Decoder CV Instruction.

NMRA standard conformity.
Manufacturer ID 142

12.Aug.2015

Ver. 1.4

SLOMO

Revision History

Ver1.3	26.Apr.2015	Add manufacture ID number.
Ver1.4	12.Aug.2015	Easy Connectiom Function,Alternation lighting,when short circuit, CV15=0 access permit. Function Decoder Mode CV171 bit1 Symmetric DCC Breaking CV156/CV166 bit0 Mascon mode step change

Contents.

I. Introduction.

I-1. Introduction.

Thank you for purchasing SLOMO decoder. This DCC decoder is designed based on NMRA rules, so this decoder can be used with product of other manufacture which obeys NMRA rules.

How to program CV value is written in this manual. How to install decoder into the vehicle is written in distinct decoder hardware manual.

Notice!

Please read carefully around this mark.
There is highly possibility that the models gets damage.

II. CV Programming

II-1 Programming Mode

Supported CV programming mode is shown in Table.II-1. Some use programming line and others use driving line. When basic acknowledgment is used, motor or 200 ohom register must be connected to the decoder. When railcom is used, railcom detector is needed. When some decoders are installed in one vehicle, there is the way that identical decoder can be programmed. Please show chapter IV-6.

Table. II-1 Supported CV Programming Mode

Programming Mode	Accessible CV	Write	Verify	Bit Manipulation	Acknowledgment	Line
Paged Mode	All	○	○		Basic	Programming Line
Direct Mode	All	○	○	○	Basic	Programming Line
Physical Register Mode	*CV1–CV4 CV29 CV7 CV8*	○	○		Basic	Programming Line
Operating Mode	All	○	○ *	○	Railcom	Driving Line
Operating Mode Short	*CV23 CV24*	○	○ *	○	Railcom	Driving Line

*Note CVs are able to read only when Railcom is used.

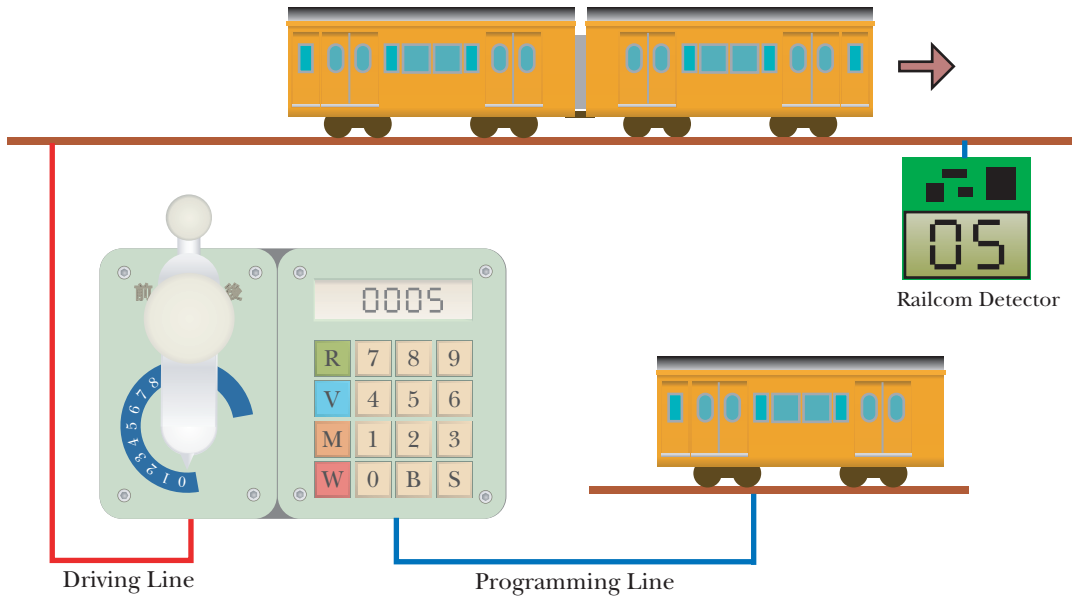


Fig. II-1 The Connection of CV Programmer.

II-2 Data Format.

There are five kinds of CV data format below according to how many data are included in one byte.

1bit x 8 Format

Please add the numeral when bit data is one, and write this value.

Example

bit	7	6	5	4	3	2	1	0
CV**	128	64	32	16	8	4	2	1
Set Data	1	0	1	0	0	1	0	1

128 + 32 + 4 + 1 = 165

Write Data

2bit x 4 Format

Please add the value multiplied each two bit data (0-3) and coefficient, and write this value.

Example

CV**	64	16	4	1
Set Data	1	3	0	2

1 x 64 + 3 x 16 + 2 x 1 = 114

Write Data

4bit x 2 Format

Please add the value multiplied each two bit data (0-15) and coefficient, and write this value.

Example

	High order 4bit	Low order 4bit
CV**	16	1
Set Data	12	5

16 x 12 + 5 x 1 = 197

Write Data

1bit + 7bit Format

Please multiply one bit data and 128, add seven bit data to it, and write this value.

Example

CV**	128	1
Set Data	1	34

128 x 1 + 1 x 34 = 162

Write Data

8bit Format

Please write eight bit data directly.

Example

CV**	1
Set Data	123

1 x 123 = 123

Write Data

III. Table of CV.

Table of CV.

CV Number	Type	CV name	Data Format	Default Value	Reference
CV1	NMRA	Primary Address	1bit+7bit	3	IV-2
CV2	NMRA	Start Speed Step	8bit	0	V-3
CV3	NMRA	Acceleration Rate	8bit	0	V-2
CV4	NMRA	Deceleration Rate	8bit	0	V-2
CV5	NMRA	Maximum Speed Step	8bit	0	V-3
CV6	NMRA	Mid Speed Step	8bit	0	V-3
CV7	NMRA	Version Number(Read)/CV Store(write)	8bit	-	XI-3
CV8	NMRA	Manufacturer ID/Status(Read)/CV Restore(write)	8bit	142	XI-3
CV11	NMRA	Packet Time-Out Value	8bit	20	XI-3
CV12	NMRA	Analog Mode Conversion	8bit	1	IV-5
CV13	NMRA	Analog Mode Function Status F1-F8	1bit x 8	0	IV-5
CV14	NMRA	Analog Mode Function Status FL F9-F12	1bit x 8	3	IV-5
CV15	NMRA	Decoder Lock #1	8bit	0	IV-6
CV16	NMRA	Decoder Lock #2	8bit	0	IV-6
CV17	NMRA	Extended Address High-Order	8bit	0	IV-3
CV18	NMRA	Extended Address Low-Order	8bit	0	IV-3
CV19	NMRA	Consist Address	1bit+7bit	0	IV-4
CV21	NMRA	Consist Address Active Function for F1-F8	1bit x 8	0	IV-4
CV22	NMRA	Consist Address Active Function for FL F9-F12	1bit x 8	0	IV-4
CV23	NMRA	Acceleration Rate Adjustment(Temp)	1bit+7bit	0	V-2
CV24	NMRA	Deceleration Rate Adjustment(Temp)	1bit+7bit	0	V-2
CV25	NMRA	Speed Table Mid Step Position	8bit	0	V-3
CV27	NMRA	Decoder Automatic Stopping Configuration	2bit x 4	0	IX-2
CV28	NMRA	Bi-Directional Communication Configuration	2bit x 4	0	VIII-2
CV29	NMRA	Configuration Data #1	1bit x 8	130	IV-2
CV33	NMRA	Function Output Location FL(F)	1bit x 8	1	VI-2
CV34	NMRA	Function Output Location FL(R)	1bit x 8	2	VI-2
CV35	NMRA	Function Output Location F1	1bit x 8	4	VI-2
CV36	NMRA	Function Output Location F2	1bit x 8	8	VI-2
CV37	NMRA	Function Output Location F3	1bit x 8	16	VI-2
CV38	NMRA	Function Output Location F4	1bit x 8	4	VI-2
CV39	NMRA	Function Output Location F5	1bit x 8	8	VI-2
CV40	NMRA	Function Output Location F6	1bit x 8	16	VI-2
CV41	NMRA	Function Output Location F7	1bit x 8	32	VI-2
CV42	NMRA	Function Output Location F8	1bit x 8	64	VI-2
CV43	NMRA	Function Output Location F9	1bit x 8	128	VI-2
CV44	NMRA	Function Output Location F10	1bit x 8	0	VI-2

Table of CV.

CV Number	Type	CV name	Data Format	Default Value	Reference
CV45	NMRA	Function Output Location F11	1bit x 8	0	VI-2
CV46	NMRA	Function Output Location F12	1bit x 8	0	VI-2
CV47	ORG	Motor Control Preset Value Select	8bit	0	VII-7
CV48	ORG	Function Output 1 Intensity of Light	4bit x 2	31	VI-3
CV49	ORG	Function Output 2 Intensity of Light	4bit x 2	31	VI-3
CV50	ORG	Function Output 3 Intensity of Light	4bit x 2	31	VI-3
CV51	ORG	Function Output 4 Intensity of Light	4bit x 2	31	VI-3
CV52	ORG	Function Output 5 Intensity of Light	4bit x 2	31	VI-3
CV53	ORG	Function Output 6 Intensity of Light	4bit x 2	31	VI-3
CV54	ORG	Function Output 7 Intensity of Light	4bit x 2	31	VI-3
CV55	ORG	Function Output 8 Intensity of Light	4bit x 2	31	VI-3
CV56	ORG	Function Output 1 Special Efect Configuration	1bit x 8	39	VI-3
CV57	ORG	Function Output 2 Special Efect Configuration	1bit x 8	21	VI-3
CV58	ORG	Function Output 3 Special Efect Configuration	1bit x 8	53	VI-3
CV59	ORG	Function Output 4 Special Efect Configuration	1bit x 8	53	VI-3
CV60	ORG	Function Output 5 Special Efect Configuration	1bit x 8	53	VI-3
CV61	ORG	Function Output 6 Special Efect Configuration	1bit x 8	53	VI-3
CV62	ORG	Function Output 7 Special Efect Configuration	1bit x 8	53	VI-3
CV63	ORG	Function Output 8 Special Efect Configuration	1bit x 8	53	VI-3
CV64	ORG	Function Output Intensity of Light On/Off Speed	4bit x 2	6	VI-3
CV65	NMRA	Kick Start Time	8bit	0	V-7
CV66	NMRA	Forward Speed Trim	8bit	0	V-5
CV67-CV94	NMRA	Speed Table 1-28	8bit	Linear	V-4
CV95	NMRA	Reverse Speed Trim	8bit	0	V-5
CV105	NMRA	User Identifier #1	8bit	0	-
CV106	NMRA	User Identifier #2	8bit	0	-
CV112	ORG	(Motor) Loop Gain	8bit	4	VII-6
CV113	ORG	(Motor) Speed Detect Timing	8bit	0	VII-6
CV114	ORG	(Motor) Speed Compensation Level	8bit	50	VII-2
CV115	ORG	(Motor) Speed Offset	8bit	0	VII-3
CV116	ORG	(Motor) Speed of Ultra Low Speed Pulse Out	8bit	0	VII-3
CV117	ORG	(Motor) Ultra Low Speed Pulse Duration	8bit	80	VII-3
CV118	ORG	(Motor) Pulse Off Minimum Duration	8bit	2	VII-2
CV119	ORG	(Motor) Pulse Off Maximum Duration	8bit	8	VII-2
CV120	ORG	(Motor) Pulse On Duration as Low Speed	8bit	7	VII-2
CV121	ORG	(Motor) Pulse On Duration as High Speed	8bit	30	VII-4
CV122	ORG	(Motor) A Change Speed of Pulse On Duration (L)	8bit	30	VII-4
CV123	ORG	(Motor) A Change Speed of Pulse On Duration (H)	8bit	250	VII-4
CV124	ORG	(Motor) Pulse On Duration Distribution Level	8bit	3	VII-2

Table of CV.

CV Number	Type	CV name	Data Format	Default Value	Reference
CV125	ORG	(Motor) Thin Pulse Off Duration	8bit	0	VII-5
CV126	ORG	(Motor) Minimum Speed of Thin Pulse Mode	8bit	255	VII-5
CV127	ORG	(Motor) Thin Pulse Mode Speed Offset	8bit	0	VII-5
CV128	ORG	(Motor) Thin Pulse Mode Speed Compensation Level	8bit	0	VII-5
CV130 -CV145	ORG	Function Output Location F13-F28	1bit x 8	0	VI-2
CV146	ORG	Special Action Configuration	1bit x 8	32	VI-3
CV147	ORG	Deceleration Rate in Inertia at Real Driving Mode	8bit	10	X-1
CV148	ORG	The Pattern of On of Fluorescent Lamp I	1bit x 8	0	VI-3
CV149	ORG	The Pattern of On of Fluorescent Lamp II	1bit x 8	32	VI-3
CV150	ORG	The Pattern of On of Fluorescent Lamp III	1bit x 8	181	VI-3
CV151	ORG	Automatic Stopping Distance	8bit	20	IX-2
CV152	ORG	Automatic Slow Speed	8bit	10	IX-2
CV153	ORG	Minimum Deceleration in Braking Section	8bit	40	IX-2
CV154	ORG	Maximum Speed in Braking Section	8bit	255	IX-2
CV155	ORG	Controller Instructions Speed Distance	8bit	0	IX-2
CV156	ORG	Symmetric and Asymmetric change	1bit x 8	0	IX-5
CV158	ORG	Asymmetric DCC details	4bit x 2	20	IX-3
CV159	ORG	Minimum Speed in breaking Section	8bit	2	IX-3
CV161	ORG	Automatic Stopping Distance(Temp)	8bit	—	IX-2
CV162	ORG	Automatic Slow Speed(Temp)	8bit	—	IX-2
CV163	ORG	Minimum Deceleration in Braking Section(Temp)	8bit	—	IX-2
CV164	ORG	Maximum Speed in Braking Section(Temp)	8bit	--	IX-2
CV165	ORG	Controller Instructions Speed Distance(Temp)	8bit	--	IX-2
CV166	ORG	Symmetric and Asymmetric change(Temp)	1bit x 8	0	IX-5
CV168	ORG	Constant Time Acceleraion Speed Change Time	8bit	0	X-3
CV169	ORG	Output Time for Absorbing Gear Backrush	8bit	0	V-9
CV170	ORG	Speed Start Speed	8bit	0	V-9
CV171	ORG	Easy Function Connection/Function Decoder Mode.	8bit	0	VI-7

IV. Decoder Address.

IV-1. A kind of Address.

All decoders basically are connected with one line which is connected with power station. What decoder is controlled is decided by decoder address which is set in each decoder. A kind of address is shown in table. IV-1.

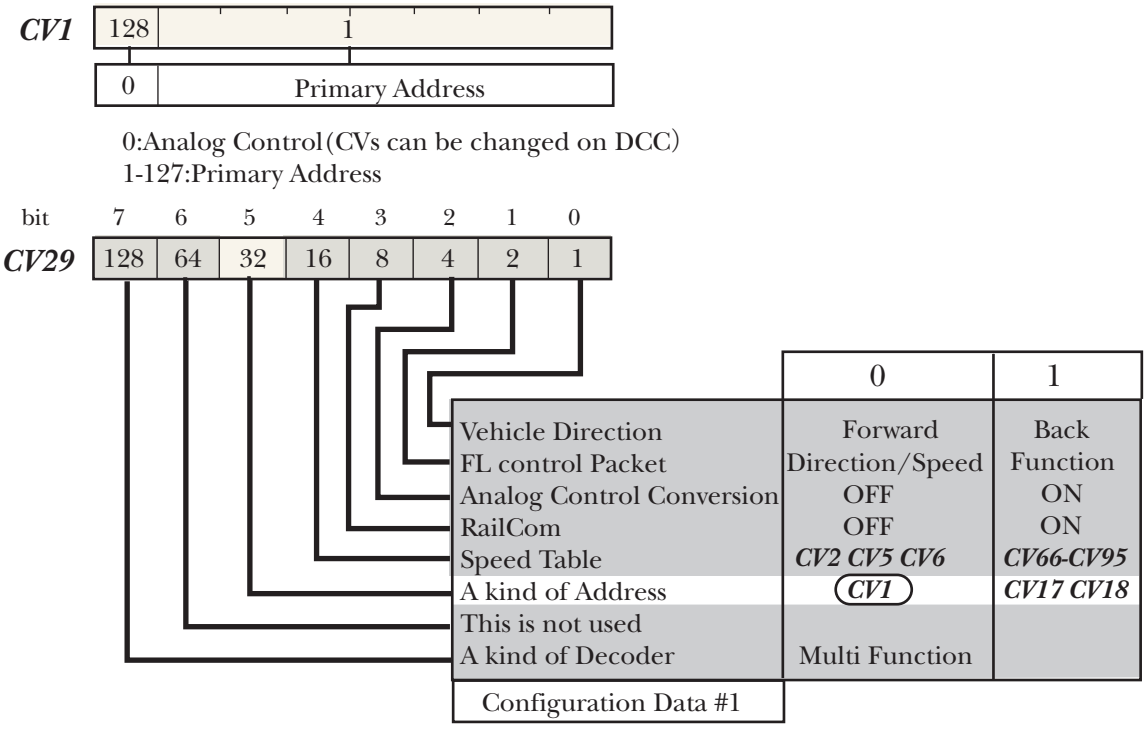
.Table IV-1 A kind of Address.

A kind of Address	Setting CV	Select Conditions	Address Range	Function Setting	Purpose
Primary Address	***CV1***	***CV29*** bit5=1 ***CV19*** =0	1～127		Normal
Extended Address	***CV17 CV18***	***CV29*** bit5=1	49152～59391 *注		Normal
Consist Address	***CV19***	***CV29*** bit5=0 ***CV19*** ≠0	1～127	***CV21 CV22***	Temporary
Analog Control		***CV1*** =0 ***CV12*** =1		***CV13 CV14***	Analog
		CV12 =1 ***CV29*** bit2=1 DCC signal is not detected			
Decoder Lock	***CV15 CV16***	Address is same. ***CV15*** =***CV16***	0～255		Set CVs

*Note Different extended address range is used for control by some command station.
Example. Decoder Address=49152(***CV17***=192 ***CV18***=0) is controlled by Address 128 at command station

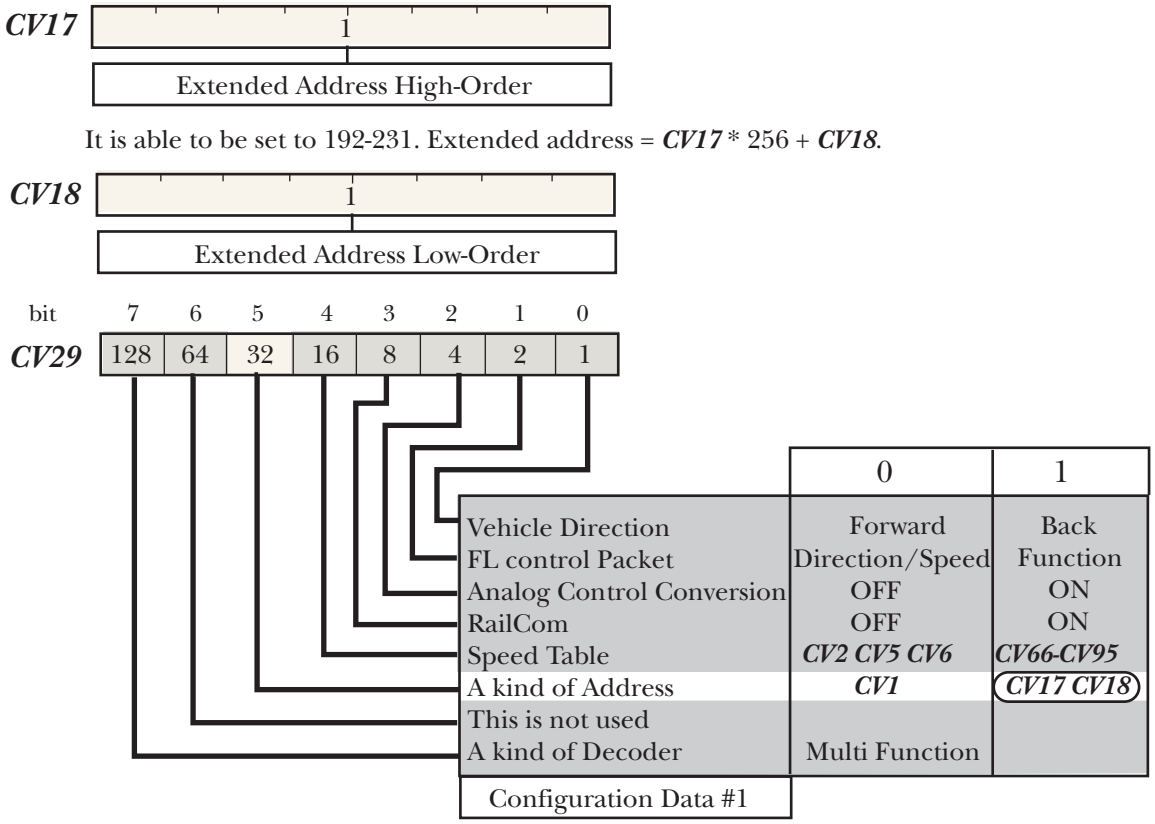
IV-2 Primary Address

This is DCC primary address which is able to set to 1-127. When ***CV1*** is set to 0, Decode is in the analog mode, in which speed is controlled by rail voltage. For that, DCC packet except for CV setting packet is ignored. Primary address is valid when ***CV29*** bit5 is set to 0.



IV-3 Extended Address.

DCC extended address is used when lots of train exist. This is able to set to 49152-59391. But different extended address range is used for control by some command station. For example. Decoder Address= 49152(***CV17***=192 ***CV18***=0) is controlled by Address 128 at command station. ***CV17*** is high order data, and ***CV18*** is for low order data. Extended address is valid when ***CV29*** bit5 is set to 1.



IV-4 Consist Address

This is used for temporary address, when the primary address is used. This is used for running train by one address. Bit7 of ***CV19*** is for direction setting of each car. Thus, when vehicle are connected, running direction will be same.

