



527F CNC

Retrofit controller for machines made by Fadal Machining Centers

Installation and set-up manual

2008-2023 Calmotion LLC ®

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Introduction

This manual is intended to provide a description of the installation steps for the 527F CNC. The 527F CNC has been designed to fit in a like form factor as the IEEE S100 card edge bus used in machines made by Fadal Machining Centers.

The 527F CNC controller cards primarily use the power and ground connections of the S100 bus. The data bus connections are not connected. The connections to the amplifier control, motor feedback,.. have been placed as closely to the same location as possible to the existing connections in order to minimize the disturbance of the original wiring.

Communication takes place with a daisy chained high speed bus on the front of the cards. Industry standard CAT5 cables are used to connect each card for communication to the CNC master.

The 527F CNC is a multiprocessor embedded control and many of the processors communicate over high speed CAT5 connections. The cables provided with the 527F CNC are color coded by function in order to more easily identify the purpose of the cables.

Main CNC / Axis cards – Blue

Video – Yellow

Ethernet – Orange

The connectors on the CNC are covered with colored plastic covers to identify the functions of each connector.

Requirements

The installer should have basic skills working with a voltmeter. Please review the instruction manual thoroughly before beginning installation.

The installer should verify that proper space and clearance has been taken into account prior to drilling holes in the CNC pendant. This includes cable bending radius and cable length.

All work while installing the 527F must be done with the power disconnected to the machine.

The 527F CNC requires a super VGA (800 x 600) capable monitor in order to view all of the screen data. Many of the original LCD monitors installed in the machines were preset to standard VGA (640 x 480) specifications. Some of these monitors are not multi-sync capable and require that the setting of the monitor resolution be changed to SVGA. An

external button board, p/n PCB-0270 or equivalent, may be required to change the VGA input type to the monitor.

Composite video monitors will need to be replaced. These are identified with a green screen and coaxial cable connection. There are a number of vendors who supply VGA monitors that fit in the same form factor as the composite video monitors and can supply a replacement monitor that will meet the SVGA specification.

The 527F uses a stand-alone video board that is typically installed in the control cabinet that contains the S100 card cage. The video board has an HDMI output and is supplied with DIN rail clips and din rail to be secured in the control cabinet at the rear of the machine. The installer should consider the path to route an HDMI cable that must be run from the control cabinet to the front pendant.

USB

A panel mount USB connector is typically installed at the pendant for ease of use for the operator. A 14 foot USB cable is provided with the 527F and should be routed at the same time as the video Ethernet CAT5 cable.

Ethernet

The 527F has powerful Ethernet capability and the installer should consider connection to a local network prior to installation. A panel mount CAT5 plug is provided with the 527F kit. When installed, a wired or wireless access point can be added in order for the 527F to be added to a network.

Although not required, the Ethernet connection provides the fastest way to transfer programs to the CNC memory and allows an operator to pull files from server locations on the network. Optional email capability of the 527F requires an Ethernet connection to the facility network. Updates to the CNC are done with the Ethernet connection.

Installation steps

Prior to removing any of the original control cards

1. Record all SETP parameters.
2. Record all BL settings.
3. For AC machines, record the ZERO offset for each axis. Record surveys.
4. A photo of the controller cards in card cage can be helpful should the need arise to replace them back into the S100 card cage.

Removal of existing controller cards

1. Power off the machine. Push the emergency stop button in.
2. Remove all of the cards in the 1060 card cage, except for the 1550 chiller and the 1040 mill interface. Place tape on the cards as they are removed and record which slot in which they were previously located. In the case of DC machines, the clock card located in slot 15, must be left in place.

