



SGM8781x-1Q

Automotive, 40V, Rail-to-Rail Input, High Voltage Comparator

GENERAL DESCRIPTION

The SGM8781x-1Q series is a high voltage comparator, featuring rail-to-rail input, push-pull and open-drain outputs, low quiescent current, shutdown capability and fast response. These characteristics make it suitable for voltage sensing tasks such as reverse current protection in smart diode controllers, over-current detection, and over-voltage protection circuits, where its push-pull output can drive the gate of a MOSFET switch.

The SGM8781A-1Q and SGM8781C-1Q have a special push-pull output stage that delivers high peak current. This allows the output to quickly drive the load to either power supply level, which is especially useful for rapidly switching a MOSFET gate on or off to protect a system from unexpected high voltage. The SGM8781A-1Q also has a shutdown capability. With features including low offset voltage, high-Z shutdown, and a power-on reset, the SGM8781A-1Q is a versatile solution for various application fields.

The SGM8781B-1Q has an open-drain output stage. The open collector output can be pulled up to a voltage up to 40V higher than its negative supply rail, independent of its own supply voltage.

The device is AEC-Q100 qualified (Automotive Electronics Council (AEC) standard Q100 Grade 1) and it is suitable for automotive applications.

The SGM8781A-1Q is available in a Green SOT-23-6 package. The SGM8781B-1Q and SGM8781C-1Q are available in a Green SOT-23-5 package. They are specified over the extended -40 °C to +125 °C temperature range.

FEATURES

- **AEC-Q100 Qualified for Automotive Applications**
Device Temperature Grade 1
 $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$
- **Wide Supply Range: 3.3V to 40V**
- **Low Quiescent Current: 115 μ A (TYP)**
- **Rail-to-Rail Input with Phase Reversal Protection**
- **Output Structure:**
 - ♦ **High Peak Current Push-Pull Output:**
SGM8781A-1Q and SGM8781C-1Q
 - ♦ **Open-Drain Output: SGM8781B-1Q**
- **Low Input Offset Voltage: $\pm 2.5\text{mV}$ (MAX)**
- **Internal Hysteresis: 14mV**
- **Propagation Delay: 200ns**
- **Shutdown Capability with High-Impedance Output (SGM8781A-1Q)**
- **Power-On-Reset**
- **Small Packaging:**
SGM8781A-1Q Available in a Green SOT-23-6 Package
SGM8781B-1Q Available in a Green SOT-23-5 Package
SGM8781C-1Q Available in a Green SOT-23-5 Package

APPLICATIONS

Automotive Power Systems
Smart Diode Controllers
OR-ing MOSFET Controllers
Industrial Equipment
Medical Equipment
Telecom Equipment

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE TOP MARKING	PACKING OPTION
SGM8781A-1Q (Push-Pull)	SOT-23-6	-40°C to +125°C	SGM8781A-1QN6G/TR	XXXXYY 2BF	Tape and Reel, 3000
SGM8781B-1Q (Open-Drain)	SOT-23-5	-40°C to +125°C	SGM8781B-1QN5G/TR	2SH XXXXYY	Tape and Reel, 3000
SGM8781C-1Q (Push-Pull)	SOT-23-5	-40°C to +125°C	SGM8781C-1QN5G/TR	2BT XXXXYY	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXX = Date Code and Trace Code.

SOT-23-6

XXXYY
 YYY

Date Code - Year
 Trace Code
 Lot Number
 Serial Number

SOT-23-5

YYY
 XXXYY

Serial Number
 Lot Number
 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

Supply Voltage Range, $+V_S$ to $-V_S$	-0.3V to 42V
Input Pins (+IN, -IN) ⁽¹⁾	$(-V_S) - 0.3V$ to $(+V_S) + 0.3V$
Shutdown Pin (SHDN) (SGM8781A-1Q) ⁽²⁾	
	$(-V_S) - 0.3V$ to $(-V_S) + 5.5V$
Current into Input Pins (+IN, -IN, SHDN) ⁽¹⁾	$\pm 10mA$
Output (OUT)	
SGM8781A/C-1Q	$(-V_S) - 0.3V$ to $(+V_S) + 0.3V$
SGM8781B-1Q	$(-V_S) - 0.3V$ to $(-V_S) + 42V$
Package Thermal Resistance	
SOT-23-6, θ_{JA} (SGM8781A-1Q)	152.4°C/W
SOT-23-6, θ_{JB} (SGM8781A-1Q)	40.7°C/W
SOT-23-5, θ_{JA} (SGM8781B-1Q)	153.2°C/W
SOT-23-5, θ_{JB} (SGM8781B-1Q)	32.8°C/W
SOT-23-5, θ_{JA} (SGM8781C-1Q)	150.4°C/W
SOT-23-5, θ_{JB} (SGM8781C-1Q)	30.9°C/W
Junction Temperature	+150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10s)	+260°C
ESD Susceptibility ^{(3) (4)}	
HBM (SGM8781A/C-1Q)	$\pm 8000V$
HBM (SGM8781B-1Q)	$\pm 5000V$
CDM	$\pm 1000V$

NOTES:

1. Clamping diodes are added between the input terminal pins and power supply rails. So voltage at input pins can swing more than 0.3V beyond the supply rails, and the current of the input signal should be limited within the range of 10mA.
2. A clamping diode is added between the input Shutdown pin and negative power supply. So voltage at input pins can be $(-V_S) - 0.3V$, and the current of the input signal should be limited within the range of 10mA.
3. For human body model (HBM), all pins comply with AEC-Q100-002 specification.
4. For charged device model (CDM), all pins comply with AEC-Q100-011 specification.

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range, $+V_S$ to $-V_S$	3.3V to 40V
Operating Temperature Range	-40°C to +125°C

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.

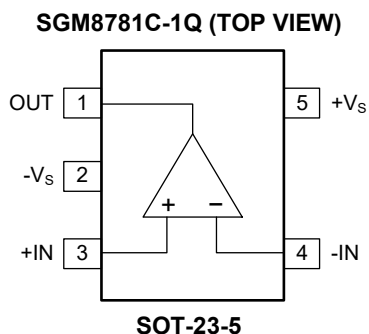
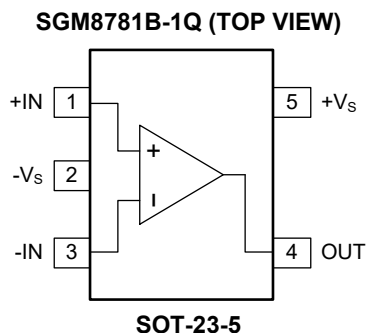
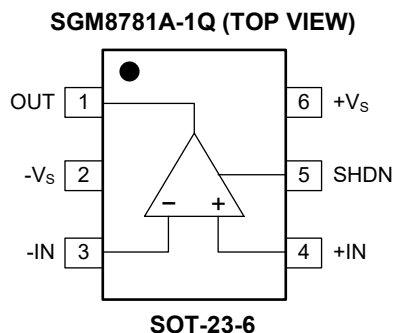
ESD SENSITIVITY CAUTION

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 CONFIGURATIONS



PIN DESCRIPTION

PIN			NAME	TYPE	FUNCTION
SOT-23-6 (SGM8781A-1Q)	SOT-23-5 (SGM8781B-1Q)	SOT-23-5 (SGM8781C-1Q)			
1	4	1	OUT	O	Output.
2	2	2	-Vs	P	Negative (Lowest) Power Supply.
3	3	4	-IN	I	Inverting Input.
4	1	3	+IN	I	Non-Inverting Input.
5	—	—	SHDN	I	Shutdown (Active High).
6	5	5	+Vs	P	Positive (Highest) Power Supply.

NOTE: I = input, O = output, P = power.

ELECTRICAL CHARACTERISTICS

($V_S = 3.3V$ to $40V$, $V_S = V_P$, $R_P = 5.1k\Omega$, $C_L = 15pF$, Full = $-40^\circ C$ to $+125^\circ C$, typical values are measured at $V_S = 12V$, $V_{CM} = V_S/2$, and $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input Offset Voltage	V_{OS}	$V_S = 3.3V, 12V$ and $40V$	$+25^\circ C$		± 0.4	± 2.5	mV
			Full			± 3	
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		Full		± 1.5		$\mu V/^\circ C$
Input Bias Current	I_B		Full		± 0.01	± 22	nA
Input Offset Current	I_{OS}		Full		± 0.01	± 15	nA
Input Common Mode Voltage Range	V_{CM}		Full	$(-V_S) - 0.2$		$(+V_S) + 0.2$	V
Common Mode Rejection Ratio	CMRR	$V_S = 3.3V, (-V_S) < V_{CM} < (+V_S)$	$+25^\circ C$	83	96		dB
			Full	80			
		$V_S = 40V, (-V_S) < V_{CM} < (+V_S)$	$+25^\circ C$	92	105		
			Full	89			
Power Supply Rejection Ratio	PSRR	$V_{CM} = -V_S$	$+25^\circ C$	92	105		dB
			Full	89			
Input Hysteresis Voltage	V_{HYST}		$+25^\circ C$		14		mV
Output Voltage Swing from $-V_S$	V_{OL}	Input overdrive = $-100mV$, $I_{SINK} \leq 5mA$	Full		110	200	mV
Output Voltage Swing from $+V_S$ (for SGM8781A-1Q and SGM8781C-1Q Only)	V_{OH}	Input overdrive = $+100mV$, $I_{SOURCE} \leq 5mA$	Full		125	220	mV
Output Leakage Current (for SGM8781B-1Q Only)	I_{OH}	Input overdrive = $+100mV$, $V_{OUT} \leq 40V$	$+25^\circ C$		± 5	± 20	nA
			Full			± 60	
Peak Charging Current (Sourcing) with Output Shorted to $-V_S$ ⁽¹⁾ (for SGM8781A-1Q and SGM8781C-1Q Only)	I_{SOURCE}	$V_S = 5V$ to $40V$	$+25^\circ C$		140		mA
Peak Dis-Charging Current (Sinking) with Output Shorted to $+V_S$ ⁽¹⁾	I_{SINK}	$V_S = 5V$ to $40V$	$+25^\circ C$		115		mA
Quiescent Current	I_Q	$V_{ID} = -0.1V$ (output low), no load	$+25^\circ C$		115	150	μA
			Full			165	

NOTE:

1. When a short-circuit occurs continuously, it can lead to overheating and cause the junction temperature exceed its maximum permissible limit of $+150^\circ C$.

ELECTRICAL CHARACTERISTICS (continued)

($V_S = 3.3V$ to $40V$, $V_S = V_P$, $R_P = 5.1k\Omega$, $C_L = 15pF$, Full = $-40^\circ C$ to $+125^\circ C$, typical values are measured at $V_S = 12V$, $V_{CM} = V_S/2$, and $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Shutdown (For SGM8781A-1Q Only)							
Time to Enter Shutdown	t_{OFF}	$R_L = 10k\Omega$, $C_L = 15pF$	$+25^\circ C$		0.3		μs
Time to Exit Shutdown	t_{ON}	$R_L = 10k\Omega$, $C_L = 15pF$	$+25^\circ C$		2.6		μs
Shutdown Input Voltage Range ⁽²⁾	V_{SD}		$+25^\circ C$	0		5.5	V
SHDN Pin Input High Level	V_{SD_VIH}	$V_S = 3.3V$ and $40V$	Full	2			V
SHDN Pin Input Low Level	V_{SD_VIL}	$V_S = 3.3V$ and $40V$	Full			0.4	V
SHDN Pin Input Bias Current	I_{B_SD}	$V_S = V_{SD} = 5.5V$	$+25^\circ C$		± 0.5	± 15	nA
			Full			± 30	
		$V_S = 5V$, $V_{SD} = 0V$	$+25^\circ C$		± 0.3	± 12	
			Full			± 25	
Shutdown Supply Current	I_{Q_SD}	$V_S = 12V$, $V_{SD} > V_{SD_VIH\ MIN}$	$+25^\circ C$		9.5	13	μA
		$V_S = 3.3V$ to $40V$, $V_{SD} > V_{SD_VIH\ MIN}$	$+25^\circ C$		10.5	14	
			Full			20	

NOTE:

2. Shutdown input voltage range is defined as the recommended voltage range that the shutdown input should operate within when the V_{SD} operates independently of the V_S .

SWITCHING CHARACTERISTICS (SGM8781A/C-1Q)(V_S = 3.3V, V_{CM} = V_S/2, input overdrive = 100mV, typical values are measured at T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Propagation Delay Time, High-to-Low ⁽¹⁾	t _{PHL}	C _L = 15pF	+25°C		270		ns
		C _L = 4nF	+25°C		450		
Propagation Delay Time, Low-to-High ⁽¹⁾	t _{PLH}	C _L = 15pF	+25°C		330		ns
		C _L = 4nF	+25°C		530		
Rise Time	t _R	20% to 80%, C _L = 15pF	+25°C		45		ns
		20% to 80%, C _L = 4nF	+25°C		0.26		μs
Fall Time	t _F	80% to 20%, C _L = 15pF	+25°C		60		ns
		80% to 20%, C _L = 4nF	+25°C		0.23		μs
Power-Up Time ⁽²⁾	t _{UP}		+25°C		52		μs

(V_S = 40V, V_{CM} = V_S/2, input overdrive = 100mV, typical values are measured at T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Propagation Delay Time, High-to-Low ⁽¹⁾	t _{PHL}	C _L = 15pF	+25°C		200		ns
		C _L = 4nF	+25°C		1000		
Propagation Delay Time, Low-to-High ⁽¹⁾	t _{PLH}	C _L = 15pF	+25°C		220		ns
		C _L = 4nF	+25°C		930		
Rise Time	t _R	20% to 80%, C _L = 15pF	+25°C		24		ns
		20% to 80%, C _L = 4nF	+25°C		0.9		μs
Fall Time	t _F	80% to 20%, C _L = 15pF	+25°C		30		ns
		80% to 20%, C _L = 4nF	+25°C		1		μs
Power-Up Time ⁽²⁾	t _{UP}		+25°C		45		μs

NOTES:

1. The terms "high-to-low" and "low-to-high" denote the transition occurring at the input terminal.
2. When powering up, ensure that V_S is above 3.3V for a certain duration (t_{UP}) before the output enters a proper state.

