Clock Sourcing and Phase Spreading

Application Note | May 04, 2009 | AN2024.0

Introduction

A switching power supply operates from a switching clock source. In systems with multiple switching power supplies, the switching phase between power supplies may need to be manipulated to reduce undesired effects in a system. These undesired effects include large peak current drawn from the input voltage and high levels of radiated emissions due to synchronized edges of the switching frequency. Phase spreading is a method of reducing these effects. Applications of multiple switching power supplies include multi-phase (single rail, current shared) and multi-rail (tracking and Autonomous Sequencing™) designs.

Phase Spreading Types

Phase spreading can be achieved in a number of ways. One type of phase spreading is to allow the switching power supplies to operate individually, from their own internally generated clock. This type of phase spreading effectively randomizes the occurrence of the switching frequency edges, which reduces the chances of high peak currents from the input source. This type will be referred to as "non-coherent phase spreading."

Another type of phase spreading involves distributing phase edges of each power supply operating from a common switching clock. This type of phase spreading utilizes a single reference clock. All of the power supply devices then use this clock, but each device has its phase set to a different value through out the cycle of the clock. A two-device power supply group may have the phases set 180° from each other. A three-device group may have the phases set to 120° from each other and so on. This type of phase spreading reduces the peak current draw from the input source. It also effectively reduces the magnitude and increases the frequency of radiated emissions. This type will be referred to as "synchronized phase spreading."

Synchronized Phase Spreading in the ZL2005

Pin-Strap Configuration

Multiple instances of the ZL2005 are referred to as a "group." For a group of ZL2005 devices, a single switching clock can be sourced to all devices. Therefore, all devices of the group are synchronized to a single source. This synchronized clock sourcing can be realized by one of two methods. One method of sourcing the switching clock is to supply it from the main system and configure the CFG pin of all ZL2005 devices in the group to set the SYNC pin as an input. The CFG pin configuration definitions are found in the ZL2005 data sheet.

A second method of sourcing the switching clock is to configure a ZL2005 device to source the switching clock. The CFG pin is used to set the sourcing device's SYNC pin to an output state. The CFG pins of the other devices are then set to configure their SYNC pins to an input state. When using the ZL2005 in a bus sequenced group, the device with no prequel in the group (first device to power-on) must be used as the SYNC output source.

In either method of pin-strap clock sourcing, each device within a group is set to a phase position within the cycle of the sourced clock by virtue of each device's address pins settings. A device's address within a group determines the device's phase position within the group in modulo eight fashion. This means that the address settings of 0x20 through 0x27 will have corresponding phase offsets of 0° for address 0x20, 45° for address

0x21 and so on up to 315° for address 0x27. Other example address ranges for phase spreading are 0x28 through 0x2F, 0x50 through 0x57, or 0x68 through 0x6F. The device address is configured by the SA1:SA0 pins. Refer to the ZL2005 data sheet for the address pins' settings.

Note that for certain group applications, such as Autonomous Sequencing, the device addresses must be set in a consecutive order. This means that the operating phase of each device may not be evenly distributed throughout the cycle of the sourced switching clock. However, the effect of reducing peak current draw will be achieved.

PMBus Configuration

A group of ZL2005s can also be configured for synchronized phase spreading via PMBus commands. As described in the pin-strap configuration section, the ZL2005's SYNC pin can be configured as an input to accept an external switching clock. The USER_CONFIG command is used to perform this setting. The command should be written to set the SYNC pin as an input and to use the source applied to SYNC as the switching clock.

To configure one of the ZL2005 devices of a group to be the source of the switching clock, the USER_CONFIG command is again used. The USER_CONFIG command is written to cause the internal switching signal to drive the SYNC pin as an output. The MFR_CONFIG command should also be considered to set the mode of the SYNC pin when used as an output. MFR_CONFIG can be written to set the pin's operation to open-drain or push-pull.

The PMBus command, INTERLEAVE, can be used to accurately set the position of a device's operational phase. If the INTERLEAVE command is not set (0x0000 default), the address of each device will determine the position of its phase within the switching clock's cycle. The setting of device address pins for phase position is described above, in the pinstrap configuration section. The INTERLEAVE command is used to set each device's phase position relative to the group number, number of devices in the group and the specific device's number within the group. Refer to the PMBus specification: "*PMBus Power System Management Protocol Specification; Part II – Command Language*." The command allows for 16 positions of phase settings resulting in 22.5° increments.

Refer to Zilker Labs Application Note AN2013 for a complete description of the USER_CONFIG and MFR_CONFIG commands.

References

[1] *ZL2005 Data Sheet*, Zilker Labs, Inc., 2005.

[2] AN2013 – *ZL2005 and PMBus™*, Zilker Labs, Inc., 2005.

Revision History

Date	Rev. #	
June 28, 2006	1.4	Initial release
May 4, 2009	AN2024.0	Assigned file number AN2024 to app note as this will be the first release with an Intersil file number. Replaced header and footer with Intersil header and footer. Updated disclaimer information to read “Intersil and it’s subsidiaries including Zilker Labs, Inc.” No changes to app note content.

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