SGM8715
WLCSP Package, Low Power Comparator with Precision Voltage Reference

GENERAL DESCRIPTION

The SGM8715 series is a single, micro-power, high accuracy and small size comparator with precision voltage references. There are three precision references for SGM8715 series: 0.2V, 0.5V and 1.2V.

The SGM8715 is optimized for low voltage operation from 1.6V to 5.5V single supply. The device consumes only 1.8μA of supply current. Meanwhile, SGM8715 has a great trade-off between low power and high speed, with propagation delays of just 380ns for both the 0.2V and 0.5V versions, and 330ns for the 1.2V version, at 100mV overdrive.

The SGM8715 is packaged in a space-saving WLCSP package (only 0.72mm × 0.72mm). The combination of these features makes it a good choice for battery-powered or portable equipment.

The SGM8715 is designed with precision hysteresis, which enables the comparator to effectively suppress interference pulses on the input signal and transform slow-moving input signals into clear digital outputs. This ensures stable output operation, and there will be no false triggering even when monitoring current and voltage in noisy and demanding settings.

The SGM8715 series supports push-pull output.

The SGM8715 series is available in a Green WLCSP-0.72×0.72-4B package. It is specified over the operating temperature range of -40℃ to +125℃.

FEATURES

- **Wide Supply Voltage Range: 1.6V to 5.5V**
- **Low Supply Current: 1.8μA (TYP) at V_S = 1.6V**
- **Low Propagation Delay:**
  - **SGM8715-0.2/SGM8715-0.5: 380ns (TYP)**
  - **SGM8715-1.2: 330ns (TYP)**
- **Precision Voltage References:**
  - **Reference Voltage: 0.2V, 0.5V and 1.2V**
  - **Accuracy: 0.5% at +25℃ and 1% Over Temperature**
- **Precision Hysteresis**
- **Push-Pull Output**
- **Non-Inverting Input**
- **Known Startup Conditions**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in a Green WLCSP-0.72×0.72-4B Package**

APPLICATIONS

Medical Equipment
Battery-Powered Systems
Industrial Equipment
Telecom Equipment

TYPICAL APPLICATION

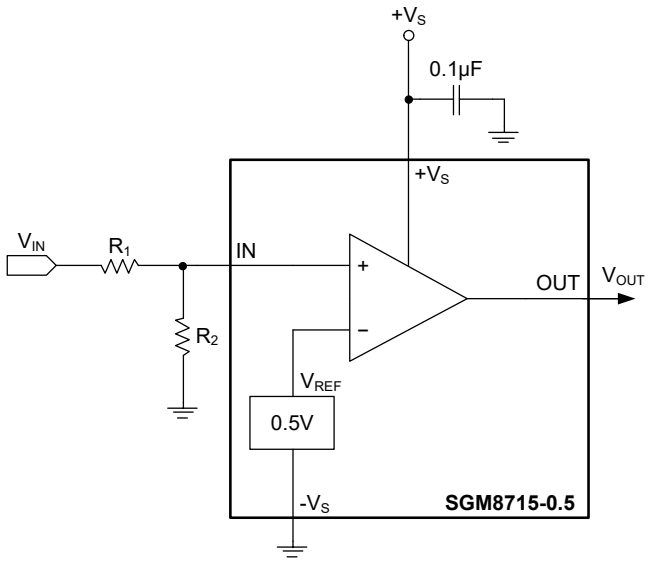


Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM8715-0.2	WLCSP-0.72×0.72-4B	-40℃ to +125℃	SGM8715-0.2XG/TR	00	Tape and Reel, 3000
SGM8715-0.5	WLCSP-0.72×0.72-4B	-40℃ to +125℃	SGM8715-0.5XG/TR	01	Tape and Reel, 3000
SGM8715-1.2	WLCSP-0.72×0.72-4B	-40℃ to +125℃	SGM8715-1.2XG/TR	02	Tape and Reel, 3000

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 6V
Input Voltage Range (1) ..... -0.3V to 6V
Input Current (1) ..... ±10mA
Output Voltage Range ..... -0.3V to $(+V_S)$ + 0.3V
Output Short-Circuit Duration (2) 10s
Package Thermal Resistance
WLCSP-0.72×0.72-4B, θ_{JA} ..... 335.9℃/W
WLCSP-0.72×0.72-4B, θ_{JB} ..... 134.6℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility (3) (4)
HBM ..... ±8000V
CDM ..... ±1000V

NOTES:

1. A clamping diode is added between the input and negative power supply. So voltage at input pin can be $(-V_S)$ - 0.3V, and current of the input signal should be limited within the range of 10mA. Furthermore, voltage at input pin can exceed $(+V_S)$ and output voltage, provided that it remains within the -0.3V to 6V limits. For input signals that vary outside this specified range, their current must be limited to a maximum of 10mA.
2. Short-circuit to ground.
3. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.
4. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications.

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range ..... 1.6V to 5.5V
Operating Temperature Range ..... -40℃ to +125℃

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

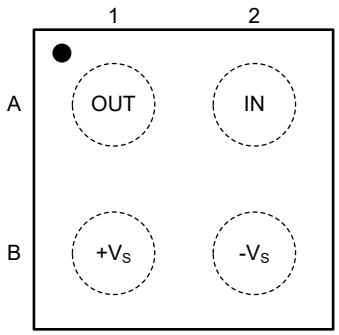
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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)



WLCSP-0.72×0.72-4B

PIN DESCRIPTION

PIN	NAME	I/O	FUNCTION
A1	OUT	O	Output of Comparator. OUT is push-pull structure.
A2	IN	I	Non-Inverting Input of Comparator.
B1	$+V_S$	—	Positive Power Supply.
B2	$-V_S$	—	Negative Power Supply. $-V_S$ pin is connected to GND in single power supply application.

NOTE: I = input, O = output.

ELECTRICAL CHARACTERISTICS

(V_S = 1.6V to 5.5V, Full = -40℃ to +125℃, and typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		TEMP	MIN	TYP	MAX	UNITS
Positive-Going Input Threshold Voltage	V_{IT+}	V_S = 1.6V and 5.5V	SGM8715-0.2	+25℃	0.1975	0.2	0.2025	V
				Full	0.196		0.204	
		V_S = 1.6V and 5.5V	SGM8715-0.5	+25℃	0.4975	0.5	0.5025	
				Full	0.495		0.505	
		V_S = 1.6V and 5.5V	SGM8715-1.2	+25℃	1.194	1.2	1.206	
				Full	1.188		1.212	
Negative-Going Input Threshold Voltage	V_{IT-}	V_S = 1.6V and 5.5V	SGM8715-0.2	+25℃	0.177	0.18	0.183	V
				Full	0.176		0.184	
		V_S = 1.6V and 5.5V	SGM8715-0.5	+25℃	0.4775	0.48	0.4825	
				Full	0.475		0.485	
		V_S = 1.6V and 5.5V	SGM8715-1.2	+25℃	1.174	1.18	1.186	
				Full	1.168		1.192	
Input Hysteresis Voltage	V_{HYS}	V_S = 1.6V and 5.5V		+25℃	16	20	23	mV
				Full	15		24	
Input Voltage Range	V_{IN}			Full	$-V_S$		5.5	V
Input Bias Current	I_B	Over V_{IN} range		+25℃		10	400	pA
				Full			15	nA
Output Voltage Low from $-V_S$	V_{OL}	V_S = 5.5V, OUT asserted low, I_{SINK} = 200μA		+25℃		10	50	mV
				Full			100	
		V_S = 5.5V, OUT asserted low, I_{SINK} = 3mA		+25℃		80	150	
				Full			200	
Output Voltage High from $+V_S$	V_{OH}	V_S = 5.5V, OUT asserted high, I_{SOURCE} = 200μA		+25℃		10	50	
				Full			100	
		V_S = 5.5V, OUT asserted high, I_{SOURCE} = 3mA		+25℃		50	100	
				Full			150	
Output Short-Circuit Current	I_{SC}	V_S = 5.5V, sinking		+25℃	45	50		mA
				Full	25			
		V_S = 5.5V, sourcing		+25℃	45	50		
				Full	35			
Supply Current	I_S	V_S = 1.6V, output low, no load		+25℃		1.8	3	μA
				Full			4	
		V_S = 5.5V, output low, no load		+25℃		2	3.5	
				Full			5	
Power-On Reset Voltage	V_{POR}			+25℃		1.5		V

SWITCHING CHARACTERISTICS

(V_S = 3.3V, C_L = 15pF, and typical values are at T_A = +25℃, unless otherwise noted.)