SWITCHING CHARACTERISTICS (SGM8781B-1Q)

($V_S = 3.3V$, $V_{CM} = V_S/2$, input overdrive = 100mV, $V_S = V_P$, $R_P = 5.1k\Omega$, $C_L = 15pF$, typical values are measured at $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Propagation Delay Time, High-to-Low ⁽¹⁾	t_{PHL}	$C_L = 15pF$	$+25^\circ C$		270		ns
		$C_L = 4nF$	$+25^\circ C$		450		
Propagation Delay Time, Low-to-High ⁽¹⁾	t_{PLH}	$C_L = 15pF$	$+25^\circ C$		290		ns
		$C_L = 4nF$	$+25^\circ C$		16		μs
Rise Time	t_R	20% to 80%, $C_L = 15pF$	$+25^\circ C$		200		ns
		20% to 80%, $C_L = 4nF$	$+25^\circ C$		30		μs
Fall Time	t_F	80% to 20%, $C_L = 15pF$	$+25^\circ C$		60		ns
		80% to 20%, $C_L = 4nF$	$+25^\circ C$		0.23		μs
Power-Up Time ⁽²⁾	t_{UP}		$+25^\circ C$		52		μs

($V_S = 40V$, $V_{CM} = V_S/2$, input overdrive = 100mV, $V_S = V_P$, $R_P = 5.1k\Omega$, $C_L = 15pF$, typical values are measured at $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Propagation Delay Time, High-to-Low ⁽¹⁾	t_{PHL}	$C_L = 15pF$	$+25^\circ C$		200		ns
		$C_L = 4nF$	$+25^\circ C$		1000		
Propagation Delay Time, Low-to-High ⁽¹⁾	t_{PLH}	$C_L = 15pF$	$+25^\circ C$		230		ns
		$C_L = 4nF$	$+25^\circ C$		16		μs
Rise Time	t_R	20% to 80%, $C_L = 15pF$	$+25^\circ C$		160		ns
		20% to 80%, $C_L = 4nF$	$+25^\circ C$		30		μs
Fall Time	t_F	80% to 20%, $C_L = 15pF$	$+25^\circ C$		30		ns
		80% to 20%, $C_L = 4nF$	$+25^\circ C$		1		μs
Power-Up Time ⁽²⁾	t_{UP}		$+25^\circ C$		45		μs

NOTES:

1. The terms "high-to-low" and "low-to-high" denote the transition occurring at the input terminal.
2. When powering up, ensure that V_S is above 3.3V for a certain duration (t_{UP}) before the output enters a proper state.

TIMING DIAGRAM

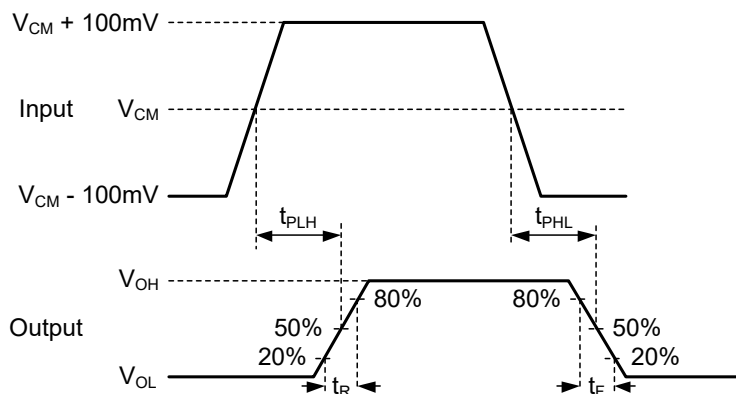


Figure 1. Propagation Delay Timing Diagram

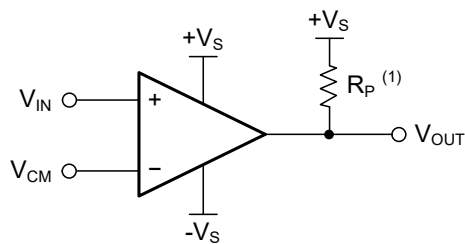
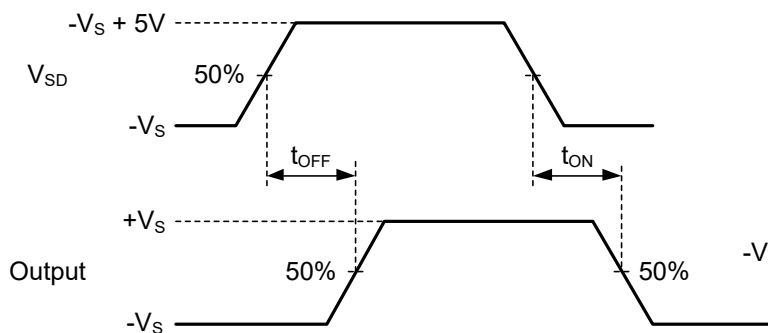
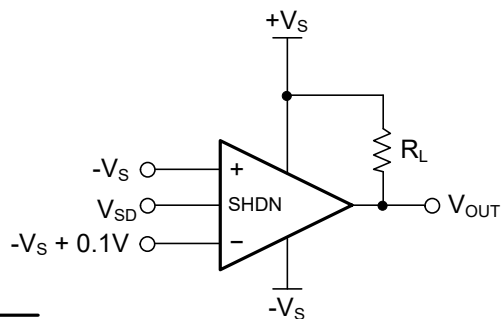
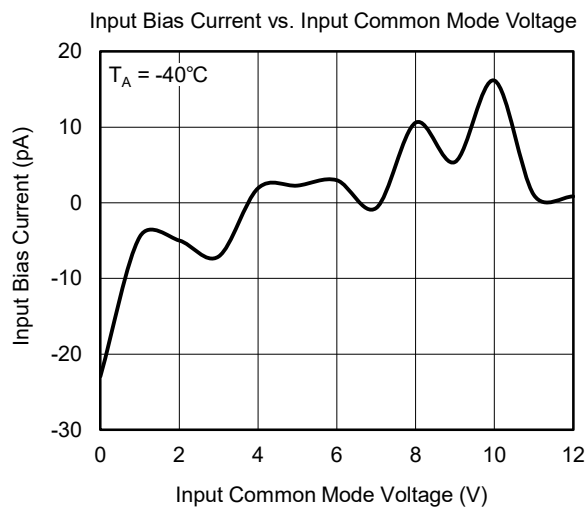
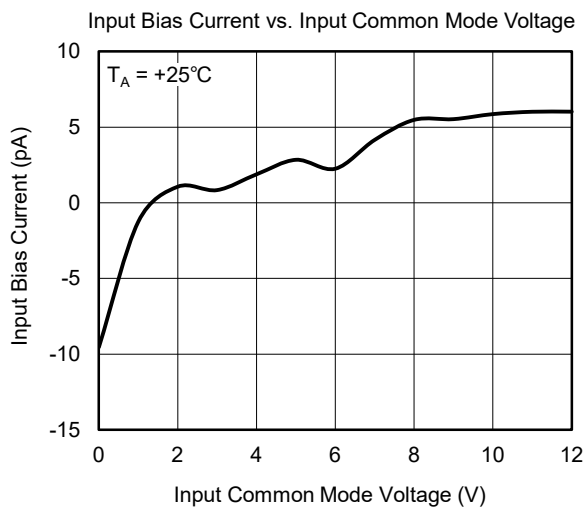
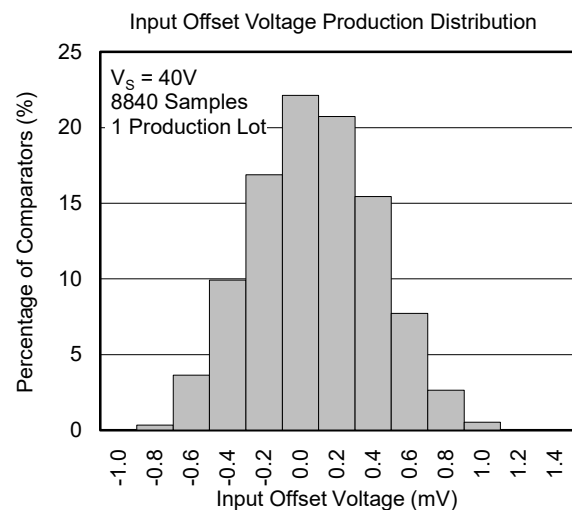
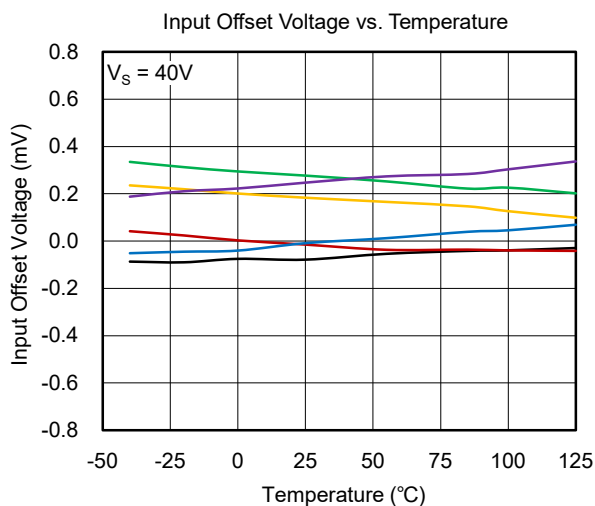
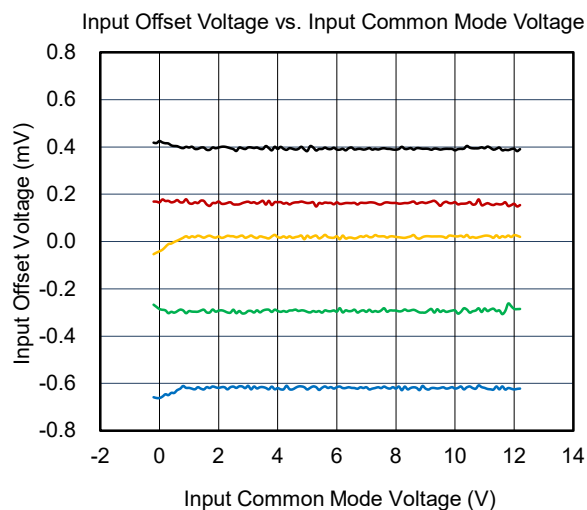
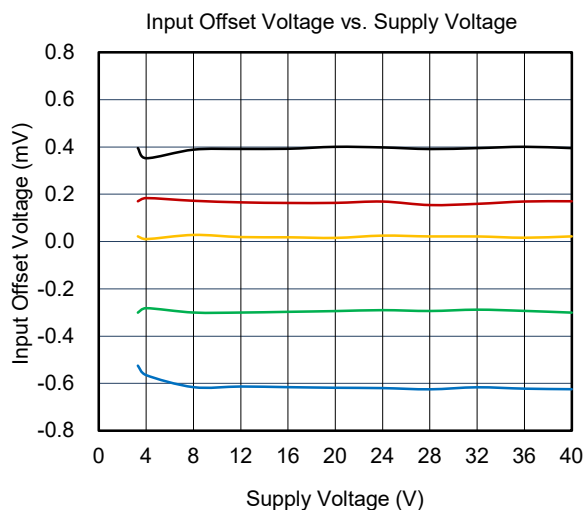
NOTE: 1. R_P only for SGM8781B-1Q.

