

CPC COOPERATIVE PATENT CLASSIFICATION

H ELECTRICITY

(NOTE omitted)

H10 SEMICONDUCTOR DEVICES; ELECTRIC SOLID-STATE DEVICES NOT OTHERWISE PROVIDED FOR

H10N ELECTRIC SOLID-STATE DEVICES NOT OTHERWISE PROVIDED FOR

NOTE

In this subclass, the periodic system used is the I to VIII group system indicated in the Periodic Table under Note (3) of section [C](#).

Thermoelectric or thermomagnetic devices

10/00 Thermoelectric devices comprising a junction of dissimilar materials, i.e. devices exhibiting Seebeck or Peltier effects ([integrated devices or assemblies of multiple devices H10N 19/00](#))

- 10/01 . Manufacture or treatment
- 10/10 . operating with only the Peltier or Seebeck effects
- 10/13 . . characterised by the heat-exchanging means at the junction
- 10/17 . . characterised by the structure or configuration of the cell or thermocouple forming the device
- 10/80 . Constructional details
- 10/81 . . Structural details of the junction
- 10/813 . . . the junction being separable, e.g. using a spring
- 10/817 . . . the junction being non-separable, e.g. being cemented, sintered or soldered
- 10/82 . . Interconnections
- 10/85 . . Thermoelectric active materials
- 10/851 . . . comprising inorganic compositions
- 10/852 comprising tellurium, selenium or sulfur
- 10/853 comprising arsenic, antimony or bismuth ([H10N 10/852 takes precedence](#))
- 10/854 comprising only metals ([H10N 10/852](#), [H10N 10/853 take precedence](#))
- 10/855 comprising compounds containing boron, carbon, oxygen or nitrogen

WARNING

Group [H10N 10/855](#) is impacted by reclassification into group [H10N 10/8556](#).

Groups [H10N 10/855](#) and [H10N 10/8556](#) should be considered in order to perform a complete search.

- 10/8552 {the compounds being superconducting}
- 10/8556 {comprising compounds containing germanium or silicon}

WARNING

Group [H10N 10/8556](#) is incomplete pending reclassification of documents from group [H10N 10/855](#).

Groups [H10N 10/855](#) and [H10N 10/8556](#) should be considered in order to perform a complete search.

- 10/856 . . . comprising organic compositions
- 10/857 . . . comprising compositions changing continuously or discontinuously inside the material

15/00 Thermoelectric devices without a junction of dissimilar materials; Thermomagnetic devices, e.g. using the Nernst-Ettingshausen effect ([integrated devices or assemblies of multiple devices H10N 19/00](#))

- 15/10 . Thermoelectric devices using thermal change of the dielectric constant, e.g. working above and below the Curie point
- 15/15 . . {Thermoelectric active materials}
- 15/20 . Thermomagnetic devices using thermal change of the magnetic permeability, e.g. working above and below the Curie point

19/00 Integrated devices, or assemblies of multiple devices, comprising at least one thermoelectric or thermomagnetic element covered by groups [H10N 10/00](#) - [H10N 15/00](#)

WARNING

Group [H10N 19/00](#) is incomplete pending reclassification of documents from groups [H01L 25/04](#), [H01L 25/065](#), [H01L 25/0652](#), [H01L 25/0655](#), [H01L 25/0657](#), [H01L 25/16](#), [H01L 25/162](#), [H01L 25/165](#), [H01L 25/167](#) and [H01L 25/18](#).

All groups listed in this Warning should be considered in order to perform a complete search.

- 19/101 . {Multiple thermocouples connected in a cascade arrangement}

Piezoelectric, electrostrictive or magnetostrictive devices

30/00 Piezoelectric or electrostrictive devices ([integrated devices or assemblies of multiple devices H10N 39/00](#))

WARNING

Group [H10N 30/00](#) is impacted by reclassification into group [H10N 35/00](#).

Groups [H10N 30/00](#) and [H10N 35/00](#) should be considered in order to perform a complete search.

