

## GENERAL DESCRIPTION

The XRP2524 is a dual channel integrated high-side power distribution switch optimized for self or bus-powered USB applications and it is compliant with the latest USB 3.0 specification. It accepts an input voltage between 2.7V and 6.5V allowing for operations from industry standard 3.3V and 5V power rails.

The XRP2524 is provided with an enable pin while an error flag is available to indicate fault conditions. With a low quiescent current as well as a small package, the XRP2524 is ideal for battery powered applications. The power-switch rise and fall times are controlled to minimize current surges during turn on/off.

Built-in over current, reverse current and over temperature protections insure safe operations under abnormal operating conditions.

XRP2524 is offered in a RoHS compliant "green"/halogen free 8-pin NSOIC package.

## APPLICATIONS

- **Self Powered USB 2.0 and 3.0 Hubs**
- **USB Compliant  $V_{BUS}$  Power Distribution**
- **Portable Equipment**

## FEATURES

- **Dual Channel Current Switch**
  - 1A continuous load current per channel
  - 1.5A Typical Over-current Limit
  - 2.7V to 6.5V Input Voltage Range
- **USB 2.0 and USB 3.0 Compliant**
- **Active High Enable**
- **Soft Start**
- **Channel Error Flag Indicator**
  - 9ms Blanking Time
- **UVLO, Reverse Current, Short circuit and Thermal Shutdown Protection**
- **RoHS Compliant, Green/Halogen Free 8-Pin NSOIC Package**

## TYPICAL APPLICATION DIAGRAM

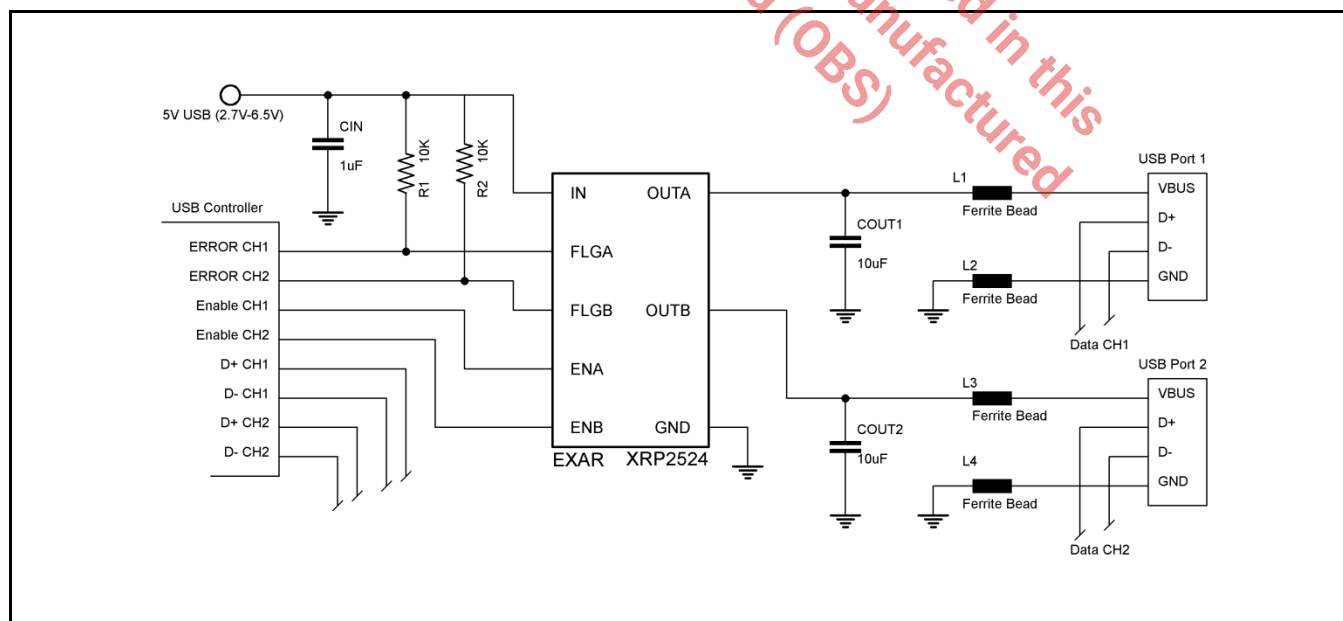


Fig. 1: XRP2524 Application Diagram

# 1A Dual Channel USB 3.0 Power Distribution Switch

## ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

$V_{IN}$  ..... 7.0V  
 $V_{ENX}$ ,  $V_{FLGX}$  ..... -0.3V to 7.0V  
 Storage Temperature ..... -65°C to 150°C  
 Junction Temperature ..... 150°C  
 Power Dissipation ..... Internally Limited  
 Lead Temperature (Soldering, 10 sec) ..... 260°C  
 ESD Rating (HBM - Human Body Model) ..... 2kV

