GLF72110, GLF72111, GLF72112
3 A, Ultra-low Power I_QSmart™ Power Load Switch with True Reverse Current Blocking

Product Specification

DESCRIPTION

The GLF72110 / GLF72111 / GLF72112 is an advanced technology fully integrated I_QSmart™ load switch device with True Reverse Current Blocking (TRCB) technology and slew rate control of the output voltage.

The GLF72110 / GLF72111 / GLF72112 offers industry leading True Reverse Current Blocking (TRCB) 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 industry leading efficiency. It features a R_{ON} as low as 29 mΩ typical at 5.5 V, reducing power loss during conduction. The device 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 and helps to improve operating life and system robustness. Furthermore, one device can be used in multiple voltage rail applications which helps to simplify inventory management and reduces operating cost.

The GLF72110 / GLF72111 / GLF72112 load switch device is small, utilizing 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.

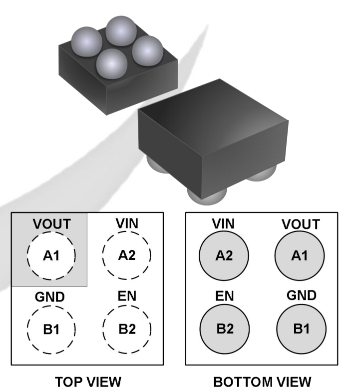
FEATURES

- True Reverse Current Blocking
- 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
- Wide Input Range: 1.5 V to 5.5 V
  6 V_{ABS} max
- 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

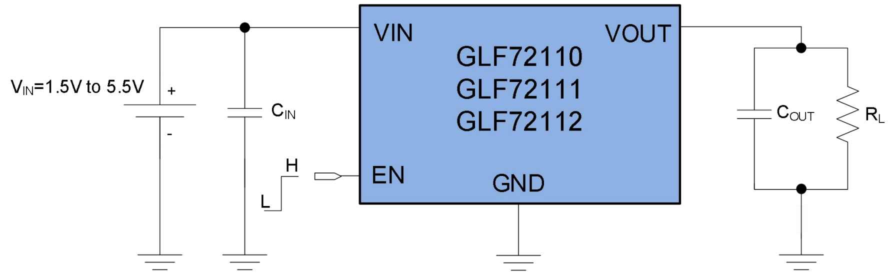
- Mobile Devices
- Wearables
- Low Power Subsystems

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

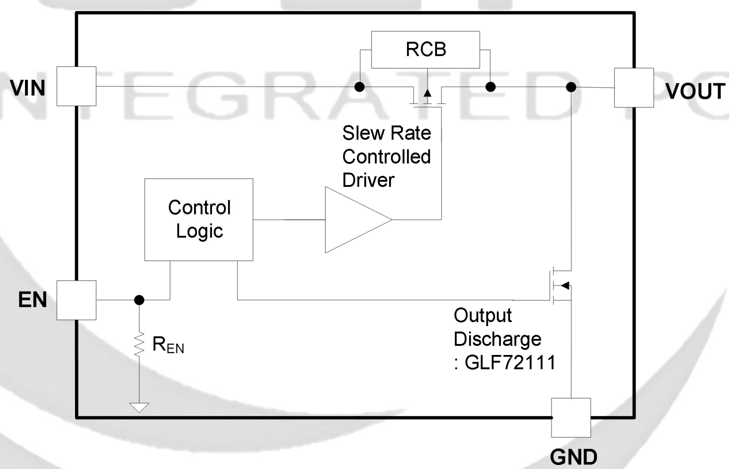


Figure 1. Functional Block Diagram

PIN CONFIGURATION

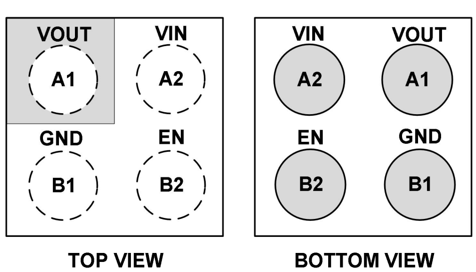


Figure 2. 0.97mm x 0.97mm x 0.55mm WLCSP

PIN DEFINITION

Pin #	Name	Description
A1	V_{OUT}	Switch Output
A2	V_{IN}	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}.

