DEPARTMENT OF COMMERCE

Bureau of Industry and Security

15 CFR Part 774

[Docket No. 181129999–8999–01]

RIN 0694–AH69

Implementation of Certain New Controls on Emerging Technologies Agreed at Wassenaar Arrangement 2018 Plenary

AGENCY: Bureau of Industry and Security, Commerce.

ACTION: Final rule.

SUMMARY: The Bureau of Industry and Security maintains, as part of its Export Administration Regulations, the Commerce Control List (CCL), which identifies certain items subject to Department of Commerce's jurisdiction. This final rule revises the CCL to implement certain changes made to the Wassenaar Arrangement List of Dual-Use Goods and Technologies maintained and agreed to by governments participating in the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies (Wassenaar Arrangement, or WA) at the December 2018 WA Plenary meeting. The Wassenaar Arrangement advocates implementation of effective export controls on strategic items with the objective of improving regional and international security and stability. This rule harmonizes the CCL with only the agreements on recently developed or developing technologies not previously controlled that are essential to the national security of the United States and warrant early implementation. The remaining agreements will be implemented in a separate rule.

DATES: This rule is effective May 23, 2019.

FOR FURTHER INFORMATION CONTACT: For general questions, contact Sharron Cook, Office of Exporter Services, Bureau of Industry and Security, U.S. Department of Commerce at 202–482–2440 or by email: *Sharron.Cook@bis.doc.gov.*

For technical questions contact:

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Category 5 (Information Security): Aaron Amundson or Anita Zinzuvadia 202–482–0707.

Category 6 (Acoustic projector/transducer): Michael Tu 202–482–6462.

Category 9x515 (Satellites): Michael Tu 202–482–6462.

SUPPLEMENTARY INFORMATION:

Background

The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies (Wassenaar or WA) (*http://www.wassenaar.org/*) is a group of 42 like-minded states committed to promoting responsibility and transparency in the global arms trade, and preventing destabilizing accumulations of arms. As a Participating State, the United States has committed to controlling for export all items on the WA control lists. The control lists, which include the Wassenaar Arrangement Munitions List and the Wassenaar Arrangement List of Dual-Use Goods and Technologies, were first established in 1996 and have been revised annually thereafter. Proposals for changes to the WA control lists are reviewed by Participating States at expert group and annual plenary meetings. Participating States are charged with implementing the agreed list changes as soon as possible after approval. The United States' implementation of WA list changes ensures U.S. companies have a level playing field with their competitors in other WA Participating States.

This rule adds to the EAR's Commerce Control List (CCL) five recently developed or developing technologies that are essential to the national security of the United States: discrete microwave transistors (a major component of wideband semiconductors), continuity of operation software, post-quantum cryptography, underwater transducers designed to operate as hydrophones, and air-launch platforms.

Revisions to the Commerce Control List Related to WA 2018 Plenary Agreements

Revises (4) ECCNs: 3A001, 5A002, 6A001 and 9A004.

Added ECCNs: 3D005.

3A001 Electronic Items

ECCN 3A001 is amended by adding paragraph b.3.f to control discrete microwave transistors ''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''. While older devices specified limited frequency ranges, new microwave transistors cover wider frequency bands at higher power levels, opening up new possibilities for radar and other transmitting applications.

Note 1 that appears after paragraph b.3.f is revised, so that it does not apply to new paragraph b.3.f, meaning that the control status of a transistor in b.3.f is not determined by the lowest peak saturated power output control threshold.

Discrete microwave transistors are used in microwave semiconductors and are applicable for both civilian use, such as mobile phone base stations and weather radars, and military use, such as fire control radars, decoys and jammers. Discrete microwave transistors are also increasingly used in wideband semiconductors, which have less power output and are more energy-efficient than the narrowband semiconductors. These features permit wideband semiconductors to operate at much higher voltages, frequencies and temperatures than conventional semiconductors. The wideband semiconductor is mainly used for military applications, such as electronic counter-measures for decoys, jammers and military radars, because it has a fractional bandwidth greater than 100%, and can enable a wide range of military radars, seekers, decoys and jammers. However, there are also instances of wideband semiconductors being used in civilian applications, such as to make green and blue light emitting diodes (LEDs) and lasers, which are used in DVD players (the Blu-ray and HD DVD formats). Wideband semiconductors will likely be a technology used in new electrical grid and alternative energy devices, in which such semiconductors will reduce energy loss and enable longer performance life in solar and wind energy power converters and eliminate bulky grid substation transformers. In addition, these robust and efficient power components are expected to be used in high energy vehicles, including electric trains and plug-in electric vehicles. It has been predicted that wideband semiconductors will facilitate simpler and higher efficiency charging for hybrid and all-electric vehicles.

These discrete microwave transistors are subject to National Security (NS Column 1), Regional Stability (RS Column 1) and Anti-terrorism (AT Column 1) license requirements, except those being exported or reexported for use in civil telecommunications applications, as indicated on the Commerce Country Chart in Supplement No. 1 to part 738 of the EAR. List-based license exceptions (Limited Value Shipment (LVS) and Group B Shipments (GBS) and Strategic Trade Authorization (STA), see part 740 of the EAR), are available for those discrete microwave transistors that are being exported or reexported for use in civil telecommunications applications that meet the criteria of the license

exception and where none of the license exception restrictions of § 740.2 apply. Transaction-based license exceptions may be available depending on the transaction meeting the license exception criteria; see part 740 of the EAR.

