

Controller USB

User's Manual

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intelitek▶▶

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General Information

About the Controller USB

The Controller USB is part of the SCORBOT- robotic system. It can also be used to control two peripheral devices offered by Intelitek. A Teach Pendant is available for this system.

Block Diagram Description

The basic RoboCell for SCORBASE system is comprised of the following three hardware modules:

- * Computer
- * Controller USB
- * Robot

Extended features

The Controller USB can be connected to:

- * Teach Pendant (direct manual control)
- * Two Peripheral Axes with axes control
- * Analog and digital I/O devices
- * RS-232 communication port (for future use).

The Controller USB interfaces the computer with the robot and the expanded features. The computer is connected with the Controller USB via an USB module. The robot is interfaced to the Controller USB by a proprietary interface cable. See block diagram in Figure 1-2.

An overview of the system with the Teach Pendant is given in *Figure 1-1*.



Figure 1-1: System Overview

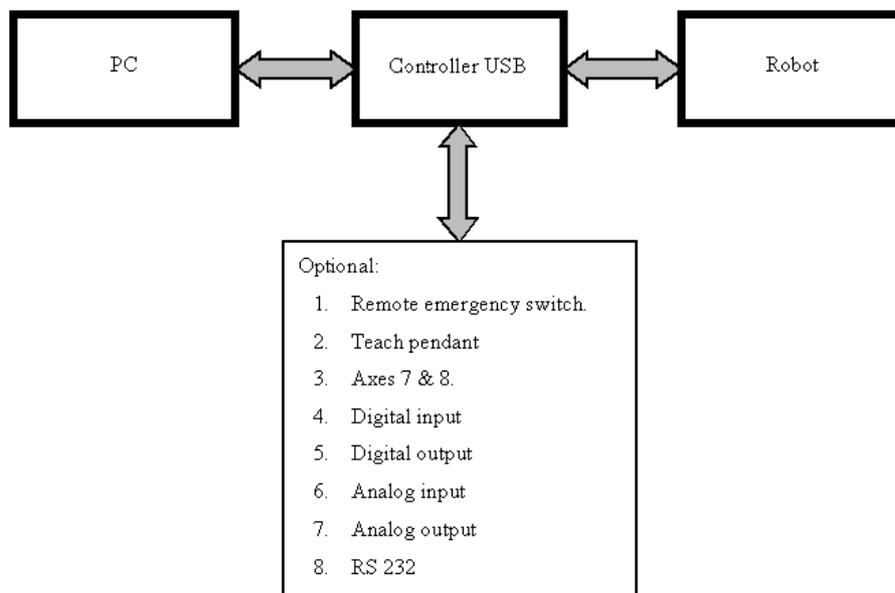


Figure 1-2: Block Diagram

Controller USB

The Controller USB controls the 24V-power supply to six robot motors and to two (optional) accessory motors of the peripheral devices (axes 7 & 8).

The Controller USB contains the circuits that control the motors (by means of PWM signals), and reads the encoder and microswitch signals.

Analog and digital I/O devices can also be interfaced with the Controller USB via the digital and analog I/O ports.

Acceptance Inspection

After removing the Controller USB from the shipping carton, examine all components for signs of shipping damage. If any damage is evident, do not install or operate the Controller USB. Notify your freight carrier and begin appropriate claims procedures.

The following items are standard components in the Controller USB package.

Make sure you have received all the items listed on the shipment's packing list. If anything is missing, contact your supplier.

Controller USB Package packing list	
1.	<i>Controller USB 110/220V AC</i>
2.	<i>Cables:</i> Power Cable 110/220 VAC UBS Cable Remote emergency switch by pass cable.
3.	<i>Emergency Bypass Plug</i> (required when TP not connected)
4.	<i>SCORBASE software</i> - on CD.
5.	<i>Documentation:</i> Controller USB for ER4 USB - User's Manual SCORBASE User's Manual
6.	<i>Teach Pendant (TP)</i> (Optional and supplied only when ordered): Teach Pendant Mounting fixture; <i>Teach Pendant for Controller USB User's Manual</i>

Repackaging the Controller USB

Save the packing materials and shipping carton. You may need them later for shipment or for storage of the Controller USB.

The Controller USB should be repacked in its original packaging for transport.

