

Kronos Robotics Build-it Series

Electronic Racket Launch Control
as seen in
November 2005 of Nuts & Volts Magazine

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In this article I will show you how to build an electronic launch control with the Athena microcontroller.

My son and I have been avid model rocket enthusiasts for years. We have used various lunch pads and controls over the years. One thing we have noticed is that they are being made cheaper and cheaper. Several times we have gone to use the control, and it just would not work. They are not that expensive and for around \$7 you can pick one up. What it comes down to: you get what you pay for.

I decided to build one that was durable, reliable, and safe. I wanted to keep the cost down so I chose the Athena microcontroller as the brain.

Let me go over how the unit works.

The master switch is the arming and reset switch. When turned on the unit does a pre check and indicates with the LED's the status of the igniter clips. If they have a good connection all LED's will light. If not only the two outside LED's will light indicating the unit is armed but has a bad connection.

The launcher will not allow you to proceed with a count down until the proper connection has been made.

During field tests, we found that on sunny days it was difficult to see the LEDs, so we added sound. When Armed the unit now has a high frequency tick if a good connection to the igniter is made, and a low frequency tick if not.

Once you have a good connection to the igniter you can push the start countdown button. As a safety feature, you must hold down the button for the complete count down. Each LED will blink out and a beep will be heard. This beep will go up in frequency slightly with each count.

If igniter connection is lost or you lift your finger from the start launch button the unit will abort the count down. Once aborted you are required to reset the launcher by switching off, then back to arm position.

Once the countdown has completed 10 steps, the launcher will beep several times and the main relay will close causing full battery power to be applied to igniter. Depending on how fresh your batteries are, the igniter will light in a second or two and the rocket will launch.

