Testra Corporation
RoadRunner Series Microstepping Motor Drive
R213S Specifications

Aug 2014

SoftStep2

The Newest Art of Stepper Motor Control

With SoftStep you get the benefits of ultra smooth operation regardless of your selected step size. The intelligent on board processor treats the input steps as small vector moves and smoothly chains them together with 250 or 256 micro-steps per regular motor step with controlled accelerations. Dual chopper stabilized current comparators along with auto-calibration gets rid of commutation discontinuities and maintain a near perfect sine wave drive, further reducing motor noise and increasing accuracy and stability.

AVAILABLE OPTIONS FOR OEM'S ONLY!

- ★ Optional custom waveforms to match individual motor characteristics, eliminating torque and velocity ripple.
- ★ CW, CCW input
- ★ Quadrature Input
- ★ User programmable waveform
- ★ Step on + or - transition
- ★ Custom Current Reduction
- ★ 3.3v Input Drive
- ★ 50kHz Chop Frequency

STANDARD MODELS

GekoDrive Compatible

- ▸ R213S

HARDWARE FEATURES

- ♦ 20-80v Input Power
- ♦ Current Drive 1 to 7 amp
- ♦ Resistor Programmable Current
- ♦ Opto Isolated Inputs
  Step, Direction
- ♦ Disable input (not-isolated)
- ♦ Step Frequency to 5Mhz
- ♦ Bipolar 4-wire D-mos Drive
- ♦ 25 khz Chopper Drive
- ♦ Electronic Fusing - Any Fault
- ♦ Thermal Shutdown
- ♦ Status Indicator - No Fault
- ♦ Mechanical Dimensions,
  2.5(69.9)x2.5(76.2)x0.825(30.5)
- ♦ Operating 0-70 C at Heatsink
- ♦ Dual 8 Bit D/A Current Control
- ♦ Flash Waveform Tables
- ♦ Flash Programmable Logic

FIRMWARE FEATURES

R213S

(Gecko G2xx Compatible)

- Input Step Resolutions
  DS (Double Step)
  FS (Full Step)
  1/2 1/4 1/5 1/8 1/10 1/16 1/25
  1/32 1/50 1/64 1/125 1/128
  1/250 1/256

- Current Reduction, 0.5 sec after last step input to ½ Power.
- Always Microsteps at 1/250 or 1/256th step size, regardless of selected input step size resulting in ultra smooth operation of your motor.

SynchroStepping * All of our motion systems and drivers utilize a method that synchronously, microstep, sample and correct the current on multiple motor windings at a 20-50 kHz rate resulting in stable, quiet, smooth control of a stepper motor. US Patent # 5,650,705

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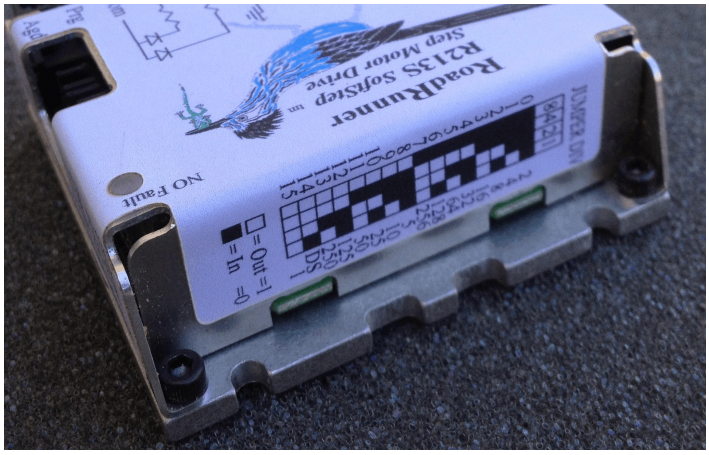
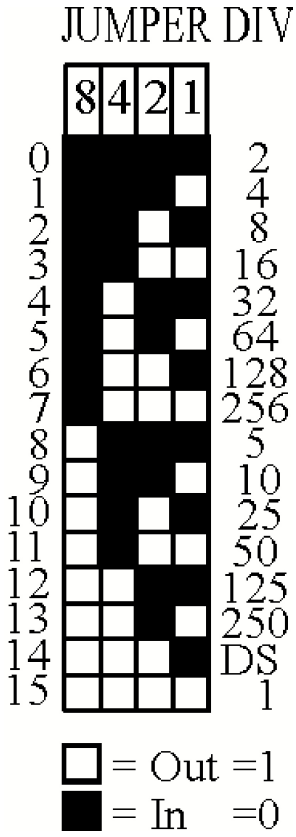