Specifications

The following table describes the Controller USB specifications:

Controller USB Specifications	
Item	Specification
<i>Type of Control</i>	Real time; Multi-tasking; PID (proportional, integral, differential); PWM (pulse width modulation).
<i>Number of Servo Axes</i>	Maximum: 8
<i>Groups of Control</i>	8 axes can be divided into 2 control groups: 6 robot axes and 2 peripheral axes. Axis interpolation in robot and peripherals groups.
<i>Axis Drivers</i>	PWM H-bridge drivers 15 kHz, 3A standard; 7A peak 12/24V (depending on input voltage and load)
<i>Path / Trajectory Control</i>	CP: Joint; Linear; Circular. 1.5 ms control cycle parameter. Software controlled acceleration/deceleration. PID parameters.
<i>Speed Control</i>	Speed or Travel time definitions. Ten Speed levels are available
<i>Control Parameters</i>	I/O control Speed, velocity profile, smoothing Axis position error Gripper operation Thermic, impact, limit protection Homing Encoder interface Cartesian calculations
<i>Power Requirements</i>	110/220V AC (+15%, -10%), 50/60Hz, 180W max.
<i>Internal Power Supplies</i>	Servo: 24V (depending on input voltage and load) Digital: 5V, +15V, -12V
<i>Controller USB Weight</i>	7kg
<i>Controller USB Dimensions</i>	L=315mm; W=223.5mm; H=117
<i>Ambient Operating Temperature</i>	Range 10 ⁰ C - 35 ⁰ C
<i>Micro-controls</i>	Controller USB: NEC V853 on I/O card
<i>Communication</i>	2 integrated RS232 channels: one for Teach Pendant; one for future use.

Controller USB Specifications	
Item	Specification
<i>12 Volt power supply</i>	12 volt power supply 0.1A Max
<i>Digital Output</i>	8 digital outputs, 24V max 1 - 4 Relays 1.5A Max. 5 - 8 open collectors, source
<i>Digital Input</i>	8 Dry Contacts or 0 - 24 V 0.5A Max. PNP/NPN connections configurable.
<i>Analog Output</i>	2 analog outputs: 8-bit 20mA Max. resolution; output voltage 0-10V
<i>Analog Input</i>	4 analog inputs 8-bit resolution digital signal; input voltage 0-10V
<i>Programming Language</i>	SCORBASE Software
<i>Position Teaching</i>	SCORBASE; Teach Pendant. Position type (Absolute; Relative; Cartesian; Joint)
<i>Positioning Sensors</i>	Incremental optical encoders for each axis
<i>Coordinate System</i>	XYZ coordinates; Joint coordinates
<i>LED Indicators</i>	Main power - red power on, Orange online. 8 Digital Inputs 8 Digital Outputs Motors Emergency Stop
<i>Safety Features</i>	Emergency switches: on Controller USB; on Teach Pendant; optional connection of remote switches.
	Short-circuit protection; On overheating, driver power shutdown; On failure, motor power shutdown; On communication failure, motor power shutdown.
	Thermal, impact and limit software protection Hardware watchdog for each axis protects against software faults.

Controller USB Specifications	
Item	Specification
<i>Teach Pendant (optional)</i>	25 multi-function keys 4 line LCD display; 20 characters per line Emergency Stop push button Dead man switch Auto/Teach selector switch Full control features Mounted (full features) Hand-held (no program execution).

Safety

Handling the Controller USB

Do not hold the Controller USB by either the front or rear panels.

- * Make sure that all cables are disconnected before moving the Controller USB.

Warning!

Do not operate the Controller USB until you have studied this manual thoroughly.

Do not install or operate the Controller USB under any of the following conditions:

- * Power supply is not grounded
- * Ambient temperature drops below or exceeds the specified limits
- * Exposed to large amounts of dust, dirt, salt, iron powder, or similar substances
- * Subject to vibrations or shocks
- * Exposed to direct sunlight
- * Subject to chemical, oil or water splashes
- * Corrosive or flammable gas is present
- * Power line contains spikes

Do not operate the Controller USB near any equipment that generates large electrical noise.

Turn off the Controller USB before you connect any inputs or outputs.

Do not plug the Controller USB into the AC power outlet before making sure that its voltage requirement (as marked at the rear panel of the Controller USB) matches your voltage supply.

If the voltage setting does not match your supply, follow the instructions in **Chapter 7** for changing the Controller USB voltage setting.

Pressing the Emergency button disconnects the power supply to the robot, to axes 7 & 8, and halts the SCORBASE program. The digital and analog outputs freeze their status.

Do not connect voltage source to input terminals exceeding +24V.

Do not connect any output device that does not meet Controller USB specifications.

Never connect voltage from an external power supply directly to any open collector outputs.

The open collector outputs must always be connected to a load that meets Controller USB specifications.

Do not drive a current higher than 1.5A through the relay outputs.

Do not drive a current higher than 0.5A through the open collector outputs.

Make sure that the voltage supply of a device connected via the relay output does not exceed 24VDC.

CHAPTER 3.

Hardware Installation

Getting to Know Controller USB

Before beginning the installation, it is recommended that you familiarize yourself with the Controller USB. Please refer to Figures 3-1 and 3-2, and the legend that follows.