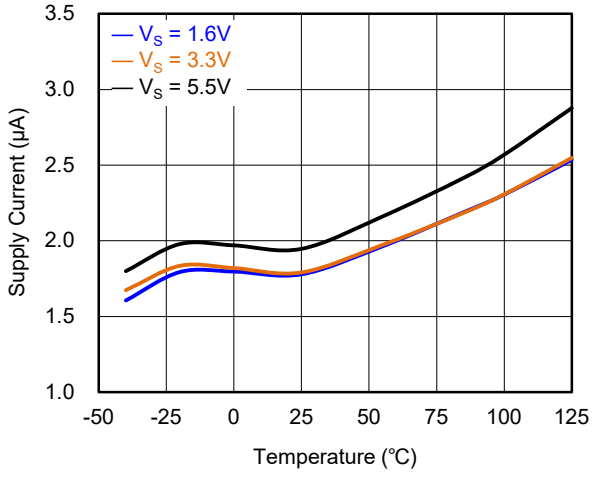
PARAMETER	SYMBOL	CONDITIONS		TEMP	MIN	TYP	MAX	UNITS
Propagation Delay, High-to-Low (1)	t_{PHL}	Overdrive = 100mV, midpoint of input to midpoint of output	SGM8715-0.2/0.5	+25℃		310		ns
			SGM8715-1.2	+25℃		330		
Propagation Delay, Low-to-High (1)	t_{PLH}	Overdrive = 100mV, midpoint of input to midpoint of output	SGM8715-0.2/0.5	+25℃		380		ns
			SGM8715-1.2	+25℃		230		
Rise Time	t_R	20% to 80%		+25℃		9		ns
Fall Time	t_F	20% to 80%		+25℃		9.5		ns
Power-Up Time (2)	t_{ON}			+25℃		530		μs

NOTES:

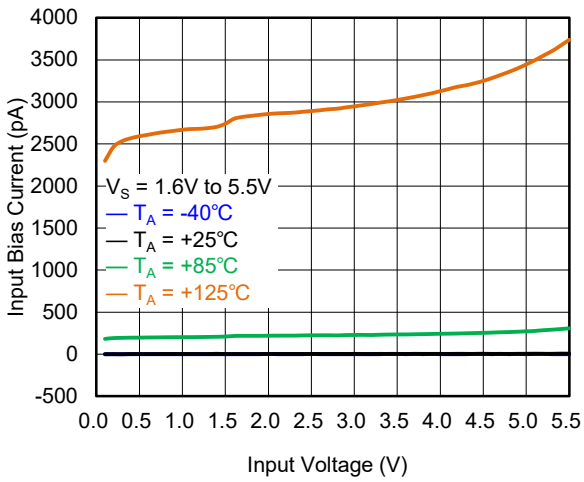
1. The terms high-to-low and low-to-high describe the changes occurring at the input.
2. When powering up, ensure that V_S is above 1.6V for a certain duration (t_{ON}) before the output begins to follow the input signal. Until the t_{ON} period has passed, the output is under the control of the POR circuit.

TYPICAL PERFORMANCE CHARACTERISTICS

Supply Current vs. Temperature

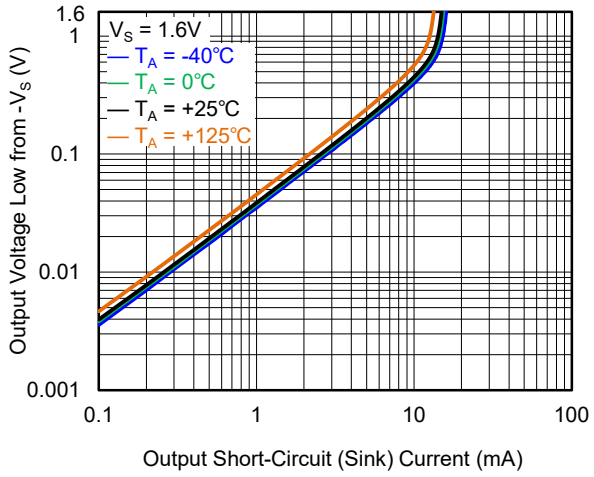


Input Bias Current vs. Input Voltage

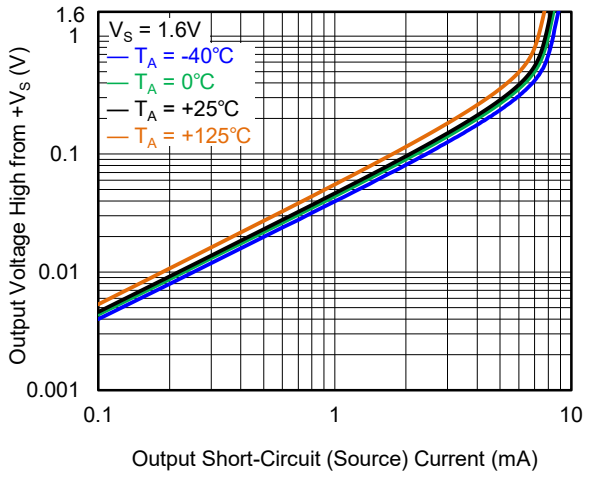


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

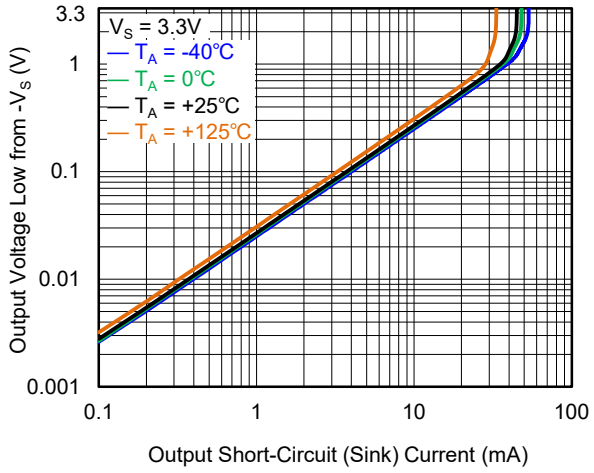
Output Voltage Low from -V_S vs. Output Short-Circuit (Sink) Current



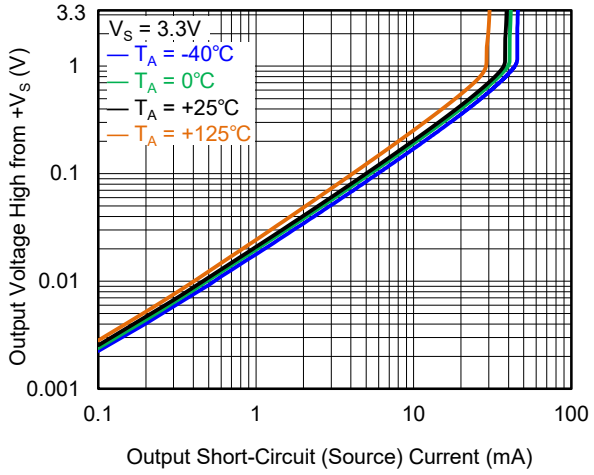
Output Voltage High from +V_S vs. Output Short-Circuit (Source) Current



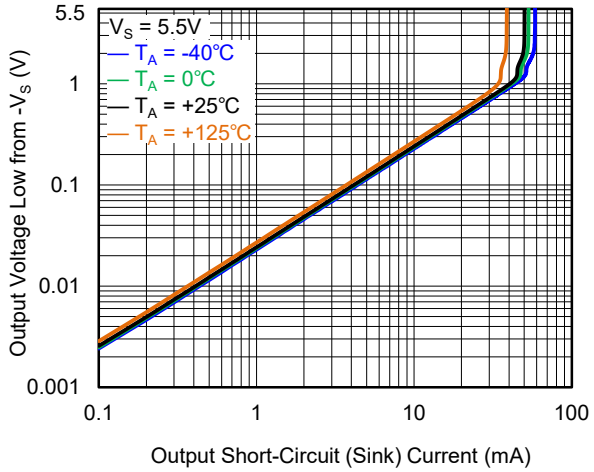
Output Voltage Low from -V_S vs. Output Short-Circuit (Sink) Current



