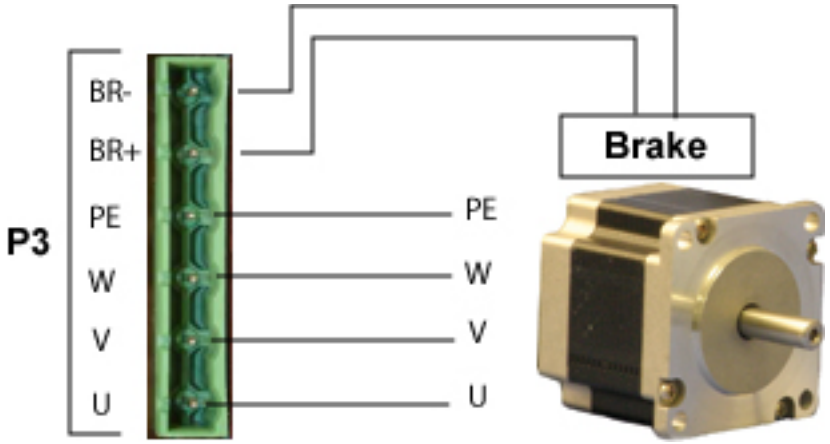
Ruby Installation Manual



Version 02

Table of Contents:

Table of Figures:

Table of Tables:

1 Introduction

This servo drive is designed to meet the simplest and most critical applications. The performance is delivered through a digital signal processor (DSP) and external high resolution A/D's and D/A's. The construction is designed to maintain the lowest level of radiation emission and electrical noise. This servo drive can run brushless servomotors, brush servomotors and voice coil motors. The packaging is a compact bookshelf mounting design with maximum current output capabilities. The design is CE, RoHS and UL 508C compliant.

This design optimizes the packaging keeping it as small as possible but delivering maximum power.
The servo drive operates in torque, velocity or position mode. The position mode has added features such as, electronic gearing and 2^{nd} encoder feedback. The commutation is field-oriented sinusoidal delivering the highest performance of motion control. Feedback devices can be incremental encoder, resolver or sin/cos encoder. The drive outputs a TTL differential signal that can be programmed to different frequencies not to exceed 4 times the resolution of the primary feedback device. The servo drive has a fail-safe brake output with programmable on/off response times. An internal regeneration circuit handles most situations, however when necessary an external regen component can be added and multiple servo drives can be connected together to share regeneration. The servo drive requires a 24 VDC or VAC input for supplying the logic power. This is mandatory for isolating the drive output power from the drive logic power for controlled shut downs.

The servo drive inputs consist of enable, command signal, travel limits (positive and negative) and TTL inputs (pulse/direction, electronic gearing). The servo drive has 2 programmable 16 bit analog outputs. These are typically used for monitoring velocity or torque output, but can also be used for control feedback. There are 2 digital outputs, one for drive ready and one for fault condition. The fault condition can trip a hard relay which can be powered by the servo drive.

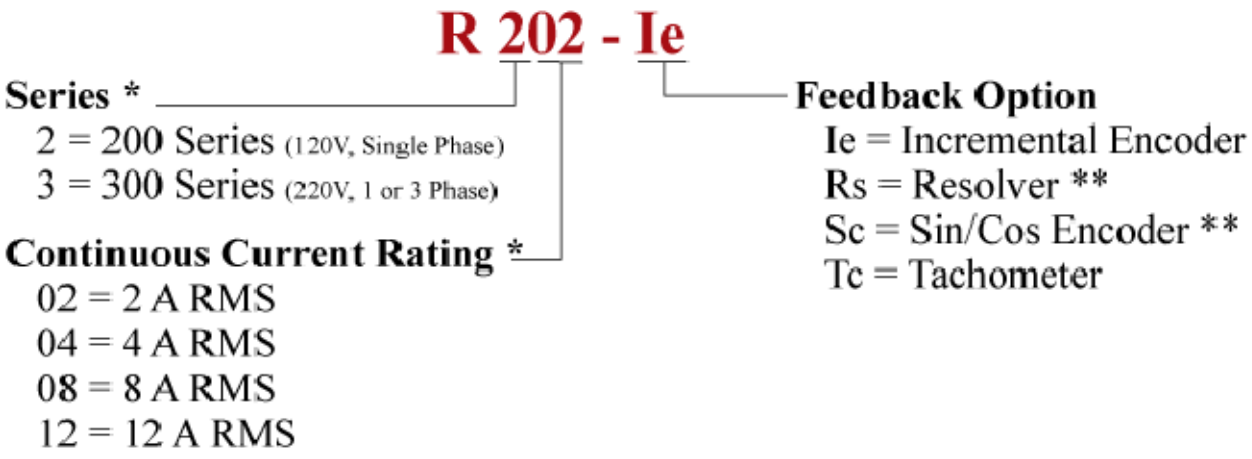
An LED is visible from the front of the servo drive for preliminary fault analysis. For complete analysis the servo drive must be connected to a PC. The servo drives is fully protected against irregular operating conditions and miss wiring.

Commissioning software assists the user in installation and tuning the servo drive. A PC is connected to the servo drive through a USB connection. The commissioning software must be installed on the PC. Simple instructions guide the user through setup and tuning. An oscilloscope in the commissioning software is provided for the advanced user.

