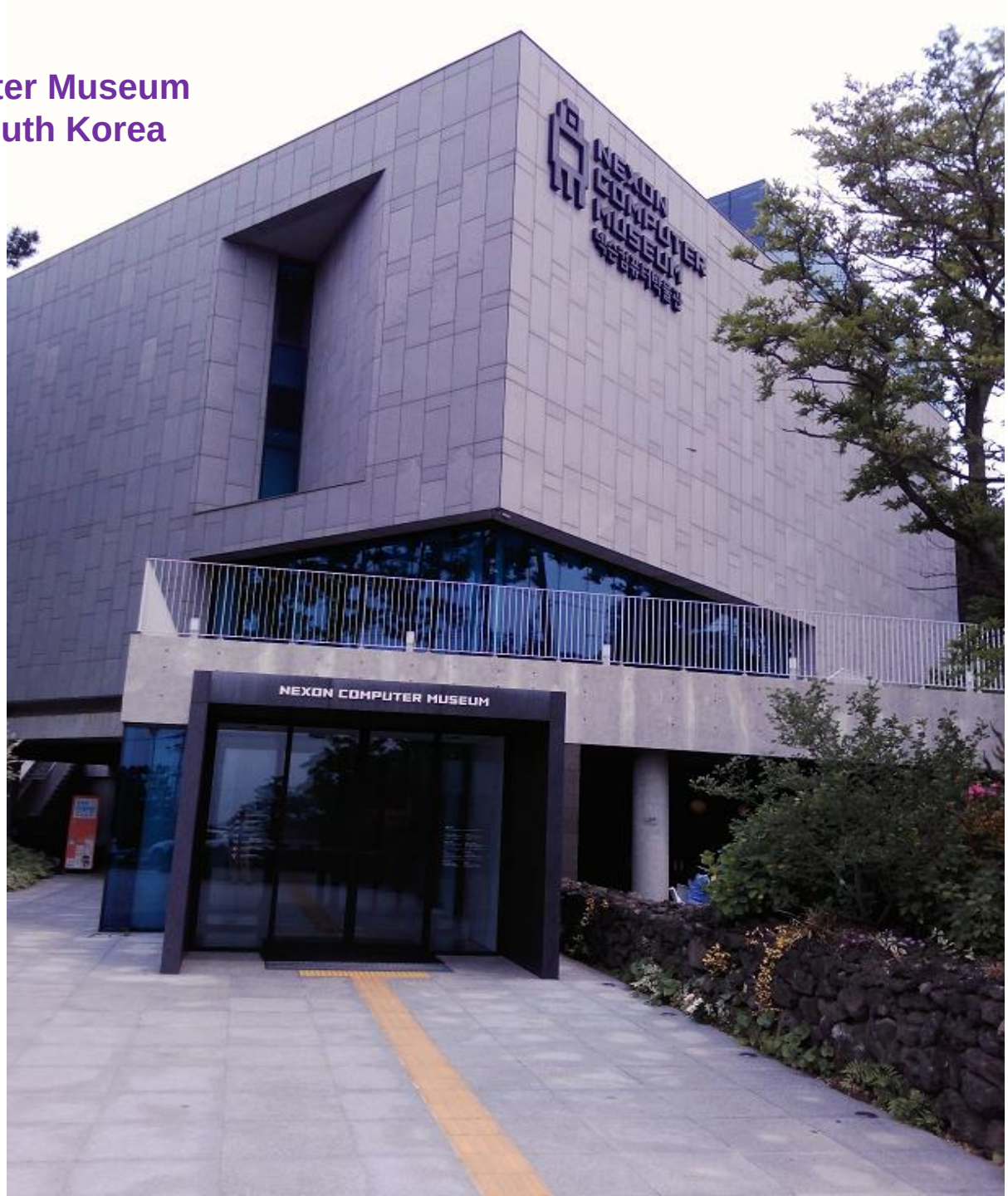
PH 301

ENGINEERING OPTICS

Lecture_Consumer Devices_32

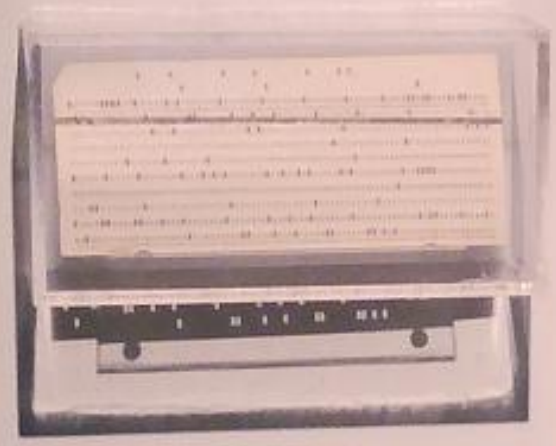
Nexon Computer Museum
Jeju Island, South Korea



Punched Card

120 Byte

60 글자수 (한글 유니코드 기준)



8" Floppy Disk

0.25 MB

131,072 글자수 (한글 유니코드 기준)


Cassette Tape
0.6
MB
314,573
글자수
(한글 유니코드 기준)
California
epyx


5.25" Floppy Disk
1.25
MB
655,360
글자수
(한글 유니코드 기준)


3.5" Floppy Disk
1.44
MB
754,975
글자수
(한글 유니코드 기준)


Zip Disk
100
MB
52,428,800
글자수
(한글 유니코드 기준)
zip
PC100


CD
650
MB
340,787,200
글자수
(한글 유니코드 기준)


DVD
4.7
GB
2,522,873,856
글자수
(한글 유니코드 기준)


USB Memory /
SD Card / CF Card
8
GB
4,294,967,296
글자수
(한글 유니코드 기준)


Blu-ray Disc
25
GB
13,421,772,800
글자수
(한글 유니코드 기준)

HDD

512 GB