Figure 2. SGM8781A-1Q Shutdown Timing Diagram



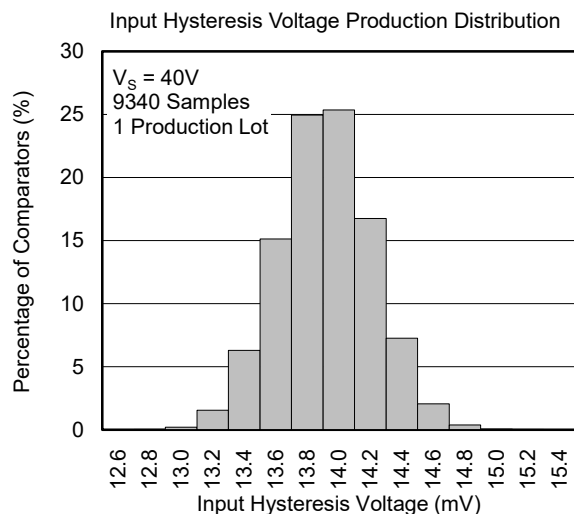
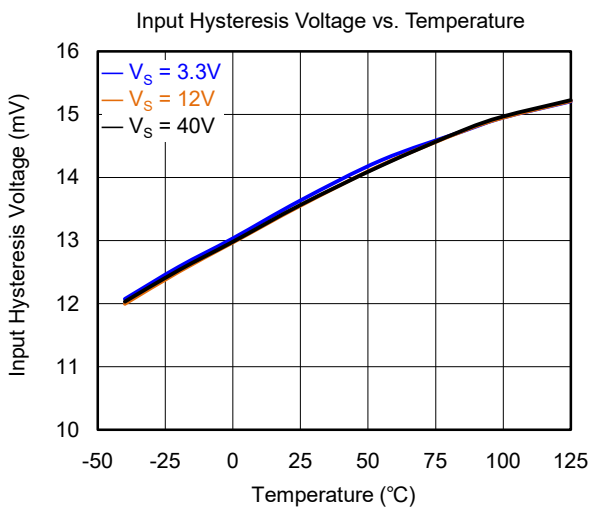
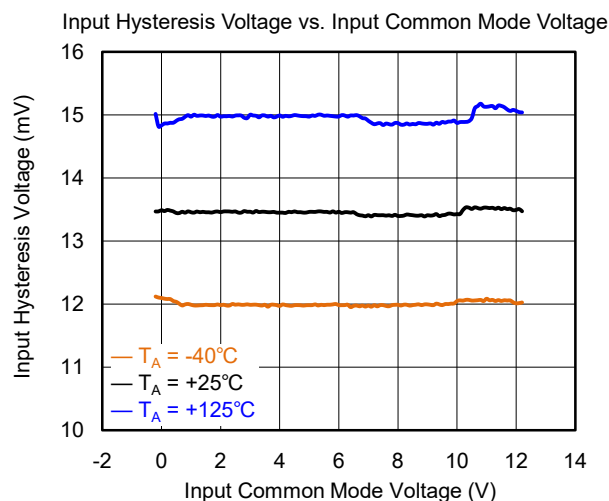
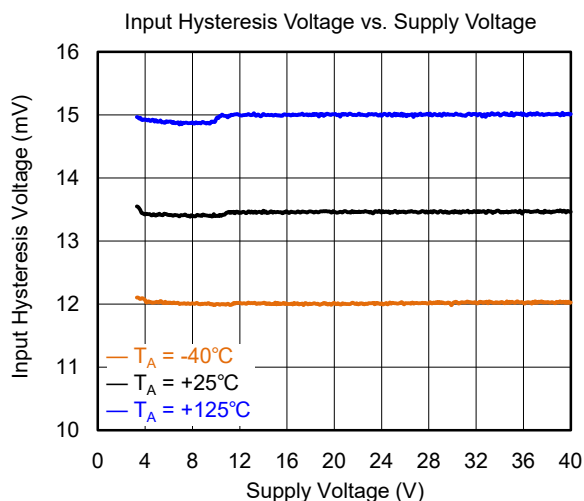
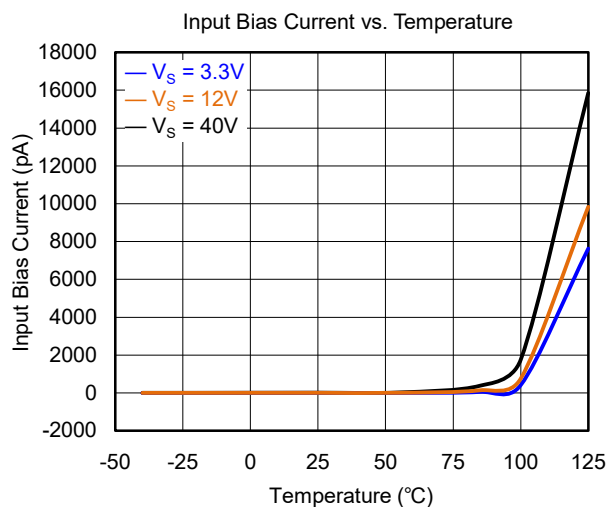
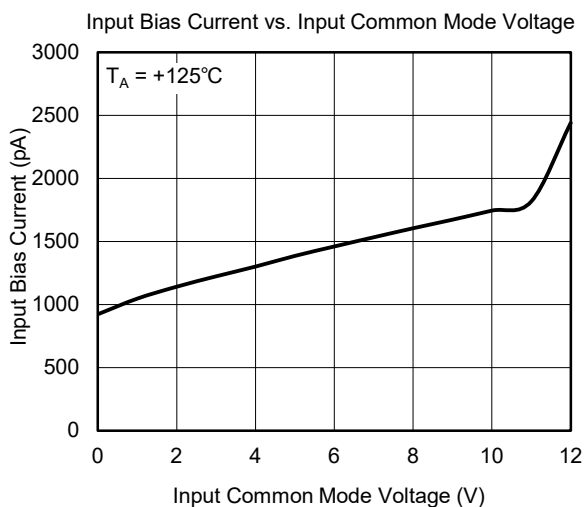
TYPICAL PERFORMANCE CHARACTERISTICS

At $T_A = +25^\circ\text{C}$, $V_S = 12\text{V}$, $V_{CM} = V_S/2$, and input overdrive = 100mV, unless otherwise noted.



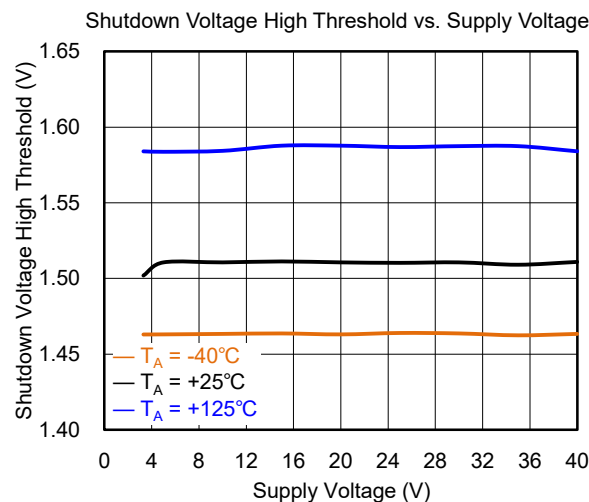
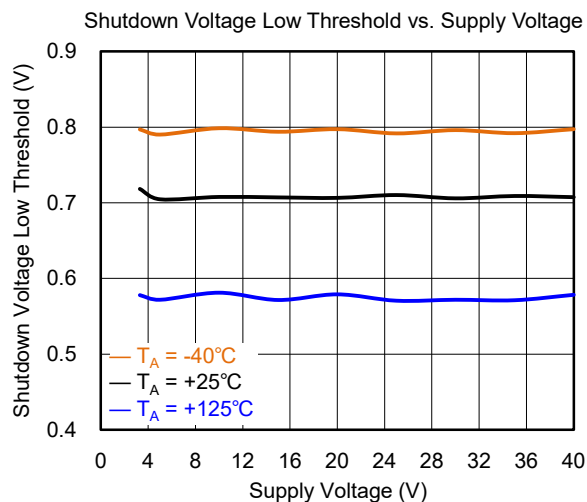
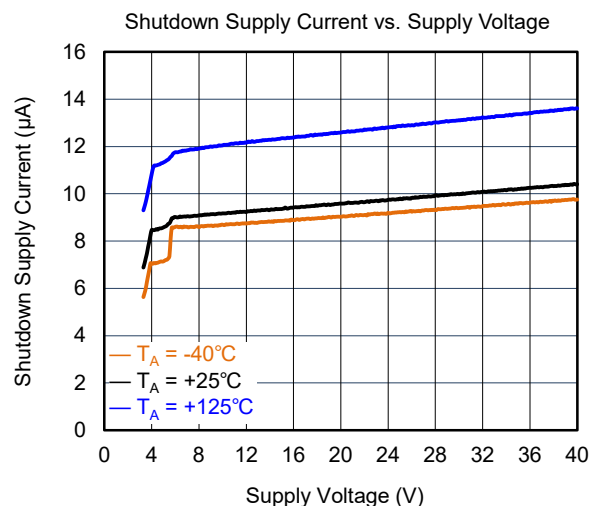
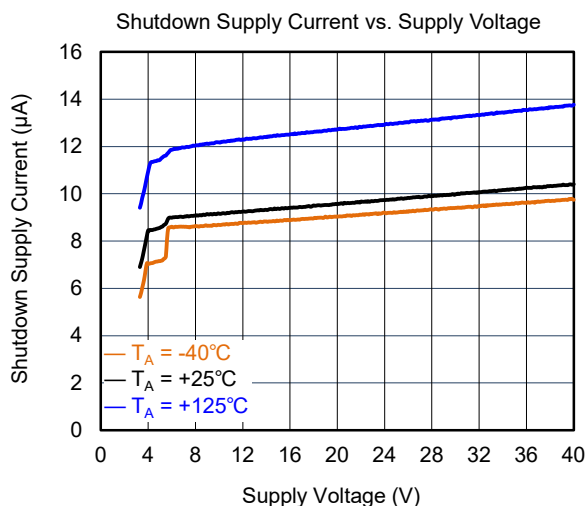
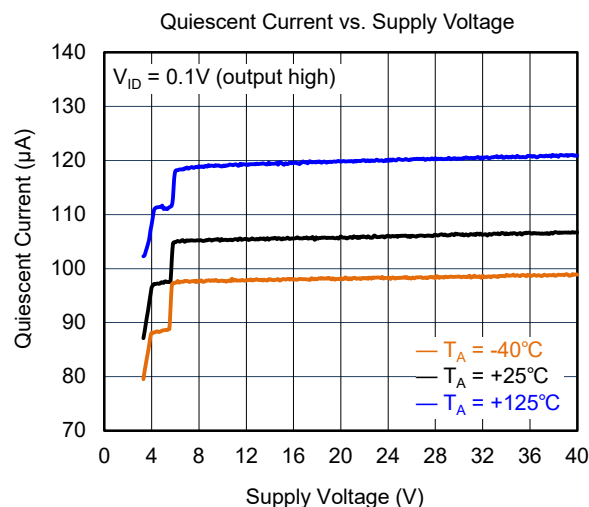
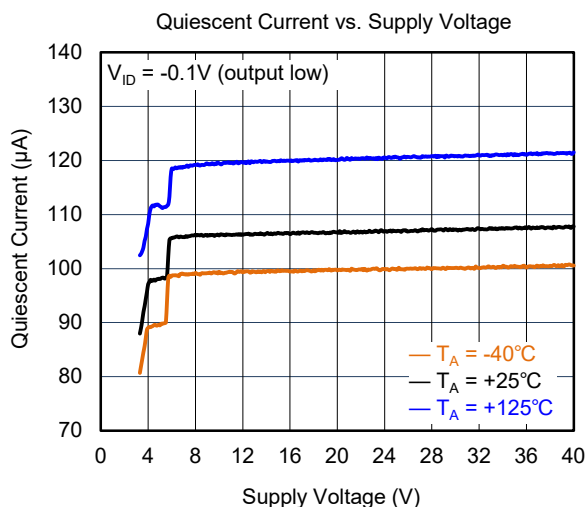
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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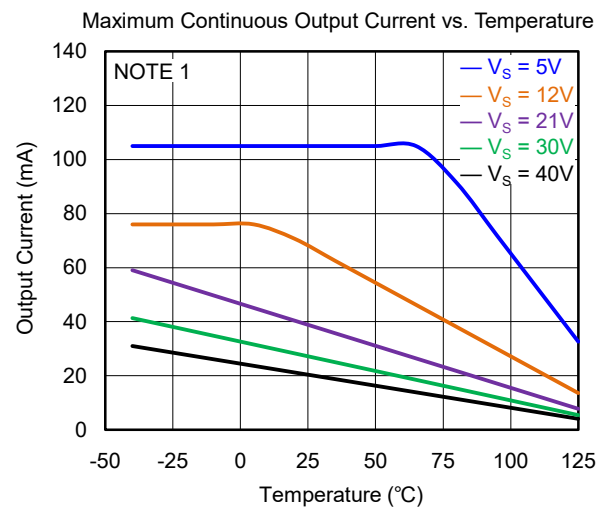
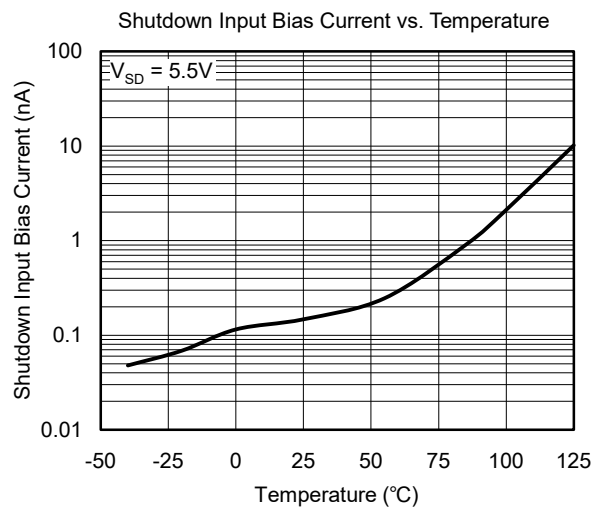
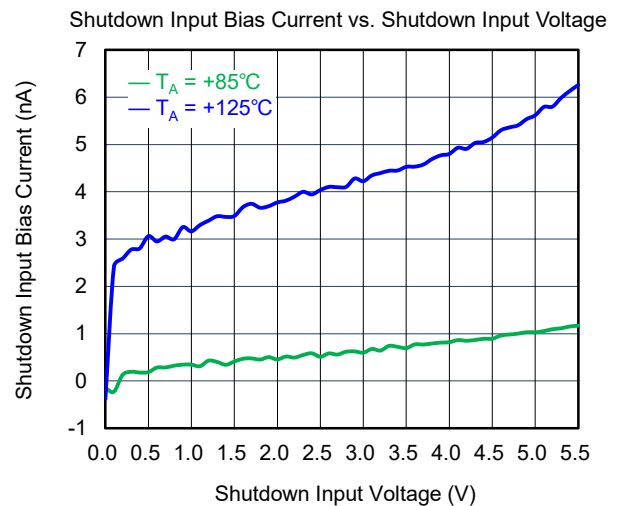
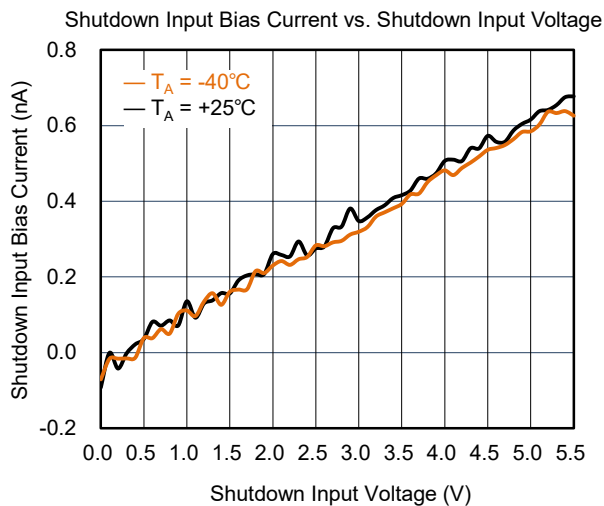
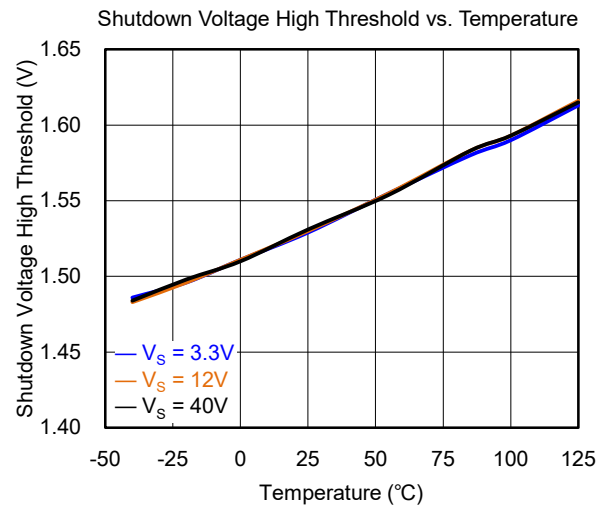
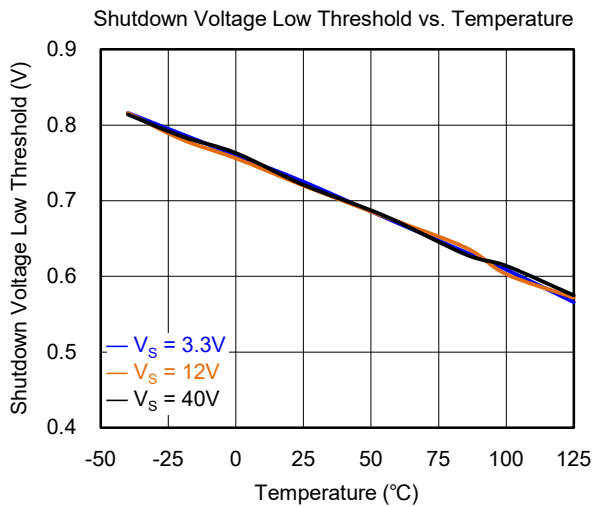
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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TYPICAL PERFORMANCE CHARACTERISTICS (continued)

