User's Guide
SLVUB53–July 2017

LSF-EVM Hardware User's Guide

Contents

List of Figures

List of Tables

Trademarks

1 Introduction

The Texas Instruments' LSF-EVM aids in the evaluation of the operation and performance of the LSF family of auto-bidirectional multi-voltage level translators. The LSF family of devices are level translators that support a voltage range of 0.95 V to 5.5 V and provide multi-voltage bidirectional translation without the need for a direction pin.

The LSF-EVM comes populated with the LSF0108PWR device and has landing patterns that are compatible with the LSF0101DRYR, LSF0102DCTR, and LSF0204PWR devices.

The LSF-EVM is optimized for high-speed translation by reducing reflections for data rates greater than 100 MHz. Additionally, the design of the board enables simple evaluation as multiple connection interfaces are available and pullups are populated which is easily connected or disconnected by using shunt jumpers.

2 Hardware Description

2.1 Board View and Supported Devices

The LSF-EVM comes populated with the LSF0108 device in the PW (TSSOP) package; however, this EVM can evaluate additional devices as well. Figure 1 shows the EVM populated with the LSF0108PWR device, and Table 1 lists all of the part numbers and packages that are compatible with the LSF-EVM.

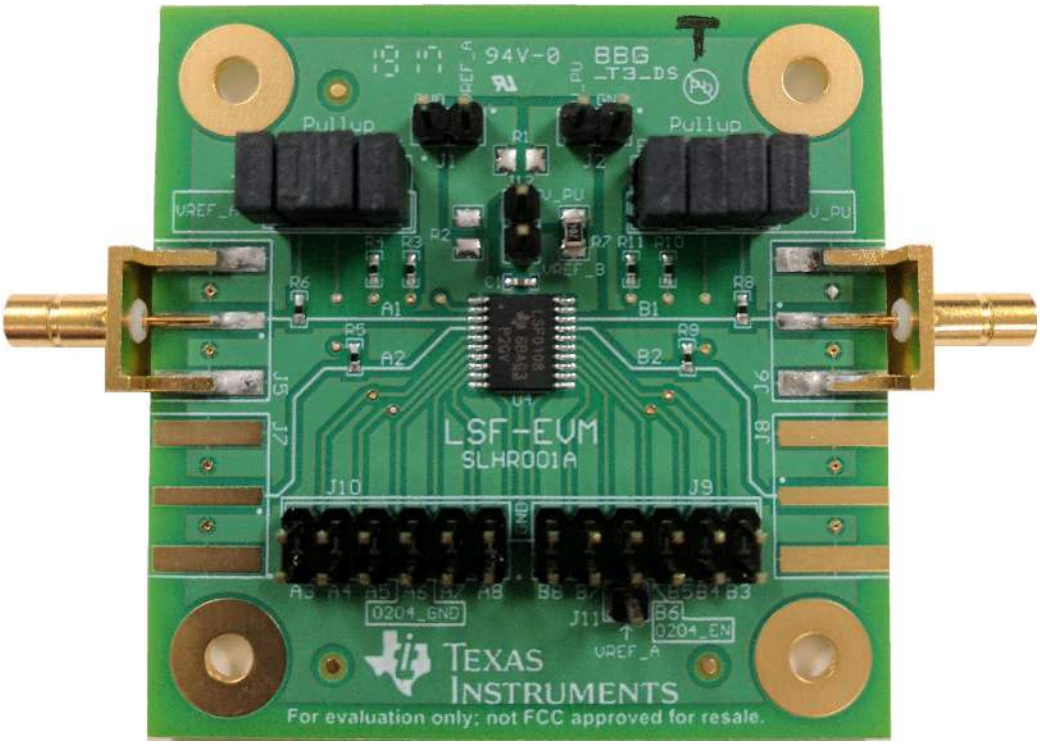

Figure 1. LSF-EVM With LSF0108PW Populated

Table 1. Compatible Parts and Packages for LSF-EVM

Part Number	Packages
LSF0101DRYR	SON (DRY) - See Figure 2 for device pad location
LSF0102DCTR	SSOP (DCT) - See Figure 3 for device pad location
LSF0204PWR	TSSOP (PW) - See Figure 4 for device pad location
LSF0204DPWR	TSSOP (PW) - See Figure 4 for device pad location
LSF0108PWR	TSSOP (PW) - default populated device