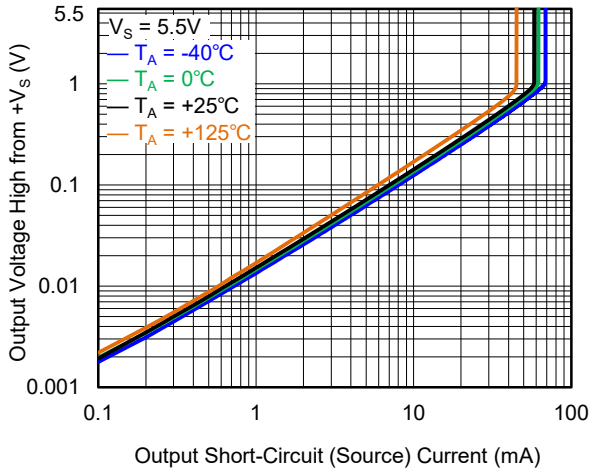
Output Voltage High from +V_S vs. Output Short-Circuit (Source) Current



Output Voltage Low from -V_S vs. Output Short-Circuit (Sink) Current



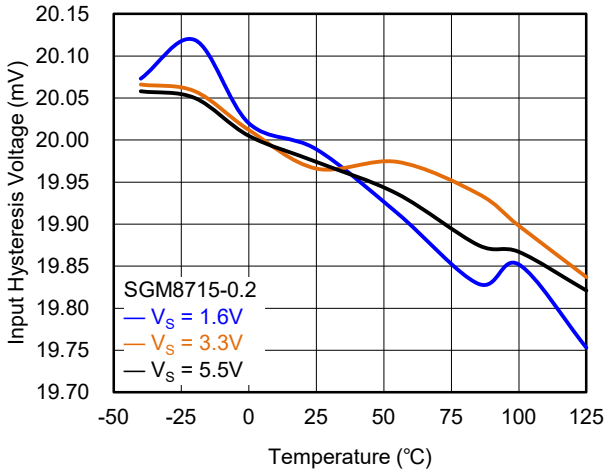
Output Voltage High from +V_S vs. Output Short-Circuit (Source) Current



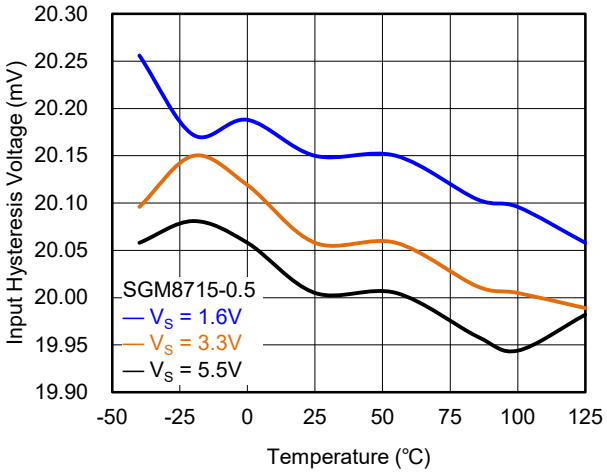
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 5.5V, unless otherwise noted.

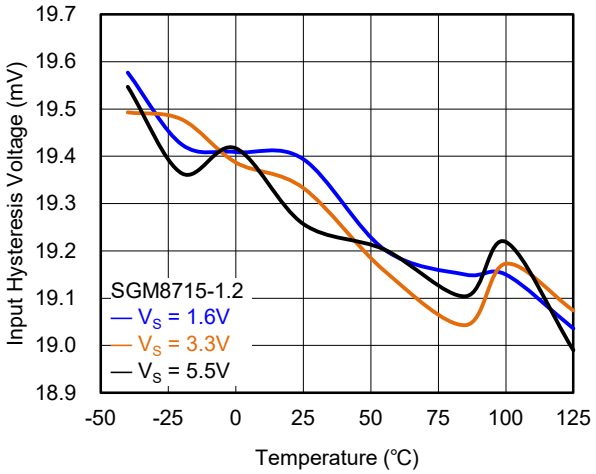
Input Hysteresis Voltage vs. Temperature



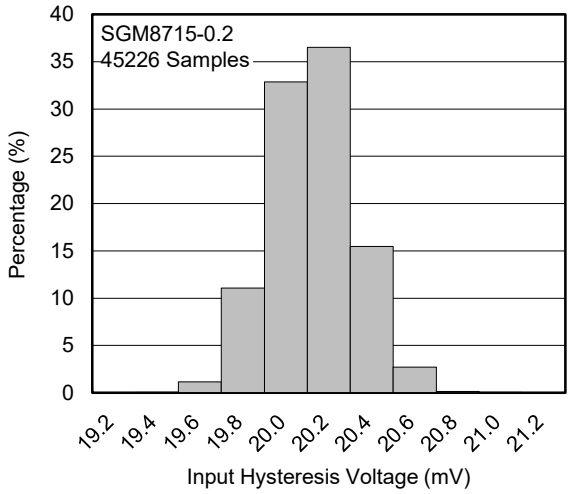
Input Hysteresis Voltage vs. Temperature



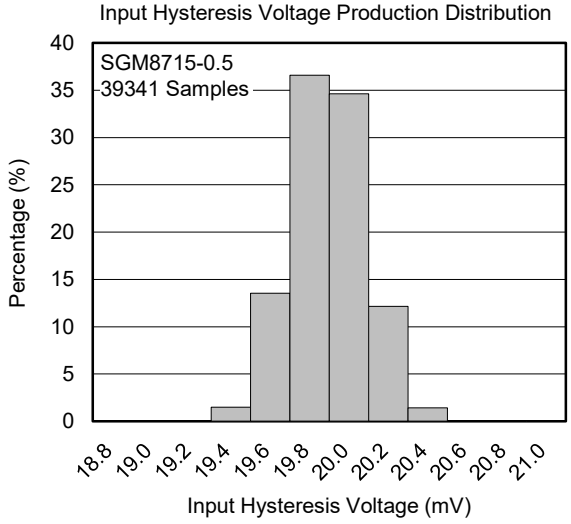
Input Hysteresis Voltage vs. Temperature



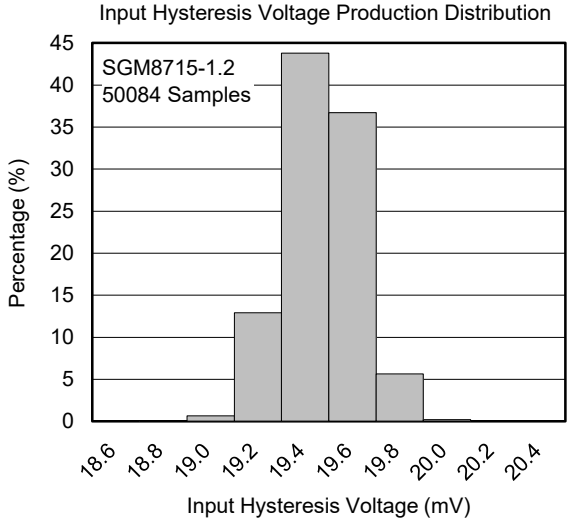
Input Hysteresis Voltage Production Distribution



