AS1163 – Communication mode (MCU mode type-B)

Application Note

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Valid for:
AS1163

Abstract

This document will provide a comprehensive overview of the various communication modes supported by the SAID (AS1163) device within the Open System Protocol (OSP) ecosystem and will then explain the new MCU mode Type-B in more detail.

Table of contents

1 Introduction 4

1.1 Communication modes 4

2 MCU mode type-B 9

3 Summary 13

4 Appendix 13

4.1 List of abbreviations and acronyms 13

5 Revision information 14

1 Introduction

The AS1163 device, working as an OSP node, features two identical Serial I/O (SIO) interfaces, which are utilized for communication between devices and between a device and a microcontroller unit (MCU). Each SIO interface consists of a P terminal (= SIO_P) and an N terminal (=SIO_N), with the functionality of each terminal determined by the configured SIO mode. From the functional mode point of view, the SIO interface is symmetrical, except for the MCU Mode type-B, which is only available at port 1.

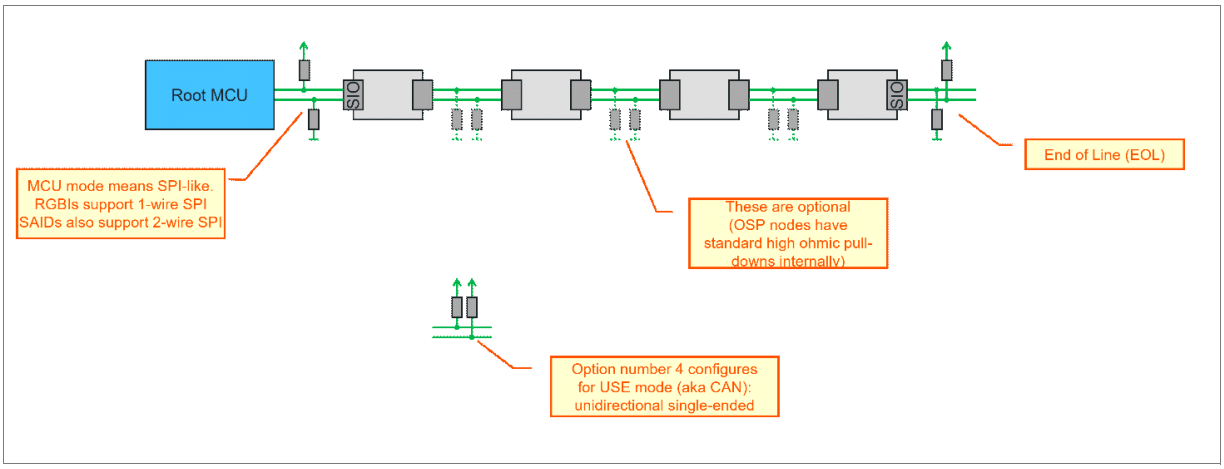
Each of the two SIO interfaces supports four different communication modes and can operate in half-duplex mode. Additionally, it is possible to simultaneously receive a telegram at one SIO port while transmitting at the other.

1.1 Communication modes

The SIO mode is defined by pull-up/pull-down resistors connected to the SIO pins, as shown in Figure 1. A device will monitor each SIO pin at startup to detect the programmed SIO mode for SIO1 and SIO2.

The recommended value for pull-up and pull-down resistors is 10kOhm.