2 Technical Data and Specs

2.1 Ruby Model Numbering

Ruby - Model Number - Version 3.03



* Please refer to the Ruby Technical Specifications Table
** Not available now

2.2 Ruby Technical Data

Series	200				300			
Model	**202**	**204**	**208**	**212**	**302**	**304**	**308**	**312**
Motor	Brush, Brushless and Linear							
Operating Modes	Current, Velocity, Position, Gearing, Dual Loop							
Supply Voltage (VAC)	80-130 (1 Φ)				190-260 (1,3 Φ)			
Continuous Output Current (Amp)	2	4	8	12	2	4	8	12
Peak Output Current (Amp), Max 3 Sec	6	12	24	36	6	12	24	36
DC Bus Voltage (VDC)	112-182				266-364			
Current Loop Bandwidth (Hz)	3300							
Velocity Loop Bandwidth (Hz)	350							
Digital In, Digital Out, Analog In, Analog Out	4, 3, 2, 2							
Communications	USB 2.0 Mini-B-Receptacle, Current Rating 1 A, Voltage Rating 5 VAC, Transmission speeds up to 480 Mbps							

2.3 Ruby Mechanical Specifications

Series	200				300			
Model	202	204	208	212	302	304	308	312
Width mm(in)	65 (2.56)		86 (3.4)		65 (2.56)		86 (3.4)	
Height mm(in)	187 (7.35)							
Depth mm(in)	113 (4.45)							
Weigh kg(lb)	1.02 (2.25)				1.40 (3.10)			

3 Mechanical Installation

The important elements to mechanical installation are providing adequate cooling, a non-corrosive environment, and grounding. Four mounting slots are provided as shown below.

3.1 Ruby "2" and "4" Amp

Units in Inch (mm)

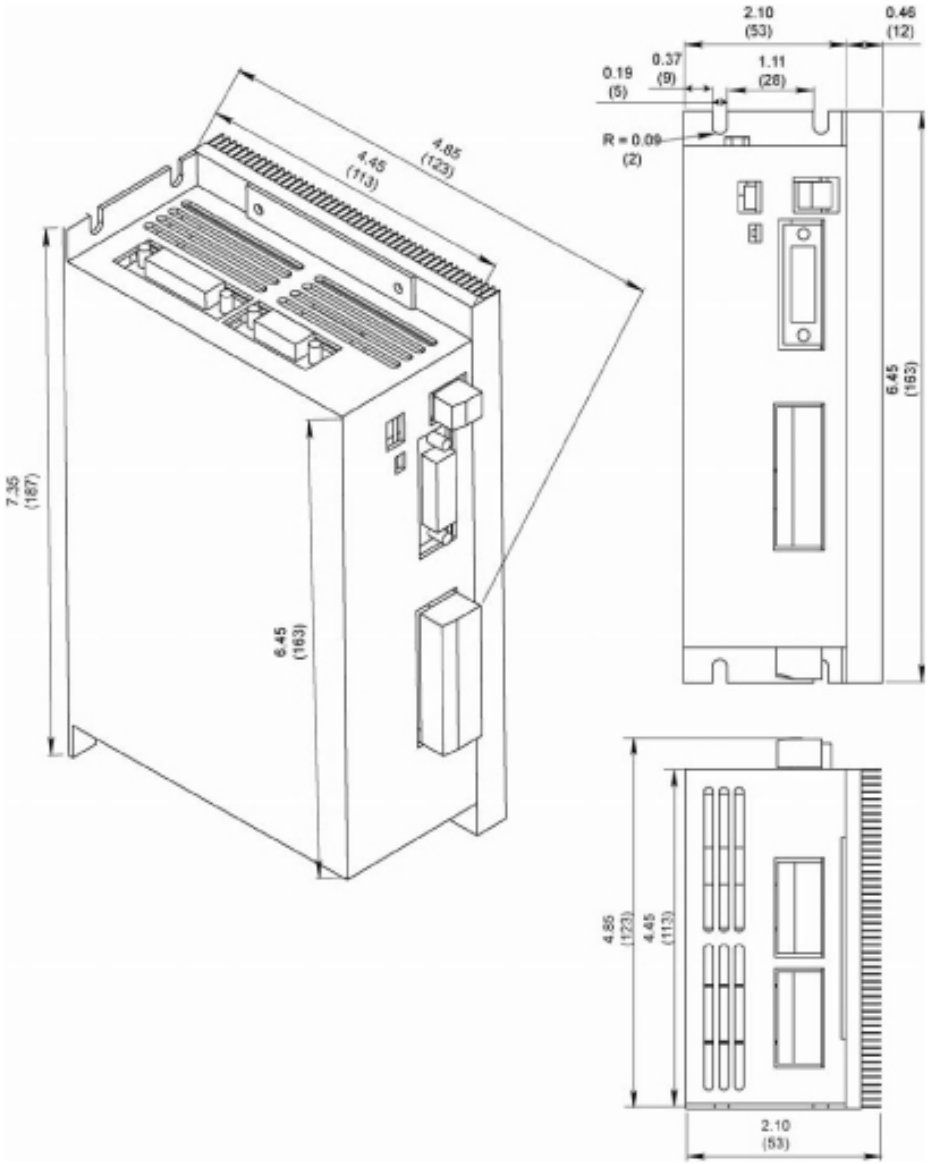


Figure 1 – Ruby 2 and 4 Amp Mechanical Dimensions

3.2 Ruby “8” and “12” Amp

Units in Inch (mm)

