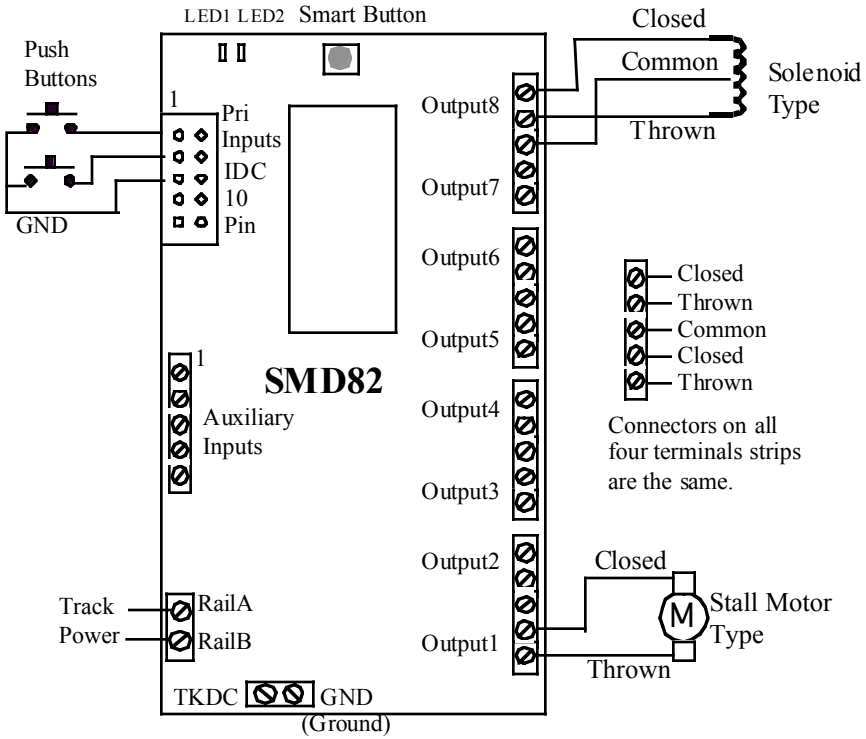
CV#	Function/Default Value		CV#	Function/Default Value	
81	Route 1 Selection	255	97	Route 9 Selection	00
82	Route 1 Switch State	255	98	Route 9 Switch State	00
83	Route 2 Selection	255	99	Route 10 Selection	00
84	Route 2 Switch State	00	100	Route 10 Switch State	00
85	Route 3 Selection	00	101	Route 11 Selection	00
86	Route 3 Switch State	00	102	Route 11 Switch State	00
87	Route 4 Selection	00	103	Route 12 Selection	00
88	Route 4 Switch State	00	104	Route 12 Switch State	00
89	Route 5 Selection	00	105	Route 13 Selection	00
90	Route 5 Switch State	00	106	Route 13 Switch State	00
91	Route 6 Selection	00	107	Route 14 Selection	00
92	Route 6 Switch State	22	108	Route 14 Switch State	00
93	Route 7 Selection	00	109	Route 15 Selection	101
94	Route 7 Switch State	38	110	Route 15 Switch State	00
95	Route 8 Selection	00	111	Route 16 Selection	00
96	Route 8 Switch State	54	112	Route 16 Switch State	00

WARNING: This product contains a chemical known to the state of California to cause cancer, birth defects or other reproductive harm.

SMD82
Switch Machine Driver

> DCC compatible accessory decoder
> Drives eight solenoid and/or stall type machines
> 16 programmable remote controlled routes
> 13 inputs for programmable local routes
> Five conditional routes
> "Smart" Programming



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08.28.06 V1

1 Introduction

The SMD82 is capable of driving eight solenoid and/or stall motor type switch machines. It contains a Capacitor Discharge Unit to store energy. A discharge of this energy is used to energize the solenoid to change the switch state. Using a CDU reduces the current drawn from the track to a small level sufficient to recharge the CDU. However, once the CDU has been discharged (a switch state changed) a time period is required for the CDU to recharge. This is typically about three seconds. Since more than one switch may be requested to change state at the same time, as in a local route, the requests are held so that each switch may change state in turn. A stall motor type does not use the CDU and therefore, no re-charge time is required when activated.
Caution: The CDU retains a voltage charge several minutes after power is removed.