CV21 and ***CV22*** each bit can set whether each function is controlled by primary address or consist address. This feature allows the user that function is controlled by consist address but cab light in the middle of the train is left off. Please show chapter VI-2.

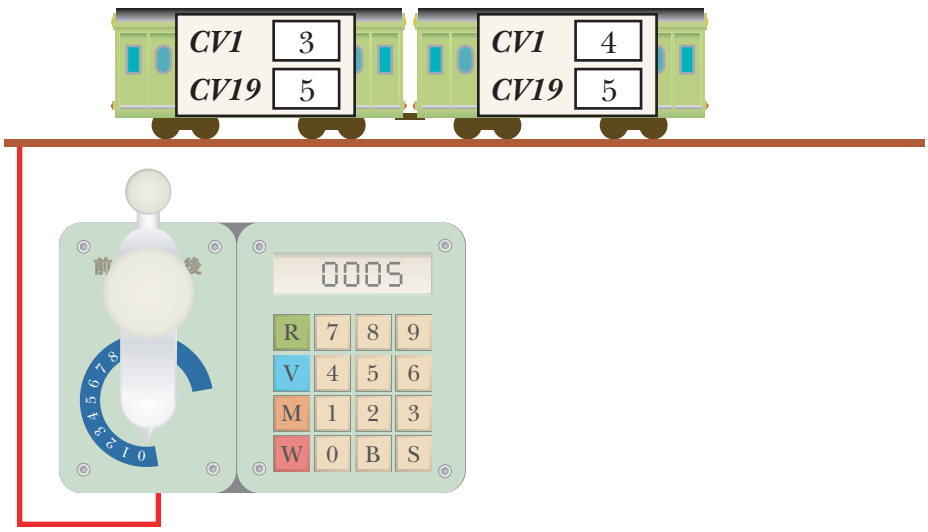
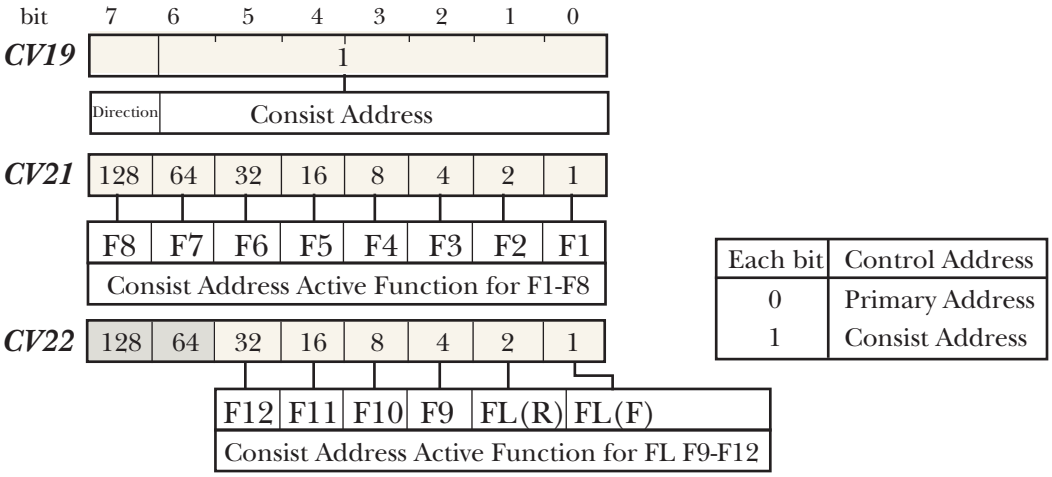


Fig.IV-1 Driving by Consist Address.



Each bit	Control Address
0	Primary Address
1	Consist Address

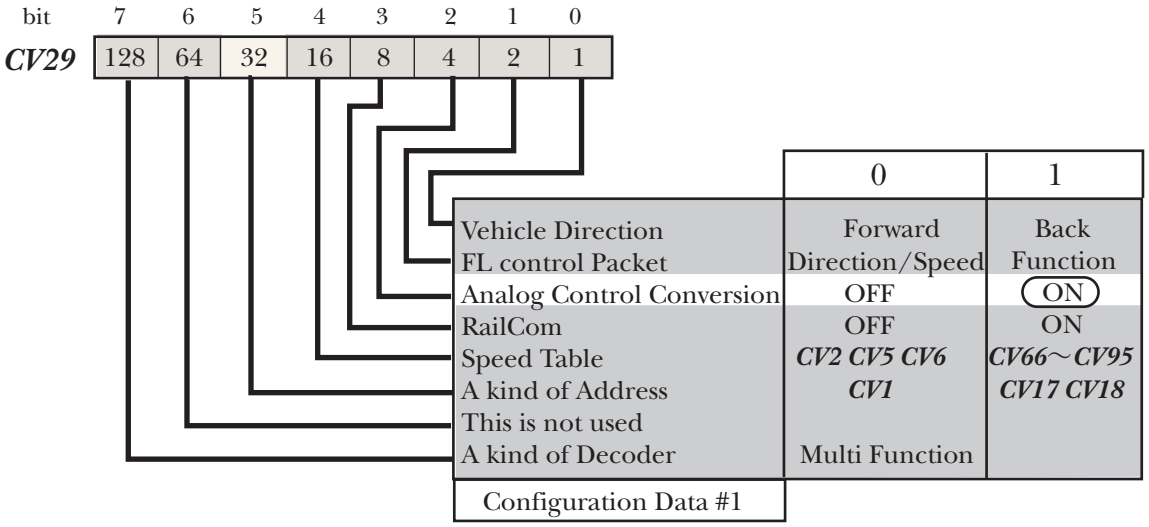
Table.IV-2 Primary Address and Consist Address Operation Conditions

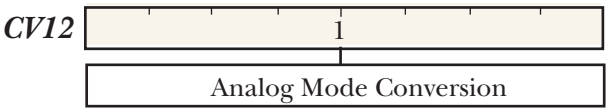
Consist Address ***CV19*** Value	0		Except for 0			
Primary Adress ***CV1*** is same as DCC Packet Address.	○	X	○	X	○	X
Consist Address ***CV19*** is same as DCC Packet Address.	-	-	○	○	X	X
Motor Control	○	X	○	○	X	X
Function Control	***CV21/CV22*** each bit = 0	X	○	***CV21/CV22*** each bit = 1	***CV21/CV22*** each bit = 0	X
Operation Mode CV Programming	○	X	○	X	○	X

IV-5 Analog Control.

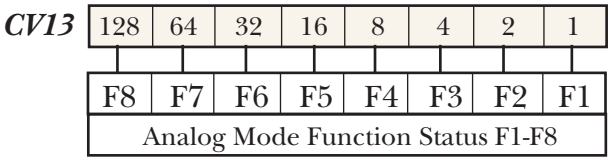
It is converted into analog control mode when primary address ***CV1*** is set to 0, or、when primary address ***CV1*** is not set to 0, ***CV29*** bit2 is set to 1, ***CV12*** is set to 1, and DCC packet can not be detected more than 0.2 second. Voltage of rail decides speed of the vehicle in ananlog mode. ***CV13*** and ***CV14*** can set whether each function is on or off. It is not allowed the user to change function state in analog mode.

In analog control mode decoder performance will not be same as the performance decoder really has. Just consider this mode is only for test. Note that when ***CV29*** bit2 is set to 1, if DCC packet can not be detected more than 0.2 second, there is possibility that the train runs at full speed. We strongly recommend that ***CV12*** is set to 0, and ***CV29*** bit2 is set 0.

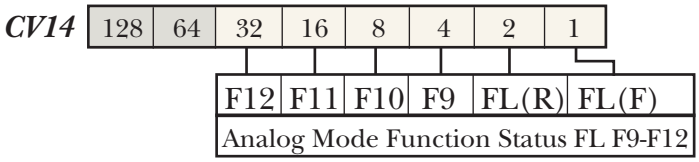




0:Only DCC 1:Analog Control Mode is available.



Each bit	Operation
0	When analog mode, function is on.
1	When analog mode, function is off.



IV-6 CV programming of Many Same Address Decoders.

This is way that one particular decoder can be programmed among a lot of same address decoders are installed in one vehicle. Please set ***CV16*** to distinct value before decoders are installed. ***CV15*** has to be set to same value as ***CV16*** before programming. The decoder in which ***CV15*** value is as same as ***CV16*** value can be programmed. The decoder also can be programmed when ***CV15*** is set to 0 regardless of ***CV16*** setting value.

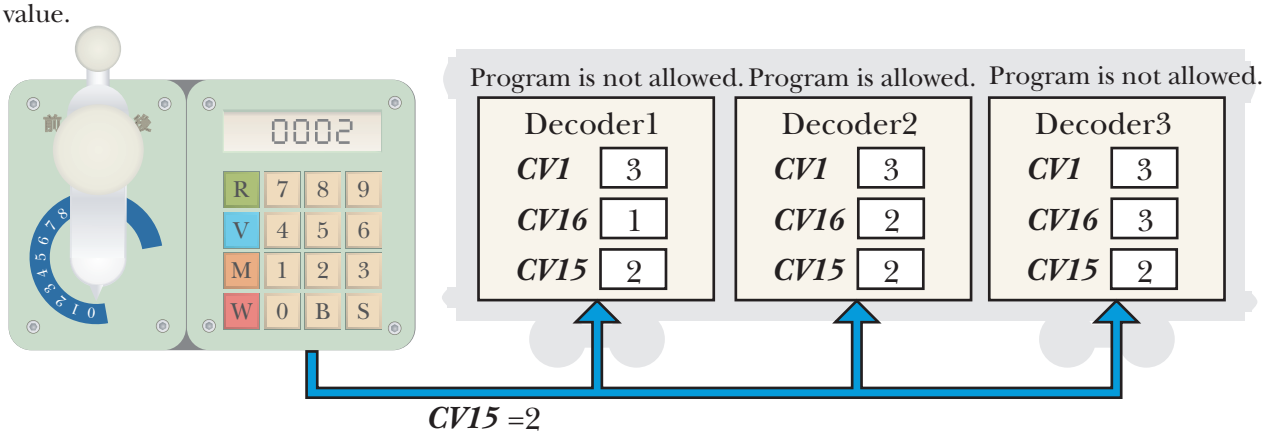
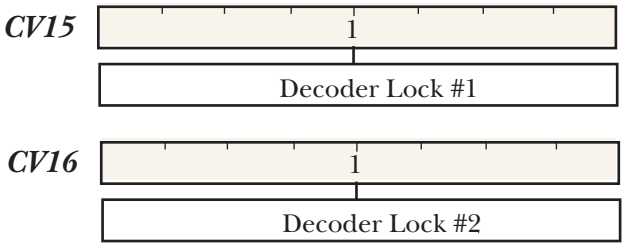


Fig.IV-2 CV programming of Many Same Address Decoders.



V. Speed and Direction Control

V-1 Speed and Direction Control.

Basic configuration of speed and direction control is illustrated in Fig.V-1. Firstly, speed step is directed by command station is changed to gentle speed step slope at acceleration and deceleration block. Nextly, 3 speed table or 28 speed table is selected according to ***CV29*** bit4. And, accelerated speed is changed to tabled speed using selected speed table. This is used for adjusting accelerated speed to real speed when EFM is not used. Nextly, forward or reverse speed is trimmed individually for a vehicle having different forward and reverse speed. And start kick is perfomed for a vehicle having extreme rapid start. Lastly, direction is decided by ***CV29*** bit0.

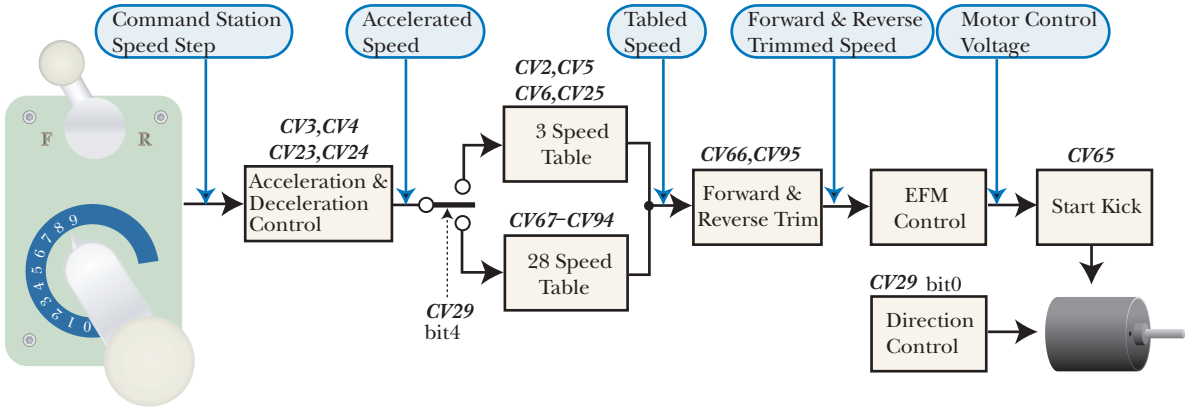


Fig. V-1 Basic Configuration of Speed and Direction Control.

V-2 Acceleration and Deceleration Control.

Speed can be changed with gentle slope, even when command station speed is changed with steep slope as illustrated in Fig. V-2. ***CV3*** and ***CV23*** is for acceleration and ***CV4*** and ***CV24*** is for deceleration. Calculation formula and example is shown in Table. V-1.

Table. V-1 Acceleration and Deceleration Control.

		14 Speed Step Mode	28 Speed Step Mode	128 Speed Step Mode
Acceleration [sec/step]		$\frac{(CV3 +/- CV23 * 0.896)}{14}$	$\frac{(CV3 +/- CV23 * 0.896)}{28}$	$\frac{(CV3 +/- CV23 * 0.896)}{126}$
Deceleration [sec/step]		$\frac{(CV4 +/- CV24 * 0.896)}{14}$	$\frac{(CV4 +/- CV24 * 0.896)}{28}$	$\frac{(CV4 +/- CV24 * 0.896)}{126}$
Time from stop to maximum speed [sec]	***CV3***=1 ***CV23***=0	0.896	0.896	0.896
	CV3=255 ***CV23***=0	228	228	228
	CV3=0 ***CV23***=0	0	0	0

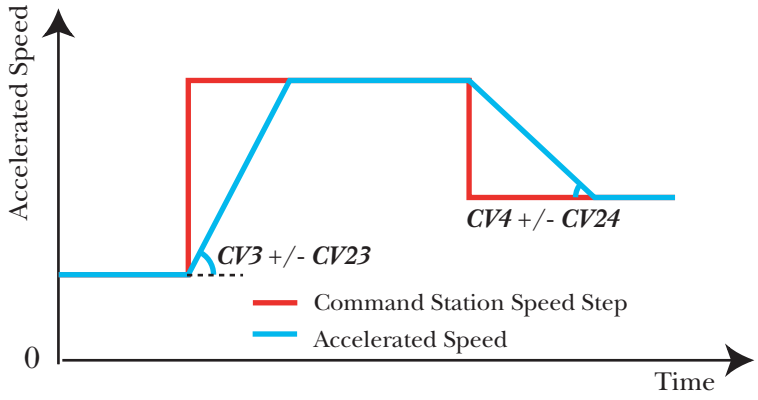


Fig. V-2 Acceleration and Deceleration Control.

CV3

1
Acceleration Rate

When value is set to 0, acceleration is disabled regardless of ***CV23*** value.

bit 7 6 5 4 3 2 1 0

CV23

128	1
+/-	Acceleration Rate Adjustment

bit7 0:Add adjustment value to ***CV3*** .
1:Subtract adjustment value to ***CV3*** .

This setting is temporary.

CV4

1
Deceleration Rate

When value is set to 0, deceleration is disabled regardless of ***CV24*** value.

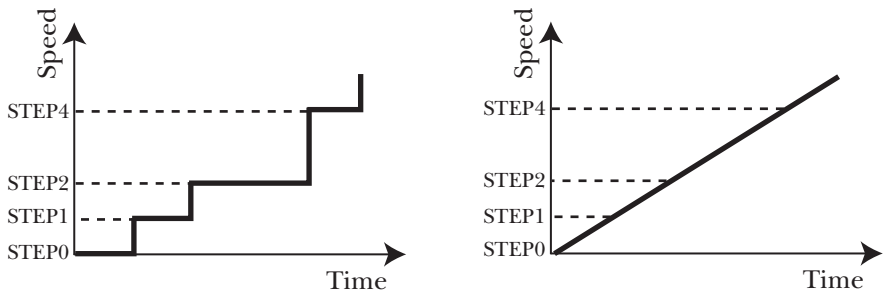
bit 7 6 5 4 3 2 1 0

CV24

128	1
+/-	Deceleration Rate Adjustment

bit7 0:Add adjustment value to ***CV4*** .
1:Subtract adjustment value to ***CV4*** .
This setting is temporary.

When speed step is changed, speed step is slowly changed with finer step than 126 speed steps. This function will make acceleration smoothly when the vehicle starts or runs at other speed.



(1) Basic Decoder. (2) Slow up & down speed change.

Fig.VII-3 Slow up & down speed change.

CV170

1
Speed Slow Up&Down Start Speed

Minimum speed as slow up & down speed change can be set. When it takes long time to start the vehicle, this value must be set. Value 255 is same as step1 speed.

V-3 3 Speed Table.

CV value can decide how to change command station speed step to motor voltage. This is used for adjusting command station speed step to real speed. When EFM is used, command station speed step is in proportion to real speed. In this case, only maximum speed ***CV5*** is needed to adjust. In 3 speed table, only three position can be adjusted. When finer adjustment is needed, please use 28 speed table. 3 speed table or 28 speed table is selected according to ***CV29*** bit4.

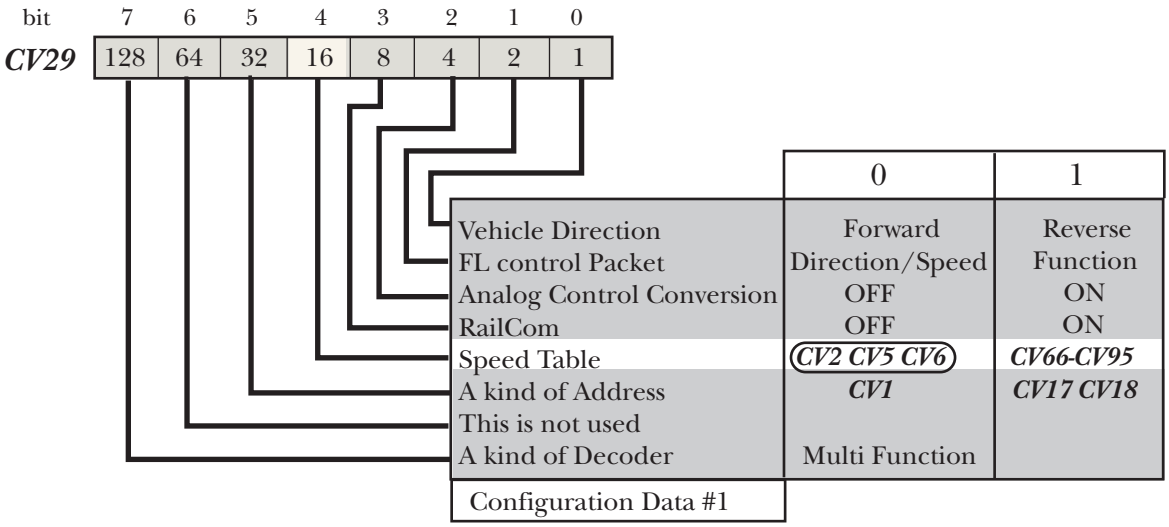
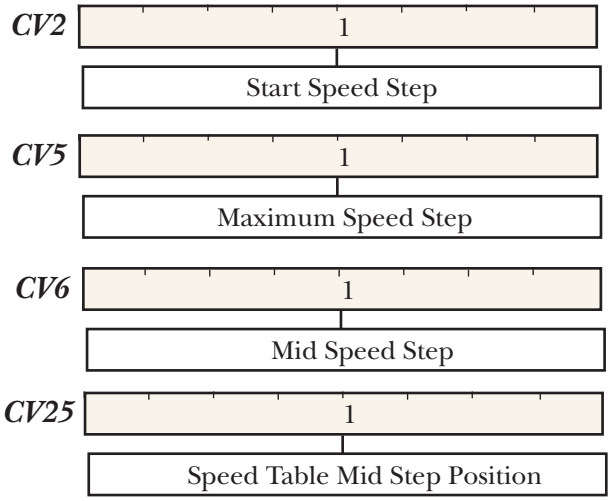


Fig. V-3 shows the characteristics of 3 speed table, and Table. V-2 shows how to set characteristics of 3 speed table. ***CV25*** can be set the position of middle step.



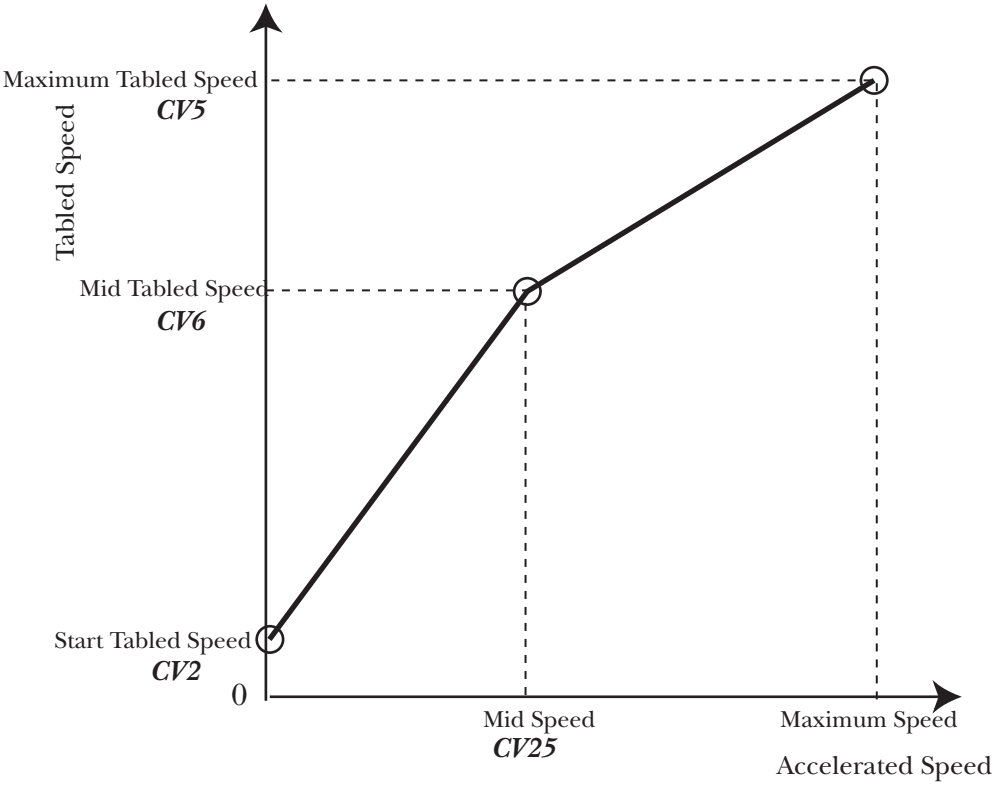


Fig. V-3. 3 Speed Table Characteristics.

