

***TPS2412/13 Evaluation Module,  
HPA227***

*User's Guide*

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## ***User's Guide***

Literature Number: sluu267  
January 2007

## **TPS2412/13 Evaluation Module, HPA227**

### **1 Purpose**

This user guide is to facilitate operation of the TPS2412/13 Evaluation Module, HPA227. It is used by an engineer or technician and supplements the TPS2412/13 datasheet, HPA227 schematics, and HPA227 circuit board labeling.

### **2 Introduction**

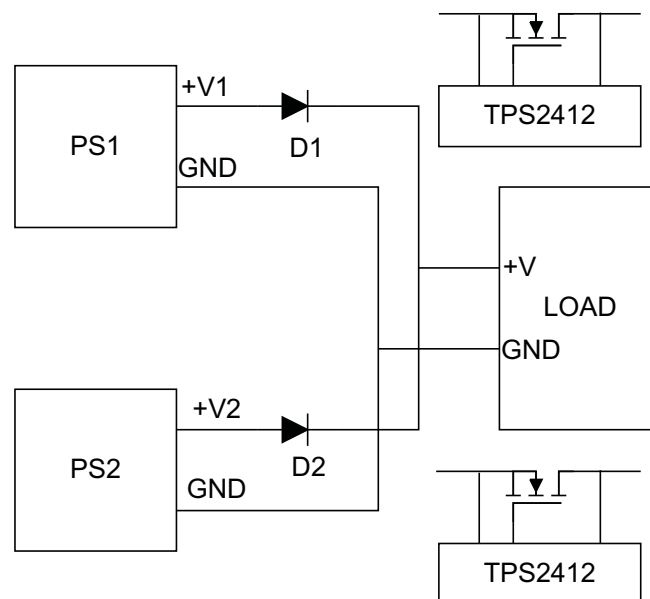
The TPS2412 controls an N-channel MOSFET to operate in circuit as an ideal diode. The MOSFET source and drain voltages are monitored by TPS2412 pins A and C. The TPS2412 drives the MOSFET gate high if  $V_{AC}$  exceeds 10 mV, and turns the MOSFET off if  $V_{AC}$  falls below a threshold that is both programmable and dependent on the choice of TPS2412 or TPS2413.

The TPS2412 has a fixed turn off point of 3.0 mV  $V_{AC}$ .

TPS2413 is similar to TPS2412 but has a resistor programmable MOSFET turn off point. The TPS2413 can even be set to slightly negative allowing some back current.

Figure 1 shows the conventional wire-OR of power supplies with diodes. Each diode D1 and D2 is replaced by a TPS2412 and MOSFET eliminating the voltage and power loss in the diode.

The evaluation module is set up to wire-OR two power supplies for redundant power to a load using two TPS2410s and MOSFETs. This document contains setup and user information about this evaluation module to assist with the operation of TPS2412.