Figure 1: Pull-up and pull-down configurations

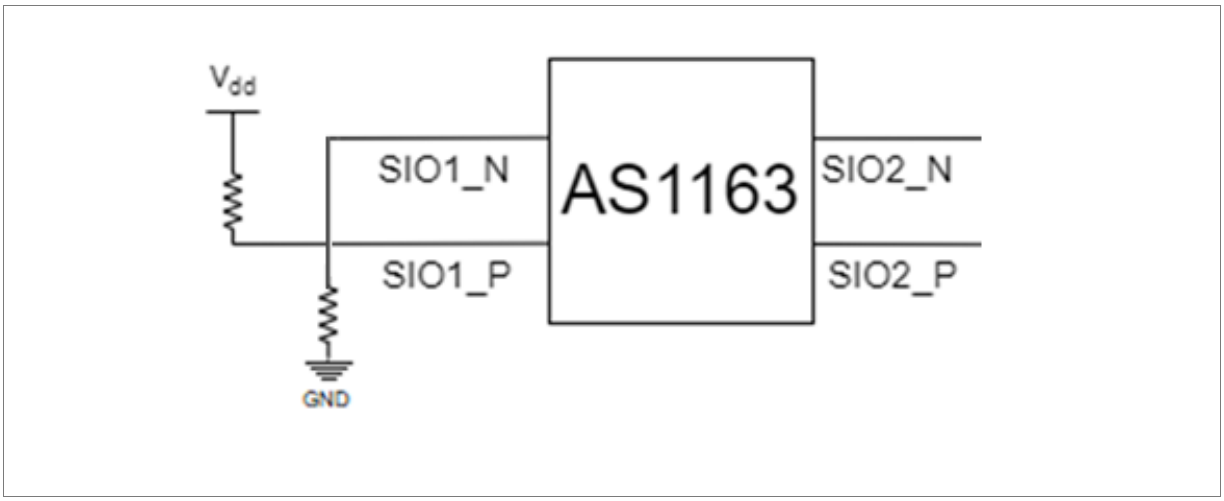


In the following document we are focusing on the newly introduced communication mode for AS1163, MCU mode type-B. All the information regarding the other communication modes are already available in the document about the OSP protocol: Open System Protocol base documentation.

The OSP communication modes are listed below:

1. **MCU mode Type A:**
   The SIO uses a single-ended mode for signaling. The telegrams received by a SIO interface are Manchester encoded and are expected on the SIOx_P port. Telegrams transmitted by a SIO interface do send data on SIOx_P in NRZ format together with the corresponding clock on SIOx_N.

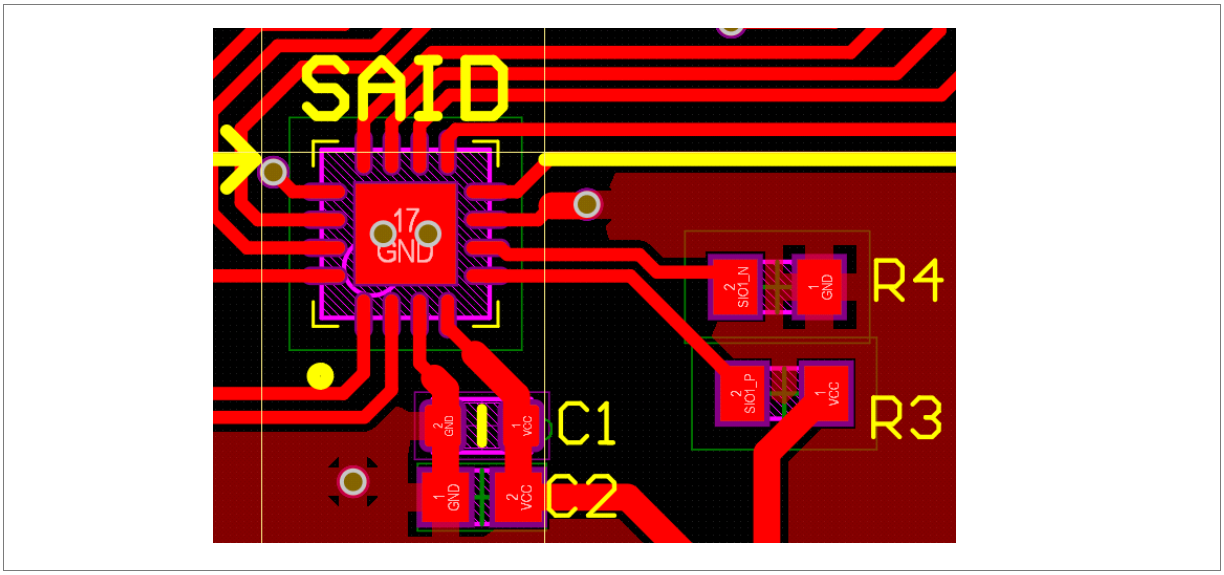
Figure 2: MCU mode pull-up configuration



(1) Pull-down resistors are optional thanks to high ohmic internal resistance.

