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| Category | **Description** |
| *Category XI —* *Military Electronics* | **\*(3) Radar systems and equipment, as follows:[[1]](#footnote-1)**(i) Airborne radar that maintains positional state of an object or objects of interest, other than weather phenomena, in a received radar signal through time;[[2]](#footnote-2)(ii) Synthetic Aperture Radar (SAR) incorporating image resolution less than (better than) 0.3 m, or incorporating Coherent Change Detection (CCD) with geo-registration accuracy less than (better than) 0.3 m, not including concealed object detection equipment operating in the frequency range from 30 GHz to 3,000 GHz and having a spatial resolution of 0.5 milliradians up to and including 1 milliradians at a standoff distance of 100 m;(iii) Inverse Synthetic Aperture Radar (ISAR);(iv) Radar that geodetically-locates (i.e., geodetic latitude, geodetic longitude, and geodetic height) with a target location error 50 (TLE50) less than or equal to 10 m at ranges greater than 1 km;(v) Any Ocean Surveillance Radar with an average-power-aperture product of greater than 50 Wm2;(vi) Any ocean surveillance radar that transmits a waveform with an instantaneous bandwidth greater than 100 MHz and has an antenna rotation rate greater than 60 revolutions per minute (RPM);(vii) Air surveillance radar with free space detection of 1 square meter RCS target at 85 nmi or greater range, scaled to RCS values as RCS to the 1⁄4 power;(viii) Air surveillance radar with free space detection of 1 square meter RCS target[[3]](#footnote-3) at an altitude of65,000 feet and an elevation angle greater than 20 degrees (*i.e.,* counter-battery);(ix) Air surveillance radar with multiple elevation beams, phase or amplitude monopulse estimation, or 3D height-finding;[[4]](#footnote-4)(x) Air surveillance radar with a beam solid angle less than or equal to 16 degrees2 that performs free space tracking of 1 square meter RCS target at a range greater or equal to 25 nmi with revisit rate greater or equal to 1⁄3 Hz;(xi) Instrumentation radar for anechoic test facility or outdoor range that maintains positional state of an object of interest in a received radar signal 0through time or provides measurement of RCS of a static target less than or equal to minus 10dBsm, or RCS of a dynamic target;(xii) Radar incorporating pulsed operation with electronics steering of transmit beam in elevation and azimuth;[[5]](#footnote-5)**Note to paragraph (a)(3)(xii)**: This paragraph does not control radars not otherwise controlled in this subchapter, operating with a peak transmit power less than or equal to 250 watts, and employing a design determined to be subject to the EAR via a commodity jurisdiction determination (see §120.4 of this subchapter).(xiii) Radar with mode(s) for ballistic tracking or ballistic extrapolation to source of launch or impact point of articles controlled in USML Categories III, IV, or XV;(xiv) Active protection radar and missile warning radar with mode(s) implemented for detection of incoming munitions;(xv) Over the horizon high frequency sky-wave (ionosphere) radar;(xvi) Radar that detects a moving object through a physical obstruction at distance greater than 0.2 m from the obstruction;(xvii) Radar having moving target indicator (MTI) or pulse-Doppler processing where any single Doppler filter provides a normalized clutter attenuation of greater than 60 dB;**Note to paragraph (a)(3)(xvii):** Normalized clutter attenuation is defined as the reduction in the power level of received distributed clutter when normalized to the thermal noise level.(xviii) Radar having electronic protection or electronic counter- countermeasures (ECCM) other than*.***Note to Paragraph (a)(3)(xxi)**: The definition of “type” in this paragraph is that provided in 14 CFR §1.1.(xxii) Radar employing automatic target recognition (ATR) (*i.e.,* recognition of target using structural features (e.g., tank versus car) of the target with system resolution better than (less than) 0.3 m);(xxiii) Radar that sends interceptor guidance commands or provides illumination keyed to an interceptor seeker;(xxiv) Radar employing waveform generation for LPI other than frequency modulated continuous wave (FMCW) with linear ramp modulation;(xxv) Radar that sends and receives communications;(xxvi) Radar that tracks or discriminates ballistic missile warhead from debris or countermeasures;(xxvii) Bi-static/multi-static radar that exploits greater than 125 kHz bandwidth and is lower than 2 GHz center frequency to passively detect or track using radio frequency (RF) transmissions (e.g., commercial radio, television stations);(xxviii) Radar target generators, projectors, or simulators, specially designed for radars controlled by this category; or(xxix) Radar and laser radar systems specially designed for defense articles in paragraph (a)(1) of USML Category IV or paragraphs (a)(5), (a)(6), or (a)(13) of USML Category VIII (MT if specially designed for rockets, space launch vehicles, missiles, drones, or unmanned aerial vehicles capable of delivering a payload of at least 500 kg to a range of at least 300 km);**Note 1 to paragraph (a)(3)(xxix):** Laser radar systems embody specialized transmission, scanning, receiving, and signal processing techniques for utilization of lasers for echo ranging, direction finding, and discrimination of targets by location, radial speed, and body reflection characteristics.**Note 2 to paragraph (a)(3)(xxix)**: For definition of “range” as it pertains to rocket systems, see note 1 to paragraph (a) of USML Category IV. ‘‘Payload’’ is the total mass that can be carried or delivered by the specified rocket, SLV, or missile that is not used to maintain flight.**Note to paragraph (a)(3)**: This paragraph does not control: (a) systems or equipment that require aircraft transponders in order to meet control parameters; (b) precision approach radar (PAR) equipment conforming to ICAO standards and employing electronically steerable linear (1-dimensional) arrays or mechanically positioned passive antennas; and (c) radio altimeter equipment conforming to FAA TSO C87. **\*(4) Electronic Combat[[6]](#footnote-6) (*i.e.,* Electronic Warfare) systems and equipment, as follows:**(i) ES systems and equipment that search for, intercept and identify, or locate sources of intentional or unintentional electromagnetic energy specially designed to provide immediate threat detection, recognition, targeting, planning, or conduct of future operations;[[7]](#footnote-7) **Note to paragraph (a)(4)(i)**: ES provides tactical situational awareness, automatic cueing, targeting, electronic order of battle planning, electronic intelligence (ELINT), communication intelligence (COMINT), or signals intelligence (SIGINT).(ii) Systems and equipment that detect and automatically discriminate acoustic energy emanating from weapons fire (e.g., gunfire, artillery, rocket propelled grenades, or other projectiles), determining location or direction of weapons fire in less than two seconds from receipt of event signal, and able to operate on-the-move (e.g., operating on personnel, land vehicles, sea vessels, or aircraft while in motion); or(iii) Systems and equipment specially designed to introduce extraneous or erroneous signals into radar, infrared based seekers, electro-optic based seekers, radio communication receivers, navigation receivers, or that otherwise hinder the reception, operation, or effectiveness of adversary electronics (e.g., active or passive electronic attack, electronic countermeasure, electronic counter-countermeasure equipment, jamming, and counter jamming equipment);**\*(5)[[8]](#footnote-8) Command, control, and communications (C3); command, control, communications, and computers (C4); command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); and identification systems or equipment, that:**(i) Are specially designed to integrate, incorporate, network, or employ defense articles that are controlled in paragraphs or subparagraphs of the categories of §121.1 of this part that do not use the term specially designed;(ii) Incorporate U.S. government identification friend or foe (IFF) Modes 4 or 5;(iii) Implement active or passive ECCM used to counter acts of communication disruption (e.g., radios that incorporate HAVE QUICK I/II, SINCGARS, SATURN);[[9]](#footnote-9)(iv) Specially designed, rated, certified, or otherwise specified or described to be in compliance with U.S. government NSTISSAM TEMPEST 1–92 standards or CNSSAM TEMPEST 01–02, to implement techniques to suppress compromising emanations of information bearing signals; or(v) Transmit voice or data signals specially designed to elude electromagnetic detection;(6) [Reserved]**(7) Developmental electronic equipment or systems funded by the Department of Defense via contract or other funding authorization;[[10]](#footnote-10)****Note 1 to paragraph (a)(7)**: This paragraph does not control electronic systems or equipment (a) in production, (b) determined to be subject to the EAR via a commodity jurisdiction determination (see §120.4 of this subchapter), or (c) identified in the relevant Department of Defense contract or other funding authorization as being developed for both civil and military applications.**Note 2 to paragraph (a)(7):** Note 1 does not apply to defense articles enumerated on the USML, whether in production or development.**Note 3 to paragraph (a)(7):** This paragraph is applicable only to those contracts and funding authorizations that are dated July 1, 2015, or later.**(8)[[11]](#footnote-11) Unattended ground sensor (UGS) systems or equipment having all of the following:[[12]](#footnote-12)**(i) Automatic target detection;(ii) Automatic target tracking, classification, recognition, or identification;(iii) Self-forming or self-healing networks; and(iv) Self-localization for geo-locating targets;**(12) Direction finding equipment for determining bearings to specific electromagnetic sources or terrain characteristics specially designed for defense articles in paragraph (a)(1) of USML Category IV or paragraphs (a)(5), (a)(6), or (a)(13) of USML Category VIII (MT if specially designed for rockets, SLVs, missiles, drones, or UAVs capable of delivering a payload of at least 500 kg to a range of at least 300 km. See note 2 to paragraph (a)(3)(xxix) of this category).****Note 1 to paragraph (a):** The term *Low Probability of Intercept* used in this paragraph and elsewhere in this category is defined as a class of measures that disguise, delay, or prevent the interception of acoustic or electromagnetic signals. LPI techniques can involve permutations of power management, energy management, frequency variability, out-of-receiver-frequency band, low-side lobe antenna, complex waveforms, and complex scanning. LPI is also referred to as Low Probability of Intercept, Low Probability of Detection, and Low Probability of Identification. **Note 2 to paragraph (a):** Paragraphs (a)(3)(xxix) and (a)(12) include terrain contour mapping equipment, scene mapping and correlation (both digital and analogue) equipment, Doppler navigation radar equipment, passive interferometer equipment, and imaging sensor equipment (both active and passive).**\*(b) Electronic systems or equipment, not elsewhere enumerated in this subchapter, specially designed for intelligence purposes that collect, survey, monitor, or exploit the electromagnetic spectrum (regardless of transmission medium), or for counteracting such activities.[[13]](#footnote-13)****(c) Parts, components, accessories, attachments, and associated equipment, as follows:[[14]](#footnote-14)**(1) Application Specific Integrated Circuits (ASICs) and Programmable Logic Devices (PLD) programmed for defense articles in this subchapter;[[15]](#footnote-15) **Note 1 to paragraph (c)(1)**: An ASIC is an integrated circuit developed and produced for a specific application or function regardless of number of customers.**Note 2 to paragraph (c)(1)**: ASICs and PLDs programmed for 600 series items are controlled in ECCN 3A611.f.**Note 3 to paragraph (c)(1)**: Unprogrammed PLDs are not controlled by this paragraph.(2) Printed Circuit Boards (PCBs) and populated circuit card assemblies for which the layout is specially designed for defense articles in this subchapter;**Note to paragraph (c)(2)**: PCBs and populated circuit card assemblies for which the layout is specially designed for 600 series items are controlled in ECCN 3A611.g.(3) Multichip modules for which the pattern or layout is specially designed for defense articles in this subchapter;**Note to paragraph (c)(3)**: Multichip modules for which the pattern or layout is specially designed for 600 series items are controlled in ECCN 3A611.h.(4) Transmit/receive modules or transmit modules that have any two perpendicular sides, with either length d (in cm) equal to or less than 15 divided by the lowest operating frequency in GHz [d≤15cm\*GHz/fGHz], with an electronically variable phase shifter or phasers that are a Monolithic Microwave Integrated Circuit (MMIC), or incorporate a MMIC or discrete RF power transistor;(5) High-energy storage capacitors with a repetition rate of 6 discharges or more per minute and full energy life greater than or equal to 10,000 discharges, at greater than 0.2 Amps per Joule peak current, that have any of the following:[[16]](#footnote-16)(i) Volumetric energy density greater than or equal to 1.5 J/cc; or(ii) Mass energy density greater than or equal to 1.3 kJ/kg;(6) Radio frequency circulators of any dimension equal to or less than one quarter (1⁄4) wavelength of the highest operating frequency and isolation greater than 30 dB;(7) Polarimeter that detects and measures polarization of radio frequency signals within a single pulse;(8) Digital radio frequency memory (DRFM) with RF instantaneous input bandwidth greater than 400 MHz, and 4 bit or higher resolution whose output signal is a translation of the input signal (*e.g.,* changes in magnitude, time, frequency) and specially designed parts and components therefor;(9) Vacuum electronic devices, as follows: (i) Multiple electron beam or sheet electron beam devices rated for operation at frequencies of 16 GHz or above, and with a saturated power output greater than 10,000 W (70 dBm) or a maximum average power output greater than 3,000 W (65 dBm); or(ii) Cross-field amplifiers with a gain of 15 dB to 17 dB or a duty factor greater than 5%;(10) Antenna, and specially designed parts and components therefor, that:(i) Employ four or more elements, electronically steer angular beams, independently steer angular nulls, create angular nulls with a null depth greater than 20 dB, and achieve a beam switching speed faster than 50 milliseconds;(ii) Form adaptive null attenuation greater than 35 dB with convergence time less than one second;(iii) Detect signals across multiple RF bands with matched left hand and right hand spiral antenna elements for determination of signal polarization; or(iv) Determine signal angle of arrival less than two degrees (*e.g.,* interferometer antenna);**Note to paragraph (c)(10)**: This category does not control Traffic Collision Avoidance Systems (TCAS) equipment conforming to FAA TSO C–119c.