Digital Communications 2

Directed and Practical Work

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Color Section

Group g	$p(g)_0$		$p(g)_1$		Code
g_1	0.6		0.6	0	0
g_2	0.3	0	0.4	1	1 0
g_3	0.1	1			1 1

Group g_1	Code
c_0	0 0 0
c_1	0 0 1
c_2	0 1 0
c_3	0 1 1

Group g_2	Code
c_4	1 0 0 0
c_5	1 0 0 1
c_6	1 0 1 0
c_7	1 0 1 1

Group g_3	Code
c_8	1 1 0 0 0
c_9	1 1 0 0 1
c_{10}	1 1 0 1 0
c_{11}	1 1 0 1 1
c_{12}	1 1 1 0 0
c_{13}	1 1 1 0 1
c_{14}	1 1 1 1 0
c_{15}	1 1 1 1 1

Table 1.6. *Construction of Huffman code C_2*
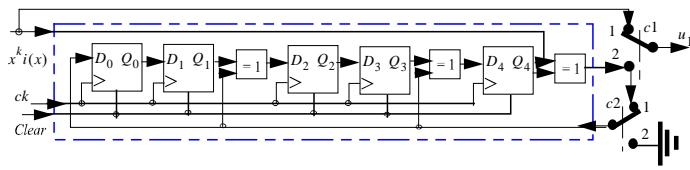
c1c2 1 1	ck	i(x)	D_0	Q_0 D_1	Q_1	D_2	Q_2 D_3	Q_3	D_4	Q_4	u_1
		$1 \; x^8$	1	**0**	**0**	1	**0**	**0**	1	**0**	1
	1°			1	0		1	0		1	
		0	1	1	1	1	1	1	1	1	0
	2°			1	1		1	1		1	
		1	0	1	1	1	1	1	1	1	1
	3°			0	1		1	1		1	
		0	1	0	1	0	1	1	0	0	0
	4°			1	0		0	1		0	
		0	0	1	1	0	0	0	1	1	0
	5°			0	1		0	0		1	
		1	0	0	0	1	0	0	0	0	1
	6°			0	0		1	0		0	
		0	0	0	0	0	1	1	0	0	0
	7°			0	0		0	1		0	
		1	1	0	0	1	0	0	0	0	1
	8°			1	0		1	0		0	
		1	1	1	1	1	1	1	1	1	1
	9°			1	1		1	1		1	
2 2		0	0	1	1	1	1	1	1	1	1
	10°			0	1		1	1		1	
		0	0	0	0	1	1	1	1	1	1
	11°			0	0		1	1		1	
		0	0	0	0	0	1	1	1	1	1
	12°			0	0		0	1		1	
		0	0	0	0	0	0	0	1	1	1
	13°			0	0		0	0		1	
		0	0	0	0	0	0	0	0	0	1
	14°			0	0		0	0		0	

