Interrupt_Prio_1
for KIT_AURIX_TC397_TFT
Interrupts prioritization
Three interrupts with different priorities are used to toggle LEDs.

Each interrupt is configured to control the state of one LED. Based on their priority, the interrupts toggle the appropriate LED. In this example, the interrupts are triggered by GPT12 module.
The interrupt system in the AURIX™ TC3xx devices is implemented in the **Interrupt Router (IR)**

**Interrupt Requests** (or Service Requests) can be serviced either by the CPUs or by the DMA module (both called Service Providers)

An interrupt can be triggered by:
- Each module connected to the IR
- External peripherals
- Software via General Purpose Service Requests (GPSR)

Each Service Provider supports **up to 255** service priority levels:
- 0 to disable the interrupt
- 255 for highest priority
Introduction

› A triggered interrupt can be followed by an Interrupt Service Routine (ISR), a function which is called every time an interrupt is triggered.

› Example of ISR configuration:
  – Assign the ISR to a service provider and an interrupt priority
    `IFX_INTERRUPT(functionA, 0, ISR_Priority);`
  – ISR implementation
    ```c
    void functionA(void)
    {
      [...]  
    }
    ```

› By default, an ISR cannot be interrupted by any other interrupt. IR waits until the function is finished before servicing any pending interrupt.

› To allow interrupting the execution of ISRs by higher priority service requests, the following iLLD function must be added at the beginning of the ISR: `IfxCpu_enableInterrupts();`
Introduction

- The **General Purpose Timer** (GPT12) module has very flexible multifunctional timer structures which can be used for timing, event counting, pulse width measurement, pulse generation, frequency multiplication, and other purposes.

- The GPT12 module incorporates **five 16-bit timers** that are grouped into two timer blocks GPT1 and GPT2. Each timer can operate independently in a number of different modes such as Timer mode, Gated Timer mode, Counter mode, or can be concatenated with another timer of the same block.

- In this example, the timers are used in **timer mode**:
Hardware setup

This code example has been developed for the board KIT_A2G_TC397_5V_TFT.

The three LEDs that are used in this example are D108, D109 and D110 (1).
Implementation

Configure the LEDs

The three LEDs blink by controlling the port pins to which they are connected, using methods from the iLLD header IfxPort.h.

In the setup phase, the port pins of the LEDs have to be configured to push-pull output mode using the function IfxPort_setPinModeOutput().

During program execution, the LEDs (low active) are switched on and off using the iLLD functions

IfxPort_setPinLow() → switches on
IfxPort_setPinHigh() → switches off
Configure the Timers

Three timers are configured in order to periodically generate three different interrupts. The GPT12 module methods come from the iLLD header \textit{IfxGPT12.h}

First, the module is enabled via \textit{IfxGpt12_enableModule()}

All three timers are set in \textbf{timer mode} using the iLLD function: \textit{IfxGpt12_Tx_setMode()}, where \( x = 1, 2, 3 \)

To improve the observability during the process of interrupts handling, the timers are set to the slowest frequency. This is done via the prescalers of both the GPT1 block and the individual timers:

\begin{itemize}
  \item \textit{IfxGpt12_setGpt1BlockPrescaler()}
    \begin{itemize}
      \item with parameter \textit{IfxGpt12_Gpt1BlockPrescaler_32} for \( f_{GPT}/32 \)
    \end{itemize}
  \item \textit{IfxGpt12_Tx_setTimerPrescaler()}
    \begin{itemize}
      \item with parameter \textit{IfxGpt12_TimerInputPrescaler_128} for \( f_{GPT1}/128 \)
    \end{itemize}
\end{itemize}

\begin{align*}
  f_{GPT} &= 100\text{MHz} \rightarrow f_{T2} = f_{T3} = f_{T4} = 24.4\text{kHz} \\
  T_{T2} &= T_{T3} = T_{T4} = 2.684\text{s}
\end{align*}
Implementation

- The timer with the lowest ISR priority, T4, is launched first
- The timers T2 and T3 are launched shortly after in order to ensure that the lowest priority ISR has already started
- All timers are running with the same frequency

All cases are covered:
- Higher prioritized ISR **interrupts** lower prioritized ISR already running
- Lower prioritized ISR **waits** the end of higher prioritized ISR in case of simultaneous or belated trigger

**Legend**
- Time delay introduced by software
- Time delay due to interrupt priorities
- Total time taken by the ISR
After code compilation and flashing the device, observe the behavior of the LEDs.

- D108, D109 and D110 are blinking sequentially according to the priority level of their related timer interrupt

- The implemented priority are the following:
  - T2 ISR priority: 52
  - T3 ISR priority: 51
  - T4 ISR priority: 50
References

› AURIX™ Development Studio is available online:
  › [https://www.infineon.com/aurixdevelopmentstudio](https://www.infineon.com/aurixdevelopmentstudio)
  › Use the „Import...“ function to get access to more code examples.

› More code examples can be found on the GIT repository:
  › [https://github.com/Infineon/AURIX_code_examples](https://github.com/Infineon/AURIX_code_examples)

› For additional trainings, visit our webpage:
  › [https://www.infineon.com/aurix-expert-training](https://www.infineon.com/aurix-expert-training)

› For questions and support, use the AURIX™ Forum:
## Revision history

<table>
<thead>
<tr>
<th>Revision</th>
<th>Description of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1.0.2</td>
<td>Fixed timeline image</td>
</tr>
<tr>
<td>V1.0.1</td>
<td>Update of version to be in line with the code example’s version</td>
</tr>
<tr>
<td>V1.0.0</td>
<td>Initial version</td>
</tr>
</tbody>
</table>
IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics (“Beschaffenheitsgarantie”).

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer’s products and any use of the product of Infineon Technologies in customer’s applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer’s technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (www.infineon.com).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies’ products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.