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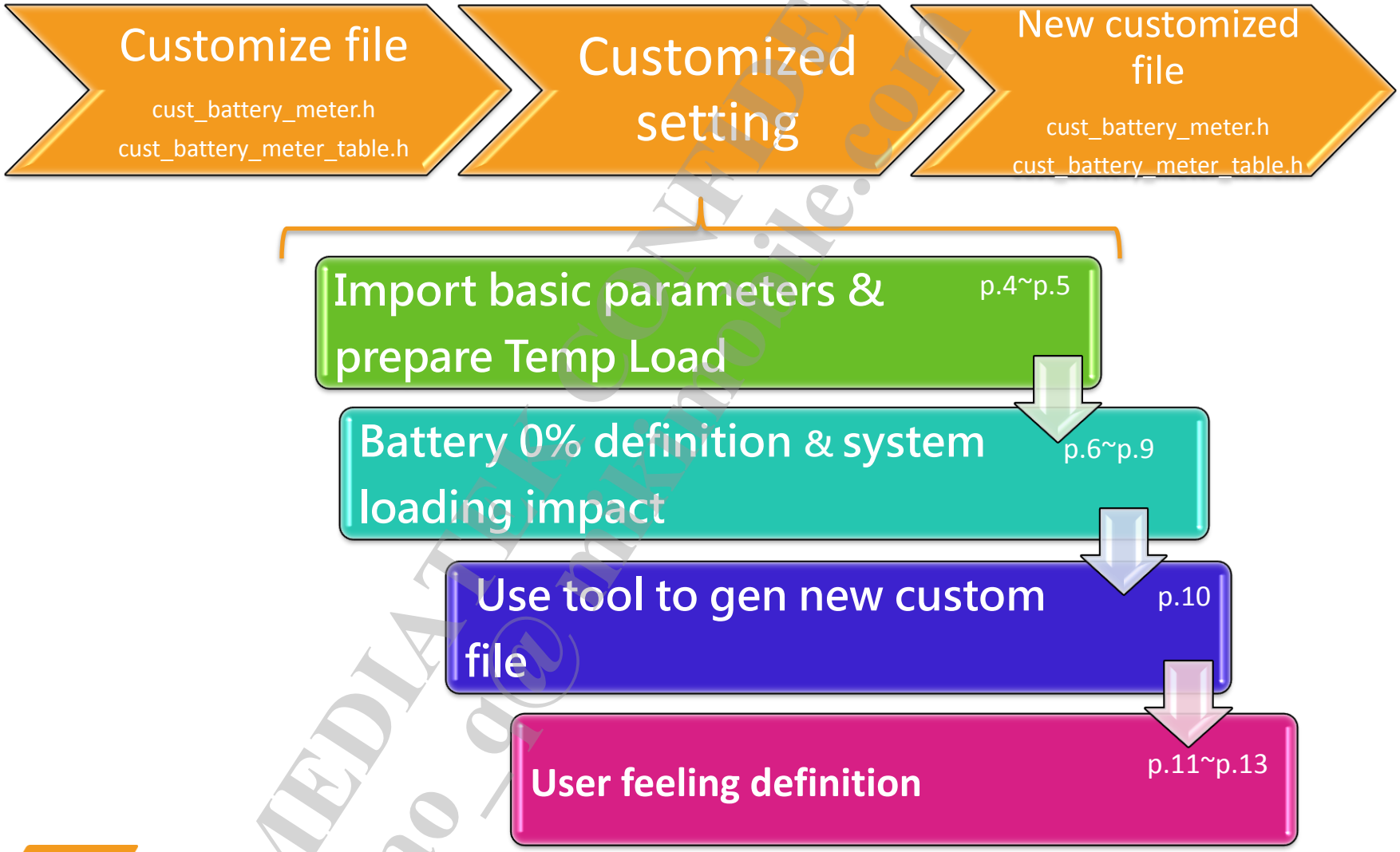
GM1.0 and 2.0 Customized Setting Flow V1.3

Revision History

Revision	Data (mm/dd/yyyy)	Author	Note
1.0	05/21/2015	Ricky Wu/Filby Horng	1st version for customer
1.1	07/21/2015	Cherry Chiu/Bo Jia	Detail test flow for customer
1.2	09/06/2015	Cherry Chiu/Bo Jia	Modified “System load impact adjustment step”.
1.3	01/08/2016	Cherry Chiu	Modified “System load impact adjustment step”.