(11) Radomes or electromagnetic antenna windows that:(i) Incorporate radio frequency selective surfaces;(ii) Operate in multiple non-adjacent frequency bands for radar applications;(iii) Incorporate a structure that is specially designed to provide ballistic protection from bullets, shrapnel, or blast;(iv) Have a melting point greater than 1,300 °C and maintain a dielectric constant less than 6 at temperatures greater than 500 ° C;(v) Are manufactured from ceramic materials with a dielectric constant less than 6 at any frequency from 100 MHz to 100 GHz (MT if usable in rockets, SLVs, or missiles capable of achieving a range greater than or equal to 300 km; or if usable in drones or UAVs capable of delivering a payload of at least 500 kg to a range of at least 300 km. See note 2 to paragraph (a)(3)(xxix) of this category);(vi) Maintain structural integrity at stagnation pressures greater than 6,000 pounds per square foot; or(vii) Withstand combined thermal shock greater than 4.184 x 106 J/m2 accompanied by a peak overpressure of greater than 50 kPa (MT if usable in rockets, SLVs, missiles, drones, or UAVs capable of delivering a payload of at least 500 kg to a range of at least 300 km and usable in protecting against nuclear effects (e.g., Electromagnetic Pulse(EMP), X-rays, combined blast and thermal effects). See note 2 to paragraph (a)(3)(xxix) of this category); (16) Hybrid (combined analogue/digital) computers specially designed for modeling, simulation, or design integration of systems enumerated in paragraphs (a)(1), (d)(1), (d)(2), (h)(1), (h)(2), (h)(4), (h)(8), and (h)(9) of USML Category IV or paragraphs (a)(5), (a)(6), or (a)(13) of USML Category VIII (MT if for rockets, SLVs, missiles, drones, or UAVs capable of delivering a payload of at least 500 kg to a range of at least 300 km or their subsystems. See note 2 to paragraph (a)(3)(xxix) of this category);(17) Chaff and flare rounds specially designed for the systems and equipment described in paragraph (a)(4)(iii) of this category, and parts and components therefor containing materials controlled in USML Category V;(18) Parts, components, or accessories specially designed for an information assurance/information security system or radio controlled in this subchapter that modify its published properties (*e.g.,* frequency range, algorithms, waveforms, CODECs, or modulation/ demodulation schemes); or\*(19) Any part, component, accessory, attachment, equipment, or system that (MT for those articles designated as such):(i) Is classified;(ii) Contains classified software directly related to defense articles in this subchapter or 600 series items subject to the EAR;[[17]](#footnote-17) or |
| ***Category XII******Optical equipment*** | *\*(a) Fire control systems; gun and missile tracking and guidance systems; gun range, position, height finders, spotting instruments and laying equipment; aiming devices (electronic, optic, and acoustic); bomb sights, bombing computers, military television sighting and viewing units, and periscopes for the articles of this section.* *\*(b) Lasers specifically designed, modified or configured for military application including those used in military communication devices, target designators and range finders, target detection systems, and directed energy weapons.**\*(c) Infrared focal plane array detectors specifically designed, modified, or configured for military use; image intensification and other night sighting equipment or systems specifically designed, modified or configured for military use; second generation and above military image intensification tubes (defined below) specifically designed, developed, modified, or configured for military use, and infrared, visible and ultraviolet devices specifically designed, developed, modified, or configured for military application. Military second and third generation image intensification tubes and military infrared focal plane arrays identified in this subparagraph are licensed by the Department of Commerce (ECCN 6A002A and 6A003A) [sic][[18]](#footnote-18) when part of a commercial system (i.e., those systems originally designed for commercial use). This does not include any military system comprised of non-military specification components. Replacement tubes or focal plane arrays identified in this paragraph being exported for commercial systems are subject to the controls of the ITAR.****NOTE****: Special Definition. For purposes of this subparagraph,* *second and third generation image intensification tubes are defined as having:* ***A peak response within the 0.4 to 1.05 micron wavelength range and incorporating a microchannel plate for electron image amplification having a hole pitch (center-to-center spacing) of less than 25 microns and having either:****(a) An S-20, S-25 or multialkali photo cathode; or* *(b) A GaAs, GaInAs, or other compound semiconductor photo cathode.*  |
| ***Category XV —******Spacecraft Systems and Associated Equipment******Nov. 14, 2014*** | *(a) Spacecraft, including satellites and space vehicles, whether designated developmental, experimental, research, or scientific, or having a commercial, civil, or military end-use, that:* *\*(1) Are specially designed to mitigate effects (e.g., scintillation) of or for detection of a nuclear detonation;* *\*(2) Autonomously track ground, airborne, missile, or space objects in real-time using imaging, infrared, radar, or laser systems;* *\*(3) Conduct signals intelligence (SIGINT) or measurement and signatures intelligence (MASINT);* *\*(4) Are specially designed to be used in a constellation or formation that when operated together, in essence or effect, form a virtual satellite (e.g., functioning as if one satellite) with the characteristics or functions of other items in paragraph (a);* *\*(5) Are anti-satellite or anti- spacecraft (e.g., kinetic, RF, laser, charged particle);* *\*(6) Have space-to-ground weapons systems (e.g., kinetic or directed energy);* *\*(7) Have any of the following electro- optical remote sensing capabilities or characteristics:* *(i) Electro-optical visible and near infrared (VNIR) (i.e., 400nm to 1,000nm) or infrared (i.e., greater than 1,000nm to 30,000nm) with less than 40 spectral bands and having a clear aperture greater than 0.35 meters;* *(ii) Electro-optical hyperspectral with 40 spectral bands or more in the VNIR, short-wavelength infrared (SWIR) (i.e., greater than 1,000nm to 2,500nm) or any* *combination of the aforementioned and having a Ground Sample Distance (GSD) less than 30 meters;* *(iii) Electro-optical hyperspectral with 40 spectral bands or more in the mid- wavelength infrared (MWIR) (i.e., greater than 2,500nm to 5,500nm) having a narrow spectral bandwidth of Dl less than or equal to 20nm full width at half maximum (FWHM) or having a wide spectral bandwidth with Dl greater than 20nm FWHM and a GSD less than 200 meters; or* *(iv) Electro-optical hyperspectral with 40 spectral bands or more in the long- wavelength infrared (LWIR) (i.e., greater than 5,500nm to 30,000nm) having a narrow spectral bandwidth of Dl less than or equal to 50nm FWHM or having a wide spectral bandwidth with Dl greater than 50nm FWHM and a GSD less than 500 meters;* ***Note 1*** *to paragraph (a)(7): Ground Sample Distance (GSD) is measured from a spacecraft’s nadir (i.e., local vertical) position.* ***Note 2*** *to paragraph (a)(7): Optical remote sensing spacecraft or satellite spectral bandwidth is the smallest difference in wavelength (i.e., Dl) that can be distinguished at full width at half maximum (FWHM) of wavelength l.* ***Note 3*** *to paragraph (a)(7): An optical satellite or spacecraft is not Significant Military Equipment (see § 120.7 of this subchapter) if non-earth pointing.* *\*(8) Have radar remote sensing capabilities or characteristics (e.g., active electronically scanned array (AESA), synthetic aperture radar (SAR), inverse synthetic aperture radar (ISAR), ultra-wideband SAR), except those having a center frequency equal to or greater than 1 GHz but less than or equal to 10 GHz and having a bandwidth less than 300 MHz;* *(9) Provide Positioning, Navigation, and Timing (PNT) signals;* ***Note to paragraph (a)(9):*** *This paragraph does not control a satellite or spacecraft that provides only a differential correction broadcast for the purposes of positioning, navigation, or timing.* *(10) Provide space-based logistics, assembly, or servicing of any spacecraft (e.g., refueling) and have integrated propulsion other than that required for attitude control;* *(11) Provide for sub-orbital or in-space human habitation and have integrated propulsion other than that required for attitude control;* *(12) That are not commercial communications satellites and that have integrated propulsion other than for attitude control or achieving initial orbit;**\* (13) Are classified, contain classified software or hardware, are manufactured using classified production data, or are being developed using classified information (e.g., having classified requirements, specifications, functions, or operational characteristics or include classified cryptographic items controlled under USML Category XIII of this subchapter). ‘‘Classified’’ means classified pursuant to Executive Order 13526, or predecessor order, and a security classification guide developed pursuant thereto or equivalent, or to the corresponding classification rules of another government or international organization.* ***Note 1 to paragraph (a):*** *Spacecraft not identified in this paragraph are subject to the EAR (see ECCNs 9A004 and 9A515). Spacecraft described in ECCNs 9A004 and 9A515 remain subject to the EAR even if defense articles described on the USML are incorporated therein, except when such incorporation results in a spacecraft described in this paragraph.* ***Note 2 to paragraph (a):*** *This paragraph does not control (a) the International Space Station (ISS) and its specially designed (as defined in the EAR) parts and components, which are subject to the EAR, or (b) those articles for the ISS that are determined to be subject to the EAR via a commodity jurisdiction determination (see § 120.4 of this subchapter). Use of a defense article on the ISS that was not specially designed (as defined in the EAR) for the ISS does not cause the item to become subject to the EAR.* ***Note 3 to paragraph (a):*** *Attitude control is the exercise of control over spacecraft orientation (e.g., pointing) within an orbital plane, which may include orbit maintenance using the attitude control thrusters.* *(b) Ground control systems or training simulators, specially designed for telemetry, tracking, and control (TT&C) of spacecraft in paragraph (a) of this category.* ***Note to paragraph (b):*** *Parts, components, accessories, attachments, equipment, or systems that are common to ground control systems or training simulators controlled in this paragraph and those that are used for spacecraft not controlled in paragraph (a) of this category are subject to the EAR.* **(b)** Ground control systems or training simulators, specially designed for telemetry, tracking, and control (TT&C) of spacecraft in paragraph (a) of this category. **Note to paragraph (b):** Parts, components, accessories, attachments, equipment, or systems that are common to ground control systems or training simulators controlled in this paragraph and those that are used for spacecraft not controlled in paragraph (a) of this category are subject to the EAR. ***(c)******Global Positioning System (GPS****) receiving equipment specially designed for military application, or GPS receiving equipment with any of the following characteristics, and specially designed parts and components therefor:* *(1) Specially designed for encryption or decryption (e.g., Y-Code) of GPS precise positioning service (PPS) signals (MT if designed or modified for airborne applications);* *(2) [Reserved]* *(3) Specially designed for use with a null steering antenna, an electronically steerable antenna, or including a null steering antenna designed to reduce or avoid jamming signals (MT if designed or modified for airborne applications);****Note to paragraph (c)(3):*** *The articles described in this paragraph are subject to the EAR when, prior to export, reexport, retransfer, or temporary import, they are integrated into and included as an integral part of an item subject to the EAR. Articles do not become subject to the EAR until integrated into the item subject to the EAR. Export, reexport, retransfer, or temporary import of, and technical data and defense services directly related to, defense articles intended to be integrated remain subject to the ITAR.**(4) Specially designed for use with rockets, missiles, SLVs, drones, or unmanned air vehicle systems capable of delivering at least a 500 kg payload to a range of at least 300 km (MT if designed or modified for rockets, missiles, SLVs, drones, or unmanned air vehicle systems controlled in this subchapter).* ***Note to paragraph (c)(4):*** *‘‘Payload’’ is the total mass that can be carried or delivered by the specified rocket, missile, SLV, drone or unmanned aerial vehicle that is not used to maintain flight. For definition of ‘‘range’’ as it pertains to rocket systems, see note 1 to paragraph (a) of USML Category IV For definition of ‘‘range’’ as it pertains to aircraft systems, see note to paragraph (a) of USML Category VIII.* *(d) [Reserved]*  |
