



# Virtual Archive

October 26 – 29, 2021  
Virtual Event

[www.testconx.org](http://www.testconx.org)



# With Thanks to Our Sponsors!

Honored



Distinguished



FELDMAN  
ENGINEERING

Exhibitor

**ADVANTEST®**

# TestConX China 2021

**Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?**

**Lin Fu**  
**VLSIresearch Europe**



**Virtual ▪ October 26-29, 2021**



# TestConX China 2021

## Overview

- How will industry megatrends drive the market?
- How geopolitical forces are changing the test landscape?
- What does the test market look like?



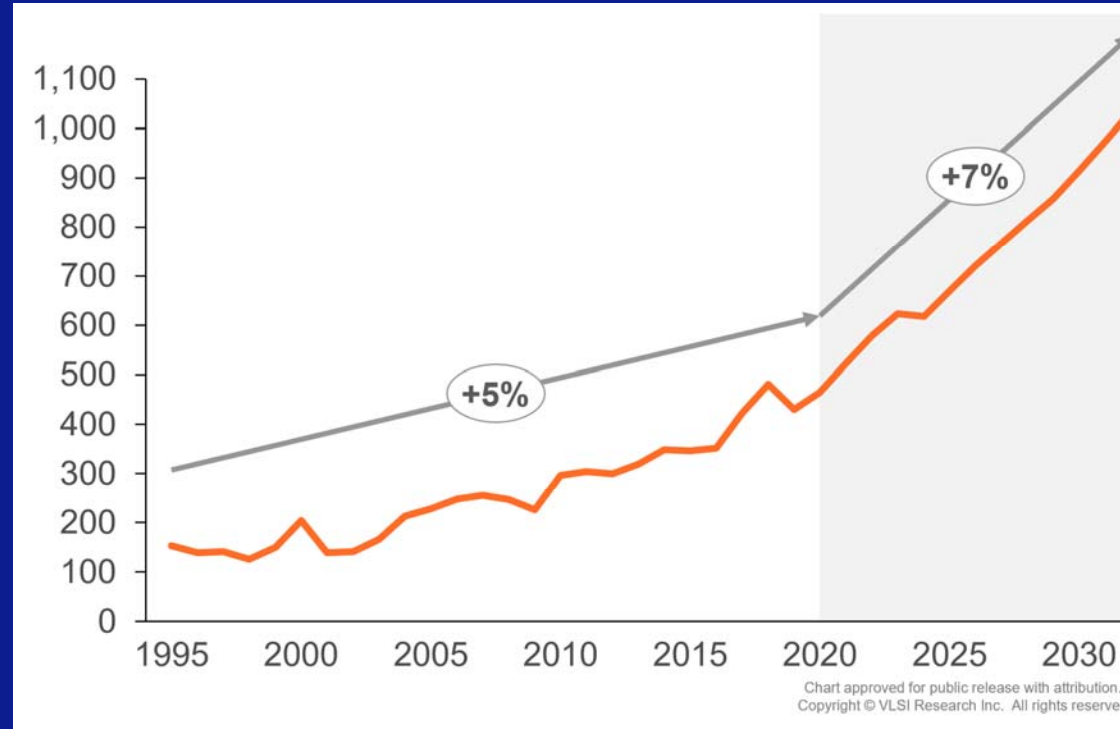
Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

2

## Semiconductor Revenues, \$Bn

50 years  
to get to  
\$500B



A trillion  
\$US Market  
by 2032?



