

ABSTRACT

The LMK1D1216 is a high-performance, low-additive jitter LVDS clock buffer with two universal inputs, 16 LVDS outputs, and an input select pin.

This evaluation module (EVM) is designed to demonstrate the electrical performance of the LMK1D1216 or other 48-pin devices in the LMK1Dxxxx family. Throughout this document, the acronym EVM and the phrases evaluation module and evaluation board are synonymous with the LMK1D1216EVM.

The LMK1D1216EVM is equipped with 50-Ω SMA connectors and impedance-controlled 50-Ω microstrip transmission lines for best performance.

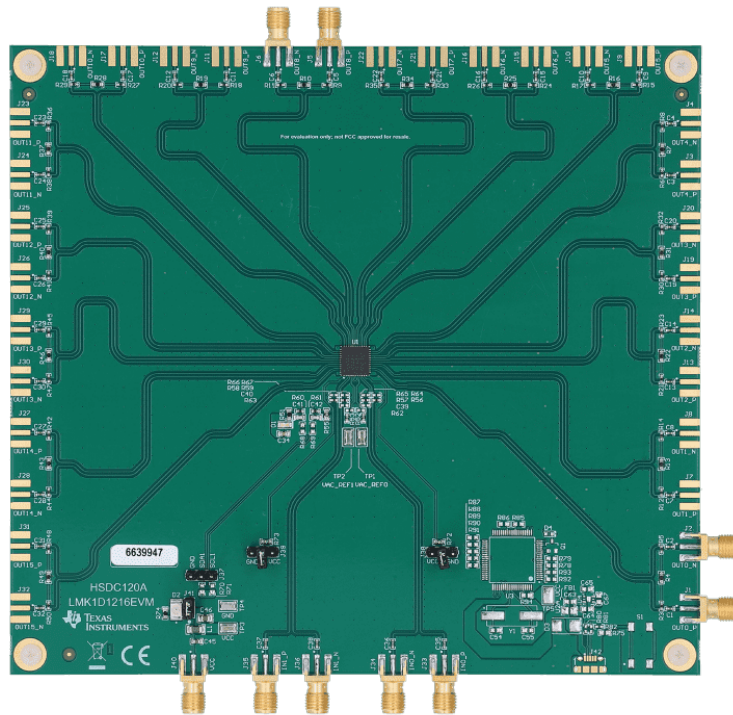


Figure 1-1. LMK1D1216 Evaluation Board

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Trademarks

All trademarks are the property of their respective owners.

1 Features

- Easy-to-use evaluation board to fan out low-phase noise clocks
- Supports output frequencies of up to 2 GHz
- Simple, fast device configuration and setup
- Control pin(s) configurable through jumpers
- Single supply input powered at either 1.8 V, 2.5 V, or 3.3 V
- Differential or single-ended input clocks accepted
- EVM supports all 16 differential LVDS outputs.

2 General Description

The LMK1D1216 is a high-performance, low-additive jitter clock buffer. This has two universal input buffers that support differential clock inputs which can be selected by the control pin. The device also features on-chip bias generators that can provide LVDS common-mode voltage for AC-coupled differential clock inputs.

By default, the evaluation module (EVM) is designed to demonstrate the electrical performance of the LMK1D1216 but can be replaced by the LMK1D2108 and, after populating the missing I2C components, the LMK1D1216I. The I2C-capable LMK1D1216I can be used through Micro-USB and by interfacing with the [TICS Pro software](#).

This fully assembled and factory-tested evaluation board allows complete validation of device functionalities. For optimum performance, the board is equipped with SMA connectors and well-controlled, 50- Ω impedance microstrip transmission lines.

3 Signal Path and Control Circuitry

The LMK1D1216 supports single-ended inputs up to 250 MHz and differential inputs up to 2 GHz. Each device provides up to 16 LVDS outputs that operate at the selected input frequency.

For more information, see the [LMK1D1216 Low Additive Jitter LVDS Buffer](#) data sheet (SNAS823) for details.

4 Getting Started

The EVM has self-explanatory labeling and offers almost the same naming convention used in the data sheets. The ***bold italic*** text in this document follows the same spelling as the actual labeling on the EVM board. By default, the EVM can be used with differential inputs and, after board modification, with single-ended inputs.

