SOLID STATE OPTRONICS



SG8020

2.5A Output Current
IGBT Gate Drive Optocoupler

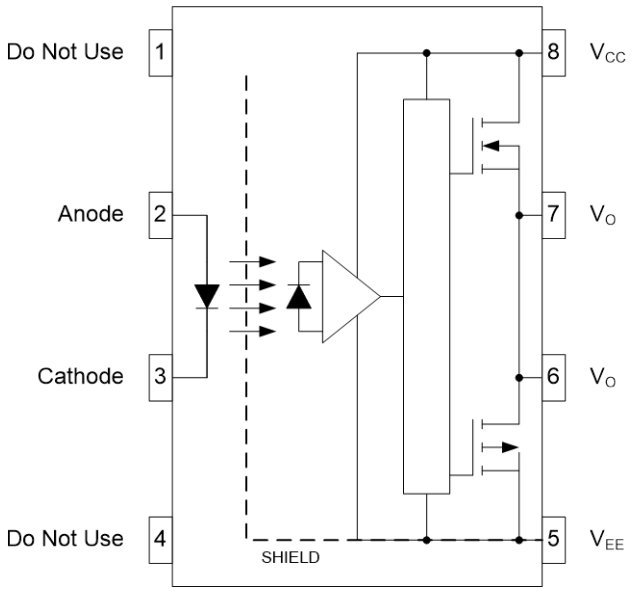
Description

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



SG8020

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 0.1µF bypass Capacitor must be connected between pins 5 & 8 (GND & V_{CC})**

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/µS minimum @ V_{CM} = 1500V
- 2.5A Maximum Peak Output Current
- Fast Switching Speeds
  - o 400nS Maximum Propagation Delay
  - o 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} ≤ 1Ω)
- Rail-to-Rail Output Voltage
- High Input to Output Isolation (5kV_{RMS})
- 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

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Absolute Maximum Ratings, T_A = 25°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
General Maximum Ratings								
Storage Temperature	T_{ST}	-55	-	125	°C			
Operating Temperature	T_A	-40	-	100	°C			
Isolation Voltage	V_{ISO}	5000	-	-	V_{RMS}			
Supply Voltage	V_{CC}	0	-	35	V			
Solder Temperature – Wave (10 sec)	T_{SOL}	-	-	260	°C			8
Total Power Dissipation	P_T	-	-	295	mW			
Input Maximum Ratings								
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	<1μS pulse width, 300pps		
Input Current (Rise / Fall Time)	$t_{r(IN)}$ / $t_{f(IN)}$	-	-	500	nS			
Input Power Dissipation	P_I	-	-	45	mW			9
Output Maximum Ratings								
“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
Recommended Specifications								
Operating Temperature	T_A	-40	-	100	°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			

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Electrical Characteristics, T_A = 25°C, V_{EE} = Ground and V_{CC} = 30V (unless otherwise specified)

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

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Electrical Characteristics, continued… T_A = 25°C, V_{EE} = Ground and V_{CC} = 30V (unless otherwise specified)

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

Notes

1. Maximum pulse width = 10µS, maximum duty cycle = 0.2%
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
3. In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage ≥6000 V_{RMS} for one second (leakage current less than 5 µA)
4. The difference between T_{PHL} and T_{PLH} between any two SG8020 devices under the same test conditions
5. 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
6. 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
7. Pulse Width Distortion is defined as $|T_{PHL} - T_{PLH}|$ for any given device
8. 260°C for 10 seconds. Refer to the lead free solder reflow profile for more information
9. Derate linearly above 70°C free air temperature at a rate of 0.47mW / °C
10. Derate linerally above 70°C free air temperature at a rate of 4.8mW / °C

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SG8020 Performance & Characteristics Plots, T_A = 25°C (unless otherwise specified)

