

*Release 0.15*

# *Paragon 3 Diesel Technical Reference Manual*



# INTRODUCTION

## Introduction

The Paragon 3 sound unit is a multi-function DCC decoder that supports the following:

### DCC Characteristics

- 14 bit addressing
- 7 bit addressing (1-127)
- Enhanced Lighting Control
- Advanced Sound Support
- Consist Support
- 14, 28 and 128 speed steps
- Support for F0—F28 including remapping
- Operations mode support for all CV settings
- Configuration Variable Access Acknowledgement in Service mode
- Direct, Address Only, Physical Addressing and Paged CV Addressing Modes support in Service Mode including Write and Verify
- Load Controlled Diesel Rev Level Sound Effects
- Macro Event Recorder

### DC characteristics

- DCMaster™ uses Direct Mode for CV Programming
- All CV's Programmable and Readable
- Enhanced Lighting Control
- Advanced Sound Support
- Consist Support
- Enhanced Motor Control
- Selectable DCMaster™ AUX Control
- Load Controlled Diesel Rev Level Sound Effects

**Please Note:** CV defaults will vary between locomotives



# System CVs Table

CV	Description	Initial	Yours
1	<a href="#">Primary Address</a>	3	
2	<a href="#">V Start</a>	1	
3	<a href="#">Acceleration Rate</a>	5	
4	<a href="#">Deceleration Rate</a>	5	
5	<a href="#">V High</a>	250	
6	<a href="#">V Mid</a>	50	
7	<a href="#">Manufacturer Version</a>	?	
8	<a href="#">Manufacturer ID</a>	38	
10	<a href="#">Back EMF Cutout</a>	1	
11	<a href="#">Packet Timeout</a>	2	
15	<a href="#">Unlock ID Code</a>	0	
16	<a href="#">Lock ID Number</a>	0	
17	<a href="#">Extended Address MSB</a>	192	
18	<a href="#">Extended Address LSB</a>	128	
19	<a href="#">Consist Address</a>	0	
21	<a href="#">Consist Functions Type 0</a>	255	
22	<a href="#">Consist Functions Type1</a>	255	
23	<a href="#">Acceleration Adjustment</a>	0	
24	<a href="#">Deceleration Adjustment</a>	0	
29	<a href="#">Configuration Bits</a>	6	



## Function/Control CVs

CV	Description	Initial	Yours
33	<a href="#">F0 (Front/Rear Lamp)</a>	1	
34	<a href="#">F1 (Bell)</a>	2	
35	<a href="#">F2 (Horn)</a>	3	
36	<a href="#">F3 (Coupler)</a>	17	
37	<a href="#">F4 (Grid Blower Motor and Compressor)</a>	5	
38	<a href="#">F5 (Ramp Diesel Engine Up)</a>	6	
39	<a href="#">F6 (Ramp Diesel Engine Down/Startup)</a>	7	
40	<a href="#">F7 (Smoke or L1 Visual Effects)</a>	8	
41	<a href="#">F8 (Master Volume)</a>	9	
42	<a href="#">F9 (Shutdown and Startup)</a>	10	
43	<a href="#">F10 (Radiator Cooling Fan)</a>	11	
44	<a href="#">F11 (Air Release and Air Filling)</a>	12	
45	<a href="#">F12 (Brake Set/Release)</a>	13	
46	<a href="#">F13 (Horn Grade Crossing)</a>	30	
47	<a href="#">F14 (Station Sounds)</a>	50	
48	<a href="#">F15 (Yard Sounds)</a>	51	
49	<a href="#">F16 (Maintenance Sounds)</a>	52	
50	<a href="#">F17 (Radio Chatter Sounds)</a>	53	
51	<a href="#">F18 (City Sounds)</a>	54	
52	<a href="#">F19 (Farm Sounds)</a>	55	
53	<a href="#">F20 (Industrial Sounds)</a>	56	
54	<a href="#">F21 (Lumber Sounds)</a>	57	
55	<a href="#">F22 (Horn2 Toggle)</a>	19	
56	<a href="#">F23 (Track Sounds)</a>	31	



# Function/Control CVs

57	<a href="#">F24 (L1 Visual Effects)</a>	8	
58	<a href="#">F25 (Complete Horn)</a>	20	
59	<a href="#">F26 (Play Macro)</a>	40	
60	<a href="#">F27 (Record Macro)</a>	41	
61	<a href="#">F28 (Brake Squeal)</a>	18	
65	<a href="#">Kick Start</a>	40	
66	<a href="#">Forward Trim</a>	0	
67	<a href="#">Speed Table Entry One</a>	6	
68	<a href="#">Speed Table Entry ...</a>	16	
69	<a href="#">Speed Table Entry ...</a>	24	
70	<a href="#">Speed Table Entry ...</a>	34	
71	<a href="#">Speed Table Entry ...</a>	42	
72	<a href="#">Speed Table Entry ...</a>	52	
73	<a href="#">Speed Table Entry ...</a>	60	
74	<a href="#">Speed Table Entry ...</a>	70	
75	<a href="#">Speed Table Entry ...</a>	78	
76	<a href="#">Speed Table Entry ...</a>	89	
77	<a href="#">Speed Table Entry ...</a>	97	
78	<a href="#">Speed Table Entry ...</a>	107	
79	<a href="#">Speed Table Entry ...</a>	115	
80	<a href="#">Speed Table Entry ...</a>	125	
81	<a href="#">Speed Table Entry ...</a>	133	



# Function/Control CVs

82	<a href="#">Speed Table Entry ...</a>	143	
83	<a href="#">Speed Table Entry ...</a>	151	
84	<a href="#">Speed Table Entry ...</a>	161	
85	<a href="#">Speed Table Entry ...</a>	169	
86	<a href="#">Speed Table Entry ...</a>	180	
87	<a href="#">Speed Table Entry ...</a>	188	
88	<a href="#">Speed Table Entry ...</a>	198	
89	<a href="#">Speed Table Entry ...</a>	206	
90	<a href="#">Speed Table Entry ...</a>	216	
91	<a href="#">Speed Table Entry ...</a>	225	
92	<a href="#">Speed Table Entry ...</a>	235	
93	<a href="#">Speed Table Entry ...</a>	245	
94	<a href="#">Speed Table Entry 28</a>	255	
95	<a href="#">Reverse Trim</a>	0	
112	<a href="#">KpLSB</a>	0	
113	<a href="#">KpMSB</a>	32	
114	<a href="#">KiLSB</a>	50	
115	<a href="#">KiMSB</a>	1	
116	<a href="#">KdLSB</a>	0	
117	<a href="#">KdMSB</a>	0	
118	<a href="#">KpSlow</a>	20	
120	<a href="#">Speed Step Smoothing</a>	25	
121	<a href="#">Consist Functions Type2</a>	255	
122	<a href="#">Consist Functions Type3</a>	255	



# Sound CVs

CV	Description	Initial	Yours
130	<a href="#">Master Volume Sound Increment</a>	16	
131	<a href="#">DC Sound Unit Startup Voltage</a>	72	
132	<a href="#">DC Sound Unit Shutdown Voltage</a>	58	
133	<a href="#">Sound Unit Master Volume</a>	128	
134	<a href="#">Maximum Volume</a>	128	
135	<a href="#">Horn Volume</a>	128	
136	<a href="#">Bell Volume</a>	128	
137	<a href="#">Diesel Volume</a>	128	
138	<a href="#">Horn2 Volume</a>	128	
139	<a href="#">Coupler Slack Volume</a>	128	
140	<a href="#">Couple Volume</a>	128	
141	<a href="#">Uncouple Volume</a>	128	
142	<a href="#">Wheel Flange Volume</a>	128	
143	<a href="#">Compressor Volume</a>	128	
144	<a href="#">Manual Air Release Volume</a>	128	
145	<a href="#">Air Filling Volume</a>	128	
146	<a href="#">Brake Set Volume</a>	128	
147	<a href="#">Brake Release Volume</a>	128	
148	<a href="#">Spit Valve Volume</a>	128	
149	<a href="#">Radiator Cooling Volume</a>	128	
150	<a href="#">Grid Blower Motor Volume</a>	128	
151	<a href="#">Brake Squeal Volume</a>	128	
152	<a href="#">Fuel Fill Volume</a>	128	



# Lighting CVs

CV	Description	Initial	Yours
153	<a href="#">Station/Yard Volume</a>	128	
155	<a href="#">Maintenance/Chatter Volume</a>	128	
156	<a href="#">City/Farm/Industrial/Lumber Volume</a>	128	
159	<a href="#">System Lighting</a>	2	
160	<a href="#">L1 Light Definition</a>	131	
161	<a href="#">L1 Parameter 1</a>	0	
162	<a href="#">L1 Parameter 2</a>	30	
163	<a href="#">L1 Parameter 3</a>	180	
164	<a href="#">L1 Parameter 4</a>	30	
231	<a href="#">Light Dimmer</a>	100	





# Setup/Control CVs

CV	Description	Initial	Yours
176	<a href="#">Fatal OverCurrent Configuration</a>	114	
177	<a href="#">Fatal OverCurrent Sensitivity</a>	120	
178	<a href="#">Coupler Slack Repeats</a>	1	
179	<a href="#">Coupler Slack Interval</a>	100	
180	<a href="#">Bell Ring Interval</a>	Varies	
184	<a href="#">DC Brake Control</a>	20	
185	<a href="#">DCC Brake Control</a>	20	
186	<a href="#">Brake Timer</a>	3	
187	<a href="#">Uncouple Throttle Stop</a>	3	
190	<a href="#">DC Sound Setup</a>	x	
191	<a href="#">DC Brake Set Voltage</a>	70	
192	<a href="#">DC Brake Release Voltage</a>	77	
193	<a href="#">Rev Level One Power</a>	105	
194	<a href="#">Rev Level Two Power</a>	120	
195	<a href="#">Rev Level Three Power</a>	130	
196	<a href="#">Rev Level Four Power</a>	160	
197	<a href="#">Rev Level Five Power</a>	180	
198	<a href="#">Rev Level Six Power</a>	200	
199	<a href="#">Rev Level Seven Power</a>	220	
201	<a href="#">N Gage Level Scalar</a>	46	
202	<a href="#">Load Power Filter</a>	12	
203	<a href="#">Ho Gage Rev Level Motor Power Scalar</a>	50	
204	<a href="#">Initial RevUp</a>	1	



# Setup/Control CVs

CV	Description	Initial	Yours
208	<a href="#">Cab Light Throttle Stop</a>	3	
209	<a href="#">DCC Brake Set Throttle Stop</a>	0	
210	<a href="#">DCC Brake Release Throttle Stop</a>	1	
212	<a href="#">Rolling Thunder Address</a>	1	
213	<a href="#">Rolling Thunder Setup</a>	128	
214	<a href="#">RollingThunder Volume</a>	128	
218	Smoke Unit Idle Set Point	70	
219	Smoke Unit High Set Point	80	
221	<a href="#">Unique Control One</a>	Varies	
222	<a href="#">AUX Select for DCMaster™</a>	Varies	
223	<a href="#">Bell Select</a>	0	
224	<a href="#">Horn Select</a>	0	
225	<a href="#">Control One</a>	3	
226	<a href="#">Control Two</a>	0	
227	<a href="#">Control Three</a>	2	
228	<a href="#">DCC Start Up Timer</a>	1	
229	<a href="#">Extended Consist Features</a>	247	
230	<a href="#">Easy Consist™</a>	0	
231	<a href="#">Light Dimmer</a>	100	
232	Fan Idle Power	8	
233	Fan High Power	60	
234	Fan Rev Up Power	80	
235	Fan Rev Down Power	70	
236	Fan Idle Delay	4	



# Setup/Control CVs

CV	Description	Initial	Yours
238	<a href="#">Macro Recorder Control</a>	79	
239	<a href="#">Macro Playback Loop Adjust</a>	0	
240	<a href="#">Random Sound Generator Timer Low</a>	4	
241	<a href="#">Random Sound Generator High</a>	20	
242	<a href="#">Track Sounds</a>	15	
244	<a href="#">Grid Blower and BroadCast Stop Packets</a>	32	
245	<a href="#">General System Controls One</a>	17	
246	<a href="#">General System Controls Two</a>	128	
247	<a href="#">Over Current Delay</a>	10	
248	<a href="#">Enhanced DC Motor Startup Delay</a>	60	
249	<a href="#">DC Motor Off Voltage</a>	70	
250	<a href="#">DC Track Voltage Read Delay</a>	0	
251	<a href="#">DC Motor Control Vmax</a>	120	
252	<a href="#">DC Motor Control Vmin</a>	92	



# REV UP/DOWN Control

## Synopsis

The diesel engine may have its engine revved up or down at any throttle stop including zero. Activating [F5](#) or [F6](#) (rev up/rev down) activates manual rev mode. A transition to speed step zero resets manual throttle control back to automatic throttle control. Under automatic throttle control the Rev Levels change up as the throttle is increased and down as the throttle is decreased. The rev level only changes after the ramp up/ramp down sound is finished and a throttle change is made. Motor power is also monitored and the rev levels will change depending on overall load on the locomotive.

## Manual

Manual mode may be activated at any throttle stop. Pressing [F5](#) causes the diesel engine to rev up one level per press.

**Example:** Power engine and start ([F9](#)). Press [F5](#) three times. Notice the rev level changes to rev level three. Increase the throttle stop to one.

Pressing [F6](#) causes the diesel to rev down one level per press.

**Example:** After following the above example, press [F6](#) once. Notice the rev level changes to rev level two. Set the throttle stop to zero. The diesel now automatically revs down to idle. Automatic mode is now engaged.

## Automatic

Once the throttle stop is greater than zero, automatic mode is activated. Make sure that [F5](#) or [F6](#) is not active. Throttle up from zero to one. The locomotive will rev up to [CV204](#) level. Now, if [CV246](#) bit1 is zero (default) motor loading is enabled. The locomotive rev levels now are controlled by two criteria; throttle changes and locomotive loading.

## Grid Blower Effects

Once the locomotive is notched up and moving, activating the grid blower motor ([CV37](#)) automatically slowly notches the locomotive down, eventually to idle. A throttle increase while the grid blower is active turns off the grid blower and throttle control is returned. Setting the throttle to zero disables the grid blower.



## REV UP/DOWN (cont)

### Locomotive Loading Rev Control

The locomotive power is monitored and filtered according to several CV's. [CV193](#) through [CV199](#) contain thresholds determining the required locomotive power needed to increase or decrease the diesel rev level. Once the power level falls above or below the threshold, the rev level changes. [CV202](#) contains a filter coefficient determining the convergence time and accuracy in measuring the locomotive's power.

The locomotive power is substantially higher in DC mode. To compensate, a DC scalar is provided at [CV200](#). This scalar changes the thresholds of [CV193](#) through [CV199](#), altering the power load thresholds providing proper rev changes from power load changes in DC mode of operation.

The locomotive power is substantially lower for N Gage locomotives. To compensate, an N Gage scalar is provided at [CV201](#). This scalar changes the thresholds of [CV193](#) through [CV199](#), altering the power load thresholds providing proper rev changes from power load during operation.

Should the desired power thresholds need to be changed, a simple tuning method may be used. Set [CV193](#) through [CV199](#) all to 255. Now, all power thresholds are disabled. While running in DCC, change [CV193](#), lowering it until the rev changes at the desired power load. Repeat for each of the other six power levels. DC mode will require more work, since changing while running is not allowed.

Setting bit1 in [CV246](#) will disable locomotive load power control.

### Locomotive Throttle Rev Control

The rev levels also change with the throttle. Once the rev up or rev down transition sound effect finishes playing, the throttle is checked for any change. A rev up sound effect plays if the throttle change is increased. A rev down sound effect plays if the throttle change is decreased. The effect is that if the throttle is slowly increased or decreased, the revs continue to increase or decrease. If the throttle is quickly moved up or down, the throttle will only change one rev level up or down.



# Advanced DC Motor Control

Dc operation with sounds creates a dilemma. The train usually will start moving at a very low track voltage, to low to power a loudspeaker with high quality sounds. A higher voltage of operation for the motor is an acceptable solution. About 8.0 volts is necessary before this sound system can function, producing loud, high quality sounds, *with* the motor powered and the train beginning to move. This motor controller gives acceptable motor control at the necessary power levels, *allowing the sound system to start at a much lower voltage*, keeping the motor from stealing the power from the sound system until enough power exists to move the train without the sounds degrading or shutting off. Also, more overall power is diverted to the motor at top speeds. The maximum train speed is higher with this advanced DC motor controller.

DC motor control may be altered by changing the control curve as well as the power curve. [CV249](#), [CV251](#) and [CV252](#) determine the control range for DC operations. Altering these values changes the train's startup behavior relative to track voltage and at what control voltage full speed is attained. The power curve may be altered by the speed table ([CV2](#), [CV5](#), [CV6](#)) if [CV29](#) bit4=0 or ([CV66](#) through [CV95](#)) [CV29](#) if bit4=1. [CV29](#) bit2 **must** be equal to 1.

## CV249

[CV249](#) defines the maximum track control voltage without applying motor power. Valid values for [CV249](#) are 0-255. The distance between [CV249](#) and [CV252](#) and must be large enough to keep the control voltage (Track Voltage) from moving between motor off and motor on due to track voltage variances. [CV249](#) must be smaller than [CV252](#)

## Vmin

Vmin ([CV252](#)) defines the track voltage that applies the lowest or starting motor power. Valid values for Vmin are 0-255. The distance between Vmin and Vmax ( $V_{max} > V_{min}$ ) is the control range. This control voltage value determines the locomotive speed.

**Note:  $V_{min} < V_{max}$ . Too low a value for Vmin may cause the sound unit to reset when power is supplied to the motor.**

## Vmax

Vmax ([CV251](#)) defines track voltage that once reached sets the locomotive to its fastest speed. Valid values for Vmax are 0-255. Increasing Vmax means a higher track control voltage is needed before the maximum speed is reached.

**Note:  $V_{max} > V_{in}$ . Too high a value for Vmax may not allow the train to reach full speed.**



## DC Motor Control

Figure one illustrates a locomotive running in DC mode. The sound unit supplies full sound volume at about 8.0 volts (See [CV131](#)) and shuts down at about 7.5 volts (See [CV132](#)). Motor power is supplied around 8.5 volts (See [CV252](#)). Between 8.5 volts and 14 volts (The Control Range—[CV252](#) and [CV251](#)), the sound unit monitors the track voltage and increase or decreases the motor speed as noted by the slope of *control range* in figure one. At about 14 volts ([CV251](#)), maximum speed is set. Motor power is removed once the control voltage falls below [CV249](#). Please note that this DC controller honors vStart ([CV2](#)), Acceleration Rate ([CV3](#)), Deceleration Rate ([CV4](#)) as well as the CV's used for the speed control as set by [CV29](#) bit 4. By using these CV's, the DC operation is smooth starting and stopping, comparing to DCC operations. Using [CV245](#) and [CV248](#) allows realistic sound synchronization to the startup and brake release before the locomotive begins to move.

