Electronics Workshop

Jessie Liu

Return Kit

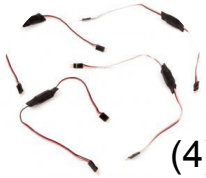
Servos

Controller

Servo Extensions

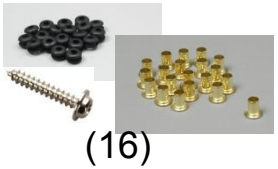
Potentiometer

Servo Power Adaptor

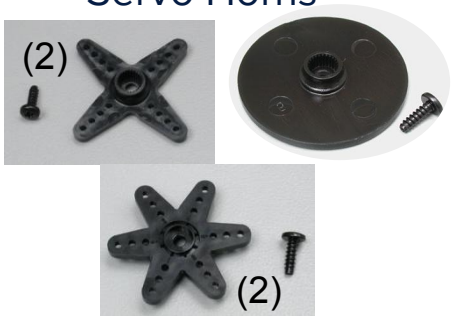


AAA Battery Charger

Servo Mounting H/W (optional)



Servo Horns



USB A-A Cable

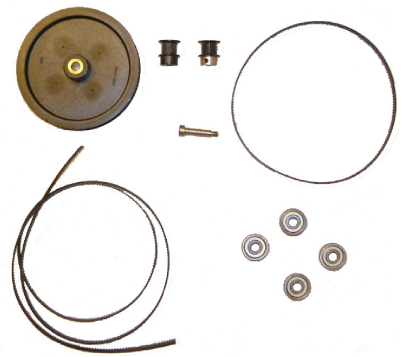
Return Kit (cont.)

Motors

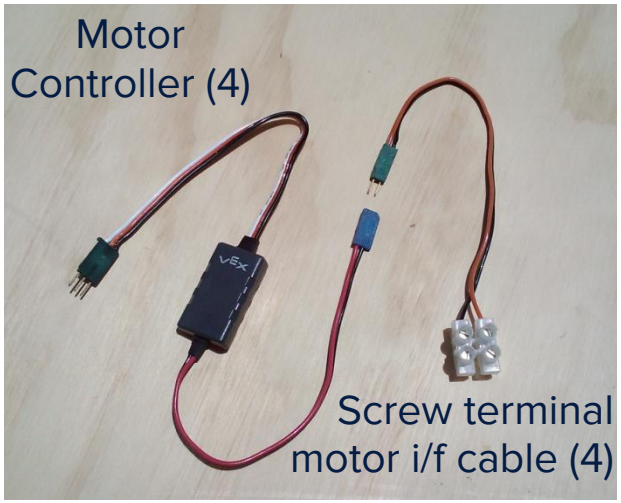
(2)

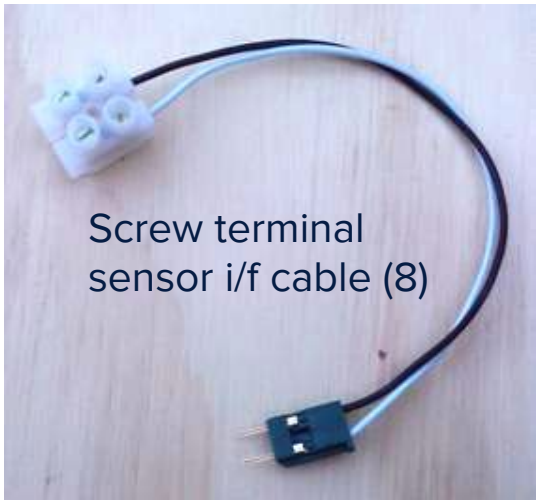
(2)

Drive components

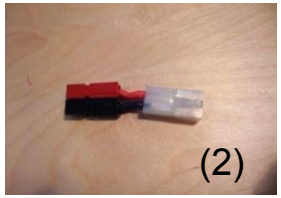


7.2V Battery charger





Battery adapter



(2)

7.2V Battery

(2)

Example Hookup

VEXnet Control System

- VEX Cortex microcontroller
- Dual ARM Cortex CPUs
- Programmable
- WiFi communications

- Gaming style controller
- Joysticks, buttons and accelerometers

VEXnet Cortex M3 Controller

8 Analog inputs

12 Digital inputs or outputs

Speaker Output

System Status Indicators

WiFi 802.11 Proprietary Comm.

