

基于ADI 锂电池EIS扫描技术的热失效早期预警

Boris Wang

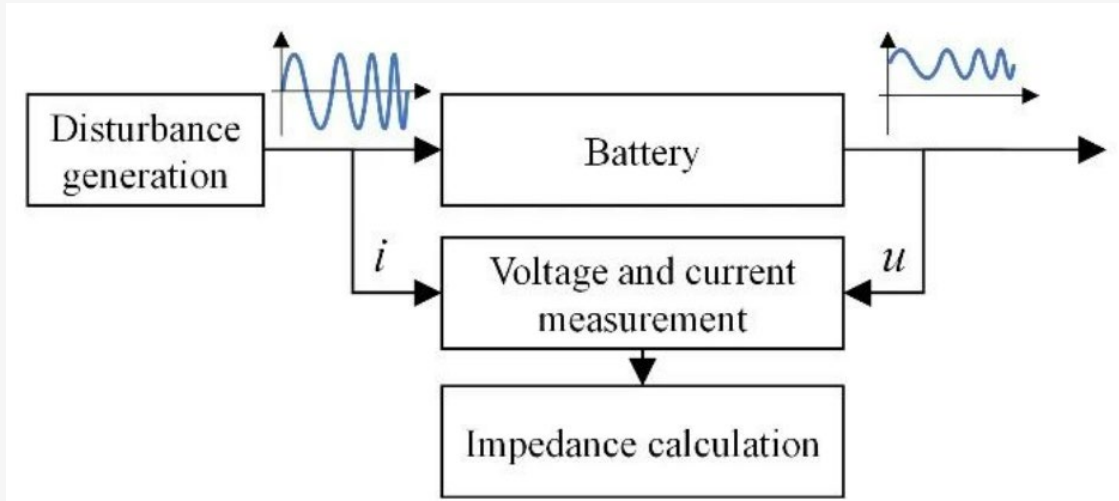
Signal Chain Specialist

Macnica Cytech

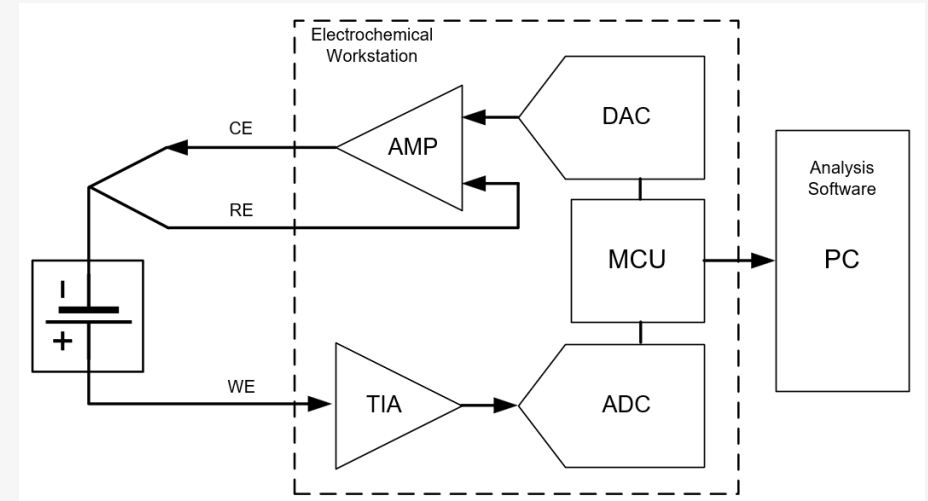
Co.Tomorrowing
MACNICA



Battery EIS Measurement



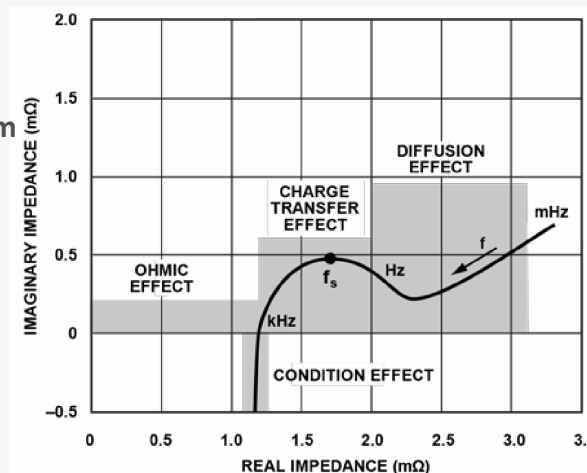
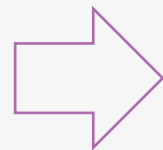
Basic method of EIS measurement



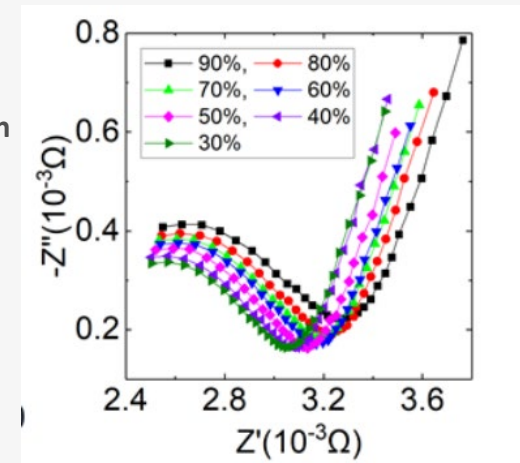
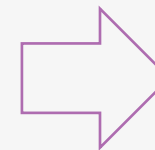
EIS using Electrochemical workstation

Freq	Real	Img
0.015	70.95519	6.225709
0.023	69.09041	5.794853
0.034	67.61266	5.327257
0.051	66.34603	4.847971
0.076	64.78619	4.335285
0.115	63.73066	3.909438
0.172	62.82759	3.450192
0.259	61.57268	3.005976
0.389	60.86899	2.565099
0.584	60.18876	2.127563
0.878	59.56717	1.686686
1.318	59.03941	1.25917
1.98	58.5636	1.063717
2.975	58.3329	1.328161
4.469	58.10037	1.656821
6.713	57.71308	2.123461

