*Application Note*

# *Configuring Multiple BQ2575x, BQ2582x, and BQ2585x-Q1 Devices in Parallel to Achieve a Higher Output Current*


**ABSTRACT**

This application note describes how to configure multiple BQ2575x, BQ2582x, or BQ2585x-Q1 devices in parallel to increase the available output current. This document outlines the key considerations for implementing parallel operation and the evaluation of the design using two BQ25756EVMs.


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# 1 Introduction

The BQ2575x, BQ2582x, and BQ2585x-Q1 devices families consists of battery charge controllers and DC/DC converters designed to support a wide range of high-power applications. A single BQ2575x, BQ2582x, BQ25856-Q1 and BQ25858-Q1 device can provide up to 20A of output current, and BQ25853-Q1 can provide up to 35A of output current, but as battery capacity and system power increase, higher output currents can be required.

To meet these higher current requirements, multiple BQ2575x, BQ2582x, or BQ2585x-Q1 devices can be connected in parallel to increase the total available output current. The devices share the same input source and output load, while each device maintains its own switching stage, inductor, and current-sense path. This allows the available output current to be increased while maintaining independent operation of each device.

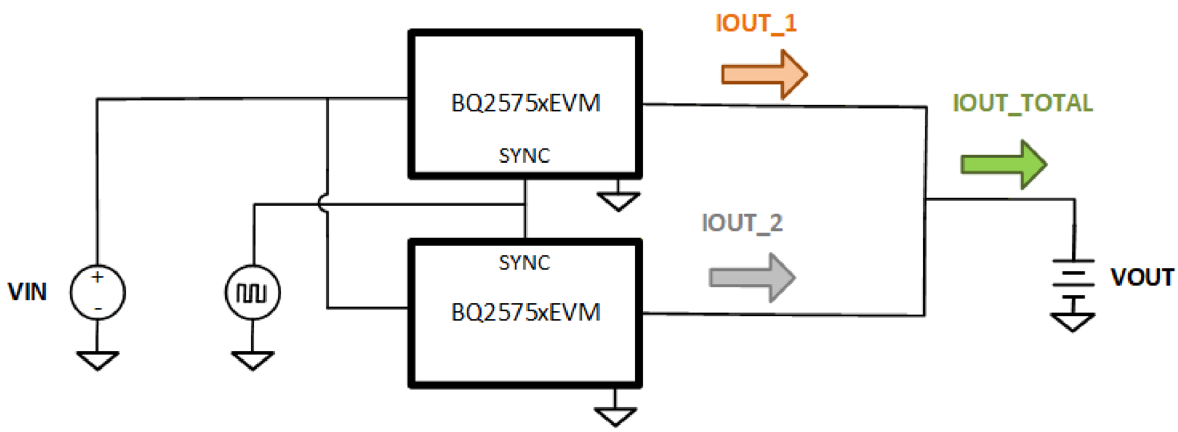


**Figure 1-1. BQ2575x Parallel Connection**

## 2 Hardware Setup and Configuration

When connecting multiple devices in parallel, proper configuration is important to make sure the devices operate together correctly. The following sections describe the key configuration considerations for implementing parallel operation.

### 2.1 Output Voltage Regulation

Several devices in the BQ2575x, BQ2582x, and BQ2585x-Q1 families are battery charger controllers that utilize a CC/CV charge profile. When multiple of these devices are connected in parallel, the voltage regulation thresholds of the devices must be slightly offset to provide a controlled transition from constant-current (CC) to constant-voltage (CV) operation. Each device has its own voltage regulation loop, so staggering the thresholds allows one device to enter CV regulation first, while the remaining devices continue operating in CC mode. This prevents multiple voltage regulation loops from competing with each other while regulating the same output. These controllers can operate in either host-controlled or standalone mode. In host-controlled operation, the regulation thresholds can be staggered by programming slightly different VFB_REG values for each device. In standalone operation, slightly different feedback resistor values can be used to set the individual regulation thresholds. For the DC/DC converters in the BQ2575x, BQ2582x, and BQ2585x-Q1, the voltage regulation threshold must be programmed to the same value for each device .

