EVM User's Guide: LMK6EVM, LMK6C, LMK6D, LMK6H, LMK6P

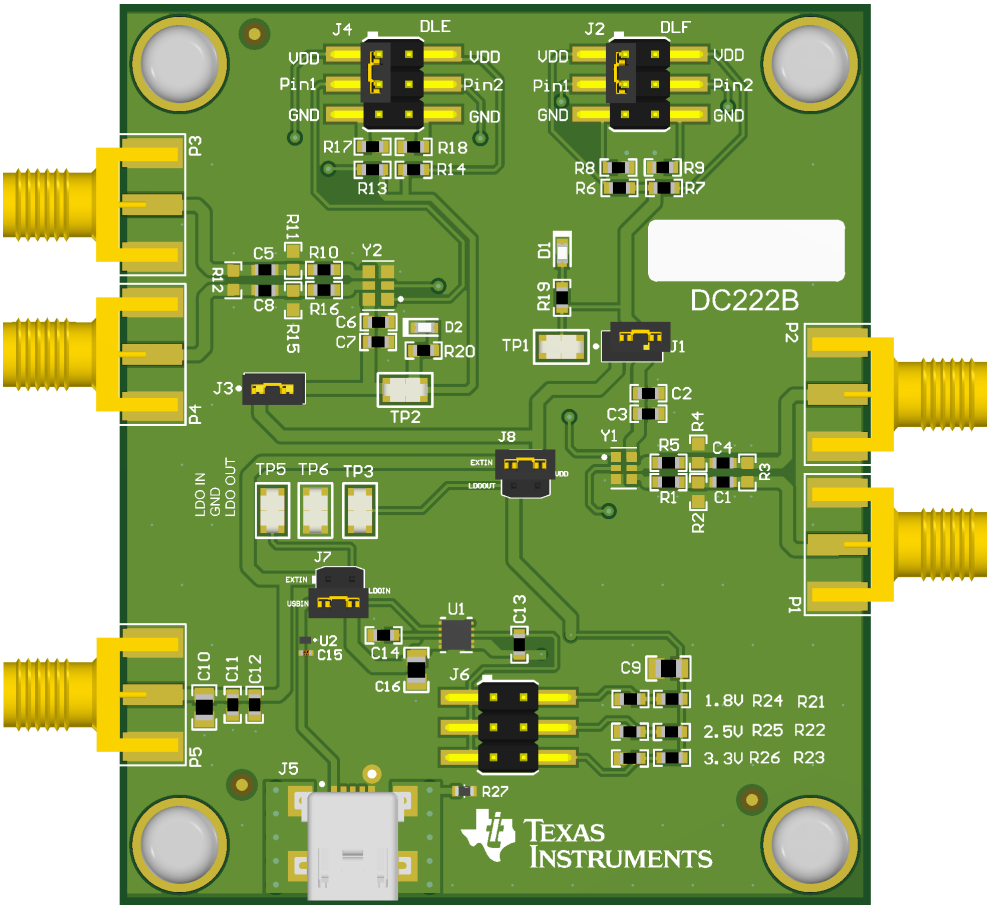
LMK6x Evaluation Module

Description

The LMK6x evaluation module (EVM) is a platform for evaluating the performance of the LMK6x family of high-performance bulk acoustic wave (BAW) oscillators. BAW is a microresonator technology that enables the integration of high-precision and ultra-low jitter clocks directly into packages that contain other circuits.

Features

- Fixed-frequency oscillator using TI's BAW technology
- Supports standard 3.2mm × 2.5mm and 2.5mm × 2mm, 4-pin or 6-pin package oscillators
- Low output jitter
- Supply voltage options of 1.8V and 2.5V to 3.3V



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1 Evaluation Module Overview

1.1 Introduction

The LMK6EVM provides a complete evaluation platform to evaluate the clock performance and flexibility of the Texas Instruments LMK6x Ultra-Low Jitter BAW Oscillator family. This EVM can be used as a flexible clock source for compliance testing, performance evaluation, and initial system prototyping. The onboard edge-launch SMA ports provide access to the configurable clock output of the LMK6x, which allows the device to interface with test equipment and reference boards using commercially available coaxial cables, adapters, or baluns (not included).

The LMK6x is a lower-power clock oscillator using TI's BAW technology. The LMK6x is available in two package sizes, DLE (3.2mm × 2.5mm) and DLF (2.5mm × 2.0mm), and four different output formats: LVCMOS, LVPECL, LVDS, and HCSL. Both footprints are included on the EVM with independent termination networks. The termination scheme can be modified by the user for the desired output format.

