Chronology

569–475 BC	Pythagoras leads the elitist *mathematikoi* and *akousmatikoi*
1026	Guido d'Arezzo's vowel-to-pitch mapping procedure for composing melodies for texts
1626	Francis Bacon describes the 'sound-house' in *The New Atlantis*
1734	Louis Bertrand Castel builds a prototype *clavecin oculaire*, the first light organ
1738	Jacques de Vaucanson's flautist automaton is exhibited
1757	Johann Philipp Kirnberger's *Allezeit fertiger Polonoisen und Menuettencomponist* ('The always ready Polonaise and Menuet Composer'), a musical dice game
1761	Jean-Baptiste Delaborde builds the *Claveçin Electrique* in Paris
1843	Lady Ada Lovelace describes the possible musical applications for Charles Babbage's machine in *The Sketch of the Analytical Engine*
	A. Seebeck formulates the *rate theory* which states that neural firing patterns encode the periodic structure of auditory stimuli
1857	Leon Scott invents the *phonoautograph*
1864	Innocenzo Manzetti invents a 'speaking telegraph' for his musical automaton
1876	Alexander Bell's (controversial) telephone patent
	Thomas Edison invents the carbon microphone
1877	Co-invention by Charles Cros and Thomas Edison of the phonograph
	Ernst Werner von Siemens invents the loudspeaker
1881	Clément Ader demonstrates stereo broadcast with the premiere of his Théâtrophone, conveying music from the Paris Opéra to the World Expo
1897	Thaddeus Cahill patents the *Art of and Apparatus for Generating and Distributing Music Electronically*
1898	Valdemar Poulson patents a magnetic *Telegraphone*, which can both record and play back sound
1899	William Duddell invents the *Singing Arc*
1906	Cahill finally builds the Telharmonium
	Lee De Forest invents the triode vacuum tube (which he calls the *Audion*), allowing controlled amplification; ironically, Cahill could have used this invention to make the Telharmonium much smaller!
1909	The Tel-musici Company combine a telephone exchange with a music room; they are bankrupt within a few years, just like Cahill

1913	Luigi Russolo writes his manifesto *The Art of Noises*
1920	Lev Termen invents the Theremin
1924	Ottorino Respighi combines a phonograph playing alongside an orchestra in *Pini di Roma*.
1928	Fritz Fleumer invents the magnetic tape recorder in Germany Maurice Martenot invents the *Ondes Martenot*
1929	Friedrich Trautwein invents the *Trautonium*
1930	Walter Ruttman's *Weekend* is an early precedent in juxtaposition of fragments of recorded sound,
	Paul Hindemith and Ernst Toth hold a multiple turntable concert of *Grammophonmusik* in Berlin, with young exchange student John Cage in attendance
1931	An electroacoustic montage is created by the sound department of Paramount Studios in Hollywood, for the film *Jekyll and Hyde*
1932	In Oskar Fischinger's film, *Tönende Ornamente* (Ornament Sound), the soundtrack is created by drawing directly onto the optical soundtrack
1933	The theremin is used by composer Max Steiner to expand the timbral palette of the orchestra in the film *King Kong*
1936	Varèse publishes his manifesto *The Liberation of Sound*
1937	John Cage delivers his lecture *The Future of Music: CREDO*
1938	Orson Welles' *War of the Worlds* radio play successfully deceives its audience into believing a Martian invasion is taking place
	Johanna Beyer's *Music of the Spheres* is composed, with parts for three electrical instruments and two percussion instruments
1939	Cage begins working with live electronic sound in his piece *Imaginary Landscape No. 1*
1944	Egyptian-born Halim El-Dabh experiments by electronically processing recordings made with a wire recorder, a medium that predated tape
1946	*The Schillinger System of Musical Composition* is published posthumously
	Raymond Scott writes the patent disclosure for the 'orchestra machine'
1948	At the French National Radio-Television (RTF), Pierre Schaeffer experiments with mixing pre-recorded sources on various turntables and creates *Etude aux Chemins de Fer*. The RTF studios eventually host the Groupe de Recherches Musicales (GRM)
	Claude Elwood Shannon publishes *A Mathematical Theory of Communication*
1951	Pierre Schaeffer and Pierre Henry compose *Symphonie pour un homme seule*, a landmark in musique concrète
	The Studio für Elektronische Musik at West German National Radio (WDR) is founded in Cologne
	Percy Grainger invents the *Kangaroo Pouch Machine*