| ***Spacecraft parts, components, accessories, attachments, equipment, or systems, as follows:*** |  (e) Spacecraft parts, components, accessories, attachments, equipment, or systems, as follows: (1) Antenna systems specially designed for spacecraft that: (i) Have a dimension greater than 25 meters in diameter or length of the major axis; (ii) Employ active electronic scanning; (iii) Are adaptive beam forming; or (iv) Are for interferometric radar;(2) Space-qualified optics (*i.e.,* lens or mirror), including optical coating, having active properties (*e.g.,* adaptive, deformable) with a largest lateral clear aperture dimension greater than 0.35 meters; (3) Space-qualified focal plane arrays (FPA) having a peak response in the wavelength range exceeding 900nm and readout integrated circuit (ROIC), whether separate or integrated, specially designed therefor; (4) Space-qualified mechanical (*i.e.,* active) cryocooler or active cold finger, and associated control electronics specially designed therefor; (5) Space-qualified active vibration suppression, including active isolation and active dampening, and associated control electronics therefor; (6) Optical bench assemblies specially designed to enable spacecraft to meet or exceed the parameters described in paragraph (a) of this category; (7) Space-qualified kinetic or directed-energy systems (*e.g.,* RF, laser, charged particle) specially designed for spacecraft in paragraph (a)(5) or (a)(6) of this category, and specially designed parts and components therefor (*e.g.,* power conditioning and beam-handling/ switching, propagation, tracking, and pointing equipment); (8) [Reserved] (9) Space-qualified cesium, rubidium, hydrogen maser, or quantum (*e.g.,* based upon Al, Hg, Yb, Sr, Be Ions) atomic clocks, and specially designed parts and components therefor; (10) Attitude determination and control systems, and specially designed parts and components therefor, that provide a spacecraft’s geolocation accuracy, without using Ground Location Points, better than or equal to: (i) 5 meters (CE90) from low earth orbit (LEO); (ii) 30 meters (CE90) from medium earth orbit (MEO); (iii) 150 meters (CE90) from geosynchronous orbit (GEO); or (iv) 225 meters (CE90) from high earth orbit (HEO); (11) Space-based systems, and specially designed parts and components therefor, as follows: (i) Nuclear reactors and associated power conversion systems (*e.g.,* liquid metal or gas-cooled fast reactors); (ii) Radioisotope-based power systems (*e.g.,* radioisotope thermoelectric generators); (iii) Nuclear thermal propulsion systems (*e.g.,* solid core, liquid core, gas core fission); or(iv)Plasma based propulsion  systems; (12) Thrusters (*e.g.,* rocket engines) that provide greater than 150 lbf (*i.e.,* 667.23 N) vacuum thrust (MT for rocket motors or engines having a total impulse capacity equal to or greater than 8.41x10∧5 newton seconds); (13) Control moment gyroscope (CMG) specially designed for spacecraft; (14) Space-qualified monolithic microwave integrated circuits (MMIC) that combine transmit and receive (T/R) functions on a single die as follows: (i) Having a power amplifier with maximum saturated peak output power (in watts), Psat, greater than 200 divided by the maximum operating frequency (in GHz) squared [Psat >200 W\*GHz2/ fGHz2]; or (ii) Having a common path (*e.g.,* phase shifter-digital attenuator) circuit with greater than 3 bits phase shifting at operating frequencies 10 GHz or below, or greater than 4 bits phase shifting at operating frequencies above 10 GHz; (15) Space-qualified oscillator for radar in paragraph (a) of this category with phase noise less than ¥120 dBc/ Hz + (20 log10(RF) (in GHz)) measured at 2 KHz\*RF (in GHz) from carrier; (16) Space-qualified star tracker or star sensor with angular accuracy less than or equal to 1 arcsec (1-Sigma) per star coordinate, and a tracking rate equal to or greater than 3.0 deg/sec, and specially designed parts and components therefor (MT); \*(17) Primary, secondary, or hosted payload that performs any of the functions described in paragraph (a) of this category; **Note 1 to paragraph (e)(17):** *Primary payload* is that complement of equipment designed from the outset to accomplish the prime mission function of the spacecraft payload mission set. The primary payload may operate independently from the secondary payload(s). *Secondary payload* is that complement of equipment designed from the outset to be fully integrated into the spacecraft payload mission set. The secondary payload may operate separately from the primary payload. *Hosted payload* is a complement of equipment or sensors that uses the available or excess capacity (mass, volume, power, etc.) of a spacecraft to accommodate an additional, independent mission. The hosted payload may share the spacecraft bus support infrastructure. The hosted payload performs an additional, independent mission which does not dictate control or operation of the spacecraft. A hosted payload is not capable of operating as an independent spacecraft. *Spacecraft bus* (distinct from the spacecraft payload), provides the support infrastructure of the spacecraft (*e.g.,* command and data handling, communications and antenna(s), electrical power, propulsion, thermal control, attitude and orbit control, guidance, navigation and control, structure and truss, life support (for crewed mission)) and location (*e.g.,* attachment, interface) for the spacecraft payload. *Spacecraft payload* is that complement of equipment attached to the spacecraft bus that performs a particular mission in space (*e.g.,* communications, observation, science). **Note 2 to paragraph (e)(17):** An ECCN 9A004 or ECCN 9A515.a spacecraft remains a spacecraft subject to the EAR even when incorporating a hosted payload performing a function described in paragraph (a) of this category. All spacecraft that incorporate primary or secondary payloads that perform a function described in paragraph (a) of this category are controlled by that paragraph. \*(18) Secondary or hosted payload, and specially designed parts and components therefor, developed with Department of Defense-funding; **Note 1 to paragraph (e)(18):** This paragraph does not control payloads that are (a) determined to be subject to the EAR viaa commodity jurisdiction determination (*see* § 120.4 of this subchapter), or (b) identified in the relevant Department of Defense contract or other funding authorization or agreement as being developed for both military and either civil or commercial applications. **Note 2 to paragraph (e)(18):** This paragraph is applicable only to those contracts or funding authorizations or agreements that are dated May 13, 2015, or later. Articles do not become subject to the EAR until integrated into the item subject to the EAR. Export, reexport, retransfer, or temporary import of, and technical data and defense services directly related to defense articles intended to be integrated remain subject to the ITAR.(19) Spacecraft heat shields or heat sinks specially designed for atmospheric entry or re-entry, and specially designed parts and components therefor (MT if usable in rockets, SLVs, missiles, drones, or UAVs capable of delivering a payload of at least 500 kg to a range of at least 300 km); **Note to paragraph (e)(19):** ‘‘Payload’’ is the total mass that can be carried or delivered by the specified rocket, SLV, missile, drone, or UAV that is not used to maintain flight. For definition of ‘‘range’’ as it pertains to aircraft systems, *see* note to paragraph (a) of USML Category VIII. For definition of ‘‘range’’ as it pertains to rocket systems, *see* note 1 to paragraph (a) of USML Category IV. (20) Equipment modules, stages, or compartments that contain propulsion other than that required for attitude control and can be separated or jettisoned from another spacecraft (*see* note 3 to paragraph (a) of this category); or \*(21) Any part, component, accessory, attachment, equipment, or system that: (i)Is classified;(ii) Contains classified software; or (iii) Is being developed using classified information. **Note to paragraph (e)(21):** ‘‘Classified’’ means classified pursuant to Executive Order 13526, or predecessor order, and a security classification guide developed pursuant thereto or equivalent, or to the corresponding classification rules of another government or international organization. **Note 1 to paragraph (e):** Parts, components, accessories, attachments, equipment, or systems specially designed for spacecraft or other articles enumerated in this category but not listed in paragraph (e) are subject to the EAR. **Note 2 to paragraph (e):** The articles described in this paragraph are subject to the EAR when, prior to export, reexport, retransfer, or temporary import, they are integrated into and included as an integral part of an item subject to the EAR (*see* note 2 to paragraph (e)(17) of this category). **Note 3 to paragraph (e):** For the purposes of this paragraph, an article is space-qualified if it is designed, manufactured, or qualified through successful testing, for operation at altitudes greater than 100 km above the surface of the Earth. The use of an altitude of 100 km above the surface of the Earth in this paragraph does not represent a legal demarcation between national air space and outer space under United States or international law. **Note 4 to paragraph (e):** (1) A determination that a specific article (or commodity) (*e.g.,* by product serial number) is space-qualified by virtue of testing alone does not mean that other articles in the same production run or model series are space- qualified if not individually tested. (2) ‘‘Article’’ is synonymous with ‘‘commodity,’’ as defined in EAR § 772.1. (3) A specific article not designed or manufactured for use at altitudes greater than 100 km above the surface of the Earth is not space-qualified before it is successfully tested. (4) The terms ‘‘designed’’ and ‘‘manufactured’’ in this definition are synonymous with ‘‘specially designed.’’  |
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| ***Proposed Category XI******Military Electronics******Radar and Tracking Systems*** | *Other paragraphs – not applicable**(vii) Air surveillance radar with free space detection of 1 square meter RCS target at 85 nmi or greater range, scaled to RCS values as RCS to the 1⁄4 power;**(viii) Air surveillance radar with free space detection of 1 square meter RCS target at an altitude of 65,000 feet and an elevation angle greater than 20 degrees (i.e., counter-battery);**(ix) Air surveillance radar with multiple elevation beams, phase or**amplitude monopulse estimation, or 3D height-finding;**(x) Air surveillance radar with a beam solid angle less than or equal to 16 degrees2 that performs free space tracking of 1 square meter RCS target at a range greater or equal to 25 nmi with revisit rate greater or equal to 1⁄3 Hz;**(xi) Instrumentation radar for anechoic test facility or outdoor range that maintains positional state of an object of interest in a received radar signal through time or provides measurement of RCS of a static target less than or equal to ¥minus 10dBsm, or RCS of a dynamic target;**(xii) Radar incorporating pulsed operation with electronics steering of transmit beam in elevation and azimuth;(xiii) Radar with mode(s) for ballistic tracking or ballistic extrapolation to source of launch or impact point of articles controlled in USML Categories III or IV;**(xiv) Active protection radar and missile warning radar with mode(s)implemented for detection of incoming munitions;**(xv) Over the horizon high frequency sky-wave (ionosphere) radar;(xvi) Radar that detects a moving object through a physical obstruction a t distance greater than 0.2 m from the obstruction;**(xvii) Radar having moving target indicator (MTI) or pulse-Doppler processing where any single Doppler filter provides a normalized clutter attenuation of greater than 50dB;****Note to paragraph (a)(3)(xvii):****‘‘Normalized clutter attenuation’’ is defined as the reduction in the power level of received distributed clutter when normalized to the thermal noise level**(xviii) Radar having electronic protection (EP) or electronic counter countermeasures(ECCM) other than manual gain control, automatic gain control, radio frequency selection, constant false alarm rate, and pulse repetition interval jitter;**(xix) Radar employing electronic attack (EA) mode(s) using the radar transmitter and antenna;**(xx) Radar employing electronic support (ES) mode(s) (i.e., the ability to use a radar system for ES purposes in one or more of the following: as a high gain receiver, as a wide-bandwidth receiver, as a multi-beam receiver, or as part of a multi-point system);**(xxi) Radar employing non-cooperative target recognition (NCTR)(i.e., the ability to recognize a specific platform type without cooperative action of the target platform);**(xxii) Radar employing automatic target recognition (ATR) (i.e., recognition of target using structural features (e.g., tank versus car) of the target with system resolution better than(less than) 0.3 m;**(xxiii) Radar that sends interceptor guidance commands or provides illumination keyed to an interceptor seeker;**(xxiv) Radar employing wave form generation for LPI other than frequency modulated continuous wave (FMCW) with linear ramp modulation;* *(xxv) Radar that sends and receives communications;**VerDate Mar<* |
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| **Type of control** | **Description** |
|  | Antenna |
| **5A001Telecommunications equipment** | d. “Electronically steerable phased array antennae” operating above 31.8 GHz; |
| *Antenna in Category XV of the ITAR* | *Antennas with a diameter >25 m**Actively scanned antennas**Adaptive beam forming antennas* |
| EAR | Optical Sensors, Cameras and Mirrors |
| **6A002 Optical sensors or equipment and components**  | a.1 Space-qualified” solid-state detectors having all of the following:a.1.a.1. A peak response in the wavelength range exceeding 10 nm but not exceeding 300 nm; *and*a.1.a.2. A response of less than 0.1% relative to the peak response at a wavelength exceeding 400 nm;a.1.b.1. A peak response in the wavelength range exceeding 900 nm but not exceeding 1,200 nm; *and* a.1.b.2. A response “time constant” of 95 ns or lessa.1.c. “Space-qualified” solid-state detectors having a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;a.1.d. “Space-qualified” “focal plane arrays” having more than 2,048 elements per array and having a peak response in the wavelength range exceeding 300 nm but not exceeding 900 nm; |
