**E 3510-33-P**

**DEPARTMENT OF COMMERCE**

**Bureau of Industry and Security**

**15 CFR Part 774**

**[Docket No. 201118–0305]**

**RIN 0694-AH77**

# Wassenaar Arrangement 2018 Plenary Decisions Implementation; and Other Revisions Related to National Security Controls; Correction

**AGENCY:** Bureau of Industry and Security, Commerce.

**ACTION:** Correcting amendments.

**SUMMARY:** In this rule, the Bureau of Industry and Security (BIS) amends the Export Administration Regulations (EAR) by making corrections to address errors that were inadvertently introduced with the September 11, 2020, *Federal Register* publication of "Wassenaar Arrangement 2018 Plenary Decisions Implementation; and Other Revisions Related to National Security Controls (Final Rule)".

**DATES:** This rule is effective [INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER].

**FOR FURTHER INFORMATION CONTACT:** Logan Norton, Regulatory Policy Division, Logan.Norton@bis.doc.gov, (202) 812-1762.

**SUPPLEMENTARY INFORMATION:**

**Background**

On September 11, 2020, BIS published "Wassenaar Arrangement 2018 Plenary Decisions Implementation; and Other Revisions Related to National Security Controls (Final Rule)" (85 FR 56294) in the *Federal Register*. This publication unintentionally introduced errors in Export Control Classification Numbers (ECCNs) 3A001, 3A002, 3A991, 5A002, 7A005, and 9E003, entries located on the Commerce Control List, Supplement No. 1 to part 774 of the EAR. This final rule revises part 774 of the EAR to correct these errors and thereby conform the entries to other recent regulatory changes. These revisions do not change BIS policy, including policy regarding any applicable licensing requirements. The specific revisions set forth in this final rule are detailed below.

3A001 Electronic Items

ECCN 3A001 is corrected as follows:

Adding double quotes around the remaining listed terms that do not have double quotes in the Note following the introductory text of Items paragraph .a. This stylistic convention is consistent with the Wassenaar Arrangement List of Dual-Use Goods and Technologies and the EAR.

Item paragraph a.2 is corrected by replacing "Electrical Erasable Programmable Read Only Memories (EEPROMS), flash memories, and MRAMs" with 'non-volatile memories' and by adding a Technical Note to define 'non-volatile memories.'

Item paragraph a.2.c is corrected by adding a plus sign before 125˚C.

The term "Mega Samples Per Second" is removed from subparagraphs a.5.a.3, a.5.a.4, and a.5.a.5 in Item paragraph a.5.a, leaving its acronym "MSPS" in all three places. Item paragraph a.5.a and the Technical Note below a.5.a are corrected by

replacing the term “output rate” with the term “sample rate”. The Technical Notes below Item paragraph a.5.a are corrected by adding an explanation for the resolution of the Analogue-to-Digital Convert (ADC), by removing the explanation for output rate, by replacing single quotes with double quotes around the terms “interleaved ADCs” and “multiple channel ADCs”, and by removing Technical Notes 5 through 9.

Item paragraph a.5.b.2.a (settling time parameter) is corrected by adding “arrive at or within” before the reference to 0.024%.

The inclusion Note to 3A001.a.7 is corrected by removing the term “Simple Programmable Logic Devices (SPLDs)”.

Item paragraph a.14 is corrected by replacing “Integrated circuits that perform all of the following:” with “Integrated circuits that perform or are programmable to perform all of the following:”. Item paragraph a.14 is corrected by replacing the term “input sample rate” with the term “sample rate”, which is defined in part 772. Item paragraph a.14 is also corrected by removing “Giga Samples Per Second” from subparagraphs a.14.a.2 and a.14.a.3, leaving the acronym “GSPS” in both places. Item paragraph a.14 is also corrected by removing “Mega Samples Per Second” from subparagraph a.14.a.5, leaving the acronym “MSPS”.

Four Technical Notes that further explain the parameters in Item paragraph a. are added below Item paragraph a.14.b.2.

Nota Bene 3 is added after Item paragraph b.4.f to reference 3A001.b.7 for converters and harmonic mixers.

In Item paragraph b.11, double quotes are replaced with single quotes around the term ‘frequency synthesizer’, the “or” is removed from the end of b.11.d, and a Technical Note below Item paragraph b.11.g is added defining ‘frequency synthesizer’.

Technical Note 5 after Item paragraph b.12.d is corrected by replacing the reference “3A001.b.4.12.c” with “3A001.b.12.c”.

The parameters for ‘primary cells’ in Item paragraph e.1.a are corrected by cascading the parameters and by adding a ‘continuous power density’ parameter and the definition for it in Technical Note 5 below Item paragraph e.1.b. In Item paragraph e.1.b, “293 K” and extraneous parentheticals around 20ºC are removed.

Item paragraph 3A001.f, which pertains to rotary input type absolute position encoders, is corrected by removing a single plus/minus sign in front of “1.0 second of arc”.

Paragraph 3A001.i, which pertains to intensity, amplitude, or phase electro-optic modulators, designed for analog signals (including electro-optic modulators having optical input and output connectors), is added. These items are eligible for License Exception Shipments to Country Group B countries (GBS); therefore, the GBS paragraph under “List Based License Exceptions” is accordingly corrected to reference Item paragraph .i. One parameter specified in Item paragraph .i, ‘half-wave voltage’ (‘$V\pi$’), is defined in a Technical Note added below the paragraph.

3A002 General Purpose “Electronic Assemblies,” Modules and Equipment

In Item paragraph c.1., the frequency parameter is corrected by replacing “exceeding 10 MHz” with “exceeding 40 MHz” for signal analyzers having a 3 dB resolution bandwidth (RBW).

Double quotes are replaced with single quotes for the term ‘real-time bandwidth’ in Item paragraph c.4.a and for the term ‘frequency mask trigger’ in Item paragraph c.4.b.2. The definitions for these terms are added to the Technical Notes after Item

paragraph c.4.b.2. Two additional Technical Notes are added, for a total of four Technical Notes.

Double quotes are added to the term “sample rate” in Item paragraph h.1. The words “an input” are replaced with the word “a” in Item paragraph h.1.

The scientific unit “billion samples per second” is replaced with “Giga Samples Per Second (GSPS)” in Item paragraph h.1.a.

The scientific unit “billion samples per second” is replaced with the acronym “GSPS” in Item paragraphs h.1.b and h.1.c.

The scientific unit “million samples per second” is replaced with “Mega Samples Per Second (MSPS)” in Item paragraph h.1.d.

The scientific unit “million samples per second” is replaced with the acronym “MSPS” in Item paragraph h.1.e.

The Technical Note below Item paragraph h.2.c is replaced by four Technical Notes that explain resolution and “sample rate” for interleaved and non-interleaved multiple-channel “electronic assemblies”, modules, or equipment.

3A991 Electronic Devices, and “Components”

Item paragraph j.2 is corrected by increasing the energy density from 300 to 350 Wh/kg or less.

5A002 “Information Security” Systems, Equipment, and “Components”

Paragraph (4)(a) of Related Controls is corrected by replacing the phrase ‘in excess of 56 bits of symmetric key length, or equivalent’ with ‘described security algorithm’.

Item paragraph .a is corrected by replacing “usable without “cryptographic activation” or has been activated” with “useable, has been activated, or can be activated by means of “cryptographic activation” not employing a secure mechanism”.

Item paragraph a.4 is corrected by removing “in excess of”.

Paragraph 2.a of the Technical Notes that follow Item paragraph a.4 is corrected by removing the word “or” at the end of the paragraph.

Paragraph 2.b of the Technical Notes that follow Item paragraph a.4 is corrected by replacing “.” with “; or” at the end.

7A005 “Satellite Navigation System” Receiving Equipment

The reference to License Exception Civil End Users, which was removed from the EAR by 85 FR 23470 (April 28, 2020), is deleted from the License Exception section of ECCN 7A005.

