Skyko Technologies™

Pixie P100™

PID servo controller analog output board with optional hall sensor generator for Fanuc® motors

Pixie P100
Pixie P100-F20
Pixie P100-F25

Pixie P100, Pixie P100-F20, Pixie P100-F25

- For use with brush or brushless servo motors.
- For use with any count encoder.
- Very fast servo loop (10 kHz).
- Tunable PID control parameters.
- Second set of PID control parameters for use when motor is idle for quieter running and less heat generation.
- On-board RS232 serial port for setting up PID parameters.
- High encoder frequency capability (1.5 million quadrature counts per second).
- Precision analog output with jumper selectable ±10v or ±5v range.
- Adjustable position error alert.
- Digital filtering of encoder channels.
- Graphical software for tuning settings and viewing position error graph.
- Screw terminals for all external connections.

Pixie P100-F20 and Pixie P100-F25

- Optional hall state generator for Fanuc® brushless motors.
- Use the P100-F20 with 2000 count encoder Fanuc® motors.
- Use the P100-F25 with 2500 count encoder Fanuc® motor.
- Can still use any count encoder when not using the optional hall state generator.

™

Board description

CAUTION: The Pixie P100(-F2x) is an electrostatic sensitive device. Handle with care.

Pixie P100, P100-F20, P100-F25

The Skyko Technologies Pixie series of servo controller analog output boards provide an interface between a host generating step/direction control signals and a motor amplifier using analog voltage reference control inputs.

These boards use quadrature signals from the motor's encoder to precisely track and control the motor shaft position based on incoming step and direction signals.

They implement a full proportional, integral, derivative (PID) loop at high speed to minimize overshoot while providing a stiff response of the motor shaft to commanded position.

The terms of this PID control loop and other parameters are fully adjustable via a serial RS232 interface to a host computer running any terminal program.

Skyko Technologies provides PixieCom – a free PC terminal program that runs on Windows® (minimum requirement Windows® 95) to make the adjustment of the PID terms easier by providing a tuning graph of position error over time over various test conditions.

Pixie P100-F20, P100-F25

The Pixie P100-F20 and Pixie P100-F25 have all of the pins and features of the P100 board with the additional ability to generate hall sensor outputs from the signals on certain Fanuc AC brushless motor encoders. The P100-F20 has been tested with the Fanuc pulse coder model A860-0315-T101 2000P which is connected to a Fanuc A06B-0512-B504 AC brushless "red cap" motor; it may work with other 2000 line Fanuc encoders but they have not been tested.

These boards take the B1, B2, B4, B8 and Z signals from the Fanuc encoder and generate a starting hall state commutation sequence for use by a brushless motor amplifier. Once the first index (Z) position is read, the hall commutation is generated from the motor shaft position determined from the Channel A and Channel B quadrature encoder signals.

Additional components

Power supply

The Pixie requires a regulated power supply capable of providing +5v DC, +12v DC and -12v DC.

The +5v DC voltage is also used by the encoder mounted to the user's motor and the current draw of this encoder should be added to the +5v DC current draw of the Pixie logic when sizing a power supply.

The +12v DC and -12v DC are only used for the analog output amplifier and have low (under 1mA in most situations) current requirements. Some motor amplifiers provide +10v DC and -10v DC outputs at a few milliamps. It is possible to power the analog section of the Pixie from these outputs with a few adjustments: set jumper J10 on the Pixie for ±5v range (see *Jumper functions*), then adjust the input reference gain on the motor amplifier to allow the reduced analog output of the Pixie to command the same torque from the motor/amplifier. In most situations, however, it is easier to use an independent power supply for ±12v. Consult the motor amplifier datasheet for more information.

It is possible to use one appropriately sized power supply to power multiple Pixie boards in a three or four axis CNC system.

Motor

The Pixie can work with either a brush or brushless servo motor provided it is accompanied by an appropriate motor amplifier. Although the Pixie P100-F2x adds the capability for controlling certain brushless Fanuc® motors, it can also be used without the extra Fanuc® signals exactly as the normal Pixie P100.

Encoders

The Pixie requires two channel inputs from a quadrature encoder. Common encoders such as the HEDS9000 or HEDS9100 are powered from +5v DC and generate single ended output phases – channel A and channel B. Some encoders generate differential signals, i.e. channel $\overline{A}$ and channel $\overline{B}$; in this case, channel $\overline{A}$ and channel $\overline{B}$ are not used and can be left unconnected.

The Pixie implements a digital noise filter on these encoder channels inputs to remove higher frequency noise spikes, and they are passed through a Schmitt trigger buffer for sharp rising and falling edges.

The Z (index) encoder channel (if available) is only used on the Pixie P100-F2x and is also digitally filtered and buffered.

Motor amplifier

The Pixie can work with either brush or brushless amplifiers as long as the amplifier accepts analog inputs (Ref ±) and can operate in current (torque) mode. The Pixie P100 (-F2x) has a jumper selectable analog output range of ±10v or ±5v which is compatible with many commercial motor amplifiers.

The Pixie takes feedback from the motor in the form of quadrature encoder signals A and B.