| **6A002 Optical sensors or equipment and components** **(cont’d)** | a.2. Image intensifier tubes and specially designed components therefor, as follows:a.2.a. Image intensifier tubes having all of the following:a.2.a. 1. A peak response in the wavelength range exceeding 400 nm but not exceeding 1,050 nm;a.2.a.2. Electron image amplification using any of the following:a.2.a.2.a. A microchannel plate with a hole pitch (center-to-center spacing) of 12 \_m or less; ora.2.a.2.b. An electron sensing device with a non-binned pixel pitch of 500 \_m or less, specially designed or modified to achieve ‘charge multiplication’ other than by a microchannel plate; *and*a.2.a.3. Any of the following photocathodes:a.2.a.3.a. Multialkali photocathodes (e.g., S-20 and S-25) having a luminous sensitivity exceeding 350 \_A/lm;a.2.a.3.b. GaAs or GaInAs photocathodes; ora.2.a.3.c. Other “III-V compound” semiconductor photocathodes having a maximum “radiant sensitivity” exceeding 10 mA/W;a.2.b. Image intensifier tubes having all of the following:a.2.b.1. A peak response in the wavelength range exceeding 1,050 nm but not exceeding 1,800 nm;a.2.b.2. Electron image amplification using any of the following:a.2.b.2.a. A microchannel plate with a hole pitch (center-to-center spacing) of 12 \_m or less; *or*a.2.b.2.b. An electron sensing device with a non-binned pixel pitch of 500 m or less, specially designed or modified to achieve 'charge multiplication' other than by a microchannel plate; *and* a.2.b.3. “III/V compound” semiconductor (e.g., GaAs or GaInAs) photocathodes and transferred electron photocathodes, having a maximum “radiant sensitivity” exceeding 15 mA/W; a.2.c. Specially designed components as follows: a.2.c.1. Microchannel plates having a hole pitch (center-to-center spacing) of 12 m or less; a.2.c.2. An electron sensing device with a non-binned pixel pitch of 500 m or less, specially designed or modified to achieve 'charge multiplication' other than by a microchannel plate; a.2.c.3. “III-V compound” semiconductor (*e.g.,* GaAs or GaInAs) photocathodes and transferred electron photocathodes; **Note:** 6A002.a.2.c.3 does not control compound semiconductor photocathodes designed to achieve a maximum “radiant sensitivity” of any of the following: a. 10 mA/W or less at the peak response in the wavelength range exceeding 400 nm but not exceeding 1,050 nm; or b.. 15 mA/W or less at the peak response in the wavelength range exceeding 1,050 nm but not exceeding 1,800 nm*.* |
| **6A002 Optical sensors or equipment and components** **(cont’d)** | a.3. Non-“space-qualified” “focal plane arrays” as follows:a.3.a. Non-“space-qualified” “focal plane arrays” having all of the following: a.3.a.1. Individual elements with a peak response within the wavelength range exceeding 900 nm but not exceeding 1,050 nm; *and* a.3.a.2. Any of the following: a.3.a.2.a. A response “time constant” of less than 0.5 ns; *or* a.3.a.2.b. Specially designed or modified to achieve 'charge multiplication' and having a maximum “radiant sensitivity” exceeding 10 mA/W. a.3.b. Non-“space-qualified” “focal plane arrays” having all of the following: a.3.b.1. Individual elements with a peak response in the wavelength range exceeding 1,050 nm but not exceeding 1,200 nm; *and* a.3.b.2. Any of the following: a.3.b.2.a. A response “time constant” of 95 ns or less; *or* a.3.b.2.b. Specially designed or modified to achieve 'charge multiplication' and having a maximum “radiant sensitivity” exceeding 10 mA/W. a.3.c. Non-“space-qualified” non-linear (2-dimensional) “focal plane arrays” having individual elements with a peak response in the wavelength range exceeding 1,200 nm but not exceeding 30,000 nm;a.3.d. Non-“space-qualified” linear (1-dimensional) “focal plane arrays” having all of the following:a.3.d.1. Individual elements with a peak response in the wavelength range exceeding 1,200 nm but not exceeding 3,000 nm; *and* a.3.d.2. Any of the following:a.3.d.2.a. A ratio of 'scan direction' dimension of the detector element to the 'cross-scan direction' dimension of the detector element of less than 3.8; *or*a.3.d.2.b. Signal Processing In The Element (SPRITE);a.3.e. Non-“space-qualified” linear (1-dimensional) “focal plane arrays” having individual elements with a peak response in the wavelength range exceeding 3,000 nm but not exceeding 30,000 nm;a.3.f. Non-“space-qualified” non-linear (2-dimensional) infrared “focal plane arrays” based on 'microbolometer' material having individual elements with an unfiltered response in the wavelength range equal to or exceeding8,000 nm but not exceeding 14,000 nm;**Technical Note:** For the purposes of 6A002.a.3.f, 'microbolometer' is defined as a thermal imaging detector that, as a result of a temperature change in the detector caused by the absorption of infrared radiation, is used to generate any usable signal.a.3.g. Non-“space-qualified” “focal plane arrays” having all of the following:a.3.g.1. Individual detector elements with a peak response in the wavelength range exceeding 400 nm but not exceeding 900 nm;a.3.g.2. Specially designed or modified to achieve 'charge multiplication' and having a maximum “radiant sensitivity”exceeding 10 mA/W for wavelengths exceeding 760 nm; *and*a.3.g.3. Greater than 32 elements. |
| **6A002 Optical sensors or equipment and components (cont’d)** | b. “Monospectral imaging sensors” and “multispectral imaging sensors”, designed for remote sensing applications and having any of the following:b.1. An Instantaneous-Field-Of-View (IFOV) of less than 200 rad (microradians); *or*b.2. Specified for operation in the wavelength range exceeding 400 nm but not exceeding 30,000 nm and having all the following:b.2.a. Providing output imaging data in digital format; *and*b.2.b. Having any of the following characteristics:b.2.b.1. “Space-qualified”; *or*b.2.b.2. Designed for airborne having an IFOV of less than 2.5 mrad (milliradians);**Note:** 6A002.b.1 does not control “monospectral imaging sensors” with a peak response in the wavelength range exceeding 300 nm but not exceeding 900 nm and only incorporating any of the following non -“space-qualified” detectors or non -“space-qualified” “focal plane arrays”:a. Charge Coupled Devices (CCD) not designed or modified to achieve 'charge multiplication'; orb. Complementary Metal Oxide Semiconductor (CMOS) devices not designed or modified to achieve 'charge multiplication |
| **6A002 Optical sensors or equipment and components (cont’d)** | c. ‘Direct view’ imaging equipment incorporating any of the following:c.1. Image intensifier tubes having the characteristics listed in 6A002.a.2.a or 6A002.a.2.b;c.2. “Focal plane arrays” having the characteristics listed in 6A002.a.3; *or* c.3. Solid state detectors specified by 6A002.a.1.**Technical Note**: 'Direct view' refers to imaging equipment that presents a visual image to a human observer without converting the image into an electronic signal for television display, and that cannot record or store the image photographically, electronically or by any other means.**Note**: 6A002 c. ‘Direct view’ imaging equipment incorporating any of the following:c.1. Image intensifier tubes having the characteristics listed in 6A002.a.2.a or 6A002.a.2.b;c.2. “Focal plane arrays” having the characteristics listed in 6A002.a.3; orc.3. Solid state detectors specified by 6A002.a.1. **Technical Note**: 'Direct view' refers to imaging equipment that presents a visual image to a human observer without converting the image into an electronic signal for television display, and that cannot record or store the image photographically, electronically or by any other means.**Note**: 6A002.c does not control equipment as follows, when incorporating other than GaAs or GaInAs photocathodes:1. Industrial or civilian intrusion alarm, traffic or industrial movement control
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| **6A002 Optical sensors or equipment and components (cont’d)** | d. Special support components for optical sensors, as follows:d.1. “Space-qualified” cryocoolers;d.2. Non-“space-qualified” cryocoolershaving a cooling source temperature below 218K (-55° C), as follows:d.2.a. Closed cycle type with a specified Mean-Time-To-Failure (MTTF) or Mean-Time-Between-Failures (MTBF), exceeding 2,500 hours;d.2.b. Joule-Thomson (JT) self-regulating minicoolers having bore (outside) diameters of less than 8 mm;d.3. Optical sensing fibers specially fabricated either compositionally or structurally, or modified by coating, to be acoustically, thermally, inertially, electromagnetically or nuclear radiation sensitive.**Note**: 6A002.d.3 does not apply to encapsulated optical sensing fibers specially designed for bore hole sensing applications. |
| **6A003 Cameras** | This entry is very long, just the headings are provided below. If your work involves use of cameras, read EAR 6A003. 1. Instrumentation cameras and specially designed components therefor,
2. Imaging cameras as follows:

b.1. Video cameras incorporating solid state sensors, having a peak response in the wavelength range exceeding 10 nm, but not exceeding 30,000 nm and having all of the following: (See text in Category 6 to Part 774 of EAR)b.2. Scanning cameras and scanning camera systems, having all of the following: (see text in Category 6 to Part 774 of EARb.3. Imaging cameras incorporating image intensifier tubes having the characteristics listed in 6A002.a.2.a or 6A002.a.2.b;b.4. Imaging cameras incorporating “focal plane arrays” having any of the following: These cameras require a security plan if it is being used outside of the countries in Europe, Canada, Japan, Australia, New Zealand and South Korea (see detail at <http://www.bis.doc.gov/policiesandregulations/ear/ccl6.pdf> page 14)b.5. Imaging cameras incorporating solid-state detectors specified by 6A002.a.1. |
| **6A004 Optical equipment and components**  | a. Optical mirrors (reflectors) as follows:a.1. “Deformable mirrors” having either continuous or multi-element surfaces, and specially designed components therefor, capable of dynamically repositioning portions of the surface of the mirror at rates exceeding 100 Hz;a.2. Lightweight monolithic mirrors having an average “equivalent density” of less than 30 kg/m and a total mass exceeding 10 kg;a.3. Lightweight “composite” or foam mirror structures having an average “equivalent density” of less than 30 kg/m 2 and a total mass exceeding 2 kg;a.4. Beam steering mirrors more than 100 mm in diameter or length of major axis, that maintain a flatness of λ/2 or better (λ is equal to 633 nm) having a control bandwidth exceeding 100 Hz; |
| **6A004 Optical equipment and components (cont’d)**  | b. Optical components made from zinc selenide (ZnSe) or zinc sulphide (ZnS) with transmission in the wavelength range exceeding 3,000 nm but not exceeding 25,000 nm and having any of the following:b.1. Exceeding 100 cm in volume; orb.2. Exceeding 80 mm in diameter or length of major axis and 20 mm in thickness (depth); |
| **6A004 Optical equipment and components (cont’d)** | c. “Space-qualified” components for optical systems, as follows:c.1. Components light weighted to less than 20% “equivalent density” compared with a solid blank of the same aperture and thickness; c.2. Raw substrates, processed substrates having surface coatings (single-layer or multi-layer, metallic or dielectric, conducting, semiconducting or insulating) or having protective films;c.3. Segments or assemblies of mirrors designed to be assembled in space into an optical system with a collecting aperture equivalent to or larger than a single optic 1 m in diameter;c.4. Components manufactured from “composite” materials having a coefficient of linear thermal expansion equal to or less than 5 x 10-6 in any coordinate direction; |
| **6A004 Optical equipment and components (cont’d)** | d. Optical control equipment as follows:d.1. Equipment specially designed to maintain the surface figure or orientation of the “space-qualified” components controlled by 6A004.c.1 or 6A004.c.3;d.2. Equipment having steering, tracking, stabilization or resonator alignment bandwidths equal to or more than 100 Hz and an accuracy of 10 μrad (microradians) or less;d.3. Gimbals having all of the following: d.3.a. A maximum slew exceeding 5°;d.3.b. A bandwidth of 100 Hz or more;d.3.c. Angular pointing errors of 200 μrad (microradians) or less; andd.3.d. Having any of the following:d.3.d.1. Exceeding 0.15 m but not exceeding 1 m in diameter or major axis length and capable of angular accelerations exceeding 2 rad (radians)/s2; *or*d.3.d.2. Exceeding 1 m in diameter accelerations exceeding 0.5 rad (radians)/s2;d.4. “Specially designed” to maintain the alignment of phased array or phased segment mirror systems consisting of mirrors with a segment diameter or major axis length of 1 m or more; |
| **6A004 Optical equipment and components (cont’d)** | e. ‘Aspheric optical elements’ having **all** of the following:e.1. Largest dimension of the optical-aperture greater than 400 mm;e.2. Surface roughness less than 1 nm (rms) for sampling lengths equal to or greater than 1 mm; ande.3. Coefficient of linear thermal expansion's absolute magnitude less than 3 x 10-6/K at 25°C.***Technical Note: 1.*** *[See Related Definitions section of this ECCN]* *2. Manufacturers are not required to measure the surface roughness listed in 6A004.e.2 unless the optical element was designed or manufactured with the intent to meet, or exceed, the control parameter.* **Note*:*** *6A004.e does not control ‘aspheric optical elements’ having any of the following:* *a. Largest optical-aperture dimension less than 1 m and focal length to aperture ratio equal to or greater than 4.5:1;* *b. Largest optical-aperture dimension equal to or greater than 1 m and focal length to aperture ratio equal to or greater than 7:1;* *c. Designed as Fresnel, flyeye, stripe, prism or diffractive optical elements;* *d. Fabricated from borosilicate glass having a coefficient of linear thermal expansion greater than 2.5 x 10-6 /K at 25° C; or* ***e. An x-ray optical element having inner mirror capabilities (e.g., tube-type mirrors)*** |
| **6A994 Optics, not controlled by 6A004, as follows** | a. Optical filters:a.1. For wavelengths longer than 250 nm, comprised of multi-layer optical coatings and having either of the following:a.1.a. Bandwidths equal to or less than 1 nm Full Width Half Intensity (FWHI) and peak transmission of 90% or more; *or*a.1.b. Bandwidths equal to or less than 0.1 nm FWHI and peak transmission of 50% or more;***Note:*** *6A994 does not control optical filters with fixed air gaps or* *Lyot-type filters.*a.2. For wavelengths longer than 250 nm, and having all of the following:a.2.a. Tunable over a spectral range of 500 nm or more;a.2.b. Instantaneous optical bandpass of 1.25 nm or less;a.2.c. Wavelength resettable within 0.1 ms to an accuracy of 1 nm or better within the tunable spectral range; *and*a.2.d. A single peak transmission of 91% or more;a.3. Optical opacity switches (filters) with a field of view of 30 or wider and a response time equal to or less than 1 ns;b. “Fluoride fiber” cable, or optical fibers therefor, having an attenuation of less than 4 dB/km in the wavelength range exceeding 1,000 nm but not exceeding 3,000 nm. |
