

**CPC****COOPERATIVE PATENT CLASSIFICATION****H03B**

**GENERATION OF OSCILLATIONS, DIRECTLY OR BY FREQUENCY-CHANGING, BY CIRCUITS EMPLOYING ACTIVE ELEMENTS WHICH OPERATE IN A NON-SWITCHING MANNER; GENERATION OF NOISE BY SUCH CIRCUITS** ([measuring, testing G01R](#); [generators adapted for electrophonic musical instruments G10H](#); [Speech synthesis G10L](#); [masers, lasers H01S](#); [dynamo-electric machines H02K](#); [power inverter circuits H02M](#); [by using pulse techniques H03K](#); [automatic control of generators H03L](#); [starting, synchronisation or stabilisation of generators where the type of generator is irrelevant or unspecified H03L](#); [generation of oscillations in plasma H05H](#))

**H03B 1/00****Details****H03B 1/02**

- Structural details of power oscillators, e.g. for heating ([construction of transmitters H04B](#); [features of generators for heating by electromagnetic fields H05B 6/00](#))

**H03B 1/04**

- Reducing undesired oscillations, e.g. harmonics

**H03B 5/00**

**Generation of oscillations using amplifier with regenerative feedback from output to input** ([H03B 9/00](#), [H03B 15/00](#) take precedence)

**H03B 5/02**

- Details

**H03B 5/04**

- . Modifications of generator to compensate for variations in physical values, e.g. power supply, load, temperature

**H03B 5/06**

- . Modifications of generator to ensure starting of oscillations

**H03B 5/08**

- with frequency-determining element comprising lumped inductance and capacitance

**H03B 5/10**

- . active element in amplifier being vacuum tube ([H03B 5/14](#) takes precedence)

**H03B 5/12**

- . active element in amplifier being semiconductor device ([H03B 5/14](#) takes precedence)

**WARNING**

Subgroups [H03B 5/1203](#) to [H03B 5/1296](#) are incomplete pending reclassification; see also the other subgroups of [H03B 5/12](#)

**H03B 5/1203**

- . . {the amplifier being a single transistor}

**H03B 5/1206**

- . . {using multiple transistors for amplification}

**H03B 5/1209**

- . . . {the amplifier having two current paths operating in a differential manner and a current source or degeneration circuit in common to both paths e.g. a long-tailed pair. ([H03B 5/1215](#) takes precedence)}

**H03B 5/1212**

- . . . . {the amplifier comprising a pair of transistors, wherein an output terminal of each being connected to an input terminal of the other, e.g. a cross coupled pair}

**H03B 5/1215**

- . . . . . {the current source or degeneration circuit being in common to both transistors of the pair, e.g. a cross-coupled long-tailed pair}

**H03B 5/1218**

- . . . . {the generator being of the balanced type}

- H03B 5/1221 . . . . {the amplifier comprising multiple amplification stages connected in cascade}
- H03B 5/1225 . . . . {the generator comprising multiple amplifiers connected in parallel}
- H03B 5/1228 . . . {the amplifier comprising one or more field effect transistors}
- H03B 5/1231 . . . {the amplifier comprising one or more bipolar transistors}
- H03B 5/1234 . . . {and comprising means for varying the output amplitude of the generator ([H03B 5/1278](#) takes precedence)}
- H03B 5/1237 . . . {comprising means for varying the frequency of the generator}
- H03B 5/124 . . . . {the means comprising a voltage dependent capacitance}
- H03B 5/1243 . . . . . {the means comprising voltage variable capacitance diodes}
- H03B 5/1246 . . . . . {the means comprising transistors used to provide a variable capacitance}
- H03B 5/125 . . . . . {the transistors being bipolar transistors}
- H03B 5/1253 . . . . . {the transistors being field-effect transistors}
- H03B 5/1256 . . . . {the means comprising a variable inductance}
- H03B 5/1259 . . . . . {the means comprising a variable active inductor e.g. gyrator circuits}
- H03B 5/1262 . . . . {the means comprising switched elements}
- H03B 5/1265 . . . . . {switched capacitors}
- H03B 5/1268 . . . . . {switched inductors}
- H03B 5/1271 . . . . {the frequency being controlled by a control current i.e. current controlled oscillators}
- H03B 5/1275 . . . . {having further means for varying a parameter in dependence on the frequency}
- H03B 5/1278 . . . . . {the parameter being an amplitude of a signal, e.g. maintaining a constant output amplitude over the frequency range}
- H03B 5/1281 . . . . . {the parameter being the amount of feedback}
- H03B 5/1284 . . . . . {the parameter being another frequency, e.g. a harmonic of the oscillating frequency}
- H03B 5/1287 . . . . . {the parameter being a quality factor, e.g. Q factor of the frequency determining element}
- H03B 5/129 . . . . . {the parameter being a bias voltage or a power supply}
- H03B 5/1293 . . . . {having means for achieving a desired tuning characteristic e.g. linearising the frequency characteristic across the tuning voltage range}
- H03B 5/1296 . . . {the feedback circuit comprising a transformer}
- H03B 5/14 . . frequency-determining element connected via bridge circuit to closed ring around which signal is transmitted
- H03B 5/16 . . . active element in amplifier being vacuum tube
- H03B 5/18 . . with frequency-determining element comprising distributed inductance and capacitance
- H03B 5/1805 . . {the frequency-determining element being a coaxial resonator}
- H03B 5/1811 . . . {the active element in the amplifier being a vacuum tube ([see provisionally also \[H03B 5/1835\]\(#\)](#))}

