# Using the TPS22930AEVM-027 Single Channel Load Switch IC

The TPS22930AEVM-027 evaluation module (EVM) allows the user to connect power to and control the Ultra Small CSP-4 package load switch. Parameters such as On State resistance, Slew Rate and Discharge properties can be easily evaluated.

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# 1 Introduction

**Table 1. TPS22930A VOUT Rise Time, Enable, and Output Discharge Options**

| EVM | Device | Rise Time (µs) Typical | VIN (V) | Max. Continuous Current | Enable (ON Pin) | Quick Output Discharge |
|---|---|---|---|---|---|---|
| HVL027 | TPS22930A | 6 | 4.2 | 2-A | Active High | No |

# 2 Description

The TPS22930A is a small, low $R_{ON}$ load switch with controlled turn on. The device contains a µP-channel MOSFET that can operate over an input voltage range of 1.4 V to 5.5 V. The switch is controlled by an on/off input (ON), which is capable of interfacing directly with low-voltage control signals. The TPS22930A is active high enable.

## *2.1 Typical Applications*

- Battery Powered Equipment
- Portable Industrial Equipment
- Portable Medical Equipment
- Portable Media Players
- Smart phones / Tablets
- Digital Cameras
- GPS Devices

## *2.2 Features*

- Ultra Low On State Resistance
- 2A Maximum Continuous Switch Current
- Controlled Slew Rate to Avoid Inrush Currents

# 3 Electrical Performance

**Table 2. TPS22930AEVM-027 Electrical Performance**

| PARAMETER | | TEST CONDITIONS | $T_A$ | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $I_{IN}$ | Quiescent current | $I_{OUT}$ = 0, $V_{IN}$ = $V_{ON}$ | Full | | 8 | 20 | µA |
| $I_{IN}$(off) | Off supply current | $V_{ON}$ = GND, $V_{OUT}$ = Open | Full | | 0.6 | 3.5 | µA |
| $I_{IN}$(Leakage) | Leakage current | $V_{ON}$ = GND, $V_{OUT}$ = 0 | Full | | 0.6 | 3.5 | µA |
| $r_{ON}$ | On-resistance | $V_{IN}$ = 5.5 V, $I_{OUT}$ = –200 mA | 25°C | | 31.7 | | mΩ |
| | | | Full | | | 40.8 | |
| | | $V_{IN}$ = 5.0 V, $I_{OUT}$ = –200 mA | 25°C | | 31.9 | | mΩ |
| | | | Full | | | 41.1 | |
| | | VIN = 4.2 V, $I_{OUT}$ = –200 mA | 25°C | | 32.2 | | mΩ |
| | | | Full | | | 41.6 | |
| | | VIN = 3.3 V, $I_{OUT}$ = –200 mA | 25°C | | 33 | | mΩ |
| | | | Full | | | 42.5 | |
| | | VIN = 2.5 V , $I_{OUT}$ = –200 mA | 25°C | | 35.4 | | mΩ |
| | | | Full | | | 44.8 | |
| | | VIN = 1.8 V, $I_{OUT}$ = –200 mA | 25°C | | 45.2 | | mΩ |
| | | | Full | | | 58.3 | |
| | | VIN = 1.5 V, $I_{OUT}$ = –200 mA | 25°C | | 54.4 | | mΩ |
| | | | Full | | | 71.1 | |
| UVLO | Under voltage lock out | $V_{IN}$ increasing, V– = 0 V, $I_{OUT}$ = –100 mA | Full | | | 1.2 | V |
| | | $_{VIN}$ decreasing, V– = 0 V, $R_L$ = 10 Ω | Full | 0.5 | | | V |
| $I_{ON}$ | ON input leakage current | $V_{ON}$ = 1.4 V to 5.5 V or GND | Full | | | 1 | µA |
| $V_{RVP}$ | Reverse current voltage threshold | | | | 44 | | mV |
| $t_{DELAY}$ | Reverse current response delay | VIN = 5 V | | | 10 | | µs |

# 4 Operation

## *4.1 Equipment*

**Voltage Sources:**

- DC supply will be used.
  - DC Supply capable of minimum of 10V, 3A.