Customized Setting Flow Step



Import Battery Meter & Gen Temp Load

- "cust_battery_meter_table.h" file parameter import:
  - Step 1: Import ZCV table (note on the next page)
    - Table size must be the same at 50˚C/25˚C/0˚C/-10˚C
    - Allow DOD > 100
    - VC voltage can be set to 2.8V.
- "cust_battery_meter.h" file parameter import :
  - Step 1: Import CAR_TUNE_VALUE
    - #define CAR_TUNE_VALUE 100 (Modify according to the calibration parameters)
  - Step 2: Import PCB impedance
    - #define FG_METER_RESISTANCE 5 (Based on the impedance modification introduced by PCB, mohm)
  - Step 3: Turn off gauge 0% and gauge 1%
    - Before the variable definition add"// ", as below
    - // #define SHUTDOWN GAUGE0
    - //#define SHUTDOWN_GAUGE1_XMINS
    - //#define SHUTDOWN_GAUGE1_MINS 60
- Use these parameter import custom files to generate temp load. Used for battery 0% definition and system load impact adjustment.

Note

Table size must be the same at 50˚C/25˚C/0˚C/-10˚C.

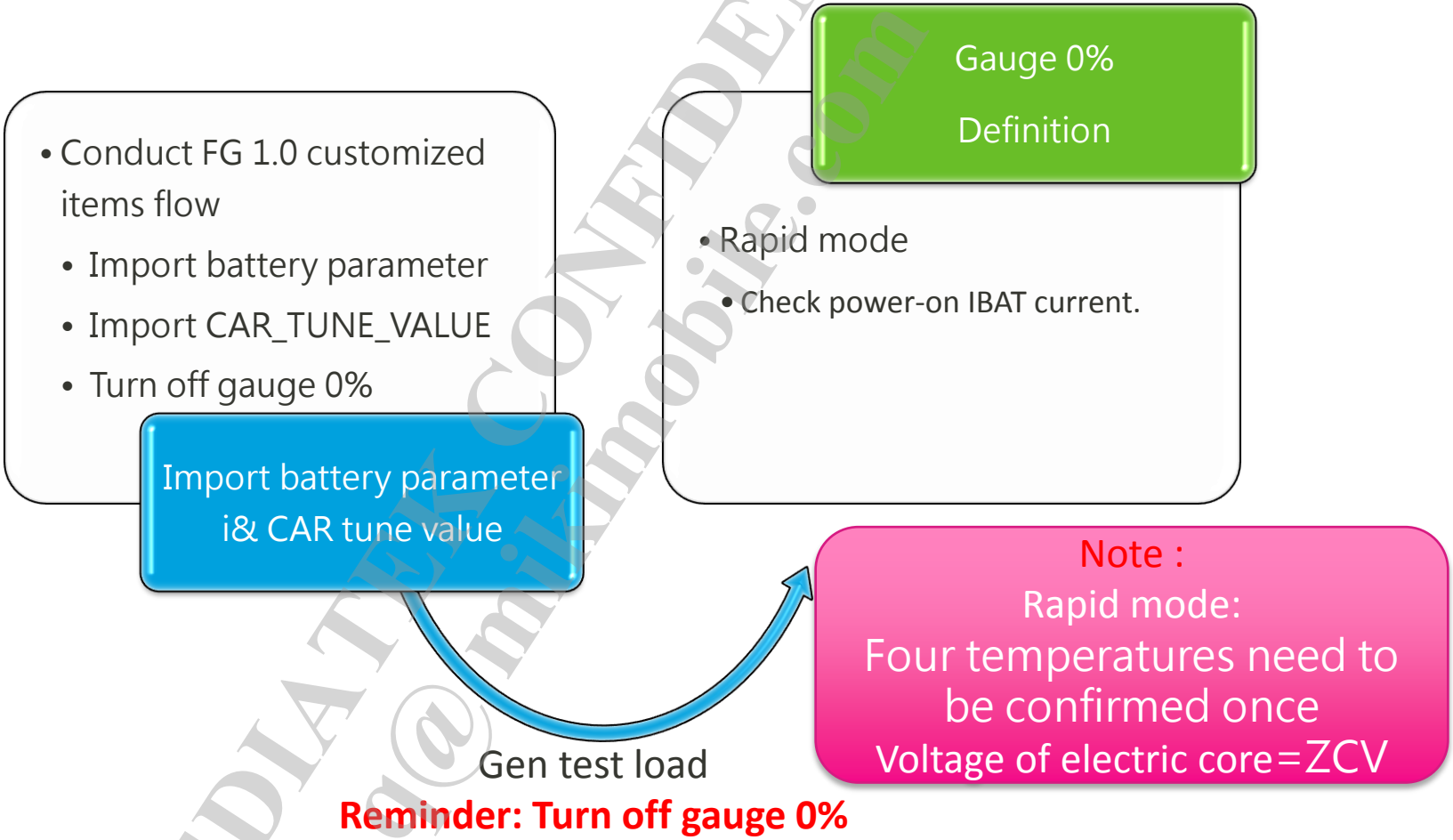
50℃	OCV	VC	mAh	R	DOD
	3678	3617	2348	153	87
	3676	3615	2376	153	88
	3675	3615	2404	150	89
	3675	3612	2432	158	90
	3673	3611	2460	155	91
	3672	3609	2488	158	92
	3670	3604	2516	165	93
	3665	3598	2544	168	94
	3643	3577	2572	165	95
	3607	3536	2600	178	96
	3560	3486	2628	185	98
	3498	3422	2656	190	99
	3442	3354	2684	220	100
	3340	3240	2712	250	101
	3169	2881	2740	720	102
	3112	2797	2746	788	102
	Cmax		2695		
	Cmax_400mA		2665		