Installation of 527F controller cards

1. Secure the DIN rail provided inside the control cabinet for the video card. It may be easiest to remove the machine screw for the upper latch of the control cabinet and use it to secure the DIN rail. The video card is supplied with power wires that must be connected to the 5 volt connection of the CNC power supply. The yellow CAT5 cable used for video must be connected from the video board to the 527F S100 interface card that resides in slot 8. The connections have yellow covers to identify the video connections.
2. Run the black USB cable from the control cabinet to the front pendant. Install the panel mount USB connector in the front pendant. This should preferably be on the bottom so that the USB flash drive is not sticking out the side where it can be more easily broken off. Connect the USB cable to the panel mount plug.
3. Install the panel mount Ethernet connector in the rear electrical cabinet. Be sure to check orientation of the connector. Plug the orange CAT5 cable into the Ethernet connector on inside of cabinet.
4. The facility network cable plugs into the external side.
5. Insert the S100 interface card into slot 8
6. Insert the axis cards into the appropriate slots as indicated below. Ensure that the dip switch settings match the location of the slot.

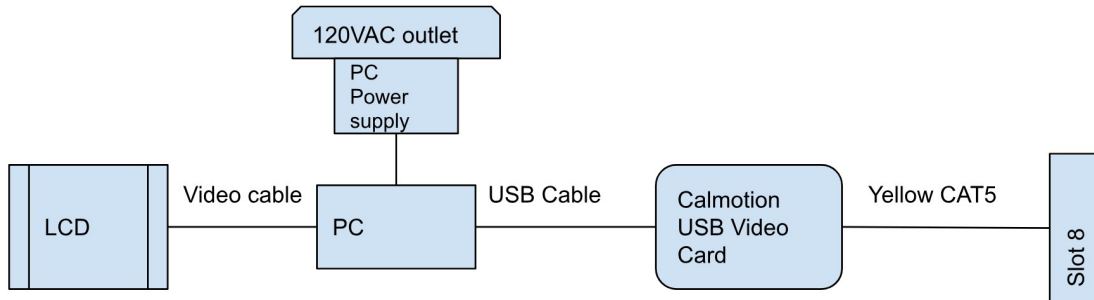
X Axis slot 9 is directly above J1
Y Axis slot 10 is directly above J2
Z Axis slot 11 is directly above J3
B Axis slot 12 is directly above J4
A Axis slot 13 is directly above J5
C Axis slot 14 is directly above J6

Note: A direction jumper located on each of the axis cards is typically not used. The direction jumper is used to change the rotation of the motor when going in the positive direction. This is used in linear axis applications if the motor is mounted on the opposite side of the ball screw than is typical.

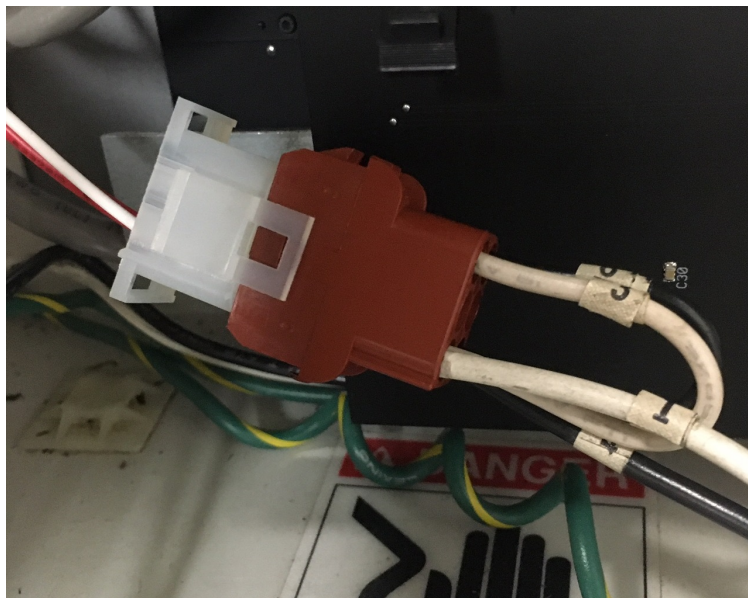
If an axis motor does not run away, but turns in the opposite direction than desired, place a jumper on the axis card and reverse the analog signal wires (AC only)

