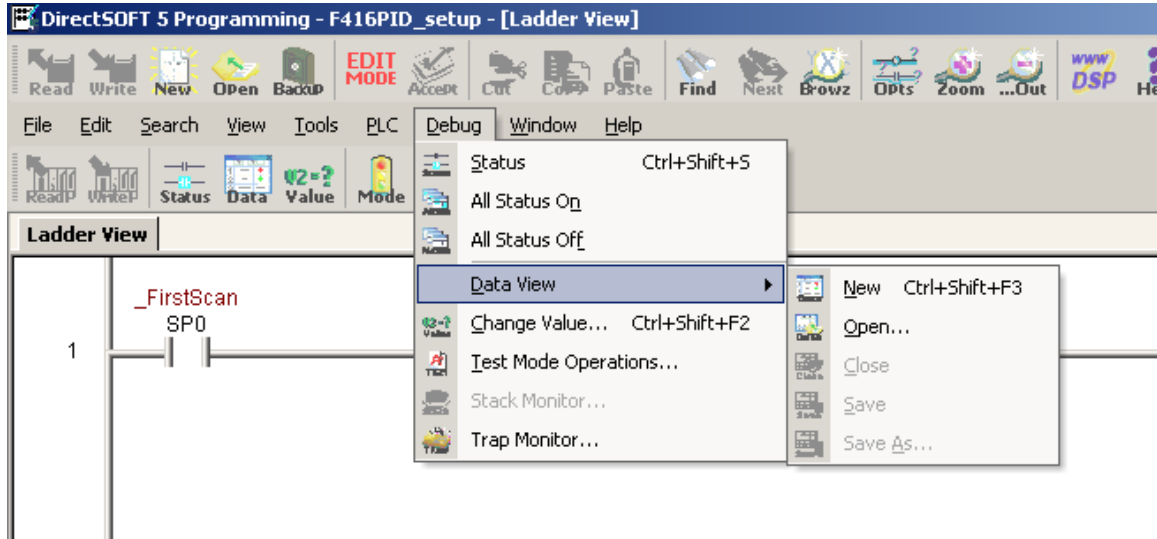
This rung configures V4000 as the 'Table Beginning Address' and sets the 'Number of Loops Enabled' to 16.

## Building a DataView Window

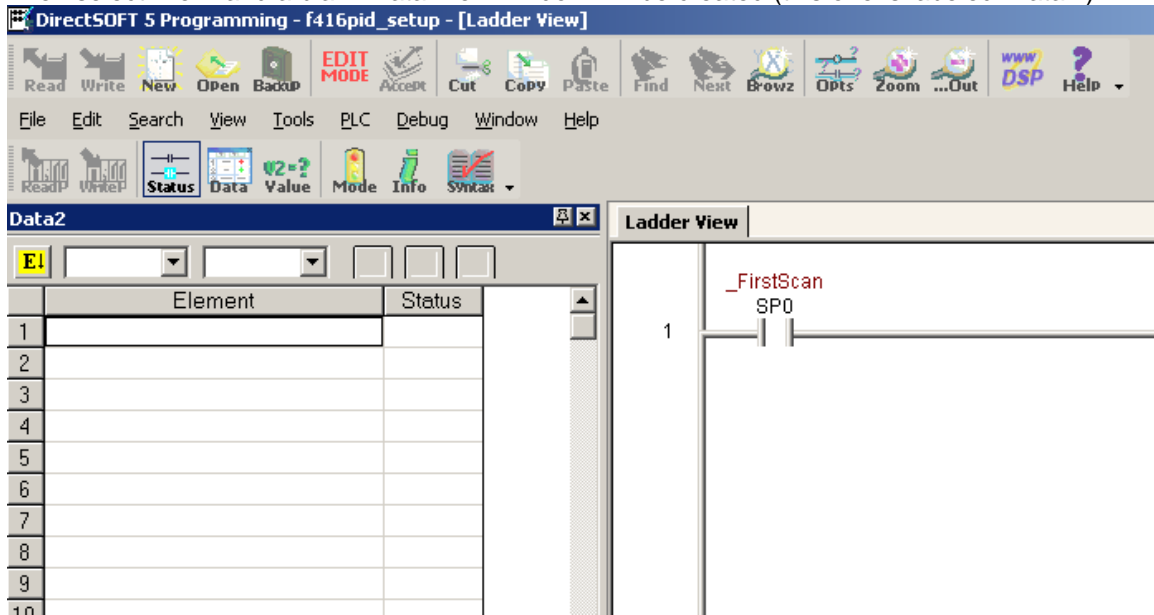
In Directsoft select 'Debug':



