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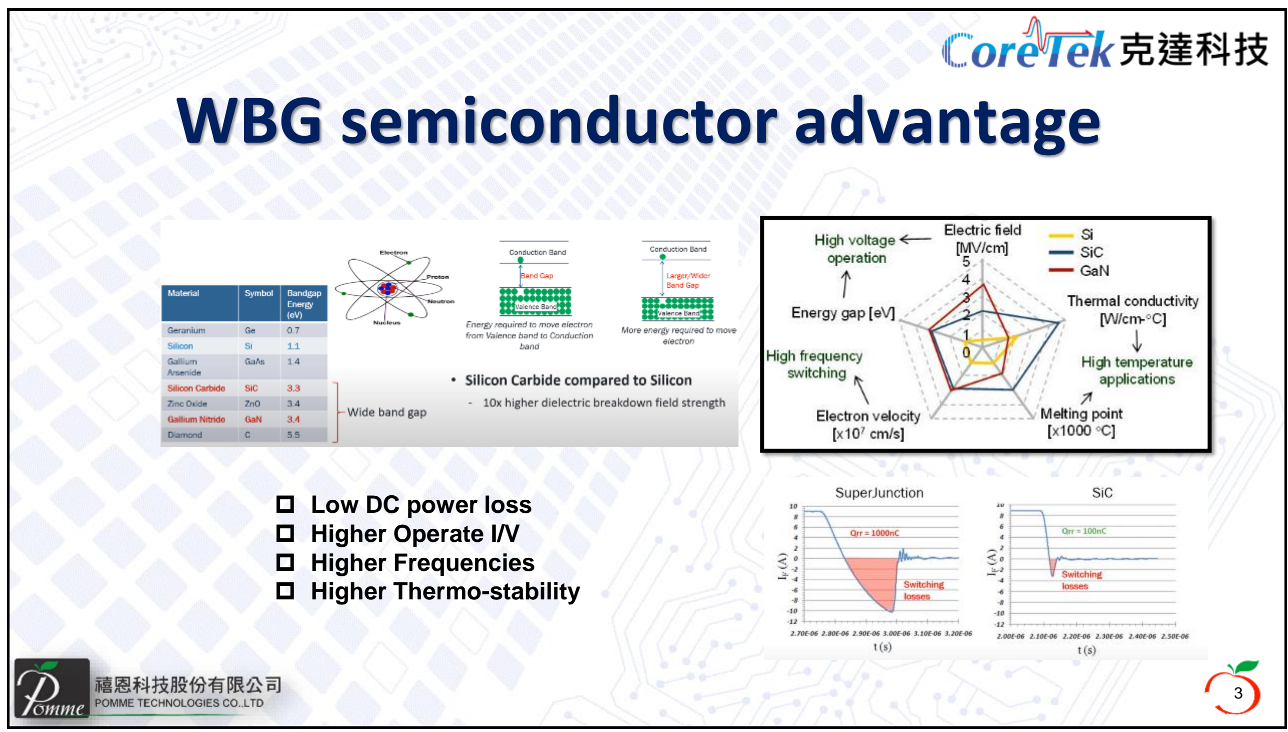

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CoreTek 克達科技

WBG Market Position

Low Resistance | Si | SiC | Downsizing of Module | 1/10

Fast Operation | Si | SiC | Downsizing of Peripherals | 1/10

High Temp Operation | Si | SiC | 200°C | 250°C | Simplification of Cooling System | Water cooling pump | Air cooling heat sink | 1/10

Power transmission | Substation Transformer Power cable | Transmission Transformation | Home | Factory | Conversion | Home Appliances

Power Loss: 3 to 5%

Convert to suitable voltage/current at power supply of equipment. Power Loss: 5 to 10%

If SiC

Si | SiC | Excellent properties beyond Si | Switching Loss | 85% Reduction

Possible greatly to reduce energy losses at power conversion processes

Comparison IGBT Module with full SiC Module

P out [W]: 10M, 1M, 100k, 10k, 1k

Fsw [Hz]: 1k, 10k, 100k, 1M, 10M

IGBT | SiC | SJ | GaN | Si

- Rail
- Solar
- EV Charging
- HEV/EV (Traction, OBC)
- Motor Drives
- HEV/EV (DC-DC, OBC)
- Networking/Servers
- Low Power Supplies