**Multimeters:**

- Multi Meter for measuring switch voltage drop and VOUT voltage.

**Output Load:**

- Variable load connected to VOUT, observe power rating,

**Oscilloscope:**

- 2 channel 100MHz

**Recommended Wire Gauge:** 18 AWG

## *4.2 Setup*

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the EVM.

### 4.2.1 J1/J3 – Input Connections

This is the connection for the leads from the input source. Connect the positive lead to VIN J1, and the negative lead connection to GND J3.

### 4.2.2 J4/J6 – Output Connections

This is the connection for the output of the EVM. Connect the positive connection of the load to VOUT J4, and the negative connection to GND J6.

### 4.2.3 JP3 – ON

This is the enable input for the device. A shorting jumper must be installed on JP3 in either the High or Low Position. The TPS22907 and TPS22908 are active High. ON must not be left floating. An external enable source can be applied to the EVM by removing the shunt and connecting a signal to the center pin of J3. Refer to the datasheet for proper ON and OFF voltage level settings. A switching signal may also be used and connected at this point.

### 4.2.4 J2/J5 - VIN Sense and VOUT Sense

These two connections are used when very accurate measurements of the input or output voltage are required. rON measurements should be made using these sense connections when measuring the voltage drop from VIN to VOUT and then calculating the resistance.

### 4.2.5 JP1/JP2 – Input Capacitors

During normal operation a shorting jumper is placed on JP2 and connects C2 capacitor from the input of the device to ground. JP1 and C1 may be used to connect a user selected capacitor value from the input of the device to ground. Refer to the Applications Section of the Datasheet for additional information on selecting the input capacitors.

### 4.2.6 JP4/JP5 – Output Capacitors

JP4 and JP5 may be used to connect a user selected capacitor value from the output of the device to ground. Refer to the Applications Section of the Datasheet for additional information on selecting the output capacitors.

### 4.2.7 JP6/JP7 – Output Resistors

During normal operation no shorting jumper is placed on JP6 or JP7. A shorting jumper may be used on JP6 to connect R1 load resistor from the output of the device to ground. JP7 may be used to connect R2 load resistor from the output to ground. R1 and R2 are sized for 1210 1/2W power rated resistors.

## 5 Operation

Connect the positive input of the power supply to VIN at J1 and the negative lead of the power supply to GND at J3. The input voltage range of the TPS22930AEVM-027 is 1.4V to 5.5V.

Output loads can be applied by connecting between J4 VOUT and J6 GND. The TPS22930AEVM-027 is rated for a maximum continuous current of 2A. Configure JP3 as required. JP3 must be installed for proper operation. When the ON pin is asserted the TPS22930A device will control the slew rate of VOUT. The slew rate of the device is internally controlled to avoid inrush current.

# 6 Test Configurations

## 6.1 On State Resistance ($r_{ON}$) Test Setup

Figure 1 shows a typical setup for measuring On State Resistance. The voltage drop across the switch is measured using the sense connections then divided by the current into the load yielding the $r_{ON}$ resistance.

