GLF76121, GLF76121S, GLF76121L

Nano Current Consumed Integrated Load Switch with Reset Timer

Product Specification

DESCRIPTION

The GLF76121, GLF76121S, and GLF76121L are an ultra-efficient I_QSmart™ load switch with an integrated reset timer for wearables and IoT devices.

The /SRO pin offers a true reset function enabling the load switch to completely disconnect the load from the input battery after a reasonable long delay time. After the reset period, the main switch of the GLF76121, GLF76121S, and GLF76121L reconnect the output load to the input battery for normal operation. The GLF76121 / GLF76121S offers 6/2.95 second delay time before the 750 ms reset duration while the GLF76121L has 12 second delay time and then 750 ms reset time.

The ultra-low I_Q enables direct interface to lower voltage chipset without any external circuit and maintains lower power consumption. The OFF input pin allows the GLF76121, GLF76121S, and GLF76121L to achieve complete shutdown with total downstream standby current of 7 nA typical. With the switch placed between a battery and system, this switch can help to significantly extend system battery life in mobile devices during shipping or periods of extended off time.

The GLF76121, GLF76121S, and GLF76121L help to reduce power consumption with the best in class R_{ON} and a breakthrough on state I_Q of only 7nA typical when the switch is on.

The GLF76121, GLF76121S, and GLF76121L integrated 1 ms slew rate control can also enhance system reliability by mitigating bus voltage swings during switching events. Where uncontrolled switching can generate high inrush current that results in voltage droop and/or bus reset events, the GLF slew rate control specifically limits inrush current during turn-on to minimize voltage droop. The output discharge function makes output voltage off quickly during the reset period.

The GLF76121, GLF76121S, and GLF76121L are available in 0.97 mm x 1.47 mm x 0.55mm wafer level chip scale package (WLCSP).

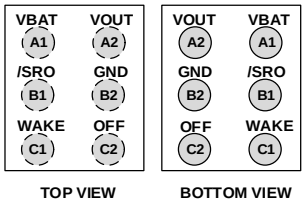
FEATURES

- Ultra-Low I_{SD}: 7 nA Typ @ 3.6 VBAT
- Ultra-Low I_Q: 7 nA Typ @ 3.6 VBAT
- Low R_{ON} : 34 mΩ Typ @ 3.6 VBAT
- I_{OUT} Max : 2 A
- Supply Voltage Range: 2.5 V to 5.5 V
  6 Vabs max
- Reset Delay Time (/SRO Hold Time)
  - GLF76121 : 6 s
  - GLF76121S : 2.95 s
  - GLF76121L : 12 s
- Reset Pulse Period
  - GLF76121 : 750 ms
  - GLF76121S : 360 ms
  - GLF76121L : 750ms
- Turn-Off Delay Time
  - GLF76121 : 6 s
  - GLF76121S : 2.95 s
  - GLF76121L : 12 s
- Controlled Output Rise Time: 1 ms at 3.6 VBAT
- Integrated Output Discharge Switch When Disabled
- Operating Temperature Range: -40 to 85 °C
- HBM: 6 kV, CDM: 2 kV
- Ultra-Small: 0.97 mm x 1.47 mm WLCSP

APPLICATIONS

- Wearables
- IoT Devices
- Medical Devices

PACKAGE



0.97 mm x 1.47 mm x 0.55 mm WLCSP

DEVICE OPTIONS / PACKAGING INFORMATION

Part Number	Top Mark	/SRO Pin Hold Time	Output Discharge	Tape and Reel Packaging
GLF76121	BN	Reset after 6 sec	85 Ω	3000 Pieces on 7 inch reel
GLF76121S	RG	Reset after 2.95 sec		
GLF76121L	RS	Reset after 12 sec		