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

3

# TestConX China 2021

## Industry Doubling What's Changed to Supercharge the Industry?

Digital Transformation – accelerated by the pandemic

Cloud, 5G & Infrastructure, AI, Intelligent Edge, Gaming and Visualization

It's a data centric world – no longer driven by human consumption

Silicon content – (cm<sup>2</sup>) of electronic devices is increasing

A clear technology pathway – manufacturing at the 3nm node



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

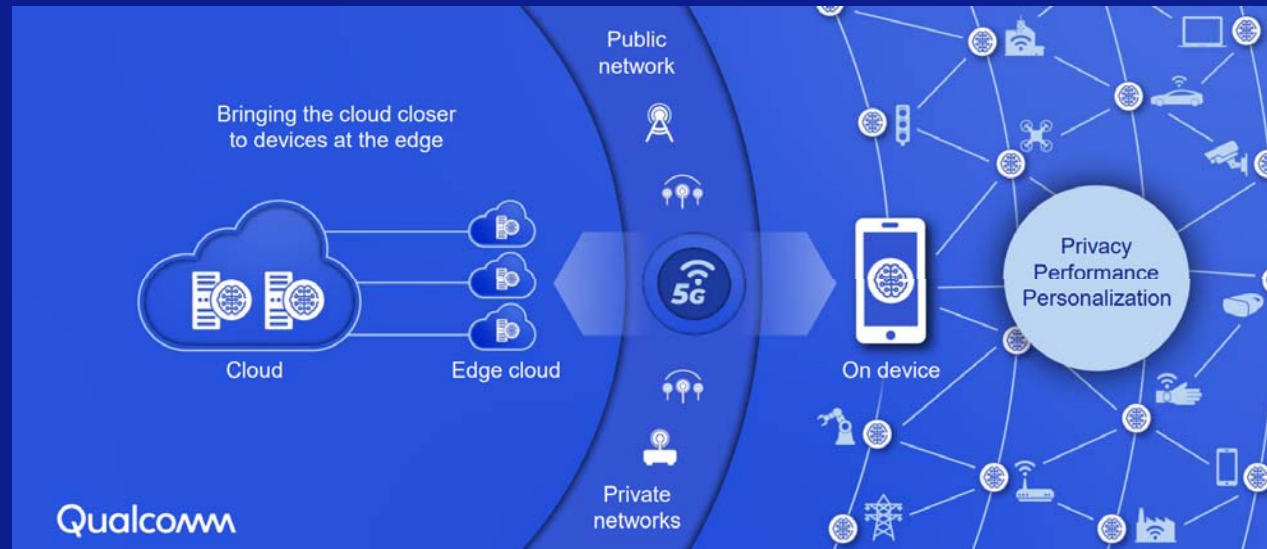
2021

4

# TestConX China 2021

## Industry doubling Distributed Computing Enabled by 5G

Bringing the cloud closer to the outside world



 **TestConX**中国  
China

Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

5

# TestConX China 2021

How **geopolitical forces**  
are changing the test landscape?



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

6



# TestConX China 2021

## Geopolitics – Industry is on the move

- Countries will protect technological sovereignty
  - Restriction of technology transfer
  - Rebuild domestic capabilities: pandemic result in supply chain not working, many countries realize too much dependency on Taiwan
- Reconfiguration of supply chains
  - Localization
  - Multiple source strategies

**The risk vs. cost equation has changed**



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

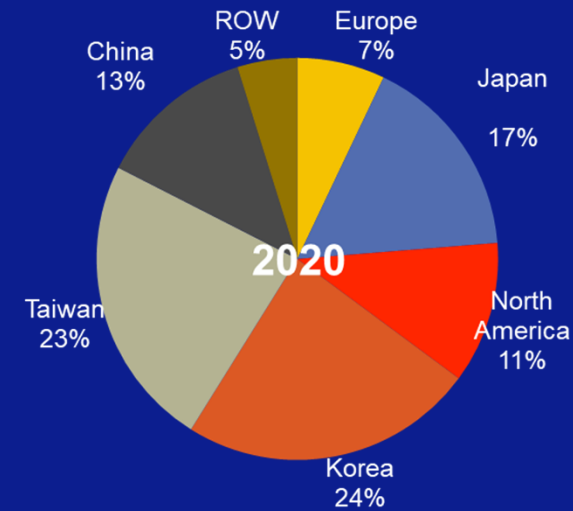
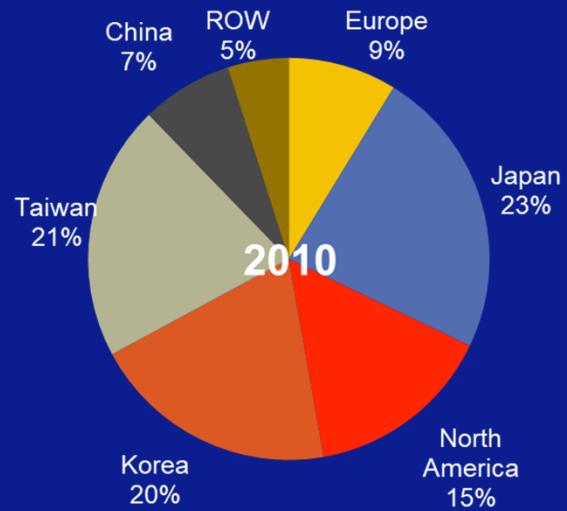
2021

7

# TestConX China 2021

## Chipmaking Capacity by Region

- China, South Korea and Taiwan have grown
- Europe, Japan and North America have declined



- Expect to see reversal of this trend over the next 10 years



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

# 2021

8

# TestConX China 2021

## Geopolitical forces – US

US - China dispute → US thinking more control of supply chain

→ reshoring their  
semiconductor  
manufacturing

Foreign foundries build new fabs in US

Profitable or not

Local fabless go back to IDM

Realistic or not

Take time

Extra Questions:

Labour shortage and cost

Impact on existing local supply chain



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

9

# TestConX China 2021

## Geopolitical forces – EU

### Problems of EU → Technology Behind & Finding Customers

- Most chips from the EU's leading semiconductor companies like Infineon, ST Microelectronics and NXP are using trailing-edge technology
- A lot of small fabless companies design chips such as processors for data centres, high-performance computing and artificial intelligence, which are in leading-edge (10nm, 7nm and 5nm). However, the number of leading-edge wafer requirement is not enough to fill a fab



