

# AN12350

## LPC802 双 IO 电源供电和电平转换

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应用笔记

### 1 引言

LPC802 ( TSSOP20 ) 和 LPC804 ( TSSOP24 ) 配备了新的功能，称为双 I/O 电源芯片。该功能使芯片具有两个电源域：VDDio 和 VDD。封装一侧的引脚由 VDDIO 提供电源，另一侧的引脚由 VDD 提供电源。此功能允许 VDD 和 VDDio 提供不同的电压，使得器件可将信号从一个片外电压域转换至另一个电压域。

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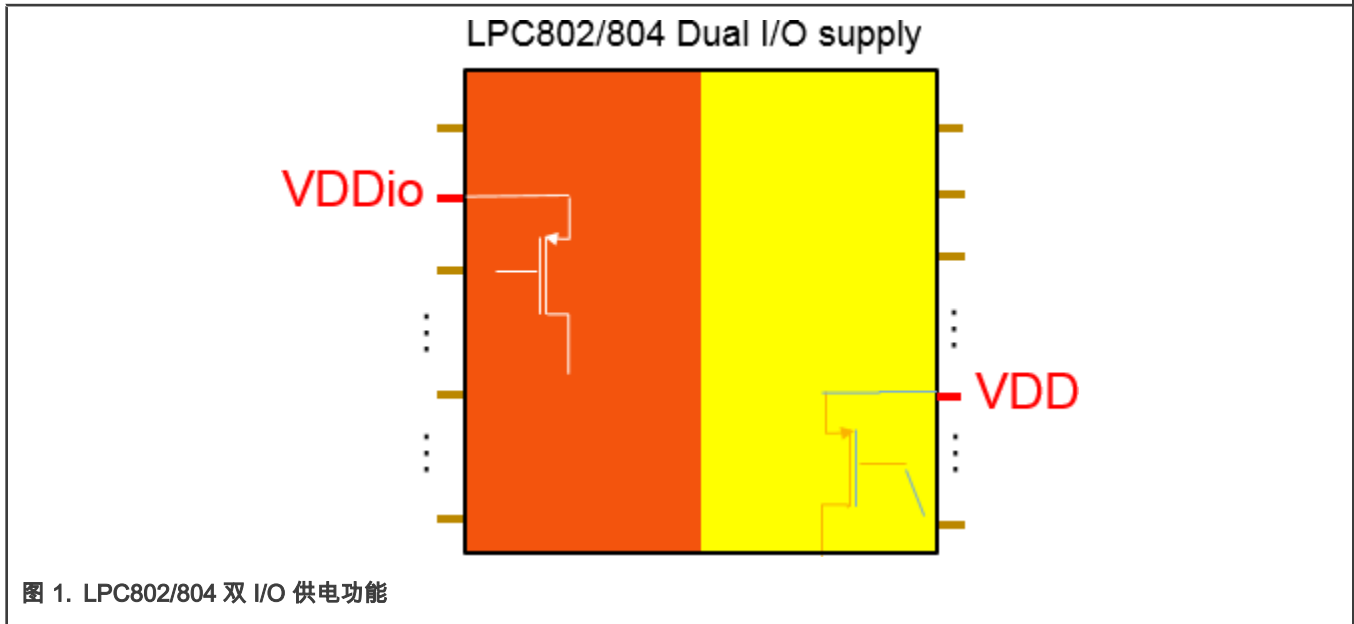


图 1. LPC802/804 双 I/O 供电功能

用户在一个电压域中最多可以选择两个引脚：In0，In1，在另一个电压域中又可以选择两个引脚：Out0，Out1。使用开关矩阵对它们进行路由连接：In0 到 Out0，In1 到 Out1。引脚 In(x)上的一个信号能够直接转移到引脚 Out(x)，而无需任何固件干预，电平就会发生变化。唯一需要做的是：用户定义输入和输出方向。

