Release 1.0
Firmware 20.0

Paragon 3 Steam 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 Chuff Sound Effects

Please Note: CV defaults will vary between locomotives

System CVs Table

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

Function/Control CVs

CV	Description	Initial	Yours
33	F0 (Front/Rear Lamp)	1	
34	F1 (Bell)	2	
35	F2 (Whistle)	3	
36	F3 (Coupler)	17	
37	F4 (Air Pump)	5	
38	F5 (Blow Down/Chuff Intensity Up)	6	
39	F6 (Water Fill/Chuff Intensity Down)	7	
40	F7 (Smoke Unit Control)	21	
41	F8 (Master Volume)	9	
42	F9 (Shutdown and Startup)	10	
43	F10 (Shovel Coal)	11	
44	F11 (Water Injectors)	12	
45	F12 (Brake Set/Release)	13	
46	F13 (Horn Grade Crossing)	30	
47	F14 (Station Sounds)	50	
48	F15 (Yard Sounds)	51	
49	F16 (Maintenance Sounds)	52	
50	F17 (Radio Chatter Sounds)	53	
51	F18 (City Sounds)	54	
52	F19 (Farm Sounds)	55	
53	F20 (Industrial Sounds)	56	
54	F21 (Lumber Sounds)	57	
55	F22 (Horn2 Toggle)	19	
56	F23 (Track Sounds)	31	

Function/Control CVs

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

Function/Control CVs

82	Speed Table Entry …	143	
83	Speed Table Entry …	151	
84	Speed Table Entry …	161	
85	Speed Table Entry …	169	
86	Speed Table Entry …	180	
87	Speed Table Entry …	188	
88	Speed Table Entry …	198	
89	Speed Table Entry …	206	
90	Speed Table Entry …	216	
91	Speed Table Entry …	225	
92	Speed Table Entry …	235	
93	Speed Table Entry …	245	
94	Speed Table Entry 28	255	
95	Reverse Trim	0	
112	KpLSB	0	
113	KpMSB	72	
114	KiLSB	50	
115	KiMSB	0	
116	KdLSB	0	
117	KdMSB	0	
118	KpSlow	20	
119	DC Alpha Filter	22	
120	Speed Step Smoothing	25	
121	Consist Functions Type2	255	
122	Consist Functions Type3	255	

Sound CVs

CV	Description	Initial	Yours
130	Master Volume Sound Increment	16	
131	DC Sound Unit Startup Voltage	78	
132	DC Sound Unit Shutdown Voltage	62	
133	Sound Unit Master Volume	128	
134	Maximum Volume	128	
135	Whistle Volume	128	
136	Bell Volume	128	
137	Steam Volume	128	
138	Whistle/Horn2 Volume	128	
139	Coupler Slack Volume	128	
140	Couple Volume	128	
141	Uncouple Volume	128	
142	Wheel Flange Volume	128	
143	Air Pump Volume	128	
144	Blow Down Volume	128	
145	Steam Cock Volume	128	
146	Brake Set Volume	128	
147	Brake Release Volume	128	
148	Pop Off Valve Volume	128	
149	Blower Volume	128	
150	Dynamo Volume	128	
151	Brake Squeal Volume	128	
152	Shovel/Augar Coal Fill Volume	128	

Lighting CVs

CV	Description	Initial	Yours
153	Water Fill Volume	128	
154	Water Injectors Volume	128	
155	Chuffs/Steam Cocks Volume	128	
156	Station/Yard Volume	128	
157	Maintenance/Chatter Volume	128	
158	City/Farm/Industrial/Lumber Volume	128	
159	System Lighting	2	
160	L1 Light Definition	131	
161	L1 Parameter 1	0	
162	L1 Parameter 2	30	
163	L1 Parameter 3	180	
164	L1 Parameter 4	30	
165	L4 Light Definition	Varies	
166	L4 Parameter 1	Varies	
170	L5 Light Definition	Varies	
171	L5 Parameter 1	Varies	
231	Light Dimmer	100	

Setup/Control CVs

CV	Description	Initial	Yours
178	Coupler Slack Repeats	1	
179	Coupler Slack Interval	100	
180	Bell Ring Interval	Varies	
182	Whistle Heat Power	Varies	
183	Whistle Fan Power	Varies	
184	DC Brake Control	20	
185	DCC Brake Control	20	
186	Brake Timer	3	
187	Uncouple Throttle Stop	3	
189	Load Chuff Power Filter	12	
190	DC Sound Setup	x	
191	DC Brake Set Voltage	76	
192	DC Brake Release Voltage	85	
193	Articulated Chuff Type	Varies	
194	Articulated Chuff Offset	17	
195	Articulated Chuff Timer	2	
196	Steam Cock Event Count	2	
197	Rod Knock Event Count	2	
198	Rod Knock Volume	90	
199	Chuff Magnitude Increase	200	
200	DCC Chuff Increase Threshold	0	
201	DCC Chuff Decrease Threshold	0	

Setup/Control CVs

CV	Description	Initial	Yours
202	DC Chuff Increase Threshold	20	
203	DC Chuff Decrease Threshold	20	
204	F5 Chuff Magnitude Increase	32	
205	F6 Chuff Magnitude Decrease	32	
206	DC Chuff Power Scalar	200	
207	N Gage Chuff Power Scalar	46	
208	Cab Light Throttle Stop	3	
209	DCC Brake Set Throttle Stop	0	
210	DCC Brake Release Throttle Stop	1	
211	Power Chuff Threshold	190	
212	Rolling Thunder Address	1	
213	Rolling Thunder Setup	128	
214	Rolling Thunder Volume	128	
215	Coal Load Decrease Time	Varies	
216	Coal Load Saved Position	Varies	
218	Smoke Unit Idle Set Point	70	
219	Smoke Unit Chuff Set Point	80	
220	Chuff Time for Broken Chuff Sensor	150	
221	Unique Control One	Varies	
222	AUX Select for DCMaster™	Varies	
223	Bell Select	0	
224	Horn Select	0	
225	Control One	3	
226	Control Two	0	

227	Control Three	2	
228	DCC Start Up Timer	1	

Setup/Control CVs

CV	Description	Initial	Yours
229	Extended Consist Features	247	
230	Easy Consist™	0	
231	Light Dimmer	100	
232	Fan Idle Power	8	
233	Fan Normal Chuff Power	60	
234	Fan Loaded Chuff Power	80	
235	Fan Steam Cock Chuff Power	70	
236	Fan Rod Knock Chuff Power	40	
237	Fan Chuff Time	75	
238	Macro Recorder Control	79	
239	Macro Playback Loop Adjust	0	
240	Random Sound Generator Timer Low	4	
241	Random Sound Generator High	20	
242	Track Sounds	15	
244	Brake Squeal/BroadCast Stop Packets	2	
245	General System Controls One	17	
246	General System Controls Two	128	
247	Over Current Delay	10	
248	Enhanced DC Motor Startup Delay	60	
249	DC Motor Off Voltage	84	
250	DC Track Voltage Read Delay	0	
251	DC Motor Control Vmax	144	
252	DC Motor Control Vmin	78	

Paragon 3 Chuff Control

Synopsis

The steam locomotive creates multiple chuff sounds when moving. At initial startup or after the locomotive is stopped for over 30 seconds, a steam cock sound occurs for several wheel rotations determined by CV196. The volume of the steam cock sounds is controlled by CV145. After the steam cock chuff event is completed, the chuff sequence starts. These chuffs occur four per drive wheel revolution (eight on articulated steams) and are timed by motor revolutions using a motor sensor. The four chuffs vary, producing a satisfactory cadence.

Locomotive Throttle Control

The chuff magnitude changes with the throttle. Increasing the throttle causes the chuff sound to increase in magnitude determined by CV199. The amount of throttle change to cause this chuff sound increase is determined by CV200 for DCC or CV202 for DC. This chuff magnitude returns back automatically over a short time period to its initial magnitude.

