### PROGRAMMING

This decoder supports all program modes and read back features. With MRC Prodigy Advance DCC you can read its address and CV value.

<table>
<thead>
<tr>
<th>CV</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV1</td>
<td>Short address</td>
<td>1-127</td>
<td>1</td>
</tr>
<tr>
<td>CV2</td>
<td>Start voltage</td>
<td>0-63</td>
<td>10</td>
</tr>
<tr>
<td>CV3</td>
<td>Acceleration, 1=sec, max = 63 sec to reach top speed</td>
<td>0-63</td>
<td>0</td>
</tr>
<tr>
<td>CV4</td>
<td>Deceleration, 1=sec, max = 63 sec to stop at top speed</td>
<td>0-63</td>
<td>0</td>
</tr>
<tr>
<td>CV5</td>
<td>Top voltage, 63/full speed, 0=half of the top speed</td>
<td>0-63</td>
<td>63</td>
</tr>
<tr>
<td>CV29</td>
<td>Basic configuration</td>
<td>--</td>
<td>2</td>
</tr>
<tr>
<td>CV3</td>
<td>Manufacturer version number</td>
<td>--</td>
<td>3</td>
</tr>
<tr>
<td>CV17</td>
<td>Long address upper byte</td>
<td>192-231</td>
<td>192</td>
</tr>
<tr>
<td>CV18</td>
<td>Long address low byte</td>
<td>0-255</td>
<td>3</td>
</tr>
<tr>
<td>CV19</td>
<td>Advanced consist address</td>
<td>0-127</td>
<td>0</td>
</tr>
<tr>
<td>CV21</td>
<td>When CV21=0, functions follow its own address, CV21=1, functions follow the consist address</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>CV37</td>
<td>0=normal, 1=SF and 2=exchange</td>
<td>0-1</td>
<td>0</td>
</tr>
<tr>
<td>CV38</td>
<td>0=normal, 1=SF and 2=exchange</td>
<td>0-1</td>
<td>0</td>
</tr>
<tr>
<td>CV42</td>
<td>0=normal, 1=F1 and 2=F2 exchange</td>
<td>0-1</td>
<td>0</td>
</tr>
<tr>
<td>CV49</td>
<td>Master sound volume, 16=max volume, 0=sound off</td>
<td>0-18</td>
<td>16</td>
</tr>
<tr>
<td>CV50</td>
<td>Horn type</td>
<td>0-3</td>
<td>0</td>
</tr>
<tr>
<td>CV51</td>
<td>Horn volume</td>
<td>0-15</td>
<td>12</td>
</tr>
<tr>
<td>CV52</td>
<td>Bell type</td>
<td>0-3</td>
<td>0</td>
</tr>
<tr>
<td>CV53</td>
<td>Bell volume</td>
<td>0-15</td>
<td>12</td>
</tr>
<tr>
<td>CV54</td>
<td>Bell ring rate</td>
<td>0-50</td>
<td>3</td>
</tr>
<tr>
<td>CV55</td>
<td>Prime mover volume</td>
<td>0-15</td>
<td>12</td>
</tr>
<tr>
<td>CV56</td>
<td>Brake squeal volume</td>
<td>0-15</td>
<td>12</td>
</tr>
<tr>
<td>CV57</td>
<td>Dynamic brake volume</td>
<td>0-15</td>
<td>12</td>
</tr>
<tr>
<td>CV58</td>
<td>Air release volume</td>
<td>0-15</td>
<td>12</td>
</tr>
<tr>
<td>CV59</td>
<td>Air jump volume</td>
<td>0-15</td>
<td>12</td>
</tr>
<tr>
<td>CV60</td>
<td>Squeeze pop valve volume</td>
<td>0-15</td>
<td>12</td>
</tr>
<tr>
<td>CV61</td>
<td>Engine cooling fan volume</td>
<td>0-15</td>
<td>12</td>
</tr>
<tr>
<td>CV62</td>
<td>Coupling volume</td>
<td>0-15</td>
<td>12</td>
</tr>
<tr>
<td>CV63</td>
<td>F3 control air release enable</td>
<td>0-1</td>
<td>1</td>
</tr>
<tr>
<td>CV64</td>
<td>Rail wheel heel clock</td>
<td>0-15</td>
<td>12</td>
</tr>
<tr>
<td>CV65</td>
<td>Kick start voltage</td>
<td>0-63</td>
<td>63</td>
</tr>
<tr>
<td>CV64</td>
<td>28 speed steps w/ the CV29 bit 4</td>
<td>1-255</td>
<td>linear</td>
</tr>
<tr>
<td>CV112</td>
<td>Back &amp;F start speed adjustment</td>
<td>0-7</td>
<td>0</td>
</tr>
<tr>
<td>CV113</td>
<td>Back &amp;F Load control proportional gain Kn</td>
<td>0-31</td>
<td>20</td>
</tr>
<tr>
<td>CV114</td>
<td>Back &amp;F Load control integral gain Kn</td>
<td>0-31</td>
<td>10</td>
</tr>
<tr>
<td>CV115</td>
<td>Brake sound type, 2=brake sound off</td>
<td>0-2</td>
<td>0</td>
</tr>
<tr>
<td>CV117</td>
<td>Headlight light effect</td>
<td>0-15</td>
<td>0</td>
</tr>
<tr>
<td>CV118</td>
<td>Auxiliary light mode</td>
<td>0-16</td>
<td>0</td>
</tr>
<tr>
<td>CV120</td>
<td>Light brightness</td>
<td>0-255</td>
<td>255</td>
</tr>
<tr>
<td>CV121</td>
<td>Air compressor mode (1=change in rpm engine rpm)</td>
<td>0-1</td>
<td>0</td>
</tr>
<tr>
<td>CV122</td>
<td>Diesel Notch mode, 0=on, 3=manual</td>
<td>0-3</td>
<td>0</td>
</tr>
<tr>
<td>CV124</td>
<td>Back &amp;F Load control intensity (Golf)</td>
<td>0-255</td>
<td>0</td>
</tr>
</tbody>
</table>

