CLASS 257, ACTIVE SOLID-STATE DEVICES (E.G.,TRANSISTORS, SOLID-STATE DIODES)

SECTION I - CLASS DEFINITION

This class provides for active solid-state electronic devices, that is, electronic devices or components that are made up primarily of solid materials, usually semiconductors, which operate by the movement of charge carriers - electrons or holes - which undergo energy level changes within the material and can modify an input voltage to achieve rectification, amplification, or switching action, and are not classified elsewhere.

SCOPE OF THE CLASS

Active solid-state electronic devices include diodes, transistors, thyristors, etc., but exclude pure resistors, capacitors, inductors, or combinations solely thereof. The latter class of devices is characterized as passive.

The subject matter to be found here includes only active solid-state devices, per se. It may include one or more such devices combined with contacts or leads, or structures configured to be tested on a semiconductor chip, or merely semiconductor material without contacts or leads where the sole disclosed use is an active solid-state device. This subject matter **does not** include active solid-state devices combined with significant circuits.

Claims reciting an integrated circuit nominally with significant metallization will be classified in Class 257, whereas otherwise, nominal recitation of an integrated circuit (i.e., without significant active solid-state device recitation) will not be sufficient to permit the device to be classified in Class 257.

KEY CONCEPTS

See Subclass References to the Current Class, below, for references that relate to key concepts and terms found in Class 257. An indication that a particular concept or term occurs in one or more subclasses does not mean that the indicated subclass or subclasses are the only places that subject matter may be found. That subject matter may possibly be found elsewhere in Class 257 listed under a related term or concept that may be broader or narrower or of the same scope.

OTHER CLASSIFICATION SYSTEMS

Each subclass definition may contain an OTHER CLASSIFICATION SYSTEMS listing that is to be used for informational purposes only. These classification listings may change at any time after their publication and are therefore not guaranteed to be current. In addition, the classification listing does not necessarily indicate the sole relationship between the U.S. Patent Classification System and foreign classifications. Even where a single classification is listed for a single U.S. subclass, a one-to-one correlation should not be inferred. As a result, information contained therein is considered to be only a guide to related subject matter.

SECTION II - LINES WITH OTHER CLASSES AND WITHIN THIS CLASS

A. Classes related to Class 257 subject matter in the sense that they employ active solid-state devices in electronic circuits and the relationship of these classes to Class 257 is mainly that of a combination to a subcombination or of a genus to a specie. See References to Other Classes, below, referencing this section.

B. Classes related to Class 257 subject matter in the sense that they employ active solid-state devices in electronic circuits and the use of active solid-state electronic devices primarily as a perfecting feature. See References to Other Classes, below, referencing this section.

C. See References to Other Classes below for classes that provide for materials used in active solid-state electronic devices.

D. See References to Other Classes, below, for classes related to Class 257 because they provide for methods of making, cleaning, coating, etc., active solid-state devices, e.g., Class 438, Semiconductor Device Manufacturing: Process.

E. See References to Other Classes, below, for Classes related to Class 257 because they provide for active solid-state electronic devices structures with a specified use, e.g., Class 136, Batteries: Thermoelectric and Photoelectric.

F. See References to Other Classes, below, for classes providing for provide for subcombination subject matter that can be used as component part of active solid-state electronic devices (e.g., lead frames) or perfect the device (e.g., a heat sink).

G. Classes which provide for passive solid-state electronic devices with names that may refer to either active or passive solid-state electronic devices, e.g., coherers, varistors, varactors. luminescent or electroluminescent

devices. The devices may be part of the main subject matter of the class or may be used as circuit elements in circuits or control or measuring systems which form the main subject matter of the class.

See References to Other Classes, below, referencing this section.

SECTION III - SUBCLASS REFERENCES TO THE CURRENT CLASS

SEE OR SEARCH THIS CLASS, SUBCLASS:

1, through 8, for bulk effect device.
2, - 5, 16, 52-63, and 646, for amorphous semiconductor material.
4, 72, 91, 144, 150, 151, 175-177, 181, 182, 207-211, 246-250, 276, 309, 317, 401, 448, 457, 459, 503, 508, 573, 584, 587, 602, 621, 625, 666-676, and 692-697, for configuration of electrode, contact, lead or pad.
4, 32, 33, 81, 91, 99, 144, 150-153, 177-179, 181, 182, 203, 207-211, 276, 377, 382-385, 459, 503, 522, 554, 573, 576, 584, 602, 621, 625, 661-677, 690-700, and 734-786, for electrical contact or lead.
6, through 8, for Gunn effect (intervalley transfer).
7, for intervalley transfer (e.g., Gunn) device in integrated circuit.
10, through 11, and 407, for controlled work function material.
10, and 11, for electron emissive layer.
10, through 27, and 104-106, for heterojunction involving quantum-mechanical tunneling.
10, and 11, for photocathode.
10, 54, 73, 155, 192-195, 217, 260, 267, 269, 275-277, 280-284, 449-457, 471-486, and 928, for Schottky barrier.
10, 11, 30-39, and 314-326, for tunneling-insulator layer.
10, 11, and 407, for work function of material, controlled, e.g., low.
13, 76, 78, 85, 90, and 94-97, for heterojunction light emitter.
13, 79-103, and 918, for light emitting device.
13, through 25, for quantum well device.
15, through 22, and 28, for superlattice.
16, 55, 63, and 65, for heterojunction in non-single-crystal material.
18, 19, and 190, for mismatched or strained lattice.
18, 19, and 190, for mismatch of lattice constant.
18, and 19, for strained layer superlattice heterojunction.
19, 76, 78, 103, 200-201, and 613-616, for alloy of two different semiconductors (e.g., $Ga_xIn_{1-x}As$).
20, 24, 27, 57-61, 66-72, 133-145, 192-195, 202-211, 213, and 252-413, for field effect devices.
20, 24, and 194, for HEMT (High electron mobility transistor).
20, 27, 187, and 192-195, for heterojunction FETs.
21, 85, 184-189, for heterojunction in light responsive device.
21, for light responsive or activated device (superlattice quantum well heterojunction).
21, 53-56, 59, 72, 80-85, 113-118, 184-189, 222, 223, 225-234, 257, 258, 290-294, 325, 428-466, 680, 681, and 749, for radiation responsive.
21, and 187, for light responsive heterojunction transistor.
21, 187, 443, and 462, for photosensitive bipolar transistor.
26, 27, and 29, for ballistic transport device.
26, 27, and 29, for ballistic transport transistor.
31, through 36, for Josephson device.
31, through 36, and 661-663, for superconductive element/device.
31, through 36, 468, and 661-663, for thermal device operated at cryogenic temperature.
33, for high temperature (30 K) Josephson device.
40, for organic semiconductor material.
41, for point contact device.
42, for Selenium (elemental).
44, through 47, for alloyed junction.
45, for thermal gradient zone melting (TGZM).
46, 104, and 105, for Esaki diode.
46, and 104-106, for p-n junction type (Esaki type) tunneling.
47, 197, 205, 273, 350, 361, 370, 378, 423, 462, 477 though 479, 511, 512, 517, 518, 525, 526, 539-543, and 552-593, for bipolar transistor structure.
47, for alloyed junction bipolar transistor.
48, and 797, for calibration or test structure.5, for array of bulk effect amorphous switches.
48, for test structures.
49, through 75, for non-single crystal, as active layer.
49, through 51, 64-75, 359, 377, 380-382, 385, 412, 505, 518, 520, 524-527, 538, 554, 576, 581, 588, and 754-757, for polycrystalline semiconductor material.
49, through 51, and 64-75, for polycrystalline active junction material.

49, through 51, and 64-75, for recrystallized active semiconductor layer.
50, and 530, for anti-fuse component or element.
50, 530, and 928, for shorted devices, in general, e.g., anti-fuse elements.
53, through 56, for amorphous semiconductor material device.
53, through 56, 108, 225, 252, and 414, for responsiveness to nonelectric signal.
55, and 63, for **alloy** of amorphous semiconductor materials.
55, 63, and 65, and 646, for silicon nitride to increase band gap of amorphous or polycrystalline silicon.
56, 58, 62, and 65, for for dangling bond.
56, 58, 62, and 68, for passivation of dangling bonds in nonsingle crystal semiconductor.
57, through 61, 66-72, and 368-401, for insulated gate FET in integrated circuit.
57, through 61, and 66-72, for FET in non-single crystal or recrystallized semiconductor material (e.g., amorphous or polycrystalline semiconductor as channel).
59, 72, and 88-93, for array as imager, or with transparent electrode, or as display (with plural light emitters).
59, 72, 449-457, and 749, for electrical contact or lead transparent to light.
59, 72, and 293, for photoresistor combined with accessing FET.
59, 72, 453, and 749, for transparent electrode.
60, 135, 136, 263-267, 302, and 328-334, for vertical channel field effect device.
64, 255, 521, 627, and 628, for crystal axis or plane.
65, for alloy of polycrystalline semiconductor materials.
66, 67, 69, 379-381, 903, and 904, for static memory cell using FET.
67, through 70, for stacked FETs.
67, 69, 70, and 74, for stacked FETs.
68, through 71, 296-313, 296, 298, 300, 906, and 908, for capacitance combined with insulated gate device. (e.g., DRAM).
68, 71, and 295-313, for insulated gate device (capacitor or combined with capacitor).
68, 71, 296-313, and 905-908, for memory device component involving a capacitor (e.g., dynamic memory cell).
68, 71, 303, and 306-309, for stacked capacitors in DRAM cell.
68, and 301-305, for capacitor in trench.
68, 283, 284, 330-334, 374, 397, 513, 514, 622, 647, and 648, for vertical walled groove in semiconductor.
69, 195, 204, 206, 338, 350, 351, 357-359, and 365-377, for CMOS.
69, 195, 204, 206, 274, 338, 350, 351, 357-359, and 369-377, for complementary field effect transistors.
74, and 278, for three-dimensional integrated circuit.
76, through 78, and 183-201, for heterojunction, generally.
76, through 78, for wide band gap semiconductor material other than GaAsP or GaAlAs.
80, through 85, for light responsive or activated device combined with light emitting device.
81, 99, 177-181, 584, 625, 675, 688, 689, 705, 707, 712-722, and 796, for heat sink.
81, 82, and 99, for housing or package for light emitter.
81, and 82, for housing or package for light emitter combined with light receiver.
81, 82, 433, 434, 680, 681, for housing or package for light responsive device.
81, 99, and 666-677, for lead frame.
83, for light coupled transistor structure.
86, and 87 for indirect band gap active layer - light emitter.
87, 131, 156, 439, 523, 590, and 608-612, for deep level dopant/impurity.
87, 126, 131, 156, 523, 590, 609-612, and 617, for recombination centers.
91, 98, 151, 175, 176, 249, 250, 276, 282-284, 309, 317, 401, 418, 435, 448, 457, 459, 503, 508, 534, 573, 587, 602, 621, 662, and 664, for shape(d) contact, electrode, conductor, or terminal.
91, 98, 294, 323, 435, and 659, for optical shield.
93, for plural light emitters in integrated circuit.
93, 374, 446, 499 and 564, for electrical isolation of components in integrated circuit.
95, 117, 118, 127, 170, 244, 283, 284, 301-305, 330-334, 418, 419, 447, 460, 466, 496, 534, 571, 586, and 618-628, for grooves, generally.
95, 170, 171, 452, 466, 496, 571, 586, 594, 600, 618, and 623-626, for mesa structure.
95, for shaped contact, electrode, etc., external of heterojunction light emitter.
98, 116, 117, 294, and 432, for light fiber, guide, or pipe.
98, for luminescent material used with light emitter.
98, 181, 418, 688, 710, 711, 728, and 730, for shaped housing or package.