Figure 1: *Output High Voltage Drop vs. Temperature (°C)*

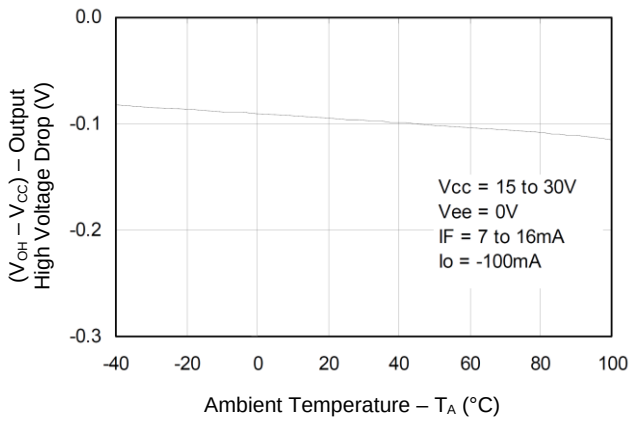


Figure 2: *Output High Current vs. Temperature (°C)*

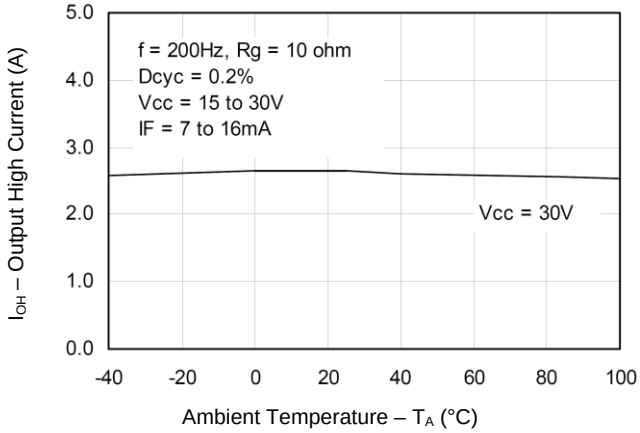


Figure 3: *Output High Voltage Drop vs. High Current*

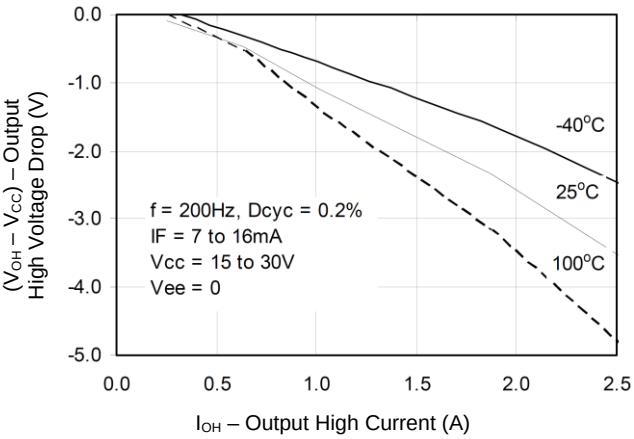


Figure 4: *Output Low Voltage vs. Temperature (°C)*

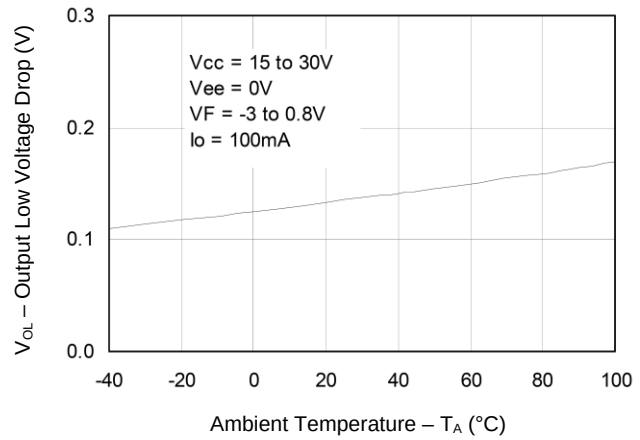


Figure 5: *Output Low Current vs. Temperature (°C)*

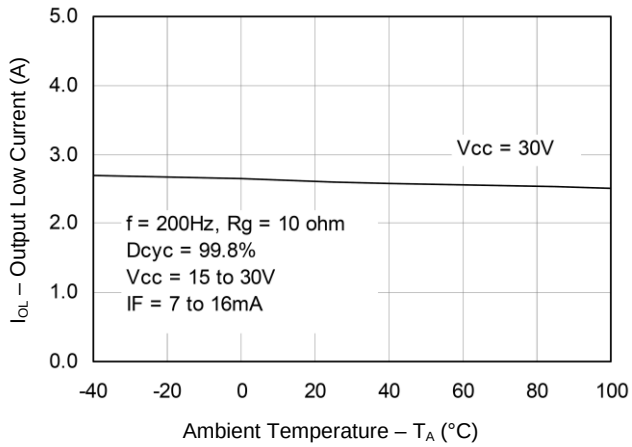
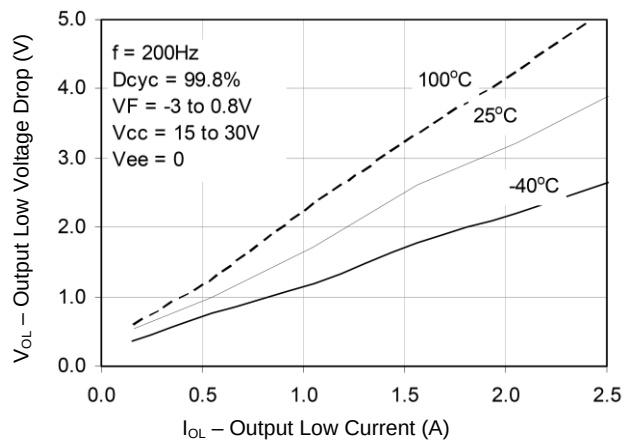


Figure 6: *Output Low Voltage Drop vs. Low Current*



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SG8020 Performance & Characteristics Plots, continued… T_A = 25°C (unless otherwise specified)

