

Consumer Electronics



CONSUMER ELECTRONICS ASSOCIATION [www.CE.org](http://www.CE.org)



Sponsored by **CE VISION** magazine

*Hall of Fame*

2006



## *CEA Honors the 2006 Inductees Into the CE Hall of Fame*

Tuesday, October 17, 2006

The Grand Ballroom

7 – 8 p.m. Dinner Service

### *Menu*

#### **Hors d' Oeuvres**

*Warm Sun-Dried Tomato and Crab Tart*

#### **Salad**

*Napa Valley Mixed Greens, Diced English Cucumber, Crumbled Bleu Cheese, Candied Walnut, Cabernet Poached Pear and Citrus Vinaigrette*

#### **Entrée**

*Beef Filet with Green and Red Peppercorns, Caramelized Onion, Swiss Chard, Brandy-Mustard Sauce, Gratin Potato, Seasonal Vegetables*

#### **8 – 9 p.m.**

#### **Presentation of the Inductees**

Master of Ceremonies

Gary Shapiro

President and CEO

Consumer Electronics Association

#### **9 – 10 p.m.**

**Buffet of Assorted Desserts**







Welcome to the third annual CE Hall of Fame Awards dinner!

The CE Hall of Fame honors the leaders who have grown the consumer electronics industry and improved consumers' lives. Although their contributions are different, each of the inductees has similar traits: will power, determination and vision. The expression "thinking outside the box" applies to this group of progressive thinkers.

Although at times discouraged, they had the desire to persevere and stay focused on their goal. Each seemed to follow Winston Churchill's simple and powerful adage: "Never, never, never give up."

Today's technology innovations continue to be built on the work of industry pioneers, many of whom are already members in the CE Hall of Fame. The first inaugural class of 50 leaders, inducted in 2000 has grown to 98 members. The 12 new inductees joining this prestigious group tonight bring that number to 110. The 2006 class will join such leaders as William Boss, Harry Elias, Ray Dolby, Ray Gates, Ken Kai, Akio Morita, Dr. Woo Paik and Steve Wozniak.

## The 2006 Class

Today, the CE industry is in full swing with 2006 sales forecast to top \$135 billion. Collectively, the class of 2006 has developed, promoted and merchandized consumer technologies and products that connect, entertain and inform consumers.

For example, **Jack Doyle**, the founding president of Pioneer (and former chairman of CEA), is credited with bringing

high-fidelity audio sound to consumers. **Robert Galvin**, chairman and CEO Motorola, expanded the company his father founded into a truly global semi-conductor and cell phone company. **Dr. George Heilmeier** led the team that developed the liquid crystal display (LCD) and earned 15 patents along the way. **Dr. Nick Holonyak Jr.**, a professor invented the light-emitting diode (LED) and earned 34 patents. **Howard Ladd** founded Concord Electronics, was chairman of Fisher (and CEA), and later established Sanyo-U.S., and launched a number of innovative products.

**Alfred J. Richard**, chairman, P.C. Richard & Son Retail Chain, an entrepreneurial retailer, founded the nation's largest family-owned and operated CE, appliance and PC retailer. **John Roach**, chairman Tandy/CEO RadioShack, was an industry advocate and early proponent of personal computing selling the TRS-80 PC in 1977.

What's more, two teams were voted in to the CE Hall of Fame this year. The first group are Intel Co-founders **Andrew Grove** and **Gordon Moore**. The second team are the co-inventors of the plasma display, **Donald Bitzer**, **Gene Slottow** and **Robert Willson**.

To select the 2006 class, a panel of 15 CE media and industry professionals met in New York last November to judge the hundreds of nominations that were submitted by manufacturers, retailers and industry journalists. The judges considered each nominee and used the democratic process of the majority of votes to determine the new class. We thank the following journalists and industry professionals for volunteering their time and expertise to participate in the 2006 CE Hall of Fame program:

Jim Barry  
Bob Borchardt  
Brian Fenton  
Rick Clancy  
Marge Costello  
Howard Geltzer  
Robert Gerson  
Peter Ildau

Joe Palenchar  
Bill Pritchard  
Richard Sherwin  
John Shalam  
John Taylor  
Jack Wayman  
Stewart Wolpin

## Participate in the Hall of Fame

You can play a role in the Hall of Fame program for 2007 by nominating the individual you believe has contributed most significantly to consumer electronics, as we know it today. Visit [www.CE.org](http://www.CE.org) for a nomination form. Final selections will be tabulated and again judged by a panel made up of CEA members, media and other industry professionals.

At the end of the day, thanks to industry visionaries, the CE industry continues to provide products that consumers' value around the globe.



Gary Shapiro,  
CEA President and CEO



Cindy Stevens,  
CEA Director, Publications

*Thank You to  
Our Industry  
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**ESPN2HD**



## *Congratulations*

*CE Vision* magazine congratulates the new inductees to the CE Hall of Fame. We thank you for your contribution to the advancement of the consumer electronics industry.

**VISION**  
Capture the *Vision* of CES all year long!  
The official publication of CEA.



*Thank you to our Hall of Fame sponsor Tradecard*

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# Distinguished Members of the CE Hall of Fame



## 2006 Inductees

*Jack Doyle*  
*Robert Galvin*  
*Dr. George Heilmeier*  
*Dr. Nick Holonyak Jr.*  
*Howard Ladd*  
*Alfred J. Richard*  
*John Roach*  
*Team: Andrew Grove and Gordon Moore*  
*Team: Dr. Donald Bitzer, Gene Slottow and Robert Willson*

## 2005 Inductees

*Ken Crane*  
*Joseph Donahue*  
*Harry Elias*  
*George Fezell*  
*Saul Gold*  
*Jack Lusk*  
*Art Levis*  
*Masaharu Matsushita*  
*John Winegard*  
*Team: William Hewlett and David Packard*

## 2004 Inductees

*Blumlein, Alan Dower*  
*Brief, Henry*  
*Gerson, Robert E.*  
*Kai, Ken*  
*Kalov, Jerry*  
*Klipsch, Paul*  
*Ohga, Norio*  
*Paik, Dr. Woo*  
*Wozniak, Steven*  
*Team: Richard Frenkiel and Joel Engel*

## 2003 Inductees

*Borchardt, Herbert*  
*Feldman, Leonard*  
*Immink, Kees A. Schouhamer*  
*Kasuga, William*  
*Kent, Atwater*  
*Steinberg, Jules*  
*Takayanagi, Kenjiro*  
*Tushinsky, Joseph*  
*Wurtzel, Alan*

## 2002 Inductees

*Alexanderson, Ernst F.W.*  
*Appel, Bernard*  
*Baker, W.G.B.*  
*Boss, William E.*  
*Ekstract, Richard*  
*Fisher, Walter*  
*Gates, Raymond*  
*Lear, William Powell*  
*Polk, Sol*  
*Sauter, Jack K.*

## 2001 Inductees

*Berliner, Emil*  
*Fleming, Sir John Ambrose*  
*Gernsback, Hugo*  
*Jensen, Peter Laurits*  
*Muntz, Earl*  
*Poulsen, Valdemar*  
*Westinghouse, George*