### SPEED TABLE CV67-CV94 FOR 28 SPEED STEPS

When CV29's bit 4 is set to "1" it will use the speed table formed by CV67-CV94 to control speed (motor voltage). It allows you to setup each speed for all 28 speed steps. First, program CV29 to 18 for short addresses (1-127) or program CV29 to 50 for long addresses (128-9999) to enable speed table control. Then set throttle to 28 speed steps and run your loco at speed step 1. Use program CV3 to change CV3's value (1-205) to adjust step 1's speed. The kick voltage, CV65 is only applied when the speed step changes from 0 to 1. You should switch between 0 to 1 many times to check step 1's speed. When done with CV37, select speed step 2 and program CV68. CV68's value must be greater then CV37's. When done with CV67-CV94, use read back CV to make sure their values are in increasing order.

Note: When using MRC Prodigy Advance DCC to program addresses it will automatically disable the speed table (set CV29's bit 4 to "0"). Programming CV125 to 1 will also disable the speed table and re-program CV67-CV94 to a default linear speed setting.

### TROUBLE SHOOTING

If the loco is running without sound click F12 to turn on the sound. Whenever the decoder doesn't work please use the program track to program CV8 125 with a value of 1 to restore the decoder to the factory settings. This should bring the decoder to life with address #3. This decoder should perform well with all DCC systems. The maximum DCC output should be less than 21 V. If the locomotive does not respond to commands, it may have lost its address. Please re-program the address and program CV19 to 0 (to disable consist), if it responds too slowly, you should clear its momentum by reprogramming CV3 and CV4 to zero. If step 1's speed is too high, you should program start voltage, CV2 to zero. If its top speed is too slow, program top voltage CV5 to 31. You should also keep the track to improve electrical pickup. Read your DCC system manual to learn how to program and operate the decoder. For more information about registers/CVs and their functions, please refer to the NMRA DCC Standard & Recommended Practices, RP-9.2.2. This is available directly from the NMRA or their website at www.nmra.org.

### FCC COMPLIANCE

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions. (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

### RETURN PROCEDURE

This decoder carries a 6 month warranty against factory defects. This warranty does not include abuse, misuse, neglect, improper installation, or any modifications made to this decoder, including but not limited to the removal of the NMRA plug if applicable. If it should become necessary to return the decoder for warranty repair/ replacement, please include a copy of the original sales receipt. Please include a letter (printed clearly) with your name, address, daytime phone number, and a detailed description of the problem you are experiencing. Please also include a check or a money order for $35.00 to cover the cost of repair or replacement and return shipping and handling. Be certain to return the decoder only.