Note

The LMK6EVM is not populated with an LMK6x device by default. The user can choose the desired oscillator variant for evaluation. Contact TI to pre-order specific LMK6x device variants at ti_osc_customer_requirement@list.ti.com.

1.2 Evaluation Module Contents

The box contains:

- One LMK6EVM board (DCC222A)

1.3 Evaluation Setup Requirement

The evaluation requires the following hardware:

- DC power supply or USB power supply
- Oscilloscope
- Signal analyzer (optional)
- LMK6x device

2 Hardware

2.1 Setup

2.1.1 Connection Diagram

Figure 2-1 shows the LMK6EVM (DCC222A) connection diagram. To test LMK6xDLF variants (DLF 2.5mm × 2.0mm package), the device must be soldered on Y1, and P1 and P2 can be connected to an oscilloscope or phase noise analyzer to evaluate the device output. Similarly for LMK6xDLE variants (DLE 3.2mm × 2.5mm package), the device must be soldered on Y2, and P3 and P4 used accordingly to measure the output. Note that for LMK6C variants with an LVCMOS output format, only the positive clock output connection is used. The 4-pin LMK6C variants can share the same footprint as the 6-pin LMK6D/P/H variants. The corner pins are shared, but the middle pins are left unused for the LMK6C devices.

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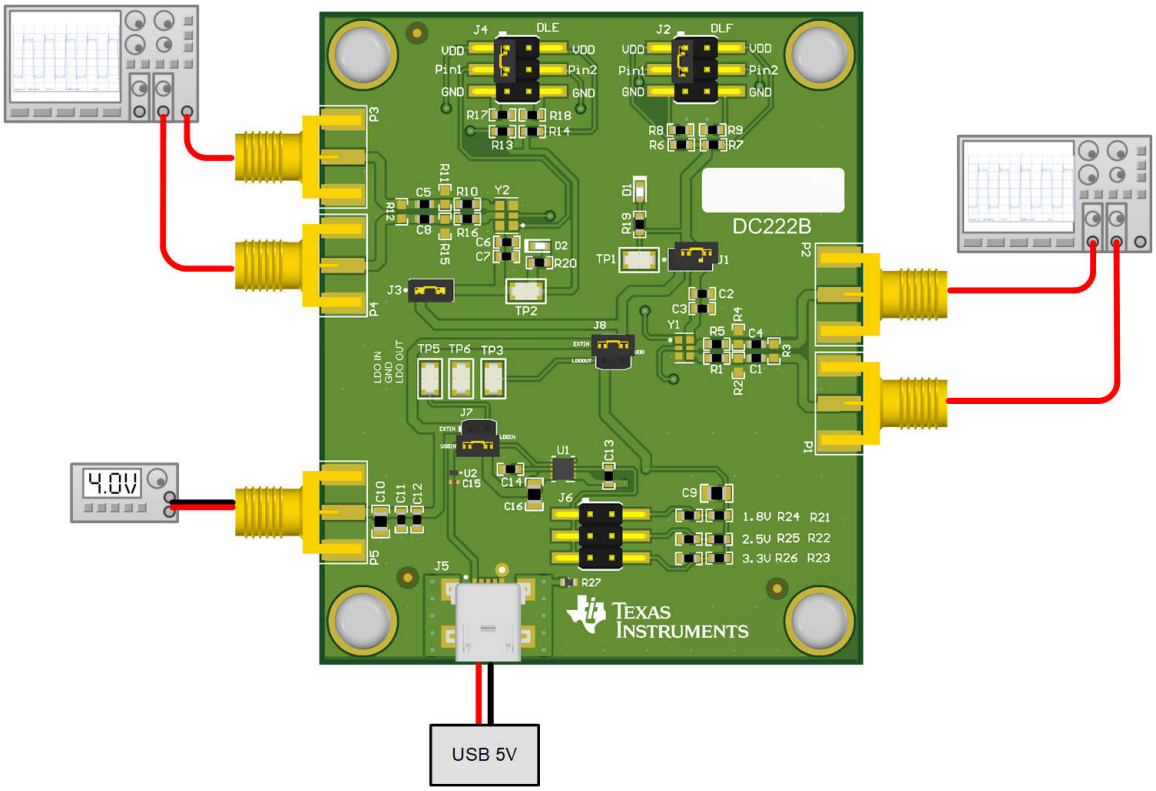

Figure 2-1. Connection Diagram

2.1.2 Power Supply

Apply 4V to the EXTIN SMA connector (P5), or supply 5V via the mini USB connector. The onboard voltage regulator provides 1.8V, 2.5V, or 3.3V to the LMK6X devices based on the jumper selection on J6. The external supply connected to P5 can also directly supply voltage to the LMK6x device by shorting pins 1 and 2 on J8.