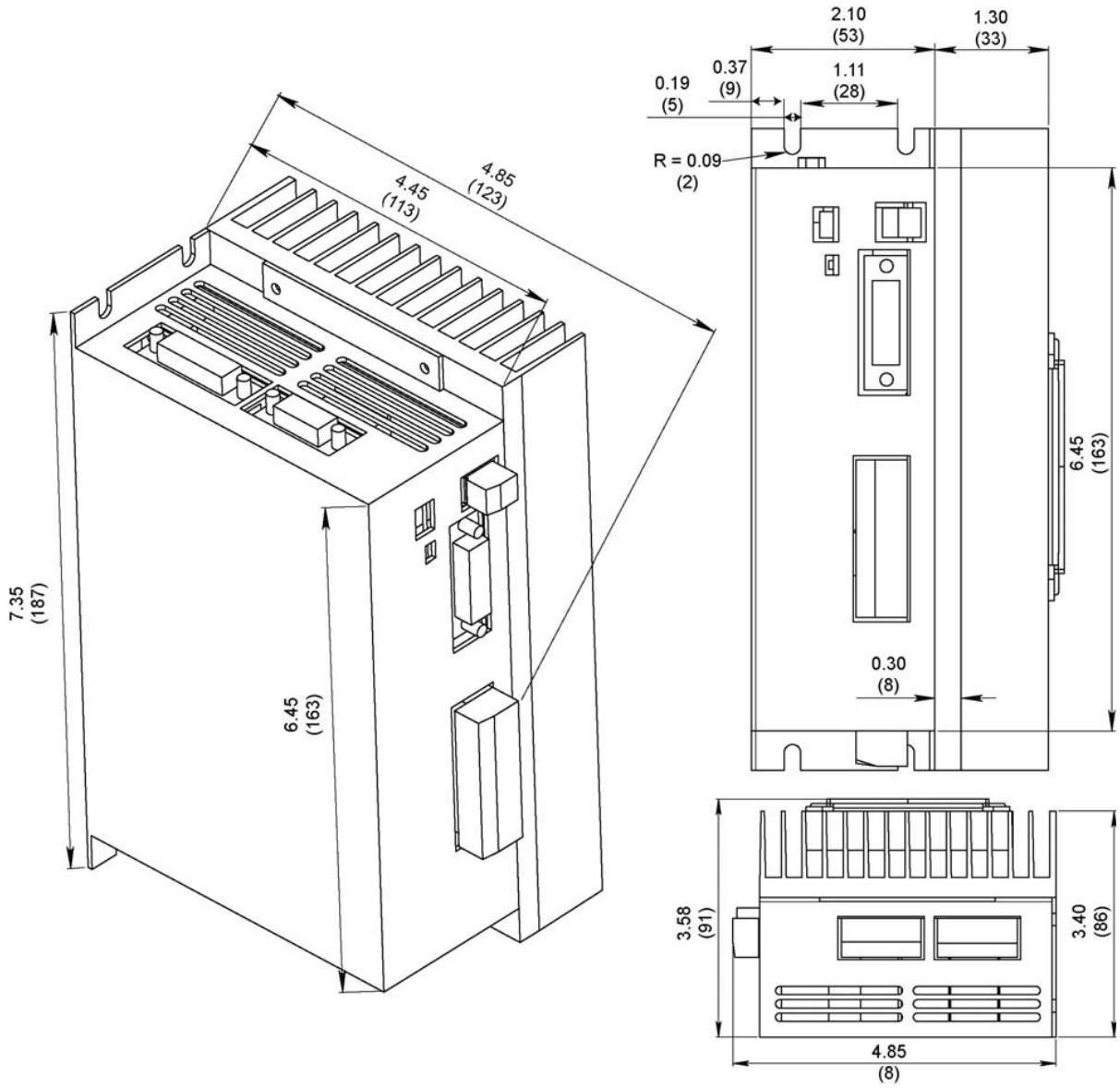


Figure 2 - Ruby “8” and “12” Amp Mechanical Dimension

4 Electrical Installation

4.1 Components of a Servo System

The servo drive and servomotor should have comparable current and voltage ratings to protect the servomotor. Fusing is the responsibility of the user. The power and control cables must be routed separately to protect against electrical noise as required by EMC regulations. Shields on all cables must be grounded on one end consistent from the controller to the servomotor and regen resisters if added.

Cabling is the responsibility of the user. The conductor cross-sections must meet EN 60204. It is recommended to use 22 awg, twisted pairs, and shielded cabling for the feedback from the servomotor to the servo drive.