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_{IN}, V_{OUT}, V_{EN} to GND		-0.3	6	V
I_{OUT}	Maximum Continuous Switch Current at T_A = 25 °C			3	A
	Maximum Continuous Switch Current at T_A = 125 °C			2	
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	125	°C
θ_{JA} (2)	Thermal Resistance, Junction to Ambient			85	°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	°C

ELECTRICAL CHARACTERISTICS

Values are at V_{IN} = 3.3 V and T_A = 25 °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	
		EN = Disable, I_{OUT}=0 mA, V_{IN}=5.5 V, T_A=85 °C (5)		0.5		µA
		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
		V_{IN}=5.5 V, I_{OUT}= 500 mA, T_A=85 °C (5)		32		
		V_{IN}=5.5 V, I_{OUT}= 500 mA, T_A=125 °C (5)		35		
		V_{IN}=3.3 V, I_{OUT}= 500 mA, T_A=25 °C		35	41	
		V_{IN}=3.3 V, I_{OUT}= 500 mA, T_A=85 °C (5)		40		
		V_{IN}=3.3 V, I_{OUT}= 500 mA, 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	E_N=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	E_N=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 Enable pull down current through the pull down resistor $R_{PD.}$
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

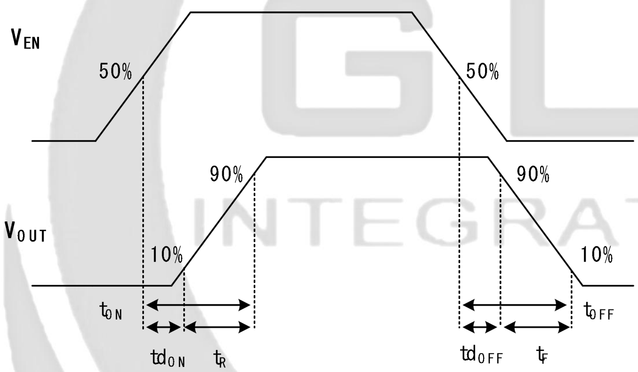


Figure 3. Timing Diagram

TYPICAL PERFORMANCE CHARACTERISTICS

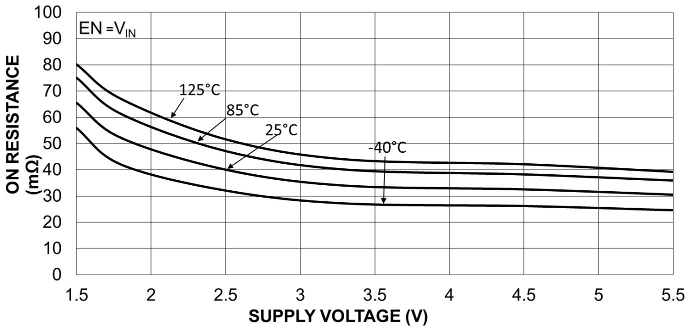


Figure 4. On-Resistance vs. Supply Voltage

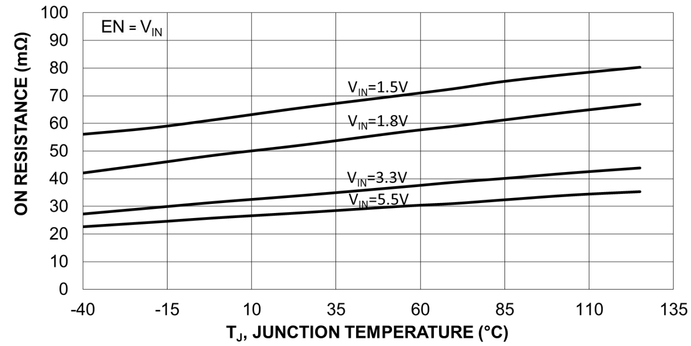


Figure 5. On-Resistance vs. Temperature

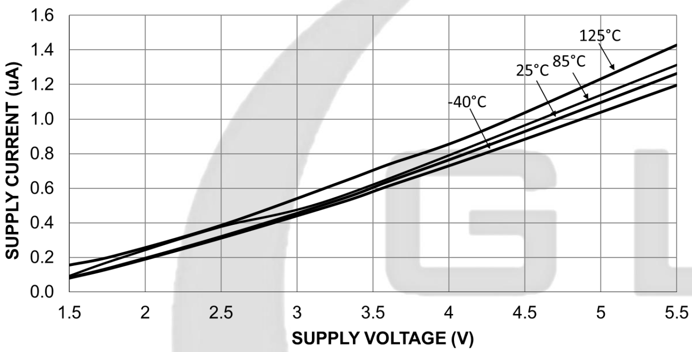


Figure 6. Quiescent Current vs. Supply Voltage

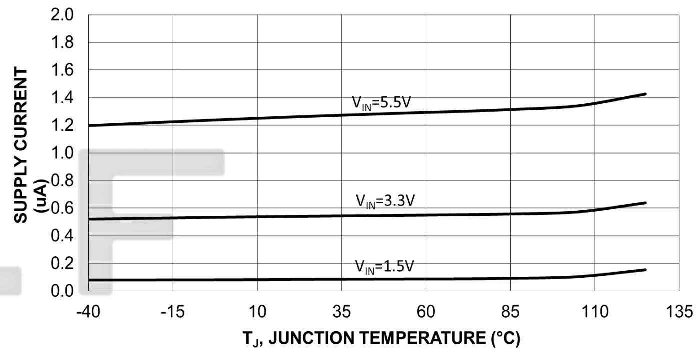