Figure 7: *Supply Current (I_{CC}) vs. Temperature (°C)*

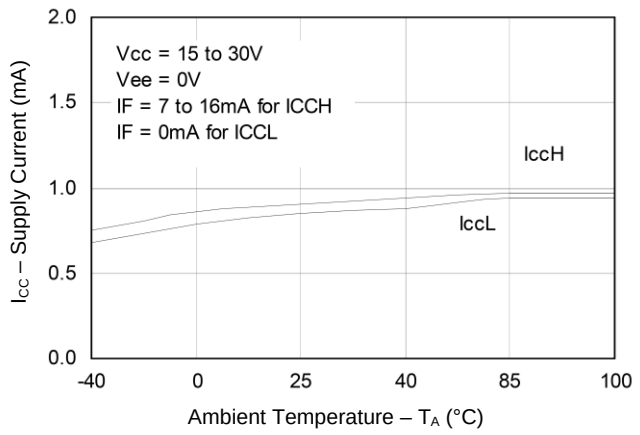


Figure 8: *Supply Current (I_{CC}) vs. Supply Voltage (V_{CC})*

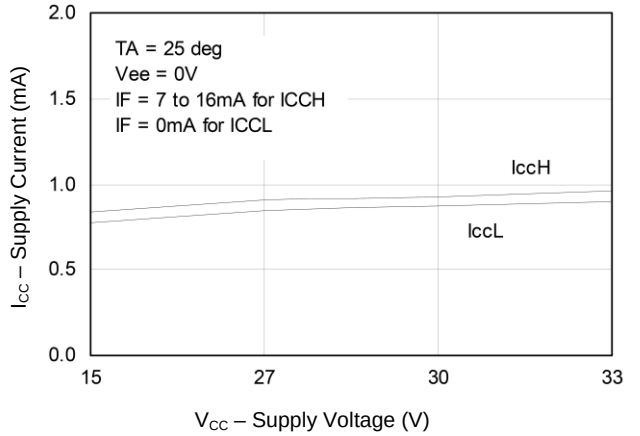


Figure 9: *Low to High Input Current Threshold (I_{FLH}) vs. Temperature (°C)*

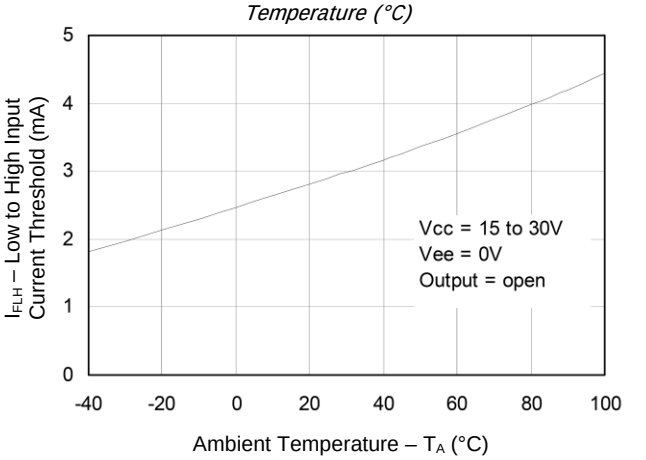


Figure 10: *Propagation Delay (t_P) vs. Supply Voltage (V_{CC})*

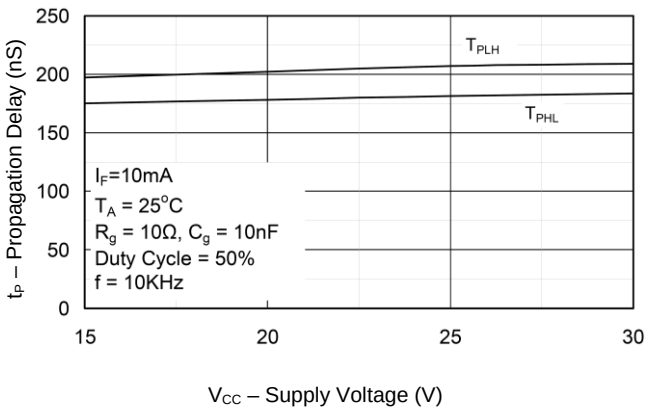


Figure 11: *Propagation Delay (t_P) vs. Forward Current (I_F)*

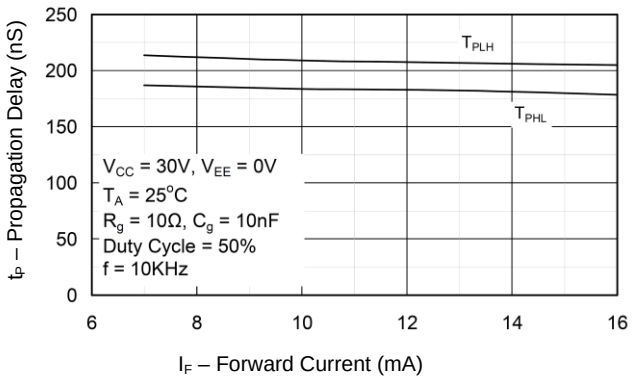
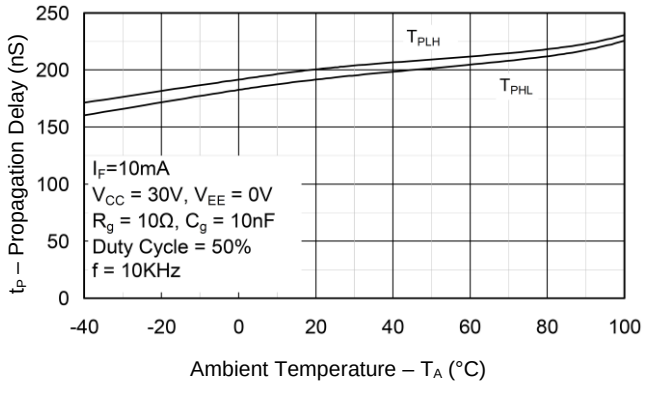


Figure 12: *Propagation Delay (t_P) vs. Temperature (°C)*



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SG8020 Performance & Characteristics Plots, continued… T_A = 25°C (unless otherwise specified)