98, 99, 116, 434, 680, and 681, for window (optical) for housing.
100, 433, 434, 667, 687, 767-and 796, for encapsulated.
101, 194, 219-221, 264, 269, 285, 335-345, 404, 430, 450, 458, 463, 492, 493, 497, 498, 543, 545, 548, 558, 583, 591, 592, 596, 597, 605, 606, 655-657, 927, and 929, for dopant/impurity concentration, incl., graded profile.
102, 227, 439, and 607-612, for specified, generally (e.g., photoionizable).
106, for reverse conducting diode (tunnel diode).
106, for Zener diode.
107, through 182, and 918, for regenerative switching device.
108, 252, and 421-427, for magnetic field responsive.
108, 225, 254, and 415 and-419, for device responsive to pressure.
108, 222, 225, 254, and 417-419, for strain sensor.
108, 225, 252, and 467-470, for passivating device responsive to temperature.
109, for Shockley diode.
110, and 119-131, for bidirectional device (diac, rectifier).
113, through 118, for regenerative-type switching device.
115, 123, and 157-161, for amplified gate in thyristor.
121, for reverse conducting thyristor.
121, for Static Induction Transistor (SIT) - Bipolar transistor as reverse path of bidirectional conducting thyristor.
122, 141, 146, and 162, for lateral structure in regenerative device.
124, 125, and 133-145, for FET in or combined with thyristor.
125, 137, 138, 143, and 149, for shunt, regenerative device.
125, 137, 138, 143, 149, and 154, for shorted emitter, anode or cathode, in thyristor.
127, 446, 510-522, 571, 577, and 594, for groove to define plural devices.
127, 170, 339, 372-376, 394-400, 409, 452, 484, 490, 493-495, and 605, for guard ring or region.
131, 156, 376, 424, 523, 590, and 617, for crystal damage.
133, 145, 195, 205, 273, 337, 350, 361, 362, 370, and 378, for field effect combined with bipolar type (including regenerative type) device.
134, through 136, 217, 256-287, and 504, for JFET.
136, 205, 264, 268, 269, 392, for enhancement mode.
139, through 145, and 212, for conductivity modulated transistor.
139, through 145, 147-153, for extended latching current device.
139, through 145, 147-153, and 372-376, for means to prevent latchup.
139, through 145, and 211, for conductivity modulated transistor.
142, 148, 376, 553, and 583, for doping for gain reduction.
146, 476-479, and 499-564, for structure with elec. isolated components.
150, 151, 177-181, for housing or package for regenerative type switching device.
154, 169, 194, 195, 218, 264, 523, 646, and 656, for high resistivity semiconductor region - see, also, intrinsic material; PIN device.
154, 350, 358, 359, 363, 379-381, 516, 533, 536-543, 571, 572, 577, 580-582, and 904, for resistive element (resistor) (passive device).
164, and 580-582, for ballasting of current (e.g., by resistors).
164, through 166, 560-561, 563, and 579- 581, for multiple/plural emitter.
170, for edge, beveled - preventing breakdown.
171, 496, 586, and 618+, for bevel.
171, 452, 483, and 484, for protection against edge breakdown.
171, and 496, for reverse bevels.
173, 174, 328, 355-363, 487-496, and 546, for protection against overcurrent or overvoltage.
173, 529, 665, and 910, for fuse/fusible link.
173, for overvoltage protection means in thyristor.
177, through 181, 467, 468, 573, 625, 675, 688, 705-707, and 712-722, for cooling.
178, 179, and 746-748, for stress avoidance between electrode and semiconductor.
178, through 179, 633, 747, and 748, for thermal expansion matching or compensation.
180, and 733, for stud-type mount for housing.
180, and 733, for stud mount.
181, 182, 688, 689, 726, 727, and 785 for press contact of electrode and semiconductor.
183.1, 193, 215-251, and 912, for charge transfer device.
184, through 189, for heterojunction.
185, and 191, for graded band gap.
185, for staircase (light responsive heterojunction).
187, 197, and 198, for heterojunction bipolar transistor.
198, for wide band gap emitter heterojunction bipolar transistor.
199, 481, 482, 551, and 603-606, for avalanche diode.

199, 482, and 604, for IMPATT.
199, 259, 275-277, 482, 523, 604, 624, 625, 659, 662, 664, and 728, for for microwave device component.
202+, and 909, for master slice (gate array).
202+, and 909, for gate arrays.
202, through 211, and 909, for gate arrays.
205, 273, 350, 361, 370, and 378, for bipolar combined with field effect type device.
205, 273, 350, 361, 370, and 378, for bipolar transistor structure combined with FET.
206, 208, 210, and 211, for configuration of elements in gate array.
209, for gate array with programmable signal paths.
210, and 758-760, for multi-level metallization.
212, for double-base diode (unijunction transistor).
212, for Static Induction Transistor (SIT) - Unijunction transistor.
212, for unijunction transistor.
214, for charge injection device.
215, 218, and 225-251, for surface channel charge transfer device.
216+, for bulk channel device.
216, and 285, for buried channel.
219, through 221, for nonuniform channel doping in buried channel CCD.
223, 230, and 445, for antiblooming.
223, 230, and 445, for suppression of blooming in light imager.
224, and 243, for channel confinement.
225, 253, and 414, for chemical sensor.
225, for CCD with fixed pattern memory as ROM.
228, 447, 460, for backside illumination.
239, for floating diffusion as CCD Output Tap.
239, 261, and 315-323, for floating gate.
240, for nonuniform channel thickness in CCD.
241, for parallel channels in CCD.
245, 364, and 489, for resistive electrode.
246, through 248, for nonuniform channel doping in CCD, for directionality.
249, 317, 359, 363, 364, 377, 380-382, 384, 385, 387, 407, 412, 413, 489, 505, 518, 520, 524-527, 538, 554, 576, 581, 588, 646, 754-756, 904, and 914, for polycrystalline material (including polysilicon contacts) other than active junction material.
251, for bucket-brigade device.
254, and 416, for **acoustic energy detector**.
256, and 257, for light responsive PIN device combined with JFET.
257, and 258, for JFET.
227, and 439, for photoionization.
258, 291-294, 443-448, and 911, for array of electrode field effect devices.
260, and 262, in or combined with a JFET device.
260, and 261, for memory device component involving a JFET (e.g., taper isolated or floating pn junction gate type).
265, for vertical current path JFET in integrated circuit.
266, 267, and 287, for parallel channels in JFET.
269, and 285, for nonuniform channel doping in JFET.
272, through 278, for JFET in integrated circuit.
275, through 278, 662, and 664, for stripline lead.
276, for air bridge electrical lead.
276, for air bridge contact.
283, and 284, for groove alignment of Schottky gate to source region in MESFET.
283, through 284, 330-334, for gate electrode of FET formed in groove.
286, for nonuniform channel thickness in JFET.
290, and 294, for IGFET.
291, through 294, 326, 334, 337, 338, 347-363, and 368-401, for insulated gate device (IGFET in integrated circuit).
294, 297, 340, 409, 435, 488-490, 503, 508, 630, 659-660, and 662, for shield electrode.
295, 298, and 314-326, for EPROM/EEPROM.
295, 298, 314, and 324-326, for MNOS insulated gate-type memory device component.
297, 349, 547, and 620, for means to prevent charge leakage or leakage current.
297, 349, 354, 372-376, 503, 547, and 620, for means to prevent leakage current or charge leakage.
297, 660, and 921, for protection against radiation (e.g., alpha particles).
297, 660, and 921, for radiation protection.
297, 422, and 659-660, for ionizing radiation shield, charged particles, electric or magnetic fields.
298, and 315-326, for insulated gate device (floating gate memory device).
298, and 315-323, for floating insulated gate memory-type memory device component.
299, for substrate bias (electrical generator.
301, through 305, 534, and 599, for groove involving a capacitor.
305, 354, 376, 398-400, 519, 620, 648, and 652, for channel stop.
305, 333, 374, 389, 395-399, 510-521, and 632-651, for field oxide.
312, 480, and 595-602, for voltage variable capacitance device.
314, through 326 for variable threshold insulated gate device (e.g., EEPROM, non-volatile memory MOSFET).

322, for programming of floating gate MISFET (avalanche breakdown).
323, 680, and 681, for light erasure of EPROM.
325, for oxynitride as insulator in MNOS memory IGFET.
327, through 346, for short channel.
328, and 355-363, for overvoltage protection means in IGFET.
328, and 355-363, for MOSFET gate protection.
331, 341, 342, and 401, for parallel channels in IGFET.
332, 346, 387, 388, 412, and 413, for self-aligned MOSFET gate.
333, 340, and 386-389, for reduction of gate capacitance (FET).
333, 346, 387, and 388, for overlap of gate electrode with source or drain in IGFET.
334, 337, and 338, for VMOS or DMOS short channel IGFET in integrated circuit.
336, 344, 408, and 900, for LDD (lightly doped drain) device.
339, 409, 483, 484, and 487-496, for preventing avalanche breakdown.
339, 409, and 488-490, for field relief electrode.
339, 409, 490, and 495, for floating pn junction guard region.
340, 394, and 630, for field shield electrode.
345, and 404, for nonuniform channel doping in IGFET. depletion mode.
347, through 354, and 507, for insulating substrate integrated circuit.
347, through 354, and 507, for single crystal insulating substrate.
347, through 354, and 507, for single crystal semiconductor layer on insulating substrate (SOI).
348, 391, 392, and 402-407, for depletion mode Insulated Gate FET.
349, 354, 372-376, 503, and 547, for controlling, reducing, etc. parasitics.
350, 511, 512, 525, and 555-562, for lateral bipolar transistor in integrated circuit.
354, through 374, 395-399, 501, and 506-527, for dielectric isolation.
355, through 363, for gate insulator breakdown protection in IGFET integrated circuit.
360, and 367, for insulated gate device (controlling pn junction breakdown).
361, 362, and 497-499, for punch-device.
366, for overlap of plural gate electrodes in IGFET.
368, through 401, for PN junction isolation in MOSFET integrated circuit.
374, 394-398, 626, 631-651, and 758-760, for insulating/passivating coating.
374, 396-398, 510-521, 647, and 648, for groove (dielectric isolation means).
377, 382-385, 388, 412, 413, 454-458, 486, 518, 554, 576, 588, 747, 748, 754-757, 761, 763-764, and 768-770, for refractory electrode material.
377, 382-384, 388, 412, 413, 454-456, 485, 486, 576, 587, 751, 754-757, and 768-770, for silicide.
379, through 381, and 903-904, for static RAM arrangement.
379, through 381, 516, 528-543, 903, 904, 919, and 924, for passive components in integrated circuits.
382, through 384, 576, 757, 768, and 769, for metal or silicide of platinum group metal, as ohmic contact.
383, 388, 412, 485, 486, 763, 764, and 770, for pure or alloyed titanium.
388, 407, 412, and 413, for metal or silicide of platinum group metal, as MOSFET gate.
390, and 391, for array of IGFETs.
390, and 391, for nonerasable (e.g., ROM).
390, and 391, for mask-programmed MOSFET ROM.
401, for nonuniform channel thickness in IGFET.
410, 411, 639-641, 649, and 760, for silicon nitride.
411, and 760, for composite insulator material.
411, for oxynitride as gate insulator in IGFET, in general.
422, and 659, for magnetic field shielding
423, 511, 512, 525, 526, 556, 557-562, 575, and 576, for lateral bipolar transistor structure.
423, for magnetic field sensing bipolar transistor.
426, and 469, for passivating means to reduce temperature sensitivity.
427, for magnetic field sensor in integrated circuit.
430, and 458, for light or radiation responsive PIN device, in general.
431, 466, for light responsive or activated device generally.
437, for anti-reflection coating.
444, for matrix or array of light sensor elements overlying active switching elements in integrated circuit.
446, for matrix or array of light sensors with specific isolation means in integrated circuit.
449, through 457, for Schottky barrier.
453, through 455, 485, and 486, for metal or silicide of platinum group metal, as Schottky barrier material.
458, 523, 538, and 656, for intrinsic material or region.
458, for PIN diode.

459, 676, and 786, for bonding flag or pad
465, 592, 599, 653, and 654, for configuration of junction geometry.
466, 496, 571, 586, 594, 599, 600, and 618-628, for configuration of external portion of active device.
474, for bipolar transistor with Schottky barrier transistor as emitter-base or base-collector junction.
474, through 479, 512, 525, 555, 556, and 574-576, for integrated injection logic.
477, through 479, for bipolar transistor in integrated circuit with Schottky barrier diode.
479, and 570, for anti-saturation diode.
479, for baker clamp.
486, 740, 751, and 767, for diffusion barrier.
491, and 492, for means to increase breakdown voltage in integrated circuit.
492, and 493, for RESURF device.
494, for reverse biased (electrical) pn junction guard region.
494, for reverse biased guard ring to prevent breakdown.
497, and 498, for punchthrough transistor.
504, for JFET isolation in integrated circuit (i.e., pinched-off region used for integrated circuit isolation).
509, through 521, 544-556, and 929, for isolated PN junction.
509, through 521, for PN junction isolation in integrated circuit combined with dielectric isolation.
511, 512, 525, 555, 556, 569, and 574-576, for complementary bipolar transistor structure.
511, 512, 525, 555, 556, 569, and 574-576, for complementary bipolar transistors.
511, 512, 514, 515, 517, 518, 525, 526, 539-543, and 552-563, for bipolar transistors in integrated circuit.
511, 512, 514, 517, 518, and 552-556, for bipolar transistors with pn junction isolation.
512, 569, and 574-576, for bipolar transistor structure with common active region.
512, 569, and 574-576, for complementary bipolar transistors with common active region.
512, 555, 556, and 574-576, for logic device (superintegrated) using Integrated Injection Logic (I^2L).
514, and 515, for walled emitter bipolar transistor.
522, for air isolation of integrated circuit.
531, for inductance in integrated circuit.
532, through 535, for capacitance as passive component in non-FET I.C.
540, for dynamic isolation pocket bias (electrical).
541, for pinch resistor.
544, through 556, for PN junction isolation in integrated circuit in general.
545, for reduction of isolation junction capacitance.
546, for overvoltage protection means in pn junction isolated integrated circuit.
546, for reverse voltage polarity protection, in pn junction isolated integrated circuit.
549, for collector diffused type isolation.
559, lateral transistor formed along groove.
560, through 564, for multiple/plural collectors.
560, 563, and 579-581, for plural emitters in bipolar transistor.
562, for logic device (superintegrated) using Current Hogging Logic (CHL).
565, through 593, for bipolar transistor structure, in general.
571, for groove resistor in Darlington bipolar device.
573, and 584, for housing or package for bipolar transistor devices.
592, for configuration of bipolar transistor base region.
602, for housing or package for voltage-variable capacitance device.
607, and 917, for plural dopants of same conductivity type.
610, for platinum (as deep level dopant).
620, for scribe line or region.
624, for prevention of skin effect, microwave device, by low resistance ohmic contact along mesa surface.
626, and 629-652, for passivation of semiconductor surface.
634, for passivating glass with ingredient to adjust softening or melting temperature.
639, and 649, for oxynitride as passivating insulating layer.
642, 643, and 759, for organic insulating material or layer.
643, 759, and 788, for polyamide.
643, 759, and 792, for polyimide.
653, 654, for shaped PN junction.
655, for reverse doping concentration gradient profile.
656, for PIN device in general.
657, for stepped profile.
657, for stepped dopant concentration profile.
660, for housing or package for radiation shielded device.
662, and 664, for transmission line lead.
663, for superconductive contact or lead on integrated circuit.