- 30/01 . Manufacture or treatment

- 30/02 . . Forming enclosures or casings
- 30/03 . . Assembling devices that include piezoelectric or electrostrictive parts
- 30/04 . . Treatments to modify a piezoelectric or electrostrictive property, e.g. polarisation characteristics, vibration characteristics or mode tuning
 - 30/045 . . . by polarising
- 30/05 . . Manufacture of multilayered piezoelectric or electrostrictive devices, or parts thereof, e.g. by stacking piezoelectric bodies and electrodes
 - 30/053 . . . by integrally sintering piezoelectric or electrostrictive bodies and electrodes
 - 30/057 . . . by stacking bulk piezoelectric or electrostrictive bodies and electrodes
- 30/06 . . Forming electrodes or interconnections, e.g. leads or terminals
 - 30/063 . . . Forming interconnections, e.g. connection electrodes of multilayered piezoelectric or electrostrictive parts
 - 30/067 . . . Forming single-layered electrodes of multilayered piezoelectric or electrostrictive parts
- 30/07 . . Forming of piezoelectric or electrostrictive parts or bodies on an electrical element or another base
 - 30/071 . . . Mounting of piezoelectric or electrostrictive parts together with semiconductor elements, or other circuit elements, on a common substrate
 - 30/072 . . . by laminating or bonding of piezoelectric or electrostrictive bodies
 - 30/073 by fusion of metals or by adhesives
 - 30/074 by depositing piezoelectric or electrostrictive layers, e.g. aerosol or screen printing
 - 30/076 by vapour phase deposition
 - 30/077 by liquid phase deposition
 - 30/078 by sol-gel deposition
 - 30/079 using intermediate layers, e.g. for growth control
- 30/08 . . Shaping or machining of piezoelectric or electrostrictive bodies
 - 30/081 . . . by coating or depositing using masks, e.g. lift-off
 - 30/082 . . . by etching, e.g. lithography
 - 30/084 . . . by moulding or extrusion
 - 30/085 . . . by machining
 - 30/086 by polishing or grinding
 - 30/088 by cutting or dicing
 - 30/089 by punching
- 30/09 . . Forming piezoelectric or electrostrictive materials
 - 30/092 . . . Forming composite materials
 - 30/093 . . . Forming inorganic materials
 - 30/095 by melting
 - 30/097 by sintering
 - 30/098 . . . Forming organic materials
- 30/101 . . {with electrical and mechanical input and output, e.g. having combined actuator and sensor parts}
- 30/20 . . with electrical input and mechanical output, e.g. functioning as actuators or vibrators
 - 30/202 . . {using longitudinal or thickness displacement combined with bending, shear or torsion displacement}
 - 30/2023 . . . {having polygonal or rectangular shape}
 - 30/2027 . . . {having cylindrical or annular shape}
- 30/204 . . {using bending displacement, e.g. unimorph, bimorph or multimorph cantilever or membrane benders}
 - 30/2041 . . . {Beam type}
 - 30/2042 {Cantilevers, i.e. having one fixed end}
 - 30/2043 {connected at their free ends, e.g. parallelogram type}
 - 30/2044 {having multiple segments mechanically connected in series, e.g. zig-zag type}
 - 30/2045 {adapted for in-plane bending displacement}
 - 30/2046 {adapted for multi-directional bending displacement}
 - 30/2047 . . . {Membrane type}
 - 30/2048 {having non-planar shape}
- 30/206 . . {using only longitudinal or thickness displacement, e.g. d_{33} or d_{31} type devices}
- 30/208 . . {using shear or torsion displacement, e.g. d_{15} type devices}
- 30/30 . . with mechanical input and electrical output, e.g. functioning as generators or sensors
 - 30/302 . . {Sensors}
 - 30/304 . . {Beam type}
 - 30/306 . . . {Cantilevers}
 - 30/308 . . {Membrane type}
- 30/40 . . with electrical input and electrical output, e.g. functioning as transformers
 - 30/50 . . having a stacked or multilayer structure
 - 30/501 . . {having a non-rectangular cross-section in a plane parallel to the stacking direction, e.g. polygonal or trapezoidal in side view}
 - 30/503 . . {having a non-rectangular cross-section in a plane orthogonal to the stacking direction, e.g. polygonal or circular in top view}
 - 30/505 . . . {the cross-section being annular}
 - 30/506 . . {having a cylindrical shape and having stacking in the radial direction, e.g. coaxial or spiral type rolls}
 - 30/508 . . {adapted for alleviating internal stress, e.g. cracking control layers}
- 30/60 . . having a coaxial cable structure
 - 30/702 . . {based on piezoelectric or electrostrictive fibres}
 - 30/704 . . {based on piezoelectric or electrostrictive films or coatings}
 - 30/706 . . . {characterised by the underlying bases, e.g. substrates}
 - 30/708 . . . {Intermediate layers, e.g. barrier, adhesion or growth control buffer layers}
- 30/80 . . Constructional details
 - WARNING**
Group [H10N 30/80](#) is impacted by reclassification into group [H10N 35/80](#).
Groups [H10N 30/80](#) and [H10N 35/80](#) should be considered in order to perform a complete search.
- 30/802 . . {Circuitry or processes for operating piezoelectric or electrostrictive devices not otherwise provided for, e.g. drive circuits}
- 30/804 . . . {for piezoelectric transformers}

