GLF1110Q, GLF1111Q

Nano-Current Power I_QSmart™ Load Switch

Product Specification

DESCRIPTION

The GLF1110Q / GLF1111Q is an ultra-efficiency, 2 A rated, load switch with integrated slew rate control. The best-in-class efficiency makes it an ideal choice for electronics requiring operation under the high temperature up to 125 °C.

The GLF1110Q / GLF1111Q features ultra-efficient I_QSmart™ technology that supports the lowest quiescent current (I_Q) and shutdown current (I_{SD}) in the industry. Low I_Q and I_{SD} solutions help designers to reduce parasitic leakage current, improve system efficiency, and increase battery lifetime.

The integrated slew rate control can also enhance system reliability by mitigating bus voltage swings during switching events. Where uncontrolled switches can generate high inrush currents that result in voltage droop and/or bus reset events, the GLF slew rate control specifically limits inrush currents during turn-on to minimize voltage droop.

The GLF1110Q / GLF1111Q supports an industry leading wide input voltage range and helps to improve operating life and system robustness.

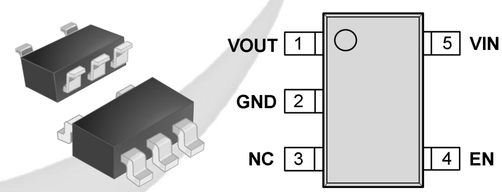
FEATURES

- AEC-Q100 Qualified
- Qualified for Automotive Applications:
  Temperature Grade 1: Ambient Operating Temperature Range: -40 °C to +125 °C
- Wide Input Range: 1.5 V to 5.5 V
  6 V abs max
- R_{ON}: 60 mΩ Typ at 5.5 V_{IN}
- I_{OUT} Max: 2 A
- Ultra-Low I_Q: 2 nA Typ at 5.5 V_{IN}
- Ultra-Low I_{SD}: 13 nA Typ at 5.5 V_{IN}
- Controlled Rise Time: 600 μs at 3.3 V_{IN}
- Internal EN Pull-Down Resistor
- Integrated Output Discharge Switch:
  GLF1111Q
- ESD Performance Tested per AEC Q100
  HBM: 4 kV, CDM: 2 kV
- Moisture Sensitivity Level: MSL-3 and 260°C Peak Reflow Temperature
- Lead-free, Halogen-free, and adhere to RoHS Directive

APPLICATIONS

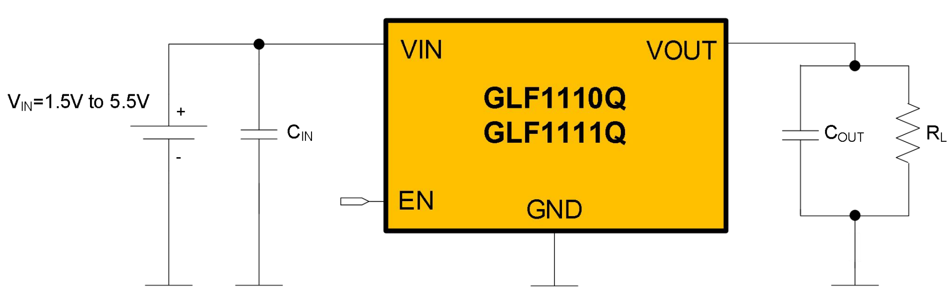
- Automotive Electronics
- Automotive Infotainment Systems
- Automotive Diagnosis System

PACKAGE



SOT23-5L

APPLICATION DIAGRAM



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ALTERNATE DEVICE OPTIONS

Part Number	Top Mark	R_{ON} (Typ) at 5.5 V	Output Discharge	EN Activity
GLF1110Q-T1G7	DKQ	60 mΩ	NA	High
GLF1111Q-T1G7	DLQ	60 mΩ	85 Ω	High

FUNCTIONAL BLOCK DIAGRAM

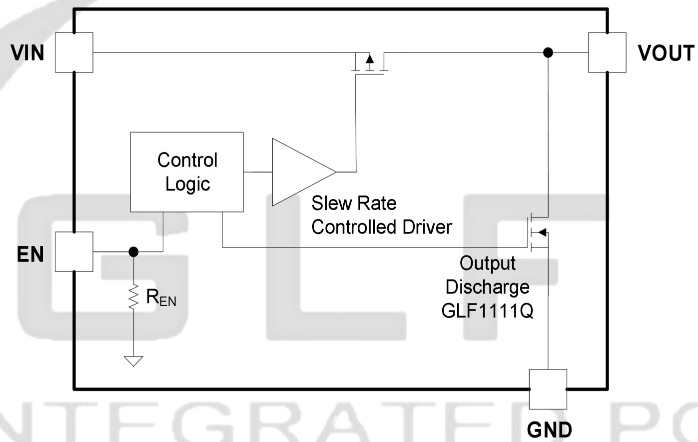


Figure 1. Functional Block Diagram

PIN CONFIGURATION

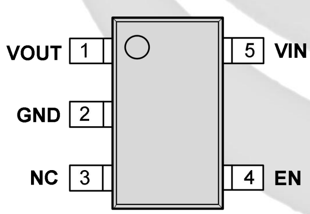


Figure 2. SOT23-5L

PIN DEFINITION

Pin #	Name	Description
1	VOUT	Switch Output
2	GND	Ground
3	NC	No connection
4	EN	Enable to control the switch
5	VIN	Switch Input. Supply Voltage for IC