Format Nyquist diagram

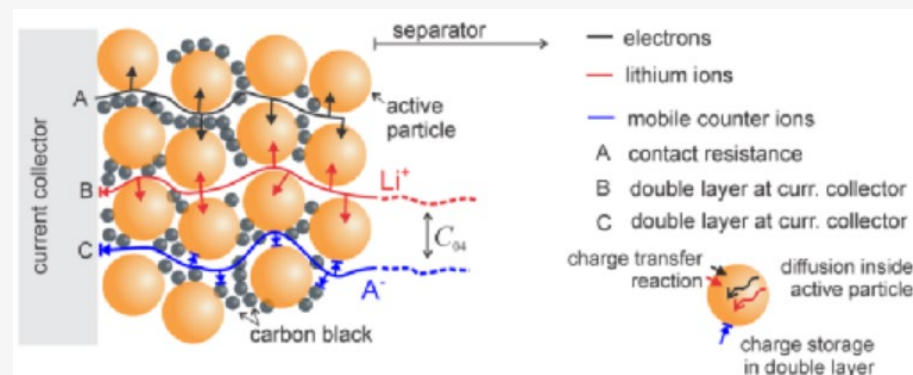


Focus on Variation

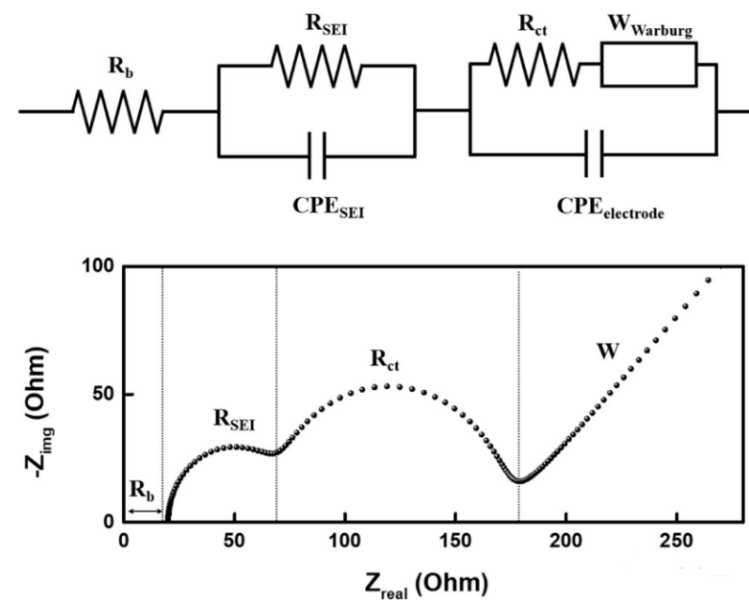
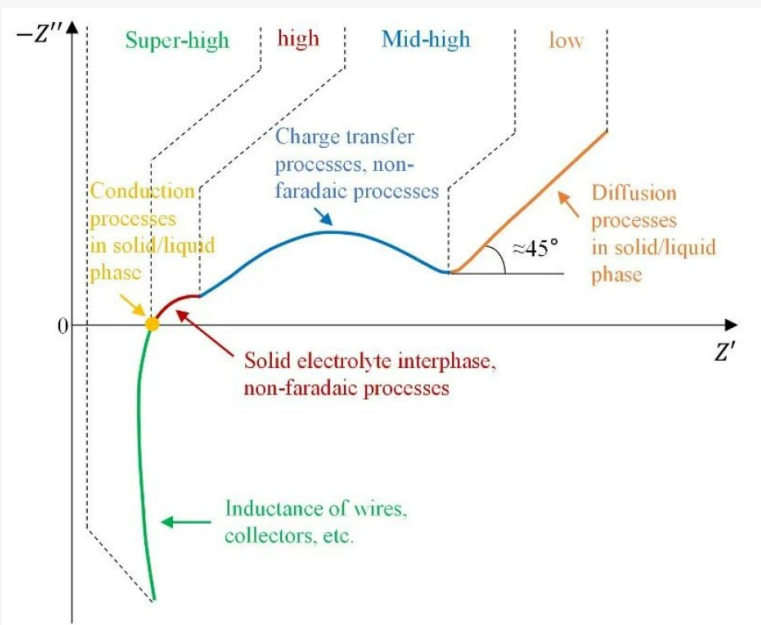