APPLICATION DIAGRAM

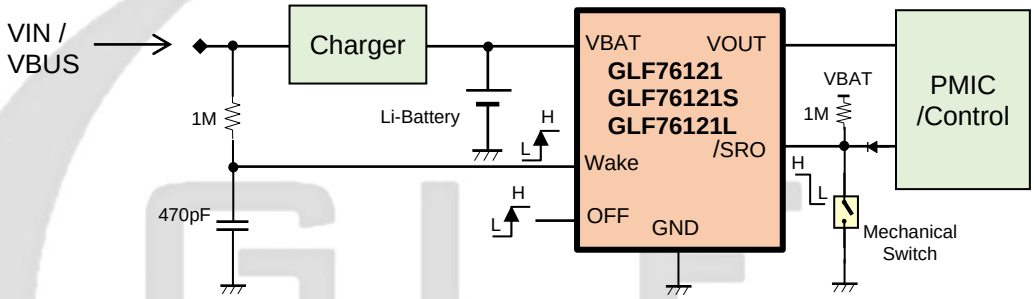


Figure 1. Typical Application with Standalone Charger IC

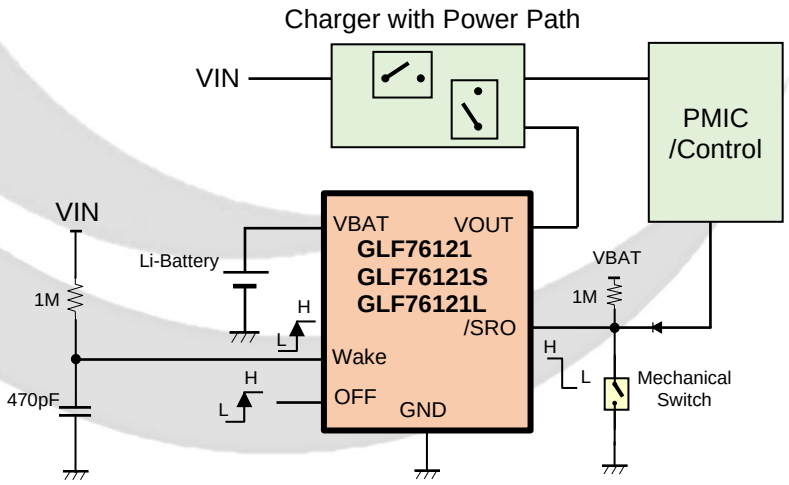


Figure 2. Typical Applications with Charger IC with Power Path and PMIC

FUNCTIONAL BLOCK DIAGRAM

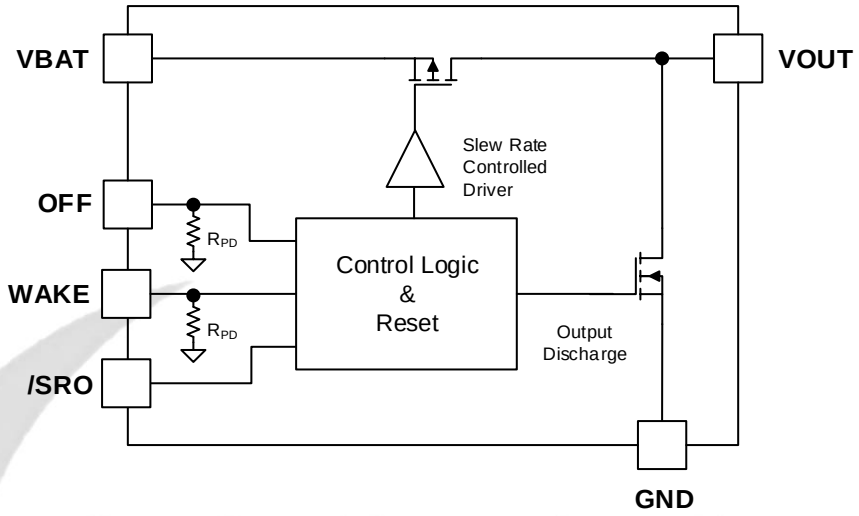


Figure 3. Functional Block Diagram

PIN CONFIGURATION

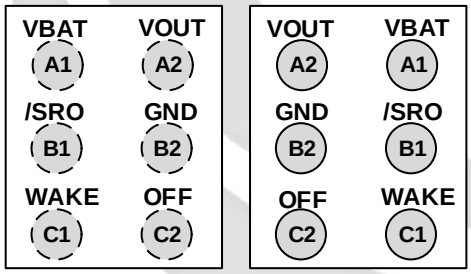


Figure 4. 0.97 mm x 1.47 mm x 0.55 mm WLCSP

PIN DEFINITION

Pin #	Name	Description
A1	VBAT	Switch Input. VBAT pin is connected to the positive input of an external battery.
A2	VOUT	Switch Output.
B1	/SRO	Reset Input or Power-On. Active Low. It needs an external pull-up resistor. It is typically connected to the center between an external pull-up resistor which is directly tied with the battery and a mechanical key button on a device.
B2	GND	Ground
C1	WAKE	System Wake Input. It is triggered by the rising edge signal to change the main switch from off to on-state. It has an internal pull-down resistance, 10MΩ Typ. to keep the WAKE pin grounded. No need an external pull-down resistor.
C2	OFF	Main Switch Off Input. It is triggered by the rising edge signal to change the main switch from on to off-state. It has an internal pull-down resistance, 10MΩ Typ. to keep the OFF pin grounded. No need an external pull-down resistor.

ABSOLUTE MAXIMUM RATINGS

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions; extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter		Min.	Max.	Unit
VBAT, VOUT	Each Pin Voltage Range to GND		-0.3	6	V
/SRO, WAKE, OFF	Each Pin Voltage Range to GND		-0.3	6	V
I_{OUT}	Maximum Continuous Switch Current			2	A
P_D	Power Dissipation at T_A = 25 °C			1.2	W
T_J	Maximum Junction Temperature			150	°C
T_{STG}	Storage Junction Temperature		-65	150	°C
T_A	Ambient Operating Temperature Range		-40	85	°C
θ_{JA}	Thermal Resistance, Junction to Ambient			85	°C/W
ESD	Electrostatic Discharge Capability	Human Body Model, JESD22-A114	6		kV
		Charged Device Model, JESD22-C101	2		

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min.	Max.	Unit
VBAT, VOUT	Supply Input and Output Voltage	2.5	5.5	V
/SRO, WAKE, OFF	Each Pin Voltage Range	0	5.5	V
T_A	Ambient Operating Temperature Range	-40	+85	°C

ELECTRICAL CHARACTERISTICS

Values are at VBAT = 3.6V and T_A = 25°C unless otherwise noted.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
Basic Operation							
I_Q	Quiescent Current	VBAT = /SRO = 3.6 V, WAKW = OFF = GND I_{OUT} = 0 mA, Load Switch = On			7		nA
I_{SD}	Shutdown Current	VBAT=3.6V, VOUT=GND, Load Switch = Off			7	20	
		VBAT=4.2V, VOUT=GND, Load Switch = Off			9		
I_Q	Dynamic Quiescent Current	VBAT = 3.6 V, /SRO = GND, WAKW = OFF = GND, Load Switch = On, I_{OUT} = 0 mA			15		uA
R_{ON}	On-Resistance	VBAT=5.5 V, I_{OUT}= 500 mA	Ta=25 °C		29		mΩ
			Ta=85 °C (1)		34		
		VBAT=4.2 V, I_{OUT}= 500 mA	Ta=25 °C		32	37	
			Ta=85 °C (1)		37		

		VBAT=3.6 V, I_{OUT}= 500 mA	Ta=25 °C		34	39	
			Ta=85 °C (1)		40		
		VBAT=3.0 V, I_{OUT}= 300 mA	Ta=25 °C		37	42	
		VBAT=2.5 V, I_{OUT}= 300 mA	Ta=25°C		42		
R_{DSC}	Output Discharge Resistance	VOUT = Off, I_{FORCE}= 10 mA		70	85	100	Ω
V_{IH}	Input Logic High Voltage (2)	VBAT=2.5 - 5.5 V		1.2			V
V_{IL}	Input Logic Low Voltage (2)	VBAT=2.5 - 5.5 V				0.5	
R_{PD}	Pull-down Resistance on OFF and WAKE	VBAT=5.5 V			10		MΩ
Power On (Load Switch Turn-On) and Reset Timing by /SRO (1)							
t_{VON}	Turn-On Delay Time(Hold Time)	VBAT=3.6 V, R_L = 150 Ω, C_L = 10 uF			1.5		s
$t_{Reset-Dly}$	GLF76121 Delay Time(Hold Time) before Reset				6		
$t_{Reset-Dly}$	GLF76121S Delay Time(Hold Time) before Reset				2.95		
$t_{Reset-Dly}$	GLF76121L Delay Time(Hold Time) before Reset				12		
t_{Reset}	GLF76121, Vout Reset Duration				750		ms
	GLF76121S, Vout Reset Duration				360		
	GLF76121L Vout Reset Duration				750		
Power On (Load Switch Turn-On) Timing by WAKE (1)							
t_{dON}	Turn-On Delay	VBAT=3.6 V, R_L = 150 Ω, C_L = 10 uF			0.9		ms
t_R	VOUT Rise Time				1		
t_{ON}	Turn-On Time (3)				1.9		
Power Off (Load Switch Turn-Off) by OFF (1)							
t_{SD}	GLF76121 Delay to Turn Off Load Switch,	VBAT=3.6 V, R_L = 150 Ω, C_L = 10 uF			6		s
t_{SD}	GLF76121S Delay to Turn Off Load Switch,				2.95		
t_{SD}	GLF76121L Delay to Turn Off Load Switch,				12		
t_F	VOUT Fall Time				1		ms
t_{OFF}	GLF76121 Turn Off Time (3)				6		s
t_{OFF}	GLF76121S Turn Off Time (3)				2.95		
t_{OFF}	GLF76121L Turn Off Time (3)				12		

