RECORD OF PUBLIC COMMENTS

Notice of Inquiry -- Civil Uses of Certain Microwave Monolithic Integrated Circuit (MMIC) Power Amplifiers, Discrete Microwave Transistors and Bi-Static and Multi-Static Radar
(79 F. Reg. 37548, July 1, 2014)

	Commenter	Date Received
1	Analog Devices	09/02/2014
2	Boeing Co., The	08/29/2014
3	Communications & Power Industries, LLC	09/02/2014
4	Cree, Inc.	08/27/2014
5	Hahn, Ken	07/07/2014
6	M/A-Com Technology Solutions	09/02/2014
7	TriQuint Semiconductor	09/02/2014
8	ViaSat	08/28/2014

From: Farrell, Dennis <Dennis.Farrell@analog.com>
Sent: Tuesday, September 02, 2014 2:06 PM
To: PublicComments
Subject: Public Comments -- Military Electronics Notice of Inquiry
Attachments: Military Electronics Notice of Inquiry - Public Comments.pdf; TriQuint MMIC & MW Trans Proposal from Aug 15.pdf

Importance: High

Dear BIS:

Attached please find our public comments in reference to the changes to the Military Electronics export regulations, which were released on July 1, 2014. In addition to our comments in the attached 5-page letter, we are also attaching a document supporting another proposed change to these regulations.

Yours truly,

Dennis Farrell

Director - Global Trade Compliance

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ANALOG DEVICES

September 2 , 2014

Regulatory Policy Division
Bureau of Industry and Security
U.S. Department of Commerce Room 2099B
14th Street and Pennsylvania Ave., N.W.
Washington, D.C. 20230

Subject: Military Electronics Notice of Inquiry

To Whom It May Concern:

Analog Devices, Inc. (ADI) designs, manufactures and markets a broad line of high performance linear, mixed signal and digital integrated circuits that address a wide range of real-world applications. ADI's products are sold primarily to original equipment manufacturers, who incorporate them into variety of equipment and systems for use in communications, computers, industrial, instrumentation, aerospace, military, automotive and consumer products. Founded in 1965, ADI employs approximately 9800 people worldwide. The company's Corporate Headquarters is in Norwood, Massachusetts; manufacturing facilities are located in Massachusetts, North Carolina, Ireland, and the Philippines with Design Centers in approximately 23 countries.

On July 23, 2014, ADI completed the acquisition of Hittite Microwave Corporation (Hittite). With the addition of Hittite's core product competencies ADI is in the business of designing, producing, marketing and selling Microwave Monolithic Integrated Circuits (MMICs) and MMIC-related products such as MMIC Power Amplifiers, many of which are currently controlled under ECCN 3A001.b.2. in the U.S. Commerce Control List (CCL).

As part of the US Export Control Reform (ECR) initiative, on July 1, 2014 the U.S. Departments of Commerce (BIS) and State (DDTC) announced new export controls on Microwave Monolithic Integrated Circuits (MMIC) power amplifiers and Discrete Microwave Transistors. The controls for these devices will be moving from a dual-use/commercial category (3A001) into a military-type category (3A611) within the US Commerce Control List. Even though these items will remain under U.S. Dept. of Commerce jurisdiction, they will be treated as military items and be subjected to more restrictive export controls than the ones currently in place. ADI sells a wide variety of MMIC power amplifiers and is well positioned in the MMICs market. ADI believes the new export controls placed on military electronics, and more specifically on MMIC and Microwave Transistor products, will be detrimental to U.S. companies and will make exporting these products much more difficult, and in some cases impossible, when these changes take effect in late December of 2014.

For ADI, the customers and market applications for the majority of these products are commercial in nature. Further, the ecosystem for these products is global – with non US-based companies providing competitive products. The effect of these rules will be to inhibit US companies from supplying these products to commercial customers and markets. These end customers will still be able to buy these components – from European and Asian based companies.

If these regulatory changes are implemented and become law, as planned, in December 2014, they will be counter-productive toward achieving the goals of US Export Control Reform (ECR). ECR was initiated to protect only those products and technology which negatively impact US national security and to move items controlled under ITAR jurisdiction into US EAR jurisdiction. These rules go in the opposite direction by taking products used in commercial/civilian applications and placing them in a military category, which will only serve to make doing business internationally more restrictive for US companies and inhibit real commercial sales opportunities.

Summary of Commercial Applications for These Products

ADI sells these amplifier products into a variety of markets. One of the major markets for these products is the microwave radio market, which is a piece of the cellular infrastructure market. The increase in demand for higher bandwidths on mobile devices has continued to drive this market to higher data rates, creating fierce competition in the industry with the market leaders located in Asia and Europe. ADI has been able to gain market share in the past few years but will likely not keep pace with competition with new restrictions in place.

A second market we serve is the test equipment market with major vendors we serve in Asia, US, and Europe. These companies make instruments for the electronics industry to measure a component's performance, which could be a mobile phone or a tablet computer. These mobile phone testers require high power, wideband amplifiers requested by the major mobile phone suppliers.

A third market we sell these products into is the satellite television/internet market where it is critical to have high power and high Power Added Efficiency of the amplifier. These amplifiers go into the satellite dish on a consumer's house to be able to watch television or surf the internet and communicate to a satellite in the sky. The Power Added Efficiency is a key selling point to the consumer who wants to save money on their electric bill and buy this service for a lower price by reducing heat dissipation material in the satellite dish which reduces the cost.

Growth of the E-Band Market

The high bandwidth demand of the microwave radio market has resulted in significantly increased bandwidth requirements – which has resulted in ADI's customers moving to higher frequency platforms in order to be able to provide these high data rates [*Reference: EJL Wireless Research Global Digital PTP Radio Market Analysis and Forecast, 2013-2017*]. The proposed regulations will have a significant negative impact on US companies' ability to participate in the development and shipment of product for these high data rate applications. Most of the projected growth over the next three years in microwave radio is in the band designated "E-Band" which lies from 71-76GHz and 81-86GHz [Allocations and Service Rules for the 71-76 GHz, 81-86 GHz and 92-95 GHz Bands, REPORT AND ORDER (FCC 03-248)]. ADI has invested millions of dollars of R&D over the past two years to develop product for this emerging market. ADI is currently shipping production E-Band MMICs to multiple customers in the US, Europe, and Asia and this revenue/market is a significant element of our growth strategy over the next three to five years. If these regulations go into effect ADI and other US companies would effectively be eliminated from being competitive in this market – and the market space will be ceded to international competitors in Europe and Asia.

Moving MMICs from ECCN 3A001 to 3A611 -- Export Control Change Impacts on the Business

If the regulatory changes announced on July 1, 2014 are implemented as currently written, they will become effective on or about December 30, 2014, which is the normal transition period (180 days) under the US Government's ECR initiative. Here is a summary of impacts these changes will have on ADI in the MMICs product and technology space:

- Products: Roughly 75% (or higher) of the MMIC products which can be exported today without a US export license will require an approved license to all destinations, except Canada, when the new regulations take effect. Also, there will be a strong "presumption of denial" for all export license applications for exports of MMICs to China (PRC).

- Technology (Know How): MMIC products can be designed and produced (manufactured) today in many countries outside the US without an export license. When the new regulations take effect, we will need to obtain US export licenses in order to both design/develop and/or produce MMIC products outside the US. To be more specific, only "build to print" production technology will be allowed in most non-US countries without a US export license. Also, the U.S. government may deny export license applications for transfers of MMIC design and production technology to the following non STA eligible countries: Taiwan, Philippines, Malaysia, Indonesia, Singapore, India, Israel and Hong Kong. The prohibition on China as mentioned in the Products section above would also apply to design and production technology.

The issues mentioned above will have a significant negative impact on the length of the ADI sales cycle, impact ADI's ability to meet customer demand for products in a timely manner (the wait for U.S. export licenses can run as high as 2-3 months) and result in significant lost revenue. Further, these issues will have a major impact on our supply chain if we were denied the ability to design and/or manufacture MMICs devices outside the U.S., which is where these products are designed and/or produced today.

Why the Move from 3A001 to 3A611 ?

U.S.- based MMICs companies have been told the primary reason for MMICs and Microwave Transistors moving from ECCN 3A001 to ECCN 3A611 is the U.S. Department of Defense (more specifically, the Defense Technology Security Administration or DTSA) and the Naval Research Labs believe that most or all of the end uses for these products are for military applications. However, there is a very healthy and robust commercial/civil market in the United States and throughout the world for MMIC power amplifiers and other microwave products. ADI has determined that 26 of our current products will likely move from ECCNs EAR99 or 3A001 to ECCN 3X611 if these new regulations go into effect. ADI is currently selling these products on the commercial market and we track the end market for our products. An analysis of the past 18 months of sales shows that the revenue for these products is 97% commercial and 3% military. This data shows that there is a robust commercial market for these products. US companies including ADI have a strong leadership position in this market today. There are, however, a number of international competitors in both Europe and Asia that provide similar competitive products. These extra restrictions will not stop products in these categories from being available in the international commercial marketplace. They will, however, provide a significant advantage to the international competitors – tipping the competitive scales in favor of these companies. The net outcome will likely be that the US companies will lose their leadership position in these markets

– and will ultimately impact the success of these companies and can lead to a loss of US technology leadership and jobs.

Impact on U.S. Export Licensing Activity

Over the past 18 months, ADI (as Hittite) has obtained seven (7) approved individual validated export licenses from BIS, authorizing export/re-export shipments of commercial MMIC products to our customers. If these devices are moved into ECCN 3A611 as planned, we estimate our U.S. licensing volume to increase by approximately ten-fold, as roughly seventy-one (71) BIS 600-series export licenses would be required to meet our estimated export shipment volume for the same time period going forward. The increase in licensing volume is due primarily to the inability to utilize License Exception GBS for items classified under 3A611. This additional licensing burden will also be shared by the U.S. government agencies who must review, approve/reject and issue these licenses.

We would also like to mention that many comments have been made by various government agencies with regards to non-US export regimes' requirement to comply with the latest changes to ECCN 3A001, which were approved at the Wassenaar plenary session in December 2013. We believe that non-US regimes will still have an advantage over US exporters when it comes to obtaining approved export licenses from their local governments for MMICs devices for the following reasons:

- The EU has not implemented any Wassenaar approved changes for 3 years. The December 2013 changes may not appear in the EU export regulations for months or years.
- ADI deals with non-US export regimes all the time and it is our experience that non-US regimes approve and issue export licenses much more quickly than the United States does. For example, the typical cycle time for an export license issued by an EU government or by Singapore Customs is 7-10 days. Many US export licenses take 2-3 months to be processed and issued.

Our customers prefer to avoid export licensing situations at all costs, because their number one priority is obtaining product, as soon as possible. If their purchases require a license and if they can obtain product more quickly from a non-US supplier because export licensing lead times are much shorter than they are in the U.S., customers will buy from non-US suppliers and continue to have a negative impact on the U.S. economy and on U.S. jobs.

Suggestions for Alternative Export Control Parameters

ADI believes that modifications to the proposed rules can be made to allow for these commercial applications to be classified outside of ECCN 3A611. One such proposal is to raise the output powers (measured in watts) for these commercial devices as proposed recently by TriQuint at a combined BIS/DTSA/NRL meeting held in Washington on August 15th. Another possible solution is to raise the fractional bandwidth requirements to greater than 15% for 43.5GHz to 90GHz, greater than 35% from 16GHz to 43.5GHz, and greater than 50% below 16GHz.

With either of these two solutions all of the 26 commercial ADI parts, which will be affected by the currently proposed regulations, will remain outside of the 3A611 regulations. For example, the Microwave Radio market demands a high power amplifier covering 37-43.5GHz, which equates to a 16.1% fractional bandwidth. For this opportunity and other similar commercial opportunities, the fractional bandwidth is too low and the above changes would provide the necessary relief to compete in this market. Further, the restrictions will be lifted for the emerging E-Band communications links. ADI believes some combination of these two recommended changes (increasing the power and/or increasing the fractional bandwidth) should be made to allow for US companies to continue to compete in these commercial markets.

Analog Devices thanks you for giving us the opportunity to provide these comments regarding the current commercial market place for MMICs devices. We would also like to express our gratitude to BIS for arranging the joint industry/government meeting with BIS, DTSA and the Naval Research Labs on August 15, 2014 in Washington, DC. If there is any other information we can provide please contact me directly.

Yours truly,

Dennis Farrell
Director - Global Trade Compliance
Analog Devices, Inc.
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E-Mail: dennis.farrell@analog.com

Attachment:

- Export controls parameter change proposed by TriQuint at August 15, 2014 industry/government meeting

Also:

ADI left the following information with Brian Baker (BIS) at the August 15, 2014 industry/government meeting:

- Datasheets for all ADI/Hittite MMICs products
- Sales Brochures from end customers for end products which incorporate ADI MMICs
- A PowerPoint presentation, which included sales volumes by part number and end customer

Recommendations

- Remove PAE
- Increase Psat limits as follows

MMICs

Frequency (GHz)	3A001 (W)	3A611 Draft (W)	**Proposed (W)**
2.7 to 2.9	75	75	**250**
2.9 to 3.2	55	55	**250**
3.2 to 3.7	40	40	**250**
3.7 to 6.8	20	20	**150**
6.8 to 8.5	10	10	**70**
8.5 to 16	5	5	**60**
16 to 31.8	3	3	**30**
31.8 to 37	0.1 nW	2	**15**
37 to 43.5	**1**	**1**	**10**
43.5 to 75	31.62 mW	31.62 mW	**8**
75 to 90	10 mW	10 mW	**5**
>90	0.1 nW		**2**

Discrete Transistors

Frequency (GHz)	3A001 (W)	3A611 Draft (W)	**Proposed (W)**
2.7 to 2.9	400	400	**700**
2.9 to 3.2	205	205	**500**
3.2 to 3.7	115	115	**300**
3.7 to 6.8	60	60	**250**
6.8 to 8.5	50	50	**200**
8.5 to 12	15	20	**150**
12 to 16	40	40	**120**
16 to 31.8	7	20	**80**
31.8 to 37	0.5	2	**15**
37 to 43.5	1	1	**10**
>43.5	0.1 nW		**5**

The Boeing Company
1200 Wilson Blvd
Arlington, VA 22209-1989

September 2, 2014

Mr. Brian Baker
Director, Electronics and Materials Division
Office of National Security and Technology Transfer Controls
Bureau of Industry and Security
U.S. Department of Commerce, Room 2099B
14th Street and Pennsylvania Avenue NW
Washington, DC 20230

Subject: **Civil Uses of Certain Microwave Monolithic Integrated Circuit (MMIC) Power Amplifiers, Discrete Microwave Transistors and Bi-Static and Multi- Static Radar**

Reference: **Federal Register /Vol. 79, No. 126 /Tuesday, July 1, 2014/Proposed Rules**

Dear Mr. Baker,

The Boeing Company ("Boeing") appreciates the opportunity to comment on the referenced Notice of Inquiry in which the Bureau of Industry and Security ("BIS") seeks specific examples of civil uses of certain microwave monolithic integrated circuit power amplifiers, discrete microwave transistors, and bi-static/multi-static radar having stated performance thresholds. The information will assist BIS in determining whether these items would be appropriately controlled on the United States Munitions List ("USML") or on the Commerce Control List ("CCL").

Boeing comments concern bi-static and multi-static radar that exploits greater than 125kHz bandwidth and is lower than 2 GHz center frequency to passively detect or track using radio frequency (RF) transmissions (*e.g.* commercial radio or television stations). In accordance with the Directorate of Defense Trade Controls' Final Rule published on July 1, 2014, this radar is to be controlled on the USML in category XI(a)(3)(xxvii). As indicated in our public comments to the related Proposed Rule, Boeing is engaged in an in internal development project that is evaluating the feasibility of applying bi-static radar to civil air traffic management applications. The bi-static radar approach could be used as an airborne collision avoidance system for civil UAVs and could apply to general aviation aircraft. The radar described in the USML Category XI(a)(3)(xxvii) control could be installed at ground based locations to provide air traffic information about aircraft not equipped with transponders to aircraft operating around uncontrolled airports.

Boeing subject matter experts are not aware of any current civil production applications of bi-static radar. Although this type of radar has not entered the production phase, a significant amount of technology has and is being generated during the research and development phase for the civil air traffic management applications previously mentioned. Prior to the publication of the DDTC Final Rule, Boeing had classified this research and development work under the jurisdiction of the Department of Commerce according to the following CCL listing:

BOEING

5A001 Telecommunications systems, equipment, components and accessories, as follows (see List of Items Controlled).

………

g. Passive Coherent Location (PCL) systems or equipment, "specially designed" for detecting and tracking moving objects by measuring reflections of ambient radio frequency emissions, supplied by non-radar transmitters.

Technical Note: *Non-radar transmitters may include commercial radio, television or cellular telecommunications base stations.*

Note: *5A001.g. does not control:*

a. Radio-astronomical equipment; or

b. Systems or equipment, that require any radio transmission from the target

………

While this listing does not use the words "bi-static or multi-static radar", various sources including a paper posted on the website of the Institute of Electrical and Electronics Engineers (link: http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=1459150) describe PCL as a variant of bi-static radar. ECCN 5A001.g carries a NS2 control and its related technology in ECCN 5E001.a carries a NS1 control, requiring licensing to most countries. Nonetheless, Boeing is applying the order of review to implement a change from CCL to USML controls across relevant Boeing systems, and we underscore that this is not an insignificant undertaking.

In addition to Boeing efforts, we are aware of a development activity being undertaken by Thales in the UK for the purpose of developing bi-static radar for civil application. The work is being funded by the Technology Strategy Board of the United Kingdom. An article containing a reference to this program is included in Attachment A and available at this link: https://www.thalesgroup.com/en/content/tracking-aircraft-digital-tv-broadcasts. Boeing does not know the classification of this effort in the UK, but if it is determined to be dual-use per the Wassenaar control reflected in ECCN 5A001.g, an unlevel playing field would result when the new USML listing goes into effect later this year.

Thank you for considering Boeing's input. Please do not hesitate to contact me if you have any questions or need additional information. I can be reached at 703-465-3505 or via email at christopher.e.haave@boeing.com.

Sincerely,

Christopher E. Haave

Christopher E. Haave
Director, Global Trade Controls

BOEING

ATTACHMENT A

TRACKING AIRCRAFT VIA DIGITAL TV BROADCASTS

February 13, 2013

Thales and partners to research air traffic management of the future

Aircraft entering UK airspace could soon be located and tracked by monitoring their interaction with digital TV broadcasts.

The Technology Strategy Board, the UK's innovation agency, today announced funding for a two-year study by Thales UK, NATS and Roke Manor Research into how an innovative system that utilises existing digital TV signals could support the UK's future air traffic management.

…this innovative application of new technology could reshape the way that air traffic is managed…"

The system works by having a number of ground stations that receive the same TV signal; each receives the signal at a slightly different time because of the reflections and interactions with aircraft flying in their vicinity. The received signals are then compared to the original broadcast, and the difference is used to triangulate the position of the aircraft.

