参考文献

EVM User's Guide: AFE88XH1-FELC-EVM

AFE88XH1-FELC 评估模块

说明

AFE88XH1-FELC 评估模块 (EVM) 实现了用于 2 线回路供电式传感器的 4 – 20mA 接口。此 EVM 支持在采用 1.8V 信号链的较低功耗应用类环境中评估 AFE881H1 和 AFE882H1。AFE881H1 和 AFE882H1 集成了高精度 16 位 DAC 和 HART® 调制解调器。

开始使用

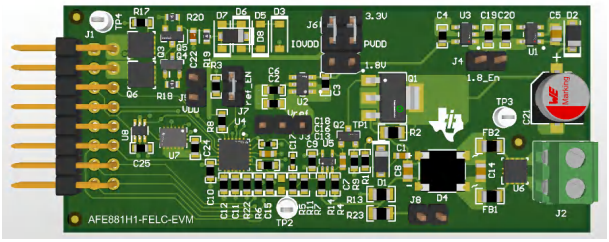
1. 订购 AFE88XH1-FELC-EVM
2. 订购 SNSR-DUAL-ADC-EVM（随附 A 转 Micro-B USB 线缆）
   a. 有关安装必要软件和使用串行通信的更多信息，请参阅 SNSR-DUAL-ADC-EVM 评估模块用户指南
3. 下载 AFE881H1 数据表或 AFE882H1 数据表
4. 下载 TIDA-010982 参考设计文件

特性

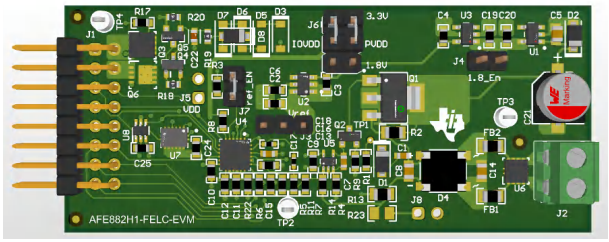
- 适用于 2 线回路供电传感器的 4 – 20mA 回路接口实现。
- 完整的 1.8V 信号链可实现低功耗。
- AFE88xH1 16 位 DAC，集成参考电压和 HART 调制解调器。
- MCU 接口提供电源输出（1.8V、3.3V、1.25V 参考电压）、SPI 和 UART 接口。

应用

- 流量变送器
- 液位变送器
- 压力变送器
- 温度变送器
- 模拟输出模块



AFE881H1-FELC-EVM 顶视图



AFE882H1-FELC-EVM 顶视图

English Document: SLVUDW7

1 评估模块概述

AFE88XH1-FELC-EVM 实现了 4-20mA、2 线回路供电式现场变送器。此设计支持在采用 3.3V 或 1.8V 信号链的较低功耗应用类环境中评估 AFE881H1 和 AFE882H1。AFE881H1 和 AFE882H1 集成了高精度 16 位数模转换器 (DAC) 和 HART® 调制解调器。此 EVM 在一个引脚接头上提供串行外设接口 (SPI) 和通用异步接收器-发送器 (UART) 接口，以连接微控制器 (MCU)。此引脚接头提供 3.3V 和 1.8V 电压来为 MCU 供电，并提供 1.25V 基准电压用于模数转换器 (ADC)。

1.1 简介

EVM 设计中包含一个 16 位 DAC，即 AFE881H1 或 AFE882H1。DAC 输出电压用于驱动 OPA391 运算放大器，将电压转换为电流以创建 4-20mA 回路控制。

此设计集成了具有 1.8V 或 3.3V 输出选项的电源。配置设置决定使用 1.8V 还是 3.3V 来为电路板上的模拟电路和连接的 MCU 供电。具有低 IQ 的低压降 (LDO) 稳压器（TPS7A0333 和 TPS7A0318）可提供稳定高效的电源输出。

此设计包含用于 MCU 的分立式 P 沟道金属氧化物半导体场效应晶体管 (PMOSFET) CSD25404 电源开关。此电源开关用于控制 1.8V 和 3.3V 电压轨，这些电压轨通过 J1 接头引脚连接到 MCU。在回路输入端添加了一个大容量电容器，以便在上电时提供浪涌电流。在进入低功耗模式之前，电容器为 MCU 初始化供电。

1.2 套件内容

该套件包含 AFE88XH1-FELC-EVM PCB。

如果缺少任何元件，请与离您最近的德州仪器 (TI) 产品信息中心联系。在 ti.com 上下载相关软件的最新版本。

1.3 规格

表 1-1 提供了 AFE88XH1-FELC-EVM 板规格参数。

表 1-1. AFE88XH1-FELC-EVM 规格

参数		值
自然通风条件下的建议工作温度范围，TA		-40°C 至 +125°C
环路电源电压		8V 至 30V
分辨率		16 位
电源输入	AFE881H1	3.3V、1.8V
	AFE882H1	3.3V
基准电压输出		1.25V
通信接口		SPI、UART

1.4 器件信息

AFE881H1 或 AFE882H1 是一款具有集成 HART 调制解调器的电压 DAC。使用作为跨阻放大器 (TIA) 的 OPA391 将 DAC 输出电压转换为电流。

AFE88XH1-FELC-EVM 通过 16 引脚接头 (J1) 从 SNSR-DUAL-ADC-EVM 上的 MCU 接收 SPI 通信。加电时，MCU 读取 SN74LV8T165BQBR 移位寄存器提供的 EVM 板 ID。ID 由施加到移位寄存器 A:H 引脚的电压决定，并允许 MCU 初始化正确的配置设置和目标地址。启动后，MCU 将 ID0 拉至 GND，以将 EVM 上的 TMUX1219 从移位寄存器输出切换到从 DAC 接收到的 SDO 信号，以进行寄存器读回。

EVM 上的分立式 LDO 提供 1.8V 和 3.3V 电源电压。这两个电源都在 J1 接头上提供，具有硅控整流器电路。当跳线 J7 短接时，AFE88XH1 默认使用内部基准电压。1.8V LDO 为 REF35125 供电，以生成 1.25V 输出，用作 AFE88XH1 VREFIO 输入上的外部电压基准。J3 接头提供 1.25V 外部基准或来自 SNSR-DUAL-ADC-EVM 的基准电压之间的选择。

