User's Guide

TCA39306 EVM User's Guide

ABSTRACT

This document covers the usage of the TCA39306 including pull up resistors, load capacitance selection, and DUT locations for difference package options.

Table of Contents

Trademarks

All trademarks are the property of their respective owners.

1 Introduction

The TCA39306 EVM allows the user's to test the device under different loading conditions using selectable pull-up resistors and loading capacitance. The EVM comes with U1 (DCU package) populated, but supports the use of the DDF and DTM package. Performance should be similar to DCU package, but the user may want to test different packages over temperature due to different temperature coefficents.

2 Concept

2.1 EVM Features

- Adjustable pull-up resistors
- Adjustable load capacitance
- Footprint available for DDF and DTM packages

2.2 Adjustable pull-up resistors

TCA39306EVM comes with adjustable pull-up resistors which allows for the user to select from a 4.7 k and 820 Ω resistor. The board itself has a 10 k pull-up resistor on the I2C bus when no resistors are selected from the adjustable pull up bank. When 4.7 k is selected, the effective pull up resistance is 3.2 kΩ. When only the 820 Ω pull-up is selected, the effective pull up resistance is about 750 Ω. When both adjustable pull-up resistors are selected the effective resistance is about 650 Ω. The pull-up resistor selectors are shown in Figure 2-1.

Table 2-1. Effective pull-up resistor values table

Pull-up resistor (Ω)	Equivalent pull-up resistance (Ω)
10k || 4.7 k	3.2 k
10k || 820	~750
10k || 4.7 k || 820	~650

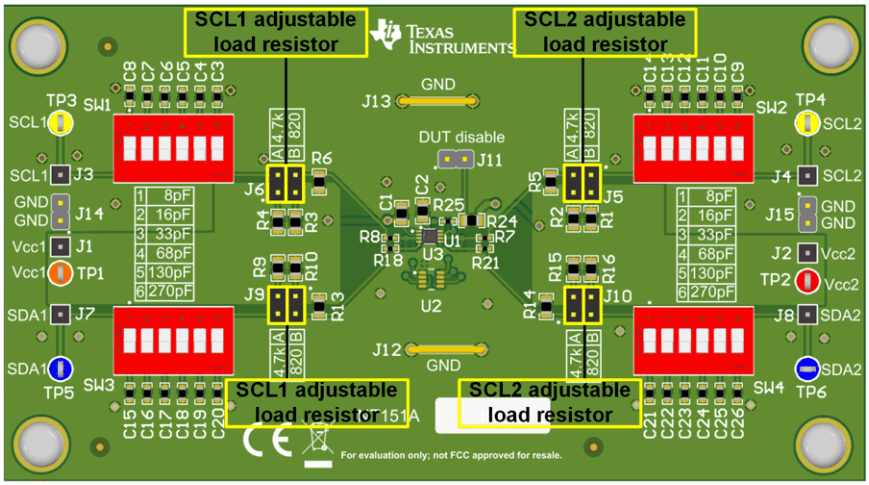

Figure 2-1. Adjustable pull-up resistors

2.3 Load Capacitance Selector

Figure 2-2 shows the board with the load capacitance selectors labeled.