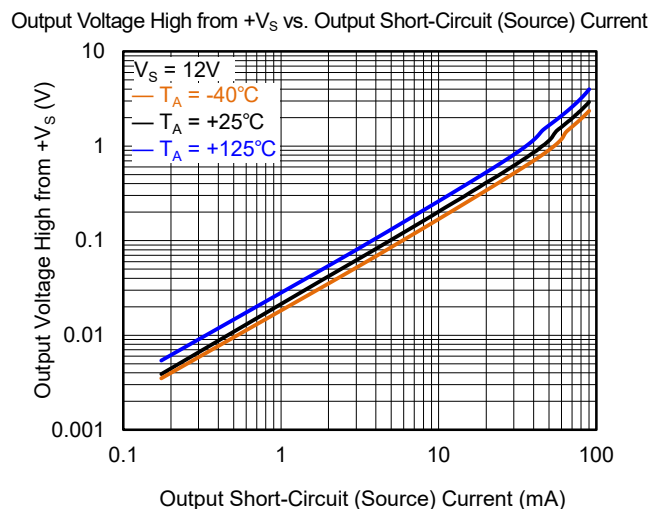
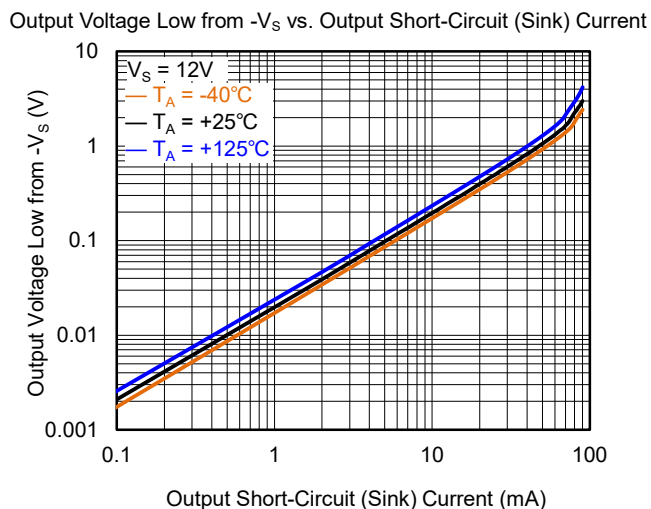
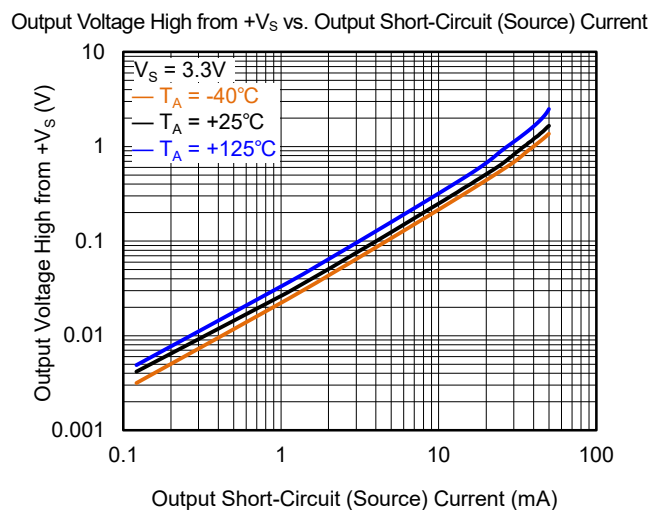
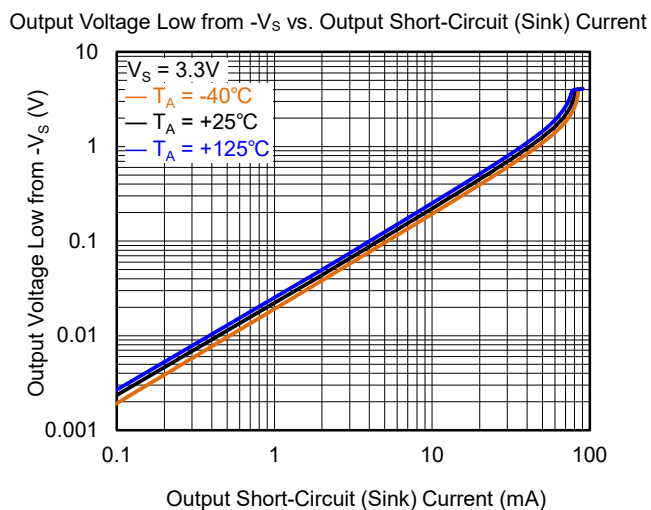
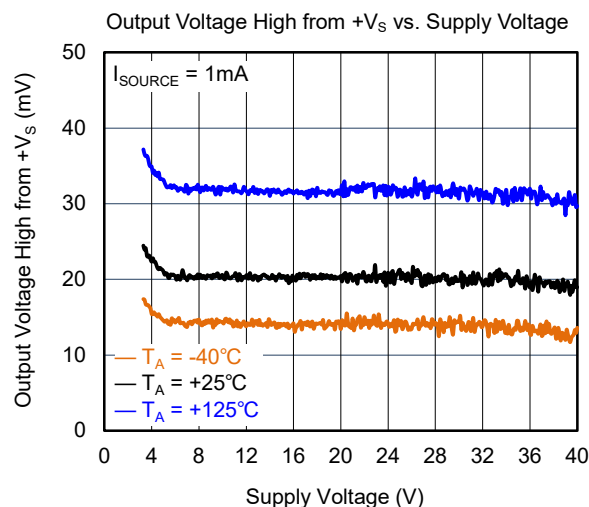
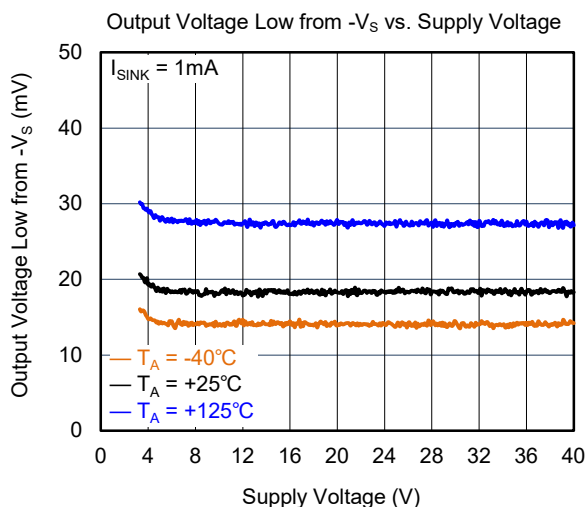
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NOTE: 1. Specified by design and characterization, not production tested.

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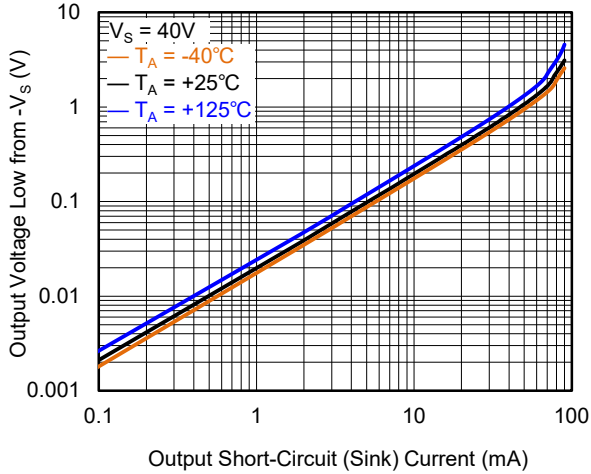
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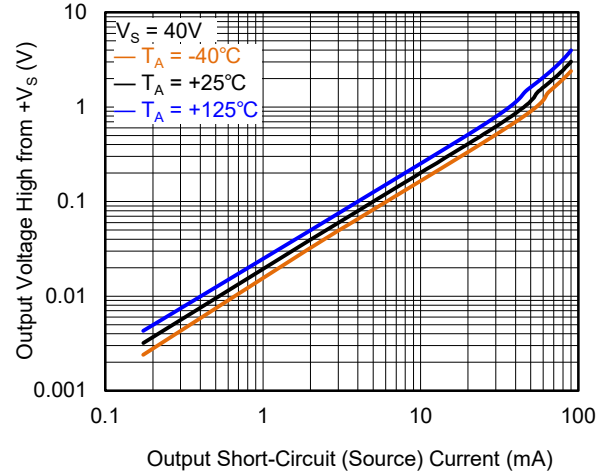
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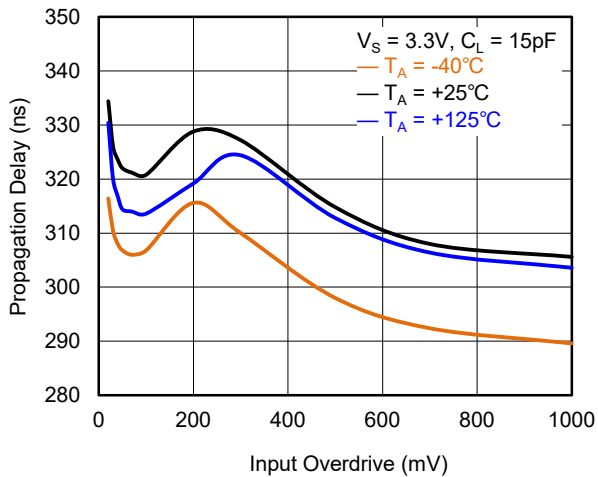
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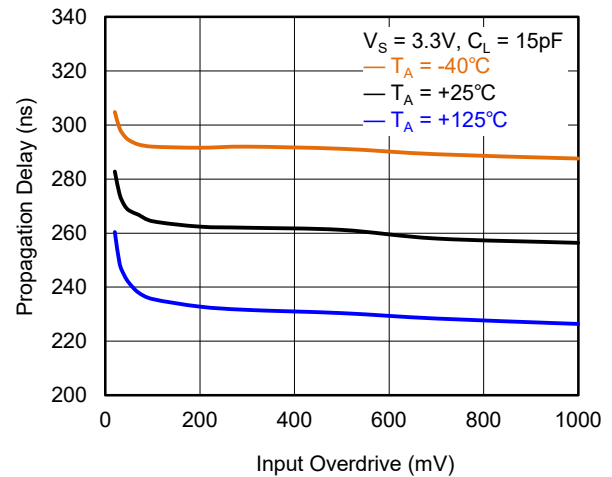
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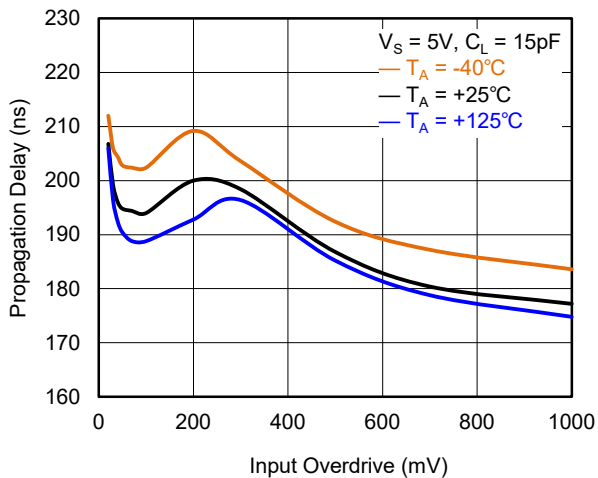
Propagation Delay (L-H) vs. Input Overdrive