Input Hysteresis Voltage Production Distribution

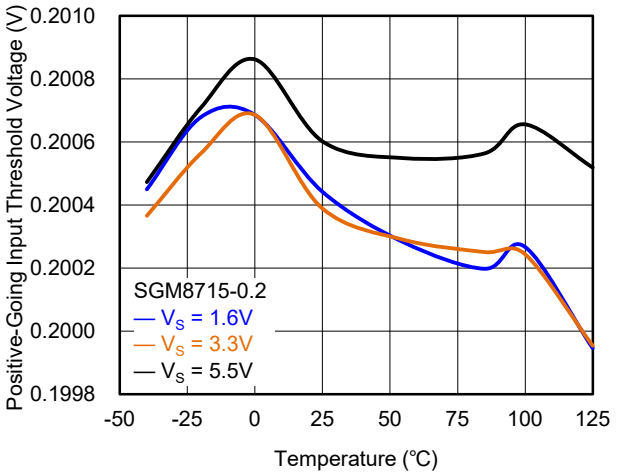


Input Hysteresis Voltage Production Distribution

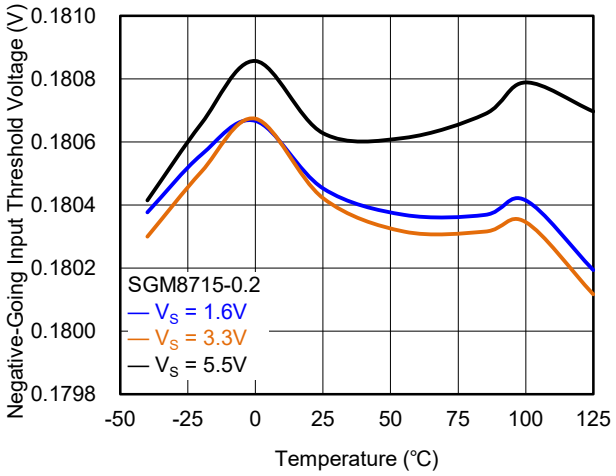


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

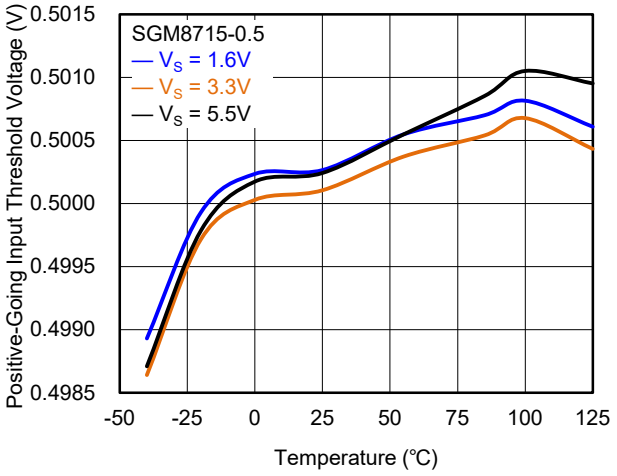
Positive-Going Input Threshold Voltage vs. Temperature



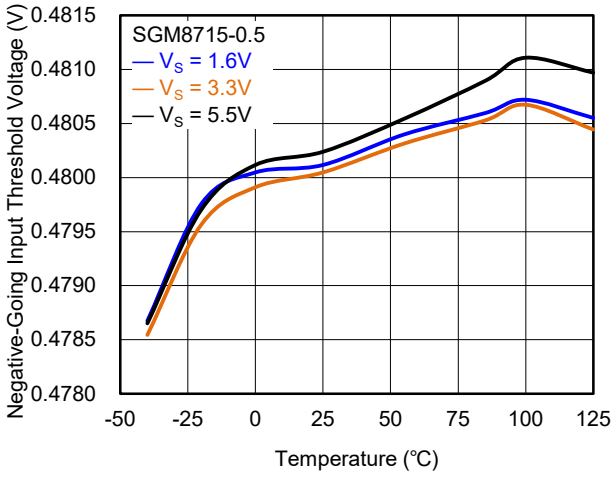
Negative-Going Input Threshold Voltage vs. Temperature



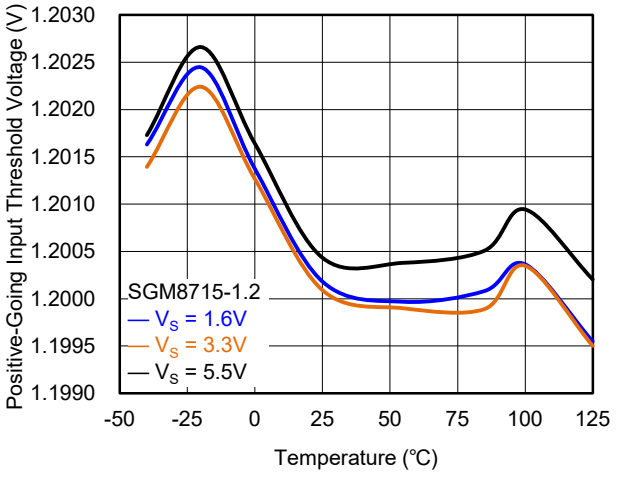
Positive-Going Input Threshold Voltage vs. Temperature



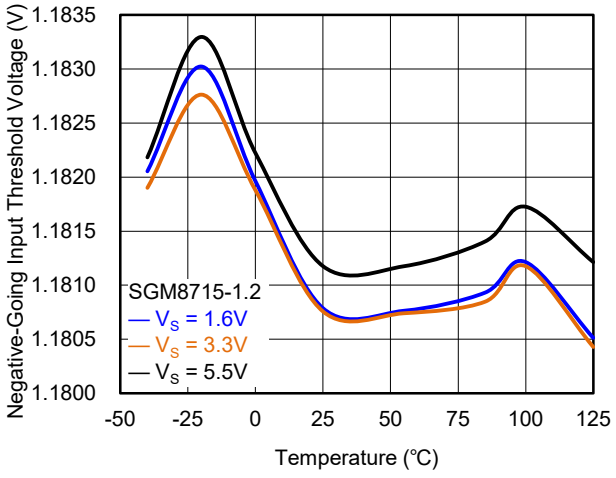
Negative-Going Input Threshold Voltage vs. Temperature



Positive-Going Input Threshold Voltage vs. Temperature



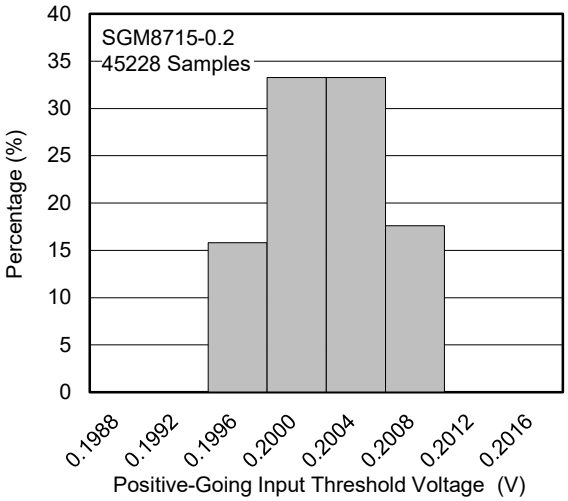
Negative-Going Input Threshold Voltage vs. Temperature



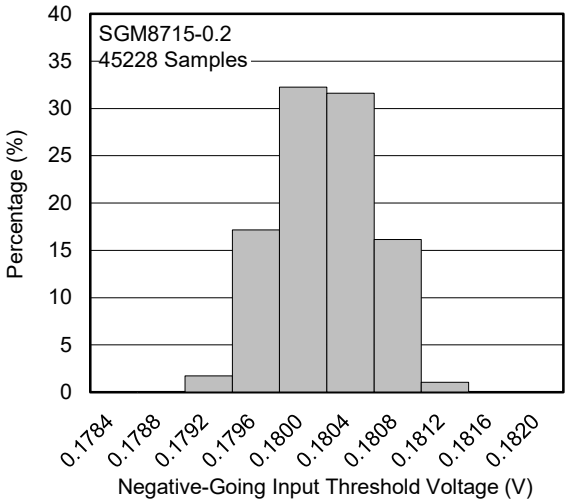
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_S = 5.5V, unless otherwise noted.