Notes:
1. By design; characterized, not production tested.
2. Input pins are /SRO, OFF, and WAKE.
3. $t_{ON} = t_{dON} + t_R$, $t_{OFF} = t_{SD} + t_F$

TIMING DIAGRAMS AND INPUT CONDITION

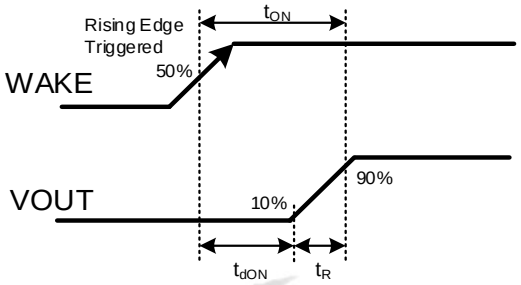


Figure 5. Power On by WAKE Pin

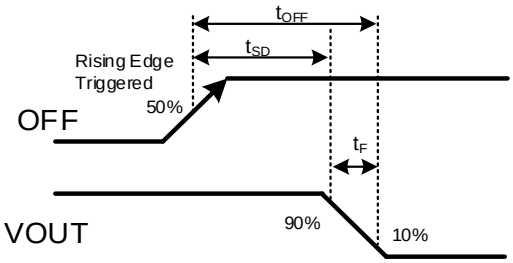


Figure 6. Power Off by OFF Pin

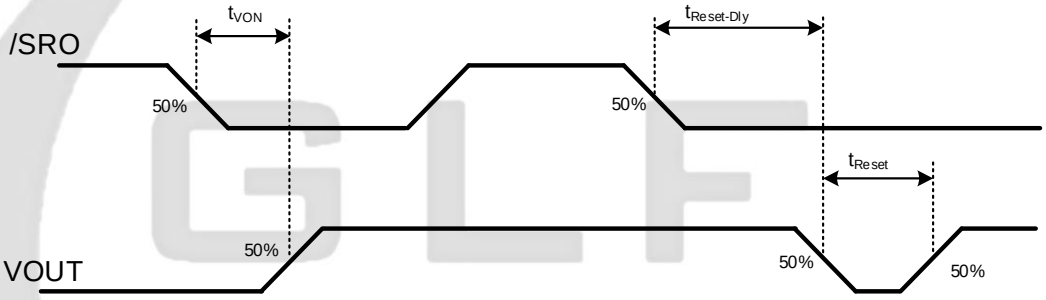


Figure 7. Power On and Reset by /SRO Pin

Table 1. Pin Default State With Input Power Source

Pin Name	/SRO	WAKE	OFF	VOUT
Default State	1	0	0	GND

Note: 1=Logic High, 0=Logic Low, The VOUT=GND means the internal load switch is off.

Table 2. Input Conditions and VOUT

Function	**/SRO**	**WAKE**	**OFF**	**Delay Time(Hold time)**	**VOUT Action**
Power On	High to Low & Hold for t_{VON}=1.5s	X	X	t_{VON}=1.5s	VOUT=VBAT
	High	Low to High Rising Edge	X	t_{dON}=0.9 ms (2)	VOUT=VBAT
Reset	High to Low & Hold for $t_{Reset-Dly}$ = 2.95 s, 6 s, 12 s	X	X	GLF76121 : $t_{Reset-Dly}$=6 s t_{Reset} =750 ms GLF76121S : $t_{Reset-Dly}$=2.95 s t_{Reset} =360 ms GLF76121L : $t_{Reset-Dly}$= 12 s t_{Reset} =750 ms	VOUT to GND to VOUT
Power Off	High	Low	Low to High Rising Edge	GLF76121 : t_{SD}=6 s GLF76121S : t_{SD}=2.95 s GLF76121L : t_{SD}=12s	VOUT to GND

Notes: 1. X = Don't Care
2. The t_{dON} can be longer with an external capacitor on the WAKE pin due to a RC time-constant to the trigger level of rising edge.

