

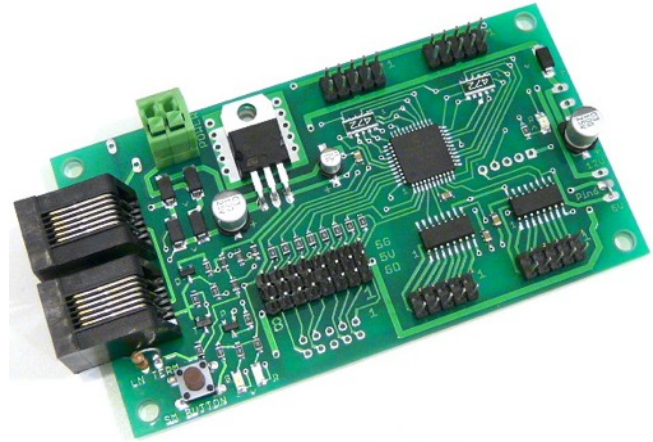


# TEAM DIGITAL

Improving the world of DCC

## SC82 Servo Controller

- > DCC compatible accessory decoder
- > Control 8 servos motors
- > Output status LEDs
- > 8 inputs for turnout control
- > 16 inputs for semaphore signaling
- > 8 configurable routes
- > “Smart” Programming
- > DCC gateway to serial bus
- > LocoNet<sup>®</sup> compatible serial bus



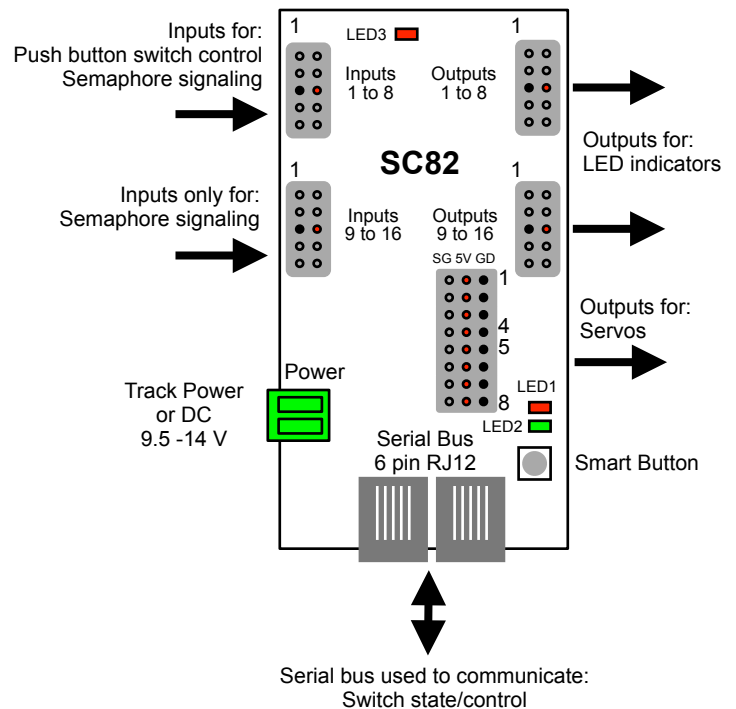
### Description

The SC82 is a DCC compatible accessory decoder. It can control up to 8 servo motors that can be used for switches (turnouts) or semaphores. It can drive LEDs for turnout state. The inputs can be used for push buttons to control switches or block detectors to control semaphores. It has route capability for multiple turnout control.

The SC82 can be used as a stand-a-lone controller or communicate with other devices that have a compatible serial bus.

Using the serial bus, one SC82 could control another. Push buttons connected to the inputs of one SC82 can control servo connected to another SC82. A route defined in SC82 could include servos controlled by another SC82. The serial bus can help in reducing and simplify the wiring.

The SC82 works out of the box with no programming. If you need to change servo position or addresses its as easy as issuing switch commands or controlling loco speed. If custom operation is required, CVs can be programmed by the DCC system.



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# 1 Operation

The SC82 is capable of driving eight servo motors. Each output (servo) can individually be assigned any switch (turnout) address. It has eight inputs for local control of the outputs and eight programmable routes.

There are two modes of operation. The modes are based on how the servo is used. All servo outputs function in either mode 1 or 2 i.e. modes can not be mixed between servo outputs.

## The first mode is moving all servos to two positions (default).

**Mode 1** - The servo outputs can be used for switch (turnout) control. There is a separate switch address for each output so they can be controlled individually. There are a total of eight switch addresses used.

## The second mode is for moving all servos to three positions.

**Mode 2** - The servo outputs can be used for semaphore control. There are 24 switch addresses used. In this mode three addresses are used to control each servo, address A(throw) will command the servo to one end, address A+1(throw) will command it to the center and address A+2(throw) will command it to the other end.

The SC82 supports routes. A route allows for the control of multiple switches (turnouts) with just one switch command. Each route is made up of eight cells (switch addresses) and one top level address (or route execution switch address). Each top address is completely independent of a servo address. Complex routes with more than eight servo addresses can be created by assigning the same address to more than one top level address. Routes are executed by issuing a switch command.

Since the SC82 is an accessory decoder, it can be controlled via DCC commands. It can also be controlled via the serial bus (LocoNet compatible). For non-Digitrax systems a DCC gateway feature allows DCC switch commands to be passed directly to the serial bus. This allows DCC switch commands to control devices connected to this serial bus.

### 1.1 LED Indicators

LED 1 flashes indicates “Smart” programming. LED 2 flash indicates accepted program value or a valid received address. LED 3 slow flash indicates heartbeat and fast flash indicates serial bus short.

## 2 Getting Started

The SC82 comes from the factory ready to use with addresses of 1 to 8. Once you plug in the servos cables, centered the servos (section 2.2) and mounted them you are ready to use the SC82. If you want to change some of the addresses or adjust servo movement see the “Smart” Programming section. For very custom programming see section 4, Configuration Variables for various options. **Before doing any programming, it is strongly recommended that you verify basic operation.**

### 2.1 Control via LocoNet - Digitrax Users

The SC82 comes from the factory ready to use by control from DCC commands when it is connected to track power. To control the SC82 via LocoNet, it must be enabled. LocoNet can be enabled using section 3, “Smart” programming Part 3 or the programming track. If the programming track is used, connect the SC82 track power terminals to the programming track and program CV9 with a value of 48. The SC82 can now be powered from a 12 volt supply and controlled via LocoNet.

### 2.2 Servo Mounting

Before mounting and/or linking the servo arm (horn) to the turnout or semaphore, the servo should be centered and then the arm attached so that when linked the turnout or semaphore will be in the approximate center of their travel.

To center the servo, press the Smart button then turn on power and continue to press the button until LED2 (green) begins to flicker. Several seconds after releasing the button, all the servo will move to the center position.

NOTE: for mounting orientation it may be useful to know that a turnout throw command causes the servo to rotate CCW when viewing the servo shaft (factory default operation).

