Innovation First, Inc.
Control System Overview

**Full Size Robot Controller
With External Radio**

**EDU Robot Controller
& Motherboard
With Internal Radio**

**Operator Interface with External Radio,
Joysticks, and AC Adaptor**

1. Two Robot Controllers, One Operator Interface

The Innovation First control system now has two different Robot Controllers. One is the Full-Size Robot Controller and the other is the smaller Isaac16 EDU Robot Controller & Motherboard. Both Robot Controllers can be used in the remote control of robots. Both Robot Controllers communicate with the same Operator Interface. The Full-Size Robot Controller is required to compete in the FIRST Regional and Championship Events. The EDU Robot Controller & Motherboard can be used with the EDUrobotics Robot Prototyping Kit.

2. Control System Overview

WARNING: Please read the following documents carefully.
Failure to configure your control system properly could result in personal injury, damage to the control system, or damage to your robot. Innovation First, Inc. will not provide free replacement of control system components damaged due to misuse or miswiring.

The documentation for the control system is divided into a System Overview, Reference Guides, and Quick Start Guides. The System Overview (the document you are now reading) touches briefly on the overall system operation. The Quick Start Guides give you brief diagrams and instructions to get your system functioning as quickly as possible. When you need detailed information, the Reference Guide should answer all your questions. If, after reading all the corresponding documentation, you have problems configuring the control system or have other questions about the control system, please contact Innovation First at 903-454-1978. We will be happy to answer any questions you have.

Below lists the documentation that is associated with the Innovation First Control Systems. All these documents are located on our web site at InnovationFirst.com.

Overview:
       Control System Overview

Quick Start Guides:
       Full-Size Control System Quick Start Guide
       EDU Control System Quick Start Guide
       EDU Default Software Quick Start Guide

Reference Guides:
       Full-Size RC Reference Guide
       Operator Interface Reference Guide
       EDU-RC & Motherboard Ref Guide
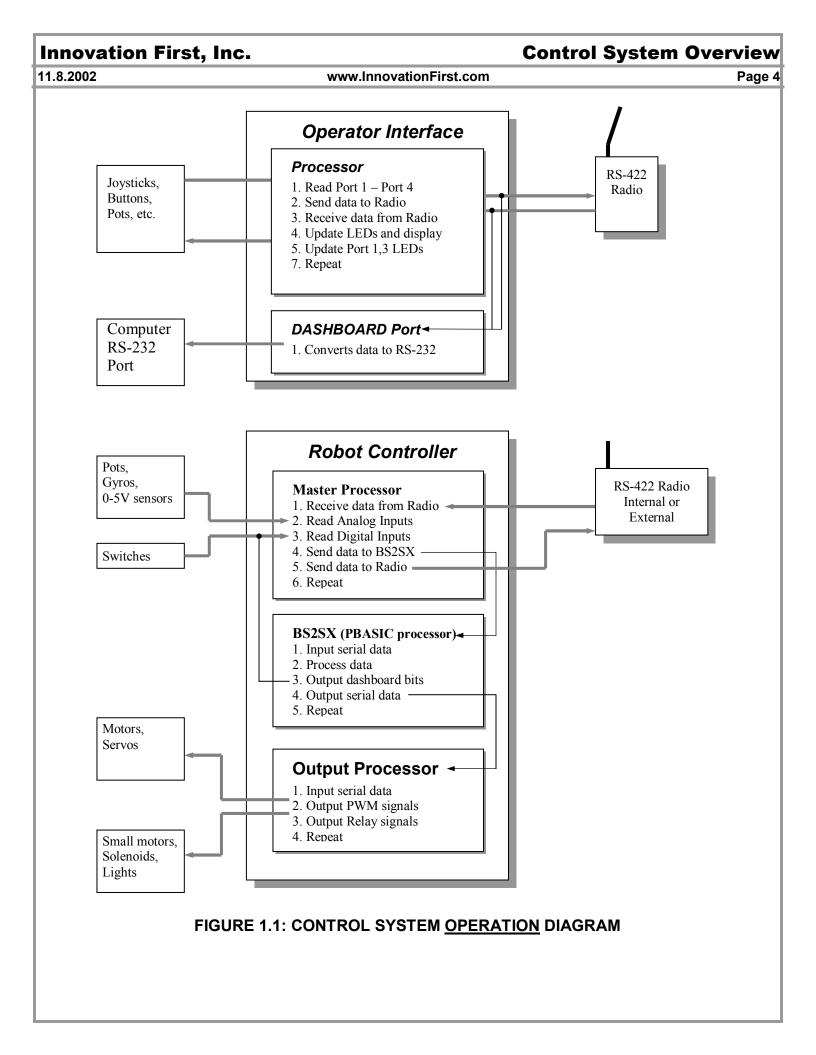   Programming Reference Guide

The heart of the Innovation First control systems are the Operator Interface and the Robot Controller. The Operator Interface takes inputs from the human operator(s) and passes it to the Robot Controller. The Robot Controller takes this information, gathers additional information from sensors on-board the robot, determines how the robot should function based on PBASIC programming, and instructs the robot to perform these functions. The Robot Controller also sends data back to the Operator Interface, giving the human operator(s) feedback of critical information. Figure 1.1 shows a block diagram illustrating this concept.

The Operator Interface and Robot Controller have two ways to communicate to each other. One way requires the use of 900 MHz radios for "wireless communication". The other way called "Tether". When using Tether, the communication between the Operator Interface and Robot Controller uses a wire cable to connect the two units together. The same data is transmitted and/or received in both methods of communication.

