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Draft**

**Serial ATA  
International Organization**

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**Serial ATA Revision 2.6 ECN # 009  
Title : Correcting LBP references in the COMP  
data pattern and other locations**

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## Document History

Version	Date	Comments
0.1	April 4 <sup>th</sup> , 2007	Initial release.
0.2	April 9 <sup>th</sup> , 2007	Added removal of NOTE and redundant LBP text definition, corrected accidental removal of D20.2 Dword following the updated RD- LBP.
1.0	April 18, 2007	Corrected (changed 128 to 8) LBP multiplier in RD+ short version total summary Corrected Corrected 2 spelling mistakes Corrected color of single bit background ECN-18 information
	April 18, 2007	Phy WG approval

# 1 Introduction

## 1.1 Problem Statement:

- 1) With the approval of SATA 2.5 ECN 18, the LBP pattern in tables 41 and 42 were changed but a number of LBP references were not, including:
  - a. The COMP data pattern definition, which includes the LBP pattern was not.
  - b. A pattern dependent note in the LBP definition is no longer applicable
  - c. Text definition of LBP is in two places

To maintain a consistent and unambiguous definition and usage of LBP, these references should be corrected.

## 1.2 Solution:

- 1) Replace the original 1 Dword LBP pattern in both the + and – disparity COMP data pattern definition with the updated 2 Dword LBP pattern. Additionally, since the new LBP pattern is twice the length, the repeat count for LBP in both the long and the short COMP pattern is cut in half.
- 2) Remove the Note at the end of section 7.2.4.3.5
- 3) Remove the redundant text from section 7.2.4.3, paragraph e) for two reasons:
  - a. The detailed pattern description is already covered by Section 7.2.4.3.5
  - b. Make it consistent with the other paragraphs of section 7.2.4.3.

## 1.3 Background – Original SATA 2.5 – ECN 18

Section 7.2.4.3.5

The lone-bit patterns, shown in Figure 92 and Figure 93, are comprised of the combination of adjacent 10B patterns, resulting in a lone one bit prefixed by a run length of four zeros, and suffixed by a run length of three zeros. It also results in a lone zero bit prefixed by a run length of two ones, one zero, two ones, one zero, four ones, and suffixed by a single one.

**LBP Starting with RD-**

Transmission order

-	D12.0(0Ch)-			D11.4(8Bh)+		D12.0(0Ch)-			D11.3(6Bh)+		+
	0011	0110	1111	0100	0010	0011	0110	1111	0100	0011	
	3	6	F	4	2	3	6	F	4	3	
+	D12.0(0Ch)+			D11.4(8Bh)-		D12.0(0Ch)+			D11.3(6Bh)-		-
	0011	0101	0011	0100	1101	0011	0101	0011	0100	1100	
	3	5	3	4	D	3	5	3	4	C	

**Figure 92 – Lone-Bit Pattern (LBP) starting with RD-**

Long version total: 1 \* 2048 = 2048 Dwords

Short version total: 1 \* 128 = 128 Dwords

**LBP Starting with RD+**

Transmission order

+	D12.0(0Ch)+			D11.4(8Bh)-		D12.0(0Ch)+			D11.3(6Bh)-		-
	0011	0101	0011	0100	1101	0011	0101	0011	0100	1100	
	3	5	3	4	D	3	5	3	4	C	
-	D12.0(0Ch)-			D11.4(8Bh)+		D12.0(0Ch)-			D11.3(6Bh)+		+
	0011	0110	1111	0100	0010	0011	0110	1111	0100	0011	
	3	6	F	4	2	3	6	F	4	3	

