# GLF71310, GLF71311, GLF71312, GLF71313
## Nano-Current Consumed I$_Q$Smart$^{TM}$ Load Switch with Slew Rate

**Product Specification**

## DESCRIPTION

The GLF7131x is an ultra-efficiency, 2 A rated, Load Switch with integrated slew rate control. The best in class efficiency makes it an ideal chose for use in IoT, mobile, and wearable electronics.

The GLF7131x features ultra-efficient I$_Q$Smart$^{TM}$ 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 GLF7131x 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.

GLF7131x Load Switch devices support 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 reduce operating cost.

GLF7131x 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 bump pitch.

## FEATURES

- Ultra-Low I$_Q$:
  7 nA Typ @ 5.5 V$_{IN}$ on GLF71310, GLF71311
  520 nA Typ @ 5.5 V$_{IN}$ on GLF71312, GLF71313
- Ultra-Low I$_{SD}$: 28 nA Typ @ 5.5 V$_{IN}$
- Low R$_{ON}$ : 31 mΩ Typ @ 5.5 V$_{IN}$
- I$_{OUT}$ Max: 2 A
- Wide Input Range: 1.1 V to 5.5 V
  6 Vabs max
- Controlled Rise Time: 335 us at 3.3 V$_{IN}$
- Internal EN Pull-Down Resistor on GLF71310 and GLF71311
- Internal EN Pull-Up Resistor on GLF71312 and GLF71313
- Integrated Output Discharge Switch: GLF71311 and GLF71313
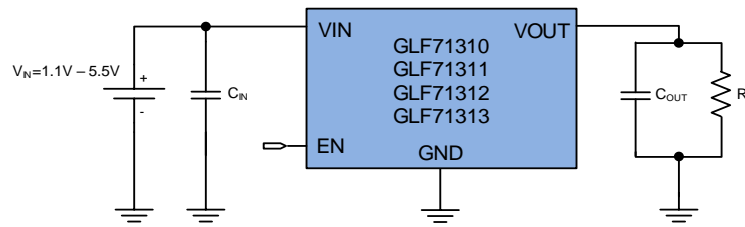- Ultra-Small: 0.97 mm x 0.97 mm

## APPLICATIONS

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

## PACKAGE
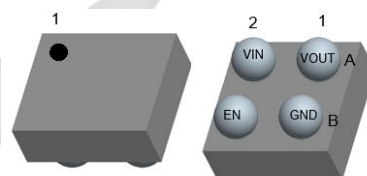


0.97 mm x 0.97 mm x 0.55 mm WLCSP

## APPLICATION DIAGRAM



## ALTERNATE DEVICE OPTIONS

| Part Number | Top Mark | $R_{ON}$ (Typ) at 5.5 V | Output Discharge | EN Activity | Availability |
|-------------|----------|-------------------------|------------------|-------------|--------------|
| GLF71310 | BA | 31 mΩ | No | High | Released |
| GLF71311 | BC | 31 mΩ | 85 Ω | High | Released |
| GLF71312 | BD | 31 mΩ | No | Low | On Request |
| GLF71313 | BE | 31 mΩ | 85 Ω | Low | Released |

Note: Contact GLF representatives for more information on alternate devices' delivery and availability.
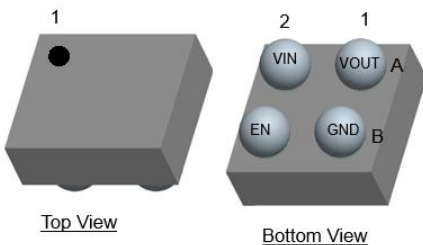
## FUNCTIONAL BLOCK DIAGRAM
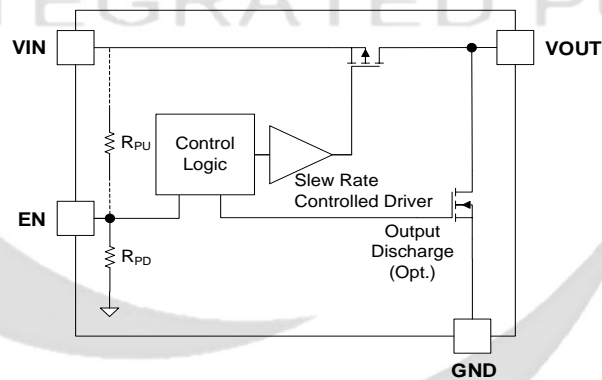


