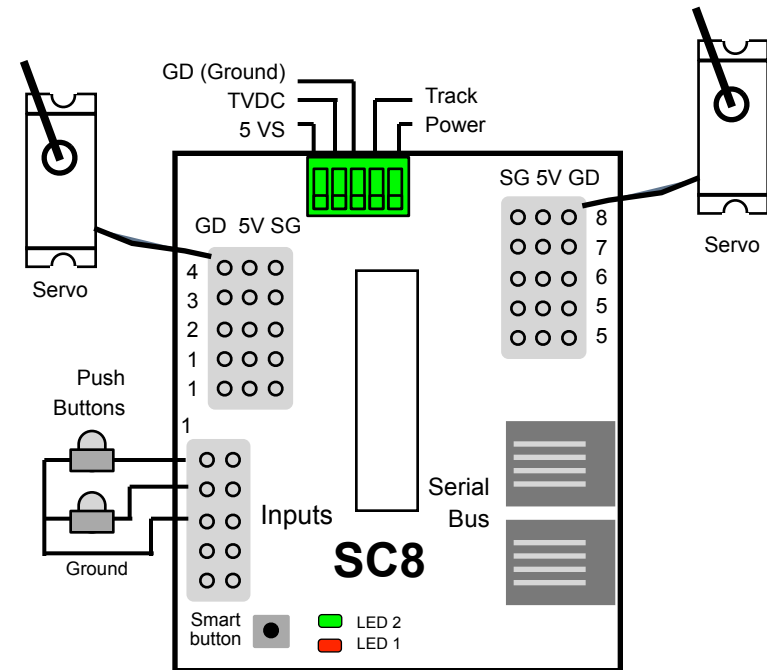| CV#	Function/Default Value		CV#	Function/Default Value	
168	Route 3 Cell 5 Address	0	212	Route 6 Cell 3 Address	0
169	Route 3 Cell 5 Address Adder	0	213	Route 6 Cell 3 Address Adder	0
170	Route 3 Cell 6 Address	0	214	Route 6 Cell 4 Address	0
171	Route 3 Cell 6 Address Adder	0	215	Route 6 Cell 4 Address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

TEAM DIGITAL

Improving the world of DCC

SC8
Servo Controller
with Serial Bus

> DCC compatible accessory decoder
> Controls 8 servos
> Programmable position, range and speed of servos
> Inputs for local control of servos
> Eight configurable routes
> Easy setup with "Smart" Programming
> DCC gateway to serial bus
> LocoNet® compatible

11.11.11 V1

1 Introduction

The SC8 is capable of driving eight servo motors. Each output can individually be assigned any 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.

The first mode is moving all servos to two positions (default).
Mode 1 - The servo outputs can be used for turnout control. There is a separate address for each output so they can be controlled individually. There are a total of eight switch addresses.

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. 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.

"Speed_to_Position" is an optional behavior that allows the throttle to variably control the position of the servo. Just as the throttle can be used to change an engine's speed, so can it be used to control the position of a servo. The throttle speed step must be set to 128. This feature is only available with the first four servo outputs and only controlled via DCC.

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 turnout address is included in the route.

The SC8 is an accessory decoder and can be controlled via DCC commands. It can also be controlled via the serial bus (LocoNet® compatible). 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.

LED 1 will light when servo state is saved. During "Smart" programming if flashes to indicate the steps. If the serial bus shorts it flashes rapidly. A LED 2 flash indicates accepted program value.

2 Getting Started

The SC8 comes from the factory ready to use in mode 1 with all eight outputs set for turnout control. Plug servos into the output connectors. Connect the power terminals to the track power. The connections locations are shown on the diagram on the front page with more detail in section 5. You are now ready to control your turnouts (switches) from the throttle. The default outputs addresses are 1 to 8 for outputs 1 to 8 respectively. See adjusting servo on the next page.

