Tsunami® Digital Sound Decoder

Diesel Technical Reference

Software Release 1.13

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Primary CVs

CV 1
Primary Address Control

Description
Contains the decoder's primary address between 1 and 127:

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

Bit 0-6: A0-A6, Decoder Address
Bit 7: Not used. Must be set to 0!

The decoder will process all valid instruction packets containing an address that matches the value contained in this register when CV 29, bit 5 is set to 0.

Programming this register with a new value will automatically clear the Consist Address (CV 19) to 0 and clear the Extended Address Enable bit in CV 29 (bit 5).

The decoder will ignore commands that attempt to program this register with values outside the range of 1 to 127.

Note that CV 1 can only be changed in operations mode if the extended address is enabled.

Default Value: 3
Related CVs: See also CV 29, Consist Address, Extended Address

CV 2
Vstart

Description

Vstart defines the initial voltage level applied to the motor at speed step 1 as a fraction of available supply voltage:

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

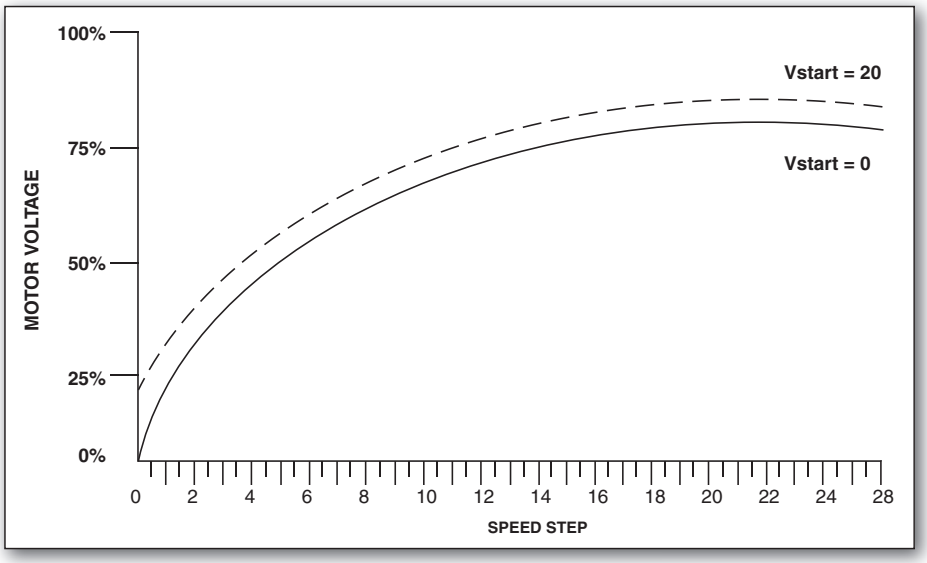
D0-D7: Motor Start Voltage

Vstart may contain any value from 0 to 255. The starting voltage applied to the motor may be computed as:

Starting Voltage = Supply Voltage X CV2÷255

where CV 2 is the contents of the Vstart register. A value of 0 corresponds to a zero starting voltage. A value of 255 corresponds to the maximum available voltage (100%).

For speed steps greater than 1, the DSD will continue to sum the initial starting voltage level into the throttle computations which has the effect of offsetting all points on a given speed curve by the level set by Vstart as illustrated in the figure below.



Default value: **0**

CV 3
Baseline Acceleration Rate

Description

Contains a value between 0 and 255 that sets the decoder's acceleration rate:

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: Baseline Acceleration Rate

Acceleration rate may be computed as:

seconds/speed step = CV 3 x 0.896÷Number of speed steps

When this CV is set to 0, the locomotive speed will respond nearly instantly to increases in the throttle setting, equivalent to no momentum. When set to 255, it will take approximately 3.8 minutes to accelerate to full speed from a standing stop.

It is recommended that this CV be set to a nonzero value when operating the DSD in 14 or 28 speed step modes as the throttle will interpolate between speed steps during acceleration to produce a smoother overall response.

Default value: 0
Related CVs: See also Baseline Braking Rate, Consist Acceleration Rate, Consist Brake Rate.

CV 4
Baseline Braking Rate

Description

Contains a value between 0 and 255 that sets the decoder's braking rate:

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: Baseline Braking Rate

Braking rate may be computed as:

seconds/speed step = CV 3 x 0.896÷Number of speed steps

When this CV is set to 0, the locomotive speed will respond nearly instantly to decreases in the throttle setting. When set to 255, it will take approximately 3.8 minutes to brake to a stop from full speed.

It is recommended that this CV be set to a nonzero value when operating the DSD in 14 or 28 speed step modes as the throttle will interpolate between speed steps during braking to produce a smoother overall response.

Default value: 0
Related CVs: See also Baseline Acceleration, Consist Acceleration Rate, Consist Brake Rate.

CV 7
Manufacturer Version ID (Read Only)

Description

Contains 8-bit software version identifier.

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: Version Code

64 = Tsunami Sound Decoder, V1.0

This CV is read only and cannot be modified.

CV 8
Manufacturer ID

Description

Contains the NMRA issued Manufacturer ID code assignment for SoundTraxx/Throttle Up! (141):

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

Writing a value of 8 to this CV will reset all CVs to their default value. All other write operations will be ignored.

CV 10
BEMF Cutout

Description

This is used to gradually reduce the effect of the BEMF Control as locomotive speed is increased. This CV contains a value from 0-127 that corresponds to the speed step at which the intensity of BEMF control will be reduced to zero.

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: BEMF Cutout

This CV can alternatively contain a value from 128-255 which will cause the BEMF intensity to decrease to a percentage between 0 and 50% of the BEMF intensity set by CV 212 as:

Full Speed BEMF Intensity = (CV 212 – 128)÷128

Default value: 0

CV 11
Packet Time Out Value

Description

Contains a value between 0 and 255 corresponding to the time period that is allowed to elapse between receipts of a valid packet addressed to the DSD before a throttle shutdown occurs.

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: Packet Time-out Value

The time out period is computed in seconds as:

Time Out Period = CV 11 X 0.25

A CV value of 0 disables the time out period and the locomotive will run indefinitely without receiving another packet.

For all other values, the DSD maintains an internal timer, which is reset every time the DSD receives a valid broadcast address packet or other valid packet whose address matches its primary address or, if enabled, the extended address or consist address.

In the event no valid packets are received within the prescribed time period, the DSD will bring the locomotive to a stop at the rate set by CV 4 and CV 24. The state of the auxiliary function outputs will remain unchanged.

Default value: 0

CV 12
Power Source Conversion

Description

Defines the type of power source the decoder should switch to whenever a DCC signal is not present and the APS bit of CV 29 (bit 2) is set.

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: Alternate Power Source
0 = No Alternate Power Source Available
1 = Analog Power Supply

Default value: 1

CV 13
Analog Function Enable 1

Description

Defines whether functions 1-8 are active during analog mode operation. If the bit is set, the corresponding function will be mapped to the output as defined by CVs 33-46.

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

F1-F8: Analog Function Enable Bit
0 = Function is disabled for analog operation
1 = Function is enabled for analog operation

Default value: 0

CV 14
Analog Function Enable 2

Description

Defines whether functions 9-12 are active during analog mode operation. If the bit is set, the corresponding function will be mapped to the output as defined by CVs 33-46.

Bit 7							Bit 0
		F12	F11	F10	F9	F0 (r)	F0 (f)

F0 (f): F0 Forward Enable Bit
0 = Function is disabled for analog operation
1 = Function is enabled for analog operation

F0 (r): F0 Reverse Enable Bit
0 = Function is disabled for analog operation
1 = Function is enabled for analog operation

F9-F12: Analog Function Enable Bit
0 = Function is disabled for analog operation
1 = Function is enabled for analog operation

Default value: 3

CV 15
CV Unlock Register

Description

Contains a value from 0-7 that is used to unlock access to the decoder's CVs in a multi-decoder installation.

CV 15 may always be written or verified regardless of the decoder's lock status. An acknowledgment will only be generated, however, when the decoder is unlocked.

Bit 7							Bit 0
0	0	0	0	0	D2	D1	D0

D0-D2: Unlock Code

Locked State
If CV 15 does not match CV 16, all read and write operations to the decoder will be ignored and no acknowledgment is generated.

Unlocked State
Access to the decoder's CVs occurs only when CV 15 = CV 16.

Note: CVLCKE Bit in CV 30 must be set to enable the lock feature in CVs 15 and 16.

Default value: 0
Related CVs: See also Error Information/Alternate Mode Selection.

CV 16
CV Lock ID Code

Description

Contains a value from 0-7 that sets the unlock code that must be programmed into CV 15 in order to access the decoder's CVs in a multi-decoder installation.

CV 15 may always be written or verified regardless of the decoder's lock status. An acknowledgment will only be generated, however, when the decoder is unlocked.

Bit 7							Bit 0
0	0	0	0	0	ID2	ID1	ID0

ID0-ID2: CV Lock Code

Note: CVLCKE Bit in CV 30 must be set to enable the lock feature in CVs 15 and 16.

Default Value: 0
Related CVs: See also Error Information/Alternate Mode Selection.

CV 17,18
Extended Address

Description

CV 17 and 18 make up a 'paired' CV, meaning that the two CV registers taken together hold one piece of data; in this case, the 14-bit extended decoder address:

CV 17 Extended Address MSB

Bit 7							Bit 0
A15	**A14**	**A13**	**A12**	**A11**	**A10**	**A9**	**A8**

CV 18 Extended Address LSB

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

A0-A15: Extended Address Value

The extended address allows the decoder to be assigned one of 10,179 addresses ranging from 0xC000 to 0xE7FF (Note however, that most command stations will only recognize addresses 0000 through 9999.). The extended address will only be recognized by the decoder when CV 29, bit 5 is set to 1. Once this bit is set, the decoder will no longer recognize its primary address until CV 29, bit 5 is cleared.

CV 17 contains the most significant byte and must be loaded with values within the range of 0xC0 and 0xE7. CV 18 contains the least significant byte and may contain any value.

To determine the extended address value, add the desired four-digit address to the number 49152. Divide this number by 256 and record the quotient and the remainder. CV 17 is then programmed with the quotient value and CV 18 is programmed with the remainder value.

Example: Compute CV 17 and 18 register values for extended address 7152.

1. Add 7152 to 49152: *Sum = 56304.*
2. Divide 56304 by 256: *Quotient = 219 Remainder = 240*
3. Program CV 17 to 219
4. Program CV 18 to 240

Note: Most command stations will handle these computations automatically

when setting the extended address. However, it's still nice to know how to derive them.

Because CV 17 and 18 make up a paired CV, programming order is important. CV 17 must be written to first, followed by a write to CV 18. The decoder will ignore commands that attempt to program these registers out of order or with values outside the allowed range of 0xC000 to 0xE7FF.

These CVs may be changed in service mode at any time, but in operations mode only when CV 29, bit 5 is cleared (i.e., CV 1, Primary Address is enabled).