9E003 “Specially Designed” Assemblies or “Components” for Aero Gas Turbine Engines

ECCN 9E003 is corrected as follows:

In Technical Note 2 below Item paragraph a.2 and in the Technical Note below Item paragraph a.5, the single quotes are replaced with double quotes around the term “steady state mode”. In Technical Note 2 below a.5, the definition for “steady state mode”, is removed.

Technical Note 4 below the Note to 9E003.c is corrected by replacing “laser” with ““laser” beam machining”, replacing “water jet” with “water jet machining”, and by replacing “Electrical Discharge Machining (EDM) methods” with “Electrical Discharge Machining (EDM)”.

**Export Control Reform Act of 2018**

On August 13, 2018, the President signed into law the John S. McCain National Defense Authorization Act for Fiscal Year 2019, which included the Export Control Reform Act of 2018 (ECRA), 50 U.S.C. Sections 4801–4852. ECRA provides the legal basis for BIS's principal authorities and serves as the authority under which BIS issues this rule.

**Rulemaking Requirements**

1. Executive Orders 13563 and 12866 direct agencies to assess all costs and benefits of available regulatory alternatives and, if regulation is necessary, to select regulatory approaches that maximize net benefits (including potential economic, environmental, public health and safety effects, and distributed impacts, and taking into account equity issues). Executive Order 13563 emphasizes the importance of quantifying both costs and benefits, of reducing costs, of harmonizing rules, and of promoting flexibility. This final rule has been designated as a regulatory action that is not significant under section 3(f) of Executive Order 12866. This rule is not an Executive Order 13771 regulatory action because this rule is not significant under Executive Order 12866.

2. Notwithstanding any other provision of law, no person may be required to respond to or be subject to a penalty for failure to comply with a collection of information, subject to the requirements of the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.) (PRA), unless that collection of information displays a currently valid Office of Management and Budget (OMB) Control Number. This regulation involves a collection currently approved by OMB under control number 0694-0088, Simplified Network Application Processing System. This collection includes, among other things, license applications, and carries a burden estimate of 42.5 minutes for a manual or electronic submission for a total burden estimate of 31,878 hours. BIS does not expect the burden

hours associated with this collection to change as a result of these correcting amendments.

3. This rule does not contain policies with federalism implications as that term is defined under Executive Order 13132.

**Administrative Procedure Act and Regulatory Flexibility Act Requirements**

Pursuant to Section 4821 of ECRA, this action is exempt from the Administrative Procedure Act (5 U.S.C. 553) requirements for notice of proposed rulemaking, opportunity for public participation and delay in effective date. Furthermore, no other law requires that a notice of proposed rulemaking and an opportunity for public comment be given for this final rule. Because a notice of proposed rulemaking and an opportunity for public comment are not required to be given for this rule under the Administrative Procedure Act or by any other law, the analytical requirements of the Regulatory Flexibility Act (5 U.S.C. 601 et seq.) are not applicable. Accordingly, no regulatory flexibility analysis is required, and none has been prepared.

**List of Subjects in 15 CFR Part 774**

Exports, Reporting and recordkeeping requirements, Terrorism.

Accordingly, part 774 of the Export Administration Regulations (15 CFR parts 730 through 774) is corrected by making the following correcting amendments:

**PART 774 – [AMENDED]**

1. The authority citation for 15 CFR part 774 continues to read as follows:

**Authority:** 50 U.S.C. 4801-4852; 50 U.S.C. 4601 et seq.; 50 U.S.C. 1701 et seq.; 10 U.S.C. 8720; 10 U.S.C. 8730(e); 22 U.S.C. 287c, 22 U.S.C. 3201 et seq.; 22 U.S.C. 6004; 42 U.S.C. 2139a; 15 U.S.C. 1824; 50 U.S.C. 4305; 22 U.S.C. 7201 et seq.; 22 U.S.C. 7210; E.O. 13026, 61 FR 58767, 3 CFR, 1996 Comp., p. 228; E.O. 13222, 66 FR 44025, 3 CFR, 2001 Comp., p. 783.

2. In Supplement No. 1 to part 774:

a. Revise ECCNs 3A001, 3A002, and 3A991 under Category 3, section A;

b. Revise ECCN 5A002 under Category 5, Part 2, section A.I.;

c. Revise ECCN 7A005 under Category 7, section A; and

d. Revise ECCN 9E003 under Category 9, section E.

The revisions read as follows:

**Supplement No. 1 to Part 774—The Commerce Control List**

* * * * *

Category 3—Electronics

*A. "End Items", "Equipment", "Accessories", "Attachments", "Parts", "Components" and "Systems"*

* * * * *

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

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

| *Control(s)* | *Country Chart (See Supp. No. 1 to part 738)* |
|---|---|
| NS applies to "Monolithic Microwave Integrated Circuit" ("MMIC") amplifiers | NS Column 1 |

| | |
|---|---|
| in 3A001.b.2 and discrete microwave transistors in 3A001.b.3, except those 3A001.b.2 and b.3 items being exported or reexported for use in civil telecommunications applications | |
| NS applies to entire entry | NS Column 2 |
| RS applies “Monolithic Microwave Integrated Circuit” (“MMIC”) amplifiers in 3A001.b.2 and discrete microwave transistors in 3A001.b.3, except those 3A001.b.2 and b.3 items being exported or | RS Column 1 |

| | |
|---|---|
| reexported for use in civil telecommunications applications | |
| 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 | NP Column 1 |

| | |
|---|---|
| 3A001.e.3 that meet or exceed the technical parameters in 3A201.a and 3A201.b, respectively | |
| AT applies to entire entry | AT Column 1 |

***Reporting Requirements:*** *See §743.1 of the EAR for reporting requirements for exports under 3A001.b.2 or b.3 under License Exceptions, and Validated End-User authorizations.*

***License Requirements Note****: See § 744.17 of the EAR for additional license requirements for microprocessors having a processing speed of 5 GFLOPS or more and an arithmetic logic unit with an access width of 32 bit or more, including those incorporating "information security" functionality, and associated "software" and "technology" for the "production" or "development" of such microprocessors.*

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

*LVS:* N/A for MT or NP; N/A for "Monolithic Microwave Integrated Circuit" ("MMIC") amplifiers in 3A001.b.2 and discrete microwave transistors in 3A001.b.3, except those that are being exported or reexported for use in civil telecommunications applications

Yes for:

$1500: 3A001.c

$3000: 3A001.b.1, b.2 (exported or reexported for use in civil telecommunications applications), b.3 (exported or reexported for use in civil telecommunications applications), b.9, .d, .e, .f, and .g.

$5000: 3A001.a (except a.1.a and a.5.a when controlled for MT), .b.4 to b.7, and b.12.

*GBS:* Yes for 3A001.a.1.b, a.2 to a.14 (except .a.5.a when controlled for MT), b.2 (exported or reexported for use in civil telecommunications applications), b.8 (except for "vacuum electronic devices" exceeding 18 GHz), b.9., b.10, .g, and .h, and .i.

**Special Conditions for STA**

*STA*: License Exception STA may not be used to ship any item in 3A001.b.2 or b.3, except those that are being exported or reexported for use in civil

telecommunications applications, to any of the destinations listed in Country Group A:5 or A:6 (See Supplement No.1 to part 740 of the EAR).

**List of Items Controlled**

*Related Controls:* (1) See Category XV of the USML for certain "space-qualified" electronics and Category XI of the USML for certain ASICs, 'transmit/receive modules,' or 'transmit modules' "subject to the ITAR" (see 22 CFR parts 120 through 130). (2) See also 3A101, 3A201, 3A611, 3A991, and 9A515.