Standard Serial Interfaces (UART, I2C)

10 Motor/Servo Ports

VEX Cortex Pinouts

- Ground
- + 5V
- Signal/Control
- + Battery Power
- + Battery Power (for + control input)
- + Battery Power (for – control input)

VEXnet Joystick

8 buttons on top

2 XY analog joysticks

Plug-in USB/ WiFi Key

Power switch

6 AAA rechargeable batteries

4 Button on front-side

Programming Interface

2 Axis Accelerometer (X Tilt and Y Tilt)

System Features

- Wireless communication using 802.11g
- 2 2-wire proportional motor control outputs (not used by BEST)
- 8 3-wire PWM servo/motor outputs
- 12 discrete digital inputs/outputs + 1 speaker
- Wireless or direct USB port for program download
- Onboard power switch
- Built-in resettable fuse for overcurrent situations
- Powered by a single 7.2 volt RC hobby battery
- 9-volt backup battery for WiFi

DC Motors

- Use of internal motor controllers is not allowed (motor ports 1 and 10)
- External motor controller(s)
  - connect via 3-wire external motor controller + 2-wire screw terminal cable
  - use motor ports 2 thru 9 only

DC Motors (cont.)

- For power reasons, spread your motors so that you have
  - no more than 2 motors plugged into ports 2-5 and
  - no more than 2 motors plugged into ports 6-9.
- You risk over current and shutdown of the processor.
- Servo/motor ports are divided into 2 banks
  - Bank1 = Ports 1-5
  - Bank2 = Ports 6-10
  - Each bank can support a maximum of 4 Amps of current
  - BEST large motor stall current can reach 3.5 Amps.
- Sheet metal shield around the large motors IS needed and should not be removed.

DC Motors (3)

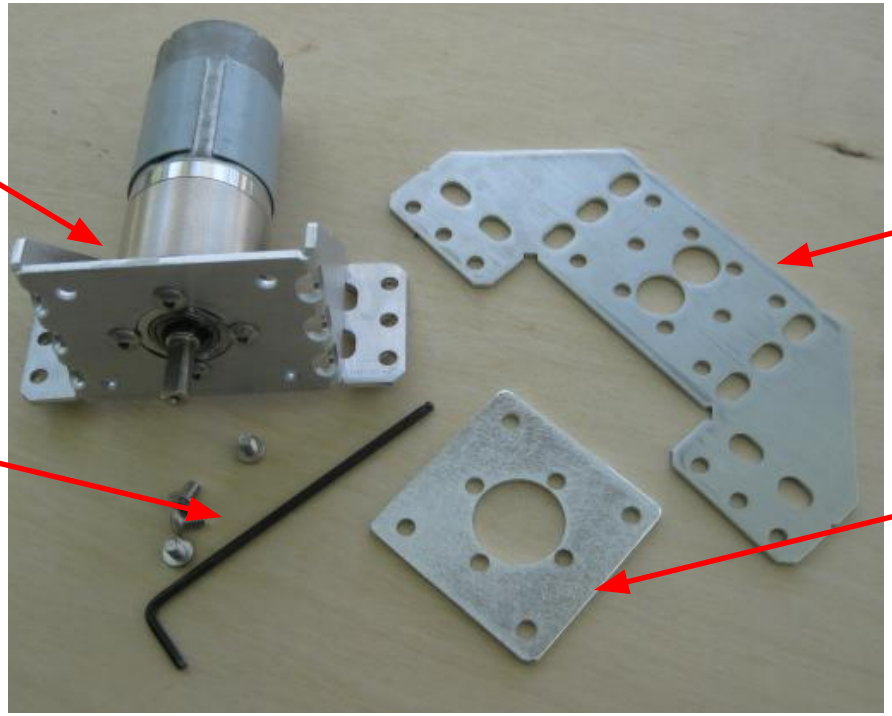
- Solder wires to motor terminals or with the optional quick-disconnect (spade) terminals
- Polarity is NOT marked on motors: positive(+), negative(-)
- Wiring (and programming) will determine clockwise or counterclockwise rotation for positive stick movement

