



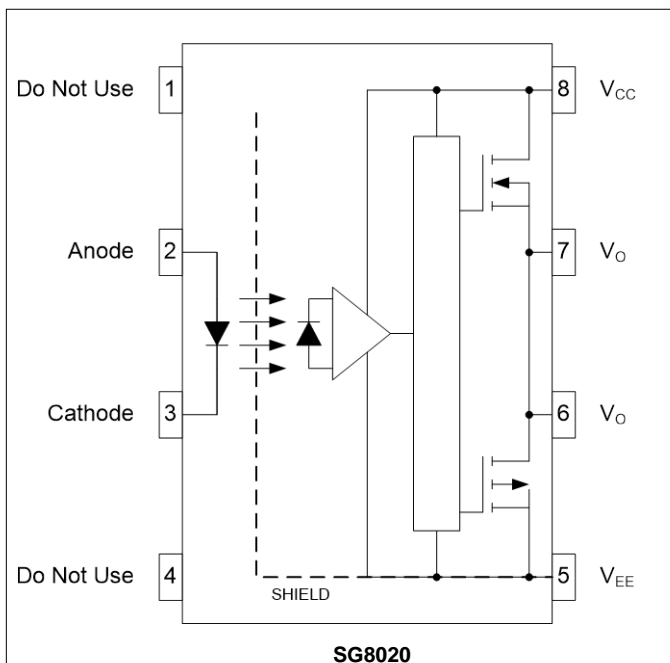
## Description

The SG8020 is an optically coupled 2.5A Output Current Gate Driver, designed to drive most 1200V / 100A IGBTs and MOSFETs. It is intended for driving high power IGBTs and MOSFETs used in motor control inverter applications.

The circuit consists of an infrared input LED optically coupled to an integrated circuit which utilizes a high speed driver.

The SG8020 comes standard in a miniature 8 pin DIP package.

## Schematic Diagram



## Truth Table (Positive Logic)

LED	$V_{CC}-V_{EE}$ ("Positive Going") Turn On	$V_{CC}-V_{EE}$ ("Negative Going") Turn Off	$V_O$
OFF	0 – 30V	0 – 30V	LOW
ON	0 – 11V	0 – 9.5V	LOW
ON	11 – 13.5V	10 – 12V	TRANSITION
ON	13.5 – 30V	12 – 30V	HIGH

**\*\* A 0.1 $\mu$ F bypass Capacitor must be connected between pins 5 & 8 (GND & V<sub>CC</sub>)**

## Applications

- IGBT / MOSFET Gate Drives
- AC & Brushless DC Motor Drives
- Industrial Inverters
- Uninterruptable Power Supplies (UPS)
- Switch Mode Power Supplies

## Features

- High Common Mode Rejection: 25kV/ $\mu$ S minimum @  $V_{CM} = 1500V$
- 2.5A Maximum Peak Output Current
- Fast Switching Speeds
  - 400nS Maximum Propagation Delay
  - 250nS Maximum Propagation Delay Difference
- $I_{CC}=3.8mA$  Maximum Supply Current
- Wide Supply Voltage Range (15V to 30V)
- Under Voltage Lockout Protection (UVLO) with Hysteresis
- Broad Temperature Performance Range (-40°C to 100°C)
- Low Power Dissipation ( $R_{ON} \leq 1\Omega$ )
- Rail-to-Rail Output Voltage
- High Input to Output Isolation (5kV<sub>RMS</sub>)
- RoHS / Pb-Free / REACH Compliant

## Agency Approvals

- UL/C-UL approved to UL1577
- VDE approved to EN60747-5-5

## Ordering Information

Part Number	Description
SG8020	8 pin DIP, (50/Tube)
SG8020-H	0.40" (10.16mm) Wide Lead Spacing (VDE0884)
SG8020-S	8 pin SMD, (50/Tube)
SG8020-STR	8 pin SMD, Tape and Reel (1000/Reel)

**NOTE: Suffixes listed above are not included in marking on device for part number identification**

**Absolute Maximum Ratings,  $T_A = 25^\circ\text{C}$  (unless otherwise specified)**

The values indicated are absolute stress ratings. Functional operation of the device is not implied at these or any conditions in excess of those defined in electrical characteristics section of this document. Exposure to absolute Maximum Ratings may cause permanent damage to the device and may adversely affect reliability.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Notes
<b>General Maximum Ratings</b>								
Storage Temperature	$T_{ST}$	-55	-	125	$^\circ\text{C}$			
Operating Temperature	$T_A$	-40	-	100	$^\circ\text{C}$			
Isolation Voltage	$V_{ISO}$	5000	-	-	$V_{RMS}$			
Supply Voltage	$V_{CC}$	0	-	35	V			
Solder Temperature – Wave (10 sec)	$T_{SOL}$	-	-	260	$^\circ\text{C}$			8
Total Power Dissipation	$P_T$	-	-	295	mW			
<b>Input Maximum Ratings</b>								
Average Forward Input Current	$I_{F(AVG)}$	-	-	25	mA			
Reverse Input Voltage	$V_R$	-	-	5	V			
Peak Transient Input Current	$I_{F(TRAN)}$	-	-	1	A	<1 $\mu\text{S}$ pulse width, 300pps		
Input Current (Rise / Fall Time)	$t_{r(IN)} / t_{f(IN)}$	-	-	500	nS			
Input Power Dissipation	$P_I$	-	-	45	mW			9
<b>Output Maximum Ratings</b>								
“High” Peak Output Current	$I_{OH(PEAK)}$	-	-	2.5	A			1
“Low” Peak Output Current	$I_{OL(PEAK)}$	-	-	2.5	A			1
Output Voltage	$V_O$	-	-	$V_{CC}$	V			
Output Power Dissipation	$P_O$	-	-	250	mW			10

**Recommended Operating Conditions**

The values indicated are recommended for steady, consistent operation with optimal performance across the operating temperature range.

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Notes
<b>Recommended Specifications</b>								
Operating Temperature	$T_A$	-40	-	100	$^\circ\text{C}$			
Supply Voltage	$V_{CC}$	15	-	30	V			
Input Current (ON)	$I_{FL(ON)}$	7	-	16	mA			
Input Voltage (OFF)	$V_{F(OFF)}$	-3.0	-	0.8	V			

**Electrical Characteristics**,  $T_A = 25^\circ\text{C}$ ,  $V_{EE} = \text{Ground}$  and  $V_{CC} = 30\text{V}$  (unless otherwise specified)