This new and pioneering type of radar – known as multi-static primary surveillance radar – is only now possible because of the increased power and reduced cost of processor technology. Through the development of a prototype system, the study will investigate the wide range of benefits it could offer to air traffic management (ATM).

The large number of TV transmitters already located across the UK could provide a more reliable infrastructure than the current system, which typically relies on one radar per airport. The continued availability of transmissions is safeguarded because the digital TV network is part of the UK's critical national infrastructure, although the study will also examine how service level agreements with broadcasters could further ensure reliability and performance.

Using existing digital TV broadcasts would mean that dedicated transmitters are no longer needed, which could simplify the system, lower the power consumption, and reduce the financial commitment of maintaining the ATM infrastructure.

Importantly, it would also mean that the existing radio spectrum used for air traffic management could be re-used to meet the increasing demand for wireless communications and other requirements. Another key benefit is the reduced interference from wind turbines, thus ensuring a safer flying environment.

"The funding that we have secured today from the Technology Strategy Board is a significant endorsement of the potential long-term benefits of this research," said Marion Broughton, head of Thales UK's aerospace business. *"Although in its infancy, this innovative application of new technology could reshape the way that air traffic is managed in the future. This is a good example of how Government and industry can work together, share expertise, and sustain innovation and high-technology research within the UK".*

From: Chin, Creighton <creighton.chin@cpii.com>
Sent: Tuesday, September 02, 2014 5:13 PM
To: PublicComments
Cc: Chin, Creighton
Subject: Military Electronics Notice of Inquiry
Attachments: MMIC_Transistor Attachment.pdf

Dear Sir/Madame:

In response to your July 1, 2014 request from the public of examples of civil uses of certain MMIC power amplifiers and discrete transistors Communication & Power Industries LLC (CPI) is submitting this e-mail with examples of civil applications that would utilize MMICs and transistors to be controlled under 3A611 on December 30, 2014.

Overview of Communications & Power Industries LLC

CPI develops, manufactures and distributes products used to generate, amplify, transmit and receive high-power/high-frequency microwave and radio frequency signals and/or provide power and control for communication, radar, electronic countermeasures, scientific, and medical applications.

CPI has operations in the US (referred to herein after as CPI US) and Canada (referred to herein after as CPI Canada) that produce Solid State Power Amplifiers (SSPAs) and Block-Up- Converters (BUCs) that are used in terrestrial and earth-to-satellite communications systems. The SSPAs and BUCs that CPI produces may contain MMICs or transistors produced by:

1) Cree Inc. located in the U.S.;

2) Triquint located in the U.S.;

3) Northrop Grumman located in the U.S.;

4) Custom MMIC located in the U.S.

5) Avago Technologies headquartered in the U.S. and Singapore;

6) Toshiba located in Japan.

7) Sumitomo Electric Device Innovations (SEDI) located in Japan

Examples of Civil Applications

CPI currently produces commercial KA-Band BUCs and expects to develop commercial KA-band SSPAs and additional KA-band BUCs that will be affected by the implementation of the 3A611.c and 3A611.d.

Attachment 1 to this letter is a table of CPI products that will be affected by this rule change.

Regulatory Impact on CPI

Implementation of 3A611.c and 3A611.d when implemented will have a negative impact on CPI as follows:

1. Reduces exportability of existing commercial products CPI Canada currently produces BUCs in Canada that are either uncontrolled (equivalent to EAR99) or controlled as 1-3.A.b.4 (equivalent to 3A001.b.4) as per the Canadian regulations. These BUCs contain MMICs that are currently classified as 3A001.b.2 that will be reclassified as 3A611.c when the final rules go into effect on December 30, 2014. Under the current rules, these BUCs may be exported to a variety of countries however when the new rules go into effect CPI Canada will be prohibited from exporting these BUCs to arms embargoed countries, such as China, as a result of the 0% de minimis rule.

To maintain existing exportability of the commercial BUCs, CPI Canada may be required to design out US origin 3A611 MMICs.

2. Creates different controls for the same product manufactured in different locations CPI, with operations in the US and in Canada, may design and prototype a SSPA or BUC in the U.S. and transfer production of the SSPA or BUC to Canada. A BUC or SSPA manufactured in Canada containing MMICs controlled under 3A611 will have tighter restrictions than an identical SSPA or BUC manufactured in the U.S. as a result of the 0% de minimis rules.

For example: A Ka-band SSPA manufactured by CPI US in the US can be exported as 3A001.b.4 to China under an approved license even though it contains 3A611.c MMICs. However the same Ka-band SSPA manufactured in Canada by CPI Canada is prohibited from being exported to China because of the 0% de minimis rule and the U.S. arms embargo.

3. Identical MMIC with different Controls Foreign produced MMICs that are classified as 3A001.b.2 by the manufacturer that meet the 3A611.c control criteria would then be controlled as3A611.c when the

MMICs are located in the U.S. The same MMIC, however, will be controlled as 3A001b.2 when it is located in Canada. As a result, various regulatory issues arise for CPI such as:

a. If a CPI US exports to CPI Canada a foreign produced MMIC controlled in the U.S. as 3A611.c but classified by the foreign manufacturer as 3A001.b.2 is CPI Canada required to include in the de minimis calculation the foreign produced MMIC because it was exported as 3A611.c to Canada?

b. Is CPI Canada required to continue to control the foreign produce MMIC as 3A611.c because it was exported from the US as 3A611.c even though the foreign manufacturer, the Canadian government, and the Wassenaar Arrangement control the MMIC as 3A001?

CPI appreciates this opportunity to comment on the impact of the 3A611.c controls on CPI’s operations.

Please contact Creighton Chin should you require additional information from CPI.

Regards,

Creighton Chin

Export Compliance Manager

Communications & Power Industries LLC

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Communications Power Industries LLC
Attachment

MMICS 16-31.8 GHz

						3A001.b.2	3A611.c.					
Supplier	Low Freq.	High Freq.	FB	PSPO (W)	PAE (%)	FB>10% & PSPO>3W	FB>10% & PSPO >3W & PAE>=20%	Application	CPI product	Defense	Commercial	Comments
Singapore Supplier 1	28	31	10.169492	4	28	Y	Y	satcom	Ka band BUC	50%	50%	In production
US Supplier 1	25	31	21.428571	4	22%	Y	Y	satcom	Ka band BUC	50%	50%	In production
US Supplier 1	26	31	17.54386	7	18%	Y	N	satcom	Ka band BUC	50%	50%	In production
US Supplier 2	27	31	13.793103	8	28%	Y	Y	satcom	Ka band BUC	25%	75%	Expected demand in 2015
US Supplier 2	27	31	13.793103	10	28%	Y	Y	satcom	Ka band BUC	25%	75%	Expected demand in 2015
US Supplier 2	27	31	13.793103	12	28%	Y	Y	satcom	Ka band BUC	0%	100%	Expected demand in 2016
US Supplier 3	0.5	20	190.2439	6	TBD	Y	MAYBE	EMI/EMC instrumentation amplifier	SSPA	50%	50	Evaluating MMICs
US Supplier 3	14	17	19.354839	6	21-31	Y	Y	satcom	Ka band BUC	50	50	Evaluating MMICs

MMICS 43.5-75 GHz

						3A001.b.2	3A611c.					
Supplier	Low Freq.	High Freq.	FB	PSPO (W)	PAE (%)	FB>10%&PSPO>31.62mW	FB>10%&PSPO>31.62mW & PAE>=10%	Application	CPI product	Defense	Commercial	Comments
US Supplier 2	47.1	51.4	8.7309645	10	20	N	N	satcom	SSPA	0%	100%	Expected demand in 2019. MMIC FB may exceed 10% depending on MMIC guard band

TRANSISTORS 3.7-6.8GHz

						3A001.b.3 controlled	3A611.d controlled					
Supplier	Low Freq.	High Freq.	FB	PSPO (W)	PAE (%)	PSPO>60W	PSPO>60W & PAE>=45%	Application	CPI product	Defense	Commercial	Comments
Japanese Supplier 2	5.85	6.75	14.285714	100	45	Y	Y	satcom	C band BUC	0%	100%	In production

Legend

satcom	Satellite communications, ground based
BUC	Block up converter, typically includes a power amplifier
SSPA	Solid state power amplifier
PAE	Power added Efficiency
PSPO	Peak Saturated power Output
FB	Fractional bandwidth
TBD	To Be Determined

Jonathan Kim, Manager of Trade Compliance
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Email: Jonathan_Kim@cree.com

4600 Silicon Drive · Durham, NC 27703 · (919) 407-5300

August 27, 2014

Rulemaking Identification Number: BIS–2012–0045
Cree, Inc. Public Comments on ECCN 3A611

In Response to "Civil Uses of Certain Microwave Monolithic Integrated Circuit (MMIC) Power Amplifiers, Discrete Microwave Transistors and Bi-Static and Multi-Static Radar," 79 Fed. Reg. 37548 (July 1, 2014).

Cree, Inc. ("Cree") appreciates the opportunity to provide comments on the new export control classification number ("ECCN") 3A611, published on July 1, 2014. The new controls on high electron mobility transistors ("HEMTs") and monolithic microwave integrate circuits (MMICs") will have disastrous consequences, not only for Cree's existing radio frequency ("RF") business, but for the entire domestic industry's ability to export and compete in the global RF market. ECCN 3A611 represents a severe tightening of controls on HEMTs and MMICs already in widespread commercial use and available from foreign sources (which are not subject to these unilateral restrictions).

Cree strongly urges the U.S. government to revise the control thresholds in ECCN 3A611 paragraphs (c) and (d) before the rule goes into effect. The intent of this rulemaking was to transition the control of HEMTs and MMICs from the U.S. Munitions List to ("USML") to the Commerce Control List ("CCL"). However, ECCN 3A611 as currently published will have the opposite effect, capturing numerous products specifically designed for commercial and dual-use applications (e.g., telecom, satcom, civilian radar, and test equipment). ECCN 3A611 will control many of Cree's commercial RF products, which Cree already has been exporting in recent years under ECCN 3A001 or EAR99 (and for several of which, Cree has obtained CJ and CCATS rulings). The attached spreadsheet lists Cree's several dozen HEMTs and MMICs covered by the ECCN 3A611 control parameters, only **one** of which (in die and packaged form) will be migrated from the USML in accordance with the intent of the rulemaking.

I. Power Added Efficiency ("PAE") Is a Problematic Threshold

The main problem with paragraphs (c) and (d) of ECCN 3A611, which control MMICs and HEMTs, is that they are essentially identical to the recently revised ECCN 3A001. The primary distinction is that ECCN 3A611 incorporates PAE as a control threshold. Otherwise, ECCNs 3A001 and 3A611 contain the same frequency tiers[1] and almost identical power

[1] We note there is a split in the ECCN 3A611 MMIC control tiers, with alternate tiers for higher power levels and wider frequency bandwidths. The alternate tiers become irrelevant if a product is captured by the lower power and frequency bandwidth thresholds. Cree is not clear on the rationale behind the split tiers, as higher power combined with larger fractional bandwidth equals a higher performance product.

thresholds.[2] However, PAE is not an effective threshold to separate out products from ECCN 3A001. Therefore, as applied to the range of commercial RF products already in widespread use, ECCN 3A611 will overlap with ECCN 3A001, undercutting the work done at Wassenaar to harmonize global controls on these products.

Following this section on why PAE is a problematic metric, Cree provides suggestions on how to draw parameters around military RF products, while keeping the majority of commercial and dual-use RF products controlled under ECCN 3A001 or EAR99.

A. The PAE Thresholds Are Too Low

The PAE thresholds in ECCN 3A611 would cover most Gallium Nitride ("GaN") HEMTs and MMICs on the commercial market operating in the controlled frequency range. GaN is a very efficient RF product material used by Cree and its competitors. For commercial GaN products, HEMT efficiency levels range from 40-70%, and GaN MMIC efficiency levels range from 30-60%. These levels would trigger ECCN 3A611.

The attached chart contains a list of Cree's RF products that would be captured by the new ECCN 3A611, with publicly available information about the products' performance specifications. (Cree considers its sales data to be highly proprietary and will make certain information about actual sales available to BIS on a strictly confidential basis.)

Highlighted below are illustrative examples of how Cree's commercial HEMTs and MMICs exceed the PAE thresholds set forth in ECCN 3A611. These products are not in development, and the end uses are not projected according to future sales. Rather, Cree has been selling these items predominantly (or entirely) for commercial applications in recent years. These ECCN 3A001 products have been eligible for export to commercial end users in certain countries without a license or under the STA license exception. Those options will be greatly restricted, or eliminated, for these products once controlled under ECCN 3A611.

- CMPA2560025F (MMIC – packaged)
    - Rated for performance up to 25 W, between 2.5-6.0 GHz, with 35-40% PAE.
    - Would be captured under ECCN 3A611.c.4.a (20 W, 3.7-6.8 GHZ, 40% PAE).
    - Currently classified: ECCN 3A001.
    - Primarily used for commercial communications (broadband amplification), RF test instrumentation, and S-band radar (civilian and military).

- CMPA5585025F (MMIC – packaged)
    - Rated for performance up to 25 W, between 5.5-8.5 GHz, with 30-40% PAE
    - Would be captured under ECCN 3A611.c.5.a (10 W, 6.8-8.5 GHz, 40% PAE).
    - Currently classified: ECCN 3A001.
    - Primarily used in commercial satcom, point-to-point radio, data link.

[2] Cree also notes that there are slightly higher power thresholds in ECCN 3A611 for the X-band range and for the range above 16 GHz. These small differences, however, do not prevent lower frequency commercial products from being captured by the ECCN 3A611.

- CGH60120D (HEMT – die)
    - Rated for performance up to 120 W, between DC-6.0 GHz, with 65% PAE.
    - Would be captured under ECCN 3A611.d.4 (60 W, 3.7-68 GHz, 45% PAE).
    - Currently classified: ECCN 3A001.
    - Primarily used in commercial telecom (cellular infrastructure).

- CGH1J025D (HEMT – die)
    - Rated for performance up to 25 W, between DC-18GHz, with 60% PAE.
    - Would be captured under ECCN 3A611.d.8 (20 W, 16-31.8 GHz, 30% PAE).
    - Currently classified: ECCN 3A001.
    - Primarily used as a driver in commercial telecom, satcom, broadband, point-to-point radio, civilian radar.

B. PAE Is Not an Effective Control Metric (Even with Higher Thresholds)

PAE is not the right parameter for distinguishing ECCN 3A611 from ECCN 3A001. As noted above, GaN RF products are highly efficient, and the commercial market is demanding the same levels of efficiency as military end users. Moreover, PAE is in itself not a precise measure. The same product can have various PAE ratings, depending on a number of circumstances, including how it is tested. Below are the reasons why PAE – regardless of how high the thresholds are set – is not an effective export control metric.

- The rated PAE of a single product can vary widely depending on a number of factors at the time of testing: bias condition, RF drive level, temperature, pulse width, duty cycle, and time period of operation.

- According to standard industry practice, there is no consistent way to measure PAE. This metric can be measured at the optimal output load, at a single point of frequency, at a peak power level, or at an average point of normal operation.

- Many products are not rated for PAE, as it does not make sense to do so, based on the intended application of the product. For example, PAE is not a useful performance parameter for RF devices designed for communications applications. Most communications devices are operated at a power level that is significantly backed-off from the peak saturated power level. Therefore, the efficiency levels can vary and are not as relevant a measure to the customer, as is the saturated peak power (which needs to be very high to achieve an average level of operation).

Because of the variability in the measurement of PAE, it is not a reliable or effective way to distinguish RF products that are uniquely military from products primarily designed for commercial or dual-use applications. The PAE metric creates the same problems that “average output power” raised under the old ECCN 3A001, which was eliminated pursuant to the 2013 Wassenaar changes. Specifically, PAE is not a metric that lends itself to clear or consistent definition in the RF industry, and as such should not be the basis for regulating RF products.

II. Suggestions for Control Parameters in ECCN 3A611

In revising the control parameters for ECCN 3A611, it is imperative to consider the purpose of this rulemaking: to remove HEMTs and MMICs entirely from the USML, and to create a place on the CCL where HEMTs and MMICs of particular military concern can be controlled. The current parameters in ECCN 3A611 are overly broad and pull in a large range of commercial products. However, Cree believes it is possible to implement more narrowly tailored and less arbitrary parameters.

Cree recognizes the challenge in developing military control parameters for RF products, in that there are mixed commercial and military uses throughout the RF frequency spectrum. This reflects how RF segments were allocated, as the telecom, satcom, and commercial radar industries grew, and it became necessary to expand the range of bandwidth available for commercial applications. It is typical for a thin sliver of military-reserved bandwidth to be sandwiched in between two commercial segments, or for a particular segment to be allocated for mixed commercial and military use. As a result, RF manufacturers such as Cree frequently design products that are primarily intended for commercial applications, but that necessarily will cross over a military bandwidth. Moreover, because commercial customers often require the same power and efficiency levels as military end users (or sometimes higher, as in the telecom industry), those metrics by themselves do not distinguish military products.

Cree recommends the following three approaches to ensure that ECCN 3A611 focuses on items of particular military concern: 1) incorporate "specially designed for military applications" into the HEMT and MMIC controls; 2) include a decontrol note for items rated for civil applications; and 2) increase the power and efficiency thresholds.

A. Incorporate "Specially Designed for Military Applications"

While paragraph (a) of ECCN 3A611 uses the "specially designed" language, that term does not appear in the headers for paragraphs (c) or (d), where MMICs and HEMTs are controlled. This would suggest that the control parameters in paragraphs (c) and (d) inherently reflect special military application. As discussed above and in Cree's prior comments, they do not. Because RF products do not lend themselves to easy distinction between military and commercial application, Cree believes that addition of the language "specially designed for military application" would be helpful in ECCN 3A611. This would enable a case-by-case analysis of each product, with a review of actual and intended end uses, commercial equivalents, and foreign availability. This approach generally has been effective for the RF industry thus far, in drawing parameters around certain products that have no or minimal commercial application.

This approach also would comport with the preamble to the ECCN 3A611 rulemaking, where BIS explained the value of using such language where a positive list is not entirely feasible. BIS stated:

> [S]ome standards must be expressed in broad terms. BIS believes that the phrase "'specially designed' for a military application" provides adequate specificity and clarity to distinguish items that are developed in ways that enable them to perform a military role or function from items that, although used by the military, are indistinguishable from items that are widely used in civil activities.

See 79 Fed. Reg. 37555.

B. Include a Decontrol Note for Items Rated for Civil Applications

In its prior public comments submitted on January 28, 2013, Cree advocated that parts designed for ITU[3] radiocommunications bands should be explicitly exempt from ECCN 3A611. Cree reiterates those same comments here. Cree recommends that BIS include a decontrol note at the end of paragraphs (c) and (d) each, stating:

Note: Does not control [discrete microwave transistors/MMICs] specifically designed for radiocommunications in a frequency band allocated by the ITU.

