CATEGORY 3 - ELECTRONICS

A. "END ITEMS," "EQUIPMENT," "ACCESSORIES," "ATTACHMENTS," "PARTS," "COMPONENTS," AND "SYSTEMS"

Note 1: *The control status of equipment and "components" described in 3A001 or 3A002, other than those described in 3A001.a.3 to 3A001.a.10, 3A001.a.12 or 3A001.a.13, which are "specially designed" for or which have the same functional characteristics as other equipment is determined by the control status of the other equipment.*

Note 2: *The control status of integrated circuits described in 3A001.a.3 to 3A001.a.9, 3A001.a.12 or 3A001.a.13 that are unalterably programmed or designed for a specific function for other equipment is determined by the control status of the other equipment.*

N.B.: *When the manufacturer or applicant cannot determine the control status of the other equipment, the control status of the integrated circuits is determined in 3A001.a.3 to 3A001.a.9, 3A001.a.12 and 3A001.a.13.*

3A001 Electronic components and "specially designed" "components" therefor, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 2
MT applies to 3A001.a.1.a when usable in "missiles"; and to 3A001.a.5.a when "designed or modified" for military use, hermetically sealed and rated for operation in the temperature range from below -54ºC to above +125ºC.	MT Column 1
NP applies to pulse discharge capacitors in 3A001.e.2 and superconducting solenoidal electromagnets in 3A001.e.3 that meet or exceed the technical parameters in 3A201.a and 3A201.b, respectively	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A for MT or NP
Yes for:
$1500: 3A001.c
$3000: 3A001.b.1, b.2, b.3, b.9, .d, .e, .f, and .g
$5000: 3A001.a (except a.1.a and a.5.a when controlled for MT), and .b.4 to b.7

GBS: Yes for 3A001.a.1.b, a.2 to a.13 (except .a.5.a when controlled for MT), b.2, b.8 (except for TWTAs exceeding 18 GHz), b.9., b.10, .g, and .h.

CIV: Yes for 3A001.a.3, a.7, and a.11.

List of Items Controlled

Related Controls: (1) The following commodities are "subject to the ITAR" when "space qualified" and operating at frequencies higher than 31.8 GHz: helix tubes (traveling wave tubes (TWT)) defined in 3A001.b.1.a.4.c; microwave solid state amplifiers defined in 3A001.b.4.b traveling wave tube amplifiers (TWTA) defined in 3A001.b.8; and derivatives thereof; (2) The following commodities are also "subject to the ITAR" (see 22 CFR parts 120 through 130): (a) "Space qualified" solar cells, coverglass-interconnect-cells or covered-interconnect-cells (CIC) assemblies, solar arrays and/or solar panels, with a minimum average efficiency of 31% or greater measured

at an operating temperature of 301 K (28ºC) under simulated 'AM0' illumination with an irradiance of 1,367 Watts per square meter (W/m^2), and associated solar concentrators, power conditioners and/or controllers, bearing and power transfer assemblies, and deployment hardware/systems; (b) Radiation-hardened microelectronic circuits controlled by Category XV (d) of the United States Munitions List (USML); and (c) All specifically designed or modified systems or subsystems, "parts," "components," "accessories," "attachments," and associated equipment controlled by Category XV (e) of the USML. See also 3A101, 3A201, and 3A991.

Related Definitions: For the purposes of integrated circuits in 3A001.a.1, 5 x 10^3 Gy(Si) = 5 x 10^5 Rads (Si); 5 x 10^6 Gy (Si)/s = 5 x 10^8 Rads (Si)/s.

Items:

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 circuits;*
- *"Three dimensional integrated circuits".*

a.1. Integrated circuits designed or rated as radiation hardened to withstand any of the following:

a.1.a. A total dose of 5 x 10^3 Gy (Si), or higher;

a.1.b. A dose rate upset of 5 x 10^6 Gy (Si)/s, or higher; *or*

a.1.c. A fluence (integrated flux) of neutrons (1 MeV equivalent) of 5 x 10^{13} 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); *or*

a.2.c. Rated for operation over the entire ambient temperature range from 218 K (-55˚C) to 398 K (125˚C);

Note**:** *3A001.a.2 does not apply to integrated circuits for civil automobile or railway train applications.*

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 1 billion 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; *or*

a.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 2^n 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 separate analog 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 analog input 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; *or*

a.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:

a.5.b.2.a. A settling time less than 9 ns to 0.024 % of full scale from a full scale step; *or*

a.5.b.2.b. A 'Spurious Free Dynamic Range' (SFDR) greater than 68 dBc (carrier) when synthesizing a full scale analog signal of 100 MHz or the highest full scale analog signal frequency specified below 100 MHz.

Technical Notes

1. 'Spurious Free Dynamic Range' (SFDR) is defined as the ratio of the RMS value of the carrier frequency (maximum signal component) at the input of the DAC to the RMS value of the next largest noise or harmonic distortion component at its output.

2. SFDR is determined directly from the specification table or from the characterization plots of SFDR versus frequency.

3. A signal is defined to be full scale when its amplitude is greater than -3 dBfs (full scale).

4. 'Adjusted update rate' for DACs is:

a. For conventional (non-interpolating) DACs, the 'adjusted update rate' is the rate at which the digital signal is converted to an analog signal and the output analog values are changed by the DAC. For DACs where the interpolation mode may be bypassed (interpolation factor of one), the DAC should be considered as a conventional (non-interpolating) DAC.

b. For interpolating DACs (oversampling DACs), the 'adjusted update rate' is defined as the DAC update rate divided by the smallest interpolating factor. For interpolating DACs, the 'adjusted update rate' may be referred to by different terms including:

- *input data rate*
- *input word rate*
- *input sample rate*
- *maximum total input bus rate*
- *maximum DAC clock rate for DAC clock input.*

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;

a.7. 'Field programmable logic devices' having any of the following:

a.7.a. A maximum number of single-ended digital input/outputs of 500 or greater; *or*

a.7.b. An 'aggregate one-way peak serial transceiver data rate' of 200 Gb/s or greater;

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)

Technical Notes:

1. *'Field programmable logic devices' are also known as field programmable gate or field programmable logic arrays.*

2. *Maximum number of digital input/outputs in 3A001.a.7.a is also referred to as maximum user input/outputs or maximum available input/ outputs, whether the integrated circuit is packaged or bare die.*

3. *'Aggregate one-way peak serial transceiver data rate' is the product of the peak serial one-way transceiver data rate times the number of transceivers on the FPGA.*

a.8. [RESERVED]

a.9. Neural network integrated circuits;

a.10. Custom integrated circuits for which the

function is unknown, or the control status of the equipment in which the integrated circuits will be used is unknown to the manufacturer, having any of the following:

a.10.a. More than 1,500 terminals;

a.10.b. A typical "basic gate propagation delay time" of less than 0.02 ns; *or*

a.10.c. An operating frequency exceeding 3 GHz;

a.11. Digital integrated circuits, other than those described in 3A001.a.3 to 3A001.a.10 and 3A001.a.12, based upon any compound semiconductor and having any of the following:

a.11.a. An equivalent gate count of more than 3,000 (2 input gates); *or*

a.11.b. A toggle frequency exceeding 1.2 GHz;

a.12. Fast Fourier Transform (FFT) processors having a rated execution time for an N-point complex FFT of less than $(N \log_2 N)/20{,}480$ ms, where N is the number of points;

Technical Note: *When N is equal to 1,024 points, the formula in 3A001.a.12 gives an execution time of 500 μs.*

a.13. Direct Digital Synthesizer (DDS) integrated circuits having any of the following:

a.13.a. A Digital-to-Analog Converter (DAC) clock frequency of 3.5 GHz or more and a DAC resolution of 10 bit or more, but less than 12 bit; *or*

a.13.b. A DAC clock frequency of 1.25 GHz or more and a DAC resolution of 12 bit or more;

Technical Note: *The DAC clock frequency may be specified as the master clock frequency or the input clock frequency.*

b. Microwave or millimeter wave components, as follows:

Technical Note*: For purposes of 3A001.b, the parameter peak saturated power output may also be referred to on product data sheets as output power, saturated power output, maximum power output, peak power output, or peak envelope power output.*

b.1. Electronic vacuum tubes and cathodes, as follows:

Note 1**:** *3A001.b.1 does not control tubes designed or rated for operation in any frequency band and having all of the following:*

a. Does not exceed 31.8 GHz; and

b. Is "allocated by the ITU" for radio-communications services, but not for radio-determination.

Note 2**:** *3A001.b.1 does not control non-"space-qualified" tubes having all the following:*

a. An average output power equal to or less than 50 W; and

b. Designed or rated for operation in any frequency band and having all of the following:

1. Exceeds 31.8 GHz but does not exceed 43.5 GHz; and

2. Is "allocated by the ITU" for radio-communications services, but not for radio-determination.

b.1.a. Traveling wave tubes, pulsed or continuous wave, as follows:

b.1.a.1. Tubes operating at frequencies exceeding 31.8 GHz;

b.1.a.2. Tubes having a cathode heater

element with a turn on time to rated RF power of less than 3 seconds;

b.1.a.3. Coupled cavity tubes, or derivatives thereof, with a "fractional bandwidth" of more than 7% or a peak power exceeding 2.5 kW;

b.1.a.4. Helix tubes, or derivatives thereof, having any of the following:

b.1.a.4.a. An "instantaneous bandwidth" of more than one octave, and average power (expressed in kW) times frequency (expressed in GHz) of more than 0.5;

b.1.a.4.b. An "instantaneous bandwidth" of one octave or less, and average power (expressed in kW) times frequency (expressed in GHz) of more than 1; *or*

b.1.a.4.c. Being "space-qualified";

b.1.b. Crossed-field amplifier tubes with a gain of more than 17 dB;

b.1.c. Impregnated cathodes designed for electronic tubes producing a continuous emission current density at rated operating conditions exceeding 5 A/cm^2;

b.2. Microwave "Monolithic Integrated Circuits" (MMIC) power amplifiers that are any of the following:

b.2.a. Rated for operation at frequencies exceeding 2.7 GHz up to and including 6.8 GHz with a "fractional bandwidth" greater than 15%, and having any of the following:

b.2.a.1. A peak saturated power output greater than 75 W (48.75 dBm) at any frequency exceeding 2.7 GHz up to and including 2.9 GHz;

b.2.a.2. A peak saturated power output greater than 55 W (47.4 dBm) at any frequency exceeding 2.9 GHz up to and including 3.2 GHz;

b.2.a.3. A peak saturated power output greater than 40 W (46 dBm) at any frequency exceeding 3.2 GHz up to and including 3.7 GHz; *or*

b.2.a.4. A peak saturated power output greater than 20 W (43 dBm) at any frequency exceeding 3.7 GHz up to and including 6.8 GHz;

b.2.b. Rated for operation at frequencies exceeding 6.8 GHz up to and including 16 GHz with a "fractional bandwidth" greater than 10%, and having any of the following:

b.2.b.1. A peak saturated power output greater than 10 W (40 dBm) at any frequency exceeding 6.8 GHz up to and including 8.5 GHz; *or*

b.2.b.2. A peak saturated power output greater than 5 W (37 dBm) at any frequency exceeding 8.5 GHz up to and including 16 GHz;

b.2.c. Rated for operation with a peak saturated power output greater than 3 W (34.77 dBm) at any frequency exceeding 16 GHz up to and including 31.8 GHz, and with a "fractional bandwidth" of greater than 10%;

b.2.d. Rated for operation with a peak saturated power output greater than 0.1n W (-70 dBm) at any frequency exceeding 31.8 GHz up to and including 37 GHz;

b.2.e. Rated for operation with a peak saturated power output greater than 1 W (30 dBm) at any frequency exceeding 37 GHz up to and including 43.5 GHz, and with a "fractional bandwidth" of greater than 10%;

b.2.f. Rated for operation with a peak saturated power output greater than 31.62 mW (15 dBm) at any frequency exceeding 43.5 GHz up to and including 75 GHz, and with a "fractional bandwidth" of greater than 10%;

b.2.g. Rated for operation with a peak

saturated power output greater than 10 mW (10 dBm) at any frequency exceeding 75 GHz up to and including 90 GHz, and with a "fractional bandwidth" of greater than 5%; *or*

b.2.h. Rated for operation with a peak saturated power output greater than 0.1 nW (-70 dBm) at any frequency exceeding 90 GHz;