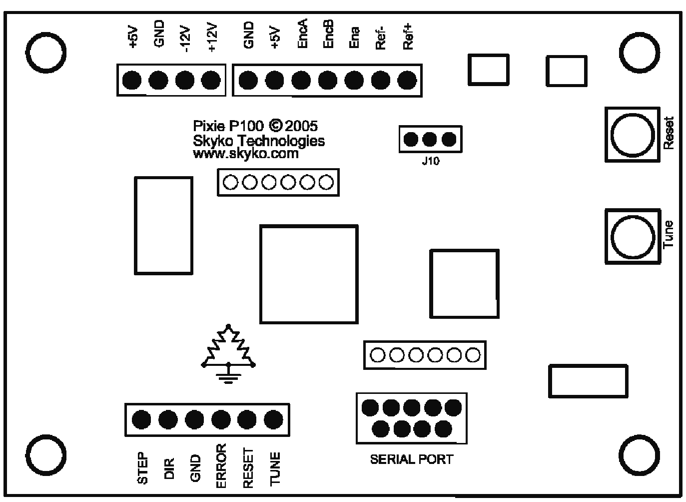
Although not needed by the Pixie, if the motor is brushless, it will need to send commutation information (usually referred to as hall sensors) to the brushless amplifier, so the amplifier can determine the sequence and timing of the brushless motor coils.

Consult the datasheet of the motor amplifier to determine if it is compatible – maximum voltage and current, brush or brushless – with the intended motor.

Additional information for brushless motors and amplifiers

The Pixie can interface with brushless amplifiers that have analog control inputs. These brushless amplifiers require commutation signals from motor, usually denoted as Hall 1, Hall 2 and Hall 3. Some brushless amplifiers may also require the quadrature encoder signals for commutation; if so, these signals need to also be connected to the Pixie (see *Pin functions* and *Wiring*).

Pixie P100 board layout

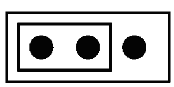
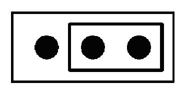


Button functions of the Pixie P100(-F2x)

Since the Pixie board may be installed inside a case, the on-board buttons may be inaccessible; therefore, each button function also has a signal line that can be brought out to a control panel button. See *Pin Functions*.

Button	Description
Tune	Places the Pixie in tuning mode which allows RS232 communications between the Pixie and a host terminal or the PixieCom graphical tuning software. See *Configuring parameters*.
Reset	Resets the Pixie from a fault state, or exits from the tuning mode.

Jumper functions of the Pixie P100(-F2x)

Jumper	Description
J10 Reference voltage selection	Selects the Ref ± output voltage range. With no jumper installed (or the jumper installed between pins 2 and 3), the Ref ± output voltage range is -10v to +10v. With the jumper installed between pins 1 and 2 (the pins farthest from the Reset button), the Ref ± output voltage range is -5v to +5v.  J10 ±5 volts  J10 ±10 volts

Pin functions of the Pixie P100(-F2x)

Pin	Description	Connection
Power		
+5v	Logic power supply.	Power supply for Pixie
Gnd[(1)]	Power supply return (ground).	Power supply for Pixie
-12v	Analog negative power supply.	Power supply for Pixie
+12v	Analog positive power supply.	
Motor encoder / Motor amplifier		

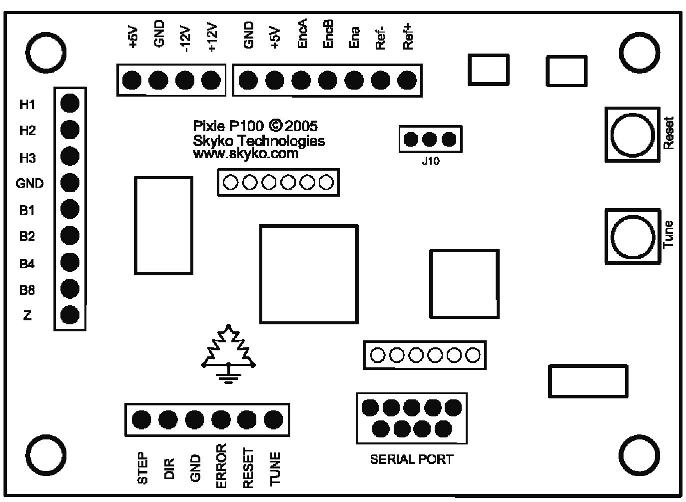
Gnd(1)	Encoder/amplifier return (ground).	Motor encoder and motor amplifier
+5v	Encoder power supply.	Motor encoder
EncA (Channel A)	Input. Quadrature encoder channel (phase) A(3), 5v maximum.	Motor encoder
EncB (Channel B)	Input. Quadrature encoder channel (phase) B(3), 5v maximum.	Motor encoder
Ena (Enable)	Output. Active low or high(5). Enable output.	Motor amplifier
Ref- (Reference-)	Output. Analog control voltage.	Motor amplifier
Ref+ (Reference+)	Output. Analog control voltage.	Motor amplifier
Host / Panel		
Step	Input. Active low or high(2). Step signal from computer/user.	Host computer
Dir	Input. Direction signal from computer/user.	Host computer
Gnd(1)	Computer/user power supply return (ground).	Host computer
Error	Input and Output. Active low. Internally pulled up to 5v. This line goes low when position error is greater than the maximum setting (fault). In addition, pulling this pin low externally will trigger a fault(2). Typically, this line is tied to the Error lines of all other Pixie boards with one line routed back to the computer/user.	Host computer
Reset(4)	Input. Active low. Equivalent to the on-board Reset button but allows for remote invocation. See *Button functions*.	External panel
Tune(4)	Input. Active low. Equivalent to the on-board Tune button but allows for remote invocation. See *Button functions*.	External panel
Serial port (5)(6)		
Serial Port: Pin 2 Rx (from host)	Output. RS232 level receive line.	Host computer