使用桥式整流器 (D4) 对回路进行极性反转保护，使用 TVS3301 (U6) 二极管对输出进行瞬态电压保护。J2 回路端子上的铁氧体磁珠形成一个低通滤波器来消除高频噪声。

2 硬件

2.1 电源要求

AFE88XH1-FELC-EVM 通过 J2 端子进行回路供电。电源必须在 LOOP+ 和 LOOP- 连接中提供 8V 至 30V 的电压，至少具有 50mA 的电流能力。

回路电源为两个 LDO（3.3V 和 1.8V）和一个电压基准 (1.25V) 供电，后者可为 AFE88XH1-FELC-EVM 和 SNSR-DUAL-ADC-EVM 供电。回路电源也用于 OPA391 跨阻放大器，通过 NPN 双极结型晶体管来控制回路电流。

AFE881H1 支持 PVDD 的 3.3V 和 1.8V 输入，而 AFE882H1 仅支持 PVDD 的 3.3V 输入。有关电源输入设置的详细跳线信息，请参见 节 2.4。

与 AFE88XH1 的 SPI 或 UART 通信来自 SNSR-DUAL-ADC-EVM，该器件通过 USB A 转 Micro-B 线缆连接主机电脑。

2.2 设置

AFE88XH1-FELC-EVM 与 SNSR-DUAL-ADC-EVM 结合使用，后者使用 MSPM0G1507 和两个 ADS122S14 ADC 来测量 J6 输入端子上的电压。AFE88XH1-FELC-EVM 的 16 引脚接头 (J1) 连接到 SNSR-DUAL-ADC-EVM 上的 J2 以实现电源和 SPI 通信。

图 2-1 显示了如何设置 EVM 以接收回路电源并连接到传感器板。有关板连接的详细视图，请参阅 节 4.1。

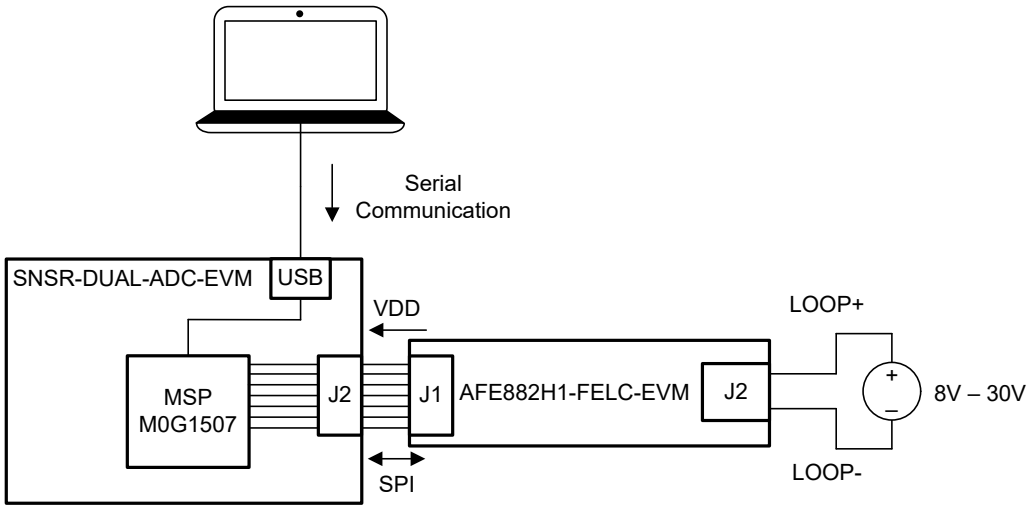


图 2-1. 现场变送器方框图

2.3 接头信息

AFE88XH1-FELC-EVM 有一个接头：J1。J1 接头连接到 SNSR-DUAL-ADC-EVM 板，用于 AFE88XH1 和 MCU 之间的通信和电源传输。有关引脚的说明，请参阅 表 2-1。

表 2-1. J1 接头说明

引脚编号	说明
1	GND
2	用于 VDD 电源电压的 3.3V LDO 输出连接
3	J3 的外部 VREF 输出连接
4	用于 VDD 电源电压的 1.8V LDO 输出连接
5	MCU 信号输入，用于在上电时控制移位寄存器
6	SCLK（SPI 时钟）
7	未使用
8	SDI（SPI 串行数据输入）
9	未使用
10	SDO（SPI 串行数据输出）
11	AFE88XH1 的 ALARM 输出端
12	CS（SPI 芯片选择）
13	载波检测输入
14	来自 AFE88XH1 的 HART 信号传输输出
15	AFE88XH1 请求发送输入
16	HART 信号接收器到 AFE88XH1 的输入

2.4 跳线信息

表 2-2 介绍了 AFE88XH1-FELC-EVM 评估模块上的六个跳线。

表 2-2. 跳线说明

跳线位号	说明
J3	AFE88XH1 VREF 电压选择 **开路（默认）：**使用 AFE88XH1 内部基准时，使跳线保持开路状态。 **引脚 1-2：**来自 REF35125 的 1.25V 电压，用于外部基准 **引脚 2-3：**来自 MCU 板的外部基准
J4	1.8V LDO 电源使能 **开路：**禁用 **短路：**启用
J5	当 PVDD < 2.7V 时，AFE881H1 内部偏置的外部 1.8V LDO 输入。**当 2.7V < PVDD < 5.5V 时保持开路**
J6	针对为 IOVDD 供电的硅控整流器 (SCR) 电路选择电压。 **引脚 1-3：**IOVDD 由 3.3V 晶体管连接供电。 **引脚 3-5：**IOVDD 由 1.8V 晶体管连接供电。 **引脚 2-4：**SCR 晶体管 Q3 的 3.3V 输入电源 **引脚 4-6：**SCR 晶体管 Q6 的 1.8V 输入电源
J7	AFE88XH1 内部基准使能。 **开路：**禁用内部基准 **短路：**启用内部基准
J8	传输回路阻抗调整 **开路：**AFE882H1（默认值） **短路：**AFE881H1（默认值）

