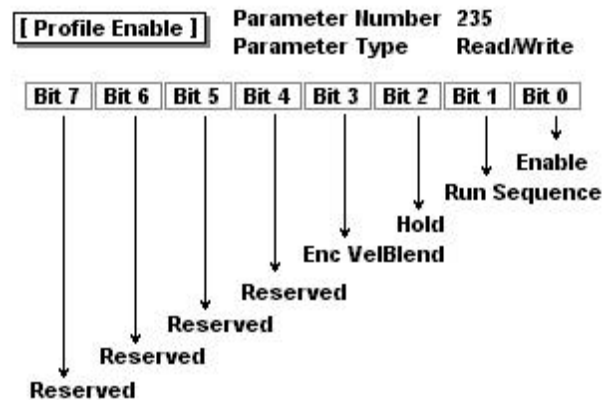


Speed Profiling

The speed profiling control allows the drive to be programmed for 16 separate speed steps. These steps can be activated by digital inputs, time, or encoder counts. The sequence of the profile can be a single cycle with a "return to home" or be a continuous loop with a "return to step 1" routine.

Each step uses three parameters for configuration - The speed in rpm to operate at during the step, the time or encoder counts of travel, and the type of index or move to perform (time based, digital input activated, or encoder count based).

Parameter Descriptions



[Profile Enable] (P235) is the command word for speed profiling.

Bit 0 - Sets the "home" position and must be set to 1 for profiling to operate.

Bit 1 - Must be set to run the sequence of the speed profile that is programmed.

Bit 2 - When set to 1 the transition to the next step is ignored, the active step will be maintained. If the active step is an encoder step, then the position will be held. For a time step, the speed will be maintained. (See figure 1)

Bit 3 - This is used with sequential encoder steps and eliminates the speed from going to zero at the end of each step. (See figure 1)

Bit 4-7 Reserved

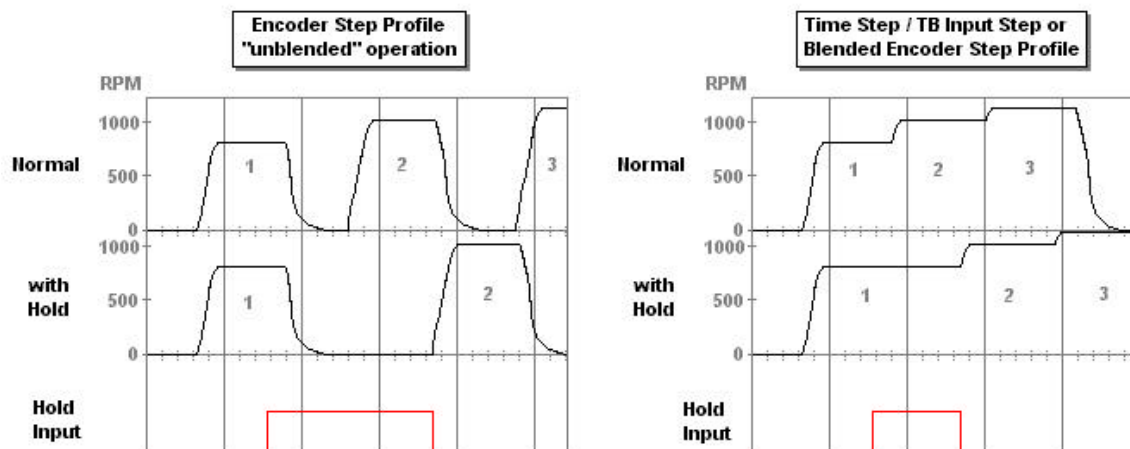
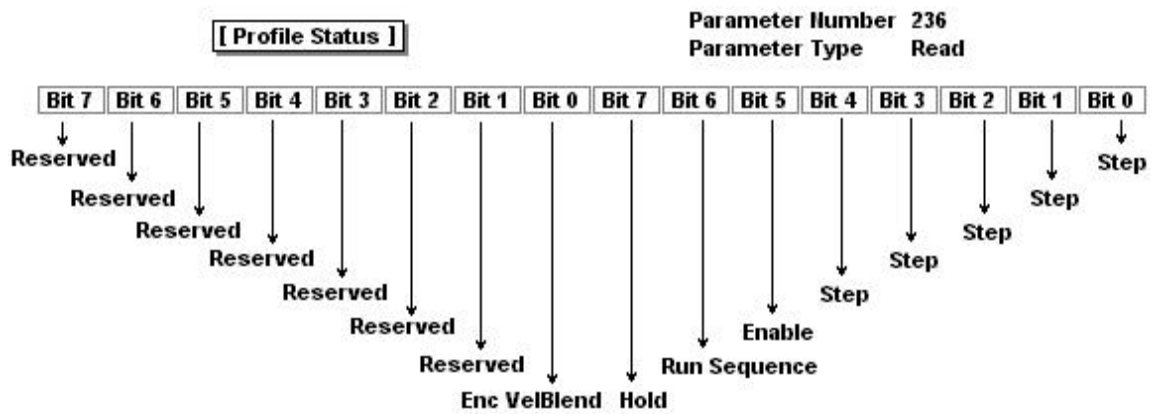