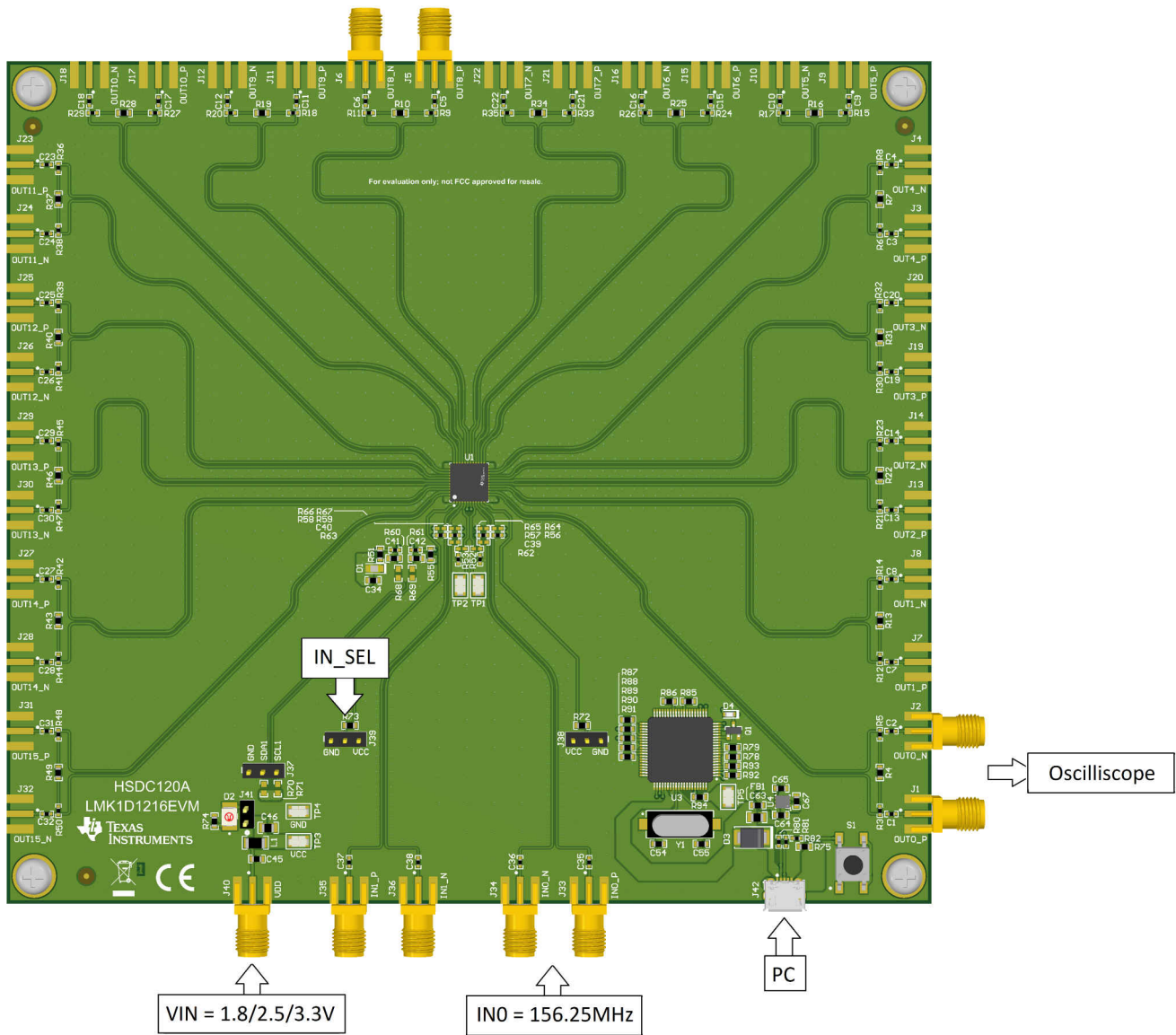


Figure 4-1. LMK1D1216EVM Quick Start Guide

5 Power Supply Connection

Connect the power supply source to the SMA connector, **J40** (VDD). Test points, **TP3** (VCC) and **TP4** (GND), can be used as an alternative power supply source. The decoupling capacitors and ferrite bead isolate the EVM power from the power pins of the device.

A supply voltage of 1.71 V to 3.465 V can be used for this EVM.

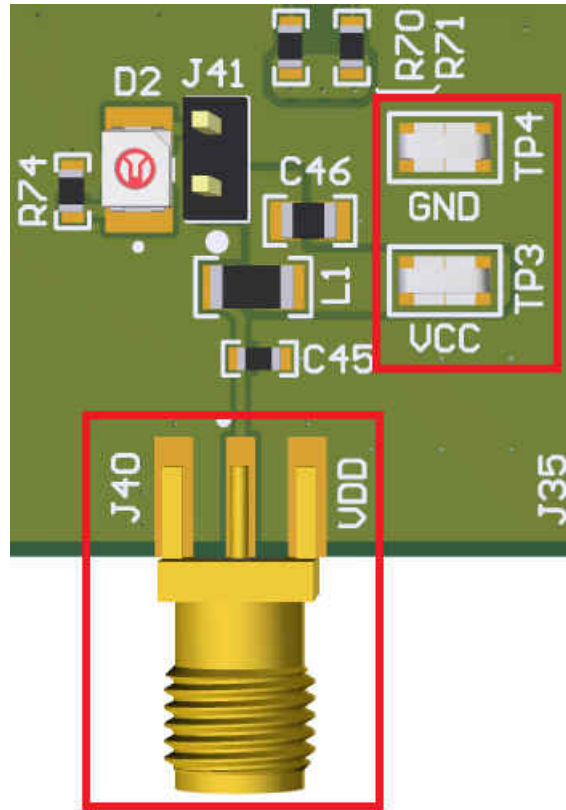


Figure 5-1. Power Supply Connection Layout

6 Input Clock Selection

The LMK1D1212 can receive either a differential or single-ended clock as input. The default board configuration is for a differential signal at both device inputs. The inputs can be applied through the SMAs, **J33**, **J34** (IN0_P, IN0_N) or **J35**, **J36** (IN1_P, IN1_N). These inputs are AC-coupled to the device. The common-mode voltage is provided by the device on-chip bias generator (V_{AC_REF}) pins or **TP2** and **TP1**.

LMK1D1216: Jumper, **J39**, can be used to select between the two input clocks. **IN0** is selected when **J39** connects **IN_SEL** to **GND**. **IN1** is selected when **J39** connects **IN_SEL** to **VDD**.

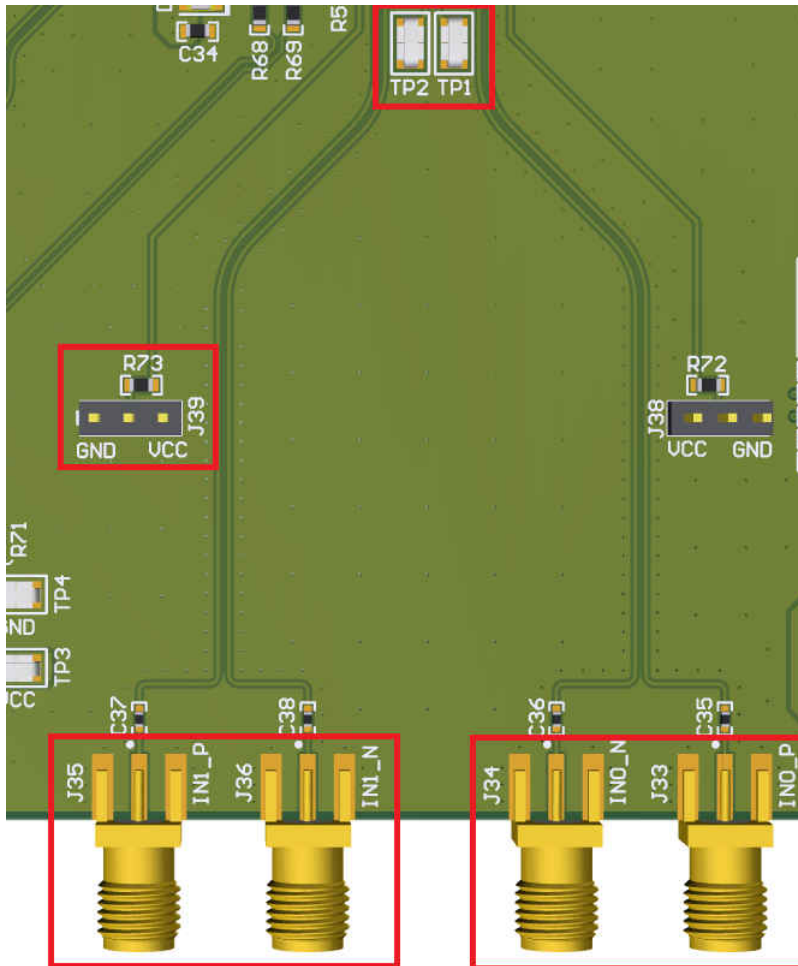


Figure 6-1. Input Clock Selection Layout

6.1 Differential Input

Differential input is configured by default.

