DF8 PLUS SERIES

¼ to 5 HP
Full Wave Regenerative Reversing
SCR Speed Controls
for DC Motors

CAUTION
Equipment is at possibly lethal AC line voltage when AC power is connected. Pressing the STOP pushbutton does not remove AC line voltage. Both phases must be disconnected before it is safe to touch motor terminals or control equipment parts.

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1.0 DESCRIPTION

1.1 Overview  DF8 "Plus" series fully regenerative four quadrant thyristor controllers are designed to control the speed of wound field or permanent magnet dc motors from ¼ to 5 hp. These drives can also be modified to become torque control regulators. DF8 "Plus" drives are supplied in either chassis or Nema 1 enclosed formats.
1.2 Standard Features

- **Isolated current feedback**
  AC current transformers sense current in each bridge.

- **Impedance-isolated armature voltage feedback**
  High impedance resistive voltage divider network used for armature voltage feedback.

- **Tachogenerator feedback**
  50 volt/1000 rpm tachometers may only be used for speed feedback.

- **Dual AC line voltage**
  120 or 240 vac line voltages are plug selectable.

- **Dual field voltage**
  100/50 or 200/100 volt field supplies for 120 or 240 ac line voltages.

- **Matched +12V and -12V reference supply**

- **Regenerative braking to zero speed with signal contact output**

- **LED indication**
  - Power on (DS8 red)
  - Forward speed reference (DS5 green)
  - Reverse speed reference (DS4 red)
  - Forward amplifier output (DS7 green)
  - Reverse amplifier output (DS6 red)
  - Run relay energized (DS2 red)
  - Inhibit (DS3 red)
  - Zero speed (DS1 red)

2.0 SPECIFICATIONS

2.1 Electrical

- **Power**
  Single phase 120 or 240 vac, 50/60 Hz., (±10%).

- **Speed range**
  30:1 with armature feedback, 50:1 with tachometer feedback.

- **Load regulation**
  ±3% with armature voltage, (±10% line voltage change).

- **Acceleration/Deceleration**
  Adjustable: 0.1-30 seconds from 0 to full speed.

- **Temperature range**
  32°F - 104°F (0-40°C).

- **Altitude**
  2000 feet (600m) maximum without derating.

- **Regenerative braking**
  Upon application of a stop signal the drive will regeneratively brake and stop at zero speed. This feature depends on the setting of jumper P1 (see page 5).
2.1 Electrical cont’d  

- **Rectifier configuration**
  The DF8 "Plus" employs two single phase, full-wave, fully controlled, (4 SCR) bridges to allow extremely rapid motor armature reversing.

- **HP & Current rating**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>HP</th>
<th>AMPS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120 VAC</td>
<td>240 VAC</td>
</tr>
<tr>
<td>DF8P-10</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>DF8P-15</td>
<td>1.5</td>
<td>3</td>
</tr>
<tr>
<td>DF8P-25</td>
<td>2.5</td>
<td>5</td>
</tr>
</tbody>
</table>

- **Voltage rating**

<table>
<thead>
<tr>
<th>INPUT</th>
<th>OUTPUT VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ARMATURE</td>
</tr>
<tr>
<td>120 VAC (J6)</td>
<td>90-0-90</td>
</tr>
<tr>
<td>240 VAC (J5)</td>
<td>180-0-180</td>
</tr>
</tbody>
</table>

- **Short circuit rating**
  Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240 V maximum.

2.2 Electrical Protection

- **Fusing**
  One fast-acting fuse in each AC leg.

- **Current limit**
  Adjustable current limit circuit for each bridge.

- **Surge suppression**
  MOV surge suppressor.

2.3 Mechanical  
For dimensional information see pages 13 & 14.
2.4 Adjustments

- **RV1 +12V reference**
  This factory preset adjustment will very seldom need adjustment. It is used to match the +12 volt reference supply to the -12 volt supply.

- **RV2 Current stability**
  This control, which has been factory preset, adjusts the stability of the current loop. The normal position of this trimpot is approximately 1/2 turn clockwise.

- **RV3 Acceleration/Deceleration**
  This control adjusts both acceleration and deceleration time. In the fully clockwise position, acceleration/deceleration time is 0.1 seconds, and in the fully counterclockwise position, acceleration/deceleration time is 30 seconds.

- **RV4 Maximum speed**
  This adjustment is used to set the maximum armature voltage or motor speed.

- **RV5 Zero speed offset**
  This adjustment is used to minimize creeping of the motor with the speed reference set to "zero".

- **RV6 IR Compensation**
  Factory set to CCW for Tach Feedback, this control rarely needs to be used. However, when using armature voltage feedback with cyclical loading applications where there is a speed drop due to operation from high to low load, the “IR Comp” adjustment corrects for voltage changes inside the DC motor when load is applied. If speed variations with load are a problem, set the “SPEED” control knob to the desired operating speed. Now load the drive. Adjust RV6 until the motor speed returns to its unloaded speed. Remove the load and ensure motor speed is stable.