*Related Definitions*: 'Microcircuit' means a device in which a number of passive or active elements are considered as indivisibly associated on or within a continuous structure to perform the function of a circuit. 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*:** *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";*

- *"Monolithic Microwave Integrated Circuits" ("MMICs").*

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;

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

a.1.c. A fluence (integrated flux) of neutrons (1 MeV equivalent) of $5 \times 10^{13}$ 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, integrated circuits that contain analog-to-digital converters and store or process the digitized data, 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, Static Random-Access Memories (SRAMs), or 'non-volatile memories,' having any of the following:

***Technical Note:*** *'Non-volatile memories' are memories with data retention over a period of time after a power shutdown.*

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 designed 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 a "sample rate" greater than 1.3 Giga Samples Per Second (GSPS);

a.5.a.2. A resolution of 10 bit or more, but less than 12 bit, with a "sample rate" greater than 600 Mega Samples Per Second (MSPS);

a.5.a.3. A resolution of 12 bit or more, but less than 14 bit, with a "sample rate" greater than 400 MSPS;

a.5.a.4. A resolution of 14 bit or more, but less than 16 bit, with a "sample rate" greater than 250 MSPS; *or*

a.5.a.5. A resolution of 16 bit or more with a “sample rate” greater than 65 MSPS;

***N.B.:*** *For integrated circuits that contain analog-to-digital converters and store or process the digitized data see 3A001.a.14.*

***Technical Notes*:**

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

***2.*** *The resolution of the ADC is the number of bits of the digital output that represents the measured analog input. Effective Number of Bits (ENOB) is not used to determine the resolution of the ADC.*

***3.*** *For “multiple channel ADCs”, the “sample rate” is not aggregated and the “sample rate” is the maximum rate of any single channel.*

***4.*** *For “interleaved ADCs” or for “multiple channel ADCs” that are specified to have an interleaved mode of operation, the “sample rates” are aggregated and the “sample rate” is the maximum combined total rate of all of the interleaved channels.*

a.5.b. Digital-to-Analog Converters (DAC) having any of the following:

a.5.b.1. A resolution of 10-bit or more but less than 12-bit,with an ‘adjusted update rate’ of exceeding 3,500 MSPS; *or*

a.5.b.2. A resolution of 12-bit or more and having any of the following:

a.5.b.2.a. An ‘adjusted update rate’ exceeding 1,250 MSPS but not exceeding 3,500 MSPS, and having any of the following:

a.5.b.2.a.1. A settling time less than 9 ns to arrive at or within 0.024 % of full scale from a full scale step; *or*

a.5.b.2.a.2. 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; *or*

a.5.b.2.b. An ‘adjusted update rate’ exceeding 3,500 MSPS;

***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 greater than 700; *or*

a.7.b. An ‘aggregate one-way peak serial transceiver data rate’ of 500 Gb/s or greater;

***Note*: *3A001.a.7 includes:***

*-Complex Programmable Logic Devices (CPLDs);*

*-Field Programmable Gate Arrays (FPGAs);*

*-Field Programmable Logic Arrays (FPLAs);*

*-Field Programmable Interconnects (FPICs).*

***N.B.**: For integrated circuits having field programmable logic devices that are combined with an analog-to-digital converter, see 3A001.a.14.*

***Technical Notes**:*

***1**. 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.*

***2**. '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.*

a.14. Integrated circuits that perform or are programmable to perform all of the following:

a.14.a. Analog-to-digital conversions meeting any of the following:

a.14.a.1. A resolution of 8 bit or more, but less than 10 bit, with a “sample rate” greater than 1.3 Giga Samples Per Second (GSPS);

a.14.a.2. A resolution of 10 bit or more, but less than 12 bit, with a “sample rate” greater than 1.0 GSPS;

a.14.a.3. A resolution of 12 bit or more, but less than 14 bit, with a “sample rate” greater than 1.0 GSPS;

A.14.a.4. A resolution of 14 bit or more, but less than 16 bit, with a “sample rate” greater than 400 Mega Samples Per Second (MSPS); *or*

a.14.a.5. A resolution of 16 bit or more with a “sample rate” greater than 180 MSPS; *and*

a.14.b. Any of the following:

a.14.b.1. Storage of digitized data; *or*

a.14.b.2. Processing of digitized data;

***N.B. 1****: For analog-to-digital converter integrated circuits see 3A001.a.5.a.*

***N.B. 2**:For field programmable logic devices see 3A001.a.7.*

***Technical Notes:***

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

*2. The resolution of the ADC is the number of bits of the digital output of the ADC that represents the measured analog input. Effective Number of Bits (ENOB) is not used to determine the resolution of the ADC.*

*3. For integrated circuits with non- interleaving "multiple channel ADCs", the "sample rate" is not aggregated and the "sample rate" is the maximum rate of any single channel.*

*4. For integrated circuits with "interleaved ADCs" or with "multiple channel ADCs" that are specified to have an interleaved mode of operation, the "sample rates" are aggregated and the "sample rate" is the maximum combined total rate of all of the interleaved channels.*

b. Microwave or millimeter wave items, 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. "Vacuum electronic devices" and cathodes, as follows:

***Note 1*:** *3A001.b.1 does not control "vacuum electronic devices" 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" "vacuum electronic devices" 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 “vacuum electronic devices,” pulsed or continuous wave, as follows:

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

b.1.a.2. Devices having a cathode heater with a turn on time to rated RF power of less than 3 seconds;

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

b.1.a.4. Devices based on helix, folded waveguide, or serpentine waveguide circuits, 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;

b.1.a.4.c. Being “space-qualified”; *or*

b.1.a.4.d. Having a gridded electron gun;

b.1.a.5. Devices with a “fractional bandwidth” greater than or equal to 10%, with any of the following:

b.1.a.5.a. An annular electron beam;

b.1.a.5.b. A non-axisymmetric electron beam; *or*

b.1.a.5.c. Multiple electron beams;

b.1.b. Crossed-field amplifier “vacuum electronic devices” with a gain of more than 17 dB;

b.1.c. Thermionic cathodes, designed for “vacuum electronic devices,” producing an emission current density at rated operating conditions exceeding 5 A/cm$^2$ or a pulsed (non-continuous) current density at rated operating conditions exceeding 10 A/cm$^2$;

b.1.d. “Vacuum electronic devices” with the capability to operate in a ‘dual mode.’

***Technical Note**: 'Dual mode' means the "vacuum electronic device" beam current can be intentionally changed between continuous-wave and pulsed mode operation by use of a grid and produces a peak pulse output power greater than the continuous-wave output power.*

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

***N.B.:** For "MMIC" amplifiers that have an integrated phase shifter see 3A001.b.12.*

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 0.1 nW (-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;

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; *or*

b.3.f. Other than those specified by 3A001.b.3.a to 3A001.b.3.e and rated for operation with a peak saturated power output greater than 5 W (37.0 dBm) at all frequencies exceeding 8.5 GHz up to and including 31.8 GHz;

***Note 1*:** *The control status of a transistor in 3A001.b.3.a through 3A001.b.3.e, 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. [Reserved]

***N.B.*:**

1. For "*MMIC" amplifiers see 3A001.b.2.*

2. *For 'transmit/receive modules' and 'transmit modules' see 3A001.b.12.*

3. *For converters and harmonic mixers, designed to extend the operating or frequency range of signal analyzers, signal generators, network analyzers or microwave test receivers, see 3A001.b.7.*

***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.*

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, that are any of the following:

b.7.a. Designed to extend the frequency range of "signal analyzers" beyond 90 GHz;

b.7.b. Designed to extend the operating range of signal generators as follows:

b.7.b.1. Beyond 90 GHz;

b.7.b.2. To an output power greater than 100 mW (20 dBm) anywhere within the frequency range exceeding 43.5 GHz but not exceeding 90 GHz;

b.7.c. Designed to extend the operating range of network analyzers as follows:

b.7.c.1. Beyond 110 GHz;

b.7.c.2. To an output power greater than 31.62 mW (15 dBm) anywhere within the frequency range exceeding 43.5 GHz but not exceeding 90 GHz;

b.7.c.3. To an output power greater than 1 mW (0 dBm) anywhere within the frequency range exceeding 90 GHz but not exceeding 110 GHz; *or*

b.7.d. Designed to extend the frequency range of microwave test receivers beyond 110 GHz;

b.8. Microwave power amplifiers containing "vacuum electronic devices" 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 "vacuum electronic device," a "Monolithic Microwave Integrated Circuit" ("MMIC") 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 a single sideband (SSB) phase noise, in dBc/Hz, less (better) than $-(126 + 20\log_{10}F - 20\log_{10}f)$ anywhere within the range of $10\ \text{Hz} \leq F \leq 10\ \text{kHz}$;