The Columbia Tape Music Center, in New York, is started by Luenning and Ussachevsky. It would later become the Columbia–Princeton Electronic Music Center in 1959

Louis and Bebe Barron compose *Heavenly Menagerie* in their studio, months before the more famous Cologne Studio is established

Bernard Herrmann uses theremins as main instruments with the film orchestra in his score for *The Day the Earth Stood Still*

Schaeffer investigates spatialisation with the *potentiomètre d'espace*

1952   Schaeffer publishes a syntax for musique concrète in the treatise *Esquisse d'un solfège concrete*

Monique Rollin's *Étude Vocale* (1952) is an early musique concrète study

Cage is composing *Williams Mix* (completed by 1953); the realisation takes a team of tape splicers (in reality, Louis and Bebe Barron) many months

1953   In Milan, the Studio di Fonologia is established. In Tokyo the Electronic Music Studio for Japan Radio (NHK) is opened

Herbert Eimert composes *Struktur 8*

1950–4 Varèse composes *Déserts*, which combines an ensemble of live instrumentalists with tape

1955–9 Lejaren Hiller and Leonard Isaacson experiment with using a mainframe computer to algorithmically generate musical scores, composing the *Illiac Suite* for string quartet in 1956

1955   Iannis Xenakis publishes *The Crisis of Serial Music*, critiquing integral serialism on psychological and statistical grounds

1956   Louis and Bebe Barron create the first purely electronic film score for *Forbidden Planet*

In the Netherlands, the Center for Electronic Music is established within the Philips Research Laboratory

Stockhausen's *Gesang der Jünglinge* combines concrète and elektronische

Xenakis completes the first granular study: *Analogue B*

1957   In Warsaw, the Studio Experimentalne is established at Polish National Radio

The Bell Telephone Laboratories host the first digital music experiments: Max Mathews programs the first sounds ever generated by a digital computer and creates *MUSIC 1*, the earliest programming environment for sound synthesis

1958   The BBC Radiophonic Workshop is founded, after years of effort from Daphne Oram in particular

Xenakis designs the Philips Pavilion at the Brussels World's Fair for which Varèse composes *Poème électronique*; Xenakis also provides *Concrèt PH* for the interludes between shows

	In Santiago de Chile, the Laboratorio de Acústica is used for the earliest electronic music in South America
	Raymond Scott invents and begins development of the Electronium, an algorithmic composing machine without a musical keyboard
	In Toronto, the University of Toronto Electronic Music Studio is founded
1958–60	Stockhausen works on *Kontakte*
1960	Andreij Markowski creates, at the Experimental Studio in Warsaw, electronic music and sound design for *The Silent Star*, directed by Kurt Maetzig
	Raymond Scott composes a completely electronic soundtrack for the *Vicks: Medicated Cough Drops* commercial
1961	The Norsk Rikskringkasting (NRK) in Oslo allows its studios to be used for the earliest experiments in electronic music in Norway
	Kelly and Lochbaum design an algorithm to simulate the human vocal tract
	James Tenney creates the plunderphonic tape piece *Collage #1 (Blue Suede)*, sampling and manipulating a famous Elvis track
1962	In Buenos Aires, the Laboratorio de Música Electrónica associated to the Instituto Torcuato di Tella is founded; in Ghent, Belgium, the Institut vor Psychoakoestiek en Elektronische Muziek; in East Berlin, the Experimentalstudio für Kunstliche Klang und Gerauscherzeugung, Laboratorium für Akustisch-Musikalische Grenzprobleme
1963	Gottfried Michael Koenig's *Projekt 1* program is devised, for automatic aleatoric serial composition
1964	Stockhausen composes *Mikrophonie I* for amplified and processed tam-tam
	Jean-Claude Risset visits Bell Labs for the first time and uses MUSIC IV to investigate the timbre of trumpets
1965	Steve Reich creates his first phase piece: *It's Gonna Rain*
	Alvin Lucier creates his *Music for Solo Performer*, the first live electronics piece to use amplified alpha brainwaves
1967	In Gordon Mumma's composition *Hornpipe* an analogue device analyses and amplifies the resonances of the hall in which a performer is playing the French horn, thus predating interactive machine-listening systems
	John Chowning discovers Frequency Modulation sound synthesis
1968	MUSIC V becomes the first computer music programming system to be implemented in FORTRAN
	David Tudor composes the first of his *Rainforest* pieces, featuring a multitude of objects acting as loudspeakers dangling directly from their cables