This decontrol note would have the effect of excluding items from ECCN 3A611 (thus defaulting to ECCN 3A001 or EAR99), if those items are primarily designed to function in commercial telecom, satcom, backhaul, and point-to-point bandwidths. Similar exclusion language is used throughout ECCN 3A001 (see, for example, ECCN 3A001.b.1 and b.8). Furthermore, the term "allocated by the ITU" already is listed in the CCL Definitions at Part 772. The addition of this note would be consistent with BIS practice throughout the EAR, and it would add clarity that ECCN 3A611 is not intended to control items that are truly commercial.

C. Increase the Power and Efficiency Thresholds

To the extent that high powered, highly efficient RF products do create an advantage for military applications, Cree urges BIS to adopt control thresholds that reflect the current reality of the commercial market. As demonstrated in the attached product chart, the power and PAE thresholds in the published ECCN 3A611 would capture numerous products that already are in widespread commercial use. The power thresholds should be higher than (not the same as) those in ECCN 3A001. Moreover, PAE thresholds need to be lifted so that they target especially high performance products, and not the mid-range of commercial GaN RF devices. Additionally, Cree recommends incorporating fractional bandwidth as a third metric in ECCN 3A611, paragraph (d) for HEMTs, following the control structure for MMICs (i.e., a part must meet all three of the power, PAE, and fractional bandwidth criteria).

Finally, the split-frequency tiers in the controls on MMICs do not make sense from a practical stand-point. Cree understands that the two tiers are intended to present alternate control options for each frequency level. However, the level (b) tiers in ECCN 3A611.c control vastly more powerful products than the level (a) tiers. Higher power, combined with a larger fractional bandwidth, equals a higher performance product. MMICs captured under the level (b) tiers already will be captured under the level (a) tiers, making the level (b) tiers irrelevant. Cree suggests that BIS abolish the lower power level (a) tiers and adopt parameters more similar to those in the level (b) tiers.

Cree proposes revised control parameters for ECCN 3A611, set forth in the charts on the following page.

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[3] The ITU – International Telecommunication Union – is the United Nations specialized agency responsible for standardizing international telecom and radio frequency operations.)

Frequency	ECCN 3A611.c (MMICs)		
Bandwidth (GHz)	**Power (W)**	**Power Added Efficiency (PAE)**	**Fractional Bandwidth (FBW)**
2.7-2.9 GHz	150 W	77%	40%
2.9-3.2 GHz	110 W	77%	40%
3.2-3.8 GHz	80 W	75%	35%
3.8-6.8 GHz	40 W	75%	35%
6.8-8.5 GHz	30 W	50%	35%
8.5-16 GHz	20 W	50%	30%
16-31.8 GHz	10 W	45%	20%

Frequency	ECCN 3A611.d (HEMTs)		
Bandwidth (GHz)	**Power (W)**	**Power Added Efficiency (PAE)**	**Fractional Bandwidth (FBW)**
2.7-2.9 GHz	500 W	80%	30%
2.9-3.2 GHz	450 W	80%	30%
3.2-4.0 GHz	330 W	80%	30%
4.0-6.8 GHz	250 W	80%	25%
6.8-8.5 GHz	125 W	55%	25%
8.5-12 GHz	100 W	55%	25%
12-16 GHz	125 W	50%	15%
16-31.8 GHz	90 W	50%	15%
31.8-37 GHz	15 W	40%	-
37-43.5 GHz	10 W	35%	-
> 43.5 GHz	5 W	30%	-

Public Comments - August 27, 2014

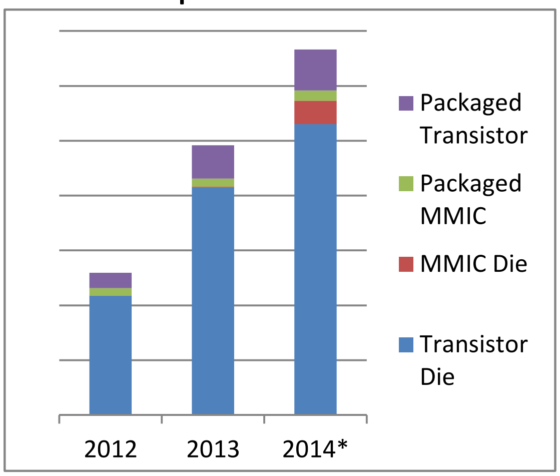
CREE, INC.

Impact of ECCN 3A611 on Commercial Radio Frequency ("RF") Sales

Percentage of Cree's RF Revenue from Products Captured Under ECCN 3A611

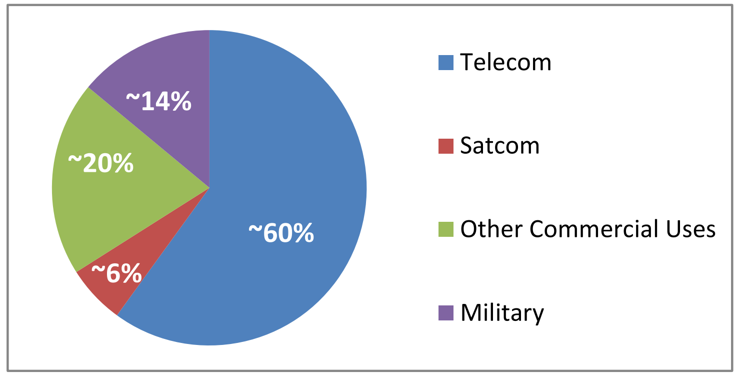
2012	2013	2014*	2015**
48%	59%	65%	60%

Breakdown of Revenue from Products That Will Be Captured Under ECCN 3A611



The bars represent relative percentages of product groups, within the total portion of revenues attributed to products meeting the ECCN 3A611 control criteria.

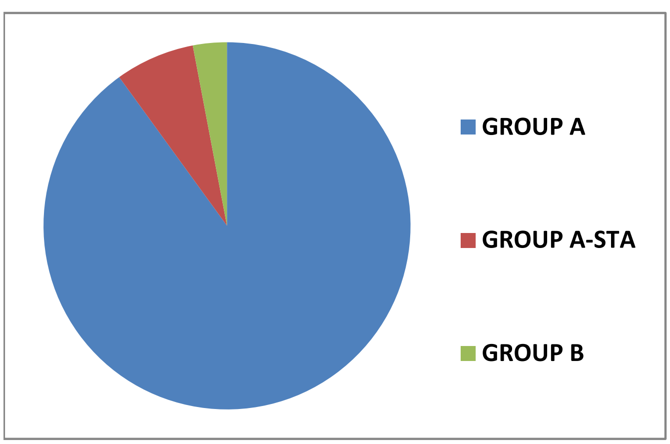
Actual Customer End Uses of Cree's RF Products Captured Under ECCN 3A611



Telecom includes:
WiMax, LTE infrastructure, backhaul, point-to-point radio, datalink

Other commercial includes:
Radar (marine, air traffic, weather) and industrial, scientific and medical ("ISM")

Existing Country Sales for Cree's Parts Captured by ECCN 3A611



"Group A" - countries not requiring a license under NS2 controls, per EAR Part 742

"Group A-STA" - Countries eligible for STA exception under NS and RS controls, per EAR Part 740

"Group B" - Countries listed in Country Group B of the EAR, Part 738

Date: August 27, 2014

Company: Cree, Inc.

Public Comments - Impact of ECCN 3A611 on Commercial RF Products

MMICs **Non-confidential product examples captured by ECCN 3A611**

Part Number	Operating Frequency (GHz)		Peak Sat. Power (w)	Fractional Bandwidth	PAE	Product Form	Actual Commercial Applications	Actual Sales Examples
ECCN 3A611 Tier C.3	**> 3.2**	**3.7**	**> 40.0**	**> 15%**	**45%**			
CMPA2735075F	2.7	3.5	75.0	26%	55-60%	packaged	S-band radar (civil & military)	Evaluation for use in homeland security radars; marine radar
CMPA2735075D	2.7	3.5	75.0	26%	60%	die	S-band radar (civil & military)	Evaluation for use in homeland security radars
ECCN 3A611 Tier C.4	**> 3.7**	**6.8**	**> 20.0**	**> 15%**	**40%**			
CMPA2060025D	2.0	6.0	25.0	100%	40%	die	Broadband amplifiers; RF test instruments; EMC amplifier	ISM Broadband amplifiers
CMPA2560025F	2.5	6.0	25.0	82%	35-40%	packaged	Broadband amplifiers; s-band radar (civil & military); RF test instruments	ISM Broadband amplifiers
CMPA2560025D	2.5	6.0	25.0	82%	35-40%	die	Broadband amplifiers; S-band radar (civil & military); RF test instruments	ISM Broadband amplifiers
ECCN 3A611 Tier C.5	**> 6.8**	**8.5**	**> 10.0**	**> 10%**	**40%**			
CMPA5585025F	5.5	8.5	25.0	43%	30-40%	packaged	Satcom & point-to-point radio; data link	Satcom Boost up convertors
CMPA5585025D	5.5	8.5	25.0	43%	35-40%	die	Satcom; point-to-point radio; RF test instruments; EMC amplifiers	Satcom Boost up convertors
ECCN 3A611 Tier C.6	**> 8.5**	**16.0**	**> 5.0**	**> 10%**	**35%**			
CMPA801B025F	8.0	11.0	25.0	32%	35-40%	packaged	X-band radar; satcom & point-to-point radio	Marine Radar
CMPA801B025D	8.0	11.0	25.0	32%	40-45%	die	X-band radar; satcom & point-to-point radio	Marine Radar

Date: August 27, 2014

Company: Cree, Inc.

Public Comments - Impact of ECCN 3A611 on Commercial RF Products

Transistors

Non-confidential product examples captured by ECCN 3A611

Part Number	Operating Frequency (GHz)		Peak Sat. Power (w)	PAE	Product Form	Actual Commercial Applications	Actual Sales Examples
ECCN 3A611 Tier D.2	**> 2.9**	**3.2**	**> 205.0**	**60%**			
CGH31240	2.7	3.1	240.0	60%	packaged	S-band radar (civil & military)	Evaluation for use in homeland security radars
ECCN 3A611 Tier D.3	**> 3.2**	**3.7**	**> 115.0**	**45%**			
CGHV35150F	2.9	3.5	150.0	45-50%	packaged	S-band radar (civil & military); broadband amplifiers	Marine Radar; LTE Telecom
CGHV35150P	2.9	3.5	150.0	45-50%	packaged	S-band radar (civil & military); broadband amplifiers	Marine Radar; LTE Telecom
CGH35240	3.1	3.5	240.0	52-60%	packaged	S-band radar (civil & military); broadband amplifiers	Evaluation for use in homeland security radars; LTE Telecom
CGHV35400F	2.9	3.5	400.0	60%	packaged	S-band radar (civil & military); broadband amplifiers	Evaluation for use in homeland security radars; LTE Telecom
ECCN 3A611 Tier D.4	**> 3.7**	**6.8**	**> 60.0**	**45%**			
CGH35060P1	3.3	3.9	60.0	60%	packaged	Telecom	WiMax and LTE Telecom
CGH35060F1	3.3	3.9	60.0	60%	packaged	Telecom	WiMax and LTE Telecom
CGH40090PP*	DC	2.5 (4.0)	90.0	55%	packaged	Broadband amplifiers; data link	Industrial application, ISM Broadband amplifier
CGH40120F*	DC	2.5 (4.0)	120.0	70%	packaged	Broadband amplifiers; data link; S-band radar (civil & military)	LTE Telecom, Industrial, Medical
CGH40120P*	DC	2.5 (4.0)	120.0	70%	packaged	Broadband amplifiers; data link; S-band radar (civil & military)	LTE Telecom, Industrial, Medical

CGH40180PP*	DC	2.5 (4.0)	220.0	70%	packaged	Broadband amplifiers; data link; S-band radar (civil & military)	Industrial application, ISM Broadband amplifier
CGH60060D	DC	6.0	60.0	65%	die	Broadband amplifiers; data link; S-band radar (civil & military)	LTE Telecom, Industrial, Medical
CGH60120D	DC	6.0	120.0	65%	die	Broadband amplifiers; data link; S-band radar (civil & military)	LTE Telecom, Industrial, Medical
ECCN 3A611 Tier D.5	**> 6.8**	**8.5**	**> 50.0**	**50%**			
CGHV96050F1	7.9	8.4	80.0	30-35%, measured data only available at back-off power, would be higher at full power	packaged	Satcom & point-to-point radio	Satcom Upconvertors
ECCN 3A611 Tier D.6	**> 8.5**	**12.0**	**> 20.0**	**35%**			
CGHV96050F2	8.4	9.6	80.0	55%	packaged	Commercial radar (maritime, weather, air traffic control)	Leisure boat company use in maritime, weather and air traffic control communications systems; X-band commercial data link telecom applications;
CGHV96100F2	7.9	9.6	100-145	45%	packaged	Commercial radar (maritime, weather, air traffic control)	Leisure boat company use in maritime, weather and air traffic control communications systems; X-band commercial data link telecom applications;
ECCN 3A611 Tier D.8	**> 16.0**	**31.8**	**> 20.0**	**30%**			
CGHV1J025D	DC	18.0	25.0	60%	die	Broadband amplifiers; radar; satcom & point-to-point radio; telecom	LTE Telecom
CGHV1J070D	DC	18.0	70.0	60%	die	Broadband amplifiers; radar; satcom; point-to-point radio; telecom	Satcom Upconvertors

*** Product numbers CGH40120F, CGH40120P, CGH40090PP, CGH40180PP curently are rated as operating between DC-2.5 GHz based on actual test data. However, they are listed in this chart because the parts originally were designed for operation up to 4.0 GHz and could be modified to do so.**

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Revisions to the Export Administration Regulations (EAR): Control of Military
Electronic Equipment and Related Items the President Determines No Longer Warrant Control Under the United States Munitions List (USML)
Comment On: BIS-2012-0045-0048
Civil Uses of Certain Microwave Monolithic Integrated Circuit Power Amplifiers,
Discrete Microwave Transistors and Bi-static and Multi-static Radar
Document: BIS-2012-0045-DRAFT-0046
Comment on FR Doc # 2014-14682

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General Comment
I started an aerial picture company shooting mainly real estate pictures. I have an awesome DJI quadcopter with a high end camera weighing 1180g or 2.6 pounds that sounds like a weed-wacker when in flight, not a good tool for spying. With DJI radio-control FAA regulation airspace downloads, satellite GPS keeps quadcopters out and clear of FAA regulated air space. Being said, all DJI quadcopters with updated downloads are no longer a threat to FAA regulated airspace.

Mainly due to piloting error, a DJI quadcopter does not suddenly fall out of the sky unless it collides with another object.
Therefore as with anything that poses a threat to the public and/or property regulation/s may be set and communicated effectively by a new UAV/ air-drone web-page on the FAA website, and/or emailing. If cars, guns, boats, planes, etc, require licensing, perhaps licensing of drones warrants the same.

Technology advances and the purchase of air-drones has exploded.. The FAA must consider new policies for commercial and public UAV uses. Sure there will be those UAV pilots who misuse their expensive toy, but most UAV pilots will adhere to FAA regulations when known.

Unfortunate for me my aerial picture business is halted until the FAA approves commercial uses for my quadcopter. By the way, is a 2.6 lbs. quadcopter truly considered a UAV? Perhaps weight classifications of UAV's need be addressed too.

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September 2, 2014

Regulatory Policy Division
Bureau of Industry and Security
U.S. Department of Commerce
Room 2099B
14th Street and Pennsylvania Avenue NW.
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Email: publiccomments@bis.doc.gov

Re: Military Electronics Notice of Inquiry

Dear Mr. Baker:

In response to the Department of Commerce's Notice of Inquiry requesting comments related to certain MMIC power amplifiers and discrete microwave transistors which operate at frequencies exceeding 2.7GHz, M/A-COM Technology Solutions ("MACOM") is pleased to provide the following information regarding the commercial use of certain MMIC amplifiers and transistors.

MACOM is a leading supplier of high performance analog RF, microwave, and millimeter wave products that enable next-generation Internet and modern communication applications. Recognized for its broad catalog portfolio of technologies and products, MACOM serves diverse markets, including high speed optical, satellite, radar, wired & wireless networks, CATV, automotive, industrial, medical, and mobile devices. A pillar of the semiconductor industry, we thrive on more than 60 years of solving our customers' most complex problems, serving as a true partner for applications ranging from RF to Light.

There are three primary civil communications applications which will be effected either today or in the near future by the implementation of 3A611:

- VSAT
- Point to Point radios for cellular backhaul
- Emerging 3.5 GHz cellular basestation band.

At this time, MACOM has only a limited number of released products which will be subject to 3A611. One example is our E-band power amplifier designed for use in point to point civil communications, part number MAAP-011106. This amplifier is rated for operation in the frequency range of 71 – 86 GHz, with 25 dBm of saturated output power and a PAE at Psat of >10%. We have attached the datasheet for the MAAP-011106 and the datasheets from several of our customers detailing the end use of this amplifier. In addition, we have attached a presentation expanding on the potential impact of 3A611.

MACOM recognizes that it is the intent of the Departments of Defense, State and Commerce to tailor the text of 3A611 such that it only controls MMIC power amplifiers and discrete microwave transistors that have significant military application. While we believe that performance parameters alone are unable to distinguish commercial devices from military devices, we understand that controlling certain high power devices is in the interest of the national security of the United States. To that end, we believe a small increase in the fractional bandwidth will allow for the continued control of technology that is critical to national security, while excluding many of the commercial devices currently impacted under the parameters described in 3A611.

MACOM proposes increasing the fractional bandwidth to 15% across all frequencies, including those above 6.8 GHz. We believe doing so will significantly reduce the number of commercial devices inadvertently caught by 3A611. We also believe that this relatively small increase in fractional bandwidth will not adversely impact the strict control of technology that is critical to national security.

