FLIR | The World's Sixth Sense™

April 01, 2016

Regulatory Policy Division
Bureau of Industry and Security
U.S. Department of Commerce
Washington, DC 20230
Email To: publiccomments@bis.doc.gov

Subject: Comments of FLIR Systems, Inc., to the Proposed Rule Revising the Export Administration Regulations to Control Fire Control, Laser, Imaging, and Guidance and Control Equipment No Longer Warranting Control Under the U.S. Munitions List (81 Fed. Reg. 33; RIN 0694-AF75)

Dear Sir/Madam,

FLIR Systems, Inc. (FLIR) hereby submits the following comments in response to the proposed revision of the U.S. Export Administration Regulations (EAR) to control certain fire control, laser, imaging, and guidance and control equipment that no longer warrants control under the U.S. Munitions List, as published in the Federal Register on February 19, 2016. These comments are timely submitted by the April 4, 2016, due date published in the Federal Register notice.

FLIR is a world leader in the design, manufacture, and marketing of sensor systems that enhance perception and awareness. FLIR's advanced thermal imaging and threat detection systems are used for a wide variety of imaging, thermography, and security applications, including airborne and ground-based surveillance, condition monitoring, research and development, manufacturing process control, search and rescue, drug interdiction, navigation, transportation safety, border and maritime patrol, and environmental monitoring. FLIR has annual revenues of approximately $1.6B, with over half of that revenue generated by sales outside of the United States. Many of FLIR's products, software and technology are currently controlled for export under Category XII of the ITAR and under Control List entries 6A002, 6A003 and 6A993 of the EAR. The exportability of products and technology is a major factor in FLIR's ability to compete successfully and to sell in the global marketplace. Any revision of Category XII of the ITAR and corresponding changes to the EAR therefore have the potential to significantly impact FLIR's product sales.

GENERAL COMMENTS

As a general comment, we believe that the February 2016 proposal is significantly improved from the May 2015 draft and is in much better alignment with the guiding principles of Export Control Reform (ECR). We were pleased that the interagency reviewers appear to have seriously considered the input from industry, academia, and government research institutes and took a fresh approach to drafting new language for Category XII. The February 2016 proposed rule better balances national security concerns while providing a much-needed updating of the ITAR and EAR to reflect the advancement of technology, the continued expansion of foreign manufacturing of this technology, and the significant and rapid growth of commercial markets.

Bright Line. This proposed rule addresses one of FLIR's prior concerns, by appropriately placing the bright line controls on military end-items rather than on the parts, components, and sub-systems that are used for commercial, industrial, and military systems. FLIR provided data in its July 2015 comments to the May 2015 proposal that demonstrated that commercial markets dominate the demand for infrared focal plane arrays (IRFPAs). The commercial demand to incorporate sensors into consumer products is driving many companies to invest their own research and development funds to advance sensor technology. Additionally, FLIR's prior

27700 SW Parkway Avenue, Wilsonville, OR 97070 USA [T] 503.498.3547 [T] 800.322.3731 [F] 503.498.3911
www.flir.com

comments incorporated specific data demonstrating foreign availability of IRFPAs, as validated by multiple independent market research organizations. FLIR provided similar foreign availability data for other components such as lasers, optics, ROICs, cameras and many other sub-assemblies.
The new proposed rule now clearly delineates that only IRFPAs specially designed for articles controlled by the ITAR should be controlled under CAT XII. FLIR supports this critical change that will allow U.S. companies to compete with the growing number of non-U.S. IRFPA manufacturers.

Definitions. The current proposed rule successfully aligns key definitions set forth in the EAR and will reduce confusion and complexity that would have been introduced by the May 2015 proposal. For example, both the EAR and the Wassenaar Dual-Use List use the same language to describe a "camera." However, the May 2015 proposal introduced a slightly different definition that would have resulted in disparate interpretations and treatment. There were several other definitions such as "core" and "permanently encapsulated sensor assembly" that were introduced in the May proposal and subsequently removed from the current proposal. which reduces the probability of significant inconsistent treatment by various manufacturers and U.S. Government personnel required to rule on export licensing requests.