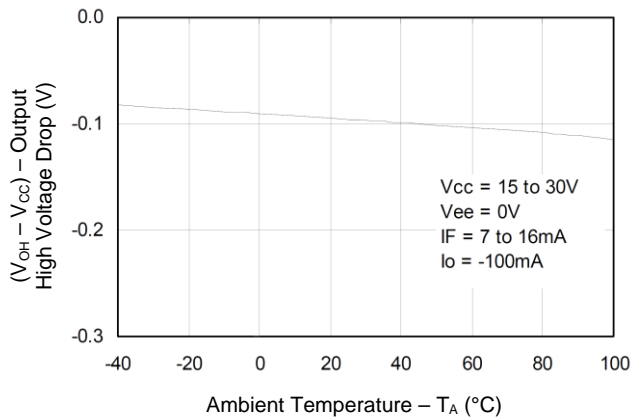
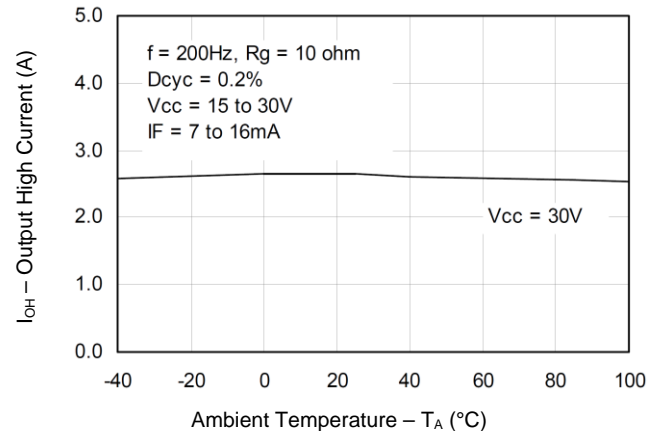
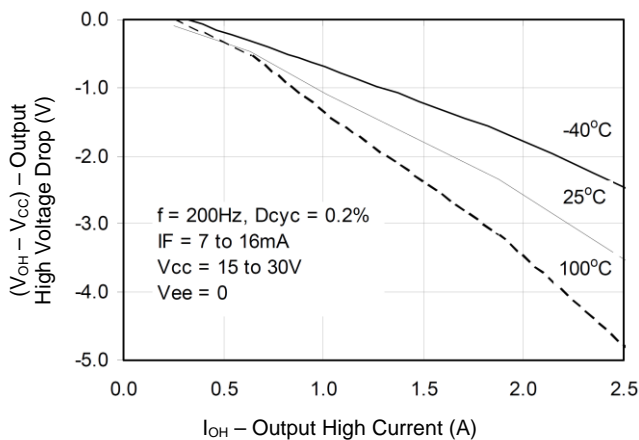
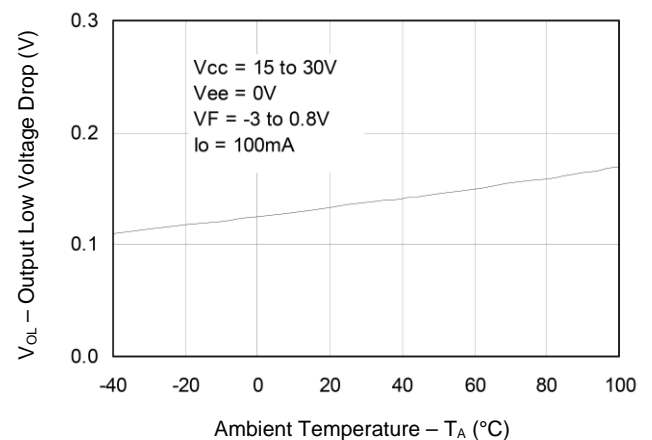
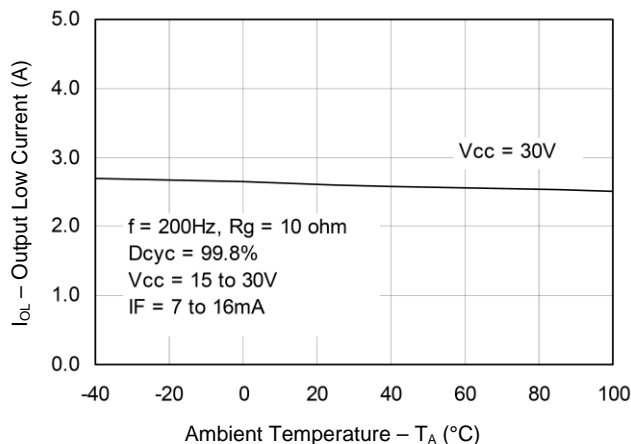
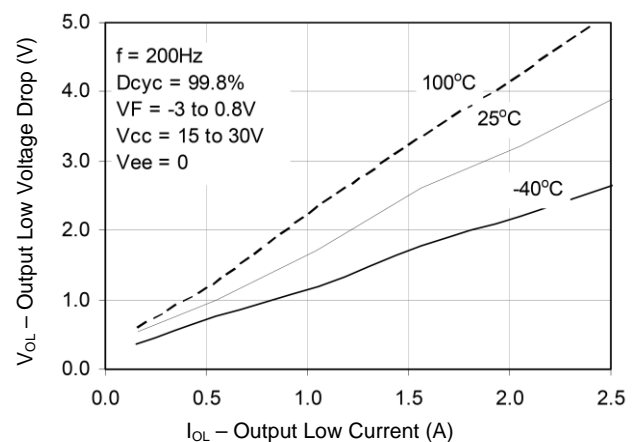
Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Notes
<b>Input Specifications</b>								
LED Forward Voltage	$V_F$	1.2	1.4	1.8	V	$I_F = 10\text{mA}$	15	
LED Forward Voltage Temperature Coefficient	$\Delta V_F / \Delta T$	-	-1.24	-	mV/°C	$I_F = 10\text{mA}$		
LED Reverse Voltage	$BV_R$	5	-	-	V	$I_R = 10\mu\text{A}$		
Input Threshold Current (Low to High)	$I_{FLH}$	-	2.9	5	mA	$V_O > 5\text{V}$ , $I_O = 0\text{A}$	9,16,21	
Input Threshold Voltage (High to Low)	$V_{FHL}$	0.8	-	-	V	$V_O < 5\text{V}$ , $I_O = 0\text{A}$		
Input Capacitance	$C_{IN}$	-	33	-	pF	$f = 1\text{MHz}$ , $V_F = 0\text{V}$		
<b>Output Specifications</b>								
High Level Supply Current	$I_{CCH}$	-	1	3	mA	Open $V_O$ , $I_F = 7$ to $16\text{mA}$	7,8	
Low Level Supply Current	$I_{CCL}$	-	1	3	mA	Open $V_O$ , $V_F = -3$ to $+0.8\text{V}$	7,8	
High Level Output Current	$I_{OH}$	-1.0	-2.0	-2.5	A	$V_O = (V_{CC} - 3\text{V})$	2,13,19	1
		-	-	2.0	A	$V_O = (V_{CC} - 6\text{V})$	2,13,19	1
Low Level Output Current	$I_{OL}$	1.0	2.0	2.5	A	$V_O = (V_{CC} + 3\text{V})$	5,6,20	1
		2.5	-	-	A	$V_O = (V_{CC} + 6\text{V})$	5,6,20	1
High Level Output Voltage	$V_{OH}$	$V_{CC} - 0.25$	$V_{CC} - 0.1$	-	V	$I_F = 10\text{mA}$ , $I_O = -100\text{mA}$	1,3,17	
Low Level Output Voltage	$V_{OL}$	-	$V_{EE} + 0.1$	$V_{EE} + 0.25$	V	$I_F = 0\text{mA}$ , $I_O = 100\text{mA}$	4,16,18	
Under Voltage Lockout Threshold	$V_{UVLO+}$	11.5	13.1	13.5	V	$V_O > 5\text{V}$ , $I_F = 10\text{mA}$	22	
	$V_{UVLO-}$	10.0	11.5	12.0	V	$V_O < 5\text{V}$ , $I_F = 10\text{mA}$	22	
Under Voltage Lockout Hysteresis	$UVLO_{HYS}$	-	1.6	-	V		22	
<b>Isolation Specifications</b>								
Withstand Insulation Test	$V_{ISO}$	5000	-	-	V	$RH \leq 40\text{-}60\%$ , $t = 1$ min		2,3
Input-Output Resistance	$R_{I-O}$	-	$10^{12}$	-	$\Omega$	$V_{I-O} = 500\text{V}_{DC}$		2
Input-Output Capacitance	$C_{I-O}$	-	0.9	-	pF	$f = 1\text{MHz}$		2