7. Connect the blue CAT5 cables across the front of the axis cards and the S100 interface board ending with the spindle card. These connections are daisy chained and end with the spindle card. The spindle card must be the last connection.
8. The orange CAT5 cable plugs into the S100 interface daughter board
9. Connect the USB cable into the S100 interface daughter board
10. Connect the feed rate pot cable into S100 interface board. If the 1020 card is being used for a DC machine, the feed rate pot cable must be connected to the S100 interface board. Do not leave the 3 pin Feed Pot cable attached to the 1020 card it must be moved to the 527F card in slot 8.

527F PC Video Installation



1. Disconnect power from the machine tool.
2. Mount the support tray for the keyboard and mouse to the bottom of the pendant and secure with the provided hardware.



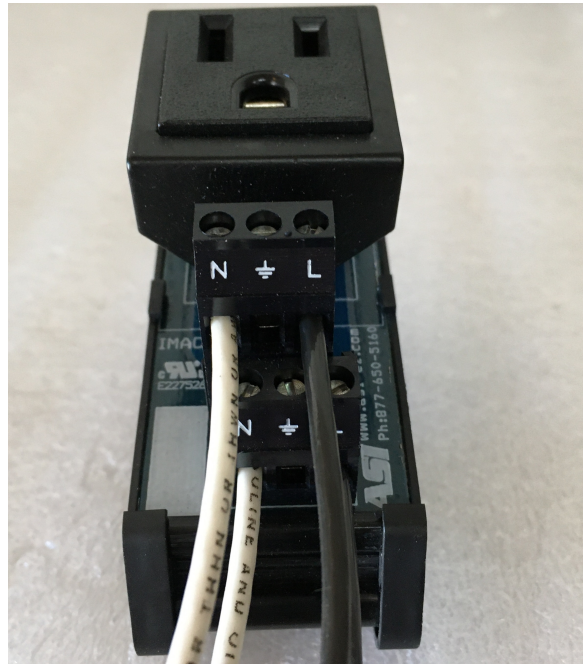
3. Disconnect the Molex power plug for the monitor as shown above.

4. Some models have a tray used to support the weight of the CRT. If installed in the pendant, it can act as a shelf for the customer supplied NUC computer. Not all pendants will have the tray.



5. Locate the harness assembly used to power the monitor for the CNC. A typical assembly is shown above. They can be identified as having large Molex connector with one end connected to the monitor and the other end with a 115VAC source from the control cabinet.
6. The din rail receptacle should now be mounted. Remove one of the nuts securing the pendant handle. Slide the din rail over the exposed screw and secure with the nut.
7. Ensure that there is enough length to reach the receptacle AND for the Molex plug to reach the monitor prior to cutting the wire. Snap the receptacle into the DIN rail and find an appropriate place in the power cable to cut. The black wires should be connected to the L terminal block of the receptacle and the white wires should be connected to the N terminal block as shown above. Snap the receptacle into the DIN rail. The power supply for the NUC computer may have a ground plug. If so, connect a ground wire on the DIN outlet to the sheet metal of the pendant box. It is good practice to connect a ground in either case in the event the power plug is used in some other way.

NOTE: The AC power outlet will be fed by the power wires used for the monitor. The 115VAC will be cut and re-connected using the terminal blocks of the DIN rail mount receptacle. The terminal block connectors are a way to splice the power wires back together.



8. Connect the Calmotion USB video dongle to the PC and secure. Connect the yellow CAT5 cable to the video communication port of the 527F CNC in the control cabinet to the USB dongle. The connection will have a yellow tab around the connector for identification purposes. An HDMI or VGA cable should then be connected to the monitor as appropriate. Plug the PC power supply into the power outlet installed in the previous step.

9. With the E-Stop switch pressed in, apply power to the machine. The PC is configured to auto run upon application of machine power. The 527F viewing software will auto boot if the computer has been supplied from Calmotion.



