

## GE Fuji AF-300 Mini Motor Speed Controller Laboratory

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1/14/10

### Laboratory Goals:

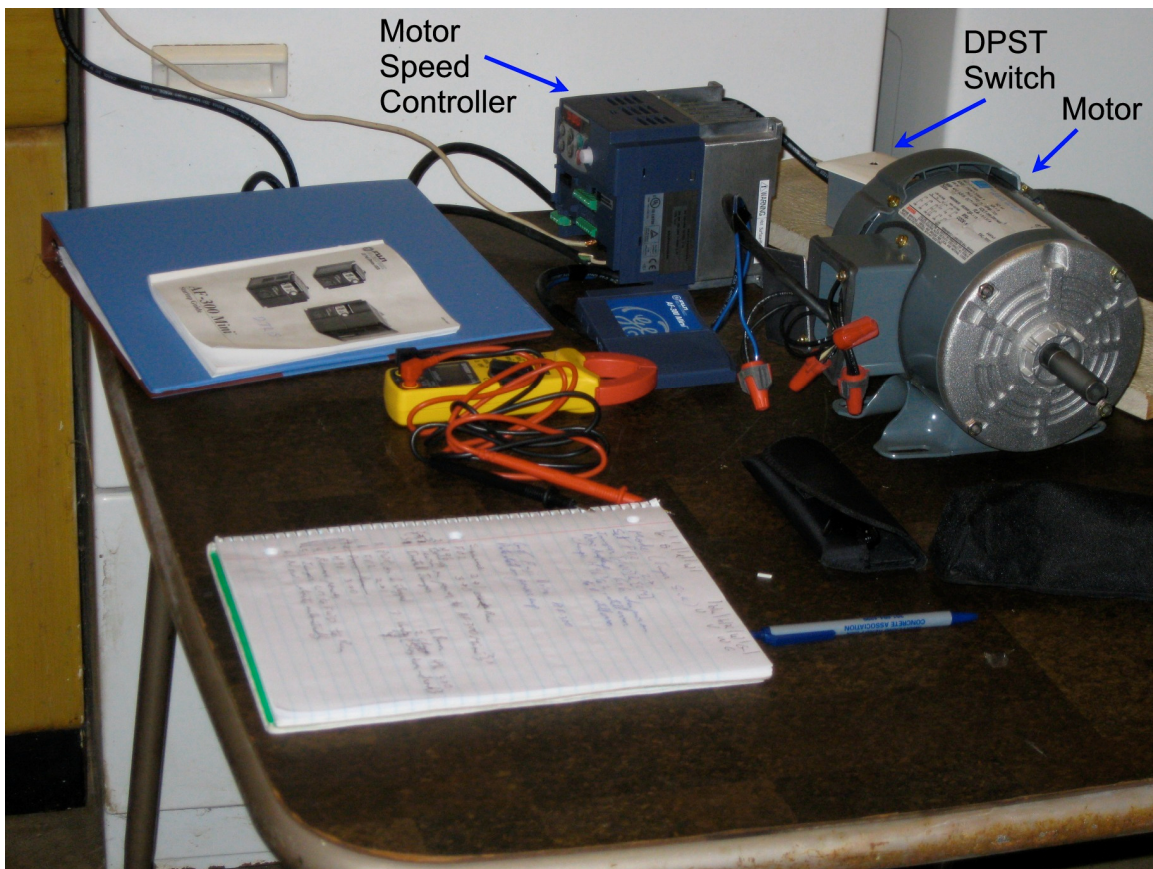
1. Gain experience in wiring the motor controller.
2. Gain experience in controlling the motor controller.
3. Identify and test the programming and wiring for the controller to meet the **Application Goals** (see page 6 of this report).

The specific model of the controller in this lab is: 6KXC123002X9, Catalog number: D7215  
It uses 230 volts, 1 or 3 phase to power a motor up to 2 HP (3 phase input) or 1 HP (1 phase input).

### Questions / issues:

Support number: GE: 800-431-7867, 4, 1 (8 to 4:30)