**Figure 93 – Lone-Bit Pattern (LBP) starting with RD+**

Long version total: 1 \* 2048 = 2048 Dwords

Short version total: 1 \* 128 = 128 Dwords

## 2 Technical Specification Changes

### 2.1 COMP table updates

**Table 43 – Composite-Bit Pattern (COMP) Starting with RD–**

Transmission Order →												
-	D31.3(7Fh)-			D31.3(7Fh)+			D31.3(7Fh)-			D31.3(7Fh)+		-
	1010	1100	1101	0100	1100	1010	1100	1101	0100	1100		
	A	C	D	4	C	A	C	D	4	C		
Above Dword is repeated a total of 256 times for long version. Above Dword is repeated a total of 16 times for short version.												
-	D21.5(B5h)-			D21.5(B5h)-			D21.5(B5h)-			D21.5(B5h)-		-
	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010		
	A	A	A	A	A	A	A	A	A	A		
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.												
-	D24.3(78h)-			D24.3(78h)+			D24.3(78h)-			D24.3(78h)+		-
	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100		
	C	C	C	C	C	C	C	C	C	C		
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.												
-	D10.2(4Ah)-			D10.2(4Ah)-			D10.2(4Ah)-			D10.2(4Ah)-		-
	0101	0101	0101	0101	0101	0101	0101	0101	0101	0101		
	5	5	5	5	5	5	5	5	5	5		
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.												
-	D25.6(D9h)-			D6.1(26h)+			D25.6(D9h)-			D6.1(26h)+		-
	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001		
	9	9	9	9	9	9	9	9	9	9		
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.												
-	D17.7(F1h)-			D30.7(FEh)+			D7.1(27h)+			D14.7(EEh)+		-
	1000	1101	1110	0001	1110	0001	1110	0101	1100	1000		
	8	D	E	1	E	1	E	5	C	8		
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.												
-	D30.7(FEh)-			D7.6(C7h)-			D30.3(7Eh)-			D30.3(7Eh)+		-
	0111	1000	0111	1000	0110	0111	1000	1110	0001	1100		
	7	8	7	8	6	7	8	E	1	C		
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.												
-	D30.3(7Eh)-			D30.3(7Eh)+			D30.3(7Eh)-			D30.3(7Eh)+		-



Transmission Order →												
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.												
-	D24.3(78h)-			D24.3(78h)-			D24.3(78h)-			D24.3(78h)-		-
	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	
	C	C	C	C	C	C	C	C	C	C	C	
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.												
-	D10.2(4Ah)-			D10.2(4Ah)-			D10.2(4Ah)-			D10.2(4Ah)-		-
	0101	0101	0101	0101	0101	0101	0101	0101	0101	0101	0101	
	5	5	5	5	5	5	5	5	5	5	5	
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.												
-	D25.6(D9h)-			D6.1(26h)+			D25.6(D9h)-			D6.1(26h)+		-
	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	
	9	9	9	9	9	9	9	9	9	9	9	
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.												

Long version total: 2048 Dwords total  
256DW SSOP  
256DW HTDP (64DW, 64DW, 64DW, 64DW)  
512DW LTDP (1DW, 1DW, 509DW, 1DW)  
256DW LBP ((1DW, 1DW) x 128)  
512DW LFSCP (255DW, 1DW, 255DW, 1DW)  
256DW HTDP (64DW, 64DW, 64DW, 64DW)

Short version total: 128 Dwords total  
16DW SSOP  
16DW HTDP (4DW, 4DW, 4DW, 4DW)  
32DW LTDP (1DW, 1DW, 29DW, 1DW)  
16DW LBP ((1DW, 1DW) x 8)  
32DW LFSCP (15DW, 1DW, 15DW, 1DW)  
16DW HTDP (4DW, 4DW, 4DW, 4DW)

**Table 44 – Composite-Bit Pattern (COMP) Starting with RD+**

Transmission Order →													
+	D31.3(7Fh)+			D31.3(7Fh)-			D31.3(7Fh)+			D31.3(7Fh)-		+	
	0101	0011	0010	1011	0011	0101	0011	0010	1011	0011			
	5	3	2	B	3	5	3	2	B	3			
Above Dword is repeated a total of 256 times for long version. Above Dword is repeated a total of 16 times for short version.													
+	D21.5(B5h)+			D21.5(B5h)+			D21.5(B5h)+			D21.5(B5h)+		+	
	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010		
	A	A	A	A	A	A	A	A	A	A	A		



