

S-CAB Throttle User Guide



Radio communication
from CAB to loco



The figure left illustrates an electric multiple unit modeled in HO scale. The only factor limiting choice of model is space available to accommodate a radio receiver and decoder.

For convenience, let's use the name 'S-CAB Throttle' or "Throttle" for the hand-held controller. Our objective is to explain the throttle's basic design and, more importantly, the logic behind the buttons. Ideally, with experience and some knowledge of how S-CAB works, you won't need tedious cook-book instructions to become an expert user.

Switches, Buttons and Displays

- **Mode switch:** Located upper left side of throttle. Selects either control mode (labeled 'CAB') for operating locos or service mode ('CV') for editing decoder configuration variables. In 'CAB' (or control) mode, the throttle is a device for controlling trains. In 'CV' mode, it is a simplified tool to edit (program) a few important decoder configuration variables.
- **Throttle slider:** Controls loco by sending speed commands as the throttle moves. It is disabled in CV mode.
- **Direction switch:** Switch right sets forward direction, switch left sets backward direction. Direction is included in the speed command. Switch is disabled in CV mode.
- **Keypad:** Ten numeric keys and seven command buttons.

What command keys do is summarized in the table 1 below. The display's most significant digit shows a character prompt, unless over-written by a 2-digit number.

Format guide

'7', 'CV' are labels

L3 is what the LED displays

Loco# is a key or button press

{5207} is a loco number

[12] is a decoder ID

When S-CAB enters CV mode, commands are sent to decoders in service mode

Table 1. Keypad Commands

Button	Prompt	What it does
S-CAB in control (CAB) mode		
<code>Loco#</code>	L	Loco ID assignment and selection
<code>Speed</code>	P	Preset speed (P ower) steps
<code>FG1</code>	F	Loco F unctions F0 to F9
<code>FG2</code>	I	Loco F unctions F10 to F12 and Info
<code>ALL</code>	A	Broadcast commands (A ll decoders)
<code>HALT</code>	H	Emergency stop (H alt)
<code>Enter/Send</code>		Sends command or enters a number
S-CAB in service (CV) mode		
<code>C#</code>	C	Select a CV number (#)
<code>C=</code>	U	Enter a CV val U e
<code>Enter/Send</code>		Sends command or enters a number

By thinking of this as a simple command language, you will be able to intuitively figure out command sequences that would be tedious to document and boring to read. Try this obvious example. In a situation of imminent disaster from run-away locos; use the sequence `ALL`, `HALT` to abruptly end the emergency.

When in control mode, it is okay to experiment. No combination of keypad entries, legal or otherwise, should cause the S-CAB to lock-up, freeze, or go blank. (Report any exceptions to this rule, ASAP). Illegal commands will not be transmitted; although legal, but unexpected, commands are possible. Keypad sequences with no associated action or command will generally display a character prompt followed by blank digit.

Worst case, turn Throttle off and back on to reboot. This is not recommended during an operating session because reboot clears the operating loco roster from Throttle's memory. However, you can reboot and immediately send `ALL`, `HALT`, or `ALL`, '0'.

In CV mode, a "push-any-button" technique is not recommended and we use a different user interface procedure. CV numbers cannot be selected using Throttle's number keys. Instead, the Throttle steps sequentially through a list of supported CVs with each click of `C#`. Once the desired CV is displayed, pressing `C=` locks the CV number and displays a suggested default value. *Note: This default value is not*

the CV value stored in the decoder; just a suggested value stored in the Throttle. Number keys are used to edit a CV value before it is sent. **Enter(Send)** transmits the selected value. As a further precaution, S-CAB will not send CV values that may be legal for certain decoders but risk putting a decoder in a non-recoverable configuration. This also prevents programming the decoder with a configuration that is incompatible with S-CAB radio. For example, S-CAB Throttle uses 28 speed steps and will not allow a decoder to be configured for 14 or 128 speed steps.

Radio On Indicator (right-hand decimal point)

To minimize radio interference, the Throttle's transmitter turns on only for a fraction of a second (approx. 0.01 seconds) while sending a control message. To increase reliability, each message is repeated four times, requiring a total transmission time of 0.035 seconds. The number of repetitions is specified in throttle firmware and is not accessible by a user.