| **6A005 “Lasers,” “components” and optical equipment, as follows (see List of Items Controlled),** | a. **Non-“tunable” continuous wave “(CW) lasers**” having any of the following:a.1. Output wavelength less than 150 nm and output power exceeding 1W;a.2. Output wavelength of 150 nm or more but not exceeding 510 nm and output power exceeding 30 W;***Note:*** *6A005.a.2 does not control Argon “lasers” having an output power equal to or less than 50 W*.a.3. Output wavelength exceeding 510 nm but not exceeding 540 nm and any of the following:a.3.a. Single transverse mode output and output power exceeding 50 W; *or*a.3.b. Multiple transverse mode output and output power exceeding 150 W;a.4. Output wavelength exceeding 540 nm but not exceeding 800 nm and output power exceeding 30 W;a.5. Output wavelength exceeding 800 nm but not exceeding 975 nm and any of the following:a.5.a. Single transverse mode output and output power exceeding 50 W; *or*a.5.b. Multiple transverse mode output and output power exceeding 80 W;a.6. Output wavelength exceeding 975 nm but not exceeding 1,150 nm and any of the following;a.6.a. Single transverse mode output and output power exceeding 200 W; *or*a.6.b. Multiple transverse mode output and any of the following:a.6.b.1. ‘Wall-plug efficiency’ exceeding 18% and output power exceeding 500 W; ora.6.b.2. Output power exceeding 2 kW;***Note:*** *6A005.a.6.b does not control multiple transverse mode, industrial “lasers” with output power exceeding 2kW and not exceeding 6 kW with a total mass greater than 1,200 kg. For the purpose of this note, total**mass includes all “components” required to operate the “laser,” e.g., “laser,” power supply, heat exchanger, but excludes external optics for**beam conditioning and/or delivery*.a.7. **Output wavelength exceeding 1,150 nm but not exceeding 1,555** nm and any of the following:a.7.a. Single transverse mode and output power exceeding 50 W; *or*a.7.b. Multiple transverse mode and output power exceeding 80 W; *or*a.8. Output wavelength exceeding 1,555 nm and output power exceeding 1 W;b. **Non-“tunable” “pulsed lasers”** having any of the following:b.1. Output wavelength less than 150 nm and any of the following:b.1.a. Output energy exceeding 50 mJ per pulse and “peak power” exceeding 1 W; *or*b.1.b. “Average output power” exceeding 1 W;b.2. Output wavelength of 150 nm or more but not exceeding 510 nm and any of the following:b.2.a. Output energy exceeding 1.5 J per pulse and “peak power” exceeding 30 W; *or* b.2.b. “Average output power” exceeding 30 W;***Note:*** *6A005.b.2.b does not control Argon “lasers” having an “average output power” equal to or less than 50 W*.b.3. Output wavelength exceeding 510 nm, but not exceeding 540 nm and any of the following:b.3.a. Single transverse mode output and any of the following:b.3.a.1. Output energy exceeding 1.5 J per pulse and “peak power” exceeding 50 W; *or*b.3.a.2. “Average output power” exceeding 50 W; *or*b.3.b. Multiple transverse mode output and any of the following:b.3.b.1. Output energy exceeding 1.5 J per pulse and “peak power” exceeding 150 W; orb.3.b.2. “Average output power” exceeding 150 W;b.4. Output wavelength exceeding 540 nm but not exceeding 800 nm and any of the following:b.4.a. Output energy exceeding 1.5 J per pulse and “peak power” exceeding 30 W; *or*b.4.b. “Average output power” exceeding 30 Wb.6.c. “Pulse duration” exceeding 1 μs and any of the following:b.6.c.1. Single transverse mode output and any of the following:b.6.c.1.a. “Peak power” exceeding 500 kW;b.6.c.1.b. ‘Wall-plug efficiency’ exceeding 12% and “average outputpower” exceeding 100 W; *or*b.6.c.1.c. “Average output power” exceeding 150 W; *or*b.6.c.2. Multiple transverse mode output and any of the following:b.6.c.2.a. “Peak power” exceeding 1 MW;b.6.c.2.b. ‘Wall-plug efficiency’ exceeding 18% and “average outputpower” exceeding 500 W; *or*b.6.c.2.c. “Average output power” exceeding 2 kW;b.7. Output wavelength exceeding 1,150 nm but not exceeding 1,555 nm and any of the following:b.7.a. “Pulse duration” not exceeding 1 μs and any of the following:b.7.a.1. Output energy exceeding 0.5 J per pulse and “peak power” exceeding 50 W;b.7.a.2. Single transverse mode output and “average output power” exceeding 20 W; *or*b.7.a.3. Multiple transverse mode output and “average output power” exceeding 50 W; *or*b.7.b. “Pulse duration” exceeding 1 μs and any of the following:b.7.b.1. Output energy exceeding 2 J per pulse and “peak power” exceeding 50 W;b.7.b.2. Single transverse mode output and “average output power” exceeding 50 W; *or*b.7.b.3. Multiple transverse mode output and “average output power” exceeding 80 W; *or*b.8. Output wavelength exceeding 1,555 nm and any of the following:b.8.a. Output energy exceeding 100 mJ per pulse and “peak power” exceeding 1 W; *or*b.8.b. “Average output power” exceeding 1 W;c. “Tunable” lasers having any of the following:***Note:*** *6A005.c includes titanium-sapphire (Ti: Al203), thulium-YAG (Tm: YAG), thulium-YSGG (Tm:YSGG), alexandrite (Cr:BeAl204), color center “lasers”, dye “lasers”, and liquid “lasers”*.c.1. Output wavelength less than 600 nm and any of the following:***Note****: 6A005.c.1 does not apply to dye lasers or other liquid lasers, having a multimode output and a wavelength of 150 nm or more but**not exceeding 600 nm and all of the following:**1. Output energy less than 1.5 J per pulse or a "peak power" less than 20 W; and**2. Average or CW output power less than 20 W.*c.1.a. Output energy exceeding 50 mJ per pulse and “peak power” exceeding 1 W; *or*c.1.b. Average or CW output power exceeding 1W;c.2. Output wavelength of 600 nm or more but not exceeding 1,400 nm, and any of the following:c.2.a. Output energy exceeding 1 J per pulse and “peak power” exceeding 20 W; *or*c.2.b. Average or CW output power exceeding 20 W; *or*c.3. Output wavelength exceeding 1,400 nm and any of the following:c.3.a. Output energy exceeding 50 mJ per pulse and “peak power” exceeding 1 W; *or*c.3.b. Average or CW output power exceeding 1 W;d. Other “lasers”, not controlled by 6A005.a., 6A005.b, or 6A005.c as follows:d.1. Semiconductor “lasers” as follows:***Note:****1. 6A005.d.1 includes semiconductor**“lasers” having optical output connectors (e.g.,**fiber optic pigtails).**2. The control status of semiconductor**“lasers” “specially designed” for other**equipment is determined by the control status of**the other equipment.*d.1.a. Individual single transverse mode semiconductor “lasers” having any of the following:d.1.a.1. Wavelength equal to or less than 1,510 nm and average or CW output power, exceeding 1.5 W; *or*d.1.a.2. Wavelength greater than 1,510 nm and average or CW output power, exceeding 500 mW;d.1.b. Individual, multiple-transversemode semiconductor “lasers” having any of the following:d.1.b.1. Wavelength of less than 1,400 nm and average or CW output power, exceeding 15 W;d.1.b.2. Wavelength equal to or greater than 1,400 nm and less than 1,900 nm and average or CW output power, exceeding 2.5 W;*or*d.1.b.3. Wavelength equal to or greater than 1,900 nm and average or CW output power, exceeding 1 W;d.1.c. Individual semiconductor “laser” 'bars' having any of the following:d.1.c.1. Wavelength of less than 1,400 nm and average or CW output power, exceeding 100 W;d.1.c.2. Wavelength equal to or greater than 1,400 nm and less than 1,900 nm and average or CW output power, exceeding 25 W; *or*d.1.c.3. Wavelength equal to or greater than 1,900 nm and average or CW output power, exceeding 10 W;d.1.d. Semiconductor “laser” ‘stacked arrays’ (two dimensional arrays) having any of the following:d.1.d.1. Wavelength less than 1,400 nm and having any of the following:d.1.d.1.a. Average or CW total output power less than 3 kW and havingaverage or CW output ‘power density’ greater than 500 W/cm2;d.1.d.1.b. Average or CWtotal output power equal to or exceeding 3 kWbut less than or equal to 5 kW, and havingaverage or CW output ‘power density’ greaterthan 350W/cm2;d.1.d.1.c. Average or CWtotal output power exceeding 5 kW;d.1.d.1.d. Peak pulsed ‘powerdensity’ exceeding 2,500 W/cm2; *or*d.1.d.1.e. Spatially coherentaverage or CW total output power, greater than150 W;d.1.d.2. Wavelength greater thanor equal to 1,400 nm but less than 1,900 nm, andhaving any of the following:d.1.d.2.a. Average or CWtotal output power less than 250 W and averageor CW output ‘power density’ greater than 150W/cm2;d.1.d.2.b. Average or CWtotal output power equal to or exceeding 250 Wbut less than or equal to 500 W, and havingaverage or CW output ‘power density’ greaterthan 50W/cm2;d.1.d.2.c. Average or CWtotal output power exceeding 500 W;d.1.d.2.d. Peak pulsed‘power density’ exceeding 500 W/cm2; ord.1.d.2.e. Spatiallycoherent average or CW total output power,exceeding 15 W;d.1.d.3. Wavelength greater thanor equal to 1,900 nm and having any of thefollowing:d.1.d.3.a. Average or CWoutput ‘power density’ greater than 50 W/cm2;d.1.d.3.b. Average or CWoutput power greater than 10 W; *or*d.1.d.3.c. Spatiallycoherent average or CW total output power,exceeding 1.5 W; *or*d.1.d.4. At least one “laser” ‘bar’specified by 6A005.d.1.c;***Technical Note:*** *For the purposes of**6A005.d.1.d, 'power density' means the total**“laser” output power divided by the emitter**surface area of the ‘stacked array’.*d.1.e. Semiconductor “laser” ‘stackedarrays’, other than those specified by6.A005.d.1.d., having all of the following:d.1.e.1. “Specially designed” ormodified to be combined with other ‘stackedarrays’ to form a larger ‘stacked array’; *and*d.1.e.2. Integrated connections,common for both electronics and cooling;***Note 1****: ‘Stacked arrays’, formed by**combining semiconductor “laser” ‘stacked**arrays’ specified by 6A005.d.1.e, that are not**designed to be further combined or modified are**specified by 6A005.d.1.d.****Note 2:*** *‘Stacked arrays’, formed by**combining semiconductor “laser” ‘stacked**arrays’ specified by 6A005.d.1.e, that are**designed to be further combined or modified are**specified by 6A005.d.1.e.****Note 3:*** *6A005.d.1.e does not apply to**modular assemblies of single ‘bars’ designed to**be fabricated into end to end stacked linear**arrays.***Commerce Control List Supplement No. 1 to Part 774 Category 6—page 28****Export Administration Regulations Bureau of Industry and Security October 15, 2013*****Technical Notes:****1. Semiconductor “lasers” are commonly**called “laser” diodes.**2. A ‘bar’ (also called a semiconductor**“laser” ‘bar’, a “laser” diode ‘bar’ or diode**‘bar’) consists of multiple semiconductor**“lasers” in a one dimensional array.**3. A ‘stacked array’ consists of multiple**‘bars’ forming a two dimensional array of**semiconductor “lasers”.*d.2. Carbon monoxide (CO) “lasers” havingany of the following:d.2.a. Output energy exceeding 2 J per pulse and “peak power” exceeding 5 kW; *or*d.2.b. Average or CW output power, exceeding 5 kW;d.3. Carbon dioxide (CO2) “lasers” having any of the following:d.3.a. CW output power exceeding 15 kW;d.3.b. Pulsed output with “pulse duration” exceeding 10 μs and any of the following:d.3.b.1. “Average output power” exceeding 10 kW; *or*d.3.b.2. “Peak power” exceeding 100 kW; *or*d.3.c. Pulsed output with a “pulse duration” equal to or less than 10 μs and any of the following:d.3.c.1. Pulse energy exceeding 5 J per pulse; *or*d.3.c.2. “Average output power” exceeding 2.5 kW;d.4. Excimer “lasers” having any of the following:d.4.a. Output wavelength not exceeding 150 nm and any of the following:d.4.a.1. Output energy exceeding 50 mJ per pulse; *or*d.4.a.2. “Average output power” exceeding 1 W;d.4.b. Output wavelength exceeding 150 nm but not exceeding 190 nm and any of the following:d.4.b.1. Output energy exceeding 1.5 J per pulse; *or*d.4.b.2. “Average output power” exceeding 120 W;d.4.c. Output wavelength exceeding 190 nm but not exceeding 360 nm and any of the following:d.4.c.1. Output energy exceeding 10 J per pulse; *or*d.4.c.2. “Average output power” exceeding 500 W; *or*d.4.d. Output wavelength exceeding 360 nm and any of the following:d.4.d.1. Output energy exceeding 1.5 J per pulse; *or*d.4.d.2. “Average output power” exceeding 30 W;***Note:*** *For excimer “lasers” “specially designed” for lithography equipment, see 3B001*.d.5. “Chemical lasers” as follows:d.5.a. Hydrogen Fluoride (HF) “lasers’;d.5.b. Deuterium Fluoride (DF) “lasers”;d.5.c. “Transfer lasers” as follows:d.5.c.1. Oxygen Iodine (O2-I) “lasers”;d.5.c.2. Deuterium Fluoride-Carbon dioxide (DF-CO2) “lasers”;d.6. ‘Non-repetitive pulsed’ Neodymium (Nd) glass “lasers” having any of the following:d.6.a. A “pulse duration” not exceeding 1 μs and output energy exceeding 50 J per pulse; *or*d.6.b. A “pulse duration” exceeding 1 μs and output energy exceeding 100 J per pulse;***Note:*** *‘Non-repetitive pulsed’ refers to “lasers” that produce either a single output pulse or that have a time interval between pulses**exceeding one minute.*e. “Components” as follows:e.1. Mirrors cooled either by ‘active cooling’ or by heat pipe cooling;***Technical Note:*** *‘Active cooling’ is a cooling technique for optical “components” using flowing fluids within the subsurface (nominally**less than 1 mm below the optical surface) of the optical component to remove heat from the optic*. e.2. Optical mirrors or transmissive or partially transmissive optical or electro-optical– “components,” “specially designed” for use withcontrolled “lasers”;f. Optical equipment as follows:***N.B.:*** *For shared aperture optical elements, capable of operating in “Super-High Power Laser” (“SHPL”) applications, see the U.S.**Munitions List (22 CFR part 121)*.f.1. Dynamic wavefront (phase) measuring equipment capable of mapping at least 50 positions on a beam wavefront having any thefollowing:f.1.a. Frame rates equal to or more than 100 Hz and phase discrimination of at least 5% of the beam’s wavelength; *or*f.1.b. Frame rates equal to or more than 1,000 Hz and phase discrimination of at least 20% of the beam’s wavelength;f.2. “Laser” diagnostic equipment capable of measuring “SHPL” system angular beam steering errors of equal to or less than 10 μrad;f.3. Optical equipment and “components,” “specially designed” for a phased-array “SHPL” system for coherent beam combination to anaccuracy of λ/10 at the designed wavelength, or 0.1 μm, whichever is the smaller;f.4. Projection telescopes “specially designed” for use with “SHPL” systems;g. ‘Laser acoustic detection equipment’ having all of the following:g.1. CW laser output power greater than or equal to 20 mW;g.2. Laser frequency stability equal to or better (less) than 10 MHz;g.3. Laser wavelengths equal to or exceeding 1,000 nm but not exceeding 2,000 nm;g.4. Optical system resolution better (less) than 1 nm; *and*g.5. Optical Signal to Noise ratio equal or exceeding to 103.***Technical Note****: ‘Laser acoustic detection equipment’ is sometimes referred to as a Laser Microphone or Particle Flow Detection Microphone.* |