669, 670, 673, 674, 676, 688, 689, 692-697, 728, 735-739, 752, 758, 773-776, and 780-786, for shaped contact, electrode, etc.
669, for lead frame having stress relief.
676, for die bonding flag.
676, for lead frame-type mount for chip.
678, through 733, for housing or package, generally.
679, and 922, for smart card (e.g., “credit card” integrated circuit package).
686, for stacked housings.
700, 701, and 703-707, for ceramic housing or package material.
705, for high thermal conductivity ceramic for package.
711, for metal housing with mount for chip.
713, for cooling of housing or contents for integrated circuit.
714, through 716, for liquid coolant.
719, for press contact of heat sink and semiconductor.
720, for high thermal conductivity insert in heat sink.
731, for mount for housing.
732, for flanged type mount for housing.
735, through 739, 746, 758-760, 773-776, 780-781, 786, 920, 923, 926, for configuration of electrode, etc.
738, 780, and 781, for ball-shaped leads, contacts or bonds.
740, for prevention of spiking of contact metal.
741, through 745, and 751, for gold (deep level dopant as contact or electrode).
742, and 743, for dopant/impurity conductivity type in electrical contact material.
746, for composite electrode material.
746, for electrode material.
749, for electrode transparent to light.
751, 767, and 915, for titanium nitride.
758, through 760, for multiple metallization layers separated by insulating layer on integrated circuit.
760, for oxynitride between metal levels in integrated circuit.
764, 765, and 768-771, for alloy of materials forming electrical contacts.
767, for electromigration prevention or reduction.
777, for chip on chip mount for chip.
778, for flip chip mount for chip.
779, and 780-784, for die or lead bond.
782, and 783, for die bond.
900, for MOSFET type gate sidewall insulating spacer.
901, for MOSFET substrate bias (electrical).
901, for MOSFET substrate bias.
902, for FET with metal source region.
903, and 904, for configuration of FETs for Static Memory Cell (SRAM).
905, through 908, for configuration of Dynamic Memory (DRAM).
905, for trench shared by plural DRAM cells.
906, Electrode use for accessing capacitance, in DRAM.
910, for array of diodes.
911, for vidicon array (cross-reference collection).
915, for titanium nitride.
919, for parallel electrical connections to average out manufacturing variations.
920, for parallel electrical connections to reduce resistance.
922, for anti-tamper device.
922, for diode arrays.
922, for anti-tamper or inspection means for
923, for conductor aspect ratio.
925, for bridge rectifier module.
927, for shaped depletion layer.
930, for Peltier cooling (cross-reference collection).

SECTION IV - REFERENCES TO OTHER CLASSES

SEE OR SEARCH CLASS:

29, Metal Working, subclasses 25.01+ for process and apparatus for making barrier layer or semiconductor devices not elsewhere classified; subclass 25.35 for piezoelectric device making not elsewhere classified; subclasses 25.41+ for electric condenser making not elsewhere classified; subclasses 592.1+ for process of mechanical manufacture of electrical devices, not elsewhere classified; and subclasses 825+ for electrical conductor manufacturing processes, including subclass 827 regarding beam lead frames and beam leads. (class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D).
29, Metal Working, subclass 612 for making thermally variable resistors. (See G, Lines With Other Classes and Within This Class, above).
29, Metal Working, appropriate subclasses for manufacturing methods of beam lead frame or beam lead devices. (Class providing for subcombination subject matter used as component part of active solid-state electronic devices. See Lines with Other Clases and Within This Class, F, above).

40, Card, Picture, or Sign Exhibiting, subclass 544 for electroluminescent signs. (See B, Lines With Other Classes and Within This Class, above.)

62, Refrigeration, subclasses 3.2+ for thermoelectric, e.g., Peltier effect cooling processes and apparatus. (See B, Lines With Other Classes and Within This Class, above.)

65, Glass Manufacturing, subclasses 138+ for Electronic envelope header, terminal, or stem making means and subclass 155 for electronic device making involving fusion bonding. (Class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D).

73, Measuring and Testing, subclass 31.06 for gas analysis semiconductor detector details; subclass 777 for semiconductor stress sensor structure; and subclass 754 for semiconductor type fluid pressure gauges. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

84, Music, subclasses 676 and 678 for transistorized analog oscillator circuits. (See B, Lines With Other Classes and Within This Class, above.)

102, Ammunition and Explosives, subclass 202.4 for semiconductor voltage variable resistance shunts in devices used to prevent accidental fuse ignition. (See G, Lines With Other Classes and Within This Class, above)

102, Ammunition and Explosives, subclass 202.4 for semiconductor fuse shunts and subclass 220 for silicon controlled rectifier ignition or detonation switch devices. (See B, Lines With Other Classes and Within This Class, above.)

116, Signals and Indicators, digest 35 for electroluminescent dials. (See B, Lines With Other Classes and Within This Class, above.)

117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, for processes and non-coating apparatus for growing therein-defined single-crystal of all types of materials, including those which may be suitable as or to produce an active solid-state device. Class 118 generally provides for coating apparatus, including single-crystal (e.g., epitaxy) coating means. (Class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D).

118, Coating Apparatus, subclass 900 for semiconductor vapor doping. (Class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D)

123, Internal-Combustion Engines, subclasses 650+ for ignition systems with power supplies having diode and transistor features. (See B, Lines With Other Classes and Within This Class, above.)

134, Cleaning and Liquid Contact With Solids, subclasses 1.2, 1.3, and 902 for semiconductor wafer cleaning. (Class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D, above).

136, Batteries: Thermoelectric and Photoelectric, subclasses 203+ for Peltier effect device; subclasses 200+ for batteries which generate electricity under the action of heat (thermoelectric); and subclasses 243+ for batteries which generate electricity under the action of light, such as photovoltaic batteries, some of these batteries utilize potential barrier layers. (class providing for active solid-state electronic devices structures with a specified use.)

148, Metal Treatment, subclasses 33+ for PN type barrier layer stock material treatment and numerous digests concerning treatment of semiconductor materials, dopants, and active solid-state electronic devices. (Class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D, above).

148, Metal Treatment, digest 171 for metal treatment involving varistors. (See G, Lines With Other Classes, above).

165, Heat Exchange, subclasses 80.2+ and 104.33 for electrical device or component heat exchangers. (Class providing for subcombination subject matter used as component part of active solid-state electronic devices. See Lines with Other Clases and Within This Class, F, above).

174, Electricity: Conductors and Insulators, subclasses 15.1 through 16.3 for fluid cooling of electrical conductors or insulator; subclasses 250-268 for printed circuit devices; and subclasses 520-64 for housings with electric devices or mounting means. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

178, Telegraphy, subclass 117 for coherer type AC systems. (See B, Lines With Other Classes and Within This Class, above.)

178, Telegraphy, subclass 117 for coherer type AC systems. (See G, Lines With Other Classes and Within This Class, above).

194, Check-Actuated Control Mechanisms, subclasses 216+ for value accumulator having solid-state circuitry. (See B, Lines With Other Classes and Within This Class, above.)

204, Chemistry: Electrical and Wave Energy, subclasses 400+ for active solid-state devices used in measuring and testing involving electrolytic analysis. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

204, Chemistry: Electrical and Wave Energy, subclass 192.25 for semiconductor coating, forming, or etching by sputtering. (Class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D, above)

216, Etching a Substrate: Processes, subclass 16 for active solid state devices involved in an etching process. (Class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D, above).

219, Electric Heating, subclass 501 for automatic regulation or control means for heating devices which include semiconductor, e.g., transistor, means. (See B, Lines With Other Classes and Within This Class, above.)

228, Metal Fusion Bonding, subclass 123 for processes of bonding metal to semiconductor-type material and subclasses 179+ for processes of bonding electrical device (e.g., semiconductor) joints. (Class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D, above).

250, Radiant Energy, subclass 492.2 for irradiation of semiconductor devices. (Class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D, above).

250, Radiant Energy, subclass 338.4 for infrared responsive semiconductor devices, subclasses 370.01-370.15 for invisible radiant energy responsive semiconductor devices; subclass 371 for invisible radiant energy responsive methods using semiconductor devices; subclass 492.2 for irradiation of semiconductor devices; subclasses 552 and 553 for photocell circuits and apparatus involving solid-state light sources; subclasses 211 for photocells including photosensitive junctions; and subclasses 208.1-208.6 for plural photosensitive elements, including arrays. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclass 272.11 for electrical component encapsulating processes, including subclass 272.17 for encapsulating semiconductor or barrier layer device. (Class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D, above).

252, Compositions, subclass 62.3 for barrier layer device compositions, e.g., N-material, P-material and, subclasses 500+ for electrically conductive or emissive compositions. (Class providing for materials used in active solid-state devices, Lines With Other Classes and Within This Class, C, above).

273, Amusement Devices: Games, digest 24 for luminescent devices. (See B, Lines With Other Classes, above.)

307, Electrical Transmission or Interconnection Systems, subclasses 401+ for nonlinear reactor systems which typically employ active solid-state devices; subclass 91 for magnetic or electrostatic field shielding; and subclasses 109+ for systems involving capacitors.

310, Electrical Generator or Motor Structure, subclass 303 for energy conversion devices employing pn semiconductor junction devices, and digest 3 for Hall effect generators and converters. (See B, Lines With Other Classes and Within This Class, above.)

313, Electric Lamp and Discharge Devices, subclasses 498+ for electric lamp and discharge devices having solid-state luminescent materials, including nominally recited luminescent semiconductor type materials; subclasses 329 and 367+ for mosaic electrodes; subclasses 366+ for semiconductor depletion layer type image pickup tubes; subclass 463 for electroluminescent cathoderay tube screens; subclasses 346 and 346 for photoemissive cathodes; and subclass 504 for solid-state organic phosphor material luminescent devices. (Class employ-

ing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

315, Electric Lamp and Discharge Devices: Systems, subclass 12.1 for secondary emissive stage in a cathoderay tube; subclass 407 for a deflection coil circuit including a diode; subclass 408 for deflection coil circuits including a solid-state switch; and digest 7 for starting and control circuits using transistors. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

323, Electricity: Power Supply or Regulation Systems, subclasses 229+ for power supply or regulation systems using a diode in shunt with a source or load; subclasses 237+, 254, 257, 258, 263, 265+, and 292 for output level devices employing three or more terminal semiconductor devices; subclass 300 for input level devices or systems employing three or more terminal semiconductor devices; subclasses 311+ for self-regulating systems employing three or more terminal semiconductor devices; subclasses 325+, 339, 343, and 349+ for external or operator controlled systems employing three or more terminal semiconductor devices; subclass 360 for superconductor type transformers or inductors; digest 902 for device with optical coupling to a semiconductor; and digest 907 for temperature compensation of a semiconductor. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

318, Electricity: Motive Power Systems, subclass 681 for positional servomechanisms using solid-state servo amplifiers. (see B, Lines With Other Classes and Within This Class, above.)

315, Electric Lamp and Discharge Devices: Systems, subclass 311 for variable impedance device in automatic regulator in supply circuit of an electric lamp or discharge device. (See G, Lines With Other Classes and Within This Class, above).

318, Electricity: Motive Power Systems, subclass 662 for variable capacitor type positional servo systems and subclasses 788 and 792 for variable temperature impedance (e.g., resistor) elements in induction motor systems. (See G, Lines With Other Classes and Within This Class, above).

320, Electricity: Battery or Capacitor Charging or Discharging, appropriate subclass for an active solid-state device included in a charging or discharging circuit for a battery or capacitor. (See B, Lines With Other Classes, above.)

322, Electricity: Single Generator Systems, digest 5 for Hall effect elements. (see B, Lines With Other Classes and Within This Class, above.)

323, Electricity: Power Supply or Regulation Systems, subclass 298 for output level responsive devices including a variable resistor. (See G, Lines With Other Classes and Within This Class, above).

324, Electricity: Measuring and Testing, subclasses 762.01 through 762.1 for testing semiconductor devices, SCR and transistor testing and subclasses 244+ for magnetometers many of which employ active solid-state devices, e.g., subclasses 248 (thin film), 251 (Hall plate) and 252 (semiconductor type solid-state or magneto resistive). (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

327, Miscellaneous Active Electrical Nonlinear Devices, Circuits, and Systems, appropriate subclasses for miscellaneous nonlinear circuits utilizing an active device. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

327, Miscellaneous Active Electrical Nonlinear Devices, Circuits, and Systems, subclasses 185+ for a stable state circuit utilizing an electron tube and a transistor and subclasses 568+ for a miscellaneous negative resistance circuit. (See B, Lines With Other Classes and Within This Class, above.)

