

Voltage Regulators for the IBM 6x86MX Microprocessor

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Introduction

Microprocessors are being designed with more transistors which operate at higher frequencies to meet the demand for faster and more complex computers. This translates into higher power and more strict decoupling requirements for motherboard design. This application note summarizes the key points to design an adequate power supply for the IBM 6x86MX™ Microprocessor¹.

Increased Current Demand from the Voltage Regulator

The IBM 6x86MX Microprocessor has the high performance features of the IBM 6x86L (low power) Microprocessor. It also has an enhanced L1 cache, BTB and TLB which result in more power consumption than the IBM 6x86L Microprocessor. Similar to the low power CPU, the IBM 6x86MX Microprocessor requires dual voltage supply with the following recommended operating conditions:

- for CPU core, $V_{CC2} = 2.80 - 3.00V$
- for CPU I/O, $V_{CC3} = 3.135 - 3.60V$

Present implementations of the 6x86 Microprocessor can draw up to 10.7A on V_{CC2} . It is recommended that the regulator designer refer to the *IBM 6x86MX Microprocessor Databook* to determine the maximum I_{CC2} requirements for the highest core speed microprocessor they are planning to use in their design (a soft copy of the latest databook can be found at www.chips.ibm.com/products/x86/).

Robust power supply designs should include at least a 10-15% margin above the maximum I_{CC2} requirement to provide adequate power to support the IBM 6x86MX Microprocessor operations on a motherboard. Under normal operations, the current drawn by the CPU I/O is much lower than the CPU core.

Voltage Regulators

Two types of voltage regulators can be used to supply power to IBM 6x86MX Microprocessors: Linear or switching regulators.

Linear Regulators

The linear voltage regulator has the advantages of simplicity, low cost, and quick dynamic load response. However, the heat generated due to its low efficiency requires special attention to select proper thermal solutions to meet the case temperature requirement. The excessive heat generated from the low efficiency power loss of linear regulators becomes more significant at lower output voltage and higher output current.

These thermal and power issues can complicate the implementation of linear regulators for the core of IBM 6x86MX Microprocessors. Therefore, if linear regulators must be used, it is recommended they be used only to supply V_{CC3} (CPU I/O voltage).

Switching Regulators

The switching regulator has a much higher efficiency than the linear regulator and, consequently, reduces the heat dissipation significantly. This allows the switching regulator to supply high current with simple thermal solutions. In addition to greater complexity, switching regulators can produce higher noise in output voltage and slower transient current response than linear regulators. All of these factors need to be considered when selecting regulators and designing decoupling solutions for a system board.

Based on the current and voltage requirement, switching regulators are recommended to be used to supply core voltage to IBM 6x86MX Microprocessors. Table 1 on page 2 lists a few examples of switching regulators available in the market. Please consult the vendor's appropriate literature and data sheet for detailed information and circuitry design.

1. The IBM 6x86MX and 6x86L Microprocessors are designed by Cyrix Corporation and manufactured by IBM Microelectronics. 6x86, 6x86L, and 6x86MX are trademarks of Cyrix Corp.



Increased Decoupling Capacitance for CPU Voltage Plane

As the demand for current increases in conjunction with higher operating frequencies, the proper bulk and high frequency decoupling solutions are essential to ensure that voltages supplied to the microprocessor meet specifications. Please refer to application note #40215, *Proper Decoupling Solutions for the IBM 6x86 and 6x86L Microprocessors*, for suggestions.

Vendor	Part Number	Voltage (V)		Current Limit (A)	Contact
		Input	Output		
Harris Semiconductor ²	HIP5011	5.00	up to 3.3	>10	24012 Palm Bay Rd. Palm Bay, FL 42905 tel. (407) 729-4984 www.semi.harris.com
	HIP6008	5.00	2.0-3.5	>10	
Linear Technology ³	LTC1430	5.00	up to 4.0	>10	1630 McCarthy Blvd. Milpitas, CA 950357 tel. (408) 432-1900 www.linear.com
	LTC1553	5.00	1.8-3.5	>10	
Semtech Corporation ⁴	SC1101	5.00	1.8-3.5	>10	652 Mitchell Road Newbury Park, CA 91320 tel. (805) 498-2111 www.semtech.com
	SC1150CS	5.00	2.0-3.5	>10	

² Harris Semiconductor AnswerFAX product data sheets for HIP5011 and HIP600

³ Linear Technology product data sheets for LTC1430 and LTC155

⁴ Semtech product data sheets for SC1101 and SC1150CS

Table 1: Examples of switching regulator power solutions for IBM 6x86MX Microprocessor



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