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| **B. TEST, INSPECTION AND PRODUCTION EQUIPMENT****6B004 Optical equipment as follows (see List of Items Controlled).** | a. Equipment for measuring absolute reflectance to an accuracy of ± 0.1% of the reflectance value; b. Equipment other than optical surface scattering measurement equipment, having an unobscured aperture of more than 10 cm, specially designed for the non-contact optical measurement of a non-planar optical surface figure (profile) to an “accuracy” of 2 nm or less (better) against the required profile.  |
| ***Spacecraft and satellites- ITAR Category XV******Proposed in ECR change*** | *Space-qualified optics (i.e., lens or mirror), including optical coating, having active properties (e.g., adaptive or deformable), or having a largest lateral dimension greater than 0.35 meters;*  *(3) ``Space-qualified'' focal plane arrays (FPA) having a peak response in the wavelength range exceeding 900nm and readout integrated circuit (ROIC) specially designed therefor;* |
| **1B018 Items on the Wassenaar Arrangement****Munitions List (see List of Items Controlled).** | Environmental chambers capable of pressures below (10-4) Torr, and “specially designed” components therefor. |

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| **EAR** | **Computers** |
| **4A003 Digital computers,** **Electronic assemblies and related equipment** | Items: **Note 1**: 4A003 includes the following: **- ‘Vector processors’ (as defined in Note 7 of the “Technical Note on “Adjusted Peak Performance” (“APP”)”);** **- Array processors;** **- Digital signal processors;** **- Logic processors;** **- Equipment designed for “image enhancement”;** **- Equipment designed for “signal processing”.****Note 2:**The control status of the “digital computers” and related equipment described in 4A003 is determined by the control status of other equipment or systems provided: a. The “digital computers” or related equipment are essential for the operation of the other equipment or systems; b. The “digital computers” or related equipment are not a “principal element” of the other equipment or systems; and N.B. 1:The control status of “signal processing” or “image enhancement” equipment specially designed for other equipment with functions limited to those required for the other equipment is determined by the control status of the other equipment even if it exceeds the “principal element” criterion. N.B. 2:For the control status of “digital computers” or related equipment for telecommunications equipment, see Category 5, Part 1 (Telecommunications). c. The “technology” for the “digital computers” and related equipment is determined by 4E.a. [RESERVED]**b. “Digital computers” having an “Adjusted Peak Performance” (“APP”) exceeding 3.0 weighted TeraFLOPS (WT);** **c. “Electronic assemblies” specially designed or modified to be capable of enhancing performance by aggregation of processors so that the “APP” of the aggregation exceeds the limit in 4A003.b.;** **Note 1:**4A003.c applies only to “electronic assemblies” and programmable interconnections not exceeding the limit in 4A003.b. when shipped as unintegrated “electronic assemblies”. It does not apply to “electronic assemblies” inherently limited by nature of their design for use as related equipment controlled by 4A003.e. **Note 2**: 4A003.c does not control “electronic assemblies” specially designed for a product or family of products whose maximum configuration does not exceed the limit of 4A003.b.d. [RESERVED] **e. Equipment performing analog-to-digital conversions exceeding the limits in 3A001.a.5**f. [RESERVED] **g. Equipment specially designed for aggregating the performance of “digital computers” by providing external interconnections which allow communications at unidirectonal data rates exceeding 2.0 Gbyte/s per link.****Note: 4A003.g does not control internal interconnection equipment (e.g., backplanes, buses) passive interconnection equipment, “network access controllers” or “communication channel controllers”** |
| **3A001 Electronic Components** | a. General purpose integrated circuits, as follows:**Note 1:** The control status of wafers (finished or unfinished), in which the function has been determined, is to be evaluated against the parameters of 3A001.a.**Note 2**: Integrated circuits include the following types:- Monolithic integrated circuits- Hybrid integrated circuits- Multichip integrated circuits- Film type integrated circuits, including silicon-on-sapphire integrated circuits- Optical integrated circuitsa.1. Integrated circuits designed or rated as radiation hardened to withstand any of the following:a.1.a. A total dose of 5 x 103 Gy (Si), or higher;a.1.b. A dose rate upset of 5 x 106 Gy (Si)/s, or higher; ora.1.c. A fluence (integrated flux) of neutrons (1 MeV equivalent) of 5 x 1013 n/cm² or higher on silicon, or its equivalent for other materials;**Note:** 3A001.a.1.c does not apply to Metal Insulator Semiconductors (MIS).a.2. “Microprocessor microcircuits”, “microcomputer microcircuits”, microcontroller microcircuits, storage integrated circuits manufactured from a compound semiconductor, analog-to-digital converters, digital-to-analog converters, electro-optical or “optical integrated circuits” designed for “signal processing”, field programmable logic devices, custom integrated circuits for which either the function is unknown or the control status of the equipment in which the integrated circuit will be used in unknown, Fast Fourier Transform (FFT) processors, electrical erasable programmable read-only memories (EEPROMs), flash memories or static random-access memories (SRAMs), having any of the following: a.2.a. Rated for operation at an ambient temperature above 398 K (+125°C);a.2.b. Rated for operation at an ambient temperature below 218 K (-55°C); ora.2.c. Rated for operation over the entire ambient temperature range from 218 K (-55°C) to 398 K (125°C);a.3. “Microprocessor microcircuits”, “microcomputer microcircuits” and microcontroller microcircuits, manufactured from a compound semiconductor and operating at a clock frequency exceeding 40 MHz;*Note: 3A001.a.3 includes digital signal processors, digital array processors and digital coprocessors.*a.4. [RESERVED]a.5. Analog-to-Digital Converter (ADC) and Digital-to-Analog Converter (DAC) integrated circuits, as follows:a.5.a. ADCs having any of the following:a.5.a.1. A resolution of 8 bit or more, but less than 10 bit, with an output rate greater than 500 million words per second;a.5.a.2. A resolution of 10 bit or more, but less than 12 bit, with an output rate greater than 300 million words per second;a.5.a.3. A resolution of 12 bit with an output rate greater than 200 million words per second;a.5.a.4. A resolution of more than 12 bit but equal to or less than 14 bit with an output rate greater than 125 million words per second; ora.5.a.5. A resolution of more than 14 bit with an output rate greater than 20 million words per second;**Technical Notes:**1. A resolution of n bit corresponds to a quantization of 2n levels.2. The number of bits in the output word is equal to the resolution of the ADC.3. The output rate is the maximum output rate of the converter, regardless of architecture or oversampling.4. For ‘multiple channel ADCs’, the outputs are not aggregated and the output rate is the maximum output rate of any single channel.5. For ‘interleaved ADCs’ or for ‘multiple channel ADCs’ that are specified to have an interleaved mode of operation, the outputs are aggregated and the output rate is the maximum combined total output rate of all of the outputs. 6. Vendors may also refer to the output rate as sampling rate, conversion rate or throughput rate. It is often specified in megahertz (MHz) or mega samples per second (MSPS).7. For the purpose of measuring output rate, one output word per second is equivalent to one Hertz or one sample per second.8. ‘Multiple channel ADCs’ are defined as devices which integrate more than one ADC, designed so that each ADC has a separateanalog input.9. ‘Interleaved ADCs’ are defined as devices which have multiple ADC units that sample the same analog input at different times such that when the outputs are aggregated, the analoginput has been effectively sampled and converted at a higher sampling rate.a.5.b. Digital-to-Analog Converters (DAC) having any of the following:a.5.b.1. A resolution of 10 bit or more with an ‘adjusted update rate’ of 3,500 MSPS or greater; ora.5.b.2. A resolution of 12-bit or more with an ‘adjusted update rate’ of equal to or greater than 1,250 MSPS and having any of the following: (consult category 3 of Commerce Control List of EAR)a.6. Electro-optical and “optical integrated circuits”, designed for “signal processing” and having all of the following:a.6.a. One or more than one internal “laser” diode;a.6.b. One or more than one internal light detecting element; *and*a.6.c. Optical waveguides;**Note:** 3A001. a.7 includes:-Simple Programmable Logic Devices (SPLDs)-Complex Programmable Logic Devices (CPLDs)-Field Programmable Gate Arrays (FPGAs)-Field Programmable Logic Arrays (FPLAs)-Field Programmable Interconnects (FPICs) |
| **3A002 General purpose electronic equipment****and accessories therefor** | a. Recording equipment as follows and specially designed test tape therefor:a.1. Analog instrumentation magnetic tape recorders, including those permitting the recording of digital signals (*e.g.*, using a high density digital recording (HDDR) module), having any of the following:a.1.a. A bandwidth exceeding 4 MHz per electronic channel or track;a.1.b. A bandwidth exceeding 2 MHz per electronic channel or track and having more than 42 tracks; ora.1.c. A time displacement (base) error, measured in accordance with applicable IRIG or EIA documents, of less than ± 0.1 s;**Note:** Analog magnetic tape recorders specially designed for civilian video purposes are not considered to be instrumentation taperecorders.a.2. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 360 Mbit/s;**Note:** 3A002.a.2 does not control digital video magnetic tape recorders specially designed for television recording using a signal format, which may include a compressed signal format, standardized or recommended by the ITU, the IEC, the SMPTE, the EBU , the ETSI, or the IEEE for civil television applications.a.3. Digital instrumentation magnetic tape data recorders employing helical scan techniques or fixed head techniques and having any of the following:a.3.a. A maximum digital interface transfer rate exceeding 175 Mbit/s; *or* a.3.b. Being “space-qualified”;***Note*:** *3A002.a.3 does not control analog magnetic tape recorders equipped with HDDR conversion electronics and configured to record only digital data.*a.4. Equipment having a maximum digital interface transfer rate exceeding 175 Mbit/s and designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders;a.5. Waveform digitizers and transient recorders, having all of the following:a.5.a. Digitizing rates equal to or more than 200 million samples per second and a resolution of 10 bits or more; *and*a.5.b. A ‘continuous throughput’ of 2 Gbit/s or more;**Technical Notes:** **1.** For those instruments with a parallel bus architecture, the ‘continuous’ throughput rate is the highest word rate multiplied by the number of bits in a word.**2.** ‘Continuous throughput’ is the fastest data rate the instrument can output to mass storage without the loss of any information while sustaining the sampling rate and analog-to digital conversion.a.6. Digital instrumentation data recorders using magnetic disk storage technique and having all of the following:a.6.a. Digitizing rate equal to or more than 100 million samples per second and a resolution of 8 bits or more; *and*a.6.b. A ‘continuous throughput’ of 1 Gbit/s or more;b. [RESERVED]c. Radio-frequency “signal analyzers” as follows:c.1. “Signal analyzers” having a 3 dB resolution bandwidth (RBW) exceeding 10 MHz anywhere within the frequency range exceeding31.8 GHz but not exceeding 37.5 GHz;c.2. “Signal analyzers” having Displayed Average Noise Level (DANL) less (better) than –150 dBm/Hz anywhere within the frequencyrange exceeding 43.5 GHz but not exceeding 75 GHz;c.3. “Signal analyzers”having a frequency exceeding 75 GHz;c.4. “Signal analyzers” having all of the following:c.4.a. “Real-time bandwidth” exceeding 85 MHz; *and*c.4.b. 100% probability of discovery with less than a 3 dB reduction from full amplitude due to gaps or windowing effects of signals having a duration of 15 μs or less;**Note:** 3A002.c.4 does not apply to those “signal analyzers” using only constant percentage bandwidth filters (also known as octave or fractional octave filters). **Technical Notes:**1. Probability of discovery in 3A002.c.4.b is also referred to as probability of intercept or probability of capture.2. For the purposes of 3A002.c.4.b, the duration for 100% probability of discovery is equivalent to the minimum signal duration necessary for the specified level measurement uncertainty.c.5. “Signal analyzers” having a “frequency mask trigger” function with 100% probability of trigger (capture) for signals having a duration of 15 s or less;d. Frequency synthesized signal generators producing output frequencies, the accuracy and short term and long term stability of which are controlled, derived from or disciplined by the internal master reference oscillator, and having any of the following:d.1. Specified to generate pulses having all of the following**,** anywhere within the synthesized frequency range exceeding 31.8 GHz but not exceeding 75 GHz:d.1.a. ‘Pulse duration’ of less than 100 ns; *and*d.1.b. On/off ratio equal to or exceeding 65 dB;d.2. An output power exceeding 100 mW (20 dBm) anywhere within the synthesized frequency range exceeding 43.5 GHz but not exceeding 75 GHz;d.3. A “frequency switching time” as specified by any of the following:d.3.a. [RESERVED];d.3.b. Less than 100 μs for any frequency change exceeding 1.6 GHz within the synthesized frequency range exceeding 4.8 GHz but not exceeding 10.6 GHz;d.3.c. Less than 250 μs for any frequency change exceeding 550 MHz within the synthesized frequency range exceeding 10.6 GHz but not exceeding 31.8 GHz; d.3.d. Less than 500 μs for any frequency change exceeding 550 MHz within the synthesized frequency range exceeding 31.8 GHz but not exceeding 43.5 GHz;d.3.e. Less than 1 ms for any frequency change exceeding 550 MHz within the synthesized frequency range exceeding 43.5 GHz but not exceeding 56 GHz; *or*d.3.f. Less than 1 ms for any frequency change exceeding 2.2 GHz within the synthesized frequency range exceeding 56 GHz but not exceeding 75 GHz;d.4. Single sideband (SSB) phase noise, in dBc/Hz, specified as being all of the following:d.4.a. Less (better) than - (126+20 log10 F-20 log10f) for anywhere within the range of 10 Hz <F<10 kHz anywhere within the synthesized frequency range exceeding 3.2 GHz but not exceeding 75 GHz; *and*d.4.b. Less (better) than - (114+20 log10 F-20 log10f) for anywhere within the range of 10 kHz <F< 500 kHz anywhere within the synthesized frequency range exceeding 3.2 GHz but not exceeding 75 GHz; *or***Technical Note:** In 3A002.d.4, F is the offset from the operating frequency in Hz and f is the operating frequency in MHz.d.5. A maximum synthesized frequency exceeding 75 GHz;**Note 1**: For the purpose of 3A002.d, frequency synthesized signal generators include arbitrary waveform and function generators.