Specification

Continuous Power	750mA (Continuous)
Peak Power	1.0A
Light Function output max	100mA
Version	V9-B3

1、 **Short address**

7-bit Short address	CV1

To modify this address simply program CV 1 to a different value between 1-127. 2、

Long address

Long address (High Byte)	CV17
Long address (Low Byte)	CV18
Enable long address	CV29

To modify long address simply program CV17 and CV18 to a different value between 128-9999. Once the derived values have been programmed, enable the Long Address by adding a value of 32 to CV 29. CV 29 has a default value of 6, so to enable the 4-Digit Address just add a value of 32 and program the resulting value of 38 into CV 29.

3、 **Consist address**

Consist address	CV19

Consist Addressing is similar to Short Addressing in that it can accept values from 1-128. 4、

Decoder lock

Unlock decoder	CV15
Decoder lock number	CV16

Decoder Lock is used when a locomotive has 2 or more decoders in it. With the CV 16 values defined you are ready to lock and unlock each decoder. To unlock a decoder simply put the locomotive on the programming track and program CV 15 to whatever value the decoder you want to program has in CV 16.

5、 **Light effects**

Light feature   Light function

	Forward	Reverse	Both
Constant Bright	0	16	32
Random Flicker	1	17	33
Mars Light	2	18	34
Flashing Light	3	19	35
Single Pulse Strobe	4	20	36
Double Pulse Strobe	5	21	37
Rotary Beacon	6	22	38
Gyra Light	7	23	39
Rule 17 (dimmable light)	8	24	40
Ditch Light phase A	10	26	42
Ditch Light phase B	11	27	43
Constant Dim light	12	28	44
Auto Mars Light	13	29	45

CV49	F0F	White wire
CV50	F0R	Yellow wire
CV51	F1	Green wire
CV52	F2	Purple wire
CV53	F3	Pink wire
CV54	F4	Brown wire

*Not all decoders have all 6 light functions. Check your decoders spec and function list to determine how many of the above listing functions you have.

*Take the value corresponding to the feature & directionality you decided on from the table above. Enter that value into table above in the row for the light function you want to apply the feature to.

6、 **Modify lighting effects**

6.1、 Mars/Gyra light adjustment

Mars/Gyra light	CV	Values
Min Brightness	CV112	1-25
Max Bright Duration	CV113	1-255
Total Light Cycle	CV114	1-3
Mid Brightness	CV115	1-25
Max Brightness	CV116	1-25

6.2、 Rotary Beacon

Rotary Beacon	CV	Values
Min Brightness	CV118	1-25
MaxBright Duration	CV119	1-255
TotalLight Cycle	CV120	1-3
Mid Brightness	CV121	1-25
Max Brightness	CV122	1-25

Mars Light, Gyra Light, and Rotary Beacon Modification:

- Note: All of the above lighting features allow for 3 points of brightness adjustment, as well as 2 timing related CV's.

- The Total Light Cycle adjustment is a multiplier with increasing values (2 & 3) increasing the length of each light cycle.

- The Max Bright Duration dictates how long the lighting feature will remain at full brightness.

- The Total Life Cycle value will act as a multiplier on the Max Bright Duration & increase the time at max bright.

- When adjusting the brightness values keep these tips:

- All values must be above 0.

- All three values (Min., Mid., and Max) cannot be the same.

- Min. brightness must always be lower than (or equal to) mid. brightness, and mid. brightness must be lower than (or equal to) the max brightness

6.3、Flashing light

Flashing light	CV	Values
Light on duration	CV144	0-255
Light off duration	CV145	0-255

Values between 0-255 are accepted (the larger the value, the longer the light will remain in the specified state).

6.4、Single Pulse Strobe

Single Pulse Strobe	CV	Values
Light on duration	CV141	0-255
Light off duration	CV140	0-255

Values between 0-255 are accepted (the larger the value, the longer the light will remain in the specified state).

6.5、Double Pulse Strobe

Single Pulse Strobe	CV	Values
1st Light on duration	CV147	0-255
Short off duration	CV148	0-255
2nd Light on duration	CV147	0-255
Long off duration	CV146	0-255

Values between 0-255 are accepted (the larger the value, the longer the light will remain in the specified state).

6.6、**Rule 17 (dimmable light)**

Rule 17 Dimming includes three different types of functionality: Opposite Dim (when travelling forward the reverse light is on dimmed, and when travelling in reverse the forward light is on dimmed), Dim when stopped (when a locomotive comes to a complete stop the light(s) dim), and button controlled dimming.

By default button controlled dimming is in place any time a lighting function is assigned the Rule 17 lighting effect, however, Opposite Dim & Dim when Stopped must be enabled in CV 61 before they will effect the decoders operation. See the table below for information on enabling these effects.