329, Demodulators, subclass 370 for diode demodulators and subclass 371 for coherer type demodulators. (See B, Lines With Other Classes and Within This Class, above.)

329, Demodulators, subclass 370 for diode demodulators and subclass 371 for coherer type demodulators. (See G, Lines With Other Classes and Within This Class, above).

330, Amplifiers, subclass 145 for diode type variable impedances for signal channel controlled by a separate control path and subclasses 282+ for semiconductor amplifier devices with gain control means and feedback means acting as a variable impedance.

330, Amplifiers, subclass 4.9 for semiconductor type parametric amplifiers; subclass 183 for

DC interstage coupling with as nonlinear device; and subclasses 250+ for semiconductor amplifying devices. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

331, Oscillators, subclass 51 for semiconductor type cascade or tandem connected oscillators and subclasses 107-117 for solid-state active element oscillators. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

331, Oscillators, subclasses 36+ for AFC devices using particular frequency control means, including reactance devices (e.g., variable capacitors) and subclass 177 for voltage sensitive capacitor type frequency adjusting means. (See G, Lines With Other Classes and Within This Class, above).

332, Modulators, subclasses 105, 116, 135+, 146, 152, 168, and 178 for modulators with discrete semiconductor devices (subclass 136 includes varactors). (See B, Lines With Other Classes and Within This Class, above.)

332, Modulators, subclasses 105, 116, 135+, 146, 152, 168, and 178 for modulators with discrete semiconductor devices (subclass 136 includes varactors). (See G, Lines With Other Classes and Within This Class, above).

333, Wave Transmission Lines and Networks, subclass 263 for variable impedance devices connected in circuit with a long line element or component. (See G, Lines With Other Classes and Within This Class, above).

333, Wave Transmission Lines and NetWorks, subclasses 103 and 104 for branched circuits with switching means having semiconductor operating means; subclass 165 for frequency or time domain filters using charge transfer devices; subclasses 216 and 217 for negative impedance devices; subclass 247 for semiconductor mounts for strip type long line elements; and subclass 99 for super conductive devices. (class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above)

334, Tuners, subclasses 66 and 69 for series tuned circuits with variable impedance elements.

334, Tuners, subclass 15 for semiconductor reactance tuning circuits. (See B, Lines With Other Classes and Within This Class, above.)

338, Electrical Resistors, subclass 1 for coherer type resistors, subclass 22 for semiconductor type thermistors, and subclass 32 for magnetic field responsive devices, including Hall effect types and super conductive types. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

338, Electrical Resistors, subclass 1 for coherer type resistors; subclass 22 for semiconductor type thermistors; and subclass 32 for magnetic field responsive devices, including Hall effect types and superconductive types. (See G, Lines With Other Classes and Within This Class, above).

343, Communications: Radio Wave Antennas, subclass 745 for antennas with variable reactance tuning; subclass 750 for adjustable lumped reactance antenna tuning; and subclass 861 for adjustable impedance matching network leadins. (See G, Lines With Other Classes and Within This Class, above).

340, Communications: Electrical, subclass 598 for barrier layer thermal sensors in condition responsive device; subclass 815.03 for a visual indicator using a light emitting diode; subclasses 2.2-2.31 for a channel selecting matrix; and subclasses 14.1-14.69 for a decoder matrix.

341, Coded Data Generation or Conversion, subclasses 133+ for analog-to-digital conversion with particular solid-state devices; subclass 150 for digital to analog conversion using charge coupled devices or switched capacitances; and subclass 172 for analog to digital conversion using charge transfer devices. (See B, Lines With Other Classes and Within This Class, above.)

345, Computer Graphics Processing and Selective Visual Display Systems, subclasses 30+ for selective visual display systems which may employ active solid-state device light sources, including subclasses 44 and 82 for visual display systems having solid-state light emitters. (class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

348, Television, subclasses 272+ and 294+ for solid-state image sensors in television cameras and subclasses 800+ for electroluminescent video display with solid-state scanned matrix. (class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

358, Facsimile and Static Presentation Processing, subclasses 482 and 483 solid-state picture generators, including charge coupled devices.

(Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

359, Optical: Systems and Elements, subclass 248 for semiconductor polarization type light modulators and subclasses 321+ for modulators having significant chemical composition or structure. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

361, Electricity: Electrical Systems and Devices, subclass 2 for solid-state switch type arc suppressors; subclasses 98, 100, and 101 for current fault responsive sensors involving semiconductor active solid-state devices; subclasses 196+ for semiconductor time delay devices; subclass 205 for threshold devices including SCR thyratrons; subclasses 275.1+ for electrical, e.g., fuse element for electrolytic capacitors; subclasses 277+ for variable capacitor not involving active solid-state devices; subclasses 525 for solid electrolytic capacitors with significant semiconductor; subclasses 679.01-679.61 for cooling devices, housings, supports, electrical contacts, etc., for diverse electrical components; subclass 421 for lead frames; and subclasses 523+ for solid electrolytic capacitors. (class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above)

361, Electricity: Electrical Systems and Devices, subclass 188 for variable impedance condition responsive devices for relay or solenoid safety or protection; and subclasses 277+ for variable electrostatic capacitors. (See G, Lines With Other Classes and Within This Class, above)

361, Electricity: Electrical Systems and Devices, subclass 421 for lead frames. (Class providing for subcombination subject matter used as component part of active solid-state electronic devices. See Lines with Other Clases and Within This Class, F, above)

362, Illumination, subclass 84 for light source or light source support and luminescent material and subclass 800 (cross-reference art collection) for light emitting diode light sources. (See B, Lines With Other Classes and Within This Class, above.)

363, Electric Power Conversion Systems, subclasses 10+ for combined phase and frequency conversion using a semiconductor device converter, and subclasses 13-147 for current conversion devices many of which explicitly call for semiconductor active solid-state devices, and subclasses 159-163 for frequency conversion using semiconductor type devices. (See B, Lines With Other Classes and Within This Class, above.)

365, Static Information Storage and Retrieval, subclasses 52+ for hardware, including shields, for storage elements; subclass 71 for negative resistance; and subclass 72 for transistor or diode interconnection arrangement; subclass 96 for fusible link storage elements; subclasses 103-105 for semiconductive semipermanent read only systems; subclasses 106+ for systems involving radiant energy, including subclasses 109-115 for photoconductive, electroluminescent, amorphous, semiconductive and diode devices; subclasses 129+ for systems using a particular element, including subclasses 154-188 for systems using particular elements including active solid-state devices; subclasses 185.01+ for floating gate memory storage (e.g., flash memory); and subclasses 208 and 212 for semiconductive differential (e.g., thermal) noise suppression means in read/write circuits. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

367, Communications, Electrical: Acoustic Wave Systems and Devices, subclasses 140+ for signal transducers which may be active solid-state devices, and including support structures, diaphragm, and pressure compensation means. (See B, Lines With Other Classes and Within This Class, above.)

368, Horology: Time Measuring Systems or Devices, subclass 83 for solid body light emitters, e.g., diodes; subclasses 86 and 87 for transistorized pulse transforming means; subclasses 56+ for solid-state oscillating time base circuits; and subclasses 239+ for optical display devices, including subclass 241 for solid-state, e.g., LED light emitting displays. (See B, Lines With Other Classes and Within This Class, above.)

369, Dynamic Information Storage or Retrieval, subclass 44.12 for optical servo systems having solid-state optical elements; subclasses 121+ for light sources, including solid-state light source; subclass 145 for semiconductive information handling transducers. (class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above)

372, Coherent Light Generator, subclasses 43 through 50 for semiconductor layers and subclass 75 for semiconductor optical laser pump devices. (class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

374, Thermal Measuring and Testing, subclass 178 for barrier layer (e.g., semiconductor junction) heat sensors and subclasses 183+ for current modifying sensors. (Class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

377, Electrical Pulse Counters, Pulse Dividers, or Shift Registers: Circuits and Systems, subclasses 57 through 63 for charge transfer device systems; subclass 74 for input circuits involving field-effect transistors; subclass 79 and 117 for transfer means including a field effect transistor; and subclass 93 for superconductive elements. (class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above)

378, X-Ray or Gamma Ray Systems or Devices, subclass 104 for X-ray source power supplies with specified rectifier. (See B, Lines With Other Classes and Within This Class, above.)

379, Telephonic Communications, subclass 294 for semiconductor line finders. (See B, Lines With Other Classes, above.)

381, Electrical Audio Signal Processing Systems and Devices, subclass 100 for crossover filters with active devices and subclass 175 for semiconductor junction microphones. (see B, Lines With Other Classes and Within This Class, above.)

388, Electricity: Motor Control Systems, subclasses 917 through 920 for thyristor or SCR devices or control circuit elements and subclass 926 for a specific feedback control or device which controls a solid-state device in a motor circuit.

388, Electricity: Motor Control Systems, subclass 807 for variable impedance type field control circuits and subclasses 855+ for selectable or variable impedance armature control devices. (see G, Lines With Other Classes and Within This Class, above)

427, Coating Processes, subclasses 58 through 126.6 , especially subclasses 62 and 63, 66, 74-76, 79-81, 96.1-99.5, 100, and 101-103 for coating processes to make an electrical product (for methods of making, cleaning, coating, etc., active solid-state devices, see Lines With Other Classes and Within This Class, D., above).

428, Stock Material or Miscellaneous Articles, subclass 620 for composite metallic stock having a semiconductor component, subclasses 690 and 691 for fluorescent, phosphorescent or luminescent inorganic layer composites; subclasses 917 for electroluminescent material; and subclasses 928-931 for materials with special properties, including magnetic properties, electrical contact features and superconductivity. (Class providing for materials used in active solid-state devices, Lines With Other Classes and Within This Class, C, above).

430, Radiation Imagery Chemistry: Process, Composition, or Product Thereof, subclasses 56 through 96 for radiation sensitive compositions or products; subclass 139 for luminescent imaging process, composition or product; and subclass 900 for donor-acceptor complex photoconductors. (Class providing for materials used in active solid-state devices, Lines With Other Classes and Within This Class, C, above)

430, Radiation Imagery Chemistry: Process, Composition, or Product Thereof, subclasses 56 through 96 for radiation sensitive compositions or products; subclass 139 for luminescent imaging process, composition or product; and subclass 900 for donor-acceptor complex photoconductors. (Class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D, above).

438, Semiconductor Device Manufacturing: Process, for (a) combined operations (steps) for producing a semiconductor substrate having a junction, usually between p-type and n-type material or (b) a unit operation involving semiconductor material, not elsewhere provided; see the search notes therein. (class providing for methods of making, cleaning, coating, etc., active solid-state devices, See Lines With Other Classes and Within This Class, D, above).

439, Electrical Connectors, appropriate subclasses for features related or analogous to electrical contact or housing features of active solid-state devices, e.g., subclasses 271+ for sealing elements, or subclasses 449+ for stress relief means for conductor to terminal joint. (class employing active solid-state devices in electronic circuits. See Lines With Other Classes and Within This Class, A, above).

455, Telecommunications, subclass 253.1 for semiconductor gain, level or volume control; subclass 291 for receivers having a wave collector with coupling to a stage of the receiver using an active device, and subclass 333 for transistorized or integrated circuit type frequency conversion structure or circuitry. (see B, Lines With Other Classes and Within This Class, above.)

455, Telecommunications, subclasses 261 and 262 for variable reactance, e.g., variable capacitance type automatic local oscillator control devices. (see G, Lines With Other Classes and Within This Class, above)

505, Superconductor Technology: Apparatus, Material, Process, subclasses 150+ for high temperature (T_c > 30 K) superconducting devices, and particularly subclasses 161 and 162 for bolometers or SQUIDs, subclasses 190+ for Josephson junctions, per se, and subclasses 191+ for other thin film solid-state devices; and pertinent cross-reference art collections, including subclasses 831+, for static information storage and retrieval system or device; subclasses 857+ for nonlinear solid-state device, system, or circuit; subclasses 873+ for active solid-state devices; subclass 883 for housing and mounting assemblies with plural diverse electrical components; subclasses 884+ for conductors; and subclasses 900+ for heat exchangers. (see B, Lines With Other Classes and Within This Class, above.)

505, Superconductor Technology: Apparatus, Material, Process, subclasses 150+ for high temperature (T_c > 30 K) superconducting devices, and particularly subclasses 161 and 162 for bolometers or SQUIDs, subclasses 190+ for Josephson junctions, per se, and subclasses 191+ for other thin film solid-state devices; and pertinent cross-reference art collections, including subclasses 831+, for static information storage and retrieval system or device; subclasses 857+ for nonlinear solid-state device, system, or circuit; subclasses 873+ for active solid-state devices; subclass 883 for housing and mounting assemblies with plural diverse electrical components; subclasses 884+ for conductors; and subclasses 900+ for heat exchangers. (Class providing for materials used in active solid-state devices, Lines With Other Classes and Within This Class, C, above)

600, Surgery, subclasses 486+ and 505 for active solid-state devices inserted inside a body and used for measuring and testing. (class employing active solid-state devices in electronic circuits. See Lines With Other Classes, A, above)

708, Electrical Computers: Arithmetic Processing and Calculating, subclass 190 for integrated circuit type digital computers.

