

## DESCRIPTION

The GLF112x is an ultra-efficiency, 1.0 A rated, integrated load switch with the slew rate control. The best-in-class efficiency makes it an ideal choice for use in IoT, mobile, and wearable electronics.

The GLF112x features an ultra-efficient I<sub>Q</sub>Smart™ technology that supports the lowest quiescent current (I<sub>Q</sub>) and shutdown current (I<sub>SD</sub>) in the industry. Low I<sub>Q</sub> and I<sub>SD</sub> 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 GLF112x slew rate control specifically limits inrush current during turn-on to minimize voltage droop.

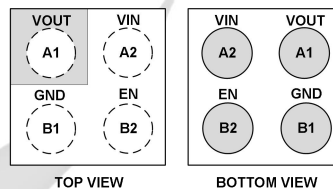
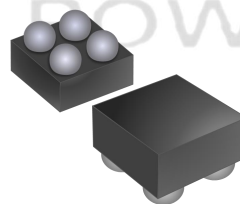
## FEATURES

- Wide Input Range, V<sub>IN</sub> = 1.1 V to 5.5 V  
6 V<sub>ABS</sub> Max
- I<sub>OUT</sub> Max = 1.0 A
- Low R<sub>ON</sub> = 52 mΩ Typ. at 5.5 V<sub>IN</sub>
- Ultra-Low I<sub>Q</sub>:  
5.0 nA Typ at 5.5 V<sub>IN</sub>: GLF112xH / HN  
550 nA Typ at 5.5 V<sub>IN</sub>: GLF1121L
- Ultra-Low I<sub>SD</sub>: 10 nA Typ at 5.5 V<sub>IN</sub>
- Integrated Output Discharge Switch (Optional)
- Internal Pull-down Resistor on EN Pin: GLF112xH
- Internal Pull-up Resistor on EN Pin: GLF112xL

## APPLICATIONS

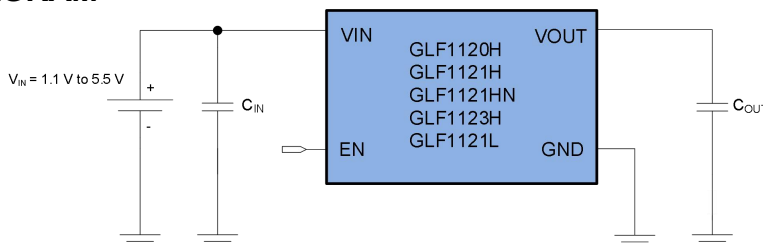
- Wearables
- Mobile Devices
- Low Power Subsystems

## PACKAGE



0.67 mm x 0.67 mm x 0.425 mm  
0.35 mm Pitch WL-CSP

## APPLICATION DIAGRAM



## ALTERNATE DEVICE OPTIONS

| Part Number | Top Mark | R <sub>ON</sub> (Typ)<br>at V <sub>IN</sub> (MAX) | V <sub>OUT</sub> Rise Time<br>at 3.3 V <sub>IN</sub> | Output Discharge | EN Activity | Internal Pull up/down |
|-------------|----------|---|--|------------------|-------------|-----------------------|
| GLF1120H    | T        | 52 mΩ   | 380 μs   | NA               | High        | Yes                   |
| GLF1121H    | U        |   |  | 85 Ω             |             | Yes                   |
| GLF1121HN   | V        |   |  |                  |             | NA                    |
| GLF1121L    | X        |   | Low  |                  | Yes         |                       |
| GLF1123H    | W        |   | 4 μs   |                  | High        | Yes                   |

## FUNCTIONAL BLOCK DIAGRAM

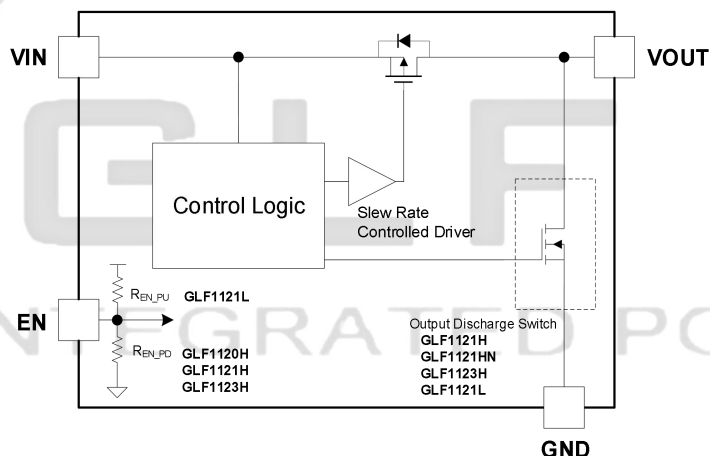
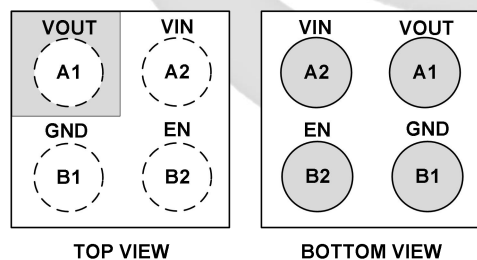