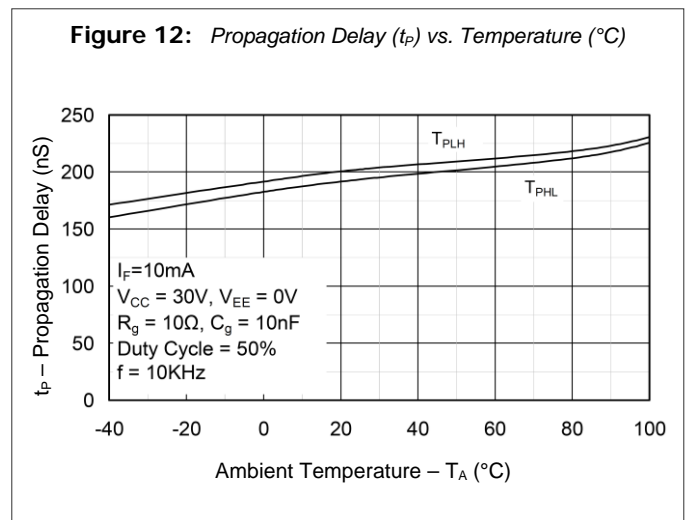
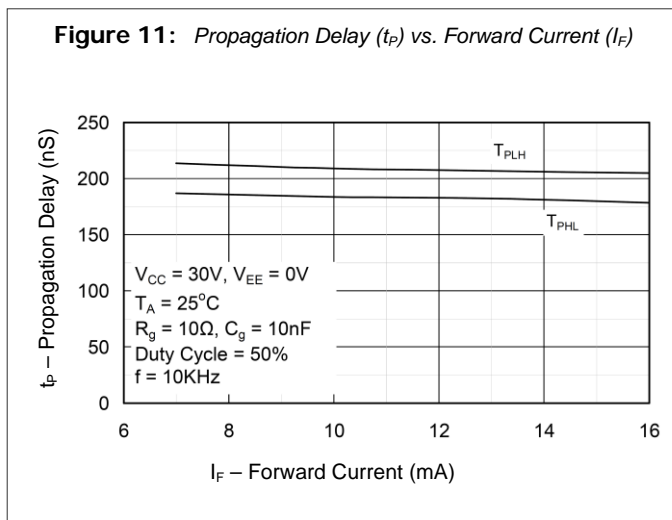
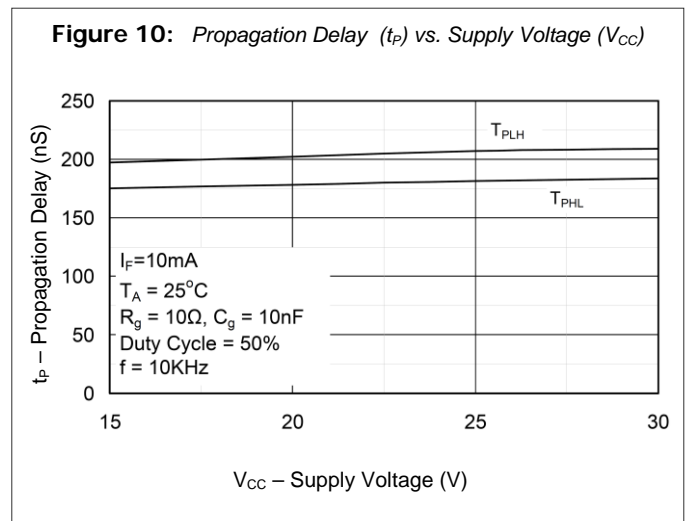
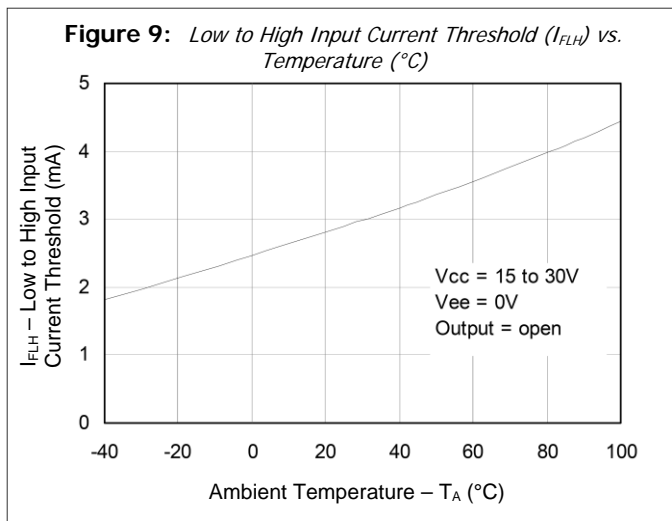
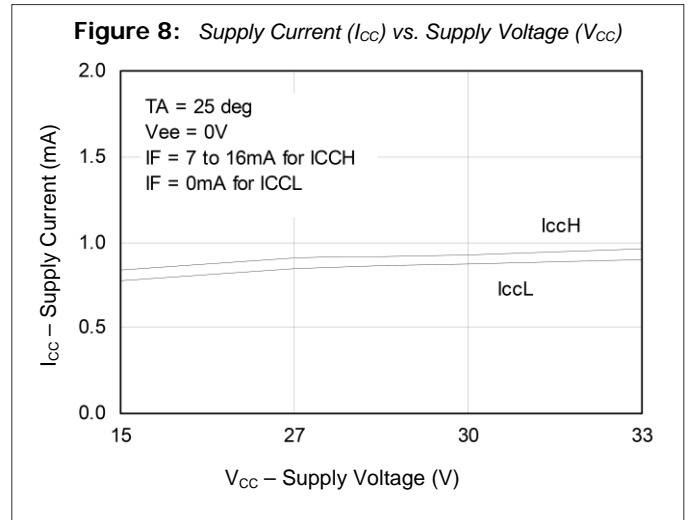
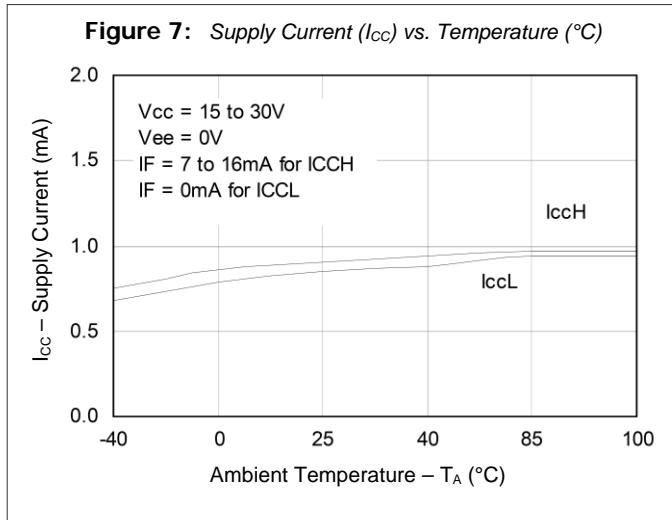
**Electrical Characteristics, continued...**  $T_A = 25^\circ\text{C}$ ,  $V_{EE} = \text{Ground}$  and  $V_{CC} = 30\text{V}$  (unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Notes
<b>Switching Specifications</b>								
Propagation Delay Time to High Output Level	$t_{PLH}$	100	210	400	nS	$I_F = 7$ to $16\text{mA}$ $V_{CC} = 15$ to $30\text{V}$ $V_{EE} = \text{Ground}$ $R_g = 10\Omega$ $C_g = 10\text{nF}$ $f = 10\text{kHz}$ Duty Cycle = 50%	10 11 12 13 14 23	7
Propagation Delay Time to Low Output Level	$t_{PHL}$	100	185	400				
Pulse Width Distortion	PWD	-	25	100				
Propagation Delay Difference Between Any Two Parts	PDD	-250	-	250			23	4
Output Rise Time (10 to 90%)	$t_r$	-	50	-				
Output Fall Time (90 – 10%)	$t_f$	-	45	-				
UVLO Turn On Delay	$t_{UVLO\ ON}$	-	1.5	-	$\mu\text{S}$	$I_F = 10\text{mA}$ , $V_O > 5\text{V}$		
UVLO Turn Off Delay	$t_{UVLO\ OFF}$	-	0.2	-	$\mu\text{S}$	$I_F = 10\text{mA}$ , $V_O < 5\text{V}$		
Common Mode Transient Immunity at HIGH Level Output	$ CM_H $	25	35	-	$\text{kV}/\mu\text{S}$	$I_F = 10$ to $16\text{mA}$ $V_{CM} = 1500\text{V}$ $T_A = 25^\circ\text{C}$ $V_{CC} = 30\text{V}$	24	5
Common Mode Transient Immunity at LOW Level Output	$ CM_L $	25	35	-	$\text{kV}/\mu\text{S}$	$V_F = 0\text{V}$ $V_{CM} = 1500\text{V}$ $T_A = 25^\circ\text{C}$ $V_{CC} = 3\text{V}$		6