Table. V-2 3 Speed Table Characteristics Setting.

	Condition	14 Speed Step Mode	28 Speed Step Mode	128 Speed Step Mode
Mid Speed	***CV25*** <=1	Not be used	Not be used	Not be used
	CV25 =2	7	14	63
	CV25 =128−154	$\frac{(CV25-128)}{2}$	***CV25***-128	(***CV25***-128)*9
Maximum Speed		14	28	126
Start Tabled Speed		***CV2***	***CV2***	***CV2***
Mid Tabled Speed	***CV6*** <=1	Not be used	Not be used	Not be used
	CV6 >2	***CV6***	***CV6***	***CV6***
Maximum Tabled Speed	***CV5*** <=1	Maximum	Maximum	Maximum
	CV5 >2	***CV5***	***CV5***	***CV5***

V-4 28 Speed Table.

CV value can decide how to change command station speed step to motor voltage. This is used for adjusting command station speed step to real speed. When EFM is used, command station speed step is in proportion to real speed. In this case, 28 speed table is not needed to use. Please use 3 speed table and adjust only maximum speed ***CV5***. In 28 speed table, 28 position has to be adjusted. When fine adjustment is not needed, please use 3 speed table. 3 speed table or 28 speed table is selected according to ***CV29*** bit4.

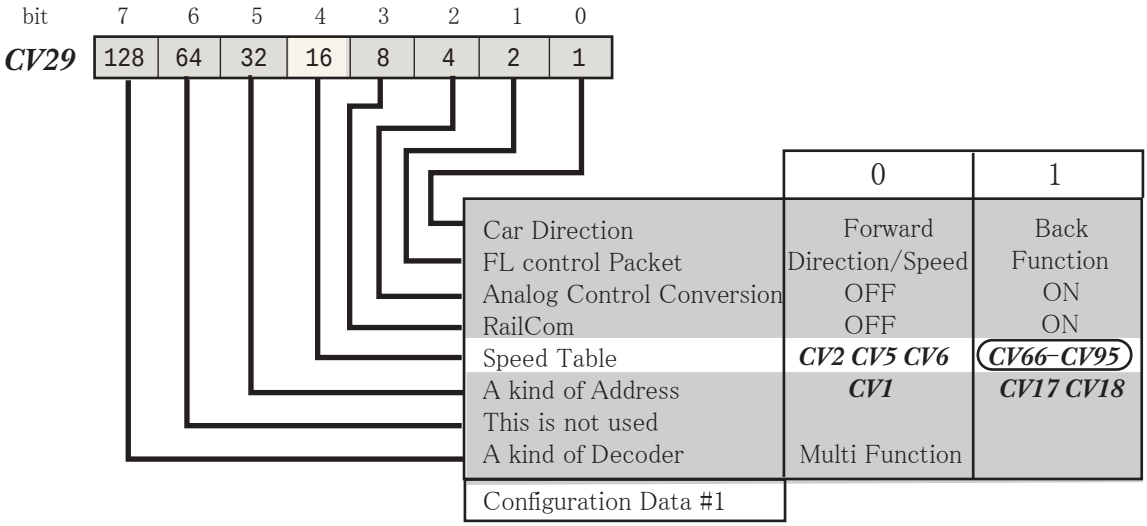


Fig. V-5 shows the characteristics of 28 speed table, and Table. V-3 shows how to set characteristics of 28 speed table. Please note that speed step between two 28 speed tables is compensated linearly, but compensation is not performed in the case that big table value is smaller than small table value, such as ***CV70*** value>***CV71*** value.

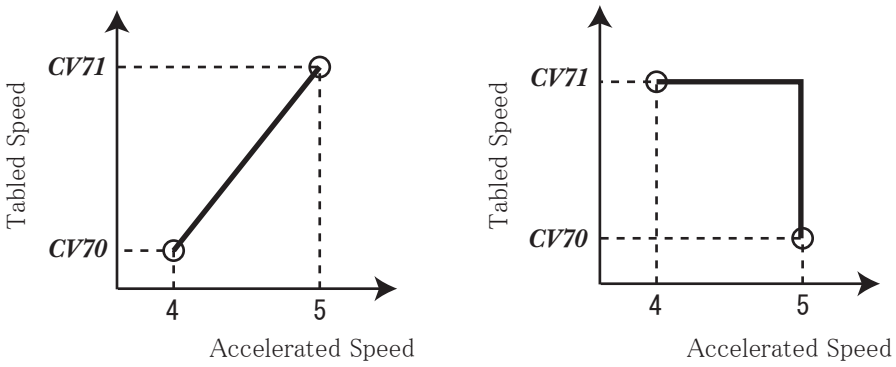
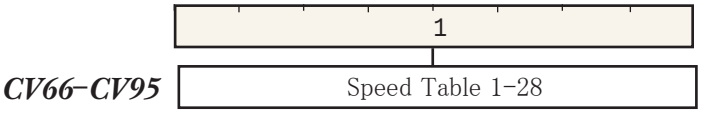


Fig. V-4 28 Speed Table Compensation Method.



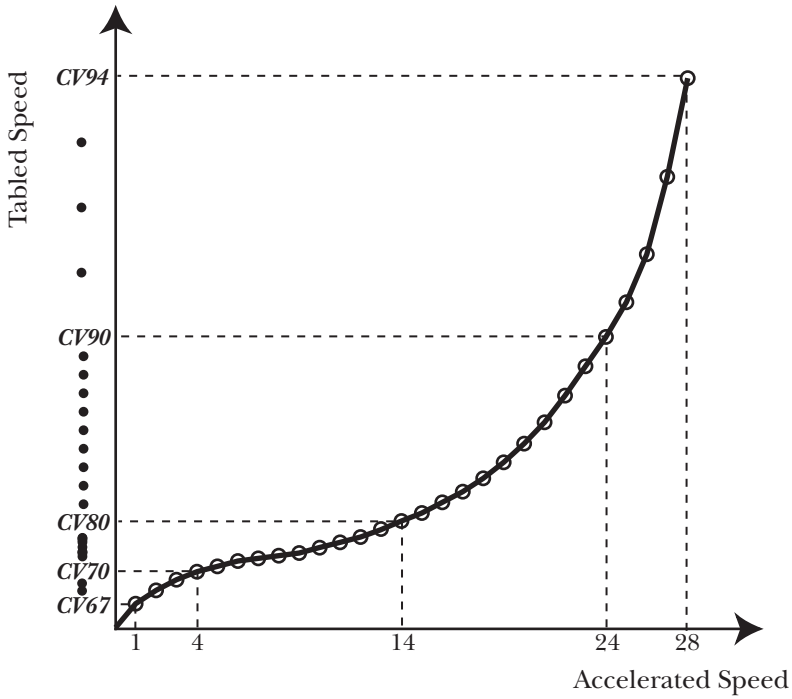


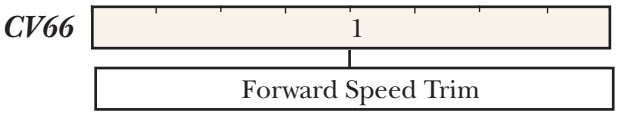
Fig. V-5 28 Speed Table Characteristics.

Table.V-3 28 Speed Table Characteristics Setting

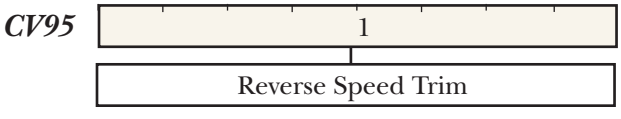
Speed Table	14 Speed Step Table	28 Speed Step Table	128 Speed Step Table
CV67	0.5	1	4.5
CV68	1	2	9
CV69	1.5	3	13.5
● ● ●			
CV93	13	27	121.5
CV94	14	28	126

V-5 Forward and Reverse Speed Trim.

Forward or reverse speed is trimmed individually for a vehicle having different forward and reverse speed. When EFM is used, this trimming is not needed.



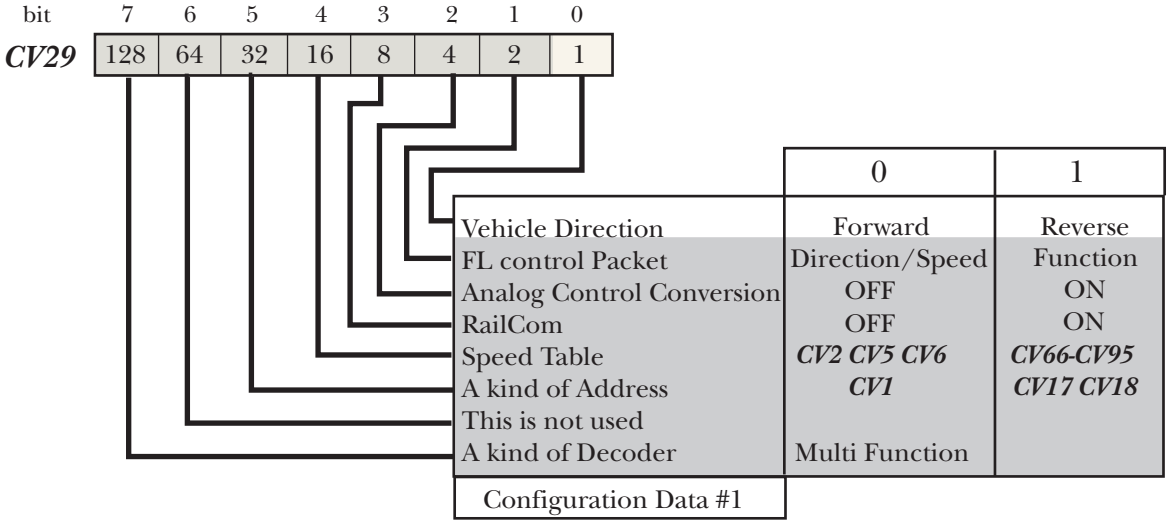
0:No trim.
Except for 0:Forward speed is increased (value/256) times.



0:No trim.
Except for 0:Reverse speed is increased (value/256) times.

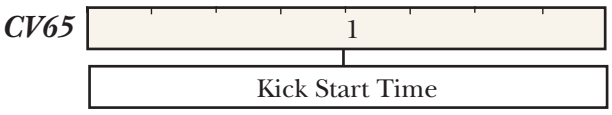
V-6 Direction Control.

The model vehicle runs settled direction all the time as illustrated in below. For that, each vehicles are needed to connect with same direction. If direction is different, ***CV29*** bit1 has to be change. If direction on rail basis mode is used, this setting is not needed. (Chanpter X-2 shows direction on rail basis mode.)



V-7 Start Kick.

Start kick is illustrated in Fig. V-6 helps a model vehicle having extreme rapid start. The period of time which maximum voltage is output can be set in ***CV65*** when vehicle starts. This future is not needed, when EFM is used.



Maximum voltage is output during this value*0.0039 second when a model vehicle starts.

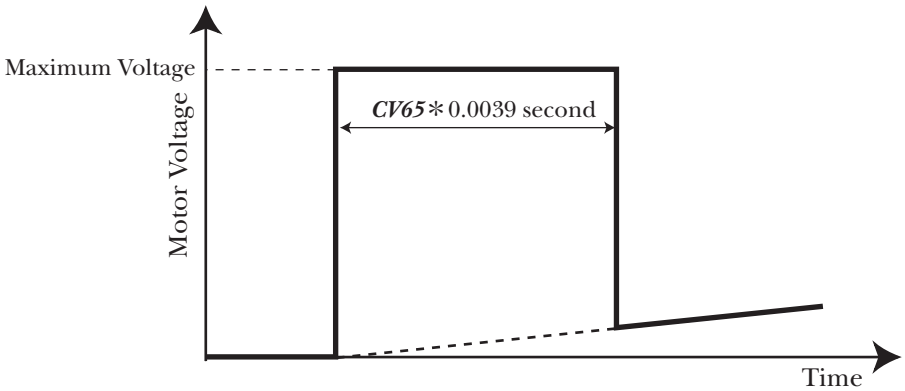


Fig.V-6 Start Kick.

V-8. Speed when Analog and DCC control conversion.

When control is converted from DCC to analog, if setting speed of analog control is higher than DCC control, speed changes by acceleration according to ***CV3*** and ***CV23***. Conversely, if setting speed of analog control is lower, speed changes by deceleration according to ***CV4*** and ***CV24***.

When control is converted from analog to DCC, speed changes by deceleration according to ***CV4*** and ***CV24*** before first DCC speed and direction packet is received. After its packet is received, speed changes like control is converted from DCC to analog.

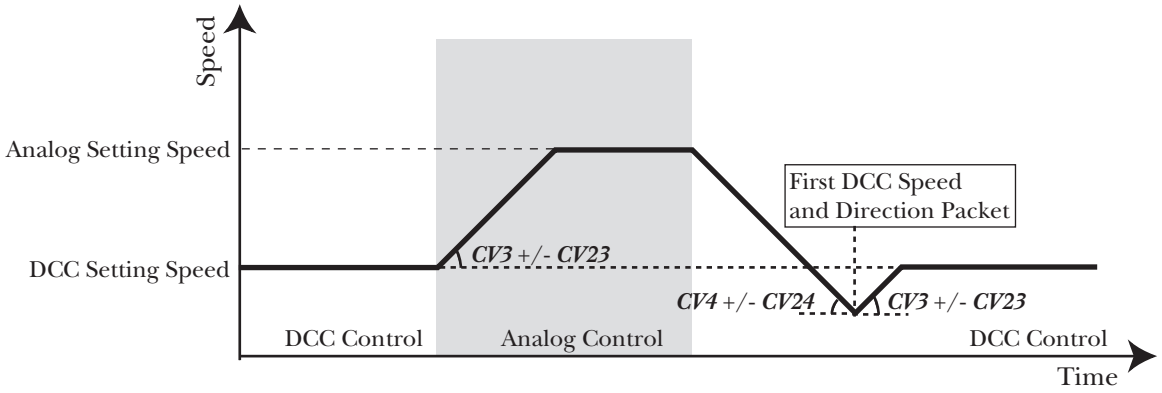


Fig.V-7 Speed when Analog and DCC Control Conversion.

V-9. Prevention of gears backrush for smooth start when direction is changed.

The model vehicle starts are not smooth occasionally. It's for gear backrush. To avoid it, output voltage as illustated in FigV-8 can absorb gear backrush.

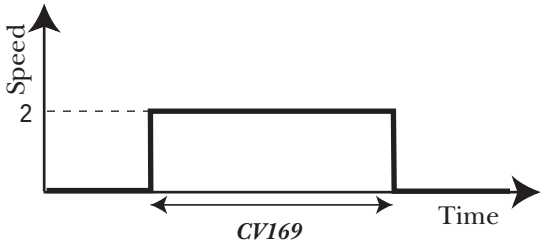


Fig.V-8 Output for absorbing gear backrush.

CV169 | 1 |

Output Time for Absorbing Gear Backrush

When zero is set, no output occurs.

VI. Function.

VI-1 How to Connect Function Number and Output.

To decide which function output has to be on/off when some function number turns on/off is allowed the user. This future allows the user to change function number connected to function output without changing electrical wiring. Function configuration is illustrated in Fig. VI-1. FL(F0) controls FL(F) and FL(R) for direction control.

Primary or consist address select is explained in chapter VI-2. Special effect means adjusting light intensity and direction control. Internal control means internal state is able to changed by function. Table.VI-1 shows how to set a selection of function output to ***CV33-CV46,CV130-CV145***.

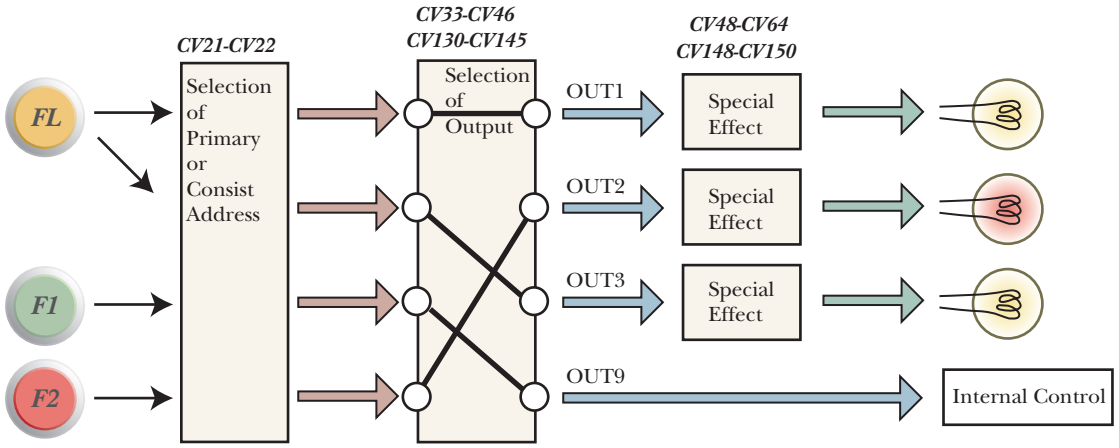
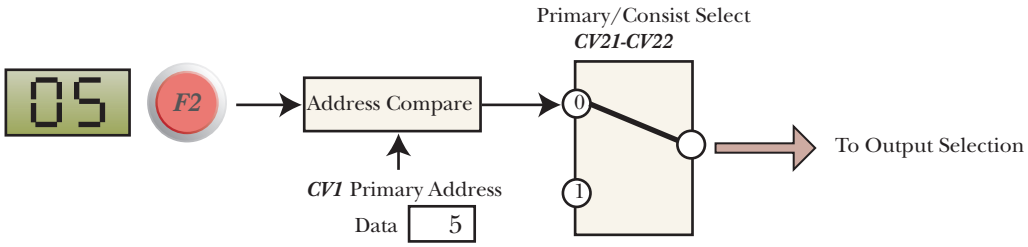


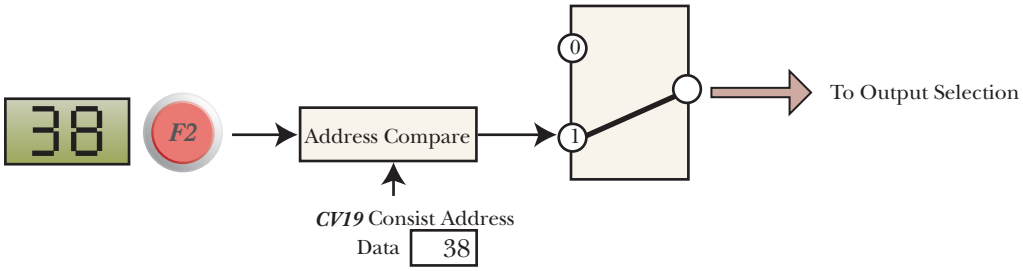
Fig.VI-1 Function Configuration.

VI-2 Function and Consist Address.

The user can select whether each function is controlled by primary address or consist address. The case of primary address is illustrated in Fig.VI-2-(a) and the case of consist address is illustrated in Fig.VI-2-(b). If each bit of ***CV21*** and ***CV22*** is set to 0, its function can be controlled by primary address. If each bit of ***CV21*** and ***CV22*** is set to 1, its function can be controlled by consist address. FL(F0) performs to control head light and teal light simultaneously. FL(F)とFL(R) has to be set distinctly because of direction control. This feature allows the user that function is controlled by consist address but cab light in the middle of the train is left off. If function which the user wants to left off is set to primary address, this function can not be on when train is controlled by consist address.

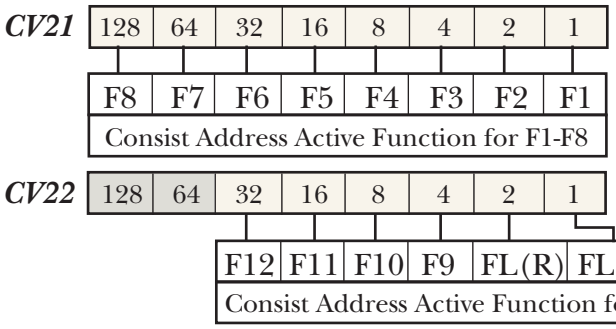


(a) In the case of Primary Address.



(b) In the case of Consist Address.

Fig.VI-2 Function Primary Address or Consist Address Control.



Each bit	Control Address
0	Controlled by Primary Address
1	Controlled by Consist Address

Table. VI-1 Selection of Function Output.

