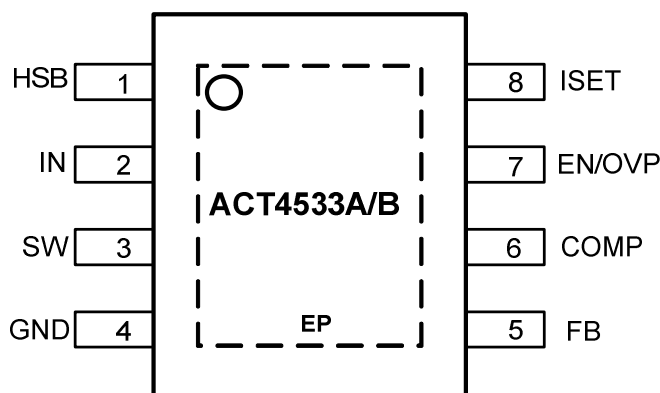


## ORDERING INFORMATION

| PART NUMBER  | OPERATION AMBIENT TEMPERATURE RANGE | OVP/EN PIN | PACKAGE | PINS | PACKING     |
|--------------|-------------------------------------|------------|---------|------|-------------|
| ACT4533AYH-T | -40 °C to 85 °C                     | OVP        | SOP-8EP | 8    | TAPE & REEL |
| ACT4533BYH-T | -40 °C to 85 °C                     | OVP/EN     | SOP-8EP | 8    | TAPE & REEL |

## PIN CONFIGURATION



**SOP-8EP**

## PIN DESCRIPTIONS

| PIN | NAME        | DESCRIPTION   |
|-----|-------------|---|
| 1   | HSB         | High Side Bias Pin. This provides power to the internal high-side MOSFET gate driver. Connect a 22 nF capacitor from HSB pin to SW pin.   |
| 2   | IN          | Power Supply Input. Bypass this pin with a 10 $\mu$ F ceramic capacitor to GND, placed as close to the IC as possible.  |
| 3   | SW          | Power Switching Output to External Inductor.  |
| 4   | GND         | Ground. Connect this pin to a large PCB copper area for best heat dissipation. Return FB, COMP, and ISET to this GND, and connect this GND to power GND at a single point for best noise immunity.  |
| 5   | FB          | Feedback Input. The voltage at this pin is regulated to 0.808 V. Connect to the resistor divider between output and GND to set the output voltage.  |
| 6   | COMP        | Error Amplifier Output. This pin is used to compensate the converter.   |
| 7   | EN/OVP      | ACT4533A: OVP input. If the voltage at this pin exceeds 0.8 V, the IC shuts down high-side switch. There is a 4 $\mu$ A pull-up current at this pin.<br>ACT4533B: EN/OVP input. If the voltage at this pin is below 0.65 V, the IC remains shut-off, if the Voltage at this pin exceeds 2.26 V, the IC shuts down high side switch. There is a 4 $\mu$ A pull-up current at this pin. |
| 8   | ISET        | Output Current Setting Pin. Connect a resistor from ISET to GND to program the output current.  |
|     | Exposed Pad | Heat Dissipation Pad. Connect this exposed pad to large ground copper area with copper and vias.  |

**ABSOLUTE MAXIMUM RATINGS<sup>①</sup>**

| PARAMETER                              | VALUE                          | UNIT |
|--|--------------------------------|------|
| IN to GND                              | -0.3 to 40                     | V    |
| SW to GND                              | -1 to $V_{IN} + 1$             | V    |
| HSB to GND                             | $V_{SW} - 0.3$ to $V_{SW} + 7$ | V    |
| FB, ISET, COMP to GND                  | -0.3 to +6                     | V    |
| Junction to Ambient Thermal Resistance | 46                             | °C/W |
| Operating Junction Temperature         | -40 to 150                     | °C   |
| Storage Junction Temperature           | -55 to 150                     | °C   |
| Lead Temperature (Soldering 10 sec.)   | 300                            | °C   |

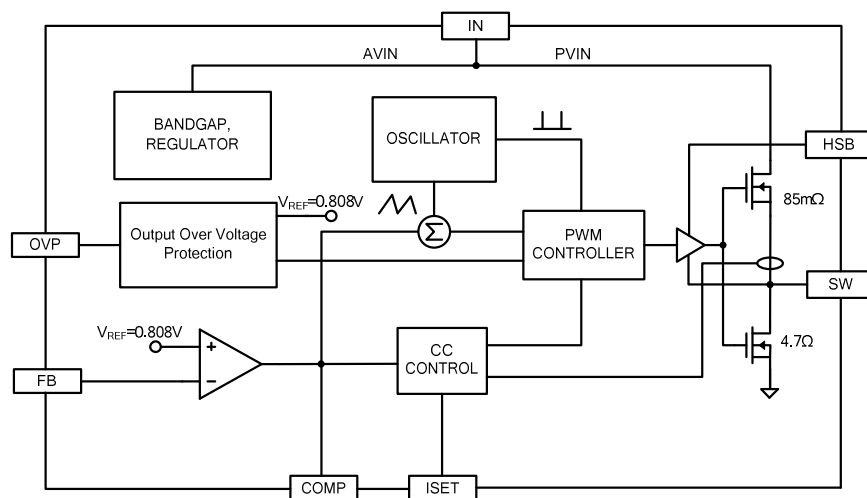
①: Do not exceed these limits to prevent damage to the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

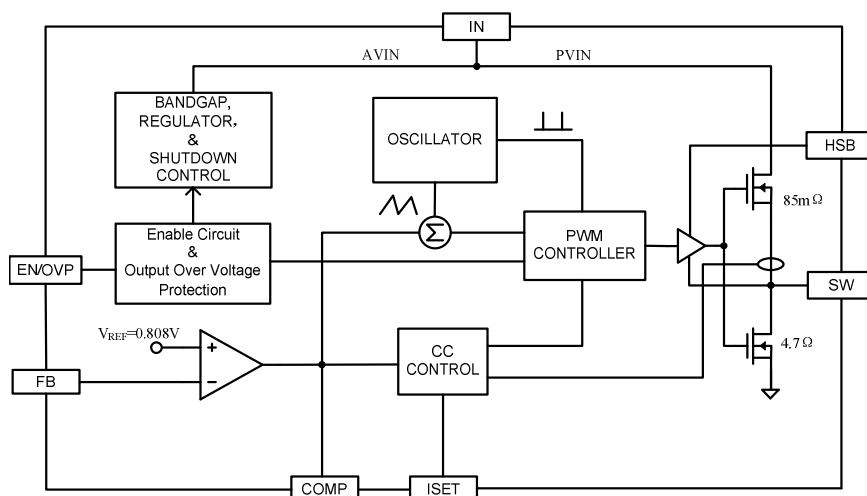
( $V_{IN} = 12\text{ V}$ ,  $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified.)