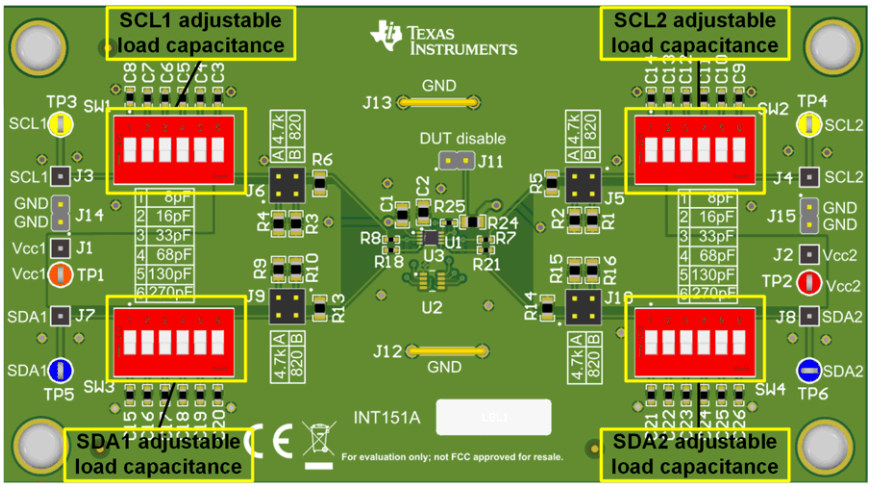

Figure 2-2. Load capacitor selector

The TCA39306 EVM provides a way for the designer to test the device under capacitive loading which is one of the main constraints in an I^2C system. Switches denoted as S1, S2, S3, and S4 provide the user with the ability to change the I^2C bus capacitance with up to about 525 pF of capacitance. The switched capacitor can be selected in increments of approximately 8 pF, 1 6pF, 33 pF, 68 pF, 130 pF, and 270 pF. For example: if the designer wants a total capacitance of 275 pF, the designer chooses to switch in 130 pF, 68 pF, 33 pF, 16 pF, and 8 pF for a combined capacitance of approximately 255 pF, device capacitance and PCB capacitance can be estimated to be about 20 pF resulting in approximately 275 pF.

Note that there is additional capacitance due to parasitics from the PCB line traces and ICs on the board. For SDA and SCL pins of a device, assume 10 pF maximum per device on the I^2C line. One important aspect to remember is the TCA39306 device does not redrive an I^2C signal. This means the capacitance on both sides of the device are not separated but are technically connected (meaning they add up in parallel) when the signal goes from LOW to HIGH from either SDA or SCL. This is highlighted because the I^2C standard limits the bus capacitance to 400 pF for standard and fast mode and 550 pF for fast mode plus. If the I^2C system is expected to exceed this amount, an I^2C buffer and redriver will be necessary to separate the capacitance between the two sides to be below the required capacitance limits.

Current I^3C specifications state bus capacitance loading should be less than 50 pF, so all switches should be turned to the off position when testing with I^3C.

2.4 DUT locations

The TCA39306EVM comes populated with U1 as the DUT (Device Under Test) which is the TCA39306 in the DCU package seen in the Figure 2-3. The EVM includes the DDF package and the DTM package unpopulated.

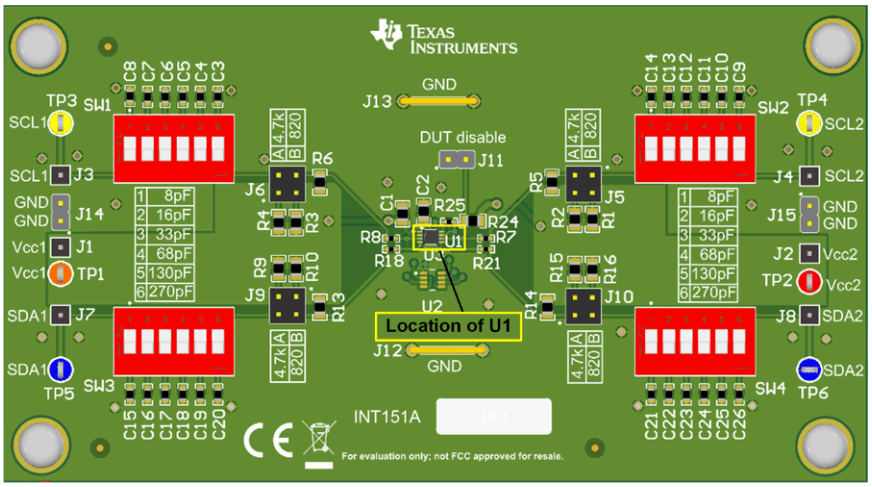

Figure 2-3. U1 location

If the user would prefer to use the DDF package, then U1 would need to be removed and U2 can then be populated. In additional to populating U2, the resistors: R11, R12, R17, R19, R22, R20, and R23 all must be populated with 0 Ω resistors. These resistors can be found on the back of the EVM and shown in Figure 2-4.

