Application Report
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Compatibility Considerations: Migrating From TMS570LS31x/21x to TMS570LS12x/11x Safety Microcontrollers

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ABSTRACT

This application report provides a summary of the differences between the TMS570LS31x/21x and the TMS570LS12x/11x series of microcontrollers.

Contents

1 Introduction

The LS31x/21x series incorporates a superset of the functionality incorporated on the LS12x/11x series. There are some enhancements implemented on the LS12x/11x series, while still maintaining application code compatibility to the LS31x/21x series. An application written for the LS31x/21x series runs correctly on the LS12x/11x series as long as only the common functions are exercised.

Memory Configuration Differences

There are some memory configuration differences between the LS31x/21x and LS12x/11x series of microcontrollers. These are listed below:

- Flash: Program Memory:

  The LS31x/21x series includes parts with either 3MB of 2MB of program Flash, while the LS12x/11x series includes parts with 1.25MB or 1MB of program Flash.
- Program Flash Memory: Boot Sector:

  The first sector in the Flash program memory is 32kB on the LS31x/21x series, while the first sector is 16kB on the LS12x/11x series. The second sector on the LS12x/11x is also 16kB, so that a boot code that uses the full 32kB on LS31x/21x can run as-is on the LS12x/11x. The Flash API calls for programming or erasing use the absolute address as an argument passed by the calling routine.
- CPU Data RAM:

  The LS3137 superset part in the LS31x/21x series includes 256kB of tightly-coupled RAM, while the LS1227 superset part in the LS12x/11x series includes 192kB of tightly-coupled RAM. The 256kB RAM on the LS3137 is divided into four separate power domains of 64kB each. The 192kB RAM on LS1227 is divided into three separate power domains of 64kB each.

2 Package Compatibility Considerations

All the parts in the LS31x/21x and LS12x/11x series of microcontrollers are supported in either a 337 ball grid array (337 BGA) or a 144-pin quad flat pack (144 QFP) package.

2.1 144QFP Pin-Out Compatibility

The parts in LS31x/21x and the LS12x/11x series are 100% pin-out compatible in the 144QFP package. The parts have been designed to allow the same hardware to be used for parts from both the series, as long as the common functions are exercised.

2.2 337BGA Ball-Map Compatibility

The LS12x/11x series of microcontrollers does not include trace and debug modules such as the ARM Embedded Trace Macrocell (ETM-R4), the RAM trace port (RTP) and the Data Modification Module (DMM). The terminals assigned to these modules are either "No Connects" or they now default to any alternate function implemented on these terminals. Please check the device-specific data sheet for details.

The LS12x/11x series also implements an external memory interface (EMIF) with a reduced number of external address lines – 13, compared to the 23 address lines implemented on the LS31x/21x series of microcontrollers. The terminals assigned to the nine fewer higher-order external address lines are now either "No Connects" or they now default to any alternate function implemented on these terminals. Please check the device-specific data sheet for details.

Input/Output Considerations

There are some drive strength differences for output signals between the LS31x/21x and LS12x/11x series of microcontrollers. These are listed in Output Drive-Strength Differences Between LS31x/21x and LS12x/11x.

Output Drive-Strength Differences Between LS31x/21x and LS12x/11x

Output Signal Name	Drive Strength on LS31x/21x	Drive Strength on LS12x/11x
N2HET2[5]	2 mA Zero-Dominant	8 mA
N2HET2[7]	2 mA Zero-Dominant	8 mA
N2HET2[9]	2 mA Zero-Dominant	8 mA
N2HET2[11]	2 mA Zero-Dominant	8 mA
N2HET2[13]	2 mA Zero-Dominant	8 mA
N2HET2[15]	2 mA Zero-Dominant	8 mA
SPI4_nCS[0]	2 mA Zero-Dominant	8 mA
SPI4_nENA	2 mA Zero-Dominant	8 mA

Module Compatibility Considerations

All the **common** modules implemented on the LS12x/11x series of microcontrollers are functionally compatible to those on the LS31x/21x series of microcontrollers. Code written for these modules on the LS31x/21x parts will function on the LS12x/11x parts with no changes required. The LS12x/11x series also includes some new peripherals as well as some enhancements to some common peripherals. These are listed and briefly described in the following sections.