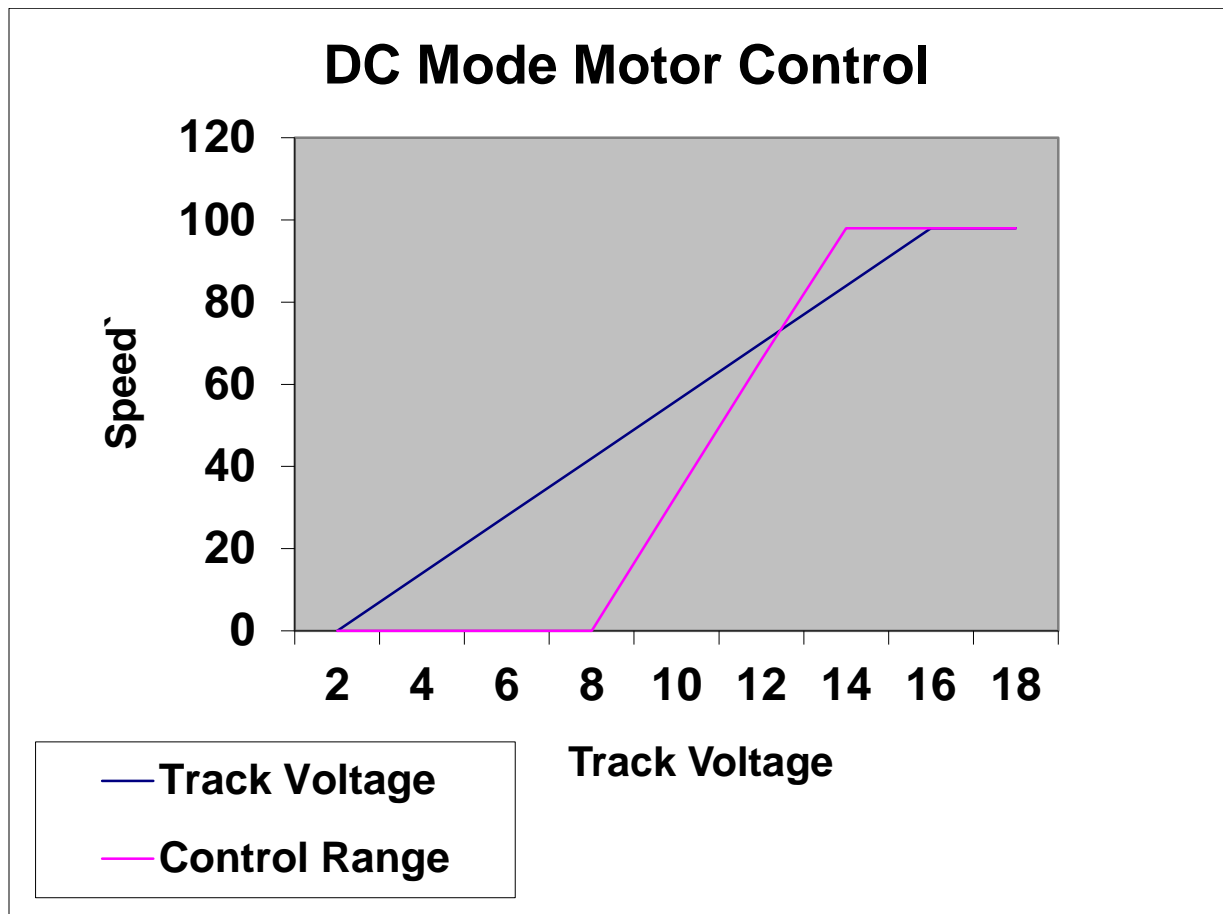


Figure 1



# Enhanced Sounds

## Station Sounds

Station Sounds are activated with the [F14](#) Function Key.

From an initial power up start condition, press [F14](#). A Station Sounds effect will play every time [F14](#) is pressed. Once the locomotive starts moving and for 10 seconds 1 of 4 different Station Departure sound effects will play. Note: If a Yard sound effect key is defined and pressed as the last key before moving the locomotive, then the 1 of 4 different sounds playing during the 10 second period of time will be Yard Departure sounds.

After 10 seconds, all Station Sounds are off and will not play unless [F14](#) is pressed again. From this moving condition and after 10 seconds, pressing [F14](#) plays an arrival sound effect once and on subsequent presses of [F14](#), plays 1 of 3 different arrival sound effects until the locomotive stops. Once stopped, 1 of 4 different sound effects will continue to play until the [F14](#) is pressed again. The sequence now repeats.

At any time when the locomotive is stopped, throttling up and down within 10 seconds will de-activate the Station sounds. Reactivation is accomplished by pressing the [F14](#) key again.

Station Sounds may also be activated for just the arrival. Press [F14](#) after 10 seconds of movement and hear just the arrival sounds. Once stopped, throttle to one and then zero.





# Enhanced Sounds

## Yard Sounds

Yard Sounds are activated with the [F15](#) Function Key.

From an initial power up start condition, press [F15](#). A Yard Sounds effect will play every time [F15](#) is pressed. Once the locomotive starts moving and for 10 seconds 1 of 4 different Yard Departure sound effects will play. Note: If a Station sound effect key is defined and pressed as the last key before moving the locomotive, then the 1 of 4 different sounds playing during the 10 second period of time will be Station Departure sounds.

After 10 seconds, all Yard Sounds are off and will not play unless [F15](#) is pressed again. From this moving condition and after 10 seconds, pressing [F15](#) plays a sound effect once and on subsequent presses of [F15](#), plays 1 of 3 different sound effects until the locomotive stops. Once stopped, 1 of 4 different sound effects will continue to play until the [F15](#) is pressed again. The sequence now repeats.

At any time when the locomotive is stopped, throttling up and down within 10 seconds will de-activate the Yard sounds. Re-activation is accomplished by pressing the [F15](#) key again.

Yard Sounds may also be activated for just the arrival. Press [F15](#) after 10 seconds of movement and hear just the arrival sounds. Once stopped, throttle to one and then zero.



# Consists Configuration Synopsis

Consisting multiple DCC locomotives has become a daunting task due to more advanced lighting and sounds used in modern sound decoders. In addition, two methods are used by most DCC controllers to manage these consists. These two methods are Advanced Consists and Universal Consists.

## Universal Consist

Universal consists are those that the controller remembers and interprets all commands, sending out appropriate DCC commands to all engines in an addressed consist. With a universal consist, proper sound functioning will be at best difficult, since there is no NMRA definitions for sounds beyond horn and bell. Which horns, bells and other sounds should play on each engine part of the consist is important in the consist though. A decoder has no control over the universal consist and this consist is not portable to other layouts. The controller is configured to remember what engine ID's belong to what consist ID and which engines receive the programmed function commands. Now, is not that easy?

## Advanced Consist

The advanced consist is defined by the NMRA. [CV19](#) contains a number from 0-127 or 129 to 255. What do these numbers mean?

0 and 128	Indicates the engine does not belong to any consist
1-127	Defines the consist 1 to 127
129-255	Defines consists 1 to 127 but with reverse lighting (129 is consist 1 reverse lighting)

So now the consist may be set within [CV19](#), but what is the relationship between the engine ID and its active consist ID? Once the engine is part of a consist, certain NMRA rules exist for functions ([F0-F12](#)). Rules for the engine ID addressed as the engine ID that is part of a consist are different than the rules for the engine ID addressed as the consist ID. Whew! Lets look at what this means!



## Consists (Continued)

Addressing the engine ID while the engine is part of an active consist results in the following:

1. Speed and direction requests are ignored unless the engine ID is the same as the consist ID.
2. All functions ([F0-F12](#)) are honored.
3. CV's may be changed.

Addressing the active consists ID results in the following:

1. Speed and direction are honored
2. All functions ([F0-F12](#)) are honored or ignored depending on [CV21](#) and [CV22](#)
3. CV's may not be changed

Bit 7				Bit 0			
F8	F7	F6	F5	F4	F3	F2	F1

**CV21**

The decoder responds to all functions that have a "1" set in [CV21](#) and defines which function keys are active for [F1](#) thru [F8](#). Default is all set to "1".

Bit 7				Bit 0			
nu	nu	F12	F11	F10	F9	nu	F0

**CV22**

The decoder responds to all functions that have a "1" set in [CV22](#) and defines which function keys are active for [F0](#) and [F9](#) thru [F12](#). Default is all set to "1". nu=not used.

So, depending on where the engine is in the consist, Function keys may be enabled or disabled. For instance, the horn may be functioning in only the forward facing engine and disabled in the other engines in the consist.

Our sound decoder supports the NMRA standard and allows the enabling/disabling of these functions [F0](#) thru [F12](#). Similarly, [F13](#) thru [F28](#) may be enabled/disabled with [CV121](#) and [CV122](#).

So now we may program a consist and configure how each engine handles the function keys. But what about other lighting and sounds not covered by NMRA standards?



## Consists (Continued)

### Advanced Lighting

Other lighting needs to be controlled in a similar manner. Our decoder allows consist setup for advanced lighting using [CV229](#).

Bit 7				Bit 0			
X	X	X	X	X	X	X	X

#### **CV229**

Bit7:	Cab Disabled=0; Cab Enabled=1
Bit6:	Horn Enabled=1 (DC Only)
Bit5:	Bell Enabled=1 (DC Only)
Bit4:	AUX Enabled=1 (DC Only)
Bit3:	Not used
Bit2:	L1 Disabled=0; L1 Enabled=1
Bit1:	Front Light Disabled=0; Front Light Enabled=1
Bit0:	Rear Light Disabled=0; Rear Light Enabled=1

When the locomotive is part of a consist, this CV allows individual lighting. So now, let see how we can configure an engine in a consist. Set the engine ID to engine 3. Now, set a consist address at [CV19](#). Lets make it consist 60. So program [CV19](#) to 60. Now we need to know where the engine is located in the consist so [CV21](#), [CV22](#), [CV121](#), [CV122](#) and [CV229](#) may be set correctly.



## Consists (Continued)

### *For a Front Engine forward facing:*

<a href="#">CV21</a> =255	<a href="#">F1</a> thru <a href="#">F8</a> enabled for consist address
<a href="#">CV22</a> =255	<a href="#">F0</a> and <a href="#">F9</a> thru <a href="#">F12</a> enabled for consist address
<a href="#">CV121</a> =255	<a href="#">F13</a> thru <a href="#">F20</a> are enabled for consist address
<a href="#">CV122</a> =255	<a href="#">F21</a> thru <a href="#">F28</a> are enabled for consist address
<a href="#">CV229</a> =246	Cab light enabled; DC Horn enabled; DC Bell enabled; AUX enabled; L1 enabled; Front light enabled; Rear light disabled AUX enabled

### *For a Middle Engine:*

<a href="#">CV21</a> =176	<a href="#">F1</a> , <a href="#">F2</a> , <a href="#">F3</a> , <a href="#">F4</a> , <a href="#">F7</a> disabled and <a href="#">F5</a> , <a href="#">F6</a> and <a href="#">F8</a> enabled for consist address
<a href="#">CV22</a> =5	<a href="#">F0</a> and <a href="#">F10</a> thru <a href="#">F12</a> disabled and <a href="#">F9</a> enabled for consist address
<a href="#">CV121</a> =255	<a href="#">F13</a> thru <a href="#">F20</a> are disabled for consist address
<a href="#">CV122</a> =96	<a href="#">F26</a> and <a href="#">F27</a> are enabled for consist address
<a href="#">CV229</a> =0	Cab light disabled; DC Horn disabled; DC Bell disabled; AUX disabled; L1 disabled; Front light disabled; Rear light disabled

*Note: [F8](#) and [F9](#) allow for consist starting, shutdown, volume control and muting. [F5](#) and [F6](#) allow manual rev control.*

### *For a Rear Engine forward facing:*

<a href="#">CV21</a> =176	<a href="#">F1</a> , <a href="#">F2</a> , <a href="#">F3</a> , <a href="#">F4</a> , <a href="#">F7</a> disabled and <a href="#">F5</a> , <a href="#">F6</a> and <a href="#">F8</a> enabled for consist address
<a href="#">CV22</a> =5	<a href="#">F0</a> and <a href="#">F10</a> thru <a href="#">F12</a> disabled and <a href="#">F9</a> enabled for consist address
<a href="#">CV121</a> =255	<a href="#">F13</a> thru <a href="#">F20</a> are disabled for consist address
<a href="#">CV122</a> =96	<a href="#">F26</a> and <a href="#">F27</a> are enabled for consist address
<a href="#">CV229</a> =2	Cab light disabled; DC Horn disabled; DC Bell disabled; AUX disabled; L1 disabled; Front light enabled; Rear light disabled

*Note: [F8](#) and [F9](#) allow for consist starting, shutdown, volume control and muting. [F5](#) and [F6](#) allow manual rev control.*



# Consists (Continued)

## Easy Consist Programming

Now that we can program a consist, let consider an easy way to program a generic consist. [CV230](#) for advanced DCC or DC consist performs the consisting functions for you.

### Easy Consist ([CV230](#))

The easy consist feature sets the decoder [CV19](#) for consist 60. Program [CV230](#) with 1, 2 or 3 to set the engine position in the consist.

0 = Consist Disabled

1 = Front Engine

All consist function keys are enabled ([CV21](#), [CV22](#))

All lights except the rear light are enabled ([CV229](#))

2 = Middle Engine

All consist function keys except [F0](#), [F5](#), [F6](#), [F8](#), [F9](#), [F26](#) and [F27](#) are disabled ([CV21](#), [CV22](#), [CV121](#), [CV122](#)); All lights are disabled ([CV229](#))

3 = Rear Engine

All consist function keys except [F0](#), [F5](#), [F6](#), [F8](#), [F9](#), [F26](#) and [F27](#) are disabled ([CV21](#), [CV22](#), [CV121](#), [CV122](#)). Only the front light is enabled ([CV229](#))

Now, program [CV19](#) from 60 to whatever consist number you desire. Repeat for each engine and the consist is completed.



# Decimal to Binary Primer

## Setting CV's

Setting the CV's requires knowledge of conversion between binary and decimal. The following examples demonstrates the conversion process from binary to decimal after determining which bits in a CV need to be "1" and which needs to be "0". The tables are also useful for converting binary to decimal.

## Reading CV's

The tables are also useful for converting decimal to binary when reading the CV's in service mode. After reading the CV, use the tables to determine which bits are "1" and which bits are "0". Once the bit patterns are identified, find the CV in this manual to determine what functions are controlled by the bits.

Bit 7				Bit 0			
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
128	64	32	16	8	4	2	1

Consider a binary number 10001011

$$128+0+0+0+8+0+2+1=139$$

Consider a binary number 00011101

$$0+0+0+16+8+4+0+1=29$$

CVxx read is 39. Table lookup is: 00100111



# Decimal to Hexadecimal Conversion

Dec	Hex	Oct	Bin
0	0	000	00000000
1	1	001	00000001
2	2	002	00000010
3	3	003	00000011
4	4	004	00000100
5	5	005	00000101
6	6	006	00000110
7	7	007	00000111
8	8	010	00001000
9	9	011	00001001
10	A	012	00001010
11	B	013	00001011
12	C	014	00001100
13	D	015	00001101
14	E	016	00001110
15	F	017	00001111

Dec	Hex	Oct	Bin
16	10	020	00010000
17	11	021	00010001
18	12	022	00010010
19	13	023	00010011
20	14	024	00010100
21	15	025	00010101
22	16	026	00010110
23	17	027	00010111
24	18	030	00011000
25	19	031	00011001
26	1A	032	00011010
27	1B	033	00011011
28	1C	034	00011100
29	1D	035	00011101
30	1E	036	00011110
31	1F	037	00011111

Dec	Hex	Oct	Bin
32	20	040	00100000
33	21	041	00100001
34	22	042	00100010
35	23	043	00100011
36	24	044	00100100
37	25	045	00100101
38	26	046	00100110
39	27	047	00100111
40	28	050	00101000
41	29	051	00101001
42	2A	052	00101010
43	2B	053	00101011
44	2C	054	00101100
45	2D	055	00101101
46	2E	056	00101110
47	2F	057	00101111

Dec	Hex	Oct	Bin
48	30	060	00110000
49	31	061	00110001
50	32	062	00110010
51	33	063	00110011
52	34	064	00110100
53	35	065	00110101
54	36	066	00110110
55	37	067	00110111
56	38	070	00111000
57	39	071	00111001
58	3A	072	00111010
59	3B	073	00111011
60	3C	074	00111100
61	3D	075	00111101
62	3E	076	00111110
63	3F	077	00111111

Dec	Hex	Oct	Bin
64	40	100	01000000
65	41	101	01000001
66	42	102	01000010
67	43	103	01000011
68	44	104	01000100
69	45	105	01000101
70	46	106	01000110
71	47	107	01000111
72	48	110	01001000
73	49	111	01001001
74	4A	112	01001010
75	4B	113	01001011
76	4C	114	01001100
77	4D	115	01001101
78	4E	116	01001110
79	4F	117	01001111

Dec	Hex	Oct	Bin
80	50	120	01010000
81	51	121	01010001
82	52	122	01010010
83	53	123	01010011
84	54	124	01010100
85	55	125	01010101
86	56	126	01010110
87	57	127	01010111
88	58	130	01011000
89	59	131	01011001
90	5A	132	01011010
91	5B	133	01011011
92	5C	134	01011100
93	5D	135	01011101
94	5E	136	01011110
95	5F	137	01011111





# Decimal to Hexadecimal Conversion

Dec	Hex	Oct	Bin
96	60	140	01100000
97	61	141	01100001
98	62	142	01100010
99	63	143	01100011
100	64	144	01100100
101	65	145	01100101
102	66	146	01100110
103	67	147	01100111
104	68	150	01101000
105	69	151	01101001
106	6A	152	01101010
107	6B	153	01101011
108	6C	154	01101100
109	6D	155	01101101
110	6E	156	01101110
111	6F	157	01101111

Dec	Hex	Oct	Bin
112	70	160	01110000
113	71	161	01110001
114	72	162	01110010
115	73	163	01110011
116	74	164	01110100
117	75	165	01110101
118	76	166	01110110
119	77	167	01110111
120	78	170	01111000
121	79	171	01111001
122	7A	172	01111010
123	7B	173	01111011
124	7C	174	01111100
125	7D	175	01111101
126	7E	176	01111110
127	7F	177	01111111

Dec	Hex	Oct	Bin
128	80	200	10000000
129	81	201	10000001
130	82	202	10000010
131	83	203	10000011
132	84	204	10000100
133	85	205	10000101
134	86	206	10000110
135	87	207	10000111
136	88	210	10001000
137	89	211	10001001
138	8A	212	10001010
139	8B	213	10001011
140	8C	214	10001100
141	8D	215	10001101
142	8E	216	10001110
143	8F	217	10001111

Dec	Hex	Oct	Bin
144	90	220	10010000
145	91	221	10010001
146	92	222	10010010
147	93	223	10010011
148	94	224	10010100
149	95	225	10010101
150	96	226	10010110
151	97	227	10010111
152	98	230	10011000
153	99	231	10011001
154	9A	232	10011010
155	9B	233	10011011
156	9C	234	10011100
157	9D	235	10011101
158	9E	236	10011110
159	9F	237	10011111

Dec	Hex	Oct	Bin
160	A0	240	10100000
161	A1	241	10100001
162	A2	242	10100010
163	A3	243	10100011
164	A4	244	10100100
165	A5	245	10100101
166	A6	246	10100110
167	A7	247	10100111
168	A8	250	10101000
169	A9	251	10101001
170	AA	252	10101010
171	AB	253	10101011
172	AC	254	10101100
173	AD	255	10101101
174	AE	256	10101110
175	AF	257	10101111

Dec	Hex	Oct	Bin
176	B0	260	10110000
177	B1	261	10110001
178	B2	262	10110010
179	B3	263	10110011
180	B4	264	10110100
181	B5	265	10110101
182	B6	266	10110110
183	B7	267	10110111
184	B8	270	10111000
185	B9	271	10111001
186	BA	272	10111010
187	BB	273	10111011
188	BC	274	10111100
189	BD	275	10111101
190	BE	276	10111110
191	BF	277	10111111



# SYSTEM CVs

## CV1

### Primary Address

#### *Description*

The Decoders Primary Address is Stored Here

#### *Values*

Bits 0-6 contain an address with a value between 1 and 127

#### *Initial Value*

3 (Engine 3)

#### *Related CVs*

[CV29](#) Bit 5

[CV17](#), [CV18](#), [CV19](#)

Bit 7

Bit 0

0	A6	A5	A4	A3	A2	A1	A0
---	----	----	----	----	----	----	----

The decoder responds to all valid commands if the address matches the value in CV1 and CV29 Bit 5 is set to 0.

