Section 57 of the Competition Act (Cap. 50B)

Grounds of Decision issued by the Competition and Consumer Commission of Singapore

In relation to the notification for decision on the proposed acquisition by Analog Devices, Inc. of Maxim Integrated Products, Inc.

Date: 23 April 2021

Case number: CCCS 400/140/2020/007

Confidential information in the original version of this Decision has been redacted from the published version on the public register. Redacted confidential information in the text of the published version of the Decision is denoted by [✂].

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I. Introduction

1. On 17 December 2020, the Competition and Consumer Commission of Singapore ("CCCS") accepted a joint notification, pursuant to section 57 of the Competition Act (Cap. 50B) (the "Act"), by Analog Devices, Inc. ("ADI") and Maxim Integrated Products, Inc. ("Maxim") for a decision as to whether the proposed acquisition of Maxim by ADI, through its wholly-owned subsidiary, Magneto Corp. ("Magneto") will infringe the section 54 prohibition, if carried into effect ("the Proposed Transaction").

2. In assessing the Proposed Transaction, CCCS contacted a total of a hundred and eight (108) stakeholders, comprising twenty (20)[1] competitors and eighty-eight (88)[2] intermediate and end-customers in the market for the design, manufacture and supply of integrated circuits. Responses were received from forty-four (44) third parties. Out of the twenty (20) competitors contacted, twelve (12) replied with eight (8) providing substantive responses. Out of the eighty-eight (88) intermediate and end customers contacted, thirty-two (32) replied with twenty-two (22) providing substantive responses. All, except one third party, indicated that they do not have concerns with the Proposed Transaction.

3. At the end of the consultation process and based on the information received, CCCS has concluded that the Proposed Transaction, if carried into effect, will not infringe section 54 of the Act.

II. The Parties

ADI

4. ADI is a public company incorporated and headquartered in Massachusetts, USA. ADI designs, manufactures, and markets a broad line of integrated circuits ("ICs"), including general-purpose products used by a broad range of customers and applications, as well as application-specific products designed for specific types of customers or end-uses. ADI's ICs are incorporated in electronics equipment across various industries, particularly in the automotive, consumer, communications and industrial sectors.[3]

5. ADI supplies its ICs globally and in Singapore either directly to end-customers, which are Original Equipment Manufacturers ("OEMs") who incorporate ICs into the electronic equipment they manufacture, or to intermediate customers i.e. distributors[4].[5] ADI's global

[1] [✂].
[2] [✂].
[3] Paragraphs 10.6 and 10.7 of Form M1.
[4] The Parties submitted that distributors who sell the Parties' products to end-customers are third-party commercial entities that operate independently of the Parties. Cooperation between the Parties is generally limited to inventory management, product marketing and field sales. Where products are purchased from a distributor, pricing and discounts are generally left to the distributor. Paragraphs 2.1 to 2.5 of the Parties' response dated 18 March 2021 to CCCS's Request for Information ("RFI") dated 25 February 2021.
[5] Paragraphs 10.13, 18.13 and 18.14 of Form M1.

and Singapore turnovers for the fiscal year 2020 were US$5,603,056,000 (approximately S$7.50 billion) and US$[✂] (approximately S$[✂]) respectively.[6]

Maxim

6. Maxim is a public company incorporated under the laws of Delaware, USA and headquartered in California, USA. Maxim designs, develops, manufactures and markets a range of analogue, mixed-signal and digital ICs. Its products serve a diverse range of geographic locations, including Singapore, in the following segments – automotive, communications and data centre, computing, and other consumer and industrial applications – and are incorporated in a broad range of electronics equipment.[7] Maxim's global and Singapore turnover were US$2,191,395,199 (approximately S$2.93 billion) and US$[✂] (approximately S$[✂]) respectively in the fiscal year 2020.[8]

III. The Proposed Transaction

7. The Proposed Transaction will involve the acquisition of the entire issued share capital of Maxim by ADI, through ADI's wholly-owned subsidiary, Magneto. As such, ADI will acquire sole control over Maxim. Based on the Parties' submissions, CCCS considers that the Proposed Transaction constitutes a merger pursuant to section 54(2)(b) of the Act.

IV. Competition Issues

8. The Parties submitted that they overlap in the supply of the following products globally[9] which is in line with the classification of semiconductor devices by one of the main trade organisations, World Semiconductor Trade Statistics Inc. ("WSTS"):

   (a) within general-purpose analogue ICs[10]:
      i. Amplifiers and Comparators;
      ii. Signal Conversion;
      iii. Interfaces and Isolators; and
      iv. Power Management;

   (b) within application-specific analogue ICs:
      i. Consumer;
      ii. Industrial;

[6] Paragraph 13.1 of Form M1.
[7] Paragraphs 10.9 and 10.14 of Form M1.
[8] Paragraph 13.2 of Form M1.
[9] Paragraph 15.3 of Form M1.
[10] See paragraphs 18.7 to 18.9, 19.1, 19.42, 19.47, 19.53 and 19.58 of Form M1 where the Parties submitted that general-purpose analogue ICs are used in a broad range of end-applications whereas application-specific analogue ICs are designed for specific applications or category of applications.

iii. Communications; and
iv. Automotive;

(c) within digital ICs, only microcontrollers ("MCUs"); and

(d) within sensors and actuators, only temperature & other sensors[11]

(collectively, the "Overlapping Products").

9. In Singapore, the Parties submitted that they overlap in the same categories of products as those stated above, except in the category of Temperature and Other Sensors, where ADI did not generate any revenue in Singapore in 2017, 2018 and 2019.[12] Nevertheless, the Parties submitted that ADI supplies temperature and other sensors globally, and ADI expects that minimal time and costs would be incurred to supply these products to Singapore.[13] For completeness, CCCS has therefore included this product segment in its assessment as ADI could be a potential competitor.

10. In view of the above, CCCS considered whether the Proposed Transaction will lead to non-coordinated or coordinated effects that would substantially lessen competition in relation to each of the Overlapping Products in Singapore.

V. Counterfactual

11. The Parties submitted that, in the absence of the Proposed Transaction, they would continue to operate separately and independently in relation to the Overlapping Products.[14] The Parties further submitted that there are many other competitors in the industry that are likely to continue to compete strongly with them for customers with, or without, the Proposed Transaction.[15]

12. CCCS is of the view that the prevailing conditions of competition, where the Parties operate separately and independently, would be the likely scenario without the merger and accordingly, has used this as the appropriate counterfactual when applying the Substantial Lessening of Competition ("SLC") test.

[11] "Temperature and other sensors" refer to devices used to measure temperature and all other non-optical sensors, with the exception of sensors to measure pressure, acceleration and yaw rate, magnetic field, and actuators. According to WSTS product classification, "sensors & actuators" refer to semiconductor devices whose electrical properties are designed to correlate to temperature, pressure, displacement, velocity, acceleration, stress, strain or any other physical, chemical or biological property.
[12] Paragraph 15.4 of Form M1, Parties' response dated 15 January 2021 to Q11 of CCCS's RFI dated 28 December 2020.
[13] Paragraph 11.6 of Parties' response dated 15 January 2021 to CCCS's RFI dated 28 December 2020.
[14] Paragraph 23.1 of Form M1.
[15] Paragraph 23.2 of Form M1.

VI. Relevant Markets

a) Product Market

The Parties' Submissions

13. The Parties submitted that the relevant product markets in respect of the Overlapping Products are, at the narrowest (i.e. according to WSTS level 3 product categorisation), as follows[16]:

    (a) Within general-purpose analogue ICs:
        i. The supply of amplifiers and comparators (or signal conditioning ICs);
        ii. The supply of signal conversion ICs,
        iii. The supply of interface and isolator ICs, and
        iv. The supply of power management ICs,
    (b) Within application-specific analogue ICs;
        i. The supply of consumer application-specific standard products ("ASSPs");
        ii. The supply of industrial ASSPs;
        iii. The supply of communications ASSPs; and
        iv. The supply of automotive ASSPs.
    (c) Within digital ICs, the supply of MCUs; and
    (d) Within sensors and actuators, the supply of temperature and other sensors.

14. According to the Parties, the categorisation of the semiconductor devices above is in line with the approach adopted by the European Commission ("EC") in past decisions, as well as the practices of competitors, customers and main trade organisations (e.g. WSTS).[17]

CCCS Assessment on Relevant Product Markets

15. CCCS notes that the WSTS product classification segments analogue ICs, digital ICs, and sensors and actuators broadly based on an IC's functionality. Within analogue ICs, it segments general-purpose and application-specific analogue ICs based on whether an IC is designed for a wide range of applications (i.e. general-purpose analogue ICs) or for a specific application or category of applications (i.e. ASSPs). Within these level 2 categories, the WSTS further subdivides semiconductor devices into level 3 categories (i.e. the narrowest product markets that the Parties had submitted, as provided in paragraph 13 above) and level 4 categories (for some level 3 categories) based on their primary or

[16] Paragraph 20.39 of Form M1.
[17] Paragraph 15.2 of Form M1.

dominant function or the function that is the most important part of the IC.[18] In this regard, CCCS is of the view that the methodology of the WSTS product classification broadly captures the demand-side substitutability (or lack thereof) of semiconductor devices. CCCS notes that this is supported by the third party feedback received that suggested that some customers and competitors categorise their products by the WSTS categorisation, or in a way that is similar to the WSTS categorisation.[19] There is also third party feedback to suggest that the WSTS classification is commonly adopted in the industry.[20] As such, CCCS considers that the WSTS product categorisation serves as a starting point for the assessment of the relevant product markets for this merger.