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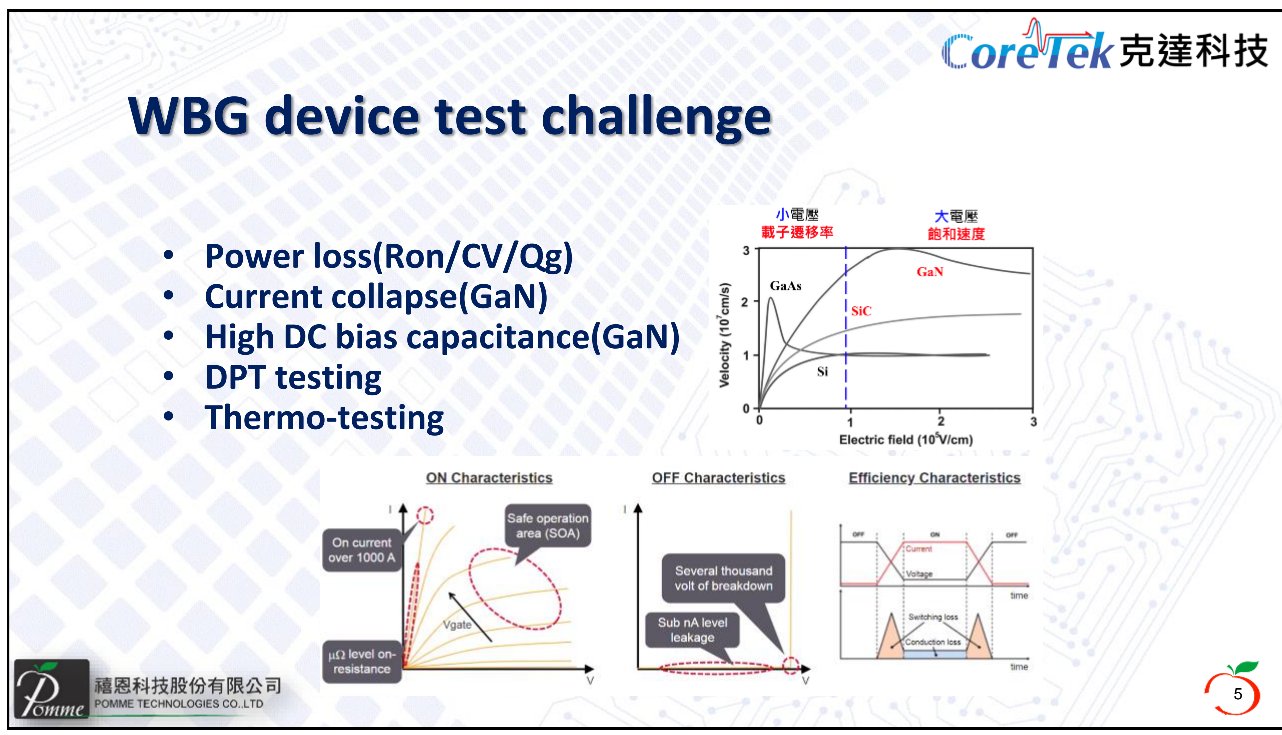

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CoreTek 克達科技

Traditional Test Equipment Weakness

- Poor IV accuracy, non-CV/ Qg/ GaN C.C.
- Hard to prevent self-heating
  - Wide Pulse Width
- No well prepare test fixture
  - Rewire instrument connection
  - Wafer → Die → PKG → Module
- Thermal testing limit
  - Long cabling
  - Hard temperature monitor
  - Thermal chuck as a test pad(Vertical DUT)
- Wafer prober auto-testing
- No switching solution for HV/HC
- WBG DPT solution lack: Higher V/C, Higher speed