CV61	
Enable BEMF	1
Enable Button Control of BEMF	2
Dim when Stopped	16
Opposite Dim	32

NOTE: CV61 controls the use of BEMF as well as the Rule 17 lighting. To program this CV properly select the features from the left that you want then add up the corresponding values and program the result of that summation in CV 61. If you program an even number in CV 61 BEMF will be disabled which may significantly effect the slow speed per-formance of your locomotive.

Please note that will Dim when Stopped will work on any function output Opposite Dim can only be used with the White or Yellow Wires (F0F, F0R). Button controlled Rule 17 Dimming is always enabled so if you program a light function to the Rule 17 lighting feature and press the Rule 17 button (by default button 4) any light using the Rule 17 feature will dim.

6.7、**Ditch Light**

	Alternation rate
Ditch Light	CV117

Each decoder includes a Left (phase A) and Right Ditch Light (phase B) which are controlled by a Single Ditch Light generator. The overall speed at which the ditch lights alternate can be adjusted with values from 1-255. The lower the number slower the alternation, and the higher the number the faster they blink.

6.8、**Constant Dim Light**

	Brightness setting
Constant Dim	CV64

Each Constant Dim light values can be adjusted between 1-20 (with 20 being full brightness and 1 being least bright).

6.9、**Auto Mars Light**

This lighting feature will remain at full brightness until the locomotive is decelerating below 36% speed at which point it will switch to the mars light pattern. When the locomotive accelerates over 36% speed it will again return to a full brightness light.

7、Function Remapping

In most cases, you can control almost any wire (function) with almost any button on your controller.

	8	7	6	5	4	3	2	1	R-0-F	Default CV	
White wire					32	16	8	4	2	1	CV33	1
Yellow wire					32	16	8	4	2	1	CV34	2
Green wire					32	16	8	4	2	1	CV35	4
	8	4	2	1							CV37	0
Purple wire					32	16	8	4	2	1	CV36	8
	8	4	2	1							CV38	0
Brown wire					32	16	8	4	2	1	CV39	16
	8	4	2	1							CV41	0
Pink wire					32	16	8	4	2	1	CV40	32
	8	4	2	1							CV42	0

NOTE: If you are using Ditch Lights, do not use buttons 2 or 5 for any wires because these buttons control the ditch light flash. If you are using Rule 17 light dimming, do not use button 4 for any wire because it controls light dimming. You may use buttons 2, 4 & 5 as you wish if you are not using ditch lights or headlight dimming.

8、Flicker Effects

Flicker Effects		CV47
F0F	Stays on with no flicker only in forward direction when F0 available	
F0R	Stays on with no flicker only in reverse direction when F0 available	
F1	Flickers and then stays on in both directions when F0 available	
F2	Flickers and then stays on in both directions when F0 available	CV47 = 1
F3	Flickers and then stays on in both directions when F0 available	
F4	Flickers and then stays on in both directions when F0 available	
F0F	Flickers and then stays on in both directions when F0 available	
F0R	Flickers and then stays on in both directions when F0 available	
F1	Flickers and then stays on in both directions when F0 available	
F2	Flickers and then stays on in both directions when F0 available	CV47 = 2
F3	Flickers and then stays on in both directions when F0 available	
F4	Flickers and then stays on in both directions when F0 available	
F0F	Stays on with no flicker only in forward direction when F0 available	
F0R	Stays on with no flicker only in reverse direction when F0 available	CV47 = 3

Function	Description	CV
F1	Flickers and then stays on in both directions when F1 available	
F2	Flickers and then stays on in both directions when F2 available	
F3	Flickers and then stays on in both directions when F3 available	
F4	Flickers and then stays on in both directions when F4 available	
F0F	Flickers and then stays on in both directions when F1 available	
F0R	Flickers and then stays on in both directions when F2 available	
F1	Flickers and then stays on in both directions when F3 available	CV47 = 4
F2	Flickers and then stays on in both directions when F4 available	
F3	Flickers and then stays on in both directions when F5 available	
F4	Flickers and then stays on in both directions when F6 is available	CV47 = 5

9、Consist Light Control

WhiteF(0)F	1		GreenF(1)	1
YellowF(0)R	2		PurpleF(2)	2
CV22			BrownF(3)	4
			PinkF(4)	8
			CV21	

By default none of the lights controlled by a decoder can be turned on or off when using the consist address to identify the locomotive. However, all of the lighting functions can be controlled by modifying CV's 21 and 22. CV 21 controls F(1) through F(4) and CV 22 controls F(0)F and F(0)R.

