GLF71300, GLF71301, GLF71302
GLF71303, GLF71306, GLF71308

Nano-Current Consumed, I_QSmart™ Power Load Switch with Slew Rate Control

DESCRIPTION

The GLF7130x is an ultra-efficiency, 2.0 A rated, Load Switch with integrated slew rate control. The best in class efficiency makes it an ideal choice for use in IoT, mobile, and wearable electronics.

The GLF7130x features an 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 GLF7130x 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 GLF7130x slew rate control specifically limits inrush current during turn-on to minimize voltage droop.

The GLF7130x 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 GLF7130x Load Switch device is small utilizing a wafer level chip scale package with 4 bumps in a 0.77 mm x 0.77 mm x 0.46 mm die size and a 0.4 mm bump pitch.

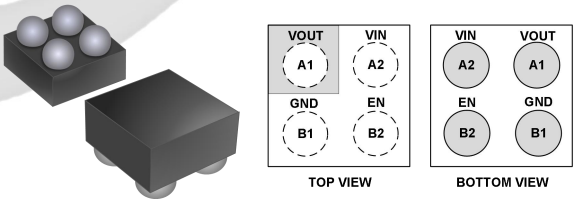
FEATURES

- Ultra-Low I_Q:
  - 1 nA Typ at 5.5 V_{IN} on GLF71300, GLF71301, GLF71306, GLF71308
  - 540 nA Typ at 5.5 V_{IN} on GLF71302, GLF71303
- Ultra-Low I_{SD}: 19 nA Typ at 5.5 V_{IN}
- Low R_{ON} = 34 mΩ Typ. at 5.5 V_{IN}
- I_{OUT} Max = 2.0 A
- Wide Input Range: 1.1 V to 5.5 V
  - 6 Vabs max
- Controlled Rise Time:
  - 430 µs at 3.3V_{IN}: GLF71300, GLF71301, GLF71302, GLF71303
  - 42 µs at 3.3V_{IN}: GLF71306, GLF71308
- Internal EN Pull-Down Resistor on GLF71300, GLF71301, GLF71306, GLF71308
- Internal EN Pull-Up Resistor on GLF71302 and GLF71303
- Integrated Output Discharge Switch: GLF71301, GLF71303, GLF71308
- Ultra-Small: 0.77 mm x 0.77 mm

APPLICATIONS

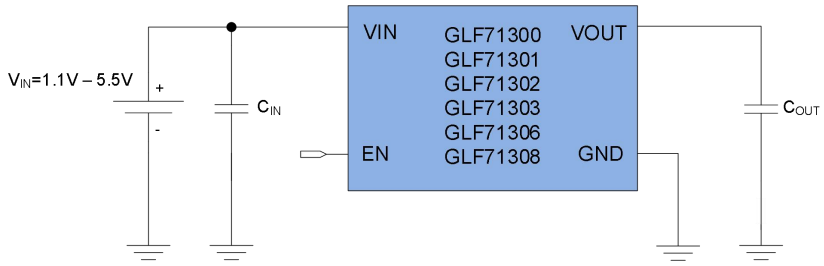
- Wearables
- Data Storage, SSD
- Mobile Devices
- Low Power Subsystems

PACKAGE



0.77 mm x 0.77 mm x 0.46 mm WLCSP

APPLICATION DIAGRAM



ALTERNATE DEVICE OPTIONS

Part Number	Top Mark	Vout Rise Time at 3.3Vin (Typ)	R_{ON} (Typ) at 5.5 V	Output Discharge	EN Activity	Package
GLF71300	A	430 µs	34 mΩ	NA	High	0.77 mm x 0.77 mm x 0.46 mm WLCSP
GLF71301	B	430 µs		85 Ω		
GLF71302	C	430 µs		NA	Low	
GLF71303	D	430 µs		85 Ω		
GLF71306	K	42 µs		NA	High	
GLF71308	L	42 µs		85 Ω		

FUNCTIONAL BLOCK DIAGRAM

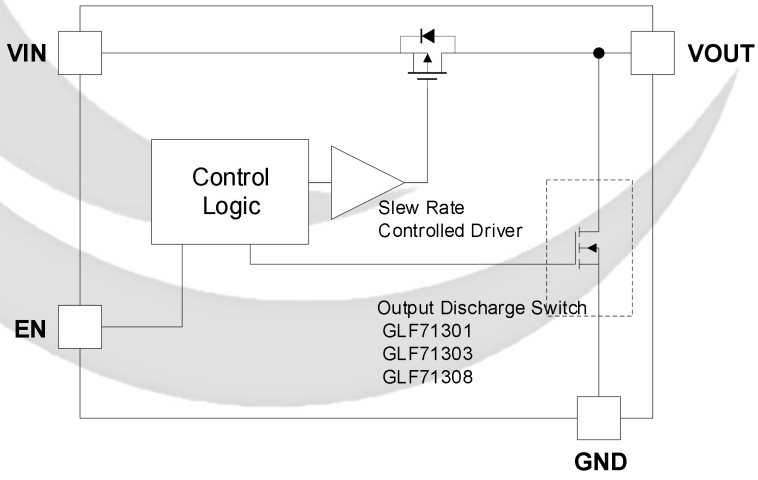


Figure 1. Functional Block Diagram

PIN CONFIGURATION

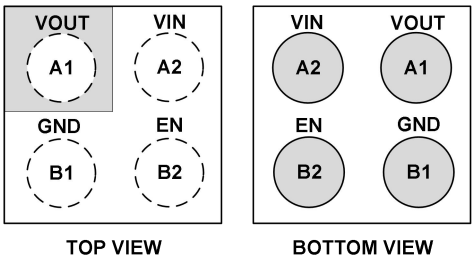


Figure 2. 0.77 mm x 0.77 mm x 0.46 mm WLCSP

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. The EN pin has an internal pull-down resistor for GLF71300, GLF71301, GLF71306, GLF71308, and pull-up for GLF71302 and GLF71303.