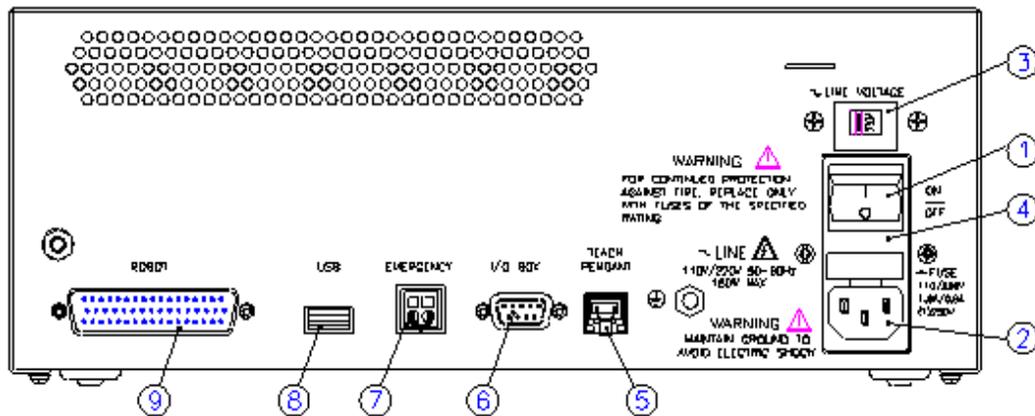


Figure 3-1: CONTROLLER USB - Rear Panel

Legend	
Rear Panel	
1	Power On/Off Switch
2	Power Line 110/220VAC socket
3	Line Voltage Selector
4	AC Power Fuse Drawer - 110V 1.6A; 220V 0.8A
5	TEACH PENDANT connection
6	RS-232 Com. port for future use
7	Remote EMERGENCY switch 2 pin connector
8	USB connector (to PC)
9	Robot 62-pin D-type high density connector

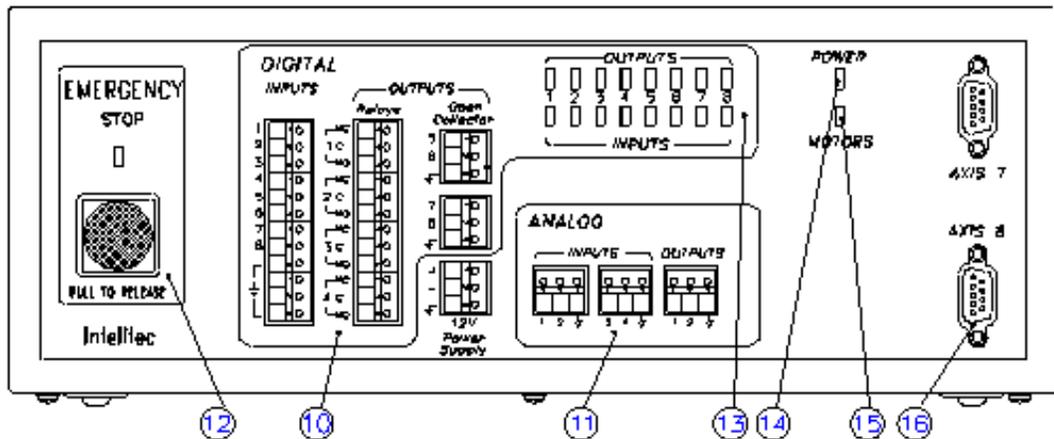


Figure 3-2: CONTROLLER USB - Front Panel

Legend	
Front Panel	
10	Digital Input / Output terminals
11	Analog Input / Output terminals
12	Emergency Button and LED indicator
13	Digital Input / Output LED indicators
14	Power LED indicator
15	Motors LED indicator (lit when control on) see note
16	Axes 7 and 8 Driver D9 connectors (separate for each device)
17	Auxiliary 12V DC Supply. - 0.1 Amp max.

Note:

The MOTORS LED indicates whether or not power is being supplied to all connected motors. LED lights after SCORBASE starts and CON (control on) command is issued.

MOTORS LED goes out whenever any of the following occurs:

- * COFF (control off) command is issued.
- * EMERGENCY button is pressed.
- * Controller USB detects a communication time-out.
- * Controller USB detects an over-current error
- * SCORBASE closes.

Computer Requirements

To operate and control the robot via SCORBASE and the Controller USB, the following requirements must be met:

- * Computer: Minimum - Pentium III PC with 350 MHz processor, or higher.
- * At least 128 MB of RAM.
- * A hard drive with at least 20 -Megabyte of free disk space.
- * Windows 98/2000.
- * A Super VGA or better graphics display, minimum 256 colors.
- * A Mouse or other pointing device.
- * USB port.

Controller USB Installation

Do not yet connect the Controller USB to the AC power supply.

Numbers in parenthesis refer to Figure 3-1 and 3-2.

Cable Connections

The numbers in brackets () refer to drawings 3-1 and 3-2.

Make sure that the Controller USB voltage setting (3) matches your voltage supply. If not refer to Changing the Voltage Setting in Chapter 7.

Make sure the Controller USB switch (1) is turned off.

Connect the Controller USB socket (8) to the USB socket on the computer.

Connect the robot cable to ROBOT port (9) on the Controller USB. Tighten the connector screws.