#### 1.1 引脚特性

双电源功能仅适用于如下特定型号的器件：

- LPC802M011JDH20
- LPC804M111JDH24

相应的引脚电压值和所使用的电源域电压值相一致。

- 对于 VDDio 侧的引脚：



V <sub>O</sub>	output voltage	output active		0	-	V <sub>DDIO</sub>	V
V <sub>IH</sub>	HIGH-level input voltage			0.7V <sub>DDIO</sub>	-	-	V
V <sub>IL</sub>	LOW-level input voltage			-	-	0.3V <sub>DDIO</sub>	V
V <sub>hys</sub>	hysteresis voltage			-	0.4	-	V
V <sub>OH</sub>	HIGH-level output voltage	I <sub>OH</sub> = 4 mA; 2.5 V ≤ V <sub>DD</sub> ≤ 3.6 V		V <sub>DDIO</sub> - 0.4	-	-	V
		I <sub>OH</sub> = 3 mA; 1.71 V ≤ V <sub>DD</sub> < 2.5 V		V <sub>DDIO</sub> - 0.5	-	-	V

**图 2. VDDio 侧的引脚规格**

- 对于 VDD 侧的引脚：

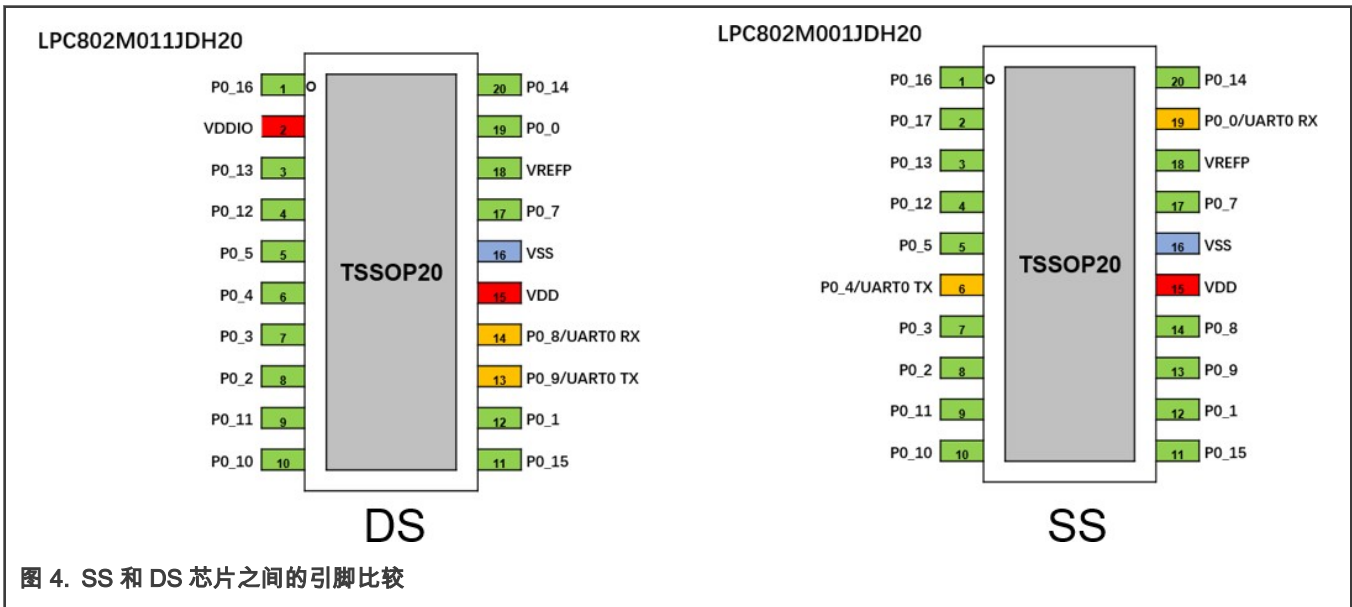
V <sub>O</sub>	output voltage	output active		0	-	V <sub>DD</sub>	V
V <sub>IH</sub>	HIGH-level input voltage			0.7V <sub>DD</sub>	-	-	V
V <sub>IL</sub>	LOW-level input voltage			-	-	0.3V <sub>DD</sub>	V
V <sub>hys</sub>	hysteresis voltage			-	0.4	-	V
V <sub>OH</sub>	HIGH-level output voltage	I <sub>OH</sub> = 4 mA; 2.5 V ≤ V <sub>DD</sub> ≤ 3.6 V		V <sub>DD</sub> - 0.4	-	-	V
		I <sub>OH</sub> = 3 mA; 1.71 V ≤ V <sub>DD</sub> < 2.5 V		V <sub>DD</sub> - 0.5	-	-	V