- **RV7 Voltage stability**
  This is factory preset and very seldom needs adjustment. If the motor should hunt, rotate this trimpot until the motor runs smoothly. The normal position of this trimpot is approximately 1/2 turn clockwise.

- **RV8 I Forward**
  This adjustment is factory preset for the maximum allowable DC current in the forward motoring direction. This trimpot will adjust the current limit setting from 20 - 150% of the drive rating.

- **RV9 I Reverse**
  This adjustment is factory preset for the maximum allowable DC current in the reverse motoring direction. This trimpot will adjust the current limit setting from 20 - 150% of the drive rating.

**CAUTION: Adjusting RV6 to over 50% clockwise rotation, may cause drive instability which cannot be corrected by RV7 voltage stability. In such a case, back off slightly from the position where RV6 causes instability. This may result in a slight decrease in speed holding.**
2.5 Jumper Selections

- **J5 & J6 AC Input selection**
  This jumper is used to select the correct AC line input voltage.
  J5: 240 vac (factory default)
  J6: 120 vac

- **P1 Stopping mode**
  Motor coasts to zero speed on stop command. Connect P1 on the AA1152 control card to the “IN” position.

  ![P1 Stopping mode diagram]

  Motor regenerates to zero speed on stop command. ("OUT" position, factory default).

- **JP1 Programmable input**
  This jumper is used to select either tachometer feedback 50v/1000 rpm) or auxiliary speed reference input. The auxiliary speed input will allow the user to trim (±) the main speed reference. The auxiliary input is not affected by the accel/decel circuit.

**Auxiliary speed input**

With JP1 in the "AUX SPD" position, the drive is configured to accept an auxiliary speed command. The speed input will then be accepted on input terminals J1-1 and J1-2.

**Tachometer feedback**

With JP1 in the "TACH" position, the drive is configured to accept a 50v/1000 rpm analog DC tachometer only. The tachometer input will be accepted on input terminals J1-1 and J1-2.

Locate jumpers E1 and E2 above the control transformer T1. These jumpers will be connected to a black wire terminal. Separate the plug from the socket for tachometer feedback.

To set the drive back to armature feedback, insert the plug into the socket and remove the tach wires from terminals J1-1 and J1-2.

**Note:** If P1 is in the “IN” position, the drive will still regenerate when the speed reference command is reduced.

**Caution:** This drive can not be configured to accept tachometer feedback and an auxiliary speed command together.
3.0 RECEIVING & INSTALLATION

3.1 Installation

The cabinet containing the DF8 Plus must be installed in an area where the following conditions exist:

- Ambient temperature does not exceed 40ºC (104ºF).
- Ambient temperature is not less than 10ºC (50ºF).
- Altitude above sea level is 2000 feet (600m) or less.
- Ambient air is reasonably clean, dry and free of flammable or combustible vapors, steam, or corrosive gases, etc.

The cabinet must be installed away from any heat source, and a minimum of 1 foot (30.48 cm) is required around the air inlet and outlet, on ventilated units.

The DF8 Plus has been designed for 50ºC maximum inside the enclosure.

3.2 Derating Data

When the unit is installed in poor environmental conditions, it must be derated as follows:

- 1.5% per Cº above 40ºC, or 0.75% per Fº above 104ºF.
- 15% per 1000 feet (300m) above 2000 feet (600m).

3.3 Wiring

The DF8 Plus is to be connected according to the NEC and any other applicable Electrical Codes in the customer’s area. The chassis must be bonded to earth ground.

Section 6 pages 8, 9, and 10 show typical connections for speed controlled wound field motors. For permanent magnet motors, there will be no connections to F+ and F-.

See page 11 for typical torque control connections.

Note: For motor field connections of 100/50 or 200/100, refer to page 12.
4.0 STARTUP

4.1 Inspection
Ensure that the drive has been installed according to the previous
guidelines. Also, ensure that the unit has been wired according to the
schematics. Check that all connections are tight and that the motor can
rotate freely.

4.2 Pre-start adjustments
Before power is applied, confirm that the voltage selection plug (J5, J6) on the AA1152 card matches the supply voltage. **Factory default setting is 240 vac.**

**Note: When tachometer feedback is used, the auxiliary input is not available.**
The DF8 Plus drive has been preset for **armature voltage feedback.** To use tachometer feedback refer to page 5, section 2.5, for complete details.

Confirm that all jumper selections have been made correctly to ensure
proper drive performance (i.e. P1, JP1, JP5, JP6, see page 5).

All controls have been preset at the factory and should not require
further adjustment.

4.3 Starting
Before applying power, refer to section 6.0 and ensure that all control
and power wiring is correct, the power source, motor, and drive are
matched, and that all links are properly set. Turn the speed pot to the
zero reference position and ensure that the run circuit is disabled.