**Figure 1. Functional Block Diagram**

## PIN CONFIGURATION



**Figure 2. 0.97 mm x 0.97 mm x 0.55 mm 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 |

## 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 | | | 1.2 | W |
| $T_{STG}$ | Storage Junction Temperature | | -65 | 150 | °C |
| $T_A$ | Operating Temperature Range | | -40 | 85 | °C |
| $\theta_{JA}$ | Thermal Resistance, Junction to Ambient | | | 85 | °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] GLF71310, GLF71311 | V$_{IN}$ = V$_{EN}$ =5.5 V, I$_{OUT}$=0 mA | | | 7 | 70 | |
| | | V$_{IN}$ = V$_{EN}$ =5.5 V, I$_{OUT}$=0 mA, Ta=85 °C [5] | | | 12 | | |
| | Quiescent Current GLF71312, GLF71313 | V$_{IN}$ =5.5 V, V$_{EN}$ =0 V, I$_{OUT}$=0 mA | | | 520 | | |
| | | V$_{IN}$ =5.5 V, V$_{EN}$ =0 V, I$_{OUT}$=0 mA, Ta=85 °C [5] | | | 640 | | |
| I$_{SD}$ | Shut Down Current | EN = Disable, I$_{OUT}$=0 mA, V$_{IN}$=1.1 V | | | 5 | | nA |
| | | EN = Disable, I$_{OUT}$=0 mA, V$_{IN}$=1.8 V | | | 6 | | |
| | | EN = Disable, I$_{OUT}$=0 mA, V$_{IN}$=3.3 V | | | 9 | 35 | |
| | | EN = Disable, I$_{OUT}$=0 mA, V$_{IN}$=4.5 V | | | 13 | | |
| | | EN = Disable, I$_{OUT}$=0 mA, V$_{IN}$=5.5 V | | | 28 | 100 | |
| | | EN = Disable, I$_{OUT}$=0 mA, V$_{IN}$=5.5 V, Ta=55 °C [5] | | | 200 | | |
| | | EN = Disable, I$_{OUT}$=0 mA, V$_{IN}$=5.5 V, Ta=85 °C [5] | | | 1 | | uA |
| R$_{ON}$ | On-Resistance | V$_{IN}$=5.5V, I$_{OUT}$= 500mA | Ta=25 °C | | 31 | 34 | mΩ |
| | | | Ta=85 °C [5] | | 36 | | |
| | | V$_{IN}$=3.3V, I$_{OUT}$= 500mA | Ta=25 °C | | 36 | 41 | |
| | | | Ta=85 °C [5] | | 43 | | |
| | | V$_{IN}$=1.8V, I$_{OUT}$= 300mA | Ta=25 °C | | 52 | 60 | |
| | | V$_{IN}$=1.1V, I$_{OUT}$= 100mA | Ta=25 °C | | 95 | 120 | |
| R$_{DSC}$ | Output Discharge Resistance | E$_N$=Low , I$_{FORCE}$= 10 mA | | 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 : GLF71310, GLF71311 Internal Pull-up Resistance : GLF71312, GLF71313 | | | 9.5 | | MΩ |
| I$_{EN}$ | EN Current | E$_N$=5.5 V | | | | 1.0 | µA |

### Switching Characteristics

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| t$_{dON}$ | Turn-On Delay[2] | R$_L$=150 Ω, C$_{OUT}$=0.1 µF | | | 210 | | µs |
| t$_R$ | V$_{OUT}$ Rise Time[2] | | | | 335 | | |
| t$_{dON}$ | Turn-On Delay[2,5] | R$_L$=500 Ω, C$_{OUT}$=0.1 µF | | | 220 | | |
| t$_R$ | V$_{OUT}$ Rise Time[2,5] | | | | 330 | | |
| t$_{dOFF}$ | Turn-Off Delay [3,4,5] | R$_L$=10 Ω, C$_{OUT}$=0.1 µF, GLF71311, GLF71313 | | | 0.38 | | |
| t$_F$ | V$_{OUT}$ Fall Time [3,4,5] | | | | 1.30 | | |
| t$_{dOFF}$ | Turn-Off Delay [3, 5] | R$_L$=10 Ω, C$_{OUT}$=0.1 µF GLF71310, GLF71312 : No Output Discharge, R$_{DSC}$ | | | 0.35 | | |
| t$_F$ | V$_{OUT}$ Fall Time [3, 5] | | | | 2.45 | | |
| t$_{dOFF}$ | Turn-Off Delay [3,4,5] | R$_L$=500 Ω, C$_{OUT}$=0.1 µF, GLF71311, GLF71313 | | | 0.9 | | |
| t$_F$ | V$_{OUT}$ Fall Time [3,4,5] | | | | 16 | | |

| t$_{dOFF}$ | Turn-Off Delay [3, 5] | R$_L$=500 Ω, C$_{OUT}$=0.1 µF | | 4.0 | | µs |
|---|---|---|---|---|---|---|
| t$_F$ | V$_{OUT}$ Fall Time [3, 5] | GLF71310, GLF71312 : No Output Discharge, R$_{DSC}$ | | 105 | | |

Notes:
1. I$_Q$ does NOT include Enable pull down current through the pull-down resistor R$_{DSC}$.
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