TYPICAL PERFORMANCE CHARACTERISTICS

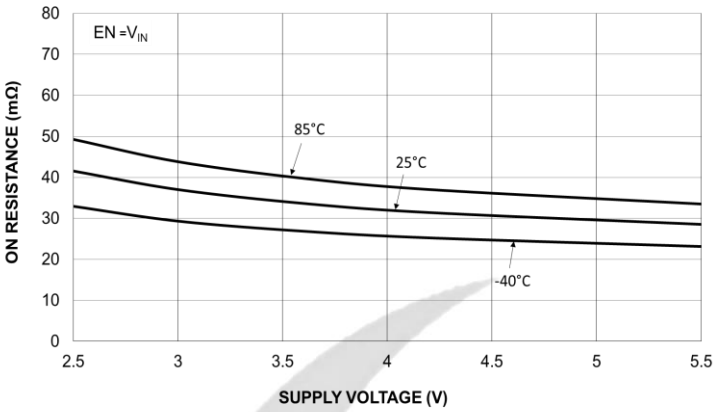


Figure 8. On-Resistance vs. Supply Voltage

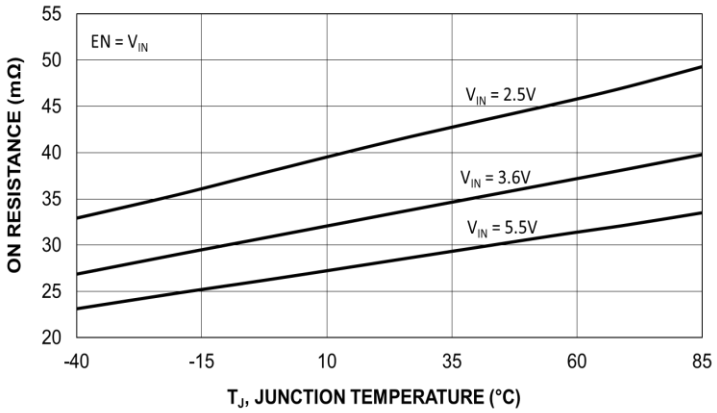


Figure 9. On-Resistance vs. Temperature

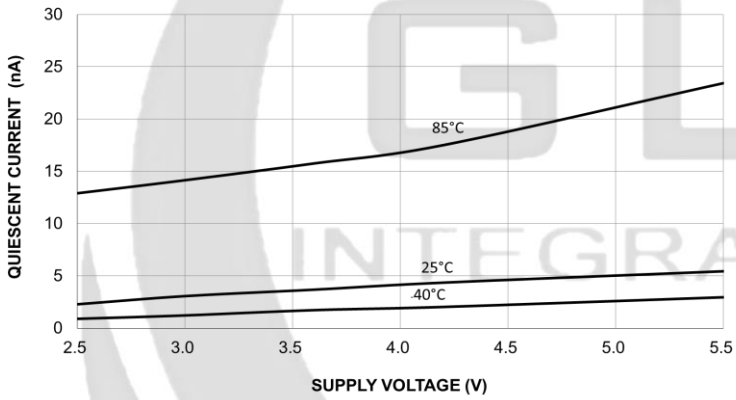


Figure 10. Quiescent Current vs. Supply Voltage

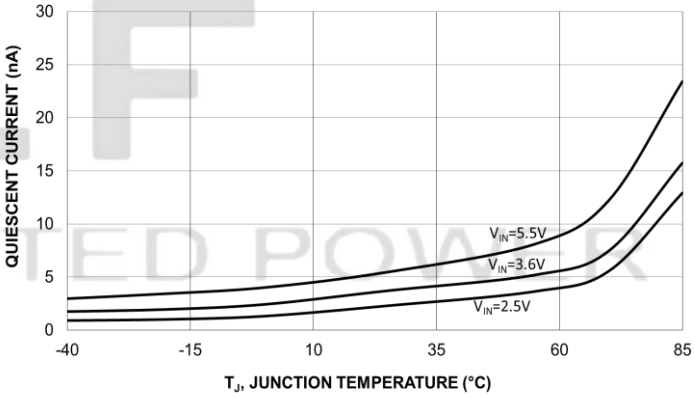


Figure 11. Quiescent Current vs. Temperature

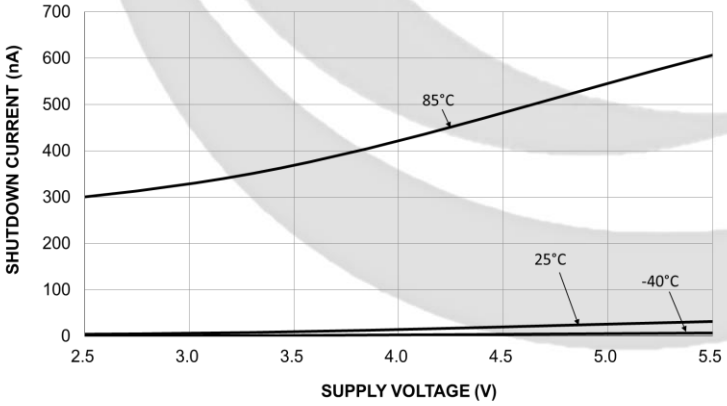


Figure 12. Shutdown Current vs. Input Voltage

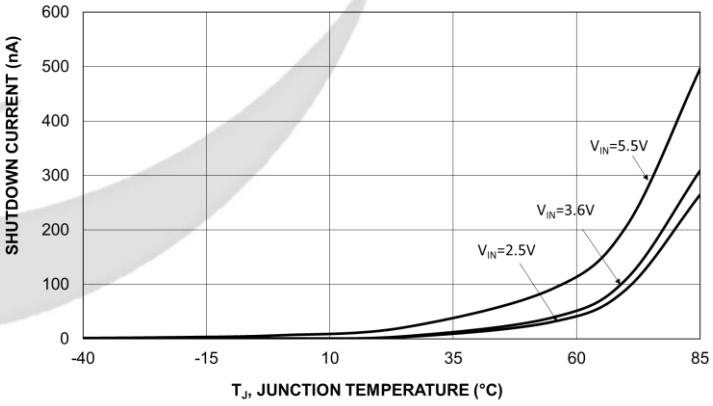


Figure 13. Shutdown current vs. Temperature

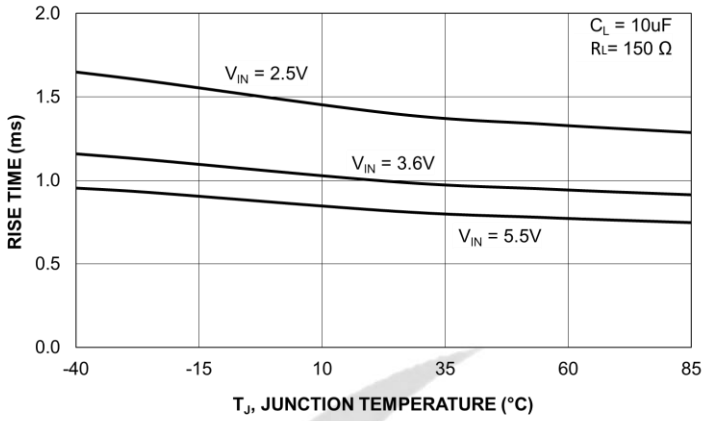


Figure 14. V_{OUT} Rise Time vs. Temperature

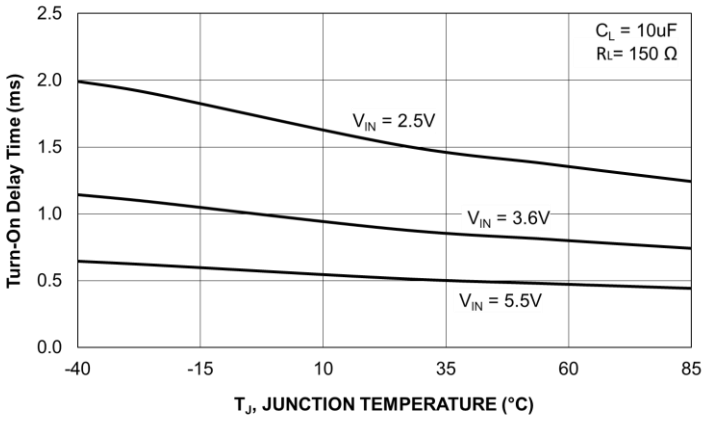


Figure 15. Turn-On Delay Time vs. Temperature

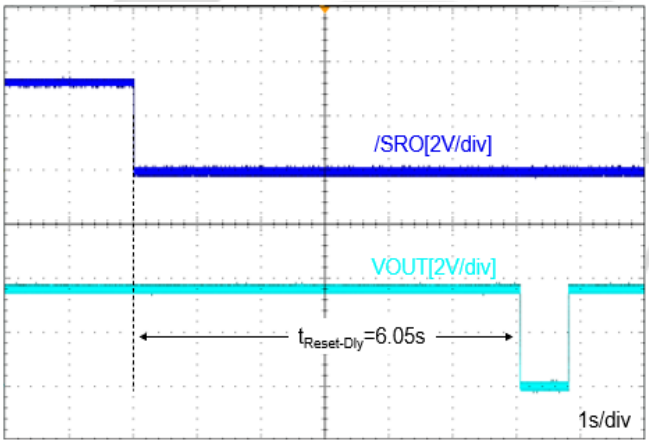


