



Brookhaven National Laboratory

FOCUS: Microelectronics

Guidance for Determining the ECCN for Microelectronics and Semiconductor Related Items

Purpose

This document provides guidance for identifying the correct Export Control Classification Number (ECCN) for microelectronics, integrated circuits, semiconductor manufacturing equipment, quantum-related microelectronics, and associated software and technology under the U.S. Department of Commerce Export Administration Regulations (EAR). It highlights the principal Category 3 controls, the worldwide controls applicable to specified quantum and other advanced-technology items, and the additional advanced-computing and semiconductor-manufacturing restrictions that can apply under Parts 734, 742, and 744.

Scope Note - Order of Review: *This guide starts with Commerce controls for microelectronics and semiconductor related items. It does not walk through the full jurisdiction or CCL Order of Review. Before using this guide, possible ITAR jurisdiction and applicable 600 series ECCNs should already have been considered and ruled out **If the item, software, or technology was developed or modified for a military or defense application, STOP and contact the Export Control Office before continuing with this guide.***

What's Controlled? – The Big Picture

Microelectronics is a broad technology area. The correct classification depends on the item type and its technical characteristics - for example, whether the item is an integrated circuit, wafer/die, electronic assembly, semiconductor manufacturing tool, test/inspection equipment, software, or technology. A lower-performance commercial item may fall under 3A991 or EAR99, while advanced electronic devices, advanced-computing ICs, and specified semiconductor manufacturing equipment can be controlled under more restrictive Category 3 ECCNs.

For semiconductor work, classification is only the first step. Destination-based, end-use/end-user, U.S.-person, de minimis, and foreign-direct-product provisions can create license requirements beyond the ordinary Commerce Country Chart analysis.

ECCN 3A001 - Advanced Electronic Items

3A001 controls specified electronic items, including certain integrated circuits and related electronic components, based on enumerated technical characteristics such as radiation tolerance, processing, analog/RF performance, signal conversion, timing, and other parameters. The applicable subparagraph must be identified; the broad label "microelectronics" is not by itself a classification.

ECCN 3A090 - Advanced Computing Integrated Circuits / High-bandwidth memory

3A090 controls specified advanced-computing integrated circuits and high-bandwidth memory (HBM). The current entry uses technical performance criteria for digital processing ICs and includes a separate HBM paragraph. Because 3A090 and related .z controls are revised frequently, use the current BIS/eCFR text to evaluate the exact performance thresholds and notes at the time of classification. Reason for Control: RS, AT. License Exception LPP (Low Processing Performance), 15 CFR 740.29 may authorize certain exports and re-exports of eligible advanced-computing items, subject to destination, end-user, cumulative processing-performance, certification, and other requirements. Confirm current eligibility before relying on this license exception LPP.

ECCN 3A991 - Lower-Level Electronic Devices and Components

3A991 covers specified electronic devices and components not controlled by 3A001 or other more specific Category 3 entries. It is often relevant to commercial microelectronics that remain on the CCL but do not meet higher-level parameters.

ECCN 3B001 / 3B002 - Semiconductor Manufacturing and Test Equipment

3B001 controls enumerated equipment for the manufacturing of semiconductor devices or materials and "specially designed" components/accessories. **3B002** controls specified test equipment for finished or unfinished semiconductor devices. These entries include detailed technical parameters for processes such as deposition, etch, lithography, wafer processing, inspection/metrology, and other semiconductor-production functions.

ECCN 3B993 / 3B994 - Additional Semiconductor Manufacturing Equipment

3B993 and **3B994** control specified semiconductor manufacturing equipment that is not captured by higher-level 3B entries. These ECCNs are particularly important because special destination, Entity List Footnote 5, de minimis, and foreign-direct-product provisions can apply to the equipment and its associated software/technology.

ECCN 3B903 - Semiconductor Inspection Equipment

3B903 controls specified scanning electron microscope (SEM) equipment designed for imaging semiconductor devices or integrated circuits. Check the current technical parameters in the ECCN when SEM equipment is used for semiconductor inspection or analysis.

Quantum / Cryogenic Microelectronics - Worldwide Controls

The EAR contains a separate group of controls for specified quantum and cryogenic technologies. These are especially important in a microelectronics environment because they reach cryogenic integrated circuits, quantum-limited/parametric amplifiers, cryogenic cooling and wafer-probing equipment, isotopically controlled semiconductor materials, and related software and technology.