- 30/85 . . Piezoelectric or electrostrictive active materials

WARNING

Group [H10N 30/85](#) is impacted by reclassification into group [H10N 35/85](#).

Groups [H10N 30/85](#) and [H10N 35/85](#) should be considered in order to perform a complete search.

- 30/852 . . . {Composite materials, e.g. having 1-3 or 2-2 type connectivity}
- 30/853 . . . Ceramic compositions
- 30/8536 {Alkaline earth metal based oxides, e.g. barium titanates}
- 30/8542 {Alkali metal based oxides, e.g. lithium, sodium or potassium niobates}
- 30/8548 {Lead-based oxides}
- 30/8554 {Lead-zirconium titanate [PZT] based}
- 30/8561 {Bismuth-based oxides}
- 30/857 . . . Macromolecular compositions
- 30/87 . . Electrodes or interconnections, e.g. leads or terminals
- 30/871 . . . {Single-layered electrodes of multilayer piezoelectric or electrostrictive devices, e.g. internal electrodes}
- 30/872 . . . {Interconnections, e.g. connection electrodes of multilayer piezoelectric or electrostrictive devices}
- 30/874 {embedded within piezoelectric or electrostrictive material, e.g. via connections}
- 30/875 . . . {Further connection or lead arrangements, e.g. flexible wiring boards, terminal pins}
- 30/877 . . . {Conductive materials}
- 30/878 {the principal material being non-metallic, e.g. oxide or carbon based}
- 30/88 . . Mounts; Supports; Enclosures; Casings
- 30/883 . . . {Additional insulation means preventing electrical, physical or chemical damage, e.g. protective coatings}
- 30/886 . . . {Additional mechanical prestressing means, e.g. springs}

35/00 **Magnetostrictive devices** (integrated devices or assemblies of multiple devices [H10N 39/00](#))

WARNING

Group [H10N 35/00](#) is incomplete pending reclassification of documents from group [H10N 30/00](#).

Groups [H10N 30/00](#) and [H10N 35/00](#) should be considered in order to perform a complete search.

- 35/01 . Manufacture or treatment
- 35/101 . {with mechanical input and electrical output, e.g. generators, sensors}
- 35/80 . Constructional details

WARNING

Group [H10N 35/80](#) is incomplete pending reclassification of documents from group [H10N 30/80](#).

Groups [H10N 30/80](#) and [H10N 35/80](#) should be considered in order to perform a complete search.

- 35/85 . . Magnetostrictive active materials

WARNING

Group [H10N 35/85](#) is incomplete pending reclassification of documents from group [H10N 30/85](#).

Groups [H10N 30/85](#) and [H10N 35/85](#) should be considered in order to perform a complete search.

39/00 **Integrated devices, or assemblies of multiple devices, comprising at least one piezoelectric, electrostrictive or magnetostrictive element covered by groups [H10N 30/00](#) – [H10N 35/00](#)**

WARNING

Group [H10N 39/00](#) is incomplete pending reclassification of documents from groups [H01L 25/04](#), [H01L 25/065](#), [H01L 25/0652](#), [H01L 25/0655](#), [H01L 25/0657](#), [H01L 25/16](#), [H01L 25/162](#), [H01L 25/165](#), [H01L 25/167](#) and [H01L 25/18](#).

All groups listed in this Warning should be considered in order to perform a complete search.