## 2000 Inductees

*Abrams, Benjamin*  
*Adler, Robert*  
*Armstrong, Edwin*  
*Baird, John Logie*  
*Balderston, William*  
*Bardeen, John*  
*Bell, Alexander Graham*  
*Blay, Andre*  
*Brattain, Walter*  
*Braun, Karl Ferdinand*  
*Busnell, Nolan*  
*Crosley Jr., Powel*  
*DeForest, Lee*  
*Dolby, Ray*  
*DuMont, Allen*  
*Edison, Thomas*  
*Eilers, Carl*  
*Farnsworth, Philo T.*  
*Fessenden, Reginald Aubrey*  
*Fisher, Avery*  
*Freimann, Frank*  
*Galvin, Paul*  
*Ginsberg, Charles*  
*Goldmark, Peter*  
*Harman, Dr. Sidney*  
*Hertz, Heinrich*  
*Ibuka, Masaru*  
*Johnson, Eldridge*  
*Kilby, Jack*  
*Kloss, Henry*  
*Koss Sr., John*  
*Lachenbruch, David*  
*Lansing, James B.*

*Marantz, Saul*  
*Marconi, Guglielmo*  
*Matsushita, Konosuke*  
*McDonald Jr., Cmdr. Eugene*  
*Morita, Akio*  
*Noyce, Robert*  
*Poniatoff, Alexander M.*  
*Roberts, Ed*  
*Sarnoff, David*  
*Scott, Hermon Hosmer*  
*Shiraishi, Yuma*  
*Shockley, William*  
*Siragusa Sr., Ross*  
*Takano, Shizuo*  
*Tesla, Nikola*  
*Wayman, Jack*  
*Zworykin, Vladimir*





BENJAMIN ABRAMS



ROBERT ADLER



ERNST F.W. ALEXANDERSON



BERNARD APPEL



EDWIN ARMSTRONG



JOHN LOGIE BAIRD



W.G.B. BAKER



WILLIAM BALDERSTON



JOHN BARDEEN



ALEXANDER GRAHAM BELL



EMILE BERLINER



ANDRE BLAY



DR. DONALD BITZER



ALAN DOWER BLUMLEIN



HERBERT BORCHARDT



WILLIAM E. BOSS



WALTER BRATTAIN



KARL FERDINAND BRAUN



HENRY BRIEF



NOLAN BUSHNELL



KEN CRANE



POWELL CROSLLEY JR.



LEE DEFESTRE



RAY DOLBY



JOSEPH DONAHUE



JOHN "JACK" DOYLE



ALLEN DUMONT



THOMAS EDISON



RICHARD EKSTRAT



CARL EILERS



HARRY ELIAS



JOEL ENGEL



PHILO T. FARNSWORTH



LEONARD FELDMAN



REGINALD AUBREY FESSENDEN



AVERY FISHER



WALTER FISHER



JOHN AMBROSE  
FLEMING



RICHARD FRANKIEL



FRANK FREIMANN



GEORGE FEZELL



PAUL GALVIN



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RAYMOND GATES



HUGO GERNSBACK



ROBERT E. GERSON



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PETER GOLDMARK



ANDREW STEPHEN  
GROVE



DR. SIDNEY HARMAN



DR. GEORGE HEILMEIER



HEINRICH HERTZ



WILLIAM HEWLETT



DR. NICK HOLONYAK JR.



MASARU IBUKA



DR. KEES A.  
SCHOUHAMER IMMINK



PETER LAURITIS  
JENSEN



ELDRIDGE JOHNSON



KEN KAI



JERRY KALOV



WILLIAM KASUGA



ATWATER KENT



JACK KILBY



PAUL KLIPSCH



HENRY KLOSS



JOHN KOSS SR.



DAVID LACHENBRUCH



HOWARD LADD



JAMES LANSING



WILLIAM POWELL LEAR



ART LEWIS



											
JACK LUSKIN	SAUL MARANTZ	GUGLIELMO MARCONI	KONOSUKE MATSUSHITA	MASAHARU MATSUSHITA	COMMANDER EUGENE McDONALD JR.	GORDON MOORE	AKIO MORITA	EARL MUNTZ	ROBERT NOYCE	NORIO OHGA	DAVID PACKARD
											
DR. WOO PAIK	SOL POLK	ALEXANDER PONIA TOFF	VALDEMAR POULSEN	ALFRED J. RICHARD	JOHN ROACH	ED ROBERTS	JACK SAUTER	DAVID SARNOFF	HERMON HOSMER SCOTT	YUMA SHIRAIISHI	WILLIAM SHOCKLEY
											
ROSS SIRAGUSA SR.	H. GENE SLOTTOW	JULES STEINBERG	SHIZUO TAKANO	KENJIRO TAKAYANAGI	NIKOLA TESLA	JOSEPH TUSHINSKY	JACK WAYMAN	GEORGE WESTINGHOUSE	ROBERT WILLSON	JOHN WINEGARD	STEVEN WOZNIAK
											
ALAN WURTZEL	VLADIMIR ZWORYKIN										



## Dr. Donald Bitzer



(1934 - )

Co-Inventor, Plasma Display

When newly-minted Ph.D. Don Bitzer, along with fellow University of Illinois professor and senior research engineer Gene Slottow and graduate student Robert Willson, developed the first plasma display, they had no concept of high-definition TV. Bitzer, Slottow and Willson were merely trying to help solve the illiteracy problems in inner city schools.

Bitzer was born in East St. Louis, Illinois, at the stroke of midnight on January 1, 1934, the first baby born in the area that year, and grew up in nearby Collinsville. His interest in science was sparked by an uncle, a civil engineer and an electronics hobbyist who helped his nephew build radio sets, and was fueled by *Popular Mechanics* and *Popular Science* magazines. Bitzer earned his bachelor's degree in 1955, his master's degree in 1956 and his doctoral degree in 1960, all in electrical engineering, all from the University of Illinois at Urbana-Champaign (UIUC).

Soon after graduation, Bitzer became an assistant professor of the Electrical and Computer Engineering Department at UIUC, and was asked by Daniel Alpert, director of the Coordinated Science Laboratory at the University of Illinois, if he thought computers could be used as private tutors. Within a few months, Bitzer had produced the first computer-based instructional system, PLATO (Programmed Logic for Automatic Teaching Operations), which presented computer graphics with overlaid slides on a television set viewed by the students. As the system expanded to several terminals, it was clear that using storage tubes for memory and a television channel per terminal would not be economical and digital memory was too expensive to use in large quantities at the terminals. A display that was bright, had high contrast, was transparent, and had inherent memory was needed. These were needs that drove Bitzer to recruit Slottow and Willson to invent the A.C. plasma display panel, which they finished in July 1964.

The original panels of these early plasma displays were orange and found early use for computer graphic displays. But by 1966, Bitzer, now an associate professor, along with Slottow and Willson demonstrated multicolor panels using a gas discharge rich in ultraviolet light and color phosphors. In 1967, the plasma display was given the Industrial Research 100 award, presented to the most important inventions of the year and Bitzer was made a full professor.