- Technology behind Taiwan, South Korea and the US
- If Europe were able to set up an advanced fab
  - what will they make
  - who to sell to



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

10



# TestConX China 2021

## Geopolitical forces – Japan

### Problems of Japan → Technology Behind & Finding Investment



Memory : Most memory manufactures in Japan currently are owned by foreigners, such as previous Elpida and Toshiba



Non-memory: leading-edge non-memory capability is far behind (Japan's most advanced semiconductor plant is a 40 nm chip factory operated by Renesas Electronics)



- Technology far behind Taiwan, South Korea and the US
- Under the decline of Japan's semiconductor industry
  - Where will the (local) investment come from?



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

# 2021

11

# TestConX China 2021

## Different Stage – US, EU and Japan



- Each region already has their own existing strength in semiconductor manufacturing supply chain
- The leading manufacturing equipment suppliers, Applied material, Lam research, ASML and Tokyo electron are all from Japan, the US, and the EU

**More thinking & planning in US, EU and Japan.  
Government incentives will change but takes time.**



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

12

# TestConX China 2021

## Different Stage - China



**Mainland China has had to adjust quickly because it is still developing its own cutting-edge technology**

- **Government & Capital invest heavily**
- **International talent & technology introduce largely**
- **Tech giants partner with local suppliers as much as they can**
- **Cover as many sub-industries as they can to establish own ecosystem**



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

13

# TestConX China 2021

## China faces different but equally painful problems, these need to be solved to avoid bubble



- Fill Technology gap – combination of money, time, innovation and “know-how” experience
- Seek breakthrough point of complex semiconductor manufacturing supply chain
- Reduce the impact of the US, the EU and Japan reshoring



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

14



# TestConX China 2021

## China faces different but equally painful problems, these need to be solved to avoid bubble



- Reduce impact of outflow to the southeast of Asia like Malaysia, Vietnam and Philippines due to increasing labour cost in China and spreading risk
- Maintain continuous investment on research and development facing long payback period



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

15

# TestConX China 2021

How geopolitical forces  
are changing the test landscape?



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

16

# TestConX China 2021

## Changes of Test Landscape

- **New suppliers coming out / small suppliers growing** – even if there is a trend of more consolidated globally, some suppliers bound with specific customers locally can still find space to compete
- **Top suppliers adjusting market strategy frequently (The pandemic contribute it as well)** – Except solid domination of Teradyne and Advantest in ATE market, top suppliers in the rest of test market did not grow in step with each other per year
- **Diversity of customer increasing** – Leadership of data era (speed of data transferring and computing, security of data storage) make previous chip users like Google and Huawei are becoming more integrated. Suppliers are keeping their eyes open for new buyers entering the market and decision-maker replacing existing clients



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

17

# TestConX China 2021

What does the test market  
look like?