Caution! For their size, servos have a lot of power. We recommend you initially center the servo's rotation before linking it to a device. Semaphores and other devices can be easily damaged.

CV#	Function/Default Value		CV#	Function/Default Value	
65	Servo 7 Move Speed Direction 1	18	122	Route 6 Top Address	0
66	Servo 8 Move Speed Direction 1	18	123	Route 6 Top Address Adder	0
67	Servo 1 Move Speed Direction 2	18	124	Route 7 Top Address	0
68	Servo 2 Move Speed Direction 2	18	125	Route 7 Top Address Adder	0
69	Servo 3 Move Speed Direction 2	18	126	Route 8 Top Address	0
70	Servo 4 Move Speed Direction 2	18	127	Route 8 Top Address Adder	0
71	Servo 5 Move Speed Direction 2	18	128	Route 1 Cell 1 Address	0
72	Servo 6 Move Speed Direction 2	18	129	Route 1 Cell 1 Address Adder	0
73	Servo 7 Move Speed Direction 2	18	130	Route 1 Cell 2 Address	0
74	Servo 8 Move Speed Direction 2	18	131	Route 1 Cell 2 Address Adder	0
75	Input Lockout Control Address	0	132	Route 1 Cell 3 Address	0
76	Input Lockout Address Adder	0	133	Route 1 Cell 3 Address Adder	0
-	-	-	134	Route 1 Cell 4 Address	0
81	Servo 1 Behavior	0	135	Route 1 Cell 4 Address Adder	0
82	Servo 2 Behavior	0	136	Route 1 Cell 5 Address	0
83	Servo 3 Behavior	0	137	Route 1 Cell 5 Address Adder	0
84	Servo 4 Behavior	0	138	Route 1 Cell 6 Address	0
85	Servo 5 Behavior	0	139	Route 1 Cell 6 Address Adder	0
86	Servo 6 Behavior	0	140	Route 1 Cell 7 Address	0
87	Servo 7 Behavior	0	141	Route 1 Cell 7 Address Adder	0
88	Servo 8 Behavior	0	142	Route 1 Cell 8 Address	0
-	-	-	143	Route 1 Cell 8 Address Adder	0
91	Servo 5 Move Range	35	144	Route 2 Cell 1 Address	0
92	Servo 6 Move Range	35	145	Route 2 Cell 1 Address Adder	0
93	Servo 7 Move Range	35	146	Route 2 Cell 2 Address	0
94	Servo 8 Move Range	35	147	Route 2 Cell 2 Address Adder	0
95	Servo 5 Center Position	62	148	Route 2 Cell 3 Address	0
96	Servo 6 Center Position	62	149	Route 2 Cell 3 Address Adder	0
97	Servo 7 Center Position	62	150	Route 2 Cell 4 Address	0
98	Servo 8 Center Position	62	151	Route 2 Cell 4 Address Adder	0
-	-	-	152	Route 2 Cell 5 Address	0
-	-	-	153	Route 2 Cell 5 Address Adder	0
-	-	-	154	Route 2 Cell 6 Address	0
-	-	-	155	Route 2 Cell 6 Address Adder	0
111	Route Send Delay	0	156	Route 2 Cell 7 Address	0
-	-	-	157	Route 2 Cell 7 Address Adder	0
112	Route 1 Top Address	0	158	Route 2 Cell 8 Address	0
113	Route 1 Top Address Adder	0	159	Route 2 Cell 8 Address Adder	0
114	Route 2 Top Address	0	160	Route 3 Cell 1 Address	0
115	Route 2 Top Address Adder	0	161	Route 3 Cell 1 Address Adder	0
116	Route 3 Top Address	0	162	Route 3 Cell 2 Address	0
117	Route 3 Top Address Adder	0	163	Route 3 Cell 2 Address Adder	0
118	Route 4 Top Address	0	164	Route 3 Cell 3 Address	0
119	Route 4 Top Address Adder	0	165	Route 3 Cell 3 Address Adder	0
120	Route 5 Top Address	0	166	Route 3 Cell 4 Address	0
121	Route 5 Top Address Adder	0	167	Route 3 Cell 4 Address Adder	0