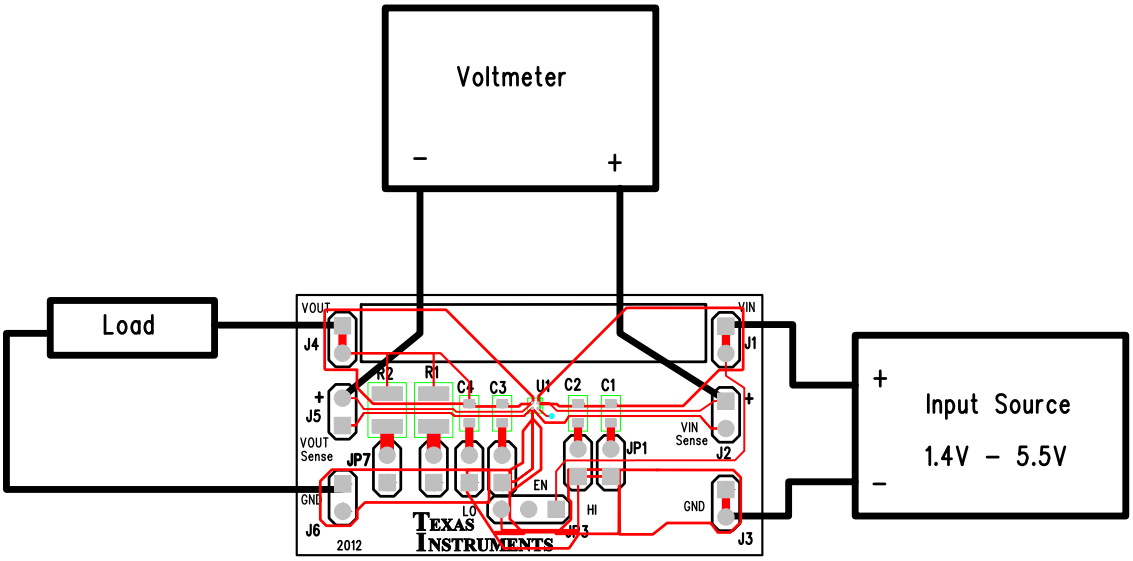



**Figure 1. $r_{ON}$ Setup**

## 6.2 Slew Rate Test Setup

Figure 2 shows a test setup for measuring the Slew Rate of the Load Switch. Controlling the ON pin of the switch with a signal source and then measuring the output with a scope shows the switches ability to avoid inrush current.