***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 143 ps;

b.11.b. Less than 100 μs for any frequency change exceeding 2.2 GHz within the synthesized frequency range exceeding 4.8 GHz but not exceeding 31.8 GHz;

b.11.c. [Reserved]

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 37 GHz;

b.11.e. Less than 100 μs for any frequency change exceeding 2.2 GHz within the synthesized frequency range exceeding 37 GHz but not exceeding 90 GHz; *or*

b.11.f. [Reserved]

b.11.g. Less than 1 ms within the synthesized frequency range exceeding 90 GHz;

***Technical Note:*** *A 'frequency synthesizer' is any kind of frequency source, regardless of the actual technique used, providing a multiplicity of simultaneous or alternative output frequencies, from one or more outputs, controlled by, derived from or disciplined by a lesser number of standard (or master) frequencies.*

***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.*

b.12. 'Transmit/receive modules,' 'transmit/receive MMICs,' 'transmit modules,' and 'transmit MMICs,' rated for operation at frequencies above 2.7 GHz and having all of the following*:*

b.12.a. A peak saturated power output (in watts), $P_{sat}$, greater than 505.62 divided by the maximum operating frequency (in GHz) squared [$P_{sat}$>505.62 W*$GHz^2/f_{GHz}^2$] for any channel;

b.12.b. A “fractional bandwidth” of 5% or greater for any channel;

b.12.c. Any planar side with length d (in cm) equal to or less than 15 divided by the lowest operating frequency in GHz [$d \leq 15cm*GHz*N/f_{GHz}$] where N is the number of transmit or transmit/receive channels; *and*

b.12.d. An electronically variable phase shifter per channel.

***Technical Notes:***

*1. A ‘transmit/receive module’ is a multifunction “electronic assembly” that provides bi-directional amplitude and phase control for transmission and reception of signals.*

*2. A ‘transmit module’ is an “electronic assembly” that provides amplitude and phase control for transmission of signals.*

*3. A ‘transmit/receive MMIC’ is a multifunction “MMIC” that provides bi-directional amplitude and phase control for transmission and reception of signals.*

*4. A ‘transmit MMIC’ is a “MMIC” that provides amplitude and phase control for transmission of signals.*

*5. 2.7 GHz should be used as the lowest operating frequency ($f_{GHz}$) in the formula in 3A001.b.12.c for transmit/receive or transmit modules that have a rated operation range extending downward to 2.7 GHz and below [d≤15cm*GHz*N/2.7 GHz].*

*6. 3A001.b.12 applies to 'transmit/receive modules' or 'transmit modules' with or without a heat sink. The value of d in 3A001.b.12.c does not include any portion of the 'transmit/receive module' or 'transmit module' that functions as a heat sink.*

*7. 'Transmit/receive modules' or 'transmit modules,' 'transmit/receive MMICs' or 'transmit MMICs' may or may not have N integrated radiating antenna elements where N is the number of transmit or transmit/receive channels.*

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 any of the following at 20ºC:

e.1.a.1. ‘Energy density’ exceeding 550 Wh/kg and a ‘continuous power density’ exceeding 50 W/kg; *or*

e.1.a.2. ‘Energy density’ exceeding 50 Wh/kg and a ‘continuous power density’ exceeding 350 W/kg;

e.1.b. ‘Secondary cells’ having an ‘energy density’ exceeding 350 Wh/kg at 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.*

***5.*** *For the purpose of 3A001.e.1.a, 'continuous power density' (W/kg) is calculated from the nominal voltage multiplied by the specified maximum continuous discharge current in ampere (A) divided by the mass in kilograms. 'Continuous power density' is also referred to as specific power.*

***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 and "specially designed" encoder rings, discs or scales therefor;

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.*

i. Intensity, amplitude, or phase electro-optic modulators, designed for analog signals and having any of the following:

i.1. A maximum operating frequency of more than 10 GHz but less than 20 GHz, an optical insertion loss equal to or less than 3 dB and having any of the following:

i.1.a. A 'half-wave voltage' ('Vπ') less than 2.7 V when measured at a frequency of 1 GHz or below; *or*

i.1.b. A ‘Vπ’ of less than 4 V when measured at a frequency of more than 1 GHz; *or*

i.2. A maximum operating frequency equal to or greater than 20 GHz, an optical insertion loss equal to or less than 3 dB and having any of the following:

i.2.a. A ‘Vπ’ less than 3.3 V when measured at a frequency of 1 GHz or below; *or*

i.2.b. A ‘Vπ’ less than 5 V when measured at a frequency of more than 1 GHz.

***Note:*** *3A001.i includes electro-optic modulators having optical input and output connectors (e.g., fiber-optic pigtails).*

***Technical Note:*** *For the purposes of 3A001.i, a ‘half-wave voltage’ (‘Vπ’) is the applied voltage necessary to make a phase change of 180 degrees in the wavelength of light propagating through the optical modulator.*

**3A002 General purpose “electronic assemblies,” modules and equipment, as follows (see List of Items Controlled).**

**License Requirements**

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

| *Control(s)* | *Country Chart (See Supp. No. 1 to part 738)* |
|---|---|

| | |
|---|---|
| NS applies to entire entry | NS Column 2 |
| MT applies to 3A002.h when the parameters in 3A101.a.2.b are met or exceeded | MT 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, 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, and .g

$5000: 3A002.c to .d, and .h (unless controlled for MT);

*GBS*: Yes, for 3A002.h (unless controlled for MT)

**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*: See Category XV(e)(9) of the USML for certain "space-qualified" atomic frequency standards "subject to the ITAR" (see 22 CFR parts 120 through 130). See also 3A101, 3A992 and 9A515.x.

*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.5. [Reserved]

***N.B.*:** *For waveform digitizers and transient recorders, see 3A002.h.*

a.6. Digital data recorders having all of the following:

a.6.a. A sustained 'continuous throughput' of more than 6.4 Gbit/s to disk or solid-state drive memory; *and*

a.6.b. "Signal processing" of the radio frequency signal data while it is being

recorded;

***Technical Notes**:*

*1. For recorders 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 record to disk or solid-state drive memory without the loss of any information while sustaining the input digital data rate or digitizer conversion rate.*

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. "Signal analyzers" as follows:

c.1. “Signal analyzers” having a 3 dB resolution bandwidth (RBW) exceeding 40 MHz anywhere within the frequency range exceeding 31.8 GHz but not exceeding 37 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 90 GHz;

c.3. “Signal analyzers” having a frequency exceeding 90 GHz;

c.4. “Signal analyzers” having all of the following:

c.4.a. ‘Real-time bandwidth’ exceeding 170 MHz; *and*

c.4.b. Having any of the following:

c.4.b.1. 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; *or*

c.4.b.2. A ‘frequency mask trigger’ function, with 100% probability of trigger (capture) for signals having a duration of 15 μs or less;

***Technical Notes:***

*1. 'Real-time bandwidth' is the widest frequency range for which the analyzer can continuously transform time-domain data entirely into frequency-domain results, using a Fourier or other discrete time transform that processes every incoming time point, without a reduction of measured amplitude of more than 3 dB below the actual signal amplitude caused by gaps or windowing effects, while outputting or displaying the transformed data.*

*2. Probability of discovery in 3A002.c.4.b.1 is also referred to as probability of intercept or probability of capture.*

*3. For the purposes of 3A002.c.4.b.1, the duration for 100% probability of discovery is equivalent to the minimum signal duration necessary for the specified level measurement uncertainty.*

