# AN14565

## 在MCXN236上实现USB转I2C的演示

第1.0版—2025年1月30日 应用笔记

**文档信息**

| 信息 | 内容 |
| --- | --- |
| 关键词 | AN14565、MCXNx4x/Nx3x、DCDC、USB、I2C、CDC类 |
| 摘要 | 本应用笔记介绍了如何在MCXN236微控制器上实现USB转I2C的桥接功能。 |

# 1 介绍

某些应用，如传感器测试和光模块，需要一个I2C接口来支持信息传输。同时，它们还需要一个接口与PC进行通信，以便向I2C设备发送测试命令和数据来测试其产品。

USB接口在许多应用中被广泛使用，在高速（HS）模式的USB2.0协议下，其传输速度可达480Mbps。因此，USB是一个非常适合用作桥接的接口，可用于将来自其他接口（如USART、SPI和I2C）的数据传输到USB主机。本应用笔记提供了一个演示，该演示使用USB接口来桥接I2C接口。MCXN236微控制器具有一个高速USB接口和七个I2C接口。

## 1.1 MCXN236的I2C接口特性

MCXN236上的I2C接口支持：

- 控制器模式，可支持标准模式、快速模式、快速+模式以及超快速模式
- 目标模式，可支持高速模式
- 多控制器，包括同步和仲裁功能，这意味着可以存在任意数量的控制器节点。此外，控制器和目标角色可以在消息之间进行互换（在发送停止信号后）
- 时钟延长，在SCL线上使用，作为一种I2C的流量控制机制
- 仲裁机制，适用于系统有多个控制器的情况。当在SDA线上使用时，可确保同一时间只有一个I2C发送器
- 通用回调，支持7位地址和10位地址格式
- 软件复位、起始字节和设备ID（还需要软件支持）

# 2 MCXN236的USB转I2C演示介绍

在这个基于MCXN236 芯片的 USB 转 I2C 演示中，USB 设备使用 USB CDC 虚拟串口类与 PC 主机进行通信。使用终端工具发送串行数据来控制 I2C 接口。在后续内容中使用的终端工具是 `pzh-py-com` 工具。用户可以从以下网址下载该工具：https://github.com/JayHeng/pzh-py-com。

