



勢流科技

SIEMENS

2023年5月26日

# POWERTESTER PWT Post-Processing Tool-v2212 參數說明



葉元婷



精密儀器事業部/技術經理

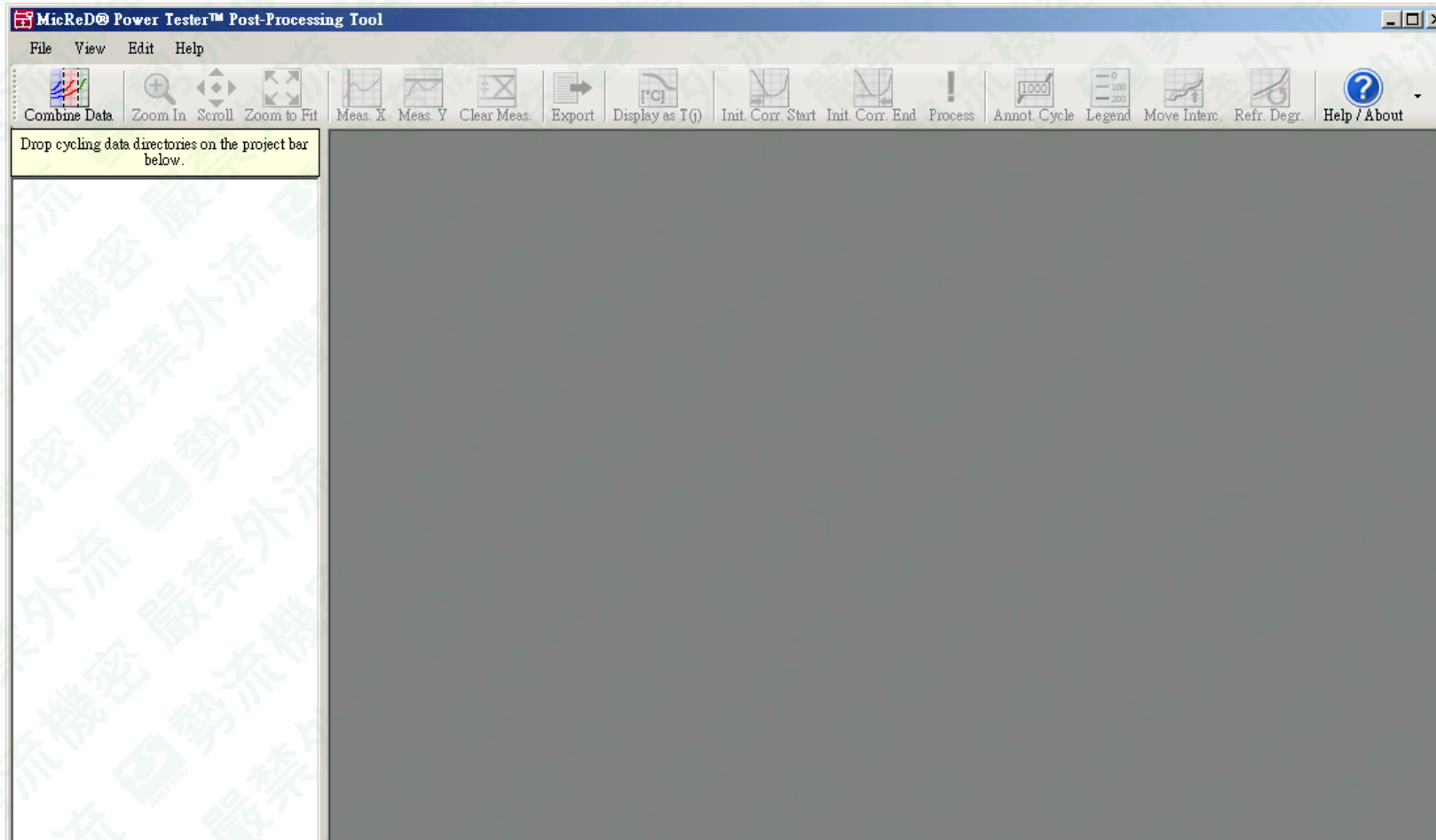


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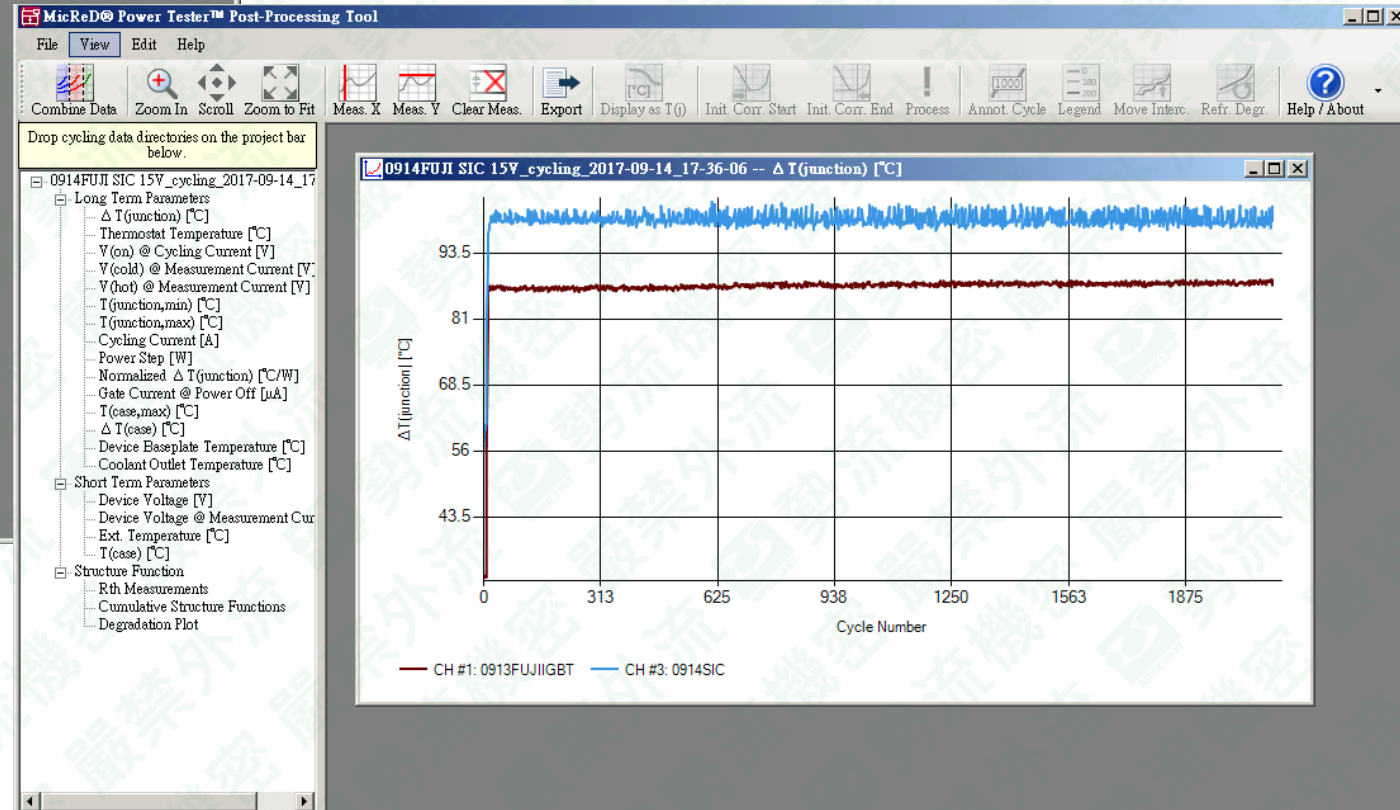
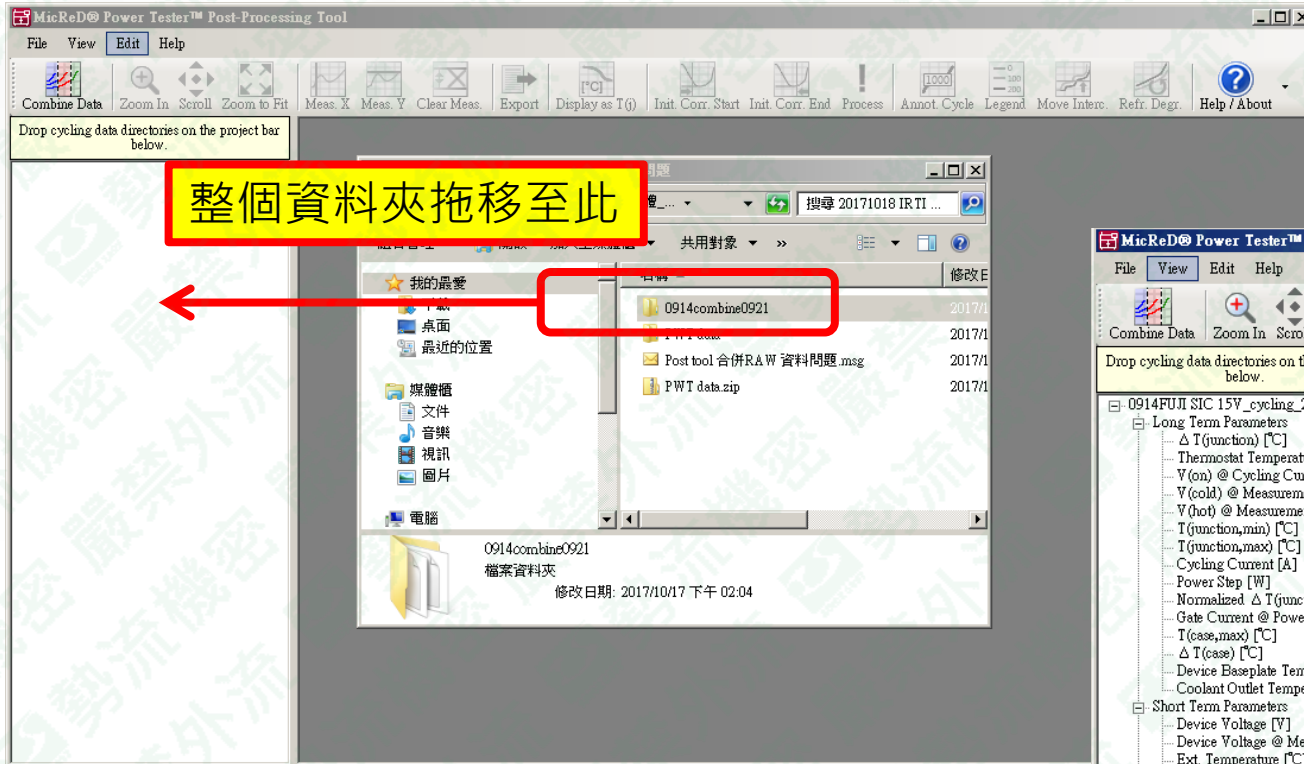
# 開啟軟體

➤ 點選PWT Post-Processing Tool



# 開啟測試檔案

➤ 將匯入至USB的資料，整個量測資料夾拖移至左邊空白處，即可開啟

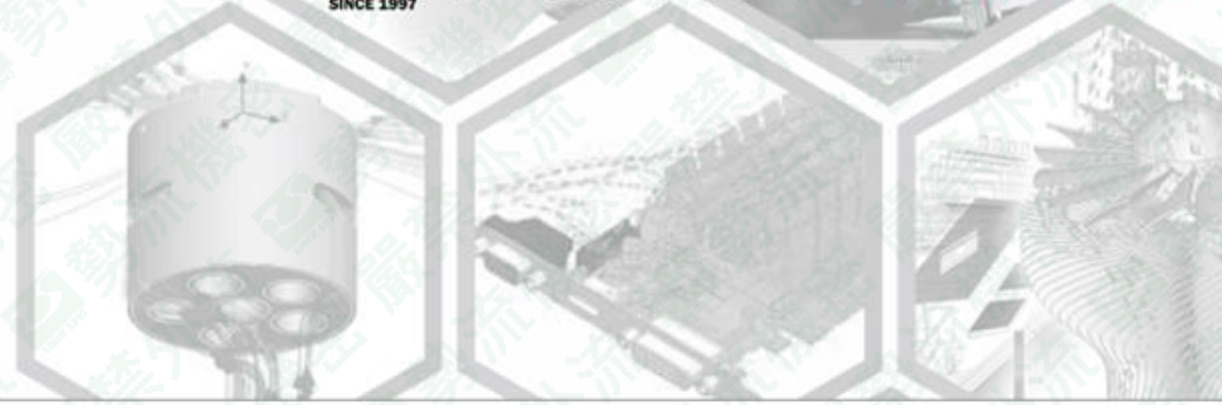


- 所有資料可區分為以下三種
1. Long Term Parameters
  2. Short Term Parameters
  3. Structure Function



