

GLF72110, GLF72111, GLF72112

3 A, Ultra-low Leakage I_QSmart™ Load Switch with Reverse Current Blocking Protection

Product Specification

DESCRIPTION

The GLF72110 / GLF72111 / GLF72112 is an advanced technology fully integrated I_QSmart™ load switch device with reverse current blocking (RCB) protection and slew rate control of the output voltage.

The GLF72110 / GLF72111 / GLF72112 offers industry RCB performance, featuring an ultra-low threshold voltage. It minimizes reverse current flow in the event that the VOUT pin voltage exceeds the VIN voltage.

The GLF72110 / GLF72111 / GLF72112 has an industry leading power efficiency. It features an on-resistance (R_{ON}) as low as 29 mΩ typical at 5.5 V, reducing power loss during conduction. The GLF72110 / GLF72111 / GLF72112 also features ultra-low shutdown current (I_{SD}) to reduce power loss and battery drain in the off state. When EN is pulled low, and the output is grounded, the GLF72110 / GLF72111 / GLF72112 can achieve an I_{SD} as low as 24 nA typical at 5.5 V.

The GLF72110 / GLF72111 / GLF72112 load switch device supports an industry leading wide input voltage range that helps to improve system operating life and overall performance. One GLF7211x device can be used in multiple voltage rail applications which helps mitigate inventory management and reduces BOM cost.

The GLF72110 / GLF72111 / GLF72112 load switch device utilizes a chip scale package with 4 bumps in a 0.97 mm x 0.97 mm x 0.55 mm die size and a 0.5 mm pitch.

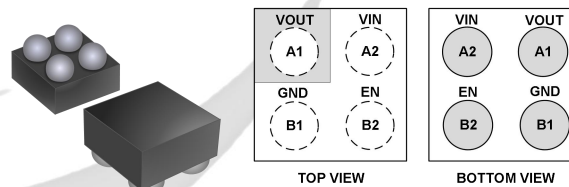
FEATURES

- Wide Input Range: 1.5 V to 5.5 V
6 V_{ABS} max
- Ultra-Low I_Q: 1.3 μA Typ at 5.5 V_{IN}
- Ultra-Low I_{SD}: 24 nA Typ at 5.5 V_{IN}
- Low R_{ON}: 29 mΩ Typ at 5.5V_{IN}
- I_{OUT} Max: 3 A
- Reverse Current Blocking Protection
- Controlled Rise Time
- Internal EN Pull-Down Resistor, R_{EN}
- Integrated Output Discharge Switch:
GLF72111
- 0.97 mm x 0.97 mm x 0.55 mm Wafer Level
Chip Scale Package

APPLICATIONS

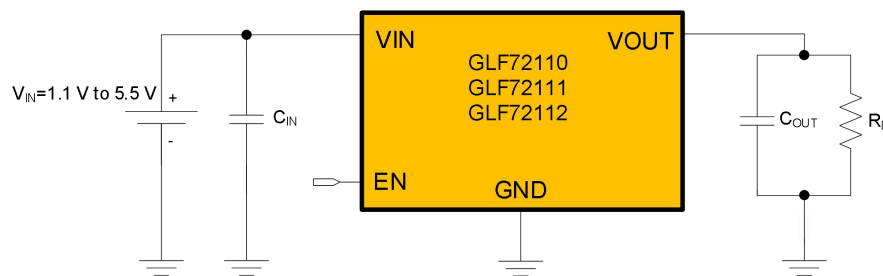
- Portable Devices
- Wearable Devices
- Low Power Subsystems
- Smart IoT Devices

PACKAGE



0.97 mm x 0.97 mm x 0.55 mm WLCSP

APPLICATION DIAGRAM



ALTERNATE DEVICE OPTIONS

Part Number	Top Mark	R _{ON} (Typ) at 5.5 V	Rise Time t _r (μs) at 3.3 V	Output Discharge	EN Activity
GLF72110	DC	29 mΩ	1200	NA	High
GLF72111	BJ		1200	85 Ω	
GLF72112	KC		18	NA	

FUNCTIONAL BLOCK DIAGRAM

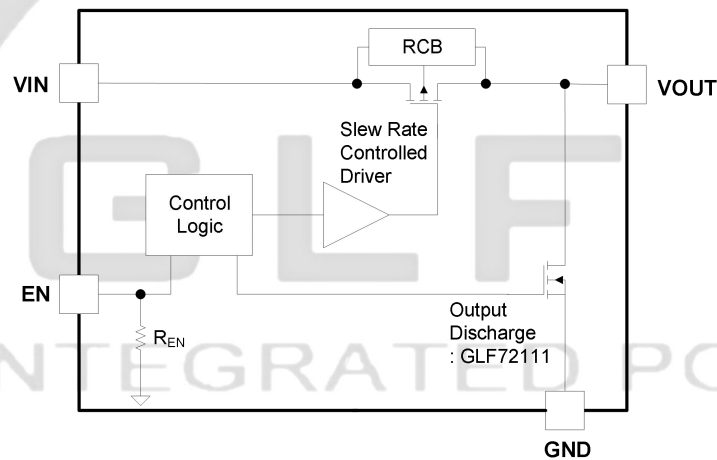
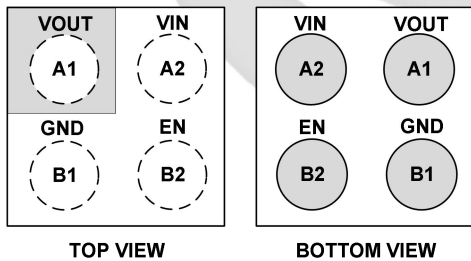


Figure 1. Functional Block Diagram

PIN CONFIGURATION



PIN DEFINITION

Pin #	Name	Description
A1	VOUT	Switch Output
A2	VIN	Switch Input. Supply Voltage for IC
B1	GND	Ground
B2	EN	Enable to control the switch. It has an internal 10 MΩ pull down resistor, R _{EN} .