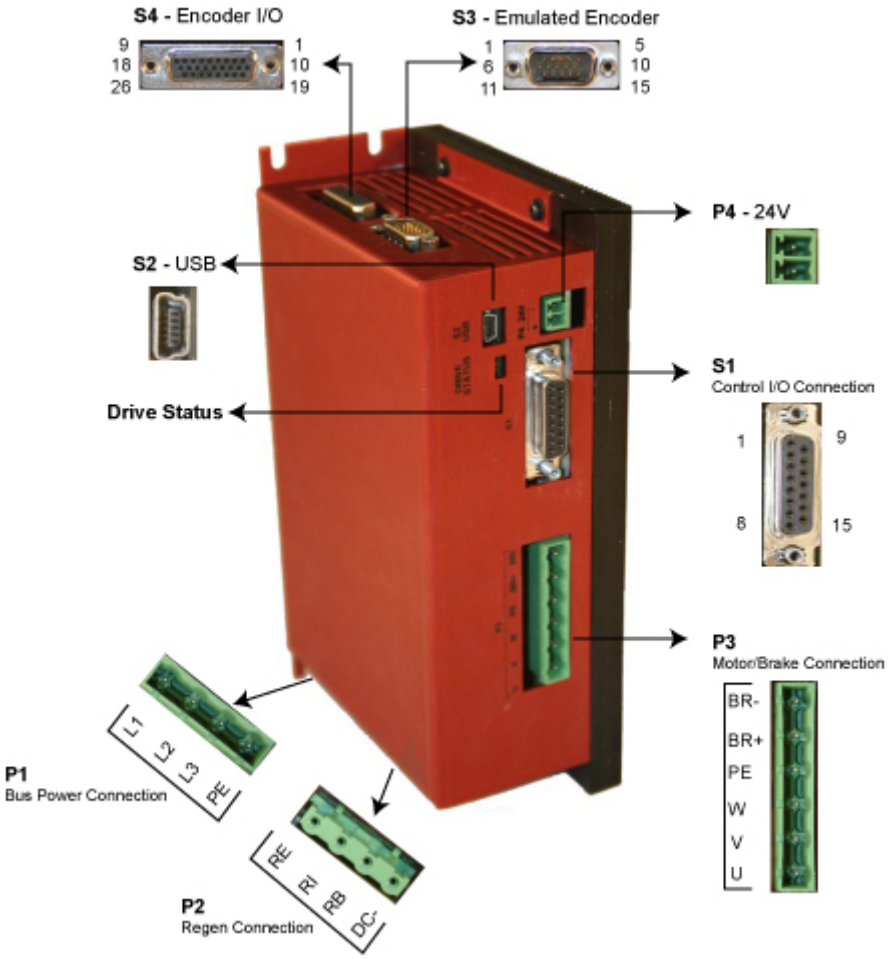


Figure 3 - Drive Components

Note: S1, S2, S3 and S4 mating connectors are supplied by the customer.

4.2 Electrical Supply Connection

4.2.1 Bus Supply – P1 *(fusing provided by the user)*

AC Voltage Supply

4.2.1.1 Three Phase

Input voltage range: **190-260V @ 50/60 Hz**

All ground leads must lead to a central ground point. Failure to do so may result in ground loops.

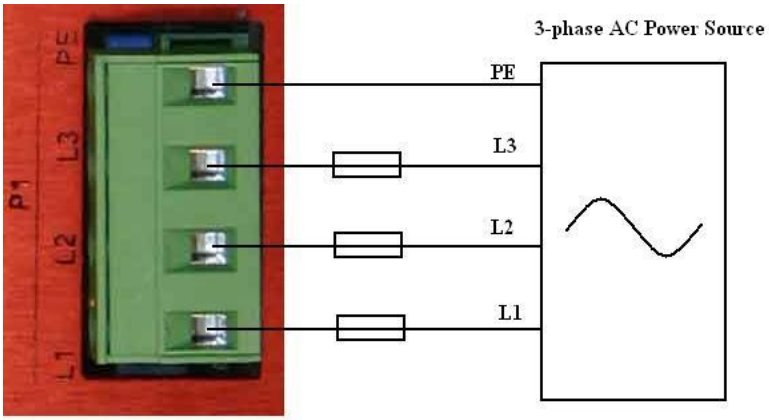


Figure 4 - Three Phase Input Connection

The protective earth (PE) connection ensures that all exposed conductive surfaces are at the same electrical potential as the surface of the Earth. It also ensures that in the case of an insulation fault, a high fault current flows, which will trigger an overcurrent protection device (fuse) that disconnects the power supply. Failure to connect the PE could result in electrical shock. The PE wire needs to be thick enough to handle the current in case of an insulation fault. It is a good practice to connect the shield on just one side. Connecting on both ends could cause a potential difference that may result in current flow in the shield.

4.2.1.2 Single Phase

Input Voltage range: **80V-130V @ 50/60Hz**.
L1 phase must be connected through an external fuse.

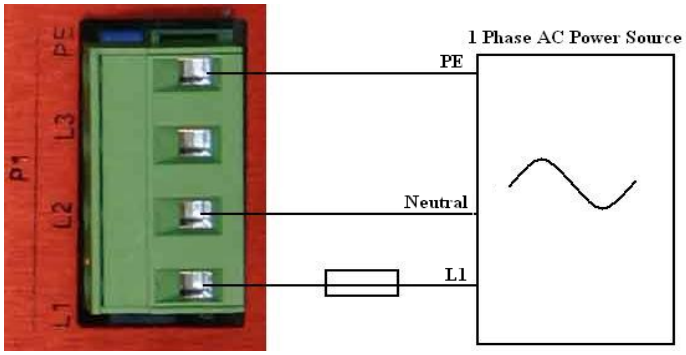


Figure 5 - P1

4.2.2 24V Auxiliary Supply – P4 *(supplied by User)*

24 VDC or 24VAC input if not powering servomotor brake

Figure 6 – P4

Pin	Description
1	24VDC or 24VAC[Note]
2	GND

Table 1 – 24VDC pin description

Input Voltage (VDC)	Input Current (mA)
12	400
24	200
30	160

Table 2 – Auxiliary input current

Note: 24VAC may be used only when the brake is not present.

4.2.3 Regen Circuit – P2

4.2.3.1 Functional Description

4.2.3.1.1 Regen in individual drives

In some applications where the servomotor decelerates with a lot of inertia, or is running at high speed and commanded to stop, the system kinetic energy that is being regenerated is greater than the losses in the system. This means that electrical energy is pumped back into the main bus capacitors and may cause them to charge up to a voltage level beyond the capability of the drive and the capacitors.