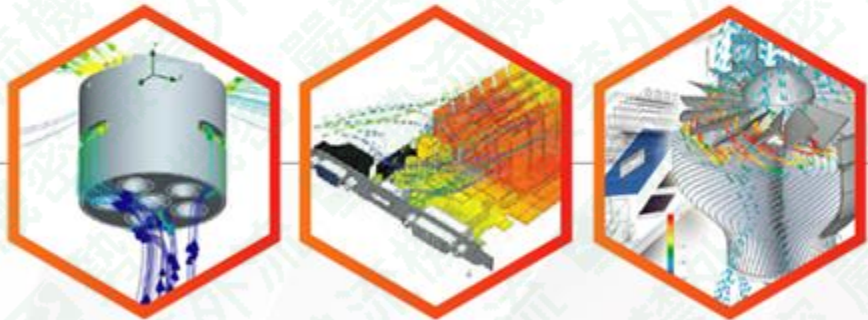
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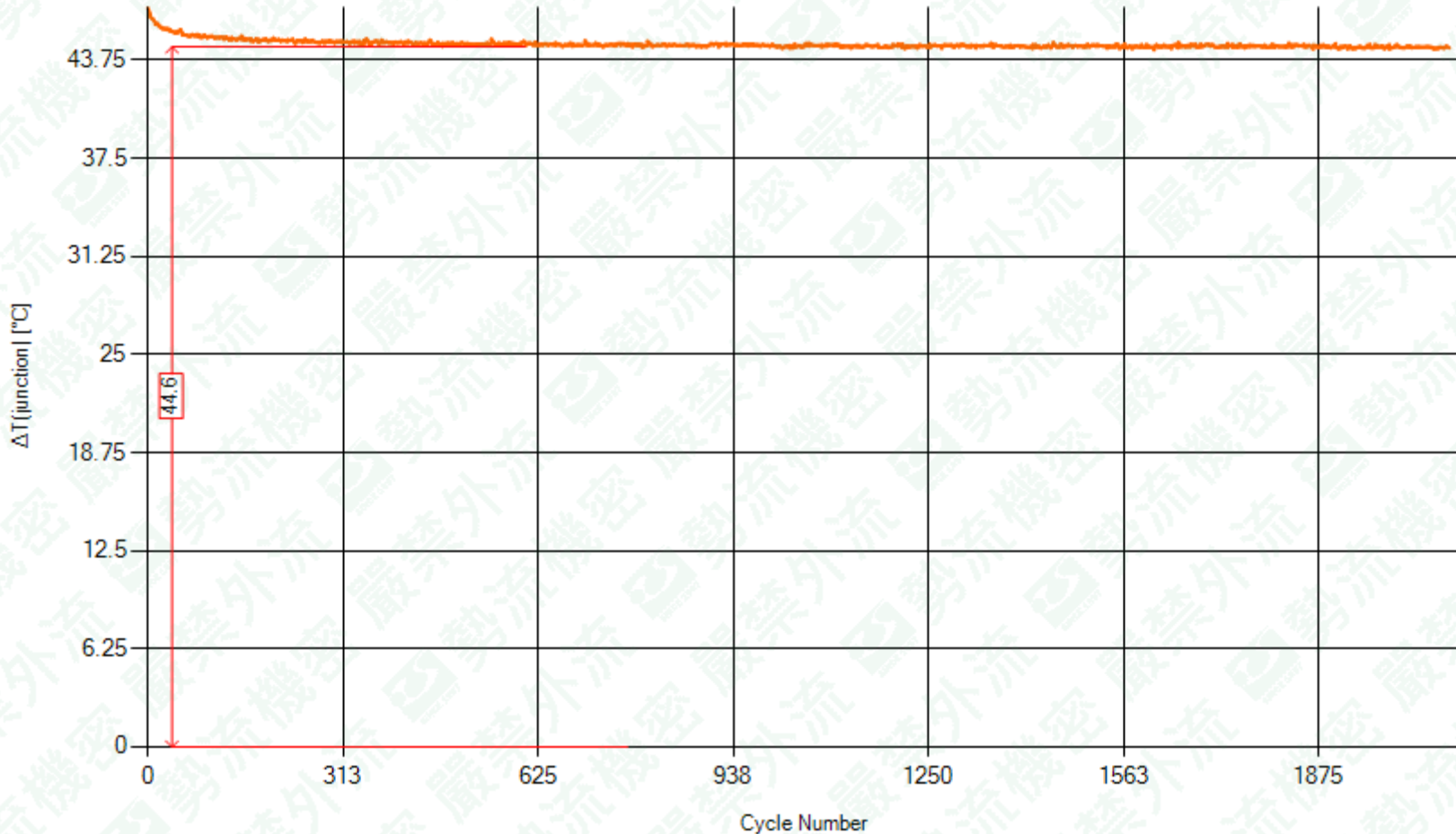
# Long Term Parameters

每一個迴圈中紀錄熱與電性數據



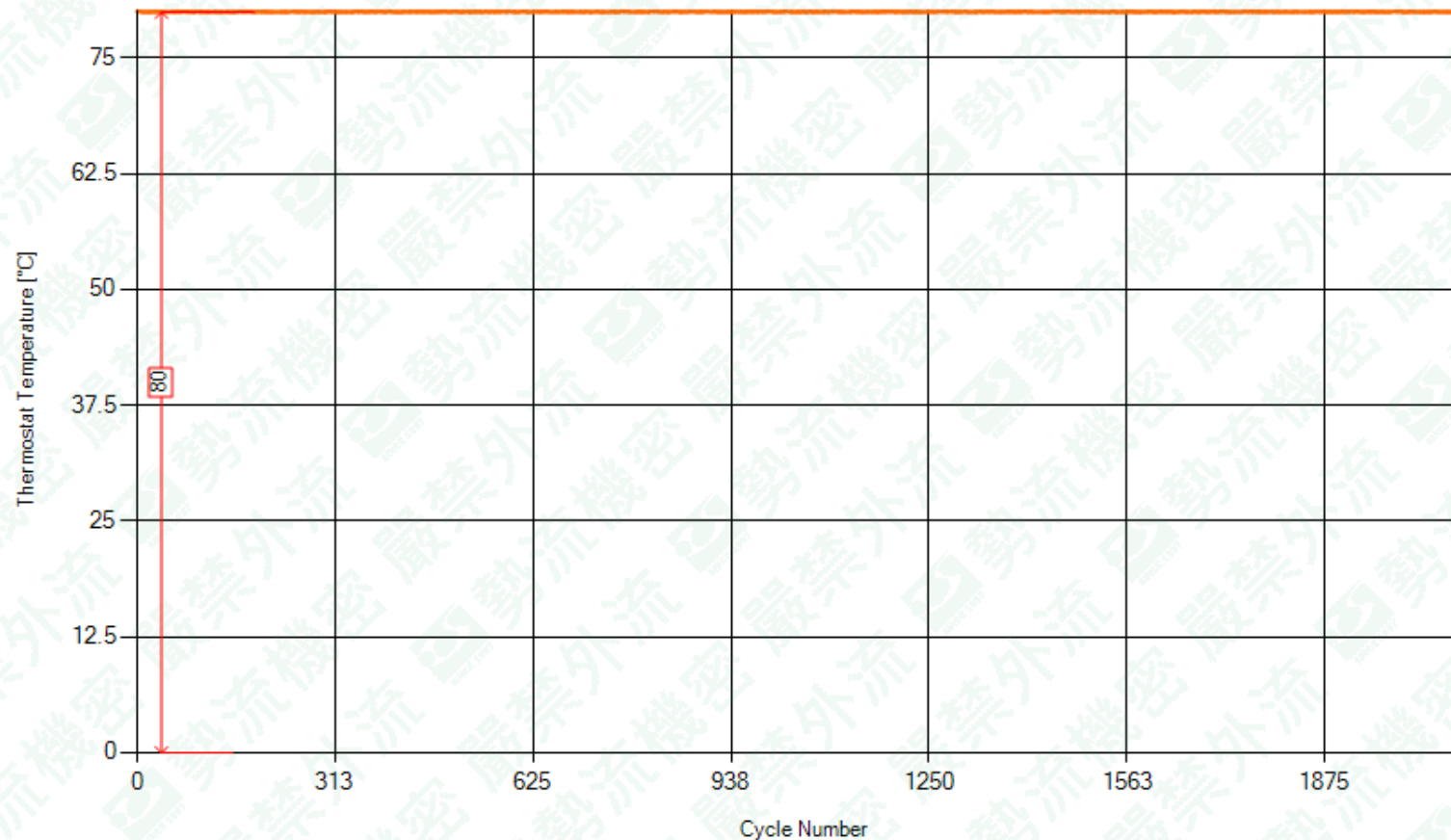
# Long Term Parameters- $\Delta T$ (junction)

$\Delta T$  (junction)顯示每個功率迴圈(Power cycling)執行時，待測物的晶片溫度變化，單位 $^{\circ}\text{C}$



# Long Term Parameters -Thermostat Temperature(°C)

冰水機(Julabo)每個功率迴圈(Power cycling)執行時機台表頭溫度紀錄，單位°C

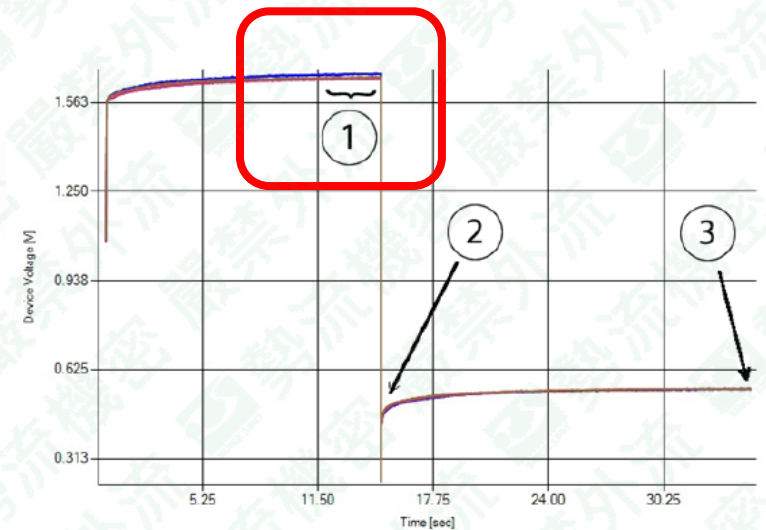


# Long Term Parameters -V(on) @ Cycling Current(V)

每個功率迴圈(Power cycling)執行時，cycling current電流運行下紀錄其電壓結果，單位V  
 系統數據擷取時間解析度約0.02秒，此V(on)數據會擷取switch off前的最後8筆取平均做紀錄



※若為body diode或diode測試模式，此Y軸表示Vf

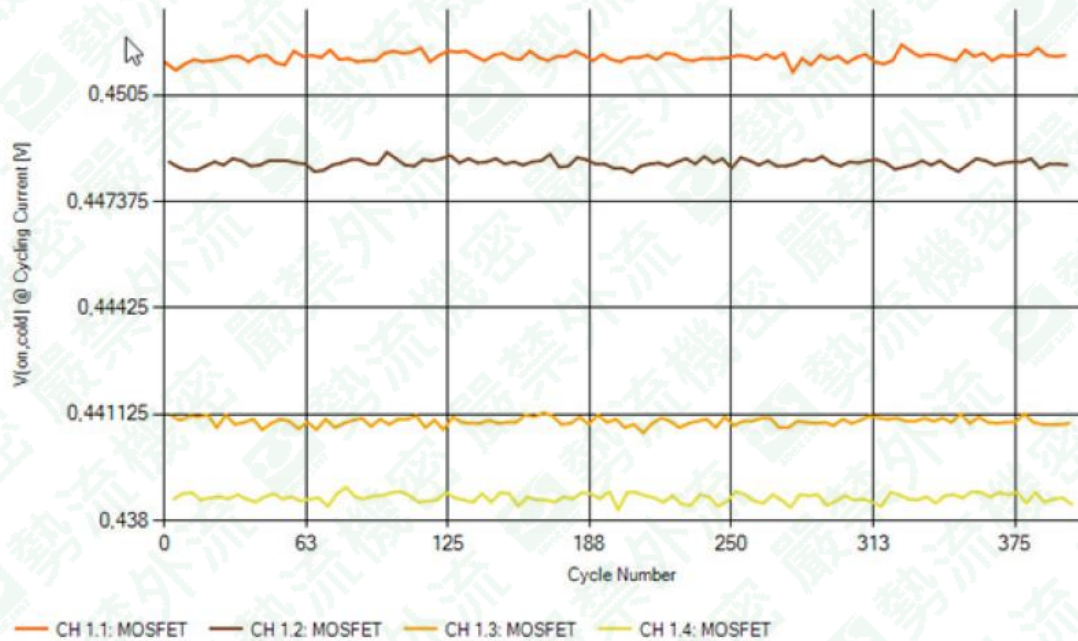
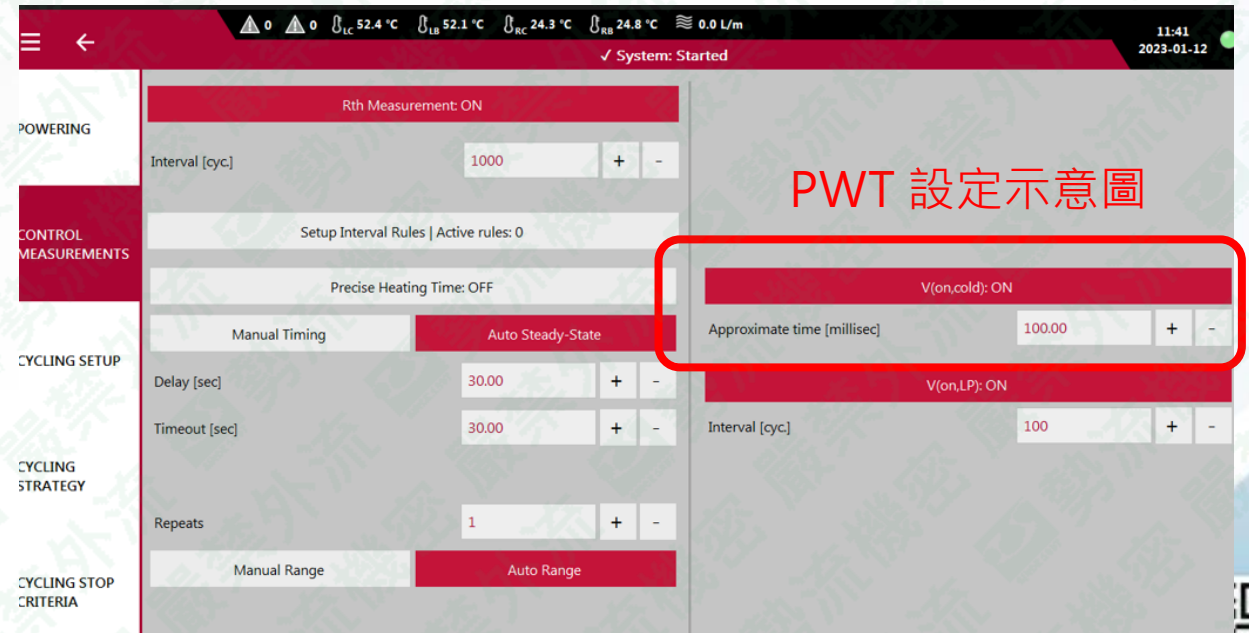


此數據擷取之電壓值在位置①



# Long Term Parameters -V(on, cold) @ Cycling Current(V)

每個功率迴圈(Power cycling)執行時，cycling current電流運行下紀錄其電壓結果，單位V  
 此電壓結果將採用User設定的特殊delay時間進行擷取，可以選擇記錄不被溫度影響之  $V_{DS}$  電壓值  
 $V_{(on)}$ 數據會擷取指定時間後的前8筆取平均做紀錄

**PWT 設定示意圖**

- POWERING: Rth Measurement: ON
- CONTROL MEASUREMENTS: Interval [cyc] 1000
- Setup Interval Rules | Active rules: 0
- Precise Heating Time: OFF
- Manual Timing: Auto Steady-State
- Delay [sec] 30.00
- Timeout [sec] 30.00
- CYCLING STRATEGY: Repeats 1
- CYCLING STOP CRITERIA: Manual Range / Auto Range
- V(on,cold): ON** (highlighted): Approximate time [millisec] 100.00
- V(on,LP): ON: Interval [cyc] 100



# Long Term Parameters -V(on, LP) @ Cycling Current(V)

每個功率迴圈(Power cycling)執行時，user自定義降額電流運行下紀錄其電壓結果，單位V  
 User需指定特殊的降額電流還有cycle數量進行



System: Started

POWERING: Rth Measurement: ON  
 Interval [cyc]: 1000

CONTROL MEASUREMENTS: Setup Interval Rules | Active rules: 0  
 Precise Heating Time: OFF

CYCLING SETUP: Manual Timing: Auto Steady-State  
 Delay [sec]: 30.00  
 Timeout [sec]: 30.00