Table 1.15. *Description of the operations of the premultiplied coder*
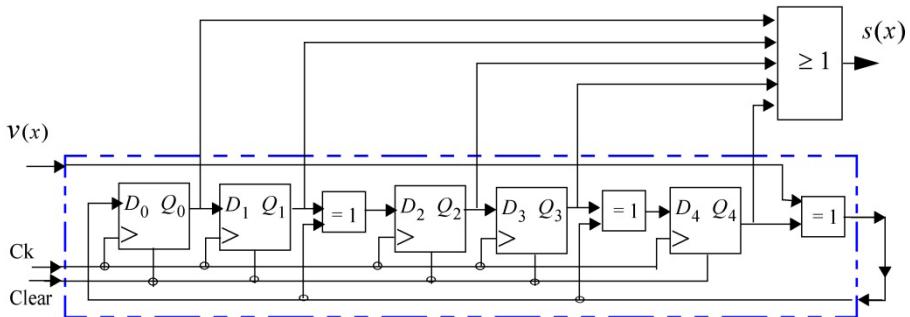
**Figure 1.14.** *Structure of the decoder for the detection of errors*
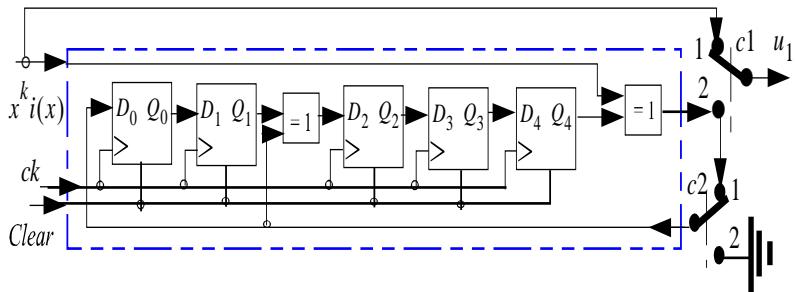
**Figure 1.17.** *Implementation scheme of the coder*
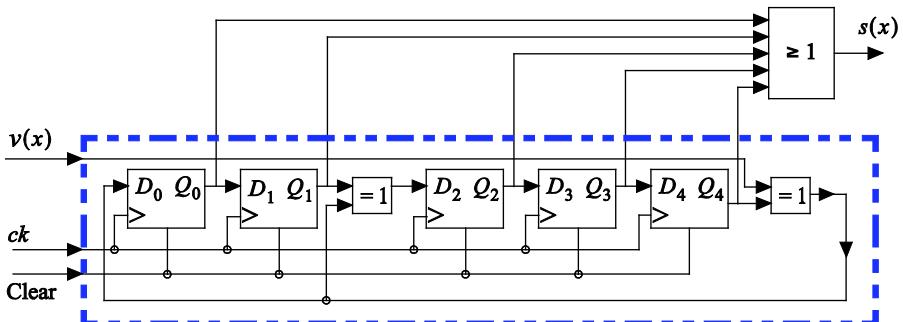