Figure 2. 0.97mm x 0.97mm x 0.55mm WLCSP

ABSOLUTE MAXIMUM RATINGS ⁽¹⁾

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_{OUT}, V_{EN}	V_{IN}, V_{OUT}, V_{EN} to GND	-0.3	6	V
I_{OUT}	Maximum Continuous Switch Current at $T_A = 25\text{ }^{\circ}\text{C}$		3	A
	Maximum Continuous Switch Current at $T_A = 125\text{ }^{\circ}\text{C}$		2	
P_D	Power Dissipation at $T_A = 25\text{ }^{\circ}\text{C}$		1.2	W
T_J	Maximum Junction Temperature		150	$^{\circ}\text{C}$
T_{STG}	Storage Junction Temperature	-65	150	$^{\circ}\text{C}$
T_A	Ambient Operating Temperature Range	-40	125	$^{\circ}\text{C}$
$\theta_{JA}^{(2)}$	Thermal Resistance, Junction to Ambient		85	$^{\circ}\text{C/W}$
ESD	Electrostatic Discharge Capability	Human Body Model, JESD22-A114	± 4	kV
		Charged Device Model, JESD22-C101	± 2	

Notes:

1. Continuous operation even under Absolute Maximum Ratings may cause this device serious reliability problems.
2. The thermal resistance depends on the PCB conditions for heat dissipation. All pins are strongly recommended to have a solid contact to larger Cu layer areas

RECOMMENDED OPERATING CONDITIONS

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

ELECTRICAL CHARACTERISTICS

Values are at $V_{IN} = 3.3\text{ V}$ and $T_A = 25\text{ °C}$ unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units	
Basic Operation							
I _Q	Quiescent Current ⁽¹⁾	EN = Enable, I _{OUT} = 0 mA, V _{IN} = V _{EN} = 5.5 V		1.3	2.0	μA	
		EN=Enable, I _{OUT} = 0 mA, V _{IN} =V _{EN} = 5.5 V, T _A = 85 °C ⁽⁵⁾		1.4			
		EN=Enable, I _{OUT} = 0 mA, V _{IN} =V _{EN} =5.5 V, T _A = 125 °C ⁽⁵⁾		1.5			
I _{SD}	Shutdown Current	EN = Disable, I _{OUT} = 0 mA, V _{IN} = 1.5 V		3		nA	
		EN = Disable, I _{OUT} = 0 mA, V _{IN} = 3.3 V		5	30		
		EN = Disable, I _{OUT} = 0 mA, V _{IN} = 4.2 V		12			
		EN = Disable, I _{OUT} = 0 mA, V _{IN} = 5.5 V		24	50	μA	
		EN = Disable, I _{OUT} = 0 mA, V _{IN} = 5.5 V, T _A = 85 °C ⁽⁵⁾		0.5			
		EN = Disable, I _{OUT} = 0 mA, V _{IN} = 5.5 V, T _A = 125 °C ⁽⁵⁾		4.4			
R _{ON}	On-Resistance	V _{IN} = 5.5 V, I _{OUT} = 500 mA	T _A = 25 °C		29	34	mΩ
			T _A = 85 °C ⁽⁵⁾		32		
			T _A = 125 °C ⁽⁵⁾		35		
		V _{IN} = 3.3 V, I _{OUT} = 500 mA	T _A = 25 °C		35	41	
			T _A = 85 °C ⁽⁵⁾		40		
			T _A = 125 °C ⁽⁵⁾		44		
		V _{IN} = 1.8 V, I _{OUT} = 300 mA	T _A = 25 °C		54		
		V _{IN} = 1.5 V, I _{OUT} = 100 mA	T _A = 25 °C		66		
R _{DSC}	Output Discharge Resistance, GLF72111	EN=Low , I _{FORCE} = 10 mA	70	85	100	Ω	
V _{IH}	EN Input Logic High Voltage	V _{IN} = 1.5 V to 5.5 V	1.2			V	
V _{IL}	EN Input Logic Low Voltage	V _{IN} = 1.5 V to 5.5 V			0.4		
R _{EN}	EN pull down resistance	Internal Resistance		10		MΩ	
I _{EN}	EN Source or Sink Current	EN=V _{IN} or GND			0.6	μA	
V _{RCB_TH}	RCB Protection Threshold Voltage	V _{OUT} – V _{IN}		28		mV	
V _{RCB_RL}	RCB Protection Release Voltage	V _{IN} – V _{OUT}		28			
Switching Characteristics ^{(4), (5)} : GLF72110, GLF72111							
t _{dON}	Turn-On Delay ⁽²⁾	3.3 V _{IN} , R _L = 150 Ω, C _{OUT} = 0.1 μF	0.75	1.0	1.25	ms	
t _R	V _{OUT} Rise Time ⁽²⁾		0.9	1.2	1.5		
t _{dOFF}	Turn-Off Delay ⁽³⁾	3.3 V _{IN} , R _L = 150 Ω, C _{OUT} = 0.1 μF, GLF72110		1.8		μs	
t _F	V _{OUT} Fall Time ⁽³⁾			29			
t _{dOFF}	Turn-Off Delay ⁽³⁾	3.3 V _{IN} , R _L = 150 Ω, C _{OUT} = 0.1 μF, GLF72111		0.9			
t _F	V _{OUT} Fall Time ⁽³⁾			15			
Switching Characteristics ^{(4), (5)} : GLF72112							
t _{dON}	Turn-On Delay ⁽²⁾	3.3 V _{IN} , R _L = 150 Ω, C _{OUT} = 0.1 μF		15		μs	
t _R	V _{OUT} Rise Time ⁽²⁾			18			
t _{dOFF}	Turn-Off Delay ⁽³⁾			1.8			
t _F	V _{OUT} Fall Time ⁽³⁾			29			
t _{dON}	Turn-On Delay ⁽²⁾	5.5 V _{IN} , R _L = 150 Ω, C _{OUT} = 0.1 μF		5			
t _R	V _{OUT} Rise Time ⁽²⁾			9			
t _{dOFF}	Turn-Off Delay ⁽³⁾			1.5			
t _F	V _{OUT} Fall Time ⁽³⁾			32			

