

EVM User's Guide: AWRL6844EVM IWRL6844EVM

AWRL6844/IWRL6844 评估模块



说明

德州仪器 (TI) 的 xWRL6844EVM 是一款用于 xWRL6844 毫米雷达波传感器的易用型评估模块。xWRL6844EVM 支持独立运行以及直接连接到 DCA1000EVM 进行原始 ADC 采集和离线信号处理开发。此 EVM 包含开始为芯片上 DSP、硬件加速器和低功耗 ARM® Cortex® - R5F 控制器开发软件所需的一切资源。除了用于编程和调试的板载仿真功能，该 EVM 还包括用于快速集成简单用户界面的板载按钮和 LED。

入门

有关入门指南和运行开箱即用演示的信息，请参阅 [SWRU636](#)

特性

- 57GHz 至 64GHz 毫米波雷达传感器
- 片上 C66x DSP、ARM Cortex-R5F 控制器和硬件加速器 (HWA 1.2)
- 具有高射频性能 RO3003 PCB 基板的板载四发送和四接收天线 (4TX/4RX)
- 基于 TPS650365x 的电源管理拓扑
- 与 DCA1000 直接连接，用于调试和原始 ADC 数据采集。
- 2 个板载 CAN-FD 收发器和 1 个板载 LIN PHY 收发器



图 1-1. xWRL6844EVM

1 xWRL6844EVM 修订历史记录

表 1-1. xWRL6844EVM 修订历史记录

修订版本	变更	注释
Rev A1		用于启用看门狗的 B0 版本 PMIC
Rev A Assy Rev A12	R87 DNP	用于启用看门狗的 B0 版本 PMIC。移除了 R87 以延长 PMIC 关断窗口时间
Rev A Assy Rev A23	PMIC 硅变化	用于禁用看门狗的 B1 版本 PMIC

- 在此 EVM 版本中启用了 PMIC 看门狗。因此、如果未及时禁用/维护看门狗，PMIC 会在 EVM 加电后每 13 分钟向雷达器件发出一次 nRESET 信号
- 在此 EVM 版本中启用 PMIC 看门狗，R87 被标记为 DNP。这样可确保发送到雷达器件的 nRESET 信号之间没有连接。雷达器件不会每 13 分钟复位一次，但 PMIC 会在加电后每 3.25 小时关断一次
- 在此 EVM 版本中禁用 PMIC 看门狗，R87 被标记为 DNP。不会向雷达器件发送 nRESET 信号。

备注

- 如果用户想要禁用 PMIC WD，请参阅
“`mmwave_l_sdk_06_xx_xx_xx\examples\mmw_demo\mmwave_demo\source\mmwave_demo.c`” 文件中的 “Pmic_wdgDisable” 调用方函数。

2 评估模块概述

2.1 引言

xWRL6844 毫米波雷达传感器是一款能够在 57GHz 至 64GHz 频段中运行且基于 FMCW 雷达技术的集成式单芯片毫米波传感器。xWRL6844 专为汽车和工业应用领域的低功耗、自监控、超精确雷达系统而设计。xWRL6844 EVM 通过 XDS110 USB 接口提供点云数据访问，并在与 DCA1000 开发套件连接时提供原始 ADC 数据。xWRL6844EVM 由多种毫米波工具、演示和软件提供支持，包括 [MMWAVE-L-SDK](#) 和 TI 的 Code Composer Studio™ (使用板载 XDS110 仿真器)。xWRL6844EVM 还可以通过安装 LaunchPad BoosterPack 连接器与 MCU LaunchPad™ 开发套件生态系统连接。

2.2 主要特性

- 板载蚀刻天线 (4TX、4RX) 具有宽 4GHz 带宽 (57GHz 至 61GHz)，具有高射频性能 Rogers RO3003 PCB 基板
- 通过用于板载 64 位 QSPI 闪存编程的串行端口，进行基于 XDS110 的 JTAG 仿真
- UART 转 USB 调试端口，用于通过 FT4232H 实现终端访问
- 用于调试、SPI、I2C 和 LVDS 的 60 引脚高密度 (HD) 连接器，可直接对接到 DCA1000 开发套件。
- 2 个板载 CAN-FD 收发器和 1 个板载 LIN PHY 收发器
- EVM 在使用直流插孔为板供电时支持输入电压范围 (5V 至 12V)
- 5V USB 供电的独立运行模式
- 板载 INA228A 电流传感器可用于测量雷达器件各电源轨的功耗

2.3 套件内容

xWRL6844EVM 套件包括：

- xWRL6844EVM 评估板
- Micro USB 电缆
- 快速入门指南
- 用于安装 EVM 的螺钉、垫片和螺母

2.4 规格

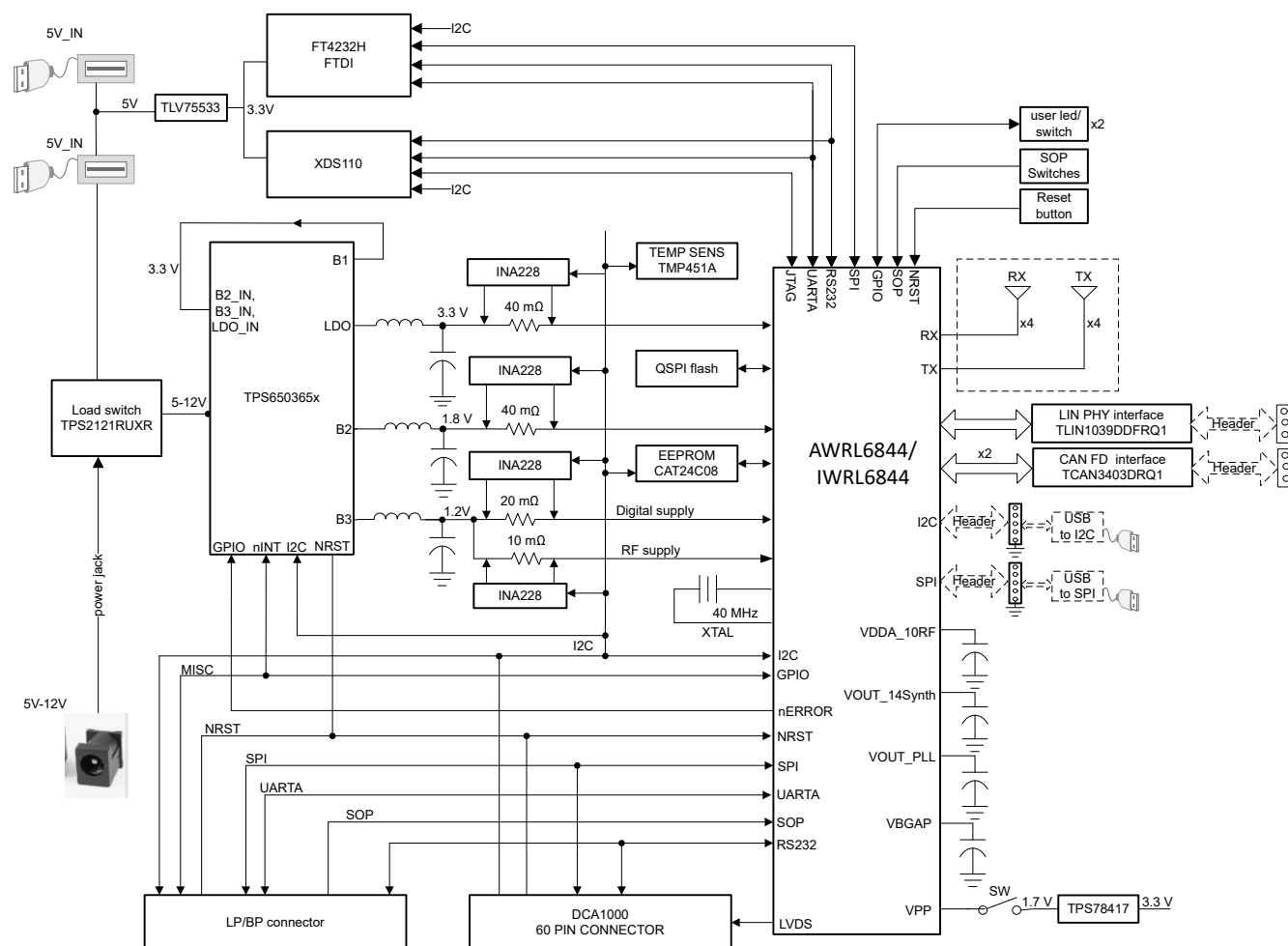


图 2-1. 功能方框图

图 2-1 显示了 xWRL6844EVM 的功能方框图。该 EVM 包含 TI 毫米波雷达系统的所有基本组件：PMIC、SFLASH、SOP 配置、电源滤波器、毫米波雷达传感器、USB/UART 转换器和一个用于连接 DCA1000 的 60 引脚 Samtec 连接器。xWRL6844EVM 还配备一个可连接到 TI LaunchPad 板的 Launch Pad Booster Pack 连接器。

2.5 器件信息

表 2-1 中的文档提供了有关 xWRL6844 EVM 组件中使用的德州仪器 (TI) 器件的信息。本用户指南可从 TI 网站上获得，文献编号为 SWRU630。附加到文献编号的任何字母对应于撰写本文档时已有的最新文档修订版。

表 2-1. 相关器件文档

EVM 上使用的器件	数据表
TMP451-Q1	TMP451AQDQFRQ1
TPDE004D	TPDE004DRYR
TPS2121	TPS2121
TPS65036501	TPS650365-Q1
TLV75533PDRV	TLV755P
TPS78417QDBVRQ1	TPS784-Q1
INA228A	INA228AIDGST
TS3A5018RSVR	TS3A5018
TS3A44159PWR	TS3A44159
TS3A24157DGSR	TS3A24157
TS3A27518EPWR	TS3A27518E
TM4C1294NCPDTT3	TM4C1294NCPDT
TCAN3403DRQ1	TCAN3403-Q1
TLIN1039DDFRQ1	TLIN1039-Q1
SN74LVC1G11DSFR	SN74LVC1G11D