Proper connection of CAT5 cables

SETP Parameters

A	0.0000	0.0000	0	0.000
B	0.0000	0.0000	0	0.000
C	0 RPM			

PAGE 1 OF 3			SPINDLE / FEEDRATE	
FORMAT: 1	BAUD RATE: 110		S 300 T 1	POCKET 1
AXES: X,Y,Z	>TRAVEL: X22 Y16 Z20	PENDANT: BELOW	F 3.00 / F	0.00 150
DEFAULT: G0			COOLANT1 OFF	COOLANT2
DEFAULT: G90				
DEFAULT: G17	TOOL CHANGER CAP: 21	IMM. FIXED CYCLE: YES		
RPM FACTOR: 1	SPINDLE TYPE: 10000	ORIENTATION FACTR: 1		
ENTER X, Y, Z TRAVEL			TOOLS	
>1) X22 Y16 Z20 10) X22 Y16 Z28 19) X30 Y20 Z32 2) X20 Y12 Z20 11) X20 Y16 Z20 20) X20 Y20 Z24 3) X45 Y25 Z24 12) X20 Y16 Z28 21) X20 Y20 Z32 4) X45 Y25 Z32 13) X30 Y16 Z20 22) X65 Y35 Z34 5) X22 Y13 Z20 14) X30 Y16 Z28 23) X30 Y14 Z14 6) X20 Y13 Z20 15) X50 Y20 Z20 7) X40 Y20 Z20 16) X50 Y20 Z28 8) X40 Y20 Z28 17) X80 Y30 Z30 9) X60 Y30 Z30 18) X30 Y20 Z24			H0 = 0 D0 = 0 E0X0Y0Z0	
P-PAGE ENTER-RT BACKSP-LT U-UP D-DN MAN-EXIT OR SELECT NUM.			Active G / M Codes	
			G0 G2 G17 G20/G70 G9	
			G9 G40 G80 G98	
			M9 M0 OPT STP	
			FORMAT 1	
			LAST 00:00:00	RUN 00:00:

Illustration 1: Page 1 of the SETP menu

Illustration 2: Page 1 of the SETP menu

Restore settings

Press the emergency stop button in prior to applying power.

At the ENTER NEXT COMMAND prompt, type SETP to enter the machine parameters. Restore the settings from legacy CNC. Most of the settings are the same as the legacy CNC, however, there are a few additions to the 527F CNC that require special attention:

FEED RATE 100% parameter starting suggested value is 160, this will change the Feed Rate % reading, physically unscrewing and rotating the knob on the shaft might be required for best results.