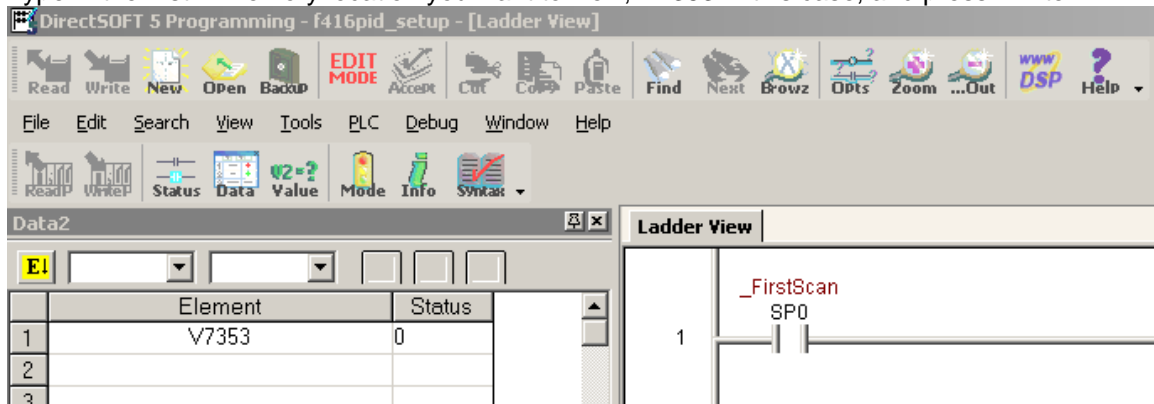
Then select 'Data View >':



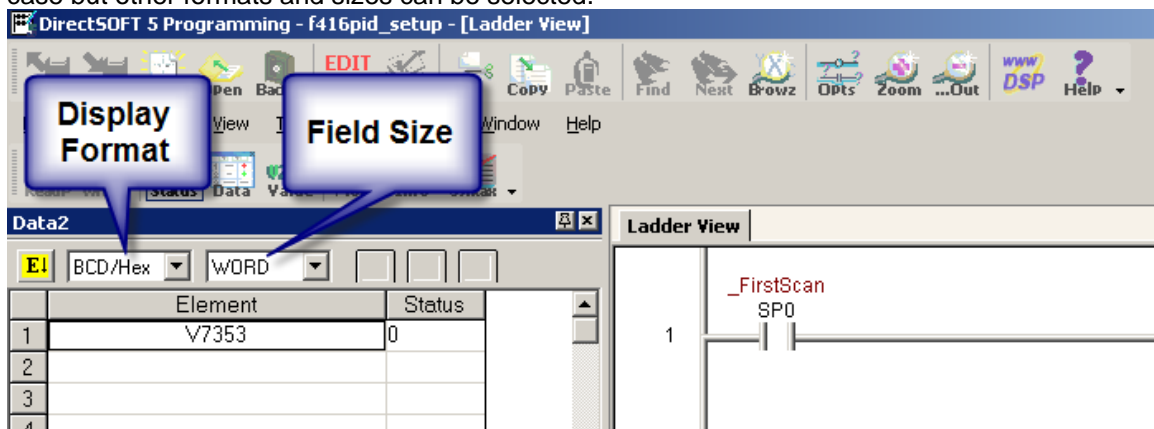
Then select 'New' and a blank Data View window will be created (this one is labeled 'Data2'):



