

S15 Application Note 2.8.0

Motor Auto-tuning

How to enter motor settings and run the auto-tune process for induction motors.

Estimated Time: 10 - 15 Minutes

Level: 2

Prerequisite:

- S15 Application Note 1.1.0
Navigating Menus & Parameters

STEP A

Background Information

The V/f Pattern or Volts per Hertz ratio is the ratio of the output voltage and output frequency to the motor. For constant torque applications, this is a linear relationship, and for variable torque applications it is exponential. Some applications require increased speed accuracy, greater torque performance at lower speeds, etc. In these applications, it is necessary to utilize one of the forms of vector control listed in the table below. When using vector control, the S15 requires an auto-tune, so the drive can differentiate between magnetizing current and torque current.

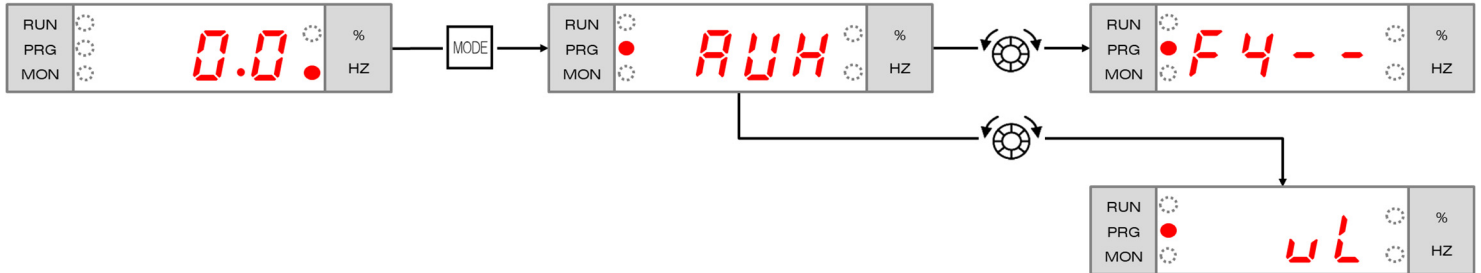
The S15 must be connected to the motor to perform the auto-tune. The motor does not have to be loaded, and will not rotate until the auto-tune is complete.

The auto-tune will not work if there are other devices installed between the S15 and the motor like a load reactor, long lead filter, or sinewave filter. A manual tune is required, and is not covered here.



Parameter	Direct Access	Description	Forms of Vector Control
P_L	0015	V/f Pattern	\mathcal{L} : Automatic Torque Boost \mathcal{J} : Vector Control \mathcal{H} : Energy-Saving \mathcal{S} : Dynamic Energy-Saving (Fan and Pump)

STEP B Programming



Using the motor nameplate, program the motor ratings into the following parameters.

Parameter	Description	Information to Enter	Notes
<i>uL</i>	Base Frequency	Frequency (Hz)	Typically 60 Hz or 50 Hz.
<i>uL u</i>	Base Frequency Voltage 1	Voltage (V)	If the motor is dual rated, reference the supply voltage.
<i>F405</i>	Motor Rated Capacity	Kilowatts (kW)	kW = 0.746 x HP
<i>F415</i>	Motor Rated Current	Amps (A)	Enter motor FLA, not SF.
<i>F417</i>	Motor Rated Speed	RPM	Enter the specific RPM listed, not synchronous speed.

The purpose of the auto-tune is to gather additional motor information that is not listed on the nameplate. Fill in the “Value before Auto-tune” column below. A successful auto-tune will change these values.

Parameter	Description	Value before Auto-tune	Value after Auto-tune
<i>F402</i>	Automatic Torque Boost		
<i>F412</i>	Leakage Inductance		
<i>F416</i>	Motor No Load Current		

Select the desired form of vector control, and enable the auto-tune.

Parameter	Description	Information to Enter	Notes
<i>Pt</i>	V/f Pattern	<i>2, 3, 4, or 5</i>	Does not have to be set to vector control for the auto-tune to work.
<i>F400</i>	Offline auto-tuning	<i>5: 4 + 2 (0 after execution)</i>	Value will change from 5 to 2 once OK is pressed. That is expected.

STEP C

Verification & Troubleshooting

Once the motor parameters have been entered, the next time the S15 receives a run command the auto-tune will be performed. The 'At n' message will appear on the screen for the duration of the process. This can be as quick as one second or as long as five minutes depending on the HP and the application. The motor will begin to run after the auto-tune is complete. If the motor data is entered incorrectly, or the S15 is unable to tune, then one of the 'Et n' fault codes will appear.



Fault Code	Fault Name	Reason for Trip	Verification
<i>E t n</i>	Auto-tuning Error	1. Motor parameters do not match the motor.	1. Verify the settings of vL, vLv, F405, F415, F417.
<i>E t n 1</i>	Auto-tuning Error 1	1. VFD is much larger than the motor. 2. Something other than the motor is connected or output cable is too thin.	1. Verify the settings of vL, vLv, F405, F415, F417. 2. Ensure that only the motor is connected.
<i>E t n 2</i>	Auto-tuning Error 2	Motor is not connected.	Ensure that the motor is connected.
<i>E t n 3</i>	Auto-tuning Error 3	Motor is rotating.	Ensure that the motor is stopped.

After the auto-tune is complete, fill in the "Value after Auto-tune" column on the previous page (Step B). The values will change if the auto-tune was successful. Redo the auto-tune by setting *F 4 0 0* to 2 if the values did not change.

Because vector control performs slip compensation, the output frequency may be higher than the commanded frequency. Due to this, it is recommended that the Maximum Frequency (*F H*) is set 10% higher than the Upper Limit Frequency (*U L*). If the Maximum Frequency and Upper Limit Frequency are set to the same value, then nuisance faults may occur like *E - 1 3*.

For special high speed motors, it may be necessary to calculate the RPMs at 60.0Hz. For example, if the motor is rated for 25,000 RPM at 450 Hz, then the settings of *u L* and *F 4 1 7* will be 60.0 Hz and 3333 RPM.

$$\frac{25,000 \text{ RPM}}{450.0 \text{ Hz}} = \frac{x \text{ RPM}}{60.0 \text{ Hz}}$$

$$x = \frac{60 \text{ Hz} * 25,000 \text{ RPM}}{450 \text{ Hz}} = 3333 \text{ RPM}$$