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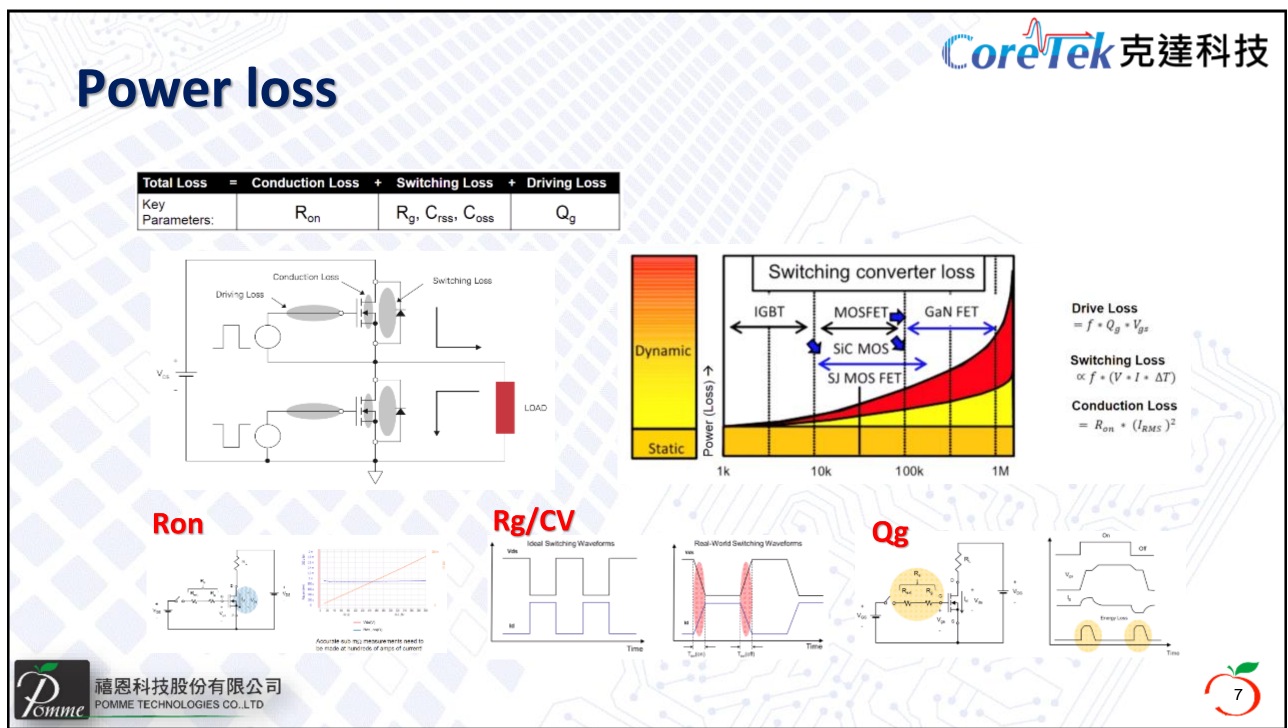

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CoreTek 克達科技

On-Resistance: Rdson

Drain to Source Resistance vs. Drain Current

Drain to Source Resistance vs. Gate to Source Voltage

- WBG Rdson is very low to conductive loss can be ignored.
- How to measure uOhm Rdson is the key:

① Specified test fixture with low R_L
② High current affordable
③ Suitable Rg and duty cycle on Gate/Drain to prevent DUT broken!

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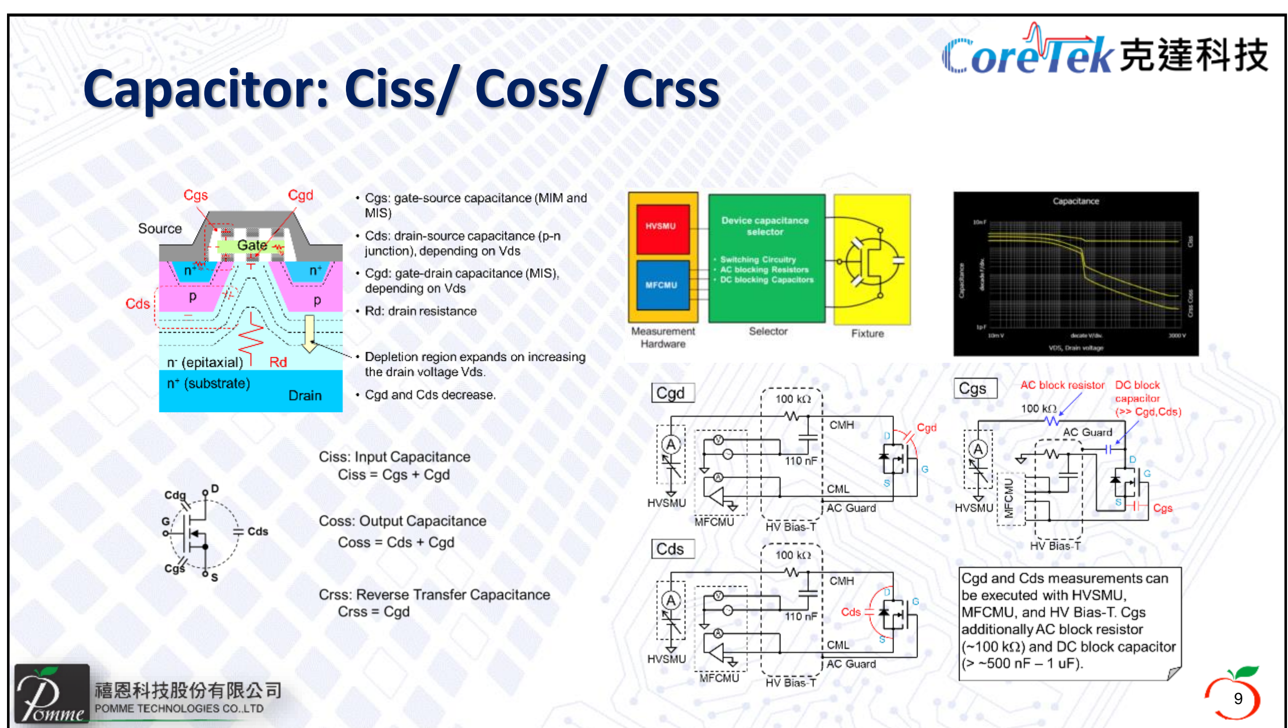

