GLF2310, GLF2311, GLF2313, GLF2321
High Precision Current Limit Power Switch
Product Specification

DESCRIPTION

The GLF2310, GLF2311, GLF2313 and GLF2321 are an advanced technology fully integrated power switch for applications required for precision output current limiting. The GLF2310, GLF2311, GLF2313 and GLF2321 feature also various protection functions such as under voltage lockout, true reverse current blocking (TRCB), short circuit protection, and thermal shutdown.

The GLF2310, GLF2311, GLF2313 and GLF2321 provide a built-in output voltage slew rate control to limit the inrush current and voltage surges. The FLGB output pin can be used to send a signal of fault events to the system controller. The integrated thermal shutdown (TSD) insures complete protection for the switch during output current limit and short circuit conditions. The GLF2310, GLF2311, GLF2313 and GLF2321 are an ideal switch for USB power supply.

FEATURES

- Input Range: 2.5 V to 5.5 V
- Programmable Output Constant Current Limit: GLF2310A, GLF2311A
    - Range: 40 mA ~ 2.2 A
- Fixed Output Constant Current Limit:
    - GLF2311B, GLF2313B: 2.0 A Min
    - GLF2321B: 1.5 A Min
- Low R_{ON}:   56 mΩ Typ. @ 5.0 V_{IN}
- Ultra-Low I_Q: 20 uA Typ. @ 5.0 V_{IN}
- Ultra-Low I_{SD}: 50 nA Typ. @ 5.0 V_{IN}
- Under Voltage Lockout Protection
- Output Voltage Slew Rate Controlled
- True Reverse Current Blocking Protection
- Short Circuit Protection
- Deglitched Fault Flag Indication
- Integrated Output Discharge Switch
    - GLF2311x, GLF2313x, GLF2321x
- Thermal Shutdown Protection
- IEC 62368-1:2018 CB Certification No. FI-52066

APPLICATIONS

- USB ports
- Notebooks
- Set-Top Boxes
- Telecom Systems

PACKAGE
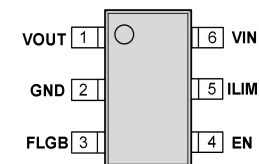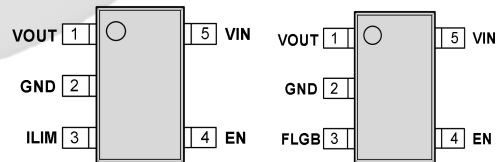
SOT23-5L, SOT23-6L

DEVICE ORDERING INFORMATION

| Part Number	Top Mark	Output Current Limit I_{LIM}	Output Discharge	Fault Flag FLGB	EN Activity	Package
GLF2310A-T1G7	FA	Programmable Up to 2.1 A	NA	NA	High	SOT23-5L
GLF2311A-T1G7	FB		85 Ω	NA		SOT23-5L
GLF2310A-T2G7	HA		NA	Yes		SOT23-6L
GLF2311A-T2G7	HB		85 Ω	Yes		SOT23-6L
GLF2311B-T1G7	GB	Fixed 2.0 A Min	85 Ω	Yes		SOT23-5L
GLF2313B-T1G7	KD	Fixed 2.0 A Min	85 Ω	Yes	Low	SOT23-5L
GLF2321B-T1G7	KB	Fixed 1.5 A Min	85 Ω	Yes	High	SOT23-5L

APPLICATION DIAGRAM
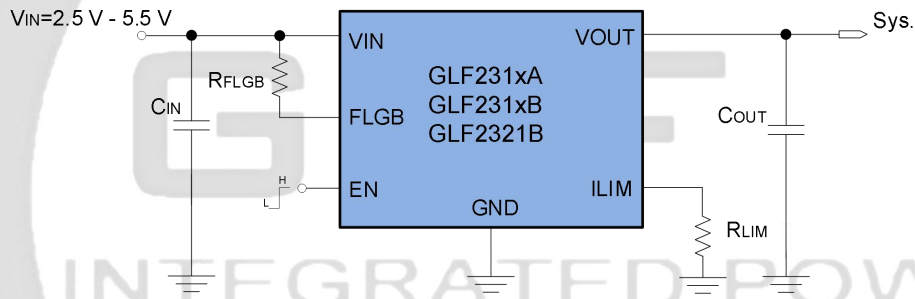
Note) ILIM pin for GLF23xxA Only
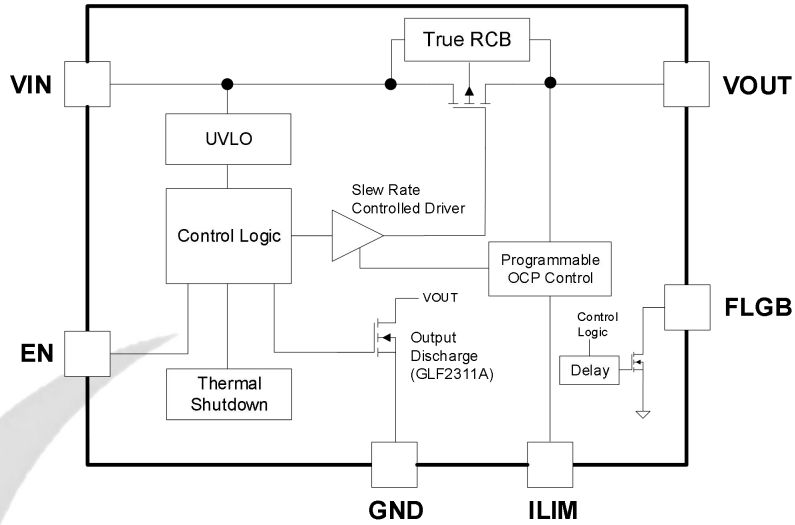
Figure 1. Typical Application