3 硬件



xWRL6844EVM 包含安装在高频性能 ROGERS3003 PCB 基板上的四个接收器和四个发送器 (具有宽视野天线) 。

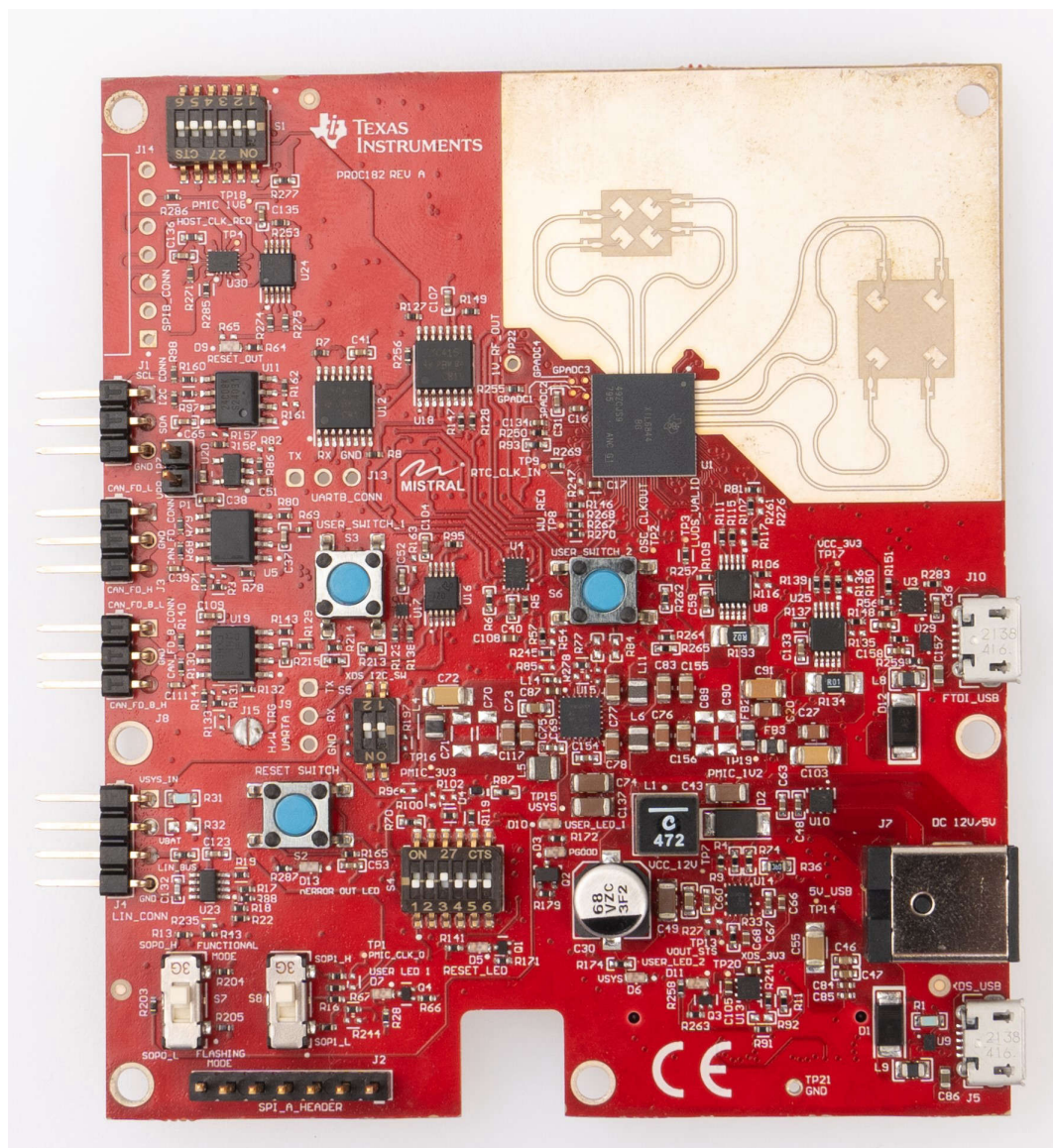


图 3-1. xWRL6844EVM (顶视图)

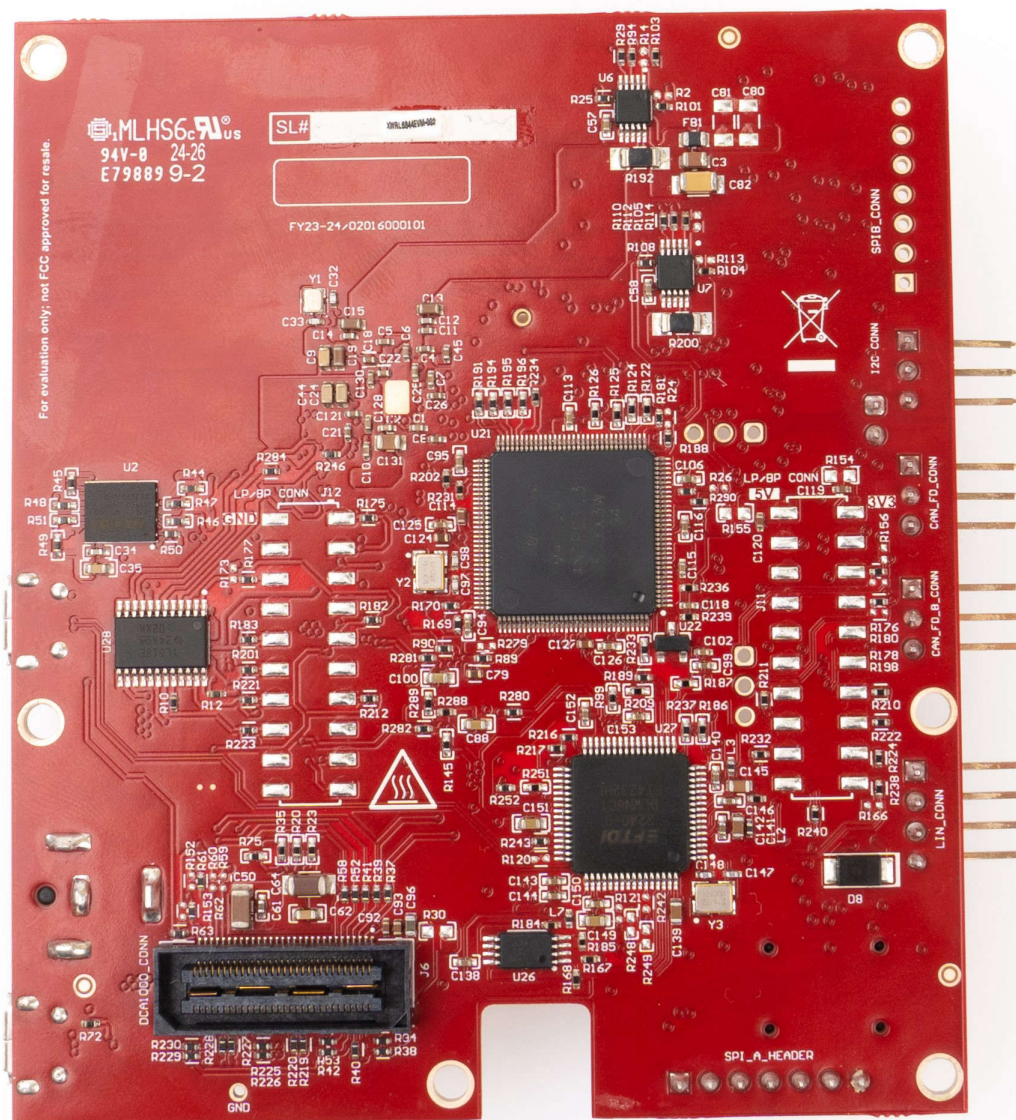


图 3-2. xWRL6844EVM (底视图)