Note 1**:** *[RESERVED]*

Note 2**:** *The control status of the MMIC whose rated operating frequency includes frequencies listed in more than one frequency range, as defined by 3A001.b.2.a through 3A001.b.2.h, is determined by the lowest peak saturated power output control threshold.*

Note 3**:** *Notes 1 and 2 following the Category 3 heading for product group A. Systems, Equipment, and Components mean that 3A001.b.2 does not control MMICs if they are "specially designed" for other applications, e.g., telecommunications, radar, automobiles.*

b.3. Discrete microwave transistors that are any of the following:

b.3.a. Rated for operation at frequencies exceeding 2.7 GHz up to and including 6.8 GHz and having any of the following:

b.3.a.1. A peak saturated power output greater than 400 W (56 dBm) at any frequency exceeding 2.7 GHz up to and including 2.9 GHz;

b.3.a.2. A peak saturated power output greater than 205 W (53.12 dBm) at any frequency exceeding 2.9 GHz up to and including 3.2 GHz;

b.3.a.3. A peak saturated power output greater than 115 W (50.61 dBm) at any frequency exceeding 3.2 GHz up to and including 3.7 GHz; *or*

b.3.a.4. A peak saturated power output greater than 60 W (47.78 dBm) at any frequency exceeding 3.7 GHz up to and including 6.8 GHz;

b.3.b. Rated for operation at frequencies exceeding 6.8 GHz up to and including 31.8 GHz and having any of the following:

b.3.b.1. A peak saturated power output greater than 50 W (47 dBm) at any frequency exceeding 6.8 GHz up to and including 8.5 GHz;

b.3.b.2. A peak saturated power output greater than 15 W (41.76 dBm) at any frequency exceeding 8.5 GHz up to and including 12 GHz;

b.3.b.3. A peak saturated power output greater than 40 W (46 dBm) at any frequency exceeding 12 GHz up to and including 16 GHz; *or*

b.3.b.4. A peak saturated power output greater than 7 W (38.45 dBm) at any frequency exceeding 16 GHz up to and including 31.8 GHz;

b.3.c. Rated for operation with a peak saturated power output greater than 0.5 W (27 dBm) at any frequency exceeding 31.8 GHz up to and including 37 GHz;

b.3.d. Rated for operation with a peak saturated power output greater than 1 W (30 dBm) at any frequency exceeding 37 GHz up to and including 43.5 GHz; *or*

b.3.e. Rated for operation with a peak saturated power output greater than 0.1 nW (-70 dBm) at any frequency exceeding 43.5 GHz;

Note 1**:** *The control status of a transistor, whose rated operating frequency includes frequencies listed in more than one frequency range, as defined by 3A001.b.3.a through 3A001.b.3.e, is determined by the lowest peak saturated power output control threshold.*

Note 2*:* *3A001.b.3 includes bare dice, dice*

mounted on carriers, or dice mounted in packages. Some discrete transistors may also be referred to as power amplifiers, but the status of these discrete transistors is determined by 3A001.b.3.

b.4. Microwave solid state amplifiers and microwave assemblies/modules containing microwave solid state amplifiers, that are any of the following:

b.4.a. Rated for operation at frequencies exceeding 2.7 GHz up to and including 6.8 GHz with a "fractional bandwidth" greater than 15%, and having any of the following:

b.4.a.1. A peak saturated power output greater than 500 W (57 dBm) at any frequency exceeding 2.7 GHz up to and including 2.9 GHz;

b.4.a.2. A peak saturated power output greater than 270 W (54.3 dBm) at any frequency exceeding 2.9 GHz up to and including 3.2 GHz;

b.4.a.3. A peak saturated power output greater than 200 W (53 dBm) at any frequency exceeding 3.2 GHz up to and including 3.7 GHz; *or*

b.4.a.4. A peak saturated power output greater than 90 W (49.54 dBm) at any frequency exceeding 3.7 GHz up to and including 6.8 GHz;

b.4.b. Rated for operation at frequencies exceeding 6.8 GHz up to and including 31.8 GHz with a "fractional bandwidth" greater than 10%, and having any of the following:

b.4.b.1. A peak saturated power output greater than 70 W (48.54 dBm) at any frequency exceeding 6.8 GHz up to and including 8.5 GHz;

b.4.b.2. A peak saturated power output greater than 50 W (47 dBm) at any frequency exceeding 8.5 GHz up to and including 12 GHz;

b.4.b.3. A peak saturated power output greater than 30 W (44.77 dBm) at any frequency exceeding 12 GHz up to and including 16 GHz; *or*

b.4.b.4. A peak saturated power output greater than 20 W (43 dBm) at any frequency exceeding 16 GHz up to and including 31.8 GHz;

b.4.c. Rated for operation with a peak saturated power output greater than 0.5 W (27 dBm) at any frequency exceeding 31.8 GHz up to and including 37 GHz;

b.4.d. Rated for operation with a peak saturated power output greater than 2 W (33 dBm) at any frequency exceeding 37 GHz up to and including 43.5 GHz, and with a "fractional bandwidth" of greater than 10%;

b.4.e. Rated for operation at frequencies exceeding 43.5 GHz and having any of the following:

b.4.e.1. A peak saturated power output greater than 0.2 W (23 dBm) at any frequency exceeding 43.5 GHz up to and including 75 GHz, and with a "fractional bandwidth" of greater than 10%;

b.4.e.2. A peak saturated power output greater than 20 mW (13 dBm) at any frequency exceeding 75 GHz up to and including 90 GHz, and with a "fractional bandwidth" of greater than 5%; *or*

b.4.e.3. A peak saturated power output greater than 0.1 nW (-70 dBm) at any frequency exceeding 90 GHz; *or*

b.4.f. Rated for operation at frequencies above 2.7 GHz and all of the following:

b.4.f.1. A peak saturated power output (in watts), P_{sat}, greater than 400 divided by the maximum operating frequency (in GHz) squared [$P_{sat} > 400\ W*GHz^2/f_{GHz}^2$];

b.4.f.2. A "fractional bandwidth" of 5% or greater; *and*

b.4.f.3. Any two sides perpendicular to one another with either length d (in cm) equal to or less than 15 divided by the lowest operating frequency in GHz [$d \leq 15$ cm*GHz/ f_{GHz}];

Technical Note: *2.7 GHz should be used as the lowest operating frequency (f_{GHz}) in the formula in 3A001.b.4.f.3., for amplifiers that have a rated operation range extending downward to 2.7 GHz and below [d≤15cm*GHz/2.7 GHz].*

N.B.**:** *MMIC power amplifiers should be evaluated against the criteria in 3A001.b.2.*

Note 1**:** *[RESERVED]*

Note 2**:** *The control status of an item whose rated operating frequency includes frequencies listed in more than one frequency range, as defined by 3A001.b.4.a through 3A001.b.4.e, is determined by the lowest peak saturated power output control threshold.*

Note 3*: 3A001.b.4 includes transmit/receive modules and transmit modules.*

b.5. Electronically or magnetically tunable band-pass or band-stop filters, having more than 5 tunable resonators capable of tuning across a 1.5:1 frequency band (f_{max}/f_{min}) in less than 10 μs and having any of the following:

b.5.a. A band-pass bandwidth of more than 0.5% of center frequency; *or*

b.5.b. A band-stop bandwidth of less than 0.5% of center frequency;

b.6. [RESERVED]

b.7. Converters and harmonic mixers, designed to extend the frequency range of equipment described in 3A002.c, 3A002.d, 3A002.e or 3A002.f beyond the limits stated therein;

b.8. Microwave power amplifiers containing tubes controlled by 3A001.b.1 and having all of the following:

b.8.a. Operating frequencies above 3 GHz;

b.8.b. An average output power to mass ratio exceeding 80 W/kg; *and*

b.8.c. A volume of less than 400 cm^3;

Note**:** *3A001.b.8 does not control equipment designed or rated for operation in any frequency band which is "allocated by the ITU" for radio-communications services, but not for radio-determination.*

b.9. Microwave power modules (MPM), consisting of, at least, a traveling wave tube, a microwave "monolithic integrated circuit" and an integrated electronic power conditioner and having all of the following:

b.9.a. A 'turn-on time' from off to fully operational in less than 10 seconds;

b.9.b. A volume less than the maximum rated power in Watts multiplied by 10 cm^3/W; *and*

b.9.c. An "instantaneous bandwidth" greater than 1 octave ($f_{max}. > 2f_{min},$) and having any of the following:

b.9.c.1. For frequencies equal to or less than 18 GHz, an RF output power greater than 100 W; *or*

b.9.c.2. A frequency greater than 18 GHz;

Technical Notes*:*

1. *To calculate the volume in 3A001.b.9.b., the following example is provided: for a maximum rated power of 20 W, the volume would be: 20 W X 10 cm^3/W = 200 cm^3.*

2. *The 'turn-on time' in 3A001.b.9.a. refers to the time from fully-off to fully operational, i.e., it includes the warm-up time of the MPM.*

b.10. Oscillators or oscillator assemblies, specified to operate with all of the following:

b.10.a. A single sideband (SSB) phase noise, in dBc/Hz, better than -(126+20 $\log_{10}$F-20 $\log_{10}$f) anywhere within the range of 10 Hz <F<10 kHz; *and*

b.10.b. A single sideband (SSB) phase noise, in dBc/Hz, better than -(114+20 $\log_{10}$F-20 $\log_{10}$f) anywhere within the range of 10 kHz $\leq$ F < 500 kHz;

Technical Note: *In 3A001.b.10, F is the offset from the operating frequency in Hz and f is the operating frequency in MHz.*

b.11. "Frequency synthesizer" "electronic assemblies" having a "frequency switching time" as specified by any of the following:

b.11.a. Less than 156 ps;

b.11.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;

b.11.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;

b.11.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; *or*

b.11.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;

b.11.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; *or*

b.11.g. Less than 1 ms within the synthesized frequency range exceeding 75 GHz;

N.B.*: For general purpose "signal analyzers", signal generators, network analyzers and microwave test receivers, see 3A002.c, 3A002.d, 3A002.e and 3A002.f, respectively.*

c. Acoustic wave devices as follows and "specially designed" "components" therefor:

c.1. Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices , having any of the following:

c.1.a. A carrier frequency exceeding 6 GHz;

c.1.b. A carrier frequency exceeding 1 GHz, but not exceeding 6 GHz and having any of the following:

c.1.b.1. A 'frequency side-lobe rejection' exceeding 65 dB;

c.1.b.2. A product of the maximum delay time and the bandwidth (time in μs and bandwidth in MHz) of more than 100;

c.1.b.3. A bandwidth greater than 250 MHz; *or*

c.1.b.4. A dispersive delay of more than 10 μs; *or*

c.1.c. A carrier frequency of 1 GHz or less and having any of the following:

c.1.c.1. A product of the maximum delay time and the bandwidth (time in μs and bandwidth in MHz) of more than 100;

c.1.c.2. A dispersive delay of more than 10

μs; *or*

c.1.c.3. A 'frequency side-lobe rejection' exceeding 65 dB and a bandwidth greater than 100 MHz;