Sincerely,

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MACOM™

Partners from RF to Light

RF Power Devices for Civil Applications

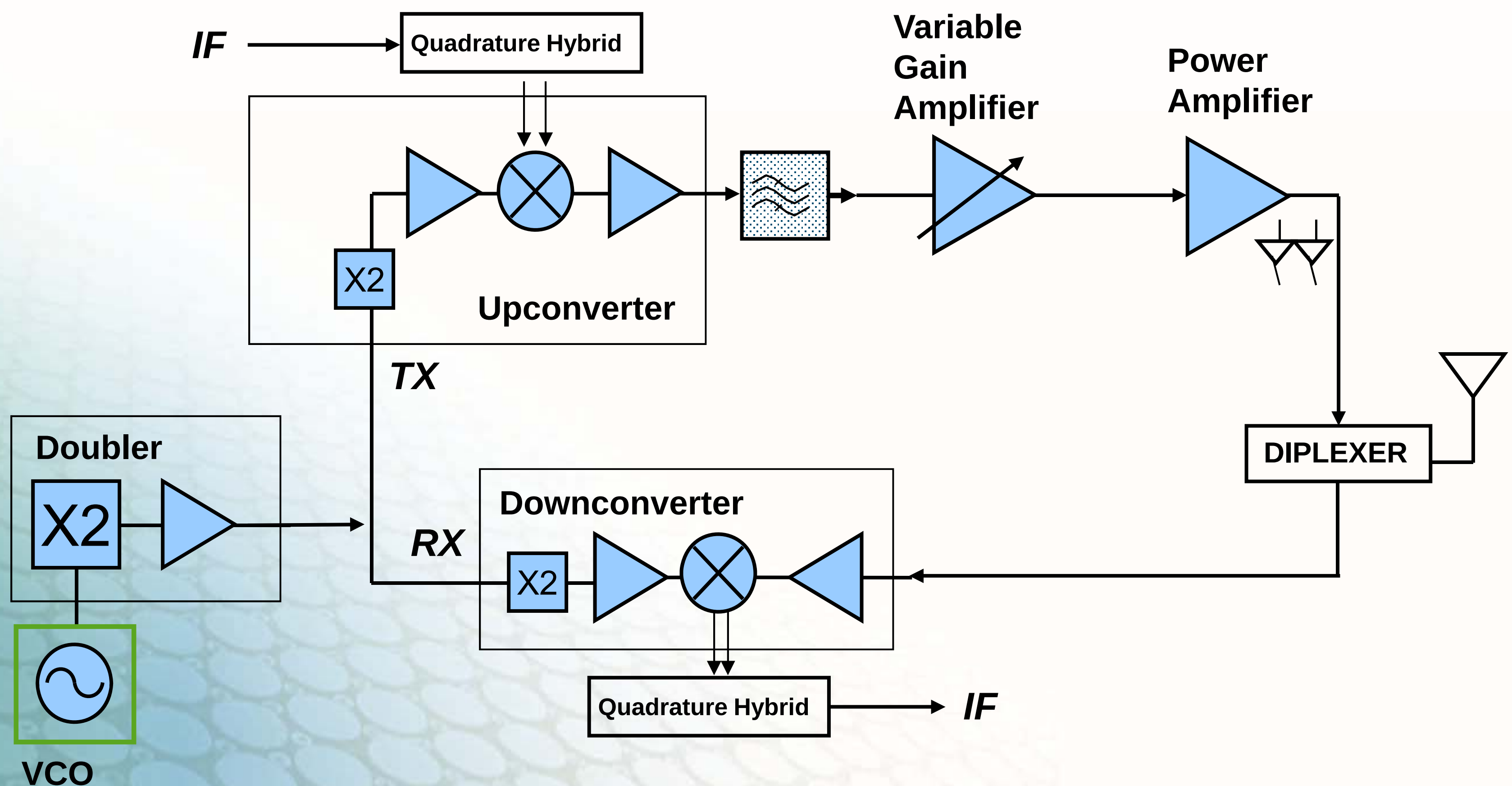
Aug 15, 2014

Executive Summary

- MACOM intimately familiar with the RF requirements of many U.S. Defense systems
  - We understand and support the intent of 3A611
- Commercial Communications Backhaul is the largest market for MMIC devices after the mobile handheld (Cellular) market
  - An essential market for the viability of US MMIC suppliers
  - Communications Backhaul includes Cellular Base Stations, WiFi, Point to Point Radios, and VSAT (satellite backhaul)
  - Major Communications System OEMS are European or Asian
  - Point to Point Radio, and Base Station manufacturing is migrating rapidly to China
  - Chinese OEMs are emerging as dominant players
- MMIC and Radio Design and Manufacturing Expertise is Worldwide
  - WIN Semiconductor (Taiwan) is the leading Foundry for MMIC devices
- >98% of transceivers (Point to Point, VSAT, Base station) are manufactured outside the USA

Microwave Transceiver

- Generic Block Diagram



Frequency Allocations

Designation	Frequency Band (GHz)	Licensed
2.3	2.3 - 2.4	X
2.4	2.4 - 2.483	
2.5	2.496 - 2.69	X
4.5	4.4 - 4.6	X
4.8	4.7 - 5.0	X
4.9	4.94 - 4.99	X
5.3	5.15 - 5.35	X
5.4	5.470 - 5.725	X
5.8	5.725 - 5.825	X
5.9	5.825 - 5.925	X
6L	5.925 - 6.425	X
6U	6.425 - 7.100	
7	7.125 - 7.9	X
8	7.725 - 8.5	X
11	10.7 - 11.7	X
13	12.75 - 13.25	X
15	14.25 - 15.35	X
18	17.7 - 19.7	X
23	21.2 - 23.6	X
24	24-24.5	
25	24.25 - 25.25	X
26	24.25 - 26.5	X
28/29	27.3 - 31.3	X
31/32	31.8 - 33.4	X
38	37.0 - 40.0	X
42	40.5 - 43.5	X
60	57 - 66	
E-Band	71 - 76/81 - 86	“lightly”

- Many Standard Frequency Bands Used for Wireless Backhaul
- Bandwidth, Spectrum Availability and Propagation Characteristics Drive Use
  - < 6 GHz – Good propagation – but limited bandwidth (≤ 250 MHz)
  - > 6GHz - Propagation challenges – but – Bandwidth > 1 GHz
- VSAT Ka Tx: 27.5 – 31 GHz
- New Base Station: 3.5 GHz

A complex combination of International Regulations, bandwidth requirement and buying preference influence the frequencies network providers support

MMICs – Cellular Backhaul

- MMICs are widely used in commercial cellular backhaul. Radios cover from C-band to 42 GHz band. See the 2 top Tier 1 customers offerings below. E-Band is Emerging.

ERICSSON

TECHNICAL DATA: MINI-LINK TN RELEASE 4.3

Frequency (GHz)	6L 6U*	7 8	10	11	13 15	18	23	26*	28	32	38
Max. RF output power (dBm)											
256 QAM	+23	+25	+24	+24	+20 +24*	+17 +22*	+17 +21*	+19	+18	+17	+16
128 QAM	+26	+26	+25	+25	+21 +25*	+18 +23*	+18 +22*	+20	+19	+18	+17
64 QAM	+26	+26	+25	+25	+21 +25*	+18 +23*	+18 +22*	+20	+19	+18	+17
16 QAM	+27	+27	+26	+26	+22 +26*	+19 +24*	+19 +23*	+21	+20	+19	+18
4 QAM	+29	+29	+28	+28	+24 +28*	+21 +26*	+21 +25*	+23	+22	+21	+20
C-QPSK	+30	+30	+29	+29	+25 +29*	+24 +27*	+24 +26*	+24	+23	+22	+21

HUAWEI

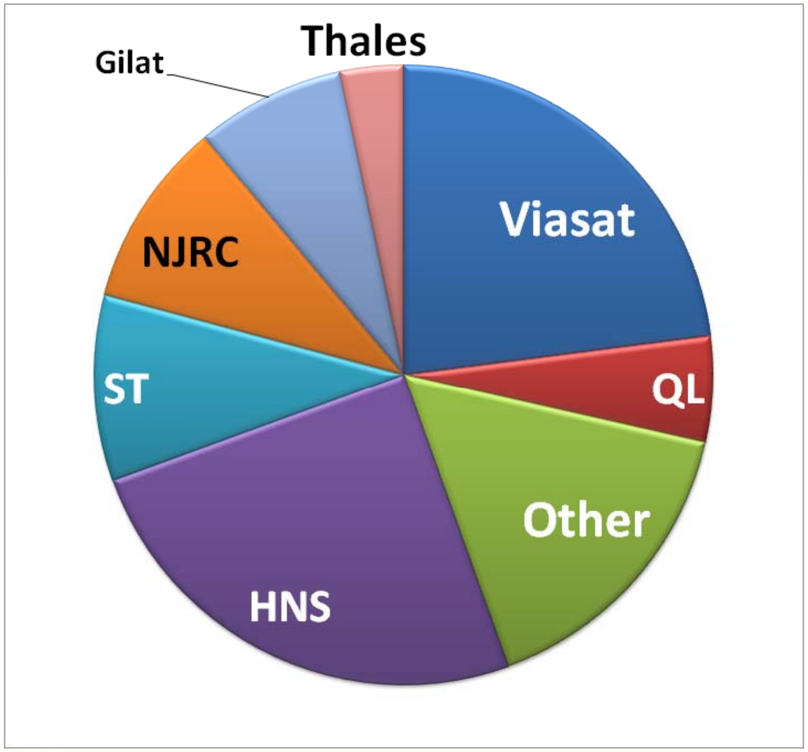
Frequency Band (GHz)		6GHz	7GHz	8GHz	11GHz	13GHz	15GHz	18GHz	23GHz	26GHz	32 GHz	38GHz
Frequency Range (GHz)		5.850–6.425(L6) 6.425–7.125(U6)	7.093–7.897	7.731–8.497	10.675–11.745	12.750–13.250	14.400–15.358	17.685–19.710	21.200–23.618	24.250–26.453	31.815–33.383	37.044–40.105
Channel Spacing (MHz)		3.5, 7, 14, 28										
Standard / High-Power Nominal Maximum Output Power (dBm)	QPSK	26	25.5/30	25.5/30	24.5/28	24.5/26	24.5/26	24/25.5	22.5/25	22	23	20.5/23
	16QAM/32 QAM	24	21/28	21/28	20/26	20/23	20/23	20/22	19/22	18	21	16/20
	64QAM/128QAM	23	15/24	15/24	14/21	14/18	14/18	14/17	13/17	12	16	10/16

Commercial VSAT

Emerging In Cellular Backhaul

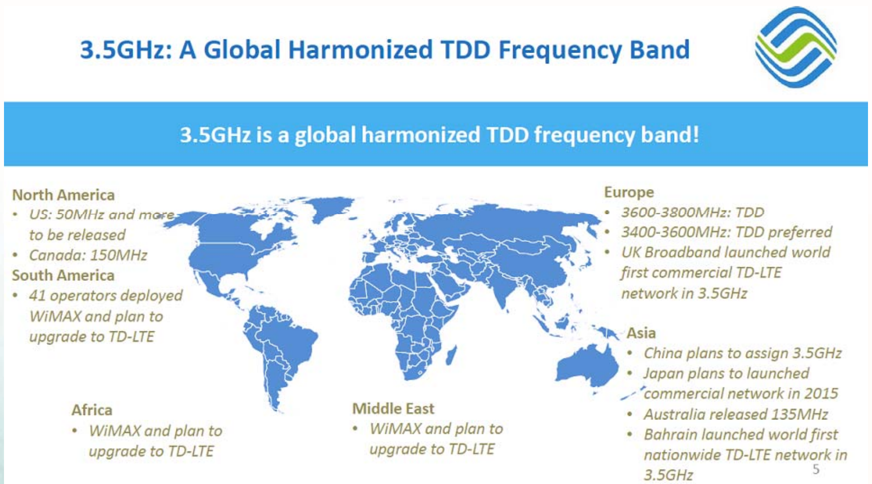
Primary Bands: Ku and Ka

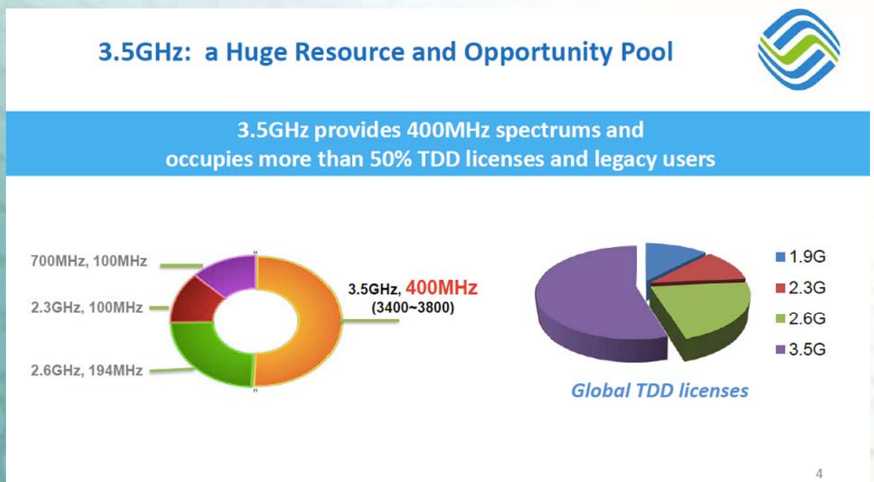
- Ku Band Systems
  - Tx: 13.75 – 14.5 GHz
  - Power Levels to 1KW
    - Both Linear and P1dB modes
- Ka Band Systems
  - Tx: 29.5 – 31
  - Power Levels to 50W

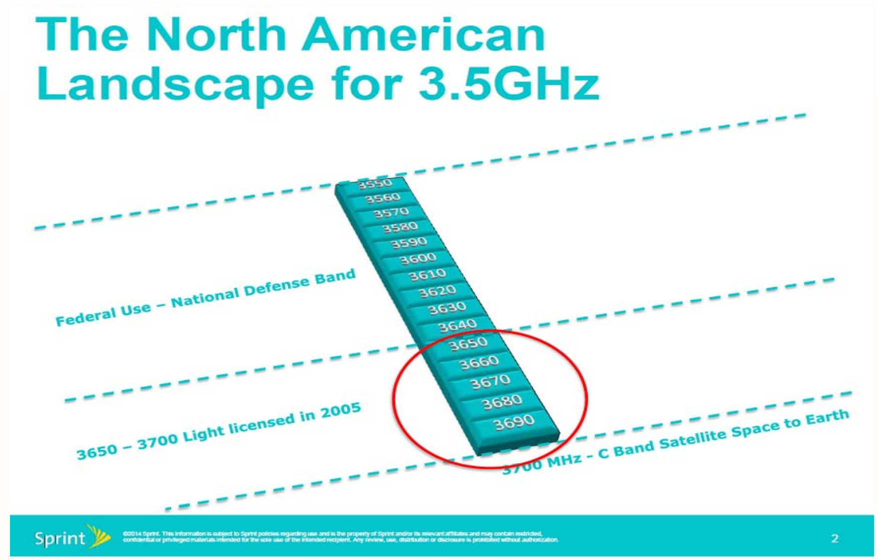


System Integrators are moving from GaAs to GaN, to higher power individual parts, to simplify manufacturing and improve system efficiency (operating cost)

3.5 GHz Cellular Backhaul







Technology Trends

- Higher Capacity Radios
  - Higher output power and linearity requirements
  - Output power is operating power, not saturated power
- Multi-modulation Radios
  - Power amplifiers must work well backed off and near P1dB
  - Balance IP3 and P1dB performance
- Pre-distortion
  - Improves linearity for given output power and modulation

The technology trends in Point to Point Radios are entirely consistent with the demands of high capacity, high bandwidth communications systems (Backhaul) and do not reflect or overlap in frequency, bandwidth or power level with the trends in the Military Market

MAAP-011106 – E-Band Power Amplifier

- Released in 2014 Targeting E-Band

Parameter	Units	MACOM MMIC	3A001.b.2.g	3A611.c.11
Frequency	GHz	71 – 86	75 – 90	75 – 90
Output Power	dBm	>25	>10	>10
Bandwidth	%	20	>5	>5
PAE	%	>10	N/A	>10

Recommendations

- MACOM fully understands and supports the intent of the 3A611 thresholds
  - We are seeking possible solutions which protect military critical performance while not inadvertently capturing parts designed and used for truly civil application
- Today's state of the art defense systems: (Higher Fences Around Smaller Yards)
  - JFS, G/ATOR, 3DELRR, TPQ53, AMDR, NGJ, EAPS, InTop ….
  - General Defining characteristics
    - Broadband – Typically >>25% Bandwidth (30 - >70%)
    - MMIC Based: No use of discrete transistors in advanced systems
    - Power Levels: High
    - Efficiency: As high as possible
- Civil Communications Systems
  - General Defining Characteristics
    - Narrow Band (for the most part): 10-15% bandwidth, but increasing
    - Power Levels: moderate
    - Efficiency: As High as possible

Recommendations

- Increase Bandwidth to >15%
- Selectively increase power levels
  - F^2 scaling law leads to unrealistically low power levels in millimeter wave region
  - Current GaAs Technologies support powers higher then threshold – powers are required by systems for data link integrity.

MAAP-011106

Power Amplifier,
71 - 86 GHz

***Preliminary* - Rev. V1P**

Features

- 4 Stage Power Amplifier for E Band
- 20 dB Gain
- 15 dB input and output match
- 25 dBm saturated output power
- 30 dBm OIP3
- Variable gain with adjustable bias
- Integrated detector
- Bare die
- RoHS* compliant and 260°C reflow compatible
- HBM ESD rating of 100 V
- Size: 3780x2500x50µm

Description

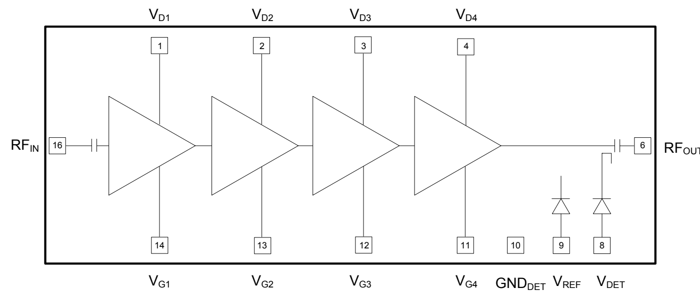
The MAAP-011106 is a bare die power amplifier that operates from 71 - 86 GHz. The amplifier provides 20 dB small signal gain. The input and output are matched to 50 Ω with bond wires to external board. It is designed for use as a power amplifier stage in transmit chains and is ideally suited for E band point to point radios.

Each device is 100% RF tested to ensure performance compliance. The part is fabricated using an efficient pHEMT process.

Ordering Information

Part Number	Package
MAAP-011106-DIEPPR	Die in Vacuum release gel pack

Chip Device Layout



Pad Configuration

Pad No.	Function	Pad No.	Function
1	V_D1	9	V_{REF}
2	V_D2	10	GND_{DET}
3	V_D3	11	V_G4
4	V_D4	12	V_G3
5	GND	13	V_G2
6	RF_{OUT}	14	V_G1
7	GND	15	GND
8	V_{DET}	16	RF_{IN}
		17	GND

* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

• **North America** Tel: 800.366.2266 • **Europe** Tel: +353.21.244.6400
• **India** Tel: +91.80.43537383 • **China** Tel: +86.21.2407.1588
Visit www.macomtech.com for additional data sheets and product information.

