

## $\$ 29.95$

This is an EPF (extended packet format) decoder supporting:
, Four digit address (long)
, Uploadable speed table with programmable motor drive frequency
, 128 Speed mode operation
, Decoder assisted consisting
, All forms of operations mode programming (programming on the mainline)
, Programmable Start Voltage works for all speed modes
, Motor rating 1.3 Amp continuous, 2 Amp peak (stall)
, 2 Function outputs rated for up to 40 mA incandescent bulbs ( 150 mA when used with LEDs or if a 22 to 33 ohm resistor is used in series with bulb)
, Automatic reversing headlights

## Every attempt has been made to ensure this decoder complies with all applicable NMRA Standards and Recommended Practices

## Configuration Variables used by D102 Decoders

CV1 normal 7 bit loco (short) address; 1-127 valid
CV2 vstart, value added to all speed steps of "standard speed table", 1 count $=.89 \%$ of full voltage when using the normal speed table. If uploadable speed table is used the percentage varies with the frequency of PWM motor control in CV9.
CV3 acceleration rate (each unit $=32 \mathrm{mS}$ between speed steps) 254 max. CV23 is added to this value on power up]
CV4 deceleration rate (each unit = 32mS between speed steps) 254 max. CV23 is added to this value on power up
CV7 Manufactuer ID. North Coast = 11
CV8 Decoder version number. This decoder is 23 which means ver. 2.3
CV9 PWM frequency. This CV determinesthe total PWM period for the uploadable speed table. Each unit $=128$ uS this allows a frequency of 30 hz to 279 hz . 279 hz comes from using each speed $=1$ count this yields: max speed $=28^{*} 128$ us for a 3.58 mS period which equals 279 hz .
CV17 high byte of 14 bit address
bit 6,7 always=1
bits $0-5$ are upper 6 bits of 14 bit address
CV18 low byte of 14 bit address (lower 8 bits)
CV19 8 bit address for consist, when active the consist responds to all commands addressed to it the same as it would to it's normal 8 or 14 bit address. Note: the normal $8 / 14$ bit address is still active for all non-speed/direction commands (especially useful for headlight and other function controls of individual locomotives while in consist). If the consist address is set to 0 then the consist is inactive.
bits 0-6 7 bit consist address (1-127)
bit $7 \quad 0=$ direction is normal, $1=$ direction is reversed
CV23 acceleration rate adjust (each unit $=32 \mathrm{mS}$ between speed steps) this value is added to the value in CV3 at power up or when reprogrammed
CV24 deceleration rate adjust (each unit $=32 \mathrm{mS}$ between speed steps) this value is added to the value in CV4 at power up or when reprogrammed
CV29 - bit 0 1=direction of operation is reversed, $0=$ direction is normal

- bit $11=$ use 28 speeds mode, $0=14$ speed mode
- bit 21 = DC conversion enabled. $0=$ disable DC mode
- bit 3 not used
- bit $41=$ use alternate (uploadable) speed table, $0=$ use normal speed table
- bit 51 = use 14 bit address in CV17,18 (do not use CV1), 0= use CV1 not CV17,18
- bit 6 not used
- bit 7 not used


## UPLOADABLE SPEED TABLE VARIABLES

CV66 Speed step 0 of uploadable table (Must be 0 for proper operation
CV67-CV94 Speed step 1 to 28 of uploadable speed table

## PROGRAMMING INFORMATION：

This decoder complies with NMRA RP－9．2．3 for paged mode and register mode programming．

## Details on register mode programming：

Register 1：CV1
Register 2：CV2
Register 3：CV3
Register 4：CV4
Register 5：CV29
Register 6：Page register
Page 1 uses registers 1－4 to access CVs 1－4
Page 2 uses registers 1－4 to access CVs 5－8
Page 3 uses registers 1－4 to access CVs 9－12，etc．
Register 7：Software version number
Register 8：Manufacturer Code（NCE＝12 decimal，0C hex）
OPERATIONS MODE PROGRAMMING：Decoders will only respond to long form ops mode programming at their normal（long or short）address．They do not respond to the long form ops mode programming instructions at their consist address（per RP－9．2．1）． Use the short form to modify consist momentum．Lenz command stations only generate short form and Digitrax only generates long form．North Coast Master Series， System One，Dynatrol and Ramtraxx use both types automatically．