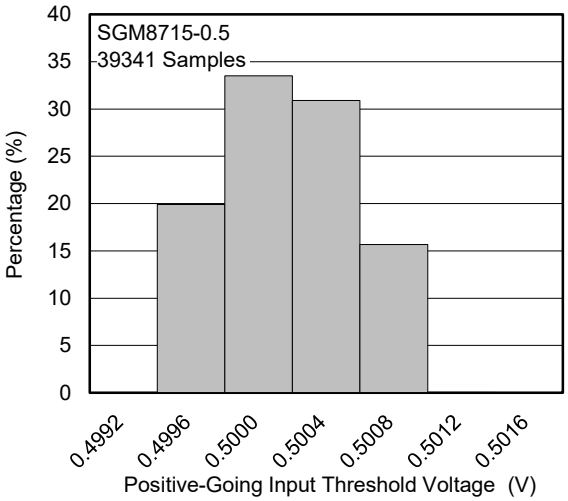
Positive-Going Input Threshold Voltage Production Distribution



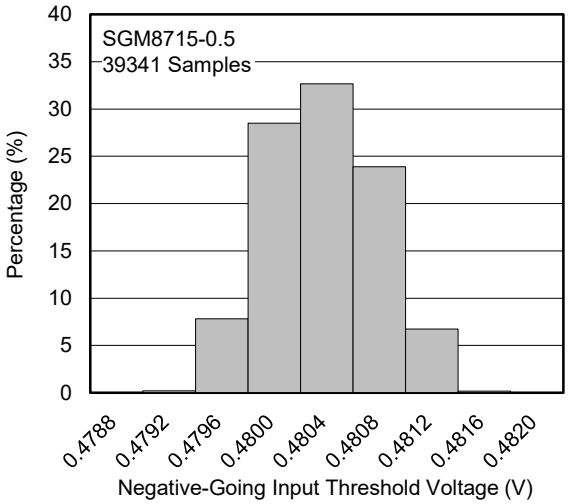
Negative-Going Input Threshold Voltage Production Distribution



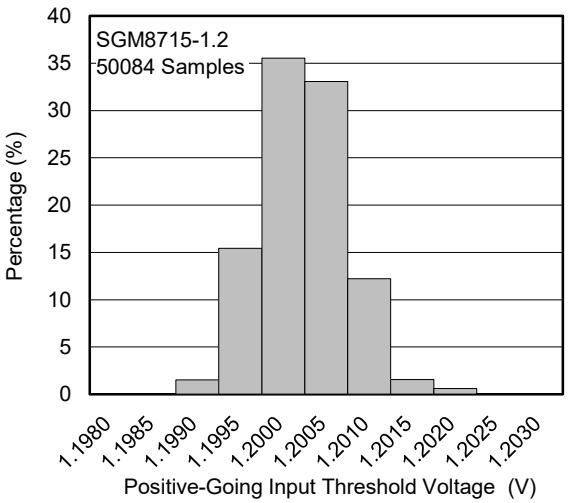
Positive-Going Input Threshold Voltage Production Distribution



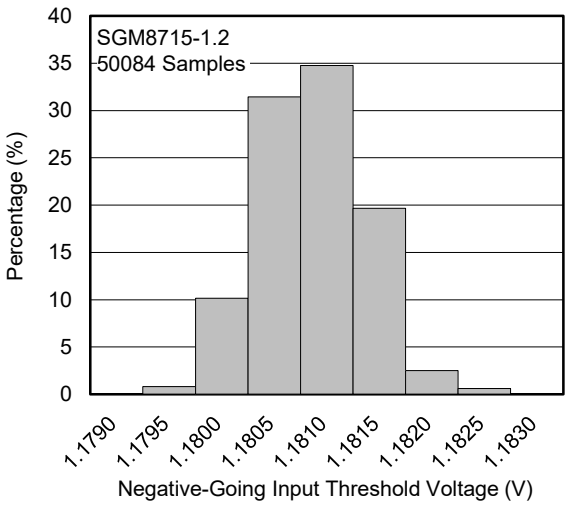
Negative-Going Input Threshold Voltage Production Distribution



Positive-Going Input Threshold Voltage Production Distribution



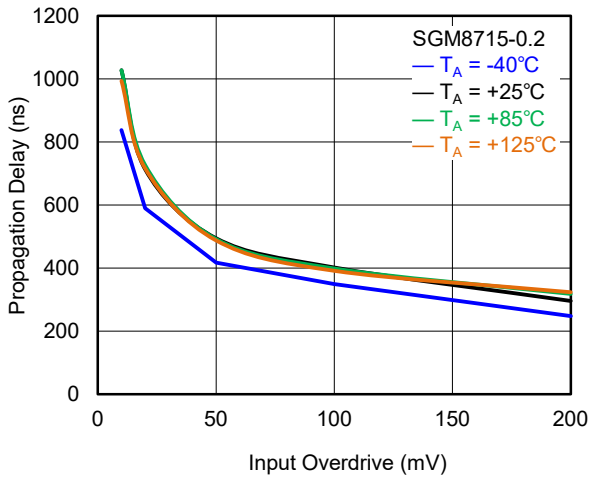
Negative-Going Input Threshold Voltage Production Distribution



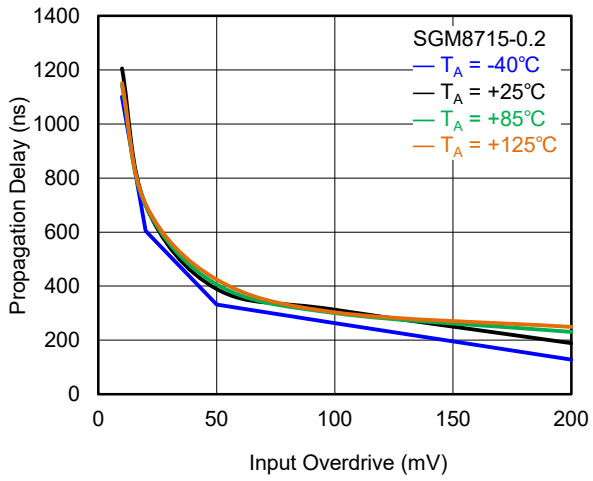
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At V_S = 3.3V, unless otherwise noted.

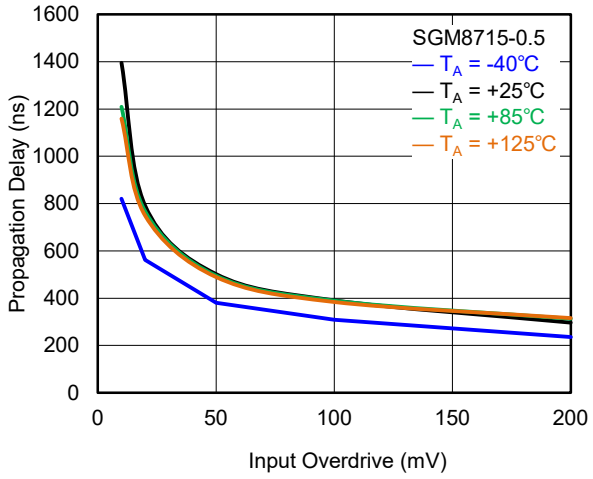
Propagation Delay (L-H) vs. Input Overdrive



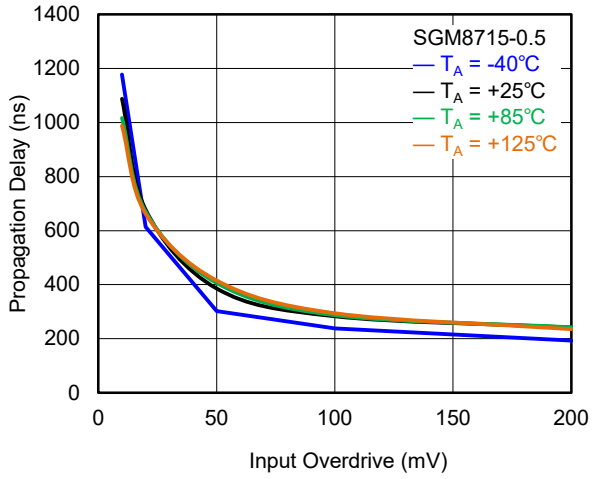
Propagation Delay (H-L) vs. Input Overdrive



