



对NGK单节锂离子电池的电池管理方案

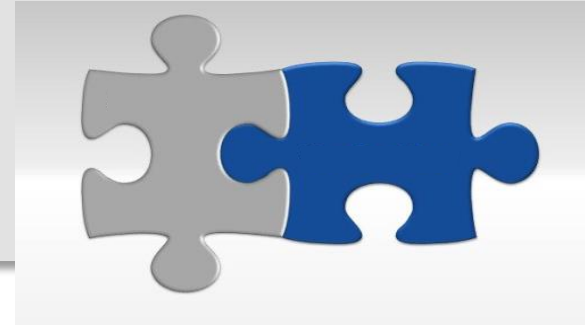
Oct. 2022

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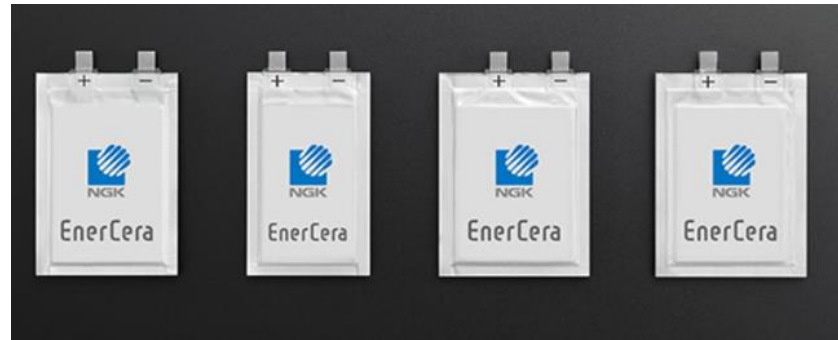
“NGK & onsemi 提供支持服务”

提前提供最优化的参数/数据

- 1) 节省验证时间
- 2) 减少替换风险



+



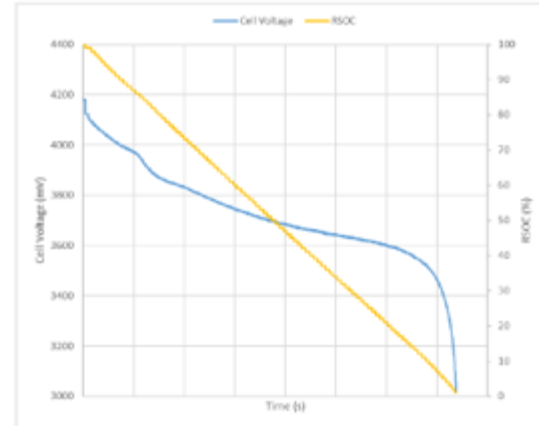
* EnerCera is a products of NGK Insulators, Ltd. *NGK EnerCera Lithium-ion battery image (used with permission from NGK Insulators, Ltd.)

对顾客提供支持服务

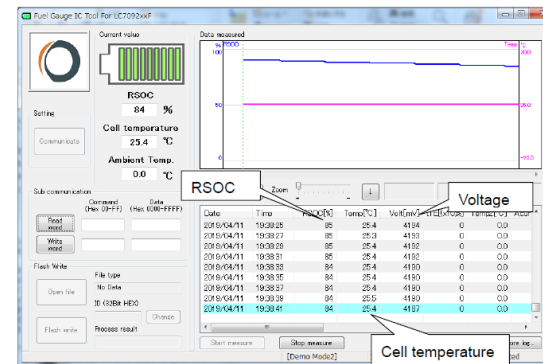
- *NGK EnerCera电池与onsemi的电池传感器（电池电量计）IC合作提供匹配数据以缩短评估过程
- FG软件工具为低功耗的验证提供帮助
- *NGK EnerCera电池和onsemi所提供的方案有助于系统规模的小型化

* EnerCera是日本碍子公司的产品

Graph the .csv file.



This graph shows association between time and cell voltage and RSOC in constant current discharging.