716, Computer-Aided Design and Analysis of Circuits and Semiconductor Masks, subclasses 50 through 56 for design and analysis of a semiconductor mask or reticle and subclasses 100 through 139 for the design and analysis of circuit systems and integrated circuit structure by data processing and computer programming techniques.

902, Electronic Funds Transfer, subclass 26 for identification, means with a semiconductor chip, e.g., a smart card. (see B, Lines With Other Classes and Within This Class, above.)

D10, Measuring, Testing or Signalling Instruments, subclass 77 for transistor testers. (see B, Lines With Other Classes and Within This Class, above.)

D13, Equipment for Production, Distribution or Transformation of Energy, appropriate subclass for semiconductor, transistor or integrated circuit energy conversion or transformation. (see B, Lines With Other Classes and Within This Class, above.)

SECTION V - GLOSSARY

ACCEPTOR IMPURITY

An atom or ion different from or foreign to, but present in, a semiconductor material and which has insufficient valence electrons to complete the normal bonding arrangement in the semiconductor crystal structure. An acceptor impurity accepts an electron from an adjacent atom to create a hole. Acceptor impurities are also referred to as p-type impurities. Common acceptor impurities in silicon or germanium are boron, gallium, and indium.

ACTINIDES

Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, E, Fm, Mv, No, Lw.

ALKALI METALS

Li, Na, K, Rb, Cs, Fr.

ALKALINE-EARTH METALS

Ca, Sr, Ba, Ra.

ACTIVE SOLID-STATE ELECTRONIC DEVICE

An electronic device or component that is made up primarily of solid materials, usually semiconductors, which operates by the movement of charge carriers - electrons or holes - which undergo energy level changes within the material and can modify an input voltage to achieve rectification, amplification, or switching action. Active solid-state electronic devices include diodes, transistors, thyristors, etc., but exclude pure resistors, capacitors, inductors, or combinations solely thereof. The latter class of devices is characterized as passive.

ALLOY JUNCTION

A fused junction produced by combining one or more elemental impurity metals with a semiconductor. Typical alloyed junctions include indium- germanium and aluminum-silicon.

ALLOY TRANSISTOR

A transistor in which the emitter-base and collector-base junctions are alloy junctions.

AVALANCHE BREAKDOWN

A sudden change from high dynamic electrical resistance to very low dynamic resistance in a reverse biased semiconductor device, e.g., a reverse biased junction between p-type and n-type semiconductor materials, wherein current carriers are created by electrons or holes which have gained sufficient speed to dislodge valence electrons. Avalanche breakdown can cause structural damage to a semiconductor device.

AXIAL LEAD

A wire lead coming from the end of and along the axis of a resistor, capacitor, or other component.

BACK BONDED

The bonding of active chips to a substrate using the back of the chip opposite the side containing active solid-state devices.

BALL BOND

A bond formed by a round, ball-shaped lead on a semiconductor device.

BALLISTIC TRANSPORT DEVICE

An active solid-state electronic device in which an active layer is present through which carriers* pass, wherein the active layer is thinner than the mean free path of the carriers* in the material in that layer, so that carriers* can pass through the layer without scattering. Carriers* are typically injected into the ballistic transport layer as “hot” carriers*, having an energy, in the case of electrons, substantially greater than the minimum of the conduction band*, or in the case of holes, substantially lower than the maximum of the valence band. Ballistic electron injectors include heterojunctions, tunnel barriers, and punchthrough (e.g., planar doped or camel) barriers.

BAND GAP

The difference between the energy levels of electrons bound to their nuclei (valence electrons) and the energy levels that allow electrons to migrate freely (conduction electrons). The band gap depends on the particular semiconductor involved.

BARRIER REGION OR LAYER

A region which extends on both sides of a semiconductor junction in which all carriers are swept away from the junction region. The region is depleted of carriers. This is also referred to as a depletion region.

BARRITT DIODE

Barrier injection transit time diode. A bipolar or device in which a type of breakdown known as punchthrough occurs and wherein the punchthrough structure device is operable at microwave frequencies. In bipolar transistors a direct current path is formed from emitter to collector due to the formation of a depletion region throughout the base region and charge carriers from the emitter punch through to the collector. Carriers flowing from the emitter to the collector take a controlled time to pass through the depletion layer, leading to a controlled delay in current after a voltage is applied, and effective negative impedance.

BASE REGION

The region between the emitter and collector of a bipo-

lar transistor into which minority carriers are injected by the emitter.

BASE CURRENT

The electrical current that flows in the base terminal of a bipolar transistor.

BEAM LEADS

Flat, metallic leads which extend beyond the edges of a chip component like wooden beams extend from a roof overhang. Beam leads are used to interconnect a component to film circuitry.

BIAS

A direct current or voltage applied to an active solid-state device that establishes certain operating characteristics of the device.

BI-FET

An active solid-state electronic device that contains both bipolar and field effect transistors.

BILATERAL

A characteristic of an active solid-state electronic device that permits it to support current flow in opposite directions.

BINARY COMPOUND

A substance that always contains the same two elements in a fixed atomic ratio.

BIPOLAR

An active solid-state electronic device in which both positive and negative current carriers are used to support current flow.

BIPOLAR TRANSISTOR

An active solid-state electronic device with a base electrode and two or more junction electrodes in which both positive and negative current carriers are used to support current flow.

BLOCH WAVELENGTH

The effective wavelength of electrons in a semiconductor crystal, sometimes referred to as a **wave packet** or **wave function**. It can be an order of magnitude larger than the de broglie wavelength of electrons having the same energy.

BONDING AREA

The area, defined by the extent of a metallization land or the top surface of a terminal, to which a lead is or is to be bonded.

BONDING PAD

A metallized area to which an electrical connection is to be made. It is also called a bonding island or a controlled collapse chip connection.

BONDING WIRE

Fine wire for making electrical connections in hybrid circuits between various bonding pads on the semiconductor device substrate and device terminals or substrate lands.

BREAKDOWN

A sudden change from high dynamic electrical resistance to a very low dynamic resistance in a reverse biased semiconductor device, e.g., a reverse biased junction between p-type and n-type semiconductor materials, wherein reverse current increases rapidly for a small increase in reverse applied voltage, and the device behaves as if it had negative electrical resistance.

BREAKDOWN POINT/VOLTAGE

The voltage value at which breakdown occurs.

BREAKOVER

The start of current flow in a silicon controlled rectifier.

BUCKET BRIGADE DEVICE

A charge transfer device in which only a portion of the charge carriers (electrons or holes) at each storage site are transferred to the next storage site.

BUMP CONTACT

A term used to describe, typically, solder bumps on a chip or substrate which are found on only one side of the chip or substrate as, for example, on a flip-chip.

BULK-CHANNEL CCD

A charge coupled device in which charge is stored and transferred below the surface of the device.

BULK-EFFECT DEVICE

An active solid-state device made up of a semiconductor material whose electrical characteristics and electronic properties are exhibited throughout the entire body of the material, rather than in just a localized region thereof, e.g., the surface.

BURIED CHANNEL CCD

See BULK-CHANNEL CCD.

CB JUNCTION

The collector-base junction of a bipolar transistor.

CAPACITOR

A component used in electrical and electronic circuits which stores a charge of electricity, usually for very brief periods of time, with the ability to rapidly charge and discharge. A capacitor is usually considered a passive component since it does not rectify, amplify, or switch and because charge carriers do not undergo energy level changes therein, although some active solid-state devices function as voltage variable capacitors.

CARRIER

A mobile free electron or hole.

CARRIER CONCENTRATION

The number of electrical charge carriers in a given volume, usually a cubic centimeter, of semiconductor material.

CELL

An individual integrated circuit element located on a large, or master chip of, semiconductor material.

CHANNEL

A path for conducting current between a source and drain of a field effect transistor.

CHANNEL LENGTH EFFECTS

Operating characteristics of FETs which depend on the length (distance between source and drain) of the channel regions. Such effects include switching speed change and threshold voltage change with channel length change.

CHANNEL WIDTH EFFECTS

Operating characteristics of FETs which depend on the width (horizontal distance perpendicular to channel length and parallel to upper surface of device) of the channel. Such effects include conductance and threshold voltage change with channel width change.

CHANNEL STOP

Means for limiting channel formation in a semiconductor device by surrounding the affected area with a ring of highly doped, low resistivity semiconductor material. In a field effect transistor, it is a region of highly doped material of the same type as the lightly doped substrate used to prevent leakage paths along the chip surface from developing. Also referred to as "chanstop."

CHANNEL PINCH-OFF REGION

The location in a current channel portion of a field effect transistor (FET) where the current is reduced to a minimum value due to its diameter being reduced to a minimum.

CHARACTERISTIC CURVE

A graph showing the relationship between two or more changing parameters, e.g., current and voltage of an electronic device.

CHARGE CARRIER

A mobile conduction electron or hole in a semiconductor.

CHARGE CONFINEMENT

Restriction of electrical charge carriers, e.g., electrons or holes, to specified locations, e.g., by quantum wells, gate electrode potentials, etc.

CHARGE-COUPLED DEVICE

A charge transfer device in which all carriers (electrons or holes) are transferred from one storage site to the next upon application of a shifting voltage.

CHARGE INJECTION DEVICE

A field effect device in which storage sites for packets of electric charge are induced at or below the surface of an active solid-state device by an electric field applied to the device and wherein carrier potential energy per unit charge minima are established at a given storage site and such charge packets are injected into the device substrate or into a data bus. This type device differs from a charge transfer device in that, in the latter, charge is transferred to adjacent charge storage sites in a serial manner, whereas, in a charge injection device, the charge is injected in a non-serial manner to the device substrate or to a data bus.

CHARGE TRANSFER DEVICE

A semiconductor device in which discrete packets of electrical charge are transferred from one location to another. Examples of charge transfer devices include charge-coupled devices (CCDs) and bucket-brigade devices (BBDs).

CHIP

A single crystal substrate of semiconductor material on which one or more active or passive solid-state electronic devices are formed. A chip may contain an integrated circuit. A chip is not normally ready for use until packaged and provided with external connectors.

CHIP CARRIER

A package with terminals, for solid-state electronic devices, including chips which facilitates handling of the chip during assembly of the chip to other electronic elements.

CHIP COMPONENT

A circuit element (active or passive) for use in microelectronics. Besides integrated circuits, the term includes diodes, transistors, resistors, and capacitors.

CIRCUIT

A number of devices interconnected in a one or more closed paths to perform a desired electrical or electronic function.

CLADDING BARRIER

A higher band gap material which encases a lower band gap material that defines the walls of a quantum well.

CMOS

See COMPLEMENTARY METAL OXIDE SEMICONDUCTOR.

COHERENCE LENGTH

The typical distance an electron can travel before it is scattered (e.g., by a phonon, a defect, or an impurity).

COHERER

A term which encompasses both active and passive type devices, the passive type being a resistor whose resistance decreases when subjected to a high frequency signal, and the active type being a rectifier which is made up of active solid-state particles which conduct and rectify current when connected into a cohesive element but which loses that characteristic when the particles are separated (e.g., by shaking a container in which the particles are located).

COLLECTOR

That end region of a bipolar transistor which forms one of the main current regions and which is reverse biased in operation with respect to the base region.

COLLECTOR CURRENT

The current which flows through the terminal of the collector region of a bipolar transistor.

COLLECTOR DIFFUSION ISOLATION (CDI)

An electrical isolation technology used for bipolar devices which employs an epitaxial layer, which forms transistor base regions, laid on a substrate of the same conductivity type (p or n) as the epitaxial layer, with an opposite conductivity type region, more heavily doped than the epitaxial base layer and located between the layer and the substrate, forming the collector and isolating the transistor from the substrate.

COMMON-BASE CONFIGURATION

A bipolar transistor in which the base region is common to both the input and output circuit. This is also known as a grounded-base bipolar transistor circuit.

COMMON-COLLECTOR CONFIGURATION

A bipolar transistor in which the collector region is common to both the input and output circuit. It is also known as an emitter-follower bipolar transistor circuit.

COMMON-DRAIN CONFIGURATION

A unipolar transistor in which the drain region is common to both the input and output circuit.

COMMON-EMITTER CONFIGURATION

A bipolar transistor in which the emitter region is common to both the input and output circuit. It is also known as a grounded-emitter bipolar transistor circuit.

COMMON- OR GATE-CONFIGURATION

A unipolar transistor in which the gate region is common to both input and output circuits.

COMPLEMENTARY METAL OXIDE SEMICONDUCTOR (CMOS)

Both n-type and p-type metal oxide semiconductor devices, e.g., transistors, formed on the same substrate.

COMPONENT

An electronic device - active or passive - which has distinct electrical characteristics and has terminals for connection to other components to form a circuit.

COMPOUND

A homogeneous material which has definite proportions of chemically combined atoms or ions.

CONCENTRATION GRADIENT

A difference in dopant concentration (p- or n-type) from one position to another in a semiconductor.

CONDUCTION BAND

A partially filled energy band in which electrons can move freely, permitting a material to carry electric current where electrons are the current carriers.

CONDUCTION ELECTRONS

In a conductor or n-type semiconductor, outer shell electrons that are bound so loosely that they can move freely in the conduction band of a solid material under the influence of an electric field.

CONDUCTIVITY

The ability of a material to conduct electric current. Its converse is resistivity.

CONDUCTOR

A material which offers comparatively little resistance to the flow of current.

