Core Semiconductor Technologies

1876 / 1897 / 1900

Telephone invented by Graham Bell
Cathode ray tube invented by Karl Ferdinand Braun

Two-electrode vacuum tube invented by John Fleming

Three-electrode vacuum tube invented by Lee De Forest
Television receiver with a cathode ray tube devised by Russian scientist Boris Rosing

Development of electronic circuit and control technology

Demand for durable solid state devices

Photovoltaic effect in silicon discovered by Russell Ohl (at Bell Labs)
P- and n-type conduction discovered by Jack Scaff
Technique to manufacture p- and n-type semiconductors by doping impurities discovered by Henry Theuerer and Jack Scaff

Point-contact transistor discovered by Walter Brattain and John Bardeen
Junction transistor theory published by William Shockley

Bell Labs licenses transistor technology
Field-effect transistor theory published by William Shockley
Solar cell invented

Gas diffusion method invented by Calvin Fuller
Esaki diode invented by Leo Esaki
Demonstration of IC by Texas Instruments (TI)
Fairchild and TI announce IC

Prototyping of MOSFET at Bell Labs
Planar IC patent granted

CCD invented at Bell Labs

Memory	Power Device
First semiconductor memory DRAM prototyped at IBM Intel ships 64-bit bipolar memory chips	Hitachi and AIST invent power MOSFET

MPU(CPU)/GPU/QPU

World's first microprocessor
Intel 4004 announced
Intel 8080 announced
Motorola 6800 announced
Z80 announced by Masatoshi Shima, Zilog
Intel 8086 (16-bit) announced

Intel 80286 announced
Intel 80386 (32-bit) announced

Intel 80486 announced

Intel Ships World's First DRAM 1103 (1kbit)

Flash memory invented
by Fujio Masuoka, Toshiba
Successful prototyping of
16 Mb DRAM by NTT

GE invents IGBT
Toshiba develops popular IGBT

Blue LED invented
by Shuji Nakamura

Intel Pentium announced
Intel Xeon announced

NVIDIA GPU invented

Fuji Electric invents superjunction
power MOSFET

Cell Broadband Engine
announced
Research in quantum bits,
quantum algorithms, and
quantum optics makes progress

D-Wave Systems delivers
a quantum computer product

Method for enabling massive
optical quantum computing
invented by Akira Furusawa
at the University of Tokyo

NVIDIA GeForce GT1030 announced
Intel Core i9 MPU announced

AMD Ryzen 4xx series announced
IBM 27 Quantum bits QPU "Falcon" announced

HBM1 (4-chip stacked DRAM) announced
HBM2 (4/8-chips stacked DRAM) announced
Gen. 1x-nm DRAM volume production start

Infineon releases high voltage (1.2KV) IGBT4

Infenion releases low and medium
voltage Si power MOSFET "OptMOS6"
Infineon announces the "CoolGaN"
series of normally-off GaN-HEMTs

Infineon releases high voltage (1.2KV) IGBT7
Infineon starts normally-off GaN-HEMTs
volume production

Apple M1 MPU announced
IBM 65 Quantum bits QPU "Hummingbird" announced

IBM 127 Quantum bits QPU "Eagle" announced

tsmc starts N3(3nm) Logic device volume priduction
AMD Ryzen 7xx series announced
IBM 433 Quantum bits QPU "Osprey" announced

Intel Core Ultra 9 announced
IBM 1121 Quantum bits QPU "Condor" announced

AMD Ryzen 8xx series announced
NVIDIA GPU "Blackwell B200" announced

Micron starts 176-layer 3D-NAND
volume production

Micron/SK-Hynix/Samsung starts
Gen.1a(α)-nm Gen. DRAM volume production

Samsung announce HBM3
(8/12-chip stacked DRAM)
236-layer 3D-NAND volume production
starts
Micron/Samsung starts
GEN.1b(β)-nm Gen. DRAM volume production