Any questions regarding Warranty Policy can be directed to our Customer Service Department by calling 732-223-6360 between the hours of 8:30am and 6:00pm EST, or by emailing: rrtech@modelrectifier.com

Send the decoder to:

Model Rectifier Corporation
Attn: Parts & Service
80 Newfield Avenue
Edison, NJ 08837-3817 U.S.A
Printed in USA
INSTALLATION
If your loco has a 9 pin JST plug or NMRA 8 pin socket, you can simply unplug the original connector and plug in the decoder. If not, you have to remove the circuit board and hard wire in the decoder. The decoder will be inserted between the wheel pickups and the motor. After disconnecting the motor terminals from the pickups, connect the right side pickup wires to the red decoder wire, and connect the left side pickup wires to the blue decoder wire. Connect the right motor terminal to the orange wire, then connect the left motor terminal to the grey wire. The motor terminals must be isolated from the wheel pickups. The white wire is for the front headlight and the yellow wire is for the rear light. The blue wire is for the light common, or if using LED’s, the blue wire is LED positive. The green wire (ACC1) and brown wire (ACC2) are for your accessory lights. Use good soldering techniques, and use shrink wrap to isolate the connections. The decoder can’t touch any metal part or bare wires. You can use 8 Ohm speakers sizes from 18mm to 28mm. The larger speaker will give you the better the sound quality.

If you use 1.5V bulbs or LED’s, you should connect a 1k ohm resistor in series to one of the leads to reduce the voltage. Also use CV120 to adjust the brightness.

OPERATION
The decoder has a default address #3. Select address #3 on your DCC. Release service brake (F5) and dynamic brake (F6). You will hear the brake release sound when you turn off F5. Move up the throttle and the loco should start to move. If the loco does not move on speed 1 you can add more start voltage by programming CV2 with a large number. You can program the acceleration momentum CV3 and deceleration momentum CV4 to simulate a real train. The decoder has start up and shut down features. If the loco was previously shut down you have to start up the engine first. Press any function key to start up the engine. To shut down the engine you must bring the loco to idle and then press F8 three times.

This decoder has 4 different horns and bells. You can use F19 or program CV50 to select horn. Also use F18 or program CV52 to select bell.

This decoder has an easy function exchange feature (re-mapping) that allows certain pairs of functions to be swapped. For example, program CV37 with a value of 1 will make F3 and F4 exchanged.

This decoder has an 17 different lights effects. CV 117 controls both front and rear headlight effect. Use F5 to turn on or off the Headlights. CV118/119 control ACC1/ACC2 light effect. Use F3 to turn on or off ACC1 and ACC2. For ditch light operation you must program CV118 and CV119 to the same ditch light type. In type A the ditch lights will flash when F2 (horn) or F3 is on. In type B the ditch lights will flash when F2 is on and stay on when F3 is on. If you use a value inconsistent with actual headlights, (CV117), the headlights will default to normal/off. For example try using to use a value of 14 in CV117 for firebox flasher, the headlights will default to normal on/off.

BACK EMF LOAD CONTROL (PID CONTROLLER)
This decoder is equipped with adjustable back EMF load control feature. It is a close loop speed control. With back EMF load control the locomotive will maintain its speed regardless of pulling up hill or driving down hill. You may program the back EMF load control intensity, CV124, to a lower value to get less back EMF load control. This will enable the locomotive to slow down during uphill travel like a real locomotive.

The PID controller contains three components: proportional gain (CV113), the integral gain (CV114), and derivative gain (fixed). Designing (tuning) a PID controller is a kind of “rocket science”. So we optimized these gains at the factory but still give the customer final adjustments. We recommend that you do not change these settings. Too much gain may cause the motor to oscillate (become unstable). Too little gain may cause a slow response. Additional knowledge of PID feedback control is required before attempting to adjust CV113 and CV114. If CV113 and CV114 are programmed incorrectly, the locomotive will not run smoothly. Program CV125 to “1” will automatically restore the default PID controller settings. If you can not get the PID controller work properly or you don’t know to tune it you should turn off the Back EMF load control by program CV124 with a value of 0.