Correspondingly, decreasing the throttle causes a change in chuff magnitude as well as playing coasting rod knock chuff sound. Decreasing the throttle causes the coasting rod knock chuff sound to play at a magnitude determined by CV198. This coasting rod knock chuff sound plays for a number of drive wheel revolutions determined by CV197, then returns to the normal chuff. The amount of throttle change to cause this coasting rod knock chuff sound to play is determined by CV201 for DCC or CV203 for DC.

Functions F5 and F6 allow manual control of the chuff magnitude. Pressing F5 repeatly allows the user to simulate a heavier load by increasing the chuff magnitude. The increased value of the chuff magnitude is represented by each press of F5 and is set by CV204. Pressing F6 repeatly allows the user to simulate a lighter load by decreasing the chuff magnitude. The decreased value of the chuff magnitude is represented by each press of F6 and is set by CV205.

Chuff Control (cont)

Locomotive Loading Control

The locomotive power is monitored and filtered according to two CV's. CV211 contains a threshold determining the required locomotive power needed to play the power chuff. Once the power level falls above or below the threshold, the chuff changes. CV189 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 CV206. This scalar changes the thresholds of CV211, altering the power load threshold providing proper chuff 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 CV207. This scalar changes the thresholds of CV211, altering the power load threshold providing proper chuff changes from power load during operation.

Should the desired power thresholds need to be changed, a simple tuning method may be used. Set CV211 to 255. Now, thel power threshold is disabled. While running in DCC, change CV211, lowering it until the chuff changes at the desired power load. DC mode will require more work, since changing while running is not allowed.

Setting bit 1 in CV246 will disable locomotive load power control.

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 (Vmax > Vmin) is the control range. This control voltage value determines the locomotive speed.

Note: Vmin < Vmax. 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: Vmax > Vin. 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.

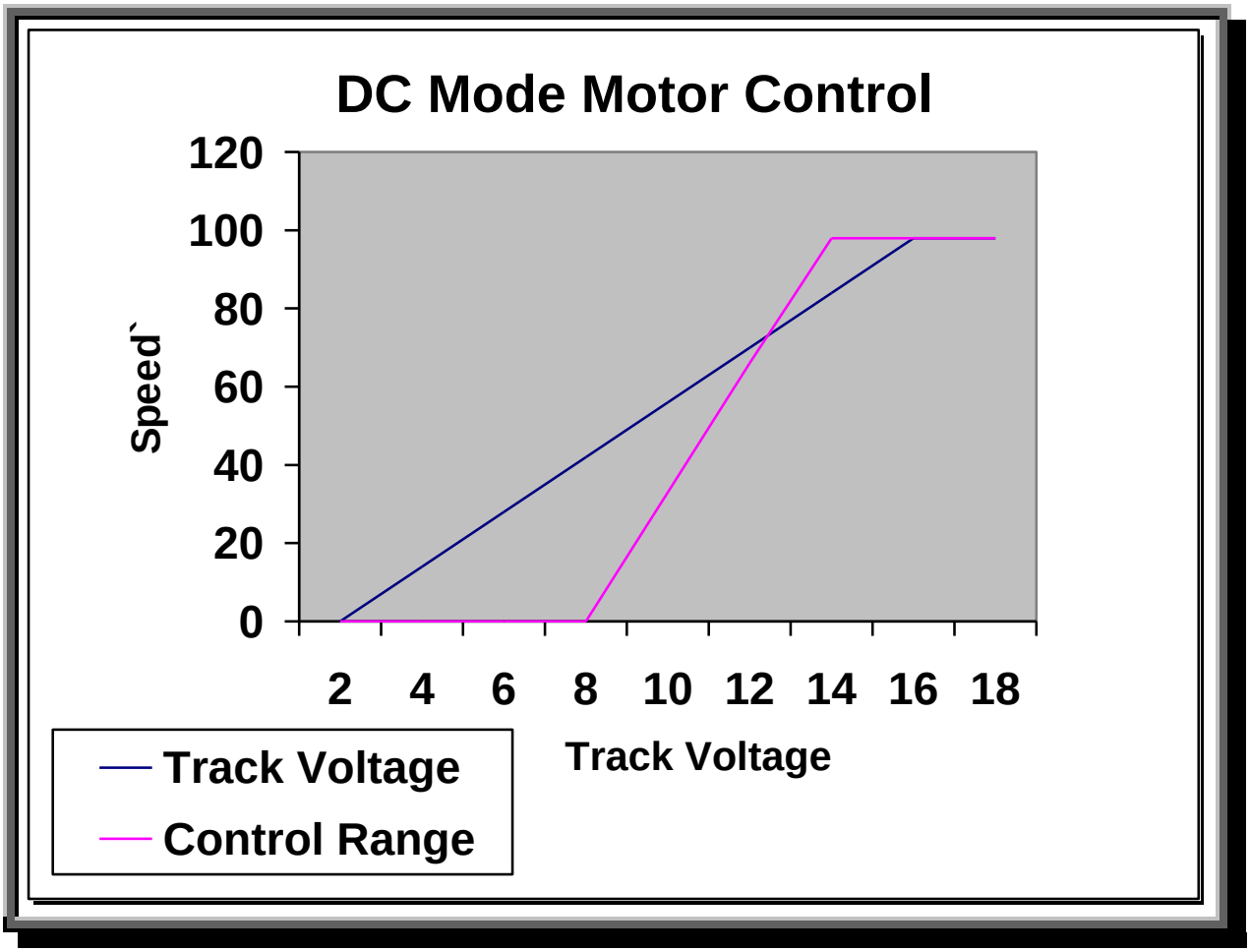


Figure 1

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, than 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 30 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, than 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.

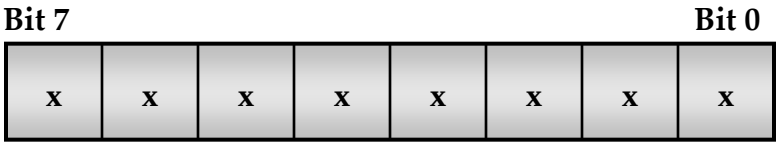
Our sound decoder supports the NMRA standard and allows the enabling/disabling of these functions F0 thru F12. Similiarly, F13 thru F28 may be enabled/disabled with CV121 and CV122.

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.



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:

CV21=255	F1 thru F8 enabled for consist address
CV22=255	F0 and F9 thru F12 enabled for consist address
CV121=255	F13 thru F20 are enabled for consist address
CV122=255	F21 thru F28 are enabled for consist address
CV229=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:

CV21=176	F1, F2, F3, F4, F7 disabled and F5, F6 and F8 enabled for consist address
CV22=5	F0 and F10 thru F12 disabled and F9 enabled for consist address
CV121=255	F13 thru F20 are disabled for consist address
CV122=96	F26 and F27 are enabled for consist address
CV229=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:

CV21=176	F1, F2, F3, F4, F7 disabled and F5, F6 and F8 enabled for consist address
CV22=5	F0 and F10 thru F12 disabled and F9 enabled for consist address
CV121=255	F13 thru F20 are disabled for consist address
CV122=96	F26 and F27 are enabled for consist address
CV229=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

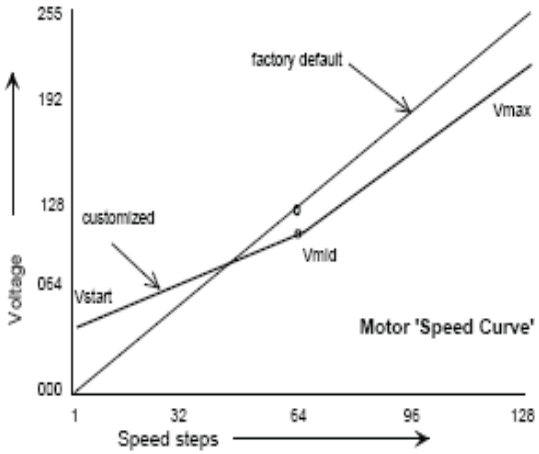
Description
This Value Determines the Motor Speed at Step One
Values
0-255
Initial Value
1
Related CVs
CV5, CV6, CV66, CV95, CV29 Bit 4, CV120

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
Vhigh

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 Vstart and Vmid.