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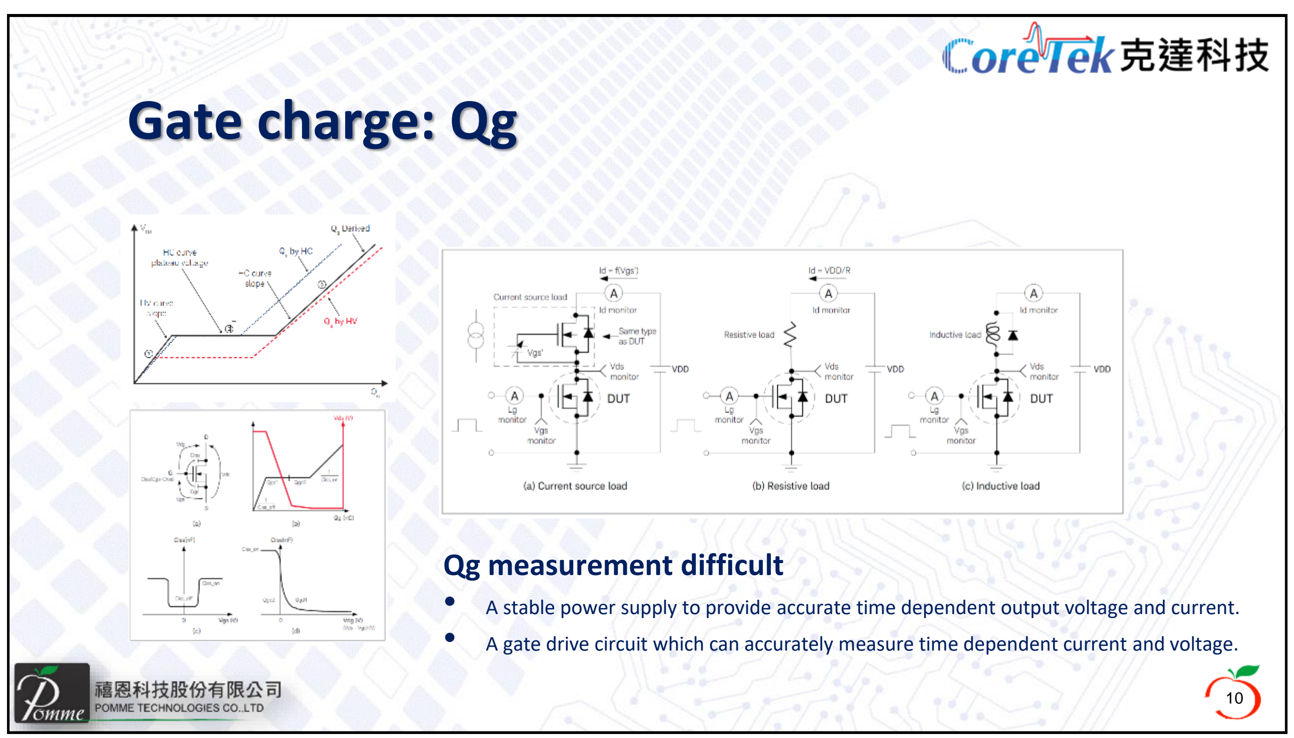

