Accu-Tach

Accu-Tach general description

The Accu-Tach is a combination process control and display device that allows adjusting process drivers, while numerically showing the actual process speed in user defined units on a 4-digit Liquid Crystal Display (LCD). A built-in 10 k-ohm potentiometer controls the process drive.

A feedback sensor provides the Accu-Tach with the process frequency (i.e., process speed).

A common application of the Accu-Tach is controlling the speed of a motor drive by replacing its standard speed-control potentiometer. The Accu-Tach has two modes of operation: Decimal and Time. In Decimal Mode, the display represents values in decimal digits, and in Time Mode, as units of time.
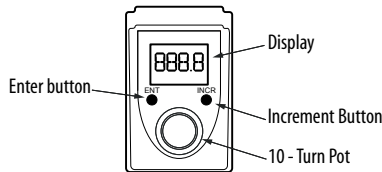

Figure 1: Accu-Tach Face Parts

Table 1: Accu-Tach Face Parts and Functions

Part	Function
Display	Displays process speed in decimal values from 0.000 to 9999, and time from 59:59 to 00:00
Enter (ENT) Button	This button enters Programming Mode for each variable, selects the digit position, and saves the numerical value for each digit position
Increment (INCR) Button	This button increments each digit from 0 to 9, positions the decimal point on the display, selects the 7-programmable variables, and exits Programming Mode
10-Turn Pot	This pot sets process driver operating voltage

Installation overview

The Accu-Tach mounts to the surface of a control panel, using supplied double-sided tape. Eight wires exit the back of the Accu-Tach through a mounting post. The mounting post inserts into a 3/8-inch diameter hole in a control panel. See Figure 2.
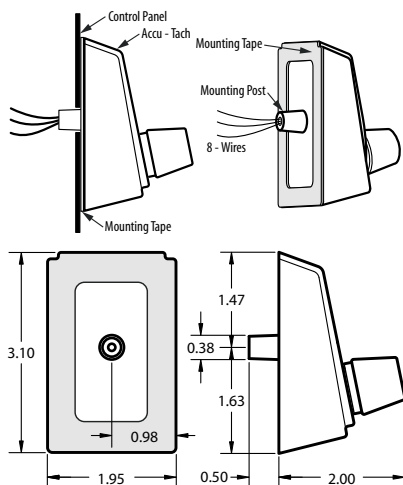

Figure 2: Accu-Tach Mounting Features and Dimensions

Mount the Accu-Tach

To mount the Accu-Tach to the control panel: (See Figure 2).

1. Clean the control panel surface with alcohol to remove any dirt, oil, or grease.
2. Thread Accu-Tach wires into the 3/8-inch diameter hole in control panel.
3. Before removing the tape's protective backing, position the Accu-Tach on the control panel to get an idea about positioning.
4. Remove the backing from the mounting tape.
   Note: The mounting tape is very high bonding; after removing the protective backing from the tape, make sure nothing contacts the tape's surface before mounting the Accu-Tach.
5. Insert the mounting post into the 3/8-inch hole and carefully position the Accu-Tach, ensuring the proper position before pressing to mount.
6. Firmly press the Accu-Tach to mount it to the control panel.

Electrical connections

CAUTION!

The Accu-Tach is compatible with process drivers having pot supply voltages up to 28 Vdc, as measured across the pot supply's high-end to low-end terminals. Failure to observe this caution could result in damage to the Accu-Tach.

Figure 2. Connect the Accu-Tach's eight wires to the application as follows.
Potentiometer connections:
- Connect the Orange wire to the process driver's pot-supply high voltage terminal
- Connect the White wire to the process driver's potentiometer wiper input terminal
- Connect the Gray wire to the process driver's pot-supply low voltage terminal

Feedback sensor connections:
- Connect the Blue wire to the sensor's signal terminal
- Connect the Brown wire to the sensor's power terminal
- Connect a Black wire to the sensor's ground terminal

Power connections:
- Connect the Red wire to the external power supply's positive terminal (+12 to + 24 Vdc).
- Connect the remaining Black wire to the external power supply's negative terminal (gnd).

Definitions of variables

The Accu-Tach has 7-programmable variables: Var00 through Var06. The variables and their parameter values are described on the next page in Table 2 and Table 3.

About calibration, error messages, and alerts

Var02, Var03, Var05 and Var06 have a hierarchy order:
Because of this hierarchy, program Var02 before programming, Var03. Then later program Var05 or Var06.