2.1.3 Clock Output

To test the clock output of Y1, connect P1 (+) and P2 (–) SMA connectors to an oscilloscope or phase noise analyzer. To test the clock output of Y2, use P3 (–) and P4 (+). The output frequency, amplitude, and common-mode voltage depends on the LMK6x variant that is attached to the board, as well as the termination scheme.

2.1.4 EVM Strap Options

2.1.4.1 J1 Header

Put the short across J1 to provide the supply voltage to Y1.

2.1.4.2 J2 Header

J2 is used to pull pin 1 and pin 2 of Y1 to VDD/GND to select the output enable (OE) pin of the LMK6x device. 6-pin LMK6xA/LMK6xE variants use pin 1 for OE, and LMK6xB/LMK6xF variants use pin 2. All 4-pin LMK6C variants use pin 1 for OE.

2.1.4.3 J3 Header

Put the short across J3 to provide the supply voltage to Y2.

2.1.4.4 J4 Header

J4 is used to pull pin 1 and pin 2 of Y2 to VDD/Gnd to select the output enable (OE) pin of the LMK6x device. 6-pin LMK6xA/LMK6xE variants use pin 1 for OE, and LMK6xB/LMK6xF variants use pin 2. All 4-pin LMK6C variants use pin 1 for OE.

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2.1.4.5 J6 Header

J6 is used to select the output voltage of the onboard voltage regulator.

2.1.4.6 J7 Header

J7 selects the input voltage source for the onboard regulator. Short pins 1 and 2 to use an external supply connected to the SMA connector P5. Short pins 3 and 4 to use a USB supply.

2.1.4.7 J8 Header

J8 selects the input voltage source for the LMK6x device. Short pins 1 and 2 to use an external supply directly. Short pins 3 and 4 to use the output from the onboard voltage regulator.

2.1.5 Configuring the Clock Output Termination

The LMK6EVM comes pre-populated with an AC-coupled LVCMOS termination. The termination can be modified by the user to support LVPECL, LVDS, and HCSL output formats according to the component values in the table below.

Table 2-1. Output Termination Schemes for Y1

OUTPUT FORMAT	COUPLING	COMPONENT	VALUE
LVPECL	AC	R1, R5	0Ω
		R2, R4	210Ω
		C1, C4	0.01µF
		R3	DNP
	DC(1)	R1, R5, C1, C4	0Ω
		R2, R3, R4	DNP
LVDS (2)	AC	R1, R5	0Ω
		R3	100Ω
		C1, C4	0.01µF
		R2, R4	DNP
	DC	R1, R5, C1, C4	0Ω
		R3	100Ω
		R2, R4	DNP
HCSL	AC	R1, R5	0Ω
		R2, R4	50Ω
		C1, C4	0.01µF
		R3	DNP
	DC	R1, R5, C1, C4	0Ω
		R2, R4	50Ω
		R3	DNP

(1) 50Ω to Vcc – 2V termination is required on the receiver.
(2) 100Ω differential termination (R3) is provided on the LMK6EVM. Removing the differential termination on the EVM is possible if the differential termination is available on the receiver.

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Table 2-2. Output Termination Schemes for Y2

OUTPUT FORMAT	COUPLING	COMPONENT	VALUE
LVPECL	AC	R10, R16	0Ω
		R11, R15	210Ω
		C5, C8	0.01µF
		R12	DNP
	DC(1)	R10, R16, C5, C8	0Ω
		R11, R12, R15	DNP
LVDS(2)	AC	R10, R16	0Ω
		R12	100Ω
		C5, C8	0.01µF
		R11, R15	DNP
	DC	R10, R16, C5, C8	0Ω
		R12	100Ω
		R11, R15	DNP
HCSL	AC	R10, R16	0Ω
		R11, R15	50Ω
		C5, C10	0.01µF
		R12	DNP
	DC	R10, R16, C5, C8	0Ω
		R11, R15	50Ω
		R12	DNP

(1) 50Ω to Vcc - 2V termination is required on the receiver.
(2) 100Ω differential termination (R3) is provided on the LMK6EVM. Removing the differential termination on the EVM is possible if the differential termination is available on the receiver.

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3 Implementation Results

3.1 Typical Measurement

3.1.1 Phase Noise

Figure 3-1 shows the typical phase noise for the LMK6EVM populated with the 156.25MHz variant of the LMK6H/LMK6P.

