

**FEATURES**

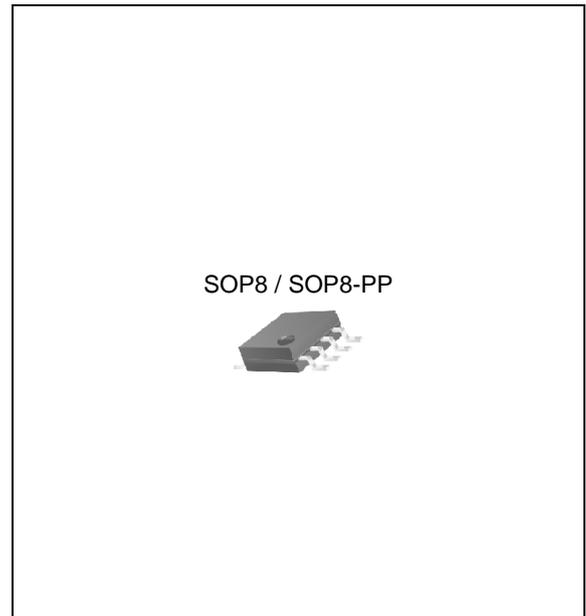
- Dual Channel Ultra Low Dropout Voltage
- Compatible with low ESR MLCC as Input/Output Capacitor
- Good Line and Load Regulation
- Guaranteed Output Current of 600/600mA
- Available in SOP8, SOP8-PP
- Fixed Output Voltage: 1V ~ 5V
- Over-Temperature Protection
- Over-Current Protection
- -40 °C to 125 °C Operating Junction Temperature Range

**APPLICATION**

- LCD TVs and SETTOP Boxes
- Battery Powered Equipments
- Motherboards and Graphic Cards
- Microprocessor Power Supplies
- Peripheral Cards
- High Efficiency Linear Regulators
- Battery Chargers

**DESCRIPTION**

The TJ5641 of two channels high performance ultra-low dropout linear regulators operates from 2.5V to 5.5V input supply and provides ultra-low dropout voltage with low ground current. These ultra-low dropout linear regulators respond fast to step changes in load which makes them suitable for low voltage micro-processor applications. The TJ5641 is developed on a CMOS process technology which allows low quiescent current operation independent of output load current. This CMOS process also allows the TJ5641 to operate under extremely low dropout conditions.

**ORDERING INFORMATION**

| Device         | Package |
|----------------|---------|
| TJ5641GD-XXYY  | SOP8    |
| TJ5641GDP-XXYY | SOP8-PP |

XX : Output Voltage code of channel 1 (VOUT1)

YY : Output Voltage code of channel 2 (VOUT2)

**ABSOLUTE MAXIMUM RATINGS**

| CHARACTERISTIC                       | SYMBOL                | MIN. | MAX.    | UNIT |
|--------------------------------------|-----------------------|------|---------|------|
| Input Supply Voltage (Survival)      | $V_{IN1}, V_{IN2}$    | -    | 6.5     | V    |
| Enable Input Voltage (Survival)      | $V_{EN1}, V_{EN2}$    | -    | 6.5     | V    |
| Maximum Continuous Output Current    | $I_{MAX}$             | -    | 600/600 | mA   |
| Lead Temperature (Soldering, 5 sec)  | $T_{SOL}$             |      | 260     | °C   |
| Storage Temperature Range            | $T_{STG}$             | -65  | 150     | °C   |
| Operating Junction Temperature Range | $T_{JOPR}$            | -40  | 125     | °C   |
| Package Thermal Resistance *         | $\theta_{JA-SOP8-PP}$ |      | 68      | °C/W |
|                                      | $\theta_{JC-SOP8-PP}$ |      | 15      |      |

\* Calculated from package in still air, mounted to 2.6mm X 3.5mm(minimum foot print) 2 layer PCB without thermal vias per JESD51 standards.

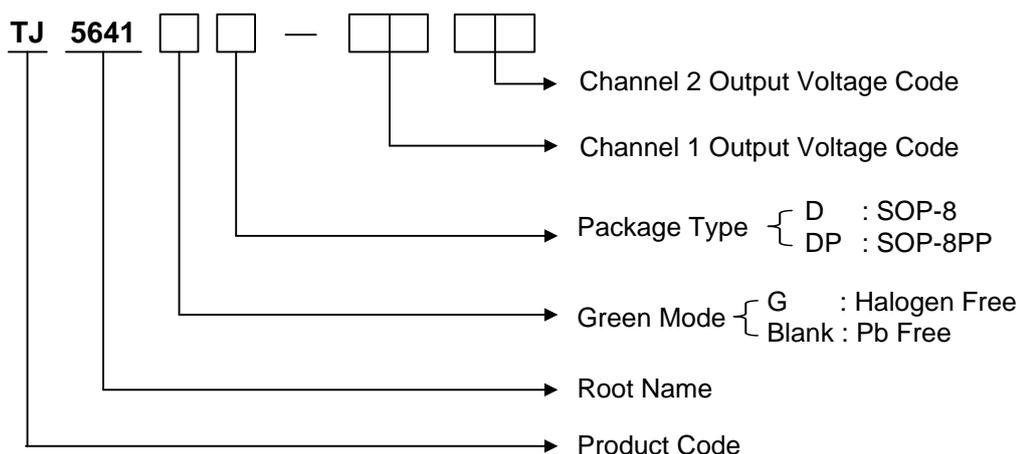
## ORDERING INFORMATION

| Package | Order No.        | Channel 1 Output Voltage [V] | Channel 2 Output Voltage [V] | Description   | Package Marking | Status     |
|---------|------------------|------------------------------|------------------------------|---------------|-----------------|------------|
| SOP8    | TJ5641GD – XXYY  | X.X                          | Y.Y                          | Fixed, Enable | XXYY<br>TJ5641G | Contact Us |
| SOP8-PP | TJ5641GDP – XXYY | X.X                          | Y.Y                          | Fixed, Enable | XXYY<br>TJ5641G | Contact Us |