Raymond Scott invents the first 'drum machine', *Bandito the bongo artist*

Jean-Claude Risset creates a catalogue of computer-generated sounds at Bell Labs including guidelines to synthesise different musical instruments using MUSIC V; Risset also composes *Computer Suite from Little Boy*, utilising auditory illusions

Wendy Carlos' *Switched-On Bach* achieves popular success, promoting Robert Moog's modular synthesisers

Lee Scratch Perry sets up his Upsetter record label – the Jamaican sound system and studio scene is a fertile backdrop for the development of dub and the remix

1969   Max Mathews builds the GROOVE system to connect a computer to an analogue synthesiser

First performance of Lejaren Hiller and John Cage's *HPSCHD*, for massed audiovisual forces

Luc Ferrari's *music promenade* manipulated field recording

1970   Pierre Boulez founds the Institut de Recherche et Coordination Acoustique/Musique (IRCAM)

1970–2   François Bayle's *L'expérience acoustique*

1971   Richard Teitelbaum's piece *Alpha Bean Lima Brain* involves the transmission of brain waves by telephone to control jumping beans

Wendy Carlos creates the electronically instrumental score for *A Clockwork Orange* by Stanley Kubrick

Hiller and Ruiz develop the first computer simulations by physical models, of instrumental sounds

John Chowning describes techniques for the computer simulation of moving sound sources that are based on the Doppler effect as well as reverberation effects

Tonto's Expanding Head Band release the psychedelic and progressive *Zero Time*, composed with the expanded Series III Moog synthesiser

1972   Salvatore Martirano builds the *SalMar Construction*, a realtime generative electronic music instrument.

F. Richard Moore, Gareth Loy, and others at the Computer Audio Research Laboratory (CARL) at University of California at San Diego develop and distribute an open-source, portable system for signal processing and music synthesis, called the *CARL* System, modelled after *UNIX*