Battery EIS Measurement

Li-On Battery internal
Chemical changes



➤ Warburg Circuit Model



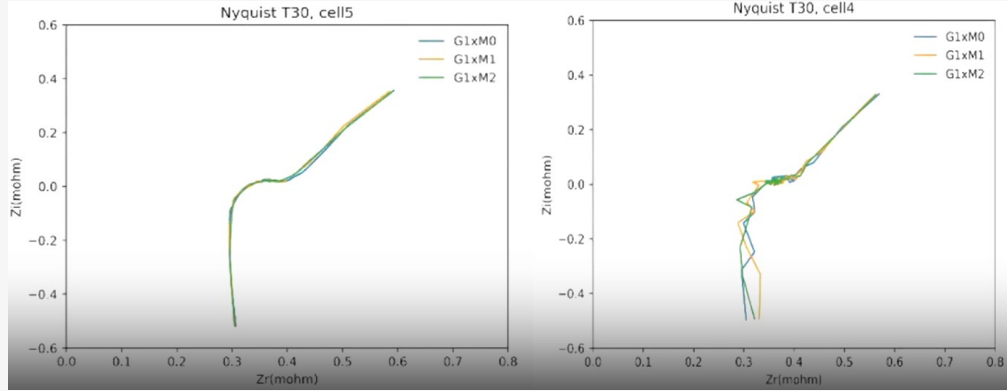
R_b:
Electrolytic Resistance

SEI:
Solid electrolyte interface

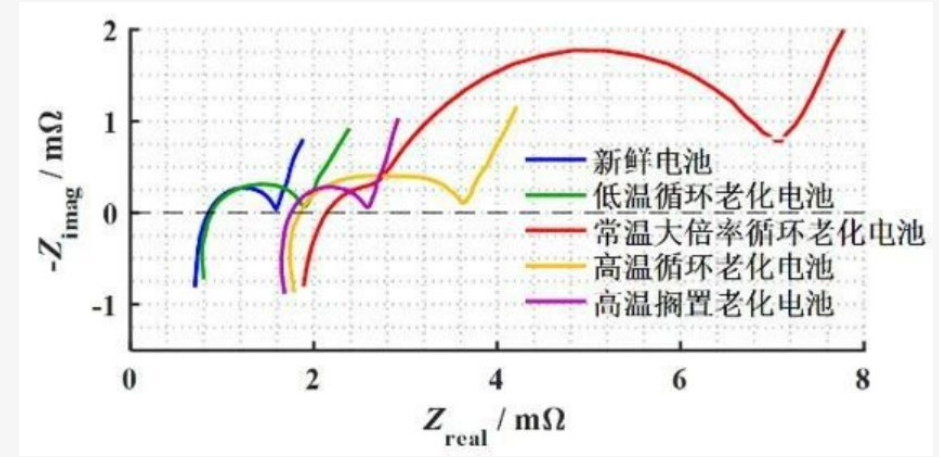
R_{ct}:
Charge transfer Resistance

W:
Warburg (diffusion) Impedance

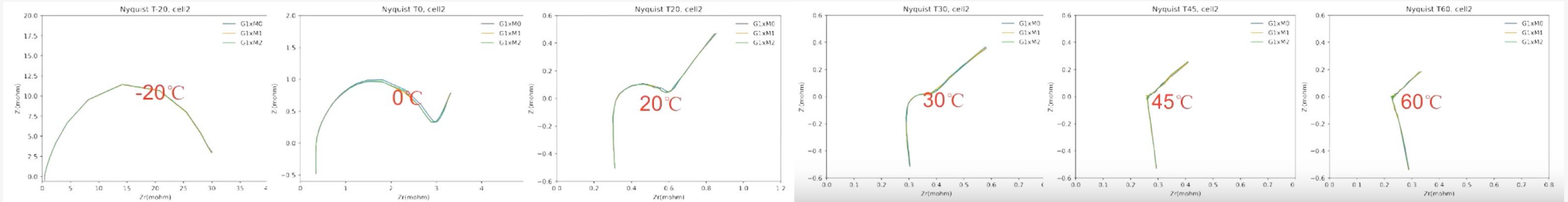
Applications of Battery EIS



➤ Poor electrode contact



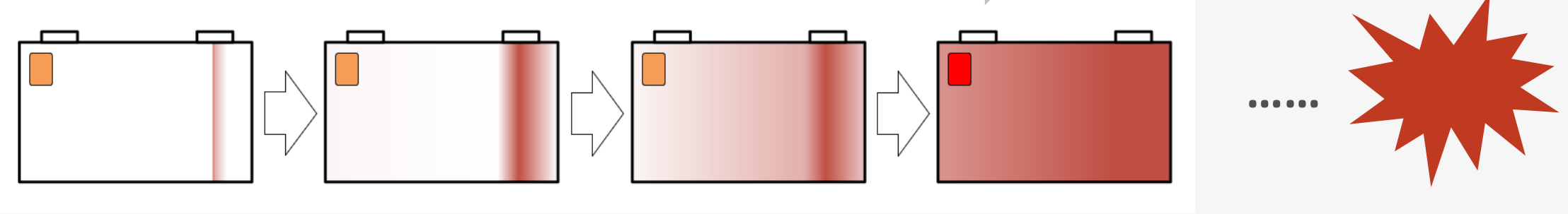
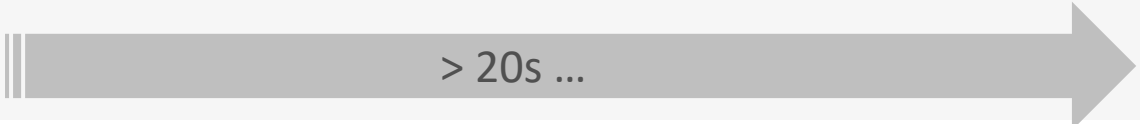
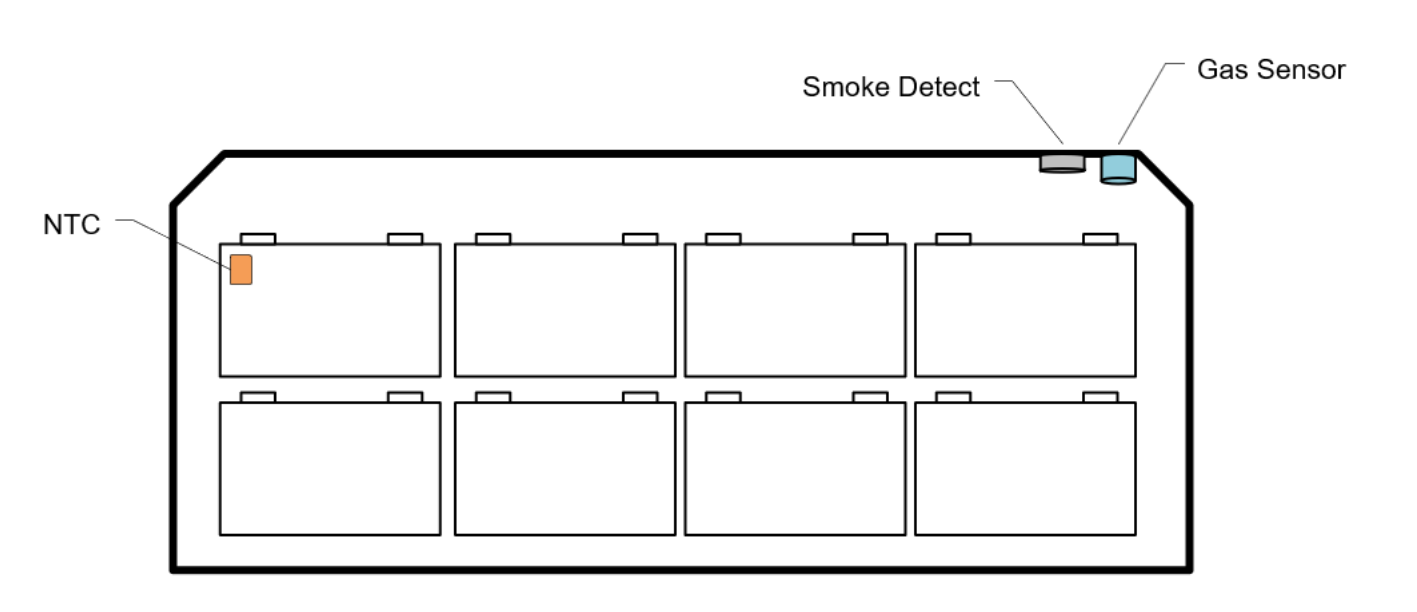
➤ Burn-in to 80% SOH