CONDUCTOR SPACING

The distance between adjacent edges (not centerline to centerline) of isolated conductive patterns in a conductor layer.

CONNECTOR AREA

That portion of metallized conductors used for providing external electrical connections from a component to a chip or other component.

CONTACT

The parts of a conductor designed to touch or be touched by other such parts of an electrical conductor to carry current to or from the conductor.

CONTACT WINDOW

An opening in an insulating layer to expose an underlying conductor to permit electrical contact thereto. It is also called a via hole.

COVALENT BONDING

The sharing of electrons by atoms in which each atom contributes one of a pair of electrons shared by another atom and forming a bond between those two atoms.

CRYOSAR

An active solid-state device which operates at cryogenic temperatures, i.e., at temperatures at or below 77 degrees Kelvin, by avalanche breakdown caused by impact ionization of device impurities.

CRYSTAL

A solid substance whose atoms are arranged with periodic geometric regularity, called a lattice.

CRYSTAL DEFECT

Any nonuniformity in a crystal lattice. There are four categories of crystal defects: (1) point defects, (2) line defects, (3) area defects, and (4) volume defects. Point defects include any foreign atom at a regular lattice site (substitutional site) or between lattice sites (interstitial site), anti-site defects in compound semiconductors, e.g., Ga in As or As in Ga, missing lattice atoms, and host atoms located between lattice sites and adjacent to a vacant site (Frenkel defects). Line defects, also called edge dislocations, include extra planes of atoms in a lattice. Area defects include twins or twinning (a change in crystal orientation across a lattice) and grain boundaries (a transition between crystals having no particular positional orientation to one another. Volume defects include precipitates of impurity or dopant atoms caused by volume mismatch between a host lattice and precipitates.

CUTOFF

A minimum value of voltage or current applied to an active device which stops the device from operating in a particular manner.

DE BROGLIE WAVELENGTH

The wavelength of a particle, based on L.V. de Broglie"s theory that particles exhibit wavelike characteristics.

DEEP DEPLETION

The condition in which a depletion layer formed in a MOS active device due to voltage applied to the gate electrode of the device, is deeper than the maximum depth at which inversion would normally be expected to occur at room temperature in a semiconductor device at the surface closest to the gate electrode, without formation of an inversion layer.

DEEP GROOVE ISOLATION

Electrical isolation of adjacent devices in a single monolithic semiconductor chip by grooves extending deeply into and below the surface of the chip between the devices.

DEEP-LEVEL CENTERS

Energy levels that can act as traps located in the forbidden band of a semiconductor material that are not near the conduction or valence band edges.

DEGENERATION

Doping of a semiconductor to such an extent that the Fermi level lies within the conduction band (N+ semiconductor) or within the valence band (P+ semiconductor). Also, in circuit applications, negative feedback between two or more active solid-state devices.

DEPLETION LAYER

See DEPLETION REGION.

DEPLETION MODE

The operation of a field-effect transistor having appreciable channel conductivity for zero gate- source voltage and whose channel conductivity may be increased or decreased according to the polarity of the applied gate-source voltage, by changing the gate-to-source voltage from zero to a finite value, resulting in a decrease in the magnitude of the drain current.

DEPLETION REGION

The region extending on both sides of a reverse biased semiconductor junction in which free carriers are removed from the vicinity of the junction. It is also called a space charge region, a barrier region, or an intrinsic semiconductor region.

DEVICE (ACTIVE)

The physical realization of an individual electrical element in a physically independent body which cannot be further divided without destroying its stated function. Examples are transistors, pnpn structures, and tunnel diodes.

DIE

A tiny piece of semiconductor material, separated from a semiconductor slice, on which one or more active electronic components are formed. Sometimes called a chip.

DIE BOND

Attachment of a semiconductor chip to a substrate or

chip carrier or package, usually with an epoxy, eutectic, or solder alloy.

DIFFUSED JUNCTION

A junction between two different conductivity regions within a semiconductor and which is formed by diffusion of appropriate impurity atoms into the material.

DIFFUSED TRANSISTOR

A transistor in which the emitter and collector junctions are formed by diffusion of dopant atoms into the semiconductor material.

DIFFUSION

(1) The movement of carriers from a region of concentration to one of lower concentration; (2) a process of adding impurities to a semiconductor material to change its electrical characteristics.

DIFFUSION BARRIER

An obstacle to the diffusion of charge carriers in an active solid-state device.

DIFFUSION CURRENT

Current caused by charge carriers diffusing from a volume of high carrier concentration to a volume of lower carrier concentration in a solid-state material.

DIFFUSION LENGTH

In a homogeneous semiconductor material, the average distance minority carriers move during their lifetime (i.e., between generation and recombination).

DIODE

An electronic device which has two terminals and an asymmetrical or nonlinear voltage-current characteristic.

DIODE ISOLATION

A technique in which a high electrical resistance between an integrated circuit element and its substrate is achieved by surrounding the element with a reverse biased pn junction.

DIP (DUAL-IN-LINE PACKAGE)

A chip carrier or package consisting of a plastic or ceramic body with two rows of vertical leads in which a semiconductor integrated circuit is assembled and sealed. The leads are typically inserted into a circuit board and secured by soldering.

DIRECT BAND GAP SEMICONDUCTOR

A semiconductor material in which an electron transition from the conduction to the valence band, or vice versa, does not require a change in crystal momentum for the electron. Gallium arsenide is a direct band gap semiconductor material.

DISCRETE CIRCUIT

A circuit which has an individual identity and which is fabricated prior to installation, or is separately packaged and is not part of an integrated circuit.

DISLOCATION

A region in a crystal in which the atoms are not arranged in a perfect lattice-like structure. See CRYSTAL DEFECT for examples of crystal defects/dislocations.

DMOSFET

Depletion type metal oxide semiconductor field effect transistor. Such devices are normally in the on condition with no applied gate voltage.

DONOR IMPURITY

An element which when added to a semiconductor provides unbound or free electrons to the semiconductor which may serve as current carriers. Typically, donors are atoms which have more valence electrons than the atoms of the semiconductor material into which they are introduced in small quantities as an impurity or dopant. Since such donor impurities have more valence electrons than the semiconductor, a semiconductor doped with donor impurities is an n-type semiconductor.

DOPANT

An impurity added to a semiconductor material to change its electrical conductivity or other characteristics. N-type (negative) dopants, such as phosphorus, for a group IV semiconductor such as silicon typically come from group V of the periodic table. When added to silicon n-type dopants create a material that contains

conduction electrons. P-type (positive) dopants, such as boron, for a group IV semiconductor such as silicon, typically come from group III and result in holes.

DOPING PROFILE

The point to point concentration throughout a semiconductor of an impurity atom doped into the semiconductor.

DOUBLE-DIFFUSED MOS (DMOS)

A metal oxide semiconductor having diffused junctions in which successive diffusions of different impurity types are made in the same well-defined region of the semiconductor.

DRAIN

The electrode of a field effect transistor which receives charge carriers which pass through the transistor channel from the source electrode.

DRAIN CURRENT

The flow of charge carriers in the drain region of a field effect transistor.

DRAIN-SOURCE SATURATION CURRENT

The maximum amount of current carried by the drain of a field-effect transistor when the gate- source voltage equals zero volts.

DRIFT CURRENT

Current produced in a solid-state electronic device by charge carriers (e.g., holes or electrons) drifting in the direction of an applied electric field.

DUAL GUARD-BAND ISOLATION

A type of electrical isolation of functional elements of an integrated circuit comprised of two distinct unused areas of chip surface area adjacent to the elements desired to be electrically isolated.

DUAL-IN-LINE (DIP)

See DIP.

DYNAMIC RANDOM ACCESS MEMORY (DRAM)

solid-state memory in which the information decays over time and needs to be periodically refreshed.

EB JUNCTION

Emitter base junction in a bipolar transistor.

ELECTRON

The negatively charged particle in an atom that orbits the nucleus in specific energy levels.

ELECTRON FLOW

Movement of electrons from a source of negative potential to a positive potential.

ELECTRON-HOLE PAIR

A positive charge carrier (i.e., hole) and a negative charge carrier (i.e., electron) considered together as being created or destroyed as part of one and the same event.

EMITTER

The region of a bipolar junction transistor from which charge carriers flow through the emitter-base junction into the base region of the device.

EMITTER CURRENT

The amount of current flowing from the emitter across the emitter-base junction into the base region of the device.

E-MOSFET

Enhancement mode metal oxide semiconductor device. See ENHANCEMENT MODE and MOSFET.

ENERGY LEVELS

The possible energy values that an atom or molecule or subatomic particle (e.g., an electron) can have.

ENHANCEMENT MODE

The operation of a field effect transistor which has a channel formed therein between its source and drain regions and which normally does not conduct current through its channel with zero voltage applied to its gate electrode. Voltage of the correct polarity will accumu-

late minority carriers in the channel to permit conduction of current in the channel, thus turning on the transistor.

EPITAXY

The growth of a crystal of one substance on the surface of a crystal of the same or another substance so that the crystal lattice of the base substance controls the orientation of the atoms in the grown crystal.

EPITAXIAL LAYER

An added layer of crystal that takes on the same crystalline orientation as the substrate crystal.

ESAKI DIODE

A heavily doped pn junction diode where conduction occurs through the junction potential barrier due to a quantum mechanical effect even though the carriers which tunnel through the potential barrier do not have enough energy to overcome the potential barrier. Esaki tunneling involves a tunneling barrier formed by a macroscopic depletion layer between n-type and p-type regions. It does not involve a resonant tunneling barrier using controlled quantum confinement, a layer located between junctions, nor a thin superlattice layer.

EXCESS CARRIERS

Charge carriers present in a semiconductor in excess of those present in thermal equilibrium.

EXTRINSIC SEMICONDUCTOR

A semiconductor whose charge carrier concentration and, therefore, electrical properties depend on impurity, atoms introduced therein.

FACE BONDED

A chip mounting technique wherein semiconductor chips are provided with small mounting pads, turned face down, and bonded directly to conductors on a substrate.

FANNED LEADS

Leads placed through a package wall at closer intervals than normal and radiated (fanned) out on the exterior of the package until a desired center-to-center lead spacing is achieved.

FET

Acronym for field effect transistor.

FIELD EFFECT TRANSISTOR

A unipolar transistor in which current carriers are injected at a source terminal and pass to a drain terminal through a channel of semiconductor material whose conductivity depends largely on an electric field applied to the semiconductor from a control electrode. There are two main types of FET, a junction FET and an insulated-gate FET. In the junction FET, the gate is isolated from the channel by a pn junction. In an insulated-gate FET, the gate is isolated from the channel by an insulating layer, so that the gate and channel form a capacitor with the insulating layer as the capacitor dielectric.

FIELD OXIDE

A thin (on a macroscopic scale) film made up of an oxide of a material which overlies a device substrate to reduce parasitic capacitive coupling between conductors overlying the oxide and the substrate or devices below the oxide layer (e.g., in the substrate).

FLAT PACK

An integrated circuit package with leads extending from it in the same plane as that of the package. It has a low profile.

FLIP-CHIP

A term which describes the situation wherein a semiconductor device which has all terminations on one side thereof in the form of bump contacts, has a passivated surface and has been flipped over and attached to a matching substrate.

FLOATING DIFFUSION

A region of a semiconductor device in which impurity atoms have been doped and which is electrically floating, that is, has no direct electrical connection.

FLOATING GATE

A gate electrode that is electrically floating, that is, has no direct electrical connection.

FOOTPRINT

Also called a land pattern. It is a combination of lands used to mount a surface mount component. Metal pads on a substrate surface are arranged in the same pattern as the leads or pads on the component itself.

FORBIDDEN ENERGY BAND/REGION/GAP

The energy band of a material which is located between a solid material"s conduction and valence bands. It is defined by the amount of energy that is needed to release an electron from its valence band to its conduction band. Electrons cannot exist in this gap. They are either below it, and bound to an atom, or above it, and able to move freely.

FORWARD BIAS

An external voltage applied in the conducting direction of a pn junction. A positive potential is connected to the p-type material and a negative potential to the n-type semiconductor material.

FORWARD BREAKOVER POTENTIAL

The value of positive terminal voltage at which a regenerative device (e.g., a silicon controlled rectifier), with its gate circuit open, becomes conductive.

FORWARD CURRENT

The current which flows across a semiconductor junction when a forward bias is applied across the junction.

FOUR-LAYER DIODE

A semiconductor diode with three junctions and only two terminals connected to the outer layers forming the junctions. This includes two terminal pnpn thyristors.

FOUR-PHASE CCD

A charge coupled device having four electrode sets and four gate voltages.

FOUR-SIDE LEAD LAYOUT

The situation wherein there are leads through all four sides of an integrated circuit package.

FRAME TRANSFER CCD

A charge coupled device area imager array with a separate image area, storage area, and read-out register area, the storage area being located between the image area and the readout area. This is distinguished from an interline-transfer CCD in which the sensing and storage/ readout function areas are located next to each other.

FREE ELECTRON

An electron not bound to a particular atom, but free to circulate among the atoms of a solid material.

GAIN

The ratio of the magnitude of the electrical output of a device to the magnitude of its electrical input.

GALLIUM ARSENIDE

A semiconducting chemical compound which is often used in active solid-state devices.

GATE

The control electrode or region of a field effect transistor, located between the source and drain electrodes, and regions thereof.