CYCLING STRATEGY: Repeats: 1

CYCLING STOP CRITERIA: Manual Range: Auto Range

**V(on,cold): ON**  
 Approximate time [milled] 100.00

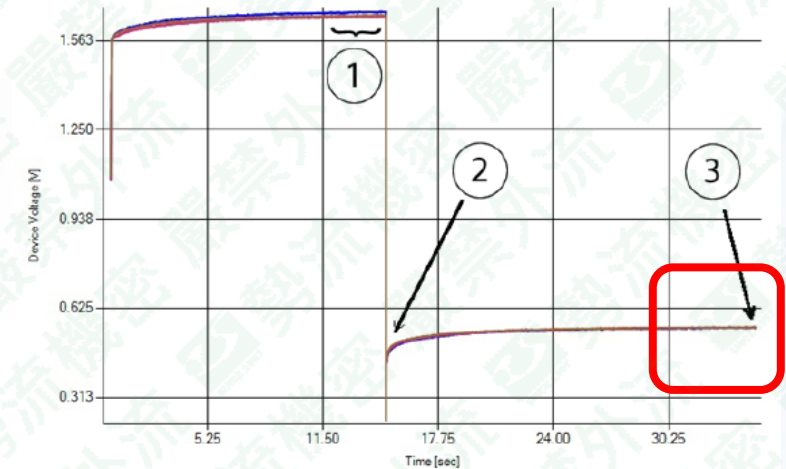
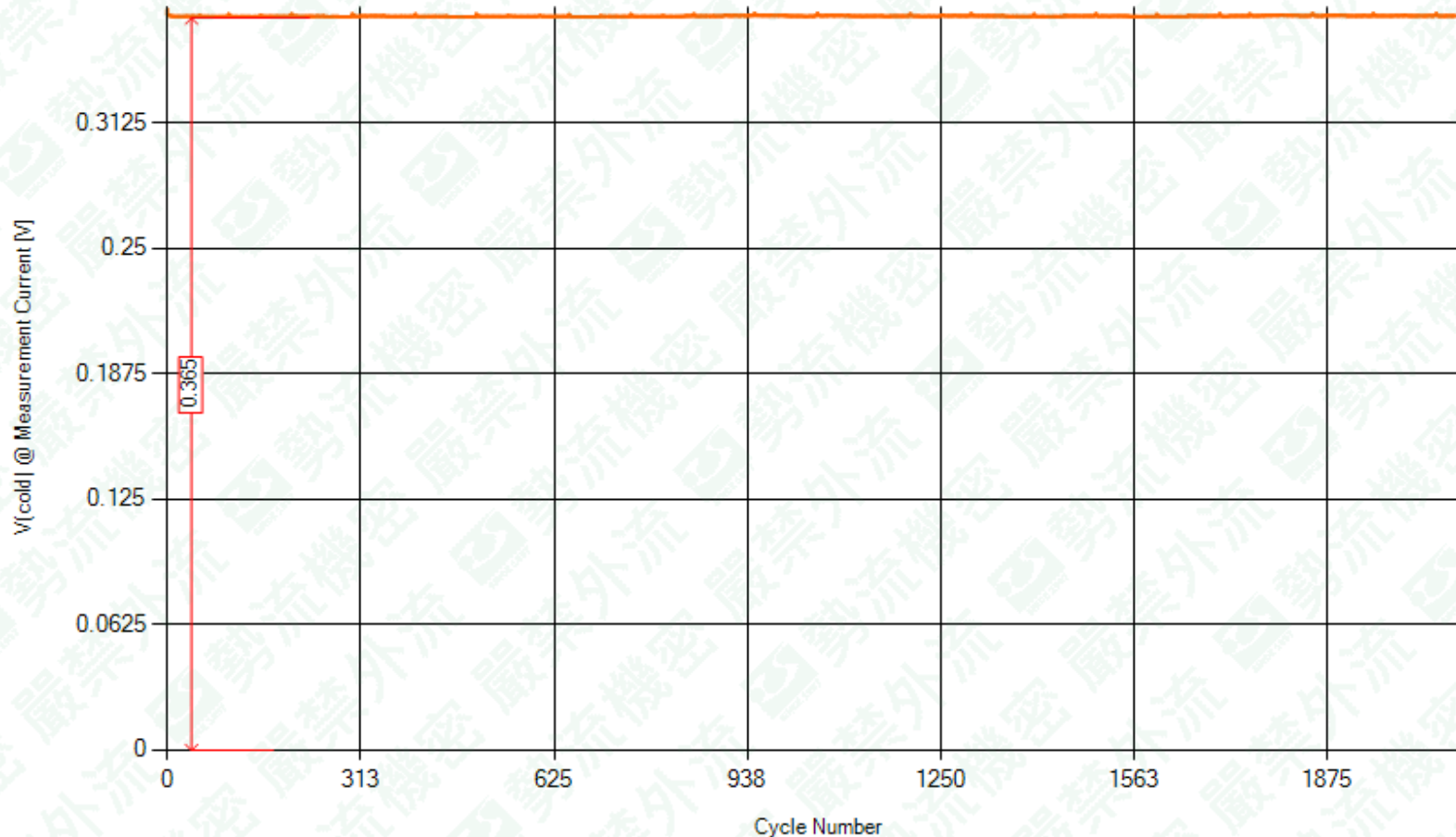
**V(on,LP): ON**  
 Interval [cyc] 100

PWT 設定示意圖



# Long Term Parameters -V(cold) @ Measurement Current(V)

每個功率迴圈(Power cycling)執行時，measurement current電流運行下，待測物已冷卻的狀態紀錄其電壓結果，單位V

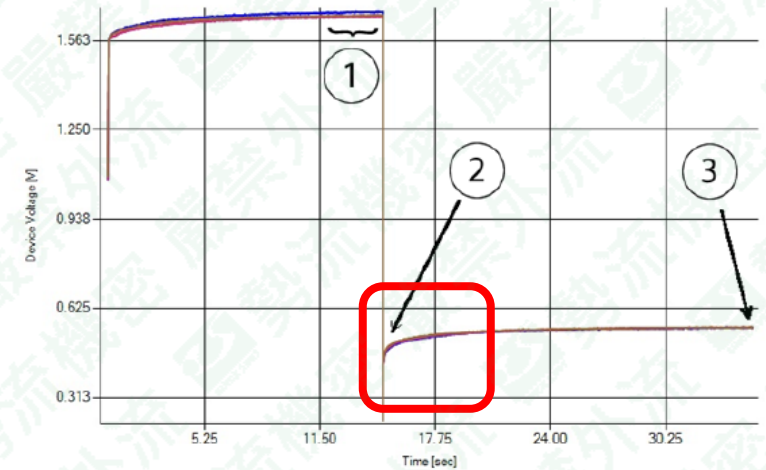
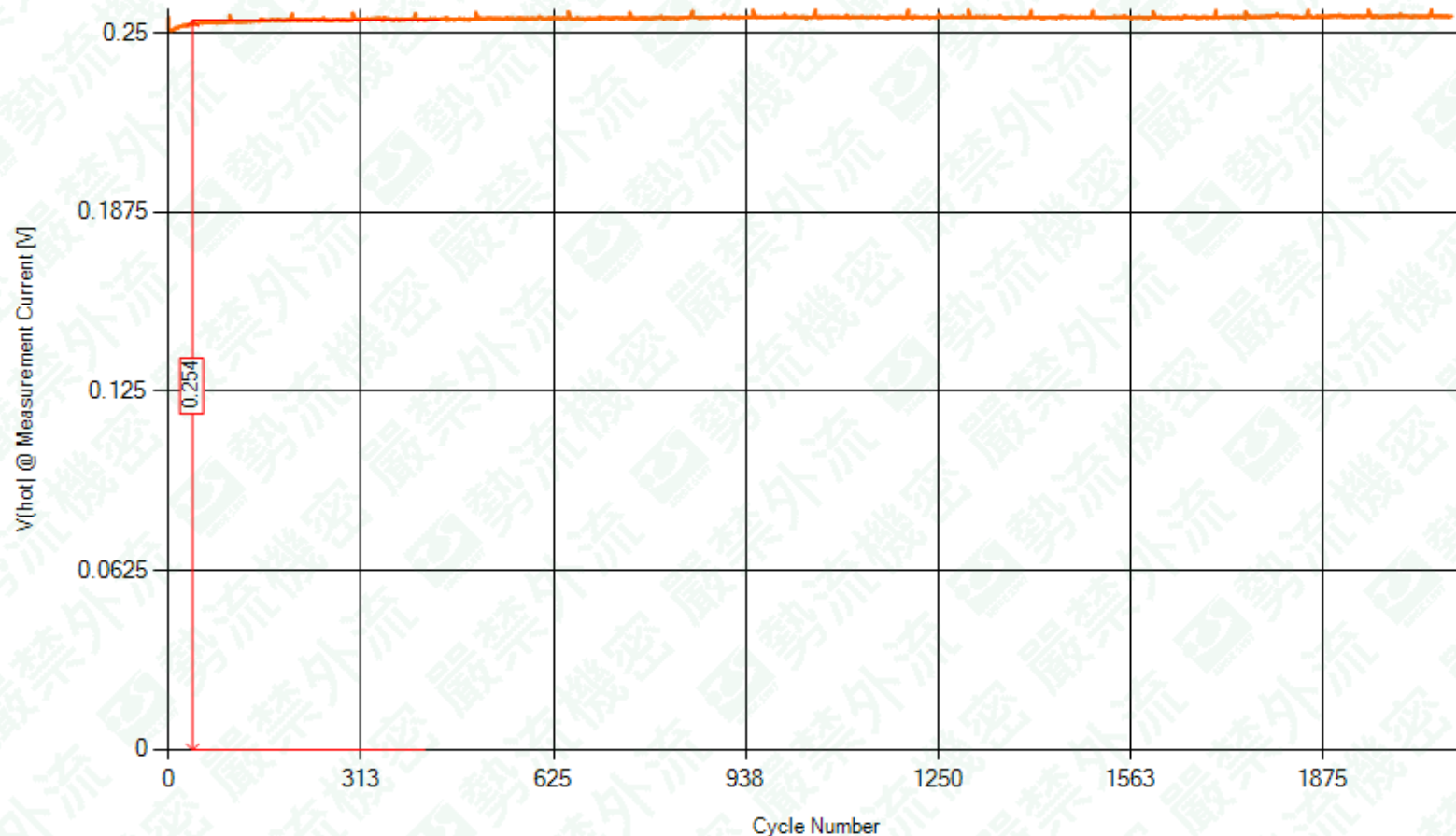


此數據擷取之電壓值在位置③  
cycling current關閉後已放置一段時間，故待測物為已冷卻狀態



# Long Term Parameters -V(hot) @ Measurement Current(V)

每個功率迴圈(Power cycling)執行時，measurement current電流運行下，待測物發熱的狀態紀錄其電壓結果，單位V。將採用一開始執行pre-test中square root的設定進行溫度補償