Simply select the lighting features above that you would like to control while in a consist, add up the corresponding values from the right column and program the resulting value in the CV listed at the bottom of each table.

10、DC light operation

White and Yellow(F0F and F0R)	1
GreenF(1)	2
PurpleF(2)	4
BrownF(3)	8
PinkF(4)	16
CV13	

Enabling Lights on DC:
Add the corresponding values from the right hand column of the table and program that value into CV13.

11、BEMF

11.1、Programmed ON/OFF

Programmed On/Off simply refers to turning on or off BEMF by adjusting CV values. To disable BEMF simply set CV 61 to the next smallest even number. For instance, if CV 61 has a value of 17, programming a value of 16 will disable BEMF.

11.2、Button Control of BEMF

To enable Button Control of BEMF a value of 2 should be added to the value in CV 61. Being that CV 61 has a default value of 1 adding a value of 2 and programming the resulting value of 3 into CV 61. By default after enabling button control of BEMF turning on and off function button 6 will turn on and off BEMF. To remap button control of BEMF select the function button from the table below and program the selected value into CV 136.

Function Button	5	6	7	8	9	10	11	12
Value	1	2	4	8	16	32	64	128

11.3、BEMF Cutout

To enable BEMF Cutout simply enter a value into CV 10 that is between 1 and 128.

The value entered into CV 10 directly correlates to the speed step at which it will cut out. That is to say if you wish to disable BEMF at speed steps above speed step 50 enter a value of 50 into CV 10.

12、Momentum

Momentum is controlled by adjusting the values of CV 3(The rate of Acceleration) and CV 4(The rate of Deceleration). Values between 1-255 are accepted and the larger the value used the longer it will take for the decoder to ramp up its speed.

13、Variable Momentum

Acceleration					Deceleration	
CV132	Acceleration Rate3	Rate3	Rate4	CV128	Deceleration Rate4
CV131	Rate3 starting point	Rate3	Rate4	CV127	Rate4 ending point
CV130	Acceleration Rate2	Rate2	Rate5	CV126	Deceleration Rate5
CV129	Rate2 starting point	Rate2	Rate5	CV125	Rate5 ending point
CV3	Acceleration Rate1	Rate1	Rate6	CV4	Deceleration Rate6

- Variable uses five CV's for Acceleration & five CV's for deceleration as pictured in the above diagram. Both Accel. and Decel. have three different rates of speed change and two points used to identify when to move from one to the next.

- As you can see above Acceleration has Rates 1, 2, and 3, and transition points between 1 and 2, and 2 and 3.

- Deceleration has Rates 4, 5, and 6 and transition points between 4 and 5, and 5 and 6.

- Implementing Variable Momentum is as simple as programming values between 0-255 into all of the CV's above.

- To achieve the ideal curve a bit of trial and error and adjustment will be required.

14、3 Point Speed Curves

To enable 3 Point Speed Curves simply program values into CV 2 (Start Volts), CV 6 (Mid Volts), and CV 5 (Top Volts). The Speed Curve is defined in CV's 2, 6 and 5 with each CV corresponding to approximately 1/3 of the speed range. Values may range from 1-255.

NOTE: 3 Point Speed Curves do not allow for parabolic speed curves. That is to say each consecutive CV must have a value higher than, or equal to, the CV before it.

15、Speed Tables

Speed steps	Step1	Step2	Step3	......	......	Step126	Step127	Step128
CV	67	68	69	......	......	92	93	94

To enable user speed tables add a value of 16 to whatever value you find in CV 29.
Speed table values are defined in 28 CV's from CV 67 to 94. Each CV defines 1/28 of the speed range and the decoder uses each value as a point to generate the speed curve used by the locomotive .

16、Button Control of Motor

• Button Control of the Motor has two forms: Automatic (direction of motor spin determined by the direction command sent to the decoder) or Manual (direction of motor spin determined by which button is pressed). * To enable Automatic button control add a value of 68 to whatever value is found in CV 61. By default CV 61 has a value of 1 so simply program a value of 69 into CV 61.

• If CV 134 set to 8 when button 2 is pressed the motor will run at full speed in the direction identified on the handheld. To remap the button please set the value of CV 134 by referring to the table below.

Button	Fwd 0 Rev		1	**2**	3	4
Value	1	2	4	**8**	16	32

To enable Manual button control add a value of 64 to the value is found in CV 61. Once completed the decoder will run in the forward direction when button 2 is enabled and in reverse when button 3 is enabled. In both cases to set speed (voltage) of the motor adjust the value of CV 133 (This value ranges from 0-128 which equates to to 128 speed steps).