## OPERATING RATINGS

Input Voltage Range  $V_{IN}$  ..... 2.7V to 6.5V  
 Ambient Temperature Range ..... -40°C to 85°C  
 Thermal Resistance  $\theta_{JA}$  ..... 160°C/W

## ELECTRICAL SPECIFICATIONS

Specifications are for an Operating Temperature of  $T_A = T_J = 25^\circ\text{C}$  only; limits applying over the full Operating Ambient Temperature range are denoted by a "\*". Minimum and Maximum limits are guaranteed through test, design, or statistical correlation. Typical values represent the most likely parametric norm at  $T_A = 25^\circ\text{C}$ , and are provided for reference purposes only. Unless otherwise indicated,  $V_{IN} = 5\text{V}$ ,  $C_{IN} = C_{OUT} = 1\mu\text{F}$ ,  $T_A = 25^\circ\text{C}$ .

| Parameter                                      | Min. | Typ. | Max. | Units            | Conditions                                            |
|------------------------------------------------|------|------|------|------------------|-------------------------------------------------------|
| Input Supply Voltage                           | 2.7  |      | 6.5  | V                |                                                       |
| Input Quiescent Current                        |      | 80   | 160  | $\mu\text{A}$    | $V_{IN}=5\text{V}$ , No load<br>Both channels enabled |
| Input Shutdown Current                         |      | 0.2  | 2    | $\mu\text{A}$    | $V_{IN}=5\text{V}$ , No load, Switch OFF              |
| Maximum Output Current per channel             | 1    |      |      | A                |                                                       |
| Output Leakage Current                         |      | 0.5  | 1    | $\mu\text{A}$    | $V_{EN}=0\text{V}$ , $V_{OUT}=0\text{V}$              |
| Output MOSFET Resistance                       |      | 90   | 110  | $\text{m}\Omega$ | $I_{OUT}=0.1\text{A}$                                 |
| Output turn-on rise time                       |      | 1000 | 2500 | $\mu\text{s}$    | $R_L=10\Omega$ each output, $C_{OUT}$ not used        |
| Output turn-off fall time                      |      | 0.7  | 20   | $\mu\text{s}$    | $R_L=10\Omega$ each output, $C_{OUT}$ not used        |
| Current limit threshold                        | 1    | 1.5  | 2    | A                |                                                       |
| EN input threshold                             | 0.6  | 1.3  | 1.8  | V                |                                                       |
| EN Input Current                               |      | 0.01 | 0.1  | $\mu\text{A}$    | EN = HIGH                                             |
| Over temperature shutdown threshold            |      | 150  |      | $^\circ\text{C}$ | Temperature rising                                    |
| Over temperature shutdown threshold hysteresis |      | 30   |      | $^\circ\text{C}$ |                                                       |
| Under-voltage lockout threshold                |      | 2.3  |      | V                | $V_{IN}$ rising                                       |
| Under-voltage lockout hysteresis               |      | 200  |      | mV               |                                                       |
| FLG blanking time                              |      | 9    |      | ms               |                                                       |
| FLG Leakage Current                            |      | 0.01 | 1    | $\mu\text{A}$    | $V_{FLG}=5\text{V}$                                   |