**Note 2**: 3A002.d does not control equipment in which the output frequency is either produced by the addition or subtraction of two or more crystal oscillator frequencies, or by an addition or subtraction followed by a multiplication of the result.**Technical Notes:**1. The maximum synthesized frequency of an arbitrary waveform or function generator is calculated by dividing the sample rate, in samples/second, by a factor of 2.5.2. For the purposes of 3A002.d.1.a, ‘pulse duration’ is defined as the time interval between the leading edge of the pulse achieving 90% of the peak and the trailing edge of the pulseachieving 10% of the peak.e. Network analyzers having any of the following:e.1. An output power exceeding 31.62 mW (15 dBm) anywhere within the operating frequency range exceeding 43.5 GHz but not exceeding 75 GHz;e.2. An output power exceeding 1 mW (0 dBm) anywhere within the operating frequency range exceeding 75 GHz but not exceeding 110 GHz;e.3. ‘Nonlinear vector measurement functionality’ at frequencies exceeding 50 GHz but not exceeding 110 GHz; *or***Technical Note**:‘Nonlinear vector measurement functionality’ is an instrument’s ability to analyze the test results of devices driven into the large-signal domain or the non-linear distortion range.e.4. A maximum operating frequency exceeding 110 GHz;f. Microwave test receivers having all of the following:f.1. Maximum operating frequency exceeding 110 GHz; *and*f.2. Being capable of measuring amplitude and phase simultaneously;g. Atomic frequency standards being any of the following:g.1. “Space-qualified”;g.2. Non-rubidium and having a long-term stability less (better) than 1 x 10-11/month; *or*g.3. Non-”space-qualified” and having all ofthe following:g.3.a. Being a rubidium standard;g.3.b. Long-term stability less (better) than 1 x 10-11/month; *and*g.3.c. Total power consumption of less than 1 Watt. |
| **2B006 Dimensional inspection or measuring systems, equipment, and “electronic assemblies”** | 1. Computer controlled or “numerically controlled” Coordinate Measuring Machines (CMM), having a three dimensional length (volumetric) maximum permissible error of length measurement (E0,MPE) at any point within the operating range of the machine (*i.e.*, within the length of axes) equal to or less (better) than (1.7 + L/1,000) μm (L is the measured length in mm) according to ISO 10360-2 (2009);
2. Technical Note: The E0,MPE of the most accurate configuration of the CMM specified by the manufacturer (e.g., best of the following: Probe, stylus length, motion parameters, environment) and with “all compensations available” shall be compared to the 1.7 + L/1,000 μm threshold.

b. Linear and angular displacement measuring instruments, as follows:b.1. ‘Linear displacement’ measuring instruments having any of the following:Note: Displacement measuring “laser” interferometers are only specified by 2B006.b.1.c.Technical Note: For the purpose of 2B006.b.1 ‘linear displacement’ means the change of distance between the measuring probe and the measured object.b.1.a. Non-contact type measuring systems with a “resolution” equal to or less (better) than 0.2 μm within a measuring range up to 0.2 mm;b.1.b. Linear voltage differential transformer systems having all of the following:b.1.b.1. “Linearity” equal to or less (better) than 0.1% within a measuring range up to 5 mm; andb.1.b.2. Drift equal to or less (better) than 0.1% per day at a standard ambient test room temperature ± 1 K;b.1.c. Measuring systems having all of the following:b.1.c.1. Containing a “laser”; andb.1.c.2. Maintaining, for at least 12 hours, at a temperature of 20 ± 1ºC, all of the following:b.1.c.2.a. A “resolution” over their full scale of 0.1 μm or less (better); andb.1.c.2.b. Capable of achieving a “measurement uncertainty”, when compensated for the refractive index of air, equal to or less (better) than (0.2 + L/2,000) μm (L is the measured length in mm); orb.1.d. “Electronic assemblies” “specially designed” to provide feedback capability in systems controlled by 2B006.b.1.c;Note: 2B006.b.1 does not control measuring interferometer systems, with an automatic control system that is designed to use no feedback techniques, containing a “laser” to measure slide movement errors of machine-tools, dimensional inspection machines or similar equipment.b.2. Angular displacement measuring instruments having an “angular position deviation” equal to or less (better) than 0.00025;*Note: 2B006.b.2 does not control optical instruments, such as autocollimators, using collimated light (e.g., laser light) to detect angular displacement of a mirror.*c. Equipment for measuring surface roughness (including surface defects), by measuring optical scatter with a sensitivity of 0.5 nm or less (better).Note: 2B006 includes machine tools, other than those specified by 2B001, that can be used as measuring machines, if they meet or exceed the criteria specified for the measuring machine function. |
| **3A999 Specific Processing Equipment** | a. Frequency changers capable of operating in the frequency range from 300 up to 600 Hz, n.e.s; b. Mass spectrometers n.e.s; c. All flash x-ray machines, and “parts” or “components” of pulsed power systems designed thereof, including Marx generators, high power pulse shaping networks, high voltage capacitors, and triggers; d. Pulse amplifiers, n.e.s.; e. Electronic equipment for time delay generation or time interval measurement, as follows: e.1. Digital time delay generators with a resolution of 50 nanoseconds or less over time intervals of 1 microsecond or greater; *or* e.2. Multi-channel (three or more) or modular time interval meter and chronometry equipment with resolution of 50 nanoseconds or less over time intervals of 1 microsecond or greater; f. Chromatography and spectrometry analytical instruments. |
| **9A004 Space launch vehicles and “spacecraft”.** | 1. The international space station operated under the supervision of the U.S. National Aeronautics and Space Administration. Hardware specific to the international space station transferred to the Department of Commerce by commodity jurisdiction action is also included.
2. Specific items as may be determined to be not subject to the ITAR through the commodity jurisdiction procedure administered by the Commerce Control List Department of State after March 15, 1999.

x. ‘‘Parts,’’ ‘‘components,’’ ‘‘accessories’’ and ‘‘attachments’’ that are ‘‘specially designed’’ for the International Space Station |
| **9A005 Liquid rocket propulsion systems****9A006 Systems and components, specially designed for liquid rocket propulsion systems.** **9A007 Solid rocket propulsion systems.****9A008 Components specially designed for solid rocket propulsion systems.** | These items are subject to the export licensing authority of the U.S. Department of State, Directorate of Defense Trade Controls. See 22 CFR part 121. |
| **9A012 Non-military “unmanned aerial** **vehicles,” (“UAVs”), unmanned “airships”, associated systems, equipment and components, as follows (see List of Items Controlled).**  | a. “UAVs” or unmanned “airships”, having any of the following:a.1. An autonomous flight control and navigation capability (e.g., an autopilot with an Inertial Navigation System); or a.2. Capability of controlled flight out of the direct visual range involving a human operator (e.g., televisual remote control);b. Associated systems, equipment and components, as follows:b.1. Equipment specially designed for remotely controlling the “UAVs” or unmanned “airships”, controlled by 9A012.a.;b.2. Systems for navigation, attitude, guidance or control, other than those controlled in Category 7, specially designed to provide autonomous flight control or navigation capability to “UAVs” or unmanned “airships”, controlled by 9A012.a.;b.3. Equipment or components specially designed to convert a manned “aircraft” or a manned “airship” to a “UAV” or unmanned “airship”, controlled by 9A012.a;b.4. Air breathing reciprocating or rotary internal combustion type engines, specially designed or modified to propel “UAVs” or unmanned “airships”, at altitudes above 50,000 feet (15,240 meters |
| **9A515 ‘‘Spacecraft’’ and related commodities, as follows (see List of Items Controlled).** | ‘‘Spacecraft’’ and other items described in ECCN 9A515 remain subject to the EAR even if exported, reexported, or transferred (incountry) with defense articles ‘‘subject to the ITAR’’ integrated into and included therein as integral parts of the item. In all other cases, such defense articles are subject to the ITAR. For example, a 9A515.a ‘‘spacecraft’’ remains ‘‘subject to the EAR’’ even when it is exported, reexported, or transferred (incountry) with a ‘‘hosted payload’’ described in USML Category XV(e)(17) incorporated therein. In all other cases, a ‘‘hosted payload’’ performing a function described in USML Category XV(a) always remains a USML item. a. ‘‘Spacecraft,’’ including satellites, and space vehicles, whether designated developmental, experimental, research or scientific, not enumerated in USML Category XV or described in 9A004.**Note:** *ECCN 9A515.a includes commercial communications satellites, remote sensing satellites not identified in USML Category XV(a), planetary rovers, planetary and interplanetary probes, and in-space habitats.*b. Ground control systems and training simulators ‘‘specially designed’’ for telemetry, tracking, and control of the ‘‘spacecraft’’ controlled in paragraph 9A515.a.c. [RESERVED]d. Microelectronic circuits (e.g., integrated circuits and micro-circuits) rated, certified, or otherwise specified or described as meeting or exceeding all the following characteristics and that are ‘‘specially designed’’ for defense articles, ‘‘600 series’’ items, or items controlled by 9A515:d.1. A total dose of 5 105 Rads (Si) (5 103 Gy (Si)); d.2. A dose rate upset threshold of 5 108 Rads (Si)/sec (5 106 Gy (Si)/sec); d.3. A neutron dose of 1 1014 n/cm2 (1 MeV equivalent);d.4. An uncorrected single event upset ensitivity of 1 10¥10 errors/bit/day or less, for the CRE` ME–MC geosynchronous orbit, Solar Minimum Environment for heavy ion flux; andd.5. An uncorrected single event upset sensitivity of 1 10¥3 errors/part or less for a fluence of 1 107 protons/cm2 for proton energy greater than 50 MeV.e. Microelectronic circuits (e.g., integrated circuits and micro-circuits) that are rated, certified, or otherwise specified or described as meeting or exceeding all the following characteristics and that are ‘‘specially designed’’ for defense articles controlled by USML Category XV or items controlled by 9A515: |
| **2E003** | Other technology as followsDeposition methods as listed at the end of this table.  |
| **3A233 Mass spectrometers, other than those described in 0B002.g, capable of measuring ions of 230 atomic mass units or greater and having a resolution of better than 2 parts in 230, and ion sources therefor.** | a. Inductively coupled plasma mass spectrometers (ICP/MS);b. Glow discharge mass spectrometers (GDMS);c. Thermal ionization mass spectrometers (TIMS);d. Electron bombardment mass spectrometers that have a source chamber constructed from, lined with or plated with materials resistant to UF6;e. Molecular beam mass spectrometers having either of the following characteristics:e.1. A source chamber constructed from, lined with or plated with stainless steel or molybdenum and equipped with a cold trapcapable of cooling to 193 K (-80°C) or less; *or*e.2. A source chamber constructed from, lined with or plated with materials resistant to UF6;1. Mass spectrometers equipped with a microfluorination ion source designed for actinides or actinide fluorides
 |
| **7A001 Accelerometers** | a. Linear accelerometers having any of the following:a.1. Specified to function at linear acceleration levels less than or equal to 15 g and having any of the following:a.1.a. A “bias” “stability” of less (better) than 130 micro g with respect to a fixed calibration value over a period of one year; ora.1.b. A “scale factor” “stability” of less (better) than 130 ppm with respect to a fixed calibration value over a period of one year;a.2. Specified to function at linear acceleration levels exceeding 15 g but less than or equal to 100 g and having all of the following:a.2.a. A “bias” “repeatability” of less (better) than 1,250 micro g over a period of one year; anda.2.b. A “scale factor” “repeatability” of less (better) than 1,250 ppm over a period of one year; ora.3. Designed for use in inertial navigation or guidance systems and specified to function at linear acceleration levels exceeding 100 g;**Note**: 7A001.a.1 and 7A001.a.2 do not apply to accelerometers limited to measurement of only vibration or shock.1. Angular or rotational accelerometers, specified to function at linear acceleration
