

## Quad USB High-Side Power Switch with Fault Detection

The IMP2524 and IMP2527 are complete power management solutions for bus-powered and self-powered USB hubs. Each device contains four independent power switches and fault detection logic. The IMP2524 channel resistance is a low 140mΩ maximum and the IMP2527 channel resistance is 300Ω maximum. Both device operate with voltage inputs from 2.7V to 5.5V

The IMP2524/2527 conform to the new USB 1.1 standard. Fault current is limited to 750mA typically, and a flag output for each switch conveys fault information to the local USB controller. The IMP252x "Soft-Start" function ramps the ON-current to eliminate any excessive voltage drop on the input side that could occur when capacitive loads are charged.

Self-monitoring features include thermal shutdown to prevent catastrophic switch failure from high-current loads and undervoltage lockout (UVLO) that insures that the device remains OFF unless there is sufficient supply voltage present.

The switch Enable input logic can interface with both 3.3V and 5V logic. Both active-HIGH (-1 devices) and active-LOW (-2 devices) enable logic versions are available. Supply current is a low 0.75μA when disabled and just 110μA when enabled

The quad IMP2524/7 devices are available in 16-pin DIP and 16-pin SO packages and are pin compatible replacements for the Micrel MIC2524-1/-2 and MIC2527-1/2 devices. IMP offers a complete family of USB power management products. For single-switch applications see the IMP2525 and IMP2525A data sheets. The single-switch IMP2525A features a 0.07Ω switch resistance. For dual-switch applications, refer to the IMP2526 data sheet.

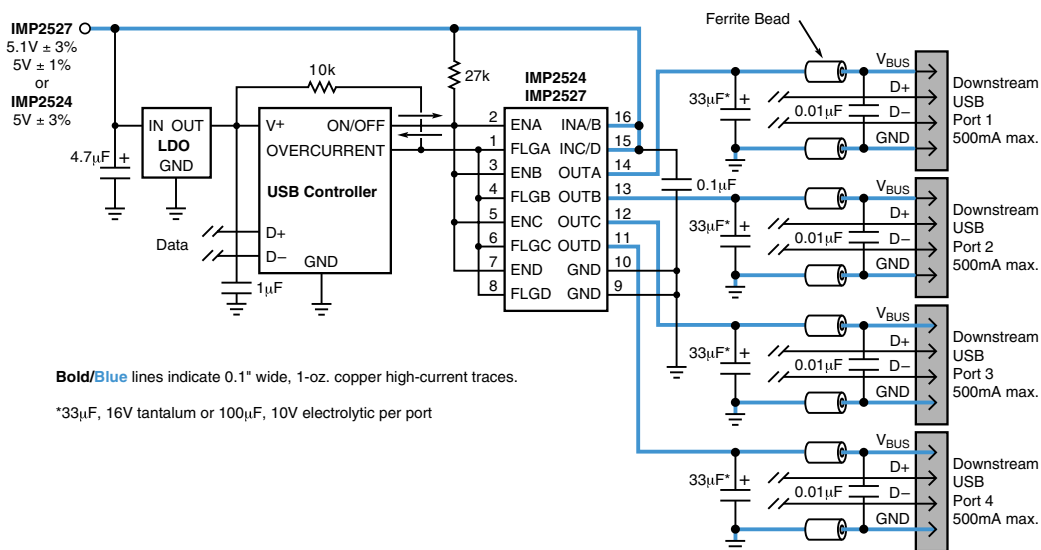
### Key Features

- ◆ USB Rev. 1.1 and 2.0 Compliant
- ◆ Four independent switches
- ◆ 2.7V to 5.5V input operation
- ◆ Low MOSFET ON resistance
  - IMP2524: 0.1Ω, 0.14Ω maximum
  - IMP2527: 0.2Ω, 0.3Ω maximum
- ◆ 500mA continuous load current per switch
- ◆ Low supply current
  - 110μA ON-state current, 0.75μA OFF-state current
- ◆ 1.25A maximum current limit, 750mA typical
- ◆ Thermal shutdown 2.4V undervoltage lockout (UVLO)
- ◆ Open-drain flag output
  - Undervoltage
  - Current limit
  - Thermal shutdown
- ◆ Output can be force higher than input
- ◆ Active HIGH(-1) and active LOW(-2) enable
- ◆ 16-pin SO and DIP packages, Die available
- ◆ Pin compatible with the Micrel MIC2524 and MIC2527