Galvanomagnetic or similar magnetic-effect devices

50/00 **Galvanomagnetic devices** (Hall-effect devices [H10N 52/00](#); integrated devices or assemblies of multiple devices [H10N 59/00](#))

WARNING

Group [H10N 50/00](#) is impacted by reclassification into group [H10N 50/20](#).

Groups [H10N 50/00](#) and [H10N 50/20](#) should be considered in order to perform a complete search.

- 50/01 . Manufacture or treatment
- 50/10 . Magnetoresistive devices
- 50/20 . Spin-polarised current-controlled devices (magnetoresistive devices [H10N 50/10](#))

WARNING

Group [H10N 50/20](#) is incomplete pending reclassification of documents from group [H10N 50/00](#).

Groups [H10N 50/00](#) and [H10N 50/20](#) should be considered in order to perform a complete search.

- 50/80 . Constructional details
- 50/85 . . Materials of the active region

WARNING

Group [H10N 50/85](#) is impacted by reclassification into group [H10N 52/85](#).

Groups [H10N 50/85](#) and [H10N 52/85](#) should be considered in order to perform a complete search.

52/00 **Hall-effect devices** (integrated devices or assemblies of multiple devices [H10N 59/00](#))

- 52/01 . Manufacture or treatment
- 52/101 . {Semiconductor Hall-effect devices}
- 52/80 . Constructional details

52/85 . . Materials of the active region

WARNING

Group [H10N 52/85](#) is incomplete pending reclassification of documents from group [H10N 50/85](#).

Groups [H10N 50/85](#) and [H10N 52/85](#) should be considered in order to perform a complete search.

59/00 Integrated devices, or assemblies of multiple devices, comprising at least one galvanomagnetic or Hall-effect element covered by groups [H10N 50/00](#) - [H10N 52/00](#) (MRAM devices [H10B 61/00](#))

WARNING

Group [H10N 59/00](#) is incomplete pending reclassification of documents from groups [H01L 25/04](#), [H01L 25/065](#), [H01L 25/0652](#), [H01L 25/0655](#), [H01L 25/0657](#), [H01L 25/16](#), [H01L 25/162](#), [H01L 25/165](#), [H01L 25/167](#) and [H01L 25/18](#).

All groups listed in this Warning should be considered in order to perform a complete search.

Group [H10N 59/00](#) is also impacted by reclassification into group [H10B 61/00](#).

All groups listed in this Warning should be considered in order to perform a complete search.

Superconducting devices

60/00 Superconducting devices (integrated devices or assemblies of multiple devices [H10N 69/00](#))

- 60/01 . Manufacture or treatment
- 60/0128 . . {of composite superconductor filaments (comprising copper oxide [H10N 60/0268](#))}
- 60/0156 . . {of devices comprising Nb or an alloy of Nb with one or more of the elements of group IVB, e.g. titanium, zirconium or hafnium}
- 60/0184 . . {of devices comprising intermetallic compounds of type A-15, e.g. Nb₃Sn}
- 60/0212 . . {of devices comprising molybdenum chalcogenides}
- 60/0241 . . {of devices comprising nitrides or carbonitrides}
- 60/0268 . . {of devices comprising copper oxide}
- 60/0296 . . . {Processes for depositing or forming copper oxide superconductor layers}
- 60/0324 {from a solution}
- 60/0352 {from a suspension or slurry, e.g. screen printing or doctor blade casting}
- 60/0381 {by evaporation, e.g. MBE}
- 60/0408 {by sputtering}
- 60/0436 {by chemical vapour deposition [CVD]}
- 60/0464 {by metalloorganic chemical vapour deposition [MOCVD]}
- 60/0492 {by thermal spraying, e.g. plasma deposition}
- 60/0521 {by pulsed laser deposition, e.g. laser sputtering}
- 60/0548 {by deposition and subsequent treatment, e.g. oxidation of pre-deposited material}
- 60/0576 {characterised by the substrate}
- 60/0604 {Monocrystalline substrates, e.g. epitaxial growth}