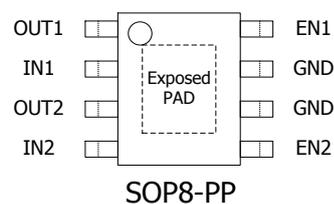
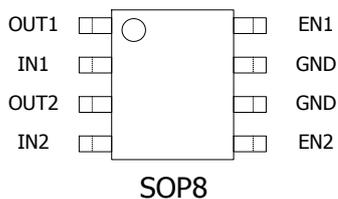
X.X = 1.0, 1.2, 1.5, 1.8, 2.5, 2.8, and 3.3

Y.Y = 1.0, 1.2, 1.5, 1.8, 2.5, 2.8, and 3.3

\* Customer can choose one of the above output voltages on each channel.



## PIN CONFIGURATION

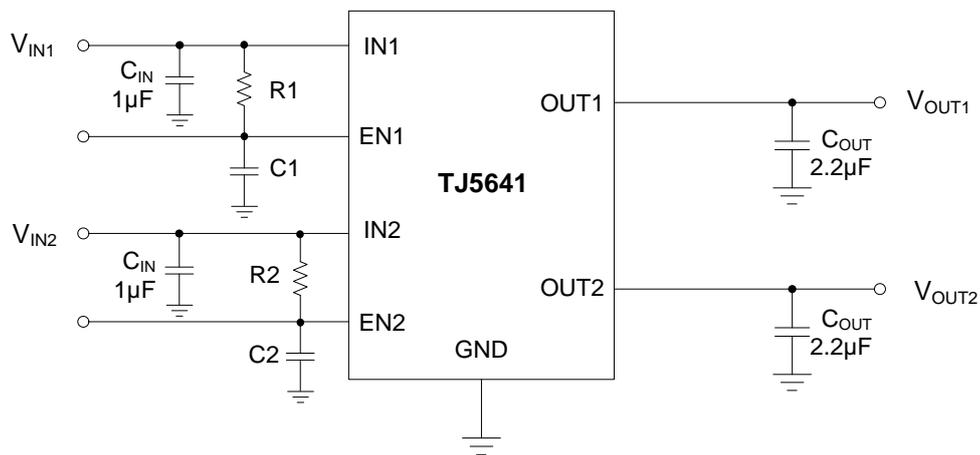
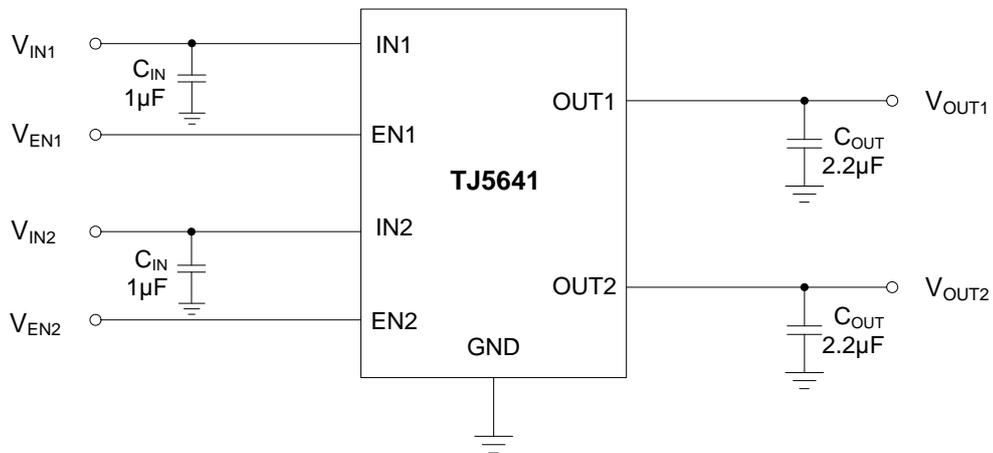


## PIN DESCRIPTION

| Pin No. | SOP8/SOP8-PP |                          |
|---------|--------------|--------------------------|
|         | Name         | Function                 |
| 1       | OUT1         | Channel 1 Output Voltage |
| 2       | IN1          | Channel 1 Input Voltage  |
| 3       | OUT2         | Channel 2 Output Voltage |
| 4       | IN2          | Channel 2 Input Voltage  |
| 5       | EN2          | Channel 2 Chip Enable    |
| 6       | GND          | Ground                   |
| 7       | GND          | Ground                   |
| 8       | EN1          | Channel 1 Chip Enable    |

- Exposed Pad of SOP8-PP package should be connected to GND.

## TYPICAL APPLICATION



\* The output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of application. With respect to the applied package, the maximum continuous output current of each channel may be still undeliverable.

\* See Application Information.