World-Wide Competition. The February 2016 proposal for CAT XII recognizes that commercial demand, foreign availability, and the ability of U.S. companies to compete in the global market are essential to U.S. industry maintaining and growing its market share and leadership in technology development.

The May 2015 proposal would have led to a severe competitive disadvantage for U.S. companies. Many systems and components that were retained under ITAR jurisdiction in the May proposal are in normal commercial use and widely available from non-US manufacturers. The current and future commercial market demand for such products far exceeds military demand (see, for example, Figure 1 for forecast of demand for uncooled focal plane (UFPA) cameras). As it is not possible to satisfy commercial markets with ITAR controlled products, non-U.S. companies would have been able to reap advantages of being able to develop, produce, and sell commercial items treated as dual-use items by every country in the world except the U.S. That would have driven sales, R&D, and high-technology jobs to companies and research institutions outside of the U.S. Additionally, controlling dual-use products under the ITAR would discourage non-U.S. companies from investing in production and research activities in the U.S.

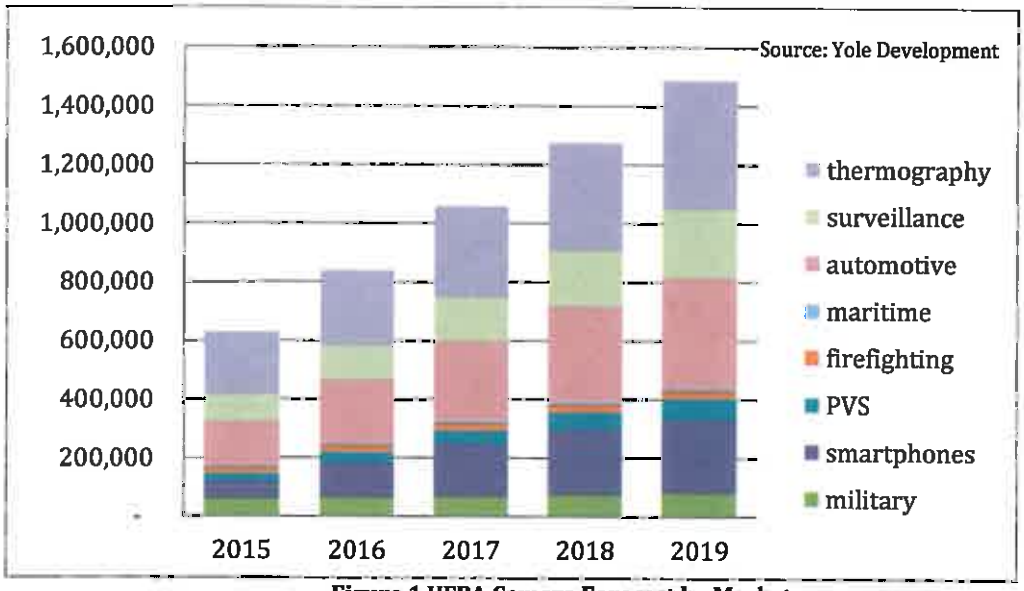


Figure 1 UFPA Camera Forecast by Market

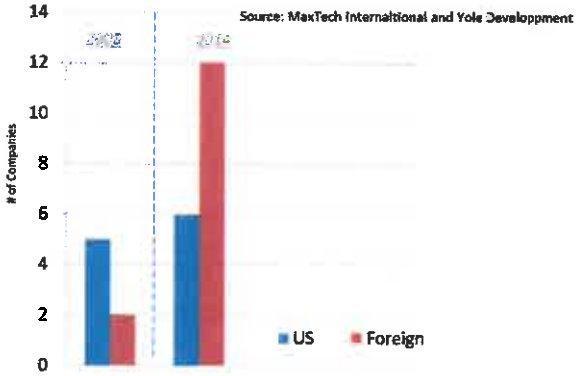
SPECIFIC COMMENTS

Restrictions on use of License Exception STA for 6A002 and 6A990:

FLIR appreciates the reason for restricting the use of License Exception STA for technology and software used for the development and production of items controlled under 6A002, 6A003 and 6A990. It is important to assure that certain development and production technologies are transferred only in accordance with U.S. Government national security and foreign policy interests. However, restricting the use of License Exception STA for exports of finished components that are controlled under 6A002 and 6A990 is inconsistent with other EAR controls, such as those set forth for 6A003. Items controlled under 6A002 and 6A990 are widely available from non-U.S. manufacturers and therefor elimination of License Exception STA will place U.S. companies at a competitive disadvantage. The data in Figures 2 and 3 was provided in FLIR's July 2015 response and demonstrates the significant foreign availability of items controlled under ECCN 6A002. We respectfully submit that authorizing use of License Exception STA would provide a sufficient level of export control over items classified under these ECCNs.

ECCN 6A002: FLIR submits that Limiting the STA license exception on items that are in commercial use and that are widely available from non-U.S. sources is contrary to the principles of ECR. The consequences of over-controlling this technology will be that non-U.S. OEMs will choose to source IRFPAs from companies that are not encumbered by the requirement for a formal export license. Authorizing use of the STA license exception for certain exports is a proven regulatory alternative that supports the commercial sales of dual-use components and systems to countries considered trustworthy by the United States.

Figure 1 **The Number of Foreign UFPA Production Manufacturing Facilities Is Increasing Dramatically**



The number and technical sophistication of foreign UFPA manufacturers has increased and will continue to do so as foreign firms benefit from the overly restrictive controls placed on U.S. manufacturers. Figure 3 is a table showing by country, Microbolometer IRFPA technology currently being manufactured.

Figure 2 Companies Producing Microbolometer IRFPAs

Number of Companies Producing Microbolometer IRFPAs

Source: MaxTech International

Material Type	U.S	Japan	Israel	China	Canada	France	Germany	Korea	Turkey
Vanadium Oxide (VOx)	5	1	1	2	2				
Amorphous Silicon (a-Si)	1			2		1	1		
Silicon-on-Insulator (SOI)		2						1	
Titanium Oxide (TiOx)								1	
Various Uncooled Technologies				1				1	1
	6	3	1	5	2	1	1	3	1

Performance is rapidly improving and commercial manufacturing techniques such as wafer-level-packaging and pixel-level-packaging, are greatly reducing manufacturing costs and reducing prices of IRFPAs. Much of this innovation is driven from commercial demand rather than military requirements. As shown above in Figures 2 and 3, a growing number of the commercial manufacturers are non-U.S. companies. FLIR recognizes and appreciates that the current proposed rule clearly places IRFPAs into ECCN 6A002; however, in order for U.S. companies to compete with the growing number of non-U.S. IRFPA manufacturers, the international sales and export process must be predictable and efficient. Placing licensing requirements on dual-use technology when License Exception STA would provide sufficient control will have the unintended effect of strengthening non-U.S. companies at the expense of U.S. manufacturers. U.S. producers will lose economies of scale, and in the end America's military will become dependent on non-U.S. sources for this vital technology. The U.S. satellite and LCD industries are examples of situations where product development and manufacturing efficiencies and expertise moved off-shore, at least in part due to restrictive U.S. export controls.

We have provided below a list of non-U.S. manufacturers of 6A002 items so that foreign availability may be considered in determining whether the proposed rule may be amended to authorize License Exception STA:

Non-U.S. Sources – Microbolometer Uncooled Focal Plane Arrays (UFPA):

1) Semi-Conductor Devices (SCD), Israel, 1024 x 768 VOX. http://www.scdusa-ir.com/bird-xga/
2) ULIS, France, Pico 1024 x 768 a-Si UFPA. http://www.ulis-ir.com/index.php?infrared-detector=gen2pico1024
3) North Guang Wei Technologies (GWIC), China, 640x480 VOX microbolometers. http://www.gwic.com.cn/en_productdetail.html?id=21
4) Dali, China, 640x480 a:Si UFPA. http://www.dali-tech.us/products/dlc640-60.html
5) i3 Systems, Korea. http://www.i3system.com/eng/n_product/product101.html
6) Wuhan Guide, China, uncooled 640x480/384x288. http://www.wuhan-guide.com/default/solution.html