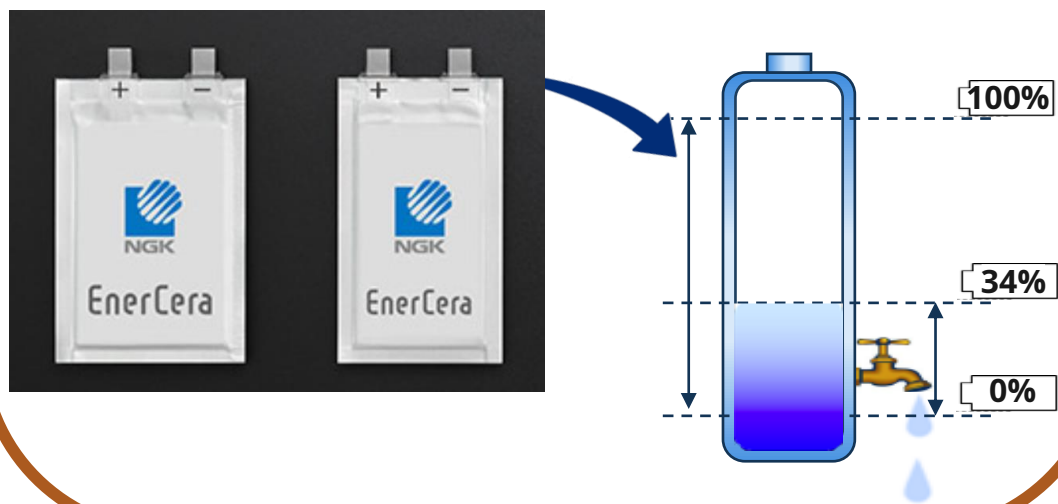


onsemi 电池传感器的应用所带来的挑战和意义

电力系统的要求

- 高度的**安全保障**
- 维持**长时间**的工作

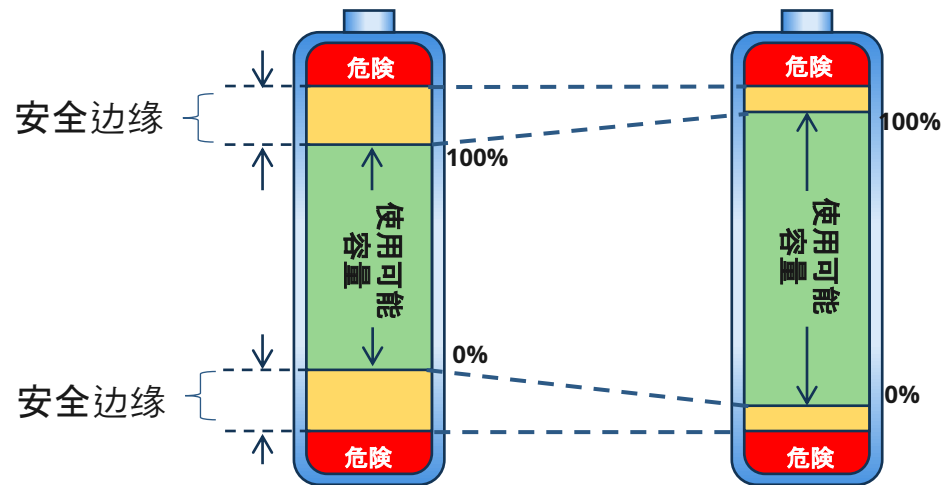
NGK EnerCera锂离子电池
(经NGK公司许可使用)