DC Motors (4)

- Motors can be mounted with VEX Motor Mounting Kit provided in the consumables kit

Large motor plate (bent up)

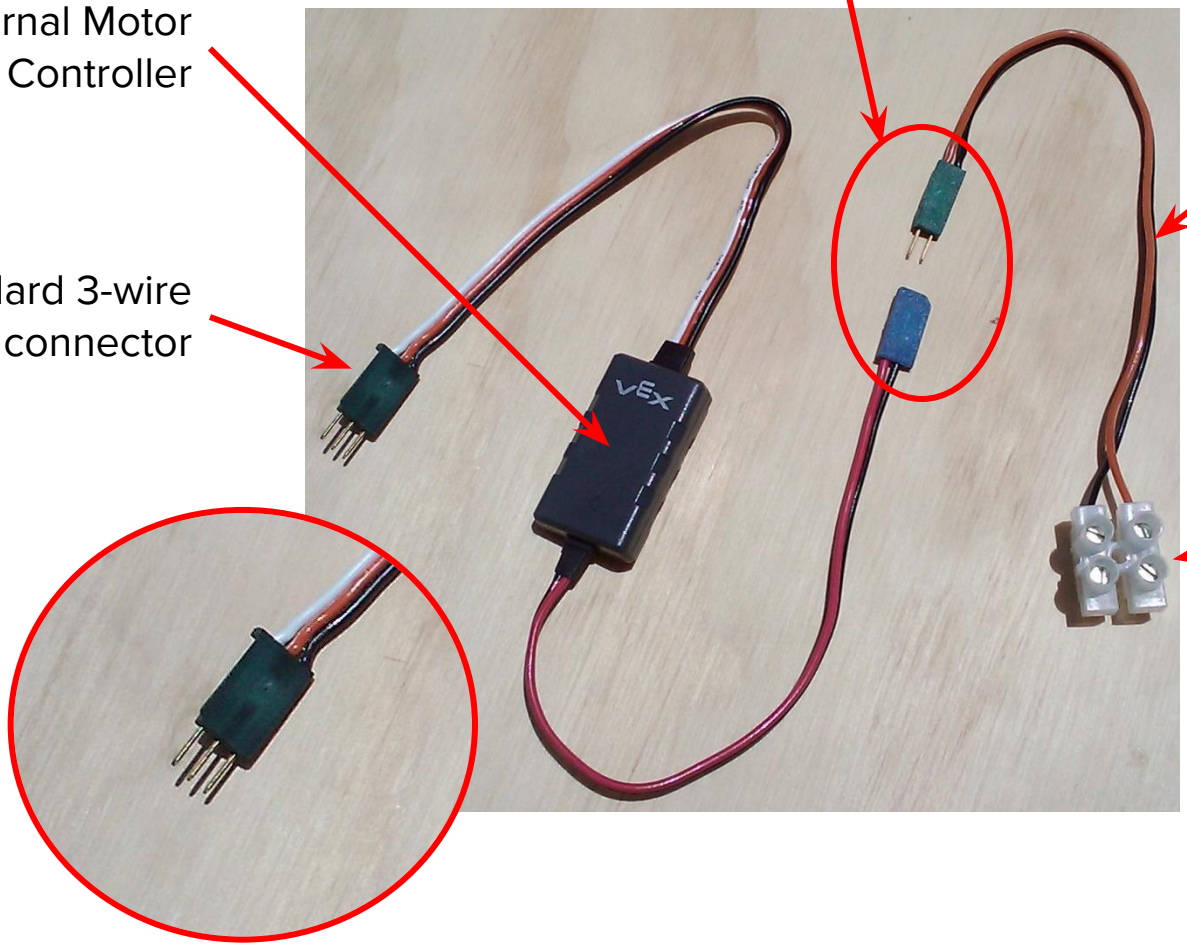
3/32 hex wrench for mounting screws



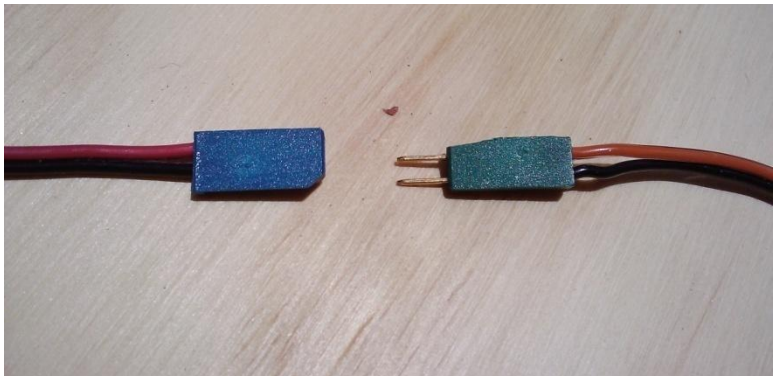
Small motor plate