**ELECTRICAL CHARACTERISTICS** <sup>(Note 1)</sup>

Limits in standard typeface are for  $T_J=25^\circ\text{C}$ , and limits in **boldface type** apply over the **full operating temperature range**.  
 Unless otherwise specified:  $V_{IN}^{(Note\ 2)} = V_{O(NOM)} + 1\text{V}$ ,  $I_L = 10\text{ mA}$ ,  $C_{IN} = 1\ \mu\text{F}$ ,  $C_{OUT} = 2.2\ \mu\text{F}$ ,  $V_{EN} = V_{IN} - 0.3\ \text{V}$

| PARAMETER                              | SYMBOL            | TEST CONDITION  | MIN.            | TYP. | MAX.            | UNIT             |   |
|--|-------------------|---|-----------------|------|-----------------|------------------|---|
| Output Voltage Tolerance               | $V_{OUT1,2}$      |   | -2<br><b>-3</b> | -    | +2<br><b>+3</b> | %                |   |
| VIN Shutdown Current                   | $I_{GND.OFF}$     | $V_{EN1} = V_{EN2} = 0\text{V}$                         | -               | 0.1  | 2               | $\mu\text{A}$    |   |
| VIN Supply Current <sup>(Note 6)</sup> | $I_{GND.ON}$      | $V_{EN1} = V_{EN2} = 5\text{V}$ , $I_{OUT} = 0\text{A}$ | -               | 140  | 220             |                  |   |
| Line Regulation <sup>(Note 3)</sup>    | $\Delta V_{LINE}$ | $V_{IN} = V_{OUT} + 1\text{V}$ to $5\text{V}$           | -               | 0.25 | -               | %/V              |   |
| Load Regulation <sup>(Note 3, 4)</sup> | $\Delta V_{LOAD}$ | $10\text{mA} \leq I_{OUT} \leq 300\text{mA}$            | -               | 15   | 30              | mV               |   |
|  |                   | $10\text{mA} \leq I_{OUT} \leq 600\text{mA}$            | -               | 30   | 50              | mV               |   |
| Dropout Voltage <sup>(Note 5)</sup>    | $V_{DROP}$        | $V_{OUT} = 3.3\text{V}$ , $I_{OUT} = 600\text{mA}$      | -               | 240  | 360             | mV               |   |
| Ripple Rejection                       | PSRR              | $V_{IN} = V_{OUT} + 2\text{V}$ , $f = 1\text{kHz}$      | -               | 55   | -               | dB               |   |
| Output Current Limit                   | $I_{LIM}$         |   | 700             | -    | -               | mA               |   |
| Thermal Shutdown Temperature           | $T_{SD}$          |   | -               | 150  | -               | $^\circ\text{C}$ |   |
| Enable threshold                       | Logic High        | $V_{IH}$  | Output = High   | 1.6  | -               | -                | V |
|  | Logic Low         | $V_{IL}$  | Output = Low    | -    | -               | 0.4              | V |

Note 1. Stresses listed as the absolute maximum ratings may cause permanent damage to the device. These are for stress ratings. Functional operating of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibly to affect device reliability.

Note 2. The minimum operating value for input voltage is equal to either  $(V_{OUT,NOM} + V_{DROP})$  or  $2.5\text{V}$ , whichever is greater.

Note 3. Output voltage line regulation is defined as the change in output voltage from the nominal value due to change in the input line voltage. Output voltage load regulation is defined as the change in output voltage from the nominal value due to change in load current.

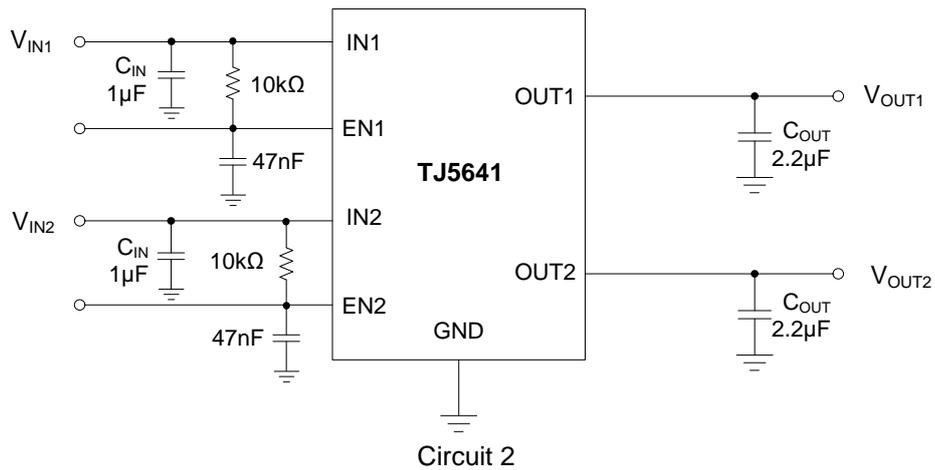
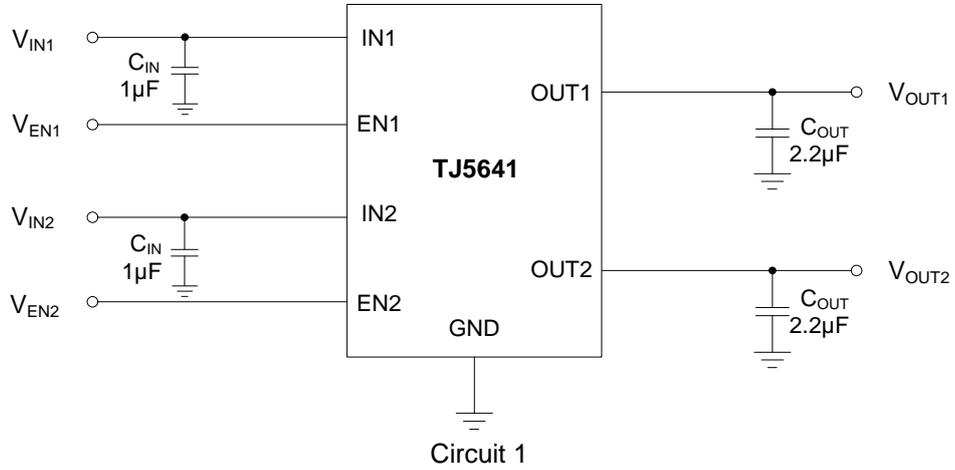
Note 4. Regulation is measured at constant junction temperature by using a 10ms current pulse. Devices are tested for load regulation in the load range from 10mA to 600mA.