➤ EIS at different Cell Temperature

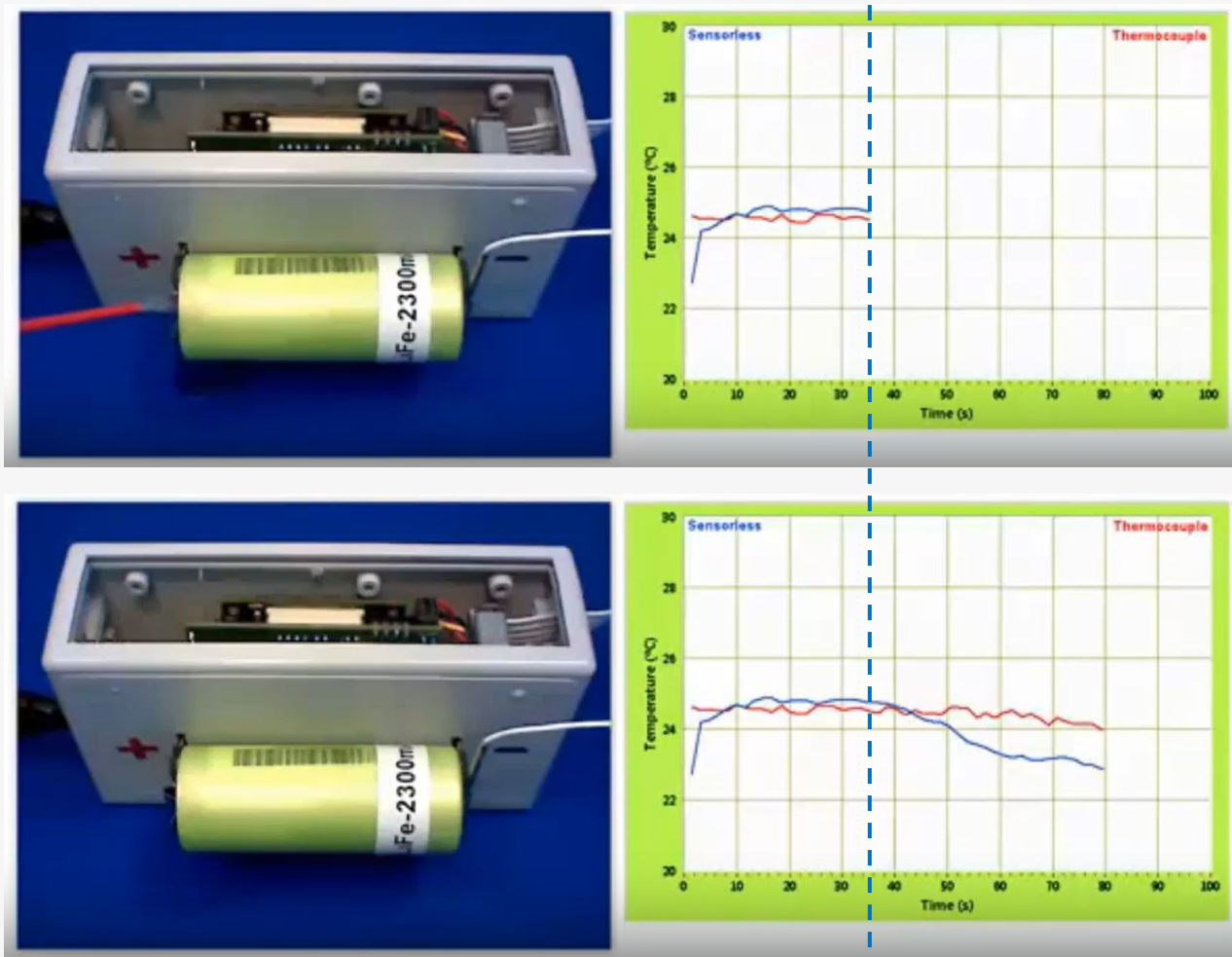
Battery Pack Thermal Monitor

General Method of Pack Thermal Alarm Monitor

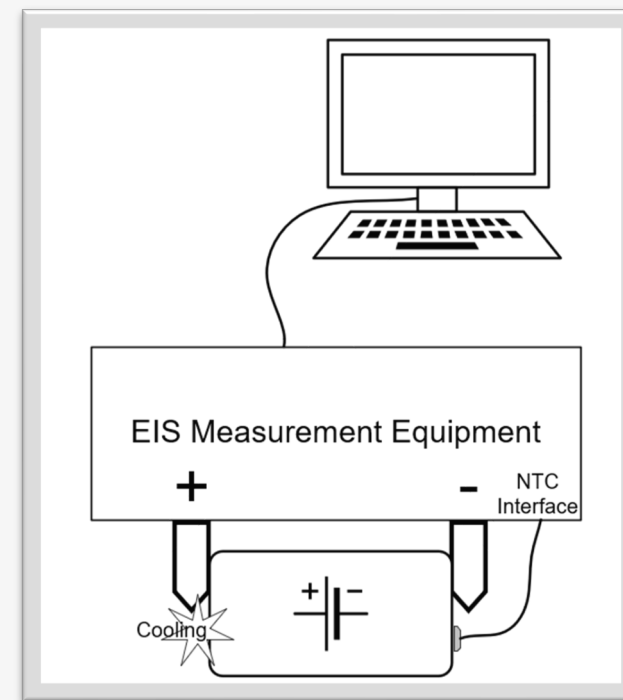


TOO LATE !

