



Document Reference: AN060003VS1

AUTO TUNING VS1 VECTOR CONTROLS

WARNING: These procedures may rotate the motor up to maximum speed. Do not perform auto tuning unless it is safe to rotate the motor under automatic control of the drive. Read the VS1 instruction manual first and observe all safety precaution prior to working on this equipment.

Equipment required:

VS1 Vector
VS1 Servo

Introduction:

Automatic tuning of the controller to the motor is accomplished by running an auto tune procedure in the QUICK SET-UP mode, or in Level 2, AUTO TUNE parameter block. One-step static tuning and select-each-step rotating auto tuning allow for various application configurations and constraints.

These procedures require the motor and encoder (if used) to be properly wired, shielded and grounded. Please read the VS1 instruction manual in detail and become familiar with the VS1 keypad operation, programming functions and keypad navigational keys prior to proceeding with auto tune.

Procedure:

A. AUTO TUNING WITHOUT A LOAD CONNECTED TO THE MOTOR

For this test the motor must be free to rotate with no external load or source of significant windage or friction. The simplest auto tuning method is to run the auto tuning procedure in "QUICK SET-UP" mode, as follows:

1. After power-up the keypad displays the STATUS screen.
2. Press the MENU key to display menu options.
3. Press navigational arrow to move cursor, and select QUICK SET-UP, then press ENTER.

4. Press navigational arrow to go to CONTROL TYPE screen and press ENTER.
5. Select "Closed Vector" or Open Vector, as required, and press ENTER.
6. Next, program Motor Rated Volts, Motor Rated Amps, Motor Rated Speed, and Motor Rated Frequency by entering data found on the motor nameplate.
7. Press navigational arrow to go to CALC MOTOR MODEL screen. Press ENTER, select YES, press ENTER.
This procedure loads into memory the preset values that are required to perform auto tune. Always run CALC MOTOR MODEL prior to auto tune!
8. Next, press navigational arrow to go to FEEDBACK SOURCE screen. DAUGHTER FDBK is a default parameter in Closed Loop Vector mode and is most often used. Press ENTER to select DAUGHTER FDBK. Other possible feedback selections are: None (used in Open Loop Vector mode), Option Slot 1, and Option Slot 2. Slot 1 and Slot 2 options are used in special applications.
9. Next, press navigational arrow to go to ENCODER COUNTS screen (Default value is 1024). Program the desired encoder count, if different than 1024, and press ENTER.
10. Next, press navigational arrow to go to ANALOG OFFSET TRIM screen. All analog inputs should be set to zero before running this procedure. This procedure trims out (or offsets) each analog input in order to zero out the analog command. Test will fail if inputs are greater than 2.5 volts. Programmable options are NO or YES. Select YES and press ENTER.
11. Next, press navigational arrow to go to ONE-STEP TUNING, Press ENTER, select YES, press ENTER. The control will now measure the following motor circuit data: Motor R1-Stator Resistance; Motor X1-Stator Reactance; Motor R2-Rotor Resistance; Motor Xm-Magnetizing Reactance; Rotor Time Constant; Electrical Slip Frequency. These values are used to create a motor model. They are extremely important, especially for open-loop vector operation. The One-Step Tuning Procedure takes approximately 3 minutes to complete. The motor will not rotate during this test.
12. When One-Step Tuning is completed, the screen will show "STATIC TEST DONE/ROT TEST FOLLOWS – PRESS ENTER FOR FEEDBACK ALIGN."
13. Press ENTER for FEEDBACK ALIGN test - **the motor will run.** During this test the controller checks encoder ALIGNMENT parameters while the motor is running at near full speed. Test will automatically switch encoder phasing to match motor rotational direction. (This test is only active in Closed Loop Vector mode, and is not available for Open Loop Vector.) At the completion of this test,

the screen will show “TEST PASSED – PRESS ENTER FOR FLUX CURRENT TUNE”.

14. Press ENTER to run FLUX CURRENT Tuning test. Motor will ramp up to 80% base speed and measure the current. The current to the motor is recorded as the Motor Magnetizing Amps. When completed, the screen will show “TEST PASSED – PRESS ENTER FOR SLIP FREQUENCY TUNE.”
15. Press ENTER for SLIP FREQUENCY tuning. Using quick accelerations, the slip of the motor will be determined. When completed, the screen will show “TEST PASSED – PRESS ENTER FOR SPEED LOOP TUNE.
16. Press ENTER for SPEED LOOP tuning. This test uses quick acceleration to calculate the Speed Proportional and Integral Gains with an unloaded motor. This test should be repeated with the load connected to fine tune the Speed Proportional and Integral Gains. If necessary, Speed Proportional and Integral Gains can be individually adjusted in Level 1, MOTOR CONTROL block, for best machine operation and speed regulation. Always make any gain adjustments in small increments, one at a time.

Note: Dynamic Brake Hardware is required to perform the Slip Frequency Tuning test and the Speed Loop Tuning test.

B. AUTO TUNING WITH A LOAD CONNECTED TO THE MOTOR

1. If a load cannot be disconnected from the motor, run only the ONE-STEP Stationary Tuning procedure! Follow steps A-1 through A-11 above.
2. After completing the ONE-STEP Stationary Tuning procedure press MENU, select STATUS and press ENTER. Next press JOG and jog the machine at low speed for a short time by momentarily pressing FWD or REV, if safe, to make sure that there are no electrical or mechanical problems, then run the machine **slowly** up to full speed. Note: If the motor runs only at very low speed (typically 50 RPM) and does not respond to speed command inputs, stop the drive and change FEEDBACK ALIGN parameter from FWD to REV (or REV to FWD) in Level 1, MOTOR CONTROL block, and then run the drive again. The FEEDBACK ALIGN parameter sets the encoder’s electrical direction of rotation to match that of the motor. This parameter is normally set during the rotating auto tuning procedure. Running the one-step static tuning procedure, there is a 50:50 chance of this parameter being correct on the first try. There is no FEEDBACK ALIGN parameter in Open Loop Vector!
3. If, after completing test B-2 above, everything seems fine, and no problems exist with any part of the machine, motor or controller, the SPEED LOOP TUNE Test , Item A-16 above, may be run.

4. If there are any performance problems with stability, response or speed regulation that cannot be corrected by auto tuning or by manually adjusting individual gain parameters in Level 1, MOTOR CONTROL block, please refer to section 6 of the VS1 instruction manual titled “Manually Tuning the VS1 Control”. This section shows how to calculate and manually adjust various important parameters and gains, if necessary.

In addition to auto tuning the controller in the QUICK SET-UP mode, the above-described tuning procedure (with or without a load) may be performed in Level 2 Programming Block. Enter the motor nameplate data in Level 2, MOTOR DATA block, and perform tuning in Level 2, AUTO TUNE block following similar procedure.