6.2 Single-Ended Input

Single-ended input must be configured by replacing or removing passive components on the board. Follow [Table 6-1](#) for proper setup of a single-ended input.

Table 6-1. Single-Ended Configurations by Bias Voltage

BIAS VOLTAGE TO IN _x _N (V)	INPUT TO IN _x _P (V)	INPUT	REMOVE BIASING RESISTOR	REMOVE COMMON-MODE RESISTOR	REPLACE WITH 0-Ω RESISTOR	REPLACE WITH 100-Ω RESISTOR
0.9	1.8 (LVCMOS)	IN0_N	R56	R38	C35	N/A
		IN0_P	R57		C36	N/A

Table 6-1. Single-Ended Configurations by Bias Voltage (continued)

BIAS VOLTAGE TO INx_N (V)	INPUT TO INx_P (V)	INPUT	REMOVE BIASING RESISTOR	REMOVE COMMON-MODE RESISTOR	REPLACE WITH 0-Ω RESISTOR	REPLACE WITH 100-Ω RESISTOR
0.9	1.8 (LVCMOS)	IN1_N	R58	R39	C37	N/A
		IN1_P	R59		C38	N/A
1.25	2.5 (LVCMOS)	IN0_N	R57	R38	R52 C35, C36	R64
		IN0_P				R56
1.25	2.5 (LVCMOS)	IN1_N	R59	R39	R53 C37, C38	R66
		IN1_P				R58
1.65	3.3 (LVCMOS)	IN0_N	R57	R38	R52 C35, C36	R64
		IN0_P				R56
1.65	3.3 (LVCMOS)	IN1_N	R59	R39	R53 C37, C38	R66
		IN1_P				R58

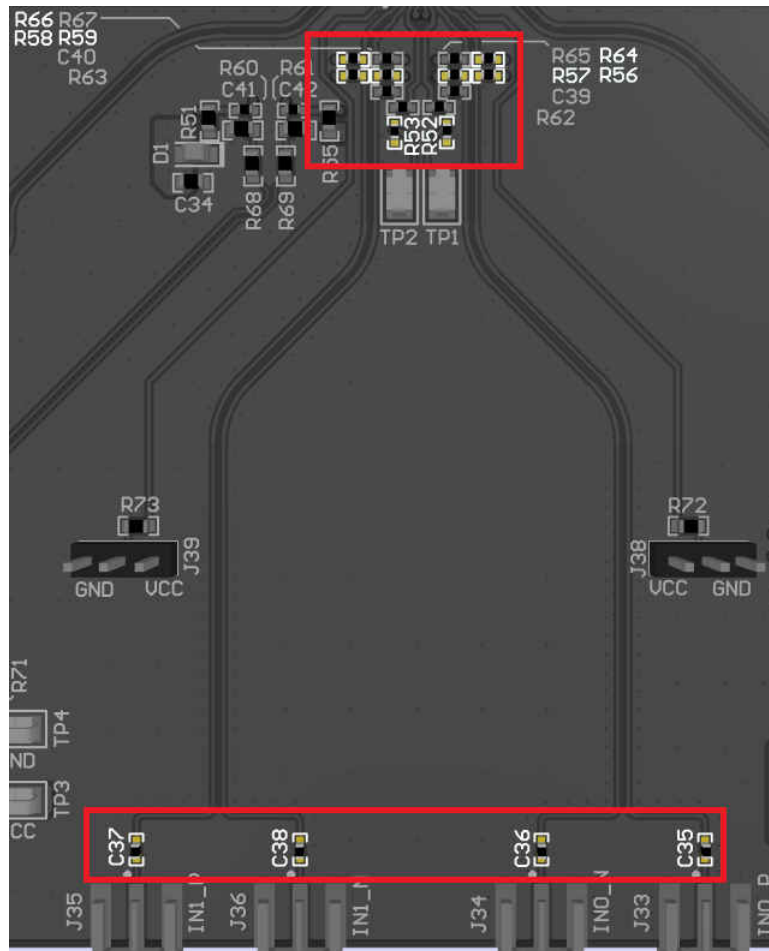


Figure 6-2. Components to Modify for Single-Ended Configuration

7 Output Clock

The LMK1D1216 generates up to 16 LVDS outputs. Two outputs (OUT0 and OUT8) are available by default on the EVM through the following SMAs: **J1**, **J2** (OUT0_P, OUT0_N) and **J5**, **J6** (OUT8_P, OUT8_N). The LVDS outputs are AC-coupled to their respective SMAs. Each output pair has the 100-Ω termination on the board already populated: **R4** (OUT0) and **R10** (OUT8).

The LVDS outputs are AC-coupled to their respective SMAs. Each output pair has the 100-Ω termination on the board already populated: **R4** (OUT0) and **R10** (OUT8).

