

**CATEGORY 3 - ELECTRONICS**

**A. SYSTEMS, EQUIPMENT AND COMPONENTS**

**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 or 3A001.a.12, 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 or 3A001.a.12 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 and 3A001.a.12. If the integrated circuit is a silicon-based "microcomputer microcircuit" or microcontroller microcircuit described in 3A001.a.3 having an operand (data) word length of 8 bit or less, the control status of the integrated circuit is determined in 3A001.a.3.

**3A001 Electronic components, as follows (see List of Items Controlled).**

**License Requirements**

*Reason for Control:* NS, MT, AT

<i>Control(s)</i>	<i>Country Chart</i>
NS applies to entire entry	NS Column 2
MT applies to 3A001.a.1.a	MT Column 1
AT applies to entire entry	AT Column 1

**Export Administration Regulations**

**License Exceptions**

- LVS: N/A for MT  
 \$1500: 3A001.c  
 \$3000: 3A001.b.1, b.2, b.3, .d, .e and .f  
 \$5000: 3A001.a, and .b.4 to b.7
- GBS: Yes, except 3A001.a.1.a, b.1, b.3 to b.7, .c to .f
- CIV: Yes, except 3A001.a.1, a.2, a.3.a, a.5, a.6, a.9, a.10, and a.12, .b, .c, .d, .e, and .f

**●List of Items Controlled**

*Unit:* Number

*Related Controls:* See also 3A101, 3A201, and 3A991

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

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

a.1.a. A total dose of  $5 \times 10^3$  Gy (Si), or higher; *or*

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

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, neural network integrated circuits, 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 is 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 automobiles or railway train applications.

a.3. "Microprocessor microcircuits", "micro-computer microcircuits" and microcontroller microcircuits, having any of the following characteristics:

**Note:** 3A001.a.3 includes digital signal processors, digital array processors and digital coprocessors.

a.3.a. A "composite theoretical performance" ("CTP") of 6,500 million theoretical operations per second (MTOPS) or more and an arithmetic logic unit with an access width of 32 bit or more;

a.3.b. Manufactured from a compound semiconductor and operating at a clock frequency exceeding 40 MHz; *or*

a.3.c. More than one data or instruction bus or serial communication port for external interconnection in a parallel processor with a transfer rate exceeding 2.5 Mbyte/s;

a.4. Storage integrated circuits manufactured from a compound semiconductor;

a.5. Analog-to-digital and digital-to-analog converter integrated circuits, as follows:

a.5.a. Analog-to-digital converters having any of the following:

a.5.a.1. A resolution of 8 bit or more, but less than 12 bit, with a total conversion time of less than 10 ns;

a.5.a.2. A resolution of 12 bit with a total conversion time of less than 200 ns; *or*

a.5.a.3. A resolution of more than 12 bit with a total conversion time of less than 2  $\mu$ s;

a.5.b. Digital-to-analog converters with a resolution of 12 bit or more, and a "settling time" of less than 10 ns;

**Technical Note:**

1. A resolution of n bit corresponds to a quantization of  $2^n$  levels.

2. Total conversion time is the inverse of the sample rate.

a.6. Electro-optical and "optical integrated circuits" designed for "signal processing" 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. An equivalent usable gate count of more than 30,000 (2 input gates);

a.7.b. A typical "basic gate propagation delay time" of less than 0.4 ns; *or*

a.7.c. A toggle frequency exceeding 133 Mhz;

**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), and Field Programmable Interconnects (FPICs).

**N.B.:** Field programmable logic devices are also known as field programmable gate or field programmable logic arrays.

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 208 terminals;

a.10.b. A typical "basic gate propagation

delay time" of less than 0.35 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 any of the following:

a.12.a. A rated execution time for a 1,024 point complex FFT of less than 1 ms;

a.12.b. A rated execution time for an N-point complex FFT of other than 1,024 points of less than  $N \log_2 N / 10,240$  ms, where N is the number of points; *or*

a.12.c. A butterfly throughput of more than 5.12 MHz;

b. Microwave or millimeter wave components, as follows:

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

**Note:** 3A001.b.1 does not control tubes designed or rated to operate in the ITU allocated bands at frequencies not exceeding 31 GHz.

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

b.1.a.1. Operating at frequencies higher than 31 GHz;

b.1.a.2. 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 an "instantaneous bandwidth" of more than 7% or a peak power exceeding 2.5 kW;

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

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<sup>2</sup>;

b.2. Microwave integrated circuits or modules having all of the following:

b.2.a. Containing "monolithic integrated circuits"; *and*

b.2.b. Operating at frequencies above 3 GHz;

**Note:** 3A001.b.2 does not control circuits or modules for equipment designed or rated to operate in the ITU allocated bands at frequencies not exceeding 31 GHz.

b.3. Microwave transistors rated for operation at frequencies exceeding 31 GHz;

b.4. Microwave solid state amplifiers, having any of the following:

b.4.a. Operating frequencies exceeding 10.5 GHz and an "instantaneous bandwidth" of more than half an octave; *or*

b.4.b. Operating frequencies exceeding 31 GHz;

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  $\mu$ s 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. Microwave "assemblies" capable of operating at frequencies exceeding 31 GHz;

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

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

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

b.8.b. An average output power density exceeding 80 W/kg; *and*

b.8.c. A volume of less than 400 cm<sup>3</sup>;

**Note:** 3A001.b.8 does not control equipment designed or rated for operation in an ITU

allocated band.