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_{OUT}, V_{EN}	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	W
T_{STG}	Storage Junction Temperature		-65	150	°C
T_A	Operating Temperature Range		-40	85	°C
θ_{JA}	Thermal Resistance, Junction to Ambient (board dependent)			110	°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
V_{IN}	Supply Voltage	1.1	5.5	V
T_A	Ambient Operating Temperature	-40	+85	°C

ELECTRICAL CHARACTERISTICS

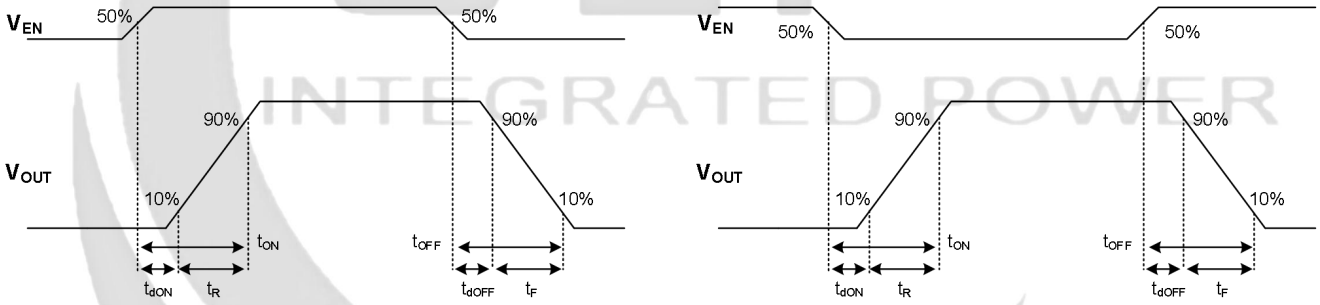
Values are at V_{IN} = 3.3 V and T_A = 25 °C unless otherwise noted.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
Basic Operation							
V_{IN}	Supply Voltage			1.1		5.5	V
I_Q	Quiescent Current (1) GLF71300, GLF71301, GLF71306, GLF71308	V_{IN} = V_{EN} =5.5 V, I_{OUT}=0 mA			1		nA
		V_{IN} = V_{EN} =5.5 V, I_{OUT}=0 mA, Ta=85 °C (5)			12		
	Quiescent Current on GLF71302, GLF71303	V_{IN} =5.5 V, V_{EN} =0 V, I_{OUT}=0 mA			540		
		V_{IN} =5.5 V, V_{EN} =0 V, I_{OUT}=0 mA, Ta=85 °C (5)			620		
I_{SD}	Shutdown Current	EN = Disable, I_{OUT}=0 mA, V_{IN}=1.1 V			3		nA
		EN = Disable, I_{OUT}=0 mA, V_{IN}=1.8 V			4		
		EN = Disable, I_{OUT}=0 mA, V_{IN}=3.3 V			6		
		EN = Disable, I_{OUT}=0 mA, V_{IN}=4.5 V			9		
		EN = Disable, I_{OUT}=0 mA, V_{IN}=5.5 V			19	50	
		EN = Disable, I_{OUT}=0 mA, V_{IN}=5.5 V, Ta=55 °C (5)			110		
		EN = Disable, I_{OUT}=0 mA, V_{IN}=5.5V, Ta=85 °C (5)			600		
R_{ON}	On-Resistance	V_{IN}=5.5 V, I_{OUT}= 500 mA	Ta=25 °C		34	47	mΩ
			Ta=85 °C (5)		40		
		V_{IN}=3.3 V, I_{OUT}= 500 mA	Ta=25 °C		42	56	
			Ta=85 °C (5)		50		
		V_{IN}=1.8 V, I_{OUT}= 300 mA	Ta=25 °C		68		
		V_{IN}=1.2 V, I_{OUT}= 100 mA	Ta=25 °C		125		
		V_{IN}=1.1 V, I_{OUT}= 100 mA	Ta=25 °C		155		
R_{DSC}	Output Discharge Resistance	EN=Low , I_{FORCE}= 10 mA for GLF71302, GLF71303 EN=High , I_{FORCE}= 10 mA except GLF71302, GLF71303		70	85	100	Ω
V_{IH}	EN Input Logic High Voltage	V_{IN}=1.1 V - 1.8 V		0.9			V
		V_{IN}=1.8 V - 5.5 V		1.2			V
V_{IL}	EN Input Logic Low Voltage	V_{IN}=1.1 V - 1.8 V				0.3	V
		V_{IN}=1.8 V - 5.5 V				0.4	V
R_{EN}	EN Internal resistance	Internal Pull-down Resistance: GLF71300, GLF71301, GLF71306, GLF71308 Internal Pull-up Resistance: GLF71302, GLF71303		7	10.1	13	MΩ
I_{EN}	EN Current (2)	EN=5.5 V				0.8	μA
Switching Characteristics: GLF71300, GLF71301, GLF71302, GLF71303 (3)							
t_{dON}	Turn-On Delay	R_L=150 Ω, C_{OUT}=0.1 μF			275		μs
t_R	V_{OUT} Rise Time				430		
t_{dON}	Turn-On Delay (5)	R_L=500 Ω, C_{OUT}=0.1 μF			245		
t_R	V_{OUT} Rise Time (5)				410		
t_{dOFF}	Turn-Off Delay (4,5)	R_L=10 Ω, C_{OUT}=0.1 μF GLF71301, GLF71303			0.38		
t_F	V_{OUT} Fall Time (4,5)				1.32		
t_{dOFF}	Turn-Off Delay (5)	R_L=10 Ω, C_{OUT}=0.1 μF GLF71300, GLF71302 : No Output Discharge, R_{DSC}			0.35		
t_F	V_{OUT} Fall Time (5)				2.3		
t_{dOFF}	Turn-Off Delay (4,5)	R_L=500 Ω, C_{OUT}=0.1 μF GLF71301, GLF71303			1.1		
t_F	V_{OUT} Fall Time (4,5)				18		
t_{dOFF}	Turn-Off Delay (5)	R_L=500 Ω, C_{OUT}=0.1 μF GLF71300, GLF71302 : No Output Discharge, R_{DSC}			5.0		
t_F	V_{OUT} Fall Time (5)				101		

Switching Characteristics: GLF71306, GLF71308 (3)						
t_{dON}	Turn-On Delay	R_L=150 Ω, C_{OUT}=0.1 μF		32		μs
t_R	V_{OUT} Rise Time			42		
t_{dON}	Turn-On Delay (5)	R_L=500 Ω, C_{OUT}=0.1 μF		32		
t_R	V_{OUT} Rise Time (5)			40		
t_{dOFF}	Turn-Off Delay (5)	R_L=150 Ω, C_{OUT}=0.1 μF GLF71306 : No Output Discharge, R_{DSC}		2		
t_F	V_{OUT} Fall Time (5)			32		
t_{dOFF}	Turn-Off Delay (4,5)	R_L=150 Ω, C_{OUT}=0.1 μF, GLF71308		1		
t_F	V_{OUT} Fall Time (4,5)			13		
t_{dOFF}	Turn-Off Delay (5)	R_L=500 Ω, C_{OUT}=0.1 μF GLF71306 : No Output Discharge, R_{DSC}		4.6		
t_F	V_{OUT} Fall Time (5)			97		
t_{dOFF}	Turn-Off Delay (4,5)	R_L=500 Ω, C_{OUT}=0.1 μF, GLF71308		1		
t_F	V_{OUT} Fall Time (4,5)			17		

Notes:
1. I_Q of GLF71300, GLF71301, GLF71306, and GLF71308 does not include the EN pin current through the pull-down resistor R_{PD}.
2. I_{EN} applies only for GLF71300, GLF71301, GLF71306, and GLF71308 with the active high EN pin.
3. $t_{ON} = t_{dON} + t_R$, $t_{OFF} = t_{dOFF} + t_F$
4. Output discharge path is enabled during off.
5. By design; characterized, not production tested.