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

TIMING DIAGRAM

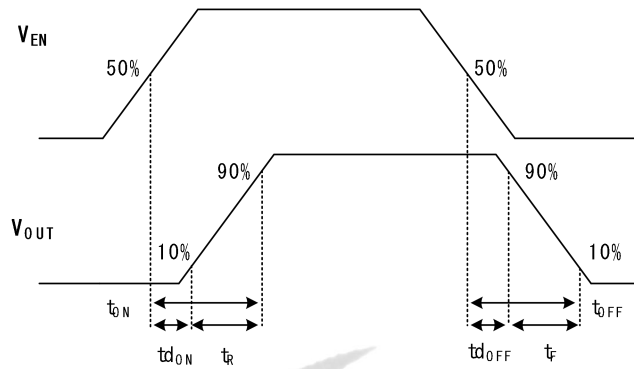


Figure 3. Timing Diagram

GLF
INTEGRATED POWER

TYPICAL PERFORMANCE CHARACTERISTICS

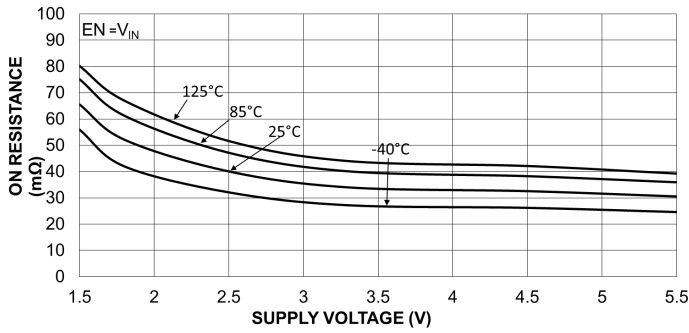


Figure 4. On-Resistance vs. Supply Voltage

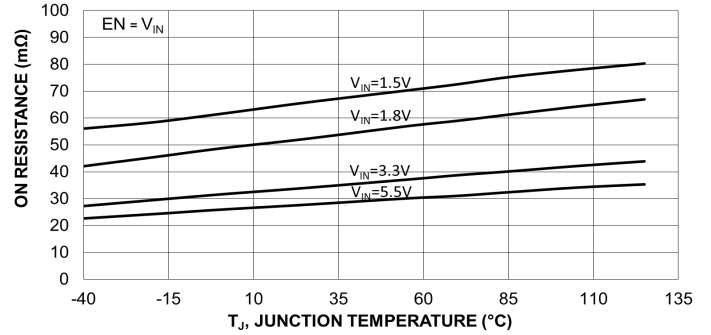


Figure 5. On-Resistance vs. Temperature

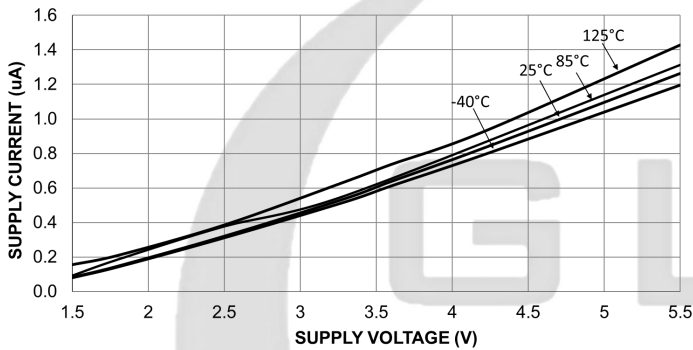


Figure 6. Quiescent Current vs. Supply Voltage

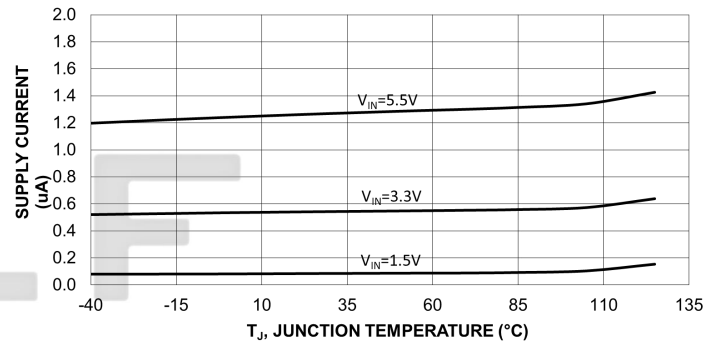


Figure 7. Quiescent Current vs. Temperature

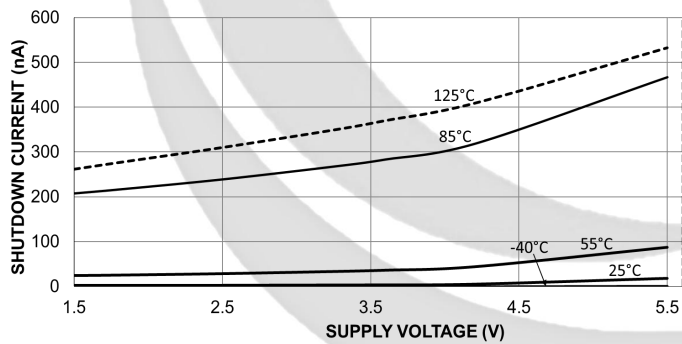


Figure 8. Shutdown Current vs. Supply Voltage