Jumper settings table for step divisor on rear of cover..



The RoadRunner Drive always micro-steps finely in either 250 increments per step for divisors of 5,10,25,50,125 and 250, or in 256 increments per step for settings for DS (double step), 1 (full step),2 (half step),4,8,16,32,64,128, and 256.

There are four sets of pins on 2mm centers accessible to the user through the cover that are populated with shunts or jumpers. The drives are shipped with jumpers installed for a divisor setting of 10 so as to be Gecko drive compatible.

Jumpers that are removed for the 1 condition may be parked along the edge of the case with just one contact inserted so they will be available in case one wants to use a different setting. The settings are documented on the Label.

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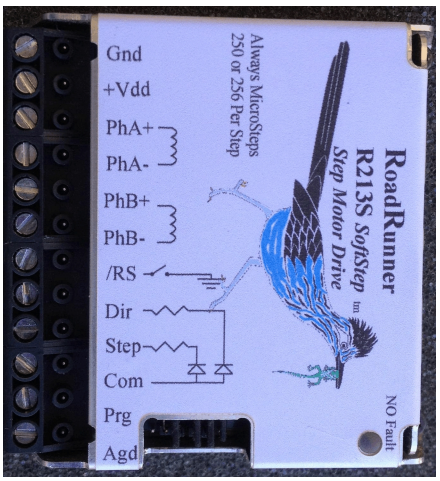
RoadRunner R213S Series Stepper Motor Drive I/O Signals Descriptions

All of the user I/O connections are available on P1, a 12 pin plug-able screw terminal connector shown on the left edge of this photo. The connector pins number from the top of the photo, 1 through 12.

The wire used for connections to the power supply and to the motors should be sized properly. Use these recommended gages or smaller. This applies only to pins 1 through 6.

Motor Current	Wire
<3 amp	22 ga
<4 amp	20 ga
<5 amp	18 ga
<7 amp	16 ga



Top View Showing P1 I/O Connections

SIGNAL	DESCRIPTION
GND P1- 1	This pin is used for the negative connection of the driver power supply. The heatsink of the R213S drivers is NOT connected to this GND terminal. It is isolated. You may want to add a jumper wire from this terminal to your chassis or frame ground and also connect a shield or drain wire in your motor cable to this same frame ground point to minimize any EMF radiation. You should also do this if you are going to use the /RS input that is not isolated.
+VDD P1-2	This pin should be connected to the positive output of the system power supply for the motor drives. The maximum voltage applied should not exceed 100v. This 100v includes any increase in the supply voltage due to re-generation from the motor. If you do not take this into account, this voltage may be exceeded during deceleration of the motor or crashing and driver failure will occur. The recommended maximum supply voltage is 80v.
PhA+ P1-3	Motor Phase A positive connection. Note to reverse motor direction you can just swap Phase A plus and minus connections (or alternatively Phase B plus and minus connections).
PhA- P1-4	Motor Phase A negative connection.