Note 5. Dropout voltage is defined as the minimum input to output differential voltage at which the output drops 2% below the nominal value. Dropout voltage specification applies only to output voltages of 2.5V and above. For output voltages below 2.5V, the dropout voltage is nothing but the input to output differential, since the minimum input voltage is 2.5V.

Note 6. Ground current, or quiescent current, is the difference between input and output currents. It's defined by  $I_{GND1} = I_{IN1} - I_{OUT1}$  under the given loading condition. The total current drawn from the supply is the sum of the load current plus the ground pin current.

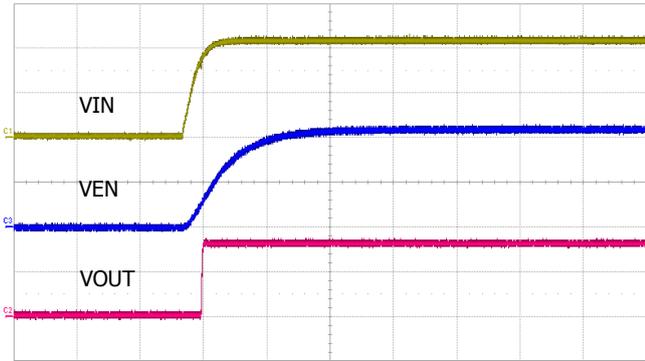
## TYPICAL OPERATING CHARACTERISTICS

### TEST CIRCUIT



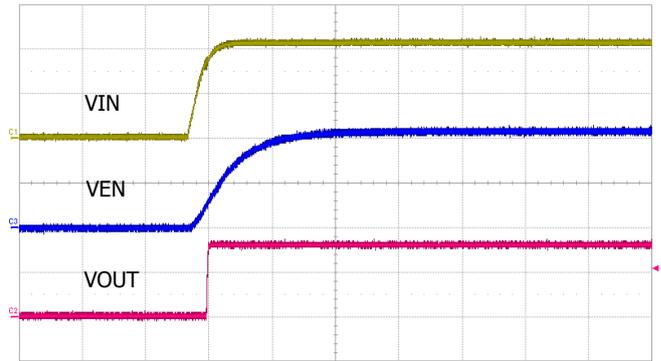
## Channel 1 (VOUT=3.3V)

Circuit 2



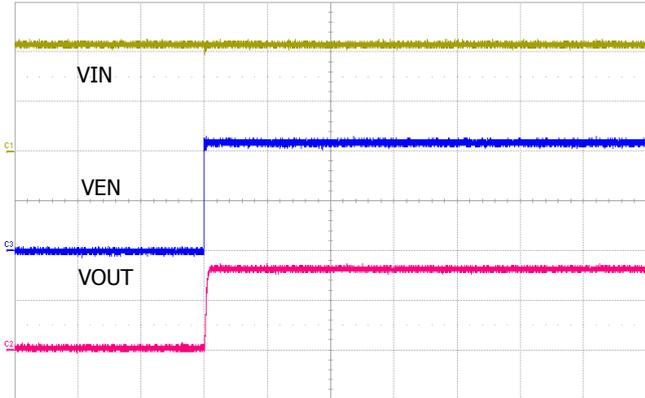
VIN: 2.0V/div, VEN: 2.0V/div, VOUT: 2.0V/div, Time: 1ms/div  
Start Up @ IOUT=10mA

Circuit 2



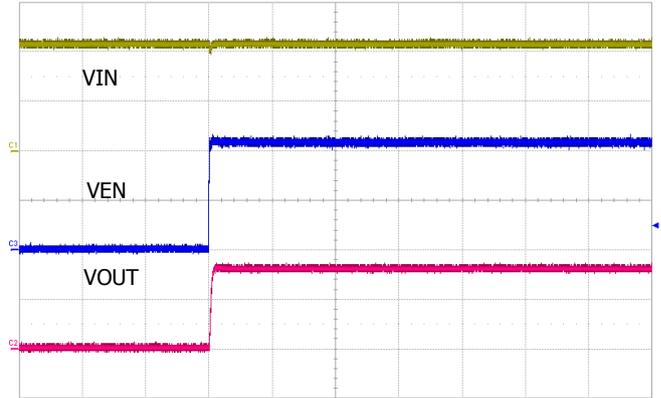
VIN: 2.0V/div, VEN: 2.0V/div, VOUT: 2.0V/div, Time: 1ms/div  
Start Up @ IOUT=600mA

Circuit 1



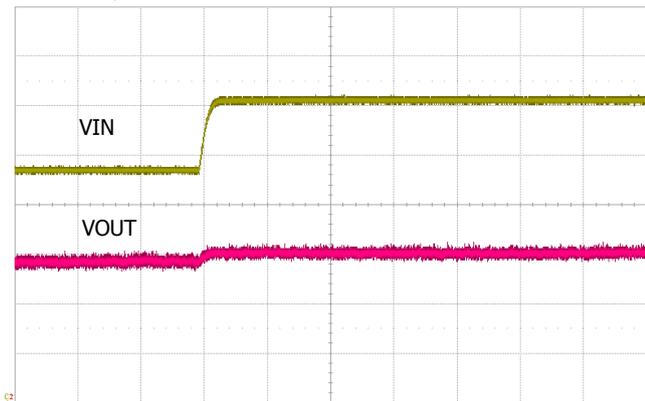
VIN: 2.0V/div, VEN: 2.0V/div, VOUT: 2.0V/div, Time: 500µs/div  
Start Up by External EN @ IOUT=10mA