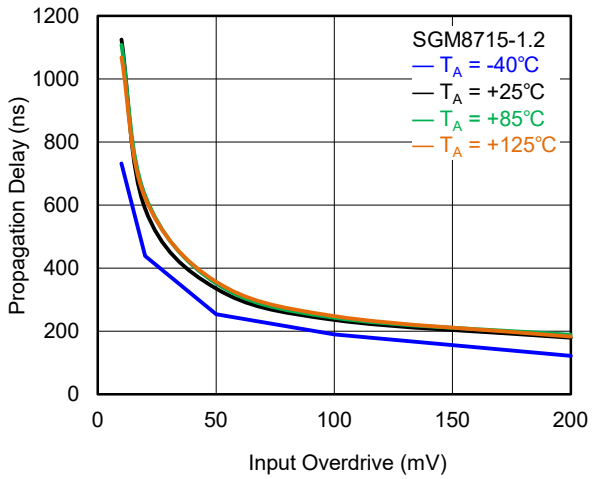
Propagation Delay (L-H) vs. Input Overdrive



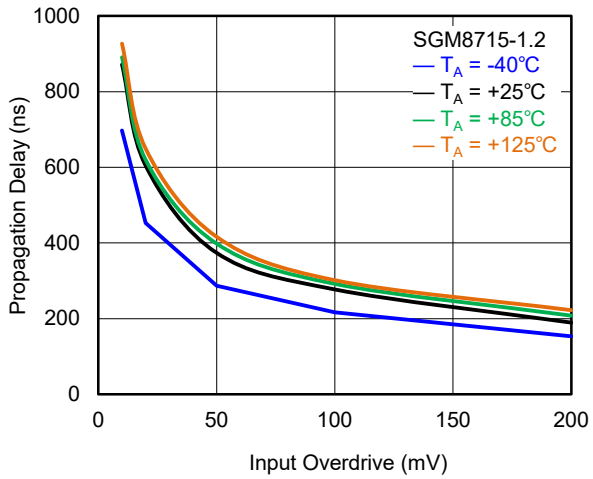
Propagation Delay (H-L) vs. Input Overdrive



Propagation Delay (L-H) vs. Input Overdrive



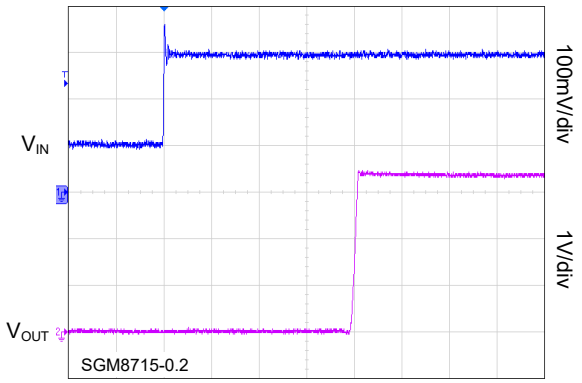
Propagation Delay (H-L) vs. Input Overdrive



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

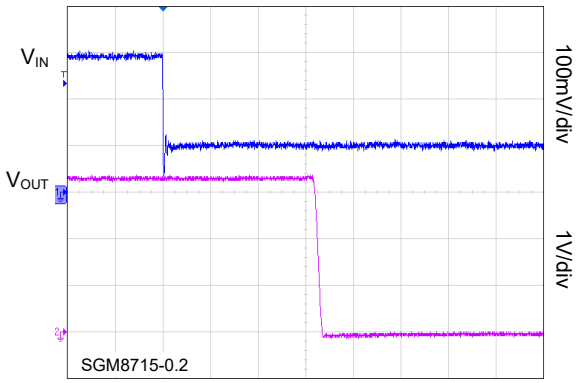
At T_A = +25℃, V_S = 3.3V, Overdrive = 100mV, unless otherwise noted.

Propagation Delay (L-H)



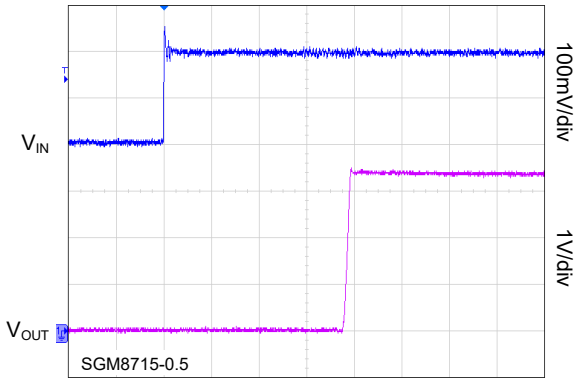
Time (100ns/div)

Propagation Delay (H-L)



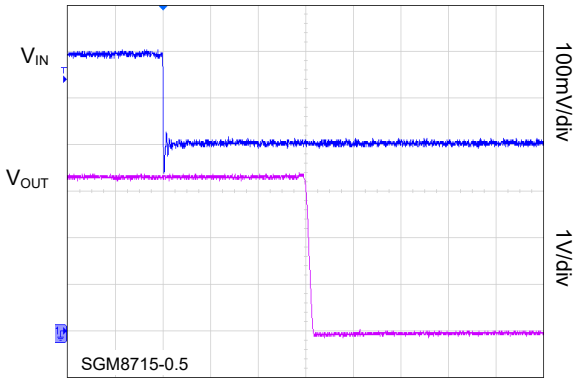
Time (100ns/div)

Propagation Delay (L-H)



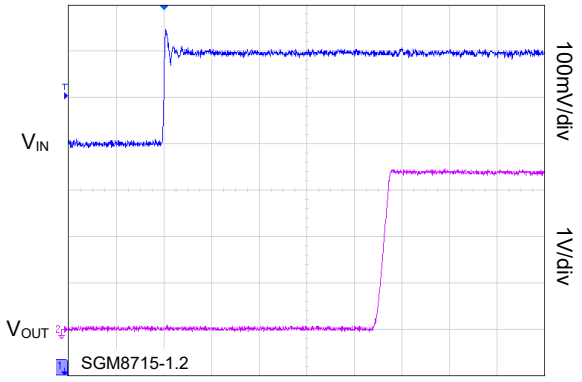
Time (100ns/div)

Propagation Delay (H-L)



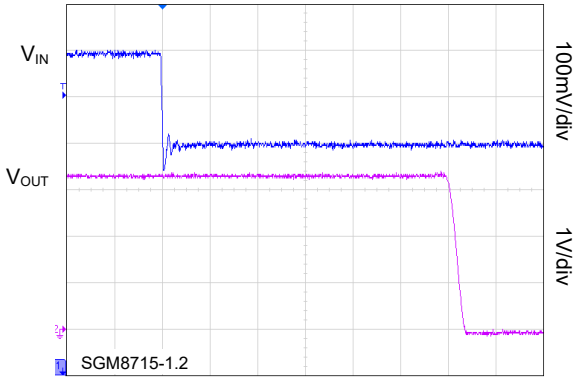
Time (100ns/div)

Propagation Delay (L-H)



Time (50ns/div)

Propagation Delay (H-L)

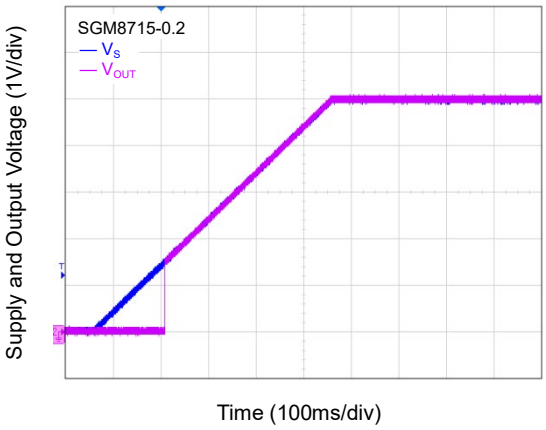


Time (50ns/div)

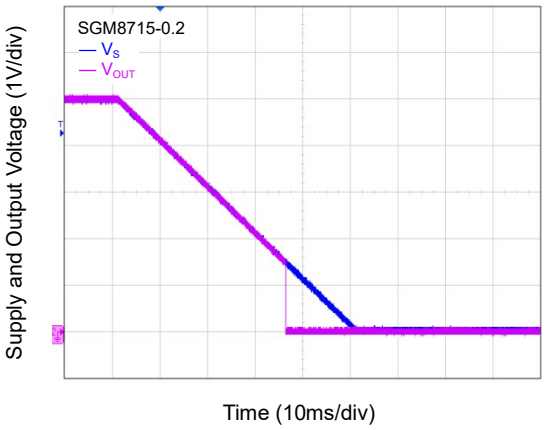
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{IN} = +V_S, unless otherwise noted.

