AN 25.7

UCS1002 Charge Rationing

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INTRODUCTION

This application note discusses the charge rationing features of the UCS1002. Examples are provided using the UCS1002 evaluation board and GUI with the UCS1002 device as the USB port power controller.

References

This application note references the following items:

- UCS1002 Data Sheet
- UCS1002 Schematic Reference Design
- UCS1002 EVB Package

Note: It is important to refer to the most recent revision of these items for complete and current information regarding the custom charger emulation capability of the UCS1002 device.

CHARGE RATIONING

This application note illustrates how the charge rationing feature may be used to limit the total energy delivered to attached portable devices. This feature is useful when considering how to allow portable device charging from a laptop or PC in standby or hibernate mode. It can also be used to prevent excessive battery drain.

Configuring Charger Emulation

In order to perform charge rationing, the UCS1002 must first be configured to charge the portable device.

For this example, a cell phone that can charge using the Legacy 1 charger emulation profile was used. The UCS1002 was configured to use the DCE Cycle. The default settings on the EVB GUI Configuration & General Status tab were used. The settings are shown in Figure 1 and summarized in Table 1.

FIGURE 1: CONFIGURATION & GENERAL STATUS TAB

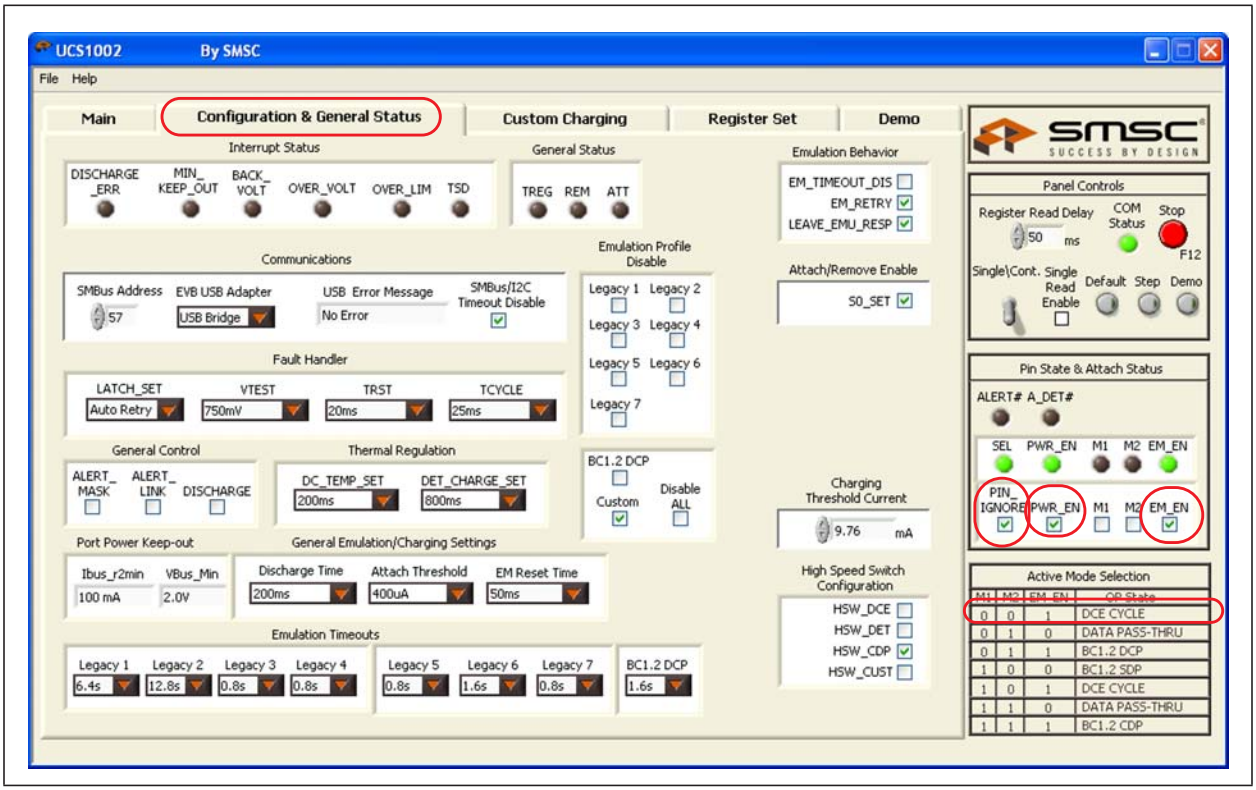


TABLE 1: GENERAL CONFIGURATION

GUI Control	Register	Purpose
PIN_IGNORE is checked	17h, bit 7 = 1b	Allows the GUI controls to be used through SMBus rather than using the pins on the UCS1002.
PWR_EN is checked	17h, bit 1 = 1b	Enable the port power switch.
EM_EN is checked	17h, bit 5 = 1b	Enable the DCE Cycle.