TIMING DIAGRAM



GLF71300, GLF71301, GLF71306, GLF71308 GLF71302, GLF71303

Figure 3. Timing Diagram

TYPICAL PERFORMANCE CHARACTERISTICS

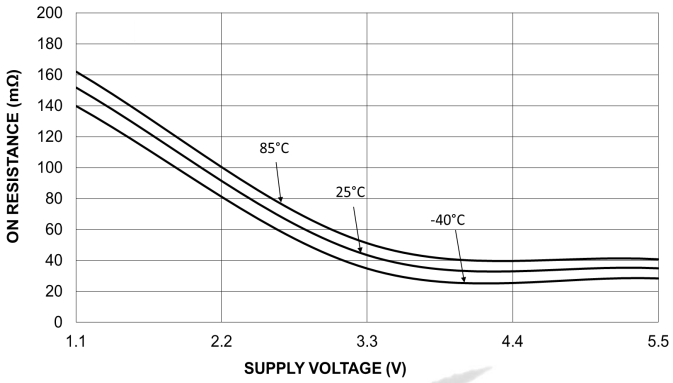


Figure 4. On-Resistance vs. Supply Voltage

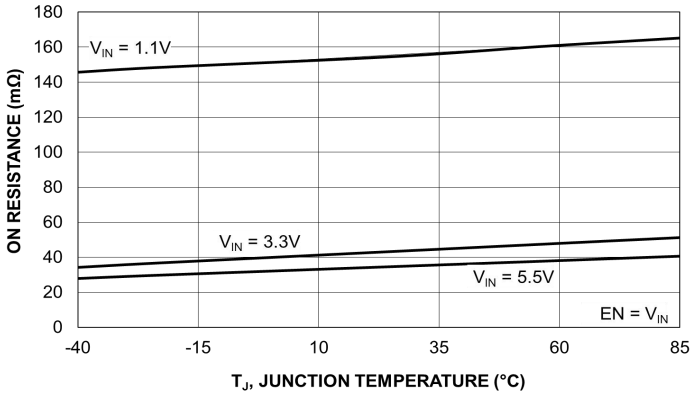


Figure 5. On-Resistance vs. Temperature

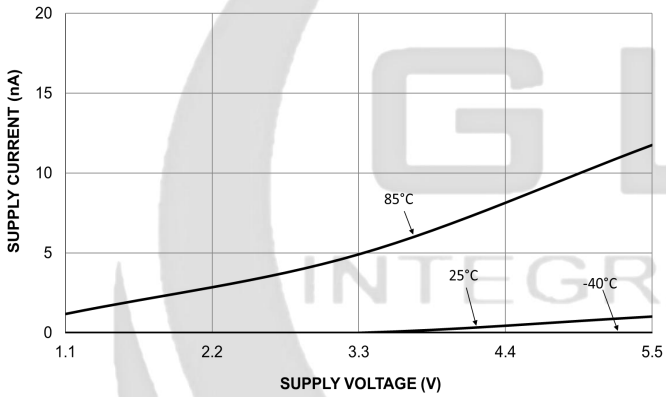


Figure 6. Quiescent Current vs. Supply Voltage (GLF71300. GLF71301, GLF71306, GLF71308)

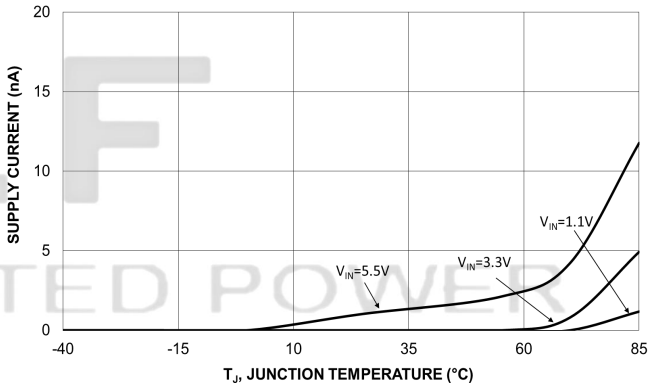


Figure 7. Quiescent Current vs. Temperature (GLF71300, GLF71301, GLF71306, GLF71308)

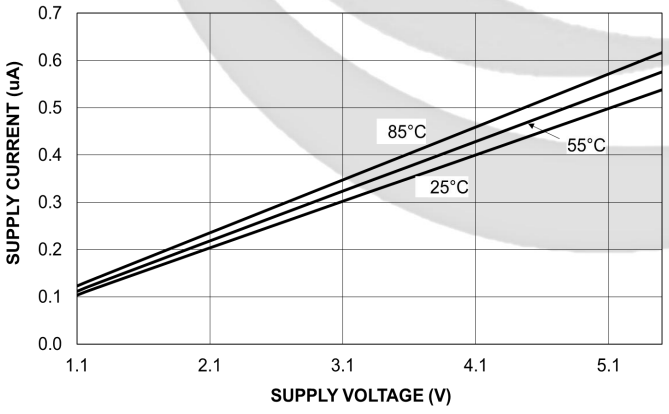


Figure 8. Quiescent Current vs. Supply Voltage (GLF71302, GLF71303)

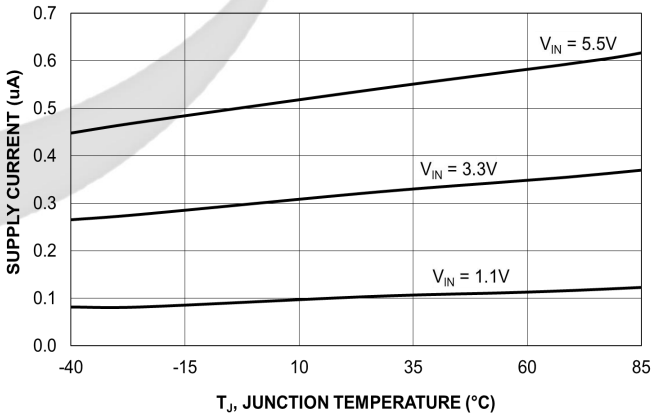


Figure 9. Quiescent Current vs. Temperature (GLF71302, GLF71303)