Programming CV1 will program CV19 (Consists Address) to zero and programs CV29 Bit 5 to 0 (Extended Addressing Off).



# SYSTEM CVs

## CV2

### Vstart

#### *Description*

This Value Determines the Motor Speed at Step One

#### *Values*

0-255

#### *Initial Value*

1

#### *Related CVs*

[CV5](#), [CV6](#), [CV66](#), [CV95](#), [CV29](#) Bit 4, [CV120](#)

Bit 7

Bit 0

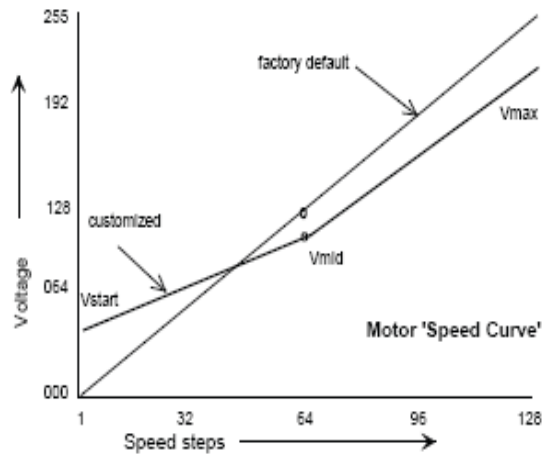
0	0	0	0	0	0	0	1
---	---	---	---	---	---	---	---

CV2 determines the motor speed at step one if CV29 bit 4 is zero. Increasing CV2 increases the initial motor start speed. If BackEMF is disabled, this value must be high enough to overcome the initial locomotive inertia (See also [CV65](#) kickstart). **Note: CV2 must be smaller than Vmid and Vhigh.**

CV2, CV5, CV6, CV65 and CV95 allow motor control using a simple line function. The start speed, the maximum speed, the mid range speed and compensation for a motor that runs faster in one direction or the other are determined by these 5 CV's. Whether BackEMF is enabled or not ([CV10](#)), the following graph illustrates how the CV's control the motor speed characteristics.



# Three Point Motor Control Analysis



Vstart is [CV2](#)

Vmid is [CV6](#)

Vmax is [CV5](#)

Whether the speed steps are set to 14, 28 or 126, the above graph illustrates how these CV's control the motor speed. The midpoint is 63 for 126-speed step mode, 14 for 28-speed step mode and 7 for 14-speed step mode. DC mode is fixed at 126 speed steps.

In addition, should the forward or reverse direction speeds not be matched, a small correction may be applied to either direction. [CV65](#) allows a small increase or decrease in forward speed while [CV95](#) allows a small increase or decrease in reverse speed. (See [CV65](#) and [CV95](#)).

**Note that whether operating in DCC or DC, the above CV's control the speed of the motor.**



# SYSTEM CVs

## CV3

### Acceleration Rate

#### *Description*

This Value Determines the Locomotives Acceleration Rate

#### *Values*

0-255

#### *Initial Value*

5

#### *Related CVs*

[CV4](#), [CV23](#), [CV24](#), [CV120](#)

Bit 7

Bit 0

0	0	0	0	0	1	0	1
---	---	---	---	---	---	---	---

The value sets the delay between each speed step change and creates a momentum effect. The delay varies with the number of speed steps selected. The acceleration rate is determined as follows:

Seconds = CV3 x 0.896 ÷ Number of Speed Steps

CV3=20     17.92 seconds for full speed

CV3=255    3.8 minutes for full speed

**Note:** CV23 is an additional acceleration rate that adds or subtracts to CV3 during active consists.



# SYSTEM CVs

## CV4

### Deceleration Rate

#### *Description*

This Value Determines the Locomotives Deceleration Rate

#### *Values*

0-255

#### *Initial Value*

5

#### *Related CVs*

[CV3](#), [CV23](#), [CV24](#), [CV120](#)

Bit 7

Bit 0

0	0	0	0	0	1	0	1
---	---	---	---	---	---	---	---

The value sets the delay between each speed step change and creates a momentum effect. The delay varies with the number of speed steps selected. The deceleration rate is determined as follows:

Seconds = CV4 x 0.896 ÷ Number of Speed Steps

CV4=20     17.92 seconds from full speed to stop

CV4=255     3.8 minutes from full speed to stop

**Note:** CV24 is an additional deceleration rate that adds or subtracts to CV4 during active consists.



# SYSTEM CVs

## CV5

### V<sub>high</sub>

#### *Description*

This Value Determines the Maximum Speed of the Selected Speed Setting

#### *Values*

0-255

#### *Initial Value*

250

#### *Related CVs*

[CV2](#), [CV6](#), [CV66](#), [CV95](#), [CV29](#) Bit 4

Bit 7

Bit 0

1	1	1	1	1	0	1	0
---	---	---	---	---	---	---	---

CV5 determines the motor speed at the maximum speed step (14, 28 or 126) if CV29 bit 4 is zero. Decreasing CV5 decreases the maximum motor speed.

**Note:** CV5 must be larger than V<sub>start</sub> and V<sub>mid</sub>.

See the [Graph](#) for CV2 for additional information.



# SYSTEM CVs

## CV6

### Vmid

#### *Description*

This Value Determines the Mid Speed of the Selected Speed Setting

#### *Values*

0-255

#### *Initial Value*

50

#### *Related CVs*

[CV2](#), [CV3](#), [CV66](#), [CV95](#), [CV29](#) Bit 4

Bit 7

Bit 0

0	0	1	1	0	0	1	0
---	---	---	---	---	---	---	---

CV6 determines the motor speed at half the maximum step or the midpoint (7 for 14 step, 14 for 28 step or 63 for 126 step) if CV29 bit 4 is zero. This value allows finer or courser control for the first half of second half of the throttle control. If CV6 is zero, this value is not used in the 3 point curve calculation.

**Note: CV6 must be larger than Vstart and smaller than Vhigh.**

See the [Graph](#) for CV2 for additional information.





# SYSTEM CVs

## CV7

### Manufacturer Version Number

#### *Description*

The Decoders Read Only Type/Revision is Stored Here

#### *Values*

#### *Initial Value*

#### *Related CVs*

None

Bit 7

Bit 0

D7	D6	D5	D4	D3	D2	D1	D0
----	----	----	----	----	----	----	----

This value cannot be modified.

000xxxxx = Diesel and xxxxx is the revision.

001xxxxx = Steam and xxxxx is the revision.



# SYSTEM CVs

## CV8

### Manufacturer ID

#### *Description*

The Decoders NMRA Assigned Number is Stored Here. Broadway Limited is assigned ID 38.

#### *Values*

#### *Initial Value*

38

#### *Related CVs*

Bit 7

Bit 0

0	0	1	0	0	1	1	0
---	---	---	---	---	---	---	---

Writing “*value*” to CV8 causes the following:

#### VALUE

- |     |  |
|-----|--|
| 8   | Resets all <a href="#">CVs</a> back to their original manufactured values unless the unit is <a href="#">locked</a> .  |
| 10  | Loads and Saves Factory Stored <a href="#">Macro</a>   |
| 12  | Loads Factory Motor Test Tune  |
| 16  | Saves Recorded <a href="#">Macro</a>   |
| 38  | Sets F0 thru F12 to match the <a href="#">Blue Line</a> engine function keys   |
| 113 | Sets F0 thru F12 to match <a href="#">QSI</a> engine function keys   |
| 141 | Sets F0 thru F12 to match <a href="#">SoundTraxx</a> engine function keys  |
| 254 | Resets all <a href="#">CVs</a> back to their original manufactured values even if the unit is <a href="#">locked</a> . |



# SYSTEM CVs

## CV10

### EMF Feedback Cutout

#### *Description*

This Value Determines Whether BackEMF is Enabled or Disabled

#### *Values*

0-1

#### *Initial Value*

1

#### *Related CVs*

[CV2](#), [CV65](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	1
---	---	---	---	---	---	---	---

Writing a one to this location enables backEMF or speed control and writing a zero disables speed control. If back EMF is disabled, CV65 or the [kickstart](#) may be used to help the locomotive start from speed step 0 to speed step one by supplying a momentary increase of power overcoming the initial locomotives inertia (See CV65). Also, CV2 may need to be increased to keep the locomotive running at the lowest speed possible.



# SYSTEM CVs

## CV11

### Packet Time-Out Value

#### *Description*

Maximum Time in Seconds Between Valid DCC Packets Before a Throttle Shutdown Occurs

#### *Values*

0-255

#### *Initial Value*

2

#### *Related CVs*

Bit 7

Bit 0

0	0	0	0	0	0	1	0
---	---	---	---	---	---	---	---

This value determines the maximum time elapsed before a throttle shutdown occurs from not receiving a valid DCC packet. If the shutdown occurs, the locomotive will be shutdown at the rate determined by [CV4](#) and [CV24](#).

Note: This shutdown only occurs if [CV29](#) bit 2=0. System default is [CV29](#) bit2=1.



# SYSTEM CVs

## CV15

### Unlock ID Code

#### *Description*

The Number is the Unlock ID

#### *Values*

0-7

#### *Initial Value*

0

#### *Related CVs*

[CV16](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

Factory new units have the unlock id code and the lock id number set to zero, allowing normal programming of all CV's. Users wishing to lock this decoder may start by programming CV16 with a recommended value of 2. Now, unlock the decoder for CV updates by writing 2 to CV15. Once all programming is completed, write a value of 0 to CV15. Now the decoder is locked. **Please note once the decoder is locked, no CV's other than [CV1](#) or CV15 may be read or changed.**



# SYSTEM CVs

## CV16

### Lock ID Number

#### *Description*

This Number Identifies this Single Decoder.

#### *Values*

0-7

#### *Initial Value*

0

#### *Related CVs*

[CV15](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

This value may only be changed when CV15 equals CV16. CV15 may always be read. The following definitions may be used when programming this number:

Lock Disabled	0
Motor Decoder	1
Sound Decoder	2
Function Decoder	3

If this feature is use, the recommendation is to program a 2 for value. **Please note once the decoder is locked, no CV's other than [CV1](#) or CV15 may be read or changed.**



# SYSTEM CVs

## CV17 and CV18 Extended Address

### *Description*

This Value Contains the Decoders Extended Address and is Valid Only if CV29 Bit 5 is 1

### *Values*

Values From 0 to 10239 are Valid

### *Initial Value*

1100 0000 1000 0000 (Engine 128)

### *Related CVs*

[CV29](#) Bit 5

Bit 15				Bit 8			
1	1	A13	A12	A11	A10	A9	A8

CV17 Extended Address MSB

Bit 7				Bit 0			
A7	A6	A5	A4	A3	A2	A1	A0

CV18 Extended Address LSB

CV17 Valid Values are 1100 0000 thru 1110 0111

CV18 Valid Values are 0000 0000 thru 1111 1111



# SYSTEM CVs

## CV19

### Consist Address

#### *Description*

The Decoders Consist Address is Stored Here

#### *Values*

0-255

#### *Initial Value*

0

#### *Related CVs*

[CV21](#), [CV22](#), [CV225](#), [CV229](#)

Bit 7

Bit 0

Dir	A6	A5	A4	A3	A2	A1	A0
-----	----	----	----	----	----	----	----

Consist valid address are 1-127 or A6-A0 where a value of 0 breaks the consist and all received consist commands are ignored. The Dir bit selects normal or reverse directional lighting. If Dir=0 than normal directional lighting is selected. If Dir=1 than reverse directional lighting is selected. Reverse directional lighting is useful when the engine is oriented backwards in the consist.

[See Consist Synopsis.](#)





# SYSTEM CVs

## CV21

### Consist Functions Type 0

#### *Description*

Determines Which Functions ([F1-F8](#)) are Allowed in the Consist

#### *Values*

0-255

#### *Initial Value*

255

#### *Related CVs*

[CV19](#), [CV22](#), [CV121](#), [CV122](#), [CV225](#), [CV226](#), [CV229](#)

Bit 7

Bit 0

F8	F7	F6	F5	F4	F3	F2	F1
----	----	----	----	----	----	----	----

The decoder responds to all functions that have a “1” set in this CV once a consist is configured. A consist is configured by [CV19](#) programmed to a value from 1-127. A value of 0 breaks the consist. See [CV19](#). This CV is used to configure the engine for a front, middle or end in the consist.

An example for consist number 60:

CV19=60

Front Engine	CV21=255	CV22=255	CV121=255	CV122=255	CV229=246
Middle Engine	CV21=176	CV22=5	CV121=0	CV122=96	CV229=0
Rear engine	CV21=176	CV22=5	CV121=0	CV122=96	CV229=2

[See Consist Synopsis.](#)

Bit 7:	0=F8 Disabled 1=F8 Enabled
Bit 6:	0=F7 Disabled 1=F7 Enabled
Bit 5:	0=F6 Disabled 1=F6 Enabled
Bit 4:	0=F5 Disabled 1=F5 Enabled
Bit 3:	0=F4 Disabled 1=F4 Enabled
Bit 2:	0=F3 Disabled 1=F3 Enabled
Bit 1:	0=F2 Disabled 1=F2 Enabled
Bit 0:	0=F1 Disabled 1=F1 Enabled



# SYSTEM CVs

## CV22

### Consist Functions Type 1

#### *Description*

Determines Which Functions (F0; F9-F12) are Allowed in the Consist

#### *Values*

0-255

#### *Initial Value*

255

#### *Related CVs*

[CV19](#), [CV21](#), [CV121](#), [CV122](#), [CV225](#), [CV226](#), [CV229](#)

Bit 7

Bit 0

nu	nu	F12	F11	F10	F9	nu	F0
----	----	-----	-----	-----	----	----	----

The decoder responds to all functions that have a “1” set in this CV once a consist is configured. A consist is configured by CV19 programmed to a value from 1-127. A value of 0 breaks the consist. See CV19. This CV is used to configure the engine for a front, middle or end in the consist.

An example for consist number 60:

CV19=60

Front Engine CV21=255 CV22=255 CV121=255 CV122=255 CV229=246

Middle Engine CV21=176 CV22=5 CV121=0 CV122=96 CV229=0

Rear engine CV21=176 CV22=5 CV121=0 CV122=96 CV229=2

[See Consist Synopsis.](#)

Bit 7:	not used
Bit 6:	not used
Bit 5:	0=F12 Disabled 1=F12 Enabled
Bit 4:	0=F11 Disabled 1=F11 Enabled
Bit 3:	0=F10 Disabled 1=F10 Enabled
Bit 2:	0=F9 Disabled 1=F9 Enabled
Bit 1:	not used
Bit 0:	0=F0 Disabled 1=F0 Enabled



# SYSTEM CVs

## CV23

### Consist Acceleration Rate

#### *Description*

This Value Determines the Locomotives Consist Acceleration Rate

#### *Values*

0-255

#### *Initial Value*

0

#### *Related CVs*

[CV3](#), [CV4](#), [CV24](#)

Bit 7

Bit 0

sign	0	0	0	0	0	0	0
------	---	---	---	---	---	---	---

During an active consist, the consist acceleration rate is added or subtracted to the Acceleration Rate (CV3). If the sign bit is 1, this value is subtracted from CV3, and if the sign bit is 0, this value is added to CV3 to create the consist acceleration rate momentum. The consist acceleration rate is determined as follows:

Seconds = (CV3 + CV23) x 0.896 ÷ Number of Speed Steps

CV3=20; CV23=100      1.792 minutes for full speed

CV3=255; CV23=127      5.7 minutes for full speed



# SYSTEM CVs

## CV24

### Consist Deceleration Rate

#### *Description*

This Value Determines the Locomotives Consist Deceleration Rate

#### *Values*

0-255

#### *Initial Value*

0

#### *Related CVs*

[CV3](#), [CV4](#), [CV23](#)

Bit 7

Bit 0

sign	0	0	0	0	0	0	0
------	---	---	---	---	---	---	---

During an active consist, the consist deceleration rate is added or subtracted to the Deceleration Rate (CV4). If the sign bit is 1, this value is subtracted from CV4, and if the sign bit is 0, this value is added to CV4 to create the consist deceleration rate momentum. The consist deceleration rate is determined as follows:

Seconds = (CV4 + CV24) x 0.896 ÷ Number of Speed Steps

CV4=20; CV24=100      1.792 minutes for full speed

CV4=255; CV24=127      5.7 minutes for full speed



# SYSTEM CVs

## CV29

### Configuration Bits

#### *Description*

Decoder Configuration Feature Bits

#### *Values*

#### *Initial Value*

6 (Primary Address)

#### *Related CVs*

[CV1](#), [CV17](#), [CV18](#)

Bit 7

Bit 0

0	0	EA	0	0	1	1	0
---	---	----	---	---	---	---	---

- Bit 5: EA (Extended Address Mode Enable)  
0 = Decoder Responds to Primary Address CV1  
1 = Decoder Responds to Extended Address CV17, CV18
- Bit 4: 0 = Speed Table set by CV2, CV5, CV6 (DCC and DC)  
1 = Speed Table set by CV66—CV95 (DCC and DC)
- Bit 2: 0 = DCC Only  
1 = DC Enabled
- Bit 1: 0 = 14 speed step if controller set for 14 bits  
1 = 28 speed step if controller set for 28 bits  
x = ignored in DC mode; 28 steps used
- Bit 0: 0 = normal lighting for front and rear lights  
1 = reverse lighting for front and rear lights



# FUNCTION CVs

## CV33-CV61

### F0 – F28 Function Definitions

The function keys may be programmed to perform any of the defined functions listed by setting the corresponding Function Key CV to the assigned value.

<u>Function Controlled</u>	<u>Assigned Value</u>
Nothing	0
Front/Rear Lights	1
Bell Sound	2
Horn Sound	3
Couple/Uncouple Sound	4
Compressor/Grid Blower Sound	5
Diesel Ramp Up	6
Diesel Ramp Down/Start Diesel Sound	7
L1 Function	8
Mute/Volume Control	9
Startup/Shutdown Sounds	10
Cooling Fan Sound	11
Air Fill/Air Release Sound	12
Brake Set/Release/Squeal Sound	13
Fuel Fill Sound	14
Spit Valve Sound	15
Wheel Flange Sound	16
Coupler Slack/Couple Sound	17
Brake Squeal Sound	18
Horn2 Toggle	19





# FUNCTION CVs

## CV33-CV61

### F0 – F28 Function Definitions (continued)

<u>Function Controlled</u>	<u>Assigned Value</u>
Complete Horn	20
Smoke Unit On/Off	21
L4	24
L5	25
Horn Grade Crossing Sound	30
Track Sounds	31
Play Macro	40
Record Macro	41
Station Sounds	50
Yard Sounds	51
Maintenance Sounds	52
Radio Chatter Sounds	53
City Sounds	54
Farm Sounds	55
Industrial Sounds	56
Lumber Yard Sounds	57
Cab Light Toggle	60
Rule 17 Dimming Toggle	61
Rolling Thunder Test Tone	86



# FUNCTION CVs

## CV33

### F0 Output Function Definition

#### *Description*

Selects Which Function(s) F0 Activates

#### *Values*

0 to 255

#### *Initial Value*

1 (Front/Rear Lighting)

#### *Related CVs*

CV33—CV61; [CV29](#), [CV159](#), [CV225](#), [CV229](#), [CV231](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	1
---	---	---	---	---	---	---	---

The front and rear light control is the default setting. The lights brightness may be controlled with CV231.