Configuring Charge Rationing

To determine the charge ration limit, the Charge Rationing Threshold registers are set. This limit could be set for the maximum number of mA-h that the port can deliver, which is useful for charging sequentially attached portable devices. Alternatively, it could be set for a target portable device. For example, most smart phone batteries can be charged to 100% capacity (battery full) with 1500 mA-h allotted.

For this example, in order to show charging of two portable devices and reaching the ration limit quickly, a low ration limit was set. Default settings on the EVB GUI Main tab were used, with two exceptions. The settings are shown in Figure 2 and summarized in Table 2.

FIGURE 2: MAIN TAB

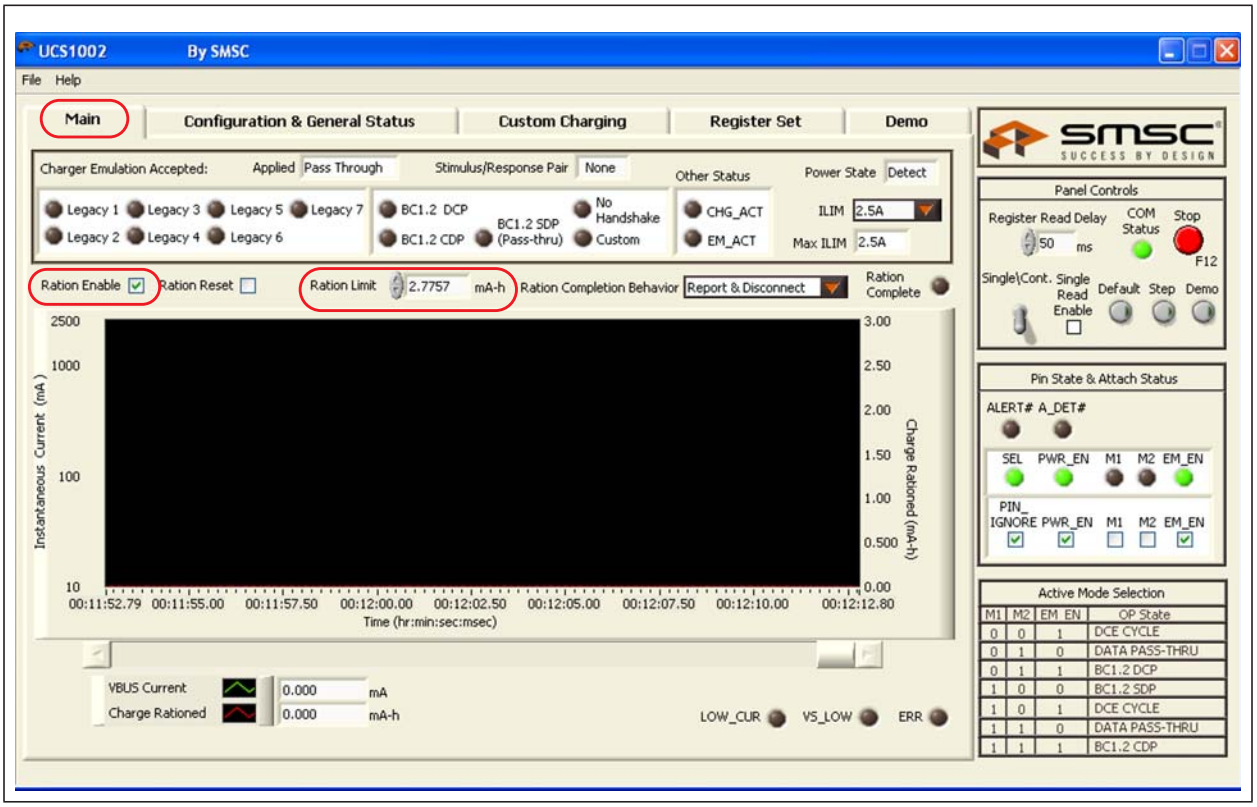


TABLE 2: CHARGE RATIONING CONFIGURATION