Figure 7. Quiescent Current vs. Temperature

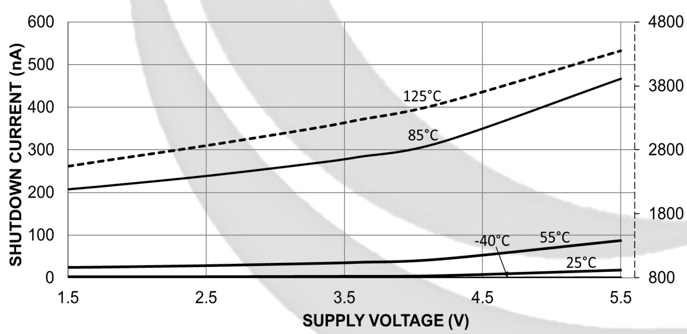


Figure 8. Shutdown Current vs. Supply Voltage

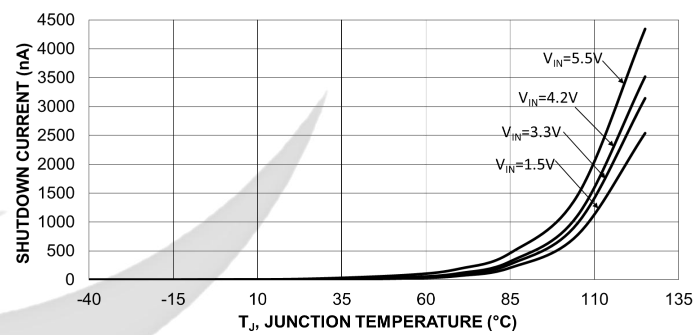


Figure 9. Shutdown Current vs. Temperature

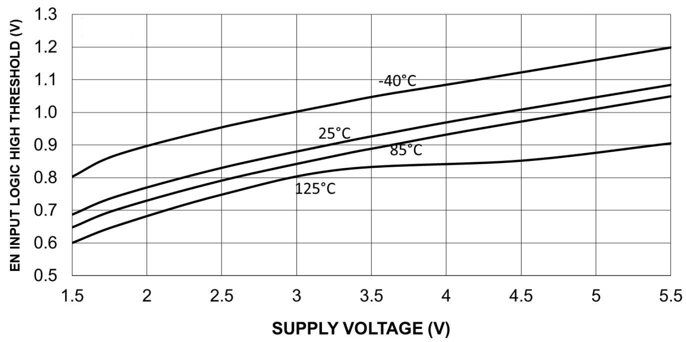


Figure 10. EN Input Logic High Threshold

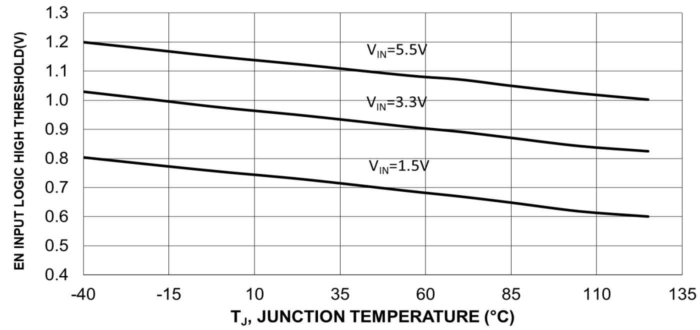


Figure 11. EN Input Logic High Threshold Vs. Temperature

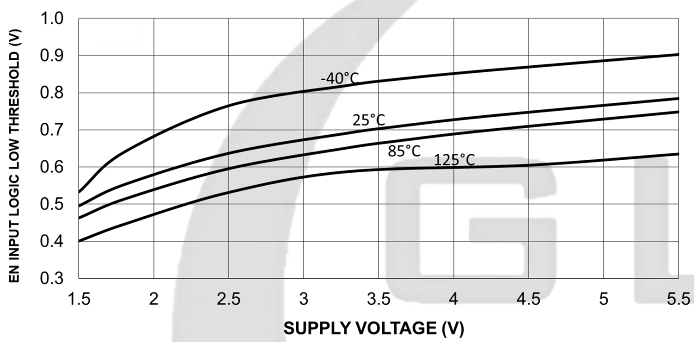


Figure 12. EN Input Logic Low Threshold

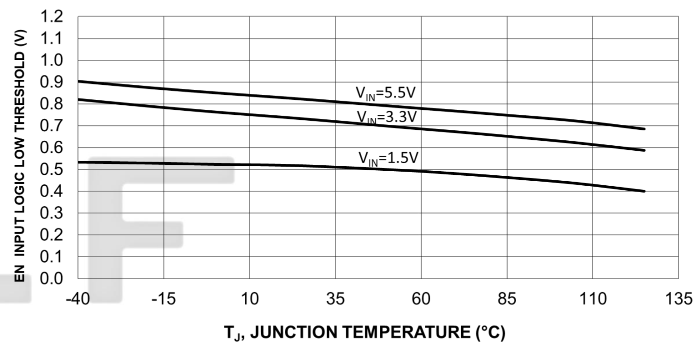


Figure 13. EN Input Logic Low Threshold Vs. Temperature

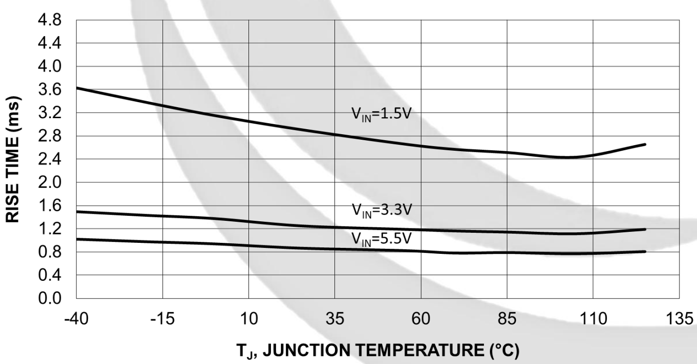


Figure 14. V_{OUT} Rise Time vs. Temperature GLF72110 and GLF72111

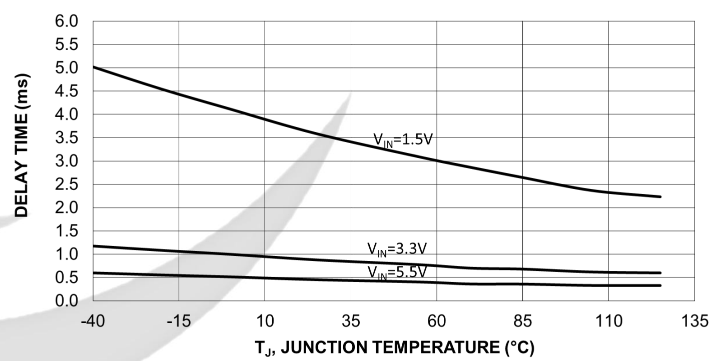