**图 3. VDD 侧的引脚规格**

ADC 电源域连接到 VDD 域。对于 ADC 操作，VDD 电压必须高于 2.5 V。

## 1.2 引脚比较

单电源（SS）芯片和双电源（DS）芯片分配给引脚的某些功能有所不同，请参阅图 4。



在 DS 芯片中，pin2 用作 VDDio，而在 SS 芯片中，pin2 用作 PIO0\_17（红色标记的引脚）。

DS/SS 芯片的 ISP USART 引脚分配不同（引脚标记为黄色）。

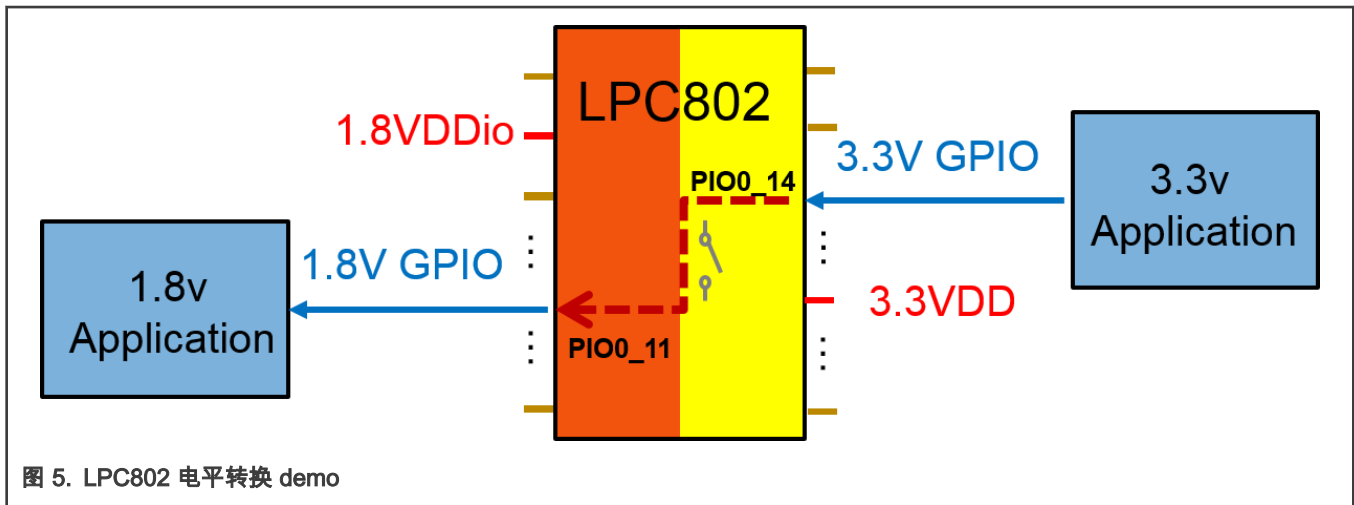
## 2 有关电平转换的示例

## 2.1 示例介绍

为了在工作于不同工作电压的应用之间进行通信，需要在它们之间添加一个电平转换芯片。在本示例中，LPC802 用于在两个电压应用之间进行信号电平转换，其中 VDD 侧的 GPIO ( PIO0\_14 ) 连接到 3.3 V 应用，而 VDDio 侧的 GPIO ( PIO0\_11 ) 连接到 1.8 V 应用。在开始通信之前，LPC802 使用开关矩阵将 PIO0\_14 配置为电平转换 input0-In0，将 PIO0\_11 配置为电平转换 output0-Out0。配置后，在 In0 上输入的任何 3.3 V 逻辑电平信号都会自动传递到 Out0，且逻辑电平更改为 1.8 V，而无需软件干预。