3D005 Continuity of Operation Software

ECCN 3D005 is added to the CCL in order to control software that ensures continuity of operation when electronics are exposed to Electromagnetic Pulse (EMP) or Electrostatic Discharge (ESD). The software is controlled for national security and anti-terrorism reasons and a license is required worldwide, except for Canada, under national security (NS Column 1) and Anti-terrorism (AT Column 1) license requirements as indicated on the Commerce Country Chart, Supplement no. 1 to part 738 of the EAR. No list-based license exceptions are applicable; however, License Exception Strategic Trade Authorization (STA) is available for countries listed in Country Group A:5, see Supplement No. 1 to part 740 of the EAR.

Research and development activities related to integrated circuit software that provides electromagnetic pulse (EMP) protective function to electronic devices is currently underway, and it is predicted that these products will be in the commercial marketplace in a few years. Because continuity of operation software would also be beneficial to military applications, it is being added to the CCL in this final rule.

Category 5—Part 2—''Information Security''

ECCN 5A002 is amended in order to add a control on certain types of post-quantum cryptographic algorithms. This rule adds paragraph 2.c of the Technical Notes that follow paragraph 5A002.a.4 to include a new paragraph addressing certain post-quantum asymmetric algorithms. This rule also revises paragraphs 5A002.a, a.4, paragraph 2 of the Technical Notes that follow paragraph 5A002.a.4, paragraph a.1.a.1.b in Note 2 to 5A002.a, and paragraph (4)(a) of Related Controls to 5A002, to replace the term 'in excess of 56 bits of symmetric key length, or equivalent' with 'described security algorithm'. These changes are being made for technical accuracy since methods for establishing equivalence between modern classical and post-quantum cryptography (PQC) are not settled. In addition, this rule revises the Nota Bene to Note 3 (the Cryptography Note) to specify that items that include post-quantum asymmetric algorithms described by paragraph 2.c of the Technical Notes are subject to the classification or self-classification reporting requirements for mass market items.

The WA cryptography controls reflect the development and application of modern cryptography. Currently, the WA includes controls over the most commonly-used forms of cryptography in the contemporary world: symmetric algorithms based on key length; and asymmetric algorithms based on factorization of integers or on the computation of discrete logarithms (over various groups). These controls are defined in the Technical Note 2 to 5A002.a of the CCL.

The WA introduced specific parameters for the export control of cryptography in 1998, along with a general Category 5—Part 2 exclusion for 'mass market' encryption products (Cryptography Note, Note 3), in recognition of the increasing use of cryptography in the public domain. While the structure of Category 5—Part 2 of the WA has evolved significantly since 1998, the algorithms addressed have remained unchanged.

These algorithms continue to provide adequate protection for encrypted data, based on the threat posed by attack by a non-quantum computer. However, if and when large scale quantum computers are built, they will likely undermine the security of current cryptographic systems.

One goal of PQC is to develop and deploy quantum-resistant algorithms well in advance of a potential attack from a quantum computer. As the threat of quantum computers grows nearer, cryptography researchers are developing algorithms and working towards standardizing algorithms that resist attack from existing known quantum algorithms (such as Shor's Algorithm). PQC is currently in use in commercial products, but those algorithms are not covered by any WA controls. Because such algorithms are becoming increasingly common, this control is being added to ensure that there is consistent treatment and a level playing field between modern classical and post-quantum cryptography.

5A002.a is subject to national security (NS Column 1), anti-terrorism (AT Column 1) and encryption items (EI) license requirements, as indicated on the Commerce Country Chart in Supplement no. 1 to part 738 of the EAR. Because this new control is added to 5A002.a with corresponding applicability to EI-controlled ECCNs 5D002.a.1, 5D002.c.1 and 5E002.a, BIS has determined that no changes to License Exception ENC are required to accommodate this change. Items with post-quantum algorithms described by the technical note are treated the same under License Exception ENC as products using classical algorithms.

6A001 Acoustic Systems, Equipment and ''Components''

ECCN 6A001 is amended by moving the Note previously located below Item paragraph a.2.g.4 to below the introductory Item paragraph a.2 for better readability. This Note informs the public that Item paragraph a.2 ''applies to receiving equipment, whether or not related in normal application to separate active equipment, and ''specially designed'' components therefor''. This rule also adds a Technical Note 2 after paragraph a.2.a to alert the public that underwater acoustic transducers designed to operate as passive receivers are hydrophones. This rule revises paragraph a.2.a.6 to add the parameter ''and having a 'hydrophone sensitivity' better than −230 dB below 4 kHz'', to remove any transducers or hydrophones that are not of strategic concern.

An underwater transducer that is designed to operate as a hydrophone, designed for operation below 1000 m and having a useful sensitivity below 4 kHz, must be controlled because of its utility in Anti-Submarine Warfare (ASW). These amendments will bridge the control gap that previously treated underwater acoustic transducers and receivers separately. Newer underwater acoustic devices can more readily operate in both transmit and receive mode. The new control structure resulting from these amendments allows each aspect of these multifunction devices to be evaluated.

This rule also corrects a License Exception LVS paragraph for 6A001.a.1.b.1 by reversing the frequency band range for the equipment from ''30 kHz to 2 kHz'' to read ''2 kHz to 30 kHz''. All items in ECCN 6A001 are subject to national security (NS Column 2) and anti-terrorism (AT Column 1) license requirements as indicated in the Commerce Country Chart in Supplement no. 1 to part 738 of the EAR. License Exception Low Value Shipment (LVS) may be available depending on the operating frequency. License Exception Strategic Trade Authorization (STA) and transaction-based license exceptions may also be available depending on the circumstances of the transaction and the destination; see part 740 of the EAR.

