



STM32F10xxx ADC application examples

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## **Introduction**

This application note is intended to provide practical application examples of the STM32F10xxx ADC peripheral use.

This document, its associated firmware, and other such application notes are written to accompany the STM32F10xxx firmware library. These are available for download from the STMicroelectronics microcontrollers website: [www.st.com](http://www.st.com).

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# 1 STM32F10xxx ADC-converted data transfer using DMA

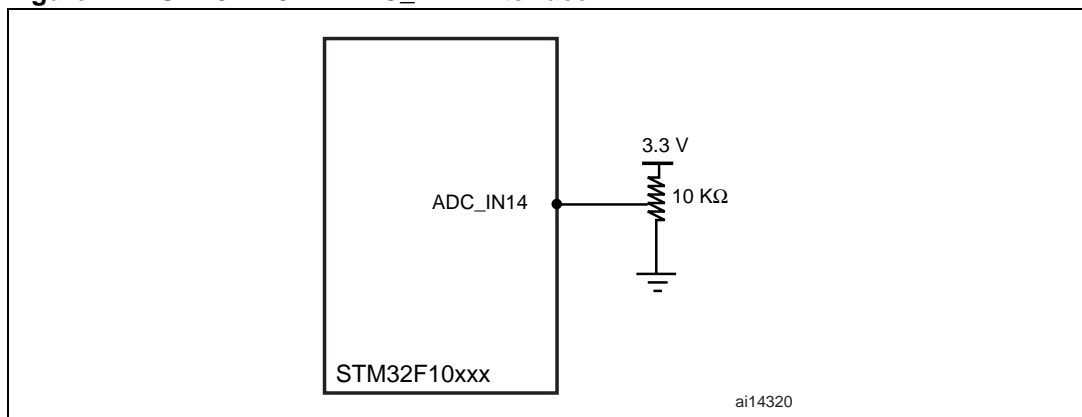
## 1.1 Overview

This section describes how to transfer a converted ADC\_IN input channel value using DMA.

## 1.2 Hardware description

*Figure 1* shows a typical connection between the STM32F10xxx ADC\_IN14 and a potentiometer.

**Figure 1. STM32F10xxx ADC\_IN14 interface**



## 1.3 Firmware description

The provided firmware includes the ADC driver that supports all ADC functionalities through a set of functions.

DMA Channel1 is configured to transfer the converted value to the ADC\_ConvertedValue variable each time ADC\_IN14 is converted. The transfer is made continuous by enabling the circular mode on the used DMA Channel. ADC\_IN14 is configured to be converted continuously.

This firmware is provided as *ADC example 1* in the STM32F10xxx firmware library, available from the STMicroelectronics microcontrollers website.

## 1.4 Conclusion

The use of DMA facilitates the transfer of data from the ADC to the memory in terms of code size and time. The DMA circular mode also allows continuous data transfer without any user intervention.

## 2 ADC conversion on external trigger with auto-injected conversion

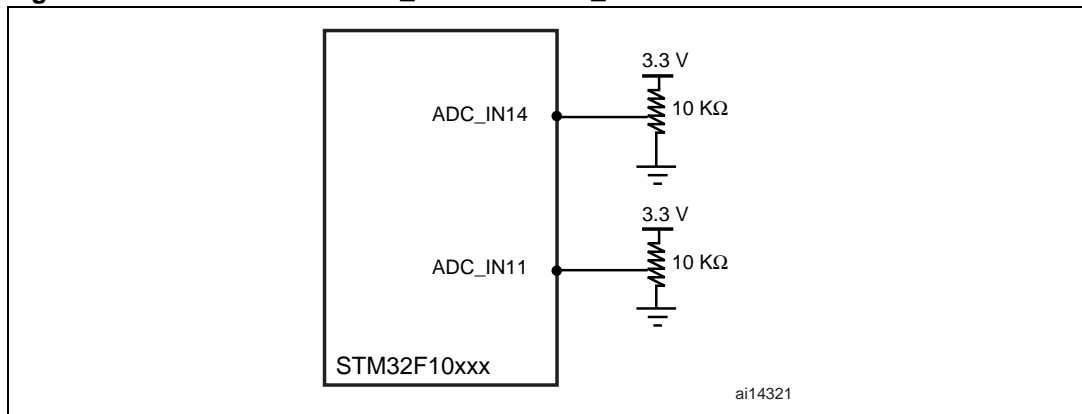
### 2.1 Overview

This section describes how to set an ADC regular conversion triggered by an external event followed by an auto-injected conversion.

