

MCS8140 Power Supply Budgeting Application Note

1. General Description

MCS8140 is a highly integrated general purpose network processor that can be used in a variety of products that require network connectivity. The CPU subsystem of the MCS8140 contains a 170 MHz ARM926EJ-S, 32-bit RISC microprocessor delivering approximately 1.1 MIPS per MHz. The MCS8140 network processor contains four high speed USB 2.0 ports. These ports have been designed to connect a wide range of USB-based devices to an Ethernet network (Internet or Intranet).

The 32-bit, 33MHz PCI host interface is compatible with the PCI 2.2 standard. The PCI controller can support up to two PCI devices. This allows the MCS8140 to connect to a variety of PCI devices such as 802.11x peripherals as well as audio, SATA, and IDE controllers. And the Ethernet controller in the MCS8140 contains an independent media access controller (MAC) and physical layer (PHY). The Ethernet interface can be connected directly to external magnetics, LED's and connectors. In addition, the MCS8140 provides an alternate Ethernet configuration that does not use the internal PHY. In this configuration all the MII pins are available on the 20-pin GPIO interface.

2. MCS8140 Power requirement estimation

Since the MCS8140 can be a part of a variety of different applications, the power requirements of the product as a whole need to be carefully analyzed. The MCS8140 requires regulated 1.8V and regulated 3.3V supplies to function correctly. The current drawn by the MCS8140 on the 1.8V core supply and 3.3V I/O supply is as follows:

1.8V supply: 450mA to 550 mA

3.3V supply: 45 mA to 100 mA depending on the interfaces used

Hence MCS8140 requires about 650mA current at full load for its operation. The system designer should apply appropriate de-rating factors and provide suitable margin to account for dynamic operation needs. An extra 200mA for the core and 100 mA for the I/O supply is adequate. This includes the current consumed for all the interfaces integrated in MCS8140, including the 10/100 ethernet PHY, the four USB 2.0 PHY's. That means an over all current budget of 1.0 Amps is required for MCS8140.

3. Power Estimate of external interfaces at System level

In addition to the current required by the MCS8140, the system power supply also needs to account for the following:

- USB devices connected to USB2.0 Host Ports
- Devices connected to PCI Host interfaces
- Other interfaces like SDRAM, Flash, SPI EEPROM, Serial Line Driver, LED's etc., etc.,

According to the USB 2.0 specification, a USB 2.0 host needs to provide upto 500mA of current to a bus powered downstream device. The system also needs to implement sufficient preventive measures to disallow a bus powered device from drawing more than the rated current. These measures are usually implementation specific. Hence, for four USB2.0 Ports, the system power supply needs to provide $4 \times 500\text{mA} = 2\text{A}$ of current just for the devices connected to the USB 2.0 ports. To account for dynamic peaks, an additional 50mA per port can be budgeted. That means an over all current budget of 2.2 Amps is required for four USB2.0 Host ports.

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If the product is implementing a PCI based chipset for any other interfaces, then the current requirements of the chipset needs to be added to the system power supply. For example, if a PCI-SATA chipset is being used for implementing a NAS product, then the current requirements of the chipset and the current required by a SATA hard drive (5V and 12V) also needs to be accounted in System Power budget. Please check with the respective manufacturer's datasheets for the power consumption details of PCI to SATA Controller ASIC & SATA hard drive.

The system power supply needs to power the SDRAM's, FLASH storage, and any other peripheral chips (Like SPI EEPROM, RTC, Serial port Line Driver, LED's etc.). Please check the datasheets of the parts being used to calculate their power needs.

4. Summary

Designing the power supply for an MCS8140 based product is one of the critical requirements to ensure reliable, trouble free operation. Appropriate de-rating factors can be added to the calculated power requirement on each voltage supply in the system. Sufficient overcurrent and over voltage /under voltage protection should also be provided on the power supply.

- For Wired Ethernet to Four Port USB Server product (with no PCI interface) over all power consumption budgeted as 4 Amps, from above estimates.

In case 5V DC is used as input power supply (V_{IN}), ensure this to be very clean & the Voltage Level does not drop below 4.85V. As per USB2.0 specification, if VBUS goes below 4.85V USB Devices may malfunction.

In case of difficulty in ensuring V_{IN} to be greater than or equal to 4.85V all the time, Use higher DC voltage (Like 7V DC) to power the board & use an additional regulator to convert 7V DC to regulated 5V DC.

- For a MCS8140 based system with Wired Ethernet interface + 4 USB 2.0 Host Ports + PCI to WiFi 802.11G + PCI to SATA Controller + SATA HDD. Approximate Power estimate is 8 Amps.
 - a). Silicon Image ASIC (SIL3114CTU) based PCI to SATA controller found to be taking around 600mA of current load on 3.3V & 5V paths.
 - b). Buffalo Air station 54Mbps Adapter ELI2-PCI-G54 (with Broadcom BCM4306KFB) i.e PCI to 802.11G adapter found to be taking a current load of 300mA on 3.3V & 5V Path.
 - c). As Per SATA Hard Drive specification sheets, it takes around 2 Amps current load for its operation. And needs 5V, 12V DC Power input.
 - d). MCS8140 takes around 1 Amp current
 - e). USB interface load = 2.2 mA

This Product needs 5V & 12V DC input voltages & a over all current load of 8 Amps

5. Technical support

Write to support-8140@moschip.com for further queries.