FUNCTIONAL BLOCK DIAGRAM

GLF2310A-T1G7, GLF2311A-T1G7
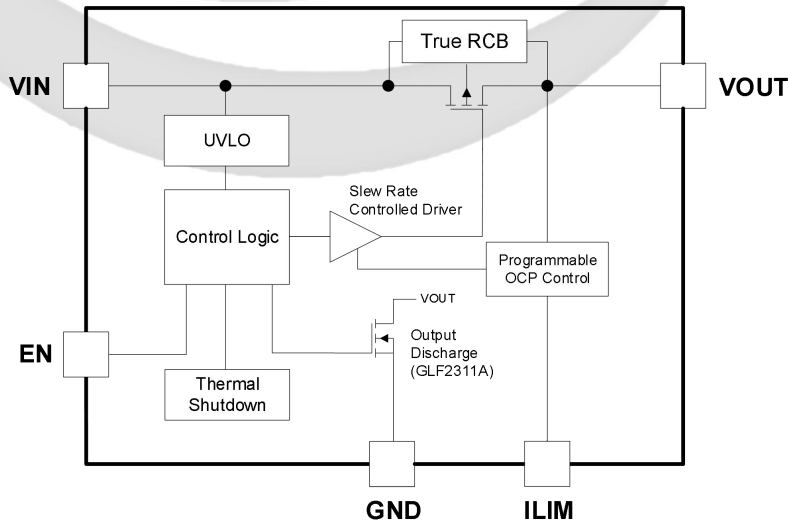
GLF2310A-T2G7, GLF2311A-T2G7
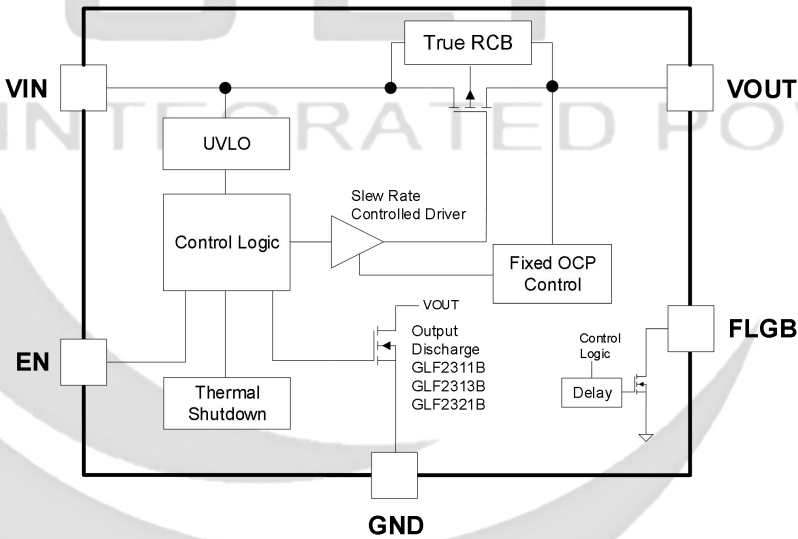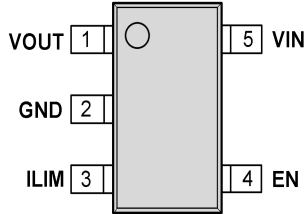

GLF2311B-T1G7, GLF2313B-T1G7, GLF2321B-T1G7

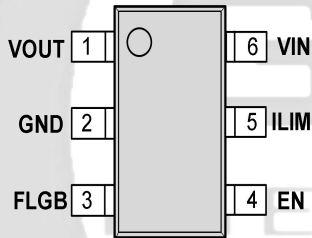**Figure 2. Functional Block Diagram**

PIN CONFIGURATION

PIN DEFINITION

GLF2310A-T1G7, GLF2311A-T1G7

Pin #	Name	Description
1	VOUT	Switch output
2	GND	Ground
3	ILIM	Programmable current limit. Do not leave this pin floating.
4	EN	Active high switch output enables to control the switch
5	VIN	Switch Input. Supply voltage for IC

GLF2310A-T2G7, GLF2311A-T2G7

Pin #	Name	Description
1	V_{OUT}	Switch output
2	GND	Ground
3	FLGB	Flag pin goes low to indicate OCP, SC, RCB, and TSD fault conditions
4	EN	Active high switch output enables to control the switch
5	ILIM	Programmable current limit Do not leave this pin floating.
6	VIN	Switch Input. Supply voltage for IC

GLF2311B-T1G7, GLF2313B-T1G7
GLF2321B-T1G7
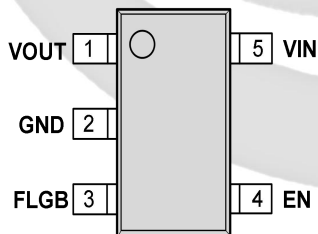
Pin #	Name	Description
1	V_{OUT}	Switch Output
2	GND	Ground
3	FLGB	Flag pin goes low to indicate OCP, SC, RCB, and TSD fault conditions
4	EN	Active high switch output enables to control the switch Active low: GLF2313B
5	VIN	Switch Input. Supply voltage for IC

Figure 3. Package and Pin configuration

GLF INTEGRATED POWER

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 and 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
V_{IN}	V_{IN}, V_{OUT}, V_{EN} to GND		- 0.3	6	V
I_{OUT}	DC Continuous Current at T_A = 25°C			2.6	A
T_{STG}	Storage Junction Temperature		- 65	150	°C
T_A	Operating Temperature Range		- 40	105	°C
θ_{JA}	Thermal Resistance, Junction to Ambient			180	°C/W
ESD	Electrostatic Discharge Capability	Human Body Model, JESD22-A114	8		kV
		Charged Device Model, JESD22-C101	2		

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min.	Max.	Unit
V_{IN}	Supply Voltage	2.5	5.5	V
T_A	Ambient Operating Temperature	-40	+85	°C

ELECTRICAL CHARACTERISTICS

Values are at V_{IN} = 5.0 V and T_A = 25°C. Unless otherwise noted

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Units
Basic Operation							
I_Q	Quiescent Current	V_{EN}= Enable, I_{OUT}= 0 mA			20	30	µA
I_{SD}	Shutdown Current	V_{EN}= Disable, I_{OUT}= 0 mA			50	100	nA
R_{ON}	On-Resistance	V_{IN}= 5.0 V, I_{OUT}= 500 mA	Ta= 25 °C		56	70	mΩ
			Ta= 85 °C [1]		64		
		V_{IN}=3.3 V, I_{OUT}= 500 mA	Ta= 25°C		64	80	
			Ta= 85 °C [1]		74		
R_{DSC}	Output Discharge Resistance	V_{EN}= Low , I_{FORCE}= 10 mA GLF2311x, GLF2313x, GLF2321x			300		Ω
V_{IH}	EN Input Logic High Voltage	V_{IN}= 2.5 V to 5.5 V		1.2			V
V_{IL}	EN Input Logic Low Voltage	V_{IN}= 2.5 V to 5.5 V				0.6	V
R_{EN}	EN pull down resistance	Internal Resistance			10	13	MΩ
R_{EN}	EN pull up resistance	Internal Resistance, GLF2313B only			10	13	MΩ
I_{EN}	EN Source or Sink Current	V_{EN}= 5.5 V				0.6	µA
V_{FLGB}	FLGB Output Low Voltage	I_{FLGB}= 0.5 mA				180	mV
I_{FLGB}	FLGB Output High Leakage	V_{FLGB}= 5.5 V			6		nA
t_{FLAG}	FLGB Output Delay Time [1]	Delay time for assertion at over current			8		ms
		Delay time for assertion at short circuit and thermal shutdown conditions			100		µs