Figure 1.18. *Implementation scheme of the decoder*

$\{b_k\}$	0	0	1	0	0	0	1	1	0	1	1	1	0	0	1	1	0	0	0	1	0	1
CODBip $\begin{matrix}V\\0\\-V\end{matrix}$ 1																						
HDB-2 $\begin{matrix}V\\0\\-V\end{matrix}$ 1																						
$\{b'_k\}$ 0 0	0	0	1	0	1	0	0	1	0	0	1	1	1	1	0	0	0	0	0	1	0	0
$\{a_k\}$ -1 -1	-1	-1	1	-1	1	-1	-1	1	-1	-1	1	1	1	1	-1	-1	-1	-1	-1	1	-1	-1
$\{c_k\}$	0	0	2	0	0	0	-2	2	0	-2	2	2	0	0	-2	-2	0	0	0	2	0	-2
PRC $s_e(t)$ $\begin{matrix}V\\0\\-V\end{matrix}$																						
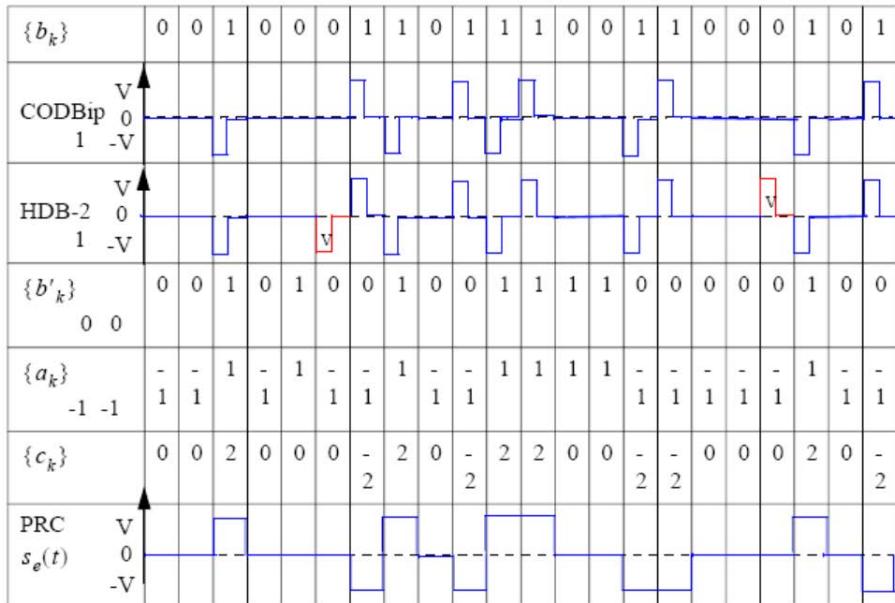
Table 2.4. *Chronograms of the signals and coded symbols*