Transmission Order →											
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.											
+	D24.3(78h)+		D24.3(78h)+			D24.3(78h)+		D24.3(78h)+			+
	0011	0011	0011	0011	0011	0011	0011	0011	0011	0011	
	3	3	3	3	3	3	3	3	3	3	
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.											
+	D10.2(4Ah)+		D10.2(4Ah)+			D10.2(4Ah)+		D10.2(4Ah)+			+
	0101	0101	0101	0101	0101	0101	0101	0101	0101	0101	
	5	5	5	5	5	5	5	5	5	5	
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.											
+	D25.6(D9h)+		D6.1(26h)+			D25.6(D9h)+		D6.1(26h)+			+
	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	
	9	9	9	9	9	9	9	9	9	9	
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.											
+	D14.7(Eeh)+		D30.7(Feh)-			D7.6(C7h)+		D17.7(F1h)-			+
	0111	0010	0001	1110	0001	1110	0001	1010	0011	0111	
	7	2	1	E	1	E	1	A	3	7	
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.											
+	D30.7(Feh)+		D7.1(27h)+			D30.3(7Eh)+		D30.3(7Eh)-			+
	1000	0111	1000	0111	1001	1000	0111	0001	1110	0011	
	8	7	8	7	9	8	7	1	E	3	
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.											
+	D30.3(7Eh)+		D30.3(7Eh)-			D30.3(7Eh)+		D30.3(7Eh)-			+
	1000	0111	0001	1110	0011	1000	0111	0001	1110	0011	
	8	7	1	E	3	8	7	1	E	3	
Above Dword is repeated a total of 509 times for long version. Above Dword is repeated a total of 29 times for short version.											
+	D28.7(FCh)+		D3.7(E3h)-			D28.7(FCh)+		D3.7(E3h)-			+
	0011	1000	0111	0001	1110	0011	1000	0111	0001	1110	
	3	8	7	1	E	3	8	7	1	E	
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.											
+	D12.0(0Ch)+		D11.4(8Bh)-			D12.0(0Ch)+		D11.3(6Bh)-			-
	0011	0101	0011	0100	1101	0011	0101	0011	0100	1100	
	3	5	3	4	D	3	5	3	4	C	

**Transmission Order** →

-	D12.0(0Ch)-		D11.4(8Bh)+			D12.0(0Ch)-		D11.3(6Bh)+			+
	0011	0110	1111	0100	0010	0011	0110	1111	0100	0011	
	3	6	F	4	2	3	6	F	4	3	
<p>Above 2 Dwords are repeated a total of 128 times for long version.                      Above 2 Dwords are repeated a total of 8 times for short version.</p>											
+	D11.5(ABh)+		D11.5(ABh)+			D11.5(ABh)+		D11.5(ABh)+			+
	1101	0010	1011	0100	1010	1101	0010	1011	0100	1010	
	D	2	B	4	A	D	2	B	4	A	
<p>Above Dword is repeated a total of 255 times for long version.                      Above Dword is repeated a total of 15 times for short version.</p>											
+	D11.5(ABh)+		D11.7(EBh)+			D20.2.(54h)-		D20.2(54h)-			-
	1101	0010	1011	0100	1000	0010	1101	0100	1011	0101	
	D	2	B	4	8	2	D	4	B	5	
<p>Above Dword is repeated a total of 255 times for long version.                      Above Dword is repeated a total of 15 times for short version.</p>											
-	D20.2(54h)-		D20.2(54h)-			D20.2(54h)-		D20.2(54h)-			-
	0010	1101	0100	1011	0101	0010	1101	0100	1011	0101	
	2	D	4	B	5	2	D	4	B	5	
<p>Above Dword is repeated a total of 255 times for long version.                      Above Dword is repeated a total of 15 times for short version.</p>											
-	D20.2(54h)-		D20.7(F4h)-			D11.5(ABh)+		D11.5(ABh)+			+
	0010	1101	0100	1011	0111	1101	0010	1011	0100	1010	
	2	D	4	B	7	D	2	B	4	A	
<p>Above Dword is repeated a total of 255 times for long version.                      Above Dword is repeated a total of 15 times for short version.</p>											
+	D21.5(B5h)+		D21.5(B5h)+			D21.5(B5h)+		D21.5(B5h)+			+
	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	
	A	A	A	A	A	A	A	A	A	A	
<p>Above Dword is repeated a total of 64 times for long version.                      Above Dword is repeated a total of 4 times for short version.</p>											
+	D24.3(78h)+		D24.3(78h)+			D24.3(78h)+		D24.3(78h)+			+
	0011	0011	0011	0011	0011	0011	0011	0011	0011	0011	
	3	3	3	3	3	3	3	3	3	3	
<p>Above Dword is repeated a total of 64 times for long version.                      Above Dword is repeated a total of 4 times for short version.</p>											

