# SGM25661
# 3.5V, 6A, Ultra-Low On-Resistance Load Switch

## GENERAL DESCRIPTION

The SGM25661 is an ultra-low on-resistance, integrated N-MOSFET, single-channel load switch. The device operates over a wide input voltage range of 0.8V to 3.5V, and is controlled by the ON pin which is capable of interfacing directly with low-voltage control signals.

The device can provide a 6A maximum continuous load current. Ultra-low on-resistance and high current capability make this product ideal for driving processor rails with tight voltage dropout tolerances. The fast rise time allows the power rails to rise quickly when the switch is enabled, thus reducing the distribution response time.

The SGM25661 offers the fast output discharge function in disable status.

The SGM25661 is available in a Green TDFN-3×3-8EL package.

## FEATURES

- **Input Voltage Range: 0.8V to 3.5V**
- **$V_{BIAS}$ Voltage Range: 3V to 5.5V**
- **Ultra-Low On-Resistance:**
  **$R_{ON}$ = 5.3mΩ (TYP) at $V_{IN}$ = 2.5V, $V_{BIAS}$ = 5V**
- **Maximum Continuous Load Current: 6A**
- **Low Quiescent Current: 0.6μA (TYP)**
- **Support with 1.2V, 1.8V, 2.5V and 3.3V GPIOs**
- **Rise Time: 8.1μs at $V_{IN}$ = 2.5V, $V_{BIAS}$ = 5V**
- **Fast Output Discharge**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in a Green TDFN-3×3-8EL Package**

## APPLICATIONS

Ultrabook
Notebook
Tablet Computer
Servers
Set-Top Boxes
Telecom Systems

## TYPICAL APPLICATION

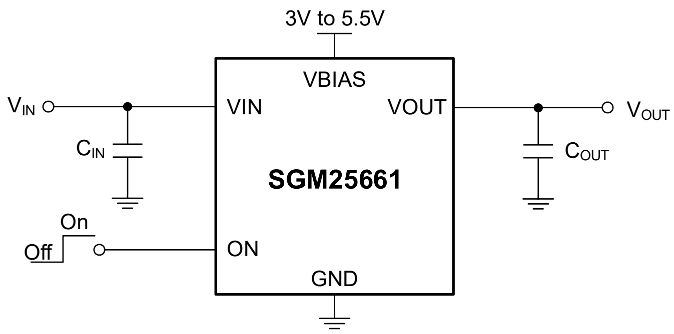



**Figure 1. Typical Application Circuit**

# PACKAGE/ORDERING INFORMATION

| MODEL | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|---|---|---|---|---|---|
| SGM25661 | TDFN-3×3-8EL | -40℃ to +85℃ | SGM25661YTGB8G/TR | SGM<br>GJPGB<br>XXXXX | Tape and Reel, 4000 |

## MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code.

XXXXX
- Vendor Code
- Trace Code
- Date Code - Year

Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

## ABSOLUTE MAXIMUM RATINGS

Input Voltage, $V_{IN}$ .................. -0.3V to 4V
Bias Voltage, $V_{BIAS}$ .................. -0.3V to 6V
Output Voltage, $V_{OUT}$ .................. -0.3V to 4V
ON Pin Voltage, $V_{ON}$ .................. -0.3V to 6V
Maximum Continuous Load Current .................. 6A
Maximum Pulsed Switch Current, Pulse < 300μs, 2% Duty Cycle .................. 8A
Package Thermal Resistance
TDFN-3×3-8EL, $\theta_{JA}$ .................. 39℃/W
Junction Temperature .................. +150℃
Storage Temperature Range .................. -65℃ to +150℃
Lead Temperature (Soldering, 10s) .................. +260℃
ESD Susceptibility
HBM .................. 2000V
CDM .................. 1000V

## RECOMMENDED OPERATING CONDITIONS

Input Voltage, $V_{IN}$ .................. 0.8V to $V_{BIAS}$ - 1.95V
Bias Voltage, $V_{BIAS}$ .................. 3V to 5.5V
ON Pin Voltage, $V_{ON}$ .................. 0V to 5.5V
Output Voltage, $V_{OUT}$ .................. $V_{IN}$
Input Capacitor, $C_{IN}$ .................. > 1μF
High-Level Threshold Voltage, $V_{IH\_ON}$ .................. 1.2V to 5.5V
Low-Level Threshold Voltage, $V_{IL\_ON}$ .................. 0V to 0.5V
Operating Junction Temperature Range .................. -40℃ to +125℃
Operating Ambient Temperature Range .................. -40℃ to +85℃

## OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

## ESD SENSITIVITY CAUTION

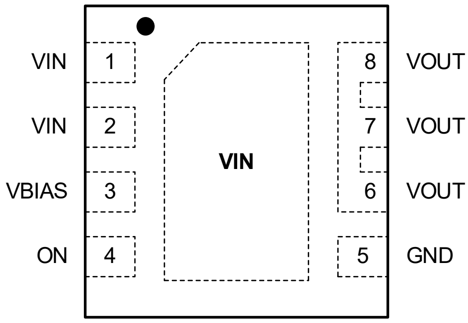
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

## DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

## PIN CONFIGURATION

(TOP VIEW)




TDFN-3×3-8EL

## PIN DESCRIPTION

| PIN | NAME | FUNCTION |
|---|---|---|
| 1, 2 | VIN | Switch Input Pins. Use a bypass capacitor ($C_{IN}$) as close as possible between this pin and GND pin. |
| 3 | VBIAS | Power Supply Pin for Internal Circuitry. $V_{BIAS}$ voltage range is from 3V to 5.5V. |
| 4 | ON | Switch Enable Input. Logic high sets the device active, logic low disables it and turns it into shutdown mode. Do not leave this pin floating. |
| 5 | GND | Ground. |
| 6, 7, 8 | VOUT | Switch Output Pins. Use a bypass capacitor ($C_{OUT}$) between this pin and GND pin. |
| Exposed Pad | VIN | Switch Input Pin. A bypass capacitor between exposed pad and GND pin is recommended. |