Figure 2-1 shows the transition from constant-current (CC) to constant-voltage (CV) operation for two BQ25756 devices connected in parallel. IOUT_1 and IOUT_2 show the individual charge currents, while VOUT_1 and VOUT_2 show the battery voltage measurements seen by each device. As the battery voltage increases, the device with the lower voltage regulation threshold reaches CV regulation first and begins reducing its charge current. The second device remains in CC operation and continues supplying its programmed charge current until its regulation threshold is reached. The second device then enters CV regulation and reduces its charge current. This staggered transition allows the devices to enter CV regulation separately rather than having both voltage regulation loops regulate the output at the same time to prevent the two voltage regulation loops from competing with each other.

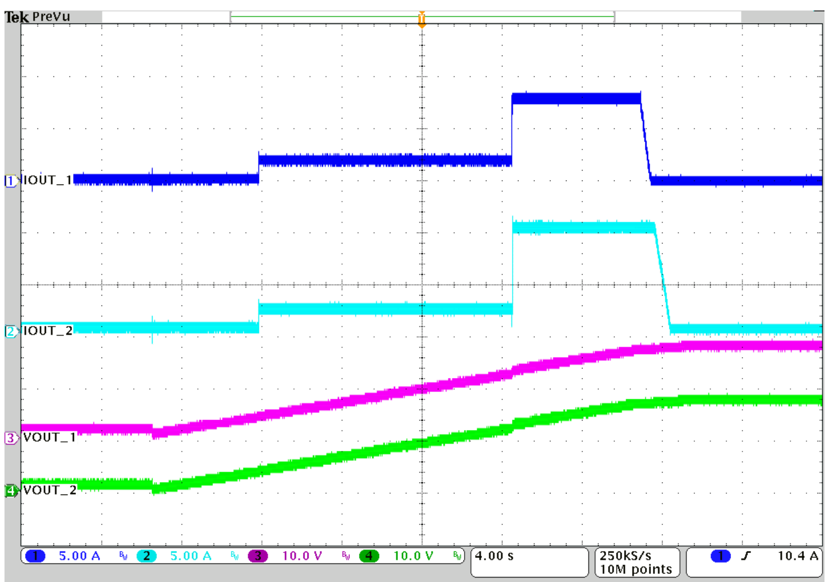


**Figure 2-1. Staggered CC-to-CV Transition**

### 2.2 FSW_SYNC Pin Configuration

The FSW_SYNC pins must be connected to a common external clock source to maintain the same switching frequency between devices. The frequency of the external clock must fall within the synchronization range specified in the device datasheet. Unsynchronized switching can significantly amplify voltage and current ripple seen on the shared input and output rails. Synchronizing the FSW_PIN pins establishes a fixed, stable phase relationship between the power stages, stabilizing the system and providing predictable ripple performance.

Figure 2-2 shows two BQ25756 devices operating in parallel with their switching frequencies synchronized to the same external clock. The SW1 of each device remain aligned at the same switching frequency.

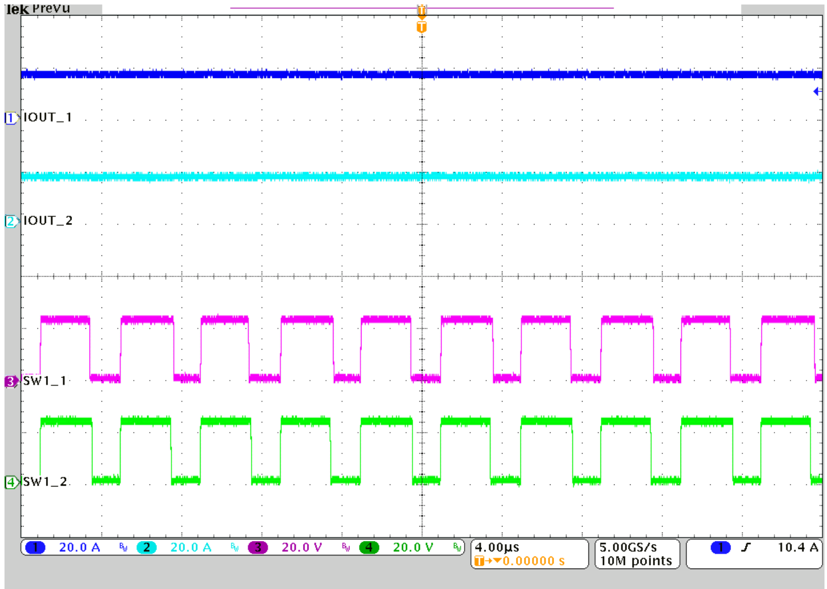


**Figure 2-2. FSW Synchronization**

## 2.3 Power Path Setup

Select devices in the BQ2575x and BQ2582x family utilize a direct power path from the input source to the system load. When multiple battery charge controllers are connected in parallel, only one device is required to control the input ACFETs, while the remaining devices can be connected upstream of the ACFETs. Each device can maintain its own BATFET connection between the battery and the shared system rail, allowing the batteries to support the system during battery-only operation. Figure 2-3 and Figure 2-4 show the battery charging and discharging paths, highlighting the current paths through the shared system rail during charging and battery only operation

