
DIGITAL
COMMUNICATION
SYSTEMS
Applications and Measurements

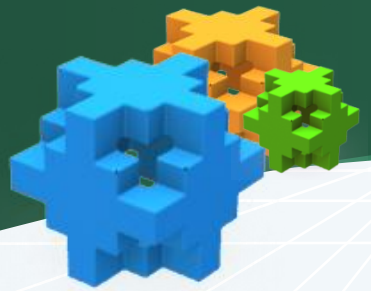
بسم الله الرحمن الرحيم

COMMUNICATION II LAB

LAB 1

Line Code Encoder

Fall-2011



Digital Modulation

is the process by which digital symbols are transformed into waveforms that are compatible with the characteristics of the channel.

In *BASEBAND MODULATION*

waveform usually take the form of shaped pulses.

In *BANDPASS MODULATION*

the shaped pulses modulate a sinusoid called a carrier wave

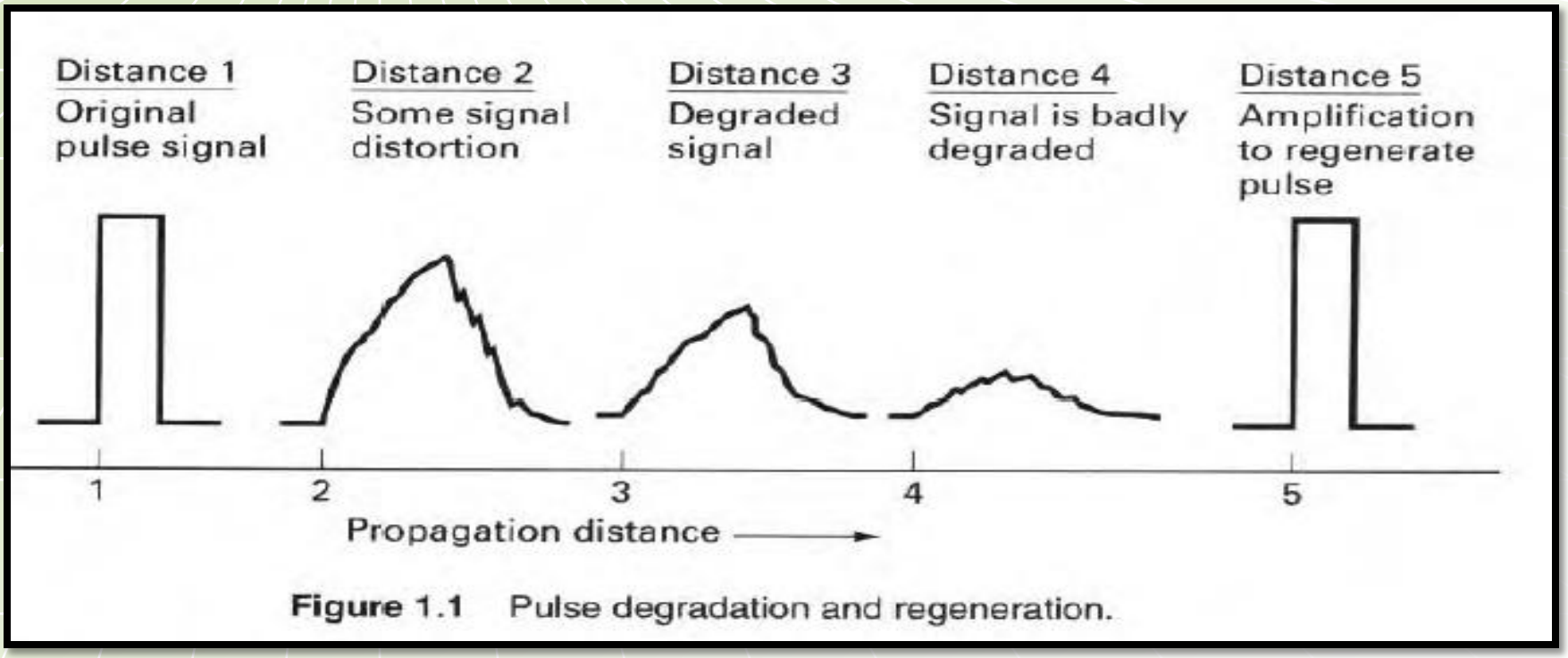
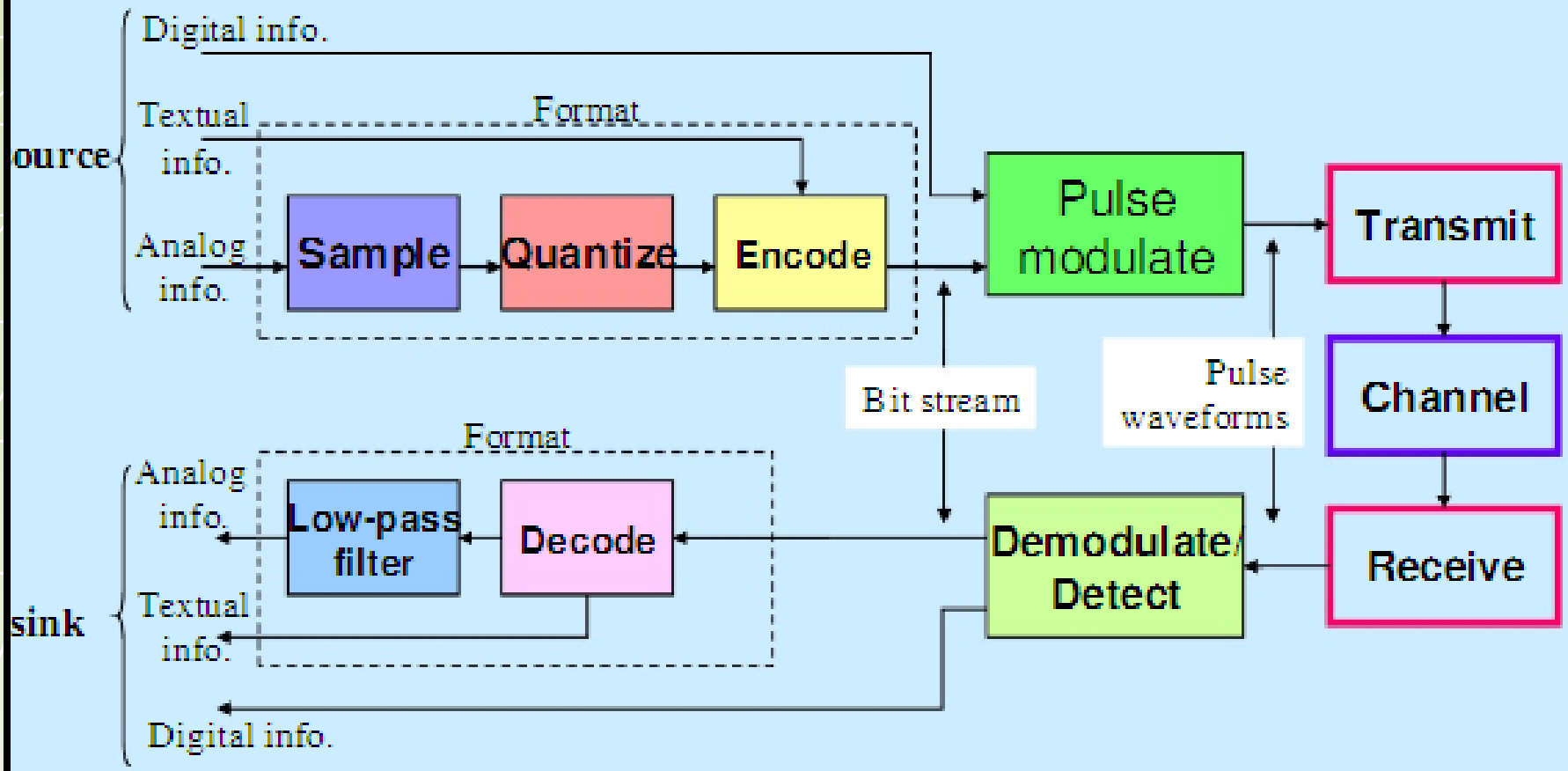
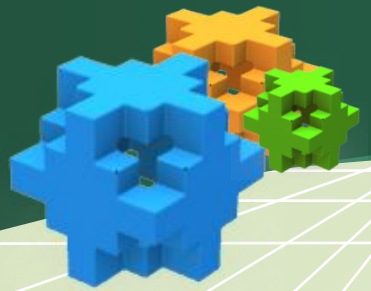


Figure 1.1 Pulse degradation and regeneration.