## ELECTRICAL CHARACTERISTICS

($V_{BIAS}$ = 5V, typical values are at $T_A$ = +25℃, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| **Power Supplies and Currents ($V_{BIAS}$ = 5V)** | | | | | | |
| VBIAS Quiescent Current | $I_{Q\_BIAS}$ | $I_{OUT}$ = 0A, $V_{IN}$ = 3V, $V_{ON}$ = $V_{BIAS}$ = 5V, $T_A$ = -40℃ to +85℃ | | 0.6 | 1 | μA |
| VBIAS Shutdown Current | $I_{SD\_BIAS}$ | $V_{ON}$ = 0V, $V_{OUT}$ = 0V, $T_A$ = -40℃ to +85℃ | | | 0.1 | μA |
| VIN Shutdown Current | $I_{SD\_VIN}$ | $V_{ON}$ = 0V, $V_{OUT}$ = 0V, $V_{IN}$ = 3V, $T_A$ = +25℃ | | 0.0009 | 0.1 | μA |
| | | $V_{ON}$ = 0V, $V_{OUT}$ = 0V, $V_{IN}$ = 2.5V, $T_A$ = +25℃ | | 0.0008 | 0.1 | |
| | | $V_{ON}$ = 0V, $V_{OUT}$ = 0V, $V_{IN}$ = 2.0V, $T_A$ = +25℃ | | 0.0007 | 0.1 | |
| | | $V_{ON}$ = 0V, $V_{OUT}$ = 0V, $V_{IN}$ = 1.05V, $T_A$ = +25℃ | | 0.0007 | 0.1 | |
| | | $V_{ON}$ = 0V, $V_{OUT}$ = 0V, $V_{IN}$ = 0.8V, $T_A$ = +25℃ | | 0.0006 | 0.1 | |
| ON Terminal Input Leakage Current | $I_{ON}$ | $V_{ON}$ = 5.5V, $T_A$ = -40℃ to +85℃ | | | 0.1 | μA |
| **Resistance Characteristics ($V_{BIAS}$ = 5V)** | | | | | | |
| On-Resistance | $R_{ON}$ | $I_{OUT}$ = -200mA, $V_{IN}$ = 3V, $T_A$ = +25℃ | | 6.5 | 8 | mΩ |
| | | $I_{OUT}$ = -200mA, $V_{IN}$ = 2.5V, $T_A$ = +25℃ | | 5.3 | 6.3 | mΩ |
| | | $I_{OUT}$ = -200mA, $V_{IN}$ = 2V, $T_A$ = +25℃ | | 4.8 | 5.8 | mΩ |
| | | $I_{OUT}$ = -200mA, $V_{IN}$ = 1.05V, $T_A$ = +25℃ | | 4.4 | 5.3 | mΩ |
| | | $I_{OUT}$ = -200mA, $V_{IN}$ = 0.8V, $T_A$ = +25℃ | | 4.3 | 5.3 | mΩ |
| Output Pull-Down Resistance | $R_{PD}$ | $V_{IN}$ = 5V, $V_{ON}$ = 0V, $V_{OUT}$ = 1V, $T_A$ = -40℃ to +85℃ | | 260 | 300 | Ω |
| **Power Supplies and Currents ($V_{BIAS}$ = 3V)** | | | | | | |
| VBIAS Quiescent Current | $I_{Q\_BIAS}$ | $I_{OUT}$ = 0A, $V_{IN}$ = 1V, $V_{ON}$ = $V_{BIAS}$ = 3V, $T_A$ = -40℃ to +85℃ | | 0.3 | 1 | μA |
| VBIAS Shutdown Current | $I_{SD\_BIAS}$ | $V_{ON}$ = 0V, $V_{OUT}$ = 0V, $T_A$ = -40℃ to +85℃ | | | 0.1 | μA |
| VIN Shutdown Current | $I_{SD\_VIN}$ | $V_{ON}$ = 0V, $V_{OUT}$ = 0V, $V_{IN}$ = 1.05V, $T_A$ = +25℃ | | 0.001 | 0.1 | μA |
| | | $V_{ON}$ = 0V, $V_{OUT}$ = 0V, $V_{IN}$ = 0.8V, $T_A$ = +25℃ | | 0.0008 | 0.1 | |
| ON Terminal Input Leakage Current | $I_{ON}$ | $V_{ON}$ = 5.5V, $T_A$ = -40℃ to +85℃ | | | 0.1 | μA |
| **Resistance Characteristics ($V_{BIAS}$ = 3V)** | | | | | | |
| On-Resistance | $R_{ON}$ | $I_{OUT}$ = -200mA, $V_{IN}$ = 1.05V, $T_A$ = +25℃ | | 6.7 | 8.4 | mΩ |
| | | $I_{OUT}$ = -200mA, $V_{IN}$ = 0.8V, $T_A$ = +25℃ | | 5.8 | 7.0 | mΩ |
| Output Pull-Down Resistance | $R_{PD}$ | $V_{IN}$ = 3V, $V_{ON}$ = 0V, $V_{OUT}$ = 1V, $T_A$ = -40℃ to +85℃ | | 260 | 300 | Ω |

## SWITCHING CHARACTERISTICS

($T_A$ = +25℃, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| **$V_{IN}$ = 2.5V, $V_{ON}$ = $V_{BIAS}$ = 5V** | | | | | | |
| Turn-On Time | $t_{ON}$ | $R_{OUT}$ = 10Ω, $C_{OUT}$ = 0.1μF | | 10.6 | | μs |
| Turn-Off Time | $t_{OFF}$ | | | 4.9 | | |
| $V_{OUT}$ Rise Time | $t_R$ | | | 8.1 | | |
| $V_{OUT}$ Fall Time | $t_F$ | | | 2.1 | | |
| Delay Time | $t_D$ | | | 8.3 | | |
| **$V_{IN}$ = 1.05V, $V_{ON}$ = $V_{BIAS}$ = 5V** | | | | | | |
| Turn-On Time | $t_{ON}$ | L = 2.2μH (DCR = 0.33Ω), $C_{OUT}$ = 2 × 22μF (Refer to Typical Application Powering Rails Sensitive to Ringing and Over-Voltage due to Fast Rise Time) | 7.49 | 10.70 | 16.05 | μs |
| Turn-Off Time | $t_{OFF}$ | | | 8000 | | |
| $V_{OUT}$ Rise Time | $t_R$ | | 1.6 | 4.2 | 7.0 | |
| $V_{OUT}$ Fall Time | $t_F$ | | | 28100 | | |
| Delay Time | $t_D$ | | 5.95 | 8.50 | 11.05 | |
| **$V_{IN}$ = 0.8V, $V_{ON}$ = $V_{BIAS}$ = 5V** | | | | | | |
| Turn-On Time | $t_{ON}$ | $R_{OUT}$ = 10Ω, $C_{OUT}$ = 0.1μF | | 10 | | μs |
| Turn-Off Time | $t_{OFF}$ | | | 5.6 | | |
| $V_{OUT}$ Rise Time | $t_R$ | | | 2.8 | | |
| $V_{OUT}$ Fall Time | $t_F$ | | | 2.0 | | |
| Delay Time | $t_D$ | | | 8.7 | | |
| **$V_{IN}$ = 1.05V, $V_{ON}$ = 5V, $V_{BIAS}$ = 3V** | | | | | | |
| Turn-On Time | $t_{ON}$ | $R_{OUT}$ = 10Ω, $C_{OUT}$ = 0.1μF | | 22.6 | | μs |
| Turn-Off Time | $t_{OFF}$ | | | 4.2 | | |
| $V_{OUT}$ Rise Time | $t_R$ | | | 11.6 | | |
| $V_{OUT}$ Fall Time | $t_F$ | | | 2 | | |
| Delay Time | $t_D$ | | | 18.4 | | |
| **$V_{IN}$ = 0.8V, $V_{ON}$ = 5V, $V_{BIAS}$ = 3V** | | | | | | |
| Turn-On Time | $t_{ON}$ | $R_{OUT}$ = 10Ω, $C_{OUT}$ = 0.1μF | | 22.1 | | μs |
| Turn-Off Time | $t_{OFF}$ | | | 4.4 | | |
| $V_{OUT}$ Rise Time | $t_R$ | | | 7.8 | | |
| $V_{OUT}$ Fall Time | $t_F$ | | | 2 | | |
| Delay Time | $t_D$ | | | 18.6 | | |

# PARAMETER MEASUREMENT INFORMATION

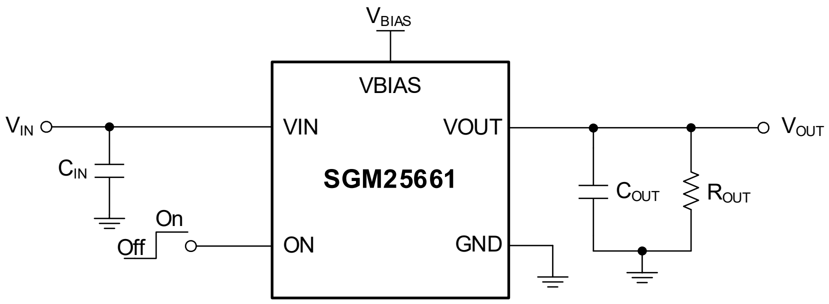



**Figure 2. Test Circuit 1**

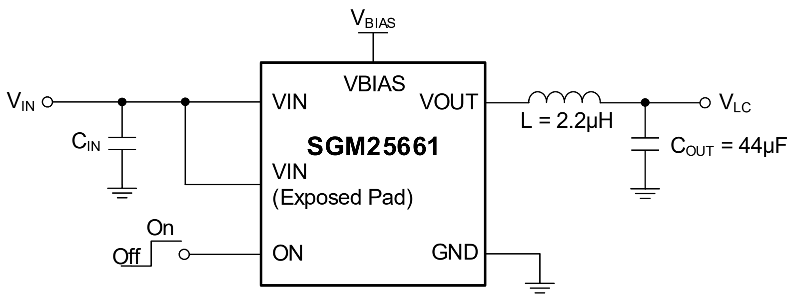



**Figure 3. Test Circuit 2**

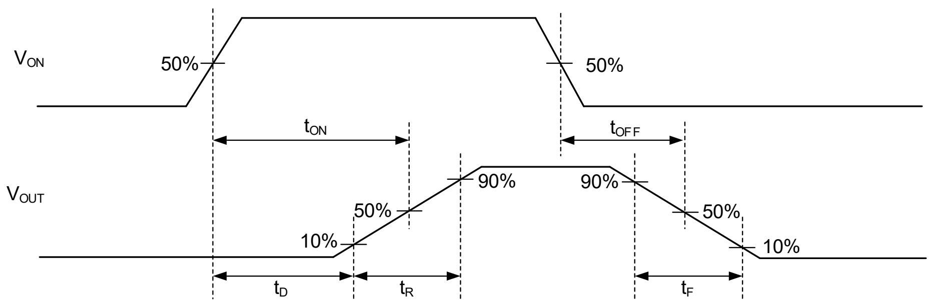
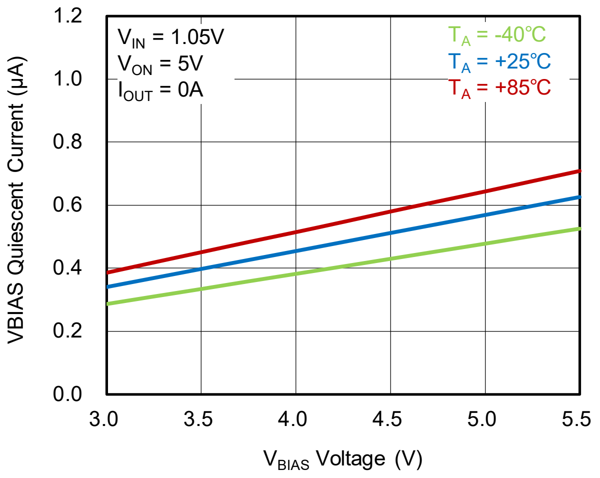