2.5 测试点

表 2-3 展示了可用的测试点。

表 2-3. 测试点说明

测试点	引脚
TP1	MOD_IN
TP2	VOUT (AFE88XH1)
TP3	GND
TP4	GND

3 软件

SNSR-DUAL-ADC-EVM 控制主机与 AFE88XH1-FELC-EVM 的通信。串行数据指令从台式 PC 发送到 SNSR-DUAL-ADC-EVM 上的 MCU。然后，MCU 将这些命令转换为 SPI 协议，然后通过 J1 接头引脚将必要的指令传递给 EVM。

有关用于与 EVM 通信的 MCU 命令结构的更多信息，请参阅 SNSR-DUAL-ADC-EVM 评估模块用户指南。

4 硬件设计文件

4.1 原理图

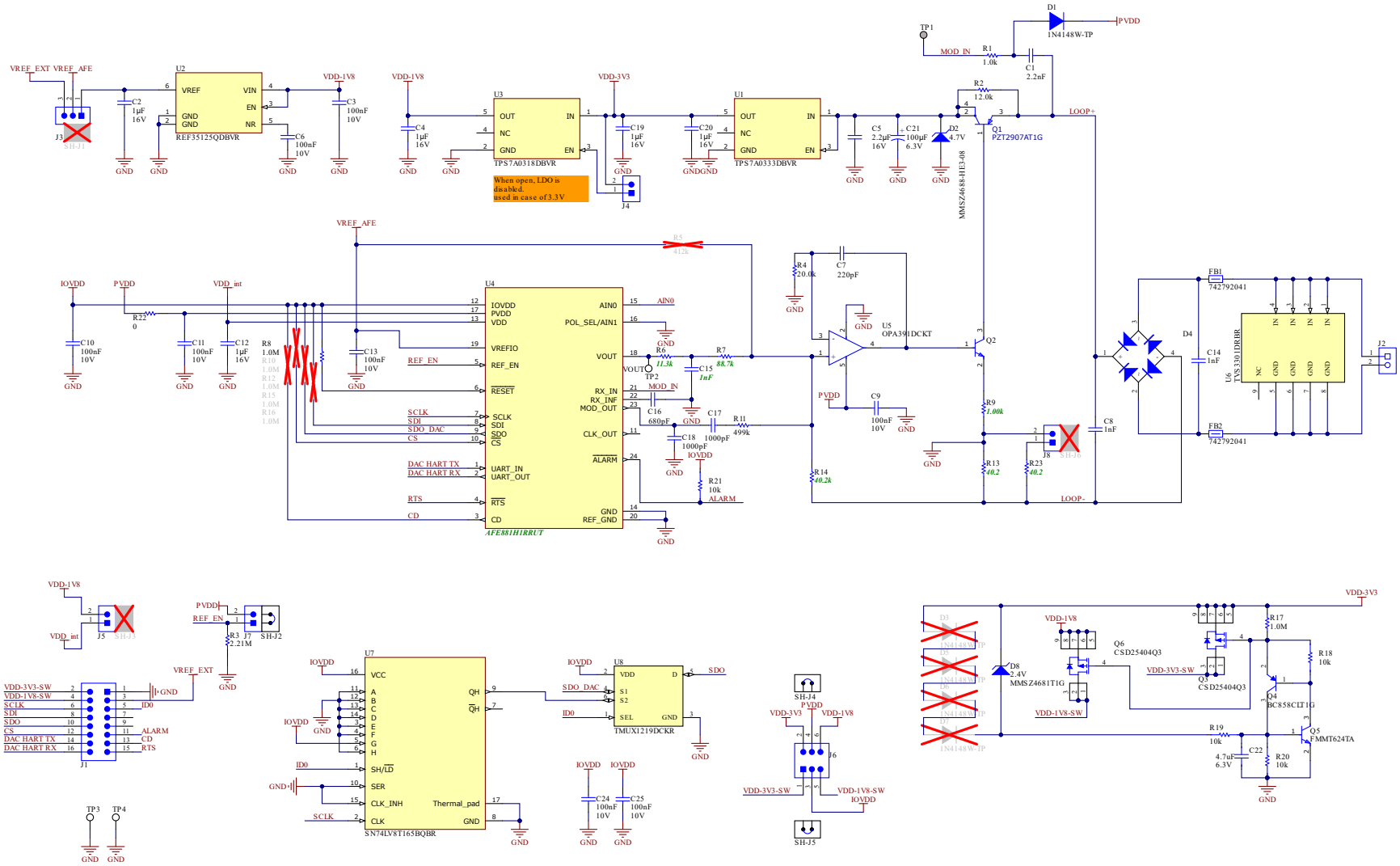


图 4-1. AFE881H1-FELC-EVM 原理图

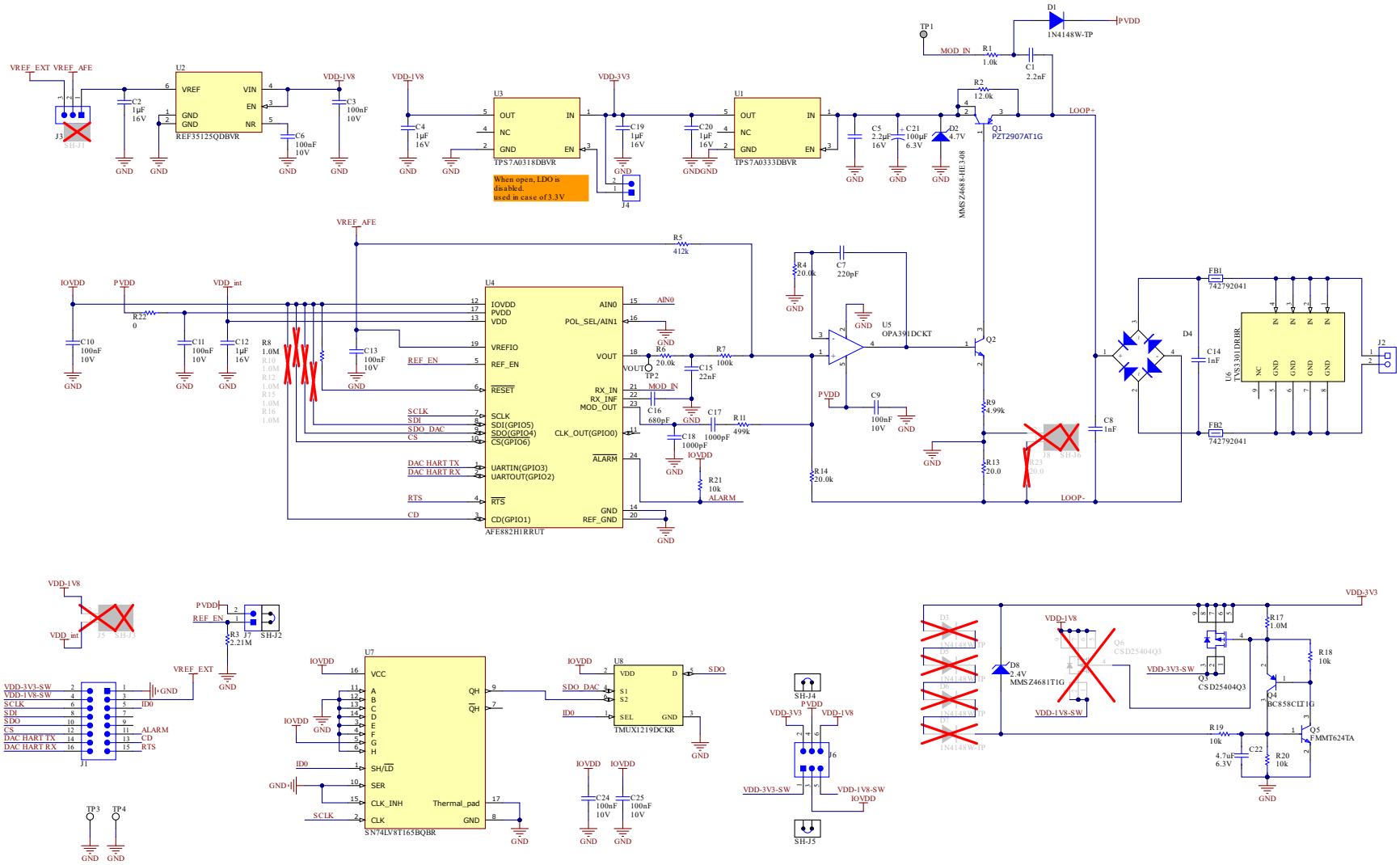


图 4-2. AFE882H1-FELC-EVM 原理图

4.2 PCB 布局

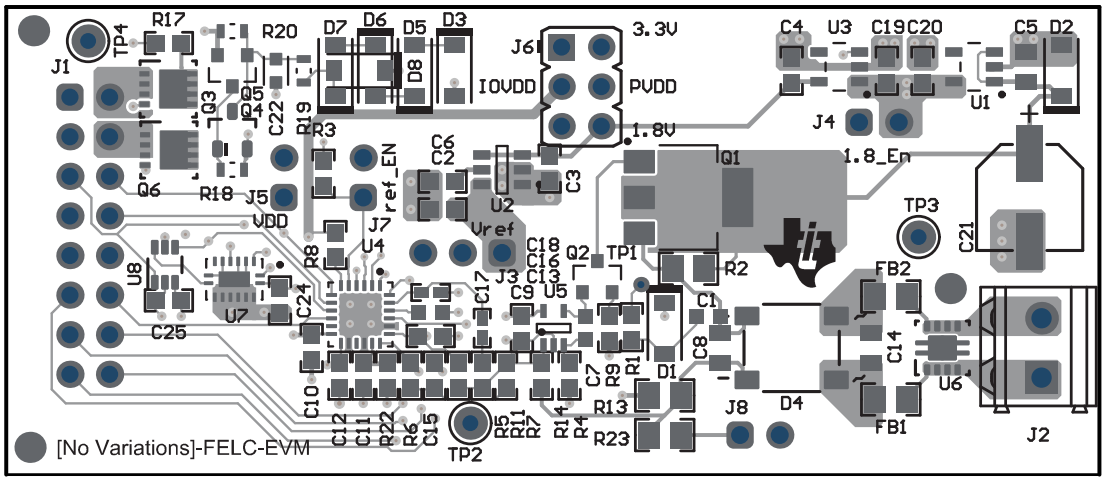


图 4-3. AFE88XH1-FELC-EVM 顶部复合视图

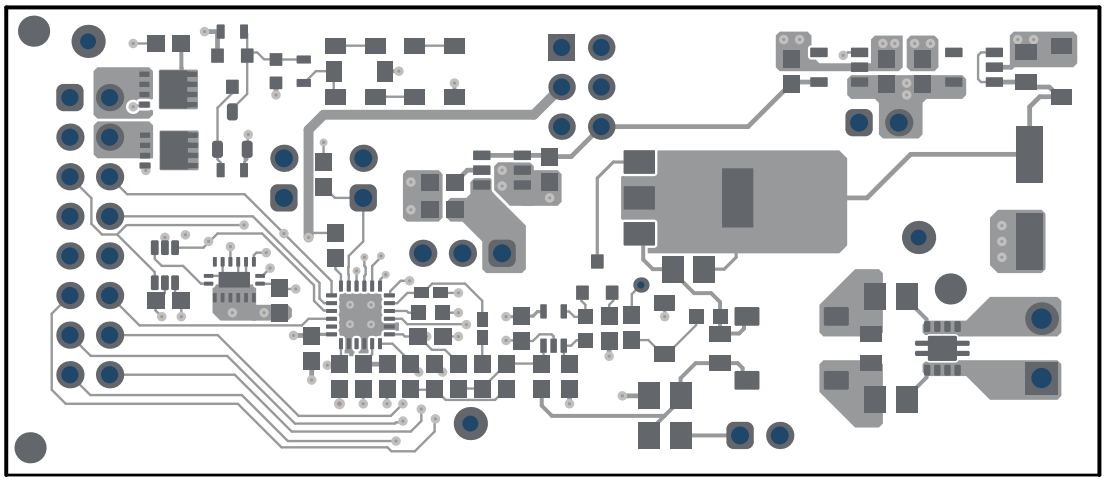


图 4-4. AFE88XH1-FELC-EVM 顶层

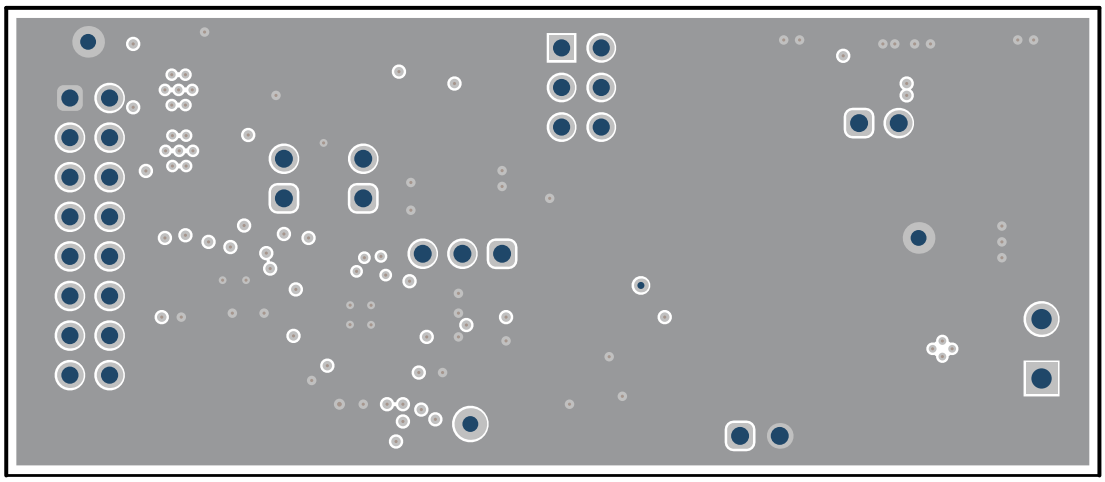


图 4-5. AFE88XH1-FELC-EVM 接地平面