If a Teach Pendant is not in use, connect the Emergency Bypass plug into the Teach Pendant port (5) on the Controller USB rear panel.

To use a Teach Pendant, connect it to the Teach Pendant connector (5) on the Controller USB rear panel. It is recommended that you set the Teach Pendant Auto/Teach switch to AUTO before you power on the system. If the switch is set to AUTO, the robot can be controlled either from the Teach Pendant or via the Controller USB. For more details, refer to the Teach Pendant Manual.

Connect power cable to the POWER socket (2) on the Controller USB rear panel and to a grounded AC power source.

If a remote emergency switch is not in use, connect the Emergency switch Bypass cable into the emergency stop terminal (7) on the Controller USB rear panel.

To install a remote emergency switch, refer to Remote Emergency Switch Installation.

Once you have made all the required hardware connections, you can turn ON the Controller USB.

After you have turned on the Controller USB, the power LED (14) lights red. If SCORBASE is open, the power LED (14) lights orange.

Remote Emergency Switch Installation

The EMERGENCY terminal at the back of the Controller USB (7) allows to add a remote switch (such as a mushroom button), which will function exactly like the control's EMERGENCY button.

To connect a remote emergency switch, do the following:

Check that the remote EMERGENCY switch contacts are normally closed (NC).

Remove the wire that shorts the two terminals of the EMERGENCY terminal (7) on the rear panel of the Controller USB. To do so, insert a small screwdriver into the upper (square) opening of the terminal and press down to release each end of the wire.

Connect two wires from the remote emergency switch terminals to the EMERGENCY terminal (7). To do so, insert a small screwdriver into the upper (square) opening of the terminal and press down while inserting each wire into the lower (round) openings of the terminal. Remove the screwdriver to clamp the wire in place.

Connecting Extended Features

Peripheral Axes: **AXIS 7 and AXIS 8**

The D9 connectors on the front panel of the Controller USB, marked **AXIS 7** and **AXIS 8**, support **SCORBOT** motorized devices that can be connected to and controlled by the Controller USB.

For a list of supported peripheral equipment, refer to **SCOREBASE for ER 4u User's Manual**.

To connect peripheral axes:

- * Turn off the Controller USB before you connect any device to Axes 7 or 8.
- * Connect peripheral device with a cable terminated by a D-type connector to a free D-type connector on the front panel of the Controller USB.
- * Tighten the cable connector screws.
The axes are configured via a **SCOREBASE** application.
- * Connect the Controller USB socket (8) to the USB socket on the computer.

Output Terminals and LEDs

The following output terminals allow the Controller USB to control external devices in the robot's environment. The Controller USB has:

- a) 4 digital relay outputs
- b) 4 digital open collector outputs, and
- c) 2 analog outputs.

Eight yellow LEDs, which correspond to the digital outputs, light up when these outputs are on.

Relay Output Specifications

Digital outputs 1 to 4 are relay outputs. The relay outputs are controlled using SCORBASE commands. Maximum voltage allowed 24Volt, maximum current allowed:1.5A

Each relay output has three terminations:

- * Common (C)
- * Normally Closed (NC)
- * Normally Open (NO).

Normally (before the relay is energized by SCORBASE command), the NO terminal is disconnected from the common line, and the NC terminal is connected to the COM terminal. When the relay is activated the NO terminal is connected to the COM terminal, and the NC terminal is disconnected from the COM terminal.

Figure 4-1 shows the interconnection scheme for devices via relay outputs.

The devices are activated via SCORBASE according to the following truth table

Output state	Device A (NO)	Device B (NC)
Off	Off	On
On	On	Off

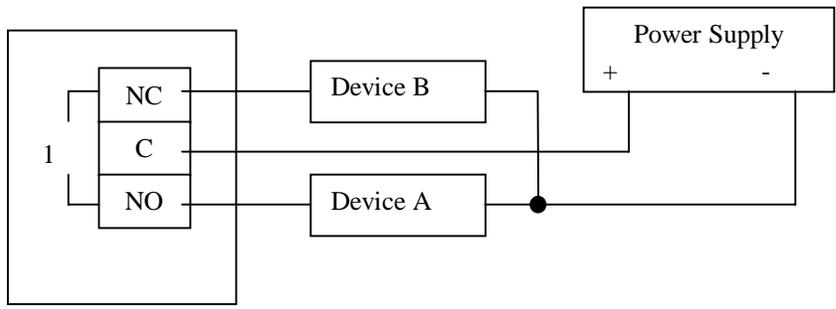


Figure 4-1: Output Relay (1 - 4) Interconnection Scheme

Open Collector Outputs

Digital outputs 5 to 8 include a transistor with an open collector in its final stage. These outputs must be connected to a load, such as a resistor, solenoid, relay or motor. When using an inductive load, such as a solenoid or a relay, connect a reversed biased protection diode across the load.

You may directly connect a Controller USB open collector output to a Controller USB digital input.

Output voltage: 24V, Maximum current: 0.5A.