| PARAMETER                               | TEST CONDITIONS   | MIN | TYP   | MAX | UNIT               |
|---|---|-----|-------|-----|--------------------|
| Input Voltage                           |   | 10  |       | 38  | V                  |
| Input Voltage Surge                     |   |     |       | 40  | V                  |
| $V_{IN}$ UVLO Turn - On Voltage         | Input Voltage Rising  | 9.0 | 9.4   | 9.7 | V                  |
| $V_{IN}$ UVLO Hysteresis                | Input Voltage Falling   |     | 1.1   |     | V                  |
| Standby Supply Current                  | $V_{FB} = 1\text{ V}$   |     | 0.9   | 1.4 | mA                 |
| Feedback Voltage                        |   | 792 | 808   | 824 | mV                 |
| Internal Soft-Start time                |   |     | 400   |     | $\mu\text{s}$      |
| Error Amplifier Transconductance        | $V_{FB} = V_{COMP} = 0.808\text{ V}$ ,<br>$\Delta I_{COMP} = \pm 10\text{ }\mu\text{A}$ |     | 650   |     | $\mu\text{A/V}$    |
| Error Amplifier DC Gain                 |   |     | 4000  |     | V/V                |
| Switching Frequency                     | $V_{FB} = 0.808\text{ V}$   |     | 125   |     | kHz                |
| Foldback Switching Frequency            | $V_{FB} = 0\text{ V}$   |     | 18    |     | kHz                |
| Maximum Duty Cycle                      |   |     | 86    |     | %                  |
| Minimum On - Time                       |   |     | 290   |     | ns                 |
| COMP to Current Limit Transconductance  | $V_{COMP} = 1.2\text{ V}$   |     | 5.1   |     | A/V                |
| Secondary Cycle-by-Cycle Current Limit  | Duty = 0.5  |     | 6.8   |     | A                  |
| Slope Compensation                      | Duty = $D_{MAX}$  |     | 3.2   |     | A                  |
| ISET Voltage                            |   |     | 1.0   |     | V                  |
| ISET to IOOUT DC Room Temp Current Gain | $I_{OUT}/I_{SET}$ , $R_{ISET} = 7.87\text{ k}\Omega$                                    |     | 20000 |     | A/A                |
| CC Controller DC Accuracy               | $R_{ISET} = 7.87\text{ k}\Omega$ , $V_{OUT} = 4.0\text{ V}$                             |     | 2650  |     | mA                 |
| OVP Pin Voltage (ACT4533A)              | OVP Pin Voltage Rising  |     | 0.8   |     | V                  |
| OVP Pin Voltage (ACT4533A)              | OVP Pin Voltage Falling   |     | 0.57  |     | V                  |
| OVP Pin Voltage (ACT4533B)              | OVP Pin Voltage Rising  |     | 2.26  |     | V                  |
| OVP Pin Voltage (ACT4533B)              | OVP Pin Voltage Falling   |     | 1.76  |     | V                  |
| EN Pin Voltage (ACT4533B)               | EN Pin Voltage Rising   |     | 0.65  |     | V                  |
| EN Pin Voltage (ACT4533B)               | EN Pin Voltage Falling  |     | 0.59  |     | V                  |
| High - Side Switch ON - Resistance      |   |     | 85    |     | m $\Omega$         |
| Thermal Shutdown Temperature            | Temperature Rising  |     | 155   |     | $^{\circ}\text{C}$ |
| Thermal Shutdown Temperature Hysteresis | Temperature Falling   |     | 25    |     | $^{\circ}\text{C}$ |

## FUNCTIONAL BLOCK DIAGRAM FOR ACT4533A



## FUNCTIONAL BLOCK DIAGRAM FOR ACT4533B



## FUNCTIONAL DESCRIPTION

## CV/CC Loop Regulation

As seen in Functional Block Diagram, the ACT4533A/B is a peak current mode pulse width modulation (PWM) converter with CC and CV control. The converter operates as follows:

A switching cycle starts when the rising edge of the Oscillator clock output causes the High-Side Power Switch to turn on and the Low-Side Power Switch to turn off. With the SW side of the inductor now connected to IN, the inductor current ramps up to store energy in the magnetic field. The inductor current level is measured by the Current Sense Amplifier and added to the Oscillator ramp signal. If the resulting summation is

higher than the COMP voltage, the output of the PWM Comparator goes high. When this happens or when Oscillator clock output goes low, the High-Side Power Switch turns off.

At this point, the SW side of the inductor swings to a diode voltage below ground, causing the inductor current to decrease and magnetic energy to be transferred to output. This state continues until the cycle starts again. The High-Side Power Switch is

## FUNCTIONAL DESCRIPTION

driven by logic using HSB as the positive rail. This pin is charged to  $V_{SW} + 5\text{ V}$  when the Low-Side Power Switch turns on. The COMP voltage is the integration of the error between FB input and the internal 0.808 V

reference. If FB is lower than the reference voltage, COMP tends to go higher to increase current to the output. Output current will increase until it reaches the CC limit set by the  $I_{SET}$  resistor. At this point, the device will transition from regulating output voltage to regulating output current, and the output voltage will drop with increasing load.

The Oscillator normally switches at 125 kHz. However, if FB voltage is less than 0.6 V, then the switching frequency decreases until it reaches a typical value of 18 kHz at  $V_{FB} = 0.15$  V

### **Over Voltage Protection (ACT4533A)**

The ACT4533A has an OVP pin. If the voltage at this pin exceeds 0.8 V, the IC shuts down high-side switch. There is a 4  $\mu$ A pull-up current at this pin.

### **EN/OVP Pin (ACT4533B)**

The ACT4533B has an enable input and OVP input for turning the IC on and off.

If the voltage at this pin rises above 0.65 V, the IC is enabled. The EN contains a 60 mV hysteresis and 4  $\mu$ A pull-up current source.

If the voltage at this pin is between 0.65 V and 2.26 V, the IC operates normally; if the voltage at this pin exceeds 2.26 V, the IC shuts down high-side switch. The OVP contains a 500 mV hysteresis and 4  $\mu$ A pull-up current source.

### **Thermal Shutdown**

The ACT4533A/B disables switching when its junction temperature exceeds 155 °C and resumes when the temperature has dropped by 25 °C.