In 1973, Dr. Bitzer received the Vladimir K. Zworkin Award from the National Academy of Engineering for "outstanding achievement in the field of electronics applied in the

service of mankind." In 1974, he was elected to the National Academy of Engineering. In 1982, Bitzer was named Laureate of the Lincoln Academy by the State of Illinois "for contributions made for the betterment of human endeavor."

Bitzer continued to work on plasma display technology as well as on the PLATO project until he retired from the University of Illinois in 1989 to become a Distinguished University Research Professor at North Carolina State University, where he continues to teach and do research. His new areas of research include multi-dimensional convolutional coding for communication and the use of signal processing and coding theory to discover genomic information that controls the translation process in protein production.

Bitzer has received many awards and is a fellow in the IEEE, AAAS, the Association for Development of Computer-based Instructional Systems and the National Engineering Consortium. He has numerous patents and publications in a variety of fields and has directed the thesis work of more than 100 graduate students.

In 2002, Bitzer became a National Associate of the National Academies of Science, Engineering, the Institute of Medicine, and the National Research Council, and, along with Slottow and Willson, was awarded an Emmy by the National Academy of Television Arts and Sciences for his efforts in advancing television technology.

# John “Jack” Doyle

(1929 - )

Founding President, Pioneer



At one time, customers for car stereo and home audio were considered to be quite different. Jack Doyle, however, didn't think so. He brought high-fidelity auto sound to audiophile customers and helped establish Pioneer as a preeminent brand.

John Doyle was born in Kentucky and raised in Cincinnati, Ohio. After graduating from Miami University, Oxford, Ohio with a BA, he joined the office products division of IBM, eventually moving to Southern California. In 1966, he joined Craig Corp. as sales manager of car stereo, later rising to director of marketing.

In 1971, Pioneer Electronics of Japan approached Doyle to start a U.S. subsidiary to distribute Pioneer-branded car stereo products. When Doyle started the new Pioneer of America, car stereo was a youth product, but was not sold in the many hi-fi stores and chains that had sprung up across the country. Doyle believed that hi-fi stores was where car stereo needed to be displayed and sold, and convinced an increasing number of home electronics retailers to stock his car stereo products.

To appeal to a more quality-conscious car stereo buyer, Pioneer worked with its Japanese factories to produce the Super Tuner, the first car stereo product with a superior FM tuner section. Between the wider distribution and the high-performance product, Pioneer quickly moved into the No. 1 position in the industry.

Pioneer had two American companies. Pioneer America sold car stereo and the separate U.S. Pioneer handled home audio. When the two companies merged as Pioneer Electronics of America, Doyle was named CEO and chairman.

In July 1986, Doyle took early retirement from Pioneer to become a partner with Bill Matthies and co-founded the Verity Group, a market research company. He remained active with the firm until its sale.

Doyle was active in industry affairs as well. He served on the board of directors of the Consumer Electronics Association (CEA), including two terms as chairman and was also on the board of governors of EIA. He has served on various boards of public and private companies, including Starsight Telecast and Inamed Corp. He presently serves on the board of the Pomona Valley Medical Center and is chairman of its foundation board. He is an active member of the Service Corps of Retired Executives (SCORE).

Jack and his wife Anne have four children and nine grandchildren and reside in Upland, California.



# Robert W. Galvin

(1922 - )

Chairman and CEO, Motorola



COURTESY OF MOTOROLA MUSEUM © 1999 MOTOROLA, INC.

Achieving success upon inheriting a successful business from your father is difficult. Robert Galvin inherited one of the country's leading consumer radio and two-way radio manufacturers from his father, Paul, in the late 1950s. Over the next 30 years leading Motorola, Robert turned his father's \$290 million company into a globally dominant semi-conductor and cell phone giant with annual sales of \$10.8 billion.

Born in 1922, Galvin started working for Motorola in 1940, starting at the bottom in the Motorola stock room and learning the business from both older employees and his father while attending Notre Dame and the University of Chicago. In 1948, he was elected executive vice president and, in 1956, was named president of the company. He took over Motorola completely after his father died on November 5, 1959.

Motorola was already a successful car radio and mobile telephone manufacturer in the late 1950s. Following a quick in-and-out in the mid-1950s, Galvin brought Motorola back into the color TV business in 1961. But Galvin soon recognized that the Japanese would exploit their lower costs and sold the business to a Japanese company, plowing the proceeds back into developing new businesses such as semi-conductors. Galvin assumed his father's position as chairman of the board of Motorola in 1964, and in 1970 also was named CEO, a post that had remained vacant since his father held it.

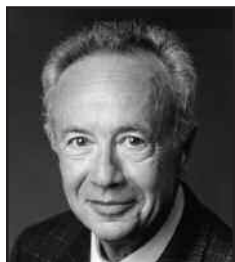
In the late 1960s, Galvin led Motorola's entry into the nascent cell phone business, encouraging the costly development of the first portable handset in 1973. Galvin's chance demonstration of the portable to President Reagan in the early 1980s led to the White House's support of opening up the cell phone business to competition rather than allowing the Federal Communications Commission (FCC) to award a monopoly to AT&T. While Motorola was establishing a dominant position in the cell phone hardware business, Galvin led the fight to open up Japanese markets to American goods and promoted the adoption of Japanese quality management methods. Galvin created both successful consumer products and direct-to-industry businesses while maintaining an entrepreneurial corporate culture. In recognition of his service to the American business community, President Reagan presented Galvin and Motorola one of the first Malcolm Baldrige awards in 1988. He was elected to the National Business Hall of Fame, and in 1991, received the National Medal of Technology.

In the late 1980s, Galvin began to step back from day-to-day involvement. In 1986, he retired as CEO and, in 1990, he stepped down as chairman of the board to become chairman of the executive committee of the board of directors. He finally retired from the board in May 2001.

But Galvin has remained active since retiring. He was chairman of the Board of Trustees of the Illinois Institute of Technology; chaired a Department of Energy task force called the Galvin Commission to research alternative futures; he chaired International Sematech, the chip consortium; co-chaired the Center for Strategic and International Studies on radio frequency spectrum management; served as vice chairman of the board of trustees for the Universities Research Association; and, was a member of the board of trustees of the Santa Fe Institute.

# Andrew Stephen Grove

(1936 - )  
Co-founder, Intel



Andrew Grove's ambition and drive led him on an unlikely course from his native Hungary to the University of California at Berkeley to found one of the most innovative and dominant American technology companies of modern times.

Grove's unlikely path started in Budapest in 1936 as Gróf András, the family name coming first in Hungary. In 1956, Grove, nicknamed Andris, escaped with his family under cover of night as the Russian's crushed the Hungarian Revolution, arriving in New York the following year. He lived with an uncle in the Bronx and worked his way through school, graduating at the head of his class with a bachelor's degree in chemical engineering from City College of New York in 1960. He then moved to California and earned his Ph.D. in physics from the University of

California, Berkeley in 1963. He immediately found work at Fairchild Semiconductor, where the integrated circuit was invented four years before. Grove became assistant director of research and development at Fairchild in 1967.