CV	OUT / Fxx	11	10	9	8	7	6	5	4	3	2	1	Default Value
CV33	FL(F)				128	64	32	16	8	4	2	**1**	1
CV34	FL(R)				128	64	32	16	8	4	**2**	1	2
CV35	F1				128	64	32	16	8	**4**	2	1	4
CV36	F2				128	64	32	16	**8**	4	2	1	8
CV37	F3				128	64	32	**16**	8	4	2	1	16
CV38	F4	128	64	32	16	8	**4**	2	1				4
CV39	F5	128	64	32	16	**8**	4	2	1				8
CV40	F6	128	64	32	**16**	8	4	2	1				16
CV41	F7	128	64	**32**	16	8	4	2	1				32
CV42	F8	128	**64**	32	16	8	4	2	1				64
CV43	F9	**128**	64	32	16	8	4	2	1				128
CV44	F10	128	64	32	16	8	4	2	1				0
CV45	F11	128	64	32	16	8	4	2	1				0
CV46	F12	128	64	32	16	8	4	2	1				0
CV130	F13	128	64	32	16	8	4	2	1				0
CV131	F14	128	64	32	16	8	4	2	1				0
CV132	F15	128	64	32	16	8	4	2	1				0
CV133	F16	128	64	32	16	8	4	2	1				0
CV134	F17	128	64	32	16	8	4	2	1				0
CV135	F18	128	64	32	16	8	4	2	1				0
CV136	F19	128	64	32	16	8	4	2	1				0
CV137	F20	128	64	32	16	8	4	2	1				0
CV138	F21	128	64	32	16	8	4	2	1				0
CV139	F22	128	64	32	16	8	4	2	1				0
CV140	F23	128	64	32	16	8	4	2	1				0
CV141	F24	128	64	32	16	8	4	2	1				0
CV142	F25	128	64	32	16	8	4	2	1				0
CV143	F26	128	64	32	16	8	4	2	1				0
CV144	F27	128	64	32	16	8	4	2	1				0
CV145	F28	128	64	32	16	8	4	2	1				0

□ Default Function Output

VI-3 Function Lighting Effect.

VI-3-(1) Function Output without Effect.

Function output operation without effect is illustrated in Fig.VI-3. When function is on, maximum voltage of function outputs is as same voltage as rail. If the device which is weak in noise is connected to function output, this mode has to be used, because this mode don't use PWM. Rail voltage is more than 12V, so there is highly possibility that it shorten the life of 12V lamp bulb.

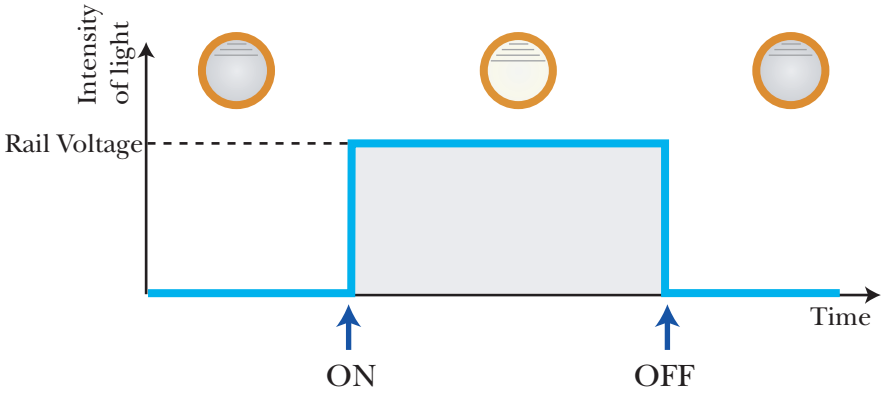


Fig.VI-3 Function Output without Effect.

	bit	7	6	5	4	3	2	1	0
		128	64	32	16	8	4	2	1
CV56	OUT1								
CV57	OUT2								
CV58	OUT3								
CV59	OUT4								
CV60	OUT5								
CV61	OUT6								
CV62	OUT7								
CV63	OUT8								

	0	1
Slow Light ON/OFF	OFF	ON
Decreasing Intensity	OFF	ON
Function PWM	OFF	ON
Fluorescent Lamp	OFF	ON
Forward On	OFF	ON
Back On	OFF	ON

Function Special Effect Configuration

VI-3-(2) Adjustment of Intensity of Light.

Intensity of light of each function can be adjusted distinctly. Please set ***CV56-CV63*** bit2 to 1. Intensity of light can be adjusted in ***CV48-CV55*** low order 4bit.

Sometimes high voltage is provided decoder from rail in DCC. But this future can make the life of lamp bulb longer. And the user can enjoy atmosphere also according to adjusting the intensity of light.

The device which is weak in noise must not be connected to function output because of PWM.

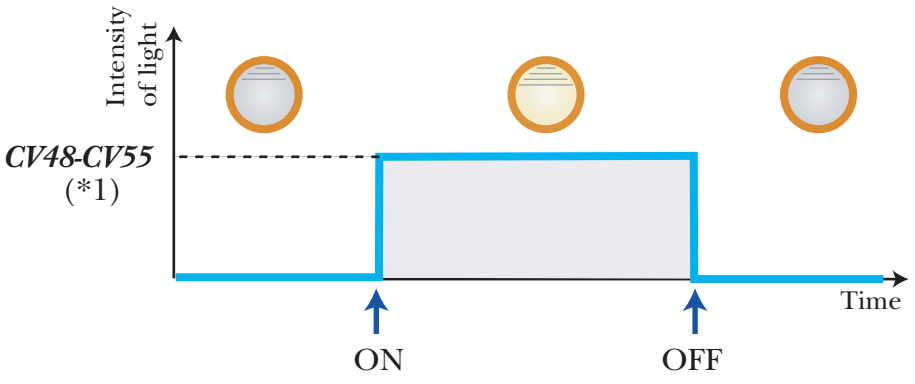
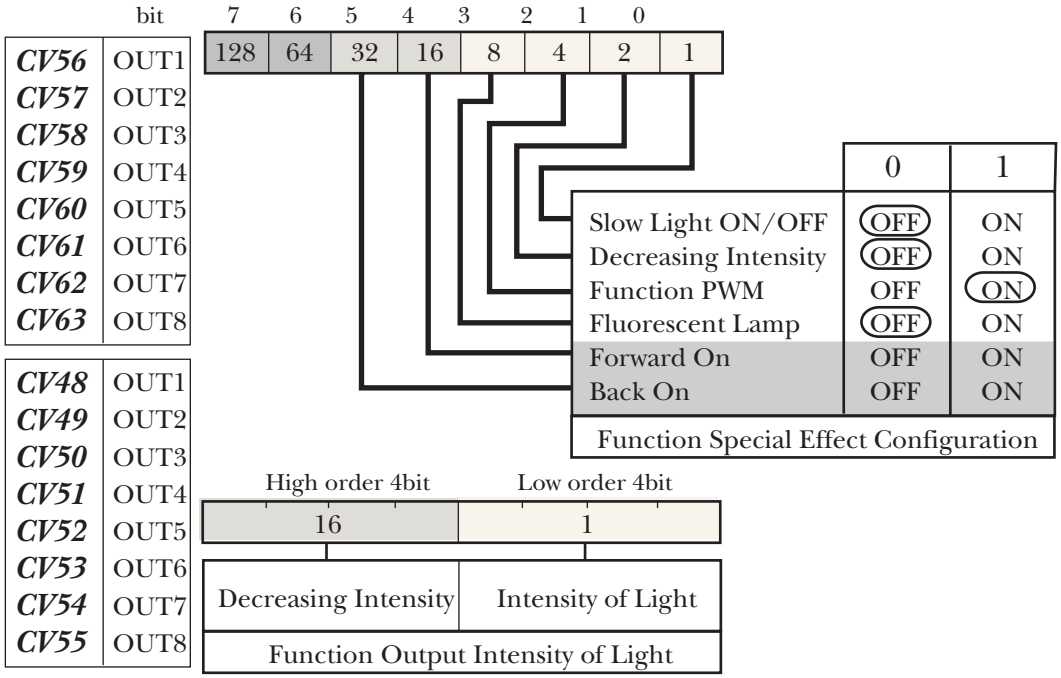


Fig.VI-4 Adjustment of Intensity of Light. (No Slow ON/OFF Mode)



VI-3-(3) Slow On/Off Mode Function.

Each function can be set to slow on/off mode where intensity of light gradually increases or decreases as Illustrated in Fig. VI-5. A speed of increasing or decreasing can be adjusted in ***CV64*** low order 4 bit. Please set ***CV56-CV63*** bit0 to 1 for each function. Please set ***CV56-CV63*** bit2 to 1 for enabling PWM. Intensity of light can be adjusted in ***CV48-CV55*** low order 4bit.

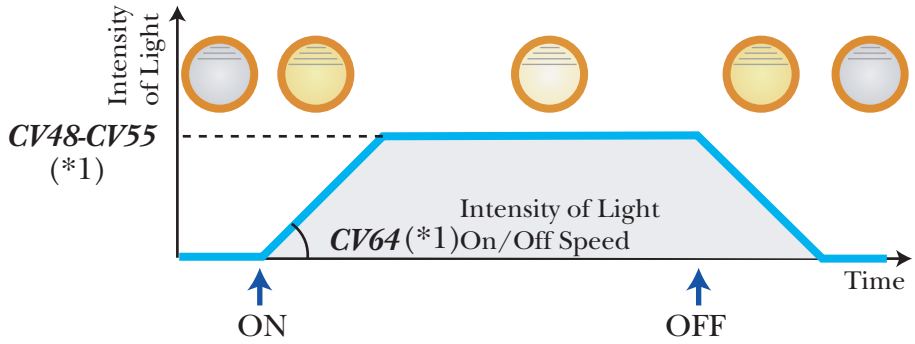
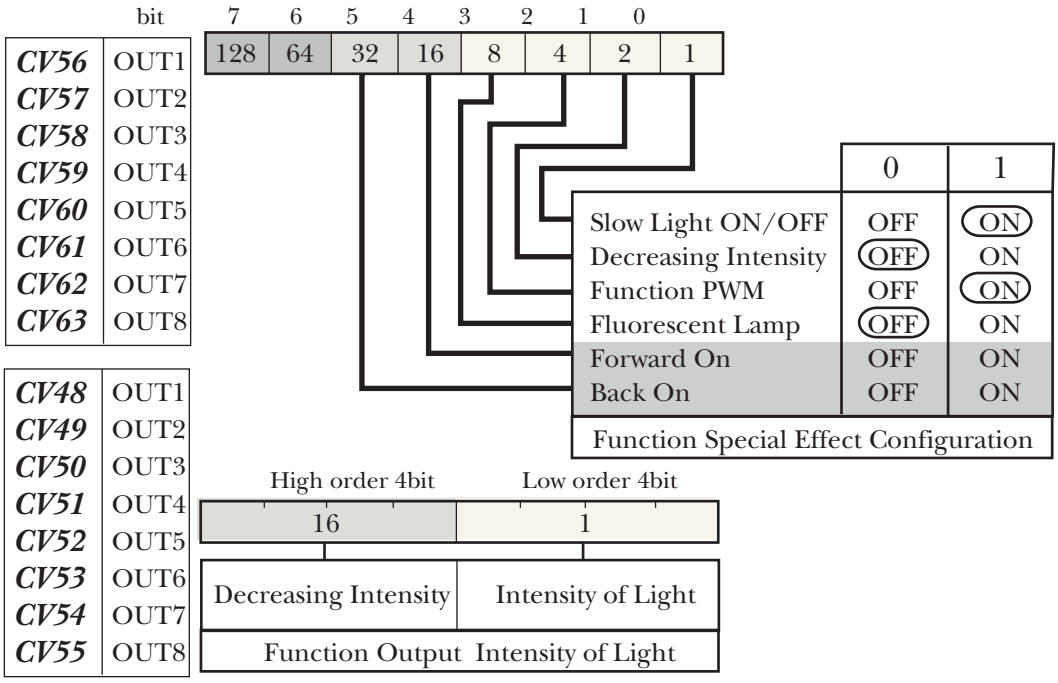
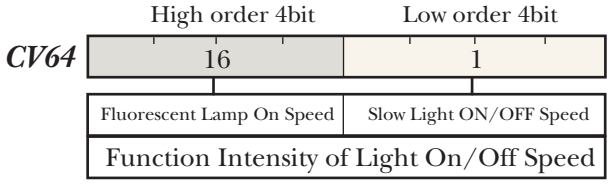


Fig.VI-5 Slow On/Off Mode Operation.





VI-3-(4) Decreasing Intensity of Light When the Vehicle Stops.

Each function output can be set to the mode to decrease intensity of light when the vehicle stops. The operation of this mode is illustrated in Fig. VI-6. Please set ***CV56-CV63*** bit1 to 1 for each function. Decreasing intensity of light can be adjusted in ***CV48-CV55*** high order 4bit. ***CV146*** bit3 can be set to whether automatic decreasing as the vehicle stops or manually decreasing by pushing the function button via out9. When decreasing intensity by out9, if out9 is connected to F4-F28 by ***CV38-CV46, CV130-CV145***, function button on controller can change the state of intensity of light.

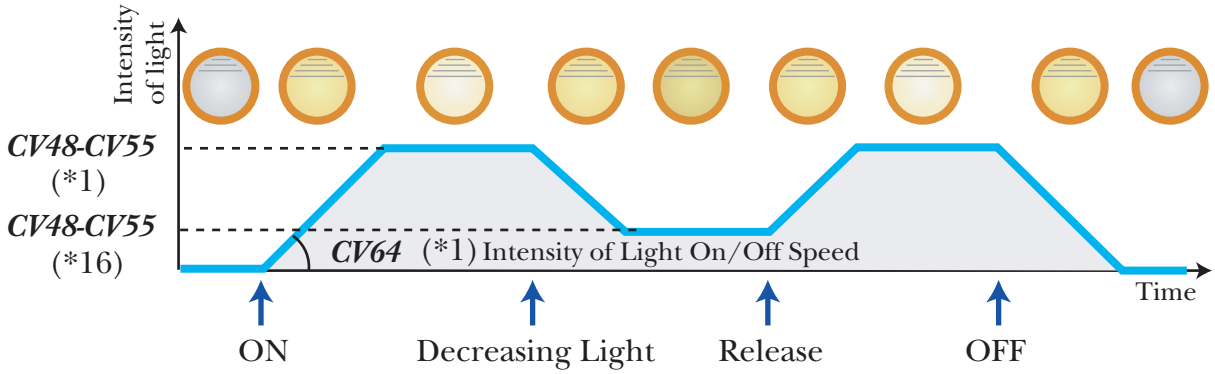
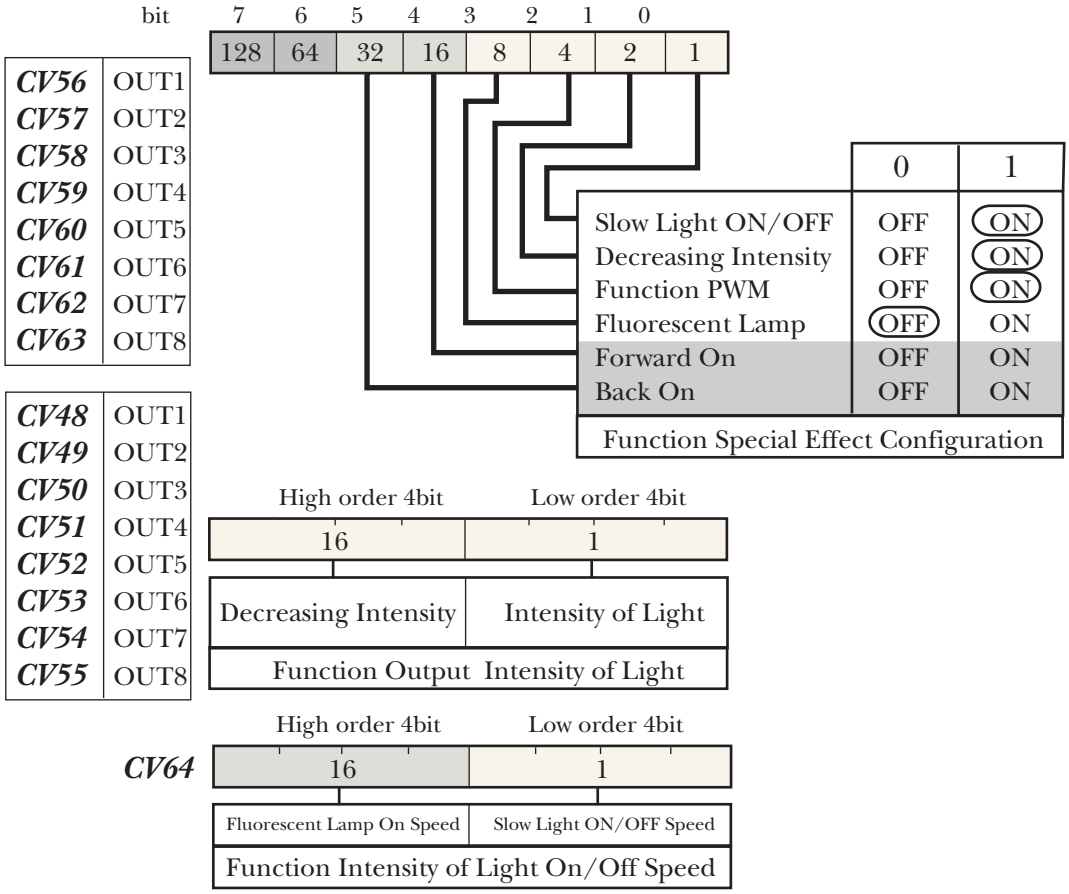
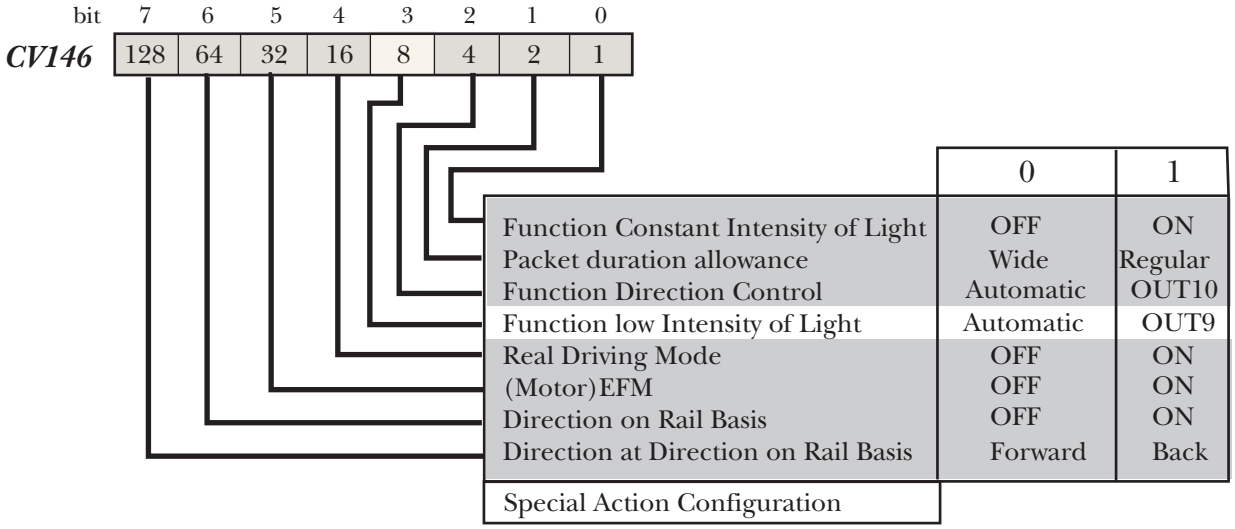


Fig. VI-6 Slow On/Off Mode and
Decreasing Intensity of Light When the Vehicle Stops Operation.





VI-3-(5) Fluorescent Lamp Mode

This mode is for expressing fluorescent lamp is turned on. Please set ***CV56-CV63*** bit3 to 1 for each function. ***CV148-CV150*** are for fluorescent lamp on patterns. These patterns are the order of ***CV148*** from bit0 to bit7, ***CV149*** from bit0 to bit7,***CV150*** from bit0 to bit7. If bit is set to 1, lamp is on. if bit is set to 0, lamp is decreasing intensity can be adjusted in ***CV48-CV55*** high order 4bit, and it can express a glow lamp. Fluorescent lamp on speed can be adjusted in ***CV64*** high order 4bit.