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 CVs back to their original manufactured values unless the unit is locked.
10	Loads and Saves Factory Stored Macro
16	Saves Recorded Macro
18	Initializes Rolling Thunder to last saves values
38	Sets F0 thru F12 to match the Blue Line engine function keys
100	Locks CV's while moving
101	Unlocks CV's while moving
113	Sets F0 thru F12 to match QSI engine function keys
141	Sets F0 thru F12 to match SoundTraxx engine function keys

254	Resets all CVs back to their original manufactured values even if the unit is locked.

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

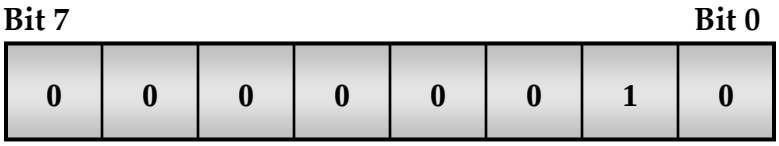
Bit 7							Bit 0
0	0	0	0	0	0	0	1

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



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 0000 0000

SYSTEM CVs

CV19
Consist Address

Description
The Decoders Consist Address is Stored Here
Values
0-255
Initial Value
0
Related CVs
CV21, CV22, 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, 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, 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.

Function Controlled	**Assigned Value**
Nothing	0
Front/Rear Lights	1
Bell Sound	2
Horn Sound	3
Couple/Uncouple Sound	4
Air Pump Sound	5
Blow Down/Chuff Magnitude Increase	6
Water Fill/Chuff Magnitude Decrease/Startup	7
L1 Function	8
Mute/Volume Control	9
Startup/Shutdown Sounds	10
Shoveling Coal Sound	11
Water Injector Sound	12
Brake Set/Release/Squeal Sound	13
Steam Cock	14
Pop-Off Valve	15
Wheel Flange Sound	16
Coupler Slack/Couple Sound	17
Brake Squeal Sound	18
Horn2 Toggle	19
Complete Horn	20

FUNCTION CVs

CV33-CV61
F0 – F28 Function Definitions (continued)

Function Controlled	Assigned Value
Smoke Control	21
Blower	22
L4 Function	24
L5 Function	25
Dynamo	28
Horn Grade Crossing Sound	30
Track Sounds	31
Johnson Bar	32
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, CV150, 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. Turning the lights on activates the Dynamo sound effect. The effect runs and than fades off. Turining the lights off de-activates the Dyanmo. The Dynamo is turned off and than fades off.

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 (Whistle)
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 whistle or 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 whistle or 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, CV178, CV179, 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 (Air Pump)
Related CVs
CV33—CV61; CV143

Bit 7							Bit 0
0	0	0	0	0	1	0	1

Pressing this function toggles the air pump sound on and off. The air pump may be activated stopped or running.

FUNCTION CVs

CV38
F5 Output Function Definition

Description
Selects Which Function(s) F5 Activates
Values
0 to 255
Initial Value
6 (Blow Down/Chuff IntensityUp)
Related CVs
CV33—CV61; CV144, CV204

Bit 7							Bit 0
0	0	0	0	0	1	1	0

Pressing this function while the engine is stopped activates the blow down sound effect. While the locomotive is moving, pressing this function increases the chuff intensity. The chuff magnitude automatically returns to its previous value over a time period.

See Chuff Control.

FUNCTION CVs

CV39
F6 Output Function Definition

Description
Selects Which Function(s) F6 Activates
Values
0 to 255
Initial Value
7 (Water Fill/Chuff Intensity Down/Startup)
Related CVs
CV33—CV61; CV153, CV205, CV245

Bit 7							Bit 0
0	0	0	0	0	1	1	1

Pressing this function while the engine is stopped activates the water fill sound effect. While the locomotive is moving, pressing this function decreases the chuff intensity. The chuff magnitude automatically returns to its previous value over a time period. If the locomotive is stopped and the sounds are off, the sound unit is activated. If the locomotive sound system is off, pressing this function starts the sound system.

See Chuff Control.

FUNCTION CVs

CV40
F7 Output Function Definition

Description
Selects Which Function(s) F7 Activates
Values
0 to 255
Initial Value
21 (Smoke Control)
Related CVs
CV33—CV61; CV234, CV235, CV236, CV237, CV246

Bit 7							Bit 0
0	0	0	1	0	1	0	1

Repeated pressing of this function key toggles the smoke output on and off if the locomotive is equipped with a smoke unit. The smoke unit may be powered up on or off with CV246 bit 7. The smoke unit may be highly customized by controlling the fan chuff time on (CV234), the fan idle power (CV235), the heat applied during the chuff (CV236) and the heat applied at idle (CV237).

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; CV133, CV134, 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 (Shovel Coal Audio Effect)
Related CVs
CV33—CV61; CV152

Bit 7							Bit 0
0	0	0	0	1	0	1	1

Pressing this function toggles the shovel coal sound effect on and off.

FUNCTION CVs

CV44
F11 Output Function Definition

Description
Selects Which Function(s) F11 Activates
Values
0 to 255
Initial Value
12 (Water Injectors Effects)
Related CVs
CV33—CV61; CV154

Bit 7							Bit 0
0	0	0	0	1	1	0	0

Pressing this function when the locomotive is stopped or moving plays the water injector 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/Brake Release)
Related CVs
CV33—CV61; CV146, CV147

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, CV156

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. CV156 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, CV156

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. CV156 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; CV157

Bit 7							Bit 0
0	0	1	1	0	1	0	0

Pressing this function activates a random Maintenance Sound. CV157 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; CV157

Bit 7							Bit 0
0	0	1	1	0	1	0	1

Pressing this function activates a random Radio Chatter Sound. CV157 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; CV158

Bit 7							Bit 0
0	0	1	1	0	1	1	0

Pressing this function activates a random City Sound. CV158 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; CV158

Bit 7							Bit 0
0	**0**	**1**	**1**	**0**	**1**	**1**	**1**

Pressing this function activates a random Farm Sound. CV158 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; CV158

Bit 7							Bit 0
0	0	1	1	1	0	0	0

Pressing this function activates a random Industrial Sound. CV158 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; CV158

Bit 7							Bit 0
0	0	1	1	1	0	0	1

Pressing this function activates a random Lumber Sound. CV158 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, CV224

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. The secondary horn may not be changed.

FUNCTION CVs

CV56
F23 Output Function Definition

Description
Selects Which Function(s) F23 Activates
Values
0 to 255
Initial Value
8 (L1 Control)
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 (L1 Control)
Related CVs
CV33—CV61; CV159 – CV164, CV225, CV229

Bit 7							Bit 0
0	0	0	0	1	0	0	0

Repeated pressing of this function key toggles the L1 output on and off. L1 may be configured for many different functions. See the CV's listed above.

FUNCTION CVs

CV58
F25 Output Function Definition

Description
Selects Which Function(s) F25 Activates
Values
0 to 255
Initial Value
0
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 form 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 ÷ 128 x (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 ÷ 128 x (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.