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

c.1. Surface acoustic wave and surface skimming (shallow bulk) acoustic wave devices (i.e., "signal processing" devices employing elastic waves in materials), having any of the following:

c.1.a. A carrier frequency exceeding 2.5 GHz;

c.1.b. A carrier frequency exceeding 1 GHz, but not exceeding 2.5 GHz, and having any of the following:

c.1.b.1. A frequency side-lobe rejection exceeding 55 Db;

c.1.b.2. A product of the maximum delay time and the bandwidth (time in  $\mu\text{s}$  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  $\mu\text{s}$ ; *or*

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

c.1.c.1. A product of the maximum delay time and the bandwidth (time in  $\mu\text{s}$  and bandwidth in MHz) of more than 100;

c.1.c.2. A dispersive delay of more than 10  $\mu\text{s}$ ; *or*

c.1.c.3. A frequency side-lobe rejection exceeding 55 Db and a bandwidth greater than 50 MHz;

c.2. Bulk (volume) acoustic wave devices (i.e., "signal processing" devices employing

elastic waves) that permit the direct processing of signals at frequencies exceeding 1 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;

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, with 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. Batteries and photovoltaic arrays, as follows:

**Note:** 3A001.e.1 does not control batteries with volumes equal to or less than  $27\text{ cm}^3$  (e.g., standard C-cells or R14 batteries).

e.1.a. Primary cells and batteries having an energy density exceeding 480 Wh/kg and rated for operation in the temperature range from below 243 K ( $-30\text{ }^\circ\text{C}$ ) to above 343 K ( $70\text{ }^\circ\text{C}$ );

e.1.b. Rechargeable cells and batteries having an energy density exceeding 150 Wh/kg after 75 charge/discharge cycles at a discharge

current equal to C/5 hours (C being the nominal capacity in ampere hours) when operating in the temperature range from below 253 K (-20 °C) to above 333 K (60 °C);

**Technical Note:** Energy density is obtained by multiplying the average power in watts (average voltage in volts times average current in amperes) by the duration of the discharge in hours to 75% of the open circuit voltage divided by the total mass of the cell (or battery) in kg.

e.1.c. "Space qualified" and radiation hardened photovoltaic arrays with a specific power exceeding 160 W/m<sup>2</sup> at an operating temperature of 301 K (28 °C) under a tungsten illumination of 1 kW/m<sup>2</sup> at 2,800 K (2,527 °C);

e.2. High energy storage capacitors, as follows:

e.2.a. Capacitors with a repetition rate of less than 10 Hz (single shot capacitors) 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) 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, 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<sup>2</sup>;

f. Rotary input type shaft absolute position encoders having any of the following:

f.1. A resolution of better than 1 part in 265,000 (18 bit resolution) of full scale; *or*

f.2. An accuracy better than ± 2.5 seconds of arc.

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

#### License Requirements

*Reason for Control:* NS, AT

*Control(s)* Country Chart

NS applies to entire entry NS Column 2

AT applies to entire entry      AT Column 1

**License Requirement Notes:** See §743.1 of the EAR for reporting requirements for exports under License Exceptions.

### License Exceptions

- LVS: \$3000: 3A002.a, .e, .f, .g;  
\$5000: 3A002.b to .d
- GBS: Yes for 3A002.a.1.;3A002.b (synthesized output frequency of 2.6 GHz or less and a "frequency switching time" of 0.3 ms or more); and 3A002.d (synthesized output frequency of 2.6 GHz or less and a "frequency switching time" of 0.3 ms or more)
- CIV: Yes for 3A002.a.1 (provided all of the following conditions are met: 1) Bandwidths do not exceed: 4 MHz per track and have up to 28 tracks *or* 2 MHz per track and have up to 42 tracks; 2) Tape speed does not exceed 6.1 m/s; 3) They are not designed for underwater use; 4) They are not ruggedized for military use; *and* 5) Recording density does not exceed 653.2 magnetic flux sine waves per mm); 3A002.b (synthesized output frequency of 2.6 GHz or less; and a "frequency switching time" of 0.3 ms or more), 3A002.d (synthesized output frequency of 2.6 GHz or less; and a "frequency switching time" of 0.3 ms or more).