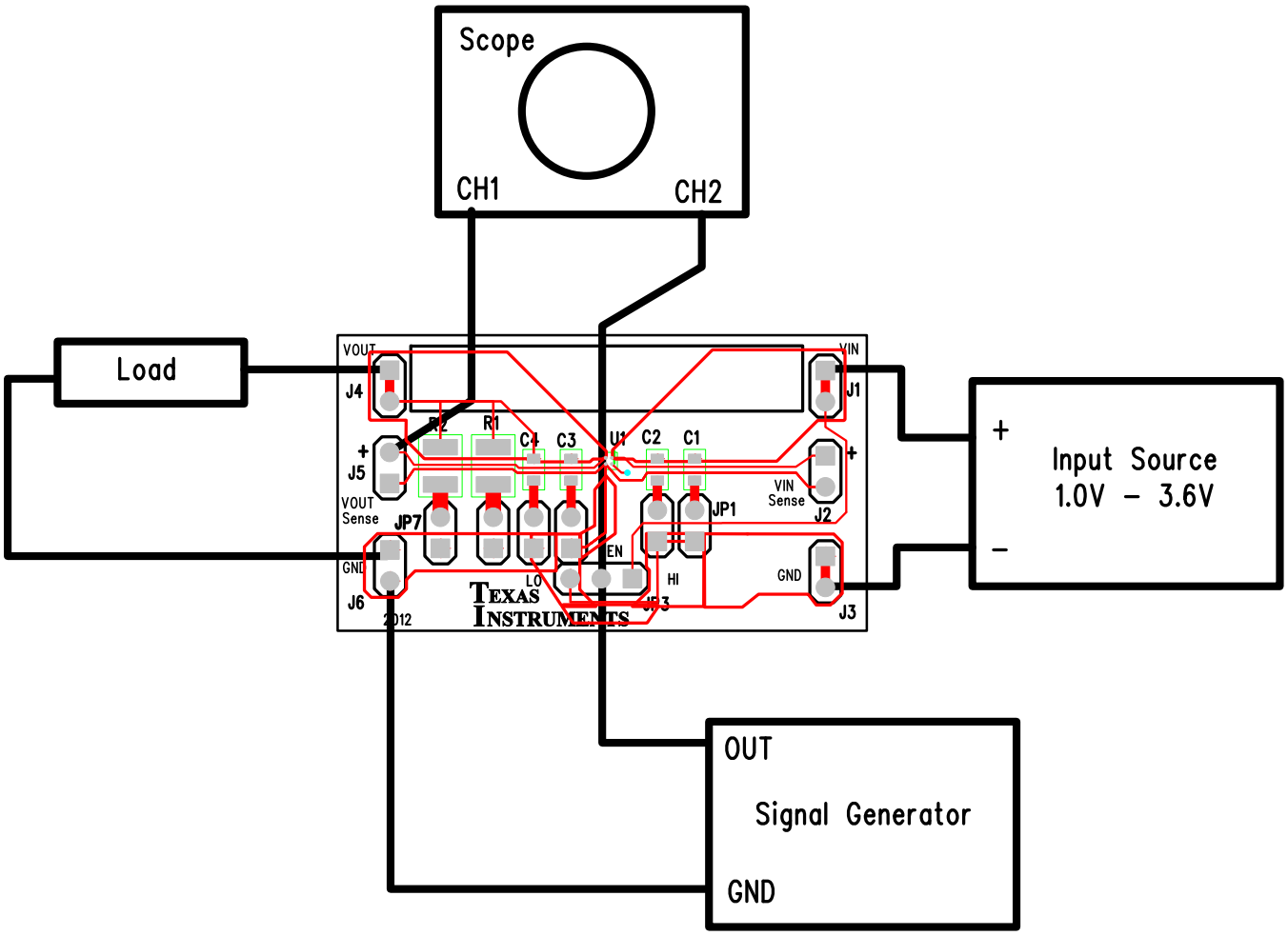



**Figure 2. Slew Rate Setup**

### 6.3 VOUT Slew