示例使用 SWM 寄存器 PINASSIGN 6 将 PIO0\_14 配置为电平转换 In0，将 PIO0\_11 配置为电平转换 Out0。

为了方便在一块板上进行演示，此 demo 使用 GPIO0\_9 输出 3.3 V 方波，然后将 PIO0\_9 连接到 PIO0\_14 ( In1 )，请参见图 5。



## 2.2 示例硬件

### 2.2.1 电路板

LPCXpresso802 开发板 (OM40000)。

### 2.2.2 调试器

开发板自带的板载调试器，提供 CMSIS-DAP 接口。

### 2.2.3 电路板设置

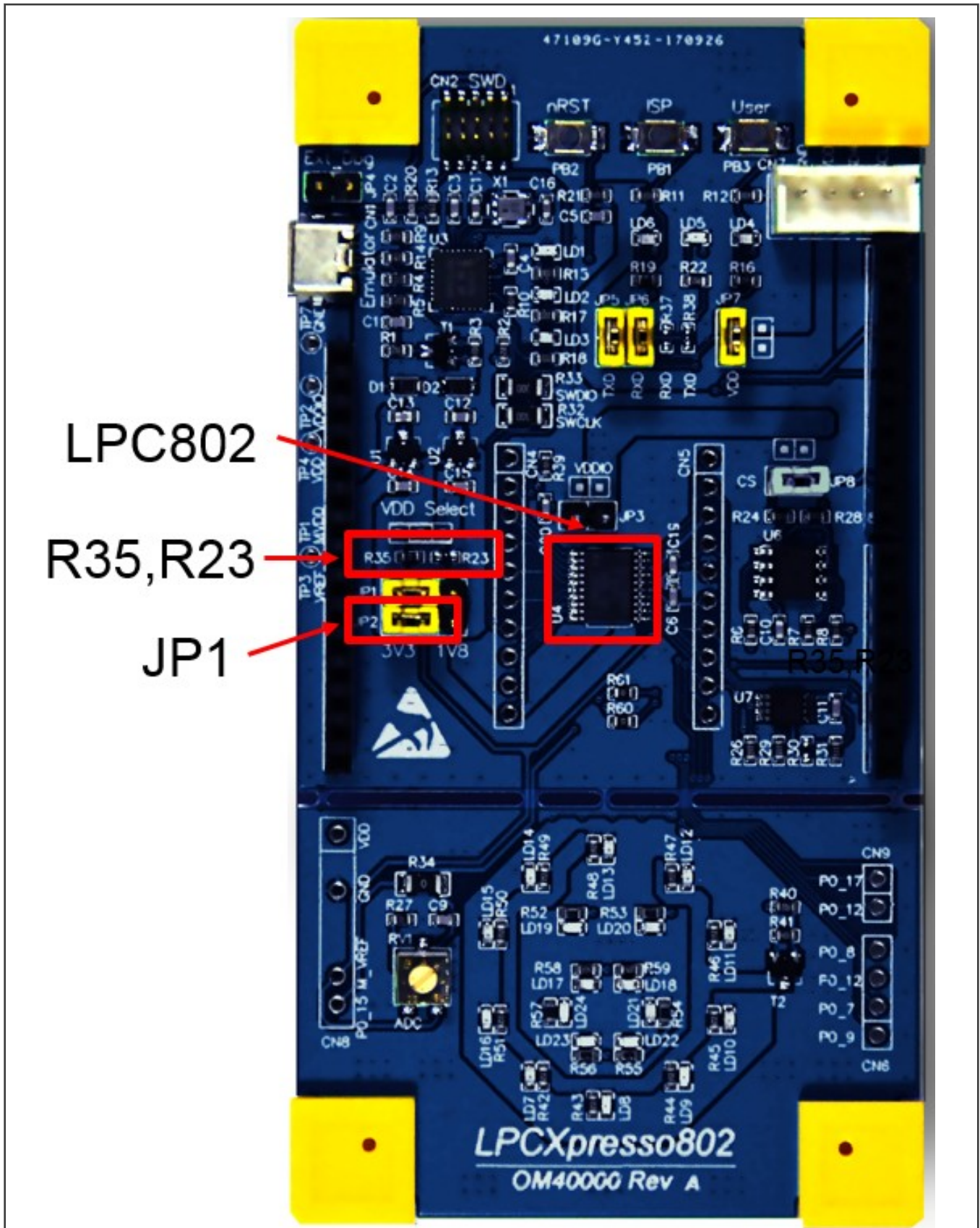