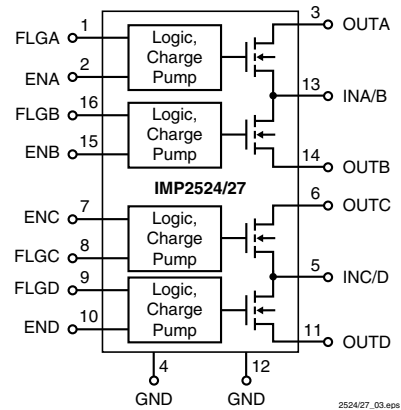
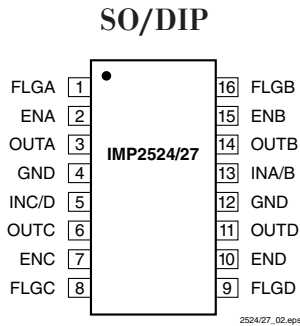
### Applications

- ◆ USB host and self-powered hubs
- ◆ USB video monitors
- ◆ USB printers

### Typical Application



## Pin Configuration



## Pin Descriptions

| Pin Number | Name  | Function  |
|------------|-------|---|
| 1          | FLGA  | Fault Flag A output. This open-drain output goes into an active-LOW state in response to under-voltage, current limit or thermal shutdown conditions.   |
| 2          | ENA   | Enable A Input. This pin is the Channel B MOSFET switch driver control logic input. Both active-HIGH (-1 suffix) and active-LOW (-2 suffix) logic devices are available.                              |
| 3          | OUTA  | Channel-A switch output (MOSFET Source). The output pin drives the load into ON and OFF states.   |
| 4          | GND   | Ground. Power supply return for the internal circuitry of the IC. Connect both pins 4 and 6 together.   |
| 5          | INC/D | Channel C and D positive power supply input voltage. This is the switching MOSFET drain connection. It is the channel C and channel D supply voltage input for the logic and the charge-pump circuit. |
| 6          | OUTC  | Channel-C switch output (MOSFET Source). The output pin drives the load into ON and OFF states.   |
| 7          | ENC   | Enable C Input. This pin is the Channel B MOSFET switch driver control logic input. Both active-HIGH (-1 suffix) and active-LOW (-2 suffix) logic devices are available.                              |
| 8          | FLGC  | Fault Flag C output. This open-drain output goes into an active-LOW state in response to under-voltage, current limit or thermal shutdown conditions.   |
| 9          | FLGD  | Fault Flag D output. This open-drain output goes into an active-LOW state in response to under-voltage, current limit or thermal shutdown conditions.   |
| 10         | END   | Enable D Input. This pin is the Channel B MOSFET switch driver control logic input. Both active-HIGH (-1 suffix) and active-LOW (-2 suffix) logic devices are available.                              |
| 11         | OUTD  | Channel-D switch output (MOSFET Source). The output pin drives the load into ON and OFF states.   |
| 12         | GND   | Ground. Power supply return for the internal circuitry of the IC. Connect both pins 4 and 6 together.   |
| 13         | INA/B | Channel A and B positive power supply input voltage. This is the switching MOSFET drain connection. It is the channel A and channel B supply voltage input for the logic and the charge-pump circuit. |
| 14         | OUTB  | Channel-B switch output (MOSFET Source). The output pin drives the load into ON and OFF states.   |
| 15         | ENB   | Enable B Input. This pin is the Channel-B MOSFET switch driver control logic input. Both active-HIGH (-1 suffix) and active-LOW (-2 suffix) logic devices are available.                              |
| 16         | FLGB  | Fault Flag B output. This open-drain output goes into an active-LOW state in response to under-voltage, current limit or thermal shutdown conditions.   |

2524/27101

## Ordering Information

| Pin Number   | Enable Logic | Typical "ON" Resistance | Temperature Range | Pins-Package |
|--------------|--------------|-------------------------|-------------------|--------------|
| IMP2524-1BWM | Active HIGH  | 100mΩ                   | -40° C to +85° C  | 16-SO        |
| IMP2524-2BWM | Active LOW   | 100mΩ                   | -40° C to +85° C  | 16-SO        |
| IMP2524-1BN  | Active HIGH  | 100mΩ                   | -40° C to +85° C  | 16-DIP       |
| IMP2524-2BN  | Active LOW   | 100mΩ                   | -40° C to +85° C  | 16-DIP       |
| IMP2527-1BWM | Active HIGH  | 200mΩ                   | -40° C to +85° C  | 16-SO        |
| IMP2527-2BWM | Active LOW   | 200mΩ                   | -40° C to +85° C  | 16-SO        |
| IMP2527-1BN  | Active HIGH  | 200mΩ                   | -40° C to +85° C  | 16-DIP       |
| IMP2527-2BN  | Active LOW   | 200mΩ                   | -40° C to +85° C  | 16-DIP       |

2524/27102

## Absolute Maximum Ratings

|                                      |                    |
|--------------------------------------|--------------------|
| Supply Voltage                       | +8.0V              |
| Fault Flag Voltage                   | +8.0V              |
| Fault Flag Current                   | 50mA               |
| Output Voltage                       | +8.0V              |
| Output Current                       | Internally Limited |
| Enable Input                         | -0.3V to 12V       |
| Storage Temperature                  | -65°C to +150°C    |
| Lead Temperature (Soldering, 5 sec.) | 260°C              |
| Package Thermal Resistance           |                    |
| SO ( $\theta_{JA}$ )                 | 160°C/W            |
| DIP( $\theta_{JA}$ )                 | 130°C/W            |

Note: All voltages are referenced to GND.

