Errata for “Battery Charging Specification Revision 1.2 October 12, 2011”, as of Mar 15, 2012.

ACA Problem

Shortly before the Battery Charging Specification 1.2 was published, the Micro-ACA was ‘redesigned’ not to need to pass on ADP probes from OTG to ACC port when it is not connected to a 5V supply on its charger port. However Table 6-2 still specifies the ‘Access Switch’ as being closed under these conditions. Bypass capacitors CMACA_VBUS were added, to aid detection of the ACA, using ADP.

The ambiguity in Table 6-2 complicates testing of the bypass capacitances CMACA_VBUS x 2. The one on the accessory port can be isolated, but the one on the OTG port can only be seen (un-powered) in parallel with the Accessory port capacitance. Whether this is true depends on whether Table 6-2 specifying the ‘Access Switch’ as being closed is actually correct.

In the same way, the appropriate test checks continuity between VBUS OTG and VBUS ACC, because the specification says it should. It is actually not necessary for it to be as low as $R_{ACA\_OTG\_ACC}$ under these conditions, but should be low enough to be able to pass ADP probes. But testing this would be incorrect if we are not expecting ADP probes because Table 6-2 may be wrong.

The problem with not closing the Accessory Switch in rows 1-3 of Table 6-2, is that a corner case exists where the two devices connected to the ACA do not see each other.

<u>Rows 1 and 3.</u>

Imagine an ACA with no charger connected. Say an A-device with ADP capability is connected to the Accessory port. This device sees the capacitor C_{MACA_VBUS} and turns on V_{BUS} for $T_{A\_WAIT\_BCON}$, then turns it off.

An OTG device (not ADP capable) is then connected to the OTG port. This sees R_{ID_FLOAT} and no VBUS, and so does not attempt to connect, or perform SRP. The ADP-capable A-device on the accessory port sees no change because the Accessory Switch is open.

<u>Row 2</u>

The same applies to row 2, but with the A and B devices the other way round. To achieve this, the Accessory Port has an A-plug inserted but no B-device yet at the start of the sequence.

<u>Conclusion</u>

So it is desirable that the Accessory Switch be closed (as currently stated in Table 6-2), even though no power supply is available to it, but not necessary that the low resistance value of 200 mΩ be achieved. In order to meet the requirement to pass ADP probes, a calculation suggests that <25Ω would be a sufficiently low value, which is readily achievable with a depletion mode device.

So to clarify the specification and to allow us to know what we are testing, this errata document proposes that the following changes are made. The changes are detailed below, but can be summarised as follows:

- Define a new 'ADP-pass' state for the Accessory Switch in rows 1 - 3 of Table 6-2, where a requirement of <25Ω would satisfy the ADP-pass condition, unless VBUS is at V_{ACA_OPR} on either the Accessory port or the OTG port.

- Add column VBUS_OTG to Table 6-2, as VBUS_OTG is an input to the Micro ACA Adaptor Controller logic.

- Split row 2 of Table 6-2 into rows 2a and 2b, as VBUS_OTG may go low after $T_{A\_WAIT\_BCON}$ of ID_OTG going low.

- Define a new VBUS_ACC and VBUS_OTG condition, 'driven', to describe the state where a pin is high because of internal ACA switching, rather than the external voltage.

- With the <25Ω 'ADP-pass' condition implemented, then the capacitors C_{MACA_VBUS} are not required for the original purpose. Change the value of C_{MACA_VBUS} to the same value as C_{SACA_VBUS}. This value (10-100nF) is a nominal value purely for the purposes of achieving a standard interface, and as a result of some designer experience input.

BC 1.2 Specification Errata

Define $R_{ADP\_OTG\_ACC}$ in Table 5-3 as:

Parameter	Symbol	Conditions	Min	Max	Units	Ref
OTG to Accessory port (ADP-Pass)	RADP_OTG_ACC	5)	-	25	Ω	6.2.6

Notes

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5) The ACA shall meet this parameter requirement when VBUS_ACC and VBUS_OTG are both below VACA_OPR, and either no Charging Port is detected or VBUS_CHG is below VACA_OPR.

Define C_{MACA_VBUS} in Table 5-4 as:

Parameter	Symbol	Conditions	Min	Max	Units	Ref
Micro ACA Capacitance from VBUS to GND	CMACA_VBUS		10	100	nF	6.2.3

Figure 6-3 Micro ACA Architecture

Modify Figure 6-3 to add an input to the 'Adapter Controller' from VBUS_OTG.

At end of 6.2.3, add reference to VBUS_OTG pin.