### 2.3 Servo Move Direction

It may be that after you have installed the servos issuing a close or throw command causes the switch to move to the opposite intended position. That is, close causes the switch to move to the thrown position. The direction can be reversed without programming if a push button is used for switch control. To reverse the servo direction press and hold the “Smart” program button until after power is turned on. If LED2 (green) begins to flicker you have pressed the “Smart” button too long. After power has been on for at least 5 seconds, press and hold the respective push button for the servo to be reversed for at least 4 seconds. Direction can also be changed in “Smart” programming Part 2.

### 2.4 Switch Position Indication

If LEDs are used to indicate the status (position) of the switch on a panel or fascia, they will flash during the time the respective servo is moving. It may be that after they are installed that the lighted color does not match the switch position. That is, green may be lit instead of red. The lighted color can be reversed without programming if a push button is used for switch control. To reverse the lighted color during normal operation, press and hold the push button for at least 4 seconds.

Once you notice the change release the button. The LEDs may be flashing during this time. Also the SC82 must NOT be in the same mode as when change the servo direction mode.

Switch (Turnout) Terminology		
This manual	throw or t	close or c
Digitrax	throw or t	close or c
NCE	reverse or OFF or 2	normal or ON or 1
Lenz	-	+
MRC	OFF	ON

### 3 “Smart” Programming

“Smart” programming is a term used to describe an easy way to program Configuration Variables (CVs). A controller (any device used for locomotive or switch/accessory control) is used to issue switch (turnout) or accessory commands. Additionally, loco speed commands may be used.

**“Smart” programming only works when the SC82 is connected to track power.**

There are three parts to “Smart” programming. You can:

1. change the addresses of the inputs and servo outputs, either for switch control (two servo positions) or semaphore control (three servo positions).
2. change the amount of servo movement and positions.
3. set the SC82 configuration and status report options.

To program in “Smart” mode, connect the SC82 power terminals to track power. The serial bus (LocoNet in Digitrax systems) should NOT be connected to the SC82 during “Smart” programming.

To start turn on track power. Wait 6 or 7 seconds.

You can start from any part. Also at any time you can exit “Smart” mode by pressing the button for approximately one second until LED1 stops flashing.

**Part 1:** To change addresses and mode, press the “Smart” program button and hold it down for approximately one second until LED1 (red) starts to flash. Then release it. The SC82 is now ready to have the addresses changed. You can set eight sequential addresses in one (first) step or continue and set each of the individual servo addresses (non-sequential). Input addresses are also changed. SC82 Configuration is unchanged.

Eight sequential addresses:

Using the controller select the switch address or accessory number you want for the start of eight sequential addresses and issue a close (normal) command for two positions (mode 1). Issue a throw (reverse) command for three positions (mode 2). Now press the “Smart” button until LED1 stops flashing, the SC82 will restart and be ready to use with the new addresses.

Smart Programming Part 1 - Change addresses and or mode (sequential addresses)				
<i>Part 1: To start - Press the “Smart” button until LED1 starts to flash</i>				
LED1 #Flashes	Description	t	c	Example
1	Select beginning address for 8 sequential addresses	3 position (mode 2)	2 position (mode 1)	9 c
<i>To stop - press the “Smart” button until LED1 stops flashing, the SC82 will then restart and be ready to operate</i>				

**For example, to set servo addresses 9-16 in mode 1, select switch address 9 and issue a c (close) command**

Non-sequential addresses:

Using the controller select the switch address or accessory number you want for the first servo output address and issue a close (normal) command for 2 positions (mode 1). Issue a throw (reverse) command for 3 positions (mode 2). LED1 will be flashing twice with a pause and then repeats indicating that the servo 2 output address is ready to be programmed. Select the switch address you want for the second servo output address and issue the same close/throw command as in step one.

Smart Programming Part 1 - Change addresses and or mode (non-sequential addresses)					
<i>Part 1: To start - Press the “Smart” button until LED1 starts to flash</i>					
LED1 #Flashes	Description	t	c		
1	Select servo 1 output address	3 position	2 position		
<i>Continue to step 2 for non-sequential addresses</i>					
2	Select servo 2 output address	3 position	2 position		
3	Select servo 3 output address	3 position	2 position		
4	Select servo 4 output address	3 position	2 position		
5	Select servo 5 output address	3 position	2 position		
6	Select servo 6 output address	3 position	2 position		
7	Select servo 7 output address	3 position	2 position		
8	Select servo 8 output address	3 position	2 position		
<i>After the last step the SC82 will restart and be ready to operate</i>					

**Servo 2 position and 3 position modes can NOT be mixed.**

As you progress through the “Smart” programming steps, LED1 flashes the number of times indicating which servo output is ready to be programmed. After the 8th step the SC82 will restart and be ready to use with the new addresses.  
 Note: servo 3 position (mode 2) used for semaphore requires 3 addresses, one for each position. Enter only the first address and be sure to skip at least 3 addresses when programming. You can exit “Smart” programming after any step by pressing the “Smart” button until LED1 stops flashing.

**Part 2:** To change servo position press the “Smart” program button and hold it down. After about a second LED1 (red) starts to flash. Continue to hold it down until LED2 (green) turns on. Then release it. LED1 will be flashing and LED2 will be on. The SC82 is now ready to have the servo movement changed. You need to be able to see the servo arm, switch or semaphore to make adjustments.

Using the controller select a loco address (not a switch address) that corresponds to the servo output (1-8) that is to be changed. For example select loco 2 for output 2. Adjust the speed of the loco to move the servo. Set the loco to forward to move the servo in one direction, set the loco to reverse to move it in the other direction.

To program the switch position for close, use the manner just described and move the servo to the position you want it to be in when closed. Now issue a switch close command with address 1.  
 To program the turnout position for throw, use the manner just described and move the servo to the position you want it to be in when thrown. Now issue a switch throw command with address 1.

The switch address (1-8) is used for programming the servo position of the respective output. If a switch address higher than 8 is used, the SC82 will restart and be ready to use with the new positions. You can also exit “Smart” programming by pressing the “Smart” button until LED1 stops flashing.

**Note:** The controller must be set for 128 speed steps and there should not be any other locos addresses selected in the 1-8 range.

Smart Programming Part 2 - Set (Program) Servo Position					
<i>Part 2: To start here - Press the “Smart” button until LED2 lights - Output addresses are not changed</i>					
Loco address	Description	t	c		
1	Use loco address 1 speed and direction to position servo 1 Issue switch address 1 to set (program) the position	set throw position	set close position		
2	Use loco address 2 speed and direction to position servo 2 Issue switch address 1 to set (program) the position	set throw position	set close position		
3	Use loco address 3 speed and direction to position servo 3 Issue switch address 1 to set (program) the position	set throw position	set close position		
4	Use loco address 4 speed and direction to position servo 4 Issue switch address 1 to set (program) the position	set throw position	set close position		
5	Use loco address 5 speed and direction to position servo 5 Issue switch address 1 to set (program) the position	set throw position	set close position		
6	Use loco address 6 speed and direction to position servo 6 Issue switch address 1 to set (program) the position	set throw position	set close position		
7	Use loco address 7 speed and direction to position servo 7 Issue switch address 1 to set (program) the position	set throw position	set close position		
8	Use loco address 8 speed and direction to position servo 8 Issue switch address 1 to set (program) the position	set throw position	set close position		

**Part 3:** To change the SC82 Decoder Configuration and/or the Status Report options press the “Smart” program button and hold it down. After about a second LED1 (red) starts to flash. Continue to hold it down until LED2 (green) turns on and then off. Then release it. The SC82 is now ready to have the options changed. LED1 (red) will be flashing.  
 The CV value is the switch address you select. For example, to enable the serial bus and disable DCC control for a Digitrax system select a switch address of 48 and issue a throw command.