GLF71310, GLF71311                    GLF71312, GLF71313
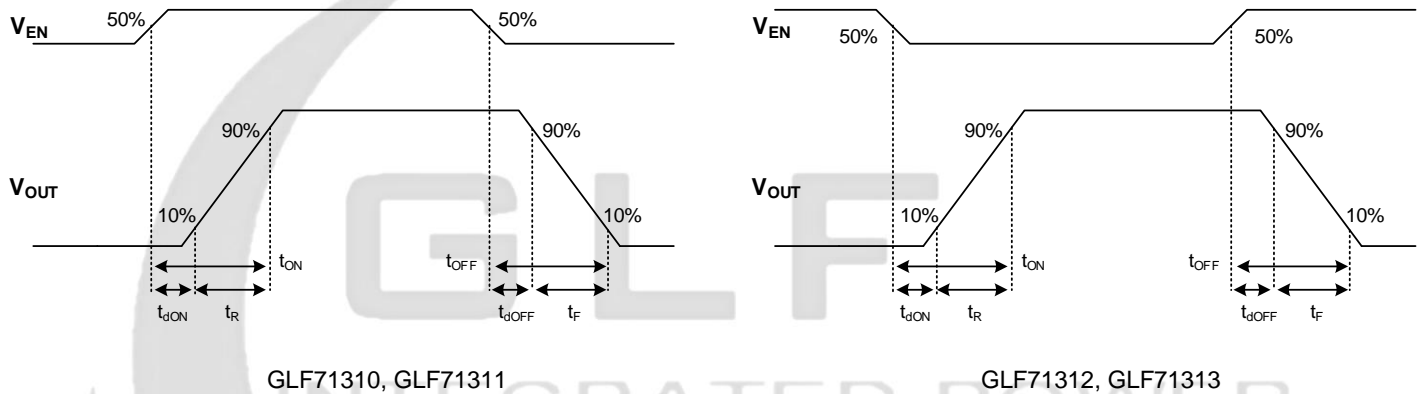
**Figure 3.  Timing Diagram**