Technical Note: *'Frequency side-lobe rejection' is the maximum rejection value specified in data sheet.*

c.2. Bulk (volume) acoustic wave devices that permit the direct processing of signals at frequencies exceeding 6 GHz;

c.3. Acoustic-optic "signal processing" devices employing interaction between acoustic waves (bulk wave or surface wave) and light waves that permit the direct processing of signals or images, including spectral analysis, correlation or convolution;

Note: *3A001.c does not control acoustic wave devices that are limited to a single band pass, low pass, high pass or notch filtering, or resonating function.*

d. Electronic devices and circuits containing "components," manufactured from "superconductive" materials, "specially designed" for operation at temperatures below the "critical temperature" of at least one of the "superconductive" constituents and having any of the following:

d.1. Current switching for digital circuits using "superconductive" gates with a product of delay time per gate (in seconds) and power dissipation per gate (in watts) of less than 10^{-14} J; *or*

d.2. Frequency selection at all frequencies using resonant circuits with Q-values exceeding 10,000;

e. High energy devices as follows:

e.1. 'Cells' as follows:

e.1.a. 'Primary cells' having an 'energy density' exceeding 550 Wh/kg at 293 K (20ºC);

e.1.b. 'Secondary cells' having an 'energy density' exceeding 300 Wh/kg at 293 K (20ºC);

***Technical Notes*:**

1. *For the purpose of 3A001.e.1., 'energy density' (Wh/kg) is calculated from the nominal voltage multiplied by the nominal capacity in ampere-hours (Ah) divided by the mass in kilograms. If the nominal capacity is not stated, energy density is calculated from the nominal voltage squared then multiplied by the discharge duration in hours divided by the discharge load in Ohms and the mass in kilograms.*

2. *For the purpose of 3A001.e.1., a 'cell' is defined as an electrochemical device, which has positive and negative electrodes, an electrolyte, and is a source of electrical energy. It is the basic building block of a battery.*

3. *For the purpose of 3A001.e.1.a., a 'primary cell' is a 'cell' that is not designed to be charged by any other source.*

4. *For the purpose of 3A001.e.1.b., a 'secondary cell' is a 'cell' that is designed to be charged by an external electrical source.*

Note: *3A001.e. does not control batteries, including single-cell batteries.*

e.2. High energy storage capacitors as follows:

e.2.a. Capacitors with a repetition rate of less than 10 Hz (single shot capacitors) and having all of the following:

e.2.a.1. A voltage rating equal to or more than 5 kV;

e.2.a.2. An energy density equal to or more than 250 J/kg; *and*

e.2.a.3. A total energy equal to or more than

25 kJ;

e.2.b. Capacitors with a repetition rate of 10 Hz or more (repetition rated capacitors) and having all of the following:

e.2.b.1. A voltage rating equal to or more than 5 kV;

e.2.b.2. An energy density equal to or more than 50 J/kg;

e.2.b.3. A total energy equal to or more than 100 J; *and*

e.2.b.4. A charge/discharge cycle life equal to or more than 10,000;

e.3. "Superconductive" electromagnets and solenoids, "specially designed" to be fully charged or discharged in less than one second and having all of the following:

***Note*:** *3A001.e.3 does not control "superconductive" electromagnets or solenoids "specially designed" for Magnetic Resonance Imaging (MRI) medical equipment.*

e.3.a. Energy delivered during the discharge exceeding 10 kJ in the first second;

e.3.b. Inner diameter of the current carrying windings of more than 250 mm; *and*

e.3.c. Rated for a magnetic induction of more than 8 T or "overall current density" in the winding of more than 300 A/mm^2;

e.4. Solar cells, cell-interconnect-coverglass (CIC) assemblies, solar panels, and solar arrays, which are "space-qualified," having a minimum average efficiency exceeding 20% at an operating temperature of 301 K (28ºC) under simulated 'AM0' illumination with an irradiance of 1,367 Watts per square meter (W/m^2);

Technical Note*: 'AM0', or 'Air Mass Zero', refers to the spectral irradiance of sun light in the earth's outer atmosphere when the distance between the earth and sun is one astronomical unit (AU).*

f. Rotary input type absolute position encoders having an accuracy equal to or less (better) than ± 1.0 second of arc;

g. Solid-state pulsed power switching thyristor devices and 'thyristor modules', using either electrically, optically, or electron radiation controlled switch methods and having any of the following:

g.1. A maximum turn-on current rate of rise (di/dt) greater than 30,000 A/µs and off-state voltage greater than 1,100 V; *or*

g.2. A maximum turn-on current rate of rise (di/dt) greater than 2,000 A/µs and having all of the following:

g.2.a. An off-state peak voltage equal to or greater than 3,000 V; *and*

g.2.b. A peak (surge) current equal to or greater than 3,000 A;

Note 1: *3A001.g. includes:*

- *Silicon Controlled Rectifiers (SCRs)*

- *Electrical Triggering Thyristors (ETTs)*

- *Light Triggering Thyristors (LTTs)*

- *Integrated Gate Commutated Thyristors (IGCTs)*

- *Gate Turn-off Thyristors (GTOs)*

- *MOS Controlled Thyristors (MCTs)*

- *Solidtrons*

Note 2: *3A001.g. does not control thyristor devices and 'thyristor modules' incorporated into equipment designed for civil railway or "civil aircraft" applications.*

Technical Note*: For the purposes of 3A001.g, a 'thyristor module' contains one or more thyristor devices.*

h. Solid-state power semiconductor switches, diodes, or 'modules', having all of the following:

h.1. Rated for a maximum operating junction temperature greater than 488 K (215˚C);

h.2. Repetitive peak off-state voltage (blocking voltage) exceeding 300 V; *and*

h.3. Continuous current greater than 1 A.

Technical Note: *For the purposes of 3A001.h, 'modules' contain one or more solid-state power semiconductor switches or diodes.*

Note 1: *Repetitive peak off-state voltage in 3A001.h includes drain to source voltage, collector to emitter voltage, repetitive peak reverse voltage and peak repetitive off-state blocking voltage.*

Note 2: *3A001.h. includes:*

- *Junction Field Effect Transistors (JFETs)*
  - *Vertical Junction Field Effect Transistors (VJFETs)*
  - *Metal Oxide Semiconductor Field Effect Transistors (MOSFETs)*
  - *Double Diffused Metal Oxide Semiconductor Field Effect Transistor (DMOSFET)*
- *Insulated Gate Bipolar Transistor (IGBT)*
  - *High Electron Mobility Transistors (HEMTs)*
- *Bipolar Junction Transistors (BJTs)*
  - *Thyristors and Silicon Controlled Rectifiers (SCRs)*
- *Gate Turn-Off Thyristors (GTOs)*
- *Emitter Turn-Off Thyristors (ETOs)*
- *PiN Diodes*
- *Schottky Diodes*

Note 3: *3A001.h does not apply to switches, diodes, or 'modules', incorporated into equipment designed for civil automobile, civil railway, or "civil aircraft" applications.*

3A002 General purpose electronic equipment, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, Special Comprehensive Licenses, and Validated End-User authorizations .

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: $3000: 3A002.a, .e, .f, .g;
$5000: 3A002.c to .d

GBS: N/A

CIV: N/A

Special Conditions for STA

STA: License Exception STA may not be used to ship any item in 3A002.g.1 to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: "Space-qualified" atomic frequency standards defined in 3A002.g.1 are "subject to the ITAR" (see 22 CFR parts 120 through 130, including USML Category XV). See also 3A292 and 3A992.

Related Definitions: Constant percentage bandwidth filters are also known as octave or fractional octave filters.

Items:

a. Recording equipment and oscilloscopes, as follows:

a.1. to a.4. [RESERVED]

a.5. Waveform digitizers and transient recorders, having all of the following:

N.B.: *See also 3A292.*

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 recorder systems using magnetic disk storage technique and having all of the following, and "specially designed" digital recorders therefor:

a.6.a. Digitized instrumentation data rate equal to or more than 100 million samples per second and at a resolution of 8 bits or more; *and*

a.6.b. A 'continuous throughput' of 1 Gbit/s or more;

Technical Note*: Digital instrumentation data recorder systems can be configured either with a digitizer integrated within or outside the digital recorder.*

a.7. Real-time oscilloscopes having a vertical root-mean-square (rms) noise voltage of less than 2% of full-scale at the vertical scale setting that provides the lowest noise value for any input 3dB bandwidth of 60 GHz or greater per channel;

Note*: 3A002.a.7 does not apply to equivalent-time sampling oscilloscopes.*

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 exceeding 31.8 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 frequency range 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 µs 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 pulse-modulated signals 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 - $(126+20 \log_{10} F-20 \log_{10} f)$ 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 $\log_{10}$ F-20 $\log_{10}$f) for anywhere within the range of 10 kHz $\leq$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 from the point on the leading edge that is 50% of the pulse amplitude to the point on the trailing edge that is 50% of the pulse amplitude.*

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 of the 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.

3A003 Spray cooling thermal management

systems employing closed loop fluid handling and reconditioning equipment in a sealed enclosure where a dielectric fluid is sprayed onto electronic "components" using "specially designed" spray nozzles that are designed to maintain electronic "components" within their operating temperature range, and "specially designed" "components" therefor.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3A101 Electronic equipment, devices, "parts" and "components," other than those controlled by 3A001, as follows (see List of Items Controlled).

License Requirements

Reason for Control: MT, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: Items controlled in 3A101.a are "subject to the ITAR" (see 22 CFR parts 120 through 130).

Related Definitions: N/A
Items:

a. Analog-to-digital converters, usable in "missiles", designed to meet military specifications for ruggedized equipment;

b. Accelerators capable of delivering electromagnetic radiation produced by bremsstrahlung from accelerated electrons of 2 MeV or greater, and systems containing those accelerators, usable for the "missiles" or the subsystems of "missiles".

