

## USB2227 and USB2228 USB2.0 Flash Card Reader Media Power Considerations

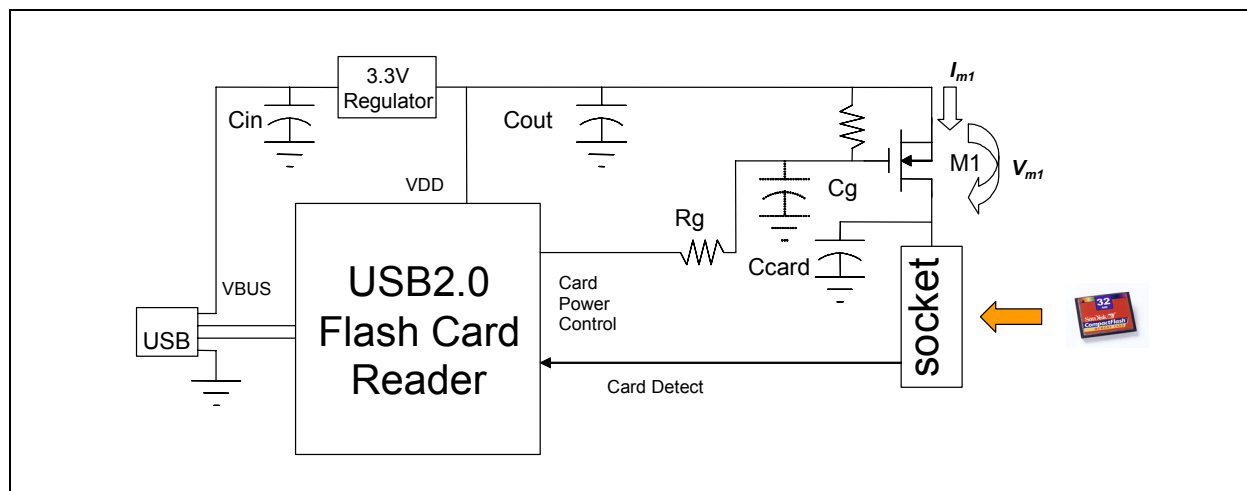
### Introduction

Bus-powered USB2.0 Flash Media Card Readers are enjoying an explosive growth due to the increasing popularity of digital photography and portable music players. The basic card formats now stand at four types, but all of these require the careful implementation of their power control. Historically, this is provided via discrete power FETs which are external to the card reader controller (e.g. SMSC's USB2223 and USB2224 devices), and requires careful design and component selection to avoid several possible system issues. This paper addresses some of those issues.

In addition, fourth generation controllers, such as SMSC's USB2227 and USB2228 devices, integrate some of the power FETs internally to the controller itself, to further save system cost. The design of these integrated FETs must account for these issues also in order to obtain successful operation.

### Design Considerations

Figure 1 illustrates a typical card reader implementation and the card power supply circuit.



**Figure 1 Card Reader Implementation/Card Power Supply Circuit**

In operation, when the user inserts the card into its socket, the card insertion is signaled to the Reader Controller which then applies power, by driving the power FET, M1, on. In many cases, the turn on time of the FET is managed via Rg/Cg.

## DC Voltage Drop and Current

One consideration in selecting M1 is the DC voltage drop across it,  $V_{m1}$ , and current requirements,  $I_{m1}$ . With the exception of compact Flash format interface which can support CF form factor hard drives that can consume over 300mA, most card formats require under 100mA maximum. The FET, M1, needs to be selected such that the minimum card voltage specs at the maximum rated current are met. In general, a drop of less than 150mV is acceptable.

## Inrush Transient

When M1 is turned on, the card supply filter capacitor,  $C_{card}$ , is charged. The inrush current can drop the voltage provided by the 3.3V regulator, VDD, until it can recover. The amount of drop is determined by the turn on rate of M1 and the sizes of  $C_{out}$ ,  $C_{card}$ , and the response time of the regulator. If VDD drops below 3.0V erroneous operation of the card reader can occur. The case of multiple simultaneous card insertions must also be considered.