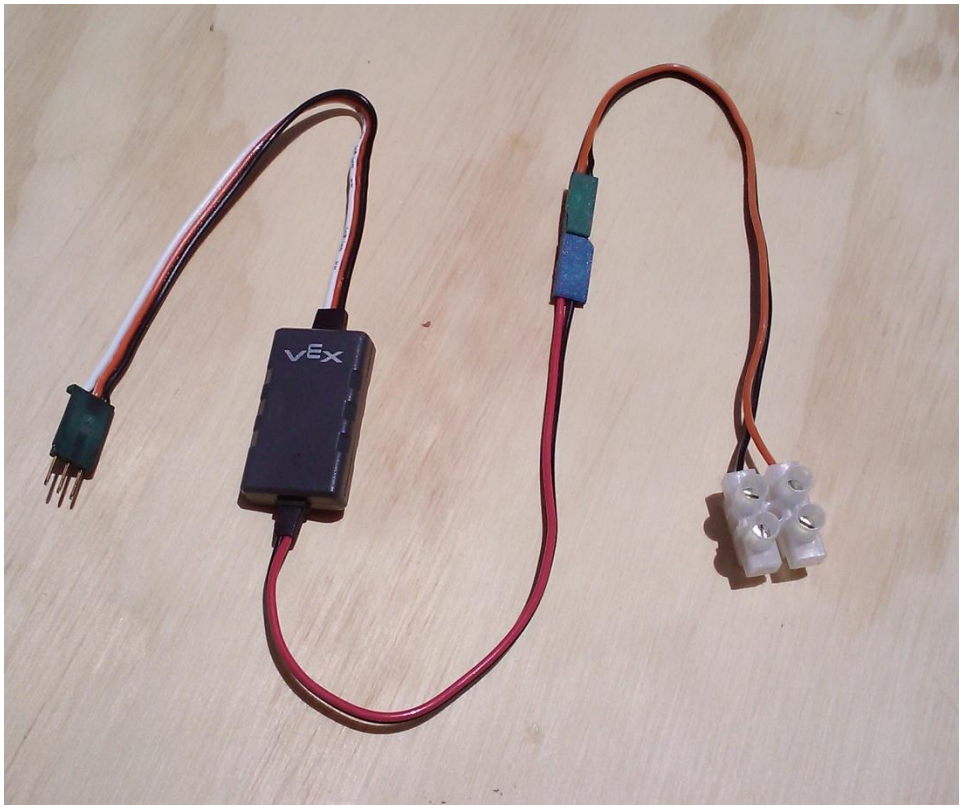
Large motor plate (cut down)

3-Wire Motor Connection (1)



3-Wire Motor Connection (2)



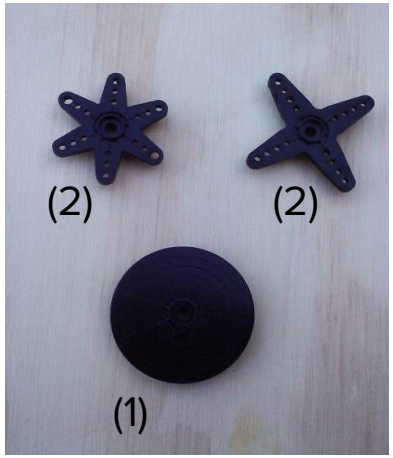


- Connectors are not keyed
- Connect red to red, black to black or reverse to change the motor response