## 1A Dual Channel USB 3.0 Power Distribution Switch

### BLOCK DIAGRAM

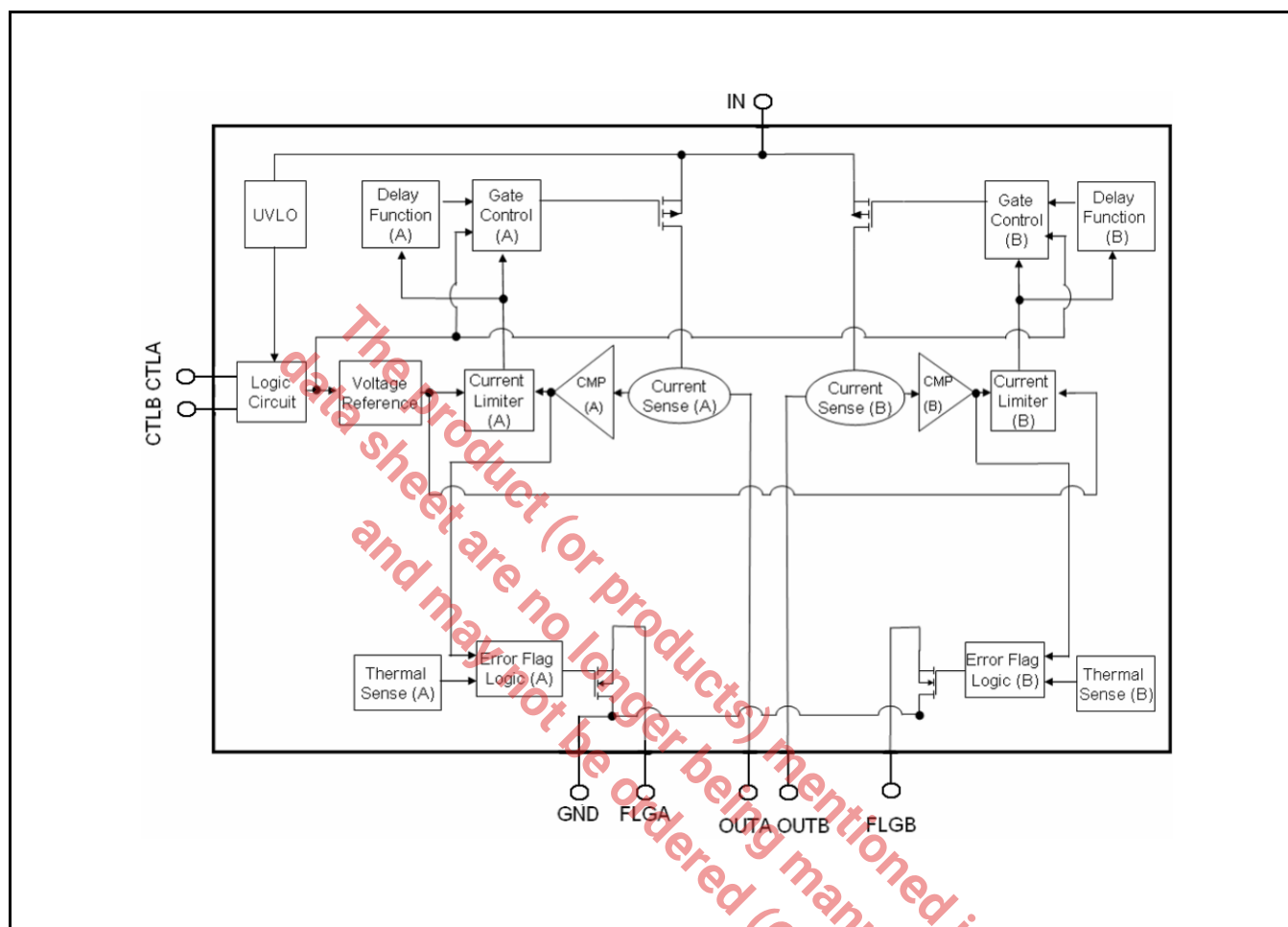


Fig. 2: XRP2524 Block Diagram

### PIN ASSIGNMENT

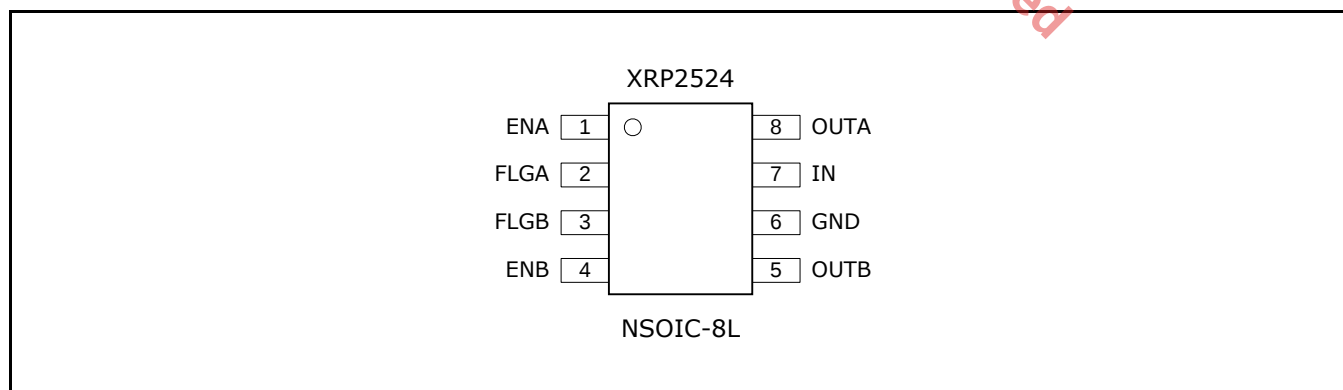


Fig. 3: XRP2524 Pin Assignment

## 1A Dual Channel USB 3.0 Power Distribution Switch

### PIN DESCRIPTION

| Name             | Pin Number | Description                                                                                                                 |
|------------------|------------|-----------------------------------------------------------------------------------------------------------------------------|
| EN <sub>x</sub>  | 1, 4       | Channel Enable Input<br>Active High                                                                                         |
| FLG <sub>x</sub> | 2, 3       | Error Flag Signal<br>Active low open drain output.<br>Active on over-current, over-temperature or short-circuit conditions. |
| GND              | 6          | Ground Signal                                                                                                               |
| IN               | 7          | Voltage Input Pin                                                                                                           |
| OUT <sub>x</sub> | 5, 8       | Voltage Output Pin                                                                                                          |

### ORDERING INFORMATION

| Part Number   | Temperature Range              | Marking                | Package | Packing Quantity | Note 1                         | Note 2                      |
|---------------|--------------------------------|------------------------|---------|------------------|--------------------------------|-----------------------------|
| XRP2524IDTR-F | -40°C ≤ T <sub>A</sub> ≤ +85°C | 2524ID<br>YYWWF<br>XXX | NSOIC-8 | 2.5K/Tape & Reel | RoHS Compliant<br>Halogen Free | Dual Channel<br>Active high |
| XRP2524EVB    | XRP2524 Evaluation Board       |                        |         |                  |                                |                             |

"YY" = Year – "WW" = Work Week – "X" = Lot Number; when applicable.

## 1A Dual Channel USB 3.0 Power Distribution Switch

### TYPICAL PERFORMANCE CHARACTERISTICS

All data taken at  $V_{IN} = 5V$ ,  $C_{IN} = 1\mu F$ ,  $C_{OUT} = 1\mu F$ ,  $T_J = T_A = 25^\circ C$ , unless otherwise specified - Schematic and BOM from Application Information section of this datasheet.