Once the switch command has been issued, LED1 will be flashing twice with a pause and then repeats indicating that the Status Report options are ready to be programmed.

Smart Programming Part 3 - Change Configuration and Status Report					
Part 3: To start here - Press the "Smart" button until LED2 lights and hold until it turns off					
LED1 #Flashes	Description	t	c	Example	
1	Decoder configuration	set	clear	48	t
2	Status report (useful only with serial bus and mode 1)	set	clear	48	c
After the last step the SC82 will restart and be ready to operate					

Example: for Digitrax systems, select switch address 48 and issue a t (throw) command. 48 is 16 (enable serial bus) plus 32 (disable DCC control).

Decoder Configuration (Section 4.4)	Value	Select
No options	0	
Option 2 - enable fixed output state at power on	2	
Option 3 - enable ops mode programming	4	
Option 4 - enable DCC to serial bus gateway	8	
Option 5 - enable serial bus communication	16	
Option 6 - disable control from DCC	32	
Option 7 - disable power save	64	
Option 8 - enable common cathode	128	
Configuration values total		

Example: clear (zero) the status report CV. When a c (close) command is issued, the switch address is unimportant.

Status Report (Section 4.5)	Value	Select
No options	0	
Option 1 - Send input state at power on enabled	1	
Option 2 - Send output state at power on enabled	2	
Option 3 - Interrogate input state enabled	4	
Option 4 - Interrogate output state enabled	8	
Option 5 - Use 1 LED output instead of 2 to indicate servo position	16	
Status Report values total		

State Report Options 1- 4 are only useful if the serial bus is enabled.

Options 5 is used with the optional 3 wire button/LED interface board.

## 4 Configuration Variables (CVs)

The SC82 supports **Paged Mode Programming in Service Mode and Operations (Ops) Mode** programming. To program in paged mode, connect the Track Power terminals to the programming track. See diagram on the front page. 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 SC82 does not have built in feedback like a mobile decoder. Therefore, some systems may show a "no decoder on track" error or "can not read CV". However it still is programmed. To enter normal operation, disconnect from the program track and connect as defined in section 5.

To program in ops mode (On the Main Programming) connect the power terminals to track power. Hold down the Smart button just before power is turned on. When the green LED turns on release the button then wait until the red LED turns off. The SC82 is now in ops mode until power is turned off. The default ops address is one (1). **This is a loco address, so be careful when using this feature.** The SC82 can be programmed so it is always in ops mode by setting option 3 in CV9. **When using ops mode to change CV values, the SC82 does not recognize some new values until power is turned off and then back on.** Programming CV7 with a value of 1 will restart the SC82 so power need not be cycled when programming in ops mode. This is the same as turning power off and then back on. Read/write CVs can be done via the serial bus if enabled. For programming with DecoderPro and other programming tips see Team Digital's web site.

### 4.01 Changing servo position

Once the SC82 is in ops mode the servos can be set to various positions. This is an alternative to using Smart programming.

To move the servo to the center, program CV7 with a value of 2.

To move the servos to one end program CV7 to a value of 4.

To move the servos to the other end program CV7 to a value of 5.

To move the servo to the center with power save off, program CV7 with a value of 6.

## 4.02 Reset the SC82 to factory defaults

To “reset” the SC82 to factory defaults, turn power on and wait until LED 1 turns off. Then press the “Smart” button and continue to hold the button down (at least 16 seconds) until both LED 1 & 2 are alternately flashing. Alternately, programming 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.

### 4.1 Servo Output Address

CV56-71 - These CVs determine the address of the servo outputs. Each output has two CVs, an address and an address adder, that makes up the address.

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.

Servo Output		
<b>Address CV</b>	Value	Select
Address	1 - 255	
Program this value into the appropriate address CV		
<b>Address Adder</b>	Value	Select
Address adder (see the address adder table for the value)	0 - 9	
Program this value into the appropriate type CV		

Address Adder										
CV Value	0	1	2	3	4	5	6	7	8	9
ADD	0	256	512	768	1024	1280	1536	1792	2048	2304

### 4.2 Servo Position and Range

CV72-87 - There are two positions the servo can move too in Mode 1. These positions are determined by two CV values for each servo. The servo will move to position 1 when a close command is issued and position 2 when a throw command is issued. The difference between these two positions determines the servo movement or range. In Mode 2 the the center position is half way between position 1 and 2.

### 4.3 Servo Move Speed

CV88-95 - Move Speed Direction 1, a maximum value of 127.

CV96-103 - Move Speed Direction 2, a maximum value of 127.

These CVs determine the servo’s speed when it moves. The larger the number the slower the servo moves. A value of zero will cause the servo to move at it’s maximum speed.

**Note:** Reasons why you may see the servo move strangely or at maximum speed at power on even if the servo move speed has been set to a very slow value.

1. If the servo position is changed during power off.
2. Some servos twitch, jump or move erratically when power is first applied to them.
3. Some inexpensive servos have poor performance.

### 4.4 Decoder Configuration

CV9 - This CV determines the configuration which consists of several options.

\* Note: Setting the SC82 mode by programming this CV does not change any of the servo or input addresses. To change modes and or addresses use “Smart” programming.

**Option 2** - Default output state. At power on each output will be set to the state as determined by CV12 and CV13. You must program CV12 and CV13 to the desired state at power on. See section 4.x.

Decoder Configuration (Section 4.4)	Value	Select
No options	0	
Option 2 - enable fixed output state at power on	2	
Option 3 - enable ops mode programming	4	
Option 4 - enable DCC to serial bus gateway	8	
Option 5 - enable serial bus communication	16	
Option 6 - <b>disable</b> control from DCC	32	
Option 7 - <b>disable</b> power save	64	
Option 8 - enable common cathode	128	
Configuration values total		

**Option 3** - Ops Mode Programming. Allows Operations mode (On the Main) programming using a Loco address to be enabled all the time. See section 4.10.

**Option 4** - DCC to bus gateway. Allows DCC switch command packets to be put the serial bus. Any device connected to the bus will have access to these DCC commands. Requires option 5.

**Option 5** - Serial Bus communication. Allows the SC82 to communication with devices connected to the serial bus.

**Option 6** - DCC control. Allows the SC82 to receive instructions from DCC (track). **Note:** Selecting this option **DISABLES** this feature.

**Option 7** - Power save.  
Reduces power when servo are not moving. **Note:** Selecting this option **DISABLES** this feature.

