AN4113
Application note

Managing the Driver Enable signal for RS-485 and IO-Link communications with the STM32F05x USART

Introduction

RS-485 and IO-Link are half-duplex communication protocols that offer easy ways of implementing the physical layer in industrial networks.

The STM32F05x, which comes with 2 UART interfaces and features, fast DMA transfer and low interrupt latency, meets the RS-485 and IO-Link timing specifications.

This application note aims at providing timing measurements of the DE signal (Driver Enable) switching.

The application note is organized into three parts:

- it first explains why the timing of the DE signal is critical
- it then describes DE feature in the STM32F05x USARTs.
- and, finally, it gives measurement of the DE signal switching time

Table 1. Applicable products and tools

Type	Part numbers
Microcontroller	STM32F05xx

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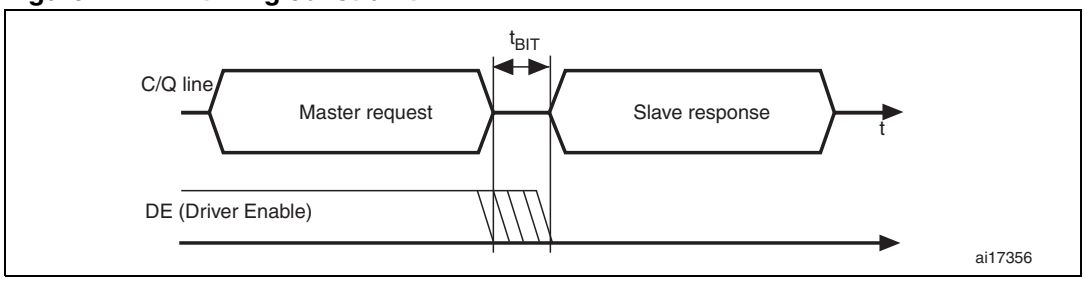
1 DE signal timing constraint

For serial half-duplex communication protocols like RS-485 & IO-Link, the master needs to generate a direction signal to control the transceiver (PHY). This signal informs the PHY if it must act in send or receive mode.

The timing of this control is critical, especially when switching from the send to the receive mode, as the application has to make sure that the device is in reception mode before data is sent by the other entity.

The master has to free the Tx/Rx line in no more than a bit time, otherwise there is a collision with the slave response. So the DE signal has to switch from high to low level within the bit time that follows the last bit of the last byte sent by the master.

Figure 1. DE timing constraint



The master should be able to guarantee the timing of the DE signal (imposed by the RS-485 & IO-Link specifications). The DE signal is managed by the USART.

The DE signal is mapped to the RTS pin of the USART, and in this application it is connected with the pin 12 of port A (PA12).

2 Description of the DE feature in STM32F05x

The driver enable signal is managed automatically via the USART.

The driver enable feature is enabled using the USART_DECmd() function.

This allows the user to activate the external transceiver control, through the DE (Driver Enable) signal.

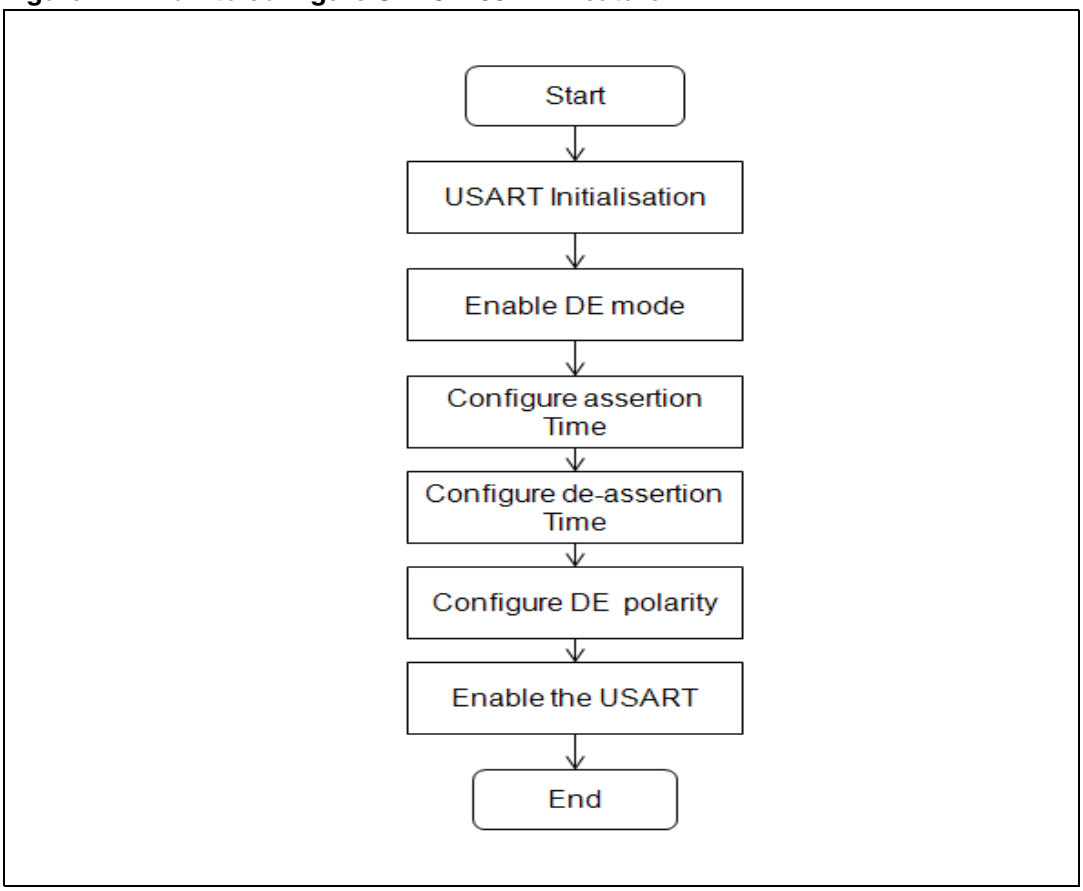
The assertion time is the time between the activation of the DE signal and the beginning of the START bit. It is programmed using the USART_SetDEAssertionTime() function.