## APPLICATIONS INFORMATION

### Output Voltage Setting

Figure 1:

#### Output Voltage Setting

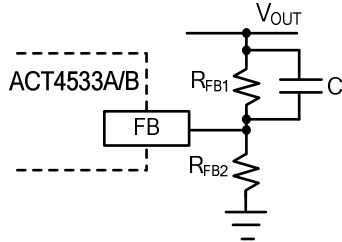


Figure 1 shows the connections for setting the output voltage. Select the proper ratio of the two feedback resistors  $R_{FB1}$  and  $R_{FB2}$  based on the output voltage. Adding a capacitor in parallel with  $R_{FB1}$  helps the system stability. Typically, use  $R_{FB2} \approx 10 \text{ k}\Omega$  and determine  $R_{FB1}$  from the following equation:

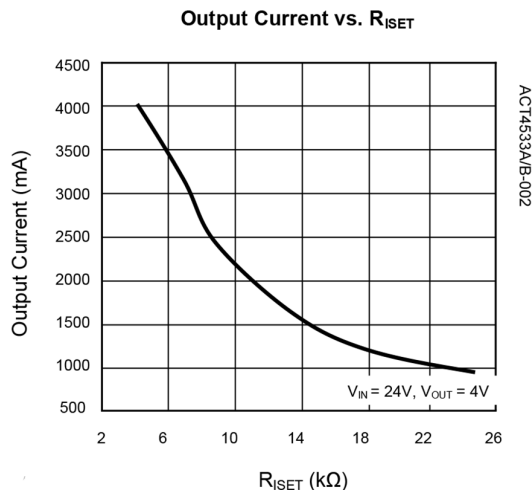
$$R_{FB1} = R_{FB2} \left( \frac{V_{OUT}}{0.808V} - 1 \right) \quad (1)$$

### CC Current Setting

ACT4533A/B constant current value is set by a resistor connected between the  $I_{SET}$  pin and GND. The CC output current is linearly proportional to the current flowing out of the  $I_{SET}$  pin. The voltage at  $I_{SET}$  is roughly 1.1 V and the current gain from  $I_{SET}$  to output is roughly 21000 (21 mA/1  $\mu$ A). To determine the proper resistor for a desired current, please refer to Figure 2 below.

Figure 2:

#### Curve for Programming Output CC Current

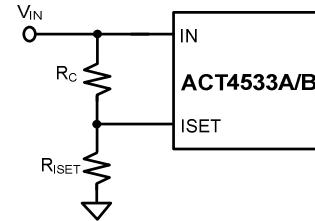


### CC Current Line Compensation

When operating at constant current mode, the current limit increase slightly with input voltage. For wide input voltage applications, a resistor  $R_C$  may be added to compensate line change and keep output high CC accuracy, as shown in Figure 3.

Figure 3:

#### Input Line Compensation



### Inductor Selection

The inductor maintains a continuous current to the output load. This inductor current has a ripple that is dependent on the inductance value:

Higher inductance reduces the peak-to-peak ripple current. The trade-off for high inductance value is the increase in inductor core size and series resistance, and the reduction in current handling capability. In general, select an inductance value  $L$  based on ripple current requirement:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} f_{SW} I_{LOADMAX} K_{RIPPLE}} \quad (2)$$

where  $V_{IN}$  is the input voltage,  $V_{OUT}$  is the output voltage,  $f_{SW}$  is the switching frequency,  $I_{LOADMAX}$  is the maximum load current, and  $K_{RIPPLE}$  is the ripple factor. Typically, choose  $K_{RIPPLE} = 30\%$  to correspond to the peak-to-peak ripple current being 30% of the maximum load current.

With a selected inductor value the peak-to-peak inductor current is estimated as:

$$I_{LPK-PK} = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{L \times V_{IN} \times f_{SW}} \quad (3)$$

The peak inductor current is estimated as:

$$I_{LPK} = I_{LOADMAX} + \frac{1}{2} I_{LPK-PK} \quad (4)$$

The selected inductor should not saturate at  $I_{LPK}$ .

The maximum output current is calculated as:

$$I_{OUTMAX} = I_{LIM} - \frac{1}{2} I_{LPK-PK} \quad (5)$$

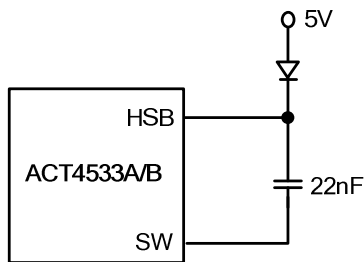
$I_{LIM}$  is the internal current limit, which is typically 4.5 A, as shown in Electrical Characteristics Table.

### External High Voltage Bias Diode

It is recommended that an external High Voltage Bias diode be added when the system has a 5 V fixed input or the power supply generates a 5 V output. This helps improve the efficiency of the regulator. The High Voltage Bias diode can be a low cost one such as IN4148 or BAT54.

Figure 4:

#### External High Voltage Bias Diode



This diode is also recommended for high duty cycle operation and high output voltage applications.

### Input Capacitor

The input capacitor needs to be carefully selected to maintain sufficiently low ripple at the supply input of the converter. A low ESR capacitor is highly recommended. Since large current flows in and out of this capacitor during switching, its ESR also affects efficiency.

The input capacitance needs to be higher than 10  $\mu$ F. The best choice is the ceramic type, however, low ESR tantalum or electrolytic types may also be used provided that the RMS ripple current rating is higher than 50% of the output current. The input capacitor should be placed close to the IN and G pins of the IC, with the shortest traces possible. In the case of tantalum or electrolytic types, they can be further away if a small parallel 0.1  $\mu$ F ceramic capacitor is placed right next to the IC.

### Output Capacitor

The output capacitor also needs to have low ESR to keep low output voltage ripple. The output ripple voltage is:

$$V_{RIPPLE} = I_{LPK-PK} \times (R_{ESR} + \frac{1}{8 \times f_{SW} \times C_{OUT}}) \quad (6)$$

Where  $I_{OUTMAX}$  is the maximum output current,  $K_{RIPPLE}$  is the ripple factor,  $R_{ESR}$  is the ESR of the output capacitor,  $f_{SW}$  is the switching frequency,  $L$  is the inductor value, and  $C_{OUT}$  is the output capacitance. In the case of ceramic output capacitors,  $R_{ESR}$  is very small and does

not contribute to the ripple. Therefore, a lower capacitance value can be used for ceramic type. In the case of tantalum or electrolytic capacitors, the ripple is dominated by  $R_{ESR}$  multiplied by the ripple current. In that case, the output capacitor is chosen to have sufficiently low ESR.

For ceramic output capacitor, typically choose a capacitance of about 22  $\mu$ F. For tantalum or electrolytic capacitors, choose a capacitor with less than 50 m $\Omega$  ESR.

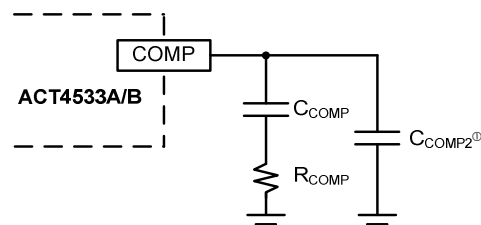
### Rectifier Diode

Use a Schottky diode as the rectifier to conduct current when the High-Side Power Switch is off. The Schottky diode must have current rating higher than the maximum output current and a reverse voltage rating higher than the maximum input voltage.