274,877,906,944 글자수
(한글 유니코드 기준)

Compact Disc's & Digital Versatile Disc's

- **Data is stored digitally**
  - **A series of ones & zeros read by laser light reflected from disc**

- **Strong reflections correspond to constructive interference**
  - **These reflections are chosen to represent zeros**

- **Weak reflections correspond to destructive interference**
  - **These reflections are chosen to represent ones**

CD's & Thin Film Interference

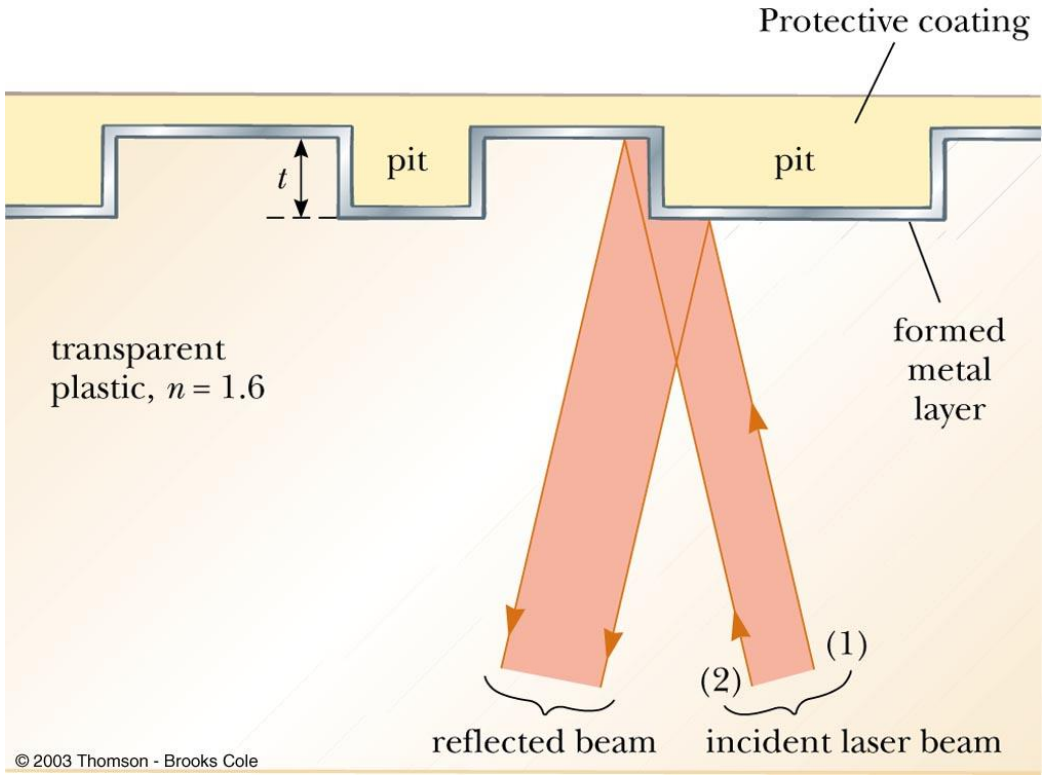
- **A CD has multiple tracks**
  - **Tracks consist of a sequence of pits of varying length formed in a reflecting information layer**
- **Pits appear as bumps to laser beam**
  - **Laser beam shines on metallic layer through a clear plastic coating**