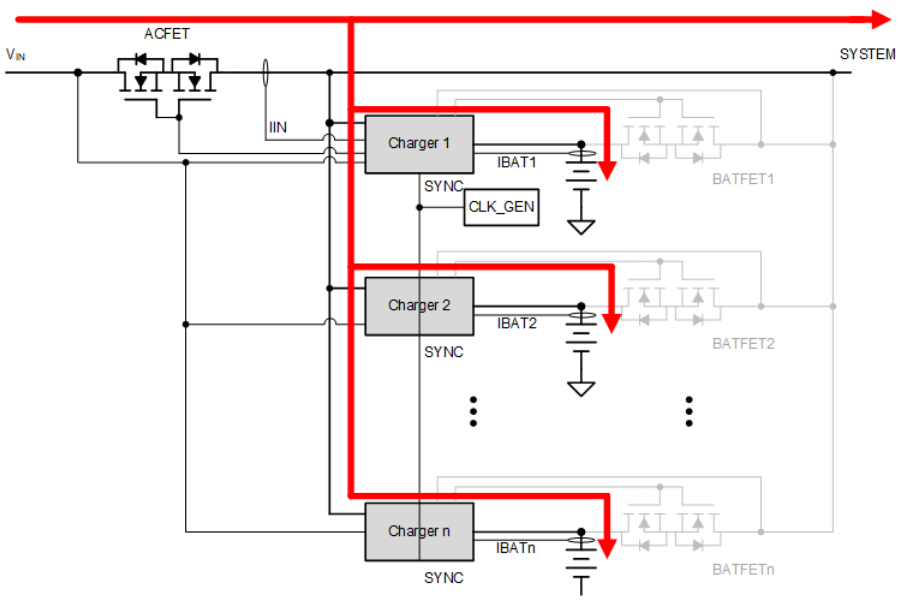


**Figure 2-3. Battery Charging Path**

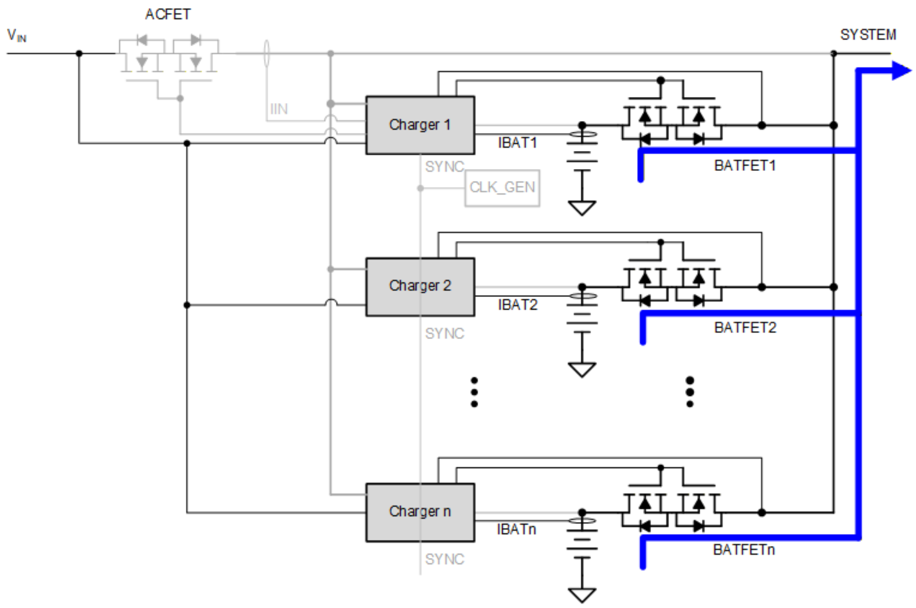


**Figure 2-4. Battery Discharge Path**

## 2.4 Dynamic Power Management

The BQ2575x, BQ2582x, and BQ2585x families feature dynamic power management (DPM), which continuously monitors the input current and input voltage. When the input source is overloaded, either the input current exceeds the input current limit or the input voltage falls below the input voltage regulation threshold. The device reduces the charge current until the input current and input voltage return within programmed limits, preventing the input source from being overloaded.