Transmission Order →											
+	D10.2(4Ah)+		D10.2(4Ah)+			D10.2(4Ah)+		D10.2(4Ah)+			+
	0101	0101	0101	0101	0101	0101	0101	0101	0101	0101	
	5	5	5	5	5	5	5	5	5	5	
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.											
+	D25.6(D9h)+		D6.1(26h)+			D25.6(D9h)+		D6.1(26h)+			+
	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	
	9	9	9	9	9	9	9	9	9	9	
Above Dword is repeated a total of 64 times for long version. Above Dword is repeated a total of 4 times for short version.											

Long version total: 2048 Dwords total  
 256DW SSOP  
 256DW HTDP (64DW, 64DW, 64DW, 64DW)  
 512DW LTDP (1DW, 1DW, 509DW, 1DW)  
 256DW LBP ((1DW, 1DW) x 128)  
 512DW LFSCP (255DW, 1DW, 255DW, 1DW)  
 256DW HTDP (64DW, 64DW, 64DW, 64DW)

Short version total: 128 Dwords total  
 16DW SSOP  
 16DW HTDP (4DW, 4DW, 4DW, 4DW)  
 32DW LTDP (1DW, 1DW, 29DW, 1DW)  
 16DW LBP ((1DW, 1DW) x 8)  
 32DW LFSCP (15DW, 1DW, 15DW, 1DW)  
 16DW HTDP (4DW, 4DW, 4DW, 4DW)

Note that only 128 Dwords total for the composite pattern is too short to get a sufficient number of continuous repeats for each pattern type.

## 2.2 Section 7.2.4.3.5 Note removal

Remove the last paragraph NOTE from section 7.2.4.3.5 as the new LBP no longer has a starting disparity dependency as long as the complete (2 Dwords) LBP is use .

Text to be removed:

~~NOTE: Care should be taken when generating the lone bit pattern. Two potential patterns are available: 8Bh\_0Ch\_8Bh\_0Ch if the initial running disparity is positive (RD+) or 0Ch\_8Bh\_0Ch\_8Bh if the initial running disparity is negative (RD-). It is important that the selected pattern match the initial running disparity or else the encoded pattern will not match the desired lone bit pattern. For example, if 8Bh\_0Ch\_8Bh\_0Ch is transmitted when the initial running disparity is negative, the encoded data will not match the desired lone bit pattern. A similar mismatch will occur if the 0Ch\_8Bh\_0Ch\_8Bh pattern is transmitted when the initial running disparity is positive.~~

## 2.3 Section 7.2.4.3 – paragraph e)

Section 7.2.4.3 paragraph e) contains a redundant text definition of LBP (section 7.2.4.3.5) and for consistency with other paragraphs of section 7.2.4.3, the following change should be made:

- e) The lone-bit patterns (LBP) are comprised of the consecutive combination of certain 10b patterns that result in a lone-bit. ~~More specifically, a lone-bit is prefixed by a run-length of four bits and followed by a run-length of three or prefixed by a run length of two ones, one zero, two ones, one zero, four ones, and suffixed by a single one.~~ These patterns create a condition where the preceding 4-bit run-length results in minimum amplitude of the lone-bit as well as its time-width in comparison to its surrounding segments. This is often the worst case condition that the receiving data recovery circuits may encounter.