密级状态： 绝密(　　) 秘密(　　) 内部资料(　　) 公开(　√)

Security Class: Top-Secret (　　) Secret (　　) Internal (　　) Public (√)

RK817_RK809_电量计开发指南

RK817_RK809_Fuel_Gauge_Developer_Guide

（技术部，第二系统产品部）

(Technical Department, R & D Dept. II）

文件状态： **Status:** [　] 草稿 [　] Draft [　] 正在修改 [　] Modifying [√] 正式发布 [√] Released	**文件标识：** **File No.:**	RK-KF-YF-257
	当前版本： **Current Version:**	V1.0
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	完成日期： **Finish Date:**	2019-2-17
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	审核日期： **Finish Date:**	2019-2-17

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修改记录 Revision History

版本号 Version no.	作者 Author	修改日期 Revision Date	修改说明 Revision description	备注 Remark
V1.0	陈顺庆 Chen Shunqing	2019-2-17	发布初始版本 Initial version release	

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前言 Preface

概述 Overview

本文档主要介绍 Rockchip 的 RK817/RK809 子模块电量计的开发指南，旨在介绍相关的概念、配置与一些常见问题的分析定位。

This document is the developer guide of Rockchip RK817/RK809 sub module fuel gauge, mainly introducing the relevant concepts, configurations and some common issues analyzing/debugging.

产品版本 Product Version

芯片名称 Chip Name	内核版本 Kernel Version
RK817	Linux4.4
RK809	Linux4.4

读者对象 Applicable subjects

本文档主要适用于以下工程师：

This document is mainly suitable for the following engineers:

技术支持工程师

Field application engineers

软件开发工程师

Software development engineers

1 概述 Overview

RK817/RK809 是一款高性能 PMIC，集成了多路大电流 DCDC，多个 LDO 和线性开关，1 个 USB 5V 输入及 boost 输出，高性能 codec，电量计，然而不同的是，RK817 多了充电功能，RK809 不带充电功能。所以下面提到的充电功能默认指的是 RK817。

The RK817/RK809 is a high performance power-management integrated circuit (PMIC) integrated CODEC for multi-core system applications powered by a Li-ion or a Li-ion polymer battery cell, or by a 5V input either from an USB port or from an adaptor. The difference is that the RK817 supports charging function while RK809 does not support charging function. Therefore, the charging function mentioned below is referring to RK817 by default.

另外一个不同的，RK809 可以支持多节电池，RK817 只支持单节电池，因为 RK817 只支持最大 5.5v 的输入电压。

Another difference is that, RK809 can support multiple batteries, while RK817 only supports single battery because the maximum input voltage supported by RK817 is only 5.5V.

2 驱动文件 Driver files

drivers/power/rk817_battery.c	RK817 与 RK809 共用电量计驱动
drivers/power/rk817_battery.c	RK817 and RK809 share fuel gauge driver
drivers/power/rk817_charger.c	RK817 充电驱动
drivers/power/rk817_charger.c	RK817 charging driver

如果 defconfig 默认没有配置上，请在 menuconfig 中选上：

If defconfig is not configured by default, please select in menuconfig:

```
Symbol: BATTERY_RK817 [=y]
Type  : boolean
Prompt: RK817 Battery driver
  Location:
    -> Device Drivers
(1)   -> Power supply class support (POWER_SUPPLY [=y])
  Defined at drivers/power/Kconfig:540
  Depends on: POWER_SUPPLY [=y] && MFD_RK808 [=y]


Symbol: CHARGER_RK817 [=y]
Type  : boolean
Prompt: RK817 Charger driver
  Location:
    -> Device Drivers
(2)   -> Power supply class support (POWER_SUPPLY [=y])
  Defined at drivers/power/Kconfig:547
  Depends on: POWER_SUPPLY [=y] && MFD_RK808 [=y]
```

同时记住请把 test_power 驱动去掉：

Meanwhile remember to disable the test_power driver:

```
Symbol: TEST_POWER [=y]
Type  : tristate
Prompt: Test power driver
  Location:
    -> Device Drivers
(1)   -> Power supply class support (POWER_SUPPLY [=y])
  Defined at drivers/power/Kconfig:67
  Depends on: POWER_SUPPLY [=y]
```

说明：test_power 是一个向 android 固定上报电池状态的驱动，主要是为了在没有电量计驱动的情况下使用。

Note: test_power is a driver that reports the battery status to android on a regular basis, mainly used in the case of no fuel gauge driver.