Thermal monitor of Battery EIS —— Contrast Experiment

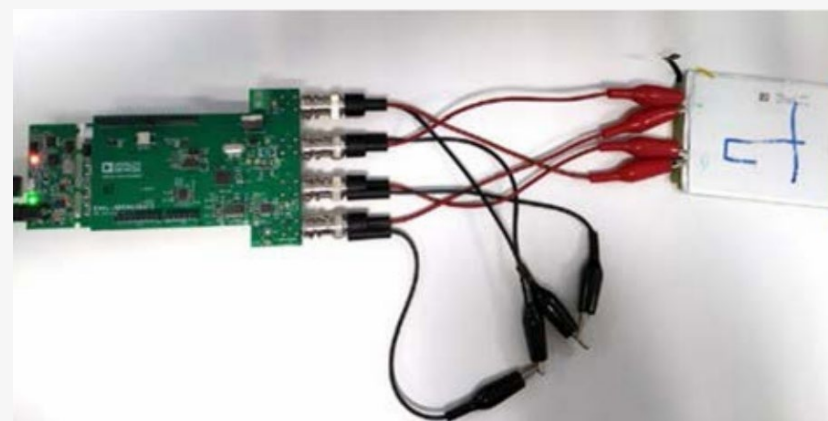
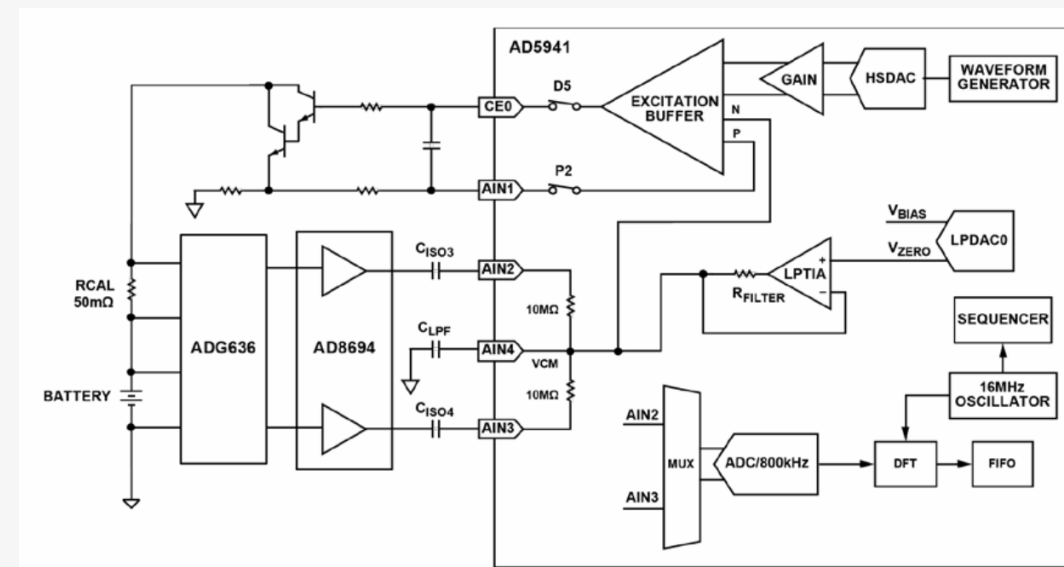
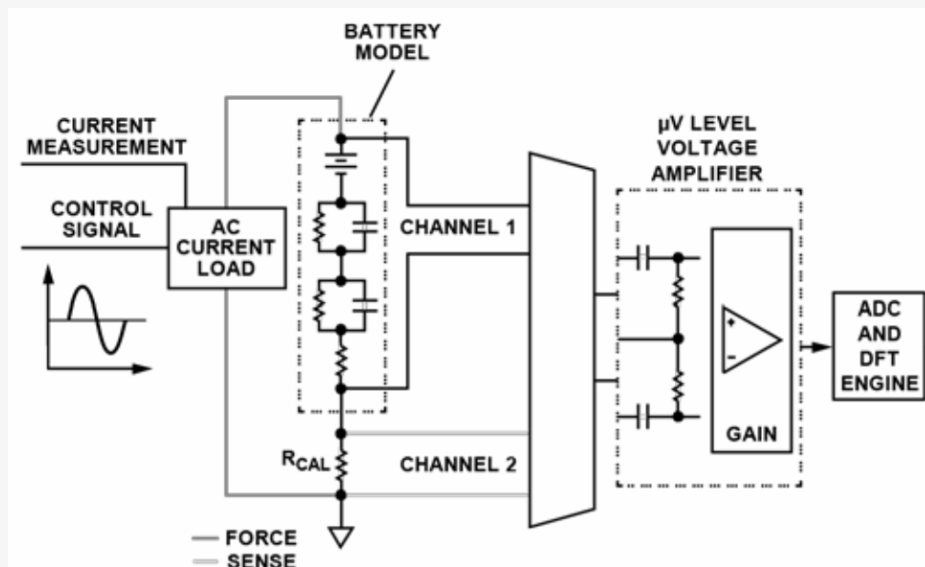


- Thermal forecast based on EIS
- Thermal forecast based on NTC sensor



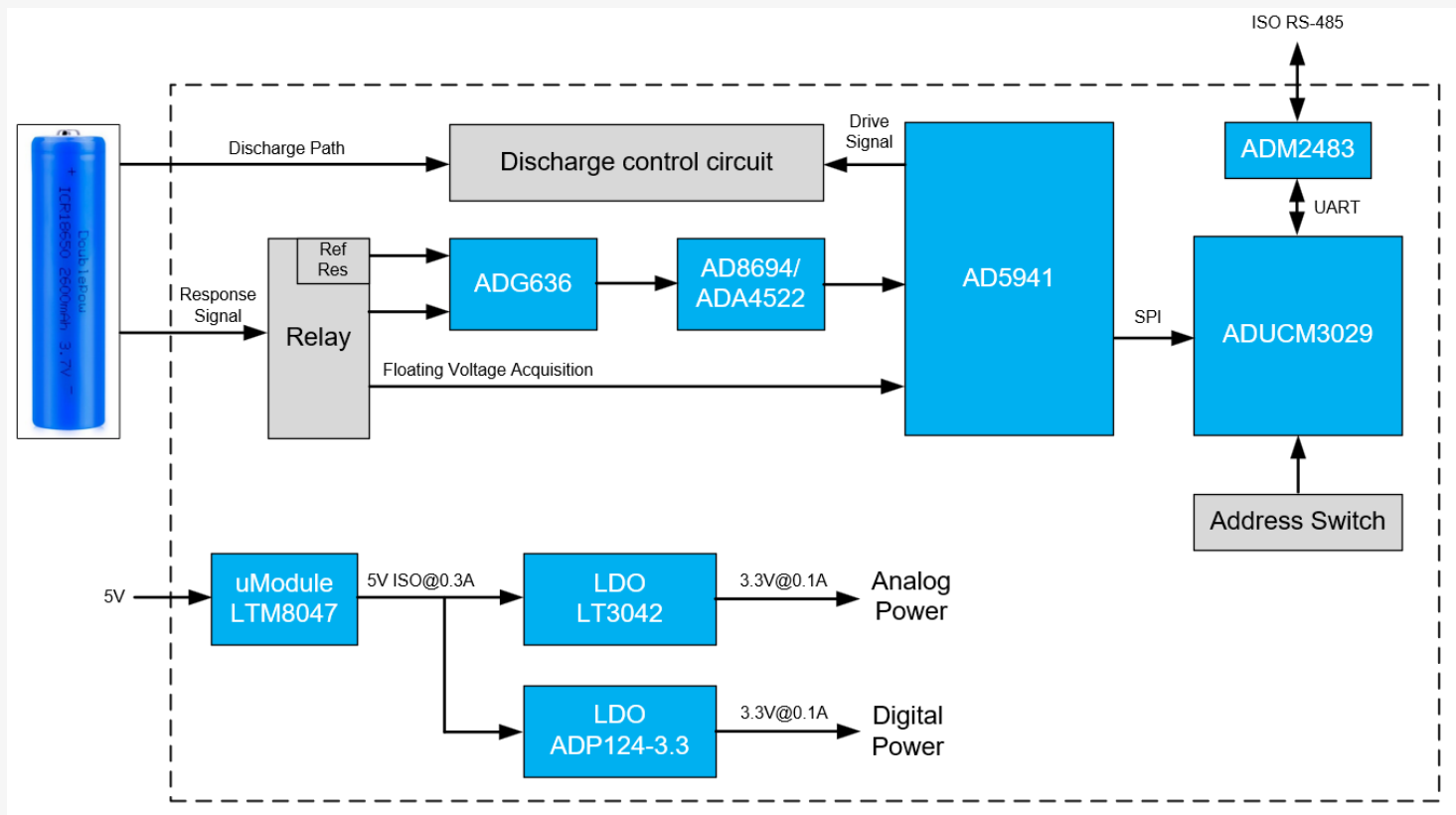
Blue rail Falls First —— Early warning!