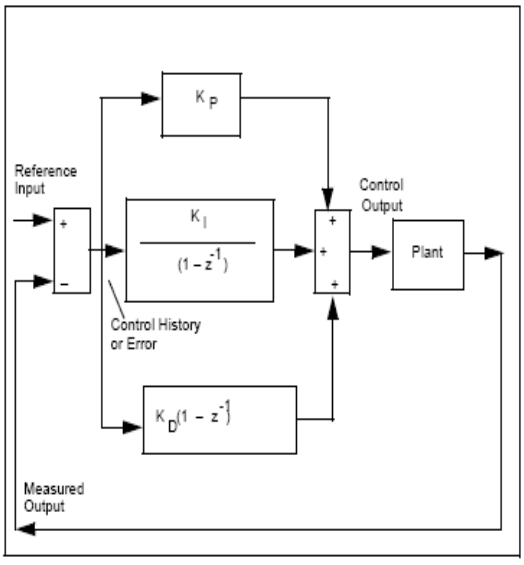
SYSTEM CVs

CV112-113
Kp

Description
The Proportional Gain of the Motor Controller
Values
0-32767
Initial Value
CV113=72; 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.



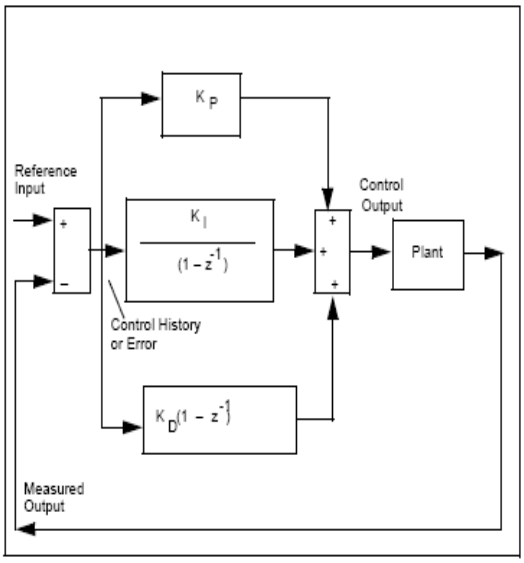
SYSTEM CVs

CV114-115
Ki

Description
The Integral Gain of the Motor Controller
Values
0-32767
Initial Value
CV115=8; CV114=0
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.



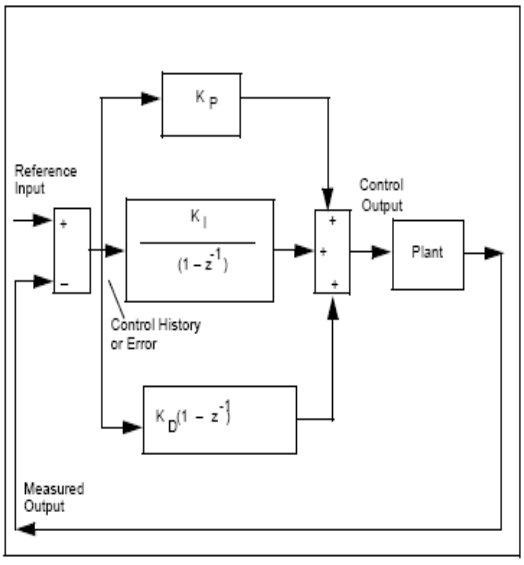
SYSTEM CVs

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
60
Related CVs
CV112—CV120

Bit 7							Bit 0
0	0	1	1	1	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

CV119
DC Alpha Filter

Description
This Value Controls a Value that Controls a Low Pass Filter for DC Track reading
Values
1-255
Initial Value
22
Related CVs
CV248 -- CV253

Bit 7							Bit 0
0	0	1	0	0	0	1	0

The Alpha value is used in the DC low pass filter, allowing better speed control in DC mode.

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
78
Related CVs
CV130, CV132, CV133, CV134

Bit 7							Bit 0
0	1	0	0	1	1	1	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
62
Related CVs
CV130, CV131, CV133, CV134

Bit 7							Bit 0
0	0	1	1	1	1	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
Whistle Volume

Description
This Value Controls the Whistle 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 whistle 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, CV180

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
Steam Volume

Description
This Value Controls the Startup, Three Backgrounds 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 steam engine sound effects 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: steam startup, three unique steam backgrounds and steam shutdown sound effects.

SOUND CVs

CV138
Whistle/Horn2 Volume

Description
This Value Controls the Whistle/Horn2 Sound Effects Volume
Values
0 to 255
Initial Value
128
Related CVs
CV55, CV133

Bit 7							Bit 0
1	0	0	0	0	0	0	0

The decoder's whistle/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
CV36, 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
CV36, 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
Air Pump Volume

Description
This Value Controls the Air Pump 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 air pump sound effect volume is variable from 0 to 255. The air pump sound effect plays if the engine is moving or 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
Blow Down Volume

Description
This Value Controls the Blow Down Sound Effects Volume
Values
0 to 255
Initial Value
128
Related CVs
CV38, CV133

Bit 7							Bit 0
1	0	0	0	0	0	0	0

The decoder's blow down sound effect volume is variable from 0 to 255. This sound effect may be activated if the locomotive is stopped and is also a random sound effect when stopped. A higher value increases the volume while a lower value decreases the volume.

SOUND CVs

CV145
Steam Cock Volume

Description
This Value Controls the Steam Cock 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 steam cock sound effects volume is variable from 0 to 255. This sound effect is a random sound effect that only plays 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
CV45, 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
CV45, 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
Pop Off Valve Volume

Description
This Value Controls the Pop Off 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 pop-off valve sound effect volume is variable from 0 to 255. The pop-off 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
Blower Volume

Description
This Value Controls the Blower 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 blower sound effect volume is variable from 0 to 255. This sound effect is a random sound effect when the locomotive is stopped. A higher value increases the volume while a lower value decreases the volume.

SOUND CVs

CV150
Dynamo Volume

Description
This Value Controls the Dynamo Sound Effects Volume
Values
0 to 255
Initial Value
128
Related CVs
CV33, CV133

Bit 7							Bit 0
1	0	0	0	0	0	0	0

The decoder's dynamo sound effect volume is variable from 0 to 255. The dynamo on sound effect plays for a short period before the headlights are turned on. The sound effect then fades into the background. The dynamo off sound effect plays for a short period after the lights are turned off. The sound effect then fades into the background. 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
CV61, 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
Shovel/Auger Coal Volume

Description
This Value Controls the Shovel Coal Sound Effects Volume
Values
0 to 255
Initial Value
128
Related CVs
CV43, CV133

Bit 7							Bit 0
1	0	0	0	0	0	0	0

The decoder's shovel/auger coal sound effect volume is variable from 0 to 255. The shovel/auger coal sound effect is active on stopped locomotives and also randomly plays when the engine is stopped. A higher value increases the volume while a lower value decreases the volume.

SOUND CVs

CV153
Water Fill Volume

Description
This Value Controls the Water Fill Sound Effects Volume
Values
0 to 255
Initial Value
100
Related CVs
CV39, CV133

Bit 7							Bit 0
0	1	1	0	0	1	0	0

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

SOUND CVs

CV154
Injector Volume

Description
This Value Controls the Water Injector Sound Effects Volume
Values
0 to 255
Initial Value
100
Related CVs
CV44, CV133

Bit 7							Bit 0
0	1	1	0	0	1	0	0

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

SOUND CVs

CV155
Chuff/Steam Cock Chuffs Volume

Description
This Value Controls the Chuff and Steam Cock Chuffs Sound Effects Volume
Values
0 to 255
Initial Value
128
Related CVs
CV133, CV196

Bit 7 **Bit 0**

1	0	0	0	0	0	0	0

The decoder's chuff and steam cock chuffs sound effect volume is variable from 0 to 255%. A higher value increases the volume while a lower value decreases the volume.

See Chuff Control.