The eight outputs of the SMD82 can individually be assigned any address from 1 to 2040. There are 13 inputs available for local control. An addition eight inputs are available with the use of some resistors.

Two types of route control are supported. The remote controlled routes are controlled from the throttle just like a single switch is, except that multiple switches may be activated. The local routes are activated by using the inputs. Routes are configured by programming the respective CVs as to which outputs are selected in the route and the output state. Remote controlled routes are in two groups of eight. Each group has a group address to allow the throttle to access it.

2 Getting Started

The SMD82 comes from the factory ready to use. It is programmed to drive solenoid switch machines (three wire). An example of a three wire (twin coil) type switch machine is an Atlas Snap Switch TM or a Peco. The eight outputs are programmed with addresses one to eight respectively. Connect the outputs of the SMD82 to the solenoid switch machines and RAIL A and RAIL B terminals to the track power as shown in the diagram on the front page. You are now ready to control your switches from the throttle.

You can control the outputs from fascia buttons by connecting them to the primary or the auxiliary inputs. The eight primary inputs, when grounded, will toggle the eight outputs respectively. The five auxiliary inputs, when grounded, will close the first five outputs respectively. They can also be directly connected to other devices to set a switch for correct alignment for approaching trains. See the application section.

Two routes have been programmed. By issuing switch commands from the throttle you can execute routes. Throwing switch 101 will cause all the outputs to be thrown and closing switch 101 will cause all the outputs to be closed.

If you want to change the type of switch machine an output drives or some of the output addresses go on to the “Smart” Programming section. If you want to customize the SMD82 such as implementing custom routes, go on to the Configuration Variables section.

Note: Switch or turnout position can be referred to by throw (t) or Reverse (R) and close (c) or Normal (N). Throw and close are used in this document.

7 Summary of Configuration Variables

CV#	Function/Default Value		CV#	Function/Default Value	
1	Output 1 Address	01	41	Pri Input 4 Route Number	00
2	Output On Time	31	42	Pri Input 4 Action	70
3	Output 1 Configuration	00	43	Pri Input 5 Route Number	00
4	Output 2 Configuration	00	44	Pri Input 5 Action	86
5	Output 3 Configuration	00	45	Pri Input 6 Route Number	00
6	Output 4 Configuration	00	46	Pri Input 6 Action	102
7	Manufacturer Version No.	-	47	Pri Input 7 Route Number	00
8	Manufacturer ID	25	48	Pri Input 7 Action	118
9	Output 1 Address Adder	00	49	Pri Input 8 Route Number	00
10	Output 5 Configuration	00	50	Pri Input 8 Action	134
11	Output 6 Configuration	00	51	Sec Input 1 Route Number	00
12	Output 7 Configuration	00	52	Sec Input 1 Action	00
13	Output 8 Configuration	00	53	Sec Input 2 Route Number	00
14	Output 2 Address	00	54	Sec Input 2 Action	00
15	Output 2 Address Adder	00	55	Sec Input 3 Route Number	00
16	Output 3 Address	00	56	Sec Input 3 Action	00
17	Output 3 Address Adder	00	57	Sec Input 4 Route Number	00
18	Output 4 Address	00	58	Sec Input 4 Action	00
19	Output 4 Address Adder	00	59	Sec Input 5 Route Number	00
20	Output 5 Address	00	60	Sec Input 5 Action	00
21	Output 5 Address Adder	00	61	Sec Input 6 Route Number	00
22	Output 6 Address	00	62	Sec Input 6 Action	00
23	Output 6 Address Adder	00	63	Sec Input 7 Route Number	00
24	Output 7 Address	00	64	Sec Input 7 Action	00
25	Output 7 Address Adder	00	65	Sec Input 8 Route Number	00
26	Output 8 Address	00	66	Sec Input 8 Action	00
27	Output 8 Address Adder	00	67	Aux Input 1 Route Number	00
28	reserved	00	68	Aux Input 1 Action	18
29	Decoder Configuration	00	69	Aux Input 2 Route Number	00
30	reserved	00	70	Aux Input 2 Action	34
31	Ops Mode Address	00	71	Aux Input 3 Route Number	00
32	reserved	00	72	Aux Input 3 Action	50
33	Pwr On State - Outputs 1-4	00	73	Aux Input 4 Route Number	00
34	Pwr On State - Outputs 5-8	00	74	Aux Input 4 Action	66
35	Pri Input 1 Route Number	00	75	Aux Input 5 Route Number	00
36	Pri Input 1 Action	22	76	Aux Input 5 Action	82
37	Pri Input 2 Route Number	00	77	Route group 1-8 Address	101
38	Pri Input 2 Action	38	78	Route group 1-8 Address Adder	00
39	Pri Input 3 Route Number	00	79	Route group 9-16 Address	00
40	Pri Input 3 Action	54	80	Route group 9-16 Address Adder	00