Circuit 1



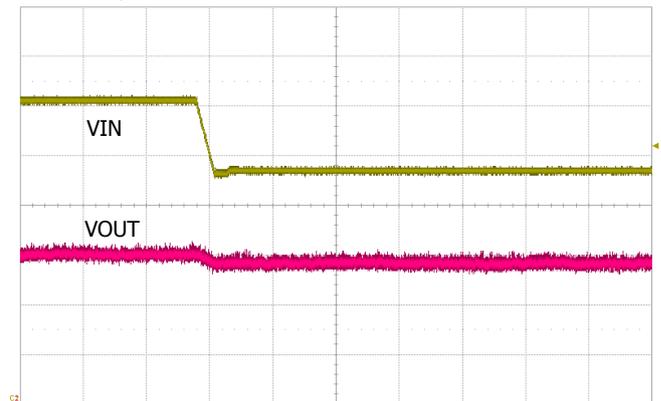
VIN: 2.0V/div, VEN: 2.0V/div, VOUT: 2.0V/div, Time: 500µs/div  
Start Up by External EN @ IOUT=600mA

Circuit 1, 2



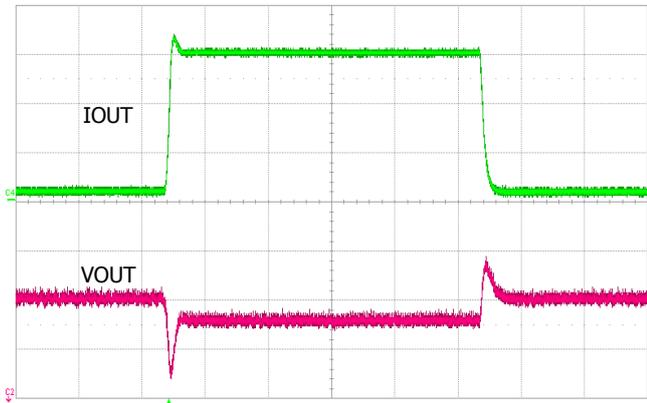
VIN: 0.5V/div, VOUT: 50mV/div, Time: 2ms/div  
VIN:4.3 to 5.0V @ IOUT=10mA  
Line Transient Response

Circuit 1, 2



VIN: 0.5V/div, VOUT: 50mV/div, Time: 2ms/div  
VIN:5.0 to 4.3V @ IOUT=10mA  
Line Transient Response

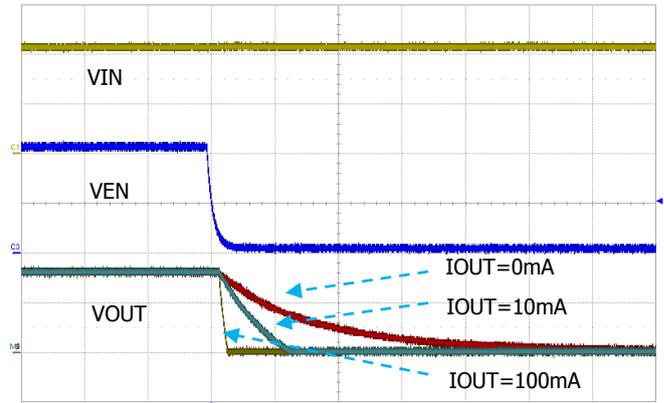
Circuit 1, 2



IOUT: 200mA/div, VOUT: 50mV/div, Time: 200 $\mu$ s/div  
 VIN=VEN=4.3V @ IOUT=10mA to 600mA