电池传感器的作用

- 维护系统的**安全性**
- 为**有效利用能源**提供帮助

onsemi
Battery
sensing



电池感测功能

- 支持RSOC报告
- 支持报告电池电压、温度和劣化情况

onsemi 电池传感器解决方案的主要特点



高精度

针对变化的稳定和准确的测量

基于用能表现电池化学成分特性的测量方法，即使面对温度变化和电池老化，也能实现高度精确的电池电量的测量。

低功耗

业界最低功耗

高低双功耗模式的自动切换，实现了超低功耗。

不需要外部检流 电阻测量电流

减少BoM的使用数量

采用了不需要外部电阻进行电流测量的算法。减少印刷电路板上的元件安装面积，增加了产品设计的自由度，有助于提高产品的优势。

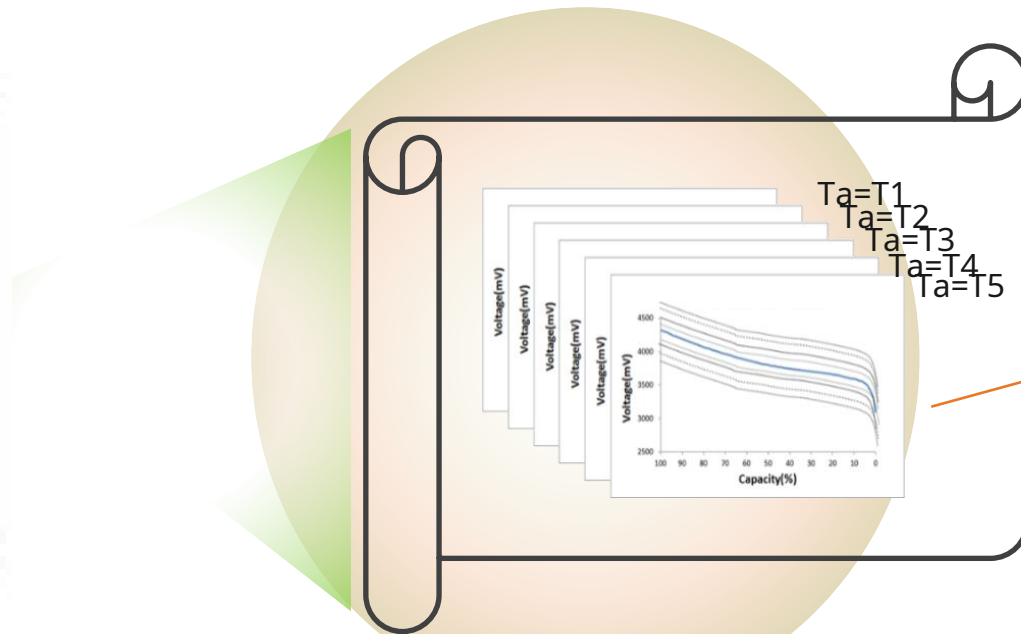
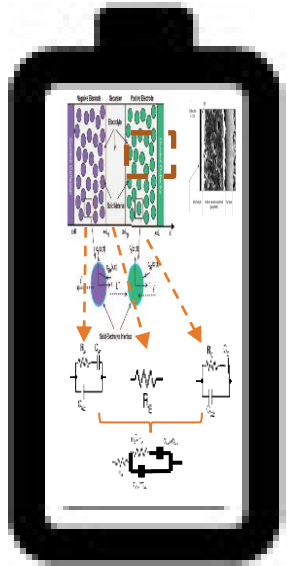
实现高精度的电量测量

onsemi 解决方案的优势

- 电量的分析基于由电池化学成分的参数组成的独特数据库
- 即使在不同环境下也能进行稳定的测量

onsemi的电池传感技术确保在任何情况下都有稳定的精度

- 电池的劣化
- 温度的变化
- 反复的充放电

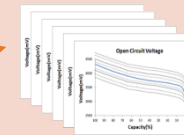


Fuel Gauge

感知条件

- 1) 温度
- 2) 电压
- 3) 电流

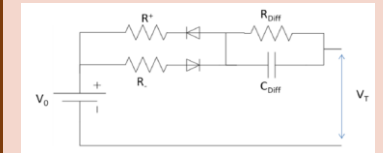
电池特性 (NV 记忆体)