Sch of EIS board —— CN0510 (ADI)



Useful for Native R&D Test!

Sch of EIS board — MCUM5941-EIS (Cytech)

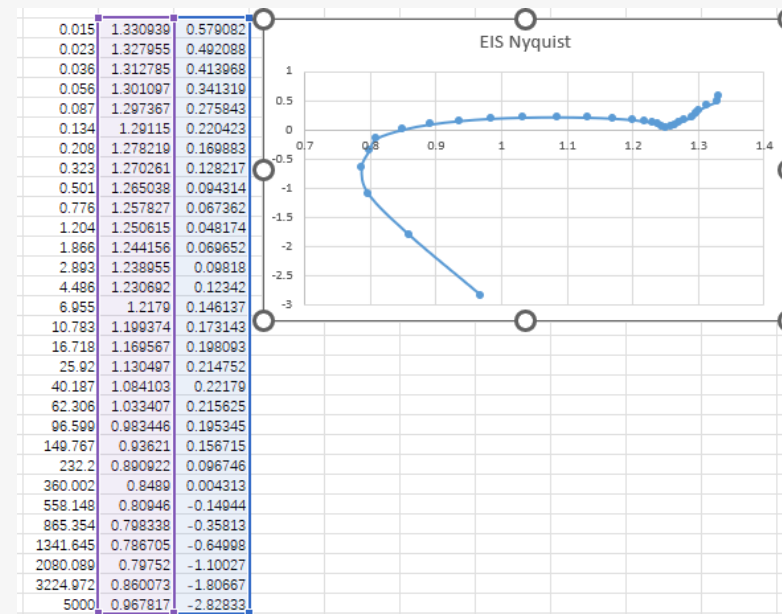
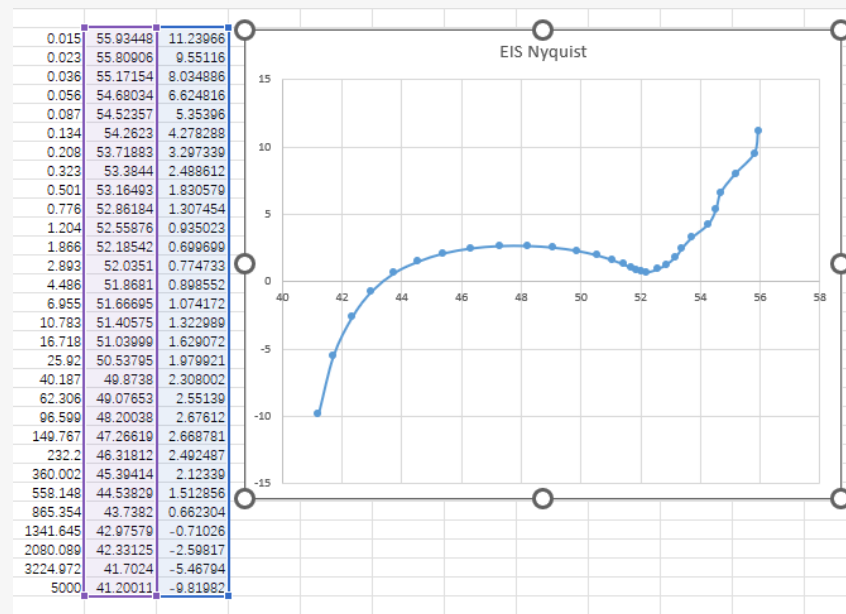
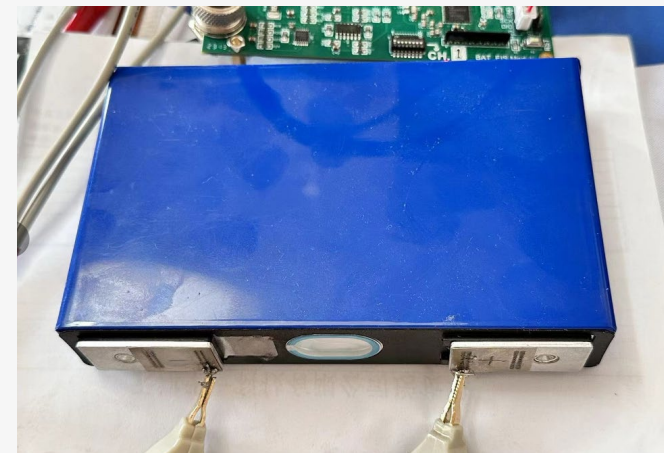
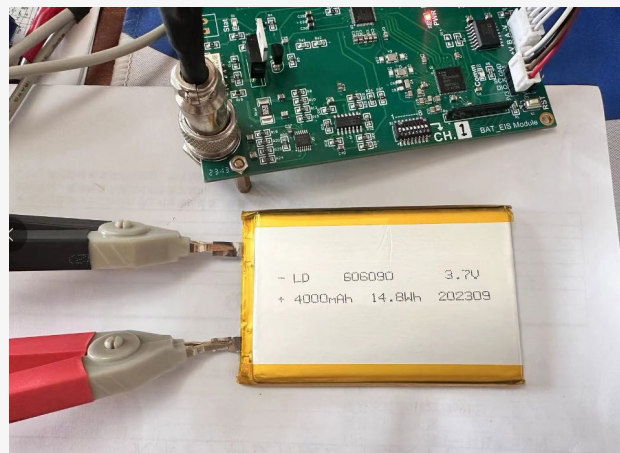


Useful for Fast Integration!