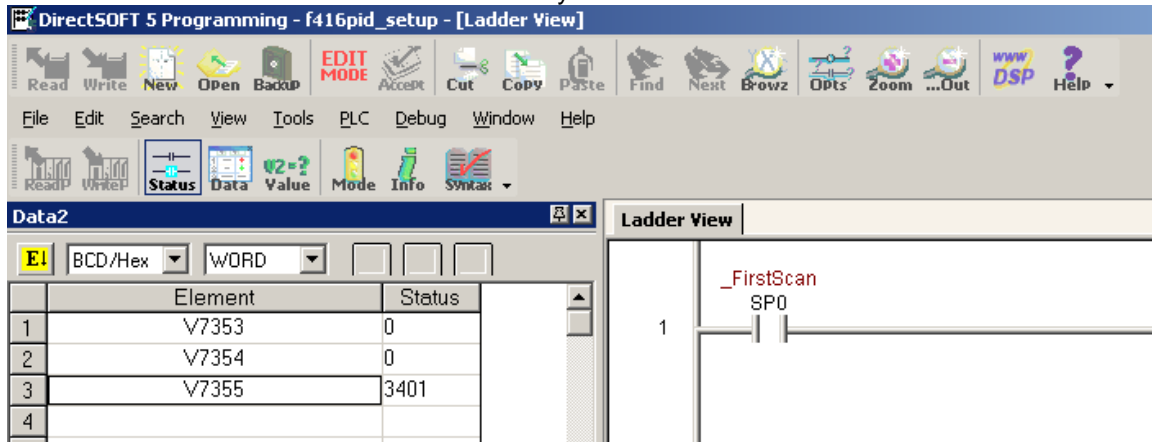
Type in the first V-memory location you want to view, V7353 in this case, and press <Enter>:



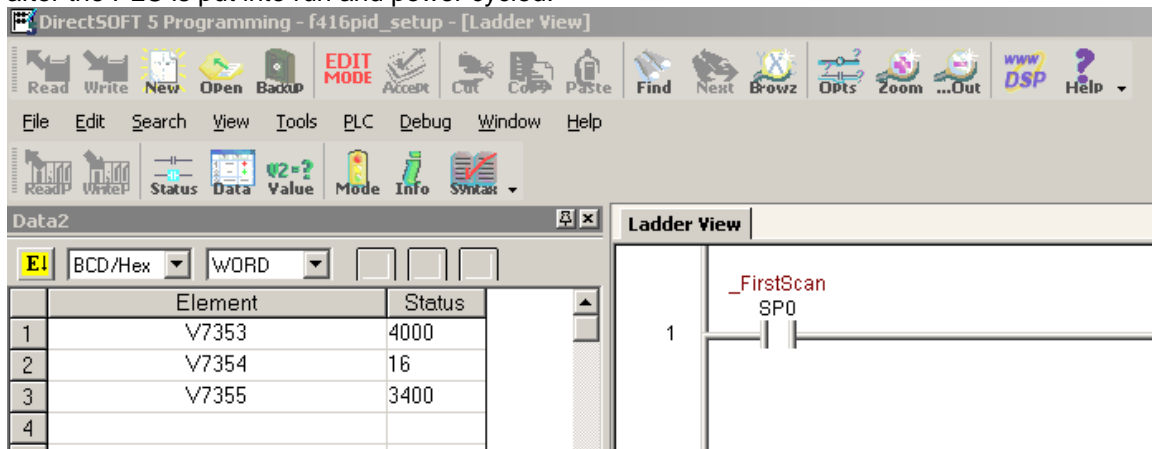
Left click with your mouse on the field you just created and note the 'BCD/Hex' and 'WORD' drop down combo boxes. 'BCD/Hex' is the display format for the selected row. 'WORD' is the size for the selected row. These are the default format and size for V-memory and these are OK in this case but other formats and sizes can be selected.



With the 'V7353' row selected press and hold the <Ctrl> key and press <Enter> twice, this will auto-increment and add the next two V-memory locations with the same format and size:



The above window shows the values before the PLC is put into Run, this window shows the value after the PLC is put into run and power cycled:



Note that V7355 changed from '3401' to '3400'. This is a good sign that you have the correct Slot dependent V-memory locations. V7355 is the 'Error Code' location for Slot 1. Page 5.1 of the F4-16PID-M manual shows:

The dedicated V-Memory Error Code location for each PIDCOP contains a configuration error code plus firmware revision level.