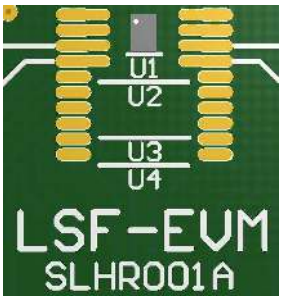

Figure 2. LSF-EVM With LSF0101 Populated

Figure 3. LSF-EVM With LSF0102 Populated

Figure 4. LSF-EVM With LSF0204 Populated

NOTE: The location of pin 1 of the LSF0204 and LSF0204D is not the same as the LSF0108 which comes pre-populated on the board. Please note the location of the LSF0204 device in Figure 4 carefully, as pin 1 of the LSF0204 is located on the LSF0108 pin 2 landing pad.

2.2 Board Overview

Figure 5 shows an overview of the LSF-EVM. The main features, such as connectors, pullups, and headers are highlighted. A more detailed description of the board is given in Section 2.3, and a schematic is provided in the Section 4.2 section.

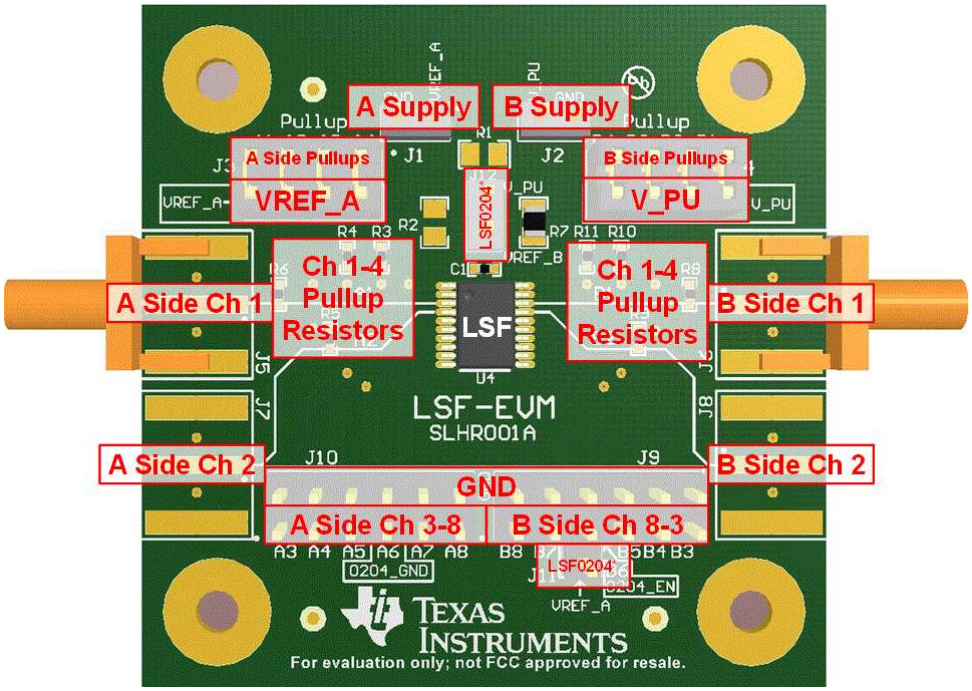

Figure 5. LSF-EVM Board Overview

NOTE: *Two sections of the board are labeled as LSF0204*.* The LSF0204 has a different pinout, and additional jumpers are required for proper operation. See Section 3.2 for additional information regarding evaluation of the LSF0204 and LSF0204D devices.

2.3 Board Component Descriptions

This section describes the components on the LSF-EVM to aid in configuration of the EVM prior to evaluation of the selected LSF device.

2.3.1 J1, J2 - A Supply (Vref_A), B Supply (V_PU)

These jumpers provide connections for the A side and B side supplies for the LSF device. The grounds of each jumper are shorted, with two positions provided for convenience. Be sure that the two supplies share the same ground.

Refer to Table 2 for allowable supply voltages.