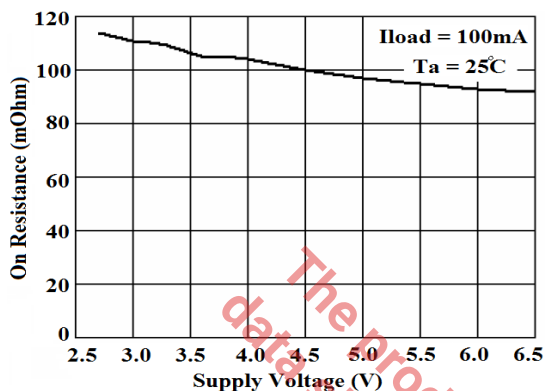


Fig. 4: Output On-Resistance vs. Supply Voltage

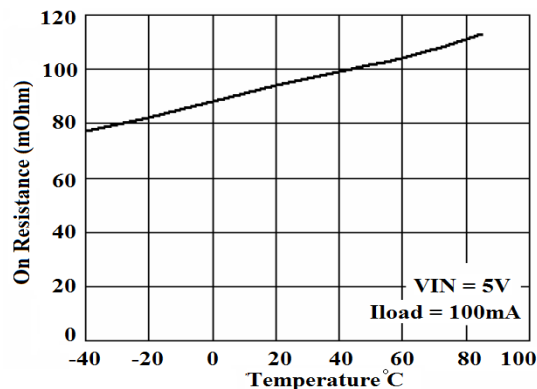


Fig. 5: Output On-Resistance vs. Temperature

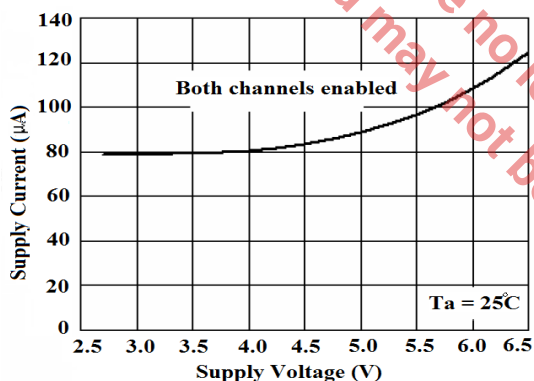


Fig. 6: ON-State Supply Current vs. Supply Voltage

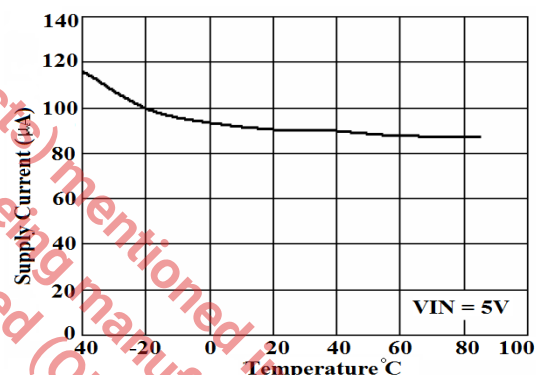


Fig. 7: ON-State Supply Current vs. Temperature

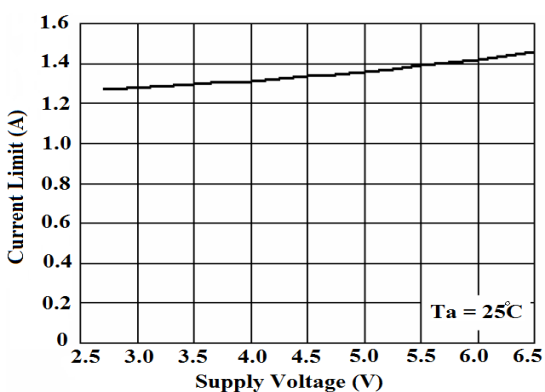


Fig. 8: Current Limit Threshold vs. Supply Voltage

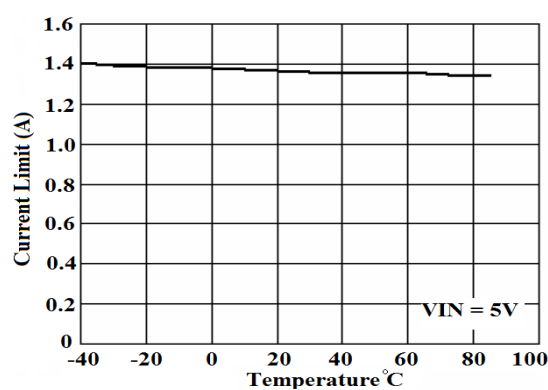


Fig. 9: Current Limit Threshold vs. Temperature

# 1A Dual Channel USB 3.0 Power Distribution Switch

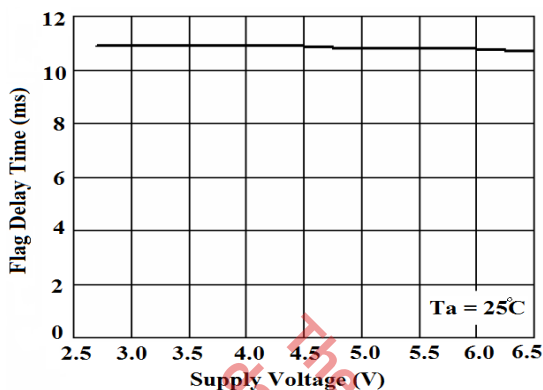


Fig. 10: Flag Delay Time vs. Supply Voltage

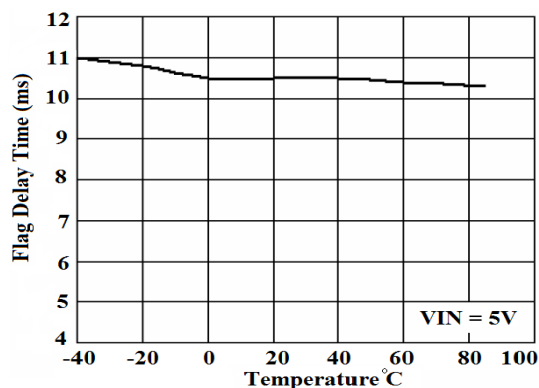


Fig. 11: Flag Delay Time vs. Temperature

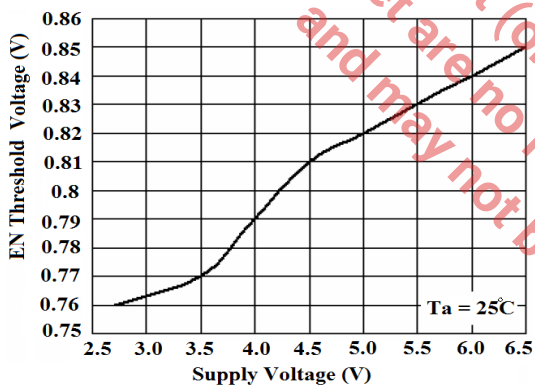


Fig. 12: Enable Threshold vs. Supply Voltage

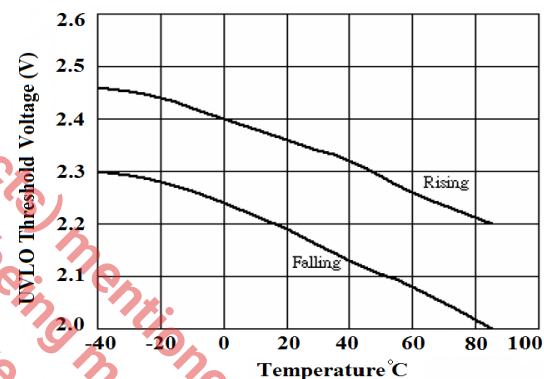


Fig. 13: UVLO Threshold Voltage vs. Temperature

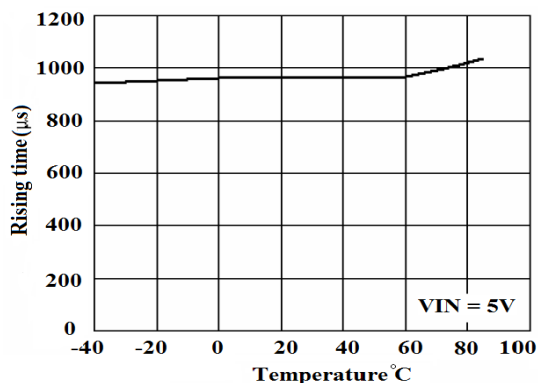


Fig. 14: Output Rising Time vs. Temperature

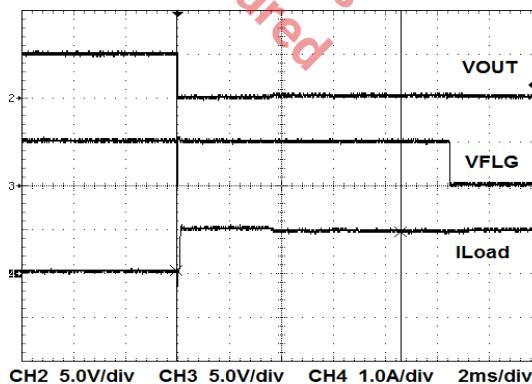


Fig. 15: Short circuit protection  
 $V_{IN} = 5.0V$

# 1A Dual Channel USB 3.0 Power Distribution Switch

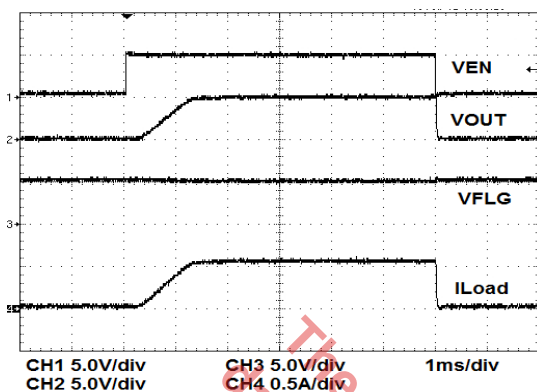


Fig. 16: Turn-On/Off Characteristics  
 $C_{OUT}=1\mu F$ ,  $R_{LOAD}=10\Omega$

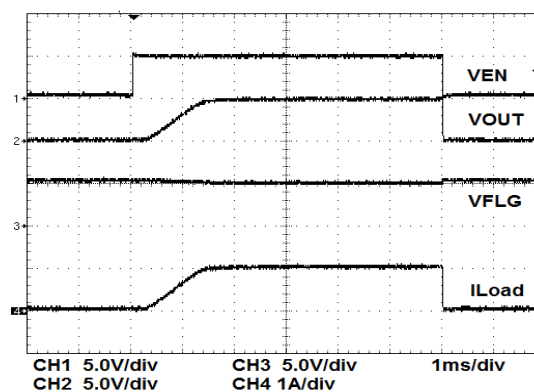


Fig. 17: Turn-On/Off Characteristics  
 $C_{OUT}=1\mu F$ ,  $R_{LOAD}=5.1\Omega$

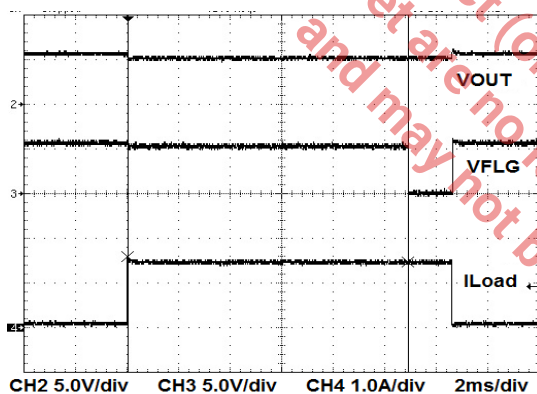