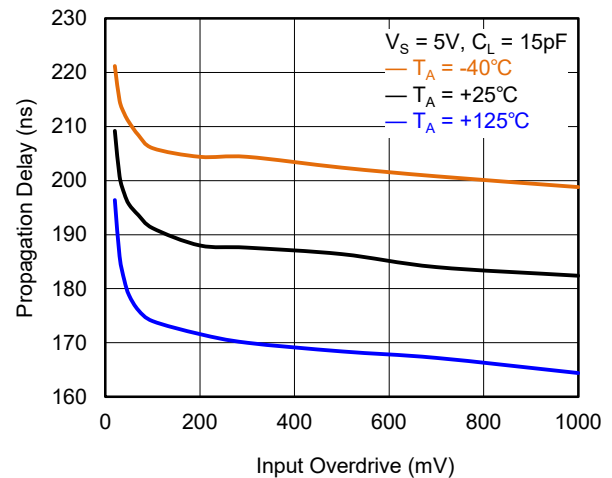
Propagation Delay (H-L) vs. Input Overdrive



Propagation Delay (L-H) vs. Input Overdrive

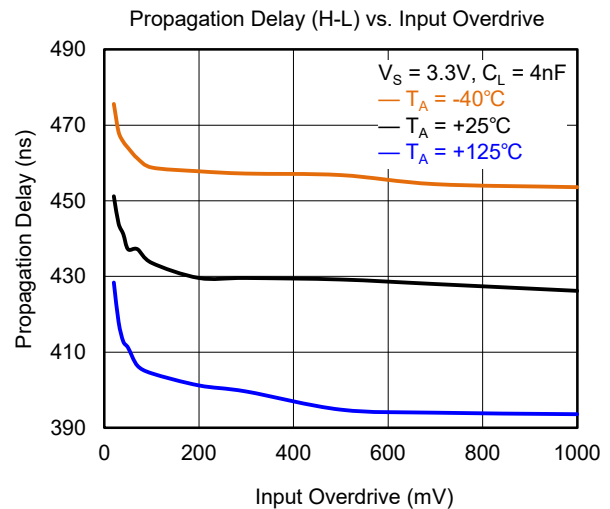
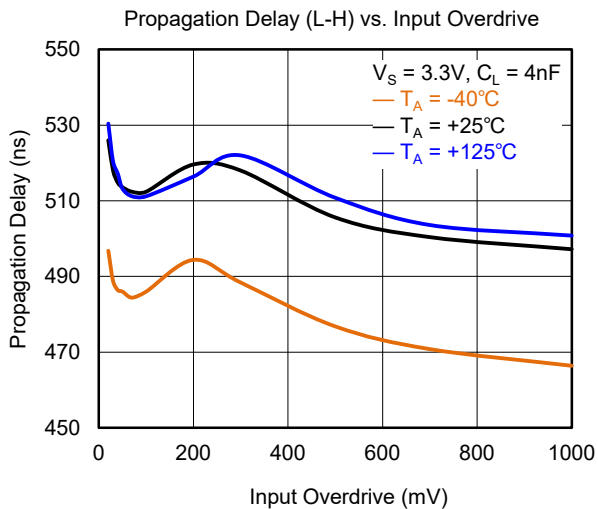
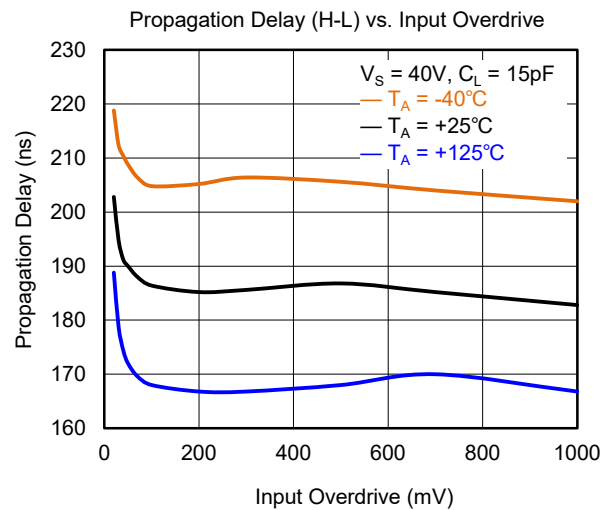
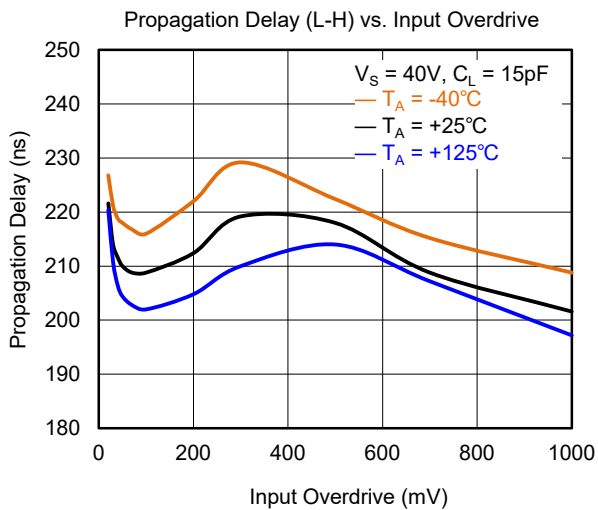
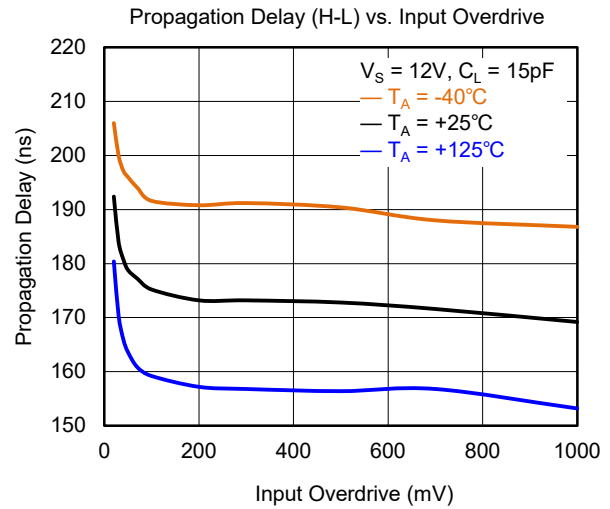
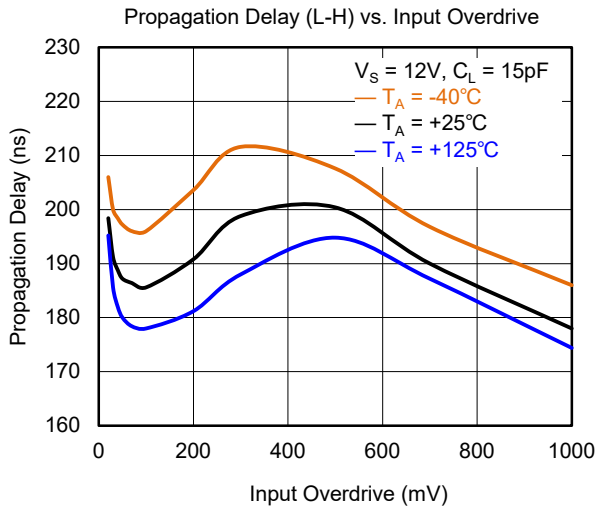