**Option 8** - Common cathode LEDs. Allows common cathode connection of LEDs to the outputs.

To calculate the value of CV9, add up the selected values. Example: Option 1 and option 3 - CV9 = 1 + 4 = 5

This table will help you determine how to configure the SC82. If there are more than one SC82 or other Gateway capable devices, only one should have the gateway enabled. In a Digitrax system DO NOT connect the SC82 to the throttle LocoNet if the gateway, DCC control and serial bus are enabled. This could cause an endless sending of switch commands from the track to LocoNet and back to the track.

System	DCC Control Option 6	Gate-Way Option 4	Serial Bus Option 5	CV Value	Notes
All DCC Compatible Systems	Enabled			0	The SC82 is controlled via the track (DCC commands). The bus is not used by the SC82.
Digitrax System	<b>Disabled</b>		Enabled	48	The SC82 is controlled via LocoNet.
Digitrax System	Enabled	Enabled	Enabled	24	Provides a separate LocoNet bus for LocoNet accessory devices. Allows devices to receive turnout commands from the track (DCC commands). Reduces throttle bus traffic.
NCE System and others	Enabled	Enabled	Enabled	24	Provides separate bus for bus enabled accessory devices. Allows devices to receive turnout commands from the track (DCC commands)

#### 4.5 Status Report

CV10 - This CV determines which input and output states the SC82 reports (Options 1- 4) when used for turnout control and useful only when the serial bus is enabled. This will not work correctly if the servos are configured for mode 2 (3 positions). This also determines how the LED driver outputs are configured. These options can be enabled in part 3 of Smart Programming.

**Option 1** - Input state messages are sent on the serial bus at power on. This options is typically used for inputs that are used for block detection or turnout feedback. This does NOT apply to inputs that are used for switch (turnout) control.

**Option 2** - Output servo position (state) messages are sent on the serial bus at power on. These are switch type messages. Do NOT enable option 4 at the same time.

Status Report	Value	Select
No options	0	
Option 1 - Send input state at power on enabled	1	
Option 2 - Send output state at power on enabled	2	
Option 3 - Interrogate input state enabled	4	
Option 4 - Interrogate output state enabled	8	
Option 5 - Use 1 LED output instead of 2 to indicate servo position	16	
Status Report values total		

**Option 3** - Input state messages are sent on the serial bus when a Digitrax interrogation command is received.

**Option 4** - Output servo position (state) messages are sent on the serial bus when a Digitrax interrogation command is received. These are feedback type messages. Do NOT enable option 2 at the same time.

**Option 5** - One LED output is used to indicate servo position. This is required if you want to connect two LEDs and a push button by a 3 wire servo cable to the SC82. A 3 wire interface board is required. See section 6.1.

#### 4.6 Input Control

CV16-39 These CVs determine what action the inputs 1-8 will have when activated. (Inputs 9-16 are used for semaphore signaling and can not be independently programmed.) There are three CVs for each input. An address, type and transition CV. 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.

They can each be programmed to operate independently and are not linked or connected to the outputs in any way except by a common address and type.

In order for an input to cause an action, including executing a route, a transition must be selected. The input is normally at 5 volts. An input transition occurs 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. To set addresses for both inputs and outputs see "Smart" Programming for easier programming.



Input Control		
Address CV	Value	Select
Address	1 - 255	
Program this value into the appropriate address CV		
Type CV	Value	Select
Invert the normal state	128	Select one
Normal state	0	
Toggle state (only if switch type)	64	
Message type, sensor	32	Select one
Message type, feedback (actual switch position)	16	
Message type, switch (commanded switch position)	0	
Address adder (see the address adder table for the value)	0 - 9	
Program this value into the appropriate type CV		
Transition CV	Value	Select
Execute route number x 16 (example to execute route 2, 2 x 16 = 32) *	0 - 128	
Send message on change transition	3	Select one
Send message on hi to low transition	2	
Send message on low to hi transition	1	One
Disable message	0	
Program this value into the appropriate transition CV		

\* An input may execute a route directly.

#### 4.7 Route Execute Address

CV112-127 - These CVs determine the top or execute address of a route. Each top address is completely independent of an input or output address. A route is executed when a turnout (switch) command from any source including those from the SC82, throttles or computers matches the top address and switch state for that route. To increase a route to greater than eight turnouts, give more than one top address the same address. When a route is executed, turnout commands are sent for each cell containing an address. Optionally, a route can be executed by a block sensor message. In this way several turnouts can automatically be alined when a block becomes occupied.

Route Top (Execute) Address		
Address CV	Value	Select
Address	1 - 255	
Program this value into the appropriate address CV		
Type CV	Value	Select
Close	64	Select one
Throw	0	
Execution type, sensor	32	Select one
Execution type, switch (turnout command)	0	
Address adder (see the address adder table for the value)	0 - 9	
Program this value into the appropriate type CV		

#### 4.8 Route Cell Address

CV128-255 - These CVs determine the address in a route cell. When a route is executed all cell addresses are sent one at a time. For all addresses in a route to be sent there must be no empty cells between cells with addresses.

Route Cell Address		
Address CV	Value	Select
Address	1 - 255	
Program this value into the appropriate address CV		
Type CV	Value	Select
Close	64	Select one
Throw	0	
Address adder (see the address adder table for the value)	0 - 9	
Program this value into the appropriate type CV		

#### 4.9 Route Address Send Delay

CV11- Send address time delay, value 0 to 255.

This CV determines the time delay the SC82 waits before sending the next address in a route. Some switch machine drivers require a time delay between switch activation.

Delay between sending route addresses								
CV11 Value	0	1	2	4	8	12	16	<b>20</b>
Delay (sec)	0.23	0.45	0.68	1	2	3	4	5

#### 4.10 Operations Mode Loco Address

CV1 - Ops mode address, a value of 1 to 127. Default is one (1). (If using LocoNet and JMRI higher values are allowed.)

This CV sets the operations mode program address. This address is used ONLY for programming and has NOTHING to do with normal operation. This allows programming the SC82 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 power is turned on, option 3 (ops mode) is enabled until power is removed. Useful if you do not want to have ops mode enabled all the time.

#### 4.11 Input Lockout Address

CV14 - Address, value 0 to 255: CV15 - Address adder, value 0 to 9

These CVs set the input lockout address. When a switch (turnout) throw command is issued that matches this address the SC82 inputs are disabled. When a close command is issued with this address the inputs are enabled. This feature is useful for dispatcher control when the SC82 inputs are used for local turnout control.

#### 4.12 Power On Output State

CV12 - Power on state for output groups 1 to 4

CV13 - Power on state for output groups 5 to 8

These CVs determine the state of each output at power on. Decoder configuration option 2 has to be enabled for these CVs to function. Normally the SC82 sets the servo position to the same state as they were in when power was turned off.

To program these CVs to set the outputs to a fixed state at power on do the following.

1. Enter normal operating mode and command each of the outputs to the desired state.
2. Enter Smart programming mode Part 3 and program CV9 (enable option 2).
3. Exit programming mode.