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
V_{IN}	V_{IN}, V_{OUT}, V_{EN} to GND		-0.3	6	V
I_{OUT}	Maximum Continuous Switch Current			2	A
T_{STG}	Storage Junction Temperature		-65	150	°C
T_J	Maximum Junction Temperature			150	°C
θ_{JC}	Thermal Resistance, Junction to Case			90	°C/W
θ_{JA}	Thermal Resistance, Junction to Ambient (1)			180	°C/W
ESD	Electrostatic Discharge Capability	Human Body Model, per AEC Q100-002	4		kV
		Charged Device Model, per AEC Q100-011	2		V

Note. The θ_{JA} is measured at T_A = 25°C on a high effective thermal conductivity four-layer test board per JEDEC 51-7.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min.	Max.	Unit
V_{IN}	Supply Voltage	1.5	5.5	V
T_A	Ambient Operating Temperature	-40	+125	°C

ELECTRICAL CHARACTERISTICS

Values are at T_A = 25 °C unless otherwise noted.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Units
Basic Operation							
I_Q	Quiescent Current (1)	V_{IN} = V_{EN} = 5.5 V, I_{OUT} = 0 mA			2	20	nA
		V_{IN} = V_{EN} = 5.5 V, I_{OUT} = 0 mA, T_A= 125 °C (4)			75		
I_{SD}	Shut Down Current	V_{EN} = 0 V, V_{IN} = 1.5 V, I_{OUT} = 0 mA			2	20	
		V_{EN} = 0 V, V_{IN} = 3.3 V, I_{OUT} = 0 mA			3		
		V_{EN} = 0 V, V_{IN} = 4.2 V, I_{OUT} = 0 mA			5		
		V_{EN} = 0 V, V_{IN} = 5.5 V, I_{OUT} = 0 mA			13	30	
		V_{EN} = 0 V, V_{IN} = 5.5 V, I_{OUT} = 0 mA, T_A = 85 °C (4)			0.3	0.4	µA
		V_{EN} = 0 V, V_{IN} = 5.5 V, I_{OUT} = 0 mA, T_A = 125 °C			3	4	
R_{ON}	On-Resistance	V_{IN} = 5.5 V, I_{OUT} = 500 mA	T_A = 25 °C		60	68	mΩ
			T_A = 125 °C		78		
		V_{IN} = 3.3 V, I_{OUT} = 500 mA	T_A = 25 °C		70	79	
			T_A = 125 °C		92		
		V_{IN} = 1.8 V, I_{OUT} = 500 mA	T_A = 25 °C		110	124	
			T_A = 125 °C		150		
		V_{IN} = 1.5 V, I_{OUT} = 100 mA	T_A = 25 °C		120	135	
			T_A = 125 °C		166		
R_{DSC}	Output Discharge Resistance, GLF1111Q	V_{EN} = Low , I_{FORCE} = 10 mA			85		Ω
		V_{EN} = Low , I_{FORCE} = 10 mA, T_A = 125 °C			90		

V_{IH}	EN Input Logic High Voltage	V_{IN} = 1.5 V to 1.8 V, T_A= -40 °C to +125 °C (4)	0.9			V
		V_{IN} = 1.8 V to 5.5 V, T_A= -40 °C to +125 °C (4)	1.2			
V_{IL}	EN Input Logic Low Voltage	V_{IN} = 1.5 V to 1.8 V, T_A= -40 °C to +125 °C (4)			0.3	
		V_{IN} = 1.8 V to 5.5 V, T_A= -40 °C to +125 °C (4)			0.4	
R_{EN}	EN pull down resistance	Internal Resistance		10		MΩ
I_{EN}	EN Current	V_{EN} = 5.5 V		0.5		µA
Switching Characteristics (2), (3)						
t_{dON}	Turn-On Delay	V_{IN} = 3.3 V, R_L = 150 Ω, C_{OUT} = 0.1 µF GLF1111Q		450		µs
t_R	V_{OUT} Rise Time			600		
t_{dOFF}	Turn-Off Delay (4)			17		
t_F	V_{OUT} Fall Time (4), GLF1110Q			32		
	V_{OUT} Fall Time (4), GLF1111Q			12		
t_{dON}	Turn-On Delay	V_{IN} = 5.0 V, R_L = 150 Ω, C_{OUT} = 0.1 µF GLF1111Q		220		
t_R	V_{OUT} Rise Time			400		
t_{dOFF}	Turn-Off Delay (4)			17		
t_F	V_{OUT} Fall Time (4), GLF1110Q			32		
	V_{OUT} Fall Time (4), GLF1111Q			12		

