AN12899

Using TRGMUX on K32L2A Based on SDK

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Application Note

Contents

1 Introduction

This application note introduces the Trigger MUX (TRGMUX) module and related API based on SDK2.7. This application note also provides two examples of using TRGMUX:

1. Connecting TPM to ADC via TRGMUX
2. Connecting TPM to DMA and LPUART via TRGMUX

2 TRGMUX module

The TRGMUX module enables software to configure the trigger inputs for various peripherals. The structure of TRGMUX is shown in the following figure. As the figure shows, TPM0 is the trigger source. After moving through TRGMUX, it can be routed to the output for DMA and ADC. TRGMUX must be configured by setting the registers in TRGMUX. TRGMUX features 1 to 4 outputs for a peripheral. For different peripherals, the output is different. TRGMUX provides four trigger outputs for DMA, which are connected separately to DMA channels 0 to 3. It provides two trigger outputs for ADC, which go separately to the ADC hardware trigger select signal ADHWTSA and ADHWTSB. The trigger source of each output can be set in the TRGMUX_Periperal [SELn] register.

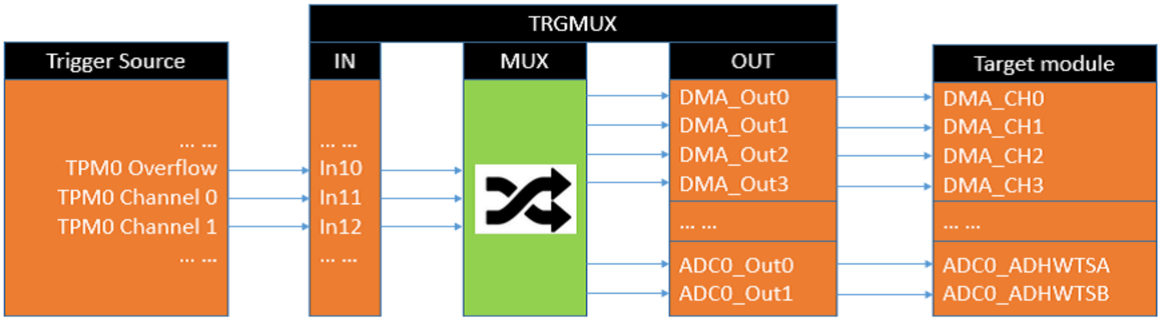


Figure 1. TRGMUX structure

3 Related API in SDK2.7 introduction

To implement an application on the TRGMUX based on SDK2.7, the API must be called from the TRGMUX driver. Also, call the related API for the target module to enable the trigger function.

3.1 API from TRGMUX

The API from TRGMUX is defined as:

```
status_t TRGMUX_SetTriggerSource(TRGMUX_Type *base,
                                 trgmux_device_t index,
                                 trgmux_trigger_input_t input,
                                 trgmux_source_t trigger_src);
```

- The first parameter specifies the TRGMUX module currently being used.
- The second parameter specifies the target module which is to be triggered.
- The third parameter specifies the trigger index, as for some modules there are more than one TRGMUX output. The trigger source for each TRGMUX output can be set with this parameter.
- The final parameter specifies the trigger source for the specified TRGMUX output channel.

For example:

```
TRGMUX_SetTriggerSource(TRGMUX0,
               kTRGMUX_Trgmux0Adc0,
               kTRGMUX_TriggerInput0,
               kTRGMUX_SourceTpm0Ch1);
```

In this example, TRGMUX0 is used and ADC is the target module that is to be triggered. It is triggered by the first TRGMUX output channel for ADC which goes to ADHWTSA and the trigger source is TMP0 CH1.

3.2 API from target module

The related API is different for different target modules.

The API examples for ADC and DMA as the target modules are as follows.

- For ADC, the API to enable the trigger function is:

  ```
  static inline void ADC16_EnableHardwareTrigger(ADC_Type *base, bool enable);
  ```

  It is called as follows:

  ```
  ADC16_EnableHardwareTrigger(ADC0, true);
  ```

- For DMA, there are two related APIs to configure DMAMUX:

  ```
  static inline void DMAMUX_EnablePeriodTrigger(DMAMUX_Type *base, uint32_t channel);
  static inline void DMAMUX_SetSource(DMAMUX_Type *base, uint32_t channel, uint8_t source);
  ```