SOUND CVs

CV156
Station/Yard Volume

Description
This Value Controls the Station and Yard Sound Effects Volume
Values
0 to 255
Initial Value
128
Related CVs
CV47, CV48, 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.
See Yard Sounds.

SOUND CVs

CV157
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
CV49, CV50, 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.

SOUND CVs

CV158
City/Farm/Industrial/Lumber Volume

Description
This Value Controls the Fuel Fill Sound Effects Volume
Values
0 to 255
Initial Value
128
Related CVs
CV51, CV52, CV53, CV54, 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

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 sidetracks 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: 0=smokeunit logic reversed from D5/D6 below for L4/L5;
1=smokeunit logic follows D5/D6 below
Bit6: 0=L5 Active Low; 1=Active High
Bit5: 0=L4 Active Low; 1=Active High
Bit4: 0=L1 powerup on
Bit3: 0=L4/L5 Power-Up On
Bit2: 0=Headlight Power-Up On
1=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

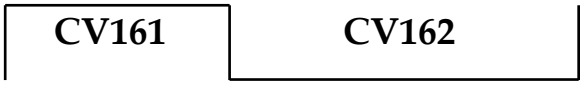
Bit 7							Bit 0
1	0	0	0	0	0	1	1

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. The L1 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)

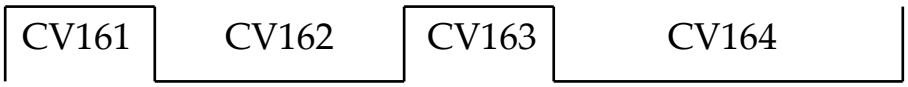
Type 0: Output is disabled.

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.



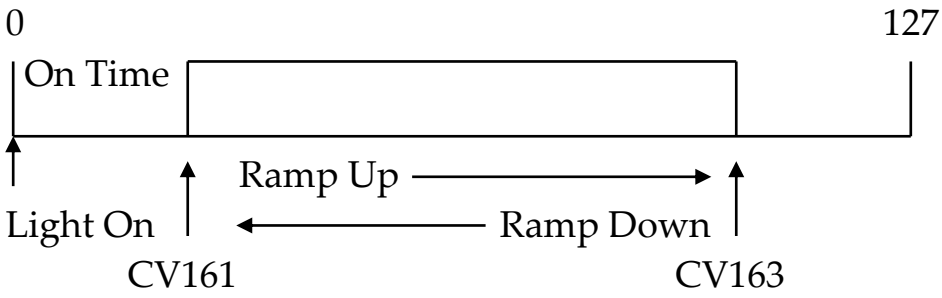
Example: CV160=1
CV161=32 for 1 second on
CV162=64 for 2 seconds off

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

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 90.7usec 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 90.7usec per count

Lighting CVs

CV165
L4 Output Type

Description
This Value Sets the Function Type and Definition for Output L4
Values
0, 4
Initial Value
Varies with Locomotive
Related CVs
CV166

Bit 7							Bit 0
0	0	0	0	0	x	x	x

The decoder's visual lighting effects for L4 output is as selected below. Each defined type then uses 1 to 4 of the next 4 CV's allowing uses definition of all the parameters. At present only Parameter One is defined.

Bit7: Not Used
Bit6: Not Used
Bit5-Bit0: Type (0-4)
Type 0: Output is disabled.
Type 4: Firebox Flicker (Only if unit has this feature)

Lighting CVs

CV166
L4 Parameter One

Description
This Value is a Light Parameter, Dependant on CV165
Values
Dependant on Type
Initial Value
0
Related CVs
CV165

Bit 7							Bit 0
0	0	0	0	0	0	0	0

0 – User activates the feature
1 – Startup lights activates the feature

Lighting CVs

CV170
L5 Output Type

Description
This Value Sets the Function Type and Definition for Output L5
Values
0, 4
Initial Value
Varies with Locomotive
Related CVs
CV171

Bit 7							Bit 0
0	0	0	0	0	x	x	x

The decoder's visual lighting effects for L5 output is as selected below. Each defined type then uses 1 to 4 of the next 4 CV's allowing uses definition of all the parameters. At present only Parameter One is defined.

Bit7: Not Used
Bit6: Not Used
Bit5-Bit0: Type (0-4)
Type 0: Output is disabled.
Type 4: Firebox Flicker (Only if unit has this feature)

Lighting CVs

CV171
L5 Parameter One

Description
This Value is a Light Parameter, Dependant on CV170
Values
Dependant on Type
Initial Value
0
Related CVs
CV170

Bit 7							Bit 0
0	0	0	0	0	0	0	0

0 – User activates the feature
1 – Startup lights activates the feature

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

CV182
Whistle Heat Power

Description
This Value Controls the Whistle Heat/Smoke
Values
0-110
Initial Value
Varies
Related CVs
CV183

Bit 7							Bit 0
0	0	0	0	0	0	0	0

On Locomotives equipped with whistle smoke, the amount of heat applied to generate smoke when the main whistle sound effect is activated is contolled by this CV. A value of 0 turns off the smoke heater and a value of 110 is maimum heat. Please be sure to always maintain enough oil in the smoke unit. (Not used in M3 N Gage decoders).

SETUP CVs

CV183
Whistle Fan Power

Description
This Value Controls the Whistle Fan/Smoke
Values
0-255
Initial Value
Varies
Related CVs
CV182

Bit 7							Bit 0
0	0	0	0	0	0	0	0

On Locomotives equipped with whistle smoke, the fan speed may be adjusted from 0 (off) to 255 (maximum), which pushes out the plume of smoke when the main whistle sound effect is activated. Please be sure to always maintain enough oil in the smoke unit. (Not used in M3 N Gage decoders).

SETUP CVs

CV184
DC Brake Control

Description
This Value Controls DC Brake Effect Activation
Values
0-255
Initial Value
20
Related CVs
CV45, CV61, 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
CV45, CV61, 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
CV45, CV61, 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

CV189
Motor Load Chuff 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. If the power requirement change enough, the chuff 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.

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.

Value	What is saved	Destination of Saved Track Voltage
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
76
Related CVs
CV146, CV190, CV192

Bit 7							Bit 0
0	1	0	0	1	1	0	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
85
Related CVs
CV147, CV190, CV191

Bit 7							Bit 0
0	1	0	1	0	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
Articulated Chuff Type

Description
The Sound Memory Device sets this Value
Values
0-255
Initial Value
Varies
Related CVs
CV194, CV195

Bit 7							Bit 0
x	0	0	0	0	0	0	0

The steam type -- articulated or non-articulated is stored here and used by the decoder. Clearing this value on an articulated steam will force the steam into normal steam sounds mode. A reset will set this back to the defined locomotive.