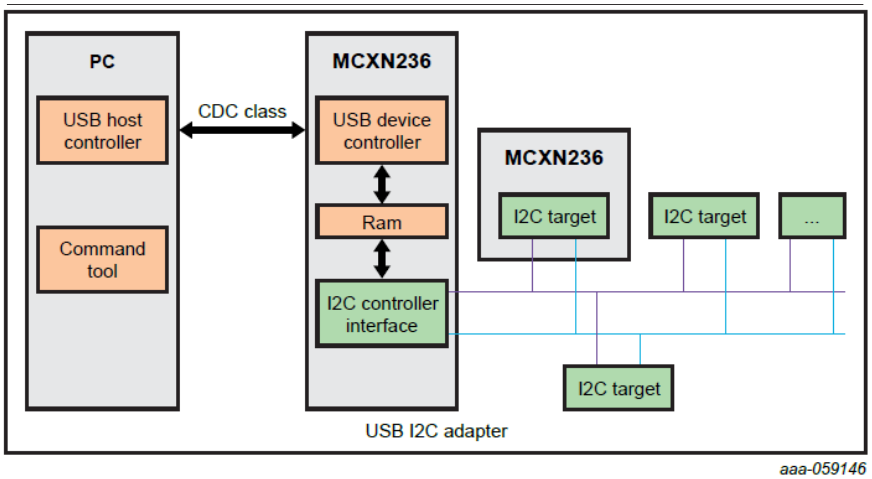


**图1. MCXN236 USB转I2C演示硬件框图**

## 2.1 硬件设置

要执行 MCXN236 USB 转 I2C 演示，需使用两块 FRDM-MCXN236 开发板：

- 一块开发板用作 I2C 控制器
- 另一块开发板用作 I2C 目标设备

此演示使用 P4_0(I2C2_SDA) 和 P4_1(I2C2_SCL) 引脚作为 I2C 功能接口。

关于硬件连接，请参见图2。连接线必须尽可能短。

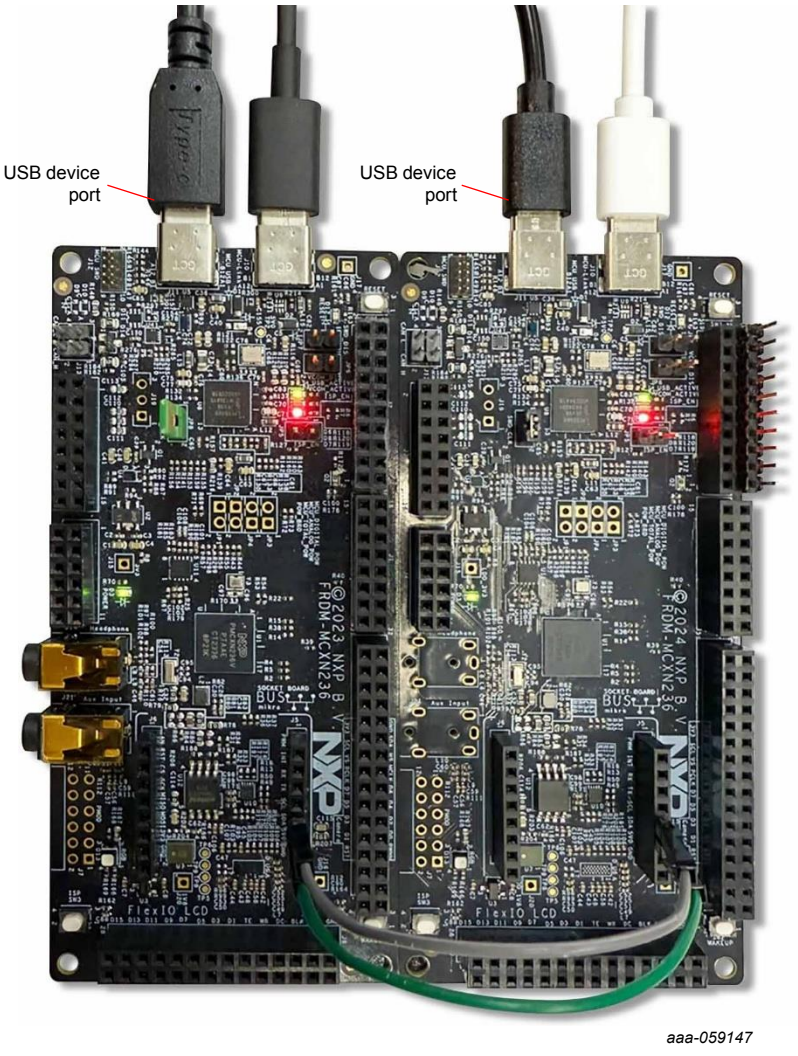


**图2. MCXN236 USB转I2C演示硬件设置**

## 2.2 软件介绍

该MCXN236 USB 转 I2C 的演示提供了以下通过 USB 进行 I2C 配置的命令：

- 第 2.2.1 节 “TargetBufferFill 命令”
- 第 2.2.2 节 “TargetStart 命令”
- 第 2.2.3 节 “Write without register address命令” （控制器直接写入）
- 第 2.2.5 节 “Read without register address命令” （直接读取）
- 第 2.2.4 节 “Write with register address命令”

- 第 2.2.6 节 "Read with register address命令"