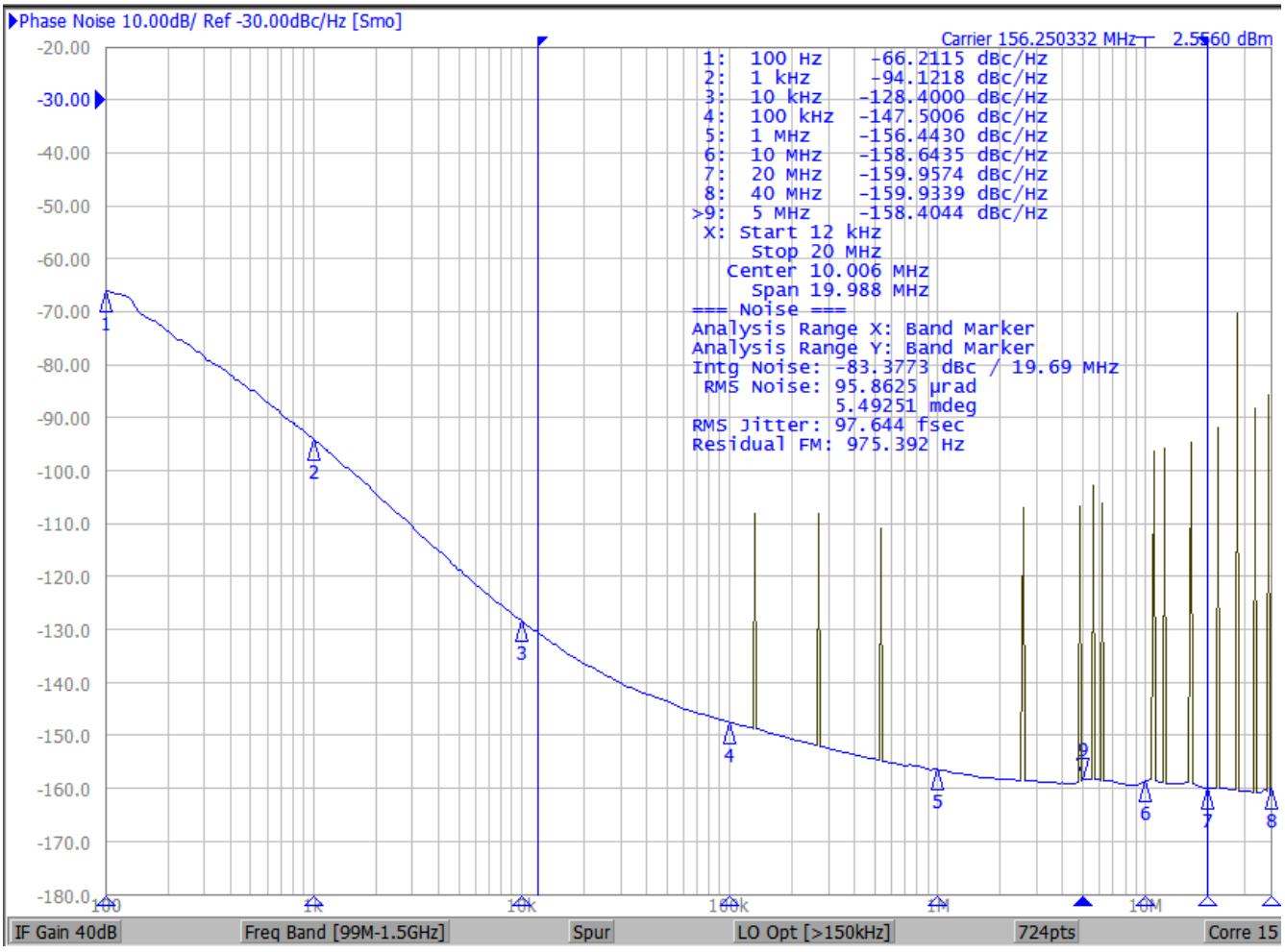

Figure 3-1. LMK6EVM Phase Noise

4 Hardware Design Files

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