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R213S Series Step Motor Driver I/O Signal Descriptions

SIGNAL	DESCRIPTION
PhB+ P1-5	Motor Phase B positive connection.
PhB- P1-6	Motor Phase B negative connection.
/RS P1-7	This is a NON opto-isolated ***input*** when OPEN or HIGH enables the driver, turning on the Motor phase currents. When held low the motor drive outputs are disabled and disconnected from the motor. When the driver is disabled it is safe to connect or disconnect a motor without damaging the driver. Since this is a non-isolated signal you must be careful about noise and ground loops. The ground reference for this is the same as the GND connection on pin 1. If you are not going to use this signal, ***do NOT leave a dangling wire connected to this pin***. It will act like an antenna! If you are going to use this signal, You should use a twisted pair connection, with the ground return connected to the GND (pin 1) of the drive. (See discussion about GND pin 1) If you need an isolated input for this function, there will be another version of the RoadRunner that accommodates that.
Dir P1-8	The DIR ***input*** is an Opto-Isolated signal. The positive input to the opto is connected to the OPTO +5V (J3-4) with a 390 ohm series resistor. The input must be driven to ground by a device that can sink at least 8 ma at 0.4v. The stepping action of the driver is triggered by the positive edge of the step pulse. Change in direction must take place at least 100ns before the positive edge of the step pulse and hold for at least 100ns after. The direction polarity has been set to match the Geko Drive motor rotation results.
Step P1-9	The STEP ***input*** is an Opto-Isolated signal. The positive input to the opto is connected to the OPTO +5V (J3-4) with a 390 ohm series resistor. The input must be driven to ground by a device that can sink at least 8 ma at 0.4v. The stepping action of the driver is triggered by the positive edge of the step pulse. Maximum input step rate 5.0 Mhz. The standard chop frequency is 25kHz so your maximum input step rate divided by your divisor should be no more that about 10kHz.
Com P1-10	This is the common connection for the isolated Step and Dir connections. It should be connected to the +5v logic supply at the source of the Step and Dir signals. It is recommended that twisted pair be used.
Prg P1-11	A resistor is used to set the peak current of the drive. It is connected between this pin and the analog ground on pin 12 (Agd). The formula for setting the current I is **R=47.3I/(7-I)** in K ohms.
Agd P1-12	This is the return connection for the motor current programming resistor, the other connection of the resistor being P1-11 (Prg). ***Do NOT connect to any external signal or ground!***

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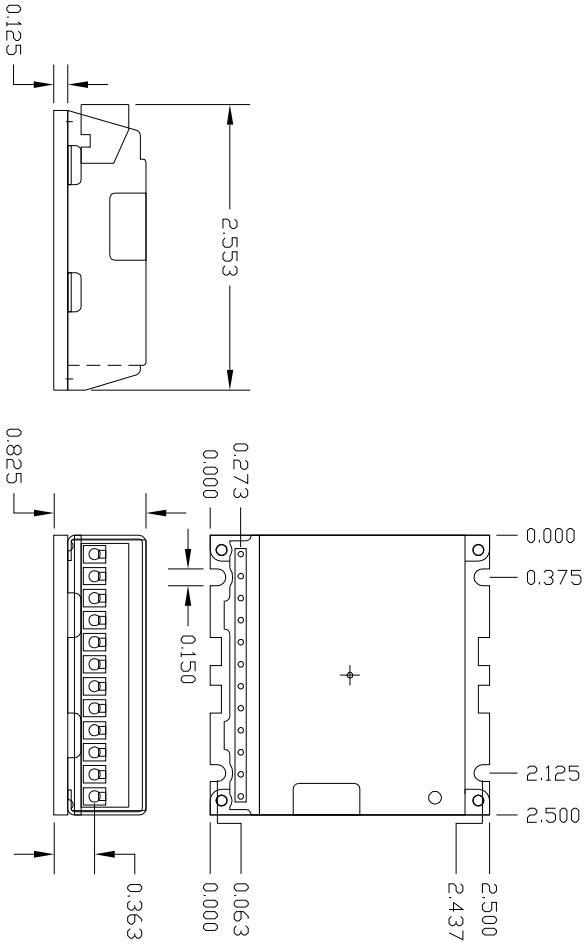
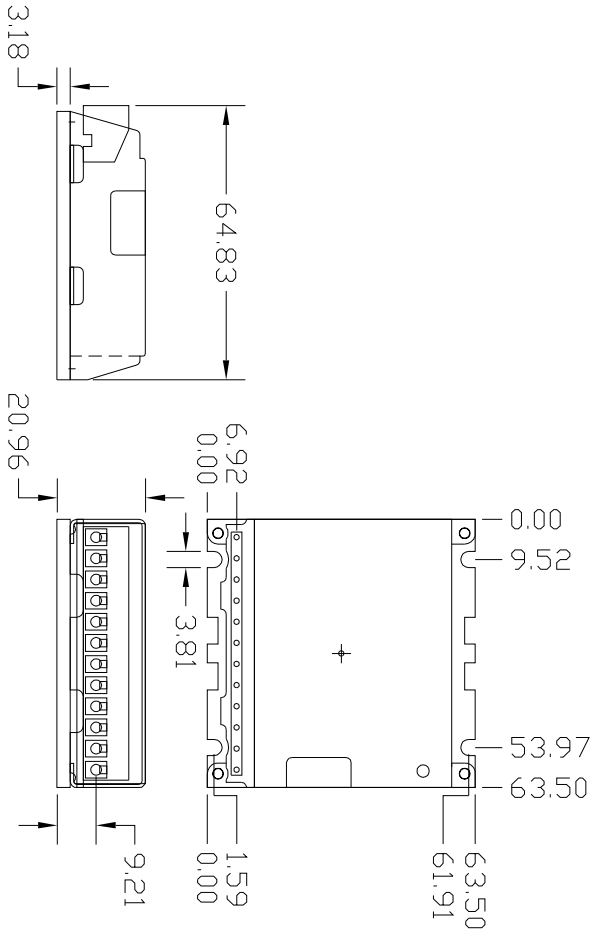
RoadRunner Mechanical Dimensions