Propagation Delay (H-L) vs. Input Overdrive



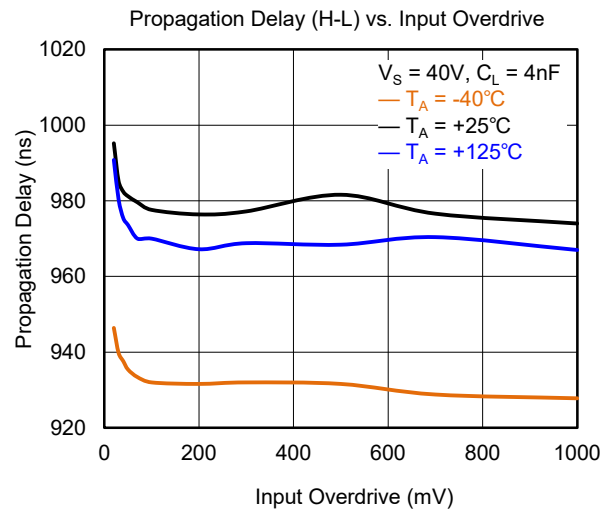
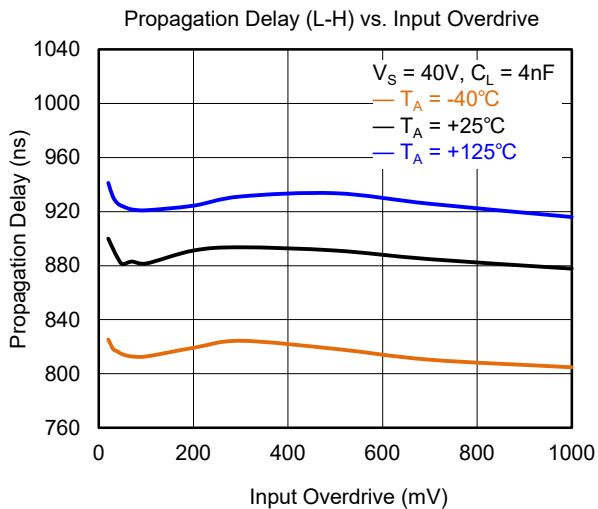
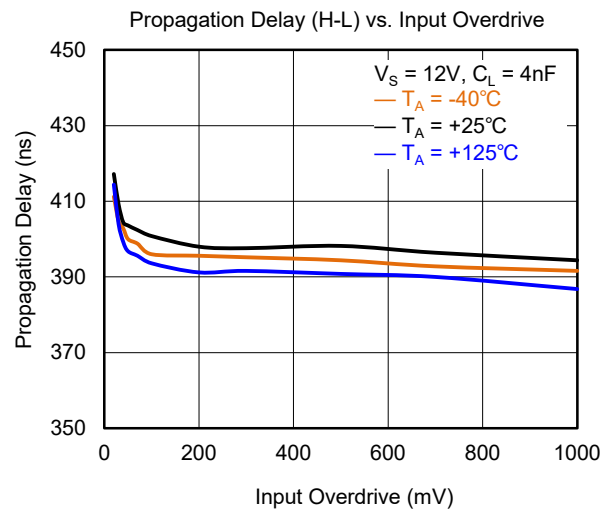
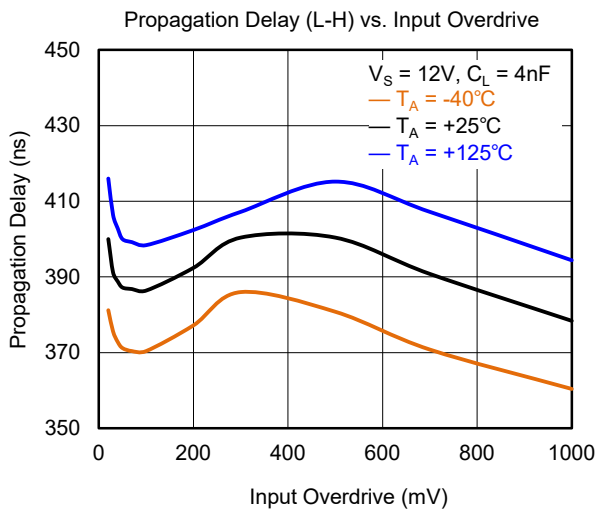
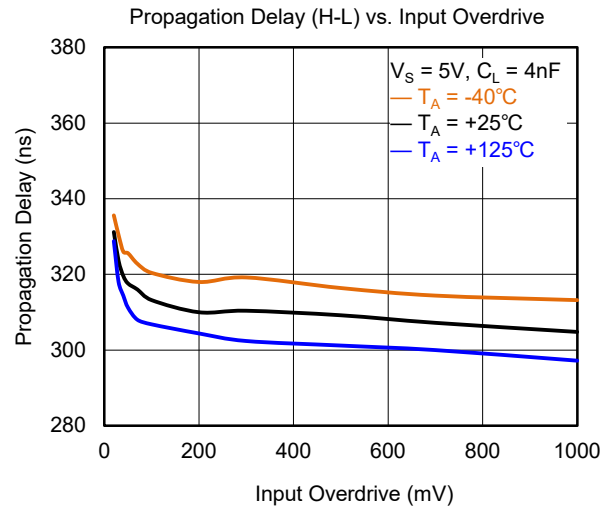
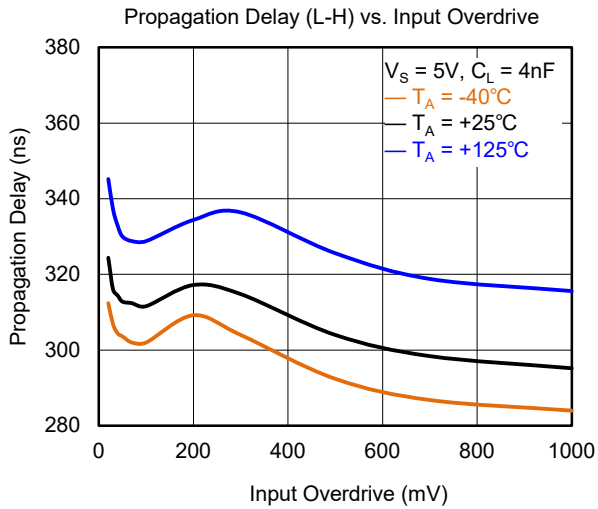
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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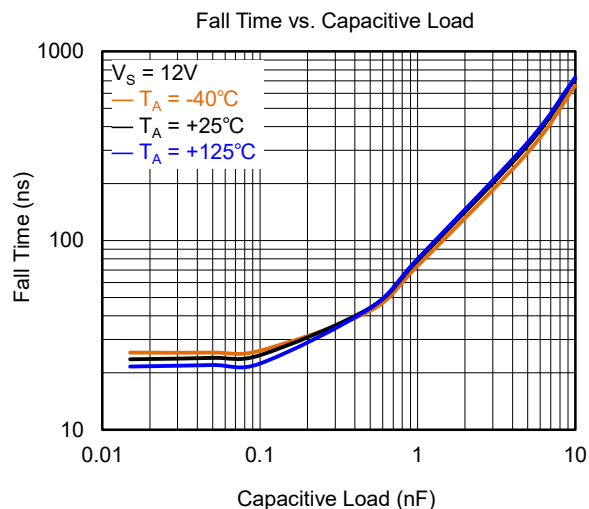
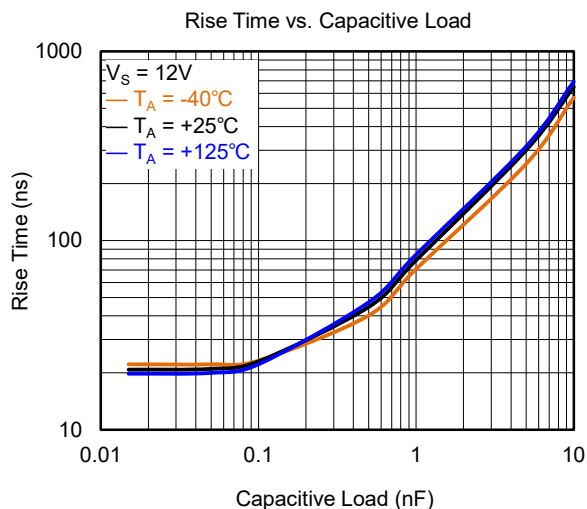
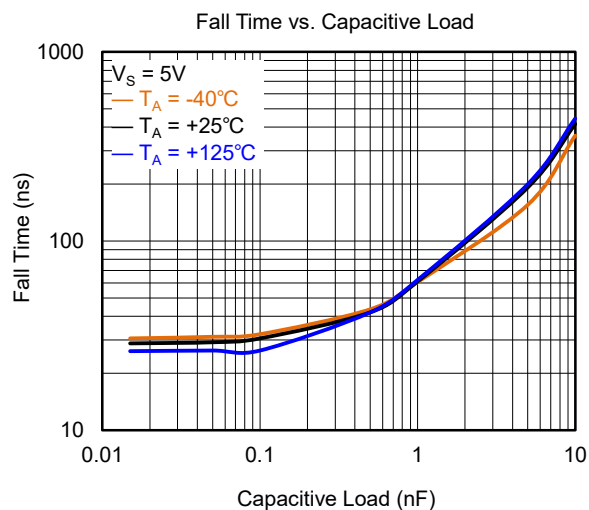
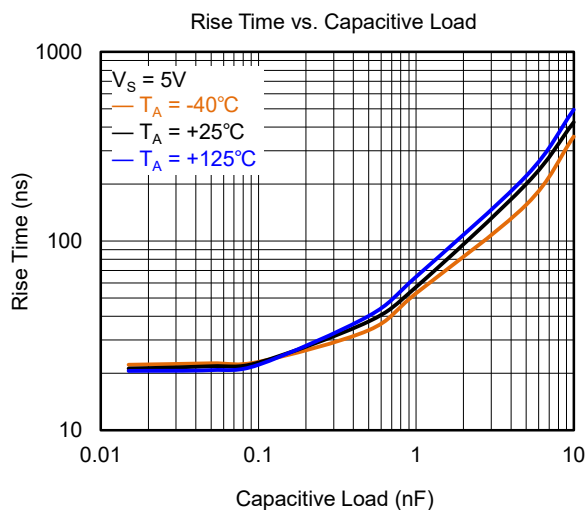
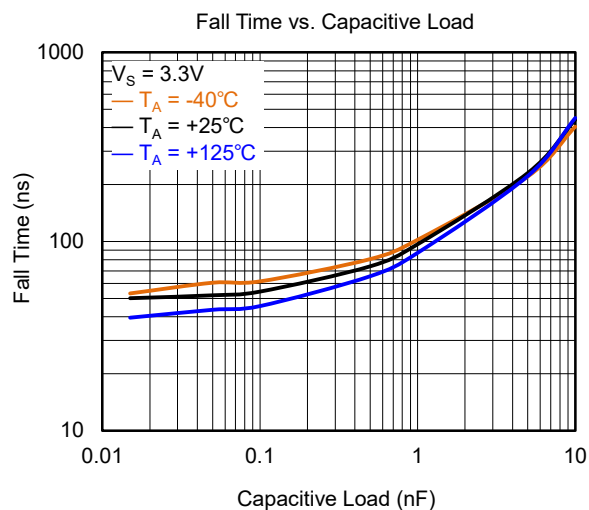
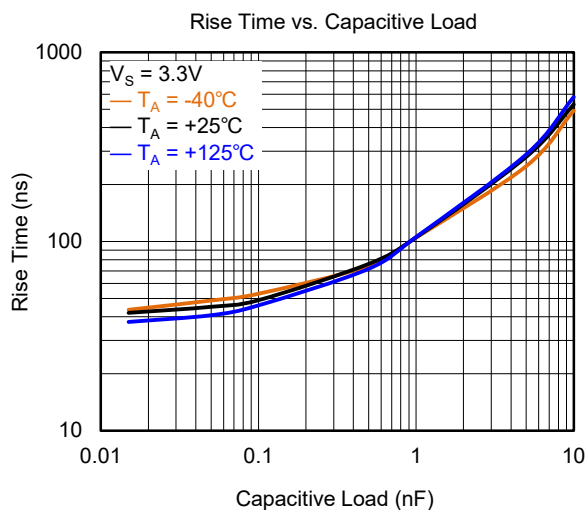
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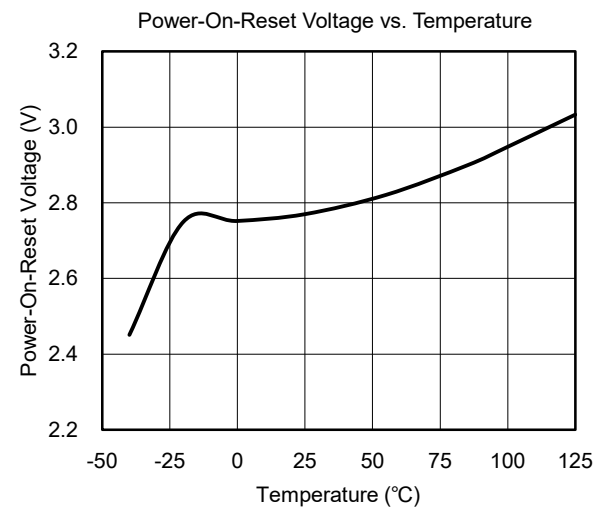
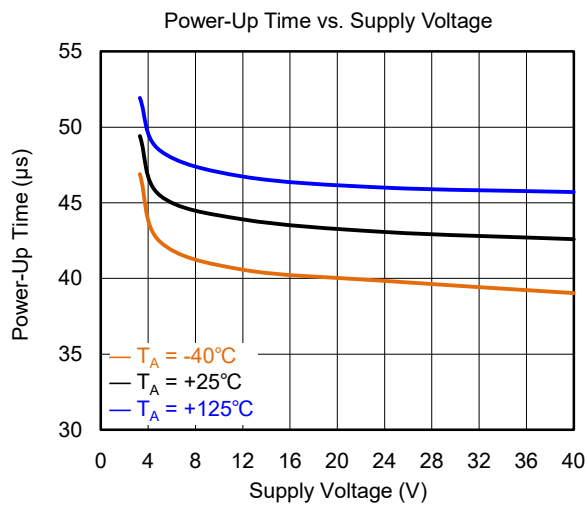
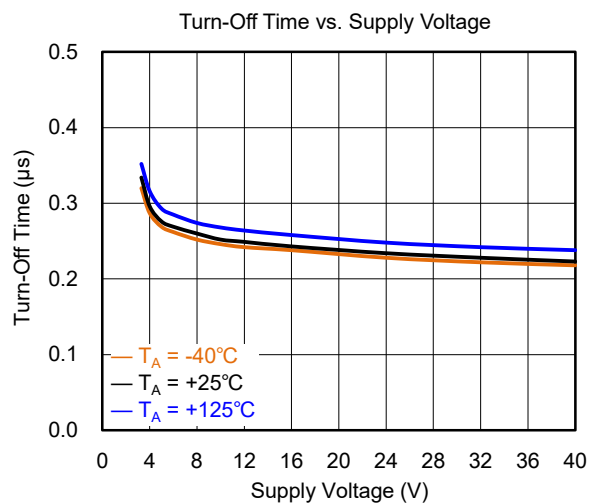
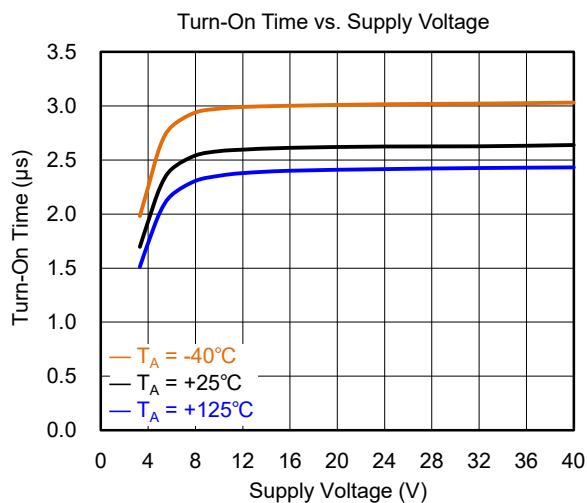
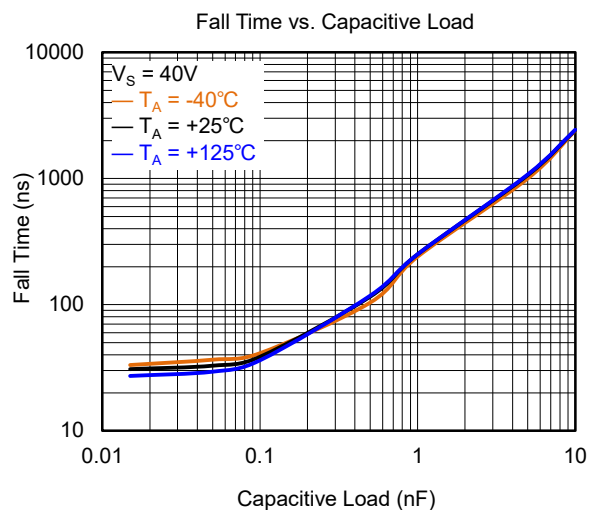
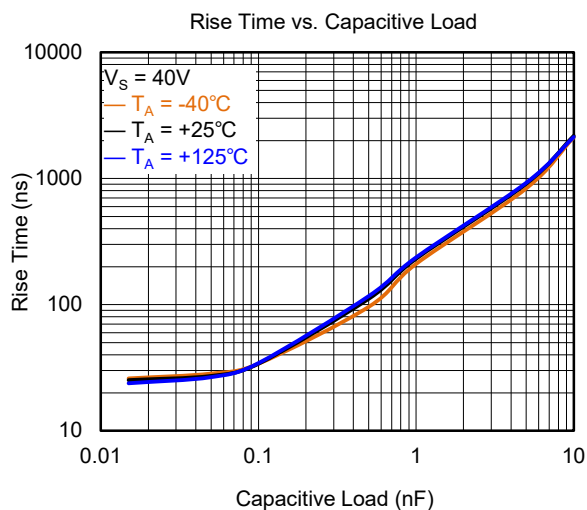
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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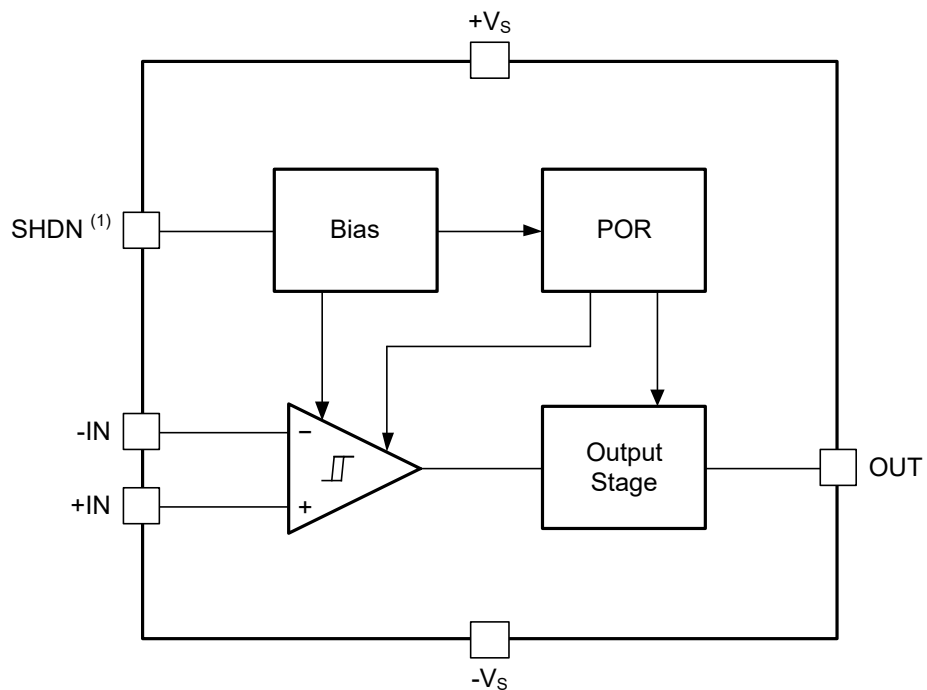


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A = +25^\circ\text{C}$, $V_S = 12\text{V}$, $V_{CM} = V_S/2$, and input overdrive = 100mV, unless otherwise noted.