Infineon announces SiC Power Module
for EV

FLOSFIA develops SBD using
Gallium Oxide (α-Ga2O3)

Diamond MOSFET developed (NIMS)

tsmc starts N3(3nm) Logic device volume priduction
NVIDIA GPU "Blackwell ULTRA" announced

SK-Hynix starts 321-layer 3D-NAND
volume production to be started

GaN-on-GaN vertical HEMT to be
commercialized

NVIDIA GPU "Rubbin" announced
tsmc starts A16(1.6nm) Logic device volume priduction
to be started
NVIDIA GPU "Rubbin ULTRA" to be announced
Photonics-electronics fusion chips

Gen. 1c(γ)-nm Gen. DRAM volume production
to be started
HBM4 (16-chips stacked DRAM) to be
announced
Gen. 1d(α)-nm Gen. DRAM volume production
to be started (final product of 2D DRAM)
500-layer 3D-NAND volume production
to be started
3D-DRAM volume production to be started
1000-layer 3D-NAND to be announced

Commercialization of power devices
using Gallium Oxide (Ga2O3)
Commercialization of power devices
using diamond

1910 – 2025 / Beyond 2025

Applied technologies

Telegraph, telephone, wireless communication

Wireless communication technology

Vacuum tube technology

Radio broadcasting

- First radio station starts broadcasting
- Radio broadcasting starts in the UK
- Radio broadcasting starts in Japan

Television Broadcast

- World's first successful reception of images using a cathode ray tube Successful
- TV transmission experiment between New York and Washington DC Experimental
- TV broadcasting starts
- Worlds' first commercial TV broadcasting starts in the UK (BBC)
- NHK starts experimental TV broadcasting in Japan

Transistor technology

- Japan's first transistor radio TR-55 released by Sony

IC technology

Microprocessor technology

Mobile phone service

- Digital mobile phone service starts
- PHS service starts
- i-mode phone service starts
- Apple announces the iPhone
- HTC Dream released
- Android phones announced
- Google Glass announced
- 3.9G LTE cellular network mobile phone released
- 4G LTE Advanced network mobile phone released
- Apple: Apple Watch released
- Apple iPhone 11 series released
- Apple iPhone 12 series released
- 5G network compatible mobile phone released
- Apple iPhone 13 series released
- Bone Conduction MEMS Microphone released
- Apple iPhone 14 series released
- Apple iPhone 15 series released
- Apple AI-powered iPhone16 series released
- Samsung Galaxy S24 released
- Apple Vison pro released
- Apple iPhone 17 series to be released
- Apple iPhone 18 series to be released
- Widespread use of metaverse represented by AR/VR such as TWS earbuds (fully wireless connected earphones/speakers)
- 6G network compatible mobile phone to be released

Calculator

- First electronic calculator ANITA Mk VIII introduced
- IC-based calculator CS-31A released by Sharp
- LSI-based calculator QT-80 released by Sharp

Gaming

- Video game Pong announced
- Video game Space Invaders announced
- Atari shock (video game crash)
- Nintendo Family Computer released
- Sega Mega Drive released
- Nintendo Game Boy released
- Nintendo Super Famicom released
- Panasonic 3DO REAL released
- Sega Saturn released
- SCE PlayStation released
- Nintendo 64 released
- SCE PlayStation 2 released
- SCE PSP released
- Nintendo DS released
- SCE PlayStation 3 released
- SCE PlayStation 4 released
- Virtual Reality(VR)
- Augmentted Reality(AR)
- SCE PlayStationS released
- VR game Oculus Quest2 released
- Nintendo Switch released
- Nintendo Switch II released

- One-seg service starts in Japan
- Digital TV broadcast in terrestrial base in Japan
- NHK starts 4K and 8K experimental broadcasting
- NHK starts 4K and 8K satellite broadcasting