Default Value: CV 17 = 192, CV 18 = 03 (Long Address 0003)
Related CVs: See also Primary Address, CV 29, Consist Address.

CV 19
Consist Address

Description

Contains address and direction data for consist operation:

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

Bit 0-6: A0-A6, Consist Address Value
Bit 7: CDIR, Consist Direction
0 = Normal Direction
1 = Reverse Direction

The CDIR bit defines orientation of the locomotive within a consist and specifies whether the direction bit in a speed/direction data packet should be inverted.

Bits A0-A6 assigns the consist address from 0 to 127. If A0-A6 = 00, consist commands are ignored. Otherwise, if the decoder receives a valid command packet whose address matches the consist address, the packet will be processed as any other packet with the following exceptions:

Long Form CV Access instructions will be ignored.

The direction bit in a speed/direction or advanced operation packet is inverted if CDIR = 1.

Only the auxiliary functions enabled in CV 21 and CV 22 are allowed to change.

When the consist address is active, speed/direction and advanced operations packets sent to the decoder's primary address (or extended address, if enabled) will be ignored. All other instruction packets sent to the decoder's primary (or extended) address, including CV access and function control, will continue to be processed as normal.

In summary, setting CV 19 to 0 or 128 disables consist addressing. Setting CV to a value between 1 and 127 enables consist addresses 1 to 127 with the locomotive oriented facing forward in the consist. Setting CV to a value between 129 and 255 enables consist addresses 1 to 127 with the locomotive oriented facing backwards in the consist.

Default Value: 0
Related CVs: See also Primary Address, Consist Function Active, Consist F0 Function Active.

CV 21
Consist Function Group 1

Description

Defines which Group 1 functions may be controlled by packets sent to the decoder's consist address. Disabled functions may be controlled only from decoder's primary or extended address:

Bit 7							Bit 0
F7	F6	F5	F4	F3	F2	F1	F0

Bit 0: F1, Consist Function 1 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 1: F2, Consist Function 2 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 2: F3, Consist Function 3 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 3: F4, Consist Function 4 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 4: F5, Consist Function 5 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 5: F6, Consist Function 6 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 6: F7, Consist Function 7 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 7: F8, Consist Function 8 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

This register is useful for differentiating the lead engine in the consist from the other engines. For example, by setting this register in the lead locomotive

to 2 and the same register in all other engines to 0, only the whistle on the lead locomotive will blow when the command to turn on Function 2 is sent to the consist.

Default Value: 0
Related CVs: See also Consist Address, Consist F0 Function Active. Consist F0 Function Active.

CV 22
Consist Function Group 2

Description

Defines which Group 2 functions may be controlled by packets sent to the decoder's consist address. Disabled functions may be controlled only from decoder's primary or extended address:

Bit 7							Bit 0
		F12	F11	F10	F9	F0 (r)	F0 (f)

Bit 0: F0(f), Function 0, Forward enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 1: F0(r), Function 0, Reverse enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 2: F9, Consist Function 9 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 3: F10, Consist Function 10 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 4: F11, Consist Function 11 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 5: F12, Consist Function 12 Enable Bit
0 = function is disabled for consist operation.
1 = function is enabled for consist operation.

Bit 6: Reserved.

Bit 7: Reserved.

This register is useful for differentiating the Headlight and Backup Light functions in the lead engine of the consist from the other engines. For example, by setting this register in the lead locomotive to 1 and the same register in all other engines to 0, only the headlight in the lead engine will be on and only when the consist is moving forward.

Default Value: 0
Related CVs: See also Consist Address, Consist Function Active.

CV 23
Consist Acceleration Rate

Description

Contains a value between -127 to +127 corresponding to the decoder's consist acceleration offset:

Bit 7							Bit 0
sign	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**

Bits 0-6: D0-D6, Consist Acceleration value
Bit 7: Sign
0 = positive value
1 = negative value

When the consist address is active, the consist acceleration rate is added to or subtracted from the decoder's base acceleration rate depending on the sign bit. The acceleration is then computed as:

seconds/speed step = (CV 3 + CV 23) x 0.896÷Number of speed steps

If the sum of CV 3 and CV 23 is negative, then the acceleration rate is set to 0 (i.e., acceleration is instant.) If the sum of CV 3 and CV 23 exceeds 255, then the acceleration rate is set to the maximum value of 255.

This CV has no effect when the consist address is set to 0.

In summary, a CV value between 0 and 127 will increase the decoder's base acceleration rate. Values between 128 and 255 will decrease the decoder's base acceleration rate.

Default value: 0
Related CVs: See also Baseline Acceleration Rate, Baseline Braking Rate, Consist Brake Rate.

CV 24
Consist Braking Rate

Description

Contains a value between -127 to +127 corresponding to the decoder's consist braking offset:

Bit 7							Bit 0
sign	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**

Bits 0-6: D0-D6, Consist Braking value
Bit 7: Sign
0 = positive value
1 = negative value

When the consist address is active, the consist braking rate is added to or subtracted from the decoder's baseline braking rate depending on the sign bit. The braking rate is then computed as:

seconds/speed step = (CV 4 + CV 24) x 0.896÷Number of speed steps

If the sum of CV 4 and CV 24 is negative, then the braking rate is set to 0 (i.e., braking is instant.) If the sum of CV 4 and CV 24 exceeds 255, then the braking rate is set to the maximum value of 255.

This CV has no effect when the consist address is set to 0.

In summary, a CV value between 0 and 127 will increase the decoder's base braking rate. Values between 128 and 255 will decrease the decoder's base braking rate.

Default value: 0
Related CVs: See also Baseline Acceleration Rate, Baseline Braking Rate, Consist Acceleration Rate.

CV 25
Speed Table Select Register

Description

Used to select one of 15 Speed Curves:

Bit 7							Bit 0
MIDSPD	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**

D0-D6: Table Identifier/Speed Step Value
MIDSPD: 0 = Factory Speed Table Select
1 = Mid Range Speed (Not used)

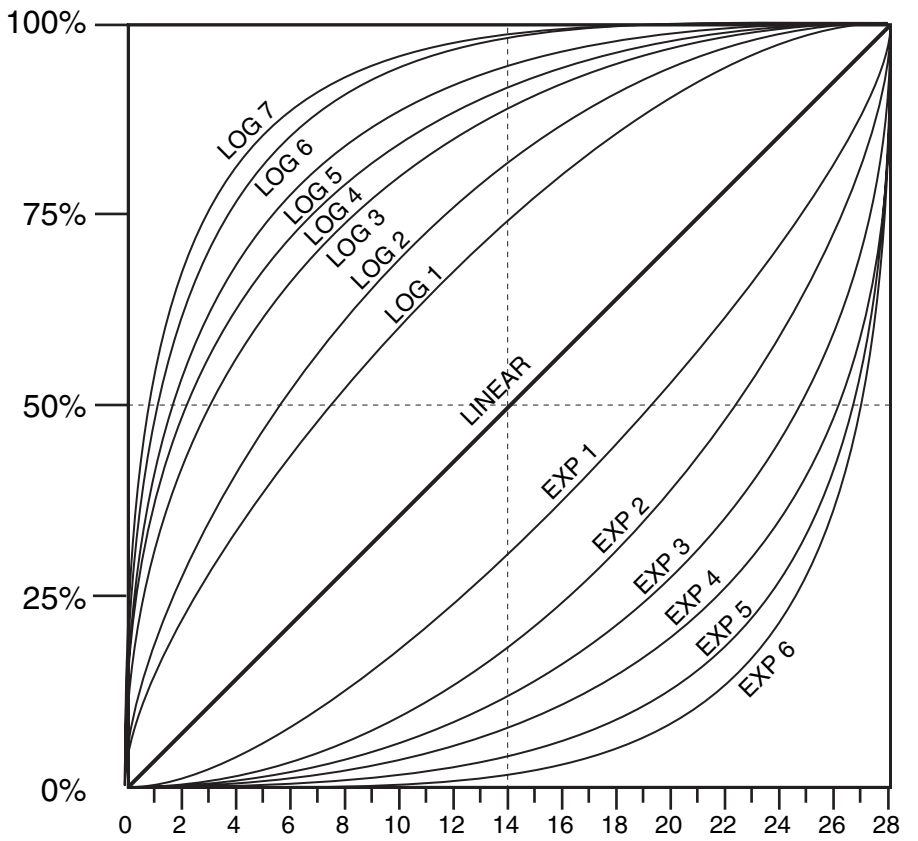
When MIDSPD = 0, D0-D6 defines which preset factory speed table is used.

0 = Disabled, Speed Curves not used
1 = Disabled, Speed Curves not used
2 = Linear Speed Curve
3 = Logarithmic Curve 1
4 = Logarithmic Curve 2
5 = Logarithmic Curve 3
6 = Logarithmic Curve 4
7 = Logarithmic Curve 5
8 = Logarithmic Curve 6
9 = Logarithmic Curve 7
10 = Exponential Curve 1
11 = Exponential Curve 2
12 = Exponential Curve 3
13 = Exponential Curve 4
14 = Exponential Curve 5
15 = Exponential Curve 6
16 = User Defined Speed Table defined by CVs 67-94.

CV 25 may be programmed with any value between 0 and 31. Values between 2 and 15 allow the user to select from one of 14 predefined speed curves as depicted below. The logarithmic curves provide a shallower speed response as the throttle is increased. These curves are useful for locomotives that require a high starting voltage to get moving or matching a highly geared locomotive to one that has less gearing. The exponential curves are useful for slowing down locomotives that have a “slot car” response.

Setting this CV to a value of 16 will enable the speed curve programmed into CVs 67-94. This curve may be programmed by the user to get virtually any response desired.

Note that in order for the selected curve to be active, bit 4 of CV 29 must also be set to 1. If CV 29, bit 4 is 0, the throttle response will be linear (straight line).



The speed curves can be used in 14, 28 and 128 speed step modes.

Bit 7 is defined by the NMRA RPs as the Mid Range Speed Step select bit. The DSD does not implement this feature and will ignore commands that attempt to program this bit with a 1 (i.e., data values between 128-255).

Default value: 0
Related CVs: See also CV 29, Loadable Speed Table.

CV 29
Configuration Register 1

Description

CV 29 contains miscellaneous decoder configuration bits:

Bit 7							Bit 0
0	0	EAM	STE	ACK	APS	F0	DIR

Bit 0: DIR, Direction Bit
0 = normal operation
1 = direction bit in Speed/Direction instruction is inverted before processing.

Bit 1: F0 Location
0 = F0 state is controlled by bit 4 of Speed/Direction Instruction (14 Speed Step Mode)
1 = F0 state is controlled by bit 4 of Function Group 1 Instruction (28 and 128 Speed Step Modes)

Bit 2: APS, Alternate Power Source enable
0 = NMRA Digital Only
1 = Alternate Power Source enabled as set by CV 12

Bit 3: ACK, Advanced Acknowledge Mode enable (not used)
0 = Advanced Acknowledge mode disabled.
1 = Advanced Acknowledge mode enabled.

Bit 4: STE, Speed Table Enable
0 = Speed Table set by CV 2, 4 and 6.
1 = Use custom speed table selected by CV 25.