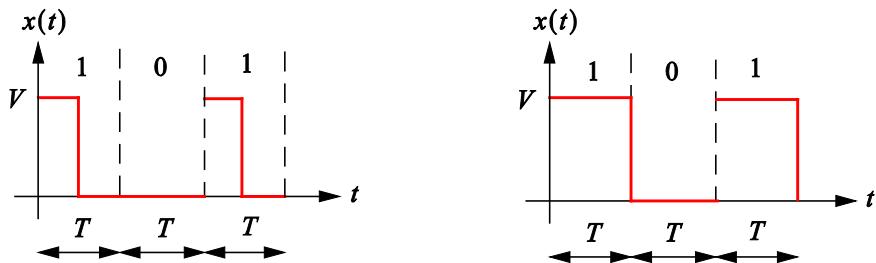
Figure 2.2. *Examples of binary RZ and NRZ codes*
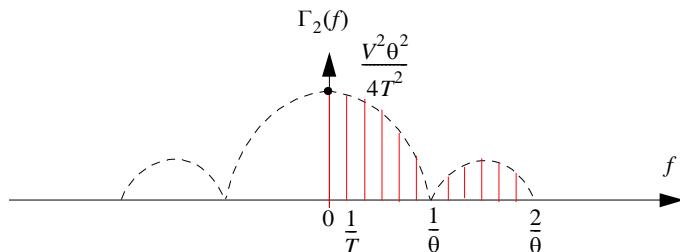
**Figure 2.8.** *Discrete spectral components of the power spectral density $\Gamma_2(f)$*
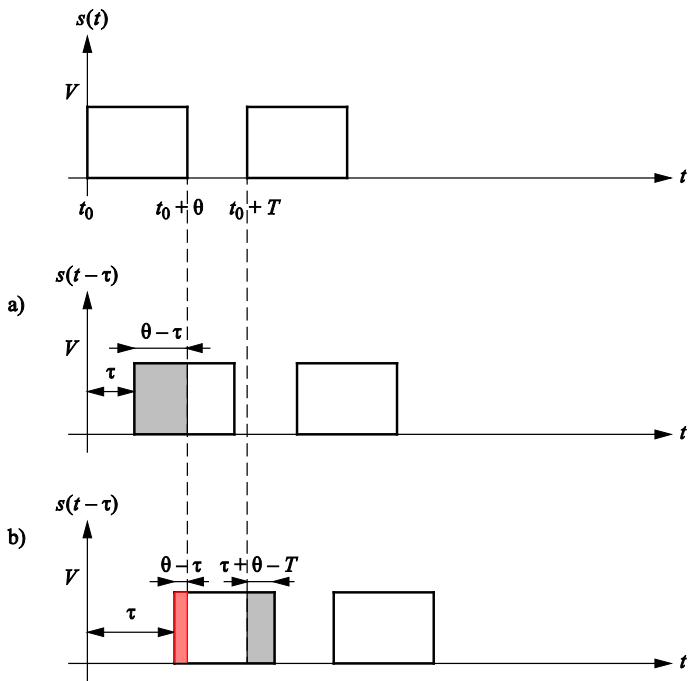
**Figure 2.9.** *First situation:* $0 < \tau \leq \theta$ *(with* $T/2 < \theta \leq T$*)*
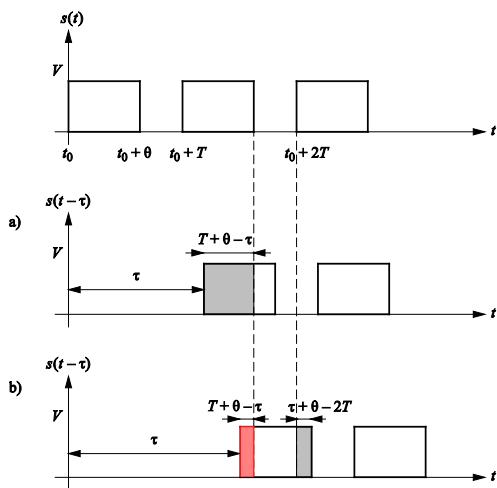
Figure 2.11. *Third situation:* $T \leq \tau < T + \theta$
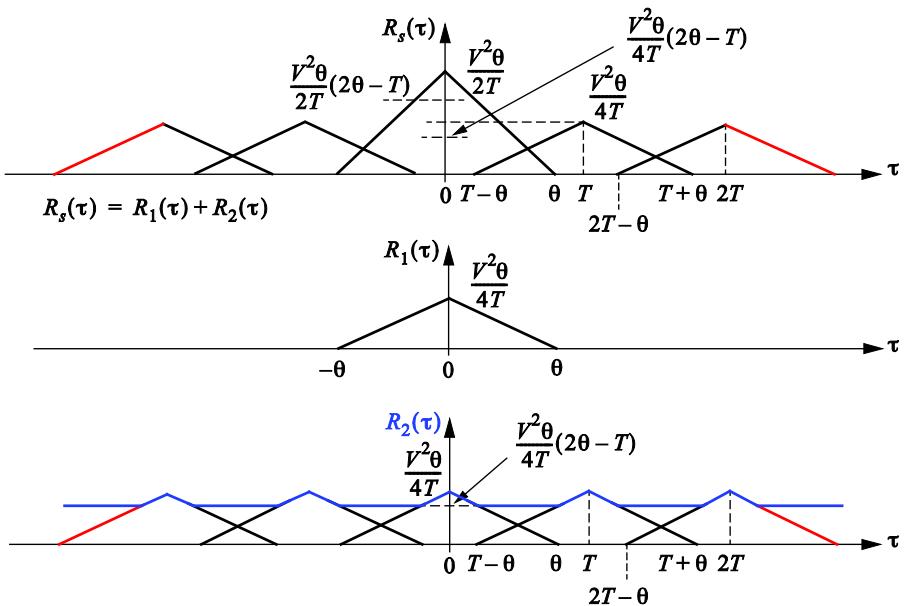
Figure 2.12. *Autocorrelation function $R_s(\tau)$ and its decomposition*
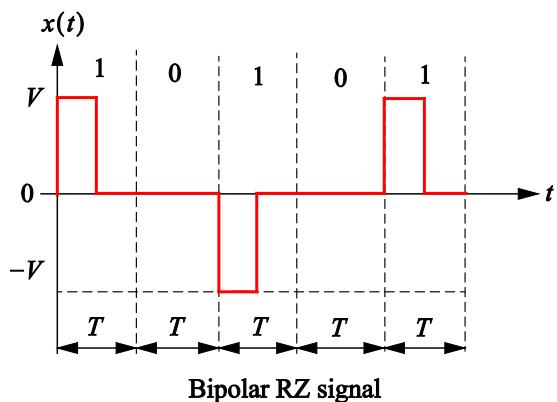
Bipolar RZ signal