- H03B 5/1817 . . {the frequency-determining element being a cavity resonator}
- H03B 5/1823 . . . {the active element in the amplifier being a semiconductor device}
- H03B 5/1829 . . . . {the semiconductor device being a field-effect device}
- H03B 5/1835 . . . {the active element in the amplifier being a vacuum tube}
- H03B 5/1841 . . {the frequency-determining element being a strip line resonator  
([H03B 5/1805](#), [H03B 5/1817](#), [H03B 5/1864](#) and [H03B 5/1882](#) take precedence)}
- H03B 5/1847 . . . {the active element in the amplifier being a semiconductor device}
- H03B 5/1852 . . . . {the semiconductor device being a field-effect device}
- H03B 5/1858 . . . {the active element in the amplifier being a vacuum tube (see provisionally also [H03B 5/1835](#))}
- H03B 5/1864 . . {the frequency-determining element being a dielectric resonator}
- H03B 5/187 . . . {the active element in the amplifier being a semiconductor device}
- H03B 5/1876 . . . . {the semiconductor device being a field-effect device}
- H03B 5/1882 . . {the frequency-determining element being a magnetic-field sensitive resonator, e.g. a Yttrium Iron Garnet or a magnetostatic surface wave resonator}
- H03B 5/1888 . . . {the active element in the amplifier being a semiconductor device}
- H03B 5/1894 . . . . {the semiconductor device being a field-effect device}
- H03B 5/20 . with frequency-determining element comprising resistance and either capacitance or inductance, e.g. phase-shift oscillator
- H03B 5/22 . . active element in amplifier being vacuum tube ([H03B 5/26](#) takes precedence)
- H03B 5/24 . . active element in amplifier being semiconductor device ([H03B 5/26](#) takes precedence)
- H03B 5/26 . . frequency-determining element being part of bridge circuit in closed ring around which signal is transmitted; frequency-determining element being connected via a bridge circuit to such a closed ring, e.g. Wien-Bridge oscillator, parallel-T oscillator
- H03B 5/28 . . . active element in amplifier being vacuum tube
- H03B 5/30 . with frequency-determining element being electromechanical resonator
- H03B 5/32 . . being a piezo-electric resonator (selection of piezo-electric material [H01L 41/00](#))
- H03B 5/323 . . . {the resonator having more than two terminals ([H03B 5/326](#) takes precedence)}
- H03B 5/326 . . . {the resonator being an acoustic wave device, e.g. SAW or BAW device}
- H03B 5/34 . . . active element in amplifier being vacuum tube ([H03B 5/38](#) takes precedence)
- H03B 5/36 . . . active element in amplifier being semiconductor device ([H03B 5/323](#), [H03B 5/326](#) , [H03B 5/38](#) take precedence)
- H03B 5/362 . . . . {the amplifier being a single transistor ([H03B 5/364](#) to [H03B 5/368](#) take precedence)}
- H03B 5/364 . . . . {the amplifier comprising field effect transistors ([H03B 5/366](#) takes precedence)}

