描述 / Descriptions

BRCL4058EZZ 是一款DFN2×2-8L封装的高集成度、高性价比的单节锂离子电池充电器。BRCL4058EZZ 采用恒定电流/恒定电压线性控制，只需较少的外部元件数目，使得BRCL4058EZZ 是便携式应用的理想选择；同时，也可以适合USB电源和适配器电源工作。BRCL4058EZZ 采用了内部PMOSFET架构，加上防倒充电路，所以不需要外部检测电阻和隔离二极管。热反馈可对充电电流进行自动调节，以便在大功率操作或高环境温度条件下对芯片温度加以限制。充满电压固定于 4.2 V。充电电流可通过PROG脚外接一个电阻设置，最高可达1.0A。当输入电压（交流适配器或USB电源）被拿掉时，BRCL4058EZZ 自动进入一个低电流状态，电池漏电流在3uA以下。BRCL4058EZZ 的其他特点包括充电电流监控器、输入过压保护、欠压闭锁、自动再充电和两个用于指示充电结束和输入电压接入的状态引脚。

The BRCL4058EZZ is a high integration level and high cost performance charger in DFN2×2-8L package for single-cell Li-Ion and Li-Polymer batteries.

The device employs a full charge algorithm with trickle current, constant current (CC), constant voltage (CV) modes, charge termination and automatic recharge. The device is ideally suited for portable applications due to the small DFN2×2-8L package and low number of external components required. At the same time, it can also be suitable for USB power supply and adapter power supply.

BRCL4058EZZ adopts internal P MOSFET architecture and anti-reverse charging circuit, so external detection resistor and isolation diode are not needed.

Thermal feedback can automatically adjust the charging current to limit the chip temperature under high power operation or high ambient temperature conditions.

The full voltage is fixed at 4.2V. The charging current can be set by connecting a resistor to the PROG pin, and the maximum charging current can reach 1.0A.

When the input voltage (AC adapter or USB power supply) is removed, BRCL4058EZZ automatically enters a low current state, and the battery leakage current is below 3uA.

Other features of BRCL4058EZZ include charging current monitor, input overvoltage protection, undervoltage lockout, automatic recharging and two status pins for indicating the end of charging and the input voltage access.

特点 / Features

- 最高30 V输入电压以及6.9 V过压保护
  Support up to 6.9V operating input voltage with 30V absolute maximum input rating
- 高精度充满检测电压阈值：4.2 V精度±42 mV
  High-precision full-charge detection voltage threshold:4.2V±42mV
- 待机电流<3 uA
  Standby current < 3 uA
- 具有BAT-VDD防倒灌功能
  With BAT-VDD backflow prevention function
- 支持0V电池充电
  Support 0V battery charging.
- 线性充电模式，充电电流可达 1.0 A
  Linear charging mode, charging current can reach 1.0 A.
- 涓流/恒流/恒压三段式充电
  Trickle/constant current/constant voltage three-stage charging

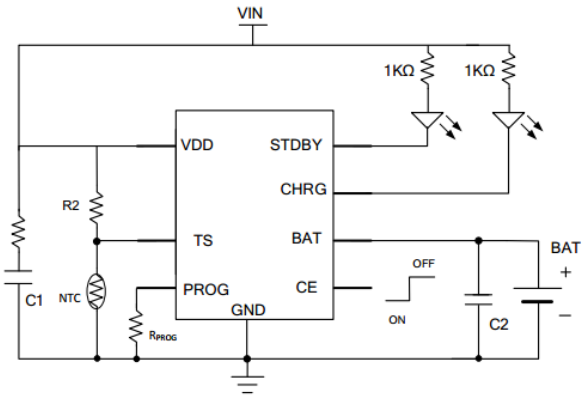
特点 / Features

- 充电电流外部可调
  The charging current is externally adjustable
- 充电电流智能热调节
  Intelligent thermal regulation of charging current
- 电池温度检测保护
  Battery temperature detection protection
- 自动再充电
  Automatic recharging
- 充电状态指示
  Charging status indication
- 符合IEC62368最新标准
  Meet the latest standard of IEC62368.
- DFN2×2-8L封装，无卤产品
  DFN2×2-8L package, halogen-free product.