Never connect voltage from a power supply directly to any open collector outputs (terminals 5-8). The open collector outputs must always be connected to a load of the above rating.

The interconnection scheme is illustrated in *Figure 4-2*.

Device B will be energized when SCORBASE turns ON output 5. Device A will be energized when output 6 is turned ON by SCOREBASE

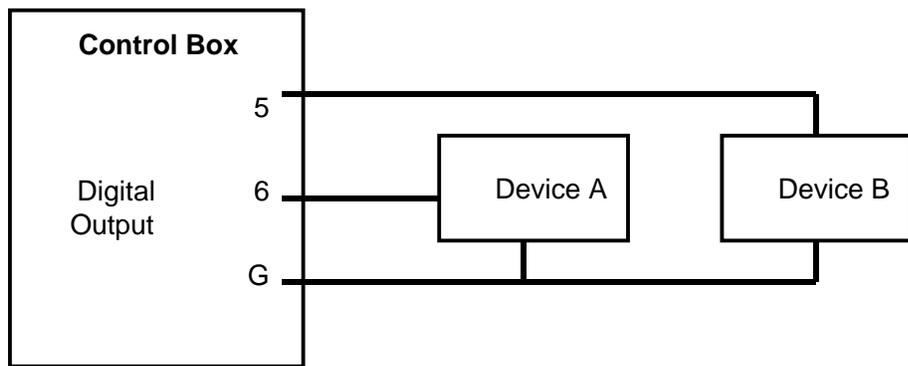


Figure 4-2: Open Collector Output - Interconnection Scheme

Note:

The open collector output is factory preset to source. To change setting, refer to *Figure 6-2: Jumpers Blow Ups*.

Analog Outputs

Analog outputs 1 and 2 allow you to control two devices that operate in accordance with an analog input voltage, such as a LED or a motor driver.

The analog outputs have 8-bit resolution A/D converter and an output voltage of 0-10V. The voltage is controlled via SCORBASE (output word 0-255 \Leftrightarrow 0-10V)

The analog output current is limited to 20mA. Use a hardware driver (booster) to energize a device requiring higher power.

Figure 4-3 shows the interconnection scheme to analog outputs.

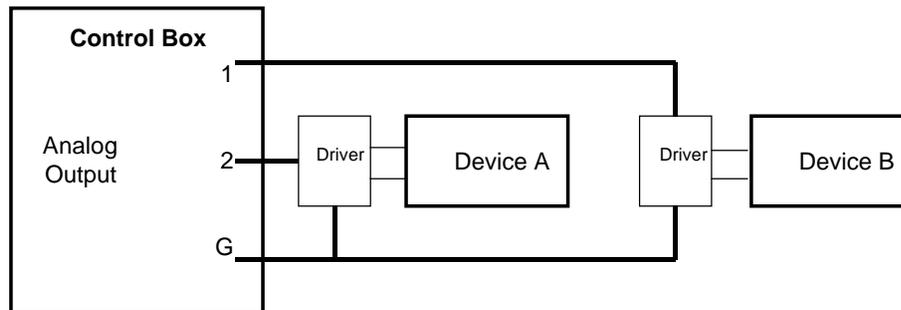


Figure 4-3: Analog Outputs Interconnection Scheme

Input Terminals and LEDs

The Controller USB holds 8 digital inputs and 4 analog inputs. Eight green LEDs, which correspond to the digital input status, lights up when the digital inputs are on.

Controller USB digital inputs are factory pre-set as SOURCE. For proper I/O operation, a paired source/sink connection is required. When connecting a Controller USB input to an external device, be sure the external device output is SINK (NPN) type. To change the input setting to sink refer to *Figure 6-2: Jumpers Blow Ups*.

The states of the inputs are read by software commands.

Digital Inputs

Two types of devices can be connected to digital inputs 1 – 8:

- 1) A *dry-contact* switch or sensor can be connected directly to a Controller USB input terminal and to a Controller USB inputs ground. Closing the switch or sensor contacts turns the output ON. The interconnection scheme is shown in Figure 4-4.

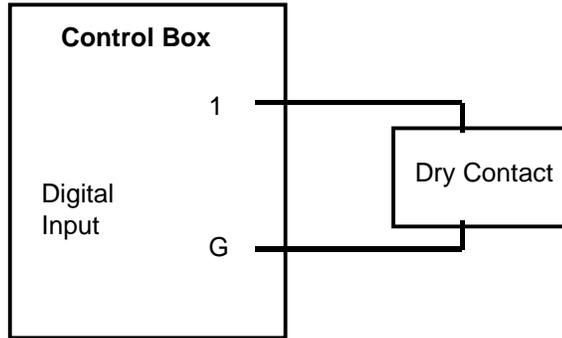


Figure 4-4: Digital Input dry-contact switch, or sensor, is connected to a Controller USB input

- 2) NPN sensing devices can be connected to Controller USB input. Connect the sensor output to a Controller USB input, and the sensor ground to a Controller USB input ground, as shown in Figure 4-5.