## TYPICAL PERFORMANCE CHARACTERISTICS
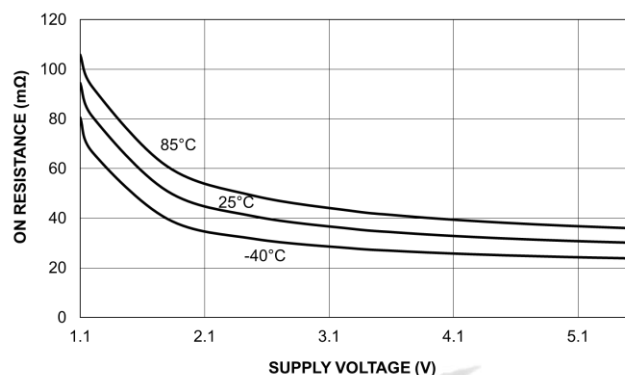


**Figure 4. On-Resistance vs. Input Voltage**
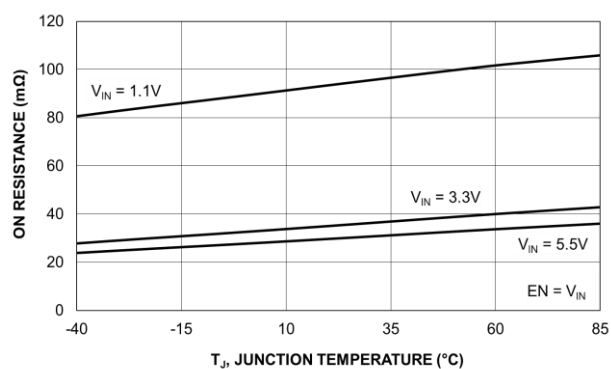


**Figure 5. On-Resistance vs. Temperature**
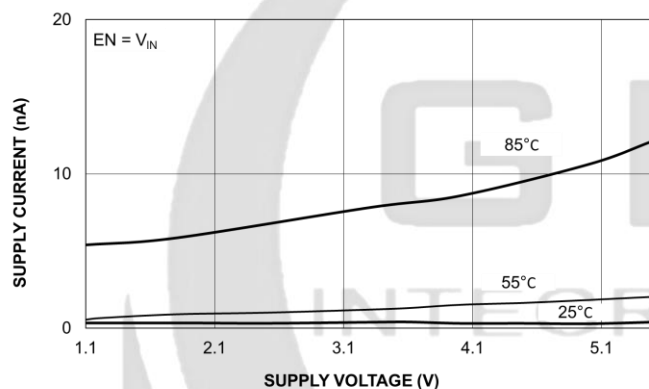


**Figure 6. Quiescent Current vs. Input Voltage**
**GLF71310, GLF71311**
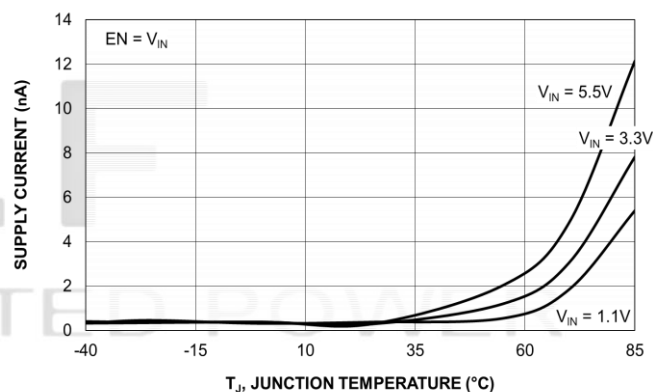


**Figure 7. Quiescent Current vs. Temperature**
**GLF71310, GLF71311**
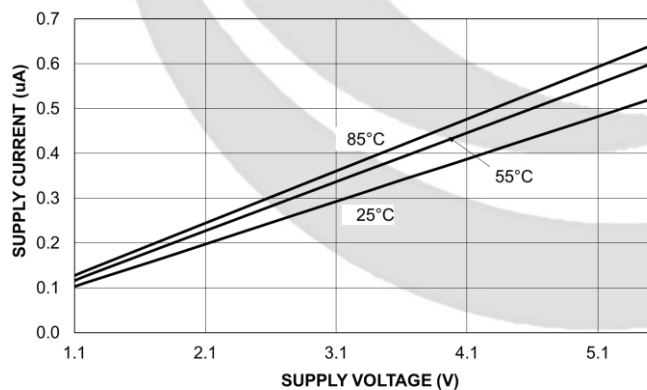


**Figure 8. Quiescent Current vs. Input Voltage**
**GLF71312, GLF71313**
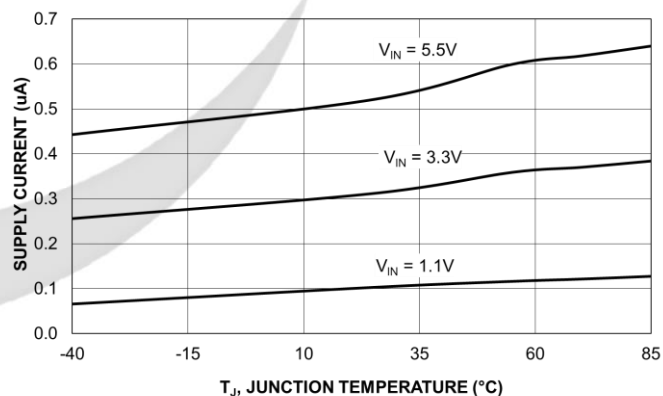


**Figure 9. Quiescent Current vs. Temperature**
**GLF71312, GLF71313**
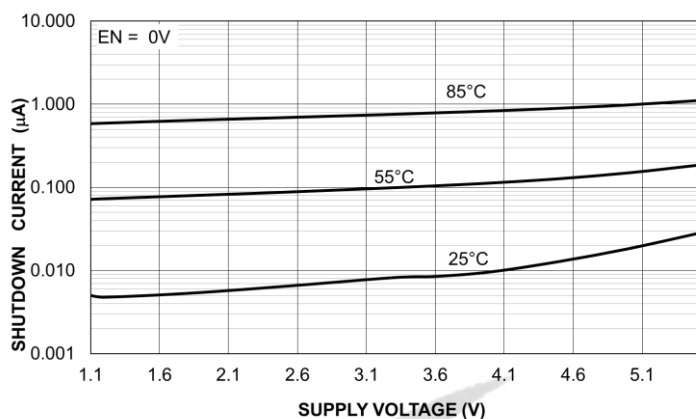
**Figure 10. Shut Down Current vs. Input Voltage**
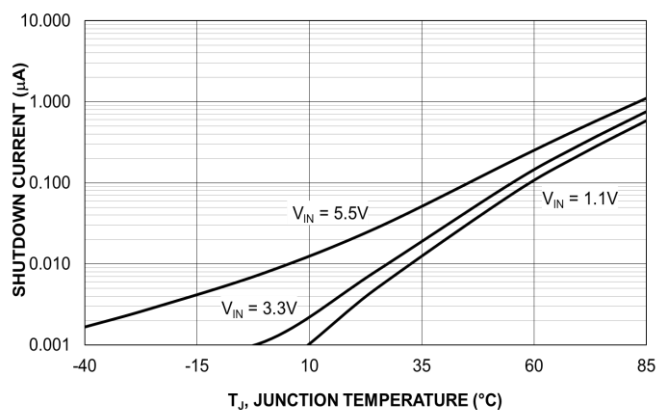