# FUNCTION CVs

## CV34

### F1 Output Function Definition

#### *Description*

Selects Which Function(s) F1 Activates

#### *Values*

0 to 255

#### *Initial Value*

2 (Bell)

#### *Related CVs*

CV33—CV61; [CV136](#), [CV180](#)

Bit 7

Bit 0

0	0	0	0	0	0	1	0
---	---	---	---	---	---	---	---

The bell control is the default setting.



# FUNCTION CVs

## CV35

### F2 Output Function Definition

#### *Description*

Selects Which Function(s) F2 Activates

#### *Values*

0 to 255

#### *Initial Value*

3 (Horn)

#### *Related CVs*

CV33—CV61; [CV135](#), [CV138](#), [CV224](#)

Bit 7

Bit 0

0	0	0	0	0	0	1	1
---	---	---	---	---	---	---	---

The horn control is the default setting. If a secondary horn is included in your locomotive, this function may activate it by setting a function key to the [Horn2 Toggle](#) (19) and pressing that function key. Now the horn function plays the secondary horn.



# FUNCTION CVs

## CV36

### F3 Output Function Definition

#### *Description*

Selects Which Function(s) F3 Activates

#### *Values*

0 to 255

#### *Initial Value*

17(Coupler Slack/Couple Sound)

#### *Related CVs*

CV33—CV61; [CV139](#), [CV140](#), [CV141](#), [CV187](#)

Bit 7

Bit 0

0	0	0	0	0	1	0	0
---	---	---	---	---	---	---	---

#### **CV36=17(Coupler Slack/Couple Sound)**

The couple sound effect plays when moving while the coupler slack arms when not moving and starts playing at throttle stop one.

#### **CV36=4(Couple/Uncouple Sound)**

The couple sound effect plays when moving while the uncouple arms when not moving and plays at a predetermined throttle stop (CV187) after moving.



# FUNCTION CVs

## CV37

### F4 Output Function Definition

#### *Description*

Selects Which Function(s) F4 Activates

#### *Values*

0 to 255

#### *Initial Value*

5 (Compressor/Grid Blower)

#### *Related CVs*

CV33—CV61; [CV143](#), [CV150](#)

Bit 7

Bit 0

0	0	0	0	0	1	0	1
---	---	---	---	---	---	---	---

The compressor sound effect plays when stopped while the grid blower motor plays when moving. The grid blower plays if the locomotive is moving. While the grid blower is active, the locomotive's rev levels will slowly be decreased down to idle. If the throttle is increased while the grid blower is active, the grid blower is turned off and rev levels follow the throttle/power levels. The grid blower motor is turned off at throttle stop zero.

See [DCC Rev Up/Down Control](#).



# FUNCTION CVs

## CV38

### F5 Output Function Definition

#### *Description*

Selects Which Function(s) F5 Activates

#### *Values*

0 to 255

#### *Initial Value*

6 (Diesel Ramp Up)

#### *Related CVs*

CV33—CV61; [CV137](#), [CV193—CV202](#)

Bit 7

Bit 0

0	0	0	0	0	1	1	0
---	---	---	---	---	---	---	---

Repeated pressings of this function key may ramp the diesel locomotive up. If the locomotive throttle is higher than the rev level, one press will ramp the locomotive up to the throttle setting rev level. The locomotive must be moving before this function is allowed.

See [DCC Rev Up/Down Control](#).



# FUNCTION CVs

## CV39

### F6 Output Function Definition

#### *Description*

Selects Which Function(s) F6 Activates

#### *Values*

0 to 255

#### *Initial Value*

7 (Diesel Ramp Down/Startup)

#### *Related CVs*

CV33—CV61; [CV137](#), [CV193—CV202](#)

Bit 7

Bit 0

0	0	0	0	0	1	1	1
---	---	---	---	---	---	---	---

Repeated pressings of this function key may ramp the diesel locomotive down. If the locomotive throttle is lower than the rev level, one press will ramp the locomotive down to the throttle setting rev level. The locomotive must be moving before this function is allowed. If the locomotive is stopped and the sounds are off, the sound unit is activated.

See [DCC Rev Up/Down Control](#).





# FUNCTION CVs

## CV40

### F7 Output Function Definition

#### *Description*

Selects Which Function(s) F7 Activates

#### *Values*

0 to 255

#### *Initial Value*

21 (Smoke Unit Control/L1 Visual Effects)

#### *Related CVs*

CV33—CV61; [CV246](#)

Bit 7

Bit 0

0	0	0	1	0	1	0	1
---	---	---	---	---	---	---	---

Repeated pressing of this function key toggles the Smoke Unit on and off for Locomotives that have Smoke Units. If the Locomotive has no smoke unit, then this function key toggles the L1 Visual Effects on and off.



# FUNCTION CVs

## CV41

### F8 Output Function Definition

#### *Description*

Selects Which Function(s) F8 Activates

#### *Values*

0 to 255

#### *Initial Value*

9 (Mute/Volume Control)

#### *Related CVs*

CV33—CV61; [CV130 – CV134](#)

Bit 7

Bit 0

0	0	0	0	1	0	0	1
---	---	---	---	---	---	---	---

Pressing this function once mutes the volume and reverses the volume control direction. Double pressings of this function cause the volume to either increase or decrease by a factor of step size (CV130).



# FUNCTION CVs

## CV42

### F9 Output Function Definition

#### *Description*

Selects Which Function(s) F9 Activates

#### *Values*

0 to 255

#### *Initial Value*

10 (Startup/Shutdown Locomotive)

#### *Related CVs*

CV33—CV61; [CV137](#), [CV245](#)

Bit 7

Bit 0

0	0	0	0	1	0	1	0
---	---	---	---	---	---	---	---

Pressing this function, if the locomotive is silent, enables the audio. The startup sounds plays if enabled (CV245). Pressing this function if the sound unit is active and if the locomotive is stopped (brake set), the shutdown sound will play and then the sound unit deactivates.



# FUNCTION CVs

## CV43

### F10 Output Function Definition

*Description*

Selects Which Function(s) F10 Activates

*Values*

0 to 255

*Initial Value*

11 (Radiator-Cooling Fan Audio Effect)

*Related CVs*

CV33—CV61; [CV149](#)

Bit 7

Bit 0

0	0	0	0	1	0	1	1
---	---	---	---	---	---	---	---

Pressing this function toggles the radiator-cooling fan on and off.



# FUNCTION CVs

## CV44

### F11 Output Function Definition

#### *Description*

Selects Which Function(s) F11 Activates

#### *Values*

0 to 255

#### *Initial Value*

12 (Air Release and Air Filling Audio Effects)

#### *Related CVs*

CV33—CV61; [CV144](#), [CV145](#)

Bit 7

Bit 0

0	0	0	0	1	1	0	0
---	---	---	---	---	---	---	---

Pressing this function when the locomotive is stopped plays the air filling sound effects while pressing this function when the locomotive is moving plays the air release sound effects.



# FUNCTION CVs

## CV45

### F12 Output Function Definition

#### *Description*

Selects Which Function(s) F12 Activates

#### *Values*

0 to 255

#### *Initial Value*

13 (Brake Set/Release)

#### *Related CVs*

CV33—CV61; [CV146](#), [CV147](#), [CV191](#), [CV192](#), [CV209](#), [CV210](#), [CV227](#)

Bit 7

Bit 0

0	0	0	0	1	1	0	1
---	---	---	---	---	---	---	---

Pressing this function when the locomotive is stopped plays the brake set sound effects while pressing this function when the locomotive is moving below throttle stop 5 plays the brake release sound effects.



# FUNCTION CVs

## CV46

### F13 Output Function Definition

#### *Description*

Selects Which Function(s) F13 Activates

#### *Values*

0 to 255

#### *Initial Value*

30 (Horn Grade Crossing Sound)

#### *Related CVs*

CV33—CV61; [CV224](#)

Bit 7

Bit 0

0	0	0	1	1	1	1	0
---	---	---	---	---	---	---	---

Pressing this function activates the grade crossing warning signal. The currently selected whistle is used (See CV224). This signal sequence is as follows:

Long whistle

Long whistle

Short whistle

Long whistle



# FUNCTION CVs

## CV47

### F14 Output Function Definition

#### *Description*

Selects Which Function(s) F14 Activates

#### *Values*

0 to 255

#### *Initial Value*

50 (Station Sounds)

#### *Related CVs*

CV33—CV61, [CV153](#)

Bit 7

Bit 0

0	0	1	1	0	0	1	0
---	---	---	---	---	---	---	---

Pressing this function activates the Station Sounds. See Station Sounds under the Enhanced Sounds Section. CV153 sets the volume for this sound effect.





# FUNCTION CVs

## CV48

### F15 Output Function Definition

#### *Description*

Selects Which Function(s) F15 Activates

#### *Values*

0 to 255

#### *Initial Value*

51 (Yard Sounds)

#### *Related CVs*

CV33—CV61, [CV153](#)

Bit 7

Bit 0

0	0	1	1	0	0	1	1
---	---	---	---	---	---	---	---

Pressing this function activates the Yard Sounds. See Yard Sounds under the Enhanced Sounds Section. CV153 sets the volume for this sound effect.



# FUNCTION CVs

## CV49

### F16 Output Function Definition

#### *Description*

Selects Which Function(s) F16 Activates

#### *Values*

0 to 255

#### *Initial Value*

52 (Maintenance Sounds)

#### *Related CVs*

CV33—CV61; [CV155](#)

Bit 7

Bit 0

0	0	1	1	0	1	0	0
---	---	---	---	---	---	---	---

Pressing this function activates a random Maintenance Sound.  
CV155 sets the volume for this sound effect.



# FUNCTION CVs

## CV50

### F17 Output Function Definition

#### *Description*

Selects Which Function(s) F17 Activates

#### *Values*

0 to 255

#### *Initial Value*

53 (Radio Chatter Sounds)

#### *Related CVs*

CV33—CV61; [CV155](#)

Bit 7

Bit 0

0	0	1	1	0	1	0	1
---	---	---	---	---	---	---	---

Pressing this function activates a random Radio Chatter Sound.  
CV155 sets the volume for this sound effect.



# FUNCTION CVs

## CV51

### F18 Output Function Definition

#### *Description*

Selects Which Function(s) F18 Activates

#### *Values*

0 to 255

#### *Initial Value*

54 (City Sounds)

#### *Related CVs*

CV33—CV61; [CV156](#)

Bit 7

Bit 0

0	0	1	1	0	1	1	0
---	---	---	---	---	---	---	---

Pressing this function activates a random City Sound. CV156 sets the volume for this sound effect.



# FUNCTION CVs

## CV52

### F19 Output Function Definition

#### *Description*

Selects Which Function(s) F19 Activates

#### *Values*

0 to 255

#### *Initial Value*

55 (Farm Sounds)

#### *Related CVs*

CV33—CV61; [CV156](#)

Bit 7

Bit 0

0	0	1	1	0	1	1	1
---	---	---	---	---	---	---	---

Pressing this function activates a random Farm Sound. CV156 sets the volume for this sound effect.



# FUNCTION CVs

## CV53

### F20 Output Function Definition

#### *Description*

Selects Which Function(s) F20 Activates

#### *Values*

0 to 255

#### *Initial Value*

56 (Industrial Sounds)

#### *Related CVs*

CV33—CV61; [CV156](#)

Bit 7

Bit 0

0	0	1	1	1	0	0	0
---	---	---	---	---	---	---	---

Pressing this function activates a random Industrial Sound. CV156 sets the volume for this sound effect.



# FUNCTION CVs

## CV54

### F21 Output Function Definition

#### *Description*

Selects Which Function(s) F21 Activates

#### *Values*

0 to 255

#### *Initial Value*

57 (Lumber Sounds)

#### *Related CVs*

CV33—CV61; [CV156](#)

Bit 7

Bit 0

0	0	1	1	1	0	0	1
---	---	---	---	---	---	---	---

Pressing this function activates a random Lumber Sound. CV156 sets the volume for this sound effect.



# FUNCTION CVs

## CV55

### F22 Output Function Definition

#### *Description*

Selects Which Function(s) F22 Activates

#### *Values*

0 to 255

#### *Initial Value*

19 (Horn2 Toggle)

#### *Related CVs*

CV33—CV61; [CV35](#)

Bit 7

Bit 0

0	0	0	1	0	0	1	1
---	---	---	---	---	---	---	---

This function toggles the horn F2 (default) between the primary horn and a secondary horn.





# FUNCTION CVs

## CV56

### F23 Output Function Definition

#### *Description*

Selects Which Function(s) F23 Activates

#### *Values*

0 to 255

#### *Initial Value*

31

#### *Related CVs*

CV33—CV61

Bit 7

Bit 0

0	0	1	1	0	0	0	1
---	---	---	---	---	---	---	---

Repeated pressing of this function key toggles the Track Sounds Effects on and off.



# FUNCTION CVs

## CV57

### F24 Output Function Definition

#### *Description*

Selects Which Function(s) F24 Activates

#### *Values*

0 to 255

#### *Initial Value*

8

#### *Related CVs*

CV33—CV61

Bit 7

Bit 0

0	0	0	0	1	0	0	0
---	---	---	---	---	---	---	---

Repeated pressing of this function key toggles the L1 Visual Effects on and off.



# FUNCTION CVs

## CV58

### F25 Output Function Definition

#### *Description*

Selects Which Function(s) F25 Activates

#### *Values*

0 to 255

#### *Initial Value*

20

#### *Related CVs*

CV33—CV61

Bit 7

Bit 0

0	0	1	0	0	0	0	0
---	---	---	---	---	---	---	---

Pressing this function activates a pre-recorded horn. This horn will play through and stop.



# FUNCTION CVs

## CV59

### F26 Output Function Definition

#### *Description*

Selects Which Function(s) F26 Activates

#### *Values*

0 to 255

#### *Initial Value*

40 (Play Macro)

#### *Related CVs*

CV33—CV61; [CV238](#)

Bit 7

Bit 0

0	0	1	0	1	0	0	0
---	---	---	---	---	---	---	---

This function plays the recorded locomotive actions. See CV238 for a further explanation on recording and playing back a macro.



# FUNCTION CVs

## CV60

### F27 Output Function Definition

#### *Description*

Selects Which Function(s) F27 Activates

#### *Values*

0 to 255

#### *Initial Value*

41 (Record Macro)

#### *Related CVs*

CV33—CV61; [CV238](#)

Bit 7

Bit 0

0	0	1	0	1	0	0	1
---	---	---	---	---	---	---	---

This function records the locomotive actions over a period of time. See CV238 for a further explanation on recording and playing back a macro.



# FUNCTION CVs

## CV61

### F28 Output Function Definition

#### *Description*

Selects Which Function(s) F28 Activates

#### *Values*

0 to 255

#### *Initial Value*

18 (Brake Squeal)

#### *Related CVs*

CV33—CV61; [CV151](#), [CV184](#), [CV185](#), [CV186](#), [CV227](#)

Bit 7

Bit 0

0	0	0	1	0	0	1	0
---	---	---	---	---	---	---	---

Pressing this function activates the Brake Squeal Sound Effect. CV151 sets the volume for this sound effect. CV184, CV185 and CV186 control how the brake squeal is triggered and CV227 allows disabling the automatic brake squeal. The sound will continue to play while the locomotive slows down. Pressing F28 or moving the throttle deactivates the effect.



# SYSTEM CVs

## CV65

### Kick-Start

#### *Description*

This Value Allows Additional Motor Power to Overcome Initial Inertia at Locomotive Starts

#### *Values*

0-255

#### *Initial Value*

40

#### *Related CVs*

[CV2](#), [CV10](#)

Bit 7

Bit 0

0	0	1	0	1	0	0	0
---	---	---	---	---	---	---	---

The kick-start is only enabled when the backemf is disabled. See CV10 on backemf disabling. The kick-start value is added to the motor power startup voltage (CV2) for a short duration of time and only during the transition from speed step zero to speed step one. The kick start value is decreased from its initial value slowly to zero, allowing a smoother operation.



# SYSTEM CVs

## CV66

### Forward Trim

#### *Description*

A Value that Permits Fine Changes to Match Forward and Reverse Speed Variances

#### *Values*

0-255

#### *Initial Value*

0

#### *Related CVs*

[CV2](#), [CV5](#), [CV6](#), [CV67—CV94](#), [CV95](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The forward trim allows an adjustment to the overall forward speed for consist matching, etc. The value is scalar in nature, that is, it is multiplied by the desired output speed. The output speed is determined as follows:

$$CV66 \div 128 \times (\text{output speed})$$

A value less than 128 scales down, a value greater the 128 scales up. So, if CV66=16 than the speed will be multiplied by 0.125 for a 12.5% reduction. Likewise, if CV66=160 then the speed will be multiplied by 1.25 for a 125% increase. A value of 0 disables CV66 computation. CV66 is used on the 3 point as well as the speed table for speed computations.





# SYSTEM CVs

## CV67—CV94 Speed Table

### *Description*

28 Value Speed Table

### *Values*

0-255

### *Initial Value*

See Below

### *Related CVs*

[CV3](#), [CV4](#), [CV23](#), [CV24](#), [CV66](#), [CV95](#), [CV120](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The speed table is selected if CV29 bit4=1. This speed table functions for 14, 28 and 126 speed step modes. Each table value represents motor speed where 0 is off and 255 is maximum. Each ascending value from CV67 must be a larger value than the previous. For 14 speed steps every other value is used starting with CV67. For 28 speed steps, every value is used and 126 speed step; interpolation between the points is used.



# SYSTEM CVs

## CV67—CV94 Speed Table

Default Table:

CV67	6
CV68	16
CV69	24
CV70	34
CV71	42
CV72	52
CV73	60
CV74	70
CV75	78
CV76	89
CV77	97
CV78	107
CV79	115
CV80	125
CV81	133
CV82	143
CV83	151
CV84	161
CV85	169
CV86	180
CV87	188
CV88	198
CV89	206
CV90	216
CV91	225
CV92	235
CV93	245
CV94	255



# SYSTEM CVs

## CV95

### Reverse Trim

#### *Description*

A Value that Permits Fine Changes to Match Forward and Reverse Speed Variances

#### *Values*

0-255

#### *Initial Value*

0

#### *Related CVs*

[CV2](#), [CV5](#), [CV6](#), [CV66—CV94](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The reverse trim allows an adjustment to the overall reverse speed for consist matching, etc. The value is scalar in nature, that is, it is multiplied by the desired output speed. The output speed is determined as follows:

$$CV66 \div 128 \times (\text{output speed})$$

A value less than 128 scales down, a value greater the 128 scales up. So, if CV95=16 than the speed will be multiplied by 0.125 for a 12.5% reduction. Likewise, if CV95=160 then the speed will be multiplied by 1.25 for a 125% increase. A value of 0 disables CV95 computation. CV95 is used on the 3-point as well as the speed table for speed computations.