Electrical Specifications: RF: 71 - 86 GHz, VD = 4 V, Drain Current = 720 mA, T_A = 25°C

Parameter	Units	Min.[1]	Typ.	Max.
Frequency Range	GHz	71	-	86
Gain	dB	18	20	-
Input Return Loss	dB	-	15	-
Output Return Loss	dB	-	15	-
P1dB	dB	-	23	-
Pout with Pin = 13 dBm	dBm	-	25	-
Psat (P4dB)	dBm	24	25	-
OIP3 (worst tone)	dBm	-	30	-
IIP3 (worst tone) for Gain = 20 turned-down to -5 dB	dBm	-	10	-

Quiescent DC Bias: ID1= 60 mA, ID2 = 120 mA, ID3 = 240 mA, ID4 = 300 mA. Total DC Power = 2.88 W
[1]Minimum limits are the on-wafer minimum test limits

Absolute Maximum Ratings [2,3,4]

Parameter	Absolute Max.
Drain Voltage	+4.3 V
Drain Current	935 mA
Gate Bias Voltage (VG1,2)	-1.5V < VG < 0V
Input Power	+16 dBm
Storage Temperature	-55°C to +150°C
Operating Temperature	-40°C to +85°C
Junction Temperature	150°C
Thermal Resistance	16.15°C/W

2. Exceeding any one or combination of these limits may cause permanent damage to this device.
3. M/A-COM Technology Solutions does not recommend sustained operation near these survivability limits.
4. Operating at nominal conditions with $T_J \leq 150$°C will ensure MTTF > 1 x 10^6 hours.

Handling Procedures

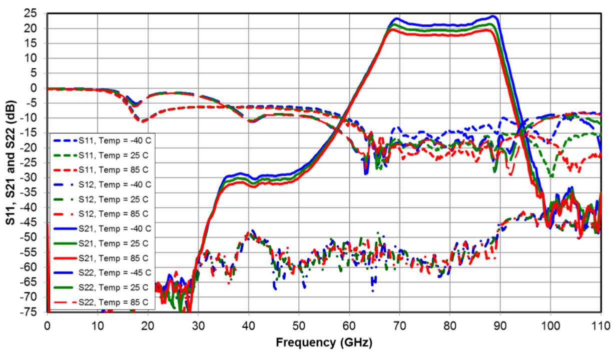
Please observe the following precautions to avoid damage:

Static Sensitivity

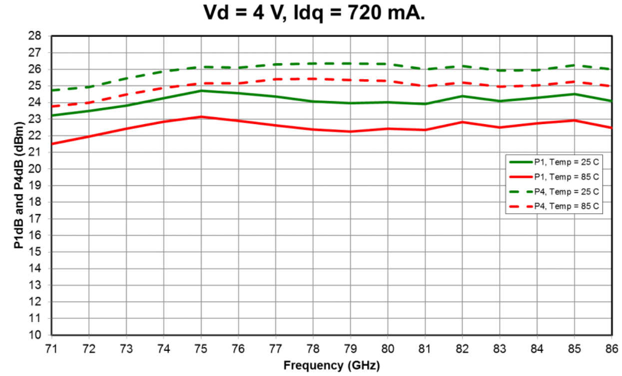
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these static sensitive devices.

• **North America** Tel: 800.366.2266 • **Europe** Tel: +353.21.244.6400
• **India** Tel: +91.80.43537383 • **China** Tel: +86.21.2407.1588
Visit www.macomtech.com for additional data sheets and product information.

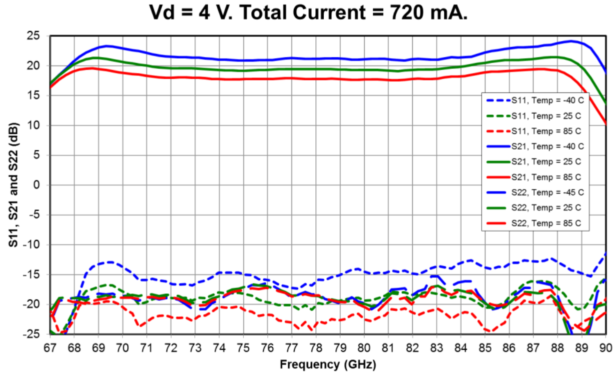
MAAP-011106 S-Parameters at -40, 25 and 85 C.
Vd = 4 V. Total Current = 720 mA.



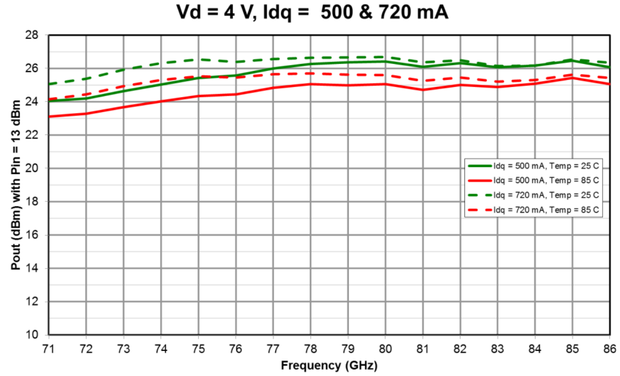
MAAP-011106: P1dB and P4dB at 25 C and 85 C:
Vd = 4 V, Idq = 720 mA.



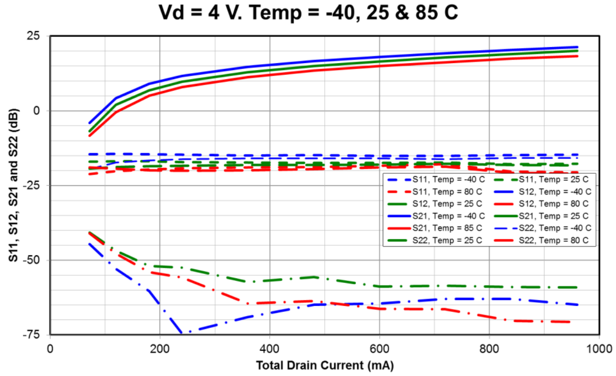
MAAP-011106 S-Parameters at -40, 25 and 85 C.
Vd = 4 V. Total Current = 720 mA.



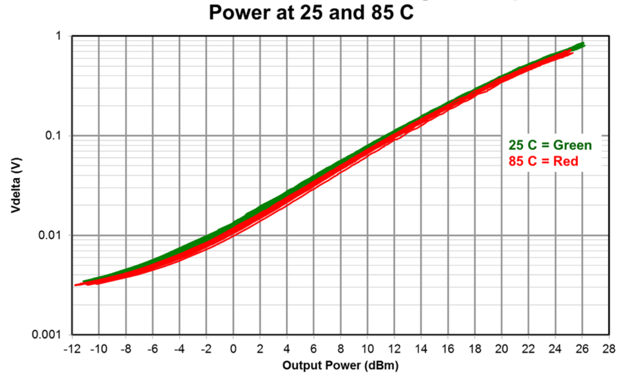
MAAP-011106: Pout with Pin = 13 dBm at 25C & 85C:
Vd = 4 V, Idq = 500 & 720 mA

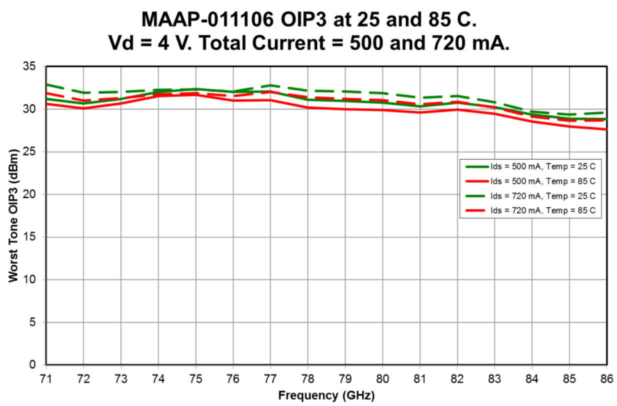


MAAP-011106 S-Parameters at 80 GHz vs Current.
Vd = 4 V. Temp = -40, 25 & 85 C

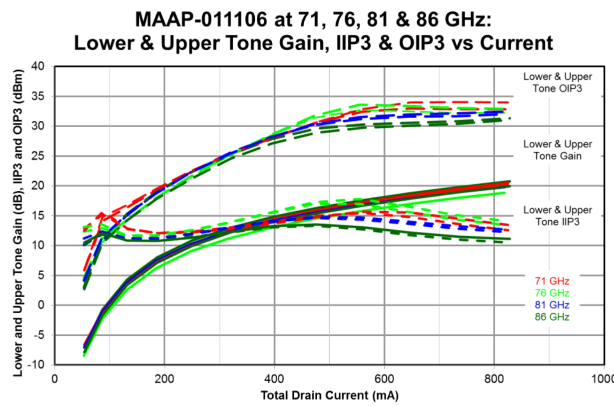


MAAP-011106: Detector Delta Voltage vs Output
Power at 25 and 85 C





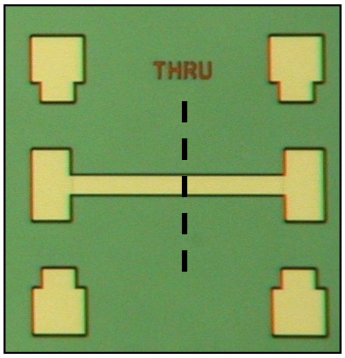
MAAP-011106 OIP3 at 25 and 85 C.
Vd = 4 V. Total Current = 500 and 720 mA.
Worst Tone OIP3 (dBm)
Frequency (GHz)
Ids = 500 mA, Temp = 25 C
Ids = 500 mA, Temp = 85 C
Ids = 720 mA, Temp = 25 C
Ids = 720 mA, Temp = 85 C



MAAP-011106 at 71, 76, 81 & 86 GHz:
Lower & Upper Tone Gain, IIP3 & OIP3 vs Current
Lower and Upper Tone Gain (dB), IIP3 and OIP3 (dBm)
Total Drain Current (mA)
Lower & Upper Tone OIP3
Lower & Upper Tone Gain
Lower & Upper Tone IIP3
71 GHz
76 GHz
81 GHz
86 GHz

Calibration Plane

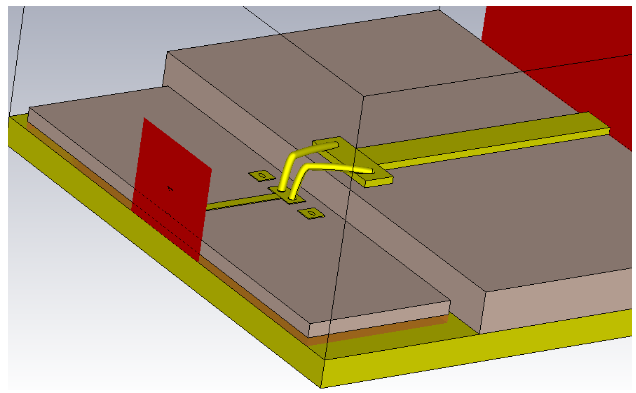
All data was measured on die with 200µm pitch probes. The calibration plane is at the middle of the through, 178.5 µm from the middle of the RF pad.

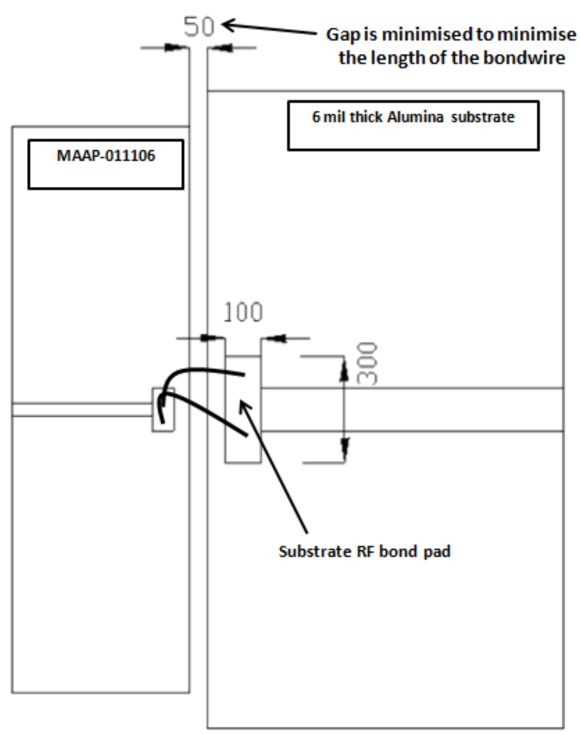


App Note [1] Biasing - It is recommended to bias the amplifier with quiescent bias of Vd=4.0 V and Id=720 mA. It is also recommended to tune each gate voltage individually to get the recommended quiescent current for this stage. And once the recommended total quiescent drain current is achieved (720 mA), it is recommended that the gate voltages to be kept fixed and the drain current not to be regulated for power operations; this gives the most reproducible results. Depending on the supply voltage available and the power dissipation constraints, the bias circuit may be a single transistor or a low power operational amplifier, with a low value resistor in series with the drain supply used to sense the current. The gate of the pHEMT is controlled to maintain correct drain current and thus drain voltage. The typical gate voltage needed to do this is -0.6 V. Typically the gate is protected with Silicon diodes to limit the applied voltage. Also, make sure to sequence the applied voltage to ensure negative gate bias is available before applying the positive drain supply.

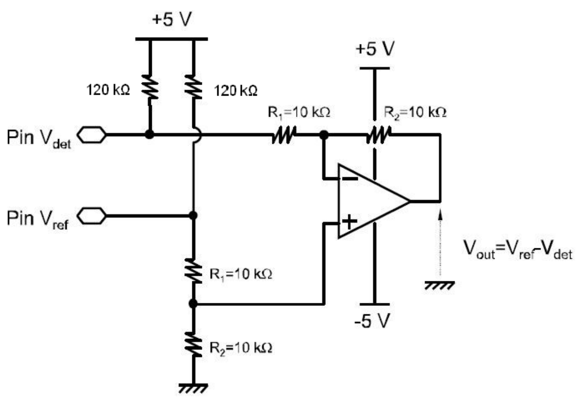
App Note [2] Bias Arrangement - Each DC pin (Vd1,2,3,4 and Vg1,2,3,4) needs to have DC bypass Capacitance (120 pF/10 nF) as close to the MMIC as possible.

App Note [3] Wire Bonding - It is recommended for RF bonds to be Reverse Ball-Stitch-on-Ball bonds (BSOB).
DC bonds can be wedge bonds.
V-shaped RF bond with two wires (diameter = 25µm) is recommended for optimum RF performance.
RF bond wire length to be minimized to reduce the inductance effect. Simulations suggest no more than 300µm.
Substrate RF pad can be optimised to improve the microstrip to MMIC bond transition as shown in the example below.

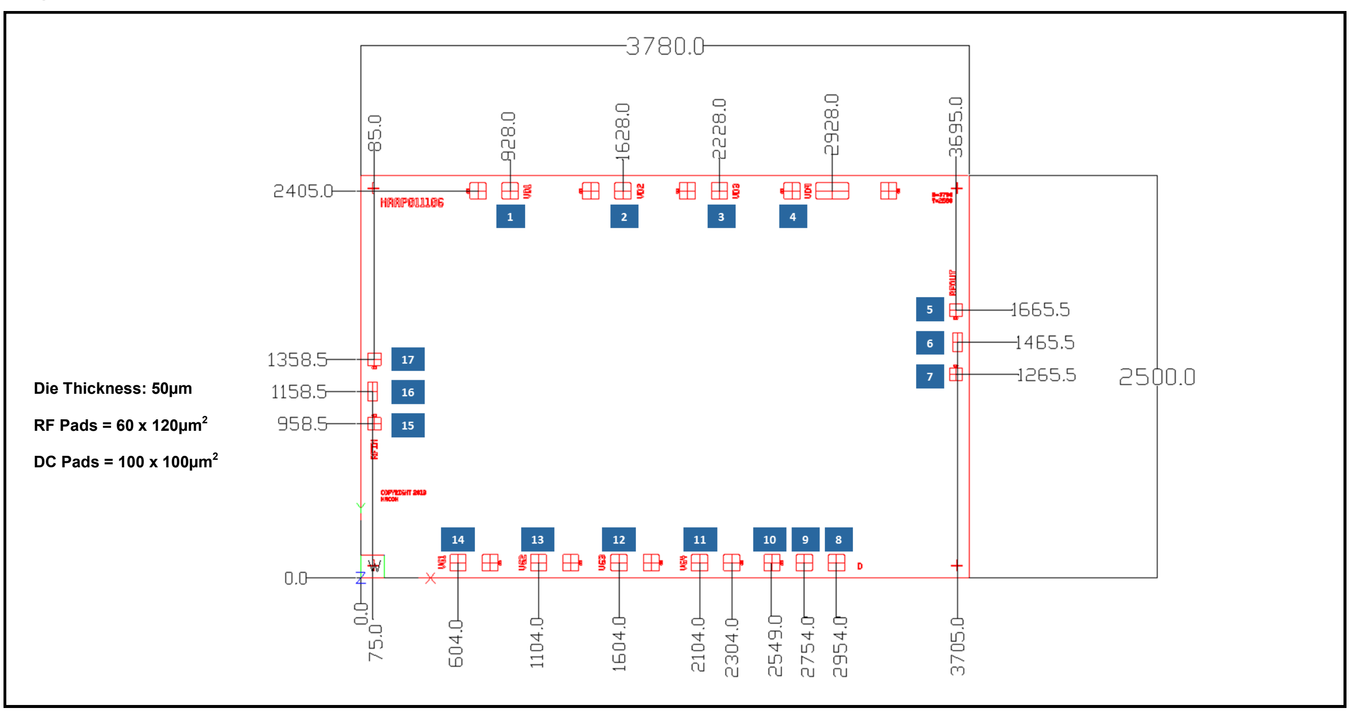




App Note [4] Detector biasing schematic - As shown in the schematic below, the power detector is implemented by providing +5 V bias and measuring the difference in the output voltage with standard op-amp in a differential mod configuration



Layout Dimensions



ERICSSON

PRESS RELEASE
FEBRUARY 12, 2010

WORLD'S FASTEST MICROWAVE BACKHAUL SOLUTION WITH 2.5GBPS

- Demonstrates world's first 2.5Gbps microwave radio connection live
- More than 60 percent of radio base stations are backhauled using microwave solutions
- Delivered 2 million MINI-LINK microwave radio units

By 2014, more than 3 billion subscribers will use broadband, with 80 percent on mobile broadband according to Ericsson. High transmission speeds are critical to meet the ever increasing demand placed on mobile networks by the dramatic rise in traffic from smartphones and other devices as well as applications such as video, internet TV and business services. Mobile operators see high capacity microwave radio connections as a fast and cost-effective way to backhaul broadband services on WCDMA and LTE networks efficiently and reliably, particularly in urban areas.

Ericsson (NASDAQ: ERIC) will provide a live demonstration of the world's first high-speed microwave radio connection with a transporting capacity of 2.5Gbps at GSMA Mobile World Congress (MWC) in Barcelona on February 15-18. This is one of Ericsson's latest efforts to support increased data speeds in networks and ensure they can scale up to manage the capacity needed for fully fledged LTE systems. The 2.5Gbps connection uses the new 70-80GHz frequency band (E-band) to transport high levels of data on the air.

Georges Antoun, head of IP and Broadband at Ericsson, says: "Microwave has been a key component when it comes to fast and cost-effective rollouts of mobile networks, and will continue to be just that when the capacities take off in the networks. We have now delivered more than 2 million MINI-LINKs around the globe and we see that microwave will remain as the solution for mobile backhaul as it provides the lowest total cost of ownership."