Bit 5: EAM, Extended Address Mode enable
0 = Decoder responds to Primary Address in CV 1
1 = Decoder responds to Extended Address in CV 17-18

Bit 6: Reserved for future use.

Bit 7: Multifunction Decoder - Always reads as 0.

When the DIR bit is set, the locomotive and headlight will run in a direction opposite to the speed/direction instruction received. This bit is mostly useful for diesel locomotives that are run long hood forward and has little use for steam operation.

The F0 bit should be cleared to 0 if you are using the decoder in 14 speed step mode. If you are using 28 or 128 speed step modes, this bit should be

set to 1.

The STE bit must be set to 1 in order to enable any of the speed curves selected using CV 25. Otherwise, the DSD will provide a linear (straight-line) throttle response.

The EAM bit must be set to 1 in order to activate extended address capability. Note that once this bit is set, the decoder will respond to commands sent to the extended address only and commands sent to the primary address will be ignored. This can be a problem if you are using a command station that does not support extended addressing and the bit gets accidentally set. In such a case, you must connect the DSD to a programming track to gain access to the CV and clear the bit.

The APS bit must be set to 1 in order to activate an alternate power mode as set in CV 12. To activate Analog Mode Operation, you must also set CV 12 to 1.

The DSD does not support advanced acknowledgment and the ACK bit will always read as 0.

Default value: 6
Related CVs: See also Extended Address, Loadable Speed Table.

CV 30
Error Information/Alternate Mode Selection

Description

Contains manufacturer defined error codes and provides feedback in the event an operational failure occurred within the DSD. It is also used to re-configure the decoder for non-NMRA compliant options:

Bit 7							Bit 0
					GRP23	CVCLR	CVLCKE

Bit 0: CVLCKE, CV Lock Enable
0 = Normal operation.
1 = Enables CV Lock as set in CVs 15 and 16.

Bit 1: CVCLR, CV Clear
0 = Normal operation.
1 = All CVs will be reset to default values at next power cycle.

Bit 2: GRP23, Function Group 2 and 3 Exchange
0 = System Normal, DSD processes group 2 and 3 function commands according to the NMRA standard.
1 = Function Group 2 (F5-F8) assignments are swapped with Function Group 3 (F9-F12)

Bits 3-7: Reserved.

Default value: 0
Related CVs: See also CV Unlock Register, CV Lock ID Code.

Function Output CVs

CV 33-46
Function Output Map

CVs 33-46 allow the user to customize which DSD outputs or sound effects are controlled by which function keys. Each function input, F0 through F12, is assigned a unique CV that allows the corresponding function control to be redirected to up to fifteen different DSD function outputs or sound effects. This allows a single function key to control more than one output if desired.

The F0 function has two CVs - one for forward direction and one for reverse. Function outputs mapped to these registers will be directional unless the same output is mapped to both CVs.

Note that all function inputs cannot be mapped to all outputs. The matrix below graphically indicates which inputs can control which outputs:

Function Mapping Table

Function Key	Control CV	Headlight	Backup Light	HORN	BELL	FX5	FX6	Dynamic Brale	Short Horn	RESERVED	Radiator Fans (RPM +)	Dimmer	Mute	Air Compressor (RPM -)	Brakes	Coupler
F0 (f)	33	**1**	2	4	8	16	32	64	128							
F0 (r)	34	1	**2**	4	8	16	32	64	128							
F1	35	1	2	4	**8**	16	32	64	128							
F2	36	1	2	**4**	8	16	32	64	128							
F3	37				1	2	4	8	**16**	32	64	128				
F4	38				1	2	4	**8**	16	32	64	128				
F5	39				1	**2**	4	8	16	32	64	128				
F6	40				1	2	**4**	8	16	32	64	128				
F7	41							1	2	4	8	**16**	32	64	128	
F8	42							1	2	4	8	16	**32**	64	128	
F9	43							1	2	4	**8**	16	32	64	128	
F10	44								1	2	4	8	16	**32**	64	128
F11	45								1	2	4	8	16	32	**64**	128
F12	46								1	2	4	8	16	32	64	**128**

Bold Numbers indicate default settings.

CV 33
F0(f) Output Location

Description

Maps the F0(fwd) function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
SHH	DB	FX6	FX5	BEL	HORN	BL	HL

Bit 0: HL, Head light output
0 = Output is unaffected by F0(fwd).
1 = Output is activated when F0(fwd) is on.

Bit 1: BL, Backup light output
0 = Output is unaffected by F0(fwd).
1 = Output is activated when F0(fwd) is on.

Bit 2: HORN, Horn Sound Effect
0 = Sound is unaffected by F0(fwd).
1 = Sound is activated when F0(fwd) is on.

Bit 3: BEL, Bell Sound Effect
0 = Sound is unaffected by F0(fwd).
1 = Sound is activated when F0(fwd) is on.

Bit 4: FX5, Effect 1 output
0 = Output is unaffected by F0(fwd).
1 = Output is activated when F0(fwd) is on.

Bit 5: FX6, Effect 2 output
0 = Output is unaffected by F0(fwd).
1 = Output is activated when F0(fwd) is on.

Bit 6: DB, Dynamic Brake Sound Effect
0 = Sound is unaffected by F0(fwd).
1 = Sound is activated when F0(fwd) is on.

Bit 7: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F0(fwd).
1 = Sound is activated when F0(fwd) is on.

Default Value: 1
Related CVs: See also CVs 34-46

CV 34
F0(r) Output Location

Description

Maps the F0(rev) function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
SHH	DB	FX6	FX5	BEL	HORN	BL	HL

Bit 0: HL, Head light output
0 = Output is unaffected by F0(rev).
1 = Output is activated when F0(rev) is on.

Bit 1: BL, Backup light output
0 = Output is unaffected by F0(rev).
1 = Output is activated when F0(rev) is on.

Bit 2: HORN, Horn Sound Effect
0 = Sound is unaffected by F0(rev).
1 = Sound is activated when F0(rev) is on.

Bit 3: BEL, Bell Sound Effect
0 = Sound is unaffected by F0(rev).
1 = Sound is activated when F0(rev) is on.

Bit 4: FX5, Effect 1 output
0 = Output is unaffected by F0(rev).
1 = Output is activated when F0(rev) is on.

Bit 5: FX6, Effect 2 output
0 = Output is unaffected by F0(rev).
1 = Output is activated when F0(rev) is on.

Bit 6: DB, Dynamic Brake Sound Effect
0 = Sound is unaffected by F0(rev).
1 = Sound is activated when F0(rev) is on.

Bit 7: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F0(rev).
1 = Sound is activated when F0(rev) is on.

Default Value: 2
Related CVs: See also CVs 33, 35-46

CV 35
F1 Output Location

Description

Maps the F1 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
SHH	DB	FX6	FX5	BEL	HORN	BL	HL

Bit 0: HL, Head light output
0 = Output is unaffected by F1.
1 = Output is activated when F1 is on.

Bit 1: BL, Backup light output
0 = Output is unaffected by F1.
1 = Output is activated when F1 is on.

Bit 2: HORN, Horn Sound Effect
0 = Sound is unaffected by F1.
1 = Sound is activated when F1 is on.

Bit 3: BEL, Bell Sound Effect
0 = Sound is unaffected by F1.
1 = Sound is activated when F1 is on.

Bit 4: FX5, Effect 1 output
0 = Output is unaffected by F1.
1 = Output is activated when F1 is on.

Bit 5: FX6, Effect 2 output
0 = Output is unaffected by F1.
1 = Output is activated when F1 is on.

Bit 6: DB, Dynamic Brake Sound Effect
0 = Sound is unaffected by F1.
1 = Sound is activated when F1 is on.

Bit 7: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F1.
1 = Sound is activated when F1 is on.

Default Value: 8
Related CVs: See also CVs 33-34, 36-46

CV 36
F2 Output Location

Description

Maps the F2 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
SHH	DB	FX6	FX5	BEL	HORN	BL	HL

Bit 0: HL, Head light output
0 = Output is unaffected by F2.
1 = Output is activated when F2 is on.

Bit 1: BL, Backup light output
0 = Output is unaffected by F2.
1 = Output is activated when F2 is on.

Bit 2: HORN, Horn Sound Effect
0 = Sound is unaffected by F2.
1 = Sound is activated when F2 is on.

Bit 3: BEL, Bell Sound Effect
0 = Sound is unaffected by F2.
1 = Sound is activated when F2 is on.

Bit 4: FX5, Effect 1 output
0 = Output is unaffected by F2.
1 = Output is activated when F2 is on.

Bit 5: FX6, Effect 2 output
0 = Output is unaffected by F2.
1 = Output is activated when F2 is on.

Bit 6: DB, Dynamic Brake Sound Effect
0 = Sound is unaffected by F2.
1 = Sound is activated when F2 is on.

Bit 7: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F2.
1 = Sound is activated when F2 is on.

Default Value: 4
Related CVs: See also CVs 33-35, 37-46

CV 37
F3 Output Location

Description

Maps the F3 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
DIM	FAN		SHH	DB	FX6	FX5	BEL

Bit 0: BEL, Bell Sound Effect
0 = Sound is unaffected by F3.
1 = Sound is activated when F3 is on.

Bit 1: FX5, Effect 1 output
0 = Output is unaffected by F3.
1 = Output is activated when F3 is on.

Bit 2: FX6, Effect 2 output
0 = Output is unaffected by F3.
1 = Output is activated when F3 is on.

Bit 3: DB, Dynamic Brake Sound Effect
0 = Sound is unaffected by F3.
1 = Sound is activated when F3 is on.

Bit 4: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F3.
1 = Sound is activated when F3 is on.

Bit 5: Reserved

Bit 6: FAN, Radiator Fans (RPM+)
0 = Sound is unaffected by F3.
1 = Sound is activated when F3 is on.

Bit 7: DIM, Headlight Dimmer Function
0 = Lighting outputs are unaffected by F3.
1 = Lighting outputs set up as “Dimmable Headlights” are dimmed when F3 is on.

Default Value: 16
Related CVs: See also CVs 33-36, 38-46

CV 38
F4 Output Location

Description

Maps the F4 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
DIM	FAN		SHH	DB	FX6	FX5	BEL

Bit 0: BEL, Bell Sound Effect
0 = Sound is unaffected by F4.
1 = Sound is activated when F4 is on.

Bit 1: FX5, Effect 1 output
0 = Output is unaffected by F4.
1 = Output is activated when F4 is on.

Bit 2: FX6, Effect 2 output
0 = Output is unaffected by F4.
1 = Output is activated when F4 is on.

Bit 3: DB, Dynamic Brake Sound Effect
0 = Sound is unaffected by F4.
1 = Sound is activated when F4 is on.

Bit 4: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F4.
1 = Sound is activated when F4 is on.

Bit 5: Reserved

Bit 6: FAN, Radiator Fans (RPM+)
0 = Sound is unaffected by F4.
1 = Sound is activated when F4 is on.