## STABILITY COMPENSATION

Figure 5:

#### Stability Compensation



①:  $C_{COMP2}$  is needed only for high ESR output capacitor

The feedback loop of the IC is stabilized by the components at the COMP pin, as shown in Figure 5. The DC loop gain of the system is determined by the following equation:

$$A_{VDC} = \frac{0.808V}{I_{OUT}} A_{VEA} G_{COMP} \quad (7)$$

The dominant pole P1 is due to  $C_{COMP}$ :

$$f_{P1} = \frac{G_{EA}}{2\pi A_{VEA} C_{COMP}} \quad (8)$$

The second pole P2 is the output pole:

$$f_{P2} = \frac{I_{OUT}}{2\pi V_{OUT} C_{OUT}} \quad (9)$$

The first zero Z1 is due to  $R_{COMP}$  and  $C_{COMP}$ :

$$f_{Z1} = \frac{1}{2\pi R_{COMP} C_{COMP}} \quad (10)$$

And finally, the third pole is due to  $R_{COMP}$  and  $C_{COMP2}$  (if  $C_{COMP2}$  is used):

$$f_{P3} = \frac{1}{2\pi R_{COMP} C_{COMP2}} \quad (11)$$

The following steps should be used to compensate the IC:

STEP 1. Set the cross over frequency at 1/10 of the switching frequency via  $R_{COMP}$ :

$$R_{COMP} = \frac{2\pi V_{OUT} C_{OUT} f_{SW}}{10 G_{EA} G_{COMP} \times 0.808V} \quad (12)$$

$$= 5.12 \times 10^7 V_{OUT} C_{OUT} (\Omega)$$

STEP 2. Set the zero  $f_{Z1}$  at 1/4 of the cross over frequency. If  $R_{COMP}$  is less than 15 k $\Omega$ , the equation for  $C_{COMP}$  is:

$$C_{COMP} = \frac{2.83 \times 10^{-5}}{R_{COMP}} (F) \quad (13)$$

If  $R_{COMP}$  is limited to 15 k $\Omega$ , then the actual cross over frequency is  $6.58 / (V_{OUT} C_{OUT})$ . Therefore:

$$C_{COMP} = 6.45 \times 10^{-6} V_{OUT} C_{OUT} (F) \quad (14)$$

STEP 3. If the output capacitor's ESR is high enough to cause a zero at lower than 4 times the cross over frequency, an additional compensation capacitor  $C_{COMP2}$  is required. The condition for using  $C_{COMP2}$  is:

$$R_{ESRCOUT} \geq \text{Min} \left( \frac{1.77 \times 10^{-6}}{C_{OUT}}, 0.006 \times V_{OUT} \right) (\Omega) \quad (15)$$

And the proper value for  $C_{COMP2}$  is:

$$C_{COMP2} = \frac{C_{OUT} R_{ESRCOUT}}{R_{COMP}} \quad (16)$$

Though  $C_{COMP2}$  is unnecessary when the output capacitor has sufficiently low ESR, a small value  $C_{COMP2}$  such as 100 pF may improve stability against PCB layout parasitic effects.

Table 1 shows some calculated results based on the compensation method above.

Table 1:

Typical Compensation for Different Output Voltages and Output Capacitors

| V <sub>OUT</sub> | C <sub>OUT</sub>               | R <sub>COMP</sub> | V <sub>COMP</sub> | C <sub>COMP2</sub> <sup>①</sup> |
|------------------|--------------------------------|-------------------|-------------------|---------------------------------|
| 2.5 V            | 47 $\mu$ F Ceramic CAP         | 5.6 k $\Omega$    | 10 nF             | None                            |
| 3.3 V            | 47 $\mu$ F Ceramic CAP         | 8.2 k $\Omega$    | 10 nF             | None                            |
| 5 V              | 47 $\mu$ F Ceramic CAP         | 15 k $\Omega$     | 10 nF             | None                            |
| 2.5 V            | 220 $\mu$ F/10 V/30 m $\Omega$ | 15 k $\Omega$     | 2.2 nF            | 47 pF                           |
| 3.3 V            | 220 $\mu$ F/10 V/30 m $\Omega$ | 15 k $\Omega$     | 2.2 nF            | 47 pF                           |
| 5 V              | 220 $\mu$ F/10 V/30 m $\Omega$ | 15 k $\Omega$     | 2.2 nF            | 47 pF                           |

①:  $C_{COMP2}$  is needed for high ESR output capacitor.  
CCOMP2  $\leq$  47 pF is recommended.

## CC Loop Stability

The constant-current control loop is internally compensated over the 1500 mA - 3500 mA output range. No additional external compensation is required to stabilize the CC current.

## Output Cable Resistance Compensation

To compensate for resistive voltage drop across the charger's output cable, the ACT4533A/B integrates a simple, user-programmable cable voltage drop compensation using the impedance at the FB pin. Use the curve in Figure 6 to choose the proper feedback resistance values for cable compensation.  $R_{FB1}$  is the high side resistor of voltage divider.

In the case of high  $R_{FB1}$  used, the frequency compensation needs to be adjusted correspondingly. As show in Figure 7, adding a capacitor in paralleled with  $R_{FB1}$  or increasing the compensation capacitance at COMP pin helps the system stability.

Figure 6:

Cable Compensation at Various Resistor Divider Values

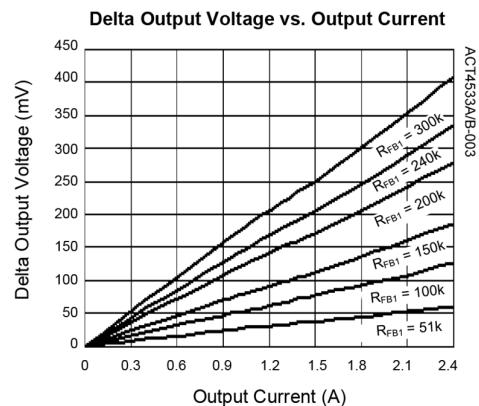
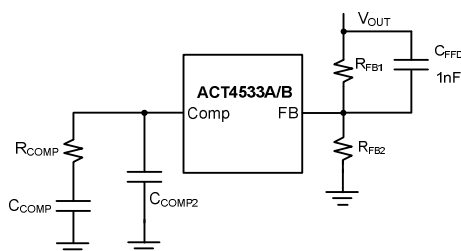




Figure 7:

Frequency Compensation for High  $R_{FB1}$



## PC Board Layout Guidance

When laying out the printed circuit board, the following checklist should be used to ensure proper operation of the IC.

1. Arrange the power components to reduce the AC loop size consisting of  $C_{IN}$ , IN pin, SW pin and the Schottky diode.
2. Place input decoupling ceramic capacitor  $C_{IN}$  as close to IN pin as possible.  $C_{IN}$  is connected power GND with vias or short and wide path.
3. Return FB, COMP and  $I_{SET}$  to signal GND pin, and connect the signal GND to power GND at a single point for best noise immunity. Connect exposed pad to power ground copper area with copper and vias.
4. Use copper plane for power GND for best heat dissipation and noise immunity.
5. Place feedback resistor close to FB pin.
6. Use short trace connecting HSB- $C_{HSB}$ -SW loop.

Figure 8 shows an example of PCB layout.