*4. A 'frequency mask trigger' is a mechanism where the trigger function is able to select a frequency range to be triggered on as a subset of the acquisition bandwidth while ignoring other signals that may also be present within the same acquisition bandwidth. A 'frequency mask trigger' may contain more than one independent set of limits.*

***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).***

c.5. [Reserved]

d. Signal generators having any of the following:

d.1. Specified to generate pulse-modulated signals having all of the following, anywhere within the frequency range exceeding 31.8 GHz but not exceeding 37 GHz:

d.1.a. ‘Pulse duration’ of less than 25 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 frequency range exceeding 43.5 GHz but not exceeding 90 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 2.2 GHz within the frequency range exceeding 4.8 GHz but not exceeding 31.8 GHz;

d.3.c. [Reserved]

d.3.d. Less than 500 μs for any frequency change exceeding 550 MHz within the frequency range exceeding 31.8 GHz but not exceeding 37 GHz; *or*

d.3.e. Less than 100 μs for any frequency change exceeding 2.2 GHz within the frequency range exceeding 37 GHz but not exceeding 90 GHz;

d.3.f. [Reserved]

d.4. Single sideband (SSB) phase noise, in dBc/Hz, specified as being any 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 frequency range exceeding 3.2 GHz but not exceeding 90 GHz; *or*

d.4.b. Less (better) than (206 20$\log_{10}$f) for anywhere within the range of 10 kHz < F ≤ 100 kHz anywhere within the frequency range exceeding 3.2 GHz but not exceeding 90 GHz;

***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. An 'RF modulation bandwidth' of digital baseband signals as specified by any of the following:

d.5.a. Exceeding 2.2 GHz within the frequency range exceeding 4.8 GHz

but not exceeding 31.8 GHz;

d.5.b. Exceeding 550 MHz within the frequency range exceeding 31.8 GHz but not exceeding 37 GHz; *or*

d.5.c. Exceeding 2.2 GHz within the frequency range exceeding 37 GHz but not exceeding 90 GHz; *or*

***Technical Note:*** *'RF modulation bandwidth' is the Radio Frequency (RF) bandwidth occupied by a digitally encoded baseband signal modulated onto an RF signal. It is also referred to as information bandwidth or vector modulation bandwidth. I/Q digital modulation is the technical method for producing a vector-modulated RF output signal, and that output signal is typically specified as having an 'RF modulation bandwidth'.*

d.6. A maximum frequency exceeding 90 GHz;

***Note 1****: For the purpose of 3A002.d, 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 Note*s:**

***1.*** *The maximum 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 90 GHz;

e.2. An output power exceeding 1 mW (0 dBm) anywhere within the operating frequency range exceeding 90 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.

h. “Electronic assemblies,” modules or equipment, specified to perform all of the following:

h.1. Analog-to-digital conversions meeting any of the following:

h.1.a. A resolution of 8 bit or more, but less than 10 bit, with a “sample rate” greater than 1.3 Giga Samples Per Second (GSPS);

h.1.b. A resolution of 10 bit or more, but less than 12 bit, with a “sample rate” greater than 1.0 GSPS;

h.1.c. A resolution of 12 bit or more, but less than 14 bit, with a “sample rate” greater than 1.0 GSPS;

h.1.d. A resolution of 14 bit or more but less than 16 bit, with a “sample rate” greater than 400 Mega Samples Per Second (MSPS); *or*

h.1.e. A resolution of 16 bit or more with a “sample rate” greater than 180 MSPS; *and*

h.2. Any of the following:

h.2.a. Output of digitized data;

h.2.b. Storage of digitized data; *or*

h.2.c. Processing of digitized data;

***N.B.:*** *Digital data recorders, oscilloscopes, "signal analyzers," signal generators, network analyzers and microwave test receivers, are specified by 3A002.a.6, 3A002.a.7, 3A002.c, 3A002.d, 3A002.e and 3A002.f, respectively.*

***Technical Notes:***

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

*2. The resolution of the ADC is the number of bits in of the digital output of the ADC that represents the measured analog input word. Effective Number of Bits (ENOB) is not used to determine the resolution of the ADC.*

*3. For non-interleaved multiple-channel "electronic assemblies", modules, or equipment, the "sample rate" is not aggregated and the "sample rate" is the maximum rate of any single channel.*

*4. For interleaved channels on multiple- channel "electronic assemblies", modules, or equipment, the "sample rates" are aggregated and the "sample rate" is the maximum combined total rate of all the interleaved channels.*

***Note:*** *3A002.h includes ADC cards, waveform digitizers, data acquisition cards, signal acquisition boards and transient recorders.*

*****

**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 Note****: See § 744.17 of the EAR for additional license requirements for microprocessors having a processing speed of 5 GFLOPS or more and an arithmetic logic unit with an access width of 32 bit or more, including those incorporating "information security" functionality, and associated "software" and "technology" for the "production" or "development" of such microprocessors.*

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

*LVS:* N/A

*GBS:* 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 between 200 and 700;

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 "vacuum electronic devices," pulsed or continuous wave, as follows:

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

g.2. Helix devices based on helix, folded waveguide, or serpentine waveguide circuits, *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 350 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 the discharge 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.

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Category 5—Telecommunications and “Information Security”

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Part 2—“Information Security”

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A. “End Items”, “Equipment”, “Accessories”, “Attachments”, “Parts”, “Components” and “Systems”

I. Cryptographic “Information Security”

**5A002 “Information security” systems, equipment and “components,” as follows (see List of Items Controlled).**

**License Requirements**

*Reason for Control*: NS, AT, EI

| *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 |
| EI applies to entire entry | Refer to §742.15 of the EAR. |

***License Requirements Note**: See § 744.17 of the EAR for additional license requirements for microprocessors having a processing speed of 5 GFLOPS or more and an arithmetic logic unit with an access width of 32 bit or more, including those incorporating "information security" functionality, and associated "software" and "technology" for the "production" or "development" of such microprocessors.*

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

*LVS:* Yes: $500 for "components".

N/A for systems and equipment.

*GBS:* N/A

*ENC:* Yes for certain EI controlled commodities, see §740.17 of the EAR for eligibility.

**List of Items Controlled**

*Related Controls:* (1) ECCN 5A002.a controls "component" providing the means or functions necessary for "information security." All such "components" are presumptively "specially designed" and controlled by 5A002.a. (2) See USML Categories XI (including XI(b)) and XIII(b) (including XIII(b)(2)) for controls on

systems, equipment, and components described in 5A002.d or .e that are subject to the ITAR. (3) For "satellite navigation system" receiving equipment containing or employing decryption see 7A005, and for related decryption "software" and "technology" see 7D005 and 7E001. (4) Noting that items may be controlled elsewhere on the CCL, examples of items not controlled by ECCN 5A002.a.4 include the following: (a) An automobile where the only 'cryptography for data confidentiality' having a 'described security algorithm' is performed by a Category 5 – Part 2 Note 3 eligible mobile telephone that is built into the car. In this case, secure phone communications support a non-primary function of the automobile but the mobile telephone (equipment), as a standalone item, is not controlled by ECCN 5A002 because it is excluded by the Cryptography Note (Note 3) (See ECCN 5A992.c). (b) An exercise bike with an embedded Category 5 – Part 2 Note 3 eligible web browser, where the only controlled cryptography is performed by the web browser. In this case, secure web browsing supports a non-primary function of the exercise bike but the web browser ("software"), as a standalone item, is not controlled by ECCN 5D002 because it is excluded by the Cryptography Note (Note 3) (See ECCN 5D992.c). (5) After classification or self-classification in accordance with § 740.17(b) of the EAR, mass market encryption commodities that meet eligibility requirements are released from "EI" and "NS" controls. These commodities are designated 5A992.c.