**Notes**

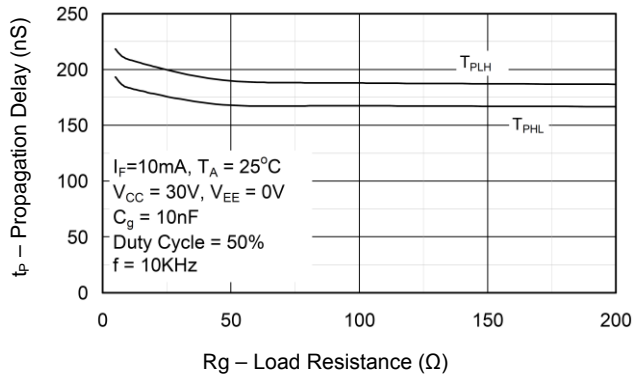
- Maximum pulse width =  $10\mu\text{S}$ , maximum duty cycle = 0.2%
- Device is considered a two-terminal device: pins 1, 2, 3, and 4 shorted together, and pins 5, 6, 7, and 8 shorted together
- In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage  $\geq 6000 V_{RMS}$  for one second (leakage current less than  $5\mu\text{A}$ )
- The difference between  $T_{PHL}$  and  $T_{PLH}$  between any two SG8020 devices under the same test conditions
- Common mode transient immunity in HIGH stage is the maximum tolerable negative  $dV_{CM}/dt$  on the trailing edge of the common mode impulse signal,  $V_{CM}$ , to assure that the output will remain HIGH
- Common mode transient immunity in LOW stage is the maximum tolerable positive  $dV_{CM}/dt$  on the leading edge of the common mode impulse signal,  $V_{CM}$ , to assure that the output will remain LOW
- Pulse Width Distortion is defined as  $|T_{PHL} - T_{PLH}|$  for any given device
- $260^\circ\text{C}$  for 10 seconds. Refer to the lead free solder reflow profile for more information
- Derate linearly above  $70^\circ\text{C}$  free air temperature at a rate of  $0.47\text{mW} / ^\circ\text{C}$
- Derate linearly above  $70^\circ\text{C}$  free air temperature at a rate of  $4.8\text{mW} / ^\circ\text{C}$

**SG8020 Performance & Characteristics Plots,  $T_A = 25^\circ\text{C}$  (unless otherwise specified)**
**Figure 1: Output High Voltage Drop vs. Temperature ( $^\circ\text{C}$ )**

**Figure 2: Output High Current vs. Temperature ( $^\circ\text{C}$ )**

**Figure 3: Output High Voltage Drop vs. High Current**

**Figure 4: Output Low Voltage Drop vs. Temperature ( $^\circ\text{C}$ )**

**Figure 5: Output Low Current vs. Temperature ( $^\circ\text{C}$ )**

**Figure 6: Output Low Voltage Drop vs. Low Current**


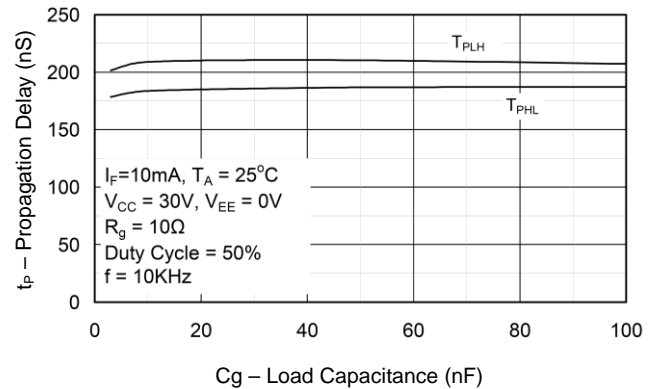
**SG8020 Performance & Characteristics Plots, continued...**  $T_A = 25^\circ\text{C}$  (unless otherwise specified)


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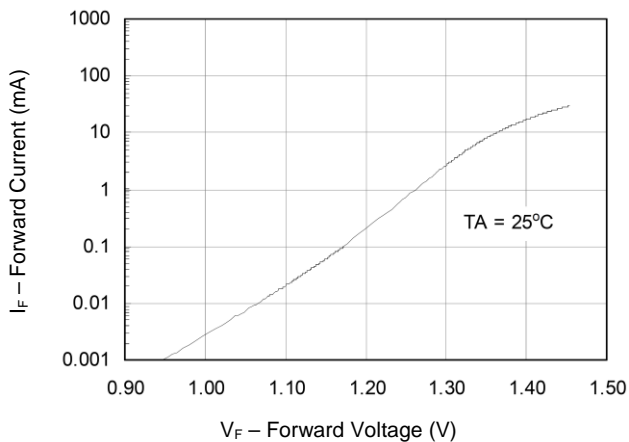
**Figure 13:** Propagation Delay ( $t_p$ ) vs. Series Load Resistance ( $R_g$ )