3 DTS 配置说明 DTS configuration description

```
battery {
        compatible = "rk817,battery";
        ocv_table = <3500 3625 3685 3697 3718 3735 3748
                     3760 3774 3788 3802 3816 3834 3853
                     3877 3908 3946 3975 4018 4071 4106>;
        design_capacity = <2500>;
        design_qmax = <2750>;
        bat_res = <100>;
        sleep_enter_current = <300>;
        sleep_exit_current = <300>;
        sleep_filter_current = <100>;
        power_off_thresd = <3500>;
        zero_algorithm_vol = <3850>;
        max_soc_offset = <60>;
        monitor_sec = <5>;
        sample_res = <10>;
        virtual_power = <0>;
};

charger {
        compatible = "rk817,charger";
        min_input_voltage = <4500>;
        max_input_current = <1500>;
        max_chrg_current = <2000>;
```

```
            max_chrg_voltage = <4200>;
            chrg_term_mode = <0>;
            chrg_finish_cur = <300>;
            virtual_power = <0>;
            dc_det_adc = <0>;
            extcon = <&u2phy>;
    };
```

battery 是 RK817 和 RK809 电量计驱动节点。

battery is the driver node of RK817 and RK809 fuel gauge.

charger 是 RK817 充电驱动节点。

charger is the charging driver node of RK817.

battery 节点参数说明：

Battery node parameters description:

【ocv_table】

开路电压-电量表。即“电压对应电量”，一共 21 个电压值，分别对应 0% --> 100%, 电压值之间的电量步进为 5%。该数据表可以由电池原厂提供，也可以由 RK 深圳分公司进行测量，或者 RK 提供的测量工具得到，具体请咨询深圳分公司相关工程师。

Table of open-circuit voltage mapping the electric quantity. That is the voltage mapping to the battery level, there are 21 voltage values, corresponding to 0% --> 100% respectively, with the step pitch 5%. The data can be provided by the battery vendor, or measured by RK ShenZhen office, or measured by customers using the tool provided by RK. For more details, please consult relevant engineers in RK ShenZhen office.

【design_capacity】

实际电池容量。经实际测量后确定的实际可用容量。例如标称 4000mah，但是实测只有 3850mah，则该值请填写 3850。

The actual battery capacity that is usable after actually measured. For example, the nominal is 4000mah, but the capacity actually measured is only 3850mah, then you should fill in 3850 for this value.

【design_qmax】

最大容量值。主要用途是作为软件处理的纠错条件之一。目前该值请填写标称容量的 1.1 倍数值：即标称容量*1.1。

The maximum capacity which is mainly used as one of error correction conditions in software processing. Please fill in 1.1 times of the nominal capacity: that is, the **design_capacity** *1.1.

【bat_res】

电池内阻。主要在放电算法中会用到，非常重要！该值在测量 ocv_table 时一起获取，所以请注意这个参数的测量，切勿遗漏。

Internal resistance of the battery. It is mainly used in the discharging algorithm, which is very important! This value is obtained when measuring ocv_table, so please remember to measure this parameter.

【sleep_enter_current】

进入松弛模式的条件之一。 目前填写 300，不做改动。

One of the conditions to enter the relax mode. At present, fill in 300, no need to change.

在极低负载情况下（目前只针对于二级待机），如果系统的负载电流持续超过一定时间（软件可配）都小于某个阈值，则电量计模块进入松弛模式。

In the case of extremely low load (currently only for deepsleep), if the load current of the system keeps less than a certain threshold for a certain time (configurable by software), the fuel gauge module will enter the relax mode.

在松弛模式下电量计每隔 8 分钟会采集一组电压，我们称之为松弛电压。用途：二级待机的负载很小，我们近似地认为松弛电压近似于开路电压，因此驱动处理上，在系统从二级待机唤醒且满足一定条件时会用它查询 ocv_table 表进行库仑计的校正。

In the relax mode, the fuel gauge will collect a set of voltages every 8 minutes, which is called the relax voltage. Purpose: the load of deep sleep is very small, we consider that the relax voltage is similar to the open circuit voltage, so in the driver processing, when the system wakes up from deep sleep and meets certain conditions, it will be used to query the ocv_table for the correction of the coulombmeter.

【sleep_exit_current】

退出松弛模式的条件之一。 目前填写 300，不做改动。

One of the conditions to exit the relax mode. At present, fill in 300, no need to change.

【sleep_filter_current】

过滤无效的松弛电流。目前填写 100，不做改动。

Filter invalid relax current. At present, fill in 100, no need to change.