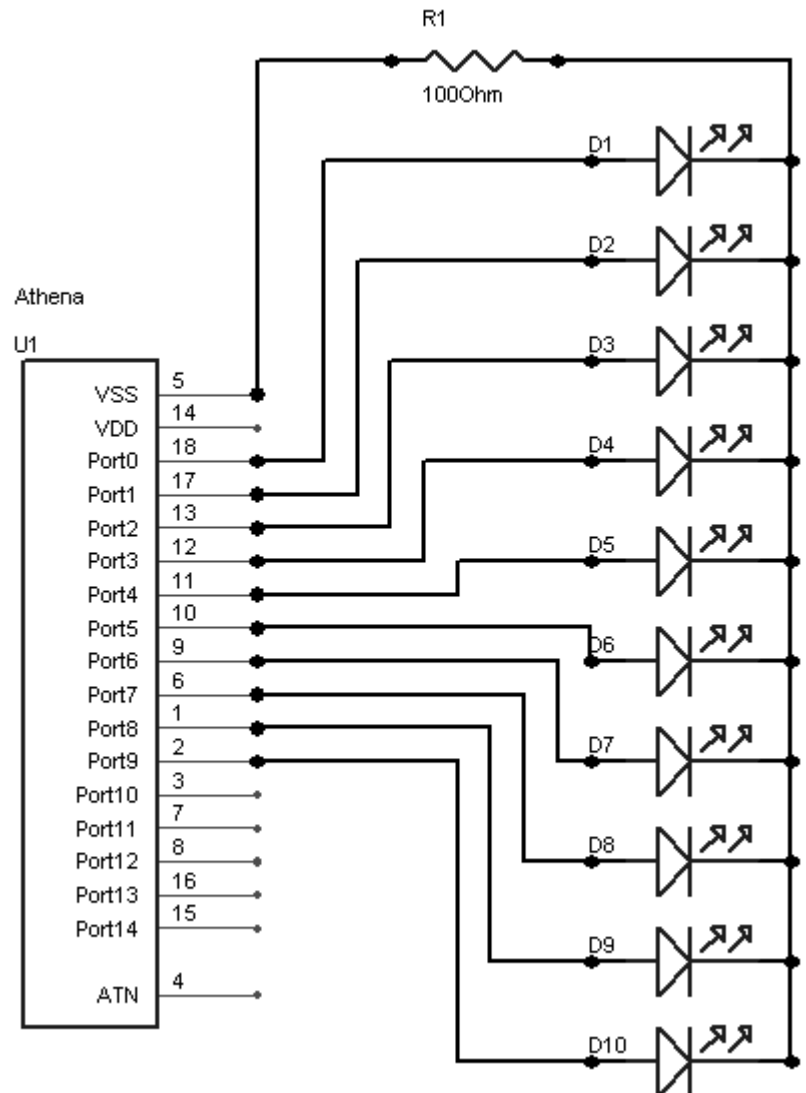
Hookup

In order to make assembly as simple as possible I will break the project down to 4 schematics. To make assembly even easier you can use a Athena 1u Carrier.

LED Section

Whether you are using a 10 segment bar or individual LEDs the Anode of each LED is connected to ports 0-9 as shown. All the Cathodes are connected together then to VSS through a 100 ohm resistor as shown in Schematic 1.

Connections are the same when using the Athena Carrier 1u. You should assemble the carrier as indicated by the included instructions but leave off the headers so you can connect the LEDs directly to the board.

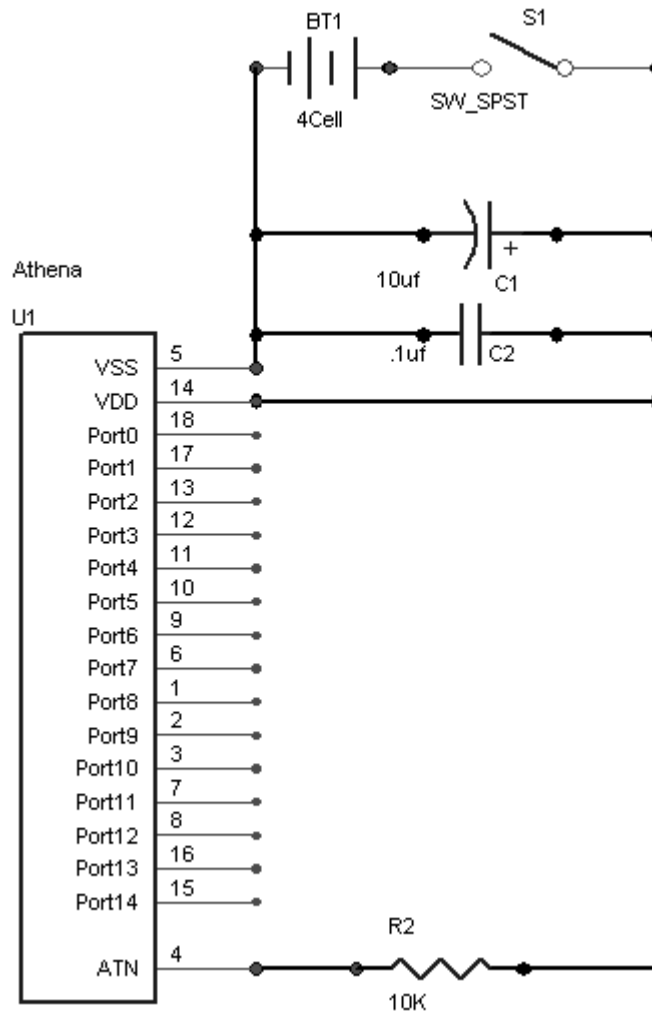


Schematic 1

Power Section

If you decide to use the Athena 1u carrier then C1, C2 and R1 will be included on the board. These components are only needed if you plan on building your own circuit as shown in Schematic 2.

When using the 1u carrier I used a 2 pin header on the + and - pins located next to port 8. You then have two choices on connecting the power/switch to the PCB. You can solder directly to this header or using a female header you can create a plug.