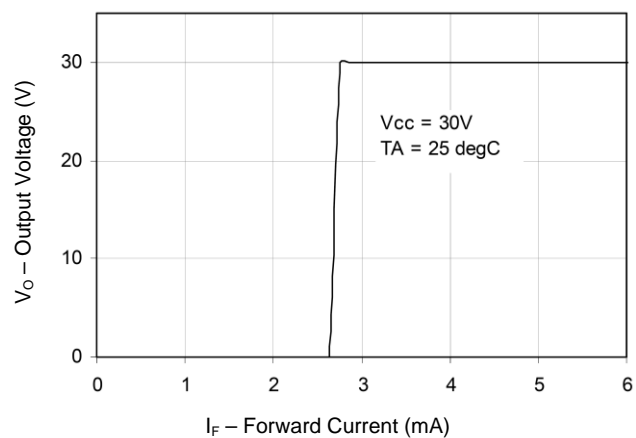
**Figure 14:** Propagation Delay ( $t_p$ ) vs. Load Capacitance ( $C_g$ )



**Figure 15:** Forward Current ( $I_F$ ) vs. Forward Voltage ( $V_F$ )

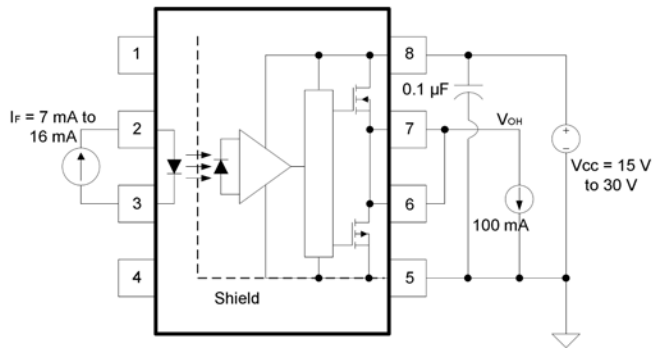


**Figure 16:** Transfer Characteristics

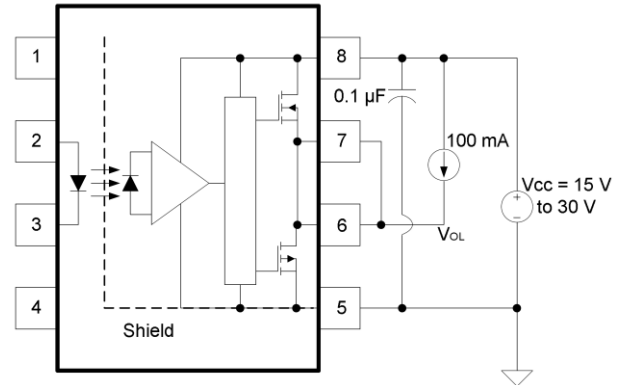


**SG8020 Electrical Test Circuits**

**Figure 17: High Level Output Voltage ( $V_{OH}$ ) Test Circuit**

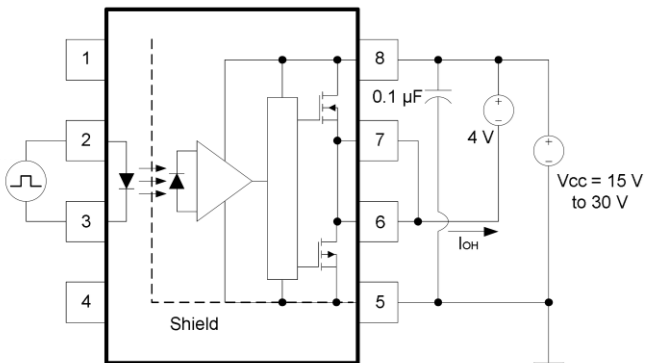


**Figure 18: Low Level Output Voltage ( $V_{OL}$ ) Test Circuit**



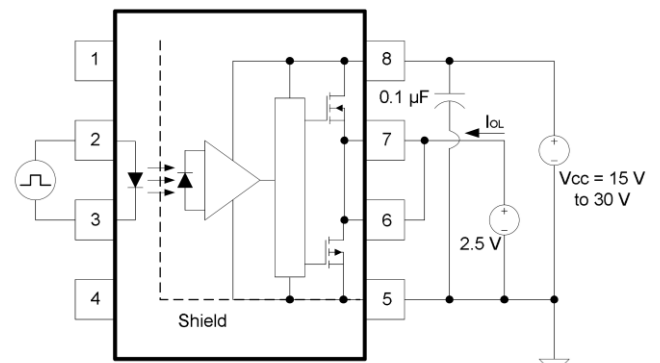
**Figure 19: High Level Output Current ( $I_{OH}$ ) Test Circuit**

$I_F = 7\text{mA to }16\text{mA}$   
 $PW = 10\mu\text{S}$   
Period = 5mS

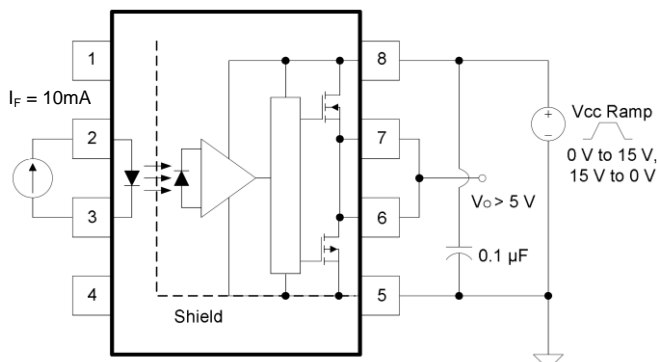


**Figure 20: Low Level Output Current ( $I_{OL}$ ) Test Circuit**

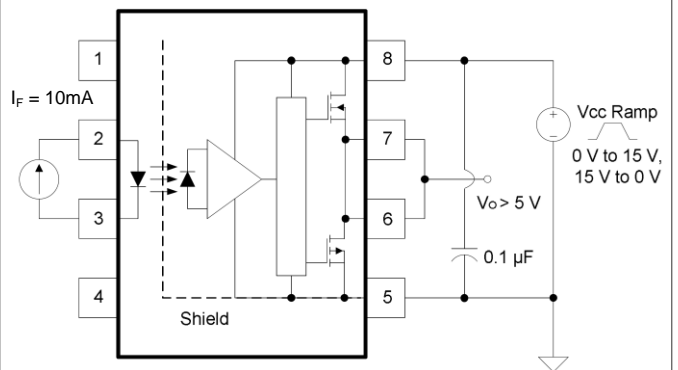
$I_F = 7\text{mA to }16\text{mA}$   
 $PW = 4.99\text{mS}$   
Period = 5mS