Figure 1



[Profile Status] (P236) indicates the state of the profiling routine.

Bit 0-4 = the binary value of active step, 1-16.

Bit 5 = Enabled when set to 1.

Bit 6 = Run Sequence on when set to 1, bit clears upon completion of one cycle.

Bit 7 = Hold is active when set to 1.

Bit 8 = EncVel Blend mode selected when set to 1.

[Error Trim Gain] (P237) sets the gain for the speed profiling control. The range is from 1.0-16.0. When sending values over a network connection, the scaling is 128 = 1.0 (example: 409 = 3.2).

[End Action Sel] (P238) is used to select how the end of the run sequence is done.

0 = Stop

1 = Goto Step, uses P240 to determine which step to goto when end is reached.

2 = TB3 Input, uses P241 to select which TB3 terminal to use.

3 = Compare, uses P242 as the value to compare.

4 = Encoder Home, goes to the home position set when profile enabled.

[End Action Speed] (P239) sets the speed for the end action. 4096 = Base Speed.

[End Action Go To] (P240) sets the step to go to when P238 = 1.

[End Action Input] (P241) selects the TB3 terminal used when P238 = 2.

0 = TB3-19

4 = TB3-27

1 = TB3-22

5 = TB3-28

2 = TB3-23

6 = Reserved

3 = TB3-26

[End Action Comp] (P242) sets the value used when P238 = 3.

[End Action Value] (P243) used when end action is set to "compare".

[Value Tolerance] (P244) Sets the tolerance window for the end of each encoder step. (Scaling: 10 = 1.0)

[Counts per Unit] (P245) Set this to 4 times the encoder PPR for step increments measured in motor revolutions. (Scaling: 10 = 1.0)

[Profile Units] (P246) This shows the value traveled from the "home" position.

[Profile CMD LSW] (P247) This is the lower word of the 32-bit speed reference. This must be linked to P28 [Speed Ref 1 Frac].

[Profile CMD MSW] (P248) This is the upper word of the 32-bit speed reference. This must be linked to P29 [Speed Ref 1].

[Step 1 Speed] (P249) Sets the rpm value for this step. (Scaling: 4096 = Base Speed)

[Step 1 Value] (P250) Sets the time in seconds for time steps, the counts in units for encoder steps, and the TB3 input to trigger on for TB Input steps. Scaling:
Time Step: 10 x desired value (10 = 0.1 sec)
Encoder Step: 1 = 1 revolution (refer to P245)
TB Input Step: dependent on [L Option Mode Sel] (P116)

[Step 1 Index] (P251) Selects the type of step to be used.
0 = Not Used (this forces an End Action)
1 = Time Step, operate at speed shown in P249 for time in P250
2 = TB3 Input Step, operate at speed shown in P249 until this input goes true.
3 = Encoder Step, operate at speed shown in P249 for counts in P250.

Refer to the descriptions of the *step 1* parameters (P249-P251) for steps 2-16.

P252-254 Step 2	P255-257 Step 3	P258-260 Step 4
P261-263 Step 5	P264-266 Step 6	P267-269 Step 7
P270-272 Step 8	P273-275 Step 9	P276-278 Step 10
P279-281 Step 11	P282-284 Step 12	P285-287 Step 13
P288-290 Step 14	P291-293 Step 15	P294-296 Step 16

Initial Setup

Relay Output Configuration

When Speed Profiling is enabled, [Relay 4 Config] (P191) is set to 39 "@ Profile Pos". This relay will energize when the position is within tolerance for each step that is programmed for "encoder step".