Decimal and time mode default displays

Because of the hierarchy order of Var02, Var03, Var05 and Var06, when Var02 or Var03 are changed, the following effects on default values must be noted. When changing Var02 from Decimal Mode to Time Mode operation, Var03 and Var05 are set to their Time Mode default values:
- Var03 = 0006, (maximum frequency range of 9999 Hz).
- Var05 = 59.59 ("59:59" time units, at just above 0 Hz speed).

When changing Var02 from Time Mode to Decimal Mode operation, Var03, Var05, and Var06 are set to their factory default values:
- See '*Reset the variables to factory defaults*' for these defaults.

Table 2: Operational Setup Variables

Variable	Parameter	Function
Var00	6170	**User Var security** Prevents inadvertent programming. User must first enter 6170 into Var00, before being allowed to change the values in Var01 through Var06.
Var01	1, 2, or 3	**Feedback Sensor Type select** Matches the Accu-Tach to the type of sensor output used by the application. The sensor selections are: 1 = NPN output 2 = PNP, and/or 5V logic-level output. 3 = Magnetic pickup (sinewave output)
Var02	1 or 2	**Display Format select** Sets the mode of operation to either a Decimal or Time display format. The format selections are: 1 = decimal *(digits)* 2 = time *(hrs:mins or mins:secs)*
Var03	3, 4, 5, or 6	**Maximum Frequency select** Selects the frequency range that covers the application's highest expected feedback frequency. The range selections are: 3 = maximum frequency of 9.999 Hz 4 = maximum frequency of 99.99 Hz 5 = maximum frequency of 999.9 Hz 6 = maximum frequency of 9999. Hz
Var04	1 to 250	**Analog Filtering select** Selects the number of feedback pulses to average over. This improves the stability of the value shown on the LCD. Typically Var04 is set to the PPR value of the sensor, however any value from 1 to 250 can be entered.

Table 3: Decimal and Time Mode Calibration Variables

Mode	Var#	Parameter	Description
Decimal (Var02 = 1)	Var05	0.000 to 9999.	Decimal value that appears on the LCD display when the feedback speed is at the selected low (LO) calibration frequency.
	Var06	0.000 to 9999.	Decimal value that appears on the LCD display when the feedback speed is at the selected high (HI) calibration frequency.
Time (Var02 = 2)	Var05	59.59 to 00.00	Time value that appears on the LCD display when the feedback speed is at the selected calibration frequency.
	Var06		Not used, not accessible, in Time Mode

Decimal and time mode default displays (cont. from previous page)

If in Decimal Mode operation, when changing Var03 Maximum Frequency selection, Var05 and Var06 are set to these default values:

- Var05 = 0000. (0 user units, at 0 Hz speed).
- If Var03 = 3, then Var06 = 9.999   (9.999 user units, at 9.999 Hz).
  If Var03 = 4, then Var06 = 99.99   (99.99 user units, at 99.99 Hz).
  If Var03 = 5, then Var06 = 999.9   (999.9 user units, at 999.9 Hz).

If Var03 = 6, then Var06 = 9999.   (9999. user units, at 9999. Hz).
If in Time Mode operation, when changing Var03 Maximum Frequency selection, Var05 is set to its Time Mode default value:

- Var05 = 59.59. ("59:59" time units, at just above 0 Hz speed).

Error messages and alerts
Calibration error messages and how to clear them

- **Err1** (Decimal Mode): "**Err1**" displays <u>after</u> exiting programming mode, <u>if</u> Var05 and Var06 were calibrated with less than a '2.5% of Var03 max freq' separation between them.
  Note: Var05 and Var06 calibration speeds must have at least a '2.5% of Var03 max frequency' separation between each other. This separation is defined as follows:
  Var03 = 3   (9.999 Hz).   minimum separation of   0.25 Hz.
  Var03 = 4   (99.99 Hz).   minimum separation of   2.5 Hz.
  Var03 = 5   (999.9 Hz).   minimum separation of   25 Hz.
  Var03 = 6   (9999. Hz).   minimum separation of   250 Hz.

- **Err2** (Decimal Mode): "**Err2**" displays <u>after</u> exiting programming mode, <u>if</u> Var05 was calibrated at a faster speed than Var06.
  Note: Var05 must always be the slower speed calibration point.
  Var06 must always be the faster speed calibration point.

- To correct the "**Err1**" or "**Err2**" message, keep the above mentioned constraints in mind, and follow these steps:
  - verify that the feedback sensor has not been damaged, and that it still produces a feedback signal.
  - recalibrate Var05 at the process's slow speed (even if 0 Hz).
  - recalibrate Var06 at the process's higher speed.
  - exit Programming Mode.