Bit 7: DIM, Headlight Dimmer Function
0 = Lighting outputs are unaffected by F4.
1 = Lighting outputs set up as “Dimmable Headlights” are dimmed when F4 is on.

Default Value: 8
Related CVs: See also CVs 33-37, 39-46

CV 39
F5 Output Location

Description

Maps the F5 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
DIM	FAN		SHH	DB	FX6	FX5	BEL

Bit 0: BEL, Bell Sound Effect
0 = Sound is unaffected by F5.
1 = Sound is activated when F5 is on.

Bit 1: FX5, Effect 1 output
0 = Output is unaffected by F5.
1 = Output is activated when F5 is on.

Bit 2: FX6, Effect 2 output
0 = Output is unaffected by F5.
1 = Output is activated when F5 is on.

Bit 3: DB, Dynamic Brake Sound Effect
0 = Sound is unaffected by F5.
1 = Sound is activated when F5 is on.

Bit 4: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F5.
1 = Sound is activated when F5 is on.

Bit 5: Reserved

Bit 6: FAN, Radiator Fans (RPM+)
0 = Sound is unaffected by F5.
1 = Sound is activated when F5 is on.

Bit 7: DIM, Headlight Dimmer Function
0 = Lighting outputs are unaffected by F5.
1 = Lighting outputs set up as “Dimmable Headlights” are dimmed when F5 is on.

Default Value: 2
Related CVs: See also CVs 33-38, 40-46

CV 40
F6 Output Location

Description

Maps the F6 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
DIM	FAN		SHH	DB	FX6	FX5	BEL

Bit 0: BEL, Bell Sound Effect
0 = Sound is unaffected by F6.
1 = Sound is activated when F6 is on.

Bit 1: FX5, Effect 1 output
0 = Output is unaffected by F6.
1 = Output is activated when F6 is on.

Bit 2: FX6, Effect 2 output
0 = Output is unaffected by F6.
1 = Output is activated when F6 is on.

Bit 3: DB, Dynamic Brake Sound Effect
0 = Sound is unaffected by F6.
1 = Sound is activated when F6 is on.

Bit 4: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F6.
1 = Sound is activated when F6 is on.

Bit 5: Reserved

Bit 6: FAN, Radiator Fans (RPM+)
0 = Sound is unaffected by F6.
1 = Sound is activated when F6 is on.

Bit 7: DIM, Headlight Dimmer Function
0 = Lighting outputs are unaffected by F6.
1 = Lighting outputs set up as “Dimmable Headlights” are dimmed when F6 is on.

Default Value: 4
Related CVs: See also CVs 33-39, 41-46

CV 41
F7 Output Location

Description

Maps the F7 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
BRK	AC	MUT	DIM	FAN		SHH	DB

Bit 0: DB, Dynamic Brake Sound Effect
0 = Sound is unaffected by F7.
1 = Sound is activated when F7 is on.

Bit 1: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F7.
1 = Sound is activated when F7 is on.

Bit 2: Reserved

Bit 3: FAN, Radiator Fans (RPM+)
0 = Sound is unaffected by F7.
1 = Sound is activated when F7 is on.

Bit 4: DIM, Headlight Dimmer Function
0 = Lighting outputs are unaffected by F7.
1 = Lighting outputs set up as “Dimmable Headlights” are dimmed when F7 is on.

Bit 5: MUT, Audio Mute
0 = Sound is unaffected by F7.
1 = Sound is muted when F7 is on.

Bit 6: AC, Air Compressor (RPM-)
0 = Sound is unaffected by F7.
1 = Sound is activated when F7 is on.

Bit 7: BRK, Brake Squeal/Brake Release
0 = Sound is unaffected by F7.
1 = Sound is activated when F7 is on.

Default Value: 16
Related CVs: See also CVs 33-40, 42-46

CV 42
F8 Output Location

Description

Maps the F8 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
BRK	AC	MUT	DIM	FAN		SHH	DB

Bit 0: DB, Dynamic Brake Sound Effect
0 = Sound is unaffected by F8.
1 = Sound is activated when F8 is on.

Bit 1: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F8.
1 = Sound is activated when F8 is on.

Bit 2: Reserved

Bit 3: FAN, Radiator Fans (RPM+)
0 = Sound is unaffected by F8.
1 = Sound is activated when F8 is on.

Bit 4: DIM, Headlight Dimmer Function
0 = Lighting outputs are unaffected by F8.
1 = Lighting outputs set up as “Dimmable Headlights” are dimmed when F8 is on.

Bit 5: MUT, Audio Mute
0 = Sound is unaffected by F8.
1 = Sound is muted when F8 is on.

Bit 6: AC, Air Compressor (RPM-)
0 = Sound is unaffected by F8.
1 = Sound is activated when F8 is on.

Bit 7: BRK, Brake Squeal/Brake Release
0 = Sound is unaffected by F8.
1 = Sound is activated when F8 is on.

Default Value: 32
Related CVs: See also CVs 33-41, 43-46

CV 43
F9 Output Location

Description

Maps the F9 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
BRK	AC	MUT	DIM	FAN		SHH	DB

Bit 0: DB, Dynamic Brake Sound Effect
0 = Sound is unaffected by F9.
1 = Sound is activated when F9 is on.

Bit 1: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F9.
1 = Sound is activated when F9 is on.

Bit 2: Reserved

Bit 3: FAN, Radiator Fans (RPM+)
0 = Sound is unaffected by F9.
1 = Sound is activated when F9 is on.

Bit 4: DIM, Headlight Dimmer Function
0 = Lighting outputs are unaffected by F9.
1 = Lighting outputs set up as “Dimmable Headlights” are dimmed when F9 is on.

Bit 5: MUT, Audio Mute
0 = Sound is unaffected by F9.
1 = Sound is muted when F9 is on.

Bit 6: AC, Air Compressor (RPM-)
0 = Sound is unaffected by F9.
1 = Sound is activated when F9 is on.

Bit 7: BRK, Brake Squeal/Brake Release
0 = Sound is unaffected by F9.
1 = Sound is activated when F9 is on.

Default Value: 8
Related CVs: See also CVs 33-42, 44-46

CV 44
F10 Output Location

Description

Maps the F10 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
CPL	BRK	AC	MUT	DIM	FAN		SHH

Bit 0: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F10.
1 = Sound is activated when F10 is on.

Bit 1: Reserved

Bit 2: FAN, Radiator Fans (RPM+)
0 = Sound is unaffected by F10.
1 = Sound is activated when F10 is on.

Bit 3: DIM, Headlight Dimmer Function
0 = Lighting outputs are unaffected by F10.
1 = Lighting outputs set up as “Dimmable Headlights” are dimmed when F10 is on.

Bit 4: MUT, Audio Mute
0 = Sound is unaffected by F10.
1 = Sound is muted when F10 is on.

Bit 5: AC, Air Compressor (RPM-)
0 = Sound is unaffected by F10.
1 = Sound is muted when F10 is on.

Bit 6: BRK, Brake Squeal/Brake Release
0 = Sound is unaffected by F10.
1 = Sound is activated when F10 is on.

Bit 7: CPL, Coupler Sound Effect
0 = Sound is unaffected by F10.
1 = Sound is activated when F10 is on.

Default Value: 32
Related CVs: See also CVs 33-43, 45-46

CV 45
F11 Output Location

Description

Maps the F11 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
CPL	BRK	AC	MUT	DIM	FAN		SHH

Bit 0: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F11.
1 = Sound is activated when F11 is on.

Bit 1: Reserved

Bit 2: FAN, Radiator Fans (RPM+)
0 = Sound is unaffected by F11.
1 = Sound is activated when F11 is on.

Bit 3: DIM, Headlight Dimmer Function
0 = Lighting outputs are unaffected by F11.
1 = Lighting outputs set up as “Dimmable Headlights” are dimmed when F11 is on.

Bit 4: MUT, Audio Mute
0 = Sound is unaffected by F11.
1 = Sound is muted when F11 is on.

Bit 5: AC, Air Compressor (RPM-)
0 = Sound is unaffected by F11.
1 = Sound is muted when F11 is on.

Bit 6: BRK, Brake Squeal/Brake Release
0 = Sound is unaffected by F11.
1 = Sound is activated when F11 is on.

Bit 7: CPL, Coupler Sound Effect
0 = Sound is unaffected by F11.
1 = Sound is activated when F11 is on.

Default Value: 64
Related CVs: See also CVs 33-44, 46

CV 46
F12 Output Location

Description

Maps the F12 function to any of eight DSD auxiliary function outputs as defined by a 1 in the corresponding bit position:

Bit 7							Bit 0
CPL	BRK	AC	MUT	DIM	FAN		SHH

Bit 0: SHH, Short Horn Sound Effect
0 = Sound is unaffected by F12.
1 = Sound is activated when F12 is on.

Bit 1: Reserved

Bit 2: FAN, Radiator Fans (RPM+)
0 = Sound is unaffected by F12.
1 = Sound is activated when F12 is on.

Bit 3: DIM, Headlight Dimmer Function
0 = Lighting outputs are unaffected by F12.
1 = Lighting outputs set up as “Dimmable Headlights” are dimmed when F12 is on.

Bit 4: MUT, Audio Mute
0 = Sound is unaffected by F12.
1 = Sound is muted when F12 is on.

Bit 5: AC, Air Compressor (RPM-)
0 = Sound is unaffected by F12.
1 = Sound is muted when F12 is on.

Bit 6: BRK, Brake Squeal/Brake Release
0 = Sound is unaffected by F12.
1 = Sound is activated when F12 is on.

Bit 7: CPL, Coupler Sound Effect
0 = Sound is unaffected by F12.
1 = Sound is activated when F12 is on.

Default Value: 128
Related CVs: See also CVs 33-45

CV 47
Analog Whistle Control

Description

Contains a value between 0 and 255 that selects the use of the Analog Whistle Control:

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: Analog Whistle Control

This CV is used when the user wishes to activate an Analog Function for controlling the whistle with either a pressure or position response rather than responding to the press of a key or button.

When this CV is set to 0, the Analog Whistle Function is disabled. The value in CV 47 should match the value set by the command station manufacturer for an Analog Function in order to enable this feature.

Default value: 0
Related CVs: See also Reverb Control, Whistle Reverb Effect Send Level

Lighting Effect CVs

CV 49-52
Hyperlight Effect Select

Description

Used to set the Hyperlight lighting effect and control mode for their respective output:

CV 49, Headlight Effect Select
CV 50, Backup Light Effect Select
CV 51, FX5 Effect Select
CV 52, FX6 Effect Select

Bit 7							Bit 0
LED	**R17**	**XING**	**PHSE**	**EF3**	**EF2**	**EF1**	**EF0**

Bits 0-3: EF[0..3] Effect Type Select

0	=	On/Off output
1	=	Rule 17 Dimmable headlight
2	=	Mars Light
3	=	Pyle Gyralite
4	=	Oscillating Headlight
5	=	Single Flash Strobe
6	=	Double Flash Strobe
7	=	Western Cullen D312 Rotary Beacon
8	=	Prime Stratolite
9	=	Type I Ditch Light
10	=	Type II Ditch Light
11	=	FRED (End of Train flasher)
12	=	Engine Exhaust Flicker
13	=	Firebox Flicker
14	=	Smart Firebox Flicker
15	=	Dyno-Light

Most of the effects are self-descriptive. However a few need some additional notes:

Dimmable Headlight - The function output is normally an on/off output. If the output is on, the output level will be reduced about 60% whenever the dimmer function is on.