Table 2. Allowable Operating Voltages

PARAMETER		MIN	MAX	UNIT
V_PU	Pullup supply voltage	Vref_A + 0.85	5.5	V
Vref_A	A side reference voltage	0.95	5.5	V
$V_{I(EN)}$	Enable pin input voltage	Vref_A + 0.85	5.5	V

2.3.2 J3, J4 - A Side and B Side Pullup Headers

These jumpers are provided to be able to quickly connect or disconnect the pullup resistors connected to the A side supply (Vref_A) or the B side supply (V_PU). Additionally for multi-supply voltage level translation, a separate supply voltage could be connected to the side of the header that is directly connected to the resistor. See Figure 6 for an example of this additional supply.

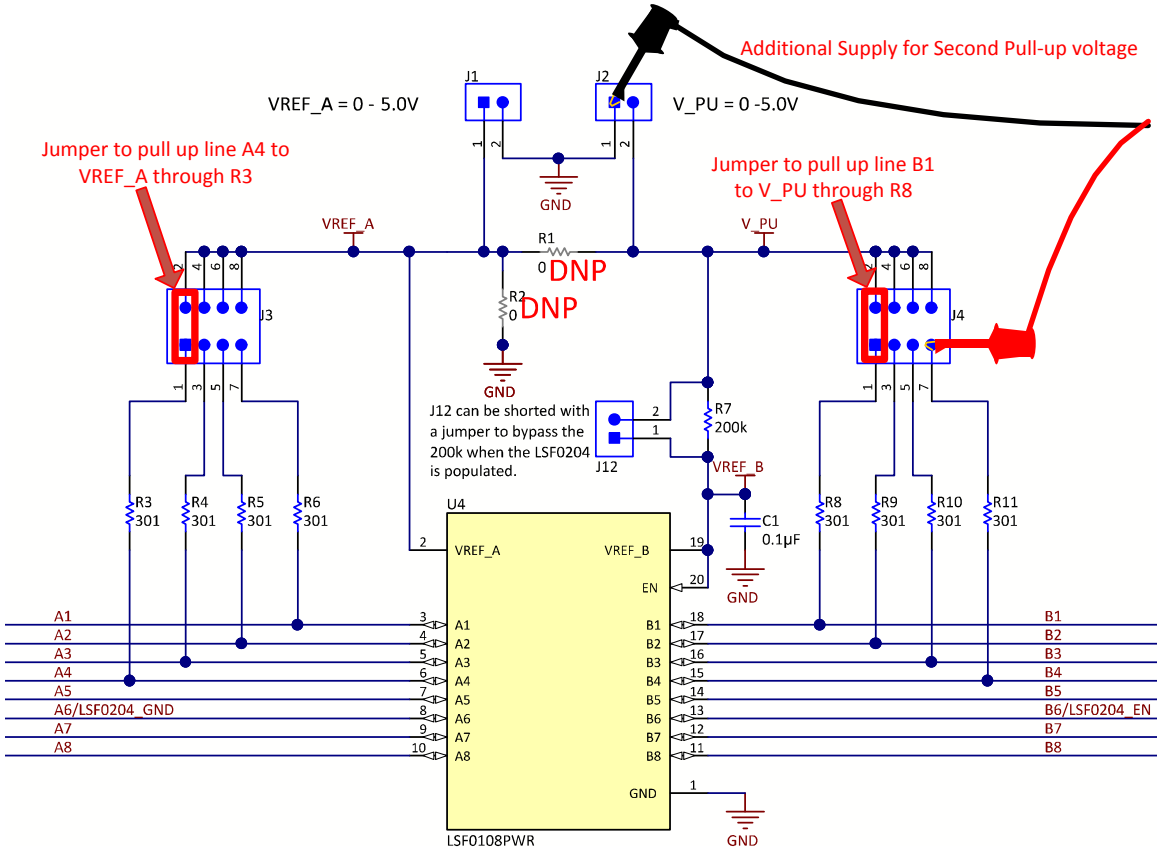

Figure 6. Jumper and Supply Connections for Multi-Voltage Level Translation (Zoom for High Resolution)

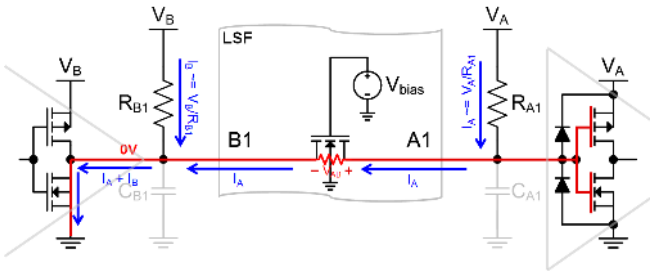

Figure 7. LSF Pass Transistor LOW-State Operation

The pullup resistors that come populated on the board are 310 Ω.