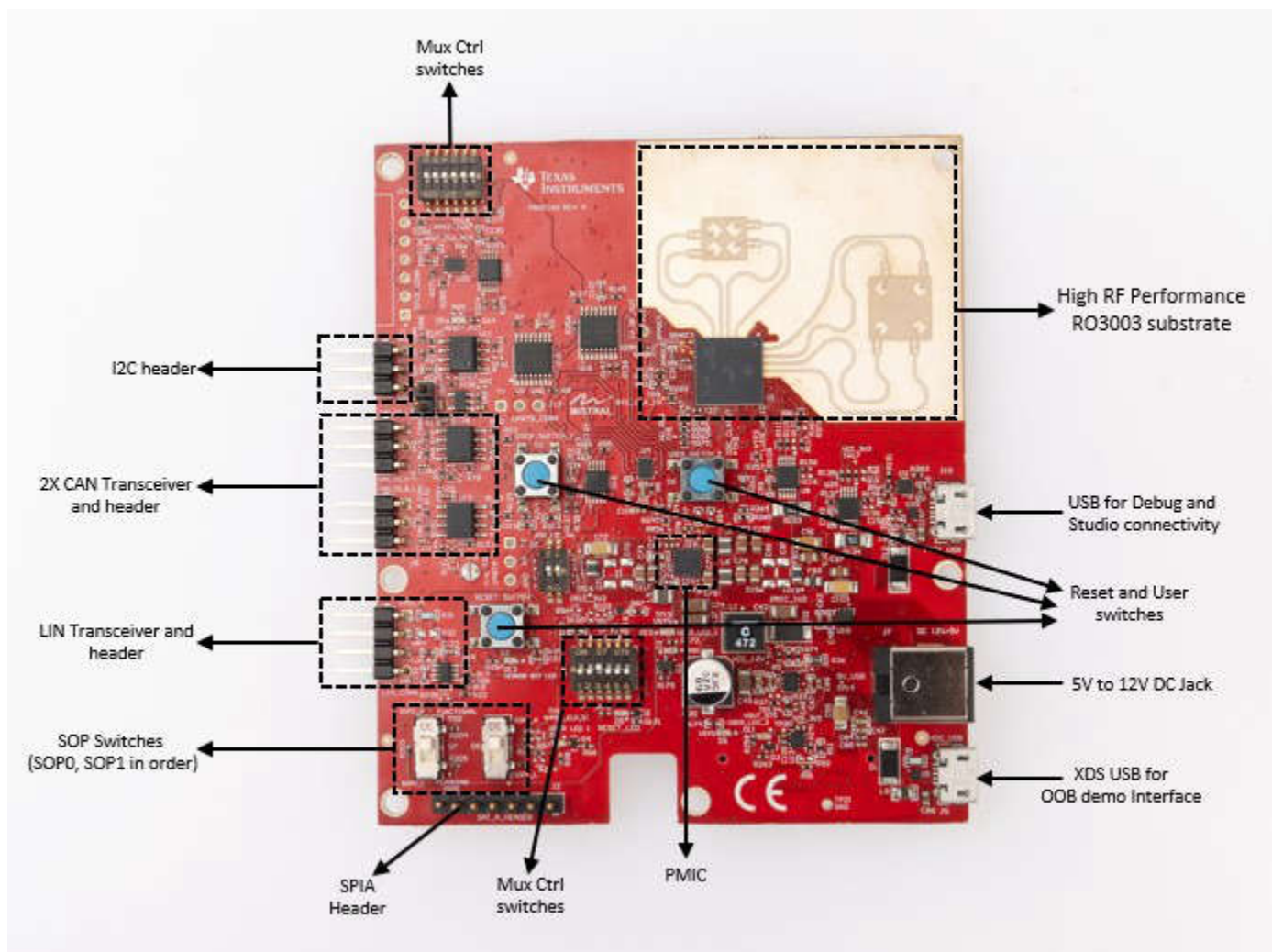


图 3-3. EVM 的显著特性 (顶面)

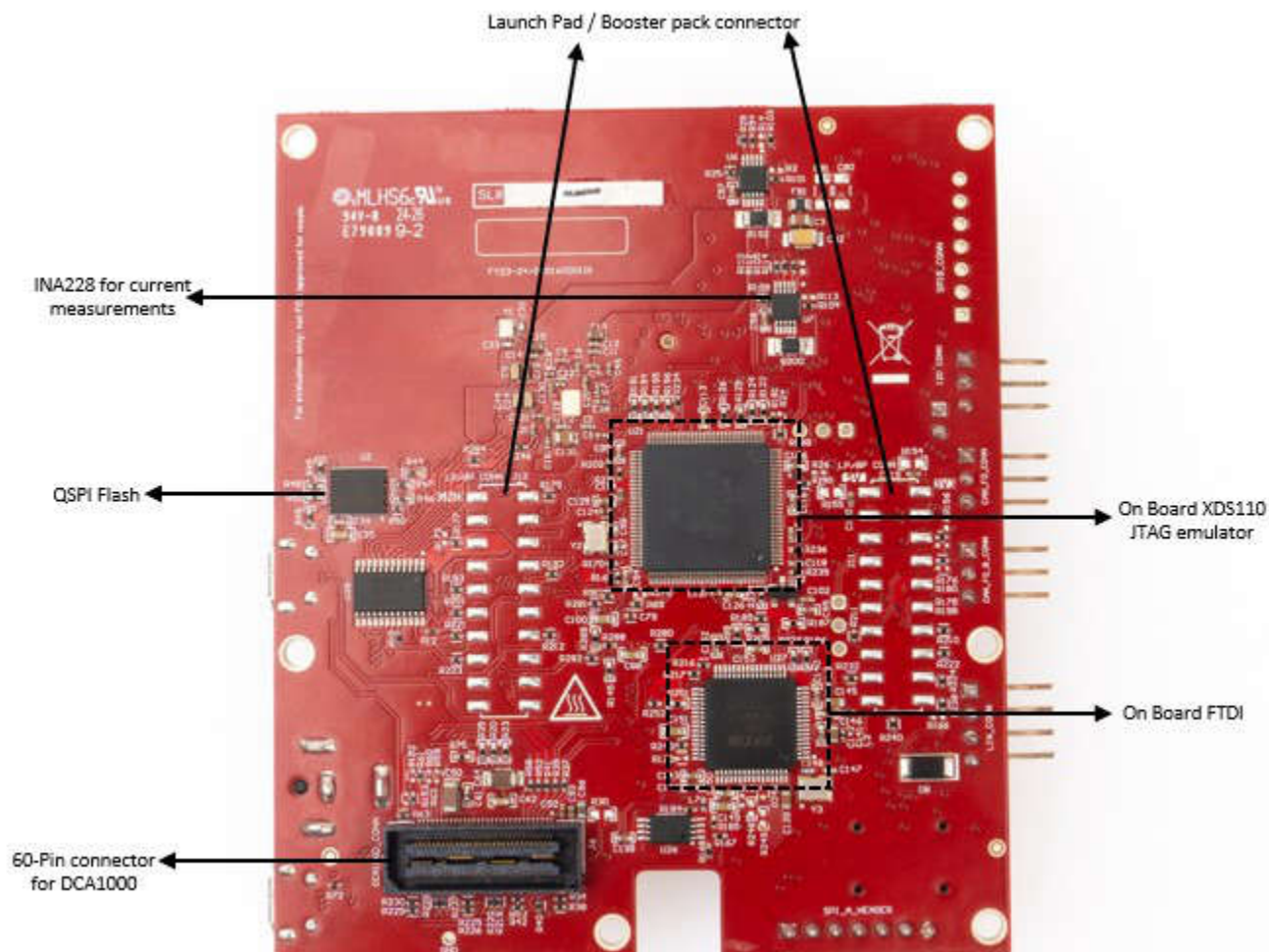


图 3-4. EVM 的显著特性 (底面)

3.1 xWRL6844EVM 天线

xWRL6844EVM 的 PCB 上包含四个发送器和四个接收器基于 Rogers RO3003 的天线。图 3-5 展示了天线配置。

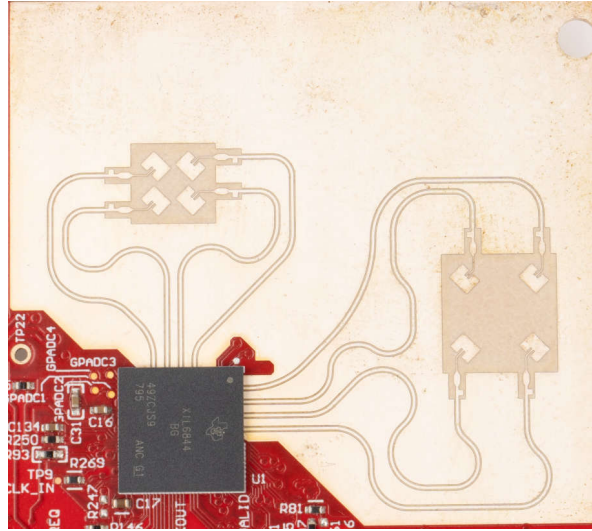


图 3-5. EVM 的 Tx 和 Rx 天线

备注

xWRL6844EVM 在每个天线元件上有大约 5-6dBi 的天线增益。

3.1.1 PCB 材料

此 PCB 使用的介电材料为 5mil 厚的 ROGERS RO3003，其中天线和传输线使用轧制铜，其余层使用 370HR。

Type	Layer	Total Cu Thickness		Final Thickness		Construction
		μm	mils	μm	mils	
Solder Mask				20	0,8	IMM SILVER
	1	40	1,6	23	0,9	Plating Cu (Total Cu final minimum = 34μm)
				17	0,7	Copper RA
	2	35	1,4	127	5,0	Core Rogers RO3003 RA
				35	1,4	Copper RA
	3	35	1,4	140	5,5	Prepreg 370HR
				35	1,4	Copper
	4	35	1,4	254	10,0	Core 370HR
				35	1,4	Copper
	5	35	1,4	140	5,5	Prepreg 370HR
				35	1,4	Copper
	6	35	1,4	254	10,0	Core 370HR
				35	1,4	Copper
	7	35	1,4	140	5,5	Prepreg 370HR
				35	1,4	Copper
	8	40	1,6	127	5,0	Core 370HR
				17	0,7	Copper
				23	0,9	Plating Cu (Total Cu final minimum = 34μm)
Solder Mask				20	0,8	IMM SILVER
Total Thickness :				1,512	mm	± 10%
				0,0595	(inch)	

3.1.1.1 发送器和接收器虚拟阵列

图 3-6 中显示的发送器和接收器天线位置形成一个包含十六个发送器和接收器对的虚拟阵列。这样便在可方位角和仰角平面上更精细地进行物体检测，角分辨率为 29° 。接收器天线在方位角和仰角平面上的间距均为 $D(\lambda/2)$ 。发送器天线在方位角和仰角平面上的间距均为 $D(\lambda)$ 。