对应于电池特性的多个参数
- 充电电流, - 放电电流
- 温度, - OCV 的电压变化

计算

$$SOC(t) = SOC(t_0) - \frac{1}{Q_{rated}} \int_{t_0}^t \eta(t) I_{bat} dt$$



报告事项

- I2C communication
- Alert output

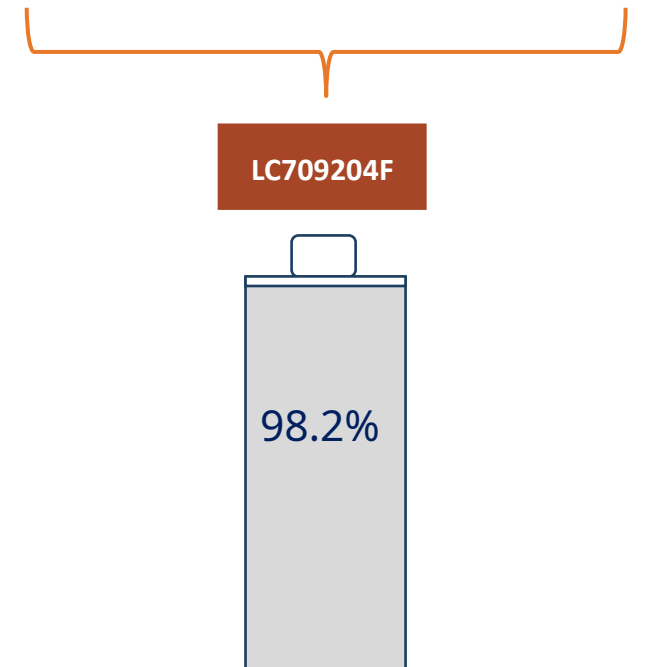
低功耗

功耗

	LC709204F
测量方法	onsemi 独自技术
电流消耗 (工作模式)	<u>2</u> μ A

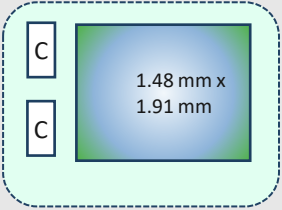
- LC709204F仅消耗2 μ A的工作电流
- 工作模式下的功耗极低

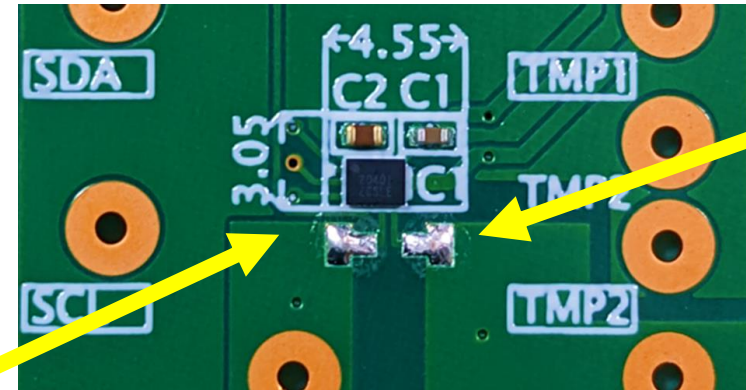
客户产品在仓库中存放30天
后的电池电量
(理论值)



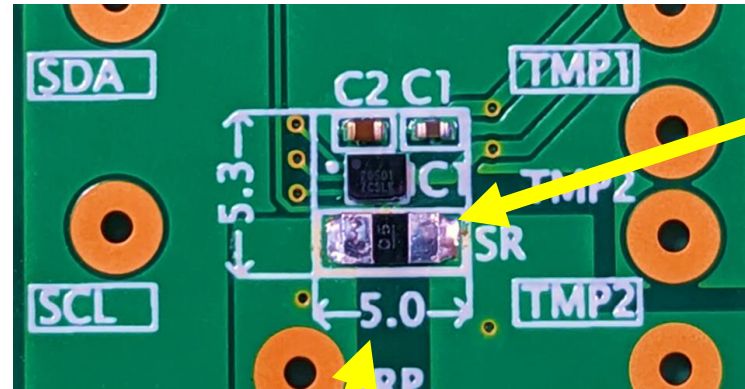
(80 mAh Battery)

不需要外部电阻进行电流测量

	onsemi LC709204F
检流电阻	不需要
外部元件数量	检流电阻: 0 电阻: 0 电容: 2
元件封装图	 <p>1.48 mm x 1.91 mm</p>