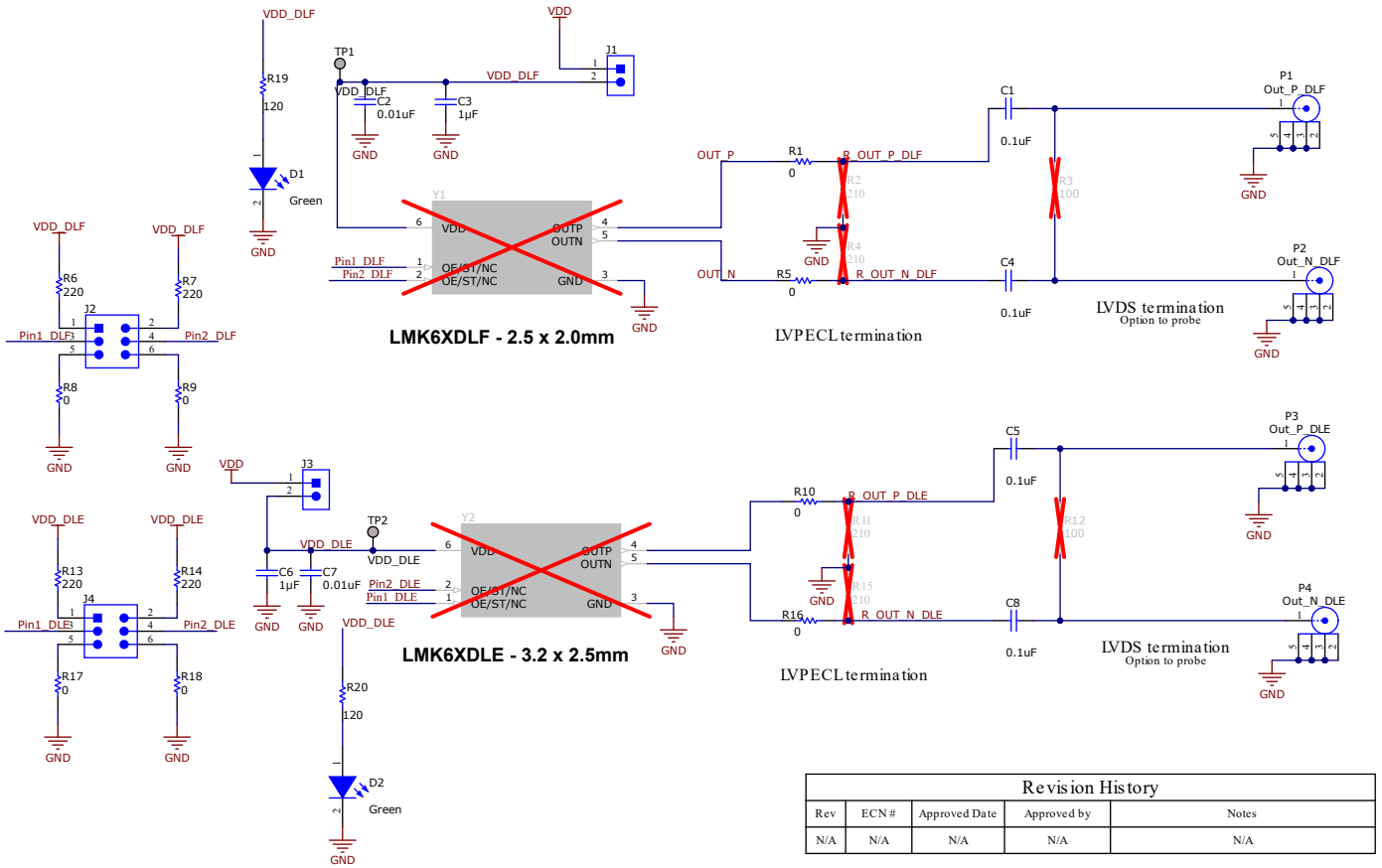
4.1 Schematics



Revision History				
Rev	ECN #	Approved Date	Approved by	Notes
N/A	N/A	N/A	N/A	N/A