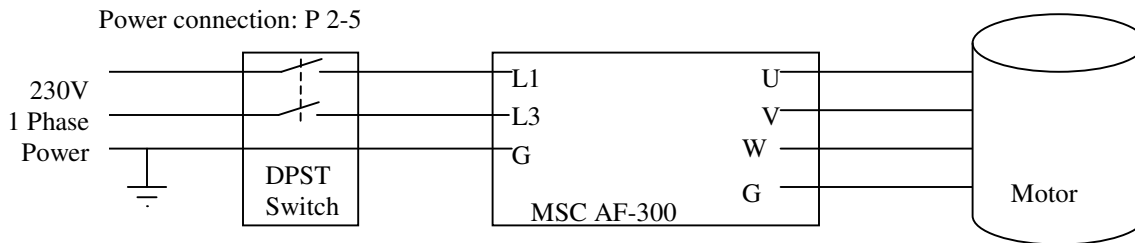
1. When using the controller with 1 phase power, which terminals are used? (**L1 and L3**)
2. Can the unit be operated with no load (to exercise programming options)? **Yes**
3. What is the purpose of the SINK / SOURCE jumper bar? (P 2-13) **LEAVE in SINK.** (use Source if external 24 V supply)
4. Can the unit be tested with 115 VAC? **No, the unit will turn on, but you will get an LU error and you will not be able to change the control code settings.**
5. What software can be used to connect to and program the controller? **None available**
6. How can the controller be configured to run immediately on power up? **See code settings, page 7 of this report.**



### Wiring for the laboratory:

From Page 2-5, wire the following:

1. Using 1 phase 230 volt input.
2. Input line. (GIL) (ground (green), hot (black), and hot – 2 (white))
3. Modify the motor to be a 3 phase motor by:
  - 3.1. Record motor data: (Motor used in laboratory)
    - 3.1.1. Make: WEG Electric Motor Corp.
    - 3.1.2. Model: 7VC56T17F3800P
    - 3.1.3. Horsepower 1/3 HP
    - 3.1.4. FL Amperage: 1.5 A
    - 3.1.5. RPM: 1725
  - 3.2. Connect the PH1 (black), PH2 (white), and PH3 (brown) wires to the 3 motor inputs.
4. Install a double pole switch to shut off both hot legs of the input power.
5. GIL ground (green wire) to ground terminal (G).
6. GIL hot (black) to L1/R
7. GIL hot – 2 (white) to L3/T
8. Connect motor cable (MC):
  - 8.1. MC-ground (green) to G (next to W)
  - 8.2. MC-PH1 (blue) to U.
  - 8.3. MC-PH2 (black) to V.
  - 8.4. MC-PH3 (white) to W



### DC Control wiring: P2-9

Note: [13], [12], and [11] are for an external speed control potentiometer.

1. [13] Potentiometer PS (+10VDC) – not used
2. [12] Voltage input – not used
3. [C1] Current input – not used
4. [11] Analog common – not used
5. [X1] Digital input 1 – not used
6. [X2] Digital input 2 – not used
7. [X3] Digital input 3 – not used
8. [FWD] Forward – may need to jumper to [CM]
9. [REV] Reverse – not used
10. [PLC] PLC signal power – 24 VDC up to 50 ma
11. [CM] Digital input common (see [FWD])

#### Outputs

12. [FMA] Analog monitor – not used
  13. [11] Analog common – not used
- Transistor Output
14. [Y1] Transistor Output – not used
  15. Y1E] TO Common – not used
- 
16. [30A], [30B], [30C] Alarm relay output
  17. RS485 port RS485 communications – not used

### Display and control keys:

Display: 4 digit LED display

Potentiometer

Run key

Stop key

^ (Up) - up key

v (Dn) – down key

Program / Reset key (P/R)

Function / Data key (F/D)

Note: Symbols for various control keys, especially Programs / Reset (P/R) and Function / Data (F/D), are so small (small) as to be practically illegible within the manual supplied with the controller. With a magnifying glass and practice, it is possible to recognize the various keys. (The diagrams within the corresponding PDF file are less legible and thus impossible to read.)

### Simultaneous keying

Run Mode            Stop+Up keys – enter / leave jog state

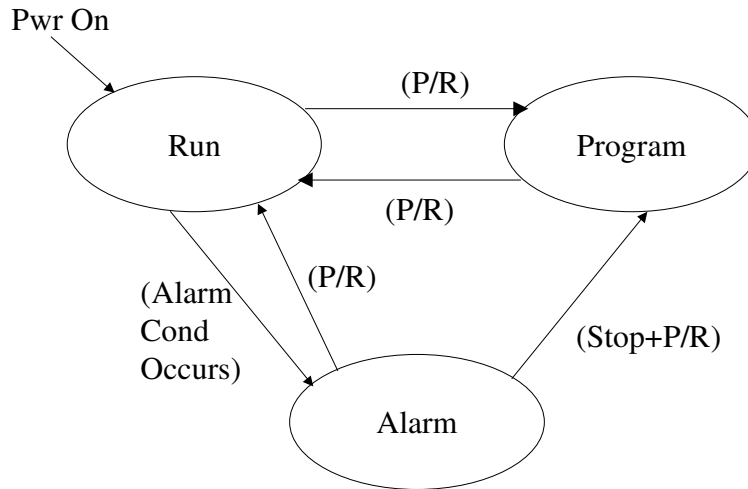
Program Mode      Stop+Dn keys – Change special function code data (F00 and H03 in chapter 5)