应用 / Applications

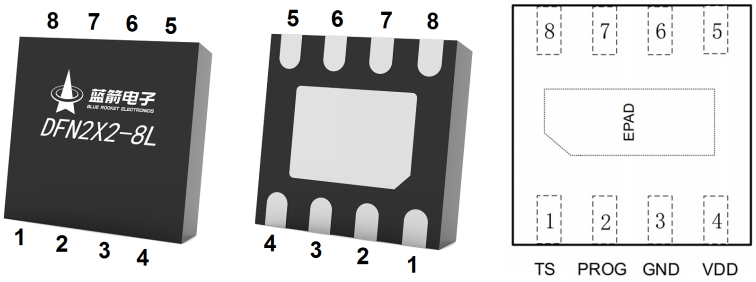
- 移动电话 mobile phone
- 便携式媒体播放 portable Media Players
- 蓝牙耳机 bluetooth headset

应用电路 / Application Circuit



Note: Suggested value(R1=4.7~10Ω , C1,C2=1~10pF)

引脚 / Pinning



PIN Num.	Symbol	Function
1	TS	External temperature sensing pin, grounded when not in use.
2	PROG	Charging current adjusting pin
3	GND	GND
4	VDD	Power input terminal
5	BAT	Battery output terminal
6	STDBY	Full charge indicator light
7	CHRG	Charging indicator light
8	CE	Charging function enabling pin, suspended when not in use; High level shutdown
EPAD	NC	There is no electricity, so it is recommended to connect with GND(BAT-) in practical application to enhance heat dissipation.

极限参数 / Absolute Maximum Ratings(Ta=25℃)

PARAMETER	SYMBOL	RATINGS	UNITS
Input Supply Voltage	V_{DD}	-0.3~30	V
CHRG Pin Voltage	V_{CHRG}	-0.3~30	
STDBY Pin Voltage	V_{STDBY}	-0.3~30	
TS Pin Voltage	V_{TS}	-0.3~30	
CE Pin Voltage	V_{CE}	-0.3~6	
PROG Pin Voltage	V_{PROG}	-0.3~6	
BAT Pin Voltage	V_{BAT}	-0.3~20	
Operating Ambient Temperature Range	T_A	-40~85	°C
Junction Temperature	T_J	150	°C
Storage Temperature	T_{stg}	-55~150	°C
Lead Temperature (Soldering, 10s)	T_{solder}	260	°C
ESD	HBM	2000	V