**Figure 21: Input Threshold Current ( $I_{FLH}$ ) Test Circuit**



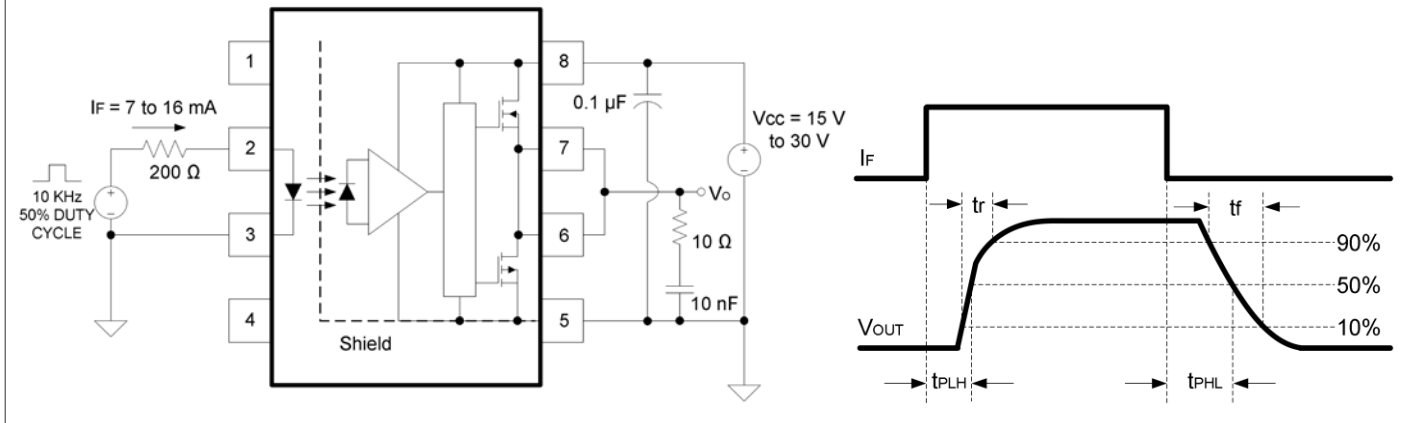
**Figure 22: UVLO Test Circuit**



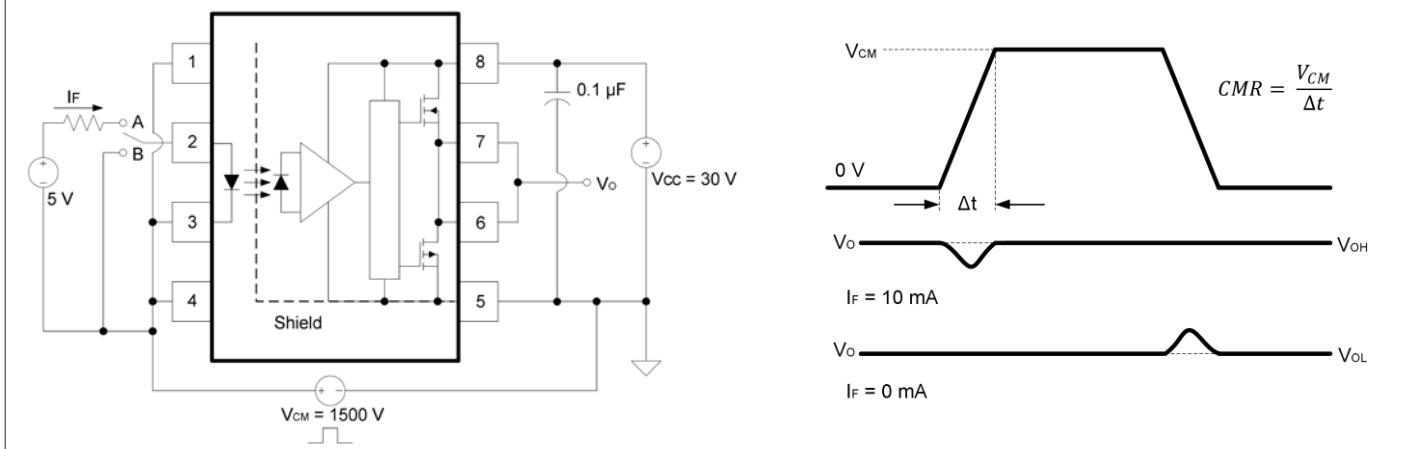


**SG8020 Electrical Test Circuits, continued...**

**Figure 23:** Rise Time ( $t_r$ ), Fall Time ( $t_f$ ), and Propagation Delay Times ( $t_{PLH}$  and  $t_{PHL}$ ) Test Circuit & Waveforms

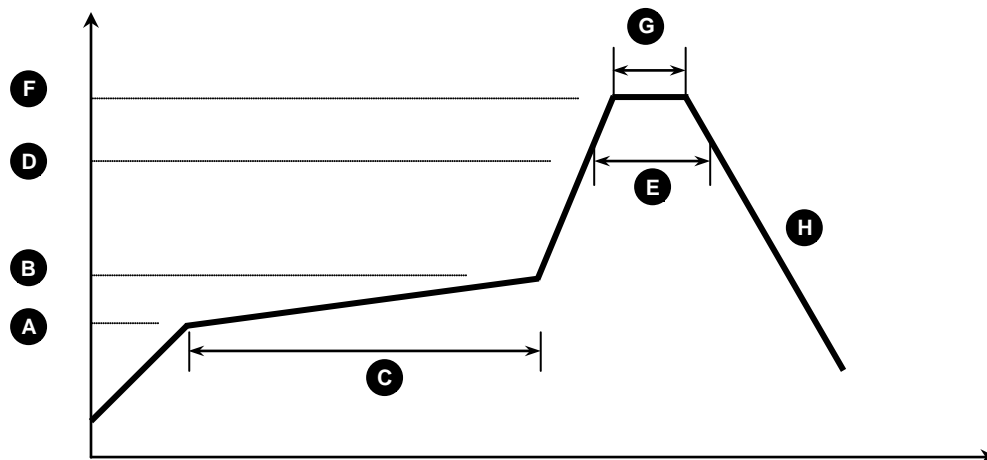


**Figure 24:** CMR Test Circuit & Waveforms



**SG8020 Solder Reflow Temperature Profile Recommendations**
**(1) Infrared Reflow:**

Refer to the following figure as an example of an optimal temperature profile for single occurrence infrared reflow. Soldering process should not exceed temperature or time limits expressed herein. Surface temperature of device package should not exceed 250°C:



Process Step	Description	Parameter
A	Preheat Start Temperature (°C)	150°C
B	Preheat Finish Temperature (°C)	180°C
C	Preheat Time (s)	90 - 120s
D	Melting Temperature (°C)	230°C
E	Time above Melting Temperature (s)	30s
F	Peak Temperature, at Terminal (°C)	260°C
G	Dwell Time at Peak Temperature (s)	10s
H	Cool-down (°C/s)	<6°C/s

**(2) Wave Solder:**

Maximum Temperature: 260°C (at terminal)  
 Maximum Time: 10s  
 Pre-heating: 100 - 150°C (30 - 90s)  
 Single Occurrence