Tracks of a CD act as a diffraction grating, producing a separation of colors of white light. Nominal track separation on a *CD* is 1.6 *μm*, corresponding to about 625 tracks per mm. For *λ* = 600 *nm*, this would give a first order diffraction maximum at about 22º.

Reading a CD

- As disk rotates, laser reflects off sequence of bumps & lower areas into a photodector.
  - Photodector converts fluctuating reflected light intensity into an electrical string of zeros & ones

- Pit depth is made equal to one-quarter of wavelength of light.



Reading a CD

- When laser beam hits a rising or falling bump edge, part of the beam reflects from top of bump & part from lower adjacent area.
  - This ensures destructive interference & very low intensity when reflected beams combine at the detector
- Bump edges are read as ones.
- Flat bump tops & intervening flat plains are read as zeros.

DVD's

- DVD: developed by Panasonic, Philips, Sony, & Toshiba in 1995.

- Laser & Optics:
- DVD's use shorter wavelength lasers

  - Track separation, pit depth, & minimum pit length are all smaller.

  - Therefore, DVD can store about 30 times more information than a CD.

Laser & Optics

- **All three common optical disc media (CD, DVD, & Blu-ray) use light from laser diodes, for its spectral purity & ability to be focused precisely.**

- **DVD uses light of 650 nm wavelength (red), as opposed to 780 nm for CD. This shorter wavelength allows a smaller pit on the media surface compared to CDs (0.74 µm for DVD versus 1.6 µm for CD), accounting in part for DVD's increased storage capacity.**

- **Blu-ray Disc, successor to DVD format, uses a wavelength of 405 nm (violet), & one dual-layer disc has a 50 GB storage capacity.**

Laser Printer

Gray Starkweather, 1969

- Printers are classified into Impact & Non-impact printers.
- Laser printers use electrostatic printing process. It is a type of printer that utilizes a laser beam to produce an image on drum.
- It uses a non-impact (keys don't strike the paper), photocopier technology.
- Commercially IBM introduced 1st laser printer in 1975 to use it with mainframe computers.
- In 1984, Hewlett-Packard (HP) revolutionized laser printing technology with its 1st LaserJet, a compact, fast, & reliable printer.