# SYSTEM CVs

## CV112-113

### K<sub>p</sub>

#### *Description*

The Proportional Gain of the Motor Controller

#### *Values*

0-32767

#### *Initial Value*

CV113=32; CV112=0

#### *Related CVs*

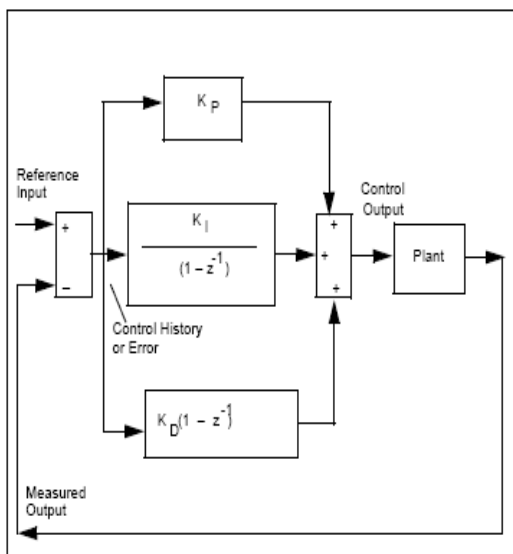
[CV114–CV120](#)

Bit 7

Bit 0

X	X	X	X	X	X	X	X
---	---	---	---	---	---	---	---

CV113 is the MSB while CV112 is the LSB representing the PID controller's proportional gain.





# SYSTEM CVs

## CV114-115

### Ki

#### *Description*

The Integral Gain of the Motor Controller

#### *Values*

0-32767

#### *Initial Value*

CV115=1; CV114=50

#### *Related CVs*

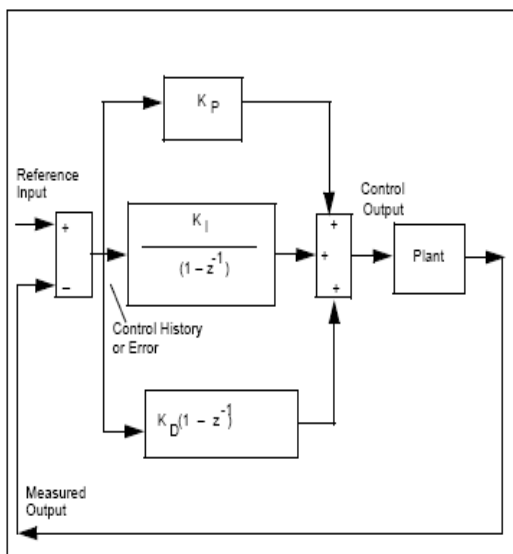
[CV112–CV120](#)

Bit 7

Bit 0

X	X	X	X	X	X	X	X
---	---	---	---	---	---	---	---

CV115 is the MSB while CV114 is the LSB representing the PID controller's integral gain.





# SYSTEM CVs

## CV116-117

### Kd

#### Description

The Derivative Gain of the Motor Controller

#### Values

0-32767

#### Initial Value

CV117=0; CV116=0

#### Related CVs

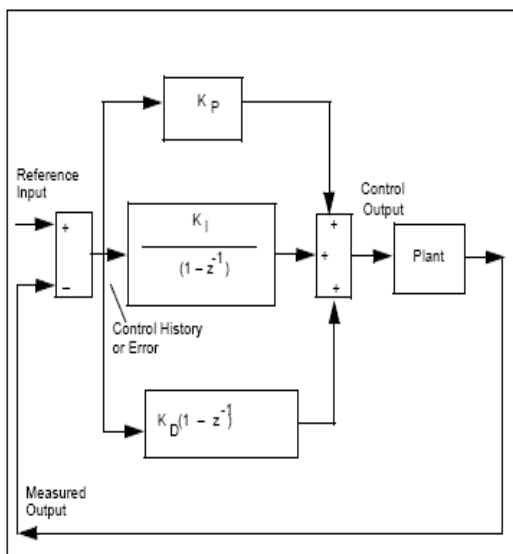
[CV112–CV120](#)

Bit 7

Bit 0

X	X	X	X	X	X	X	X
---	---	---	---	---	---	---	---

CV117 is the MSB while CV116 is the LSB representing the PID controllers proportional gain.





# SYSTEM CVs

## CV118

### KpSlow

#### *Description*

The Slow Speed Proportional Gain of the Motor Controller

#### *Values*

0-255

#### *Initial Value*

20

#### *Related CVs*

[CV112–CV120](#)

Bit 7

Bit 0

0	0	0	1	0	1	0	0
---	---	---	---	---	---	---	---

This value allows the locomotive to creep at very slow speeds. Increasing this value increases the added torque at these very slow speeds. Setting this value to zero disables the slow speed algorithm and may cause the slow speed to become jerky or not run at all.



# SYSTEM CVs

## CV120

### Speed Step Smoothing

#### *Description*

This Value Controls a Smoothing Routine Designed to Interpolate Motor Speeds in Between Large Changes

#### *Values*

1-255

#### *Initial Value*

25

#### *Related CVs*

[CV3](#), [CV4](#), [CV245](#)

Bit 7

Bit 0

0	0	0	1	1	0	0	1
---	---	---	---	---	---	---	---

Changing speed steps with backemf enabled creates a quick, fast change of speed, which is not smooth. This parameter allows interpolation between the speed steps, creating a very smooth effect. This effect also adds momentum. It is recommended that CV3 and CV4 be disabled while setting this feature. If additional momentum is still needed, than adjust CV3 and CV4 as needed. A lower value for CV120 creates a smoother change, but adds momentum. This CV only functions in all speed step modes, DC as well as DCC. CV245 bit 5 may be cleared to disable Speed Step Smoothing.





# SYSTEM CVs

## CV121

### Consist Functions Type 2

#### *Description*

Determines Which Functions ([F13-F20](#)) are Allowed in the Consist

#### *Values*

0-255

#### *Initial Value*

255

#### *Related CVs*

[CV19](#), [CV21](#), [CV22](#), [CV122](#), [CV229](#)

Bit 7

Bit 0

F20	F19	F18	F17	F16	F15	F14	F13
-----	-----	-----	-----	-----	-----	-----	-----

The decoder responds to all functions that have a “1” set in this CV once a consist is configured. A consist is configured by [CV19](#) programmed to a value from 1-127. A value of 0 breaks the consist. See [CV19](#). This CV is used to configure the engine for a front, middle or end in the consist.

An example for consist number 60:

CV19=60

Front Engine	CV21=255	CV22=255	CV121=255	CV122=255	CV229=246
Middle Engine	CV21=176	CV22=5	CV121=0	CV122=96	CV229=0
Rear engine	CV21=176	CV22=5	CV121=0	CV122=96	CV229=2

[See Consist Synopsis.](#)

Bit 7:	0=F20 Disabled 1=F20 Enabled
Bit 6:	0=F19 Disabled 1=F19 Enabled
Bit 5:	0=F18 Disabled 1=F18 Enabled
Bit 4:	0=F17 Disabled 1=F17 Enabled
Bit 3:	0=F16 Disabled 1=F16 Enabled
Bit 2:	0=F15 Disabled 1=F15 Enabled
Bit 1:	0=F14 Disabled 1=F14 Enabled
Bit 0:	0=F13 Disabled 1=F13 Enabled



# SYSTEM CVs

## CV122

### Consist Functions Type 3

#### *Description*

Determines Which Functions ([F21-F28](#)) are allowed in the Consist

#### *Values*

0-255

#### *Initial Value*

255

#### *Related CVs*

[CV19](#), [CV21](#), [CV22](#), [CV121](#), [CV229](#)

Bit 7

Bit 0

F28	F27	F26	F25	F24	F23	F22	F21
-----	-----	-----	-----	-----	-----	-----	-----

The decoder responds to all functions that have a “1” set in this CV once a consist is configured. A consist is configured by CV19 programmed to a value from 1-127. A value of 0 breaks the consist. See CV19. This CV is used to configure the engine for a front, middle or end in the consist.

An example for consist number 60:

CV19=60

Front Engine CV21=255 CV22=255 CV121=255 CV122=255 CV229=246

Middle Engine CV21=176 CV22=5 CV121=0 CV122=96 CV229=0

Rear engine CV21=176 CV22=5 CV121=0 CV122=96 CV229=2

[See Consist Synopsis.](#)

Bit 7:	0=F28 Disabled 1=F28 Enabled
Bit 6:	0=F27 Disabled 1=F27 Enabled
Bit 5:	0=F26 Disabled 1=F26 Enabled
Bit 4:	0=F25 Disabled 1=F25 Enabled
Bit 3:	0=F24 Disabled 1=F24 Enabled
Bit 2:	0=F23 Disabled 1=F23 Enabled
Bit 1:	0=F22 Disabled 1=F22 Enabled
Bit 0:	0=F21 Disabled 1=F21 Enabled



# SOUND CVs

## CV130

### Master Volume Sound Increment

#### *Description*

This Value is the Increment/Decrement Amount for Master Volume Values

0 to 255

#### *Initial Value*

16

#### *Related CVs*

[CV41](#), [CV133](#), [CV134](#)

Bit 7

Bit 0

0	0	0	1	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's analog potentiometer (volume control) increases or decreases the volume of the sound. The change between the 255 available steps may be set from 0 to 255. Every press of the volume toggle switch will result in a volume change incrementing or decrementing by this value.



# SOUND CVs

## CV131

### DC Sound Unit Startup (Turn-On) Voltage

#### *Description*

This Value Sets the Decoders DC Sound Turn-On Voltage

#### *Values*

0 to 255

#### *Initial Value*

72

#### *Related CVs*

[CV130](#), [CV132](#), [CV133](#), [CV134](#)

Bit 7

Bit 0

0	1	0	0	1	0	0	0
---	---	---	---	---	---	---	---

The sound unit has a minimum power requirement necessary to play all sound effects. Many factors contribute to what the necessary voltage is such as the power source, the startup volume (CV133) and system loading. Lowering this value will instruct the sound unit to start the audio effects at a lower voltage.

**Note:** Care should be taken with this value. Lowering this value too low will result in the unit not being able to function at all. If this occurs, set this value to a larger number or the initial value and reprogram the value in service mode.



# SOUND CVs

## CV132

### DC Sound Unit Shutdown (Turn-Off) Voltage

#### *Description*

This Value Sets the Decoders DC Sound Turn-Off Voltage

#### *Values*

0 to 255

#### *Initial Value*

58

#### *Related CVs*

[CV130](#), [CV131](#), [CV133](#), [CV134](#)

Bit 7

Bit 0

0	0	1	1	1	0	1	0
---	---	---	---	---	---	---	---

The sound unit is instructed to play the shutdown effect and turn off all effects at this value. The shutdown effect only plays from the idle condition. Many factors contribute to what this actual voltage is such as the power source, system volume, individual volumes (CV133, CV135—CV156) and system loading. Lowering this value will instruct the sound unit to play the shutdown effect at a lower voltage.

**Note:** Care should be taken with this value. Lowering this value too low will result in the unit not being able to play the shutdown effect and terminate all effects properly. The sound unit could abruptly shut off. If this occurs, set this value to a larger number or the initial value.



# SOUND CVs

## CV133

### Sound Unit Master Volume

#### *Description*

This Value Sets the Power Up Master Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV130](#), [CV134](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's digital volume control increases or decreases the volume of the sound. The change between the 255 available steps may be set from 0 to 255 (**CV130**). Every press of the volume toggle switch will result in a volume change incrementing or decrementing by the value in CV130. This value (CV133) is the decoder's power up value. A higher value increases the volume while a lower value decreases the volume.





# SOUND CVs

## CV134

### Sound Unit Maximum Volume

#### *Description*

This Value Sets the Maximum Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV130](#), [CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's digital volume control increases or decreases the volume of the sound. The change between the 255 available steps may be set from 0 to 255 (**CV130**). Every press of the volume toggle switch will result in a volume change incrementing or decrementing by the value in CV130. This value (CV134) is the decoder's maximum allowed value. A higher value allows a louder volume while a lower value allows a quieter volume. Note that the initial value sets the volume at 100%. Increasing this value allows the unit to be overdriven and distortion may be heard.



# SOUND CVs

## CV135

### Horn Volume

#### *Description*

This Value Controls the Horn Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV35](#), [CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's horn sound effect volume is variable from 0 to 255. A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV136

### Bell Volume

#### *Description*

This Value Controls the Bell Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV34](#), [CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's bell sound effect volume is variable from 0 to 255. A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV137

### Diesel Volume

#### *Description*

This Value Controls the Startup, Rev Levels and Shutdown Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's diesel engine sound effect volume is variable from 0 to 255. A higher value increases the volume while a lower value decreases the volume. This value controls a group of sounds: diesel startup, diesel rev levels and diesel shutdown sound effects.



# SOUND CVs

## CV138

### Horn2 Volume

#### *Description*

This Value Controls the Horn2 Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's horn2 sound effect volume is variable from 0 to 255. A higher value increases the volume while a lower value decreases the volume. **Note: This sound effect is not used in all locomotives.**



# SOUND CVs

## CV139

### Couple Slack Volume

#### *Description*

This Value Controls the Couple Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV178](#), [CV179](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's couple slack sound effect volume is variable from 0 to 255. The couple sound effect arms when the locomotive is not moving and the function is pressed. Once armed, the sound effect plays once the locomotive starts moving. The amount of coupler slack sounds played is determined by CV178 while the time between the sounds is determined by CV179. A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV140

### Couple Volume

#### *Description*

This Value Controls the Couple Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's couple sound effect volume is variable from 0 to 255. The couple sound effect only plays if the engine is moving and the function is pressed. A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV141

### Uncouple Volume

#### *Description*

This Value Controls the Uncouple Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's uncouple sound effect volume is variable from 0 to 255. The uncouple sound effect plays once after it is armed. The process of arming is: press the function with engine stopped, upon engine moving the uncouple sound effect plays. A higher value increases the volume while a lower value decreases the volume.





# SOUND CVs

## CV142

### Wheel Flange Volume

#### *Description*

This Value Controls the Wheel Flange Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's wheel flange sound effect volume is variable from 0 to 255. The wheel flange sound effect only plays if the engine is moving and is also a random sound effect when moving. A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV143

### Compressor Volume

#### *Description*

This Value Controls the Compressor Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's compressor sound effect volume is variable from 0 to 255. The compressor sound effect only plays if the engine is stopped. This sound effect is also a random sound effect when stopped. A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV144

### Manual Air Release Volume

#### *Description*

This Value Controls the Manual Air Release Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's manual air release sound effect volume is variable from 0 to 255. This sound effect is also a random sound effect when stopped. A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV145

### Air Filling Volume

#### *Description*

This Value Controls the Air Filling Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's air filling sound effect volume is variable from 0 to 255. The air filling sound effect only plays if the engine is stopped. This sound effect is also a random sound effect when stopped. A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV146

### Brake Set Volume

#### *Description*

This Value Controls the Brake Set Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#), [CV191](#), [CV209](#), [CV227](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's brake set sound effect volume is variable from 0 to 255. The brake set sound effect only plays if the track voltage falls below the analog brake set voltage (CV191) for analog mode or pressing the Function for DCC. In DCC mode the brake set effect plays when the current speed step matches or is lower than the DCC Brake Set Throttle Stop (CV209). A higher value increases the volume while a lower value decreases the volume. CV227 bit 0 enables or disables this effect.



# SOUND CVs

## CV147

### Brake Release Volume

#### *Description*

This Value Controls the Brake Release Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#), [CV192](#), [CV210](#), [CV227](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's brake release sound effect volume is variable from 0 to 255. The brake release sound effect only plays if the track voltage is increased above the analog brake set voltage (CV192) for analog mode or pressing the Function for DCC. In DCC mode the brake release effect plays when the current speed step matches or is higher than the DCC Brake Release Throttle Stop (CV210). A higher value increases the volume while a lower value decreases the volume. CV227 bit 0 enables or disables this effect.



# SOUND CVs

## CV148

### Spit Valve Volume

#### *Description*

This Value Controls the Spit Valve Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's spit valve sound effect volume is variable from 0 to 255. The spit valve sound effect is a random sound that only plays when the engine is stopped. A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV149

### Radiator Cooling Volume

#### *Description*

This Value Controls the Radiator Cooling Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's radiator cooling sound effect volume is variable from 0 to 255. The radiator cooling sound effect plays if the Function is on. This sound effect is also a random sound effect when the engine is stopped. A higher value increases the volume while a lower value decreases the volume.





# SOUND CVs

## CV150

### Grid Blower Motor Volume

#### *Description*

This Value Controls the Grid Blower Motor Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV37](#), [CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's grid blower motor sound effect volume is variable from 0 to 255. The grid blower motor sound effect plays if the Function is on when the engine is moving. A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV151

### Brakes Squeal Volume

#### *Description*

This Value Controls the Brakes Squeal Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV184](#), [CV185](#), [CV133](#), [CV227](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's brake squeal sound effect volume is variable from 0 to 255. In analog and DCC mode, the brakes squeal sound effect plays if the change in track voltage (analog mode [CV184]) or the speed steps (DCC Mode [CV185]) exceeds the preset threshold. The brakes squeal sound effect plays if the Function is enabled (CV227). A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV152

### Fuel Fill Volume

#### *Description*

This Value Controls the Fuel Fill Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's fuel fill sound effect volume is variable from 0 to 255. The fuel fill sound effect plays once at a random time after the engine becomes stopped from a moving condition. A higher value increases the volume while a lower value decreases the volume.



# SOUND CVs

## CV153

### Station/Yard Volume

#### *Description*

This Value Controls the Station and Yard Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's station and yard sound effect volume is variable from 0 to 255. See Enhanced Sounds. A higher value increases the volume while a lower value decreases the volume.

See [Station Sounds](#).



# SOUND CVs

## CV155

### Maintenance/Radio Chatter Volume

#### *Description*

This Value Controls the Maintenance and Radio Chatter Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's maintenance and radio chatter sound effect volume is variable from 0 to 255. These effects plays ever time the defined function key is pressed. The sound effect is randomly selected between 1 of 4 sound effects. A higher value increases the volume while a lower value decreases the volume.

See [Yard Sounds](#).



# SOUND CVs

## CV156

### City/Farm/Industrial/Lumber Volume

#### *Description*

This Value Controls the Fuel Fill Sound Effects Volume

#### *Values*

0 to 255

#### *Initial Value*

128

#### *Related CVs*

[CV133](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's city, farm, industrial and lumber sound effect volume is variable from 0 to 255. These effects plays ever time the defined function key is pressed. The sound effect is randomly selected between 1 of 4 sound effects. A higher value increases the volume while a lower value decreases the volume.



# Lighting CVs

## CV159

### System Lighting

#### *Description*

This Value Controls System Lighting Functions

#### *Values*

0-255

#### *Initial Value*

2

#### *Related CVs*

[CV231](#)

Bit 7

Bit 0

0	0	0	0	0	0	1	0
---	---	---	---	---	---	---	---

The decoder's visual lighting effects for the front and rear light are configured here. Rule 17 lighting may be enabled or disabled by writing a "0" or a "1" to Value.

### **Rule 17 Lighting**

Rule 17 Lighting says "Headlights shall be dimmed when standing at stations or waiting on side tracks for an oncoming train". When rule 17 lighting is enabled, the headlight will be noticeable dimmed at appropriately times.

### DCC Rule 17 Lighting

For DC operators, the lights will dim per rule 17 when the brake set sound effect plays ([CV209](#)). The lights will return to normal brightness when the brake release sound plays ([CV210](#)). In addition, [CV227](#) allows for disabling the brake set and brake release. Disabling these automatic effects does not disable rule 17 lighting. Only CV159 can disable rule 17 lighting. If the brake set/release sounds are disabled, than throttle zero activates this lighting feature and throttle greater than zero deactivates this feature.

### DC Rule 17 Lighting

For DC operators, the lights will dim per rule 17 when the brake set sound effect plays ([CV191](#)). The lights will return to normal brightness when the brake release sound plays ([CV192](#)). If the brake set/release sounds are disabled, than throttle zero activates this lighting feature and throttle greater than zero deactivates this feature.