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

18

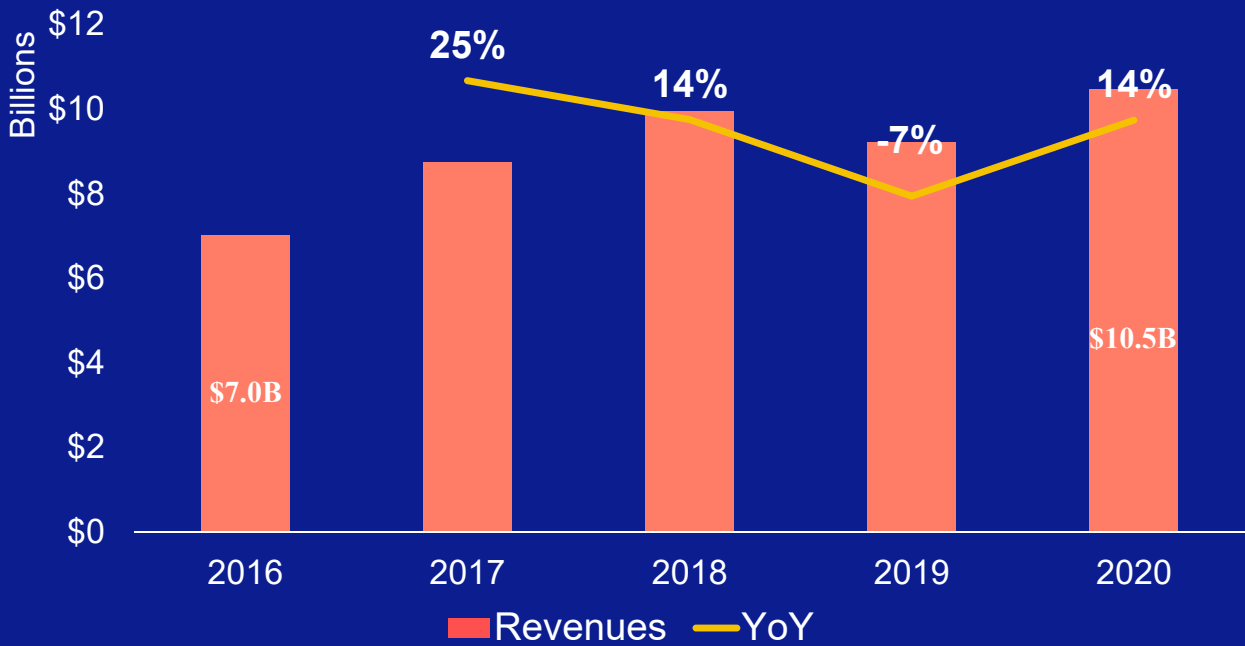


# TestConX China 2021

## Semiconductor Test Cost

Cost \$10.5B on test, increased by 50% compared to 2016

- ATE
- Prober & Handler
- Probe Card
- Socket
- Load Board



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

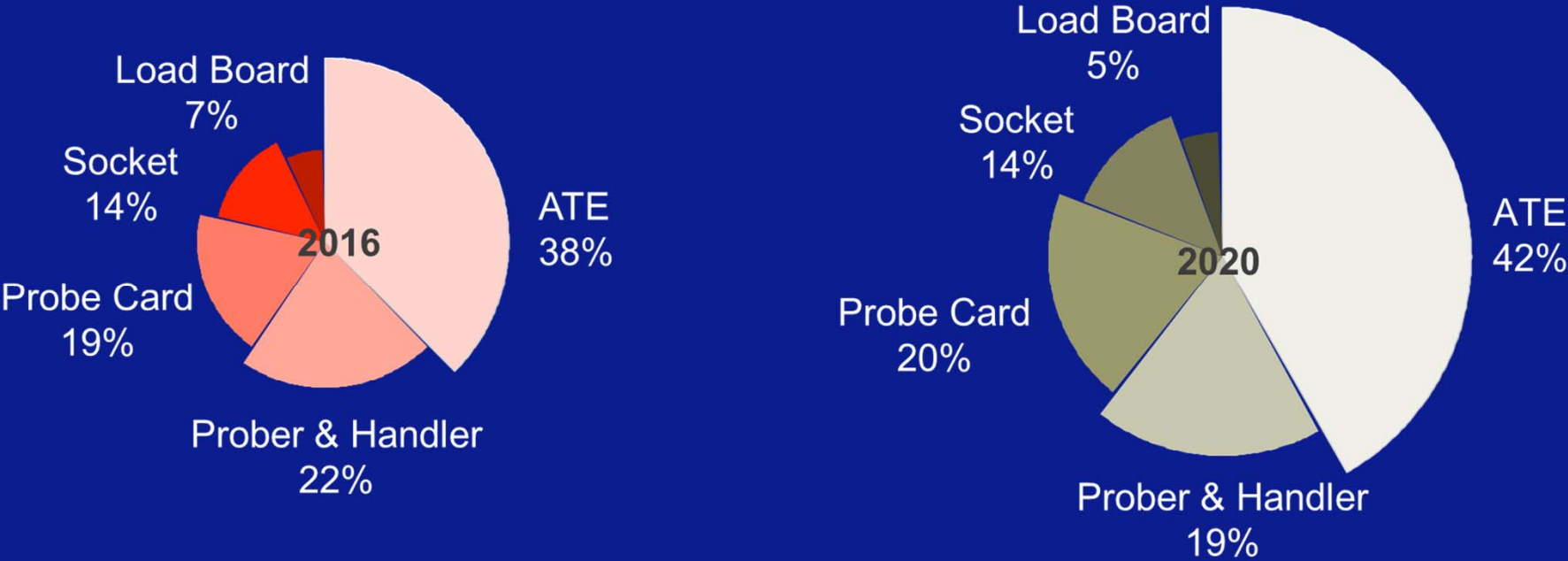
2021

19

# TestConX China 2021

## Distribution of Cost

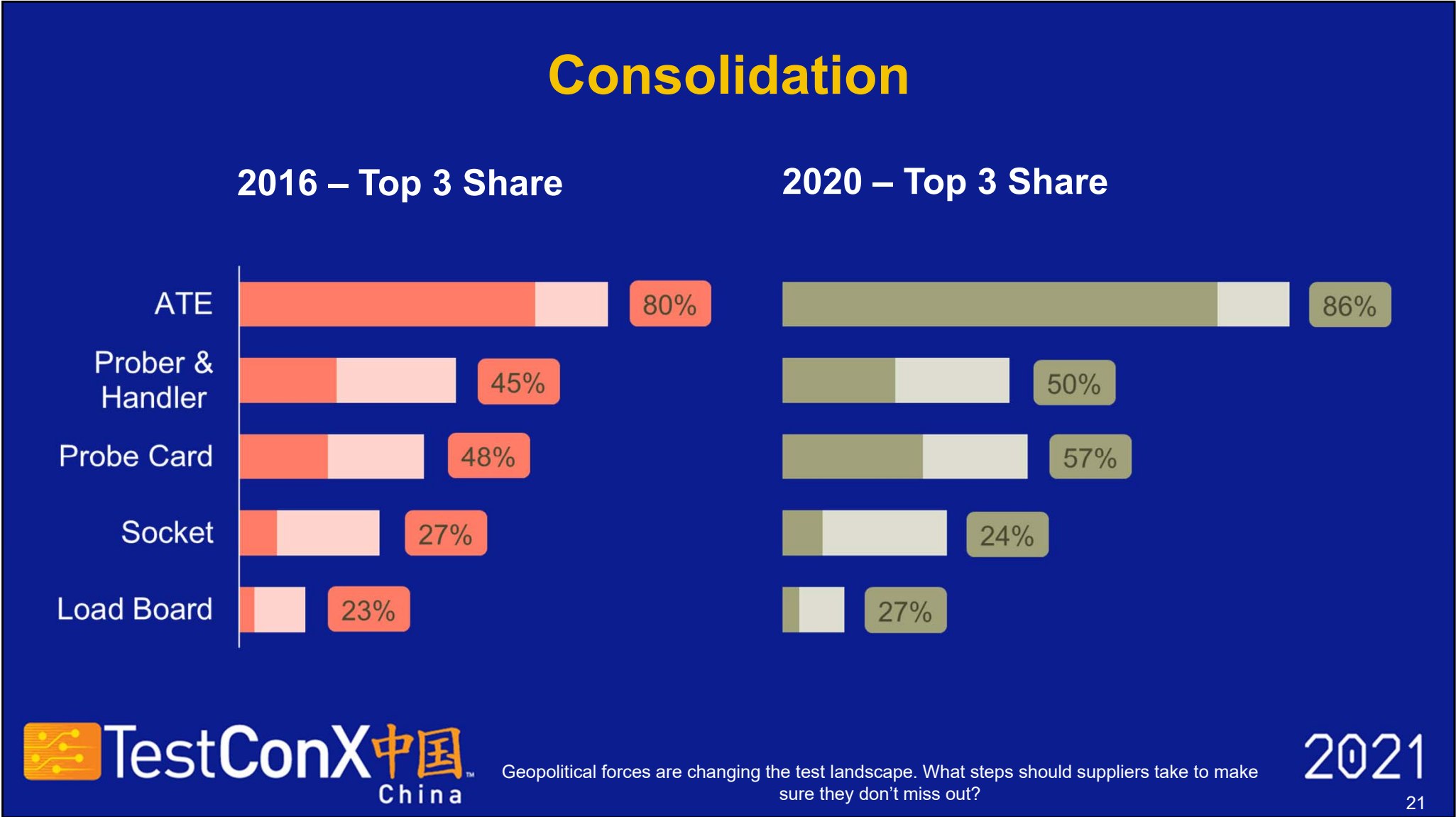
ATE cost continued to dominate. Probe card cost were 2<sup>nd</sup> in 2020



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021  
20

# TestConX China 2021



# TestConX China 2021

## Before Forecast

### What will drive the semiconductor test market?

- ✓ Number of chips will increase
- ✓ Complexity of test increase resulting in more testing steps involved
  - More wafer level burn-in
  - More system level test
- ✓ Price of products
  - for high-end applications increase