Module Enhancements on LS12x/11x Series

The LS12x/11x series of microcontrollers implements enhancements to two peripherals: the high-end timer (N2HET) and the multi-buffered analog-to-digital converter (ADC).

2.2.1 N2HET Enhancements on LS12x/11x Series

- Selectable Hardware Angle Generator (HWAG) Toothed-Wheel Input

  The N2HET modules, on both the LS31x/21x as well as the LS12x/11x microcontrollers, supports an embedded HWAG. The function of the HWAG is to generate an angle value from a toothed-wheel input. This toothed-wheel input to the N2HET came from the N2HET[2] channel. This allocation was fixed and could not be programmed by the application on the LS31x/21x series of microcontrollers. The HWAG on the LS12x/11x series now includes a programmable register that allows the application to select the N2HET channel that is used to provide the toothed-wheel input. This register still defaults to using N2HET[2] as the toothed-wheel input, thereby, maintaining backwards compatibility to the N2HET peripheral on LS31x/21x.

- Input Capture Enhancements

  The N2HET input capture functionality is also enhanced on the LS12x/11x series of microcontrollers compared to the LS31x/21x series. On the LS31x/21x series, the input signal on an N2HET channel must follow these two rules:

  – The input signal period must be at least twice the N2HET loop-resolution-clock period, and

  – Each phase of the input signal must be at least one N2HET loop-resolution-clock period

  On the LS12x/11x series, the input signal on an N2HET channel must follow these two rules:

  – The input signal period must be at least one N2HET loop-resolution-clock period, and

  – Each phase of the input signal must be at least twice the N2HET high-resolution-clock period

  As can be seen, the N2HET on the LS12x/11x can be used to measure input pulse widths smaller than one loop-resolution-clock period.

ADC Enhancements on the LS12x/11x Series

- Enhanced Channel Selection Mode

  The ADC module on the LS31x/21x series performs sequential conversions on the number of channels selected in any particular conversion group (event group, group1 or group2). This conversion starts with the lowest numbered channel selected and proceeds in ascending order until all selected channels have been converted. The LS12x/11x series introduces an enhanced channel selection mode, wherein, a look-up table is used to define the channel number to be converted. This provides the application the capability of repeatedly sampling the same analog input channel, or to define an arbitrary channel conversion sequence, or to switch the conversion sequence while conversions are already ongoing. For more details, see the *ADC* chapter of the *TMS570LS12x/11x 16/32-Bit RISC Flash Microcontroller Technical Reference Manual* (SPNU515).

- Support for External Analog Multiplexors

  The look-up table used to support the enhanced channel selection mode also allows the application to output external channel select and enable signals. These signals can then be connected to external analog multiplexors, thereby, increasing the number of analog input channels that can be converted by the ADC. The LS12x/11x series supports connecting up to 4:1 external analog multiplexor on each of the 24 unique ADC input channels, effectively providing the ability to convert up to 96 input channels.

New Modules on the LS12x/11x Series

The LS12x/11x series introduces enhanced timing peripherals listed below. The terminals for these peripherals are multiplexed with existing functions and require additional configuration of the I/O multiplexing module to enable outputs from these peripherals.

- Enhanced Translator Pulse-Width Modulator (eTPWM)

  There are seven eTPWM modules that could be synchronized to a single time base, or run on their own time base. Each eTPWM module can output two pulse width modulation (PWM) signals that are synchronized to a common time base and are generated based on independent or complementary counter compares. The eTPWM modules also support adjustable dead-band generation for leading or trailing edges. There are also six separate fault conditions that can be used by the application to trip the eTPWM module outputs. Three of these trip conditions can be driven from external sources, with the other three being internal.

- Enhanced Capture Module (eCAP)

  There are six eCAP modules on the LS12x/11x series. The enhanced capture module uses a 32-bit time base and registers up to four programmable events in continuous, or one-shot capture modes. This module can also be configured to generate an auxiliary PWM signal.

- Enhanced Quadrature Encoded Pulse Generator (eQEP)

  There are two eQEP modules on the LS12x/11x series. The eQEP module uses a 32-bit position counter, supports low-speed measurement using capture unit and high-speed measurement using a 32-bit unit timer. This module has a watchdog timer to detect motor stall and input error detection logic to identify simultaneous edge transition in QEP signals.

3 References

- *TMS570LS12x/11x 16/32-Bit RISC Flash Microcontroller Technical Reference Manual* (SPNU515)

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