For the ECCNs identified below, the applicable ECCN license-requirement table invokes National Security (NS) and/or Regional Stability (RS) controls on a worldwide basis under 15 CFR 742.4(a)(5) and 742.6(a)(10). A worldwide license requirement does not mean every transaction is prohibited: License Exception IEC (Implemented Export Controls) may be available for eligible items and destinations that BIS identifies as having implemented equivalent controls, and special deemed-export/deemed-reexport provisions must also be checked.

3A901 - specified electronic items not controlled by 3A001, including quantum-relevant cryogenic electronics such as certain cryogenic CMOS integrated circuits and parametric/quantum-limited amplifiers. NS and RS: worldwide controls.

3A904 - specified cryogenic cooling systems and components used at very low temperatures. NS and RS: worldwide controls.

3B903 - specified scanning electron microscope (SEM) equipment designed for imaging semiconductor devices or integrated circuits and meeting the ECCN technical parameters. NS and RS: worldwide controls.

3B904 - specified cryogenic wafer probing equipment. NS and RS: worldwide controls.

3C907 / 3C908 / 3C909 - specified isotopically controlled silicon/germanium epitaxial materials, compounds, and silicon/germanium materials relevant to semiconductor-qubit development. NS and RS: worldwide controls.

3D901 - specified software associated with certain quantum/cryogenic and semiconductor-inspection items, including software for items controlled by 3A901.b, 3B903, and 3B904. NS and RS: worldwide controls for the covered software.

3E901 - development or production technology for 3A901, 3A904, 3B903, 3B904, 3C907, 3C908, and 3C909. NS and RS: worldwide controls.

4A906 / 4D906 / 4E906 - quantum computers and related electronic assemblies/components, and associated software and technology. These Category 4 ECCNs also carry NS and RS worldwide controls and should be evaluated when microelectronics work is integrated into a controlled quantum-computing system.

STOP - ***Because these controls are worldwide***, do not assume that collaboration with a friendly-country institution or foreign national is automatically authorized. Confirm the ECCN, current license exception IEC eligibility for the specific item and destination, and any applicable deemed-export/deemed-reexport exclusion, general license, reporting requirement, or other authorization before release or transfer.

Applicable Software and Technology Controls

Software and technology associated with microelectronics must be classified independently from the hardware. Key software classifications include:

3D001 / 3D002 / 3D003 - specified software associated with Category 3 electronic and semiconductor-manufacturing items. Check the exact scope and exclusions in each ECCN; certain semiconductor equipment is instead covered by 3D901, 3D907, 3D992, 3D993, or 3D994.

3D907 - specified software used to extract GDSII or equivalent layout data from SEM images, perform layer-to-layer alignment, and generate multilayer layout data or a circuit netlist.

3D006 - specified Electronic Computer-Aided Design (ECAD) software specially designed for the development of integrated circuits using GAAFET structures and meeting the ECCN technical criteria. EDA/ECAD tools, process design kits (PDKs), layout data, and related design technology should be reviewed based on their actual functions and technical content; do not classify them based only on the commercial product name.

3D992 / 3E992 - software and technology associated with specified semiconductor manufacturing and test equipment identified in 3B001 and 3B002. These entries are subject to special semiconductor controls and should be checked separately from 3D001 / 3E001.

3D993 / 3D994 - software associated with equipment controlled by 3B993 / 3B994.

3E001 - "technology" according to the General Technology Note for the "development" or "production" of specified Category 3 items and software.

3E905 - technology for the development or production of integrated circuits or devices using Gate-all-around Field-Effect Transistor (GAAFET) structures. Worldwide NS/RS controls, deemed-export provisions, General Order No. 6, and reporting requirements may apply.

3E993 / 3E994 - technology associated with specified equipment controlled by 3B993 / 3B994.

3D901 / 3E901 - software and technology for specified quantum/cryogenic Category 3 items subject to the worldwide NS/RS control framework.

4D906 / 4E906 - software and technology for specified quantum computers and related items controlled under 4A906.

Not every document that mentions a controlled semiconductor item is controlled "technology." The analysis turns on whether the information is the specific information "necessary" for the controlled development, production, or other activity specified by the ECCN. *Published information and information arising during or resulting from fundamental research may be outside the EAR* when the regulatory criteria are satisfied;

proprietary design, process, fabrication, mask/reticle, equipment-control, integration, or production know-how requires closer review.

PDKs, ECAD Software, and Design / Manufacturing Files

Process Design Kits (PDKs) - The EAR gives PDKs specific treatment in Category 3, Product Group E. ECCNs 3E001 and 3E905 do not apply to a PDK unless it includes libraries that implement functions or technologies for items specified by 3A001. For this purpose, a PDK is a software tool provided by a semiconductor manufacturer for a particular manufacturing process. It contains the design practices and rules needed to design an IC for that process. Review what is actually included in the PDK before assigning the classification.