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

# 2021

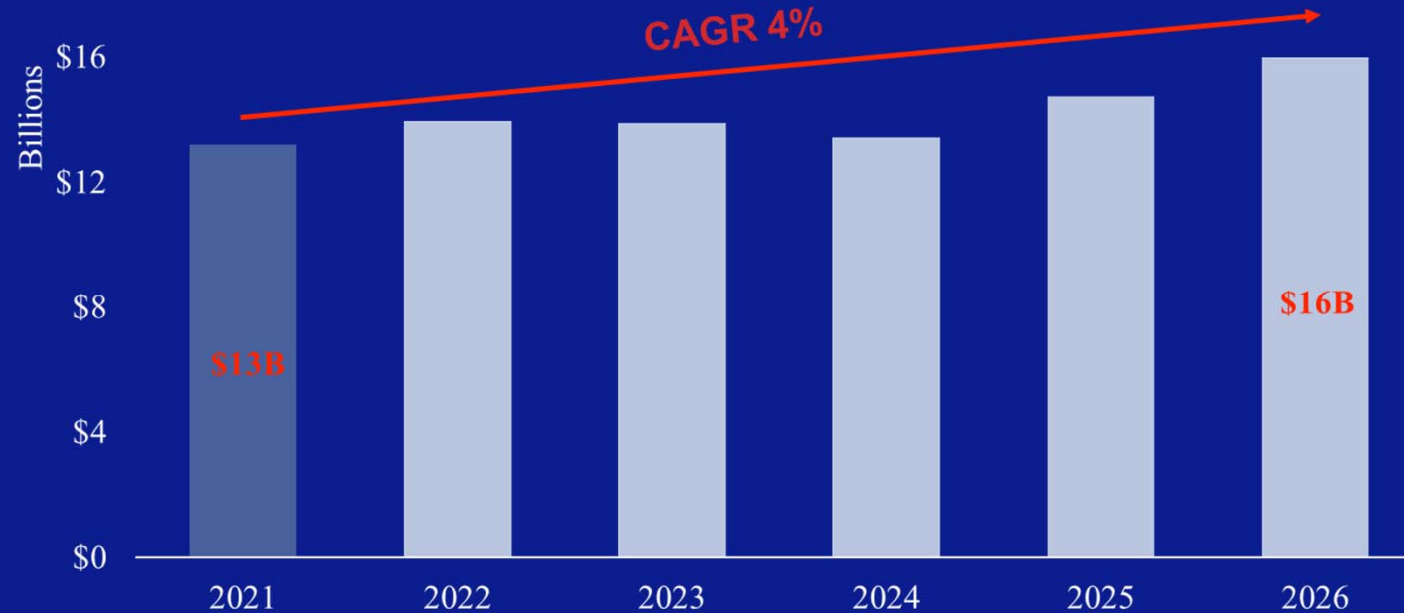
22



# TestConX China 2021

## Forecast – Semiconductor Test Cost

Overall trend – continue to increase



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

23

# TestConX China 2021

- ATE
- Prober & Handler
- Probe Card
- Socket
- Load Board



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

24

# TestConX China 2021

## ATE Market

- In the middle of a replacement cycle. New machines are much more efficient with more channels
- Grow in line with semiconductor equipment overall over the next five years
- Oligopoly of Teradyne and Advantest will be difficult to break, US and Japan will continue to dominate this market
- Other 50 suppliers battle for the rest market (<15%, \$600M)



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

# 2021

25

# TestConX China 2021

- ATE
- **Prober & Handler**
- Probe Card
- Socket
- Load Board



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

26

# TestConX China 2021

## Prober and Handler

- Grow in line with semiconductor equipment overall over the next five years
- Stiff competition among top 3 suppliers (Tokyo Electron, Tokyo Seimitsu and Cohu), no obvious leader
- Japan and US still dominate, but South Korea, Taiwan and Mainland China are not far behind, and gap is tightening



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

27

# TestConX China 2021

- ATE
- Prober & Handler
- Probe Card
- Socket
- Load Board



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

28



# TestConX China 2021

## Probe Card

- Most suppliers have their own expertise and emphasis, either memory or non-memory

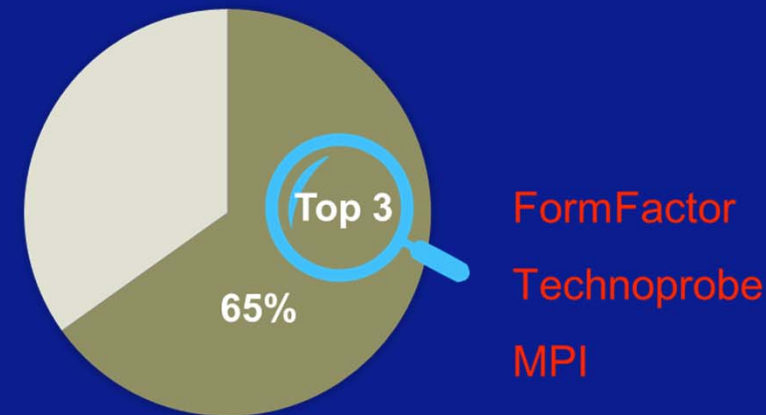
### Probe cards for Memory Applications

Market share of Top 3 suppliers - 2020



### Probe cards for Non-memory Applications

Market share of Top 3 suppliers - 2020



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

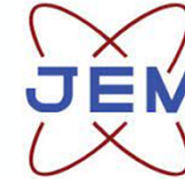
2021

29

# TestConX China 2021

## Probe Card

- Regionalization is not obvious. The US, Japan, the EU, South Korea and Taiwan all have notable suppliers



- Barrier of MEMS probe cards is high and even limit growth of some top suppliers in the past several years



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

30

# TestConX China 2021

## Probe Card – Chinese Market

- The market share of Chinese suppliers was 1.1% in 2020, mainly focusing on cantilever and vertical type (more price matter). Started to make some progress to enter MEMS card market. Either develop own MEMS pins or purchase pins from others