要执行相关的 I2C 功能，用户可以使用这些命令。

要测试此演示，请使用支持多字符串发送功能的终端工具。

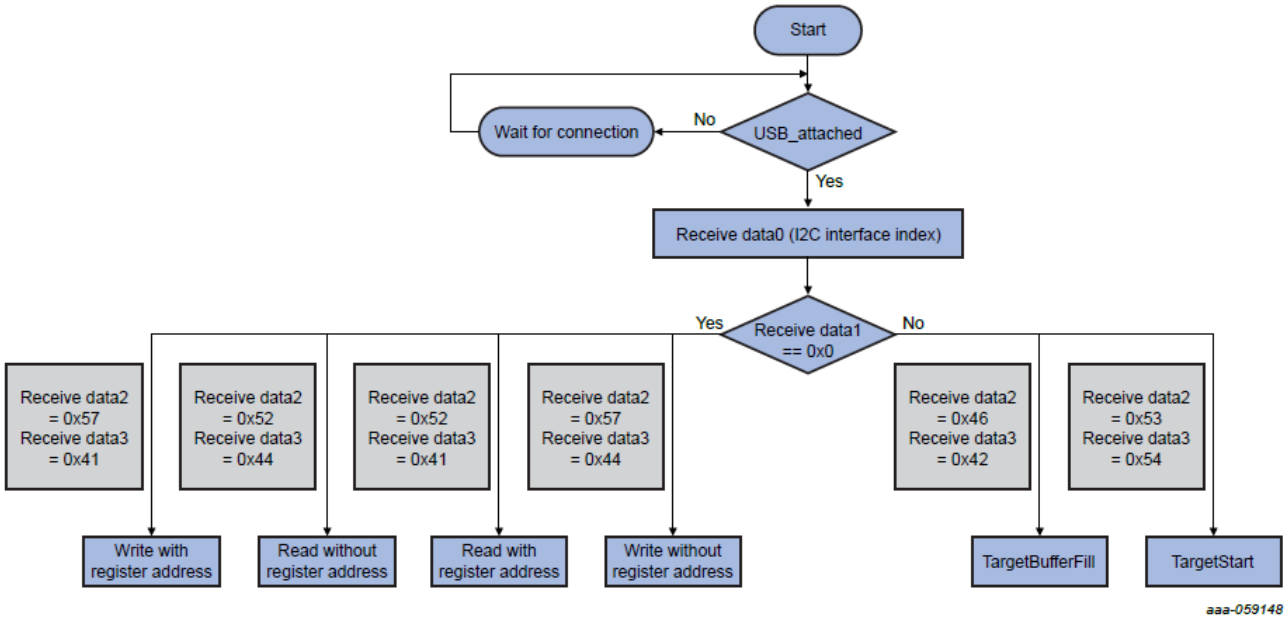


**图3. MCXN236 USB转I2C演示软件流程**

### 2.2.1 TargetBufferFill 命令

`TargetBufferFill`命令用于填充目标发送缓冲区，该缓冲区用于存储要传输到控制器的数据。图4显示了TargetBufferFill 命令的结构（发送ASCII码）。

| Supported commands | | | | | | | |
|---|---|---|---|---|---|---|---|
| TargetBufferFill | | | | | | | |
| USB virtual com send | Interface index | I2C role | F | B | BufferAddress | len | Data(N bytes) |
| | 0x2 | 0x1 | 0x46 | 0x42 | | | |
| USB virtual com receive | | | | | | | |
| | | | | | | | |

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**图4. TargetBufferFill命令结构**

用户可以预先将寄存器地址填充到目标发送缓冲区。

在此演示中，当终端发送`TargetBufferFill`命令时，数据会连同寄存器地址一起被填充到目标发送缓冲区，如图5所示。

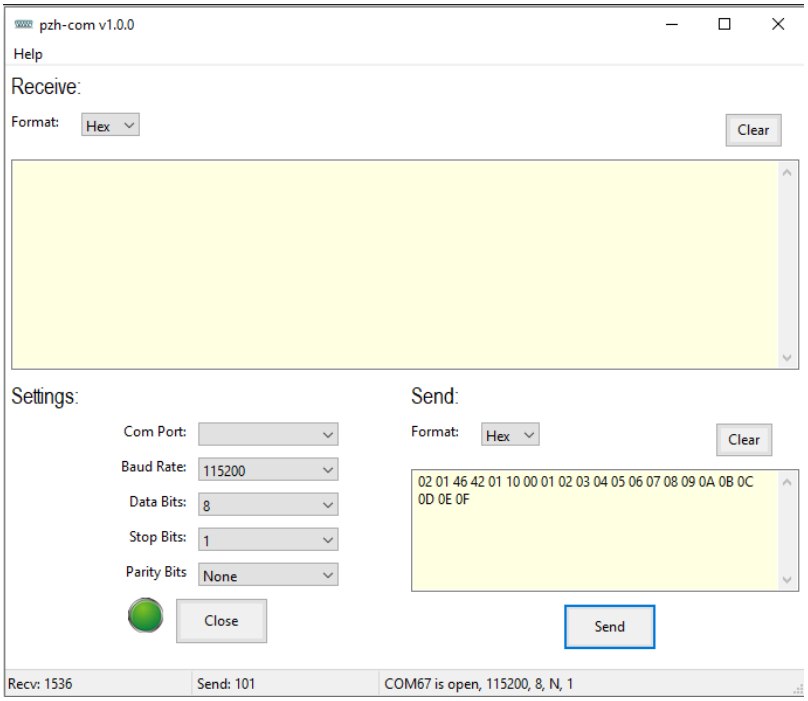


**图5. TargetBufferFill命令终端显示**

### 2.2.2 TargetStart 命令

`TargetStart` 命令用于使目标设备开始传输。图6显示了该命令的结构（发送 ASCII 码）。

| Supported commands | | | | | | |
|---|---|---|---|---|---|---|
| TargetStart | | | | | | |
| USB virtual com send | Interface index | I2C role | T | S | TargetAddress | |
| | 0x2 | 0x1 | 0x53 | 0x54 | | |
| USB virtual com receive | | | | | | |
| | | | | | | |