- H03B 5/366 . . . . {and comprising means for varying the frequency by a variable voltage or current}
- H03B 5/368 . . . . . {the means being voltage variable capacitance diodes}
- H03B 5/38 . . . frequency-determining element being connected via bridge circuit to closed ring around which signal is transmitted
- H03B 5/40 . . being a magnetostrictive resonator ([H03B 5/42](#) takes precedence; selection of magneto-strictive material [H01F 1/00](#) ; [H01L 41/00](#))
- H03B 5/42 . . frequency-determining element connected via bridge circuit to closed ring around which signal is transmitted
  
- H03B 7/00** **Generation of oscillations using active element having a negative resistance between two of its electrodes** ([H03B 9/00](#) takes precedence)
- H03B 7/02 . with frequency-determining element comprising lumped inductance and capacitance
- H03B 7/04 . . active element being vacuum tube
- H03B 7/06 . . active element being semiconductor device
- H03B 7/08 . . . being a tunnel diode
- H03B 7/10 . . active element being gas-discharge or arc-discharge tube
- H03B 7/12 . with frequency-determining element comprising distributed inductance and capacitance
- H03B 7/14 . . active element being semiconductor device
- H03B 7/143 . . . {and which comprises an element depending on a voltage or a magnetic field, e.g. varactor- YIG}
- H03B 7/146 . . . {with several semiconductor devices}
  
- H03B 9/00** **Generation of oscillations using transit-time effects** {(construction of tube and circuit arrangements not adapted to a particular application [H01J](#); construction of the semiconductor devices [H01L](#))}
- H03B 9/01 . using discharge tubes
- H03B 9/02 . . using a retarding-field tube ([using klystrons H03B 9/04](#))
- H03B 9/04 . . using a klystron
- H03B 9/06 . . . using a reflex klystron
- H03B 9/08 . . using a travelling-wave tube
- H03B 9/10 . . using a magnetron
- H03B 9/12 . using solid state devices, e.g. Gunn-effect devices
- H03B 2009/123 . . {using Gunn diodes}
- H03B 2009/126 . . {using impact ionization avalanche transit time [IMPATT] diodes}
- H03B 9/14 . . and elements comprising distributed inductance and capacitance
- H03B 9/141 . . . {and comprising a voltage sensitive element, e.g. varactor}
- H03B 9/142 . . . {and comprising a magnetic field sensitive element, e.g. YIG}
- H03B 9/143 . . . {using more than one solid state device}
- H03B 9/145 . . . {the frequency being determined by a cavity resonator, e.g. a hollow waveguide cavity or a coaxial cavity ([H03B 9/141](#) to [H03B 9/143](#), [H03B 9/147](#), [H03B 9/148](#) take precedence)}