Figure 2.13. *Example of a bipolar RZ signal waveform*
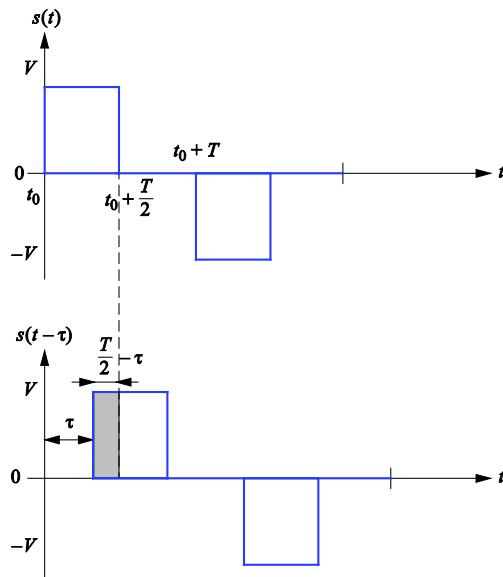
Figure 2.14. *First case:* $0 < \tau < T/2$ *and a positive impulsion at t*
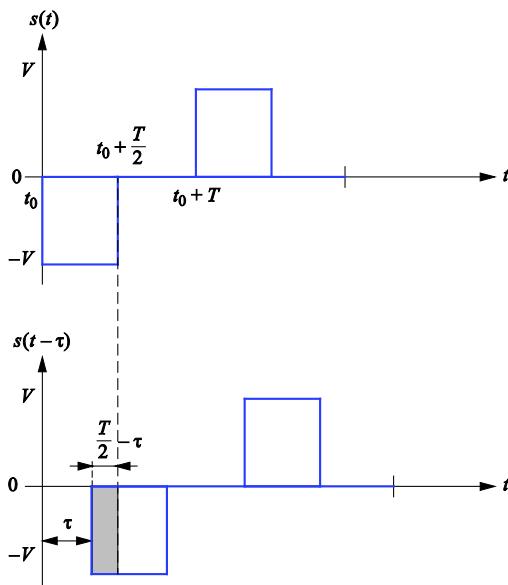
**Figure 2.15.** *First case:* $0 \leq \tau \leq T/2$ *and negative impulse at t*
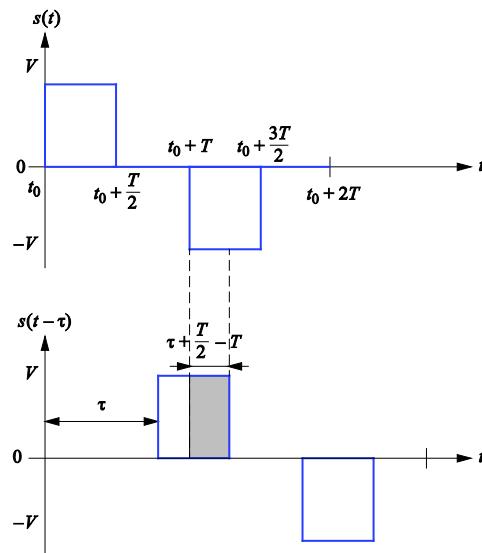
Figure 2.16. *Second case: $T/2 < \tau \leq T$*