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**图6. TargetStart命令结构**

在此演示中，当终端发送`TargetStart`命令时，目标设备开始传输数据，请参见图7。

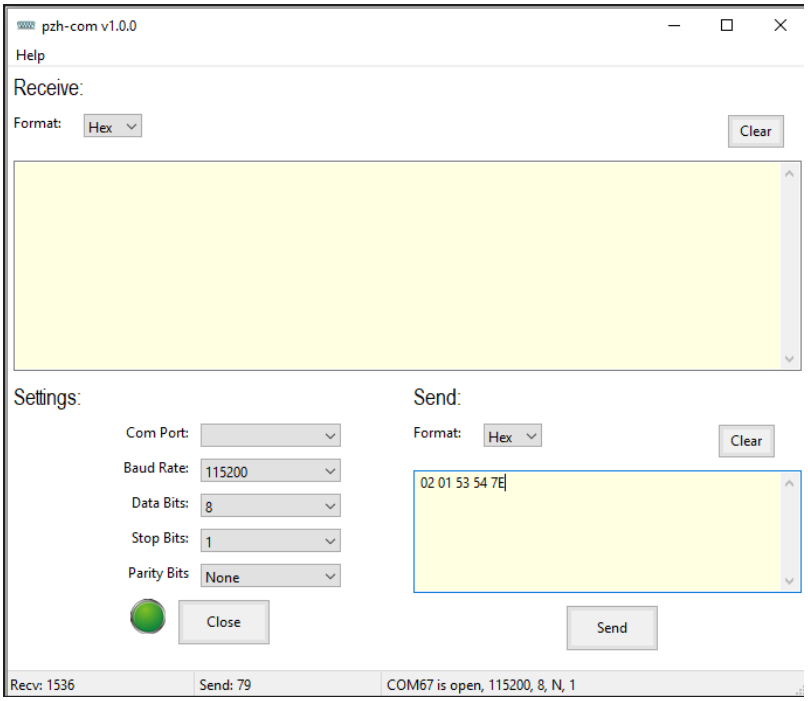


**图7. TargetStart命令终端显示**

### 2.2.3 Write without register address命令

图8显示了`Write without register address`命令的结构（发送ASCII码）。使用此命令时，需要提供一些信息，包括目标地址/数据大小和写入数据。

| Supported commands | | | | | | | |
|---|---|---|---|---|---|---|---|
| Write without register address | | | | | | | |
| USB virtual com send | Interface index | I2C role | W | N | TargetAddress | len | Data(N bytes) |
| | 0x2 | 0x0 | 0x57 | 0x44 | | | |
| USB virtual com receive | O | | | | K | | |
| | 0x4F | | | | 0x4B | | |

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**图8. Write without register address命令结构**

图9显示了终端中`Write without register address`命令的输出（OUT）和输入（IN）结构。命令执行完成后，终端会接收到OK（0x4F，0x4B）字符。