9A004 Space Launch Vehicles and ''Spacecraft'', ''Spacecraft Buses'', ''Spacecraft Payloads'', ''Spacecraft'' On-Board Systems or Equipment, and Terrestrial Equipment

ECCN 9A004 is amended by revising the Heading to add air-launch platforms. This rule adds new Item paragraph 9A004.g, which controls ''aircraft'' ''specially designed'' or modified to be air-launch platforms for space launch vehicles (SLV). The license requirements table is revised to add 9A004.g to the NS and AT license requirements paragraphs.

Several commercial entities are building space-bound craft that will utilize an air-launch rather than traditional ground launch. This new Item paragraph expands existing space-launch controls to include this developing technology. Originally, military aircraft were used for air-launched rockets to carry satellites specifically for military applications. Now, air-launch platforms allow the use of specialized commercial aircraft instead of rockets or military aircraft to facilitate the transport and launch of commercial satellites. The increase in commercial space activities has commercial satellite owners and space tourism companies moving toward air-launch platforms to support their endeavours.

Items specified in 9A004.g require a license for national security (NS Column 1) and anti-terrorism reasons (AT Column 1) as indicated on the Commerce Country Chart in Supplement no. 1 to part 738 of the EAR. There are no list-based license exceptions, but transaction-based license exceptions may be available; see part 740 of the EAR.

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. 4801 to 4852) that provides the legal basis for BIS's principal authorities. As set forth in Section 4826 of ECRA, all delegations, rules, regulations, orders, determinations, licenses, or other forms of administrative action that have been made, issued, conducted, or allowed to become effective under the Export Administration Act of 1979 (50 U.S.C. 4601 *et seq.*) and as continued in effect pursuant to the International Emergency Economic Powers Act (50 U.S.C. 1701 *et seq.*), shall continue in effect according to their terms until modified, superseded, set aside, or revoked under the authority of the ECRA.

Saving Clause

Shipments of items removed from license exception eligibility or eligibility for export, reexport or transfer (in-country) without a license as a result of this regulatory action that were on dock for loading, on lighter, laden aboard an exporting carrier, or en route aboard a carrier to a port of export, on May 23, 2019, pursuant to actual orders for exports, reexports and transfers (in-country) to a foreign destination, may proceed to that destination under the previous license exception eligibility or without a license so long as they have been exported, reexported or transferred (in-country) before July 22, 2019. Any such items not actually exported, reexported or transferred (in-country) before midnight, on July 22, 2019, require a license in accordance with this final rule.

Executive Order Requirements

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, distributive impacts, and equity). Executive Order 13563 emphasizes the importance of quantifying both costs and benefits, of reducing costs, of harmonizing rules, and of promoting flexibility.

This rule has been designated a ''significant regulatory action'' under Executive Order 12866. The Wassenaar Arrangement (WA) has been established in order to contribute to regional and international security and stability, by promoting transparency and greater responsibility in transfers of conventional arms and dual-use goods and technologies, thus preventing destabilizing accumulations. The aim is also to prevent the acquisition of these items by terrorists. There are presently 42 Participating States, including the United States, that seek through their national policies to ensure that transfers of these items do not contribute to the development or enhancement of military capabilities that undermine these goals, and to ensure that these items are not diverted to support such military capabilities that undermine these goals. Implementation of the WA agreements in a timely manner enhances the national security of the United States and global international trade.

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

This rule is not subject to the requirements of Executive Order 13771 (82 FR 9339, February 3, 2017) because it is issued with respect to a national security function of the United States.

Paperwork Reduction Act Requirements

Notwithstanding any other provision of law, no person is required to respond to, nor shall any person 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 rule involves the following OMB approved collections of information subject to the PRA: 0694–0088, ''Multi-Purpose Application'', and carries a burden hour estimate of 29.6 minutes for a manual or electronic submission; 0694–0106, ''Reporting and Recordkeeping Requirements under the Wassenaar Arrangement'', which carries a burden hour estimate of 21 minutes for a manual or electronic submission; 0694–0137 ''License Exceptions and Exclusions'', which carries a burden hour estimate average of 1.5 hours per submission (Note: submissions for License Exceptions are rarely required); 0694–0096 ''Five Year Records Retention Period'', which carries a burden hour estimate of less than 1 minute; and 0607–0152 ''Automated Export System (AES) Program, which carries a burden hour estimate of 3 minutes per electronic submission. Specific license application submission estimates are discussed further in the preamble of this rule where the revision is explained. BIS estimates that revisions that are editorial, moving the location of control text on the Commerce Control List, or clarifications will result in no change in license application submissions.

Any comments regarding these collections of information, including suggestions for reducing the burden, may be sent to OMB Desk Officer, New Executive Office Building, Washington, DC 20503; and to Jasmeet K. Seehra, Office of Management and Budget (OMB), by email to *Jasmeet_K._Seehra@omb.eop.gov,* or by fax to (202) 395–7285.

Administrative Procedure Act and Regulatory Flexibility Act Requirements

Pursuant to § 4821 of the 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. Because a notice of proposed rulemaking and an opportunity for public comment are not required to be given for this rule by 5 U.S.C. 553, 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.

Accordingly, part 774 of the Export Administration Regulations (15 CFR parts 730 through 774) is amended as follows:

PART 774—[AMENDED]

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

Authority: Pub. L. 115–232, Title XVII, Subtitle B. 50 U.S.C. 4601 *et seq.*; 50 U.S.C. 1701 *et seq.*; 10 U.S.C. 7420; 10 U.S.C. 7430(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. 1824a; 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; Notice of August 8, 2018, 83 FR 39871 (August 13, 2018).