- **Err3** (Decimal or Time Mode): "**Err3**" displays <u>during</u> the programming mode and prohibits the calibration of Var05 or Var06, <u>if</u> Var05 or Var06 calibration is attempted at feedback speeds above the selected 'Var03 maximum frequency'.
  To correct the "**Err3**" message, follow these steps:
  - if need be, adjust the selection of Var03 maximum frequency.
  - recalibrate Var05 or Var06 at correct feedback speed.
  - exit Programming Mode.
  Note: speed in Hz = (Sensor RPM) * (Sensor PPR) / 60.

- **Err4** (Time Mode): "**Err4**" displays <u>during</u> the programming mode and prohibits the calibration of Var05, <u>if</u> Var05 calibration is attempted for a feedback speed of 0 Hz. (This because calibration of Var05 at 0 Hz speed would result in an infinite large time).
  To correct the "**Err4**" Time Mode message, follow these steps:
  - verify that the feedback sensor has not been damaged, and that it still produces a feedback signal.
  - recalibrate Var05 at correct speed.
  - exit Programming Mode.

- **General Note**: When recalibrating Var05 or Var06 to their same respective values, you must actually change the variable's value, and then change it back to the desired value, in order for the recalibration to be effective. (Ex: Enter the variable and use the INCR button to change the right-most flashing digit, then keep changing it fully back to your initial value).

Display mode alert messages and what they mean

- "**St0P**" (Decimal or Time Mode): means no pulses are being received (sensor is stopped or has failed).
  - For Var03 = 3: "St0P" after 20 seconds of no pulses.
  - For Var03 = 4, 5, 6: "St0P" after 2 seconds of no pulses.
- Flashing "**0000**" (Decimal or Time Mode): means the speed in User Units value is less than 0 (outside the displayable range).
- Flashing "**9999**" (Decimal Mode): means the speed in User Units value is

greater than 9999 (outside the displayable range).
• Flashing "**59:59**" (Time Mode): means the speed time value is greater than 59:59 (outside the displayable range).
• "**Err1**" (Decimal Mode): see '*calibration error messages'.*
• "**Err2**" (Decimal Mode): see '*calibration error messages'.*
• "**Err3**" (Decimal or Time Mode): means the feedback speed has exceeded the 'Var03 maximum frequency'.

How to set up and calibrate the Accu-Tach
To pass through User Var Security, and gain access to the programmable variables Var01 through Var06:
Var00 must be set to '6170' each time programming mode is entered.
1. Press the INCR button: Pr00 appears; this selects Var00.
2. Press the ENT button: the first digit is flashing.
3. Press the INCR button to increment the digit (0 thru 9); press the ENT button to select the next digit, saving the previous value.
   Do this for each digit until the '6170' password has been entered.
4. Press the ENT button until Pr00 appears on the display.
Note: If Var00 does not equal 6170 then the user is only allowed to view the values in Var01 through Var06, but not allowed to change them.

Set feedback sensor select, operation mode, maximum frequency, and analog filtering parameters: Var01, Var02, Var03, and Var04
To set the sensor select parameter (Var01) to match the application's feedback sensor:
1. Press the INCR button: Pr01 appears; this selects Var01.
2. Press the ENT button: the first digit is flashing.
3. View Table 2 to match the type of sensor for the application; then press the INCR button to select the digit 1, 2 or 3 that represents the correct sensor.
4. Press the ENT button until Pr01 appears on the display.

To set the mode of operation (Var02) to decimal or time mode:
5. Press the INCR button: Pr02 appears; this selects Var02.
6. Press the ENT button: the first digit is flashing.
7. Press the INCR button to select '1' for Decimal or '2' for Time operation.
8. Press the ENT button until Pr02 appears on the display.

To set the maximum frequency (Var03) to match the application:
9. Press the INCR button: Pr03 appears; this selects Var03.
10. Press the ENT button: the first digit is flashing.
11. View Table 2 to select the frequency range for the application; then press the INCR button to select the digit 3, 4, 5 or 6 that represents the correct range.
12. Press the ENT button until Pr02 appears on the display.

To set the analog filtering parameter (Var04) to match the PPR (pulses per revolution) of the application's feedback sensor:
13. Press the INCR button: Pr04 appears; this selects Var04.
14. Press the ENT button: the first digit is flashing.
15. Press the INCR button to increment the digit (0 thru 9); press the ENT button to select the next digit, saving the previous value. Do this for each digit until the entire PPR value has been entered.
    Note: Var04 is initially set to the 'pulse per revolution' (PPR) value of the sensor. If the sensor has more than 250 PPR, then enter 250. Var04 can be tweaked for desired display response and stability. However, best results are often found when set to the PPR value of the sensor.
16. Press the ENT button until Pr04 appears on the display.

