MTK Battery Management
- Gauge Master 2

Revision History

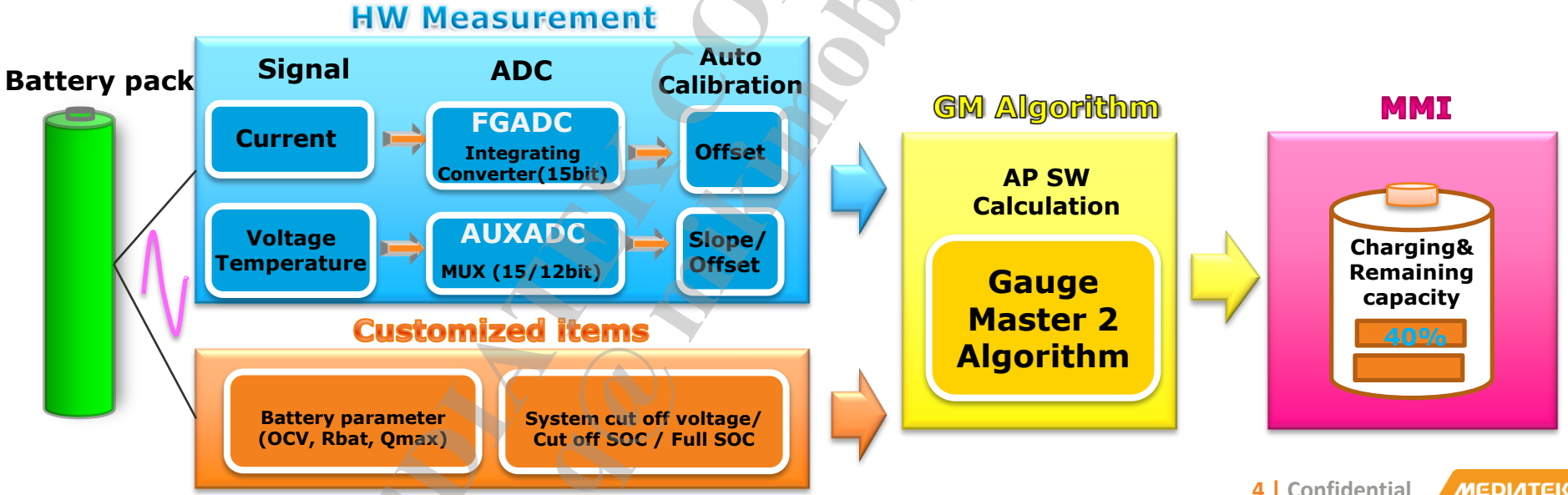
Revision	Data (mm/dd/yyyy)	Author	Note
V1.0	05/21/2015	Ricky Wu	1st version for customer

Preface

- **SOC** – Status of charge
- **DOD** – Depth of discharge
- **D0** – DOD0, initial depth of discharge
- **OCV/ZCV** – Open circuit voltage / Zero current voltage
- **Qmax** – Maximum available capacity of battery
- **Rbat** – Internal impedance of battery package