Notes:
1. I_Q does not include the enable pull down current (I_{EN}) through the pull-down resistor R_{EN}.
2. $t_{ON} = t_{dON} + t_R$, $t_{OFF} = t_{dOFF} + t_F$
3. Output discharge path is enabled during off.
4. By design; characterized, not production tested

TIMING DIAGRAM

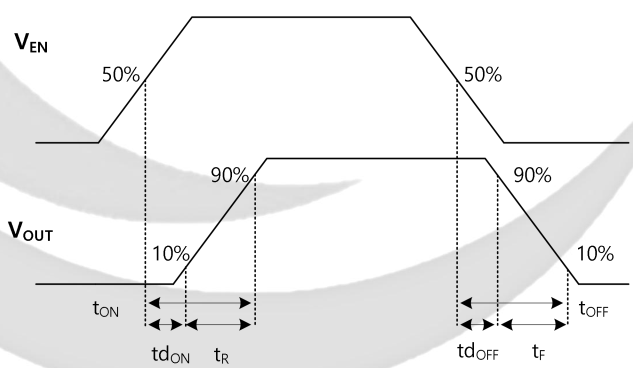


Figure 3. Timing Diagram

TYPICAL PERFORMANCE CHARACTERISTICS

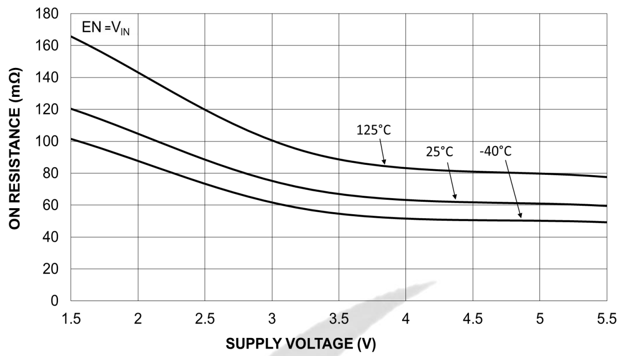


Figure 4. On-Resistance vs. Supply Voltage

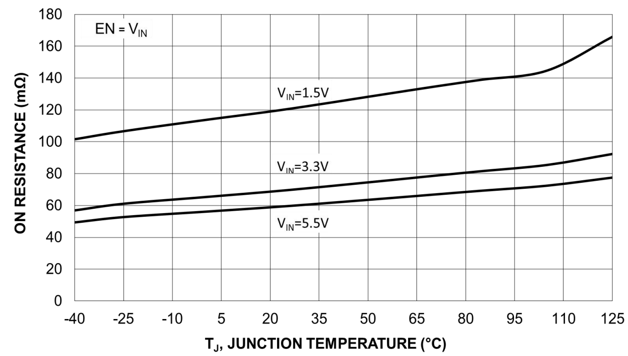


Figure 5. On-Resistance vs. Temperature

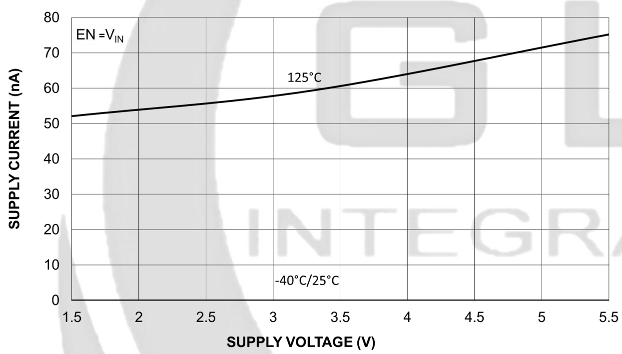


Figure 6. Quiescent Current vs. Supply Voltage

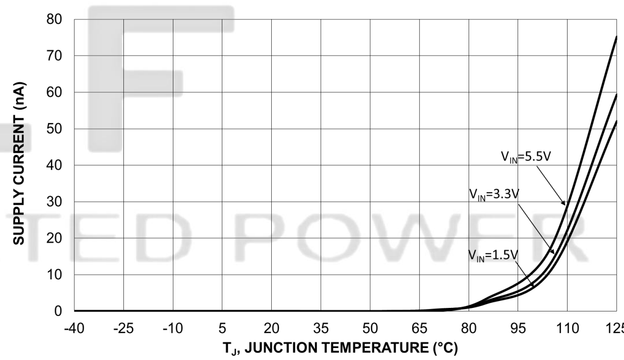