### 2.2 Hardware description

[Figure 2](#) shows a typical connection between STM32F10xxx ADC\_IN11 and ADC\_IN14 and two external analog inputs (in the example, two potentiometers).

**Figure 2. STM32F10xxx ADC\_IN11 and ADC\_IN14 conversion**



### 2.3 Firmware description

The provided firmware includes the ADC driver that supports all ADC functionalities through a set of functions.

ADC1 is configured to convert ADC\_IN14 as a regular channel and ADC\_IN11 as an injected channel. The regular conversion is triggered by the TIM1 CC1 signal and the auto-injected mode is enabled for the start of the injected channel conversion. The end of the injected conversion interrupt is enabled so as to ensure that the converted value is saved and pin PC6 is toggled in the ADC interrupt routine. The regular-channel converted values are transferred by means of DMA Channel1. Once 32 regular-channel values have been transferred, TIM1 is disabled in order not to trigger any new ADC regular conversion and, so, no auto-injected conversion is done.

This firmware is provided as *ADC example 2* in the STM32F10xxx firmware library, available from the STMicroelectronics microcontrollers website.

### 2.4 Conclusion

There are several ways of starting regular and injected conversions in the STM32F10xxx ADC. This gives the user a large choice when implementing any application.

## 3 ADC analog watchdog guard

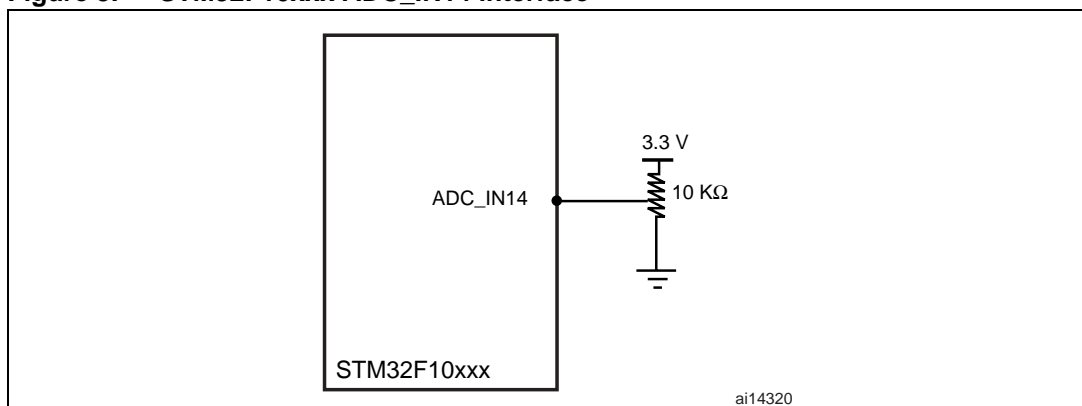
### 3.1 Overview

This section describes how to set an ADC analog watchdog to guard an ADC\_IN input channel.

### 3.2 Hardware description

*Figure 3* shows a typical connection between the STM32F10xxx ADC\_IN14 and a potentiometer.

**Figure 3. STM32F10xxx ADC\_IN14 interface**



### 3.3 Firmware description

The provided firmware includes the ADC driver that supports all ADC communications through a set of functions.

ADC1 is configured to convert regular channel ADC\_IN14 continuously. Both upper and lower analog watchdog thresholds are configured and enabled to guard only ADC\_IN14. The analog watchdog event is enabled to generate an ADC interrupt within the program, which toggles the PC6 pin in the routine. Each time the converted value passes the upper or lower threshold, the interrupt is generated and the pin toggles continuously since the value is no longer in the defined range, limited by the defined thresholds.