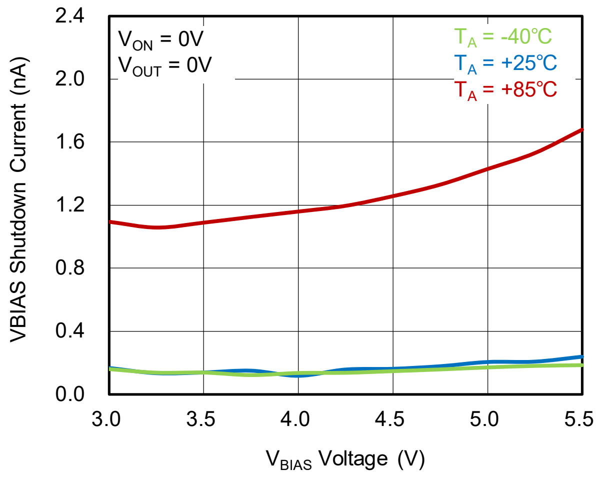

**Figure 4. Timing Waveforms**

## TYPICAL PERFORMANCE CHARACTERISTICS

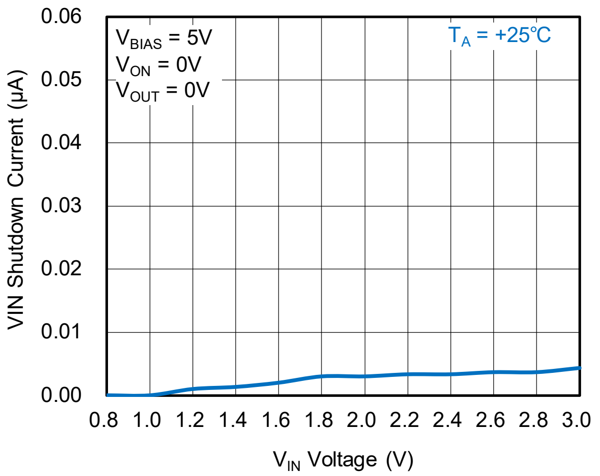
VBIAS Quiescent Current vs. $V_{BIAS}$ Voltage