Bipolar Signal Reference

Set P17 [Logic Options] bit 11 "Bipolar Sref" to 1 to enable bipolar references for speed and direction control. If this is not set for bipolar operation, a reverse speed command, which is a negative value, will not be able to be accomplished. This will cause the profile to lock-up at the first negative speed step.

Accel / Decel Rates

The acceleration and deceleration control is part of the speed PI regulator. It is important that the rate limits set in this regulator do not interfere with the speed profile regulator.

If the deceleration rate is too long, the speed profile loop output will not be followed if the gain is set to a reasonable level. The result is an overshoot of the travel distance programmed. If the gain is lowered, then the speed profile output is overly damped and the overall cycle of the speed profile is increased.

Bus Regulator

If the bus voltage regulator is enabled P13 [Bus/Brake Opts] bit 10 set to "0", then the speed profile will be overridden by the bus regulator. This can cause an over-travel condition on the speed profile steps.

Limits

If the drive runs into current or torque limit during a timed step, the distance of travel will be reduced. For TB3 input and encoder steps, the time to travel a given distance will be increased.

Using TB3 Inputs

When the speed profiling steps are going to use TB3 terminal inputs, the [L Option Mode] (P116) must be set to proper value for the inputs to work. Modes 31 and 32 have been designed specifically for use with speed profiling.

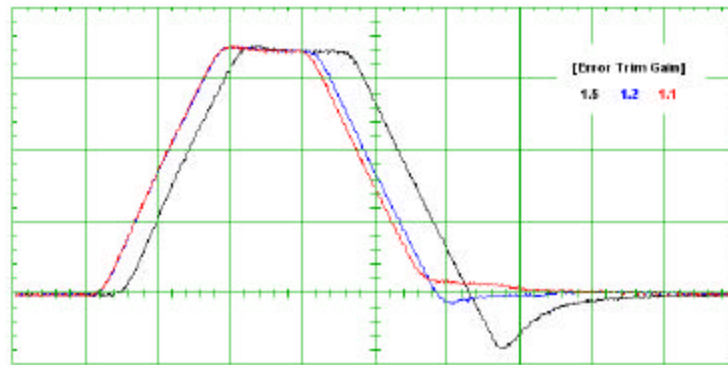
TB3	[L Option Mode]	
	31	32
19	Step Trigger	Step Trigger
20	Hot Stop Fault Clear	Hot Stop Fault Clear
21	Common	Common
22	Step Trigger	Step Trigger
23	Step Trigger	Blend Mode
24	Hot Ext Flt	Hot Ext Flt
25	Common	Common
26	Step Trigger	Profile Enable
27	Step Trigger	Run Sequence
28	Step Trigger	Position Hold
29	Common	Common
30	Enable	Enable

When mode 31 is selected, the *Step Value* parameters have a range of 0-5. Mode 32 allows speed profiling to be accomplished through digital inputs. The *position hold* and *blend mode* bits will show up in the status word (P236) only when active (ie; if the hold input is true and the profiling has reached the end of a step).