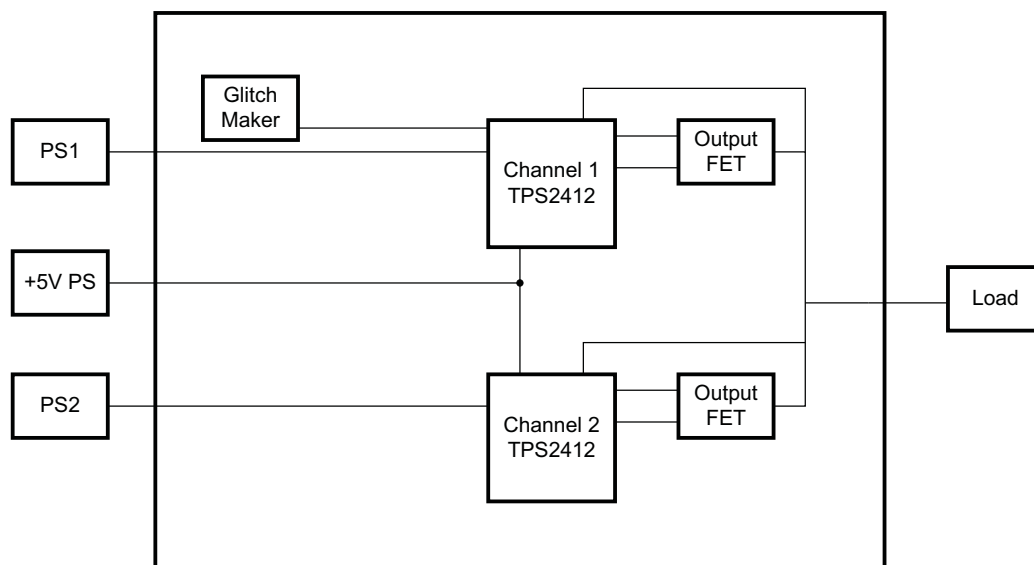


**Figure 1. Conventional Wire-OR Power Supplies**

## Materials Needed

Reference [Figure 2](#), a block diagram of the HPA227.

- The 5-V supply is jumper selected to power  $V_{DD}$  on the TPS2412s and the glitch circuit if the control voltage is less than 3.0 V.
- The Glitch maker, discussed in the Test Methods section applies a 1- $\Omega$  load to the input supply for 1 ms. This disruption allows the user to scope test points and observe system recovery.
- The  $R_{SET}$  resistor is used to program the turn off point of the TPS2411.



**Figure 2. EVM Block Diagram**

### 3 Materials Needed

TI Supplied:

- TPS2412 evaluation module
- TPS2412 reference design documentation
- TPS2412 datasheet

User Supplied:

- Two power supplies for wire-OR to load, up to 15 A
- 1-V to 5-V power supply for  $V_{DD}$
- Power supply cables
- Load-active load, power resistors or actual load
- Oscilloscope
- Current probe
- Differential probe

## 4 Jumper Description

### 4.1 Jumpers J1, J2, J8, J9

$V_{DD}$  can be powered by the input power supply pin A, Jump J1-2, 3 and J9-2, 3. When it is powered by the load, pin C, jump J1-1, 2 and J9-1, 2. If A and C are less than 3 V, connect the 5 V to  $V_{DD}$ , jumper J1-1 to J2 -2 and J8-1 to J9-2.

### 4.2 J13

Jumper J8 is the gate voltage for the Glitch FET. Jump J13-2, 3 when the PS1 voltage is greater than 5 volts. Jump J13-1, 2 to use the 5 volt supply when PS1 is less than 5 volts.

### 4.3 J14

J14 is used to short out the current limit resistor on glitching the power supply. This jumper is installed only when the voltage is less than 3 volts and a glitch is not generated because of current limit.

## 5 Procedure

### 5.1 Jumper Set-Up

An initial jumper setup is recommended in [Table 1](#). The module has flexibility to operate in other modes. Change jumpers to operate in other configurations as required after getting started. After the initial setup, reference the schematic and set jumpers as required for testing. Other J reference designators on the schematic are simple connectors.

**Table 1. Initial Jumper Settings**

Jumper	Function	Selection	Comment
J1	5 V to $V_{DD}$ , CH1	Open	
J2	A or C to $V_{DD}$ , CH1	Jumper A – $V_{DD}$	Connects A
J8	5 V to $V_{DD}$ , CH2	Open	
J9	A or C to $V_{DD}$ , CH2	Jumper A - $V_{DD}$	Connects A
J13	PS1 to Glitcher	Jumper PS1 to Glitcher	Connects PS1
J14	Glitcher	Open	Shorts 1 $\Omega$

## 5.2 Power Supply Connection

Connect the power supplies and load to the TPS2410 test card as shown in [Table 2](#). Loading less than 30 A is safe for IRI3713S. The load can be a test load or the actual system load.

**Table 2. Power Supply Connection**

Connection	Supply	Terminal
PS1	+V	PS1, J3
	GND	PS1GND, J27
PS2	+V	PS2, J10
	GND	PS2GND, J11
5 V	5 V	J15-2
5GND	GND	J15-1
Load +	Load	J5
Load -	GND	J7

## 5.3 Test Points

[Table 3](#) lists some common test points for observation. There are more test points shown on the Schematic.

**Table 3. Common Test Points**

Function	TP Channel 1	TP Channel 2
A	TP3	TP11
C	TP1	TP9
GATE	TP6	TP14

## 5.4 $R_{SET}$

$R_{SET}$  is used in TPS2411 to program the MOSFET turn-off point. The  $R_{SET}$  calculation from the datasheet is:

$$R_{SET} = \left( \frac{-500}{V_{OFF} - 0.003} \right)$$

Calculate the  $R_{SET}$  resistor and install. The component reference designators for both channels are summarized in [Table 4](#).

