# CHAPTER 1

- **SNR (unit less) :**

  SNR = $\frac{S}{N} = \frac{P_S}{P_N}$

  SNR = $\frac{{V_S}^2/_{Rin}}{{V_N}^2/_{Rout}}$

- **SNR (dB) :**

  SNR (dB) = 10log $\left(\frac{S}{N}\right)$

  SNR (dB) = 10log $\left(\frac{{V_S}^2/_{Rin}}{{V_N}^2/_{Rout}}\right)$

  Where ;

- S = signal power (watts)
- N = noise power (watts)
- $V_S$ = signal voltage (volts)
- $V_N$ = noise voltage (volts)
- $R_{in}$ = input resistance (ohms)
- $R_{out}$ = output resistance (ohms)

- **NOISE FACTOR (F) :**

  F = $\frac{SNR_{in}}{SNR_{out}} = \frac{{S_{in}}/{N_{in}}}{{S_{out}}/{N_{out}}}$ (unitless)

- **NOISE FIGURE (NF) :**

  NF (dB) = 10log $F$

  NF (dB) = 10log $\left(\frac{SNR_{in}}{SNR_{out}}\right)$

  NF (dB) = 10log $\left(\frac{{S_{in}}/{N_{in}}}{{S_{out}}/{N_{out}}}\right)$

- **FREQUENCY SPECTRUM**

1) 30 Hz to 300 Hz – Extremely Low Frequencies (ELF)
2) 300 Hz to 3000 Hz – Voice Frequencies (VF)
3) 3 kHz to 30 kHz – Very Low Frequencies (VLF)
4) 30 kHz to 300 kHz – Low Frequencies (LF)
5) 300 kHz to 3 MHz – Medium Frequencies (MF)
6) 3 MHz to 30 MHz – High Frequencies (HF)
7) 30 MHz to 300 MHz – Very High Frequencies (VHF)
8) 300 MHz to 3 GHz – Ultra High Frequencies (UHF)
9) 3 GHz to 30 GHz – Super High Frequencies (SHF)
10) 30 GHz to 300 GHz – Extremely High Frequencies (EHF)
11) 0.3 THz to 300 THz – Infrared
12) 0.3 PHz to 3 PHz – Visible Light
13) Ultraviolet rays, X rays, Gamma rays, and Cosmic rays have little application to electronic communications.

- **WAVELENGTH**

$\lambda = \frac{C}{f}$

where ;

$\lambda$ = wavelength (meter)

C = velocity of light (3 x $10^8$ m/s)

f = frequency (Hz)

- **BANDWIDTH**

BW (Hz) = frequency range = $f_{max}$ - $f_{min}$

- **SHANNON'S LIMIT**

$I = \mathrm{B} \log_2 \left(1 + \frac{S}{N}\right)$

or

$I = 3.32\ \mathrm{B} \log_{10} \left(1 + \frac{S}{N}\right)$

# CHAPTER 2

- **SUMMARY OF THE VARIOUS MODULATION TECHNIQUE**

  Vc(t) = Vp sin (2πft + $\theta$)

  Where ;

  Vc(t) = time-varying sine wave of Carrier signal voltage
  f = frequency (Hz)
  θ = phase shift (radians)

- **M-ary CODING**

  M = $2^n$

  n = $\log_2 M$

  where ;

  n = number of bits
  M = number of conditions, or levels, or combinations possible with n bits

- **NYQUIST SAMPLING THEOREM**

  fs = $2f_{max}$

  Ts = 1/fs

- **QUANTIZATION**

  L = $2^n$

  Step size, Δ = 2 $V_{max}$ / L

- **QUANTIZATION ERROR ($Q_e$)**

  Qe = Quantized value – Sampled value (V)