1. Apply power and observe that LED DS8 is illuminated. Press the
start button. LED’s DS2 (Run) and DS3 (Inh) should turn on and
the motor should not rotate. If the motor rotates, see troubleshooting.

2. Slowly rotate the speed pot so that a negative reference is applied
to J1-5 (see section 6.0). LED DS5 (Fwd ref) and DS7 (Fwd out)
will intensify as the speed pot is increased to full and the motor
should rotate in the forward direction. If motor rotation is incor-
correct, remove power completely and interchange the motor arma-
ture connections. With link P1 in the bottom position, LED DS1
(ZSA) will illuminate when the motor is above zero speed.

3. With a positive reference applied to J1-5 (see section 6.0), LED’s
DS4 (Rev ref) and DS6 (Rev out) will intensify as the speed pot
is increased to full and the motor should rotate in the reverse
direction.

4. With the speed reference set at maximum, the motor should rotate
at rated speed and/or voltage. If not, adjust RV4 for the correct
setting.

5. Press the stop button. With link P1 in the “IN” position, the motor
will coast to rest. If P1 is in the “OUT” position, the motor will
regenerate to zero speed.

6. If the acceleration and deceleration rates are not suitable, see
section 2.4, p.4, for adjustment.
## 5.0 TROUBLESHOOTING

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>PROBABLE CAUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor does not run</td>
<td>- No Run command.</td>
</tr>
<tr>
<td></td>
<td>- Speed reference at 0 volts.</td>
</tr>
<tr>
<td></td>
<td>- Blown fuses or no AC source.</td>
</tr>
<tr>
<td>AC line fuse/fuses blown</td>
<td>- SCR shorted.</td>
</tr>
<tr>
<td></td>
<td>- Field diodes shorted (D18).</td>
</tr>
<tr>
<td></td>
<td>- Grounded motor armature or field.</td>
</tr>
<tr>
<td>Motor runs at slow speed with the speed pot set fully cw.</td>
<td>- Max speed set too low.</td>
</tr>
<tr>
<td></td>
<td>- Drive in current limit.</td>
</tr>
<tr>
<td></td>
<td>- Tach feedback resistor incorrect (if used).</td>
</tr>
<tr>
<td></td>
<td>- Bad speed pot.</td>
</tr>
<tr>
<td>Motor unstable.</td>
<td>- IR comp turned too high</td>
</tr>
<tr>
<td></td>
<td>- Voltage stability set incorrectly.</td>
</tr>
<tr>
<td></td>
<td>- Current stability set incorrectly.</td>
</tr>
<tr>
<td></td>
<td>- Max speed set too high</td>
</tr>
<tr>
<td></td>
<td>- Fwd/Rev current limits set differently.</td>
</tr>
<tr>
<td>Motor overspeeds with low speed reference</td>
<td>- Max speed set too high</td>
</tr>
<tr>
<td></td>
<td>- Tach input reversed (if used).</td>
</tr>
<tr>
<td></td>
<td>- No tach feedback if in tach mode.</td>
</tr>
<tr>
<td>Motor drifts at zero speed</td>
<td>- Adjust RV5 potentiometer.</td>
</tr>
</tbody>
</table>
6.0 WIRING DIAGRAMS

6.1 DF8P-10 & DF8P-15

[Diagram of wiring connections with labels and symbols]
6.3 Typical Torque control connection
6.4 MOTOR CONNECTIONS

50V WOUND FIELD

100V WOUND FIELD

100V WOUND FIELD

200V WOUND FIELD
7.0 DIMENSIONAL OUTLINES

7.1 DF8P-10 & DF8P-15 CHASSIS

DF8P-10

DF8P-15
7.0 DIMENSIONAL OUTLINES CONT'D

7.2 DF8P-25 CHASSIS
7.0 DIMENSIONAL OUTLINES CONT'D

7.3 NEMA 1 ENCLOSED WITH OPERATORS
### 8.0 SPARE PARTS

<table>
<thead>
<tr>
<th>SPARE PART</th>
<th>MODEL</th>
</tr>
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<tbody>
<tr>
<td>Controller card</td>
<td>DF8P-10</td>
</tr>
<tr>
<td></td>
<td>AA1152-1</td>
</tr>
<tr>
<td>SCR</td>
<td>N610016</td>
</tr>
<tr>
<td>SCR</td>
<td>—</td>
</tr>
<tr>
<td>Fuse FU1, FU2</td>
<td>F601005-34</td>
</tr>
<tr>
<td>Field Bridge</td>
<td>D1010-04</td>
</tr>
<tr>
<td>Fuse FU3, FU4</td>
<td>—</td>
</tr>
</tbody>
</table>

**Note:**

When replacing the controller card AA1152-1, ensure that all jumpers are configured the same way as the card being replaced.
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