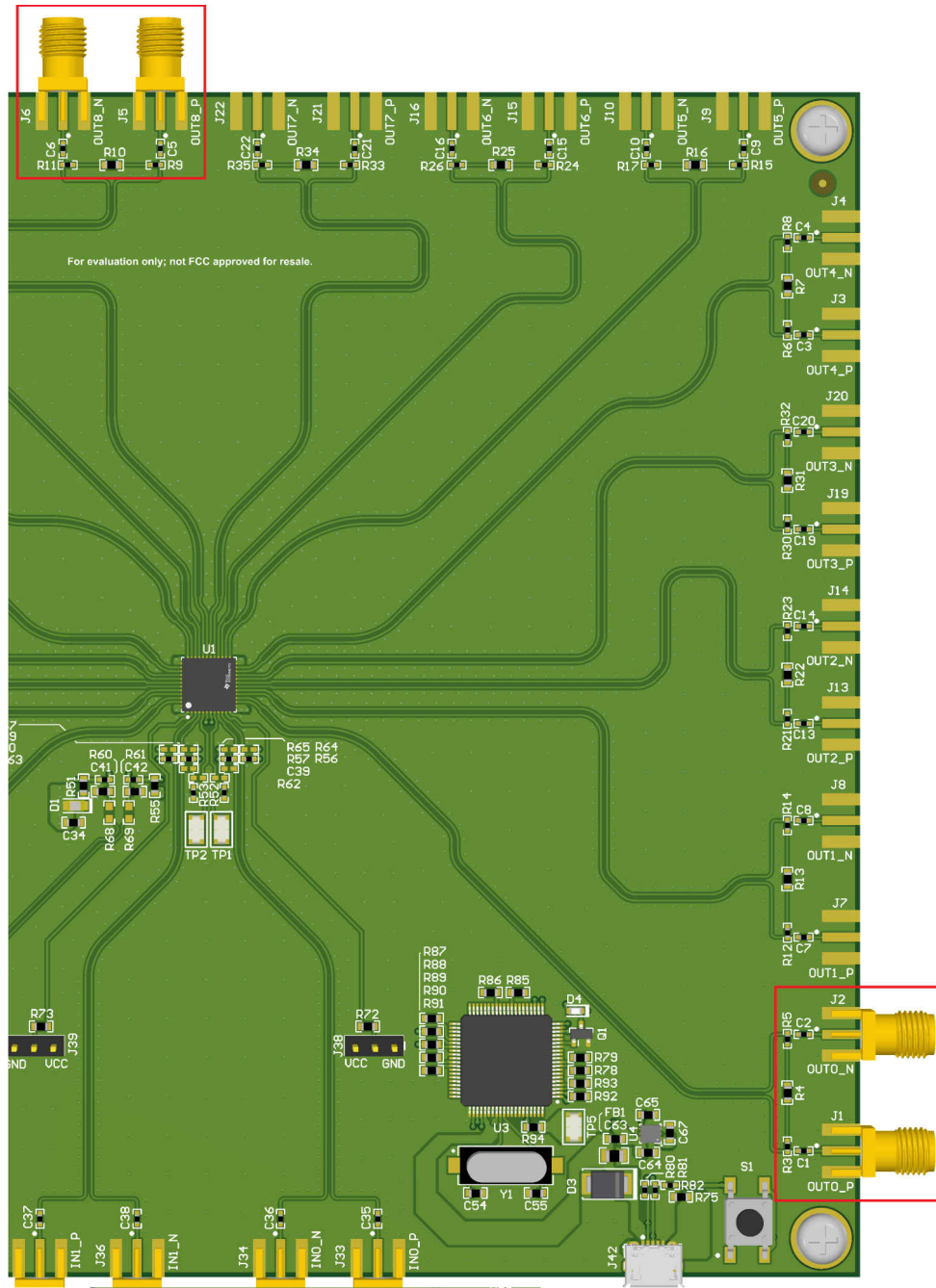


Figure 7-1. Output Clock EVM Layout

8 EVM Board Schematic

Figure 8-6 shows the printed circuit board (PCB) schematic.