Now at each power on, the outputs will go to the same state as set in step 1

## 5 Connections

### 5.1 Power

The SC82 is powered by using the two terminal connector labeled Power. See diagram on front page. Power can be from the track (accessory decoder operation) or a filtered DC voltage (9.5 to 14 VDC) power supply. For a DC supply do not use old analog 'Power Packs'. The SC82 power connector is non polarized and either terminal can be connected to plus or minus of the DC power supply. The power supply should be isolated from the system ground. That is, not connected to ground (booster ground, house wiring ground, etc). When multiple SC82s are used they can be all connected to one power supply. The plus and minus of the power supply must be connected to the same power input terminal on each SC82.

Power supply current requirements: 20mA for just a SC82, 20mA for each Tortoise™ using a MotoD. Good practice - select a supply with at least 10% more current capability than required.

### 5.2 Input Interface

Each input has a 4.7K 'pullup' resistor connected to 5 volts, so the input is normally at 5 volts with respect to pin 5 (minus) when no device is connected. This is a high or true state. When the input is connected to pin 5 (minus) by a push button switch or block sensor, the input is "grounded" and the state is low or false.

### 5.3 LED Output Drive

The output connectors supplies 5 volts to drive LEDs. If LEDs are used current limiting resistors are required and should not be less the 470 ohms. This is a general guide line for a typical LED. The current limit for any single output is 20 mA and the total of any connector group of eight outputs (1-8 or 9-16) is 50 mA.

### 5.4 10 PIN Input and Output

Input and output connectors have the same pin definitions. Connections can be made using our terminal strip adapter (TSA) or our Connector Cable Kit. You can build your own by using flat ribbon cable Insulation Displacement (IDC) and connectors from Jameco. The mating connector is #138376. 10 ft of multicolor flat ribbon cable is #639672.

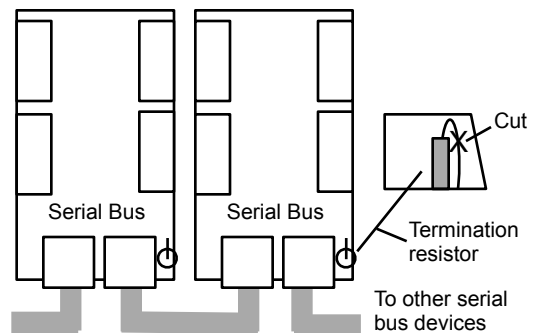
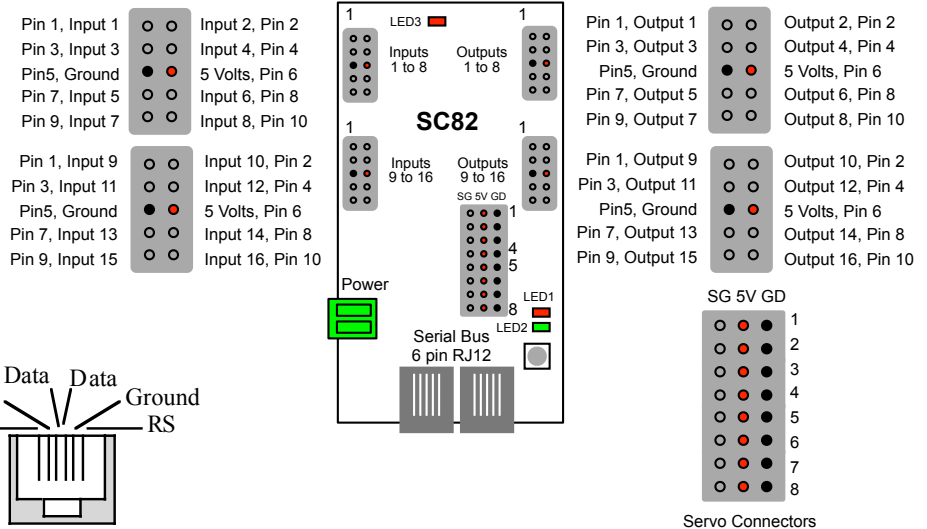
**Warning:** Do not connect the power supply ground (minus) to the ground (minus) pin 5 of the 10 pin IDC connector. Do not connect any outputs together or to other SC82 outputs.

### 5.5 3 PIN Servo

The servo output connectors have pin definitions to match the 3 pin connector on most servos. there are 3 pins per servo signal (SG), 5 volts (5V) and ground (GD).

### 5.6 Serial Bus

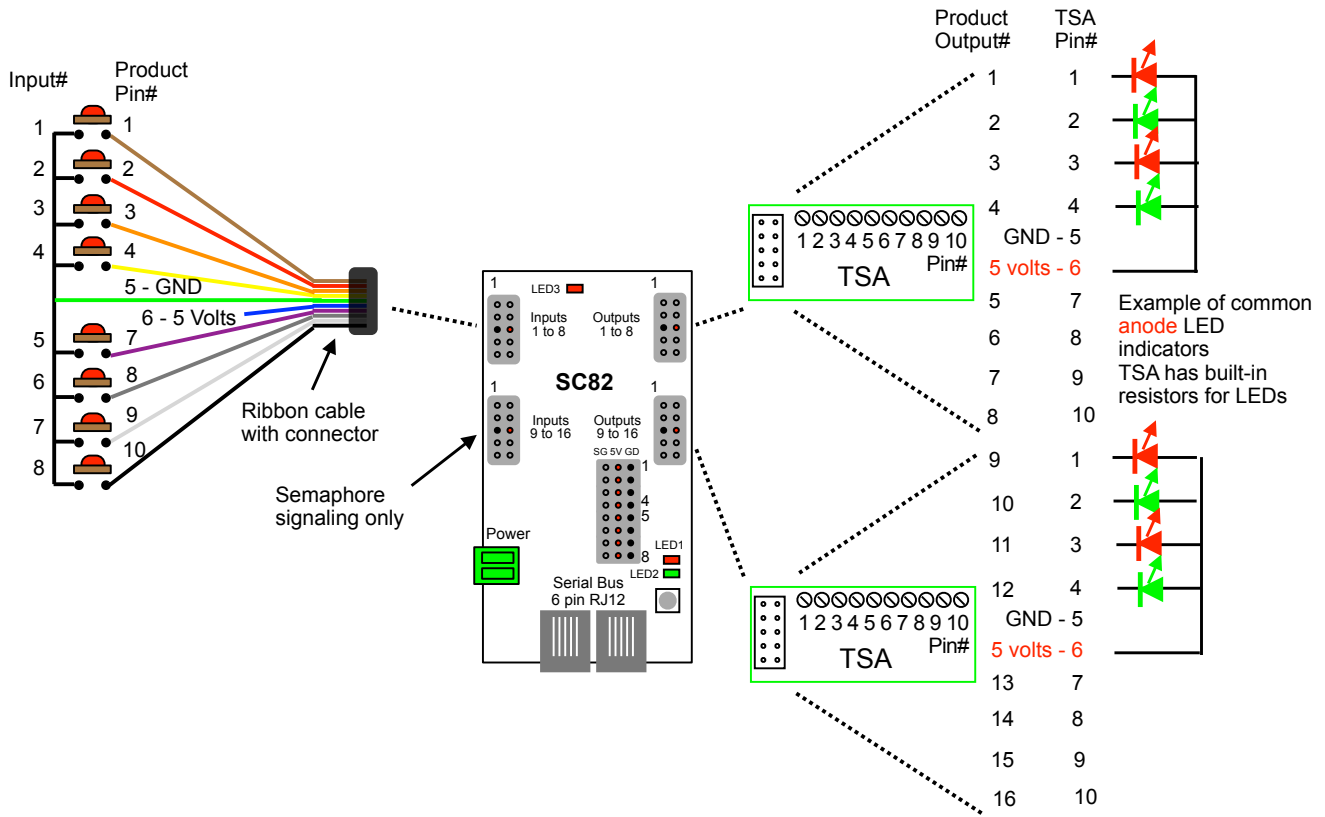
The SC82 has two RJ12 connectors for ease in making connections as shown below. In a Digitrax system the data pins are LocoNet and the RS pins are Rail Sync. In a Digitrax system Rail Sync is a replica of the track power signal but has limited power. One of its uses is to provide power to throttles connected to LocoNet. In the SC82 the RS is not used. In a systems when more than 10 SC82s are used the bus terminating resistor should be cut on any additional devices.