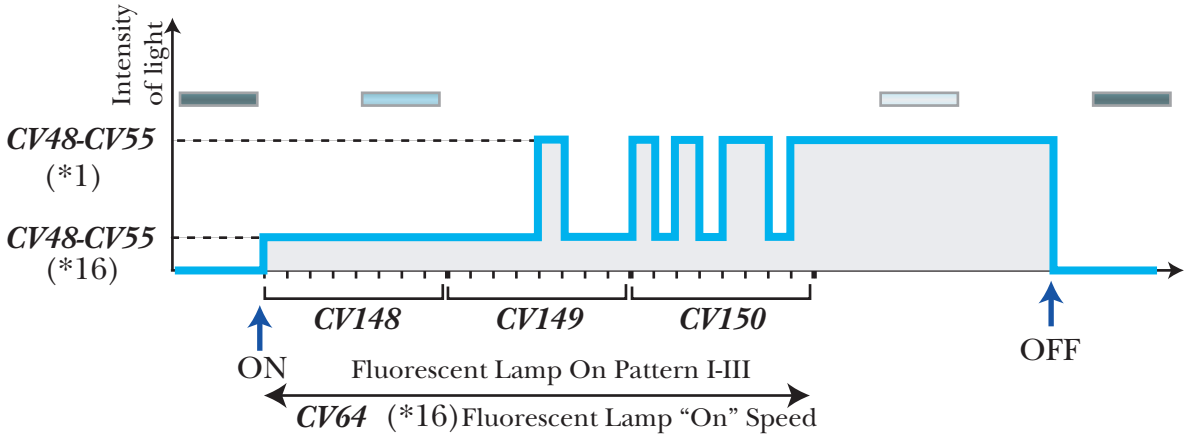
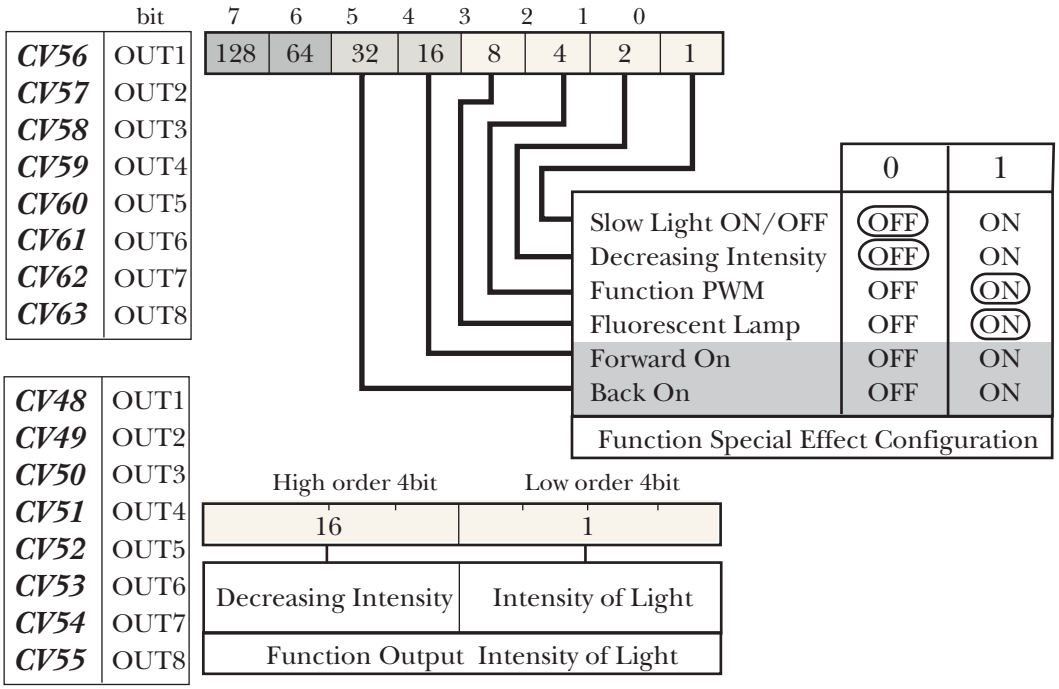
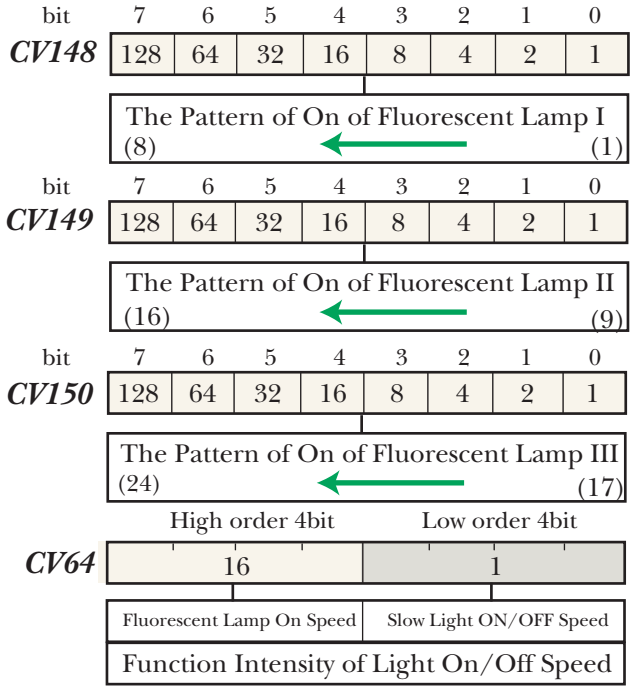


Fig.VI-7 Fluorescent Lamp Mode Operation.

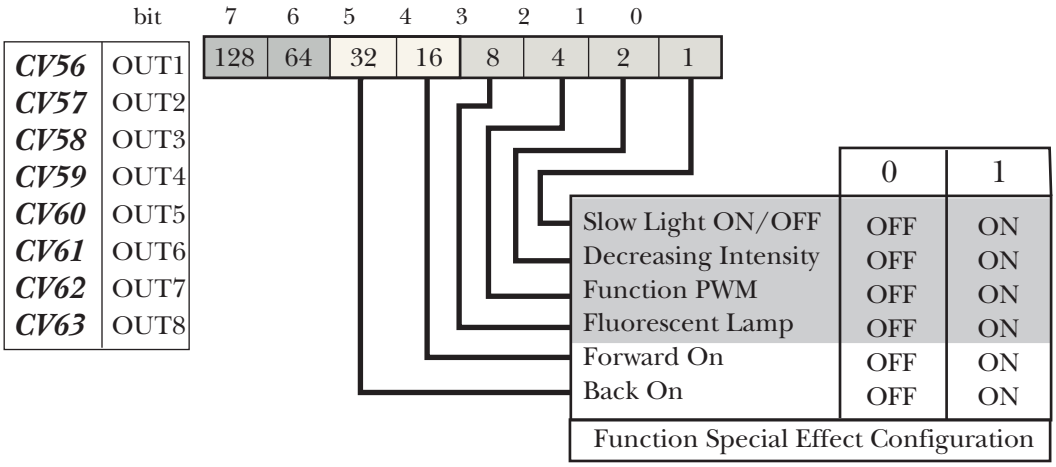




VI-4 Function Direction Control.

VI-4-(1) Function Direction Control.

FL(F) and FL(R) is only function to control head and teal lamps depending on direction in NMRA rules. But, it is difficult for the vehicle which has two cabs of both side to control head and teal lamps distinctly. Then, we decided to equip future that all function outputs can be set as output depending on direction. Please set ***CV56-CV63*** bit4 for forward on and bit5 for back on as illustrated in Fig.VI-8.



Forward On (Head Lamp)

Function output which turns on only when the vehicle runs in a forward direction has to be set as follows.

	0	1
Forward ON	OFF	(ON)
Back ON	(OFF)	ON

Back On (Teal Lamp)

Function output which turns on only when the vehicle runs in a back direction has to be set as follows.

	0	1
	(OFF)	ON
	OFF	(ON)

Regardless of Direction On (Room Lamp)

Function output which turns on regardless of direction has to be set as follows.

	0	1
	OFF	(ON)
	OFF	(ON)

Fig.IV-8 Function Direction Control.

VI-4-(2) Function Manual Direction Control.

Head lamps or tail lamps are automatically switched depending on direction from old days. It might be good way to drive easily. But real train sometimes goes back leaving the head light on. Then, we decided to equip future that head and teal lamps are able to be changed manually to enjoy it. When ***CV146*** bit2 is set to 0, head and teal lamp are automatically switched depending on direction. When ***CV146*** bit2 is set to 1, the state of function internal out10 decides whether head or teal lamp is turned on. If out10 is connected to F4-F28 by ***CV38-CV46, CV130-CV145***, function button on controller can switch head and teal lamps.

bit	7	6	5	4	3	2	1	0
CV146	128	64	32	16	8	4	2	1

	0	1
Function Constant Intensity of Light	OFF	ON
Packet duration allowance	Wide	Regular
Function Direction Control	Automatic	OUT10
Function low Intensity of Light	Automatic	OUT9
Real Driving Mode	OFF	ON
(Motor)EFM	OFF	ON
Direction on Rail Basis	OFF	ON
Direction at Direction on Rail Basis	Forward	Back
Special Action Configuration		

	0	1
Function Direction Control	(Automatic)	OUT10

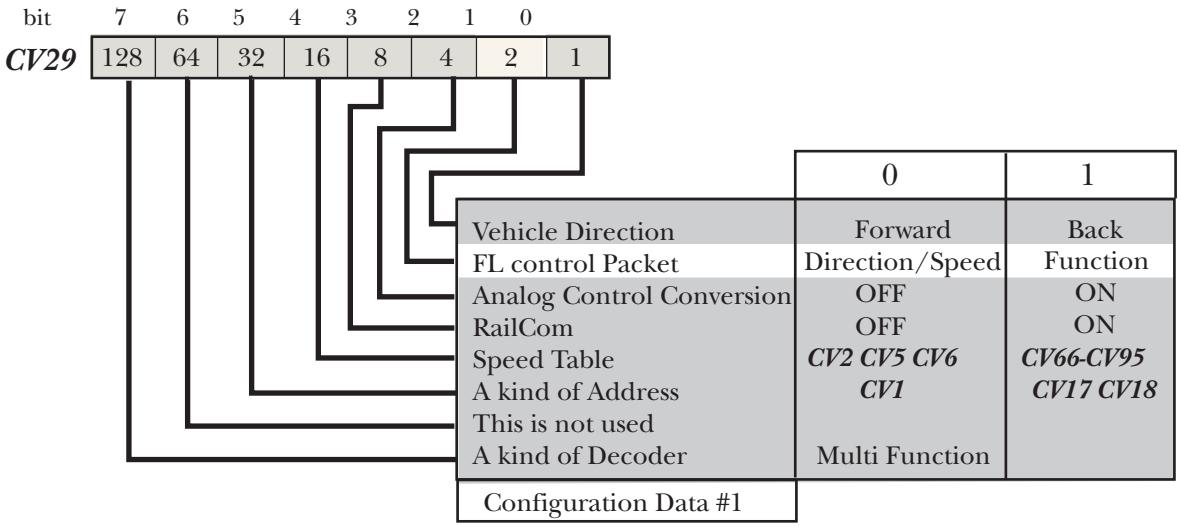
This mode is for automatically switching head and teal lamps depending on direction.

	0	1
Function Direction Control	Automatic	(OUT10)

This mode is for manually switching head and teal lamps depending on out10.
If out10 is connected to F4-F28 by ***CV38-CV46, CV130-CV145***, function button on controller can switch head and teal lamps.

VI-5 FL Function 14 Step Mode DCC Packet Control.

FL function control data can be embedded in a 14 step speed mode DCC packet. In this case, please set CV29 bit1 to 1.



VI-6 Example of Function Setting.

Example of function setting for both side vehicle is illustrated in Fig.IV-9, Table.IV-2.

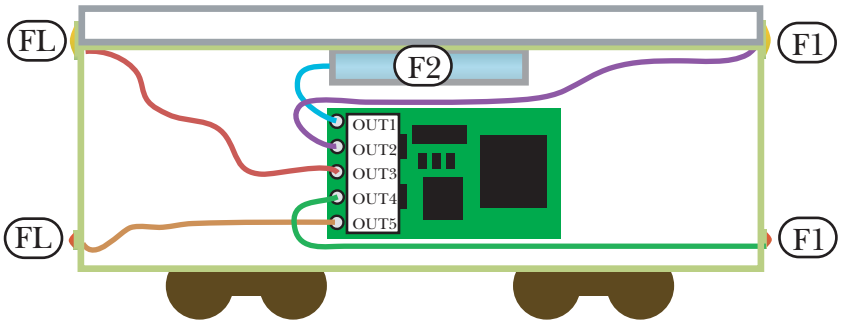


Fig.IV-9 Example of Function Setting.

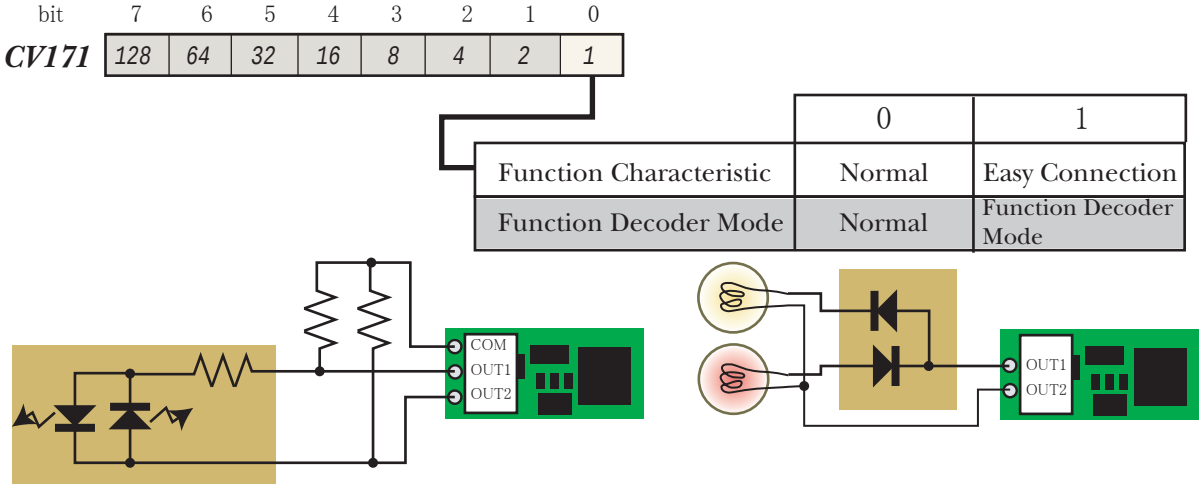
Table.IV-2 Example of Function Setting.

		Selection of Output	Output	Special Effect	Intensity of Light
FL	FL(F)	*CV33*=4	OUT3	*CV58*=23 Slow Light ON/OFF Decreasing Intensity PWM, Forward On	*CV50*=42 Decreasing Intensity=2 Intensity of Light=10
	FL(R)	*CV34*=16	OUT5	*CV60*=37 Slow Light ON/OFF PWM, Back On	*CV52*=7 Intensity of Light=7
F1	F1	*CV35*=10	OUT2	*CV57*=39 Slow Light ON/OFF Decreasing Intensity PWM, Back On	*CV49*=42 Decreasing Intensity=2 Intensity of Light=10
			OUT4	*CV59*=21 Slow Light ON/OFF PWM, Forward On	*CV51*=7 Intensity of Light=7
F2	F2	*CV36*=1	OUT1	*CV56*=56 Fluorescent Lamp Forward On Back "On"	*CV48*=25 Intensity of Light=9 Decreasing Intensity=1

VI-7 Easy Function Connection.

The LED is connected to the opposite direction with , and, in the case of an electric bulb, a diode is connected for changing a headlight and the tail light of the vehicle by a direction. It may be troublesome that we dissolve these conection and wire the function output of the decoder. In the case of LED, function output can be easily connected showing in figure VI-10.But an electric current flows in the resistance connected to a function common terminal from the function output. In the case of an electric bulb, it is necessary to use a biderectional function output decoder.

When you use these function output connection, please set BIT0 of CV171 to 1. Two outputs are not ON state at the same time when direction is changed.



(1)Normal Function Output Decoder (2)Bidirectional Function Output Decoder

Fig.IV-10 Example of Easy Connection Function.

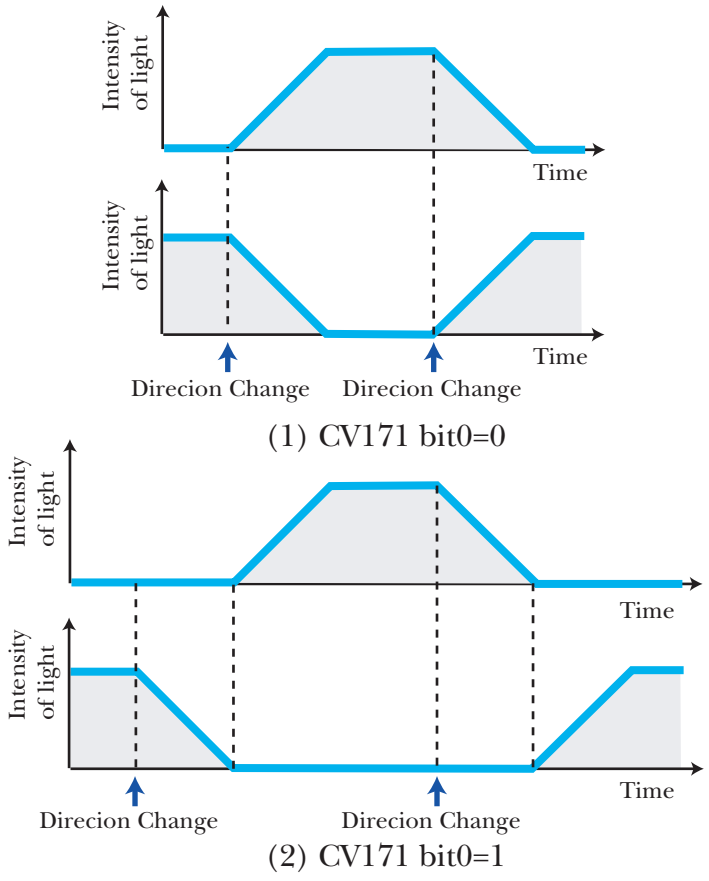


Fig.IV-11 Slow on/off mode Operations as Direction is Changed.

VI-8 Function Decoder Mode

The mode to use a mobile decoder as a function exclusive decoder. The motor terminal when running by this mode isn't output, but it's output to a motor terminal for the acknowledge signaling when programing. Therefore please connect 220 Ω of resistance like figure 12.

bit	7	6	5	4	3	2	1	0
CV171	*128*	*64*	*32*	*16*	*8*	*4*	*2*	*1*

	0	1
Function Characteristic	Normal	Easy Connection
Function Decoder Mode	Normal	Function Decoder Mode

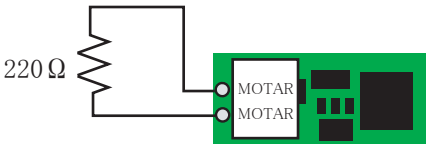
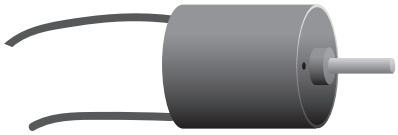


Fig.IV-12 The Register Connection for acknoledge in Function Decoder Mode.

VII. Motor Control.

VII-1 EFM Control Method.

The reverse voltage of motor are in proportion to number of revolutions. Thus, number of revolution is controlled into designated speed according to measuring reverse voltage while pulse off duration.



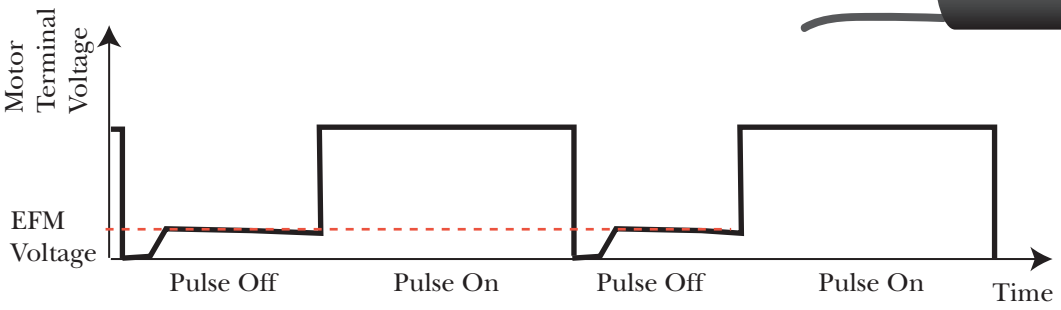


Fig. VII-1 EFM Control method.

For achieving speed stability and low noise, three kinds of pulse below are used.

Table.VII-1 Kinds of Motor Control Pulse.

Pulse	Frequency	Purpose
Base Pulse	31.25KHz	For Supply Voltage
EFM Pulse	Fluctuate	For control speed
Ultra Low Speed Pulse	Variable	For Ultra Low Speed

VII-2 Low Speed Adjustment(Step1 Adjustment).

Pulse drive is only way to perform slow motor rotation. Our decoder adjusts pulse off duration every time , so smooth slow running with low noise is possible. Best low speed running without loud motor noise is able to be performed according to match this pulse off time with motor characteristics.

Firstly, please set ***CV5*** to 126 ,then set speed knob of controller to slowest speed, lastly adjust CVs.

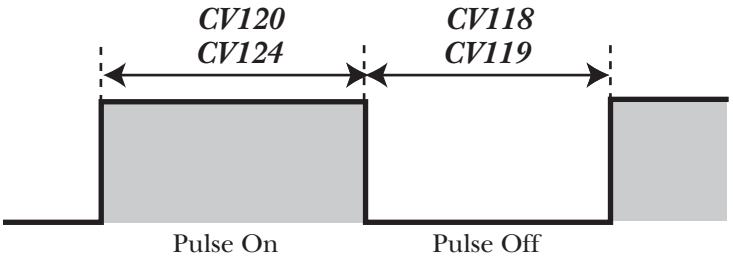


Fig.VII-2 EFM Pulse Waveform.

CV118 1

Pulse Off Minimum Duration

When too big value is set, running stability will be bad.

CV119 1

Pulse Off Maximum Duration

When too big value is set, running stability will be bad.

CV120 1

Pulse On Duration as Low Speed

When too big value is set, running stability will be bad.

CV124

1

Pulse On Duration Distribution Level

Distributed pulse on duration makes motor noise lower, but running stability may be lower. When 0 is set, distribution gets off. When 4 is set, distribution gets maximum.

CV114

1

Speed Compensation Level

When speed lowers if the load of the motor is light, it lowers than correct speed. It becomes right speed by adjusting this value.

CV115

1

Speed Offset

Speed becomes right speed by adjusting this value.

VII-3 Ultra Low Speed Adjustment

EFM pulse has limit low speed for running stably. So, ultra low speed pulse performs ultra low speed running. But this pulse acommpanys vibrations, so this pulse is used only in lower speed than step1.

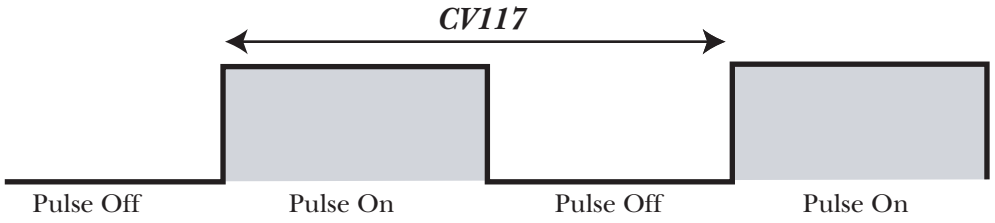


Fig.VII-3 Ultra Low Speed Pulse Waveform.

CV117

1

Ultra Low Speed Pulse Duration

Ultra low speed pulse duration is set. Less value has to be set for less vivuration.

CV116

1

Speed of Ultra Low Speed Pulse Output

Maximum speed when ultra low speed pulse is output can be set.
When 255 is set, ultra low speed pulse is output just before step1 speed.
When 0 is set, ultra low speed pulse is not output.

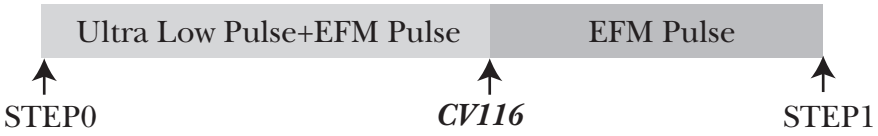


Fig.VII-4 Speed of Ultra Low Pulse Output.

