Prop-SX Controller
PN: 31103

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DESCRIPTION

The Prop-SX is a small-scale controller designed to meet the needs to prop builders, effects technicians, and others involved in light industrial control. The Prop-SX combines a Parallax SX28AC/SS microcontroller core with two high-current sink drivers (ULN2803A), allowing the user to connect devices like relays, solenoids, and lamps directly to the controller. Dual connections are provided for all I/O pins (3-pin header for TTL input/output connections; terminal block for high-current, open-collector outputs).

PRODUCT APPLICATIONS

- Holiday and museum displays
- Special FX and props
- Small-scale industrial control

FEATURES & BENEFITS

- SX28 microcontroller core; capable of up to 50 MIPS operation (@ 50 MHz)
- 3-pin socket allows user to set processor speed with external resonator
- 2.1 mm (center positive) power input (9 to 24 VDC)
- Three-position power switch (OFF, SX only, SX and V+ terminal)
- 5v regulator provides up to 0.5 amps for TTL circuits
- ULN2803A high-current sink (open collector) drivers for outputs
- All TTL I/O pins are protected with 220 Ω inline resistors
- Servo-style 3-pin header (Signal-Vdd-Vss) on all TTL I/O pins
- Optional pull-up / pull-down setup resistors available on P12 through P15
- RS-232 (TX and RX) connection for user applications
- 32K (24F256) EEPROM for user applications
- Compact size: 3.2" x 4.15" (82.8mm x 50.8mm)

Power Connection / Power Switch

Power to the Prop-SX controller is provided through a 2.1 mm, center-positive barrel connector (commonly used with "wall-wart" power supplies). Use of a center negative supply will damage the controller.

> **CAUTION**: Check the power supply carefully before connecting to the Prop-SX; the use of a center-negative, AC, or unregulated supply that significantly exceeds 30 VDC *will damage the controller*.
>
> Before connecting power to the Prop-SX controller, ensure that it is not resting on a metallic (conductive) surface; doing so could damage the Prop-SX circuitry and external power supply.
>
> **NOTE**: Do not exceed 30 VDC at the input of the Prop-SX controller. Doing so will cause the onboard regulator to shut-down and prevent operation of the controller. When in doubt, use a regulated power supply.

A three-position switch controls power on the Prop-SX. In position 0, all power is off. In position 1, power is supplied to the regulator and to the SX28; power is indicated by an LED near the power input connector. In position 1, the SX is active for programming and control via the 3-pin I/O headers. In position 2, the voltage supplied at the power connector is routed to the V+ terminal for use by external devices (relays, solenoids, lights, etc.). In position 2, a second power LED (near the V+ terminal) will be lit.
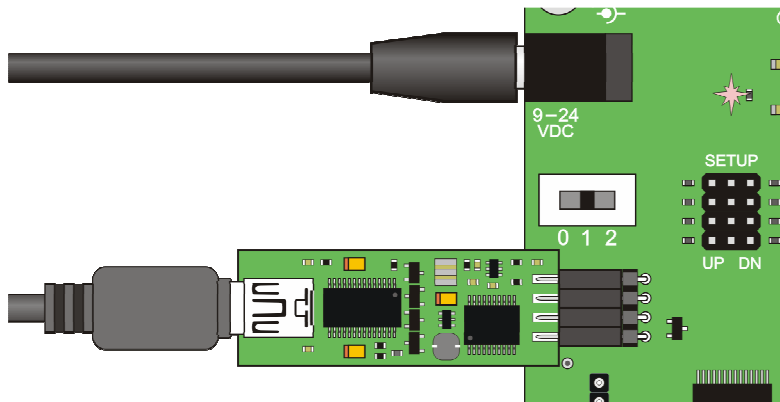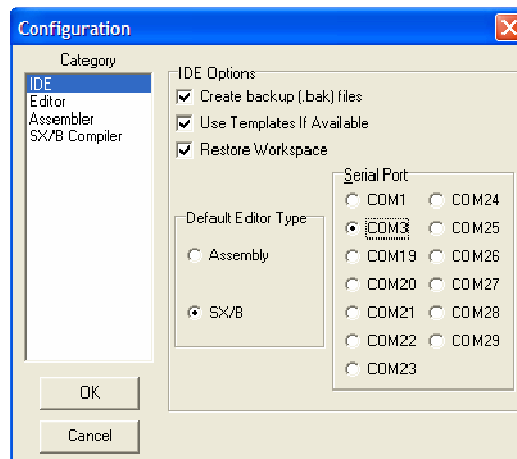
Programming the Prop-SX Controller