## OTHER NOTES：

A decoder can only respond to either it＇s 8 bit＇base＇address（CV1）or it＇s 14 bit ＇base＇address（CV17，CV18）according to the state of CV29 bit 5 but not both at one time．

Regardless of the state of CV29 bit 5，a decoder will still always respond to any 8 bit address other than zero that is programmed into the consist address （CV19）．In this manner consist control always works no matter which＇base＇ address is being used by the decoder．

The long form of Ops Mode Programming only works at a decoder＇s normal address and not to it＇s consist address．This avoids setting CV29 while in a consist then later wondering why the decoder now only responds to it＇s long address rather than the short or vice－versa．

The extended address of 0 is a valid address（11000000 00000000）．
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## CV17 CV18

So are extended addresses in the range of 1－127，（please be aware that the Digitrax Chief can not use these addresses）

Tip for using consists and extended addresses：leave CV1 set to 3 ，or some other conveniently remembered address and only use the extended address（CV17，CV18）set to your desired value．This avoids mixing up normal ＇short＇addresses with consist addresses．

Factory default values for decoder Configuration Variables (CVs)
Digitrax users: use the hex numbers, all other systems use normal decimal numbers

| CV | Default value in decimal hex |  | Description |
| :---: | :---: | :---: | :---: |
| 1 | 3 | 3 | short address |
| 2 | 4 | 4 | start voltage |
| 3 | 0 | 0 | acceleration |
| 4 | 0 | 0 | deceleration |
| 9 | 195 | C3 | PWM frequency |
| 17 | 192 | C0 | long address high byte |
| 18 | 0 | 0 | long address low byte |
| 19 | 0 | 0 | consist address |
| 23 | 0 | 0 | acceleration adjust |
| 24 | 0 | 0 | deceleration adjust |
| 29 | 6 | 6 | decoder configuration |
| 30 | 0 | 0 | error register |
| 66 | 0 | 0 | alt spd table step 0 |
| 67 | 2 | 2 | alt spd table step 1 |
| 68 | 4 | 4 | alt spd table step 2 |
| 69 | 5 | 5 | alt spd table step 3 |
| 70 | 9 | 9 | alt spd table step 4 |
| 71 | 12 | OC | alt spd table step 5 |
| 72 | 16 | 10 | alt spd table step 6 |
| 73 | 20 | 14 | alt spd table step 7 |
|  |  |  |  |


| CV | Default value in decimal hex |  | Description |
| :---: | :---: | :---: | :---: |
| 74 | 23 | 17 | alt spd table step 8 |
| 75 | 27 | 1B | alt spd table step 9 |
| 76 | 31 | 1F | alt spd table step 10 |
| 77 | 36 | 24 | alt spd table step 11 |
| 78 | 39 | 27 | alt spd table step 12 |
| 79 | 44 | 2C | alt spd table step 13 |
| 80 | 50 | 32 | alt spd table step 14 |
| 81 | 55 | 37 | alt spd table step 15 |
| 82 | 60 | 3C | alt spd table step 16 |
| 83 | 64 | 40 | alt spd table step 17 |
| 84 | 71 | 47 | alt spd table step 18 |
| 85 | 77 | 4D | alt spd table step 19 |
| 86 | 86 | 56 | alt spd table step 20 |
| 87 | 93 | 5D | alt spd table step 21 |
| 88 | 103 | 67 | alt spd table step 22 |
| 89 | 112 | 70 | alt spd table step 23 |
| 90 | 123 | 7B | alt spd table step 24 |
| 91 | 135 | 87 | alt spd table step 25 |
| 92 | 150 | 96 | alt spd table step 26 |
| 93 | 168 | A8 | alt spd table step 27 |
| 94 | 195 | C3 | alt spd table step 28 |

## CONNECTION DIAGRAM



Due to the high in-rush current of an incandescent grain-of- wheat type bulb (about 10 times the normal operating current) function outputs are rated at 40 mA each. We recommend Miniatronics part number 18-014-10 (2.4mm diameter 14 volt/30mA) bulbs or, if you like a whiter light, the 18-712-10 ( 1.7 mm diameter 12 volt $/ 30 \mathrm{~mA}$ ) bulb for best results. If LEDs are used the functions are rated at 150 mA continuous.