The following year, fellow Fairchild engineers Gordon Moore and integrated circuit co-inventor Robert Noyce left to form a new electronics company eventually named Intel. Grove asked to come along, and became Intel employee number three. None of the three knew exactly what the new company would be. According to Grove, the first Intel business plan was one page that said "absolutely nothing."

What Intel did was to invent and commercialize the microprocessor, starting with the four-bit 4004 chip in 1971, followed by the eight-bit 8008 in 1972 and what is considered the first all-purpose chip, the 8080 in 1974, which was used in the first personal computer, the Altair 8800. Grove soon came to be recognized as the company visionary and the driving force in moving the company from being merely a chip provider to a technology leader. In 1979, Grove was named president of Intel. Two years later, IBM tapped Intel to supply the new 8088 chips for the IBM PC. Grove was the day-to-day leader at Intel and is largely credited for building the company into the market leader it is today and is one of the primary drivers in ushering in the Information Age.

In 1987, Grove was named Intel's CEO, the same year he received the IEEE Engineering Leadership Recognition award. In May 1997, he added chairman to his list of Intel titles, the same year he was named Technology Leader of the Year by *Industry Week*, CEO of the Year by *CEO* magazine, and "Man of the Year" by *Time* magazine. Ironically, Grove resigned as CEO the following year.

Grove has written more than 40 technical papers and holds several patents on semiconductor devices and technology. He taught a graduate course in semiconductor device physics at his alma mater Cal Berkeley for six years. In 2004, Grove was named the "Most Influential Business Person in the Last Twenty-Five Years" by the Wharton School of Business and the *Nightly Business Report*. He stepped down as chairman in May 2005, but still holds the title senior advisor. Grove is involved in numerous industry and charitable organizations, most prominently in research to cure prostate cancer, which he suffered from in the mid-1990s. He also teaches a course entitled "Strategy and Action in the Information Processing Industry" at the Stanford University Graduate School of Business.



## George Heilmeier



(1936 - )  
Team leader, LCD  
Development

Calculators, cell phones, iPods. Computer flat screens. Any device that requires a screen would be almost impossible without the development of liquid crystal display (LCD) technology. And LCD development would have been almost impossible without George Heilmeier, who led the team at RCA's David Sarnoff Research Center that developed the technology in the mid-1960s.

Heilmeier was born, raised and educated in Philadelphia, graduating from the University of Pennsylvania with a degree in electrical engineering in 1958. He then earned his master of science in engineering degree in solid-state electronics and a Ph.D. in electrical engineering from Princeton.

Soon after graduation, Heilmeier joined RCA Labs. In the period 1963-1970, he discovered four new electro-optic

effects in liquid crystals and demonstrated their use in display applications that included alpha numeric displays for instruments, electronic clocks, TV-like static picture displays, electronically controlled window transparency and optical shutters. But LCD use in flat panel TVs was deemed years away awaiting advances in integrated circuits for addressing, so Heilmeier and his team concentrated on more immediate, commercial smaller screen applications. Even though Heilmeier's DSM technology was later improved and replaced, Heilmeier is credited with the major contributions that led to LCD's commercial use. In fact, several engineers who worked under Heilmeier left RCA and formed Optel in 1970, which produced the first commercial LCD watches.

In 1966, Heilmeier was named Sarnoff's head of solid-state device research and, four years later, was chosen as a White House fellow. As a Special Assistant to the Secretary of Defense, Heilmeier worked on long-range R&D and technology assessment. A year later, he was named Assistant Director of Defense Research and Engineering in charge of all Defense Department electronics, computer technology and physical sciences programs. In early 1975, he became Director of the Defense Advanced Research Projects Agency (DARPA). Over his six-year tenure in the Department of Defense, Heilmeier was awarded the Department of Defense Distinguished Civilian Service Medal, the highest civilian award given by the department, on two separate occasions.

Heilmeier left the federal government to become a vice president at Texas Instruments (TI) in late 1977. In 1983, he was named TI's senior vice president and chief technical officer. In 1991, he became president and CEO at Bellcore, a research and engineering consortium owned by the regional bell companies, and was being named chairman. In 1997, he became chairman emeritus of the company, which had changed its name to Telcordia.

Over the course of his career, Heilmeier earned 15 patents and received numerous awards including the National Medal of Science presented by President Bush in 1991. In 1993, he received the Industrial Research Institute Medal for outstanding accomplishment in leadership of industrial research and was named the first "Technology Leader of the Year" by *Industry Week* magazine. In 1997, he received the IEEE Medal of Honor, "for discovery and initial development of electro-optic effects in liquid crystals." More recently, old Alumni Hall, the primary engineering department lecture hall at his alma mater, Penn, was renamed Heilmeier Hall in his honor. In November 2005, Heilmeier was honored for his LCD innovations with a Kyoto Prize, Japan's version of the Nobel Prize.



## Dr. Nick Holonyak Jr.



(1928 - )

Inventor of LED

Don't blame the flashing "12:00" on VCRs on poor product design. Blame them on Dr. Nick Holonyak Jr., who, among his many accomplishments, invented the light-emitting diode, or LED.

The son of a coal miner originally from the Carpathian Mountains in what is now western Ukraine, the Illinois native studied at the University of Illinois, where he earned his bachelor of science degree in 1950, his master's in 1951 and his Ph.D. in electrical engineering in 1954. He conducted his graduate work under the watchful eye of transistor co-inventor John Bardeen.

After graduation, Holonyak joined the prestigious Bell Labs in Murray Hill, N.J. He served in the Army Signal Corp from 1955 to 1957, and then was hired by GE's Advanced Semiconductor Laboratory in Syracuse, N.Y., where he worked as a consulting scientist on semiconduc-

tor devices. In 1958, he invented the shorted emitter p-n-p-n switch used in electric dimmer switches, and invented the first visible semiconductor laser, commonly known as a laser diode, in 1960.

Holonyak also learned about research on how semiconductors could generate infrared light. Holonyak believed the technology could have a greater impact if people could actually see the results. In 1962, Holonyak developed the red GaAs1-xPx – otherwise known as the light-emitting diode, or LED, which used crystal alloys to make semiconductors emit red light visible to the human eye. Holonyak's red LEDs were first used commercially in the Hamilton Pulsar watch developed with Monsanto in 1972 and in Mattel's Electronic Football Game. LEDs in other colors soon followed. LEDs produce more light per watt than both incandescent and halogen lighting sources, making them more environmentally friendly and cost effective in the long run. LEDs last an average of ten times longer than incandescent bulbs and are threatening to replace other chemical-based lighting technologies in flashlights and household light bulbs.

Holonyak returned home and to his alma mater in 1963, becoming a professor in electrical and computer engineering and working in Illinois' Materials Research Laboratory and Electrical Engineering Research Laboratory, where he still works primarily on lasers and LED technology.