### List of Items Controlled

*Unit:* Number  
*Related Controls:* See also 3A292 and 3A992  
*Related Definitions:* N/A  
*Items:*

- a. Recording equipment, as follows, and specially designed test tape therefor:

a.1. Analog instrumentation magnetic tape recorders, including those permitting the recording of digital signals (e.g., using a high density digital recording (HDDR) module), having any of the following:

a.1.a. A bandwidth exceeding 4 MHz per electronic channel or track;

a.1.b. A bandwidth exceeding 2 MHz per electronic channel or track and having more than 42 tracks; *or*

a.1.c. A time displacement (base) error, measured in accordance with applicable IRIG or EIA documents, of less than  $\pm 0.1 \mu\text{s}$ ;

**Note:** Analog magnetic tape recorders specially designed for civilian video purposes are not considered to be instrumentation tape recorders.

a.2. Digital video magnetic tape recorders having a maximum digital interface transfer rate exceeding 360 Mbit/s;

**Note:** 3A002.a.2 does not control digital video magnetic tape recorders specially designed for television recording using a signal format, which may include a compressed signal format, standardized or recommended by the ITU, the IEC, the SMPTE, the EBU or the IEEE for civil television applications.

a.3. Digital instrumentation magnetic tape data recorders employing helical scan techniques or fixed head techniques, having any of the following:

a.3.a. A maximum digital interface transfer rate exceeding 175 Mbit/s; *or*

a.3.b. Being "space qualified";

**Note:** 3A002.a.3 does not control analog magnetic tape recorders equipped with HDDR

conversion electronics and configured to record only digital data.

a.4. Equipment, having a maximum digital interface transfer rate exceeding 175 Mbit/s, designed to convert digital video magnetic tape recorders for use as digital instrumentation data recorders;

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

**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 Note:** 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. 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.

b. "Frequency synthesizer", "assemblies" having a "frequency switching time" from one selected frequency to another of less than 1 ms;

c. "Signal analyzers", as follows:

c.1. "Signal analyzers" capable of analyzing frequencies exceeding 31 GHz;

c.2. "Dynamic signal analyzers" having a "real-time bandwidth" exceeding 25.6 kHz;

**Note:** 3A002.c.2 does not control those "dynamic signal analyzers" using only constant percentage bandwidth filters (also known as octave or fractional octave filters).

**Technical Note:** Constant percentage bandwidth filters are also known as octave or fractional octave filters.

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 frequency, and having any of the following:

d.1. A maximum synthesized frequency exceeding 31 GHz;

d.2. A "frequency switching time" from one selected frequency to another of less than 1 ms; *or*

d.3. A single sideband (SSB) phase noise better than  $-(126 + 20 \log_{10} F - 20 \log_{10} f)$  in dBc/Hz, where F is the off-set from the operating frequency in Hz and f is the operating frequency in MHz;

**Note:** 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.

e. Network analyzers with a maximum operating frequency exceeding 40 GHz;

f. Microwave test receivers having all of the following:

f.1. A maximum operating frequency exceeding 40 GHz; *and*

f.2. Being capable of measuring amplitude and phase simultaneously;

g. Atomic frequency standards having any of the following:

g.1. Long-term stability (aging) less (better)

than  $1 \times 10^{-11}$ /month; *or*

g.2. Being "space qualified".

**Note:** 3A002.g.1 does not control non-"space qualified" rubidium standards.

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

**License Requirements**

*Reason for Control:* MT, AT

<i>Control(s)</i>	<i>Country Chart</i>
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

**License Exceptions**

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

**List of Items Controlled**

*Unit:* Number

*Related Controls:* Items controlled in 3A101.a are subject to the export licensing authority of the U.S. Department of State, Office of Defense Trade Controls (See 22 CFR part 121).

*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

**Export Administration Regulations**

electromagnetic radiation produced by bremsstrahlung from accelerated electrons of 2 MeV or greater, and systems containing those accelerators.

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

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

**License Requirements**

*Reason for Control:* NP, AT

<i>Control(s)</i>	<i>Country Chart</i>
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

**License Exceptions**

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

**List of Items Controlled**

*Unit:* Number

*Related Controls:* This entry does not control magnets that are specially designed for and exported as parts of medical nuclear magnetic resonance (NMR) imaging systems. Such parts may be exported in separate shipments from different sources, provided that the related export control documents clearly specify that the parts are for medical NMR imaging systems that are being exported.

*Related Definition:* N/A

*Items:*

- a. Capacitors with the following 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 with all of the following characteristics:

b.1. Capable of creating magnetic fields of more than 2 teslas (20 kilogauss);

b.2. With an L/D ratio (length divided by inner diameter) greater than 2;

b.3. With an inner diameter of more than 300 mm; *and*

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

**Note:** 3A201.b does not specify 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 with peak energy of 500 keV or greater, as follows, except accelerators that are component parts of devices designed for purposes other than electron beam or X-ray radiation (electron microscopy, for example) and those designed for medical purposes:

c.1. Having 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, where K is defined as:

$K = 1.7 \times 10^3 V^{2.65} Q$ , where V is the peak electron energy in million electron volts and Q is the total accelerated charge in coulombs if the accelerator beam pulse duration is less than or equal to 1 microsecond; if the accelerator beam pulse duration is greater than 1 microsecond, Q is the maximum accelerated charge in 1 microsecond {Q equals the integral of i with respect to t, over the lesser of 1 microsecond or the time duration of the beam pulse ( $Q = \int i dt$ ), where i is beam current in amperes and t is time in seconds}; *or*

c.2. Having an accelerator peak electron energy of 25 MeV or greater and a peak power greater than 50 MW. {Peak power = (peak potential in volts) x (peak beam current in amperes)}.