**Figure 11. Shut Down Current vs. Temperature**
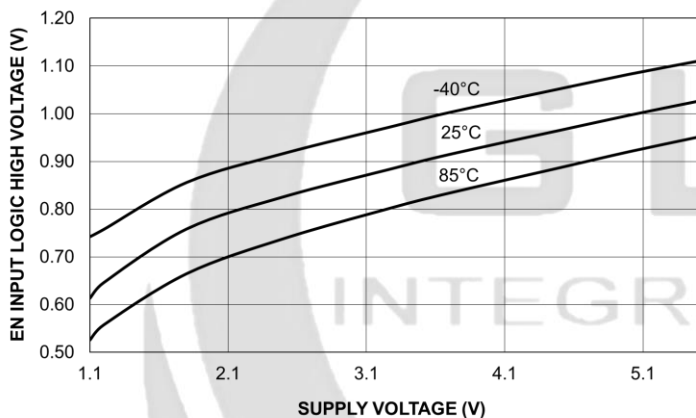


**Figure 12. EN Input Logic High Threshold**
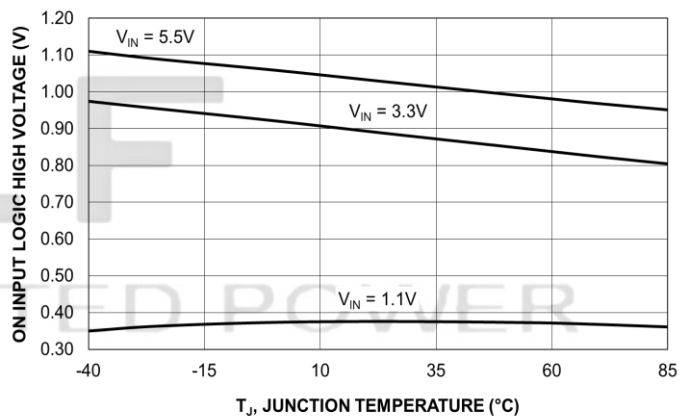


**Figure 13. EN Input Logic High Threshold Vs. Temperature**
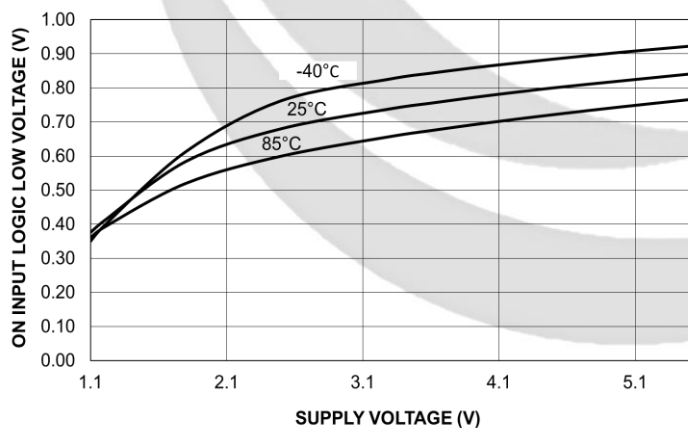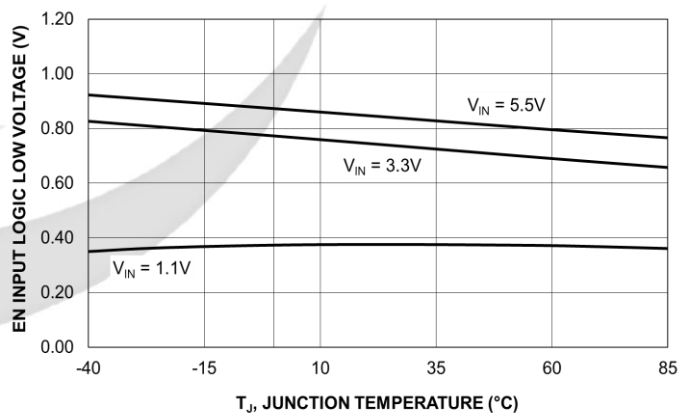


**Figure 14. EN Input Logic Low Threshold**



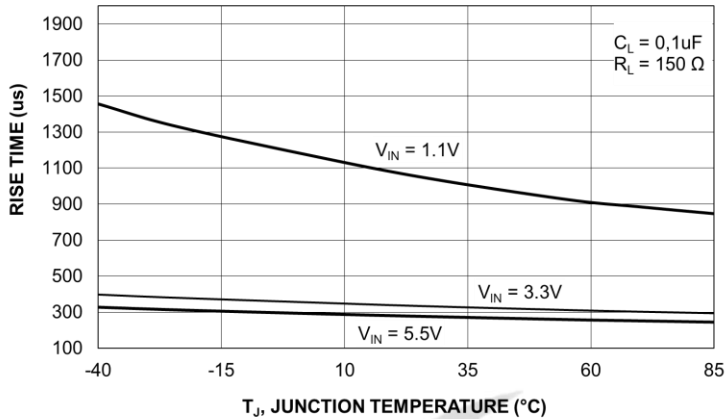**Figure 15. EN Input Logic Low Threshold Vs. Temperature**
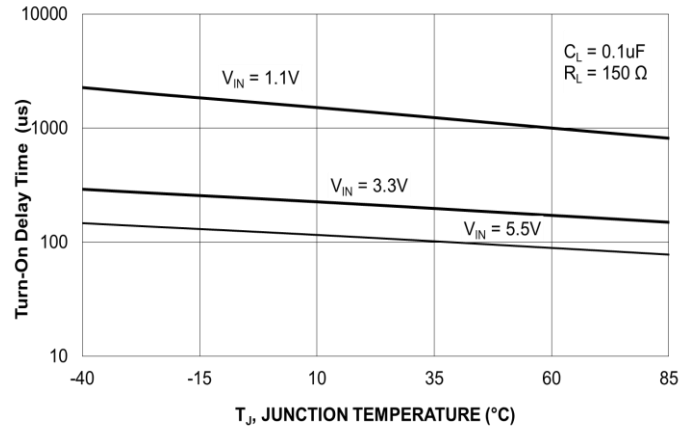
**Figure 16. VOUT Rise Time vs. Temperature**