Holonyak has published more than 500 papers and has been issued 34 patents. Among his numerous awards and honors are the 1989 IEEE Edison Medal for "an outstanding career in the field of electrical engineering with contributions to major advances in the field of semiconductor materials and devices." In 1990, he was presented the National Medal of Science by President George H.W. Bush and in 1993, he was named John Bardeen Endowed Chair Professor of Electrical and Computer Engineering and Physics at the University of Illinois at Urbana-Champaign, in 2002, he received by President George W. Bush, one of only 13 bestowed with both honors. In 2003, he was given the IEEE Medal of Honor; and the Russian Global Energy prize (in 1995 the Japan Prize), in 2004, he was awarded the annual Lemelson-MIT Prize.

Holonyak is still innovating. In 2005, a research center was set up by the Defense Advanced Research Projects Agency (DARPA) to develop Holonyak's proposed LET – light-emitting transistor. LETs and transistor laser senable optical and electronic functions to be integrated on a single chip and could lead to the development of optical computers that can run 1,000 times faster than today's electronic computers. And, he is still supervising graduate students at the University of Illinois' College of Engineering.

# Howard Ladd



(1921 - )  
Founder of Concord  
Electronics, Establisher of  
Sanyo-US, Chairman of Fisher

Boomboxes and compact stereos now are ubiquitous products, Sanyo a prestigious brand name and Sanyo-Fisher a prominent consumer electronics company. All are ubiquitous because of Howard Ladd.

Born in Providence, R.I., Ladd's family moved to Philadelphia in 1931. Graduating from the University of Pennsylvania in 1942 after studying electrical engineering, and taking courses at Wharton School of Business in accounting and business management, he joined the U.S. Navy with a commission as an ensign. During the war, Ladd designed radio-controlled target drone aircraft while working at The Naval Aircraft Factory in Philadelphia, and participated in the invasion of Okinawa.

After being released from active duty in 1946, Ladd was active in various business ventures before becoming sales

and marketing manager in 1957 for the American Concertone line of \$1000-plus professional level reel-to-reel audio tape recorders. After hearing that a company called Superscope was importing and selling lower-priced Sony tape recorders in the U.S., and after his own company decided to focus on high-end products, Ladd formed Concord Electronics in 1959 and designed a line of \$100 to \$500 tape recorders to be sold in the U.S. under the Concord brand name.

Within six years, Concord had broadened its product line to include a new product category, a portable, battery-operated tape recorder that was priced at a mere \$29.95. Other innovative products Ladd and Concord introduced included a reel-to-reel recorder with a built-in AM/FM radio, the world's first cassette audio tape deck, one of the first stereo cassette boom boxes and all-in-one stereo compact music systems.

When Concord merged with another company in 1969, Ladd accepted an offer from Sanyo to start and operate a Sanyo brand distribution and marketing company in the U.S., based in Los Angeles. At the time, Sanyo's product line consisted of just three color TVs, which Ladd, as executive vice president and COO, expanded to include stereo music systems, car stereo equipment, portable tape recorders and an expanded television line.

In 1975, Ladd initiated a process to acquire Fisher Radio, which at the time was owned by Emerson, and in turn had

bought the company from its founder, Avery Fisher. Once the acquisition was completed, Ladd became president of the new Fisher Corp., which sold primarily high fidelity audio receivers, compact stereo music systems and speakers manufactured in Pennsylvania. Ladd led an expansion of the Fisher line to include an integrated amplifier/tuner/tape deck/turntable/speaker system, cosmetically matched one-brand and racked audio component systems, as well as portable stereo products, stereo televisions and the newly-developed wireless remote-controlled VCR. Within less than ten years, Fisher annual sales grew from \$30 million to nearly \$1 billion. As Fisher's growth continued, Ladd went on to become the chairman and president of Fisher Corporation.

When Sanyo Electric and Fisher Corp. merged to become the Sanyo Fisher (USA) Corp., Ladd retired in 1988, but the retirement didn't last long. With some associates and friends, Ladd started a bank in the Los Angeles neighborhood of Century City and served as vice chairman and chairman of the board for 10 years before retiring for good.

# Gordon Moore



(1929 - )  
Co-founder, Intel

Not many people have a law named after them. Gordon Moore's eponymous prediction that the number of transistors on a computer chip would double every 18 months is familiar to everyone in the technology business. But as co-founder of chip giant Intel, Moore has more on his resume than just a tech truism.

A native of San Francisco, Moore's interest in science was stimulated by a chemistry set a neighbor received for Christmas when he was about 11 years old. Moore spent two years at San Jose State College before transferring to the University of California in Berkeley, where he received his bachelor of science degree in chemistry in 1950, followed by a Ph.D. in chemistry and physics from the California Institute of Technology in 1954.

In 1953, he joined the technical staff of the Applied

Physics laboratory at Johns Hopkins University, where he did basis research in chemical physics. He joined Shockley Semiconductor Laboratory in 1956 shortly after it was established by Dr. William Shockley, one of the inventors of the transistor. In 1957, Moore and seven other engineers and scientists, the so-called "Traitorous Eight" left Shockley and founded Fairchild Semiconductor Corp.

At Fairchild, Dr. Robert Noyce developed the first integrated circuit. Soon after this development, Moore succeeded Noyce as director of R&D, becoming responsible for the realization of Noyce's ideas. During his tenure at Fairchild, integrated circuit technology advanced rapidly and, in April 1965, Moore published an article entitled "Cramming More Components onto Integrated Circuits" in *Electronics* magazine projecting chip advances expected in the next ten years and establishing "Moore's Law." In 1975, he updated his prediction from doubling chip capacity every 18 months to once every two years.

In July 1968, Moore and Noyce left Fairchild to found Intel, a contraction of "integrated electronics." The plan for the new company was to develop and market large scale integrated circuits (LSI) significantly more complex than anything being produced at that time. Moore wanted to empower employees to increase a sense of ownership in the company by encouraging risk-taking and concentrating on results. By 1971, Intel's research in general

purpose computer architecture controlled by software had evolved into the 4004, a 4-bit microprocessor that started a new revolution in electronics. Intel shipped the first microprocessors in February 1971. Ten years later, IBM introduced its PC using the Intel 8088 microprocessor. In addition to Moore's Law, Moore developed a mathematical model to predict how many completely defect-free chips could be yielded from a silicon wafer, a formula Intel continues to use.

Moore initially served as executive vice president of Intel, becoming president and CEO in 1975 and chairman of the board and CEO in 1979. He served as CEO until 1987, when Andrew Grove took on the title. In 1990, he received the National Medal of Technology from President George H.W. Bush and, in 2002, was awarded the Presidential Medal of Freedom by President George W. Bush.

Moore remained Intel's chairman of the board for several more years and is now chairman emeritus. Moore and his wife established the Gordon and Betty Moore Foundation, which supports programs with lasting positive impacts on the quality of life. Major areas of interest for the foundation include higher education, scientific research and world-wide conservation.