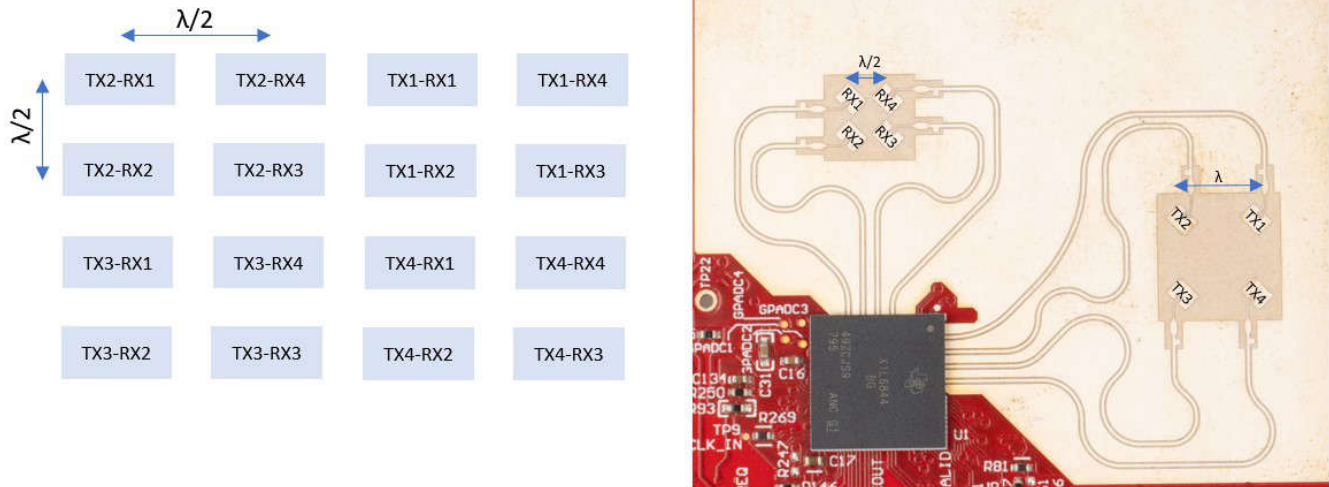


图 3-6. 关于 TX 和 RX 的天线虚拟阵列

下方的图 3-7 和图 3-8 显示了相对于方位角和仰角平面的天线辐射图。两图显示了 TX1、TX2、TX3、TX4 以及 RX1、RX2、RX3 和 RX4 的辐射图。所有测量都是同时针对 Tx 和 Rx 进行的。因此，对于 -6dB 波束宽度，用户必须看到 12dB 的压降 (Tx 为 6dB，Rx 为 6dB)

备注

波长 (λ) 基于 59GHz 的频率计算得出。天线放置根据该频率进行。

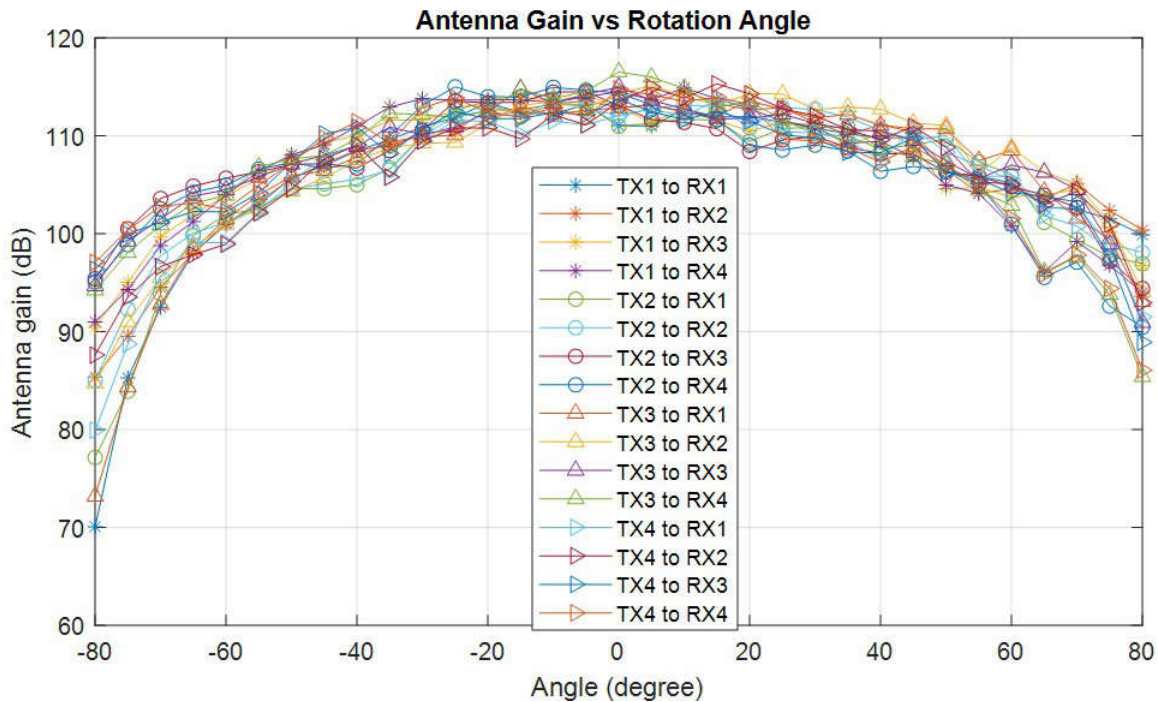


图 3-7. xWRL6844EVM 方位角天线辐射图

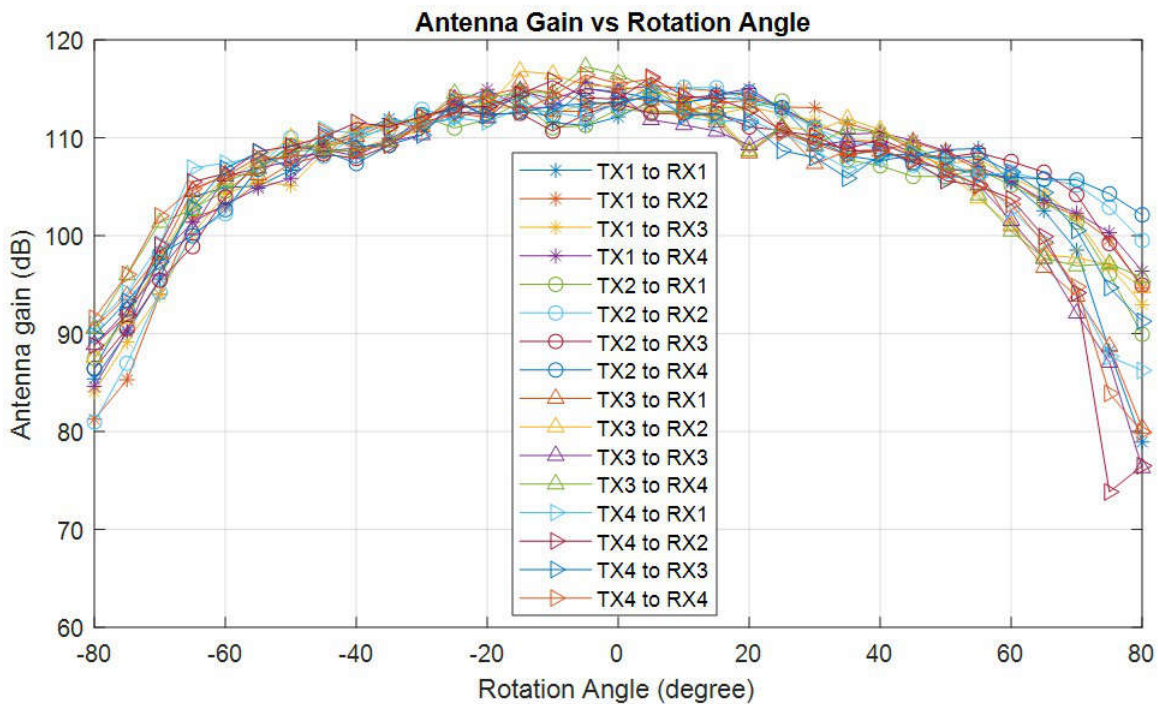


图 3-8. xWRL6844EVM 仰角天线辐射图

备注

根据 EN 62311 射频暴露测试，在操作过程中，用户和 EVM 之间必须保持至少 20 厘米的分隔距离。

3.1.1.2 xWRL6844 器件 + 天线组合的相位汇总

下表提供了 xWRL6844 IC 与 xWRL6844 板组合在一起时对应的相位汇总信息。

1. 在 xWRL6844 IC 内部 ,
 - a. RX1/RX2 同相、RX3/RX4 同相。但这两组之间具有 180° 的相位差
 - b. TX1/TX4 同相、TX2/RX3 同相。但这两组之间具有 180° 的相位差
2. 由于 EVM 上的天线馈电 ,
 - a. RX1/RX2 同相、RX3/RX4 同相。但这两组之间具有 180° 的相位差
 - b. TX1/TX2 同相、TX3/RX4 同相。但这两组之间具有 180° 的相位差
3. 当 IC 和 EVM 天线组合在一起时 ,
 - a. RX1/RX2/RX3/RX4 同相。
 - b. TX1/TX3 同相、TX2/RX4 同相。但这两组之间具有 180° 的相位差

表 3-1.

	RX1	RX2	RX3	RX4	TX1	TX2	TX3	TX4
xWRL6844 IC	+1	+1	-1	-1	+1	-1	-1	+1
xWRL6844 EVM	+1	+1	-1	-1	+1	+1	-1	-1
器件 + EVM	+1	+1	+1	+1	+1	-1	+1	-1

备注

“*h_ChirpTxBpmEnSel*” 字段可用于执行二进制相位反转。为了确保所有虚拟通道保持同相，用户可以对两对 Tx 通道中的任意一对编程加入 180° 相移。有关 API 级别的更多详细信息，请参阅接口控制文档和 TI 毫米波 SDK。

3.3 开关设置

图 3-10 展示了 xWRL6844EVM 上不同 SOP 模式设置对应开关的器件标识符和位置。表 3-2 显示了器件的不同引导模式配置。xWRL6844 支持应用模式/功能模式、器件管理模式/QSPI 刷写模式以及调试模式。必须先执行下方表 3-2 所示的模式 (SOP) 配置。在设置正确的 SOP 模式之后，必须发出 nRESET 以注册 SOP 设置。在图 3-10 中，当前 SOP 模式显示为调试模式。