■ 2. In supplement no. 1 to part 774, Category 3, ECCN 3A001 is revised to read as follows:

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

* * * * *

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 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 Column 1
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 reexported for use in civil telecommunications applications.	RS Column 1
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 −54°C to above +125°C.	MT Column 1
NP applies to pulse discharge capacitors in 3A001.e.2 and superconducting solenoidal electromagnets in 3A001.e.3 that meet or exceed the technical parameters in 3A201.a and 3A201.b, respectively.	NP Column 1
AT applies to entire entry.	AT Column 1

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 device amplifiers exceeding 18 GHz), b.9, b.10, .g, .h, and .i.

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

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, 5×10^3 Gy (Si) = 5×10^5 Rads (Si); 5×10^6 Gy (Si)/s = 5×10^8 Rads (Si)/s.

Items:

a. General purpose integrated circuits, as follows:

Note 1: *The control status of wafers (finished or unfinished), in which the function has been determined, is to be evaluated against the parameters of 3A001.a.*

Note 2: *Integrated circuits include the following types:*

—''Monolithic integrated circuits'';

—''Hybrid integrated circuits'';

—''Multichip integrated circuits'';

—''Film type integrated circuits'', including silicon-on-sapphire integrated circuits;

—''Optical integrated circuits'';

—''Three dimensional integrated circuits'';

—''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 5×10^3 Gy (Si), or higher;

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

a.1.c. A fluence (integrated flux) of neutrons (1 MeV equivalent) of 5×10^{13} n/cm^2 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 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'' 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'' 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'' rate greater than 250 MSPS; *or*

a.5.a.5. A resolution of 16 bit or more with a ''sample rate'' 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 with an 'adjusted update rate' of greater than 3,500 MSPS; *or*

a.5.b.2. A resolution of 12-bit or more with an 'adjusted update rate' of greater than 1,250 MSPS and having any of the following:

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

Technical Notes:

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

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

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

4. 'Adjusted update rate' for DACs is:

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

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

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

a.6. Electro-optical and ''optical integrated circuits'', designed for ''signal processing'' and having all of the following:

a.6.a. One or more than one internal ''laser'' diode;

a.6.b. One or more than one internal light detecting element; *and*

a.6.c. Optical waveguides;

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

a.7.a. A maximum number of single-ended digital input/outputs of 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* μ*s.*

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 Notes:

1. 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.

2. For purposes of 3A001.b.1, 'vacuum electronic devices' are electronic devices based on the interaction of an electron beam with an electromagnetic wave propagating in a vacuum circuit or interacting with radio-frequency vacuum cavity resonators. 'Vacuum electronic devices' include klystrons, traveling-wave tubes, and their derivatives.

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 0.1n W (−70 dBm) at any frequency exceeding 31.8 GHz up to and including 37 GHz;

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

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

b.2.g. Rated for operation with a peak saturated power output greater than 10 mW (10 dBm) at any frequency exceeding 75 GHz up to and including 90 GHz, and with a ''fractional bandwidth'' of greater than 5%; *or*

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

Note 1: *[Reserved]*

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

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

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

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

b.3.a.1. A peak saturated power output greater than 400 W (56 dBm) at any

frequency exceeding 2.7 GHz up to and including 2.9 GHz;

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

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

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

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

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

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

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

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

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

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

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 × 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 Hz ≤F ≤10 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; *or*

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 ≤ 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 20 °C:

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 293 K (20 °C);

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/mm²;

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 (28 °C) under simulated 'AM0' illumination with an irradiance of 1,367 Watts per square meter (W/m²);

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.*

■ 3. In supplement no. 1 to part 774, Category 3, add ECCN 3D005, after ECCN 3D004, to read as follows:

3D005 ''Software'' ''specially designed'' to restore normal operation of a microcomputer, ''microprocessor microcircuit'' or ''microcomputer microcircuit'' within 1 ms after an Electromagnetic Pulse (EMP) or Electrostatic Discharge (ESD) disruption, without loss of continuation of operation.

License Requirements

Reason for Control: NS, AT

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

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

CIV: N/A
TSR: N/A

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit ''software'' 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: N/A
Related Definitions: N/A
Items:

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

■ 4. In supplement no. 1 to part 774, Category 5 Part 2, the N.B. to Note 3 (Cryptography Note) at the beginning of the Category is revised to read as follows:

Category 5—Telecommunications and ''Information Security''

* * * * *

Part 2—''Information Security''

* * * * *

N.B. to Note 3 (Cryptography Note): You must submit a classification request or self-classification report to BIS for mass market encryption commodities and software eligible for the Cryptography Note employing a key length greater than 64 bits for the symmetric algorithm (or, for commodities and software not implementing any symmetric algorithms, employing a key length greater than 768 bits for asymmetric algorithms described by Technical note 2.b to 5A002.a or greater than 128 bits for elliptic curve algorithms, or any asymmetric algorithm described by Technical Note 2.c to 5A002.a) in accordance with the requirements of § 740.17(b) of the EAR in order to be released from the ''EI'' and ''NS'' controls of ECCN 5A002 or 5D002.

* * * * *

■ 5. In supplement no. 1 to part 774, Category 5 Part 2, ECCN 5A002 is revised to read as follows:

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
CIV: 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 ''components'' 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 Global Navigation Satellite Systems (GNSS) 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 usable, 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; or

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'; or

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

a.1.a.2. It cannot be reprogrammed for any other use; or

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; or

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.

b. Designed or modified for 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 for 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.