## Short Circuits

Precautions must be taken to tolerate potential short circuits to the card power supply. This can occur during manufacturing test or if a defective card is inserted.

## External Implementations

If discrete FETs are used, they are selected to provide the required DC voltage drop at the maximum rated card currents. Usually, this is 100mA for non-CF interfaces and 300mA+ for CF/Microdrive interfaces. Turn-on surge currents are managed by using the intrinsic FET gate capacitance,  $C_g$ , and a series resistor,  $R_g$ , to provide turn on delay. A value of 15  $\mu$ S is usually acceptable, but may have to be adjusted to assure that the VDD never drops below 3.0V.

## Implementation using integrated FETs

SMSC's USB2227 and USB2228 provides the power FETs for the non-CF interfaces internally and can directly drive the other card interfaces without external components as long as the current to the card does not exceed 100mA. This is illustrated in [Figure 2, "Implementation Using Integrated FETs"](#). The internal FETs have fold-back current limiting and can sustain any load, including a direct short to ground, indefinitely (See [Figure 3, "Output Voltage vs. Load Current for VDDIO = 3.3V"](#)). Since external FETs must be sized to tolerate a short circuit, often, they must be oversized and add cost. In addition, the integrated internal FETs have their turn on times controlled to limit supply voltage drops with commonly available 3.3V voltage regulators and filter capacitor sizes, eliminating the need for external components to control turn on time to eliminate supply droops.