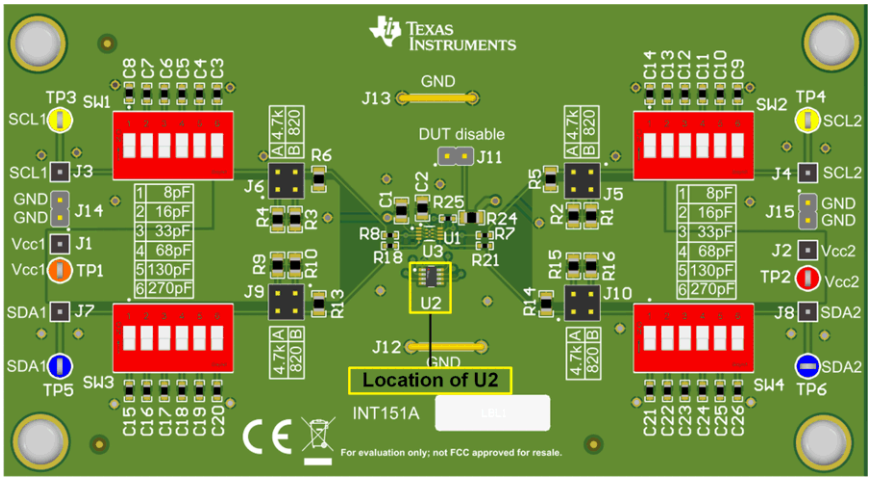

Figure 2-4. U2 populated

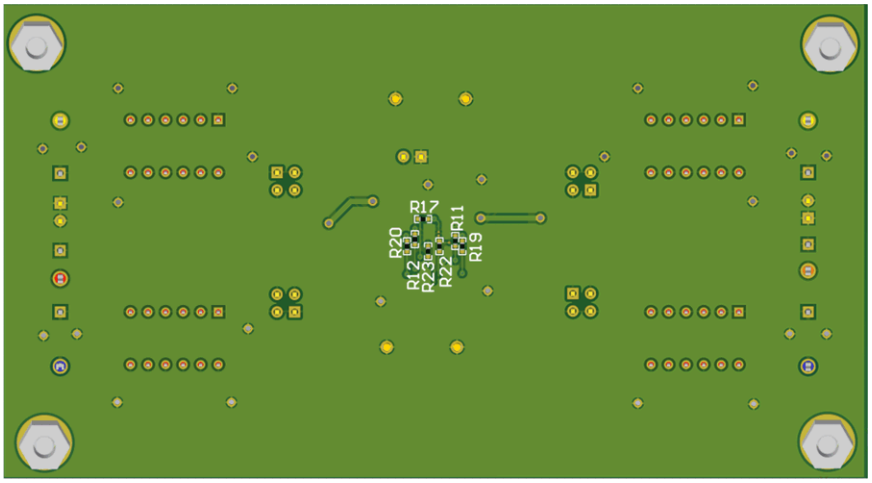

Figure 2-5. Resistors on back of board

If the DTM package is required to be populated, U1 must be unpopulated to reveal the location of U3. Figure 2-6 shows the location of U3.

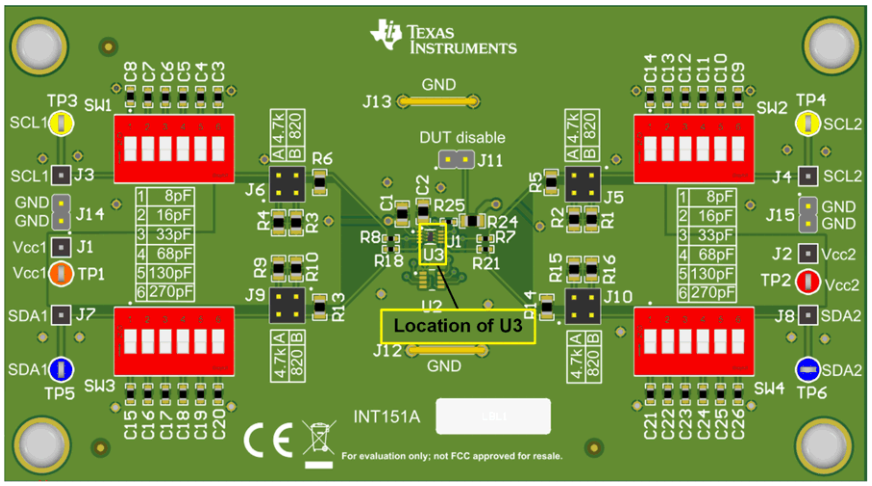

Figure 2-6. U3 Location

3 Schematic

Figure 3-1 illustrates the EVM schematic.