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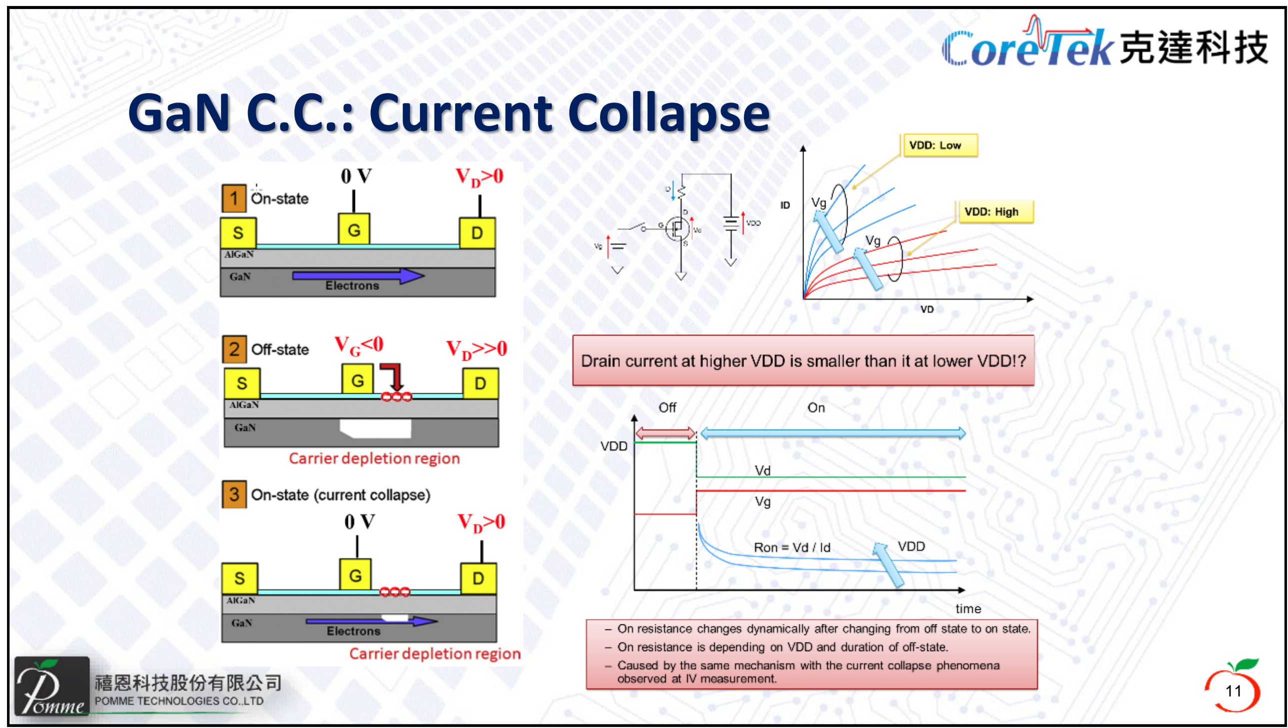

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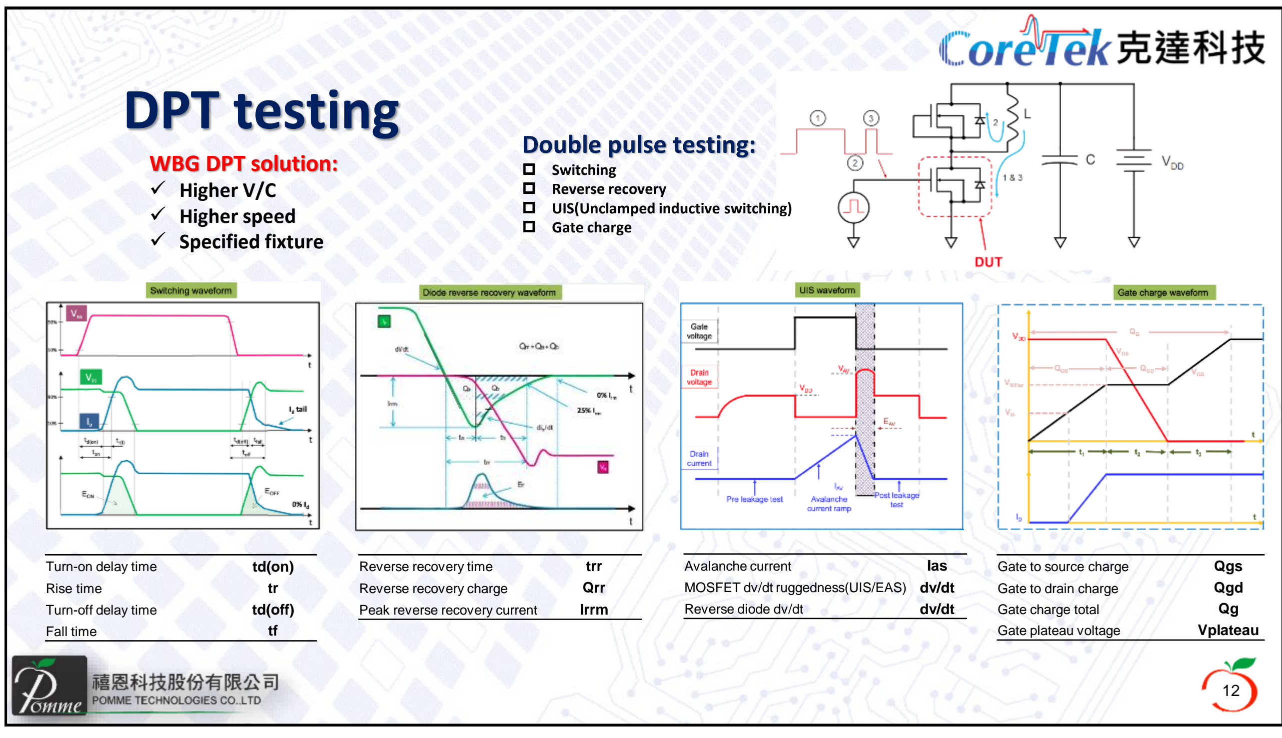