25℃	OCV	VC	mAh	R	DOD
	3695	3646	2352	123	86
	3691	3643	2380	120	87
	3690	3643	2408	118	88
	3689	3641	2436	120	89
	3688	3639	2464	123	90
	3689	3636	2492	133	91
	3686	3631	2520	138	92
	3684	3628	2548	140	93
	3677	3617	2576	150	94
	3651	3592	2604	148	95
	3617	3554	2632	158	96
	3570	3504	2660	165	97
	3513	3441	2688	180	98
	3471	3378	2716	233	99
	3406	3309	2744	243	100
	3280	3154	2772	315	101
	Cmax		2745		
	Cmax_400mA		2706		

Allow DOD > 100%

VC voltage can be set to 2.8V.

Steps for Adjusting Gauge 0% Definition



Gauge 0% Rapid Mode Steps

- For GM1.0 & 2.0
  - Step 1: Place the device in the chamber for 30 mins.
  - Step 2: Power on the phone and check the log[FGADC_D0] to get the **boot current I**.
  - Step 3: Fill in the form.

[FGADC_D0] (HW OCV 4126, HW OCV% 97, SW OCV 4131, SW OCV% 97, RTC% 19, VBAT% 86, VBAT 4037, T_avg 29, I 3984)

  - Note: Set the battery voltage to 3.7~3.8V, close to the lowest power-on battery voltage.
- Example:

Temp (℃)	50℃	25℃	0℃	-10℃
Power-on current I (mA)	363.3	188.2	183.1	263.5

Steps for Adjusting System Loading Impact

- Conduct FG 1.0 customized items flow
  - Import battery parameter
  - Import CAR_TUNE_VALUE
  - Turn off gauge 0%

Import battery parameter & CAR tune value

Gen test load

Reminder: Turn off gauge 0%

System heavy load capacity collection

- Charge to battery full. Run heavy loading until shutdown. **Confirm the shutdown voltage ZCV V2.**
- Check the max. average current I during heavy load