**Technical Notes:** a. Time duration of the beam pulse -In machines, based on microwave accelerating cavities, the time duration of the beam pulse is the lesser of 1 microsecond or the duration of the bunched beam packet resulting from one microwave modulator pulse.

b. Peak beam current -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 (also known as converters or inverters) or generators, other than those controlled by 0B001.c.11, having all of the characteristics (see List of Items Controlled).**

**License Requirements**

*Reason for Control:* NP, AT

<i>Control(s)</i>	<i>Country Chart</i>
NP applies to entire entry	NP Column 1

AT applies to entire entry AT Column 1

**other than those controlled by 0B001.j.6, capable of continuously producing, over a time period of 8 hours, 100 V or greater with current output of 500 A or greater and with current or voltage regulation better than 0.1%.**

**License Exceptions**

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

**License Requirements**

*Reason for Control:* NP, AT

**List of Items Controlled**

*Unit:* Number  
*Related Controls:* Frequency changers (also known as converters or inverters) especially designed or prepared to supply motor stators and having the characteristics described in 3A225.b and .d, together with a total harmonic distortion of less than 2 percent and an efficiency of greater than 80 percent are subject to the export licensing authority of the Nuclear Regulatory Commission. (See 10 CFR part 110.)

<i>Control(s)</i>	<i>Country Chart</i>
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

*Related Definition:* Motor stators are especially designed or prepared ring-shaped stators for high-speed multiphase AC hysteresis (or reluctance) motors for synchronous operation within a vacuum in the frequency range of 600 Hz to 2,000 Hz, and a power range of 50 VA to 1,000 VA. The stators consist of multiphase windings on a laminated low-loss iron core comprising thin layers typically to 2.0 mm (.008 in) thick or less.

**License Exceptions**

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

*Items:*

**List of Items Controlled**

*Unit:* \$ value  
*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

- a. A multiphase output capable of providing a power of 40 W or more;
- b. Capable of operating in the frequency range between 600 and 2000 Hz;
- c. Total harmonic distortion below 10%; *and*
- d. Frequency control better than 0.1%.

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

**3A227 High-voltage direct current power supplies, other than those controlled by 0B001.j.5, capable of continuously producing, over a time period of 8 hours, 20,000 V or greater with current output of 1 A or greater and with current or voltage regulation better than 0.1%.**

**License Requirements**

*Reason for Control:* NP, AT

**3A226 Direct current high-power supplies,**

<i>Control(s)</i>	<i>Country Chart</i>	<i>Items:</i>
NP applies to entire entry	NP Column 1	a. Cold-cathode tubes (including gas krytron tubes and vacuum spraytron tubes), whether gas filled or not, operating similarly to a spark gap, containing three or more electrodes, and having all of the following characteristics:
AT applies to entire entry	AT Column 1	

**License Exceptions**

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

**List of Items Controlled**

*Unit:* \$ value  
*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

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

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

**License Requirements**

*Reason for Control:* NP, AT

<i>Control(s)</i>	<i>Country Chart</i>	
NP applies to entire entry	NP Column 1	a.1. Anode peak voltage rating of 2,500 V or more;
AT applies to entire entry	AT Column 1	a.2. Anode peak current rating of 100 A or more; <i>and</i>
		a.3. Anode delay time of 10 microsecond or less;
		b. Triggered spark-gaps having an anode delay time of 15 microsecond or less and 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 2,000 V;
		c.2. Anode peak current rating of 500 A or more; <i>and</i>
		c.3. Turn-on time of 1 microsecond or less.

**License Exceptions**

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

**List of Items Controlled**

*Unit:* Number  
*Related Controls:* N/A  
*Related Definitions:* N/A

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

**License Requirements**

*Reason for Control:* NP, AT

<i>Control(s)</i>	<i>Country Chart</i>
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NP applies to entire entry NP Column 1

AT applies to entire entry AT Column 1

**License Exceptions**

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

**List of Items Controlled**

*Unit:* Number  
*Related Controls:* See also U.S. Munitions List  
*Related Definitions:* N/A  
*Items:*

- a. Explosive detonator firing sets designed to drive multiple controlled detonators controlled by 3A232;
- b. Modular electrical pulse generators (pulsers) designed for portable, mobile or ruggedized use (including xenon flash-lamp drivers) having all the following characteristics:
  - b.1. Capable of delivering their energy in less than 15 microsecond;
  - b.2. Having an output greater than 100 A;
  - b.3. Having a rise time of less than 10 microsecond into loads of less than 40 ohms (rise time is the time interval from 10% to 90% current amplitude when driving a resistive load);
  - b.4. Enclosed in a dust-tight enclosure;
  - b.5. No dimension greater than 254 mm;
  - b.6. Weight less than 25 kg; *and*
  - b.7. Specified for use over an extended temperature range 223 K (-50 °C) to 373 K (100 °C) or specified as suitable for aerospace use.

**Export Administration Regulations**

**3A230 High-speed pulse generators with output voltages greater than 6 volts into a less than 55 ohm resistive load, and with pulse transition times less than 500 picoseconds.**

**License Requirements**

*Reason for Control:* NP, AT

<i>Control(s)</i>	<i>Country Chart</i>
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

**License Exceptions**

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

**List of Items Controlled**

*Unit:* Number  
*Related Controls:* N/A  
*Related Definitions:* In this entry, "pulse transition time" is defined as the time interval between 10% and 90% voltage amplitude.  
*Items:*

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

**3A231 Neutron generator systems, including tubes, designed for operation without an external vacuum system and utilizing electrostatic acceleration to induce a tritium-deuterium nuclear reaction.**

**License Requirements**

*Reason for Control:* NP, AT

<i>Control(s)</i>	<i>Country Chart</i>
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

*Unit:* Number  
*Related Controls:* This entry does not control detonators using only primary explosives, such as lead azide.