  It is called as follows:

  ```
  DMAMUX_EnablePeriodTrigger(DMAMUX0, 0);
  DMAMUX_SetSource(DMAMUX0,0, kDmaRequestMux0LPUART0Rx);
  ```

4 Example – Connecting TPM to ADC via TRGMUX

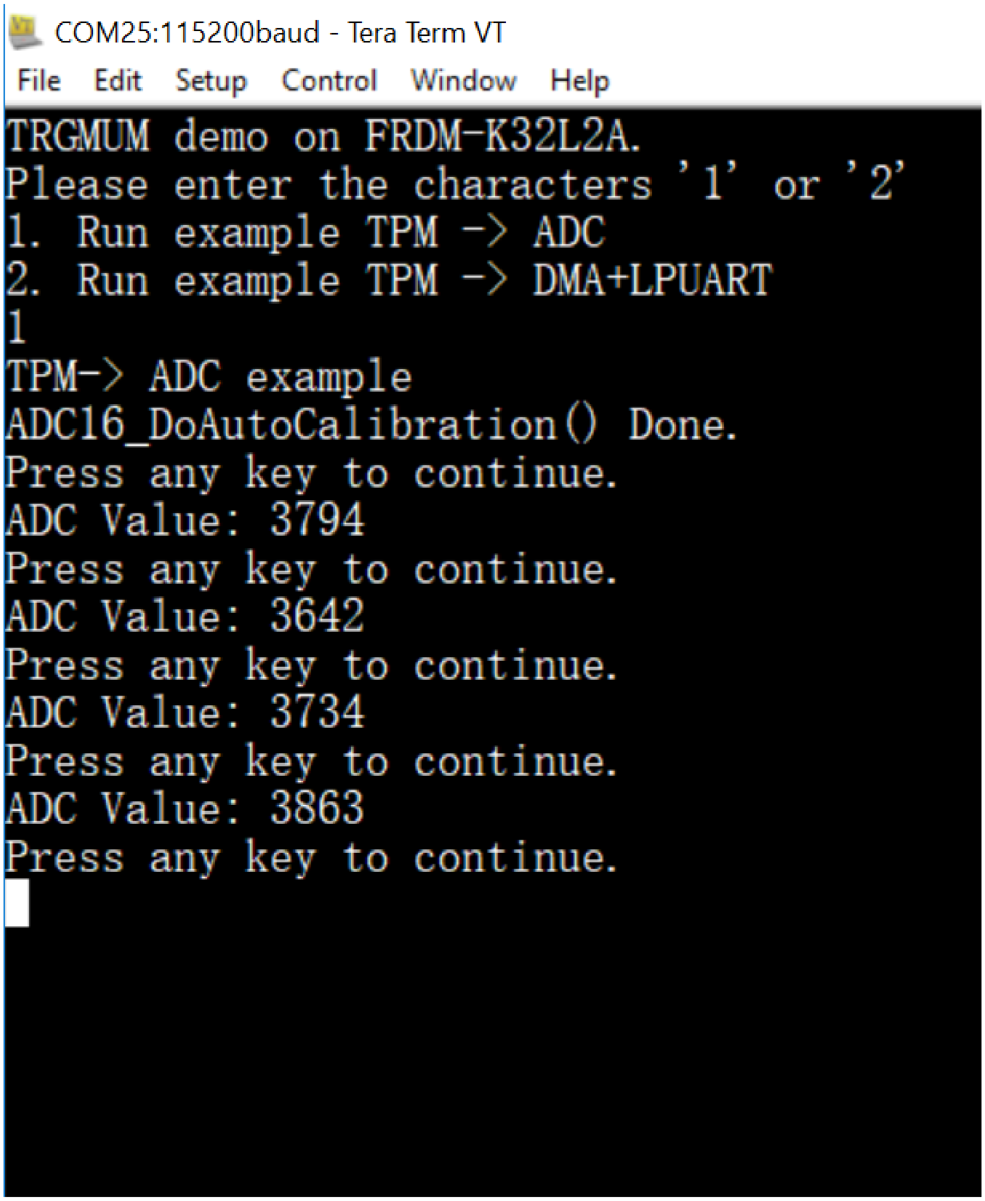
This example is based on the driver example tpm_simple_pwm and adc16_polling for FRDM-K32L2A. For ADC to work, select the trigger source which can provide the both trigger and pre-trigger. Otherwise, ADC does not work.

For example, when using TPM as the trigger source, the TPM overflow does not provide a pre-trigger, therefore it cannot be the trigger source for ADC. In this example TPM CH1 is selected as the trigger source.