Type I and Type II Ditch Lights - These are identical when operating. However, if the grade crossing logic is enabled, the Type I ditch light will revert to a steady on state when it is not flashing whereas the Type II lights will turn off.

Lighting Effect CVs

Engine Exhaust - This effect produces a random flicker whose intensity is proportional to the engine RPMs. It is best used by placing a red/ orange lamp under the model's exhaust port, out of direct view. As the engine is revved up, it will glow brighter, imitating unmuffled exhaust gases and sparks.

Dyno-Light - This effect for diesel locomotives softly fades the lamp brightness on and off to simulate the heating and cooling of the bulb filament.

Bit 4: PHSE, Phase Select Bit
0 = Phase A
1 = Phase B

Phase Select Bit - Alters the timing of the effect so that it is 180 degrees out of phase with the other effects. This allows you to have two light effects that blink back and forth if desired. Set one effect to phase A and the other to phase B.

Bit 5: XING, Grade Crossing Logic Enable
0 = Crossing Logic disabled
1 = Crossing Logic enabled when Horn function is on.

Grade Crossing Logic Bit - Causes the lighting effect to become active only when the horn has been sounded (and the corresponding lighting function key is also on). A typical use would be to cause the ditch lights to flash at a grade crossing. The grade crossing logic can be used with almost all the Hyperlight effects. The on/off, dimmable headlight, FRED, engine exhaust, and firebox flicker effects will not be affected. The other effects will either turn off (strobes and beacons) or revert to a steady on state (mars light, ditch lights, etc.) as appropriate to prototype practice.

Bit 6: R17, Rule 17 Mode
0 = Rule 17 Mode disabled
1 = Rule 17 Mode enabled

Rule 17 Mode - Converts the headlight and backup light to independent, non-directional lights. When this mode is active, the headlight is controlled as if it were FX5 and the backup light as FX6 and vice-versa.

Bit 7: LED, LED Compensation Enable
0 = Incandescent Compatible Lighting Outputs enabled
1 = LED Compatible Lighting Outputs enabled

LED Compensation - Improves lighting effect contrast when using LEDs instead of incandescent lamps.

Default Value: 15 (CV 49, 50), 1 (Varies)
Related CVs: See also CV 59, CV 60

CV 53
FX5B Lighting Control

Description

CV 53 is used to control the second lighting output associated with Function 5.

Bit 7							Bit 0
LED	R17	XING	PHSE	EF3	EF2	EF1	EF0

Bits 0-3: EF[0..3] Effect Type Select

0	=	On/Off output
1	=	Rule 17 Dimmable headlight
2	=	Mars Light
3	=	Pyle Gyralite
4	=	Oscillating Headlight
5	=	Single Flash Strobe
6	=	Double Flash Strobe
7	=	Western Cullen D312 Rotary Beacon
8	=	Prime Stratolite
9	=	Type I Ditch Light
10	=	Type II Ditch Light
11	=	FRED (End of Train flasher)
12	=	Engine Exhaust Flicker
13	=	Firebox Flicker
14	=	Smart Firebox Flicker
15	=	Dyno-Light

Most of the effects are self-descriptive. However a few need some additional notes:

Dimmable Headlight - The function output is normally an on/off output. If the output is on, the output level will be reduced about 60% whenever the dimmer function is on.

Type I and Type II Ditch Lights - These are identical when operating. However, if the grade crossing logic is enabled, the Type I ditch light will revert to a steady on state when it is not flashing whereas the Type II lights will turn off.

Engine Exhaust - This effect produces a random flicker whose intensity is proportional to the engine RPMs. It is best used by placing a red/orange lamp under the model's exhaust port, out of direct view. As the engine is revved up, it will glow brighter, imitating unmuffled exhaust gases and sparks.

Lighting Effect CVs

Dyno-Light - This effect for diesel locomotives softly fades the lamp brightness on and off to simulate the heating and cooling of the bulb filament.

Bit 4: PHSE, Phase Select Bit
0 = Phase A
1 = Phase B

Phase Select Bit - Alters the timing of the effect so that it is 180 degrees out of phase with the other effects. This allows you to have two light effects that blink back and forth if desired. Set one effect to phase A and the other to phase B.

Bit 5: XING, Grade Crossing Logic Enable
0 = Crossing Logic disabled
1 = Crossing Logic enabled when Horn function is on.

Grade Crossing Logic Bit - Causes the lighting effect to become active only when the horn has been sounded (and the corresponding lighting function key is also on). A typical use would be to cause the ditch lights to flash at a grade crossing. The grade crossing logic can be used with almost all the Hyperlight effects. The on/off, dimmable headlight, FRED, engine exhaust, and firebox flicker effects will not be affected. The other effects will either turn off (strobes and beacons) or revert to a steady on state (mars light, ditch lights, etc.) as appropriate to prototype practice.

Bit 6: R17, Rule 17 Mode
0 = Rule 17 Mode disabled
1 = Rule 17 Mode enabled

Rule 17 Mode - Converts the headlight and backup light to independent, non-directional lights. When this mode is active, the headlight is controlled as if it were FX5 and the backup light as FX6 and vice-versa.

Bit 7: LED, LED Compensation Enable
0 = Incandescent Compatible Lighting Outputs enabled
1 = LED Compatible Lighting Outputs enabled

LED Compensation - Improves lighting effect contrast when using LEDs instead of incandescent lamps.

Default Value:
Related CVs: See also CV 59, CV 60

CV 54
FX6B Lighting Control

Description

CV 54 is used to control the second lighting output associated with Function 6.

Bit 7							Bit 0
LED	**R17**	**XING**	**PHSE**	**EF3**	**EF2**	**EF1**	**EF0**

Bits 0-3: EF[0..3] Effect Type Select

0	=	On/Off output
1	=	Rule 17 Dimmable headlight
2	=	Mars Light
3	=	Pyle Gyralite
4	=	Oscillating Headlight
5	=	Single Flash Strobe
6	=	Double Flash Strobe
7	=	Western Cullen D312 Rotary Beacon
8	=	Prime Stratolite
9	=	Type I Ditch Light
10	=	Type II Ditch Light
11	=	FRED (End of Train flasher)
12	=	Engine Exhaust Flicker
13	=	Firebox Flicker
14	=	Smart Firebox Flicker
15	=	Dyno-Light

Most of the effects are self-descriptive. However a few need some additional notes:

Dimmable Headlight - The function output is normally an on/off output. If the output is on, the output level will be reduced about 60% whenever the dimmer function is on.

Type I and Type II Ditch Lights - These are identical when operating. However, if the grade crossing logic is enabled, the Type I ditch light will revert to a steady on state when it is not flashing whereas the Type II lights will turn off.

Engine Exhaust - This effect produces a random flicker whose intensity is proportional to the engine RPMs. It is best used by placing a red/orange lamp under the model's exhaust port, out of direct view. As the engine is revved up, it will glow brighter, imitating unmuffled exhaust gases and sparks.

Lighting Effect CVs

Dyno-Light - This effect for diesel locomotives softly fades the lamp brightness on and off to simulate the heating and cooling of the bulb filament.

Bit 4: PHSE, Phase Select Bit
0 = Phase A
1 = Phase B

Phase Select Bit - Alters the timing of the effect so that it is 180 degrees out of phase with the other effects. This allows you to have two light effects that blink back and forth if desired. Set one effect to phase A and the other to phase B.

Bit 5: XING, Grade Crossing Logic Enable
0 = Crossing Logic disabled
1 = Crossing Logic enabled when Horn function is on.

Grade Crossing Logic Bit - Causes the lighting effect to become active only when the horn has been sounded (and the corresponding lighting function key is also on). A typical use would be to cause the ditch lights to flash at a grade crossing. The grade crossing logic can be used with almost all the Hyperlight effects. The on/off, dimmable headlight, FRED, engine exhaust, and firebox flicker effects will not be affected. The other effects will either turn off (strobes and beacons) or revert to a steady on state (mars light, ditch lights, etc.) as appropriate to prototype practice.

Bit 6: R17, Rule 17 Mode
0 = Rule 17 Mode disabled
1 = Rule 17 Mode enabled

Rule 17 Mode - Converts the headlight and backup light to independent, non-directional lights. When this mode is active, the headlight is controlled as if it were FX5 and the backup light as FX6 and vice-versa.

Bit 7: LED, LED Compensation Enable
0 = Incandescent Compatible Lighting Outputs enabled
1 = LED Compatible Lighting Outputs enabled

LED Compensation - Improves lighting effect contrast when using LEDs instead of incandescent lamps.

Default Value: 15
Related CVs: See also CV 59, CV 60

CV 57
FX5, FX6 Directional Control Enable Bits

Description

CV 57 is used to configure the directionality of FX5A, FX5B, FX6A and FX6B function outputs. Setting a bit to 1 enables the corresponding function in the indicated direction. A function may be made bi-directional by setting both the forward and reverse bits to 1.

Bit 7							Bit 0
FX6B.R	FX6B.F	FX6A.R	FX6A.F	FX5B.R	FX5B.F	FX5A.R	FX5A.F

Bit 0: FX5A.F
Enables or disables the directionality of FX5A output
0 = FX5A function output disabled in forward
1 = FX5A function output enabled in forward

Bit 1: FX5A.R
Enables or disables the directionality of FX5A output
0 = FX5A function output disabled in reverse
1 = FX5A function output enabled in reverse

Bit 2: FX5B.F
Enables or disables the directionality of FX5B output
0 = FX5B function output disabled in forward
1 = FX5B function output enabled in forward

Bit 3: FX5B.R
Enables or disables the directionality of FX5B output
0 = FX5B function output disabled in reverse
1 = FX5B function output enabled in reverse

Bit 4: FX6A.F
Enables or disables the directionality of FX6A output
0 = FX6A function output disabled in forward
1 = FX6A function output enabled in forward

Bit 5: FX6A.R
Enables or disables the directionality of FX6A output
0 = FX6A function output disabled in reverse
1 = FX6A function output enabled in reverse

Bit 6: FX6B.F
Enables or disables the directionality of FX6B output
0 = FX6B function output disabled in forward
1 = FX6B function output enabled in forward

Bit 7: FX6B.R
Enables or disables the directionality of FX6B output
0 = FX6B function output disabled in reverse
1 = FX6B function output enabled in reverse

Default Value: 255, may vary
Related CVs: See also CVs 49-52, CV 60

CV 58
FX5, FX6 Lighting Override Enable Bits

Description

CV 58 is used to configure FX5 or FX6 such that all other lighting function outputs automatically turn off when the corresponding function is turned on.