Figure 16. GLF76121 Delay time before Reset, $t_{Reset-Dly}$

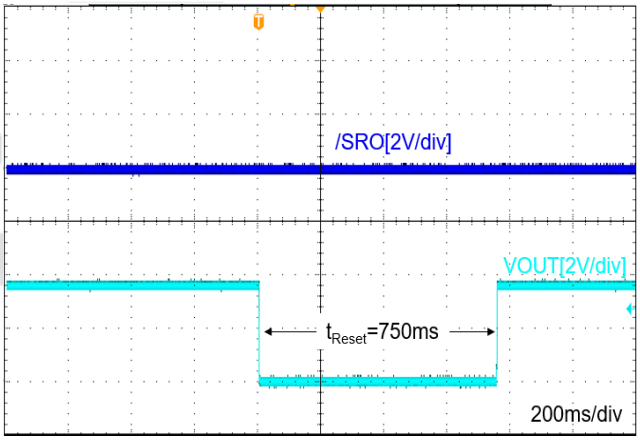


Figure 17. GLF76121 Vout Reset Duration, t_{Reset}

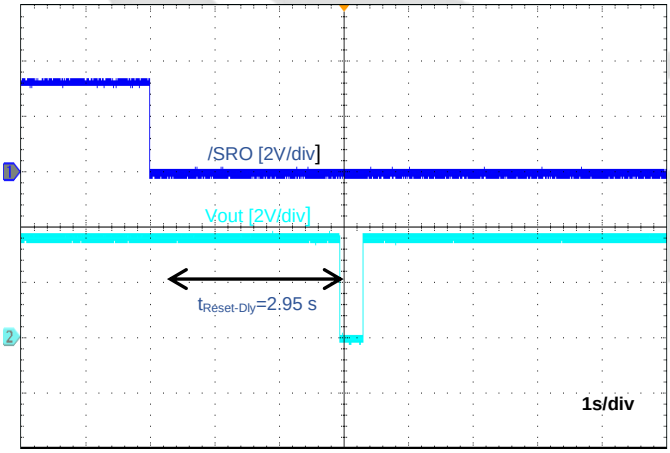


Figure 18. GLF76121S Delay time before Reset, $t_{Reset-Dly}$

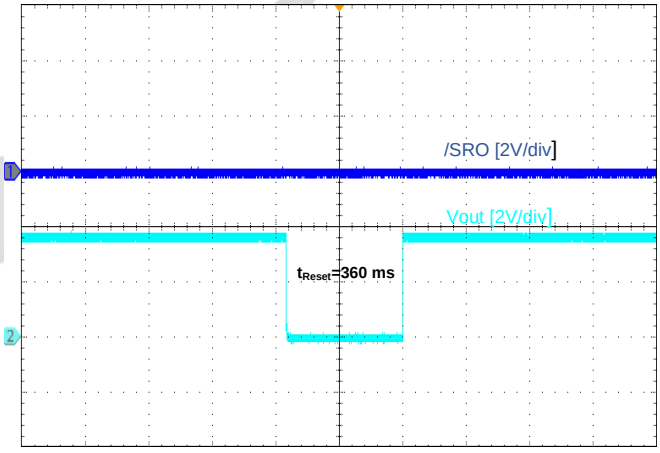


Figure 19. GLF76121S Vout Reset Duration, t_{Reset}

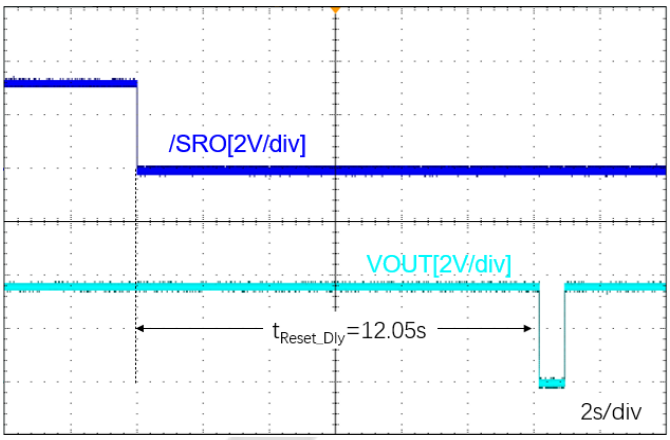


Figure 20. GLF76121L Delay time before Reset, $t_{Reset-Dly}$

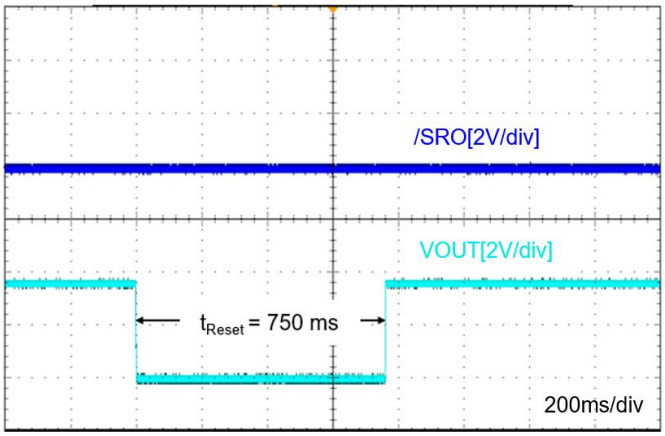


Figure 21. GLF76121L Vout Reset Duration, t_{Reset}

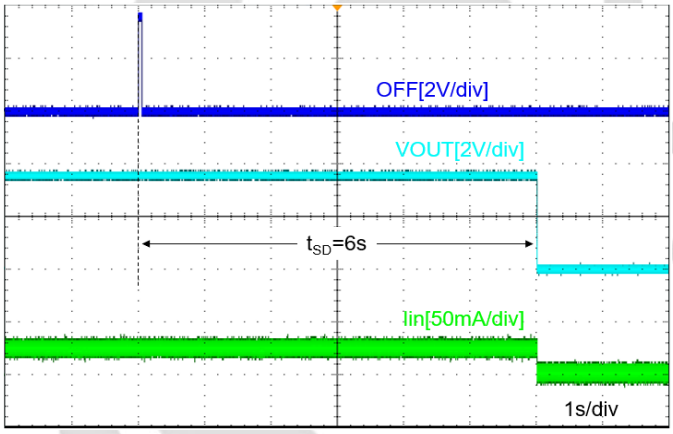


Figure 22. GLF76121 Turn-Off Response, t_{SD}
V_{IN}=3.6 V, C_{IN}=10 uF, C_L=10 uF, R_L=150 Ω

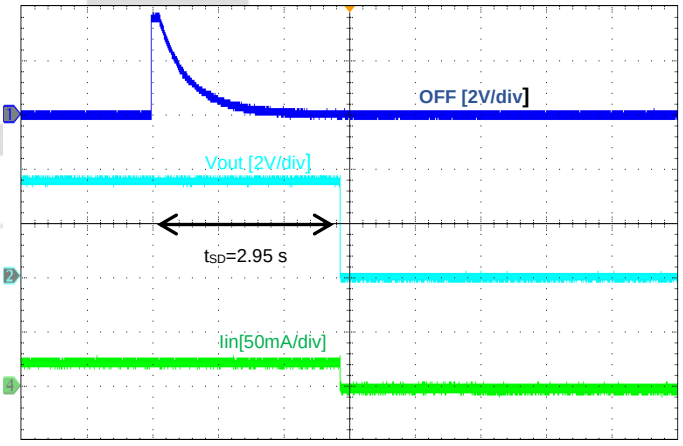