■ 6. In supplement no. 1 to part 774, Category 6, ECCN 6A001 is revised to read as follows:

6A001 Acoustic systems, equipment and ''components,'' as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

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

Reporting Requirements

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

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

LVS: $3000; N/A for 6A001.a.1.b.1 object detection and location systems having a transmitting frequency below 5 kHz or a sound pressure level exceeding 210 dB (reference 1 μPa at 1 m) for equipment with an operating frequency in the band from 2 kHz to 30 kHz inclusive; 6A001.a.1.e, 6A001.a.2.a.1, a.2.a.2, 6A001.a.2.a.3, a.2.a.5, a.2.a.6, 6A001.a.2.b; processing equipment controlled by 6A001.a.2.c, and ''specially designed'' for real-time application with towed acoustic hydrophone arrays; a.2.e.1, a.2.e.2; and bottom or bay cable systems controlled by 6A001.a.2.f and having processing equipment ''specially designed'' for real-time application with bottom or bay cable systems.

GBS: Yes for 6A001.a.1.b.4.

CIV: Yes for 6A001.a.1.b.4.

Special Conditions for STA

STA: License Exception STA may not be used to ship commodities in 6A001.a.1.b, 6A001.a.1.e or 6A001.a.2 (except .a.2.a.4) 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 also 6A991.

Related Definitions: N/A

Items:

a. Marine acoustic systems, equipment and ''specially designed'' ''components'' therefor, as follows:

a.1. Active (transmitting or transmitting-and-receiving) systems, equipment and ''specially designed'' ''components'' therefor, as follows:

Note: 6A001.a.1 does not control equipment as follows:

a. Depth sounders operating vertically below the apparatus, not including a scanning function exceeding ± 20°, and limited to measuring the depth of water, the distance of submerged or buried objects or fish finding;

b. Acoustic beacons, as follows:

1. Acoustic emergency beacons;

2. Pingers ''specially designed'' for relocating or returning to an underwater position.

a.1.a. Acoustic seabed survey equipment as follows:

a.1.a.1. Surface vessel survey equipment designed for sea bed topographic mapping and having all of the following:

a.1.a.1.a. Designed to take measurements at an angle exceeding 20° from the vertical;

a.1.a.1.b. Designed to measure seabed topography at seabed depths exceeding 600 m;

a.1.a.1.c.'Sounding resolution' less than 2; and

a.1.a.1.d. 'Enhancement' of the depth ''accuracy'' through compensation for all the following:

a.1.a.1.d.1. Motion of the acoustic sensor;

a.1.a.1.d.2. In-water propagation from sensor to the seabed and back; and

a.1.a.1.d.3. Sound speed at the sensor;

Technical Notes:

1. 'Sounding resolution' is the swath width (degrees) divided by the maximum number of soundings per swath.

2. 'Enhancement' includes the ability to compensate by external means.

a.1.a.2. Underwater survey equipment designed for seabed topographic mapping and having any of the following:

Technical Note: The acoustic sensor pressure rating determines the depth rating of the equipment specified by 6A001.a.1.a.2.

a.1.a.2.a. Having all of the following:

a.1.a.2.a.1. Designed or modified to operate at depths exceeding 300 m; and

a.1.a.2.a.2. 'Sounding rate' greater than 3,800 m/s; *or*

Technical Note: 'Sounding rate' is the product of the maximum speed (m/s) at which the sensor can operate and the maximum number of soundings per swath assuming 100% coverage. For systems that produce soundings in two directions (3D sonars), the maximum of the 'sounding rate' in either direction should be used.

a.1.a.2.b. Survey equipment, not specified by 6A001.a.1.a.2.a, having all of the following:

a.1.a.2.b.1. Designed or modified to operate at depths exceeding 100 m;

a.1.a.2.b.2. Designed to take measurements at an angle exceeding 20°from the vertical;

a.1.a.2.b.3. Having any of the following:

a.1.a.2.b.3.a. Operating frequency below 350 kHz; *or*

a.1.a.2.b.3.b. Designed to measure seabed topography at a range exceeding 200 m from the acoustic sensor; *and*

a.1.a.2.b.4. 'Enhancement' of the depth ''accuracy'' through compensation of all of the following:

a.1.a.2.b.4.a. Motion of the acoustic sensor;

a.1.a.2.b.4.b. In-water propagation from sensor to the seabed and back; *and*

a.1.a.2.b.4.c. Sound speed at the sensor.

a.1.a.3. Side Scan Sonar (SSS) or Synthetic Aperture Sonar (SAS), designed for seabed imaging and having all of the following, and ''specially designed'' transmitting and receiving acoustic arrays therefor:

a.1.a.3.a. Designed or modified to operate at depths exceeding 500 m; and

a.1.a.3.b. An 'area coverage rate' of greater than 570 m^2/s while operating at the

maximum range that it can operate with an 'along track resolution' of less than 15 cm; *and*

a.1.a.3.c. An 'across track resolution' of less than 15 cm;

Technical Notes:

1. 'Area coverage rate' (m^2/s) is twice the product of the sonar range (m) and the maximum speed (m/s) at which the sensor can operate at that range.

2. 'Along track resolution' (cm), for SSS only, is the product of azimuth (horizontal) beamwidth (degrees) and sonar range (m) and 0.873.