☞ | **NOTE**: EFX-TEK recommends using the Parallax SX-Key IDE which can be downloaded from this link:

www.parallax.com >> Downloads >> SX Software and Documentation Downloads

1. Start by making sure that you have the latest SX-Key IDE; please download and install the latest update before proceeding. Start the SX-Key IDE.

2. Connect the SX-Blitz (#45170) or SX-Key (#552-00007) to the Prop-SX as shown below. For SX-Key users that do not have an available serial port a USB-to-Serial adapter (#28030) may be used to connect the Key to your PC.

3. Connect a 9 to 24 VDC power supply to the Prop-SX.

4. Move the power switch to position 1. An LED adjacent to the power connector will light; if it doesn't, check your power supply.

5. Select the serial/USB port from the SX-Key IDE Run>>Configure menu (Note: Your system will probably have different serial ports):

6. Use the **Program** or **Run** tools from the SX-Key IDE to program the Prop-SX controller.
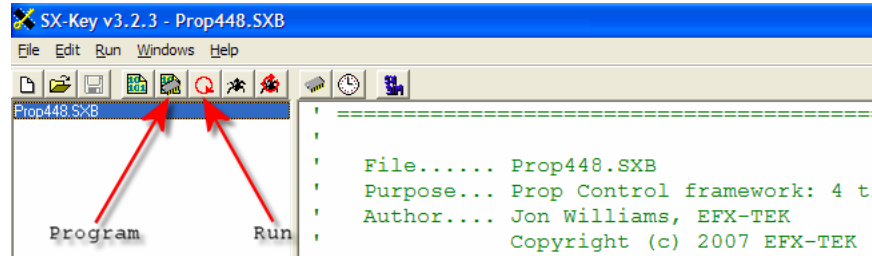
Setting SX Speed

The speed at which the SX processor runs is set by the **DEVICE** (internal or external clock source) and **FREQ** (clock speed) directives and the [optional] use of an external clock source; the Prop-SX is designed to accommodate a 3-pin ceramic resonator. The resonator [3-pin, female] socket is located just below the SX-Key programming header.

> **NOTE**: The SX **DEVICE** and **FREQ** directives must be set appropriately for all applications, regardless of the type of clock source employed.

Making Connections

There are two ways to make connections to the Prop-SX Controller:

1. Pin headers, P0..P15 (0.025" square pins on 0.1" (2.54mm) centers – compatible with hobby servo connectors)

2. Terminal block, OUT0..OUT15 (will accept up to 14-gauge wire) – *these are for outputs only*

The pin headers are compatible with 0.025" female crimp pin sockets (e.g., Molex 16-02-0103) that are available from a wide variety of electronics retailers (e.g., Jameco - #100766). Another good source of these connectors and a kit to build cables is Lynxmotion (*www.lynxmotion.com*). An easy way to connect to the 3-pin headers is by using the 12" extender cable (#805-00002); these can be cut in half to make two custom connections for your Prop-2 controller.

The terminal block provides connection for ground, V+ (when power switch is in position 2), and switched, low-side outputs for P0..P15; these terminals *are outputs only* and cannot be used for input connections. Note that the switched outputs connect to ground when active, and "float" (are disconnected) when not active.