Values are at V_{IN} = 5.0 V and T_A = 25°C. Unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
Protection						
V_{UVLO}	Under Voltage Lockout Voltage	Input Rising		2.3		V
		Input Falling		2.2		V
I_{LIM}	Over Current Limit	R_{LIM}= 1.3 kΩ, GLF231xA [1]		2.2		A
		GLF231xB	2.0	2.2	2.4	
		GLF2321B	1.5	1.8	2.0	
I_{SC}	Short Circuit [1]	R_{LIM}= 1.3 kΩ, GLF231xA		6.6		A
		GLF231xB		6.6		
		GLF2321B		5.3		
t_{OC}	Over Current limit Protection Delay Time [1]	R_{LIM} = 1.3 kΩ, R_{OUT}= 2 Ω, See Figure 20		84		μs
t_{SC}	Short Circuit Protection Delay Time [1]	R_{LIM} = 1.3 kΩ, R_{OUT}= 0.2 Ω, See Figure 20		8		μs
V_{RCB}	Reverse Current Blocking Protection Trip Voltage	V_{OUT} - V_{IN}	20	40	105	mV
	Reverse Current Blocking Protection Release Voltage	V_{IN} - V_{OUT}	12	25	80	
I_{RCB}	Reverse Current Blocking Protection Leakage	$(V_{OUT} - V_{IN})$ > V_{RCB}			1	uA
TSD	Thermal Shutdown	20 °C Hysteresis [1]		140		°C
Switching Characteristics [2]						
t_{dON}	Turn-On Delay	R_{OUT}= 150 Ω, C_{OUT}=1.0 μF		160		μs
t_R	V_{OUT} Rise Time			600		
t_{dOFF}	Turn-Off Delay	R_{OUT}=150 Ω, C_{OUT}=1.0 μF GLF2310x		15		
t_F	V_{OUT} Fall Time			270		
t_{dOFF}	Turn-Off Delay	R_{OUT}=150 Ω, C_{OUT}=1.0 μF GLF2311x, GLF2313x, GLF2321x		15		
t_F	V_{OUT} Fall Time			200		

Notes: 1. By design; characterized; not production tested.
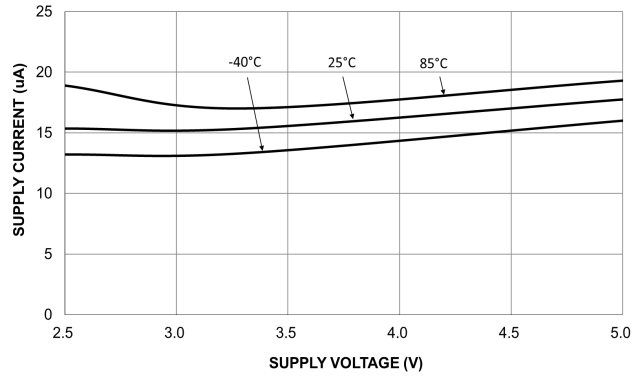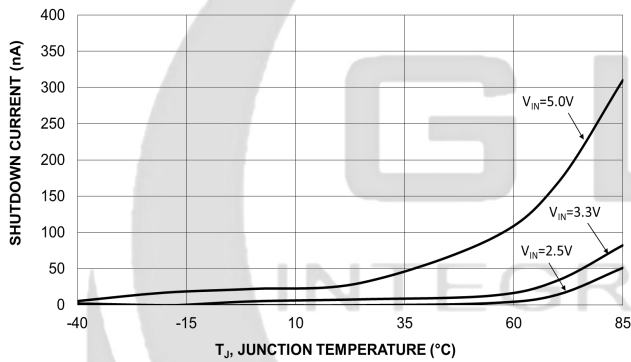2. Switching Timing Diagram
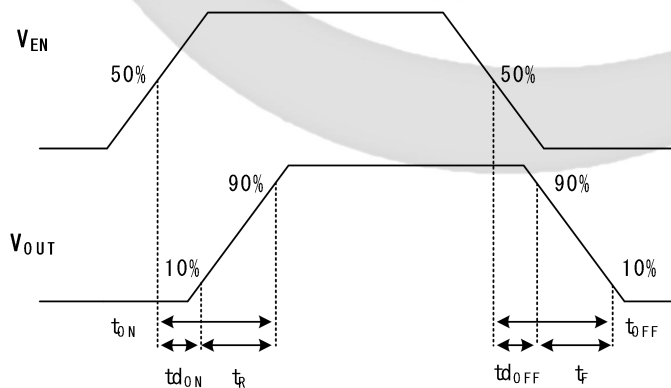
Figure 4. Switching Timing Diagram
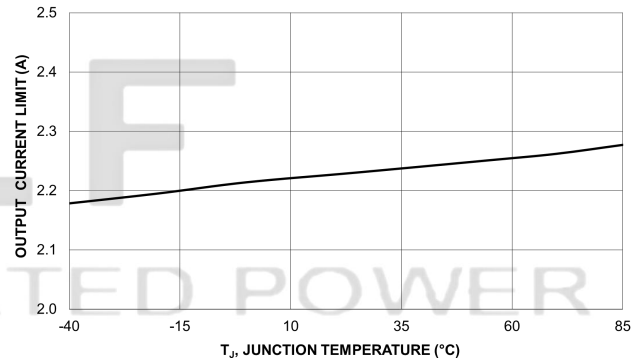
TYPICAL PERFORMANCE CHARACTERISTICS
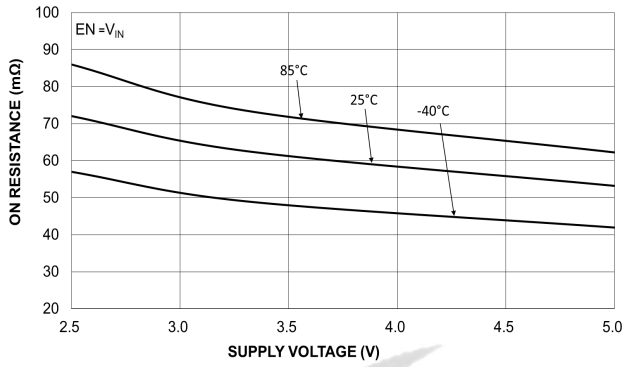
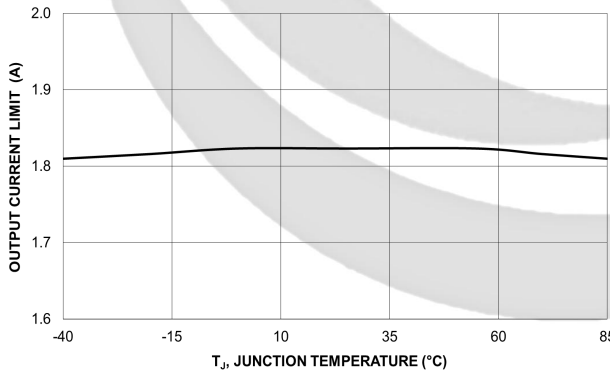**Figure 5. On-Resistance vs. Supply Voltage**
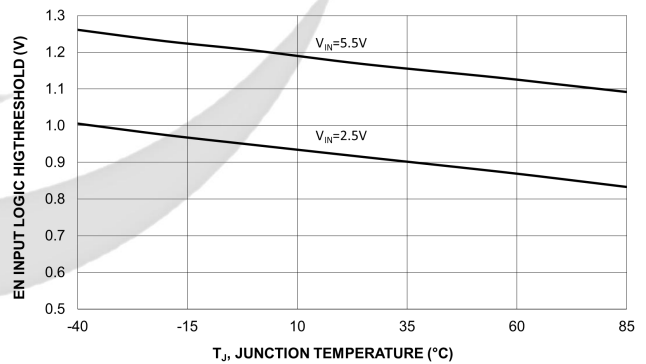
Figure 6. Quiescent Current vs. Supply Voltage