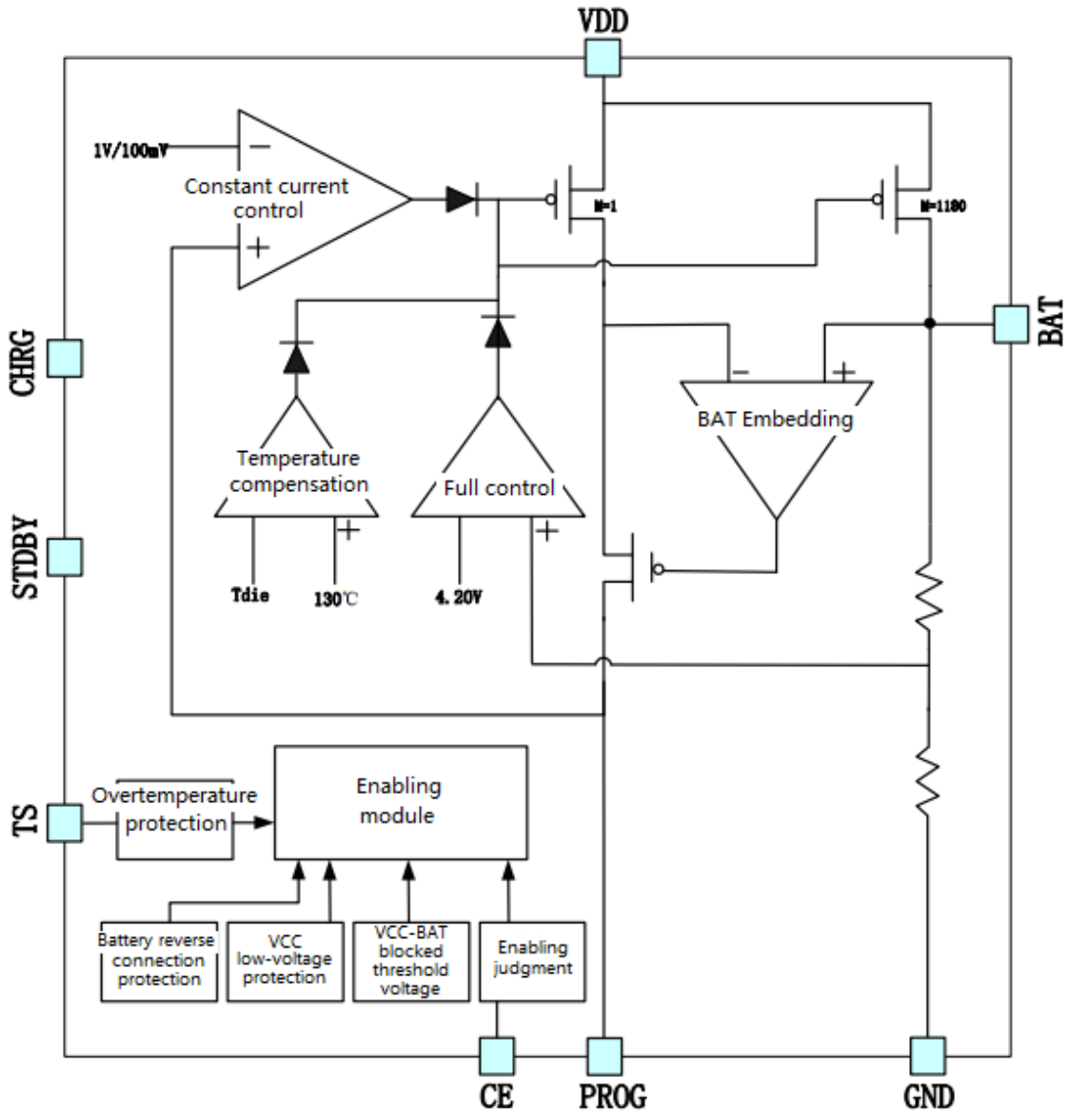
电性能参数 / Electrical Characteristics(Ta=25℃)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Supply Voltage			4.5	5.0	6.0	V
Input Over-Voltage Protection Voltage	V_{ovp}	V_{DD} Rising	6.3	6.9	7.5	V
Input Over-Voltage Protection Voltage Hysteresis	ΔV_{OVP}	V_{DD} from High to Low		500		mV
V_{CC} Under voltage Lockout Threshold	V_{UVL}	V_{DD} from Low to High		3.5		V
V_{CC} Under voltage Lockout Hysteresis	ΔV_{UVL}	V_{DD} from High to Low		200		mV
Input Supply Current	I_{CC}	Charge Mode, R_{PROG}=1.62 K		90	180	uA
		Standby Mode (Charge Terminated)		60	120	
		Shutdown Mode: R_{PROG} Not Connected, V_{DD}<V_{BAT}, or V_{DD}<V_{UVL}: CE=GND,OVP		60	120	
Trickle Charge Threshold	V_{TRIKL}	V_{BAT} Rising	2.6	2.8	3.0	V
Trickle Charge Hysteresis	ΔV_{TRIKL}	V_{DD} from High to Low		150		mV
Trickle Charge Current	I_{TRIKL}	V_{BAT}＜V_{TRIKL}, R_{PROG}=1.62 K	45	66	85	mA
BAT Pin Current	I_{BAT}	V_{DD} =5 V,R_{PROG}=1.62 K, V_{BAT}=3.95 V	657	730	803	mA
		V_{DD} Not Connected, V_{BAT}=4 V		0.5	3	uA
PROG Pin Voltage	V_{PROG}	V_{DD}=5 V，R_{PROG}=1.62 K	0.9	1.0	1.1	V
PROG Pin Pull-Up Current	I_{PROG}			1		μA
Regulated Output (Float) Voltage	V_{FLOAT}	V_{DD}=5V，R_{PROG}=1.62 K	4.158	4.200	4.242	V
C/10 Termination Current Threshold	I_{TERM}	R_{PROG}=1.62 K	45	66	85	mA
Termination Comparator Filter Time	t_{Term}	I_{BAT} Falling Below I_{TERM}	0.8	1.8	4.0	mS
Recharge Battery Threshold	$\triangle V_{RECHG}$	V_{FLOAT}－V_{RECHG}		150		mV
Recharge Comparator Filter Time	$t_{RECHARGE}$	V_{BAT} High to Low	0.8	1.8	4.0	mS
Power FET “ON” Resistance (Between V_{CC} and BAT)	R_{ON}	V_{BAT}=3.8 V,I_{CHG}=0.73 A, R_{PROG}=1.62 K		500		mΩ
Built in temperature compensation	OTC	R_{PROG}=1.62K		130		℃