> **NOTE**: When powering external devices from a voltage source other than that used to power the Prop-SX controller board, do not place the power switch in position 2. Doing so could cause damage to the Prop-SX and external circuitry.

Trigger Inputs

I/O pins P12..P15 have additional configuration (SETUP) jumpers that allow either of these pins to be set to a predetermined state when used as an input. When the jumper is placed in the "UP" position, the pin is pulled up to Vdd (+5v) through a 4.7 kΩ resistor – this is the setting to use for active-low trigger devices or configurations (i.e., a normally open switch placed between the trigger pin and Vss). When the jumper is placed in the "DN" position, the pin is pulled down to Vss (ground) through a 4.7 kΩ resistor; this is the setting to use for active-high trigger devices or configurations (i.e., the output from a PIR or sonic sensor).

Use of the SETUP jumper is optional, but should be used when either of these pins is used as an input as a "floating" input pin can cause false triggering. Note that if not needed as inputs, P12..P15 may be used as outputs (remove SETUP jumper when using either as an output).

The illustration below shows typical connections where P14 is used as the trigger input with OUT0, OUT1, and OUT2 are outputs. Note the P14 SETUP jumper (DN position) and that the power switch is set to position 2 so that power is available for the valves.
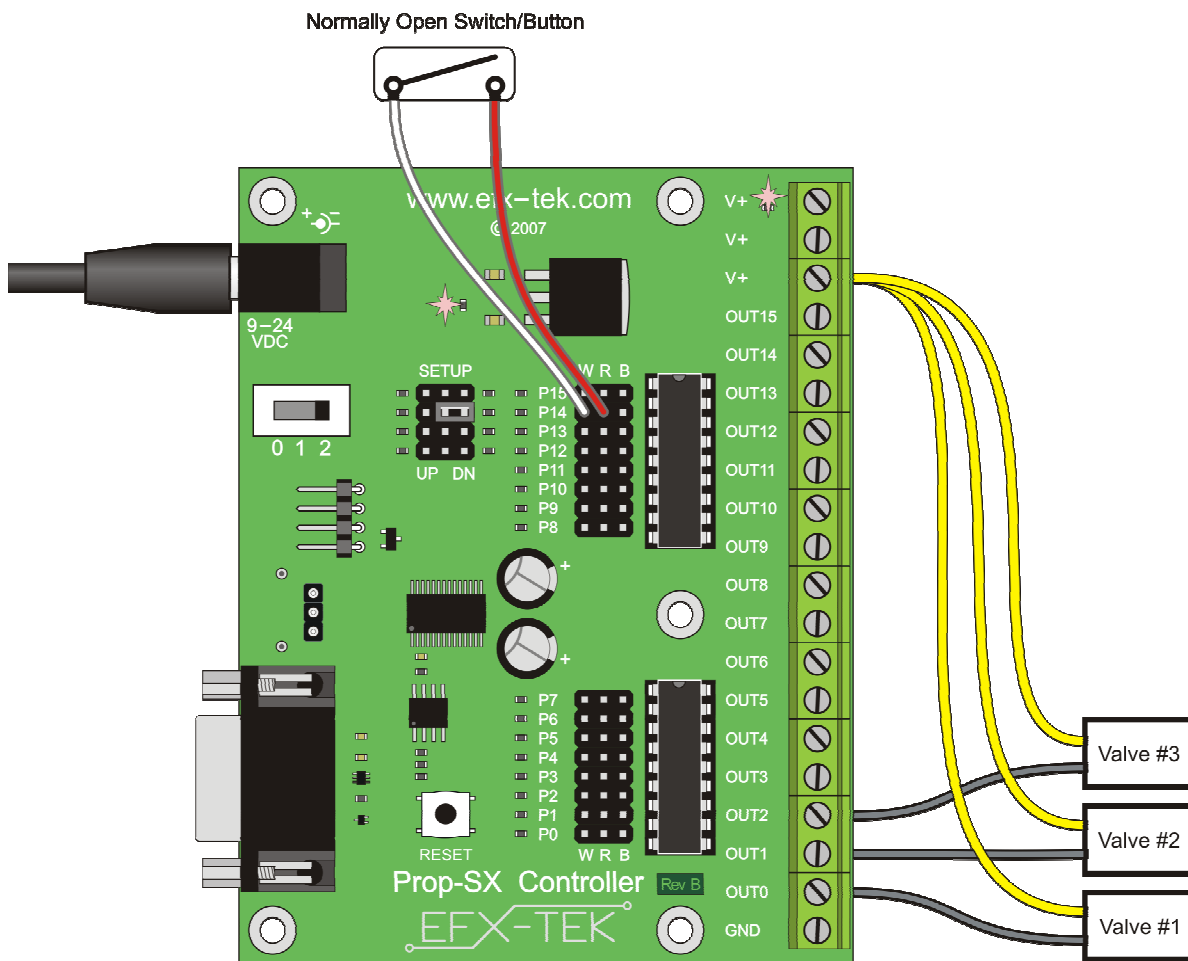
MECHANICAL SPECIFICATIONS
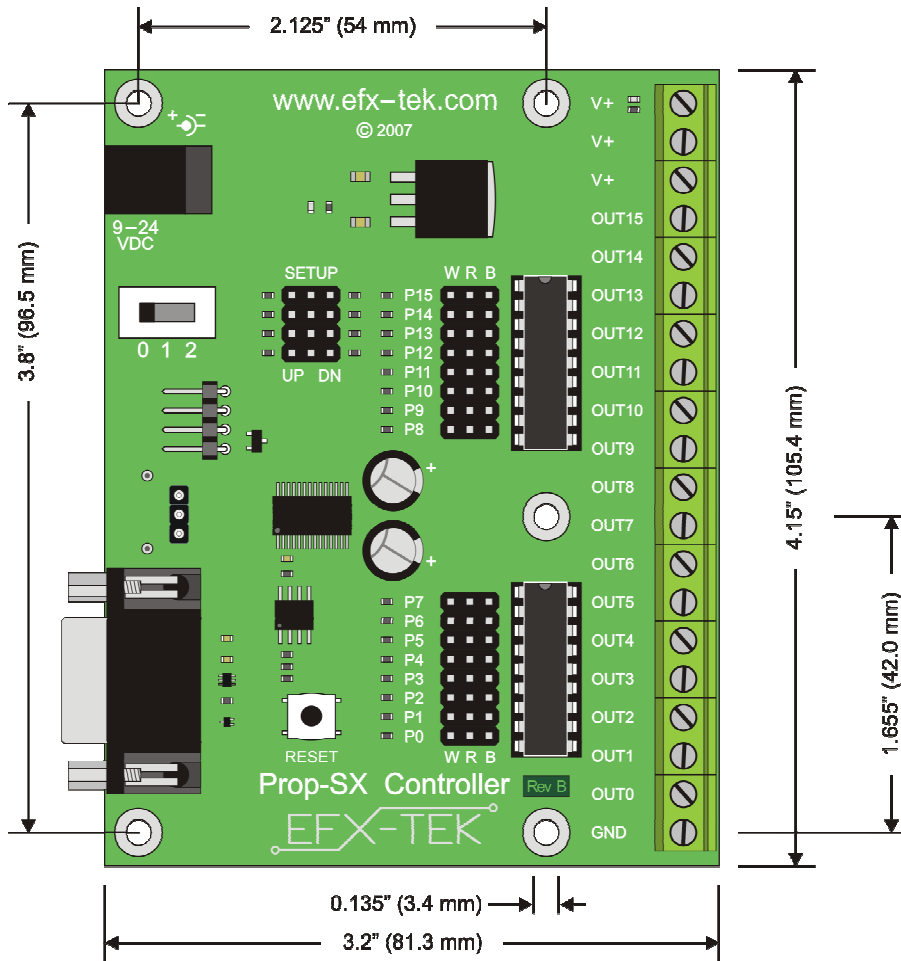
ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Specification			Unit
		Min.	Typical	Max.	
Supply Voltage	V_{IN}	9	12	30	VDC
Supply Current (no loads, 4 MHz)	I_{IN}	35			mA
Supply Current (no loads, 50 MHz)	I_{IN}	110			mA
TTL input low	V_{IL}	0		0.8	VDC
TTL input high	V_{IH}	2		5	VDC
TTL output low	V_{OL}	0		0.6	VDC
TTL output high	V_{OH}	4.3		5	VDC
TTL output low current (sink) – per pin	I_{OL}			45	mA
TTL output high current (source) – per pin	I_{OH}			45	mA
TTL output low current (sink)	I_{VSS}			130	mA
TTL output high current (source)	I_{VDD}			130	mA
OUTx output low current (sink) – per pin	I_{OUT}		150	500	mA
OUTx output low current (sink) – per group	I_{OUT8}			1200	mA
Operating Temperature	T_{OP}	-40	25	85	C