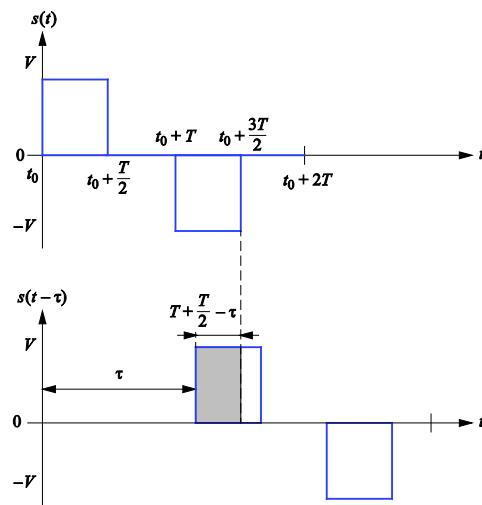
**Figure 2.17.** *Third case: $T < \tau \leq T + T/2$*
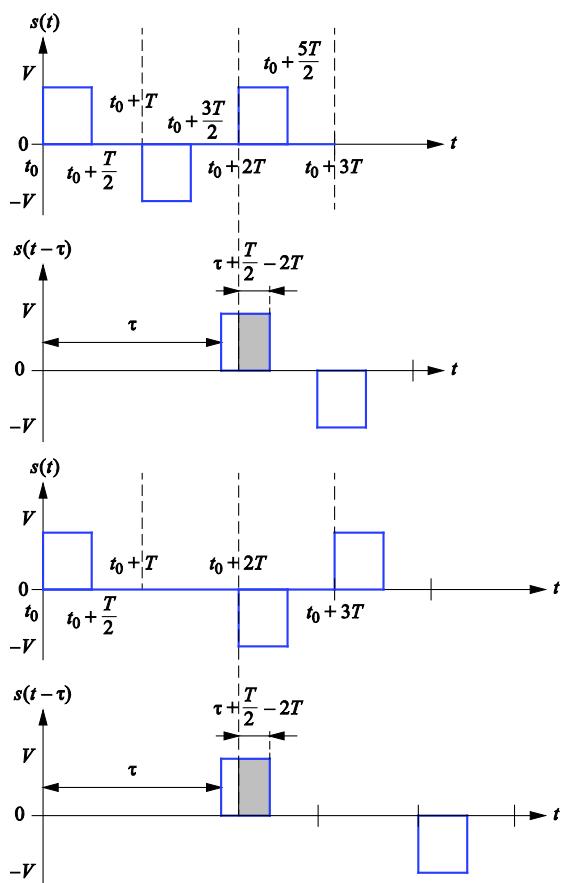
**Figure 2.18.** *Fourth case:* $3T/2 < \tau \leq 2T$
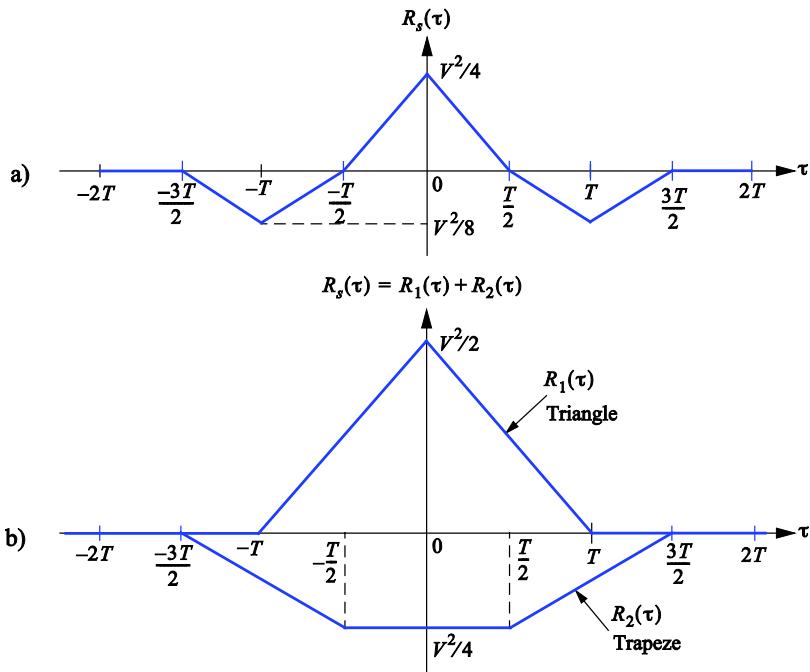
Figure 2.19. *(a) Autocorrelation function of the bipolar RZ code and (b) its decomposition into the sum of two functions*
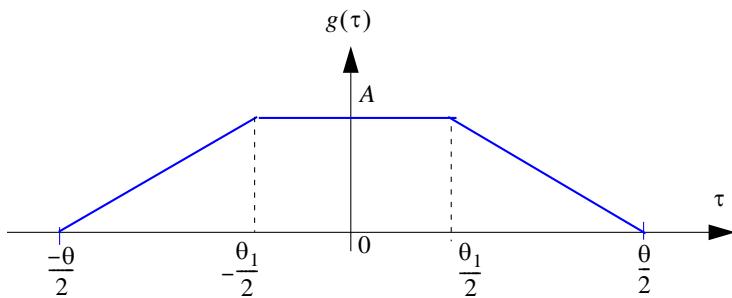

