DCC Protocol.

In general

**Speed and Direction Packet For Locomotive Decoders**

Short address:

1111 1111 1111 0 0AAA AAAA 0 01DC SSSS 0 EEEE EEEE 1

Long address:

1111 1111 1111 0 11AA AAAA 0 AAAA AAAA 0 01DC SSSS 0 EEEE EEEE 1

**Preample:**

Send at least 12 “ones”.

**Startbit:**

Send 1 “zero”.

**Locomotive address :**

**Short address <128**

**Byte 1 = address, always starting with a zero as MSB** followed by locomotive number max 7 bit**.**

An example locomotive number is 36

0010 0100

Send Byte 1.

**Separator bit**

Send 1 “zero”.

**Long address, it means address >127.**

**Byte 1 = address MSB.**

**Byte 2 = address LSB.**

1. byte Msb bits are always one, one, followed by the locomotive address MSB 6 bits.
2. byte is the locomotive address 8 LSB bits.

11xxxxxx xxxxxxxx

An example is a locomotive with the number 1140 in binary 0100 0111 0100

Byte 2 = address&255 =116 // 0100 0111 0100 & 0000 1111 1111 = 0111 0100

Byte 1= 192

Byte 1 = Byte1 +((address-byte2)>>8) // address – byte2 (1140-116 = 1024) (1024>>8 = 4)

Byte1 = 192+4 = 196

11000100 01110100

Send Byte 1.

**Separator bit**

Send 1 “zero”.

Send Byte 2.

**Separator bit**

Send 1 “zero”.

**Command Byte.**

Command byte information about speed, direction and function registers.

Standard speed and direction command byte

01DC SSSS

D = direction: 1=forward 0=reverse

C = LSB for speed set as default to zero.

SSSS 0000 = stop

SSSS 0001 = Emergency stop

SSSS 0010 = speed step 1

SSSS 0011 = speed step3

SSSS 0100 = speed step 5

SSSS 0101 = speed step 7

SSSS 0110 = speed step 9

SSSS 0111 = speed step 11

SSSS 1000 = speed step 13

SSSS 1001 = speed step 15

SSSS 1010 = speed step 17

SSSS 1011 = speed step 19

SSSS 1100 = speed step 21

SSSS 1101 = speed step 23

SSSS 1110 = speed step 25

SSSS 1111 = speed step 27

Send Command Byte

**Separator bit**

Send 1 “zero”.

**Error Byte:**

This byte

Is a byte which is byte 1 exclusive or byte 2 for a short address.

Byte 1 exclusive or byte 2 exclusive or byte 3

Send error Byte

**Stop bit**

Send 1 “one”.

Functions registers on a locomotive

This byte is the command byte, send it like it was the speed command.

F4 – F1 100xxxxx

0,4,3,2,1

0 Light

1 Sound

2 Horn 1

3 Horn 2

4 Bell

F8 – F5 1011xxxx

8,7,6,5

F12 – F9 1010xxxx

12,11,10,9

F20 – F13 1101xxxx

16,15,14,13

Bit values: 1 = on 0 = off

**How to address an accessory**

**Light signal**

The main address example 131

Address = (mainaddress/4)+1

Register = (mainaddress%4)-1

Byte1 = Address&63;

Byte1 = Byte1+128; // this is the first Byte

Byte2 = 128;

X = 0;

Y = Address & 64;

If (Y == 0) X = X + 64;

Y = Address & 128;

If (Y == 0) X = X + 128;

Y = Address & 256;

If (Y == 0) X = X + 256;

X = X >>2;

Byte2 = Byte2 + X;

Byte2 = Byte2 + (Register << 1);

**Turn the light to RED**

Byte 2 = Byte 2 + 8;

Send Byte 1 + Byte 2 // output 0 on

Wait 200 mS

Byte 2 = Byte 2 - 8;

Send Byte 1 + Byte 2 // output 0 off

**Turn the light to Green**

Byte 2 = Byte 2 + 9;

Send Byte 1 + Byte 2 // output 1 on

Wait 200 mS

Byte 2 = Byte 2 - 8;

Send Byte 1 + Byte 2 // output 1 off

More examples

Ex acc 5

A: Acc/4 = 1

B: Acc % 4 = 1

Addressing A+1 = address 2

B-1 = register 0

Ex acc 131

A: Acc/4 = 32

B: Acc % 4 = 3

Addressing A+1 = address 33

B-1 = register 2

How to assemble the bitcombination

Byte 1

10xxxxxx for Basic Accessory Decoder

Xx100001 for adresse 33

Byte 2

10000000 1xxxxxxx

11111100 1AAABCCD AAA inv MSB addressbit 000

B 1=on 0=off

CC = register 0-3

D output 0-1

**For lightsignals send :**

**Turn to RED:**

Address reg output 0 on

Address reg output 0 off

**Turn to GREEN:**

Address reg output 1 on

Address reg output 1 off

**For track switch send:**

**For straight:**

Address reg output 1 on

Address reg output 1 off

wait 200 mS

**For turn:**

Address reg output 0 on

Address reg output 0 off

Evt pause 200 mS

**Cross switch:**

**Straight**

Address reg Output 1 on

Address reg Output 1 off

**Cross:**

Address reg Output 0 on

Address reg Output 0 off

**Tripple switch**

**Straight**

Address reg Output 1 on

Address reg Output 1 off

Address reg+1 Output 1 on

Address reg+1 Output 1 off

**Right**

Address reg Output 0 on

Address reg Output 0 off

Address reg+1 Output 1 on

Address reg+1 Output 1 off

**Left**

Address reg Output 1 on

Address reg Output 1 off

Address reg+1 Output 0 on

Address reg+1 Output 0 off

Address 223 = 56:2 224 = 56:3

Address 231 = 58:2 232 = 58:3

Address 233 = 59:0 234 = 59:1