Figure 7. Shutdown Current vs. Temperature

Figure 8. Over Current Limit vs. Temperature, GLF231xB

Figure 9. Over Current Limit vs. Temperature, GLF2321B

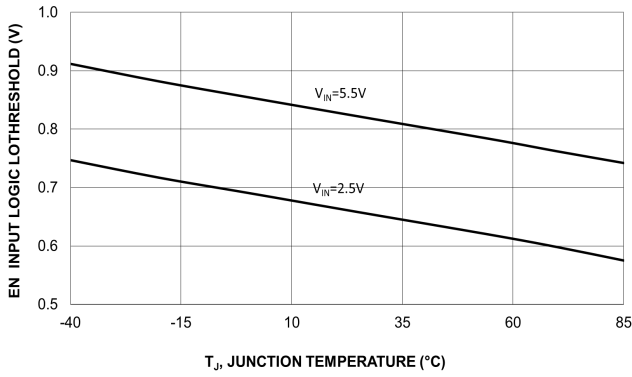**Figure 10. EN Input Logic High Threshold**
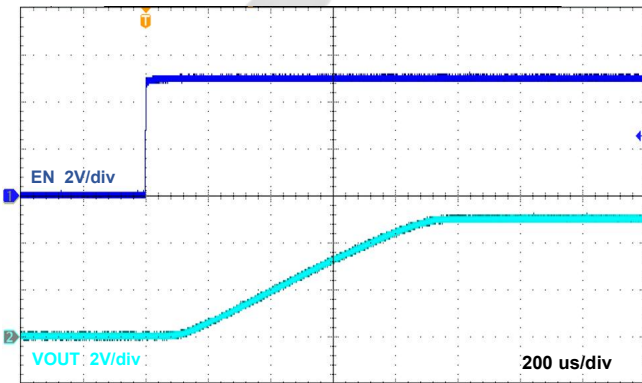
Figure 11. EN Input Logic Low Threshold