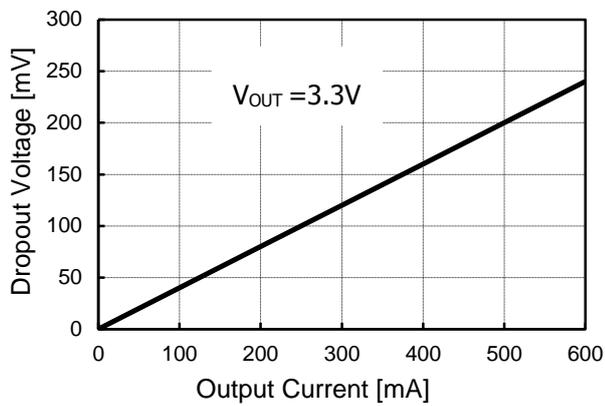
Load Transient Response

Circuit 1



VIN: 2.0V/div, VEN: 2.0V/div, VOUT: 2.0V/div, Time : 1ms/div

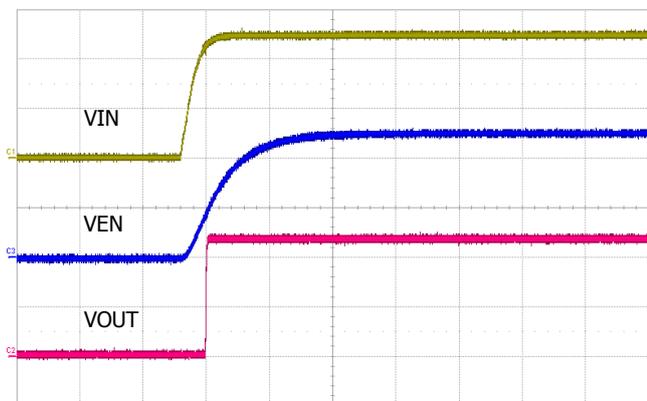
EN off



Dropout Voltage

## Channel 2 (VOUT=1.2V)

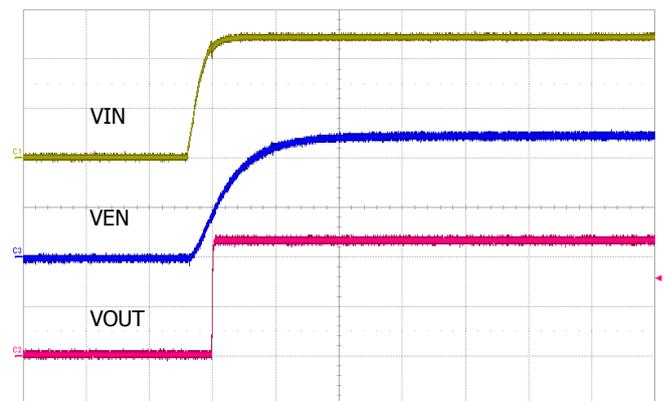
Circuit 2



VIN: 1.0V/div, VEN: 1.0V/div, VOUT: 0.5V/div, Time: 1ms/div

Start Up @ IOUT=10mA

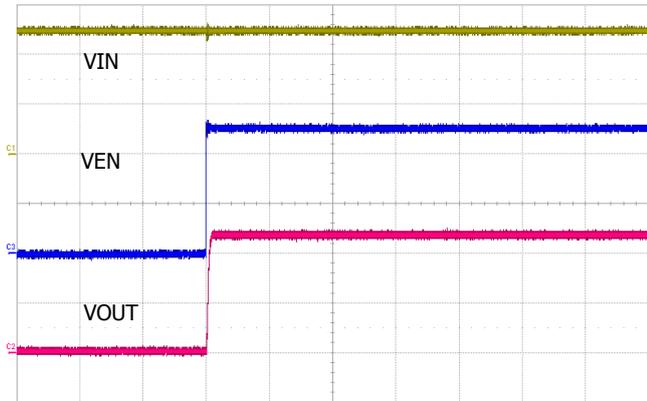
Circuit 2



VIN: 1.0V/div, VEN: 1.0V/div, VOUT: 0.5V/div, Time: 1ms/div

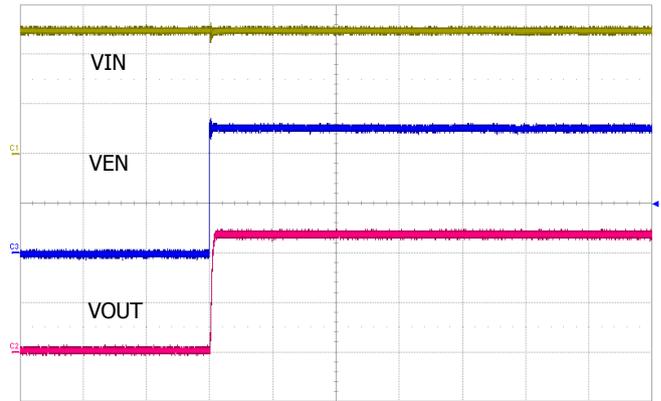
Start Up @ IOUT=600mA

Circuit 1



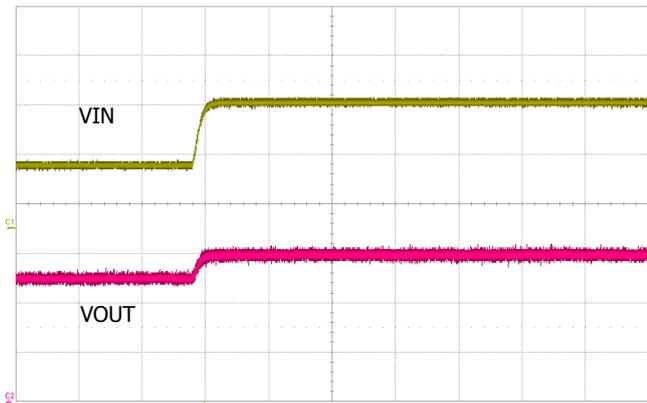
VIN: 1.0V/div, VEN: 1.0V/div, VOUT: 0.5V/div, Time: 0.5ms/div  
Start Up By External EN @ IOUT=10mA

Circuit 1



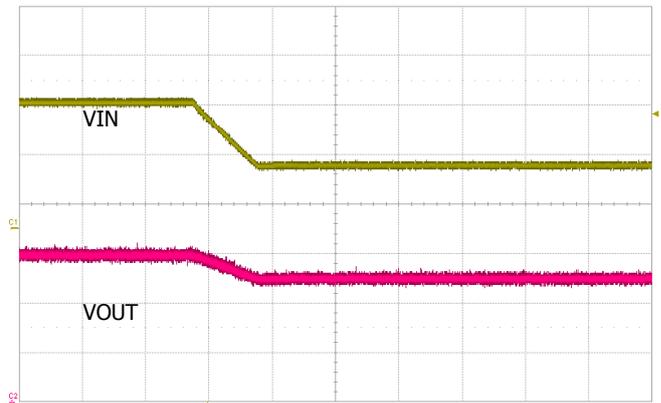
VIN: 1.0V/div, VEN: 1.0V/div, VOUT: 0.5V/div, Time: 0.5ms/div  
Start Up By External EN @ IOUT=600mA

Circuit 1, 2



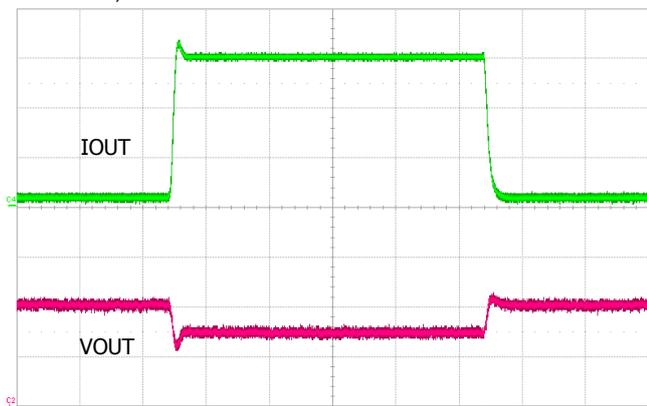
VIN: 0.5V/div, VOUT: 50mV/div, Time: 2ms/div  
VIN: 2.5 to 5.0V @ IOUT=10mA  
Line Transient Response