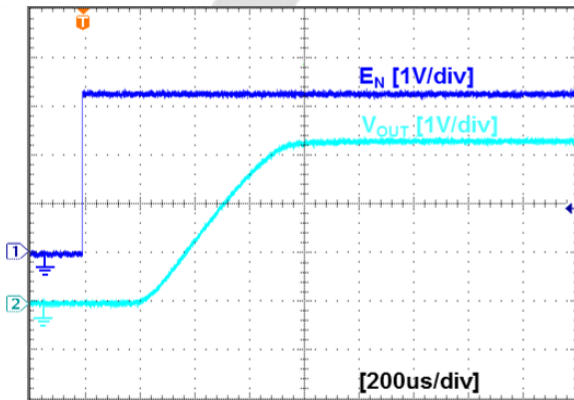**Figure 17. Turn-On Delay Time vs. Temperature**
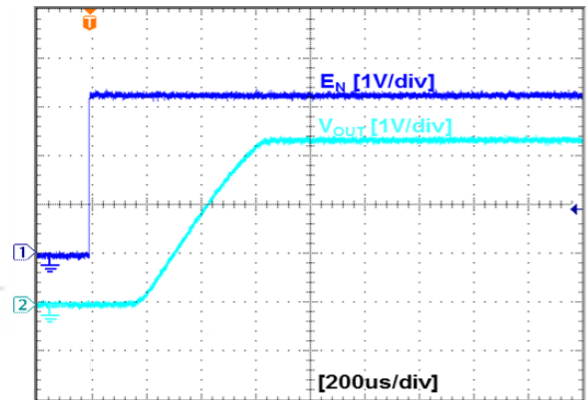


**Figure 18. Turn-On Response, GLF71311**
$V_{IN}$=3.3 V, $C_{IN}$=1.0 uF, $C_{OUT}$=0.1 uF, $R_L$=10 Ω



**Figure 19. Turn-On Response, GLF71311**
$V_{IN}$=3.3 V, $C_{IN}$=1.0 uF, $C_{OUT}$=0.1 uF, $R_L$=500 Ω
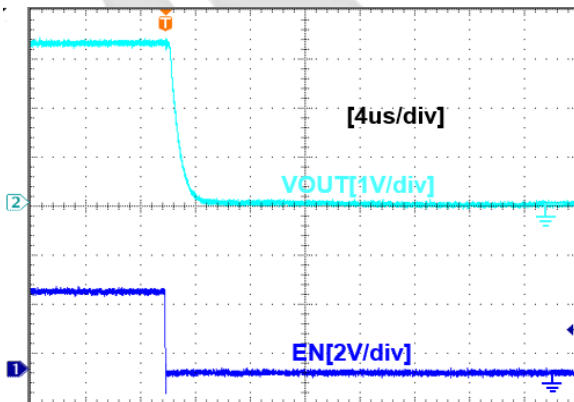


**Figure 20. Turn-Off Response, Output Discharge, GLF71311**
$V_{IN}$=3.3 V, $C_{IN}$=1.0 uF, $C_{OUT}$=0.1 uF, $R_L$=10 Ω
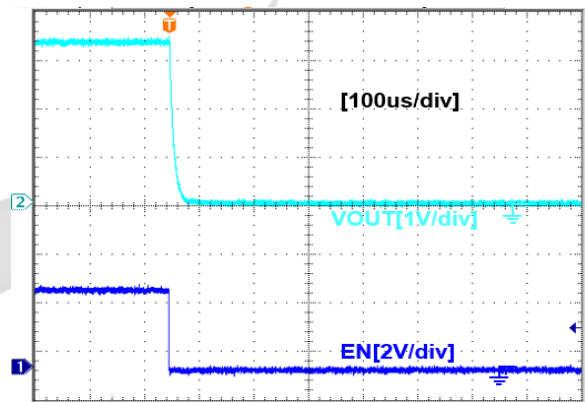


**Figure 21. Turn-Off Response, Output Discharge, GLF71311**
$V_{IN}$=3.3 V, $C_{IN}$=1.0 uF, $C_{OUT}$=0.1 uF, $R_L$=500 Ω
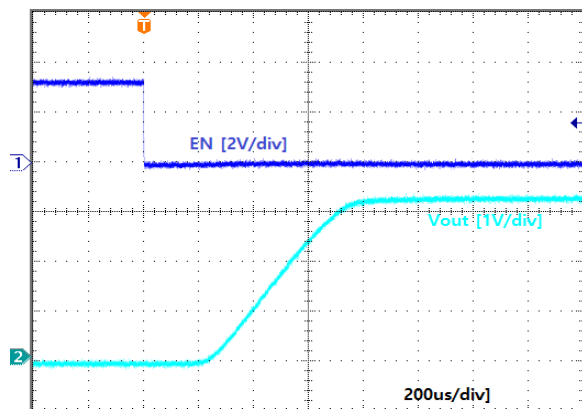
**Figure 22. Turn-On Response, GLF71313**

V$_{IN}$=3.3 V, C$_{IN}$=1.0 uF, C$_{OUT}$=0.1 uF, R$_L$=10 Ω
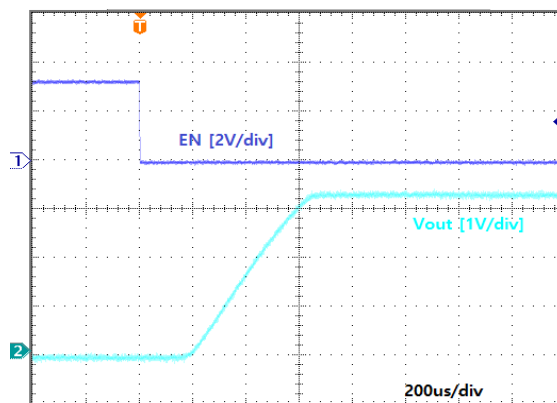