Bit 7							Bit 0
						FX6OVR	FX5OVR

Bit 0: FX5OVR
0 = Normal FX5 operation
1 = When FX5 is on, HL, BL and FX6 turn off

Bit 1: FX6OVR
0 = Normal FX6 operation
1 = When FX6 is on, HL, BL and FX5 turn off

Note: If both FX5OVR and FX6OVR are both set, FX5 will have precedence.

Default Value: 0, may vary
Related CVs: See also CVs 49-52, CV 60

CV 59
Flash Rate

Description

CV 59 is used to adjust the Hyperlight effect's flash rate.

Bit 7							Bit 0
				FR3	FR2	FR1	FR0

Bit 0-3: FR0-3, Flash Rate Select
Sets the overall flash rate of the Hyperlight effects.
0 = Maximum Flash Rate
:
15 = Minimum Flash Rate

Default Value: 4
Related CVs: See also CVs 49-52, CV 60

CV 60
Crossing Hold Time

Description

CV 60 is used to adjust the hold time for grade crossing logic.

Bit 7							Bit 0
				HT3	HT2	HT1	HT0

Bit 0-3: HT0-3, Hold Time Select
Sets the time an effect will stay on after the horn button is released (if it is set up to do so) and has a range of zero to 15 seconds.

0 = Minimum Hold Time = 0
:
15 = Maximum Hold Time = 15 Seconds

Default Value: 4
Related CVs: See also CVs 49-52.

CV 61
F11 Braking Rate

Description

Contains a value between -127 to +127 corresponding to the decoder's brake deceleration offset:

Bit 7							Bit 0
sign	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**

Bits 0-6: D0-D6, F11 Braking value
Bit 7: sign
0 = positive value
1 = negative value

The F11 braking rate is added to or subtracted from the decoder's base braking rate when the F11 button is pressed. The throttle is set to 0, forcing the decoder to decelerate to a stop.

A value of +0 or –0 disables this feature.

Default value: 0

CV 62
Transponding Control

Description

Compensates for incompatibilities that may occur when using some methods of transponding.

Bit 7							Bit 0
							XPDR_EN

Bit 0: XPNDER_EN, Transponder Mode Enable
0 = Normal Operation
1= Decoder configured for compatibility with external transponding devices.

Bits 1-7: Not used

Note: Power to the decoder must be cycled before any changes to this register will take effect.

Default value: 0

CV 63
Analog Mode Motor Start Voltage

Description

CV 63 contains a value between 0 and 255 corresponding to the voltage difference between when the decoder first powers up and when the locomotive starts to move.

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: Analog Mode Motor Start Voltage Value

CV 63 may be set to any value between 0 and 255 corresponding to tenths of a volt. Thus, a setting of 23 adds 2.3 volts to Tsunami's default start voltage of 7.5 volts.

Normally, Tsunami will power up in Analog mode around 5 volts or so and the engine will begin moving around 7.5 volts. Under certain circumstances you may experience a condition where the decoder cycles back and forth between start up sounds and locomotive movement. The problem is usually due to a poorly regulated power pack output. The sudden increase in load due to the motor starting causes the track voltage to droop which in turn resets the sound decoder. By increasing the setting of CV 63, you can adjust the decoder so that when the motor starts, the track voltage will be sufficiently high so that any droop that occurs will not turn off or reset the decoder.

Default Value: 20

CV 64
Analog Mode Maximum Motor Voltage

Description

Contains a value between 0 and 255 corresponding to the maximum average voltage Tsunami can apply to the motor when operating in analog mode.

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: Analog Mode Maximum Motor Voltage

CV 64 may be set to any value between 0 and 255 corresponding to tenths of a volt. A setting of 180 therefore sets the maximum average motor to 18.0 volts.

CV 64 allows you to set the maximum average voltage that will be applied to the motor when operating in analog mode. This is useful for limiting a locomotive's top speed as well as providing some margin of safety against burning out a motor whose voltage rating may be lower than your power pack's maximum output

Caution: Tsunami only limits the average voltage to the motor. The peak voltage applied to the motor will still be the same as the track voltage.

Default value: 180

Speed Table CVs

CV 66
Forward Trim

Description

Contains a value, n, between 0 and 255 that specifies a scaling factor interpreted as n/128 by which the forward drive voltage is multiplied.

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: Forward Trim Scalar

The forward trim scalar allows the decoder's overall throttle response in the forward direction to be adjusted up or down for the purpose of matching one locomotive's speed curve to another. See graph below.

A trim value of 128 (0x80) yields a scaling factor of 1.0 which will have no net effect on the speed response.

Trim values between 129 and 255 (0x81-0xFF) have the effect of increasing the motor voltage by a factor ranging between 1.01 to 1.99.

Trim values between 1 and 127 (0x01-0x7F) will decrease the motor voltage by a factor between 0.008 and 0.99.

A trim value of 0 disables the trim scalar computation.

This CV is used only when speed tables are enabled (CV 29, Bit 4 = 1). Otherwise, this CV will have no effect.

Default Value: 128
Related CVs: See also Reverse Trim CV 95, CV 29, CV 25.

CV 67-94
Loadable Speed Table

Description

The loadable speed table is made up of 28 CVs. Each CV contains a value, n, between 0 and 255 that specifies the percentage of the maximum throttle voltage interpreted as n/255 that is to be applied to the motor when the speed step in use corresponds to that CV.

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: Speed Table Data

The loadable speed table may be used in the 14, 28 and 128 speed step modes. When 14 speed step mode is in effect, the DSD will use a curve defined by every other speed table value starting with speed step 1.

When 28 step mode is enabled, the DSD will simply use one table value for each speed step.

When 128 step mode is enabled, the DSD will interpolate 4-5 points between each speed table entry to build a 128 point curve.

Note that the DSD will not use the loadable speed table until bit 5 in both CV 25 and CV 29 are set to 1.

Default values: The default values provide a linear (straight line) response. Individual CVs are loaded as follows:

CV	Speed Step	Value
CV 67	(Speed Step 1):	9
CV 68	(Speed Step 2):	18
CV 69	(Speed Step 3):	27
CV 70	(Speed Step 4):	36
CV 71	(Speed Step 5):	45
CV 72	(Speed Step 6):	55
CV 73	(Speed Step 7):	64
CV 74	(Speed Step 8):	73
CV 75	(Speed Step 9):	82
CV 76	(Speed Step 10):	91
CV 77	(Speed Step 11):	100
CV 78	(Speed Step 12):	109
CV 79	(Speed Step 13):	118
CV 80	(Speed Step 14):	127
CV 81	(Speed Step 15):	137

Speed Table CVs

CV 82	(Speed Step 16):	146
CV 83	(Speed Step 17):	155
CV 84	(Speed Step 18):	164
CV 85	(Speed Step 19):	173
CV 86	(Speed Step 20):	182
CV 87	(Speed Step 21):	191
CV 88	(Speed Step 22):	200
CV 89	(Speed Step 23):	209
CV 90	(Speed Step 24):	219
CV 91	(Speed Step 25):	228
CV 92	(Speed Step 26):	237
CV 93	(Speed Step 27):	246
CV 94	(Speed Step 28):	255

Related CVs: See also CV 25, CV 29.

CV 95
Reverse Trim

Description

Contains a value, n, between 0 and 255 that specifies a scaling factor interpreted as n/128 by which the reverse drive voltage is multiplied.

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: Reverse Trim Scalar

The reverse trim scalar allows the decoder's overall throttle response in the reverse direction to be adjusted up or down for the purpose of matching one locomotive's speed curve to another.

A trim value of 128 (0x80) yields a scaling factor of 1.0 which will have no net effect on the speed response.

Trim values between 129 and 255 (0x81-0xFF) have the effect of increasing the motor voltage by a factor ranging between 1.01 to 1.99.

Trim values between 1 and 127 (0x01-0x7F) will decrease the motor voltage by a factor between 0.008 and 0.99.

A trim value of 0 disables the trim scalar computation.

This CV is used only when speed tables are enabled (CV 29, Bit 4 = 1). Otherwise, this CV will have no effect.

Default Value: 128
Related CVs: See also Forward Trim CV 66, CV 25, CV 29.

User ID CVs

CV 105
User Identifier #1

Description

Provides storage for user supplied data such as purchase date, serial numbers, spouse's birthday, etc. This CV otherwise has no effect on the DSD operation.

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: User Identifier data

This CV may be programmed with any value between 0 and 255.

When the decoder is reset to default values, this CV is preset to the software's minor revision code.

Default Value: Varies
Related CVs: See also User Identifier #2.

CV 106
User Identifier #2

Description

Provides storage for user supplied data such as purchase date, serial numbers, spouse's birthday, etc. This CV otherwise has no effect on the DSD operation.

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

D0-D7: User Identifier data

This CV may be programmed with any value between 0 and 255.

When the decoder is reset to default values, this CV is preset to the software's default CV value configuration.

Default Value: Varies
Related CVs: See also User Identifier #1.

Sound Control CVs

CV 112
Sound Configuration 1

Description

This CV is used to configure select sound effects. A 1 in the corresponding bit position enables the selected sound effect:

Bit 7							Bit 0
						RFE	ACE

Bit 0: ACE, Auto Air Compressor Enable
0 = Air Compressor turns on/off with Function 10
1 = Auto Air Compressor turns on/off automatically with engine sound

Bit 1: RFE, Auto Radiator Fans Enable
0 = Radiator Fans turns on/off with Function 9
1 = Radiator Fans turns on/off automatically with engine sound

Bits 2-7: Not Used

Default Value: 0

**This CV is used to configure additional sound effects in any version of the Gas-Turbine Electric Tsunami.*

Gas-Turbine Electric:

Bit 7							Bit 0
			BFE2	BFE1	APM	RFE	ACE

Bit 0: As above.
Bit 1: As above.

Bit 2: APM, Alternate Prime Mover Select
0 = Diesel Engine remains on when turbine is on
1 = Diesel Engine turns off when turbine is on

Bits 3-4: BFE, Backfire Enable
00 = Backfire is off
01 = Backfire turns on with first startup only
10 = Backfire turns on with every startup

Default Value: 8

CV 113
Quiet Mode Timeout Period

Description

When the Quiet Mode Timeout Period is set to a non-zero value, sounds become active only when the decoder is addressed. When the locomotive has been stopped and all functions have been turned off, the sound effects will turn off automatically after the timeout period has elapsed as set by CV 113.

Bit 7							Bit 0
Q7	Q6	Q5	Q4	Q3	Q2	Q1	Q0

Q0-Q7: Quiet Bit Time Out Period
0 = Sound turns on a few seconds after power is turned on.
1-255 = Quiet Mode Timeout period

Timeout period (seconds) = CV 113 x 0.25

Default Value: 0

CV 114
Bell Ring Rate

Description

This CV contains a value from 0 to 15 and is used to control the speed at which the bell rings:

Bit 7							Bit 0
				BR3	BR2	BR1	BR0

Bit 0-3: BR0:BR3, Bell Ring Rate
Controls the ringing rate of the bell sound.