Fig. 18: Current Limit Operation  
 $V_{IN}=5.5V$ ,  $R_{LOAD}=3.3\Omega$

**1A Dual Channel USB 3.0 Power Distribution Switch****APPLICATION INFORMATION**

The XRP2524 device is a dual channel integrated high-side power distribution switch that can be used in any self or bus powered USB applications. It is compliant with the latest USB 3.0 specifications. The reverse current protection feature prevents current to flow from OUT to IN when the device is disabled.

**INPUT & OUTPUT**

It is important to place a 1 $\mu$ F ceramic bypass capacitor from IN to GND as close as possible to the device in order to control supply transients. A high capacitor value and short wires from power supply to VIN can further reduce voltage droop on the input.

Placing bulk capacitance of at least 22 $\mu$ F at the output pin reduces power supply transients under heavy current load conditions.

Furthermore, bypassing the output pin with a 0.1 $\mu$ F to 1 $\mu$ F ceramic capacitor placed close to OUT and PGND improves the device response to short-circuit transients.

**ENABLE CONTROL**

The device is disabled when the enable pin is in logic low condition. During this condition, the internal circuitry and the switch are turned off thereby reducing the supply current to 0.1 $\mu$ A typical. Enable must be driven logic high for a clearly defined input. Floating the input may cause unpredictable operation.