H03B 9/146	<ul style="list-style-type: none"> <li>. . . . {formed by a disc, e.g. a waveguide cap resonator}</li> </ul>
H03B 9/147	<ul style="list-style-type: none"> <li>. . . {the frequency being determined by a stripline resonator (<a href="#">H03B 9/141</a> to <a href="#">H03B 9/143</a>, <a href="#">H03B 9/148</a> take precedence)}</li> </ul>
H03B 9/148	<ul style="list-style-type: none"> <li>. . . {the frequency being determined by a dielectric resonator (<a href="#">H03B 9/141</a> to <a href="#">H03B 9/143</a> take precedence)}</li> </ul>
<b>H03B 11/00</b>	<b>Generation of oscillations using a shock-excited tuned circuit</b> (with feedback <a href="#">H03B 5/00</a> )
H03B 11/02	<ul style="list-style-type: none"> <li>. excited by spark (<a href="#">spark gaps therefor H01T 9/00</a>)</li> </ul>
H03B 11/04	<ul style="list-style-type: none"> <li>. excited by interrupter</li> </ul>
H03B 11/06	<ul style="list-style-type: none"> <li>. . by mechanical interrupter</li> </ul>
H03B 11/08	<ul style="list-style-type: none"> <li>. . interrupter being discharge tube</li> </ul>
H03B 11/10	<ul style="list-style-type: none"> <li>. . interrupter being semiconductor device</li> </ul>
<b>H03B 13/00</b>	<b>Generation of oscillations using deflection of electron beam in a cathode-ray tube</b>
<b>H03B 15/00</b>	<b>Generation of oscillations using galvano-magnetic devices, e.g. Hall-effect devices, or using super-conductivity effects</b> ( <a href="#">galvano-magnetic devices per se H01L 43/00</a> )
H03B 15/003	<ul style="list-style-type: none"> <li>. {using superconductivity effects (<a href="#">devices using superconductivity H01L 39/00</a>)}</li> </ul>
H03B 15/006	<ul style="list-style-type: none"> <li>. {using spin transfer effects or giant magnetoresistance}</li> </ul>
<b>H03B 17/00</b>	<b>Generation of oscillations using radiation source and detector, e.g. with interposed variable obturator</b>
<b>H03B 19/00</b>	<b>Generation of oscillations by non-regenerative frequency multiplication or division of a signal from a separate source</b> ( <a href="#">transference of modulation from one carrier to another H03D 7/00</a> )
H03B 19/03	<ul style="list-style-type: none"> <li>. using non-linear inductance</li> </ul>
H03B 19/05	<ul style="list-style-type: none"> <li>. using non-linear capacitance, e.g. varactor diodes</li> </ul>
H03B 19/06	<ul style="list-style-type: none"> <li>. by means of discharge device or semiconductor device with more than two electrodes</li> </ul>
H03B 19/08	<ul style="list-style-type: none"> <li>. . by means of a discharge device</li> </ul>
H03B 19/10	<ul style="list-style-type: none"> <li>. . . using multiplication only</li> </ul>
H03B 19/12	<ul style="list-style-type: none"> <li>. . . using division only</li> </ul>
H03B 19/14	<ul style="list-style-type: none"> <li>. . by means of a semiconductor device</li> </ul>
H03B 19/16	<ul style="list-style-type: none"> <li>. using uncontrolled rectifying devices, e.g. rectifying diodes or Schottky diodes</li> </ul>
H03B 19/18	<ul style="list-style-type: none"> <li>. . and elements comprising distributed inductance and capacitance</li> </ul>
H03B 19/20	<ul style="list-style-type: none"> <li>. . being diodes exhibiting charge storage or enhancement effects</li> </ul>
<b>H03B 21/00</b>	<b>Generation of oscillations by combining unmodulated signals of different frequencies</b> ( <a href="#">H03B 19/00</a> takes precedence; frequency changing circuits in general <a href="#">H03D</a> )
H03B 21/01	<ul style="list-style-type: none"> <li>. by beating unmodulated signals of different frequencies</li> </ul>