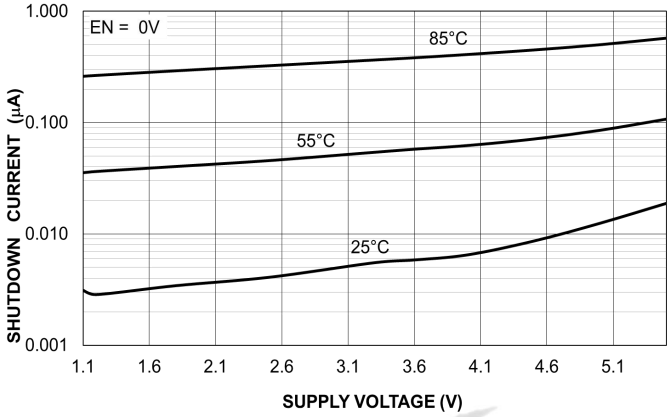


Figure 10. Shutdown Current vs. Supply Voltage

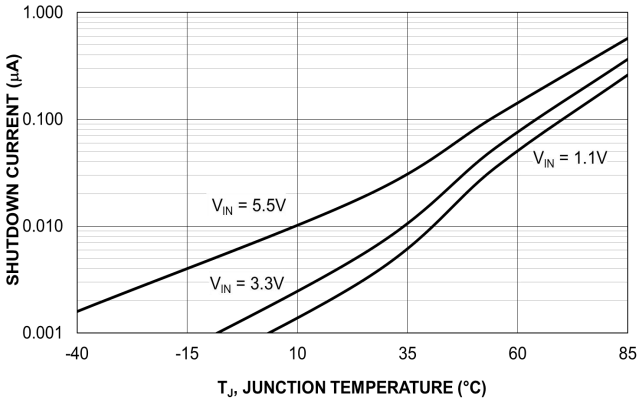


Figure 11. Shutdown Current vs. Temperature

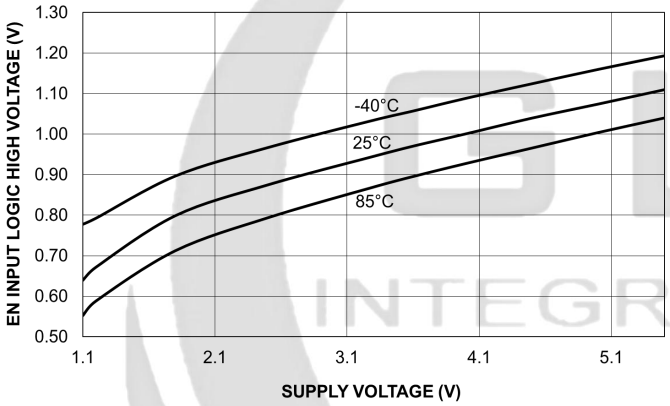


Figure 12. EN Input Logic High Threshold

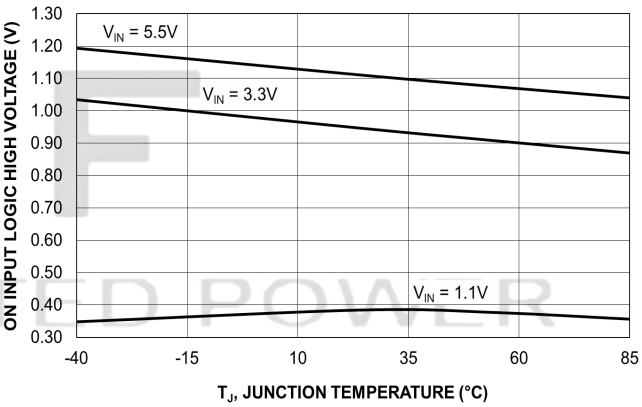


Figure 13. EN Input Logic High Threshold Vs. Temperature

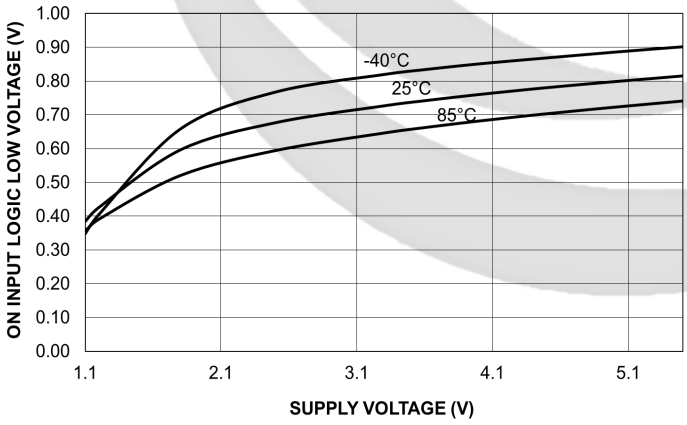


Figure 14. EN Input Logic Low Threshold

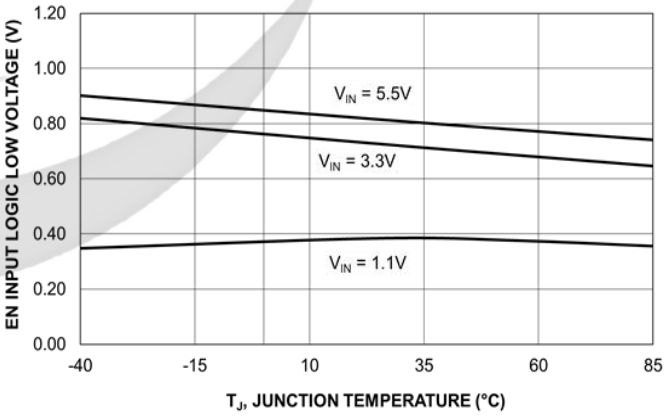


Figure 15. EN Input Logic Low Threshold Vs. Temperature

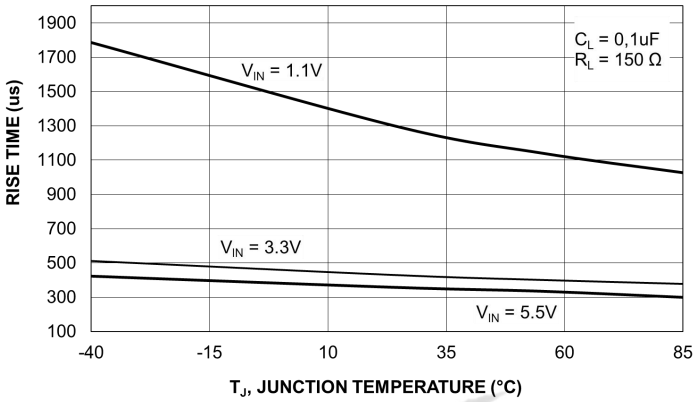


Figure 16. V_{OUT} Rise Time vs. Temperature
GLF71300, GLF71301, GLF71302, GLF71303