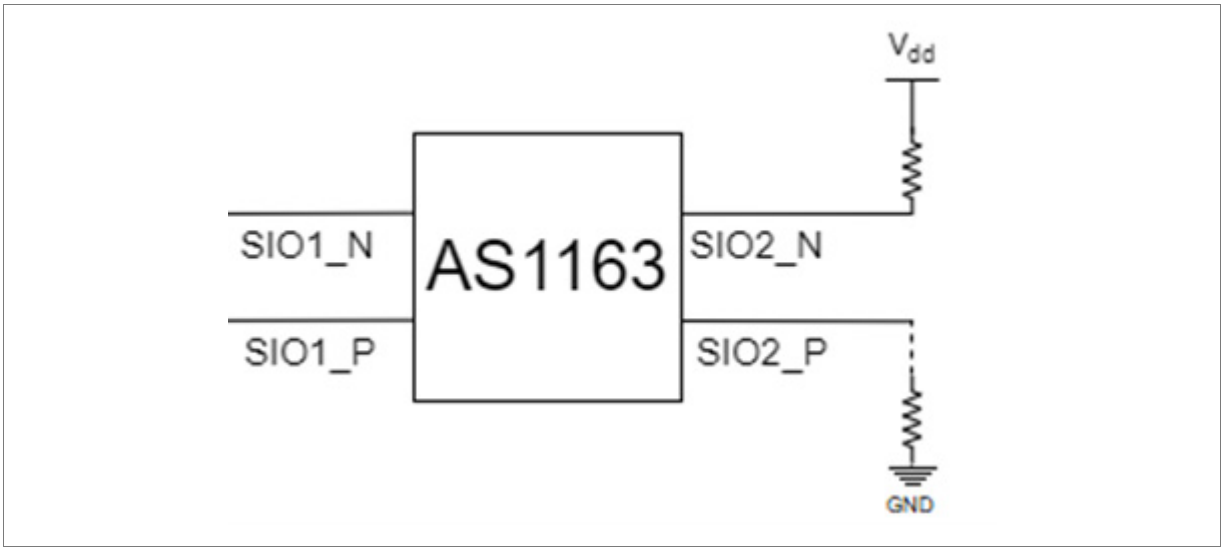
2. **MCU mode Type B:**
   This configuration is the same as the previous configuration from a resistor point of view. In this case, instead of sending a Manchester encoded data on SIO1_P, the MCU will send clock and data over SIO1_N and SIO1_P and will receive a clock and data signal back over SIO2_N and SIO2_P respectively.
   Both downstream and upstream communication use a regular 2 wire SPI interface with clock and data signals with NRZ coding (no Manchester encoding).

Figure 3: MCU mode pull-up / pull-down (optional)



3. **MCU mode, EOL (End of Line):**
   This configuration is like “MCU mode type-A” but the SIO port considers itself to be at the end of the daisy chain. It is sufficient to place a pull-up resistor on the SIOx_N line of the last node in the chain.
   This is needed for some commands that require the daisy chain topology information, like for example addressing commands.