Demand-side substitutability

16. Substitutability between WSTS level 3 categories of ASSPs: CCCS considered whether ASSPs can be viable substitutes across WSTS level 3 categories. In this regard, CCCS understands from the Parties' submissions that ASSPs are designed for specific end-uses and these product groups differ from one another in terms of their function, target customers and end applications. ASSPs are also based on highly specialised technology and have features specific to an application that prevents them from being used in other applications. In this regard, it is widely recognised in the industry that ASSPs are not substitutable for each other from a demand perspective.[21] Third party feedback has also indicated that the lack of pin-to-pin compatibility between different semiconductor devices will limit substitutability. Given that ASSPs are customised products, there will likely be technical limitations to substitute between ASSPs in different WSTS level 3 categories which are built for different applications.[22] In view of the above, CCCS is of the view that this suggests that ASSPs are not likely to be demand-side substitutes across the WSTS level 3 categories.

17. Substitutability between general-purpose analogue ICs and ASSPs: Given that general-purpose analogue ICs can be used in a broad range of applications, CCCS considered whether they can act as viable substitutes to the ASSPs used for the same application or types of applications. In this regard, the Parties submitted that ASSPs often contain application-specific circuitry or even digital circuitry that make them specifically suited for certain applications and can thus be considered to be customised. This is unlike

[18] This means that a specific device could contain a mixture of different circuits e.g. amplifier, converter and power management circuitry but it will be classified as either an Amplifier/Comparator, Signal Converter, or Power Management IC based on its primary or dominant function. See Annex 11 of Form M1.
[19] [✂] response dated 4 January 2021 to Q5 of CCCS's RFI dated 28 December 2020, [✂] response dated 6 January 2021 to Q5 of CCCS's RFI dated 28 December 2020, [✂] response dated 11 January 2021 to Q5 of CCCS's RFI dated 28 December 2020, [✂] response dated 11 January 2021 to Q3 of CCCS's RFI dated 28 December 2020, [✂] response dated 9 January 2021 to Q3 of CCCS's RFI dated 28 December 2020.
[20] Paragraph 10 of notes of call with [✂] dated 6 January 2021.
[21] Paragraph 31.1 of the Parties' response dated 15 January 2021 to CCCS's RFI dated 28 December 2020.
[22] [✂] response dated 21 January 2021 to Q16, Q25 and Q26 of CCCS's RFI dated 13 January 2021, paragraph 20 of notes of call with [✂] dated 6 January 2021, [✂] response dated 20 January 2021 to Q16 and Q24 to Q26 of CCCS's RFI dated 13 January 2021, [✂] response dated 11 January 2021 to Q16 and Q24 to Q26 of CCCS's RFI dated 28 December 2020, [✂] response dated 6 January 2021 to Q12 and Q26 of CCCS's RFI dated 28 December 2020, [✂] response dated 12 January 2021 to Q26 of CCCS's RFI dated 28 December 2020.

general-purpose analogue ICs which are designed to be used and substituted between many end-applications.[23] This therefore suggests that general-purpose analogue ICs may not have the required function(s) and specification(s) (e.g. pin-to-pin compatibility) which can allow it to act as a substitute to ASSPs or even fit into the same socket in the end-product. Third party feedback has also highlighted the importance of pin-to-pin compatibility for ICs to be substitutable.[24] In view of the above, CCCS is of the view that it is unlikely that general-purpose analogue ICs can be viable demand-side substitutes to ASSPs.

18. Narrower markets according to WSTS level 4 categories: CCCS further considered whether ICs are viable substitutes across WSTS level 4 categories such that narrower product markets can be defined.

19. The Parties submitted that there is some demand-side substitutability within the WSTS level 4 categories. As an example, the Parties submitted that, for automotive application-specific analogue ICs, the same customers who purchase one type of IC tend to purchase ICs across the full spectrum of automotive application-specific analogue ICs.[25] While CCCS notes the tendency for customers to purchase ICs across multiple WSTS level 4 categories, this does not imply that one product category is substitutable for another. Rather, CCCS is of the view that the relevant product markets could still be segmented further. CCCS first highlights that the methodology for WSTS product classification allocates ASSPs to the specific application or category of applications that they are used in.[26] Secondly, given that ASSPs are customised to specific applications, there are likely to be technical limitations for ASSPs within a specific WSTS level 4 product category to act as viable substitutes to those in a different category. Thirdly, CCCS further notes the Parties' submission that there is typically little or no substitutability once an IC is designed into a product as it has specific properties such as a unique size, footprint (i.e. where the input pins are located and where the output pins are located), power, noise, resistances, drift, etc.[27] As mentioned in paragraph 17 above, third party feedback has corroborated the lack of substitutability without pin-to-pin compatibility.[28] Consequently, CCCS is of the view that from the demand-side perspective, the relevant product markets could be narrowed according to the WSTS level 4 categories.

[23] Paragraph 30.1 of the Parties' response dated 15 January 2021 to CCCS's RFI dated 28 December 2020.
[24] [✂] response dated 21 January 2021 to Q16, Q25 and Q26 of CCCS's RFI dated 13 January 2021, paragraph 20 of notes of call with [✂] dated 6 January 2021, [✂] response dated 20 January 2021 to Q16 and Q24 to Q26 of CCCS's RFI dated 13 January 2021, [✂] response dated 11 January 2021 to Q16 and Q24 to Q26 of CCCS's RFI dated 28 December 2020, [✂] response dated 6 January 2021 to Q12 and Q26 of CCCS's RFI dated 28 December 2020, [✂] response dated 12 January 2021 to Q26 of CCCS's RFI dated 28 December 2020.
[25] Paragraph 32.1 of the Parties' response dated 15 January 2021 to CCCS's RFI dated 28 December 2020.
[26] Annex 11 of Form M1.
[27] Paragraph 32.2 of the Parties' response dated 15 January 2021 to CCCS's RFI dated 28 December 2020.
[28] [✂] response dated 21 January 2021 to Q16, Q25 and Q26 of CCCS's RFI dated 13 January 2021, paragraph 20 of notes of call with [✂] dated 6 January 2021, [✂] response dated 20 January 2021 to Q16 and Q24 to Q26 of CCCS's RFI dated 13 January 2021, [✂] response dated 11 January 2021 to Q16 and Q24 to Q26 of CCCS's RFI dated 28 December 2020, [✂] response dated 6 January 2021 to Q12 and Q26 of CCCS's RFI dated 28 December 2020, [✂] response dated 12 January 2021 to Q26 of CCCS's RFI dated 28 December 2020.

Supply-side substitutability

20. The Parties submitted that the manufacturing of semiconductors is a multi-step process and many different process technologies, also called "product or process nodes", are used in the manufacturing of semiconductors. The performance requirements of an IC determine the process node that is used to make the chip. Therefore, the same process node can be used to make chips with similar performance characteristics and a manufacturer can easily switch production resources between ICs within the same process node.[29] While this may suggest that supply-side substitution may be possible within each process node, third party feedback does not corroborate the Parties' submissions.

21. Third party feedback suggested that it may not be easy or sufficiently timely to shift production resources between products because of the need to ensure high quality and reliability in semiconductor manufacturing, and depending on the supply chain configuration as well as the type of ICs to be produced.[30] In this regard, a competitor estimates that it would take 2 to 4 years to shift production resources between different WSTS level 3 product categories or between different WSTS level 4 product categories within each WSTS level 3 product category.[31] Whereas third party feedback suggests that the use of third-party foundries for manufacturing may make it faster and less costly to switch production resources between different semiconductor devices,[32] it is unclear whether this would be sufficiently cost effective and timely to exert competitive constraints from the supply-side.

Conclusion

22. As detailed above, CCCS considers that there may be justification, from the demand-side perspective, to support a product market definition that is narrower than that submitted by the Parties i.e. according to WSTS level 4 product categories. CCCS further notes that the feedback is mixed in relation to the extent to which supply-side substitutability may justify a broader product market definition. In view of CCCS's assessment that an SLC is unlikely to arise whether a broader or narrow market definition is adopted (refer to paragraphs 45 to 58), CCCS considers, for the purpose of this Proposed Transaction, it is not necessary to conclude on a precise product market definition nor is there a need in this case to define narrower markets according to the WSTS level 4 product categories.

[29] Paragraphs 33.1 to 33.8, 43.1, 46.1 and 46.2, 49.1 and 51.1 of the Parties' response dated 27 January 2021 to CCCS's RFI dated 28 December 2020, paragraphs 10.1 to 10.5 of the Parties' response dated 18 March 2021 to CCCS's RFI dated 25 February 2021.
[30] [✂] response dated 6 January 2021 to Q28 of CCCS's RFI dated 28 December 2020, [✂] response dated 9 January 2021 to Q28 of CCCS's RFI dated 28 December 2020.
[31] [✂] response dated 11 January 2021 to Q28 of CCCS's RFI dated 28 December 2020.
[32] [✂] response dated 9 January 2021 to Q28 of CCCS's RFI dated 28 December 2020.

b) Geographic Market

The Parties' Submissions

23. The Parties submitted that the relevant geographic market is global in scope because customers purchase all of the relevant products[33] and suppliers typically supply semiconductor devices on a global basis.[34] As manufacturing is performed on a global basis with manufacturing facilities (owned in-house or by third parties) located around the globe,[35] competition between suppliers is global for existing and new products.[36] The Parties further submitted that there are generally no regulatory barriers, material tariffs or quotas restricting the supply of the relevant products,[37] price differences between geographical regions are small[38] and transportation costs are very low (generally below one per cent of the value of the IC sold by the Parties, and are roughly the same for different suppliers).[39]

CCCS Assessment on Relevant Geographic Market

24. Third party feedback received by CCCS generally corroborates the Parties' submissions in that customers generally source for the Overlapping Products at a global or regional level, price differences between countries are not materially different and semiconductor suppliers are generally able to readily supply the semiconductor devices that they offer in other countries and regions into Singapore.[40]

25. In light of the above, CCCS is of the view that the relevant geographic market for the purpose of assessing this Proposed Transaction is likely to be the global supply of the relevant products to customers globally. However, CCCS is of the view that it is not necessary to conclude on a precise geographic market definition as the Proposed Transaction is unlikely to result in a SLC on either a global or local basis.