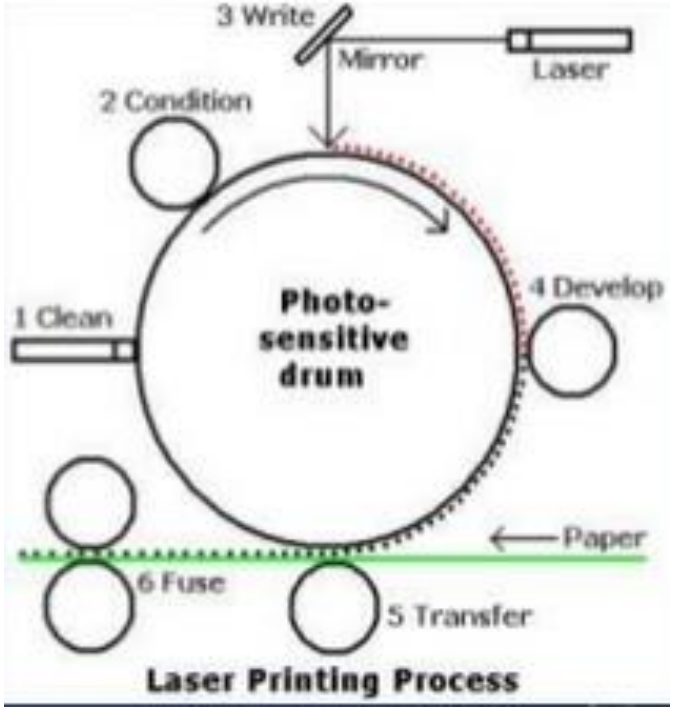
Laser Printing Process

Cleaning

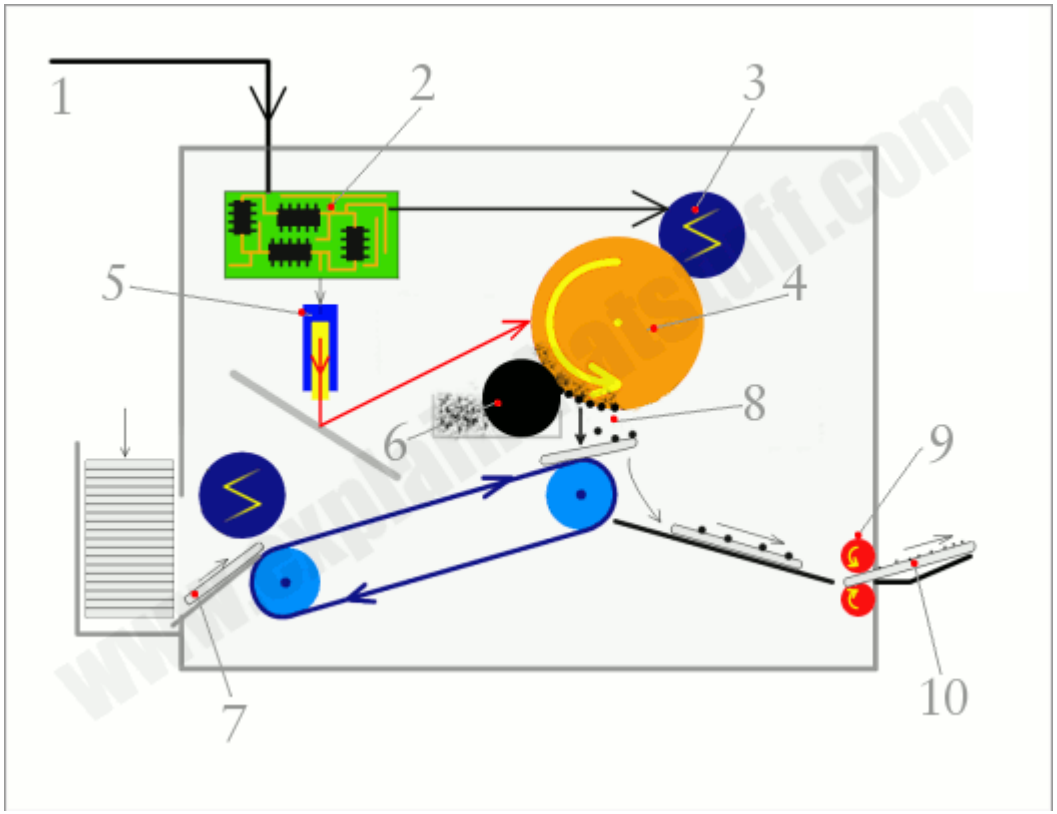
Before a new page is printed, any remaining from previous page are cleared away. The drum is swept free with a rubber blade, & a fluorescent lamp removes any electrical charge remaining on the drum.

Conditioning

Entire drum is uniformly charged by primary corona wire. This charge conditions the drum for next step.



Laser Printing Process



1. Millions of bytes (characters) of data stream into the printer PC.

2. An electronic circuit in printer (effectively, a small computer in its own right) figures out how to print this data so it looks correct on the page.