Eduard Artemiev produces the electronic score for *Solaris* by Andrei Tarkovsky

Pong by Atari becomes a mass gaming phenomenon

1973   The Composers inside Electronics collective is formed

DJ Kool Herc is experimenting with turntable mixing at parties in the Bronx

1974	Paul De Marinis builds *Parrot Pleaser*, an automatic music composing circuit intended to be played by a bird
	Curtis Roads writes a program with MUSIC V implementing granular synthesis
	François Bayle establishes the Acousmonium loudspeaker orchestra
1974–9	Laurie Spiegel develops the *VAMPIRE* (Video And Music Program for Interactive Realtime Exploration/Experimentation) system
1975	Michel Waisvisz unleashes the Cracklebox synthesiser
	John Appleton produces the prototype for the Synclavier
1976	Denis Smalley writes *Darkness After Time's Colours*
1977	*The League of Automatic Composers* is founded by Jim Horton, John Bischoff and Rich Gold
	Ben Burtt coins the term 'sound designer' to reflect his contribution to the film *Star Wars*
	Hildegard Westerkamp creates *Lighthouse Park Soundwalk*
1978	Atari releases the Atari Video Music audio-visualiser
	Brian Eno creates the ambient music installation *Music for Airports*
	Kraftwerk create their *The Man-Machine* album, touring with robotic mannequins
	Space Invaders by Toshihiro Nishikado is the first game to have continuous music throughout
	Trevor Wishart composes *Red Bird: A Political Prisoner's Dream*
1979	Merzbow starts his Lowest Music and Arts record label to release his music on cassette
1980	Fonction d'onde formantique (*FOF*) sound synthesis (or formant wave function synthesis), is developed at IRCAM by Xavier Rodet, Yves Potard and Jean-Baptiste Barrière
1981	The launch of Music TeleVision; MTV appropriates the existing term VJ for their presenters, starting a parallel use of this descriptor, later fully reclaimed by live club visual artists
1981–8	Boulez works on *Répons*
1982	David Jaffe's *Silicon Valley Breakdown* utilises an extended version of Karplus-Strong synthesis
1983	The *Musical Instruments Digital Interface* protocol (MIDI) is established
	The Yamaha DX7 is released and becomes the first widely accessible digital synthesiser
	Double D and Steinski win a remix competition with the first of their influential cut and paste *Lessons*
1984	Paul Lansky develops *Cmix*, later to become *RTCmix*, an extension for realtime use created by Brad Garton and David Topper
	Yasunao Tone begins 'wounding' CDs through the application of perforated Scotch tape

First attempts at automatic accompaniment systems from Roger Dannenberg and Barry Vercoe presented at the International Computer Music Conference at IRCAM

The *Wabot-2* score reading and keyboard playing robot is completed, the first of a series of musical robots produced at Waseda University

Early Chicago House recordings from Jesse Saunders, amongst others

1985 Laurie Spiegel develops *Music Mouse*

Paul Lansky's *Idle Chatter*

Detroit Techno provides one historical strand amongst many of electronic dance music: Juan Atkins had been recording in the duo Cybotron since 1981, and released his first Model 500 tracks in 1985; influences included electronic, disco and funk artists such as Kraftwerk, Giorgio Moroder and Parliament

1986 *Csound* is originally authored by Barry Vercoe and colleagues at the MIT Media Labs

George E. Lewis begins working on the *Voyager* interactive music system

The Akai S900 becomes one of the first (and possibly the most accessible) commercially available sampling modules for mass consumers

1987 The Hierarchical Music Scoring Language (HMSL) is authored by Polansky, Rosenboom and Burk

1988 Miller Puckette publishes his paper *The Patcher*; at IRCAM he develops this visual patching system into an interactive computer music programming environment called *Max*

1989 John Oswald releases the *Plunderphonic* EP and is later forced to 'recant', destroying all remaining copies, by the litigious music industry

1990 Max (later Max/MSP, then later still just Max again) is released commercially, becoming available to non-academic musicians

Public Enemy's album *Fear of a Black Planet* demonstrates the power of their sampled hip hop production, allied to strong political messages

1991 Nic Collins creates the piece *Broken Light* by hardware hacking CD players

Common Lisp Music (or CLM), a sound synthesis language is written by Bill Schottstaedt at Stanford University

1992 Reed Ghazala starts publishing articles on 'Circuit Bending' in the journal Experimental Musical Instruments

1993 Björk's *Debut* is the first example of her many collaborations with electronic dance music producers

2010   The Turner Prize is given to sound artist Susan Philipsz
2011   Amon Tobin's ISAM stage show maps audio synchronized graphics onto a large on-stage sculpture

    The *Oramics to Electronica* exhibition opens at London's Science Museum

2014   The HTML 5 specification is finalized; an era of realtime web browser audio applications has already begun
2016   Daphne Oram's *Still Point* (1949) for double orchestra, pre-recorded sound and electronic processing via microphones is finally premiered, at the *Deep Minimalism* Festival in London