Servos

- Futaba S3003 or S3004 series
- Maximum 120 degree rotation (+60, -60)
- Connection to Cortex controller
    - via 3-wire PWM + Servo Power Adaptor
    - use motor ports 2 thru 9 only
- Servo horns may be modified

Servo Horns



Servo

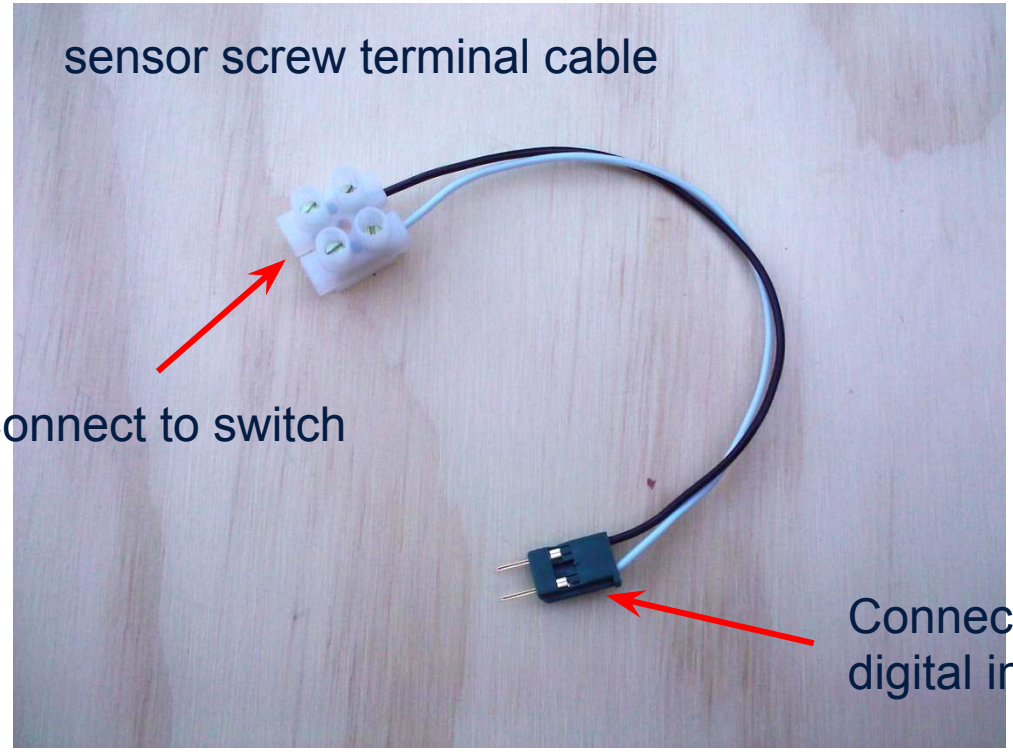
Servo Power Adaptors

Connecting a Servo

- Insert a Servo Power Adaptor cable into a motor port (2 through 9)
- Connect a servo (or servo extension cable) to the Servo Power Adaptor cable