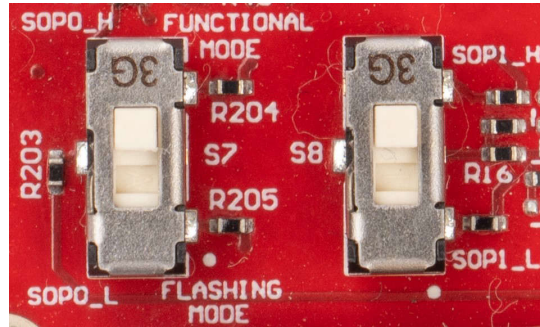


图 3-10. SOP 开关 (S7、S8)

表 3-2. SOP 设置

SOP 模式	PMIC_CLK_OUT、TDO	组合 SOP1 (S8)、SOP0 (S7)
SOP_MODE1	器件管理模式/QSPI 刷写模式	00
SOP_MODE2	应用模式/功能模式	01
SOP_MODE4	调试模式/开发模式	11

S1 和 S4 滑动开关使用户能够从不同外设连接到数字接口

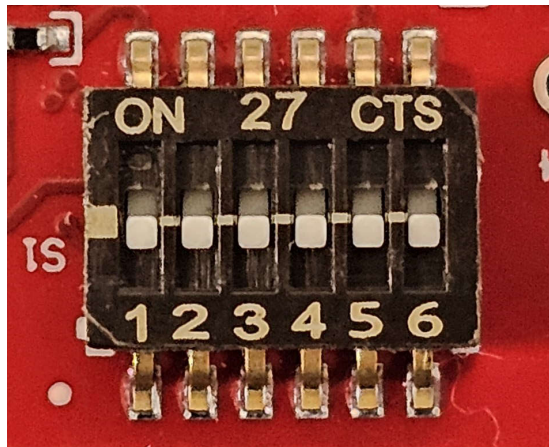


图 3-11. 滑动开关 (S1)

表 3-3. S1 开关设置

参考指示符	开关关闭	开关打开
S1.1	CAN PHY B : 禁用待机模式	CAN PHY B : 启用待机模式
S1.2	XDS_RS232	FTDI_DCA_LP/BP_RS232
S1.3	FTDI_RS232	DCA_LP/BP_RS232
S1.4	CAN_FD_A	XDS_DCA_LP/BP_FTDI_UARTA
S1.5	DCA_LP/BP_FTDI_UARTA	XDS_UARTA
S1.6	FTDI_UARTA	DCA_LP/BP_UARTA

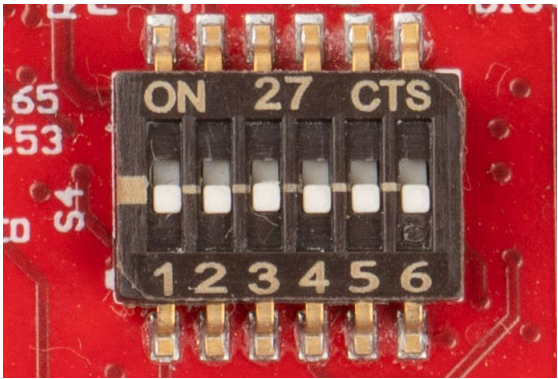


图 3-12. 滑动开关 (S4)

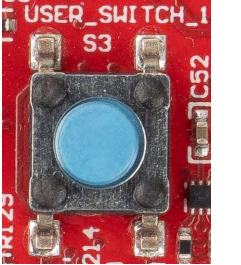
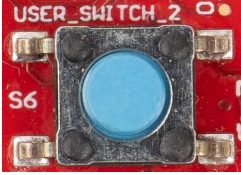
表 3-4. S4 开关设置

参考指示符	开关关闭	开关打开
S4.1	CAN PHY A : 禁用待机模式	CAN PHY A : 启用待机模式
S4.2	LIN PHY : 启用	LIN PHY : 禁用
S4.3	FTDI_SPI	DCA_SPI
S4.4	XDS_JTAG	DCA_JTAG
S4.5	UARTB	LIN
S4.6	SPIB	I2C/HOST_CLK_REQ/SYS_RST_OUT

3.4 按钮开关

表 3-5 包含 xWRL6844EVM 上的按钮开关列表。用户开关连接到 GPIO，可用于快速集成简单接口

表 3-5. 按钮开关列表

开关参考标识符	用法	说明	图像
S2	复位开关	此开关可用于复位 xWRL6844 器件	
S3	用户开关 1	按下后，GPIO_2 逻辑会被拉高	
S6	用户开关 2	按下后，GPIO_6 逻辑会被拉高	

3.5 LED

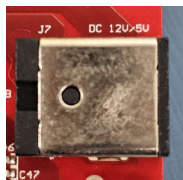
表 3-6 包含 xWRL6844EVM 上 LED 的列表。用户 LED 用于集成，可以使用 xWRL6844 的 GPIO 进行控制。

表 3-6. LED 清单

LED 参考标识符	用法	说明	图像
D3	PGood LED	当 PMIC 的所有电源稳定后亮起一次	
D6	上电 LED	5V 或 12V 电源指示	
D5	Reset LED	此 LED 指示 xWRL6844 器件上复位引脚的状态。 LED 亮起表明器件未复位	
D7	用户 LED : 客户可编程	GPIO_2 为逻辑 1 时亮起	
D9	SYS_RST_OUT LED	当 xWRL6844 器件进行任何系统复位时亮起	
D10	FTDI 挂起 LED	当 FTDI 处于挂起状态时亮起	
D11	用户 LED : 客户可编程	GPIO_6 为逻辑 1 时亮起	
D13	nERROR LED	xWRL6844 器件有任何硬件错误时亮起	

3.6 直流输入插孔

可以使用 5V 至 12V 直流插孔为 xWRL6844EVM 供电。连接直流插孔时，会优先切换到电源多路复用器 (TPS2121) 上处的直流插孔电压。



备注

向 EVM 提供 5V-12V 电源后，TI 建议按一次 NRST 开关，以确认引导状态可靠。

备注

并非器件的所有数字 IO 引脚 (NRESET 除外) 都具有失效防护功能。因此需要注意，在器件没有 VIO 电源的情况下，不要从外部驱动数字 IO 引脚。

3.7 USB 连接器

xWRL6844EVM 有两个标准 Micro USB 连接器。这些连接器用于 xds110 和 FTDI 接口连接。这些连接器还可用于向 EVM 提供 5V 电源输入。

FTDI 接口： Micro USB 连接器 J10 用于访问 xWL6844 器件的 UART-A、SPI、I2C、RS232/UART-B、SOP 和复位信号



图 3-13. FTDI USB (J10)

XDS 接口： Micro USB 连接器 J5 用于访问 xWL6844 器件的 I2C、JTAG、UART_A、RS232/UART-B 信号。这是用于将二进制文件烧录到板载串行闪存和运行开箱即用 (OOB) 演示的 UART 接口。

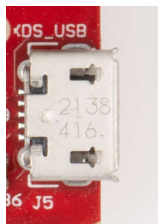


图 3-14. XDS USB (J5)

3.8 DCA1000 HD 连接器

图 3-15 中显示的 60 引脚高速连接器可通过 DCA1000 提供对 xWRL6844 器件高速数据和控制信号 (I2C、LVDS、NRST、RS232/UART-B、SPI、UART-A) 的访问。