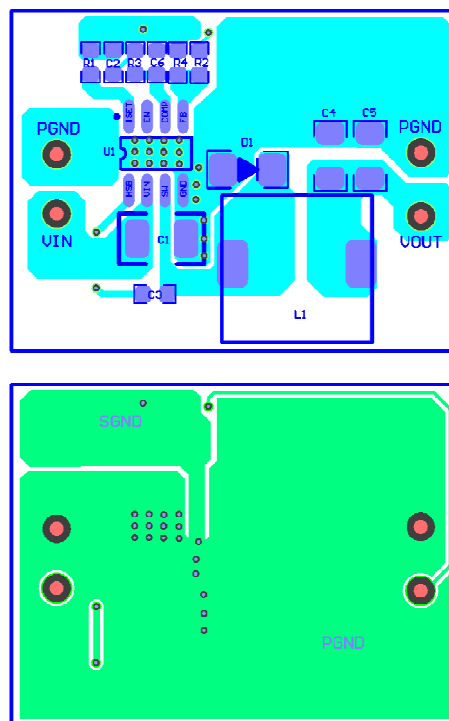


Figure 9:

Typical Application Circuit for 5 V/2.4 A Car Charger with OVP Circuit

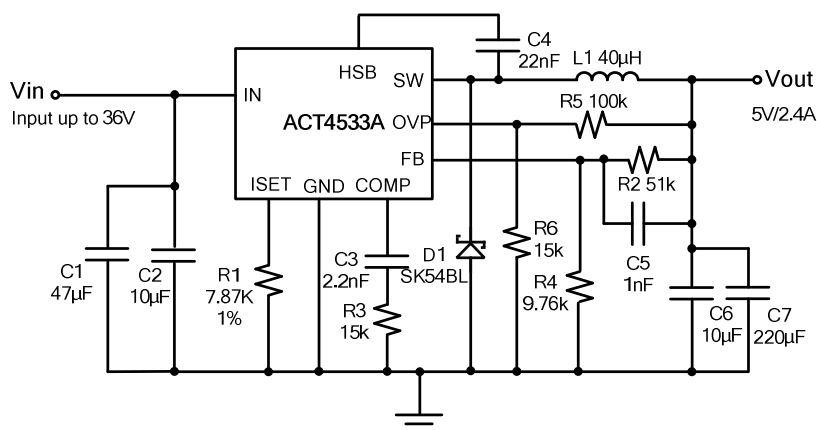


Table 2:

BOM List for 5 V/2.4 A Car Charger

| ITEM | REFERENCE | DESCRIPTION                                      | MANUFACTURER     | QTY |
|------|-----------|--|------------------|-----|
| 1    | U1        | IC, ACT4533AYH, SOP-8EP                          | Active-Semi      | 1   |
| 2    | C1        | Capacitor, Electrolytic, 47 µF/50 V, 6.3 x 7 mm  | Murata, TDK      | 1   |
| 3    | C2        | Capacitor, Ceramic, 10 µF/50 V, 1206, SMD        | Murata, TDK      | 1   |
| 4    | C3        | Capacitor, Ceramic, 2.2 nF/6.3 V, 0603, SMD      | Murata, TDK      | 1   |
| 5    | C4        | Capacitor, Ceramic, 22 nF/50 V, 1206, SMD        | Murata, TDK      | 1   |
| 6    | C5        | Capacitor, Ceramic, 1 nF/10 V, 0603, SMD         | Murata, TDK      | 1   |
| 7    | C6        | Capacitor, Ceramic, 10 µF/10 V, 0603, SMD        | Murata, TDK      | 1   |
| 8    | C7        | Capacitor, Electrolytic, 220 µF/10 V, 6.3 x 7 mm | Murata, TDK      | 1   |
| 9    | L1        | Inductor, 40 µH, 5 A, 20%, SMD                   | Tyco Electronics | 1   |
| 10   | D1        | Diode, Schottky, 40 V/5 A, SK54BL                | Diodes           | 1   |
| 11   | R1        | Chip Resistor, 7.87 kΩ, 0603, 1%                 | Murata, TDK      | 1   |
| 12   | R2        | Chip Resistor, 51 kΩ, 0603, 1%                   | Murata, TDK      | 1   |
| 13   | R3        | Chip Resistor, 15 kΩ, 0603, 5%                   | Murata, TDK      | 1   |
| 14   | R4        | Chip Resistor, 9.76 kΩ, 0603, 1%                 | Murata, TDK      | 1   |
| 15   | R5        | Chip Resistor, 100 kΩ, 0603, 1%                  | Murata, TDK      | 1   |
| 16   | R6        | Chip Resistor, 15 kΩ, 0603, 1%                   | Murata, TDK      | 1   |

Figure 10:

Typical Application Circuit for 5 V/2.4 A Car Charger with OVP and Short Circuit Protection