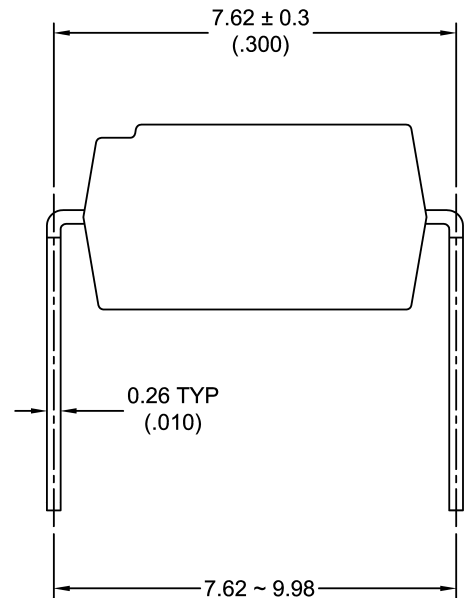
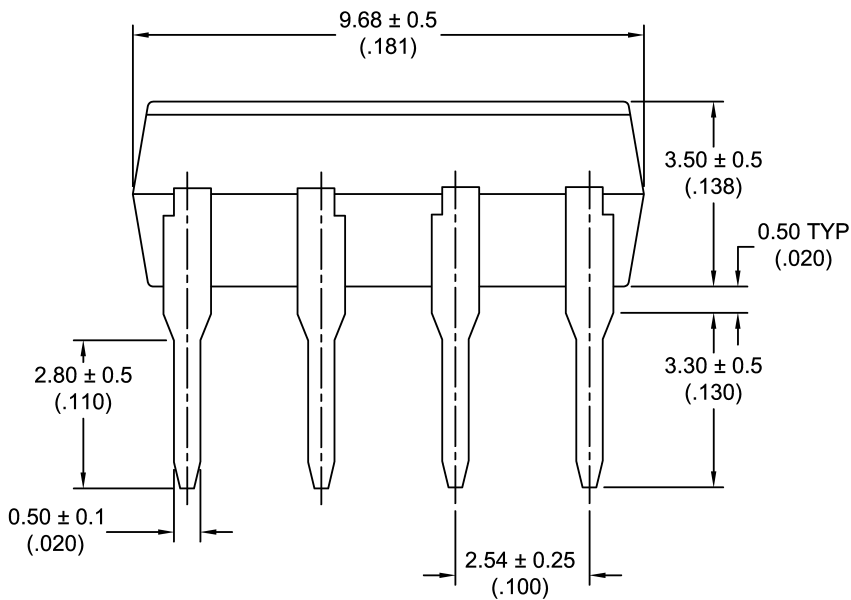
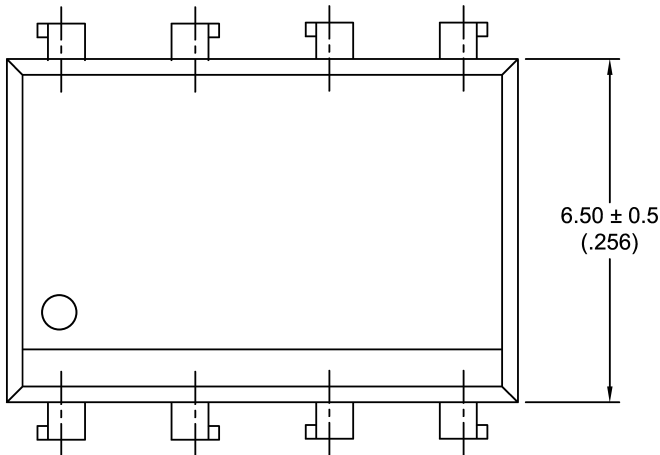
**(3) Hand Solder:**

Maximum Temperature: 350°C (at tip of soldering iron)  
 Maximum Time: 3s  
 Single Occurrence

**SG8020 Package Dimensions**

8 PIN DIP Package

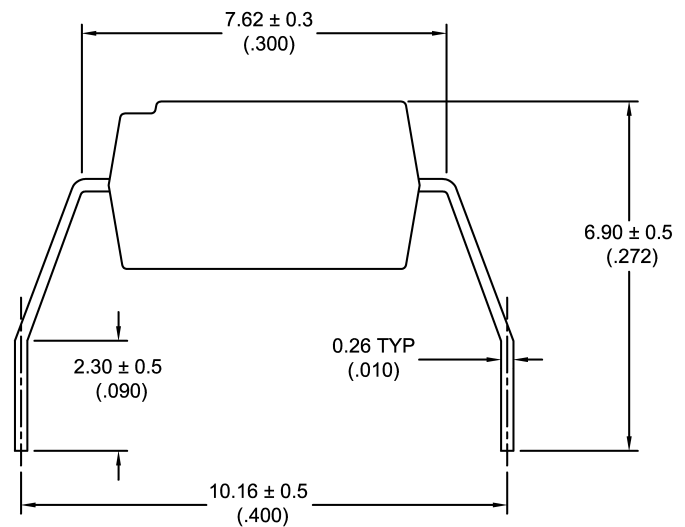
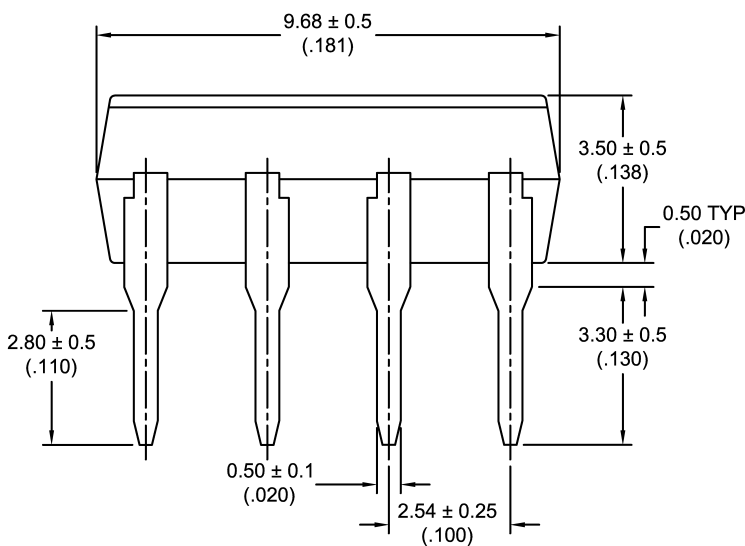
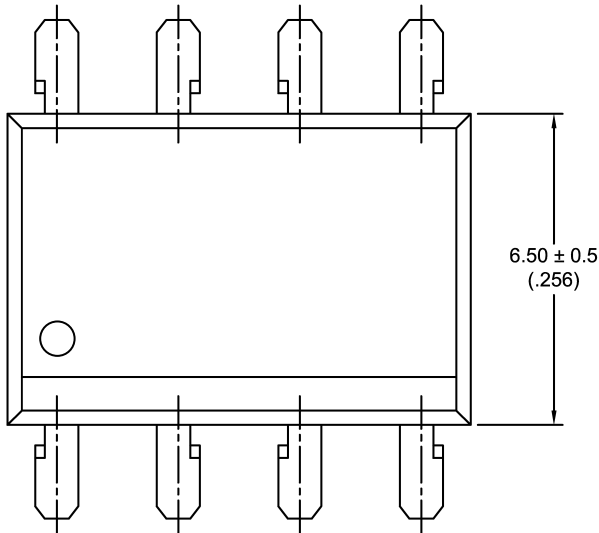
**Note:** All dimensions in millimeters [mm] with inches in parenthesis ( )