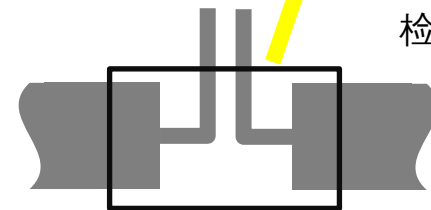
没安装检流电阻



安装了检流电阻

客户利益（微型化）：

- 没有检流电阻元件的设计对于可穿戴设备和小型产品来说变得越来越重要
- 检流电阻元件的封装大小比元件本身要大



检流电阻例子(5 mΩ, 1%)：

PCB封装：接线图

onsemi 电池传感基本模型LC709204F

onsemi
LC709204F

LC709204F

标准型号有着业界最低功耗与极小体积的，为安全灵活的设计，提供丰富的警报功能

- 外部元件：**2pcs**
- 电流功耗：**2uA**

强化的电池监测报告

IC	LC709204F
Advanced	Rescaled RSOC
	Time to Empty
	Time to Full
Alarm	Ambient Temperature
	High/Low Voltage
	Low RSOC
	High/Low Temperature
Battery Lifetime	Estimated SOH
	Cycle Count
	Max/Min Cell Voltage
	Max/Min Cell Temperature
	Total Runtime
	Accumulated Temperature
	Accumulated RSOC

主要优势

onsemi 电池感测解决方案

高精度测量

在不稳定的电池条件下可以得到高精度而稳定的测量

监测电池状态，并最大限度地减少电力消耗

无检流电阻，减少BoM的数量

Data Sheet
[Click Here](#)

Battery Fuel Gauge LSI [Smart LiB Gauge] for 1-Cell Lithium-ion/ Polymer (Li+) with Low Power 2 μ A Operation

ON Semiconductor
www.onsemi.com

LC709204F

Overview
 LC709204F is a Fuel Gauge for 1-Cell Lithium-ion/Polymer batteries. It is part of our Smart LiB Gauge family of Fuel Gauges which measure the battery RSOC (Relative State Of Charge) using its unique algorithm called HG-CVR2. The HG-CVR2 algorithm provides accurate RSOC information even under unstable conditions (e.g. changes of battery; temperature, loading, aging and self-discharge). An accurate RSOC contributes to the operating time of portable devices. The Fuel Gauge (in other words, Gas Gauge, Battery Monitor or Battery Gauge) feature of HG-CVR2 algorithm makes LSI highly applicable in various application. The LSI can immediately start battery measurement by setting a few parameters after battery insertion. Learning cycles that make complicated manufacturing process of applications can be avoided. The LSI also supports battery safety by alarm functions and SOH (State of Health) reporting to the application processor. The operating consumption current is very low 2 μ A and it is suitable for applications such as wearables and 1 series N parallel batteries.

Features

- HG-CVR2 Algorithm Technology
 - Small Footprint: No Need for Current Sensing Resistor
 - Accurate RSOC of Aging Battery
 - Stable Gauging by Automatic Convergence of Error
 - Immediate Accurate Gauging after Battery Insertion
 - Eliminates Learning Cycle
- Low Power Consumption
 - 2 μ A Operational Mode Current
- Improvement of the Battery Safety by Alarm Function
 - RSOC / Voltage / Temperature
- Battery Lifetime Measurement
 - SOH / Cycle Count / Operating Time
- Remaining Time Estimation
 - Time to Full / Time to Empty
- Three Temperature Inputs
 - Inputs to sense two NTC Thermistors
 - Via I²C
- Detection of Battery Operating Conditions
 - Charging / Discharging
- Detection of Battery Insertion
 - I²C Interface (supported up to 400 kHz)
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- Wearables / IoT Devices
- Smartphones/PDA Devices
- Digital Cameras
- Portable Game Players
- USB-related Devices

MARKING DIAGRAM

204** = 20401 (LC709204FXE-01TBG)
 A = Assembly Site
 WL = Wafer Lot Number
 YW = Assembly Start Week

ORDERING INFORMATION
 See detailed ordering and shipping information on page 20 of this data sheet.

Applications

- Wearables / IoT Devices
- Smartphones/PDA Devices
- Digital Cameras
- Portable Game Players
- USB-related Devices

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 September, 2019 - Rev. 0
 Publication Order Number: LC709204F-D

App Note
[Click Here](#)

Battery Fuel Gauge [Smart LiB Gauge] for 1-Cell Lithium-ion/Polymer with LC709204F

ON Semiconductor
www.onsemi.com

AND9985/D

APPLICATION NOTE

LC709204F is a Fuel Gauge for 1-Cell Lithium-ion/Polymer batteries. It is a part of our Smart LiB Gauge family of Fuel Gauges which measure the battery RSOC (Relative State Of Charge) using its unique algorithm called HG-CVR2. The HG-CVR2 algorithm provides accurate RSOC information even under unstable conditions (e.g. changes of battery; temperature, loading, aging and self-discharge). This application note will explain how to initialize various parameters for the selected battery to start a higher accuracy gauging. Users can see various registers based on their application requirement using the notes, guidelines and examples given in this note. Sample program codes explained at the end of the note will provide various guidelines on how this device communicates with the host side application processors.