Serial Port: Pin 3 Tx (to host)	Input. RS232 level transmit line.	Host computer
Serial Port: Pin 5 Gnd[(1)]	RS232 return (ground).	Host computer

Notes:
1. All of the ground pins on the Pixie are electrically connected and can be used interchangeably.
2. See Configuring parameters to set up the pin functionality.
3. For differential output encoders, leave $\overline{A}$ and $\overline{B}$ unconnected.
4. If external switches are used for Reset and/or Tune, a ground line must also be run to the switches.
5. Serial port pin 4 is connected to pin 6, and pin 7 is connected to pin 8 to simulate hardware handshaking if necessary. Pin 9 of the serial port is not used by the Pixie.
6. The serial port can be connected to a different host than that which is supplying step and direction. It only needs to be connected while tuning the motor or setting other parameters.

Pixie P100-F2x board layout

All of the jumpers and pins as described in the above *Pixie P100 board layout* section are also applicable.



Additional pin functions of the Pixie P100-F2x

Pin	Description	Connection
H1	Hall sensor 1 output generated from B1-B8 or from motor shaft position.	Motor amplifier

H2	Hall sensor 2 output generated from B1-B8 or from motor shaft position.	Motor amplifier
H3	Hall sensor 3 output generated from B1-B8 or from motor shaft position.	Motor amplifier
Gnd	Hall sensor return (ground).	Motor amplifier
B1	Signal from Fanuc encoder.	Motor encoder
B2	Signal from Fanuc encoder.	Motor encoder
B4	Signal from Fanuc encoder.	Motor encoder
B8	Signal from Fanuc encoder.	Motor encoder
Z	Index channel from Fanuc encoder.	Motor encoder