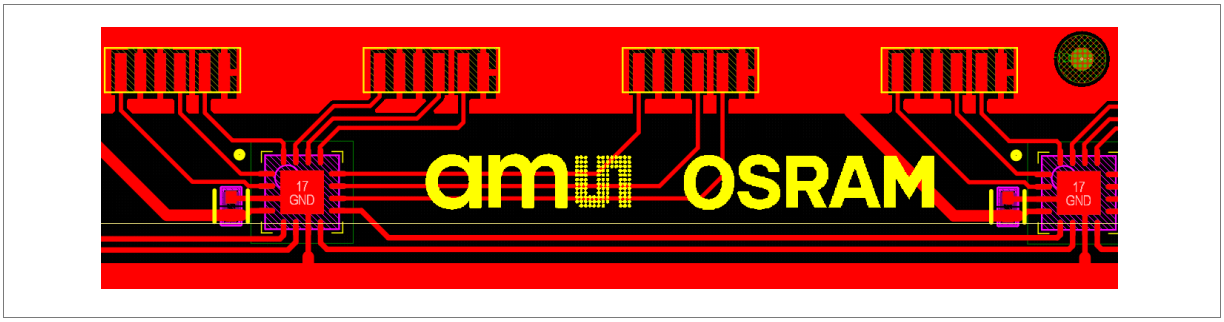
Figure 4: EOL resistor configuration



(1) Pull-down resistors are optional thanks to high ohmic internal resistance.

4. **LVDS mode:**
   The SIO uses LVDS signaling for transmitting and receiving telegrams. Manchester encoding is used to transfer DATA & CLK on the same line.
   There is no need for resistors, as shown in Figure 5. OSP nodes have high standard ohmic internal pull-downs which let the user avoid placing additional components.

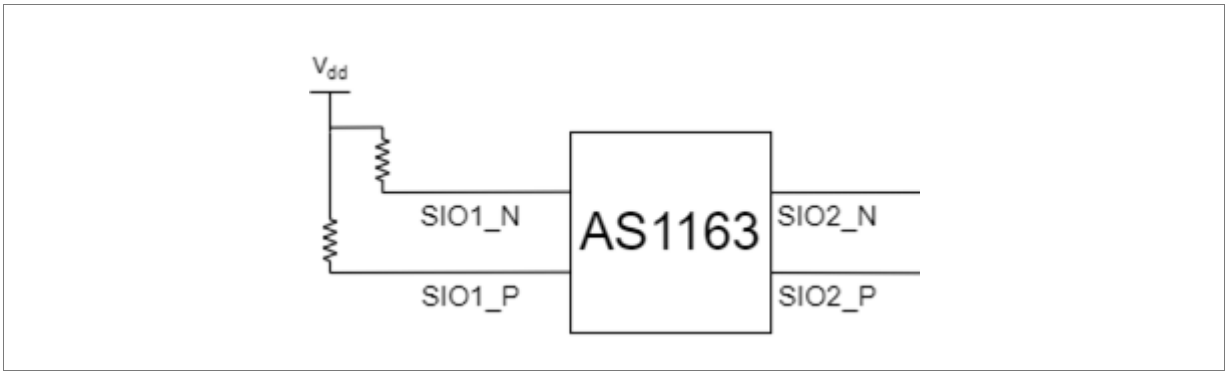
Figure 5: LVDS configuration



5. **Unidirectional single ended (USE) mode:**
   In this mode upstream and downstream telegrams are always Manchester encoded and single ended. By this it is possible to use CAN-FD transceivers for communication through CAN physical layer between different PCBs, to support automotive requirements regarding robustness. Data is received via SIO_N only and is sent via SIO_P only. During receiving, SIO_P is switched to a high-Z state and during sending, data on SIO_N is ignored. The bit stream is Manchester encoded. This mode is selected through two pull-up resistors and the idle state in this mode is high on SIO_P and SIO_N. Implementation of this mode is mandatory. Note: This mode is also referred to as "CAN" mode, as it enables the use of CAN-FD transceivers. Due to the Manchester coding, the CAN-FD transceiver needs to support at least twice the data rate of the OSP.