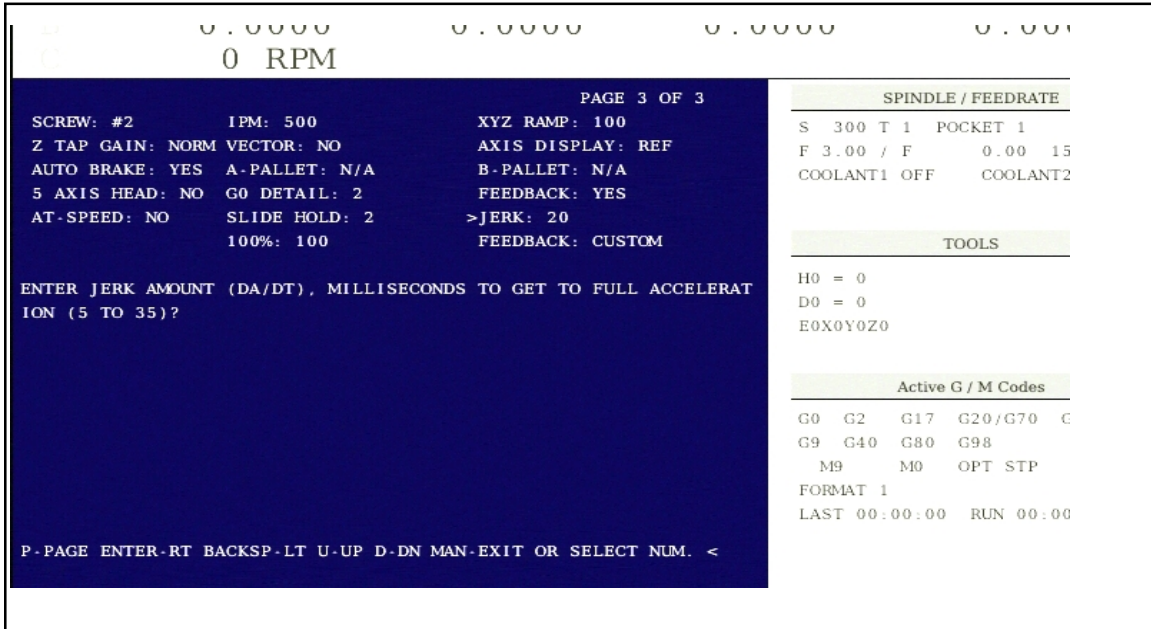


Illustration 3: Page 3 of the SETP menu

XYZ RAMP – Use a suggested value of 100 or lower to control the crispness of movement. The acceleration used by the CNC is dependent on the machine size selected on page 1 of the menu. The XYZ Ramp allows the user to adjust this ramp. The value in this parameter has no units and is normalized to 100.

JERK Parameter- Use a suggested value of 5 to control the initial ramp of the acceleration. Rapid changes in acceleration can lead to unwanted performance, machine bumping, uneven cuts. A JERK parameter has been added to change the rate of acceleration that will be allowed. A larger value will create longer acceleration ramps while smaller values will allow the machine to reach its acceleration more quickly. This value establishes the number of milliseconds it takes to reach the require acceleration from one acceleration value to another.

100% - Use a starting suggested value is 160. Feed pot calibration is performed by using this setting to adjust the analog value input to the CNC to match the desired position of the potentiometer. Set the potentiometer to 100% and observe the % value of the feed rate potentiometer under the Spindle / Feedrate menu. If the value shown is not 100%, raise or lower the value in this setting until 100% is shown. Note, that the knob can be loosened and physically moved to a achieve the best position on the potentiometer shaft.

FEEDBACK – The 527F control will allow a mix of axis motor feedback types for each axis. The choices for encoder feedback are 5000 and 8192 encoders. If a resolver is used for feedback, set this parameter to 4096. If scales are used enter the letter 'S'. Note that

Calmotion axis cards are different depending on whether encoder or resolver feedback is used.

ORIENTATION FACTOR now has 2 values that can be set differently for each range, or use the same value for each range.

AXES	PROGRAM	DISTANCE TO GO	REFERENCE	MACHINE
X	0.0000	0.0000	0.0000	0.0000
Y	0.0000	0.0000	0.0000	0.0000
Z	0.0000	0.0000	0.0000	0.0000
A	0.0000	0.0000	0.0000	0.0000
B	0.0000	0.0000	0.0000	0.0000
C	0 RPM			

SPINDLE / FEEDRATE
S 300 T 1 POCKET 1
F 3.00 / F 0.00 150%
COOLANT1 OFF COOLANT2 OFF

TOOLS
H0 = 0
D0 = 0
E0X0Y0Z0

Active G / M Codes
G0 G2 G17 G20/G70 G90
G9 G40 G80 G98
M9 M0 OPT STP
FORMAT 1
LAST 00:00:00 RUN 00:00:00


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ENTER NEXT COMMAND IP
EXAMPLE TO CHANGE NETWORK SETTINGS:  IPA,192.168.1.123