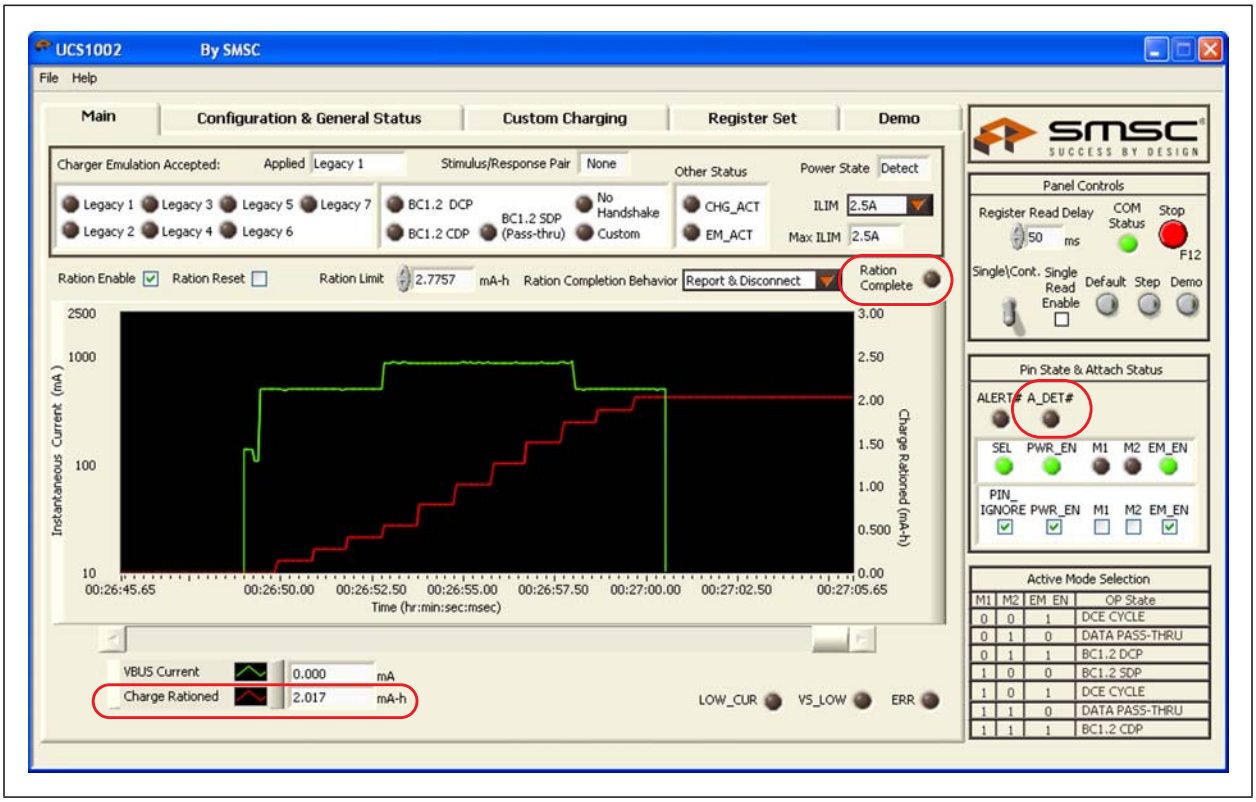
GUI Control	Register	Purpose
Ration Enable checked	15h, bit 3 = 1b	Enable charge rationing.
Ration Limit set to 2.7757 mA-h	1Ah = 00h 1Bh = 01h	Set charge ration limit to 2.7757 mA-h.

Note that ILIM and Maximum ILIM were already set to 2.5 A, so they did not need to be changed for this example. In addition, the default Ration Completion Behavior “Report & Disconnect” was used in this example, but it could be changed if a different behavior is desired when the Ration Limit is reached. Other Ration Completion Behavior options are “Report”, “Report & Sleep”, and “Take No Action”.

Using Charge Rationing

In this example, a cell phone was attached and charged briefly before being removed, as shown in Figure 3. Notice that 2.017 mA-h charge was accumulated, so the 2.7757 mA-h ration limit was not reached.