Figure 7. Quiescent Current vs. Temperature

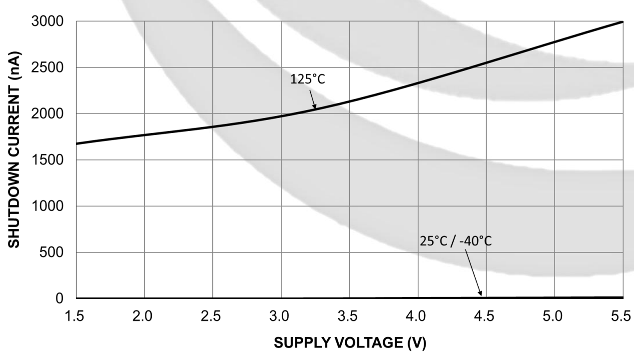


Figure 8. Shutdown Current vs. Input Voltage

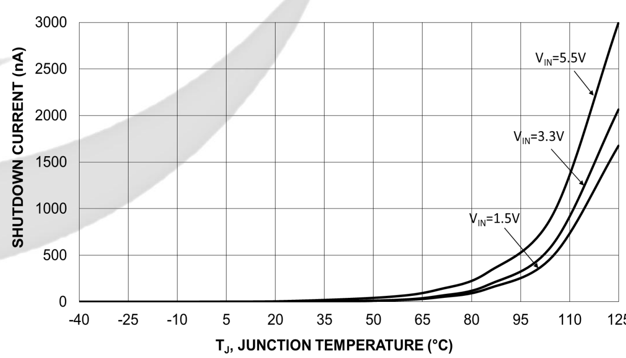


Figure 9. Shutdown Current vs. Temperature

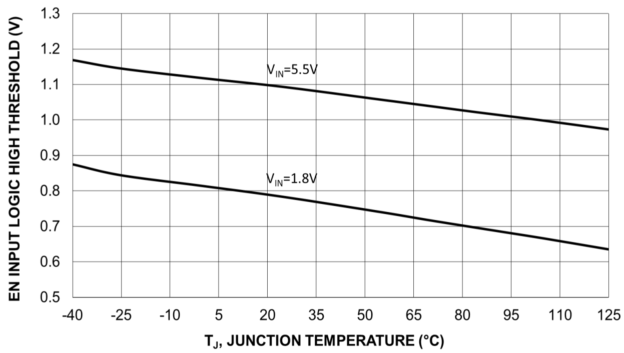


Figure 10. EN Input Logic High Threshold Vs. Temperature

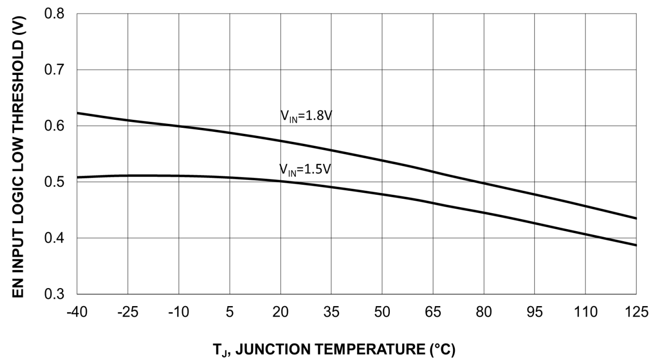


Figure 11. EN Input Logic Low Threshold Vs. Temperature

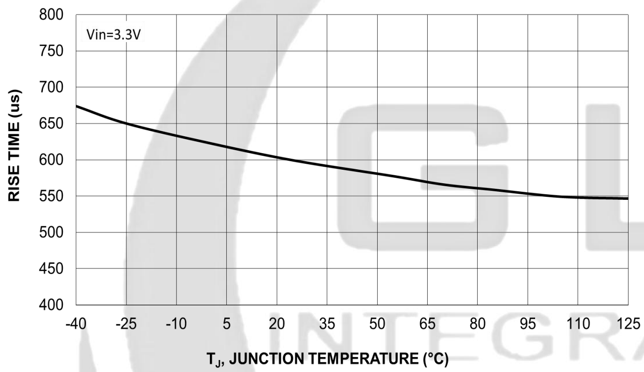


Figure 12. V_{OUT} Rise Time vs. Temperature

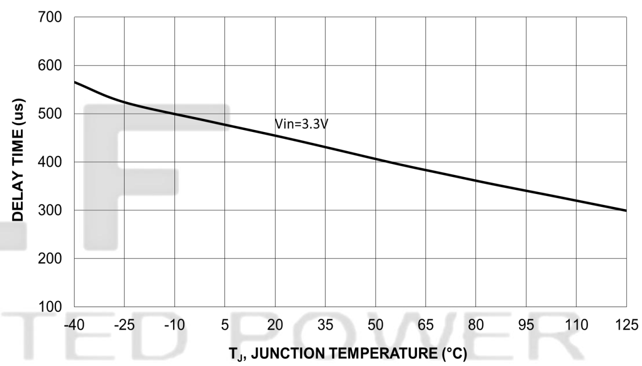


Figure 13. Turn-On Delay Time vs. Temperature

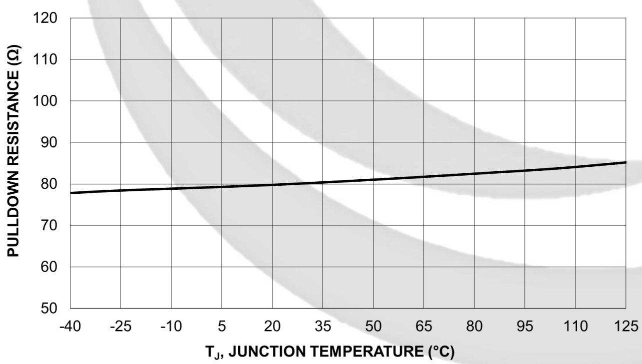