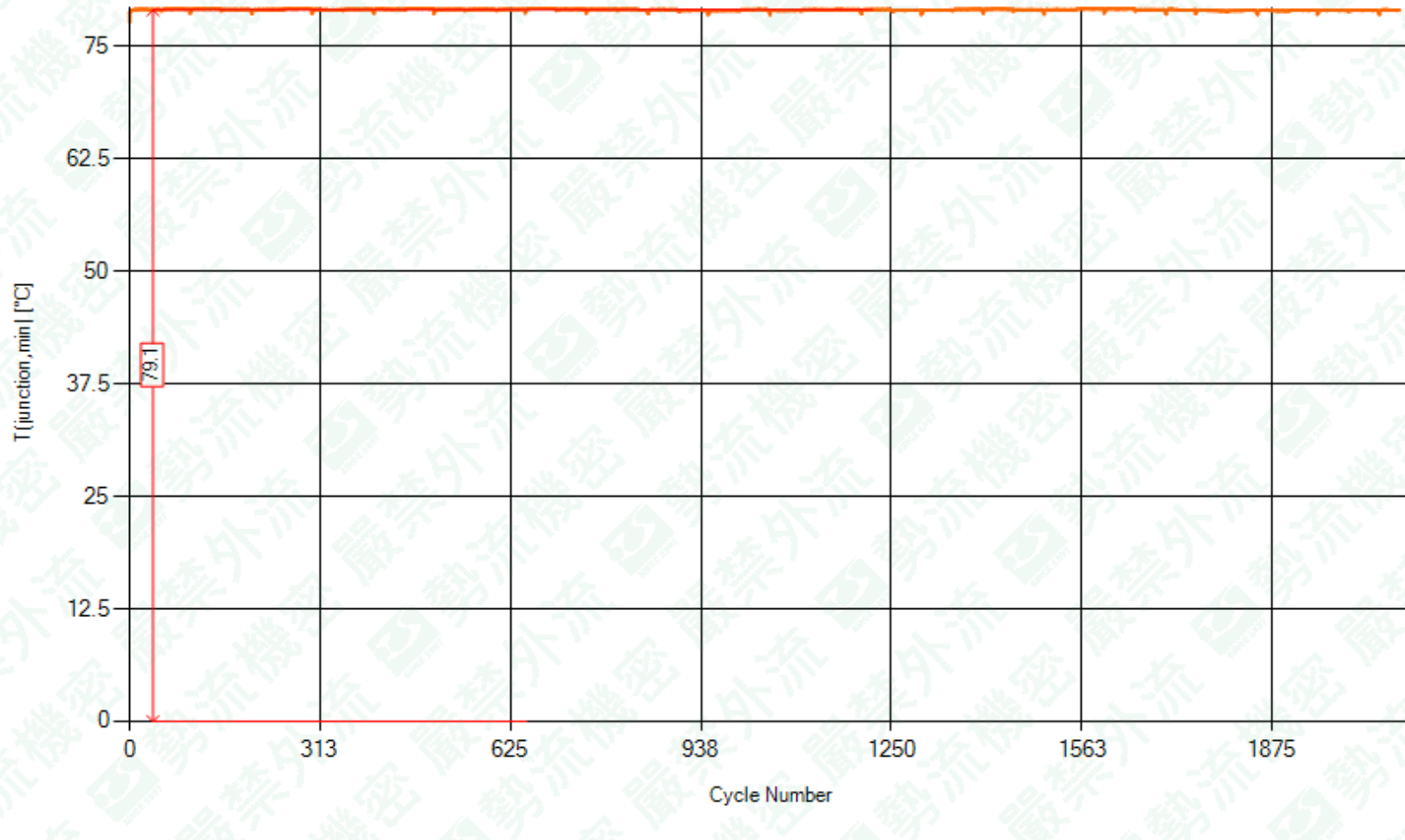


此數據擷取之電壓值在位置②  
 剛把cycling current關閉，故待測物為發熱狀態



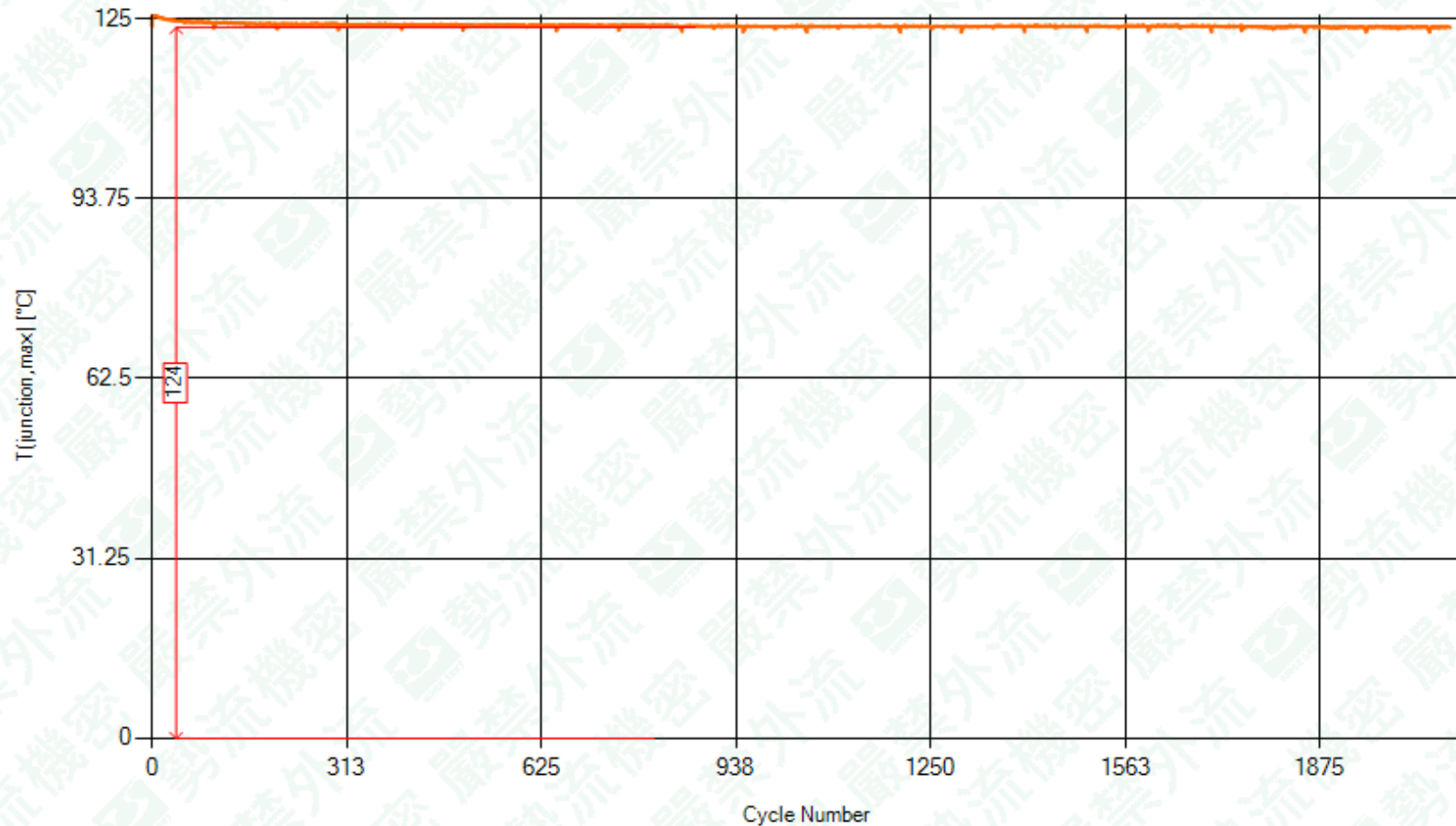
# Long Term Parameters -T (junction, min) (°C)

顯示每個功率迴圈(Power cycling)執行時，待測物的晶片最小溫度，單位°C  
 主要由V(cold) @ measurement current、TSP calibration結果計算出來



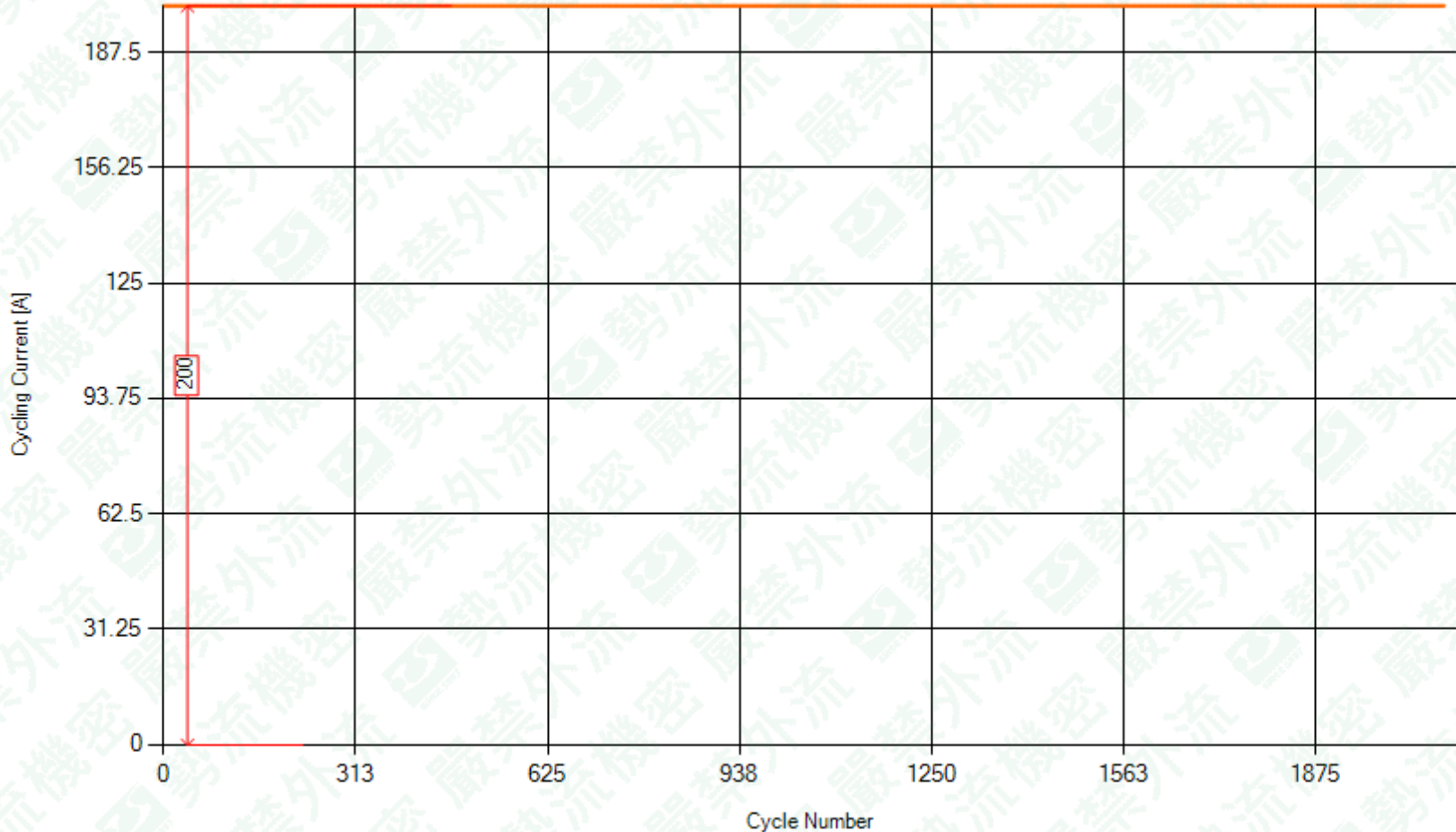
# Long Term Parameters - T(junction, max) (°C)

顯示每個功率迴圈(Power cycling)執行時，待測物的晶片最大溫度，單位°C  
 主要由V(hot) @ measurement current、TSP calibration結果計算出來



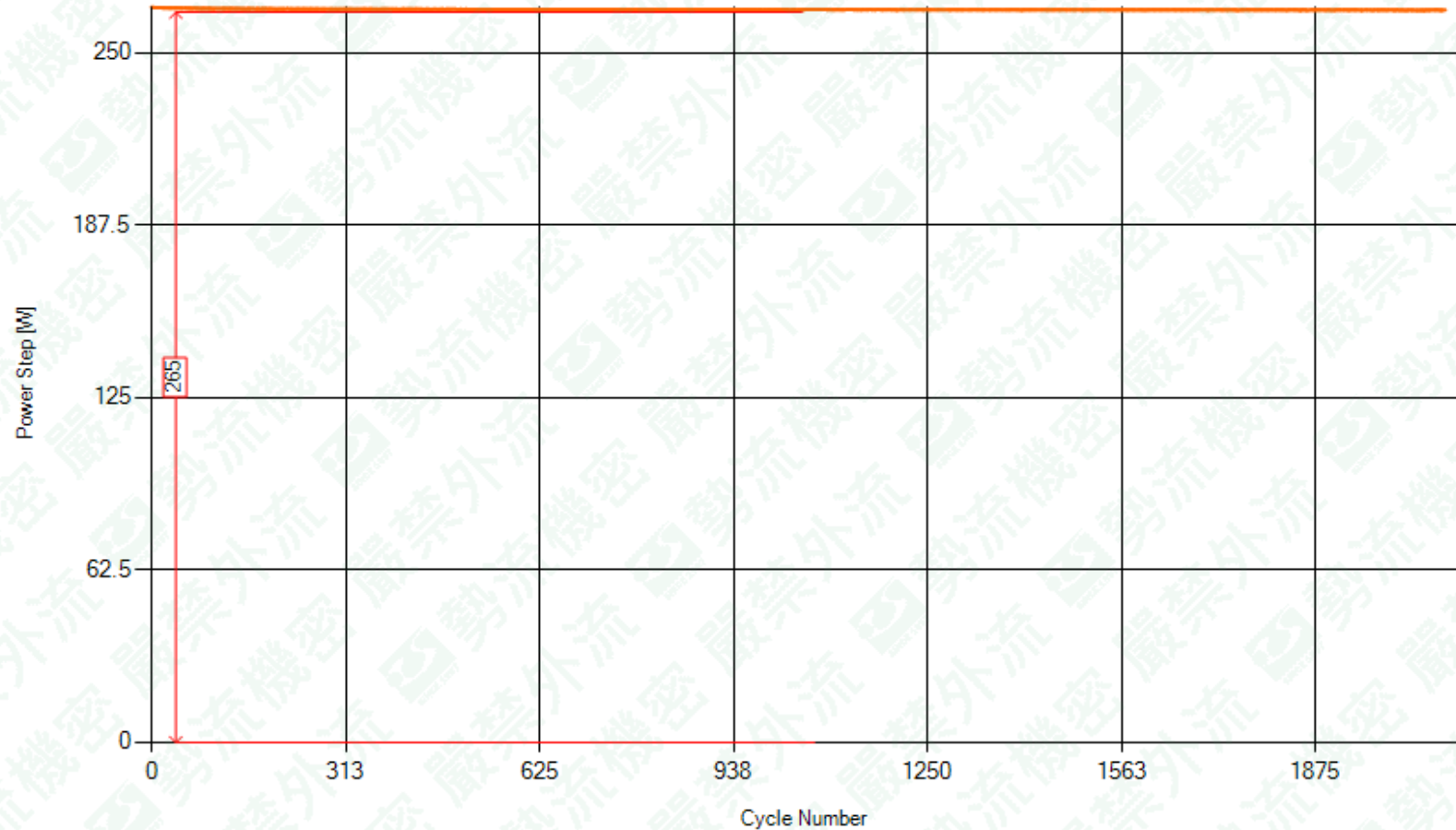
# Long Term Parameters -Cycling Current (A)

功率迴圈(Power cycling)執行時的電流值，單位A



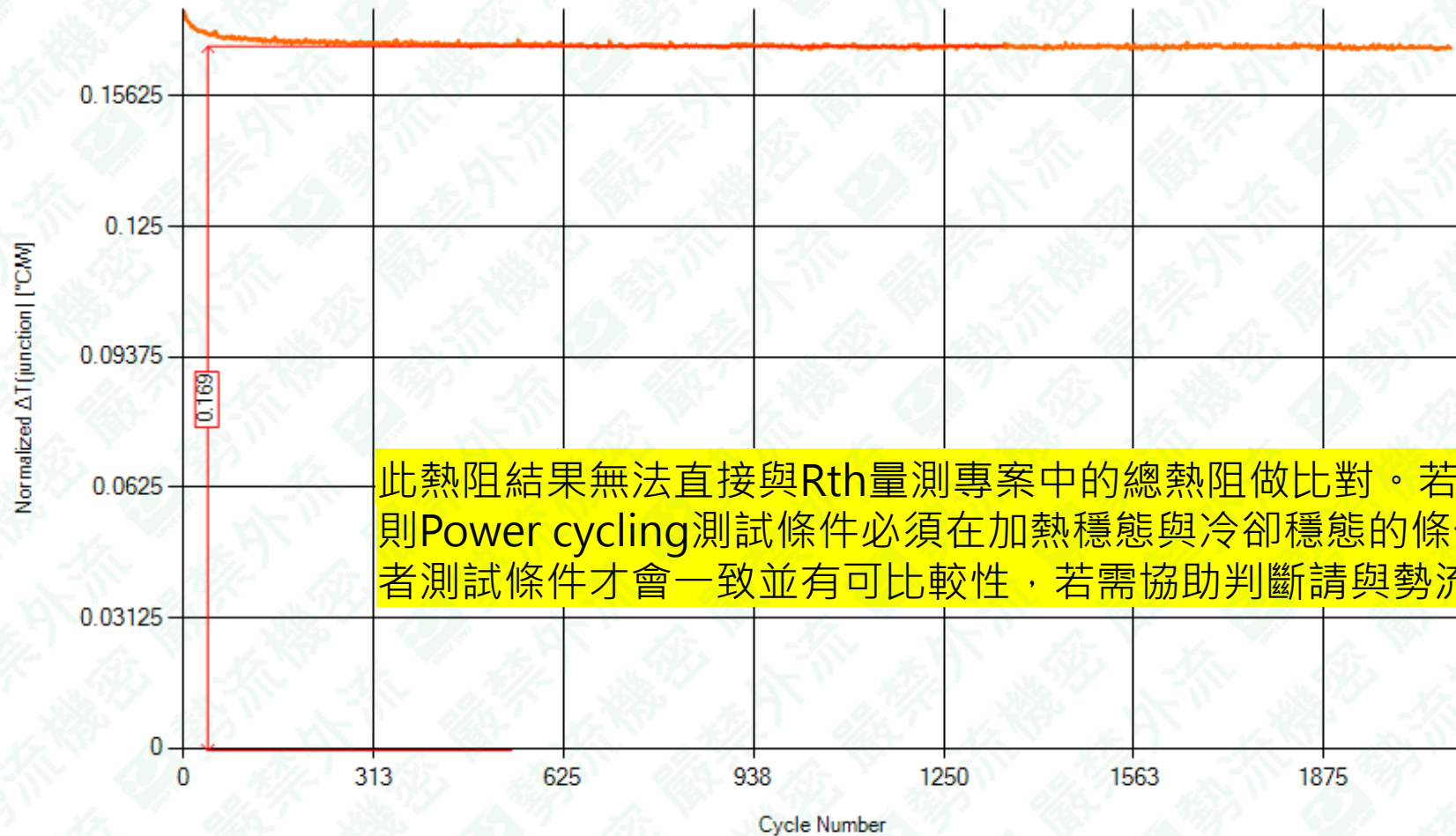
# Long Term Parameters -Power Step (W)