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability.

## Electrical Characteristics

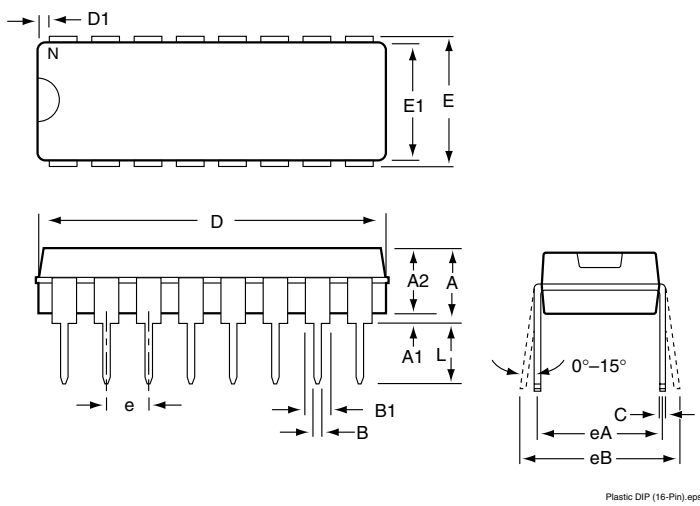
Unless otherwise noted,  $V_{IN} = 5V$  and  $T_A = 25^\circ C$ .

| Parameter                             | Symbol        | Conditions  | Min  | Typ  | Max  | Units      |
|---------------------------------------|---------------|---|------|------|------|------------|
| Supply Voltage Range                  | $V_{IN}$      | $T_A = -40^\circ C$ to $+85^\circ C$  | 2.7  |      | 5.5  | V          |
| Operating Temperature Range           | $T_A$         |   | -40  |      | 85   | $^\circ C$ |
| Supply Current<br>Switch OFF          | $I_{IN\ OFF}$ | Switch OFF, No load<br>$V_{ENOFF} \leq 0.8V$ , $V_{ENON} \geq 2.4V$ IMP2524/27-1<br>$V_{ENON} \leq 0.8V$ , $V_{ENOFF} \geq 2.4V$ IMP2524/27-2 |      | 0.75 | 10   | $\mu A$    |
| Supply Current<br>Switch ON           | $I_{IN\ ON}$  | Switch ON, No load<br>$V_{ENOFF} \leq 0.8V$ , $V_{ENON} \geq 2.4V$ IMP2524/27-1<br>$V_{ENON} \leq 0.8V$ , $V_{ENOFF} \geq 2.4V$ IMP2524/27-2  |      | 110  | 320  | $\mu A$    |
| Enable Input Threshold                | $V_{ENH}$     | LOW to HIGH ("0" to "1") Enable Voltage, Note 1   | 0.8  | 2.1  | 2.4  | V          |
|                                       | $V_{ENL}$     | HIGH to LOW ("1" to "0") Enable Voltage, Note 1   |      | 1.9  |      |            |
| Enable Input Current                  | $I_{EN}$      | $V_{EN} = 2.4V$   |      | 0.01 | 1    | $\mu A$    |
|                                       |               | $V_{EN} = 0.8V$   |      | 0.01 | 1    | $\mu A$    |
| Enable Input Capacitance              | $C_{EN}$      |   |      | 1    |      | pF         |
| Switch ON Resistance                  | $R_{ON}$      | IMP2524: $I_{OUT} = 500mA$ each switch  |      | 0.10 | 0.14 | $\Omega$   |
|                                       |               | IMP2527: $I_{OUT} = 500mA$ each switch  |      | 0.20 | 0.30 | $\Omega$   |
| Continuous Load Current               | $I_L$         | Each output   | 0.5  |      |      | A          |
| Output Turn-On Delay                  | $T_{DON}$     | $R_L = 10\Omega$ each output  |      | 0.25 |      | ms         |
| Output Turn-On Rise Time              | $T_{RON}$     | $R_L = 10\Omega$ each output  |      | 1    |      | ms         |
| Output Turn-Off Delay                 | $T_{DOFF}$    | $R_L = 10\Omega$ each output  |      | 1    | 20   | $\mu s$    |
| Output Turn-Off Fall Time             | $T_{FOFF}$    | $R_L = 10\Omega$ each output  |      | 1    | 20   | $\mu s$    |
| Output Leakage Current                | $I_{OFF}$     |   |      |      | 10   | $\mu A$    |
| Short-circuit Current Limit           | $I_{SC}$      |   | 0.50 | 0.75 | 1.25 | A          |
| Overtemperature Shutdown<br>Threshold |               | $T_J$ increasing  |      | 135  |      | $^\circ C$ |
|                                       |               | $T_J$ decreasing  |      | 125  |      | $^\circ C$ |
| Error Flag Output Resistance          | $R_{FLAG}$    | $V_{IN} = 5V$ , $I_L = 10mA$  |      | 10   |      | $\Omega$   |
|                                       |               | $V_{IN} = 3.3V$ , $I_L = 10mA$  |      | 15   |      | $\Omega$   |
| Error Flag Output Current             | $I_{FLAG}$    | $V_{FLAG} = 5V$   |      | 0.01 | 1    | $\mu A$    |
| UVLO Threshold                        | $V_{UVLO}$    | $V_{IN}$ Increasing   |      | 2.5  |      | V          |
|                                       |               | $V_{IN}$ Decreasing   |      | 2.3  |      | V          |