【power_off_thresd】请仔细阅读和理解 Please read and understand carefully

期待的系统关机电压，单位：mV。特别注意：该值指的是 VSYS 的瞬时电压，而不是 vbat 端的电压（电量计采集的是 vbat 端的电压）！原理说明：Vbat 端的电压需要经过一个阻值大约 50 毫欧的 mos 管后（除此外，其实另外还有部分 PCB 走线带来的阻抗）才转换为 VSYS 供给系统，所以把 VSYS 作为关机点依据才是正确的。由此我们可知：相同的 vbat 端电压，当前的负载电流越大，则 vsys 端电压就越低；反之，相同 vsys 下，当前负载电流越大，对应的 vbat 电压也就越高。RK 的平台不建议 vsys 端的电压低于 3.4V，这样容易导致 VCC_IO（ 3.3V）等 dcdc/ldo 的供电不稳定。

The expected shutdown voltage of the system, unit: mV. Note: this value refers to the instantaneous voltage of VSYS, but not the voltage at the vbat (the fuel gauge captures the voltage at the vbat)! Principle: the voltage at the Vbat end needs to pass through a MOS tube with a resistance value of about 50 mΩ (in fact, there are also some impedance caused by PCB wiring) before being converted to the VSYS to supply system, therefore, it is correct to use VSYS as the basis of the shutdown point. Thus, we can see that with the same voltage at the vbat, the higher the load current is, the lower the vsys voltage will be. Conversely, with the same vsys voltage, the higher the load current is, the higher the corresponding vbat voltage is. It is recommend vsys voltage should not be less than 3.4V on RK platforms, otherwise it may lead to unstable power supply for dcdc/ldo such as VCC IO (3.3V) etc.

【zero_algorithm_vol】

进入电压+库仑计放电模式的电压值，单位： mV。低于该值，进入电压+库仑计结合的软件放电算法。建议：4.2V 电池设置为 3850mV，4.3V 及其以上的电池设置为 3950mV。

The voltage value to enter the discharging mode of voltage + coulombmeter, unit: mV. If the voltage

is less than this value, the software will enter the discharging algorithm combining voltage + coulombmeter. Recommendations: if the battery is 4.2V, set the value to 3850mV, and if the battery is 4.3V or above, set the value to 3950mV.

【max_soc_offset】

开机校正时允许的最大电量误差。如果关机至少 30 分钟，则开机时会进行一次 ocv 表的电量查询，并且对比关机前的电量，如果偏差超过 max_soc_offset，即进行强制校正，把电量设置为 ocv 表对应的真实值。例如：当前显示电量是 20%，但是根据 ocv 电压推算的实际电量为 80%，则此时显示的电量直接显示为 80%。一般在发生死机后会出现这种电量偏差极大的情况，这个值的大小依客户的可接受程度，由客户自己进行设置，不建议这个值小于 60。

The maximum allowable electric quantity error during startup calibration. If the power off lasts for at least 30 minutes, it will query the ocv table when the machine is powered on and compare with the electric quantity before power off. If the deviation exceeds max_soc_offset, it will perform mandatory correction, and the electric quantity will be set to the true value corresponding to the ocv table. For example, if current displayed electric quantity is 20%, but the actual electric quantity inferred based on the ocv voltage is 80%, then it will directly display the electric quantity as 80%. Generally, such a huge power deviation will occur after the crash. This value can be set by customers based on their requirements and it is recommended that this value should not be less than 60.

【monitor_sec】

轮询时间（秒）。电量计驱动是需要不停地进行轮询才能正常工作，期间需要进行不少 I2C 读写操作，但是考虑到不同平台上 I2C 的健壮程度不同，所以预留该配置选项。目前建议 5~10s 比较合适，设置为 5s 是最佳选择。

Polling time (second). The battery driver requires constant polling to work properly, during which many I2C read and write operations are required. However, considering the robustness of I2C on different platforms, this configuration option is reserved. Currently it is recommended that 5~10s is appropriate, and 5s is the best choice.

【sample_res】

电池端附近的采样电阻大小，单位：毫欧。库仑计是通过该电阻来获知当前系统的电流大小，请根据实际硬件贴的电阻大小填写。目前电阻的大小只支持 10mR 或者 20mR。

The value of the sampling resistor near the battery end, unit: milliohm. The coulombmeter gets the system current through this resistor. Please fill in the value of the resistor actually pasted. Currently the resistor only supports 10mR or 20mR.