功率迴圈(Power cycling)執行時的Power值，單位W，可由cycling current與V(on)@cycling current相乘求得



# Long Term Parameters - Normalized $\Delta T$ junction( $^{\circ}\text{C}/\text{W}$ )

每個功率迴圈(Power cycling)執行時，待測物的熱阻變化，單位 $^{\circ}\text{C}/\text{W}$   
 可採用  $[T(\text{junction, max}) - T(\text{junction, min})] / \text{Power}$  求得



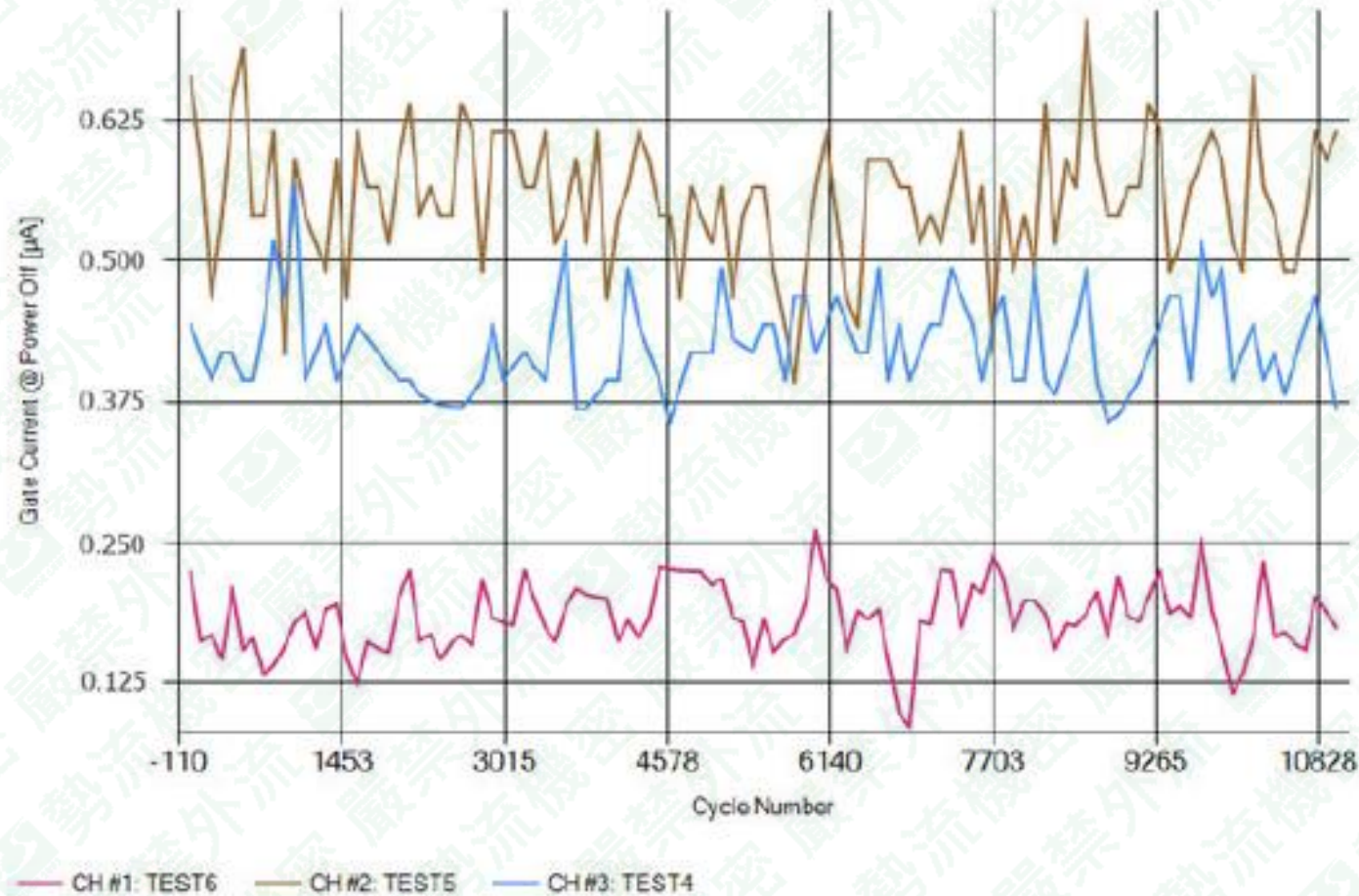
此熱阻結果無法直接與Rth量測專案中的總熱阻做比對。若要比對，則Power cycling測試條件必須在加熱穩態與冷卻穩態的條件下，兩者測試條件才會一致並有可比較性，若需協助判斷請與勢流聯繫





# Long Term Parameters -Gate Current @ Power off(uA)

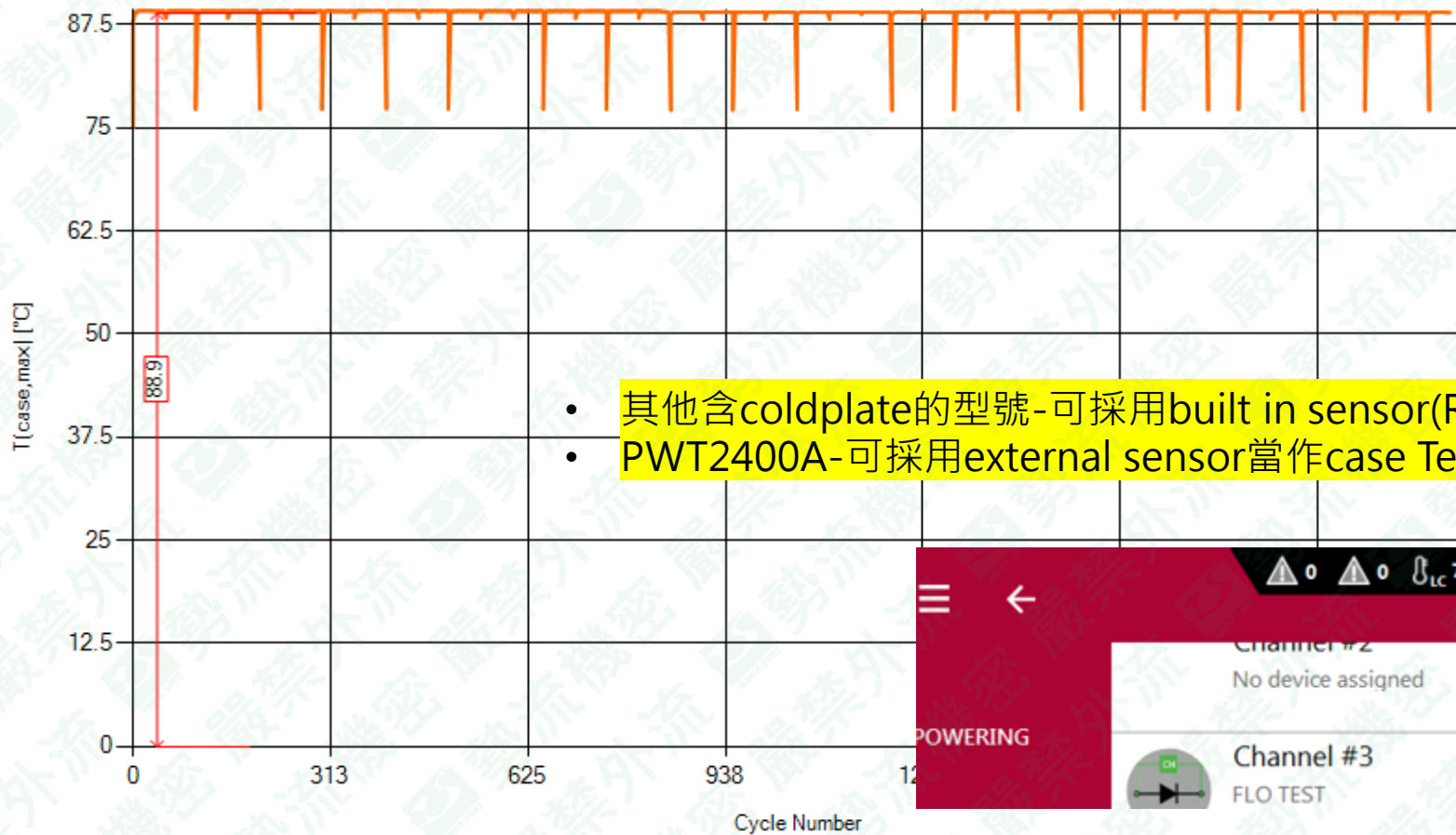
Gate Current在Power cycling switch off時啟動量測，單位uA  
 目前僅在MOSFET-saturation mode才有辦法開啟此功能



# Long Term Parameters -T (case, max) (°C)

顯示每個功率迴圈(Power cycling)執行時，待測物的最高殼溫，單位°C

POWERTESTER2400A與其他含coldplate的型號， assign case的流程有些不同，詳細可找勢流工程師討論

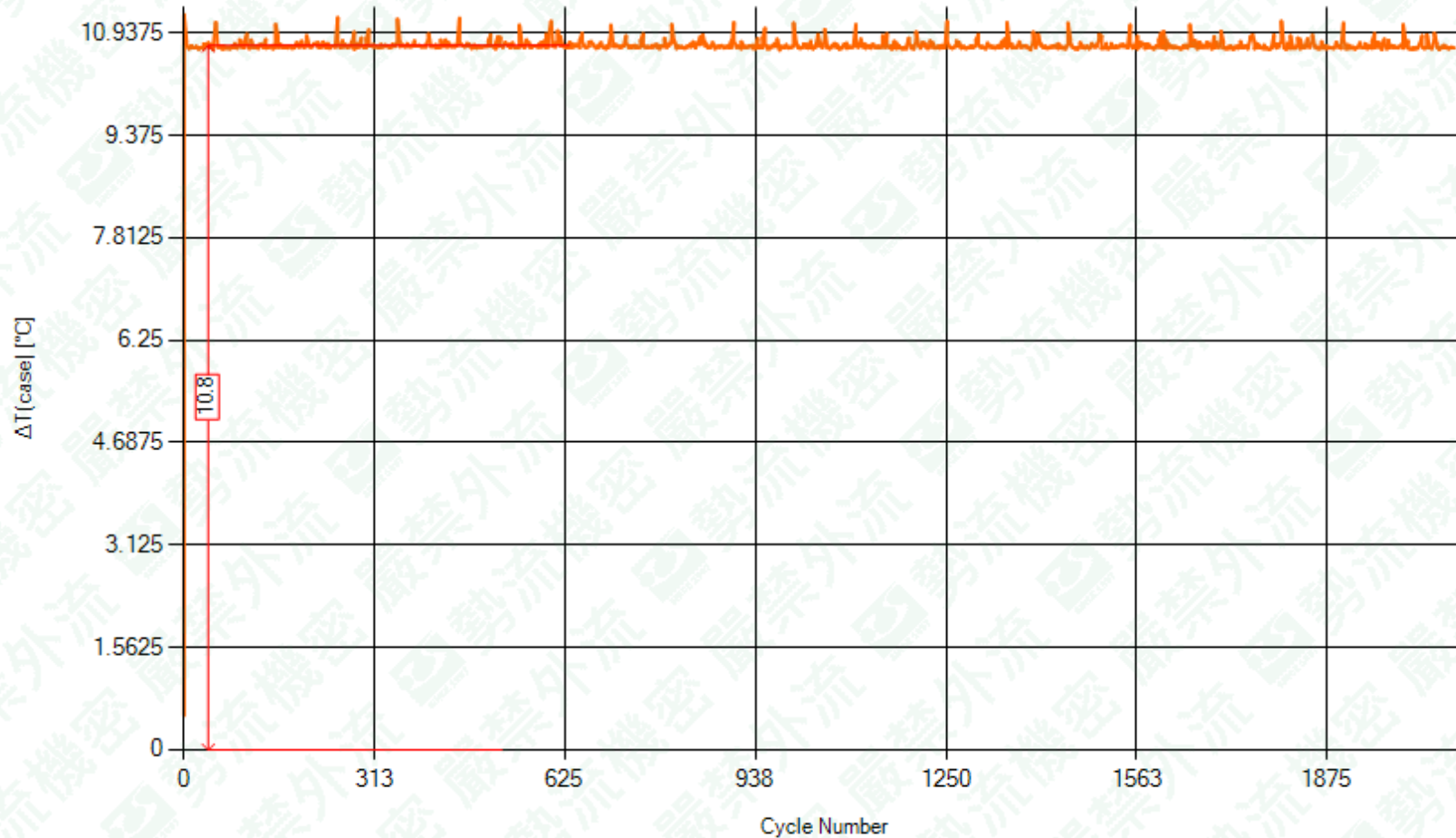


- 其他含coldplate的型號-可採用built in sensor(RB&LB)或external sensor當作case Temp
- PWT2400A-可採用external sensor當作case Temp