Figure 4-1. Schematic - Oscillators

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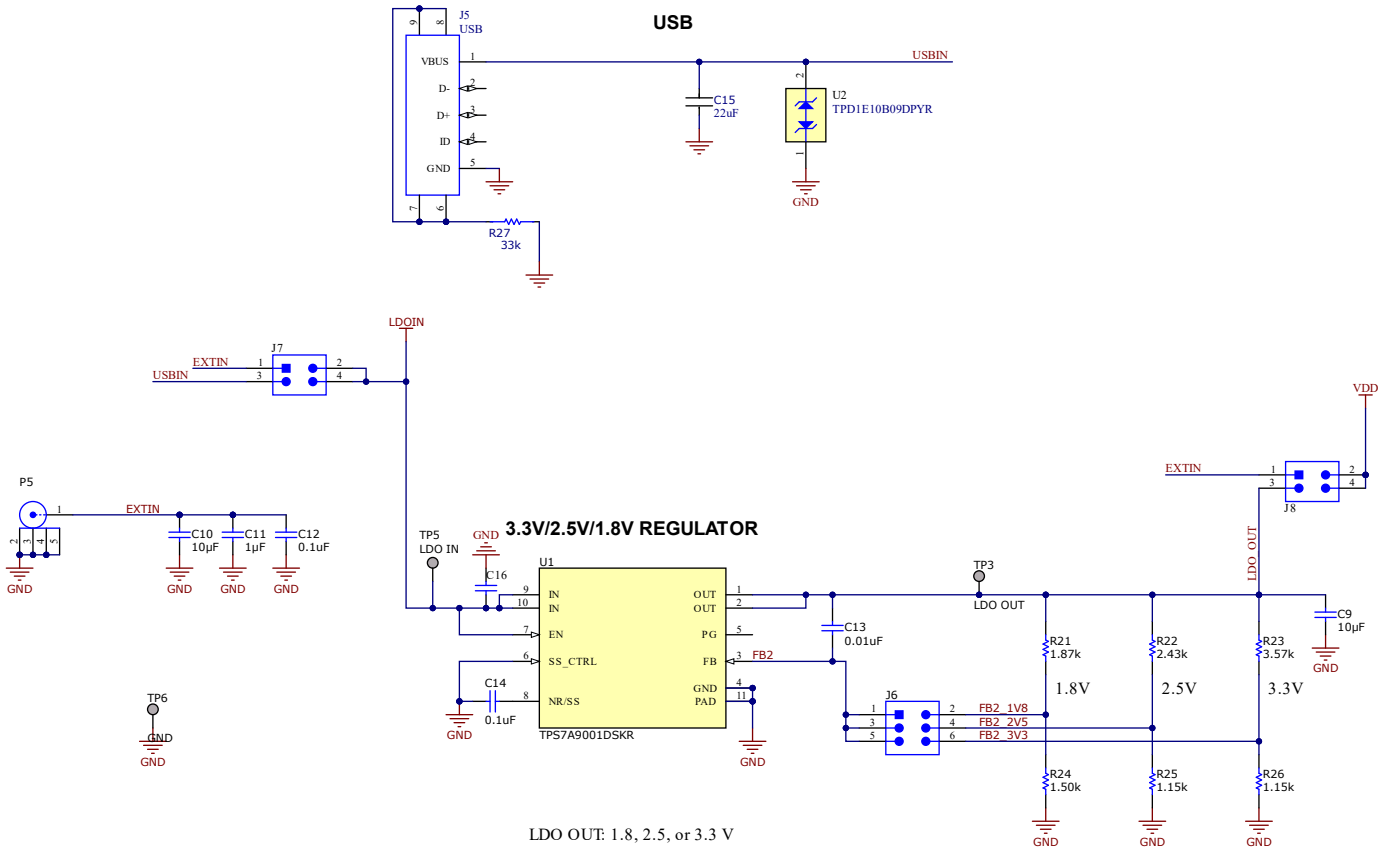

Figure 4-2. Schematic - Power Supply

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4.2 PCB Layout and Layer Stack-Up