**SG8020 Package Dimensions**

8 PIN WIDE Lead Space Package (-H)

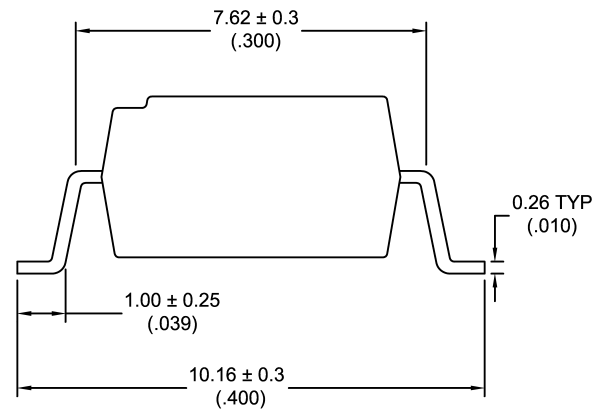
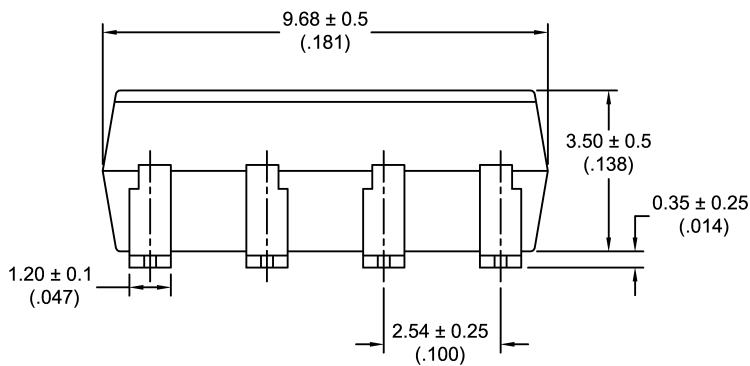
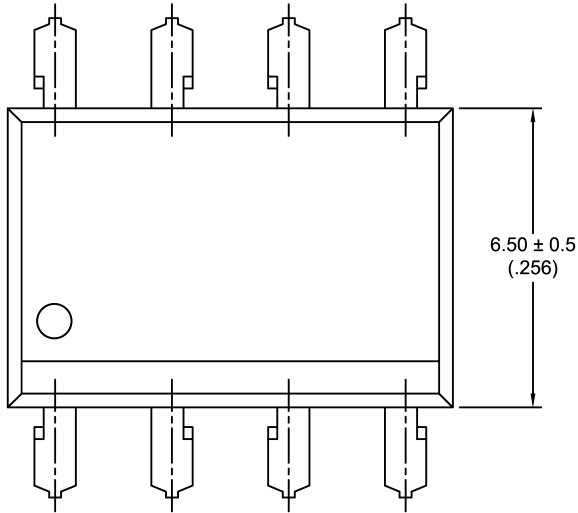
**Note:** All dimensions in millimeters [mm] with inches in parenthesis ( )



**SG8020 Package Dimensions**

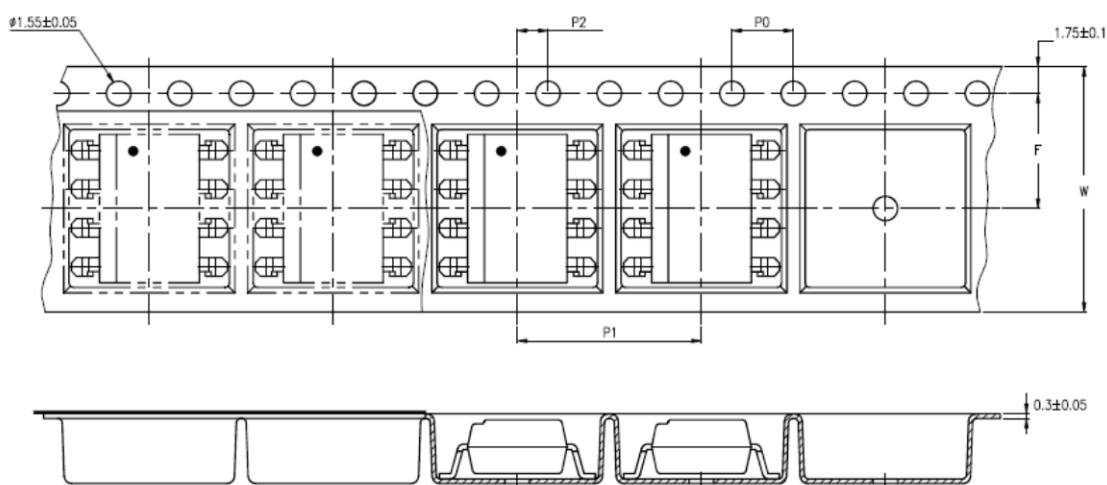
8 PIN SMD Surface Mount Package (-S)

**Note:** All dimensions in millimeters [mm] with inches in parenthesis ( )

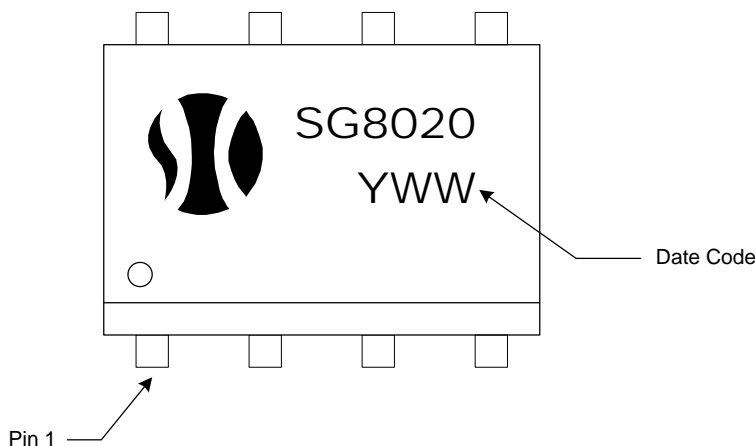


**SG8020 Packaging Specifications**

Tape &amp; Reel Specifications (T&amp;R)

**Note:** All dimensions in millimeters [mm] with inches in parenthesis ( )


Specification	Symbol	Dimensions, mm ( inches )
Tape Width	W	$16 \pm 0.3$ ( 0.63 )
Sprocket Hole Pitch	P0	$4 \pm 0.1$ ( 0.15 )
Compartment Location	F P2	$7.5 \pm 0.1$ ( 0.295 ) $2 \pm 0.1$ ( 0.079 )
Compartment Pitch	P1	$12 \pm 0.1$ ( 0.472 )

**SG8020 Packaging Marking**

**SG8020 Package Weights**

Device	Single Unit	Full Tube (50pcs)	Full Pouch (10 tubes)	Full Reel (1000pcs)
SG8020	0.54	48	490	-
SG8020-S	0.53	46	470	-
SG8020-H	0.55	49	500	-
SG8020-STR	0.53	-	-	480

**Note:** All weights above are in GRAMS, and include packaging materials where applicable

**DISCLAIMER**

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