Since it can sometimes be helpful to watch radio activity, the display's right-most decimal point lights while the throttle's radio is on. When commands fail, decoder radio reception is often the problem, so it helps to watch radio activity and determine that the command is being transmitted.

Firmware Version Display

The only use of the left-hand decimal point is when displaying the firmware version (i.e. 2.3). To view S-CAB's firmware version number, press **FG2** followed by number key **8**.

Reversing Option

FG2, **7** toggles the reversing option. Option = 1, the default, retains the loco's speed setting when reversing direction. Option = 0 sets loco speed to zero when direction is changed.

Charging Throttle's Battery

The Throttle will operate for several days without recharge and the display's brightness is the first indication that recharge is necessary.

The battery's protective circuit will automatically shut off to protect the battery against low voltage or over-discharge. Recharge is slow, with a charging rate of 100 mA, which is compatible with PC USB sockets.



Since Throttle's charging circuit protects the battery from over-voltage or over-charging, it's safe and convenient to allow the battery to recharge over-night.

Throttle Control (CAB) Mode

Adding Locos to S-CAB's Operating Roster

The Throttle can handle up to 15 active locos in an operating roster and can address loco decoder IDs from 1 to 99. It is more natural to identify models by loco or vehicle number, rather than decoder ID, but a decoder knows nothing about loco numbers. Long addresses (4-digit IDs) are not used by S-CAB.

A 4-digit loco number, {5245}, for example, can be assigned a short address (CV#1, Primary Address) of [45] or [5]. When **Loco#** is pressed, Throttle displays the loco decoder's primary address.

The operating roster is a list of decoder IDs that the Throttle accumulates before, or during, an operating session. Each time a previously unused loco is selected, that loco's decoder ID is memorized and added to a 'decoders-in-use' list.

The first press of **Loco#** always displays the decoder ID of the active loco (the loco being controlled by the Throttle). Assigning a new loco to Throttle's operating roster requires the command sequence:

Loco#, one or two number key-presses, **Enter(Send)**

For example, **Loco#**, **1**, **2**, **Enter(Send)** adds loco decoder ID number 12 to Throttle's loco roster and immediately selects it as the active loco. The last key pressed performs 'Enter', because no command is sent to decoder [12]. S-CAB simply expands the loco roster and switches control to the new loco. A command will be sent as soon as the throttle is moved, or direction switched, or some other action is initiated by user.

Switching Control between Locos

A convenient way to switch loco control uses **Loco#** to recall locos already in the Throttle's operating roster. As explained earlier, the first press of **Loco#** displays the active loco's ID. Each subsequent press steps through the Throttle's loco roster and continues to repeat the cycle with each key press. When ID of the desired loco is displayed, it becomes the active loco. If attempting to operate two or more locos simultaneously, it helps to have only 2 or 3 locos in the Throttle's roster.

A key sequence such as: **Loco#**, **2**, **5**, **Enter(Send)**, also selects a new active loco ([25] in this example), but with a more complicated key sequence.

Speed Control

Loco speed can be controlled with slide throttle (which is always operational in control mode) or with numeric keys. The throttle uses 28 speed steps and is the preferred method of speed control.

When used with the **Speed** button, the numeric keypad provides 10 steps. Speed control with the keypad reduces radio transmissions, since each key press transmits one speed command, whereas the throttle produces a stream of commands

generated by throttle movement. With one or two operators, this is not a problem. Although unlikely, the probability of radio interference increases in an environment with a number of operators and/or other wireless controllers operating simultaneously in the same radio space; (a train show, for example).

Using speed buttons is also a more realistic way to control trolley cars and older electric or diesel multiple units.

The **Speed** button always displays the last speed command sent to a loco by either throttle or keypad action; a capability that is useful when operating more than one loco. **Speed** displays speed step, but does not send any speed command until a number key is pressed. The throttle can always be used to control loco speed.

Direction Control

Reversing Option 1: With this option, the Throttle does not change loco speed when sending a direction command. As with a real loco, it's best to bring the throttle to zero speed to stop a loco before changing direction. Otherwise, depending on decoder's momentum settings, direction change with a non-zero speed can produce a sudden, unrealistic loco reversal.