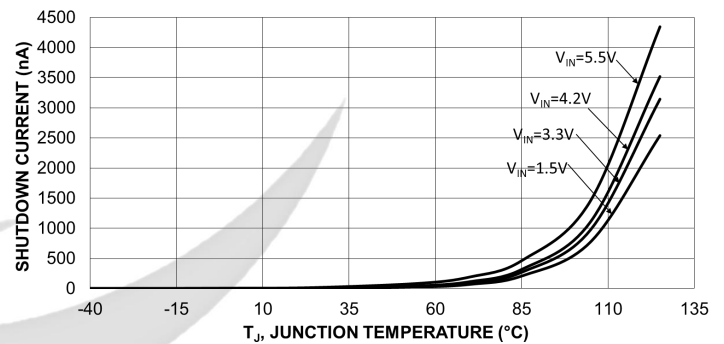


Figure 9. Shutdown Current vs. Temperature

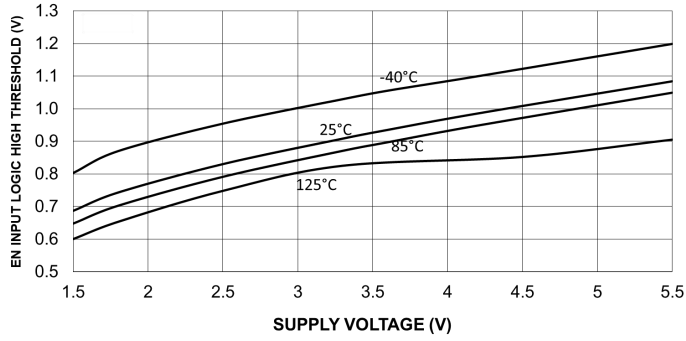


Figure 10. EN Input Logic High Threshold

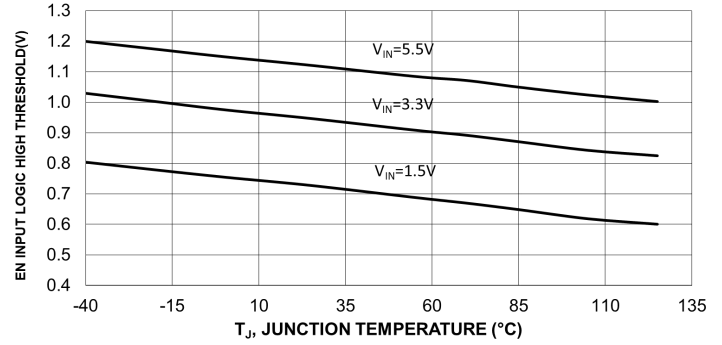


Figure 11. EN Input Logic High Threshold Vs. Temperature

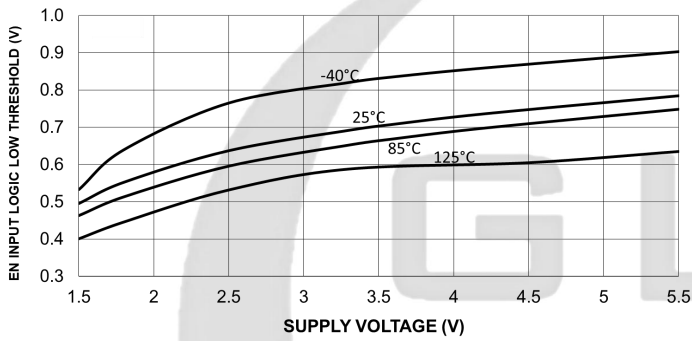


Figure 12. EN Input Logic Low Threshold

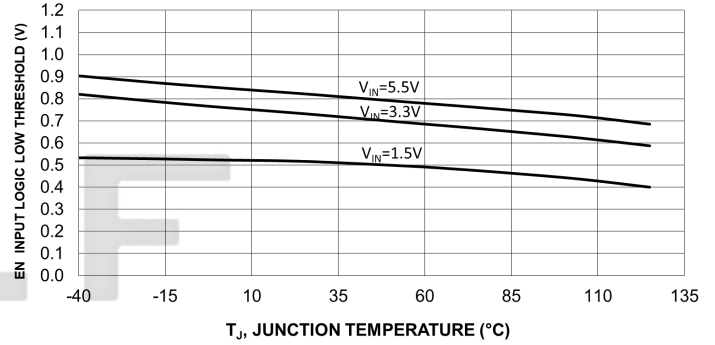


Figure 13. EN Input Logic Low Threshold Vs. Temperature

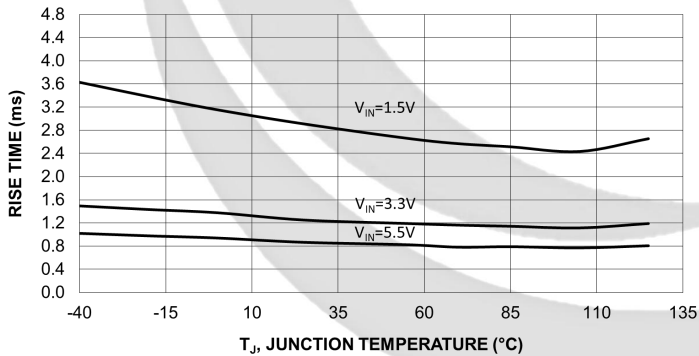


Figure 14. V_{OUT} Rise Time vs. Temperature
GLF72110 and GLF72111

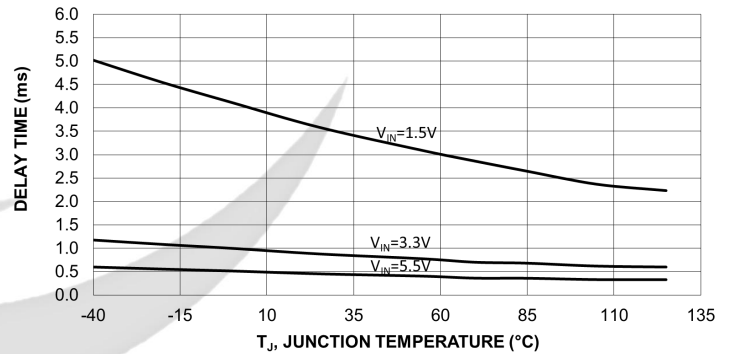