电性能参数 / Electrical Characteristics(Ta=25℃)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
External temperature too high detection threshold	OTPH	TS connected to NTC resistance	43%× VDD	45% × VDD		V
External temperature too low detection threshold	OTPL	TS connected to NTC resistance		80% × VDD	82% × VDD	V
CE high level(Shutdown Mode)	V_{CEH}		1.5		5	V
CE low level(Work Mode)	V_{CEL}				0.2	V

原理框图 / Principle block diagram



功能描述 / Function description

BRCL4058EZZ 是一款采用恒定电流/恒定电压算法的单节锂离子电池充电器。BRCL4058EZZ 可以依靠一个 USB 端口或 AC 适配器工作，最大能够提供 1.0A 的充电电流。支持最高 30 V 输入电压以和 6.9 V 过压保护功能。

BRCL4058EZZ is a single-cell Li-Ion and Li-Polymer batteries charger. with constant current/constant voltage algorithm. BRCL4058EZZ can work with a USB port or AC adapter, and can provide a maximum charging current of 1.0A. Supports up to 30 V input voltage and 6.9 V overvoltage protection.

◆ 正常充电循环 Normal charging cycle

当 V_{DD} 引脚电压升至 UVLO 门限电压以上且在 PROG 引脚与地之间连接了一个精度为 1%的电阻，然后一个电池与充电器输出端相连时，一个充电循环开始。如果 BAT 引脚电压低于 V_{TRKL}，则充电器进入涓流充电模式。在该模式中，BRCL4058EZZ 提供约 1/10 的设定充电电流，以便将电池电压提升至一个安全的电压，从而实现满电流充电。当 BAT 引脚电压升至 V_{TRKL} 以上时，充电器进入恒定电流模式，此时向电池提供恒定的充电电流。当 BAT 引脚电压达到最终浮充电压 V_{FLOAT} 时，BRCL4058EZZ 进入恒定电压模式，且充电电流开始减小。当充电电流降至设定值的 1/10，充电循环结束。

When the voltage at the VDD pin rises above the UVLO threshold voltage, a resistor with an accuracy of 1% is connected between the PROG pin and the ground, and then a battery is connected to the charger output, a charging cycle begins. If the voltage of BAT pin is lower than V_{TRKL}, the charger enters trickle charging mode.

In this mode, BRCL4058EZZ provides about 1/10 of the set charging current, so as to raise the battery voltage to a safe voltage, thus realizing full current charging. When the voltage at the BAT pin rises above V_{TRKL}, the charger enters the constant current mode, and provides a constant charging current to the battery at this time. When the voltage of BAT pin reaches the final floating charge voltage V_{FLOAT}, BRCL4058EZZ enters the constant voltage mode, and the charging current begins to decrease. When the charging current drops to 1/10 of the set value, the charging cycle ends.

◆ 充电电流设置 Charging current setting

充电电流是采用一个连接在PROG引脚与地之间的电阻器来设定的，设定电阻器和充电电流采用下列公式来计算。根据需要的充电电流来确定电阻器阻值。

The charging current is set by a resistor connected between the PROG pin and the ground. The setting resistor and charging current are calculated by the following formula. Determine the resistance of the resistor according to the required charging current.

$$R_{PROG}(k\Omega) = 1180 / I_{BAT}(mA)$$

对于大于 0.5 A 应用中，芯片热量相对较大，智能温度控制会降低充电电流，不同环境测试电流与公式计算理论值也变得不完全一致。客户应用中，可根据需求选取合适大小的 R_{PROG}。

For applications greater than 0.5 A, the chip heat is relatively large, and intelligent temperature control will reduce the charging current, and the test current in different environments will not be completely consistent with the theoretical value calculated by the formula. In customer application, R_{PROG} with appropriate size can be selected according to requirements.

功能描述 / Function description

◆ 电池反接保护功能 Battery reverse connection protection function

BRCL4058EZZ 内置锂电池反接保护功能，当锂电池反接于 BRCL4058EZZ 输出引脚，BRCL4058EZZ 会停机显示故障状态，无充电电流，两个 LED 指示灯全灭，此时反接的锂电池漏电电流小于 0.5 mA。将反接的电池正确接入， BRCL4058EZZ 自动开始充电循环。反接后的 BRCL4058EZZ 当电池去除后，由于 BRCL4058EZZ 输出端 BAT 管脚电容电位仍为负值，则 BRCL4058EZZ 指示灯不会立刻正常亮，只有正确接入电池可自动激活充电。或者等待 BAT 端电容负电位的电量放光， BAT 端电位大于零伏， BRCL4058EZZ 会显示正常的无电池指示灯状态。反接情况下， 过高的电源电压在反接电池电压情形下，芯片压差会超过 10 V，故在反接情况下电源电压不宜过高。