Note :

Four temperatures need to be confirmed once

Voltage of electric core=ZCV

Steps for Adjusting System Loading Impact

- Step 1: Place the phone and battery in the chamber for 30 mins. (Battery full, chamber temperature: 40/25/0/-10℃)
- Step 2: Record battery OCV then power on and open the log.
  - **adb shell setprop persist.mediatek.fg.log.enable 1**
- Step 3: Run heavy loading until power-off .(Run GP2 + elephant stress apk or other heavy scenarios.)
- Step 4: Fill in temperature in the table.
- Step 5: Through log and ZCV table, check OCV when AvgVbat is smaller than system power-off voltage and fill the OCV in the table.
  - Refer to page 10-12 for details.
- Step 6: Fill the maximum average current in the table.

Reminder: Check keywords Iavg fg_current_avg

Step 5

Temperature

Search log for the max. fg_current_avg

Heavy loading result	HOT	WARM	COOL	COLD
Temp (℃)	40	25	0	-10
Shutdown vol (mV)	3657	3687	3854	4080
Max. average current (mA)	1467.2	1148.9	1238.8	1324.9

Steps for Adjusting System Loading Impact

- Step 5-1. Check HWOCV and ZCV table for the initial capacity
  - For MT6795, get HWOCV by meter.
  - For other platforms, get HWOCV by [FGADC_D0] log, for example:

```
1.[FGADC_D0] (HW OCV 4239, HW OCV% 93, SW OCV 4223, SW OCV% 92, RTC% 0, VBAT% 90
```

  - Get the initial capacity by HWOCV and ZCV table, for example:

25℃	OCV	VC	mAh	R	DOD
	4331		0	130	0
Qmax	4308	4251	47	130	1
3362	4289	4233	93	133	3
	4271	4216	140	130	4
	4255	4200	186	133	6
	4239	4186	233	133	7
	4223	4168	279	133	8
	4207	4153	326	133	10
	4192	4137	372	133	11
	4178	4122	419	138	12

Initial capacity=233mAh

  - Note: For hot temperatures, check 50℃ ZCV table.

Steps for Adjusting System Loading Impact

- Step 5-2. Check capacity when AvgVbat < power-off voltage
  - kernel log search AvgVbat < power off voltage and timestamp
    - ✓ The power-off voltage is usually 3.4V; for MT6753/53T power-off voltage can be 3.3V.
    - ✓ For MT6797 power-off voltage, refer to conditions for DLPT shutdown. See the next page for the step.
  - Keyword: fg_coulomb_act = consume capacity, unit: 0.1mAh, example:

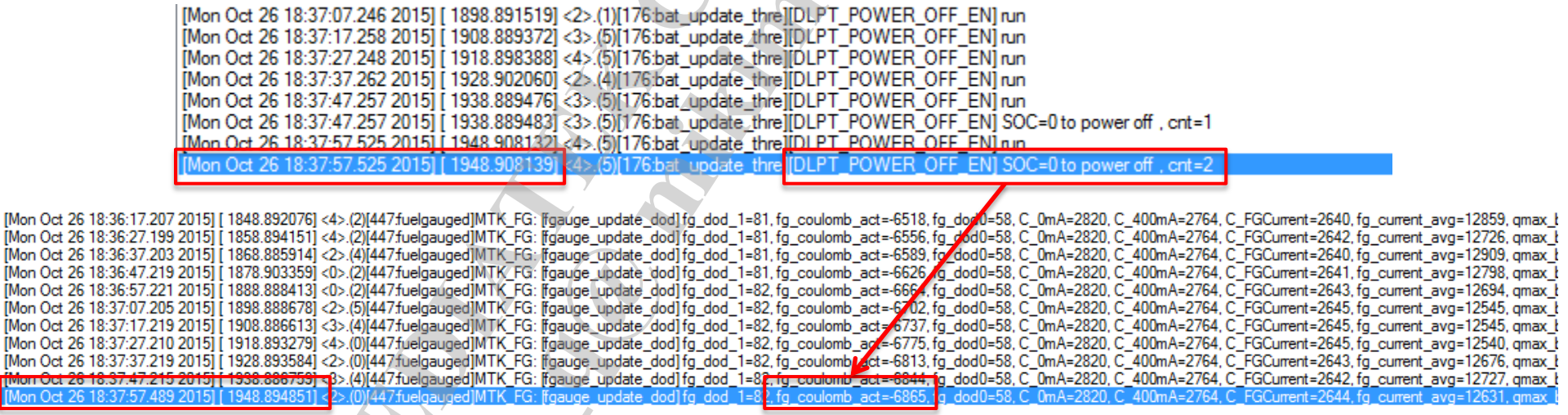
```
[Tue Aug 11 15:10:58.033 2015] [ 8279.756920]<1>.(1)[173:bat_routine_thr][kernel]AvgVbat 3419,bt_vol 3445, AvgI 0, I 0, VChr 0, AvgT 43, T 44, ZCV 3600
[Tue Aug 11 15:11:08.251 2015] [ 8289.961926]<1>.(3)[173bat_routine_thr][kernel]AvgVbat 3415,bat_vol 3359, AvgI 0, I 0, VChr 0, AvgT 43, T 44, ZCV 3487
[Tue Aug 11 15:11:28.265 2015] [ 8309.960288]<2>.(2)[173:bat_routine_thr][kernel]AvgVbat 3411,bat_vol 3413, AvgI 0, I 0, VChr 0, AvgT 43, T 44, ZCV 347
[Tue Aug 11 15:11:38.139 2015] [ 8319.878554]<4>.(4)[173:bat_routine_thr][kernel]AvgVbat 3410,bat_vol 3389, AvgI 0, I 0, VChr 0, AvgT 43, T 44, ZCV 3600
[Tue Aug 11 15:11:58.137 2015] [ 8339.845580]<4>.(4)[173:bat_routine_thr][kernel]AvgVbat 3406,bat_vol 3355, AvgI 0, I 0, VChr 0, AvgT 43, T 44, ZCV 3600
[Tue Aug 11 15:12:08.137 2015] [ 8349.874910<4>.(4)[173:bat_routine_thr][kernel]AvgVbat 3405,bat_vol 3408, AvgI 0, I 0, VChr 0, AvgT 43, T 44, ZCV 3487
[Tue Aug 11 15:12:28.182 2015] [ 8369.894785]<4>.(4)[173:bat_routne_thr][kernel]AvgVbat 3400,bat_vol 3366, AvgI 0, I 0, VChr 0, AvgT 43, T 44, ZCV 3600
[Tue Aug 11 15:12:48.149 2015] [ 8389.901531]<3>.(2)[173:bat_routine_thr][kernel]AvgVbat 3391,bat_vol 3325, AvgI 0, I 0, VChr 0, AvgT 43, T 44, ZCV 3600
[Tue Aug 11 15:12:58.102 2015] [ 8399.791394]<1>.(2)[173:bat_routine_thr][kernel]AvgVbat 3389,bat_vol 3345, AvgI 0, I 0, VChr 0, AvgT 43, T 45, ZCV 3600

[Tue Aug 11 15:11:28.062 2015] [ 8309.744935]<0>.(4)[360:fuelgauged]MTK_FG: [fgauge_update_dod] fg_dod_1=94, fg_coulomb_act=-28246, fg_dod0=8, C_0mA=3356, C_400mA=
[Tue Aug 11 15:11:38.014 2015] [ 8319.683890]<4>.(1)[360:fuelgauged]MTK_FG: fg_coulomb_act_pre=-28205 fg_coulomb_act=-28290 duration_time=10 fg_coulomb_act_time=20
[Tue Aug 11 15:11:48.123 2015] [ 8329.797044]<3>.(4)[360:fuelgauged]MTK_FG fg_coulomb_act_pre=-28205 fg_coulomb_act=-28333 duration_time=10 fg_couomb_act_time=30 f
[Tue Aug 11 15:12:38.088 2015] [ 8379.793276]<2>.(1)[360:fuelgauged]MTK_FG: fg_coulomb_act_pre=-28460 fg_coulomb_act=-28545 duration_time=10 fg_coulomb_act_time=20
[Tue Aug 11 15:12:38.166 2015] [ 8379.873544]<1>.(3)[360:fuelgauged]MTK_FG: [fgauge_udate_dod] fg_dod_1=95, fg_coulomb_act=-28545, fg_dod0=8, C_0mA=3356, C_40mA=33
[Tue Aug 11 15:12:48.196 2015] [ 8389.916194]<1>.(1)[360:fuelgauged]MTK_FG: fg_coulomb_act_pre=-28460 fg_coulomb_act=-28591 duration_time=10 fg_coulomb_act_time=30
[Tue Aug 11 15:12:48.212 2015] [ 8389.922836]<1>.(2)[360:fuelgauged]MTK_FG: [fgauge_update_dod] fg_dod_1=95, fg_coulomb_act=-28591, fg_dod=8, C_0mA=3356, C_400mA=3
[Tue Aug 11 15:13:18.054 2015] [ 8419.745761]<2>.(7)[360:fuelgauged]MTK_FG: fg_coulomb_act_pre=-28719 fg_coulomb_act=-28719 duration_time=10 fg_coulomb_act_time=0
```