FUNCTIONAL BLOCK DIAGRAM



NOTE: 1. SHDN only for SGM8781A-1Q.

Figure 3. Block Diagram

DETAILED DESCRIPTION

The SGM8781x-1Q series is a rail-to-rail input comparator. It comes in small and space-saving packages, with a maximum operating voltage of up to 40V or $\pm 20\text{V}$ and a power consumption of $115\mu\text{A}$. The SGM8781A-1Q and SGM8781C-1Q have a push-pull output stage. The SGM8781B-1Q has an open-drain output stage.

Inputs

The SGM8781x-1Q series is designed to handle input signals across the entire supply range and to prevent phase reversal even if the input voltage exceeds the supply rails.

POR Function

The SGM8781x-1Q series integrates a power-on-reset (POR) circuit that becomes active during the rising or falling ramp of the power supply ($+V_S$). The SGM8781x-1Q ensures its output stays off (High-Z) until the power supply is stable for at least $52\mu\text{s}$. Only after this does the output become active and respond to inputs.

High Power Push-Pull Output

The high voltage comparators (SGM8781A-1Q and SGM8781C-1Q) have a built-in push-pull output that is both powerful and fast. They can drive loads such as MOSFET gates. Just be mindful of power limits at high voltages.

Shutdown Function

The SGM8781A-1Q integrates a logic-level SHDN input. The SGM8781A-1Q enters shutdown mode when the SHDN pin voltage is 2V above $-V_S$. In this state, the supply current drops below $13\mu\text{A}$ and the output becomes high-impedance (High-Z), while the inputs remain active. Key requirements for the shutdown pin:

- ♦ Voltage Limit: The voltage on SHDN (relative to $-V_S$) must not exceed $+5.5\text{V}$.

- ♦ Connection: If unused, connect SHDN to $-V_S$; never leave it floating. A pull-up or pull-down resistor on the output is recommended to prevent a floating logic level when the output is in High-Z.

In addition, the SHDN pin can function as a second input. This provides an additional measurement capability because its threshold is a tested parameter.

Internal Hysteresis

The SGM8781x-1Q series has 14mV hysteresis (V_{HYST}), which helps improve the noise immunity. Figure 4 shows the relationship among V_{TH} , V_{OS} , and V_{HYST} . V_{TH} is the trip voltage or set voltage of the comparator. V_{OS} is defined as the input offset voltage between $V_{\text{IN}+}$ and $V_{\text{IN}-}$. V_{OS} is considered into the influence of the hysteresis which can affect the response of the output.

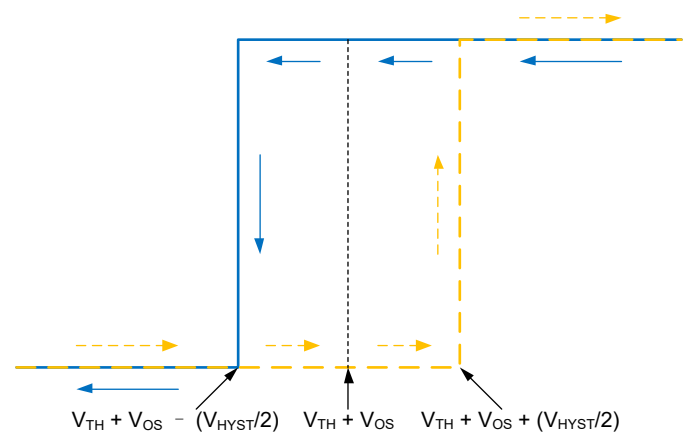


Figure 4. Hysteresis Transfer Curve

APPLICATION INFORMATION

Adding External Hysteresis

Figure 5 illustrates the inverting circuit with the external hysteresis.

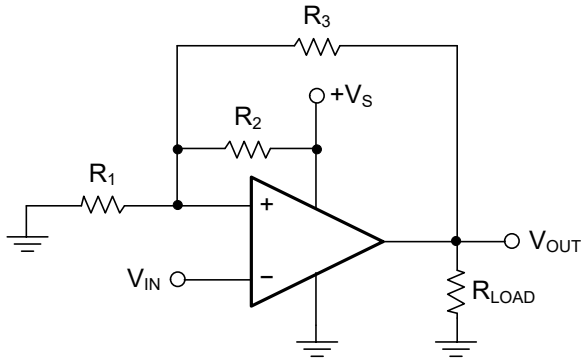


Figure 5. Inverting Configuration with Hysteresis of SGM8781A-1Q and SGM8781C-1Q

The external hysteresis caused by the circuit is shown in Equation 1. In Equation 1, $R_{F1} = (R_2 // R_3)$ and $R_{F2} = (R_1 // R_3)$.

$$V_{HYST} = (+V_S) \left(\frac{R_1}{R_{F1} + R_1} - \frac{R_{F2}}{R_2 + R_{F2}} \right) \quad (1)$$

Figure 6 illustrates the non-inverting circuit with external hysteresis.

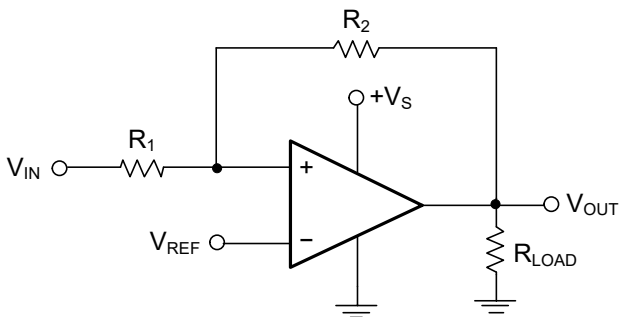


Figure 6. Non-Inverting Configuration with Hysteresis of SGM8781A-1Q and SGM8781C-1Q

The external hysteresis of this circuit can be calculated using Equation 2.

$$V_{HYST} = (+V_S) \times \frac{R_1}{R_2} \quad (2)$$

Reverse Current Protection

The SGM8781x-1Q and the MOSFET form a reverse current protection circuit, with the specific block diagram shown in Figure 7. The MOSFET acts as a "switch" between the source (V_{SOURCE}) and the load (V_{LOAD}). The SGM8781x-1Q monitors V_{SOURCE} and V_{LOAD} . When current flows from the load side toward the source, causing V_{LOAD} to exceed V_{SOURCE} , the MOSFET remains off, preventing current from flowing from the load side to the battery. Due to the hysteresis voltage V_{HYST} and offset voltage V_{OS} of the SGM8781x-1Q, as well as the on-resistance $R_{DS(ON)}$ of the MOSFET, the reverse current must reach a certain threshold before the comparator can switch.

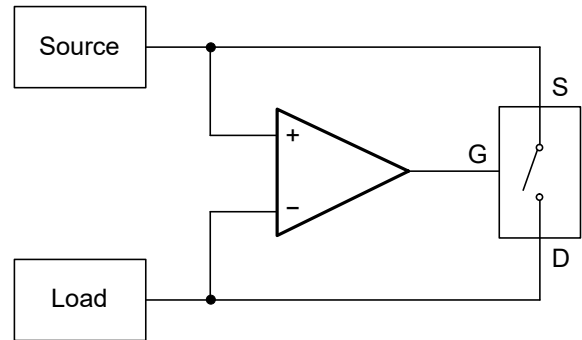


Figure 7. Simplified Block Diagram

APPLICATION INFORMATION (continued)

N-MOSFET Circuit

A reverse current protection circuit using an N-Channel MOSFET is shown in Figure 8 and Figure 9. The function of each component is as follows:

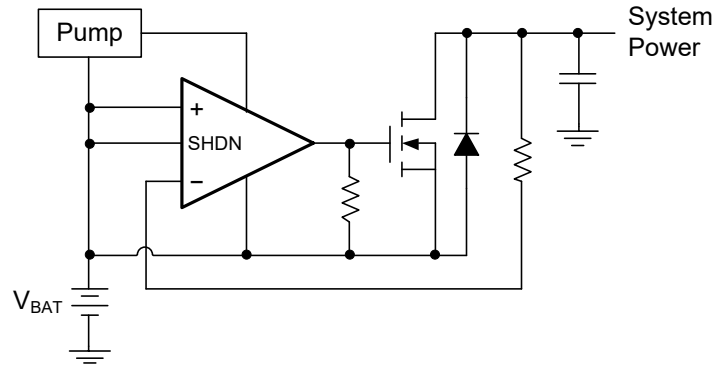


Figure 8. SGM8781A-1Q Using an N-Channel MOSFET for Reverse Current Protection Circuit Diagram

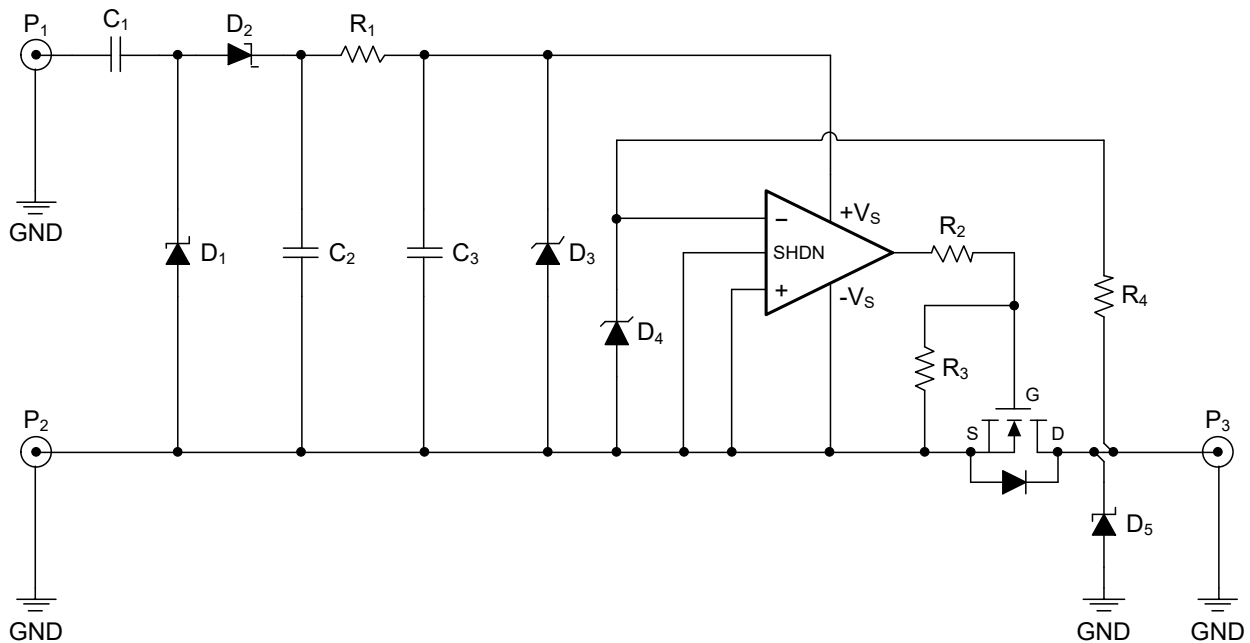


Figure 9. N-MOSFET Protection Detailed Circuit Diagram

- ♦ C_1 , D_1 , D_2 , and C_2 form a charge pump. The comparator output must be high to turn on the MOSFET. If a high voltage supply is available, it can also power the comparator directly.
- ♦ R_1 and D_3 provide clamp protection to prevent the comparator's high-level output from exceeding the MOSFET's V_{GS_MAX} .
- ♦ D_5 is a reverse protection diode. It clamps any negative voltage and pulls down V_{LOAD} under no-load conditions. It ensures current flows during reverse source and light-load situations.
- ♦ P_1 connects to an external clock signal to drive the charge pump; P_2 connects to Source; P_3 connects to Load.