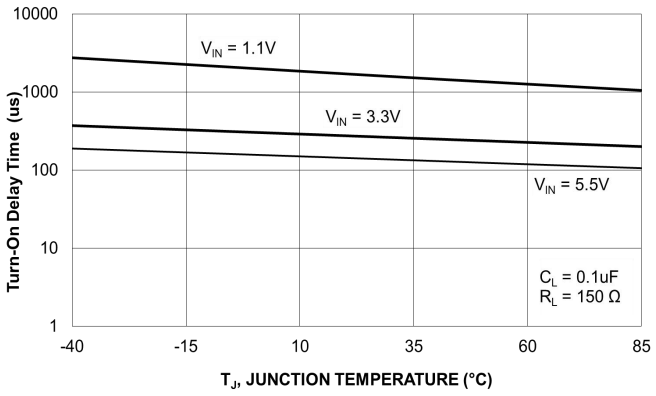


Figure 17. Turn-On Delay Time vs. Temperature
GLF71300, GLF71301, GLF71302, GLF71303

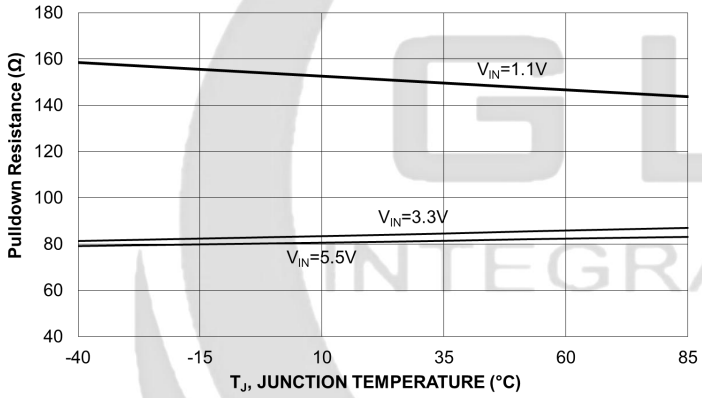


Figure 18. Pull-down Resistance vs. Temperature

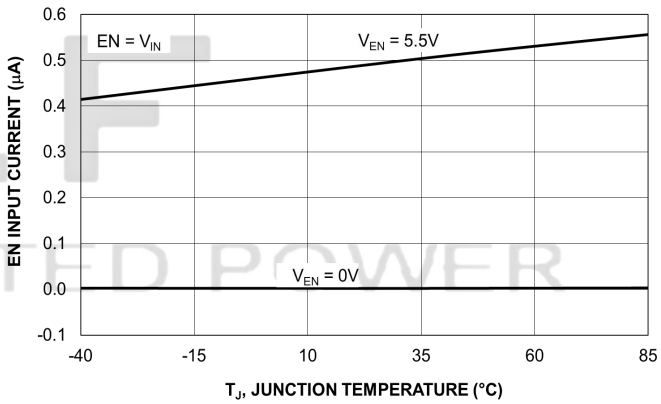


Figure 19. Enable Input Current vs. Temperature

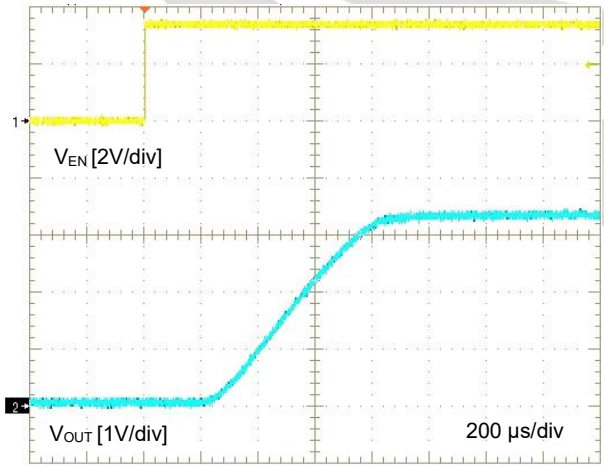


Figure 20. Turn-On Response (GLF71301)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=150 Ω

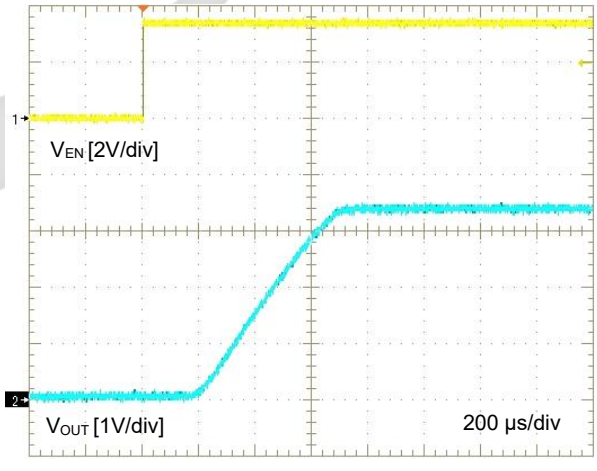


Figure 21. Turn-On Response (GLF71301)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=500 Ω

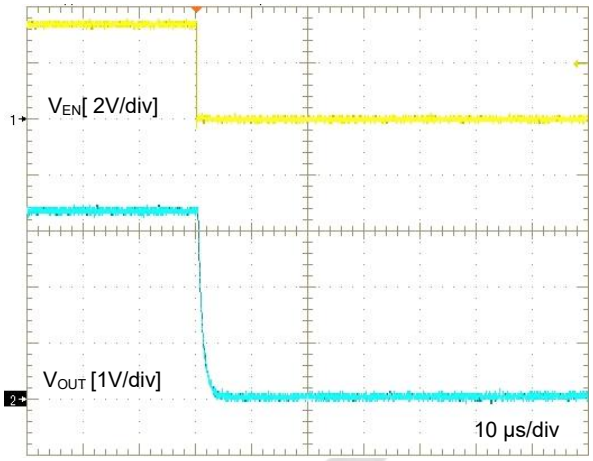


Figure 22. Turn-Off Response, Output Discharge (GLF71301)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=150 Ω

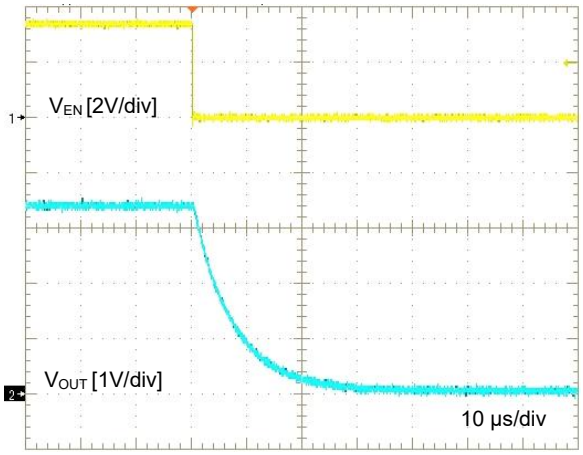


Figure 23. Turn-Off Response, Output Discharge (GLF71301)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=500 Ω