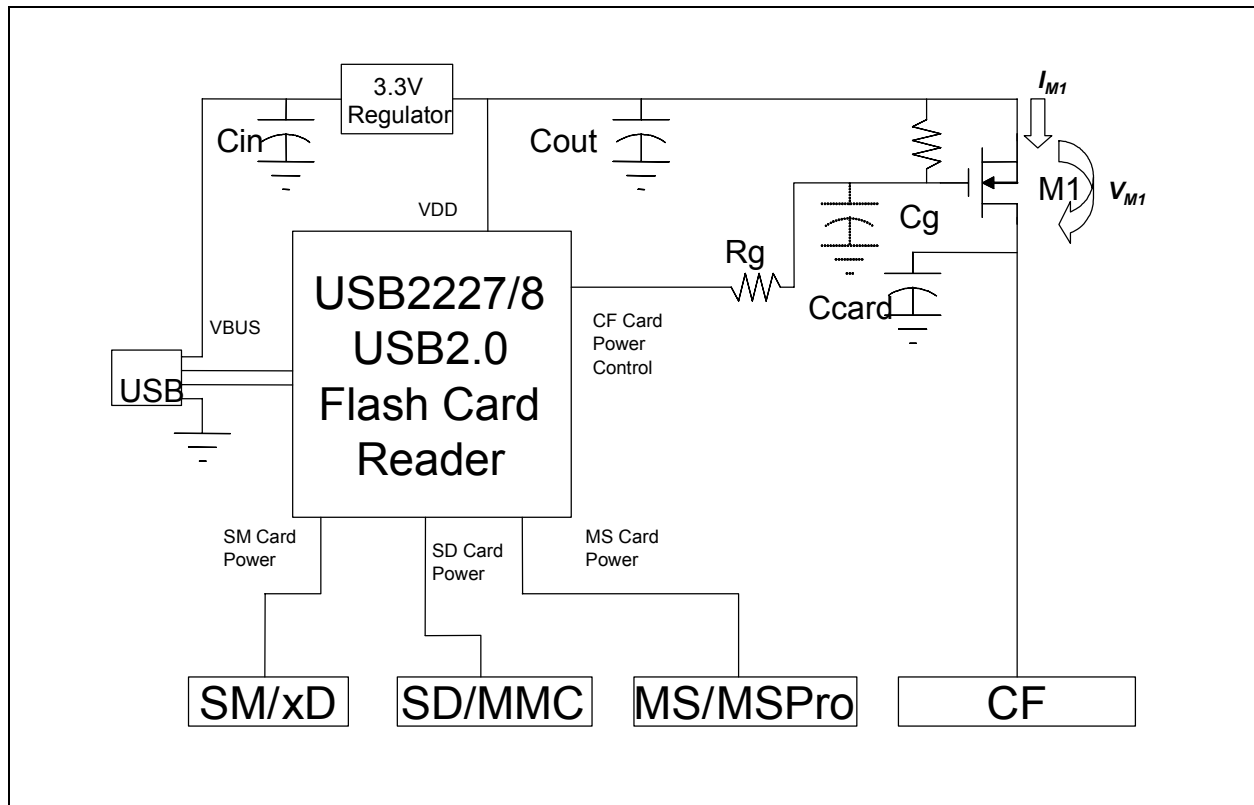


Figure 2 Implementation Using Integrated FETs

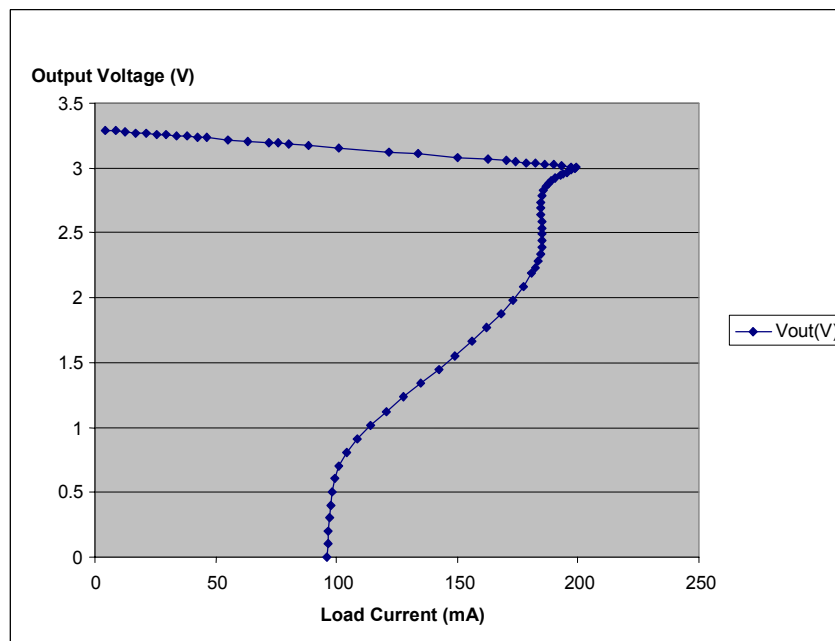


Figure 3 Output Voltage vs. Load Current for VDDIO = 3.3V

## Special Cases

In some cases, it may be desired to have specific non-CF interfaces also use external power FETs. These would be interfaces that are expected to require greater than the 100mA maximum supply current that the USB2227 and USB2228's internally integrated power FETs can supply. In this case, it would be desired that this interface, as well as the CF interfaces use external FETs, while the remaining card interfaces use the internal FETs. The USB2227 and USB2228 can be configured via its attribute bit settings contained in its optional external serial EEPROM to select which interfaces use the internal versus external FETs.

## Integrated FET Parallel Operation

The design of the USB2227 and USB2228's internal power FETs are such that they may be paralleled to supply increased current. Two of the internal power FETS are capable of 100ma output operating current, while one output (pin 76, GPIO11) is capable of supplying 200ma by itself. Therefore, up to 400ma may be obtained by paralleling the internal power FETs in a single card interface application. The firmware of the USB2227 and USB2228 allows any combination of the three internal FETs to be used for any card interface. The FETs are designed not only to sustain individual short circuits, but simultaneous shorts as long as the operating ambient temperature and power supply voltage limits are not exceeded.

## Summary

Proper card power supply design and component selection is necessary for error free operation of USB card readers. Whether using external FETs or the internally integrated FETs of advanced controllers, such as SMSC's USB2227 and USB2228, problem free implementations are possible by following several simple guidelines.



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