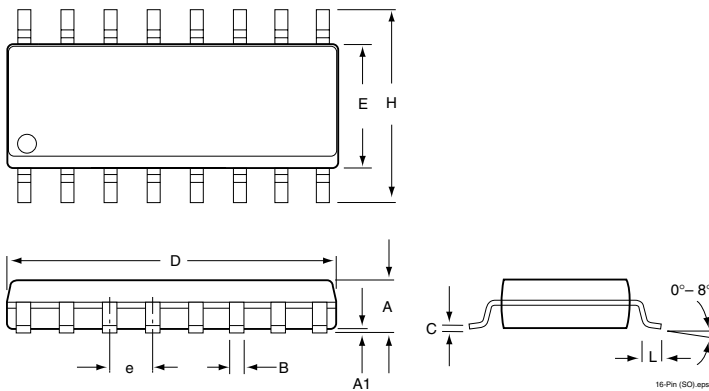
Notes 1. Switch OFF is  $V_{EN} \leq 0.8V$  and Switch ON is  $V_{EN} \geq 2.4V$  for the IMP2524/27-1. Switch OFF is  $V_{EN} \geq 2.4V$  and Switch ON is  $V_{EN} \leq 0.8V$  for the IMP2524/27-2. The Enable input has approximately 200mV of hysteresis.

## Package Dimensions

### Plastic DIP (16-Pin)



### SO (16-Pin)



|                              | Inches    |        | Millimeters |       |
|------------------------------|-----------|--------|-------------|-------|
|                              | Min       | Max    | Min         | Max   |
| <b>Plastic DIP (16-Pin)*</b> |           |        |             |       |
| A                            | —         | 0.200  | —           | 5.08  |
| A1                           | 0.015     | —      | 0.38        | —     |
| A2                           | 0.125     | 0.175  | 3.18        | 4.45  |
| B                            | 0.016     | 0.022  | 0.41        | 0.56  |
| B1                           | 0.045     | 0.065  | 1.14        | 1.65  |
| C                            | 0.008     | 0.012  | 0.20        | 0.30  |
| D                            | 0.745     | 0.765  | 18.92       | 19.43 |
| D1                           | 0.005     | 0.080  | 0.13        | 2.03  |
| E                            | 0.300     | 0.325  | 7.62        | 8.26  |
| E1                           | 0.240     | 0.310  | 6.10        | 7.87  |
| e                            | 0.100     | —      | 2.54        | —     |
| eA                           | 0.300     | —      | 7.62        | —     |
| eB                           | —         | 0.400  | —           | 10.16 |
| L                            | 0.115     | 0.150  | 2.92        | 3.81  |
| <b>SO (16-Pin)**</b>         |           |        |             |       |
| A                            | 0.926     | 0.1043 | 2.35        | 2.65  |
| A1                           | 0.0040    | 0.0118 | 0.10        | 0.30  |
| B                            | 0.013     | 0.020  | 0.33        | 0.51  |
| C                            | 0.0091    | 0.0125 | 0.23        | 0.32  |
| D                            | 0.3977    | 0.4133 | 10.10       | 10.50 |
| E                            | 0.2914    | 0.2662 | 7.40        | 7.60  |
| e                            | 0.050 BSC |        | 1.27 BSC    |       |
| H                            | 0.394     | 0.419  | 10.00       | 10.65 |
| L                            | 0.016     | 0.050  | 0.40        | 1.27  |

\* JEDEC Drawing MO-058AB

\*\* JEDEC Drawing MS-013AA

2524/26\_103.at3