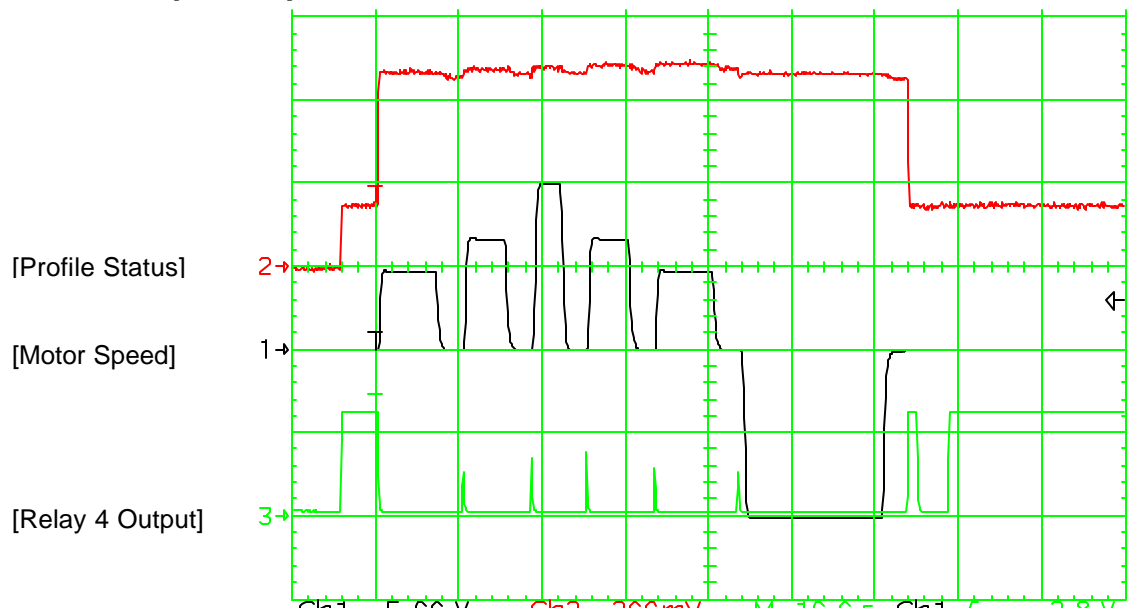
Tuning the Gain

The acceleration and deceleration ramps programmed into the drive will be followed by the speed profile block. The [Error Trim Gain] parameter must then be adjusted to meet the desired performance. In the example below, three different settings of gain show how they affect overshoot of a step. The accel/decel rate was set to 0.1 seconds. Each machine will have unique characteristics that will require different values for gain. The system inertia will have the greatest affect on how critically damped the profile steps can be tuned.

Speed vs. Time



Encoder Step Example



[Profile Enable] xxxx0011
 [Error Trim Gain] 3.2

[End Action Sel] 4 (Encoder Home)
 [End Action Speed] -1786 RPM

[Step 1 Speed] +860 RPM
 [Step 1 Value] +100 unit
 [Step 1 Index] Encoder Step

[Step 4 Speed] +1200 RPM
 [Step 4 Value] +100 unit
 [Step 4 Index] Encoder Step

[Step 2 Speed] +1200 RPM
 [Step 2 Value] +100 unit
 [Step 2 Index] Encoder Step

[Step 5 Speed] +860 RPM
 [Step 5 Value] +100 unit
 [Step 5 Index] Encoder Step

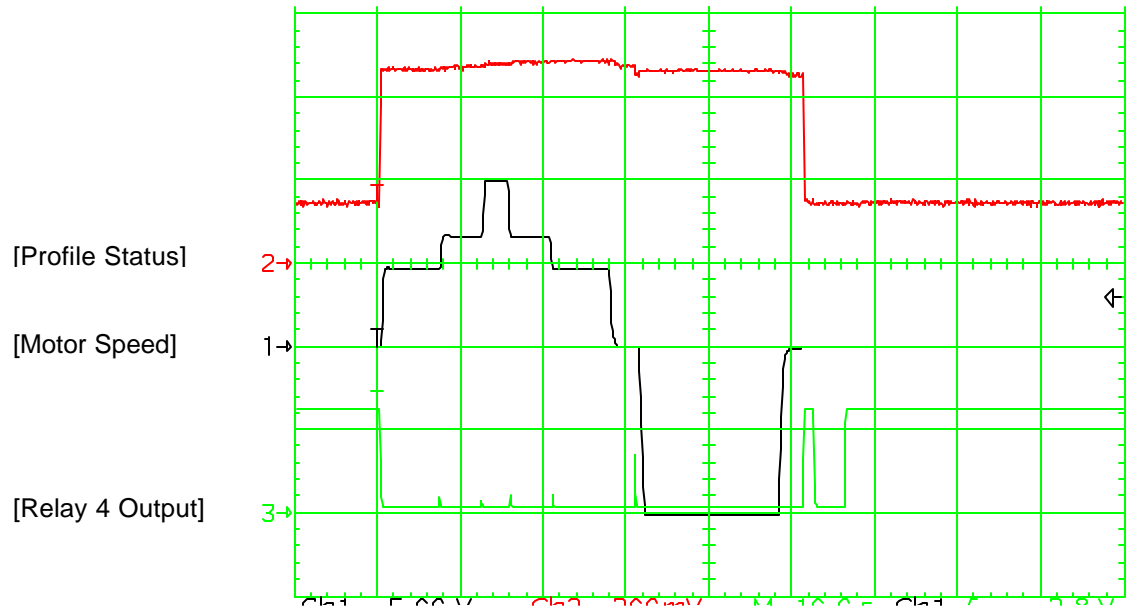
[Step 3 Speed] +1786 RPM
 [Step 3 Value] +100 unit
 [Step 3 Index] Encoder Step

[Step 6 Speed] +0 RPM
 [Step 6 Value] 0.0 none
 [Step 6 Index] Step NotUsed

Notice that each step is a precise movement and the control brings the motor to zero speed at the end of each step. When the step is within the tolerance value, the relay output activates. Once the next step is initiated, the relay opens (out of tolerance).