Schematic 2

Launch Switch and Sound Section

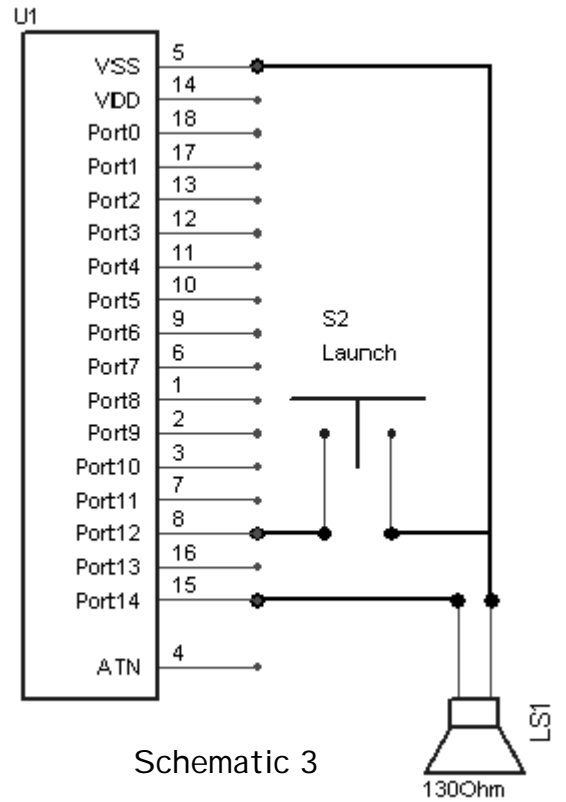
Here we tie the launch switch to port 12 and VSS and the 130 ohm speaker to Port 14 and VSS as shown in Schematic 3. Again the connections are the same for the 1u Carrier.

Igniter Section

The NPN transistor is a generic 2N2222 and I soldered mine directly to the relay. Just about any 10-20 amp relay can be used as long as its rated at 5v.

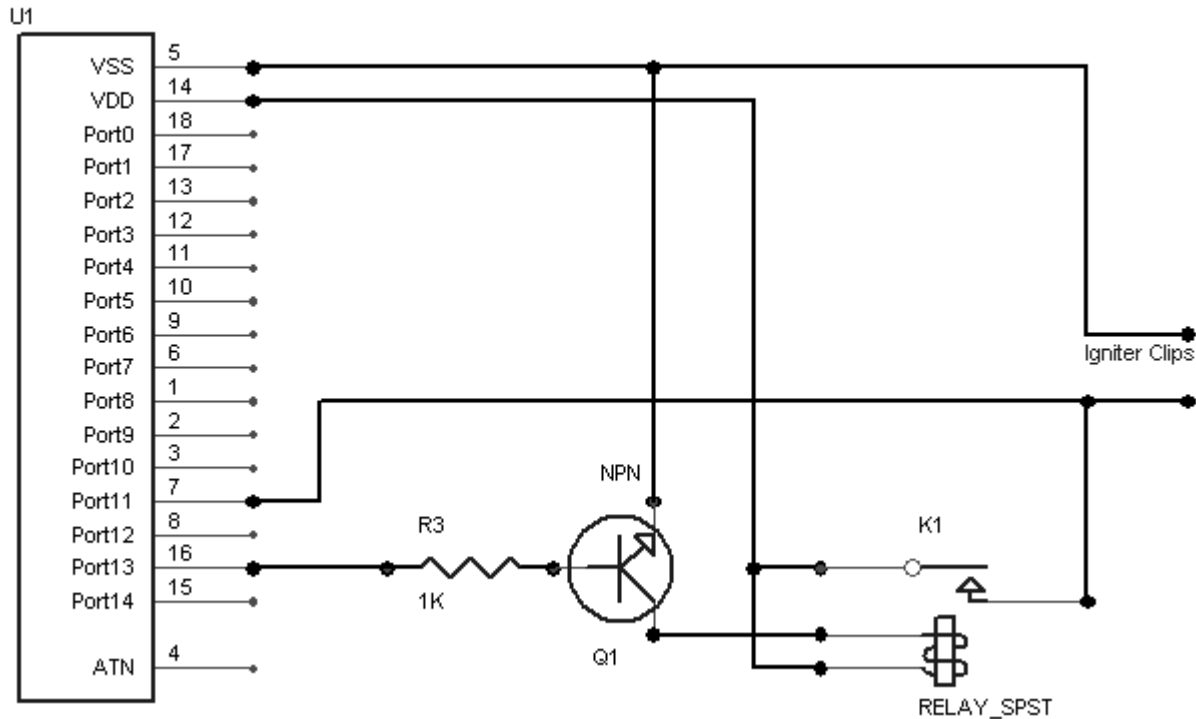
The igniter clip connected to VSS should be connected as close to the battery as possible. Also The K1 coil lead connected to VDD should be connected as close as possible to S1.