Circuit 1, 2



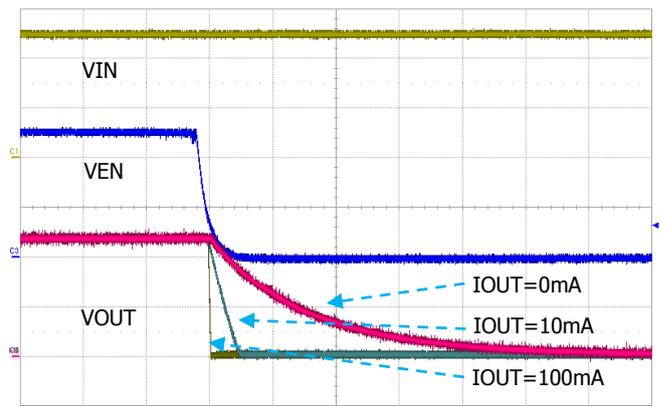
VIN: 0.5V/div, VOUT: 50mV/div, Time: 2ms/div  
VIN: 5.0 to 2.5V @ IOUT=10mA  
Line Transient Response

Circuit 1, 2



IOUT: 200mA/div, VOUT: 50mV/div, Time: 200μs/div  
VIN=VEN=2.5V @ IOUT=10mA to 600mA  
Load Transient Response

Circuit 1



VIN: 1.0V/div, VEN: 1.0V/div, VOUT: 0.5V/div, Time: 1ms/div

EN off

## APPLICATION INFORMATION

## Introduction

TJ5641 is intended for applications where very low dropout voltage and current capability are required. It provides a simple, low cost solution that occupies very little PCB estate. Additional features include an enable pin to allow for a very low power consumption standby mode.

## Component Selection

## Input Capacitor

A ceramic capacitance over than  $1\mu\text{F}$  should be closely placed to the input supply pin of the TJ5641 to ensure that the input supply voltage does not sag. Also a minimum of  $1\mu\text{F}$  ceramic capacitor is recommended to be placed directly next to the  $V_{\text{IN}1}$  and  $V_{\text{IN}2}$  Pin. It allows for the device being some distance from any bulk capacitor on the rail. Additionally, input droop due to load transients is reduced, improving load transient response. Additional capacitance may be added if required by the application.

## Output Capacitor

A minimum ceramic capacitor over than  $2.2\mu\text{F}$  should be very closely placed to the output voltage pin of the TJ5641. Increasing capacitance will improve the overall transient response and stability.

## Decoupling (Bypass) Capacitor

In very electrically noisy environments, it is recommended that additional ceramic capacitors be placed from VIN to GND. The use of multiple lower value ceramic capacitors in parallel with output capacitor also allows to achieve better transient performance and stability if required by the application.

## Start-Up

To turn on TJ5641, Input Voltage should be supplied with than Enable Voltage in advance. So, it is recommended to apply delayed start-up by using C1 as shown in Fig. 1. It can adjust proper delay by R1-C1 time constant. It is recommended that R1 and R2 value are greater than  $10\text{k}\Omega$ . Also, it is suggested that C1 and C2 value are greater than  $47\text{nF}$ .

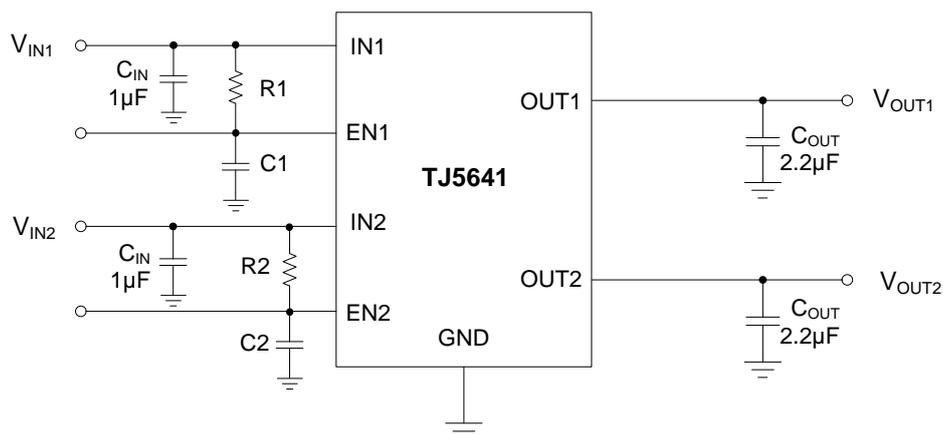


Fig. 1

## Maximum Continuous Output Current Capability

The TJ5641 can deliver a continuous current of  $600\text{mA}/600\text{mA}$  over the full operating junction temperature range. However, the output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and

maximum ambient temperature of application. With respect to the applied package, the maximum continuous output current of 600mA may be still undeliverable due to the restriction of the power dissipation of TJ5641. Under all possible conditions, the junction temperature must be within the range specified under operating conditions.