The pullup resistor must be selected to limit the current through the pass transistor to 64 mA maximum. To ensure a pass voltage of 260 mV to 350 mV, the pullup resistor should be sized to limit the current through the pass transistor to 15 mA, see Figure 7. To set the current through each pass transistor at 15 mA, calculate the pullup resistor value using Equation 1:

$$Rpu = (Vpu - 0.35\ V) / 0.015\ A \quad (1)$$

Table 3 summarizes resistor values, reference voltages, and currents at 15 mA, 10 mA, and 3 mA. The resistor value shown in the +10% column (or a larger value) must be used to ensure that the pass voltage of the transistor is 350 mV or less.

Table 3. Pullup Resistor Values(1)(2)

V_{PU}	15 mA		10 mA		3 mA	
	NOMINAL (Ω)	+10%(3) (Ω)	NOMINAL (Ω)	+10%(3) (Ω)	NOMINAL (Ω)	+10%(3) (Ω)
5 V	**310 (Populated Resistance)**	341	465	512	1550	1705
3.3 V	197	217	295	325	983	1082
2.5 V	143	158	215	237	717	788
1.8 V	97	106	145	160	483	532
1.5 V	77	85	115	127	383	422
1.2 V	57	63	85	94	283	312

(1) Calculated for V_{OL} = 0.35 V
(2) Assumes output driver V_{OL} = 0.175 V at stated current
(3) +10% to compensate for V_{DD} range and resistor tolerance

2.3.3 J5 - J8 - Channel 1-2 Edge-Mounted SMB Connectors

Connectors J5 and J6 are provided for channel 1 of the device to enable optimal conditions for high-speed operation of the LSF devices. J7 and J8 are spaces left for additional edge-mount connectors to connect channel 2. See Section 4.3 for orderable part numbers.

For input signals that are being driven by a 50-Ω source, TI recommends to have a 50-Ω termination either at the device, see Figure 8.

2.3.4 J9, J10 - Channel 3-8 Header Connectors

Connectors J9 and J10 are provided for channels 3-8 of the device to enable the remaining connections for the LSF0108 device. Each output has a corresponding ground connection to enable measurement of the output using a differential probe for optimal signal integrity.

2.3.5 J11, J12 - Additional Headers for LSF0204 and LSF0204D Operation

J11 and J12 are provided as connectors for use when the LSF0204 device is populated. See Section 3.2 for additional information.

3 Setup

The following sections describe the jumpers and connectors on the EVM as well as how to properly connect, setup, and use the LSF-EVM.

3.1 LSF0108 Setup (Out of Box Setup)

Figure 8 shows a typical setup of the LSF-EVM. Note the following connections:

- VREF_A is connected to J1
- V_PU is connected to J2
- A high-speed signal is connected into the SMA Connector on the A side with a 50-Ω termination impedance to reduce line reflections
- An SMA cable is connected from the B side to a high-impedance oscilloscope input to monitor the output waveform
- The yellow cable on the left is connected to A3 on the A side to provide an input signal
- The yellow cable on the right is connected to B3 on the B side to monitor the output waveform
- Two red boxes indicate the positions for shunt jumpers placed on J4 which connect pullups for channels 1 and 3 on the B side for up-translation.