Figure 15. Turn-On Delay Time vs. Temperature GLF72110 and GLF72111

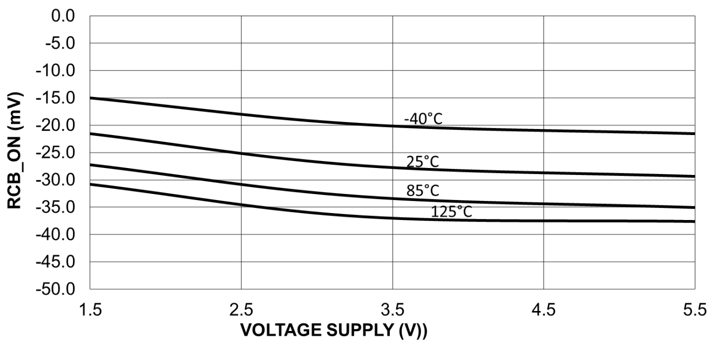


Figure 16. RCB Threshold Voltage vs. Supply Voltage

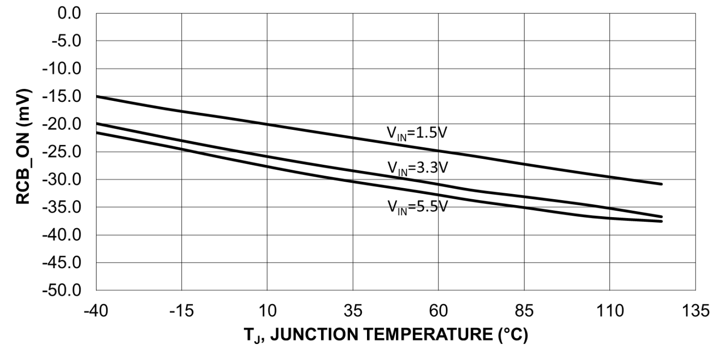


Figure 17. RCB Threshold Voltage vs. Temperature

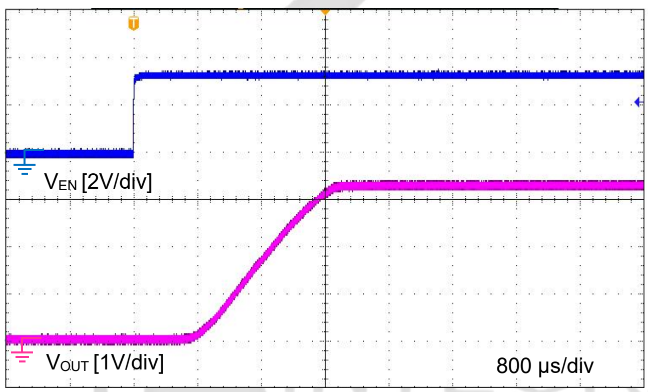


Figure 18. Turn-On Response, GLF72110
V_{IN}=3.3 V, C_{IN}=0.1 µF, C_{OUT}=0.1 µF, R_L=150 Ω

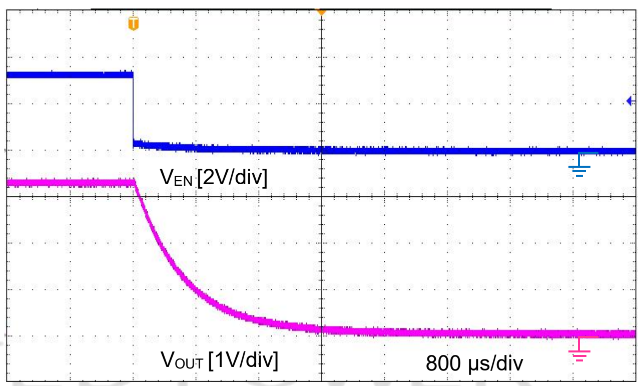


Figure 19. Turn-Off Response, GLF72110
V_{IN}=3.3 V, C_{IN}=0.1 µF, C_{OUT}=0.1 µF, R_L=150 Ω

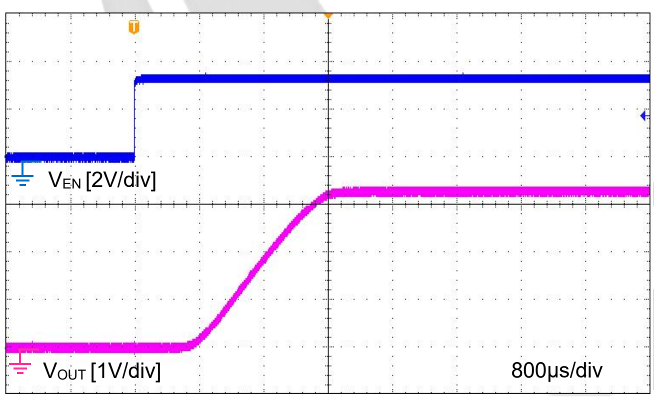


Figure 20. Turn-On Response, GLF72111
V_{IN}=3.3 V, C_{IN}=0.1 µF, C_{OUT}=0.1 µF, R_L=150 Ω

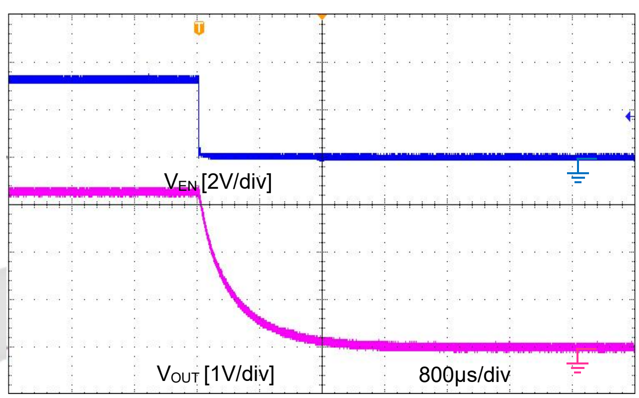


Figure 21. Turn-Off Response, GLF72111
V_{IN}=3.3 V, C_{IN}=0.1 µF, C_{OUT}=0.1 µF, R_L=150 Ω