Formatting and transmission of baseband signal





Formatting

*Anti aliasing

*Sampling

*Quantization

*Encoding

Baseband Signaling

*PCM waveforms
NRZ,RZ

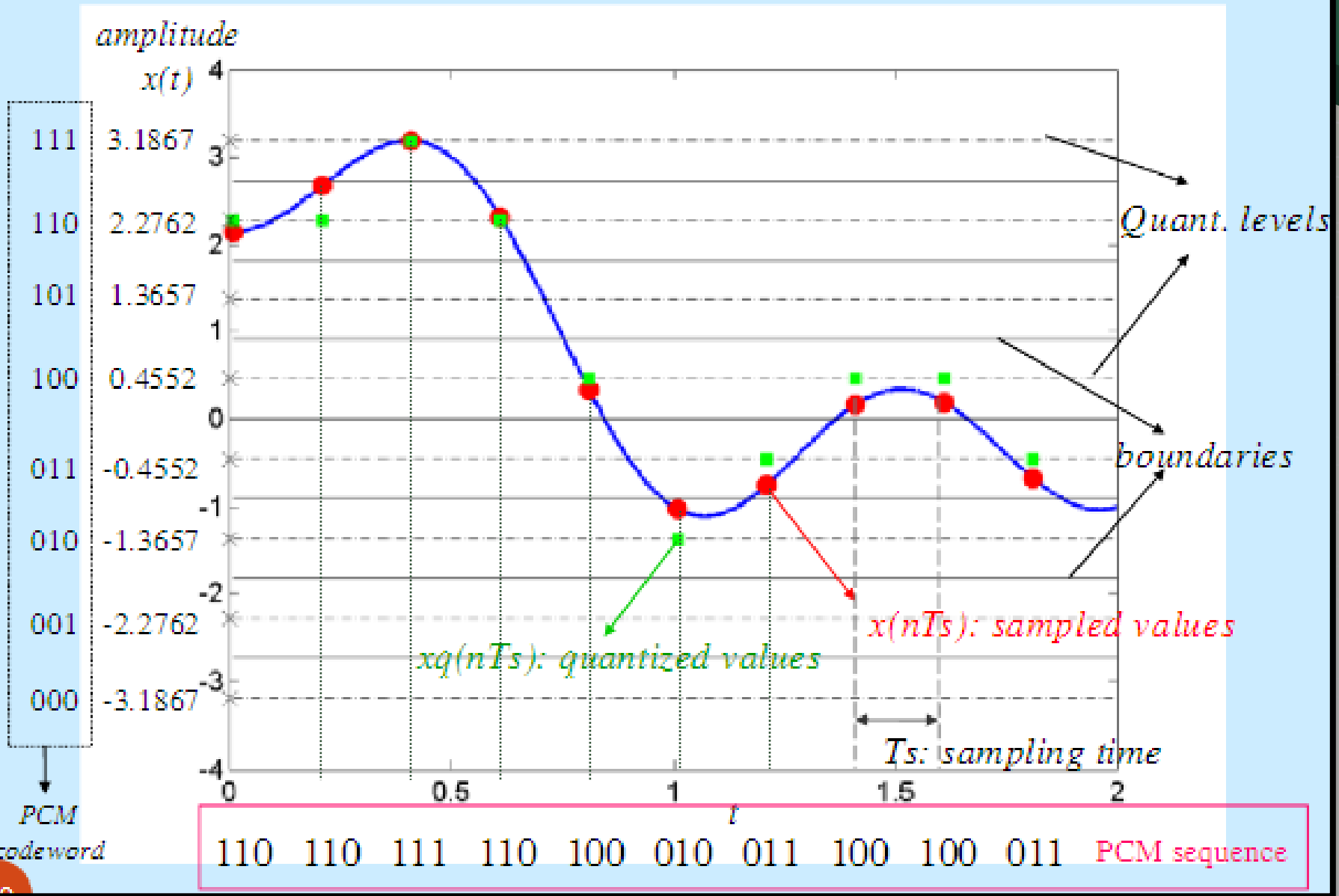
*M-ary Pulse Modualtion
PAM,PPM,PDM

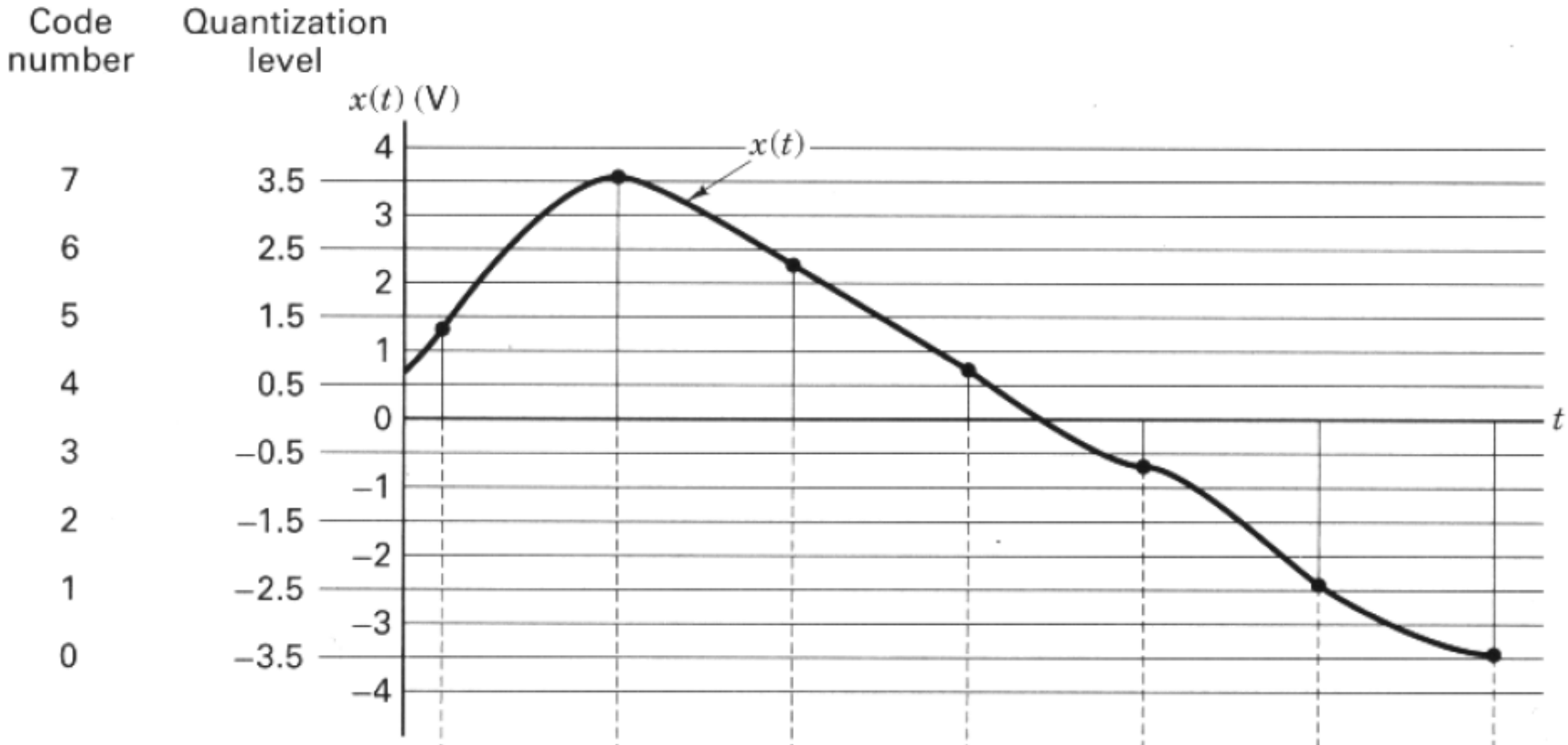
Bandpass Signaling

*Coherent:
PSK,FSK,ASK

*Non-coherent:
DFSK,Hybrids

Quantization example



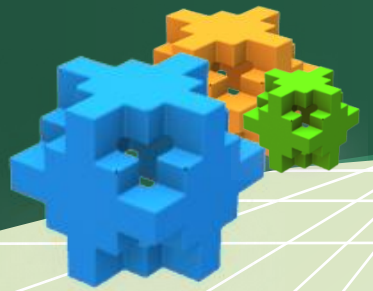


Natural sample value	1.3	3.6	2.3	0.7	−0.7	−2.4	−3.4
Quantized sample value	1.5	3.5	2.5	0.5	−0.5	−2.5	−3.5
Code number	5	7	6	4	3	1	0
PCM sequence	101	111	110	100	011	001	000

PCM waveform (line code)

PCM waveform (line code) is used to carry the PCM digits.

PCM : represents a bits sequence.
PCM waveform : is a practical waveform .



Baseband Transmission

PCM: convert analog waveforms into binary digits.

Digits are not physical need something physical to carry the digits

Electrical pulses transmit through a base band channel

PCM waveforms (line codes)

PCM sequence

Pulse representation of PCM

Pulse waveform

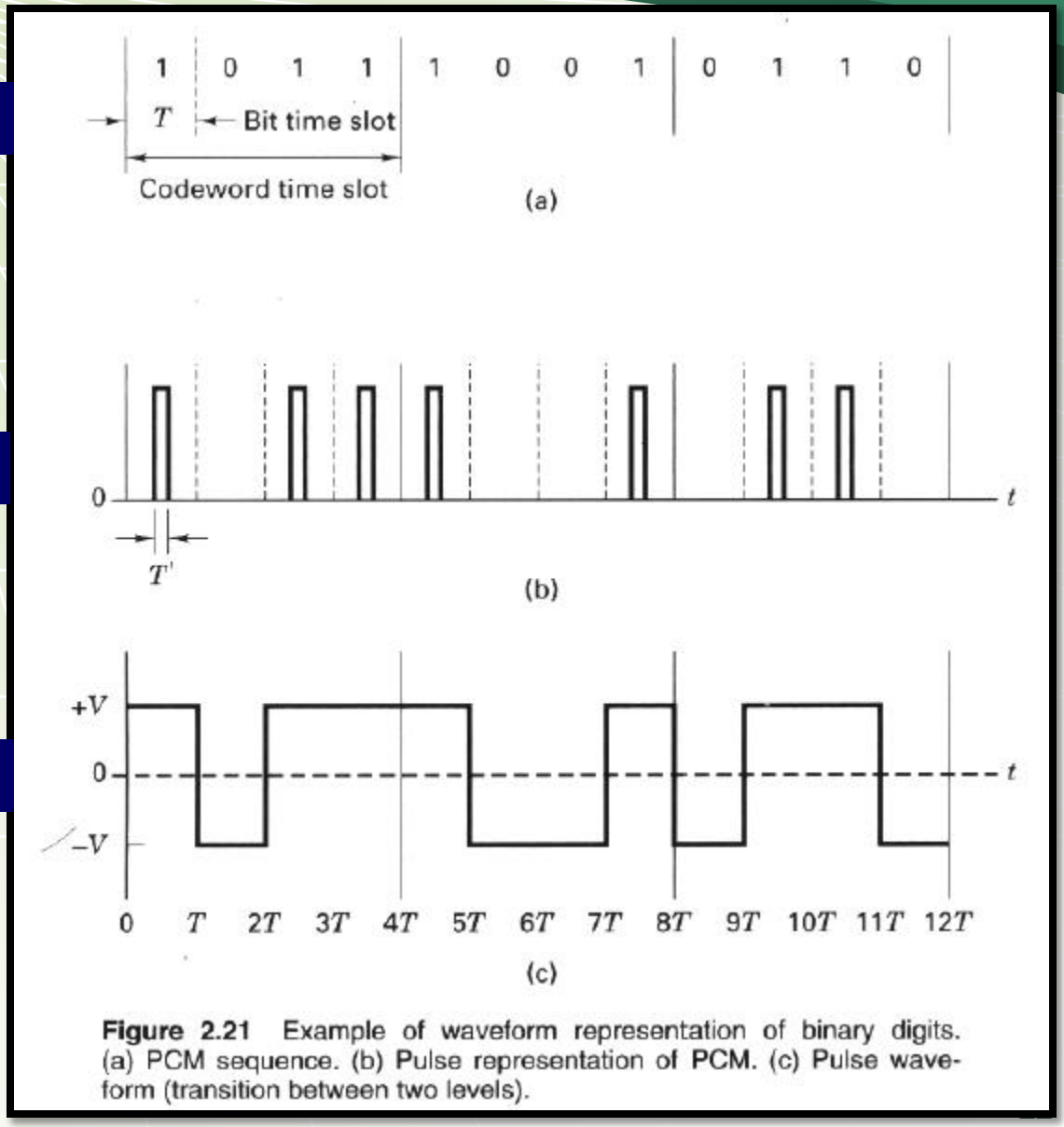
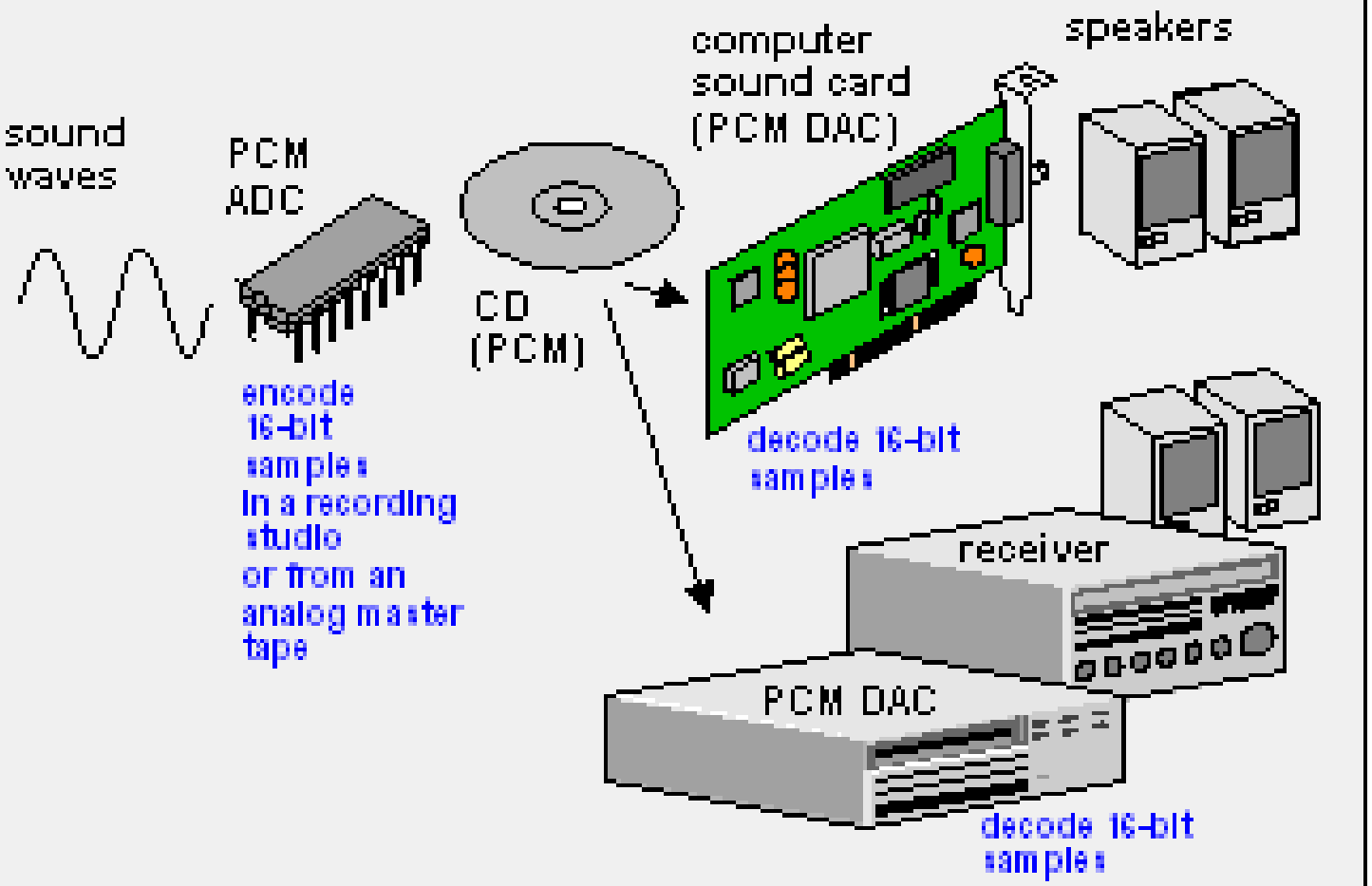
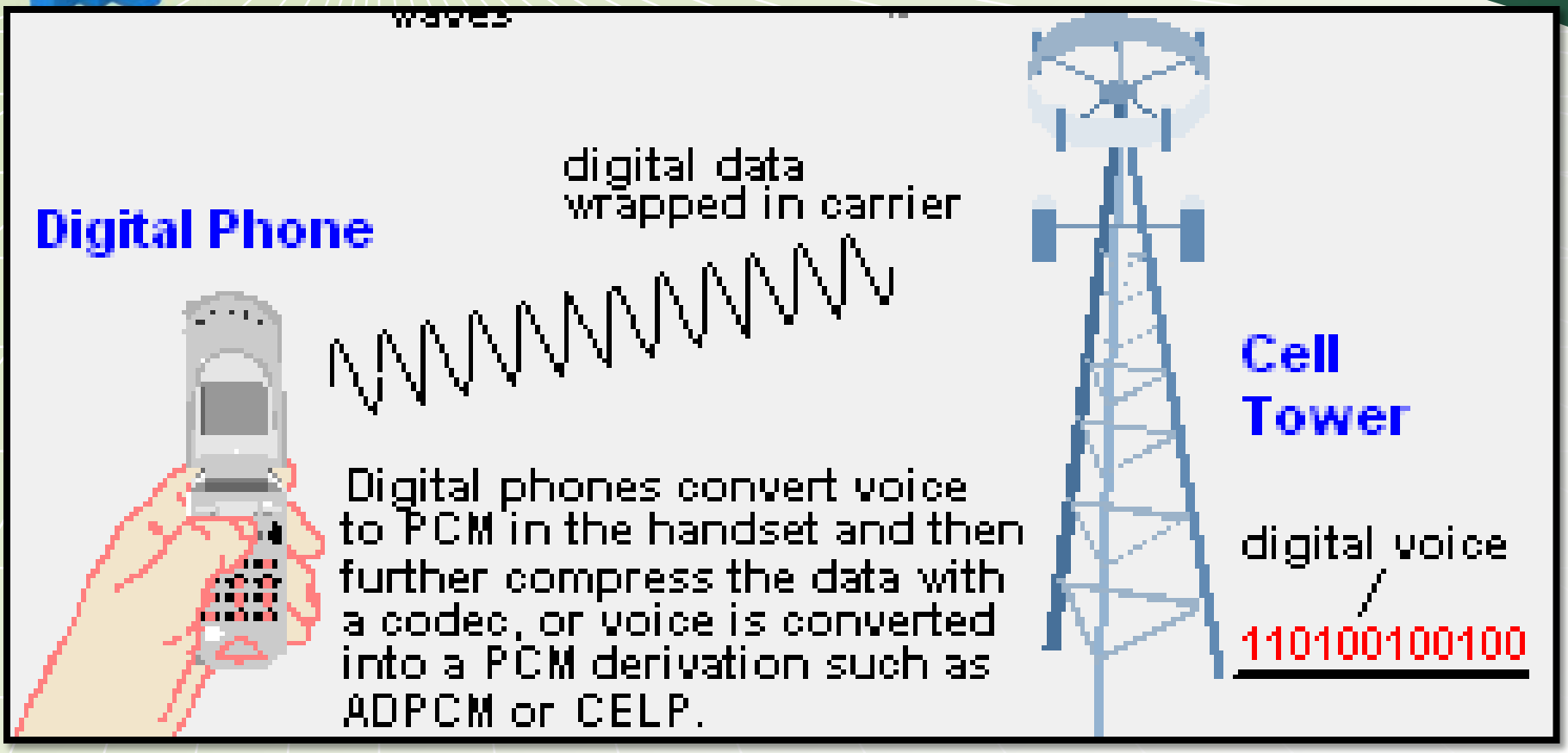