A PDK generally falls within this treatment when it comes from the semiconductor manufacturer or foundry for a specific process and contains the design rules, models, specifications, and related information needed to design an IC for that process. It must not include libraries implementing functions or technologies for items specified by 3A001.

If the PDK includes libraries implementing functions or technologies for items specified by 3A001, the 3E001/3E905 PDK exclusion does not apply. Review the PDK and the included libraries before export or release. Also remember that the PDK note only addresses 3E001 and 3E905. A qualifying PDK is not automatically EAR99, and other EAR requirements may still apply.

GAAFET PDKs - A PDK used for a GAAFET process is not automatically controlled under 3E905. Apply the PDK note first and look at what the PDK actually contains. Separate GAAFET process technology needed for wafer-level development or production of GAAFET structures still needs its own 3E905 review.

ECAD / CAD Software - Classify the software based on what it actually does. For example, 3D006 covers specified ECAD software specially designed for developing integrated circuits using GAAFET structures when the ECCN technical criteria are met. A CAD or ECAD design file does not automatically take the ECCN of the software that created it.

CAD, Layout, and Manufacturing Files - CAD files, Gerber files, GDSII files, mask/reticle layouts, schematics, drill files, stack-up drawings, fabrication notes, BOMs, pick-and-place files, and similar files are not automatically "software" just because they are electronic files. Look at the information in the file and what it is being used to develop or produce. A file may be controlled technology if it contains the specific information controlled by the applicable technology ECCN.

PCB Manufacturing - When we send PCB work to an outside fabricator, review the manufacturing package being sent and the board or assembly being produced. Do not assume the Gerber or other fabrication files have the same ECCN as the finished board. Also confirm where the board will actually be made and where the files will be accessed. A U.S. supplier may send the work to an overseas facility or subcontractor.

STOP - Do not classify a design or manufacturing file based only on the file extension. Look at what the file contains, what it will be used to develop or produce, and whether the applicable ECCN controls that information.

Special Semiconductor / Advanced-Computing Rules

- Part 742 contains additional Regional Stability license requirements for specified advanced-computing and semiconductor-manufacturing items, including special requirements for certain 3B993/3B994, 3D993/3D994, and 3E993/3E994 items involving Footnote 5 entities.

- Part 744 includes end-use/end-user controls for advanced-node integrated-circuit production, advanced computing, supercomputers, and semiconductor manufacturing equipment. These restrictions can apply based on destination, fabrication facility, end use, end user, or entity-list designation.
- U.S.-Person Restrictions – 15 CFR 744.6. Part 744 also restricts certain activities of U.S. persons involving the development or production of advanced-node integrated circuits and specified semiconductor activities. These controls can apply to certain support involving items not subject to the EAR, including covered shipments, transfers, or servicing activities. Check 744.6 when U.S. persons will support semiconductor development or production involving covered destinations, facilities, end uses, or end users.
- Part 734 de minimis and foreign-direct-product rules can cause certain foreign-produced semiconductor items to be subject to the EAR, including rules tied to advanced-node integrated-circuit production and Footnote 5 entities.
- License-exception eligibility for semiconductor items is highly fact-specific. Confirm the current Part 740 requirements and limitations before relying on an exception.

How to Determine the Correct Microelectronics ECCN

1. Identify exactly what is being classified: IC, wafer/die, module, board, mask/reticle, fabrication tool, test/inspection equipment, software, source code, or technical information.
2. Evaluate the technical parameters in the applicable Category 3 ECCNs before moving to a lower-level ECCN or EAR99.
3. For advanced digital processing ICs and HBM, evaluate 3A090 and any applicable .z paragraph in another ECCN using the current BIS/eCFR thresholds and notes.
4. For semiconductor manufacturing and inspection equipment, evaluate 3B001 and 3B002 first, then applicable entries such as 3B903, 3B993, and 3B994. Apply the current technical parameters in each ECCN.
5. For quantum, cryogenic, or related advanced microelectronics, evaluate 3A901, 3A904, 3B903, 3B904, and 3C907 through 3C909; also evaluate 4A906 when the item is part of a controlled quantum computer or related electronic assembly. Treat the worldwide NS/RS license requirements as a separate authorization checkpoint.
6. Classify associated software and technology separately; do not assume the hardware ECCN applies automatically to software, source code, process data, design files, or fabrication know-how.
7. After classification, screen Parts 734, 742, 744, and 746 for destination, end-use/end-user, Entity List, foreign-direct-product, de minimis, and sanctions-related requirements.