6.3 External 5 Volt Power

In some applications where one or more servos have a heavy load, i.e.. they are drawing a lot of current, it may necessary to use an external 5 volt power supply. If the servos draw to much current, the SC8's internal regulator will over heat and shut the SC8 down. This will more likely happen if the SC8 "power save" option is disabled. Connect the external 5 volt power supply to the 5V and GD (ground) terminals of the SC8 power connector.

7 Summary of Configuration Variables

CV#	Function/Default Value		CV#	Function/Default Value	
1	Servo 1 Address	1	33	Pwr On State - Outputs 1-4	255
2	reserved	-	34	Pwr On State - Outputs 5-8	255
3	Servo 1 Move Range	35	35	Input 1 Address	1
4	Servo 2 Move Range	35	36	Input 1 Type & Address Adder	64
5	Servo 3 Move Range	35	37	Input 1 Transition & Route	2
6	Servo 4 Move Range	35	38	Input 2 Address	2
7	Manufacturer Version No.	-	39	Input 2 Type & Address Adder	64
8	Manufacturer ID	25	40	Input 2 Transition & Route	2
9	Servo 1 Address Adder	0	41	Input 3 Address	3
10	Servo 1 Center Position	62	42	Input 3 Type & Address Adder	64
11	Servo 2 Center Position	62	43	Input 3 Transition & Route	2
12	Servo 3 Center Position	62	44	Input 4 Address	4
13	Servo 4 Center Position	62	45	Input 4 Type & Address Adder	64
14	Servo 2 Address	2	46	Input 4 Transition & Route	2
15	Servo 2 Address Adder	0	47	Input 5 Address	5
16	Servo 3 Address	3	48	Input 5 Type & Address Adder	64
17	Servo 3 Address Adder	0	49	Input 5 Transition & Route	2
18	Servo 4 Address	4	50	Input 6 Address	6
19	Servo 4 Address Adder	0	51	Input 6 Type & Address Adder	64
20	Servo 5 Address	5	52	Input 6 Transition & Route	2
21	Servo 5 Address Adder	0	53	Input 7 Address	7
22	Servo 6 Address	6	54	Input 7 Type & Address Adder	64
23	Servo 6 Address Adder	0	55	Input 7 Transition & Route	2
24	Servo 7 Address	7	56	Input 8 Address	8
25	Servo 7 Address Adder	0	57	Input 8 Type & Address Adder	64
26	Servo 8 Address	8	58	Input 8 Transition & Route	2
27	Servo 8 Address Adder	0	59	Servo 1 Move Speed Direction 1	18
28	Status Report	0	60	Servo 2 Move Speed Direction 1	18
29	Decoder Configuration	0	61	Servo 3 Move Speed Direction 1	18
30	reserved	0	62	Servo 4 Move Speed Direction 1	18
31	Ops Mode Loco Address	0	63	Servo 5 Move Speed Direction 1	18
32	reserved	0	64	Servo 6 Move Speed Direction 1	18

You can control the outputs from fascia buttons by connecting them to the inputs. The 8 inputs, when grounded, will toggle outputs 1 to 8 respectively.

If you want to change the mode, output addresses or control the SC8 via the serial bus instead of DCC, see the "Smart" Programming section. If you want to customize the SC8 such as implementing routes see the Configuration Variables section.

2.1 Control via LocoNet® - Digitrax Users

The SC8 comes from the factory ready to use by control from DCC commands. To control the SC8 via LocoNet®, it must be enabled. Connect the SC8 track power terminals to the programming track and program CV29 with a value of 48. The SC8 is now ready to be controlled via LocoNet®.