【virtual_power】

测试模式。有时候在拷机过程中不希望因为电量、充电电流等原因导致系统供电不足导系统关机。设置该值为 1，即放开充电电流限制，系统输入电流始终为 max_input_current 来满足供电。此时驱动始终上报给 android，当前为充电状态，电量 66%。

Test mode. Sometimes during the test we don't want the system to be shut down due to insufficient power supply caused by charging current or other reasons. Set this value as 1, that is, to remove the charging current limit, and the system input current is always max_input_current to meet the power supply requirement. In this way, the driver always reports to android that currently device is in charging mode and the electric quantity is 66%.

charger 节点参数说明：

charger node parameters description:

【min_input_voltage】

输入电压限制。目前有如下档位（单位： mV）：

The minimum value of input voltage. There are the options as follows (unit: mV):

<4000, 4100, 4200, 4300, 4400, 4500, 4600, 4700>

【max_input_current】

最大输入电流。目前有如下档位（单位： mA）：

The maximum value of input current. There are the options as follows (unit: mA):

<450, 80, 850, 1500, 1750, 2000, 2500, 3000>

注意，第二个档位是 80，不是 800！使用中一般不去设置 80mA 的档位。

Note: the second level is 80, but not 800. Generally 80mA is not used.

如果配置不在上面这些档位里面的，比如配置<1700>，那驱动会设置输入电流为 1500mA。

If the configuration is not involved in the above Settings, such as <1700>, the driver will set the input current to 1500mA.

【max_chrg_current】

最大充电电流。目前有如下档位（单位： mA）：

The maximum charging current. There are the options as follows (unit: mA):

<1000, 1500, 2000, 2500, 2750, 3000, 3500, 500>

如果配置不在上面这些档位里面的，比如配置<1700>，那驱动会设置输入电流为 1500mA。

If the configuration is not involved in the above Settings, such as <1700>, the driver will set the input current to 1500mA.

【max_chrg_voltage】

最大充电电压，即电池满充的截止电压。目前有如下档位（单位： mV）：

The maximum charging voltage, that is, the cut-off voltage when fully charged. There are the options as follows (unit: mV):

<4100, 4150, 4200, 4250, 4300, 4350, 4400, 4450>

【chrg_term_mode】

配置模拟/数字模式，0:模拟，1:数字。

Configure analog or digital mode, 0: analog, 1: digital.

不要配置成 1，不然可能会导致电池电压充不上去。

Do not set it to 1, otherwise it may cause that the battery cannot be charged to the expected voltage.

【chrg_finish_cur】

充电截止电流。

The cut-off current for charging.

当充电电流达到截止电流，电压达到截止电压，且没有发生输入限流的情况下产生充电截止信号，不再继续充电，我们认为此时电池已经充满。（这里需要输入限流的条件来判读，否则无法分清是真的充电电流变小了，还是因为此时的系统负载比较大导致给电池的充电电流小）。

When the charging current reaches the cut-off current and the voltage reaches the cut-off voltage, and there is no input current limit occurring, the charging cut-off signal will be generated to stop charging

the battery. We believe that the battery is full at this time. (here we need to judge according to the condition of input current limit, otherwise it is not able to distinguish whether the charging current is really decreased, or whether the charging current to the battery is low because of the larger system load at this time.)

【virtual_power】

测试模式。设置该值为 1，无论有没有接充电器都会上报正在充电状态。

Test mode. Set this value as 1. The drive will report it is in charging mode no matter if the charger is connected or not.

【dc_det_adc】

RK817 DC 充电目前还不支持通过 adc 检测。

RK817 DC charging does not support adc detect at present.

【extcon】

RK817 通过注册 extcon 通知链来获取充电类型。

RK817 obtains the charging type by registering extcon notification chain.

如果是 usb 充电口，extcon = <&u2phy>，如果多个 usb 口，请配置成对应的 u2phy；

If it is a usb charging port, extcon = <&u2phy>, and if there are multiple usb ports, please configure to the corresponding u2phy.

如果是 type-c 充电口，extcon = <&fusb0>，如果多个 type-c 口，请配置成对应的 fusbn。

If it is a type-c charging port, extcon = <&fusb0>, and if there are multiple type-c ports, please configure to the corresponding fusbn.

4 实例配置 Instance configuration

目前有以下几种组合方案：

Currently there are several combinations as follows:

RK817(自带充电和电量计功能)

RK817 (Built-in charger and fuel gauge function)

RK809+BQ25700(充电电流为软件控制)

RK809+BQ25700 (The charging current is controlled by software)

RK809+BQ24133(充电电流为硬件控制，BQ24133 不需要驱动)

RK809+BQ24133 (The charging current is controlled by hardware, and BQ24133 does not need software driver)