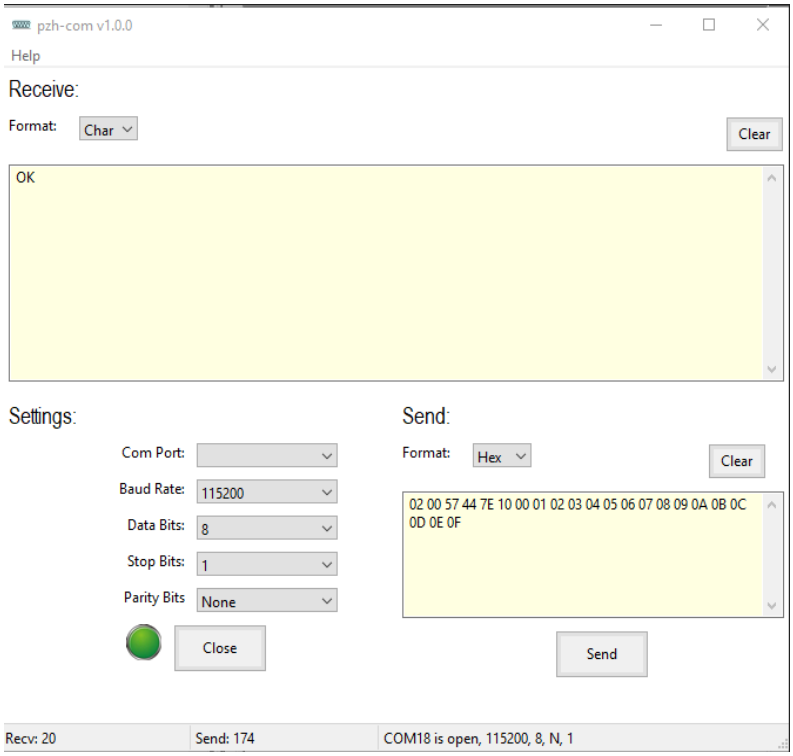


**图9. Write without register address命令终端显示**

图10显示了在控制器通过I2C接口完成数据写入后，目标设备接收到数据。

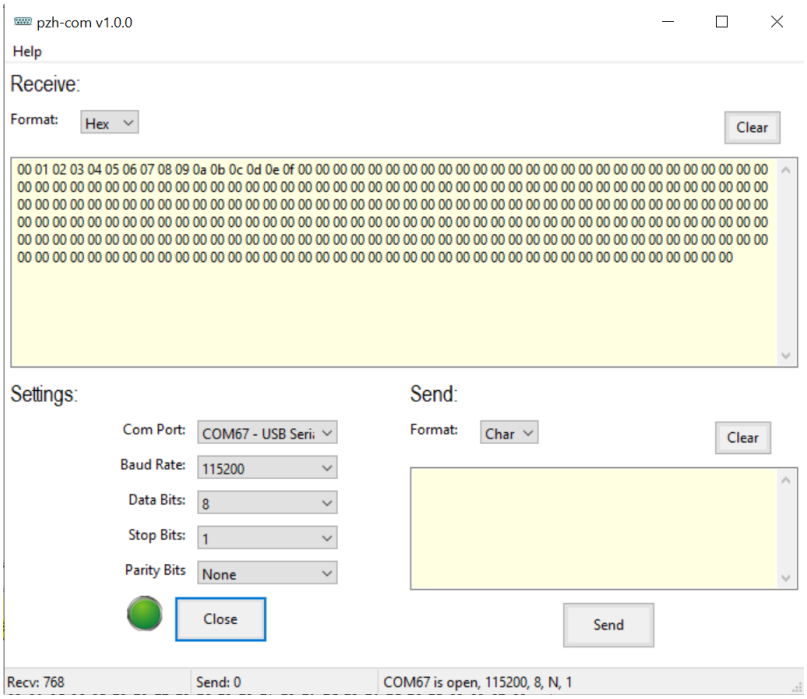


**图10. 目标接收终端显示**

图11显示了`Write without register address`命令处理的I2C时序。

图11. Write without register address命令处理时序

### 2.2.4 Write with register address命令

图12显示了Write with register address命令的结构（发送ASCII码）。使用此命令时，需要提供一些信息，包括目标地址/数据大小和写入数据。

| Supported commands | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Write with register address | | | | | | | | |
| USB virtual com send | Interface index | I2C role | W | A | TargetAddress | RegAddress | len | Data(N bytes) |
| | 0x2 | 0x0 | 0x57 | 0x41 | | | | |
| USB virtual com receive | O | | | | K | | | |
| | 0x4F | | | | 0x4B | | | |

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图12. Write with register address命令结构

图13显示了终端中Write with register address命令的输出（OUT）和输入（IN）结构。命令执行完成后，终端会接收到OK（0x4F，0x4B）字符。