VII-4 Mid or High Adjustment.

When mid or high speed, the vehicle can run more stabler compeared with the case of low speed originally. So frequent speed check is not needed. Thus, pulse on dulation can be longer. For that, motor noise will be lower. Actually pulse duration is gradually longer like Fig. VII-5.

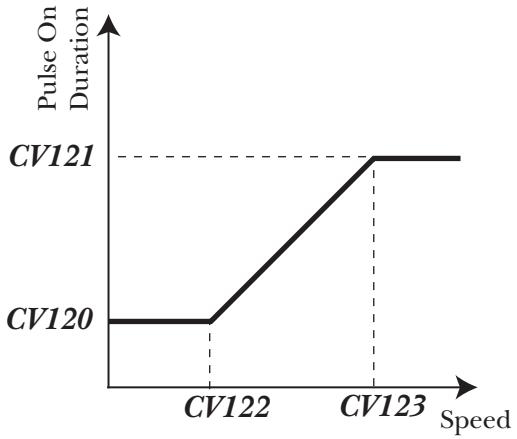


Fig.VII-5 Mid & High Speed Pulse On Duration.

CV120 1

Pulse On Duration as Low Speed

Please show chapter VII-2.

CV121 1

Pulse On Duration as High Speed

Pulse on duration when mid or high speed running is set. Generally, when mid or high speed, the train can run more stabler compared with the case of low speed, so pulse on duration can be longer. When set value is big, motor noise will be low. But big value makes speed unstably.

CV122 1

A Change Speed of Pulse On Duration (L)

A change speed of pulse on duration (low) is set. Small value makes low speed unstably. Please show Fig.VII-2.

CV123 1

A Change Speed of Pulse On Duration (H)

A change speed of pulse on duration (high) is set. Please show Fig.VII-2.

VII-5 Thin Pulse Mode (Only for core less motor).

The model vehicle is made brass into makes more motor noise caused by EFM pulse than the model vehicle made plastic into. The vehicle equipped with core less motor which has low inductance coil is that reverse voltage duration is very short. In this case, pulse off duration can be shorter. This mode is only for mid or high speed. low speed running needs normal EFM pulse. This mode is only for core less motor. Must not use this mode for cored motor.

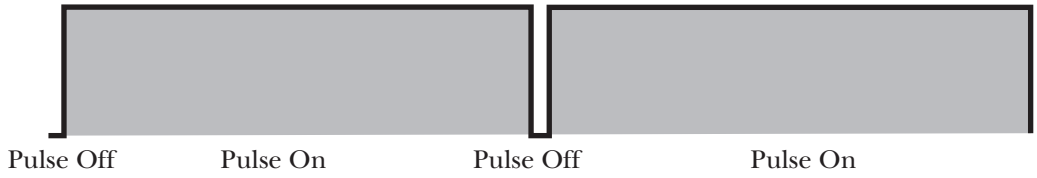


Fig.VII-6 Thin Pulse Waveform.

CV125 1

Thin Pulse Off Duration

Please set the value where the vehicle can run stably, when the vehicle runs at mid speed. Note that too small value makes the vehicle being out of control. So,adjustment must be done in the situation where being out of control is allowed. When this value is small, motor noise gets small. But this value must be little bigger than minimum value where the vehicle can run stably.

CV126 1

Minimum Speed of Thin Pulse Mode

Thin pulse mode is lack of stability when low speed running. Please set minimum speed where the vehicle can run stably.

Fig.VII-7 Minimum Speed of Thin Pulse Output.

CV127 1

Thin Pulse Mode Speed Offset

When thin pulse mode, speed becomes right speed by adjusting this value.

CV128 1

Thin Pulse Mode Speed Compensation Level

In thin pulse mode, when speed lowers if the load of the motor is light, it lowers than correct speed. It becomes right speed by adjusting this value.

VII-6 Other Adjustment

CV112 1

Loop Gain

This value is loop gain of motor control. Please set the value where speed is stable.

CV113 1

Speed Detect Timing

This value decides the time between pulse off and measuring EFM voltage. Small value can be set when core less motor is used. Note that too small value makes the vehicle being out of control. So,adjustment must be done in the situation where being out of control is allowed. This value must be little bigger than minimum value where the vehicle can run stably.

VII-7 Preset Value

Motor adjustment has to set many CVs. So, adjustment is troublesome. Then there is preset value. When motor type is set to ***CV47***, appropriate value is written in ***CV112-CV128*** as shown in table VII-2. Please try to run the vehicle in this state. If there is problem, please adjust each CV.

CV47 1

Motor Control Preset Value Select

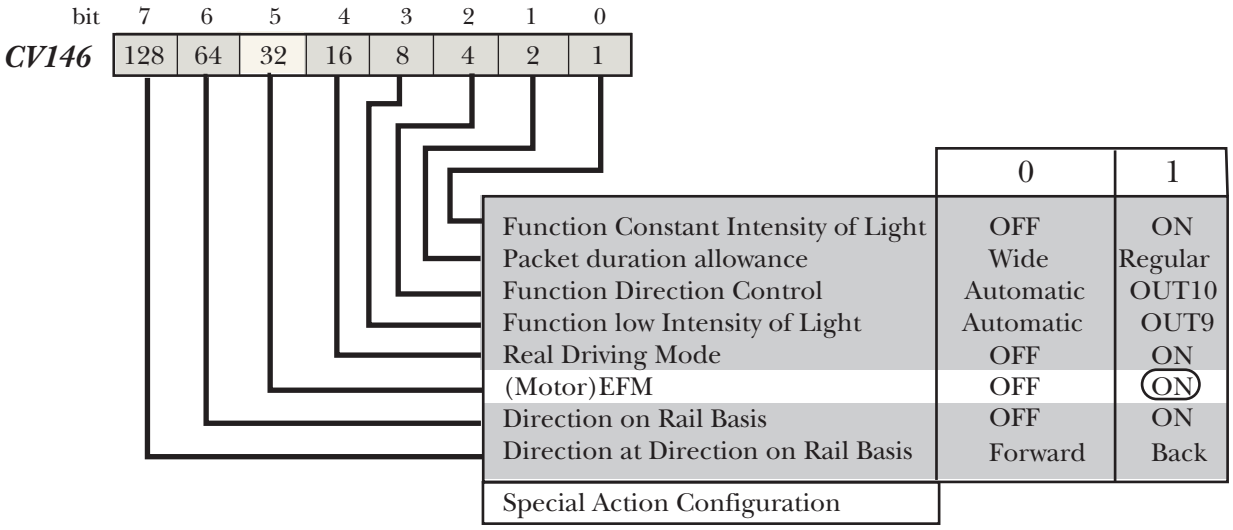
When motor type is set, appropriate value is written in ***CV112-CV129***.
CV112-CV128 is changed, ***CV47*** will be set to 0.

Table. VII-2 Preset Value.

Scale	HO		N
Motor type	Cored Motor with Fry Wheel	Core less Motor without Fry Wheel	Cored Motor with Fry Wheel
Preset ***CV47***	2	1	3
CV112	4	4	4
CV113	2	0	0
CV114	80	40	100
CV115	30	0	0
CV116	255	0	0
CV117	20	–	80
CV118	4	2	2
CV119	24	4	8
CV120	12	6	7
CV121	10	30	30
CV122	10	30	30
CV123	250	250	250
CV124	3	3	3
CV125	0	2	0
CV126	–	255	–
CV127	4	6	0
CV128	0	16	0

VII-8 EFM ON.

EFM is set to OFF at the manufacture. Please don't forget to set C146 bit5 to 1.



VIII. RailCom.

VIII-1 Foundation of RailCom.

RailCom is the method of interactive communication which is developed by Lenz corporation. This future is valid when power station with cutout future and RailCom detector are used. Even if power station without cutout future is used, decoder won't be damaged.

RailCom packet is transmitted after DCC packet as illustrated in Fig. VIII-1. RailCom packet is constructed from CH1 and CH2. CH1 can send one byte data and CH2 can send two byte data. Power station ,rail, detector and decoder are connected in series as illustrated in Fig.VIII-2.

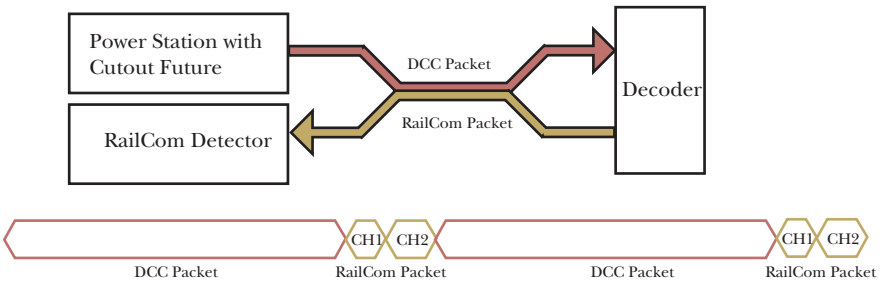


Fig. VIII-1 Foundation of RailCom.

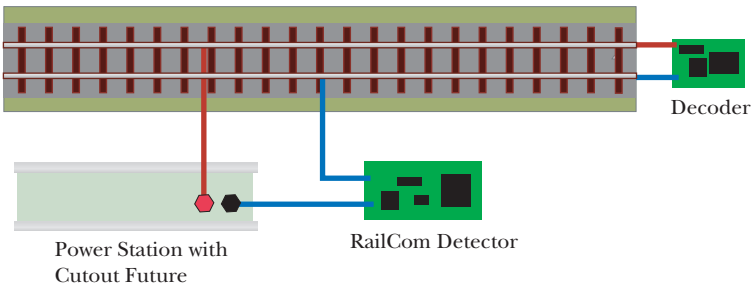


Fig. VIII-2 A Connection of RailCom.

VIII-2 RailCom Data and Operation.

VER Response of CV Value.

CV number and CV value is transmitted from decoder, just after CV verify DCC packet is received. When operation mode verify is performed on command station, CV value can be read immediately on RailCom detector. For that, it can solve the problem that it takes long time to read CV value using Page Mode.

BROAD-ADR Broad Cast Address

Primary address is always transmitted for position detection of the train. If RailCom detector is connected to gapped section, when train enters its gapped section, primary address of this train can be detected. But if two vehicles which have different primary address enter same section, address can not be detected. Thus, only leading vehicle can be detected. Please don't set data output except for BROAD-CAST for other vehicles to output same position (CH1,CH2-1ST,CH2-2ST) has been set to BROAD-CAST.

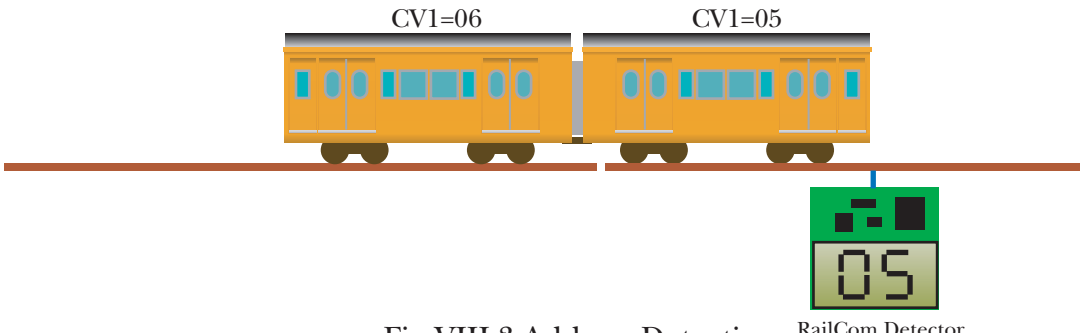


Fig.VIII-3 Address Detection.

ACK Acknowledge of DCC Packet

Decoder send whether DCC packets successfully are received or not. Therefore command station don't have to send same packet many times.

SPD Speed Step(Before Speed Table)

Speed Step after ***CV3*** acceleration or ***CV4*** deceleration is sent. (see Fig.V-1) If speed step is the same as real speed, the user can know real speed.

SPD2 Speed(After Speed Table)

Speed step after speed table is sent.(see Fig.V-1) The user can know speed direction applied to the motor.

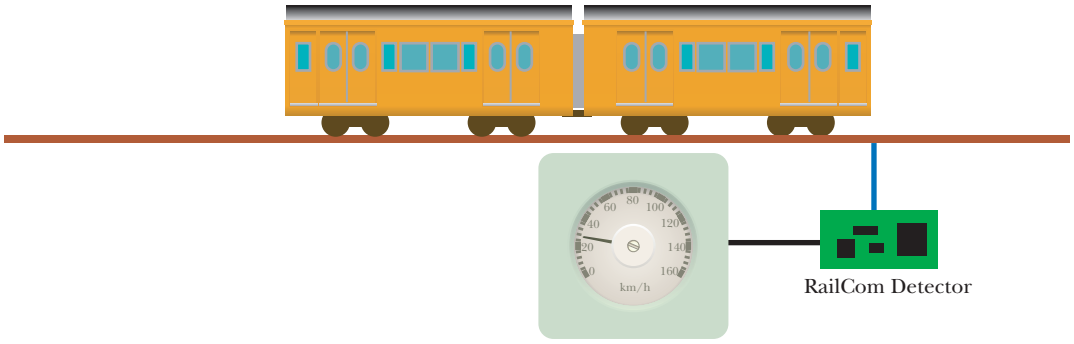


Fig.VIII-4 Speed Detection

ASIM Asymmetric Signal Detection

Detected asymmetric signal is sent.

Value	0	1	2	3	4
Detected Signal	Symmetric DCC	Semi-Asymmetric DCC (Forward)	Asymmetric DCC (Forward)	Semi-Asymmetric DCC (Reverse)	Asymmetric DCC (Reverse)

ASIM2 Distance in Breaking Section

Distance in breaking section is sent.

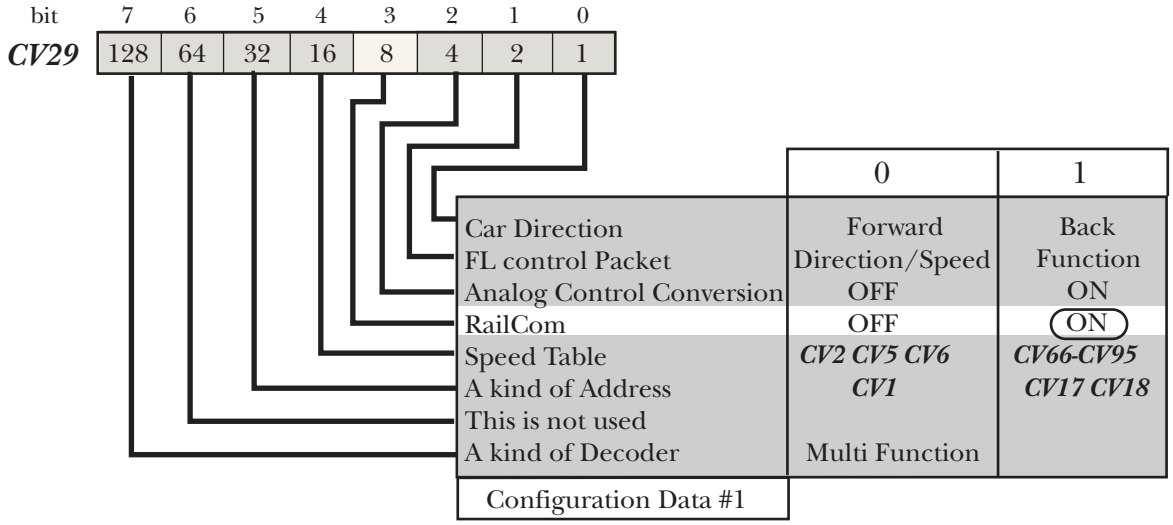
VER/SPD VER/SPD2 VER/ASIM VER/ASIM2

When VER has to be sent, Ver is sent, other time SPD , SPD2,ASIM,ASM2 is sent.

CV28

64	16	4	1

Value \ CH	CH2-2ST	CH2-1ST	CH1
0	No Output	No Output	No Output
1	VER/SPD2	VER/SPD	BROAD-ADR
2	ACK	ACK	ACK
3	VER/ASIM2	VER/ASIM	VER
Bi-Directional Communication Configuration			



VIII-3 RailCom Motor Noise.

When RailCom is used, power station performs cutout which means that DCC packet transmission is suspended while decoder sends RailCom packets. Cutout also means that power supply is suspended. Power supply is suspended can not make the decoder stop. But it makes motor noise. The user can not hear this noise from model vehicle is made plastic into. But the user can hear this noise from the vehicle is made brass into. We can recommend low noise type decoder for preventing this noise. This decoder equips capacity, so power supply is provided into motor even during cutout period.

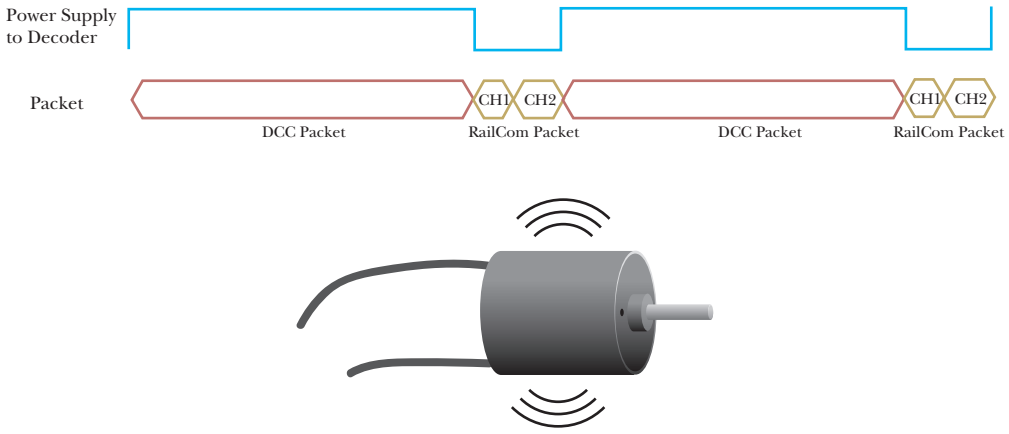


Fig. VIII-5 RailCom Motor Noise.

IX. Automatic Driving Mode.

IX-1 Automatic Stop and Slow Down by Asymmetric DCC.

Automatic stopping or slow down is performed according to asymmetric DCC signal. When the model vehicle enters braking section in asymmetric DCC signal, automatic braking is performed and the model vehicle stops at constant distance regardless to speed. semi-asymmetric DCC signal makes a model vehicle slow down.

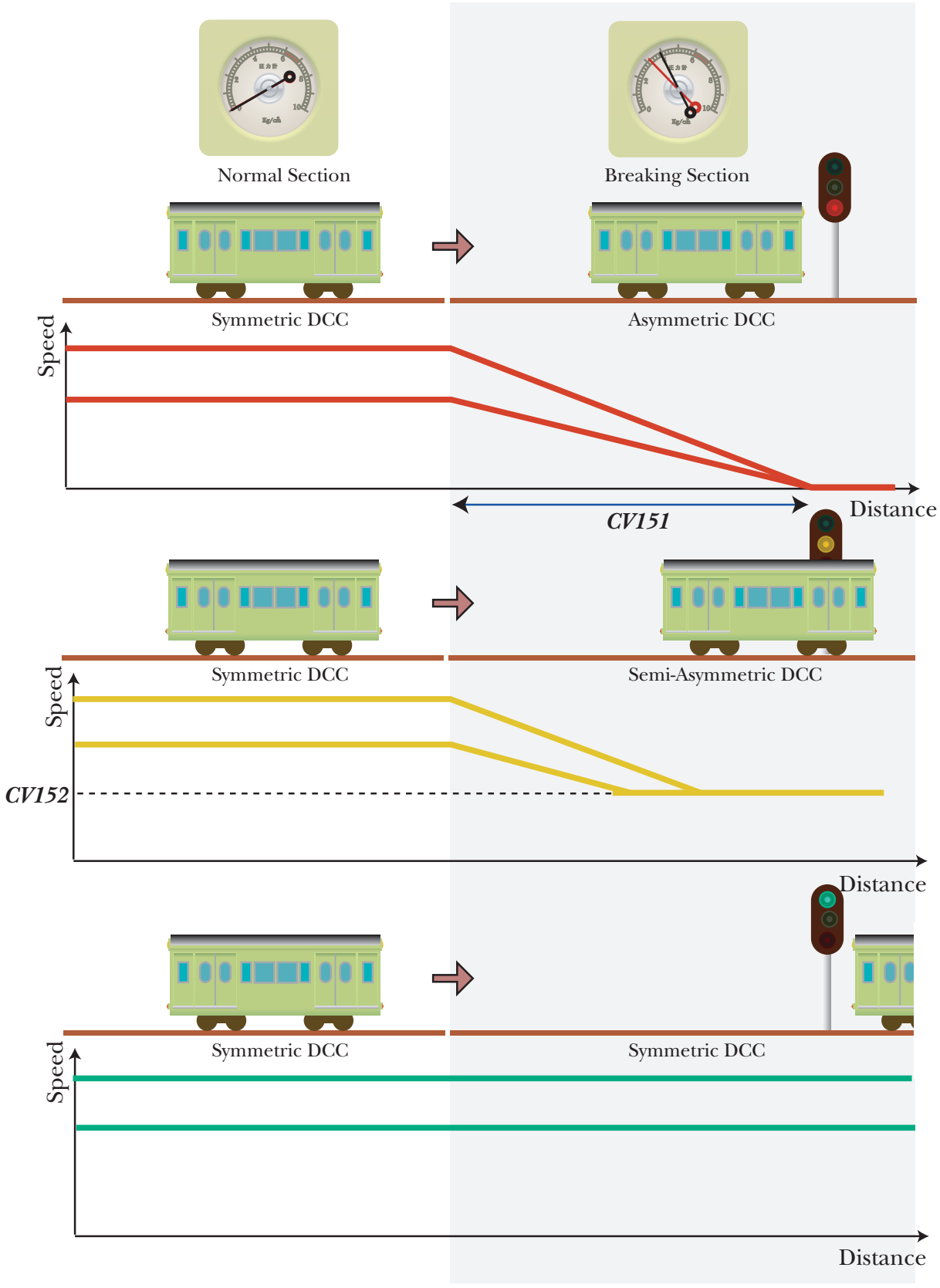


Fig.IX-1 The Operation of Braking Section.