2.2 Adjusting Servo Movement

The total movement or range of a servo is typically much more than is required for turnout or semaphore control. For this reason the range of the servo may need to be adjusted for the specific application. In addition the center of movement or center offset may need to be changed. The SC8 has a built in feature that allows the servos to be positioned while programming the making the adjustments. All these CVs can be programmed in ops mode (on the main programming) while directly observing the results.

Before linking the servo arm (horn) to the semaphore or turnout, manually position the servo to the center of it's rotation.

1. Use the "Smart" button to put the SC8 into ops mode as described in section 4.

2. Use your throttle to enter ops mode with a loco address of one (1). One is the SC8 default ops address. The servos may twitch or jump during adjustment.

3. Program CV7 with a value of 2 to put all the servos in the center position.

Maximum range typically 90º   Range   Center offset
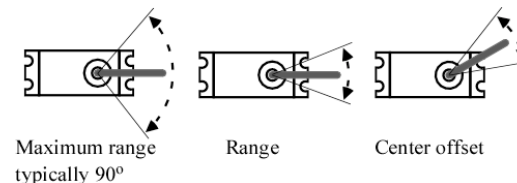
4. Program CV10, 11, 12 and 13 for servo 1, 2, 3 and 4 respectively to change the center offset. Start with a value of 60 and repeat with small changes until the desire center is reached. You may only want to connect one servo at a time.

5. Program CV7 with a value of 4 to move all the servos to one end. Program CV7 with a value of 5 to move all the servos to the other end.

6. Program CV3, 4, 5 and 6 for servo 1, 2, 3 and 4 respectively to set the desired range. Start with a value of 20 (increase range with higher numbers) and repeat with small changes as needed.

7. When finished adjusting the servos, program CV7 with a value of 1 to restart the SC8.

3 "Smart" Programming

"Smart" programming is a term used to describe an easy way to program the SC8 addresses. The throttle is used to issue switch or accessory commands just like controlling switches (turnouts).

To program in "Smart" mode, connect the SC8 power terminals to track power. Turn on power. Wait about 5 or 6 seconds until the LED turns off.

Press the "Smart" program button and hold it down for approximately one second until LED1 starts to flash. Then release it. The SC8 is now ready to have the addresses changed.

Using the throttle select the switch (turnout) address or accessory number you want for the start of eight sequential addresses and issue a throw command for 2 positions (Mode 1) or for the start of 24 sequential addresses issue a close command for 3 positions (Mode 2). The SC8 will then restart and be ready to use with the new addresses. When programming for Mode 1, the input addresses are programmed with addresses to match the outputs. For Mode 2 the input addresses are unchanged.

The servo rotation direction may need to be changed to correctly respond to close and throw switch (turnout) commands. Using the throttle select a switch address corresponding to the output number. Up to 8 outputs can be set. The number of LED flashes indicates the step number.

See an example of "Smart" programming in section 6.1.

Smart Programming Summary				User input	
#Flashes	**Description**	throw state	close state	address	state
To change addresses - Press the "Smart" button until LED1 starts to flash					
Example: Issuing a 9c sets the addresses from 9 to 16 for two position movement					
1	Beginning address for sequential addresses	3 positions	2 positions	9	c
To change servo rotation direction - Press the "Smart" button until the green LED lights					
Example: Issuing a 2t reverses the rotation direction of output 2					
1	Output number rotation direction	reverse	normal	2	t
2	Output number rotation direction	reverse	normal		
3	Output number rotation direction	reverse	normal		
4	Output number rotation direction	reverse	normal		
5	Output number rotation direction	reverse	normal		
6	Output number rotation direction	reverse	normal		
7	Output number rotation direction	reverse	normal		
8	Output number rotation direction	reverse	normal		
To change the value of CV29 - Press the "Smart" button until the green LED lights and then turns off					
1	Value of CV29 - Decoder configuration	value*	clear		

* A CV value is programmed. Check the section 4.4 in the manual to determine the CV value and use a switch address for that value.

.