Figure 2.21 Example of waveform representation of binary digits. (a) PCM sequence. (b) Pulse representation of PCM. (c) Pulse waveform (transition between two levels).

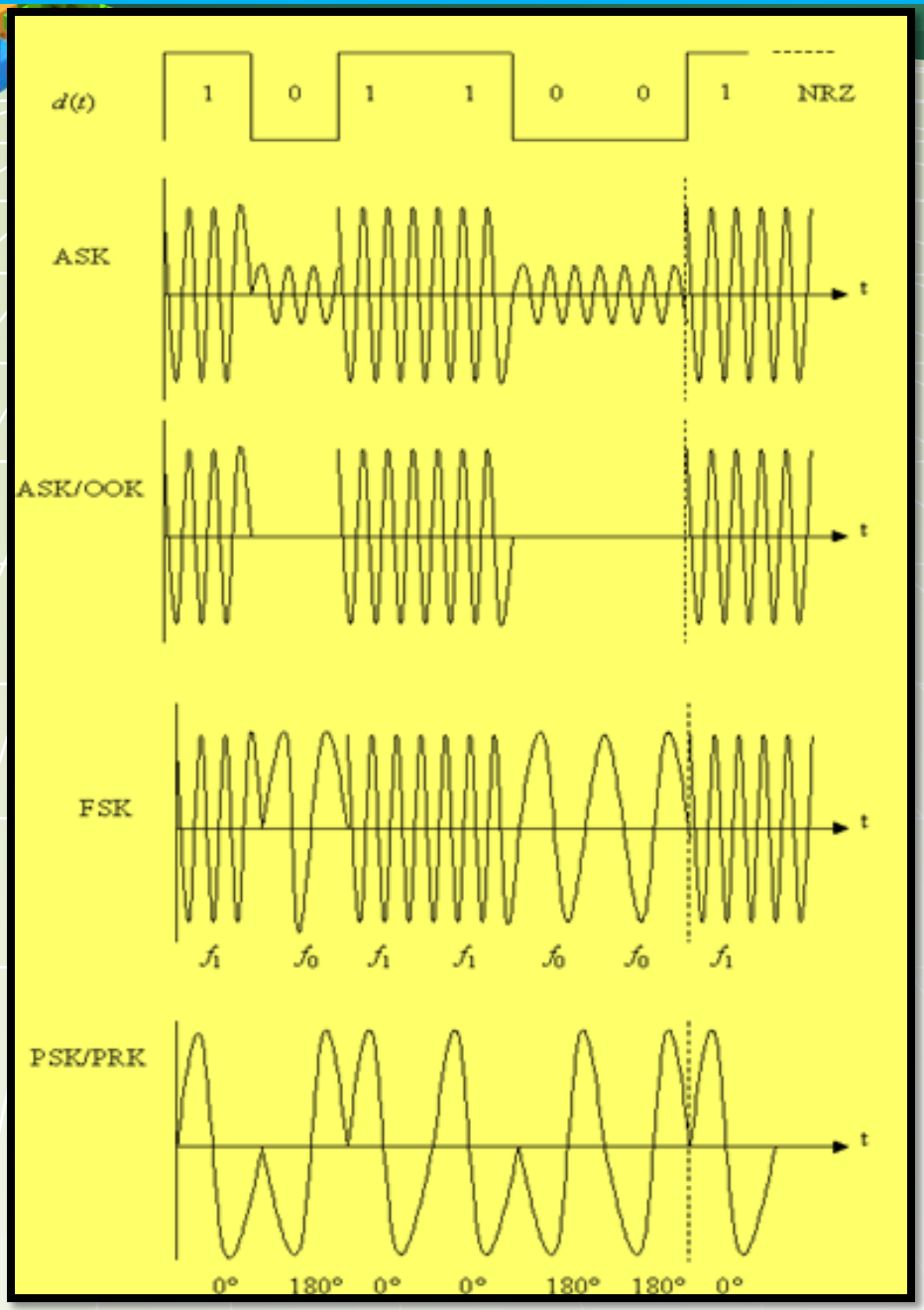
PCM for Music (CD-DA)

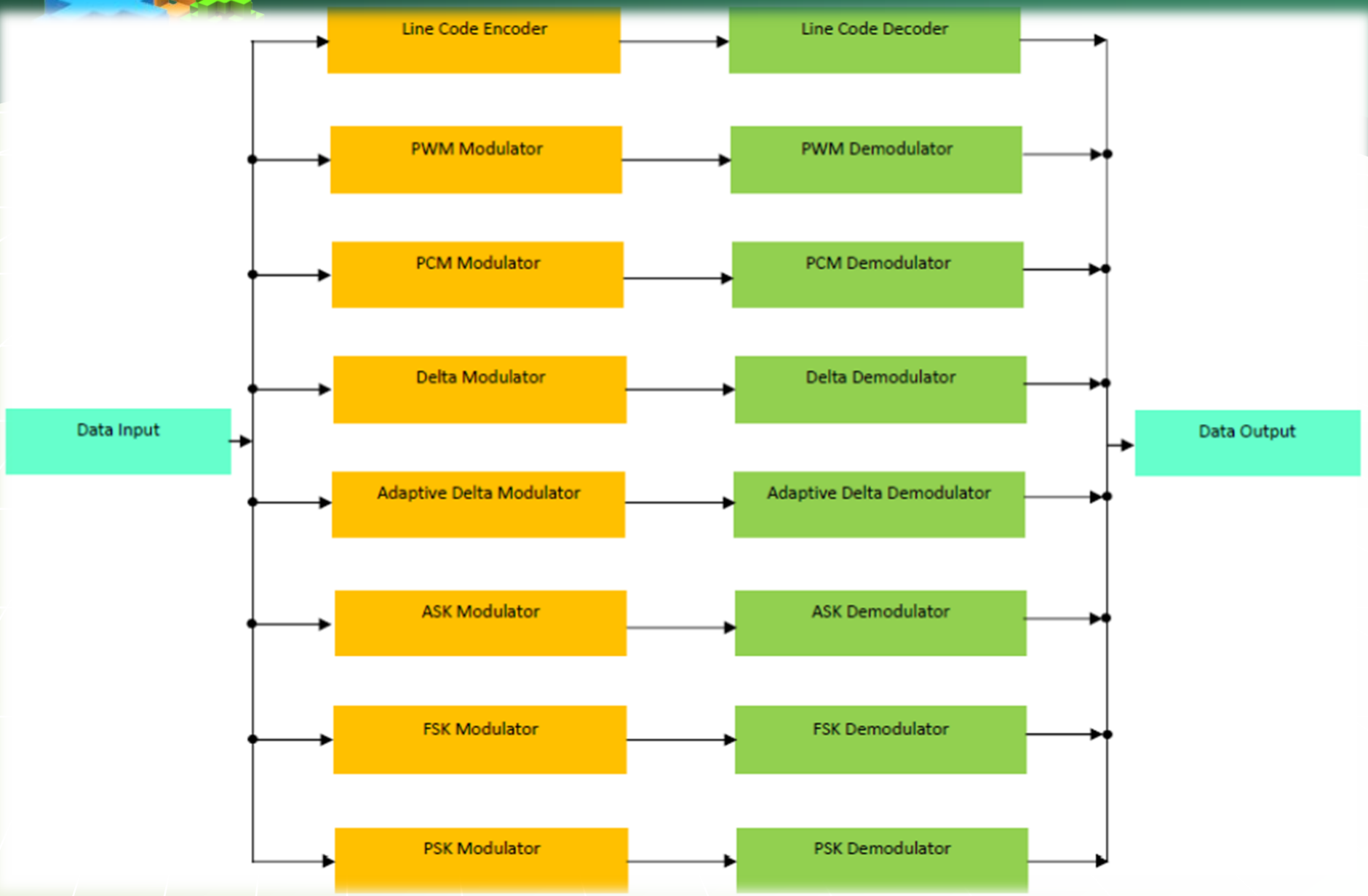


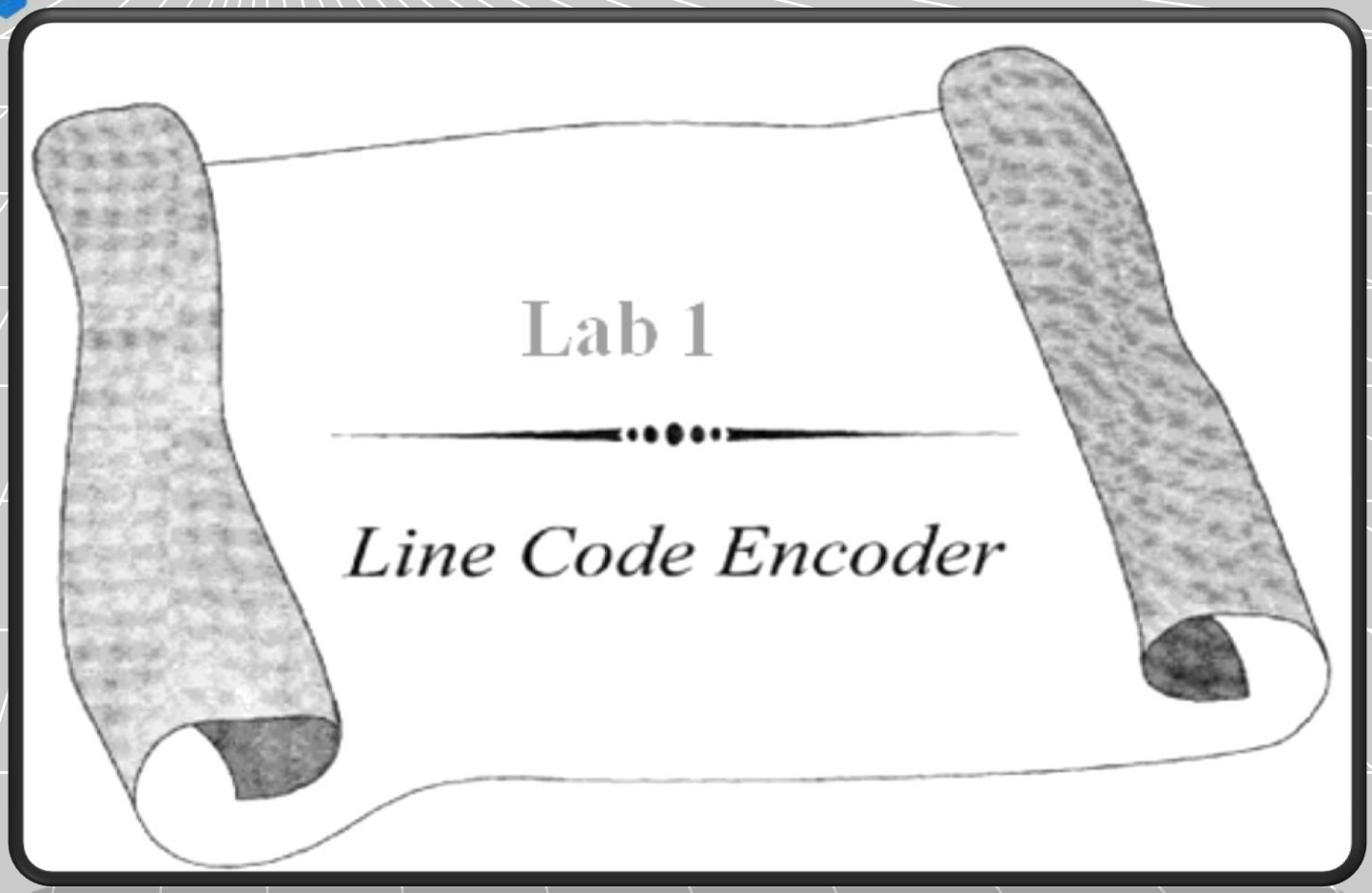

Digital Phone
digital data
wrapped in carrier
Cell
Tower
Digital phones convert voice
to PCM in the handset and then
further compress the data with
a codec, or voice is converted
into a PCM derivation such as
ADPCM or CELP.
digital voice
/
1101001001100