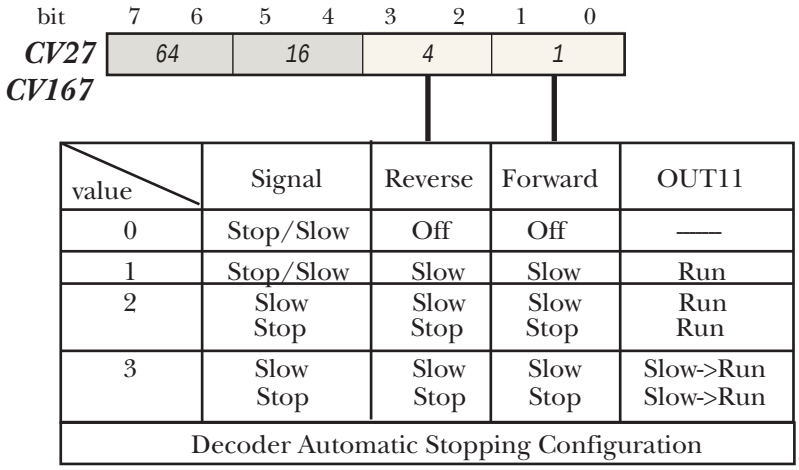
IX-2 How to Set Automatic Stop and Slow.

Please set ***CV27*** bit1-0 to 3 and automatic stopping are performed as stopping signal is detected and slow down are performed as slowdown signal is detected when the model vehicle with forward direction enters into breaking section. If ***CV27*** bit1-0 is set to 1, even if whichever of the stopping signal and the slowdown signal is detected, slow down are performed. If 1 or 2 is set, the stop or slow down is canceled when I let internal fanction output out11 vary from on to off. By changes from the first on of the out11 to off, slow down is performed, and by changes from the second on of the out11 to off, the stop is canceled.

Similarly, please set ***CV27*** bit3-2 in case of back for reverse direction.

Please adjust ***CV151*** for stopping distance of automatic stopping. Distance at that time is set to ***CV151*** when zero is set to ***CV151*** during automatic stopping or slowdown operation in braking section. A stop position is not set even if zero is set to ***CV151*** when stopping or slow down operation is canceled even if in braking section.

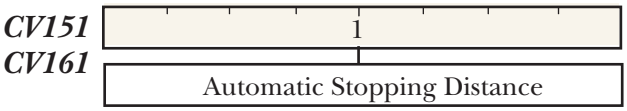
Please adjust ***CV152*** slow down speed of automatic slow down. Maximum speed in braking section can be set to ***CV154***. The minimum deceleration as automatic stopping is set to ***CV153***.



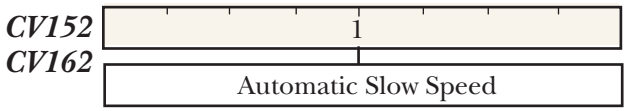
value	Signal	Reverse	Forward	OUT11
0	Stop/Slow	Off	Off	——
1	Stop/Slow	Slow	Slow	Run
2	Slow Stop	Slow Stop	Slow Stop	Run Run
3	Slow Stop	Slow Stop	Slow Stop	Slow->Run Slow->Run

Decoder Automatic Stopping Configuration

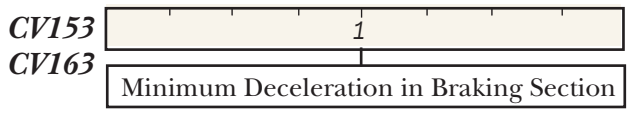
CV167 is used for changing ***CV27*** setting value temporary.



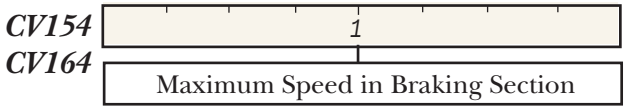
This CV decides stopping distance when the model vehicle enters into breaking section which has asymmetric DCC signal. Distance at that time is set to ***CV151*** when zero is set to ***CV151*** during automatic stopping or slowdown operation in braking section. ***CV161*** is used for changing ***CV151*** setting value temporary. When ***CV161*** is changed in breaking section, distance value is set to zero.



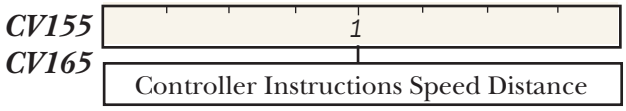
This CV decides slow down speed when the model vehicle enters into breaking section which has semi-asynmetric DCC signal. ***CV162*** is used for changing ***CV152*** setting value temporary.



The model vehicle can be controlled by controller to the distance that can stop in the decelaration set in ***CV153***. When a model vehicle enters in breaking section in lower than speed to be set in ***CV154***, it is accelerated to speed to be set in ***CV159*** by acceleration to be set in ***CV153*** .



Maximum speed in braking section can be set. ***CV164*** is used for changing ***CV154*** setting value temporary.

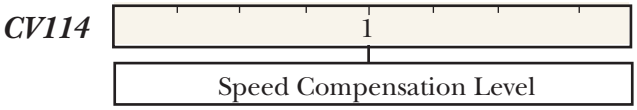


This value can set controller instructions speed distance when entering braking section. It is used for preventing that the speed of the rear vehicle which does not enter in braking section is different from the speed of the front vehicle. ***CV165*** is used for changing ***CV155*** setting value temporary.

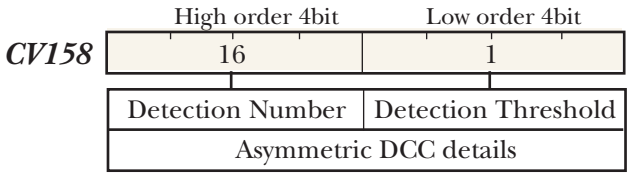
IX-3 Adjustment Stop Position accuracy

EFM has to be on for constant stopping distance. Even if EFM is set to ON, stop position precision may worsen at low speed. In this case, please set CV114 for adjusting speed accuracy at low speed. Or please set cv154 to avoid low speed running which has low precision.

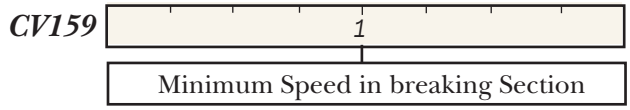
There are cases asymmetry signal detection has low precision,so the model vehicle cannot stop at designated position. In this case,please adjust CV153 to between 20 and 24. When the model vehicle cannot stop after adjusting CV153,please try to connect dummy load which is illustrated in IX-5.



When speed lowers if the load of the motor is light, it lowers than correct speed. It becomes right speed by adjusting this value.



When detection of Asymmetric DCC signal is unstable, this has to be adjusted.



Minimum Speed in breaking section can be set. This is for avoiding low speed running which has low precision.

IX-4 The Details of the Operation of the Automatic Constant Distance Stop.

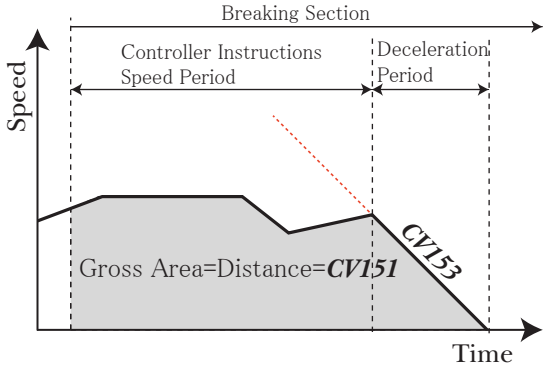
The model vehicle can be controlled by controller to the distance that can stop in the deceleration set in ***CV153*** as illustrated in Fig.IX-2(1). The model vehicle will stop in higher deceleration than ***CV153*** when it enters braking section at high speed.

Stop position precision may worsen at low speed. Thus, Stop position precision decreases when the model vehicle runs braking section at low speed. For that ***CV159*** for minimum speed in braking section can be set. For the same reason, stop position precision may decrease when a big value is set in ***CV153***. When a model vehicle enters in breaking section in lower than speed to be set in ***CV159***, it is accelerated to speed to be set in ***CV159*** by acceleration to be set in ***CV153*** .

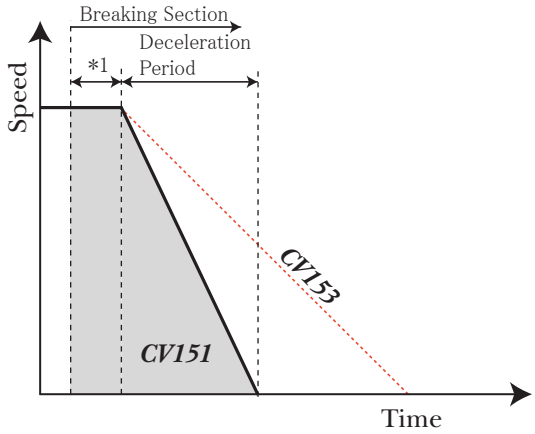
The model vehicle can stop when the instructions speed of the controller is zero. In this case ,the model vehicle can accelerate again, and can automatically stop at the stop position.

When a model vehicle enters in breaking section in higher than speed to be set in ***CV154***, it is decelerated to speed to be set in ***CV154*** by acceleration to be set in ***CV153*** . And a model vehicle can not run in heigher than speed to be set in ***CV154***.

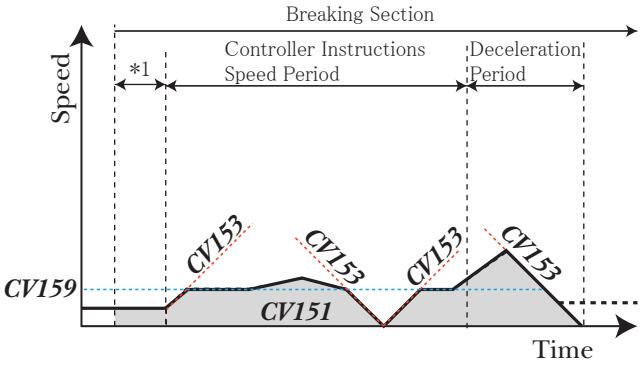
CV155 is used for preventing that the speed of the rear vehicle which does not enter in braking section is different from the speed of the front vehicle.



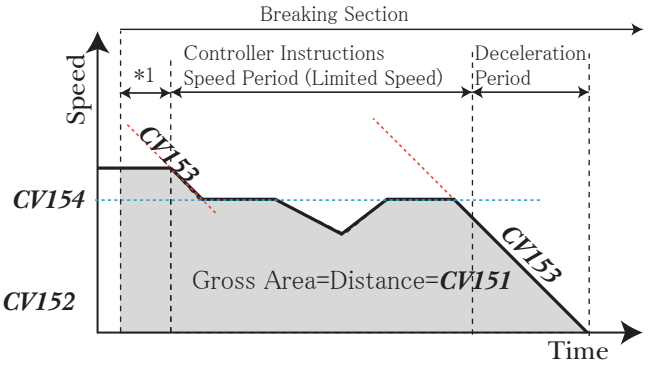
(1)Approach to Breaking Section in the Middle Speed.



(2)Approach to Breaking Section in the High Speed.



(3)Approach to Breaking Section in the Low Speed.



(4) Speed Limit in Breaking Section.

*1 Controller Instructions Speed Distance ***CV155***

Fig.IX-2 The Speed Control Operation of Braking Section.

When a model vehicle enters in breaking section in a stopping direction and runs to the opposite irection and reverse a direction again, it can stop at the stop position.

When a model vehicle enters in breaking section in a running direction runs in the instructions speed of the controller.It can not run to the opposite direction.

When NMRA signal is turned on from off, a model vehicle can not run in a stopping direction but it can run in running direction.

Please turn off internal function output OUT11 from on to cancel automatic stop operation temporarily in a breaking section. In this case stopping operation becomes effective again when it goes out of breaking section once. A function button can be used such as the ATS cancellation button switch assume that internal function output is assigned OUT11 to a function button by ***CV38 - CV46,CV130 - CV145***. When Setting of ***CV27*** is 3,12,15, by changes from the first on of the out11 to off, slow down operation is performed, and by changes from the second on of the out11 to off, the stop operation is canceled.

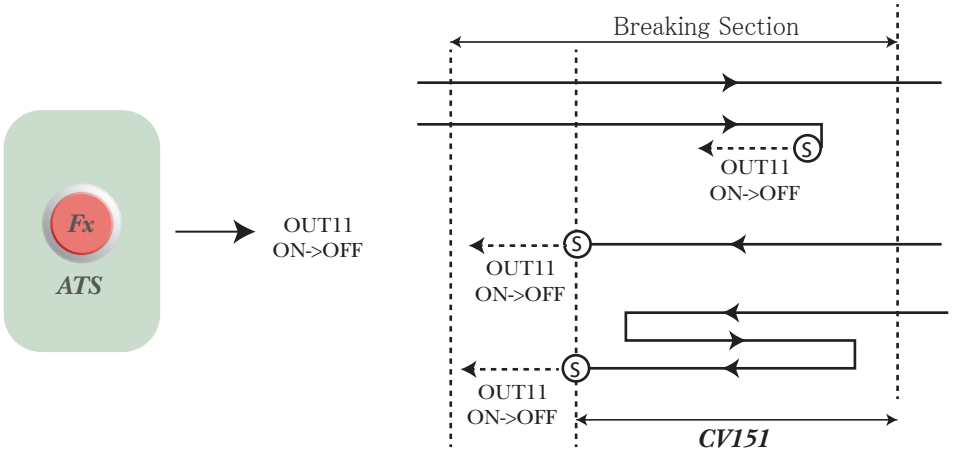


Fig.IX-3 The Operation in Braking Section.

IX-5 How to Connect Breaking Section.

A circuit diagram of breaking section is shown in figure XI-4. A product made in SLOMO and a product made in other companies can be used as breaking section module. In the case of SLOMO low noise decoder, the dummy road for stability may be necessary in particular. When it is unstable after adjusting ***CV158***, please connect it. Please use a product made in SLOMO or a register to consume current.

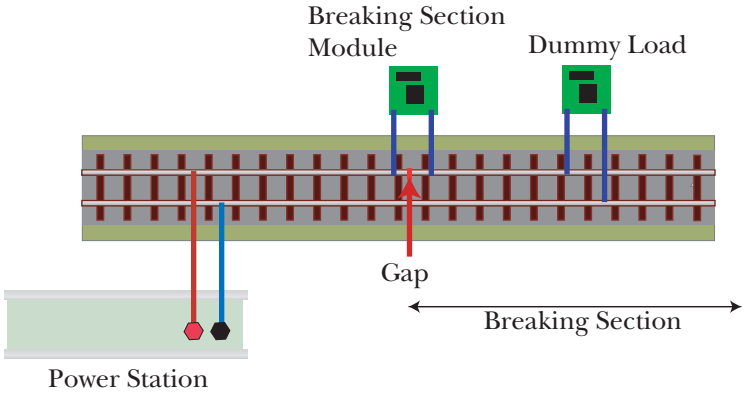


Fig.IX-4 The Connection of Braking Section.

The stopping distance of the train is decided after short-circuited of a rail gap at constant time. In the case of a bogie, short-circuit of a rail gap is detected, and therefore the stopping distance is from a last wheel of the tail of the train. Short-circuit isn't detected unless it stops on a gap in the case of an insulation wheel.

In the case of the train which has multiple motor vehicles, please couple all wheels current collecting vehicles between motar vehicles, or ,please take the controller instructions speed section ***CV155*** to lengthen distance of breaking section, so that the speed of the rear vehicle which does not enter in braking section is not different from the speed of the front vehicle which enters in breaking section.

When the trains stopped automatically in the braking section exists and the other tarin enters in a braking section ,short-circuits occurs and the vehicle stopped automatically begins to move. It's necessary to provide a short protection section for the length of the train like figure XI-5 to prevent this. As shown in figure XI-6,by **short-circuited of** symmetric DCC section and a short protection section, a short protection section will get a symmetrical DCC signal, but a braking section is kept in an asymmetric DCC signal.

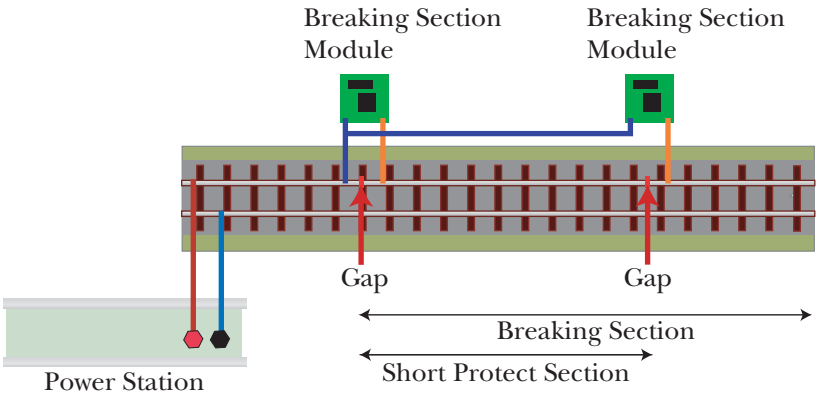


Fig.IX-5 The Connection of Short Protect Breaking Section.

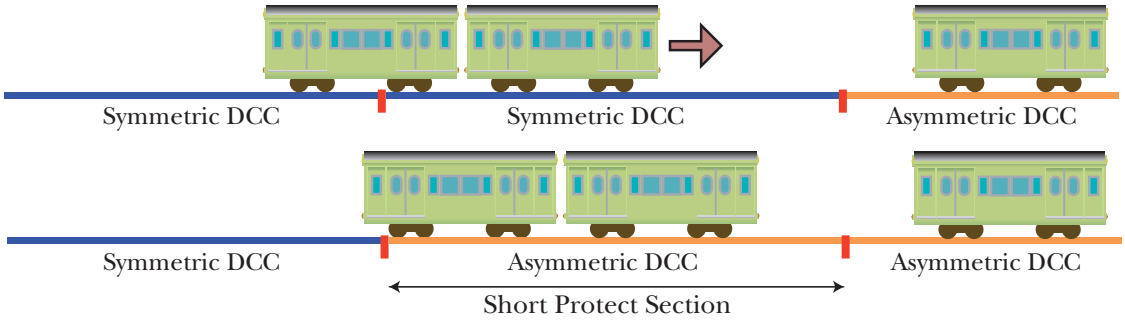
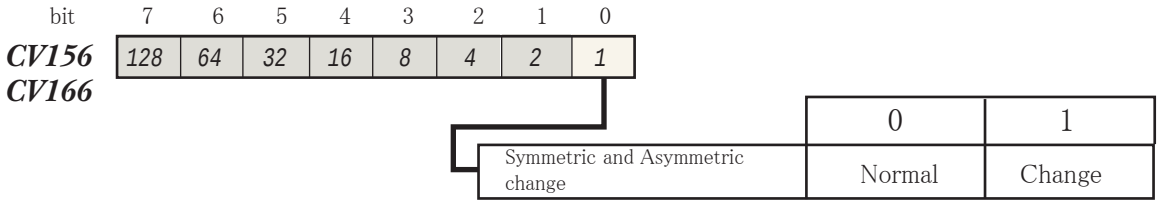


Fig.IX-6 The Operation of Short Protect Section.

The stopping distance is from a last wheel of the tail of the train. If contact with a rail and wheels of last vehicle is unstableness, the stopping distance becomes unstable. This becomes easy to happen in case that last vehicle is light such as the motorless car in the N gage in particular. There is a way to set CV156/CV166 as 1 and make the symmetrical DCC area a braking section. When this way is used, the stopping distance will be the distance after a motor car enters a target DCC section regardless of the car of following.



When it's set as 1, a symmetrical DCC section will be a braking section and an asymmetric DCC section will be a run area. It doesn't correspond to semi-asymmetric DCC signal.

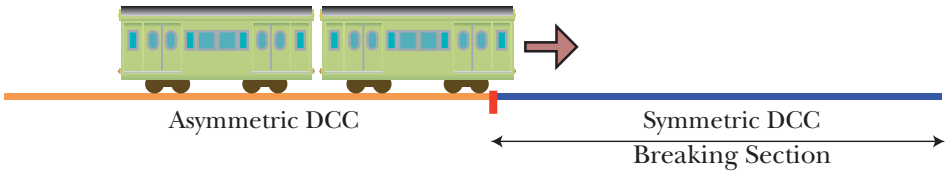


Fig.IX-7 The Operation of Symmetric DCC Breaking. (***CV156/CV166***=1)

IX-6 Automatic Driving.

We can move the train according to decided diagram, by using automatic driving script function of SLOMO controller and automatic stop by asymmetric DCC signal. It gradually slows down and stops at the stop position of the platform like a genuine train.

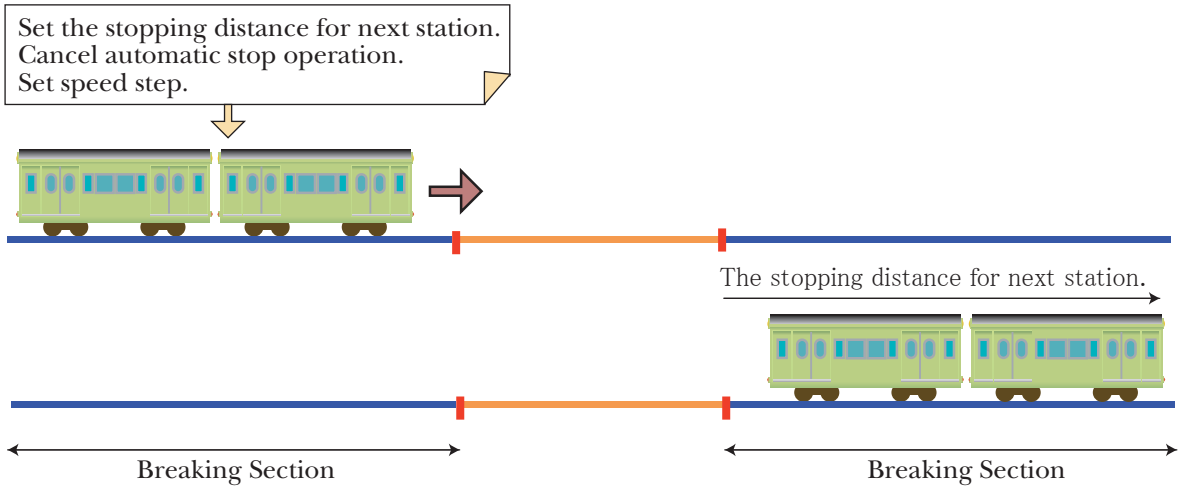


Fig.IX-6 The basic operation of Automatic Driving.