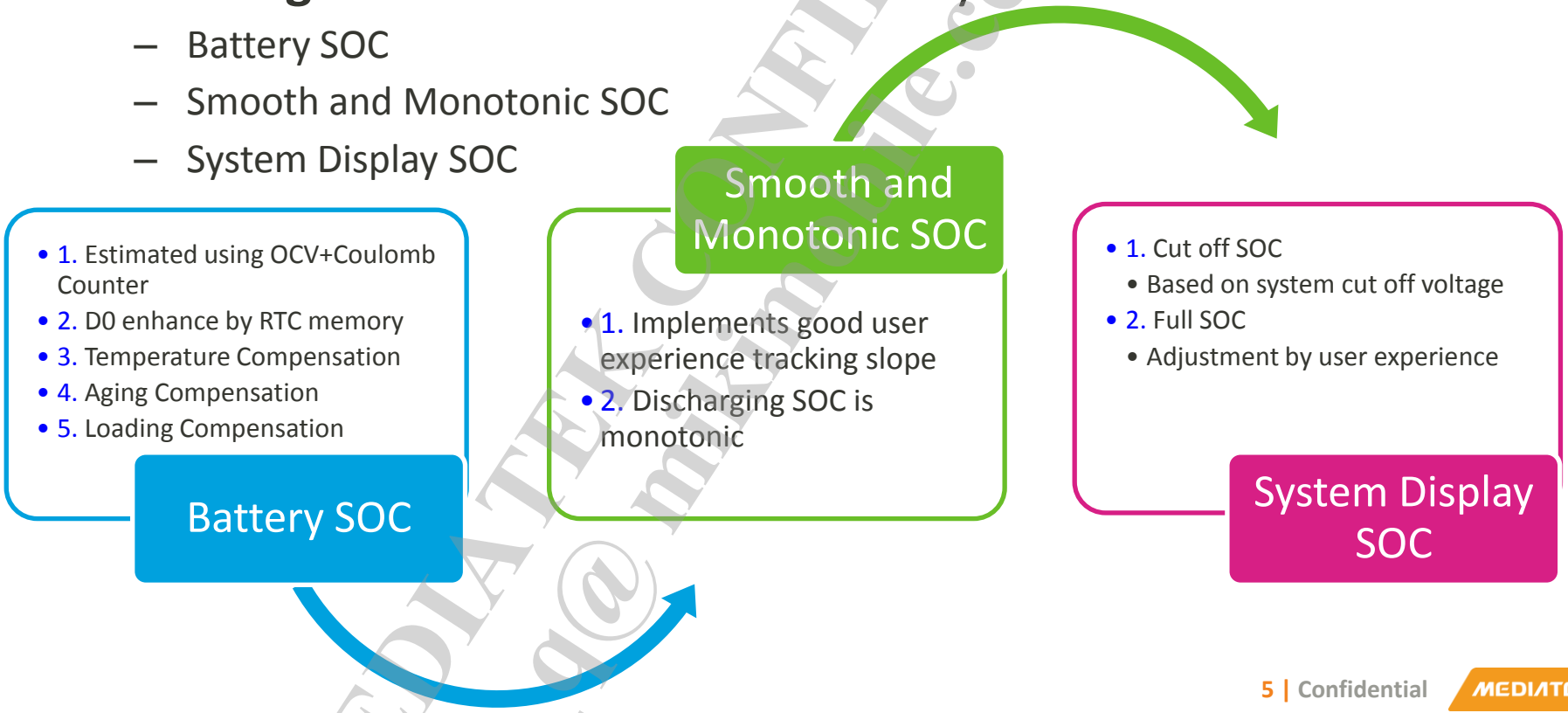
MTK Gauge Master 2 System Architecture

- System-side Li-Ion battery fuel gauge SOC
  - Precise Battery Fuel Gauge
  - Battery current measurement
  - Temperature Reporting



MTK Gauge Master2 Algorithm Overview

- **GM2 Algorithm** are three different layers of SOC
  - Battery SOC
  - Smooth and Monotonic SOC
  - System Display SOC