Figure 15. Turn-On Delay Time vs. Temperature
GLF72110 and GLF72111

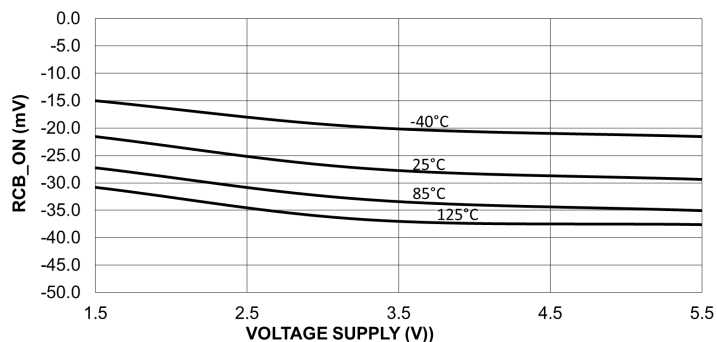


Figure 16. RCB Threshold Voltage vs. Supply Voltage

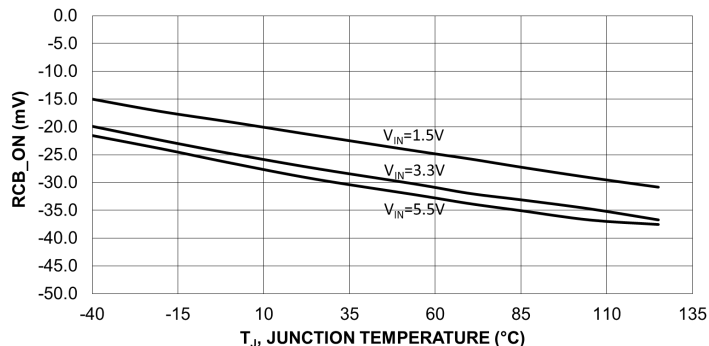


Figure 17. RCB Threshold Voltage vs. Temperature

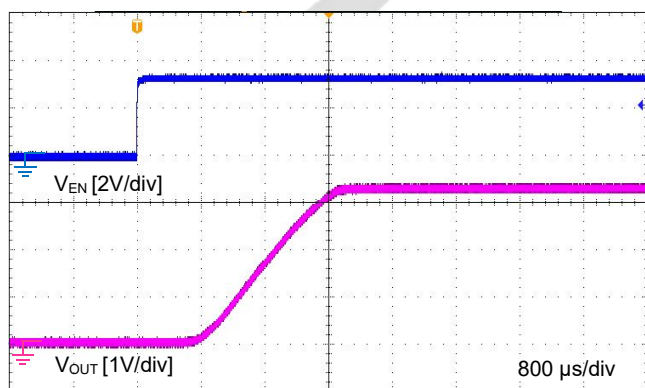


Figure 18. Turn-On Response, GLF72110
 $V_{IN}=3.3\text{ V}$, $C_{IN}=0.1\text{ }\mu\text{F}$, $C_{OUT}=0.1\text{ }\mu\text{F}$, $R_L=150\text{ }\Omega$

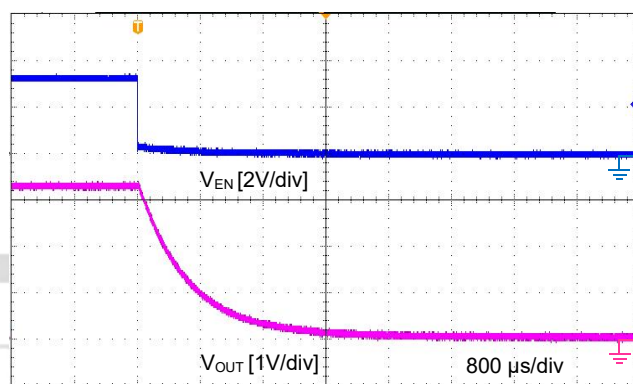


Figure 19. Turn-Off Response, GLF72110
 $V_{IN}=3.3\text{ V}$, $C_{IN}=0.1\text{ }\mu\text{F}$, $C_{OUT}=0.1\text{ }\mu\text{F}$, $R_L=150\text{ }\Omega$