The de-assertion time is the time between the end of the last stop bit, in a transmitted message, and the de-activation of the DE signal. It is programmed using the USART_SetDEDeassertionTime() function.

The polarity of the DE signal can be configured using the USART_DEPolarityConfig() function.

Figure 2 describes how to configure STM32F05x DE feature.

Figure 2. how to configure STM32F05x DE feature



3 How to configure DE timing

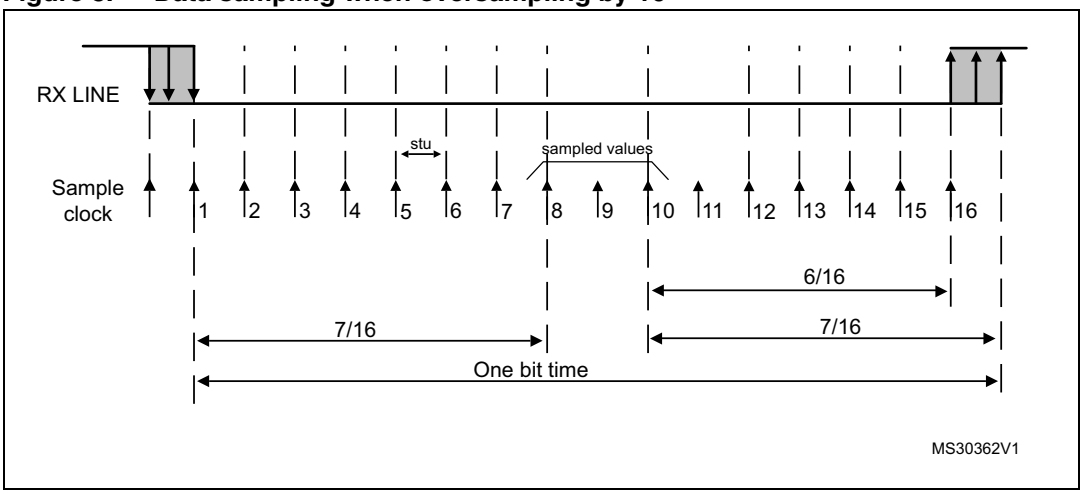
The assertion and de-assertion values are expressed in term of simple time unit (stu) which depends on the data oversampling mode.

There are 2 cases:

3.1 Case of oversampling by 16

In case of oversampling by 16 (see *Figure 3*), DE value must be less or equal to 16 stu.