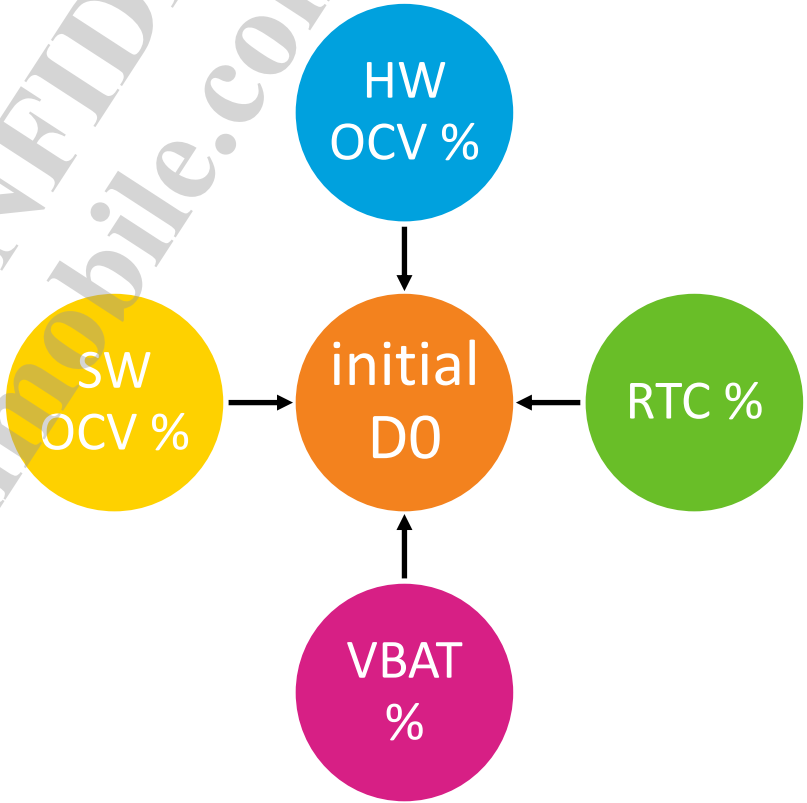


MTK Gauge Master2 Algorithm

		Before	GM2.0
Battery SOC	Principle	OCV+Coulomb Counter	OCV+Coulomb Counter
	Power on off initial D0	Use RTC for Keep SOC (Customized)	Use RTC for Keep SOC Enhance (Customized)
	Temperature Compensation	Only Initial	Always
	Aging Compensation	NA	Learning Qmax
	Loading Compensation	NA	Yes
	Error Compensation when System Sleep	NA	Yes

Power on off initial D0

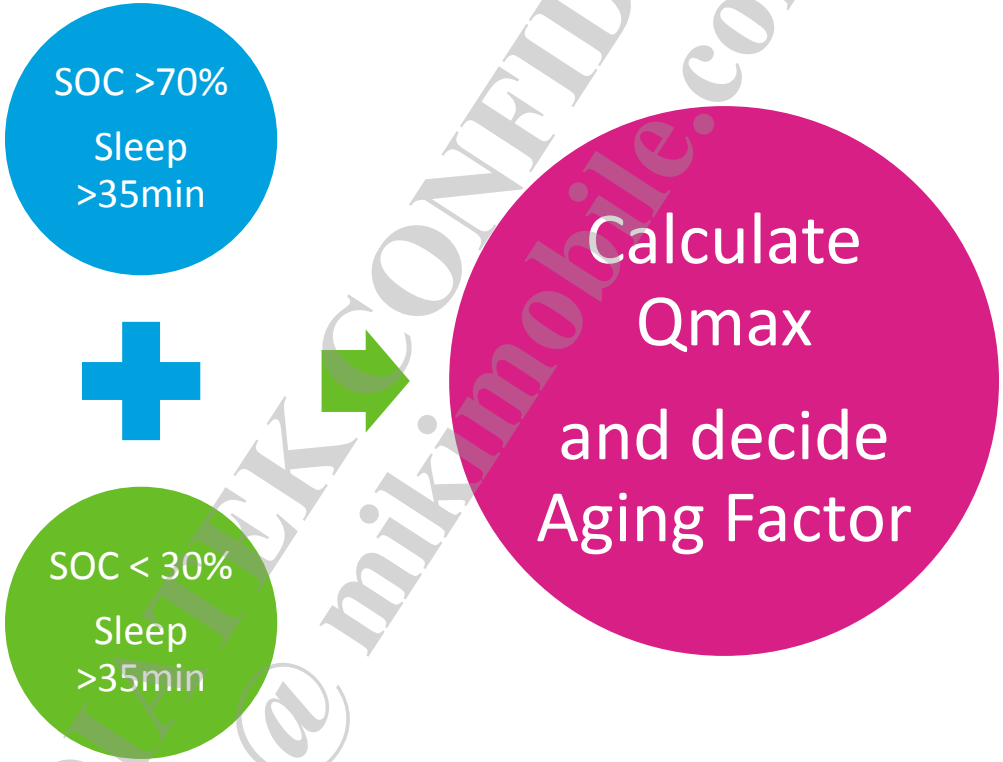
- Initial D0 is determined by the following percentage
  - HW OCV
  - SW OCV
  - RTC Record
- Analyzing Initial D0 results by the following factors
  - HW OCV
  - SW OCV
  - RTC Record
  - VBAT