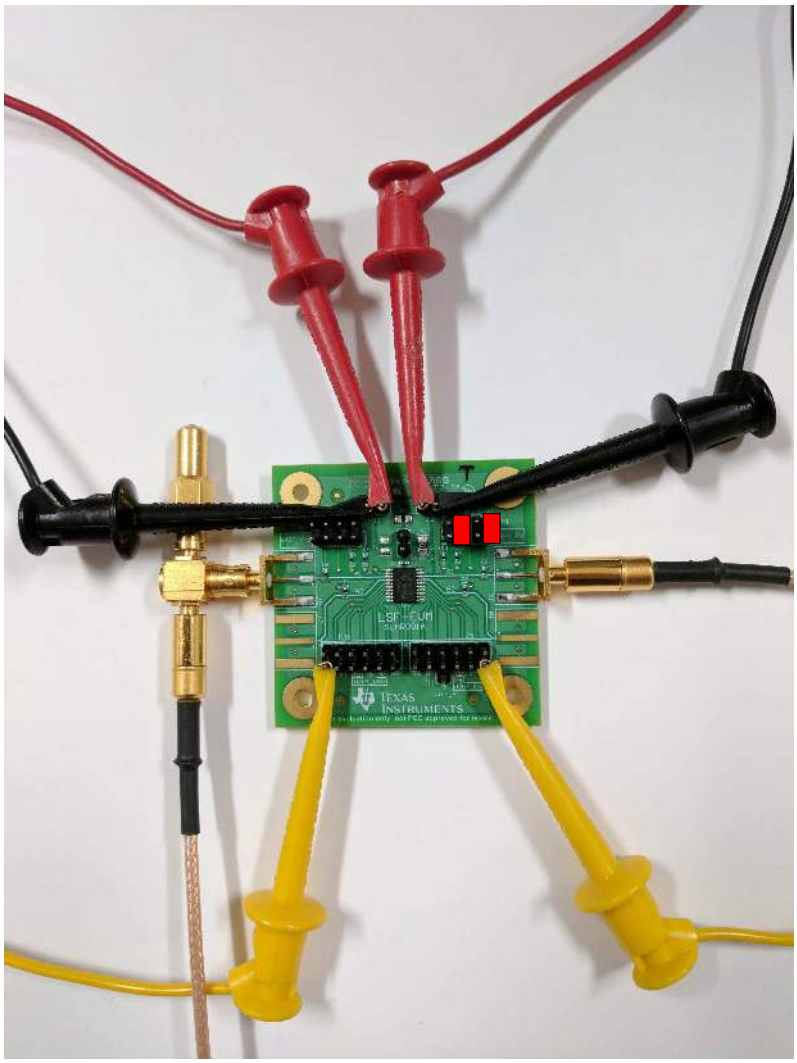

Figure 8. Typical LSF-EVM Setup

3.2 LSF0204 Setup

Figure 9 shows a typical setup of the LSF-EVM with the LSF0204 device populated. Note the following connections:

- VREF_A is connected to J1
- V_PU is connected to J2
- A high-speed signal can be connected into the SMA Connector on the A side with a 50-Ω termination impedance to reduce line reflections
- An SMA cable is connected from the B side to a high-impedance oscilloscope input to monitor the output waveform
- Four red boxes indicate the positions for shunt jumpers, refer to the following descriptions:
  - SH1: This shunt jumper is populated to pull up the B3 line to up translate the signal from the A side
  - SH2: This shunt jumper is populated to pull up the B1 line to up translate the signal from the A side
  - SH3: This shunt jumper is populated to short/bypass the R7 200-kΩ resistor. This resistor is not required for operation with the LSF0204 devices, as the 200-kΩ resistor is integrated.
  - SH4: This shunt jumper is populated to connect the EN pin of the LSF0204 to VREF_A to enable the device. For the LSF0204D device, this shunt/jumper should be connected to GND to enable the device (shifting the shunt/jumper up one position pulls this line to ground).