6 Applications

6.1 Example of "Smart" programming
Example to set the rotation direction of output 2 to reverse, output 5 to reverse and output 6 to normal.
See section 2 of the table in section 3.
Power on the SC8 with track power, after 6 or 7 seconds hold down the Smart button until LED1 (red) is flashing and LED 2 (green) is on solid. Using the throttle in switch mode issue the output number (2) with a throw. LED 2 (green) will flash briefly and LED1 (red) will now be flashing a two (step 2, two quick flashes with a pause then repeat). Using the throttle in switch mode issue the output number (5) with a close. Again LED 2 (green) will flash briefly. Using the throttle in switch mode issue the output number (6) with a close. Again LED 2 (green) will flash briefly. Now hold down the Smart button until LED1 (red) stops flashing. At this point the SC8 will restart indicated by LED 1 (red) on solid for several seconds.

6.2 Routes
The SC8 supports eight routes which requires the use of the serial bus. Each route has eight cells. There is one top or route execution address for each route. A route can be executed by a block sensor or switch type message. When using a block sensor message several turnouts can automatically be alined went a block becomes occupied.

Multiple routes can be executed be having more than one top address the same address. Also a route can execute from other routes (nested). This occurs when a route cell has an address that matches the top address of another route.
Warning: Do not create recursive loops. That is, do not have a route executing itself or two routes executing each other. Otherwise various unexplained problems will occur.
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.

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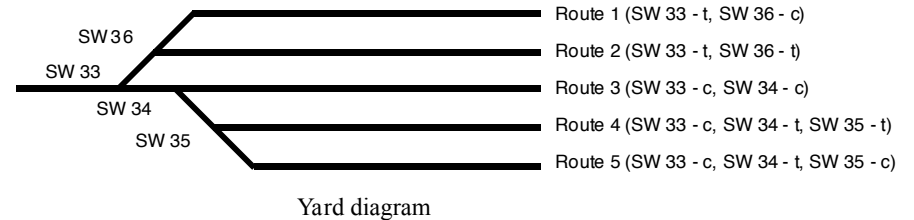
| Route Example								
Route	1	2	3	4	5	6	7	**8**
Execute address	101 t	101 c	102 t	102 c	103 t			
Address 1	33 t	33 t	33 c	33 c	33 c			
Address 2	36 c	36 t	34 c	34 t	34 t			
Address 3				35 t	35 c			
Address 4								
Address 5								
Address 6								
Address 7								
Address 8								

5 Connections

The input connector is a 10 pin flat ribbon cable (IDC) type. Jameco #138376 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 connector has spring type terminals. Use a small screw driver to push in on the slotted button and insert the bare wire into the terminal.

The TVDC terminal is rectified track voltage (DC). This output and the 5 volt output (pin 6 , 10 pin connector) may be used to power LEDs or a block detector like the Team Digital DBD22. The 5VS is an input to optionally power ONLY the servos.

The servo connectors is made so that you can just plug the servo harness in. There is a duplicate for output 1 and 5 so that two servos can be plugged in and be controlled the same.