Figure 11. Turn-On Response
V_{IN}=5.0 V, C_{IN}=1.0 uF, C_{OUT}=1.0 uF, R_L=150 Ω
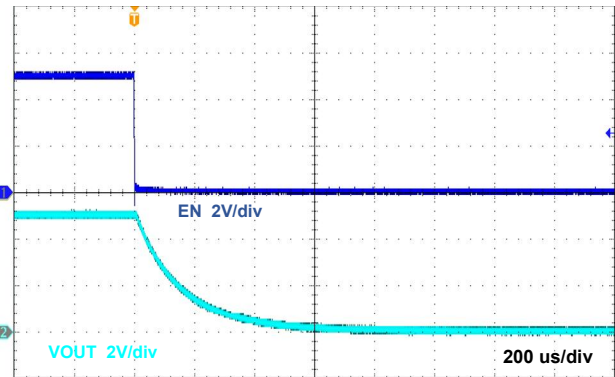
Figure 12. Turn-Off Response
V_{IN}=5.0 V, C_{IN}=1.0 uF, C_{OUT}=1.0 uF, R_L=150 Ω
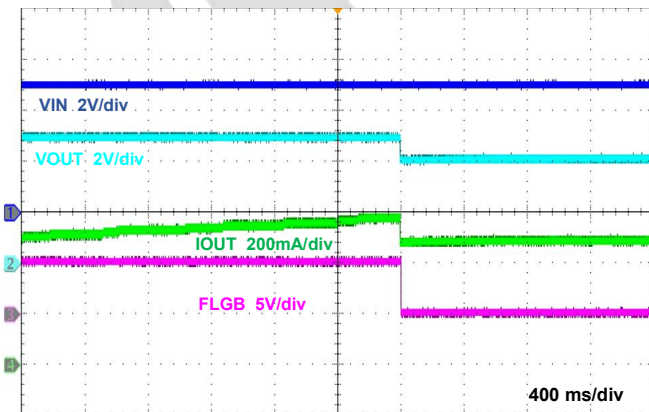
Figure 13. Current Limit Response, GLF232xA
V_{IN}=5.0 V, C_{IN}=1.0 µF, C_{OUT}=1.0 µF, R_{LIM}=5 kΩ
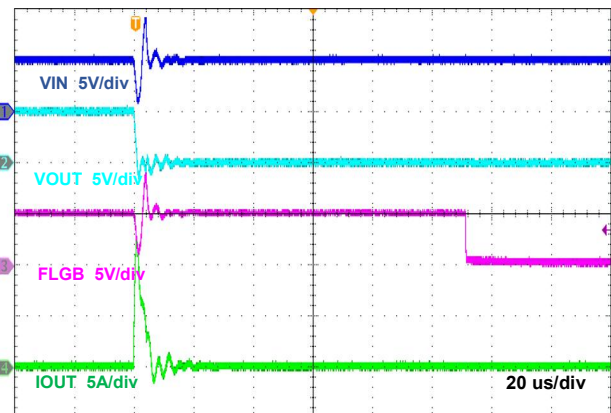
Figure 14. Short Circuit Response
V_{IN}=5.0 V, C_{IN}=1.0 µF, C_{OUT}=1.0 µF, R_{LIM}=5 kΩ, R_L=0 Ω
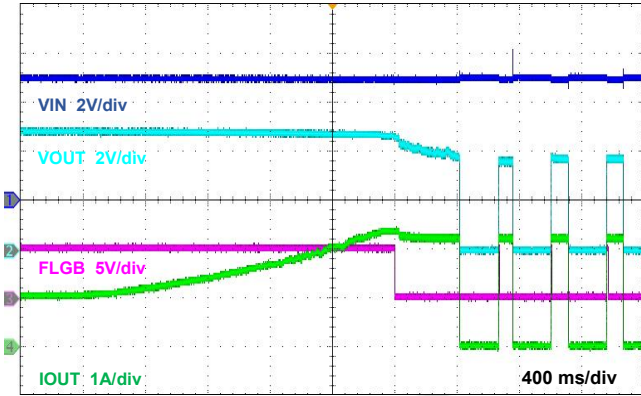
Figure 15. Current Limit Response, GLF231xB
V$_{IN}$=5.0 V, C$_{IN}$=1.0 µF, C$_{OUT}$=1.0 µF, R$_{LIM}$=5 kΩ
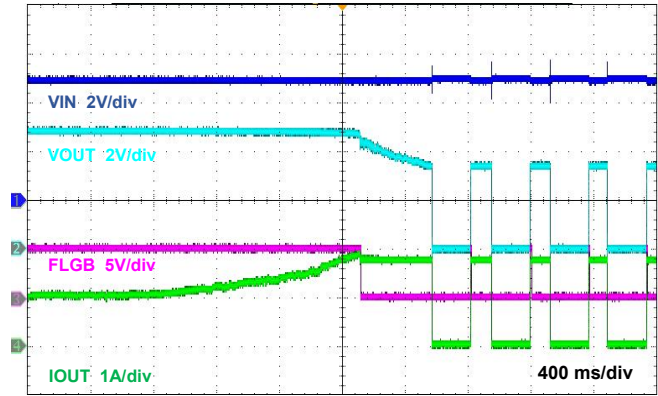
Figure 16. Current Limit Response, GLF2321B
V$_{IN}$=5.0 V, C$_{IN}$=1.0 µF, C$_{OUT}$=1.0 µF, R$_{LIM}$=5 kΩ
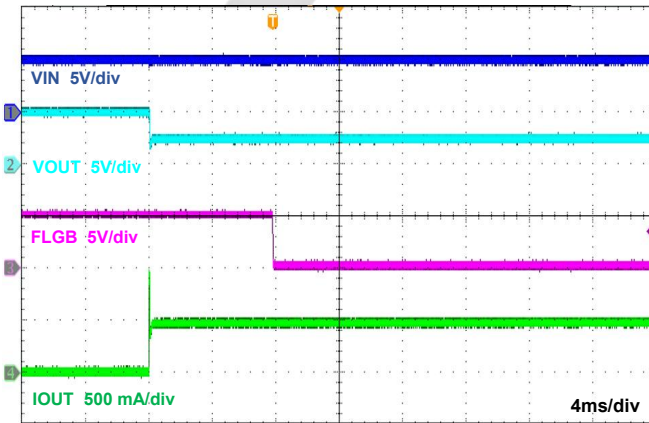
Figure 17. FLGB Response
V$_{IN}$=5.0 V, C$_{IN}$=C$_{OUT}$=1.0 µF
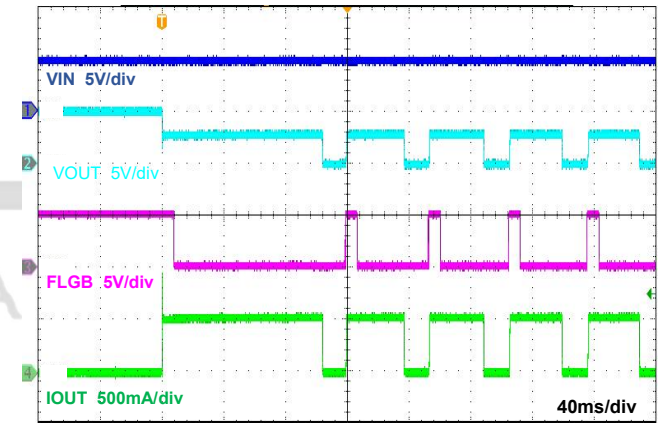
Figure 18. OTP Response
V$_{IN}$=5.0 V, C$_{IN}$=C$_{OUT}$=1.0 µF
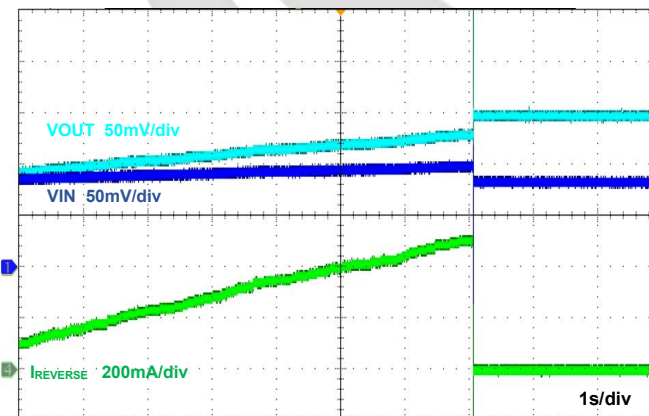
Figure 19. Reverse Current Blocking Threshold
V$_{IN}$=3.3 V, V$_{OUT}$=Up to 3.4 V, C$_{IN}$=1.0 µF, C$_{OUT}$=1.0 µF
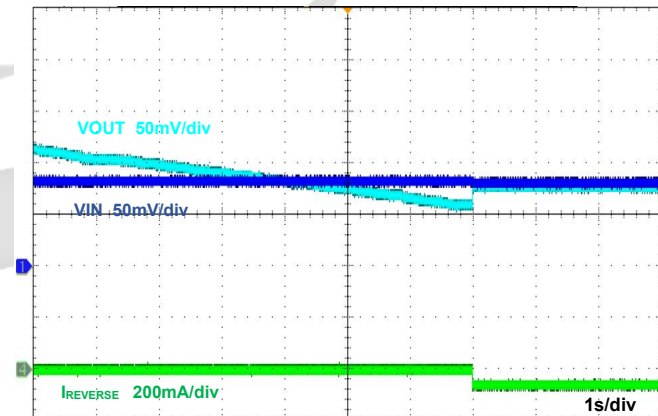
Figure 20. Reverse Current Blocking Release
V$_{IN}$=3.3 V, V$_{OUT}$=Up to 3.4 V, C$_{IN}$=1.0 µF, C$_{OUT}$=1.0 µF