However, it's okay to be lazy by setting the loco's acceleration and braking rates (momentum) to non-zero values and allowing decoder do all the work of braking, stopping, reversing and accelerating the loco.

When operating this way, throttle position is consistent with loco speed, before and after direction change.

Reversing Option 0: With this option, the Throttle sends a zero speed command with change of direction. Depending on momentum, the loco slows to zero speed, changes direction and waits for a new speed command.

Loco Function Control

The Throttle provides 13 loco function commands numbered F0 thru F12.

FG1 uses keys 0 to 9 to control functions F0 to F9.

FG2 uses keys 0, 1 and 2 to control F10, F11 and F12.

The following function assignments have become common practice among decoder manufacturers:

F0: headlight on/off

F1: loco bell sound

F2: Whistle or horn

To send function commands, press **FG1** or **FG2** followed by a number key. Once selected, a function group remains active until the numeric keys are assigned a different task. It's convenient to operate with the keypad used for function group 1, which includes most commonly used functions.

With the exception of F2, each press and release of a number key toggles the corresponding loco function. Button '2' keeps F2 (whistle or horn) on when held down. (Down-on, Up-off).

Start-up Decoder Selection

S-CAB Throttle is delivered with '3' as default decoder ID. This can be changed using the following procedure.

With Throttle in control mode,

Use to make the desired loco ID active

Press followed by key '9'.

The active loco's ID will be the Throttle's new startup selection.

Broadcast Commands

All DCC-compliant decoders must respond to commands with global or broadcast address '0'. In control mode, only a few commands are appropriate for global addressing and the following commands are mandatory:

<input type="text" value="ALL,"/> <input type="text" value="HALT"/>	all loco emergency stop
<input type="text" value="ALL,"/> <input type="text" value="0"/>	all loco reset

S-CAB Service (CV) Mode

First, some terminology associated with programming decoder CVs. The oldest (and the most reliable) programming method uses a "programming track", which is simply an isolated section of track connected to appropriate terminals of a DCC command station. A loco with a decoder to be programmed is placed on the programming track where it is isolated from the rest of the layout.

Since, with S-CAB radio, there is no command station and no programming track, an equivalent method is called "global addressing".

Today's decoders generally support a technique called "Programming on Main" or "Ops Mode" which allows programming to be performed on any track connected to a DCC command station. The equivalent method with S-CAB radio is called "local addressing".

While most DCC manufacturers support "Programming on Main", implementation is inconsistent. Consequently, when "Programming on Main" fails, the reliable alternative is Programming Track. Similarly, with S-CAB radio, local addressing is convenient, but global addressing works with a larger selection of decoder products.

Global or Local Addressing?

All decoders must respond to ID = '0'; the global address. A local address will be recognized only by a decoder (or decoders) with a matching address. Obviously, local addressing is a safer way to change CV values.

There are two reasons to use global addressing:

1. To deal with situations where we don't know or remember a decoder's address. Rather than waste time guessing, it's quicker to turn off all decoder radio receivers, except the decoder requiring a new address, and use global addressing to set the desired address.
2. We cannot be sure that all decoders support local addressing to program all CVs. If individual addressing does not work, try global addressing, which is a mandatory requirement for compliance with NMRA RP 9.2.3.

Programming Procedure

The Throttle must be communicating with a decoder in control mode before switching to CV mode. The address of the active decoder defines the decoder that will receive configuration commands when using local addressing. A different decoder address cannot be selected once the Throttle is in CV mode.

If global addressing is used, the active address is irrelevant. However, it is best to check that a decoder is operating correctly before entering CV mode. If the decoder is not installed in a loco, connect a motor and test it with speed control. Most decoders acknowledge a CV command by pulsing the motor, which reacts with an observable jerk. Watch and listen for this response.

With global addressing, there is a risk of accidentally programming any decoder that receives the radio transmission. For this reason, local addressing is the default method when S-CAB is switched to CV mode.

Local Addressing

To continue programming with local address:

1. Begin with Throttle controlling the target decoder.
2. Switch Throttle to CV mode.
3. Follow CV programming steps described below.
4. When done, switch Throttle back to CAB mode.