Figure 1. An Example of an Application Schematic Using LC709204F

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 April, 2021 - Rev. 1
 Publication Order Number: AND9985/D

Evaluation Board
[Click Here](#)



LC709204FXE-N01-GEVB

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Test Procedure for LC709204FXE-N01-GEVB

1 Evaluation Kit

1.1 How to select Evaluation board

Select a suitable Evaluation board according to target device and your battery.

Evaluation board	Target device	Battery Type	Related documents
LC709204FXE-N01-GEVB	LC709204FXE-01TBG	EC01	LC709204FXE-01-GEVB_SCHEMATIC.pdf
		EC02	LC709204FXE-01-GEVB_GERBER.zip
		EC03	LC709204FXE-01-GEVB_BOM.pdf
		EC04	

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Appendix

LC709204F Product Overview

Battery Fuel Gauge with Low-Power 2 μ A Operation

Unique Features	Benefits
HG-CVR2: Unique gauging methodology based on battery's chemical composition	Highly accurate and robust RSOC gauging
2 μ A ultra low operating current	Energy efficient
Battery lifetime report	Provides system safety
Multi NTC thermistor sensing inputs	Monitors system/battery temperature
One-chip sensing without sensing resistor	PCB footprint area

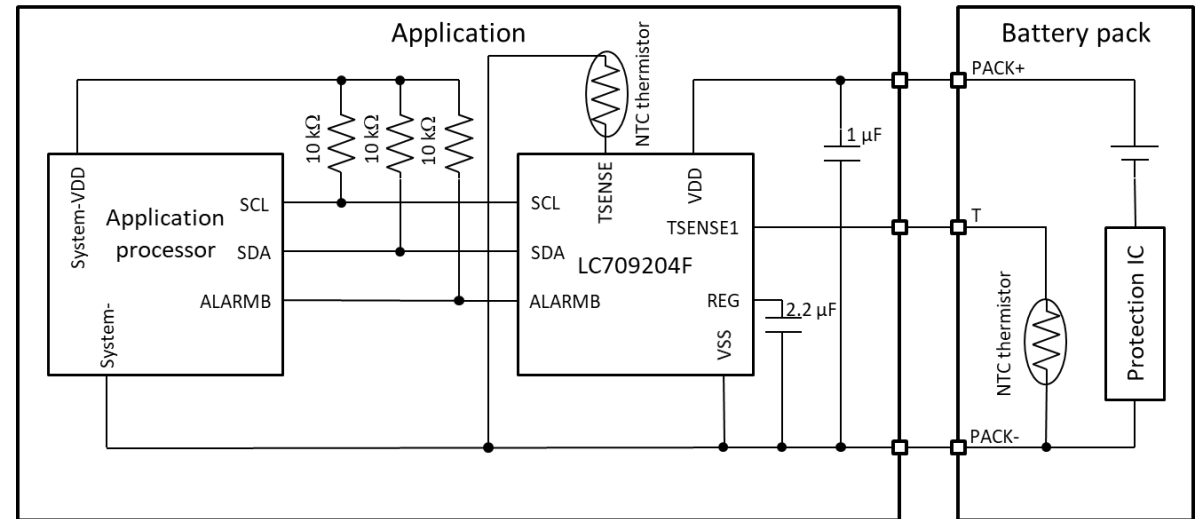
Other Features

- Target battery type: 1-Cell Lithium-ion/Polymer. Pouch and Prism, Cylinder type
- Battery capacity range: Up to 6,500 mAh x Parallel cell number
- Alarms for high and low voltage, current, temperature, RSOC to the host using dedicated output
- Auto empty adjustment to protect the system from voltage drop of aged battery
- The maximum and minimum condition records for failure analysis
- I²C Interface (supported up to 400 kHz)
- 32 bits non volatile memory to be usable for any usage