3. 'Across track resolution' (cm) is 75 divided by the signal bandwidth (kHz).

a.1.b Systems or transmitting and receiving arrays, designed for object detection or location, having any of the following:

a.1.b.1. A transmitting frequency below 10 kHz;

a.1.b.2. Sound pressure level exceeding 224dB (reference 1 μPa at 1 m) for equipment with an operating frequency in the band from 10 kHz to 24 kHz inclusive;

a.1.b.3. Sound pressure level exceeding 235 dB (reference 1 μPa at 1 m) for equipment with an operating frequency in the band between 24 kHz and 30 kHz;

a.1.b.4. Forming beams of less than 1° on any axis and having an operating frequency of less than 100 kHz;

a.1.b.5. Designed to operate with an unambiguous display range exceeding 5,120 m; *or*

a.1.b.6. Designed to withstand pressure during normal operation at depths exceeding 1,000 m and having transducers with any of the following:

a.1.b.6.a. Dynamic compensation for pressure; *or*

a.1.b.6.b. Incorporating other than lead zirconate titanate as the transduction element;

a.1.c. Acoustic projectors, including transducers, incorporating piezoelectric, magnetostrictive, electrostrictive, electrodynamic or hydraulic elements operating individually or in a designed combination and having any of the following:

Notes:

1. The control status of acoustic projectors, including transducers, ''specially designed'' for other equipment is determined by the control status of the other equipment.

2. 6A001.a.1.c does not control electronic sources that direct the sound vertically only, or mechanical (e.g., air gun or vapor-shock gun) or chemical (e.g., explosive) sources.

3. Piezoelectric elements specified in 6A001.a.1.c include those made from lead-magnesium-niobate/lead-titanate ($Pb(Mg_{1/3}Nb_{2/3})O_3-PbTiO_3$, or PMN–PT) single crystals grown from solid solution or lead-indium-niobate/lead-magnesium niobate/lead-titanate ($Pb(In_{1/2}Nb_{1/2})O_3$–$Pb(Mg_{1/3}Nb_{2/3})O_3$–$PbTiO_3$, or PIN–PMN–PT) single crystals grown from solid solution.

a.1.c.1. Operating at frequencies below 10 kHz and having any of the following:

a.1.c.1.a. Not designed for continuous operation at 100% duty cycle and having a radiated 'free-field Source Level (SLRMS)' exceeding (10log(f) + 169.77)dB (reference 1 μPa at 1 m) where f is the frequency in Hertz of maximum Transmitting Voltage Response (TVR) below 10 kHz; *or*

a.1.c.1.b. Designed for continuous operation at 100% duty cycle and having a continuously radiated 'free-field Source Level (SLRMS)' at 100% duty cycle exceeding (10log(f) + 159.77)dB (reference 1 μPa at 1 m) where f is the frequency in Hertz of maximum Transmitting Voltage Response (TVR) below 10 kHz; *or*

Technical Note: *The 'free-field Source Level (SL_{RMS})' is defined along the maximum response axis and in the far field of the acoustic projector. It can be obtained from the Transmitting Voltage Response using the following equation: $SL_{RMS} = (TVR + 20log V_{RMS})$ dB (ref 1μPa at 1 m), where SL_{RMS} is the source level, TVR is the Transmitting Voltage Response and V_{RMS} is the Driving Voltage of the Projector.*

a.1.c.2. [Reserved]

N.B. *See 6A001.a.1.c.1 for items previously specified in 6A001.a.1.c.2.*

a.1.c.3. Side-lobe suppression exceeding 22 dB;

a.1.d. Acoustic systems and equipment, designed to determine the position of surface vessels or underwater vehicles and having all of the following, and ''specially designed'' ''components'' therefor:

a.1.d.1. Detection range exceeding 1,000 m; *and*

a.1.d.2. Determined position error of less than 10 m rms (root mean square) when measured at a range of 1,000 m;

Note: *6A001.a.1.d includes:*

a. Equipment using coherent ''signal processing'' between two or more beacons and the hydrophone unit carried by the surface vessel or underwater vehicle;

b. Equipment capable of automatically correcting speed-of-sound propagation errors for calculation of a point.

a.1.e. Active individual sonars, ''specially designed'' or modified to detect, locate and automatically classify swimmers or divers, having all of the following, and ''specially designed'' transmitting and receiving acoustic arrays therefor:

a.1.e.1. Detection range exceeding 530 m;

a.1.e.2. Determined position error of less than 15 m rms (root mean square) when measured at a range of 530 m; *and*

a.1.e.3. Transmitted pulse signal bandwidth exceeding 3 kHz;

N.B.*: For diver detection systems ''specially designed'' or modified for military use, see the U.S. Munitions List in the International Traffic in Arms Regulations (ITAR) (22 CFR part 121).*

Note: *For 6A001.a.1.e, where multiple detection ranges are specified for various environments, the greatest detection range is used.*

a.2. Passive systems, equipment and ''specially designed'' ''components'' therefor, as follows:

Note: 6A001.a.2 also applies to receiving equipment, whether or not related in normal application to separate active equipment, and ''specially designed'' components therefor.

a.2.a. Hydrophones having any of the following:

Note: The control status of hydrophones ''specially designed'' for other equipment is determined by the control status of the other equipment.

Technical Notes:

1. Hydrophones consist of one or more sensing elements producing a single acoustic output channel. Those that contain multiple elements can be referred to as a hydrophone group.