RoadRunner English Dimensions



RoadRunner Metric Dimensions

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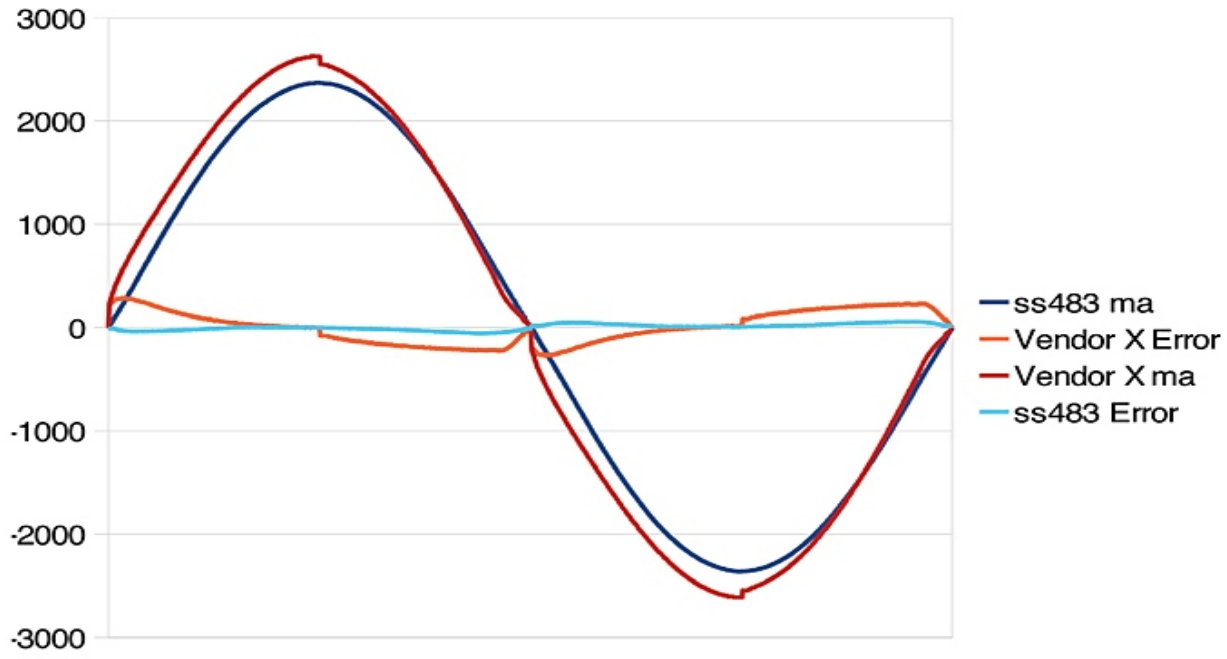
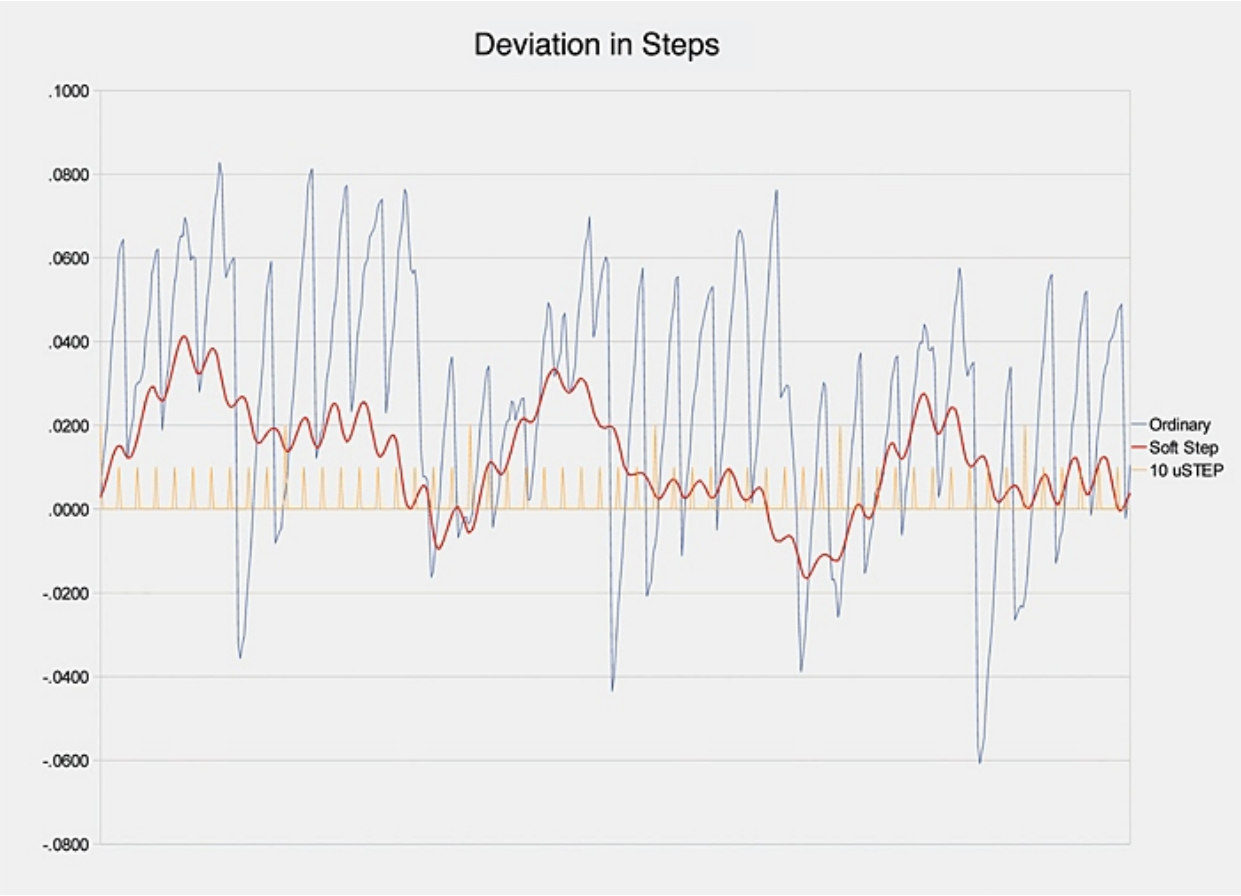