High Byte = Version Number

Low Byte = Configuration Error Codes

- 0 = Valid configuration
- 1 = Starting table address below user v-memory
- 2 = Starting table address too high
- 3 = More than 16 loops enabled
- 4 = Starting address is too low for number of loops

So '34'='Version Number' and '01'='Starting table address below user V-memory' and '00'='Valid Configuration'

## Setting up PID Loop Parameters

Once you have the slot dependent V-memory configured you are ready to setup the PID parameters. Add V4000-4031 to your existing data view as shown here:

The screenshot shows the DirectSOFT 5 Programming interface. The main window is titled "Data2" and displays a table of memory elements. The table has columns for "Element" and "Status". The elements listed are V7353 through V4027. The status values are: V7353 (4000), V7354 (16), V7355 (3400), V4000 (0), V4001 (0), V4002 (0), V4003 (0), V4004 (0), V4005 (8000), V4006 (0), V4007 (0), V4010 (9999), V4011 (0), V4012 (0), V4013 (0), V4014 (0), V4015 (0), V4016 (0), V4017 (0), V4020 (0), V4021 (1), V4022 (0), V4023 (0), V4024 (1), V4025 (0), V4026 (4095), and V4027 (4095). The "Ladder View" window on the right shows a ladder logic diagram with a normally open contact labeled "\_FirstScan SP0" connected to rung 1. Rungs 2 through 8 are empty.

Element	Status
V7353	4000
V7354	16
V7355	3400
V4000	0
V4001	0
V4002	0
V4003	0
V4004	0
V4005	8000
V4006	0
V4007	0
V4010	9999
V4011	0
V4012	0
V4013	0
V4014	0
V4015	0
V4016	0
V4017	0
V4020	0
V4021	1
V4022	0
V4023	0
V4024	1
V4025	0
V4026	4095
V4027	4095

For Help, press F1

Note that V4005 (Alarm Word) is alternating between 0 and 8000, this is a good thing and another indication that the F4-16PID is working as expected. The F4-16PID has also written default values to V4010 (disable Reset), V4026 (Setpoint High Limit), and V4027 (Maximum Output Clamp).

Enable editing of the values in the data view by clicking on the 'E' with the arrow point down beside it, this will display the column labeled 'Edits'. Size the column widths to your preference.

The screenshot shows the DirectSOFT 5 Programming interface. The title bar reads "DirectSOFT 5 Programming - f416pid\_setup - [Ladder View]". The menu bar includes "File", "Edit", "LC", "Debug", "Window", and "Help". The toolbar contains icons for "Accept", "Cut", "Copy", "Paste", "Find", "Next", "Browse", and "Options".

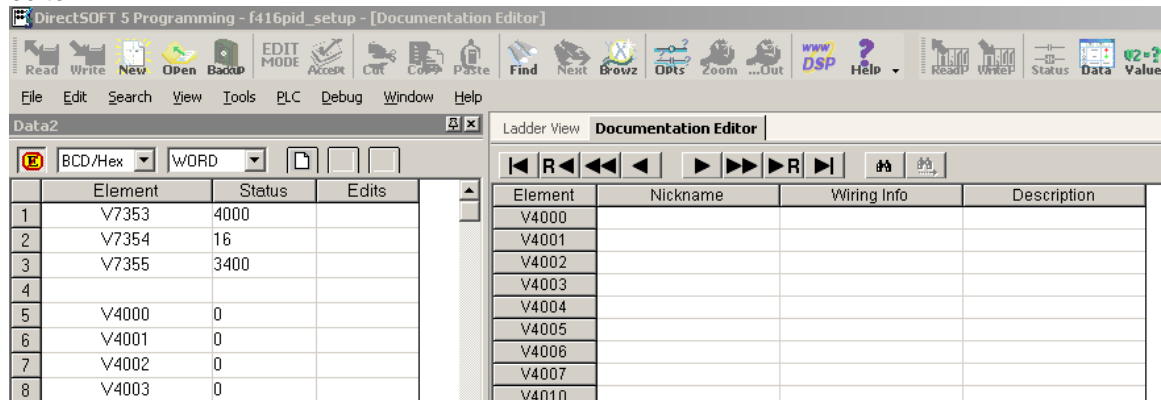
The "Data2" window is active, displaying a table with the following columns: "Element", "Status", and "Edits". The "Edits" column is currently hidden. A callout "Toggle Edit Column" points to the "E" icon with a downward arrow in the toolbar. Another callout "Left click to change the column width" points to the vertical line between the "Status" and "Edits" columns. A third callout "Left click to change the column width" points to the vertical line between the "Edits" column and the ladder logic view.