2. *For the purposes of 6A001.a.2.a, underwater acoustic transducers designed to operate as passive receivers are hydrophones.*

a.2.a.1. Incorporating continuous flexible sensing elements;

a.2.a.2. Incorporating flexible assemblies of discrete sensing elements with either a diameter or length less than 20 mm and with a separation between elements of less than 20 mm;

a.2.a.3. Having any of the following sensing elements:

a.2.a.3.a. Optical fibers;

a.2.a.3.b. 'Piezoelectric polymer films' other than polyvinylidene-fluoride (PVDF) and its co-polymers {P(VDF − TrFE) and P(VDF–TFE)};

a.2.a.3.c. 'Flexible piezoelectric composites';

a.2.a.3.d. Lead-magnesium- niobate/lead-titanate (*i.e.,* $Pb(Mg_{1/3}Nb_{2/3})O_3-PbTiO_3$, or PMN–PT) piezoelectric single crystals grown from solid solution; *or*

a.2.a.3.e.Lead-indium-niobate/lead-magnesium niobate/lead-titanate (*i.e.,* $Pb(In_{1/2}Nb_{1/2})O_3$–$Pb(Mg_{1/3}Nb_{2/3})O_3$–$PbTiO_3$, or PIN–PMN–PT) piezoelectric single crystals grown from solid solution;

a.2.a.4. A 'hydrophone sensitivity' better than −180dB at any depth with no acceleration compensation;

a.2.a.5. Designed to operate at depths exceeding 35 m with acceleration compensation; *or*

a.2.a.6. Designed for operation at depths exceeding 1,000 m and having a 'hydrophone sensitivity' better than −230 dB below 4 kHz;

Technical Notes:

1. '*Piezoelectric polymer film*' *sensing elements consist of polarized polymer film that is stretched over and attached to a supporting frame or spool (mandrel).*

2. '*Flexible piezoelectric composite*' *sensing elements consist of piezoelectric ceramic particles or fibers combined with an electrically insulating, acoustically transparent rubber, polymer or epoxy compound, where the compound is an integral part of the sensing elements.*

3. '*Hydrophone sensitivity*' *is defined as twenty times the logarithm to the base 10 of the ratio of rms output voltage to a 1 V rms reference, when the hydrophone sensor, without a pre-amplifier, is placed in a plane wave acoustic field with an rms pressure of 1 μPa. For example, a hydrophone of −160 dB (reference 1 V per μPa) would yield an output voltage of 10^{-8} V in such a field, while one of −180 dB sensitivity would yield only 10^{-9} V output. Thus, −160 dB is better than −180 dB.*

a.2.b. Towed acoustic hydrophone arrays having any of the following:

Technical Note: *Hydrophones arrays consist of a number of hydrophones providing multiple acoustic output channels.*

a.2.b.1. Hydrophone group spacing of less than 12.5 m or 'able to be modified' to have hydrophone group spacing of less than 12.5 m;

a.2.b.2. Designed or 'able to be modified' to operate at depths exceeding 35m;

Technical Note: '*Able to be modified*' *in 6A001.a.2.b means having provisions to allow a change of the wiring or interconnections to alter hydrophone group spacing or operating depth limits. These provisions are: Spare wiring exceeding 10% of the number of wires, hydrophone group spacing adjustment blocks or internal depth limiting devices that are adjustable or that control more than one hydrophone group.*

a.2.b.3. Heading sensors controlled by 6A001.a.2.d;

a.2.b.4. Longitudinally reinforced array hoses;

a.2.b.5. An assembled array of less than 40 mm in diameter;

a.2.b.6. [Reserved];

a.2.b.7. Hydrophone characteristics controlled by 6A001.a.2.a; *or*

a.2.b.8. Accelerometer-based hydro-acoustic sensors specified by 6A001.a.2.g;

a.2.c. Processing equipment, ''specially designed'' for towed acoustic hydrophone arrays, having ''user-accessible programmability'' and time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes;

a.2.d. Heading sensors having all of the following:

a.2.d.1. An ''accuracy'' of better than ± 0.5°; *and*

a.2.d.2. Designed to operate at depths exceeding 35 m or having an adjustable or removable depth sensing device in order to operate at depths exceeding 35 m;

N.B.: *For inertial heading systems, see 7A003.c.*

a.2.e. Bottom or bay-cable hydrophone arrays having any of the following:

a.2.e.1. Incorporating hydrophones controlled by 6A001.a.2.a;

a.2.e.2. Incorporating multiplexed hydrophone group signal modules having all of the following characteristics:

a.2.e.2.a. Designed to operate at depths exceeding 35 m or having an adjustable or removal depth sensing device in order to operate at depths exceeding 35 m; *and*

a.2.e.2.b. Capable of being operationally interchanged with towed acoustic hydrophone array modules; *or*

a.2.e.3. Incorporating accelerometer-based hydro-acoustic sensors specified by 6A001.a.2.g;

a.2.f. Processing equipment, ''specially designed'' for bottom or bay cable systems, having ''user-accessible programmability'' and time or frequency domain processing and correlation, including spectral analysis, digital filtering and beamforming using Fast Fourier or other transforms or processes;

a.2.g. Accelerometer-based hydro-acoustic sensors having all of the following:

a.2.g.1. Composed of three accelerometers arranged along three distinct axes;

a.2.g.2. Having an overall 'acceleration sensitivity' better than 48 dB (reference 1,000 mV rms per 1g);

a.2.g.3. Designed to operate at depths greater than 35 meters; *and*

a.2.g.4. Operating frequency below 20 kHz;

Note: *6A001.a.2.g does not apply to particle velocity sensors or geophones.*

Technical Notes:

1. *Accelerometer-based hydro-acoustic sensors are also known as vector sensors.*