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APPLICATION INFORMATION

The GLF2310, GLF2311, GLF2313 and GLF2321 are an advanced technology fully integrated power switch for applications required for precision output current limiting. It features also various protection functions such as under voltage lockout, true reverse current blocking (TRCB), short circuit protection, and thermal shutdown.

Input and Output Capacitor

A capacitor is recommended to be placed close to the V_{IN} 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. An output capacitor is recommended to minimize voltage undershoot on the output pin during the transition when the switch is turned off. Undershoot can be caused by parasitic inductance from board traces or intentional load inductances. If load inductances do 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.

EN pin

The GLF2310, GLF2311, and GLF2321 can be activated by EN pin high and the GLF2313 can be enabled by low. Note that the EN pin has an internal pull-down or pull-up resistor to maintain a reliable status without EN signal applied from an external controller.

True Reverse Current Blocking

The GLF2310, GLF2311, GLF2313 and GLF2321 have a built-in reverse current blocking protection which always monitors the output voltage level regardless of the status of EN pin to check if it is greater than the input voltage. When the output voltage goes beyond the input voltage by 40 mV, that is the reverse current blocking protection trip voltage, the reverse current blocking function block turns off the switch. Note that some reverse current can occur until the V_{RCB} is triggered. The main switch will resume normal operation when the output voltage drops below the input source by the RCB protection release voltage.

Fault Flag Response

The output of the open drain FLGB pin goes active low for any of following fault conditions: output current limit, output short-circuit, reverse current blocking, or thermal shutdown. It is designed to avoid false FLGB reporting by using an internal 8 ms deglitch delay for the current limit condition and 100 µs delay for the short circuit and over temperature conditions. The FLGB output remains low until over-current or over-temperature condition is removed. When short circuit fault conditions occur, the device is latched-off and the FLGB output remains low. The FLGB signal is de-asserted once device power is cycled or the enable is toggled and the device resumes normal operation.

Current Limiting and Short Circuit Protection

When the GLF231x and GLF2321 are enabled, the current-limit circuitry starts monitoring the output current. When the load current reaches up to the over current protection threshold, the device clamps the output current to a constant current limit level. The preset constant current limits of GLF231xB and GLF2321B are 2.0 A and 1.5 A respectively. A constant output current limit level of GLF231xA can be programmed by an external resistor (R_{LIM}) between ILIM and GND. The 1% precision resistors are recommended. The R_{LIM} resistor traces should be as short as possible to reduce parasitic effects on the current-limit accuracy. Refer to the table 1 and Figure 21 to find the resistor values corresponding to different current limit levels. The over temperature protection (OTP) turns off the device when the junction temperature exceeds 140 °C at the current limit condition. As the junction temperature cools down to 120 °C, the device is turned on again. The short circuit protection will take action immediately to shut down the device once a short circuit on the output node is detected. The device remains off until power is cycled or the EN pin is toggled.

Current Limiting and Short Circuit Protection (continued)

Figure 21. Current Trip and Limit vs. R_{LIM}
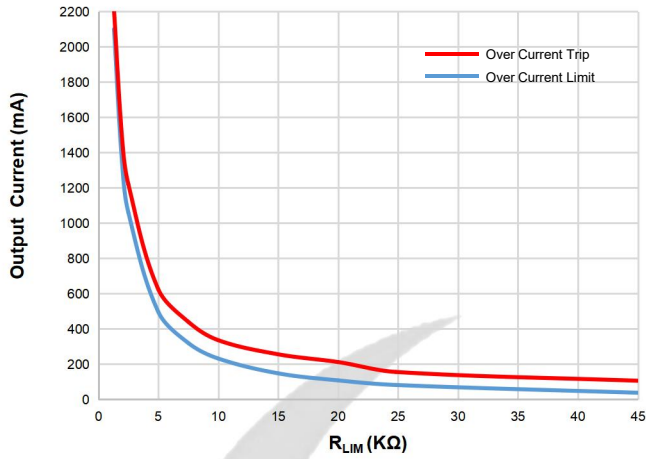
R_LIM (kΩ)	OCP Trip (mA) Typ.	OCP Limit (mA) Typ.
1.3	2210	2100
2.0	1460	1320
2.5	1220	1060
5.0	624	496
7.5	440	320
10	336	232
15	256	148
20	212	108
45	106	38