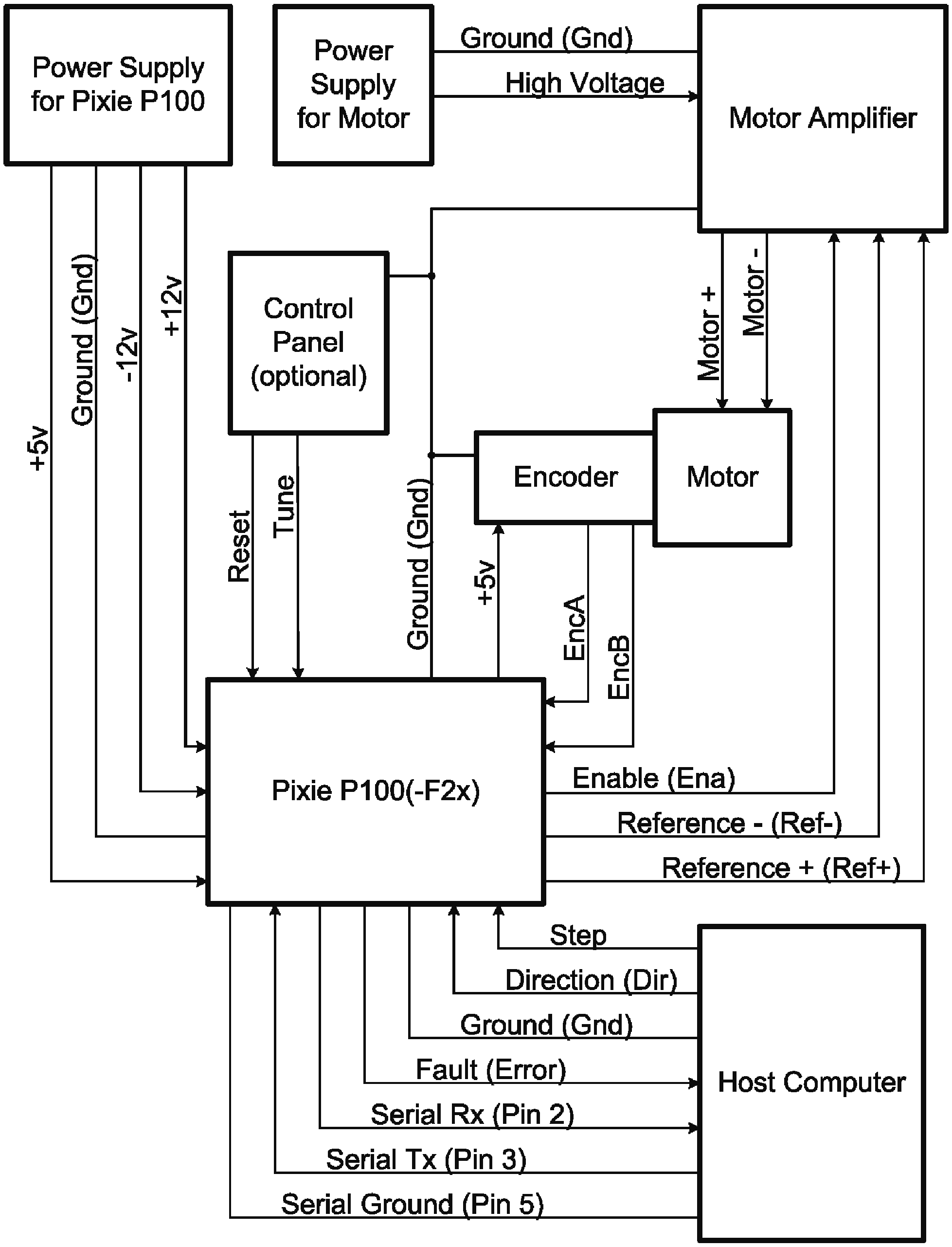
Wiring diagrams

The following wiring diagrams are intended to give the user an overview of the connections and components required in typical servo system setups. For any particular application, it is strongly recommended that the user consult the datasheets and manuals of each component in the servo system to determine the correct connection information.

Both brush and brushless motors operate at high speeds, and large voltages and currents can be present in the motor wires and motor amplifier power supply cables. The digital signals MUST be shielded from this electrical noise, and the shield should be properly grounded. The encoder signals (including the hall sensor outputs on brushless motors) should be shielded with the shield connected to earth ground in most situations. The control signals from the host (step, direction, error, reset, tune) should also be shielded with the shield connected to the Pixie ground in most situations. Unshielded control lines may result in erratic motor behavior including unintended movement of the motor shaft.

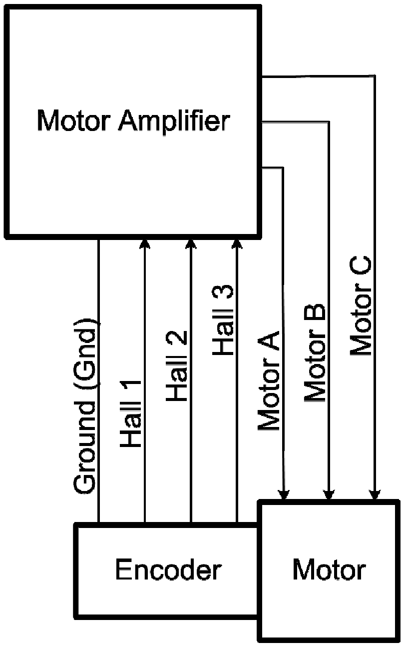
The Pixie includes an error/fault line that acts as both an input and an output. Inside the Pixie, this line is pulled high to +5v through a 5kΩ resistor. If the Pixie encounters a position error large than the maximum allowed (see *Parameters*), the Pixie will drive this line low (pull it to ground). Alternatively, if this line is pulled low externally, the Pixie will register an error/fault. This means that the error/fault line from multiple Pixie units can be tied together and routed back to the control host. A fault by any one of the Pixie units will cause all of the units to fault and signal this condition to the control host. How the Pixie handles an error/fault situation is configurable (see *Parameters*).

Brush motor wiring diagram



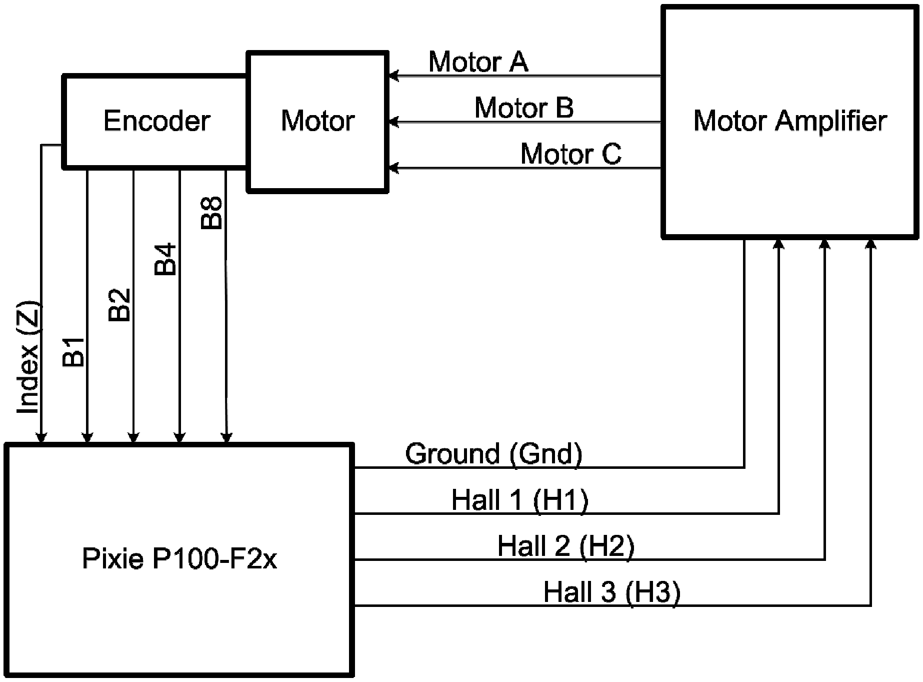
Additional wiring for brushless motor

Includes all of the connections of the brush motor wiring diagram except the Motor+ and Motor- connections. On some systems, Motor A, Motor B and Motor C are referred to as Motor U, Motor V and Motor W.