Figure 14. V_{OUT} Discharge Resistance vs. Temperature GLF1111Q Only

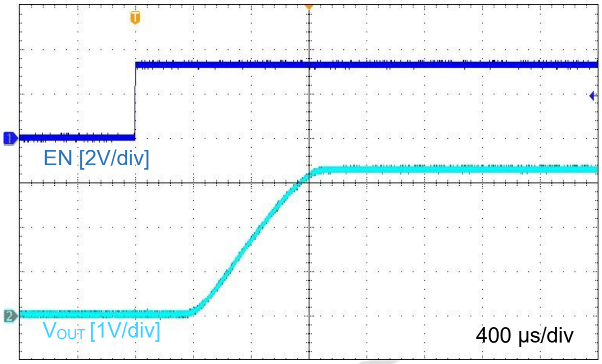


Figure 15. Turn-On Response, GLF1110Q
V_{IN}=3.3 V, C_{IN}=C_{OUT}=0.1 µF, R_L=150 Ω

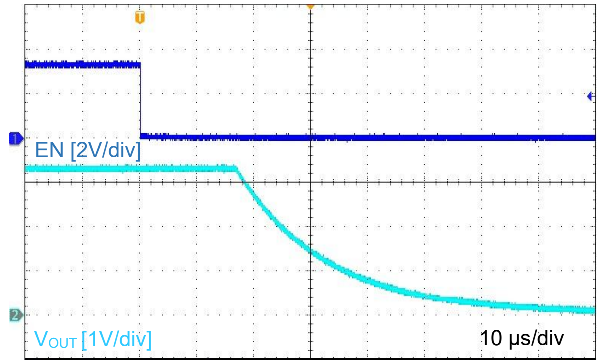


Figure 16. Turn-Off Response, GLF1110Q
V_{IN}=3.3 V, C_{IN}=C_{OUT}=0.1 µF, R_L=150 Ω

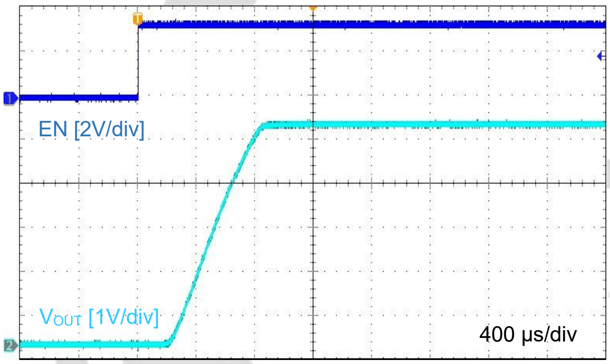


Figure 17. Turn-On Response, GLF1110Q
V_{IN}=5.0 V, C_{IN}=C_{OUT}=0.1 µF, R_L=150 Ω

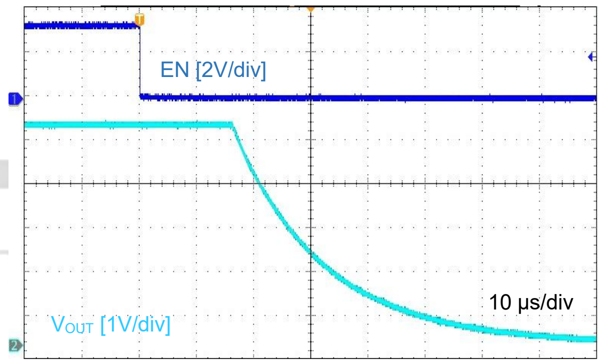


Figure 18. Turn-Off Response, GLF1110Q
V_{IN}=5.0 V, C_{IN}=C_{OUT}=0.1µF, R_L=150 Ω

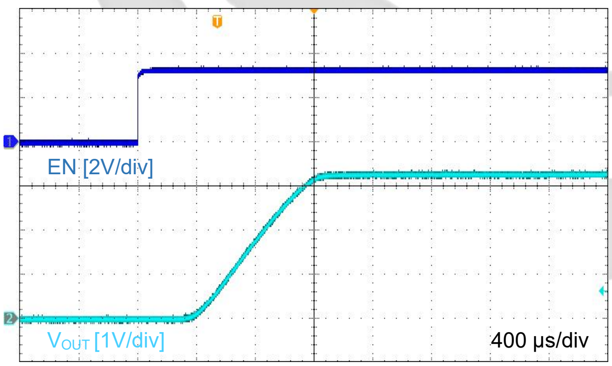


Figure 19. Turn-On Response, GLF1111Q
V_{IN}=3.3 V, C_{IN}=C_{OUT}=0.1 µF, R_L=150 Ω