**Note:** If an [Fx key](#) is defined for Rule 17 control, CV159 Bit 0 **MUST** be disabled.

Bit7:	Not used
Bit6:	0=L5 Active Low; 1=Active High
Bit5:	0=L4 Active Low; 1=Active High
Bit4:	Not used
Bit3:	0=L4/L5 Power-Up On
Bit2:	0=L1/Headlight Power-Up On 1=L1/Headlight Power-Up Off
Bit1:	L1 Inactive State 0=Off (Ditch Lights Off) 1=50% Duty Cycle On (Ditch Lights On)
Bit0:	0= Rule 17 Lighting Enabled 1= Rule 17 Lighting Disabled





# Lighting CVs

## CV160

### L1 Light Definition

#### *Description*

This Value Sets the Function Type and Definition for Output L1

#### *Values*

0 to 3

#### *Initial Value*

131

#### *Related CVs*

[CV161](#), [CV162](#), [CV163](#), [CV164](#), [CV225](#)

Bit 7

Bit 0

1	0	0	0	0	0	1	1
---	---	---	---	---	---	---	---

The decoder's visual lighting effects for L1 output may be one of three types. Each defined type then uses 2 to 4 of the next 4 CV's allowing uses definition of all the parameters. **CV225 (bit 1)** must be configured to enable L1. Additionally, CV225 may be set so the horn or bell activates L1 for ditch lights. CV226 permits L1 activation by the horn or bell for ditch lights. The ditch lights may be type 1, 2 or 3. CV160 bits 6 and 7 permit directional control for ditch lights.

Bit7:        0=Not Directional  
              1=Directional

Bit6:        0=Active Forward  
              1=Active Reverse

Bit5-Bit0:   Type (0-3)

**Type 0:** Output is disabled.

**Type 1:** Duty Cycle Strobe. CV161 defines the on time and CV162 defines the off time. Time is measured in 1/32 seconds per count.



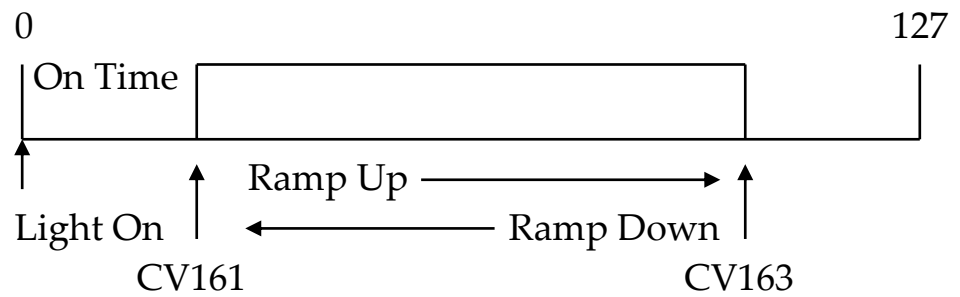
Example: CV160=1  
CV161=32 for 1 second on  
CV162=64 for 2 seconds off

**Type 2:** Double Pulsed Duty Cycle Strobe. CV161 defines the on time one; CV162 defines off time one; CV163 defines on time two; CV164 defines off time two. Time is measured in 1/32 seconds per count.



Example: CV160=2  
CV161=8 for .25 seconds for on time one  
CV162=16 for .5 seconds for off time one  
CV163=16 for .5 seconds for on time two  
CV164=64 for 2 seconds for off time two

**Type 3:** Ramped Duty Cycle. CV161 defines the start of the on time within the period; CV162 defines the ramp up time; CV163 defines the end of the on time within the period; CV164 defines the ramp down time. The period is 127 counts.  $CV161 < CV163$  and both should be less than 128. CV162 and CV164 can be any range from 0 to 255.



The time between 0 and CV161 represents the total time the light is turned on over one period. The actual period time (0 to 127) is 11.6ms. CV162 is a ramp up timer determining how many periods elapse before the On Time is increased by one. Once CV161 increases to CV163 value, the ramp down begins. CV164 is a ramp down timer determining how many periods elapse before the On Time is decreases by one. Once CV163 decreases to CV161, the ramp up cycle repeats, etc. CV162 and CV164 increment/decrement at 90.7usec per count.

Soft Strobe Example: CV160=3; CV161=10  
CV162=100; CV163=127  
CV164=100

Ditch Light Example: CV160=131; CV161=0  
CV162=40; CV163=130  
CV164=40

Gyro Light Example: CV160=3; CV161=0  
CV162=50; CV163=130  
CV164=50



# Lighting CVs

## CV161

### L1 Parameter One

#### *Description*

This Value is a Light Parameter, Dependant on CV160

#### *Values*

Dependant on Type

#### *Initial Value*

0

#### *Related CVs*

[CV160](#), [CV162](#), [CV163](#), [CV164](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

Type 0: Not Used

Type1: Sets the On Time; Valid Values 0-255

Type2: Sets On Time One; Valid Values 0-255

Type3: Sets the Start Point for Power On; Valid Values 0-255  
CV161<CV163



# Lighting CVs

## CV162

### L1 Parameter Two

#### *Description*

This Value is a Light Parameter, Dependant on CV160

#### *Values*

Dependant on Type

#### *Initial Value*

30

#### *Related CVs*

[CV160](#), [CV161](#), [CV163](#), [CV164](#)

Bit 7

Bit 0

0	0	0	1	1	1	1	0
---	---	---	---	---	---	---	---

Type 0: Not Used

Type1: Sets the Off Time; Valid Values 0-255

Type2: Sets Off Time One; Valid Values 0-255

Type3: Sets the Ramp Up Time; Valid Values 0-255  
Time measured in 90.7us per count



# Lighting CVs

## CV163

### L1 Parameter Three

#### *Description*

This Value is a Light Parameter, Dependant on CV160

#### *Values*

Dependant on Type

#### *Initial Value*

180

#### *Related CVs*

[CV160](#), [CV161](#), [CV162](#), [CV164](#)

Bit 7

Bit 0

1	0	1	1	0	1	0	0
---	---	---	---	---	---	---	---

Type 0: Not Used

Type1: Not Used

Type2: Sets On Time Two; Valid Values 0-255

Type3: Sets the End Point for Power On; Valid Values 0-255  
CV163>CV161



# Lighting CVs

## CV164

### L1 Parameter Four

#### *Description*

This Value is a Light Parameter, Dependant on CV160

#### *Values*

Dependant on Type

#### *Initial Value*

30

#### *Related CVs*

[CV160](#), [CV161](#), [CV162](#), [CV163](#)

Bit 7

Bit 0

0	0	0	1	1	1	1	0
---	---	---	---	---	---	---	---

Type 0: Not Used

Type1: Not Used

Type2: Sets Off Time Two; Valid Values 0-255

Type3: Sets the Ramp Down Time; Valid Values 0-255  
Time measured in 90.7us per count



# SETUP CVs

## CV176

### Fatal OverCurrent Configuration

#### *Description*

This Value Configures the Fatal Overcurrent Protection

#### *Values*

0-255

#### *Initial Value*

114

#### *Related CVs*

[CV177](#), [CV247](#)

Bit 7

Bit 0

0	1	1	1	0	0	1	0
---	---	---	---	---	---	---	---

This value determines the internal references, multiplies and comparator selection. **DO NOT CHANGE.**





## SETUP CVs

### CV177

#### Fatal OverCurrent Sensitivity

##### *Description*

This Value Sets the Fatal Overcurrent Sensitivity

##### *Values*

0-255

##### *Initial Value*

120

##### *Related CVs*

[CV176](#), [CV247](#)

Bit 7

Bit 0

0	1	1	1	1	0	0	0
---	---	---	---	---	---	---	---

This value determines how sensitive or not the over current circuit is. Increasing this value decreases the sensitivity. If this value is too high, the locomotive may be unprotected if a short occurs in the motor or motor wiring connections.



## SETUP CVs

### CV178

#### Coupler Slack Repeats

##### *Description*

This Value Determines the Quantity of Coupler Slack Effects Played

##### *Values*

0-255

##### *Initial Value*

1

##### *Related CVs*

[CV36](#), [CV139](#), [CV179](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	1
---	---	---	---	---	---	---	---

This value determines the quantity of effects that play and allows the user to customize based on the amount of attached cars. Increasing this value will increase the amount of coupler effects played.



# SETUP CVs

## CV179

### Coupler Slack Interval

#### *Description*

This Value Determines the Time Interval Between Coupler Slack Sound Effects

#### *Values*

0-255

#### *Initial Value*

100

#### *Related CVs*

[CV36](#), [CV139](#), [CV178](#)

Bit 7

Bit 0

0	1	1	0	0	1	0	0
---	---	---	---	---	---	---	---

The decoder's slack interval allows the user to customize the time duration between coupler slack effects. Increasing this value will increase the time between effects. This value is measured in .01 second per count.



## SETUP CVs

### CV180

#### Bell Ring Interval

##### *Description*

This Value Controls the Time Interval Between Bell Strikes

##### *Values*

0-128

##### *Initial Value*

Varies With Each Bell Sound Effect

##### *Related CVs*

[CV34](#)

Bit 7

Bit 0

D7	D6	D5	D4	D3	D2	D1	D0
----	----	----	----	----	----	----	----

The decoder's bell ring interval allows the user to customize the time duration between bell strikes. Increasing this value will increase the time between bell strikes. This value is updated in operations mode. Turn on the bell and change this value and hear the bell ring interval change.



## SETUP CVs

### CV184

#### DC Brake Control

##### *Description*

This Value Controls DC Brake Effect Activation

##### *Values*

0-255

##### *Initial Value*

20

##### *Related CVs*

[CV186](#), [CV227](#)

Bit 7

Bit 0

0	0	0	1	0	1	0	0
---	---	---	---	---	---	---	---

The decoder's brake squeal effect plays when a speed step threshold is met. The threshold is met when the speed step decreases fast enough to meet this threshold (CV184). Increasing this value decreases the brake sensitivity. Setting CV184 to 255 disables the brake squeal sound effect. Clearing bit1 of CV227 disables the brake squeal sound effect.



## SETUP CVs

### CV185

#### DCC Brake Control

##### *Description*

This Value Controls the DCC Brake Effect Activation

##### *Values*

0-255

##### *Initial Value*

20

##### *Related CVs*

[CV186](#), [CV227](#)

Bit 7

Bit 0

0	0	0	1	0	1	0	0
---	---	---	---	---	---	---	---

The decoder's brake squeal effect plays when a speed step threshold is met. The threshold is met when the speed step decreases fast enough to meet this threshold (CV185). Increasing this value decreases the brake sensitivity. Clearing bit1 of CV227 disables the brake squeal sound effect.



## SETUP CVs

### CV186

#### Brake Timer

##### *Description*

This Value Controls DCC and DC Brake Effect Activation

##### *Values*

0-255

##### *Initial Value*

3

##### *Related CVs*

[CV184](#), [CV185](#)

Bit 7

Bit 0

0	0	0	0	0	0	1	1
---	---	---	---	---	---	---	---

The decoder's brake squeal effect plays when a speed step threshold is met (CV184-CV185). The threshold is met when the speed step decreases fast enough to meet this threshold (CV184-CV185). This value determines when the current speed step is sampled.



## SETUP CVs

### CV187

#### DCC Uncouple Throttle Stop

##### *Description*

This Value Controls When the Uncouple Effect Plays

##### *Values*

0-255

##### *Initial Value*

3

##### *Related CVs*

Bit 7

Bit 0

0	0	0	0	0	0	1	1
---	---	---	---	---	---	---	---

The decode plays the uncouple sound effects at this value of throttle stop if the uncouple sound is armed. Arm the uncouple effects by activating the uncouple Function when the engine is stopped.





# SETUP CVs

## CV190

### DC Sound Setup

#### *Description*

This Value Contains Various DC Sound Setup Features

#### *Values*

0-255

#### *Initial Value*

1-7; 12

#### *Related CVs*

[CV131](#), [CV132](#), [CV191](#), [CV192](#)

Bit 7

Bit 0

D7	D6	D5	D4	D3	D2	D1	D0
----	----	----	----	----	----	----	----

This value is write Only. Prior to writing this value, use the DCMaster™ and save the desired track voltage. The voltage is saved by Muting the sounds, than Pressing AUX. The current track voltage is saved for later storage. Writing the following value to CV190 indicates where the saved voltage is applied.

<u>Value</u>	<u>What is saved</u>	<u>Destination of Saved Track Voltage</u>
4	Analog Brake Release Voltage	CV192
3	Analog Brake Set Voltage	CV191
2	Shut Down Voltage	CV132
1	Sound Start Up Voltage	CV131



## SETUP CVs

### CV191

#### DC Brake Set Voltage

##### *Description*

This Value Sets the DC Track Voltage for Brake Set Sound Effect

##### *Values*

0-255

##### *Initial Value*

70

##### *Related CVs*

[CV146](#), [CV190](#), [CV192](#)

Bit 7

Bit 0

0	1	0	0	0	1	1	0
---	---	---	---	---	---	---	---

The decoder's dc brake set sound effect is activated when the track voltage reaches this value. Increasing this value increases the track voltage threshold needed before the brake set sound effect plays.

**Note: This value must be lower than the analog brake release voltage CV192.**



## SETUP CVs

### CV192

#### DC Brake Release Voltage

##### *Description*

This Value Sets the DC Track Voltage for Brake Release Sound Effect

##### *Values*

0-255

##### *Initial Value*

77

##### *Related CVs*

[CV147](#), [CV190](#), [CV191](#)

Bit 7

Bit 0

0	1	0	0	1	1	0	1
---	---	---	---	---	---	---	---

The decoder's DC brake release sound effect is activated when the track voltage reaches this value. Increasing this value increases the track voltage threshold needed before the brake release sound effect plays. **Note: This value must be higher than the analog brake set voltage CV191.**



## SETUP CVs

### CV193

#### Rev Level One Motor Load Power

##### *Description*

This Value Sets the Motor Load Power Rev Level One Sound Effect

##### *Values*

0-255

##### *Initial Value*

105

##### *Related CVs*

[CV137](#), CV194—CV202

Bit 7

Bit 0

0	1	1	0	1	0	0	1
---	---	---	---	---	---	---	---

The decoder's rev level one sound effect is activated when the motor power exceeds this value or falls below the next rev level load power threshold. Increasing this value increases the power needed before the diesel changes to the next rev level sound effect. **Note: This value must be lower than next rev level.**

See [Rev Up/Down](#).



## SETUP CVs

### CV194

#### Rev Level Two Motor Load Power

##### *Description*

This Value Sets the Motor Load Power Rev Level Two Sound Effect

##### *Values*

0-255

##### *Initial Value*

120

##### *Related CVs*

[CV137](#), CV193—CV202

Bit 7

Bit 0

0	1	1	1	1	0	0	0
---	---	---	---	---	---	---	---

The decoder's rev level two sound effect is activated when the motor power exceeds this value or falls below the next rev level load power threshold. Increasing this value increases the power needed before the diesel changes to the next rev level sound effect. **Note: This value must be lower than next rev level.**

See [Rev Up/Down](#).



## SETUP CVs

### CV195

#### Rev Level Three Motor Load Power

##### *Description*

This Value Sets the Motor Load Power Rev Level Three Sound Effect

##### *Values*

0-255

##### *Initial Value*

130

##### *Related CVs*

[CV137](#), CV193—CV202

Bit 7

Bit 0

1	0	0	0	0	0	1	0
---	---	---	---	---	---	---	---

The decoder's rev level three sound effect is activated when the motor power exceeds this value or falls below the next rev level load power threshold. Increasing this value increases the power needed before the diesel changes to the next rev level sound effect. **Note:** This value must be lower than next rev level.

See [Rev Up/Down](#).



## SETUP CVs

### CV196

#### Rev Level Four Motor Load Power

##### *Description*

This Value Sets the Motor Load Power Rev Level Four Sound Effect

##### *Values*

0-255

##### *Initial Value*

160

##### *Related CVs*

[CV137](#), CV193—CV202

Bit 7

Bit 0

1	0	1	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's rev level four sound effect is activated when the motor power exceeds this value or falls below the next rev level load power threshold. Increasing this value increases the power needed before the diesel changes to the next rev level sound effect. **Note: This value must be lower than next rev level.**

See [Rev Up/Down](#).



## SETUP CVs

### CV197

#### Rev Level Five Motor Load Power

##### *Description*

This Value Sets the Motor Load Power Rev Level Five Sound Effect

##### *Values*

0-255

##### *Initial Value*

180

##### *Related CVs*

[CV137](#), CV193—CV202

Bit 7

Bit 0

1	0	1	1	0	1	0	0
---	---	---	---	---	---	---	---

The decoder's rev level five sound effect is activated when the motor power exceeds this value or falls below the next rev level load power threshold. Increasing this value increases the power needed before the diesel changes to the next rev level sound effect. **Note: This value must be lower than next rev level.**

See [Rev Up/Down](#).





## SETUP CVs

### CV198

#### Rev Level Six Motor Load Power

##### *Description*

This Value Sets the Motor Load Power Rev Level Six Sound Effect

##### *Values*

0-255

##### *Initial Value*

200

##### *Related CVs*

[CV137](#), CV193—CV202

Bit 7

Bit 0

1	1	0	0	1	0	0	0
---	---	---	---	---	---	---	---

The decoder's rev level six sound effect is activated when the motor power exceeds this value or falls below the next rev level load power threshold. Increasing this value increases the power needed before the diesel changes to the next rev level sound effect. **Note: This value must be lower than next rev level.**

See [Rev Up/Down](#).



## SETUP CVs

### CV199

#### Rev Level Seven Motor Load Power

##### *Description*

This Value Sets the Motor Load Power Rev Level Seven Sound Effect

##### *Values*

0-255

##### *Initial Value*

220

##### *Related CVs*

[CV137](#), CV193—CV202

Bit 7

Bit 0

1	1	0	1	1	1	0	0
---	---	---	---	---	---	---	---

The decoder's rev level seven sound effect is activated when the motor power exceeds this value or falls below the next rev level load power threshold. Increasing this value increases the power needed before the diesel changes to the next rev level sound effect. **Note:** This value must be lower than next rev level.

See [Rev Up/Down](#).



# SETUP CVs

## CV201

### N Gage Rev Level Motor Power Scalar

#### *Description*

This Value Scales the N GageMotor Load Power Rev Level Sound Effects

#### *Values*

0-255

#### *Initial Value*

46

#### *Related CVs*

CV193—CV202

Bit 7

Bit 0

0	0	1	0	1	1	1	0
---	---	---	---	---	---	---	---

The decoder's rev levels change when the motor power or falls below the load power thresholds at CV193 through CV199. However, the N Gage operating efficiency is very high. This higher efficiency means a smaller amount of power is necessary to produce the same speeds. This smaller amount of power results in the load power thresholds at CV193 through CV199 being too high for N Gage locomotives. CV201 is a scalar that is multiplied to each motor load power threshold. The scalar is in percent, thus 46 means 46% or .46 times the values saved in CV193 through CV199.

See [Rev Up/Down](#).



## SETUP CVs

### CV202

#### Motor Load Power Filter

##### *Description*

This Value Sets the Motor Load Power's Filter Convergence Time

##### *Values*

0-255

##### *Initial Value*

12

##### *Related CVs*

[CV201](#)

Bit 7

Bit 0

0	0	0	0	1	1	0	0
---	---	---	---	---	---	---	---

The locomotive's power is monitored and filtered, thus tracking the amount of power used at any given instance. Should the power requirement change enough, the rev up or down sound effects change, following the power requirements. This value determines the convergence time of the reading. Increasing the value increases the accuracy, but increases the response time. Decreasing the value decreases the response time but also decreases the accuracy.