Typical servo harness wire color:
Ground - black or brown
5 V - red
Signal - yellow, white or orange
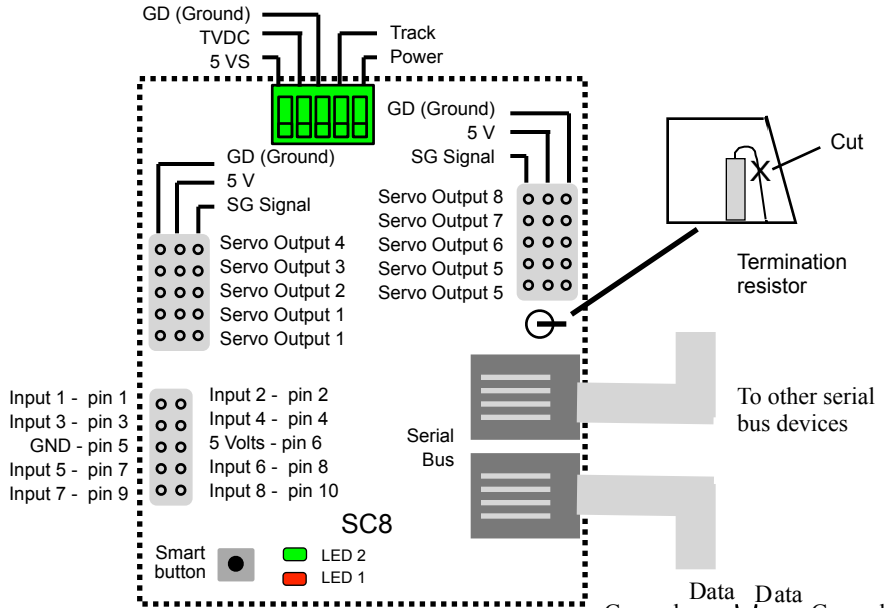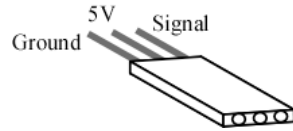
Serial Bus
The SC8 has two RJ12 connectors for ease in making connections. In a Digitrax system the data pins are LocoNet® and the RS pins are Rail Sync. RS is not used by the SC8. If you are using more than 10 SC8s connected via the serial bus in a system the bus terminating resistor should be cut on any additional devices.
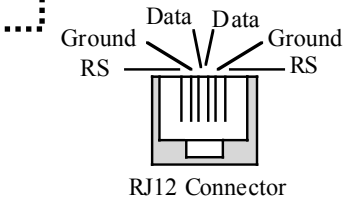
Switch (Turnout) Terminology		
This manual	throw or t	close or c
Digitrax	throw or t	close or c
NCE	reverse or OFF or 2	normal or ON or 1
Lenz	-	+
MRC	OFF	ON

4 Configuration Variables (CVs)

The SC8 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 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 SC8 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. To enter normal operation, disconnect from the program track. Now connect terminals Rail A & B to the main track power.

To program in ops mode (On the Main Programming) connect terminals Rail A and Rail B 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 LED1 turns off. The SC8 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 SC8 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 SC8 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 SC8 so power need not be cycled when programming in ops mode. This is the same as turning power off and then back on.

In ops mode he SC8 can be programmed via the serial bus. CV values can be written and read. In a Digitrax system the SC8 should be powered from a DC power supply when programming via Loconet.

Ops mode programming commands for servo adjustment in section 2.2.
Programming CV7 with a value of 2 will cause all the servo to move to their center position. You can then program the center offset CVs if needed.
Programming CV7 with a value of 3 will cause all the servo to move from end to end of their range. You can then program the range CVs to easily adjust the servo's movement.
Note: When adjusting servo position, be sure Speed_to_Position is disabled. Also if you program when the servo is moving it my jump erratically.

Summary of ops mode programming commands for servo adjustment.
To center the servos, program CV7 with 2.
To move the servos back-n-forth, program CV7 with 3 (range adjustment are not accurate with large range values or very slow speeds because end of travel may not be reached).
To move the servos to one end, program CV7 with 4.
To move the servos to the other end, program CV7 with 5.
To restart the SC8 when finished with programming, program CV7 with 1.

Reset the SC8 to factory defaults.
To "reset" the SC8 to factory defaults, turn power on and wait until the LED turns off. Then press the "Smart" button and continue to hold the button down (at least 16 seconds) until both LEDs are alternately flashing. Then release the button. The SC8 then restarts.