fg_coulomb_act unit 0.1mAh
→consume capacity=2859.1mAh

Steps for Adjusting System Loading Impact

- Confirm the consumed capacity when the battery voltage is less than the system shutdown voltage (for MT6797).
- Before heavy loading, cmd to record DLPT log:
  - echo 1 > /proc/pbm/pbm_debug
- Keyword:
  - [DLPT_POWER_OFF_EN] SOC=0 to power off , cnt=



fg_coulomb_act unit 0.1mAh
→ Consume capacity=686.5mAh

Steps for Adjusting System Loading Impact

- Step 5-3: Initial capacity + consume capacity = total capacity. Get power-off voltage OCV by ZCV table.
  - Initial capacity + consume capacity = total capacity
  - Use total capacity to get OCV from ZCV table.
  - Example:
    - ✓ 233 mAh + 2859.1 mAh = 3092.1 mAh

25°C	OCV	VC	mAh	R	DOD
	3730	3657	2791	128	83
	3722	3649	2837	128	84
	3714	3640	2884	128	86
	3706	3629	2930	128	87
	3695	3625	2977	128	89
	3688	3622	3023	125	90
	3687	3618	3070	130	91
	3685	3612	3116	133	93
	3683	3596	3163	140	94

OCV = 3687mV

Heavy load test result	HOT	WARM	COOL	COLD
Temp (°C)	40	25	0	-10
Power off OCV (mV)	3657	3687	3854	4080
Max. average current (mA)	1467.2	1148.9	1238.8	1324.9

Use Tool to Gen New Custom File

- Use ”Gauge Master-Customized Setting” tool to generate new custom file. Refer to document “Gauge Master-Customized Setting Tool SOP”.
- Input file:
  - Insert “custom_battery_meter_table.h”.
  - Insert “custom_battery_meter.h”.
    - reopen gauge 0%
  - “Power-on current” table

Temp (℃)	50℃	25℃	0℃	-10℃
Power-on current (mA)	363.3	188.2	183.1	263.5

  - “System loading impact” table

Heavy load test result	HOT	WARM	COOL	COLD
Temp (℃)	40	25	0	-10
Power off OCV (mV)	3657	3687	3854	4080
Max. average current (mA)	1467.2	1148.9	1238.8	1324.9

Steps for Adjusting Sensitivity

- Set UI to showing 1% hold time T1 until system shutdown
- Example :
  - Set #define SHUTDOWN_GAUGE1_MINS **60**
  - When UI SOC=1% , system will shut down beyond 60 mins.