	Element	Status	Edits
1	V7353	4000	
2	V7354	16	
3	V7355	3400	
4			
5	V4000	0	
6	V4001	0	
7	V4002	0	
8	V4003	0	
9	V4004	0	
10	V4005	0	
11	V4006	0	
12	V4007	0	
13	V4010	9999	
14	V4011	0	
15	V4012	0	
16	V4013	0	
17	V4014	0	
18	V4015	0	
19	V4016	0	
20	V4017	0	
21	V4020	0	
22	V4021	1	
23	V4022	0	
24	V4023	0	
25	V4024	1	
26	V4025	0	
27	V4026	4095	
28	V4027	4095	

The ladder logic view on the right shows rungs 1 through 8. The status of the elements in the table corresponds to the rungs in the ladder logic.

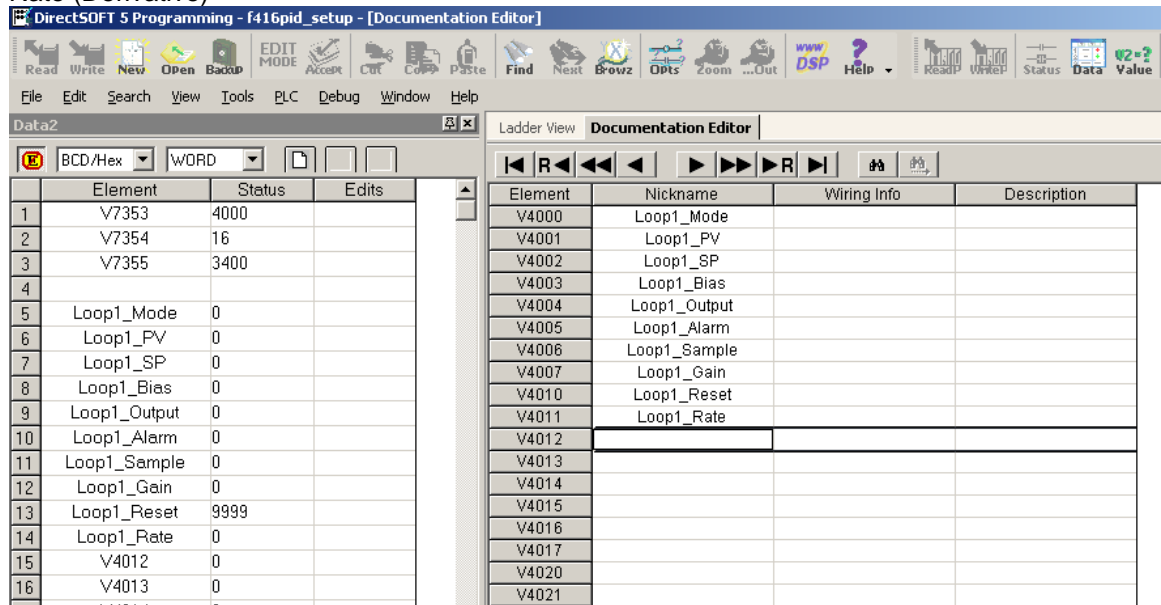
For Help, press F1

It usually helpful to create nicknames for each loop V-memory. Create nicknames by left clicking on the V-memory you want to nickname and press <Ctrl> D. This opens the documentation editor:



Create a nickname for each V-memory that you might need to view. I would recommend nicknames for the following for basic loop setup and testing:

- Mode Word
- PV
- SP
- Bias
- Output
- Alarm Word
- Sample Rate
- Gain (Proportional)
- Reset (Integral)
- Rate (Derivative)



The F4-16PID Loop Parameter table from page 5.2 of F4-16PID-M is duplicated here for convenience:

PID Parameter Loop Table Memory Map			
Decimal Offset	Example V - Memory	Description	PIDCOP Usage
0	V5000	Mode Word (bit mapped)	<b>0 - 2 Read Continually</b>
1	V5001	PV (Process Variable)	
2	V5002	SP (SetPoint)	
3	V5003	Bias	<b>Write (Read if Proportional Control Only)</b>
4	V5004	Output (0 - 4095)	<b>4 - 5 Write after each loop update</b>
5	V5005	Alarm Word (bit mapped)	
6	V5006	Sample Rate (nnn.d)	<b>6 -31 Read if Mode Word bit 15 is set</b>
7	V5007	Gain (nn.dd) (P)	
8	V5010	Reset (nnn.d min., sec, msec, usec) (I)	(default in Min.)
9	V5011	Rate (nn.dd) (D)	
10	V5012	PV Low Low Alarm	(Note 1)
11	V5013	PV Low Alarm	(Note 1)
12	V5014	PV High High Alarm	(Note 1)
13	V5015	PV High Alarm	(Note 1)
14	V5016	PV Yellow Deviation Limit	(Note 1)
15	V5017	PV Orange Deviation Limit	(Orange > Yellow) (Note 1)
16	V5020	PV Rate of Change Limit	(Note 1)
17	V5021	Alarm Deadband (Range 0.1 - 5.0%)	
18	V5022	Error Deadband Below SP	(Note 1)
19	V5023	Error Deadband Above SP	(Note 1)
20	V5024	Derivative Gain Limiting Coefficient	
21	V5025	SetPoint Low Limit	(Note 1)
22	V5026	SetPoint High Limit	(Note 1)
23	V5027	Maximum Output Clamp	
24	V5030	Minimum Output Clamp	
25	V5031	Extended Mode Word (bit mapped)	
26	V5032	Reserved for Future use	
27	V5033	Reserved for Future use	
28	V5034	Reserved for Future use	
29	V5035	Reserved for Future use	
30	V5036	Reserved for Future use	
31	V5037	Reserved for Future use	

Note 1: Range is 0 - 4095. If 20% offset is selected in Extended Mode Word then Range is 819 - 4095. All values except bit mapped words are in BCD.

## Test Loop Operation

Set the following values to see simple loop operation:

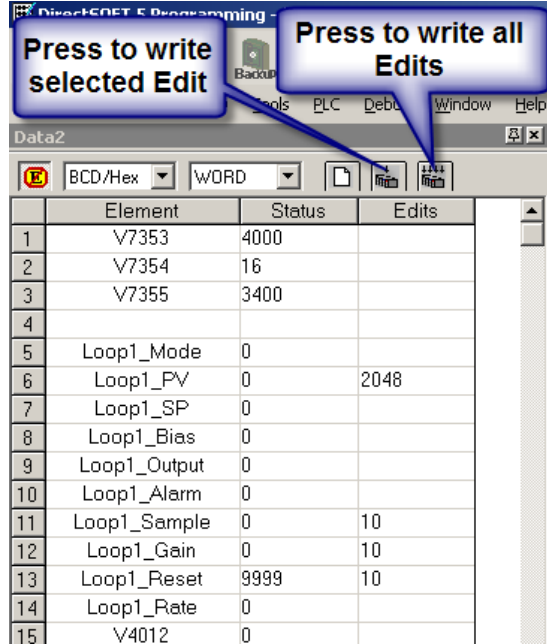
Sample Rate = 10 (Represents 1.0 Seconds)

Gain = 10 (Represents .10)

Reset = 10 (Represents 1.0 Seconds)

PV = 2048

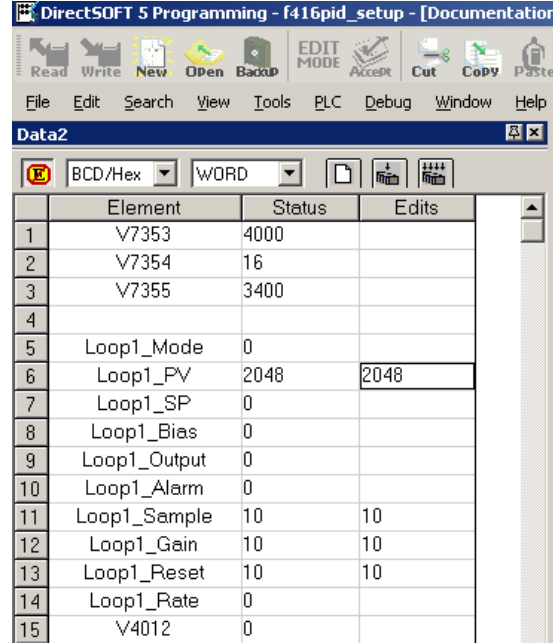
Write these values to the PLC



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Press to write all selected Edits