Figure 23. GLF76121S Turn-Off Response, t_{SD}
V_{IN}=3.3 V, C_{IN}=10 uF, C_{OUT}=10 uF, R_L=150 Ω

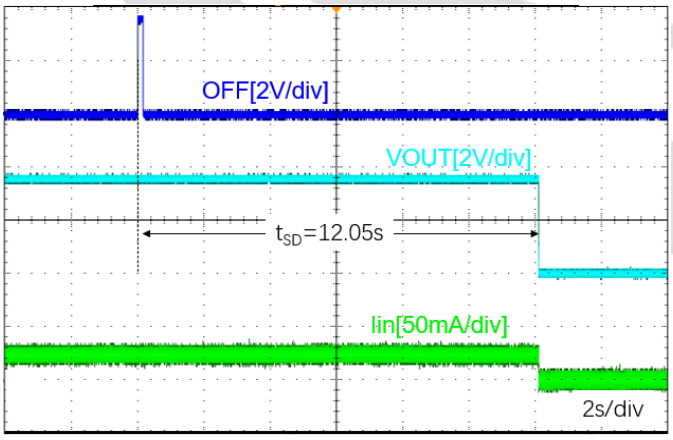


Figure 24. GLF76121L Turn-Off Response, t_{SD}
V_{IN}=3.6 V, C_{IN}=10 uF, C_L=10 uF, R_L=150 Ω

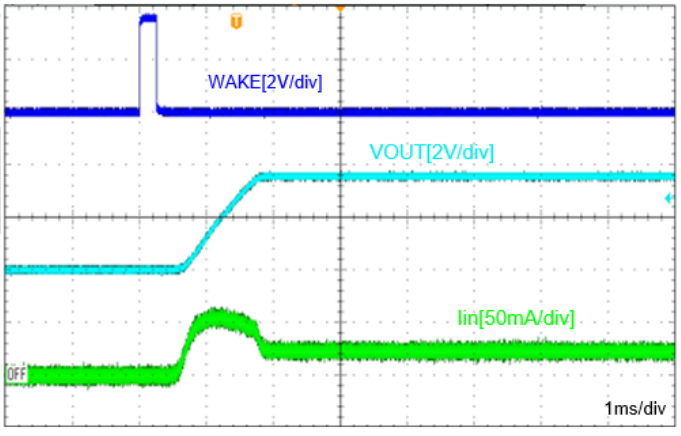


Figure 25. Turn-On Response
V_{IN}=3.6 V, C_{IN}=10 uF, C_L=10 uF, R_L=150 Ω

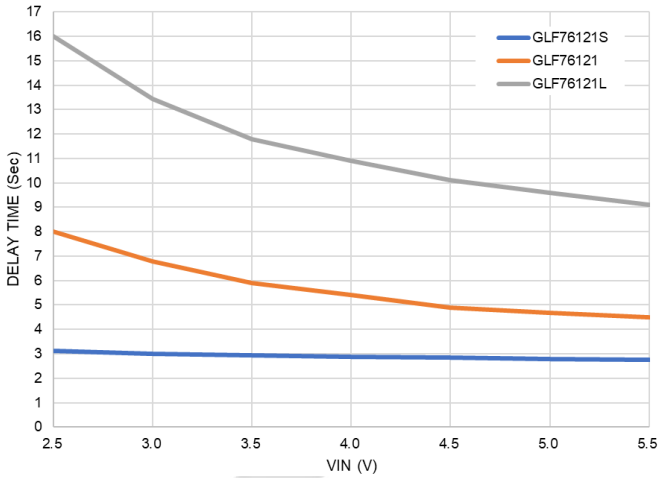


Figure 26. Delay Time of t_{SD} and $t_{Reset-Dly}$ vs. Input Voltage
C_{IN}=10 uF, C_L=10 uF, R_L=150 Ω

APPLICATION INFORMATION

The GLF76121, GLF76121S, and GLF76121L are an integrated load switch with the reset function which allows the user to reset the wearable, mobile, or IoT devices with a push button when they malfunction. Typical applications are shown in Fig.1 and Fig. 2.