Note: *3A101.b above does not include equipment "specially designed" for medical purposes.*

3A201 Electronic "parts" and "components," other than those controlled by 3A001, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*

	(See Supp. No. 1 to part 738).
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
*CIV:*N/A

List of Items Controlled

Related Controls: (1) See ECCNs 3E001 ("development" and "production") and 3E201 ("use") for technology for items controlled under this entry. (2) Also see 3A001.e.2 (capacitors) and 3A001.e.3 (superconducting electromagnets). (3) Superconducting electromagnets "specially designed" or prepared for use in separating uranium isotopes are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).
Related Definitions: N/A
Items:

a. Pulse discharge capacitors having either of the following sets of characteristics:

a.1. Voltage rating greater than 1.4 kV, energy storage greater than 10 J, capacitance greater than 0.5 μF, and series inductance less than 50 nH; *or*

a.2. Voltage rating greater than 750 V, capacitance greater than 0.25 μF, and series inductance less than 10 nH;

b. Superconducting solenoidal electromagnets having all of the following characteristics:

b.1. Capable of creating magnetic fields greater than 2 T;

b.2. A ratio of length to inner diameter greater than 2;

b.3. Inner diameter greater than 300 mm; *and*

b.4. Magnetic field uniform to better than 1% over the central 50% of the inner volume;

Note: *3A201.b does not control magnets "specially designed" for and exported "as parts of" medical nuclear magnetic resonance (NMR) imaging systems. The phrase "as part of" does not necessarily mean physical part in the same shipment; separate shipments from different sources are allowed, provided the related export documents clearly specify that the shipments are dispatched "as part of" the imaging systems.*

c. Flash X-ray generators or pulsed electron accelerators having either of the following sets of characteristics:

c.1. An accelerator peak electron energy of 500 keV or greater, but less than 25 MeV, and with a "figure of merit" (K) of 0.25 or greater; *or*

c.2. An accelerator peak electron energy of 25 MeV or greater, and a "peak power" greater than 50 MW;

Note: *3A201.c does not control accelerators that are "parts" or "components" of devices designed for purposes other than electron beam or X-ray radiation (electron microscopy, for example) nor those designed for medical purposes.*

Technical Notes:

1. *The "figure of merit" K is defined as:* $K = 1.7 \times 10^3 V^{2.65} Q$. *V is the peak electron energy in million electron volts. If the accelerator beam pulse duration is less than or equal to 1 μs, then Q is the total accelerated charge in Coulombs. If the accelerator beam pulse duration is greater*

than 1 μs, then Q is the maximum accelerated charge in 1 μs. Q equals the intergral of i with respect to t, over the lesser of 1 μs or the time duration of the beam pulse (Q = I idt), where i is beam current in amperes and t is time in seconds.

2. *"Peak power" = (peak potential in volts) x (peak beam current in amperes).*

3*. In machines based on microwave accelerating cavities, the time duration of the beam pulse is the lesser of 1 μs or the duration of the bunched beam packet resulting from one microwave modulator pulse.*

4. *In machines based on microwave accelerating cavities, the peak beam current is the average current in the time duration of a bunched beam packet.*

3A225 Frequency changers (a.k.a. converters or inverters) and generators, except those subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110), that are usable as a variable frequency or fixed frequency motor drive and have all of the characteristics described in this ECCN (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: (1) See ECCN 3D201 for "software" "specially designed" for the "use" of equipment described in this entry. (2) See ECCN 3D202 for "software" "specially designed" to enhance or release the performance characteristics of frequency changers or generators to meet or exceed the level of the performance characteristics described in this entry. (3) See ECCNs 3E001 ("development" and "production") and 3E201 ("use") for technology for items controlled under this entry. (4) Frequency changers (a.k.a. converters or inverters) "specially designed" or prepared for use in separating uranium isotopes are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).
Related Definitions: N/A
Items:

a. Multiphase output providing a power of 40 VA or greater;

b. Operating at a frequency of 600 Hz or more; *and*

c. Frequency control better (less) than 0.2%.

Notes:

1. *This ECCN controls frequency changers intended for use in specific industrial machinery and/or consumer goods (machine tools, vehicles, etc.) only if the frequency changers can meet the performance characteristics described in this entry when removed from the machinery and/or goods. This Note does not exclude from control under this entry any frequency changer described herein that is the principal element of a non-controlled item and can feasibly be removed or used for other purposes.*

2. *To determine whether a particular frequency changer meets or exceeds the performance characteristics described in this*

entry, both hardware and "software" performance constraints must be considered.

Technical Notes:

1. *Frequency changers controlled by this ECCN are also known as converters or inverters.*

2. *The performance characteristics described in this ECCN also may be met by certain equipment marketed as: generators, electronic test equipment, AC power supplies, variable speed motor drives, variable speed drives (VSDs), variable frequency drives (VFDs), adjustable frequency drives (AFDs), or adjustable speed drives (ASDs).*

3A226 High-power direct current power supplies having both of the following characteristics (see List of Items Controlled) , excluding items that are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: (1) See ECCNs 3E001 ("development" and "production") and 3E201 ("use") for technology for items controlled under this entry. (2) Also see ECCN 3A227. (3) Direct current power supplies "specially designed" or prepared for use in separating uranium isotopes are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

Related Definitions: N/A
Items:

a. Capable of continuously producing, over a time period of 8 hours, 100 V or greater with current output of 500 A or greater; *and*

b. Current or voltage stability better than 0.1% over a time period of 8 hours.

3A227 High-voltage direct current power supplies, having both of the following characteristics (see List of Items Controlled) , excluding items that are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: (1) See ECCNs 3E001 ("development" and "production") and 3E201 ("use") for technology for items controlled under this entry. (2) Also see ECCN 3A226. (3) Direct current power supplies "specially designed" or prepared for use in separating uranium isotopes are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

Related Definitions: N/A
Items:

a. Capable of continuously producing, over a time period of 8 hours, 20 kV or greater with current output of 1 A or greater; *and*

b. Current or voltage stability better than 0.1% over a time period of 8 hours.

3A228 Switching devices, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: (1) See ECCNs 3E001 ("development" and "production") and 3E201 ("use") for technology for items controlled under this entry. (2) Also see ECCN 3A991.k.
Related Definitions: N/A
Items:

a. Cold-cathode tubes, whether gas filled or not, operating similarly to a spark gap, having all of the following characteristics:

a.1. Containing three or more electrodes;

a.2. Anode peak voltage rating of 2.5 kV or more;

a.3. Anode peak current rating of 100 A or more; *and*

a.4. Anode delay time of 10 µs or less.

Technical Note: *3A228.a includes gas krytron tubes and vacuum sprytron tubes.*

b. Triggered spark-gaps having both of the following characteristics:

b.1. An anode delay time of 15µs or less; *and*

b.2. Rated for a peak current of 500 A or more.

c. Modules or assemblies with a fast switching function having all of the following characteristics:

c.1. Anode peak voltage rating greater than 2 kV;

c.2. Anode peak current rating of 500 A or more; *and*

c.3. Turn-on time of 1µs or less.

3A229 Firing sets and equivalent high-current pulse generators for detonators controlled by 3A232 (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NP applies to entire entry	NP Column 1.
AT applies to entire entry	AT Column 1.
Russian industry sector sanctions apply to entire entry.	See § 746.5 for specific license requirements and license review policy.

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: (1) See ECCNs 3E001 and 1E001 ("development" and "production") and 3E201 and 1E201 ("use") for technology for items controlled under this entry. (2) See 1A007.a for explosive detonator firing sets designed to drive explosive detonators controlled by 1A007.b. (3) High explosives and related equipment for military use are "subject to the ITAR" (see 22 CFR parts 120 through 130).

Related Definitions: N/A

ECCN Controls: (1) Optically driven firing sets include both those employing laser initiation and laser charging. (2) Explosively driven firing sets include booth explosive ferroelectric and explosive ferromagnetic firing set types. (3) 3A229.b includes xenon flash-lamp drivers.

Items:

a. Detonator firing sets (initiation systems, firesets), including electronically-charged, explosively-driven and optically-driven firing sets designed to drive multiple controlled detonators controlled by 3A232;

b. Modular electrical pulse generators (pulsers) having all of the following characteristics:

b.1. Designed for portable, mobile, or ruggedized use;

b.2. Capable of delivering their energy in less than 15 µs into loads of less than 40 Ω (ohms);

b.3. Having an output greater than 100 A;

b.4. No dimension greater than 30 cm;

b.5. Weight less than 30 kg; *and*

b.6. Specified for use over an extended temperature range 223 K (−50 °C) to 373 K (100 °C) or specified as suitable for aerospace applications.

c. Micro-firing units having all of the following characteristics:

c.1. No dimension greater than 35 mm;

c.2. Voltage rating of equal to or greater than 1 kV; *and*

c.3. Capacitance of equal to or greater than 100 nF.

3A230 High-speed pulse generators, and pulse heads therefor, having both of the following characteristics (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: (1) See ECCNs 3E001 ("development" and "production") and 3E201 ("use") for technology for items controlled under this entry. (2) See ECCNs 3A002.d.1, 3A992.a and 3A999.d.

Related Definitions: 1. In 3A230.b, the term "pulse transition time" is defined as the time interval between 10% and 90% voltage amplitude. 2. Pulse heads are impulse forming networks designed to accept a voltage step function and shape it into a variety of pulse forms that can include rectangular, triangular, step, impulse, exponential, or monocycle types. Pulse heads can be an integral part of the pulse generator, they can be a plug-in module to the device or they can be an externally connected device.

Items:

a. Output voltage greater than 6 V into a resistive load of less than 55 ohms; *and*

b. "Pulse transition time" less than 500 ps.

3A231 Neutron generator systems, including tubes, having both of the characteristics described in this ECCN (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1
Russian industry sector sanctions apply to entire entry.	See § 746.5 for specific license requirements and license review policy.

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: See ECCNs 3E001 ("development" and "production") and 3E201 ("use") for technology for items controlled under this entry.
Related Definitions: N/A
Items:

a. Designed for operation without an external vacuum system; *and*

b. Utilizing electrostatic acceleration to induce:

b.1. A tritium-deuterium nuclear reaction; *or*

b.2. A deuterium-deuterium nuclear reaction

and capable of an output of 3 x 10^9 neutrons/s or greater.

3A232 Detonators and multipoint initiation systems, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1
Russian industry sector sanctions apply to entire entry.	See § 746.5 for specific license requirements and license review policy.

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: (1) See ECCNs 0A604 and 1A007 for electrically driven explosive detonators. (2) See ECCNs 3E001 ("development" and "production") and 3E201 ("use") for technology for items controlled under this entry. (3) High explosives and related equipment for military use are "subject to the ITAR" (see 22 CFR parts 120 through 130).

Related Definitions: N/A

ECCN Controls: This entry does not control detonators using only primary explosives, such as lead azide.

Items:

a. [RESERVED]

b. Arrangements using single or multiple detonators designed to nearly simultaneously initiate an explosive surface over an area greater than 5,000 mm^2 from a single firing signal with an initiation timing spread over the surface of less than 2.5 μs.

Technical Note: *The word initiator is sometimes used in place of the word detonator.*

3A233 Mass spectrometers, 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, excluding items that are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: (1) See ECCNs 3E001 ("development" and "production") and 3E201

("use") for technology for items controlled under this entry. (2) Mass spectrometers "specially designed" or prepared for analyzing on-line samples of UF_6 gas streams are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

Related Definitions: N/A

Items:

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 having both of the following features:

d.1. A molecular beam inlet system that injects a collimated beam of analyte molecules into a region of the ion source where the molecules are ionized by an electron beam; *and*

d.2. One or more cold traps that can be cooled to a temperature of 193 K (-80 °C) or less in order to trap analyte molecules that are not ionized by the electron beam;

e. Mass spectrometers equipped with a microfluorination ion source designed for actinides or actinide fluorides.

Technical Notes:

1. *ECCN 3A233.d controls mass spectrometers that are typically used for isotopic analysis of UF_6 gas samples.*

2. *Electron bombardment mass spectrometers in ECCN 3A233.d are also known as electron impact mass spectrometers or electron ionization mass spectrometers.*

3. In ECCN 3A233.d.2, a "cold trap" is a device that traps gas molecules by condensing or freezing them on cold surfaces. For the purposes of this ECCN, a closed-loop gaseous helium cryogenic vacuum pump is not a cold trap.

3A234 Striplines to provide low inductance path to detonators with the following characteristics (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: N/A

Related Definitions: N/A

Items:

a. Voltage rating greater than 2 kV; *and*

b. Inductance of less than 20 nH.

3A292 Oscilloscopes and transient recorders other than those controlled by 3A002.a.5, and "specially designed" "parts" and

"components" therefor.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NP applies to entire entry	NP Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: See ECCN 3E292 ("development", "production", and "use") for technology for items controlled under this entry.