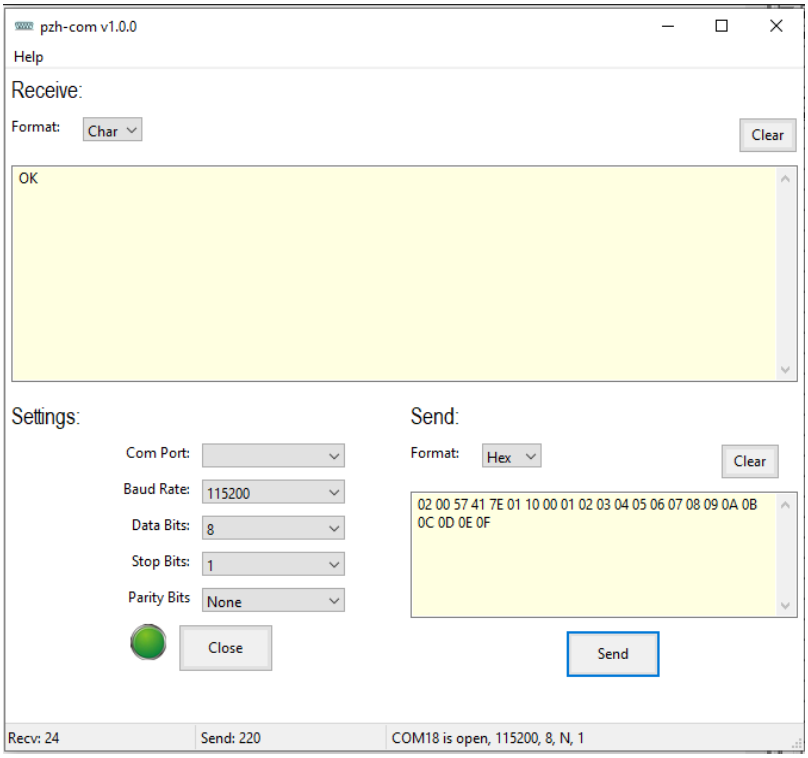


**图13. Write with register address命令终端显示**

图14显示了在控制器通过I2C接口完成数据写入后，目标设备接收到的数据。

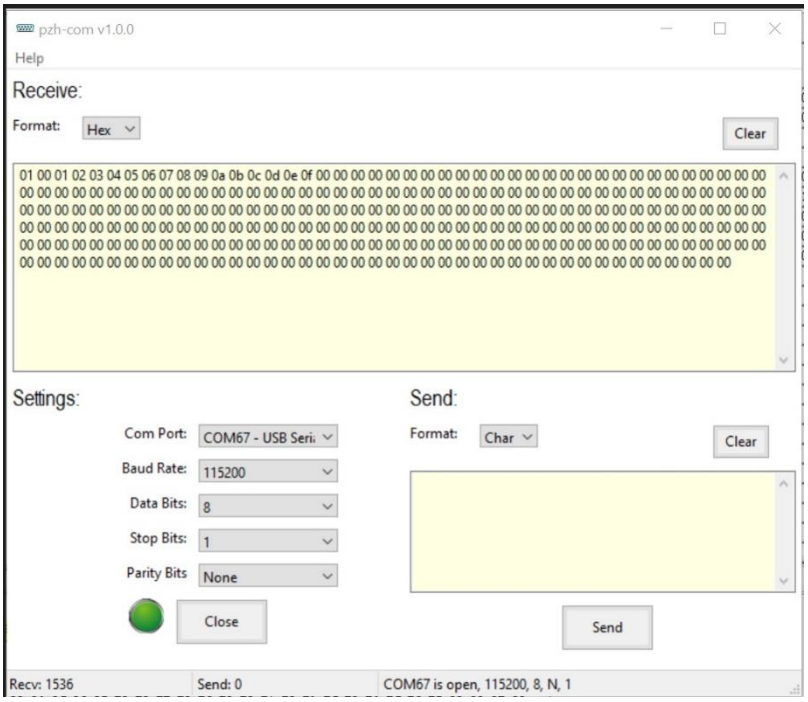


**图14. 目标接收终端显示**

图15显示了`Write with register address`命令处理的I2C时序。

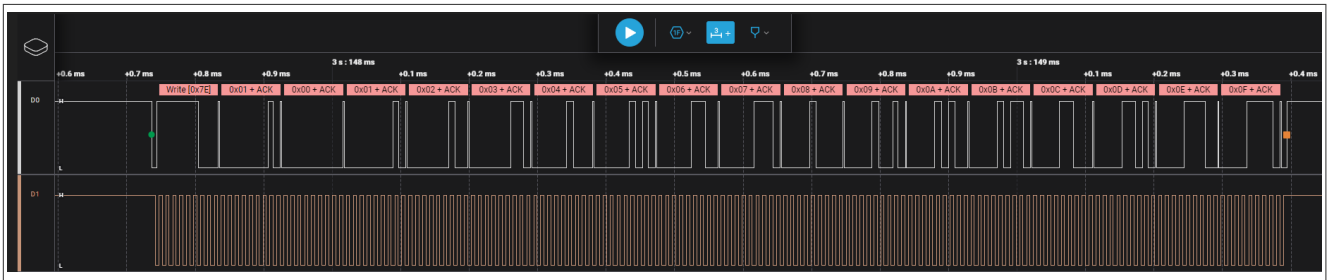


**图15. Write with register address命令处理时序**

### 2.2.5 Read without register address命令

图16显示了`Read without register address`命令的结构（发送ASCII码）。使用此命令时，需要提供一些信息，包括目标地址/数据大小和写入数据。