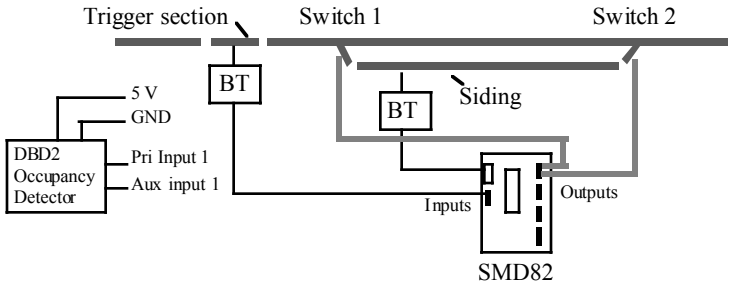
CV77 & 78 should be the same for both SMD82s because when you execute the route with one switch command both SMD82s will respond.

CV81 & 82 of the first SMD82 will determine how switches 1 to 8 operate in route 1.
CV81 & 82 of the second SMD82 will determine how switches 9 to 16 operate in route 1.

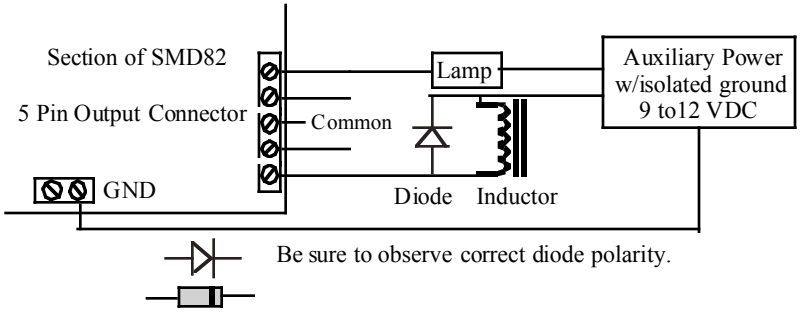
CV83 & 84 of the first SMD82 will determine how switches 1 to 8 operate in route 2.
CV83 & 84 of the second SMD82 will determine how switches 9 to 16 operate in route 2.
.....etc

This applies for routes 1 to 8 because the CV77 & CV78 values are the same for both SMD82s. If you want routes 9 to 16 in both SMD82s to function together then the CV79 & CV80 values must be the same for both SMD82s.

6.2 Other Input Devices
Typically you may connect push buttons to the SMD82 inputs as shown in section 4.4. However, the primary input connector provides a 5 volt source, so DBD2s (block detectors) can be powered and when connected to an input a route or switch can be controlled. Using primary input 1 and Aux input 1 a conditional route can be set up. When a train is in a siding and another train crosses the trigger section, the two switches can be correctly aligned. If the siding is not occupied the trigger section will have no effect.



6.3 Driving Other Devices
The SMD82 can be used to turn on devices other than switch machines. In these cases auxiliary power is required. If the load is an inductance, a diode is required to suppress the positive voltage transient when the load is turned off. An example of an inductance load is the Kadee electric uncoupler #307. The diagram shows a lamp and an inductive load.
Note: The common connection is intended only to provide power to solenoid type switch machines. Other uses will result in improper operation.



3 "Smart" Programming

"Smart" programming is a term used to describe a method to program Configuration Variables (CVs) using switch addresses. This method is a much easier way to program CVs. With "Smart" programming, you can set the output addresses and the output configuration for solenoid or stall type switch machines.