Global Addressing

To select global addressing, add an extra step to the procedure:

1. Begin with Throttle controlling the target decoder.
2. Switch Throttle to CV mode.
- 3. Press the ALL button.**
4. Follow CV programming steps described below.
5. When done, switch Throttle back to CAB mode.

Step 3 is the only difference in procedure and must be executed immediately after entering CV mode.

Detailed Programming Steps

To change a decoder's primary address, to '8', for example:

- Switch to 'CV' mode. The CAB indicator LED (green) turns off, CV indicator (amber LED) turns on and the display shows **C** with blank second digit.
- Press **ALL** to select global addressing, or skip this step for local addressing.
- Press **C#** key. The display shows **C1**, which is the CV number for the decoder's short (primary) address and is the parameter to be changed.
- Press **C=** key. This displays **U3**, where '3' is the default address value, and is *not* what we want. (Note the prompt, **U** for **value**.)
- Enter a number for the desired address; number 8, for example. Throttle displays **U8**.
- Press the **Enter(Send)** key. S-CAB display shows **L8** and the motor connected should jerk to acknowledge that address change has been processed by decoder.
- Return Mode switch to its 'CAB' position. The amber CV indicator turns off, the green CAB indicator turns on, and display continues to show **L8**, which has become the active loco.

To change other CV values, press **C#** repeatedly until desired CV number is displayed, then use previously described steps. Table 2 lists CVs supported by S-CAB Throttle.

Table 2. Supported CVs

CV#	Description	Entry Format
CV1	Primary address	1 or 2 digit number
CV2	Starting voltage	% full voltage
CV3	Acceleration rate	1 or 2 digit number
CV4	Deceleration rate	1 or 2 digit number
CV5	Maximum voltage	% full voltage
CV6	Mid voltage	0
CV29	See Appendix 1	0 or 1
CV65	Kick start	1 or 2 digit number

CVs #6 and #29 have fixed values to ensure S-CAB compatibility. The default value of CV6 is always zero and cannot be changed, which ensures that it will be ignored when determining the decoder's speed curve. It is supported only as a means to reset any non-zero value for CV6 to zero.

For compatibility with S-CAB, new decoders should always be programmed using the default value of CV29. If the loco's movement is oriented incorrectly after installing the decoder, use CV29 to flip motor polarity so that a forward command produces forward movement.

Primary Address (CV1)

S-CAB Throttle does not use long addresses or perform consist addressing. With radio, it is simpler to assign the same primary address to each loco in a consist.

Start Voltage (CV2)

Try the default value (10%) to begin experimenting with a loco's starting performance. If it starts with an unrealistic jerk, reduce the value. If there is no sign of movement, increase the value. *Remember; default the value is just a suggestion; not the value stored in a decoder.*

Acceleration (CV3)

'0' corresponds to no momentum so that speed change commands produce immediate response. Only a model can jump from zero to full speed in a fraction of a second. For more realistic acceleration, begin experimentation with '4' as a beginning value for CV3. Since manufacturers' implementations vary widely, a CV value as large as 40 may be necessary for typical loco performance.

Deceleration (CV4)

Having determined a value for CV3, try the same value for CV4 or reduce it to have the loco brake more rapidly than it accelerates.

Maximum Voltage (CV5)

Try the default value (90%) to begin experimenting with the loco's maximum speed. Since most locos run unrealistically fast at maximum voltage, reduce the value of CV5 for more realistic performance.

Mid Voltage (CV6)

Use this mandatory default ('0') to prevent use of mid-speed value in a decoder's speed curve.

Decoder configuration (CV29)

Zero is the default setting. Change to '1' to flip motor polarity. (Reverse the motor's response to a direction command).

Kick Start (CV65)

CV65 is not supported by most decoders. If available, it's useful for motors with unsatisfactory starting performance, which can be nudged into motion by temporarily exceeding the starting voltage. Try values of '2' or '3'.

Configuring a New Decoder for S-CAB Compatibility

S-CAB radio requires a decoder configured as follows:

- Short address: 7-bit primary address, no extended addressing

- 28 speed steps: 5-bit speed command
- NMRA DCC power only: This prevents the decoder from sensing track or battery voltage as DC speed control.
- CV6 is always zero.