Athena



Schematic 3

Athena



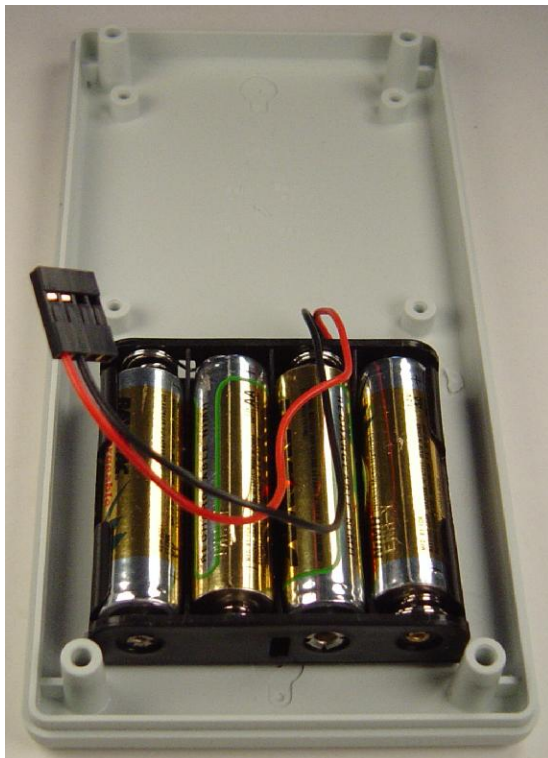
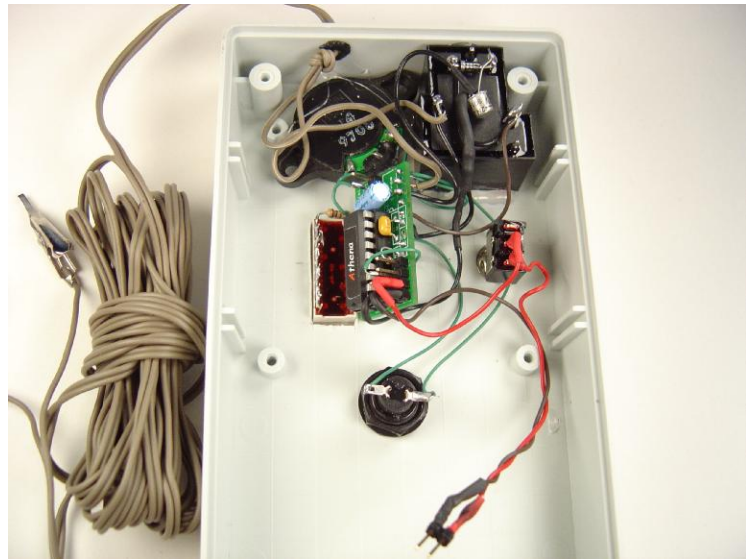
Schematic 4

Layout

You can leave off the LED's if you wish, or use an LED bar like I did with my launcher. All Electronics sell them. An LED bar is nothing more than 10 LEDs mounted in a plastic housing. I used the Athena Carrier #1u mounted directly to the LED bar. Everything on my launcher was held in place with hot glue.

You can use any case that will allow all the parts to fit. If you don't cramp the parts too much, it will be easy to add firmware changes to the Athena chip.

I used the igniter cable from an old launcher, but it is very easy to build your own. On my next launcher I will probably use 18 gauge wires with 26 gauge on the last 10". This will allow me to transfer more power to the igniter, yet keep it flexible enough not to pull out the igniter.