The key code is:

```
ADC16_EnableHardwareTrigger(DEMO_ADC16_BASE, true);
TRGMUX_SetTriggerSource(TRGMUX0,
                        kTRGMUX_Trgmux0Adc0,
                        kTRGMUX_TriggerInput0,
                        kTRGMUX_SourceTpm0Ch1);
```

There are some changes in this example. It reads the light sensor output and shows it in the console. When the demo code is running, enter 1 to go into the TPM→ADC example, as shown in the following figure.


COM25:115200baud - Tera Term VT
File Edit Setup Control Window Help

```
TRGMUM demo on FRDM-K32L2A.
Please enter the characters '1' or '2'
1. Run example TPM -> ADC
2. Run example TPM -> DMA+LPUART
1
TPM-> ADC example
ADC16_DoAutoCalibration() Done.
Press any key to continue.
ADC Value: 3794
Press any key to continue.
ADC Value: 3642
Press any key to continue.
ADC Value: 3734
Press any key to continue.
ADC Value: 3863
Press any key to continue.
```

Figure 2. TRGMUX demo – Trigger ADC by TPM

In the test, when shining a light source, such as the flashlight from a cell phone, onto the FRDM-K32L2A board, and then switching it off, the ADC output result changes. See the attached code for more details.

5 Example – Connecting TPM to DMA + LPUART via TRGMUX

This example is based on the driver example tpm_simple_pwm and lpuart_edma_transfer for FRDM-K32L2A. In this example, LPUART is working with DMA, and DMA is triggered by TPM CH1.

The LPUART pin assignments are PTB16 and PTB17, and the signal can be measured on PIN2 and PIN4 on J1, as shown in the following figure.