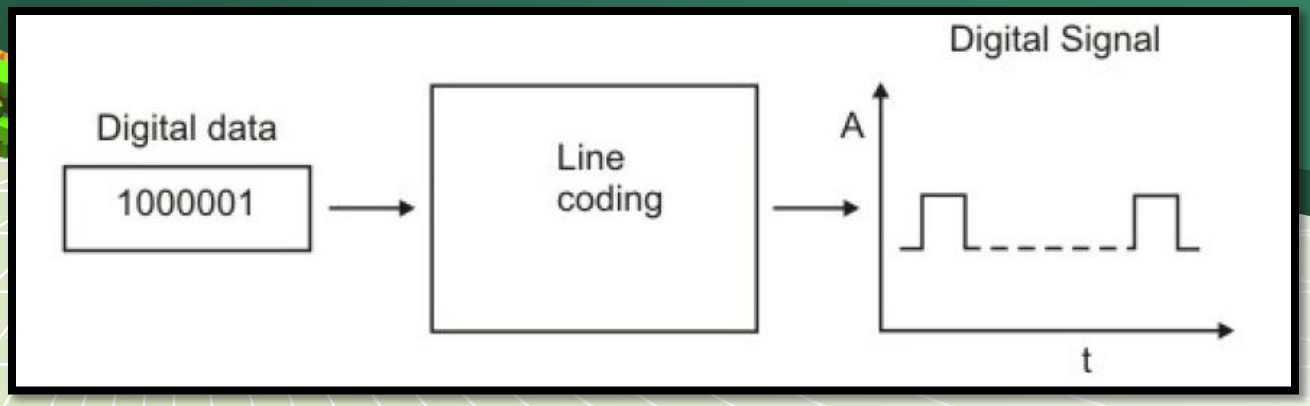

Digitizer
Modulator
Analog data
(voice)
Digital data
Analog signal
(ASK)

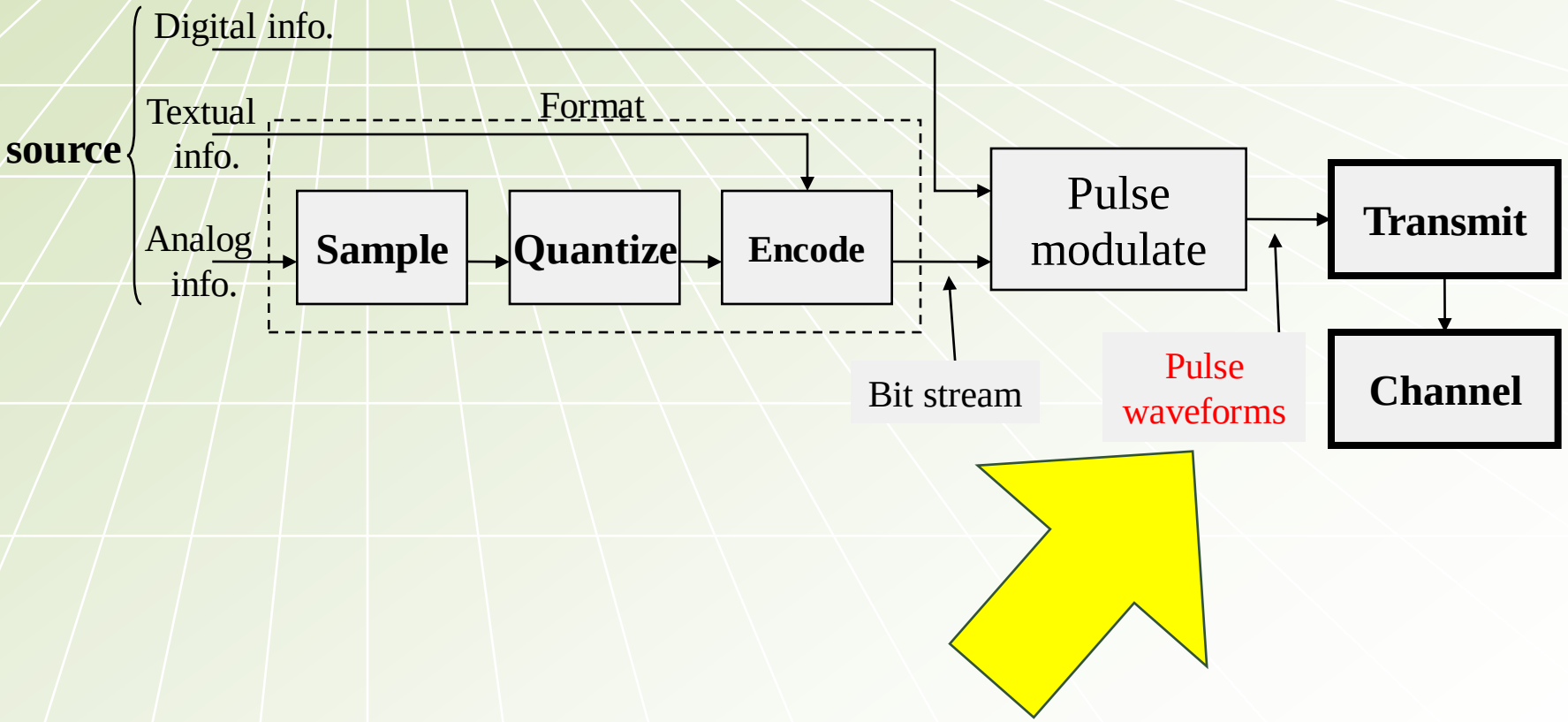
For Bandpass signal




Line Code Encoder
Line Code Decoder
PWM Modulator
PWM Demodulator
PCM Modulator
PCM Demodulator
Delta Modulator
Delta Demodulator
Data Input
Data Output
Adaptive Delta Modulator
Adaptive Delta Demodulator
ASK Modulator
ASK Demodulator
FSK Modulator
FSK Demodulator
PSK Modulator
PSK Demodulator

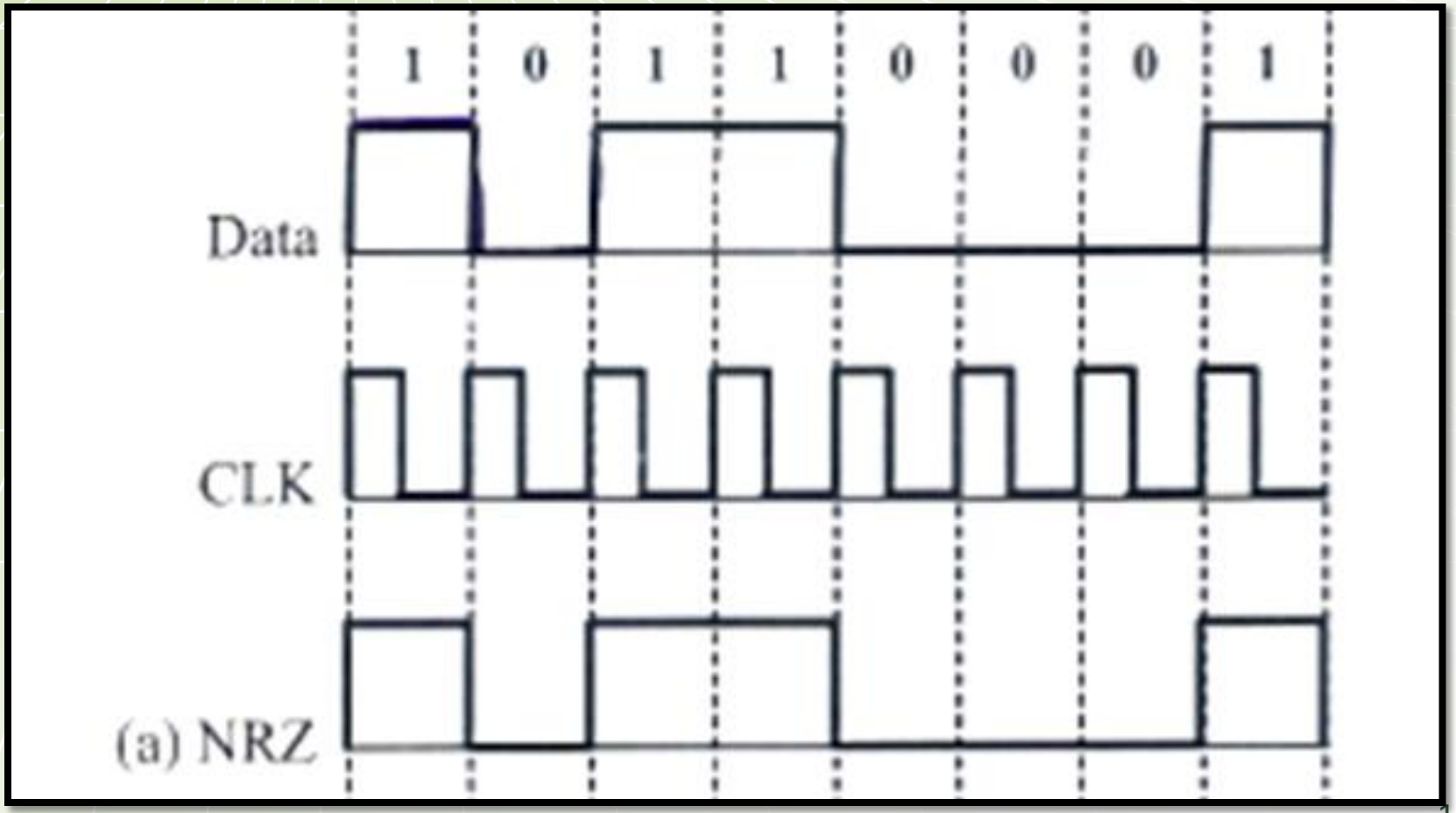

Lab 1
Line Code Encoder


Digital Signal
Digital data
1000001
Line coding
A
t

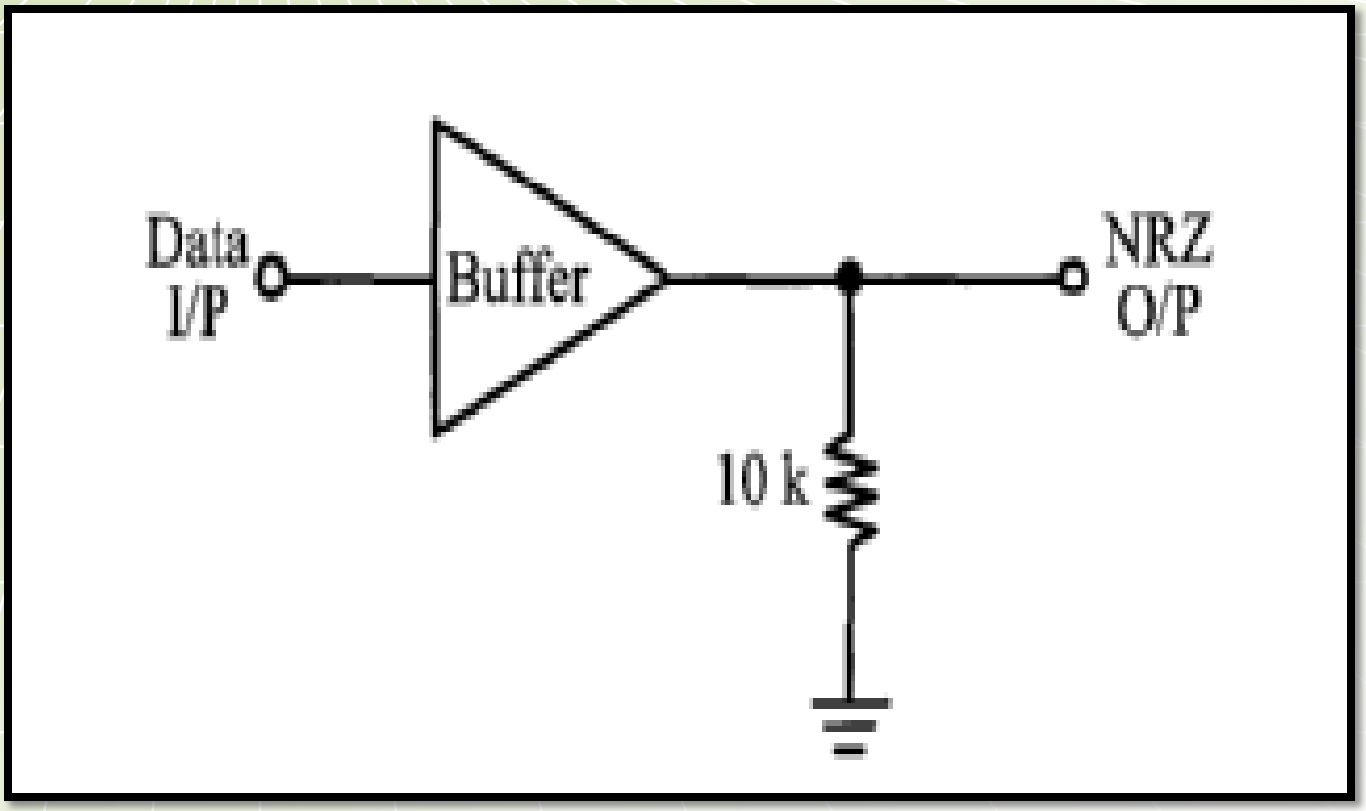

source
Digital info.
Textual info.
Analog info.
Format
Sample
Quantize
Encode
Pulse modulate
Transmit
Channel
Bit stream
Pulse waveforms