4.2.1 PCB Layer Stack-Up

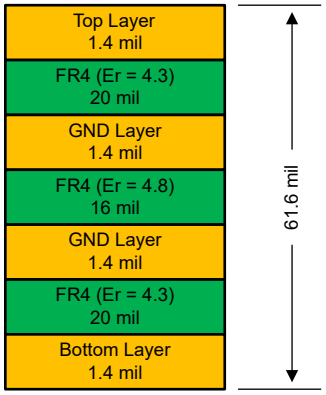

Figure 4-3. PCB Layer Stack-Up

4.2.2 PCB Layout

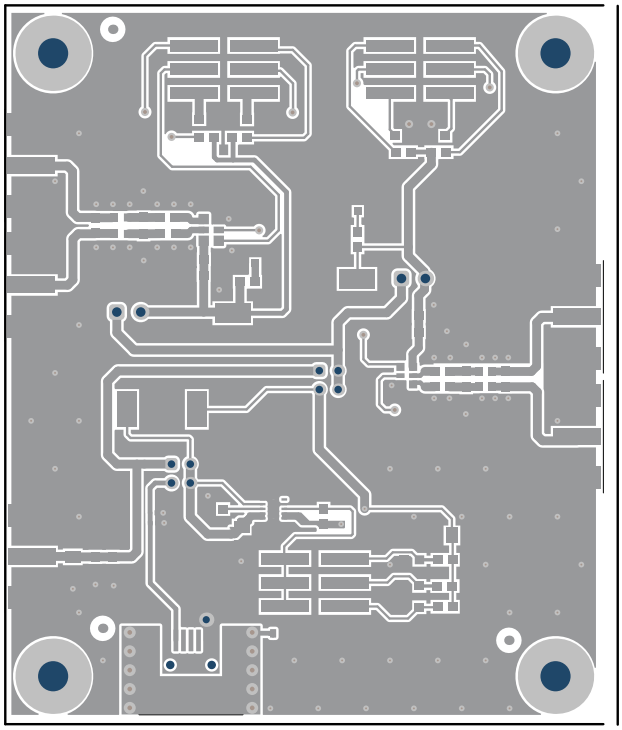

Figure 4-4. Top Layer

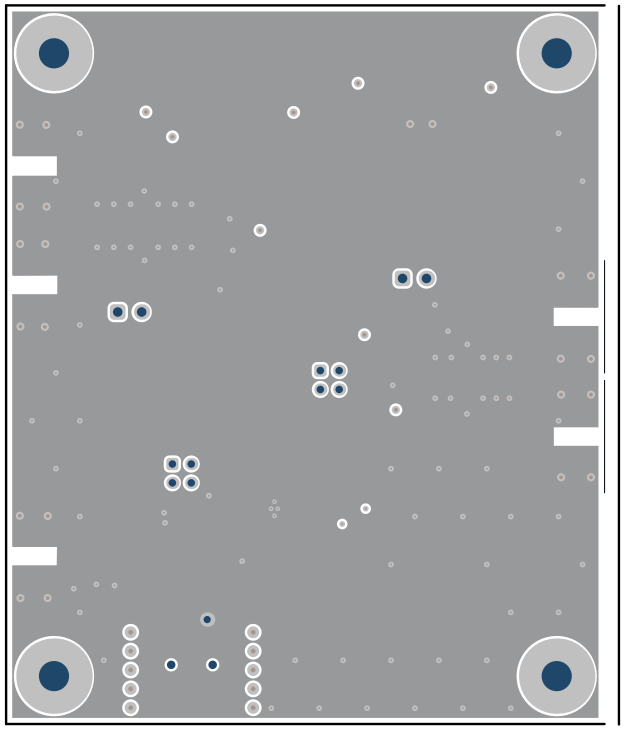

Figure 4-5. GND Layer

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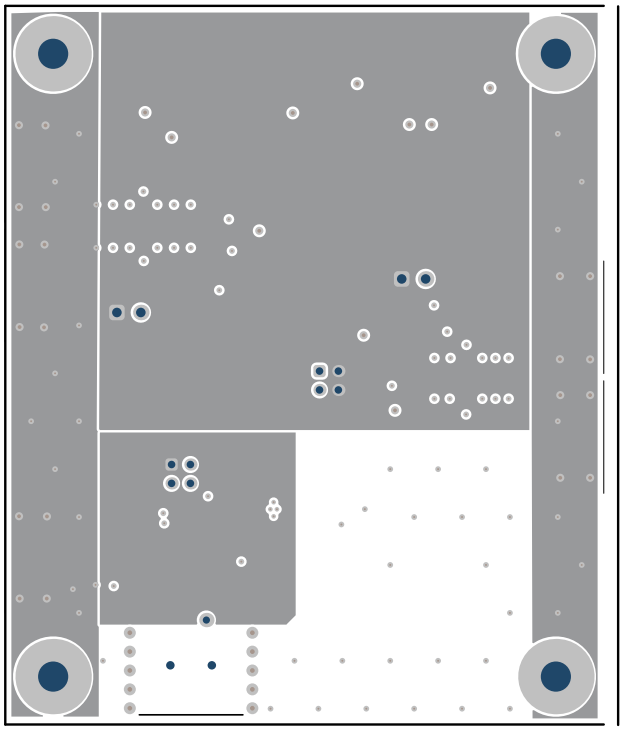