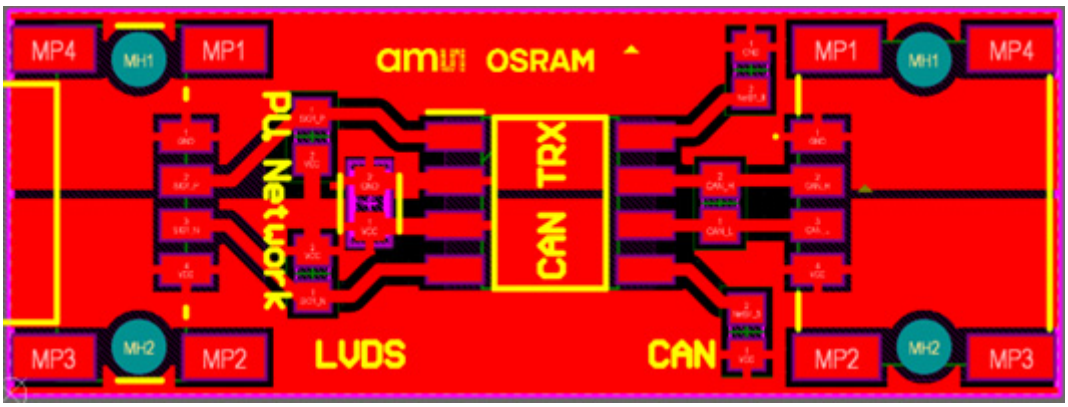
Figure 6 shows the pull-up configuration needed to configure the device in this communication mode.

Figure 6: USE pull up configuration mode



In Figure 7 you have a representation of the CAN adapter board developed internally to convert the signal from LVDS to CAN and vice versa.

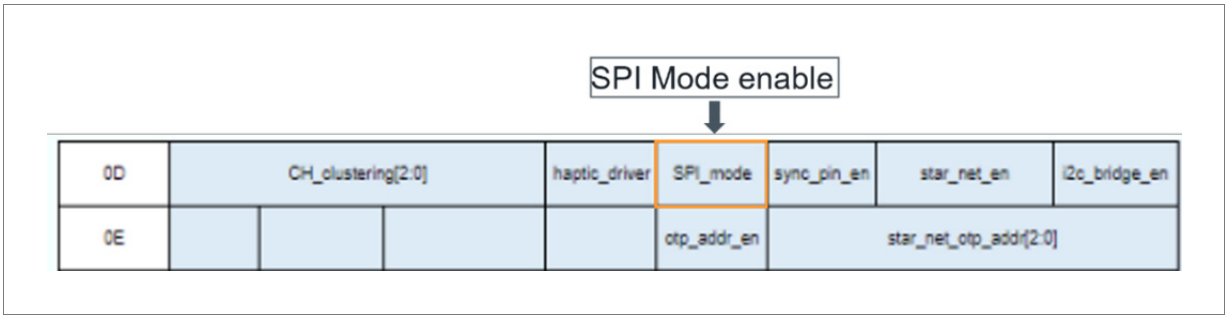
Figure 7: CAN adapter board from ams OSRAM



2 MCU mode type-B

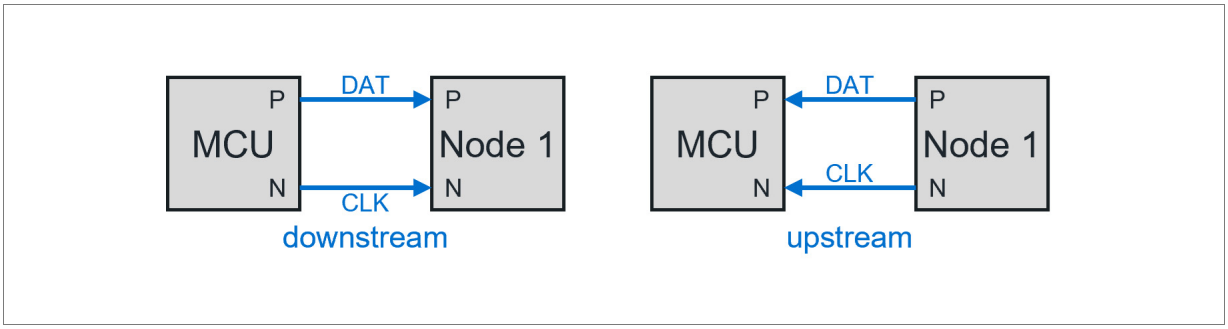
MCU mode type-B is an alternative option in MCU mode type-A, that is activated when the SPI_mode bit is set in the OTP customer block as shown in the Figure 8.