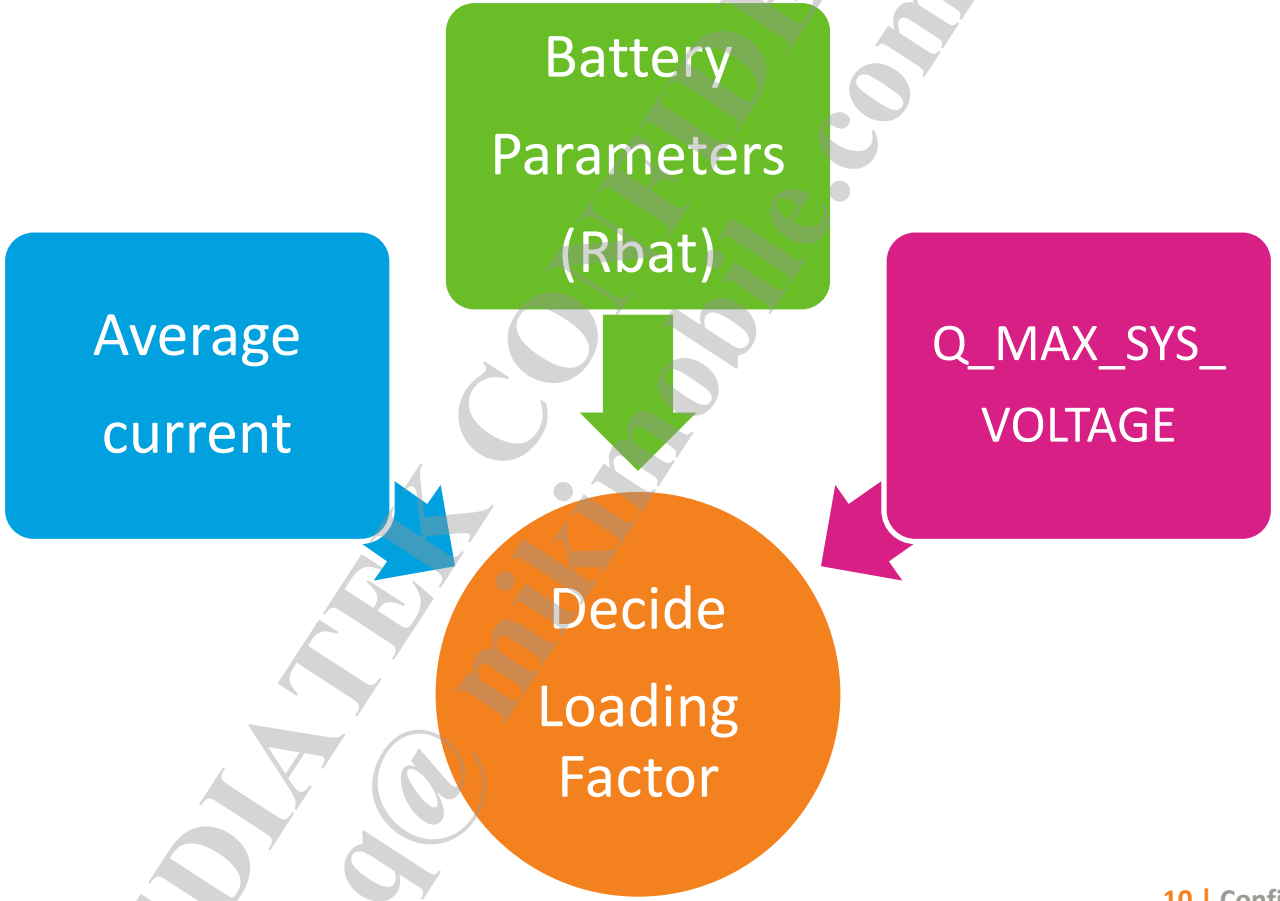
Temperature Compensation

- Based on -10 Degrees, 0 degrees, 25 degrees, 50 degrees battery parameters, using interpolation to sort out the other temperature battery parameters
- Each temperature changes, algorithm dynamic sorting battery parameters for the new temperature of the battery
  - ZCV, DOD, Rbat, Qmax