Key Terms:

Term	Definition
ECCN	Export Control Classification Number – the code used to identify items on the Commerce Control List
Microelectronics	A practical umbrella term for semiconductor devices, integrated circuits, wafers/die, electronic assemblies, and

	related fabrication/test technologies; it is not itself an EAR classification.
Advanced-node IC	A defined EAR term used in special semiconductor end-use/end-user and foreign-direct-product rules. Apply the current 15 CFR 772.1 definition.
HBM	High-bandwidth memory. Certain HBM is controlled under ECCN 3A090.c, subject to the current technical criteria and notes.
Technology	Specific information necessary for the "development," "production," or "use" of a product, as defined by the EAR and the applicable ECCN.
Foreign Direct Product	A rule in Part 734 that can make certain foreign-produced items subject to the EAR when they are direct products of specified U.S.-origin technology/software or of certain plants/major components.
Reasons for Control	NS - National Security; RS - Regional Stability; AT - Anti-Terrorism; additional controls may apply depending on the ECCN and rule.
IEC	License Exception Implemented Export Controls (IEC). It may authorize eligible exports, reexports, or in-country transfers of specified worldwide-controlled advanced-technology items to destinations BIS identifies as having implemented equivalent controls.
Worldwide Control	For specified ECCNs, the NS and/or RS license requirement applies to all destinations. Availability of License Exception IEC, deemed-export exclusions/general licenses, and other EAR provisions must still be evaluated.
GAAFET	Gate-all-around Field-Effect Transistor. Technology for the development or production of specified integrated circuits or devices using GAAFET structures may be controlled under ECCN 3E905.
PDK	Process Design Kit. For the Category 3 Product Group E note, this is a software tool provided by a semiconductor manufacturer for a particular manufacturing process. It contains the design practices and rules needed to design an IC for that process.
Gerber / PCB manufacturing files	Electronic design and fabrication files used to manufacture printed circuit boards. They are not automatically software. Review the information in the files and what is being manufactured.

Key Takeaways:

STOP - Do not share controlled microelectronics hardware, semiconductor software/source code, fabrication data, design files, or controlled technology internationally or with foreign persons until classification and authorization requirements are confirmed.

PDKs, CAD/ECAD tools, Gerber files and other design or manufacturing files need their own review. Do not classify them based only on the file type, the software that created them, or the ECCN of the finished hardware

Quantum and related advanced microelectronics can be subject to worldwide NS/RS controls. Specifically screen 3A901, 3A904, 3B903, 3B904, 3C907-3C909, 3D901, 3D907, 3E901, 3E905, and, where applicable, 4A906/4D906/4E906 before sharing hardware, software, or technology with foreign persons or outside the United States.

Microelectronics classification must be item-specific; "microelectronics" is not a single ECCN. Advanced-computing IC and semiconductor-manufacturing transactions require both CCL classification and a separate review of special Parts 734, 742, and 744 controls. Document the technical parameters, data sheets, equipment specifications, and regulatory provisions used for each classification.

Revisit the classification and authorization analysis when performance, node, design, fabrication process, equipment capability, end use, end user, destination, or the EAR changes.

References and Contacts:

- 15 CFR Parts 734, 740, 742, 744, 746, 772 and 774
- Supplement No. 1 to Part 774 - CCL Categories 3 and 4
- Category 3, Product Group E note for Process Design Kits (PDKs)
- Key ECCNs: 3A001, 3A090, 3A991, 3A901, 3A904, 3B001, 3B002, 3B903, 3B904, 3B993, 3B994, 3C907, 3C908, 3C909, 3D006, 3D901, 3D907, 3D992, 3D993, 3D994, 3E901, 3E905, 3E992, 3E993, 3E994, and where applicable 4A906, 4D906, 4E906
- 15 CFR 742.4(a)(5), 742.6(a)(10), 743.7, 743.8; Supplement No. 1 to Part 736, General Order No. 6; 15 CFR 740.24 (License Exception IEC); 15 CFR 740.29 (License Exception LPP); 15 CFR 744.6 (U.S.-person activities)
- BIS License Exception IEC eligible items and destinations table
- BIS EAR: <https://www.bis.gov/regulations/ear>

Quantum, semiconductor, advanced-computing, and U.S. person controls change frequently; verify the current EAR, applicable license exceptions, BIS tables, and general-license/reporting provisions at the time of each classification or transaction review.

For export classification assistance, contact the BNL Export Control Office @ export@bnl.gov