4.1 RK817

RK817 有充电功能，所以可以参考如下配置：

RK817 has charging function, so we can refer to the following configuration:

```
battery {
        compatible = "rk817,battery";
```

```
        ocv_table = <3500 3625 3685 3697 3718 3735 3748
                     3760 3774 3788 3802 3816 3834 3853
                     3877 3908 3946 3975 4018 4071 4106>;
        design_capacity = <2500>;
        design_qmax = <2750>;
        bat_res = <100>;
        sleep_enter_current = <300>;
        sleep_exit_current = <300>;
        sleep_filter_current = <100>;
        power_off_thresd = <3500>;
        zero_algorithm_vol = <3850>;
        max_soc_offset = <60>;
        monitor_sec = <5>;
        sample_res = <10>;
        virtual_power = <0>;
};

charger {
        compatible = "rk817,charger";
        min_input_voltage = <4500>;
        max_input_current = <1500>;
        max_chrg_current = <2000>;
        max_chrg_voltage = <4200>;
        chrg_term_mode = <0>;
        chrg_finish_cur = <300>;
        virtual_power = <0>;
        dc_det_adc = <0>;
        extcon = <&u2phy>;
};
```

4.2 RK809+BQ25700

因为 RK809 没有充电功能，所以 charger 节点不用配置，但需要把 BQ25700 的节点打开。

RK809 does not support charging function, so there is no need to configure the charger node, but need to enable the BQ25700 node.

BQ25700 我们这边用来举例，不对参数进行说明。

Here we take BQ25700 as an example, without parameter description.

```
battery {
        compatible = "rk817,battery";
        ocv_table = <3500 3625 3685 3697 3718 3735 3748
```

```
                        3760 3774 3788 3802 3816 3834 3853
                        3877 3908 3946 3975 4018 4071 4106>;
        design_capacity = <2500>;
        design_qmax = <2750>;
        bat_res = <100>;
        sleep_enter_current = <300>;
        sleep_exit_current = <300>;
        sleep_filter_current = <100>;
        power_off_thresd = <3500>;
        zero_algorithm_vol = <3850>;
        max_soc_offset = <60>;
        monitor_sec = <5>;
        sample_res = <10>;
        virtual_power = <0>;
};

……

bq25700: bq25700@6b {
        compatible = "ti,bq25703";
        reg = <0x6b>;
        extcon = <&fusb0>;
        interrupt-parent = <&gpio1>;
        interrupts = <RK_PA1 IRQ_TYPE_LEVEL_LOW>;
        pinctrl-names = "default";
        pinctrl-0 = <&charger_ok_int>;
        ti,charge-current = <1500000>;
        ti,max-charge-voltage = <8704000>;
        ti,max-input-voltage = <20000000>;
        ti,max-input-current = <6000000>;
        ti,input-current-sdp = <500000>;
        ti,input-current-dcp = <2000000>;
        ti,input-current-cdp = <2000000>;
        ti,input-current-dc = <2000000>;
        ti,minimum-sys-voltage = <6700000>;
        ti,otg-voltage = <5000000>;
        ti,otg-current = <500000>;
        ti,input-current = <500000>;
        pd-charge-only = <0>;
        status = "disabled";
```

```
};
```

4.3 RK809+BQ24133

因为 BQ24133 不需要软件驱动，并且我们的参考图没有留 DC 充电检测的 io 脚，但是可以通过 RK809 的寄存器来判断充电状态。

BQ24133 does not need a software driver, and there is no io pin reserved to detect DC charging in our reference design, but the charging state can be determined by the register of RK809.

虽然 BQ24133 不需要驱动，但是系统需要驱动上报状态，所以为了兼容硬件，我们把充电 psy 放到 rk817_battery.c 驱动里面上报。

Although BQ24133 does not need software driver, but the system requires the driver to report the state, so in order to be compatible with the hardware, we put the charging psy into rk817 battery.c driver to report the state.

```
battery {
        compatible = "rk817,battery";
        ocv_table = <3500 3625 3685 3697 3718 3735 3748
                     3760 3774 3788 3802 3816 3834 3853
                     3877 3908 3946 3975 4018 4071 4106>;
        design_capacity = <2500>;
        design_qmax = <2750>;
        bat_res = <100>;
        sleep_enter_current = <300>;
        sleep_exit_current = <300>;
        sleep_filter_current = <100>;
        power_off_thresd = <3500>;
        zero_algorithm_vol = <3850>;
        max_soc_offset = <60>;
        monitor_sec = <5>;
        sample_res = <10>;
        virtual_power = <0>;
        register_chg_psy = <1>;
};
```

register_chg_psy = <1>; 这个需要配置成 1，目的是 RK809 驱动上报充电状态。

register_chg_psy = <1>; should be configured to 1 to allow RK809 driver to report the charging status.