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CoreTek克達科技

Coretek / POMME introduce

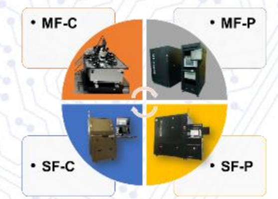
克達科技/禧恩科技提供了完整的第三代半導體所要求的規格的測試方案：

- DC Power Device Parameter 測試方案
- AC Power Device parameter 測試方案
- Low current device characterization parameter 測試方案

針對寬能隙WBG(Wide Band Gap)Device 設計了加熱器，I/V Curve，C/V Curve 及On-wafer 測試探針及客制的治具，提供一站式的解決方案，大幅減輕您測試環境的架設及測試時間。

針對On-wafer 測試，克達科技提供您完整測試方案從手動、半自動到全自動等，探針/探針卡全面性的解決方案

1. Manual: MF-P/ MF-C series
2. Semi-Auto: SF-P/ SF-C series
3. Fully-Auto: IF series



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CoreTek克達科技

WBG fitted solutions – 1

- **Great IV accuracy, non-CV/ Qg/ GaN C.C.**
  - B1505A/ B1506A
- **Hard to prevent self-heating**
  - POMME provide turnkey 10 us level testing
- **No well prepare test fixture**
  - Rewire instrument connection
  - Wafer → Die → PKG → Module

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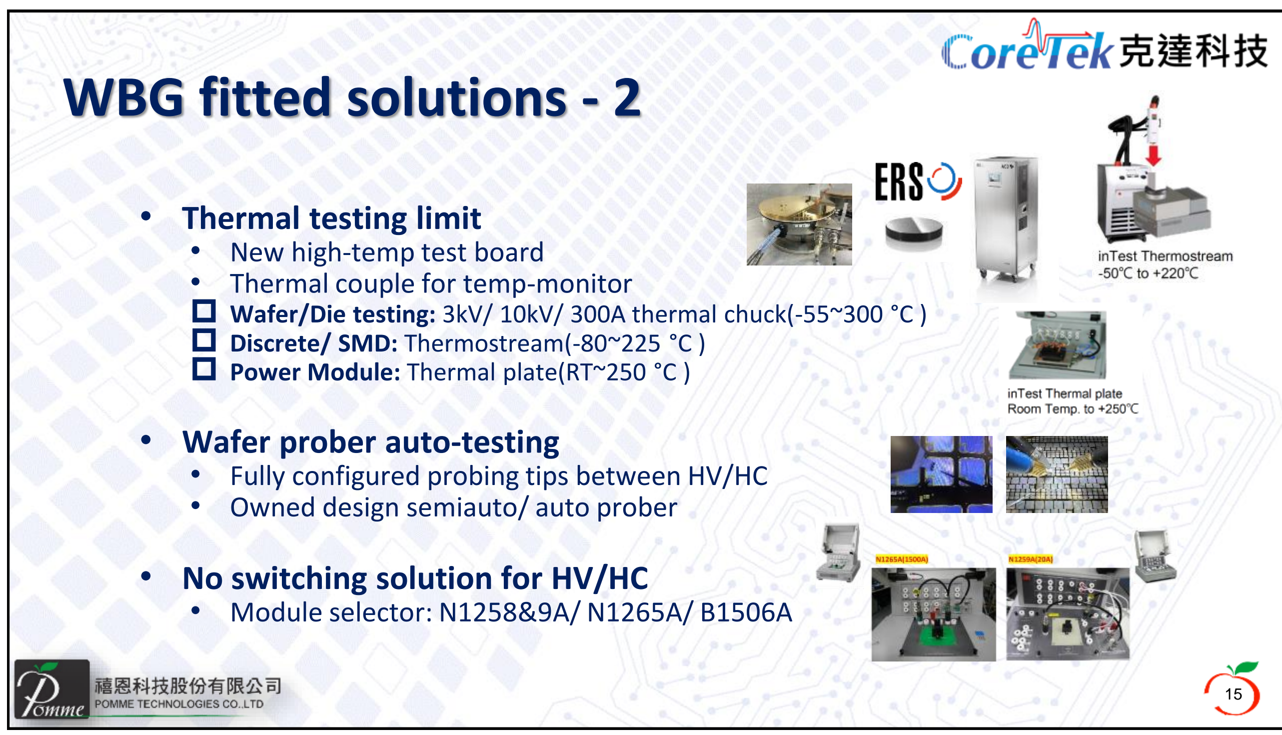