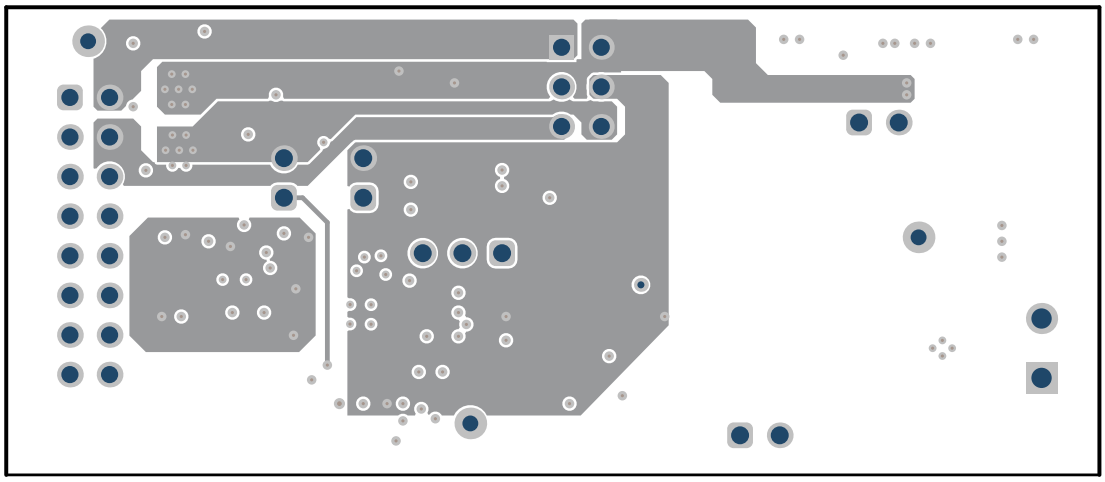


图 4-6. AFE88XH1-FELC-EVM 电源层

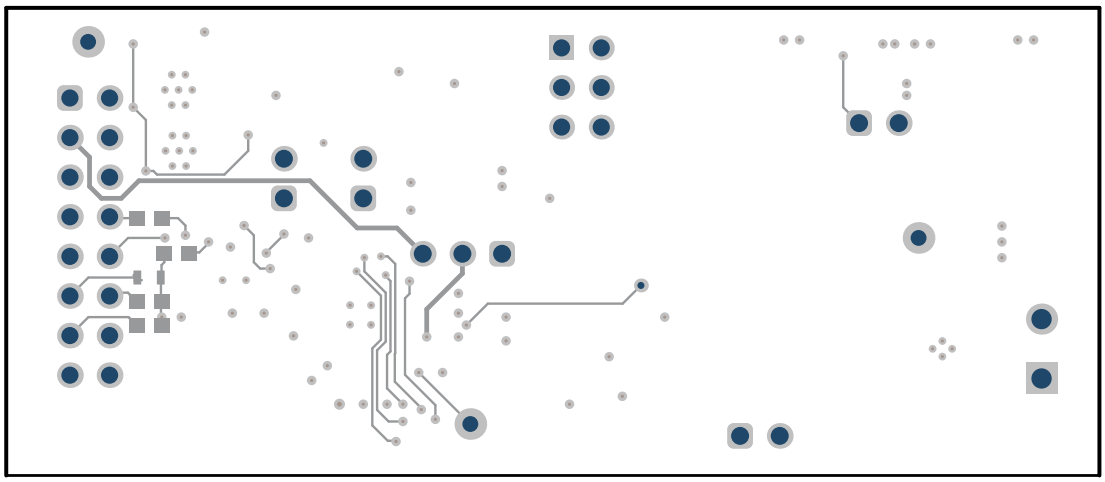


图 4-7. AFE88XH1-FELC-EVM 底层

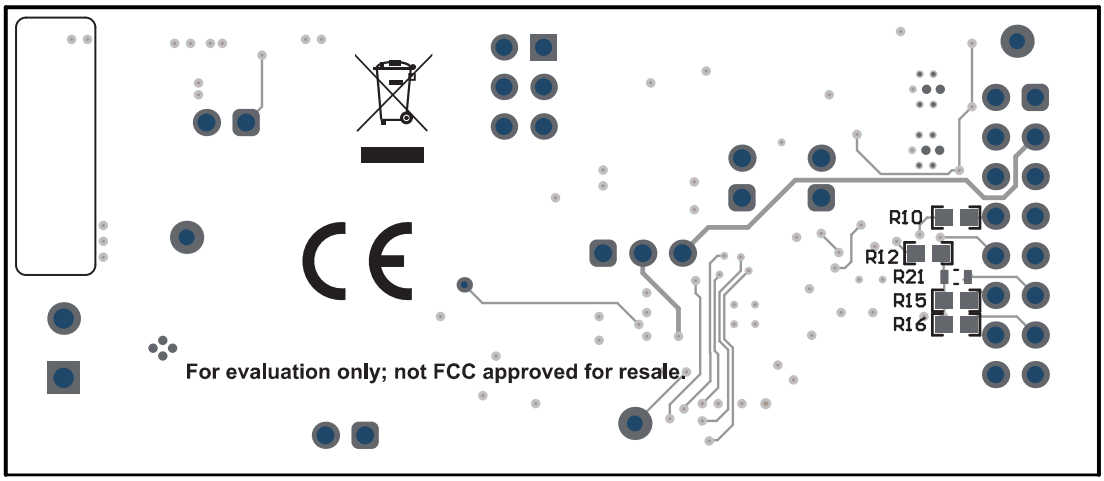


图 4-8. AFE88XH1-FELC-EVM 底层复合

4.3 物料清单 (BOM)

表 4-1. AFE881H1-FELC-EVM 物料清单

参考位号	数量	值	说明	封装参考	器件型号	制造商
C1	1	2.2nF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0603，NP0，2.2nF，10VDC		885012006015	Würth Elektronik™
C2、C4、C12、C19、C20	5	1uF	电容，陶瓷，1uF，16V，±10%，X7R，0603	0603	885012206052	Würth Elektronik
C3、C6、C9、C10、C11、C13、C24、C25	8	0.1uF	电容，陶瓷，0.1uF，10V，±10%，X7R，0603	0603	885012206020	Würth Elektronik
C5	1	2.2µF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0805，X7R，2.2µF，16VDC		885012207052	Würth Elektronik