**Figure 23. Turn-On Response, GLF71313**

V$_{IN}$=3.3 V, C$_{IN}$=1.0 uF, C$_{OUT}$=0.1 uF, R$_L$=500 Ω
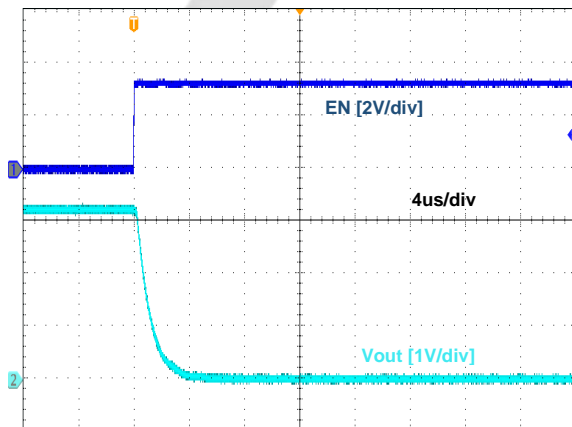


**Figure 24. Turn-Off Response, Output Discharge, GLF71313**

V$_{IN}$=3.3 V, C$_{IN}$=1.0 uF, C$_{OUT}$=0.1 uF, R$_L$=10 Ω
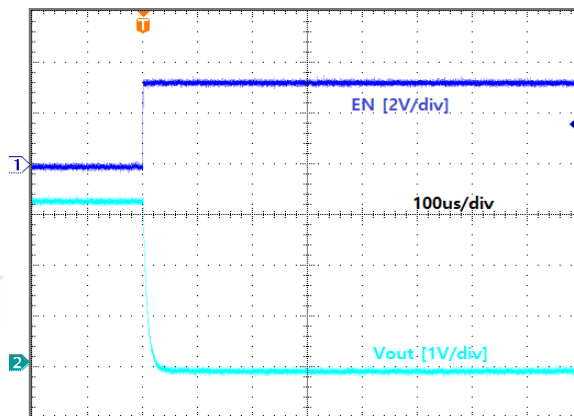


**Figure 25. Turn-Off Response, Output Discharge, GLF71313**

V$_{IN}$=3.3 V, C$_{IN}$=1.0 uF, C$_{OUT}$=0.1 uF, R$_L$=500 Ω

## APPLICATION INFORMATION

The GLF7131x family of devices are integrated 2 A, Ultra-Efficient I$_Q$Smart$^{TM}$ 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 0.97 mm x 0.97 mm x 0.5 5mm 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 Capacitor

The GLF7131x family of devices do 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 0.1uF 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 GLF7131x family of devices do 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 GLF71310 and GLF71311 can be activated by forcing EN pin high level and the GLF71312 and GLF71313 by EN pin low level. Note that the EN pin has an internal pull-down or pull-up 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 GLF71311 and GLF71313 have 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
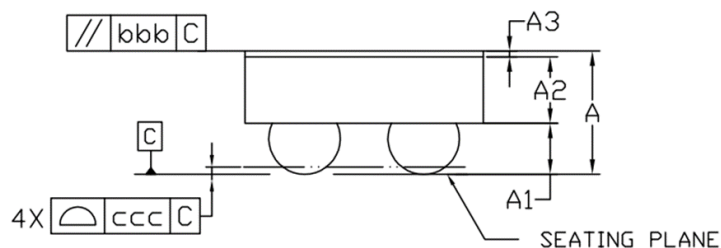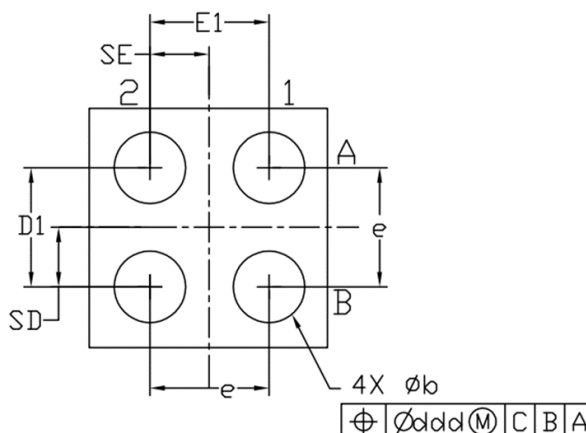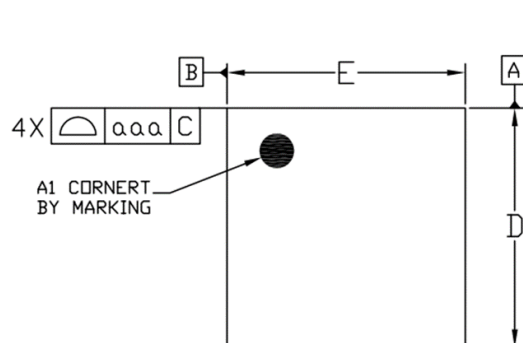