PCM waveforms category

1. Unipolar Nonreturn-to-zero Signal Encode

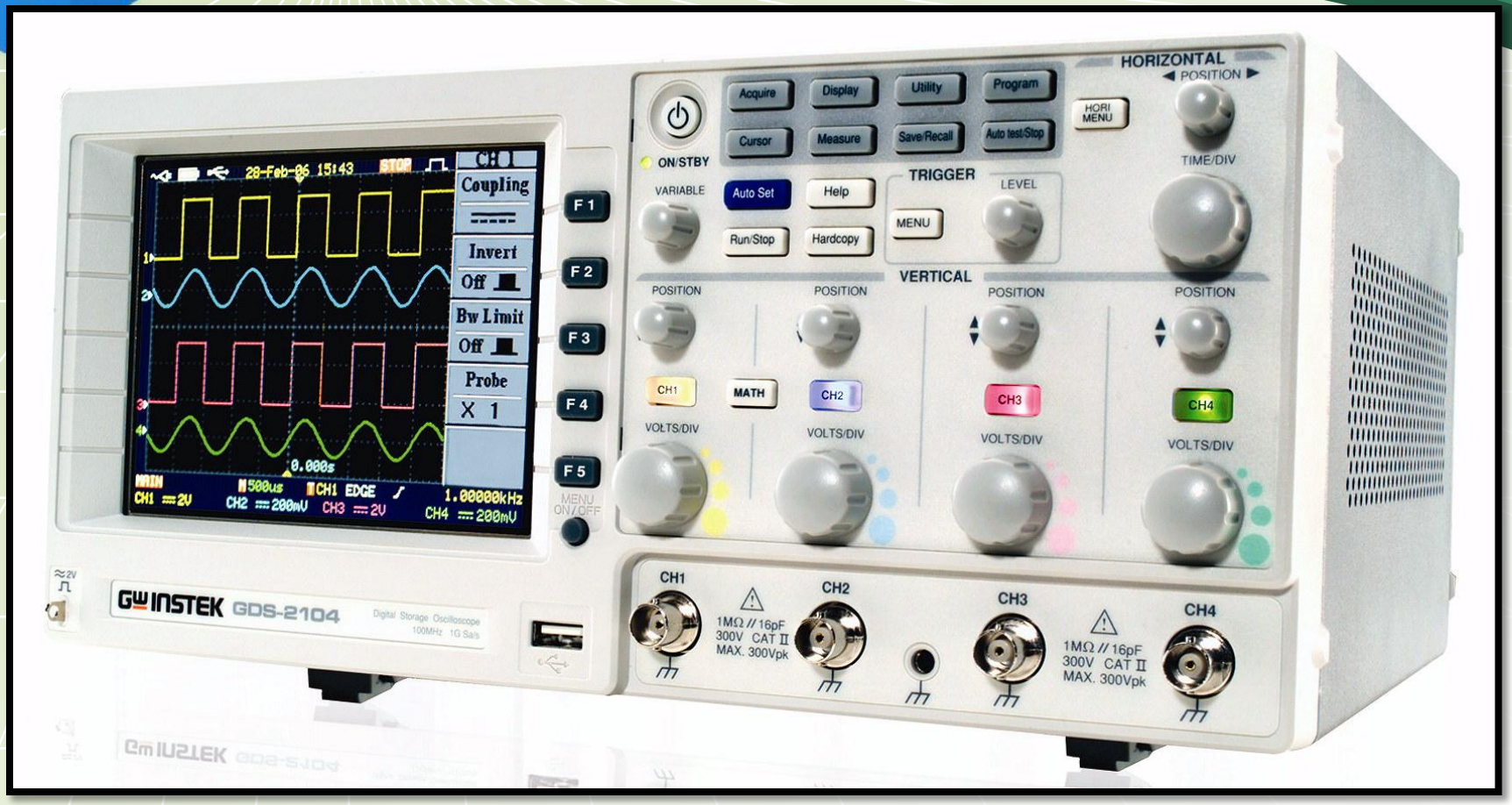


1. Unipolar Nonreturn-to-zero Signal Encode

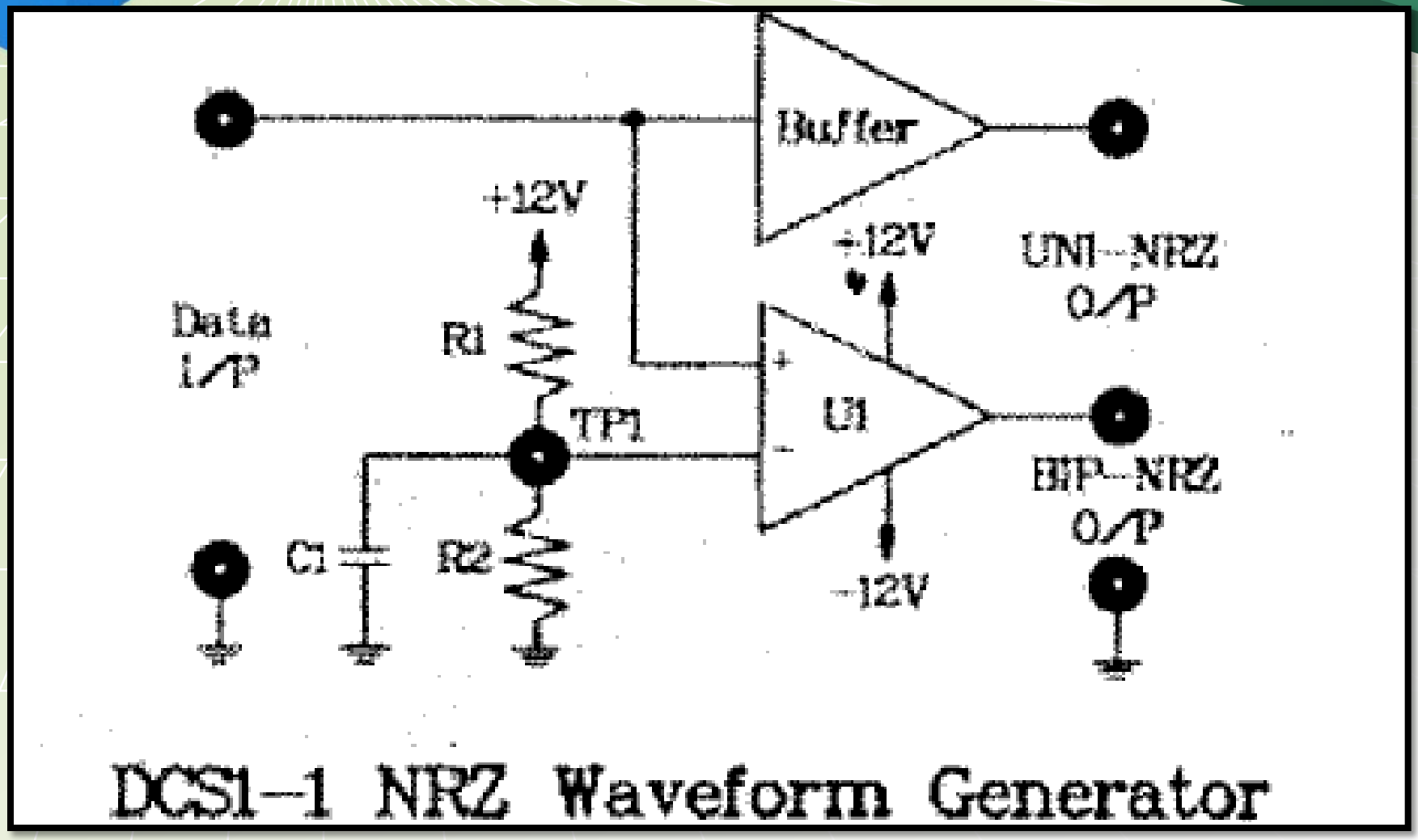



5.24188
POWER
FREQUENCY
DUTY
OFFSET
AMPL
OUTPUT
50Ω
GFG-8250A


CH2
A
3.00
V
30.0
A
3.00
V
30.0
CH1
CH4
CH3
LABORATORY DC POWER SUPPLY
4CH
GW INSTEK
GPS-4303
OUTPUT
ON/OFF
OVER LOAD CH4
VOLTAGE
CURRENT
C.V.
C.C.
PAR.
CH2
SLAVE
VOLTAGE
INDEP.
SERIES
PARALLEL
TRACKING
CURRENT
C.V.
C.C.
CH1
MASTER
VOLTAGE
OVER LOAD CH3
VOLTAGE
POWER
I
O
CH4
8–15V,1A
CH2
0–30V,3A
GND
CH1
0–30V,3A
CH3
2.2–5.2V,1A


28-Feb-06 15:43
STOP
CH1
Coupling
Invert
Off
Bw Limit
Off
Probe
X 1
0.000s
MAIN
M500us
CH1 EDGE
1.00000kHz
CH1 2V
CH2 200mV
CH3 2V
CH4 200mV
F1
F2
F3
F4
F5
MENU ON/OFF
GW INSTEK GDS-2104
Digital Storage Oscilloscope
100MHz 1G Sa/s
ON/STBY
Acquire
Display
Utility
Program
Cursor
Measure
Save/Recall
Auto test/Stop
HORI MENU
HORIZONTAL
POSITION
TIME/DIV
VARIABLE
Auto Set
Help
Run/Stop
Hardcopy
TRIGGER
MENU
LEVEL
VERTICAL
POSITION
POSITION
POSITION
POSITION
CH1
MATH
CH2
CH3
CH4
VOLTS/DIV
VOLTS/DIV
VOLTS/DIV
VOLTS/DIV
CH1
1MΩ // 16pF
300V CAT II
MAX. 300Vpk
CH2
CH3
1MΩ // 16pF
300V CAT II
MAX. 300Vpk
CH4