CCCS Overall Assessment of Relevant Market

26. Accordingly, CCCS is of the view that the following relevant markets serve as a useful frame of reference for assessing this Proposed Transaction:

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[33] Paragraph 19.81 of Form M1.
[34] Paragraph 19.82 of Form M1.
[35] Paragraph 19.82.1 of Form M1.
[36] Paragraph 19.82.2 of Form M1.
[37] Paragraph 19.82.3 of Form M1, paragraph 19.82.7 of Form M1.
[38] Paragraph 19.82.4 of Form M1.
[39] Paragraphs 19.82.6 and 28.7 of Form M1.
[40] [✂] response dated 11 January 2021 to Q14 to Q17 of CCCS's RFI dated 28 December 2020, [✂] response dated 9 January 2021 to Q14 to Q17 of CCCS's RFI dated 28 December 2020, [✂] response dated 6 January 2021 to Q14 to Q16 of CCCS's RFI dated 28 December 2020, [✂] response dated 12 January 2021 to Q14 to Q16 of CCCS's RFI dated 28 December 2020, [✂] response dated 4 January 2021 to Q18 of CCCS's RFI dated 28 December 2020, [✂] response dated 4 January 2021 to Q18 of CCCS's RFI dated 28 December 2020, [✂] response dated 21 January 2021 to Q18 of CCCS's RFI dated 13 January 2021, [✂] response dated 6 January 2021 to Q18 of CCCS's RFI dated 28 December 2020, [✂] response dated 7 January 2021 to Q17 of CCCS's RFI dated 28 December 2020.

(a) Within general-purpose analogue ICs:

i. The global supply of amplifiers and comparators (or signal conditioning ICs) to customers globally;

ii. The global supply of signal conversion ICs to customers globally,

iii. The global supply of interface and isolator ICs to customers globally, and

iv. The global supply of power management ICs to customers globally,

(b) Within application-specific analogue ICs;

i. The global supply of consumer ASSPs to customers globally;

ii. The global supply of industrial ASSPs to customers globally;

iii. The global supply of communications ASSPs to customers globally; and

iv. The global supply of automotive ASSPs to customers globally.

(c) Within digital ICs, the global supply of MCUs to customers globally; and

(d) Within sensors and actuators, the global supply of temperature and other sensors to customers globally.

(collectively, the "Relevant Markets")

VII. Market Structure

a) Market Shares and Market Concentration

The Parties' submissions

27. The Parties submitted that all relevant markets will remain highly competitive and fragmented after the merger,[41] and the Parties will continue to face fierce competition from larger competitors (e.g. Texas Instruments Incorporated "TI").[42] The Parties also submitted that their combined market shares in each Relevant Market are either not significantly large, or represent a marginal increase in market shares as a result of the Proposed Transaction.[43]

28. In this regard, the Parties submitted the estimated global[44] and Singapore[45] market share figures of semiconductor suppliers for the Relevant Markets from 2017 to 2019 based on revenue, as well as that of the Overlapping Products according to the WSTS level 4

[41] Paragraph 34.2 of Form M1.
[42] Paragraph 34.3 of Form M1.
[43] Paragraph 34.4 of Form M1.
[44] This refers to the market shares in relation to the global supply of relevant products to customers globally.
[45] This refers to the market shares in relation to the global supply of relevant products to Singapore customers.

product categories for the same period.[46] The Parties also submitted that, while they do not yet have 2020 market share figures, they do not believe their shares have changed materially in 2020.[47] The market share figures are provided in Annex A.

CCCS Assessment

29. CCCS notes that the combined Singapore market shares of the Parties from 2017 to 2019 fall below 40% for the supply of all the Overlapping Products under the WSTS level 3 and level 4 categories, which is below the indicative threshold of a merger situation that may raise competition concerns.[48] Although the combined Singapore market shares of the Parties fall within the range of 20% to 40% and post-merger CR3[49] is above 70% for signal conversion ICs, the market shares from 2017 to 2019 within this Relevant Market suggest that TI is the closest competitor of ADI and it will remain the leading supplier post-Proposed Transaction – TI has the largest market share in Singapore post-Proposed Transaction for 2017 ([40 – 50]%), 2018 ([40 – 50]%) and 2019 ([40 – 50]%). This suggests that the Proposed Transaction combines the second and third largest player in the market to create a merged entity that is better able to compete with TI, which is broadly in line with some of the feedback received from third parties, as discussed under the section on non-coordinated effects.

30. Globally, the combined market shares of the Parties – for the global supply to customers globally – for 2017, 2018 and 2019 fall below the indicative threshold of 40% for all Relevant Markets except for signal conversion ICs. As regards the latter, this is largely driven by ADI's strong market position in this market, i.e. ADI's own market share crosses the indicative threshold in 2018 and 2019 and the increase in market share of the merged entity owing to Maxim is relatively small (i.e. [0 – 10]%). CCCS further notes that the post-merger CR3 is above 70% and the combined market share of the Parties is between 20% to 40% in the supply of products under the following WSTS level 4 categories globally: (i) Automotive infotainment ASSPs; and (ii) Medical/Healthcare ASSPs. Notwithstanding that, third party feedback generally indicates that the merged entity will continue to face competitive constraints from existing competitors and the merger is unlikely to lead to SLC concerns. This will be further discussed under section VIII on competition assessment.

[46] Paragraphs 21.3 and 22.2 of Form M1, Annex 4 of the Parties' response dated 15 January 2021 to CCCS's RFI dated 28 December 2020.
[47] Paragraph 60.1 of the Parties' response dated 15 January 2021 to CCCS's RFI dated 28 December 2020.
[48] As set out at paragraph 5.15 of the *CCCS Guidelines on the Substantive Assessment of Mergers 2016*, competition concerns are unlikely to arise in a merger situation unless the merged entity will have a market share of 40% or more, or the merged entity will have a market share of between 20% to 40% and the post-merger CR3 is 70% or more.
[49] CR3 refers to the combined market share of the three largest firms.

b) **Barriers to Entry and Expansion**

The Parties' submissions

31. In general, the Parties submitted that there are no significant barriers to entry across all the Relevant Markets.[50]

32. Cost of entry and expansion: Whereas the time and capital expenditure required to build a manufacturing facility can be significant,[51] the Parties submitted that new entrants can avoid significant upfront investments by outsourcing all aspects of the production of chips and focus on circuit design (known as the "fabless" model) as many semiconductor suppliers have done.[52] In addition, the Parties submitted that the global nature of the Relevant Markets allows suppliers to choose a low-cost location for any production or design activities, without this being an impediment to supplying customers on a global basis.[53]

33. Rather, the Parties submitted that a large part of the cost of entry and expansion into other product segments is attributable to customer acquisition and building technology.[54] In relation to the process of designing general-purpose and application-specific analogue ICs, the Parties submitted that customers will call for a tender or request for proposal ("RFP") for each socket during the "design-in" stage of product development[55] and the selection process for such tenders or RFPs typically takes approximately 18 months.[56]

34. Expertise: The Parties submitted that new entrants or existing competitors looking to enter a new market in the semiconductor industry do not face significant barriers to entry in terms of know-how or intellectual property and most semiconductor manufacturers own and use their own patented or unpatented technologies.[57] However, the Parties acknowledge that analogue IC designers regularly develop new solutions in order to differentiate their products and compete with existing patented products,[58] and competitors dedicate significant resources to R&D.[59] Further, CCCS notes from the Parties'

[50] Paragraph 28.1 of Form M1.
[51] The Parties submitted that Taiwan Semiconductor Manufacturing Company ("TSMC") announced in May 2020 its plans to build a US$12 billion (approximately S$16.07 billion) factory in the US, Arizona and the facility is expected to start volume production in 2024.
[52] Paragraph 26.2 of Form M1.
[53] Paragraph 26.4 of Form M1.
[54] Paragraph 14.1 of the Parties' response dated 18 March 2021 to CCCS's RFI dated 25 February 2021.
[55] Whereas existing semiconductor suppliers may possess resources and equipment to readily participate in tenders/RFPs, new entrants will require additional time and resources to build up their capabilities in this regard.
[56] Paragraph 36.11 of the Parties' response dated 16 March 2021 to CCCS's RFI dated 28 December 2020.
[57] Paragraphs 28.5 and 28.6 of Form M1.
[58] Paragraph 28.5 of Form M1.
[59] Paragraphs 18.21, 24.8 and 26.1 of Form M1.

submissions that ADI's R&D expenditure for 2019 was US$1,130,348,000,[60] and Maxim's R&D expenditure for 2020 was US$440,166,000.[61]

35. Regulation: According to the Parties, there are generally no regulatory barriers for supplying semiconductor devices in most countries, nor are there import or export barriers for semiconductor devices e.g. material tariffs or quotas.[62]

36. New entrants and expansion by existing market players: The Parties highlighted that approximately 200 Chinese companies which are experiencing rapid domestic and international growth have recently entered the semiconductor sector. Examples of these companies include Unisoc (Shanghai) Technologies Co., Ltd. (in 2014), HiSilicon (Shanghai) Technologies Co., Limited ("HiSilicon") (in 2015) and Senscomm Semiconductor Co., Ltd. (in 2018).[63] In addition, the Parties submitted that a number of existing market players have been experiencing rapid expansion or growth in recent years in the analogue IC Relevant Markets. One example of such a market player is Monolithic.[64] The Parties also stated that existing semiconductor device manufacturers in the Chinese semiconductor industry are also increasingly expanding their operations internationally outside of China, such as 3Peak Incorporated ("3Peak"), HiSilicon, Semiconductor Manufacturing International Corporation, and SG Micro Corp ("SGMicro").[65] The Parties have also observed market expansion activity into the analogue IC sector amongst providers that have traditionally focused on digital ICs, such as Nvidia Corporation, Qualcomm Technologies, Inc. ("Qualcomm") and Xilinx, Inc..[66]

CCCS Assessment

37. CCCS notes that third party feedback supports the Parties' submissions that there does not appear to be any regulations in Singapore which will constitute a significant barrier to entry into any of the Relevant Markets.[67] Further, as it seems that the supply of semiconductor devices is global in nature, a new entrant need not be physically present in Singapore. Third party feedback also generally confirmed that, for the Relevant Markets, transportation costs are low and do not constitute a barrier to entry into Singapore.[68] CCCS further notes that new entrants can adopt a "fabless" model to reduce upfront capital expenditure.