Related Definitions: "Bandwidth" is defined as the band of frequencies over which the deflection on the cathode ray tube does not fall below 70.7% of that at the maximum point measured with a constant input voltage to the oscilloscope amplifier.

Items:

a. Non-modular analog oscilloscopes having a bandwidth of 1 GHz or greater;

b. Modular analog oscilloscope systems having either of the following characteristics:

b.1. A mainframe with a bandwidth of 1 GHz or greater; *or*

b.2. Plug-in modules with an individual bandwidth of 4 GHz or greater;

c. Analog sampling oscilloscopes for the analysis of recurring phenomena with an effective bandwidth greater than 4 GHz;

d. Digital oscilloscopes and transient recorders, using analog-to-digital conversion techniques, capable of storing transients by sequentially sampling single-shot inputs at successive intervals of less than 1 ns (greater than 1 giga-sample per second), digitizing to 8 bits or greater resolution and storing 256 or more samples.

Note: *"Specially designed" "parts" and "components" controlled by this item are the following, for analog oscilloscopes:*

1. Plug-in units;

2. External amplifiers;

3. Pre-amplifiers;

4. Sampling devices;

5. Cathode ray tubes.

3A980 Voice print identification and analysis equipment and "specially designed" "components" therefor, n.e.s.

License Requirements

Reason for Control: CC

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
CC applies to entire entry	CC Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3A981 Polygraphs (except biomedical recorders designed for use in medical facilities for monitoring biological and neurophysical responses); fingerprint analyzers, cameras and equipment, n.e.s.; automated fingerprint and identification retrieval systems, n.e.s.; psychological stress analysis equipment; electronic monitoring restraint devices; and "specially designed" "components" and "accessories" therefor, n.e.s.

License Requirements

Reason for Control: CC

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
CC applies to entire entry	CC Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
*CIV:*N/A

List of Items Controlled

Related Controls: See ECCN 0A982 for other types of restraint devices
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

Note to ECCN 3A981. *In this ECCN, electronic monitoring restraint devices are devices used to record or report the location of confined persons for law enforcement or penal reasons. The term does not include devices that confine memory impaired patents to appropriate medical facilities.*

3A991 Electronic devices, and "components" not controlled by 3A001.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
AT applies to entire entry	AT Column 1

License Requirements Notes:

See 744.17 of the EAR for additional license requirements for commodities classified as 3A991.a.1.

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

a. "Microprocessor microcircuits", "microcomputer microcircuits", and microcontroller microcircuits having any of the following:

a.1. A performance speed of 5 GFLOPS or more and an arithmetic logic unit with an access width of 32 bit or more;

a.2. A clock frequency rate exceeding 25 MHz; *or*

a.3. More than one data or instruction bus or serial communication port that provides a direct external interconnection between parallel "microprocessor microcircuits" with a transfer rate of 2.5 Mbyte/s.

b. Storage integrated circuits, as follows:

b.1. Electrical erasable programmable read-only memories (EEPROMs) with a storage capacity;

b.1.a. Exceeding 16 Mbits per package for flash memory types; *or*

b.1.b. Exceeding either of the following limits for all other EEPROM types:

b.1.b.1. Exceeding 1 Mbit per package; *or*

b.1.b.2. Exceeding 256 kbit per package and a maximum access time of less than 80 ns;

b.2. Static random access memories (SRAMs) with a storage capacity:

b.2.a. Exceeding 1 Mbit per package; *or*

b.2.b. Exceeding 256 kbit per package and a maximum access time of less than 25 ns;

c. Analog-to-digital converters having any of the following:

c.1. A resolution of 8 bit or more, but less than 12 bit, with an output rate greater than 200 million words per second;

c.2. A resolution of 12 bit with an output rate greater than 105 million words per second;

c.3. A resolution of more than 12 bit but equal to or less than 14 bit with an output rate greater than 10 million words per second; *or*

c.4. A resolution of more than 14 bit with an output rate greater than 2.5 million words per second.

d. Field programmable logic devices having a maximum number of single-ended digital input/outputs of 200 or greater and less than 500;

e. Fast Fourier Transform (FFT) processors having a rated execution time for a 1,024 point complex FFT of less than 1 ms.

f. Custom integrated circuits for which either the function is unknown, or the control status of the equipment in which the integrated circuits will be used is unknown to the manufacturer, having any of the following:

f.1. More than 144 terminals; *or*

f.2. A typical "basic propagation delay time" of less than 0.4 ns.

g. Traveling wave tubes, pulsed or continuous wave, as follows:

g.1. Coupled cavity tubes, or derivatives thereof;

g.2. Helix tubes, or derivatives thereof, with any of the following:

g.2.a. An "instantaneous bandwidth" of half an octave or more; *and*

g.2.b. The product of the rated average output power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0.2;

g.2.c. An "instantaneous bandwidth" of less than half an octave; *and*

g.2.d. The product of the rated average output power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0.4;

h. Flexible waveguides designed for use at frequencies exceeding 40 GHz;

i. Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices (i.e., "signal processing" devices employing elastic waves in materials), having either of the following:

i.1. A carrier frequency exceeding 1 GHz; *or*

i.2. A carrier frequency of 1 GHz or less; *and*

i.2.a. A frequency side-lobe rejection exceeding 55 Db;

i.2.b. A product of the maximum delay time and bandwidth (time in microseconds and bandwidth in MHz) of more than 100; *or*

i.2.c. A dispersive delay of more than 10 microseconds.

j. Cells as follows:

j.1. Primary cells having an energy density of 550 Wh/kg or less at 293 K (20ºC);

j.2. Secondary cells having an energy density of 300 Wh/kg or less at 293 K (20ºC).

Note: *3A991.j. does not control batteries, including single cell batteries.*

***Technical Notes*:**

1. *For the purpose of 3A991.j energy density (Wh/kg) is calculated from the nominal voltage multiplied by the nominal capacity in ampere-hours divided by the mass in kilograms. If the nominal capacity is not stated, energy density is calculated from the nominal voltage squared then multiplied by the discharge duration in hours divided by the discharge load in Ohms and the mass in kilograms.*

2. *For the purpose of 3A991.j, a 'cell' is defined as an electrochemical device, which has positive and negative electrodes, and electrolyte, and is a source of electrical energy. It is the basic building block of a battery.*

3. *For the purpose of 3A991.j.1, a 'primary cell' is a 'cell' that is not designed to be charged by any other source.*

4. *For the purpose of 3A991.j.2., a 'secondary cell' is a 'cell' that is designed to be charged by an external electrical source.*

k. "Superconductive" electromagnets or solenoids "specially designed" to be fully charged or discharged in less than one minute, having all of the following:

Note: *3A991.k does not control "superconductive" electromagnets or solenoids designed for Magnetic Resonance Imaging (MRI) medical equipment.*

k.1. Maximum energy delivered during thedischarge divided by the duration of the discharge of more than 500 kJ per minute;

k.2. Inner diameter of the current carrying windings of more than 250 mm; *and*

k.3. Rated for a magnetic induction of more than 8T or "overall current density" in the winding of more than 300 A/mm^2.

l. Circuits or systems for electromagnetic energy storage, containing "components" manufactured from "superconductive" materials "specially designed" for operation at temperatures below the "critical temperature" of at least one of their "superconductive" constituents, having all of the following:

l.1. Resonant operating frequencies exceeding

1 MHz;

l.2. A stored energy density of 1 MJ/M^3 or more; *and*

l.3. A discharge time of less than 1 ms;

m. Hydrogen/hydrogen-isotope thyratrons of ceramic-metal construction and rate for a peak current of 500 A or more;

n. Digital integrated circuits based on any compound semiconductor having an equivalent gate count of more than 300 (2 input gates).

o. Solar cells, cell-interconnect-coverglass (CIC) assemblies, solar panels, and solar arrays, which are "space qualified" and not controlled by 3A001.e.4.

3A992 General purpose electronic equipment not controlled by 3A002.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

a. Electronic test equipment, n.e.s.

b. Digital instrumentation magnetic tape data recorders having any of the following characteristics;

b.1. A maximum digital interface transfer rate exceeding 60 Mbit/s and employing helical scan techniques;

b.2. A maximum digital interface transfer rate exceeding 120 Mbit/s and employing fixed head techniques; *or*

b.3. "Space qualified";

c. Equipment, with a maximum digital interface transfer rate exceeding 60 Mbit/s, designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders;

3A999 Specific processing equipment, n.e.s., as follows (see List of Items Controlled).

License Requirements

Reason for Control: AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
AT applies to entire entry. A license is required for items controlled by this entry to North Korea for anti-terrorism reasons. The Commerce Country Chart is not designed to determine AT licensing requirements for this entry. See §742.19 of the EAR for additional information.	

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: (1) See also, 3A225 (for frequency changes capable of operating in the frequency range of 600 Hz and above), and 3A233. (2) Certain auxiliary systems, equipment, "parts" and "components" for isotope separation plants, made of or protected by UF_6 resistant materials are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).

Related Definitions: N/A
Items:

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.

B. TEST, INSPECTION AND "PRODUCTION EQUIPMENT"

3B001 Equipment for the manufacturing of semiconductor devices or materials, as follows (see List of Items Controlled) and "specially designed" "components" and "accessories" therefor.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: $500
GBS: Yes, except a.3 (molecular beam epitaxial growth equipment using gas sources), .e (automatic loading multi-chamber central wafer handling systems *only* if connected to equipment controlled by 3B001. a.3, or .f), and .f (lithography equipment).
CIV: Yes for equipment controlled by 3B001.a.1 and a.2.

List of Items Controlled

Related Controls: See also 3B991
Related Definitions: N/A
Items:

a. Equipment designed for epitaxial growth as follows:

a.1. Equipment capable of producing a layer of any material other than silicon with a thickness uniform to less than ± 2.5% across a distance of 75 mm or more;

Note: *3B001.a.1 includes atomic layer epitaxy (ALE) equipment.*

a.2. Metal Organic Chemical Vapor Deposition (MOCVD) reactors designed for compound semiconductor epitaxial growth of material having two or more of the following elements: aluminum, gallium, indium, arsenic, phosphorus, antimony, or nitrogen;

a.3. Molecular beam epitaxial growth equipment using gas or solid sources;

b. Equipment designed for ion implantation and having any of the following:

b.1. [RESERVED];

b.2. Being designed and optimized to operate at a beam energy of 20 keV or more and a beam current of 10 mA or more for hydrogen, deuterium, or helium implant;

b.3. Direct write capability;

b.4. A beam energy of 65 keV or more and a beam current of 45 mA or more for high energy oxygen implant into a heated semiconductor material "substrate"; *or*

b.5. Being designed and optimized to operate at beam energy of 20keV or more and a beam current of 10mA or more for silicon implant into a semiconductor material "substrate" heated to 600 ˚C or greater;

c. Anisotropic plasma dry etching equipment having all of the following:

c.1. Designed or optimized to produce critical dimensions of 65 nm or less; *and*

c.2. Within wafer non-uniformity equal to or less than 10% 3σ measured with an edge exclusion of 2 mm or less;

d. [RESERVED]

e. Automatic loading multi-chamber central wafer handling systems having all of the following:

e.1. Interfaces for wafer input and output, to which more than two functionally different 'semiconductor process tools' controlled by 3B001.a, 3B001.b, or 3B001.c are designed to be connected; *and*

e.2. Designed to form an integrated system in a vacuum environment for 'sequential multiple wafer processing';

Note*: 3B001.e does not control automatic robotic wafer handling systems "specially designed" for parallel wafer processing.*

Technical Notes*:*

1. For the purpose of 3B001.e, 'semiconductor process tools' refers to modular tools that provide physical processes for semiconductor production that are functionally different, such as deposition, etch, implant or thermal processing.