Ericsson will release its first product in the 70-80GHz frequency band supporting 1Gbps during 2010. The demonstration will be carried out at Ericsson's exhibition area in Hall 6, La Fira, Barcelona during the GSMA MWC. Access is by invitation only. Media representatives should contact Ericsson Corporate Public & Media Relations.

Ericsson at GSMA Mobile World Congress

NOTES TO EDITORS:

3G reference list

Ericsson's offering in microwave solutions

White Paper: High speed technologies for Mobile Backhaul

Photos of MINI-LINK

Ericsson is the world's leading provider of technology and services to telecom operators. Ericsson is the leader in 2G, 3G and 4G mobile technologies, and provides support for networks with over 2 billion subscribers and has the leading position in managed services. The company's portfolio comprises mobile and fixed network infrastructure, telecom services, software, broadband and multimedia solutions for operators, enterprises and the media industry. The Sony Ericsson and ST-Ericsson joint ventures provide consumers with feature-rich personal mobile devices.

Ericsson is advancing its vision of being the "prime driver in an all-communicating world" through innovation, technology, and sustainable business solutions. Working in 175 countries, more than 80,000 employees generated revenue of SEK 206.5 billion (USD 27.1 billion) in 2009. Founded in 1876 with the headquarters in Stockholm, Sweden, Ericsson is listed on OMX NASDAQ, Stockholm and NASDAQ New York.

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UPCOMING EVENTS

- Mobile World Congress Barcelona, Spain, February 15- 18
- Ericsson's Capital Markets Day, Stockholm, Sweden, May 5-6
- Ericsson Business Innovation Forum, Shanghai, China, May 17-18

For more information please contact the Ericsson Media Relations Team.

PASOLINK Series

Empowered by Innovation

NEC

Full Packet All-in-one Radio

iPASOLINK EX

True Gigabit High Speed Transmission

NEC Corporation of America
necam.com

Product Overview

The iPASOLINK EX is NEC's latest millimeter-wave radio designed for future high speed networks. The iPASOLINK EX is ideally suited to mobile backhaul for 4G (LTE/WiMAX) small cell deployment. However, this product works equally well in core network access or transport applications in dense urban areas. Other attributes of this innovative All-Outdoor radio include, easy installation, provisioning, and maintenance; advanced Ethernet functionality; high reliability and low power consumption. Moreover, the iPASOLINK EX capacity may be increased and reliability enhanced through employment of cross-polarization interference cancellation (XPIC) and 1 + 1 protection, respectively.

Features

- **Ultra high speed**
  - Full speed GbE and more capacity (3.2Gbps [with XPIC 2 + 0])
- **High spectrum efficiency**
  - QPSK to 256QAM adaptive modulation
- **Easy deployment**
  - Zero footprint
  - Low power consumption
  - Quick installation and provisioning
  - Easy maintenance
  - All-in-one configuration with integrated antenna
- **High performance switch capability**
  - Fully functional L2 switch
- **High reliability**
  - Advanced error correction
- **Man-machine interfaces**
  - Browser-based user interface with GUI
  - In-band NMS

Specifications

	iPASOLINK EX
Frequency Band	71-76GHz/81-86GHz FDD
Modulation	QPSK/16/32/64/128/256QAM (Hitless AMR)
Channel Separation	250MHz (ETSI/ANSI)
Interfaces	2 x GbE (Electrical or Optical)
Maximum Link Capacity	3.2Gbps (256QAM) [with XPIC 2 + 0]
QoS	8 classes queue strict priority/DWRR
Synchronization	Synchronous Ethernet
Ethernet OAM	IEEE802.1ag/ITU-T G.1731/IEEE802.3ah
Radio Configuration	1 + 0/1 + 1/2 + 0
Antenna	Direct mount (0.3-0.6m dia.)
Ambient Temperature	-33 to +50°C
Power Line Voltage	-40.5 to 57VDC or PoE
Power Consumption	50W typ.
Dimensions and Weight (mm)	270(W) x 270(H) x 100(D) < 5.5kg

Specifications are subject to change without notice.

Abbreviations

AMR: Adaptive Modulation Radio
ANSI: American National Standards Institute
CCDP: Co-Channel Dual Polarized
D: Depth
DWRR: Deficit Weighted Round Robin
ETSI: European Telecommunications Standards Institute
GbE: Gigabit Ethernet
GUI: Graphical User Interface
H: Height
IEEE: Institute of Electrical and Electronics Engineers
IP: Internet Protocol
L2: Network Layer 2
LTE: Long Term Evolution
NMS: Network Management System
PoE: Power over Ethernet
QAM: Quadrature Amplitude Modulation
QoS: Quality of Service
QPSK: Quadrature Phase-Shift Keying
(W): Width
WiMAX: Worldwide Interoperability for Microwave Access
XPIC: Cross-Polarization Interference Cancellation

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SW13015 | v.08.06.13

4G LTE READY

4G Evolution™ Series

E-Link 2500 Solution

4G Evolution™ Series

- Industry's first commercially available 70/80 GHz backhaul solution capable of up to 2.5 Gbps
- OMT coupler connects two radios to one antenna
- Flexible 2+0 and 1+1 configurations
- Available with long range (1' / 0.3m) or extended long range (2' / 0.6m) antennas

Industry leading technology

The E-Link 2500 takes millimeter-wave performance to a new level. An advanced OMT coupler connects two E-Link 1000 Series radios to one antenna for up to 2.5 Gbps capability. Available with either a long range or extended long range antenna, this solution can be deployed in 2+0 and 1+1 configurations. With flexibility and added performance, the 2500 is the perfect future-proof backhaul for networks with high subscriber/data usage growth.

Applications

LTE/4G/WiMAX backhaul

Mobile backhaul

Remote Storage Access

Disaster Recovery

Redundant Access/Network Diversity

Local Area Network Extension

Metropolitan Area Networks (MAN)

Homeland Security

Features & performance

- Innovative OMT Coupler connects two radios to one antenna, with each radio at a different polarization (horizontal and vertical)
- Increase the capacity of your existing E-Band network, while protecting your investment (backward compatible with E-Band 1000 Series radios)
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- Full duplex wire speed Gigabit Ethernet
- Highly secure transmission (FIPS 140-2 gov. security capable)
- Low Latency for multimedia applications (<5µs)
- Simple all outdoor installation & maintenance using PC
- Supports multiple network architectures including
  - Point-to-Point, Mesh/Ring, Repeater
- Transparent Support of all Ethernet clock sync techniques
  - Sync-E, IEEE 1588v2, Adaptive Clock recovery

E-Band Communications is the #1/fastest growing manufacturer of 60, 70 & 80 GHz point-to-point backhaul solutions in the world, with sales more than quadrupling in 2010.

E band communications

Connecting a digital world.™

Specifications

Frequency Range	71-86 GHz
Antenna Port to “V” or “H” Radio Port	Maximum - 1dB max Typical - 0.8 dB
Port-to-Port Isolation	> 30 dB
Return Loss (each port)	> 20 dB
Polarization Adjustment Range	±5º
Weight (Coupler only)	4.7 lbs / 2.1 kg

Sample Link Calculation for 1+1 and 2+0 Configurations

E-Link System Gain	189 dB
Free Space Loss (2.1 mi/3.2 km)	-141 dB
Coupler Loss (Tx+Rx)	2 dB
Rain Rate (ITU-R Region E: Denver, Stockholm, Moscow, Beijing)	22 mm/hr (0.86 in/hr)
Link Availability (Vertical)	99.996%
Link Availability (Hortizontal)	99.995%

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www.e-band.com

1 Summary

TriQuint Semiconductor, Inc. appreciates the opportunity to provide comments in response to the Bureau of Industry and Security Notice of Inquiry (NOI) BIS- 2012-0045.

We understand that BIS is seeking specific examples of MMIC power amplifiers and discrete microwave transistors that 1) would be classified as 3A611.c and d, respectively, per the performance thresholds in the NOI, and 2) are in current use in civil, or commercial, applications.

We also understand that the intent of creating the 3A611 category is to move items from the United States Munitions List (USML) to BIS jurisdiction and not to restrict commercial or dual-use products that are currently classified as 3A001.b2 and b3.

As proposed, the 3A611 performance thresholds fail to meet this objective. In TriQuint's case, 39 existing products would be reclassified from 3A001.b2 and b3 to 3A611.c and d. TriQuint is currently manufacturing and selling these products to commercial customers and, with some of the devices, has been selling them for over a decade. From 2010 through mid-2014, these 39 products have generated approximately $20 million in revenue.

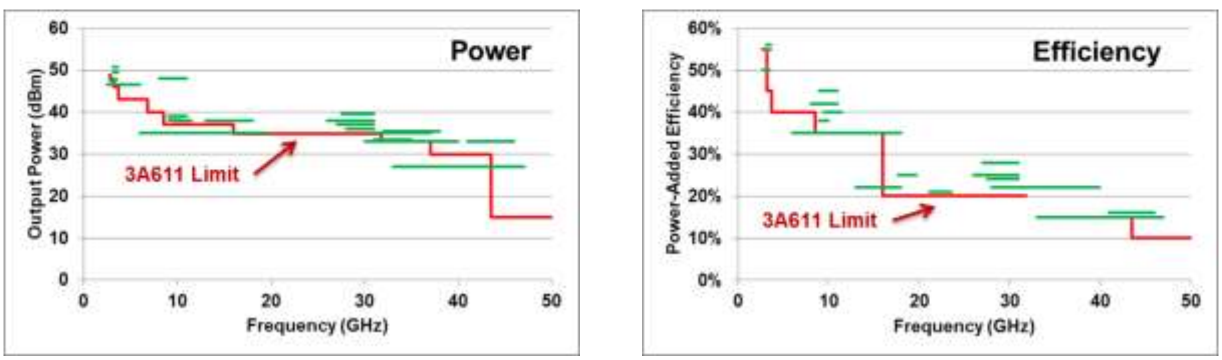


Figure 1 – TriQuint MMICs exceeding the proposed 3A611 power (left) and efficiency (right) thresholds. Each MMIC's performance across its operating frequency range is shown by a green line; the 3A611 limits are shown in red.

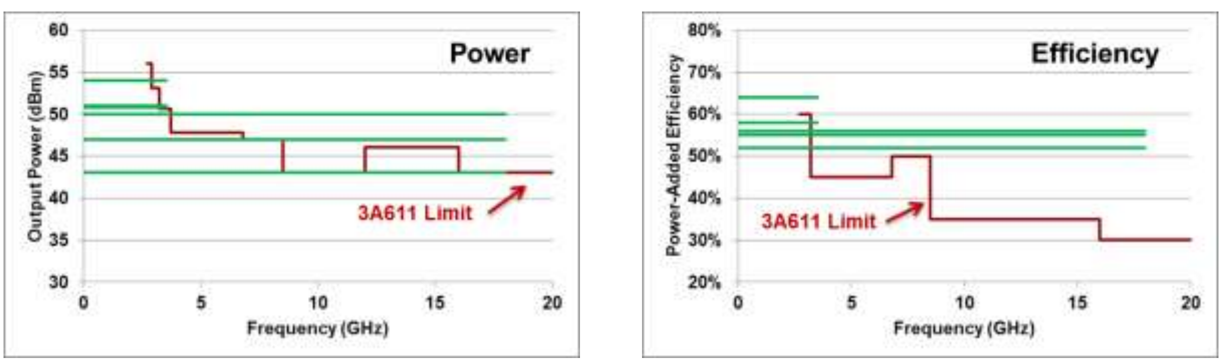


Figure 2 – TriQuint discrete power transistors exceeding the proposed 3A611 power (left) and efficiency (right) thresholds. Each transistor's performance across its operating frequency range is shown by a green line; the 3A611 limits are shown in red.

The proposed 3A611 performance thresholds would stop the export of these 39 products, significantly hindering TriQuint's participation in three of our core commercial markets: point-to-point radio, satellite ground terminal (also called VSAT, for Very Small Aperture Terminal), and cellular base stations above 2.7 GHz. These markets are global, which means the primary system suppliers to whom we market our products are international. These firms include Alcatel Lucent, Ceragon, DragonWave, Ericsson, Gilat, Huawei, Mitsubishi, Nokia Networks, SIAE Microelettronica, and ZTE.

If we cannot export, we would likely terminate current investments to develop new power amplifier products where the customers are largely outside the U.S., particularly the point-to-point radio and the emerging 3.5 GHz cellular infrastructure markets. We are investing in new products for these applications, based upon business cases that forecast greater than $10 million in future revenue.

More broadly, imposing the 3A611 criteria would preclude the U.S. RF semiconductor industry from participating in these and other commercial markets, ceding market share to international competitors such as Mitsubishi, Sumitomo Electric Device Innovations (SEDI), United Monolithic Semiconductors (UMS), and WIN Semiconductors, among others. Today, Mitsubishi, SEDI, and UMS sell catalog products that exceed the proposed 3A611 thresholds. WIN Semiconductors, a global foundry based in Taiwan, offers a GaN process that will enable their customers to develop power amplifiers that exceed the 3A611 thresholds.

While TriQuint's semiconductor wafer fabs are located in the U.S., most of our commercial product assembly and test occurs in Asia, which is the semiconductor industry's hub for low-cost assembly and test. 3A611 would require us to assemble and test within the U.S., increasing product cost and eroding our competitive position. 3A611 would also preclude using wafer fabs outside the U.S. in the future. Today, most of our competitors use a mix of internal fabs and foundries outside the U.S. This enables them to better manage business cycles and reduce capital investment in expensive fabs.

U.S. defense programs benefit from commercial volumes, which help to maintain process stability, improve yields, and amortize wafer fab costs – reducing the cost for DoD programs. While the DoD is typically the early investor in new process technology, commercial applications are often the first to reach the market, ramp to production, and dramatically reduce product costs. GaN is a good example, where cable television (CATV) and cellular base stations are leveraging the DoD's investment in the core technology.

For these reasons, we urge the U.S. Government to redefine the 3A611 category as follows:

Eliminate PAE as a defining parameter

Differentiating the efficiency requirements and performance between defense and commercial applications is not possible. The assumption that military systems uniformly require higher efficiency than commercial applications is not true.

Commercial systems are demanding ever-higher efficiency to reduce system power consumption (meaning operating cost), size, and weight. For power-intensive applications such as base stations, our customers' goals typically exceed present capabilities of device technology and power amplifier topology.

For the device, efficiency is determined by the device technology and frequency of operation. For the amplifier that uses the device, efficiency is determined by the topology and class of operation, load tuning, and bandwidth.

To illustrate this point, a major base station manufacturer is asking for GaN drain efficiency at saturated output power to be greater than 70%. They will use the device in a Doherty power amplifier designed to achieve efficiencies of 55%. TriQuint's own GaN Doherty amplifier designs demonstrate efficiencies in the low 50s, and we are actively working on design improvements to achieve 55%.

The same GaN transistors can be used in a PA for S-band radar, where the typical efficiency for a 100 watt MMIC amplifier is 58%. While the efficiency of the radar amplifier is slightly higher (3 to 5 points), this difference is not sufficient to provide a clear, long-term demarcation between these commercial and military applications.

We argue that this comparison between cellular base station and S-band radar PAs holds across all markets and frequency bands. Hence, it's impossible to clearly and cleanly distinguish between military and commercial applications using efficiency.

Increase the threshold for power

Most of the power level thresholds proposed for 3A611 are the same as those currently used for 3A001, with efficiency the only parameter distinguishing the two. As we have discussed, efficiency does not effectively differentiate between commercial and military applications. In addition to our recommendation that efficiency be eliminated, we also recommend increasing the power levels for 3A611, as shown:

MMICs

Frequency Band (GHz)	3A001 Saturated Power Level (watts)	3A611 Saturated Power Level (watts)	TriQuint Proposal for 3A611 (watts)
2.7 to 2.9	75	75	**250**
2.9 to 3.2	55	55	**250**
3.2 to 3.7	40	40	**250**
3.7 to 6.8	20	20	**150**
6.8 to 8.5	10	10	**70**
8.5 to 16	5	5	**60**
16 to 31.8	3	3	**30**
31.8 to 37	0.1 nW	2	**15**
37 to 43.5	1	1	10
43.5 to 75	31.62 mW	31.62 mW	**8**
75 to 90	10 mW	10 mW	**5**
>90	0.1 nW		**2**

Power Transistors

Frequency Band (GHz)	3A001 Saturated Power Level (watts)	3A611 Saturated Power Level (watts)	TriQuint Proposal for 3A611 (watts)
2.7 to 2.9	400	400	**700**
2.9 to 3.2	205	205	**500**
3.2 to 3.7	115	115	**300**
3.7 to 6.8	60	60	**250**
6.8 to 8.5	50	50	**200**
8.5 to 12	15	20	**150**
12 to 16	40	40	**120**
16 to 31.8	7	20	**80**
31.8 to 37	0.5	2	**15**
37 to 43.5	1	1	**10**
>43.5	0.1 nW		**5**

The following sections provide data and additional information to support our claims and recommendations.

2 TriQuint Commercial and Dual-Use Products to be Classified as 3A611

39 existing TriQuint power amplifier MMIC and transistor products will be classified as 3A611 if the proposed thresholds are implemented. As previously stated, these are currently in production and being sold to commercial customers, serving the point-to-point radio, VSAT, and base station markets. Since 2010, they have generated approximately $20 million in revenue.

A listing of these products, with their markets and performance levels, is provided in the following tables. Information identifying customers and revenue is being provided in a separate, proprietary addendum to this response.

TriQuint's products may be sold as die or packaged. The numeric portion of the part number identifies the MMIC or transistor; the alphabetic code following the dash refers to the type of packaging.

For example, the TGA2704 amplifier is offered both as a die and in a surface-mount package, the latter designated TGA2704-SM. Where the performance of the die and packaged versions are equivalent, they are shown on the same row of the table. For example, the TGA2501/TS/GSG refers to a MMIC sold as a die, mounted on a thermal spreader (TS), and in a package (GSG). The performance of the three versions is essentially the same, so all versions are shown together.

The following table lists the TriQuint MMICs that would be classified as 3A611. Except for the TGA2576-2-FL, all of the products exceed the proposed output power and efficiency thresholds. The TGA2576-2-FL, highlighted in gray, exceeds the proposed output power and bandwidth thresholds.