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

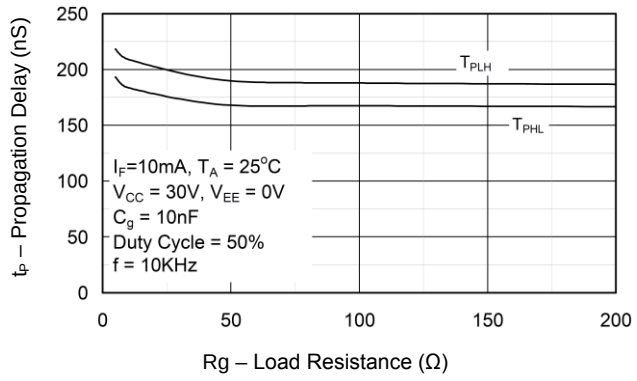


Figure 14: *Propagation Delay (t_P) vs. Load Capacitance (C_g)*

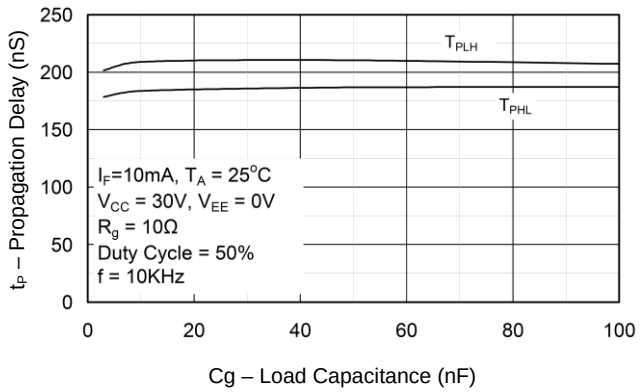


Figure 15: *Forward Current (I_F) vs. Forward Voltage (V_F)*

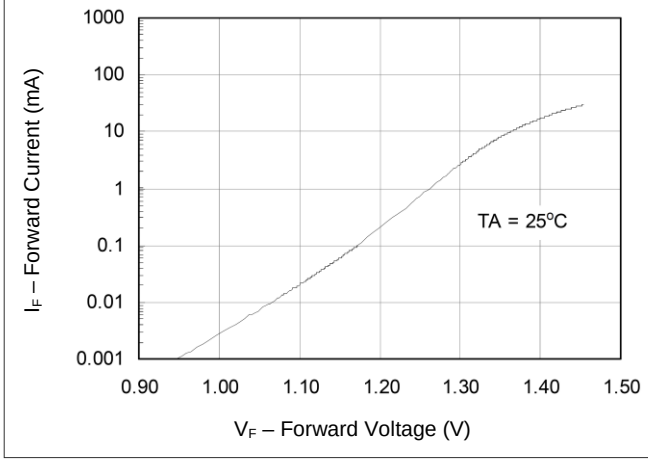
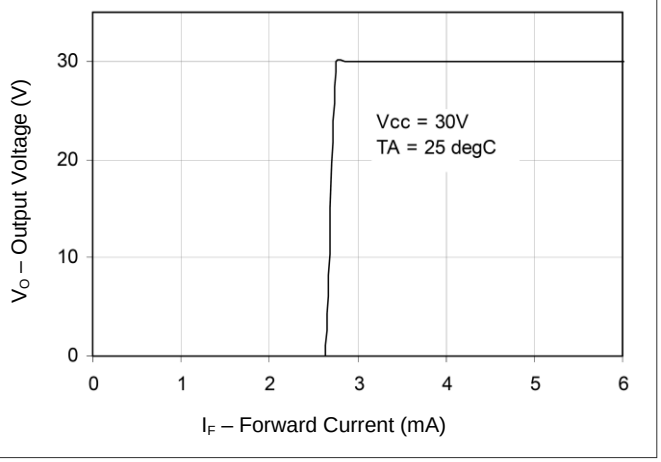