The drive is protected against this over-voltage condition. The drive has a shunt regulator connected to the DC bus capacitor. The shunt regulator turns on at Shunt Regulator Trip and shunts excessive voltage through a voltage-dropping resistor mounted on the heat sink.

An external braking resistor may be used for applications in which the servo motor has to be braked frequently and the internal braking resistor cannot dissipate the excess braking energy.

4.2.3.1.2 Multiple drives coupled through DC bus link

In multiple drive applications, the drives are set up to allow their DC link to be tied to the DC links of other drives so that the regenerative power from one motor can be used as the motor power for another.

4.2.3.2 Connection Diagram

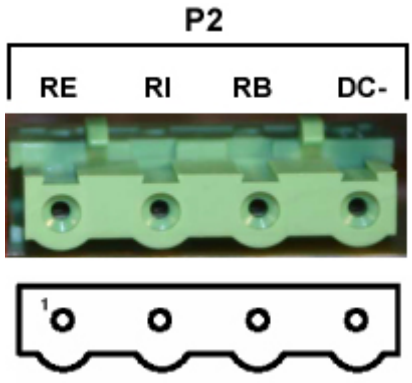


Figure 7 – P2 Connector

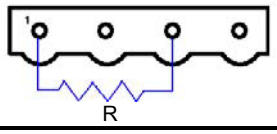
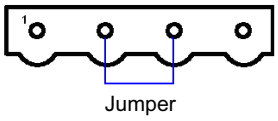
Pin	Name	External Regen Resistor	*Internal Regen Resistor
1	RE	X Ohm resistor to RB	Not Connected
2	RI	Not Connected	Connected to RB
3	RB	X Ohm resistor to RE	Connected to RI
4	DC-	Not Connected	Not Connected
Illustration			

Table 3 – P2 Connection

*Internal Regen Resistor is 30 W at 25 ohms.

4.2.4 Servomotor Connection – P3

4.2.4.1 "P3" Connection for Brushless Servomotors without Brake

Figure 8 – Brushless Motor Power

Pin	Name	Description
6	BR-	Not Connected
5	BR+	Not Connected
4	PE	Protective Earth
3	W	Motor Phase W
2	V	Motor Phase V
1	U	Motor Phase U

Table 4 – Brushless Motor power connector pinout

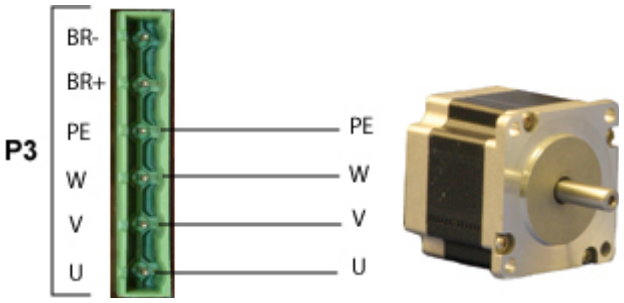


Figure 9 - P3 Connection to the Brushless Motor without Brake

The protective earth (PE) connection ensures that all exposed conductive surfaces are at the same electrical potential as the surface of the Earth. It also ensures that in the case of an insulation fault, a high fault current flows, which will trigger an overcurrent protection device (fuse) that disconnects the power supply. Failure to connect the PE could result in electrical shock. It is required to connect the shield on one side, and leave it opens on the other side. Connecting on both ends could cause a potential difference that may result in current flow in the shield.

4.2.4.2 "P3" Connection for Brush Servomotors without Brake

Figure 10 – Brush Motor Power

Pin	Name	Description
6	BR-	Not Connected
5	BR+	Not Connected
4	PE	Protective Earth
3	NC	Not Connected
2	-	Motor -
1	+	Motor +

Table 5 – Brush Motor power connector pinout

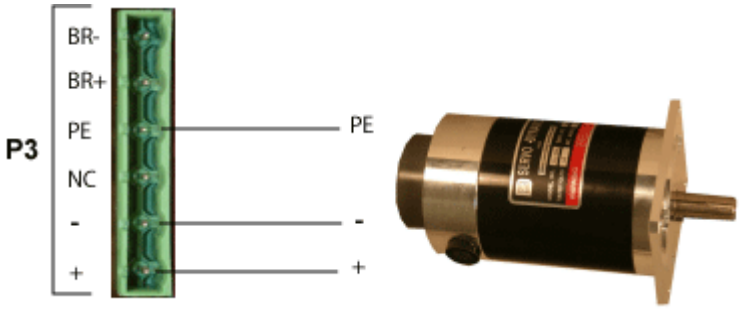


Figure 11 - P3 Connection to the Brush Motor without Brake

The protective earth (PE) connection ensures that all exposed conductive surfaces are at the same electrical potential as the surface of the Earth. It also ensures that in the case of an insulation fault, a high fault current flows, which will trigger an overcurrent protection device (fuse) that disconnects the power supply. Failure to connect the PE could result in electrical shock. It is required to connect the shield on one side, and leave it opens on the other side. Connecting on both ends could cause a potential difference that may result in current flow in the shield.

4.2.4.3 "P3" Connection for Brushless Servomotors with Brake

Ruby is compatible only with 24V brakes. The Engage and the Disengage time may be set in the commissioning software (Motor properties page).