## A.J. Richard



1909 – 2004)  
Chairman, P.C. Richard & Son  
Retail Chain

Alfred J. Richard (“A.J.”) was chairman of the board of P.C. Richard & Son, a retail chain with 49 showrooms that his father, Peter Christiaan Richard (“P.C.”), founded as a hardware store in Bensonhurst, Brooklyn in 1909.

Born the year his father established the business, A.J. was only eight when he began working with his father, handling stock and waiting on customers. He had been learning the business first-hand for nearly a decade when, in 1925, he spotted an opportunity that would change his life forever.

An abundance of new household appliances followed the increasing electrification of America. A.J. convinced his father to start selling electric irons along with the hard-

ware and plumbing supplies that were the company’s stock and trade. The irons were a hit with customers and A.J. pounced upon the trend, rapidly diversifying the store’s inventory, adding washing machines, refrigerators and a host of other appliances designed to make the lives of American homemakers easier. Simultaneously, he introduced an innovative time payment plan that helped to rapidly grow the company’s business.

Taking over the company from his father while he was still in his teens, A.J. proved to be a classic entrepreneur, combining boundless energy with a natural instinct for merchandising, marketing and customer service and a willingness to take risks. By the mid-1930s, he had converted his father’s hardware store into an appliance oasis. Though the nation was embroiled in the Great Depression, he was selling an impressive amount of appliances weekly and supervising a staff of five sales clerks and six door-to-door sales people. That remarkable transformation set the stage for even greater success as radios and, later, televisions transformed popular entertainment.

Always ahead of the times, he further distinguished P.C. Richard & Son by creating his own service department to repair the radios and televisions he sold. “I’ve been in the service business since the beginning of radio and then television,” he often boasted later in his life.

Despite his success, though, he never forgot his humble beginnings or the values that made him successful. His father had been a tinsmith, roofer and bicycle repairman before opening a part-time home repair service that would prove to be the foundation of his hardware business. And it was upon P.C.’s reputation for reliable, high quality work and fair customer service that A.J. grew the company. Until he passed away December 28, 2004, he remained a hands-on business leader and a devout advocate of honesty, integrity and reliability. Those simple standards are an unambiguous hallmark of all P.C. Richard & Son employees, with 49 showrooms serving the greater New York/New Jersey metropolitan area. Closing in on its 100th anniversary, the company is now the nation’s largest family-owned and operated consumer electronics, appliance and computer retailer.

P.C. Richard & Son continues to be a friendly, family-owned and operated business. A.J.’s son, Gary, is CEO; his son, Peter, is executive vice president; his grandson, Gregg, is president; his granddaughter, Bonni, is director of human resources; and his grandson, Peter III, is manager of warehousing and distribution.

## John Roach



(1938 - )  
Tandy/RadioShack

RadioShack became the country's most ubiquitous and iconic seller of electronics goods and parts in large measure because of its long-time CEO, John Roach.

Born in Stamford, Texas, like RadioShack, he was raised in Fort Worth. He worked at his father's grocery store as a boy after school, stocking shelves, handling the cash register and sweeping up. During his undergraduate years at Texas Christian University, Roach worked unloading box cars and as a field engineer. Two years after earning a degree in physics and mathematics, Roach received a master's in business administration. It was during his course of study for his advanced degree that Roach first learned about computer programming and the potential use of computers by consumers.

In 1967, Roach was hired by Tandy Corp. as a data processing manager, but he had far more valuable capabilities. Aware of the Roach's positive results, Tandy chairman Charles Tandy, who had bought nine RadioShack stores in 1963, kept a sharp eye on him. Within 14 years, Roach had been promoted through the ranks, first as vice president of distribution in 1972, then VP of manufacturing in 1976, executive-president of RadioShack and ultimately president of Tandy itself.

Roach promoted the idea of personal computing. As a result of his research and promotion of the concept within Tandy and to Charles Tandy, RadioShack began selling the TRS-80 PC, which sold for the low price of \$399 in 1977 and quickly became a top-seller. Several upgraded models followed, all equally successful, helping to establish the market that would be exploited by Apple and later IBM. In 1978, the first nationwide chain of RadioShack computer centers opened in Fort Worth. In 1981, Roach became the youngest CEO in the country and, in 1982, he was named chairman of Tandy. Radio Shack gave early credibility to Microsoft, Nokia, AOL and others.

Roach set about to make sure that, like himself, talented employees were found, encouraged and promoted at Tandy. Roach helped develop a strong lineup of store managers, engineers and company executives. To help feed Tandy's need for talent, Roach encouraged education with

a program of financial rewards to teachers and students who made outstanding contributions to academic excellence in science and math.

While growing RadioShack, Roach also established additional retail brands for Tandy to increase its growth potential, including the launch of Computer City in 1991 and The Incredible Universe in 1992. Roach solidified Tandy's concentration on retail when he auctioned off the company's manufacturing arm in the early 1990s.

Roach was honored throughout his career as one of the nation's leading technology executives. He served as a member of President Reagan's Council on Private Sector Initiatives, he was named *Financial World's* "CEO of the Year" in 1981, *Forbes'* Business Speaker of the Year in 1988, *Financial World's* "CEO of the Decade" in Specialty Retailing in 1989, received the EIA Medal of Honor in 1993 and was inducted into the Texas Business Hall of Fame in 1994.

Roach retired from Tandy in 1999, then served as chairman of the board of Justin Industries, was chairman of the trustees of Texas Christian University for 15 years, and, as a nod to his humble beginnings, served as a member of the board of directors the Horatio Alger Association.

# H. Gene Slottow



(1921-1989)

Co-inventor, Plasma Display

Gene Slottow's wife was late picking him up after work. As a result, the electrical engineering professor at the University of Illinois Urbana-Champaign (UIUC) helped invent the plasma display.

It was early summer, 1964. Fellow professor Dr. Donald Bitzer had been working on a display devise that could be used for the first computer-based instructional system, PLATO (Programmed Logic for Automatic Teaching Operations) that he had devised. But Bitzer was stuck. He and Slottow found themselves outside the university's

Coordinated Science Laboratory (CSL) discussing how to proceed. While they waited for their spouses discussing an approach suggested by graduate student Robert Willson, the pair discovered a solution.

Slottow had received a degree in physics from the University of Chicago, a master's in electrical engineering from Johns Hopkins and his Ph.D. in electrical engineering from the University of Illinois, where he was hired in 1954. Ten years later, Slottow, now a senior research engineer, and Bitzer figured out how to emit light by energizing neon gas sealed between two sheets of glass coated with phosphor to produce color. The morning after their revelation, Bitzer, Slottow and Willson started on a new model that used three layers of glass, the center layer with rows of tiny holes filled with a mixture of gas, and the outer layers lined with transparent metallic lines to carry the necessary electrical current to excite the gas in the tiny holes. The trio completed the first plasma panel, a monochrome display that glowed orange, in July 1964.