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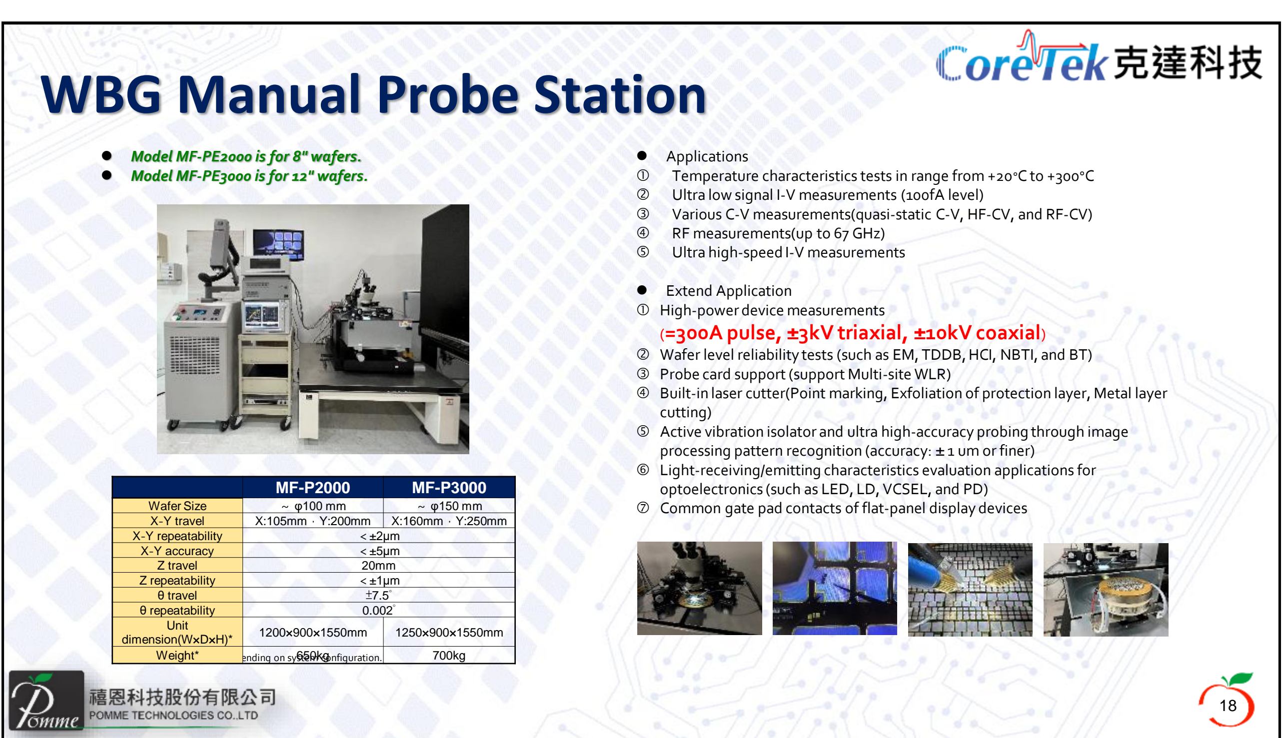

	MF-P2000	MF-P3000
Wafer Size	~ φ100 mm	~ φ150 mm
X-Y travel	X:105mm · Y:200mm	X:160mm · Y:250mm
X-Y repeatability	< ±2μm	
X-Y accuracy	< ±5μm	
Z travel	20mm	
Z repeatability	< ±1μm	
θ travel	±7.5°	
θ repeatability	0.002°	
Unit dimension(W×D×H)*	1200×900×1550mm	1250×900×1550mm
Weight*	650kg	700kg

ending on system configuration.

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OST: Out Source Testing

CoreTek克達科技

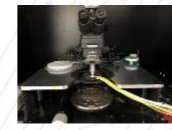
- ***Model AF-OST-AC is for dynamic testing.***
- ***Model AF-OST-DC is for DC testing.***
- ***Model AF-OST-WFR is for on-wafer testing.***

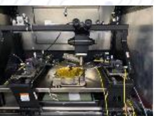
Power Device DC Parameters	Symbol
Drain-source breakdown voltage Vbd	Vbd
Gate threshold voltage Vth	Vth
Zero gate voltage drain current Idss	Idss
Gate-source leakage current include Zener diode Igss	Igss
Gate resistance Rg	Rg
Diode forward voltage VF	Vf
Typ. Output characteristics IdVd	Id-Vd
Typ. Drain-source on-state resistance Rsd-Id	Rds-Id
Drain-source on-state resistance Ron	Ron
Typ. Transfer characteristics IdVg	Id-Vg
Typ. Gate charge Qg	Qg
Typ. Capacitances Crss	Crss
Typ. Capacitances Ciss	Ciss
Typ. Capacitances Coss	Coss
Typ. Coss stored energy	Eoss
Forward characteristics of reverse diode If-Vsd	If-Vsd