To program in "Smart" mode, connect the SMD82 RAIL A and RAIL B terminals to the track power. Turn on power.
To change the output addresses follow these steps.

1. Press the "Smart" program button and hold it down for approximately one second until LED1 (typically red) starts to flash. Then release it. The SMD82 is now ready to have the output addresses changed.

2. Using the throttle select the switch address you want for output 1 and issue a throw (reverse) command.
LED1 now flashes twice with a pause and then repeats indicating that the output 2 address is ready to be programmed.

3. Again using the throttle select the switch address you want for output 2 and issue a throw (reverse) command.
LED1 flashes three times with a pause and then repeats indicating that the output 3 address is ready to be programmed.

4. Repeat step three until you have programmed all the output addresses. The LED flashes increase indicating the output number.
At any time you can exit "Smart" mode by pressing the button for approximately one second until LED1 stops flashing.

To change the output configuration start from one of these places.
1a. Continue from step 4 above. When all the output addresses have been programmed LED2 (typically green) will turn on and LED1 will flash.
1b. Press the "Smart" program button and hold down for approximately three seconds until LED2 turns on. Then release it. LED1 will be flashing.

2. Using the throttle select any switch address you want. Issue a throw (reverse) command to configure output 1 for a stall type machine or a close (normal) command to configure it for a solenoid type machine. At this point, LED2 turns off.
LED1 now flashes twice with a pause and then repeats indicating that output 2 is ready to be configured.

3. Again using the throttle, issue a throw (reverse) command to configure output 2 for a stall type machine or a close (normal) command to configure it for a solenoid type machine.
LED1 now flashes three times with a pause and then repeats indicating that output 3 is ready to be configured.

4. Repeat the previous step until you have programmed all the output configurations.
At any time you can exit "Smart" mode by pressing the button for approximately one second until LED1 stops flashing.

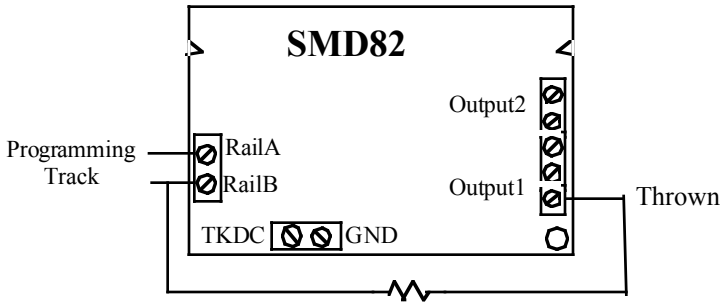
4 Configuration Variables (CVs)

The SMD82 supports **Paged Mode Programming in Service Mode and Ops Mode**. To program in paged mode, connect terminals Rail A and Rail B to the programming track. See diagram below. When power is applied, LED 1 will come on and LED 2 will flash when programming is successful. Some systems only apply power during actual programming, so LED1 will only be on during that time. The SMD82 does not have built in feedback like a mobile decoder. Because of this, some systems may show a "no decoder on track" error or "can not read CV". However it still is programmed. NOTE: if you want to provide external feedback so any CV can be read, add a resistor as shown in the diagram below.
To enter normal operation, disconnect from the program track. Now connect terminals Rail A & B to the main track power.

Ops mode programming is very convenient because you can try out the CV changes almost immediately. In order to use this type of programming the ops mode address must be set in CV31 (default is 1) and option 3 must be set in CV29. **The ops address is a loco type address, so be careful when using this feature**. You can immediately start programming in "Power On" ops mode without programming CV29 by holding down the Smart button just before power is turned on. When LED2 turns on release the button. This temporarily sets option 3 until power is turn off. When using ops mode to change CV values, the SMD82 does not recognize the new values until power is turned off and then back on.

Program CV7 with 1 will restart the SMD82 so power need not be cycled when programming in ops mode. This is the same as turning power off and then back on.