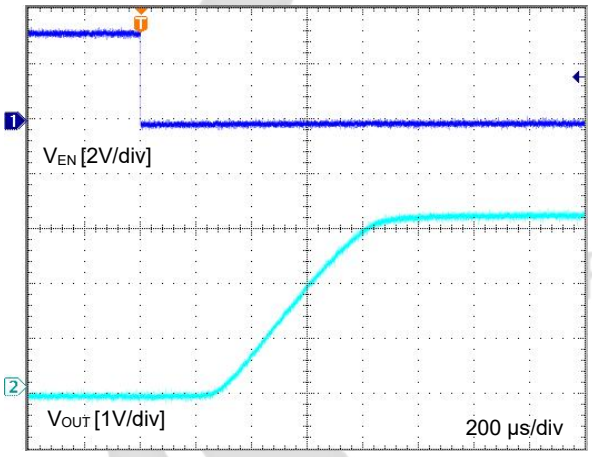


Figure 24. Turn-On Response (GLF71303)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=150 Ω

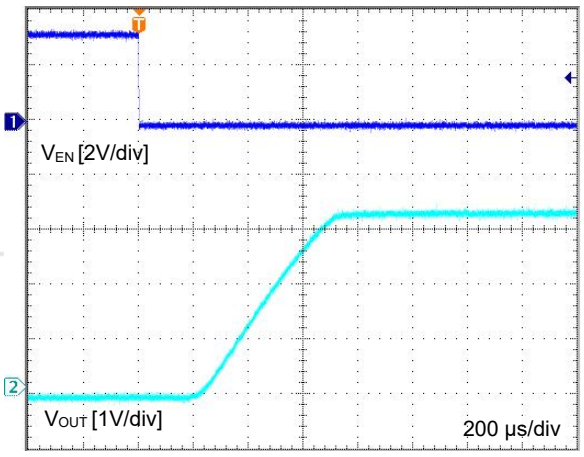


Figure 25. Turn-On Response (GLF71303)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=500 Ω

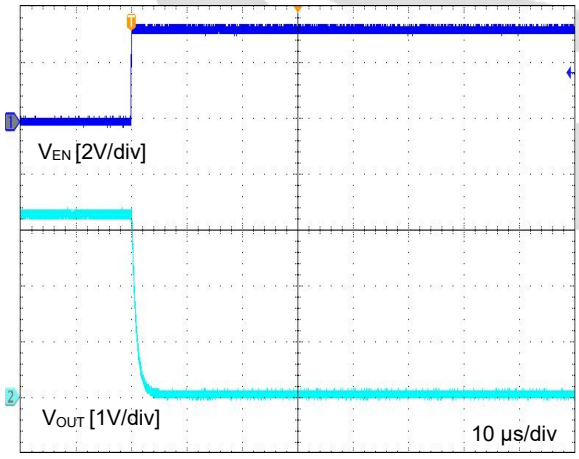


Figure 26. Turn-Off Response, Output Discharge (GLF71303)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=150 Ω

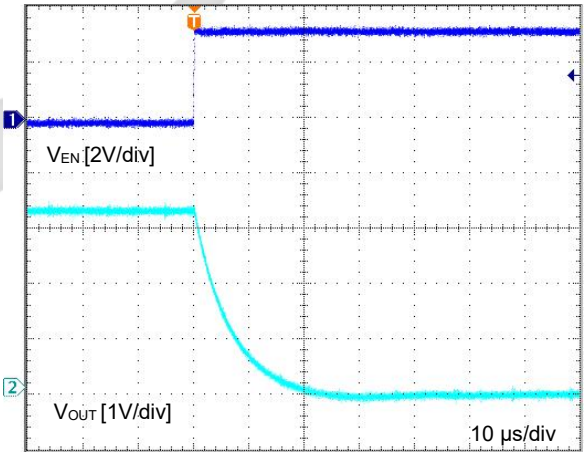


Figure 27. Turn-Off Response, Output Discharge (GLF71303)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=500 Ω

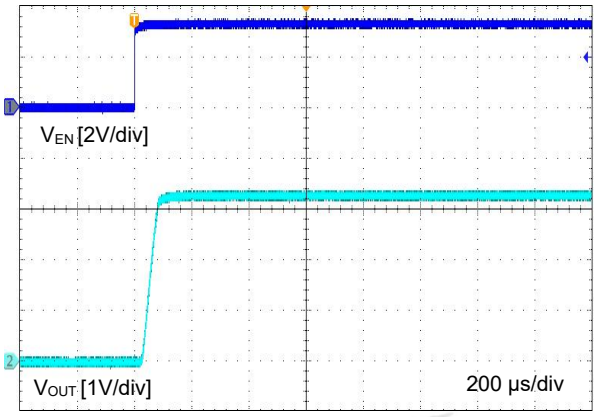


Figure 28. Turn-On Response (GLF71306)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=150 Ω

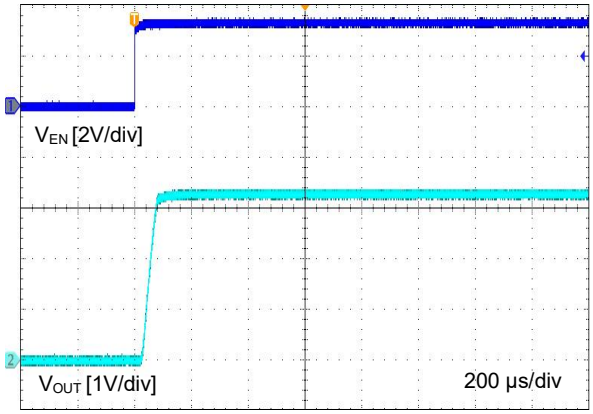


Figure 29. Turn-On Response (GLF71306)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=500 Ω

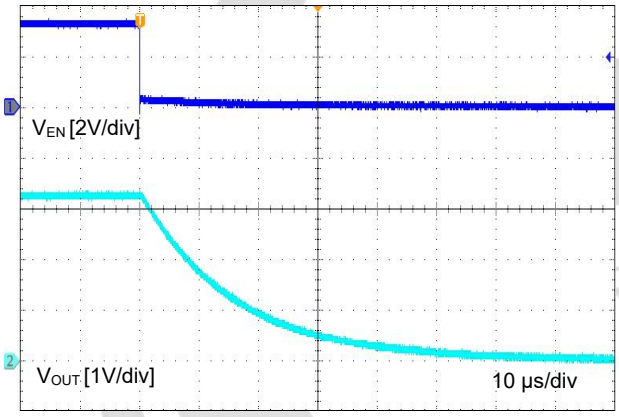


Figure 30. Turn-Off Response, Output Discharge (GLF71306)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=150 Ω