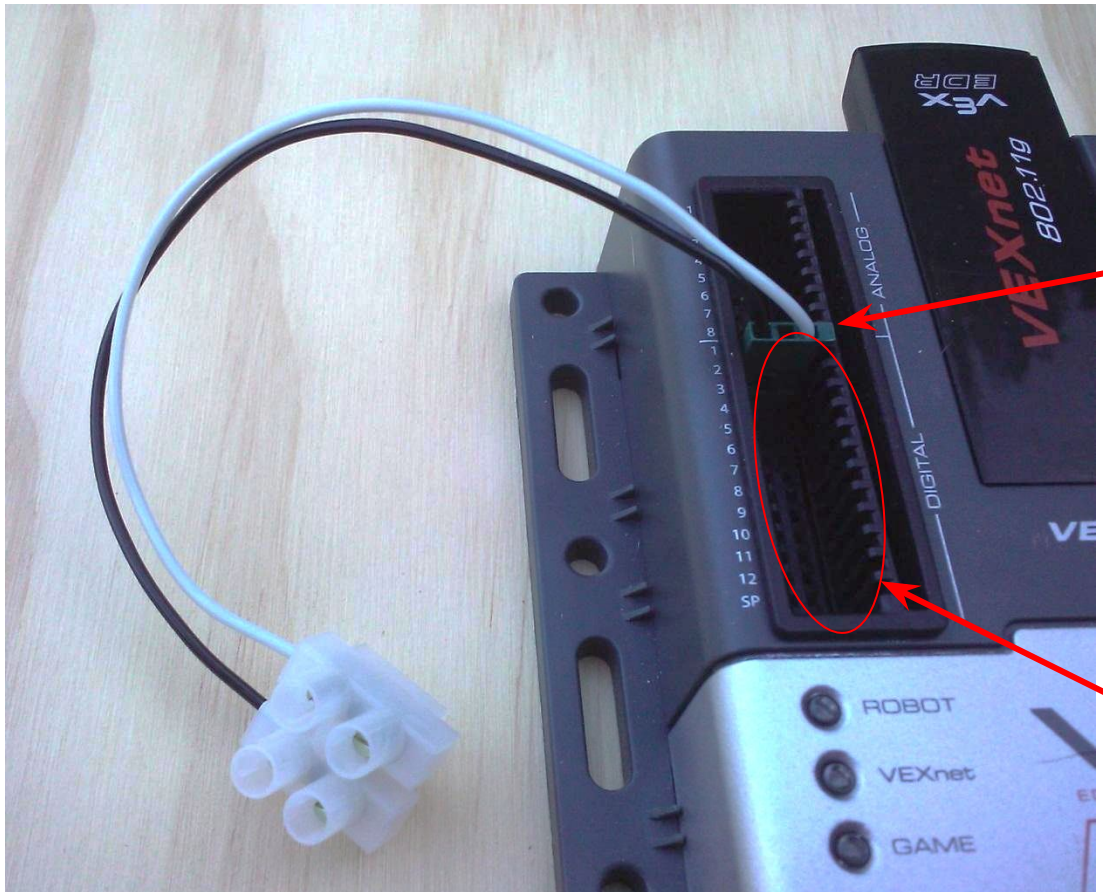
Digital Input Connections

- Use for limit switches, microswitches
- Connect to Cortex digital inputs using 2-wire sensor screw terminal cables (white/black wires)



Digital Input Connections (cont.)

- Must program digital port for proper direction (input)
- Open = reads as ‘1’ ; closed = reads as ‘0’



sensor cable connector is keyed

use digital ports 1 thru 12

Re-Syncing (Pairing) VEXnet

If VEXnet does not connect, you may need to re-sync the joystick/controller pair by simply connecting a USB cable and powering on both units.

BEST Default Program

Motor/Servo Port	Joystick Channel	Motor Limits	
		Positive Direction	Negative Direction
Motor 2 (pair opposite of Motor 9)	Stick 3	None	None
Motor 3	Stick 4	None	None
Motor 4 (pair opposite of Motor 7)	Button 7 and 8 Up/Down/Left/Right	None	None
Motor 5	Stick 1	Digital Input 1	Digital Input 2
Motor 6	Stick 2	Analog Input 1	Analog Input 1
Motor 7 (pair opposite of Motor 4)	Button 7 and 8 Up/Down/Left/Right	None	None
Motor 8	Button 6 Up	None	None
Motor 9 (pair opposite of Motor 2)	Stick 3	None	None

BEST Programming Options

- Three different programming environments available
  - MathWorks Simulink http://www.mathworks.com/academia/best-robotics/
  - easyCv4 http://www.intelitekdownloads.com/easyCV4
  - RobotC http://www.robotc.net/download/cortex
- Simulink is graphical programming/modeling environment with simulation capability (see what your program will do before you download it to the Cortex)
- easyC is a block programming environment (drag and drop programming elements)
- RobotC programs in C with a text editor, but it has runtime debugging (can step through program line by line and see what the results are)

Downloading a Program

Direct USB Download

Testing Tips

- Ensure your robot is ‘safe’ to operate:
  - Can’t move or fall off table (use a jack-stand)
  - All team members clear of moving parts
- Connect either WiFi keys or tether cable between the joystick and the Cortex controller.
- Make sure Cortex switch is in OFF position.
- Attach a charged battery.
- Turn on joystick (if not using tether).
- Turn Cortex switch to on position.
- For WiFi comm, link should establish in ~10 sec
- Test robot operations with transmitter.