CURRENT NETWORK SETTINGS:
IP ADDRESS 192.168.1.99 (USE THE IPA COMMAND TO CHANGE)
IP MASK 255.255.255.0 (USE THE IPM COMMAND TO CHANGE)
IP GATEWAY 192.168.1.1 (USE THE IPG COMMAND TO CHANGE)
IP DNS 0.0.0.0 (USE THE IPD COMMAND TO CHANGE)
IP NTP (USE THE IPN COMMAND TO CHANGE)

ENTER NEXT COMMAND
  
```

Illustration 4: Reference screen and IP command

Setting the IP address of the 527F

The IP address of the CNC is stored on an SD card that is contained on a daughter board mounted on top of the S100 interface board. The current IP address of the CNC can be viewed by typing the IP command at the ENTER NEXT COMMAND prompt. These values can be changed at the CNC or the SD card can be removed with power off and modified on a PC offline. The values are stored in the root directory within a file labeled 527F.INI .

Quick IP setup:

1. At ENTER NEXT COMMAND enter DHCP command to show the addresses of the facilities network the 527F is connected to.
2. Enter a new IP address for the 527F by using the first three numbers of the address the DHCP provided, but pick a larger number for the fourth number. For

example if DHCP showed IP:192.168.1.56, enter the command
IPA,192,168,1,230 to set the address of the 527F to be 192.168.1.230.

3. The mask should typically be set to IPM,255,255,255,0
4. The gateway and the DNS should be set if you would like to use NTP to set the time and date on the 527F
5. Use IPN to set the address of a Network Time Protocol computer that is on the internet. Search for public NTP IP addresses on the internet, there are a lot of free public NTP computers provided by the government or other agencies.

See separate manual on 527F Network Setup for more detailed information for setting up a connection to the facilities Ethernet or WiFi network.

Reference Position

An added main menu item shown in Illustration 4 allows the operator to establish a reference point with multiple offsets

Machine Initialization

1. Push emergency stop button in.
2. Power on machine.
3. Cautiously release the emergency stop button and watch for a run away. If an axis runs away, the direction on the axis card is backwards. Power off the machine and set a jumper on the axis card. The jumper is labeled with silkscreen "Direction".
Restart at step 1
4. Type ZERO at the enter next command prompt. The value of Zero for each should initially be set to a value of 0. The SV command will also show each axis offset amount, but note the SV shows a whole number, for example, in SV an offset of -150 is equivalent to -.0150 inches in the ZERO command. Enter the survey values.

Note: The 527F survey values have the opposite polarity as those used by the CNC88, CNC88HS,... The survey values entered are also 10x greater. CNC88 values should be multiplied by -10 and entered into the 527F.

5. Type BL at the Enter Next Command prompt to enter the backlash values. A value of 0 should initially be used. Note that BL values must be multiplied by 10. The 527F allows finer adjustment than the legacy control and uses units of .00001 inches.
6. Power off machine. Wait for 30 seconds and re-apply power to the machine.
7. Jog each axis to the cold start mark
8. Cold start the machine using the CS command.
9. Jog each axis to the cold start marks.
10. Using the position values on the screen, enter them using the ZERO command for each axis. Example: If the X axis display indicates a value of 0.0012, type ZERO,1,.0012 and press <Enter>. (or use the SV command to enter the zero offset).

Note: If new values are entered using the above steps, use the SETP command and exit from it to re-load these values to the axis card. Repeat the above steps until the cold start marks are lined up with the machine.

Balance Program

The signal gain values of the amplifiers must be tuned higher than those used with the legacy control in order to obtain the best performance from the 527F. Run the 5811 program and adjust the amplifier signal gain value until the suggested value of 150 is reached for DC machines. The AC machine suggested value is 250.

The values for all axis should be the same if the ball screw pitch is equal for all three axis. Some machines have a Z axis pitch different than X and Y which require a different