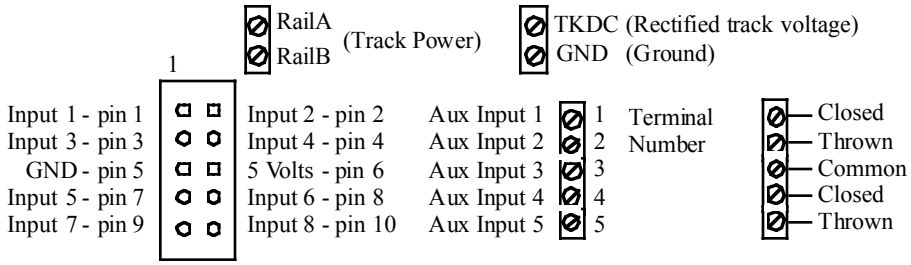
Program CV7 with 170 will "reset" all CV's to the factory default value. In page mode this may not work with some systems as they do not keep power applied to the programming track long enough for all the CVs to be programmed.



10 Ohm Resistor 1/2 Watt

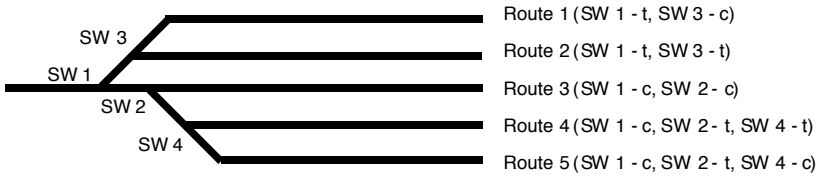
5 Connections

The primary input connector is a 10 pin flat ribbon cable (IDC) type. Jameco #32491 will work as the mating connector. 10 ft of gray flat ribbon cable is #135538. 10 ft of multicolor flat ribbon cable is #112547. If you want screw terminals for the primary inputs you can use our terminal strip adapter (TSA). The power, Aux inputs and outputs are screw terminals.



6 Applications

6.1 Routes
The SMD82 is well suited to handle routes in a yard. The following shows an example of five routes using four switches. The route CV values were determined using the information in sections 4.6 and 4.7. One very nice tool that makes custom programming much easier is JMRI DecoderPro.



Route Group 1 - 8 address CV 77 = 101

SW 1 to 4 connected to SMD82 outputs 1 to 4 respectively

Route 1 CV 81 = 5, CV 82 = 1 execute with 101t

Route 2 CV 83 = 5, CV 84 = 5 execute with 101c

Route 3 CV 85 = 5, CV 86 = 0 execute with 102t

Route 4 CV 87 = 11, CV 88 = 10 execute with 102c

Route 5 CV 89 = 11, CV 90 = 2 execute with 103t

One SMD82 can handle routes with up to eight switches. However, it may be necessary to have routes with more than eight switches and consequently more than one SMD82. Multiple SMD82 can be programmed to operate together to execute a route with one command. Lets say you have a route with 16 switches. This would require two SMD82s.

The first SMD82 controls switches 1 to 8 and the second SMD82 controls switches 9 to 16. The CV 1 & 9 values should be different for each SMD82 giving them their own address because you still may want to control each switch individually. The SMD82 output addresses are independent of the route addresses.

4.8 Power On Output State

These CVs determine the state of each output at power on. Decoder configuration option 1 or option 2 has to be enabled for this these CVs to function. You only need to program these CVs if option 2 is enabled. If option 1 is enabled, the SMD82 automatically programs them.
CV33 - Power on state for outputs 1 to 4, a value from 1 to 170
CV34 - Power on state for outputs 5 to 8, a value from 1 to 170
If neither throw or closed is selected the output does nothing. If both are selected this feature will not work correctly

Outputs 1 to 4	Value	Select
Output 1 throw	1	**1**
Output 1 close	2	
Output 2 throw	4	**4**
Output 2 close	8	
Output 3 throw	16	
Output 3 close	32	**32**
Output 4 throw	64	**64**
Output 4 close	128	
Program this value into CV33		**101**

Outputs 5 to 8	Value	Select
Output 5 throw	**1**	
Output 5 close	2	**2**
Output 6 throw	4	
Output 6 close	8	**8**
Output 7 throw	16	**16**
Output 7 close	32	
Output 8 throw	64	**64**
Output 8 close	128	
Program this value into CV34		**90**

Example: CV33 = 1 + 4 + 32 + 64 = 101, throw output 1, throw output 2, close output 3 and throw output 4
Example: CV3 = 2 + 8 + 16 + 64 = 90, close output 5, close output 6, throw output 6 and throw output 6 (**example shown above in table**)

Tip: An easy way to program CV33 and CV34.
1. Enter normal operating mode and command each of the outputs to the desired state.
2. Enter programming mode and program CV29 to 2 (enable option 2).
3. Exit programming mode.
Now at each powered on, the outputs will go to the same state as set in step 1.