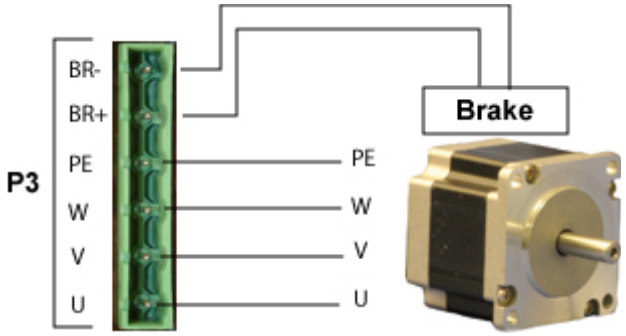


Figure 12 – "P3" Connection to the Brushless Motor with Brake

Pin	Name	Description
6	BR-	Brake -
5	BR+	Brake +
4	PE	Protective Earth
3	W	Motor Phase W
2	V	Motor Phase V
1	U	Motor Phase U

Table 6 – Brushless Motor power/brake connector pinout

The protective earth (PE) connection ensures that all exposed conductive surfaces are at the same electrical potential as the surface of the Earth. It also ensures that in the case of an insulation fault, a high fault current flows, which will trigger an over current protection device (fuse) that disconnects the power supply. It is required to connect the shield on one side, and leave it opens on the other side. Connecting on both ends could cause a potential difference that may result in current flow in the shield.

4.2.4.4 "P3" Connection for Brush Servomotors with Brake

Ruby is compatible only with 24V brakes. The Engage and the Disengage time may be set in the commissioning software (Motor properties page).

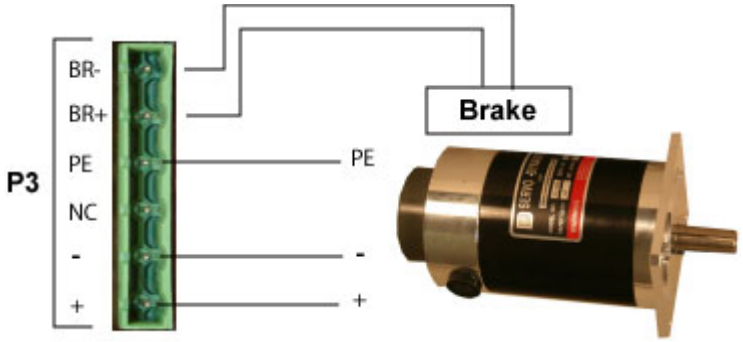


Figure 13 – "P3" Connection to the Brush Motor with Brake

Pin	Name	Description
6	BR-	Brake -
5	BR+	Brake +
4	PE	Protective Earth
3	NC	Not Connected
2	-	Motor -
1	+	Motor +

Table 7 – Brush Motor power/brake connector pinout

The protective earth (PE) connection ensures that all exposed conductive surfaces are at the same electrical potential as the surface of the Earth. It also ensures that in the case of an insulation fault, a high fault current flows, which will trigger an over current protection device (fuse) that disconnects the power supply. It is required to connect the shield on one side, and leave it opens on the other side. Connecting on both ends could cause a potential difference that may result in current flow in the shield.

4.2.5 Encoder Feedback from Servomotor – S4

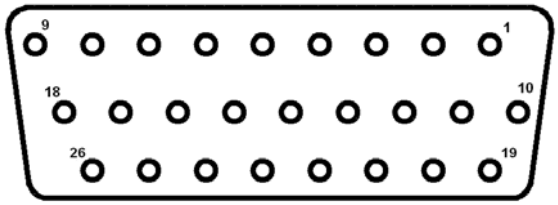


Figure 14 – S4 -Encoder I/O Connector

Pin	Name	Description
1	+5V	+5V DC Encoder power
2	D_GND	Digital Ground
3	A+	Encoder Input A+
4	A-	Encoder Input A-
5	B+	Encoder Input B+
6	B-	Encoder Input B-
7	I+	Encoder Input I+
8	I-	Encoder Input I-
9	HA+	Hall sensor Input A+
10	HA-	Hall sensor Input A-
11	HB+	Hall sensor Input B+
12	HB-	Hall sensor Input B-
13	HC+	Hall sensor Input C+
14	HC-	Hall sensor Input C-
15	TACH	Tachometer feedback (with ref to A_GND)
16	A_GND	Analog Ground
17	THERM1	Thermistor Input (PTC/NTC/Switch)
18	THERM2	Thermistor Input (PTC/NTC/Switch)
19	ENC_FBK	Encoder feedback. See Note
20	+5VDC	+5V DC
21	+5VDC	+5V DC
22	D_GND	Digital Ground
23	D_GND	Digital Ground
24	D_GND	Digital Ground
25	D_GND	Digital Ground
26	D_GND	Digital Ground

Table 8 – Encoder I/O connector pinout

Note: Pin 19 must be jumped to digital ground if the encoder is not installed or the ENC_FBK signal is not used to identify an encoder feedback.

The encoder inputs A and B provide incremental motor position information, and the input is a reference position marker to zero the position. Channels A and B are 90 degrees apart and Channel I is typically a small width pulse that marks the position of the shaft as zero when asserted.

The Hall signals are differential inputs, used for speed and coarse position feedback. There are 3 hall inputs - one signal for each motor phase.

All signals need to be connected in reference to the Digital ground.

The Ruby accepts 5V differential TTL encoder signals.