LIGHT EFFECT PROGRAMMING CHART FOR CV117/118/119
The decoder has several light effects. CV 117 controls both front and rear headlight effect. CV 118 controls the lights effect of front headlight. CV 119 controls the lights effect of rear headlight. CV117/118/119 Light effect

0 Normal on/off
1 Dyno effect (fading)
2 Dim, bright, off cycle
3 Rule 17
4 Both headlights on
5 Ditch Light type A
6 Ditch Light type B
7 Mars Light
8 Prime striato light
9 Single strobe light
10 Double strobe light
11 Rotating beacon
12 Fred Rear End Flashing
13 Firebox Flicker A
14 Firebox Flicker B
15 Engine Exhaust Flicker

SERVICE BRAKING
To apply service brake set throttle to zero and press F5. The loco will slow down fast and you will hear the brake squeal. You can pump the brake by turning F5 on and off to stop the loco at desired location. The brake rate is proportional to deceleration rate that you program in CV4. If you want to turn off F5 and move the throttle up. The loco will move. However, when you release the throttle the service brake will apply again. The service brake can only operate when throttle is at 0. If you don’t hear the brake sound program CV115 with a value of 2.

DYNAMIC BRAKING
You can use dynamic brake F6 to reduce the speed. When you turn on F6 the prime mover will notch down to 1 and you will hear the dynamic brake sound and the loco will reduce its speed. When you release F6 the loco will speed up to the original speed. If you want to turn off F6 and move throttle up it will automatically disable the dynamic brake and loco will start to move. To apply the dynamic brake again you have to cycle F6 off and on.

S-2, S-4, RS-1, RSC-1, RSD-1, DL-105, DL107, DL-108, DL-110, SD45T-2, RS-3, PA 1, PB1
SD45, SD45T-2, SD40, SD40-2, SD40-2T, SD40-3, SD45, SD45-2, SD45T-2, F45, F45A, F45B, F45B-2, F45B-2, GP38, GP38-2

Suitable for the locomotive

Function
Idle/Moving
F0
Headlight on/off
F1
Bell on/off
F2
Horn
F3
Accessory light on/off / Air release (Air release disable when CV3=0)
F4
Coupling
F5
Brake handle: brake when moving, brake release when idle
F6
Dynamic brake on/off. The loco will slow down when F6 is on
F7
Air hose flaming/uncoupling lever
F8
3 times will shut down when in idle / Notch down when in manual notch
F9
Engine cooling fan / Notch up when in manual notch
F10
Rail wheel clack (only moving)
F11
Traction air compressor
F12
Toggle between max master volume and sound off (CV49)
F13
Reduce master volume by 1 / Air release when reach minimum
F14
Increase master volume by 1 / Air release when reach maximum
F15
Air compressor on/off
F16
Flame squeal
F17
Air release
F18
Change bell type CV52 (use F1 to turn off bell after adjustment)
F19
Change horn type CV50
F20
Associated loco sound
F21
Increase bell volume CV93 by 1, it will rollback to 0 when reach 15
F22
Increase horn volume CV61 by 1, it will rollback to 0 when reach 15
F23
Increase diesel volume CV55 by 1, it will rollback to 0 when reach 15
F24
Safety valve pop
F25
Air release
F26
Flame nois
F27
Sand drop
F28
Air compressor speed mode change (CV112) / with Air release

Decoder Prime mover Suitable for the locomotive
0001619 EMD44E SD39, SD40, SD40-1, SD40-2, SD40-2T, SD45, SD45-2, SD45T-2, F45, F45A, F45B, F45B-2, GP38, GP38-2, GP38-2
0001620 EMD45 SW1000, SW1015, SW1050, SW1054, MP15DC, MP15AC, MP15, GP38-2, GP38-2, SD39-2, SD39-3, GP15, GP15-1
0001621 EMD70 SD70AC, SD70M2
0001622 ALCO 244 RG3, RG1, RG1B
0001623 ALCO 259 8-4, 8-5, 10-1, 10-2, 10-5, 10-6, 10-9, 10-11, SD39, SD40, SD40-1, SD40-2, SD40-2T, SD45, SD45-2, SD45T-2, F45, F45A, F45B, F45B-2, GP38, GP38-2, GP38-2, SD39-2, SD39-3, GP15, GP15-1