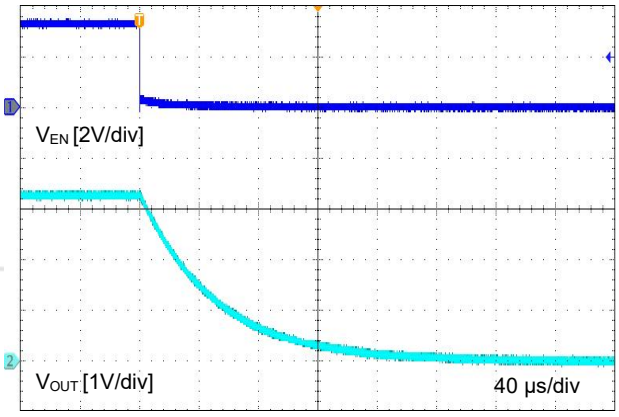


Figure 31. Turn-Off Response, Output Discharge (GLF71306)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=500 Ω

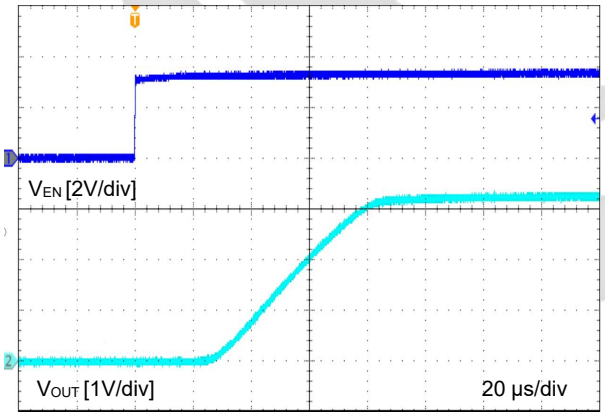


Figure 32. Turn-On Response (GLF71308)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=150 Ω

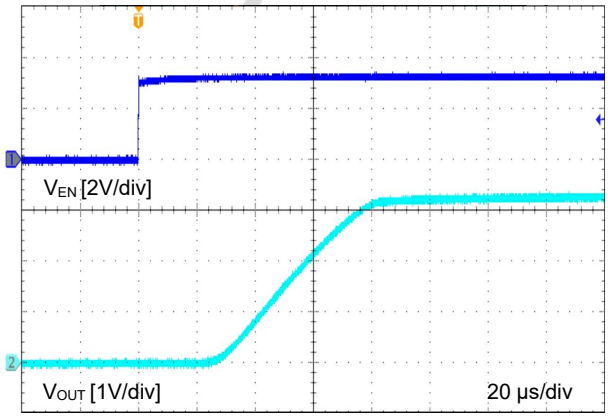


Figure 33. Turn-On Response (GLF71308)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=500 Ω

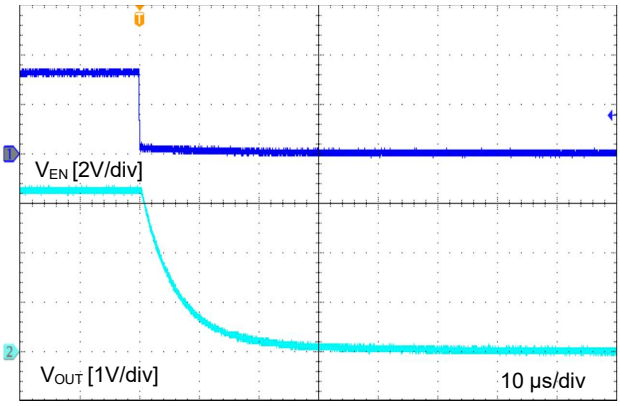


Figure 34. Turn-Off Response, Output Discharge (GLF71308)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=150 Ω

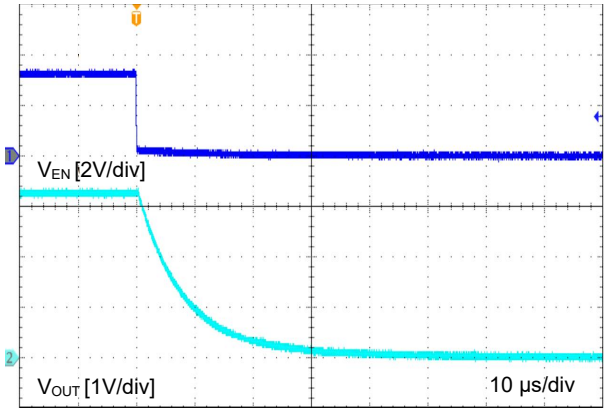


Figure 35. Turn-Off Response, Output Discharge (GLF71308)
V_{IN}=3.3 V, C_{IN}=1.0 µF, C_{OUT}=0.1 µF, R_L=500 Ω

APPLICATION INFORMATION

The GLF7130x family of devices are integrated 2.0 A, Ultra-Efficient I_QSmart™ Load Switch devices 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 1.1 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 avoid unwanted standby current and save limited input power. The package is a 0.77 mm x 0.77 mm x 0.46 mm wafer level chip scale package, saving space in compact applications. It is constructed using 4 bumps, with a 0.4 mm pitch for manufacturability.

Input 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.

Output Capacitor

An output capacitor is recommended to mitigate voltage undershoot on the output pin the moment 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 GLF71300 / GLF71301 / GLF71306 / GLF71308 can be activated by EN pin high level and the GLF71302 / GLF71303 by EN pin low 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.