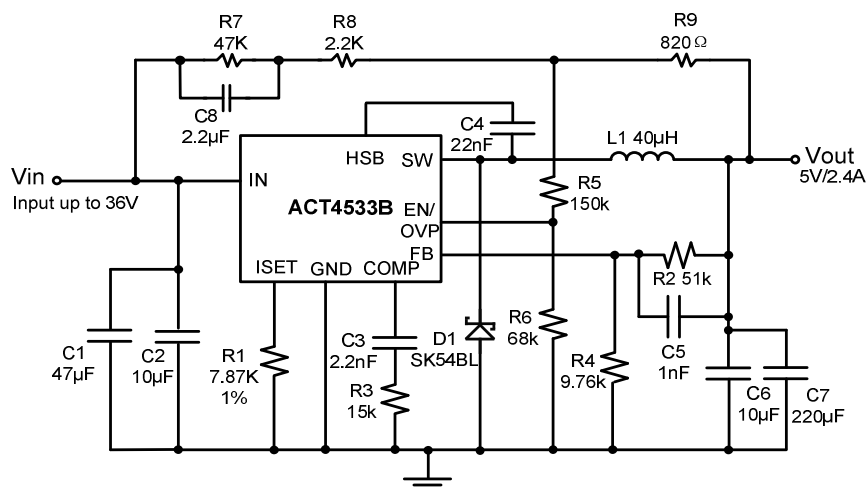


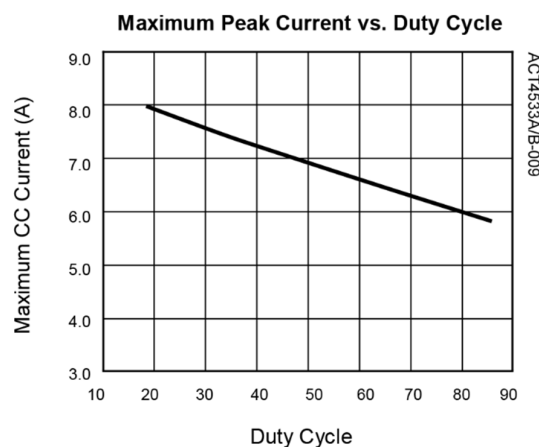
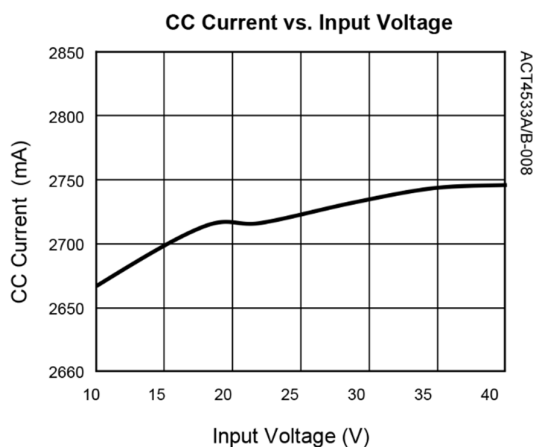
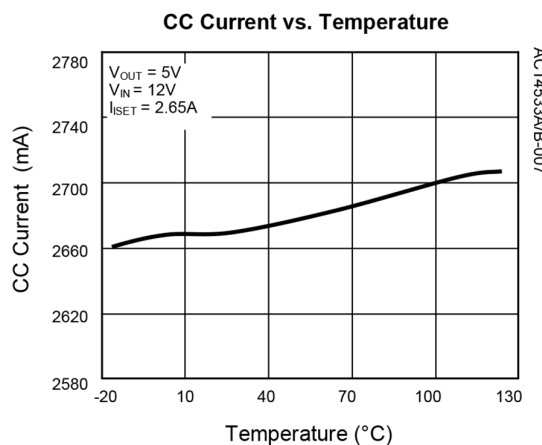
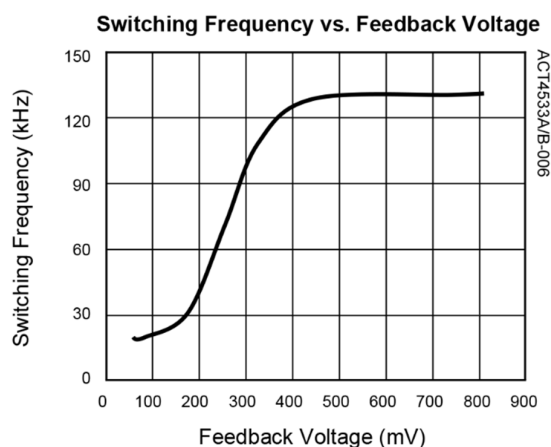
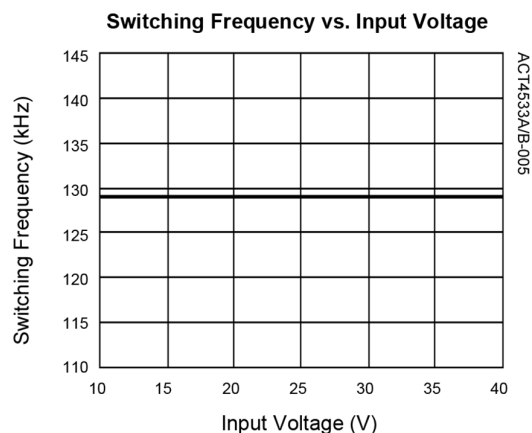
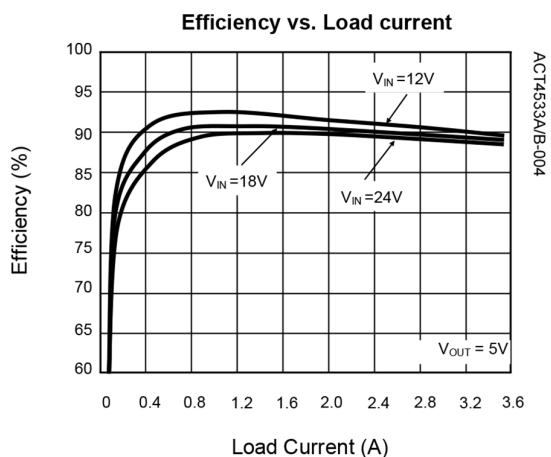
Table 3:

BOM List for 2.4 A Car Charger

| ITEM | REFERENCE | DESCRIPTION                                      | MANUFACTURER     | QTY |
|------|-----------|--|------------------|-----|
| 1    | U1        | IC, ACT4533BYH, SOP-8EP                          | Active-Semi      | 1   |
| 2    | C1        | Capacitor, Electrolytic, 47 µF/50 V, 6.3 x 7 mm  | Murata, TDK      | 1   |
| 3    | C2        | Capacitor, Ceramic, 10 µF/50 V, 1206, SMD        | Murata, TDK      | 1   |
| 4    | C3        | Capacitor, Ceramic, 2.2 nF/6.3 V, 0603, SMD      | Murata, TDK      | 1   |
| 5    | C4        | Capacitor, Ceramic, 22 nF/50 V, 1206, SMD        | Murata, TDK      | 1   |
| 6    | C5        | Capacitor, Ceramic, 1 nF/10 V, 0603, SMD         | Murata, TDK      | 1   |
| 7    | C6        | Capacitor, Ceramic, 10 µF/10 V, 0603, SMD        | Murata, TDK      | 1   |
| 8    | C7        | Capacitor, Electrolytic, 220 uF/10 V, 6.3 x 7 mm | Murata, TDK      | 1   |
| 9    | C8        | Capacitor, Electrolytic, 2.2 µF/50 V, 6.3 x 7 mm | Murata, TDK      | 1   |
| 10   | L1        | Inductor, 40 µH, 5 A, 20%, SMD                   | Tyco Electronics | 1   |
| 11   | D1        | Diode, Schottky, 40 V/5 A, SK54BL                | Diodes           | 1   |
| 12   | R1        | Chip Resistor, 7.87 kΩ, 0603, 1%                 | Murata, TDK      | 1   |
| 13   | R2        | Chip Resistor, 51 kΩ, 0603, 1%                   | Murata, TDK      | 1   |
| 14   | R3        | Chip Resistor, 15 kΩ, 0603, 5%                   | Murata, TDK      | 1   |
| 15   | R4        | Chip Resistor, 9.76 kΩ, 0603, 1%                 | Murata, TDK      | 1   |
| 16   | R5        | Chip Resistor, 150 kΩ, 0603, 1%                  | Murata, TDK      | 1   |
| 17   | R6        | Chip Resistor, 68 kΩ, 0603, 1%                   | Murata, TDK      | 1   |
| 18   | R7        | Chip Resistor, 47 kΩ, 0603, 5%                   | Murata, TDK      | 1   |
| 19   | R8        | Chip Resistor, 2.2 kΩ, 0603, 5%                  | Murata, TDK      | 1   |
| 20   | R9        | Chip Resistor, 820 Ω, 0603, 5%                   | Murata, TDK      | 1   |