H03B 21/02	<ul style="list-style-type: none"> <li>by plural beating, i.e. for frequency synthesis; {Beating in combination with multiplication or division of frequency (digital frequency synthesis using a ROM G06F 1/02; digital frequency synthesis in general H03K; indirect frequency synthesis using a PLL H03L 7/16)}</li> </ul>
H03B 21/025	<ul style="list-style-type: none"> <li>{by repeated mixing in combination with division of frequency only}</li> </ul>
H03B 21/04	<ul style="list-style-type: none"> <li>using several similar stages</li> </ul>
<b>H03B 23/00</b>	<b>Generation of oscillations periodically swept over a predetermined frequency range</b> (angle-modulating circuits in general H03C 3/00)
<b>H03B 25/00</b>	<b>Simultaneous generation by a free-running oscillator of oscillations having different frequencies</b>
<b>H03B 27/00</b>	<b>Generation of oscillations providing a plurality of outputs of the same frequency but differing in phase, other than merely two anti-phase outputs</b>
<b>H03B 28/00</b>	<b>Generation of oscillations by methods not covered by groups H03B 5/00 to H03B 27/00, including modification of the waveform to produce sinusoidal oscillations</b> (analogue function generators for performing computing operations G06G 7/26; use of transformers for conversion of waveform in ac-ac converters H02M 5/18)
<b>H03B 29/00</b>	<b>Generation of noise currents and voltages</b> {(gasfilled discharge tubes with solid cathode specially adapted as noise generators H01J 17/005)}
<b>H03B 2200/00</b>	<b>Indexing scheme relating to details of oscillators covered by H03B</b>
H03B 2200/0002	<ul style="list-style-type: none"> <li>Types of oscillators</li> </ul>
H03B 2200/0004	<ul style="list-style-type: none"> <li>Butler oscillator</li> </ul>
H03B 2200/0006	<ul style="list-style-type: none"> <li>Clapp oscillator</li> </ul>
H03B 2200/0008	<ul style="list-style-type: none"> <li>Colpitts oscillator</li> </ul>
H03B 2200/001	<ul style="list-style-type: none"> <li>Hartley oscillator</li> </ul>
H03B 2200/0012	<ul style="list-style-type: none"> <li>Pierce oscillator</li> </ul>
H03B 2200/0014	<ul style="list-style-type: none"> <li>Structural aspects of oscillators</li> </ul>
H03B 2200/0016	<ul style="list-style-type: none"> <li>including a ring, disk or loop shaped resonator</li> </ul>
H03B 2200/0018	<ul style="list-style-type: none"> <li>relating to the cutting angle of a crystal, e.g. AT cut quartz</li> </ul>
H03B 2200/002	<ul style="list-style-type: none"> <li>making use of ceramic material</li> </ul>
H03B 2200/0022	<ul style="list-style-type: none"> <li>characterised by the substrate, e.g. material</li> </ul>
H03B 2200/0024	<ul style="list-style-type: none"> <li>including parallel striplines</li> </ul>
H03B 2200/0026	<ul style="list-style-type: none"> <li>relating to the pins of integrated circuits</li> </ul>
H03B 2200/0028	<ul style="list-style-type: none"> <li>based on a monolithic microwave integrated circuit [MMIC]</li> </ul>
H03B 2200/003	<ul style="list-style-type: none"> <li>Circuit elements of oscillators</li> </ul>
H03B 2200/0032	<ul style="list-style-type: none"> <li>including a device with a Schottky junction</li> </ul>
H03B 2200/0034	<ul style="list-style-type: none"> <li>including a buffer amplifier</li> </ul>
H03B 2200/0036	<ul style="list-style-type: none"> <li>including an emitter or source coupled transistor pair or a long tail pair</li> </ul>
H03B 2200/0038	<ul style="list-style-type: none"> <li>including a current mirror</li> </ul>

- H03B 2200/004 . . including a variable capacitance, e.g. a varicap, a varactor or a variable capacitance of a diode or transistor
- H03B 2200/0042 . . . the capacitance diode being in the feedback path
- H03B 2200/0044 . . including optical elements e.g. optical injection locking
- H03B 2200/0046 . . including measures to switch the gain of an amplifier
- H03B 2200/0048 . . including measures to switch the frequency band, e.g. by harmonic selection
- H03B 2200/005 . . including measures to switch a capacitor
- H03B 2200/0052 . . including measures to switch the feedback circuit
- H03B 2200/0054 . . including measures to switch a filter, e.g. for frequency tuning or for harmonic selection
- H03B 2200/0056 . . including a diode used for switching
- H03B 2200/0058 . . with particular transconductance characteristics, e.g. an operational transconductance amplifier
- H03B 2200/006 . Functional aspects of oscillators
- H03B 2200/0062 . . Bias and operating point
- H03B 2200/0064 . . Pulse width, duty cycle or on/off ratio
- H03B 2200/0066 . . Amplitude or AM detection
- H03B 2200/0068 . . Frequency or FM detection
- H03B 2200/007 . . Generation of oscillations based on harmonic frequencies, e.g. overtone oscillators
- H03B 2200/0072 . . Frequency hopping and enabling of rapid frequency changes
- H03B 2200/0074 . . Locking of an oscillator by injecting an input signal directly into the oscillator
- H03B 2200/0076 . . Power combination of several oscillators oscillating at the same frequency
- H03B 2200/0078 . . generating or using signals in quadrature
- H03B 2200/008 . . making use of a reference frequency
- H03B 2200/0082 . . Lowering the supply voltage and saving power
- H03B 2200/0084 . . dedicated to Terahertz frequencies
- H03B 2200/0086 . . relating to the Q factor or damping of the resonant circuit
- H03B 2200/0088 . . Reduction of noise
- H03B 2200/009 . . . Reduction of phase noise
- H03B 2200/0092 . . Measures to linearise or reduce distortion of oscillator characteristics
- H03B 2200/0094 . . Measures to ensure starting of oscillations
- H03B 2200/0096 . . Measures to ensure stopping of oscillations
- H03B 2200/0098 . . having a balanced output signal