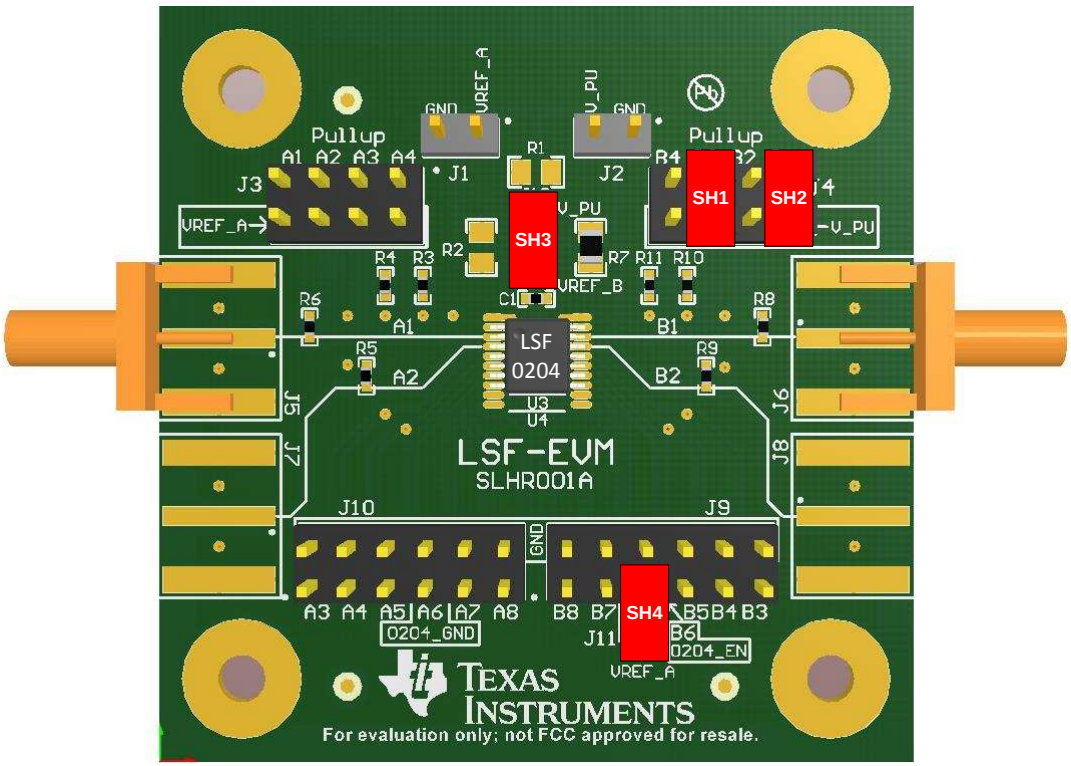

Figure 9. LSF0204 Board Setup

3.3 Operating Modes

There are two operating modes of the LSF-EVM: dual-supply operation and single-supply operation.

3.3.1 Dual Supply Operation (Typical operating mode)

This is the typical mode of operation for this EVM. Two supplies are used as shown in Figure 8. With two supplies connected, the device is able to up or down translate bidirectionally between the A and B side when the corresponding pullup resistors are connected.

3.3.2 Single-Supply Operation

Single-supply operation enables the use of a single supply to bias the LSF to enable translation. The primary application for this setup is when the A side has a variable supply. Because the VREF_A voltage must be 0.8 V less than the VREF_B voltage, this setup enables the user to bias the device and allow for a wider range of voltages on the A side.

NOTE: One limitation of this setup is that it does not allow for a pullup to be placed between the A side output and the VREF_A pin. A separate supply is required for up translation on the A side.

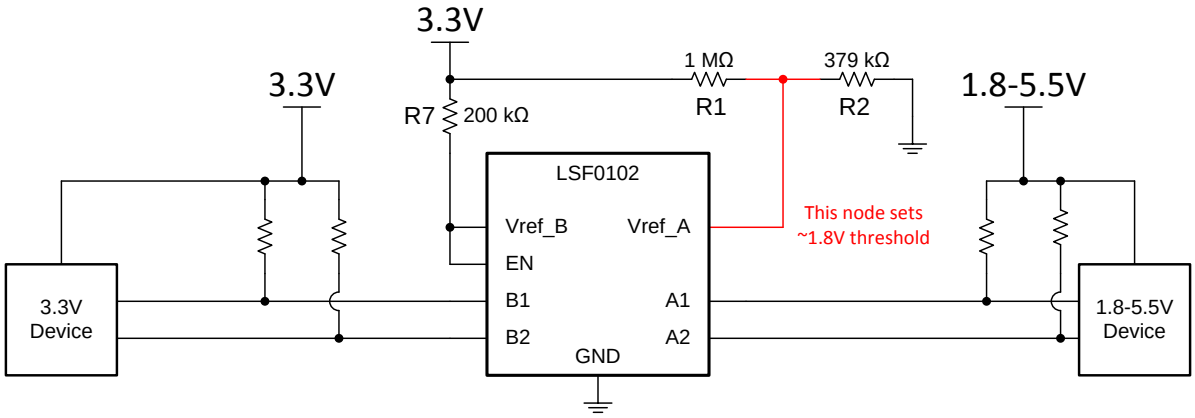

Figure 10. LSF0102 Single-Supply Operation Setup

To enable single-supply operation, resistors R_1 and R_2 must be populated, see Figure 12.