Figure 4-6. PWR Layer

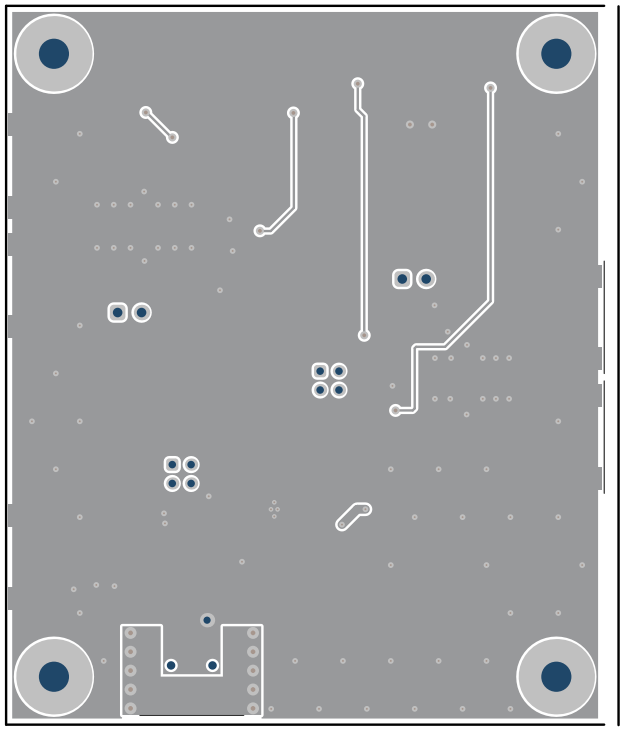

Figure 4-7. Bottom Layer

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4.3 Bill of Materials

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
C1, C4, C5, C8, C12, C14	6	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 5%, X7R, 0603	0603	C0603C104J4RACTU	Kemet
C2, C7	2	0.01uF	CAP, CERM, 0.01 uF, 100 V, +/- 5%, X7R, 0603	0603	06031C103JAT2A	AVX
C3, C6, C11	3	1uF	CAP, CERM, 1 µF, 16 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	CGA3E1X7R1C105K080AC	TDK
C9, C10, C16	3	10uF	CAP, CERM, 10 uF, 16 V, +/- 20%, X7R, 0805	0805	EMK212BB7106MG-T	Taiyo Yuden
C13	1	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 5%, X7R, 0603	0603	C0603C103J5RACTU	Kemet
C15	1		CAP CER 22UF 6.3V X5R 0402	0402 (1005 Metric)	CL05A226MQ5N6J8	Samsung Electro-Mechanics
D1, D2	2	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J3	2		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07-G-S	Samtec
J2, J4, J6	3		Header, 2.54mm, 3x2, Gold, Black, SMT	Header, 2.54mm, 3x2, SMT	GBC03DABN-M30	Sullins Connector Solutions
J5	1		Connector, Receptacle, Mini-USB Type B, R/A, Top Mount SMT	USB Mini Type B	1734035-2	TE Connectivity
J7, J8	2		Header, 2mm, 2x2, Gold, TH	Header, 2mm, 2x2, TH	951204-8622-AR	3M
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady
P1, P2, P3, P4, P5	5		Connector, End launch SMA, 50 ohm, SMT	SMA End Launch	142-0701-851	Cinch Connectivity
R1, R5, R8, R9, R10, R16, R17, R18	8	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R6, R7, R13, R14	4	220	RES, 220, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603220RJNEA	Vishay-Dale
R19, R20	2	120	RES, 120, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603120RJNEA	Vishay-Dale

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Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
R21	1	1.87k	RES, 1.87 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031K87FKEA	Vishay-Dale
R22	1	2.43k	RES, 2.43 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06032K43FKEA	Vishay-Dale
R23	1	3.57k	RES, 3.57 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06033K57FKEA	Vishay-Dale
R24	1	1.50k	RES, 1.50 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031K50FKEA	Vishay-Dale
R25, R26	2	1.15k	RES, 1.15 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031K15FKEA	Vishay-Dale
R27	1	33k	33 kOhms ±0.1% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200 Thin Film	0603	ERA-3AEB333V	Panasonic
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6	6	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP1, TP2, TP3, TP5, TP6	5		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
U1	1		500mA High-Accuracy Low-Noise Low-Dropout (LDO) Voltage Regulator, DSK0010A (WSON-10)	DSK0010A	TPS7A9001DSKR	Texas Instruments
U2	1		Single-Channel ESD Protection in 0402 Package With 10pF Capacitance and 9V Breakdown, DPY0002A (X1SON-2)	DPY0002A	TPD1E10B09DPYR	Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
R2, R4, R11, R15	0	210	RES, 210, 1%, 0.1 W, 0603	0603	RC0603FR-07210RL	Yageo
R3, R12	0	100	RES, 100, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603100RFKEA	Vishay-Dale
Y1	0		Low Jitter, High-Performance BAW Oscillator	VSON6	LMK6DxxxDLF	Texas Instruments
Y2	0		Low Jitter, High-Performance BAW Oscillator	VSON6	LMK6DxxxDLE	Texas Instruments

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5 Additional Information

5.1 Trademarks

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6 References

See the *LMK6x Low Jitter, High-Performance BAW Oscillator* data sheet for more information about the LMK6x devices.

7 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision B (February 2024) to Revision C (October 2024)	Page
• Updated the number formatting for tables, figures, and cross-references throughout the document	1
• Updated diagrams, schematics, and usage information throughout document to reflect changes made on RevB of evaluation module	2

Changes from Revision A (December 2022) to Revision B (February 2024)	Page
• Added note to *Introduction* section	2
• Updated *Connection Diagram* section	2

Changes from Revision * (April 2022) to Revision A (December 2022)	Page
• Changed the LMK6E6EVM-1/LMK6F6EVM to LMK6EVM	2

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