[60] Page 29 of Annex 8 to Form M1.
[61] Page 39 of Annex 9 to Form M1.
[62] Paragraph 28.2 of Form M1.
[63] Paragraph 29.1 of Form M1.
[64] Paragraph 29.2 of Form M1.
[65] Paragraph 29.3 of Form M1.
[66] Paragraph 29.4 of Form M1.
[67] [✂] response dated 12 January 2021 to Q17 of CCCS's RFI dated 28 December 2020; [✂] response dated 9 January 2021 to Q17 of CCCS's RFI dated 28 December 2020.
[68] See [✂] response dated 12 January 2021 to Q17 of CCCS's RFI dated 28 December 2020; [✂] response dated 9 January 2021 to Q7 of CCCS's RFI dated 28 December 2020.

38. Notwithstanding the above, CCCS is of the view that there are barriers to entry and expansion. Specifically, CCCS considers that the time and expenditure required by new entrants or existing competitors looking to enter a new product market to conduct R&D to design products and acquire customers can be significant, even though there has been a number of instances of new entry and expansion of existing suppliers into another Relevant Market or other geographic markets. On this, a competitor estimated that entry into a new semiconductor device market in Singapore may cost approximately US$2 million, assuming that the relevant semiconductor device is already in existence and does not require custom development. The competitor also indicated that generally the time period required to enter a new semiconductor device market would be at least two or three product cycles[69] in order for product development, validation by potential end-customers and road-map alignment with targeted customers to take place.[70] Another competitor submitted that the process of product design and development with a customer will require 6 months to 2 years.[71]

c) **Countervailing Buyer Power**

The Parties' submissions

39. The Parties submitted that buyers are able to self-supply and have in-house IC design and manufacturing capabilities as an alternative to purchasing ICs or semiconductor devices from suppliers, citing that some "tech giants" have invested (through acquisitions or organic growth) in chip design capabilities.[72]

40. The Parties further submitted that many key customers of the Parties are sophisticated global enterprises that are larger than the Parties combined, and customers in the semiconductor sector are generally large, global equipment manufacturers that have strong bargaining power and are able to exert strong countervailing power on the merged entity.[73] Furthermore, many key customers of the Parties also engage in repeated purchasing programmes and usually purchase a broad portfolio of semiconductor devices, such that they may easily penalise manufacturers of semiconductor devices that seek to apply unfavourable sales terms by switching to another supplier.[74] In addition, the Parties submit that [✂], especially in Singapore, account for a large proportion of their revenues in certain markets.[75]

[69] If a product has a product cycle of one year, the respondent estimated that two to three years would be required to enter the market successfully.
[70] [✂] response dated 9 January 2021 to Q32 of CCCS's RFI dated 28 December 2020.
[71] [✂] response dated 12 January 2021 to Q32 of CCCS's RFI dated 28 December 2020.
[72] Paragraph 32.2 of Form M1.
[73] Paragraph 32.3 of Form M1.
[74] Paragraph 32.4 of Form M1.
[75] Paragraphs 32.6 and 32.9 of Form M1.

41. The Parties also submitted that customers are able to threaten to switch to other suppliers or technologies,[76] and already tend to multi-source.[77] The Parties submitted that this is due to low switching costs, and customers in the markets are able to, and often, switch from one supplier's products to another supplier's products.[78] Furthermore, many of the Parties' customers are large multinational companies with the knowledge and expertise to make well-informed comparisons of alternatives available on the market, facilitating switching between different suppliers in response to unfavourable terms.[79]

CCCS Assessment

42. In relation to self-supply, third party feedback from both customers and competitors does not corroborate the Parties' submission that customers are able to self-supply, and instead indicates that customers generally do not self-supply. Feedback from a competitor indicated that it is not common for customers to develop in-house design and development capabilities for semiconductor devices due to the significant investment and expertise required.[80]

43. While the Parties submitted that customers generally are able to switch between competing suppliers relatively easily, CCCS notes that switching costs, in and of themselves, are not an indication of countervailing buyer power. CCCS also highlights that third party feedback does not corroborate the Parties' submission that switching costs will necessarily be low under all circumstances. In particular, third party feedback suggests that switching costs vary based on the project and the stage of the product that the end-customer is at. Whereas switching between competing suppliers are easy at the design-in phase of an end-product, there may be difficulties switching after an end-customer has designed a supplier's IC into its end-product if the end-customer had not used multiple suppliers. CCCS notes that the Parties' [✂] largest end-customers in each of the relevant product markets are large and account for a significant proportion of their sales.[81] However, CCCS notes that these customers are mostly [✂] and there is feedback to indicate that any increase in prices may be passed through to end-customers.[82] That said, CCCS has received feedback that corroborates the Parties' submission that large end-customers are able to exert countervailing buyer power on the Parties' prices.[83]

[76] Paragraph 32.7 of Form M1.
[77] Paragraph 32.8 of Form M1.
[78] Paragraph 32.12 of Form M1.
[79] Paragraph 32.14 of Form M1.
[80] [✂] response dated 11 January 2021 to Q35 of CCCS's RFI dated 28 December 2020, [✂] response dated 9 January 2021 to Q35 of CCCS's RFI dated 28 December 2020, [✂] response dated 6 January 2021 to Q35 of CCCS's RFI dated 28 December 2020, [✂] response dated 12 January 2021 to Q35 of CCCS's RFI dated 28 December 2020, [✂] response dated 4 January 2021 to Q30 of CCCS's RFI dated 28 December 2020, [✂] response dated 21 January 2021 to Q30 of CCCS's RFI dated 13 January 2021, [✂] response dated 20 January 2021 to Q30 of CCCS's RFI dated 13 January 2021, [✂] response dated 6 January 2021 to Q30 of CCCS's RFI dated 28 December 2020, [✂] response dated 11 January 2021 to Q30 of CCCS's RFI dated 28 December 2020.
[81] Annexes 15 and 17 to Form M1.
[82] Paragraph 9 of notes of call with [✂] dated 6 January 2021.
[83] Notes of call with [✂] dated 6 January 2021, [✂] response dated 9 January 2021 to Q36 of CCCS's RFI dated 28 December 2020.

44. Accordingly, based on the information available, CCCS is of the view that customers generally do not possess countervailing buyer power unless they are sufficiently large and possess the resources and expertise to develop in-house capabilities to design and develop their own ICs.[84] Smaller end-customers of the Parties are not likely to be able to exert such countervailing buyer power over the Parties.

VIII. Competition Assessment

a) Non-coordinated effects

The Parties' submissions

45. The Parties submitted that non-coordinated effects will not arise in the Relevant Markets, as a result of the Proposed Transaction, globally or in Singapore, for the reasons set out in paragraphs 46 to 51 below.[85]

The Parties' product portfolios are complementary

46. The Parties submitted that their activities are highly complementary with limited overlap, and often serve different segments or pockets of customers and applications. The majority of ADI's portfolio is focused on products that meet the specifications for [✂], while Maxim's strength is in ICs for [✂]. ADI also designs more of its products as [✂], whereas Maxim is relatively more focused on [✂].[86] The Parties further submitted that while they continue to supply general-purpose legacy products, [✂].[87]

47. In view of the above, the Parties submitted that they are not each other's closest competitors from customers' perspectives. ADI generally competes most closely with TI, which is also a full-service provider with a wide range of analogue ICs, as well as other competitors[88] in particular product areas. Maxim competes with various competitors, such as Renesas and ON Semi, depending on technology and application.[89]

The Parties are not each other's closest competitors and remain constrained by many existing competitors

48. The Parties submitted that at a global level and in Singapore, the Parties are not each other's closest competitor in the Relevant Markets.[90] In particular, the Parties submitted

[85] Paragraph 34.1 of Form M1.
[86] Paragraph 34.37 of Form M1.
[87] Paragraph 33.2 of Form M1.
[88] Refer to Table 1 for further details.
[89] Paragraph 33.3 of Form M1.
[90] Paragraphs 34.2 and 34.3 of Form M1.

that the existing competitors set out in Table 1 below are the most significant competitor(s) to the Parties in each of the Relevant Markets globally and in Singapore.[91]

Table 1: Parties' submission on their closest competitor

Relevant Market	Closest competitor(s) and reason	
Amplifier and comparators	Global	**TI**: TI has an estimated market share of [20 – 30]% globally. This is higher than the Parties combined market share of [20 – 30]%[92]. TI has a broad portfolio of amplifiers and continues to invest actively in comparators. TI also tends to compete aggressively on price.
	Singapore	**TI:** Same reasons as above. TI's estimated market share is [30 – 40]% which is higher than the Parties combined share of [10 – 20]%[93].
Signal conversion	Global	**TI**: TI has an estimated market share of [30 – 40]% globally. The Parties have a combined market share of [40 – 50]% but with an increment of only [0 – 10]% from Maxim[94]. TI has a broad portfolio of Analog-to-Digital Converters ("ADCs"), Digital-to-Analog Converters ("DACs") and switches/multiplexers ("muxes") and is actively investing in this technology.
	Singapore	**TI**: Same reasons as above. TI's estimated market share is [40 – 50]%, which is higher than the Parties combined estimated market share of [30 – 40]%[95].
Interface and isolators	Global	**TI:** TI is the largest player in this space, with an estimated market share of [20 – 30]% globally[96]. TI invests and competes across isolated and non-isolated interfaces and is ADI's closest competition in relation to interfaces. **Infineon:** Infineon is a close ADI competitor in inductive isolators. **Silicon Laboratories, Inc. ("Silicon Labs"), TI, Chinese manufacturers:** Maxim's closest competitors for capacitive isolators

[91] Paragraph 23.1 of the Parties' response dated 15 January 2021 to CCCS's RFI dated 28 December 2020.
[92] Paragraph 34.6 of Form M1.
[93] Paragraph 34.6 of Form M1.
[94] Paragraph 34.8 of Form M1.
[95] Paragraph 34.8 of Form M1.
[96] Paragraph 34.1.1 of Form M1.