Markets & Applications

- Wearables
- Wireless headsets
- IoT devices
- Smartphones / PDA devices
- Portable game players
- USB-related devices

Typical Application Schematic



Ordering & Packaging Information

ONPN	Description	Package
LC709204FXE-01TBG	Battery Fuel Gauge LSI for 1-Cell Lithium-ion/Polymer (Li+) with Low-Power 2 μ A Operation	WLCSP12, 1.48x1.91x0.51



onsemi Fuel Gauge Product

Model	LC709204FXE
Algorithm	HG-CVR2 ^{*1}
Package	WLCSP12
Size	1.48 mm x 1.91 mm x 0.51 mm
Pin Pitch	0.4 mm
Max Voltage	5.0 V
Accuracy	±2.0%
Operating Idd	2.0 µA
Rescaling	√
Alarm	5
Sense Temperature	2xNTC Thermistor , Host Reported
Basic Report ^{*2}	√
Advanced Report ^{*3}	√
Battery Lifetime Report ^{*4}	√
Current Report ^{*5}	Option ^{*6}
User ID	√
Battery Embedded/Removal	√
Embedded Battery Profile	5

Notes:

- *1: HG-CVR2 - Increased look-up tables to increase the device gauging accuracy
- Improved sampling timing to reduce the overall power consumption
- *2: Basic Report - RSOC, Cell Voltage, Cell Temperature
- *3: Advanced Report - Rescaled RSOC, Time to Empty, Time to Full, Ambient Temperature
- *4: Battery Lifetime Report - Cycle Count, SOH(State of Health), Total Run Time
- *5: Current Report - Remaining Capacity, FCC, Average Current, Dynamic Current
- *6: Contact your onsemi FAE

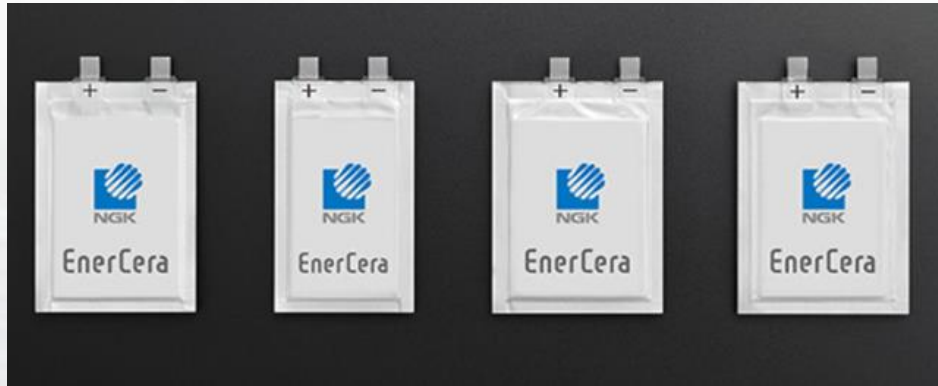
Alarms and Battery Lifetime Reporting

- LC709204F sends an alert to a host via an alarm function with little or no delay, when battery operating conditions exceed the parameters set up by the customer
- A record of historical data and stresses applied to the battery are logged in the battery lifetime report

IC	LC709204F
Advanced Reports	<ul style="list-style-type: none">• Rescaled RSOC• Time to Empty• Time to Full• Ambient Temperature• Battery Status
Alarm Conditions	<ul style="list-style-type: none">• High/Low Voltage• Low RSOC• High/Low Temperature• Over-Charge/Discharge Current ^{*1}
Battery Lifetime Reports	<ul style="list-style-type: none">• SOH• Cycle Count• Max/Min Cell Voltage• Max/Min Cell Temperature• Total Runtime• Accumulated Temperature• Accumulated RSOC• Ave/Dynamic Cell Current ^{*1}• Full Charge/Remaining Capacity ^{*1}

*1. Optional. Please contact your onsemi FAE for details.

Solutions from *NGK INSULATORS* & *onsemi*



+



以上的系统组合将“EnerCera”锂离子充电电池的电量变为了可视

Thank you