*Related Definitions*: N/A

*Items*:

a. Designed or modified to use 'cryptography for data confidentiality' having a 'described security algorithm', where that cryptographic capability is useable, has been activated, or

can be activated by means of "cryptographic activation" not employing a secure mechanism, as follows:

a.1. Items having "information security" as a primary function;

a.2. Digital communication or networking systems, equipment or components, not specified in paragraph 5A002.a.1;

a.3. Computers, other items having information storage or processing as a primary function, and components therefor, not specified in paragraphs 5A002.a.1 or .a.2;

***N.B.:*** *For operating systems see also 5D002.a.1 and .c.1.*

a.4. Items, not specified in paragraphs 5A002.a.1 to a.3, where the 'cryptography for data confidentiality' having a 'described security algorithm' meets all of the following:

a.4.a. It supports a non-primary function of the item; *and*

a.4.b. It is performed by incorporated equipment or "software" that would, as a standalone item, be specified by ECCNs 5A002, 5A003, 5A004, 5B002 or 5D002.

***N.B. to paragraph a.4****: See Related Control Paragraph (4) of this ECCN 5A002 for examples of items not controlled by 5A002.a.4.*

***Technical Notes:***

*1. For the purposes of 5A002.a, 'cryptography for data confidentiality' means "cryptography" that employs digital techniques and performs any cryptographic function other than any of the following:*

*1.a. "Authentication;"*

*1.b. Digital signature;*

*1.c. Data integrity;*

*1.d. Non-repudiation;*

*1.e. Digital rights management, including the execution of copy-protected "software;"*

*1.f. Encryption or decryption in support of entertainment, mass commercial broadcasts or medical records management; or*

*1.g. Key management in support of any function described in paragraphs 1.a to 1.f of this Technical Note paragraph 1.*

*2. For the purposes of 5A002.a, 'described security algorithm' means any of the following:*

*2.a. A "symmetric algorithm" employing a key length in excess of 56 bits, not including parity bits;*

*2.b. An "asymmetric algorithm" where the security of the algorithm is based on any of the following:*

*2.b.1. Factorization of integers in excess of 512 bits (e.g., RSA);*

*2.b.2. Computation of discrete logarithms in a multiplicative group of a finite field of size greater than 512 bits (e.g., Diffie-Hellman over Z/pZ); or*

*2.b.3. Discrete logarithms in a group other than mentioned in paragraph 2.b.2 of this Technical Note in excess of 112 bits (e.g., Diffie-Hellman over an elliptic curve); or*

*2.c. An "asymmetric algorithm" where the security of the algorithm is based on any of the following:*

*2.c.1. Shortest vector or closest vector problems associated with lattices (e.g., NewHope, Frodo, NTRUEncrypt, Kyber, Titanium);*

*2.c.2. Finding isogenies between Supersingular elliptic curves (e.g., Supersingular Isogeny Key Encapsulation); or*

*2.c.3. Decoding random codes (e.g., McEliece, Niederreiter).*

***Technical Note:*** *An algorithm described by Technical Note 2.c. may be referred to as being post-quantum, quantum-safe or quantum-resistant.*

***Note 1****: Details of items must be accessible and provided upon request, in order to establish any of the following:*

*a. Whether the item meets the criteria of 5A002.a.1 to a.4; or*

*b. Whether the cryptographic capability for data confidentiality specified by 5A002.a is usable without "cryptographic activation."*

***Note 2****: 5A002.a does not control any of the following items, or specially designed "information security" components therefor:*

*a. Smart cards and smart card 'readers/writers' as follows:*

*a.1. A smart card or an electronically readable personal document (e.g., token coin, e-passport) that meets any of the following:*

*a.1.a. The cryptographic capability meets all of the following:*

*a.1.a.1. It is restricted for use in any of the following:*

*a.1.a.1.a. Equipment or systems, not described by 5A002.a.1 to a.4;*

*a.1.a.1.b. Equipment or systems, not using 'cryptography for data confidentiality' having a 'described security algorithm'; <u>or</u>*

*a.1.a.1.c. Equipment or systems, excluded from 5A002.a by entries b. to f. of this Note; <u>and</u>*

*a.1.a.2. It cannot be reprogrammed for any other use; <u>or</u>*

*a.1.b. Having all of the following:*

*a.1.b.1. It is specially designed and limited to allow protection of 'personal data' stored within;*

*a.1.b.2. Has been, or can only be, personalized for public or commercial transactions or individual identification; and*

*a.1.b.3. Where the cryptographic capability is not user-accessible;*

***Technical Note to paragraph a.1.b of Note 2**: 'Personal data' includes any data specific to a particular person or entity, such as the amount of money stored and data necessary for "authentication."*

*a.2. 'Readers/writers' specially designed or modified, and limited, for items specified by paragraph a.1 of this Note;*

***Technical Note to paragraph a.2 of Note 2**: 'Readers/writers' include equipment that communicates with smart cards or electronically readable documents through a network.*

*b. Cryptographic equipment specially designed and limited for banking use or 'money transactions';*

***Technical Note to paragraph b. of Note 2****: 'Money transactions' in 5A002 Note 2 paragraph b. includes the collection and settlement of fares or credit functions.*

*c. Portable or mobile radiotelephones for civil use (e.g., for use with commercial civil cellular radio communication systems) that are not capable of transmitting encrypted data directly to another radiotelephone or equipment (other than Radio Access Network (RAN) equipment), nor of passing encrypted data through RAN equipment (e.g., Radio Network Controller (RNC) or Base Station Controller (BSC));*

*d. Cordless telephone equipment not capable of end-to-end encryption where the maximum effective range of unboosted cordless operation (i.e., a single, unrelayed hop between terminal and home base station) is less than 400 meters according to the manufacturer's specifications;*

*e. Portable or mobile radiotelephones and similar client wireless devices for civil use, that implement only published or commercial cryptographic standards (except for anti-piracy functions, which may be non-published) and also meet the provisions of paragraphs a.2 to a.4 of the Cryptography Note (Note 3 in Category 5 – Part 2), that have been customized for a specific civil industry application with features that do not affect the cryptographic functionality of these original non-customized devices;*

*f. Items, where the "information security" functionality is limited to wireless "personal area network" functionality, meeting all of the following:*

*f.1. Implement only published or commercial cryptographic standards; and*

*f.2. The cryptographic capability is limited to a nominal operating range not exceeding 30 meters according to the manufacturer's specifications, or not exceeding 100 meters according to the manufacturer's specifications for equipment that cannot interconnect with more than seven devices;*

*g. Mobile telecommunications Radio Access Network (RAN) equipment designed for civil use, which also meet the provisions of paragraphs a.2 to a.4 of the Cryptography Note (Note 3 in Category 5 -- Part 2), having an RF output power limited to 0.1W (20 dBm) or less, and supporting 16 or fewer concurrent users;*

*h. Routers, switches or relays, where the "information security" functionality is limited to the tasks of "Operations, Administration or Maintenance" ("OAM") implementing only published or commercial cryptographic standards;*

*i. General purpose computing equipment or servers, where the "information security" functionality meets all of the following:*

*i.1. Uses only published or commercial cryptographic standards; and*

*i.2. Is any of the following:*

*i.2.a. Integral to a CPU that meets the provisions of Note 3 in Category 5 Part 2;*

*i.2.b. Integral to an operating system that is not specified by 5D002; or*

*i.2.c. Limited to "OAM" of the equipment; or*

*j. Items specially designed for a 'connected civil industry application', meeting all of the following:*

*j.1. Being any of the following:*

*j.1.a. A network-capable endpoint device meeting any of the following:*

*j.1.a.1. The "information security" functionality is limited to securing 'non-arbitrary data' or the tasks of "Operations, Administration or Maintenance" ("OAM"); or*

*j.1.a.2. The device is limited to a specific 'connected civil industry application'; or*

*j.1.b. Networking equipment meeting all of the following:*

*j.1.b.1. Being specially designed to communicate with the devices specified by paragraph j.1.a above; and*

*j.1.b.2. The "information security" functionality is limited to supporting the 'connected civil industry application' of devices specified by paragraph j.1.a above, or the*

*tasks of "OAM" of this networking equipment or of other items specified by paragraph j. of this Note; and*

*j.2. Where the "information security" functionality implements only published or commercial cryptographic standards, and the cryptographic functionality cannot easily be changed by the user.*