Aging Compensation

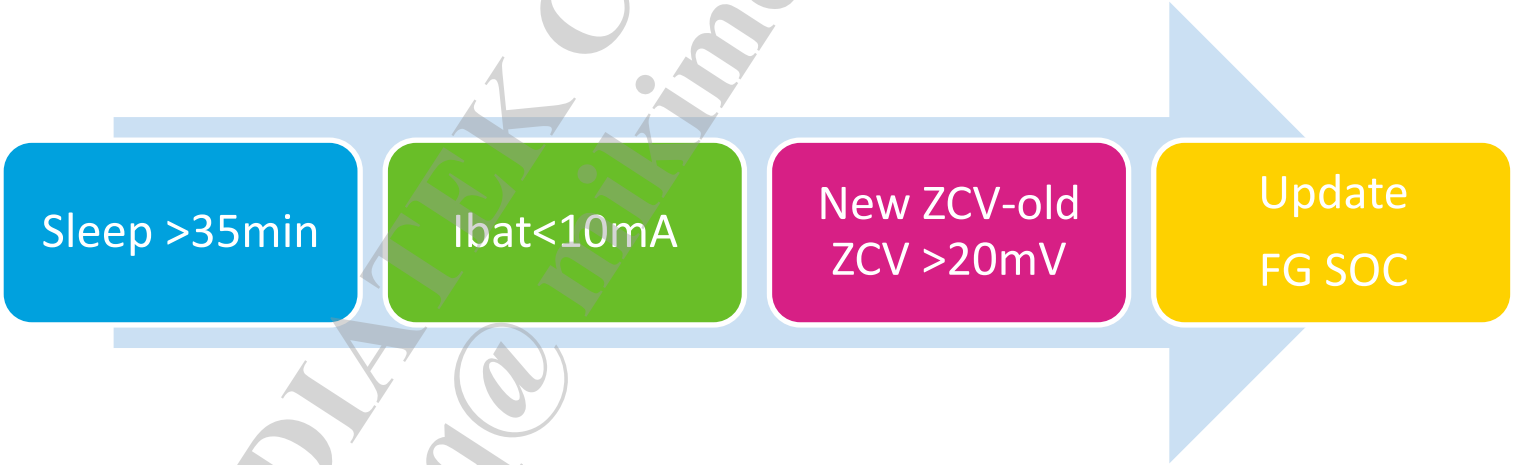


Loading Compensation



Error Compensation when System Sleep

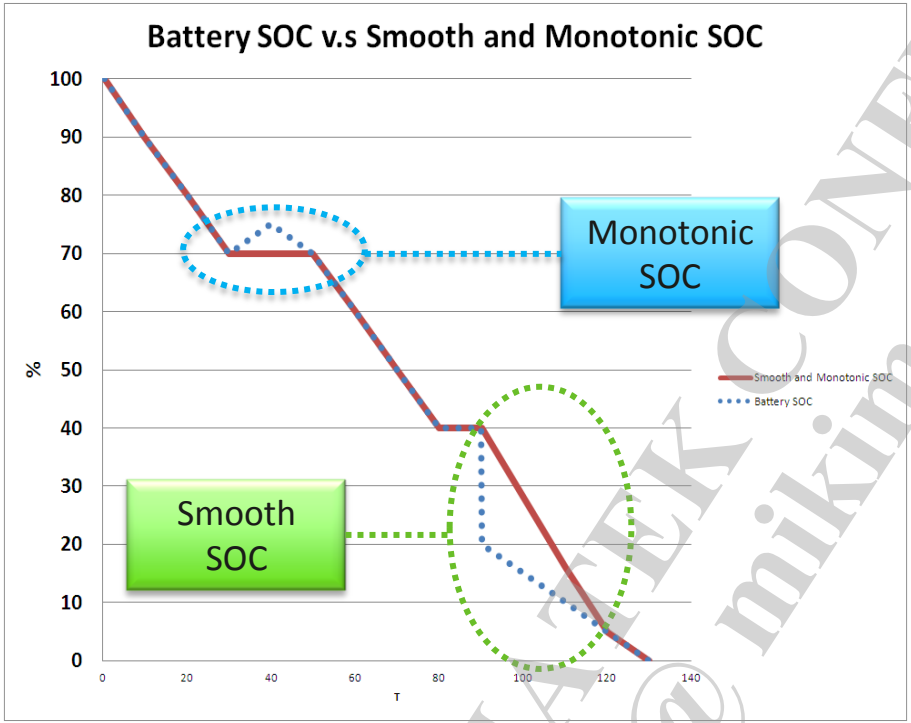
- When AP sleep more than 35 minutes, and the average current consumption <10mA, If the new battery ZCV and old battery ZCV gap> 20mV, readjust FG SOC percentage