Power On

There are two methods to enable the main switch of the GLF76121, GLF76121S, and GLF76121L to wake up the system. At this power-on process, the deep sleep function with /SRO pin is disabled. The Fig.23 shows the power-on mode by /SRO and WAKE pins.

1) /SRO pin
When the main switch of the GLF76121, GLF76121S, and GLF76121L are turned off and a system is disabled, holding the /SRO pin low for the preset delay time or hold time, 1.5 seconds, turns on the main switch to wake up the downstream system.
2) WAKE pin
When a high signal is applied to the WAKE pin, the GLF76121, GLF76121S, and GLF76121L turn on the main switch to connect the battery power to the downstream system. The Wake pin is initiated on a rising edge of a high signal. The t_{dON} of timing can be longer due to a RC time-constant to the trigger level of rising edge of WAKE pin. The WAKE pin has an internal pull-down resistance which is typically 10M Ohm to remain off state when no signal is asserted.

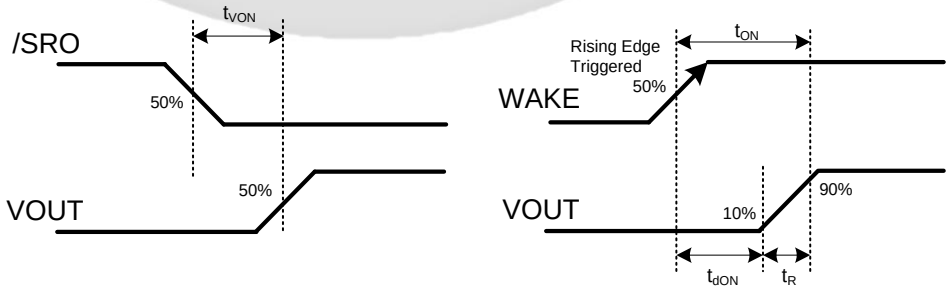


Figure 23. Power-On Mode by /SRO and WAKE

Reset Function

If a system reset is required to address malfunction of a mobile device or even during its normal operation, holding the /SRO pin low to GND by a key button for the preset delay time or hold time turns off the main switch to disconnect the batter power source from the downstream system. The output discharge switch of the GLF76121, GLF76121S, and GLF76121L are turned on to quickly bring VOUT down to GND when the main switch is turned off. In the pre-defined reset period, the GLF76121, GLF76121S, and GLF76121L reconnect the battery power source to the system by turning on the main switch and disabling the output discharge switch. The preset delay or hold time, $t_{Reset-Dly}$ is 6 s for the GLF76121, 2.95 s for GLF76121S, and 12s for the GLF76121L; the reset period, t_{Reset} is 750 ms for the GLF76121 / GLF76121S and 750ms for the GLF76121L.

Note that if the /SRO is returned to high within the preset delay time or hold time [$t_{Reset-Dly}$], the VOUT remains in the on state without initiating the reset function.

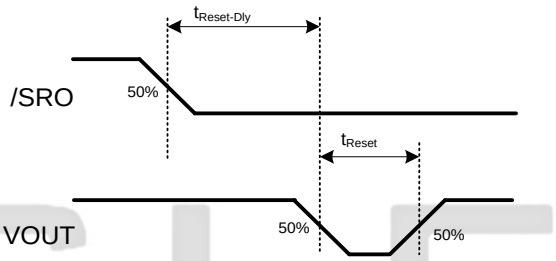


Figure 24. Reset Function by /SRO

Power Off

When the OFF pin is triggered by a rising edge of the signal from low to high, the main switch of the GLF76121 / GLF76121L is turned off in the preset delay time (t_{SD}) and enters the sleep mode. Note that if the /SRO pin action of going low and high is detected within the preset delay time (t_{SD}), the turn-off process is terminated and the VOUT remains in on state. To initiate the OFF pin again, the OFF pin needs to return to low and then a rising edge signal is asserted. The OFF pin has an internal pull-down resistor which is typically 10MOhm to remain low state when no signal is asserted. The output discharge switch of the GLF76121 / GLF76121L is turned on to quickly bring VOUT down to GND when the main switch is turned off. The preset delay time, t_{SD} is 6 s for the GLF76121, 2.95 s for GLF76121S, and 12s for the GLF76121L.

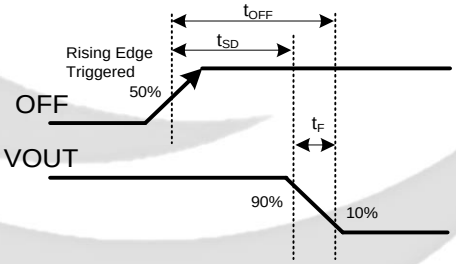


Figure 25. Power-Off Mode by OFF

Output Discharge Function

The GLF76121, GLF76121S, and GLF76221L has an internal discharge switch on VOUT. It is activated to discharge an output capacitor quickly when the main switch is turned off. With an input power source applied to VBAT and the main switch at the off state, the discharge switch keeps on holding the VOUT to GND. When the main switch is enabled, the output discharge switch is turned off.

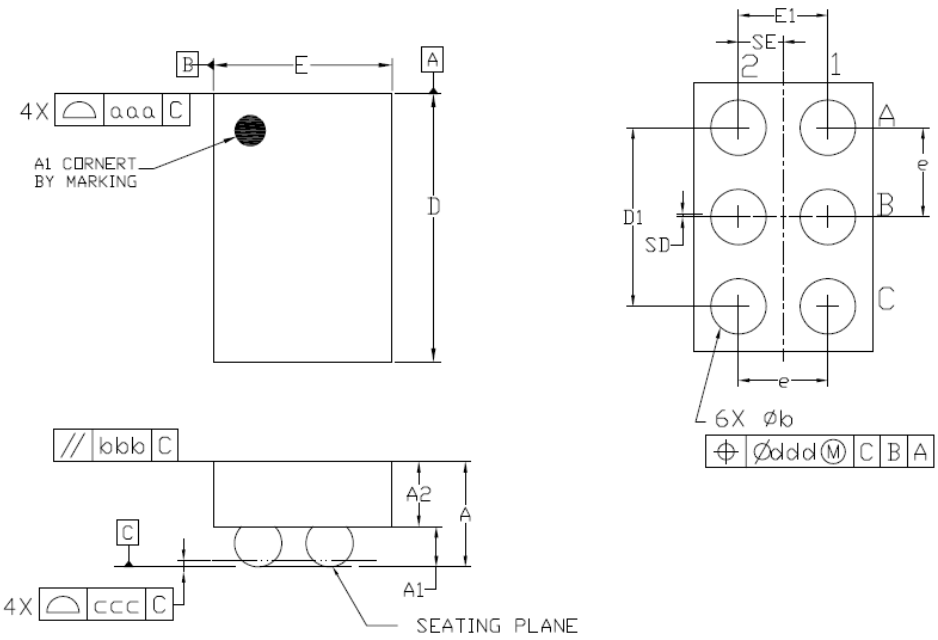
Input Capacitor

A 0.1 uF capacitor is recommended to be placed close to the VBAT pin to reduce the voltage drop on the input power rail caused by transient inrush current at start-up. A higher input capacitor value can be used to further attenuate the input voltage drop.