Figure 16: *Transfer Characteristics*



SG8020 Electrical Test Circuits

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

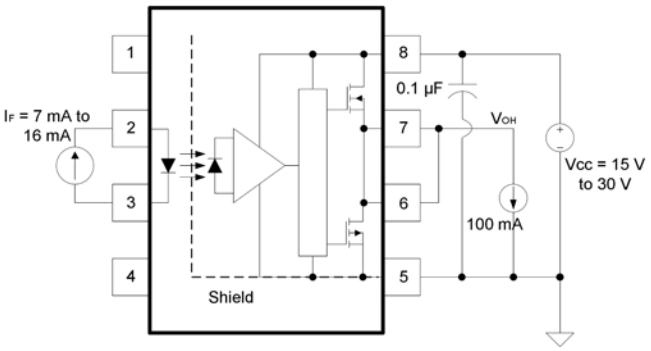


Figure 18: *Low Level Output Voltage (V_{OL}) Test Circuit*

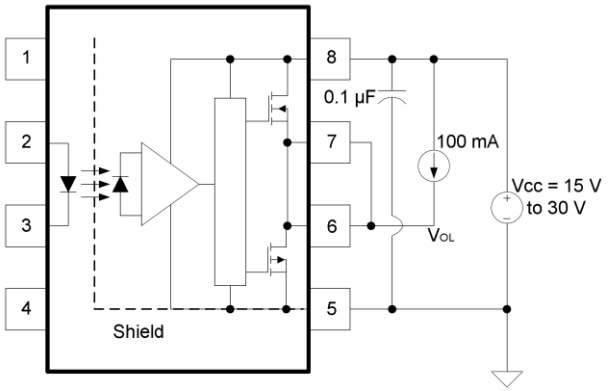


Figure 19: *High Level Output Current (I_{OH}) Test Circuit*

I_F = 7mA to 16mA
PW = 10µS
Period = 5mS

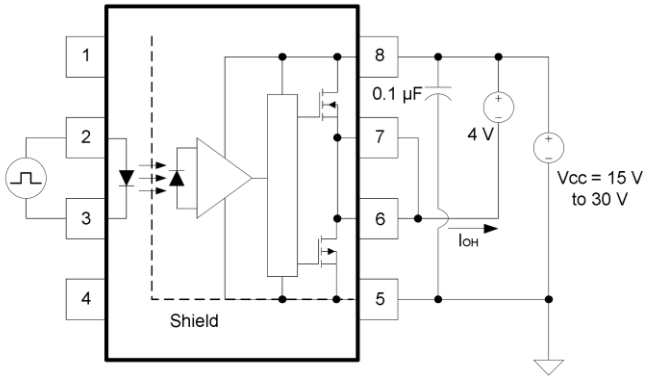


Figure 20: *Low Level Output Current (I_{OL}) Test Circuit*

I_F = 7mA to 16mA
PW = 4.99mS
Period = 5mS

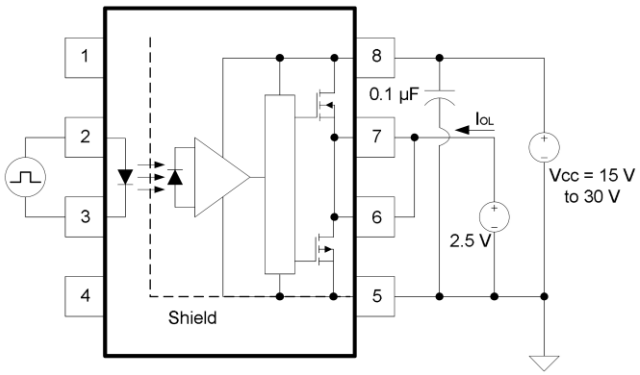


Figure 21: *Input Threshold Current (I_{FLH}) Test Circuit*

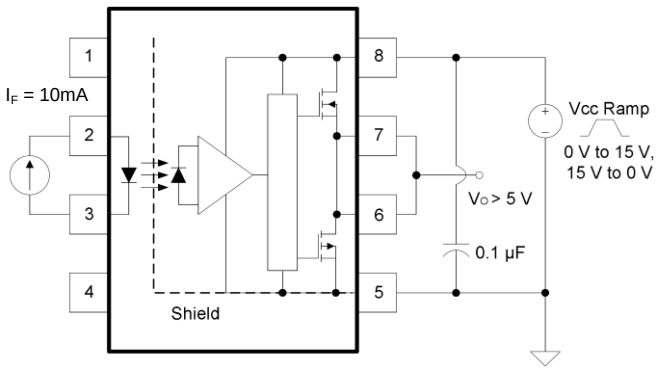
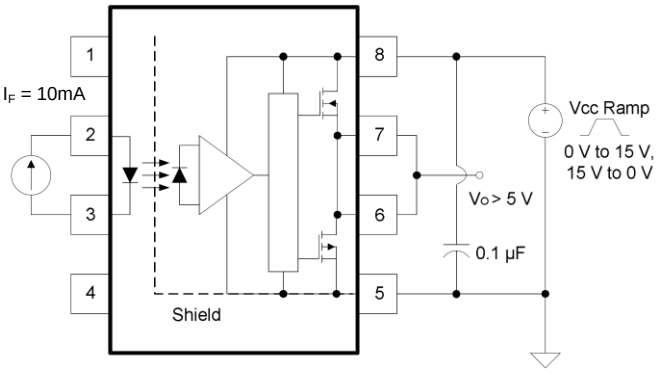


Figure 22: *UVLO Test Circuit*



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*

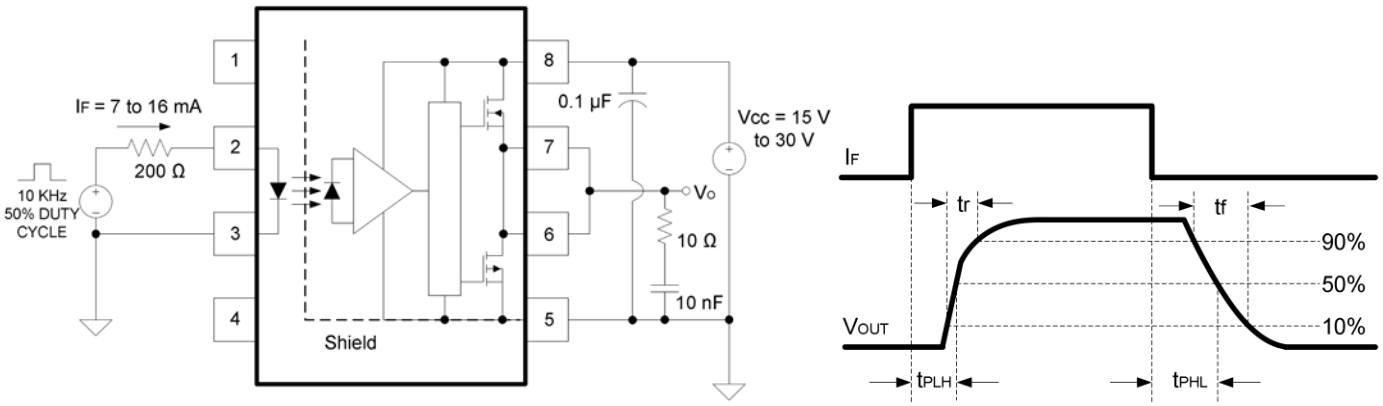
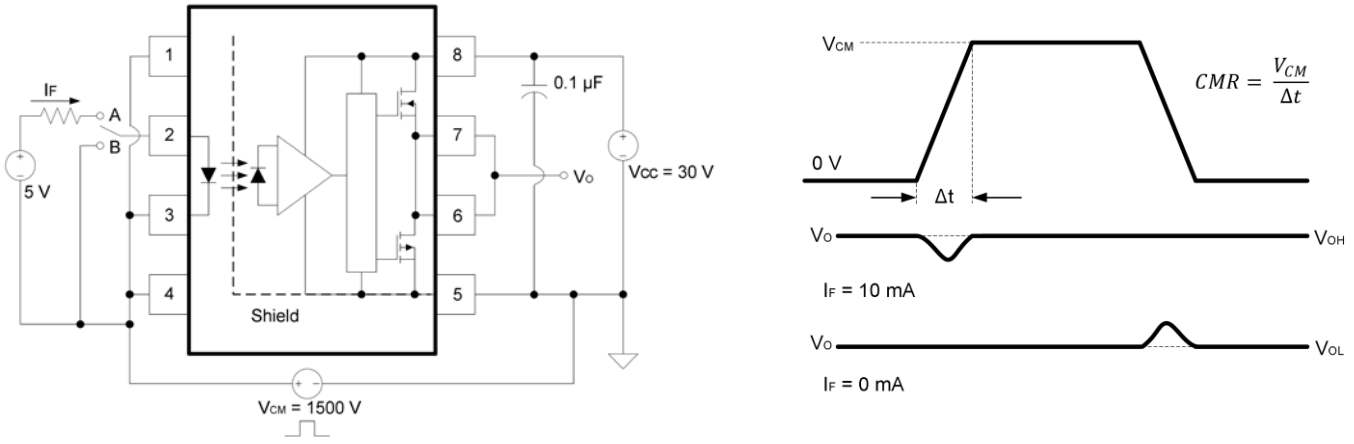