	Element	Status	Edits
1	V7353	4000	
2	V7354	16	
3	V7355	3400	
4			
5	Loop1_Mode	0	
6	Loop1_PV	0	2048
7	Loop1_SP	0	
8	Loop1_Bias	0	
9	Loop1_Output	0	
10	Loop1_Alarm	0	
11	Loop1_Sample	0	10
12	Loop1_Gain	0	10
13	Loop1_Reset	9999	10
14	Loop1_Rate	0	
15	V4012	0	



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	Element	Status	Edits
1	V7353	4000	
2	V7354	16	
3	V7355	3400	
4			
5	Loop1_Mode	0	
6	Loop1_PV	2048	2048
7	Loop1_SP	0	
8	Loop1_Bias	0	
9	Loop1_Output	0	
10	Loop1_Alarm	0	
11	Loop1_Sample	10	10
12	Loop1_Gain	10	10
13	Loop1_Reset	10	10
14	Loop1_Rate	0	
15	V4012	0	

**Set Mode Word = 8002 (Sets bit 15 to Read Loop Parameters and Bit 1 for Auto Mode)**

Element	Status	Edits
V7353	4000	
V7354	16	
V7355	3400	
Loop1_Mode	0	8002
Loop1_PV	2048	2048
Loop1_SP	0	
Loop1_Bias	0	
Loop1_Output	0	
Loop1_Alarm	8000	
Loop1_Sample	10	10
Loop1_Gain	10	10
Loop1_Reset	10	10
Loop1_Rate	0	
V4012	0	

Note that the SP changed to the same value as the PV and that the Mode Word value changed from 8002 to 2.

The SP gets changed to the PV because bit 2 of the 'Mode Word' is not turned on to enable 'Bumpless Transfer'.

The F4-16PID turns off bit 15 of the mode word after it has read the fixed loop parameters (offset 6-31).

Change the PV to a value less than the SP and you should see the 'Bias' and the 'Output' change:

Element	Status	Edits
V7353	4000	
V7354	16	
V7355	3400	
Loop1_Mode	2	8002
Loop1_PV	1000	1000
Loop1_SP	2048	
Loop1_Bias	13	
Loop1_Output	117	
Loop1_Alarm	0	
Loop1_Sample	10	10
Loop1_Gain	10	10
Loop1_Reset	10	10
Loop1_Rate	0	
V4012	0	

To change a fixed loop parameter such as 'Gain', write the new value to the 'Gain' V-memory, then write 8002 to the 'Mode Word' to tell the F4-16PID to read the new loop parameters.

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Data2

BCD/Hex WORD

	Element	Status	Edits
1	V7353	4000	
2	V7354	16	
3	V7355	3400	
4			
5	Loop1_Mode	2	8002
6	Loop1_PV	1000	1000
7	Loop1_SP	2048	
8	Loop1_Bias	418	
9	Loop1_Output	523	
10	Loop1_Alarm	0	
11	Loop1_Sample	10	10
12	Loop1_Gain	50	50
13	Loop1_Reset	10	10
14	Loop1_Rate	0	
15	V4012	0	

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Data2

BCD/Hex WORD

	Element	Status	Edits
1	V7353	4000	
2	V7354	16	
3	V7355	3400	
4			
5	Loop1_Mode	2	8002
6	Loop1_PV	1000	1000
7	Loop1_SP	2048	
8	Loop1_Bias	467	
9	Loop1_Output	991	
10	Loop1_Alarm	8000	
11	Loop1_Sample	10	10
12	Loop1_Gain	50	50
13	Loop1_Reset	10	10
14	Loop1_Rate	0	
15	V4012	0	