This firmware is provided as *ADC example 3* in the STM32F10xxx firmware library, available from the STMicroelectronics microcontrollers website.

### 3.4 Conclusion

The STM32F10xxx ADC provides an analog watchdog to guard any/all ADC\_IN inputs when the converted value passes a defined, upper or lower threshold.

## 4 ADC conversion triggered by an EXTI line in discontinuous mode

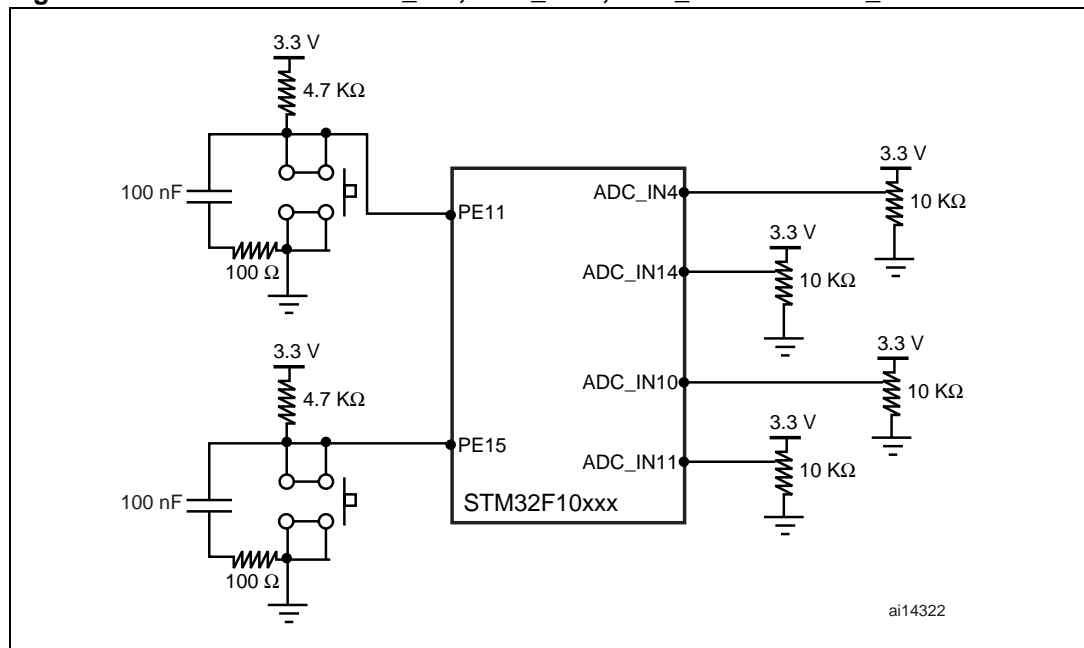
### 4.1 Overview

This section describes how to trigger an ADC regular and injected group conversion by EXTI lines with discontinuous mode enabled for a regular group.

### 4.2 Hardware description

Figure 4 shows a typical connection of the STM32F10xxx ADC\_IN4, ADC\_IN10, ADC\_IN11 and ADC\_IN14 to four potentiometers. The PE11 and PE15 pins are connected to two push-buttons to generate the rising edge to start ADC conversion.

Figure 4. STM32F10xxx ADC\_IN4, ADC\_IN10, ADC\_IN11 and ADC\_IN14 connection



### 4.3 Firmware description

The provided firmware includes the ADC driver that supports all ADC functionalities through a set of functions.

ADC\_IN4 and ADC\_IN14 are configured as regular channels with a start of conversion triggered by EXTI line11 mapped to PE11. ADC\_IN10 and ADC\_IN11 are configured as injected channels with a start of conversion triggered by EXTI line15 mapped to PE15. Discontinuous mode is enabled for regular channel with a number of one channel on each trigger. DMA Channel1 is configured to transfer 64 pieces of data from the ADC1 DR register to ADC\_RegularConvertedValueTab. The ADC1 end of injected conversion interrupt is enabled. On each rising edge detected on PE11, one regular channel is converted and its value is transferred by DMA to the ADC\_RegularConvertedValueTab buffer. On each rising edge detected on PE15, both injected channels are converted and on the ADC1 interrupt routine, both converted values are stored into the ADC\_InjectedConvertedValueTab buffer.