Use Equation 2 to determine the value of R_1 to set the threshold of the device:

$$R_2 = \frac{R_7 \cdot R_1 \cdot V_{REFA}}{(R_7+R_1)(V_{PU}-V_{REFA}) - R_1 \cdot V_{TH}} \quad (2)$$

where

- V_{REFA} is the lowest voltage that is desired on the A side.
- V_{PU} is the supply voltage provided at the J2 jumper and must be 0.85 V higher than V_{REFA}.
- V_{TH} is the threshold drop of the device, assumed to be 0.85 V.
- R7 is the pullup resistor between V_{REFB} and V_{PU}, typically 200 kΩ.
- R1 is the resistor that connects V_{PU} to V_{REFA}, recommended 1 MΩ.
- R2 is the resistor that connects V_{REFA} to ground.

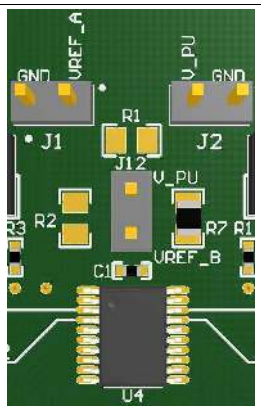

Figure 11. LSF-EVM Without Single-Supply Resistors

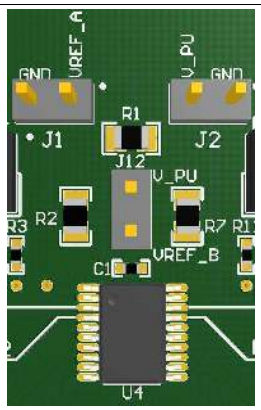

Figure 12. LSF-EVM With Single-Supply Resistors Populated

4 Additional Information

4.1 Hardware Change Log

Table 4. Description of Hardware Changes

PCB Revision	Description of Changes
Rev 1.0	Initial Release

4.2 Schematic

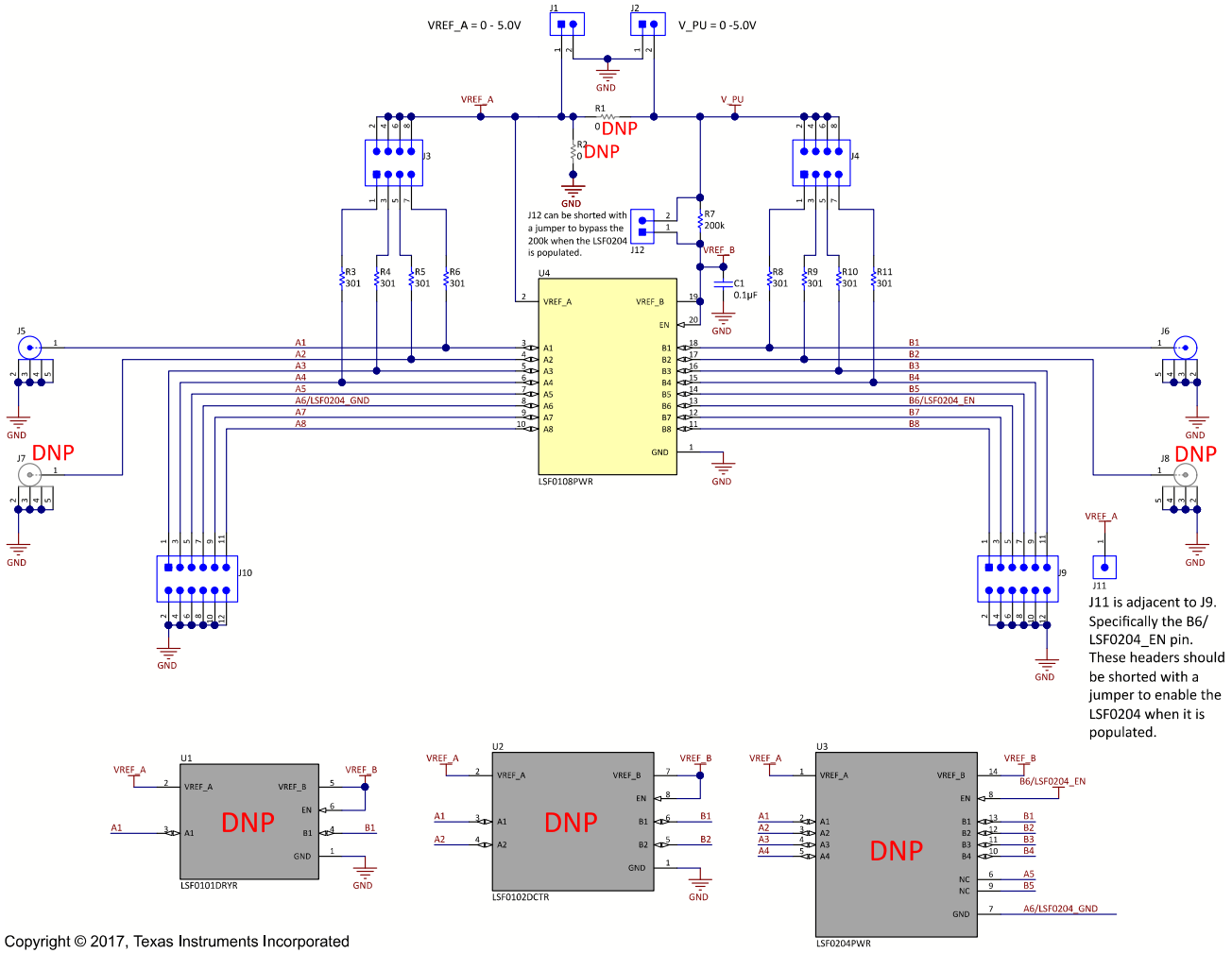

Figure 13. LSF-EVM Schematic (Zoom for Higher Resolution)

NOTE: DNP is an abbreviation for do not populate. Components highlighted as DNP in the schematic are not populated out of the box.

4.3 Bill of Materials

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		SLHR001	Any	-	-
C1	1	0.1uF	CAP, CERM, 0.1 µF, 16 V, +/- 5%, X7R, 0402	0402	GRM155R71C104JA88D	MuRata		
J1, J2, J12	3		Header, 100mil, 2x1, Gold, TH	Header, 100mil, 2x1, TH	HTSW-102-07-G-S	Samtec		
J3, J4	2		Header, 100mil, 4x2, Gold, TH	4x2 Header	TSW-104-07-G-D	Samtec		
J5, J6	2		Connector, SMB Jack, End launch, SMT	SMB End launch Jack, SMT	131-3701-801	Emerson Network Power		
J9, J10	2		Header, 100mil, 6x2, Gold, TH	6x2 Header	TSW-106-07-G-D	Samtec		
J11	1		Header, 100mil, 1pos, Gold, TH	Testpoint	TSW-101-07-G-S	Samtec		