Output Capacitor

A 0.1 uF output capacitor is recommended to mitigate voltage undershoot on the output pin when the switch is turned off. Undershoot can be caused by parasitic inductance from board traces or intentional load inductances. If load inductances exist, use of an output capacitor can improve output voltage stability and system reliability. The C_{OUT} capacitor should be placed close to the VOUT and GND pins.

PACKAGE OUTLINE



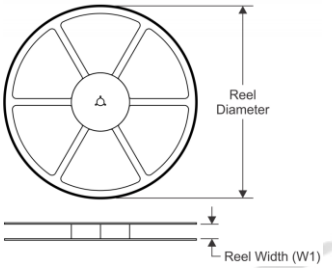
Dimensional Ref.			
REF.	Min.	Nom.	Max.
A	0.500	0.550	0.600
A1	0.225	0.250	0.275
A2	0.275	0.300	0.325
D	1.460	1.470	1.485
E	0.960	0.970	0.985
D1	0.950	1.000	1.050
E1	0.450	0.500	0.550
b	0.260	0.310	0.360
e	0.500 BSC		
SD	0.000 BSC		
SE	0.250 BSC		
Tol. of Form&Position			
aaa	0.10		
bbb	0.10		
ccc	0.05		
ddd	0.05		

Notes

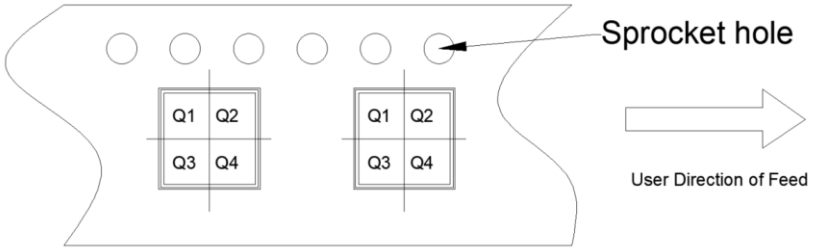
1. All DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.

TAPE AND REEL INFORMATION

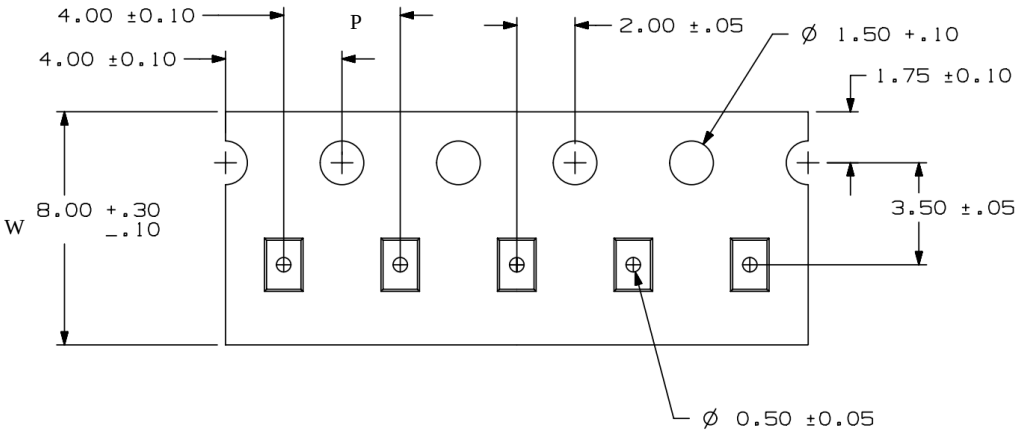
REEL DIMENSIONS

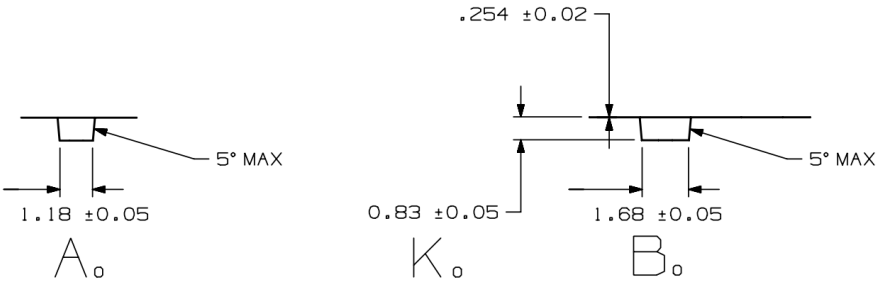


QUANRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE



TAPE DIMENSIONS





Device	Package	Pins	SPQ	Reel Diameter(mm)	Reel Width W1	A0	B0	K0	P	W	Pin1
GLF76121	WLCSP	6	3000	180	9	1.18	1.68	0.83	4	8	Q1
GLF76121S	WLCSP	6	3000	180	9	1.18	1.68	0.83	4	8	Q1
GLF76121L	WLCSP	6	3000	180	9	1.18	1.68	0.83	4	8	Q1

Remark:

A0: Dimension designed to accommodate the component width

B0: Dimension designed to accommodate the component length

C0: Dimension designed to accommodate the component thickness

W: Overall width of the carrier tape

P: Pitch between successive cavity centers

SPECIFICATION DEFINITIONS

Document Type	Meaning	Product Status
Target Specification	This is a target specification intended to support exploration and discussion of critical needs for a proposed or target device. Spec limits including typical, minimum, and maximum values are desired, or target, limits. GLF reserves the right to change limits at any time without warning or notification. A target specification in no way guarantees future production or producability of the device in question.	Design / Development
Preliminary Specification	This is a draft version of a product specification. The specification is still under internal review and subject to change. GLF reserves the right to change the specification at any time without warning or notification. A preliminary specification in no way guarantees future production or producability of the device in question.	Qualification
Product Specification	This document represents the anticipated production performance characteristics of the device.	Production

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