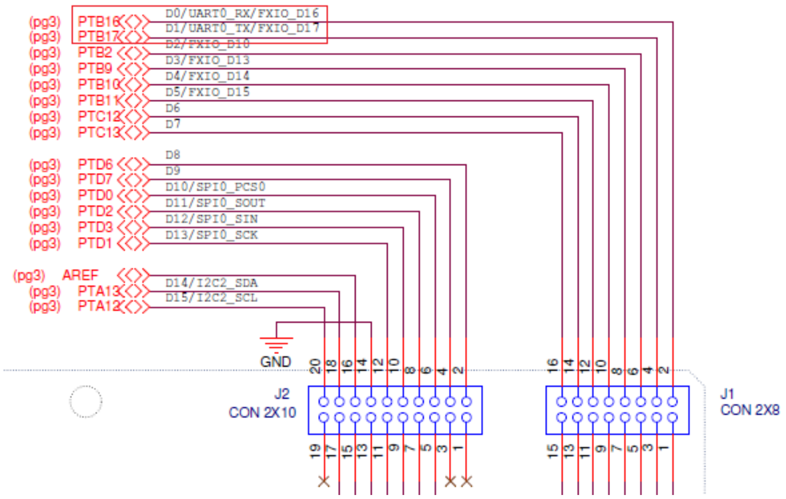


Figure 3. LPUART pin assignment

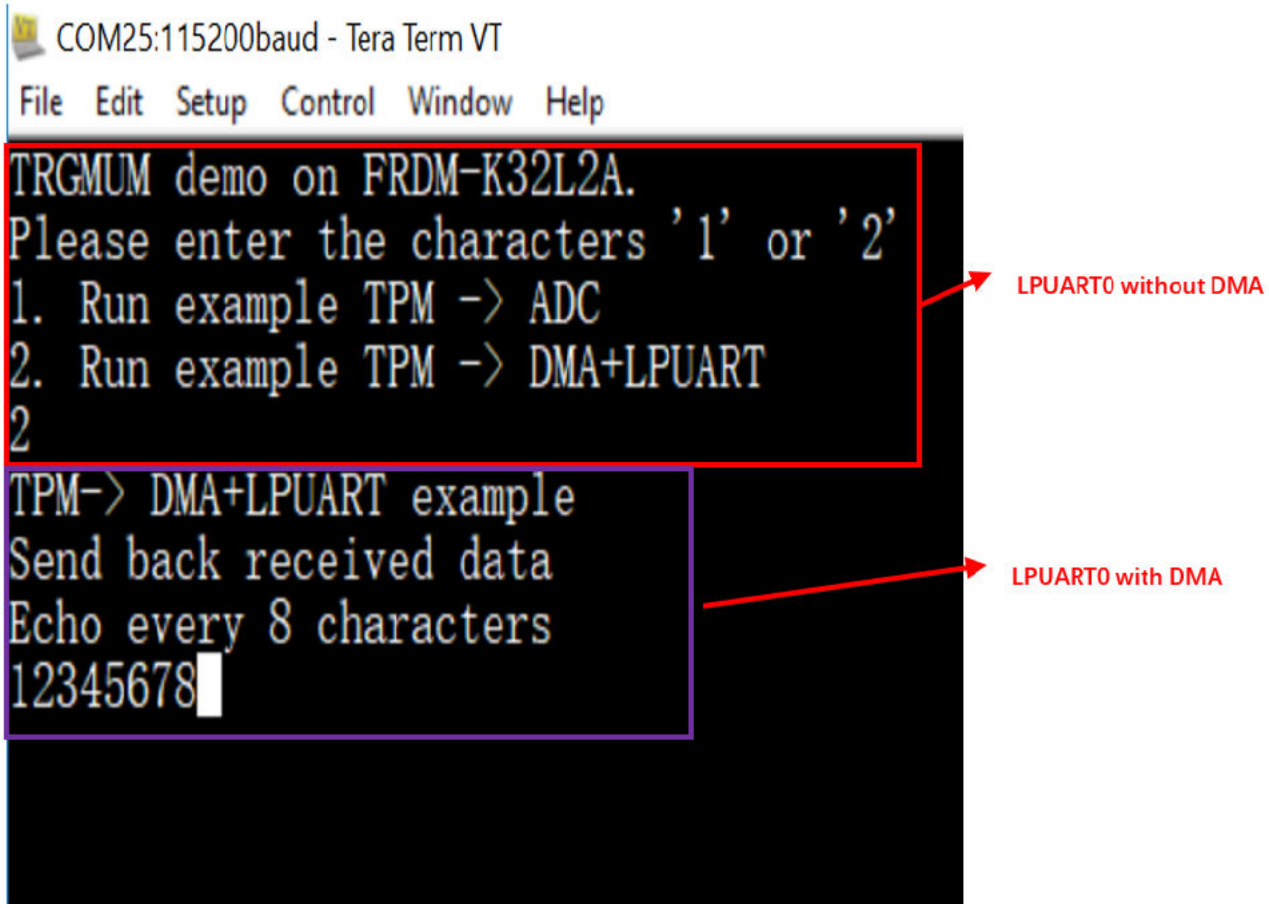
When implementing this example, follow these four key points:

1. Only DMA channel 0 to channel 3 can be connected to TRGMUX.
2. Enable the period trigger for the DMA channel which was selected to connect to TRGMUX.
3. Set the DMAMUX source as enabled for the channel used.
4. Set the trigger source to the required source. In this example it is TPM0 CH1.

The corresponding key code is:

```
DMAMUX_EnablePeriodTrigger(EXAMPLE_LPUART_DMAMUX_BASEADDR,LPUART_RX_DMA_CHANNEL);
DMAMUX_SetSource(EXAMPLE_LPUART_DMAMUX_BASEADDR,
                LPUART_RX_DMA_CHANNEL,
                LPUART_RX_DMA_REQUEST);
TRGMUX_SetTriggerSource(TRGMUX0,
                        kTRGMUX_Trgmux0Dmamux0,
                        kTRGMUX_TriggerInput1,
                        kTRGMUX_SourceTpm0Ch1);
```

When the menu is displayed, enter 2 to run the example. The console output is shown in the following figure.



COM25:115200baud - Tera Term VT
File Edit Setup Control Window Help

```
TRGMUM demo on FRDM-K32L2A.
Please enter the characters '1' or '2'
1. Run example TPM -> ADC
2. Run example TPM -> DMA+LPUART
2
TPM-> DMA+LPUART example
Send back received data
Echo every 8 characters
12345678
```

LPUART0 without DMA

LPUART0 with DMA

Figure 4. Console output for example of Connect TPM to DMA + LPUART by TRGMUX

NOTE

To facilitate the debugging process, LPUART0 is configured by the `BOARD_InitDebugConsole()` function after the MCU reset, and no DMA is used. When the character 2 is input, LPUART0 is reconfigured and data is transferred using DMA.

6 Reference

1. AN5399: Using TRGMUX on KL28 Based on SDK2.0

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