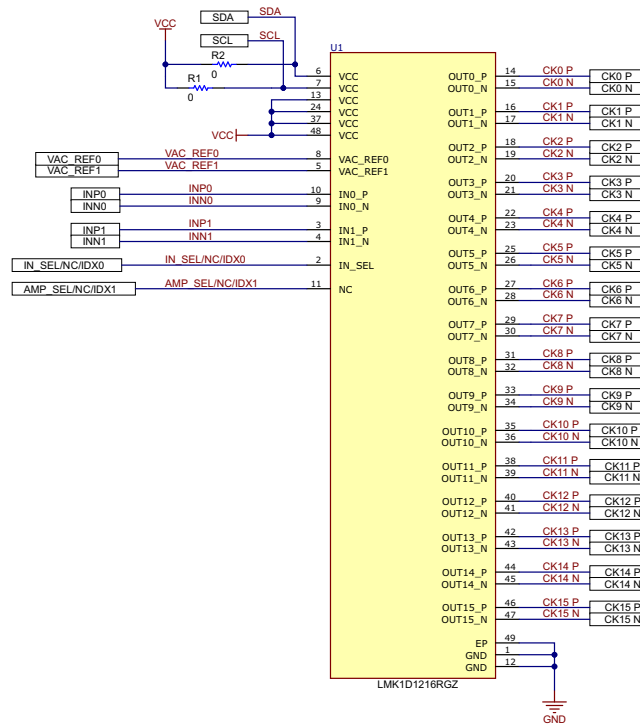


Figure 8-1. LMK1D1216EVM Schematic: Device Sheet

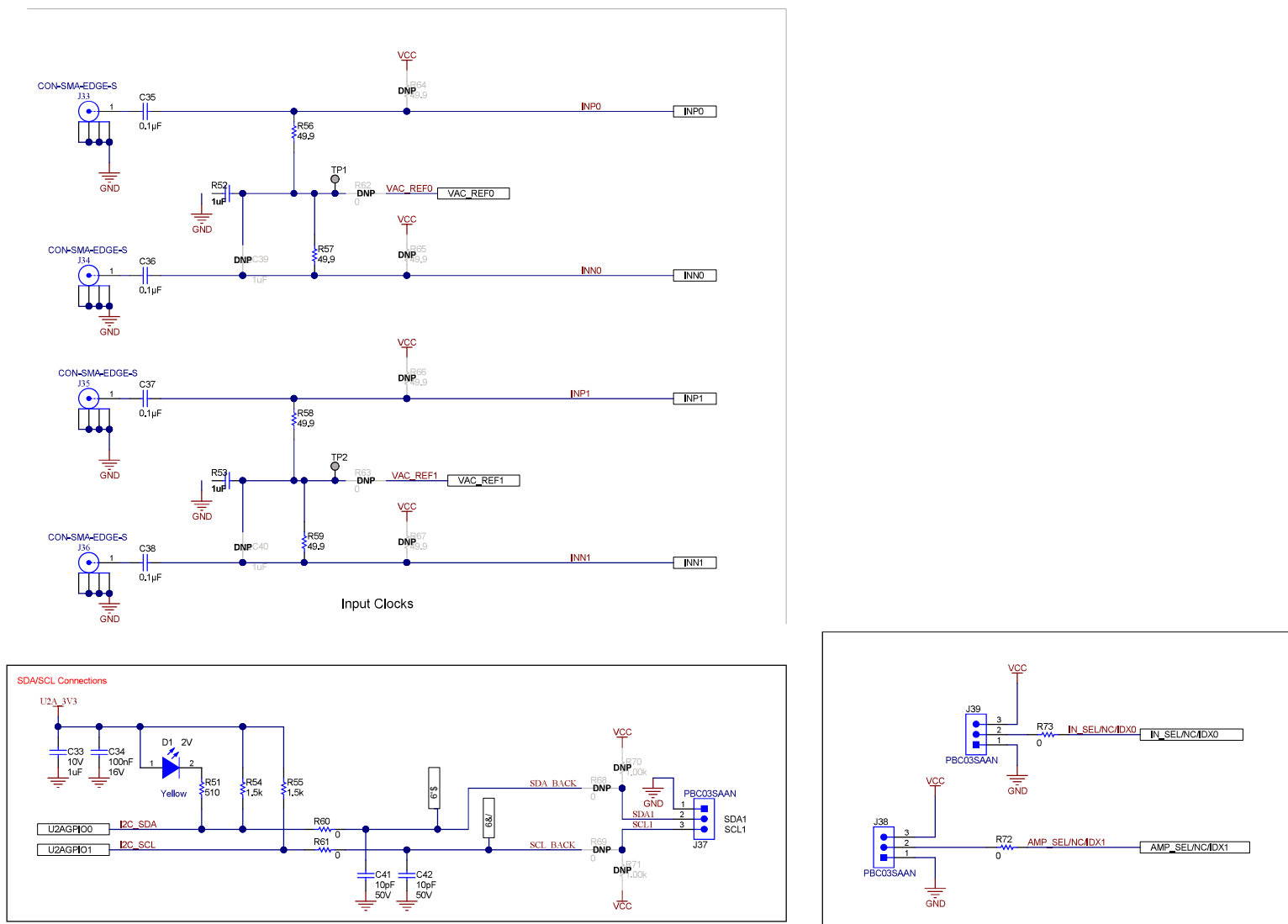


Figure 8-2. LMK1D1216EVM Schematic: Inputs Sheet

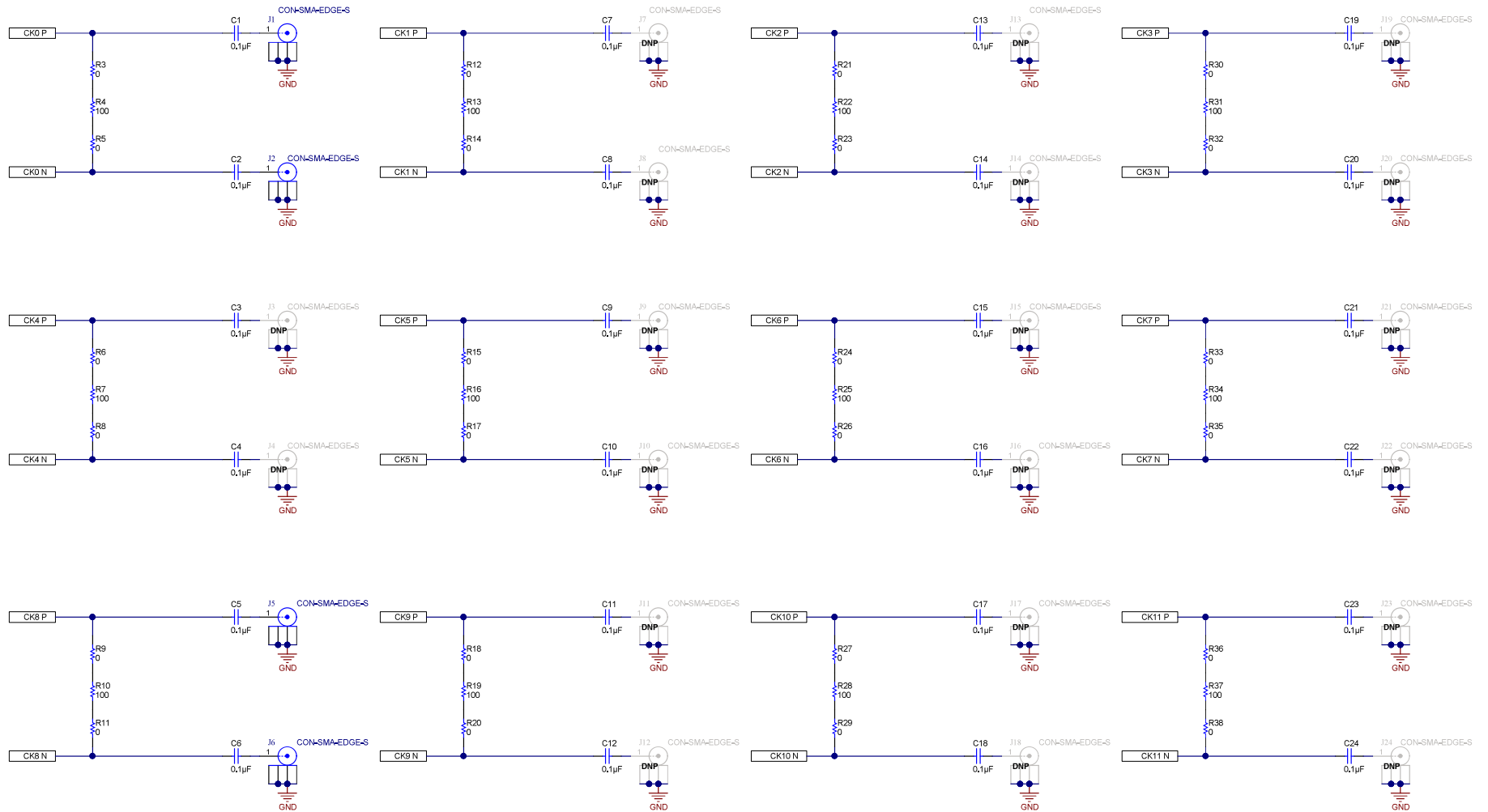


Figure 8-3. LMK1D1216EVM Schematic: Outputs 0-11 Sheet

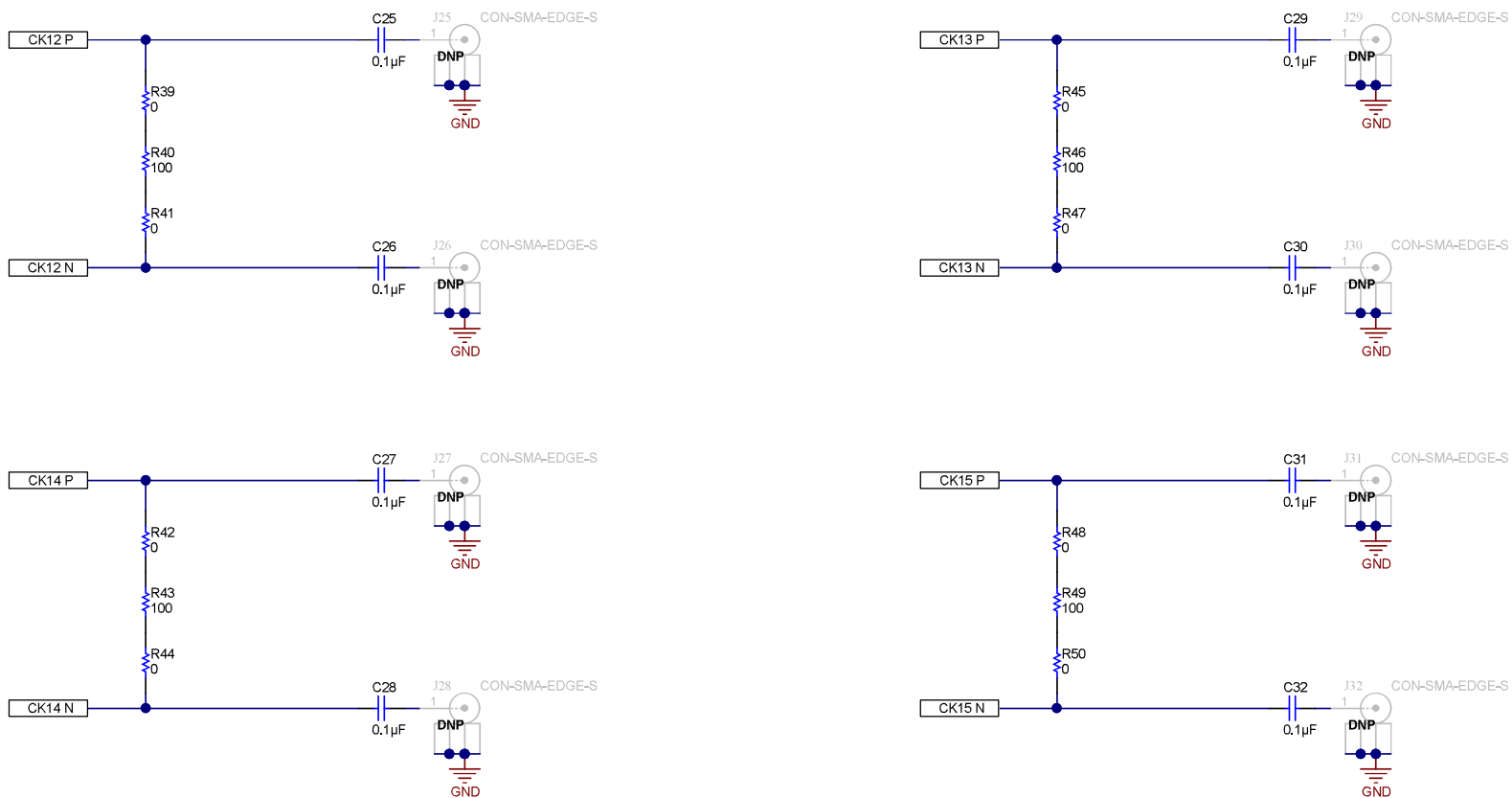


Figure 8-4. LMK1D1216EVM Schematic: Outputs 12-15 Sheet

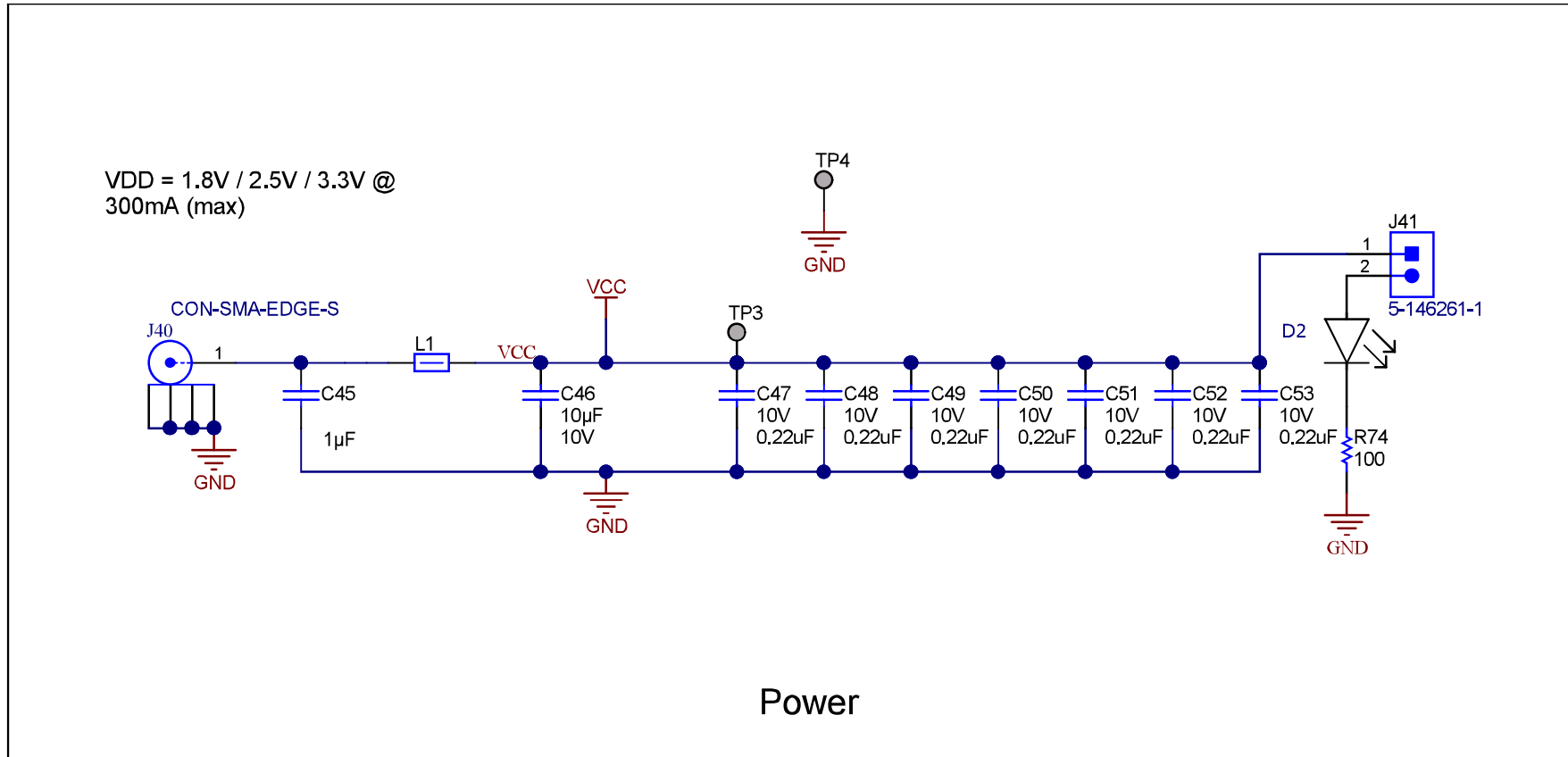


Figure 8-5. LMK1D1216EVM Schematic: Power Supply Sheet

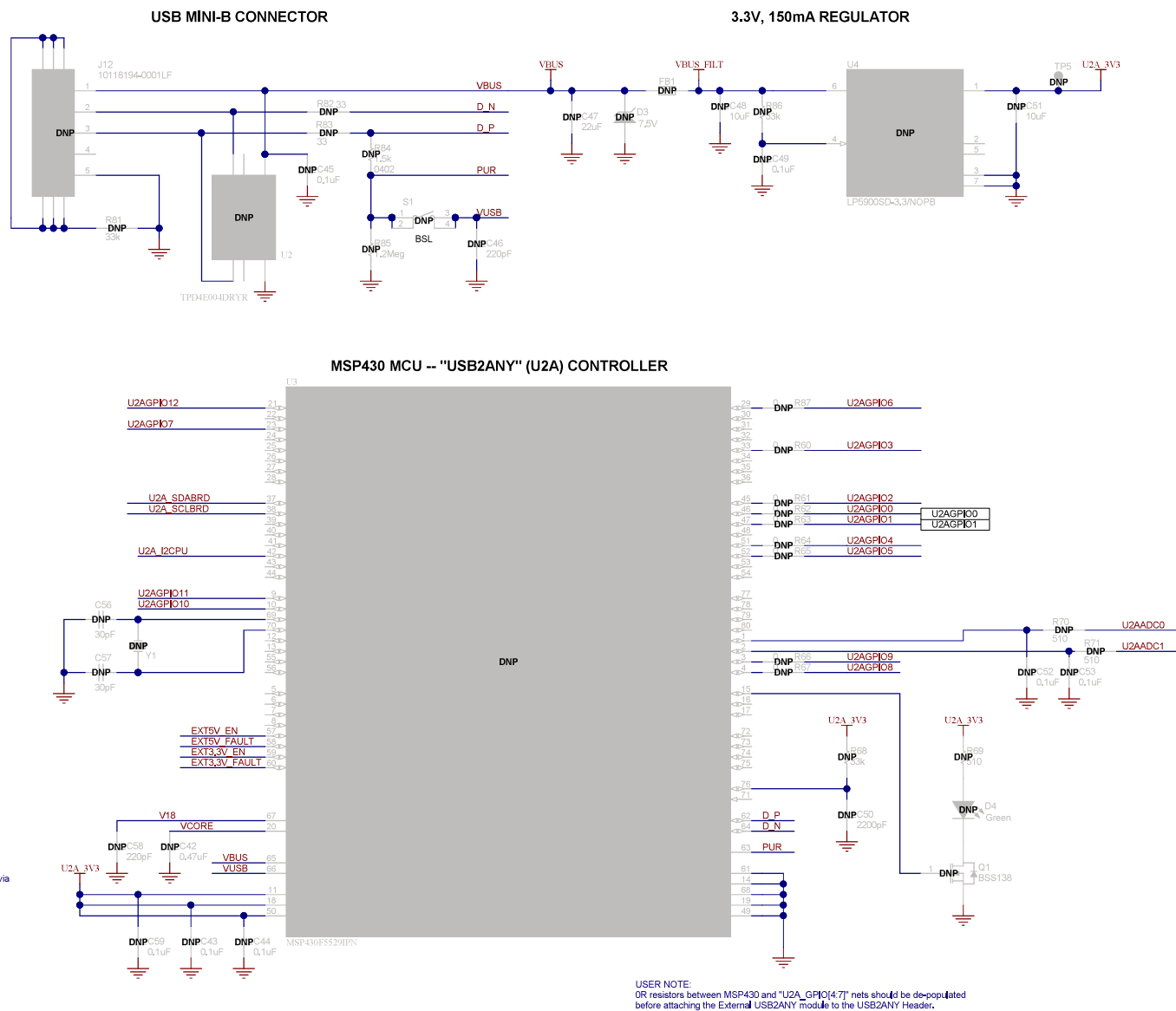


Figure 8-6. LMK1D1216EVM Schematic: USB Sheet

9 REACH Compliance

REACH Compliance

In compliance with the Article 33 provision of the EU REACH regulation we are notifying you that this EVM includes component(s) containing at least one