| Supported commands | | | | | | |
|---|---|---|---|---|---|---|
| Read without register address | | | | | | |
| USB virtual com send | Interface index | I2C role | R | N | TargetAddress | len |
| | 0x2 | 0x0 | 0x52 | 0x44 | | |
| USB virtual com receive | Data(N bytes) | | | | | |
| | | | | | | |

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**图16. Read without register address命令结构**

图17显示了终端中`Read without register address`命令的输出（OUT）和输入（IN）结构。命令执行完成后，终端会接收到目标设备发送的寄存器数据。

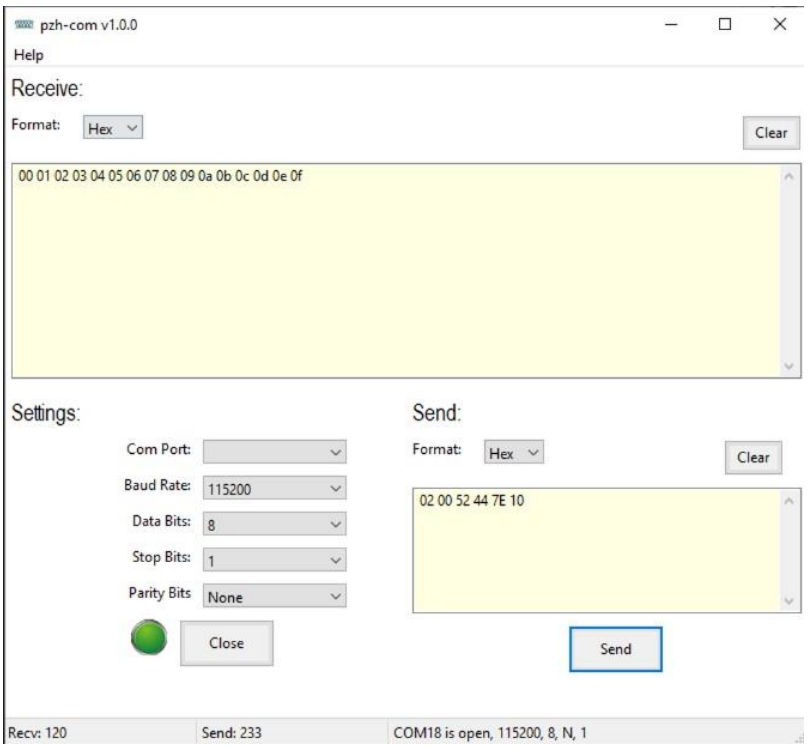


**图17. Read without register address命令终端显示**

图18显示了`Read without register address`命令处理的I2C时序。

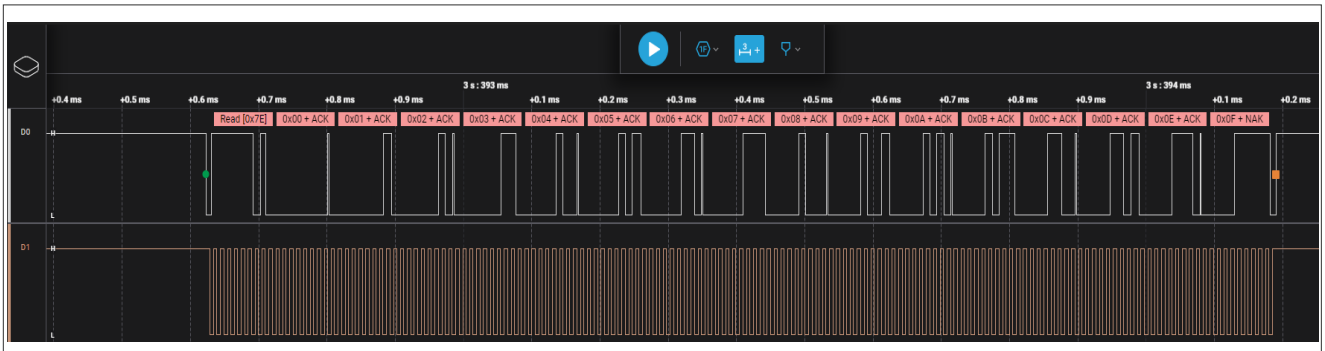

**图18. Read without register address命令处理时序**

### 2.2.6 Read with register address命令

图19显示了`Read with register address`命令的结构（发送ASCII码）。使用此命令时，需要提供一些信息，包括目标地址/数据大小和写入数据。