LED Status Lights

Joystick battery status

Robot battery status

Comm. link status

Game status (not used by BEST)

- Green battery – good charge
- Yellow battery - dying
- Red battery – dead

- Green VEXnet – comm. established
- Yellow VEXnet – searching
- Lights on the controller and the joystick are the same

Questions

Team Tips

- Tin motor wires with solder before attaching to screw terminals since frayed stranded wires can cause a short or use the optional quick-disconnect (spade) terminals.
- **Do NOT** solder wires to Cortex connectors!
- Sensor cables, servo power adapter cables and external motor controllers are all keyed in correct orientation; insert and remove carefully to avoid destroying connectors.
- Tighten screws on motor and sensor connector cables so that wires are not loose and do not pull out.
- Mount Cortex to robot using #8 screws through holes provided; be careful not to over tighten.
- Avoid “hot insertion” of USB Keys.
- You may operate tethered by removing the USB WiFi key and connecting a USB A-A cable between joystick and Cortex.

Joystick Calibration

- If the motors hum or creep (sticks not returning to zero), the joystick may need to be recalibrated
- Calibration procedure (as extracted from the easyC help file)

1) The Joystick must be "Linked" to the Cortex Microcontroller using the VEXnet Keys.
2) Hold the "6U" Back Switch depressed.
3) While the "6U" Back Switch is depressed, use a small Allen Wrench (1/16" or smaller) or similar small straight tool to depress and hold the CONFIG Switch.
4) Hold both Switches depressed until you see the Joystick LED Flash RED and GREEN - you can now release both Switches.

a. There is a 10 second time limit to complete the following steps 5 and 6.

5) Now move both Joystick Pots to the maximum position desired in all 4 directions - Up, Back, Left, and Right.

a. If a movement is not detected in all 4 directions, a timeout will occur after about 10 seconds and the Cal Mode will be discontinued and the VEXnet LED will briefly Flash Red.

b. The Joystick LED will continue to Flash RED and GREEN during the calibration process.

6) After movement is detected in all 4 directions, the Joystick LED will be ON and Solid GREEN.

a. To "Save" the Calibration, depress and release the "8U" Top Switch Button.

b. If the calibration is accepted and Saved, the Joystick LED will start Flashing Fast GREEN for a few seconds.

c. If the Calibration is not Saved, a timeout will occur after about 10 seconds and the Cal Mode will be discontinued and the VEXnet LED will briefly Flash Red.

d. To cancel a calibration, depress and release the "7U" Top Switch Button. The Cal Mode will be discontinued and the VEXnet LED will briefly Flash Red.

e. If the Cal Mode is discontinued or saved, the Joystick LEDs will resume their normal function after the VEXnet LED briefly Flashes.

Where to find help?

- Online resources/documentation (BRI Site)
  - http://best.eng.auburn.edu/b_resources1.php
- BEST Public Message Board (for anyone)
  - http://tech.groups.yahoo.com/group/bestinc/
  - Must register for login account
  - Share ideas, resolve issues, …
- Official Q&A "Control System" Category
  - http://best.eng.auburn.edu/cgi-bin/bestqna.pl
  - Use "Official Q&A" page during contest for "rules specific" questions
  - Is this legal?

Where to find help? (cont.)

- VEX Forum
  - http://www.vexforum.com/forum.php
  - Technical questions about VEX equipment
  - easyC and RobotC dedicated forums included here
- Robotevents BEST Forum
  - http://forum.robotevents.com/forumdisplay.php?f=51
  - Dedicated user forum for BEST Robotics
  - Must register for a login account