Figure 2.20. *Trapezoidal function*

$\Gamma_s(f)$

$\dfrac{2TV^2}{\pi^2}$ $\dfrac{2TV^2}{9\pi^2}$

$-\dfrac{2}{T}$ $-\dfrac{3}{2T}$ $-\dfrac{1}{T}$ $-\dfrac{1}{2T}$ 0 $\dfrac{1}{2T}$ $\dfrac{1}{T}$ $\dfrac{3}{2T}$ $\dfrac{2}{T}$ f
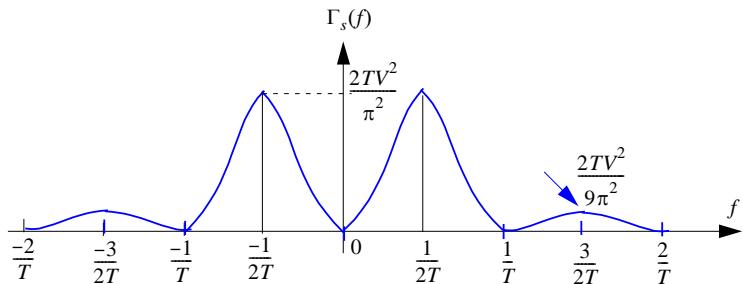
Figure 2.21. *Power spectral density of the bipolar RZ code*

$\{b_n\}$	0	0	0	0	1	0	1	1	0	1	0	0	0	1	1	1	0	1	0	0	0
$\{b'_n\}$ (0 0)	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	1	1	1	1	1
$\{a_n\}$ (-1 -1)	-1	-1	-1	-1	1	-1	-1	1	-1	-1	-1	-1	-1	1	1	-1	1	1	1	1	1
$\{c_n\}$	0	0	0	0	2	0	-2	2	0	-2	0	0	0	2	2	-2	0	2	0	0	0
$s_e(t)$	V / 0 / -V																				

Table 2.5. *Chronogram of the time sequence and of the transmitted signal*

$\{b_n\}$	1	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0
					V +				B -			V -					B +			V +		
$s_{HDB-3}(t)$	V / 0 / -V																				

With V: polarity alternation violation bit (bit of violation); B: stuffing bit.