4.9 Output On Time

This CV determines how long an output will stay on. In order for this CV to function the output configuration CV must be set to a value of two (“2"). See section 4.2. This CV applies to all outputs set to this configuration. The default value of this CV is 31 which gives an on time of about 8 seconds.
CV2 - Output on time, a value of 1 to 127.
The time is determine be the following equation.
On time = CV2 X .256 seconds

4.10 Ops Mode Address

This CV sets the operations mode program address. Program the SMD82 just like you would a loco in ops mode. This is a loco 2 digit address and therefore must be unique among locomotive addresses. Option 3 must be enabled to use this address for programming on the main. The programming track is not required once this address and option 3 have been set. TIP: If the “Smart” program button is pressed when is turned power on, option 3 is enable until power is removed. This is useful if you do not want to have ops mode enabled all the time.
CV31 - Ops mode address, a value of 1 to 127. Default is one (1).

4.1 Output Address

These CVs determine the address of the outputs. Each output has two CVs, an address and an address adder, that makes up the address. See section 7 for CV numbers.If an address greater than 255 is needed then use the address adder. The address adder value represents a number that is added to the address value to give the ‘actual’ address. The following table shows the CV value to use for the adder. For easier programming see “Smart” Programming.
Address, a value from 0 to 255, Address adder, a value from 0 to 7
Example: Output 1 address of 20, set CV1 = 20 & CV9 = 0
Output 1 address of 524, set CV1 = 12 & CV9 = 2
Note: Some systems refer to CV1 as AD, AD2 or short address.

Address Adder								
CV value	0	1	2	3	4	5	6	**7**
Add	0	256	512	768	1024	1280	1536	1792

4.2 Output Configuration

These CVs determine the output type.
CV3, 4, 5, 6, 10, 11, 12, 13- Output configuration
Set the CV value to zero (“0”) for solenoid type operation.
Set the CV value to one (“1”) for stall motor (continually on) type operation.
Set the CV value to two (“2”) for 8 second motor on type operation (not queued). If the motor doesn’t have to be continually powered, use this type to reduce track current draw. The length can be adjusted by changing the value of CV2.
Set the CV value to four (“4”) for on/off manual motor control type operation. This type doesn’t response if included in a route.

4.3 Decoder Configuration

This CV determines the decoder configuration options.
CV29 - Configuration, a value from 0 to 4
Option 1, CV29 = 1 The SMD82 will remember each outputs state at power off. Then at power on, after about five seconds, each output will be set to the same state. The output state is automatically stored in CV33 and CV34.
Option 2, CV29 = 2 At power on, after about five seconds, each output will be set to the state as determined by CV33 and CV34. You must program CV33 and CV34 to the desired state at power on. Option 2 disables option 1. See section 4.8.
Option 3, CV29 = 4 Enables ops mode programming. This allows the address in CV31 to be used as if it is a “loco” address and can be programming on the main. See section 4.10.
To combine options add their value together. In the case where only one selection is possible a box shows “Select one”.
Example: Enable options 2 and 3, CV29 = 2 + 4 = 6

Configuration CV	Value	Select
No options	0	
Option 1	1	
Option 2	2	
Option 3	4	
Program this value into the configuration CV		

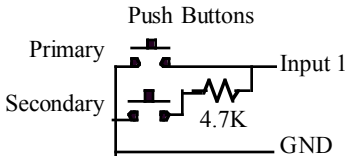
Select One

4.4 Input Control

These CVs determine what action the inputs will have when activated. There are two CVs for each input. A route number of one of the routes and an action. See section 7 for CV numbers.

There are 13 physical input terminals. Eight primary and five auxiliary. If you require more than 13, you can use the secondary inputs which use the same terminal as the primary inputs but require the use of a resistor as shown in the diagram.