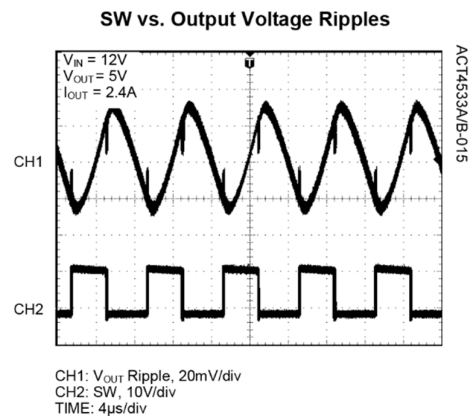
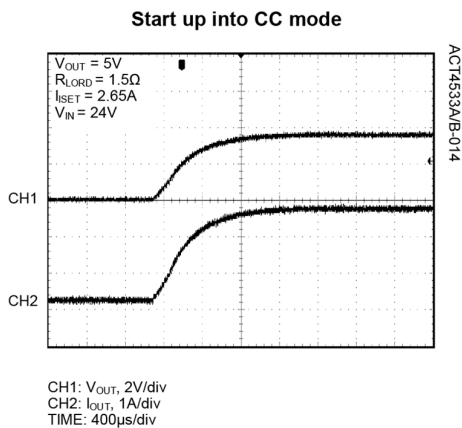
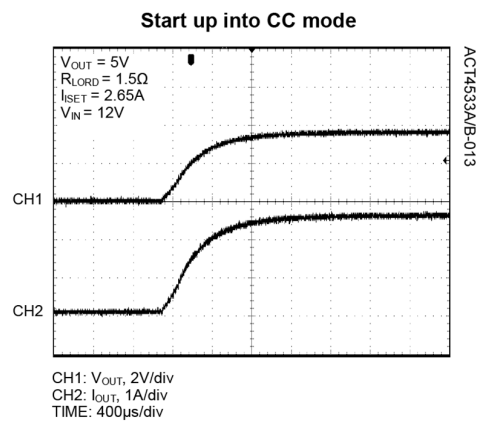
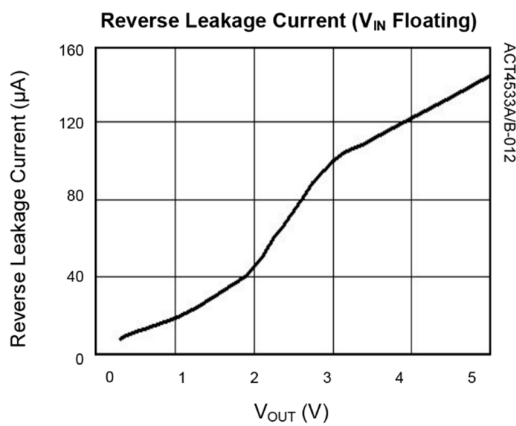
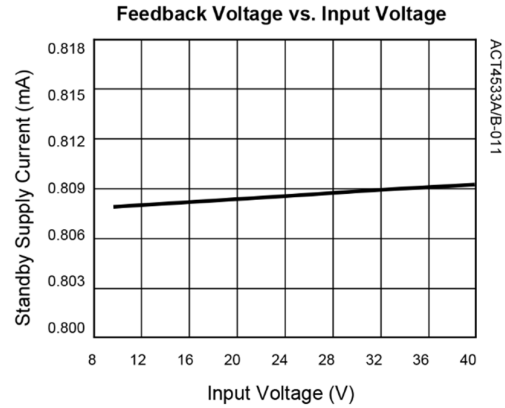
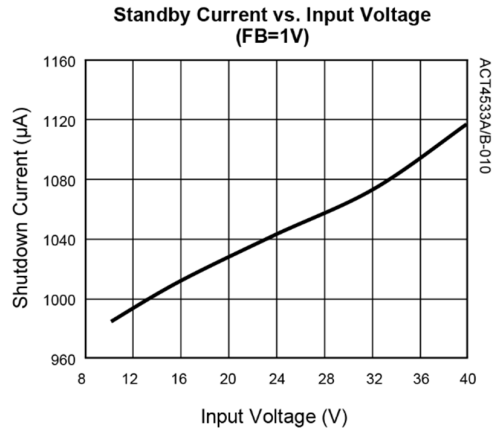
## TYPICAL PERFORMANCE CHARACTERISTICS

(Schematic as show in Figure 9,  $T_a = 25^\circ\text{C}$ , unless otherwise specified)



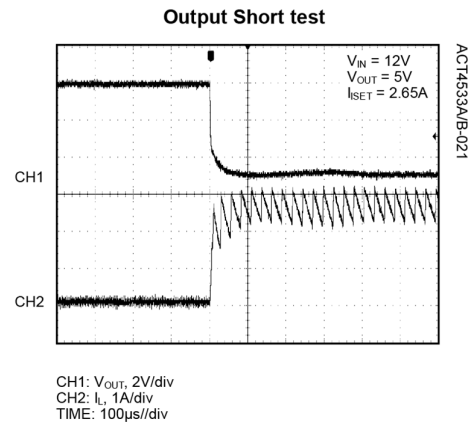
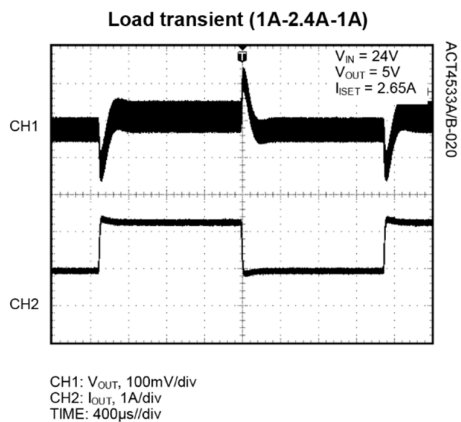
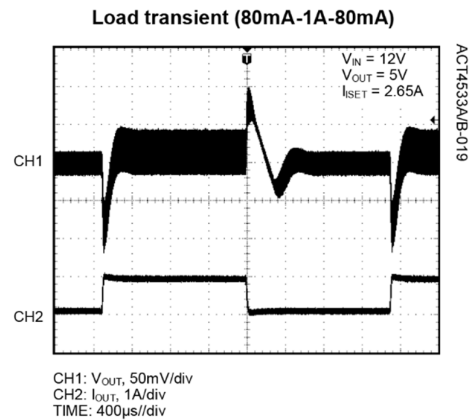
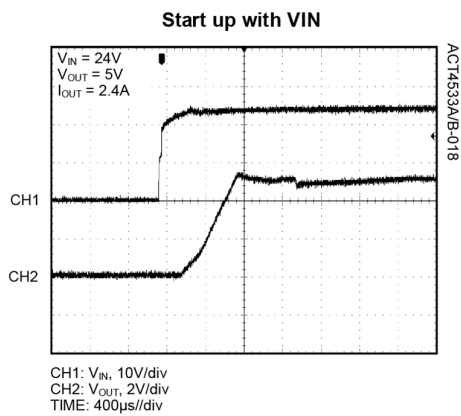
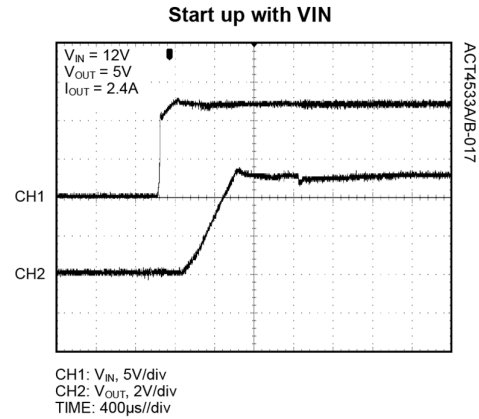
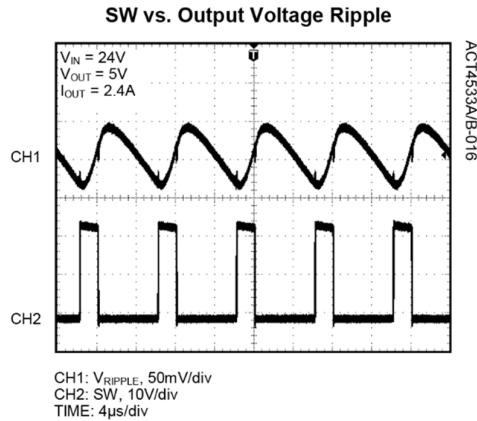
## TYPICAL PERFORMANCE CHARACTERISTICS