GATE ARRAY

A repeating geometric arrangement of groups of active solid-state devices, each group being connectable into a logic circuit, in one integrated, monolithic semiconductor chip.

GATE CHARGE

The electrical charge on a gate electrode.

GATE CONTROLLED DIODE

A three terminal semiconductor diode with the ability to be turned on or off by a pulse applied to its gate electrode.

GATE TRIGGER CURRENT

The amount of current needed to commence gate current flow in a four layer semiconductor device (e.g., a thyristor).

GATE TRIGGER VOLTAGE

The amount of voltage needed to begin gate current flow in a four layer semiconductor device (e.g., a silicon controlled rectifier).

GERMANIUM

A semiconductor material used in active solid-state devices.

GULL-WING

The name given to lead configurations of some surface mounted devices. Gull wings extend from the side of a component package and have an L-shaped bend at component ends, which extend down to the substrate surface and away from the component.

GUNN DIODE

A diode in which electrons under the influence of sufficiently high electric fields are transferred between energy valleys of different momentum in the conduction band of the active semiconductor device material or holes under the influence of sufficiently high electric fields are transferred between energy valleys of different momentum in the valence band of the active semiconductor device material. A Gunn diode does not normally have a pn junction and cannot be used as a rectifier.

GUNN EFFECT

An inter valley transfer effect wherein electrons under the influence of sufficiently high electric fields are transferred between energy valleys of different momentum in the conduction band of the active semiconductor device material, or holes under the influence of sufficiently high electric fields are transferred between energy valleys of different momentum in the valence band of the active semiconductor device material.

HALL EFFECT DEVICE

An active solid-state device in which a current is flowing and is in a magnetic field perpendicular to the current, and in which a voltage is produced that is perpendicular to both the current flow direction and the magnetic field direction.

HALOGENS

F, Cl, Br, I, At.

HEADER

A slab-like or flat plug-in base for a package that is designed to be used with a cover or lid.

HEAT SINK

Devices used to absorb or transfer heat away from heat sensitive devices or device components.

HEAVY METALS

Metals other than light metals - see LIGHT METALS.

HETEROJUNCTION /HETEROINTERFACE

An interface between two dissimilar semiconductor materials. For example, one material may by InAs and the other may be InAlAs, or one material may be GaAs and the other material may be GaAlAs.

HETEROSTRUCTURE

See HETEROJUNCTION.

HIGH ELECTRON (HOLE) MOBILITY TRANSISTOR (HEMT)

A heterojunction field effect transistor with impurity ions located on the side of the hetero junction with lower affinity for the charge carriers (holes <u>or</u> electrons) injected at the source that pass to the drain via a channel adjacent the hetero junction.

HOLDING CURRENT

The minimum current needed to maintain a generative type active solid-state device (e.g., a thyristor) in an “on” or conducting condition.

HOLE

An empty energy level in the valence band of a semiconductor crystal which exhibits properties of a real particle and can act as a mobile positive charge carrier.

HOLE FLOW

The current in a semiconductor material due to the movement of holes therein.

HOMOJUNCTION

An interface between regions of opposite polarity in the same semiconductor material.

HOT CARRIER DIODE

A diode in which electrons (or holes) have energies greater than those that are in thermal equilibrium with the material of at least one of the regions forming the diode. Schottky barrier diodes typically have "hot carriers" (hot electrons) injected into the metal from the semiconductor.

HOT ELECTRONS

See HOT CARRIER DIODE.

HYBRID CIRCUIT

A small printed circuit having miniature components, which may include passive components (resistors, capacitors, and inductors, deposited on a printed circuit board. A "hybrid circuit" is NOT an integrated circuit, and is not classifiable in this class.

IMPURITY

A foreign material present in a semiconductor crystal, such as boron or arsenic in silicon, which is added to the semiconductor to produce either p-type or n-type semiconductor material, or to otherwise result in material whose electrical characteristics depend on the impurity dopant atoms.

INDIRECT BAND GAP SEMICONDUCTOR

A semiconductor material in which a change in semiconductor crystal momentum for an electron is required when it moves from the conduction band to the valence band and vice versa. Silicon is an indirect band gap semiconductor.

INSULATED-GATE FIELD EFFECT TRANSISTOR (IGFET)

A unipolar transistor with source, gate, and drain regions and electrodes, in which conduction takes place in a channel controlled by action of the voltage applied to the gate electrode of the device, in which the gate electrode is separated from the channel by an insulator layer.

INSULATOR

A material which has a high resistance to the flow of electric current. It has such low electrical conductivity that the flow of current therethrough can usually be neglected.

INTEGRATED CIRCUIT

See MONOLITHIC DEVICE (e.g., IC) as contrasted to HYBRID CIRCUIT.

INTRINSIC CONCENTRATION

The number of minority carriers in a semiconductor due to thermal generation of electron-hole pairs.

INTRINSIC SEMICONDUCTOR

A pure semiconductor, i.e., one with no impurity atoms introduced therein.

INVERSION

A condition in a semiconductor material in which the concentration of minority carriers exceeds the concentration of majority carriers.

INVERSION LAYER/CHANNEL

A region in a semiconductor material in which the concentration of minority carriers exceeds the concentration of majority carriers.

IRON GROUP METALS

Fe, Co, Ni.

ISOLATION

Prevention of the flow of electric current between electronic component parts of a solid-state electronic device.

ISOPLANAR CMOS

A semiconductor device in which relatively thick regions of silicon dioxide, recessed into the semiconductor surface, are used to electrically isolate device areas and prevent parasitic device formation. More commonly called LOCOS CMOS.

ISOPLANAR ISOLATION

A type of electric isolation in which relatively thick regions of silicon dioxide, recessed into the semiconductor surface, are used to electrically isolate device areas and prevent parasitic device formation. More commonly called LOCOS ISOLATION.

J-LEAD

A rolled-under, J-shaped configuration of some surface mounted component leads.

JUNCTION

A joining of two different semiconductors or of a semiconductor and a metal at an interface. Types of junctions include HETEROJUNCTIONS, SCHOTTKY BARRIER JUNCTIONS, and PN JUNCTIONS.

JUNCTION BARRIER

The opposition to the diffusion of majority carriers across a pn junction due to the charge of the fixed donor and acceptor ions.

JUNCTION CAPACITANCE

The capacitance across a pn junction. It depends on the width of the depletion layer, which increases with increased reverse bias voltage across the junction.

JUNCTION GATE FIELD EFFECT TRANSISTOR (JFET)

See FIELD EFFECT TRANSISTOR.

JUNCTION ISOLATION

Electrical isolation of devices on a monolithic integrated circuit chip using a reverse biased junction diode to establish a depletion layer that forms the electrical isolation between devices.

JUNCTION RESISTANCE

The electrical resistance across a semiconductor PN junction.

LAND

The conductive areas, normally metal patterns, on a semiconductor integrated circuit, which form part of the contacts and interconnections between components on the integrated circuit.

LAND PATTERN

A combination of lands on an integrated circuit.

LANTHANIDE ELEMENTS

La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho,Er, Tm, Yb, Lu.

LATCHING/LATCHED/LATCHUP

The state or condition of a regenerative feedback device, e.g., a thyristor, in which the device remains ON when the initializing signal is removed.

LCCC

An abbreviation for a leadless ceramic chip carrier which is a hermetically-sealable ceramic package in which an integrated chip can be placed to create a surface mounted component. It has pads around its perimeter for connection to a substrate.

LEAD

The conductor brought out from a component.

LEAD FRAME

A metal frame which provides support for an integrated circuit chip or die as well as electrical leads to interconnect the integrated circuit on the die or chip to other electrical components or contacts.

LEAKAGE CURRENT

Unwanted current flow.

LIFETIME

The average time interval between the introduction of and recombination of minority charge carriers in a semiconductor.

LIGHT EMITTING DIODE (LED)

Junction diodes which give off light when energized.

LIGHT METALS

Alkali metals, alkaline-earth metals, Be, Al, Mg.

LINE DEFECT

A planar crystal defect (e.g., an extra plane of atoms in a crystal). It is also called an edge dislocation.

LOCAL OXIDE CMOS (LOCMOS)

Local oxide complementary metal oxide semiconductor structure which features oxide isolation which is recessed into the semiconductor surface.

LOCOS

(Local Oxidation of Silicon) Patterns of oxide isolation which are recessed into the semiconductor surface. Sometimes also called isoplanar, ROX (Recessed Oxide Isolation), or planox.

LUMINESCENCE

Emission of light by directly converting some other type of energy. Types include thermoluminescence, photoluminescence, cathodoluminescence, and electroluminescence. It includes fluorescence and phosphorescence. Active solid-state luminescent devices are semiconductors which operate via injection luminescence. Active devices include pn junctions (including heterojunctions), Schottky barrier junctions, metal-insulator-semiconductor (MIS) structures, and high speed traveling domains, e.g., Gunn domain and acoustoelectric wave generated domains; whereas passive solid-state electroluminescent devices (phosphors) are insulators which operate in an intrinsic luminescence phenomena, i.e., where an applied electric field generates free carriers (there being no free carriers in an insulator to be accelerated by an applied field unless the field also generates them) to initiate the light emission mechanism.

MAJORITY CARRIER

The predominant charge carrier in a semiconductor. Electrons are majority carriers in n-type semiconductors. Holes are majority carriers in p-type semiconductors.

MAJORITY CURRENT

Current caused by the flow of majority carriers.

MASTERSLICE ARRAY/MASTERCHIP

A substrate that contains active and passive electronic components in a predetermined pattern which may be connected into different logic or analog circuits.

MBM JUNCTION

Active solid-state devices having metal-barrier-metal layer junctions.

METAL-OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTOR (MOSFET)

See INSULATED GATE FIELD EFFECT TRANSISTOR.

METAL-GATE FET

A field effect transistor having a gate conductor made of metal, rather than polycrystalline semiconductor material.

METALLIZATION

A single or multilayer film pattern of electrically conductive material deposited on a substrate to interconnect electronic components, or the metal film on the bonding area of a substrate which becomes part of the bond and performs both an electrical and a mechanical function.

METALS

Elements other than non-metals. See NON-METALS.

MIM DIODE

A junction diode with a thin insulating layer of material sandwiched between two metallic surface layers which operates as a tunneling (direct or Fowler-Nordheim type) diode.

MINORITY CARRIER

The less predominant charge carrier in a semiconductor. In a p-type semiconductor, minority carriers are electrons, whereas in n-type semiconductor material, minority carriers are holes.

MINORITY CURRENT

The current caused by flowing minority carriers.

MIS

Acronym for metal-insulator-semiconductor. Typically active solid-state devices with MIS technology have a silicon dioxide layer formed on a single crystal silicon substrate. A polysilicon conductor layer is formed on the oxide.

MOBILITY

The facility with which carriers move through a semi-

conductor when subjected to an applied electric field. Electrons and holes typically have different mobilities in the same semiconductor.

MODFET

Acronym for a modulation doped field effect transistor. A high speed semiconductor FET in which dopant atom containing semiconductor layers alternate with non-doped semiconductor layers, so that the carriers (electrons or holes) resulting from the dopant atoms can travel in the undoped material, so that there is little scattering of carriers from dopant atoms. Typically, the dopant atoms are in semiconductor material having a lower carrier affinity than the undoped layers, to facilitate carrier spill over into the undoped layers. Such a structure may typically constitute a superlattice. See also HIGH ELECTRON MOBILITY TRANSISTOR (HEMT).

MODULATION DOPING

Spatial modulation of dopant atoms in a semiconductor crystal.

MONOLITHIC DEVICE (E.G., IC)

A device in which all components are fabricated on a single chip of silicon. Interconnections among components are provided by means of metallization patterns on the surface of the chip structure, and the individual parts are not separable from the complete circuit. External connecting wires are taken out to terminal pins or leads.

MSM

Acronym for metal-semiconductor-metal semiconductors. Active solid-state semiconductor devices having a semiconductor layer sandwiched between two layers of metal.

MULTILAYER METALLIZATION

Two or more layers of interconnecting metallization patterns in a monolithic integrated circuit separated by insulator material except in interconnection areas.

N-TYPE SEMICONDUCTOR

An extrinsic semiconductor in which electron density exceeds hole density.

NDM

Negative differential mobility (e.g., Gunn effect) intervalley active semiconductor devices wherein an applied electric field imparts energy to electrons or holes to permit them to jump to higher quantum electronic intervalley energy levels in which electrons have lowered electron mobility.

NEGATIVE RESISTANCE REGION

An operating region of an active solid-state electronic device in which an increase in applied voltage results in a decrease in output current.

NEGATIVE TEMPERATURE COEFFICIENT

The amount of reduction in a device parameter, such as capacitance or resistance, for each degree of device operating temperature.

NMOS

N-channel metal oxide semiconductor devices which use electrons as majority carriers.

NOBLE GASES

He, Ne, Ar, Kr, Xe, Rn.

NON-METALS

H, B, C, Si, N, P, O, S, Se, Te, noble gases, halogens.

NPN TRANSISTOR

A transistor in which the base is made of p-type material and both source and drain are made of n-type semiconductor material.

N-CHANNEL FET

A field effect transistor that has an n-type conduction channel.