Bit7: Articulated = 1
Bit0: M2 smoke unit locomotive = 1

SETUP CVs

CV194
Articulated Chuff Offset

Description
This Value Sets the Startup Articulated Chuff Offset
Values
0-25 or 0-Motor to Axle Ratio
Initial Value
17
Related CVs
CV195

Bit 7							Bit 0
0	0	0	1	0	0	0	1

The articulated chuff sounds may occur in sync with the main chuff or retarded from 1 to 255. Setting this value to zero and CV195 to zero causes only one set of chuffs to be heard. Setting CV195 to zero and setting this value from 1 to 255 causes the articulated chuff sound to be fixed. **Note: This feature is enabled only in articulated engines.**

SETUP CVs

CV195
Articulated Chuff Timer

Description
This Timer Determines When the Articulated Chuff Slips
Values
0-255
Initial Value
2
Related CVs
CV194

Bit 7							Bit 0
0	0	0	0	0	0	1	0

The articulated chuff sound slips every time value counts down to zero. Each count is 1/8 second. Setting this value to zero disables the articulated chuff slip. **Note: This feature is enabled only in articulated engines.**

SETUP CVs

CV196
Steam Cock Chuffs Event Count

Description
This Value Sets the Steam Cock Chuff Event Counter
Values
0-255
Initial Value
2
Related CVs
CV155

Bit 7							Bit 0
0	0	0	0	0	0	1	0

The decoder's steam cock chuffs sound effect is activated at the initial power up and after the engine is stopped from moving for 30 seconds. This value determines how many sets of four chuffs or drive wheel revolutions this sound effect plays at initial motion before the normal chuffs start playing. Increasing this value increases the amount of steam cock chuffs at first motion while decreasing this values decrease the amount of steam cock chuffs. Setting this value to zero turns off this sound effect. CV155 controls the volume of this sound effect. **Note: This value is ½ for articulated locomotives. The default value of two will enable the steam cock chuffs for one wheel rotation.**

SETUP CVs

CV197
Rod Knock Chuffs Event Count

Description
This Value Sets the Rod Knock Event Counter
Values
0-255
Initial Value
2
Related CVs
CV198, CV201, CV203

Bit 7							Bit 0
0	0	0	0	0	0	1	0

The decoder's rod knock sound effects play during a de-acceleration. This de-acceleration change is determined by CV203 for DC and CV201 for DCC. The automatic volume change is determined by CV198. The value for CV197, determines how many wheel revelations the rod knock chuff plays. The rod knock sound effect only plays if deaceleration occurs at throttle values 50% or greater.

SETUP CVs

CV198
Rod Knock Volume

Description
This Value Sets the Rod Knock Volume Sound Effect
Values
0-255
Initial Value
90
Related CVs
CV197, CV201, CV203

Bit 7							Bit 0
0	1	0	1	1	0	1	0

The decoder's rod knock sound effects play during a de-acceleration. This de-acceleration change is determined by CV203 for DC and CV201 for DCC. The automatic volume change is determined by CV198. The value for CV197, determines how many wheel revelations the rod knock chuff plays. The rod knock volume is applied when the de-acceleration parameter is met. This volume is slowly returned back to its initial volume as the normal chuffs play.

SETUP CVs

CV199
Chuff Magnitude Increase Volume

Description
This Value Sets Chuff Magnitude Increased Volume Sound Effect
Values
0-255
Initial Value
200
Related CVs
CV155, CV200, CV202

Bit 7							Bit 0
1	1	0	0	1	0	0	0

The decoder's chuff sound effects magnitude changes during acceleration. This acceleration is determined by CV202 for DC and CV200 for DCC. This value for CV199 determines the magnitude change from the normal chuff. Assume that CV155 is 100. If CV199 is 200, than the magnitude difference is 100%. **Note: If CV155 is set higher than CV199, than a magnitude difference will be difficult to hear.**

SETUP CVs

CV200
DCC Throttle Magnitude Increase

Description
This Value Sets the DCC Throttle Magnitude Increase Sound
Values
0-255
Initial Value
0
Related CVs
CV186, CV199, CV201

Bit 7							Bit 0
0	0	0	0	0	0	0	0

An increasing change in throttle causes the chuff sound effects magnitude to increase. This value determines the throttle change over time that triggers this magnitude change in the chuff sound effect. CV186 determines the throttle sample time period. Increasing this value increases the throttle stops necessary over the timed period CV186 to trigger this event. Decreasing this value decreases the throttle stops necessary over the timed period CV186 to trigger this event.

SETUP CVs

CV201
DCC Throttle Magnitude Decrease

Description
This Value Sets the DCC Throttle Magnitude Decrease Sound
Values
0-255
Initial Value
0
Related CVs
CV186, CV197, CV198, CV199, CV200

Bit 7							Bit 0
0	0	0	0	0	0	0	0

A decreasing change in throttle causes the chuff sound effects magnitude to decrease. Also, the chuff sounds changes to a rod knock sound. See CV197 and CV198. This value, CV201, determines the throttle change over time that triggers this magnitude change in the chuff sound effect. CV186 determines the throttle sample time period. Increasing this value increases the throttle stops necessary over the timed period CV186 to trigger this event. Decreasing this value decreases the throttle stops necessary over the timed period CV186 to trigger this event.

SETUP CVs

CV202
DC Track Change Magnitude Increase

Description
This Value Sets the DC Track Voltage Necessary for a Chuff Magnitude Increase
Values
0-255
Initial Value
20
Related CVs
CV199, CV203

Bit 7							Bit 0
0	0	0	1	0	1	0	0

An increasing change in track voltage causes the chuff sound effects magnitude to increase. This value determines the track voltage increase necessary to trigger this event. Increasing this value increases the track voltage change necessary to trigger this event. Decreasing this value decreases the track voltage change necessary to trigger this event.

SETUP CVs

CV203
DC Track Change Magnitude Decrease

Description
This Value Sets the DC Track Voltage Necessary for a Chuff Magnitude Decrease
Values
0-255
Initial Value
20
Related CVs
CV197, CV198, CV199, CV202

Bit 7							Bit 0
0	0	0	1	0	1	0	0

A decreasing change in track voltage causes the chuff sound effects magnitude to decrease. Also, the chuff sounds changes to a rod knock sound. See CV197 and CV198. This value determines the track voltage decrease necessary to trigger this event. Increasing this value increases the track voltage change necessary to trigger this event. Decreasing this value decreases the track voltage change necessary to trigger this event.

SETUP CVs

CV204
F5 Chuff Magnitude Change Increment

Description
This Value Sets the Change Increment for F5
Values
0-255
Initial Value
32
Related CVs
CV199, CV205

Bit 7							Bit 0
0	0	1	0	0	0	0	0

Pressing the F5 or its assigned function key increases the chuff magnitude. Each successive press increases the chuff magnitude until the magnitude reaches 255%. This value determines the increase per press. The chuff magnitude automatically returns to its previous value over a time period.

SETUP CVs

CV205
F6 Chuff Magnitude Change Decrement

Description
This Value Sets the Change Decrement for F6
Values
0-255
Initial Value
32
Related CVs
CV199, CV204

Bit 7							Bit 0
0	0	1	0	0	0	0	0

Pressing the F6 or its assigned function key decreases the chuff magnitude. Each successive press decreases the chuff magnitude until the magnitude reaches 0%. This value determines the decrease per press. The chuff magnitude automatically returns to its previous value over a time period.

SETUP CVs

CV206
DC Chuff Motor Power Scalar

Description
This Value Scales the Motor Load Power Rev Level Sound Effects
Values
0-255
Initial Value
200
Related CVs
CV193—CV202

Bit 7							Bit 0
1	1	0	0	1	0	0	0

The decoder's rev levels change when the motor power or falls below the load power thresholds at CV193 through CV199. However, the DCC operating voltage is 14 Volts while the DC starts much lower. The lower DC voltage means a larger amount of power is necessary to produce the same speeds. This larger amount of power results in the load power thresholds at CV193 through CV199 being too low for DC mode. CV200 is a scalar that is multiplied to each motor load power threshold. The scalar is in percent, thus 200 means 200% or 2 times the values saved in CV193 through CV199.

SETUP CVs

CV207
N Gage Rev Level Motor Power Scalar

Description
This Value Scales the Motor 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.

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

CV211
Power Chuff Threshold

Description
This Value Sets the Motor Power Threshold for the Power Chuff Sound Effect
Values
0-255
Initial Value
190
Related CVs
CV246

Bit 7							Bit 0
1	0	1	1	1	1	1	0

The decoder's sound effect for a labored chuff occurs when the motor power exceeds this value. Increasing this value means more motor power will be required to activate the power chuff. CV246 Bit 1 may be set to disable this feature.

See Chuff Control.

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.