1. Unipolar Nonreturn-to-zero Signal Encode

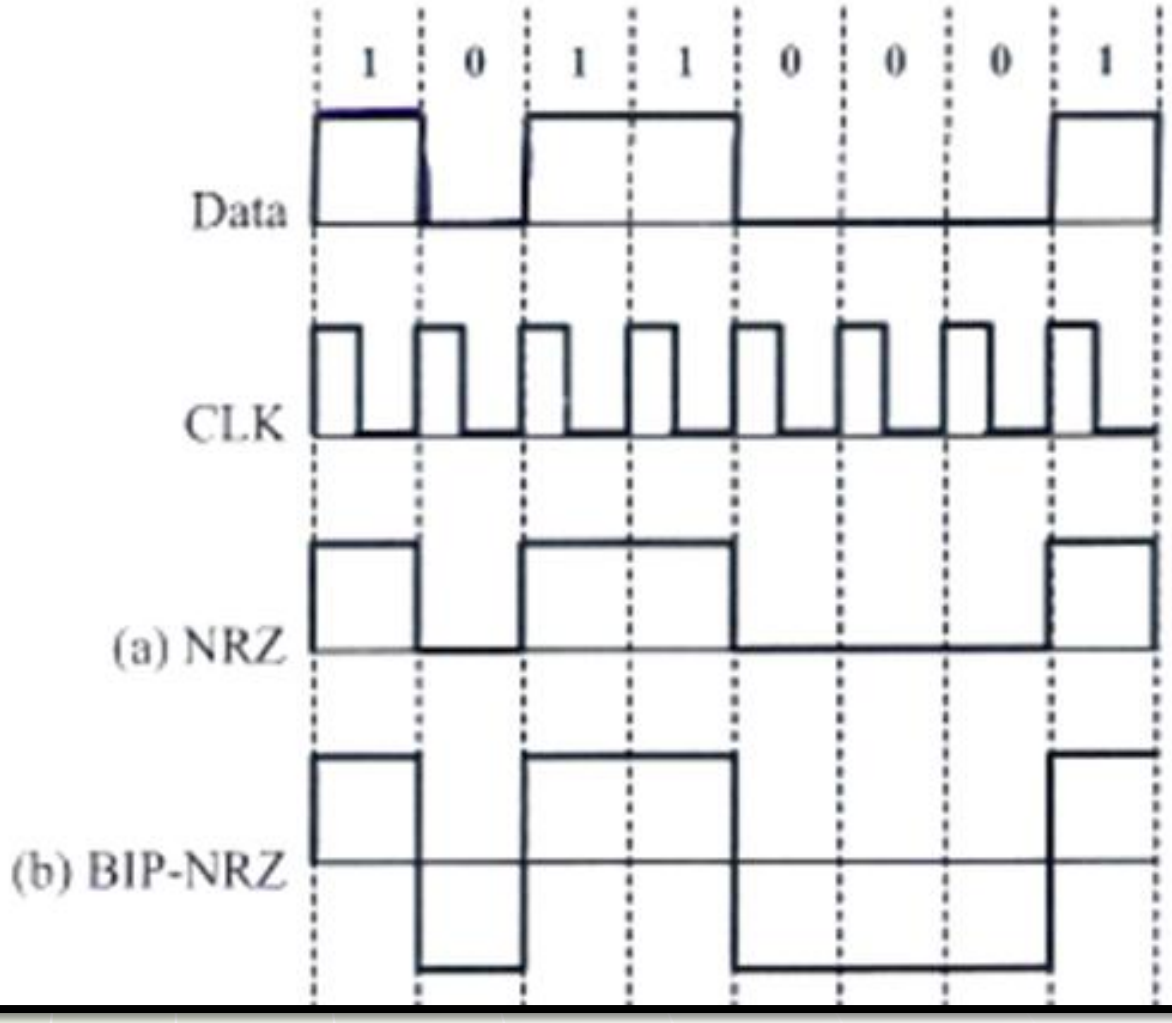


DCS1—1 NRZ Waveform Generator

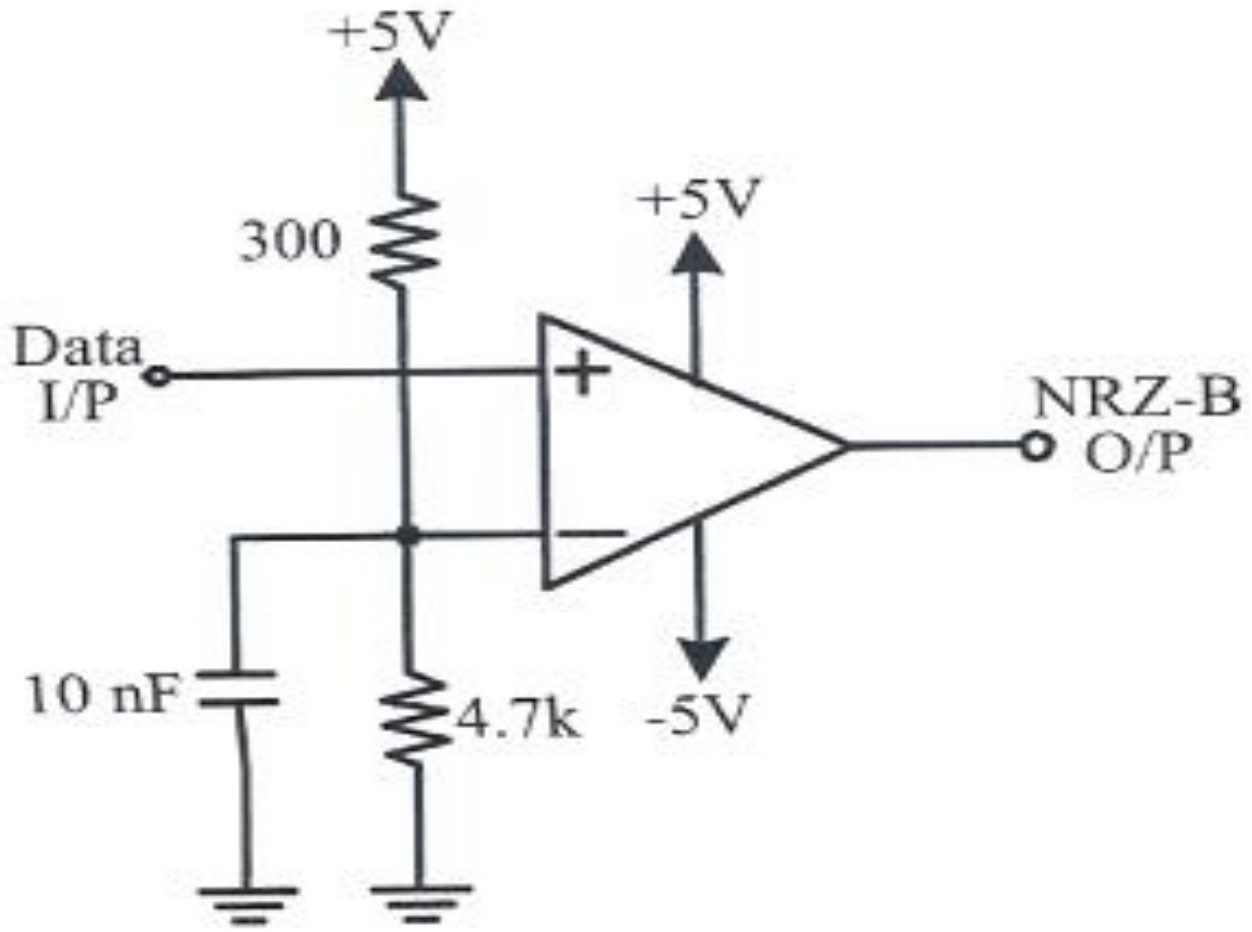
Table 1-1 Measured results of UNI-NRZ signal encode

Input Signal Frequencies (Data I/P)	Output Signal Waveforms
	UNI-NRZ O/P
1 kHz	Fig#0
2 kHz	Fig#1
5 kHz	Fig#2

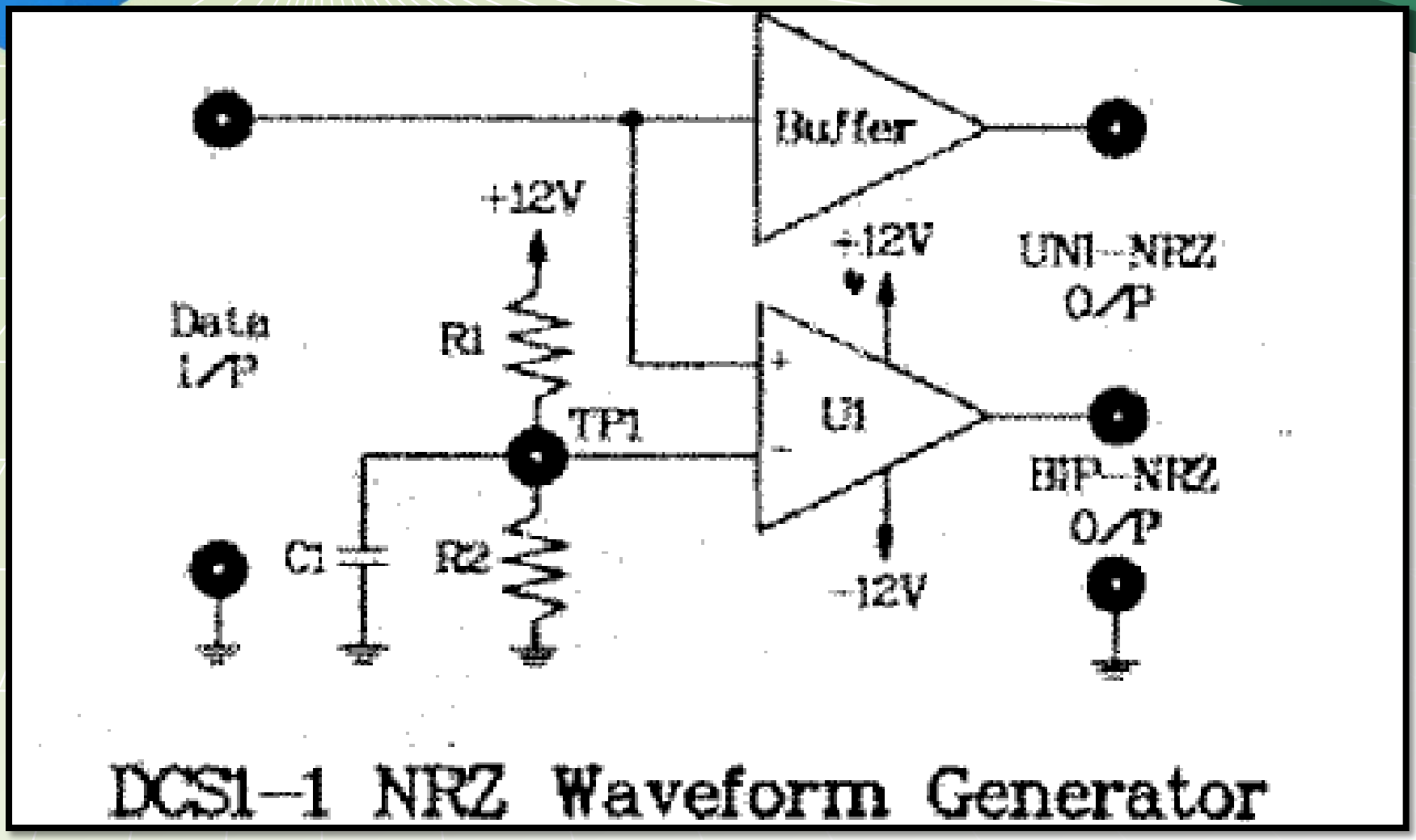
2. Bipolar NRZ signal encode



2. Bipolar NRZ signal encode



2. Bipolar NRZ signal encode

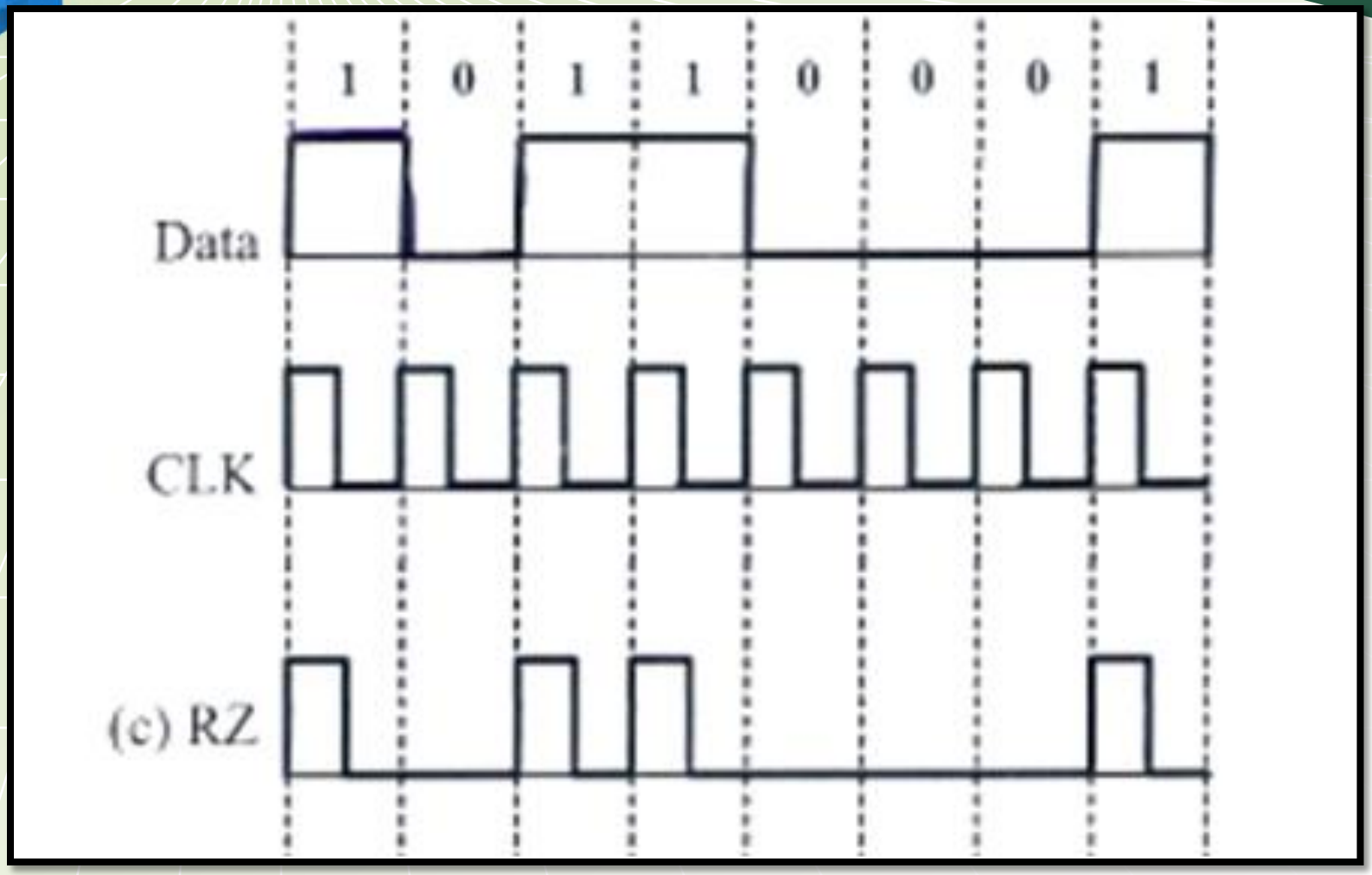


DCS1—1 NRZ Waveform Generator

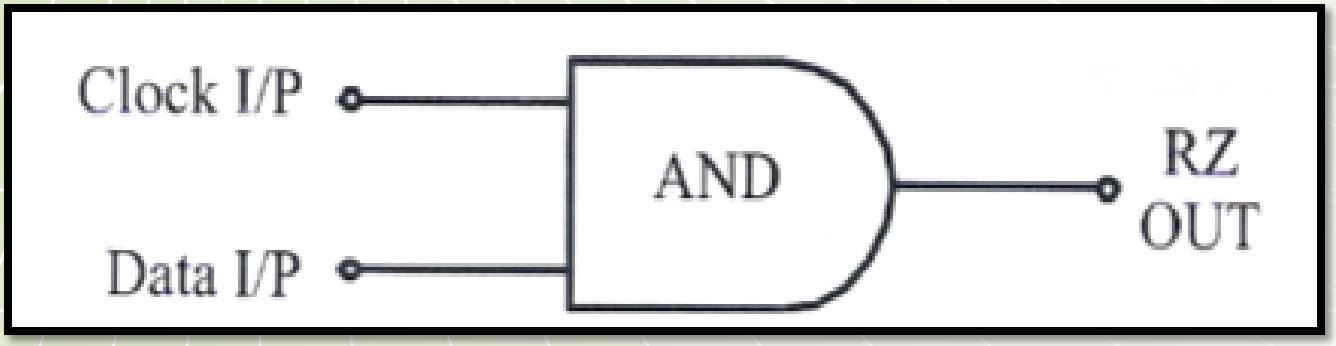
Table 1-2 Measured results of BIP-NRZ signal encode

