Model 4000 and 4050 with Auto Manual Tach Follower

Introduction

These instructions relate specifically to the following Model 4000 and 4050 controllers which are assembled for Speed Control with the Auto Manual Tach Follower Modification.

Connection diagram, schematic diagram, switch programming, plug wiring connection, adjustment procedure and recommended spare parts list for these specific assemblies are contained in this instruction sheet. Any differences between these two controllers are clearly noted.

Use instruction manual IM-130006-83-XX with this instruction sheet for complete installation, operation and maintenance instructions.

Caution: Above ground potentials can be hazardous. Always disconnect electrical power before working on the controller.

*Heat sink assembly, HS1, and its wiring apply only to the Model 4050 controllers. These parts are not supplied on the Model 4000 controllers. The parts are mounted on the 15-530-5 main 4000 board.
# Introduction

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Note 1: This equipment must be installed in compliance with National Electrical code and all applicable state and local codes.

Note 2: Transformer may be supplied as a winding in the ac motor or as a separate item. Standard connections to winding in mechanical unit and to separate transformer are both above.

Note 3: Values shown are typical. See BOM for actual values.
Schematic Diagram for 4000 controller
Connection Diagram for 4000 Panel Mount and 4050 Controllers
ED/56809

See page 2 for notes and description of symbols
Schematic Diagram for 4050 controller

Tach Follower PCB 15-444-1
General Description
This modification allows a drive to follow the speed of another drive at some proportionate ratio, 1:1, 2:2 etc. This is accomplished by first producing a dc analog voltage of the master speed by rectifying and filtering the output of the master ac tachometer generator. It is then divided with the ratio potentiometer to produce a suitable reference for the follower. This is the Automatic Follower Mode.

The Follower drive can also be placed in a Manual Mode in which its speed is set by an external Manual Speed Potentiometer. In this mode, Linear or Standard Acceleration can be selected.

Visual Inspection
1. Before proceeding to the preliminary adjustments, check the controller for any damage that may have occurred during shipment, such as loose connections and damage wire or components.
2. Check all interconnecting wires for conformance to connection diagram and schematic as supplied in this instruction sheet.
3. Check the Operator’s controls (which are supplied by customer) to see if they are connected properly per the connection diagram. This includes the Manual Speed pot R5, the Ratio pot R55, the Manual/Auto selector switch and the Start and Stop pushbutton controls.

Preliminary Adjustments
Perform the following preliminary adjustments (with no power applied to the controller).

1. Operator Controls (supplied by customer unless specified)
   a. Set the Manual Speed potentiometer R5 to 0% (Full CCW)
   b. Set the Auto/Manual selector switch to the Manual position
   c. Set the Ratio pot R55 to 0% (Full CCW)
   d. Note location of Start and Stop pushbuttons

2. Main PCB 15-530-5 or 15-530-6
   The pots used are screwdriver adjust, single turn pots. Do not use a screwdriver with a blade width exceeding 1/8 inch
   a. Set the Accel Rate potentiometer R18 to 100% (Full CW)
   b. Set the Zero Adjust potentiometer R19 to 0% (Full CCW)
   c. Set the Max Speed/Volts potentiometer R21 to 0% (Full CCW)
   d. Set the Velocity Damping potentiometer R22 as follows (See trimpot illustration)
   e. Set the Time Constant (TC) Adjust potentiometer R26 as follows (see trimpot illustration)
   f. Set the Current Feedback potentiometer R20 to 0% (Full CCW)
### Mechanical Unit Model Numbers

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<tr>
<th>Mechanical Unit Model Numbers</th>
<th>Velocity</th>
<th>Damping Setting</th>
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<table>
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</table>

*Typical product number stamped on mechanical unit nameplate:

1. A1-100214-0053, specific mechanical model is AC-214
2. B2-100210-0008, specific mechanical model is AS-21

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**Trimpot Illustration**

3. **Tach Follower Mod PCB 15-444-1**
   a. Set the Max Ratio potentiometer R3 to 0% (Full CCW)
   b. Set the programming switches and jumper as indicated in the controller programming chart on the connection diagram

**Adjustment Procedure**

Caution: To avoid personal injury or damage to the test equipment remove before connecting or disconnecting test equipment
The Model 4000 and 4050 controllers contain an LED status monitor which provides a visual means of setting the maximum speed and minimum bias. This LED set up along with an alternate method is given below.