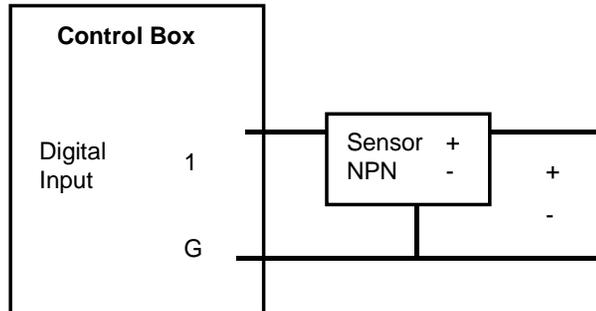


Figure 4-5: Digital Input Voltage from external sensing devices is connected to a Controller USB input

Notes:

You can use the 12 V power supply to power the sensor.

The controller inputs are factory pre-set to NPN sensors. To change to PNP sensors change the input jumpers setting.

For NPN sensors the voltage and input states are as follows:

- * Voltage of 0-1.5V DC from NPN turns the input ON.
- * Voltage of 2.5-24V DC turns the input OFF.

Do not connect voltage exceeding +24VDC to the digital inputs.

Analog Inputs

Analog Inputs 1 - 4 allow the Controller USB to receive data from analog sensors.

The analog inputs have 8-bit resolution and input voltage range of 0-10V.DC. The analog inputs are read by software commands

Figure 4-6 shows the interconnection scheme.

Before connecting an analog sensor, make sure the Controller USB is switched off.

You may use the 12 volt power supply to power the sensors.

Do not connect voltage exceeding +10VDC to the analog inputs.

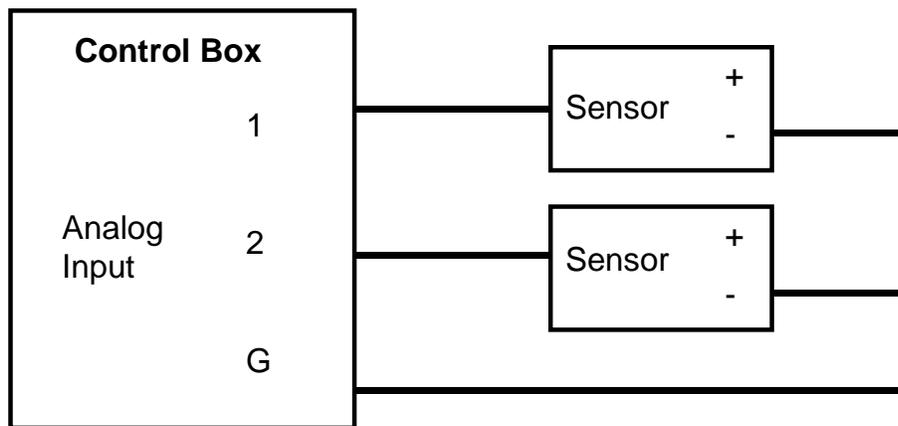


Figure 4-6: Analog Input Interconnection Scheme

Operation

EMERGENCY Button and LED

Pressing the red EMERGENCY button on the front panel or a remote EMERGENCY stop switch will lead to the following:

- * Motor power is disconnected; all motor movement stops and the MOTORS led turns off.
- * COFF state is activated.
- * Emergency LED lights up.
- * An Emergency message appears on Teach Pendant and SCORBASE screens.
- * Program is aborted.
- * The Controller USB outputs freeze in their current state.
- * All SCORBASE commands, including HOME and CON cannot be activated.

Warning:

Pressing the Emergency button will not stop the output device. To stop the output device use the device's Emergency stop button.

Pulling out the EMERGENCY button on the front panel or releasing a remote EMERGENCY stop switch will lead to the following:

- * The red emergency LED turns off.
- * A message appears on the SCORBASE screen, prompting you select between CON (control on) state or to remain in COFF state. If CON is selected the green MOTORS LED turns on.

Remote Emergency Switch

When a remote emergency switch is connected to the Controller USB (7), it functions exactly like the EMERGENCY button located on the front panel of the Controller USB.



CHAPTER 6.

Physical Description

The Controller USB holds 2 cards:

- * Power and control Card
- * I/O Card attached to the rear of the front panel

There is no need to open the Controller USB as there are no serviceable parts or fuses in it. Opening the box may be required to either set the digital input setting high/low or to change the open collector output setting sink/source.

To open the Controller USB:

- * Disconnect the power supply cable.
- * Release 4 screws at the bottom of the Controller USB.
- * Slide the cover gently to the rear.

Locate the jumpers on the upper left corner of the I/O card as shown in Figure 6-1.



Figure 6-1 Jumpers Location

Note:

The output is factory preset to Source; the input is factory pre-set to High.