Non-U.S. Sources – Photon Cooled Focal Plane Arrays

1) SCD, Israel, 1920x1536 InSb, MWIR. http://www.eurosatory.mod.gov.il/pdfs/SOD_SCD.pdf
2) Sofradir, France. 640x480 SWIR FPA. http://www.sofradir.com/product/cactus-640-sw-2/
3) SCD, Israel. 640x480 SWIR FPA. http://www.scdusa-ir.com/cardinal-640/?doing_wp_cron=1435271330.2543458938598632812500

4) Selex, UK. 1280x720 MCT. http://www.selex-es.com/product-portfolio/optronics-system/thermal-detectors
5) IR Nova, Sweden. 640x480 T2SL FPAs. http://www.ir-nova.se/products-mwir/
6) Wuhan Guide, China, Cooled FPA & Modules. http://www.wuhan-guide.com/default/Government.html
7) AIM INFRAROT GmbH, Germany, 640x512 MCT. http://www.aim-ir.com/home-aktuelles/produktneuheiten.html

ECCN 6A990: FLIR respectfully submits that authorizing use of License Exception STA would provide a sufficient level of export control over items classified under ECCN 6A990. FLIR's July 2015 comments to the May 2015 proposed CAT XII rule provided extensive data in support of its position that ROICs designed for 6A002 focal plane arrays should be classified under EAR99, rather than on the Control List. FLIR believes that there is strong evidence demonstrating that these devices are available world-wide. Although FLIR understands that the agencies have instead proposed to control such ROICs under 6A990 for national security purposes, we believe that it is unnecessarily restrictive to prohibit export under License Exception STA for the following reasons.

The details for the design and manufacturing technology of ROICs for IRFPAs is widely available in the public domain. There are hundreds of patents issued and annual papers published and presented at international technical symposiums. ROIC design techniques are taught in universities and at conferences. Entities located outside of the U.S. and Wassenaar Agreement countries, such as China, Taiwan, and Israel, design and manufacture ROICs for infrared focal plane arrays. The ROIC devices are manufactured at silicon foundries world-wide. Existence of this technical capability outside of the U.S. and Wassenaar is evident by the significant number of patents and published papers available on this technology.

1) Patents. A search of the United States Patent Technology Office database produced over five hundred (500) patents issued worldwide directly related to ROICs for IRFPAs. Additionally, of the five hundred patents there are over fifty (50) patents issued to entities in China. FLIR previously provided this list in its July 2015 comments. (Please note that the patent searches performed for these reports were not exhaustive and it is highly likely that many more patents related to this technology would be found after a more thorough search.)
2) Published Papers. Papers have been published for decades on the details of the design and testing of ROICs. The following list provides a few examples of papers that have been published by entities outside of the Wassenaar Agreement countries on this topic:
    a. The Institution of Electronics and Telecommunications Engineers (IETE) Journal of Research has published many relevant papers including: "320x256 Readout Integrated Circuit for Infrared Focal Plane Arrays with Low-Temperature MOSFET Model." Authored by a team from the National ASIC System Engineering Research Center, Southeast University, Nanjing, Jiangsu, China.
    b. SPIE – "Optimization of Readout Circuit with Background Suppression for Dual-Band Quantum Well Infrared Focal Plane Array Photodetector." Authored by a team from the National Chi Nan University in Taiwan.
    c. SPIE Photonics Asia – "Design low-noise readout circuit for near-infrared InGaAs focal plane array", Paper 8562-4 Author(s): Zhangcheng Huang, Huang Songlei, Jiaxiong Fang, Shanghai Institute of Technical Physics (China).
3) Conferences / Symposiums. The International Society of Optical Engineering (SPIE) hosts symposiums where papers on details related to ROICs, focal plane arrays, lasers, and many other

electro-optical devices are presented. Additionally, SPIE offers classes related to ROIC design at conferences, such as the Defense, Security and Sensing (DSS) Symposium, in Baltimore. The following examples represent just a small sampling of the over one hundred courses offered either on-line or during a given DSS Symposium as well as courses that have been offered for over twenty years.

a. Analog-to-Digital Converters for Digital ROICs (SC1076). This course surveys structure and operation of analog-to-digital converters (ADCs) implemented on digital readout integrated circuits (ROICs) and digital image sensors.
b. The SPIE database contains charts and notes from ROIC and FPA design courses taught annually going back to 1994.
c. The presentations and courses presented at SPIE are typically approved by the US DOD, and are attended by international and domestic audiences.