Specifications subject to change without notice.

Demo Application: LED Strobe Controller

The following application demonstrates the use of a Prop-SX as a lighting controller, simulating the landing lights at an airport. A normally-open switch is used to trigger the controller; when this switch is active the light outputs will be sequenced using a simple loop. This program is written in SX/B (SX BASIC) which is included in the Parallax SX-Key IDE.

The easiest way to see the program output is by attaching the Prop-1 Trainer (#31199) to the upper I/O group, P8..P15 (Note: You must replace the ULN2803A on this group with the ULN2003A that is provided with the Prop-1 Trainers, otherwise the ULN2803A will interfere with the potentiometer circuit). Remove the P12 and P13 SETUP jumpers, and move the P14 and P15 SETUP jumpers to the DN position before installing the Prop-1 Trainer. The Prop-1 Trainer schematic below shows the connections in the event you decide to build your own circuit. You may also wish to connect 12-volt lamps between V+ and the OUT8..OUT13 terminals (one lamp per terminal; 200 mA max each).
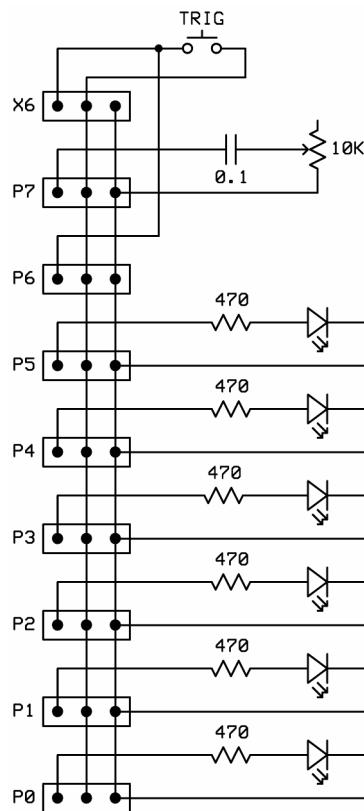
Source Code for Strobe Controller

```
' ===========================================================================
'
'   File....... Strobe_Controller.SXB
'   Purpose.... Linear strobe of six outputs
'   Author..... EFX-TEK (www.efx-tek.com)
'   E-mail..... teamefx@efx-tek.com
'   Started....
'   Updated.... 01 JUL 2007
'
' ===========================================================================


' ---------------------------------------------------------------------------
' Program Description
```

```
' -------------------------------------------------------------------------
'
' Creates a linear strobe of six lamps/LEDs on P8..P13; much like airport
' landing lights. Strobing runs when button on P14 is pressed, and rate
' can be adjusted with pot circuit on P15.
'
' Replace the ULN2803A on P8..P15 with a ULN2003A to allow the pot circuit
' on P15 to operate correctly.


' -------------------------------------------------------------------------
' Conditional Compilation Symbols
' -------------------------------------------------------------------------



' -------------------------------------------------------------------------
' Device Settings
' -------------------------------------------------------------------------

DEVICE          SX28, OSC4MHZ, TURBO, STACKX, OPTIONX, BOR42
FREQ            4_000_000
ID              "Lights"


' -------------------------------------------------------------------------
' I/O Pins
' -------------------------------------------------------------------------

Speed           PIN    RC.7                        ' SETUP = DN; remove ULN
Trigger         PIN    RC.6                        ' SETUP = DN

Lamps           PIN    RC
Lamp6           PIN    RC.5 OUTPUT
Lamp5           PIN    RC.4 OUTPUT
Lamp4           PIN    RC.3 OUTPUT
Lamp3           PIN    RC.2 OUTPUT
Lamp2           PIN    RC.1 OUTPUT
Lamp1           PIN    RC.0 OUTPUT

UnusedRB        PIN    RB    INPUT PULLUP


' -------------------------------------------------------------------------
' Constants