2. For the purpose of 3B001.e, 'sequential multiple wafer processing' means the capability to process each wafer in different 'semiconductor process tools', such as by transferring each wafer from one tool to a second tool and on to a third tool with the automatic loading multi-chamber central wafer handling systems.

f. Lithography equipment as follows:

f.1. Align and expose step and repeat (direct step on wafer) or step and scan (scanner) equipment for wafer processing using photo-optical or X-ray methods and having any of the following:

f.1.a. A light source wavelength shorter than 245 nm; *or*

f.1.b. Capable of producing a pattern with a "Minimum Resolvable Feature size" (MRF) of 95 nm or less;

Technical Note**:** *The 'Minimum Resolvable Feature size' (MRF) is calculated by the following formula:*

MRF =

(an exposure light source wavelength in nm) x (K factor)
---
numerical aperture

where the K factor = 0.35

f.2 Imprint lithography equipment capable of production features of 95 nm or less;

Note: *3B001.f.2 includes:*

- *Micro contact printing tools*

- *Hot embossing tools*

- *Nano-imprint lithography tools*

- *Step and flash imprint lithography (S-FIL) tools*

f.3. Equipment "specially designed" for mask making or semiconductor device processing using direct writing methods, having all of the following:

f.3.a. Using deflected focused electron beam, ion beam or "laser" beam; *and*

f.3.b. Having any of the following:

f.3.b.1. A spot size smaller than 0.2 μm;

f.3.b.2. Being capable of producing a pattern with a feature size of less than 1 μm; *or*

f.3.b.3. An overlay accuracy of better than ± 0.20 μm (3 sigma);

g. Masks and reticles, designed for integrated circuits controlled by 3A001;

h. Multi-layer masks with a phase shift layer not specified by 3B001.g and having any of the following:

h.1. Made on a mask "substrate blank" from glass specified as having less than 7 nm/cm birefringence; *or*

h.2. Designed to be used by lithography equipment having a light source wavelength less than 245 nm;

Note**:** *3B001.h. does not control multi-layer masks with a phase shift layer designed for the fabrication of memory devices not controlled by 3A001.*

i. Imprint lithography templates designed for integrated circuits by 3A001.

3B002 Test equipment "specially designed" for testing finished or unfinished semiconductor devices as follows (see List of Items Controlled) and "specially designed" "components" and "accessories" therefor.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: $500
GBS: Yes

CIV: N/A

List of Items Controlled

Related Controls: See also 3A999.a and 3B992
Related Definitions: N/A
Items:

a. For testing S-parameters of transistor devices at frequencies exceeding 31.8 GHz;

b. [RESERVED]

c. For testing microwave integrated circuits controlled by 3A001.b.2.

3B991 Equipment not controlled by 3B001 for the manufacture of electronic "parts," "components" and materials, and "specially designed" "parts," "components" and "accessories" therefor.

License Requirements
Reason for Control: AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: N/A

Related Definitions: 'Sputtering' is an overlay coating process wherein positively charged ions are accelerated by an electric field towards the surface of a target (coating material). The kinetic energy of the impacting ions is sufficient to cause target surface atoms to be released and deposited on the substrate. (Note: Triode, magnetron or radio frequency sputtering to increase adhesion of coating and rate of deposition are ordinary modifications of the process.)

Items:

a. Equipment "specially designed" for the manufacture of electron tubes, optical elements and "specially designed" "parts" and "components" therefor controlled by 3A001 or 3A991;

b. Equipment "specially designed" for the manufacture of semiconductor devices, integrated circuits and "electronic assemblies", as follows, and systems incorporating or having the characteristics of such equipment:

***Note*:** *3B991.b also controls equipment used or modified for use in the manufacture of other devices, such as imaging devices, electro-optical devices, acoustic-wave devices.*

b.1. Equipment for the processing of materials for the manufacture of devices, "parts" and "components" as specified in the heading of 3B991.b, as follows:

***Note*:** *3B991 does not control quartz furnace tubes, furnace liners, paddles, boats (except "specially designed" caged boats), bubblers, cassettes or crucibles "specially designed" for the processing equipment controlled by 3B991.b.1.*

b.1.a. Equipment for producing polycrystalline silicon and materials controlled by 3C001;

b.1.b. Equipment "specially designed" for purifying or processing III/V and II/VI semiconductor materials controlled by 3C001, 3C002, 3C003, 3C004, or 3C005 except crystal

pullers, for which see 3B991.b.1.c below;

b.1.c. Crystal pullers and furnaces, as follows:

Note*: *3B991.b.1.c does not control diffusion and oxidation furnaces.

b.1.c.1. Annealing or recrystallizing equipment other than constant temperature furnaces employing high rates of energy transfer capable of processing wafers at a rate exceeding 0.005 m^2 per minute;

b.1.c.2. "Stored program controlled" crystal pullers having any of the following characteristics:

b.1.c.2.a. Rechargeable without replacing the crucible container;

b.1.c.2.b. Capable of operation at pressures above 2.5 x 10^5 Pa; *or*

b.1.c.2.c. Capable of pulling crystals of a diameter exceeding 100 mm;

b.1.d. "Stored program controlled" equipment for epitaxial growth having any of the following characteristics:

b.1.d.1. Capable of producing silicon layer with a thickness uniform to less than ± 2.5% across a distance of 200 mm or more;

b.1.d.2. Capable of producing a layer of any material other than silicon with a thickness uniformity across the wafer of equal to or better than ± 3.5%; *or*

b.1.d.3. Rotation of individual wafers during processing;

b.1.e. Molecular beam epitaxial growth equipment;

b.1.f. Magnetically enhanced 'sputtering' equipment with "specially designed" integral load locks capable of transferring wafers in an isolated vacuum environment;

b.1.g. Equipment "specially designed" for ion implantation, ion-enhanced or photo-enhanced diffusion, having any of the following characteristics:

b.1.g.1. Patterning capability;

b.1.g.2. Beam energy (accelerating voltage) exceeding 200 keV;

b.1.g.3 Optimized to operate at a beam energy (accelerating voltage) of less than 10 keV; *or*

b.1.g.4. Capable of high energy oxygen implant into a heated "substrate";

b.1.h. "Stored program controlled" equipment for the selective removal (etching) by means of anisotropic dry methods (e.g., plasma), as follows:

b.1.h.1. Batch types having either of the following:

b.1.h.1.a. End-point detection, other than optical emission spectroscopy types; *or*

b.1.h.1.b. Reactor operational (etching) pressure of 26.66 Pa or less;

b.1.h.2. Single wafer types having any of the following:

b.1.h.2.a. End-point detection, other than optical emission spectroscopy types;

b.1.h.2.b. Reactor operational (etching) pressure of 26.66 Pa or less; *or*

b.1.h.2.c. Cassette-to-cassette and load locks wafer handling;

Notes*: *1. "Batch types" refers to machines not "specially designed" for production

processing of single wafers. Such machines can process two or more wafers simultaneously with common process parameters, e.g., RF power, temperature, etch gas species, flow rates.

2. "Single wafer types" refers to machines "specially designed" for production processing of single wafers. These machines may use automatic wafer handling techniques to load a single wafer into the equipment for processing. The definition includes equipment that can load and process several wafers but where the etching parameters, e.g., RF power or end point, can be independently determined for each individual wafer.

b.1.i. "Chemical vapor deposition" (CVD) equipment, e.g., plasma-enhanced CVD (PECVD) or photo-enhanced CVD, for semiconductor device manufacturing, having either of the following capabilities, for deposition of oxides, nitrides, metals or polysilicon:

b.1.i.1. "Chemical vapor deposition" equipment operating below 10^5 Pa; *or*

b.1.i.2. PECVD equipment operating either below 60 Pa (450 millitorr) or having automatic cassette-to-cassette and load lock wafer handling;

Note*: *3B991.b.1.i does not control low pressure "chemical vapor deposition" (LPCVD) systems or reactive "sputtering" equipment.

b.1.j. Electron beam systems "specially designed" or modified for mask making or semiconductor device processing having any of the following characteristics:

b.1.j.1. Electrostatic beam deflection;

b.1.j.2. Shaped, non-Gaussian beam profile;

b.1.j.3. Digital-to-analog conversion rate exceeding 3 MHz;

b.1.j.4. Digital-to-analog conversion accuracy exceeding 12 bit; *or*

b.1.j.5. Target-to-beam position feedback control precision of 1 micrometer or finer;

Note*: *3B991.b.1.j does not control electron beam deposition systems or general purpose scanning electron microscopes.

b.1.k. Surface finishing equipment for the processing of semiconductor wafers as follows:

b.1.k.1. "Specially designed" equipment for backside processing of wafers thinner than 100 micrometer and the subsequent separation thereof; *or*

b.1.k.2. "Specially designed" equipment for achieving a surface roughness of the active surface of a processed wafer with a two-sigma value of 2 micrometer or less, total indicator reading (TIR);

Note*: *3B991.b.1.k does not control single-side lapping and polishing equipment for wafer surface finishing.

b.1.l. Interconnection equipment which includes common single or multiple vacuum chambers "specially designed" to permit the integration of any equipment controlled by 3B991 into a complete system;

b.1.m. "Stored program controlled" equipment using "lasers" for the repair or trimming of "monolithic integrated circuits" with either of the following characteristics:

b.1.m.1. Positioning accuracy less than ± 1 micrometer; *or*

b.1.m.2. Spot size (kerf width) less than 3 micrometer.

b.2. Masks, mask "substrates," mask-making equipment and image transfer equipment for the manufacture of devices, "parts" and

"components" as specified in the heading of 3B991, as follows:

Note**:** *The term "masks" refers to those used in electron beam lithography, X-ray lithography, and ultraviolet lithography, as well as the usual ultraviolet and visible photo-lithography.*

b.2.a. Finished masks, reticles and designs therefor, except:

b.2.a.1. Finished masks or reticles for the production of unembargoed integrated circuits; *or*

b.2.a.2. Masks or reticles, having both of the following characteristics:

b.2.a.2.a. Their design is based on geometries of 2.5 micrometer or more; *and*

b.2.a.2.b. The design does not include special features to alter the intended use by means of production equipment or "software";

b.2.b. Mask "substrates" as follows:

b.2.b.1. Hard surface (e.g., chromium, silicon, molybdenum) coated "substrates" (e.g., glass, quartz, sapphire) for the preparation of masks having dimensions exceeding 125 mm x 125 mm; *or*

b.2.b.2. "Substrates" "specially designed" for X-ray masks;

b.2.c. Equipment, other than general purpose computers, "specially designed" for computer aided design (CAD) of semiconductor devices or integrated circuits;

b.2.d. Equipment or machines, as follows, for mask or reticle fabrication:

b.2.d.1. Photo-optical step and repeat cameras capable of producing arrays larger than 100 mm x 100 mm, or capable of producing a single exposure larger than 6 mm x 6 mm in the image (i.e., focal) plane, or capable of producing line widths of less than 2.5 micrometer in the photoresist on the "substrate";

b.2.d.2. Mask or reticle fabrication equipment using ion or "laser" beam lithography capable of producing line widths of less than 2.5 micrometer; *or*

b.2.d.3. Equipment or holders for altering masks or reticles or adding pellicles to remove defects;