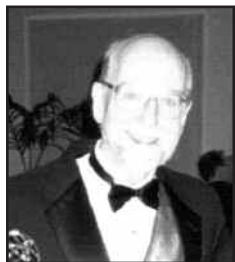
Slottow remained actively involved in perfecting the plasma panel throughout his tenure at UIUC. In 1968, Slottow was promoted to associate professor in the university's

electrical engineering department while maintaining his position in the CSL, which morphed into the Computer-Based Education Research Laboratory, where his work earned him several patents in electronic instrumentation and electronic displays.

Widely published, Slottow received numerous awards including the Frances Rice Darne Memorial Award from the Society for Information Display for technical achievement in 1973. After 32 years at UCIC, Slottow retired in 1986 and died three years later. In 2002, his wife accepted the Emmy awarded her husband, Bitzer and Willson for their work in inventing the plasma display.

Slottow also was an outstanding jazz piano musician and played at numerous faculty gatherings and with local jazz bands. He once told his brother Dick, if he had it all to do over, he would study music.

# Robert Willson



(1936 - )

Co-inventor, Plasma Display

A search for a dissertation subject led Robert Willson to become the co-inventor of the plasma display.

Willson was working in the Coordinated Science Lab (CSL) at the University of Illinois Urbana-Champaign (UIUC) under Dr. Donald Bitzer, helping to develop the PLATO (Programmed Logic for Automatic Teaching Operations) system, which presented computer graphics with overlaid slides on a television set viewed by the students. But Bitzer had a problem with CRT display devices and their endless flickering. What PLATO needed was a flicker-free screen and inherent memory in an era before microprocessors. So Willson chose the physics of trying to solve the PLATO display problem as his dissertation subject.

Willson presented one approach to Bitzer and senior research engineer Gene Slottow. One early summer evening in 1964 while waiting to be picked up by their wives, Bitzer and Slottow discussed Willson's idea and discovered a way to solve the problems. The next morning, the trio got to work on a new model, with Willson handling most of the precise drilling on the glass layers. By July, Willson, Bitzer and Slottow had solved most of the problems and created the first plasma display.

While continuing his contributions to the plasma display, Willson finished his dissertation and earned his Ph.D. in electrical engineering in 1966. Along with Bitzer and Slottow, Willson was awarded a patent for the plasma display the following year.

Unlike his two plasma display development partners, Willson didn't stay in academia and research at UCIC, instead moving into private industry. After graduation, he moved to Baltimore and became a systems analyst for several companies, including Westinghouse.

In the early 1980s, however, Willson decided to put the secular world behind him. A few years earlier, Willson had been ordained a pastor at the Baltimore Spiritual Science Center. He and his wife moved to Sparrow Hawk Mountain in the Ozarks of Tahlequah, Oklahoma, where he was

ordained in Spiritual Science in 1983. In 1990, he graduated from Sancta Sophia Seminary and was ordained by Light of Christ Community Church in Tahlequah. He later served as dean of Sancta Sophia, where he teaches rain-bow bridge meditation, inner child development, coherent heart techniques, and emotional freedom technique, a healing procedure that uses taps on the meridian system to release negative emotions. Willson was recently invited to serve as co-pastor at the Tahlequah Light of Christ Community Church in Sparrow Hawk Village.







The consumer technology industry is known for constant innovation, a direct result of the efforts of the CE Hall of Fame inductees, both in the 2006 class as well as those preceding it. Global companies continue to benefit from the technical advancements that pioneers have developed as well as product design and retail and marketing strategies and will continue to shape the way consumers work and play. The following is a snapshot of some of the most significant developments in the CE industry.

## 2006

- First consumer high-definition DVD player/recorders go on sale in the U.S.
- First videogame systems with high-definition DVD players available.
- First OCAP (Open Cable Applications Platform) cable systems begin operation and first OCAP-enabled TVs in stores.
- President Bush signs legislation to end analog television broadcasting February 17, 2009.
- First 1080p plasma HDTVs go on sale.
- First solid-state, high-definition camcorder hits the market.
- Digital TV sales to dealers surpass sales of analog TVs for the first time.
- New Wi-Fi 802.11n specification, enabling throughput of 100 Mbps for wireless local transmission of HDTV, is approved by IEEE.

## 2005

- First hard disk drive-based camcorders go on sale.

- FCC requires mandatory inclusion of ATSC HDTV tuner in 50 percent of all 24-inch to 35-inch HDTVs by July 1.
- First PCs with dual processors become available.
- First stand-alone VoIP phones introduced.
- Consumer digital cameras reach 10-megapixel resolution.
- A/V home theater receivers with HDMI connectivity and direct satellite radio connectivity go on sale.
- First portable MP3 player/satellite radio recorders announced.
- Flash media card capacity reaches 4 GB.
- First HDTV with built-in HD-DVR hits the market.

## 2004

- First U.S. 3G cellular network services and phones announced.
- Combination cable HDTV STB and HDTV DVRs and CableCARD-equipped DTVs go on sale.
- First flash memory camcorders go on sale.
- First city-wide Wi-Fi networks activated.
- USB-equipped flash memory "thumb drives" go on sale.

## 2003

- First HD radio receivers announced.
- Touchscreen tablet PCs introduced.
- Commercial voice-over-Internet (VoIP) phone service begins.
- Digital wireless home networking standard using 5-GHz frequency announced.

- First HTiB systems with built-in DVD recorders announced.
- First HDTV camcorders enter the marketplace.

## 2002

- First legal online music sites launched.
- First combination cell phones/digital cameras available.
- Blu-ray and red laser high-definition DVD recording standards announced.
- High-definition multimedia interface (HDMI) digital video connector format announced.
- TV manufacturers and cable operators announce "plug-and-play" specifications for HDTV set-top boxes and HDTVs.
- First car-based digital music hard disk drives introduced.
- FCC begins limited deployment of ultra wideband (UWB) wireless data network technology.

## 2001

- Satellite radio broadcasting begins.
- Microsoft and Sony introduce Internet gaming.
- Next-generation, higher speed USB 2.0 and FireWire IEEE-1394b standards announced.
- Car-based MP3 burner introduced.

## 2000

- First Bluetooth-enabled products launched.
- The first portable audio hard disk drive players enter the marketplace.
- Secure high-capacity solid-state flash media formats and products introduced.

- Combination cell phone/MP3 players available.
- CEA inducts its first class of industry leaders into the Consumer Electronics Hall of Fame.

## 1999

- Cable modems are first sold in stores.
- Hard disk-based digital personal video recorders (PVRs) are first introduced, capable of “smart” programming.
- Satellite and digital radio formats announced.
- DVD-Audio and Super Audio CD (SACD) players introduced.
- First MP3 tracks distributed and first portable MP3 players available.
- The high-definition VCR introduced.
- The first high-definition plasma display screen introduced.
- High-speed Wi-Fi 802.11a specification published.

## 1998

- DVD-ROM, DVD-RAM, DVD-R and DVD+R formats introduced.
- CD-Recordable decks first sold.
- The first HDTV sets sold at retail.
- TV manufacturers and cable operators agree on IEEE-1394 (FireWire) with 5C copy protection.
- Super-fast DSL Internet access using plain phones lines made available.
- MPEG-4 digital video compression technology adopted.
- Special Interest Group (SIG) for Bluetooth wireless data communication standard formed.