***Technical Notes:***

*1. 'Connected civil industry application' means a network-connected consumer or civil industry application other than "information security", digital communication, general purpose networking or computing.*

*2. 'Non-arbitrary data' means sensor or metering data directly related to the stability, performance or physical measurement of a system (e.g., temperature, pressure, flow rate, mass, volume, voltage, physical location, etc.), that cannot be changed by the user of the device.*

b. Being a 'cryptographic activation token';

***Technical Note**: A 'cryptographic activation token' is an item designed or modified for any of the following:*

*1. Converting, by means of "cryptographic activation", an item not specified by Category 5-Part 2 into an item specified by 5A002.a or 5D002.c.1, and not released*

*by the Cryptography Note (Note 3 in Category 5-Part 2); or*

2. *Enabling, by means of "cryptographic activation", additional functionality specified by 5A002.a of an item already specified by Category 5-Part 2;*

c. Designed or modified to use or perform "quantum cryptography;"

***Technical Note:*** *"Quantum cryptography" is also known as Quantum Key Distribution (QKD).*

d. Designed or modified to use cryptographic techniques to generate channelizing codes, scrambling codes or network identification codes, for systems using ultra-wideband modulation techniques and having any of the following:

d.1. A bandwidth exceeding 500 MHz; *or*

d.2. A "fractional bandwidth" of 20% or more;

e. Designed or modified to use cryptographic techniques to generate the spreading code for "spread spectrum" systems, not specified by 5A002.d, including the hopping code for "frequency hopping" systems.

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Category 7—Navigation and Avionics

A. “End Items”, “Equipment”, “Accessories”, “Attachments”, “Parts”, “Components” and “Systems”

*****

**7A005 “Satellite navigation system” receiving equipment having any of the following and “specially designed” “components” therefor.**

**License Requirements**

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

| ***Control(s)*** | ***Country Chart (See Supp. No. 1 to part 738)*** |
|---|---|
| NS applies to 7A005.b | NS Column 1 |
| MT applies to commodities in 7A005.b that meet or exceed the parameters of 7A105. | MT Column 1 |

| | |
|---|---|
| AT applies to<br><br>7A005.b | AT Column 1 |

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

*LVS:* N/A

*GBS:* N/A

**List of Items Controlled**

*Related Controls:* (1) See also ECCNs 7A105, 7A611 and 7A994. Commercially available "satellite navigation system" receivers do not typically employ decryption or adaptive antennae and are classified as 7A994. (2) See USML Category XII(d) for "satellite navigation system" receiving equipment subject to the ITAR and USML Category XI(c)(10) for antennae that are subject to the ITAR. (3) Items that otherwise would be covered by ECCN 7A005.a are "subject to the ITAR" (see 22 CFR parts 120 through 130).

*Related Definitions:* N/A

*Items:*

a. Employing a decryption algorithm "specially designed" or modified for government use to access the ranging code for position and time; *or*

b. Employing ‘adaptive antenna systems’.

***Note:*** *7A005.b does not apply to “satellite navigation system” receiving equipment that only uses “components” designed to filter, switch, or combine signals from multiple omni-directional antennas that do not implement adaptive antenna techniques.*

***Technical Note:*** *For the purposes of 7A005.b ‘adaptive antenna systems’ dynamically generate one or more spatial nulls in an antenna array pattern by signal processing in the time domain or frequency domain.*

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Category 9—Aerospace and Propulsion

*****

E. “Technology”

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**9E003 Other “technology” as follows (see List of Items Controlled).**

**License Requirements**

*Reason for Control*: NS, SI, AT

| *Control(s)* | *Country Chart (See Supp. No. 1 to part 738)* |
|---|---|
| NS applies to entire entry | NS Column 1 |
| SI applies to 9E003.a.1 through a.8, .h, .i, and .k. | See §742.14 of the EAR for additional information. |
| AT applies to entire entry | AT Column 1 |

**Reporting Requirements**

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

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

*TSR:* N/A

**Special Conditions for STA**

*STA:* License Exception STA may not be used to ship or transmit any technology in 9E003.a.1, 9E003.a.2 to a.5, 9E003.a.8, or 9E003.h 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) Hot section "technology" specifically designed, modified, or equipped for military uses or purposes, or developed principally with U.S. Department of Defense funding, is "subject to the ITAR" (see 22 CFR parts 120 through 130). (2) "Technology" is subject to the EAR when actually applied to a commercial "aircraft" engine program. Exporters may seek to establish commercial application either on a case-by-case basis through submission of documentation demonstrating application to a commercial program in requesting an export license from the Department Commerce in respect to a specific export, or in the case of use for broad categories of "aircraft," engines, "parts" or "components," a commodity jurisdiction determination from the Department of State.

*Related Definitions*: N/A

*Items*:

a. "Technology" "required" for the "development" or "production" of any of the following gas turbine engine "parts," "components" or systems:

a.1. Gas turbine blades, vanes or “tip shrouds”, made from Directionally Solidified (DS) or Single Crystal (SC) alloys and having (in the 001 Miller Index Direction) a stress-rupture life exceeding 400 hours at 1,273 K (1,000°C) at a stress of 200 MPa, based on the average property values;

***Technical Note**: For the purposes of 9E003.a.1, stress-rupture life testing is typically conducted on a test specimen.*

a.2. Combustors having any of the following:

a.2.a. ‘Thermally decoupled liners’ designed to operate at ‘combustor exit temperature’ exceeding 1,883 K (1,610°C);

a.2.b. Non-metallic liners;

a.2.c. Non-metallic shells; *or*

a.2.d. Liners designed to operate at 'combustor exit temperature' exceeding 1,883 K (1,610°C) and having holes that meet the parameters specified by 9E003.c;

***Note**: The “required” “technology” for holes in 9E003.a.2 is limited to the derivation of the geometry and location of the holes.*

***Technical Notes:***

*1. 'Thermally decoupled liners' are liners that feature at least a support structure designed to carry mechanical loads and a combustion facing structure designed to protect the support structure from the heat of combustion. The combustion facing structure and support structure have independent thermal displacement (mechanical displacement due to thermal load) with respect to one another, i.e. they are thermally decoupled.*

*2. 'Combustor exit temperature' is the bulk average gas path total (stagnation) temperature between the combustor exit plane and the leading edge of the turbine inlet guide vane (i.e., measured at engine station T40 as defined in SAE ARP 755A) when the engine is running in a "steady state mode" of operation at the certificated maximum continuous operating temperature.*

***N.B.**: See 9E003.c for "technology" "required" for manufacturing cooling holes.*

a.3. "Parts" or "components," that are any of the following:

a.3.a. Manufactured from organic "composite" materials designed to operate above 588 K (315°C);

a.3.b. Manufactured from any of the following:

a.3.b.1. Metal “matrix” “composites” reinforced by any of the following:

a.3.b.1.a. Materials controlled by 1C007;

a.3.b.1.b. “Fibrous or filamentary materials” specified by 1C010; *or*

a.3.b.1.c. Aluminides specified by 1C002.a; *or*

a.3.b.2. Ceramic “matrix” “composites” specified by 1C007; *or*

a.3.c. Stators, vanes, blades, tip seals (shrouds), rotating blings, rotating blisks or ‘splitter ducts’, that are all of the following:

a.3.c.1. Not specified in 9E003.a.3.a;

a.3.c.2. Designed for compressors or fans; *and*

a.3.c.3. Manufactured from material controlled by 1C010.e with resins controlled by 1C008;

***Technical Note**: A 'splitter duct' performs the initial separation of the air-mass flow between the bypass and core sections of the engine.*

a.4. Uncooled turbine blades, vanes or "tip shrouds" designed to operate at a 'gas path temperature' of 1,373 K (1,100°C) or more;

a.5. Cooled turbine blades, vanes or "tip-shrouds", other than those described in 9E003.a.1, designed to operate at a 'gas path temperature' of 1,693 K (1,420°C) or more;