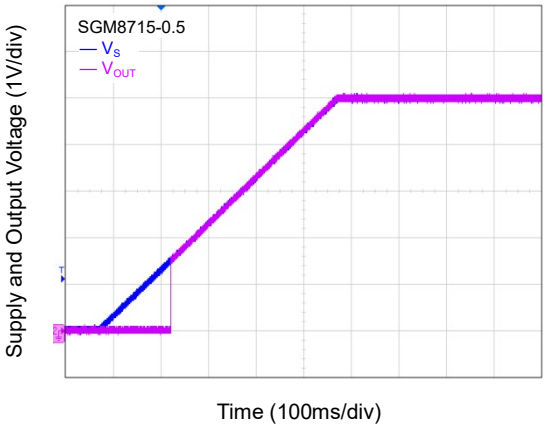
Output Response for V_S Rising



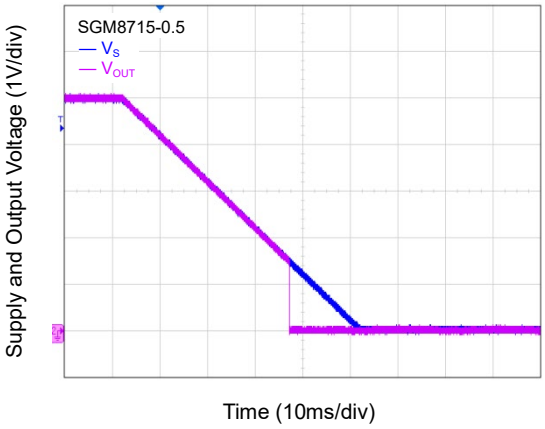
Output Response for V_S Falling



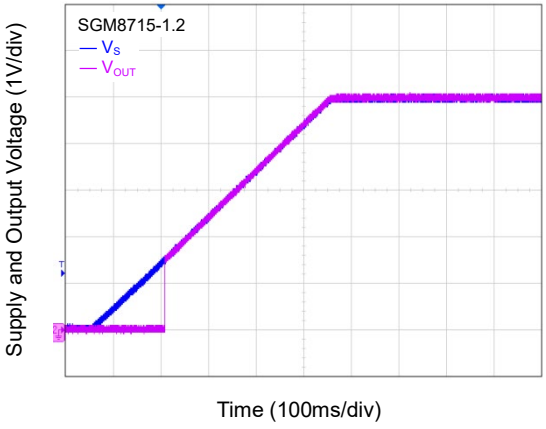
Output Response for V_S Rising



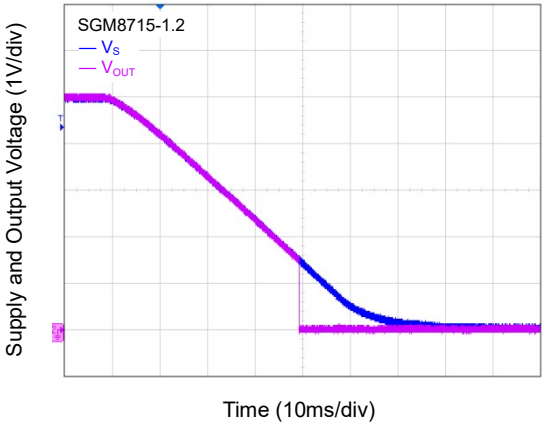
Output Response for V_S Falling



Output Response for V_S Rising



Output Response for V_S Falling



FUNCTIONAL BLOCK DIAGRAM

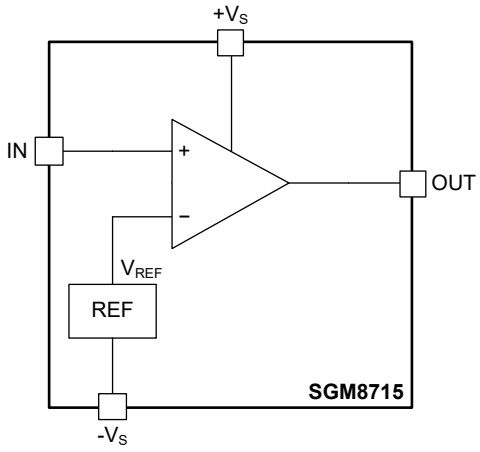


Figure 2. Block Diagram

DETAILED DESCRIPTION

The key parameters of the low power comparator SGM8715 include: a supply current of 1.8μA; switching thresholds of 0.2V, 0.5V and 1.2V, with corresponding propagation delays of 380ns for both the 0.2V and 0.5V versions, and 330ns for the 1.2V version; and a push-pull output. Table 1 illustrates the output logic of the SGM8715. V_{IT+} is the positive-going input threshold voltage that results in a state change of the comparator's output, while V_{IT-} is the negative-going input threshold voltage that triggers a change in the output state. Based on the above characteristics, the SGM8715 is suitable for voltage detection applications that require space-saving, low current and high precision performance, and can support power-sensitive systems in achieving rapid fault monitoring and response.

Table 1. SGM8715 Output Logic

Device	V_{IT+}	V_{IT-}	V_{IN}	Output Status
SGM8715-0.2	0.2V	0.18V	> V_{IT+}	High Level
			< V_{IT-}	Low Level
SGM8715-0.5	0.5V	0.48V	> V_{IT+}	High Level
			< V_{IT-}	Low Level
SGM8715-1.2	1.2V	1.18V	> V_{IT+}	High Level
			< V_{IT-}	Low Level

POR Function

The SGM8715 Power-on Reset (POR) circuit is included to ensure that the comparator output's start-up status is known. When the power supply ($+V_S$) is raised and $+V_S$ < V_{POR}, the POR circuit is activated, and the device output is clamped at the low level (on the $-V_S$ side).

Input

The external input of the SGM8715 serves as the non-inverting input of the comparator. The inverting input of the comparator is connected to the built-in voltage reference. The SGM8715 features a hysteresis voltage of 20mV. The voltage at the comparator's input terminal (IN) can always be 5.5V higher than that at the negative power supply terminal ($-V_S$), even when the power supply is not connected ($+V_S$ = 0V). In more complex environments, a bypass capacitor ranging from 1nF to 100nF can be connected to the input terminal. There is an input bias current of 10pA (TYP) between the $-V_S$ and $+V_S$ terminals. This current is affected by the ambient temperature. Inside the chip, there is a diode between the $-V_S$ and $+V_S$ terminals, which serves a protective function.

Internal Hysteresis

The SGM8715 has 20mV hysteresis (V_{HYS}), which helps improve the noise immunity. Figure 3 shows the relationship between V_{IT} and V_{HYS}. V_{IT} refers to the upper or lower switching threshold of the comparator.

V_{IT+} and V_{IT-} have variations of several mV over temperature. V_{IT+} and V_{IT-} are generated from the same internal reference voltage, so their error directions with temperature are consistent (co-directional drift). This means that the actual variation range of the hysteresis voltage is smaller than the maximum possible difference that could result from their independent errors.

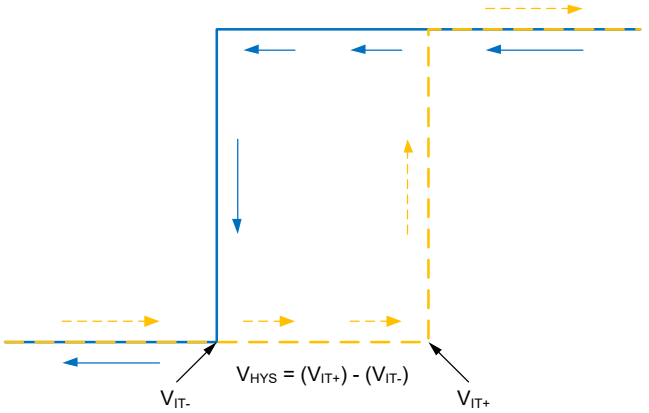


Figure 3. Hysteresis Transfer Curve

Output

The SGM8715 provides the output stage of push-pull.