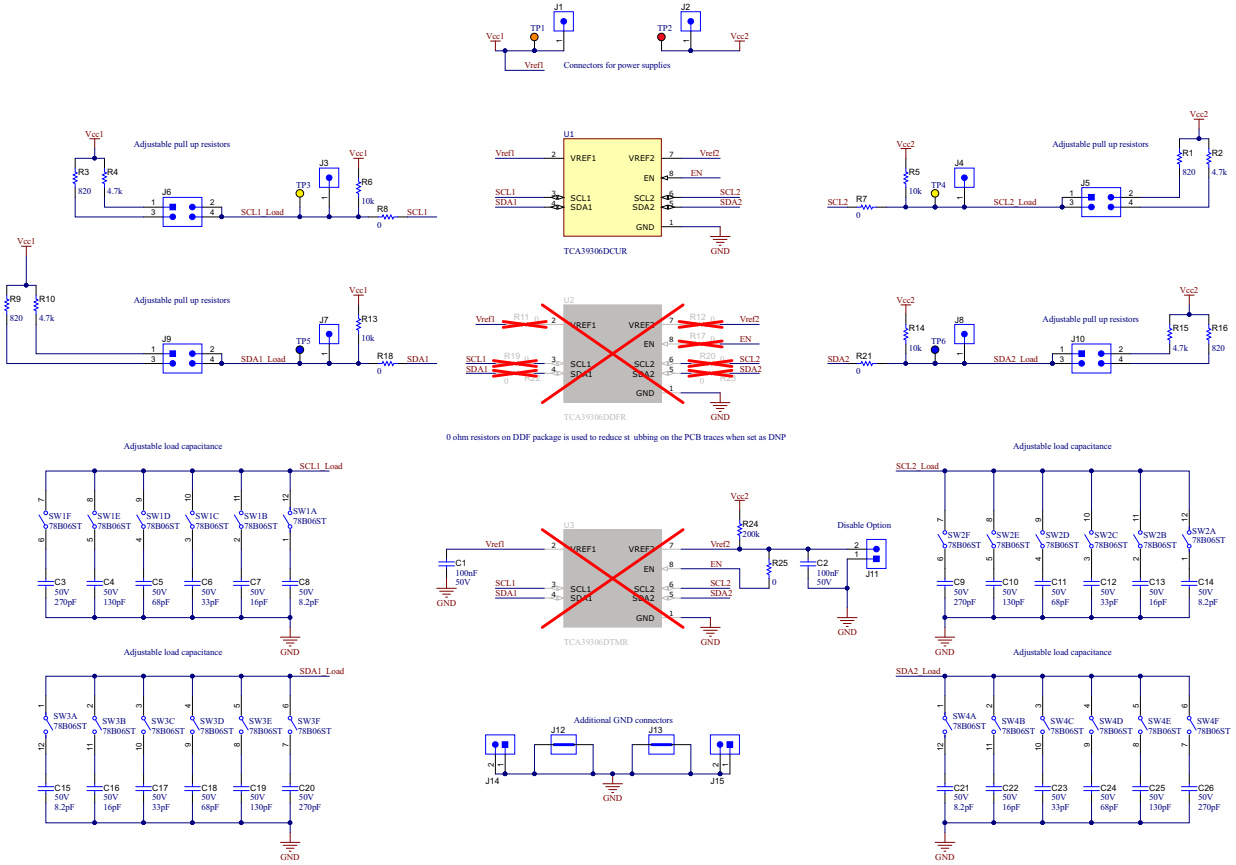

Figure 3-1. TCA39306EVM Schematic

4 Bill of Material

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
!PCB1	1		Printed Circuit Board		INT151	Any
C1, C2	2	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0805	0805	GCM21BR71H104KA37K	MuRata
C3, C9, C20, C26	4	270pF	CAP, CERM, 270 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H271JA01D	MuRata
C4, C10, C19, C25	4	130pF	CAP, CERM, 130 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H131JA01D	MuRata
C5, C11, C18, C24	4	68pF	CAP, CERM, 68 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	06035A680JAT2A	AVX
C6, C12, C17, C23	4	33pF	CAP, CERM, 33 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	06035A330JAT2A	AVX
C7, C13, C16, C22	4	16pF	CAP, CERM, 16 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H160JA01D	MuRata
C8, C14, C15, C21	4	8.2pF	CAP, CERM, 8.2 pF, 50 V, +/- 3%, C0G/NP0, 0603	0603	06035A8R2CAT2A	AVX
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, J3, J4, J7, J8	6		Header, 1x1, Tin, TH	Header, 1x1	PEC01SAAN	Sullins Connector Solutions
J5, J6, J9, J10	4		Header, 100mil, 2x2, Gold, TH	2x2 Header	TSW-102-07-G-D	Samtec
J11, J14, J15	3		Header, 100mil, 2x1, Gold, TH	Sullins 100mil, 1x2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions
J12, J13	2		1mm Uninsulated Shorting Plug, 10.16mm spacing, TH	Shorting Plug, 10.16mm spacing, TH	D3082-05	Harwin
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
R1, R3, R9, R16	4	820	RES, 820, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	ERJ-6GEYJ821V	Panasonic
R2, R4, R10, R15	4	4.7k	RES, 4.7 k, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	ERJ-6GEYJ472V	Panasonic