Jumpers Setting

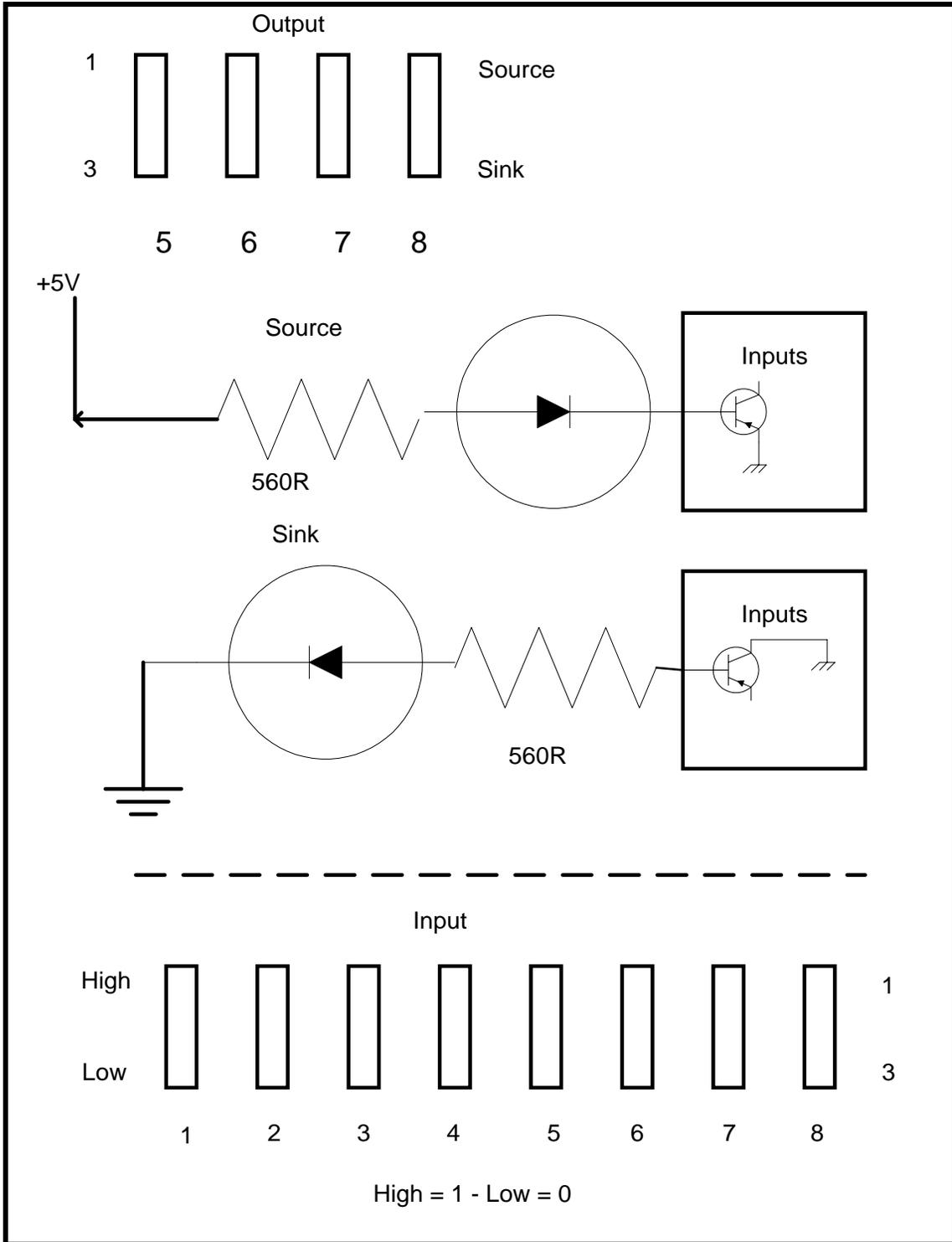


Figure 6-2: Jumpers Blow Ups

Jumper Settings

The jumpers are located on the back of the I/O card. They are used to set the output and input configuration. For enlargement, see *Figure 6-2: Jumpers Blow Ups*.

The 4 output jumpers change the configuration of digital outputs 5-8, from Source to Sink. The 8 input jumpers change the digital input configuration from High dry contact, or NPN to Low. High = 1, Low = 0.



Maintenance

To ensure continued optimum performance of the Controller USB, follow all safety guidelines and warnings, and regularly perform the inspection procedure.

Inspection

Perform a routine inspection of your system at the start of every working session, in the following order:

1. *Before you power on the system, check the following items:*
 - * The installation meets all safety standards.
 - * The robot is properly secured to the work surface.
 - * All cables are properly and securely connected.
Cable connector screws are fastened.
 - * Replace any cables that show signs of abrasion or wear.
 - * No output is connected directly to a power supply.
 - * No people are within the robot's working area.
2. *After you have switched on the PC and the Controller USB, check the following items:*
 - * The power LED is orange.
 - * Motor LEDs on after SCORBASE starts and control on is selected.
 - * No unusual noises are heard.
 - * No unusual vibrations are observed in any of the robot axes.
 - * There are no obstacles in the robot's working area.
3. *Bring the robot to a position near home, and activate the homing procedure. Check the following items:*
 - * Robot movement is normal.
 - * No unusual noise is heard when robot joins move.
 - * Robot reaches home position in all five axes, gripper (axes 7 & 8 if connected), and Homing Complete message appears.