***Technical Note**: 'Gas path temperature' is the bulk average gas path total (stagnation) temperature at the leading edge plane of the turbine component when the engine is running in a "steady state mode" of operation at the certificated or specified maximum continuous operating temperature.*

a.6. Airfoil-to-disk blade combinations using solid state joining;

a.7. [Reserved]

a.8. ‘Damage tolerant’ gas turbine engine rotor “parts” or “components” using powder metallurgy materials controlled by 1C002.b; *or*

***Technical Note****: ‘Damage tolerant’ “parts” and “components” are designed using methodology and substantiation to predict and limit crack growth.*

a.9. [Reserved]

***N.B.:*** *For “FADEC systems”, see 9E003.h.*

a.10. [Reserved]

***N.B****.: For adjustable flow path geometry, see 9E003.i.*

a.11. Hollow fan blades;

b. “Technology” “required” for the “development” or “production” of any of the following:

b.1. Wind tunnel aero-models equipped with non-intrusive sensors capable of transmitting data from the sensors to the data acquisition system; *or*

b.2. “Composite” propeller blades or prop-fans, capable of absorbing more than 2,000 kW at flight speeds exceeding Mach 0.55;

c. “Technology” “required” for manufacturing cooling holes, in gas turbine engine “parts” or “components” incorporating any of the “technologies” specified by 9E003.a.1, 9E003.a.2 or 9E003.a.5, and having any of the following:

c.1. Having all of the following:

c.1.a. Minimum ‘cross-sectional area’ less than 0.45 $mm^2$;

c.1.b. ‘Hole shape ratio’ greater than 4.52; *and*

c.1.c. ‘Incidence angle’ equal to or less than 25°; *or*

c.2. Having all of the following:

c.2.a. Minimum ‘cross-sectional area’ less than 0.12 $mm^2$;

c.2.b. ‘Hole shape ratio’ greater than 5.65; *and*

c.2.c. ‘Incidence angle’ more than 25°;

***Note**: 9E003.c does not apply to “technology” for manufacturing constant radius cylindrical holes that are straight through and enter and exit on the external surfaces of the component.*

***Technical Notes**:*

*1. For the purposes of 9E003.c, the ‘cross-sectional area’ is the area of the hole in the plane perpendicular to the hole axis.*

*2. For the purposes of 9E003.c, ‘hole shape ratio’ is the nominal length of the axis of the hole divided by the square root of its minimum 'cross-sectional area'.*

*3. For the purposes of 9E003.c, ‘incidence angle’ is the acute angle measured between the plane tangential to the airfoil surface and the hole axis at the point where the hole axis enters the airfoil surface.*

*4. Techniques for manufacturing holes in 9E003.c include “laser” beam machining, water jet machining, Electro-Chemical Machining (ECM) or Electrical Discharge Machining (EDM).*

d. “Technology” “required” for the “development” or “production” of helicopter power transfer systems or tilt rotor or tilt wing “aircraft” power transfer systems;

e. “Technology” for the “development” or “production” of reciprocating diesel engine ground vehicle propulsion systems having all of the following:

e.1. ‘Box volume’ of 1.2 $m^3$ or less;

e.2. An overall power output of more than 750 kW based on 80/1269/EEC, ISO 2534 or national equivalents; *and*

e.3. Power density of more than 700 $kW/m^3$ of ‘box volume’;

***Technical Note:*** *‘Box volume’ is the product of three perpendicular dimensions measured in the following way:*

*Length: The length of the crankshaft from front flange to flywheel face;*

*Width: The widest of any of the following:*

*a. The outside dimension from valve cover to valve cover;*

*b. The dimensions of the outside edges of the cylinder heads; or*

*c. The diameter of the flywheel housing;*

*Height: The largest of any of the following:*

*a. The dimension of the crankshaft center-line to the top plane of the valve cover (or cylinder head) plus twice the stroke; or*

*b. The diameter of the flywheel housing.*

f. "Technology" "required" for the "production" of "specially designed" "parts" or "components" for high output diesel engines, as follows:

f.1. "Technology" "required" for the "production" of engine systems having all of the following "parts" and "components" employing ceramics materials controlled by 1C007:

f.1.a Cylinder liners;

f.1.b. Pistons;

f.1.c. Cylinder heads; *and*

f.1.d. One or more other "part" or "component" (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);

f.2. "Technology" "required" for the "production" of turbocharger systems with single-stage compressors and having all of the following:

f.2.a. Operating at pressure ratios of 4:1 or higher;

f.2.b. Mass flow in the range from 30 to 130 kg per minute; *and*

f.2.c. Variable flow area capability within the compressor or turbine sections;

f.3. "Technology" "required" for the "production" of fuel injection systems with a "specially designed" multifuel (*e.g.*, diesel or jet fuel) capability covering a viscosity range from diesel fuel (2.5 cSt at 310.8 K (37.8°C)) down to gasoline fuel (0.5 cSt at 310.8 K (37.8°C)) and having all of the following:

f.3.a. Injection amount in excess of 230 $mm^3$ per injection per cylinder; *and*

f.3.b. Electronic control features “specially designed” for switching governor characteristics automatically depending on fuel property to provide the same torque characteristics by using the appropriate sensors;

g. “Technology” “required” for the development” or “production” of ‘high output diesel engines’ for solid, gas phase or liquid film (or combinations thereof) cylinder wall lubrication and permitting operation to temperatures exceeding 723 K (450°C), measured on the cylinder wall at the top limit of travel of the top ring of the piston;

***Technical Note****: ‘High output diesel engines’ are diesel engines with a specified brake mean effective pressure of 1.8 MPa or more at a speed of 2,300 r.p.m., provided the rated speed is 2,300 r.p.m. or more.*

h. “Technology” for gas turbine engine “FADEC systems” as follows:

h.1. “Development” “technology” for deriving the functional requirements for the “parts” or “components” necessary for the “FADEC system” to regulate engine thrust or shaft power (e.g., feedback sensor time constants and accuracies, fuel valve slew rate);

h.2. “Development” or “production” “technology” for control and diagnostic “parts” or “components” unique to the “FADEC system” and used to regulate engine thrust or shaft power;

h.3. “Development” “technology” for the control law algorithms, including “source code”, unique to the “FADEC system” and used to regulate engine thrust or shaft power;

***Note**: 9E003.h does not apply to technical data related to engine-“aircraft” integration required by civil aviation authorities of one or more Wassenaar Arrangement Participating States (See Supplement No. 1 to part 743 of the EAR) to be published for general airline use (e.g., installation manuals, operating instructions, instructions for continued airworthiness) or interface functions (e.g., input/output processing, airframe thrust or shaft power demand).*

i. “Technology” for adjustable flow path systems designed to maintain engine stability for gas generator turbines, fan or power turbines, or propelling nozzles, as follows:

i.1. “Development” “technology” for deriving the functional requirements for the “parts” or “components” that maintain engine stability;

i.2. “Development” or “production” “technology” for “parts” or “components” unique to the adjustable flow path system and that maintain engine stability;

i.3. “Development” “technology” for the control law algorithms, including “source code”, unique to the adjustable flow path system and that maintain engine stability;

***Note:*** *9E003.i does not apply to "technology" for any of the following:*

*a. Inlet guide vanes;*

*b. Variable pitch fans or prop-fans;*

*c. Variable compressor vanes;*

*d. Compressor bleed valves; or*

*e. Adjustable flow path geometry for reverse thrust.*

j. "Technology" "required" for the "development" of wing-folding systems designed for fixed-wing "aircraft" powered by gas turbine engines.

***N.B.:*** *For "technology" "required" for the "development" of wing-folding systems designed for fixed-wing "aircraft" specified in USML Category VIII (a), see USML Category VIII (i).*

k. "Technology" not otherwise controlled in 9E003.a.1 through a.8, a.10, and .h and used in the "development", "production", or overhaul of hot section "parts" or "components" of civil derivatives of military engines controlled on the U.S. Munitions List.

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