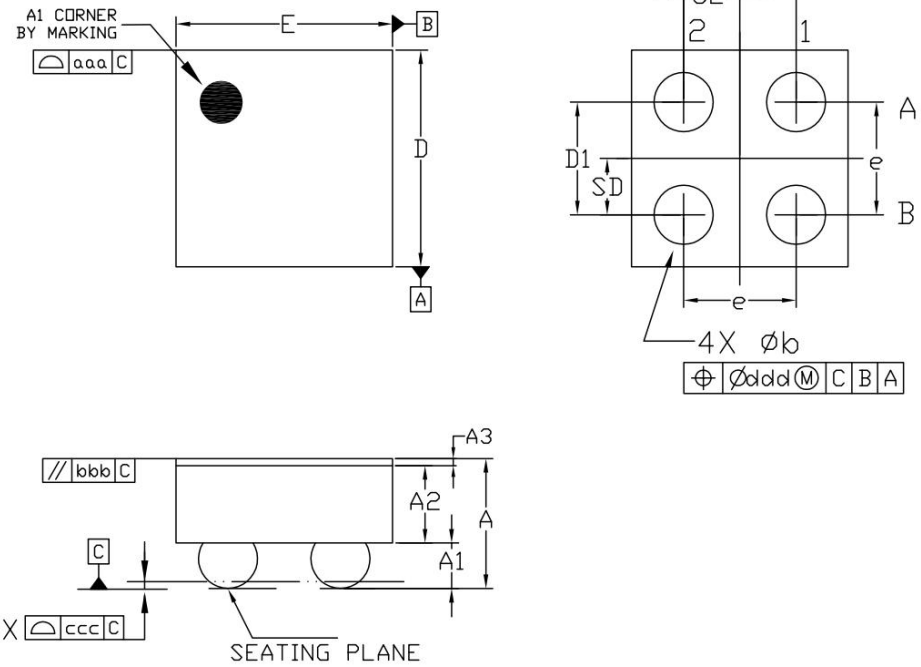
Output Discharge Function

The GLF71301 / GLF71303 / GLF71306 / GLF71308 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

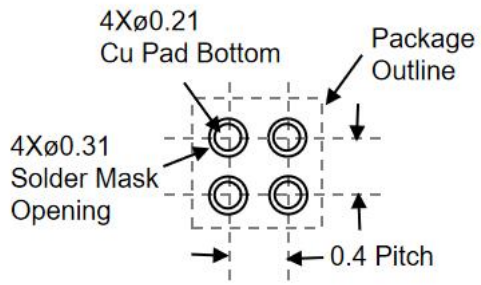
All traces should be as short as possible to minimize parasitic inductance effects. Wide traces for VIN, VOUT, and GND will help reduce voltage drops and parasitic effects during dynamic operation as well as improve the thermal performance at high load current.

PACKAGE OUTLINE



Dimensional Ref.			
REF.	Min.	Nom.	Max.
A	0.410	0.460	0.510
A1	0.135	0.160	0.185
A2	0.250	0.275	0.300
A3	0.020	0.025	0.030
D	0.755	0.770	0.785
E	0.755	0.770	0.785
D1	0.350	0.400	0.450
E1	0.350	0.400	0.450
b	0.170	0.210	0.250
e	0.400 BSC		
SD	0.200 BSC		
SE	0.200 BSC		
Tol. of Form&Position			
aaa	0.10		
bbb	0.10		
ccc	0.05		
ddd	0.05		

Recommended Footprint

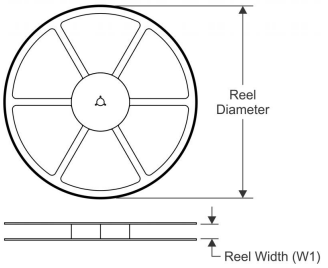


Notes

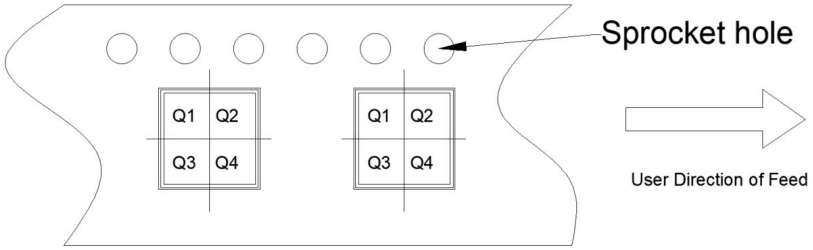
1. ALL DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGRESS)
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
3. A3: BACKSIDE LAMINATION

TAPE AND REEL INFORMATION

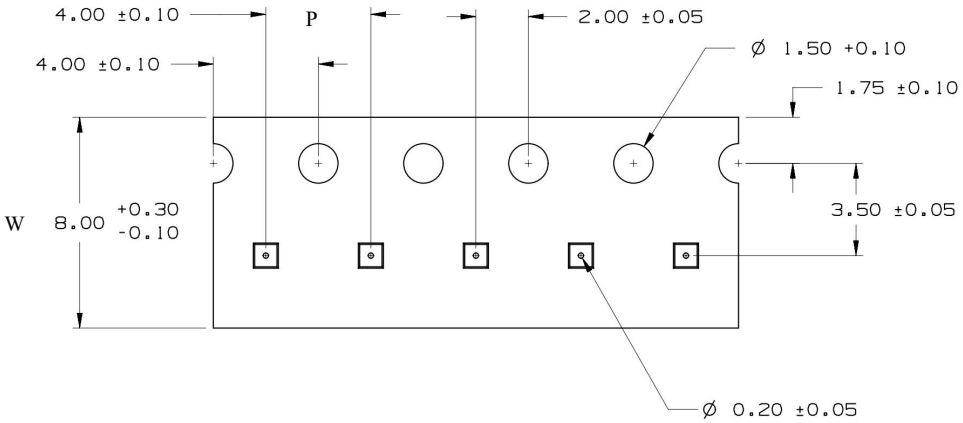
REEL DIMENSIONS

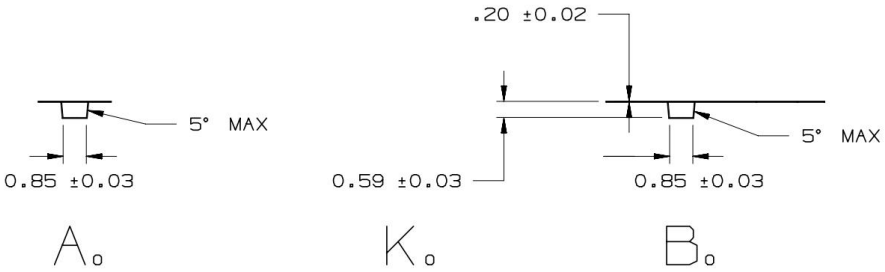


QUADRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE



TAPE DIMENSIONS





Device	Package	Pins	SPQ	Reel Diameter (mm)	Reel Width W1	A0	B0	K0	P	W	Pin1
GLF71300	WLCSP	4	4000	180	9	0.85	0.85	0.59	4	8	Q1
GLF71301	WLCSP	4	4000	180	9	0.85	0.85	0.59	4	8	Q1
GLF71302	WLCSP	4	4000	180	9	0.85	0.85	0.59	4	8	Q1
GLF71303	WLCSP	4	4000	180	9	0.85	0.85	0.59	4	8	Q1
GLF71306	WLCSP	4	4000	180	9	0.85	0.85	0.59	4	8	Q1
GLF71308	WLCSP	4	4000	180	9	0.85	0.85	0.59	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

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