CONTROL 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:

	915mhz	**868mhz**
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

CV215
Coal Load Decrease Time

Description
This Value Sets the Time between Coal Loads down Movments
Values
0-255
Initial Value
Varies
Related CVs
CV216

Bit 7							Bit 0
0	0	0	0	0	0	0	0

The coal will decrease from its maximum full load position (up) to its depleted, emply load position (down) over time. There are 35 positions of movement, 34 to 0, from full to empty. This CV controls the time interval between steps. A value of 0 stops the coal pile from moving, while 1 to 255 is the time in seconds between coal movements down. (Used in some models)

CONTROL CVs

CV216
Coal Load Saved Position

Description
This Value Sets the Coal Load Position
Values
0-34
Initial Value
Varies
Related CVs
CV215

Bit 7							Bit 0
0	0	0	0	0	0	0	0

This value sets the present coal pile position from 0=no coal to 34=full load of coal. (Used in some models)

CONTROL CVs

CV218
Smoke Unit Idle Set Point

Description
This Value Sets the Smoke Units Idle Temperature Set Point
Values
0-255
Initial Value
70
Related CVs
CV218, *CV219*, *CV232*, *CV233*, *CV244*, *CV235*, *CV236*, *CV237*

Bit 7							Bit 0
0	1	0	0	0	1	1	0

Increasing this value increases the heat to the smoke unit under idle conditions. Higher values will produce more smoke, but the oil will burn out quicker. (Not used in M3 N Gage decoders).

CONTROL CVs

CV219
Smoke Unit Chuff Set Point

Description
This Value Sets the Smoke Units Chuff Temperature Set Point
Values
0-255
Initial Value
80
Related CVs
CV218, *CV219*, *CV232*, *CV233*, *CV244*, *CV235*, *CV236*, *CV237*

Bit 7							Bit 0
0	1	0	1	0	0	0	0

Increasing this value increases the heat to the smoke unit when chuffing. Higher values will produce more smoke, but the oil will burn out quicker. (Not used in M3 N Gage decoders).

CONTROL CVs

CV220
Chuff Timer for Broken Chuff Sensor

Description
This Value Times the Next Chuff
Values
0-255
Initial Value
150
Related CVs
CV246

Bit 7							Bit 0
0	0	0	0	0	0	0	0

If CV246 D6=1 the locomotive uses this value as a timer to generate chuffs. These CV's are useful if the chuff sensor becomes damaged. The gear ratio differs from locomotive to locomotive so this value needs to be adjusted for each locomotive.

CONTROL CVs

CV221
Unique Control One

Description
This Value Sets any Locomotive Unique Functions
Values
0-255
Initial Value
Locomotive Specific
Related CVs

Bit 7							Bit 0
0	0	0	0	0	0	0	0

Bit 5: 0=keep alive active; 1=keep alive off
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

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
Front/Rear Lights	1
Bell Sound	2
Horn Sound	3
Couple/Uncouple Sound	4
Air Pump Sound	5
Blow Down/Chuff Intensity Up	6
Water Fill/Chuff Intensity Down/Startup	7

Function Controlled	Assigned Value
L1 Function	8
Mute/Volume Control	9
Startup/Shutdown Sounds	10
Shovel Coal Sound	11
Water Injector Sound	12
Brake Set/Release/Squeal Sound	13
SteamCock	14
PopOffValve	15
Wheel Flange Sound	16
Coupler Slack/Couple Sound	17
Brake Squeal Sound	18
Horn2 Toggle	19
Complete Horn	20
Smoke Control	21
Blower	22
L4/L5	24/25
Dynamo	28
Horn Grade Crossing Sound	30
Track Sounds/Johnson Bar	31/32
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

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
Whistle/Horn Select

Description
This Value determines which Whistle/Horn Plays when the Whistle/Horn is selected
Values
0-2
Initial Value
0
Related CVs
CV35, CV55

Bit 7 **Bit 0**

0	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Horn	Value
Default	0
Horn3	1
Horn4	2
Complete Horn	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
127
Related CVs
CV33, CV56, CV160

Bit 7 **Bit 0**

0	**1**	**1**	**1**	**1**	**1**	**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: 0-L5 Disabled
1=L5 Enabled(Next power cycle)
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: 1=motor waits for warning toots to finish
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
247
Related CVs
CV19, CV21, CV22

Bit 7							Bit 0
1	1	1	1	0	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, CV121, CV122, 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, CV121, CV122). All lights except the rear light enabled (CV229)
2 = **Middle Engine**--All consist function keys except F0, F8, F9, F26 and F27 disabled (CV21, CV22, CV121, CV122). All lights disabled (CV229)
3 = **Rear Engine**
All consist function keys except F0, F8, F9, F26 and F27 disabled (CV21, CV22, CV121, CV122). 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, CV22, CV121 and CV122 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 accept 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, CV22, CV121 and CV122.

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), F9 (Startup), F26(Play Macro) and F27(Record Macro) when the consist is addressed. If a change in active function keys are required, modify CV21, CV22, CV121 and CV122.

Rear Engine

Only the forward light is 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), F9 (Startup) F26(Play Macro) and F27(Record Macro) when the consist is addressed. If a change in active function keys are required, modify CV21, CV22, CV121 and CV122.

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
0-100
Initial Value
100
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 0-4 makes the lights dimmest and a value of 100 makes the lights brightest. If Rule 17 is enabled (CV159 Bit 0), a value of 4-10 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

CV232
Fan Idle Power

Description
This Value Sets the Fan Idle Speed
Values
0-255
Initial Value
8
Related CVs
CV218, *CV219*, *CV232*, *CV233*, *CV244*, *CV235*, *CV236*, *CV237*, CV246

Bit 7							Bit 0
1	0	0	1	0	1	1	0

The fan is designed to spin very slowly. During idle times, a small amount of smoke may be desired. This value determines the fan speed during the idle times. Increasing this value increases the fan speed, while decreasing thei value decreases the fan speed.

CONTROL CVs

CV233
Fan Normal Chuff Power

Description
This Value Sets the Fan Normal Chuff Speed
Values
0-255
Initial Value
60
Related CVs
CV218, *CV219*, *CV232*, *CV233*, *CV244*, *CV235*, *CV236*, *CV237*, CV246

Bit 7 **Bit 0**

1	**0**	**0**	**1**	**0**	**1**	**1**	**0**

The fan is designed to increase speed quickly. During chuff times, a larger amount of smoke is desired. This value determines the fan speed during the normal chuff times Increasing this value increases the fan speed, while decreasing thei value decreases the fan speed. Increasing this value makes the smoke push up higher, but thinner.

CONTROL CVs

CV234
Fan Loaded Chuff Power

Description
This Value Sets the Fan Loaded Chuff Speed
Values
0-255
Initial Value
80
Related CVs
CV218, *CV219*, *CV232*, *CV233*, *CV244*, *CV235*, *CV236*, *CV237*, CV246

Bit 7							Bit 0
0	0	0	1	1	0	0	1

The fan is designed to increase speed quickly. During loaded chuff times, a larger amount of smoke (from normal chuffs) is desired. This value determines the fan speed during the loaded chuff times Increasing this value increases the fan speed, while decreasing thei value decreases the fan speed. Increasing this value makes the smoke push up higher, but thinner.

CONTROL CVs

CV235
Fan Steam Cock Chuff Power

Description
This Value Sets the Fan Steam Cock Chuff Speed
Values
0-255
Initial Value
70
Related CVs
CV218, *CV219*, *CV232*, *CV233*, *CV244*, *CV235*, *CV236*, *CV237*, CV246

Bit 7							Bit 0
1	1	1	1	1	0	1	0

The fan is designed to increase speed quickly. During steam cock chuff times, a larger amount of smoke (from normal chuffs) is desired. This value determines the fan speed during the steam cock chuff times Increasing this value increases the fan speed, while decreasing thei value decreases the fan speed. Increasing this value makes the smoke push up higher, but thinner.