R5, R6, R13, R14	4	10k	RES, 10 k, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	ERJ-6GEYJ103V	Panasonic
R7, R8, R18, R21, R25	5	0	RES, 0, 5%, 0.063 W, 0402	0402	MCR01MZPJ000	Rohm
R24	1	200k	RES, 200 k, 5%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW0805200KJNEA	Vishay-Dale

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
SW1, SW2, SW3, SW4	4		SWITCH SLIDE DIP SPST 150MA 30V	SWITCH SLIDE DIP SPST	78B06ST	Grayhill Inc
TP1	1		Test Point, Multipurpose, Orange, TH	Orange Multipurpose Testpoint	5013	Keystone
TP2	1		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone
TP3, TP4	2		Test Point, Multipurpose, Yellow, TH	Yellow Multipurpose Testpoint	5014	Keystone
TP5, TP6	2		Test Point, Multipurpose, Blue, TH	Blue Multipurpose Testpoint	5127	Keystone
U1	1		Dual Bidirectional I2C Bus and SMBus Voltage-Level Translator	PSOP8	TCA39306DCUR	Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
R11, R12, R17, R19, R20, R22, R23	0	0	RES, 0, 5%, 0.063 W, 0402	0402	MCR01MZPJ000	Rohm
U2	0		Dual Bidirectional I2C Bus and SMBus Voltage-Level Translator	SOT23-8	TCA39306DDFR	Texas Instruments
U3	0		Dual Bidirectional I2C Bus and SMBus Voltage-Level Translator	X2SON8	TCA39306DTMR	Texas Instruments

5 Layout

Figure 5-1 and Figure 5-2 show the PCB layout images.

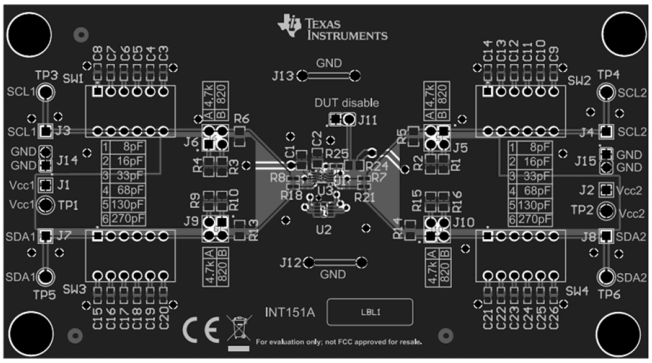

Figure 5-1. TCA39306EVM Top Layout

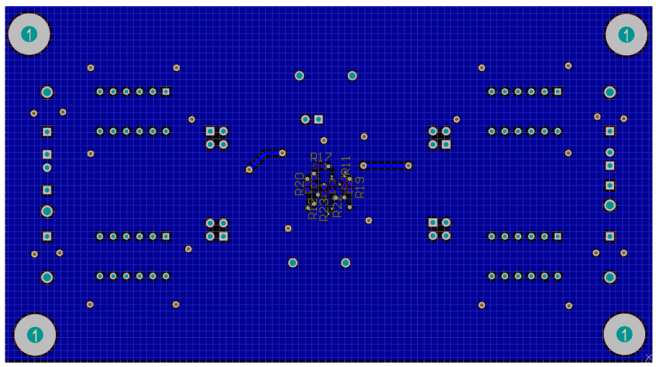

Figure 5-2. TCA39306EVM Bottom Layout

6 Revision History

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

DATE	REVISION	NOTES
June 2021	*	Initial Release

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265