**Table 4. Table 5,  $R_{SET}$  Resistor Setting**

$R_{SET}$	CH1	CH2
Resistor	R2	R4

## 5.5 Test Methods

The EVM has a few operating modes to view the system response. The user can make modifications to the EVM to test in other ways.

### **5.6 Adjust Input Power Supplies**

Vary the input voltages to observe system behavior. Jumpers can be set as in [Table 1](#). Turn the power supplies to the application typical 12 V. The load is shared between the supplies. Both gates will be on and the power supply current meters show output. Decrease one supply voltage slightly and note the gate on that channel pass FET turn off and the other channel FET gate increases to keep the FET on to supply the load. Observe the FET gates with a scope. With a voltmeter, verify  $V_{DS}$  for the on channel to be tens of millivolts.

### **5.7 Glitch Maker**

Set power supplies up for equal or slight differential voltage so that the PS1 supply is contributing to the load. Press momentary switch S1, labeled PULSE. The switch closure places a 1- $\Omega$  load across the input power supply for 1 ms. Observe the effect of an input power supply glitch at the MOSFET gates and load voltage.

### **5.8 Input Power Supplies**

Input change can be tested by cycling power, opening input, hot plugging, and shorting the supply.

### **5.9 Load change**

A dynamic change to the load can be made by switching additional load on or off with an external switch. Some power load test equipment can be used to dynamically change the load.