BRCL4058EZZ has built-in lithium battery reverse connection protection function. When the lithium battery is reversely connected to the output pin of BRCL4058EZZ, BRCL4058EZZ will stop to display the fault state, and there is no charging current, and the two LED indicators are all turned off. At this time, the leakage current of the reverse connected lithium battery is less than 0.5mA. Connect the reverse battery correctly, and BRCL4058EZZ will automatically start the charging cycle. After the reverse connection of BRCL4058EZZ, after the battery is removed, the BRCL4058EZZ indicator lamp will not light normally immediately because the capacitance potential of BAT pin at the output end of BRCL4058EZZ is still negative, and charging can be automatically activated only when the battery is connected correctly. Or wait for the negative potential of the capacitor at the BAT terminal to be discharged, and the potential at the BAT terminal is greater than 0V, and BRCL4058EZZ will display the normal battery-free indicator light. In the case of reverse connection, if the power supply voltage is too high, the chip voltage difference will exceed 10V in the case of reverse connection, so the power supply voltage should not be too high in the case of reverse connection.

◆ 充电指示功能 Charging indication function

BRCL4058EZZ 有两个漏极开路状态指示输出端，CHRG和STDBY。当充电器处于充电状态时，CHRG被拉到低电压，STDBY处于高阻态。当电池反接时，CHRG和STDBY都处于低阻态，两个灯全灭。当不用状态指示功能时，将不用的状态指示输出端接到地。

BRCL4058EZZ has two drain open state indication outputs, CHRG and STDBY. When the charger is in charging state, CHRG is pulled to low voltage, and STDBY is in high impedance state. When the battery is reversed, both CHRG and STDBY are in a low resistance state, and both lights are turned off. When the status indication function is not used, connect the unused status indication output terminal to the ground.

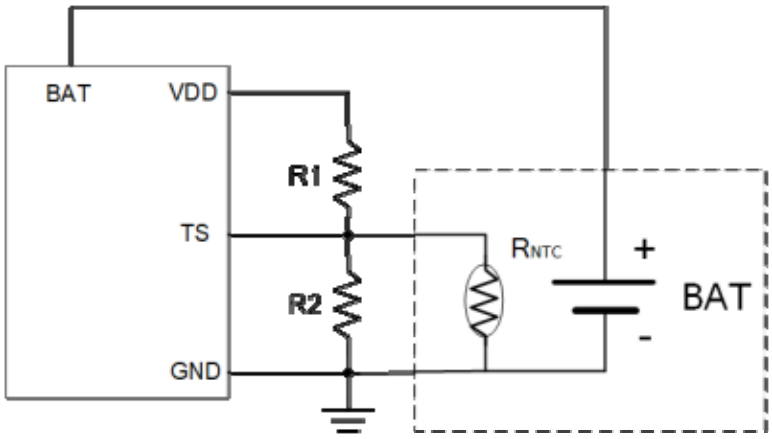
State of charge	CHRG	STDBY
Charging	ON	OFF
Battery full	OFF	ON
Over-voltage, under-voltage, over-temperature and other fault states.	OFF	OFF
VDD access, no battery	Flashing	ON

功能描述 / Function description

◆ 温度保护功能 Temperature protection function

为了防止温度过高或者过低对电池造成的损害，BRCL4058EZZ 内部集成有电池温度检测电路。电池温度检测是通过测量TS管脚的电压实现的，TS管脚的电压是外置NTC热敏电阻和一个电阻分压网络实现的，如下图所示。

In order to prevent damage to the battery caused by too high or too low temperature, BRCL4058EZZ has an integrated battery temperature detection circuit. Battery temperature detection is realized by measuring the voltage of TS pin, which is realized by external NTC thermistor and a resistor voltage dividing network, as shown in the following figure.



BRCL4058EZZ 将TS管脚的电压同芯片内部的两个阈值OTPL和OTPH相比较，以确认电池的温度是否超出正常范围。在BRCL4058EZZ 内部，OTPL被固定在45%×VDD ，OTPH被固定在80%×VDD。如果TS管脚的电压V_{TS} <OTPL或者V_{TS} >OTPH ，则表示电池的温度太高或者太低，充电过程将被暂停；如果TS管脚的电压V_{TS}在OTPL和OTPH之间，充电周期则继续。如果将TS管脚接地，电池温度检测功能将被禁止。

BRCL4058EZZ compares the voltage of TS pin with two thresholds OTPL and OTPH inside the chip to confirm whether the battery temperature is beyond the normal range. Inside BRCL4058EZZ, OTPL is fixed at 45%×VDD, and OTPH is fixed at 80%×VDD. If the voltage of TS pin VTS <OTPL or VTS >OTPH, it means that the battery temperature is too high or too low, and the charging process will be suspended; If the voltage VTS of the TS pin is between OTPL and OTPH, the charging cycle will continue. If the TS pin is grounded, the battery temperature detection function will be disabled.