Note**:** *3B991.b.2.d.1 and b.2.d.2 do not control mask fabrication equipment using photo-optical methods which was either commercially available before the 1st January, 1980, or has a performance no better than such equipment.*

b.2.e. "Stored program controlled" equipment for the inspection of masks, reticles or pellicles with:

b.2.e.1. A resolution of 0.25 micrometer or finer; *and*

b.2.e.2. A precision of 0.75 micrometer or finer over a distance in one or two coordinates of 63.5 mm or more;

Note**:** *3B991.b.2.e does not control general purpose scanning electron microscopes except when "specially designed" and instrumented for automatic pattern inspection.*

b.2.f. Align and expose equipment for wafer production using photo-optical or X-ray methods, e.g., lithography equipment, including both projection image transfer equipment and step and repeat (direct step on wafer) or step and scan (scanner) equipment, capable of performing any of the following functions:

Note**:** *3B991.b.2.f does not control photo-optical contact and proximity mask align and expose equipment or contact image transfer equipment.*

b.2.f.1. Production of a pattern size of less than 2.5 micrometer;

b.2.f.2. Alignment with a precision finer than ± 0.25 micrometer (3 sigma);

b.2.f.3. Machine-to-machine overlay no better than ± 0.3 micrometer; *or*

b.2.f.4. A light source wavelength shorter than 400 nm;

b.2.g. Electron beam, ion beam or X-ray equipment for projection image transfer capable of producing patterns less than 2.5 micrometer;

***Note*:** *For focused, deflected-beam systems(direct write systems), see 3B991.b.1.j or b.10.*

b.2.h. Equipment using "lasers" for direct write on wafers capable of producing patterns less than 2.5 micrometer.

b.3. Equipment for the assembly of integrated circuits, as follows:

b.3.a. "Stored program controlled" die bonders having all of the following characteristics:

b.3.a.1. "Specially designed" for "hybrid integrated circuits";

b.3.a.2. X-Y stage positioning travel exceeding 37.5 x 37.5 mm; *and*

b.3.a.3. Placement accuracy in the X-Y plane of finer than ± 10 micrometer;

b.3.b. "Stored program controlled" equipment for producing multiple bonds in a single operation (e.g., beam lead bonders, chip carrier bonders, tape bonders);

b.3.c. Semi-automatic or automatic hot cap sealers, in which the cap is heated locally to a higher temperature than the body of the package, "specially designed" for ceramic microcircuit packages controlled by 3A001 and that have a throughput equal to or more than one package per minute.

***Note*:** *3B991.b.3 does not control general purpose resistance type spot welders.*

b.4. Filters for clean rooms capable of providing an air environment of 10 or less particles of 0.3 micrometer or smaller per 0.02832 m^3 and filter materials therefor.

3B992 Equipment not controlled by 3B002 for the inspection or testing of electronic "components" and materials, and "specially designed" "parts," "components" and "accessories" therefor.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: See also 3A992.a.
Related Definitions: N/A
Items:

a. Equipment "specially designed" for the inspection or testing of electron tubes, optical elements and "specially designed" "parts" and "components" therefor controlled by 3A001 or 3A991;

b. Equipment "specially designed" for the

inspection or testing of semiconductor devices, integrated circuits and "electronic assemblies", as follows, and systems incorporating or having the characteristics of such equipment:

Note*: *3B992.b also controls equipment used or modified for use in the inspection or testing of other devices, such as imaging devices, electro-optical devices, acoustic-wave devices.

b.1. "Stored program controlled" inspection equipment for the automatic detection of defects, errors or contaminants of 0.6 micrometer or less in or on processed wafers, "substrates", other than printed circuit boards or chips, using optical image acquisition techniques for pattern comparison;

Note*: *3B992.b.1 does not control general purpose scanning electron microscopes, except when "specially designed" and instrumented for automatic pattern inspection.

b.2. "Specially designed" "stored program controlled" measuring and analysis equipment, as follows:

b.2.a. "Specially designed" for the measurement of oxygen or carbon content in semiconductor materials;

b.2.b. Equipment for line width measurement with a resolution of 1 micrometer or finer;

b.2.c. "Specially designed" flatness measurement instruments capable of measuring deviations from flatness of 10 micrometer or less with a resolution of 1 micrometer or finer.

b.3. "Stored program controlled" wafer probing equipment having any of the following characteristics:

b.3.a. Positioning accuracy finer than 3.5 micrometer;

b.3.b. Capable of testing devices having more than 68 terminals; *or*

b.3.c. Capable of testing at a frequency exceeding 1 GHz;

b.4. Test equipment as follows:

b.4.a. "Stored program controlled" equipment "specially designed" for testing discrete semiconductor devices and unencapsulated dice, capable of testing at frequencies exceeding 18 GHz;

Technical Note*: *Discrete semiconductor devices include photocells and solar cells.

b.4.b. "Stored program controlled" equipment "specially designed" for testing integrated circuits and "electronic assemblies" thereof, capable of functional testing:

b.4.b.1. At a 'pattern rate' exceeding 20 MHz; *or*

b.4.b.2. At a 'pattern rate' exceeding 10 MHz but not exceeding 20 MHz and capable of testing packages of more than 68 terminals.

Notes*: *3B992.b.4.b does not control test equipment "specially designed" for testing:

1. *Memories;*

2. *"Assemblies" or a class of "electronic assemblies" for home and entertainment applications; and*

3. *Electronic "parts," "components," "assemblies" and integrated circuits not controlled by 3A001 or 3A991 provided such test equipment does not incorporate computing facilities with "user accessible programmability".*

Technical Note*: *For purposes of 3B992.b.4.b, 'pattern rate' is defined as the maximum frequency of digital operation of a tester. It is therefore equivalent to the highest data rate that a tester can provide in non-multiplexed mode. It

is also referred to as test speed, maximum digital frequency or maximum digital speed.

b.4.c. Equipment "specially designed" for determining the performance of focal-plane arrays at wavelengths of more than 1,200 nm, using "stored program controlled" measurements or computer aided evaluation and having any of the following characteristics:

b.4.c.1. Using scanning light spot diameters of less than 0.12 mm;

b.4.c.2. Designed for measuring photosensitive performance parameters and for evaluating frequency response, modulation transfer function, uniformity of responsivity or noise; *or*

b.4.c.3. Designed for evaluating arrays capable of creating images with more than 32 x 32 line elements;

b.5. Electron beam test systems designed for operation at 3 keV or below, or "laser" beam systems, for non-contactive probing of powered-up semiconductor devices having any of the following:

b.5.a. Stroboscopic capability with either beam blanking or detector strobing;

b.5.b. An electron spectrometer for voltage measurements with a resolution of less than 0.5 V; *or*

b.5.c. Electrical tests fixtures for performance analysis of integrated circuits;

Note*: *3B992.b.5 does not control scanning electron microscopes, except when "specially designed" and instrumented for non-contactive probing of a powered-up semiconductor device.

b.6. "Stored program controlled" multifunctional focused ion beam systems "specially designed" for manufacturing, repairing, physical layout analysis and testing of masks or semiconductor devices and having either of the following characteristics:

b.6.a. Target-to-beam position feedback control precision of 1 micrometer or finer; *or*

b.6.b. Digital-to-analog conversion accuracy exceeding 12 bit;

b.7. Particle measuring systems employing "lasers" designed for measuring particle size and concentration in air having both of the following characteristics:

b.7.a. Capable of measuring particle sizes of 0.2 micrometer or less at a flow rate of 0.02832 m^3 per minute or more; *and*

b.7.b. Capable of characterizing Class 10 clean air or better.

C. "MATERIALS"

3C001 Hetero-epitaxial materials consisting of a "substrate" having stacked epitaxially grown multiple layers of any of the following (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: $3000
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: This entry does not control equipment or material whose functionality has been unalterably disabled are not controlled.

Related Definitions: N/A
Items:

a. Silicon (Si);

b. Germanium (Ge);

c. Silicon Carbide (SiC); *or*

d. "III/V compounds" of gallium or indium.

***Note**: 3C001.d does not apply to a "substrate" having one or more P-type epitaxial layers of GaN, InGaN, AlGaN, InAlN, InAlGaN, GaP, InGaP, AlInP or InGaAlP, independent of the sequence of the elements, except if the P-type epitaxial layer is between N-type layers.*

3C002 Resist materials as follows (see List of Items Controlled) and "substrates" coated with the following resists.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: $3000

GBS: Yes for 3C002.a provided that they are not also controlled by 3C002.b through .e.

CIV: Yes for 3C002.a provided that they are not also controlled by 3C002.b through .e.

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

a. Resists designed for semiconductor lithography as follows:

a.1. Positive resists adjusted (optimized) for use at wavelengths less than 245 nm but equal to or greater than 15 nm;

a.2. Resists adjusted (optimized) for use at wavelengths less than 15 nm but greater than 1 nm;

b. All resists designed for use with electron beams or ion beams, with a sensitivity of 0.01 μcoulomb/mm^2 or better;

c. [RESERVED]

d. All resists optimized for surface imaging technologies;

e. All resists designed or optimized for use with imprint lithography equipment specified by 3B001.f.2 that use either a thermal or photo-curable process.

3C003 Organo-inorganic compounds as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No.*

	1 to part 738).
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: $3000
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: This entry controls only compounds whose metallic, partly metallic or non-metallic element is directly linked to carbon in the organic part of the molecule.

Related Definition: N/A
Items:

a. Organo-metallic compounds of aluminum, gallium or indium, having a purity (metal basis) better than 99.999%;

b. Organo-arsenic, organo-antimony and organo-phosphorus compounds, having a purity (inorganic element basis) better than 99.999%.

3C004 Hydrides of phosphorus, arsenic or antimony, having a purity better than 99.999%, even diluted in inert gases or hydrogen.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: $3000
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: N/A
Related Definition: N/A
Items:

The list of items controlled is contained in the ECCN heading.

***Note**: This entry does not control hydrides containing 20% molar or more of inert gases or hydrogen.*

3C005 Silicon carbide (SiC), gallium nitride (GaN), aluminum nitride (AlN) or aluminum gallium nitride (AlGaN) semiconductor "substrates", or ingots, boules, or other preforms of those materials, having resistivities greater than 10,000 ohm-cm at 20°C.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: $3000
GBS: Yes
CIV: Yes

List of Items Controlled

Related Controls: See ECCN 3E001 for related development and production technology, and ECCN 3B991.b.1.b for related production equipment.
Related Definition: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3C006 "Substrates" specified in 3C005 with at least one epitaxial layer of silicon carbide, gallium nitride, aluminum nitride or aluminum gallium nitride.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: $3000
GBS: Yes
CIV: Yes

List of Items Controlled

Related Controls: See ECCN 3D001 for related "development" or "production" "software", ECCN 3E001 for related "development" and "production" "technology", and ECCN 3B991.b.1.b for related "production" equipment.

Related Definition: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3C992 Positive resists designed for semiconductor lithography specially adjusted (optimized) for use at wavelengths between 370 and 245 nm.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

D. "SOFTWARE"

3D001 "Software" "specially designed" for the "development" or "production" of equipment controlled by 3A001.b to 3A002.g or 3B (except 3B991 and 3B992).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to "software" for equipment controlled by 3A001.b to 3A001.f, 3A002, and 3B	NS Column 1
AT applies to entire entry	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, Special Comprehensive Licenses, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A

TSR: Yes, except for "software" "specially designed" for the "development" or "production" of Traveling Wave Tube Amplifiers described in 3A001.b.8 having operating frequencies exceeding 18 GHz.