Substance of Very High Concern (SVHC) above 0.1%. These uses from Texas Instruments do not exceed 1 ton per year. The SVHC's are:

Component Manufacturer	Component type	Component part number	SVHC Substance	SVHC CAS (when available)
Molex	5.08 Pitch Eurostyle Vertical Fixed Mount PCB Terminal Block, 2 Circuits	039544-3002	Lead	7439-92-1

10 Bill of Materials

Table 10-1. Bill of Materials

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C35, C36, C37, C38	36	0.1uF	CAP, CERM, 0.1 μ F, 10 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	C0402C104K8RACAUTO	Kemet
C33	1	1uF	CAP, CERM, 1 uF, 10 V, +/- 10%, X5R, 0603	0603	C0603C105K8PACTU	Kemet
C34	1	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 5%, X7R, 0603	0603	C0603C104J4RACTU	Kemet
C41, C42	2	10pF	CAP, CERM, 10 pF, 50 V, +/- 5%, C0G/ NP0, 0603	0603	C0603C100J5GACTU	Kemet
C45	1	1uF	CAP, CERM, 1 μ F, 10 V, +/- 5%, X7R, AEC-Q200 Grade 1, 0603	0603	C0603X105J8RAC7867	Kemet
C46	1	10uF	CAP, CERM, 10 μ F, 10 V, +/- 5%, X7R, AEC-Q200 Grade 1, 0805	0805	C0805C106J8RACAUTO	Kemet
C47, C48, C49, C50, C51, C52, C53	7	0.22uF	CAP, CERM, 0.22 uF, 10 V, +/- 10%, X7R, 0402	0402	GRM155R71A224KE01D	MuRata
D1	1	Yellow	LED, Yellow , SMD	0805 LED	LTST-C170KSKT	Lite-On
D2	1		SMD RED LED	SMD_LED	BOS-3528-2RCQ	BYD
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, J2, J5, J6, J33, J34, J35, J36, J40	9		CONN SMA JACK STR EDGE MNT	CONN_JACK	CON-SMA-EDGE-S	RF Solutions Ltd.
J37, J38, J39	3		Header, 100mil, 3x1, Gold, TH	PBC03SAAN	PBC03SAAN	Sullins Connector Solutions