0 = Fastest Ring Rate
:
15 = Slowest Ring Rate

Bits 4-7: Reserved.

Default Value: 4

CV 115
Airhorn Select

Description

This CV is used to select the available Airhorns. It also allows the user to choose an alternate horn to be controlled by the Short Horn Function in place of the short horn.

Bit 7							Bit 0
AAH3	**AAH2**	**AAH1**	**AAH0**	**AH3**	**AH2**	**AH1**	**AH0**

Bits 0-3: AH0:AH3, Airhorn Selection
0000 = Airhorn 1
0001 = Airhorn 2
0010 = Airhorn 3
0011 = Airhorn 4
0100 = Airhorn 5
0101 = Airhorn 6
0110 = Airhorn 7
0111 = Airhorn 8
1000 = Airhorn 9
1001 = Airhorn 10
1010 = Airhorn 11
1011 = Airhorn 12
1100 = Airhorn 13
1101 = Airhorn 14
1110 = Airhorn 15
1111 = Airhorn 16

Bits 4-7: AAH0:AAH2, Alternate Airhorn Selection
0000 = Dual Horn Mode Disabled
0001 = Airhorn 2
0010 = Airhorn 3
0011 = Airhorn 4
0100 = Airhorn 5
0101 = Airhorn 6
0110 = Airhorn 7
0111 = Airhorn 8
1000 = Airhorn 9
1001 = Airhorn 10
1010 = Airhorn 11
1011 = Airhorn 12
1100 = Airhorn 13
1101 = Airhorn 14
1110 = Airhorn 15
1111 = Airhorn 16

Default Value: 9

CV 116
Engine Exhaust Control

Description

This CV specifies the use of manual or automatic notching as well as the use of dynamic brakes.

Bit 7							Bit 0
DB1	DB0	AES	LOCK	AN3	AN2	AN1	AN0

Bits 0-3: AN0:AN3, Engine Notch Rate
0 = Manual Notching, engine RPMs are increased/ decreased with functions F9 and F10 respectively.
1-15 = Engine RPMs increase every 1-15 speed steps per setting

Bit 4: LOCK, Engine RPM Interlock
0 = Interlock is disabled
1 = When manual engine control is enabled, locomotive will not move until engine starts.

Bits 5: ASE, Auto Start Enable
0 = Prime mover starts up at speed step1
1 = Prime mover starts up when power is supplied to track.

Bits 6-7: DB0:DB1, Dynamic Brake Override Enable
00 = Dynamic Brakes operate independently of RPMs
01 = Turning on Dynamic Brakes forces engine RPMs to drop to idle.
10 = Turning on Dynamic Brakes forces engine RPMs to drop to notch 4.
11 = Turning on Dynamic Brakes forces engine RPMs to full speed.

**This CV operates in a slightly different manner when used to configure any version of the Gas-Turbine Electric Tsunami. Changes are reflected below:*

Bit 0-5: As above.
Bits 6-7: DB1:DB0, Dynamic Brake Mode
00 = Dynamic brake on with function F4
01 = Turning on Dynamic Brakes forces diesel engine RPMs to drop to notch 2 and shut the turbine OFF.
10 = Turbine drops to idle before dynamic brake active.

Default Value: 39

Misc. Control CVs

CV 118
Motor Recovery Speed

Description

This CV adjusts the motor recovery speed for momentary interruptions during power glitches.

Bit 7							Bit 0
MRS	MRS	MRS	MRS	MRS	MRS	MRS	MRS

0 = Disabled
1-127 = Absolute Limiting: When set between 1 and 127, the decoder will limit the recovery speed to the motor to the corresponding speed step.

128 = Disabled
129-255 = Proportional Limiting: When set between 129 and 255 the decoder will limit the power to the motor after a power loss to a percentage as shown below:

$$\text{Percentage} = \frac{(\text{CV } 118 - 128)}{127}$$

Default Value: 204 (60%)

CV 119
Effect Processor Select

Description

This CV selects an Effect Processor which may be programmed via CVs 120 to 127, which are then used for individual controls (see Page 93). This CV is used in situations where a cab cannot access CVs numbered above 128.

Bit 7							Bit 0
EF7	EF6	EF5	EF4	EF3	EF2	EF1	EF0

Bits 0-7: EF0-7, Effect Processor Select

0 = Foreground Sound Mixer
1 = Background Mixer 1
2 = Background Mixer 2
3 = Seven Band Equalizer
4 = Reverb Control Mixer
5 = Reverb Mixer
6 = Reserved
7 = Reserved
8 = Automatic Sound Control 1
9 = Automatic Sound Control 2
10 = Advanced Motor Control

CV 128
Master Volume Control

Description

This CV sets the overall volume of all sound channels.

Bit 7							Bit 0
VOL7	VOL6	VOL5	VOL4	VOL3	VOL2	VOL1	VOL0

Bits 0-7: VOL0:VOL7, Master Volume Control
0 = Minimum volume
255 = Maximum volume

Default Value: 192 (75%)

CV 129-136
Sound Effect Mixer

Description

The Foreground Sound Mixer sets the volume of the individual sound channels as follows:

Bit 7							Bit 0
MIX7	MIX6	MIX5	MIX4	MIX3	MIX2	MIX1	MIX0

Bits 0-7: MIX0:MIX7, Mixer Level

0 = Minimum Sound Level (0%)
255 = Maximum Sound Level (100%)

CV 129: Horn Volume
CV 130: Bell Volume
CV 131: Diesel Engine Exhaust Volume
CV 132: Air Compressor Volume
CV 133: Dynamic Brake Volume
CV 134: Radiator Fans Volume
CV 135: Reserved
CV 136: Reserved

Default Value: Varies

CVs 137-152
Background Sound Mixer

Description

The Background Sound Mixer sets the volume of the individual sound channels as follows:

Bit 7							Bit 0
MIX7	MIX6	MIX5	MIX4	MIX3	MIX2	MIX1	MIX0

Bits 0-7: MIX0:MIX7, Mixer Level
0 = Minimum Sound Level (0%)
255 = Maximum Sound Level (100%)

CV 137: Coupler Volume
CV 138: Reserved
CV 139: Brake Squeal Volume
CV 140: Brake Release Volume
CV 141: Reserved
CV 142: Reserved
CV 143: Poppet Valve Volume
CV 144: Reserved
CV 145: Reserved
CV 146: Reserved
CV 147: Reserved
CV 148: Reserved
CV 149: Reserved
CV 150: Reserved
CV 151: Reserved
CV 152: Reserved

Note: Changes to some background sound CVs may not result in an immediate change in volume level. Turn the sound effect off and back on to load the new setting.

CVs 153-160
Seven Band Equalizer

CV 153 Equalizer Control

Description

The Seven Band Equalizer selects one of six equalizer presets or selects a user adjustable profile as defined by CVs 154 through 160.

Bit 7							Bit 0
					EQ2	EQ1	EQ0

Bits 0-2: EQ0:EQ2 access the following Equalizer Presets:

0 = **Flat (off)**
Equalizer is disabled.

1 = **Tiny Speaker**
Preset for use with speakers under 1”

2 = **Small Speaker**
Preset for use with speakers from 1” to 2”

3 = **Medium Speaker**
Preset for use with speakers from 2” to 4”

4 = **Large Speaker**
Preset for use with speakers over 4”

5 = **Edgeport Speaker**
Preset for use with SoundTraxx Edgeport speaker. Improves the low end and flattens the mid-range peak.

6 = **Boom Box**
Increases bass and treble response by +dB

7 = **User Adjustable**
This setting allows the cut/boost level of each band to be individually adjusted using CVs 154-160

Default Value: 0

CV 154-160 Cut/Boost Controls

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

Bits 0-7: D0:D7 adjust the Cut/Boost level of each band:
0 = -12dB (Cut)
127 = 0dB (Flat)
255 = +12dB (Boost)

These CVs have a range of +/- 12dB. Values from 0 to 127 reduce the output from –12dB to 0dB. Values from 128 to 255 increase the output from 0dB to +12dB. Each CV from 154 to 160 controls a different frequency band as follows:

CV 154: 62 Hz Cut/Boost
CV 155: 125 Hz Cut/Boost
CV 156: 250 Hz Cut/Boost
CV 157: 500 Hz Cut/Boost
CV 158: 1K Hz Cut/Boost
CV 159: 2K Hz Cut/Boost
CV 160: 4K Hz Cut/Boost

Default Value: 0

CVs 161-164
Reverb

Description

The Reverb features one of six reverb presets or selects a user adjustable profile as defined by CVs 162 through 164.

CV 161 Reverb Control

Bit 7							Bit 0
					RV2	RV1	RV0

Bits 0-2: RV0:RV2, Reverb Preset Select

0 = Reverb Disabled
1 = Additional Reverb for Whistle Functions
2 = Light Reverb in Exhaust
3 = Medium Reverb in Exhaust
4 = Heavy Reverb in Exhaust
5 = Reserved
6 = Reserved
7 = User Adjustable

This setting allows the reverb level to be individually adjusted using CVs 162-164.

Default Value: 0

CV 162 Reverb Output Level

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

Bits 0-7: D0:D7 adjust the reverb output level:

Contains a value between 0 and 255 (n) that specifies a percentage of the reverb output (n/255) that is to be mixed back into the original audio signal.

Default Value: 128 (50%)

CV 163 Reverb Delay

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

Bits 0-7: D0:D7, Reverb Delay Time

This CV specifies the total reverb delay time from 0 to 64mS. The delay time is calculated as:

Delay = n x 0.25mS where n = the CV value from 0 to 255

Default Value: 255 (64mS)

CV 164 Reverb Gain

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

Bits 0-7: D0:D7, Reverb Feedback Gain

Contains a value between 0 and 255 (n) that specifies a percentage of the reverb output (n/255) that is to be mixed back into the delay line.

Note: High feedback levels may result in very high audio levels and can potentially damage speakers.

Default Value: 64 (25%)

CVs 169-176
Reverb Mixer

Description

The Reverb Mixer determines the volume level of select sound effects to be applied to the reverb effect.

Bit 7							Bit 0
RMX7	RMX6	RMX5	RMX4	RMX3	RMX2	RMX1	RMX0

Bits 0-7: RMX0:RMX7 sets the percentage of selected signal level to mix into the reverb input from 0 to 255.
0 = Minimum volume
255 = Maximum volume

CV 169: Horn Reverb Effect Send Level
CV 170: Bell Reverb Effect Send Level
CV 171: Diesel Engine Exhaust Reverb Effect Send Level
CV 172: Air Compressor Reverb Effect Send Level
CV 173: Reserved
CV 174: Reserved
CV 175: Reserved
CV 176: Reserved

Default Value: 0

CVs 193 - 198
Automatic Sound Control

Description

These CVs allow the user to set the parameters for the Automatic Sound Control features.

CV 193 Bell-On Set Point

Bit 7							Bit 0
	D6	D5	D4	D3	D2	D1	D0

Bits 0-6: D0:D6, Bell-On Set Point
This CV contains a value between 0 and 127 that specifies throttle speed step where the automatic bell will first turn on.