Selection of R_1、R_2、R_{NTC}:

R_1和R_2的值要根据电池的温度检测范围和热敏电阻R_{NTC}的电阻值来确定，举例来设计：

假设设定的电池温度范围为TL-TH（其中 TL<TH）；电池中使用的是负温度系数的热敏电阻（NTC），R_{TL}是其在温度TL时的电阻值，R_{TH}是其在温度TH时的阻值，则R_{TL}>R_{TH}。

The values of R1 and R2 should be determined according to the temperature detection range of the battery and the resistance value of the thermistor RNTC, for example:

Assume that the set battery temperature range is TL-TH (where TL < TH); The negative temperature coefficient thermistor (NTC) is used in the battery, RTL is its resistance at temperature TL and RTH is its resistance at temperature TH, so R_{TL}>R_{TH}.

功能描述 / Function description

在温度TL和TH时，TS管脚的电压分别为：
At temperatures TL and TH, the voltages of TS pins are:

$$V_{TS\_L} = \frac{R_2 // R_{TL}}{R_1 + R_2 // R_{TL}} \times VDD$$

$$V_{TS\_H} = \frac{R_2 // R_{TH}}{R_1 + R_2 // R_{TH}} \times VDD$$

同时 meanwhile

$$V_{TS\_L} = V_{OTPL} = K_2 \times VDD (K_2 = 0.8)$$

$$V_{TS\_H} = V_{OTPH} = K_1 \times VDD (K_1 = 0.45)$$

综合上式，可推导出：
Based on the above formula, it can be deduced that:

$$R_1 = \frac{R_{TL} R_{TH} (K_2 - K_1)}{(R_{TL} - R_{TH}) K_1 K_2}$$

$$R_2 = \frac{R_{TL} R_{TH} (K_2 - K_1)}{R_{TL} (K_1 - K_1 K_2) - R_{TH} (K_2 - K_1 K_2)}$$

如果电池内部采用的正温度系数的热敏电阻(PTC)，则R1和R2可按照下式来计算：
If a positive temperature coefficient thermistor (PTC) is used inside the battery, R1 and R2 can be calculated according to the following formula:

$$R_1 = \frac{R_{TL} R_{TH} (K_2 - K_1)}{(R_{TH} - R_{TL}) K_1 K_2}$$

$$R_2 = \frac{R_{TL} R_{TH} (K_2 - K_1)}{R_{TH} (K_1 - K_1 K_2) - R_{TL} (K_2 - K_1 K_2)}$$

从上面的推导中可以看出，待设定的温度范围与电源电压V_{DD}无关，仅与电阻R_1、R_2、R_{TH}、R_{TL}有关，其中R_{TH}、R_{TL}可通过电池查阅相关的电池手册或通过实验获得。
It can be seen from the above derivation that the temperature range to be set has nothing to do with the power supply voltage V_{DD}, but only with the resistors R_1, R_2, R_{TH} and R_{TL}, among which R_{TH} and R_{TL} can be obtained by consulting relevant battery manuals or through experiments.

假定电池温度检测范围： 0℃-60℃，选用某品牌热敏电阻 10 K（B=3435），在 0℃时，R_{TL}=27.445 Kohm；在 60℃时，R_{TH}=3.024 Kohm，代入上述公式，可得到（通过计算，取接近标称值的电阻）：
Set the battery temperature detection range: 0℃-60℃, choose a brand thermistor 10 K(B=3435), at 0℃, R_{TL}=27.445 KΩ ; At 60℃, R_{TH}=3.024 KΩ. Substituting the above formula, we can get (through calculation, take the resistance close to the nominal value):

R_1 = 3.3 KΩ；R_2 = 27 KΩ

功能描述 / Function description

在实际应用中，若只关注某一端的温度特性，比如过热保护，则R_2可以不用；选用R_1即可；R_1的推导变得简单，在此不再赘述。

In practical application, if we only pay attention to the temperature characteristics of one end, such as overheating protection, R_2 can be omitted. Select R_1; The derivation of R_1 becomes simple and will not be described here.