Single-ended or open-collector type hall signals may be used by connecting the positive hall signals to the respective positive hall inputs, and pulling up the negative hall signals to 5V through *475 Ohms* resistor.

Frequency limit for encoder channels A & B is 15MHz.

Note: The mating connector to S4 is **DB 26 pins shell size 2 male connector** and is provided by the customer.

4.2.6 I/O Connection – S1

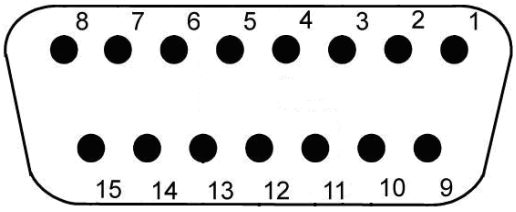


Figure 15 – S1-Control I/O pins

Pin	Name	Description
1	REF+	+ Command Input (ref. to A_Gnd)
2	REF-	- Command Input (ref. to A_Gnd)
3	A_GND	Analog Ground (for single-ended command input)
4	AO_1	Programmable analog output 1 (ref to A_Gnd)
5	AO_2	Programmable analog output 2 (ref to A_Gnd)
6	A_GND	Analog Ground
7	ENABLE	Enable the amplifier (refer to I_Gnd)
8	Limit+	Limit Switch Positive (ref to I_Gnd)
9	Limit-	Limit Switch Negative (ref to I_Gnd)
10	DO1/Fault	Digital output 1 – Amplifier Fault (ref to I_Gnd)
11	DO2/Ready	Digital output 2 – Ready (ref to I_Gnd)
12	I_GND	Isolated Ground
13	I_GND	Isolated Ground
14	I_GND	Isolated Ground
15	24V	24V DC switch power (ref to I_Gnd)

Table 9 – Pinout of Control I/O Connector – S1

Note: The command voltage input range is +/-10V.

Note: The mating connector to S1 is **DB 15 pins shell size 2 male connector** and is provided by the customer.

4.2.6.1 Analog Command Signal

The Ruby accepts single or differential command input. Figures below illustrate the input stage.

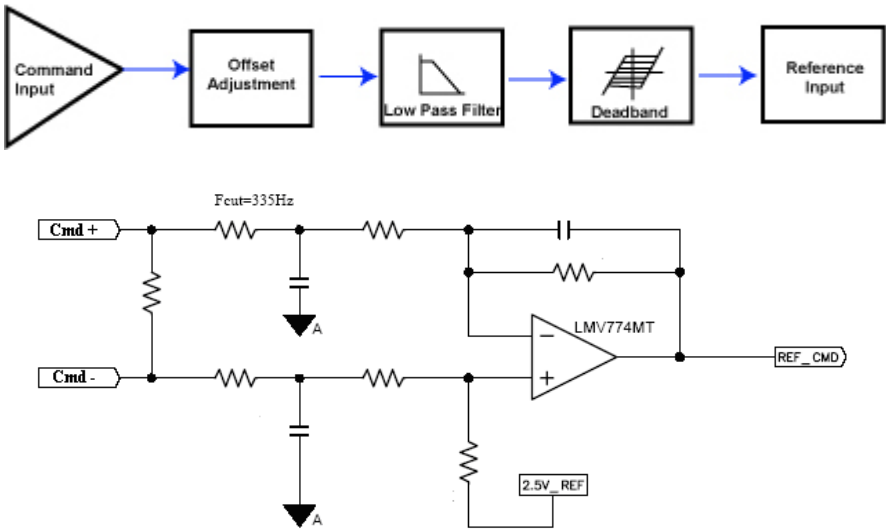


Figure 16 – Analog Command Signals

The recommended full-scale differential command input range is ± 10V.
The offset voltage is the input value at which the output is zero.
The deadband is the voltage range for which there is no output response. For example, if the deadband voltage is 100mV, then the drive treats any input up to 100mV as zero, and hence only outputs for input greater than 100mV. Deadband is useful in cases where the rotation due to noise needs to be minimized/eliminated.

The offset and the deadband for the input voltage may be set in the commissioning software Analog I/O page. Using Autobalancing (in the Analog I/O page) in the commissioning software sets the offset automatically.

The direction of the torque depends on the Velocity/Current command direction in the commissioning software as listed below.

Vel/Dir Command Direction	Command Input Polarity	Direction
0	Positive	Clockwise
	Negative	Counter Clockwise
1	Positive	Counter Clockwise
	Negative	Clockwise

Table 10 – Torque Direction

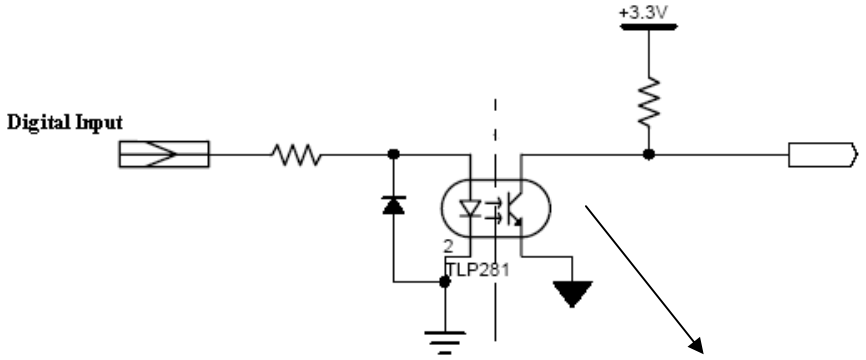
4.2.6.2 Programmable Analog Outputs

Ruby has two programmable analog outputs, which can be selected in the commissioning software. The outputs may be chosen to represent the following motor data:

- Motor Current
- Command Current
- Current Error (Motor current – command current)
- Velocity Feedback
- Command Velocity
- Velocity Error (Velocity feedback – command velocity)

4.2.6.3 Digital Inputs

Illustrates the digital input stage. All the digital inputs are optically isolated.