Rate Example

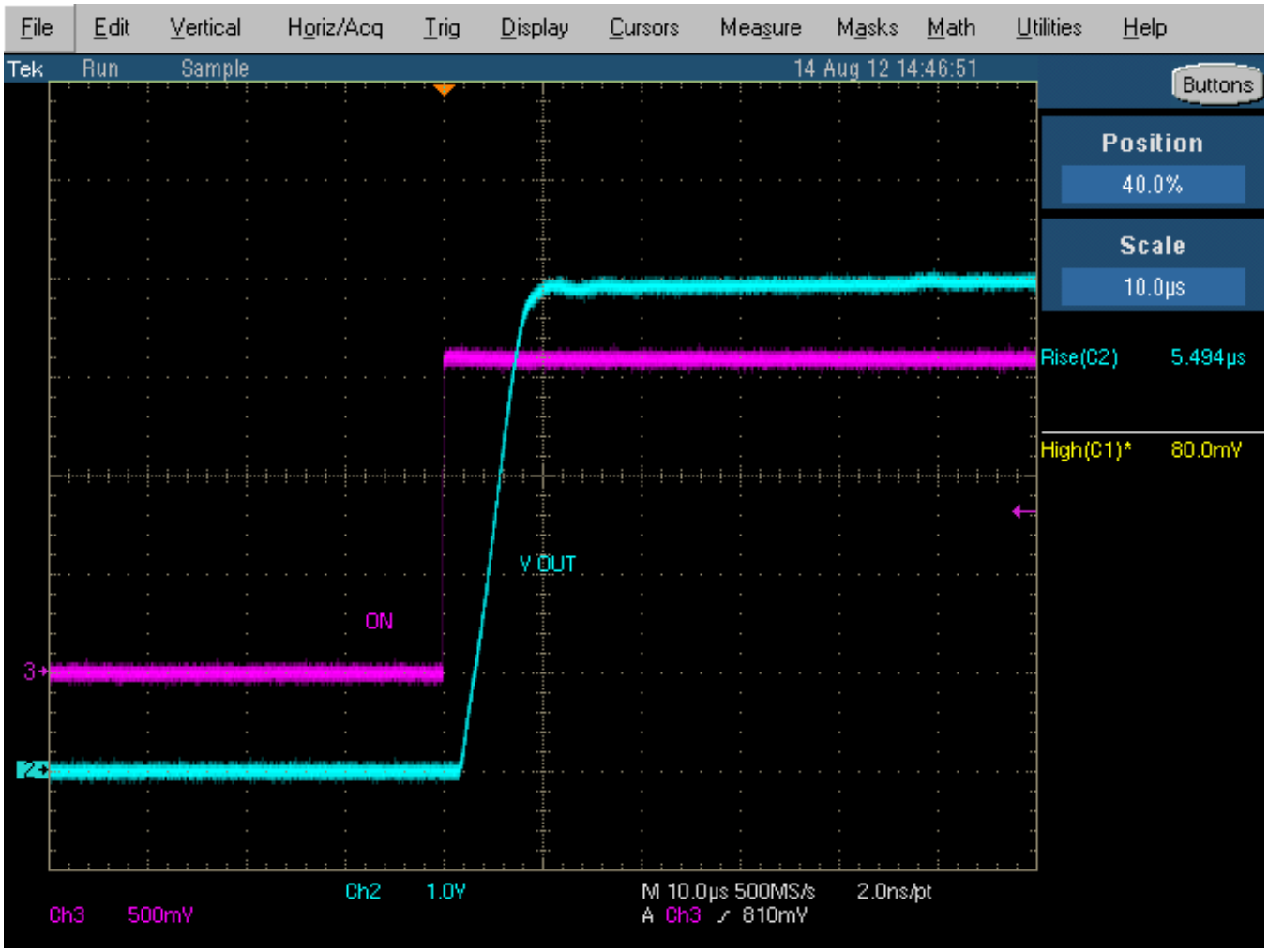



**Figure 3. Trise TPS22930A