16、CVs and Description

CV	Description	Default	CV	Description	Default
1	Primary Address	3	40	Function 4Map (Pink0-6)	32
2	Vstart	0	41	Function 3Map (Brown7-12)	0
3	Acceleration	12	42	Function 4Map (Pink7-12)	0
4	Deceleration	12	43	Not in Use	64
5	Vhigh	0	44	Not in Use	128
6	Vmid	0	45	Not in Use	0

7	Manufacturer Version	09	46	Not in Use	0
8	Manufacturer ID (AE Electronic Ltd)	169	47	Easy Fluorescent Light Effects	0
9	Not in Use	0	48	Not in Use	0
10	BEMF Feedback Cut-out	0	49	Forward Light Feature (White)	0
11	Not in Use	0	50	Reverse Light Feature (Yellow)	16
12	Not in Use	0	51	Function 1 Feature (Green)	32
13	Alternate Mode Function Status F1-F8	255	52	Function 2 Feature (Purple)	32
14	Alternate Mode Function Status F9-F12	0	53	Function 3 Feature (Brown)	32
15	Decoder lock Number	0	54	Function 4 Feature (Pink)	32
16	Decoder Unlock Number	1	55	Not in Use	0
17	Upper Byte extended Address	0	56	Not in Use	0
18	Lower Byte extended Address	0	57	Not in Use	0
19	Consist Address	0	58	Not in Use	0
20	Not in Use	0	59	Not in Use	0
21	Consist Address Active forF1-F8	0	60	Year & Month of Manufacture	80
22	Consist Address Active for FL-F9-F12	0	61	Button Control	1
23	Acceleration Adjustment	0	62	Auto Stopping sensitivity voltage	32
24	Deceleration Adjustment	0	63	Ditch Light blink rate timer	64
25	Pre-sets for locomotive type	0	64	Constant dimming level	4
26	Not in Use	0	65	Stay alive time	0
27	Decoder Automatic Stopping	0	66	Motor type	0
28	Not in Use	0	67	Step 1SpeedTable	1
29	Decoder Configuration	6	68	Step 2SpeedTable	10
30	Not in Use	0	69	Step 3SpeedTable	19
31	Not in Use	0	70	Step 4SpeedTable	29
32	Not in Use	0	71	Step 5SpeedTable	38
33	Forward Light Map	1	72	Step 6SpeedTable	48

CV	Description	Default	CV	Description	Default
34	Reverse Light Map	2	73	Step 7SpeedTable	57
35	Function 1Map (Green0-6)	4	74	Step 8SpeedTable	66
36	Function 2Map (Purple0-6)	8	75	Step 9SpeedTable	76
37	Function 1Map (Green7-12)	0	76	Step 10SpeedTable	85
38	Function 2Map (Purple7-12)	0	77	Step 11SpeedTable	95
39	Function 3Map (Brown0-6)	16	78	Step 12SpeedTable	104

16、CVs and Description (continued)

CV	Description	Default	CV	Description	Default
79	Step 13SpeedTable	113	126	DecelerationRate2	0
80	Step 14Speed Table	123	127	Rate3EndingPoint	0
81	Step 15Speed Table	132	128	DecelerationRate3	0
82	Step 16Speed Table	142	129	Rate2 Start point	0
83	Step 17Speed Table	151	130	Acceleration Rate 2	0
84	Step 18Speed Table	160	131	Rate3Start point	0
85	Step 19Speed Table	170	132	Acceleration Rate3	0
86	Step 20Speed Table	179	133	Power for Button Control	0
87	Step 21Speed Table	189	134	Button Control of Motor Circuit	0
88	Step 22Speed Table	198	135	RandomFlicker1 Adjustment	32
89	Step 23Speed Table	207	136	BEMF Map	0
90	Step 24Speed Table	217	137	Not in Use	128
91	Step 25Speed Table	226	138	Not in Use	16
92	Step 26Speed Table	236	139	Not in Use	128
93	Step 27Speed Table	245	140	Single Pulse Strobe off duration	200
94	Step 28Speed Table	254	141	Single Pulse Strobe on duration	20
112	Mars Min Brightness	1	144	Flashing light on duration	144

113	Mars Max Bright Time	9	145	Flashing light off duration	48
114	Mars Total Light Cycle	1	146	Double Pulse Strobe Long Off	200
115	Mars Mid Brightness	6	147	Double Pulse Strobe Long On	20
116	Mars Max Brightness	22	148	Double Pulse Strobe Short Off	50
117	Ditch Light Blink Rate	3			
118	Rotary Min Bright	1			
119	Rotary Max Bright Time	5			
120	Rotary Total Light Cycle	1			
121	Rotary Mid Brightness	15			
122	Rotary Max Brightness	25			
125	Rate 2 Ending Point	0			