- 60/0632 {Intermediate layers, e.g. for growth control}
- 60/0661 . . . {Processes performed after copper oxide formation, e.g. patterning}
- 60/0688 {Etching}
- 60/0716 {Passivating}
- 60/0744 . . . {Manufacture or deposition of electrodes}
- 60/0772 . . . {Processes including the use of non-gaseous precursors}
- 60/0801 . . . {Manufacture or treatment of filaments or composite wires}
- 60/0828 . . . {Introducing flux pinning centres}
- 60/0856 . . {of devices comprising metal borides, e.g. MgB₂}
- 60/0884 . . {Treatment of superconductor layers by irradiation, e.g. ion-beam, electron-beam, laser beam or X-rays}
- 60/0912 . . {of Josephson-effect devices}
- 60/0941 . . . {comprising high-T_c ceramic materials}
- 60/10 . Junction-based devices
- 60/11 . . {Single-electron tunnelling devices}
- 60/12 . . Josephson-effect devices
- 60/124 . . . {comprising high-T_c ceramic materials}
- 60/126 . . . {comprising metal borides, e.g. MgB₂}
- 60/128 . . {having three or more electrodes, e.g. transistor-like structures}
- 60/20 . Permanent superconducting devices
- 60/202 . . {comprising metal borides, e.g. MgB₂}
- 60/203 . . {comprising high-T_c ceramic materials}
- 60/205 . . {having three or more electrodes, e.g. transistor-like structures ([H10N 60/128](#) takes precedence)}
- 60/207 . . . {Field effect devices}
- 60/208 . . {based on Abrikosov vortices}
- 60/30 . Devices switchable between superconducting and normal states
- 60/35 . . Cryotrons
- 60/355 . . . Power cryotrons
- 60/80 . Constructional details
- 60/805 . . {for Josephson-effect devices}
- 60/81 . . Containers; Mountings
- 60/815 . . . {for Josephson-effect devices}
- 60/82 . . Current path
- 60/83 . . Element shape
- 60/84 . . Switching means for devices switchable between superconducting and normal states
- 60/85 . . Superconducting active materials
- 60/851 . . . {Organic superconductors}
- 60/853 {Fullerene superconductors, e.g. soccer ball-shaped allotropes of carbon, e.g. C₆₀ or C₉₄}
- 60/855 . . . {Ceramic superconductors}
- 60/857 {comprising copper oxide}
- 60/858 {having multilayered structures, e.g. superlattices}
- 60/99 . {Alleged superconductivity}

69/00 Integrated devices, or assemblies of multiple devices, comprising at least one superconducting element covered by group [H10N 60/00](#)

WARNING

Group [H10N 69/00](#) is incomplete pending reclassification of documents from groups [H01L 25/04](#), [H01L 25/065](#), [H01L 25/0652](#), [H01L 25/0655](#), [H01L 25/0657](#), [H01L 25/16](#), [H01L 25/162](#), [H01L 25/165](#), [H01L 25/167](#) and [H01L 25/18](#).

All groups listed in this Warning should be considered in order to perform a complete search.

Other electric solid-state devices

70/00 Solid-state devices having no potential barriers, and specially adapted for rectifying, amplifying, oscillating or switching (integrated devices or assemblies of multiple devices [H10N 79/00](#))

- 70/011 . {Manufacture or treatment of multistable switching devices}
- 70/021 . . {Formation of switching materials, e.g. deposition of layers}
- 70/023 . . . {by chemical vapor deposition, e.g. MOCVD, ALD}
- 70/026 . . . {by physical vapor deposition, e.g. sputtering}
- 70/028 . . . {by conversion of electrode material, e.g. oxidation}
- 70/041 . . {Modification of switching materials after formation, e.g. doping ([shaping H10N 70/061](#))}
- 70/043 . . . {by implantation}
- 70/046 . . . {by diffusion, e.g. photo-dissolution}
- 70/061 . . {Shaping switching materials}
- 70/063 . . . {by etching of pre-deposited switching material layers, e.g. lithography}
- 70/066 . . . {by filling of openings, e.g. damascene method}
- 70/068 . . . {by processes specially adapted for achieving sub-lithographic dimensions, e.g. using spacers}
- 70/10 . Solid-state travelling-wave devices
- 70/151 . {Charge density wave transport devices}
- 70/20 . Multistable switching devices, e.g. memristors
- 70/231 . . {based on solid-state phase change, e.g. between amorphous and crystalline phases, Ovshinsky effect}
- 70/235 . . . {between different crystalline phases, e.g. cubic and hexagonal}
- 70/24 . . {based on migration or redistribution of ionic species, e.g. anions, vacancies}
- 70/245 . . . {the species being metal cations, e.g. programmable metallization cells}
- 70/25 . . {based on bulk electronic defects, e.g. trapping of electrons}
- 70/253 . . {having three or more electrodes, e.g. transistor-like devices}
- 70/257 . . {having switching assisted by radiation or particle beam, e.g. optically controlled devices}
- 70/801 . {Constructional details of multistable switching devices}
- 70/821 . . {Device geometry}
- 70/823 . . . {adapted for essentially horizontal current flow, e.g. bridge type devices}