*Related Definition:* The detonators of concern all utilize a small electrical conductor (bridge, bridge wire or foil) that explosively vaporizes when a fast, high-current electrical pulse is passed through it. In nonslapper types, the exploding conductor starts a chemical detonation in a contacting high-explosive material such as PETN (Pentaerythritoltetranitrate). In slapper detonators, the explosive vaporization of the electrical conductor drives a flyer or slapper across a gap and the impact of the slapper on an explosive starts a chemical detonation. The slapper in some designs is driven by a magnetic force. The term exploding foil detonator may refer to either an EB or a slapper-type detonator. Also, the word initiator is sometimes used in place of the word detonator.

**License Exceptions**

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

**List of Items Controlled**

*Unit:* Number, parts and accessories in \$ value  
*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

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

*Items:*

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

a. Electrically driven explosive detonators, the following:

**License Requirements**

*Reason for Control:* NP, AT

- a.1. Exploding bridge (EB);
- a.2. Exploding bridge wire (EBW);
- a.3. Slapper;
- a.4. Exploding foil initiators (EFI);

<i>Control(s)</i>	<i>Country Chart</i>
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

b. Arrangements using single or multiple detonators designed to nearly simultaneously initiate an explosive surface (over greater than 5000 mm<sup>2</sup>) from a single firing signal (with an initiation timing spread over the surface of less than 2.5 microseconds).

**License Exceptions**

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

**List of Items Controlled**

**3A233 Mass spectrometers, other than those controlled by 0B002.g, capable of measuring**



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 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**

Export Administration Regulations

**equipment and parts, n.e.s.**

**License Requirements**

*Reason for Control:* CC

*Control(s)* Country Chart

CC applies to entire entry CC Column 1

**License Exceptions**

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

**List of Items Controlled**

*Unit:* Equipment in number  
*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 parts and accessories, n.e.s.**

**License Requirements**

*Reason for Control:* CC

*Control(s)* Country Chart

CC applies to entire entry CC Column 1

**License Exceptions**

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

**List of Items Controlled**

*Unit:* Equipment in number  
*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

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

**3A991 Electronic devices and components not controlled by 3A001.**

**License Requirements**

*Reason for Control:* AT

<i>Control(s)</i>	<i>Country Chart</i>
AT applies to entire entry	AT Column 1

**License Requirements Notes:** 1. Microprocessors with a CTP below 550 MTOPS listed in paragraph (a) of this entry may be shipped NLR (No License Required) when destined to North Korea, provided restrictions set forth in other sections of the EAR (e.g., end-use restrictions), do not apply.

**License Exceptions**

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

**List of Items Controlled**

*Unit:* Equipment in number  
*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

**Export Administration Regulations**

a. "Microprocessor microcircuits", "microcomputer microcircuits", and microcontroller microcircuits having a clock frequency exceeding 25 MHz;

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. Field programmable logic devices having either of the following:

c.1. An equivalent gate count of more than 5000 (2 input gates); *or*

c.2. A toggle frequency exceeding 100 MHz;

d. 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:

- d.1. More than 144 terminals; *or*
- d.2. A typical "basic propagation delay time" of less than 0.4 ns.
- e. Travelling wave tubes, pulsed or continuous wave, as follows:
- e.1. Coupled cavity tubes, or derivatives thereof;
- e.2. Helix tubes, or derivatives thereof, with any of the following:
- e.2.a.1. An "instantaneous bandwidth" of half an octave or more; *and*
- e.2.a.2. The product of the rated average output power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0.2;
- e.2.b.1. An "instantaneous bandwidth" of less than half an octave; *and*
- e.2.b.2. The product of the rated average output power (expressed in kW) and the maximum operating frequency (expressed in GHz) of more than 0.4;
- f. Flexible waveguides designed for use at frequencies exceeding 40 GHz;
- g. 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:
- g.1. A carrier frequency exceeding 1 GHz; *or*
- g.2. A carrier frequency of 1 GHz or less; *and*
- g.2.a. A frequency side-lobe rejection exceeding 55 Db;
- g.2.b. A product of the maximum delay

time and bandwidth (time in microseconds and bandwidth in MHz) of more than 100; *or*

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

h. Batteries, as follows:

**Note:** 3A991.h does not control batteries with volumes equal to or less than 26 cm<sup>3</sup> (e.g., standard C-cells or UM-2 batteries).

h.1. Primary cells and batteries having an energy density exceeding 350 Wh/kg and rated for operation in the temperature range from below 243 K (-30 °C) to above 343 K (70 °C);

h.2. Rechargeable cells and batteries having an energy density exceeding 150 Wh/kg after 75 charge/discharge cycles at a discharge current equal to C/5 hours (C being the nominal capacity in ampere hours) when operating in the temperature range from below 253 K (-20 °C) to above 333 K (60 °C);

**Technical Note:** Energy density is obtained by multiplying the average power in watts (average voltage in volts times average current in amperes) by the duration of the discharge in hours to 75 percent of the open circuit voltage divided by the total mass of the cell (or battery) in kg.