4.4 RK809+双节电池 RK809+ dual battery

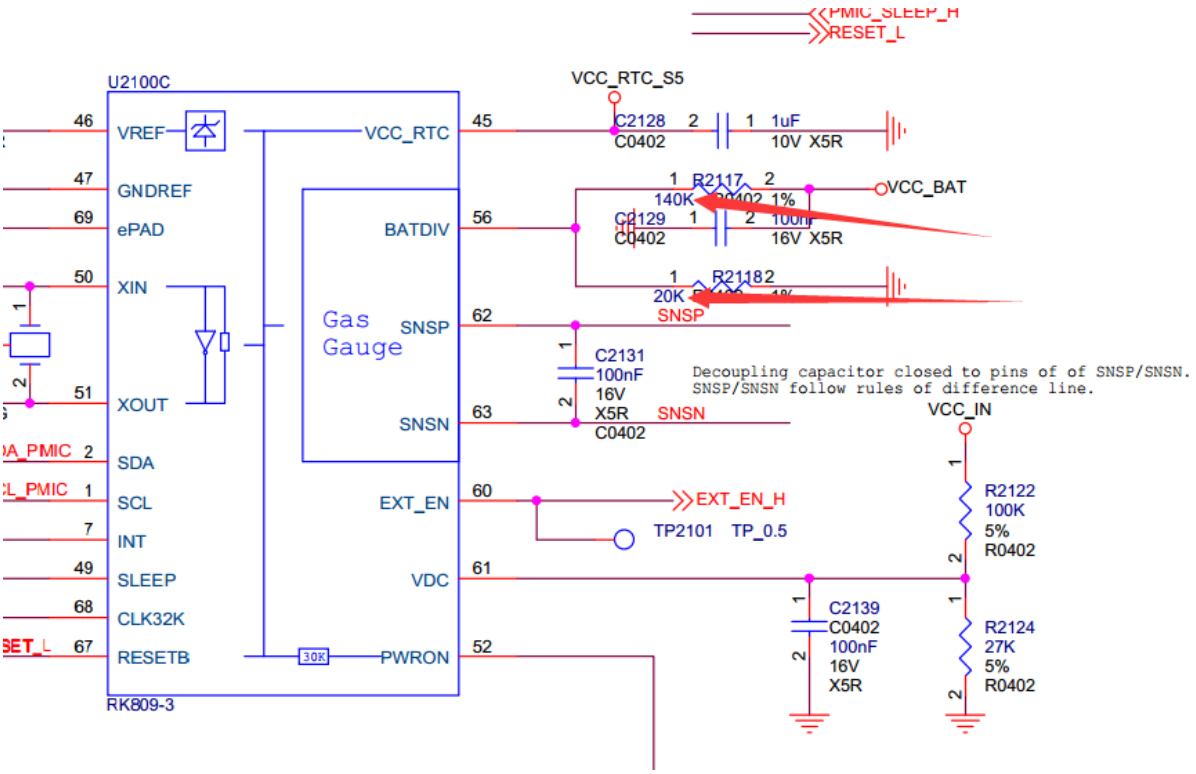
```
battery {
        compatible = "rk817,battery";
        ocv_table = <7000 7250 7370 7384 7436 7470 7496
                     7520 7548 7576 7604 7632 7668 7706
                     7754 7816 7892 7950 8036 8142 8212>;
        design_capacity = <2500>;
        design_qmax = <2750>;
        bat_res = <100>;
        sleep_enter_current = <300>;
        sleep_exit_current = <300>;
        sleep_filter_current = <100>;
        power_off_thresd = <7000>;
        zero_algorithm_vol = <7700>;
        max_soc_offset = <60>;
        monitor_sec = <5>;
        sample_res = <10>;
        virtual_power = <0>;
        bat_res_up = <140>;
        bat_res_down = <20>;
};
```

ocv_table、ower_off_thresd、zero_algorithm_vol 需要把对应的电压配置成双节电池的电压。

ocv_table, ower_off_thresd and zero_algorithm_vol are required to configure the corresponding voltages to be the voltage of the dual battery.

bat_res_up/bat_res_down 分压电阻的值，请看硬件原理图：

For the values of divider resistors bat_res_up/bat_res_down, please refer to the hardware schematic:



5 Uboot 充电 Uboot charging

参考《Rockchip-Developer-Guide-UBoot-nextdev.pdf》的<5.8 充电驱动>章节。

Refer to chapter 5.8 in 《Rockchip-Developer-Guide-UBoot-nextdev.pdf》.

6 FAQ

6.1 如何打开调试信息？ How to enable the debugging information?

1. 编译前把驱动第一行的 static int dbg_enable = 0;改为 1。

   Before compiling, modify the first line of the driver "static int db_enable = 0;" to 1.

