Example

The binary data **001101001** are applied to the input of a duo binary system.

a)Construct the duo binary coder output and corresponding receiver output, without a precoder.

b) Suppose that due to error during transmission, the level at the receiver input produced by the second digit is reduced to zero. Construct the new receiver output.

c) Repeat above two cases with use of precoder

without a precoder

Input Sequence $\{b_k\}$	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**1**
Polar Voltage Representation	**-1**	**-1**	**+1**	**+1**	**-1**	**+1**	**-1**	**-1**	**+1**
$c_k = b_k + b_{k-1}$		**-2**	**0**	**2**	**0**	**0**	**0**	**-2**	**0**
$\hat{b}_k = c_k - \hat{b}_{k-1}$	**-1**	**-1**	**+1**	**+1**	**-1**	**+1**	**-1**	**-1**	**+1**
Decoded $\hat{b}_k$	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**1**
If error occurs in second position, c_k received is 0 instead of -2V									
Received C_k		**0**	**0**	**2**	**0**	**0**	**0**	**-2**	**0**
polar form $\hat{b}_k = ck - \hat{b}_{k-1}$	**-1** $\hat{b}_{k-1}$	**1**	**-1**	**3**	**-3**	**+3**	**+3**	**1**	**-1**
Decoded $\hat{b}_k$		**1**	**0**	**1**	**0**	**1**	**0**	**1**	**0**

errors errors

With a precoder (start bit 1)

Input Sequence $\{b_k\}$		0	0	1	1	0	1	0	0	1
Precodeed sequence $\{a_k\} = b_k \oplus a_k\text{-}1$	1	1	1	0	1	1	0	0	0	1
Polar Representation	+1	+1	+1	-1	+1	+1	-1	-1	-1	+1
Duobinary coded sequence $c_k = a_k + a_{k-1}$		2	2	0	0	2	0	-2	-2	0
Decision b_k $c_k > 1$ symbol 0 $c_k < 1$ symbol 1		0	0	1	1	0	1	0	0	1
If error occurs in 2nd position then voltage level of $c_k = 0$, then										
Received c_k		2	0	0	0	2	0	-2	-2	0
Decision for b_k $c_k > 1$ symbol 0 $c_k < 1$ symbol 1		0	1 ↑	1	1	0	1	0	0	1

With a precoder (start bit 0)

Input Sequence $\{b_k\}$		0	0	1	1	0	1	0	0	1
Precodeed sequence $\{a_k\} = b_k \oplus a_k\text{-}1$	0	0	0	1	0	0	1	1	1	0
Polar Representation	-1	-1	-1	+1	-1	-1	+1	+1	+1	-1
Duobinary coded sequence $c_k = a_k + a_{k-1}$		-2	-2	0	0	-2	0	+2	+2	0
Decision b_k $c_k > 1$ symbol 0 $c_k < 1$ symbol 1		0	0	1	1	0	1	0	0	1
If error occurs in 2nd position then voltage level of $c_k = 0$, then										
Received c_k		-2	0	0	0	-2	0	+2	+2	0
Decision for b_k $c_k > 1$ symbol 0 $c_k < 1$ symbol 1		0	1 ↑	1	1	0	1	0	0	1

Example : Consider binary sequence $\{b_k\}$= {01101101} applied to input of a precoded modified duobinary filter. Determine receiver output and compare with original $\{b_k\}$.

Binary sequence $\{b_k\}$			0	1	1	0	1	1	0	1
Precoded sequence $a_k = b_k \oplus a_{k-2}$	1 (a_{k-2})	1 (a_{k-1})	1	0	0	0	1	1	1	0
Polar Representation	+1	+1	+1	-1	-1	-1	+1	+1	+1	-1
Transmitted output $c_k = a_k - a_{k-2}$			0	-2	-2	0	+2	+2	0	-2
Received Sequence decision $\|C_k\| < 1V \rightarrow 0$ $\|C_k\| > 1V \rightarrow 1$			0	-2	-2	0	2	2	0	-2
Decoded $\hat{b_k}$			0	1	1	0	1	1	0	1

Consider binary sequence {bk}={01101101}

Binary sequence $\{b_k\}$			0	1	1	0	1	1	0	1
Precoded sequence $a_k = b_k \oplus a_{k-2}$	0 (a_{k-2})	0 (a_{k-1})	0	1	1	1	0	0	0	1
Polar Representation	-1	-1	-1	+1	+1	+1	-1	-1	-1	+1
Transmitted **output** $c_k = a_k - a_{k-2}$			0	+2	2	0	-2	-2	0	2
Received **Sequence decision** $\|C_k\| < 1V \rightarrow 0$ $\|C_k\| > 1V \rightarrow 1$			0	+2	2	0	-2	-2	0	2
Decoded $\hat{b_k}$			0	1	1	0	1	1	0	1

Example

The binary data 011100101 are applied to the input of a modified duo binary system.

a) Construct the modified duobinary coder output and corresponding receiver output, without a precoder.

b) Suppose that due to error during transmission, the level at the receiver input produced by the third digit is reduced to zero. Construct the new receiver output.

c) Repeat above two cases with use of precoder

Modified duobinary coder output and corresponding receiver output, without a precoder

Binary sequence $\{b_k\}$			0	1	1	1	0	0	1	0	1
Polar Representation	+1	+1	-1	+1	+1	+1	-1	-1	+1	-1	+1
Transmitted output $c_k = b_k - b_{k-2}$			-2	0	+2	0	-2	-2	2	0	0
Received Sequence			-2	0	+2	0	-2	-2	2	0	0
Decision $b_k = c_k + b_{k-2}$	+1	+1	-1	+1	+1	+1	-1	-1	+1	-1	+1
Decoded $\hat{b_k}$			0	1	1	1	0	0	1	0	1

If error occurs in 3rd position then voltage level of $c_k = 0$, then											
Received c_k			**-2**	**0**	**0**	**0**	**-2**	**-2**	**2**	**0**	**0**
Decision for b_k $\hat{b_k}$ $b_k = c_k + b_{k-2}$	**+1**	**+1**	**-1**	**+1**	**-1**	**+1**	**-3**	**-1**	**-1**	**-1**	**-1**
Decoded			**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

Binary sequence $\{b_k\}$			0	1	1	1	0	0	1	0	1
Precoded sequence $a_k = b_k \oplus a_{k-2}$	1 (a_{k-2})	1 (a_{k-1})	1	0	0	1	0	1	1	1	0
Polar Representation	+1	+1	+1	-1	-1	+1	-1	+1	+1	+1	-1
Transmitted output $c_k = a_k - a_{k-2}$			0	-2	-2	2	0	0	2	0	0
Received Sequence decision $\|C_k\| < 1V \rightarrow 0$ $\|C_k\| > 1V \rightarrow 1$			0	-2	-2	2	0	0	2	0	0
Decoded			0	1	1	1	0	0	1	0	1

Modified duo binary coder output and corresponding receiver output, with a precoder

If error occurs in 3rd position then voltage level of $c_k = 0$, then										
Received c_k		**0**	**-2**	**0**	**2**	**0**	**0**	**2**	**0**	**0**
Decision for b_k **c_k > 1 symbol 0** **c_k < 1 symbol 1**		**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**