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

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

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



of the EAR for additional information.

**License Exceptions**

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

**List of Items Controlled**

*Unit:* \$ value  
*Related Controls:* See also 0B002, 3A225 (for frequency changes capable of operating in the frequency range of 600 Hz and above), 3A233  
*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 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 and specially designed components and accessories therefor.**

**License Requirements**

*Reason for Control:* NS, AT

<i>Control(s)</i>	<i>Country Chart</i>
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

**License Requirement Notes:** See §743.1 of the EAR for reporting requirements for exports under License Exceptions.

**License Exceptions**

LVS: \$500  
 GBS: "Yes, except 3B001 .a.2 (metal organic chemical vapor deposition reactors), 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.2 and a.3, or f), and f (lithography equipment).  
 CIV: Yes for equipment controlled by 3B001.a.1

**List of Items Controlled**

*Unit:* Number

*Related Controls:* See also 3B991

*Related Definitions:* N/A

*Items:*

a. "Stored program controlled" equipment designed for epitaxial growth, as follows:

a.1. Equipment capable of producing a layer thickness uniform to less than  $\pm 2.5\%$  across a distance of 75 mm or more;

a.2. Metal organic chemical vapor deposition (MOCVD) reactors specially designed for compound semiconductor crystal growth by the chemical reaction between materials controlled by 3C003 or 3C004;

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

b. "Stored program controlled" equipment designed for ion implantation, having any of the following:

b.1. A beam energy (accelerating voltage) exceeding 1MeV;

b.2. Being specially designed and optimized to operate at a beam energy (accelerating voltage) of less than 2 keV;

b.3. Direct write capability; *or*

b.4. Being capable of high energy oxygen implant into a heated semiconductor material "substrate";

c. "Stored program controlled" anisotropic plasma dry etching equipment, as follows:

c.1. Equipment with cassette-to-cassette operation and load-locks, and having any of the following:

c.1.a. Magnetic confinement; *or*

c.1.b. Electron cyclotron resonance (ECR);

c.2. Equipment specially designed for equipment controlled by 3B001.e. and having any of the following:

c.2.a. Magnetic confinement; *or*

c.2.b. ECR;

d. "Stored program controlled" plasma enhanced CVD equipment, as follows:

d.1. Equipment with cassette-to-cassette operation and load-locks, and having any of the following:

d.1.a. Magnetic confinement; *or*

d.1.b. ECR;

d.2. Equipment specially designed for equipment controlled by 3B001.e. and having any of the following:

d.2.a. Magnetic confinement; *or*

d.2.b. ECR;

e. "Stored program controlled" 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 pieces of semiconductor processing equipment are 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 not designed to operate in a vacuum environment.

f. "Stored program controlled" 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, having any of the following:

f.1.a. A light source wavelength shorter than 350 nm; *or*

f.1.b. Capable of producing a pattern with a minimum resolvable feature size of 0.5 μm or less;

**Technical Note:** The minimum resolvable feature size is calculated by the following formula:

$$\text{MRF} = \frac{(\text{an exposure light source wavelength in } \mu\text{m}) \times (\text{K factor})}{\text{numerical aperture}}$$

where the K factor = 0.7.  
MRF = minimum resolvable feature size.

f.2. Equipment specially designed for mask making or semiconductor device processing using deflected focussed electron beam, ion beam or "laser" beam, having any of the following:

f.2.a. A spot size smaller than 0.2 μm;

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

f.2.c. 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.

**3B002 "Stored program controlled" test equipment, specially designed for testing finished or unfinished semiconductor devices and specially designed components and accessories therefor.**

**License Requirements**

*Reason for Control:* NS, AT

<i>Control(s)</i>	<i>Country Chart</i>
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

**License Exceptions**

LVS: \$500  
GBS: Yes  
CIV: N/A

**List of Items Controlled**

*Unit:* Number  
*Related Controls:* See also 3B992  
*Related Definitions:* N/A  
*Items:*

- a. For testing S-parameters of transistor devices at frequencies exceeding 31 GHz;
- b. For testing integrated circuits capable of performing functional (truth table) testing at a pattern rate of more than 333 MHz;

**Note:** 3B002.b does not control test equipment specially designed for testing:

- 1. "Assemblies" or a class of "assemblies" for home or entertainment applications;
- 2. Uncontrolled electronic components,

"assemblies" or integrated circuits.

**Technical Note:** For purposes of 3B002.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.

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

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

**License Requirements**

*Reason for Control:* AT

*Control(s)* Country Chart

AT applies to entire entry AT Column 1

**License Exceptions**

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

**List of Items Controlled**

*Unit:* Equipment in number  
*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

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

**Export Administration Regulations**

manufacture of semiconductor devices, integrated circuits and "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 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, or 3C004, 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<sup>2</sup> 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  $2.5 \times 10^5$  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 a layer thickness uniformity across the wafer of equal to or better than  $\pm 3.5\%$ ;

b.1.d.2. Rotation of individual wafers during processing; *or*

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  $\pm 1$  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 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, 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  $\pm 0.25$  micrometer (3 sigma);

b.2.f.3. Machine-to-machine overlay no better than  $\pm 0.3$  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 focussed, 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  $\pm 10$  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<sup>3</sup> and filter materials therefor.