ratio of following error. The following error for Z should be greater than X and Y by 25% in the following cases.

6030 machines

8030 machines

Machines with a metric ball screw of X, Y 10 mm and Z ball screw of 8 mm

Setting up Rigid tapping Procedure on 527F

The GAIN and RAMP parameters determine the performance of rigid tapping. The the XYZ balance program must be completed prior to rigid tap calibration.

Note: XYZ RAMP, JERK, and Z GAIN have no effect on rigid tapping . The Z GAIN is not used by the 527F.

BEFORE running rigid tapping calibration:

1. Set the XYZ signal gain and amplifier balance with the service program 5811 first.
2. Run the auto tuning on the spindle drive or make sure the RPM for M3 & M4 RPM is the same for each direction by balancing the signal on the spindle drive.
3. In MDI:
 - (a) M49 S1000. M3.
 - (b) Measure the true RPM of the spindle.
 - (c) M49 S1000. M4.
 - (d) Measure the true RPM of the spindle. It must match the M3 RPM.
4. Use the rigid tap gauge SVT-0077, it has 14 threads per inch (0.0714")
5. Use an indicator with a small diameter ball to fit between grooves on the SVT-0077.
6. Establish which direction the pointer rotates when pressing the indicator needle up. The following steps will assume the pointer rotates CW when the needle is pressed up. Pressing the indicator needle down should cause the pointer to rotate CCW.

Rigid Tapping Calibration:

1. Use the service program 6000 to set up the rigid tapping GAIN and RAMP parameters.

2. Use the SETP command to set a default value of 100 for RAMP. The ramp will be finely tuned after the tapping gain is established.
3. Use the SETP command to enter a tapping gain factor.
4. Set the Feed Pot at 100%.
5. Ensure that the indicator needle is not touching the tapping gauge.
6. Start program 6000. Allow the spindle to calibrate. When Z moves down for first cycle, press Single Step. Move the indicator into the tapping gauge. Ensure the indicator needle ball is small enough to fit into the thread of the gauge and the ball of the needle is not touching the wall of gauge.
7. If the tapping gauge is going down (Z-) and indicator pointer is CW (to right of 0), the GAIN is too low. In this case, increase the current GAIN value. Alternatively, if the indicator pointer is CCW (to left of 0), the GAIN is too high. Decrease the current GAIN value to correct.

Note: The GAIN values should be changed between 5-10.

8. Adjust the RAMP parameter for ideal results across all spindle speeds when the pointer indicates a zero value. ~ +/- .001

Spindle RPM Offset

The spindle RPM offset parameter from the legacy controller has been replaced with 4 new parameters. The legacy value was common for both high and low ranges. The characteristics of high and low are not always related and an improvement was made in the 527F that allows for individual setting values for both ranges.

Four new parameters are available on page 4 of the SETP command.

1. Low range 0 offset
2. Low range high RPM offset
3. High range 0 offset
4. High range high RPM offset

Note the following recommendations when making adjustments to these parameter values.

1. Ensure the spindle % pot is not enabled (M49)
2. Force the range being adjusted during calibration. Use .1 or .2 with the S# to keep the range at the desired condition.

3. Do not use RPM extremes for minimum and maximum RPMs. Keep the spindle RPM in a reasonable range to avoid clipping at high RPMs and lack of power at low RPMs.

Example:

Procedure for a 10,000 RPM mechanical high/low gear machine. The low range maximum speed of 2500 RPM should not be used.

1. Set all four RPM offset parameters to 0.
2. In MDI mode, type <S300.1 M3 M49> . Use the RPM value that is short of 300 and enter it into the LOW RANGE 0 OFFSET found in the SETP page.
3. In MDI mode, type <S2400.1 M3 M49>. Use the RPM value that is short of 2400 and enter it into the LOW RANGE HIGH OFFSET found in the SETP page.
4. In MDI mode, type <S300.2 M3 M49> . Use the RPM value that is short of 300 and enter it into the HIGH RANGE 0 OFFSET found in the SETP page.
5. In MDI mode, type <S9000.2 M3 M49>. Use the RPM value that is short of 9000 and enter it into the HIGH RANGE HIGH OFFSET found in the SETP page.