Alarm Mode        Stop+P/R keys – Change to Program Mode

### 3.2 (P3.2) 3 Operation Modes:

- Run mode – normal operation
- Program mode – check function code, drive status, and maintenance status data
- Alarm mode – controller has entered alarm condition

Figure 3.1 Status Transition between Operation Modes



#### Run Mode Functions: (see 3.3 p3-5)

1. Run (Run key) or Stop (Stop key) the motor
2. Set the control frequency. The controlling element is set by PID (see F01 page 5.2). Up / Dn F01=0; potentiometer (F01=4) (default) (Other F01 options for external inputs)
3. Monitor the run items: (Press and hold the F/D key to switch between items below)
  - 3.1. Speed Hz, RPM The display indicates output frequency (E48=0 or 1), motor speed (E48=4), etc  
To display motor speed, also set E50 = (rated motor speed) / (line frequency = 60). (See Table 3.2 p 3-8 for more information.)
  - 3.2. Output current (A)
  - 3.3. Power (kW)
  - 3.4. Output voltage (V)
  - 3.5. PID process command
  - 3.6. PID feedback amount
  - 3.7. Timer (sec)

PID process data are only displayed when PID J01 = 1 or 2.

Timer is only when timer is enabled (C21=1)

4. Jog the motor. To use jogging, certain control codes such as C20 must be changed from their default values. In the Jog mode, the motor only turns while the Run key is pressed. Press Stop+Up to enter or exit the Jog mode. When the motor is ready for jogging, JoG appears on the display.

### Checking and setting the Function Codes (3.4, P3.09)

When stopped, press P/R to enter the program mode.

The 1<sup>st</sup> level in the program mode displays 1.F, 1.E, 1.C, 1.P, 1.H, 1.J, or 1.Y to indicate the code groups. (See Table 3.5, page 3-9 for a description of the various groups) Press Up/Dn to move among the various code groups.

Press the Up/Dn keys to move among the code groups.

Press F/D to check or program each code within a group.

Press Up or Down to move among the various codes within each group. (e.g., F01 is displayed)

Press the F/D key to display the code value.

Press the P/R key to return to the list of codes (E.g., F01)

OR

Optionally press the Up / Dn key to change the code value

Press the F/D key to establish the new value and return to the list of codes.

The display momentarily displays SAUE

Press P/R to go back to the list of code groups.

### Checking data

(Enable modes by changing the setting of E52 from 0 to 2.)

Press Up from 1.Y\_\_ in the program mode to get to **Checking Codes changed from default** (3.5 P3-11)

Displays 2rEP

Press F/D to see the 1<sup>st</sup> changed code number (e.g., F01)

Press Up/Dn to move among changed codes

Press F/D to view / change the code value

Press PR to return to the list of changed codes

OR

Press Up/Dn to change the code value

Press F/D to save the changed value

The display momentarily displays SAUE

Press P/R to go back to the list of code groups.

Press Up to get to **“Running Status”** menu – displays 3oPE (3.6, P 3-12).

Press Up/Dn to move among monitored items

Press F/D to see datum

Note Datum

Press P/R to return to list of monitored items

Press P/R to return to Running Status display 3oPE

Press Up to get to **“I/O signal Status** (3.7 P 3-14) displays 4i\_o

Press F/D to see datum

Note Datum

Press P/R to return to list of monitored items

Press P/R to return to Running Status display 4i\_o

Press Up to get to **Maintenance Information** (3.8 P3-16) displays 5CHE

Press F/D to see datum

Note Datum

Press P/R to return to list of monitored items

Press P/R to return to Running Status display 5CHE

Perhaps pressing down to get to **Alarm information** (3.9 P3-18) displays 6AL

Press F/D to see datum

Note Datum

Press P/R to return to list of monitored items

Press P/R to return to Running Status display 6AL

#### 4. Initial Tests Running the Motor: (P 4-1)

1. Ensure connectivity (see page 1 of this report)
2. Turn on power
3. Press the Start Key
4. Monitor display (see Run Mode Functions) P 4 of this report.
5. Press the Stop Key
6. Enter and view the Function Code values (P 5 of this report) Confirm that they match the default values given in the manual.
7. View the changed codes (should be none)
8. Check running Status
9. Check I/O signal status
10. Check Maintenance Info
11. Check Alarm Info
12. Enter Function Codes to start on power up: E.g., F14 change from 0 to 4 to restart after momentary power outage.
13. Install jumper between [CM] and [FWD]