The temperatures over the device are given by:

$$T_C = T_A + P_D \times \theta_{CA}$$

$$T_J = T_C + P_D \times \theta_{JC}$$

$$T_J = T_A + P_D \times \theta_{JA}$$

where  $T_J$  is the junction temperature,  $T_C$  is the case temperature,  $T_A$  is the ambient temperature,  $P_D$  is the total power dissipation of the device,  $\theta_{CA}$  is the thermal resistance of case-to-ambient,  $\theta_{JC}$  is the thermal

resistance of junction-to-case, and  $\theta_{JA}$  is the thermal resistance of junction to ambient.

The total power dissipation of the device is given by:

$$\begin{aligned} P_D &= P_{IN} - P_{OUT} = (V_{IN} \times I_{IN}) - (V_{OUT} \times I_{OUT}) \\ &= (V_{IN} \times (I_{OUT} + I_{GND})) - (V_{OUT} \times I_{OUT}) = (V_{IN} - V_{OUT}) \times I_{OUT} + V_{IN} \times I_{GND} \end{aligned}$$

where  $I_{GND}$  is the operating ground current of the device which is specified at the Electrical Characteristics.

The maximum allowable temperature rise ( $T_{Rmax}$ ) depends on the maximum ambient temperature ( $T_{Amax}$ ) of the application, and the maximum allowable junction temperature ( $T_{Jmax}$ ):

$$T_{Rmax} = T_{Jmax} - T_{Amax}$$

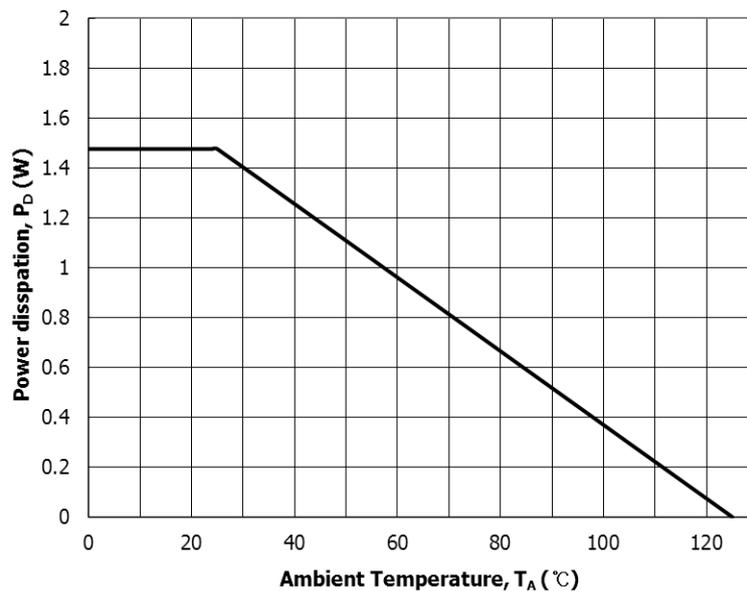
The maximum allowable value for junction-to-ambient thermal resistance,  $\theta_{JA}$ , can be calculated using the formula:

$$\theta_{JA} = T_{Rmax} / P_D$$

TJ5641 is available in SOP8 and SOP8-PP packages. The thermal resistance depends on amount of copper area or heat sink, and on air flow.

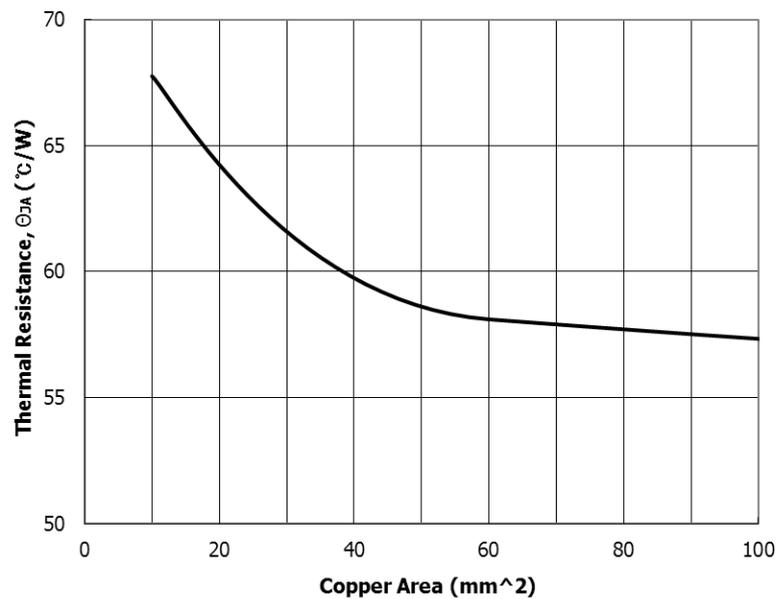
If proper cooling solution such as heat sink, copper plane area, or air flow is applied, the maximum allowable power dissipation could be increased. However, if the ambient temperature is increased, the allowable power dissipation would be decreased.

Power Dissipation( $P_D$ ) vs. Ambient Temperature( $T_A$ )



The graph above is valid for the thermal impedance specified in the Absolute Maximum Ratings section on page 1.

The  $\theta_{JA}$  could be decreased with respect to the copper plane area. So, the specification of maximum power dissipation for an application is fixed, the proper plane area could be estimated by following graphs. Wider copper plane area leads lower  $\theta_{JA}$ .

Thermal Resistance( $\theta_{JA}$ ) vs. Copper Area

The maximum allowable power dissipation is also influenced by the ambient temperature. With the  $\theta_{JA}$ -Copper plane area relationship, the maximum allowable power dissipation could be evaluated with respect to the ambient temperature. As shown in graph, the higher copper plane area leads  $\theta_{JA}$ . And the higher ambient temperature leads lower maximum allowable power dissipation.

## REVISION NOTICE

The description in this datasheet can be revised without any notice to describe its electrical characteristics properly.