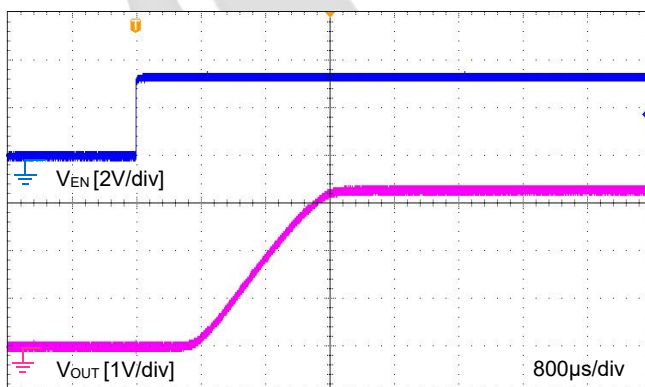


Figure 20. Turn-On Response, GLF72111
 $V_{IN}=3.3\text{ V}$, $C_{IN}=0.1\text{ }\mu\text{F}$, $C_{OUT}=0.1\text{ }\mu\text{F}$, $R_L=150\text{ }\Omega$

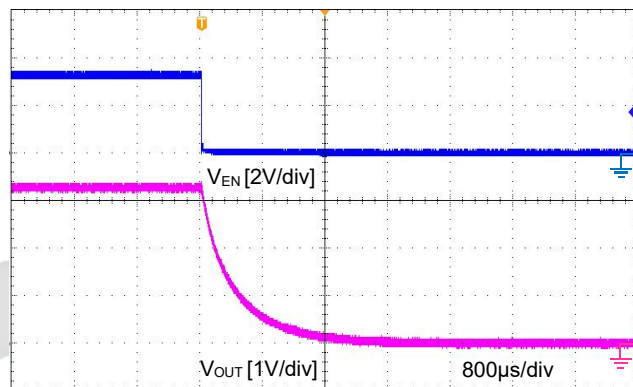


Figure 21. Turn-Off Response, GLF72111
 $V_{IN}=3.3\text{ V}$, $C_{IN}=0.1\text{ }\mu\text{F}$, $C_{OUT}=0.1\text{ }\mu\text{F}$, $R_L=150\text{ }\Omega$

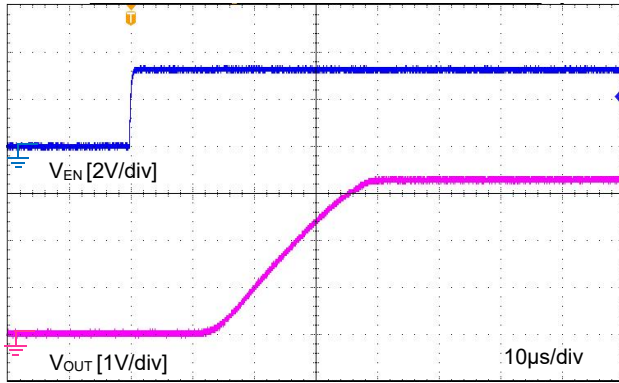


Figure 22. Turn-On Response, GLF72112
 $V_{IN}=3.3\text{ V}$, $C_{IN}=0.1\text{ }\mu\text{F}$, $C_{OUT}=0.1\text{ }\mu\text{F}$, $R_L=150\text{ }\Omega$

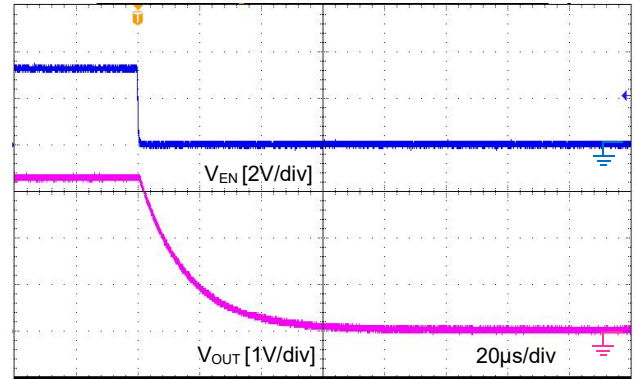


Figure 23. Turn-Off Response, GLF72112
 $V_{IN}=3.3\text{ V}$, $C_{IN}=0.1\text{ }\mu\text{F}$, $C_{OUT}=0.1\text{ }\mu\text{F}$, $R_L=150\text{ }\Omega$

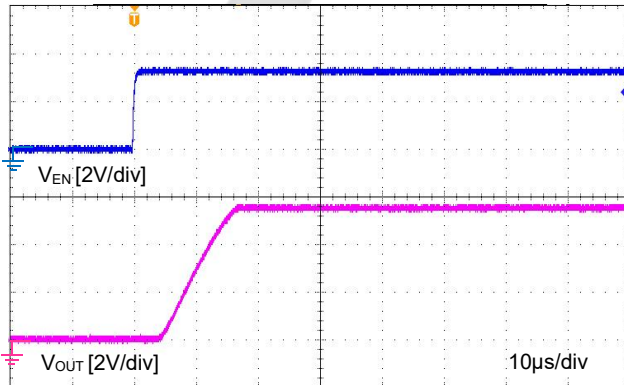


Figure 24. Turn-On Response, GLF72112
 $V_{IN}=5.5\text{ V}$, $C_{IN}=0.1\text{ }\mu\text{F}$, $C_{OUT}=0.1\text{ }\mu\text{F}$, $R_L=150\text{ }\Omega$

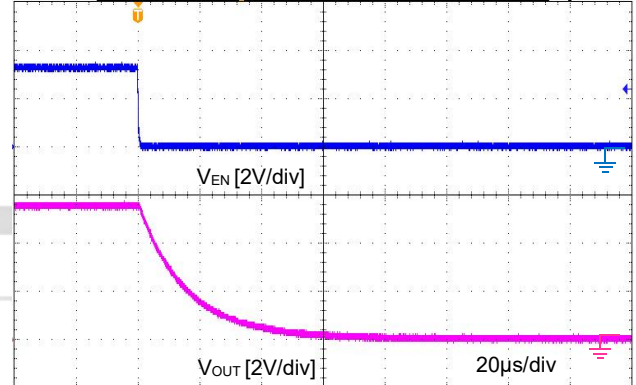


Figure 25. Turn-Off Response, GLF72112
 $V_{IN}=5.5\text{ V}$, $C_{IN}=0.1\text{ }\mu\text{F}$, $C_{OUT}=0.1\text{ }\mu\text{F}$, $R_L=150\text{ }\Omega$