MMIC Products

TriQuint Part #	Frequency (GHz)		Output Power (watts)	(dBm)	Effic-iency	Band-width	Served Markets
TGA2576-2-FL	2.5	6.0	44.7	46.5		82%	T&M, Comm, EW
TGA2817-SM	2.7	3.5	60.0	47.8	50%	26%	Radar
TGA2813 (Die)	3.1	3.6	117.5	50.7	55%	15%	Radar
TGA2814 (Die)	3.1	3.6	89.0	49.5	56%	15%	Radar
TGA2312-FL	9.0	10.0	63.0	48.0	38%	11%	Radar
TGA2704 (Die)	9.0	10.5	6.6	38.2	42%	20%	Radar, Point-to-Point
TGA2704-SM	9.0	11.0	8.0	39.0	45%	20%	Radar, Point-to-Point
TGA2710 (Die)	10.5	12.0	6.3	38.0	40%	13%	Point-to-Point
TGA2710-SM	9.5	11.5	6.3	38.0	40%	19%	Radar, Point-to-Point
TGA2514-FL	13	16	6.3	38.0	22%	21%	VSAT, Point-to-Point
TGA2514 (Die)	13	18	6.3	38.0	22%	32%	VSAT, Point-to-Point
TGA2501 Die/TS/GSG	6	18	3.2	35.1	35%	100%	EW, Point-to-Point, VSAT
TGA4534-SM	17.7	19.7	3.2	35.1	25%	11%	Point-to-Point
TGA4535-SM	21.2	23.6	3.2	35.1	21%	11%	Point-to-Point
TGA4915-CP	26	31	6.3	38.0	25%	18%	VSAT, Point-to-Point
TGA2594 Die/HM	27	31	5.0	37.0	28%	14%	VSAT, Point-to-Point
TGA2595 (Die)	27.5	31	9.0	39.5	24%	12%	VSAT, Point-to-Point
TGA4906 Die/SM	28	31	4.0	36.0	22%	10%	VSAT, Point-to-Point
TGA4514 (Die)	31	35	2.2	33.4	NA	12%	Point-to-Point, Radar
TGA4517 (Die)	31	37	3.2	35.1	NA	18%	Point-to-Point, Radar
TGA2575 Die/TS	32	38	3.5	35.4	22%	17%	Point-to-Point, Radar
TGA4516 Die/TS	30	40	2.0	33.0	22%	29%	Point-to-Point, Radar
TGA4046 (Die)	41	46	2.0	33.0	16%	11%	Point-to-Point, SatCom
TGA4522 (Die)	33	47	0.5	27.0	15%	11%	Point-to-Point, SatCom

The following table lists TriQuint's power transistor products that would be classified as 3A611.

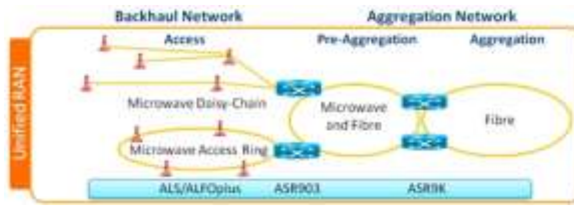
Power Transistors

TriQuint Part #	Frequency (GHz)		Output Power (watts)	(dBm)	Efficiency (%)	Served Markets
T1G4012036-FL/FS	DC	3.5	120	50.8	52%	General Purpose Power Transistors for Radar, MilCom, EW, Base Station, Instrumentation
TGF2819-FL/FS	DC	3.5	126	51.0	58%	
T1G4020036-FL/FS	DC	3.5	251	54.0	64%	
TGF2023-05 (Die)	DC	18	20	43.0	56%	Broadband Transistors for Military and Commercial Applications between DC and 18 GHz
TGF2023-10 (Die)	DC	18	50	47.0	55%	
TGF2023-2-20 (Die)	DC	18	100	50.0	52%	

3 Commercial Markets Harmed by 3A611

TriQuint's ability to serve three of our targeted commercial markets will be restricted by the proposed 3A611 thresholds: point-to-point radio, VSAT, and cellular base stations.

Point-to-Point Radio



Source: SIAE Microelettronica

Point-to-point radio refers to microwave radio links that are primarily used to connect cellular base stations to the service provider's core network and then to the Internet or, traditionally, other phones. The network that connects base stations, whatever the medium, is referred to as backhaul. The term *microwave backhaul* is used when point-to-point radio is the medium.

Radio links are used where optical fiber or copper cable connections are not feasible, due to geography or the cost of installing fixed lines. Globally, over 1 million radios are shipped each year. To support the unique needs of each country or region, including the available spectrum, many frequency bands from 6 to 86 GHz have been designated and licensed for microwave backhaul, as shown in the following table.

Allocated Frequency Bands for Point-to-Point Radio
(Frequencies are in GHz)

5.9 to 7.1	12.7 to 13.3	24.2 to 26.5	40.5 to 43.5
7.1 to 7.7	14.4 to 15.4	27.5 to 31.0	71 to 86
7.7 to 8.5	17.7 to 19.7	31.5 to 33.4	
10.0 to 11.7	21.2 to 23.6	37.0 to 39.5	

With the proliferation of smartphones and tablets and the attendant increase in data consumption by users, the data capacity of the cellular network has dramatically increased, and the exponential growth is projected to continue.

The evolution from 2G to LTE (4G) over the past decade has driven the capacity of point-to-point radio systems to gigabit rates, enabled by more complex modulation. 1028 QAM is the present standard for high-capacity radios, with leading manufacturers developing 2048 QAM systems. In parallel, millimeter-wave frequency bands with high channel bandwidths are being allocated to carry higher data rates. Shipments of E-band radios, with coverage in the 71 to 86 GHz spectrum, are beginning to grow rapidly, reflecting one approach to adding capacity in dense urban environments with many simultaneous subscribers.

To maintain quality of service as the data rates increase, radio manufacturers are asking RF power amplifier suppliers for higher output power and better linearity. To preserve efficiency, radio systems are adopting digital pre-distortion to allow the PAs to operate closer to saturation. The take-away is that radio manufacturers are specifying increasing power and efficiency across the entire frequency spectrum, and this trend will continue for the foreseeable future.

To illustrate how current point-to-point PA requirements conflict with the thresholds proposed for 3A611, one leading, international radio manufacturer has specified MMIC PAs with 1 watt saturated output power and 20% power-added efficiency for the 38 and 42 GHz radio bands. The 3A611 power and efficiency thresholds in this same frequency range are 1 watt and 15%.

The limits proposed by 3A611 will likely force the U.S. MMIC industry to withdraw from segments of the point-to-point radio market, with a continuing loss of market share as the evolution in radio data rates requires even higher performance PAs.

VSAT

Many global enterprises use satellite-based data networks to link their far-flung locations, particularly where the local communications infrastructure may be unreliable or just does not exist (for example, on a ship or an offshore oil drilling platform). Even in a country with a highly developed communications infrastructure, companies with many retail locations often use a satellite-based network to manage inventory, process customer credit-card transactions, distribute training, and handle email communication.

VSAT antenna at a gas station.

These satellite-based services have historically been termed the VSAT (Very Small Aperture Terminal) market. Such systems typically operate at K_u-band, with the uplink (ground terminal to satellite) transmission in bands between 14 and 14.5 GHz.

Hughes, based in Germantown, Maryland, and Gilat Satellite Networks, based in Petah Tikva, Israel, hold the largest market share for enterprise VSAT services, which includes the satellite ground terminals and other networking equipment.

More recently, the VSAT industry is growing by offering Internet access via satellite to consumers who don’t have a cable, fiber, or high-speed DSL connection. Hughes and ViaSat have pioneered these services in the U.S., under the brand names HughesNet Gen4, Exede, and WildBlue. Hughes reported approximately 935,000 broadband subscribers as of June 30, 2014; ViaSat had approximately 641,000 as of July 4, 2014.

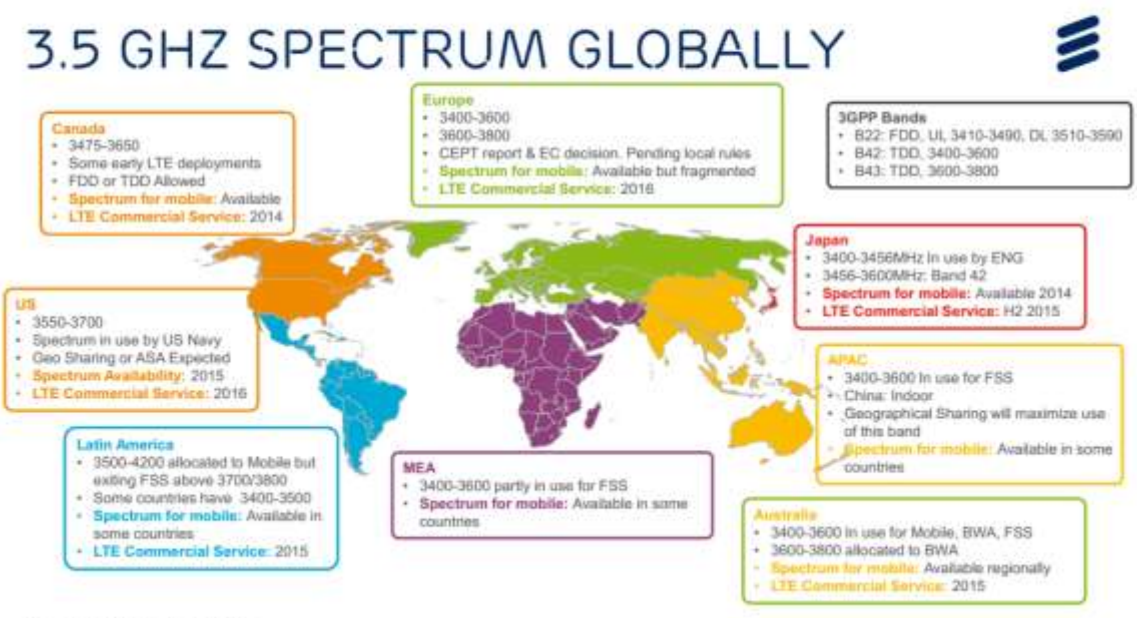
To provide attractive broadband data rates (at least 5 Mbps download and 1 Mbps upload), both Hughes and ViaSat launched satellites operating in K_a-band (27.5 to 31 GHz for the uplink), where more bandwidth is available. However, at these frequencies, the link is more prone to rain fade, and the path loss slightly greater. While the size of the antenna could be increased to improve the link margin, consumer preference is to minimize antenna size. As with point-to-point radio, to achieve the desired link budgets, VSAT suppliers are asking for higher output power PAs with better linearity to meet consumer demand for increasing data rates.

TriQuint currently offers four catalog power amplifiers for the K_a-band segment of the VSAT market that exceed the proposed 3A611 thresholds of greater than 10% bandwidth, 3 watts output power, and 20% efficiency. With the successful deployment in the U.S., the satellite Internet service model will grow globally, particularly in regions of the world without basic telecommunications infrastructure. The implementation of the proposed 3A611 thresholds would preclude U.S. industry from competing in this growing international market.

3.5 GHz Cellular Infrastructure

As previously noted, the use of mobile devices is fueling a dramatic increase in wireless data consumption. Service providers, such as AT&T and Verizon, have adopted a three-prong strategy to ensure sufficient data capacity in their networks and stay ahead of user demand: 1) more cells covering smaller geographies, to handle more simultaneous users; 2) improvements in the air interface modulation, to increase the number of bits transmitted per Hertz of spectrum; and 3) more spectrum or bandwidth to carry more data.

The cellular bands have historically been scattered between 450 MHz and 2.7 GHz, with various proposals and regulatory moves to add bands above and below this range — 44 bands so far. One such proposal is to allocate three bands near 3.5 GHz: Band 42 for TDD-LTE from 3.4 to 3.6 GHz, Band 43for TDD-LTE from 3.6 to 3.8 GHz, and Band 22 for FDD-LTE, with the downlink from the base station extending from 3.51 to 3.59 GHz.



Summary of the allocation of 3.5 GHz spectrum by region. Source: Ericsson

Japan is the lead country moving to adopt 3.5 GHz. Field trials have demonstrated up to 1 Gbps download speeds, and the country plans spectrum auctions this year, with cellular service offered by 2016. Europe will likely be the second region to deploy, since the 3.5 GHz spectrum was previously allocated for WiMAX, which never got off the ground. The spectrum can be reallocated for LTE service.

In the U.S., the use of this band is more challenging because of incumbent users, including the U.S. Navy for radar. In April, the FCC proposed a three-tier model for sharing 150 MHz of the 3.5 GHz spectrum: existing Federal and non-federal users would retain priority, with cellular services allowed on a non-interference basis.

A reasonable assumption is that the continuing growth of data traffic will lead to the use of 3.5 GHz spectrum for cellular services in a good portion of the world. Initial transistor specifications we have received from base station suppliers exceed the proposed thresholds of 115 watts and 45% PAE for the 3.2 to 3.7 GHz frequency range and 60 watts and 45% PAE above 3.7 GHz. Base station manufacturers would like transistors with greater than 120 watts output power and 70% device efficiency.

While we cannot show revenue from this market segment today, the secular growth of data demand combined with government licensing of the 3.5 GHz frequency bands should be sufficient to warrant changing the 3A611 thresholds.

4 International Competition

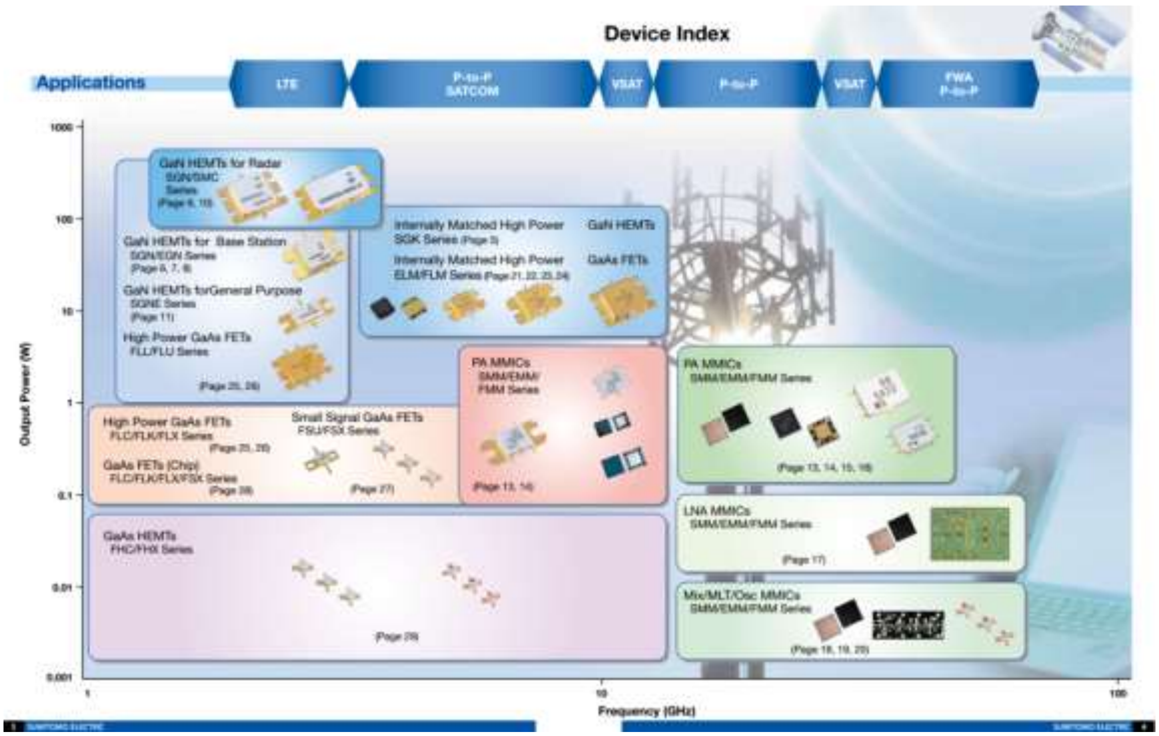
Several international companies that compete with U.S. industry sell products and/or foundry services that exceed the proposed 3A611 thresholds. The following sections identify the companies and provide an overview of their products and capabilities.

Sumitomo Electric Device Innovations

Sumitomo Electric Device Innovations (SEDI), a Japanese firm, is our strongest international competitor for GaAs and GaN power transistors, as well as a strong contender for MMICs for point-to-point radio and VSAT. The company's lineage traces to Fujitsu, one of the pioneers and early market leaders in power GaAs FETs for K_u-band VSAT, point-to-point, and satellite applications.

During the past decade, Sumitomo has developed GaN PAs targeting radar, satellite ground terminal, VSAT, point-to-point, and base station applications. The company currently holds the largest market share of GaN PAs for base stations, estimated by ABI Research to represent approximately $50 million in revenue in 2013.

This page from SEDI's 2013 product catalog shows the power and frequency coverage of their MMIC and transistor products.



The table shows seven SEDI GaN products with power and efficiency that either exceed or equal the 3A611 thresholds, based upon technical information and data sheets obtained from their web site.

Sumitomo Part Number	Frequency Band (GHz)		P_{out} (watts)	Efficiency (%)	Performance vs. 3A611
SGN2731-500H-R	2.7	3.1	500	60	Exceeds power, at efficiency
SGN2933-320D-R	2.9	3.3	400	55	Exceeds power , efficiency
SGN2933-600D-R	2.9	3.3	600	52	Exceeds power , efficiency
SGN3135-500H-R	3.1	3.5	500	60	Exceeds power, efficiency
SGK5867-100A	5.85	6.75	100	45	Exceeds power, at efficiency
SGK0910-60A-R	9.2	10.0	70	35	Exceeds power, at efficiency
SGK0910-120A-R	9.2	10.0	120	35	Exceeds power, at efficiency

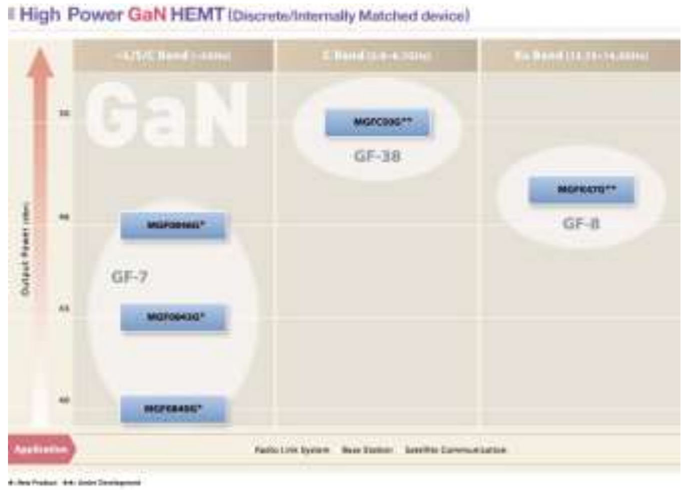
The table is not meant to reflect a complete assessment of all Sumitomo products, rather to illustrate a large enough sample to indicate that 1) markets have requirements at or exceeding the 3A611 thresholds and 2) SEDI is capable of developing such products.

Mitsubishi Electric

Mitsubishi Electric, also based in Japan, offers GaAs and GaN power amplifier products for point-to-point radio, VSAT, base station, radar, and satellite communications. Their product portfolio includes small-signal and low-noise GaAs FETs and HEMTs up to 20 GHz and silicon MOSFET power amplifiers for applications below 1 GHz.

Two of the packaged GaN transistors shown on Mitsubishi's web site have performance levels above or near the 3A611 thresholds.

