Cycle Analyst
DIY Custom Digital Aux Controls
Instructional Notes

document version 1.1-a
2018.10.19

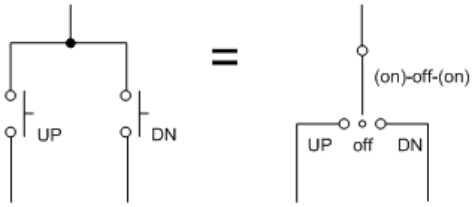
1.0 Overview

Custom Digital Aux controls for Cycle Analyst can be fabricated using a just few commonly available electronic parts. The following sections show sample circuits and describe the DigiAux theory of operation.

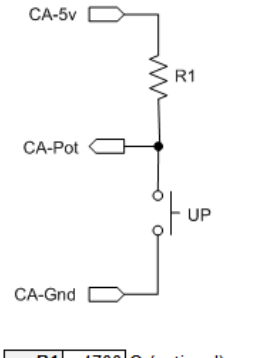
2.0 Sample Circuits

2.1 Buttons and Switches

DigiAux controls can be constructed of either momentary push buttons or (ON)-OFF-(ON) momentary SPDT switches. The sample circuits show pushbuttons but can be modified for switch operation by the circuit substitution shown here.

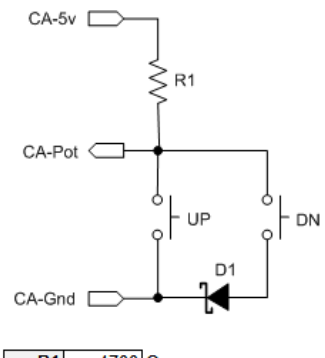


SPDT switches can be standard toggle or rocker switches similar to those found in auto window controls. Cycle Analyst '1 BTN' mode allows re-purposing common regen or horn buttons. '2 BTN' mode is more desirable, but may require a bit more fabrication. One approach is to re-fit a controller 3-speed switch with a momentary mini-rocker switch (eBay, etc).



R1	4700	Ω (optional)

Basic Digital-Only 1 Button Circuit



R1	4700	Ω
D1	1N5711	or similar Schottky

Basic Digital-Only 2 Button Circuit

2.2 Simple Digital-Only Controls

The illustrations to the left show basic one and two button controls that plug into the CA Aux input and operate stand-alone with no analog Aux device.

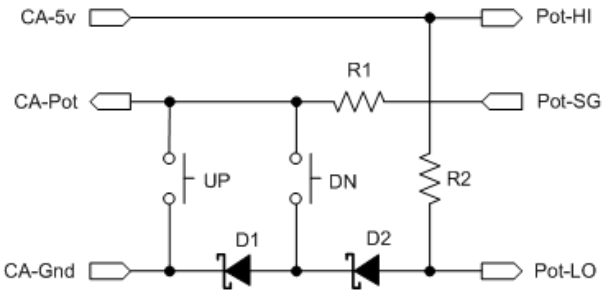
The resistor is optional in the single button case reducing the parts to a single pushbutton.

Cycle Analyst level selection with a single button control ('1-BTN' mode) wraps around making it best for selecting presets or for limiting functions with few levels.

2.3 Combined Analog/Digital Controls (Grin Compatible)

The circuit to the right supports both digital-only and combined analog/digital modes and is the exact equivalent of the Grin digital button control. It can be fabricated with male and female JST-3 connectors and inserted between the CA Aux input and a standard Grin 3-position switch or Grin pot. It can also be used with any 2K – 10K pot (the Grin pot is 5K). The CA and optional analog control use the left and right connections respectively.

If the analog device is unplugged, the analog channel defaults to 100%.



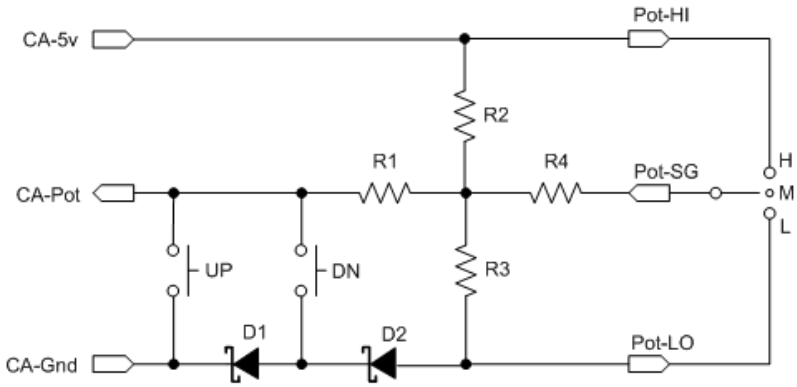
R1	4700	Ω
R2	4700	Ω
D1, D2	1N5711	or similar small signal Schottky

The circuit above might be constructed as an in-line adapter as shown here, wired inside the switch housing, or attached directly to the CA PCB AuxPot pads with short AuxA and AuxD wiring running out of the case back to JST connectors.

2.4 Combined Analog/Digital Controls (Custom 3-Position Switch)

Installations using a 3-position switch as the analog control can be fabricated using a common SPDT center-off ON-OFF-ON switch such as used for ebike controller 3-speed switches or motorcycle lighting controls (turn signal, hi/lo beams). These differ from the Grin CA 3-position switches which contain internal resistors.

The circuit to the right supports ONLY simple switch controls; pots and Grin CA controls are not supported. This circuit can also be used with a basic 2-position SPDT ON-ON switch.



R1	4700	Ω
R2	2400	Ω
R3	2400	Ω
R4	2400	Ω
D1,D2	1N5711	or similar small signal Schottky

3.0 Theory of Operation

The Digital Aux feature uses an analog range of 0.86V-5V reserving the 0.0V-0.86V range for button signaling. This allows use of either dual pushbuttons with a common connection or SPDT center-off switches.

The CA discriminates Up, Down, and analog ranges using fixed thresholds of 0.215V, 0.645V, and 0.86V respectively. The plot to the right shows these fixed threshold voltages, the analog voltage range, and the recommended button trigger voltages.

The Grin DigiAux pushbutton switch and the sample circuits shown here use Schottky diodes to develop button trigger voltages with fair accuracy in spite of different current loading imposed by various analog controls. 1N5711 Schottky small signal diodes are suggested, however, any Schottky part with a ~0.43V forward voltage at about 1ma can be used without adjusting the resistors. The 1N5711 part is readily available from popular parts suppliers, eBay, and Amazon. The Grin control uses a dual diode SMD package (BAS70-04).

Although Schottky diodes are used in these samples, resistor dividers are an attractive approach for purpose-built applications where a variety of different analog controls need not be supported. For instance the Schottky diode in the *'Basic Digital-only 2-Button Circuit'* on the previous page could be replaced with a 470 ohm resistor to develop the required ~0.43V trigger voltage. This approach will typically require precision or selected resistors.