MTK Gauge Master2 Algorithm

		Before	GM 2.0
Smooth and Monotonic SOC	Monotonic SOC	NA	Yes
	Smooth tracking SOC	Only 60/10 S tracking	Yes (Smooth Time depend on Loading, Qmax, SOC, T)

Smooth and Monotonic SOC



Monotonic SOC

- Decrease only during battery discharge
- Increase only during battery charge

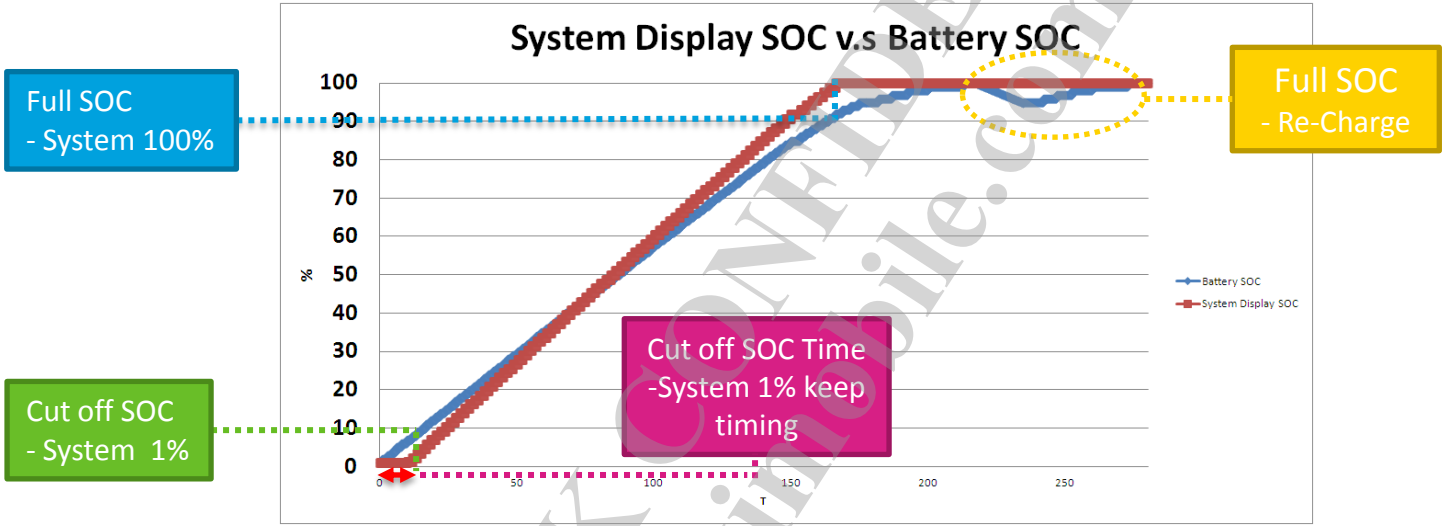
Smooth SOC

- Smooth tracking SOC depend on Loading, Qmax, SOC, Temp
- Good user experience slope

MTK Gauge Master2 Algorithm

		Before	GM 2.0
System Display SOC	Full SOC - System 100%	NA	Yes (Customized)
	Cut off SOC - System 1%	NA	Yes (Customized)
	Cut off SOC Time -System 1% keep timing	NA	Yes (Customized)
	Full SOC - Re-Charge	Keep 100% when FG SOC> 90%	Keep 100% when FG SOC > CV-10%

System Display SOC



Full SOC
- System 100%

- Customized Feature
- Enhance User experience for CV stage

Cut off SOC
- System 1%

- Customized Feature
- Enhance User experience for Heavy Loading

Cut off SOC Time
-System 1% keep timing

- Customized Feature
- Enhance User experience for Light Loading

Full SOC
- Re-Charge

- Enhance User experience for Re-Charge stage

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