4) University Degrees. Many U.S. and non-U.S. universities have practical courses in IC design. Some of the best universities in this area of study are MIT, Stanford, UC Berkeley, Cal Tech, and the University of Utah. It is common for non-U.S. citizens, including Chinese nationals, who have been educated and received advanced degrees from one of the universities listed above, to apply for and in some cases be hired for IC design positions to U.S. companies that design ROICs.
5) Non-U.S. sources provide ROICs on a commercial basis.
   a. Mikro Tasarim, in Turkey is a merchant supplier of ROICs for IRFPAs offer a variety of ROICs including a 1280x1024 for SWIR IRFPAs. http://www.mikro-tasarim.com.tr/products
   b. Xenics, in Belgium offers a wide variety of IRFPA devices and ROIC design services. http://www.xenics.com/en/application/custom-infrared-roic-design
   c. New Imaging Technologies (NIT), in France offers standard components and ROIC design services. http://www.new-imaging-technologies.com/ingaas-products.html
   d. Tumsis, in Turkey designs ROICs for IRFPAs. http://www.tumsis.com/capabilities.html
   e. Imec, in Belgium offers components and design services. http://www2.imec.be/be_en/research/image-sensors-and-vision-systems/hyperspectral-imaging.html
6) Major non-U.S. IRFPA manufacturers have in-house ROIC design capability. Companies such as Semi-Conductor Devices (SCD) in Israel, Sagem and Sofradir in France, Selex in the UK all have in-house ROIC design capability.
7) As shown in Figure 3, there are many Chinese IRFPA manufacturers and they claim to design their own ROICs for the IRFPAs they manufacture. The ROICs are manufactured at silicon foundries in China.
8) As noted by BIS, in the CAT XII Website Guidance dated 15 June 2015, many ROICs for IRFPAs that are not designed for military applications have been controlled as EAR 99 dual-use items.

COMMENT: Items controlled under 6A002 and proposed for control under 6A990 are commercially available and manufactured world-wide. This proposed language is overly restrictive and not conducive to supporting commercial sales of these dual-use products by adding an additional layer of bureaucracy. U.S. manufacturers will be further restricted from competing globally and non-U.S. manufacturers will continue to grow their market share. Restricting the use of License Exception STA for these products represents an inconsistent application of the regulations since STA is widely available for most items controlled under ECCN 6.

RECOMMENDATION: FLIR recommends that the agencies authorize the use of License Exception STA for products that are classified under ECCNs 6A002 and 6A990.

CONCLUSION

FLIR believes that the recommendations that it has provided in this document will help to fine-tune the proposed changes to the EAR in a way that continues to balance national security concerns against the need for U.S. technology evolution and innovation and commercial competition considerations. We greatly appreciate the enormous effort that the interagency drafters and reviewers have put into the February 2016 rewrite of CAT XII and the EAR. FLIR and many others in industry, research institutes, universities, and government agencies provided voluminous comments, with supporting data, and expressed serious concern about the May 2015 draft. It is apparent that the Interagency group carefully reviewed the comments, analyzed supporting data related to commercial demand and foreign availability, and weighed those issues against U.S. national security concerns. We would like to commend the interagency group for creating a new proposed rule that took into consideration and integrated many suggestions from the May 2015 public comment period.

Please contact Nancy Boughton, Vice President & Deputy General Counsel, by phone at 503-498-3301, or by e-mail at nancy.boughton@flir.com, should you require any further information in support of our comments herein.

Best regards,
FLIR SYSTEMS, INC.

Andrew C. Teich
Chief Executive Officer