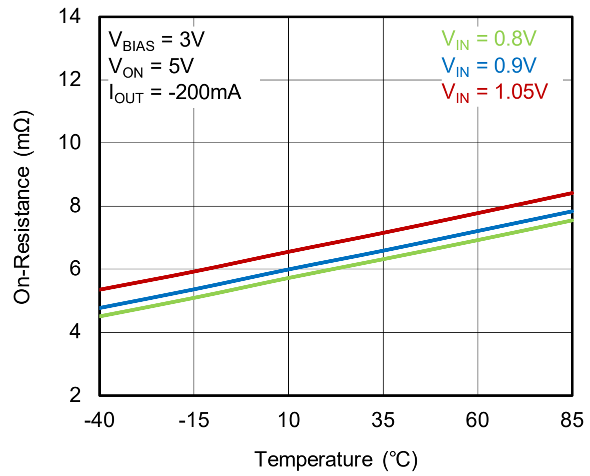

VBIAS Shutdown Current vs. $V_{BIAS}$ Voltage



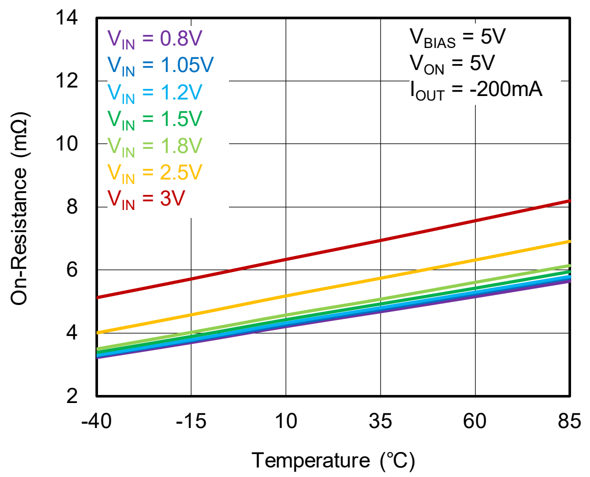

VIN Shutdown Current vs. $V_{IN}$ Voltage



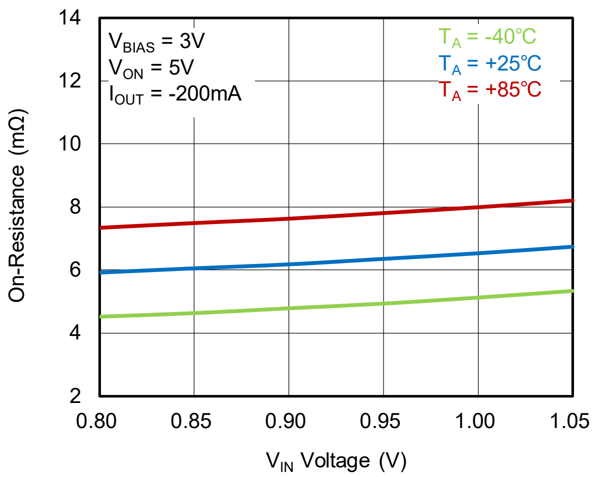

On-Resistance vs. Temperature




On-Resistance vs. Temperature

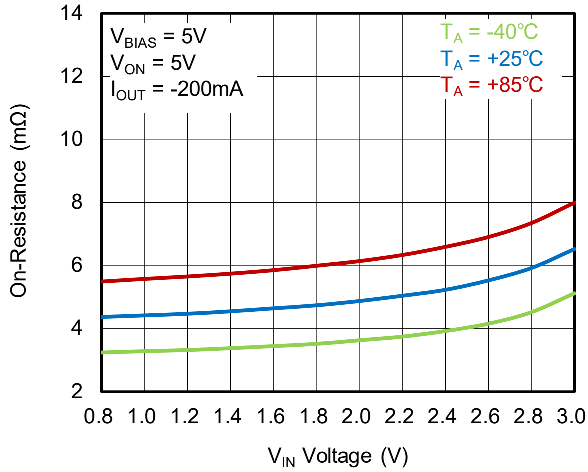



On-Resistance vs. $V_{IN}$ Voltage

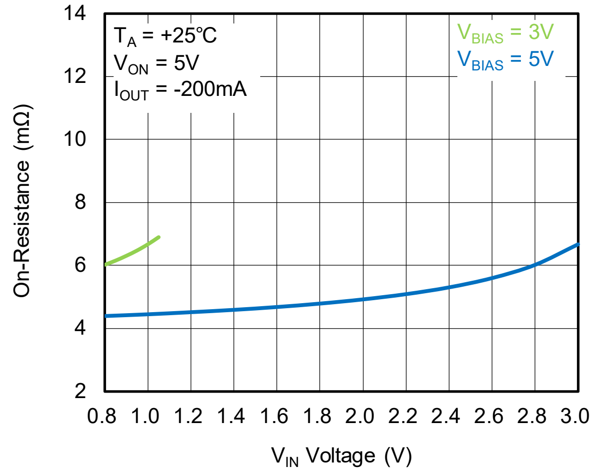


# TYPICAL PERFORMANCE CHARACTERISTICS (continued)

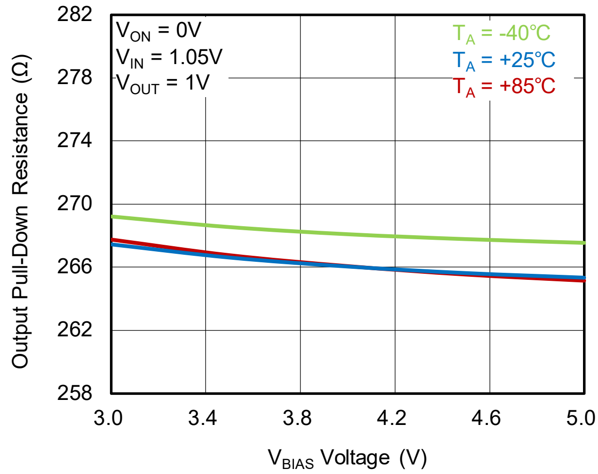
On-Resistance vs. $V_{IN}$ Voltage



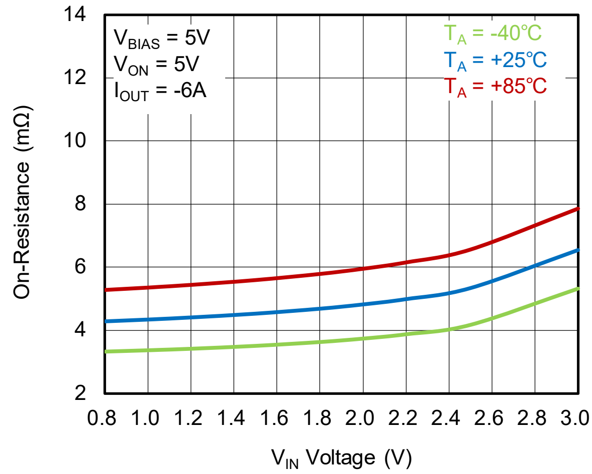

On-Resistance vs. $V_{IN}$ Voltage



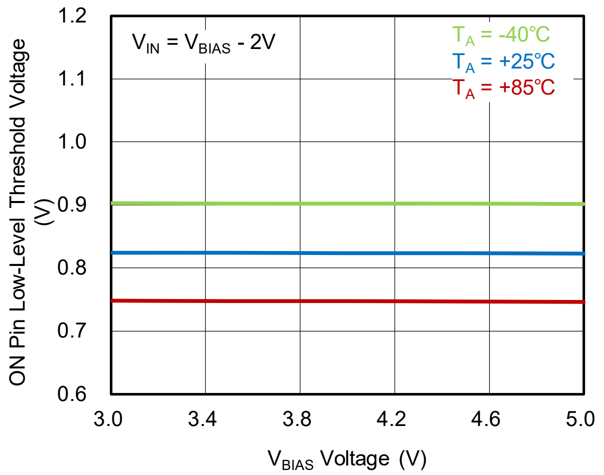

Output Pull-Down Resistance vs. $V_{BIAS}$ Voltage



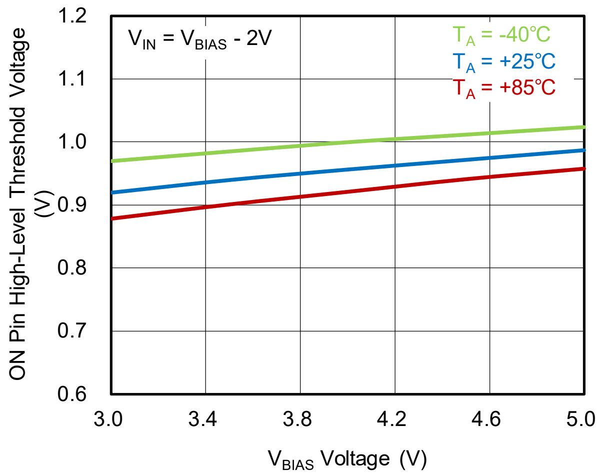

On-Resistance vs. $V_{IN}$ Voltage at 6A Load




ON Pin Low-Level Threshold Voltage vs. $V_{BIAS}$ Voltage

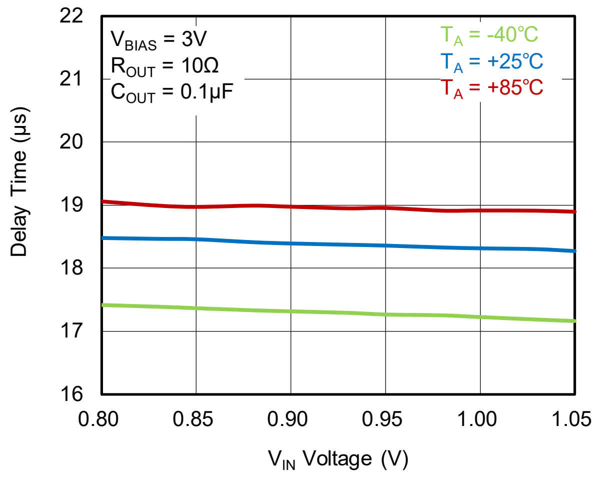



ON Pin High-Level Threshold Voltage vs. $V_{BIAS}$ Voltage