The [Profile Status] value changes with each step. The initial value and end value are identical because the step value and the run sequence value are zeroed on an end action of encoder home.

Blended Encoder Step Example



[Profile Enable] xxxx1011
 [Error Trim Gain] 3.2

[End Action Sel] 4 (Encoder Home)
 [End Action Speed] -1786 RPM

[Step 1 Speed] +860 RPM
 [Step 1 Value] +100 unit
 [Step 1 Index] Encoder Step

[Step 4 Speed] +1200 RPM
 [Step 4 Value] +100 unit
 [Step 4 Index] Encoder Step

[Step 2 Speed] +1200 RPM
 [Step 2 Value] +100 unit
 [Step 2 Index] Encoder Step

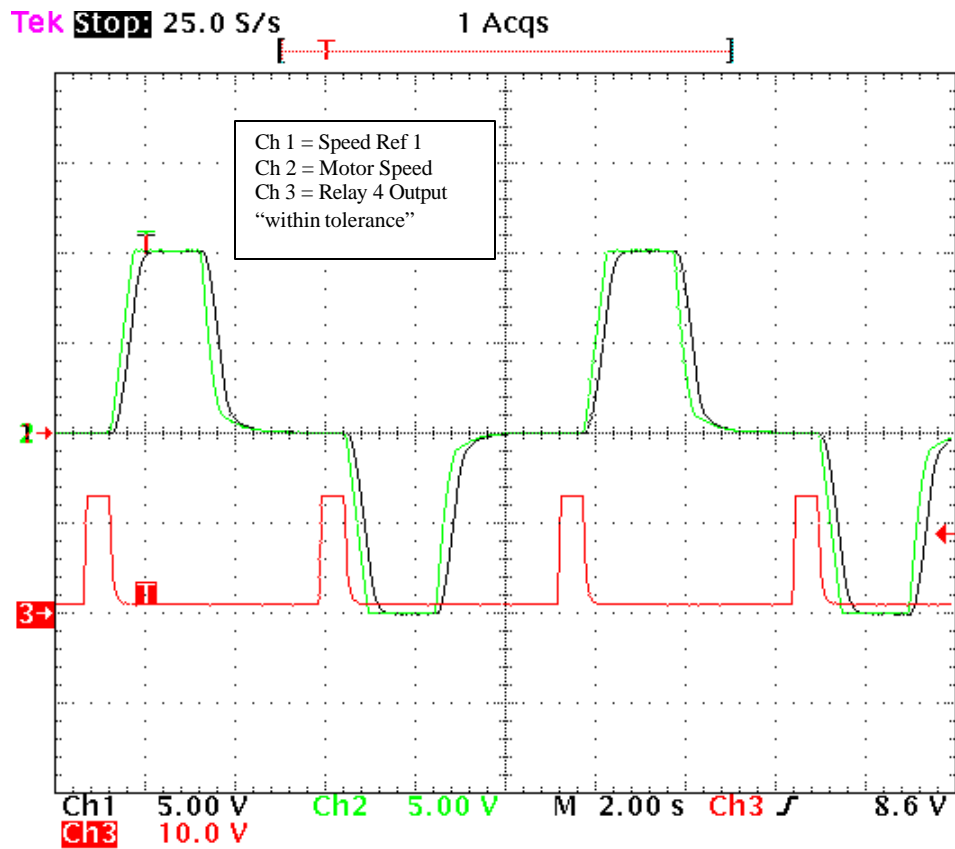
[Step 5 Speed] +860 RPM
 [Step 5 Value] +100 unit
 [Step 5 Index] Encoder Step

[Step 3 Speed] +1786 RPM
 [Step 3 Value] +100 unit
 [Step 3 Index] Encoder Step

[Step 6 Speed] +0 RPM
 [Step 6 Value] 0.0 none
 [Step 6 Index] Step NotUsed

Notice that the steps are “blended” together in this mode. The position accuracy at each step is limited but with an encoder home end action, the starting position is very accurate.