	Singapore	**TI, Infineon, Silicon Labs**: TI is the largest player in this space, with an estimated market share of [30 – 40]% in Singapore[97]. Same reasons as above.
Power management	Global	**TI:** TI is the largest player, with an estimated market share of [30 – 40]% globally. It is a strong competitor to both Parties in power management and competes aggressively on price.
	Singapore	**TI**: Same reasons as above. TI is the largest player and has a market share of [30 – 40]% in Singapore.
Automotive ASSPs	Global	**Infineon**: Infineon is the leading global player in automotive ASSPs, with a [10 – 20]% market share globally. It has an attractive price offering and is able to leverage its broad relationships selling many ICs to automotive OEMs (believed to include [✂], among others) and auto parts suppliers.
	Singapore	**Infineon**: Same reasons as above. It has a market share of [10 – 20]% in Singapore.
Communications ASSPs	Global	**NXP:** NXP describes itself as a "market leader" in high- performance Radio Frequency ("RF") power amplifiers; in relation to base station infrastructure technology, it offers a range of solutions addressing 5G RF amplification needs. **Qorvo, Inc. ("Qorvo"):** Qorvo's wireless portfolio targets wireless infrastructure solutions for 4G/5G base stations. Its portfolio includes front end modules, CATV amplifiers, driver amplifiers, gain block amplifiers, repeaters, boosters and smart cells. **Infineon:** Infineon has a sizable share of the wireless ASSP market. As stated in its recent annual reports, Infineon's RF wireless offering will focus on RF solutions for cellular infrastructure as well as 5F mmWave products and antenna modules. **TI:** TI has established supply relationships with key global customers such as [✂]**.**
	Singapore	**NXP, Qorvo, Infineon and TI**: The same reasons above apply.
Consumer ASSPs	Global	**TI, NXP and STMicro**: TI is a strong competitor in consumer ASSPs (the market leader in Class D amplifiers), with significant competitive constraint also coming from Infineon, NXP and STMicro. TI

[97] Paragraph 34.1.1 of Form M1.

		is ADI's closest competitor in relation to Consumer ASSPs. **Cirrus**: Maxim's closest competitor in Personal Electronics is Cirrus by virtue of its position as the main Class D amplifier supplier for [✂].
	Singapore	**TI, NXP and STMicro**: The same reasons above apply. **Cirrus**: The same reasons above apply.
Industrial ASSPs	Global	**TI**: TI is currently the largest global player in this segment and continues to grow due to its aggressively low pricing.
	Singapore	**TI**: Same reasons as above.
MCUs	Global	**Renesas**: Renesas is the leading global supplier of MCUs, with an estimated market share of [20 – 30]% worldwide. There is also fierce competition from a number of other established players, including NXP, Microchip, Infineon and TI.
	Singapore	**Renesas:** Same reasons as above.
Temperature and other sensors	Global	**TI**: is a leading global supplier of temperature and other sensors, with an estimated market share of [10 – 20]% global.
	Singapore	**TI:** Same reasons as above.

49. The Parties further submitted that the merged entity will continue to face fierce competition due to many existing competitors of varying sizes and increasing competition from rapidly growing Chinese semiconductor companies that can offer low prices, as listed in Table 2 below.[98]

Table 2: Parties' submission on other existing competitors

Relevant Market	Other existing competitors
Amplifiers and comparators	The following competitors generally have a strong portfolio in each Relevant Market and are encountered by Parties in their bids to win customers: TI, Microchip, NJR, ON Semi, Renasas, SGMicro, STMicro. Chinese manufacturers such as 3Peak, Runic Technology Co., Ltd ("Runic") and SGMicro competes with ADI to sell precision amplifiers. ADI also frequently encounters competition from MaCOM Technology Solutions Inc. and Qorvo. Maxim often

[98] Paragraphs 34.2, 34.3 and 34.5 to 34.30 of Form M1.

	competes with low-cost Chinese suppliers when seeking to sell signal conditioning devices.
Signal conversion	The Parties will continue to face competition from the following existing competitors: TI, Microchip, ON Semi, Renasas and STMicro. The Parties will face additional competition from Asahi Kasei Microdevices Corporation ("AKM"), ams AG ("ams"), Chipsea Technologies (Shenzhen) Corp, Suzhou Novosense Microelectronics Co., Ltd. and Silicon Labs, which are investing in general-purpose ADCs, and Chinese semiconductor companies which are quickly growing in this area, including 3Peak, HiSilicon, Runic and SGMicro.
Interface and isolators	The following competitors will continue to constrain the Parties post-Proposed Transaction: TI, Chinese manufacturers (e.g. 2Pai Semiconductor Co., Limited, Shanghai Chipanalog Microelectronics Co., Ltd., Mornsun Guangzhou Science & Technology Co., Ltd.), Broadcom Inc. ("Broadcom"), NJR, NXP, ON Semi, Renesas, Rohm, STMicro, Silicon Labs, Infineon, MaxLinear Inc. ("MaxLinear") and Microchip.
Power management	The following competitors will continue to constrain the Parties post-Proposed Transaction: TI, ON Semi, Monolithic, Power Integrations, Dialog, Infineon, ams, Broadcom, MediaTek, Microchip/Microsemi, NXP, Power Integrations, Renasas, Rohm, Silicon Labs and STMicro.
Automotive ASSPs	The following are strong competitors to the Parties: Infineon, TI, Bosch, NXP, STMicro, Microchip, Qorvo, Renesas and Skyworks. Some Chinese start-ups are also developing technologies for automotive applications. 3Peak, Datang (in conjunction with NXP, already has a marketable solution) and Silego are three notable entrants.
Consumer ASSPs	Significant competitors include: Cirrus, NXP, Rohm, STMicro, TI, Others (AKM, Awinic, Goodix, Infineon, Monolithic, ON Semi, Renesas, Silegy and Silicon Labs).

	There is increasing competition from emerging Chinese suppliers such as Goodix.
Communications ASSPs	The larger competitors in the market are Qualcomm and Skyworks while other smaller but not insignificant competitors include TI, Broadcom, MediaTek, NXP, Qorvo, Others (Goodix, Infineon, Marvell, MaxLinear, Silicon Labs, STMicro and Toshiba).
Industrial ASSPs	The Parties will continue to face a broad array of competitors including: TI, Others (Infineon, STMicro, Skyworks, ON Semi, Qorvo, Broadcom, Microchip, NJR, Allegro, NXP, Renesas and Toshiba). The Parties also compete with niche players specialising in specific areas within industrial ASSPs, including but not limited to ABLIC, ams, AT Engines, ElevATE, Goodix, Hitachi, MediaTek, Monolithic, Osram, Qorvo, and Xilinx.
MCUs	The Parties face competition from the largest supplier Renasas and other established players including Infineon, Microchip, NXP, STMicro and TI.
Temperature and other sensors	TI is the market leader with a [10 – 20]% market share.

50. Data on sales opportunities: The Parties also submitted data capturing ADI's past sales opportunities in Singapore for new and existing customers and the identity of the main competitor, where available.[99] Based on the sales opportunities where the identity of the main competitor was available (approximately [✂]% of sales opportunities), the Parties submitted that the data supports TI as ADI's closest competitor. In most cases, Maxim was not even identified or a close competitor. Table 3 below lists the competitor that was identified as the main competitor in most sales opportunities within each Relevant Market.[100]

Table 3: Competitor identified in most of ADI's sales opportunities

Relevant Market	**Competitor most frequently identified as main competitor in sales opportunities**	**% of sales opportunities in which it is identified**
Amplifier and comparator	TI	[✂]%
Signal conversion	TI	[✂]%
Interface and isolators	TI	[✂]%
Power management	TI	[✂]%

[99] Paragraphs 64.1 to 64.9 of the Parties' response dated 16 March 2021 to CCCS's RFI dated 28 December 2020.
[100] Annex 13 of the Parties' response dated 16 March 2021 to CCCS's RFI dated 28 December 2020.