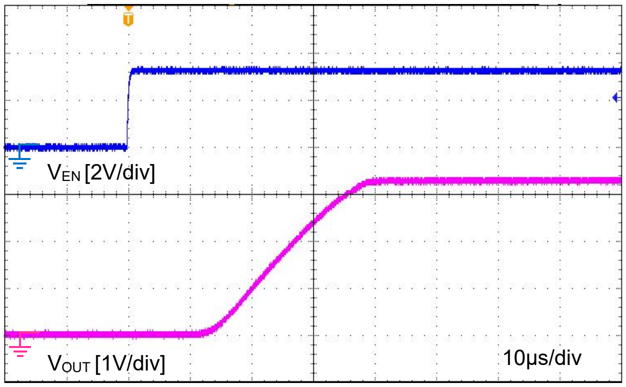


Figure 22. Turn-On Response, GLF72112
V_{IN}=3.3 V, C_{IN}=0.1 µF, C_{OUT}=0.1 µF, R_L=150 Ω

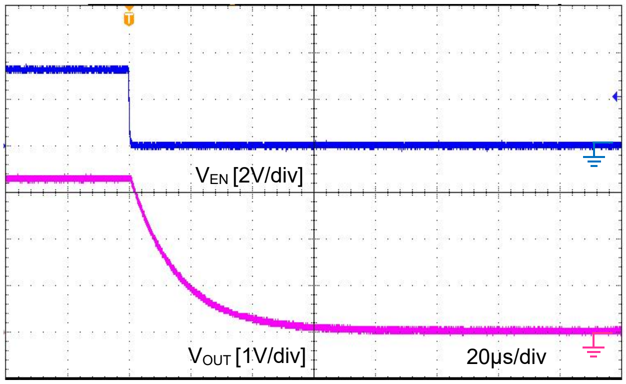


Figure 23. Turn-Off Response, GLF72112
V_{IN}=3.3 V, C_{IN}=0.1 µF, C_{OUT}=0.1 µF, R_L=150 Ω

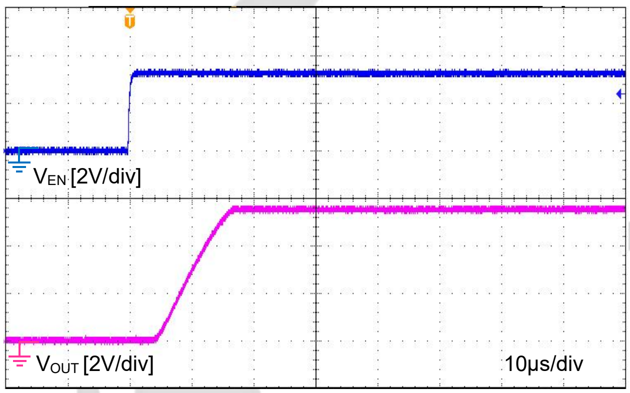


Figure 24. Turn-On Response, GLF72112
V_{IN}=5.5 V, C_{IN}=0.1 µF, C_{OUT}=0.1 µF, R_L=150 Ω

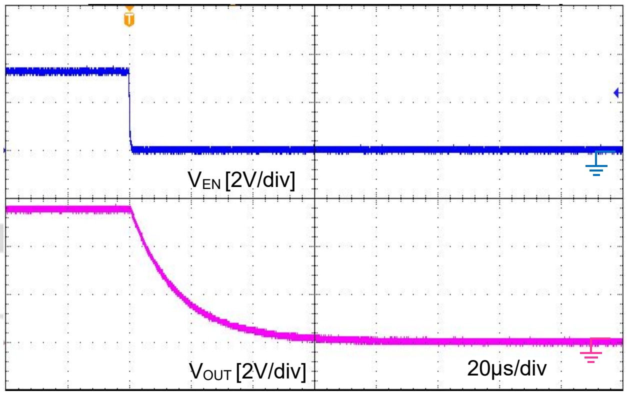


Figure 25. Turn-Off Response, GLF72112
V_{IN}=5.5 V, C_{IN}=0.1 µF, C_{OUT}=0.1 µF, R_L=150 Ω