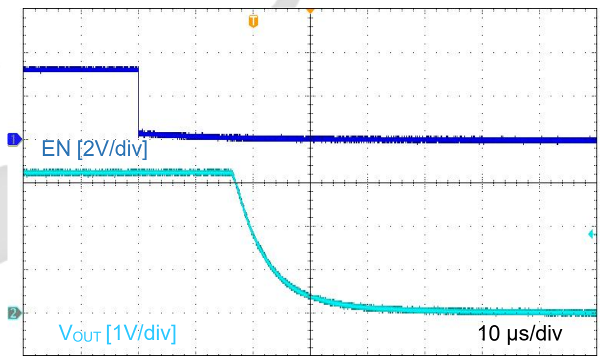


Figure 20. Turn-Off Response, GLF1111Q
V_{IN}=3.3 V, C_{IN}=C_{OUT}=0.1 µF, R_L=150 Ω

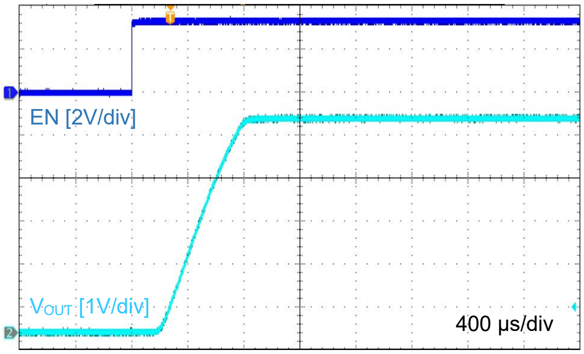


Figure 21. Turn-On Response, GLF1111Q
V_{IN}=5.0 V, C_{IN}=C_{OUT}=0.1 µF, R_L=150 Ω

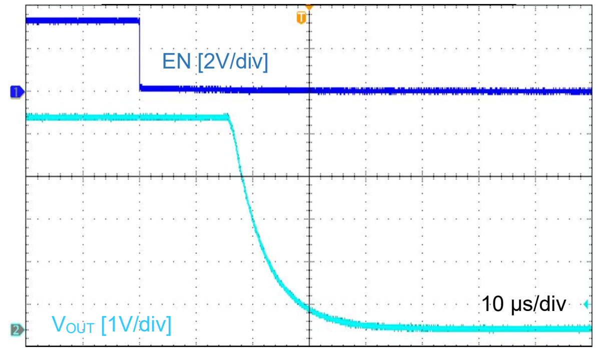


Figure 22. Turn-Off Response, GLF1111Q
V_{IN}=5.0 V, C_{IN}=C_{OUT}=0.1µF, R_L=150 Ω

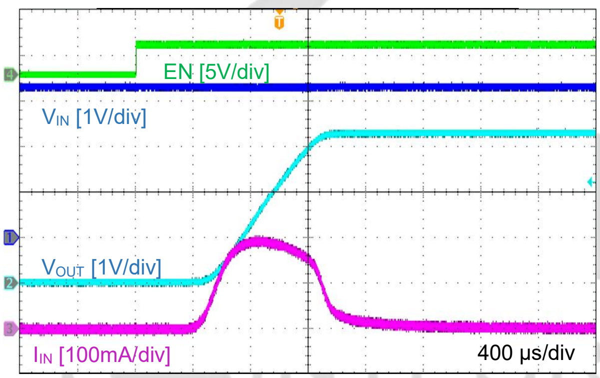


Figure 23. Inrush Current
V_{IN}=3.3 V, C_{IN}=0.1 µF, C_{OUT}=47 µF

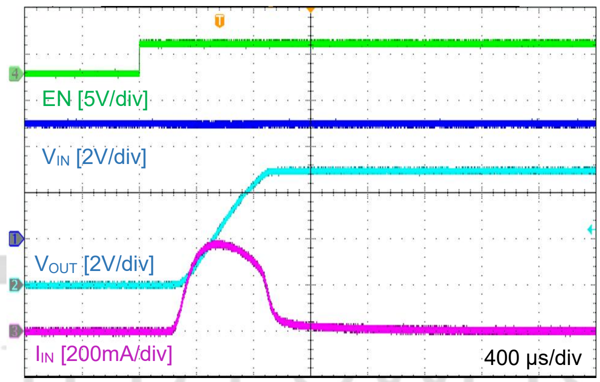


Figure 24. Inrush Current
V_{IN}=5.0 V, C_{IN}=0.1 µF, C_{OUT}=47 µF

APPLICATION INFORMATION

The GLF1110Q / GLF1111Q is an integrated 2 A, Ultra-Efficient I_QSmart™ Load Switch devices with a fixed slew rate control to limit the inrush current during turn on. It is capable of operating over a wide input range from 1.5 V to 5.5 V with very low on-resistance to reduce conduction loss. In the off state, these devices consume very low leakage current to lengthen the lifespan of a battery.

Input Capacitor

The GLF1110Q / GLF1111Q does not require an input capacitor. However, to reduce the voltage drop on the input power rail caused by transient inrush current at start-up, a 0.1 µF capacitor is recommended to be placed close to the V_{IN} pin. A higher input capacitor value can be used to further attenuate the input voltage drop.

Output Capacitor

The GLF1110Q / GLF1111Q does not require an output capacitor. However, use of an output capacitor is recommended to mitigate voltage undershoot on the output pin when the switch is turning 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 spaced close to the VOUT and GND pins.