Input Signal Frequencies (Data I/P)	Output Signal Waveforms	
	TP1	BIP-NRZ O/P
2 kHz	Fig#3	Fig#4
3.5 kHz	Fig#5	Fig#6

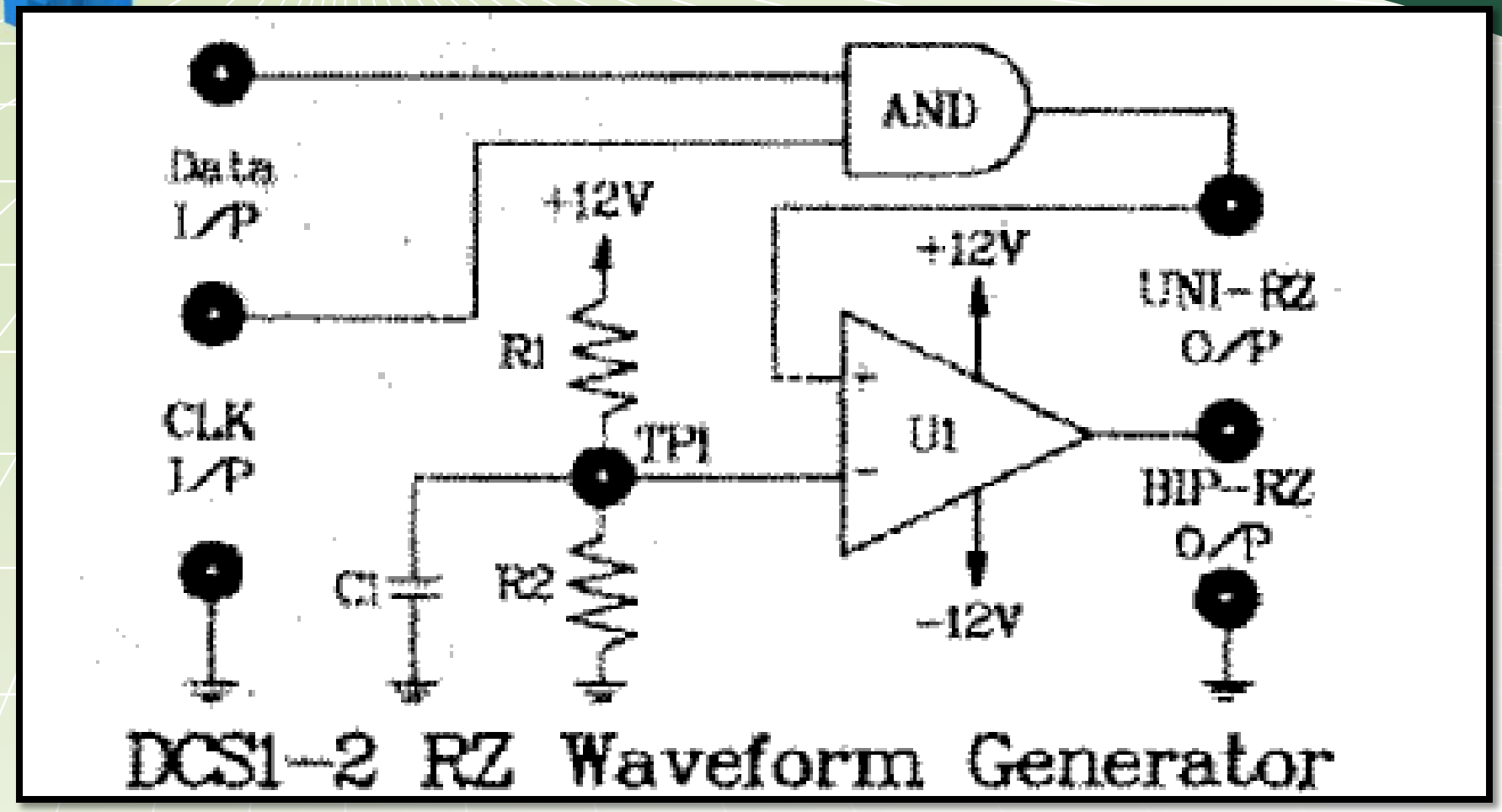
3. Unipolar RZ signal encode



3. Unipolar RZ signal encode



3. Unipolar RZ signal encode

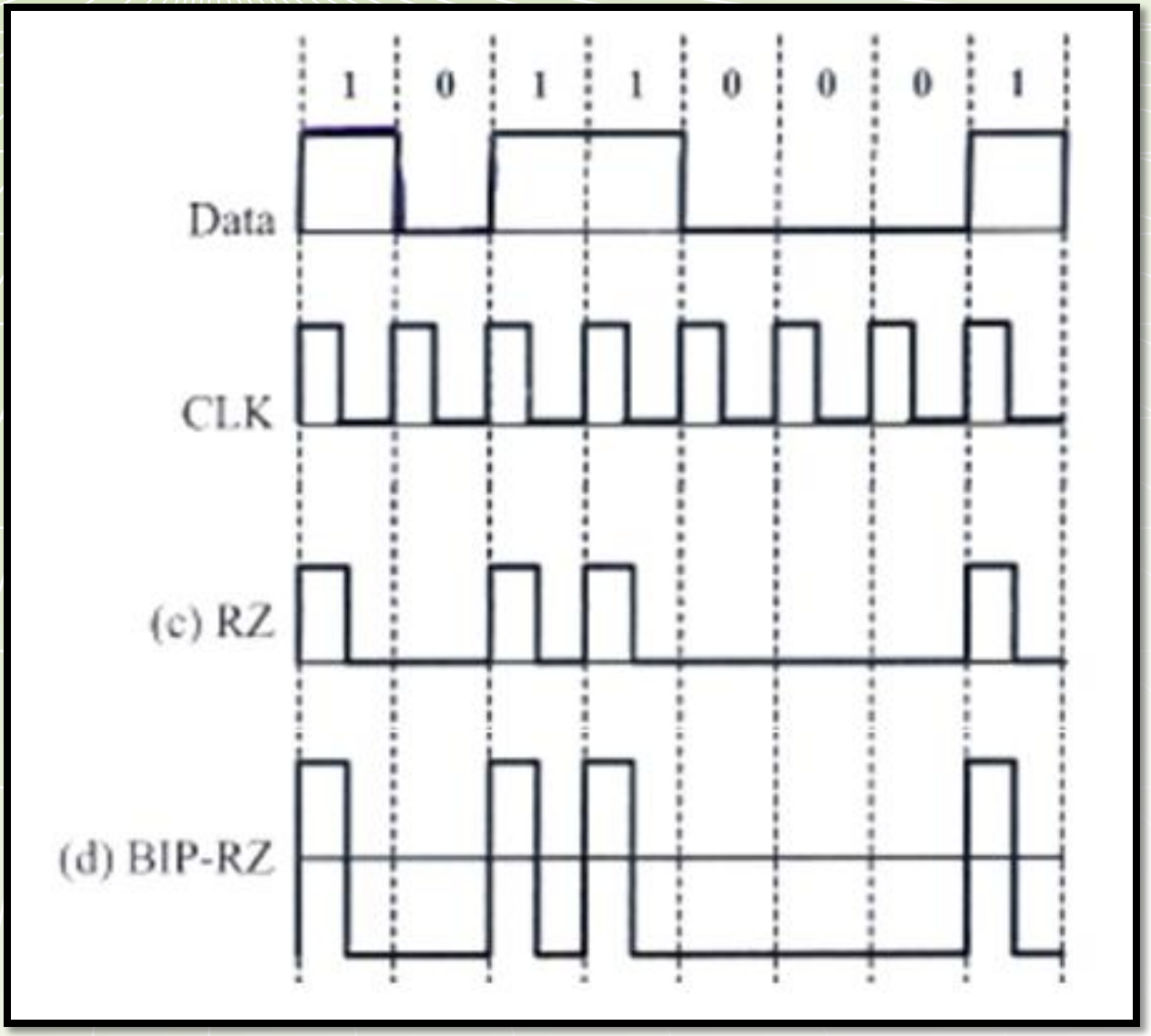


DCS1-2 RZ Waveform Generator

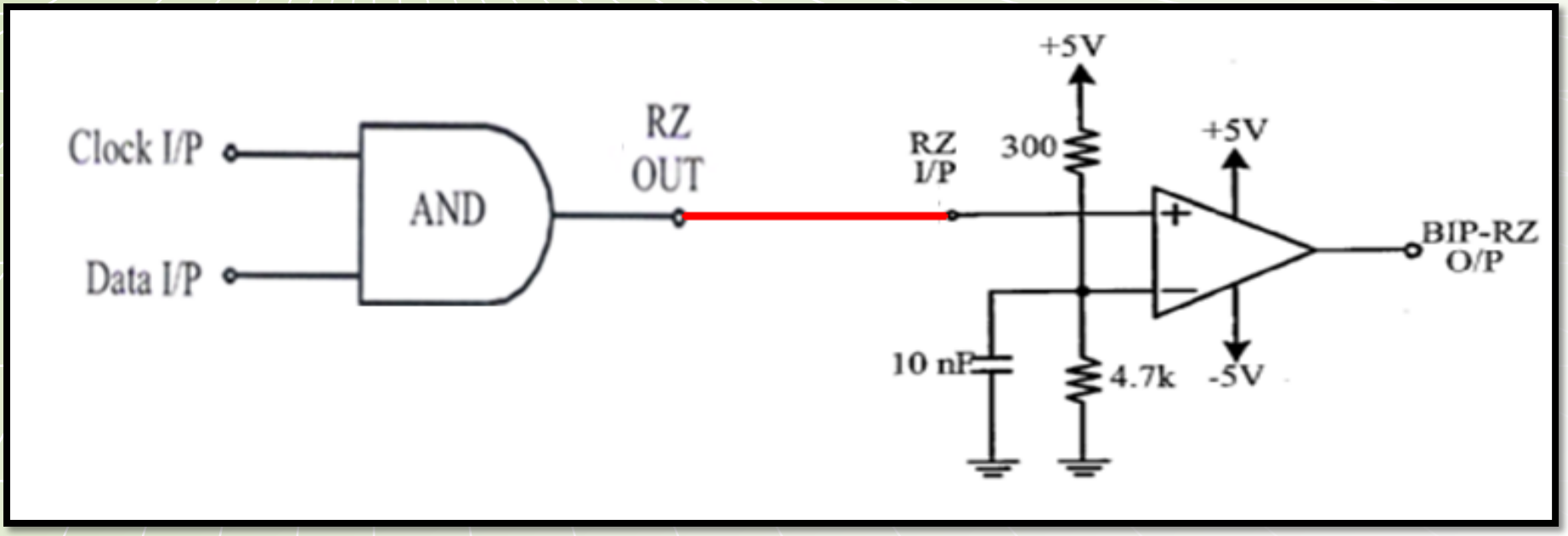
Table 1-3 Measured results of Unipolar RZ signal encode

Input Signal Frequencies		Output Signal Waveforms		
CLK I/P	Data I/P	CLK I/P	Data I/P	UNI-RZ O/P
2 kHz	1 kHz	Fig#7	Fig#8	Fig#9
8 kHz	4 kHz	Fig#10	Fig#11	Fig#12