◆ 智能温控 Intelligent temperature control

如果芯片温度试图升至约 130℃的预设值以上 ，BRCL4058EZZ 内部热反馈环路将减小设定的充电电流。该功能可防止芯片过热，并允许用户提高给定电路板功率处理能力的上限而没有损坏 BRCL4058EZZ 的风险。在保证充电器将在最坏情况条件下自动减小电流的前提下，可根据典型环境温度来设定充电电流。

If the chip temperature tries to rise above the preset value of about 130℃, the internal thermal feedback loop of BRCL4058EZZ will reduce the set charging current. This function can prevent the chip from overheating and allow the user to increase the upper limit of the power handling capacity of a given circuit board without the risk of damaging BRCL4058EZZ. On the premise of ensuring that the charger will automatically reduce the current in the worst case, the charging current can be set according to the typical ambient temperature.

◆ 欠压闭锁 Undervoltage lockout

一个内部欠压闭锁电路对输入电压进行监控，并在V_{DD}升至欠压闭锁门限以上之前使充电器保持在停机模式。如果UVLO比较器发生跳变，则在V_{DD}升至比电池电压高 200 mV之前充电器将不会退出停机模式。

An internal undervoltage lockout circuit monitors the input voltage and keeps the charger in shutdown mode until VDD rises above the undervoltage lockout threshold. If the UVLO comparator jumps, the charger will not exit the shutdown mode until VDD rises to 200 mV higher than the battery voltage.

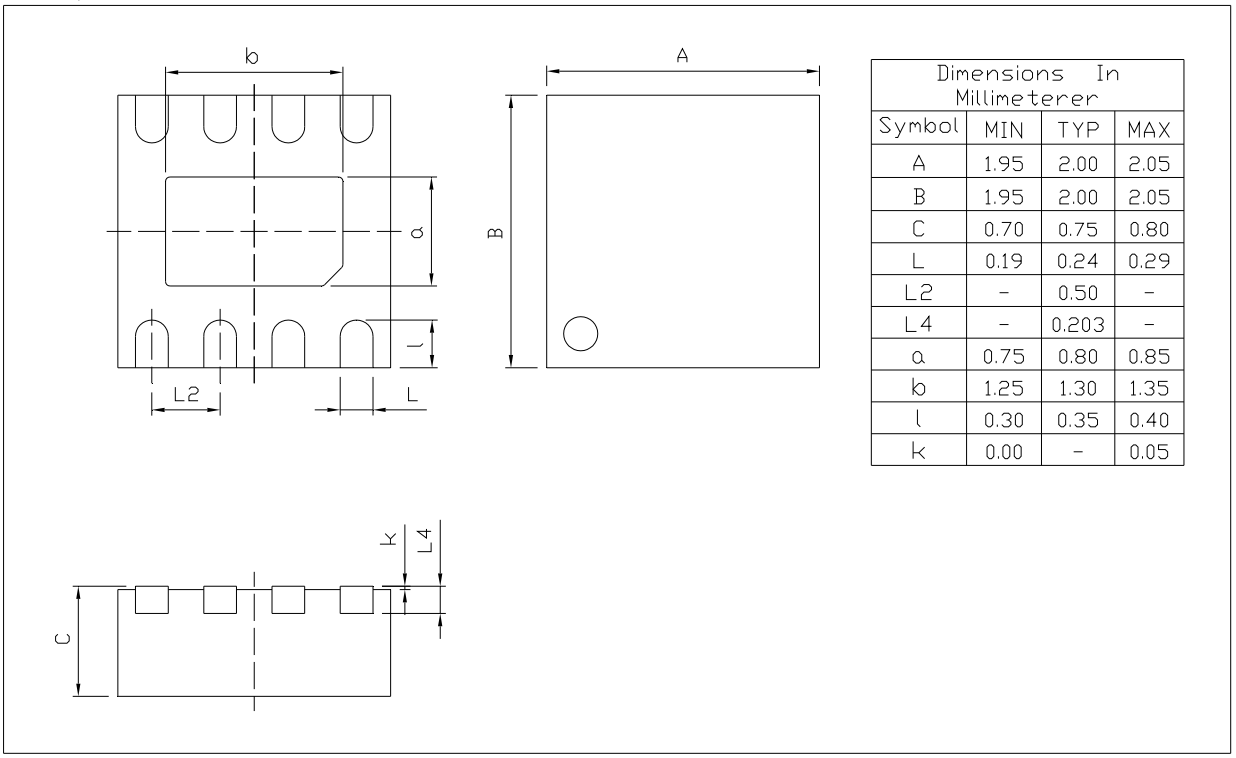
◆ 自动再启动 Automatic restart

一旦充电循环被终止，BRCL4058EZZ 立即采用一个具有 1.8 ms滤波时间（TECHARGE ）的比较器来对 BAT 引脚上的电压进行连续监控。当电池电压降至 4.05 V（大致对应于电池容量的 80%至 90%）以下时，充电循环重新开始。这确保了电池被维持在（或接近）一个满充电状态，并免除了进行周期性充电循环启动的需要。