Figure 8: OTP bit setting



Both downstream and upstream communication use a regular 2-wire SPI interface with clock and data signals with NRZ coding (no Manchester encoding).

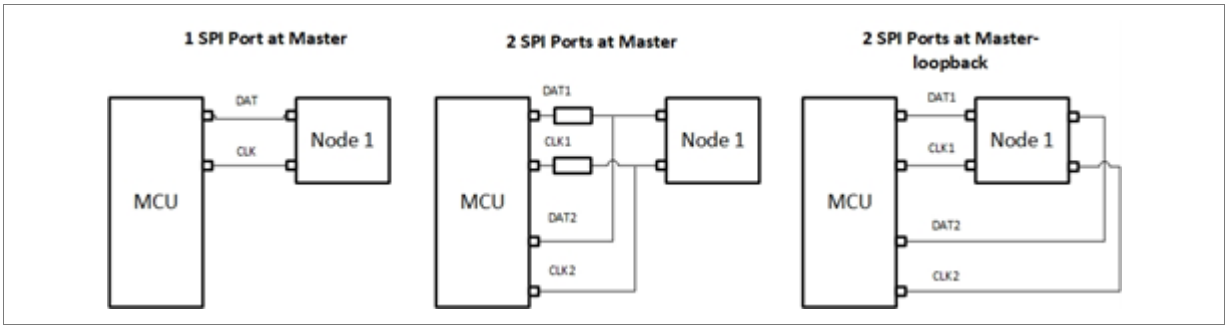
Figure 9: MCU mode type-B



The communication is executed as shown above in Figure 9.

The SPI master role is always taken by the transmitting device, i.e., for downstream communication by the MCU and for upstream communication by the first node. There are three possible options to realize this on MCU side as shown in Figure 10.

Figure 10: Connection with the MCU



The first two options work in bidirectional mode, the third option is only for the loop-back mode. When 2 SPI ports are used on the MCU, the first is always master and the second is always slave. The two resistors in the second case are needed to decouple the master and slave pins.

When only 1 SPI port of the MCU is used, it needs to toggle the SPI role between master and slave after a message has been sent and before the response is received. A wait time of minimum 5 µs is observed between the end of an incoming telegram and the start of a response that is sent back to the master.

The clock phase on SIOx_N is selectable through register settings, using the COM_INV bit in the SETUP register.