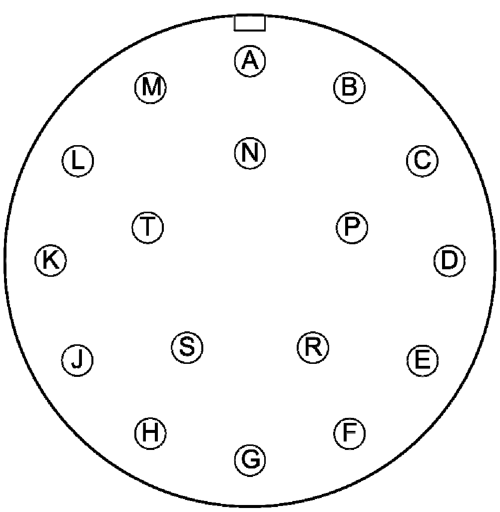


Additional wiring for brushless Fanuc® motor with Pixie P100-F2x

Includes all of the connections of the brush motor wiring diagram except the Motor+ and Motor- connections. On some systems, Motor A, Motor B and Motor C are referred to as Motor U, Motor V and Motor W.



Pin out for the Fanuc A860-0315-T101 2000P encoder



A	Channel A	**K**	+5v
B	Channel B	**L**	Bit 4 (B4)
C	Bit 1 (B1)	**M**	Bit 8 (B8)
D	Channel $\overline{A}$	**N**	Ground (Gnd)
E	Channel $\overline{B}$	**P**	Bit 2 (B2)
F	Z (Index)	**R**	No connect
G	$\overline{Z}$	**S**	No connect
H	Shield	**T**	Ground (Gnd)
J	+5v		

PID control loop and Tuning

The Pixie implements a Proportional, Integral, Derivative (PID) control loop using position feedback from the motor shaft in the form of quadrature encoder signals (denoted by channel A and channel B). Each time through the loop, the Pixie calculates analog reference voltages to control the speed and direction of the motor to bring the current actual position of the motor shaft to the desired position (usually commanded by a control host through the step and direction signal lines). It does this calculation 10,000 times per second to achieve and maintain the desired position through a changing load.

How it does this – speed of response, overshoot, and stiffness – is controlled by the values assigned to the constants K_P, K_I and K_D for the proportional, integral and derivative terms respectively (see the formula below). These parameters are settable via the RS232 port on the Pixie (see *Parameters*).

$$\text{output} = (K_P \times \text{error}) + ((K_I \times \text{total\_error}) / 1024) + (K_D \times \text{delta\_error})$$

where

K_P = the proportional constant
K_I = the integral constant
K_D = the derivative constant
error = the difference between the desired position and the current position
total_error = the total accumulated error
delta_error = the difference the current error and the error the last time through the loop

Note: output may be further modified by the minimum and maximum output values (see *Parameters*).

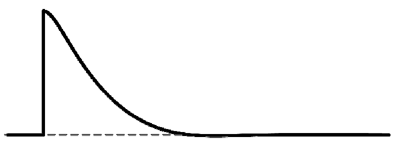
The proportional, or P, term (sometimes referred to as gain) determines how quickly the motor shaft position changes in response to a change in the desired position. A larger value of K_D will result in a larger kick given to the motor shaft (in the form of a larger current).

When the value of K_P is increased, the value of the derivative, or D, term also needs to be increased to provide damping. Without increasing K_D, the kick given the motor by the P term will cause it to overshoot the desired position. This can result in violent oscillations in the extreme case, so K_P and K_D should be increased slowly and together. Too large a value of K_P can result in excessive motor noise and heating. Too small a value of K_P can result in a sluggish response.

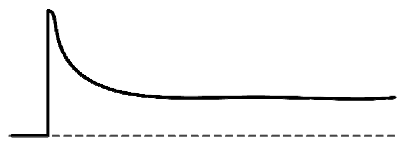
The integral, or I, term determines how quickly the motor shaft settles to the desired position and maintains the desired position in the steady state. The K_I value should start small and be increased slowly until the user is satisfied with the motor response.

The graph of position error over time that is provided in the PixieCom software when doing an Impulse test (see *Running tuning tests*) will aid in determining the correct values for the K_P, K_I and K_D constants.

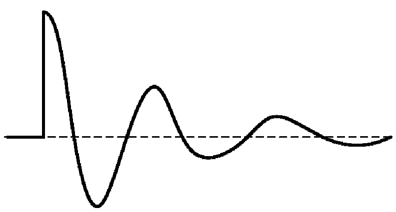
K_P too small.



K_I too small.



K_D too small.



Correct K_P, K_I and K_D.