[Rev Up/Down.](#)



## SETUP CVs

### CV203

#### Ho Gage Rev Level Motor Power Scalar

##### *Description*

This Value Scales the Ho Motor Load Power Rev Level Sound Effects

##### *Values*

0-255

##### *Initial Value*

50

##### *Related CVs*

Bit 7

Bit 0

0	0	1	1	0	0	1	0
---	---	---	---	---	---	---	---

The decoder's rev levels change when the motor power or falls below the load power thresholds at CV193 through CV199. CV203 is a scalar that is multiplied to each motor load power threshold. The scalar is in percent, thus 46 means 46% or .46 times the values saved in CV193 through CV199.

[Rev Up/Down.](#)



## SETUP CVs

### CV204

#### Initial RevUp

##### *Description*

This Value Sets the Rev Level Ramp Up at Throttle Stop 0

##### *Values*

0-255

##### *Initial Value*

1

##### *Related CVs*

Bit 7

Bit 0

0	0	0	0	0	0	0	1
---	---	---	---	---	---	---	---

From a stopped condition, throttle up to throttle stop one, the locomotive will ramp up after some random time to the rev level contained in CV204. The locomotive will move from stopped at throttle stop two, and if decreased to throttle stop one, continue at the slow speed of throttle stop one.



## SETUP CVs

### CV208

#### Cab Light Throttle Stop

##### *Description*

This Value Sets the Throttle Stop for Turning off the Cab Light

##### *Values*

0-255

##### *Initial Value*

3

##### *Related CVs*

Bit 7

Bit 0

0	0	0	0	0	0	1	1
---	---	---	---	---	---	---	---

The decoder's Cab Light is turned off at this value. A throttle stop below this value will turn on the Cab Light. Setting this value to 255 turns off the Cab Light and setting this value to zero turns on the Cab Light.



## SETUP CVs

### CV209

#### DCC Brake Set Throttle Stop

##### *Description*

This Value Sets the Throttle Stop for the Brake Set Sound Effect

##### *Values*

0-128

##### *Initial Value*

0

##### *Related CVs*

[CV210](#), [CV227](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The decoder's sound effect for DCC brake set plays at this throttle stop provided the effect is enabled. See CV227 bit 0.





## SETUP CVs

### CV210

#### DCC Brake Release Throttle Stop

##### *Description*

This Value Sets the Throttle Stop for the Brake Release Sound Effect

##### *Values*

0-128

##### *Initial Value*

1

##### *Related CVs*

[CV209](#), [CV227](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	1
---	---	---	---	---	---	---	---

The decoder's sound effect for DCC brake release plays at this throttle stop if this effect is enabled. See CV227 bit 0.



## SETUP CVs

### CV212

#### Rolling Thunder Address

##### *Description*

Set Unique Locomotives Rolling Thunder Address

##### *Values*

1-29

##### *Initial Value*

1

##### *Related CVs*

[CV213](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	1
---	---	---	---	---	---	---	---

Set the rolling thunder locomotive to a unique address. The rolling thunder receiver will lock to a transmitter, but each active transmitter must have a unique address. The receiver can only hear one transmitter. Setting to zero disables the transmitter.



## SETUP CVs

### CV213

#### Rolling Thunder Setup

##### *Description*

Configure Rolling Thunder Frequency and Power

##### *Values*

0-255

##### *Initial Value*

128

##### *Related CVs*

[CV212](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	d
---	---	---	---	---	---	---	---

Configuration for Rolling Thunder:

	<u>915mhz</u>	<u>868mhz</u>
Max Power	128	0
	144	16
	160	32
	176	48
	192	64
	208	80
	224	96
Min Power	240	112

d=1 sends track voltage for diagnostics; See Rolling Thunder Tuner Document



# CONTROL CVs

## CV214

### Rolling Thunder Volume

#### *Description*

Sets Rolling Thunder Volume

#### *Values*

0-255

#### *Initial Value*

128

#### *Related CVs*

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

This value determines the bass sub-woofer volume relative to the locomotive sound volume. Increasing this value increases the bass sub-woofer volume while decreasing this value decreases the bass sub-woofer volume.



# CONTROL CVs

## CV221

### Unique Control One

#### *Description*

This Value Sets any Locomotive Unique Functions

#### *Values*

0-255

#### *Initial Value*

Locomotive Specific

#### *Related CVs*

[CV246](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

Bit 1: 0=No Smoke Unit

1=Smoke Unit

Bit 0: 0 = HO Selected for Rev Level Power Thresholds

1 = N Gage Selected for Rev Level Power Thresholds

These bits are set by the decoder's sound file.



# CONTROL CVs

## CV222

### AUX Select for DCMaster™

#### *Description*

This Value Sets the Function for AUX on the DCMaster™

#### *Values*

0-255

#### *Initial Value*

Locomotive Specific

#### *Related CVs*

CV225, CV226

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The AUX may be programmed to perform any of the defined functions listed by setting the AUX CV222 to the assigned value.

#### Function Controlled

#### Assigned Value

Nothing	0
<a href="#">Front/Rear Lights</a>	1
<a href="#">Bell Sound</a>	2
<a href="#">Horn Sound</a>	3
Couple/Uncouple Sound	4
<a href="#">Compressor/Grid Blower Sound</a>	5
<a href="#">Diesel Ramp Up</a>	6
<a href="#">Diesel Ramp Down/Start Diesel Sound</a>	7

<b><u>Function Controlled</u></b>	<b><u>Assigned Value</u></b>
<a href="#"><u>L1 Function</u></a>	8
<a href="#"><u>Mute/Volume Control</u></a>	9
<a href="#"><u>Startup/Shutdown Sounds</u></a>	10
<a href="#"><u>Cooling Fan Sound</u></a>	11
<a href="#"><u>Air Fill/Air Release Sound</u></a>	12
<a href="#"><u>Brake Set/Release/Squeal Sound</u></a>	13
Fuel Fill Sound	14
Spit Valve Sound	15
Wheel Flange Sound	16
<a href="#"><u>Coupler Slack/Couple Sound</u></a>	17
<a href="#"><u>Brake Squeal Sound</u></a>	18
<a href="#"><u>Horn2 Toggle</u></a>	19
Horn Complete	20
Smoke Toggle	21
L4 Toggle	24
L5 Toggle	25
<a href="#"><u>Horn Grade Crossing Sound</u></a>	30
<a href="#"><u>Track Sounds Maximum Speed Step</u></a>	31
<a href="#"><u>Play Macro</u></a>	40
<a href="#"><u>Record Macro</u></a>	41
<a href="#"><u>Station Sounds</u></a>	50
<a href="#"><u>Yard Sounds</u></a>	51
<a href="#"><u>Maintenance Sounds</u></a>	52
<a href="#"><u>Radio Chatter Sounds</u></a>	53
<a href="#"><u>City Sounds</u></a>	54
<a href="#"><u>Farm Sounds</u></a>	55
<a href="#"><u>Industrial Sounds</u></a>	56
<a href="#"><u>Lumber Yard Sounds</u></a>	57
<a href="#"><u>Cab Light Toggle</u></a>	60
<a href="#"><u>Rule 17 Dimming Toggle</u></a>	61



# CONTROL CVs

## CV223

### Bell Select

#### *Description*

This Value determines which Bell Plays when the Bell is selected

#### *Values*

0-2

#### *Initial Value*

0

#### *Related CVs*

[CV34](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

#### Horn

#### Value

Bell1

0

Bell2

1

The default bell is the correct bell for the locomotive. Bell2 may be selected to play instead of the default bell.





# CONTROL CVs

## CV224

### Horn Select

#### *Description*

This Value determines which Horn Plays when the Horn is selected

#### *Values*

0-2

#### *Initial Value*

0

#### *Related CVs*

[CV35](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

#### Horn

#### Value

Default	0
Horn3	1
Horn4	2
Complete Horn/Whistle	3

The default horn is the correct horn for the locomotive. Horn3 or Horn4 may be selected to play instead of the default horn.



# CONTROL CVs

## CV225

### Control One

#### *Description*

This Value Contains Various Control Bits

#### *Values*

0-255

#### *Initial Value*

3

#### *Related CVs*

[CV33](#), [CV160](#), [CV226](#)

Bit 7

Bit 0

0	0	0	0	0	0	1	1
---	---	---	---	---	---	---	---

Bit7: Not used

Bit6: 1=L5 if enabled follows front/rear on/off

Bit5: 1=L4 if enabled follows front/rear on/off

Bit4: 0=L1 Does not Activate on Bell or Horn  
1=L1 Activates on Bell or Horn (See CV226)

Bit3: Not used

Bit2: 0=L4 Disabled  
1=L4 Enabled(Next power cycle)

Bit1: 0=L1 Disabled  
1=L1 Enabled

Bit0: 0=Front and Rear Lights Disabled  
1=Front and Rear Lights Enabled



# CONTROL CVs

## CV226

### Control Two

#### *Description*

This Value Contains Various Control Bits

#### *Values*

0-255

#### *Initial Value*

0

#### *Related CVs*

[CV225](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

Bit7: Not used

Bit6: Not used

Bit5: Not used

Bit4: Not used

Bit3: Not used

Bit2: Not used

Bit1: Not used

Bit0: 0=Horn Activates L1 (See Bit 4 CV225)

1=Bell Activates L1 (See Bit 4 CV225)



# CONTROL CVs

## CV227

### Control Three

#### *Description*

This Value Contains Various Control Bits

#### *Values*

0-255

#### *Initial Value*

2

#### *Related CVs*

[CV61](#), [CV191](#), [CV192](#), [CV209](#), [CV210](#)

Bit 7

Bit 0

0	0	0	0	0	0	1	0
---	---	---	---	---	---	---	---

Bit7: Not used

Bit6: Not used

Bit5: Not used

Bit4: Not used

Bit3: Not used

Bit2: 0=Forward/Reverse Startup Toots Disabled

1=Forward/Reverse Startup Toots Enables

Bit1: 0=Brake Squeal Disabled on Quick Decelerations

1=Brake Squeal Automatic on Quick Decelerations

Bit0: 0=Brake Set and Brake Release Disabled on Throttle

Stop Zero Transitions

1=Brake Set and Brake Release Automatic on Throttle

Stop Zero Transitions



# CONTROL CVs

## CV228

### DCC Startup Timer

#### *Description*

This Value Contains the DCC Startup Timer

#### *Values*

0-255

#### *Initial Value*

1

#### *Related CVs*

Bit 7

Bit 0

0	0	0	0	0	0	0	1
---	---	---	---	---	---	---	---

On power up, the decoder will wait this much time in seconds to detect the DCC system. If this value is too low, DC mode will start the system resulting in strange behavior. The initial value is 1 second.



# CONTROL CVs

## CV229

### Extended Consist Features

#### *Description*

This Value Controls Extended Consist Features

#### *Values*

0-255

#### *Initial Value*

255

#### *Related CVs*

[CV19](#), [CV21](#), [CV22](#)

Bit 7

Bit 0

1	1	1	1	1	1	1	1
---	---	---	---	---	---	---	---

Bit7: Cab Disabled=0; Cab Enabled=1 (DCC and DC)

Bit6: Horn Disabled=0; Horn Enabled=1 (DC Only)

Bit5: Bell Disabled=0; Bell Enabled=1 (DC Only)

Bit4: AUX Enabled=1 (DC Only)

Bit3: L4/L5 Enabled=1 (DCC and DC)

Bit2: L1 Disabled=0; L1 Enabled=1

Bit1: Front Light Disabled=0; Front Light Enabled=1

Bit0: Rear Light Disabled=0; Rear Light Enabled=1

[See Consist Synopsis.](#)



# CONTROL CVs

## CV230

### Easy Consist™

#### *Description*

This Value Allows Convenient Consist Configurations

#### *Values*

1,2,3

#### *Initial Value*

0

#### *Related CVs*

[CV19](#), [CV21](#), [CV22](#), [CV229](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

The easy consist feature sets the decoder CV19 for consist 60 forward facing engine. Select 1, 2 or 3 for value to set the consist position.

- Values:
- 0 = Consist Disabled
  - 1 = Front Engine
    - All consist function keys enabled (CV21, CV22)
    - All lights except the rear light enabled (CV229)
  - 2 = Middle Engine
    - All consist function keys except F0, F8 and F9 disabled (CV21, CV22); All lights disabled (CV229)
  - 3 = Rear Engine
    - All consist function keys except F0, F8 and F9 disabled (CV21, CV22)
    - Only front light enabled (CV229)

The consist may be disabled by setting CV19 to zero or CV230 to zero. No CV's may be changed when the consist is addressed. The engine in a consist must be addressed when modifying its CV. All function keys are honored by addressing the engine. Additionally, function keys enabled by CV21 and CV22 are honored by addressing the consist. Using the Easy Consist™ feature allows a quick programming of a basic consist.

### **Front Engine**

All lights are active except the reverse light. If a change in this lighting is required, modify CV229 for the appropriate lighting changes. All functions keys are enable when the consist is addressed. If a change in active function keys are required, modify CV21 and CV22.

### **Middle Engine**

All lights are inactive. If a change in this lighting is required, modify CV229 for the appropriate lighting changes. All functions keys are disabled except F0 (Headlight), F8 (Mute-Volume) and F9 (Startup) when the consist is addressed. If a change in active function keys are required, modify CV21 and CV22.

### **Rear Engine**

Only the forward light, F4 and F5 are active. If a change in this lighting is required, modify CV229 for the appropriate lighting changes. All functions keys are disabled except F0 (Headlight), F8 (Mute-Volume) and F9 (Startup) when the consist is addressed. If a change in active function keys are required, modify CV21 and CV22.

**Note:** Set [CV159](#) appropriate for L1 and Rule 17 Lighting. CV159 will be honored in a consist.

[See Consist Synopsis.](#)





# CONTROL CVs

## CV231

### Light Dimmer

#### *Description*

This Value Allows Programmable Front/Rear Light Intensities

#### *Values*

4-100

#### *Initial Value*

96

#### *Related CVs*

[CV33](#), [CV159](#)

Bit 7

Bit 0

0	1	1	0	0	1	0	0
---	---	---	---	---	---	---	---

The Front and Rear Lights may be programmed for their maximum brightness. A value of 4 makes the lights dimmest and a value of 100 makes the lights brightest. If Rule 17 is enabled (CV159 Bit 0), a value of 4 for the light dimmer will match the light intensity at the dimmest for rule 17 lighting, so no change is noticed from stop to start.



# CONTROL CVs

## CV233

### Smoke Unit Power On Delay

#### *Description*

This Value Sets the Smoke Units Power On Delay

#### *Values*

0-255

#### *Initial Value*

Locomotive Dependant

#### *Related CVs*

[CV234](#), [CV235](#), [CV236](#), [CV237](#)

Bit 7

Bit 0

x	x	x	x	x	x	x	x
---	---	---	---	---	---	---	---

The smoke unit is delayed during the startup record play. Each count is .5 seconds delay.



# CONTROL CVs

## CV234

### Smoke Unit Fan Minimal Speed

#### *Description*

This Value Sets the Smoke Units Fan Speed For Each Rev

#### *Values*

0-255

#### *Initial Value*

Locomotive Dependant

#### *Related CVs*

[CV233](#), [CV235](#), [CV236](#), [CV237](#)

Bit 7

Bit 0

x	x	x	x	x	x	x	x
---	---	---	---	---	---	---	---

The smoke unit's fan speed varies from the minimal speed (CV234) to the maximum speed (CV235) with each rev level increase. Fan speed is a linear function. Increasing this value results in the smoke pushing up higher at idle and each increased rev, but thinner.



# CONTROL CVs

## CV235

### Smoke Unit Fan Maximum Speed

#### *Description*

This Value Sets the Smoke Units Fan Idle Speed

#### *Values*

0-255

#### *Initial Value*

Locomotive Dependant

#### *Related CVs*

[CV233](#), [CV234](#), [CV236](#), [CV237](#)

Bit 7

Bit 0

x	x	x	x	x	x	x	x
---	---	---	---	---	---	---	---

The smoke unit's fan speed varies from the minimal speed (CV234) to the maximum speed (CV235) with each rev level increase. Fan speed is a linear function. Increasing this value results in the smoke pushing up higher at idle and each increased rev, but thinner.



# CONTROL CVs

## CV236

### Smoke Unit Minimal Heater Power

#### *Description*

This Value Sets the Smoke Units Heater Power For Each Rev

#### *Values*

0-110

#### *Initial Value*

Locomotive Dependant

#### *Related CVs*

[CV233](#), [CV234](#), [CV235](#), [CV237](#)

Bit 7

Bit 0

x	x	x	x	x	x	x	x
---	---	---	---	---	---	---	---

The smoke unit's heater varies from the minimal power (CV236) to the maximum power (CV237) with each rev level increase. Heater power is a linear function. Increasing this value results in more smoke at all speeds.

**Note:** Care should be given as this value is increased, the oil will burn quicker. Monitor the oil level so as not to burn out the heater element.



# CONTROL CVs

## CV237

### Smoke Unit Maximum Heater Power

#### *Description*

This Value Sets the Smoke Units Idle Heater Power

#### *Values*

0-110

#### *Initial Value*

Locomotive Dependant

#### *Related CVs*

[CV233](#), [CV234](#), [CV235](#), [CV236](#)

Bit 7

Bit 0

x	x	x	x	x	x	x	x
---	---	---	---	---	---	---	---

The smoke unit's heater varies from the minimal power (CV236) to the maximum power (CV237) with each rev level increase. Heater power is a linear function. Increasing this value results in more smoke at all speeds.

**Note:** Care should be given as this value is increased, the oil will burn quicker. Monitor the oil level so as not to burn out the heater element.



# CONTROL CVs

## CV238

### Macro Recorder Control

#### *Description*

This Value Sets Up the Macro Recorder

#### *Values*

0-255

#### *Initial Value*

79

#### *Related CVs*

[CV59](#), [CV60](#), [CV239](#), [CV245](#)

Bit 7

Bit 0

0	1	0	0	1	1	1	1
---	---	---	---	---	---	---	---

This value sets the speed step mode the macro plays back (Make sure the recorded mode is the same). Also, the amount of times the macro is repeated may be set.

mmxx-llll

mm:	00	126-speed step mode
	11	126-speed step mode
	01	28-speed step mode
	10	14-speed step mode

llll:	00	macro player off
	1-14	repeat macro times
	15	play macro indefinitely



# CONTROL CVs

## CV238

### Macro Recorder Control (Continued)

#### Record Mode

The macro recorder allows the locomotive operator the ability to record most events as they occur during a session. An event is defined as a locomotive action such as activating sounds or throttle control. A session is defined as a time duration running the locomotive on a layout. The following events are not recorded:

- Horn Frequency Shift
- Record Macro Event
- Emergency Stop

Pressing Emergency Stop during a macro record or play session stops the recording or playback. Also, using the direction change while the locomotive is moving uses up the macro recording space quickly.

Activate the macro recorder by pressing F27 (default) or whatever key has been defined to start the macro recorder. The front light flashes and if the sound is on, the sound mutes. Once the front light stops flashing, the macro recorder is actively recording events. Stop recording by pressing F27 (default) or whatever key has been defined to start the macro recorder. The rear light flashes and if the sound is on, the sound mutes. Writing 16 into CV8 saves the macro permanently. If desired, CV245 bit 4 may be set and the macro will be automatically saved after the rear lights stop flashing.