Calibration for decimal mode operation: Var05 and Var06
1. Press the INCR button: Pr05 appears; this selects Var05.
2. Set the pot to run the process at desired LO speed for Var05.
   Note: The default for Var05 is zero user units at 0 Hz.
         For most Decimal Mode applications, Var05 can be left at its default calibration, but exceptions do exist.

3. Press the ENT button: the first digit is flashing.
4. Press the INCR button to increment the digit (0 thru 9); press the ENT button to select the next digit, saving the previous value. Do this for each digit until the entire user unit value has been entered.
5. After entering the entire decimal value, press the ENT button until Pr05 appears on the display.
6. Press the INCR button: Pr06 appears; this selects Var06.
7. Set the pot to run the process at desired HI speed for Var06
   Note: The speed for Var06 must be faster than that for Var05.
   See '*calibration error messages…'***Err1** and **Err2** for details.
8. Press the ENT button: the first digit is flashing.
9. Press the INCR button to increment the digit (0 thru 9); press the ENT button to select the next digit, saving the previous value. Do this for each digit until the entire user unit value has been entered.
10. The last action is to set the position of the decimal point, if desired. Press the ENT button until the decimal point flashes.
11. Press the INCR button to position the decimal point.
12. Press the ENT button until Pr06 appears on the display.
13. Press the INCR button to exit Programming Mode.

Calibration procedure for time mode operation: Var05 and Var06
Note: In Time Mode operation, the decimal point position for Var05 is fixed as shown: [XX.XX].
1. Press the ENT button, then the INCR button until Pr02 appears on the display; this selects Var02.
2. Press the ENT button: the first digit is flashing.
3. Use the INCR button to increment the digit to '2,' Time Mode.
4. Press the ENT button until Pr02 appears.
5. Press the INCR button until Pr05 appears; this selects Var05.
6. Set the pot to run the process at desired speed for Var05.
7. Press the ENT button: the first digit is flashing.
8. Press the INCR button to increment the digit (0 thru 9); press the ENT button to select the next digit, saving the previous value. Do this for each digit until the time is set.
9. Press the ENT button until Pr05 appears on the display.
10. Press the INCR button to exit Programming Mode.

Decimal and time mode operation examples
Decimal example 1: Assembly line application producing widgets
• A motor drive controls the motor speed. (The motor drive uses a 10 Vdc pot supply).
• The application uses an NPN type feedback sensor with 60 PPR, mounted directly on the motor.
• At normal speed the motor spins 1800 RPM, and the line produces 500 widgets per day.
• The Accu-Tach is to show the number of widgets made per day.

Setup and calibration procedure for example 1:
a. Enter '1' into Var01, since the sensor used is an NPN type.
b. Enter '1' into Var02, to show the process output as decimal *(i.e., the number of widgets produced)*.
c. Enter '6' into Var03, since the application's maximum frequency is 1800 Hz.   (1800 RPM with a 60 PPR sensor is 1800 Hz).
d. Enter '60' into Var04, since the sensor has 60 PPR.
e. Access Var05, and set the pot to run the process at a LO speed of 0 Hz for Var05. Enter '0' into Var05, and then exit Var05.
f. Access Var06, and set the pot to run the process at the desired HI speed that produces 500 widgets per day. Enter 500 into Var06, and then exit Var06.
g. Setup and calibration is complete; exit Programming Mode.

Results for example 1:
To make 500 widgets per day, turn the pot until 500 appears on the display. To make 450 widgets per day, turn the pot until 450 appears on the display. The line runs at the displayed production rate.

Time example 2: Conveyor oven application baking pizzas

- A motor drive controls the motor's speed running the conveyor. (The motor drive uses a 15 Vdc pot supply).
- The application uses a magnetic pickup feedback sensor with 30 PPR, mounted directly on the motor.
- At normal speed the motor spins 1500 RPM, taking 15 minutes and 30 seconds to send the pizza through the oven.
- The Accu-Tach is to show the 'baking time' rather than conveyor oven motor speed.