The Pixie includes the capability of using a second set of K_P, K_I and K_D values when in idle mode. When the commanded position has not changed for a defined length of time (i.e., no steps from the control host), and the position error is less than a defined threshold, the Pixie will switch the PID control loop to use the second set of values. This allows the user to develop a servo system that has high stiffness and quick response (with the associated higher motor noise and heating) but that can idle back to a quieter and cooler mode when the motor is not being commanded to move. If this mode is not required, set the second set of values the same as the first or set the idle mode exit error threshold to zero.

Parameters

The following parameters are settable using the RS232 serial port on the Pixie connected to a host running a terminal program or running the PixieCom program. See *Configuring parameters* for how to set the values.

	Parameter	Description	Default	Min	Max
0	K_p normal	K_P = Proportional term constant in normal operating mode. See *PID control loop*.	2	0	32767
1	K_d normal	K_D = Derivative term constant in normal operating mode. See *PID control loop*.	100	0	32767

2	K_i normal (* 1024)	K_I = Integral term constant × 1024 in idle operating mode (i.e., Pixie divides this parameter by 1024 after multiplying by the integral). See *PID control loop*.	1	0	32767
3	Maximum error before fault	Maximum following error allowed before triggering a fault.	100	0	2047
4	K_p idle	K_P = Proportional term constant in idle operating mode. See *PID control loop*.	2	0	32767
5	K_d idle	K_D = Derivative term constant in idle operating mode. See *PID control loop*.	100	0	32767
6	K_i idle (* 1024)	K_I = Integral term constant × 1024 in idle operating mode (i.e., Pixie divides this parameter by 1024 after multiplying by the integral). See *PID control loop*.	1	0	32767
7	Idle mode exit error threshold	Following error threshold that switches idle operating mode to normal operating mode.	0	0	255
8	Still time before idle	Time delay, in seconds, before switching to idle mode (if conditions allow).	0	0	255
9	Minimum output	Minimum value output (when output is non-zero).	0	0	2047
10	Maximum output	Maximum value output.	2047	1	2047
11	Maximum integral	Maximum value of integral term (sum of the errors). See *PID control loop*.	10000	0	32767

12	Step multiplier	Value by which to multiply each incoming step. For control hosts that cannot generate steps quickly and motors that have high encoder counts, in order to get higher speed out of the system, set this parameter above 1. Step frequency × step multiplier cannot exceed maximum encoder frequency.	1	1	10
13	Derivative sampling divisor	Value to reduce the frequency of the derivative calculation. If a high enough value of K_D to properly damp the system causes the motor to hum at low speeds, set this parameter above 1. For example, if set to 2, the derivative will only be recalculated every other time through the PID control loop.	1	1	255
14	Step active high	Whether incoming steps are active high or active low. In many control applications, the step signal generated is normally (on idle) low with the step pulse active high. Set this parameter to false if your control application does the reverse.	true		
15	Enable active high	Whether the motor amplifier has an enable or inhibit line. Set this parameter to true for an enable line (amplifier requires a high signal to be enabled), and set this parameter to false for an inhibit line (amplifier requires a low signal to be enabled).	true		
16	Reverse encoders	Whether or not to reverse encoder signals. If the Encoder A and Encoder B lines are connected backwards, either reconnect them correctly or set this parameter to true. (1)	false		

17	Reverse direction	Whether or not to reverse reference outputs. If the motor moves in the opposite direction from what the Pixie is expecting, set this parameter to true. (1)	false		
18	Fault timeout (0 = stop)	Time, in seconds, to remain in fault on maximum following error or after external fault is cleared. Set this parameter to 0 to stop until the Reset button is pressed.	0	0	255
19	Stop on external fault	Whether or not to put the Pixie in fault when another component of the system is in fault. In most cases, the Error lines from all control boards should be tied together (and sent to the control host), so that if one of them faults, the entire system is stopped.	true		
20	Send results to host	Whether or not to send tuning test results (binary data) to the host. If using PixieCom (or an equivalent host program that does graphical test display), set this parameter to true. If using a simple terminal program, set this parameter to false.	true		
21	Impulse test value	When doing an Impulse test, the value to inject into the system to see how well the PID parameters response.	50	1	1023
22	Running test frequency	When doing a Running test, the frequency of simulated steps.	1000	10	250000

Notes:

1. If, when doing an impulse test (with reasonable PID parameters), the system faults out immediately, the motor is probably spinning opposite of what the Pixie expects. Set either *Reverse encoders* or *Reverse direction* to false. After tuning, when using a control host, if the motor moves opposite of what the host expects, invert both of these parameters (or invert the direction in the control host).

Configuring parameters and Running tuning tests

In order to set the values of the parameters or to run one of the tuning tests, the Pixie needs to be connected to a user controllable host running a terminal program via the RS232 port with a standard (not a null modem) serial cable.

On Windows® systems, PixieCom (available at http://www.skyko.com/downloads) is the easiest terminal program to use as it is already set up for the proper serial communications settings and can graphically display the results of the tuning tests.

Other terminal programs, such as HyperTerminal® can be used (see *Signal characteristics* for information on baud rate, etc.). When using something other than PixieCom, the *Send results to host* parameter should be set to false.