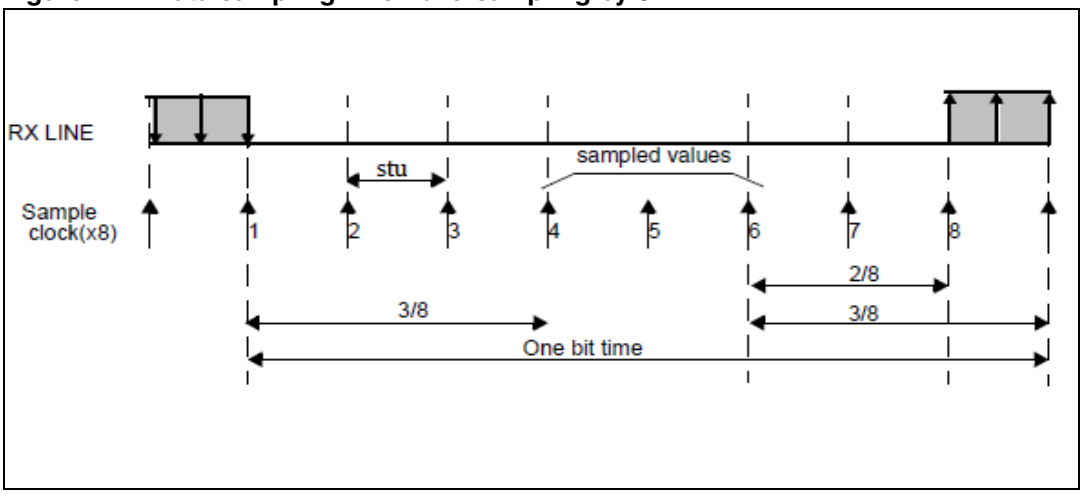
Figure 3. Data sampling when oversampling by 16



3.2 Case of oversampling by 8

In case of oversampling by 8 (see *Figure 4*), DE value must be less or equal to 8 stu.

Figure 4. Data sampling when oversampling by 8

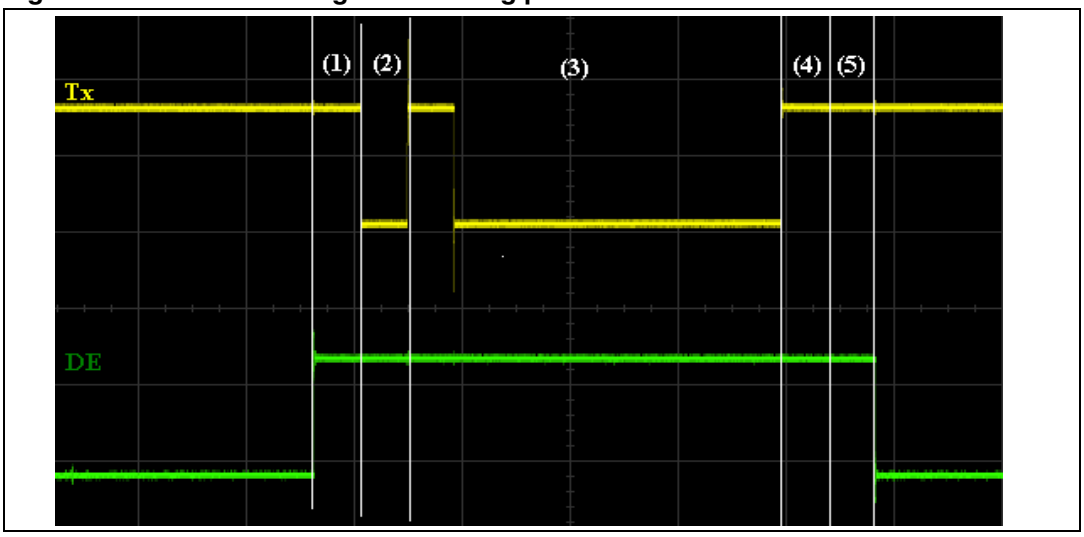


4 Measuring the DE signal switching time

This section gives some DE timing measurements using the two previously described oversampling cases.

The timing to be measured is the time interval between the end of the stop bit of the last byte and the falling edge of the DE signal. It is measured in CPU clock cycles (refer to *Figure 5*).

Figure 5. Zoom in DE signal switching period



1. (1) DE assertion period
2. (2) Start bit
3. (3) Data (8 bits)
4. (4) Stop bit
5. (5) DE de-assertion period

DE measured timing value was 4.2 µs which is equal to one bit time with following configuration:

1. oversampling by 16
   - Data sent : 0x01
   - BaudRate = 230400 baud
   - DE assertion time = 0x10
   - DE deassertion time = 0x10
2. oversampling by 8
   - Data sent : 0x01
   - BaudRate = 230400 baud
   - DE assertion time = 0x08
   - DE deassertion time = 0x08

5 Conclusion

Thanks to the STM32F05x USART Driver Enable feature, the user can develop RS-485 & IO-link applications with reduced firmware and hardware resources.

6 Revision history

Table 2. Document revision history

Date	Revision	Changes
07-Nov-2012	1	Initial release.

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