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021  
31

# TestConX China 2021

- ATE
- Prober & Handler
- Probe Card
- Socket
- Load Board



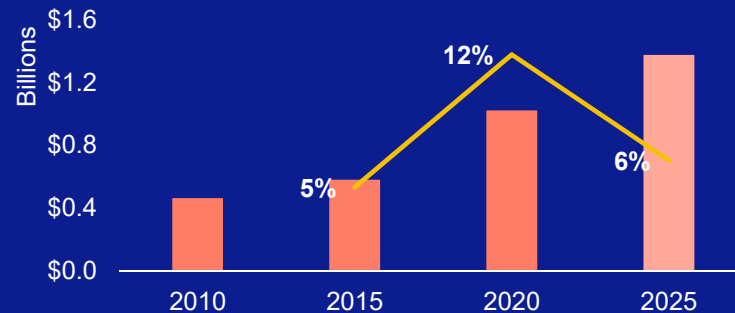
Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

32

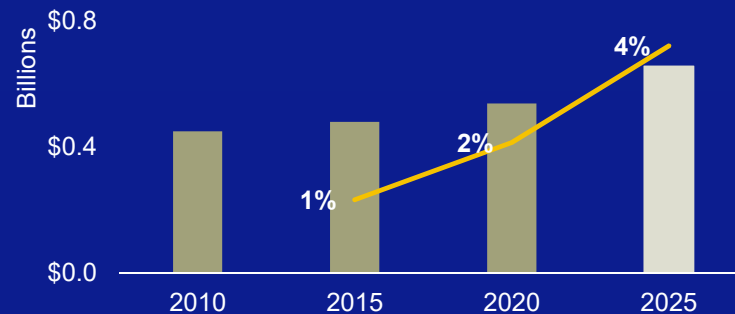
# TestConX China 2021

## Test Socket and Load Board

Test Socket Revenues and CAGR



Load Board Revenues and CAGR



- Test socket sales were quite strong from 2015, with a CAGR of 12%; broke through the \$1Bn barrier in 2020. 2021 has gotten off to a strong start. The current upturn will continue until a cyclical downturn in semiconductors
- Test socket shipments is currently running at a CAGR of 5.1%. This is slightly lower than the CAGR for IC unit shipments (7.1%), as the lifetime of test sockets continues to grow
- The predicted growth in the load board market is due to a combination of several factors: increasing complexity which is driving up the prices for design and manufacture of boards for leading-edge applications, the growing number of devices to be tested, and a higher number of boards being consumed per chip design



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

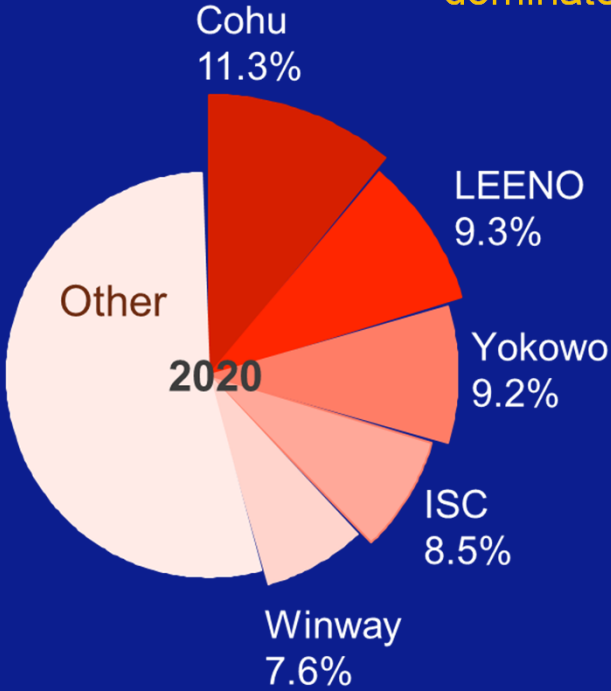
2021

33

# TestConX China 2021

## Test Socket Supplier

This is a highly competitive and vibrant marketplace where no single supplier dominates. Each has its own distinctive character and technological edge



- Cohu from North America is the market leader in 2020 and specializes in test sockets for high end non-memory applications
- LEENO from South Korea, who also supply test socket pins to their competitors, is in second place and is slowly gaining ground on Cohu
- In third place, Yokowo from Japan has been on a surge due to sales of sockets for mobile and 5G applications
- ISC from South Korea are leaders in elastomer test sockets
- Winway from Taiwan have a focus on serving the Taiwanese market



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021



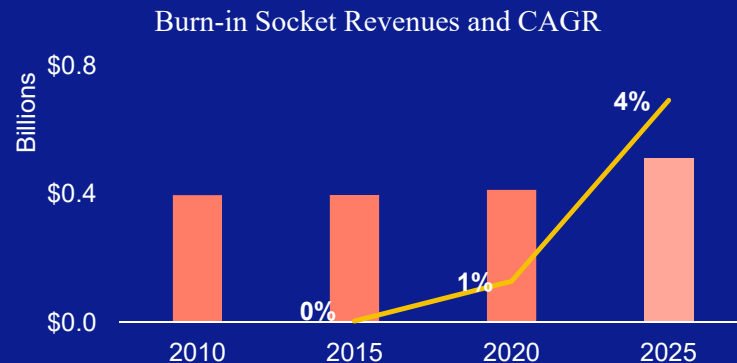
# TestConX China 2021

## Burn-in Socket

The overall market for burn-in sockets has been growing at a much lower rate than for semiconductors. However, closer inspection reveals a bifurcated market.