System 1% keep timing definition

System 100% Definition

- Discharge from 100% , display 100% time
- Example :
  - Set #define BATTERYPSEUDO100 **95**
  - FG SOC >= 95% ➔ UI SOC =100%

System Display SOC: System 1% Keep Timing

- Set up customized file cust_battery_meter.h.
  - #define SHUTDOWN_GAUGE1_MINS **60**
    - The number is UI%=1% display timing. When this timing (min) is exceeded, system will shut down.

System Display SOC: System 100%

- Set up customized file cust_battery_meter.h.
  - #define BATTERYPSEUDO100 **95**
    - The number near 100 Discharge Battery Full to 99% is fast.
    - The number near 90 Discharge Battery Full to 99% is slow.

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Advanced Customized Setting

System Display SOC: System 1%

- Set up customized file cust_battery_meter.h.
  - #define BATTERYPSEUDO1 **4**
    - When the number is near 0, large loading UI will drop to 0% too fast.

Battery SOC: Loading Parameter Adjustment

- Set up customized file cust_battery_meter.h.
  - #define Q_MAX_SYS_VOLTAGE **3400**
    - The factor can optimize loading to Qmax ratio.

Battery SOC: SW OCV Precision Adjustment

- Set up customized file cust_battery_meter.h.
  - #define FG_METER_RESISTANCE **5**
    - Use this setting to adjust the PCB impedance.

Battery SOC: Power On/Off

- Set up customized file cust_battery_meter.h.
  - #define DIFFERENCE_HWOCV_RTC **30**
    - The number is as large as keep D0=RTC
  - #define DIFFERENCE_HWOCV_SWOCV **10**
    - When the number is as small as high probability, let D0=SW OCV.
  - #define DIFFERENCE_SWOCV_RTC **10**
    - When the number is as large as high probability, let D0=RTC.

Smooth and Monotonic SOC: 100% Tracking Time

- Set up customized file cust_battery_meter.h.
  - #define CHARGE_TRACKING_TIME **60**
    - When the charger first lets battery to be full, UI% will per CHARGE_TRACKING_TIME UI+1% until 100%.

Customized Setting Check List

No.	Item	Details Reference
1	Battery ZCV table measurement and import	“Fuel Gauge Battery ZCV Table Test SOP_V1.0” “Fuel Gauge Application Notes_V1.0”
2	CAR_TUNE_VALUE tuning	“Fuel Gauge Application Notes_V1.0”
3	PCB impedance parameter tuning	“GM1.0_2.0 Customized Setting Flow_V1.1” - SW OCV Precision Adjustment, “define FG_METER_RESISTANCE **5**”
4	Gauge 0% definition tuning	“GM1.0_2.0 Customized Setting Flow_V1.1”
5	Loading parameter tuning	“GM1.0_2.0 Customized Setting Flow_V1.1” - System 1%, “#define BATTERYPSEUDO1 **4”** - Loading Parameter, “#define Q_MAX_SYS_VOLTAGE **3400**”
6	User experience parameter tuning	“GM1.0_2.0 Customized Setting Flow_V1.1” - System 1% keep timing, “#define SHUTDOWN_GAUGE1_MINS **60**” - System 100%, “#define BATTERYPSEUDO100 **95**”

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Q&A

Q&A

Question	Ans
1. Charging UI 99% to 100% takes too long.	Refer to system 100% setting.
2. Discharging battery full to 99% is too fast.	
3. Charge curve needs linearity.	
4. UI% less than 5% cannot be powered on after system power-down.	Refer to gauge 0% definition setting.
5. UI% still has 8% but uses heavy loading; UI% fast drops to 0% shutdown.	Refer to system 1% setting.
6. UI% 1% display is too long.	Refer to system 1% keep timing setting.
7. When battery is changed, UI% does not change.	Refer to power on/off setting.
8. Charging 95% to 100% is too fast.	Refer to 100% tracking time setting.
9. The resistance distribution of Rfg is wide after SMT, and one CAR_TUNE_VALUE can not cover all devices.	Using metal film resistor as Rfg is suggested.

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