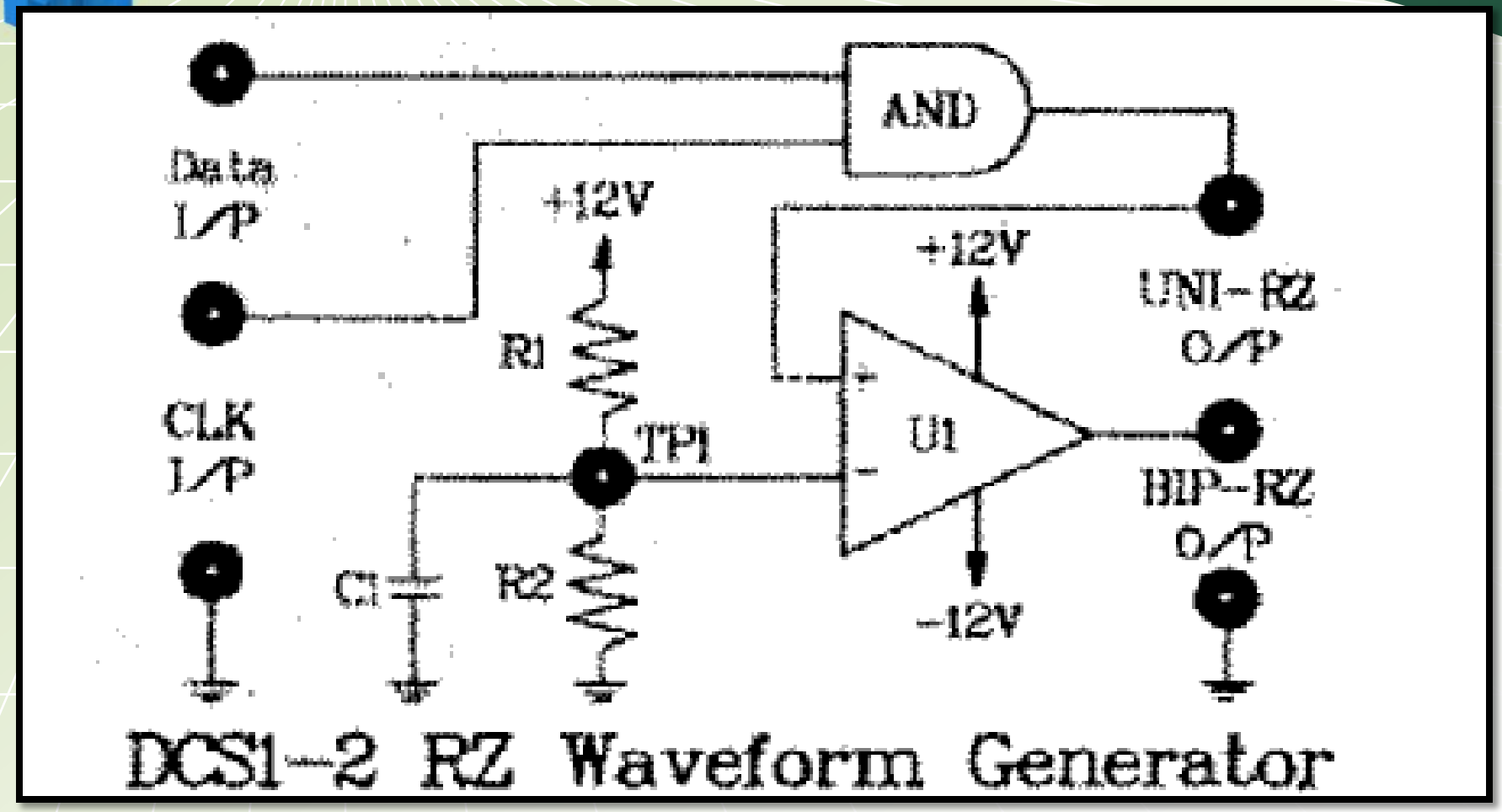
4. Bipolar NRZ signal encode



4. Bipolar NRZ signal encode



4. Bipolar NRZ signal encode

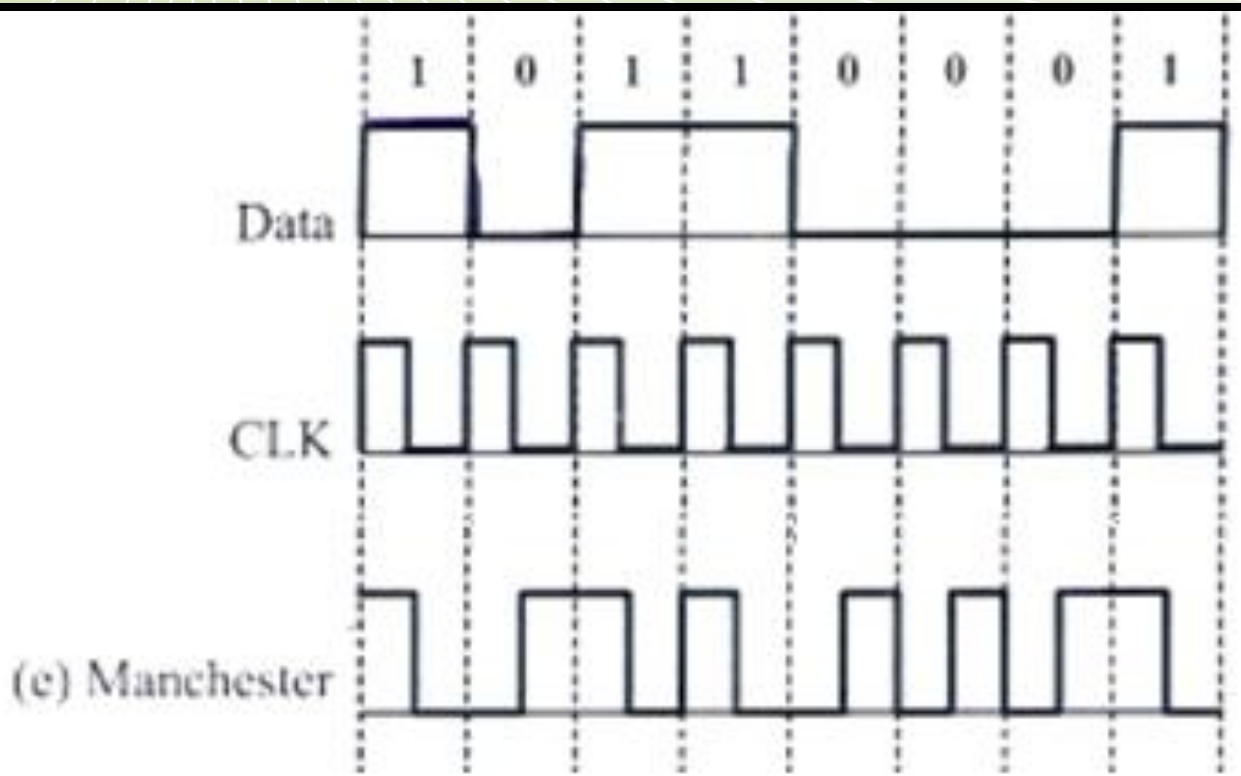


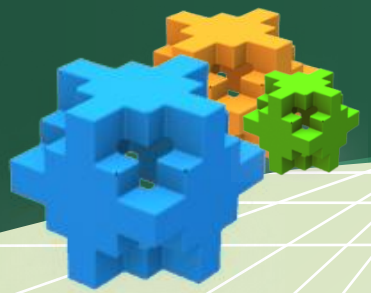
DCS1-2 RZ Waveform Generator

Table 1-4 Measured results of Unipolar RZ signal encode

Input Signal Frequencies		Output Signal Waveforms	
CLK I/P	Data I/P		
		CLK I/P	Data I/P
2 kHz	1 kHz	Fig#13	Fig#14
		TP1	BIP-RZ O/P
		Fig#15	Fig#16

5. Manchester signal encode

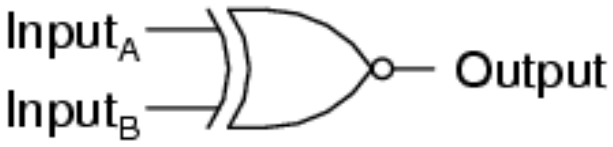




Exclusive-OR gate

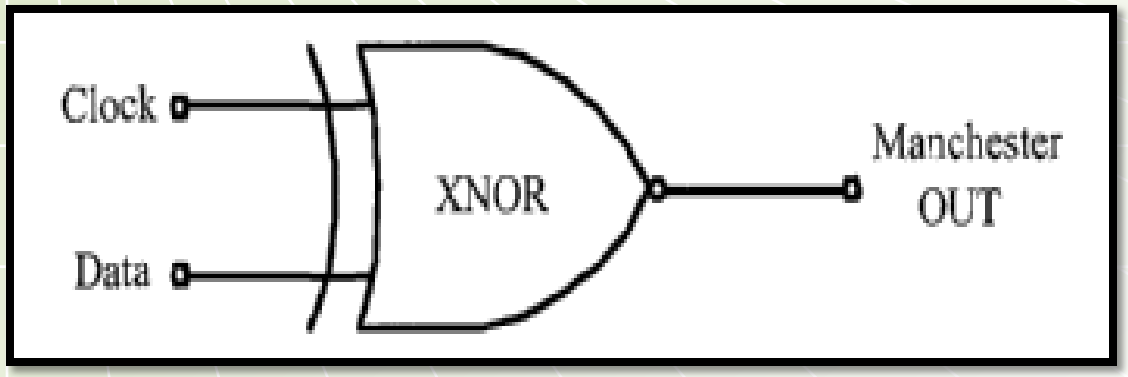
A	B	Output
0	0	0
0	1	1
1	0	1
1	1	0

Exclusive-NOR gate

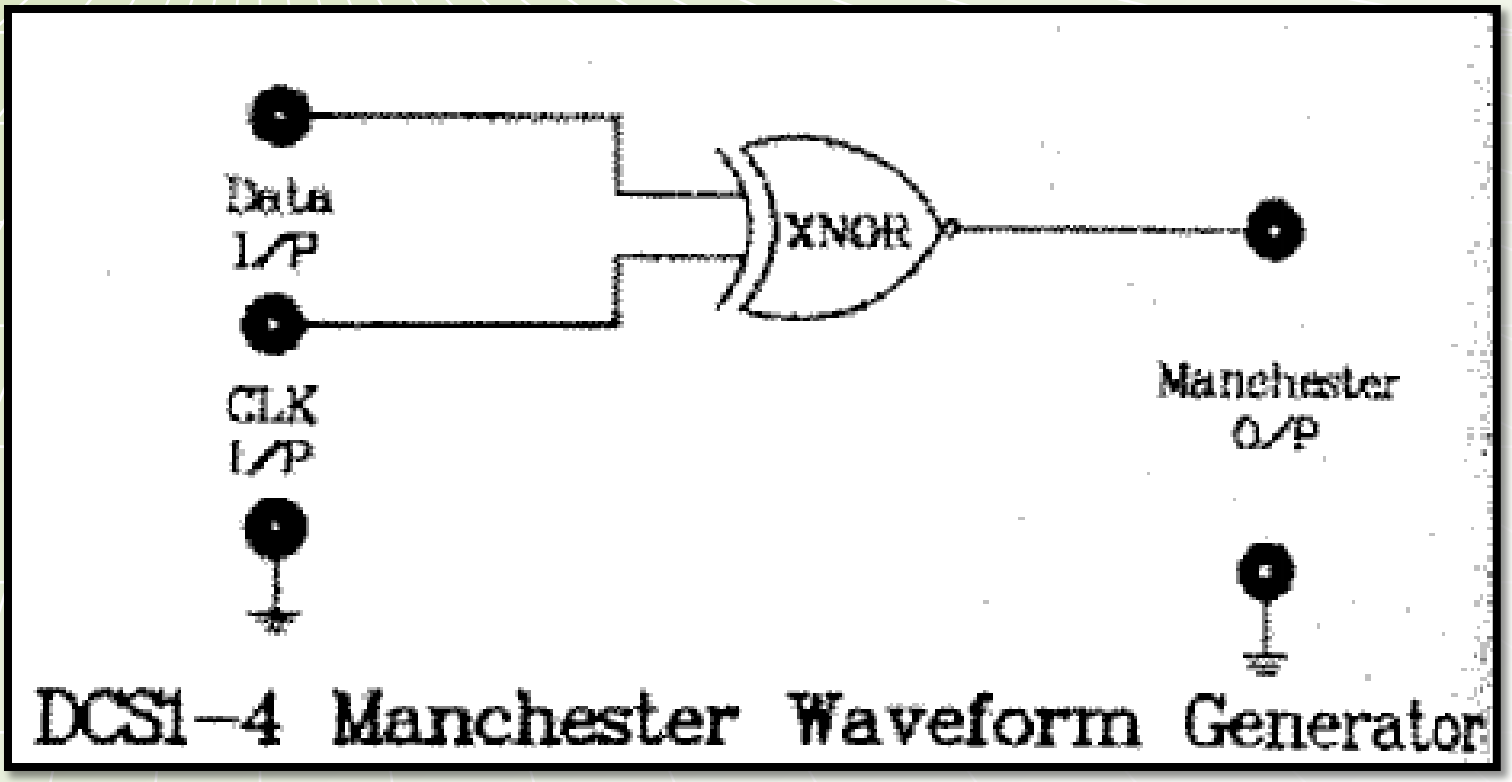


A	B	Output
0	0	1
0	1	0
1	0	0
1	1	1

5. Manchester signal encode



5. Manchester signal encode



DCS1–4 Manchester Waveform Generator

Table 1-5 Measured results of Manchester signal encode

Input Signal Frequencies		Output Signal Waveforms		
CLK I/P	Data I/P	CLK I/P	Data I/P	Manchester O/P
2 kHz	1 kHz	Fig#17	Fig#18	Fig#19
3 kHz	1.5 kHz	Fig#20	Fig#21	Fig#22

Thank You !