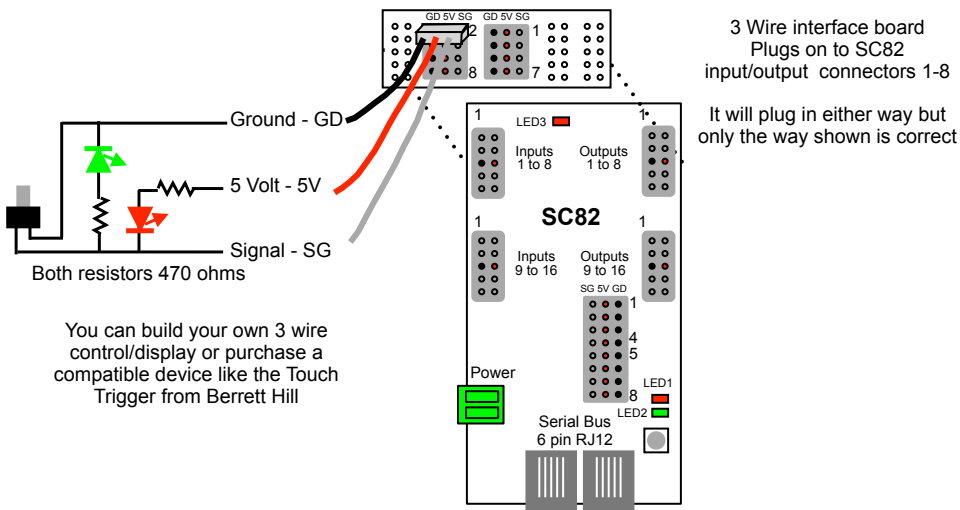
# 6 Applications

## 6.1 Wiring Examples

These diagrams show wiring for push buttons and LEDs that can be used with the SC82 for switch control.

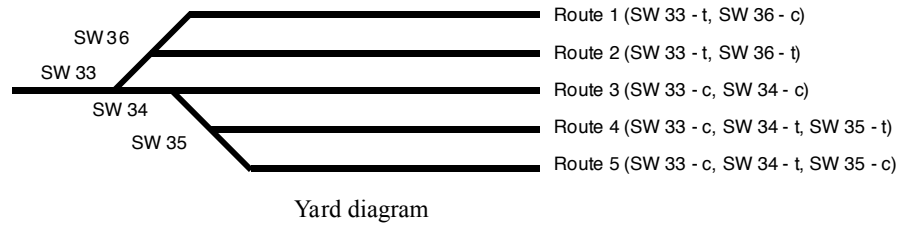


To use the 3 wire interface board, sold separately, option 5 must be enabled in the Status Report CV. See section 4.5.



## 6.2 Routes

The SC82 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 4.7 and 4.8. One very nice tool that makes custom programming much easier is JMRI DecoderPro.



A route can be executed with an actual turnout (switch) address or a pseudo address of a switch (not a physical switch). Program the top address of the route with the address you want to execute the route. Inputs can be programmed to execute a route from a push button.

Route Example								
Route	1	2	3	4	5	6	7	8
Execute address	101 t	101 c	102 t	102 c	103 t			
Address 1	33 t	33 t	33 c	33 c	33 c			
Address 2	36 c	36 t	34 c	34 t	34 t			
Address 3				35 t	35 c			
Address 4								
Address 5								
Address 6								
Address 7								
Address 8								

## 6.3 Simple Semaphore Signaling

Simple ABS semaphore signaling of up to 8 semaphores can be implemented with just block and optionally turnout state devices connected to the SC82 inputs. No programming is required except a couple of Smart programming steps. Use Smart programming Part 1 for 8 sequential addresses for 3 positions (mode 2).

Two inputs work together to control a servo for 3 position movement of a semaphore. Input 1-8 give red or green signal (semaphore at one end or the other) and inputs 9-16 give yellow signal (semaphore in center position). The chart below shows how inputs 1-4 work together with inputs 9-12. Inputs 5-8 and inputs 13-16 work the same way.