Setup and calibration procedure for example 2:

a. Enter '3' into Var01, since the sensor used is a magnetic pickup type.
b. Enter '2' into Var02, to show process output as time *(i.e., how long the pizza remains in the oven at this motor speed)*.
c. Enter '5' into Var03, since the application's maximum frequency is 750 Hz. (1500 RPM with a 30 PPR sensor is 750 Hz).
d. Enter '30' into Var04, since the sensor has 30 PPR.
e. Access Var05, and set the pot so the process runs at the speed that sends the pizza through the oven in 15 minutes and 30 seconds. Enter 15:30 into Var05, and then exit Var05.
f. Setup and calibration is complete; exit Programming Mode.

Results for example 2:

To send the pizza through the oven in 15 minutes and 30 seconds, turn the pot until 15:30 appears on the display. To send the pizza through the oven at a slower speed for pizzas needing 17 minutes to bake, turn the pot until 17:00 appears on the display.

LCD Self-Test and Firmware Identification

During power-up the Accu-Tach first displays "8.8.:8.8." along with the small "VAR" icon for about 3 seconds, (as a self-test of the LCD).

The Accu-Tach then displays the firmware identification number in the "X.X.X.X" format, for about 2 seconds. The first two digits reflect the version number. The last two digits reflect the revision number. (e.g. "0.2.0.1." for version 02, revision 01).

Reset the variables to factory defaults

To reset the Accu-Tach's programmable variables to factory defaults, simultaneously press the ENT and INCR buttons while applying power to the Accu-Tach. Release the buttons only after the display shows 'rESE' (for reset). The factory defaults are:

- Var00 = 0000.   (User Var security enabled).
- Var01 = 0001.   (Feedback sensor has NPN output).
- Var02 = 0001.   (Decimal mode format)
- Var03 = 0006.   (Maximum frequency of 9999 Hz).
- Var04 = 0001.   (1 pulse of analog filtering).
- Var05 = 0000. (0 user units, at 0 Hz speed).
- Var06 = 9999. (9999. user units, at 9999. Hz speed).

Specifications

Performance

- LCD max range of 0.000 to 9999. for Decimal Mode operation
- LCD max range of 59:59 to 00:00 for Time Mode operation *(hrs:mins or mins:secs)*
- Measures feedback sensor frequencies from 0.500 Hz up to 9999 Hz, to within 0.2% of actual frequency.
- Open loop control
- EEPROM protects programming and feedback speed calibration points

Mechanical packaging

- Mounts through control panel via single 3/8-inch diameter hole, using highly bonding tape
- Footprint of 1.95-inches wide *(left to right)* by 3.10-inches long

Environmental considerations

- NEMA 4 enclosure type
- Temperature range of 0ºC to 60ºC
- Humidity range of 0% to 90% non-condensing

Electrical considerations

- Compatible with process drivers having pot supply voltages up to +28 Vdc *(as measured across the process drive's pot supply high-end to low-end terminals)*
- Compatible with process drivers using an external control voltage potentiometer of 10k ohms
- Accu-Tach's 10k pot is isolated from internal circuitry.
- Current draw of 60 mA or less (max draw of 10 mA for the Accu-Tach internal circuitry, plus 50mA for the sensor power supply output).
- Programmable sensor selection matches the Accu-Tach to the type of feedback sensor used by the application. *(This allows accurate LCD readouts, independent of the type of sensor used – NPN, PNP, 5V Logic-level-line-driver, magnetic pickup)*

Operator interface

- Built-in 10-turn, 10k-ohm potentiometer, *(sets operating voltage for process drive)*
- Two pushbuttons: ENT and INCR *(setup and calibration)*

Configuration modes

- Display Mode: Units in decimal or as time
- Programming Mode: Variables 00, 01, 02, 03, 04, 05, 06.

Operation modes

- Decimal based mode *(decimal digits)*
- Time based mode *(units of time in hrs:mins or mins:secs)*

I/O requirements

- Input: external power supply of +12Vdc to +24Vdc.
- Input: potentiometer terminals accepts pot supply voltages up to +28 Vdc
- Input: feedback sensor frequency of 0.50 Hz to 9999 Hz *(with NPN, PNP, and 5V logic-level-line-driver sensors)*.
- Input: feedback sensor frequency of 50 Hz to 4000 Hz *(with magnetic pickup sensors: minimum input of 0.2V p-p sinewave, maximum input of 20V p-p sinewave.)*
- Output: control voltage from potentiometer to process drive.
- Output: sensor power supply 50 mA max, short-circuit protected (cycle power to reset). Output voltage level slightly less than external power supply input voltage.
- Output: feedback speed readout to a built-in LCD display

Additional information

Accu-Tach has US Patent # 6,809,531.

To get additional technical information about the Accu-Tach, visit our website at: www.electro-sensors.com

ELECTRO·SENSORS