## 1997

- Smart phones allow access to the Internet and e-mail.
- The Wi-Fi (802.11) wireless local area network (WLAN) Ethernet standard adopted.

## 1996

- FCC adopts ATSC HDTV standards.
- WRAL, Raleigh, N.C., receives first HDTV broadcast license; first commercial HDTV broadcast by WHD-TV in Washington, D.C.
- Set-top boxes plug into televisions to let viewers surf the Internet via remote control.
- The first DVD players sold in Japan.

## 1995

- Competing DVD standards are introduced; a single DVD standard selected.
- Sony announces the first digital camcorders to be sold worldwide.
- Dolby Digital surround sound introduced.
- The flash memory technology standard introduced.
- Flat-screen plasma display TVs introduced.
- The first MiniDV digital video camcorders enter the marketplace in the U.S.

## 1994

- GPS auto navigation systems are marketed in the United States.
- Direct broadcast system (DBS) receivers introduced.
- The first digital still cameras are available for sale in the U.S.
- FCC begins auction of 1900-MHz digital PCS bands for digital cell phone service.

## 1993

- The Grand Alliance forms to develop the HDTV system.
- First plasma display screens available.
- Personal digital assistants (PDA) introduced.
- The first wireless headset portable CD player marketed in Japan.

## 1992

- The World Wide Web becomes available.
- MP3 music compression coding integrated into new MPEG-1 format.
- Digital cellular phone service introduced.
- MiniDisc launched.

## 1990

- The all-digital high-definition television (HDTV) system is proposed.

## 1988

- CDs become more popular than vinyl records.

## 1987

- Higher resolution VCRs and camcorders introduced (S-VHS and ED-Beta).

## 1984

- The CD-ROM introduced.

## 1983

- Cellular telephone service introduced.
- The first digital signal-processing chip (DSP) made by Texas Instruments.



## 1982

- Dolby Laboratories introduces surround sound for home use.
- The first CD players for sale in the U.S.

## 1981

- IBM PC, using Microsoft's Disk Operating System (MS-DOS), introduced.
- First U.S. public demonstration of HDTV done by Japan's NHK network.

## 1980

- The world standard for optical digital audio compact disc (CD) established.
- The first portable VCR-camera combinations (cam-corders) demonstrated.

## 1979

- Personal headset audio introduced.

## 1976

- The first VHS VCR introduced.

## 1975

- The first Betamax VCR introduced.
- The first personal computer, the Altair 8800, debuts.

## 1972

- The first home videogames, designed to play through TV receivers, marketed.
- Sony introduces U-Matic VCR, the forerunner of Beta.

## 1971

- AT&T proposes the cellular phone system.

## 1970

- Intel Corp. introduces the computer memory chip.

## 1969

- ARPnet, a forerunner of the Internet, becomes operational.

## 1967

- The first Consumer Electronics Show (CES) held in New York.

## 1966

- Integrated circuits introduced into consumer products, starting with pocket calculators and electronic watches.

## 1965

- Sony Corp. introduces the first portable consumer video recorder.

## 1964

- Sony engineer Koichi Tsunoda proposes the videocassette.

## 1963

- Philips Electronics NV introduces the compact audio-cassette.
- Optical videodisc, the basis for today's laserdisc and DVD, first demonstrated.

## 1960

- The first telephone-answering device available to consumers.

## 1959

- **Jack Kilby** of Texas Instruments and **Robert Noyce** of Fairchild Semiconductors separately invent the integrated circuit.

- The first Xerox copier introduced.
- The consumer alkaline battery invented.

## 1956

- Ampex introduces the commercial videotape recorder.
- The computer hard drive developed.
- The acoustic-suspension loudspeaker invented.
- The first transistorized stereo receiver comes on the market.

## 1954

- Color TV broadcasting begins.
- The first transistor made from silicon developed.
- The first mass-market transistor "pocket radio" introduced at \$49.95.

## 1952

- The first transistorized device, a hearing aid, sold.

## 1951

- John T. Mullin demonstrates a magnetic videotape recorder, an altered audio tape recorder.

## 1948

- 33-RPM vinyl LP records introduced.
- The first magnetic tape recorders sold in the United States by Ampex Corp.
- The first cable TV systems in the United States developed.

## 1947

- **William Shockley**, **John Bardeen** and **Walter Brattain** invent the transistor at Bell Telephone Laboratories.

**1946**

- The first mobile telephone service initiated.
- The first electronic computer, ENIAC, demonstrated.

**1942**

- The first all-electronic digital computer completed.
- First stereo tape recordings made.

**1940**

- The first color TV broadcast airs.

**1939**

- Television introduced at the New York World's Fair.
- RCA, GE, DuMont, Philco and two other companies sell the first television sets.
- The first experimental FM stations go on air.

**1933**

- Howard Armstrong patents FM radio.

**1931**

- Binaural," better known as stereo recording, invented separately by **Alan Blumlein** in England and A.C. Keller of Bell Labs.

**1929**

- Galvin Manufacturing unveils "Motorola," the first car radio, invented by **William Lear**.

**1928**

- **Kenjiro Takayanagi** demonstrates the cathode ray system in Japan.

**1927**

- **Philo Farnsworth** applies for a patent on his electronic television.
- Bell Telephone Laboratories demonstrates wireless TV.
- **John Logie Baird** creates the first videodisc.

**1926**

- Zenith introduces AC radio receivers designed to plug into electrical outlets.

**1925**

- **John Logie Baird** produces a TV picture of human faces.
- **Vladimir Zworkin** files for a color TV patent.

**1924**

- The Radio Manufacturers Association, the predecessor of the Electronic Industries Association and Consumer Electronics Association, founded.
- Zenith Electronics Corp. produces the first portable radio.

**1923**

- The first transatlantic radio broadcast made.
- The complete TV system including kinescope, or picture tube, demonstrated by **Dr. Vladimir K. Zworkin**, who then applies for a patent for an iconoscope or the TV camera tube.

**1922**

- Farm boy **Philo T. Farnsworth** envisions an electronic TV system; the resulting sketch later proves Farnsworth's patent claim.

**1920**

- Commercial radio broadcasting begins (KDKA, Pittsburgh); the first radio receivers for sale.

**1918**

- **Edwin Armstrong** develops the superheterodyne radio receiver, still the basic technology for all radios.

**1915**

- The first transatlantic radiotelephone call and the first transcontinental phone call made.

**1907**

- Victrola phonograph, gramophone with built-in instead of exposed horn, introduced.

**1906**

- On Christmas Eve, **Fessenden** transmits voice and music via AM radio.

**1904**

- **Sir John Ambrose Fleming** files a patent for the vacuum tube.

**1901**

- **Guglielmo Marconi** receives the first transatlantic wireless telegraph message.

**1900**

- **Professor Reginald A. Fessenden** discovers AM radio.
- **Eldridge R. Johnson** founds Consolidated Talking Machine Company, predecessor of JVC and RCA. ♦







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