1. Turn ON the power to the drive and start the ac motor.
2. Start the controller with the Start pushbutton. Note the location of the Stop pushbutton.
3. **Zero Adjust R19 with LED monitor** - Slowly increase the Zero Adjust potentiometer r19 CW while monitoring the LED, D22. When controller output is turned ON or clutch voltage is turned ON (or the drive shaft begins to rotate), the LED should start flashing. Now just back off slowly until flashing stops.

   **Zero Adjust R19, Alternate Method** - This adjustment can be set to provide zero rpm or some minimum speed greater than zero, as required by the machine operating requirements.
   a. For zero rpm, turn the Zero Adjust potentiometer R19 CW until the output shaft just begins to turn. Then, back off on the control until the output shaft just stops turning. Stop and start the controller a few times to be sure the drive shaft does not rotate.
   b. For a minimum speed greater than zero, the LED cannot be used. Turn the Zero Adjust potentiometer CW until the desired speed is attained. For an accurate setting use a tachometer or stroboscope.

4. **Max Speed/Volts R21** - This adjustment can be set to limit drive speed to its rated maximum or to a slower speed as required by the machine process. An LED status monitor has been provided on the main board to allow you to set the maximum speed without the use of a tachometer, stroboscope or voltmeter. However, an alternate method of set up using this equipment is given to set the maximum speed point. The tachometer or stroboscope will give an accurate rpm setting while the use of a voltmeter will give only an approximate speed setting. This is because the voltmeter is measuring generator voltage instead of actual output rpm.

   **Max Speed/Volts R21 with LED monitor** - Set the Manual Speed potentiometer R5 at 100% (Full CW). The drive should be loaded for best results. Set the Max Speed/Volts potentiometer R21 at 100% (Full CW) Caution: drive will go to top speed. The LED should be out when the drive is at top speed. With the LED out, slowly turn the Max Speed/Volts potentiometer R21 CCW until the LED lights. This indicates that the speed of the drive is in the regulating range of the controller. The clutch voltage should drop below 45V. This will be approximately the maximum rated speed of the drive. The maximum speed point setting will vary with different mechanical units.

There are two other conditions for which the LED will be out besides the drive being set for zero speed or running wide open above the regulating range. These are whenever the “E” relay is deenergized (the drive is stopped), or due to a wiring error, ground or some malfunction of the controller itself.
Max Speed/Volts R21, Alternate Methods

a. To set maximum rated speed with a tach or stroboscope: turn the Manual Speed potentiometer R5 to 100% (Full CW). Allow the drive to accelerate to full speed, turn the Max Speed/Volts pot CW until the rated speed indicated is the same as the speed listed on the nameplate of the mechanical unit.

b. To set approximate maximum speed with a voltmeter, connect a voltmeter (60 Vac scale) across terminals G1 and G2. Turn the Manual Speed pot R5 to 100% (Full CW). Allow the drive to accelerate to full speed, turn the Max Speed/Volts pot CW until the meter Reading ceases to rise.

c. To set a maximum speed that is less than rated maximum speed requires the use of a tachometer or stroboscope indicator. This cannot be accomplished with the LED status monitor. Turn the Manual Speed Potentiometer to 100% (Full CW). Allow the drive to accelerate to full speed, slowly increase Max Speed/Volts potentiometer setting CW until the desired speed is indicated.

5. Since there may be some interaction between the Zero Adjust and the Max Speed/Volts, particularly if the minimum speed is other than zero, repeat steps 3 and 4 until the desired speeds are obtained for both the zero and max positions of the Manual Speed pot.