C7	1	220pF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0603，NP0，220pF，10VDC		885012006010	Würth Elektronik
C8、C14	2	1nF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0805，X7R，1nF，50VDC		885012207086	Würth Elektronik
C15	1	1000pF	电容，陶瓷，1000pF，50V，±10%，X7R，0603	0603	885012206083	Würth Elektronik
C16	1	680pF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0603，NP0，680pF，10VDC		885012006013	Würth Elektronik
C17、C18	2	1000pF	电容，陶瓷，1000pF，50V，±10%，X7R，0402	0402	885012205061	Würth Elektronik
C21	1	100µF	WCAP-AS5H 铝电解电容器，V 形芯片，D6.3x H5.5mm，100 µ F，6.3V		865230143004	Würth Elektronik
C22	1	4.7µF	4.7µF ±20% 6.3V 陶瓷电容器 X5R 0603（公制 1608）	0603	885012106005	Würth Electronics
D1	1	100V	二极管，开关，100V，0.15A，SOD-123	SOD-123	1N4148W-TP	Micro Commercial Components
D2	1	4.7V	二极管，齐纳，4.7V，500mW，SOD-123	SOD-123	MMSZ4688T1G	onsemi®
D4	1	600V	二极管，P-N-桥，600V，2A，5.8mm × 5.3mm	5.8mm × 5.3mm	CD-MBL206SL	Bourns™
D8	1	2.4V	二极管，齐纳，2.4V，500mW，SOD-123	SOD-123	MMSZ4681T1G	onsemi
FB1、FB2	2	600Ω	铁氧体磁珠，600Ω（在 100MHz 时），0.2A，0805	0805	742792041	Würth Elektronik
J1	1		接头，2.54mm，8 × 2，镀金，R/A，TH	接头，2.54mm，8 × 2，R/A，TH	61301621021	Würth Elektronik
J2	1		接线端子，2x1，3.81mm，24-16 AWG，10A，300VAC，TH	2 × 1 端子块	691214310002	Würth Elektronik
J3	1		接头，2.54mm，3 × 1，镀金，TH	接头，2.54mm，3 × 1，TH	61300311121	Würth Elektronik
J4、J5、J7、J8	4		接头，2.54mm，2 × 1，镀金，TH	接头，2.54mm，2 × 1，TH	61300211121	Würth Elektronik