Open Collector, 80 mA max

Figure 17 - Digital Input Stage

4.2.6.4 Enable

The function of this signal is to enable/disable the drive. The enable signal has to be wired through an external switch.

The enable input accepts voltage in the range of 4.5-24VDC.

The enable input signal may be configured as active high or active low in the commissioning software.

4.2.6.5 Travel Limit Inputs

The function of the Limit switches (LS+ and LS-) is to provide an inhibit signal. When either of the inputs is asserted, the motor faults out. When the motor is re-enabled, it starts moving in the opposite direction (relative to the direction in which it was moving prior to the fault).
These signals maybe configured as active high or active low in the commissioning software.

4.2.6.6 Digital Outputs

Ruby has two digital outputs – Fault and Ready. Both outputs are open collector type and are fully isolated from rest of the circuits. This picture shows the output stage of the digital outputs.

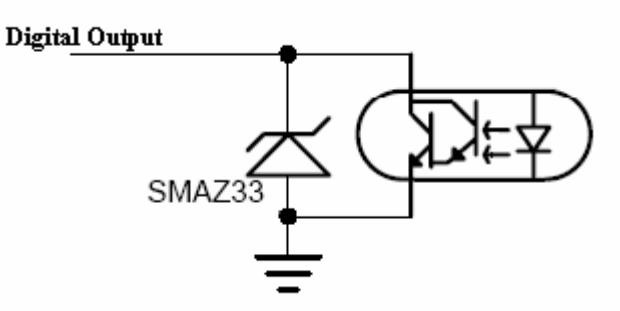


Figure 18 - Digital Outputs

Digital output max voltage -- 30V

4.2.6.7 Digital Output 1 – Fault

This output is asserted when there is fault in the system.
This may be configured as active high or active low in the commissioning software.

4.2.6.8 Digital Output 2 – Ready

This output is asserted when the system is enabled/ready.
This maybe configured as active high or active low in the commissioning software.

4.2.6.9 VDC Output

The 24 VDC output may be used to power the digital signals.

4.2.6.10 Grounding

4.2.6.10.1 Digital Ground

Isolated Ground is used as reference ground for digital I/O.

4.2.6.10.2 Analog Ground

Used as reference ground for analog I/O.

4.2.7 Special Function I/O Connection – S3

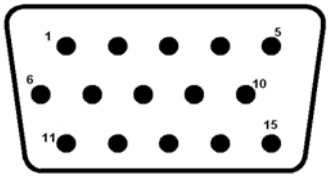


Figure 19 - S3 Connection

Pin	Name	Function
1	+5V	+5 VDC
2	D_GND	Digital Ground
3	OUTA+	Encoder output A+
4	OUTA-	Encoder output A-
5	OUTB+	Encoder output B+
6	OUTB-	Encoder output B-
7	OUTC+	Encoder output C+
8	OUTC-	Encoder output C-
9	PULSE+	Pulse input +
10	PULSE-	Pulse input -
11	DIR+	Direction +
12	DIR-	Direction -
13	+5V	+5V DC
14	D_GND	Digital Ground
15	D_GND	Digital Ground

Table 11 - S3 Connection Pinout

Note: The mating connector to S3 is **DB 15 pins shell size 1 female connector** and is provided by the customer.

4.2.7.1 Position Mode

The pulse input determines the distance moved and the pulse frequency determines the velocity.

The direction of torque is determined by the Direction input.

These inputs are optically isolated from rest of the circuit.

Differential signals are recommended for these inputs since they result in better resolution.

Pulse and direction input voltage range – 5V Dif.
Pulse frequency range -
Scaling –
Direction - + CW and – CCW

4.2.7.2 Master/Slave

Ruby supports drive slaving from an external pulse input.

Desired ratio is selected during commissioning.
Connect the Encoder outputs A & B of the master drive to the pulse and direction input of the slave drive. This enables the slave drive to follow the master drive.

4.2.7.3 2nd Encoder Input

In cases where the drive is in position mode and the application requires high position resolution with minimum backlash, a second encoder can be installed on the load side. The encoder is fed into the Ruby for closing the position loop reducing backlash in the system.

The pulse and direction inputs may optionally be used as the second encoder input.

4.2.8 S2 – USB Interface to PC

The USB connector enables the user to connect the drive to the PC. The windows based program ServoVista is used to configure and tune the drive.

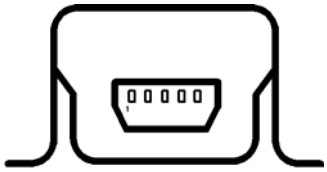


Figure 20 - USB Connector

Pin	Description
1	VBUS
2	D-
3	D+
4	Not Connected
5	GND

Table 12 - USB Pin Description

4.2.9 Drive Status LED

The LED in Ruby indicates the status of the drive. Here are the lists of the LED status with its respective description.

LED Status	Description
Solid Orange	Drive is powered on, and disabled
Solid Green	Drive is enabled
Solid Red	Drive is under fault