(Schematic as show in Figure 9,  $T_a = 25^\circ\text{C}$ , unless otherwise specified)



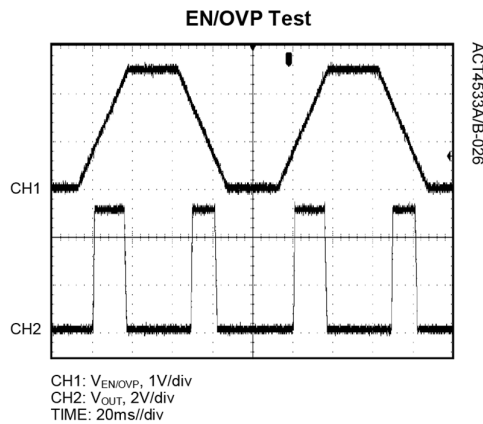
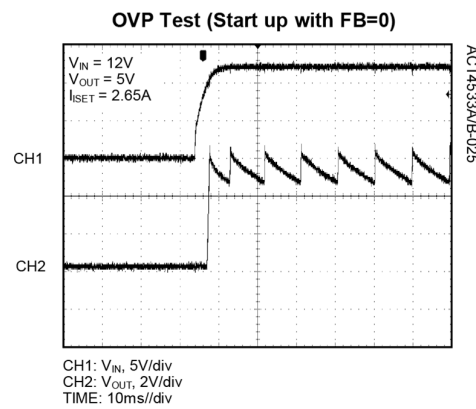
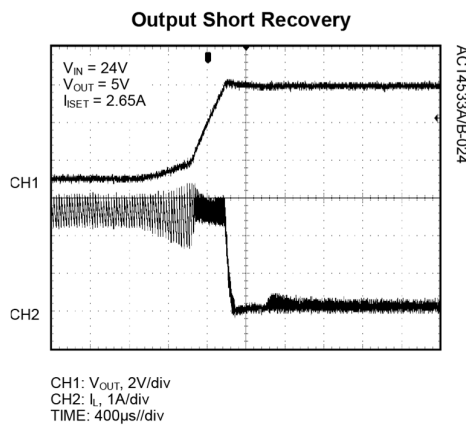
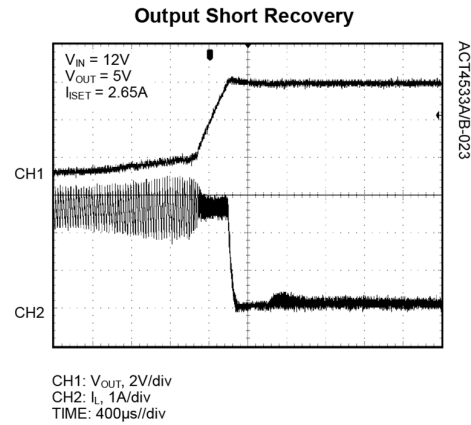
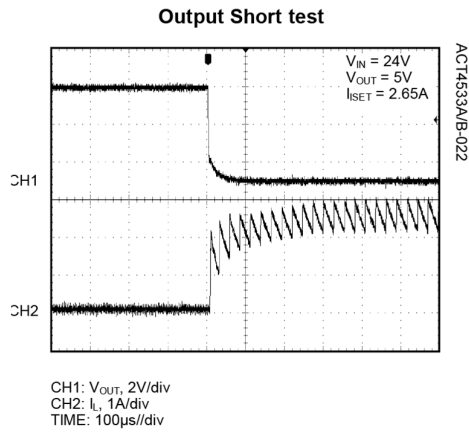
## TYPICAL PERFORMANCE CHARACTERISTICS

(Schematic as show in Figure 9,  $T_a = 25^\circ\text{C}$ , unless otherwise specified)



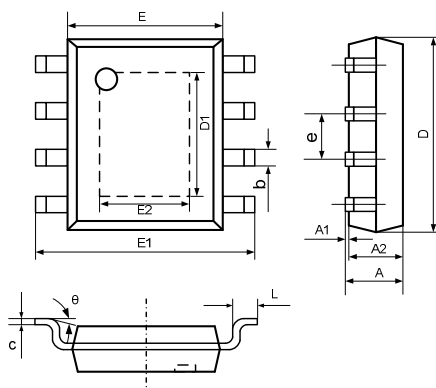
## TYPICAL PERFORMANCE CHARACTERISTICS

(Schematic as show in Figure 9,  $T_a = 25^\circ\text{C}$ , unless otherwise specified)



# PACKAGE OUTLINE

## SOP-8EP PACKAGE OUTLINE AND DIMENSIONS



| SYMBOL | DIMENSION IN MILLIMETERS |       | DIMENSION IN INCHES |       |
|--------|--------------------------|-------|---------------------|-------|
|        | MIN                      | MAX   | MIN                 | MAX   |
| A      | 1.350                    | 1.700 | 0.053               | 0.067 |
| A1     | 0.000                    | 0.100 | 0.000               | 0.004 |
| A2     | 1.350                    | 1.550 | 0.053               | 0.061 |
| b      | 0.330                    | 0.510 | 0.013               | 0.020 |
| c      | 0.170                    | 0.250 | 0.007               | 0.010 |
| D      | 4.700                    | 5.100 | 0.185               | 0.200 |
| D1     | 3.202                    | 3.402 | 0.126               | 0.134 |
| E      | 3.800                    | 4.000 | 0.150               | 0.157 |
| E1     | 5.800                    | 6.200 | 0.228               | 0.244 |
| E2     | 2.313                    | 2.513 | 0.091               | 0.099 |
| e      | 1.270 TYP                |       | 0.050 TYP           |       |
| L      | 0.400                    | 1.270 | 0.016               | 0.050 |
| theta  | 0°                       | 8°    | 0°                  | 8°    |

### Notes:

1. Lead Coplanarity is 0.1 mm max.
2. Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm per end.
3. Dimension E does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.25 mm per side.





## Contact Information

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For the latest specifications, additional product information, worldwide sales and distribution locations:

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Tel: 1-844-890-8163

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For technical questions and application information:

Email: [appsupport@qorvo.com](mailto:appsupport@qorvo.com)

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