4.1 Output Address

These CVs determine the address of the outputs. Each output address is constructed of two CVs, an address and an address adder. See section 7 for CV numbers. If an address greater than 255 is needed then the address adder value will be greater than zero. Otherwise the address is set by the address value only. The address adder value represents a number that is added to the address value to give the required 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 Servo Move Range

CV3, 4, 5, 6 - Outputs 1 - 4 Move Range, a maximum value of 127.
CV91, 92, 93, 94 - Outputs 5 - 8 Move Range, a maximum value of 127.
These CVs determine the servo's range or how far it moves.
A typical value to move a turnout is probably between 20 and 35 depending on the mechanical connection from the servo to the turnout.

Timing: Output servo pulse: 1 ms - 2 ms with 8 us resolution. This pulse range will give a servo about a 90 degree move range. Many servos can physically move more than 90 degrees.

4.3 Servo Center Position

CV10, 11, 12, 13 - Center Position, a maximum value of 127.
CV95, 96, 97, 98 - Center Position, a maximum value of 127.
These CVs determine the servo's center position of the move range.
If the value of these CVs are set too close to either zero or 127 than the range of movement as defined by the move range will not be available.

4.11 Route Cell Address

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. See section 7 for CV numbers.

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
Throw	0		one
Address adder (see the address adder table for amount to add)	0 - 9		
Program this value into the appropriate type CV			

4.12 Send Address Delay

CV111 - Send address time delay, value 0 to 255.
This CV determines the time delay the SC8 waits before sending the next address in a route. Some switch machine drivers require a time delay between switch activation. The delay is the CV111 value x 0.25 seconds.

Delay between sending route addresses								
CV11 Value	0	1	2	4	8	12	16	**20**
Delay (sec)	0	0.25	0.5	1	2	3	4	5

4.13 Power On Output State

CV33 - Power on state for outputs 1 to 4.
CV34 - Power on state for outputs 5 to 8.
These CVs determine the state of each output at power on. When ever there is an output state change, the SC8 automatic programs these CVs unless Option 1 is set.

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 programming mode and program CV29 (enable option 1).
3. Exit programming mode.
Now at each power on, the outputs will go to the same state as set in step 1.

4.14 Ops Mode Loco Address

CV31 - Ops mode address, a value of 1 to 127. Default is one (1).
This CV sets the operations mode program address. You can program the SC8 just like a loco in ops mode. This is a loco 2 digit address and therefore must be unique among locomotive addresses. Option 2 must be enabled to use this address for programming on the main. The programming track is not required once this address and option 2 have been set.
TIP: If the "Smart" program button is pressed when power is turned on, option 2 is enabled until power is removed. This is useful if you do not want to have ops mode enabled all the time.

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.

Some inputs can NOT be activated at the same time. These are 1 & 5, 2 & 6, 3 & 7, 4 & 8. For example when input 1 in grounded, input 5 will not work. This means that feedback and sensor type input bus messages are not supported in a Digitrax system.

Example: Input 1 when grounded will toggle the output with address 1.
Address CV36=1, Type CV36=64, Transition CV37=2
Example: Input 2 when grounded will throw the output with address 2 and execute route 2.
Address CV38=2, Type CV39=0, Transition CV40=2+2x16=34
Tip: Use ops mode to quickly experiment with input settings.

4.9 Input Lockout Address
CV75 - Address, value 0 to 255: CV76 - Address adder, value 0 to 9.
These CVs set the input lockout address. When a turnout (switch) throw command is issued that matches this address the SC8 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 SC8 inputs are used for local turnout control.

4.10 Route Execute Address
These CVs determine the top or execute address of a route. See section 7 for CV numbers. 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 SC8, throttles or computers matches the top address and switch state for that route. 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 went 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	
Throw	0	
Execution type, sensor	32	
Execution type, switch (turnout command)	0	
Address adder (see the address adder table for amount to add)	0 - 9	
Program this value into the appropriate type CV		

4.4 Servo Move Speed
CV59, 60, 61, 62, 63, 64, 65, 66 - Move Speed Direction 1, a maximum value of 127.
CV67, 68, 69, 70, 71, 72, 73, 74 - 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.