This firmware is provided as *ADC example 4* in the STM32F10xxx firmware library, available from the STMicroelectronics microcontrollers website.

### 4.4 Conclusion

The STM32F10xxx ADC offers a new way of starting conversion for regular and injected group channels using EXTI lines. The discontinuous mode is also available for both regular and injected conversions to allow the conversion of a specified number of channels as a subgroup of the total number of channels to be converted.

## 5 Regular simultaneous conversion in dual ADC mode

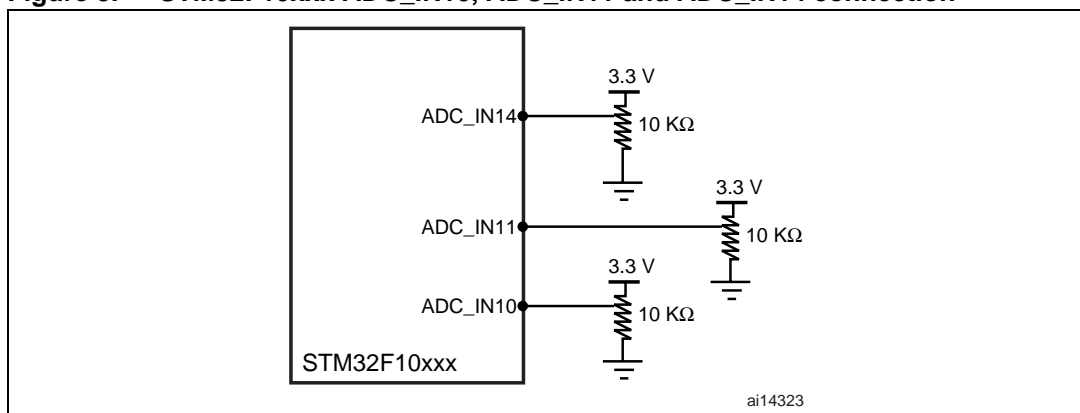
### 5.1 Overview

This section describes how to set the regular simultaneous dual mode with ADC1 and ADC2.

### 5.2 Hardware description

*Figure 5* shows a typical connection between the STM32F10xxx ADC\_IN10, ADC\_IN11 and ADC\_IN14 and three potentiometers.

**Figure 5. STM32F10xxx ADC\_IN10, ADC\_IN11 and ADC\_IN14 connection**



### 5.3 Firmware description

The provided firmware includes the ADC driver that supports all ADC functionalities through a set of functions.

ADC\_IN14 and ADC\_IN17 are configured as regular channels for ADC1. They are converted continuously with a software start of conversion. ADC\_IN10 and ADC\_IN11 are configured as regular channels for ADC2 and are converted continuously with a start of conversion synchronized to that of ADC1. DMA Channel1 is configured to transfer 16 pieces of 32-bit data from the ADC1 DR register to ADC\_DualConvertedValueTab. Once the ADC1 software start is enabled, regular channel conversion begins simultaneously on both ADCs and completes after 16 conversions on each ADC. All converted values are transferred by DMA to the 32-bit data buffer ADC\_DualConvertedValueTab that holds both ADC1 and ADC2 conversion results.

This firmware is provided as the *ADC example 5* of the STM32F10xxx firmware library, available from the STMicroelectronics microcontrollers website.

### 5.4 Conclusion

The STM32F10xxx gives the user the possibility of converting two channels at the same time owing to the presence of two ADCs that can be synchronized to work in different dual modes such as the regular simultaneous mode.



## 6 Revision history

Table 1. Document revision history

Date	Revision	Changes
14-Jun-2007	1	Initial release.

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