Default Value: 15

CV 194 Bell-Off Set Point

Bit 7							Bit 0
	D6	D5	D4	D3	D2	D1	D0

Bits 0-6: D0:D6, Bell-Off Set Point
This CV contains a value between 0 and 127 that specifies throttle speed step where the automatic bell will turn off.

Note: If CV 194 is set to a value equal or lower than CV 193, the automatic bell will not turn on.

Default Value: 19

CV 195 Grade Crossing Airhorn Sensitivity

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

Bits 0-7: D0:D7, Grade Crossing Horn Sensitivity
This CV contains a value between 0 and 255 that specifies the positive rate of throttle change needed to activate the automatic grade crossing horn. The CV setting is interpreted as:

CV Value = Speed Steps per Second÷10

Default Value: 4

CV 196 Brake Squeal Sensitivity

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

Bits 0-7: D0:D7, Brake Squeal Sensitivity
This CV contains a value between 0 and 255 that specifies the negative rate of throttle change needed to activate the automatic brake squeal. The CV setting is interpreted as:

CV Value = Speed Steps per Second÷10

Default Value: 3

CV 197 Analog Mode Automatic Sound Configuration

Bit 7							Bit 0
				BRK	BELL	AHSIG	AHXNG

Bit 0: AHXNG, Automatic Grade Crossing Horn Enable
0 = Effect disabled
1 = Effect enabled

Bit 1: AHSIG, Automatic Horn Signal Enable
0 = Effect disabled
1 = Effect enabled

Bit 2: BELL, Automatic Bell Enable
0 = Effect disabled
1 = Effect enabled

Bit 3: BRK, Automatic Brake Squeal Enable
0 = Effect disabled
1 = Effect enabled

Default Value: 0

CV 198 Digital Mode Automatic Sound Configuration

Bit 7							Bit 0
				BRK	BELL	AHSIG	AHXNG

Bit 0: AHXNG, Automatic Grade Crossing Horn Enable
0 = Effect disabled
1 = Effect enabled

Bit 1: AHSIG, Automatic Horn Signal Enable
0 = Effect disabled
1 = Effect enabled

Bit 2: BELL, Automatic Bell Enable
0 = Effect disabled
1 = Effect enabled

Bit 3: BRK, Automatic Brake Squeal Enable
0 = Effect disabled
1 = Effect enabled

Default Value: 0

CVs 199 - 200
Turbine Sound Control

Description

These CVs allow the user to set the parameters unique to the Gas-Turbine Electric Tsunami decoders.

CV 199 Turbine Start Speed

Bit 7							Bit 0
T7	T6	T5	T4	T3	T2	T1	T0

Bits 0-7: T0:T7, Turbine Start Speed
This CV contains a value between 0 and 255 that specifies throttle speed step where the turbine will turn on. It also sets the maximum motor speed step while the interlock bit is set (Bit 4, CV 116)

Default Value: 7

CV 200 Turbine Timeout

Bit 7							Bit 0
T7	T6	T5	T4	T3	T2	T1	T0

Bits 0-7: T0:T7, Turbine Timeout
This CV contains a value between 0 and 255 that specifies the number of seconds (0-255 seconds) before the turbine will turn off in Automatic Engine Notching mode when the engine is at speed step 0 and no function commands are being sent to the decoder. Setting this CV to 0 allows the turbine to be turned on using functions F9 and F10 in Semi-Auto-notching mode.

0 = Semi Auto-notching Mode enabled
1-255 = Seconds to Turbine Timeout

Default Value: 10

CVs 209 - 214
Advanced Motor Control Features

CV 209 Kp Coefficient

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

Bits 0-7: D0:D7 sets the Kp Coefficient
The CV contains a value between 0 and 255 that specifies a gain factor for the proportional part of the PID motor control equation.

Default Value: 25

CV 210 Ki Coefficient

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

Bits 0-7: D0:D7 sets the Ki Coefficient
The CV contains a value between 0 and 255 that specifies a gain factor for the integral part of the PID motor control equation.

Default Value: 20

CV 212 Motor Control Intensity

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

Bits 0-7: D0:D7 sets the Motor Control Intensity
The CV contains a value between 0 and 255, interpreted as n/32 that is fed back from the control loop.

Default Value: 255

CV 213 Motor Control Sample Period

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

Bits 0-7: D0:D7 sets the Motor Control Sample Period
The CV contains a value between 0 and 31, that specifies the time period in mS (milliseconds) between measurements.

Default Value: 15

CV 214 Motor Control Sample Aperture Time

Bit 7							Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

Bits 0-7: D0:D7 sets the Motor Control Sample Aperture Time The CV contains a value between 0 and 255 that specifies a gain factor for the derivative part of the PID motor control equation.

Default Value: 15

Effect Processor Select CVs

Using the Effect Processor Select

Description

Because there are so many sound effects, the Tsunami decoder uses a relatively large number of CVs! In some cases, however, a command station may not support CVs numbered above 128. If this is the case with your command station, Tsunami uses something rather akin to pages in a book to program these CVs. Different Mixers and Control sets reside on different pages, so the before anything else you need to choose the correct page using CV 119, Effect Processor Select.

CV 119 Effect Processor Select

CV 119 selects an Effect Processor which may be programmed via CVs 120 to 127, which are then used for individual controls as shown in the table. Choose the Effect Processor you want and program CV 119 accordingly:

0	=	Foreground Sound Mixer
1	=	Background Mixer 1
2	=	Background Mixer 2
3	=	Seven Band Equalizer
4	=	Reverb Control Mixer
5	=	Reverb Mixer
6	=	Reserved
7	=	Reserved
8	=	Automatic Sound Control 1
9	=	Automatic Sound Control 2
10	=	Advanced Motor Control
11	=	Reserved

Once you've programmed CV 119, program CVs 120 to 127 with the desired values as shown in the tables on the following pages.

Note: Tsunami will remember the value programmed into CV 119. To prevent inadvertent modifications of another effect, it is always wise to check the value in CV 119 before changing CVs 120-127. When you have completed your modifications, you might also want to set CV 119 to an unused value such as 12 or higher in case you forget to change it next time.

Effect Processor Select CVs

Effect Processor Selection and Programming		
CV 119 = 0	**Description**	**Range of Values**
CV 120	Airhon Volume	0 - 255
CV 121	Bell Volume	0 - 255
CV 122	Diesel Engine Exhaust Volume	0 - 255
CV 123	Air Compressor Volume	0 - 255
CV 124	Dynamic Brake Volume	0 - 255
CV 125	Radiator Fans Volume	0 - 255
CV 126	Reserved	0 - 255
CV 127	Reserved	0 - 255
CV 119 = 1	**Description**	**Range of Values**
CV 120	Coupler Volume	0 - 255
CV 121	Reserved	0 - 255
CV 122	Brake Squeal Volume	0 - 255
CV 123	Brake Release Volume	0 - 255
CV 124	Reserved	0 - 255
CV 125	Reserved	0 - 255
CV 126	Poppet Valve Volume	0 - 255
CV 127	Reserved	0 - 255
CV 119 = 2	**Description**	**Range of Values**
CV 120	Reserved	0 - 255
CV 121	Reserved	0 - 255
CV 122	Reserved	0 - 255
CV 123	Reserved	0 - 255
CV 124	Reserved	0 - 255
CV 125	Reserved	0 - 255
CV 126	Reserved	0 - 255
CV 127	Reserved	0 - 255

Effect Processor Select CVs

CV 119 = 3	Seven Band Equalizer	Range of Values
CV 120	Equalizer Preset Selection	0 - 7
CV 121	62 Hz Cut/Boost	0 - 255
CV 122	125 Hz Cut/Boost	0 - 255
CV 123	250 Hz Cut/Boost	0 - 255
CV 124	500 Hz Cut/Boost	0 - 255
CV 125	1K Hz Cut/Boost	0 - 255
CV 126	2K Hz Cut/Boost	0 - 255
CV 127	4K Hz Cut/Boost	0 - 255
CV 119 = 4	**Reverb Control Mixer**	**Range of Values**
CV 120	Reverb Preset Selection	0 - 7
CV 121	Reverb Output Level	0 - 255
CV 122	Reverb Delay Time	0 - 255
CV 123	Reverb Gain	0 - 255
CV 124	Not Assigned	-
CV 125	Not Assigned	-
CV 126	Not Assigned	-
CV 127	Not Assigned	-
CV 119 = 5	**Reverb Mixer**	**Range of Values**
CV 120	Airhorn Reverb Effect Send Level	0 - 255
CV 121	Bell Reverb Effect Send Level	0 - 255
CV 122	Diesel Exhaust Reverb Effect Send Level	0 - 255
CV 123	Air Compressor Reverb Effect Send Level	0 - 255
CV 124	Not Assigned	-
CV 125	Not Assigned	-
CV 126	Not Assigned	-
CV 127	Not Assigned	-

Effect Processor Select CVs

CV 119 = 6	DDE Mixer 1	Range of Values
CV 120	Reserved	0 - 255
CV 121	Reserved	0 - 255
CV 122	Reserved	0 - 255
CV 123	Reserved	0 - 255
CV 124	Reserved	0 - 255
CV 125	Reserved	0 - 255
CV 126	Reserved	0 - 255
CV 127	Reserved	0 - 255
CV 119 = 7	**DDE Mixer 2**	**Range of Values**
CV 120	Reserved	0 - 255
CV 121	Reserved	0 - 255
CV 122	Reserved	0 - 255
CV 123	Reserved	-
CV 124	Reserved	-
CV 125	Reserved	-
CV 126	Reserved	-
CV 127	Reserved	-
CV 119 = 8	**Automatic Sound Control 1**	**Range of Values**
CV 120	Bell-on Set Speed Step	0 - 255
CV 121	Bell-off Set Speed Step	0 - 255
CV 122	Grade Crossing Sensitivity	0 - 255
CV 123	Brake Squeal Sensitivity	0 - 255
CV 124	Automatic Analog Sound Enable	0 - 255
CV 125	Automatic Digital Sound Enable	0 - 255
CV 126	Reserved	0 - 255
CV 127	Reserved	0 - 255

Effect Processor Select CVs

CV 119 = 9	Automatic Sound Control 2	Range of Values
CV 120	Reserved	0 - 255
CV 121	Reserved	0 - 255
CV 122	Reserved	0 - 255
CV 123	Reserved	0 - 255
CV 124	Reserved	0 - 255
CV 125	Reserved	0 - 255
CV 126	Reserved	0 - 255
CV 127	Reserved	0 - 255
CV 119 = 10	**Advanced Motor Control**	**Range of Values**
CV 120	Kp Coefficient	0 - 255
CV 121	Ki Coefficient	0 - 255
CV 122	Reserved	0 - 255
CV 123	Motor Control Intensity	0 - 255
CV 124	Motor Control Sample Period	0 - 255
CV 125	Motor Control Sample Aperture Time	0 - 255
CV 126	Reserved	-
CV 127	Reserved	-

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