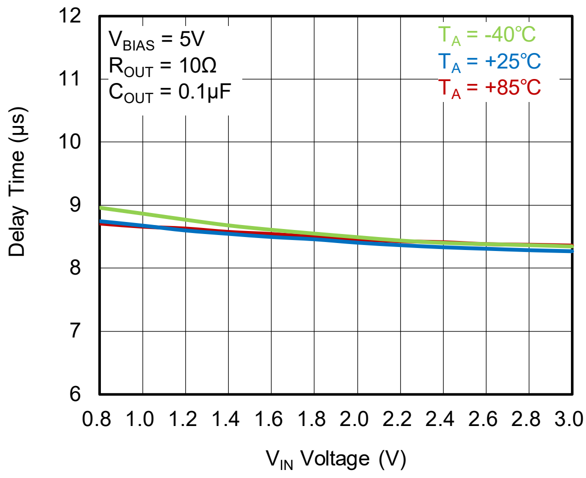


## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

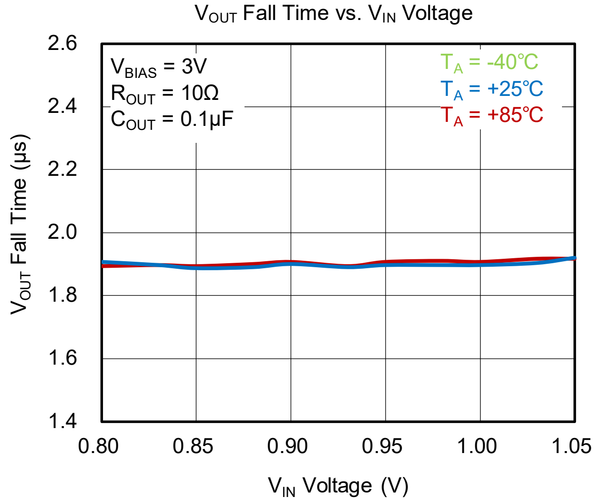
Delay Time vs. $V_{IN}$ Voltage



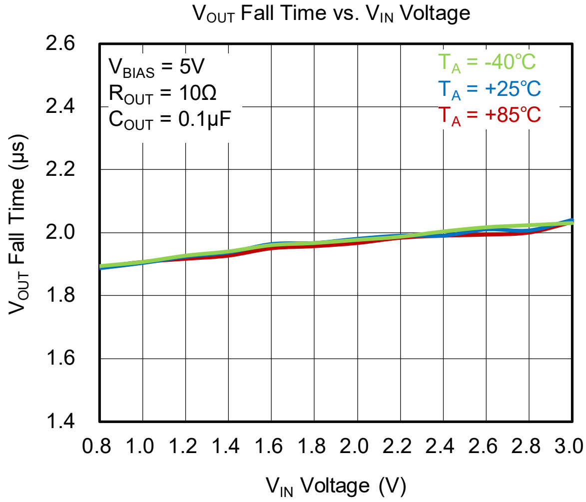

Delay Time vs. $V_{IN}$ Voltage



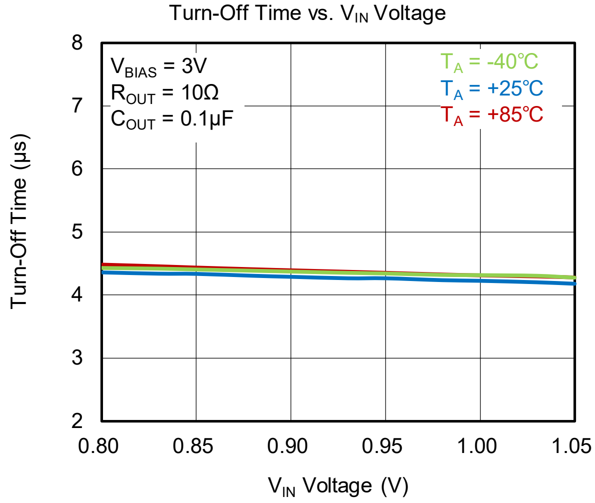

$V_{OUT}$ Fall Time vs. $V_{IN}$ Voltage



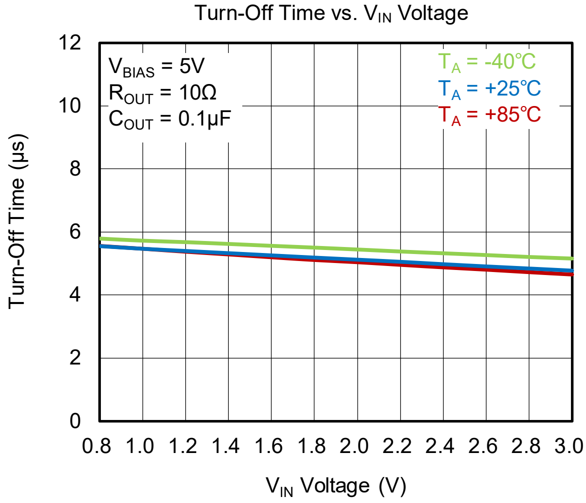

$V_{OUT}$ Fall Time vs. $V_{IN}$ Voltage



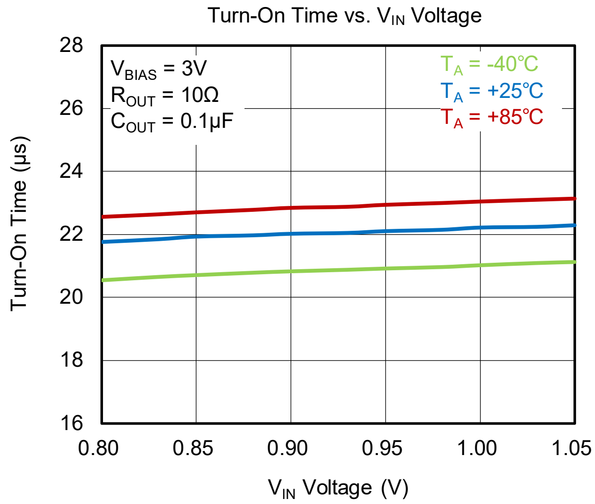

Turn-Off Time vs. $V_{IN}$ Voltage

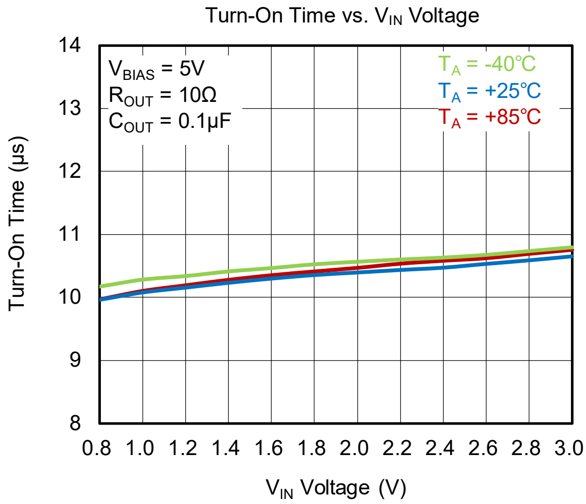


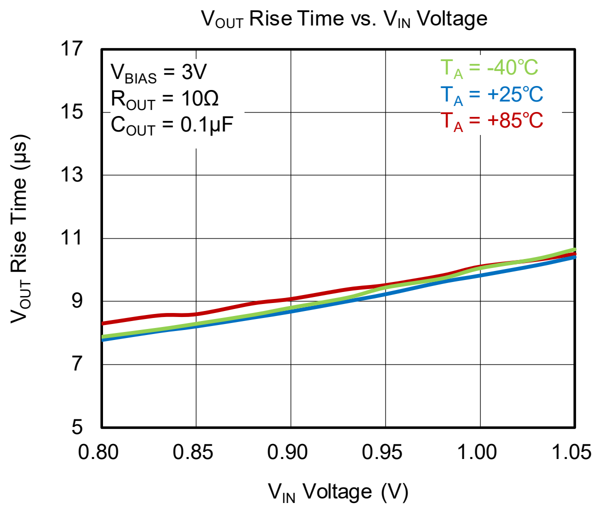

Turn-Off Time vs. $V_{IN}$ Voltage

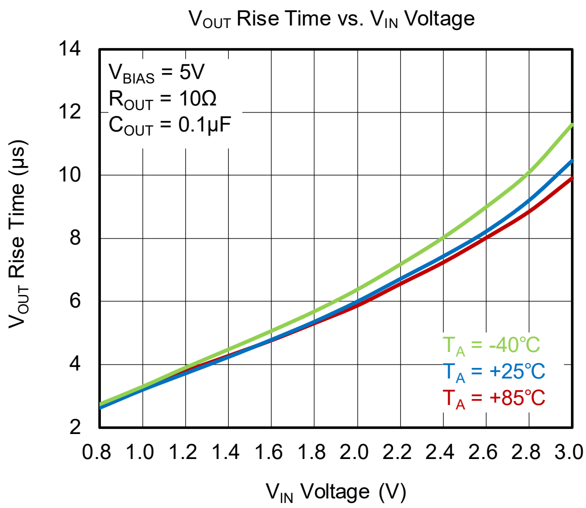


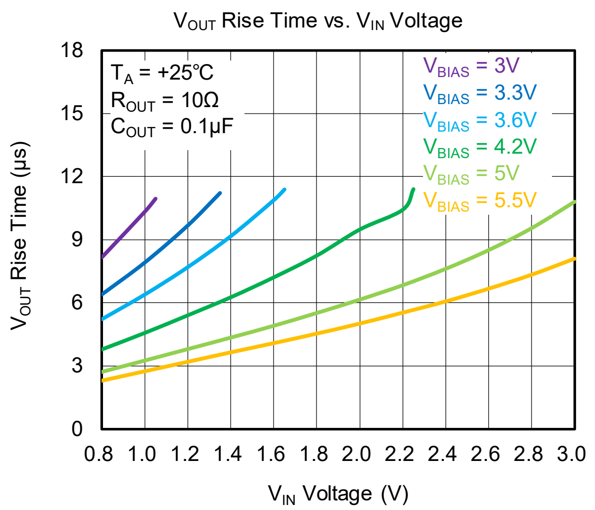
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)



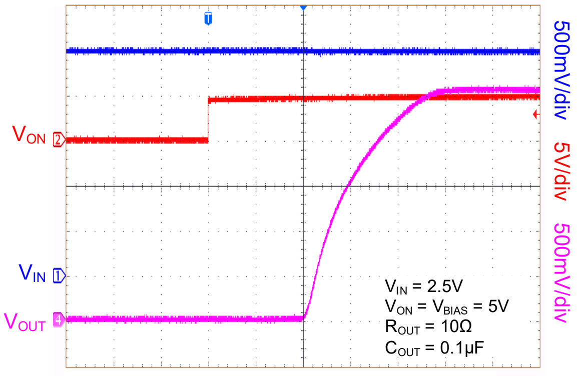



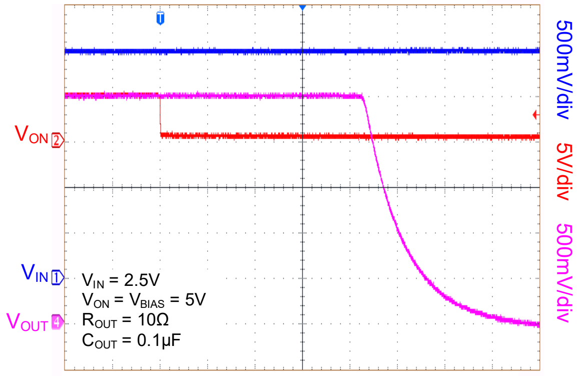
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{OUT}$ Rise Time ($V_{BIAS}$ = 5V)