The MGFC50G5867 covers 5.8 to 6.7 GHz (a C-band SATCOM band) and provides 50 to 51 dBm output power with 37.5 to 47.5% efficiency across the band, based on the performance plots shown in the data sheet. The output power exceeds the 3A611 47.8 dBm limit across the full band and the 45% efficiency limit over a portion of the band.



GaN product portfolio shown on Mitsubishi's web site.

A second device, the MGFK47G3745, covers 13.75 to 14.5 GHz (K_u-band VSAT) and provides 47 dBm output power with 30% efficiency, according to the typical values shown in the product data sheet. The power exceeds the 3A611 limits by 1 dB, and the stated efficiency is 5 points below the 3A611 threshold of 35%. However, the data sheet does not show performance plots over frequency. Since efficiency tends not to be flat with frequency, it may well exceed the 3A611 limit over some portion of the band.

As with Sumitomo, Mitsubishi seems capable of developing products that exceed the proposed 3A611 thresholds.

United Monolithic Semiconductor

United Monolithic Semiconductor (UMS) is a joint venture between European defense companies Thales and EADS. UMS was established and continues to be a strategic source for high-performance GaAs and GaN process technology and products for European defense programs and MoDs wary of depending upon U.S. MMIC technology.

Reflecting this strategic role, UMS promotes four X-band power amplifier MMICs on their web site, two based upon GaAs pHEMT technology and two designed with GaAs HBT. The table shows the performance of these MMICs and indicates UMS' capability.

UMS Part Number	Frequency Band (GHz)		P_{out} (watts)	Efficiency (%)	Bandwidth (%)	MMIC Technology
CHA7114	8.5	11.5	8	40	30	GaAs pHEMT
CHA7215	8.5	11.5	9	30 to 35	30	GaAs pHEMT
CHA8100	9.0	10.5	10	38 to 43	15	GaAs HBT
CHA7012	9.2	10.4	7.1	40	12	GaAs HBT

The proposed 3A611 thresholds for this band are 5 watts output power, 35% efficiency, and 10% fractional bandwidth. Except for the CHA7215, the PAs exceed both the power and efficiency limits. The efficiency of the CHA7215 is slightly below the limit.

Since the military market alone won't support a GaAs fab – particularly the European defense market – UMS has pursued commercial opportunities as a strategy to grow and sustain wafer volume. These commercial markets include point-to-point radio, automotive, and, most recently, base stations. UMS has teamed with NXP to develop GaN PAs for base stations. NXP, based in the Netherlands, is the second largest supplier of LDMOS power transistors for base stations, aerospace and defense, and industrial applications.

From a review of their web site, UMS has also released seven GaN power transistors as catalog products. The performance of one, CHZ050A-SEA, closely approaches the proposed 3A611 thresholds: designed for pulsed radar and SATCOM applications, the PA provides 50 watts output power with 45% efficiency over 5.2 to 5.8 GHz. The 3A611 limits are 60 watts and 45% efficiency.

WIN Semiconductor

WIN Semiconductor, based in Taiwan, is the largest pure-play GaAs foundry, with 2013 revenue of NT$10,481 million or $350 million. The company offers a variety of GaAs HBT and pHEMT processes that support the full range of commercial markets, from low-cost RFICs for cellular handsets and tablets to higher performance, millimeter-wave MMICs for SATCOM, VSAT, automotive radar, and 40 and 100 Gb/s fiber-optic systems.

WIN has presented several papers at technical conferences[1], describing their GaN on SiC process that is offered as a foundry service. WIN has stated that the process performs through X-band, showing performance and reliability data.

While their GaN performance is not on par with TriQuint's, WIN is allowing global designers to access and design with GaN. Running GaN wafers in parallel with high-volume GaAs, WIN can offer attractive pricing that will aid GaN in entering new markets and, in turn, provide performance feedback and cycles of learning to improve process performance and yield.

TriQuint cannot directly access WIN's process to assess performance; however, we posit that their GaN will enable products that exceed the performance thresholds set by 3A611.

5 Summary

For the reasons we have articulated, TriQuint respectfully submits that the proposed 3A611 performance thresholds will not achieve the U.S. Government's intended objective of controlling only bona fide military products. TriQuint has a large number of products in production being

[1] *Yield Enhancement of 0.25µm GaN HEMT Foundry Technology*, presented at the CS MANTECH Conference, May 19-22, 2014 in Denver, Colorado; *AlGaN/GaN HEMT Development Targeted for X-Band Applications*, presented at the 2013 IEEE International Conference on Microwaves, Communications, Antennas and Electronic Systems, October 21-23, 2013 in Tel Aviv, Israel; *Pure Play GaN Foundry 0.25µm HEMT Technology for RF Applications*, presented at the 2013 IEEE Compound Semiconductor Integrated Circuit Symposium (CSICS), October 13-16, 2013 in Monterey, California.

sold to commercial customers that would be reclassified as 3A611 – 39 products that have generated approximately $20 million in revenue since 2010. We understand that other U.S. companies face the same issue.

The proposed performance limits will restrict the U.S. compound semiconductor industry's ability to participate in several global wireless markets, markets where today's performance requirements exceed the 3A611 thresholds. Adopting these limits will halt the export of existing products that generate significant revenue and profit. It will also stop development of new products for these and attractive, emerging markets.

Operationally, implementing 3A611 as proposed will disrupt our supply chain, requiring that we establish domestic sources for assembly and test. This will increase product cost, incur re-qualification delays and costs, and halt product shipments until the new sources are qualified by us and our products are re-qualified by our customers.

We have provided examples from several international competitors that show their products and technology can exceed the proposed power and efficiency limits. Hence, it's difficult to fathom how 3A611 protects our national security by restricting access to such products and technology.

TriQuint has a long and proud history of providing superior technology to our armed forces. Serving the defense market is core to our strategy. Our opposition to the proposed 3A611 thresholds is not a retreat from that tradition. Our recommendation to eliminate efficiency and increase the power limits reflects the goal of truly segregating differentiated products for defense systems.

The DoD benefits from a strong commercial base for U.S. suppliers. Commercial volumes drive yield improvements and cost reduction. These, in turn, reduce the cost of the MMICs and power transistors supplied for U.S. defense systems.

Thank you for considering our position. We welcome your questions and further dialog.

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August 28, 2014

Regulatory Policy Division
Bureau of Industry and Security
U.S. Department of Commerce
Room 2099B
14th Street and Pennsylvania Avenue, N.W.
Washington, DC 20230
Submitted electronically via e-mail

Attn: Brian Baker, Director, Electronics and Materials Division, Office of National Security and Technology Transfer Controls

Re: BIS-2012-0045
Military Electronics Notice of Inquiry

Dear Mr. Baker,

ViaSat appreciates the opportunity to provide the following comment to the notice of inquiry specific to civil uses of certain MMIC power amplifiers listed under 3A611.c. The aim of this comment is to address who we are and what we do, convey the civilian application involving this MMIC power amplifier, and outline the impact of the 3A611.c controls on MMICs as implemented in the Military Electronics Final Rule.

Background

ViaSat is an Internet Service Provider (ISP) to the global consumer market using digital satellite communications, ground network systems, and other wireless networking and signal processing equipment. ViaSat also develops and manufactures satellite antenna systems, data link terminals, information security for networking, mobile IP networking, communications microprocessor chipsets, and communications simulation and training systems. ViaSat is headquartered in Carlsbad, California. Additional information about ViaSat is available at www.viasat.com.

Under the brand name Exede® (www.exede.com), ViaSat has shown that satellite has become another way to provide broadband internet services to the home in a way that matches speed, capacity, and price of terrestrial broadband. In addition to providing broadband satellite internet service to the home, ViaSat employs the Exede® network architecture to provide mobile broadband satellite internet services for industries such as disaster recovery/first responders, news gathering, and aviation.

In the past, satellite internet was viewed as the solution of last resort for those who did not have access to fiber or cable. However, with the development and launch of the highest capacity satellite in the world, ViaSat-1, satellite internet became a legitimate option for those seeking an alternative to DSL or cable. Through the Exede® brand, ViaSat services over 600,000 subscribers in the continental United States today. As of March 2014, ViaSat has deployed over 2 million satellite broadband terminals to customers and partners, such as Eutelsat (EMEA) and Xplornet (Canada), for consumer, enterprise, on-the-move and portable applications worldwide.

Specifically for aviation, ViaSat has developed Exede® In The Air (www.viasat.com/exede-in-the-air), a service designed to provide satellite broadband services to passengers on-board commercial airlines and business jets. On aircraft today, consumers seek an at-home internet experience and Exede® In The Air is a service that is able to provide high-speed service to each passenger – up to 12 Mbps to each seat – rather than simply an aggregate amount of bandwidth to the plane that leaves passengers competing for service.

The service successfully launched in 2013 with JetBlue Airways and United Airlines followed shortly thereafter. In March 2014, ViaSat announced that El Al Israel Airlines has agreed to be the launch customer in Europe for Exede® In The Air service. In 2016, ViaSat will be launching its next satellite, ViaSat-2, which will provide satellite coverage over the North Atlantic for transatlantic international flights and opening the service up to many more potential airlines and passengers. But not only is ViaSat working with airlines to retrofit aircraft for Exede® In The Air service. ViaSat and Boeing Commercial Airplanes have agreed to work together towards offering Ka-band satellite terminals as a factory line-fit option on Boeing commercial aircraft. ViaSat expects approximately 400 aircraft to be outfitted with its Exede® In The Air service before the end of next year.

ViaSat is focused on designing and building high capacity Ka-band satellite systems that deliver unprecedented amounts of bandwidth with compelling economics. Our system enables a very fast online experience for consumers and has the capacity to sustain that experience when adoption is very high, and deliver it with an affordable price.

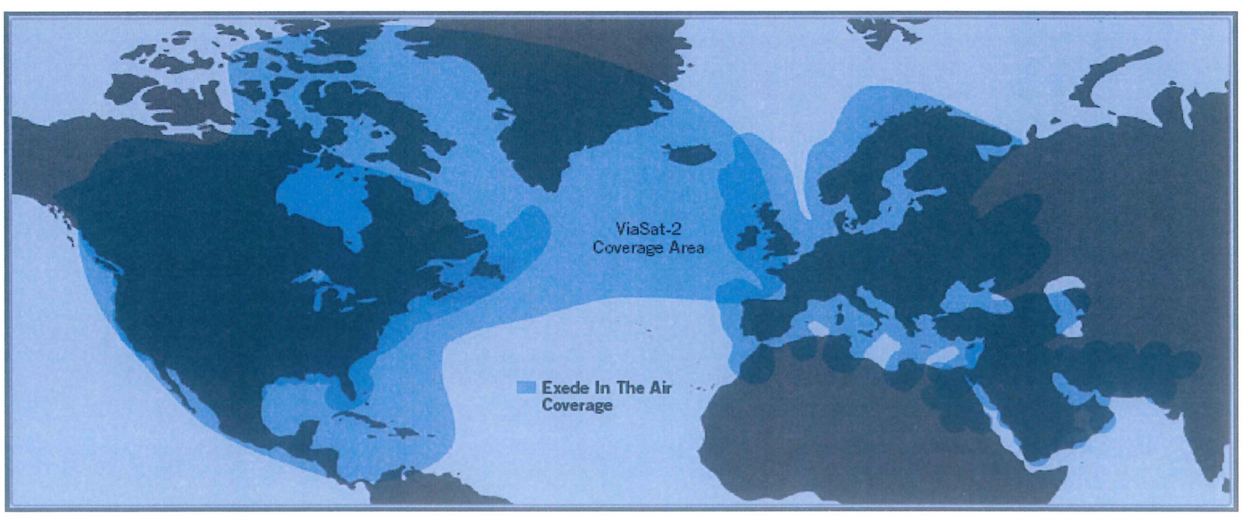

Fig. 1 Exede® In The Air Coverage Map

In support of ViaSat's ongoing mission to provide broadband satellite internet to the unserved and underserved, ViaSat has developed a MMIC power amplifier for use in civil satellite telecommunications that will be enumerated under 3A611.c.7 upon the rules effective date of December 30, 2014. For reference, ViaSat is providing technical specifications for our device along with the thresholds for 3A001.b.2.c and 3A611.c.7. This MMIC power amplifier was self-determined to be subject to the EAR based on the fact pattern of its development and was previously adjudicated to be subject to control under 5A991.g via interagency CCATS (G155457).

Parameter	Units	ViaSat MMIC	3A001.b.2.c	3A611.c.7
Frequency	GHz	27.5-31	16-31.8	16-31.8
Output Power	dBm	>34.77[1]	>29	>34.77
Bandwidth	%	12	>10	>10
PAE	%	≥20[1]	N/A	≥20

This MMIC device is specially designed for use as a component within ViaSat's Ka-band broadband satellite internet earth station terminals such as ViaSat's in-flight mobility terminal, adjudicated to be subject to the EAR via commodity jurisdiction (CJ 101-13). Located within our purposefully designed transceivers, the specific function of the MMIC device is to amplify the modulated transmit signals to a power level sufficient to provide high speed data connection between the commercial user terminal and the satellite. It is a critical component of the technology that allows ViaSat to provide fast and reliable satellite internet that matches terrestrial quality service levels.

This MMIC device has been in development to allow our satellite terminals to operate across the full International Telecommunications Union (ITU) allocated Ka-band in order to provide the broadest operational coverage and widest selection of Ka-band satellites.[2] This increase in frequency band enables our airborne and maritime mobile terminals worldwide roaming and will expand all service capabilities to address customers on a truly international basis. The technical specifications of this MMIC device (frequency range, power output, power added efficiency) are necessary to provide high speed broadband internet communications via satellite that are competitive with terrestrial communications and to maximize the useable allocated spectrum for Ka-band satellite service.

The 21st century so far is focused on increasing interconnectedness and access to the internet, both at home and on the move. The U.S. government has recognized the valuable role of the internet in today's age and has directed multiple initiatives for enhanced broadband coverage and service in the United States, including wireless. The creation of 3A611.c however has the effect of harming the continual development of non-terrestrial alternatives for broadband internet.

ViaSat is the technology leader in Ka-Band satellite broadband internet. When ViaSat-1 was launched in 2011, it brought online more satellite bandwidth than all the other communications satellites already in space. However, our technology evolution has not stopped there. ViaSat-2, due to be launched in 2016, has a coverage area seven times larger and double the subscriber capacity of ViaSat-1. ViaSat's MMIC power amplifier that is affected by the new 3A611.c controls is the enabling technology that supports ViaSat's response to the insatiable appetite for broadband internet. These devices are not where the technology is going tomorrow, but where

[1] Exact technical information on this device was provided to BIS on August 15, 2014.
[2] 27.5-31 GHz is allocated for Fixed Satellite Service and Mobile Satellite Service by the International Telecommunications Union (ITU) across all three regions. This frequency range is inherently above the 10% fractional bandwidth threshold within 3A611.c.7.

the technology stands today. This technology is a continuation of the broadband satellite internet technology that ViaSat employs today through its own Exede® brand, and within the networks of customers and partners, such as Xplornet (Canada), NBN Co. (Australia), and Eutelsat (EMEA).

Impacts

The effect of the change from 5A991.g controls to 3A611.c controls on ViaSat is significant. An item that is currently controlled for AT-only reasons will require a license to all destinations but Canada, introducing risk and possible delays into the links of our supply chain. Concurrently, the 0% de minimis rule of §734.4(a)(6)(i) of the EAR effectively institutes a 600 series see through rule on any foreign-made assembly that incorporates this MMIC power amplifier. Any portion of a company's supply chain involving a Country Group D:5 country will be impacted by this rule, leading to costly delays as a company has to realign their supply chain.

Additionally, because ViaSat has mobile offerings (both airborne and maritime), customers with these units installed into their aircraft or vessel will potentially be unable to travel to any D:5 country as a result of the 600 series see through rule created by §734.4(a)(6)(i). This creates a significant administrative and logistic burden for both us and our customers, as a foreign-made assembly with the ECCN 5A991 that incorporates a 3A611.c MMIC power amplifier will also carry some 600 series restrictions, leading to double licensing requirements on some items.

The consequences of the creation of 3A611.c are such that a critical component of a product and service that is currently commercially available has been designated as a less critical military technology. It unfairly harms producers and service providers of advanced commercial broadband satellite internet. Therefore, ViaSat respectfully requests the implementation of the control of MMIC power amplifiers under 3A611.c be reconsidered with the following remedies in mind.

Recommendations

As part of our comment letter, ViaSat is submitting two solutions that would address and eliminate the significant impacts to ViaSat's business this regulatory language change would cause while maintaining the intent of the language change. Our recommended solutions are as follows:

(Preferred Solution) Add exclusionary note as follows:

"Note: 3A611.c does not control MMICs if they are "specially designed" for operation in any frequency band which is "allocated by the ITU" for radio-communications services, but not for radio-determination;"

Creating an exclusionary note for those MMIC power amplifiers that are "specially designed" for operation over an ITU allocated frequency for radio-communication would be sufficient to remove ViaSat's Full ITU MMIC device from control as a 600-series item, while still allowing the U.S. government to control those devices that are not "specially designed" for telecommunications applications. This exclusionary note already exists elsewhere in the Commerce Control List, such as in Note 1 to the 3A001.b.1, which excludes from control items such as traveling wave tubes ("TWT") when designed for use in telecommunications.

(Secondary Solution) Change the fractional bandwidth from 10% to 12% as follows:

"3A611.c - Microwave "monolithic integrated circuits" (MMIC) power amplifiers having any of the following:

> *c.7 - Rated for operation at frequencies exceeding 16 GHz up to and including 31.8 GHz with a "fractional bandwidth" greater than ~~10%~~ **12%**, and having a peak saturated power output greater than 3 W (34.77 dBm) and a power added efficiency of 20% or greater anywhere within the operating frequency range;"*

Secondarily, ViaSat recommends increasing the fractional bandwidth parameter from 10% to 12% in order to allow our MMIC power amplifier to be aligned with the full ITU allocated frequency band for fixed and mobile satellite service in the Ka-band (27.5-31 GHz). The allocated band is inherently over the 10% fractional bandwidth threshold established by 3A611.c.7, automatically fulfilling one of the controlling parameters. Increasing the fractional bandwidth in this manner would alleviate the issue of 600 series controls specifically for this device, but may not solve the wider issue of treating those MMIC power amplifiers with civilian applications as military items.

Conclusion

As requested in the notice of inquiry, ViaSat has provided information on the specific civil use of a MMIC power amplifier that will be controlled under 3A611.c.7 upon the effective date of December 30, 2014 for the Military Electronic Final Rule. In addition, ViaSat has outlined the impact of this change on our business and provided possible remedies that we believe would address and eliminate the significant impacts to ViaSat's commercial satellite broadband business this regulatory language change would cause while maintaining the original intent of the creation 600 series controls on MMIC power amplifiers.

If you require any further information, please contact me at (760) 893-2918 or via email at joshua.millan@viasat.com.

Sincerely,

ViaSat, Inc.

Joshua Millan
Global Trade Compliance