TEXAS INSTRUMENTS

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CEDV Algorithm Update to the bq2084-V133 and Above

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ABSTRACT

This document discusses the Compensated End of Discharge Voltage (CEDV) algorithm update to the bq2084-V133 and later versions.

1 Introduction

The Compensated End of Discharge Voltage (CEDV) algorithm mathematically models cell voltage as a function of battery state-of-charge, temperature, and current. Changes in the bq2084 CEDV algorithm have been implemented to enable greater capacity prediction accuracy during low temperature (–20°C to –40°C) conditions.

2 Existing Algorithm

The temperature-based CEDV correction is disabled if the condition EDVTC × (296 – T) < T is satisfied, where T is temperature in degrees Kelvin (K).

This limits an acceptable range of EDVTC values to EDVTC < T/(296 – T), where T is the minimal temperature at which device operation is required.

For example, if T is 0°C, maximum allowable EDVTC is 11; for –10, it is 7; and for –20, it is 5. In some cases, a good fit of low temperature data could not be achieved with EDVTC values that have satisfied this requirement.

3 New Algorithm Modifications

1. The limitation of EDVTC was changed to allow a much wider range, defined by inequality as Equation 1 shows.

$$\text{EDVTC} < \frac{\text{EDVT0} \times \text{T} + \frac{256 \times 65536}{10}}{\text{EDVT0} \times (296 - \text{T})} \tag{1}$$

   For the same minimal temperature values that the preceding example shows (0, –10, –20), maximum EDVTCs are now 35, 24, and 18. This is more than enough to achieve a good fit at low temperatures for all batteries.
2. The behavior is changed when temperature is below the limit defined by the present EDVTC. In previous firmware, low temperature correction was reduced in this case, which caused a *jump* in calculating the EDV2 threshold. In the modified algorithm, no jumps occur but correction stops increasing with decreasing temperature. Thus, any abnormal behavior is excluded even in the much less likely event that the temperature goes below the limit.

4 Changes in CEDV Parameters Caused by the Change of the Algorithm

1. No changes are necessary. Parameters that worked well with the old algorithm work well with the new algorithm.
2. Even without parameter changes, the operation at low temperatures becomes more robust, because no EDV2 threshold jump occurs and because a limiting temperature is no longer reached for typical

EDVTC values.

3. However, if old parameters resulted in an unsatisfactory fit, the increased range of valid EDVTC values in the new algorithm sometimes allows achieving a better fit by recalculating parameters with higher EDVTC.

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