**Table 2.6.** *Generation of the HDB-3 signal and chronogram*

{b_k}	1	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	1	0	1
$s_1(t)$																				
$s_2(t)$																				
$s_3(t)$																				
{b'_k}	1	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	0	0	0	1
{a_k}	1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1	-1	1	-1	-1	-1	1
{c_k}	2	0	-2	0	0	0	2	2	0	0	0	0	0	0	-2	0	0	-2	0	2
$s_4(t)$																				
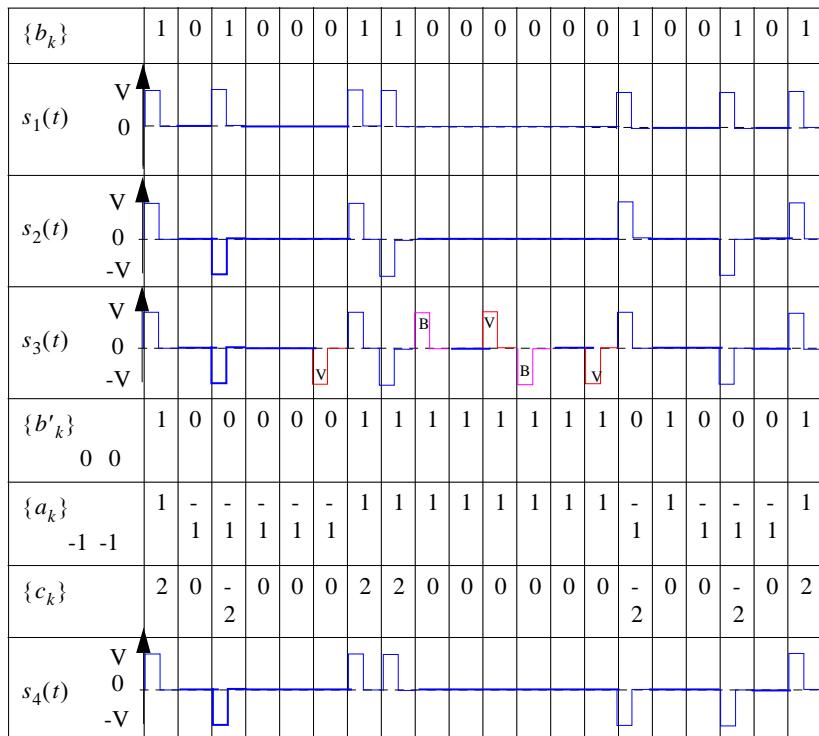
Table 2.7. *Temporal representations of the different signals*
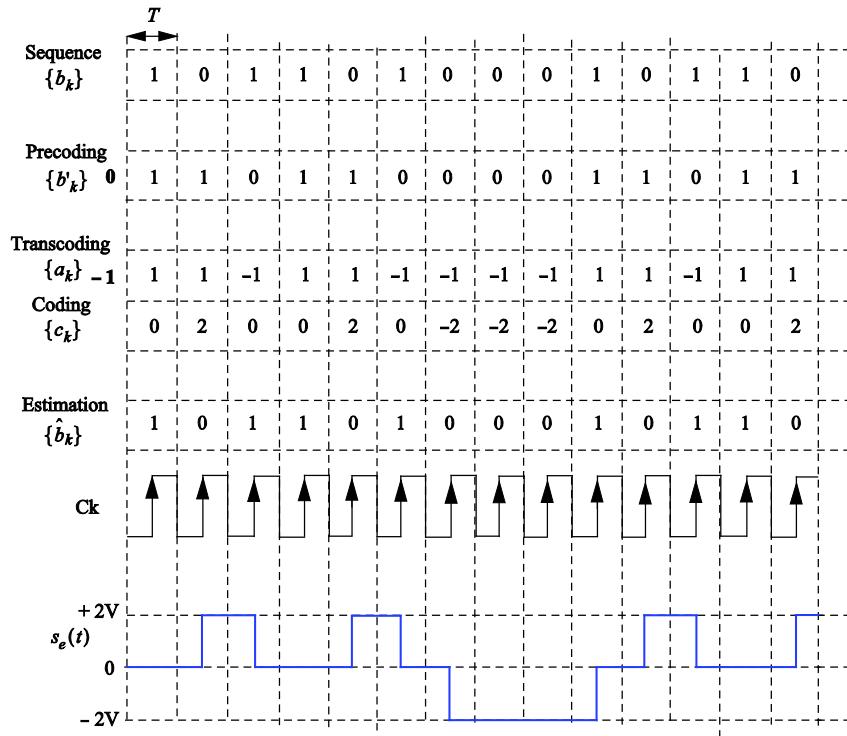
Figure 2.45. *Chronograms of duobinary coding and decoding*

|																	
$\{b_k\}$				1	0	0	1	0	1	1	1	0	1	0	0	1	0
b'_k	0	0	0	1	0	0	0	0	1	1	1	1	0	1	1	1	1
$\{a_k\}$	-1	-1	-1	1	-1	-1	-1	-1	1	1	1	1	-1	1	1	1	1
$\{c_k\}$				2	0	0	-2	0	2	2	2	0	-2	0	0	2	0
$\{\bar{b}_k\}$				1	0	0	1	0	1	1	1	0	1	0	0	1	0
$s_e(t)$			V 0 $-V$														

Table 2.31. *Temporal sequences*
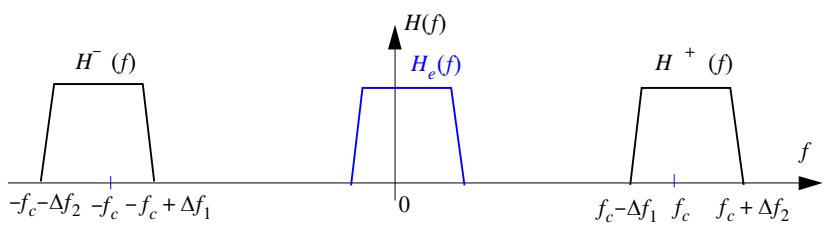
Figure 3.2. *Supports of transfer function $H(f)$ and $H_e(f)$*