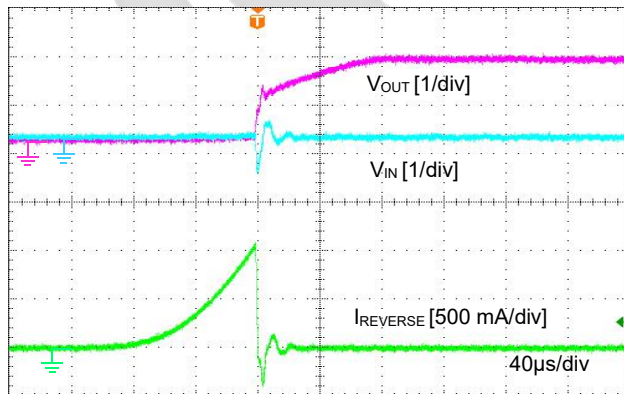


Figure 26. Reverse Current Blocking
 $V_{IN}=3.3\text{ V}$, $V_{OUT}=\text{Up to }4.0\text{ V}$, $C_{IN}=0.1\text{ }\mu\text{F}$, $C_{OUT}=0.1\text{ }\mu\text{F}$

APPLICATION INFORMATION

The GLF72110, GLF72111 and GLF72112 are an integrated 3 A, ultra-low leakage I_QSmart™ load switch device with a fixed slew rate control to limit the inrush current during turn on. Each device 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 losses. In the off state, these devices consume very low leakage current to avoid unwanted standby current and save limited input power. The package is a 0.97 mm x 0.97 mm x 0.55 mm wafer level chip scale package, saving space in compact applications. It is constructed using 4 bumps, with a 0.5 mm pitch for manufacturability.

Input and Output Capacitor

The GLF72110, GLF72111 and GLF72112 require an input capacitor to function. To reduce a voltage drop on the input power rail caused by transient inrush current at start-up, a 0.1 μ F capacitor is recommended to be placed close to V_{IN} pin. A higher input capacitor value can be used to attenuate the input voltage drop. In addition, a 0.1 μ F capacitor or higher can be also used to prevent undershoot caused by parasitic inductance on board traces and improve reliability of a controlled voltage rail. The C_{OUT} should be placed close to V_{OUT} and GND pins.

EN Pin

The GLF72110, GLF72111 and GLF72112 can be activated by forcing the EN pin to a 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.

Reverse Current Blocking

The GLF72110, GLF72111 and GLF72112 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 28 mV, that is the reverse current blocking protection threshold voltage (V_{RCB_TH}), the reverse current blocking function block turns off the switch. Note that some reverse current can occur until the V_{RCB_TH} is triggered. The main switch will resume normal operation when the output voltage drops below the input source by the reverse current blocking protection release voltage (V_{RCB_RL}).

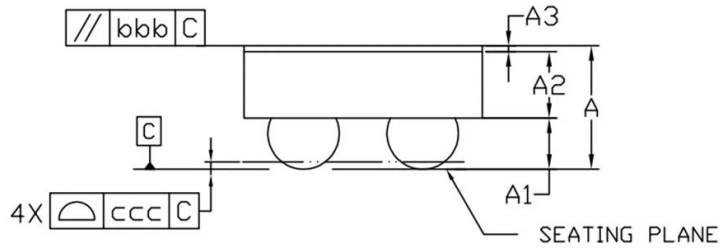
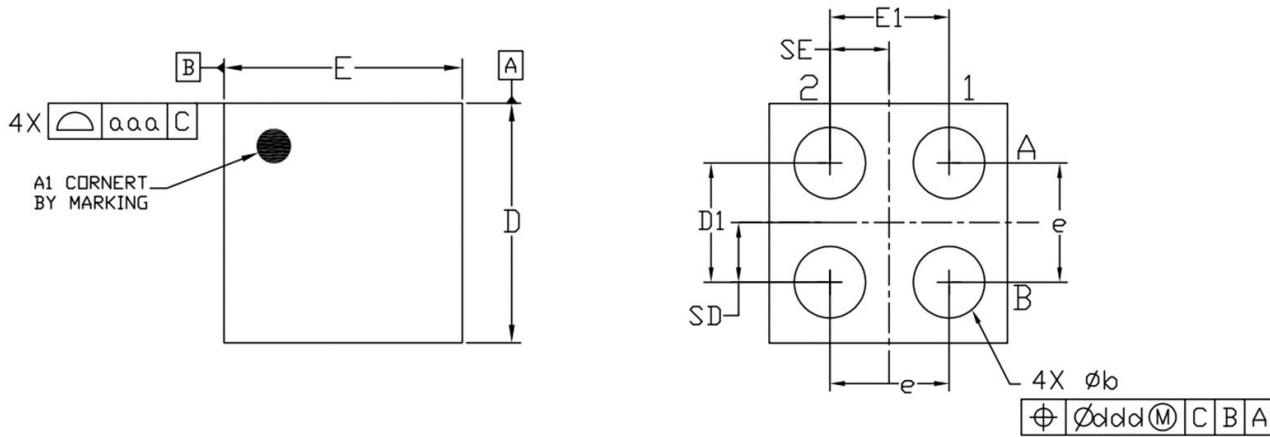
Output Discharge Function

The GLF72111 has an internal discharge N-channel FET switch on the V_{OUT} 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.