PCs

- Xerox Alto completed
- Altair 8800 computer kit announced
- NEC TK-80 introduced
- Microcomputer magazine I/O launched
- First West Coast Computer Faire held
- Apple II released by Apple Computer
- ASCII magazine launched
- IBM PC released
- NEC PC-8801, PC-6001 announced
- IBM PC compatible co mputer released by Compaq
- Macintosh announced
- Windows 95 announced
- Apple releases iPad
- Microsoft Window8 announced
- Personal 3D printer released
- Microsoft Windows10 announced
- Microsoft Window11 announced
- Microsoft AI-powered Window 12 announced
- Window13 with Microsoft AI & Quantum C to be announced

Computers

- Atanasoff–Berry computer (ABC) invented
- Bell Labs Model 1 relay computer introduced
- Decrypt computer Colossus introduced
- World's first general-purpose computer ENIAC completed
- First commercial-use computer UNIVAC I introduced
- First transistorized computer TRADIC introduced
- Eiichi Goto at the University of Tokyo invents "parametron" logic circuit element
- First commercial-use transistor computer IBM 608 announced
- Japan's first electronic computer FUJIC introduced
- Last vacuum tube computer IBM 709 released
- IBM 7070, 7090, CDC 1604
- PDP-1 released by DEC
- PDP-5 released by DEC
- IBM System 360 announced
- PDP-11 released by DEC
- Cray-1 announced
- K computer starts operations
- Parrot (France) Multicopter AR.Drone released for commercial use
- IBM AI Watson Public released
- 118 qubit D-wave one announced
- AI (artificial intelligence)
- Deep learning
- 512 qubits D-wave Two announced
- 2048 qubits D-Wave 2000Q announced
- FUGAKU computer starts operations
- IBM Quantum System One in operation
- RIKEN operates Japan's first quantum computer "A"
- IBM Quantum System Two starts operation
- Earth Simulator starts operations

Computer technology

Comminication Networks

- ARPANET introduced
- Ethernet announced
- TRON project launched by Ken Sakamura
- WWW specification released
- Mosaic browser released
- IIJ starts network connection service in Japan
- Netscape Navigator announced
- Java announced
- Bluetooth
- WiFi/Wireless LAN service starts in Japan
- Remote medical treatment (virtual care)
- NTT successfully conducts 5G trial communications in outside environment
- Four Japanese GPS "Michibiki" satellites start operation
- SpaceX Launches Starlink (Satellite) for Satellite Internet Service
- Widespread use of cloud-based conferencing tools
- Practical Application of Blockchain Technology
- 5G Network Deployment
- Realization of commercial space travel (Blue Origin, SpaceX)
- Start of 6G service to be started

Autonomous driving

- Tesla Motors Established
- Start of sales for Subaru EyeSight (Autonomous Emergency Braking System)
- Start of sales for BEV Nissan Leaf
- Autonomous driving becomes commercially available
- Start of sales for Tesla Motors Model 3
- Start of sales for Tesla Motors Model Y
- Widespread adoption of battery electric vehicles (BEVs)
- Hyundai Robo-taxi IONIQ 5 achieves Level 4 certification.
- Achievement of Level 4 autonomous driving on highways (in Japan)
- Level 5 autonomous driving (fully autonomous driving) Proof of Concept starts
- Commercialization of fully electric vehicles (BEVs) with all solid-state battery systems
- Level 5 autonomous driving (fully autonomous driving)
- Widespread adoption of commercial vehicles (taxis, buses, trucks)
- Complete electrification of new vehicles (in Japan)

Generated AI

- Announcement of OpenAI GPT-1
- Announcement of OpenAI GPT-2
- Announcement of OpenAI GPT-3
- Announcement of OpenAI ChatGPT
- Announcement of Google PaLM
- Announcement of Microsoft Copilot
- Announcement of OpenAI GPT-4
- Announcement of Meta LLaMA
- NTT "tsuzumi" Service Launch
- NEC "cotomi" Service Launch
- Announcement of OpenAI Sora
- Announcement of Meta LLaMA3.1
- OpenAI GPT-5 to be announced

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