2. 如果固件没有打开 dbg_enable，运行时也可以串口输入如下命令进行开关：

   If the firmware does not enable dbg_enable, you can also input the following command through serial port to switch:

```
enable：echo 1 > /sys/module/rk817_battery/parameters/dbg_ldevel
        echo 1 > /sys/module/rk817_charger/parameters/dbg_ldevel
disable：echo 0 > /sys/module/rk817_battery/parameters/dbg_ldevel
        echo 0 > /sys/module/rk817_charger/parameters/dbg_ldevel
```

6.2 电池校准 Battery calibration

6.2.1 电池校准方式 Battery calibration mode

1. 卸下电池 10s 左右，再重新接上。
   Disconnect the battery for about 10s and reconnect.
2. 做一次完整的充放电。
   Perform a full charging and discharging.

6.2.2 何时需要校准 When to calibrate

1. 当 DTS 配置的电池容量有改变时；
   When the battery capacity configured in the DTS is changed.
2. 很明显电量已经不准（原因可能是机器死机、某些特别的非电量计压力测试等）；
   The electric quantity is obviously incorrect (may be caused by the crash or some special non-fuel gauge stress test and so on).
3. 电量计专项拷机前校正一次，保证电池是在准确的情况下开始的测试。
   Calibrate before the stress test of fuel gauge to make sure the battery is accurate for the testing.

6.3 为什么显示电量与 DTS 中的 ocv_table 对不上？ Why does the displayed electric quantity not match ocv_table?

ocv_table 是开路不带负载情况状态下的【电压-电量】的比值，并且我们只是在开机校正、休眠较正时用到这个表。

Ocv_table is the ratio of the voltage to the electric quantity in the open circuit state without load, and it is only used for bootup correction and sleep correction.

6.4 为什么关机后电池电压比DTS配置关机电压高？ Why is the battery voltage after power off higher than power_off_thresd configured in DTS?

关机电压以最后 Log 打印的实时电压为准，而且这个关机电压是 vsys 电压（具体参考 power_off_thresd 说明），我们要保证的是实时电压不低于预设的关机点。并且关机后系统下电，锂电池极化慢慢消失，会有一个电压回升的过程，这是锂电池的特性。

The power off voltage is subject to the real-time voltage printed by the last Log, and it is the vsys voltage (refer to power_off_thresd for details), so what we need to ensure is that the real-time voltage is not lower than the power_off_thresd. After power off, the polarization of lithium battery will gradually disappear, and there will be a process of voltage recovery, which is the characteristic of lithium battery.

6.5 拔掉电池再开机，电量变化 Electric quantity changes after reconnect battery

1. 拔掉电池后 PMIC 完全掉电，此时再开机只能 ocv 电压查询 ocv_table 反推电量，所以是正常的，是一次电池的重新校正；
   The PMIC completely lost power after disconnecting the battery, and we can only read electric quantity from ocv table after reboot, so this is normal and it is a recalibration of the battery.
2. 拆卸后希望电池电量不跳变，几乎不可能，除非软件做规避：把关机前的电量写到文件里，上电后再去读。客户有需求的话，请客户自己增加这部分规避处理的代码。
   It is almost impossible to keep the electric quantity unchanged after disconnecting the battery, unless the software does some evasive action: write the electric quantity into system file before power off, and read it after power on. Add this code yourself if you need.

6.6 Log 打印的电流与实际测量的差很多 Big difference between the current printed in log and the actually measured current

请确认选用的是 20/10 毫欧的采样电阻且电阻精度够高；其次请确认焊点焊接干净，采样电阻应该位于 BAT-和 GND 之间。

Please confirm to use the sampling resistor with 20 or 10 milliohms and the resistance accuracy is high enough. Then make sure the solder joint is clean and the sampling resistance should be between BAT- and GND.

6.7 为什么电量一直显示都是 50%，而且一直在充电？ Why does the battery always display 50% and keep charging all the time?

开了 test_power 驱动，请 DTS 中把 test_power disabled 掉。

test_power driver is enabled. Please disable test_power in DTS.

6.8 为什么电量一直显示都是 66%，而且一直在充电？ Why does the battery always display 66% and keep charging all the time?

当前没有接入电池；或者 DTS 的 virtual_power 被配置成了 1，请配置成 0。

The battery is not connected. Or virtual_power is configured to 1 in DTS, please configure to 0 in DTS.

6.9 RK809 为什么读到电池电压不对？ Why did RK809 get the wrong battery voltage?

根据 4.4 节定位，应该是 dts 中 bat_res_up/bat_res_down 配置错了。

Analyzing according to section 4.4, there should be something wrong with the configuration of bat_res_up/bat_es_down in DTS.