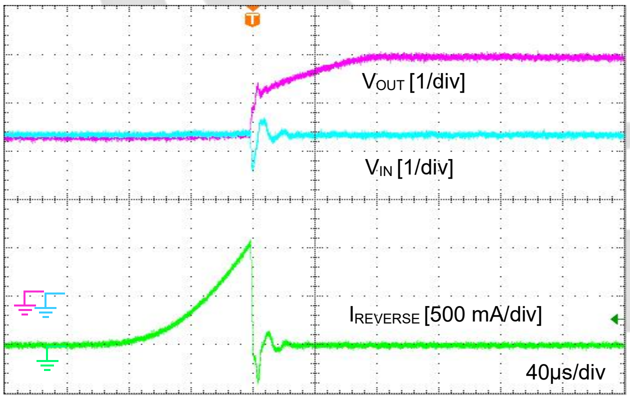


Figure 26. Reverse Current Blocking at Switch On
V_{IN} = 3.3 V, V_{OUT} = From 3.3 V to 4 V, C_{IN}=0.1 µF, C_{OUT}=0.1 µF

APPLICATION INFORMATION

The GLF72110, GLF72111 and GLF72112 are an integrated 3 A, Ultra-Efficient I_QSmart^{TM} 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 µF 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 µF 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 VOUT 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.

True 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 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.

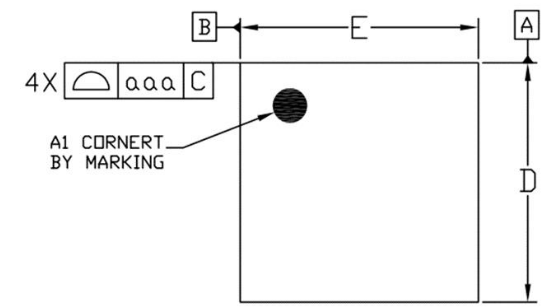
Output Discharge Function

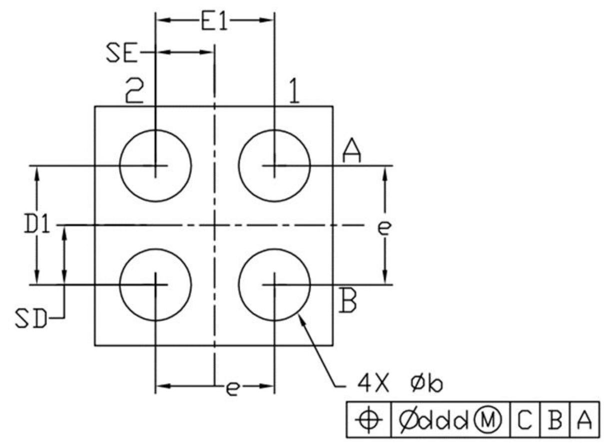
The GLF72111 has an internal discharge N-channel FET switch on the VOUT pin. When EN signal turns the main power FET to an off state, the N-channel switch turns on to discharge an output capacitor quickly.

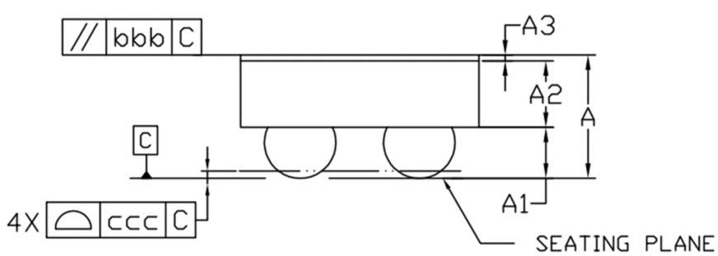
Board Layout

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.

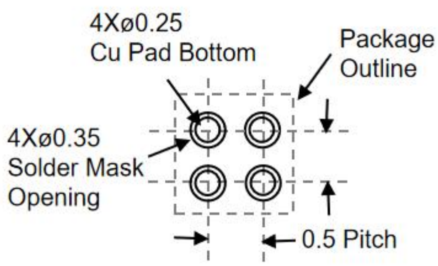
PACKAGE OUTLINE







Recommended Footprint



Dimensional Ref.