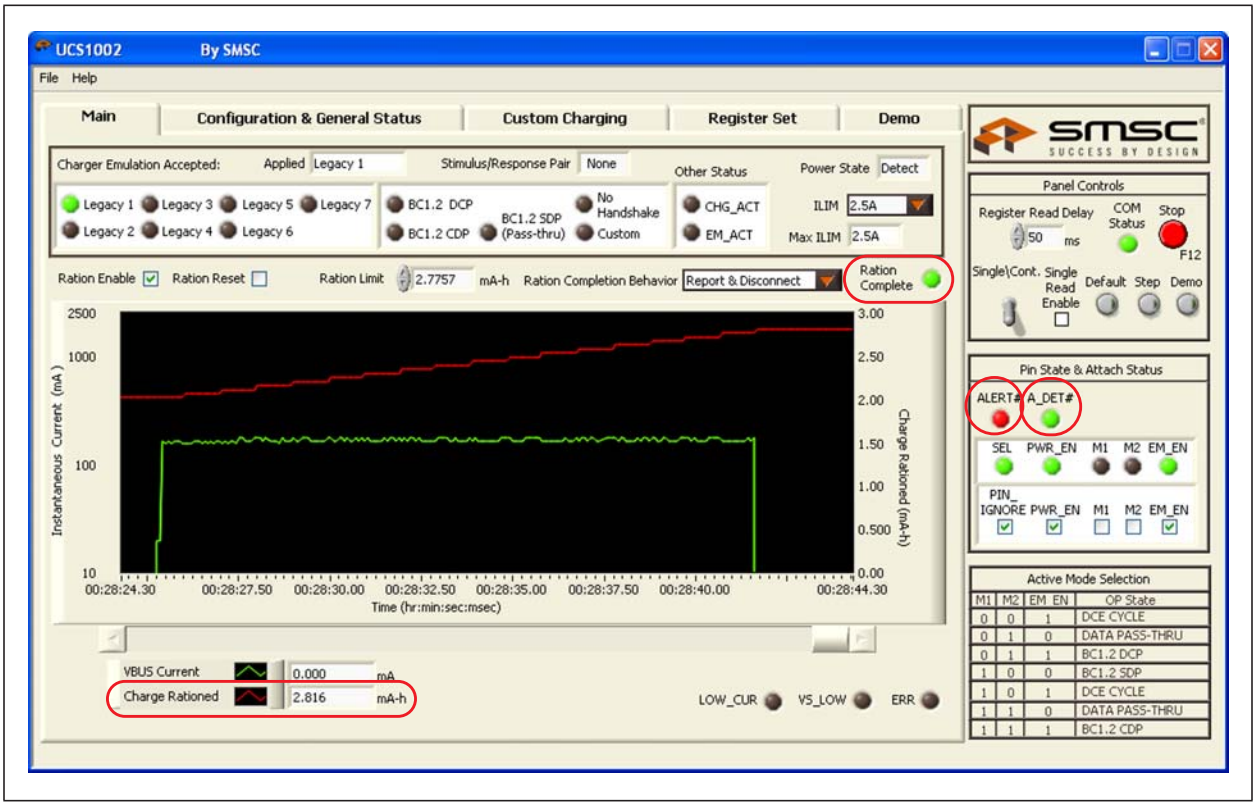
FIGURE 3: FIRST PORTABLE DEVICE CHARGE RATIONED 2.017 MA-H



Another cell phone was connected and was left attached. Charger emulation started over because a Removal Detection event occurred and the charge rationing threshold had not been reached. This allows charging of sequential portable devices while charge is being rationed, which means that the accumulated power given to several portable devices will still be held to the configured rationing limit.

While the second device was attached, the accumulated charge reached 2.816 mA-h. Since the ration limit was reached, the Ration Complete indicator was set, the ALERT# pin was set, and the portable device was no longer able to charge, as shown in Figure 4.