CONTROL CVs

CV236
Fan Rod Knock Chuff Power

Description
This Value Sets the Fan Rod Knock Chuff Speed
Values
0-255
Initial Value
40
Related CVs
CV218, *CV219*, *CV232*, *CV233*, *CV244*, *CV235*, *CV236*, *CV237*, CV246

Bit 7							Bit 0
0	1	0	1	0	0	0	0

The fan is designed to increase speed quickly. During rod knock chuff times, a smaller amount of smoke (from normal chuffs) is desired. This value determines the fan speed during the rod knock chuff times Increasing this value increases the fan speed, while decreasing thei value decreases the fan speed. Increasing this value makes the smoke push up higher, but thinner.

CONTROL CVs

CV237
Fan Chuff Time

Description
This Value Sets the Length of Time the Fan is on for Chuffs
Values
0-255
Initial Value
75
Related CVs
CV218, *CV219*, *CV232*, *CV233*, *CV244*, *CV235*, *CV236*, *CV237*, CV246

Bit 7							Bit 0
0	0	1	1	0	0	1	0

The desired fan power is applied at the start of a chuff event. This fan power is applied for a pre-determined amount of time, then reverts back to idle fan condition. The amounf of time the fan stays at the chuff event is determined by this value. Increasing this value increases the time the fan stays at the chuff event power level.

CONTROL CVs

CV238
Macro Recorder Control

Description
This Value Sets Up the Macro Recorder
Values
0-255
Initial Value
65
Related CVs
CV59, CV60, CV239, CV245

Bit 7							Bit 0
0	1	0	0	0	0	0	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

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

CV238
Macro Recorder Control (Continued)

point is early (before the actual start point), than 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.

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.**

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
BroadCast Stop Packet Count

Description
This Value Determines the Quantity of Stop Packets Needed
Values
0-255
Initial Value
38
Related CVs
None

Bit 7							Bit 0
0	**0**	**1**	**0**	**0**	**1**	**1**	**0**

sssdxbbb

sss=0-7 [0.5 seconds per count] [0.5-3.5 seconds]
d=1 disables the slowdown feature

The locomotive is slowed when the brake squeal is activated. The rate the locomotive slows is determined by values sss.

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

Some controllers can send broadcast stop packets which will halt the locomotive. The amount of consecutive broadcast packets may be set by placing a vale 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
(Usefult 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
(Usefule for real train play)
D1 – 0=Motor starts as soon as a move command is received
1=Motor waits until startup sound record finishes
(Usefule for real train play)
D0 – 0=Horn1 Long/Alternative Ending Disabled; Short Ending Only
1=Horn1 Long/Alternative Ending Enabled
(Useful for guaranteeing short signaling)

CONTROL CVs

CV246
General System Controls Two

Description
This Value Contains General Bits as Defined
Values
0-255
Initial Value
128
Related CVs
CV40, CV211

Bit 7							Bit 0
1	0	0	0	0	0	0	0

These bit value control the following:

D7 – 1=smoke unit powers up on; 0=smoke unit powers up off
D6 – 1= chuff sensor broke; calculate best chuff time
0= chuff sensor used
D5 – 0=Quantum Engineer Bell/Horn Detect **Off**
1=Quantum Engineer Bell/Horn Detect **On**
D2- 0=lock CV's while moving; 1=unlock
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)

A shut down (F9) turns the smoke unit off. User must manually turn back on or power-up follows bit D7.

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. 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, simple set your throttle to zero momentarily, than 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
20
Related CVs
CV245

Bit 7							Bit 0
0	0	0	1	0	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
70
Related CVs
CV252

Bit 7							Bit 0
0	1	0	0	0	1	1	0

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

See Advanced Motor 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.

See Advanced Motor Control.

CONTROL CVs

CV251
DC Motor Control Vmax

Description
This Value Contains the Motor Control Track Voltage Maximum
Values
0-255
Initial Value
120
Related CVs
CV249, CV252

Bit 7							Bit 0
0	1	1	1	1	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
92
Related CVs
CV29, CV249, CV251

Bit 7							Bit 0
0	1	0	1	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	Front/Rear Lighting
F1	Bell
F2	Horn
F3	**Not Moving:** Arm Coil Coupler Slack **Moving:** Plays Coil Couple
F4	Plays Air Pump
F5	Blow Down/Increase Chuff Intensity
F6	Water Fill/Decrease Chuff Intensity/Startup
F7	Smoke Control
F8	**Double Press:** System Volume Up or Down **Single Press:** All Sounds Muted Except Horn/Bell
F9	Startup or Shutdown
F10	Shovel Coal
F11	Water Injectors
F12	**Throttle Stop Zero:** Brake Set **Throttle Stop One:** Brake Release **Above Throttle Stop Five:** Brake Squeal
F13	Horn Grade Crossing
F14	Station Sounds
F15	Yard Sounds

DCC Function Keys
Blue Line

Function Key	Description
F16	Maintenance Sounds
F17	Radio Chatter Sounds
F18	City Sounds
F19	Farm Sounds
F20	Industrial Sounds
F21	Lumber Sounds
F22	Horn2 Toggle
F23	L1 Control
F24	Not Defined
F25	Not Defined
F26	Play Macro
F27	Record Macro
F28	Brake Squeal

DCC Function Keys
QSI

Function Key	Description
F0	Front/Rear Lighting
F1	Bell
F2	Horn
F3	**Not Moving:** Arm Coil Coupler Slack **Moving:** Plays Coil Couple
F4	Plays Air Pump
F5	Blow Down/Increase Chuff Intensity
F6	Water Fill/Decrease Chuff Intensity/Startup
F7	**Moving:** Wheel Flange
F8	**Double Press:** System Volume Up or Down **Single Press:** All Sounds Muted Except Horn/Bell
F9	Startup or Shutdown
F10	Maintenance Sounds
F11	Horn2 Toggle
F12	L1 Control
F13	Horn Grade Crossing
F14	Station Sounds
F15	Yard Sounds

DCC Function Keys
QSI

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

DCC Function Keys
Sound Traxx

Function Key	Description
F0	Front/Rear Lighting
F1	Bell
F2	Horn
F3	Horn2 Toggle
F4	Blow Down/Increase Chuff Intensity
F5	L1 Control
F6	Not Defined
F7	Rule 17 Dimmer Control--**(Must Disable CV159)**
F8	**Double Press:** System Volume Up or Down **Single Press:** All Sounds Muted Except Horn/Bell
F9	Water Fill/Decrease Chuff Intensity/Startup
F10	Water Injectors
F11	Brake Squeal
F12	**Not Moving:** Arm Coil Coupler Slack **Moving:** Plays Coil Couple
F13	Horn Grade Crossing
F14	Station Sounds
F15	Yard Sounds

DCC Function Keys
Sound Traxx

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

DCMaster™ Control

Key	Description
Bell	Bell
Horn	Horn
Aux (CV222)	**AUX Function Select:** Nothing 0 Front/Rear Lights 1 Bell Sound 2 Horn Sound 3 Couple/Uncouple Sound 4 Air Pump Sound 5 Blow Down/Chuff Intensity Up 6 Water Fill/Decrease Chuff/Startup 7 L1 Function 8 Mute/Volume Control 9 Startup/Shutdown Sounds 10 Shovel Coal Sound 11 Water Injector Sound 12 Brake Set/Release/Squeal Sound 13 Steam Cock Sound 14 Pop-Off Valve 15 Wheel Flange Sound 16 Coupler Slack/Couple Sound 17 Brake Squeal Sound 18 Horn2 Toggle 19 Smoke Control 21 Horn Grade Crossing Sound 30 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
Vol	**Double Press:** System Volume Up or Down **Single Press:** All Sounds Muted Except Horn/Bell