The Innovation First control system uses a unique "Team Number" identification to ensure safe and reliable human to robot communication. Users enter their team number via dipswitches on both the Operator Interface and the Robot Controller. Both units use this number as a unique identifier, ensuring that all communications received are actually "theirs". Before a received data packet is used it must pass 1) team number check, 2) channel number check, and 3) checksum verification. Figures 1.2 and 1.3 show a block diagram of the Team Number concept in a radio and tether start up.

The Operator Interface has a "Competition" connector designed specifically for connecting the system to the playing field at FIRST competitions. This connection sets the radio to one of 35 competition only channels, provides power, and even starts and stops the robot during matches.

Good luck! We hope you enjoy the new control system!

Operator Interface

Processor
1. Read Port 1 – Port 4
2. Send data to Radio
3. Receive data from Radio
4. Update LEDs and display
5. Update Port 1,3 LEDs
7. Repeat

Joysticks, Buttons, Pots, etc.

RS-422 Radio

DASHBOARD Port
1. Converts data to RS-232

Computer RS-232 Port

Robot Controller

Master Processor
1. Receive data from Radio
2. Read Analog Inputs
3. Read Digital Inputs
4. Send data to BS2SX
5. Send data to Radio
6. Repeat

Pots, Gyros, 0-5V sensors

Switches

RS-422 Radio Internal or External

BS2SX (PBASIC processor)
1. Input serial data
2. Process data
3. Output dashboard bits
4. Output serial data
5. Repeat

Output Processor
1. Input serial data
2. Output PWM signals
3. Output Relay signals
4. Repeat

Motors, Servos

Small motors, Solenoids, Lights

FIGURE 1.1: CONTROL SYSTEM OPERATION DIAGRAM

Operator Interface
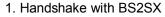
1. Read TEAM NUMBER dipswitch
2. Display Team Number
3. Read COMPETITION Port
4. Read CHANNEL dipswitch
5. Set Radio channel
6. Send data to Radio
7. Receive data from Radio
8. Wait until data contains the correct Team number and correct channel

↓

1. Display Channel
2. Begin normal operation

Robot Controller

1. Read TEAM NUMBER dipswitch
2. Check for Tether connection
3. Check for Radio Connection
4. Wait until Tether or Radio connection exists.

↓

1. Handshake with BS2SX
2. Set Radio to last used channel
3. Receive data from Radio
4. Until data contains the correct Team Number and channel, set to the next channel and repeat (scan)

↓

1. Lock to Channel. Channel remains locked until reset or power-up
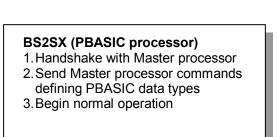2. Radio transmit enabled
3. Begin normal operation

BS2SX (PBASIC processor)
1. Handshake with Master processor
2. Send Master processor commands defining PBASIC data types
3. Begin normal operation

FIGURE 1.2: CONTROL SYSTEM RADIO STARTUP DIAGRAM

Operator Interface

1. Read TEAM NUMBER dipswitch
2. Display Team Number
3. Read COMPETITION port
4. Read CHANNEL dipswitch
5. Detect Tether connection
6. Send data to Tether
7. Receive data from Tether
8. Wait until data contains the correct Team number and correct channel

1. Display Channel
2. Begin normal operation

Robot Controller

1. Read TEAM NUMBER dipswitch
2. Check for Tether connection
3. Check for Radio Connection
4. Wait until Tether or Radio connection exists.

1. Handshake with BS2SX
2. Receive data from Tether
3. Until data contains the correct Team Number and channel, set to the next channel and repeat (scan). Channel ignored on new Robot Controllers.

1. Lock to Channel. Channel remains locked until reset or power-up
3. Begin normal operation

BS2SX (PBASIC processor)
1. Wait for Master processor
2. Send Master processor commands defining PBASIC data types
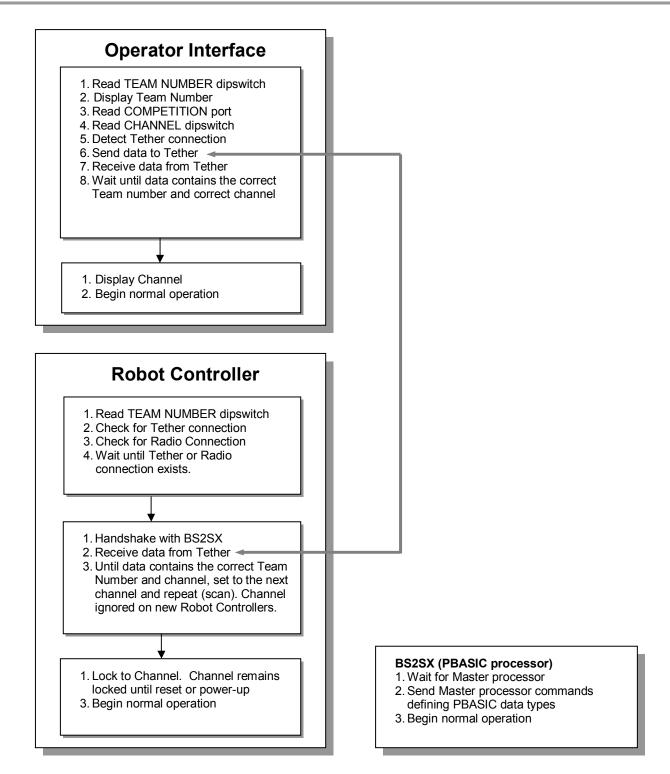3. Begin normal operation

FIGURE 1.3: CONTROL SYSTEM <u>TETHER STARTUP</u> DIAGRAM

Note: Channel scan and lock is performed during tether startup to support radio operation after tether is removed. Channel is not checked on new systems to enable fast tether connections.