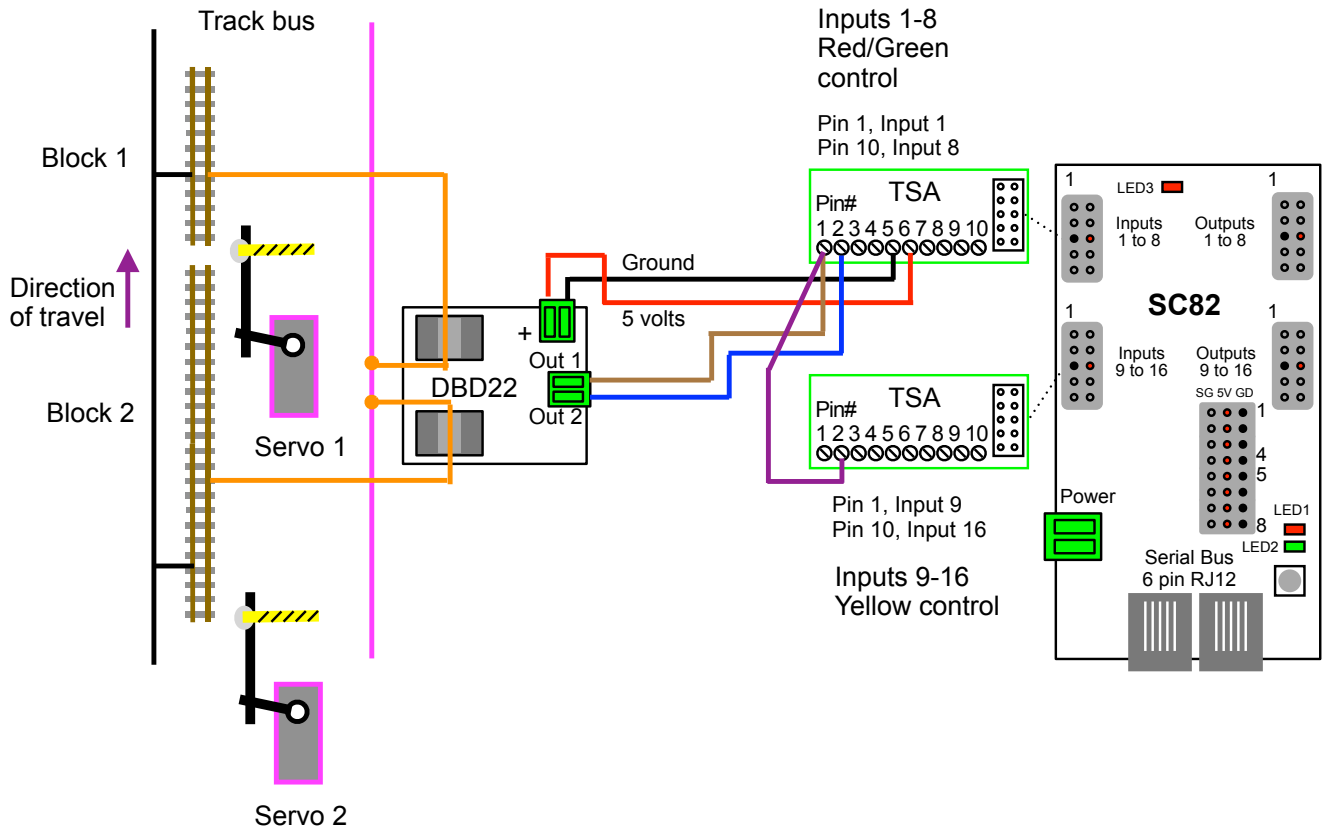
Servo Number	Servo Position	Input State
1	Red	Input 1 Low, input 9 NA
	Yellow	Input 1 High, input 9 low
	Green	Input 1 High, Input 9 High
2	Red	Input 2 Low, input 10 NA
	Yellow	Input 2 High, input 10 low
	Green	Input 2 High, Input 10 High
3	Red	Input 3 Low, input 11 NA
	Yellow	Input 3 High, input 11 low
	Green	Input 3 High, Input 11 High
4	Red	Input 4 Low, input 12 NA
	Yellow	Input 4 High, input 12 low
	Green	Input 4 High, Input 12 High

Typically the semaphore "protects" the block ahead. If the block ahead is occupied the semaphore shows stop (red) and the previous semaphore shows caution (yellow). In the example block 1 is ahead of block 2 so the output of block detector 1 is connected to SC82 inputs 1 and 10.

If there were a block 3 and corresponding semaphore, the output of block detector 2 would be connected to input 11 in addition to input 2.

In general if an occupied block should cause a red connect its block detector output to inputs 1-8. If it should cause a yellow connect its block detector output to inputs 9-16.

This diagram shows a wiring example for a simple two block, two semaphore signal system. When block 1 is occupied and block 2 is unoccupied, servo 1 is in the red position and servo 2 is in the yellow position. If both blocks are occupied then both servo are in the red position. The TSAs provide for easy connection to the SC82 inputs.



## 7 Summary of Configuration Variables

CV#	Function/Default Value		CV#	Function/Default Value		CV#	Function/Default Value	
1	Ops Mode Loco Address	1	60	Servo 3 Address	3	119	Route 4 Top Address Adder	0
2	reserved	-	61	Servo 3 Address Adder	0	120	Route 5 Top Address	0
3	reserved	-	62	Servo 4 Address	4	121	Route 5 Top Address Adder	0
4	reserved	-	63	Servo 4 Address Adder	0	122	Route 6 Top Address	0
5	reserved	-	64	Servo 5 Address	5	123	Route 6 Top Address Adder	0
6	Startup delay	1	65	Servo 5 Address Adder	0	124	Route 7 Top Address	0
7	Manufacturer Version No.	-	66	Servo 6 Address	6	125	Route 7 Top Address Adder	0
8	Manufacturer ID	25	67	Servo 6 Address Adder	0	126	Route 8 Top Address	0
9	Decoder Configuration	0	68	Servo 7 Address	7	127	Route 8 Top Address Adder	0
10	Status Report	0	69	Servo 7 Address Adder	0	128	Route 1 Cell 1 Address	0
11	Route send delay	0	70	Servo 8 Address	8	129	Route 1 Cell 1 Address Adder	0
12	Pwr on state - Outputs 1 - 4	170	71	Servo 8 Address Adder	0	130	Route 1 Cell 2 Address	0
13	Pwr on state - Outputs 5 - 8	170	72	Servo 1 Position 1	146	131	Route 1 Cell 2 Address Adder	0
14	Input Lockout Address	0	73	Servo 1 Position 2	106	132	Route 1 Cell 3 Address	0
15	Input Lockout Address Adder	0	74	Servo 2 Position 1	146	133	Route 1 Cell 3 Address Adder	0
16	Input 1 Address	1	75	Servo 2 Position 2	106	134	Route 1 Cell 4 Address	0
17	Input 1 Type & Address Adder	64	76	Servo 3 Position 1	146	135	Route 1 Cell 4 Address Adder	0
18	Input 1 Transition & Route	2	77	Servo 3 Position 2	106	136	Route 1 Cell 5 Address	0
19	Input 2 Address	3	78	Servo 4 Position 1	146	137	Route 1 Cell 5 Address Adder	0
20	Input 2 Type & Address Adder	64	79	Servo 4 Position 2	106	138	Route 1 Cell 6 Address	0
21	Input 2 Transition & Route	2	80	Servo 5 Position 1	146	139	Route 1 Cell 6 Address Adder	0
22	Input 3 Address	3	81	Servo 5 Position 2	106	140	Route 1 Cell 7 Address	0
23	Input 3 Type & Address Adder	64	82	Servo 6 Position 1	146	141	Route 1 Cell 7 Address Adder	0
24	Input 3 Transition & Route	2	83	Servo 6 Position 2	106	142	Route 1 Cell 8 Address	0
25	Input 4 Address	4	84	Servo 7 Position 1	146	143	Route 1 Cell 8 Address Adder	0
26	Input 4 Type & Address Adder	64	85	Servo 7 Position 2	106	144	Route 2 Cell 1 Address	0
27	Input 4 Transition & Route	2	86	Servo 8 Position 1	146	145	Route 2 Cell 1 Address Adder	0
28	Input 5 Address	5	87	Servo 8 Position 2	106	146	Route 2 Cell 2 Address	0
29	Input 5 Type & Address Adder	64	88	Servo 1 Moves Speed D1	18	147	Route 2 Cell 2 Address Adder	0
30	Input 5 Transition & Route	2	89	Servo 2 Moves Speed D1	18	148	Route 2 Cell 3 Address	0
31	Input 6 Address	6	90	Servo 3 Moves Speed D1	18	149	Route 2 Cell 3 Address Adder	0
32	Input 6 Type & Address Adder	64	91	Servo 4 Moves Speed D1	18	150	Route 2 Cell 4 Address	0
33	Input 6 Transition & Route	2	92	Servo 5 Moves Speed D1	18	151	Route 2 Cell 4 Address Adder	0
34	Input 7 Address	7	93	Servo 6 Moves Speed D1	18	152	Route 2 Cell 5 Address	0
35	Input 7 Type & Address Adder	64	94	Servo 7 Moves Speed D1	18	153	Route 2 Cell 5 Address Adder	0
36	Input 7 Transition & Route	2	95	Servo 8 Moves Speed D1	18	154	Route 2 Cell 6 Address	0
37	Input 8 Address	8	96	Servo 1 Moves Speed D2	18	155	Route 2 Cell 6 Address Adder	0
38	Input 8 Type & Address Adder	64	97	Servo 2 Moves Speed D2	18	156	Route 2 Cell 7 Address	0
39	Input 8 Transition & Route	2	98	Servo 3 Moves Speed D2	18	157	Route 2 Cell 7 Address Adder	0
40			99	Servo 4 Moves Speed D2	18	158	Route 2 Cell 8 Address	0
41			100	Servo 5 Moves Speed D2	18	159	Route 2 Cell 8 Address Adder	0
42			101	Servo 6 Moves Speed D2	18	160	Route 3 Cell 1 Address	0
43			102	Servo 7 Moves Speed D2	18	161	Route 3 Cell 1 Address Adder	0
44			103	Servo 8 Moves Speed D2	18	162	Route 3 Cell 2 Address	0
45			104	Servo 1 Behavior	0	163	Route 3 Cell 2 Address Adder	0
46			105	Servo 2 Behavior	0	164	Route 3 Cell 3 Address	0
47			106	Servo 3 Behavior	8	165	Route 3 Cell 3 Address Adder	0
48			107	Servo 4 Behavior	0	166	Route 3 Cell 4 Address	0
49			108	Servo 5 Behavior	0	167	Route 3 Cell 4 Address Adder	0
50			109	Servo 6 Behavior	0	168	Route 3 Cell 5 Address	0
51			110	Servo 7 Behavior	0	169	Route 3 Cell 5 Address Adder	0
52			111	Servo 8 Behavior	0	170	Route 3 Cell 6 Address	0
53			112	Route 1 Top Address	0	171	Route 3 Cell 6 Address Adder	0
54			113	Route 1 Top Address Adder	0	172	Route 3 Cell 7 Address	0
55			114	Route 2 Top Address	0	173	Route 3 Cell 7 Address Adder	0
56	Servo 1 Address	1	115	Route 2 Top Address Adder	0	174	Route 3 Cell 8 Address	0
57	Servo 1 Address Adder	0	116	Route 3 Top Address	0	175	Route 3 Cell 8 Address Adder	0
58	Servo 2 Address	2	117	Route 3 Top Address Adder	0	176	Route 4 Cell 1 Address	0
59	Servo 2 Address Adder	0	118	Route 4 Top Address	0	177	Route 4 Cell 1 Address Adder	0