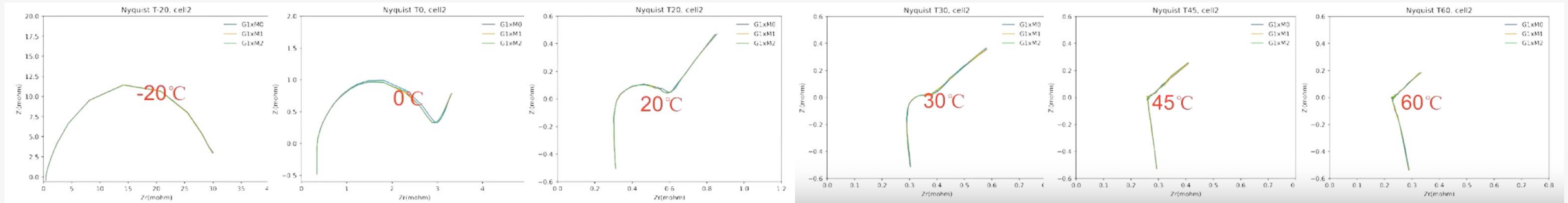


EIS Results using MCUM5941

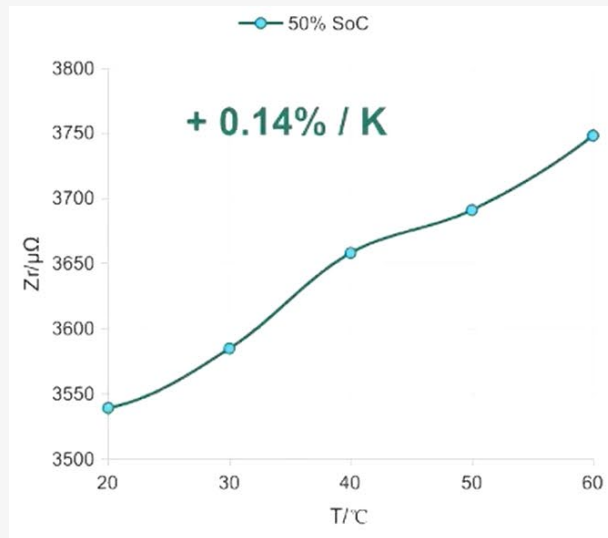
- 15mHz—20kHz
- Floating Voltage meas
- 8Ch parallel running
- Isolated each other
- 1% repeated accuracy
- Easy used Test Clamp
- Low-res mode
- Low-freq Compensation
- Auto Calibration



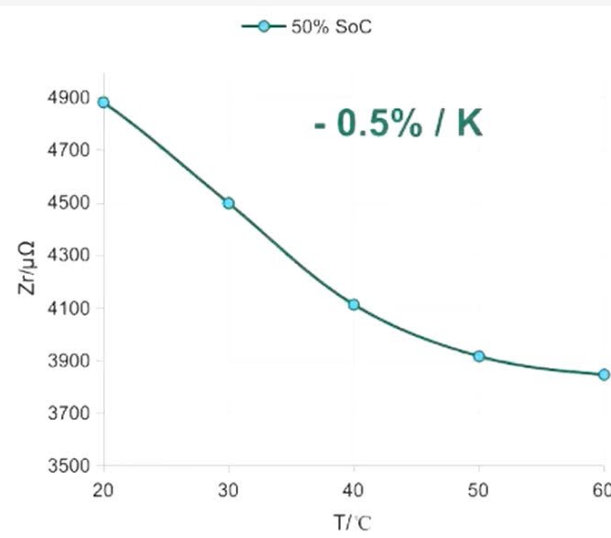
How to Monitor Thermal by EIS result



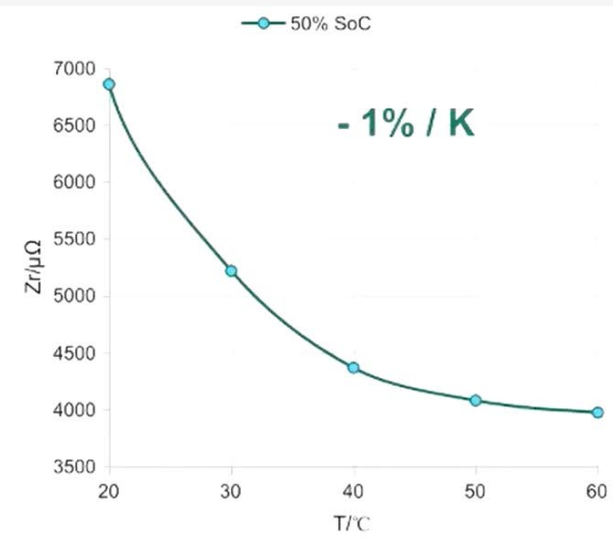
Find Characteristic frequency point !