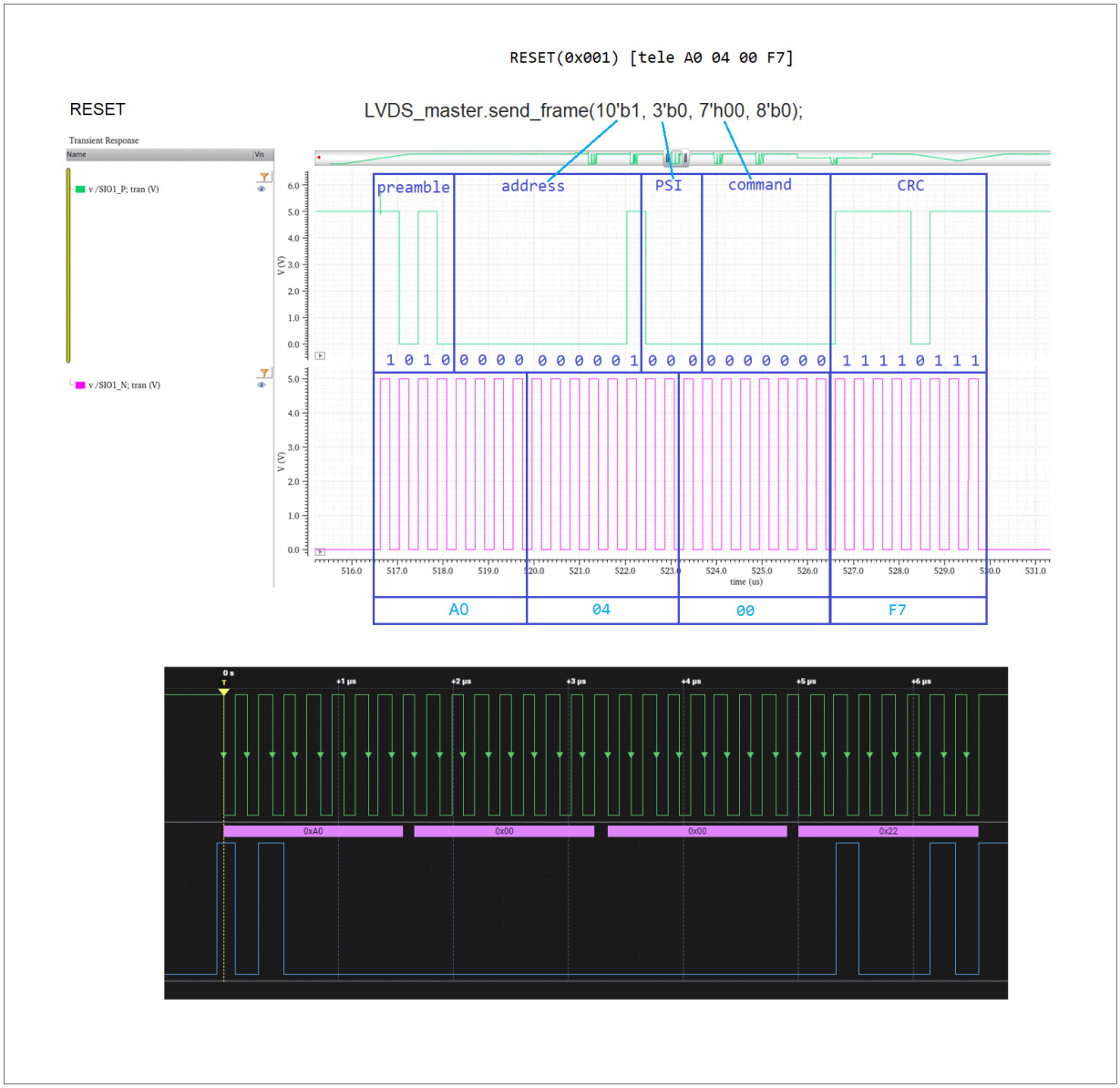
There is NO dedicated start / stop sequence.

Information:

2-wire SPI is only supported on SIO1 port.

The Figure 11 is an example trace of the reset telegram in SPI.

Figure 11: MCU mode type-B telegram examples



Information:

"RESET" telegram does trigger the mode detection of the SIO ports again similar as done at startup!

The minimum wait-time after one telegram before sending the next one depends on the communication mode:

- **BIDIR:** It depends whether you expect a response added to the latency of the chain. SAID answers after 5 µs to leave time to the SPI master to switch to slave. Wait at least 5 µs + length of response when expecting an answer times 7 µs (fast forward time). If a telegram causes a response by node at address N, the response comes after 5+(N-1)×7 µs.
- **LOOP:** The wait-time should be larger than 2 BAUDs so 2×417=833 ns.

3 Summary

This document outlines the key communication modes available for the SAID device, explicitly focusing on the newly introduced MCU mode Type B. It highlights the specific characteristics of each mode and provides guidance on implementing the AS1163 within an OSP ecosystem.

4 Appendix

4.1 List of abbreviations and acronyms

- **AS1163** – Device model
- **MCU** – Microcontroller Unit
- **OSP** – Open System Protocol
- **SIO** – Serial I/O
- **NRZ** – Non-Return-to-Zero
- **EOL** – End of Line
- **LVDS** – Low-Voltage Differential Signaling
- **USE** – Unidirectional Single-Ended
- **SPI** – Serial Peripheral Interface
- **OTP** – One-Time Programmable
- **COM_INV** – Communication Inversion (register bit)

5 Revision information

Changes from previous released version to current revision v2-00	Page
Updated description under “Unidirectional single ended (USE) mode”	7

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

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