Automotive ASSP	TI	[✂]%
Consumer ASSP	TI	[✂]%
Communications ASSP	TI	[✂]%
Industrial ASSP	TI	[✂]%
MCU	Microchip or TI	[✂]%
Temperature and other sensors[101]	NA	NA

Strong countervailing buyer power of the Parties' largest customers and ease of switching for customers

51. As discussed in paragraphs 39 to 41 above, the Parties submitted that their key customers, both globally and in Singapore, have strong countervailing buyer power[102] and customers can switch easily between many different suppliers in the market.[103]

CCCS Assessment

Complementarity of Parties' product portfolios

52. CCCS has received third party feedback that corroborates the Parties' submissions that their product portfolios are generally complementary in nature. Two end-customers submitted that the Proposed Transaction, if carried into effect, will allow the merged entity to combine their offerings as well as engineering and product capabilities to become a stronger competitor against larger semiconductor suppliers such as TI. Another end-customer submitted that ADI focuses on industrial and communication industries whereas Maxim focuses more on the automotive industry, in particular for advanced driver-assistance systems and infotainment.[104]

Closeness of competition between Parties and competition from other competitors

53. CCCS is of the view that the Parties' data on sales opportunities set out in paragraph 50 above does suggest that Maxim is not the closest competitor of ADI. In this regard, most of the feedback received by the CCCS from both competitors and customers corroborates the Parties' submissions that the Parties are not each other's closest competitors and that non-coordinated effects are unlikely to arise post-Proposed Transaction because of the competitive constraints from existing competitors, especially TI, who may be a closer

[101] ADI did not record any sales opportunities for Temperature and Other Sensors in Singapore between 2017 and October 2020.
[102] Paragraphs 34.31, 34.32 and 34.36 of Form M1.
[103] Paragraphs 34.31, 34.32 and 34.35 of Form M1.
[104] [✂] response dated 4 January 2021 to Q6 of CCCS's RFI dated 28 December 2020, [✂] response dated 7 January 2021 to CCCS's RFI dated 28 December 2020, [✂] response dated 8 January 2021 to CCCS's RFI dated 28 December 2020, [✂] response dated 12 January 2021 to CCCS's RFI dated 28 December 2020.

competitor to the Parties.[105] In this regard, CCCS notes that none of the third party feedback cited Maxim as the closest competitor to ADI for any of the WSTS level 3 or level 4 product categories. In contrast, a significant number of third parties have provided feedback that TI is the closest competitor to the Parties in most or all of the Relevant Markets and WSTS level 4 product categories, although other competitors have also been cited for specific markets, as listed below.[106] In this respect, CCCS notes that while the Parties have submitted that they will face increasing competition from a number of rapidly growing Chinese semiconductor suppliers, CCCS has not received third party feedback that explicitly supports this.

Table 4: Third parties' feedback on closest competitor to ADI[107]

Relevant Market	Closest Competitor(s) to ADI
Amplifier and comparators	TI, Infineon, STMicro, Renasas, NXP, ON Semi
Signal conversion	TI, Microchip, NXP, Renasas, ON Semi
Interface and isolators	TI, Microchip, NXP, Renasas, ON Semi, STMicro, MaxLinear
Power management	TI, Microchip, Rohm, STMicro, NXP, Renasas, ON Semi
Automotive ASSP	TI, STMicro, Infineon, Renasas, ON Semi, NXP

[105] [✂] response dated 4 January 2021 to Q6 of CCCS's RFI dated 28 December 2020, [✂] response dated 7 January 2021 to CCCS's RFI dated 28 December 2020, [✂] response dated 9 January 2021 to CCCS's RFI dated 28 December 2020, [✂] response dated 4 January 2021 to Q6 of CCCS's RFI dated 28 December 2020; [✂] response dated 5 January 2021 to Q6 of CCCS's RFI dated 28 December 2020, [✂] response dated 5 January 2021 to CCCS's RFI dated 28 December 2020, [✂] response dated 21 January 2021 to Q6 of CCCS's RFI dated 13 January 2021, [✂] response dated 8 January 2021 to CCCS's RFI dated 28 December 2020, paragraph 11 and 12 of notes of call with [✂] dated 6 January 2021, [✂] response dated 6 January 2021 to Q6 of CCCS's RFI dated 28 December 2020, [✂] response dated 8 January 2021 to CCCS's RFI dated 28 December 2020, [✂] response dated 12 January 2021 to CCCS's RFI dated 28 December 2020, [✂] response dated 6 January 2021 to Q6 of CCCS's RFI dated 28 December 2020, [✂] response dated 10 January 2021 to Q6 of CCCS's RFI dated 28 December 2020, [✂] response dated 11 January 2021 to Q6 of CCCS's RFI dated 28 December 2020, [✂] response dated 11 January 2021 to Q5 of CCCS's RFI dated 28 December 2020, [✂] response dated 9 January 2021 to Q5 of CCCS's RFI dated 28 December 2020, [✂] response dated 7 January 2021 to Q5 of CCCS's RFI dated 28 December 2020, [✂] response dated 12 January 2021 to Q5 of CCCS's RFI dated 28 December 2020, [✂] response dated 30 December 2020 to CCCS's RFI dated 28 December 2020.

[106] [✂] response dated 4 January 2021 to Q24 of CCCS's RFI dated 28 December 2020; [✂] response dated 4 January 2021 to Q24 of CCCS's RFI dated 28 December 2020; [✂] response dated 5 January 2021 to Q24 of CCCS's RFI dated 28 December 2020; [✂] response dated 21 January 2021 to Q24 of CCCS's RFI dated 13 January 2021; paragraph 16 of notes of call with [✂] dated 6 January 2021, [✂] response dated 20 January 2021 to Q24 of CCCS's RFI dated 13 January 2021, [✂] response dated 6 January 2021 to Q24 of CCCS's RFI dated 28 December 2020, [✂] response dated 10 January 2021 to Q24 of CCCS's RFI dated 28 December 2020, [✂] response dated 11 January 2021 to Q21 of CCCS's RFI dated 28 December 2020, [✂] response dated 9 January 2021 to Q21 of CCCS's RFI dated 28 December 2020, [✂] response dated 7 January 2021 to Q21 of CCCS's RFI dated 28 December 2020, [✂] response dated 12 January 2021 to Q21 of CCCS's RFI dated 28 December 2020

[107] CCCS has consolidated the closest competitors for the WSTS level 4 product categories under their respective WSTS level 3 product categories.

Consumer ASSP	TI, Qualcomm, ams, Renasas, ON Semi, NXP
Communications ASSP	TI, Qualcomm, SIMCom, NXP, Renasas, ON Semi, Sierra Wireless, Telit, MaxLinear, Broadcom
Industrial ASSP	TI, NXP, Microchip, Renasas, ON Semi
MCU	TI, Microchip, Rohm, NXP, Renasas, Infineon, STMicro, ON Semi
Temperature and other sensors	TI, Rohm, TE Sensors, ams, Murata

Table 5: Third parties' feedback on closest competitor to Maxim[108]

Relevant Market	**Closest Competitor(s) to Maxim**
Amplifier and comparators	TI, STMicro, Renasas, NXP, ON Semi
Signal conversion	TI, STMicro, Renasas, NXP, ON Semi
Interface and isolators	Microchip, NXP, Renasas, TI, ON Semi
Power management	TI, Microchip, Infineon, STMicro, NXP, Renesas, ON Semi
Automotive ASSP	Infineon, Renasas, TI, NXP, ON Semi
Consumer ASSP	Qualcomm, Renasas, NXP, ON Semi, TI
Communications ASSP	TI, Qualcomm, SIMCom, NXP, Renesas, ON Semi, Sierra Wireless, Telit
Industrial ASSP	TI, SIMCom, STMicro, Renasas, NXP, ON Semi
MCU	TI, Microchip, NXP, Renasas, Infineon, STMicro, ON Semi
Temperature and other sensors	Rohm, TE Sensors, ams, Renasas, NXP, ON Semi, TI

Countervailing buyer power and switching costs

54. As discussed in paragraphs 42 to 44 above, CCCS is of the view that customers generally do not possess countervailing buyer power unless they are sufficiently large and possess the resources and expertise to develop in-house capabilities to design and develop their own ICs. The information received by CCCS indicates that such large customers are likely to have the ability to obtain better prices and terms of sale.

55. Further, third party feedback generally suggests that customers can easily switch away from the Parties to alternative suppliers at the design-in phase of a product, but may face difficulties if they have not designed in multiple suppliers for that particular socket or product. In this regard, third party feedback is mixed as to whether customers generally

[108] CCCS has consolidated the closest competitors for the WSTS level 4 product categories under their respective WSTS level 3 product categories.

adopt the practice of designing in multiple suppliers. In a situation where a customer does not design in multiple suppliers and decides to switch to an alternative supplier whose IC is not pin-to-pin compatible, it may need to incur some time and cost to qualify a new supplier's IC and/or redesign its end-product. However, these factors are not insurmountable. In this respect, CCCS has received feedback to suggest that this process usually takes 6 months to a year and costs approximately S$30,000 or more.[109]

Conclusion

56. On balance, CCCS is of the view that the Proposed Transaction, if carried into effect, would be unlikely to lead to non-coordinated effects that would lead to competition concerns in Singapore. Third party feedback suggests that the Parties are not each other's closest competitors, which may partly be due to the Parties' complementary product portfolios. CCCS also noted that third party feedback generally suggests that the Parties will continue to face competitive constraints from many other existing competitors and that customers can switch to an alternative supplier with relative ease. While switching may be more difficult where design or qualification work is needed, the cost and time required do not appear to be insurmountable.

b) Coordinated effects

57. Having considered the Parties' submissions and third party feedback, CCCS concludes that the Proposed Transaction is unlikely to give rise to coordinated effects for the following reasons:

(a) there is a large number of competitors worldwide and in Singapore;

(b) price transparency across all the Relevant Markets is relatively low. Notwithstanding that list prices of products in the Relevant Markets are available online, third party feedback corroborates the Parties' submissions that effective prices are generally a result of negotiations and are not transparent;[110] and

(c) Product differentiation exists in the Relevant Markets, especially in relation to ASSPs. Comments from third parties corroborate the Parties' submission that R&D

[109] [✂] response dated 4 January 2021 to Q16 of CCCS's RFI dated 28 December 2020, [✂] response dated 21 January 2021 to Q16, Q25 and Q26 of CCCS's RFI dated 13 January 2021, paragraph 20 of notes of call with [✂] dated 6 January 2021, [✂] response dated 6 January 2021 to Q15 of CCCS's RFI dated 28 December 2020, [✂] response dated 20 January 2021 to Q16 and Q24 to Q26 of CCCS's RFI dated 13 January 2021, [✂] response dated 6 January 2021 to Q16 and Q24 to Q26 of CCCS's RFI dated 28 December 2020, [✂] response dated 11 January 2021 to Q16 and Q24 to Q26 of CCCS's RFI dated 28 December 2020, [✂] response dated 9 January 2021 to Q26 of CCCS's RFI dated 28 December 2020, [✂] response dated 6 January 2021 to Q12 and Q26 of CCCS's RFI dated 28 December 2020, [✂] response dated 12 January 2021 to Q26 of CCCS's RFI dated 28 December 2020.