- One part is for commodity products characterized as high volume, low price, with falling prices

2010 – 4.8M shipments  
2015 – 5.5M shipments  
2020 – 5.7M shipments



- The other part is for high-performance products, which present continuous opportunities for new products with higher prices, and the volumes are growing to the point where they more than offset the price reductions elsewhere

The change in product mix and pricing drives the overall market above historical trends making this a much more exciting space for suppliers



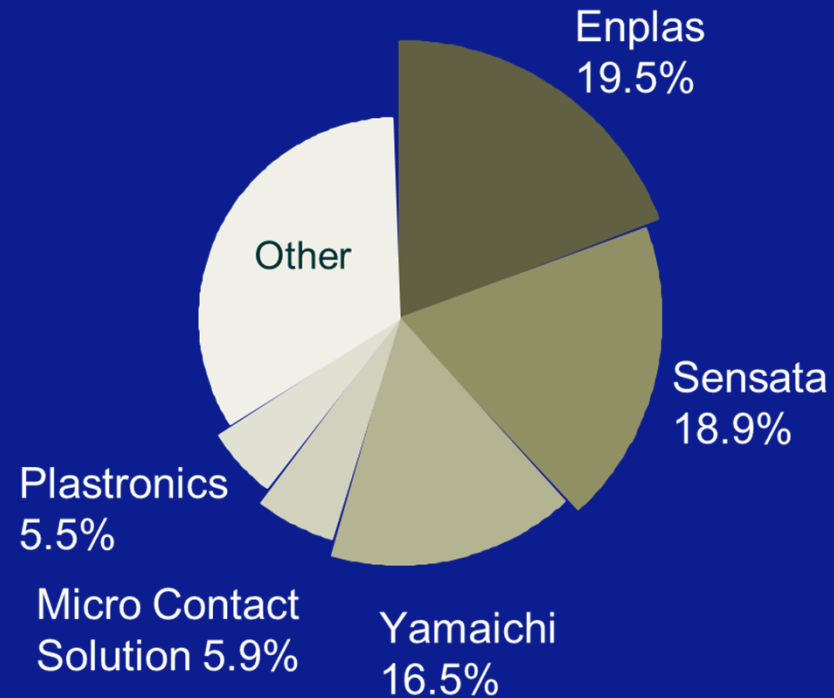
Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

35

# TestConX China 2021

## Burn-in Socket Supplier



- The top 3 suppliers are Enplas (Japan), Sensata (EU), and Yamaichi (Japan). These suppliers have strong positions in all memory and non-memory segments. The difference in revenues between first and third place is only a few million US dollars in any given year, so the rankings typically change from year to year. Currently, Enplas have the edge and have been in the top spot for the past two years
- The market shares of Micro Contact Solution (South Korea) and Plastronics (US) were just over 5%, a big gap with top 3
- Burn-in socket suppliers (about 30 active players) are much less than test socket suppliers

# TestConX China 2021

## Socket – Chinese Market

- The market share of Chinese suppliers was 4.4% in 2020. Consumption was 17.0%



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

37

# TestConX China 2021

## Data and the stories behind data help you understand

- How will industry megatrends drive the market?
- How geopolitical forces are changing the test landscape?



Where is industry going to be in the future?



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

38

# TestConX China 2021

**Data and the stories behind data  
help you understand**

What does the test market look like?



**Where are you now?**



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

**2021**

39

# TestConX China 2021

**You decide**

**What steps should you take  
to make sure you don't miss out?**



Geopolitical forces are changing the test landscape. What steps should suppliers take to make sure they don't miss out?

2021

40



# **COPYRIGHT NOTICE**

**The presentation(s)/poster(s) in this publication comprise the proceedings of the TestConX China 2021 virtual event. The content reflects the opinion of the authors and their respective companies. They are reproduced here as they were presented at TestConX China. The inclusion of the presentations/posters in this publication does not constitute an endorsement by TestConX or the workshop's sponsors.**

**There is NO copyright protection claimed on the presentation/poster content by TestConX. However, each presentation/poster is the work of the authors and their respective companies: as such, it is strongly encouraged that any use reflect proper acknowledgement to the appropriate source. Any questions regarding the use of any materials presented should be directed to the author(s) or their companies.**

**TestConX, TestConX China, the TestConX logo, and the TestConX China logo are trademarks of TestConX. All rights reserved.**