New decoders typically do not comply with the foregoing requirements and interpret battery power as full-speed DC operation. The following procedure will help avoid unexpected behavior.

- Configure CV29 by sending the default value; '0'. (The Throttle actually transmits the value '2' for CV29, which configures the decoder for short address, 28 speed steps, 'F0' for headlight control, DCC power only, default motor polarity.)

Appendices

CV29 Details (tech-talk)

Editing CV29 can be confusing, since each bit determines a separate decoder parameter. To keep things simple, S-CAB Throttle sets all parameters except one to default values. "Loco direction" is one parameter that can be edited. What is the purpose of this parameter?

Short answer: CV29, Bit 0, reverses polarity of the decoder's motor output.

Long answer: After installing a decoder, a forward command may cause the loco to go backwards. Instead of re-wiring to reverse motor connections, bit 0 of CV29, can be changed from its default value of '0' to the value '1'. This flips the polarity of the decoder's motor output, which accomplishes the same result as swapping motor connections.

The table below summarizes decoder default values of CV29 used by S-CAB Throttle. The 8-bit value sent to the decoder is '2' or '3', depending on the user's selection ('0' or '1') for motor polarity.

Bit	Description	Default	Comment
Bit 0	Motor polarity	0	0 = normal polarity 1 = reversed polarity
Bit 1	Headlight control, number of speed steps	1	Function group 1, bit 4 controls headlight. Use 5 speed bits, 28 speed steps
Bit 2	Power source	0	NMRA digital only
Bit 3	Communications	0	Bi-directional communication disabled
Bit 4	Speed table	0	Speed table determined by CVs 2, 5 and 6
Bit 5	Addressing	0	7-bit addresses
Bit 6	Future	0	No used
Bit 7	Decoder type	0	Loco decoder

Throttle and Direction Inconsistencies

When switching control between locos, throttle and/or direction switch positions may not be consistent with the state of a newly selected active loco. Assume, for example, an active loco is running at speed step 16 and forward direction when control is switched to a different loco, which is stationary.

Changing active loco sends no command, but suppose the new active loco is stationary and we want it to run backwards. Since the throttle is at speed step 16, not zero, and the direction switch is forward, we have an inconsistency. Just be prepared to move the throttle quickly to zero, then change direction. (This is where the zero speed reversing option 0 can be helpful.)

The **HALT** button sends emergency stop, but leaves direction unchanged. However, the throttle is most likely not at zero speed.

A decoder reset command (soft reset) transmits emergency stop and forward direction, which can leave both throttle and direction switch inconsistent with the decoder's reset state.

Tsunami Function Assignments

S-CAB Control of Tsunami Decoder Functions

Function Group	S-CAB Button	Tsunami Function	Diesel Function	Steam Function
FG1	0	F0	Headlight (and dynamo) on/off	
	1	F1	Bell	
	2	F2	Horn	Whistle
	3	F3	Short horn	Short whistle
	4	F4	Dynamic brake	Steam release
	5	F5	Function output control	
	6	F6	Function output control	
	7	F7	Dimmer	
	8	F8	Audio mute	
	9	F9	Radiator fans	Water stop
FG2	0	F10	Air compressor	Injectors
	1	F11	Brake squeal/release	
	2	F12	Coupler clank	

Supported Decoders: Updated May, 2013

No-sound decoders

- North Coast Engineering (NCE): Models D13SR, D13SRJ, D408SR.
S-CAB Throttle programs successfully with both Local and Global addressing.
- Train Control Systems (TCS): T-1 decoder.
CV29 must be programmed using Global addressing.
Other CVs program successfully with both Local and Global addressing.

Sound decoders

- SoundTraxx Tsunami: Both TSU-1000 and TSU-750 sound decoders.
S-CAB Throttle can program successfully only with Global addressing.
- QSI Solutions: Titan-U sound decoder.
S-CAB radio conversion by special request. Titan indexed addressing of CVs cannot be programmed with S-CAB Throttle.

Vendor-Specific CVs

For sound decoders, vendor-specific CVs must be programmed using vendor's equipment. This requires an S-CAB Radio Programming Adapter (RAPA), available by special order.