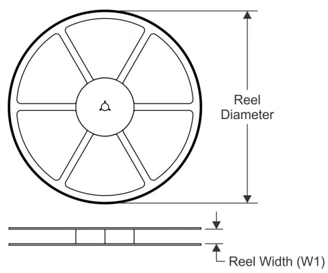
REF.	Min.	Nom.	Max.
A	0.500	0.550	0.600
A1	0.225	0.250	0.275
A2	0.255	0.275	0.300
A3	0.020	0.025	0.030
D	0.960	0.970	0.985
E	0.960	0.970	0.985
D1	0.450	0.500	0.550
E1	0.450	0.500	0.550
b	0.260	0.310	0.360
e		0.500 BSC	
SD		0.250 BSC	
SE		0.250 BSC	
Tol. of Form&Position			
aaa		0.10	
bbb		0.10	
ccc	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

Notes

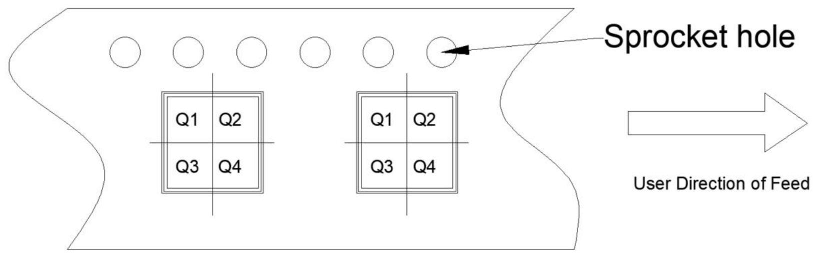
1. ALL DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGRESS)
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
3. A3: BACKSIDE LAMINATION

TAPE AND REEL INFORMATION

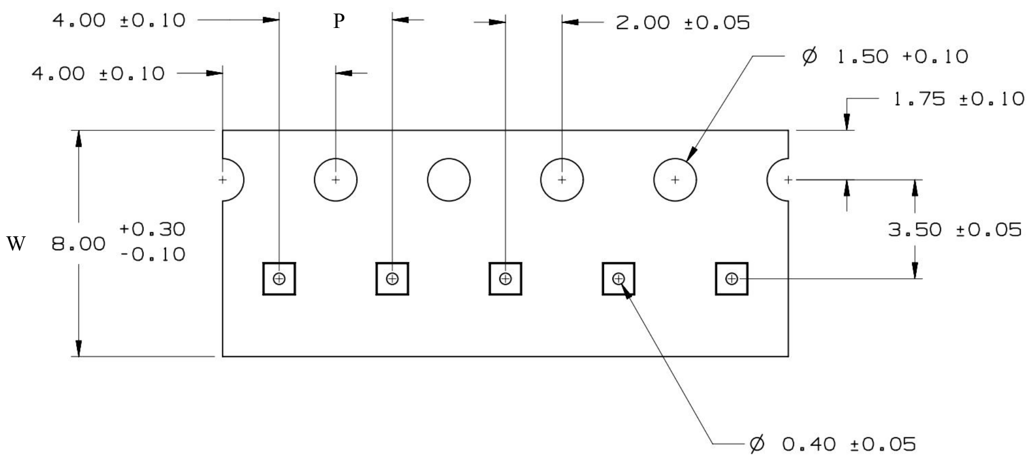
REEL DIMENSIONS

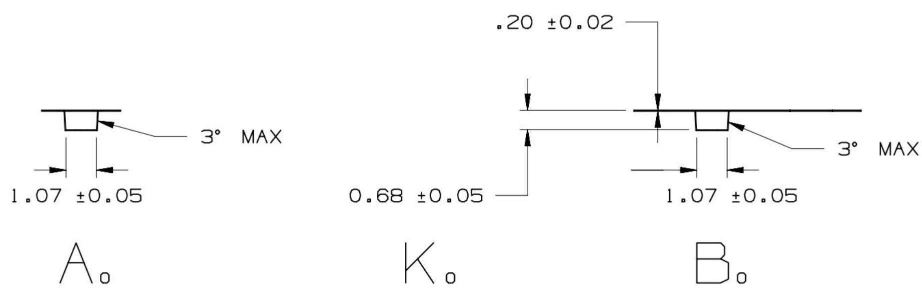


QUADRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE



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

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 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

DISCLAIMERS

Information in this document is believed to be accurate and reliable, however GLF assumes no liability for errors or omissions. Device performance may be impacted by testing methods and application use cases. Users are responsible to independently evaluate the applicability, usability, and suitability of GLF devices in their application. In no case will GLF be liable for incidental, indirect, or consequential damages associated with the use, mis-use, or sale of its product. Customers are wholly responsible to assure GLF devices meet their system level and end product requirements. GLF retains the right to change the information provided in this data sheet without notice.