SoftStep Fundamentals (curve shown applies to all of our SoftStep Drives)

The basic idea behind the SoftStep drive involves placing an input rate into the drive, which is then converted into a motion vector that tracks the input step rate. This results in the input step commands producing extremely smooth motion, as long as the input command stream is also smooth even though much coarser. The velocity is maintained by first starting out at a preset starting speed, then looking for the next input step pulse. It uses that time interval to set a new speed and continues with the process. The motor is then driven using PWM signals using patented control algorithms to control the current in the windings. The chip used in the drives containing the special algorithms was developed in-house. Another important design element was that the motor's response be linear to the input positioning step commands. Ideally, a sine wave drive to a motor designed for micro-stepping would give that result. In reality, as the current increases, the magnetics begin to saturate. This causes the motor to lose force and makes the response non-linear, which results in both a position and torque ripple at harmonics of the input sine wave. This can then greatly aggravate natural resonances present in the motor and the coupled machine, and in the worst case lose control of the motor with the loss of steps. The SoftStep technology can minimize this by modifying the drive waveform to counteract the motor non-linearity. There is also the issue of the zero-crossing point. Most micro-stepping drives have a large error around the zero crossing point when the current in the motor windings changes phase. Oscillations also often occur in this control region along with a noisy transition. The SoftStep design uses a few tricks to sort this out; by offsetting the current waveform by half a micro-step, the signal never has to be controlled at zero but at plus or minus 1/512th of the rated motor current. This precise control would not be possible

without dynamic calibration as well, auto calibrating the zero crossing point of the measurement system of the drive.



The combination of this technology yields a drive that is smooth and accurate and that can be used on all types of stepper motors . Because of it's inherent precision, it's also an ideal selection for driving linear stepper motors.

The graph shows the mechanical position error of an unloaded step motor driving a flywheel at a slow Speed of about 7.5 full steps per second. The small yellow markers are 1/10 step while the larger markers show the full step, four of which make up one pole of the step motor . The red graph shows the position error while being driven by a non-compensated SoftStep driver, while the blue graph shows the position error using a standard 1/10th microstep driver. The large slow error is caused by the non-linear response of the motor itself which can be compensated for with the SoftStep driver through OEM Motor Calibration which provides a custom waveform to match the motor...