| Supported commands | | | | | | | |
|---|---|---|---|---|---|---|---|
| Read with register address | | | | | | | |
| USB virtual com send | Interface index | I2C role | R | A | TargetAddress | RegAddress | len |
| | 0x2 | 0x0 | 0x52 | 0x41 | | | |
| USB virtual com receive | Data(N bytes) | | | | | | |
| | | | | | | | |

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**图19. Read with register address命令结构**

图20显示了终端中Read with register address命令的输出（OUT）和输入（IN）结构。命令执行完成后，终端会接收到目标设备发送的寄存器数据。

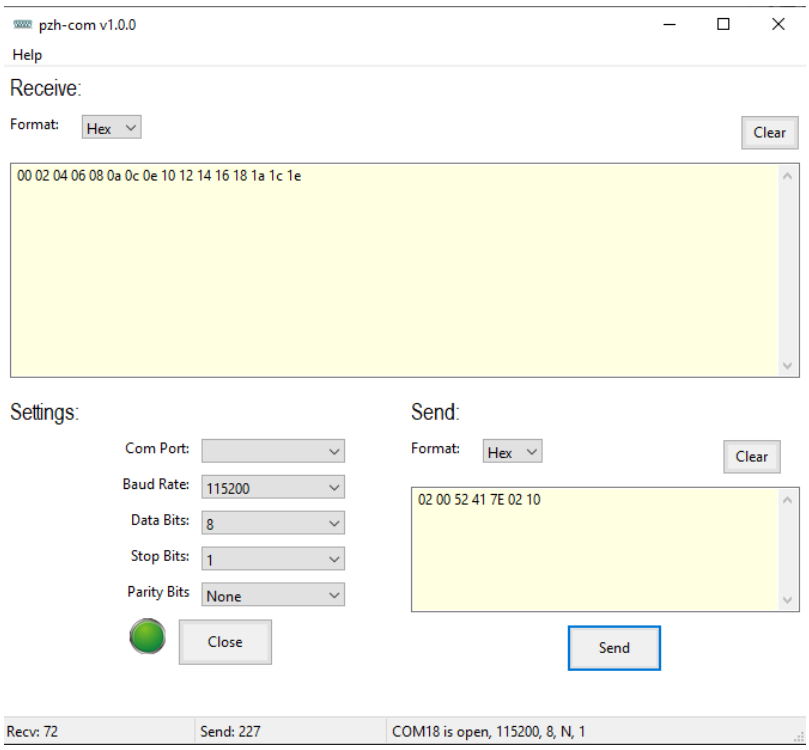


**图20. Read with register address命令终端显示**

图21显示了Read with register address命令处理的I2C时序。

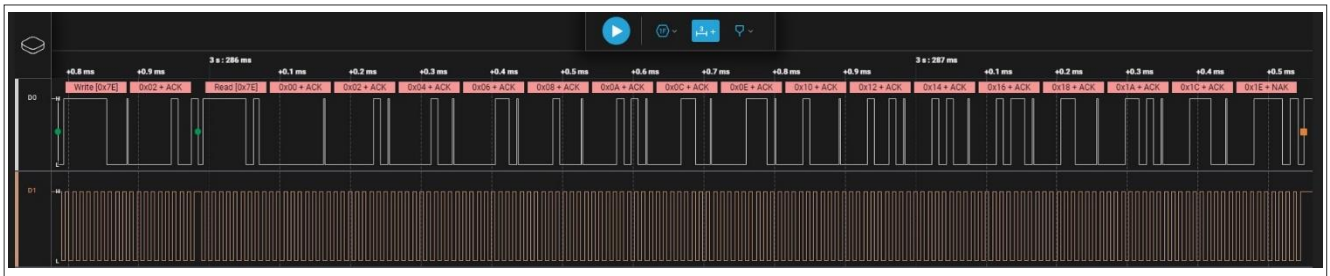

**图21. Read with register address命令处理时序**

# 3 修订历史

表1总结了本文档的修订情况。

**表1. 修订历史**

| 文档ID | 发布日期 | 描述 |
|---|---|---|
| AN14565 v.1.0 | 2025年1月30日 | 首次公开发布 |

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