## 6 Schematic/Board Layout Diagrams

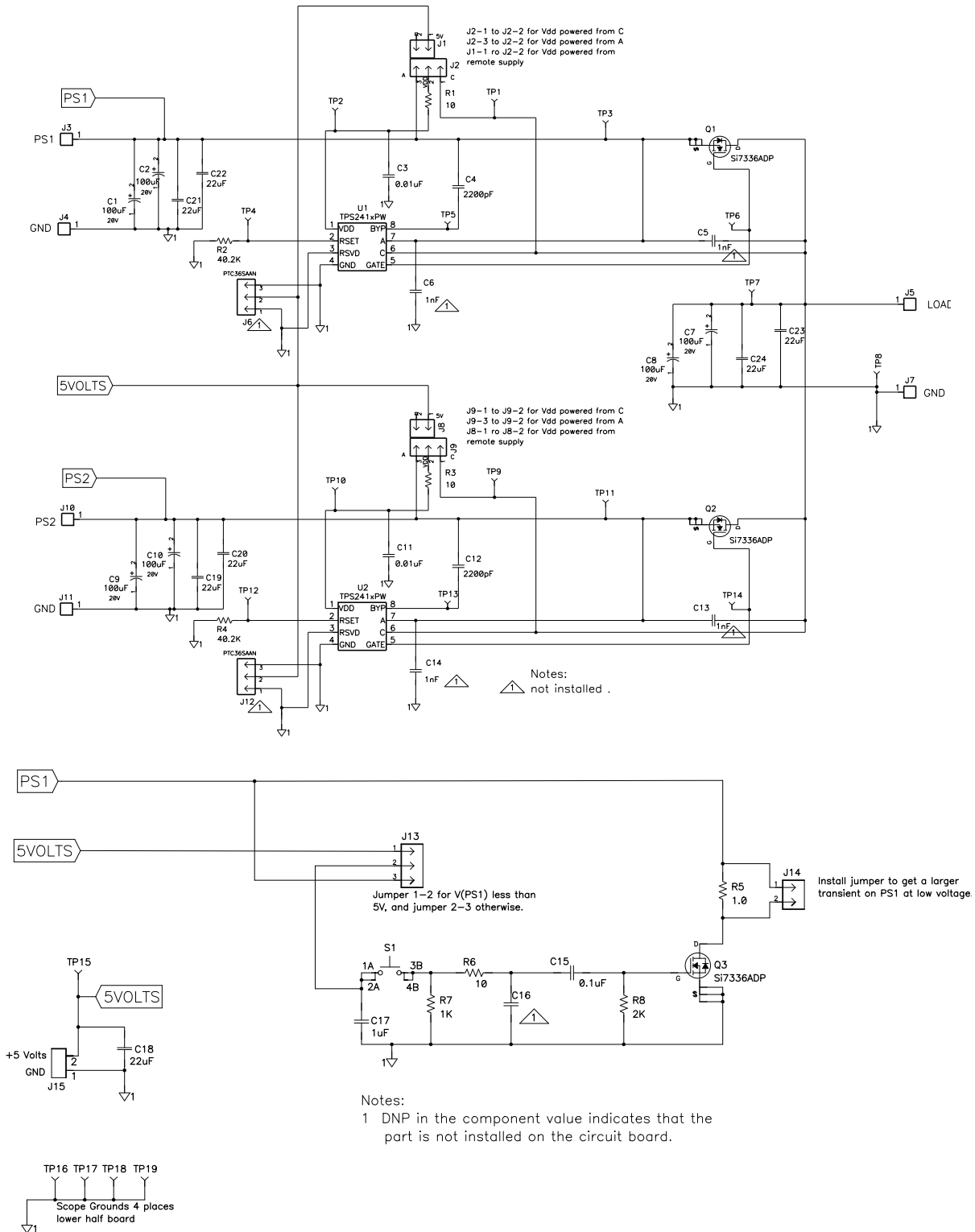


Figure 3. TPS2412/13 Schematic



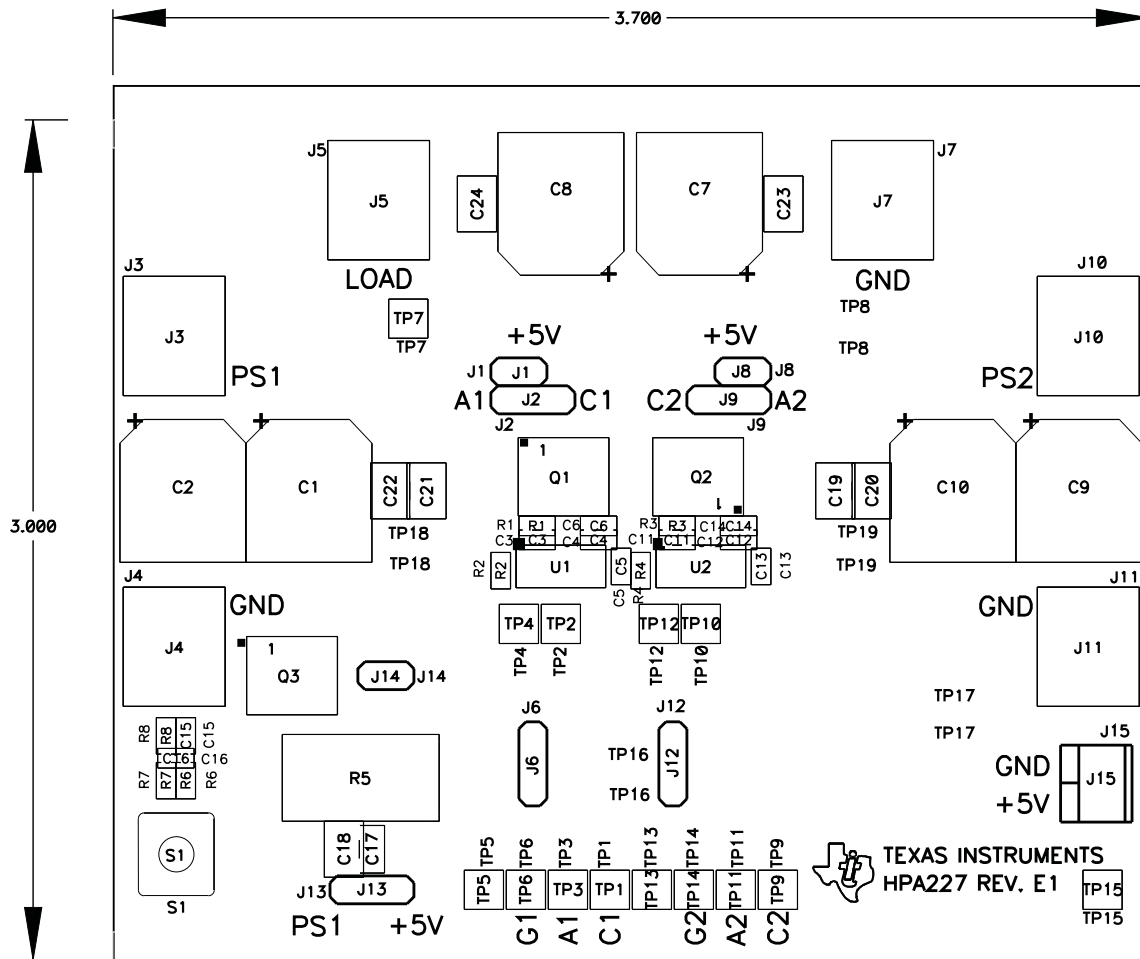


Figure 4. TPS2412/13 Layout

## 7 List of Materials

**Table 5. List of Materials for the TPS2412/13<sup>(1)(2)(3)(4)</sup>**

REF DES	COUNT	DESCRIPTION	MFR	PART NUMBER
C1, C2, C7, C8, C9, C10	6	Capacitor, OSCON, SM, 100 $\mu$ F, 20 V, 20%, G-case	Sanyo	20SVP100M
C15	1	Capacitor, ceramic, 0.1 $\mu$ F, 16 V, X5R, 20%, '0603	STD	STD
C17	1	Capacitor, ceramic, 1 $\mu$ F, 25 V, X5R, 20%, '0805	Panasonic	ECJ2FB1E105M
C18, C19, C20, C21, C22, C23, C24	7	Capacitor, ceramic, 22 $\mu$ F, 25 V, X5R, 20%, '1210	Panasonic	ECJ4YB1E226M
C3, C11	2	Capacitor, ceramic, 0.01 $\mu$ F, 25 V, X7R, 20%, '0603	STD	STD
C4, C12	2	Capacitor, ceramic, 2200 pF, 50 V, X7R, 10%, 0603	STD	STD
J1, J8, J14	3	Header, 2 pin, 100-mil spacing, (36-pin strip), 0.100 inch x 2	Sullins	PTC36SAAN
J15	1	Terminal block, 2-pin, 6-A, 3.5mm, 0.27 x 0.25 inch	OST	ED1514
J2, J9, J13	3	Header, 3 pin, 100-mil spacing, (36-pin strip), 0.100 inch x 3	Sullins	PTC36SAAN
J3, J4, J5, J7, J10, J11	6	Screw terminal, 0.310 x 0.310 inch	Keystone	7693
Q1, Q2, Q3	3	MOSFET, N-channel, 30 V, 30 A, $R_{DS}$ 3 m $\Omega$ , PWRPAK S0-8	Vishay	Si7336ADP