Table 10-1. Bill of Materials (continued)

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
J41	1		Header, 100mil, 2x1, Gold, TH	Header, 2x1, 100mil	5-146261-1	TE Connectivity
L1	1	50 ohm	Ferrite Bead, 50 ohm @ 100 MHz, 12 A, 1206	1206	BLM31SN500SZ1L	MuRata
R1, R2	2	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2GE0R00X	Panasonic
R3, R5, R6, R8, R9, R11, R12, R14, R15, R17, R18, R20, R21, R23, R24, R26, R27, R29, R30, R32, R33, R35, R36, R38, R39, R41, R42, R44, R45, R47, R48, R50, R60, R61	34	0	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04020000Z0ED	Vishay-Dale
R4, R7, R10, R13, R16, R19, R22, R25, R28, R31, R34, R37, R40, R43, R46, R49, R74	17	100	RES, 100, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603100RFKEA	Vishay-Dale
R51	1	510	RES, 510, 5%, 0.1 W, 0603	0603	RC0603JR-07510RL	Yageo
R52, R53	2	1uF	CAP, CERM, 1 uF, 6.3 V, +/- 10%, X7R, 0402	0402	GRM155R70J105KA12D	MuRata
R54, R55	2	1.5k	RES, 1.5 k, 5%, 0.1 W, 0603	0603	RC0603JR-071K5L	Yageo
R56, R57, R58, R59	4	49.9	RES, 49.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2RKF49R9X	Panasonic
R72, R73	2	0	RES, 0, 5%, 0.1 W, 0603	0603	RC0603JR-070RL	Yageo
SH1, SH2, SH3	3	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP1, TP2, TP3, TP4	4		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
U1	1		LMK1D1216RGZ	VQFN48	LMK1D1216RGZ	Texas Instruments
C39, C40	0	1uF	CAP, CERM, 1 uF, 6.3 V, +/- 20%, X7R, 0402	0402	GRM155R70J105MA12D	MuRata

Table 10-1. Bill of Materials (continued)

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
C43, C44, C57, C59, C60, C61, C65	0	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 5%, X7R, 0603	0603	C0603C104J4RACTU	Kemet
C54, C55	0	30pF	CAP, CERM, 30 pF, 100 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C2A300JA01D	MuRata
C56, C62	0	220pF	CAP, CERM, 220 pF, 50 V, +/- 1%, C0G/NP0, 0603	0603	06035A221FAT2A	AVX
C58	0	0.47uF	CAP, CERM, 0.47 uF, 10 V, +/- 10%, X7R, 0603	0603	GRM188R71A474KA61D	MuRata
C63	0	22uF	CAP, CERM, 22 uF, 10 V, +/- 20%, X5R, 0805	0805	LMK212BJ226MG-T	Taiyo Yuden
C64, C67	0	10uF	CAP, CERM, 10 uF, 10 V, +/- 20%, X5R, 0603	0603	C1608X5R1A106M080AC	TDK
C66	0	2200pF	CAP, CERM, 2200 pF, 50 V, +/- 10%, X7R, 0603	0603	C0603C222K5RACTU	Kemet
D3	0	7.5V	Diode, Zener, 7.5 V, 550 mW, SMB	SMB	1SMB5922BT3G	ON Semiconductor
D4	0	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On
FB1	0	60 ohm	Ferrite Bead, 60 ohm @ 100 MHz, 3.5 A, 0603	0603	MPZ1608S600ATAH0	TDK
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
J3, J4, J7, J8, J9, J10, J11, J12, J13, J14, J15, J16, J17, J18, J19, J20, J21, J22, J23, J24, J25, J26, J27, J28, J29, J30, J31, J32	0		CONN SMA JACK STR EDGE MNT	CONN_JACK	CON-SMA-EDGE-S	RF Solutions Ltd.
J42	0		Receptacle, USB 2.0, Micro-USB Type B, R/A, SMT	USB-micro B USB 2.0, 0.65mm, 5 Pos, R/A, SMT	10118194-0001LF	FCI
Q1	0	50V	MOSFET, N-CH, 50 V, 0.22 A, SOT-23	SOT-23	BSS138	Fairchild Semiconductor

Table 10-1. Bill of Materials (continued)

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
R62, R63	0	0	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04020000Z0ED	Vishay-Dale
R64, R65, R66, R67	0	49.9	RES, 49.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2RKF49R9X	Panasonic
R68, R69	0	0	RES, 0, 5%, 0.1 W, 0603	0603	RC0603JR-070RL	Yageo
R70, R71	0	1.00k	RES, 1.00 k, 1%, 0.1 W, 0603	0603	ERJ-3EKF1001V	Panasonic
R75, R84, R94	0	33k	RES, 33 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060333K0JNEA	Vishay-Dale
R76, R77, R85, R86, R87, R88, R89, R90, R91, R92, R93	0	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R78, R79	0	1.0k	RES, 1.0 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031K00JNEA	Vishay-Dale
R80, R81	0	33	RES, 33, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040233R0JNED	Vishay-Dale
R82	0	1.5k	RES, 1.5 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04021K50JNED	Vishay-Dale
R83	0	1.2Meg	RES, 1.2 M, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031M20JNEA	Vishay-Dale
R95, R96, R97	0	510	RES, 510, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603510RJNEA	Vishay-Dale
S1	0		Switch, Tactile, SPST-NO, 0.05A, 12V, SMT	SW, SPST 6x6 mm	FSM4JSMA	TE Connectivity
TP5	0		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
U2	0		4-Channel ESD Protection Array for High-Speed Data Interfaces, DRY0006A (USON-6)	DRY0006A	TPD4E004DRYR	Texas Instruments

Table 10-1. Bill of Materials (continued)

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
U3	0		25 MHz Mixed Signal Microcontroller with 128 KB Flash, 8192 B SRAM and 63 GPIOs, -40 to 85 degC, 80-pin QFP (PN), Green (RoHS & no Sb/Br)	PN0080A	MSP430F5529IPN	Texas Instruments
U4	0		150-mA Ultra-Low Noise LDO for RF and Analog Circuits Requires No Bypass Capacitor, NGF0006A (WSON-6)	NGF0006A	LP5900SD-3.3/NOPB	Texas Instruments
Y1	0		Crystal, 24.000 MHz, 20pF, SMD	Crystal, 11.4x4.3x3.8mm	ECS-240-20-5PX-TR	ECS Inc.

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