[110] [✂] response dated 4 January 2021 to Q31 of CCCS's RFI dated 28 December 2020, notes of call with [✂] dated 6 January 2021, [✂] response dated 11 January 2021 to Q31 of CCCS's RFI dated 28 December 2020.

expenditure across all the Relevant Markets is significant in order to support product differentiation and innovation.[111]

c) Conclusion on Competition Assessment

58. With CCCS's assessment that the Proposed Transaction is unlikely to give rise to co-ordinated and non-coordinated effects that would raise competition concerns, CCCS concludes that the Proposed Transaction will not result in an SLC in the Relevant Markets.

IX. Efficiencies

59. Given that the Proposed Transaction does not raise SLC concerns in any of the Relevant Markets, CCCS is of the view that it is not necessary to make an assessment on the claimed efficiencies by the Parties.

X. Conclusion

60. For the reasons above and based on the information available, CCCS has assessed that the Proposed Transaction will not lead to SLC concerns if carried into effect, and accordingly, will not infringe section 54 of the Act.

61. In accordance with section 57(7) of the Act, this decision shall be valid for a period of one (1) year from the date of this decision.

Sia Aik Kor
Chief Executive
Competition and Consumer Commission of Singapore

[111] [✂] response dated 9 January 2021 to Q23 and Q24 of CCCS's RFI dated 28 December 2020; [✂] response dated 12 January 2021 to Q24 of CCCS's RFI dated 28 December 2020.

Annex A

Table A1: Parties' global and Singapore market shares in 2019

		2019 Global shares (%)			*2019 Singapore shares (%)*		
Level	***WSTS Category Name***	***ADI***	***Maxim***	***Combined***	***ADI***	***Maxim***	***Combined***
L2	**General-Purpose Analog**	[10 – 20]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L3	Amplifier & Comparator	[20 – 30]%	[0 – 10]%	[20 – 30]%	[10 – 20]%	[0 – 10]%	[10 – 20]%
L3	Signal Conversion	[40 – 50]%	[0 – 10]%	[40 – 50]%	[20 – 30]%	[0 – 10]%	[30 – 40]%
L3	Interface and Isolators	[10 – 20]%	[0 – 10]%	[20 – 30]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L3	Power Management	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Linear Regulators	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Switching Regulators	[10 – 20]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Voltage References	[10 – 20]%	[0 – 10]%	[10 – 20]%	[10 – 20]%	[0 – 10]%	[10 – 20]%
L4	Other Power Management + Supervision, Sequencing & Control	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L4	Battery Charging & Management	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L2	**Application-Specific Analog**	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L3	Automotive	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Infotainment (Info & Entertainment)	[10 – 20]%	[20 – 30]%	[30 – 40]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Other Automotive	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L3	Communications	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Cellular Phones	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Wireless Infrastructure + Other Wireless Communication	[20 – 30]%	[0 – 10]%	[20 – 30]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Wired Communications/Infrastructure and Other Communications	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L3	Consumer	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Audio/Video + DSC/Camcorder	[0 – 10]%	[10 – 20]%	[20 – 30]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Other Consumer	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%

L3	Industrial & Others	[10 – 20]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L4	All Other Industrial	[10 – 20]%	[0 – 10]%	[10 – 20]%	[10 – 20]%	[0 – 10]%	[10 – 20]%
L4	Medical/Healthcare	[20 – 30]%	[0 – 10]%	[30 – 40]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L2	**MCU**	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L2	**Temperature & Other Sensors**	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%

Table A2: Parties' global and Singapore market shares in 2018

		2018 Global shares (%)			***2018 Singapore shares (%)***		
Level	***WSTS Category Name***	***ADI***	***Maxim***	***Combined***	***ADI***	***Maxim***	***Combined***
L2	**General-Purpose Analog**	[10 – 20]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L3	Amplifier & Comparator	[20 – 30]%	[0 – 10]%	[20 – 30]%	[10 – 20]%	[0 – 10]%	[10 – 20]%
L3	Signal Conversion	[40 – 50]%	[0 – 10]%	[50 – 60]%	[20 – 30]%	[0 – 10]%	[30 – 40]%
L3	Interface and Isolators	[10 – 20]%	[0 – 10]%	[20 – 30]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L3	Power Management	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Linear Regulators	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Switching Regulators	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Voltage References	[10 – 20]%	[0 – 10]%	[10 – 20]%	[10 – 20]%	[0 – 10]%	[10 – 20]%
L4	Other Power Management + Supervision, Sequencing & Control	[10 – 20]%	[10 – 20]%	[20 – 30]%	[0 – 10]%	[10 – 20]%	[10 – 20]%
L4	Battery Charging & Management	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L2	**Application-Specific Analog**	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L3	Automotive	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Infotainment (Info & Entertainment)	[10 – 20]%	[10 – 20]%	[30 – 40]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Other Automotive	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L3	Communications	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Cellular Phones	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Wireless Infrastructure + Other Wireless Communication	[30 – 40]%	[0 – 10]%	[30 – 40]%	[10 – 20]%	[0 – 10]%	[10 – 20]%

L4	Wired Communications/Infrastructure and Other Communications	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L3	Consumer	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Audio/Video + DSC/Camcorder	[0 – 10]%	[10 – 20]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Other Consumer	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L3	Industrial & Others	[10 – 20]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	All Other Industrial	[10 – 20]%	[0 – 10]%	[20 – 30]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Medical/Healthcare	[20 – 30]%	[0 – 10]%	[30 – 40]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L2	**MCU**	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L2	**Temperature & Other Sensors**	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%

Table A3: Parties' global and Singapore market shares in 2017

		2017 Global shares (%)			***2017 Singapore shares (%)***		
Level	***WSTS Category Name***	***ADI***	***Maxim***	***Combined***	***ADI***	***Maxim***	***Combined***
L2	**General-Purpose Analog**	[10 – 20]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L3	Amplifier & Comparator	[20 – 30]%	[0 – 10]%	[20 – 30]%	[10 – 20]%	[0 – 10]%	[20 – 30]%
L3	Signal Conversion	[30 – 40]%	[0 – 10]%	[40 – 50]%	[20 – 30]%	[0 – 10]%	[30 – 40]%
L3	Interface and Isolators	[10 – 20]%	[10 – 20]%	[20 – 30]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L3	Power Management	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Linear Regulators	[10 – 20]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Switching Regulators	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Voltage References	[20 – 30]%	[0 – 10]%	[20 – 30]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L4	Other Power Management + Supervision, Sequencing & Control	[0 – 10]%	[10 – 20]%	[10 – 20]%	[0 – 10]%	[10 – 20]%	[10 – 20]%
L4	Battery Charging & Management	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L2	**Application-Specific Analog**	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L3	Automotive	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%

L4	Infotainment (Info & Entertainment)	[10 – 20]%	[10 – 20]%	[30 – 40]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Other Automotive	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L3	Communications	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Cellular Phones	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Wireless Infrastructure + Other Wireless Communication	[20 – 30]%	[0 – 10]%	[20 – 30]%	[10 – 20]%	[0 – 10]%	[10 – 20]%
L4	Wired Communications/Infrastructure and Other Communications	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[10 – 20]%
L3	Consumer	[0 – 10]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Audio/Video + DSC/Camcorder	[0 – 10]%	[10 – 20]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Other Consumer	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L3	Industrial & Others	[10 – 20]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	All Other Industrial	[10 – 20]%	[0 – 10]%	[10 – 20]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L4	Medical/Healthcare	[30 – 40]%	[0 – 10]%	[40 – 50]%	[10 – 20]%	[10 – 20]%	[20 – 30]%
L2	**MCU**	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%
L2	**Temperature & Other Sensors**	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%	[0 – 10]%

Table A4: Global market shares of semiconductor suppliers in 2019 by revenue (%)

WSTS Category Name	***ADI***	***Maxim***	***Merged entity***	**Pre-merger CR3**	***Post-merger CR3***	***Top 3 suppliers pre-merger (market share)***
General-Purpose Analog	[10 – 20]	[0 – 10]	[10 – 20]	[50 – 60]	[50 – 60]	TI ([30 – 40]), ADI ([10 – 20]), ON Semi ([[0 – 10]])
Amplifier & Comparator	[20 – 30]	[0 – 10]	[20 – 30]	[50 – 60]	[60 – 70]	TI ([20 – 30]), ADI ([20 – 30]), Maxim ([[0 – 10]])
Signal Conversion	[40 – 50]	[0 – 10]	[40 – 50]	[80 – 90]	[80 – 90]	ADI ([40 – 50]), TI ([30 – 40]), Maxim ([[0 – 10]])
Interface and Isolators	[10 – 20]	[0 – 10]	[20 – 30]	[50 – 60]	[50 – 60]	TI ([20 – 30]), ADI ([10 – 20]), Maxim ([[0 – 10]])
Power Management	[0 – 10]	[0 – 10]	[10 – 20]	[40 – 50]	[40 – 50]	TI ([30 – 40]), ADI ([[0 – 10]]), ON Semi ([[0 – 10]])