EN pin

The GLF1110Q / GLF1111Q can be activated by forcing EN pin high level. Note that the EN pin has an internal pull-down resistor to help pull the main switch to a known "off state" when no EN signal is applied from an external controller.

Output Discharge Function

The GLF1111Q has an internal discharge N-channel FET switch on the VOUT pin. When EN signal turns the main power FET to an off state, the N-channel switch turns on to discharge an output capacitor quickly.

Thermal Consideration

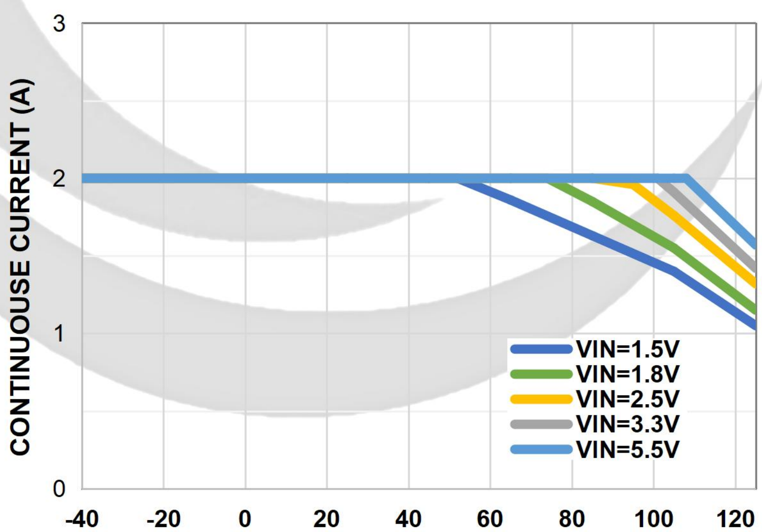
The maximum power dissipation, $P_{D(MAX)}$, dependent upon specific temperature conditions such as ambient temperature, a silicon junction temperature, printed circuit board conditions, and a thermal resistance of an IC. It can be calculated by the following equation The maximum junction temperature of the GLF1111Q is not allowed to exceed the maximum rating, 150°C to insure normal functionality.

The continuous output current given in Figure 25 shows current capability at the ambient temperature, T_A. It is limited by the maximum junction temperature, the thermal resistance, and the rise of the R_{ON} at the ambient temperature condition.

$$\mathbf{P_{D(max)}} = \frac{\mathbf{T_{J(max)}} - \mathbf{T_A}}{\boldsymbol{\theta}_{\mathbf{JA}}}$$

$$\mathbf{I_{D(DC)}} = \sqrt{\frac{\mathbf{T_{J(max)}} - \mathbf{T_A}}{\mathbf{R_{DS}} \cdot \boldsymbol{\theta}_{\mathbf{JA}}}}$$

Where
$T_{J(max)}$: Maximum junction temperature
T_A : Ambient temperature
θ_{JA} : Thermal resistance between junction and ambient



Note. This graph is based on a high effective thermal conductivity four-layer test board per JEDEC 51-7.

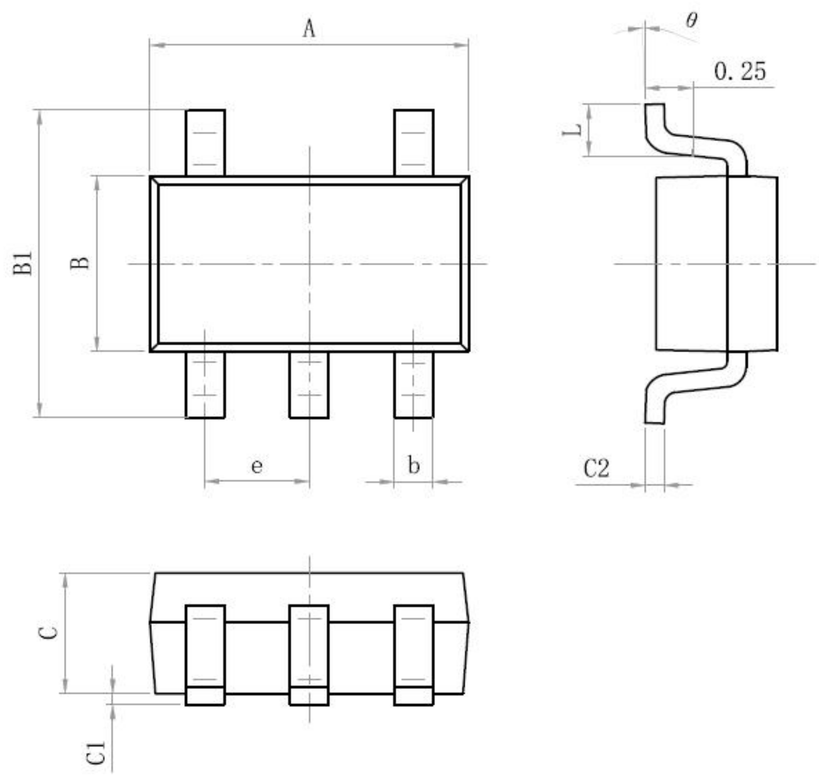
Figure 25. Continuous Current vs. Ambient Temperature