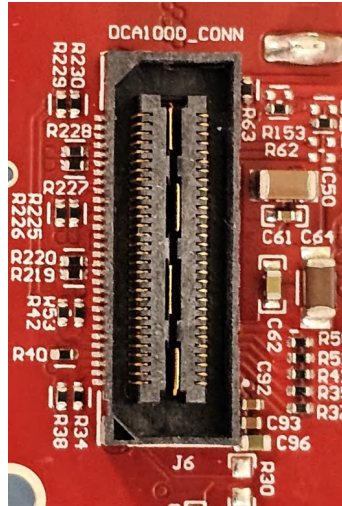


图 3-15. DCA1000 HD 连接器

图 3-16 中提供了有关 xWRL6844 器件信号在 DCA1000 对接连接器上输出的进一步详细信息。

60-PIN HD CONNECTOR FOR DCA1000

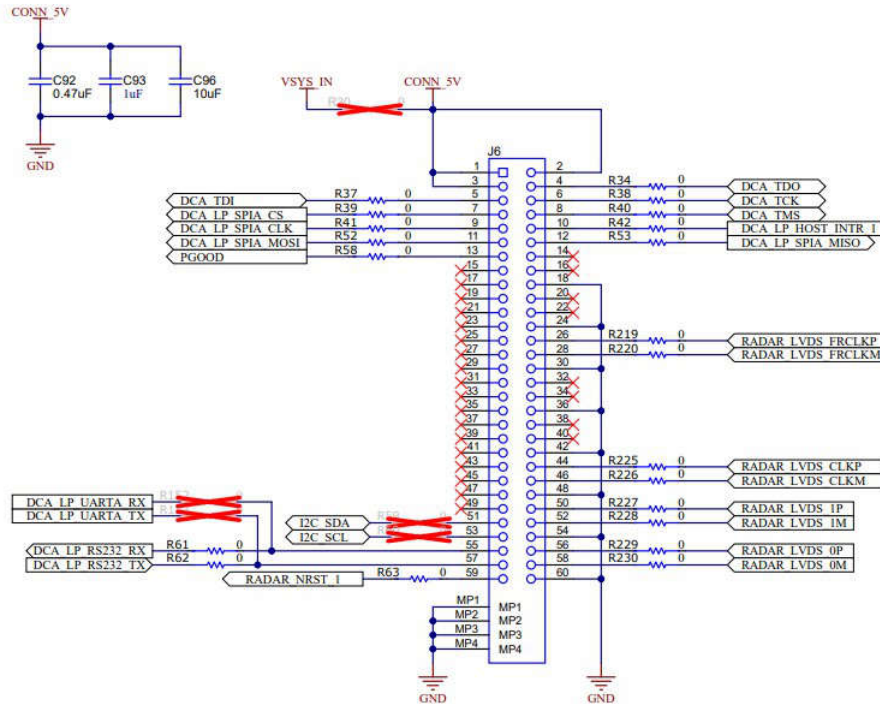


图 3-16. DCA1000 高清连接器引脚

J11/J12 是 EVM 上提供的 Booster Pack 连接器。用户可以组装 LP-BP 连接器以连接其他 TI LaunchPad 套件。

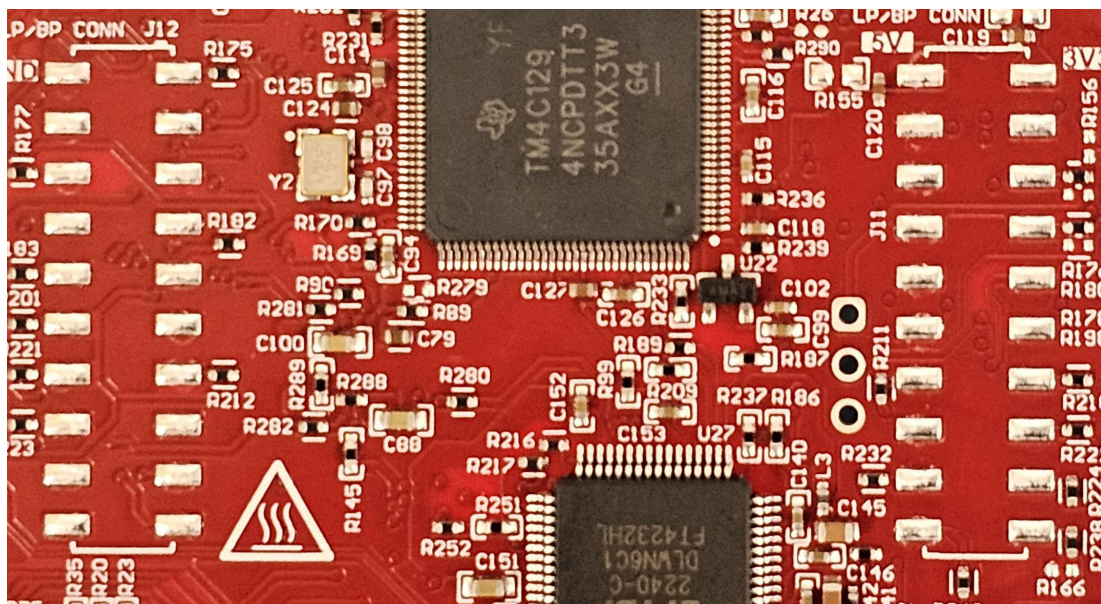


图 3-17. Booster Pack 连接器

图 3-18 展示了 LP-BP 连接器上生成的各种信号。

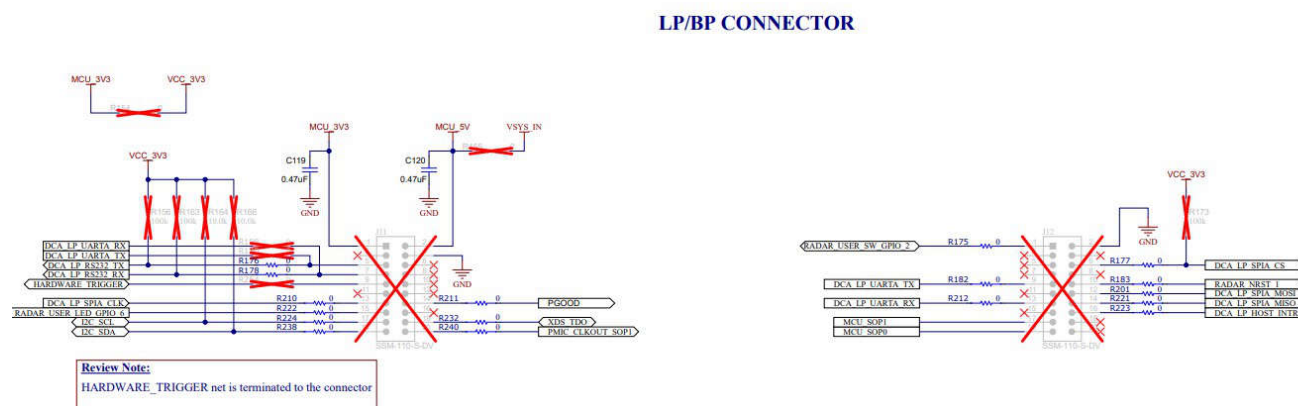


图 3-18. LP-BP 连接器引脚

3.10 CAN-FD_B 连接器

可以通过 CAN 连接器从板载 CAN_FD 收发器访问 CAN_FD_B 接口 (CAN_L 和 CAN_H 信号)。这些信号可直接连接到 CAN 总线。

图 3-19 中显示的 J8 连接器提供来自板载 CAN-FD 收发器 (TCAN3403DRQ1) 的 CAN_L 和 CAN_H 信号。可以通过切换 S1.1 开关来控制 CAN 待机输入

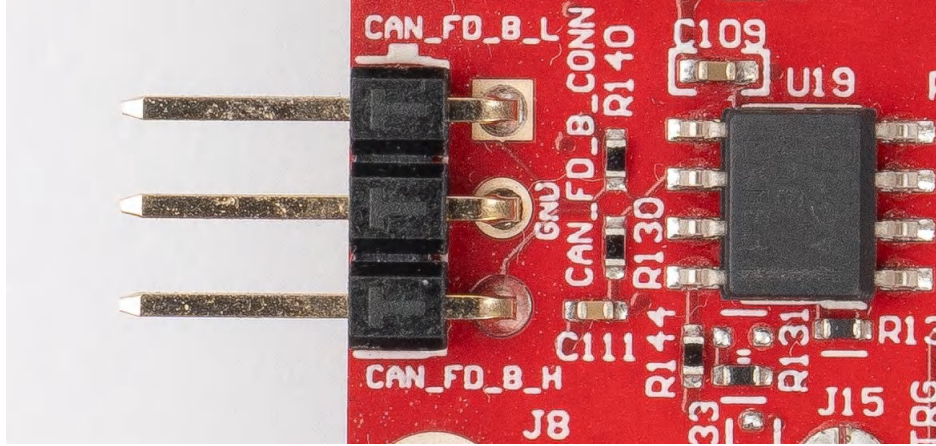


图 3-19. CAN-FD B 连接器

CAN_FD_B_TRANSCEIVER

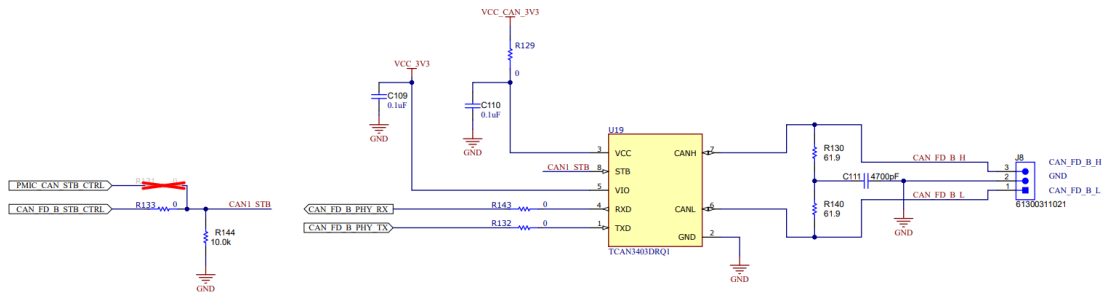


图 3-20. EVM 中使用的 CAN FD PHY

3.11 CAN-FD_A 连接器

图 3-21 中显示的 J3 连接器提供来自板载 CAN-FD 收发器 (TCAN3403DRQ1) 的 CAN_L 和 CAN_H 信号。这些信号与 UART-A 信号经过多路复用后将连接到 CAN 总线；必须选择两条路径中的一条。通过将开关 S1.4 更改到关闭位置，CAN 信号路径连接到 PHY。可以通过切换 S4.1 开关来控制 CAN 待机输入。