4.5 Servo Behaviors
CV81, 82, 83, 84, 85, 86, 87, 88 - Behaviors
These CVs determine various servo behaviors.
A value of 2 enables Speed_To_Position. The SC8 now uses the selected servo's address (only first 4 outputs) as a loco address. Speed steps must be set to 128 for this to work and can only be controlled via DCC. This is independent of the serial bus usage. Do not try and use this address as an accessory address at the same time.

A value of 128 reverses the servo position in response to commands. For example if the servo moved cw (clockwise) when issued a close command, it will now move ccw. This has the same result as reversing the wires that power a stall motor. To enable reverse with another behavior add the values together.

Servo Behaviors	Value	Select
None	0	
Speed To Position (only servo outputs 1 - 4)	2	
Reverse	128	
Program this value into the configuration CV		

4.6 Decoder Configuration
CV29 - Configuration
This CV determines the decoder configuration options.
See section 1 for a detailed description of the modes.

Option 1 - 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 to give the desired output state.

Option 2 - Ops mode programming. Allows Operations mode (On the Main) programming using a Loco address to be enabled all the time. The "Smart" button is no longer required to enter Ops mode. See section 4.12.

Option 3 - DCC to bus gateway. Allows DCC switch command packets to be put on the serial bus. Any device connected to the bus will have access to these DCC commands. Requires option 4.

Option 4 - Serial Bus communication. Allows the SC8 to communication with devices connected to the serial bus.

Option 5 - DCC control. Allows the SC8 to receive instructions from DCC (track). **Note:** Selecting this option **DISABLES** this feature.

Option 6 - Normally the SC8 stops the control signal (pulse) to the servos after they have completed their move. With this option the control signal is always on. This will draw more power from the track based on servo load.

To combine options add their value together. In the case where only one selection is possible a box shows "Select one".

Configuration CV	Value	Select	
SC8 Mode 1 - Servos 2 positions	0		Select
SC8 Mode 2 - Servos 3 positions	1		One
Option 1 - enable fixed output state at power on	2		
Option 2 - enable ops mode programming**	4		
Option 3 - enable DCC to serial bus gateway	8		
Option 4 - enable serial bus communication	16		
Option 5 - **disable** control from DCC	32		
Option 6 - **disable** power save	64		
Program this value into the configuration CV			

** If power save is disabled , option 6, there will be erratic servo movement whenever a CV is programmed. Therefore, program all CVs before setting option 2.

The following table will help you determine how to configuring the SC8. If there are more than one SC8 or other Gateway capable devices, only one should have the gateway enabled. In a Digitrax system DO NOT connect the SC8 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 5	Gate-Way* Option 3	Serial Bus Option 4	CV Value	Notes
All DCC Compatible Systems	Enabled			0	The SC8 is controlled via the track (DCC commands). The bus is not used by the SC8.
Digitrax System	**Disabled**		Enabled	48	The SC8 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. Easier trouble shooting.
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)

4.7 Status Report
CV28 - Status report.
This CV determines the type of output states the SC8 provides. This only works via the serial bus.
Option 1 - Output state messages are sent on the serial bus at power on. These are switch type messages.

Option 2 - Output state messages are sent on the serial bus when a Digitrax interrogation command is received. These are feedback type messages.

Status Report CV	Value	Select
No options	0	
Option 1 - Send output state at power on enabled	2	
Option 2 - Interrogate output state enabled	8	
Program this value into the status report CV		

4.8 Input Control
These CVs determine what action the inputs will have when activated. 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. See section 4.1.

There are 8 physical input terminals. They are not linked or connected to the outputs an any way except by a common address.

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".

Input Control			
Address CV	Value	Select	
Address	1 - 255		
Program this value into the appropriate address CV			
Type CV	Value	Select	
Message state (invert) - close	128		Select
Message state - throw	0		one
Message state - Toggle	64		
Address adder (see the address adder table for amount to add)	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
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			

** Not recommended for inputs 5,6,7 and 8.