R1, R3	2	Resistor, chip, 10 $\Omega$ , 1/16 W, 1%, 0603	STD	STD
R2, R4	0	Resistor, chip, DNP, 1/16 W, 1%, 0603	STD	STD
R5	1	Resistor, power metal strip, 1 $\Omega$ , 2 W, 1%, 4527	Panasonic	WSR2 1R000 J EA
R6	1	Resistor, chip, 10 $\Omega$ , 1/16 W, 1%, 0603	STD	STD
R7	1	Resistor, chip, 1 k $\Omega$ , 1/16 W, 1%, 0603	STD	STD
R8	1	Resistor, chip, 2 k $\Omega$ , 1/16 W, 1%, 0603	STD	STD
S1	1	Switch, 1P1T, 20 mA, 15 V, 0.240 x 0.256	Panasonic	EVQPAC04M
SH1, SH2	2	Short jumper, 0.125 x 0.125 inch		
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP9, TP10, TP11, TP12, TP13, TP14, TP15	14	Test point, white, thru hole, 0.185 x 0.135 inch	Keystone	5012
TP8, TP16, TP17, TP18, TP19	5	Test point, SM, 0.150 x 0.090,	Keystone	5016
U1, U2	2	N+1 and O-Ring Power Rail Controller, TSSOP-8	TI	TPS241xPW

- (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.

## **EVM WARNINGS AND RESTRICTIONS**

It is important to operate this EVM within the input/output voltage range of 0.8 V to 18 V +/- 5%.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 50°C. The EVM is designed to operate properly with certain components above 50°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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