To put the Pixie into tuning mode, press and hold the Tune button. The tuning menu should be displayed on the terminal. If you start the terminal after you have already entered tuning mode on the Pixie, press ENTER in the terminal program to cause the Pixie to resend the menu.

Parameters

The numbered options in the menu allow for various parameters to be modified (see Parameters). Type the number of the parameter to be changed, and press ENTER. The parameter description, the current value and valid range will be shown. Type the new value (true and false can be abbreviated t and f), and press ENTER. To cancel a change, clear the new value with BACKSPACE and press ENTER. The parameter changes will not be permanent until they are written (see below).

Menu options

The Defaults (D) menu option will reset all of the parameters back to factory settings. The reset to the defaults will not be permanent until the parameters are written (see below).

The Write (W) menu option will save the current parameter values. Any time the parameters are dirty (have been changed without writing), a * is displayed next to the Write menu option.

The Undo (U) menu option will revert any changes back to the last written state. Changes can also be undone by resetting the Pixie.

The Save to profile (P) menu option will save the current parameters to a profile (0 – 3). This allows known good parameters to be saved while experimenting, or if the Pixie is to be placed in different systems on occasion, it allows for the parameters of one motor/amplifier to be saved while using another without having to write them down and re-enter them.

The Load from profile (L) menu option will load parameters saved to a profile (0 – 3). The load will not be permanent until the parameters are written (see above).

Tuning tests

When running any of the tuning tests, the second set of PID parameters and the step multiplier are never used. Any of the tests can be aborted by a key press in the terminal program.

The Output constant value (O) menu option prompts for a value to be output to the motor amplifier. This can be useful for determining and centering the dead band (see below).

The Stiffness (S) menu option runs the PID control loop with the current parameters. If the parameters are set up correctly, the motor shaft should be locked into place. Twisting the shaft should give significant resistance (depending on the strength of the motor). If it is very easy to twist the shaft or the shaft does not quickly go back to its original stationary position when released, the K_P parameter is too low. If it settles into a position not exactly at its original stationary position, the K_I parameter is too low.

The Impulse (I) menu option runs the PID control loop, injects a desired position value into the system and lets it settle. The error values over time are stored and sent to the host when the test is complete. The PixieCom program will automatically display a graph of the error versus time (see *PID control loop*). The injected value is a settable parameter.

The Running (R) menu option runs the PID control loop moving the motor shaft at a given step frequency. This test does not guarantee an exact frequency, but it is sufficient to test the motor at various speeds. The error values over time are stored and sent to the host when the test is complete. The PixieCom program will automatically display a graph of the error versus time. There should be only a slight ripple in the error (for brushless motors using amplifiers that implement a trapezoidal excitation, there may be a larger ripple at the commutation cross-over points, but it can be reduced with careful tuning). The step frequency is a settable parameter.

The Continuous (C) menu option runs the PID control loop moving the motor shaft at a given step frequency. It does not capture any data but runs the motor at this speed until aborted. The step frequency is the same settable parameter as the Running test.

The Change direction (Z) menu option switches which direction the motor shaft spins in the Impulse, Running and Continuous tests. If tuning the parameters in an installation (for example, the X-axis of a mill), it is a good idea to occasionally reverse the direction to avoid reaching the mechanical limits of the system.

Minimum output determination and dead band adjustment

Before attempting to tune the system, it is a good idea to ensure that the dead band of the motor/amplifier is properly centered. The dead band is the range of voltage presented to the motor amplifier's Ref± inputs that does not produce enough current to move the motor shaft even under no load. The Pixie allows the user to specify the minimum output value to skip past the dead band when running the PID control loop.

The Pixie also provides a mechanism to determine the dead band and ensure the motor amplifier's offset potentiometer (found on most amplifiers) has correctly centered the dead band at 0v on the reference inputs.

With the system fully connected, run the Output constant value tuning test (see above) with an output of 0 (0v output). If the motor shaft is rotating, adjust the offset potentiometer until the motor shaft stops. Continue to run the Output constant value tuning test with increasingly positive output values until the motor shaft starts rotating, and make a note of this value. Then continue to run the test with increasingly negative output values until the shaft start rotating, and make a note of this value. If the absolute values of the two extremes are not the same, make a small adjustment to the offset potentiometer. Continue this process until the motor shaft starts rotating at close to the same value in both directions. Enter the positive value as the Minimum output parameter (see *Parameters*).

Idle mode PID parameters

Since, when in tuning mode, the Pixie does not take into account the second set of PID parameters (for the idle mode), they need to be tested as the normal parameters, and then their values copied into the corresponding idle ones. If the system is already set up with good normal mode PID parameters, either write them down or store them as a profile (see above). Experiment with much smaller values than you used for the normal PID mode until you have values that are able to maintain the stationary position with small amount of resistive force (use the Stiffness test). Write down those parameters, load the saved profile (or re-enter your normal mode parameters), and enter your idle mode parameters. Be sure to Write the parameters before exiting tuning mode.

Programming flash

If a new version of the firmware is available, the Skyko Technologies web site will have an application used to program the flash via the serial port (PixiePrg) for download along with the data file to be flashed (http://www.skyko.com/downloads).