APPLICATION INFORMATION

Typical Application

The SGM8715 can be used for under-voltage detection, with the specific circuit shown in Figure 4. The SGM8715-0.5 has a built-in 0.5V reference. When the external voltage V_{BAT} drops to a certain extent, the input voltage of the SGM8715-0.5 becomes lower than 0.48V, and the comparator outputs a low level. The MCU detects this low level, thereby triggering an alarm.

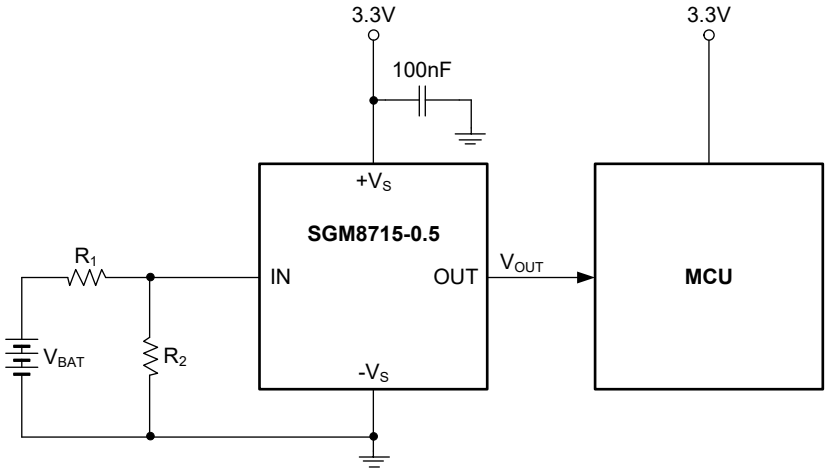


Figure 4. Under-Voltage Detection

Layout Recommendations

In applications, a 100nF bypass capacitor is recommended and should be placed as close as possible to the $+V_S$ pin.

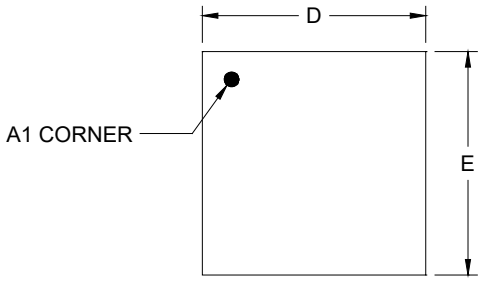
REVISION HISTORY

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

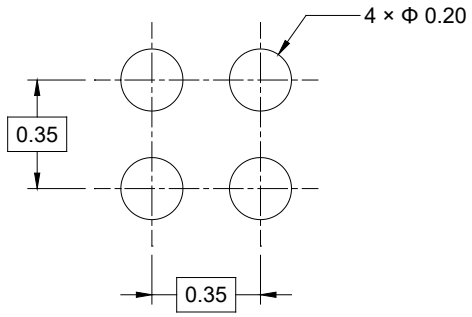
Changes from Original to REV.A (DECEMBER 2025)	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

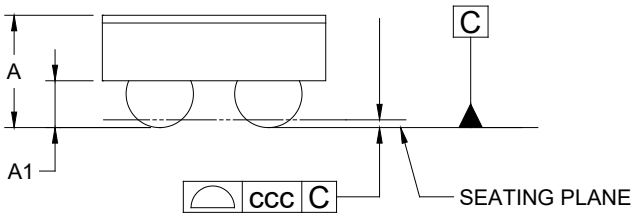
WLCSP-0.72×0.72-4B



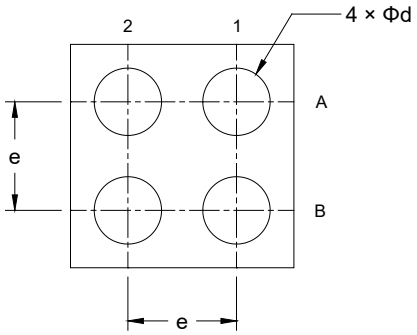
TOP VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



SIDE VIEW



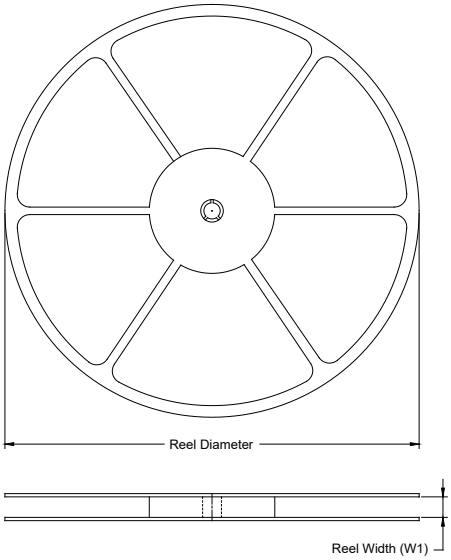
BOTTOM VIEW

Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	0.400
A1	0.131	-	0.171
D	0.690	-	0.750
E	0.690	-	0.750
d	0.187	-	0.247
e	0.350 BSC		
ccc	0.050		

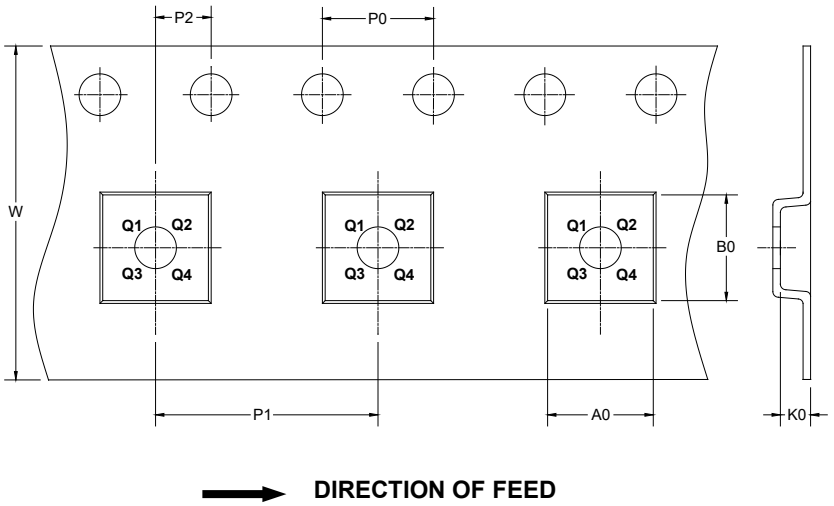
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



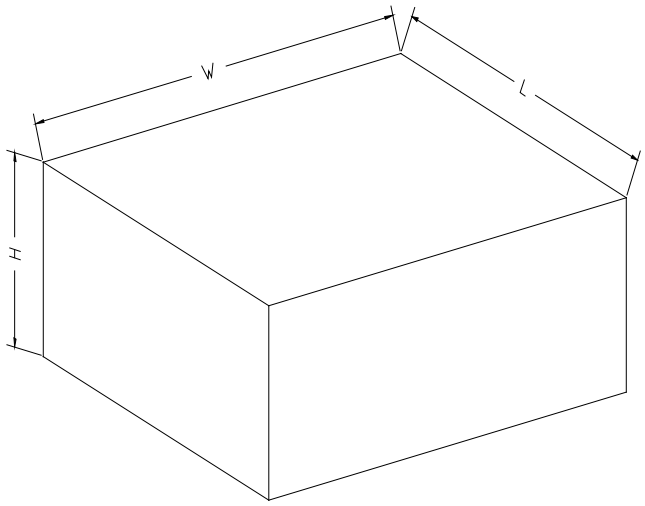
NOTE: The picture is only for reference. Please make the object as the standard.

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
WLCSP-0.72×0.72-4B	7″	9.5	0.77	0.79	0.48	4.0	4.0	2.0	8.0	Q1

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

DD0002