Primary input 1 and aux input 1, primary input 2 and aux input 2 ...etc work together and optionally can be configured so that the aux input would only execute its assigned route when the primary input is low.



The following table shows how each CV is defined and the value of each selection. Add the value of the selections together to determine the value to program the CV. To select a given output multiply its number (1-8) by 16. In some cases only one of several selections are possible and are shown by a box as "Select one".

Pri, Sec & Aux Input Control			
Route Number CV	Value	Select	
Route Disabled	0	**0**	Select
Route Number (result of transition if selected)	1 to 16		One
Route will only execute if respective Pri input low **	128		
Program this value into the appropriate route number CV		**0**	
Action CV	Value	Select	
Input disabled	0		Select
On low to high transition	1		
On high to low transition	2	**2**	
On change transition (both low to high and high to low)	3		one
Result of transition if route number CV value is (0) zero			
Transition toggles output	4	**4**	Select
Transition closes the output	0		
Transition throws the output	8		One
Output number times 16	# X 16		
example for output 1	1 X 16	**16**	
Program this value into the appropriate action CV		**22**	

** **Note**: Only applies to routes assigned to Aux inputs

In order for an input to cause an action, a transition must be selected. Each input has a 'pull-up' resistor connected to 5 volts, so the input is normally at 5 volts. An input transition is when the voltage on an input goes from high to low (falling edge) or from low to high (rising edge). For example, if a push button is connected to an input and ground, when it is pressed the input is grounded. This causes a high to low transition. When the button is released this causes a low to high transition.

Example: Primary input 1 when grounded will toggle output 1.

Route number CV35=0, Action CV36=2+4+16=22 (**example shown above in table**)

Example: Primary input 2 when grounded will execute route 2.

Route number CV37=2, Action CV38=2+32=34 (Since a route is enabled, that disables the close, throw, toggle and output number regardless of how they are selected.)

Tip: Use ops mode to quickly experiment with input settings.

4.5 Remote Control Route Address

These CVs determines the address of the route group and are independent of the SMD82 output addresses. Each output has two CVs, an address and an address adder, that makes up the address. See section 7 for CV numbers. If an address greater than 255 is needed then use the address adder. The address adder value represents a number that is added to the address value to give the 'actual' address. See section 4.1.

Note: The group 1-8 address should be at least four numbers apart from the group 9-16 address or the routes will not work correctly.

Example: CV77 = 101, CV78 = 0, throw switch 101 to execute route 1, close switch 101 to execute route 2.

Route Group 1-8 Execution Example								
Route	1	2	3	4	5	6	7	**8**
Switch address	101t	101c	102t	102c	103t	103c	104t	104c

4.6 Route Output Selection

These CVs determine which output is included in the route. Each of the eight outputs has it own value. To calculate the CV value, add up all the individual values of the outputs to be included (selected). An excluded output has a value of zero. See section 7 for CV numbers.

Example: For route 1, select outputs 1, 2, and 6. CV81 = 1+2+32 = 35.

Route Selection CV	Value	Select
Output 1	1	
Output 2	2	
Output 3	4	
Output 4	8	
Output 5	16	
Output 6	32	
Output 7	64	
Output 8	128	
Program this value into the appropriate selection CV		

4.7 Route Switch State

These CVs determine the state, closed or thrown, of the switch. Each of the eight outputs has a close and throw value. A close always has a zero ("0") value. A throw has a value greater than zero. To calculate the CV value, add up all the close and throw values. Even if an output is not selected, a close or throw value must be given.

Example: For remote route 1, close outputs 2, 4, 7 and 8, and throw outputs 1, 3, 5 and 6. CV82 = 1+4+16+32 = 53.

Switch State CV	Value	Select
Output 1 throw - not selected (0) closes	1	
Output 2 throw - not selected (0) closes	2	
Output 3 throw - not selected (0) closes	4	
Output 4 throw - not selected (0) closes	8	
Output 5 throw - not selected (0) closes	16	
Output 6 throw - not selected (0) closes	32	
Output 7 throw - not selected (0) closes	64	
Output 8 throw - not selected (0) closes	128	
Program this value into the appropriate state CV		