Board Layout

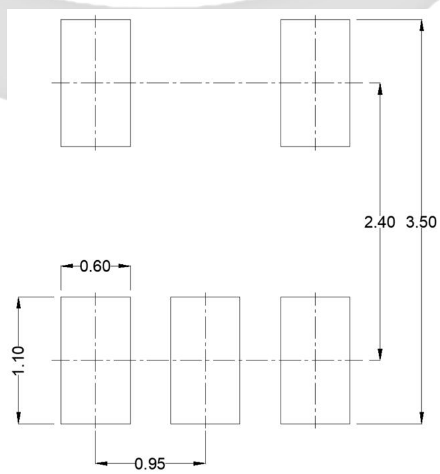
All traces should be as short as possible to minimize parasitic inductance effects. Wide traces for VIN, VOUT, and GND will help reduce signal degradation and parasitic effects during dynamic operation as well as improve the thermal performance at high load current.

PACKAGE OUTLINE

Mark \ Size	Min (mm)	Max (mm)	Mark \ Size	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°

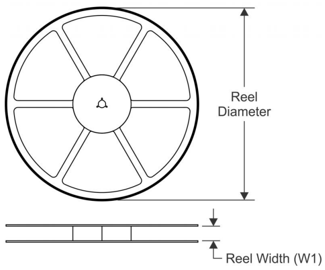


Recommended Footprint

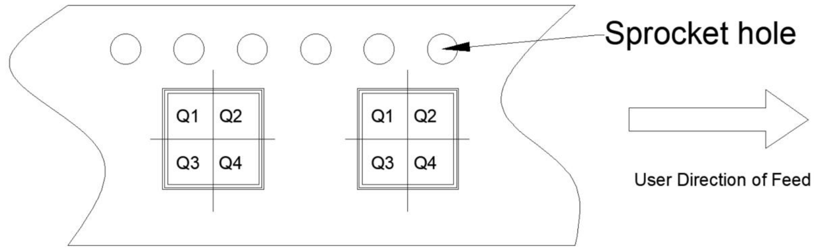


TAPE AND REEL INFORMATION

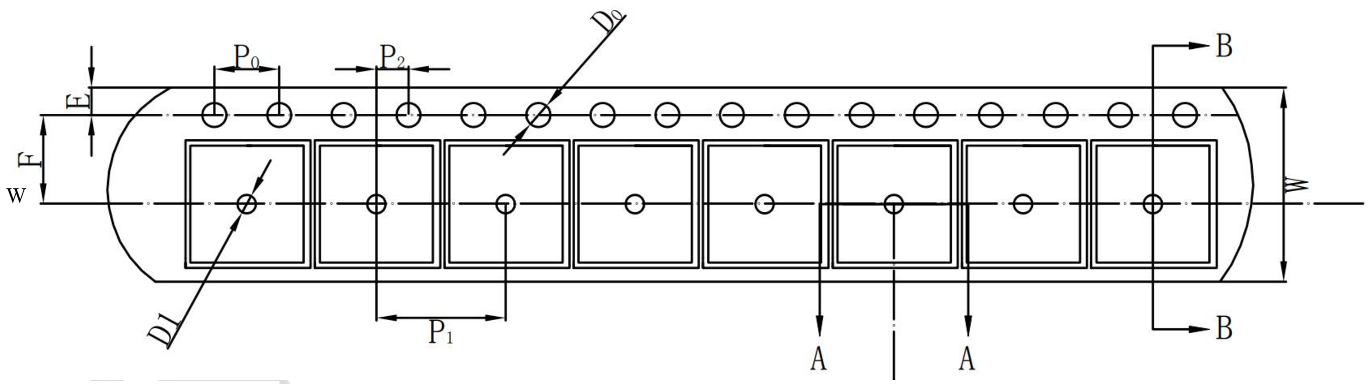
REEL DIMENSIONS

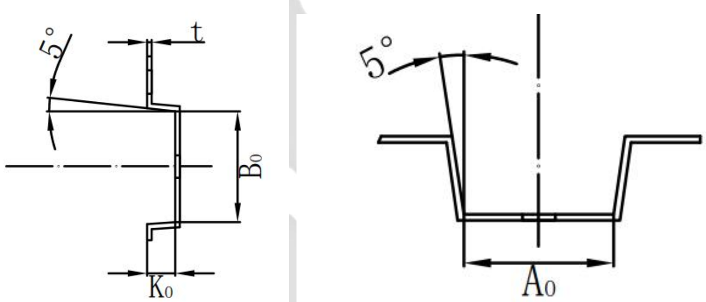


QUADRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE



TAPE DIMENSIONS





Device	Package	Pins	SPQ	Reel Diameter (mm)	Reel Width W1	A0	B0	K0	P1	W	Pin1
GLF1110Q-T1G7	SOT23-5	5	3000	178	9	3.25	3.30	1.38	4	8	Q3
GLF1111Q-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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