CV#	Function/Default Value		CV#	Function/Default Value		CV#	Function/Default Value	
178	Route 4 Cell 2 Address	0	238	Route 7 Cell 8 Address	0			
179	Route 4 Cell 2 Address Adder	0	239	Route 7 Cell 8 Address Adder	0			
180	Route 4 Cell 3 Address	0	240	Route 8 Cell 1 Address	0			
181	Route 4 Cell 3 Address Adder	0	241	Route 8 Cell 1 Address Adder	0			
182	Route 4 Cell 4 Address	0	242	Route 8 Cell 2 Address	0			
183	Route 4 Cell 4 Address Adder	0	243	Route 8 Cell 2 Address Adder	0			
184	Route 4 Cell 5 Address	0	244	Route 8 Cell 3 Address	0			
185	Route 4 Cell 5 Address Adder	0	245	Route 8 Cell 3 Address Adder	0			
186	Route 4 Cell 6 Address	0	246	Route 8 Cell 4 Address	0			
187	Route 4 Cell 6 Address Adder	0	247	Route 8 Cell 4 Address Adder	0			
188	Route 4 Cell 7 Address	0	248	Route 8 Cell 5 Address	0			
189	Route 4 Cell 7 Address Adder	0	249	Route 8 Cell 5 Address Adder	0			
190	Route 4 Cell 8 Address	0	250	Route 8 Cell 6 Address	0			
191	Route 4 Cell 8 Address Adder	0	251	Route 8 Cell 6 Address Adder	0			
192	Route 5 Cell 1 Address	0	252	Route 8 Cell 7 Address	0			
193	Route 5 Cell 1 Address Adder	0	253	Route 8 Cell 7 Address Adder	0			
194	Route 5 Cell 2 Address	0	254	Route 8 Cell 8 Address	0			
195	Route 5 Cell 2 Address Adder	0	255	Route 8 Cell 8 Address Adder	0			
196	Route 5 Cell 3 Address	0	256	reserved	-			
197	Route 5 Cell 3 Address Adder	0						
198	Route 5 Cell 4 Address	0						
199	Route 5 Cell 4 Address Adder	0						
200	Route 5 Cell 5 Address	0						
201	Route 5 Cell 5 Address Adder	0						
202	Route 5 Cell 6 Address	0						
203	Route 5 Cell 6 Address Adder	0						
204	Route 5 Cell 7 Address	0						
205	Route 5 Cell 7 Address Adder	0						
206	Route 5 Cell 8 Address	0						
207	Route 5 Cell 8 Address Adder	0						
208	Route 6 Cell 1 Address	0						
209	Route 6 Cell 1 Address Adder	0						
210	Route 6 Cell 2 Address	0						
211	Route 6 Cell 2 Address Adder	0						
212	Route 6 Cell 3 Address	0						
213	Route 6 Cell 3 Address Adder	0						
214	Route 6 Cell 4 Address	0						
215	Route 6 Cell 4 Address Adder	0						
216	Route 6 Cell 5 Address	0						
217	Route 6 Cell 5 Address Adder	0						
218	Route 6 Cell 6 Address	0						
219	Route 6 Cell 6 Address Adder	0						
220	Route 6 Cell 7 Address	0						
221	Route 6 Cell 7 Address Adder	0						
222	Route 6 Cell 8 Address	0						
223	Route 6 Cell 8 Address Adder	0						
224	Route 7 Cell 1 Address	0						
225	Route 7 Cell 1 Address Adder	0						
226	Route 7 Cell 2 Address	0						
227	Route 7 Cell 2 Address Adder	0						
228	Route 7 Cell 3 Address	0						
229	Route 7 Cell 3 Address Adder	0						
230	Route 7 Cell 4 Address	0						
231	Route 7 Cell 4 Address Adder	0						
232	Route 7 Cell 5 Address	0						
233	Route 7 Cell 5 Address Adder	0						
234	Route 7 Cell 6 Address	0						
235	Route 7 Cell 6 Address Adder	0						
236	Route 7 Cell 7 Address	0						
237	Route 7 Cell 7 Address Adder	0						
238	Route 7 Cell 8 Address	0						