PWT其他含coldplate的型號

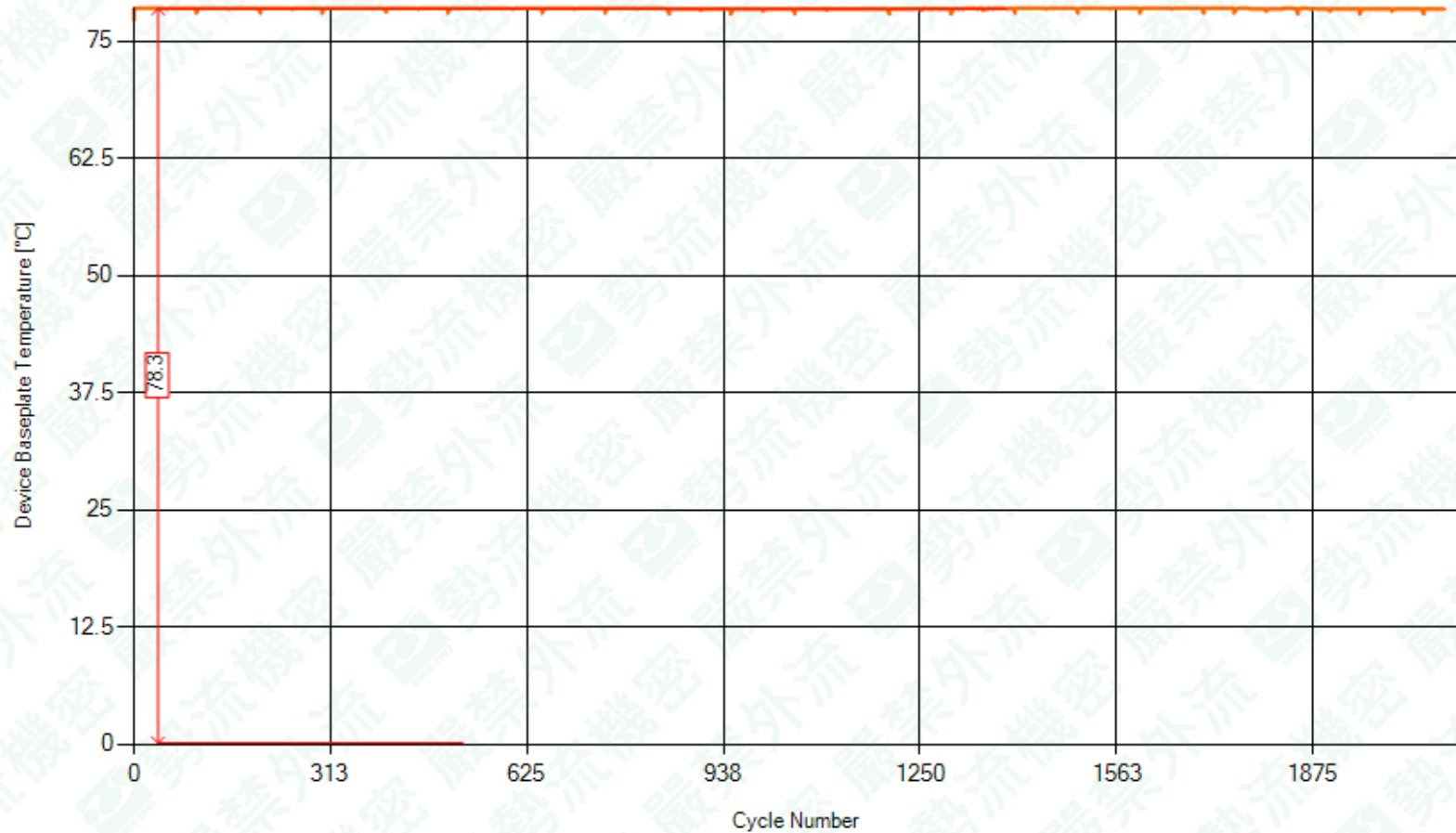
# Long Term Parameters - $\Delta T$ (case) ( $^{\circ}\text{C}$ )

顯示每個功率迴圈(Power cycling)執行時，待測物的殼溫溫度變化，單位 $^{\circ}\text{C}$



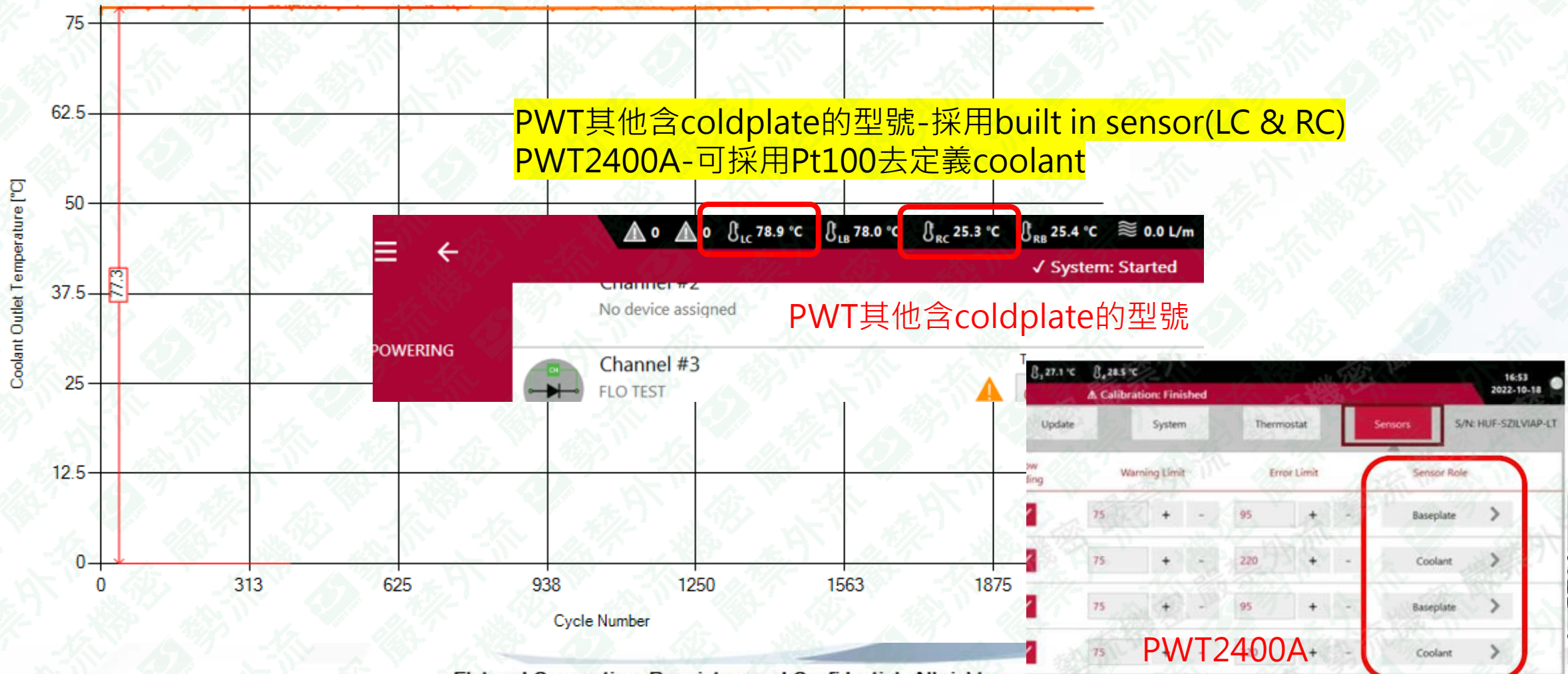
# Long Term Parameters -Device Baseplate Temperature (°C)

每個功率迴圈(Power cycling)執行時，由built in sensor記錄cycling current switch off情況下的溫度，單位°C



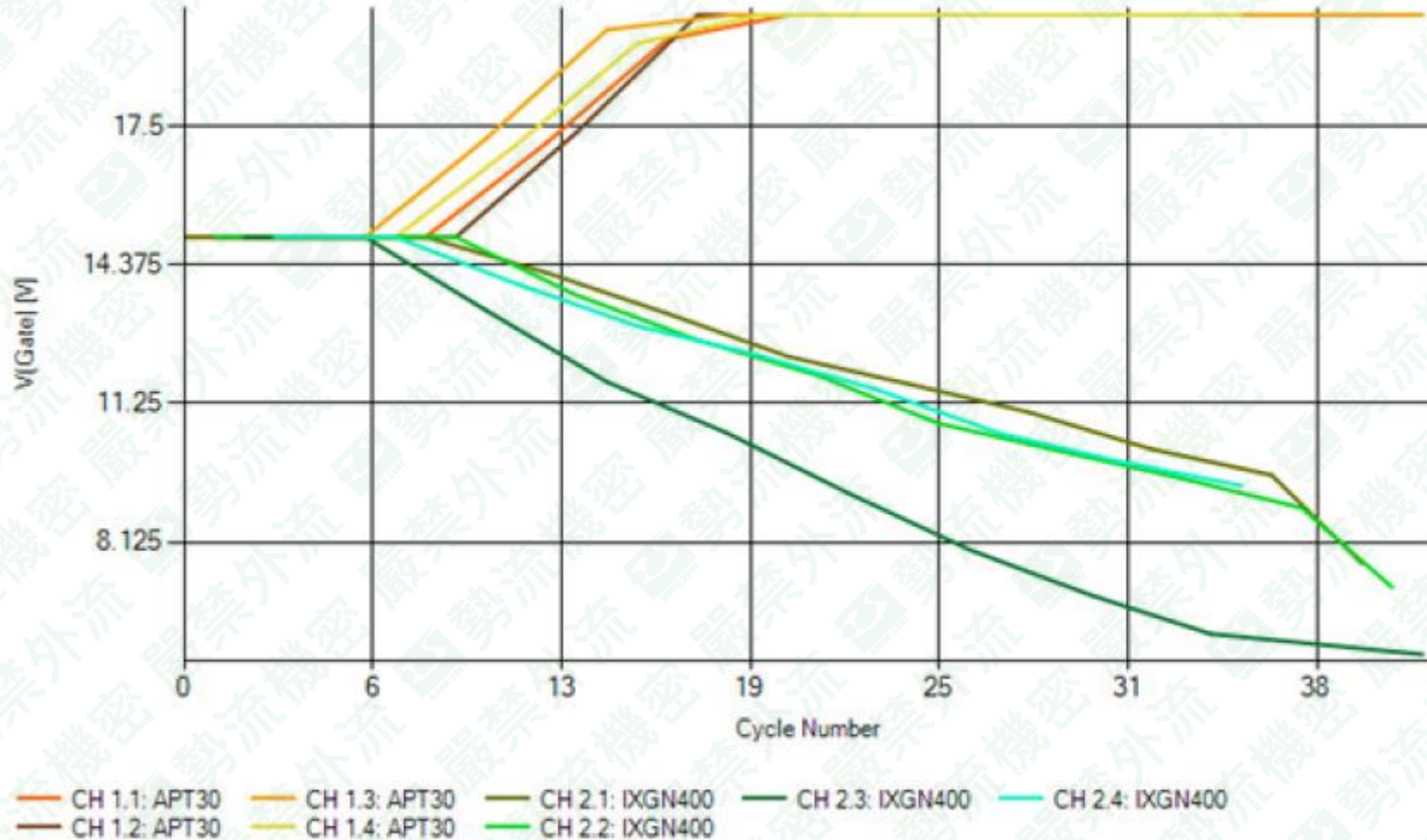
# Long Term Parameters -Coolant Outlet Temperature (°C)

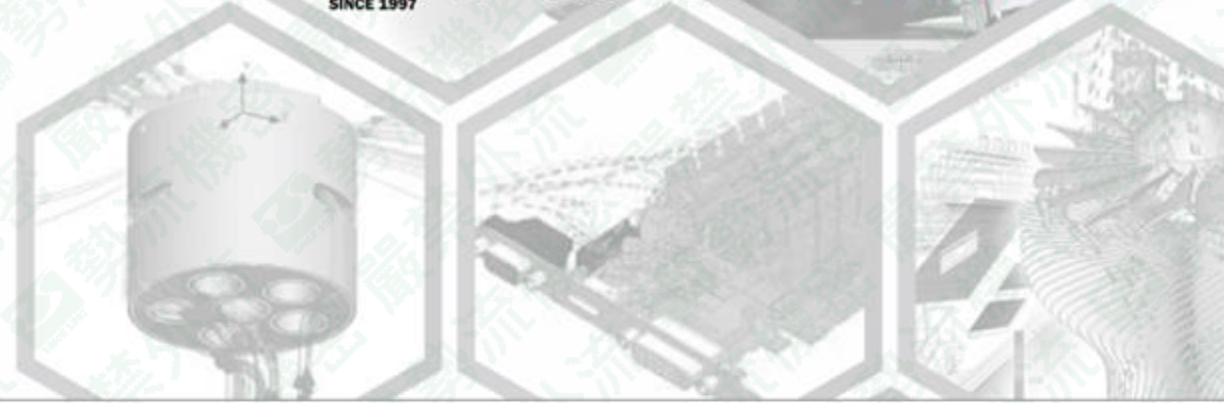
水冷循環出口端溫度，單位°C



# Long Term Parameters -V(gate)(V)

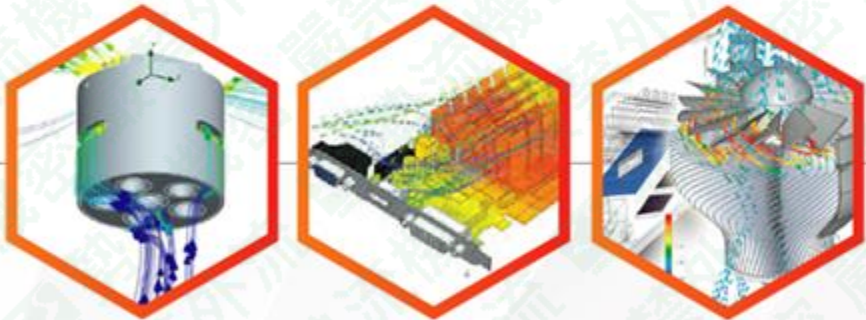
若功率迴圈專案測試採用 $V_{gate}$ 調整cycling current、Tj或Power，將會在此進行Gate電壓記錄，單位V





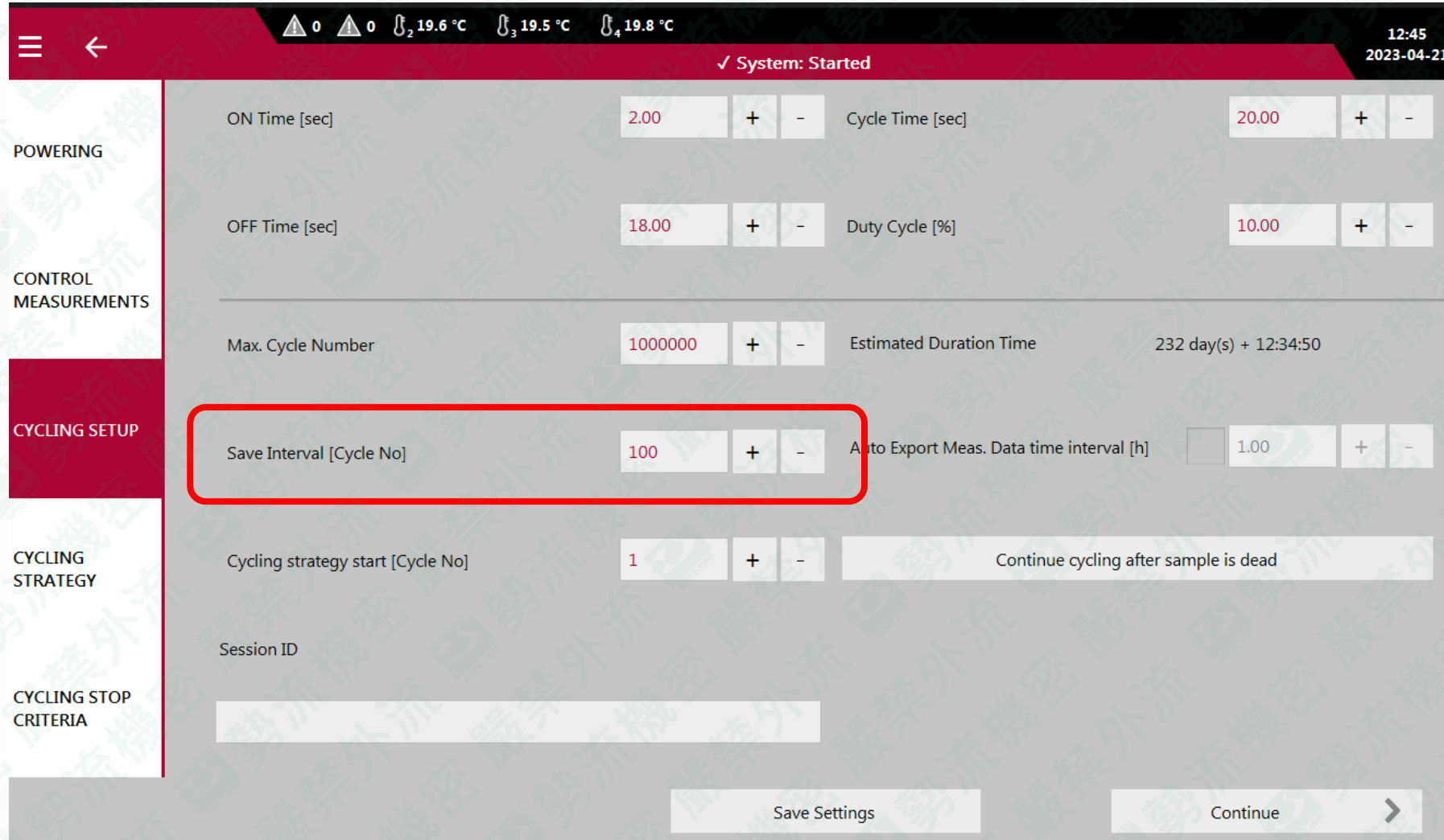
# Short Term Parameters

特定迴圈數中紀錄完整power cyclin的電壓、溫度變化



# Short Term Parameters

User可在功率迴圈(Power cycling)專案中指定**特定迴圈數**，讓系統依循此規則儲存完整的熱與電性數據



The screenshot shows a control interface for power cycling parameters. At the top, there are status indicators for three channels: 0, 0, 19.6 °C, 19.5 °C, and 19.8 °C. The system status is 'System: Started' with a checkmark, and the time is 12:45 on 2023-04-21. The interface is divided into several sections:

- POWERING:** ON Time [sec] (2.00), Cycle Time [sec] (20.00), OFF Time [sec] (18.00), Duty Cycle [%] (10.00).
- CONTROL MEASUREMENTS:** Max. Cycle Number (1000000), Estimated Duration Time (232 day(s) + 12:34:50).
- CYCLING SETUP:** Save Interval [Cycle No] (100), Auto Export Meas. Data time interval [h] (1.00).
- CYCLING STRATEGY:** Cycling strategy start [Cycle No] (1), Continue cycling after sample is dead (checkbox).
- CYCLING STOP CRITERIA:** Session ID (empty field).

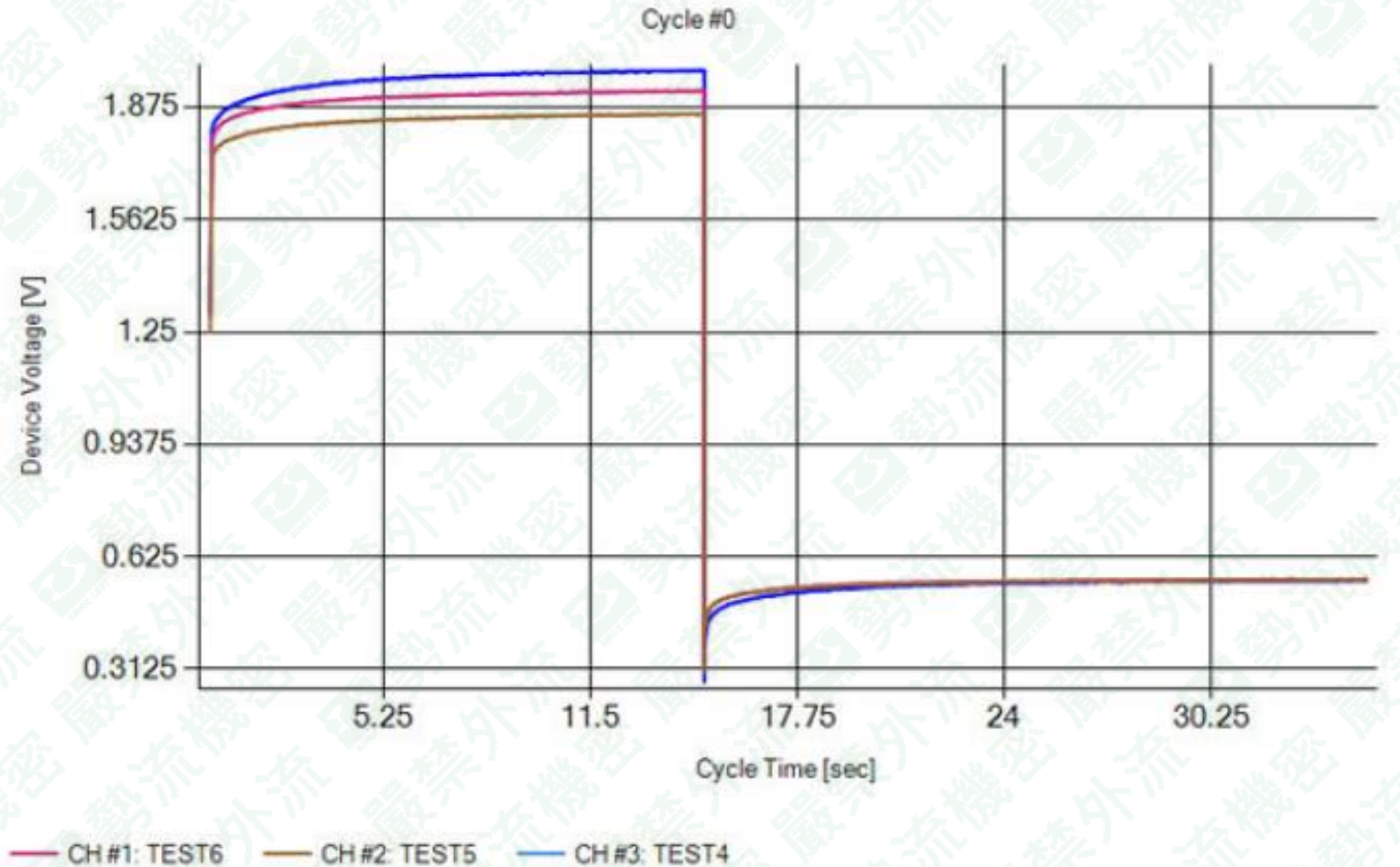
At the bottom, there are 'Save Settings' and 'Continue' buttons. A red box highlights the 'Save Interval [Cycle No]' field, which is set to 100.





# Short Term Parameters -Device Voltage (V)

特定功率迴圈(Power cycling)執行時，待測物在完整cycle的電壓變化，單位V



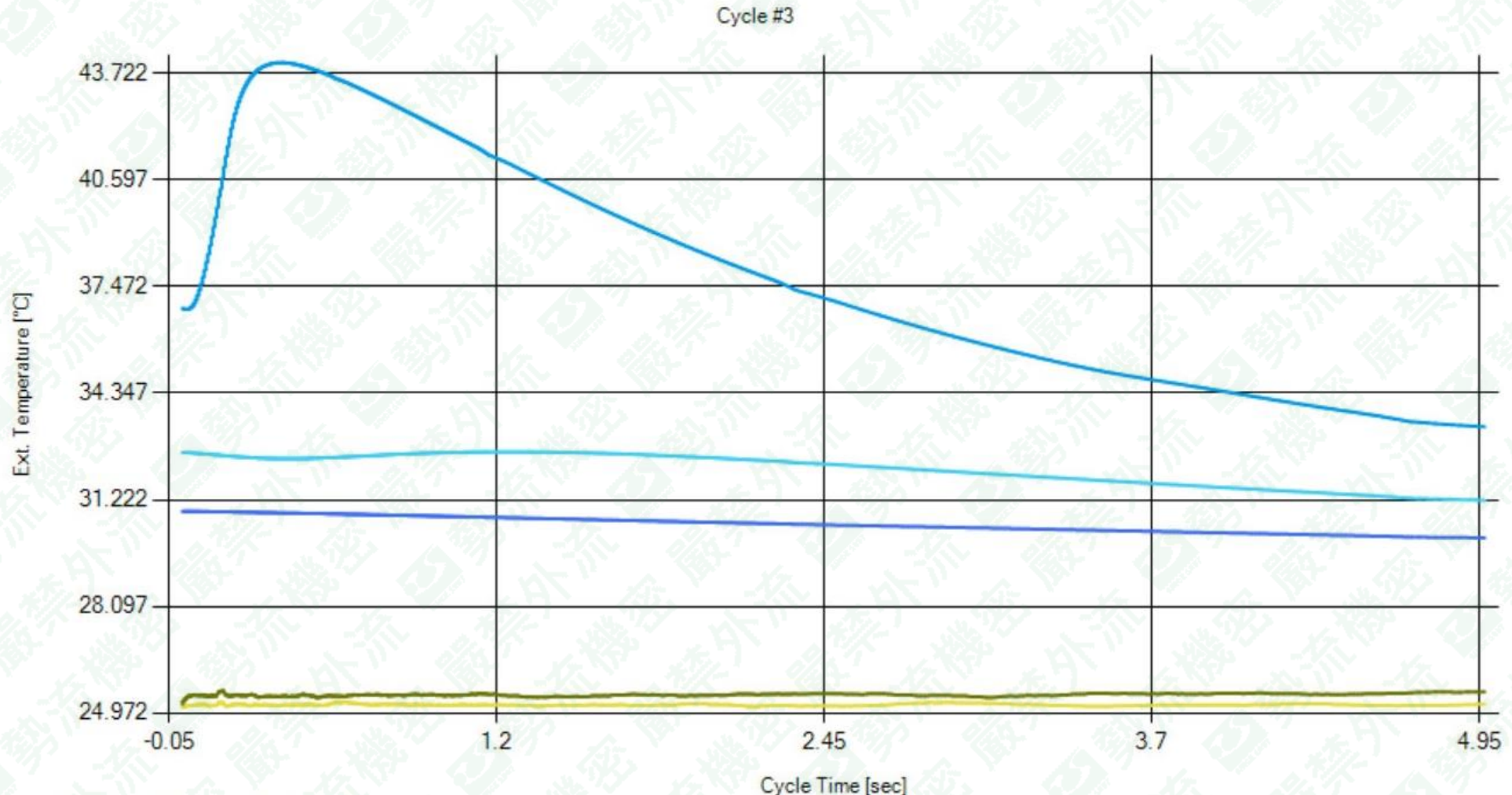
# Short Term Parameters – Device Voltage @ Measurement Current(V)

特定功率迴圈(Power cycling)執行時，待測物的measurement current之電壓變化，單位V  
 其前面實線為數據補償(擬合)的結果



# Short Term Parameters -Ext. Temperature (°C)

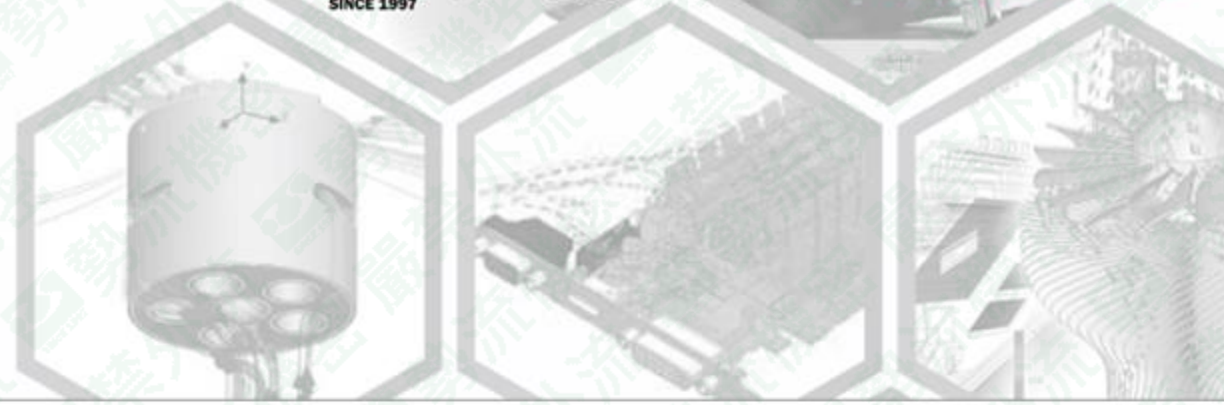
若有採用external sensor，特定功率迴圈(Power cycling)完整cycle的溫度變化則會紀錄在此圖示中





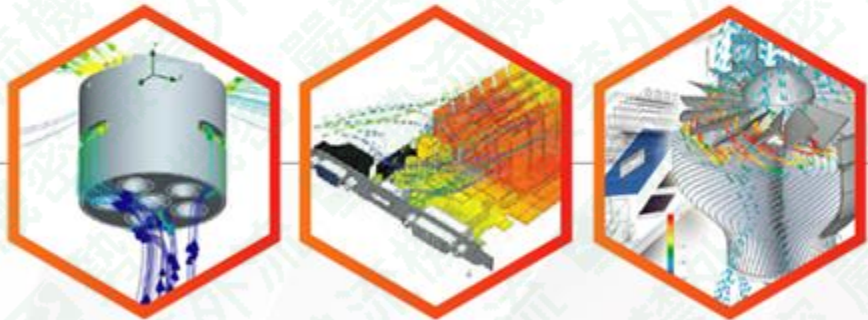
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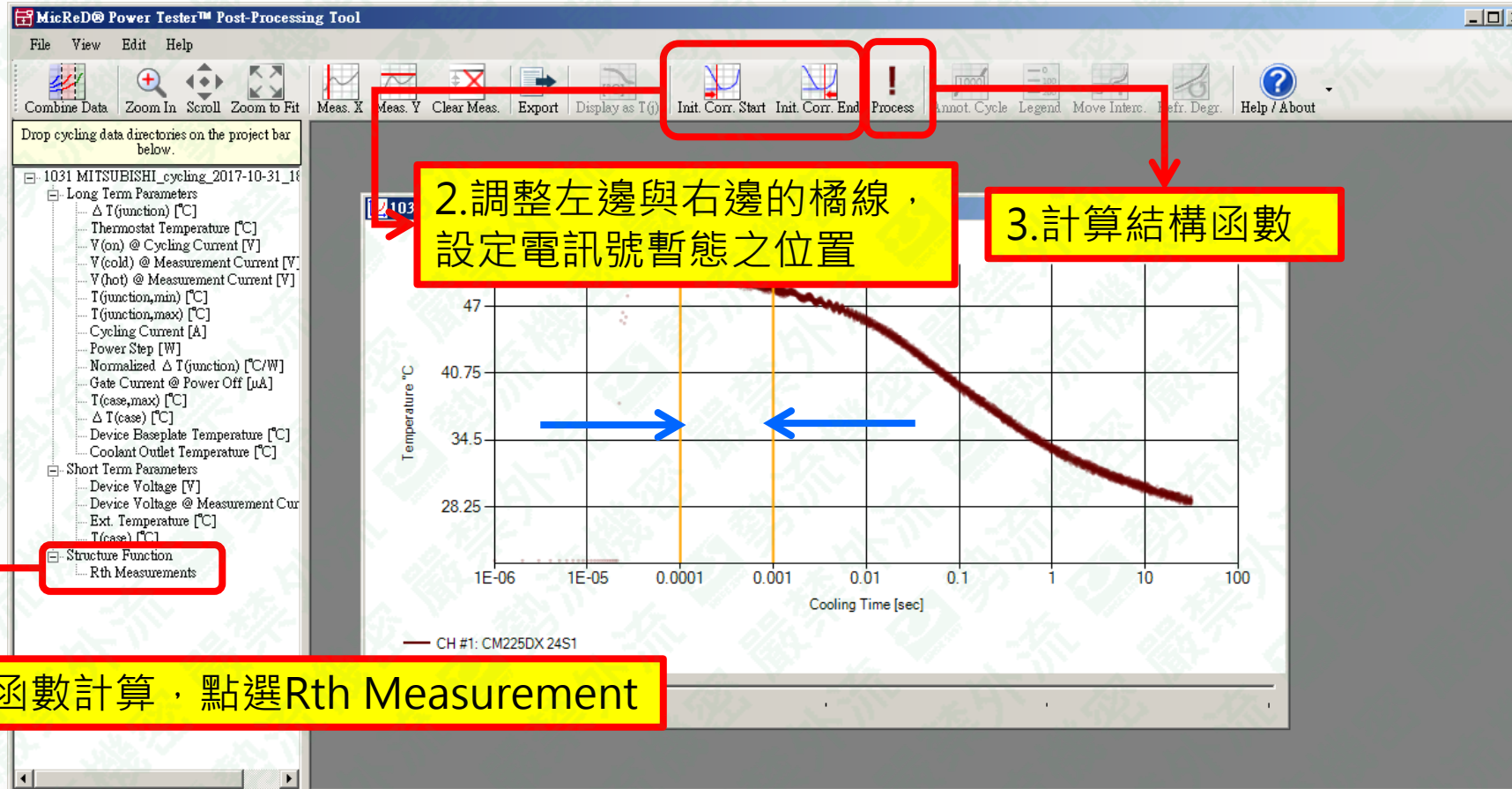
# Structure Function