When multiple devices are connected in parallel, separate input current-sense networks must be used to independently monitor the input current of the individual devices. The available input current must be divided between the devices, with the input current limit configured using the IAC_DPM register or ILIM_HIZ pin. The same VINDPM threshold must be programmed for all devices to provide consistent input voltage regulation from the shared input source.

## 2.5 I2C Communication

The BQ2575x, BQ2582x, and BQ2585x-Q1 family of devices can operate in either host controlled or standalone mode. When operating multiple devices in host controlled mode, the I2C interface must be considered because most of the devices in the these families use the same I2C target address of 0x6B. Devices with the same target address cannot be independently accessed when connected directly to the same I2C bus. An I2C mux can be used to place each device on a separate channel, or, depending on the host controller, separate I2C lines can be used for each device. Either approach allows the host controller to independently configure, control, and monitor each device.

Alternatively, applications requiring only two devices in parallel, can utilize devices with different I2C addresses, such as the BQ25756 and BQ25756E, or the BQ25858B-Q1 and BQ25858-Q1. This allows both devices to share the same I2C bus.

# 3 Achieving Increased Output Current

After proper system configuration, multiple BQ2575x, BQ2582x, or BQ2585x-Q1 devices can be connected in parallel to operate together to increase the total available output current. Figure 3-1 shows this capability using two BQ25756 devices configured to provide a total charge current of 40A. The measured output currents show both devices contributing to the total charge current while maintaining the regulated output voltage. Additional devices can be added to further increase the available output current based on the requirements of the system.

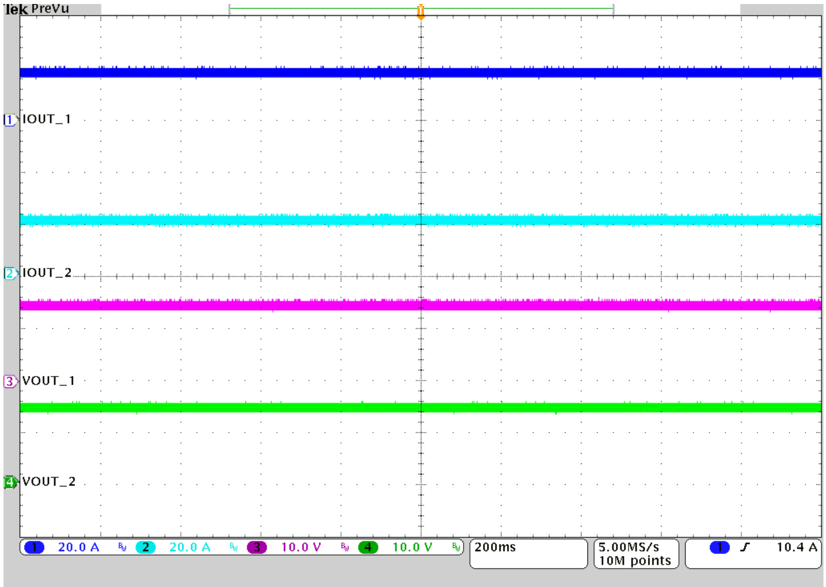


**Figure 3-1. 40A Charging with Dual BQ25756EVMs**

## 4 Summary

Connecting multiple devices in parallel provides a method for increasing the total available output current beyond the capability of a single device. Proper system configuration is important to make sure the devices operate together as the output current is increased. The results presented in this application note demonstrate these considerations using two BQ25756 devices operating together to provide up to 40A of charge current and provide guidance for extending the same approach to other devices in the BQ2575x, BQ2582x, and BQ2585x-Q1 families.

## 5 References


- Texas Instruments, *BQ25756 Standalone/I$^2$C Controlled, 1- to 14-Cell Bidirectional Buck-Boost Battery Charge Controller*, datasheet
- Texas Instruments, *BQ25750: Standalone/I$^2$C Controlled, 1- to 14-Cell Bidirectional Buck-Boost Battery Charge Controller with Direct Power Path Control*, datasheet
- Texas Instruments, *BQ25758: I$^2$C Controlled, Bidirectional Buck-Boost Controller with Wide Voltage Range*, datasheet
- Texas Instruments, *BQ25756-Design-Calc*, design calculator
- Texas Instruments, *BQ25756E Evaluation Module*, EVM user's guide.