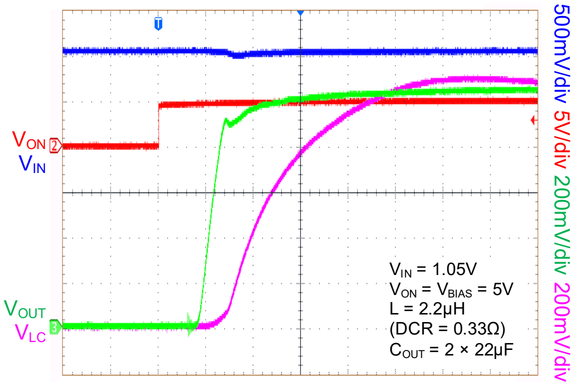

Time (4μs/div)

$V_{OUT}$ Fall Time ($V_{BIAS}$ = 5V)



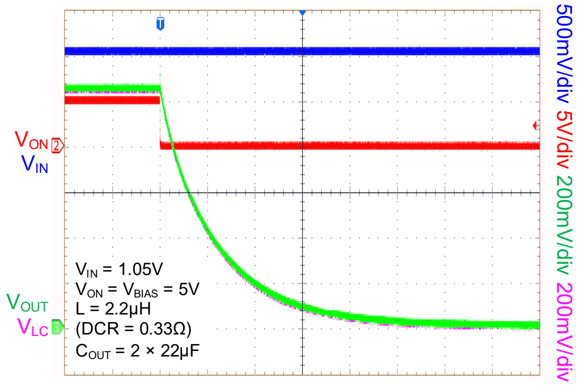

Time (1μs/div)

$V_{OUT}$ Rise Time ($V_{BIAS}$ = 5V)



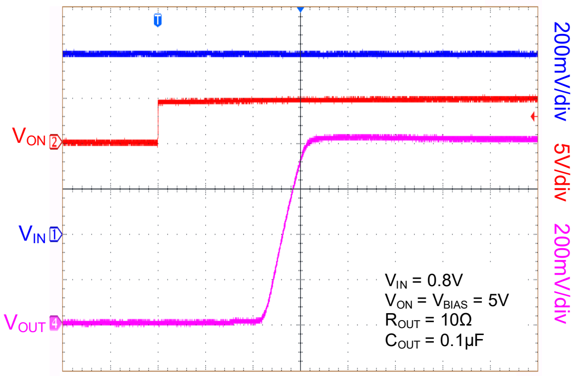

Time (10μs/div)

$V_{OUT}$ Fall Time ($V_{BIAS}$ = 5V)



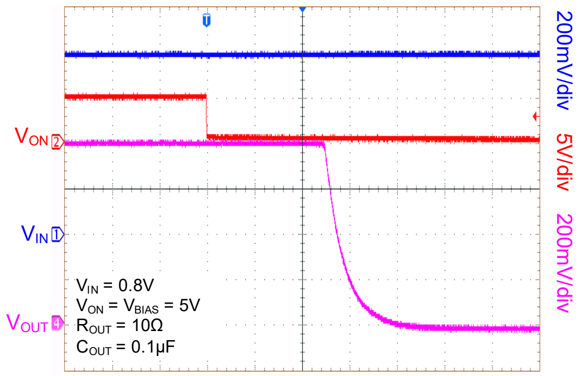

Time (10ms/div)

$V_{OUT}$ Rise Time ($V_{BIAS}$ = 5V)




Time (4μs/div)

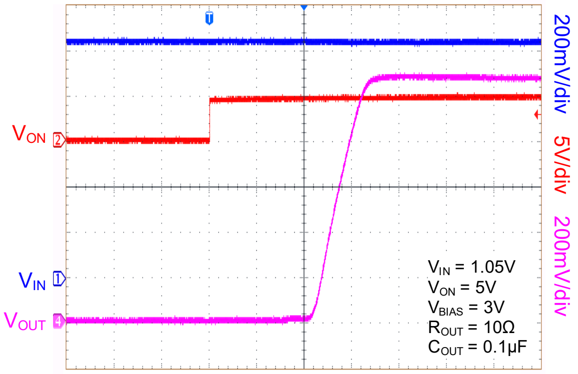
$V_{OUT}$ Fall Time ($V_{BIAS}$ = 5V)




Time (2μs/div)

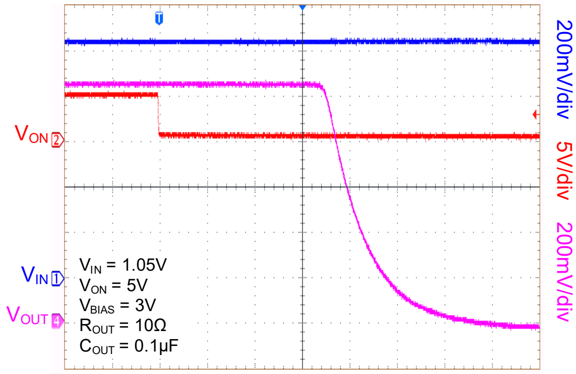
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{OUT}$ Rise Time ($V_{BIAS}$ = 3V)



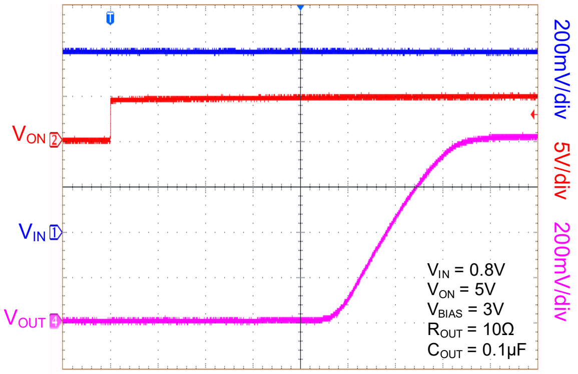

Time (4μs/div)

$V_{OUT}$ Fall Time ($V_{BIAS}$ = 3V)



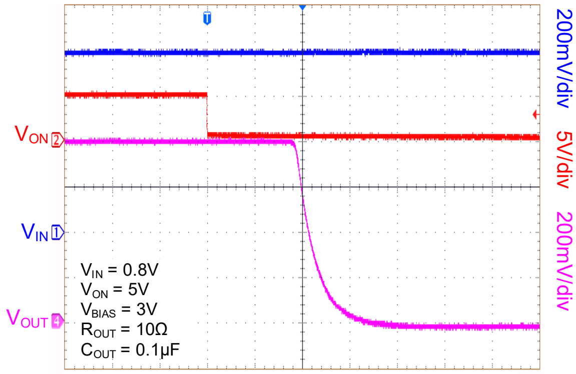

Time (1μs/div)

$V_{OUT}$ Rise Time ($V_{BIAS}$ = 3V)




Time (4μs/div)

$V_{OUT}$ Fall Time ($V_{BIAS}$ = 3V)




Time (2μs/div)

## FUNCTIONAL BLOCK DIAGRAM

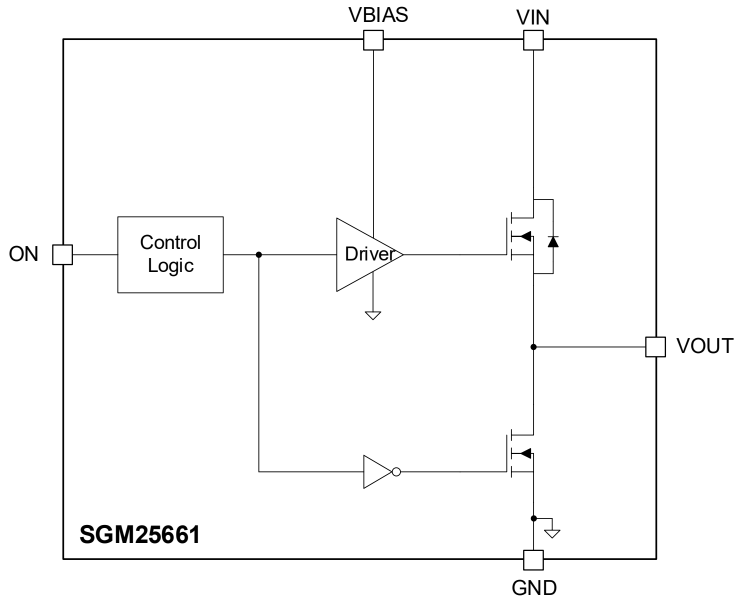



**Figure 5. Block Diagram**

# DETAILED DESCRIPTION

## Overview

The SGM25661 is a 3.5V, 5.3mΩ (TYP) on-resistance, integrated N-MOSFET, single channel load switch. It can support a 6A maximum continuous load current and be enabled by the ON pin. The device has a fixed slew rate (or the soft-start time) of $V_{OUT}$, which can control the inrush current and reduce the voltage drop. The SGM25661 includes internal integrated fast output discharge to remove the remaining charge from the output when the switch is disabled. Once the device is turned off, the leakage current will be very low, thus reducing unnecessary leakage of the downstream modules.