R3, R4, R5, R6, R8, R9, R10, R11	8	301	RES, 301, 1%, 0.063 W, 0402	0402	CRCW0402301RFKED	Vishay-Dale		
R7	1	200k	RES, 200 k, 5%, 0.125 W, 0805	0805	ERJ-6GEYJ204V	Panasonic		
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8	8	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
U4	1		8 Channel Bidirectional Multi-Voltage Level Translator for Open-Drain and Push-Pull Application, PW0020A (TSSOP-20)	PW0020A	LSF0108PWR	Texas Instruments		Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
H1, H2, H3, H4	0		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	0		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone	-	-
J7, J8	0		Connector, SMB Jack, End launch, SMT	SMB End launch Jack, SMT	131-3701-801	Emerson Network Power		
R1, R2	0	0	RES, 0, 5%, 0.125 W, 0805	0805	ERJ-6GEY0R00V	Panasonic		
U1	0		Single Bi-Directional Multi-Voltage Level Translator, DRY0006A (USON-6)	DRY0006A	LSF0101DRYR	Texas Instruments		Texas Instruments
U2	0		Dual Bidirectional Multi-Voltage Level Translator, DCT0008A (SSOP-8)	DCT0008A	LSF0102DCTR	Texas Instruments		Texas Instruments
U3	0		4-Bits Bidirectional Multi-Voltage Level Translator for Open-Drain and PushPull Application, PW0014A (TSSOP-14)	PW0014A	LSF0204PWR	Texas Instruments		Texas Instruments

Figure 14. Bill of Materials

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.

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。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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.

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2. 実験局の免許を取得後ご使用いただく。
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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
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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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