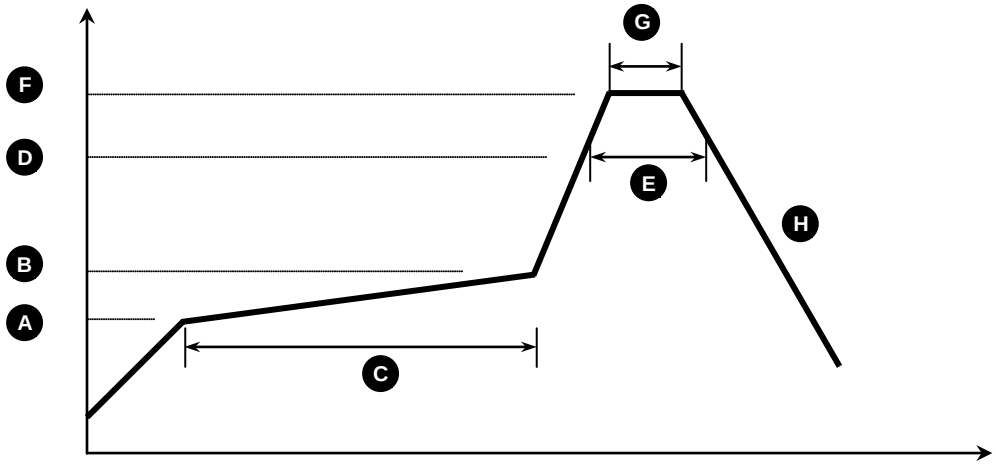
Figure 24: *CMR Test Circuit & Waveforms*



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 250ºC:



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

(2) *Wave Solder:*

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

(3) *Hand Solder:*

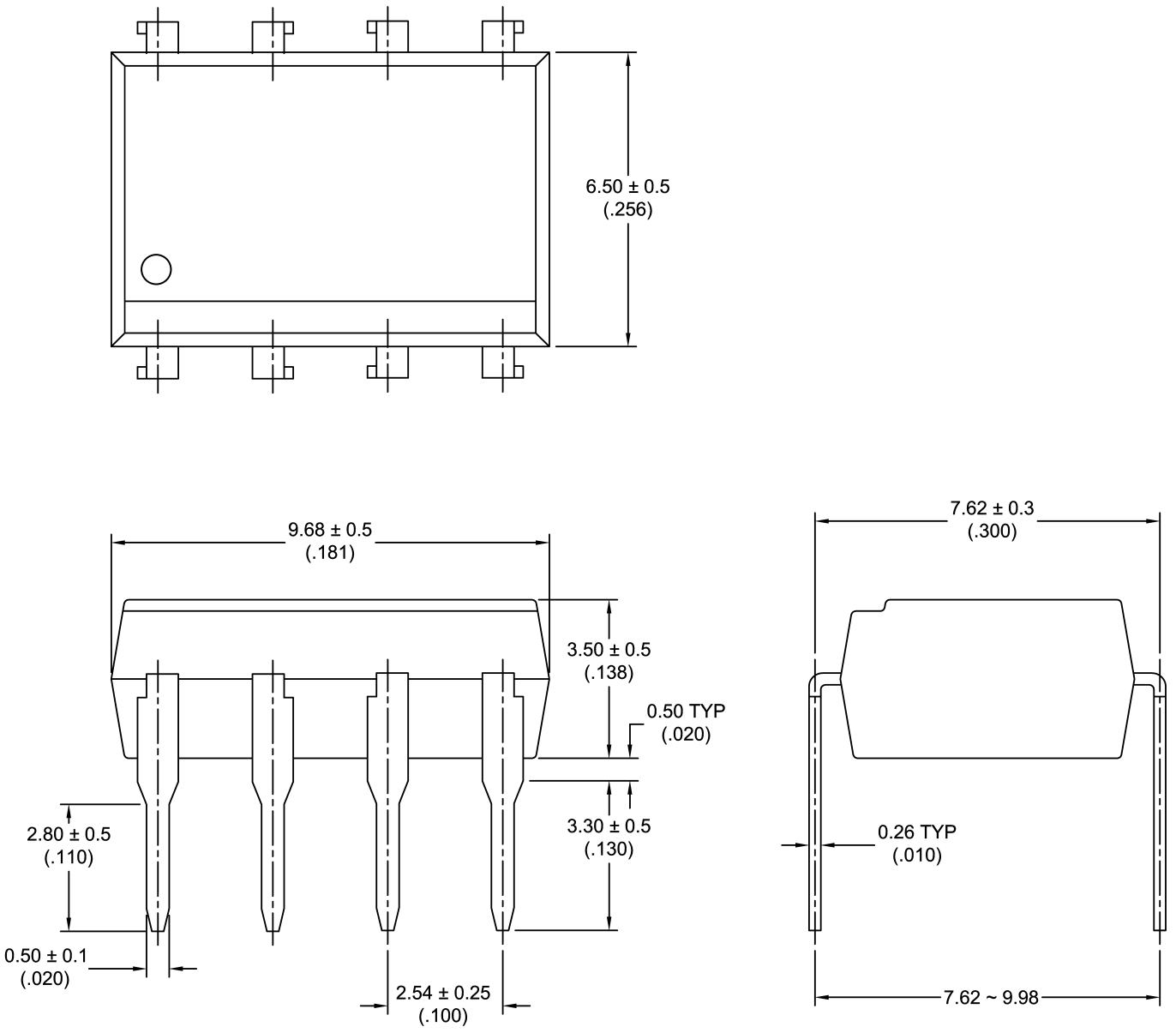
Maximum Temperature:	350ºC (at tip of soldering iron)
Maximum Time:	3s
Single Occurrence	