APPLICATION INFORMATION (continued)

P-MOSFET Circuit

A reverse current protection circuit using a P-Channel MOSFET is shown in Figure 10 and Figure 11. The function of each component is as follows:

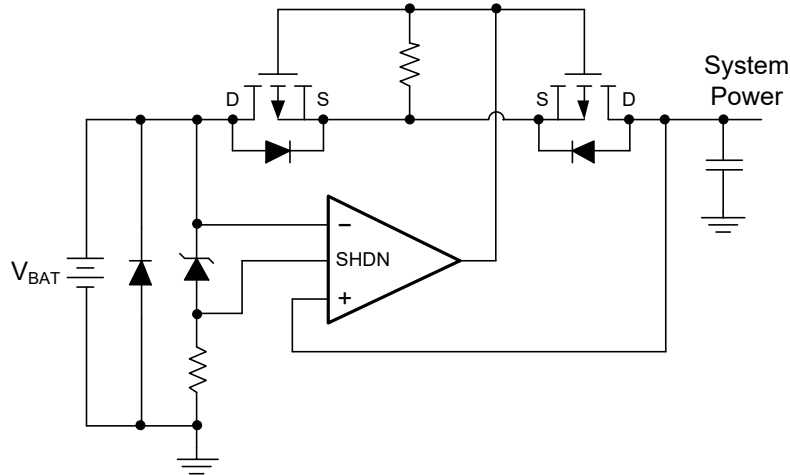


Figure 10. SGM8781A-1Q Using P-Channel MOSFETs for Reverse Current and Over-Voltage Protection Circuit Diagram

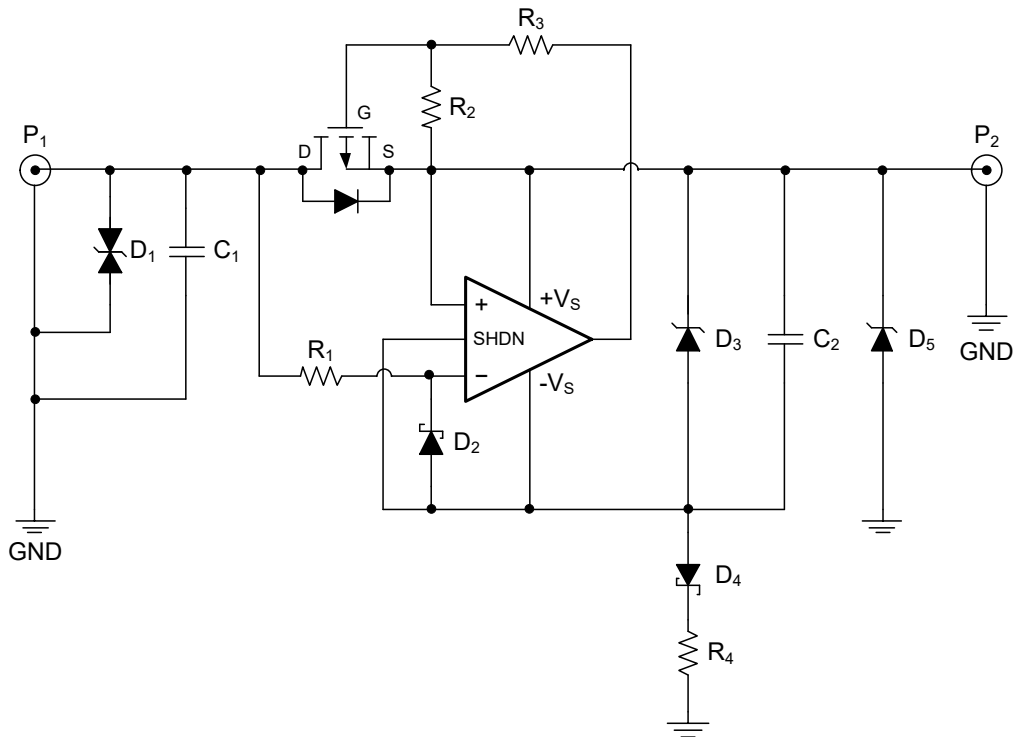


Figure 11. P-MOSFET Protection Detailed Circuit Diagram

- ♦ D_5 is a reverse protection diode. It clamps any negative voltage and ties down V_{LOAD} under no-load conditions. It forces current to flow during reverse source and light load.
- ♦ D_4 serves to prevent reverse voltage and to keep the bypass capacitor from discharging during reverse voltage or transient conditions, ensuring normal operation in these scenarios.
- ♦ The value of R_4 is determined by the voltage-limiting Zener diode and the maximum voltage. Typically, only the quiescent current of the comparator flows through it.

APPLICATION INFORMATION (continued)**Power Supply Bypassing**

A clean and stable power supply is very important in comparator circuit design to minimize noise, glitches and temporary fluctuations. The power supply is one of the important sources of noise to the comparator through the +V_S pin. Power supply bypassing is an effective method to clear up the noise at power supply. The low impedance path to ground of decoupling capacitor will bypass the noise to GND. In applications, 0.1μF ~ 1μF ceramic capacitor is always used, and this ceramic capacitor should be placed as close as possible to the +V_S pin.

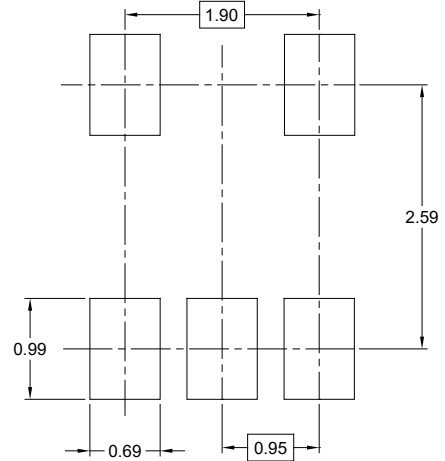
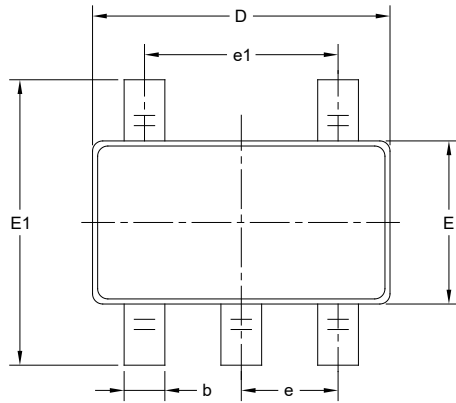
REVISION HISTORY

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

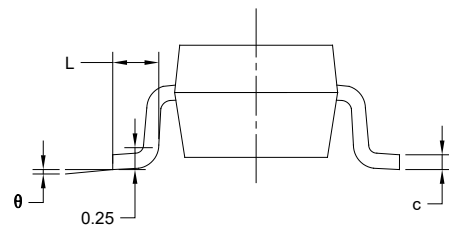
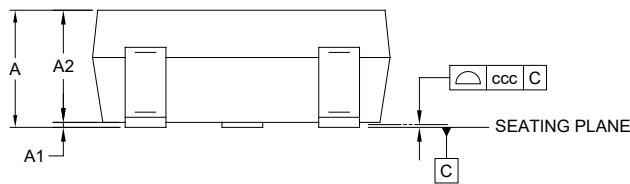
Changes from Original to REV.A (OCTOBER 2026)	Page
Changed from product preview to production data.....	All

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



RECOMMENDED LAND PATTERN (Unit: mm)



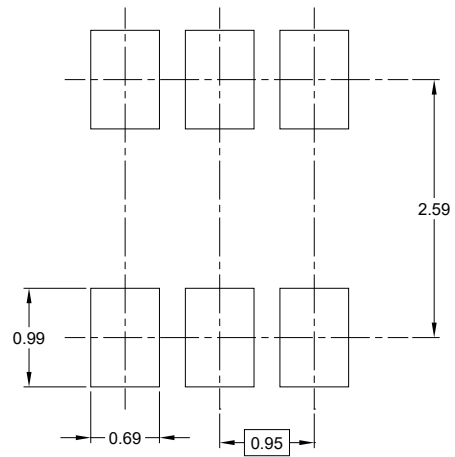
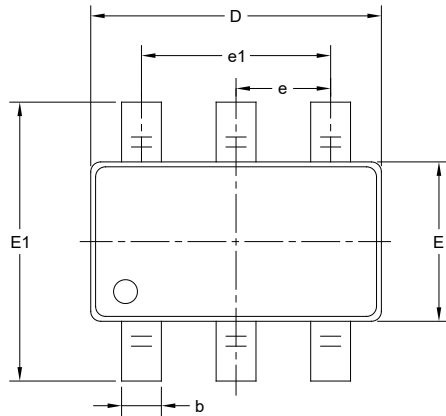
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A1	0.000	-	0.150
A2	0.900	-	1.300
b	0.300	-	0.500
c	0.080	-	0.220
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.600	-	3.000
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e1	1.900 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

NOTES:

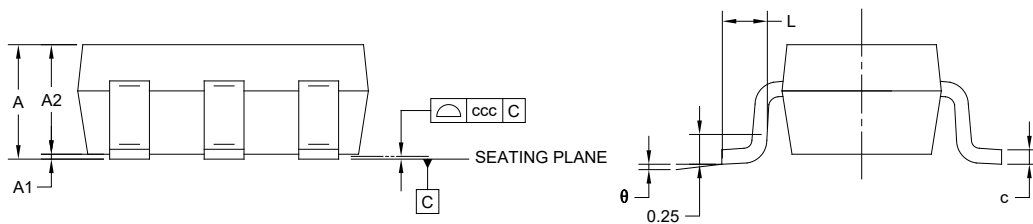
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-178.

PACKAGE OUTLINE DIMENSIONS

SOT-23-6



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	1.450
A1	0.000	-	0.150
A2	0.900	-	1.300
b	0.300	-	0.500
c	0.080	-	0.220
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.600	-	3.000
e	0.950 BSC		
e1	1.900 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

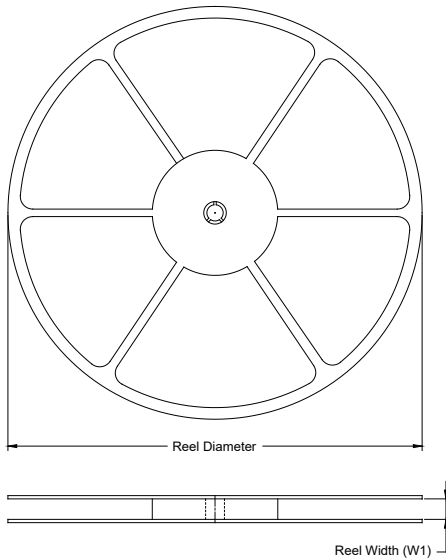
NOTES:

1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-178.

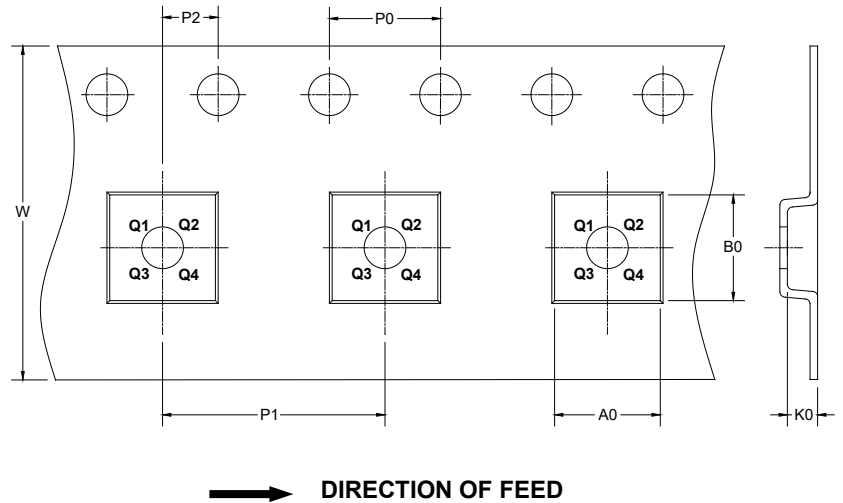
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

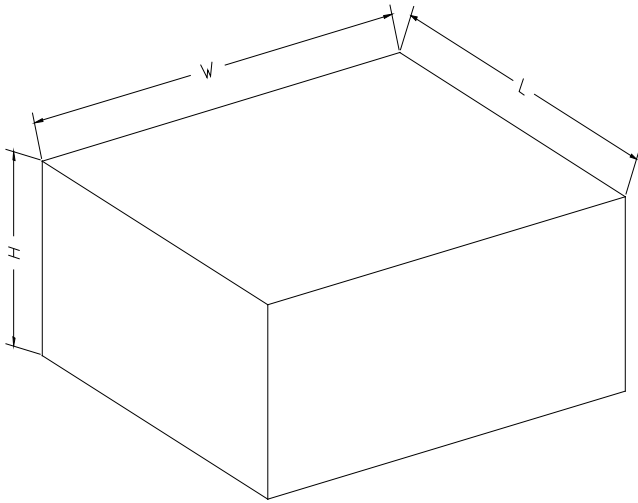
KEY PARAMETER LIST OF TAPE AND REEL

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SOT-23-6	7"	9.5	3.23	3.17	1.37	4.0	4.0	2.0	8.0	Q3

DD00001

PACKAGE INFORMATION

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
7" (Option)	368	227	224	8
7"	442	410	224	18

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