The Accessory Switch allows current to flow between VBUS_OTG and VBUS_ACC. The Charger Switch allows current to flow from VBUS_CHG and VBUS_OTG. The Adapter Controller performs several functions. These functions include:

- sensing the state of the ID_ACC pin, (grounded or floating)
- outputting a state onto the ID_OTG pin, (R_{ID_GND}, R_{ID_A}, R_{ID_B}, R_{ID_C} or R_{ID_FLOAT})
- using the DP_CHG and DN_CHG pins to detect if a Charging Port is attached to the Charger Port
- sensing the voltage on the VBUS_ACC pin
- sensing the voltage on the VBUS_OTG pin
- controlling the Charger and Accessory Switches

Table 6-2 - modify as follows:

The operation of the Micro ACA is shown in Table 6-2, and is described below. The table assumes that an OTG device is always attached to the OTG Port.

Table 6-2 Micro ACA Modes of Operation

Row	Charger Port	Accessory Port	VBUS_ ACC	VBUS_ OTG	ID_ACC	Charger Switch [1]	Access Switch [1] [2]	ID_OTG	OTG Device
1	not Chrg Port	nothing	low	low	float	open	ADP-pass	R_{ID_FLOAT}	B-dev
2a [7]	not Chrg Port	B-device	low	low	ground	open	ADP-pass	R_{ID_GND}	A-dev
2b	not Chrg Port	B-device	driven [3]	high	ground	open	closed	R_{ID_GND}	A-dev
3	not Chrg Port	A-dev off	low	low	float	open	ADP-pass	R_{ID_FLOAT}	B-dev
4	not Chrg Port	A-dev on	high	driven [4]	float	open	closed	R_{ID_FLOAT}	B-dev
5	Charging Port	nothing	low	driven [5]	float	closed	open	R_{ID_B}	B-dev
6	Charging Port	B-device	driven [6]	driven [5]	ground	closed	closed	R_{ID_A}	A-dev
7	Charging Port	A-dev off	low	driven [5]	float	closed	open	R_{ID_B}	B-dev
8	Charging Port	A-dev on	high	driven [5]	float	closed	open	R_{ID_C}	B-dev

Notes
1) ‘open’ refers to the high impedance state of the switch. ‘closed’ refers to the low impedance state of the switch ~~($R_{ACA\_OTG\_ACC}$ or $R_{ACA\_CHG\_OTG}$ as appropriate~~).
2) ‘ADP-pass’ refers to an impedance state of the switch sufficiently low to transmit ADP probes ($R_{ADP\_OTG\_ACC}$).
3) Driven via Accessory Switch from VBUS_OTG.
4) Driven via Accessory Switch from VBUS_ACC.
5) Driven via Charger Switch from VBUS_CHG.
6) Driven via Charger Switch and Accessory Switch from VBUS_CHG.
7) In row 2a, the VBUS_OTG low state can happen after TA_WAIT_BCON max of ID_OTG going low, if the OTG A-device supports sessions. (See OTG 2.0 Supplement for value.)
8) Other transitory states exist when moving between the design states shown in the rows of the table. It is the responsibility of the Micro ACA designer to take these into account.

6.2.6 - modify as follows:

6.2.6 Micro ACA Requirements

A Micro ACA Charger Port shall draw less than I_{SUSP} when anything other than a Charging Port is attached to it.

A Micro ACA shall draw less than I_{SUSP} when a Charging Port is attached to the ACA Charger Port and nothing is attached to the OTG Port or Accessory Port.

The resistance between the VBUS_CHG and VBUS_OTG pins of an ACA shall be $R_{ACA\_CHG\_OTG}$ when the Charger Switch is closed in rows 5-8 of Table 6-2, and the voltage on VBUS_CHG is at V_{ACA_OPR}.

The resistance between the VBUS_CHG and VBUS_ACC pins of an ACA shall be $R_{ACA\_CHG\_ACC}$ when both the Charger Switch and the Accessory Switch are closed in row 6 of Table 6-2, and the voltage on VBUS_CHG is at V_{ACA_OPR}.

The resistance between the VBUS_OTG and VBUS_ACC pins of an ACA shall be $R_{ACA\_OTG\_ACC}$ when the Charger Switch is open and the Accessory Switch is closed in rows 2b and 4 of Table 6-2 and the voltage on either of VBUS_ACC or VBUS_OTG is at V_{ACA_OPR}.

The resistance between the VBUS_OTG and VBUS_ACC pins of an ACA shall be $R_{ADP\_OTG\_ACC}$ when the Accessory Switch is in condition ADP-pass in rows 1, 2a or 3 of Table 6-2.

etc.