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

**License Requirements**

*Reason for Control:* AT

<i>Control(s)</i>	<i>Country Chart</i>
AT applies to entire entry	AT Column 1

**License Exceptions**

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

**List of Items Controlled**

*Unit:* Equipment in number  
*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

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

b. Equipment specially designed for the inspection or testing of semiconductor devices, integrated circuits and "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 "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;

**Note:** 3B992.b.4.b does not control equipment specially designed for testing integrated circuits not controlled by 3A001 or 3A991.

**Notes:** 1. 3B992.b.4.b does not control test equipment specially designed for testing "assemblies" or a class of "assemblies" for home and entertainment applications.

2. 3B992.b.4.b does not control test equipment specially designed for testing electronic components, "assemblies" and integrated circuits not controlled by 3A001 or 3A991 provided such test equipment does not incorporate computing facilities with "user accessible programmability".

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<sup>3</sup> 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

<i>Control(s)</i>	<i>Country Chart</i>
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

**License Exceptions**

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

**List of Items Controlled**

*Unit:* \$ value  
*Related Controls:* N/A  
*Related Definitions:* III/V compounds are polycrystalline or binary or complex monocrystalline products consisting of elements of groups IIIA and VA of Mendeleev's periodic classification table (e.g., gallium arsenide, gallium-aluminium arsenide, indium phosphide).  
*Items:*



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

*Reason for Control:* AT

*Control(s)*

*Country Chart*

AT applies to entire entry

AT Column 1

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

**License Exceptions**

LVS: N/A

GBS: N/A

CIV: N/A

**License Requirements**

*Reason for Control:* NS, AT

**List of Items Controlled**

*Control(s)*

*Country Chart*

*Unit:* \$ value

*Related Controls:* N/A

*Related Definitions:* N/A

NS applies to entire entry

NS Column 2

*Items:*

AT applies to entire entry

AT Column 1

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

**License Exceptions**

LVS: \$3000

GBS: N/A

CIV: N/A

**List of Items Controlled**

*Unit:* \$ value

*Related Controls:* This entry does not control hydrides containing less than 20% molar or more of inert gases or hydrogen.

*Related Definition:* 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).**

**3C992 Positive resists designed for semiconductor lithography specially adjusted (optimized) for use at wavelengths between 370 and 350 nm.**

**License Requirements**

*Reason for Control:* NS, AT

**License Requirements**

*Control(s)*

*Country Chart*

NS applies to "software" for equipment controlled by 3A001.b to 3A001.f, 3A002, and 3B

NS Column 1

**License Exceptions**

CIV: N/A  
 TSR: Yes

AT applies to entire entry

AT Column 1

**List of Items Controlled**

**License Requirement Notes:** See §743.1 of the EAR for reporting requirements for exports under License Exceptions.

*Unit:* \$ value  
*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

**License Exceptions**

CIV: N/A  
 TSR: Yes

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

**List of Items Controlled**

*Unit:* \$ value  
*Related Controls:* See also 3D101  
*Related Definitions:* N/A  
*Items:*

**3D003 Computer-aided-design (CAD) "software" designed for semiconductor devices or integrated circuits, having any of the following (see List of Items Controlled).**

**License Requirements**

*Reason for Control:* NS, AT

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

<i>Control(s)</i>	<i>Country Chart</i>
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NS applies to entire entry	NS Column 1
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AT applies to entire entry	AT Column 1
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**3D002 "Software" specially designed for the "use" of "stored program controlled" equipment controlled by 3B (except 3B991 and 3B992).**

**License Exceptions**

CIV: N/A  
 TSR: Yes

**License Requirements**

*Reason for Control:* NS, AT

**List of Items Controlled**

<i>Control(s)</i>	<i>Country Chart</i>
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*Unit:* \$ value  
*Related Controls:* This entry does not control "software" specially designed for schematic entry, logic simulation, placing and routing, layout verification or pattern generation tape.  
*Related Definitions:* 1.) Libraries, design attributes or associated data for the design of semiconductor devices or integrated circuits

NS applies to entire entry	NS Column 1
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AT applies to entire entry	AT Column 1
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are considered as "technology". 2.) A lithographic processing simulator is a "software" package used in the design phase to define the sequence of lithographic, etching and deposition steps for translating masking patterns into specific topographical patterns in conductors, dielectrics or semiconductor material.

*Items:*

- a. Design rules or circuit verification rules;
- b. Simulation of the physically laid out circuits;  
*or*
- c. Lithographic processing simulators for design.