Once the charging cycle is terminated, BRCL4058EZZ immediately uses a comparator with 1.8 ms filter time (TECHARGE) to continuously monitor the voltage on the BAT pin. When the battery voltage drops below 4.05 V (approximately corresponding to 80% to 90% of the battery capacity), the charging cycle is restarted. This ensures that the battery is maintained at (or near) a fully charged state, and eliminates the need to start a periodic charging cycle.

外形尺寸图 / Package Dimensions

DFN2×2-8L-0.75 Unit:mm



Dimensions In Millimeterer			
Symbol	MIN	TYP	MAX
A	1.95	2.00	2.05
B	1.95	2.00	2.05
C	0.70	0.75	0.80
L	0.19	0.24	0.29
L2	-	0.50	-
L4	-	0.203	-
a	0.75	0.80	0.85
b	1.25	1.30	1.35
l	0.30	0.35	0.40
k	0.00	-	0.05

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印章说明 / Marking Instructions

说明：

4058E： 为型号代码

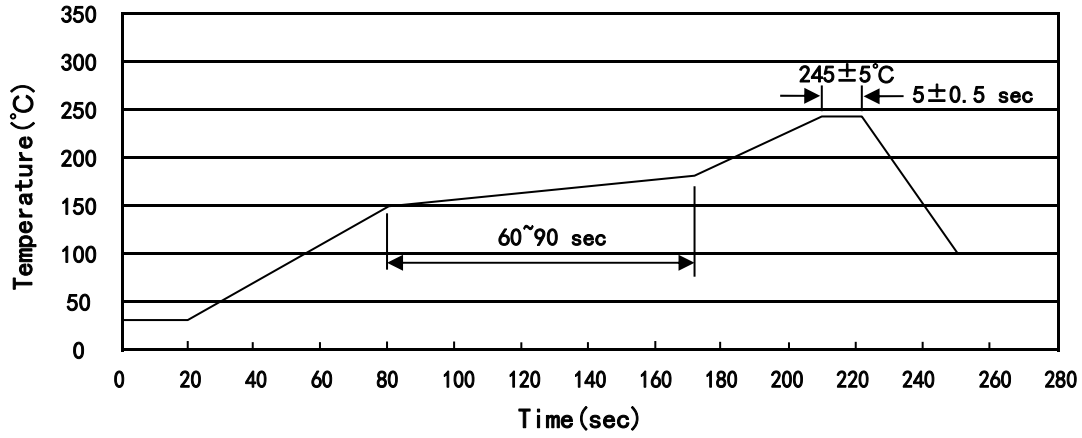
****： 为生产批号代码，随生产批号变化

Note:

4058E: Product Type Code

****: Lot No. Code, code change with Lot No

回流焊温度曲线图(无铅) / Temperature Profile for IR Reflow Soldering(Pb-Free)



说明：	Note:
1、预热温度 150～180℃，时间 60～90sec;	1.Preheating:150~180℃, Time:60~90sec.
2、峰值温度 245±5℃，时间持续为 5±0.5sec;	2.Peak Temp.:245±5℃, Duration:5±0.5sec.
3、焊接制程冷却速度为 2～10℃/sec.	3. Cooling Speed: 2~10℃/sec.

耐焊接热试验条件 / Resistance to Soldering Heat Test Conditions

温度：260±5℃	时间：10±1 sec.	Temp.:260±5℃	Time:10±1 sec

包装规格 / Packaging SPEC.

卷盘包装 / REEL

Package Type 封装形式	Units 包装数量					Dimension 包装尺寸 (unit：mm³)		
	Units/Reel 只/卷盘	Reels/Inner Box 卷盘/盒	Units/Inner Box 只/盒	Inner Boxes/Outer Box 盒/箱	Units/Outer Box 只/箱	Reel	Inner Box 盒	Outer Box 箱
DFN2×2-8L	4,000	10	40,000	4	160,000	7″ ×8	210×205×205	445×435×230

使用说明 / Notices