表 4-1. AFE881H1-FELC-EVM 物料清单（续）

参考位号	数量	值	说明	封装参考	器件型号	制造商
J6	1		接头，2.54mm，3x2，金，TH	接头，2.54mm，3 × 2，TH	61300621121	Würth Elektronik
LBL1	1		热转印打印标签 宽度：0.650in 高度：0.200in 10,000/卷	PCB 标签 0.650in × 0.200in	THT-14-423-10	Brady™
Q1	1	-60V	转型 GP BJT PNP 60V 0.6A 1500mW 4 引脚 (3+Tab) SOT-223T/R	SOT-223	PZT2907AT1G	onsemi™
Q2	1	40V	双极 (BJT) 晶体管 NPN 40V 200mA 300MHz 300mW 表面贴装 SOT-23-3 (TO-236)	SOT23	SMMBT3904LT3G	onsemi
Q3、Q6	2	-20V	MOSFET，P 沟道，-20V，-60A，DQG0008A (VSON-CLIP-8)	DQG0008A	CSD25404Q3	德州仪器 (TI)
Q4	1	30V	晶体管，PNP，30V，0.1A，SOT-23	SOT-23	BC858CLT1G	onsemi
Q5	1	125V	双极 (BJT) 晶体管 NPN 125V 1A 155MHz 625mW 表面贴装 SOT-23-3	SOT23	FMMT624TA	Diodes Incorporated
R1	1	1.0k	电阻，1.0k，5%，0.1W，0603	0603	RC0603JR-071KL	Yageo™
R2	1	12.0k	电阻，12.0k，0.1%，0.125W，0805	0805	RG2012P-123-B-T5	Susum™
R3	1	2.21Meg	电阻，2.21M，1%，0.1W，0603	0603	RC0603FR-072M21L	Yageo
R4	1	20.0k	电阻，20.0k，0.1%，0.1W，0603	0603	RG1608P-203-B-T5	Susum
R6	1	11.3k	电阻，11.3k，0.1%，0.1W，0603	0603	RG1608P-1132-B-T5	Susum
R7	1	88.7k	电阻，88.7k，0.1%，0.1W，0603	0603	RT0603BRD0788K7L	Yageo America
R8、R17	2	1.0Meg	电阻，1.0M，5%，0.1W，AEC-Q200 0 级，0603	0603	CRCW06031M00JNEA	Vishay-Dale
R9	1	1.00k	电阻，1.00k，0.5%，0.1W，0603	0603	RT0603DRE071KL	Yageo America
R11	1	499k	电阻，499k，0.5%，0.1W，0603	0603	RT0603DRE07499KL	Yageo America
R13、R23	2	40.200000000000003	电阻，40.2，0.1%，0.125W，0805	0805	RT0805BRD0740R2L	Yageo America
R14	1	40.2k	电阻，40.2k，0.1%，0.1W，0603	0603	RG1608P-4022-B-T5	Susumu
R18、R19、R20、R21	4	10k	10kΩ ±1% 0.1W，1/10W 片上电阻 0603（公制 1608）厚膜	0603	CRCW060310K0FKEAC	Vishay™ Semiconductor
R22	1	0	电阻，0，0%，0.25W，AEC-Q200 0 级，0603	0603	RCS06030000Z0EA	Vishay-Dale™
SH-J2、SH-J4、SH-J5	3		分流器，2.54mm，金，黑色	分流器，2.54mm，黑色	60900213421	Würth Elektronik
TP2、TP3、TP4	3		测试点，微型，白色，TH	白色微型测试点	5002	Keystone Electronics™
U1	1		具有快速瞬态响应的毫微功耗 IQ 200nA 200mA 低压降 (LDO) 稳压器	SOT-23-5	TPS7A0333DBVR	德州仪器 (TI)
U2	1		超低功耗、高精度电压基准	SOT23-6	REF35125QDBVR	德州仪器 (TI)

表 4-1. AFE881H1-FELC-EVM 物料清单（续）

参考位号	数量	值	说明	封装参考	器件型号	制造商
U3	1		具有快速瞬态响应的毫微功耗 IQ 200nA 200mA 低压降 (LDO) 稳压器 5-SOT-23（–40 至 125）	SOT23-5	TPS7A0318DBVR	德州仪器 (TI)
U4	1		适用于 4mA 至 20mA 环路供电应用且具有内部 HART 调制解调器、电压基准和诊断 ADC 的 16 位低功耗 DAC，UQFN24	UQFN24	AFE881H1RRUT	德州仪器 (TI)
U5	1		通用放大器 1 电路轨至轨 SC-70-5	SC70-5	OPA391DCKT	德州仪器 (TI)
U6	1		33V 双向平缓钳位浪涌保护器件，DRB0008A (VSON-8)	DRB0008A	TVS3301DRBR	德州仪器 (TI)
U7	1		具有电压转换功能的 1.65V 至 5.5V 8 位并行负载移位寄存器	WQFN16	SN74LV8T165BQBR	德州仪器 (TI)
U8	1		具有 1.8V 逻辑控制、DCK0006A (SOT-SC70-6) 的单通道、2:1 通用模拟多路复用器	DCK0006A	TMUX1219DCKR	德州仪器 (TI)

表 4-2. AFE882H1-FELC-EVM 物料清单

参考位号	数量	值	说明	封装参考	器件型号	制造商
C1	1	2.2nF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0603，NP0，2.2nF，10VDC		885012006015	Würth Elektronik
C2、C4、C12、C19、C20	5	1uF	电容，陶瓷，1uF，16V，±10%，X7R，0603	0603	885012206052	Würth Elektronik
C3、C6、C9、C10、C11、C13、C24、C25	8	0.1uF	电容，陶瓷，0.1uF，10V，±10%，X7R，0603	0603	885012206020	Würth Elektronik
C5	1	2.2µF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0805，X7R，2.2µF，16VDC		885012207052	Würth Elektronik
C7	1	220pF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0603，NP0，220pF，10VDC		885012006010	Würth Elektronik
C8、C14	2	1nF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0805，X7R，1nF，50VDC		885012207086	Würth Elektronik
C15	1	0.022uF	电容，陶瓷，0.022uF，50V，±10%，X7R，0603	0603	885012206091	Würth Elektronik
C16	1	680pF	WCAP-CSGP 多层陶瓷贴片电容器，通用，尺寸 0603，NP0，680pF，10VDC		885012006013	Würth Elektronik
C17、C18	2	1000pF	电容，陶瓷，1000pF，50V，±10%，X7R，0402	0402	885012205061	Würth Elektronik
C21	1	100µF	WCAP-AS5H 铝电解电容器，V 形芯片，6.3mm × 5.5mm，100 µ F，6.3V		865230143004	Würth Elektronik
C22	1	4.7µF	4.7µF ±20% 6.3V 陶瓷电容器 X5R 0603（公制 1608）	0603	885012106005	Würth Electronics
D1	1	100V	二极管，开关，100V，0.15A，SOD-123	SOD-123	1N4148W-TP	Micro Commercial Components™
D2	1	4.7V	二极管，齐纳，4.7V，500mW，SOD-123	SOD-123	MMSZ4688T1G	onsemi
D4	1	600V	二极管，P-N-桥，600V，2A，5.8x5.3mm	5.8x5.3mm	CD-MBL206SL	Bourns
D8	1	2.4V	二极管，齐纳，2.4V，500mW，SOD-123	SOD-123	MMSZ4681T1G	onsemi
FB1、FB2	2	600Ω	铁氧体磁珠，600Ω（在 100MHz 时），0.2A，0805	0805	742792041	Würth Elektronik
J1	1		接头，2.54mm，8 × 2，镀金，R/A，TH	接头，2.54mm，8 × 2，R/A，TH	61301621021	Würth Elektronik
J2	1		接线端子，2 × 1，3.81mm，24-16 AWG，10A，300VAC，TH	2 × 1 端子块	691214310002	Würth Elektronik
J3	1		接头，2.54mm，3 × 1，镀金，TH	接头，2.54mm，3 × 1，TH	61300311121	Würth Elektronik
J4、J7	2		接头，2.54mm，2 × 1，镀金，TH	接头，2.54mm，2 × 1，TH	61300211121	Würth Elektronik
J6	1		接头，2.54mm，3 × 2，镀金，TH	接头，2.54mm，3 × 2，TH	61300621121	Würth Elektronik