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

**License Requirements**

*Reason for Control:* MT, AT

<i>Control(s)</i>	<i>Country Chart</i>
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

**License Exceptions**

CIV: N/A  
TSR: N/A

**List of Items Controlled**

*Unit:* \$ value  
*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

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

**Export Administration Regulations**

**3D102 "Software" specially designed for the "development" or "production" of equipment controlled by 3A001.a.1.a or 3A101.**

**License Requirements**

*Reason for Control:* MT, AT

<i>Control(s)</i>	<i>Country Chart</i>
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

**License Exceptions**

CIV: N/A  
TSR: N/A

**List of Items Controlled**

*Unit:* \$ value  
*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

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

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

**License Requirements**

*Reason for Control:* CC, AT

<i>Control(s)</i>	<i>Country Chart</i>
CC applies to entire entry	CC Column 1
AT applies to entire entry	AT Column 1

**License Exceptions**

CIV: N/A  
 TSR: N/A

**List of Items Controlled**

*Unit:* \$ value  
*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 or components controlled by 3A991, general purpose electronic equipment controlled by 3A992, or manufacturing and test equipment controlled by 3B991 and 3B992.**

**License Requirements**

*Reason for Control:* AT

<i>Control(s)</i>	<i>Country Chart</i>
AT applies to entire entry	AT Column 1

**License Exceptions**

CIV: N/A  
 TSR: N/A

**List of Items Controlled**

*Unit:* \$ value  
*Related Controls:* N/A  
*Related Definitions:* N/A  
*Items:*

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

**E. TECHNOLOGY**

**Export Administration Regulations**

**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 or 3A992), 3B (except 3B991 and 3B992) or 3C.**

**License Requirements**

*Reason for Control:* NS, MT, NP, AT

<i>Control(s)</i>	<i>Country Chart</i>
NS applies to "technology" for items controlled by 3A001, 3A002, 3B001 and 3B002 or 3C001 to 3C004	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 3A201, 3A225 to 3A233 for NP reasons	NP Column 1
AT applies to entire entry	AT Column 1

**License Requirement Notes:** See §743.1 of the EAR for reporting requirements for exports under License Exceptions.

**License Exceptions**

CIV: N/A  
 TSR: Yes, except N/A for MT

**List of Items Controlled**

*Unit:* N/A  
*Related Controls:* 1.) See also 3E101 and

3E201. 2.) 3E001 does not control "technology" for the "development" or "production" of: (a) Microwave transistors operating at frequencies below 31 GHz; (b) Integrated circuits controlled by 3A001.a.3 to a.12, having all of the following: 1. Using "technology" of 0.7 micrometer or more, AND 2. Not incorporating multi-layer structures. 3.) The term multi-layer structures in this entry does not include devices incorporating a maximum of two metal layers and two polysilicon layers.

*Related Definition:* N/A

*Items:*

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

**3E002 Other "technology" for the "development" or "production" of items described in the List of Items Controlled.**

**License Requirements**

*Reason for Control:* NS, AT

<i>Control(s)</i>	<i>Country Chart</i>
NS applies to entire entry	NS Column 1
AT applies to entire entry	AT Column 1

**License Exceptions**

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

**List of Items Controlled**

*Unit:* N/A  
*Related Controls:* 1.) 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 devices such as high electron mobility transistors (HEMT), hetero-bipolar transistors (HBT), quantum well and super lattice devices;
- 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. "Technology" according to the General Technology Note other than that controlled in 3E001 for the "development" or "production" of "microprocessor microcircuits", "micro-computer microcircuits" and microcontroller microcircuits having a "composite theoretical performance" ("CTP") of 530 million theoretical operations per second (Mtops) or more and an arithmetic logic unit with an access width of more than 32 bits or more.

**Note:** 3E002.g does not control "technology" for the "development" or "production" of: (a) Microwave transistors operating at frequencies below 31 GHz; (b) Integrated circuits controlled by 3A001.a.3 to a.12, having all of the following: 1.) Using "technology" of 0.7 micrometer or more, and 2.) Not incorporating multi-layer structures. The term multi-layer structures in this entry does not include devices incorporating a maximum of two metal layers and two polysilicon layers

**3E101 "Technology" according to the General Technology Note for the "use" of equipment or**

**"software" controlled by 3A001.a.1.a. or 3A101.**

CIV: N/A  
TSR: N/A

**License Requirements**

*Reason for Control:* MT, AT

<i>Control(s)</i>	<i>Country Chart</i>
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MT applies to entire entry	MT Column 1
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AT applies to entire entry	AT Column 1
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**List of Items Controlled**

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

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

**License Exceptions**

CIV: N/A  
TSR: N/A

**List of Items Controlled**

*Unit:* N/A  
*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 3A201, 3A225 to 3A233.**

**License Requirements**

*Reason for Control:* NP, AT

<i>Control(s)</i>	<i>Country Chart</i>
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NP applies to entire entry	NP Column 1
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AT applies to entire entry	AT Column 1
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**License Exceptions**

CIV: N/A  
TSR: N/A

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

**License Requirements**

*Reason for Control:* MT, AT

<i>Control(s)</i>	<i>Country Chart</i>
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MT applies to entire entry	MT Column 1
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AT applies to entire entry	AT Column 1
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**List of Items Controlled**

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

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

**License Exceptions**

**3E292 "Technology" according to the General Technology Note for the "development",**



**any other category in the CCL are designated by the number *EAR99*.**

**EAR99** Items subject to the EAR that are *not* elsewhere specified in this CCL Category *or* in