1. As illustrated in Fig IX-6, area around station is made asymmetric DCC section by installing a module in the one side of the station.
2. Please decide the operation diagram of the train as illustrated in Fig. IX-5.
3. According to a operation diagram. please write the speed designation command of the train, the change command of the point, the stopping distance setting of the train at the next station to a script.

```
S 0030 05 H 20 F        time=30 addr=5 126speed_mode speed=20 direction forward
P 0030 05 0161 15       time=30 addr=5 CV161 15 set
S 0030 07 H 20 B        time=30 addr=7 126speed_mode speed=15 direction back
P 0030 07 0161 9        time=30 addr=7 CV161 9 set
A 0032 03 1             time=32 addr=3 point
S 0070 05 H 20 F        time=70 addr=5 126speed_mode speed=20 direction forward
P 0070 05 0161 15       time=70 addr=5 CV161 15 set
A 0072 04 1             time=72 addr=4 point
S 0075 07 H 20 B        time=75 addr=7 126speed_mode speed=15 direction back
P 0075 07 0161 20       time=75 addr=7 CV161 20 set
                        ⋮
```

4. Please download the script to SLOMO controller.
5. Start automatic driving.

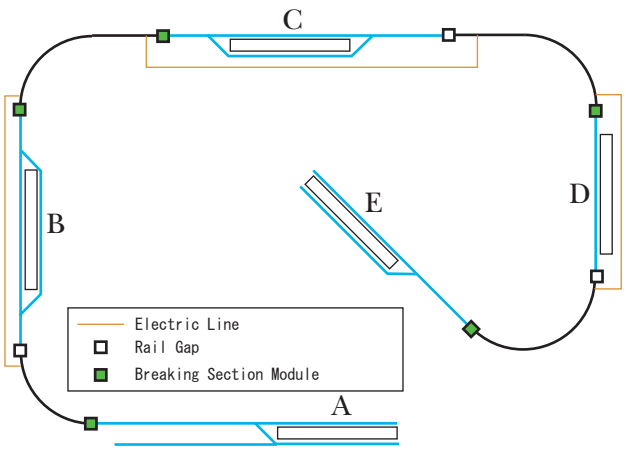


Fig.IX-7 The exmple of Automatic Driving Layout.

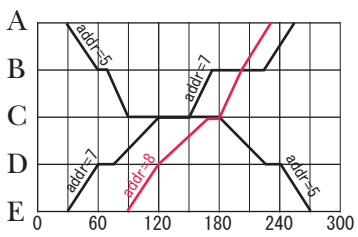


Fig.IX-8 The example of Operation Diagram.

X. Special Drive Mode.

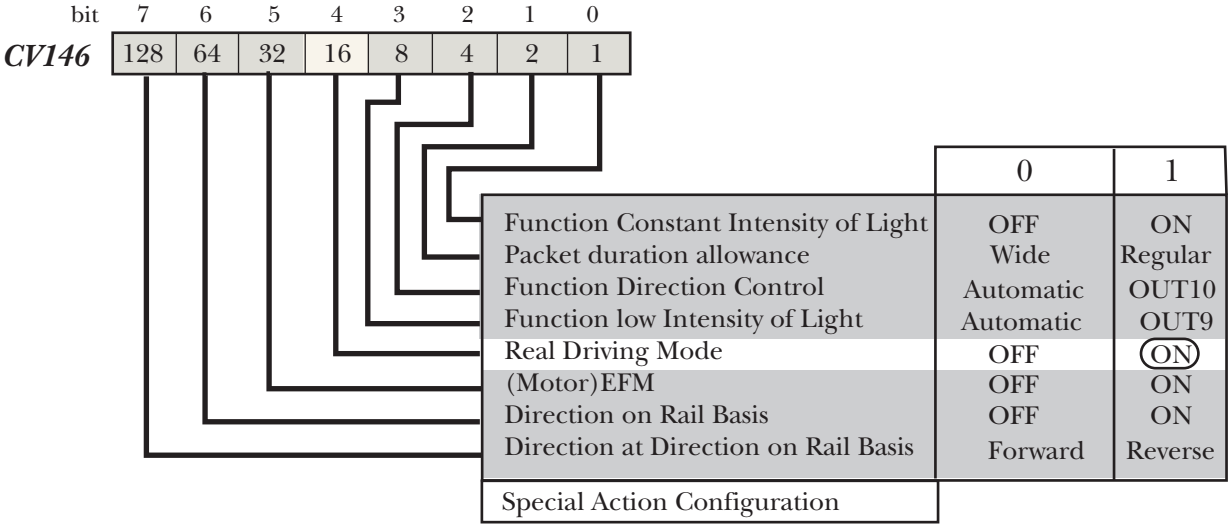
X-1 Real Driving Mode.

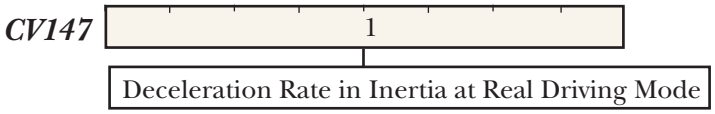
This mode is to enjoy acceleration and deceleration like driving real train using speed control knob on controller such as Digitrax(kato) DCS50K. Acceleration is based on ***CV3,CV4,CV147*** shown in Table. X-1. Please set ***CV146*** bit4 to 1.

Fig.X-1 A Image of Driving.

Table. X-1 Real Driving Mode Acceleration.

14SPD	28SPD	126SPD	Operation	Acceleration	MaxSPD
0	0	0	Emergency Stop	0	
1	1-2	1-9	Brake 7 Step	(***CV4***+***CV24***) * 1	
2	3-4	10-18	Brake 6 Step	(***CV4***+***CV24***) * 2	
3	5-6	19-27	Brake 5 Step	(***CV4***+***CV24***) * 3	
4	7-8	28-36	Brake 4 Step	(***CV4***+***CV24***) * 4	
5	9-10	37-45	Brake 3 Step	(***CV4***+***CV24***) * 5	
6	11-12	46-54	Brake 2 Step	(***CV4***+***CV24***) * 6	
7	13-14	55-63	Brake 1 Step	(***CV4***+***CV24***) * 7	
8-10	15-20	64-90	Inertia	***CV147***	
11	21-22	90-99	Mascon 1 Step	(***CV3***+***CV23***) * 4	max*1/4
12	23-24	100-108	Mascon 2 Step	(***CV3***+***CV23***) * 3	max*2/4
13	25-26	109-117	Mascon 3 Step	(***CV3***+***CV23***) * 2	max*3/4
14	27-28	118-126	Mascon 4 Step	(***CV3***+***CV23***)	max

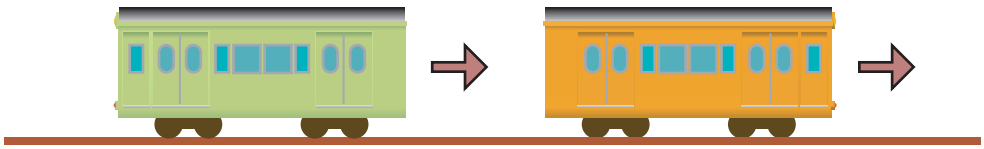




If zero is set, a model vehicle immidiately stops.

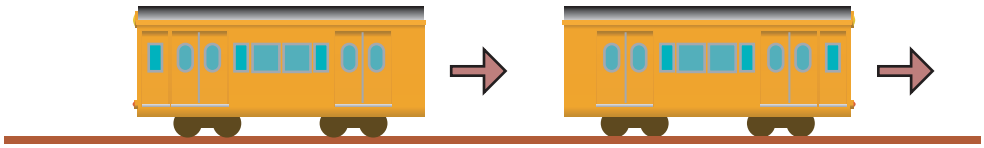
X-2 Direction on Rail Basis.

Directions of all model vehicles are same in analog control. it is decided according to which rail is plus. There is no problem that model vehicles are connected without care.

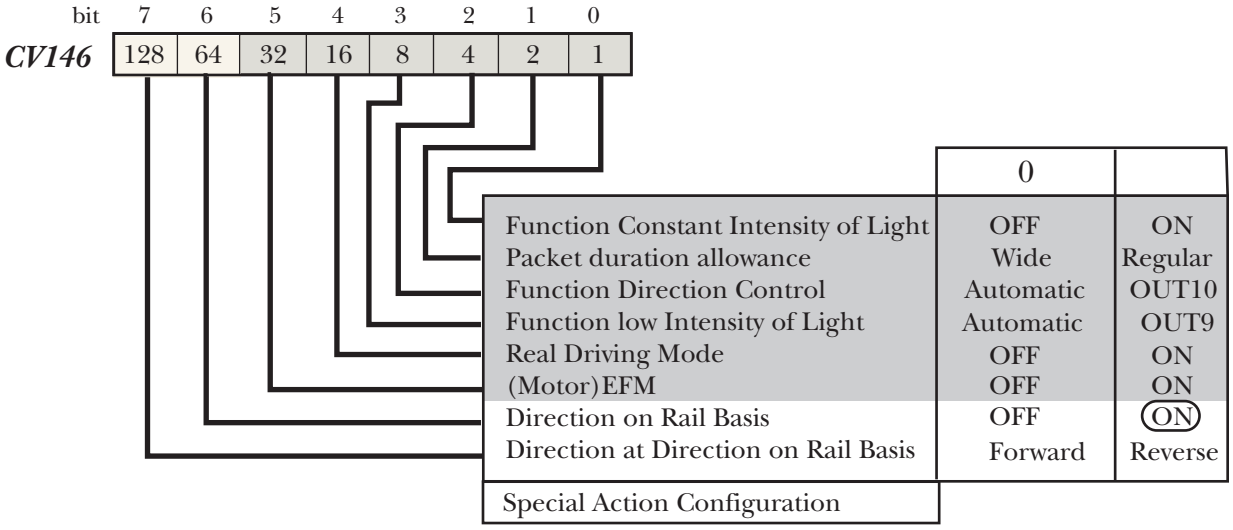


But direction of model vehicle depends on its model vehicle in DCC control. So, when model vehicles are connected, care has to be taken. If directions of each model vehicle are different, ***CV29*** bit1 has to be changed.

Direction of model vehicles are same like analog control if direction on rail basis mode is on. So it gets easy to connect model vehicles without care.



Please set ***CV146*** bit6 to 1 for direction on rail basis mode. Direction can be set in ***CV146*** bit7. If electric lines from power station are changed, direction of models vehicles are changed like analog control. Give care to auto reverse.



X-3 Constant Time Acceleration Mode.

When speed step is changed, acceleration or deceleration time is constant in this mode. This constnt time can be set in ***CV168***.

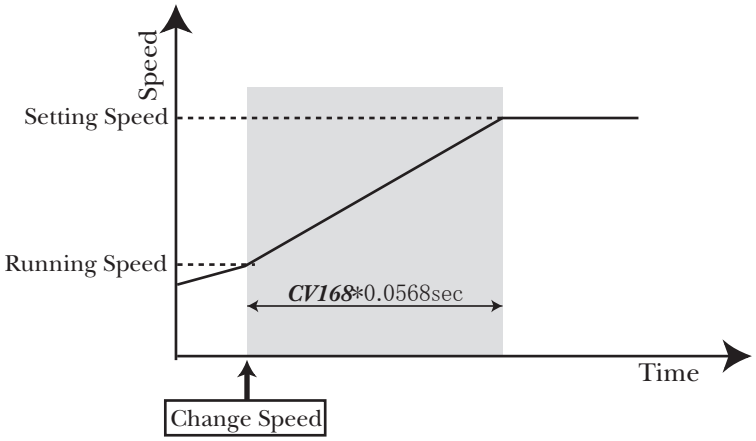
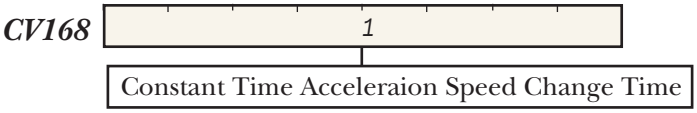


Fig.X-2 Constant time acceleration mode.



If zero is set, decoder isn't in this mode. Real driving mode has priority over this mode.

XI. Improvement of Reliability.

XI-1 Decoder Protector.

Decoder equips four kinds of protector for preventing to get damages.

Overcurrent Protection of Function Output.

All the function outputs are turned off to protect decoder, when the sum of function output current exceeds maximum current limit. Note that there is not any indication at this time. This protection is released after power on/off cycle.

Operation of protection	All the function output are turned off
Indication of protection	None
Release from protection	Power on/off cycle

There is no problem that light bulb is connected directly without series register because output device is fully maximum current limit. If inrush current exceeds maximum current limit, all the function outputs are turned off. Only in this case, series registers are needed.

Overcurrent Protection of Motor Output.

The motor output are turned off to protect decoder, when motor output current exceeds maximum current limit. Blinking function OUT2 shows occurrence of motor protection. This protection is released after complete motor stop.

Operation of protection	Motor output is turned off
Indication of protection	Blinking function OUT2
Release from protection	Complete motor stop

Motor and Rail Short Circuit.

Motor outputs are checked if motor outputs are applied voltage to, only when decoder power on. This is for detecting motor and rail output short circuit which sometimes happens as installation. When this state is detected, decoder will stop except for alternation blinking both of OUT1 and OUT2.

Operation of protection	All the operation stops
Indication of protection	Alternation Blinking function OUT1 and OUT2
Release from protection	Power on/off cycle

Over Voltage of Rail.

All the operation stops to protect decoder, when rail voltage exceeds rail voltage limit. Blinking function OUT1 shows occurrence of over voltage protection. This protection is released after power on/off cycle.

Operation of protection	All the operation stops
Indication of protection	Blinking function OUT1
Release from protection	Power on/off cycle

XI-2 Power Flicker Protector.

Decoder power from rail is flicked off around 0.1 second caused by dirty of rail or wheel. This future especially prevents that the vehicle suddenly stops and accelerates from complete stop when ***CV3*** and ***CV4*** are set to big value.

XI-3 CV value protection and Manufacture/Version Number.

Sometimes CV value is erased when power flickers are repeated caused by dirty of rail or wheels. All the CV value can store into other location where it is hard to erase them. When CV value is erased, user can restore them from this location. Two sets of CV value can be stored, so user can easily change all the CV value for different layout.

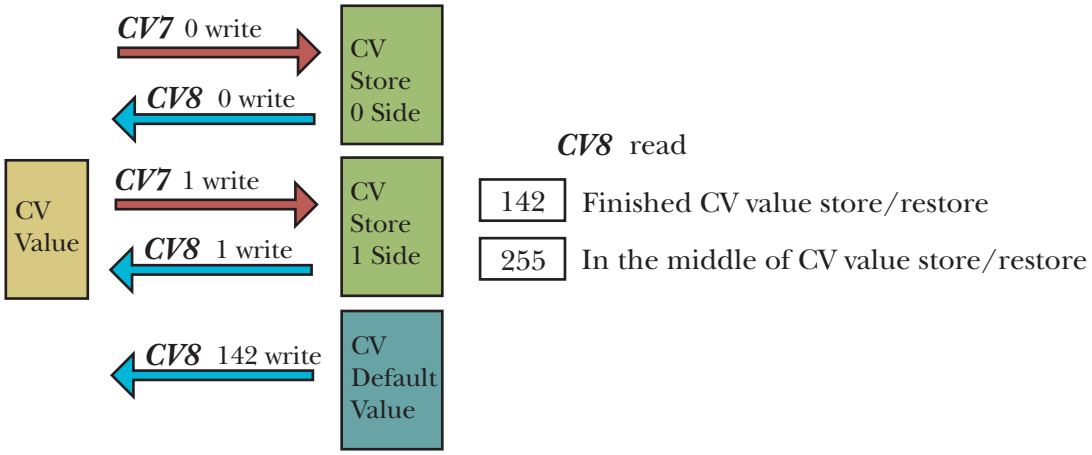
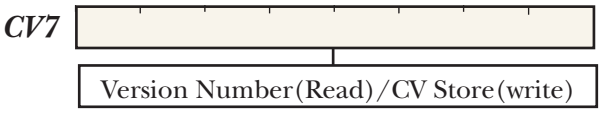


Fig.XI-1 CV value saves and restores.

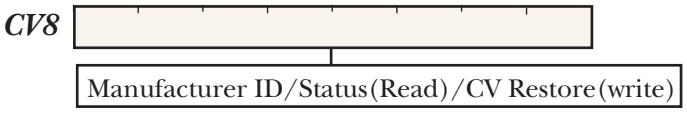


Read

Software version is written in the decoder can be read.

Write

All the CV value store into other location where it is hard to erase them.
0: All the CV value store into zero side. 255 can be read from ***CV8*** in the middle of storing.
1: All the CV value store into one side. 255 can be read from ***CV8*** in the middle of storing.



Read

Manufacturer ID can be read.
255 is read in the middle of writing or reading CV value. Please write ***CV8*** repeatedly until Manufacture ID is read.

Write

All the CV value restore from other location where it is hard to erase them or are set into default value.
0: All the CV value restore from zero side. 255 can be read from ***CV8*** in the middle of restoring.
1: All the CV value restore from one side. 255 can be read from ***CV8*** in the middle of restoring.
142: All the CV value restore to default value. 255 can be read from ***CV8*** in the middle of restoring.

XI-4 Packet Timeout.

When DCC packet which has same address as decoder don't receive beyond ***CV11*** time limit, the motor is made stop. This future exists because there is possibility that some problem occurs in command station and the train can not be controlled. This future can prevent uncontrolled train.

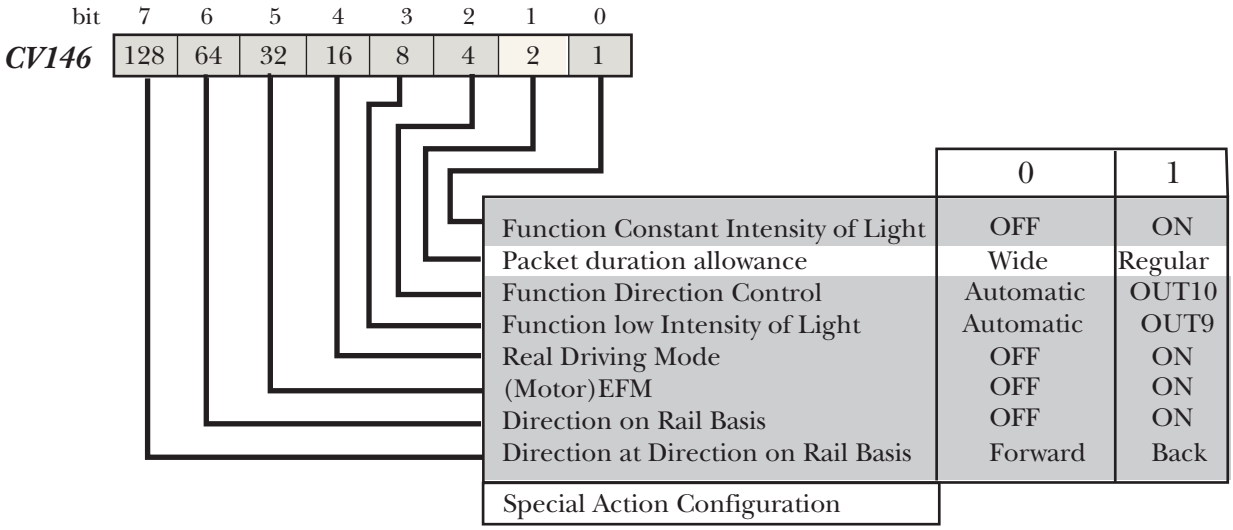
When DCC packet which has same address don't receive beyond ***CV11*** value * 0.1 second, Motor is made stop.

XI-5 Packet Duration Allowance.

Packet duration allownace is decided in NMRA standard. However, there is pawer station that has wide time range duration fluctuation compeared with NMRA standard. In this case, packet duration allowance bit has to be set to "Wide" (default) .In the case of using power staion that has regular packet duration, packet duration allowance bit has to be set to "Regular" for higher reliability.

Packet Duration allowance

	Wide ***CV146*** bit1 = 0	Regular ***CV146*** bit1 = 1
Bit1 Packet Duration	52～64 [usec]	52～73 [usec]
Bit1 Difference of Duration	6 [usec]	13 [usec]
Bit0 Minimum Duration	90 [usec]	90 [usec]



XI-6 Program Download.

Decoder program can be loaded for version up leaving the decoder installed. Please connect exclusive downloader between rail and USB terminal of personal computer and connect something to OUT1 which is used for acknowledgement during download.

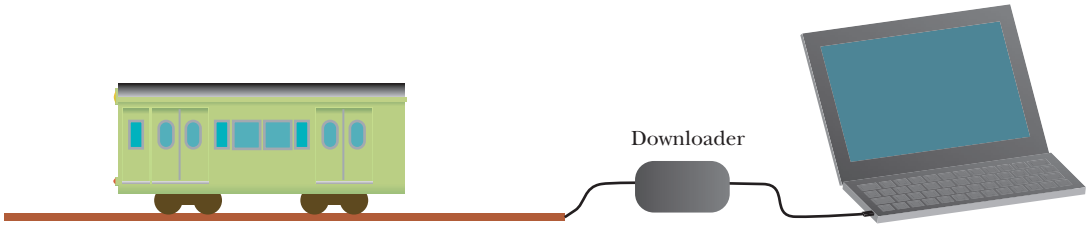


Fig. XI-2 Program Download.