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SG8020 Package Dimensions

8 PIN DIP Package

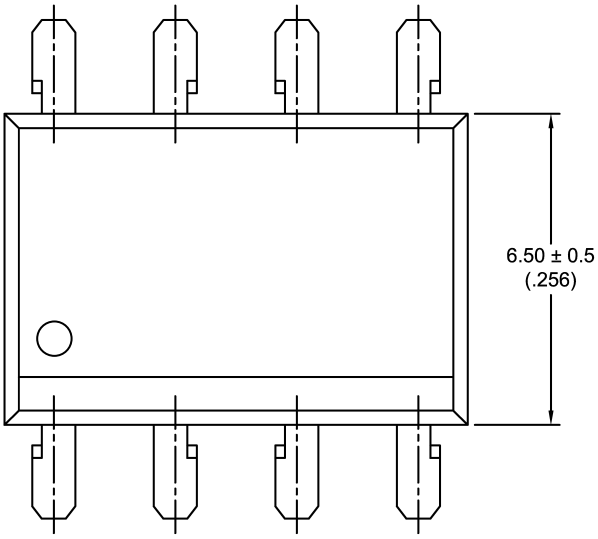
Note: *All dimensions in millimeters [mm] with inches in parenthesis ()*

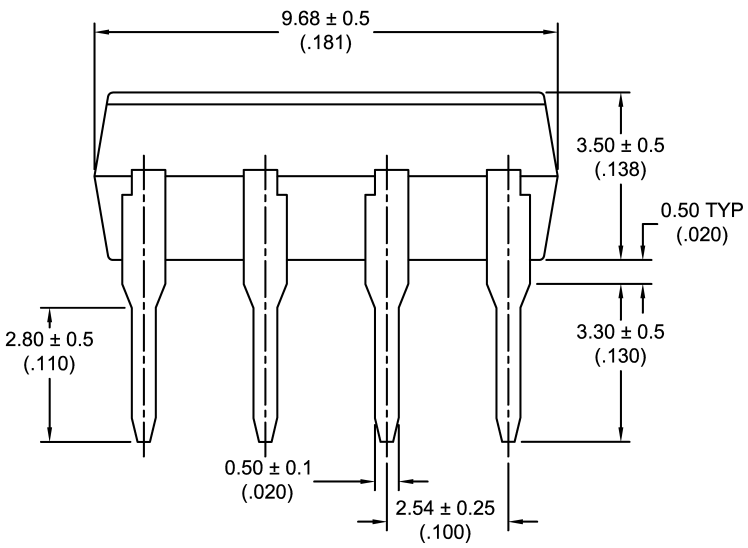


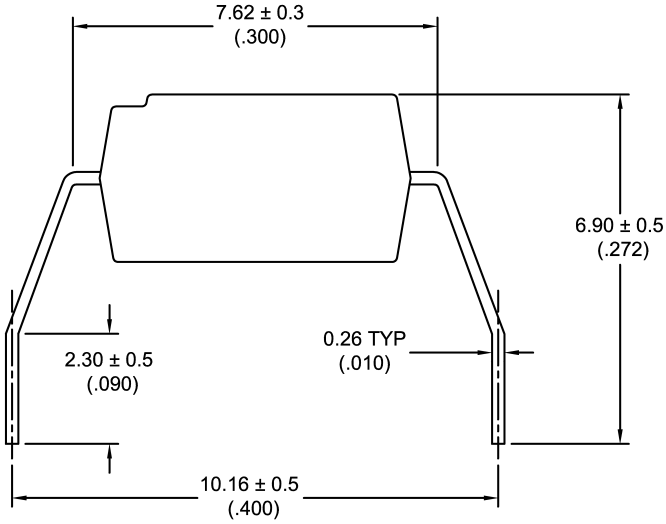
SG8020 Package Dimensions

8 PIN WIDE Lead Space Package (-H)

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



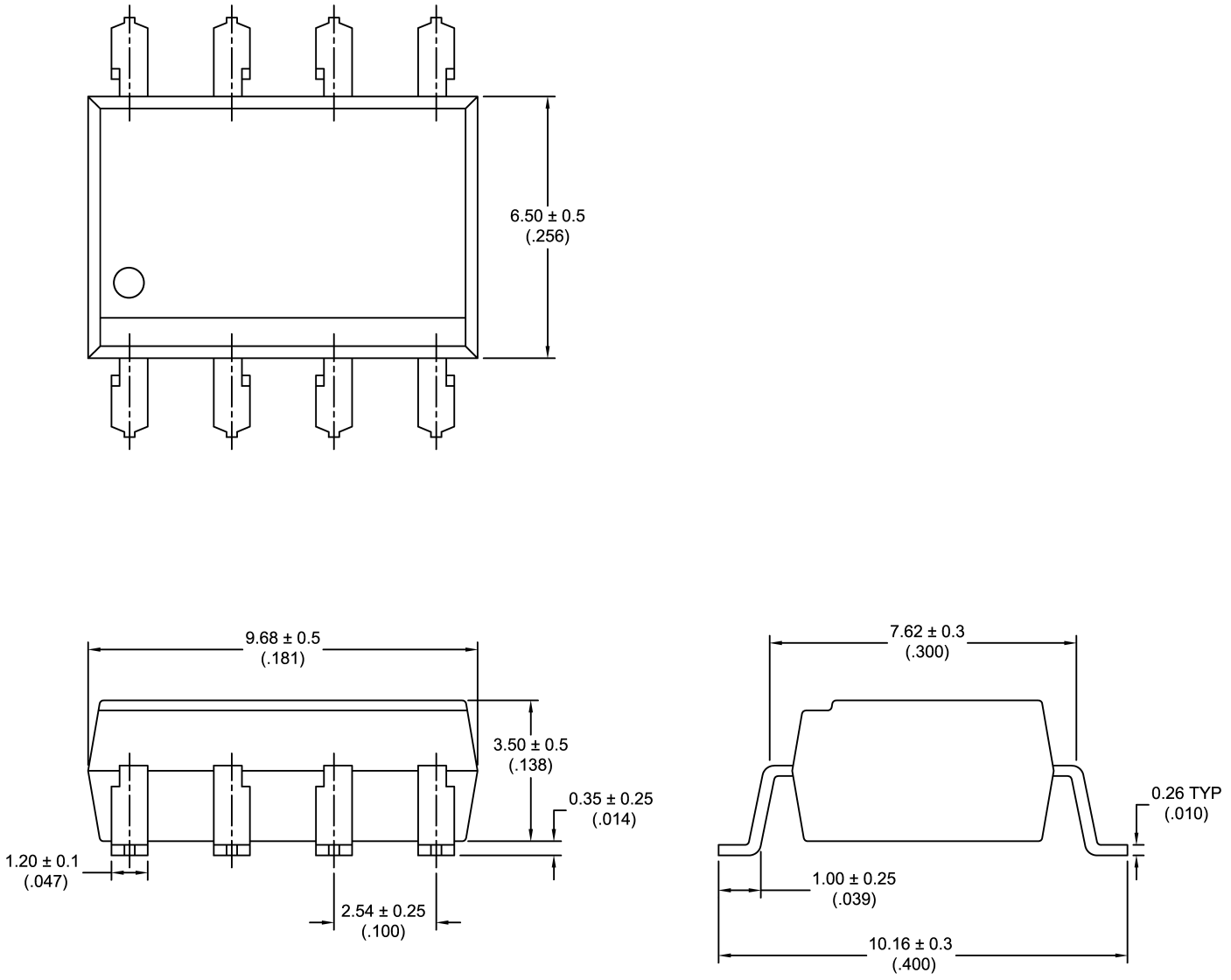




SG8020 Package Dimensions

8 PIN SMD Surface Mount Package (-S)