To put the Pixie into programming mode, press both the Reset and Tune buttons at the same time and hold them until the red LED comes on. Upon releasing the buttons, the LED will rapidly flash green and red. Follow the directions from PixiePrg.

If the programming mode is accidentally entered, simply press the Reset button to return to normal operation (or press and hold the Tune button to go into tuning mode).

Specifications

Electrical

Logic supply voltage	No encoder connected	5v DC	70 mA
Analog positive supply	For ±10v range	12 to 15v DC	1 mA to 20 mA
	For ±5v range	7 to 15v DC	1 mA to 20 mA
Analog negative supply	For ±10v range	-12 to -15v DC	1 mA to 20 mA
	For ±5v range	-7 to -15v DC	1 mA to 20 mA
All inputs	High level voltage	3v to 5.5v	
	Low level voltage	Maximum: 0.9v	
Reference ± output load	Maximum: 1kΩ		
Operating temperature range	0° - 50°C 32° - 122°F		
Operating humidity range	0 to 95% non condensing		

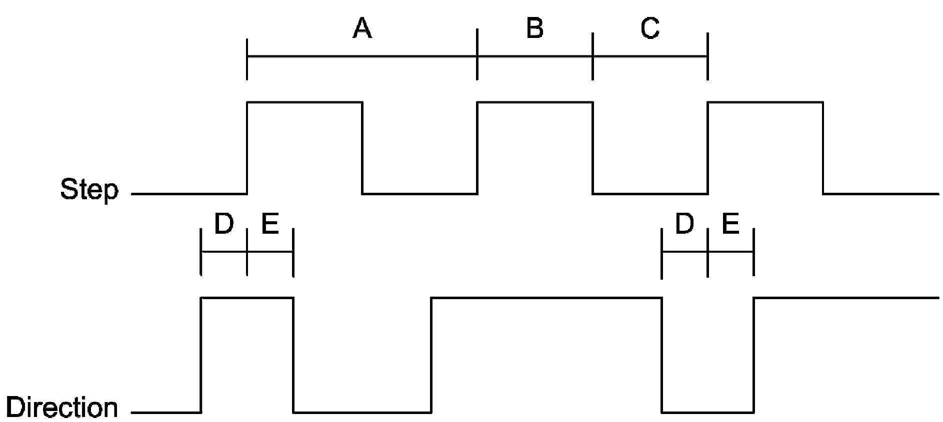
Mechanical

Connections	Screw terminal: AWG28-16 Rated torque: 0.4Nm
Size	3.5”(W) x 3.5”(H) x 0.6”(D) 88.9mm x 63.5mm x 15.2mm
Weight	1.4 oz 41 g
Mounting hole pattern	3.1” x 2.1” 78.7mm x 53.3mm
Mounting hole diameter	0.145” (± 0.005”) 3.68 mm

Signal characteristics[1]

Reference resolution	12 bit (-2047 to 2047)
PID control loop frequency	10 kHz
Maximum encoder rate (in quadrature)	1.5 MHz
Maximum encoder rate (each channel)	375 kHz
Minimum encoder step pulse width	0.5 µSec
Maximum step frequency	300 kHz
Maximum step multiplier × step frequency	1.5 MHz
Minimum step period (A)	3.33 µSec
Minimum step active time (B)	1 µSec
Minimum step inactive time (C)	1 µSec
Minimum direction set up time (D)	0.1 µSec
Minimum direction hold time after step rising edge (E)[2]	0.2 µSec

Notes:
1. Shorter pulse times may be accepted by the Pixie but are not guaranteed. If cabling is not properly shielded, motors can generate noise on signal lines causing extra steps to be read.
2. Example shows step active high, but the Pixie can be configured to accept step active low (see *Parameters*).



Communications with host via RS232

Baud rate	57600
Data bits	8
Stop bits	1
Parity	None
Hardware control	None

Skyko Technologies

Mailing address:
Skyko Technologies
219 Skywall Drive
Sultan, WA 98294

Email address:
Orders: orders@skyko.com
Questions: questions@skyko.com

Web site:
http://www.skyko.com

Ordering and product information:
http://www.skyko.com/ordering
http://www.skyko.com/products

Forum:
http://forum.skyko.com

Limited warranty

The Pixie P100(-F2x) is warranted to be free of manufacturing defects or other faults in materials or workmanship – including damage sustained in transit from Skyko Technologies to the purchaser. Limitations on this warranty are based on the fact that Skyko Technologies has no control over the final delivery of the unit or that it has been correctly installed, mounted and operated in accordance with this documentation. Units that have been used in excess of any absolute maximum parameter, have been incorrectly wired or have been damaged through improper mounting are not covered by this warranty.

If used completely within the ratings, the module is covered by a 6 month repair or replacement warranty provided that it is returned properly packed – intact and unmodified in any way. Skyko Technologies reserves the right to deny warranty claim if it is determined that the fault was caused by improper voltage, tampering of any kind, physical damage (other than damage in transit from Skyko Technologies to the purchaser), short circuit operation or incorrect mounting.

A repair service is available for units that have been damaged, but it is at the discretion of Skyko Technologies as whether to repair an existing unit or replace it completely.

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