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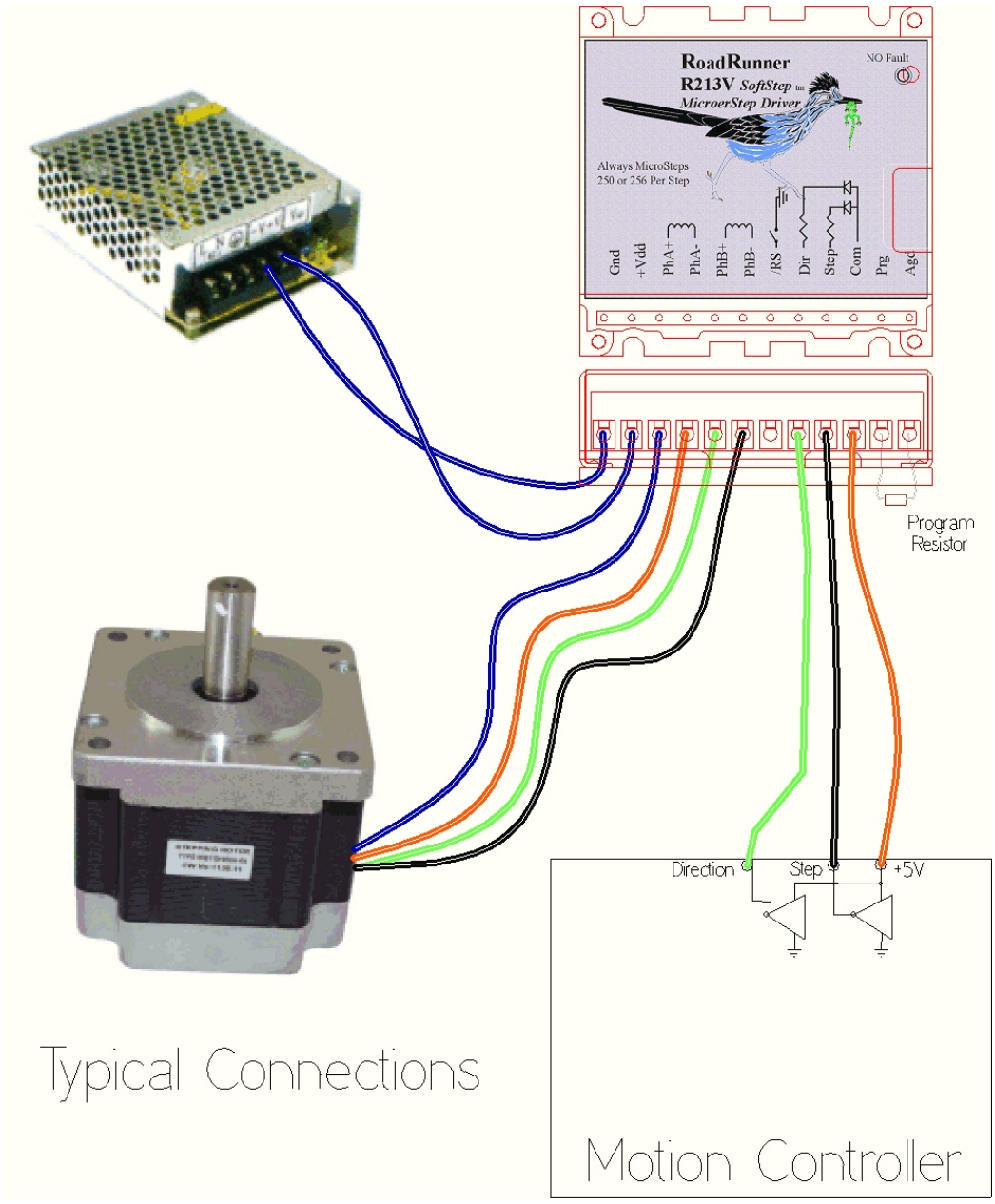

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Note: For best noise immunity use two twisted pair with the 5v connection in each pair. This will cause cancellation of common mode noise induced in the wires connecting the controller with the motor drive.

RoadRunner R213 Current Setting Resistor Nearest 1% Value
R=47.3*I/(7-I)

Desired Motor Current	Resistor Value (1%)
1.0	7.87K
1.5	13.0K
2.0	19.1K
2.5	26.1K
3.0	35.7K
3.5	47.5K
4.0	63.4K
4.5	84.5K
5.0	118K
5.5	174K
6.0	287K
6.5	619K
7.0	Open

RR213 Power Specifications

Parameter	Minimum	Typical	Maximum
Absolute Max Input Voltage			100V
Start Up Voltage	21.5V	21.8V	22.0V
Drop Out Voltage	16.0V	16.6V	17,0V
Recommended Operating Voltage	22.0V	24-72.0V	80.0V
Disabled Current	5.0ma	15.0ma	20.0ma
Enabled with no Motor Connected	20.0ma	25.0ma	30.0ma
Losses 7a 80 v Fully Loaded Motor			6.5W
Losses 1a 80v Fully Loaded Motor			1.8W

RR213 Input Parameters

Isolated Step & Direction Inputs

Parameter	Min	Max
Step Pulse Low	200ns	n/a
Step Pulse High	200ns	n/a
Direction Setup	100ns	n/a
Direction Hold	100ns	n/a
S&D Switch Threshold	1.4v	2.0v
Non-Isolated /RS Input		
Switching Threshold	0.8v	2.0v
Current to sink		0.15ma

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