Power Device AC Parameters	Symbol
Input capacitance	Ciss
Output capacitance	Coss
Effective output capacitance, energy related	Co(er)
Effective output capacitance, time related	Co(tr)
Turn on delay time	td(on)
Rise time	tr
Turn off delay time	td(off)
Fall time	tf
Reverse recovery time	trr
Reverse recovery charge	Qrr
Peak reverse recovery current	Irrm
Gate to source charge	Qgs
Gate to drain charge	Qgd
Gate charge total	Qg
Gate plateau voltage	Vplateau
Power Device Ruggedness Testing	Symbol
Application(Flyback) relevant avalanche current	Ias
MOSFET dv/dt ruggedness(UIS/EAS)	dv/dt
Reverse diode dv/dt	dv/dt
Maximum diode commutation speed	dif/dt

- Applications
1. WBG tester Keysight B1506A
2. Dynamic tester: POMME STA
3. Thermostream Temptronic TPO4500OA(-80 °C to 225 °C)
4. 5 probe station with thermo-chuck form -55 °C to 200 °C
5. Oven for 100C to 300C
6. LCR meter as CV testing
7. B1500A/ 4200/ B2201A/ 707A for low current WAT testing

- Extend Application
1. DC: IGBT/MODFET/DIODE/GaN
   1. IGBT: Ices, Iges, Vge(th), Vce(on), Vces, Vges, Vbr(ce)
   2. MOSFET: Idss, Igss, Vgs(th), Rds(on) ,Vdss, Vgss, Vbr(ds), Cdg, Cgs, Cgd
   3. DIODE: Ir, Id, Vr, Vf, Vsd.
2. AC: Switching/ Recovery/ Qg/ Roughness
   1. Switching Board: td(on)/ tr/ td(off)/ tf /E(on)/ E(off)
   2. Trr/Qrr Board: trr/ Qrr/ Irrm
   3. dv/dt for MOSFET and Diode





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Questions

CoreTek克達科技

- 在電容量測部分，有提到非常低的Crss，我們公司在GaN開發時也常遇到無法測試封裝好元件到低於1pF的結果，但換算起來的確GaN Crss的確會這麼低，請問是用什麼方式克服的:
  - GaN的切換速度非常的快，其中很關鍵的因子就是非常低的Crss(Qg也是非常低)，在量測過程中，除了需要考慮線路的補償(capacitor compensation)外，還需要想辦法去除測試電路的耦合作用，禧恩科技有針對DFN8*8/ DFN5*6封裝推出專用版，可以讓GaN封裝元件正確量測低至300fF，有興趣的朋友可以跟克達科技/禧恩科技業務洽詢。
- 請問貴司所設置的委測實驗室，有哪些配置，是否對外開放:
  - 禧恩科技委測實驗室有下列配置: DC部分備有4156C/ B1500A/ B1505A/ B1506A數套，以及針對不同電壓電流的探針台(fA~300A/ 3,000V)；AC部分有手動以及自動化(建置中)Double Pulse Tester數套。可以提供客戶非常完整的靜態/動態datasheet測試項目，熱阻部分也有配合廠商可以提供完整方案，在禧恩科技可以得到非常完整的WBG datasheet特性分析，有興趣的朋友可以跟克達科技/禧恩科技業務洽詢。
- 請問貴公司所提供的探針台方案，是否有特別針對SiC/ GaN有特殊的配置，Rdson可以測到多低:
  - 禧恩科技開發的探針台MF/SF系列，針對WBG的GaN/ SiC分別有不同PKG/on-wafer配件，可以讓客戶快速選擇或切換需要測試的元件(高電壓/高電流/快速切換等)，Rdson的部分，PKG可以測試到700u ohm，探針可以到500u ohm。
- 剛演講中有提到Keysight B1505A/ B1506A，這兩個型號功能相近，實驗室建置時，該怎麼選擇:
  - 剛開始開發設計時，B1505A會比較合適，因為彈性比較大，但後期需要製作datasheet時，B1506A可以快速產生datasheet來的更為便利。以功能面來說，B1505A可以擴增10kV/ GaN C.C.(50us)功能，是有需要測試特殊車用模組或快充時，B1505A則提供一個更好擴增的平台。不管B1505A/ B1506A，禧恩科技都有非常完整的配套方案，有興趣的朋友可以跟克達科技/禧恩科技業務洽詢，來幫您配置最好最合適的方案。

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