Example**

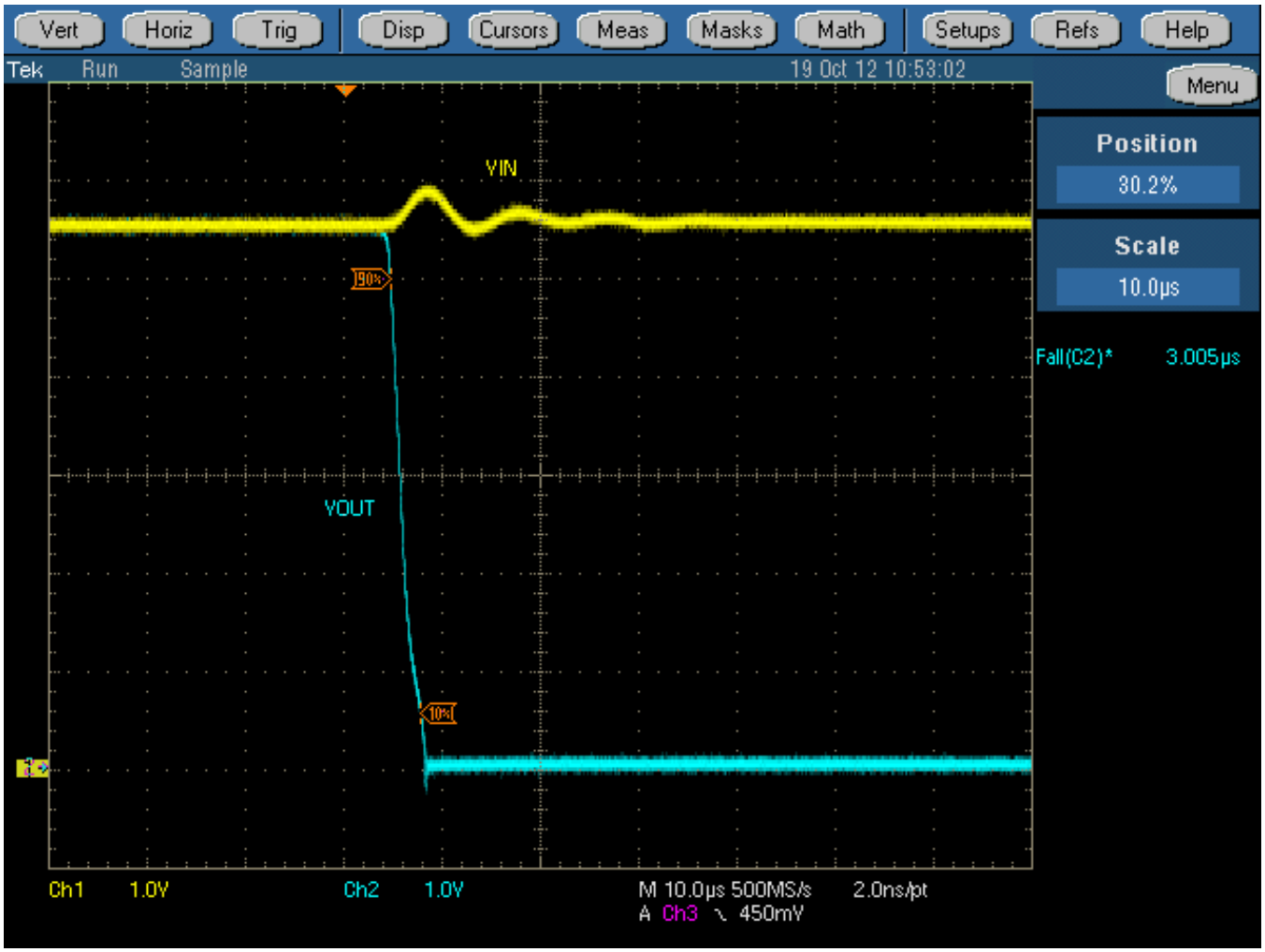
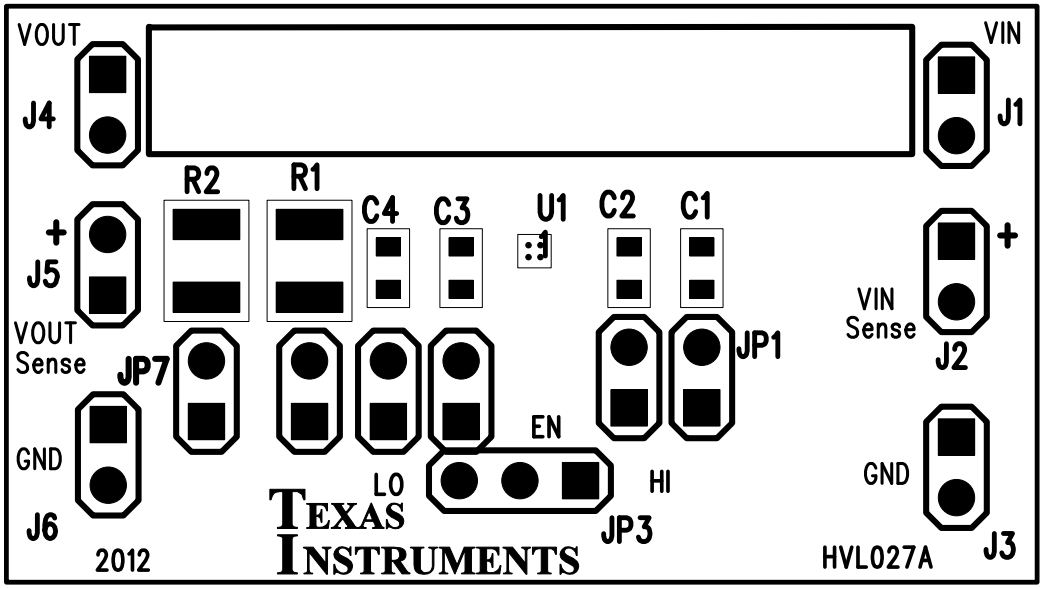