| Dimensional Ref. | | | |
|---|---|---|---|
| REF. | Min. | Nom. | Max. |
| A | 0.500 | 0.550 | 0.600 |
| A1 | 0.225 | 0.250 | 0.275 |
| A2 | 0.255 | 0.275 | 0.300 |
| A3 | 0.020 | 0.025 | 0.030 |
| D | 0.960 | 0.970 | 0.985 |
| E | 0.960 | 0.970 | 0.985 |
| D1 | 0.450 | 0.500 | 0.550 |
| E1 | 0.450 | 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
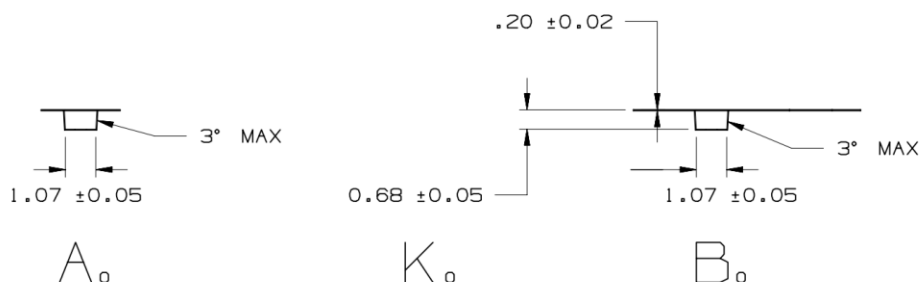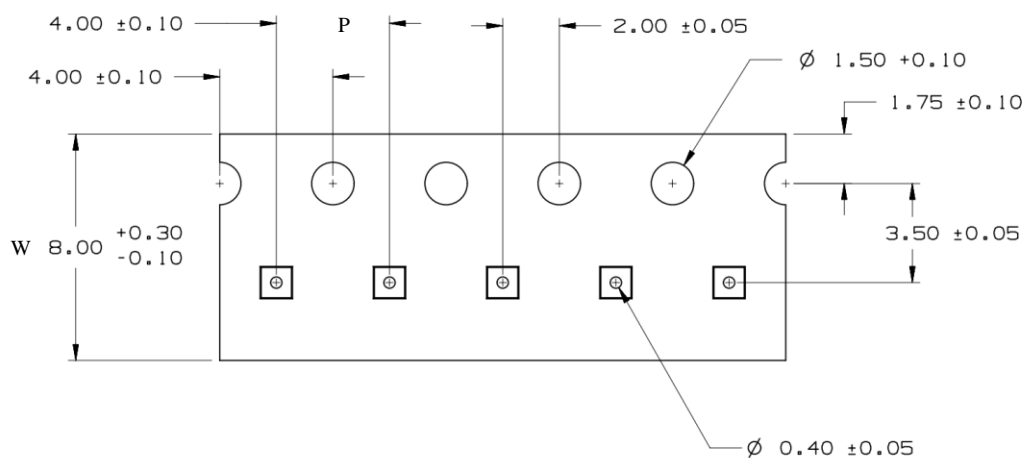
## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**
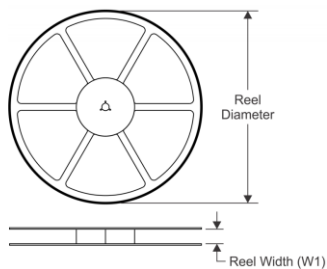
**QUADRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE**
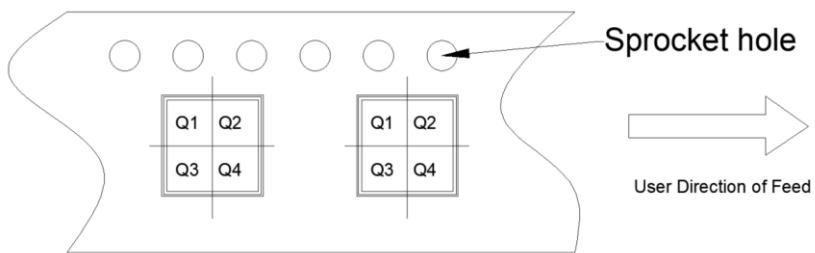
**TAPE DIMENSIONS**

| Device | Package | Pins | SPQ | Reel Diameter(mm) | Reel Width W1 | A0 | B0 | K0 | P | W | Pin1 |
|--------|---------|------|------|-------------------|--------------|------|------|------|---|---|------|
| GLF71310 | WLCSP | 4 | 3000 | 180 | 9 | 1.07 | 1.07 | 0.68 | 4 | 8 | Q1 |
| GLF71311 | WLCSP | 4 | 3000 | 180 | 9 | 1.07 | 1.07 | 0.68 | 4 | 8 | Q1 |
| GLF71312 | WLCSP | 4 | 3000 | 180 | 9 | 1.07 | 1.07 | 0.68 | 4 | 8 | Q1 |
| GLF71313 | 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 preliminary 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

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