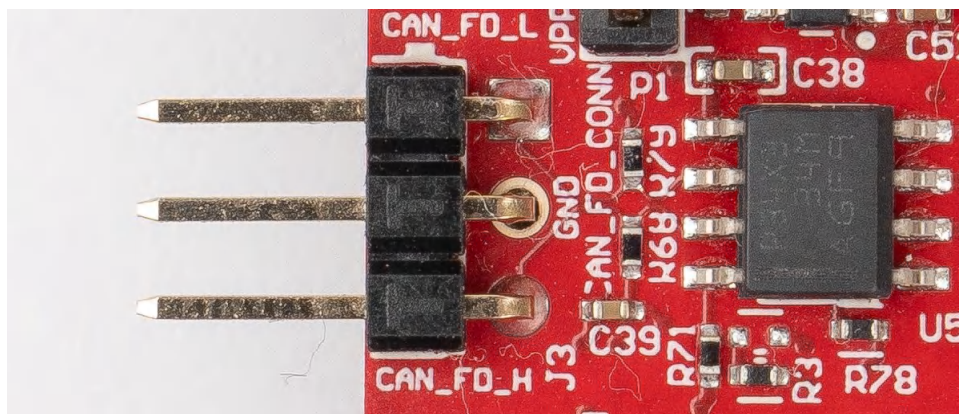


图 3-21. CAN-FD A 连接器

ANALOG MUX -XDS /FTDI, DCA RS232, CAN_FD / UART A

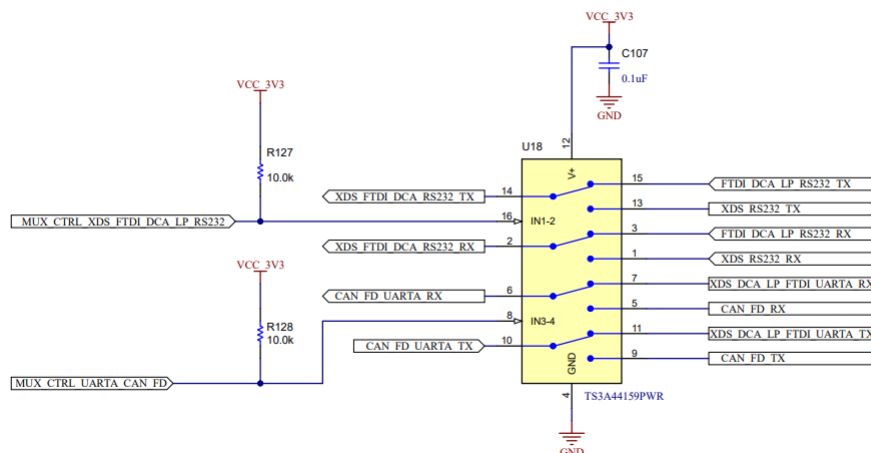


图 3-22. CAN PHY 开关的模拟多路复用器

CAN_FD_TRANSCEIVER

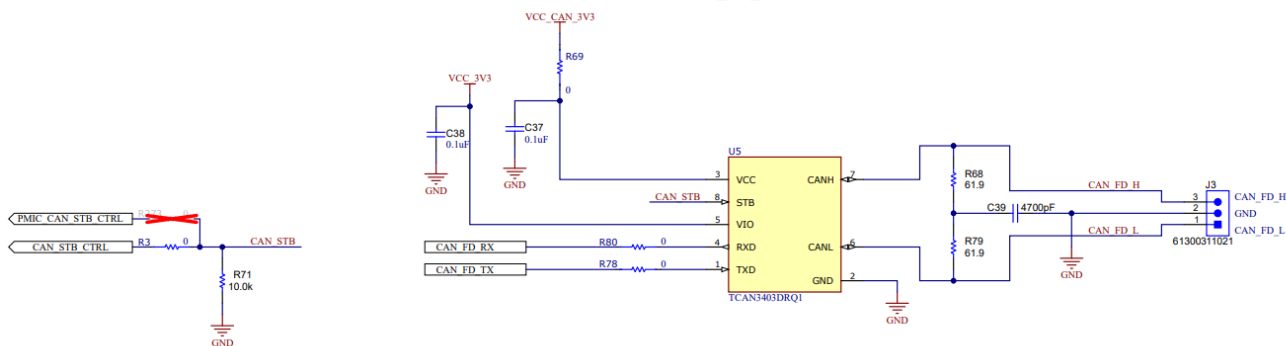


图 3-23. EVM 中使用的 CAN FD PHY

3.12 LIN-PHY 连接器

图 3-24 展示了用于连接器件的 LIN PHY (TLIN1039DDFRQ1) 接口。LIN PHY 可以使用与毫米波传感器不同的电源电压运行，为 LIN VDD 电源提供了一个外部 VBAT 选项，默认情况下为 J4 连接器提供 VSYS_IN 电源。

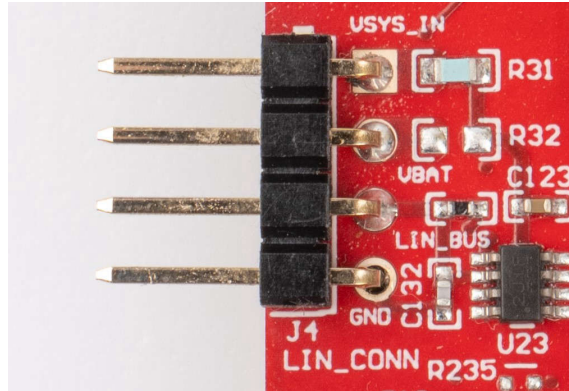


图 3-24. LIN 连接器

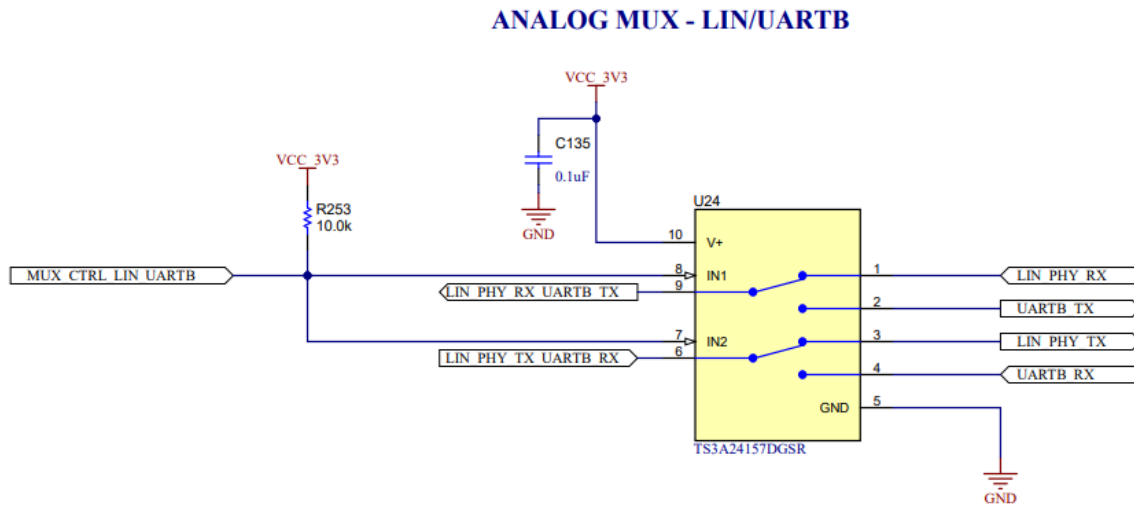


图 3-25. LIN PHY 开关的模拟多路复用器

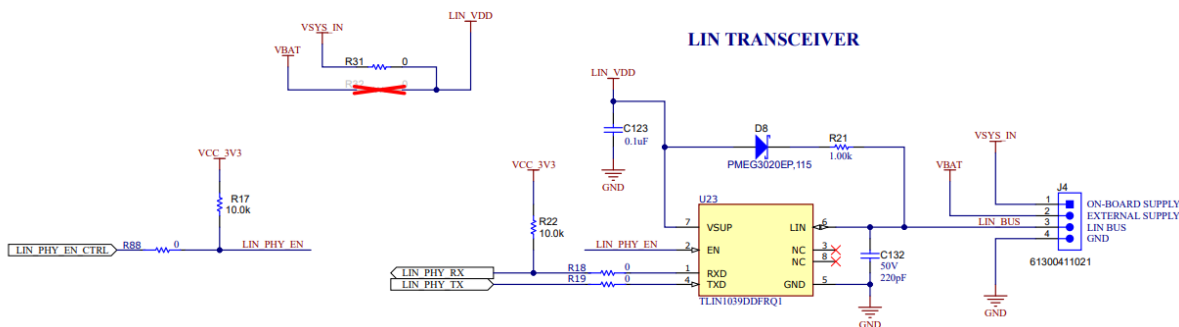


图 3-26. LIN PHY 接口

为了启用外部 VBAT 电源，需要安装 R32 电阻并移除 R31 电阻。

3.13 I2C 连接

xWRL6844EVM 板配备了一个温度传感器，具有用于测量板载温度；一个电流传感器，用于测量 xWRL6844 器件的 3.3V、1.8V、1.2VDigital、1.2VRF 电源轨的电流，以及一个 EEPROM，用于存储板 ID。这些元件通过 I2C 总线连接到 TPS65036501 和 xWRL6844。除此之外，还提供了接头 J1 以简化与 I2C 总线的连接。有关 I2C 地址的信息，请参阅 xWRL6844EVM 的原理图。

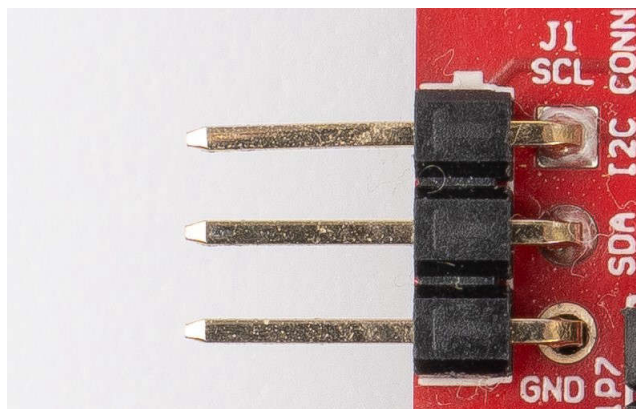


图 3-27. I2C 连接器

3.13.1 EEPROM

该板采用 EEPROM 来存储特定于该板的 ID (用于通过 XDS110 接口识别 EVM)。

3.14 XDS110 接口

通过 J5 连接器可访问板载 XDS110 (TM4C1294NCPDT) 仿真器。此连接提供以下 PC 接口：

- JTAG，用于 CCS 连接
- 应用/用户 UART (与 PC 进行配置和数据通信)

在独立运行模式下使用时，通过单个 USB 连接器供电。连接器 J5 还用于通过 PC 上经 XDS110 接口安装的用户 UART 进行配置和数据传输。正确枚举后，XDS110 的两个 UART 端口在设备管理器上显示为虚拟 COM 端口，类似于图 3-28 中所示。

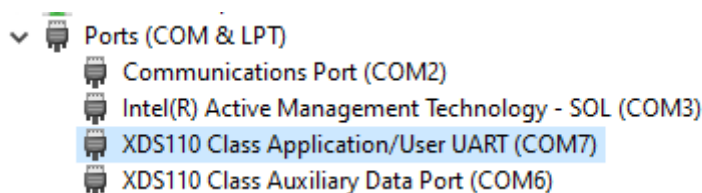


图 3-28. 虚拟 COM 端口

如果 PC 无法识别上述 COM 端口，请安装最新的 [EMUpack](#)。

3.15 FTDI 接口

J10 连接器提供访问板载 FTDI 端口的接口。这将提供以下 PC 接口：

- FTDI 端口 A：SPI
- FTDI 端口 B：I2C、HOST_INTERRUPT
- FTDI 端口 C：UARTA、nRESET
- FTDI 端口 D：RS232、SOP 控制

第一次将 xWRL6844EVM 的 FTDI USB 连接到 PC 时，Windows® 可能无法识别设备。如图 3-29 所示，设备管理器中用黄色感叹号表示和确认这种情况。

