



## **Application Note 10.8**

---

**USB97C223 and USB97C243**

**Capacitor Selection for Internal Regulator Output Pins**



80 Arkay Drive  
Hauppauge, NY 11788  
(631) 435-6000  
FAX (631) 273-3123

Copyright © SMSC 2004. All rights reserved.

Circuit diagrams and other information relating to SMSC products are included as a means of illustrating typical applications. Consequently, complete information sufficient for construction purposes is not necessarily given. Although the information has been checked and is believed to be accurate, no responsibility is assumed for inaccuracies. SMSC reserves the right to make changes to specifications and product descriptions at any time without notice. Contact your local SMSC sales office to obtain the latest specifications before placing your product order. The provision of this information does not convey to the purchaser of the described semiconductor devices any licenses under any patent rights or other intellectual property rights of SMSC or others. All sales are expressly conditional on your agreement to the terms and conditions of the most recently dated version of SMSC's standard Terms of Sale Agreement dated before the date of your order (the "Terms of Sale Agreement"). The product may contain design defects or errors known as anomalies which may cause the product's functions to deviate from published specifications. Anomaly sheets are available upon request. SMSC products are not designed, intended, authorized or warranted for use in any life support or other application where product failure could cause or contribute to personal injury or severe property damage. Any and all such uses without prior written approval of an Officer of SMSC and further testing and/or modification will be fully at the risk of the customer. Copies of this document or other SMSC literature, as well as the Terms of Sale Agreement, may be obtained by visiting SMSC's website at <http://www.smsc.com>. SMSC is a registered trademark of Standard Microsystems Corporation ("SMSC"). Product names and company names are the trademarks of their respective holders.

**SMSC DISCLAIMS AND EXCLUDES ANY AND ALL WARRANTIES, INCLUDING WITHOUT LIMITATION ANY AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, AND AGAINST INFRINGEMENT AND THE LIKE, AND ANY AND ALL WARRANTIES ARISING FROM ANY COURSE OF DEALING OR USAGE OF TRADE.**

**IN NO EVENT SHALL SMSC BE LIABLE FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES; OR FOR LOST DATA, PROFITS, SAVINGS OR REVENUES OF ANY KIND; REGARDLESS OF THE FORM OF ACTION, WHETHER BASED ON CONTRACT; TORT; NEGLIGENCE OF SMSC OR OTHERS; STRICT LIABILITY; BREACH OF WARRANTY; OR OTHERWISE; WHETHER OR NOT ANY REMEDY OF BUYER IS HELD TO HAVE FAILED OF ITS ESSENTIAL PURPOSE, AND WHETHER OR NOT SMSC HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.**

## Overview

The USB97C223 and USB97C243 have two internal 1.8V regulators used to provide the digital and analog 1.8V supplies. The output pins of the regulator have very specific capacitor requirements that are described below. It is important that the customer designs their product with the specifications set forth in this document.

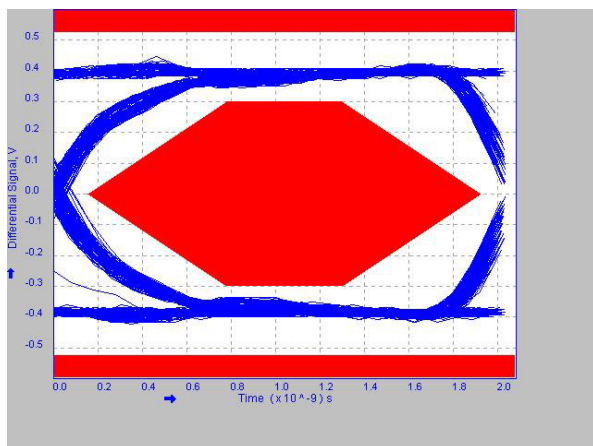
## Requirements

Table 1 lists the capacitor requirements on the regulator output pins.

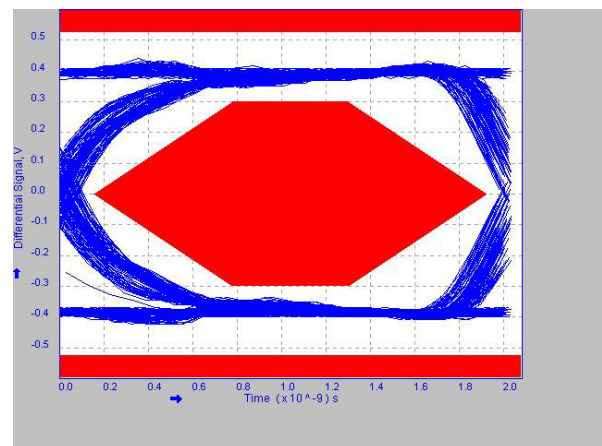
**Table 1 – Regulator Output Pins**

USB97C223			
PIN NUMBER	PIN NAME	PIN DESCRIPTION	CAPACITOR REQUIREMENT
98	VDDP	Analog Regulator Output	10uF +/- 20 % with < 0.65 Ohm ESR
91	VDDCORE	Digital Regulator Output	10uF +/- 20 % with < 0.65 Ohm ESR
USB97C243			
50	VDDP	Analog Regulator Output	10uF +/- 20 % with < 0.65 Ohm ESR
43	VDDCORE (closest to VREG)	Digital Regulator Output	10uF +/- 20 % with < 0.65 Ohm ESR

Figure 1 and Figure 2 show an example of the degradation in performance of the USB97C223 and USB97C243 as the ESR of the capacitor on the output of the regulators is increased to 0.65 Ohm.



**Figure 1 - 10uF Capacitor with 0.1 Ohm ESR**



**Figure 2 - 10uF Capacitor with 0.65 Ohm ESR**

SMSC recommends the use of **ceramic 10uF capacitors** to meet the low ESR requirements of the regulator output pins of the USB97C223. Ceramic capacitors typically have an ESR of < 0.1 Ohm.

Recommended Capacitors, or equivalent:

- Kemet C0805C106K9PACTU (0805 Package)
- Kemet C1206C106K9PACTU (1206 Package)
- Panasonic ECJ-2FF0J106Z (0805 Package)
- Panasonic ECJ-2FF1A106Z (0805 Package)

Tantalum capacitors that have low ESR specifications can also be used, but typically have an ESR closer to 0.5 Ohm.