### **H03B 2201/00 Aspects of oscillators relating to varying the frequency of the oscillations**

- H03B 2201/01 . Varying the frequency of the oscillations by manual means
- H03B 2201/011 . . the means being an element with a variable capacitance
- H03B 2201/012 . . the means being an element with a variable inductance
- H03B 2201/014 . . the means being associated with an element comprising distributed inductances and capacitances
- H03B 2201/015 . . . the element being a cavity



- H03B 2201/017 . . . the element being a dielectric resonator
- H03B 2201/018 . . the means being a manual switch
- H03B 2201/02 . Varying the frequency of the oscillations by electronic means
- H03B 2201/0208 . . the means being an element with a variable capacitance, e.g. capacitance diode
- H03B 2201/0216 . . the means being an element with a variable inductance
- H03B 2201/0225 . . the means being associated with an element comprising distributed inductances and capacitances
- H03B 2201/0233 . . . the element being a cavity
- H03B 2201/0241 . . . the element being a magnetically variable element, e.g. an Yttrium Iron Garnet
- H03B 2201/025 . . the means being an electronic switch for switching in or out oscillator elements
- H03B 2201/0258 . . . the means comprising a diode
- H03B 2201/0266 . . . the means comprising a transistor
- H03B 2201/0275 . . the means delivering several selected voltages or currents
- H03B 2201/0283 . . . the means functioning digitally
- H03B 2201/0291 . . . . and being controlled by a processing device, e.g. a microprocessor
- H03B 2201/03 . Varying beside the frequency also another parameter of the oscillator in dependence on the frequency
- H03B 2201/031 . . the parameter being the amplitude of a signal, e.g. maintaining a constant output amplitude over the frequency range
- H03B 2201/033 . . the parameter being the amount of feedback
- H03B 2201/035 . . the parameter being another frequency, e.g. a harmonic of the oscillating frequency
- H03B 2201/036 . . the parameter being the quality factor of a resonator
- H03B 2201/038 . . the parameter being a bias voltage or a power supply
- H03B 2202/00 Aspects of oscillators relating to reduction of undesired oscillations**
- H03B 2202/01 . Reduction of undesired oscillations originated from distortion in one of the circuit elements of the oscillator
- H03B 2202/012 . . the circuit element being the active device
- H03B 2202/015 . . the circuit element being a limiter
- H03B 2202/017 . . the circuit element being a frequency determining element
- H03B 2202/02 . Reduction of undesired oscillations originated from natural noise of the circuit elements of the oscillator
- H03B 2202/022 . . the noise being essentially white noise, i.e. frequency independent noise
- H03B 2202/025 . . the noise being coloured noise, i.e. frequency dependent noise
- H03B 2202/027 . . . the noise being essentially proportional to the inverse of the frequency, i.e. the so-called 1/f noise
- H03B 2202/03 . Reduction of undesired oscillations originated from internal parasitic couplings, i.e. parasitic couplings within the oscillator itself



- H03B 2202/04
  - Reduction of undesired oscillations originated from outside noise or interferences, e.g. from parasitic couplings with circuit elements outside the oscillator
- H03B 2202/042
  - . the circuit element belonging to the power supply
- H03B 2202/044
  - . the circuit element belonging to transmitter circuitry
- H03B 2202/046
  - . the circuit element belonging to receiver circuitry
- H03B 2202/048
  - . the circuit element being a frequency divider
- H03B 2202/05
  - Reduction of undesired oscillations through filtering or through special resonator characteristics
- H03B 2202/06
  - Reduction of undesired oscillations through modification of a bias voltage, e.g. selecting the operation point of an active device
- H03B 2202/07
  - Reduction of undesired oscillations through a cancelling of the undesired oscillation
- H03B 2202/073
  - . by modifying the internal feedback of the oscillator
- H03B 2202/076
  - . by using a feedback loop external to the oscillator, e.g. the so-called noise degeneration
- H03B 2202/08
  - Reduction of undesired oscillations originated from the oscillator in circuit elements external to the oscillator by means associated with the oscillator
- H03B 2202/082
  - . by avoiding coupling between these circuit elements
- H03B 2202/084
  - . . through shielding
- H03B 2202/086
  - . . through a frequency dependent coupling, e.g. which attenuates a certain frequency range
- H03B 2202/088
  - . by compensating through additional couplings with these circuit elements