Each event consumes 2 macro memory locations, one location for the event and one for the time the event occurred. A total of 1020 events may be recorded. The throttle event consumes macro space quickly. Care should be exercised to minimize unnecessary throttle events (Use fast increment/fast decrement features; use 28 speed step mode). Horn events are recorded at .25 second accuracy and all other events are recorded at 1 second accuracies. Fractional time units are added to the next event once they reach .25 seconds for horn events or 1 second for other events.

A real time counter is kept and records the last throttle zero event in the macro relative to the start of the record session. The resolution of this timer is .025 seconds. During macro playback, CV239 may be adjusted to set the loop time closer, giving more predictable loop repetition. CV239 allow adjustments in .1 second intervals. This adjustment corrects the locomotives loop end point and is negative only. The correction allowed is 25.5 seconds. If the locomotive loop





# CONTROL CVs

## CV238

### Macro Recorder Control (Continued)

point is early (before the actual start point), then record again and drive past the loop point slightly.

The couple sound effect plays continuously should macro memory space run out. The macro may be successfully saved up to the point of running out of space and played back if desired.

#### Playback Mode

Once the macro is successfully recorded and saved playback may be started. If loop accuracy is desired (will not be perfect), set the locomotive at the initial recorded start point. Set CV239 to zero. Activate the macro player by pressing F26 (default) or whatever key has been defined to start the macro player. Once the loop is played and the locomotive finishes, assuming the locomotive stopped past the start point, adjust CV239 to decrease the overshoot. Note that the overshoot may vary from a cold locomotive to a warm locomotive. The macro recorder records events over time and due to track voltage fluctuations and thermal conditions, the locomotives speed slightly varies under different conditions, resulting in a time shift. Now, if desired, the macro played may be set to loop from 1 to 14 times or indefinitely loop (See CV245).

At any time the macro player may be terminated. An emergency stop or pressing F26 (default) or whatever key has been defined to start the macro player will terminate the macro player. Note that if the locomotive is running and the F26 (default) or whatever key has been defined to start the macro player is pressed, the macro player is terminated, but the locomotive is left in its current state, running.



# CONTROL CVs

## CV239

### Macro Playback Loop Adjust

#### *Description*

This Value Contains the Macro Playback Loop Adjust Time

#### *Values*

0-255

#### *Initial Value*

0

#### *Related CVs*

[CV238](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

This value is used to stop a locomotive macro playback earlier than the recorded time of the last throttle zero event. Each count value is .1 seconds, allowing a total adjustment of 25.5 seconds.



# CONTROL CVs

## CV240

### Random Sound Effect Generator Timer Low

#### *Description*

This Value Contains the Minimal Time to the Next Random Sound

#### *Values*

1-255

#### *Initial Value*

4

#### *Related CVs*

[CV241](#)

Bit 7

Bit 0

0	0	0	0	0	1	0	0
---	---	---	---	---	---	---	---

This value determines how often random sound effects occur. A random sound cannot occur earlier than this value. This timer is measured in seconds and starts timing after the present random sound effects finishes. **Note: This number must be smaller than CV241.**



# CONTROL CVs

## CV241

### Random Sound Effect Generator Timer High

#### *Description*

This Value Contains the DCC Startup Timer

#### *Values*

1-255

#### *Initial Value*

20

#### *Related CVs*

[CV240](#)

Bit 7

Bit 0

0	0	0	1	0	1	0	0
---	---	---	---	---	---	---	---

This value determines how often random sound effects occur. A random sound cannot occur later than this value. This timer is measured in seconds and starts timing after the present random sound effects finishes. **Note: This number must be larger than CV240.**



# CONTROL CVs

## CV242

### Track Sounds Maximum Speed Step

#### *Description*

This Value Determines the Speed of Track Sound Occurrences

#### *Values*

1-255

#### *Initial Value*

15

#### *Related CVs*

Bit 7

Bit 0

0	0	0	0	1	1	1	1
---	---	---	---	---	---	---	---

This value allows the track sounds better synchronization with the locomotive speed.



# CONTROL CVs

## CV244

### Grid Blower and BroadCast Stop Packets

#### *Description*

This Value Contains the Grid Blower Brake Motor Decrease Time and The BroadCast Stop Packets Stop Count

#### *Values*

32

#### *Initial Value*

#### *Related CVs*

Bit 7

Bit 0

0	0	1	0	0	0	0	0
---	---	---	---	---	---	---	---

gggxxbbb

ggg=0-7 [0.5 seconds per count] [0.5-3.5 seconds]

bbb = 0-7 [0=disabled; 1-7=consecutive broadcast packets received]

The locomotive is slowed when the grid blower is activated. The rate the locomotive slows is determined by values ggg.

Some controllers can send broadcast stop packets which will halt the locomotive. The amount of consecutive broadcast packets may be set by placing a value of 1-7 for bbb.



# CONTROL CVs

## CV245

### General System Controls One

#### *Description*

This Value Contains General Bits as Defined

#### *Values*

0-255

#### *Initial Value*

17

#### *Related CVs*

[CV120](#), [CV238](#), [CV248](#)

Bit 7

Bit 0

0	0	0	1	0	0	0	1
---	---	---	---	---	---	---	---

These bit value control the following:

- D7 – 0=Motor changes direction when command received  
1=Motor will not change direction unless first stopped  
(Useful for QSI Quantum Engineer) Horn/Bell Control
- D6 – 0= CV write sound feedback enabled  
1= CV write sound feedback disabled  
(Some controllers need this disabled to read CV's)
- D5 – 0= Motor speed smoothing enabled  
1=Motor speed smoothing disabled  
(Most useful in DCC 28 step mode)
- D4 – 0=Macro Recorder Auto Save Off  
1= Macro Recorder Auto Save On



# CONTROL CVs

## CV245

### General System Controls One (Continued)

- D3 – 0=Analog Horn On (Frequency Shifted)  
1=Analog Horn Off (Frequency Shifted)  
(Useful on DCC controllers that have this feature)
- D2 – 0=Startup Sound Plays on Startup  
1=Startup Sound Never Plays  
(Useful for real train play)
- D1 – 0=Motor starts as soon as a move command is received  
1=Motor waits until startup sound record finishes  
(Useful for real train play)
- D0 – 0=Horn1 Alternative Ending Disabled  
1=Horn1 Alternative Ending Enabled  
(Useful for guaranteeing short/long signaling)





# CONTROL CVs

## CV246

### General System Controls Two

#### *Description*

This Value Contains General Bits as Defined

#### *Values*

0-255

#### *Initial Value*

128

#### *Related CVs*

[CV221](#)

Bit 7

Bit 0

1	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

These bit value control the following:

D7 – 0=Smoke Unit Powers Up **Off**

1=Smoke Unit Powers Up **On**

D6 – 0=Quantum Engineer Bell/Horn Detect **Off**

1=Quantum Engineer Bell/Horn Detect **On**

D1 – 0=Motor Loading Enabled

1=Motor Loading Disabled

(Useful for consists or user preference)

D0 – 0= Direction Change Sound Enabled

1=Direction Change Sound Disabled

(User preference)



# CONTROL CVs

## CV247

### Over Current Delay

#### *Description*

This Value Contains the Over Current Delay Value

#### *Values*

0-255

#### *Initial Value*

10

#### *Related CVs*

Bit 7

Bit 0

0	0	0	0	1	0	1	0
---	---	---	---	---	---	---	---

This value sets the length of time in seconds that a motor over current condition is allowed before removing motor power. This condition exists when the motor is supposed to be moving, but is not. A value too small may cause the over current circuit protect to falsely activate, while too long may cause damage to the motor or decoder if the motor is jammed from moving and motor power is applied. Once the circuit is activated, simply set your throttle to zero momentarily, then throttle up (assuming the problem was removed) and the motor will receive power again. If backEMF (CV10) is disabled, the over current is also disabled. Setting the value to 255 disables this function.



# CONTROL CVs

## CV248

### Motor Startup Delay

#### *Description*

This Value Contains the Motor Startup Delay

#### *Values*

0-255

#### *Initial Value*

60

#### *Related CVs*

[CV245](#)

Bit 7

Bit 0

0	0	1	1	1	1	0	0
---	---	---	---	---	---	---	---

This value creates a motor delay from the time the startup record finishes and the motor is allowed to move. Increasing this value increases the delay in when the motor receives power. This value allows the brake release to finish before moving. Each count delays the motor start by .1 sec. This function must be enabled by setting bit 1 of CV245.



# CONTROL CVs

## CV249

### DC Motor Off Voltage

#### *Description*

This Value Contains the Motor Off Track Voltage

#### *Values*

0-255

#### *Initial Value*

84

#### *Related CVs*

[CV252](#)

Bit 7

Bit 0

0	1	0	1	0	1	0	0
---	---	---	---	---	---	---	---

This value represents the track voltage threshold to stop the motor from moving. This value must be smaller than CV252 for proper control.



# CONTROL CVs

## CV250

### DC Track Voltage Read Delay

#### *Description*

This Value Contains the Track Voltage Read Delay

#### *Values*

1-255

#### *Initial Value*

0

#### *Related CVs*

[CV248](#), [CV249](#), [CV251](#), [CV252](#)

Bit 7

Bit 0

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

This value creates a delay in the digitally filtered track voltage. Increasing this value slows the response to changing track voltages while decreasing this value increases the response to changing track voltages. Sound and motor response varies with the change in this value.



# CONTROL CVs

## CV251

### DC Motor Control Vmax

#### *Description*

This Value Contains the Motor Control Track Voltage Maximum Values

0-255

#### *Initial Value*

144

#### *Related CVs*

[CV249](#), [CV252](#)

Bit 7

Bit 0

1	0	0	1	0	0	0	0
---	---	---	---	---	---	---	---

Vmax is the track voltage that once reached allows 100% track power to the motor. Increasing Vmax means a higher track voltage is needed before all track power is supplied to the motor. Decreasing Vmax means full power to the motor at a lower track voltage.

**Note:** Vmax must be greater than Vmin.

[See Advanced DC Motor Control](#)



# CONTROL CVs

## CV252

### DC Motor Control Vmin

#### *Description*

This Value Contains the Motor Control Track Voltage Minimum

#### *Values*

0-255

#### *Initial Value*

78

#### *Related CVs*

[CV29](#), [CV249](#), [CV251](#)

Bit 7

Bit 0

0	1	0	0	1	1	0	0
---	---	---	---	---	---	---	---

Vmin defines the track voltage that applies the lowest or starting motor power. The power applied at this voltage is the determined by CV29 bit 4 and its corresponding CV's (See CV29). Valid values for Vmin is from 0-255. Decreasing Vmin means a lower track voltage control is needed before the train begins to move. Increasing Vmin means the train begins to move at a higher track voltage control.

**Note: Vmin must be less than Vmax.**

[See Advanced DC Motor Control](#)



## **DCC Function Keys** **Blue Line**

Function Key	Description
F0	<a href="#">Front/Rear Lighting</a>
F1	<a href="#">Bell</a>
F2	<a href="#">Horn</a>
F3	<b>Not Moving:</b> <a href="#">Arm Coil Coupler Slack</a> <b>Moving:</b> <a href="#">Plays Coil Couple</a>
F4	<b>Not Moving:</b> <a href="#">Plays Compressor</a> <b>Moving:</b> <a href="#">Plays Grid Blower Motor</a>
F5	<a href="#">Ramp Up Diesel Rev Level</a>
F6	<a href="#">Ramp Down Diesel Rev Level/Startup</a>
F7	<a href="#">Smoke Unit Control</a>
F8	<b>Double Press:</b> <a href="#">System Volume Up or Down</a> <b>Single Press:</b> <a href="#">All Sounds Muted Except Horn/Bell</a>
F9	<a href="#">Startup or Shutdown</a>
F10	<a href="#">Radiator Cooling Fan</a>
F11	<b>Not Moving:</b> <a href="#">Air Filling</a> <b>Moving:</b> <a href="#">Air Release</a>
F12	<b>Throttle Stop Zero:</b> <a href="#">Brake Set</a> <b>Throttle Stop One:</b> <a href="#">Brake Release</a> <b>Above Throttle Stop Five:</b> <a href="#">Brake Squeal</a>
F13	<a href="#">Horn Grade Crossing</a>
F14	<a href="#">Station Sounds</a>
F15	<a href="#">Yard Sounds</a>





## DCC Function Keys

### Blue Line

Function Key	Description
F16	<a href="#">Maintenance Sounds</a>
F17	<a href="#">Radio Chatter Sounds</a>
F18	<a href="#">City Sounds</a>
F19	<a href="#">Farm Sounds</a>
F20	<a href="#">Industrial Sounds</a>
F21	<a href="#">Lumber Sounds</a>
F22	<a href="#">Horn2 Toggle</a>
F23	Not Defined
F24	Not Defined
F25	Not Defined
F26	<a href="#">Play Macro</a>
F27	<a href="#">Record Macro</a>
F28	<a href="#">Brake Squeal</a>



## DCC Function Keys

### QSI

Function Key	Description
F0	<a href="#">Front/Rear Lighting</a>
F1	<a href="#">Bell</a>
F2	<a href="#">Horn</a>
F3	Not Moving: <a href="#">Arm Coil Coupler Slack</a> Moving: <a href="#">Plays Coil Couple</a>
F4	<a href="#">Radiator Cooling Fan</a>
F5	Not Moving: <a href="#">Plays Compressor</a> Moving: <a href="#">Plays Grid Blower Motor</a>
F6	<a href="#">Horn2 Toggle</a>
F7	Throttle Stop Zero: <a href="#">Brake Set</a> Throttle Stop One: <a href="#">Brake Release</a> Above Throttle Stop Five: <a href="#">Brake Squeal</a>
F8	Double Press: <a href="#">System Volume Up or Down</a> Single Press: <a href="#">All Sounds Muted Except Horn/Bell</a>
F9	<a href="#">Startup or Shutdown</a>
F10	<a href="#">L1 Control</a>
F11	Not Defined
F12	<a href="#">Cab Control</a>
F13	<a href="#">Horn Grade Crossing</a>
F14	<a href="#">Station Sounds</a>
F15	<a href="#">Yard Sounds</a>



## DCC Function Keys

### QSI

Function Key	Description
F16	<a href="#">Maintenance Sounds</a>
F17	<a href="#">Radio Chatter Sounds</a>
F18	<a href="#">City Sounds</a>
F19	<a href="#">Farm Sounds</a>
F20	<a href="#">Industrial Sounds</a>
F21	<a href="#">Lumber Sounds</a>
F22	<a href="#">Horn2 Toggle</a>
F23	Not Defined
F24	Not Defined
F25	Not Defined
F26	<a href="#">Play Macro</a>
F27	<a href="#">Record Macro</a>
F28	<a href="#">Brake Squeal</a>



## **DCC Function Keys** **Sound Traxx**

Function Key	Description
F0	<a href="#">Front/Rear Lighting</a>
F1	<a href="#">Bell</a>
F2	<a href="#">Horn</a>
F3	<a href="#">Horn2 Toggle</a>
F4	<b>Not Moving:</b> <a href="#">Plays Compressor</a> <b>Moving:</b> <a href="#">Plays Grid Blower Motor</a>
F5	<a href="#">L1 Control</a>
F6	Not Defined
F7	Rule 17 Dimmer Control--( <b>Must Disable</b> <a href="#">CV159</a> )
F8	<b>Double Press:</b> <a href="#">System Volume Up or Down</a> <b>Single Press:</b> <a href="#">All Sounds Muted Except Horn/Bell</a>
F9	<a href="#">Radiator Cooling Fan</a>
F10	<b>Not Moving:</b> <a href="#">Plays Compressor</a> <b>Moving:</b> <a href="#">Plays Grid Blower Motor</a>
F11	<a href="#">Brake Squeal</a>
F12	<b>Not Moving:</b> <a href="#">Arm Coil Coupler Slack</a> <b>Moving:</b> <a href="#">Plays Coil Couple</a>
F13	<a href="#">Horn Grade Crossing</a>
F14	<a href="#">Station Sounds</a>
F15	<a href="#">Yard Sounds</a>



## DCC Function Keys Sound Traxx

Function Key	Description
F16	<a href="#">Maintenance Sounds</a>
F17	<a href="#">Radio Chatter Sounds</a>
F18	<a href="#">City Sounds</a>
F19	<a href="#">Farm Sounds</a>
F20	<a href="#">Industrial Sounds</a>
F21	<a href="#">Lumber Sounds</a>
F22	<a href="#">Horn2 Toggle</a>
F23	Not Defined
F24	Not Defined
F25	Not Defined
F26	<a href="#">Play Macro</a>
F27	<a href="#">Record Macro</a>
F28	<a href="#">Brake Squeal</a>



## DCMaster™ Control

Key	Description																																																		
<b>Bell</b>	Bell																																																		
<b>Horn</b>	Horn																																																		
<b>Aux (CV222)</b>	<u><b>AUX Function Select:</b></u> <table> <tr><td>Nothing</td><td>0</td></tr> <tr><td>Front/Rear Lights</td><td>1</td></tr> <tr><td>Bell Sound</td><td>2</td></tr> <tr><td>Horn Sound</td><td>3</td></tr> <tr><td>Couple/Uncouple Sound</td><td>4</td></tr> <tr><td>Compressor/Grid Blower Sound</td><td>5</td></tr> <tr><td>Diesel Ramp Up</td><td>6</td></tr> <tr><td>Diesel Ramp Down/Start Diesel Sound</td><td>7</td></tr> <tr><td>L1 Function</td><td>8</td></tr> <tr><td>Mute/Volume Control</td><td>9</td></tr> <tr><td>Startup/Shutdown Sounds</td><td>10</td></tr> <tr><td>Cooling Fan Sound</td><td>11</td></tr> <tr><td>Air Fill/Air Release Sound</td><td>12</td></tr> <tr><td>Brake Set/Release/Squeal Sound</td><td>13</td></tr> <tr><td>Fuel Fill Sound</td><td>14</td></tr> <tr><td>Spit Valve Sound</td><td>15</td></tr> <tr><td>Wheel Flange Sound</td><td>16</td></tr> <tr><td>Coupler Slack/Couple Sound</td><td>17</td></tr> <tr><td>Brake Squeal Sound</td><td>18</td></tr> <tr><td>Horn2 Toggle</td><td>19</td></tr> <tr><td>Complete Horn</td><td>20</td></tr> <tr><td>Smoke Toggle</td><td>21</td></tr> <tr><td>L4 Toggle</td><td>24</td></tr> <tr><td>L5 Toggle</td><td>25</td></tr> <tr><td>Horn Grade Crossing Sound</td><td>30</td></tr> </table>	Nothing	0	Front/Rear Lights	1	Bell Sound	2	Horn Sound	3	Couple/Uncouple Sound	4	Compressor/Grid Blower Sound	5	Diesel Ramp Up	6	Diesel Ramp Down/Start Diesel Sound	7	L1 Function	8	Mute/Volume Control	9	Startup/Shutdown Sounds	10	Cooling Fan Sound	11	Air Fill/Air Release Sound	12	Brake Set/Release/Squeal Sound	13	Fuel Fill Sound	14	Spit Valve Sound	15	Wheel Flange Sound	16	Coupler Slack/Couple Sound	17	Brake Squeal Sound	18	Horn2 Toggle	19	Complete Horn	20	Smoke Toggle	21	L4 Toggle	24	L5 Toggle	25	Horn Grade Crossing Sound	30
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<b>Vol</b>	<b>Double Press:</b> System Volume Up or Down <b>Single Press:</b> All Sounds Muted Except Horn/Bell	