Troubleshooting

Whenever you encounter a malfunction, try to locate source of the trouble by replacing the suspected faulty component - for example, Controller USB, robot arm, UBS cables - with an identical component from a working system.

Do not open the Controller USB (except for jumper setting). There are no user-serviceable parts inside. Do not attempt to repair and contact your agent or dealer.

The following guidelines outline common symptoms and possible remedy.

1. *Controller USB power does not turn on.
The power LED on the Controller USB front panel does not light up.*
 - * Verify that the Controller USB power switch in on.
 - * Make sure the AC power supply matches the Controller USB voltage requirement, as seen on the tag at the back of the Controller USB.
 - * If the voltage supply and Controller USB voltage setting do not match, disconnect immediately, and change the voltage setting, as described later in this chapter.
 - * Make sure AC power is being supplied to the power outlet.
 - * Make sure the power cable is connected to both the proper power source and the Controller USB.
 - * Check the 220V/110V 1.6A/0.8A fuse.
2. *No communication between the Controller USB and computer.
Communication error message while operating robot from computer power Led is RED.*
 - * Select On-line mode.
 - * Make sure the connecting cable is properly connected to the Controller USB and to the computer.
 - * If problem persists, replace USB cable.
 - * Reinstall the USB driver (refer to page 29)
3. *Controller USB is on, but robot arm cannot be activated; or one axes fails to respond and an error message is displayed..*
 - * Verify that Motors LED is lit.
 - * Make sure an obstacle is not blocking the robot.
 - * Make sure none of the axes has reached its mechanical limit.
 - * Make sure the robot cable is properly connected to the Controller USB.
 - * Reinstall the USB driver (refer to page 29).

4. . *The gripper does not respond to open or close commands, or responds incorrectly.*
 - * Make sure the robot cable is properly connected to the Controller USB.
 - * Turn the Controller USB off, then turn it on again and select on-line mode.
 - * If problem persists, contact your agent.
5. *Motor turns constantly in one direction, or responds incorrectly.*
 - * Make sure the robot cable is properly connected to the Controller USB.
 - * Turn the Controller USB off,. Then turn it on again and select on-line mode.
 - * If problem persists, contact your agent.
6. *Errors in the accuracy of the robot*
 - * A faulty encoder may cause position deviations in one or more of the axes during the running of a program.
 - * Contact your agent.
7. *The Controller USB does not receive an input signal.*
 - * Check the input wiring.
8. *The Controller USB does not issue output signals.*
 - * Check the output wiring.
 - * Check whether a load has been connected properly.
9. *The Home position suddenly changes, and the robot continues operation in relation to the new Home.*
 - * This fault may occur continually or occasionally, due to noisy electrical systems.
 - * Execute the Home routine, and reload the program you want to run.
 - * If the fault occurs frequently, use filtering equipment on your power line.
 - * If problem persists, contact your agent.

Fuse Replacement

If the Controller USB voltage setting does not match your AC power supply, you must change the Controller USB voltage setting and AC power fuse.

1. Use a small screwdriver to open the fuse drawer at the rear panel of the Control Box.
2. Use 110V 1.6A; 220V 0.8A for replacement.
3. Push the fuse drawer back to its normal position.

Changing the Voltage Setting

If the Controller USB voltage setting does not match your AC power supply, you must change the Controller USB voltage setting and AC power fuse.

1. Do not connect the Controller USB to an AC outlet during voltage setting.
2. Using a pen or screwdriver, push the voltage selector to the opposite side, so that the proper voltage selection is visible.
3. Again, using a pen or screwdriver, pull out the fuse drawer. Remove the fuse from its holder.
4. Replace the fuse with the appropriate fuse for your power supply:
 - * 110V AC requires 1.6A fuse.
 - * 220V AC requires 0.8 fuse.
5. Reinsert the fuse drawer, and push until it snaps into place.

Driver Installation Procedure

SCORBASE automatically installs a USB driver named ERUSBClass in the computer. If another application changed the driver re-install the USB driver as follows:

1. Select My computer
2. Right click and select properties (or press the ALT+ENTER keys)
3. For Win 98
 - * Click device manager
 - * If the USB driver is not ERUSBClass Select the current USB device.
 - * Click Remove to remove the driver.
4. For Win 2000
 - * Click on hardware.
 - * Select device manager.
 - * Select the wrong USB device
 - * Click remove to remove it.
5. After the USB removal (and SCORBASE installed) the correct driver is automatically updated. If not, uninstall and then reinstall SCORBASE.