Table 1. Current Limit Level by R_{LIM}
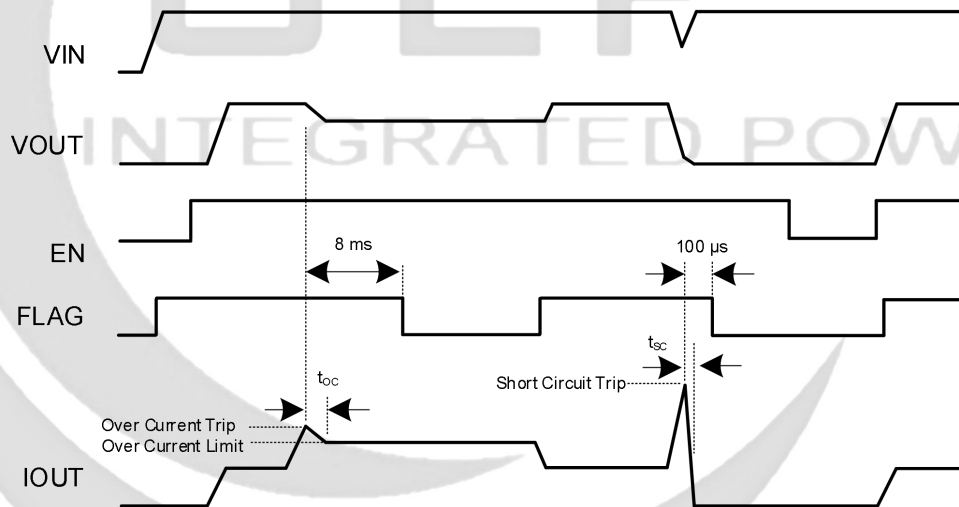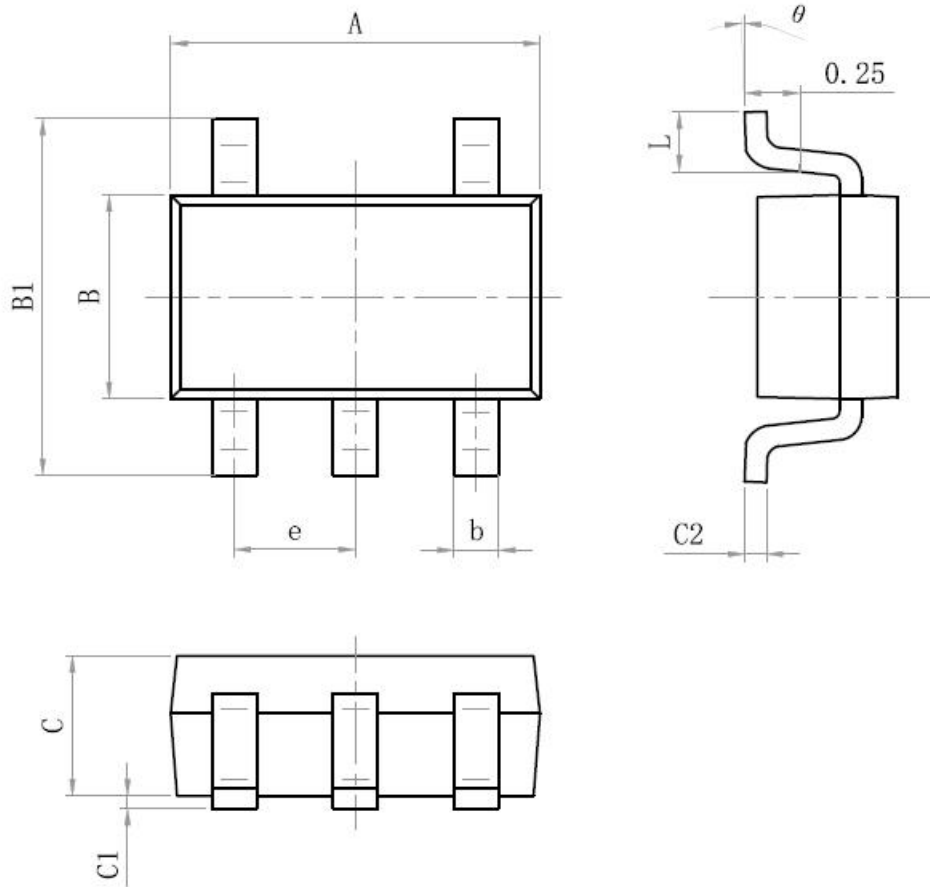

Figure 22. Over Current and Short Circuit Protection

PACKAGE OUTLINE

SOT23-5L

Size Mark	Min(mm)	Max(mm)	Size Mark	Min(mm)	Max(mm)
A	2.82	3.02	C	1.05	1.15
e	0.95 (BSC)		C1	0.03	0.15
b	0.28	0.45	C2	0.12	0.23
B	1.50	1.70	L	0.35	0.55
B1	2.60	3.00	θ	0°	8°

SOT23-6L

Size Mark	Min(mm)	Max(mm)	Size Mark	Min(mm)	Max(mm)
A	2.82	3.02	C	1.05	1.15
e	0.95 (BSC)		C1	0.03	0.15
b	0.28	0.45	C2	0.12	0.23
B	1.50	1.70	L	0.35	0.55
B1	2.60	3.00	θ	0°	8°