- **SIGNAL TO QUANTIZATION NOISE POWER RATIO (SQR)**

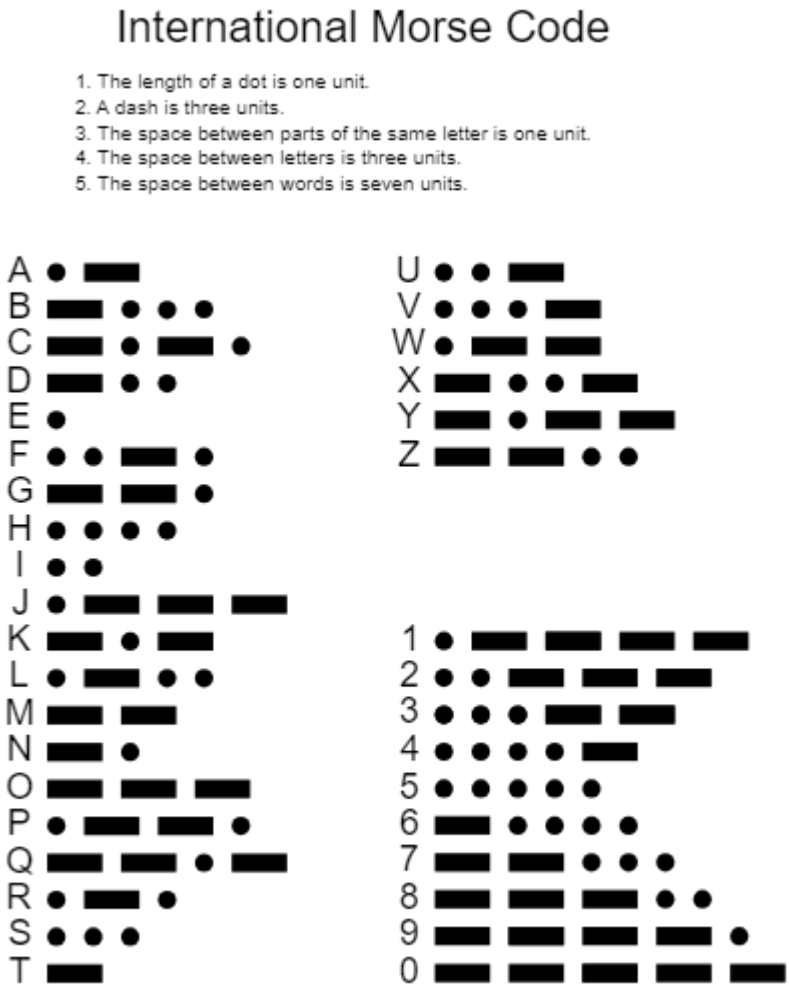
  SQR (dB) = 6.02n + 1.76 dB

- **BIT RATE**

  Bit Rate = $f_s$ x n

# CHAPTER 4

## INTERNATIONAL MORSE CODE



# BAUDOT CODE

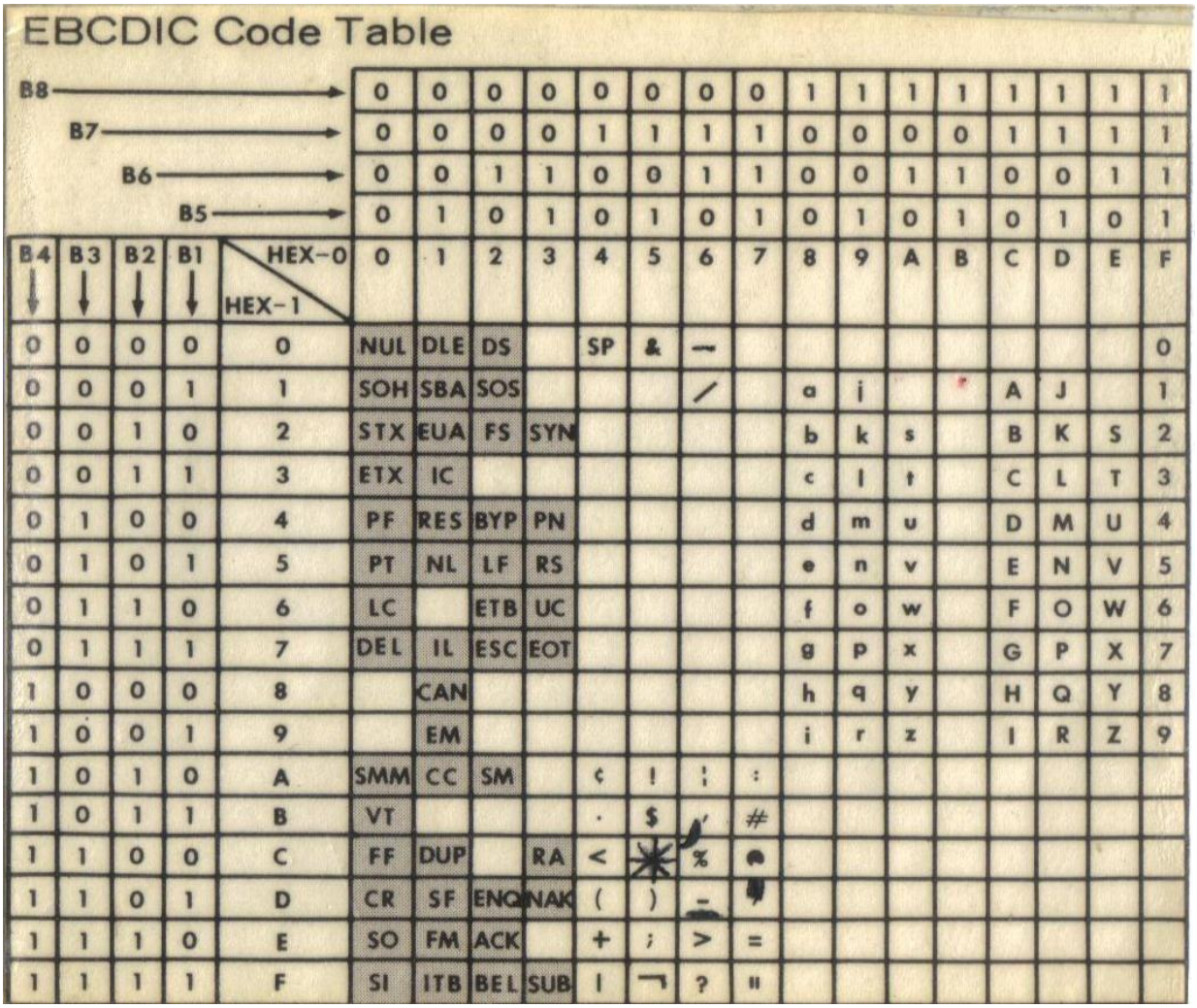
| BIT 5 4 3 2 1 | LETTERS CASE | FIGURES CASE |
|---|---|---|
| 0 0 0 0 0 | BLANK | BLANK |
| 0 0 0 0 1 | E | 3 |
| 0 0 0 1 0 | LINE FEED | LINE FEED |
| 0 0 0 1 1 | A | ..... |
| 0 0 1 0 0 | SPACE | SPACE |
| 0 0 1 0 1 | S | BELL |
| 0 0 1 1 0 | I | 8 |
| 0 0 1 1 1 | U | 7 |
| 0 1 0 0 0 | CAR. RET. | CAR. RET. |
| 0 1 0 0 1 | D | $ |
| 0 1 0 1 0 | R | 4 |
| 0 1 0 1 1 | J | (APOS)' |
| 0 1 1 0 0 | N | (COMMA), |
| 0 1 1 0 1 | F | ! |
| 0 1 1 1 0 | C | : |
| 0 1 1 1 1 | K | ( |
| 1 0 0 0 0 | T | 5 |
| 1 0 0 0 1 | Z | " |
| 1 0 0 1 0 | L | ) |
| 1 0 0 1 1 | W | 2 |
| 1 0 1 0 0 | H | STOP |
| 1 0 1 0 1 | Y | 6 |
| 1 0 1 1 0 | P | 0 |
| 1 0 1 1 1 | Q | 1 |
| 1 1 0 0 0 | O | 9 |
| 1 1 0 0 1 | B | ? |
| 1 1 0 1 0 | G | & |
| 1 1 0 1 1 | FIGURES | FIGURES |
| 1 1 1 0 0 | M | . |
| 1 1 1 0 1 | X | / |
| 1 1 1 1 0 | V | ; |
| 1 1 1 1 1 | LETTERS | LETTERS |