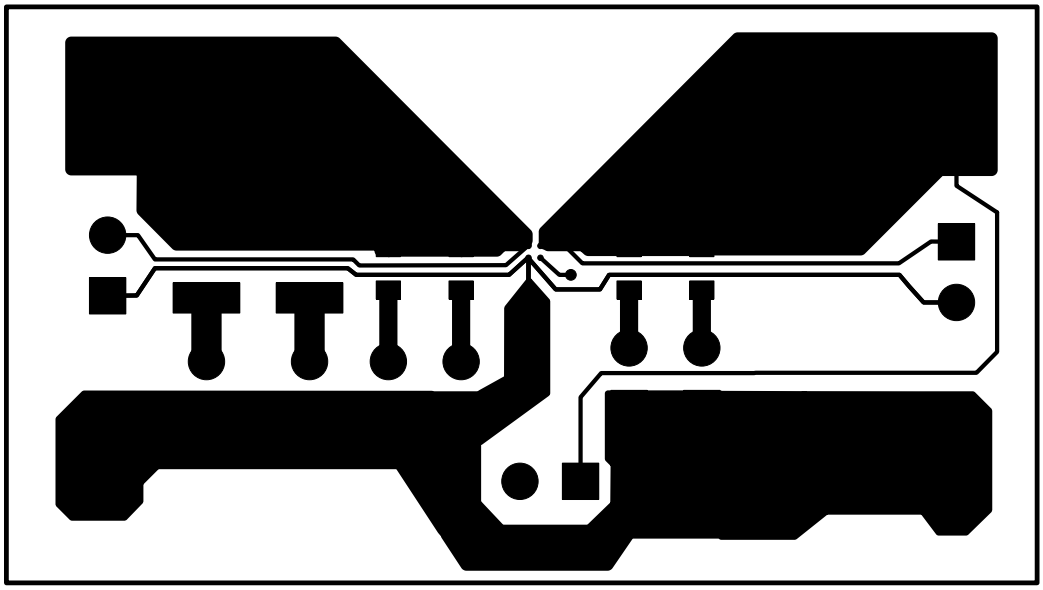

**Figure 4. Tfall TPS22930A Example**

# 7 Layout

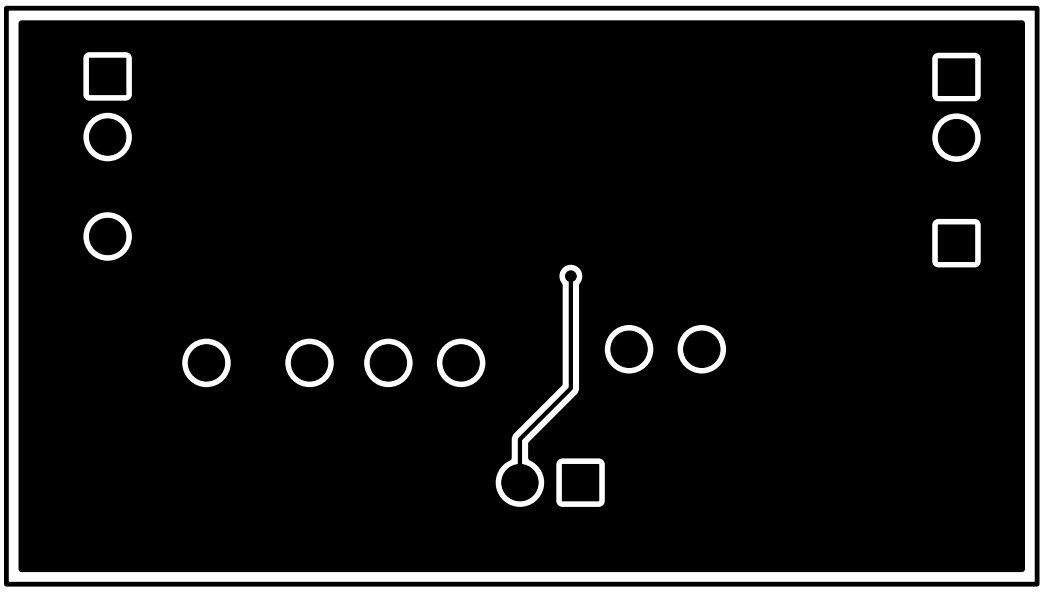
## 7.1 Assembly



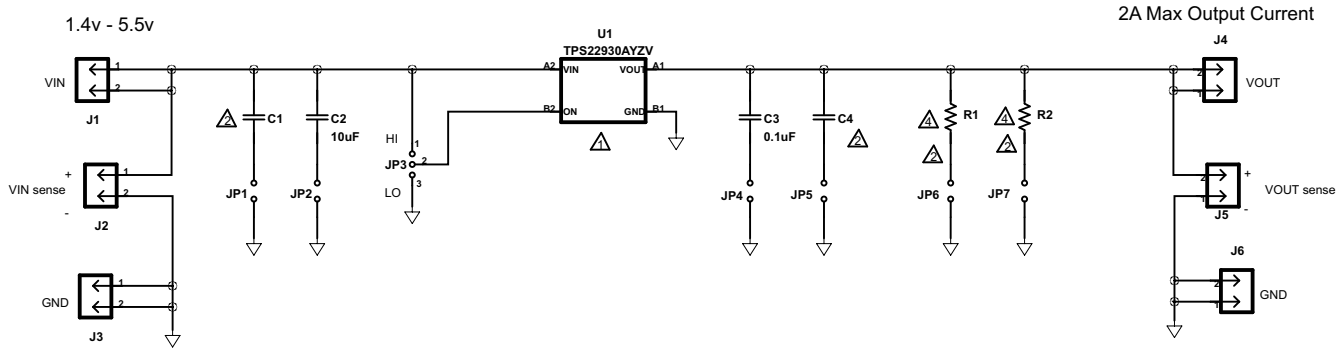

## 7.2 Top Side



### 7.3 Bottom Side



# 8 Schematic




1 See BOM for part number

2 Not Installed

3 Observe 1/2W Rating on these components

# 9 Bill of Materials

**Table 3. Bill of Materials**

| Count | RefDes | Value | Description | Size | Part Number | MFR |
|---|---|---|---|---|---|---|
| 1 | — | | PCB, 0.9 In x 1.7 In x 0.062 In | | HVL027 | Any |
| 0 | C3 | 0.1uF | Capacitor, Ceramic, 16-V, X7R,10% | 603 | Std | Std |
| 1 | C2 | 10uF | Capacitor, Ceramic, 10-V, X5R,20% | 603 | Std | Std |
| 0 | C1, C4 | OPEN | Capacitor, Ceramic | 603 | Std | Std |
| 0 | R1 | OPEN | Resistor, Chip 1/2W 5% | 1210 | Std | Std |
| 0 | R2 | OPEN | Resistor, Chip 1/2W 5% | 1210 | Std | Std |
| 12 | J1-J6, JP1-2, JP4-7 | PEC02SAAN | Header, 2pin, 100mil spacing | 0.100 inch x 2 | PEC02SAAN | Sullins |
| 1 | JP3 | PEC03SAAN | Header, 3pin, 100mil spacing | 0.100 inch x 3 | PEC03SAAN | Sullins |
| 1 | U1 | TPS22930AYZV | IC, Single Chip,Current-Limited Load Switch with Controlled Turn On | YZV | TPS22930AYZV | TI |
| 1 | — | — | Label (See note 5) | 1.25 x 0.25 inch | THT-13-457-10 | Brady |
| 1 | NA | NA | Shunt, 100-mil, Black | 0.100 | 929950-00 | 3M |

Notes:

1. These assemblies are ESD sensitive, ESD precautions shall be observed.
2. These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
3. These assemblies must comply with workmanship standards IPC-A-610 Class 2.
4. Ref designators marked with an asterisk ('**') cannot be substituted. All other components can be substituted with equivalent MFG's components.
5. Install label in silkscreened box after final wash. Text shall be 8 pt font. Text shall be per Table 1.

**Table 1**

| Assembly No. | Text |
|---|---|
| HVL027 | TPS22930AEVM -027 |

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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**

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**

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- 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.

**For EVMs annotated as IC – INDUSTRY CANADA Compliant**

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**Concerning EVMs including radio transmitters**

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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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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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.

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2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
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