' -------------------------------------------------------------------------

IsOn            CON    1
IsOff           CON    0


' -------------------------------------------------------------------------
' Variables
' -------------------------------------------------------------------------

idx             VAR    Byte                    ' loop index
holdTm          VAR    Word                    ' for timing

tmpW1           VAR    Word                    ' for subs & funcs


' =========================================================================
  PROGRAM Start
' =========================================================================


' -------------------------------------------------------------------------
' Subroutine / Function Declarations
```

```
' ----------------------------------efx@efx-tek.com----------------------------

DELAY_MS        SUB    1, 2                     ' delay in milliseconds
GET_SPEED       FUNC   2, 0                     ' read speed pot


' ---------------------------------------------------------------------------
' Program Code
' ---------------------------------------------------------------------------

Start:


Main:
  Lamps = %000000                               ' clear all
  DO WHILE Trigger = IsOn                       ' run when button pressed
    holdTm = GET_SPEED                          ' read speed setting
    FOR idx = 0 TO 5
      Lamps = 1 << idx                          ' one LED on
      DELAY_MS holdTm
      Lamps = %000000                           ' LED off
    NEXT
  LOOP
  GOTO Main

' ---------------------------------------------------------------------------
' Subroutine / Function Code
' ---------------------------------------------------------------------------

' Use: DELAY_MS mSecs
' -- 'mSecs' is delay in milliseconds, 1 – 65535

SUB DELAY_MS
  IF __PARAMCNT = 1 THEN
    tmpW1 = __PARAM1                            ' save byte value
  ELSE
    tmpW1 = __WPARAM12                          ' save word value
  ENDIF
  PAUSE tmpW1
  ENDSUB


' ---------------------------------------------------------------------------

' Use: result = GET_SPEED
' -- scales Prop-1 Trainer pot to 50 to 150

FUNC GET_SPEED
  HIGH Speed                                    ' charge cap
  DELAY_MS 1
  RCTIME Speed, 1, tmpW1                        ' measure RC circuit
  tmpW1 = tmpW1 ** $71C7                        ' x 0.44 (max = 100)
  tmpW1 = tmpW1 + 50                            ' set min to 50
  RETURN tmpW1
  ENDFUNC
```

Accessories

750-00007	12 VDC, 1 Amp power supply; *provides ample power for the Prop-SX and accessories*
31199	Prop-1 Trainer; *learn to program the Prop-SX without having to connect external devices*
805-00002	12-inch, 3-pin extension cable; *used to connect external devices to the TTL I/O pins*
45170	SX-Blitz programming tool, USB (Note: does not allow Run or Debug from SX-Key IDE)

From Parallax, Inc:

552-00007   SX-Key programming tool (EFX-TEK recommended for advanced users)

Additional Applications

For additional ideas and application notes for the Prop-SX controller, be sure to visit us on the Internet at the following links:

www.efx-tek.com
forums.efx-tek.com

Errata