表 4-2. AFE882H1-FELC-EVM 物料清单（续）

参考位号	数量	值	说明	封装参考	器件型号	制造商
LBL1	1		热转印打印标签，0.650in	PCB 标签 0.650in × 0.200in	THT-14-423-10	Brady
Q1	1	-60V	转型 GP BJT PNP 60V 0.6A 1500mW 4 引脚 (3+Tab) SOT-223T/R	SOT-223	PZT2907AT1G	onsemi
Q2	1	40V	双极 (BJT) 晶体管 NPN 40V 200mA 300MHz 300mW 表面贴装 SOT-23-3 (TO-236)	SOT23	SMMBT3904LT3G	onsemi
Q3	1	-20V	MOSFET，P 沟道，-20V，-60A，DQG0008A (VSON-CLIP-8)	DQG0008A	CSD25404Q3	德州仪器 (TI)
Q4	1	30V	晶体管，PNP，30V，0.1A，SOT-23	SOT-23	BC858CLT1G	onsemi
Q5	1	125V	双极 (BJT) 晶体管 NPN 125V 1A 155MHz 625mW 表面贴装 SOT-23-3	SOT23	FMMT624TA	Diodes Incorporated™
R1	1	1.0k	电阻，1.0k，5%，0.1W，0603	0603	RC0603JR-071KL	Yageo
R2	1	12.0k	电阻，12.0k，0.1%，0.125W，0805	0805	RG2012P-123-B-T5	Susumu
R3	1	2.21Meg	电阻，2.21M，1%，0.1W，0603	0603	RC0603FR-072M21L	Yageo
R4、R6、R14	3	20.0k	电阻，20.0k，0.1%，0.1W，0603	0603	RG1608P-203-B-T5	Susumu
R5	1	412k	电阻，412k，0.1%，0.1W，0603	0603	RT0603BRD07412KL	Yageo America
R7	1	100k	电阻，100k，0.1%，0.1W，0603	0603	RG1608P-104-B-T5	Susumu
R8、R17	2	1.0Meg	电阻，1.0M，5%，0.1W，AEC-Q200 0 级，0603	0603	CRCW06031M00JNEA	Vishay-Dale
R9	1	4.99k	电阻，4.99k，0.1%，0.1W，0603	0603	RT0603BRD074K99L	Yageo America
R11	1	499k	电阻，499k，0.5%，0.1W，0603	0603	RT0603DRE07499KL	Yageo America
R13	1	20	电阻，20.0，0.1%，0.125W，0805	0805	RT0805BRD0720RL	Yageo America
R18、R19、R20、R21	4	10k	10kΩ ±1% 0.1W，1/10W 片上电阻 0603（公制 1608）厚膜	0603	CRCW060310K0FKEAC	Vishay-Dale
R22	1	0	电阻，0，0%，0.25W，AEC-Q200 0 级，0603	0603	RCS06030000Z0EA	Vishay-Dale
SH-J2、SH-J4、SH-J5	3		分流器，2.54mm，金，黑色	分流器，2.54mm，黑色	60900213421	Würth Elektronik
TP2、TP3、TP4	3		测试点，微型，白色，TH	白色微型测试点	5002	Keystone Electronics
U1	1		具有快速瞬态响应的毫微功耗 IQ 200nA 200mA 低压降 (LDO) 稳压器	SOT-23-5	TPS7A0333DBVR	德州仪器 (TI)
U2	1		超低功耗、高精度电压基准	SOT23-6	REF35125QDBVR	德州仪器 (TI)
U3	1		具有快速瞬态响应的毫微功耗 IQ 200nA 200mA 低压降 (LDO) 稳压器 5-SOT-23（–40 至 125）	SOT23-5	TPS7A0318DBVR	德州仪器 (TI)
U4	1		AFE882H1RRUT	UQFN24	AFE882H1RRUT	德州仪器 (TI)
U5	1		通用放大器 1 电路轨至轨 SC-70-5	SC70-5	OPA391DCKT	德州仪器 (TI)
U6	1		33V 双向平缓钳位浪涌保护器件，DRB0008A (VSON-8)	DRB0008A	TVS3301DRBR	德州仪器 (TI)

表 4-2. AFE882H1-FELC-EVM 物料清单（续）

参考位号	数量	值	说明	封装参考	器件型号	制造商
U7	1		具有电压转换功能的 1.65V 至 5.5V 8 位并行负载移位寄存器	WQFN16	SN74LV8T165BQBR	德州仪器 (TI)
U8	1		具有 1.8V 逻辑控制、DCK0006A (SOT-SC70-6) 的单通道、2:1 通用模拟多路复用器	DCK0006A	TMUX1219DCKR	德州仪器 (TI)

5 其他信息

商标

Würth Elektronik™ is a trademark of Würth Elektronik GmbH & Co. KG.
Bourns™ is a trademark of Bourns, Inc..
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6 相关文档

1. 德州仪器 (TI)，*SNSR-DUAL-ADC-EVM 产品页面*
2. 德州仪器 (TI)，*SNSR-DUAL-ADC-EVM 评估模块用户指南*
3. 德州仪器 (TI)，*AFE881H1 产品页面*
4. 德州仪器 (TI)，*AFE882H1 产品页面*
5. 德州仪器 (TI)，*TIDA-010982 设计指南*

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 DEGREDATION 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 instruction manual, 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/lsds/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。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/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:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs 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 assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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