FIGURE 4: SECOND PORTABLE DEVICE LIMIT REACHED



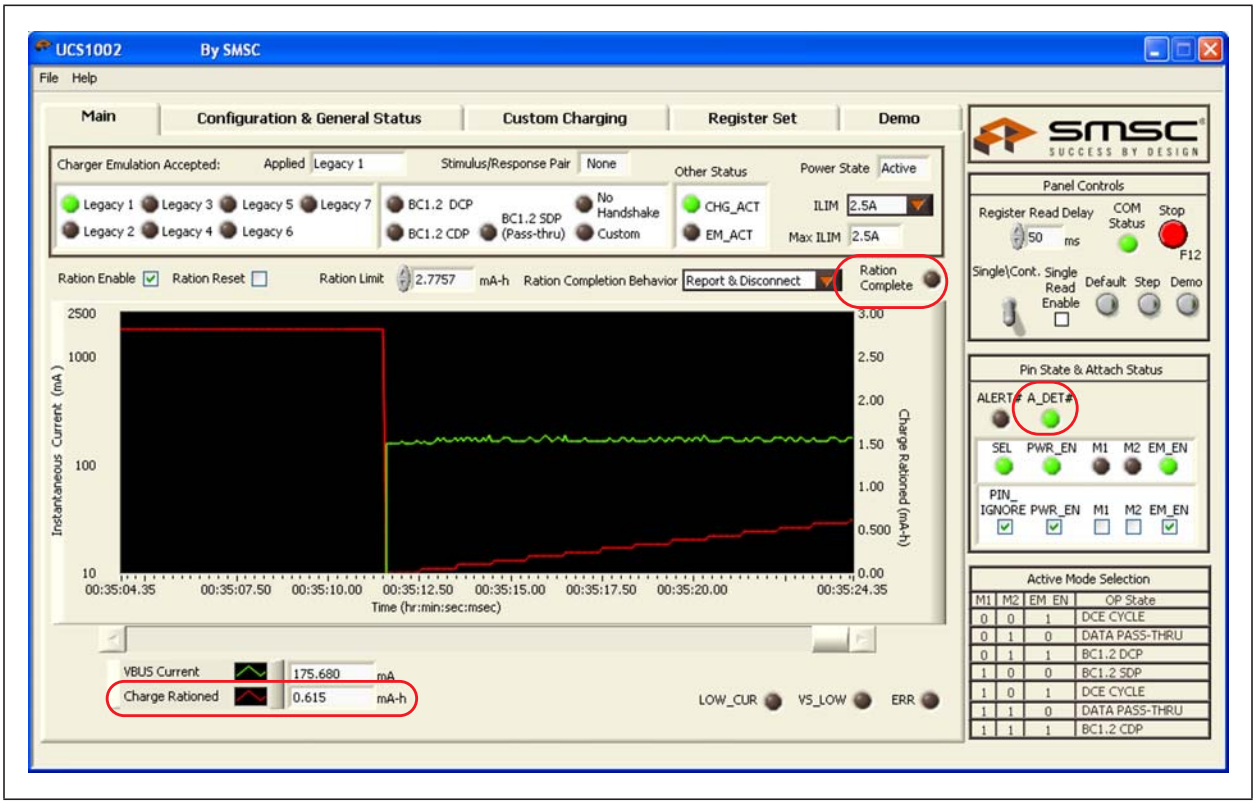
In this example, notice that Charge Rationing did not automatically reset when the Removal Detection event occurred. After the ration limit has been reached, no additional portable devices can charge in the Active state until charge rationing is disabled or reset.

The Ration Reset control (RATION_RST bit 2 in register 15h) in the EVB GUI clears the Ration Complete indicator (RATION bit 7 in register 11h) and Charge Rationed value (Total Accumulated Charge registers 01h-04h). RATION_RST will clear automatically after the ration reset is complete.

If RATION_EN is still set after resetting rationing, the charge ration process will begin again. If the behavior when the charge rationing threshold was previously reached was “Report and Disconnect” or “Disconnect and go to Sleep”, the charger emulation profile will have been removed. In this case, toggle the M1, M2, EM_EN, or PWR_EN controls to restart charger emulation. Otherwise, if the behavior was “Report” and the M1, M2, EM_EN, S0, or PWR_EN controls were not changed, the same charger emulation profile that was previously accepted will remain, independent of charge ration cycles, until the portable device is disconnected from the UCS1002. If the M1, M2, EM_EN, or PWR_EN controls changed, the UCS1002 will operate using the new settings.

Figure 5 shows the GUI after charge rationing was reset. The second portable device was not removed.

FIGURE 5: SECOND PORTABLE DEVICE AFTER RESETTING CHARGE RATIONING



APPENDIX A: APPLICATION NOTE REVISION HISTORY

TABLE A-1: REVISION HISTORY

Revision Level & Date	Section/Figure/Entry	Correction
Note: AN 25.7, Revision A replaces the previous SMSC version, Revision 1.0 (01-31-12).		
Rev. 1.0 (01-31-12)	Formal document release	

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