Laser Printing Process

3. Electronic circuit activates corona wire (a high-voltage wire that gives a static electric charge to anything nearby).

4. Corona wire charges up photoreceptor drum so drum gains a + ve charge spread uniformly across its surface.

5. Simultaneously, circuit activates laser to make it draw image of page onto the drum. Laser beam doesn't actually move, it bounces off a moving mirror that scans it over drum. Where laser beam hits drum, it erases +ve charge & creates an area of -ve charge. Gradually, an image of entire page builds up on drum: where page should be white, there are areas with a +ve charge; where page should be black, there are areas of -ve charge.

6. An ink roller touching photoreceptor drum coats it with tiny particles of powdered ink (toner). Toner has been given a +ve charge, so it sticks to parts of photoreceptor drum that have a –ve charge. No ink is attracted to parts of drum that have a +ve charge. An inked image of page builds up on drum.

Laser Printing Process

7. A sheet of paper from a hopper on the other side of printer feeds up toward the drum. As it moves along, paper is given a strong +ve charge by another corona wire.

8. When paper moves near drum, its +ve charge attracts negatively charged toner particles. Image is transferred from drum onto paper but, for the moment, toner particles are just resting lightly on paper's surface.

9. Inked paper passes through two hot rollers (fuser unit). Heat & pressure from rollers fuse the toner particles permanently into fibers of paper.

10. Printout emerges from side of the copier. Thanks to the fuser unit, paper is still warm. It's literally hot off the press!

Quick Response codes

A QR code...

- **is a matrix or a 2D barcode, first designed for the automotive industry (1994) to hold information.**
- **can hold up to 7,089 characters whereas a typical barcode can only hold a maximum of 20 digits.**
- **uses four standardized encoding modes (numeric, alphanumeric, byte/binary, & kanji) to store data.**

THE TIMES OF INDIA 9

JAN 12, 2020

How not to buy into a QR code scam

Scammers are now using WhatsApp to steal money. Find out how you can protect yourself

businessinsider.in

Selling your products on online marketplaces is easy and can be done in just a few minutes through an app. However, there has always been an element of risk involved while dealing with strangers and there have been several cases where the buyer takes the product without making the payment.

Now, a new type of scam has surfaced, in which the potential buyer scams the seller and takes their money. It involves the buyer sharing a QR code with the seller on WhatsApp and tricking them into sending them money.

How does the QR code scam work?

The scammers approach sellers listed on online portals and mention that they want to buy products from them. Then, they send a QR code to the seller on WhatsApp and ask them to scan the code to receive money. However, this is a 'collect' request and once the seller scans the QR and enters the PIN, the buyer receives money.

How to protect yourself from QR code fraud

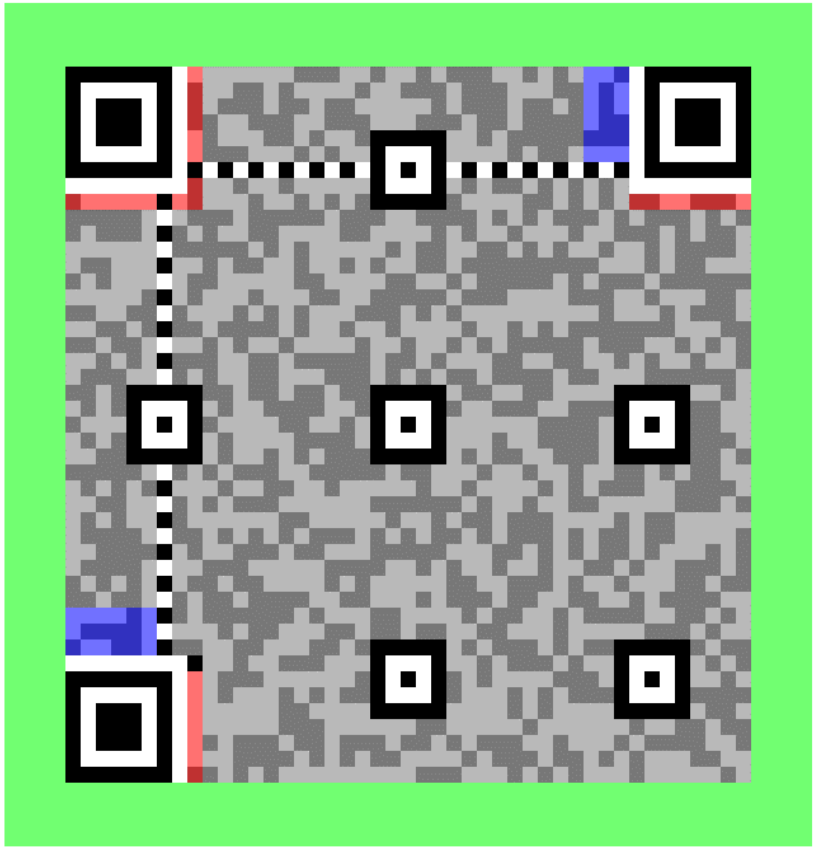
The first thing you need to remember is that when you are receiving money, you do not need to scan any QR code. Scanning of QR code is required only while making a payment.