Encoder & Time Step Example:



[Profile Enable] xxxx0011
[Error Trim Gain] 3.2

[End Action Sel] 1 (goto step)
[End Action Speed] 0 RPM (not used)

[Step 1 Speed] +0 RPM
[Step 1 Value] 0.5 sec
[Step 1 Index] 1 (Time Step)

[Step 4 Speed] -1780RPM
[Step 4 Value] +60 unit
[Step 4 Index] 3 (Encoder Step)

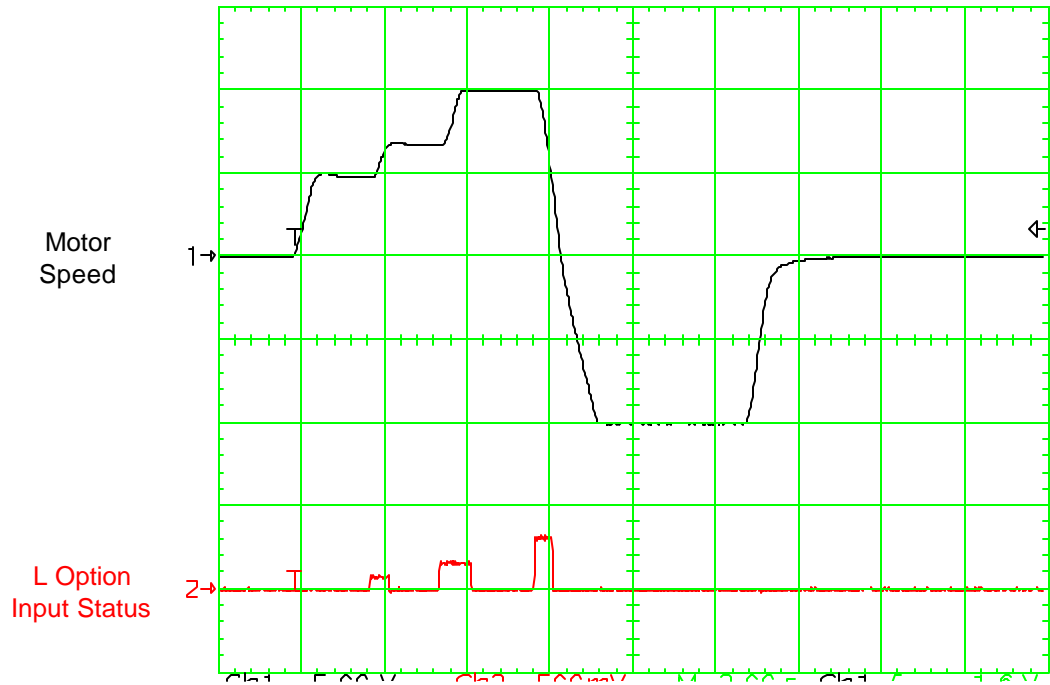
[Step 2 Speed] +1170RPM
[Step 2 Value] +60 unit
[Step 2 Index] 3 (Encoder Step)

[Step 5 Speed] +0RPM
[Step 5 Value] 0.0 unit
[Step 5 Index] 0 (Step NotUsed)

[Step 3 Speed] +0 RPM
[Step 3 Value] 0.5 sec
[Step 3 Index] 1 (Time Step)

The plot above show how the encoder step is ramped into "position" and then the relay output turns on when the motor is within the tolerance programmed in P244. Steps 1 and 3 are *timed steps* at zero rpm and therefore the relay stays on for 0.5 seconds.

TB3 Input Step Example



[Profile Enable] xxxx0011
 [Error Trim Gain] 3.0
 [L Option Mode] 31

[End Action Sel] 4 (Encoder Home)
 [End Action Speed] -1780 RPM

[Step 1 Speed] +860 RPM
 [Step 1 Value] TB3-26
 [Step 1 Index] 2 (TB3 Input Step)

[Step 3 Speed] +1780RPM
 [Step 3 Value] TB3-28
 [Step 3 Index] 2 (TB3 Input Step)

[Step 2 Speed] +1200RPM
 [Step 2 Value] TB3-27
 [Step 2 Index] 2 (TB3 Input Step)

[Step 4 Speed] +0 RPM
 [Step 4 Value] 0 unit
 [Step 4 Index] 0 (Step NotUsed)