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit "software" "specially designed" for the "development" or "production" of equipment specified by 3A002.g.1 or 3B001.a.2 to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: "Software" "specially designed" for the "development" or "production" of the following equipment is "subject to the ITAR" (see 22 CFR parts 120 through 130): 1.) When operating at frequencies higher than 31.8 GHz and "space qualified": Helix tubes (traveling wave tubes (TWT)) defined in 3A001.b.1.a.4.c; microwave solid state amplifiers defined in 3A001.b.4.b; and traveling wave tube amplifiers (TWTA) defined in 3A001.b.8; 2.) "Space qualified" solar cells, coverglass-interconnect-cells or covered-interconnect-cells (CIC) assemblies, solar arrays, and/or solar panels, with a minimum average efficiency of 31% or greater at an operating temperature of 301ºK (28ºC) under simulated 'AM0' illumination with an irradiance of 1,367 Watts per square meter (W/m^2), and associated solar concentrators, power conditioners, and/or controllers, bearing and power transfer assemblies, and deployment hardware/systems. 3.) "Space qualified" atomic frequency standards defined in 3A002.g.2. See also 3D101.

Related Definitions: N/A

Items:

The list of items controlled is contained in the ECCN heading.

3D002 "Software" "specially designed" for the "use" of equipment controlled by 3B001.a to .f, or 3B002.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740

for a description of all license exceptions)

CIV: N/A
TSR: Yes

List of Items Controlled

Related Controls: Also see 3D991.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3D003 'Physics-based' simulation "software" "specially designed" for the "development" of lithographic, etching or deposition processes for translating masking patterns into specific topographical patterns in conductors, dielectrics or semiconductor materials.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

*CIV:*N/A
TSR: Yes

List of Items Controlled

Related Controls: N/A

Related Definitions: 1.) Libraries, design attributes or associated data for the design of semiconductor devices or integrated circuits are considered as "technology". 2.) 'Physics-based' in 3D003 means using computations to determine a sequence of physical cause and effect events based on physical properties (e.g., temperature, pressure, diffusion constants and semiconductor materials properties).

Items:

The list of items controlled is contained in the ECCN heading.

3D004 "Software" "specially designed" for the "development" of equipment controlled by 3A003.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: Yes

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3D101 "Software" "specially designed" or modified for the "use" of equipment controlled by 3A101.b.

License Requirements

Reason for Control: MT, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3D201 "Software" "specially designed" for the "use" of equipment described in ECCN 3A225.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: See ECCN 3E202 ("development," "production," and "use") for "technology" for items controlled under this entry.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3D202 "Software" "specially designed" to enhance or release the performance characteristics of frequency changers or generators to meet or exceed the level of the performance characteristics described in ECCN 3A225.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: See ECCN 3E202 ("development," "production," and "use") for "technology" for items controlled under this entry.
Related Definitions: N/A
Items:

a. "Software" or encryption keys/codes "specially designed" to enhance or release the performance characteristics of equipment not controlled by ECCN 3A225, so that such equipment meets or exceeds the performance characteristics of equipment controlled by that ECCN.

b. "Software" "specially designed" to enhance or release the performance characteristics of equipment controlled by ECCN 3A225.

3D980 "Software" "specially designed" for the "development", "production", or "use" of commodities controlled by 3A980 and 3A981.

License Requirements

Reason for Control: CC, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
CC applies to entire entry	CC Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3D991 "Software" "specially designed" for the "development", "production", or "use" of electronic devices, "parts" or "components" controlled by 3A991, general purpose electronic equipment controlled by 3A992, or manufacturing and test equipment controlled by 3B991 and 3B992; or "software" "specially designed" for the "use" of equipment controlled by 3B001.g and .h.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

E. "TECHNOLOGY"

3E001 "Technology" according to the General Technology Note for the "development" or "production" of equipment or materials controlled by 3A (except 3A292, 3A980, 3A981, 3A991 3A992, or 3A999), 3B (except 3B991 or 3B992) or 3C (except 3C992).

License Requirements

Reason for Control: NS, MT, NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NS applies to "technology" for items controlled by 3A001, 3A002, 3A003, 3B001, 3B002, or 3C001 to 3C006.	NS Column 1
MT applies to "technology" for equipment controlled by 3A001 or 3A101 for MT reasons	MT Column 1
NP applies to "technology" for equipment controlled by 3A001, 3A201, or 3A225 to 3A234 for NP reasons	NP Column 1
AT applies to entire entry	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions, Special Comprehensive Licenses, and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A

TSR: Yes, except N/A for MT, and "technology" "specially designed" for the "development" or "production" of: (a) Traveling Wave Tube Amplifiers described in 3A001.b.8, having operating frequencies exceeding 19 GHz; and (b) solar cells, coverglass-interconnect-cells or covered-interconnect-cells (CIC) assemblies, solar arrays and/or solar panels, which are "space qualified," having a minimum average efficiency exceeding 20% but less than 31% described in 3A001.e.4.

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit "technology" according to the General Technology Note for the "development" or "production" of equipment specified by ECCNs 3A002.g.1 or 3B001.a.2 to any of the destinations listed in Country Group A:6 (See Supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) See also 3E101 and 3E201. (2)"Technology" according to the General Technology Note for the "development" or "production" of the following commodities is "subject to the ITAR" (see 22 CFR parts 120 through 130): (a) When operating at frequencies higher than 31.8 GHz and "space qualified": helix tubes (traveling wave tubes (TWT)) defined in 3A001.b.1.a.4.c; microwave solid state amplifiers defined in 3A001.b.4.b; or traveling wave tube amplifiers (TWTA) defined in 3A001.b.8; (b) "Space qualified" solar cells, coverglass-interconnect-cells or covered-interconnect-cells (CIC) assemblies, solar arrays, and/or solar panels, with a minimum

average efficiency of 31% or greater at an operating temperature of 301ºK (28ºC) under simulated 'AM0' illumination with an irradiance of 1,367 Watts per square meter (W/m^2), and associated solar concentrators, power conditioners, and/or controllers, bearing and power transfer assemblies, and deployment hardware/systems; and (c) "Space qualified" atomic frequency standards defined in 3A002.g.2.

Related Definition: N/A
Items:

The list of items controlled is contained in the ECCN heading.

***Note 1**: 3E001 does not control "technology" for the "production" of equipment or "components" controlled by 3A003.*

***Note 2:** 3E001 does not control "technology" for the "development" or "production" of integrated circuits controlled by 3A001.a.3 to a.12, having all of the following:*

a) Using "technology" at or above 0.130 µm; and

b) Incorporating multi-layer structures with three or fewer metal layers.

3E002 "Technology" according to the General Technology Note other than that controlled in 3E001 for the "development" or "production" of a "microprocessor microcircuit", "micro-computer microcircuit" and microcontroller microcircuit core, having an arithmetic logic unit with an access width of 32 bits or more and any of the following features or characteristics (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: Yes, for deemed exports, as described in §734.2(b)(2)(ii) of the EAR, of "technology" for the "development" or "production" of general purpose microprocessor cores with a vector processor unit with operand length of 64-bit or less, 64-bit floating operations not exceeding 50 GFLOPS, or 16-bit or more floating-point operations not exceeding 50 GMACS (billions of 16-bit fixed-point multiply-accumulate operations per second). Deemed exports under License Exception CIV are subject to a Foreign National Review (FNR) requirement, see §740.5 of the EAR for more information about the FNR. License Exception CIV does not apply to ECCN 3E002 technology also required for the development or production of items controlled under ECCNs beginning with 3A, 3B, or 3C, or to ECCN 3E002 technology also controlled under ECCN 3E003.

TSR: Yes

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

a. A 'vector processor unit' designed to perform more than two calculations on floating-point vectors (one dimensional arrays of 32-bit or larger numbers) simultaneously;

***Technical Note:** A 'vector processor unit' is a*

processor element with built-in instructions that perform multiple calculations on floating-point vectors (one-dimensional arrays of 32-bit or larger numbers) simultaneously, having at least one vector arithmetic logic unit.

b. Designed to perform more than four 64-bit or larger floating-point operation results per cycle; *or*

c. Designed to perform more than four 16-bit fixed-point multiply-accumulate results per cycle (e.g., digital manipulation of analog information that has been previously converted into digital form, also known as digital "signal processing").

Note: *3E002.c does not control "technology" for multimedia extensions.*

Notes:

1. *3E002 does not control "technology" for the "development" or "production" of microprocessor cores, having all of the following:*

a*. Using "technology" at or above 0.130 μm; and*

b. *Incorporating multi-layer structures with five or fewer metal layers.*

2. *3E002 includes "technology" for digital signal processors and digital array processors.*

3E003 Other "technology" for the "development" or "production" of the following (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NS applies to entire entry	NS Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: Yes, except .f and .g

List of Items Controlled

Related Controls: 1) Technology for the "development" or "production" of "space qualified" electronic vacuum tubes operating at frequencies of 31.8 GHz or higher, described in 3E003.g, is "subject to the ITAR" (see 22 CFR part 120 through 130); 2) See 3E001 for silicon-on-insulation (SOI) technology for the "development" or "production" related to radiation hardening of integrated circuits.

Related Definitions: N/A
Items:

a. Vacuum microelectronic devices;

b. Hetero-structure semiconductor electronic devices such as high electron mobility transistors (HEMT), hetero-bipolar transistors (HBT), quantum well and super lattice devices;

Note: *3E003.b does not control "technology" for high electron mobility transistors (HEMT) operating at frequencies lower than 31.8 GHz and hetero-junction bipolar transistors (HBT) operating at frequencies lower than 31.8 GHz.*

c. "Superconductive" electronic devices;

d. Substrates of films of diamond for electronic components;

e. Substrates of silicon-on-insulator (SOI) for integrated circuits in which the insulator is silicon dioxide;

f. Substrates of silicon carbide for electronic

components;

g. Electronic vacuum tubes operating at frequencies of 31.8 GHz or higher.

3E101 "Technology" according to the General Technology Note for the "use" of equipment or "software" controlled by 3A001.a.1 or .2, 3A101, or 3D101.

License Requirements

Reason for Control: MT, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3E102 "Technology" according to the General Technology Note for the "development" of "software" controlled by 3D101.

License Requirements

Reason for Control: MT, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3E201 "Technology" according to the General Technology Note for the "use" of equipment controlled by 3A001.e.2 or .e.3, 3A201 or 3A225 to 3A234.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NP applies to "technology" for equipment controlled by 3A001.e.2, or .e.3, 3A201 or 3A225 to 3A234 for NP reasons	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3E202 "Technology" according to the General Technology Note for the "development," "production," or "use" of "software" controlled by 3D201 or 3D202.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3E292 "Technology" according to the General Technology Note for the "development", "production", or "use" of equipment controlled by 3A292.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
NP applies to entire entry	NP Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3E980 "Technology" "specially designed" for "development", "production", or "use" of commodities controlled by 3A980 and 3A981.

License Requirements

Reason for Control: CC, AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738).*
CC applies to entire entry	CC Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

3E991 "Technology" for the "development," "production" or "use" of electronic devices, "parts" or "components" controlled by 3A991, general purpose electronic equipment controlled by 3A992, or manufacturing and test equipment controlled by 3B991 or 3B992, or materials controlled by 3C992.

License Requirements

Reason for Control:	AT	
Control(s)		*Country Chart (See Supp. No. 1 to part 738).*
AT applies to entire entry		AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

CIV: N/A
TSR: N/A

List of Items Controlled

Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

EAR99 Items subject to the EAR that are *not* elsewhere specified in this CCL Category *or* in any other category in the CCL are designated by the number *EAR99*.