I use 4 rechargeable batteries for my launcher. Rechargeable batteries deliver more amps to the igniter than Alkaline, but both will work. The battery holder is mounted on the back panel of my launcher but you can mount any where that is convenient.

When assembled place some foam rubber over the batteries to keep them from popping out if the launcher is dropped.



The Program

```
'Rocket Launcher
'-----
'Setup Section
'-----
dim x,y,z,count,count2,dur,snd

RCSTA=0
configio 0,1,2,3,4,5,6,7,8,9,13,14
setio 0,1,2,3,4,5,6,7,8,9
clearall
pullupon

if inp12 = 0 then
  signal 14,40,200
  setio
  end
endif

'-----
'Arming section
'-----
arm:
  onportgoto 11,-,clipoff
  setio 0,1,2,3,4,5,6,7,8,9
  snd = 40 : dur = 20 : gosub beep
  onportgoto 12,launch,-
  goto arm

clipoff:
  setio 0,9
  snd=250 : dur = 3 : gosub beep
  goto arm

beep:
  count = count + 1
  if count = 255 then
    count2 = count2 + 1
    count = 0
  endif
  if count2 = 10 then
    signal 14,dur,snd
    count2 = 0
  endif

  return
```

```
'-----
'Launch sequence
'-----
```

```
launch:
  low 10
  for x = 9 to 1 step -1
    high x
    onportgoto 12,-,abort
    onportgoto 11,-,error

    y = x * 2 +40
    signal 14,60,y
    low x

    onportgoto 12,-,abort
    onportgoto 11,-,error
    longpause 250,2
    low x
  next

  for x = 1 to 10
    high 0
    signal 14,10,20
    low 0
    signal 14,10,10
  next
  high 13
  goto rearm

'-----
'Error Handlers
'-----
error:
  for y = 1 to 20
    high x
    signal 14,5,150
    low x
    signal 14,5,160
  next
  goto rearm

abort:
  for y = 1 to 20
    high x
    signal 14,10,40
    low x
    signal 14,10,45
  next

rearm:
  onportgoto 12,rearm,-
  low 13
  end
```

The program is broken down into 4 sections:

Setup

Here we setup the IO ports and internal pullup resistors. We clear all variables and check to make sure the launch button is not pressed on startup.

Arming

In this section we check to see if the igniter wires are connected. If they are, we allow the launch button to be pushed.

Launch

Once the launch has started, we remove the lit LED's and beep the speaker. We also continue to check the status of the launch button and igniter wires.

Error Handler

If we get an error or abort, these are the handler routines that let you know something is wrong.

Going Further

The carrier 1u can also be used with the Nemesis microcontroller. This microcontroller is faster and has much more memory and capabilities. It would be the next logical step up if you want to add more functionality.

Be sure to visit the Kronos robotics web site for updates as well as videos of the rocket launcher in action.

Parts

Athena Microcontroller Kronos Robotics #16276
Athena Carrier #1u Kronos Robotics #16425
EZ232 Driver Kronos Robotics #16167

Red LED Kronos Robotics #16234
130Ohm Speaker Kronos Robotics #16164
SPST Switch Kronos Robotics #16241

10 Segment Bargraph LED All Electronics #BG-10
Push Button Jameco #174414CL
20Amp Relay Jameco #134949CL
2N2222 NPN Transistor Kronos Robotics #16142

Igniter Clips Radio Shack #270-373
100Ohm Resistor Kronos Robotics #16187
1K Resistor Kronos Robotics #16191
4 Cell AA Holder Kronos Robotics #16323

Athena/Nemesis Compiler Free download from the Kronos Robotics web site.

Kronosrobotics website: <http://www.kronosrobotics.com>

Jameco website: <http://www.jameco.com>

All Electronics: <http://www.allelectronics.com>

Here is a small video of the launcher in action: <http://nutsvolts.com/%7Edownloads/RocketLg.mpg>