图 6. 电路板设置

- JP1 必须连接到 3.3 V 端，否则 UART 不会输出正确的信息。
- 用 LPC802M011JDH20 (DS 芯片) 替换 LPC802M001JDH20 (SS 芯片)，使芯片具备双 I/O 电源功能。
- 移除 R35，放上 R23 (0 欧姆)，使 VDDIO = 1.8 V。

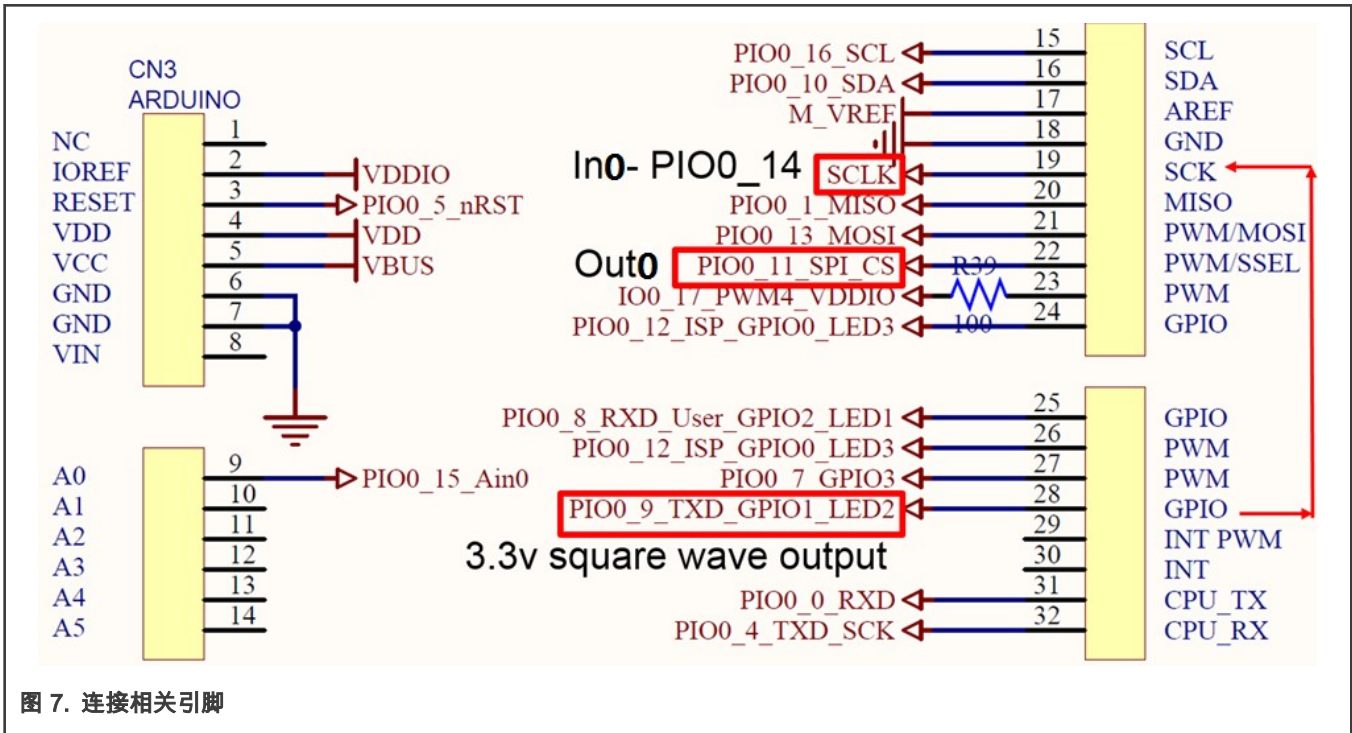


图 7. 连接相关引脚

在 arduino 的端口 CN3 上将 PIO0\_9 连接到 PIO0\_14。

### 2.3 示例软件

调试使用的 IDE:

- IAR embedded Workbench 8.22.2
- Keil MDK 5.24a
- MCUXpresso10.2.0

### 2.4 演示过程

#### 2.4.1 步骤

1. 用 micro USB 电缆连接 PC 主机和 LPCXpresso802 板上 CMSIS DAP 端口 CN1。
2. 在 PC 上打开具有以下设置的串口调试助手 (例如 Tera Term) :
  - 9600 波特率
  - 八个数据位
  - 无奇偶校验位
  - 一位停止位
  - 无流量控制
3. 编译并将代码下载到目标板。
4. 在 IDE 中启动调试器，开始运行相应代码。

5. 在调试控制台上监视信息。
6. 使用示波器观察引脚 PIO0\_14\_SCLK 上的 3.3 V 输入方波和引脚 PIO0\_11 上的 1.8 V 输出方波。

## 2.4.2 示例结果

运行示例之后，PC 中的串行终端将显示信息，如 图 8 所示。

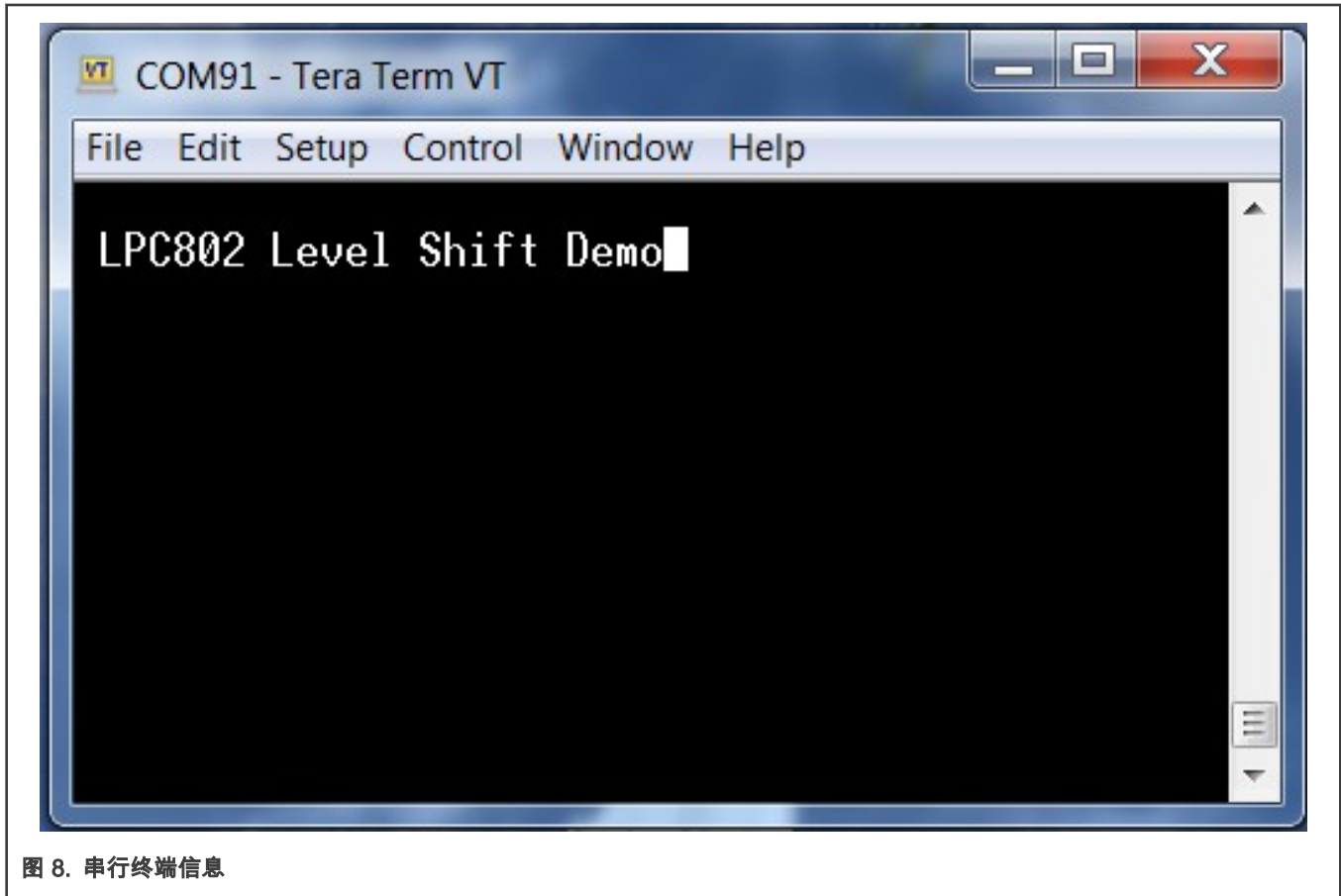


图 8. 串行终端信息

使用示波器观察 PIO0\_14\_SCLK (VDD 域，电平转换输入) 和 PIO0\_11 (VDDio 域，电平转换输出)，可以观察到方波电平从 3.3 V 变为 1.8 V。

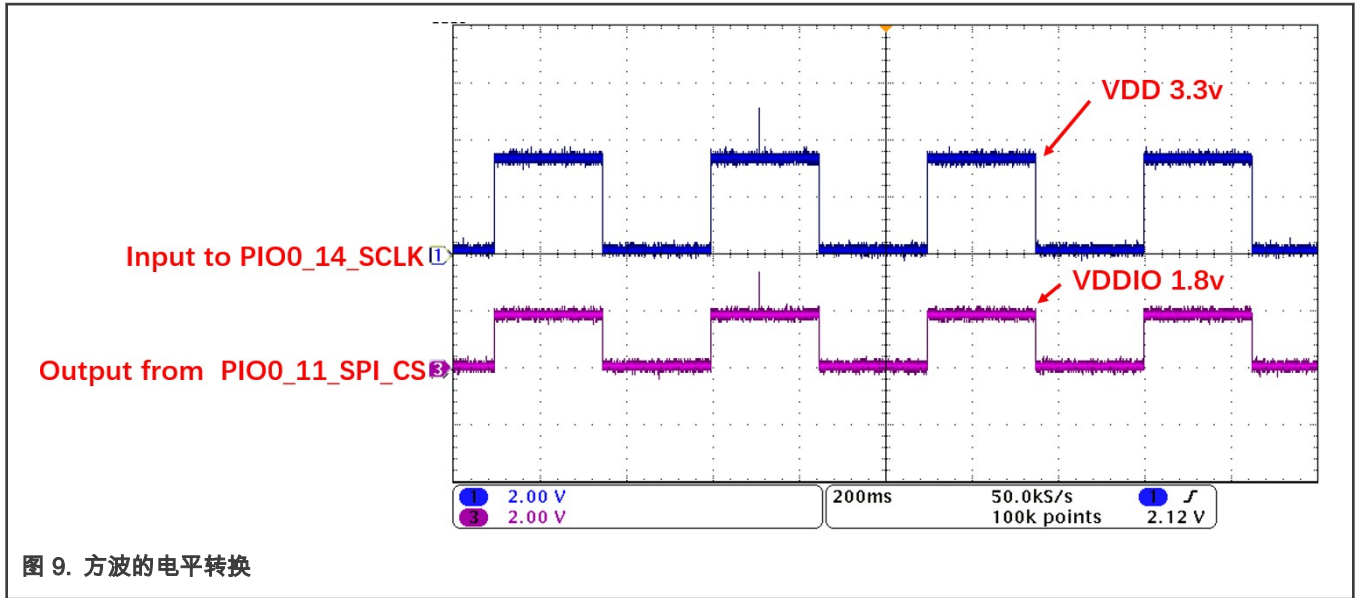


图 9. 方波的电平转换

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