特定迴圈數中量測暫態熱阻



# Structure Function

若在功率迴圈執行專案中選擇測試暫態熱阻(Rth measurement)，系統會依據user所設定的**特定迴圈數**執行暫態熱阻量測，一開始測試完的數據未經後處理無法看到結構函數，處理流程如下：



**1. 結構函數計算，點選Rth Measurement**

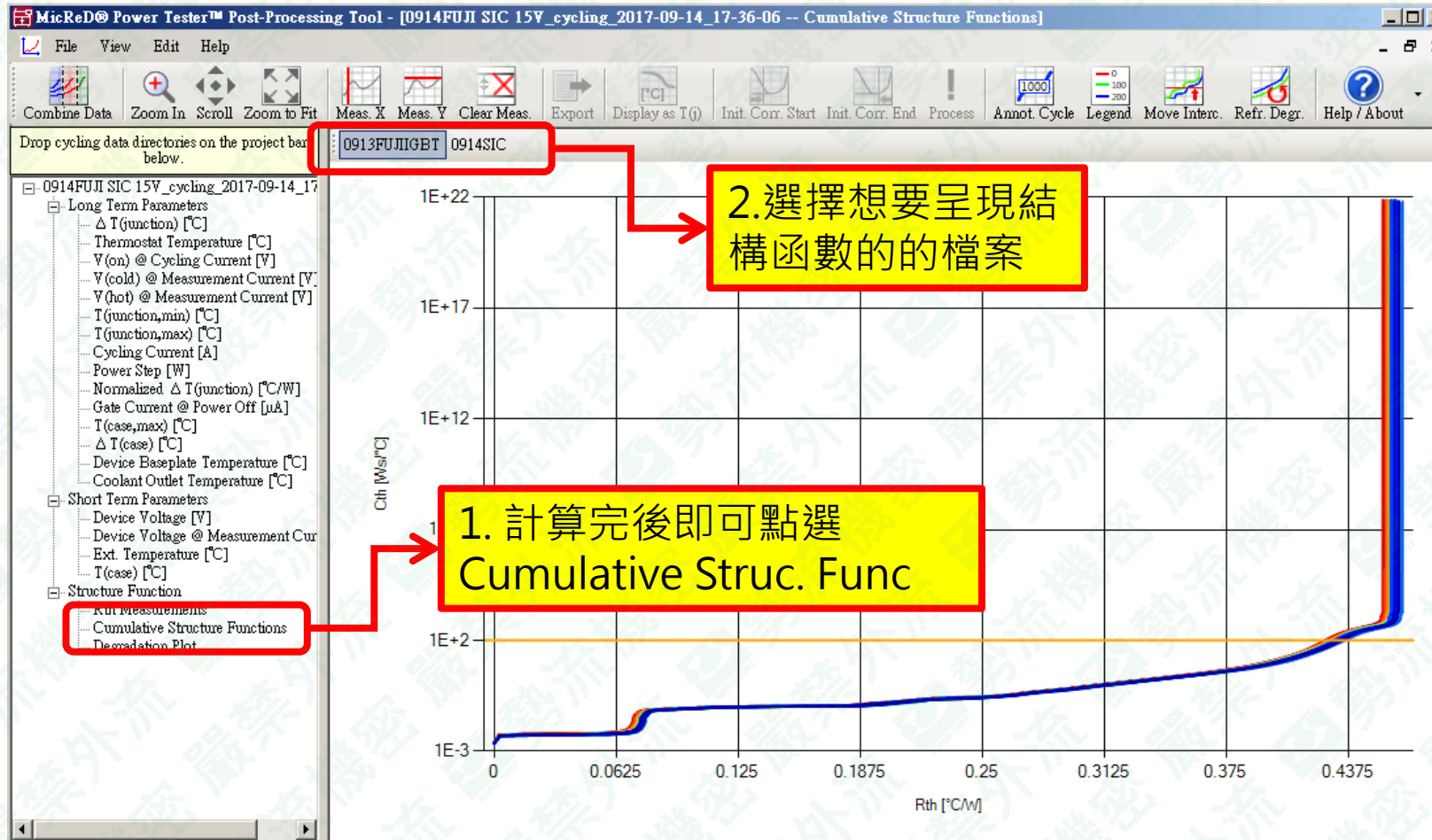
**2. 調整左邊與右邊的橘線，設定電訊號暫態之位置**

**3. 計算結構函數**

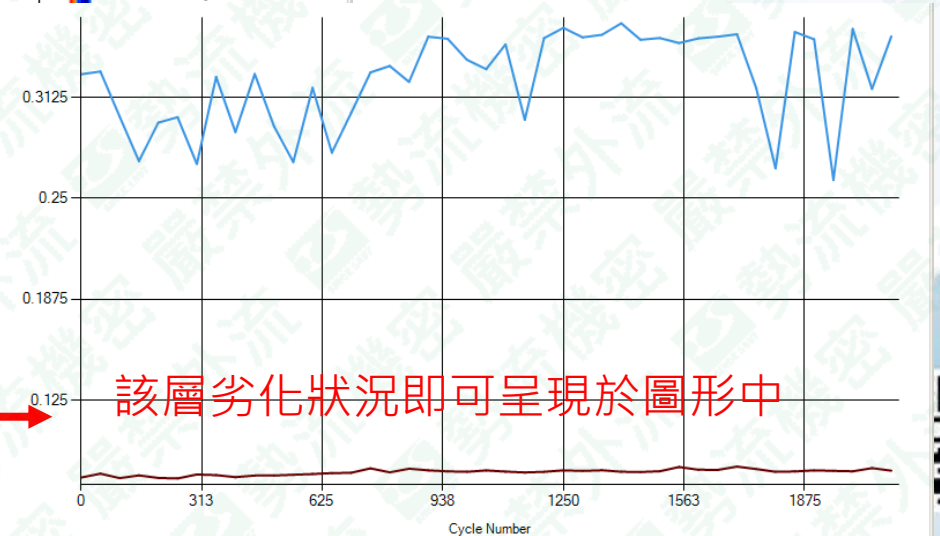
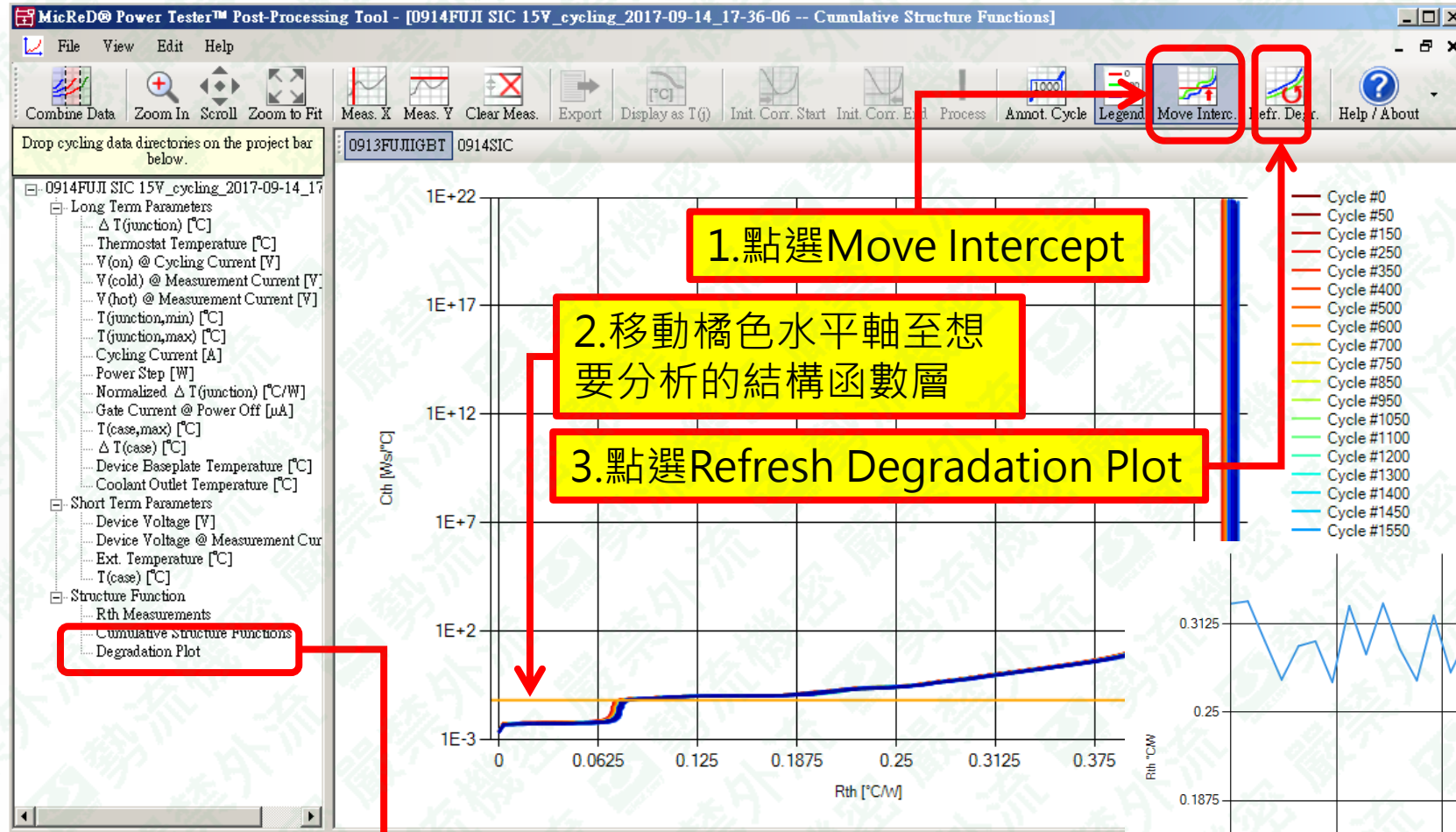
計算完結構函數，則此對應的資料夾內會多出內建檔名為stf\_processing的資料夾，裡面為所記錄的Par檔，可利用T3Master進一步分析



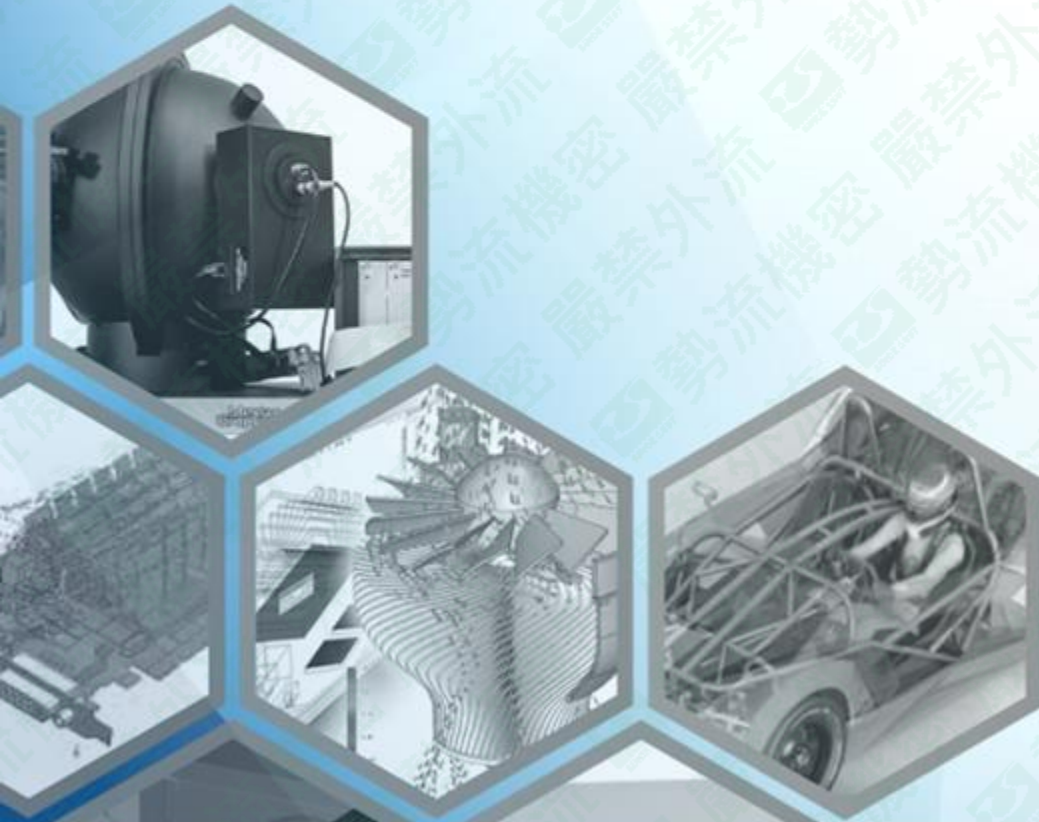
# Structure Function - Cumulative Structure Function



# Structure Function – Degradation Plot



# Thanks 謝謝



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- 📍 精密儀器事業部/技術經理
- 🏠 北市信義區忠孝東路五段550號13樓