> 1kHz



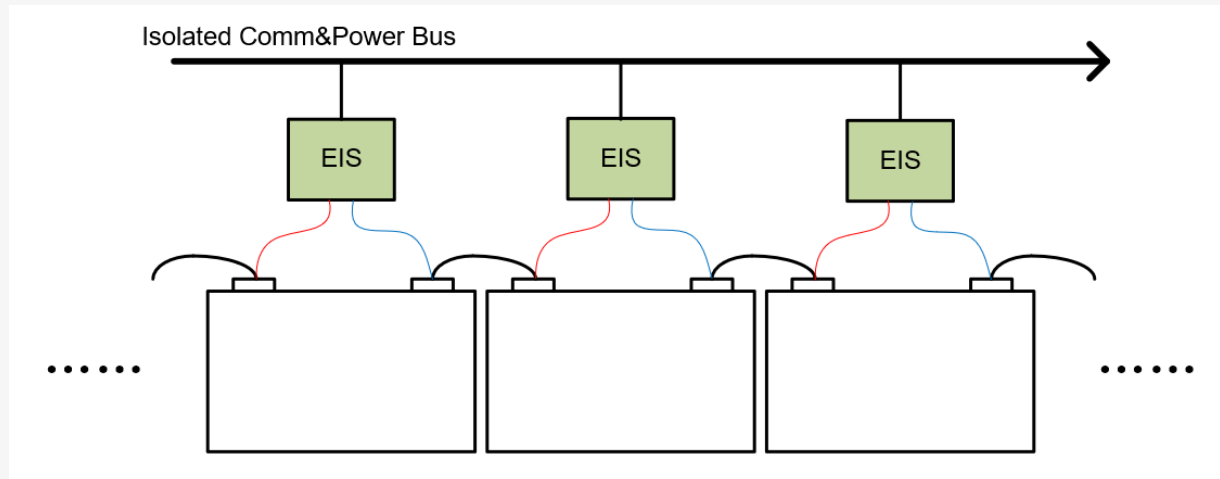
1kHz - 1Hz



< 1Hz

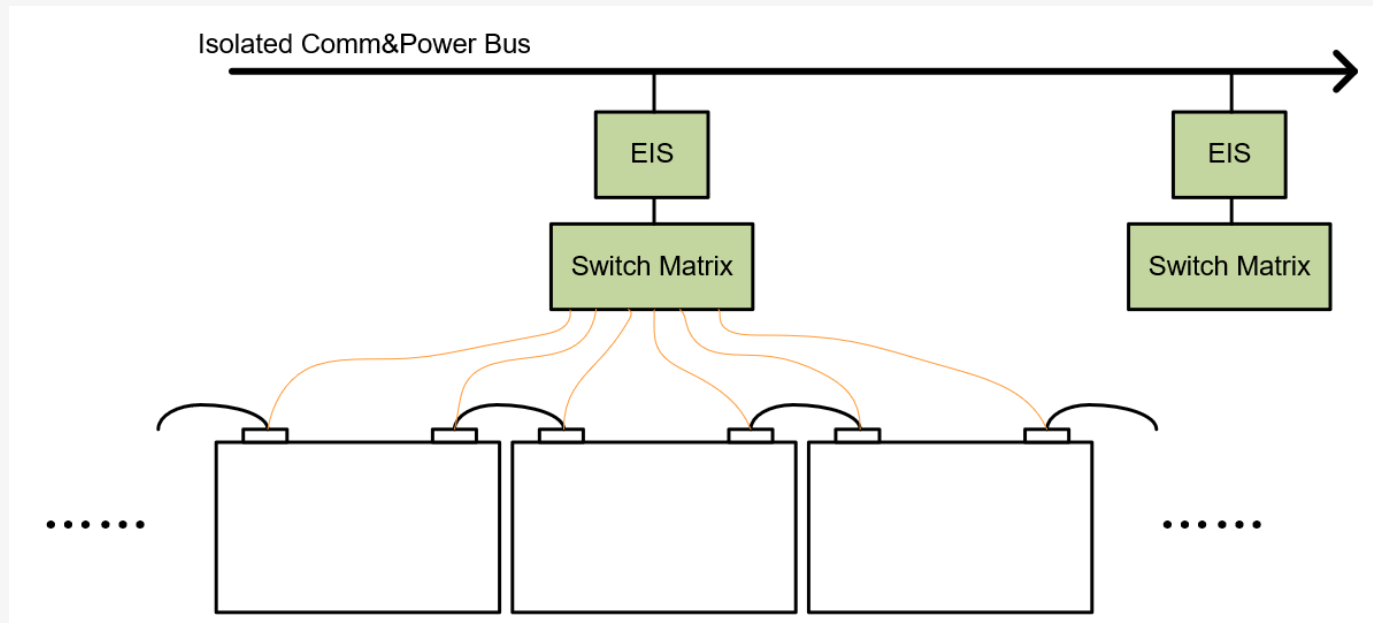
EIS measurement for Multiple battery pack

1



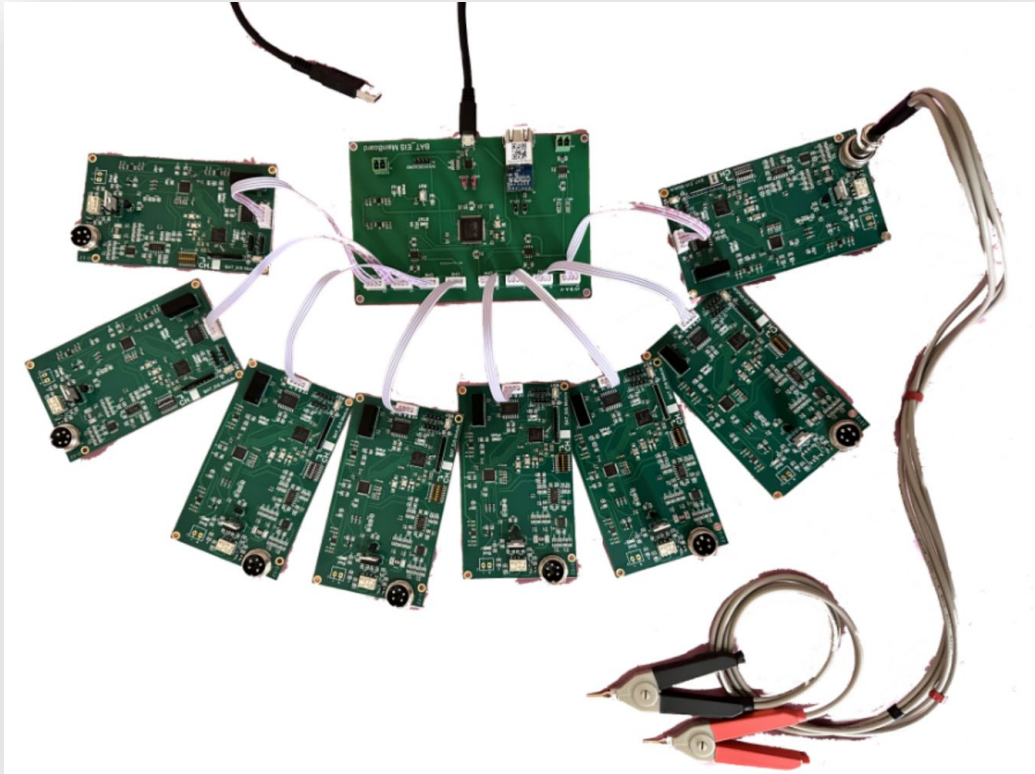
➤ Whole Distributed

2



➤ Group Integration

Demo Show



Thank You!



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