SGM25661 is highly integrated. Using SGM25661 can reduce the PCB area and the BOM count greatly, even the cost.

## On/Off Control

There is a control pin ON to turn on or turn off the corresponding N-MOSFET. When the ON pin is driven high, the switch will be turned on, and when the ON pin is driven low, the switch will be turned off. The ON pin is suitable for standard GPIO logic level threshold, such as 1.2V, 1.8V, 2.5V or 3.3V. The ON pin cannot be left floating and must be connected to either high or low level as requirement.

## Input Capacitor ($C_{IN}$)

Turning on the N-MOSFET to charge load capacitor will generate inrush current, which may cause the $V_{IN}$ drop. In order to prevent the drop, a capacitor must be placed between the VIN and GND pins. Usually, a 1μF input capacitor ($C_{IN}$) placed close to the pins is sufficient. However, higher capacitance values could reduce the voltage drop. So, larger $C_{IN}$ can be used to reduce the voltage drop in high current applications.

## Output Capacitor ($C_{OUT}$)

A 0.1μF output capacitor ($C_{OUT}$) should be placed between the VOUT and GND pins. This capacitor can prevent parasitic board inductance from forcing $V_{OUT}$ below GND when the switch is turned on. It is recommended that $C_{IN}$ should be greater than $C_{OUT}$.

## $V_{IN}$ and $V_{BIAS}$ Voltage Range

It is recommended that $V_{BIAS}$ is greater than ($V_{OUT}$ + 1.95V), otherwise $R_{ON}$ will be much larger than the rated value in the electrical characteristics ($V_{BIAS}$ = 5V table). The device can still be functional if the $V_{BIAS}$ is less than ($V_{OUT}$ + 1.95V), but the increase of $R_{ON}$ may cause the device in an undesirable condition.

In addition, the maximum rated voltage of VIN and VBIAS pins should not be exceeded when $V_{BIAS}$ is greater than ($V_{OUT}$ + 1.95V).

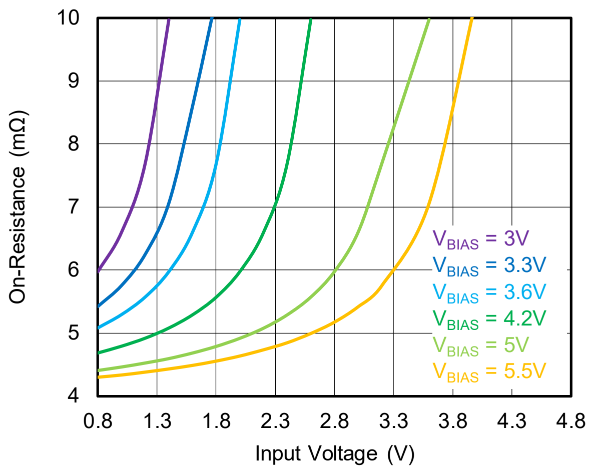



**Figure 6. On-Resistance vs. Input Voltage**

# APPLICATION INFORMATION

## Typical Application Circuit

Figure 7 shows the typical application circuit of SGM25661 as a load switch to power downstream equipment.

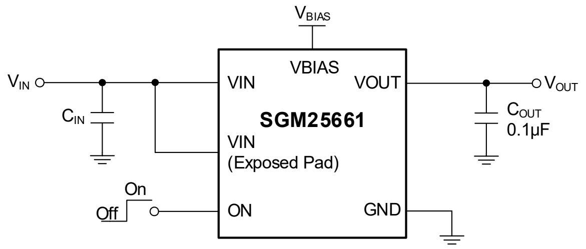



**Figure 7. Typical Application Schematic**

## Design Requirements

In the design example of this part, the specific design parameters are shown in the following table.

**Table 1. Design Parameters**

| Design Parameter | Example Value |
|---|---|
| $V_{IN}$ | 1.05V |
| $V_{BIAS}$ | 5.0V |
| Load Current | 6A |

## Detailed Design Procedure

First, the following three parameters need to be determined by the designer: $V_{IN}$ voltage, $V_{BIAS}$ voltage and load current.

### VIN to VOUT Voltage Drop

The voltage drop between input and output is determined by $R_{ON}$ and load current. $R_{ON}$ is determined by the specific $V_{IN}$ and $V_{BIAS}$ voltage. Therefore, after the above two parameters are determined, the voltage drop between input and output can be calculated by Equation 1:

$$\triangle V = I_{LOAD} \times R_{ON} \quad (1)$$

where $\triangle V$ is the voltage drop from input to output. $I_{LOAD}$ is the load current. $R_{ON}$ is the on-resistance of device determined by $V_{IN}$ and $V_{BIAS}$.

Note that the chosen load current should not exceed the maximum rated value of the load current (6A for the SGM25661).

### Inrush Current

The specific value of inrush current caused by output capacitance $C_{OUT}$ can be calculated by Equation 2:

$$I_{INRUSH} = C_{OUT} \times \frac{dV_{OUT}}{dt} \quad (2)$$

where $I_{INRUSH}$ is the value of inrush current caused by $C_{OUT}$. $C_{OUT}$ is the output capacitance value. $dV_{OUT}$ is the rising change value of $V_{OUT}$ after the device is enabled. dt is the time taken by the device to increase $V_{OUT}$ after the device is enabled.

Note that appropriate $C_{OUT}$ will be chosen to prevent excessive inrush current and exceeding the maximum current rating.

### Thermal Considerations

In order to avoid the maximum junction temperature of the device exceeding +125℃ under normal operation, the maximum power dispersion of the device can be calculated by Equation 3 when the ambient temperature and load current are given.

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{R_{\theta JA}} \quad (3)$$

where $P_{D(MAX)}$ is the maximum power dispersion of the device. $T_{J(MAX)}$ is the maximum junction temperature of the device (+125℃ for the SGM25661). $T_A$ is the ambient temperature. $\theta_{JA}$ is the junction to air thermal impedance which is highly dependent on layout of the board.

# APPLICATION INFORMATION (continued)

## Another Type of Application

Figure 8 shows the application circuit of SGM25661 on the power rail sensitive to ringing and over-voltage caused by fast rising time.

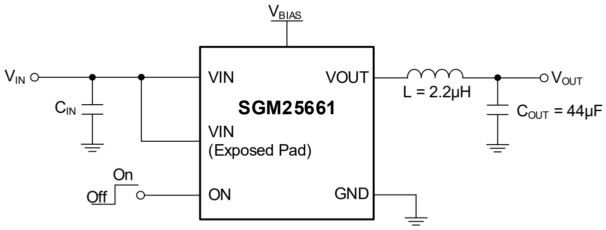



**Figure 8. Typical Application Schematic for Powering Rails Sensitive to Ringing**

## Design Requirements

In the design example of this part, the specific design parameters are shown in the following table.

**Table 2. Design Parameters**

| Design Parameter | Example Value |
|---|---|
| $V_{IN}$ | 1.05V |
| $V_{BIAS}$ | 5.0V |
| Acceptable Percent Overshoot (ρ) | 3.2% |
| Maximum Settling Time ($t_{SETTLE}$) | 40μs |

**Detailed Design Procedure**

First, the following four parameters need to be determined by the designer: $V_{IN}$ voltage, $V_{BIAS}$ voltage, acceptable percent overshoot and maximum allowed settling time for the power rail.

**Selecting Proper Inductor and Capacitor to Meet Voltage Overshoot Requirements**

In order to determine the specific parameters of L and $C_{OUT}$ in the filter circuit, the damping factor determined by the acceptable percent overshoot needs to be calculated by the predecessors. The calculation formula is shown in Equation 4:

$$\varepsilon = \frac{-\ln\rho}{\sqrt{\pi^2 + (\ln\rho)^2}} \quad (4)$$

where ε is the damping factor of the filter. ρ is the acceptable percent overshoot.