6.10 关闭关机充电之后，重启机器电量跳变 If uboot charging is disabled, the electric quantity of the device jumps after reboot

确认下 dts 中 charge-animation 是不是被 disabled 掉了？如下：

Confirm whether charge-animation in dts is disabled or not. As follows:

```
charge-animation {
        compatible = "rockchip,uboot-charge";
        rockchip,uboot-charge-on = <1>;
        rockchip,android-charge-on = <0>;
        rockchip,uboot-low-power-voltage = <3450>;
        rockchip,screen-on-voltage = <3500>;
        rockchip,uboot-exit-charge-level = <2>;
        rockchip,uboot-exit-charge-voltage = <3500>;
        status = "disabled";
    };
```

这么修改是不正确的，因为 charge-animation 关掉之后 uboot 的电量计驱动就不会跑了，很多初始化在 uboot 电量计驱动里面做，所以这个必须要开。正确的修改如下：

This modification is incorrect, because the battery driver does not run in uboot after the charge-animation is disabled, but a lot of initialization should be done in the uboot battery driver, so this must be enabled. The correct modification is as follows:

```
charge-animation {
        compatible = "rockchip,uboot-charge";
        rockchip,uboot-charge-on = <0>;
        rockchip,android-charge-on = <0>;
        rockchip,uboot-low-power-voltage = <3450>;
        rockchip,screen-on-voltage = <3500>;
        rockchip,uboot-exit-charge-level = <2>;
        rockchip,uboot-exit-charge-voltage = <3500>;
        status = "okay";
    };
```

把 charge-animation 打开，rockchip,uboot-charge-on 和 rockchip,android-charge-on 设置成 0。

Enable charge-animation, and set rockchip,uboot-charge-on and rockchip,android-charge-on to 0.

6.11 RK809 插着充电器关机，进入关机充电，再次开机，电量不准问题

RK809 enters power off charging with the charger connected, and the electricity will be incorrect after reboot

RK809 的 VDC 脚是上升沿触发开机，所以在插着充电的情况下执行关机，机器是会进入关机状态不会触发开机，在这种情况下电池还在充电。

RK809 VDC pin triggers power on at rising edge, so the execution of power off with the charger plugged in will make the machine enter power off state without triggering power on. In this case, the battery is still charging.

但是因为 RK809 不带充电功能，所以在关机的情况下电量计没有工作，不会对电量进行统计，关机之后充的这些电量不会被计入，所以再次开机还是关机之前的电量。

But the RK809 doesn't have charging function, the fuel gauge doesn’t work during power off period and the electric quantity charged after power off is not counted, so the electric quantity after reboot is the same as that before power off.

为了避免这种情况发生，需要进行如下修改：

In order to prevent this case from happening, the following modifications are required:

1. uboot：

```
--- a/drivers/power/charge_animation.c
+++ b/drivers/power/charge_animation.c
@@ -445,7 +445,7 @@ static int charge_animation_show(struct udevice *dev)
        }

        /* If there is preboot command, exit */
-       if (preboot && !strstr(preboot, "dvfs")) {
+       if (preboot && !strstr(preboot, "dvfs") && !strstr(preboot, "charge")) {
                printf("Exit charge: due to preboot cmd '%s'\n", preboot);
                return 0;
        }
```

2. android：

在执行 power off 的时候进行判断，如果插着充电器则执行”reboot charge”。

Judge before executing power off, if the charger is connected, then execute "reboot charge".

3. 这边我们没有考虑长按关机的情况，因为长按关机被视为是异常形为，如果一定得改的话，那可以把长按 power 键定义为关机并重启，如下修改：

Here we do not consider the case of long press to power off, because long press to power off is abnormal action. If you have to do so, you can define the long press power button as restart, with the following modification:

```
--- a/drivers/power/fuel_gauge/fg_rk817.c
```

```
+++ b/drivers/power/fuel_gauge/fg_rk817.c
@@ -1308,6 +1308,9 @@ static int rk817_fg_init(struct rk817_battery_device *battery)
                        value =  rk817_bat_read(battery, BAT_DISCHRG);
                        rk817_bat_write(battery, GG_CON, value & (~DIS_ILIM_EN));
                }
+
+               value = rk817_bat_read(battery, 0xf7);
+               rk817_bat_write(battery, 0xf7, value | 0x40);
                rk817_bat_gas_gaugle_enable(battery);
                rk817_bat_init_voltage_kb(battery);
                rk817_bat_calibration(battery);
```