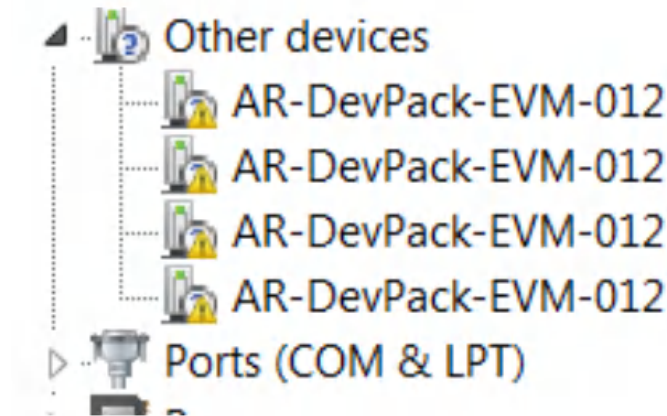


图 3-29. 未安装 FTDI 驱动程序

为了正确检测 PC 上的这些端口，请下载并安装 (C:\ti\mmwave_sdk_tools\ftdi) 中提供的最新 FTDI 驱动程序。必须对所有四个 COM 端口都执行此操作。安装完所有四个 COM 端口后，设备管理器将能够识别这些器件，并指示 COM 端口号，如图 3-30 所示。

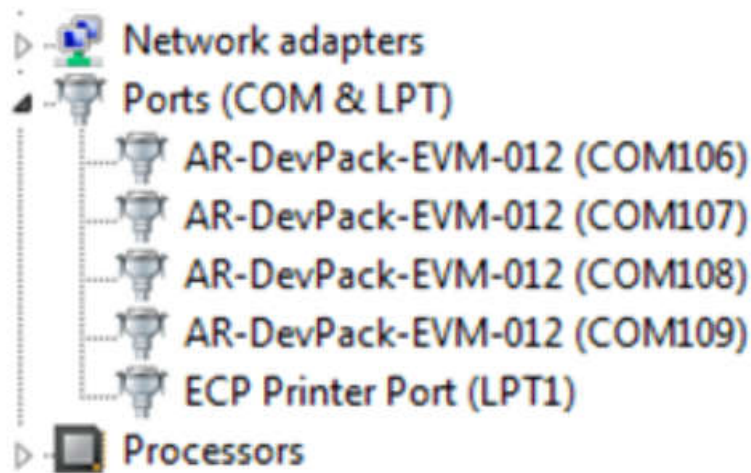


图 3-30. 已安装 FTDI 驱动程序

3.16 DCA1000EVM 模式

使用 DCA1000EVM 进行原始数据采集的设置如图 3-31 所示。有关原始 ADC 数据采集的更多详细信息，请参阅 Tirex 页面中的 **DCA1000 mmWave Studio xWRL6844** 部分，路径如下：mmWave radar sensors/ Embedded software/ Radar Toolbox/ Hardware Docs/ DCA1000 Perdevice/ DCA1000 mmWave Studio xWRL6844。

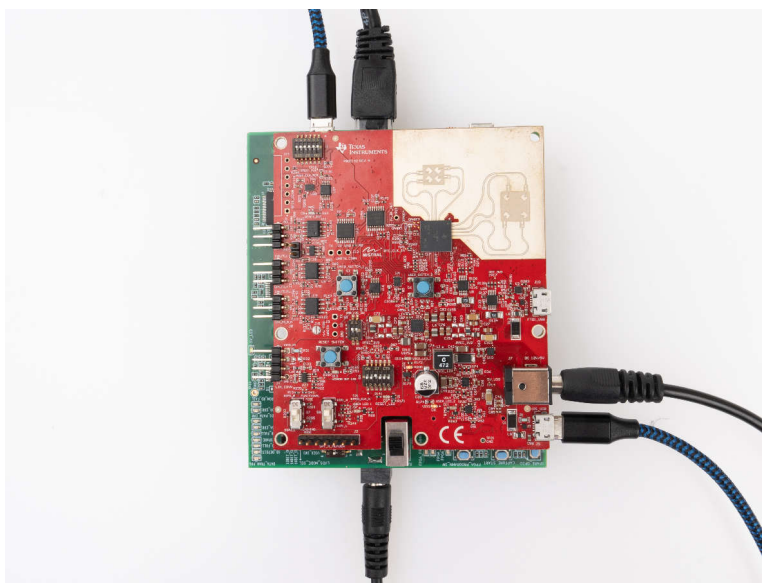


图 3-31. 用于原始数据采集的 AWRL6844EVM

原始数据采集需要遵循的 DCA 开关设置显示在图 3-32 中。

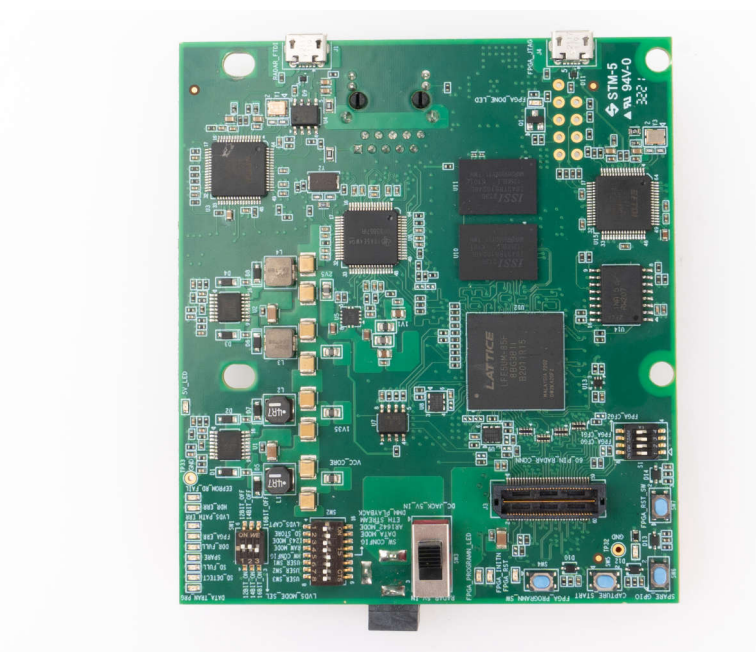


图 3-32. DCA1000 开关设置

备注

当 EVM 直接与 DCA1000 板配对时，请使用套件中包含的垫片，并确保 DCA1000 和 xWRL6844EVM 之间不会发生物理接触，因为这会损坏电路板。

3.17 PCB 贮存和搬运建议：

此 EVM 包含可能因静电放电而受损的元件。不使用时，请务必将 EVM 置于随附的 ESD 袋中进行运输和贮存。搬运时使用防静电腕带并在防静电工作台面上操作。有关正确搬运的更多信息，请参阅 [SSYA010](#)。

3.17.1 PCB 贮存和搬运建议

PCB 的浸银表面可提供更佳的高频性能，但在开放的环境中易于氧化。这种氧化会使天线区域周围的表面变黑，但毫米波雷达性能会完好无损。为了防止氧化，必须将 PCB 存放在 ESD 保护套中，并置于低湿度条件的受控室温下。使用和搬运 EVM 时，必须采取所有 ESD 预防措施。

3.17.2 需要更高功率的应用

EVM 的大部分都可以使用单根 5V USB 电缆来实现运行。对于单个 5V USB 电源无法提供所需功率的高功耗应用，请使用外部的 5V 或 12V 适配器。

4 软件、开发工具和示例代码

为了能够在 xWRL6844 中的 ARM Cortex-R5F 内核上快速开发终端应用，TI 提供了 [MMWAVE-L-SDK-6](#)，其中包含演示代码、软件驱动程序和用于调试的仿真包等。有关更多信息，请参阅 [MMWAVE-L-SDK-6](#) 用户指南和入门指南 [SWRU636](#)。

5 硬件设计文件

5.1 原理图、PCB 布局和物料清单 (BOM)

在 [SWRC394](#) 上可以找到 xWRL6844EVM 原理图、装配图和物料清单。

5.2 EVM 设计数据库

在 [SWRR198](#) 上可以找到包含 Altium 工程源文件的 xWRL6844EVM 设计数据库。

5.3 硬件设计检查表

包含原理图和布局建议的 xWRL6844 硬件设计检查清单可在 [SPRADLO](#) 上找到。

6 其他信息

6.1 商标

- Arm® 和 Cortex® 是 Arm Limited 的注册商标。
- Code Composer Studio™ 和 LaunchPad™ 是德州仪器 (TI) 的商标。
- Windows® 是 Microsoft 的注册商标。

所有商标均为其各自所有者所有。

7 参考资料

1. [DCA1000EVM 数据采集卡用户指南](#)
2. [MMWAVE-L-SDK](#)
3. [Code Composer Studio](#)

7.1 TI E2E 社区

请在 e2e.ti.com 上搜索论坛。如果您找不到问题的答案，可以将问题发布到社区。

8 修订历史记录

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision A (November 2025) to Revision B (January 2026)	Page
• 删除了“PMIC 软件实现”	28

Changes from Revision * (December 2024) to Revision A (November 2025)	Page
• 更新了原始 ADC 数据采集的说明.....	1
• 添加了 EVM 修订历史记录.....	2
• 更新了发送器和接收器虚拟阵列部分中有关发送器天线放置的说明.....	11
• 添加了 xWRL6844IC 和 EVM 的相位详细信息.....	12
• 更新了 EVM 多路复用器方框图部分中的说明.....	14

STANDARD TERMS FOR EVALUATION MODULES

1. **Delivery:** TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
 - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. **Limited Warranty and Related Remedies/Disclaimers:**
 - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
 - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
 - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/sds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/sds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html>

3.4 European Union

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

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