2. *'Acceleration sensitivity' is defined as twenty times the logarithm to the base 10 of the ratio of rms output voltage to a 1 V rms reference, when the hydro-acoustic sensor, without a preamplifier, is placed in a plane wave acoustic field with an rms acceleration of 1 g* (*i.e., 9.81 m/s*^{2}).

b. Correlation-velocity and Doppler-velocity sonar log equipment designed to measure the horizontal speed of the equipment carrier relative to the sea bed, as follows:

b.1. Correlation-velocity sonar log equipment having any of the following characteristics:

b.1.a. Designed to operate at distances between the carrier and the sea bed exceeding 500 m; *or*

b.1.b. Having speed ''accuracy'' better than 1% of speed;

b.2. Doppler-velocity sonar log equipment having speed ''accuracy'' better than 1% of speed;

Note 1: *6A001.b does not apply to depth sounders limited to any of the following:*

a. Measuring the depth of water;

b. Measuring the distance of submerged or buried objects; or

c. Fish finding.

Note 2: *6A001.b does not apply to equipment ''specially designed'' for installation on surface vessels.*

c. [Reserved]

N.B.: *For diver deterrent acoustic systems, see 8A002.r.*

■ 7. In supplement no. 1 to part 774, Category 9, ECCN 9A004 is revised to read as follows:

9A004 Space launch vehicles and ''spacecraft,'' ''spacecraft buses'', ''spacecraft payloads'', ''spacecraft'' on-board systems or equipment, terrestrial equipment, and air-launch platforms, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS and AT

Control(s)	*Country Chart (See Supp. No. 1 to part 738)*
NS applies to 9A004.g, .u, .v, .w and .x.	NS Column 1
AT applies to 9A004.g, .u, .v, .w, .x and .y.	AT Column 1

License Requirements Note: *9A004.b through .f are controlled under ECCN 9A515.*

List Based License Exceptions (See Part 740 for a Description of All License Exceptions)

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

List of Items Controlled

Related Controls: (1) See also 9A104, 9A515, and 9B515. (2) See ECCNs 9E001 (''development'') and 9E002 (''production'') for technology for items controlled by this entry. (3) See USML Categories IV for the space launch vehicles and XV for other spacecraft that are ''subject to the ITAR'' (see 22 CFR parts 120 through 130).

Related Definition: N/A

Items:

a. Space launch vehicles;

b. ''Spacecraft'';

c. ''Spacecraft buses'';

d. ''Spacecraft payloads'' incorporating items specified by 3A001.b.1.a.4, 3A002.g, 5A001.a.1, 5A001.b.3, 5A002.c, 5A002.e, 6A002.a.1, 6A002.a.2, 6A002.b, 6A002.d, 6A003.b, 6A004.c, 6A004.e, 6A008.d, 6A008.e, 6A008.k, 6A008.l or 9A010.c;

e. On-board systems or equipment, ''specially designed'' for ''spacecraft'' and having any of the following functions:

e.1. 'Command and telemetry data handling';

Note: *For the purpose of 9A004.e.1, 'command and telemetry data handling' includes bus data management, storage, and processing.*

e.2. 'Payload data handling'; *or*

Note: *For the purpose of 9A004.e.2, 'payload data handling' includes payload data management, storage, and processing.*

e.3. 'Attitude and orbit control';

Note: *For the purpose of 9A004.e.3, 'attitude and orbit control' includes sensing and actuation to determine and control the position and orientation of a ''spacecraft''.*

N.B.: *Equipment specially designed for military use is ''subject to the ITAR''. See 22 CFR parts 120 through 130.*

f. Terrestrial equipment ''specially designed'' for ''spacecraft'', as follows:

f.1. Telemetry and telecommand equipment ''specially designed'' for any of the following data processing functions:

f.1.a. Telemetry data processing of frame synchronization and error corrections, for monitoring of operational status (also known as health and safe status) of the ''spacecraft bus''; *or*

f.1.b. Command data processing for formatting command data being sent to the ''spacecraft'' to control the ''spacecraft bus'';

f.2. Simulators ''specially designed'' for 'verification of operational procedures' of ''spacecraft''.

Technical Note: *For the purposes of 9A004.f.2, 'verification of operational procedures' is any of the following:*

1. Command sequence confirmation;

2. Operational training;

3. Operational rehearsals; or

4. Operational analysis.

g. ''Aircraft'' ''specially designed'' or modified to be air-launch platforms for space launch vehicles.

h. through t. [RESERVED]

u. The James Webb Space Telescope (JWST) being developed, launched, and operated under the supervision of the U.S. National Aeronautics and Space Administration (NASA).

v. ''Parts,'' ''components,'' ''accessories'' and ''attachments'' that are ''specially designed'' for the James Webb Space Telescope and that are *not:*

v.1. Enumerated or controlled in the USML;

v.2. Microelectronic circuits;

v.3. Described in ECCNs 7A004 or 7A104; *or*

v.4. Described in an ECCN containing ''space-qualified'' as a control criterion (*See* ECCN 9A515.x.4).

w. The International Space Station being developed, launched, and operated under the supervision of the U.S. National Aeronautics and Space Administration.

x. ''Parts,'' ''components,'' ''accessories'' and ''attachments'' that are ''specially designed'' for the International Space Station.

y. Items that would otherwise be within the scope of ECCN 9A004.v or .x but that have been identified in an interagency-cleared commodity classification (CCATS) pursuant to § 748.3(e) as warranting control in 9A004.y.

Nazak Nikakhtar,

Assistant Secretary for Industry & Analysis, Performing the Non-exclusive Duties of the Under Secretary for Industry and Security.

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