 |
| **7A101 Accelerometers, other than those controlled by 7A001** | a. Linear accelerometers designed for use in inertial navigation systems or in guidance missiles” having *all* of the following characteristics, and “specially designed” “parts” and “components” therefor:a.1. ‘Scale factor’ “repeatability” less (better) than 1250 ppm; anda.2. ‘Bias’ “repeatability” less (better) than 1250 micro g.**Note:** The measurement of ‘bias’ and ‘scale factor’ refers to one sigma standard deviation with respect to a fixed calibration over a period of one year.b. Accelerometers of any type, designed for use in inertial navigation systems or in guidance systems of all types, specified to function at acceleration levels greater than 100g.**Note to paragraph (b)**: This paragraph (b) does not include accelerometers that are designed to measure vibration or shock. |
| **7A002 Gyros or angular rate sensors** | a. Specified to function at linear acceleration levels less than or equal to 100 g and having any of the following:a.1. A rate range of less than 500 degrees per second and having any of the following:a.1.a. A “bias” “stability” of less (better) than 0.5 degree per hour, when measured in a 1 g environment over a period of one month, and with respect to a fixed calibration value; *or*a.1.b. An “angle random walk” of less (better) than or equal to 0.0035 degree per square root hour; **Note**: 7A002.a.1.b does not control ‘spinning mass gyros’.**Technical Note**: ‘Spinning mass gyros’ are gyros which use a continually rotating mass to sense angular motion.a.2. A rate range greater than or equal to 500 degrees per second and having any of the following:a.2.a. A “bias” “stability” of less (better) than 40 degrees per hour, when measured in a 1 g environment over a period of three minutes, and with respect to a fixed calibration value; *or*a.2.b. An “angle random walk” of less (better) than or equal to 0.2 degree per square root hour; *or* **Note**: 7A002.a.2.b does not apply to ‘spinning mass gyros’.b. Specified to function at linear acceleration levels exceeding 100 g. |
| **7A102 Gyros, other than those controlled by 7A002** | a. All types of gyros, usable in rockets, missiles, or unmanned aerial vehicles capable of achieving a “range” equal to or greater than 300 km, with a rated “drift rate” ‘stability’ of less than 0.5 degrees (1 sigma or rms) per hour in a 1 g environment.b. Gyros of any type, designed for use in inertial navigation systems or in guidance systems of all types, specified to function at acceleration levels greater than 100 g.**Technical Note:** In this entry, the term ‘stability’ is defined as a measure of the ability of a specific mechanism or performance coefficient to remain invariant when continuously exposed to a fixed operating condition. (This definition does not refer to dynamic or servo stability.) (IEEE STD 528-2001 paragraph 2.247) |
| **7A003 Inertial systems and “specially designed” “components** | a. Inertial Navigation Systems (INS) (gimbaled or strapdown) and inertial equipment, designed for “aircraft,” land vehicles, vessels (surface or underwater) or “spacecraft,” for navigation,attitude, guidance or control and having any of the following, and “specially designed” “components” therefor:a.1. Navigation error (free inertial) subsequent to normal alignment of 0.8 nautical mile per hour (nm/hr) “Circular Error Probable” (“CEP”) or less (better); *or* a.2. Specified to function at linear acceleration levels exceeding 10 g;b. Hybrid Inertial Navigation Systems embedded with Global Navigation Satellite System(s) (GNSS) or with “Data-Based Referenced Navigation” (“DBRN”) System(s) for navigation, attitude, guidance or control, subsequent to normal alignment and having an INS navigation position accuracy, after loss of GNSS or “DBRN” for a period of up to 4 minutes, of less (better) than 10 meters “Circular Error Probable” (“CEP”);c. Inertial measurement equipment for heading or True North determination and having any of the following, and “specially designed” “components” therefor:c.1. Designed to have heading or True North determination accuracy equal to, or less (better) than 0.07 deg sec(Lat) (equivalent to 6 arc minutes (rms) at 45 degrees latitude); *or*c.2. Designed to have a non-operating shock level of 900 g or greater at a duration of 1 msec, or greater;d. Inertial measurement equipment including Inertial Measurement Units (IMU) and Inertial Reference Systems (IRS), incorporating accelerometers or gyros controlled by 7A001 or 7A002.**Note 1:** The parameters of 7A003.a and 7A003.b are applicable with any of the following environmental conditions:a. Input random vibration with an overall magnitude of 7.7 g (rms) in the first 0.5 hour and a total test duration of 1.5 hour per axis in each of the 3 perpendicular axes, when the random vibration meets all of the following:1. A constant Power Spectral Density(PSD) value of 0.04 g2/Hz over a frequency interval of 15 to 1,000 Hz; and2. The PSD attenuates with frequency from 0.04 g2/Hz to 0.01 g2/Hz over a frequency interval from 1,000 to 2,000 Hz;b. An angular rate capability about one or more axes of equal to or more than +2.62 rad/s (150 deg/s); orc. According to national standards equivalent to a. or b. of this note.**Note 2:** 7A003 does not control inertial navigation systems which are certified for use on “civil aircraft” by civil authorities of a Wassenaar Arrangement Participating State, see Supplement No. 1 to Part 743 for a list of these countries. **Note 3:** 7A003.c.1 does not control theodolite systems incorporating inertial equipment “specially designed” for civil surveying purposes.**Technical Note:** 7A003.b refers to systems in which an INS and other independent navigation aids are built into a single unit (embedded) in order to achieve improved performance. |
| **7A103 Instrumentation, navigation equipment and systems, other than those****controlled by 7A003,** | a. Inertial or other equipment using accelerometers or gyros controlled by 7A001, 7A002, 7A101 or 7A102 and systems incorporating such equipment, and “specially designed” “parts” and “components” therefor;**Note 1:** 7A103.a does not control equipment containing accelerometers “specially designed” and developed as MWD (Measurement While Drilling) sensors for use in down-hole well services operations.**Note 2**: 7A103.a does not control inertial or other equipment using accelerometers or gyros controlled by 7A001 or 7A002 that are only NS controlled.b. Integrated flight instrument systems, which include gyrostabilizers or automatic pilots, designed or modified for use in rockets, missiles, or unmanned aerial vehicles capableof achieving a “range” equal to or greater than 300 km, and “specially designed” “parts” and “components” therefor.c. Integrated Navigation Systems, designed or modified for use in rockets, missiles, or unmanned aerial vehicles capable of achieving a “range” equal to or greater than 300 km and capable of providing a navigational accuracy of 200m Circular Error Probable (CEP) or less.**Technical Note:** An ‘integrated navigation system’ typically incorporates the following “parts” and “components”:1. An inertial measurement device (e.g., an attitude and heading reference system, inertial reference unit, or inertial navigationsystem);2. One or more external sensors used to update the position and/or velocity, either periodically or continuously throughout the flight (e.g., satellite navigation receiver, radar altimeter, and/or Doppler radar); and3. Integration hardware and software. |
| **7A004 ‘Star trackers’ and “components” therefor** | a. ‘Star trackers’ with a specified azimuth accuracy of equal to or less (better) than 20 seconds of arc throughout the specified lifetime of the equipment;b. “Components” “specially designed” for equipment specified in 7A004.a as follows:b.1. Optical heads or baffles;b.2. Data processing units.**Technical Note:** ‘Star trackers’ are also referred to as stellar attitude sensors or gyroastro compasses. |
| **7A104 Gyro-astro compasses and other****devices, other than those controlled by****7A004, which derive position or orientation****by means of automatically tracking celestial****bodies or satellites and “specially designed”****“parts” and “components” therefor** | The list of items controlled is contained in the ECCN heading. |
| **7A005 Global Navigation Satellite Systems (GNSS) receiving equipment having any of the following (see List of Items Controlled) and “specially designed” “components”****therefor.** | a. Employing a decryption algorithm “specially designed” or modified for government use to access the ranging code for position and time; *or*b. Employing ‘adaptive antenna systems’.**Note:** 7A005.b does not apply to GNSS receiving equipment that only uses “components” designed to filter, switch, or combine signals from multiple omni-directionalantennas that do not implement adaptive antenna techniques.**Technical Note:** For the purposes of 7A005.b ‘adaptive antenna systems’ dynamically generate one or more spatial nulls in an antenna array pattern by signal processing in the time domain or frequency domain. |
| **7A105 Receiving equipment for Global Navigation Satellite Systems (GNSS) (e.g. GPS, GLONASS, or Galileo)**  | 1. Designed or modified for use in “missiles”; or2. Designed or modified for airborne applications and having any of the following:2.a. Capable of providing navigation information at speeds in excess of 600 m/s (1,165 nautical mph);2.b. Employing decryption, designed or modified for military or governmental services, to gain access to GNSS secured signal/data; or2.c. Being “specially designed” to employ anti-jam features (e.g. null steering antenna or electronically steerable antenna) to function in an environment of active or passive countermeasures.**Note to 7A105:** See also 7A005 and 7A994 |
| **7A006 Airborne altimeters operating at frequencies other than 4.2 to 4.4 GHz inclusive and having any of the following** | a. “Power management”; *or*b. Using phase shift key modulation. |
| **7A106 Altimeters, other than those controlled by 7A006, of radar or laser radar type, designed or modified for use in “missiles”.** | a. Internal tilt compensation in pitch (+/-90 degrees) and roll (+/-180 degrees) axes;b. Capable of providing azimuthal accuracy better (less) than 0.5 degrees rms at latitudes of +/- 80 degrees, referenced to local magnetic field; *and*c. Designed or modified to be integrated with flight control and navigation systems.**Note:** Flight control and navigation systems in 7A107 include gyrostabilizers, automatic pilots and inertial navigation systems. |
| **7A008 Underwater sonar navigation systems using Doppler velocity or correlation velocity logs integrated with a heading****source and having a positioning accuracy of****equal to or less (better) than 3% of distance****traveled “Circular Error Probable” (“CEP”)****and “specially designed”** **“components** | The list of items controlled is contained in the ECCN heading. |
| **7A115 Passive sensors for determining bearing to specific electromagnetic sources (direction finding equipment) or terrain characteristics, designed or modified for use in “missiles”.** | *(These items are “subject to the ITAR”. See 22 CFR parts 120 through 130.)* |
| **7A116 Flight control systems (hydraulic,****mechanical, electro-optical, or electromechanical flight control systems (including****fly-by-wire systems) and attitude control equipment) designed or modified for “missiles”.**  | *(These items are “subject to the ITAR”. See 22 CFR parts 120 through 130.)* |
| **7A117 “Guidance sets” capable of achieving system accuracy of 3.33% or less of the range (e.g., a “CEP” of 10 km or less at a range of 300 km** | *(These items are “subject to the ITAR”. See 22 CFR parts 120 through 130.)* |
| **7A994 Other navigation direction finding equipment, airborne communication equipment** | The list of items controlled is contained in the ECCN heading.**Note** 1) See also 7A005 and 7A105. (2) QRS11 Micromachined Angular Rate Sensors are “subject to the ITAR” (see 22 CFR parts 120 through 130), unless the QRS11-00100-100/101 is integrated into and included as an integral “component” of a commercial primary or standby instrument system of the type described in ECCN 7A994, or aircraft of the type described in ECCN 9A991 that incorporates such systems, or is exported solely for integration into such a system; or the QRS11-00050-443/569 is integrated into an automatic flight control system of the type described in ECCN 7A994, or aircraft of the type described in ECCN 9A991 that incorporates such systems, or are exported solely for integration into such a system. (See Commodity Jurisdiction requirements in 22 CFR Parts 121; Category VIII(e), Note(1).) In the latter case, such items are subject to the EAR. Technology specific to the development and production of QRS11 sensors remains “subject to the ITAR” (see 22 CFR parts120 through 130). |
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1. [↑](#footnote-ref-1)
2. [↑](#footnote-ref-2)
3. [↑](#footnote-ref-3)
4. [↑](#footnote-ref-4)
5. [↑](#footnote-ref-5)
6. [↑](#footnote-ref-6)
7. [↑](#footnote-ref-7)
8. [↑](#footnote-ref-8)
9. [↑](#footnote-ref-9)
10. [↑](#footnote-ref-10)
11. [↑](#footnote-ref-11)
12. [↑](#footnote-ref-12)
13. [↑](#footnote-ref-13)
14. [↑](#footnote-ref-14)
15. . [↑](#footnote-ref-15)
16. made subject to the EAR. The Department did not accept this recommendation on the basis that the discharge rate and energy life stipulated in the paragraph (c)(5) adequately differentiates those capacitors that warrant ITAR controls from those that are used commercially.” [↑](#footnote-ref-16)
17. 79 FR 37536-545, at 37540 (July 1, 2014), in the Supplementary Information, stated:

One commenting party suggested that paragraph (c)(19)(ii) could be interpreted as controlling commercial computers simply because they contain classified information. The Department does not agree, and believes the note to paragraph (c)(19)(ii) makes clear that it controls only those items that “store, process, or transmit classified software.” To further clarify this point, the Department amended the note to paragraph (c)(1)(ii) by adding a parenthetical reference to ITAR §121.8(f). [↑](#footnote-ref-17)
18. [↑](#footnote-ref-18)