BAUDOT CODE

# ASCII CODE

| Bits $b_4$ | $b_3$ | $b_2$ | $b_1$ | Row \ Column → | 000 | 001 | 010 | 011 | 100 | 101 | 110 | 111 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 0 | 0 | 0 | 0 | 0 | NUL | DLE | SP | 0 | @ | P | ` | p |
| 0 | 0 | 0 | 1 | 1 | SOH | DC1 | ! | 1 | A | Q | a | q |
| 0 | 0 | 1 | 0 | 2 | STX | DC2 | " | 2 | B | R | b | r |
| 0 | 0 | 1 | 1 | 3 | ETX | DC3 | # | 3 | C | S | c | s |
| 0 | 1 | 0 | 0 | 4 | EOT | DC4 | $ | 4 | D | T | d | t |
| 0 | 1 | 0 | 1 | 5 | ENQ | NAK | % | 5 | E | U | e | u |
| 0 | 1 | 1 | 0 | 6 | ACK | SYN | & | 6 | F | V | f | v |
| 0 | 1 | 1 | 1 | 7 | BEL | ETB | ' | 7 | G | W | g | w |
| 1 | 0 | 0 | 0 | 8 | BS | CAN | ( | 8 | H | X | h | x |
| 1 | 0 | 0 | 1 | 9 | HT | EM | ) | 9 | I | Y | i | y |
| 1 | 0 | 1 | 0 | 10 | LF | SUB | * | : | J | Z | j | z |
| 1 | 0 | 1 | 1 | 11 | VT | ESC | + | ; | K | [ | k | { |
| 1 | 1 | 0 | 0 | 12 | FF | FS | , | < | L | \ | l | \| |
| 1 | 1 | 0 | 1 | 13 | CR | GS | — | = | M | ] | m | } |
| 1 | 1 | 1 | 0 | 14 | SO | RS | . | > | N | ^ | n | ~ |
| 1 | 1 | 1 | 1 | 15 | SI | US | / | ? | O | _ | o | DEL |

**EBCDIC CODE**



EBCDIC Code Table

| B8 | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B7 | | | | | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| B6 | | | | | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| B5 | | | | | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| B4 | B3 | B2 | B1 | HEX-0 / HEX-1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| 0 | 0 | 0 | 0 | 0 | NUL | DLE | DS | | SP | & | - | | | | | | | | | 0 |
| 0 | 0 | 0 | 1 | 1 | SOH | SBA | SOS | | | | / | | a | j | | | A | J | | 1 |
| 0 | 0 | 1 | 0 | 2 | STX | EUA | FS | SYN | | | | | b | k | s | | B | K | S | 2 |
| 0 | 0 | 1 | 1 | 3 | ETX | IC | | | | | | | c | l | t | | C | L | T | 3 |
| 0 | 1 | 0 | 0 | 4 | PF | RES | BYP | PN | | | | | d | m | u | | D | M | U | 4 |
| 0 | 1 | 0 | 1 | 5 | PT | NL | LF | RS | | | | | e | n | v | | E | N | V | 5 |
| 0 | 1 | 1 | 0 | 6 | LC | | ETB | UC | | | | | f | o | w | | F | O | W | 6 |
| 0 | 1 | 1 | 1 | 7 | DEL | IL | ESC | EOT | | | | | g | p | x | | G | P | X | 7 |
| 1 | 0 | 0 | 0 | 8 | | CAN | | | | | | | h | q | y | | H | Q | Y | 8 |
| 1 | 0 | 0 | 1 | 9 | | EM | | | | | | | i | r | z | | I | R | Z | 9 |
| 1 | 0 | 1 | 0 | A | SMM | CC | SM | | ¢ | ! | ¦ | : | | | | | | | | |
| 1 | 0 | 1 | 1 | B | VT | | | | . | $ | , | # | | | | | | | | |
| 1 | 1 | 0 | 0 | C | FF | DUP | | RA | < | * | % | @ | | | | | | | | |
| 1 | 1 | 0 | 1 | D | CR | SF | ENQ | NAK | ( | ) | _ | ' | | | | | | | | |
| 1 | 1 | 1 | 0 | E | SO | FM | ACK | | + | ; | > | = | | | | | | | | |
| 1 | 1 | 1 | 1 | F | SI | ITB | BEL | SUB | \| | ¬ | ? | " | | | | | | | | |