6. **Time Constant (TC) Adjust R26.** The TC Adjust is used to set current feedback by using coil voltage and a variable RC combination to simulate the different coil time constants of various size drives. A trimpot illustration is provided to facilitate the setting of this control. Sufficient range has been provided for drive sizes from fractional through 20 hp for the 4000 controller and up to 125 hp for the 4050 controller. Set you TC control appropriately for your individual drive size as shown in Preliminary Adjustments.

Setting are not critical and so may be “tuned” for each drive. High inertia applications can benefit from a higher than normal setting.

7. **Current Feedback R20**- Normal operation will not require use of this potentiometer. Certain applications are best met with a negative current feedback response which is slower in settling and less likely to overshoot at low rpms. There are some low inertia, light load, linear acceleration applications that may also benefit from improved low-end linearity with current feedback damping. If you have one of these applications, remove Jumper J1 from the Normal position and place it in the Increased position. Adjust Current Feedback R20 as required to obtain desired drive response.

*See basic 4000/4050 manual for a more detailed description of this adjustment.

8. **Accel Rate R18**- The purpose of Linear Acceleration is to slow down drive response to an increase in command. Without Linear Accel control, the drive will respond to operator speed adjustments very quickly, limited only by the torque capacity of the drive. With the Linear Accel circuit, the output of the controller is linear with respect to time. This circuit is adjustable from 3 to 90 seconds. The controller output will go through Linear Acceleration in the Manual mode only. When set at the slowest acceleration rate, the drive will take 90 seconds to accelerate from zero
to rated speed, following a linear ramp. When less than rated speeds set, this time required to reach top speed is proportionally less.

The Linear Acceleration circuit may be activated or deactivated in the Manual mode by setting the programming switches as indicated on the programming chart on the connection diagram.

To set the Accel Rate: stop the controller with the Stop pushbutton. Turn the Manual Speed potentiometer to 100% (Full CW). With the drive at a complete stop, push the Start pushbutton and time the interval required for the drive to accelerate from zero to full speed. Adjust the Accel Rate potentiometer R18 CCW for a slower accel rate, or CW for a faster accel rate.

Note: Only the Acceleration Rate is adjustable. The response of the controller to a reduced command is instantaneous. The response of the drive to a decrease in command is a function of drive system load and inertia.

9. **Velocity Damping R22*** - This potentiometer is used to match the controller response to the drive response (drive response is a function of the clutch coil time constant and system inertia).

The proper setting for this adjustment depends on the drive size and total load inertia. See Preliminary Adjustments. If instability (speed control becomes erratic) occurs at any setting increase (turn CW) slightly until the speed becomes stable.

*See basic 4000/4050 manual for a more detailed description of this adjustment

10. Set the Manual/Auto switch to Auto. Set the Ratio pot to 100% (Full CW). Start the Master drive and run at maximum line speed. Start the Model 4000 or 4050 Follower controller.

11. Use a tachometer, stroboscope or voltmeter to observe the speed of both the Master Drive and the Follower Drive. Adjust the Max Ratio pot R3, on the modification PCB, to the desired maximum Follower Drive speed. Do not exceed the maximum rated speed of the follower mechanical unit.

12. Reduce speed of the Master Drive to approximately 15% of its rated speed. Measure the speed of both drives and adjust the Follower Drive’s Zero Adjust pot to match speeds.

13. Repeat steps 11 and 12 until the desired tracking is obtained.

14. To run the Follower Drive at a percentage of the Master Drive Ratio pot for the desired percentage (follower Drive Man/Auto switch must be in the Auto position)

15. For independent Speed control of the Follower Drive, place the selector switch in Manual and use the Follower Drive Manual Speed pot.

16. Check motor current to make sure the motor is operating within its rating. If motor current exceeds the nameplate rating, shut it down and correct the problem. This completes the adjustment procedure.
# Renewal Parts List for Standard 4000 & 4050 Controllers with Manual/Auto Tachometer Follower

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<th>Description</th>
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*Denotes minimum spare parts  **Denotes suggested spares when downtime is critical