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

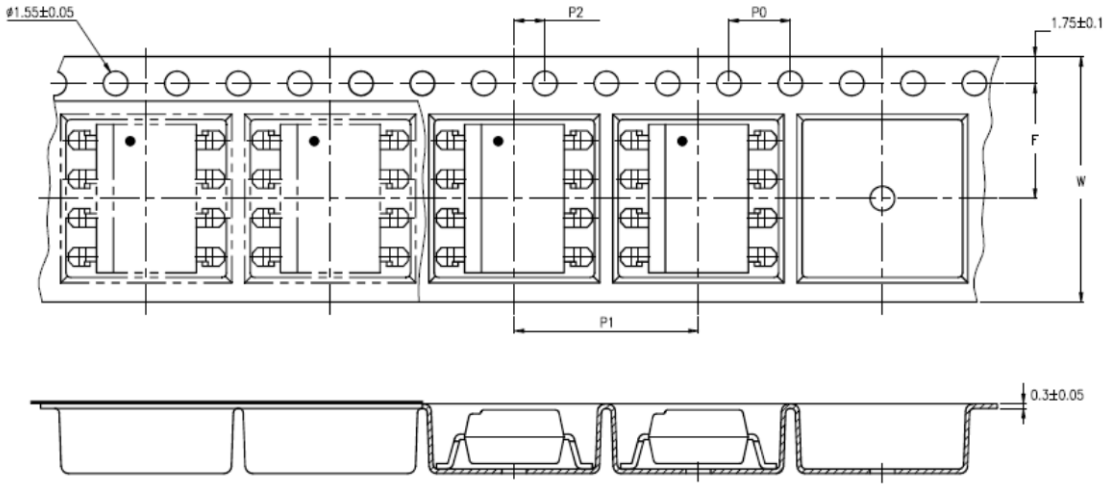


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SG8020 Packaging Specifications

Tape & Reel Specifications (T&R)

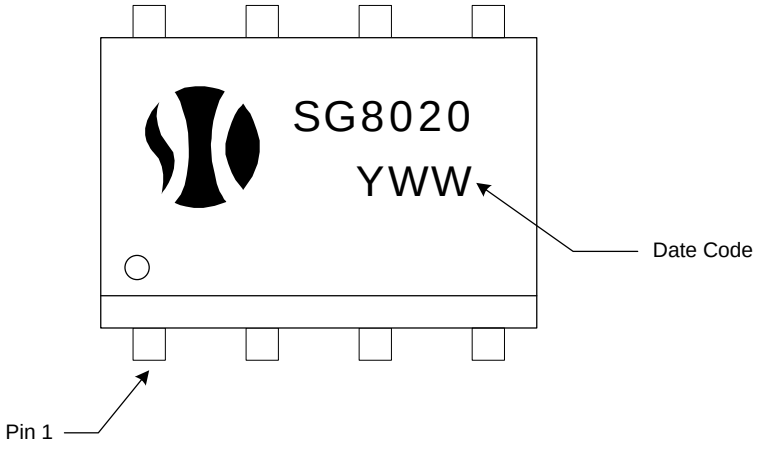
Note: *All dimensions in millimeters [mm] with inches in parenthesis ()*



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

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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*

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