**ERROR FLAG**

The error flag signal (FLG output pin) is an open-drain output and is pulled low (active low) upon detection of the following fault conditions:

- Over-current condition
- Over-temperature condition
- Short-circuit condition

Over-current, over-temperature and short-circuit conditions are reported only if the

condition persists continuously for longer than the blanking time of 9ms typical. The blanking time prevents erroneous reporting of current faults due to brief output current spikes.

Once activated, the error flag signal remains low until all fault conditions have been removed.

**CURRENT LIMIT**

The current limit threshold is preset internally. It protects the output MOSFET switch from damages resulting from undesirable short circuit conditions or excess inrush current, which is often encountered during hot plug-in. The low limit of the current limit threshold of the XRP2524 allows a minimum current of 1A through the MOSFET switch.

An over-current condition is detected once the current limit threshold is exceeded, and output current is then limited to a constant current value. Triggering the current limit function is signaled by the Error Flag after 9ms of blanking time period.

**UNDER-VOLTAGE LOCKOUT**

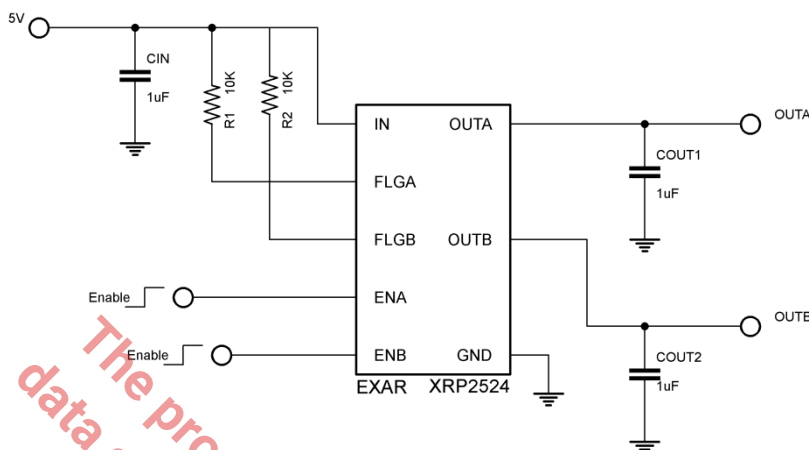
Under-voltage lockout function (UVLO) keeps the internal power switch from being turned on until the power supply exceeds 2.3V typically, even if the switch is enabled. Upon detection of an input voltage below approximately 2.1V, the power switch is turned off.