GLF INTEGRATED POWER
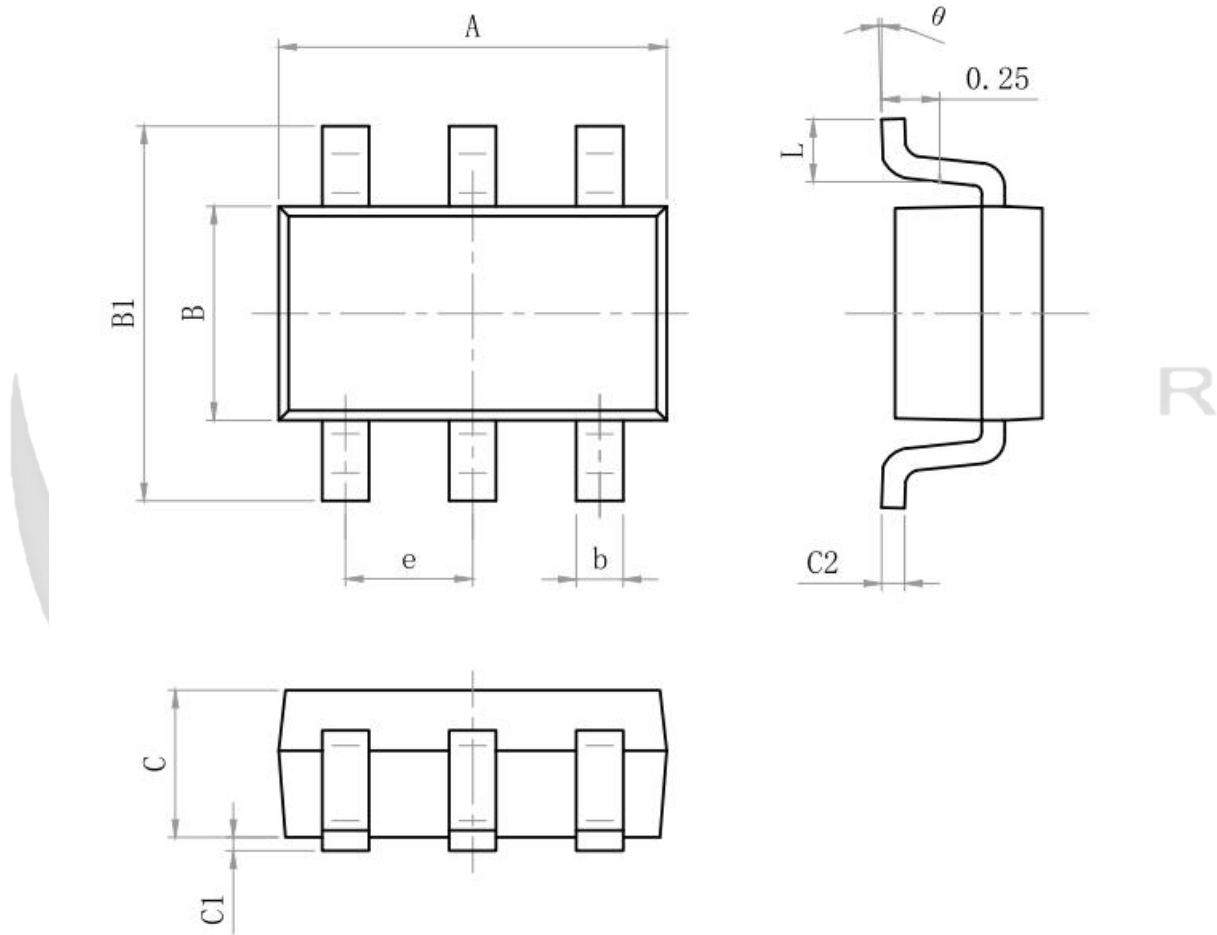
TAPE AND REEL INFORMATION

REEL DIMENSIONS
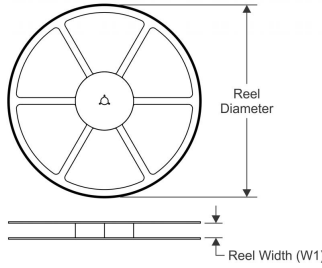
QUADRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE

TAPE DIMENSIONS

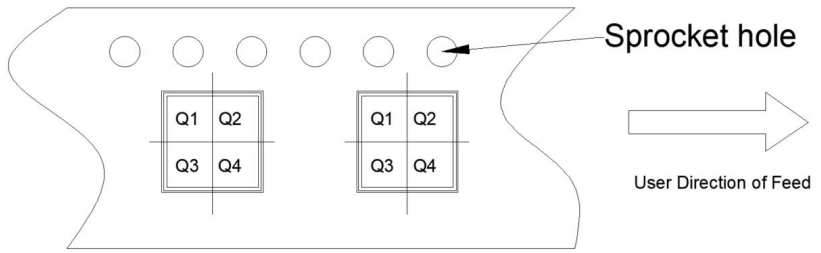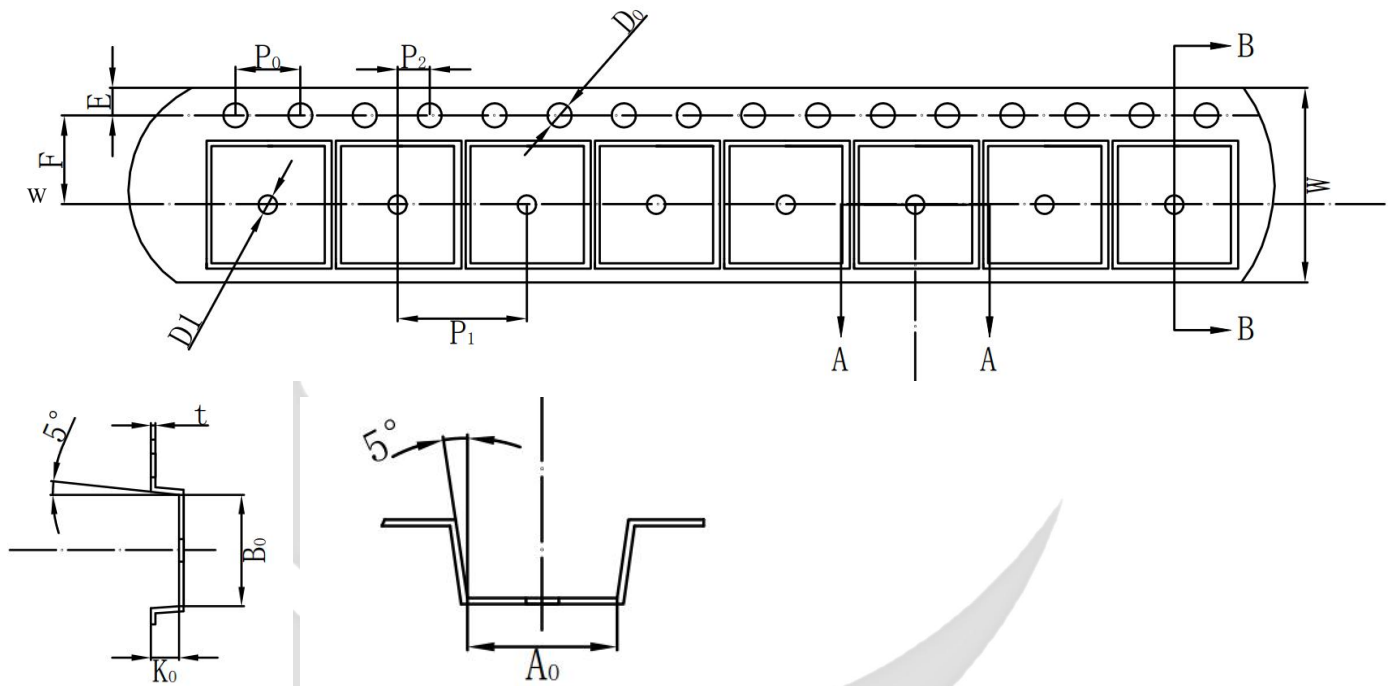| Device	Package	Pins	SPQ	Reel Diameter(mm)	Reel Width W1	A0	B0	K0	P1	W	Pin1
GLF2310A-T1G7	SOT23-5	5	3000	178	9	3.25	3.30	1.38	4	8	Q3
GLF2311A-T1G7	SOT23-5	5	3000	178	9	3.25	3.30	1.38	4	8	Q3
GLF2310A-T2G7	SOT23-6	6	3000	178	9	3.25	3.30	1.38	4	8	Q3
GLF2311A-T2G7	SOT23-6	6	3000	178	9	3.25	3.30	1.38	4	8	Q3
GLF2311B-T1G7	SOT23-5	5	3000	178	9	3.25	3.30	1.38	4	8	Q3
GLF2313B-T1G7	SOT23-5	5	3000	178	9	3.25	3.30	1.38	4	8	Q3
GLF2321B-T1G7	SOT23-5	5	3000	178	9	3.25	3.30	1.38	4	8	Q3

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

P1: 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 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 of the device in question.	Qualification
Product Specification	This document represents the anticipated production performance characteristics of the device.	Production

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