- Do not scan any QR code while accepting payments.
- Do not scan any QR code if you do not know its origin.
- If you are a seller, make sure to check your bank balance and don't just rely on SMS alerts while receiving money from a buyer.

Working of a QR code

- Consists of black squares arranged in a square grid on a white background.
- Read by an imaging device such as a digital camera.
- Processed using Reed-Solomon error correction until the image can be appropriately interpreted.

Structure of a QR code



1. Version information
2. Format information
3. Data and error correction keys
4. Required patterns
   - 4.1. Position
   - 4.2. Alignment
   - 4.3. Timing
5. Quiet zone

Preliminaries of a QR code

Capacity of a QR code depends on the version, error correction level, & type of encoded data.

Versions

Depends on sizes of QR code:

- **21 × 21 pixel size is version 1,**
- **25 × 25 pixel size is version 2, & so on**
- **177 × 177 size is version 40**

Data modes

QR code can encode in four data modes:

- **numeric, (1 2 3 4 5...)**
- **alphanumeric (8 9 a b c d e …)**
- **binary (0 1)**
- **Japanese (kanji)**

Error correction

QR codes include error correction:

- **L, allows the code to be read even if 7% of it is unreadable.**
- **M, provides 15% error correction,**
- **Q, provides 25%,**
- **H, provides 30%.**

Number of symbol characters & input data capacity for QR Code

Version	Error correction level	Number of data Code words	Number of data bits	Data capacity			
				Numeric	Alphanumeric	Byte	Kanji
1	L M Q H	19 16 13 9	152 128 104 72	41 34 27 17	25 20 16 10	17 14 11 7	10 8 7 4
2	L M Q H	34 28 22 16	272 224 176 128	77 63 48 34	47 38 29 20	32 26 20 14	20 16 12 8
3	L M Q H	55 44 34 26	440 352 272 208	127 101 77 58	77 61 47 35	53 42 32 24	32 26 20 15

Error correction characteristics for QR Code

Version	Total number of code words	Error correction level	Number of error correction code words	Value of p	Number of error correction blocks	Error correction code per block (c,k,r)
1	26	L M Q H	7 10 13 17	3 2 1 1	1 1 1 1	(26,19,2) (26,16,4) (26,13,6) (26,9,8)
2	44	L M Q H	10 16 22 28	2 0 0 0	1 1 1 1	(44,34,4) (44,28,8) (44,22,11) (44,16,14)
3	70	L M Q H	15 26 36 44	1 0 0 0	1 1 2 2	(70,55,7) (70,44,13) (35,17,9) (35,13,11)
c = total number of code words, k = number of data code words, r = error correction capacity						

Data bits required for a particular data mode

Version	1-9	10-26	27-40
Numeric (bits)	10	12	14
Alphanumeric (bits)	9	11	13
Binary (bits)	8	16	16
Japanese (bits)	8	10	12

Bit strings for a particular data mode

Bit string	Data mode
0001	Numeric mode
0010	Alphanumeric mode
0100	Binary mode
1000	Japanese mode