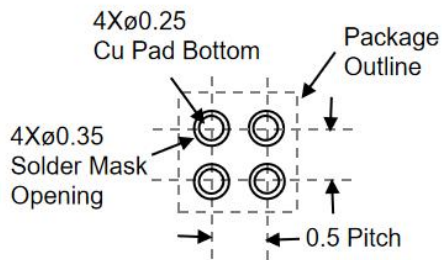
Board Layout

All traces should be as short as possible to minimize parasitic inductance effects. Wide traces for V_{IN}, V_{OUT}, 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



Recommended Footprint



Dimensional Ref.

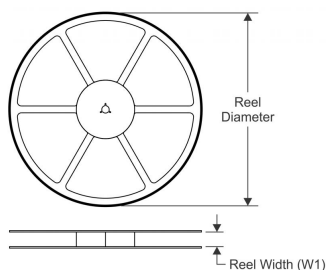
REF.	Min.	Nom.	Max.
A	0.500	0.550	0.600
A1	0.225	0.250	0.275
A2	0.255	0.275	0.300
A3	0.020	0.025	0.030
D	0.960	0.970	0.985
E	0.960	0.970	0.985
D1	0.450	0.500	0.550
E1	0.450	0.500	0.550
b	0.260	0.310	0.360
e	0.500 BSC		
SD	0.250 BSC		
SE	0.250 BSC		
Tol. of Form&Position			
aaa	0.10		
bbb	0.10		
ccc	0.05		
ddd	0.05		

Notes

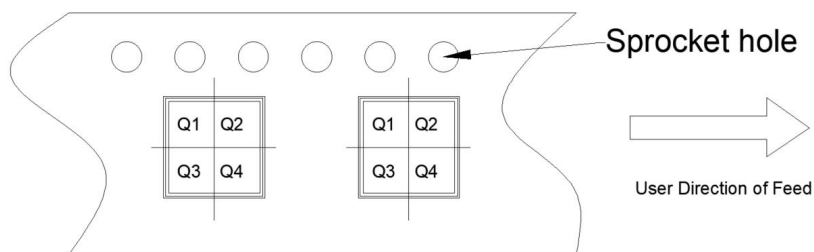
1. ALL DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES)
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
3. A3: BACKSIDE LAMINATION

TAPE AND REEL INFORMATION

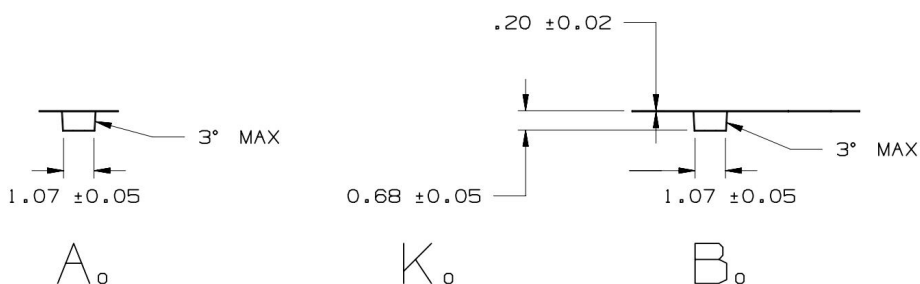
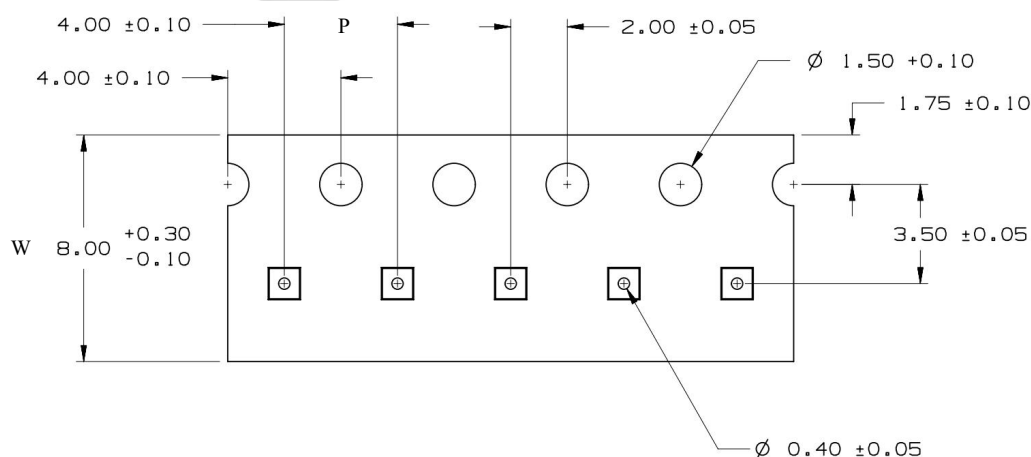
REEL DIMENSIONS



QUADRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE



TAPE DIMENSIONS



Device	Package	Pins	SPQ	Reel Diameter(mm)	Reel Width W1	A0	B0	K0	P	W	Pin1
GLF72110	WLCSP	4	3000	180	9	1.07	1.07	0.68	4	8	Q1
GLF72111	WLCSP	4	3000	180	9	1.07	1.07	0.68	4	8	Q1
GLF72112	WLCSP	4	3000	180	9	1.07	1.07	0.68	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

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. Parameters including the typical, minimum, and maximum values are desired, or target. GLF reserves the right to change contents at any time without warning or notification. A target specification will not guarantee the future production of the device.	Design / Development
Preliminary Specification	This is a draft version of a product specification which is 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 will not guarantee the future production of the device.	Qualification
Product Specification	This document represents the characteristics of the device.	Production

DISCLAIMERS

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