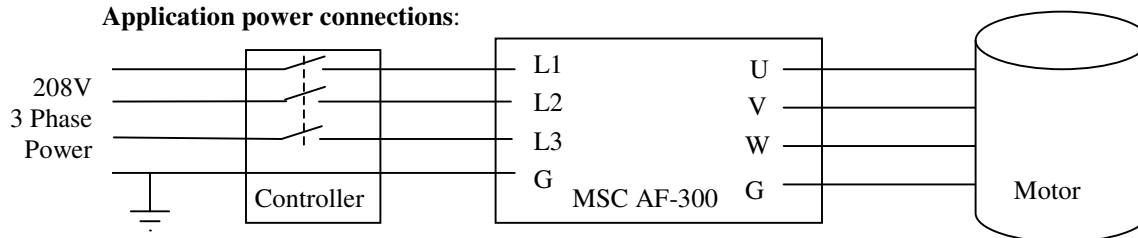
#### Observations:

1. When originally setting up the controller, a different sequence (than the one on Page 7 of this report) was followed. This led to error code Er6. To clear the error, I had to remove the jumper and press the Program / Reset key. I also had to change the default value of code H96 from 3 to 0.
2. I was able to get the controller to start repeatedly upon applying power to the controller without need to press the Start key.
3. A somewhat noisy fan cools the motor controller.
4. The controlled motor emits a high pitch sound. This is greatly reduced by changing the switching frequency (F26). The manual also suggests changing the sound tone (F27); this control code value seems to have no effect.

#### Application Goals:

1. The controller should allow us to slow the blower motor to slow the blower and thus make the blower run more quietly.
2. The motor should start whenever power is applied to the controller. Thus there is no need to press any key (including "Start") on the controller to start the motor.
3. The motor should operate as quietly as possible.
4. It should be possible, but not too easy to change the motor speed.
5. Programming capability should be locked out to discourage modifying the controller program.

#### Application power connections:



**Procedure and Pertinent Function Codes** (See section 5 of the manual)

The following table indicates the steps, applicable codes and the order in which to set them to achieve application goals.

Step	Func. Code	Name (App Goal)	Range	Min	Unit	Run Chg	Default	Test	Run
1.	-	Observe rotational direction	Mark the motor and blower with arrows indicating correct rotational direction.						
2.	-	Wire power	See page 6 of this report						
3.	F01	Frequency command (Goal 4)	0 Keypad Up / Dn 1 Voltage Input 2 Current Input 3 Voltage and current input 4. Front panel potentiometer	-	-	N	4	0	0
4.	F02	Op Method (Goal 2)	0 Keypad op ext signal 1 Ext signal (Dig input) 2 Keypad Op (FWD) 3 Keypad Op (REV)	-	-	N	2	1	1
5.	F05	Rated Volts (Goal 3)	0 Output proportional to input 80 to 240 AVR active (115, 230 class) 160 to 500 AVR active (460 class)	-	V	N	230	208	208
6.	H96	Stop Key Priority (Goal 2)	Data                    0   1   2   3 STOP key priority OFF ON   OFF ON Start key check      OFF OFF ON   ON	-	-	Y	3	0	0
7.	F07	Accel time (Goal 3)	0.00 to 3600 seconds	0.00	Secs	Y	6.00	20.00	20.00
8.	-	Turn off	Power to motor controller						
9.	-	Install jumper (Goal 2)	[CM] to [FWD] (Works with change to F02)						
10.	-	Cycle	Power to motor controller						
11.	-	Verify that (Goal 2)	Motor turns whenever controller is powered without having to press "Start"; allow ample time (1 minute) between power off and then back on						
12.	F26	Motor sound (Goal 3)	0.75 to 15	0.75	KHz	Y	2	7	*
13.	F00	Data protection (Goal 5)	0 Data change enabled 1 Data protection	-	-	-	0	0	1
14.	-	Ensure correct rotation	Observe that the motor and blower run in the direction marked in step 1. If they are running in the wrong direction, move reverse wires to terminals V and W on the controller.						

\* Adjust F26 to minimize acoustic noise from the controlled motor. The GE application engineer suggests that keeping this value at or below 10 kHz.

**Conclusion**

With the laboratory setup, good advice from GE, and some trial and error, we met all the goals of this laboratory.

A note of caution: The reason for installing the blower motor controller is to reduce blower speed and thus acoustic noise. However, the motor controller fan creates its own acoustic noise. Also the controller may cause the blower motor to emit more acoustic noise especially at higher frequencies. We will need to observe and test noise levels to ensure that these additional noises do not significantly affect the overall noise level in the main auditorium.