Linear Regulators	[0 – 10]	[0 – 10]	[0 – 10]	[20 – 30]	[20 – 30]	Infineon ([0 – 10]), TI ([[0 – 10]]), ON Semi ([[0 – 10]])
Switching Regulators	[10 – 20]	[0 – 10]	[10 – 20]	[50 – 60]	[50 – 60]	TI ([30 – 40]), ADI ([10 – 20]), Monolithic ([[0 – 10]])
Voltage References	[10 – 20]	[0 – 10]	[10 – 20]	[40 – 50]	[50 – 60]	TI ([20 – 30]), ADI ([10 – 20]), MediaTek ([10 – 20])
Other Power Management + Supervision, Sequencing & Control	[0 – 10]	[0 – 10]	[10 – 20]	[50 – 60]	[60 – 70]	On Semi ([20 – 30]), Austriamicrosystems ([10 – 20]), TI ([10 – 20])
Battery Charging & Management	[0 – 10]	[0 – 10]	[0 – 10]	[70 – 80]	[70 – 80]	TI ([70 – 80]), Semtech ([0 – 10]), Maxim ([0 – 10])
Application-Specific Analog	[0 – 10]	[0 – 10]	[0 – 10]	[20 – 30]	[20 – 30]	TI ([10 – 20]), Infineon ([0 – 10]), Qualcomm ([0 – 10])
Automotive	[0 – 10]	[0 – 10]	[0 – 10]	[30 – 40]	[30 – 40]	Infineon ([10 – 20]), TI ([10 – 20]), NXP ([0 – 10])
Infotainment (Info & Entertainment)	[10 – 20]	[20 – 30]	[30 – 40]	[60 – 70]	[70 – 80]	TI ([20 – 30]), Maxim ([20 – 30]), STMicro ([10 – 20])
Other Automotive	[0 – 10]	[0 – 10]	[0 – 10]	[40 – 50]	[40 – 50]	Infineon ([20 – 30]), NXP ([0 – 10]), TI ([0 – 10])
Communications	[0 – 10]	[0 – 10]	[0 – 10]	[40 – 50]	[40 – 50]	Qualcomm ([10 – 20]), Skyworks ([10 – 20]), Qorvo ([10 – 20])
Cellular Phones	[0 – 10]	[0 – 10]	[0 – 10]	[50 – 60]	[50 – 60]	MediaTek ([10 – 20]), Skyworks ([10 – 20]), Qorvo ([10 – 20])
Wireless Infrastructure + Other Wireless Communication	[20 – 30]	[0 – 10]	[20 – 30]	[50 – 60]	[50 – 60]	ADI ([20 – 30]), NXP ([10 – 20]), Skyworks ([0 – 10])
Wired Communications/Infrastructure and Other Communications	[0 – 10]	[0 – 10]	[10 – 20]	[50 – 60]	[50 – 60]	TI ([20 – 30]), NXP ([10 – 20]), Infineon ([10 – 20])
Consumer	[0 – 10]	[0 – 10]	[10 – 20]	[30 – 40]	[40 – 50]	Rohm ([10 – 20]), Cirrus ([10 – 20]), Maxim ([0 – 10])
Audio/Video + DSC/Camcorder	[0 – 10]	[10 – 20]	[20 – 30]	[50 – 60]	[50 – 60]	Cirrus ([10 – 20]), Rohm ([10 – 20]), Maxim ([10 – 20])
Other Consumer	[0 – 10]	[0 – 10]	[0 – 10]	[30 – 40]	[30 – 40]	STMicro ([10 – 20]), NXP ([10 – 20]), Rohm ([10 – 20])
Industrial & Others	[10 – 20]	[0 – 10]	[10 – 20]	[40 – 50]	[40 – 50]	ADI ([10 – 20]), Infineon ([10 – 20]), STMicro ([10 – 20])

All Other Industrial	[10 – 20]	[0 – 10]	[10 – 20]	[40 – 50]	[50 – 60]	Infineon ([10 – 20]), ADI ([10 – 20]), Skyworks ([10 – 20])
Medical/Healthcare	[20 – 30]	[0 – 10]	[30 – 40]	[70 – 80]	[80 – 90]	TI ([20 – 30]), ADI ([20 – 30]), STMicro ([20 – 30]),
MCU	[0 – 10]	[0 – 10]	[0 – 10]	[50 – 60]	[50 – 60]	Renasas ([20 – 30]), NXP ([10 – 20]), Microchip ([10 – 20])
Temperature & Other Sensors	[0 – 10]	[0 – 10]	[0 – 10]	[20 – 30]	[20 – 30]	TI ([10 – 20]), Infineon ([0 – 10]), Maxim ([0 – 10])

Table A5: Singapore market shares of semiconductor suppliers in 2019 by revenue (%)

WSTS Category Name	***ADI***	***Maxim***	***Merged entity***	**Pre-merger CR3**	***Post-merger CR3***	***Top 3 suppliers pre-merger (market share)***
General-Purpose Analog	[0 – 10]	[0 – 10]	[10 – 20]	[40 – 50]	[50 – 60]	TI ([30 – 40]), ADI ([0 – 10]), On Semi ([0 – 10])
Amplifier & Comparator	[10 – 20]	[0 – 10]	[10 – 20]	[50 – 60]	[50 – 60]	TI ([30 – 40]), ADI ([10 – 20]), ON Semi ([0 – 10])
Signal Conversion	[20 – 30]	[0 – 10]	[30 – 40]	[70 – 80]	[80 – 90]	TI ([40 – 50]), ADI ([20 – 30]), Maxim ([0 – 10])
Interface and Isolators	[0 – 10]	[0 – 10]	[10 – 20]	[40 – 50]	[50 – 60]	TI ([30 – 40]), Maxim ([0 – 10]), NXP ([0 – 10])
Power Management	[0 – 10]	[0 – 10]	[0 – 10]	[40 – 50]	[40 – 50]	TI ([30 – 40]), ON Semi ([0 – 10]), Monolithic ([0 – 10])
Linear Regulators	[0 – 10]	[0 – 10]	[0 – 10]	[20 – 30]	[20 – 30]	Infineon ([0 – 10]), TI ([0 – 10]), ON Semi ([0 – 10])
Switching Regulators	[0 – 10]	[0 – 10]	[0 – 10]	[50 – 60]	[50 – 60]	TI ([30 – 40]), Monolithic ([10 – 20]), Dialog ([0 – 10])
Voltage References	[10 – 20]	[0 – 10]	[10 – 20]	[50 – 60]	[60 – 70]	TI ([20 – 30]), MediaTek ([10 – 20]), ADI ([10 – 20])
Other Power Management + Supervision, Sequencing & Control	[0 – 10]	[0 – 10]	[10 – 20]	[50 – 60]	[50 – 60]	ON Semi ([20 – 30]), Austriamicrosystems ([10 – 20]), TI ([10 – 20])
Battery Charging & Management	[0 – 10]	[0 – 10]	[0 – 10]	[80 – 90]	[80 – 90]	TI ([70 – 80]), Semtech ([0 – 10]), MediaTek ([0 – 10])
Application-Specific Analog	[0 – 10]	[0 – 10]	[0 – 10]	[20 – 30]	[20 – 30]	TI ([10 – 20]), Infineon ([0 – 10]), MediaTek ([0 – 10])

Automotive	[0 – 10]	[0 – 10]	[0 – 10]	[40 – 50]	[40 – 50]	Infineon ([10 – 20]), TI ([10 – 20]), STMicro ([10 – 20])
Infotainment (Info & Entertainment)	[0 – 10]	[0 – 10]	[0 – 10]	[50 – 60]	[50 – 60]	TI ([30 – 40]), STMicro ([10 – 20]), NXP ([0 – 10])
Other Automotive	[0 – 10]	[0 – 10]	[0 – 10]	[40 – 50]	[40 – 50]	Infineon ([10 – 20]), TI ([10 – 20]), NXP ([0 – 10])
Communications	[0 – 10]	[0 – 10]	[0 – 10]	[40 – 50]	[40 – 50]	MediaTek ([10 – 20]), Qualcomm ([10 – 20]), Broadcom ([10 – 20])
Cellular Phones	[0 – 10]	[0 – 10]	[0 – 10]	[40 – 50]	[40 – 50]	Qualcomm ([20 – 30]), Qorvo ([10 – 20]), Skyworks ([0 – 10])
Wireless Infrastructure + Other Wireless Communication	[0 – 10]	[0 – 10]	[0 – 10]	[20 – 30]	[20 – 30]	NXP ([10 – 20]), Infineon ([0 – 10]), Broadcom ([0 – 10])
Wired Communications/Infrastructure and Other Communications	[0 – 10]	[0 – 10]	[10 – 20]	[50 – 60]	[50 – 60]	TI ([20 – 30]), NXP ([10 – 20]), Infineon ([10 – 20])
Consumer	[0 – 10]	[0 – 10]	[0 – 10]	[20 – 30]	[20 – 30]	STMicro ([0 – 10]), Infineon ([0 – 10]), TI ([0 – 10])
Audio/Video + DSC/Camcorder	[0 – 10]	[0 – 10]	[0 – 10]	[50 – 60]	[50 – 60]	Cirrus ([30 – 40]), Rohm ([10 – 20]), TI ([10 – 20])
Other Consumer	[0 – 10]	[0 – 10]	[0 – 10]	[40 – 50]	[40 – 50]	STMicro ([10 – 20]), NXP ([10 – 20]), Rohm ([10 – 20])
Industrial & Others	[0 – 10]	[0 – 10]	[10 – 20]	[20 – 30]	[20 – 30]	ADI ([0 – 10]), Broadcom ([0 – 10]), Qorvo ([0 – 10])
All Other Industrial	[10 – 20]	[0 – 10]	[10 – 20]	[40 – 50]	[40 – 50]	Infineon ([10 – 20]), ADI ([10 – 20]), ON Semi ([10 – 20])
Medical/Healthcare	[0 – 10]	[0 – 10]	[10 – 20]	[40 – 50]	[50 – 60]	TI ([20 – 30]), ADI ([0 – 10]), Broadcom ([0 – 10])
MCU	[0 – 10]	[0 – 10]	[0 – 10]	[50 – 60]	[50 – 60]	Renesas ([20 – 30]), NXP ([10 – 20]), Microchip ([10 – 20]))
Temperature & Other Sensors	[0 – 10]	[0 – 10]	[0 – 10]	[20 – 30]	[20 – 30]	TI ([10 – 20]), Infineon ([0 – 10]), Bosch ([0 – 10])