N-TYPE SEMICONDUCTOR

An extrinsic semiconductor having n-type dopant atoms, e.g., atoms with one more valence electron than the host atoms.

ORGANIC SEMICONDUCTOR

A semiconductor compound in which the molecule is characterized by two or more carbon atoms bonded

together, one atom of carbon bonded to at least one atom of hydrogen or halogen (i.e., chlorine, fluorine, bromine, iodine) or one atom of carbon bonded to at least one atom of nitrogen by a single or double bond.

(1) Note. Exceptions to this rule include HCN, CN-CN, HNCO, HNCS, cyanogen halides, cyanamide, fulminic acid, and metal carbides. These are not regarded as organic semiconductor materials. Also, note that graphite and diamond are not regarded as organic semiconductors since they are not compounds; silicon carbide is not regarded as organic.

OXIDE ISOLATION

Electrical isolation of semiconductor electronic devices in a monolithic integrated circuit by an oxide (e.g., silicon oxide).

PACKAGE

A container, case, or enclosure for protecting a solid-state electronic device from the environment.

PAD

(1) The portion of a conductive pattern on a solid-state electronic device for making external connection thereto; (2) the portion of a conductive pattern on a chip or a printed circuit board designed for mounting or attaching a substrate or solid-state active electronic device.

PARASITIC CURRENT

Unintended current which flows between devices in an integrated circuit, or which flows between device regions and isolation regions.

PARASITIC DEVICES/CHANNELS

Junctions forming unintended active solid-state devices which interconnect intended active solid-state devices, which unintended devices are not designed to carry current flow.

PARASITIC THYRISTOR ACTION

Unwanted active solid-state device formation in which four adjacent complementary doped regions not designed to act as an active solid-state device, lack sufficient isolation therebetween and act as a thyristor. Parasitic thyristor action is typically a problem encountered in CMOS integrated circuits.

PARASITIC TRANSISTOR ACTION

Unwanted transistor formation in an integrated circuit structure.

PASSIVE DEVICE

A solid-state electronic device or component in which charge carriers do not change their energy levels and that does not provide rectification, amplification, or switching, but which does react to voltage and current. Examples are pure resistors, capacitors, and inductors.

P-CHANNEL

A conduction path, made of p-type semiconductor material, located between the source and drain of a field effect device.

PERISTALTIC CCD

See BULK CHANNEL CCD.

PERMISSIBLE ENERGY LEVEL

An energy level in a conduction or valence band which a charge carrier (electron or hole) may have.

PHOTODIODE

A diode in which charge carriers are created by light which illuminates the diode junction. It is a photovoltaic as well as a photoconductive device.

PHOTOTRANSISTOR

A transistor having no base terminal and in which charge carriers are created by light which illuminates its collector-base junction.

PHOTOVOLTAIC CELL

An active solid-state device with a pn junction that generates a voltage in response to light impinging on the junction.

PINCH-EFFECT RESISTOR

A monolithic integrated circuit resistor having a layer of one conductivity type, typically a P-layer formed at the same time as integrated circuit bipolar transistor base

regions, which is thinned by an inset region of opposite conductivity type, typically an N-layer formed at the same time as integrated circuit bipolar transistor emitter regions.

PINCH-OFF

The condition in a depletion mode field effect transistor wherein the conducting channel is depleted of majority carriers and is thereby pinched off, no path remaining for the source-to-drain majority carrier (e.g., electron) flow.

PIN DIODE/DEVICE

A diode having an intrinsic semiconductor (i.e., one with no dopants) sandwiched between a p-type layer and an n-type layer. The depletion region (the intrinsic semiconductor layer) thickness can be tailored to optimize quantum efficiency for use as a photo diode or frequency response for use as a microwave diode.

PIN-GRID ARRAY

A semiconductor chip package having leads in the form of pins arranged in columns and rows.

PLANAR TRANSISTOR

A bipolar transistor in which the emitter base and collector regions terminate at the same plane surface without indentations in or protrusions from the surface. Hence, the emitter and base regions form dish shaped portions extending into the semiconductor from the common surface.

PLUG-IN PACKAGE

An electronic package for an active solid-state device in which the lead pins are perpendicular to the mounting area of the substrate, as contrasted with a flat package in which the leads are in the same plane as the substrate.

P-MOSFET

A metal oxide semiconductor field effect transistor having p-type source and drain regions and a p-type conduction channel which may be formed by a p type doped region (depletion mode) or induced by a voltage on the gate (enhancement mode).

PN-JUNCTION

The interface and region of transition between p-type and n-type semiconductors.

PN-JUNCTION DIODE

A semiconductor device having two terminals connected to opposite type semiconductor materials with a junction therebetween and exhibiting a non-linear voltage-current characteristic, usually used for switching or rectification.

PNP TRANSISTOR

A bipolar transistor with a p type emitter, an n-type base and a p-type collector.

POINT DEFECT

A crystal defect occurring at a point in a crystal. Examples include, (1) a foreign atom incorporated into the crystal lattice at either a substitutional (regular lattice) site or interstitial (between regular lattice sites) site, (2) a missing atom in the lattice, or (3) a host atom located between regular lattice sites and adjacent to a vacancy (called a Frenkel defect).

POLYCRYSTALLINE

A material composed of more than one crystal.

POLYSILICON

A polycrystalline form of silicon.

POSITIVE CARRIER

A charge carrier which has a net positive charge (e.g., a hole).

POSITIVE IONS

Atoms which are missing a valence shell electron.

POTENTIAL BARRIER

The difference in electrical potential across a pn junction in a semiconductor.

POTENTIAL HILL

See POTENTIAL BARRIER.

POTTING

An embedding process in which an electronic component is placed in a can, shell, or other container and buried in a liquid dielectric polymer which subsequently changes to a solid material. The container is not removed from the finished part, and a release agent is not used. This process differs from casting - which involves a removable mold.

PRINTED CIRCUIT BOARD

A structure formed on one or more layers of electrically insulating material having electrical terminals and conductive material deposited thereon, in continuous paths, from terminal to terminal, to form circuits for electronic apparatus such as chips or substrates.

P-TYPE CONDUCTIVITY

Electrical conductivity associated with positive charge carriers (holes) in a semiconductor material.

P-TYPE SEMICONDUCTOR

An extrinsic semiconductor in which the hole density exceeds the conduction electron density.

PUNCHTHROUGH

Expansion of a depletion region* from one junction to another junction in an active solid-state device.

PURPLE PLAGUE

A brittle, inter metallic electrically conductive compound which has a purplish color and is formed when aluminum and gold, used as electrical contact materials in semiconductor electronic devices, contact each other and interact. It is usually considered undesirable because it breaks easily, reduces device reliability, and lowers product yield.

QUANTIZED STATES

Discrete energy levels due to the quantum mechanical properties of a material.

QUANTUM TRANSISTOR

Transistors whose operation is based on the properties of electrons confined in quantum wells - semiconductor films only a hundred or so angstroms thick sandwiched between high confining walls made of a second semiconductor material.

QUANTUM WELL

Semiconductor films only a hundred or so angstroms thick sandwiched between high confining walls made of a second material.

RARE EARTHS

Sc, Y, Lanthanides.

READ-OUT REGISTER

Gated semiconductor devices which receive and accumulate charges and make them available to an output device.

RECOMBINATION

The process by which excess holes and electrons in a semiconductor crystal recombine and and no longer function as charge carriers in the semiconductor. Basic recombination processes are band-to-band recombination which occurs when an electron in the conduction band recombines with a hole in the valence band, and trapping recombination which occurs when an electron or hole is captured by a deep energy level, such as produced by a deep level dopant, before recombining with an opposite conductivity type carrier.

REFRACTORY METALS

Ti, V, Cr, Zr, Nb, Mo, Hf, Ta, W.

RESISTIVITY

A measure of the resistance of a material to electric current. Resistivity is a bulk material property, measured in ohm-cm.

RESONANT TUNNELLING DEVICE

A device that works on the principle of resonant electron (or hole) tunneling through a pair of matched potential barriers. This occurs when the energy of the electrons (or holes) matches that of a quantum energy level in the quantum well formed between the barriers.

REVERSE BIAS

A voltage applied across a semiconductor junction in the reverse direction, i.e., wherein a positive potential is connected to the n-type semiconductor and a negative potential is applied to the p-type semiconductor.

REVERSE BREAKDOWN VOLTAGE

The reverse bias voltage value at which electrical resistance drops appreciably and operating current sharply increases.

REVERSE CURRENT

The current flowing through a rectifying junction with a reverse voltage thereacross.

SATURATION

The current between the base and collector of a bipolar transistor when an increase in emitter to base voltage causes no further increase in the collector current.

SCATTERING CENTERS

The impurities (dopants) in semiconductors that cause electrons or holes flowing through the semiconductor to scatter. These reduce carrier mobility and represent a problem in quantum devices because they affect electron coherence length.

SCHOTTKY BARRIER

A metal to semiconductor interface in which the carrier affinity and doping level of the semiconductor are such that a rectifying junction is formed. Usually, minority carriers in the semiconductor do not significantly contribute to the current flowing in a device with such a barrier.

SCHOTTKY DIODE

A diode with a Schottky barrier.

SEMICONDUCTOR

A material whose electrical resistivity is between that of insulators and conductors. The resistivity is commonly changed by light, heat, electric, or magnetic fields incident on the material. Current flow is achieved by transfer of positive holes as well as by movement of electrons.

SEMICONDUCTOR DEVICE

A device in which current conduction takes place within a semiconductor.

SEMICONDUCTOR LASER

A light emitting diode that uses stimulated emission of radiation to produce coherent light output.

SILICON BILATERAL SWITCH (SBS)

A silicon controlled switch that can conduct current in both directions.

SILICON CONTROLLED RECTIFIER (SCR)

A four layer pnpn device that, when in a normal state, blocks applied voltage in either direction. Application of a correct voltage to a gate terminal permits the device to conduct in a forward direction.

SILICON CONTROLLED SWITCH (SCS)

A four layer pnpn semiconductor switching device that can be triggered into conduction by applying either positive or negative pulses.

SILICON-GATE FET

A field effect transistor which has a gate electrode made of silicon.

SILICON ON INSULATOR (SOI)

A semiconductor structure using an insulating substrate, instead of silicon as a substrate material, with an overlying active layer of single crystal silicon containing active solid-state devices. The substrate may typically be of the form of an insulating layer which is itself formed on a single crystal substrate.

SILICON ON SAPPHIRE (S0S) CMOS

A complementary metal oxide semiconductor device (e.g., a transistor) wherein single crystal silicon is grown on a passive insulating base of sapphire (single crystal alpha phase aluminum oxide) with complementary MOS transistors formed in the silicon in one or more island portions.

SILICON TRANSISTOR

A transistor which uses silicon as the semiconductor material.

SINGLE-IN-LINE PACKAGE

A plug-in semiconductor device package with one row of pins with specified spacings therebetween.

SINGLE CRYSTAL

A body of material having atoms regularly located at periodic lattice sites throughout.

SINKER

A buried electrically conductive, low resistance path in an integrated circuit which connects an electrical contact to a conductive region buried in the integrated circuit. It may be made up of a heavily doped impurity region.

SIS

An MIS structure (Metal-Insulator-Semiconductor) in which the “metal” layer is made of semiconductor material, typically polycrystalline silicon.

SOLAR CELL

A photovoltaic cell in the form of a semiconductor diode, usually made of silicon, that generates electricity directly from sunlight impingent on the cell.

SOLID-STATE DEVICE

An electronic device or component that uses current flow through solid (as opposed to liquid), gas, or vacuum materials. solid-state devices may be active or passive.

SOURCE

In a field effect transistor, the electrode to which the source of charge carriers is connected.

SPACE CHARGE REGION

The region around a pn junction in which holes and electrons recombine to leave no mobile charge carriers and a net charge density due to the residual dopant ions.

STEP RECOVERY DIODE

A pn junction active solid-state device in which a forward bias voltage injects charge carriers across the junction but prior to recombination of the carriers, a reverse voltage is applied to return the charge carriers to their source as a group.

SUBSTRATE

The supporting material on or in which the components of an integrated circuit are fabricated or attached.

SUBSTRATE BIAS

The electric potential applied to a substrate, which typically serves as the reference potential against which other voltages are measured. Also, in a MISFET, a voltage applied to the substrate with respect to the source region.

SUPERLATTICE

A periodic sequence of variations in carrier potential energy in a semiconductor, of such magnitude and spacing that the current carrier wave function is spread out over many periods, so that carrier energy and other properties are determined in part by the periodic variations. The variation may be in chemical composition of the material, as in a sequence of heterojunctions, or in impurity concentration, forming a doping superlattice, or both.

SURFACE-CHANNEL CCD

A charge coupled device in which charge resides at the semiconductor surface.

SURFACE MOUNT DEVICES

Active or passive solid-state devices which are structured and configured to be mounted directly to a printed circuit board surface. This type of mounting is distinguished from “through-hole” mounting which involves the electrical and physical connection of devices to a printed circuit board using drilled and plated holes through the conductive pattern of the board.

SURFACE RESISTIVITY

The resistance of a material between two opposite sides of a unit square of its surface. Also called Sheet Resistance. Measured in ohms, often written as “ohms per square” in this case.

TEST PROBES

Mechanical points of contact used for electrical measurement.

THERMISTOR

A semiconductor device whose electrical resistance var-