**THERMAL PROTECTION**

Internal thermal sensing circuitry monitors the operating temperature of the device. Upon detection of a temperature in excess of 145°C, the power switch is disabled preventing any damages to the device while a fault condition is reported by the error flag signal. A built-in 30°C hysteresis allows the device to cool down to 130°C before resuming normal operation by turning the switch on. At this time, the error flag signal is cleared.

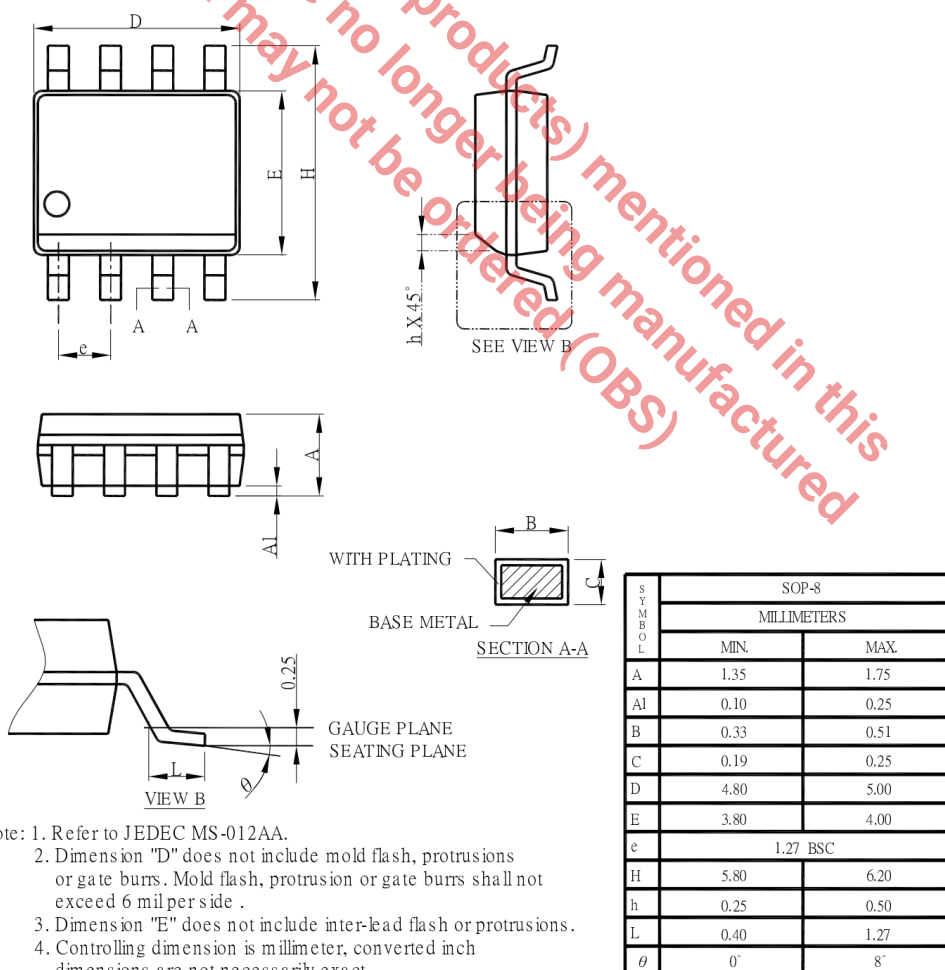


## TEST CIRCUIT



## PACKAGE SPECIFICATION

## 8-PIN NSOIC



## 1A Dual Channel USB 3.0 Power Distribution Switch

### REVISION HISTORY

| Revision | Date       | Description                  |
|----------|------------|------------------------------|
| 1.0.0    | 11/05/2012 | Initial release of datasheet |
|          |            |                              |
|          |            |                              |

### FOR FURTHER ASSISTANCE

Email:

[customersupport@exar.com](mailto:customersupport@exar.com)

[powertechsupport@exar.com](mailto:powertechsupport@exar.com)

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### EXAR CORPORATION

#### HEADQUARTERS AND SALES OFFICES

48720 Kato Road

Fremont, CA 94538 – USA

Tel.: +1 (510) 668-7000

Fax: +1 (510) 668-7030

[www.exar.com](http://www.exar.com)

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