Inductance (L), its DCR ($R_{DCR}$) and capacitance ($C_{OUT}$) will affect the damping factor calculated by Equation 4. The specific relationship is shown in Equation 5. Therefore, L and $C_{OUT}$ can determine an optimal parameter combination through multiple iterations. The calculation of filter setting time (< 5% of the steady state value) is shown in Equation 6.

$$\varepsilon = \frac{R_{DCR}}{2} \times \sqrt{\frac{C_{OUT}}{L}} \quad (5)$$

$$t_{SETTLE} \approx \frac{3 \times \sqrt{L \times C_{OUT}}}{\varepsilon} \quad (6)$$

where ε is the damping factor of the filter. $R_{DCR}$ is the DCR of inductor. $C_{OUT}$ is the capacitance of the LC filter. L is the inductance of the LC filter. $t_{SETTLE}$ is the setting time of the LC filter (< 5% of the steady state value).

The damping factor and filter setting time requirements in Table 2 will constrain the parameter selection of L, $R_{DCR}$ and $C_{OUT}$.

## Power Supply Recommendations

The voltage range of $V_{IN}$ and $V_{BIAS}$ in the device is 0.8V to 3.5V and 3V to 5.5V respectively. The power supply voltage should be well regulated and close to SGM25661. If the power supply is more than a few inches from the pin of the device, the additional bulk capacitor needs to be connected in parallel to the ceramic bypass capacitor. An electrolytic, tantalum, or 10μF ceramic capacitor may be sufficient.

## Layout Guidelines

- The main power traces should be as short and wide as possible to accommodate for high current.
- The vias should be used under the exposed pad for better heat dissipation under high current conditions.
- The VIN pin requires a ceramic capacitor with low ESR in parallel for bypass. The recommended bypass capacitor is 1μF ceramic with X5R or X7R dielectric. The bypass capacitor should be placed next to the device pin as close as possible.
- The VOUT pin requires a ceramic capacitor with low ESR in parallel for bypass. The VIN bypass capacitor with X5R or X7R dielectric should be ten times larger than the VOUT bypass capacitor. The bypass capacitor should be placed next to the device pin as close as possible.
- The $V_{BIAS}$ pin requires a ceramic capacitor with low ESR in parallel for bypass. The recommended bypass capacitor is 0.1μF with X5R or X7R dielectric.

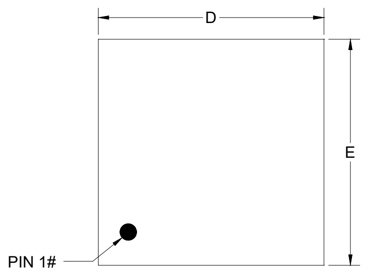
## REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

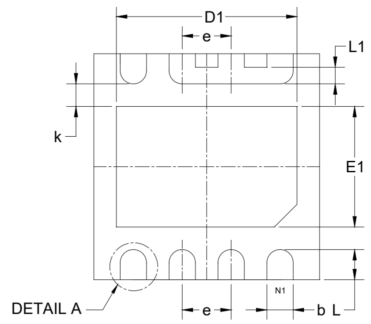
| Changes from Original (DECEMBER 2022) to REV.A | Page |
|---|---|
| Changed from product preview to production data | All |

# PACKAGE OUTLINE DIMENSIONS

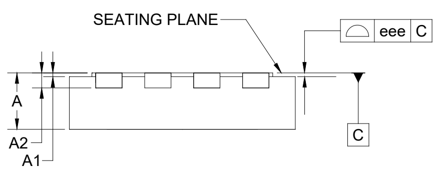
## TDFN-3×3-8EL



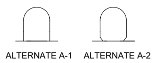

TOP VIEW



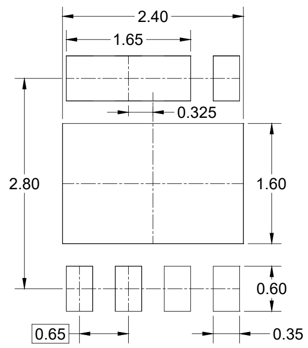

BOTTOM VIEW




SIDE VIEW




DETAIL A
ALTERNATE TERMINAL CONSTRUCTION



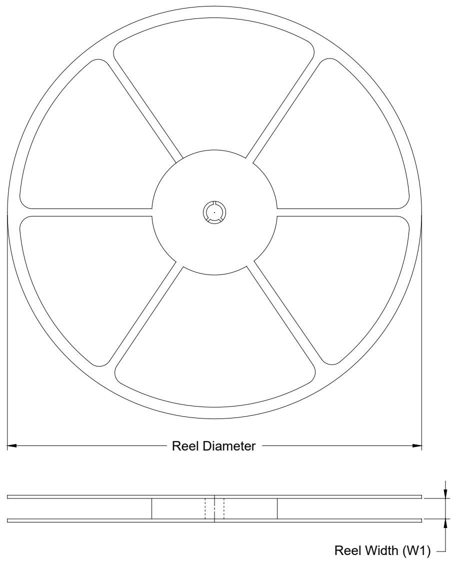

**RECOMMENDED LAND PATTERN** (Unit: mm)

| Symbol | Dimensions In Millimeters | | |
|---|---|---|---|
| | MIN | MOD | MAX |
| A | 0.700 | - | 0.800 |
| A1 | 0.000 | - | 0.050 |
| A2 | 0.200 REF | | |
| b | 0.300 | - | 0.400 |
| D | 2.900 | - | 3.100 |
| E | 2.900 | - | 3.100 |
| D1 | 2.300 | - | 2.500 |
| E1 | 1.500 | - | 1.700 |
| L | 0.300 | - | 0.500 |
| L1 | 0.120 | - | 0.320 |
| e | 0.650 BSC | | |
| k | 0.300 REF | | |
| eee | 0.080 | | |

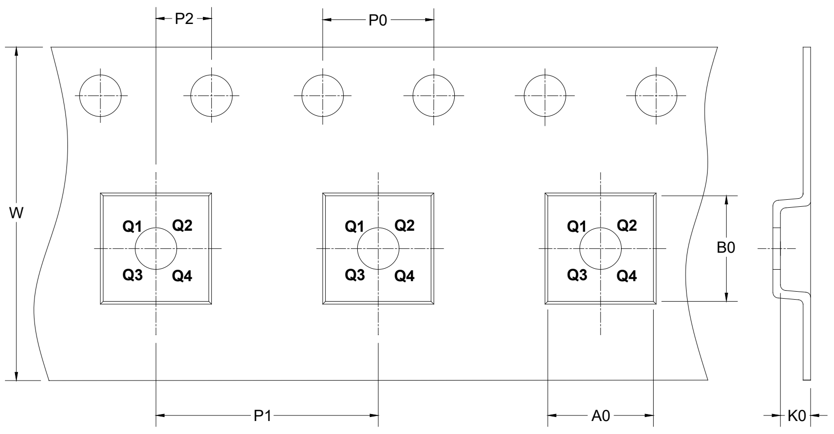
NOTE: This drawing is subject to change without notice.

# TAPE AND REEL INFORMATION

## REEL DIMENSIONS




## TAPE DIMENSIONS



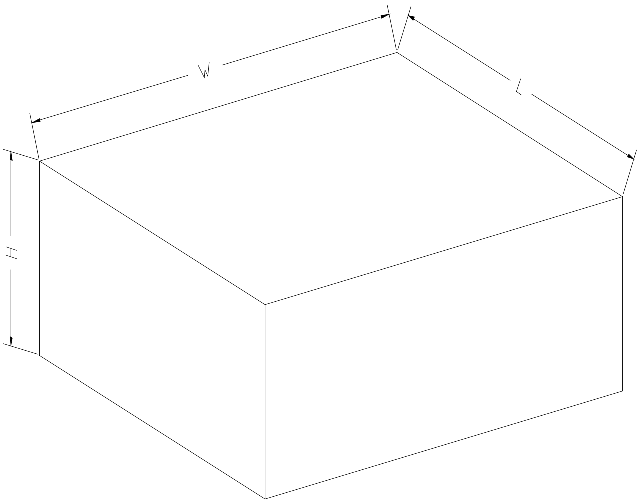

NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF TAPE AND REEL

| Package Type | Reel Diameter | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|
| TDFN-3×3-8EL | 13″ | 12.4 | 3.30 | 3.30 | 1.10 | 4.0 | 8.0 | 2.0 | 12.0 | Q2 |

DD0001

## CARTON BOX DIMENSIONS




NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF CARTON BOX

| Reel Type | Length (mm) | Width (mm) | Height (mm) | Pizza/Carton |
|---|---|---|---|---|
| 13″ | 386 | 280 | 370 | 5 |

DD0002