- 70/826 . . . {adapted for essentially vertical current flow, e.g. sandwich or pillar type devices}
- 70/8265 {on sidewalls of dielectric structures, e.g. mesa-shaped or cup-shaped devices}
- 70/828 . . . {Current flow limiting means within the switching material region, e.g. constrictions}
- 70/841 . . {Electrodes}
- 70/8413 . . . {adapted for resistive heating}
- 70/8416 . . . {adapted for supplying ionic species}
- 70/8418 . . . {adapted for focusing electric field or current, e.g. tip-shaped}
- 70/861 . . {Thermal details}
- 70/8613 . . . {Heating or cooling means other than resistive heating electrodes, e.g. heater in parallel}
- 70/8616 . . . {Thermal insulation means}
- 70/881 . . {Switching materials}
- 70/882 . . . {Compounds of sulfur, selenium or tellurium, e.g. chalcogenides}
- 70/8822 {Sulfides, e.g. CuS}
- 70/8825 {Selenides, e.g. GeSe}
- 70/8828 {Tellurides, e.g. GeSbTe}
- 70/883 . . . {Oxides or nitrides}
- 70/8833 {Binary metal oxides, e.g. TaO_x}
- 70/8836 {Complex metal oxides, e.g. perovskites, spinels}
- 70/884 . . . {based on at least one element of group IIIA, IVA or VA, e.g. elemental or compound semiconductors ([compounds of sulfur, selenium or tellurium, e.g. chalcogenides H10N 70/882; oxides or nitrides H10N 70/883](#))}
- 70/8845 {Carbon or carbides}

79/00 Integrated devices, or assemblies of multiple devices, comprising at least one solid-state element covered by group [H10N 70/00](#) (ReRAM devices [H10B 63/00](#); PCRAM devices [H10B 63/10](#))

WARNING

Group [H10N 79/00](#) is incomplete pending reclassification of documents from groups [H01L 25/04](#), [H01L 25/065](#), [H01L 25/0652](#), [H01L 25/0655](#), [H01L 25/0657](#), [H01L 25/16](#), [H01L 25/162](#), [H01L 25/165](#), [H01L 25/167](#), [H01L 25/18](#) and [H10B 63/00](#).

All groups listed in this Warning should be considered in order to perform a complete search.

80/00 Bulk negative-resistance effect devices ([integrated devices or assemblies of multiple devices H10N 89/00](#))

- 80/01 . {Manufacture or treatment}
- 80/10 . Gunn-effect devices
- 80/103 . . {controlled by electromagnetic radiation}
- 80/107 . . {Gunn diodes}

- 89/00** **Integrated devices, or assemblies of multiple devices, comprising at least one bulk negative resistance effect element covered by group [H10N 80/00](#)**

WARNING

Group [H10N 89/00](#) is incomplete pending reclassification of documents from groups [H01L 25/04](#), [H01L 25/065](#), [H01L 25/0652](#), [H01L 25/0655](#), [H01L 25/0657](#), [H01L 25/16](#), [H01L 25/162](#), [H01L 25/165](#), [H01L 25/167](#) and [H01L 25/18](#).

All groups listed in this Warning should be considered in order to perform a complete search.

- 89/02 . {Gunn-effect integrated devices}
- 97/00** **Electric solid-state thin-film or thick-film devices, not otherwise provided for**
- 99/00** **Subject matter not provided for in other groups of this subclass**
- 99/03 . {Devices using Mott metal-insulator transition, e.g. field-effect transistor-like devices}
- 99/05 . {Devices based on quantum mechanical effects, e.g. quantum interference devices or metal single-electron transistors}