Figure 1. Functional Block Diagram

## 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. The EN pin has an internal pull-down resistor for GLF1120H, GLF1121H, and GLF1123H and pull-up resistor for GLF1121L. |

Figure 2. 0.67 mm x 0.67 mm x 0.425 mm WLCSP

## 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 <sub>IN</sub> , V <sub>OUT</sub> , V <sub>EN</sub> | Each Pin Voltage Range to GND                             |                                   | -0.3 | 6    | V    |
| I <sub>OUT</sub>                                     | Maximum Continuous Switch Current                         |                                   |      | 1    | A    |
|  | Pulse, 300 us pulse and 2 % duty cycle                    |                                   |      | 2    |      |
| P <sub>D</sub>                                       | Power Dissipation at T <sub>A</sub> = 25 °C               |                                   |      | 1    | W    |
| T <sub>STG</sub>                                     | Storage Junction Temperature                              |                                   | -65  | 150  | °C   |
| T <sub>A</sub>                                       | Operating Temperature Range                               |                                   | -40  | 85   | °C   |
| θ <sub>JA</sub>                                      | Thermal Resistance, Junction to Ambient (board dependent) |                                   |      | 125  | °C/W |
| ESD  | Electrostatic Discharge Capability                        | Human Body Model, JESD22-A114     | 3    |      | kV   |
|  |   | Charged Device Model, JESD22-C101 | 2    |      |      |

## RECOMMENDED OPERATING CONDITIONS

| Symbol   | Parameter                     | Min. | Max. | Unit               |
|----------|-------------------------------|------|------|--------------------|
| $V_{IN}$ | Supply Voltage, GLF1121x      | 1.1  | 5.5  | V                  |
| $T_A$    | Ambient Operating Temperature | - 40 | + 85 | $^{\circ}\text{C}$ |

**ELECTRICAL CHARACTERISTICS**
**GLF1120H, GLF1121H, GLF1121HN, GLF1123H, GLF1121L**

 Values are at V<sub>IN</sub> = 3.3 V and T<sub>A</sub> = 25 °C unless otherwise noted.

| Symbol   | Parameter   | Conditions   | Min.                                  | Typ. | Max. | Unit |
|--|---|--|---------------------------------------|------|------|------|
| <b>Basic Operation</b>                         |   |  |                                       |      |      |      |
| V <sub>IN</sub>                                | Supply Voltage  |  | 1.1                                   |      | 5.5  | V    |
| I <sub>Q</sub> <sup>(1)</sup>                  | Quiescent Current:<br>GLF1120H, GLF1121H<br>GLF1123H, GLF1121HN | V <sub>IN</sub> = V <sub>EN</sub> = 5.5 V, I <sub>OUT</sub> = 0 mA   |                                       | 1    |      |      |
|  |   | V <sub>IN</sub> = V <sub>EN</sub> = 5.5 V, I <sub>OUT</sub> = 0 mA, T <sub>A</sub> = 85 °C <sup>(4)</sup>                                |                                       | 5    |      |      |
|  | Quiescent Current:<br>GLF1121L                                  | V <sub>IN</sub> = 5.5 V, V <sub>EN</sub> = 0 V, I <sub>OUT</sub> = 0 mA  |                                       | 550  |      |      |
|  |   | V <sub>IN</sub> = 5.5 V, V <sub>EN</sub> = 0 V, I <sub>OUT</sub> = 0 mA, T <sub>A</sub> = 85 °C <sup>(4)</sup>                           |                                       | 620  |      |      |
| I <sub>SD</sub>                                | Shutdown Current  | EN = Disable, I <sub>OUT</sub> = 0 mA, V <sub>IN</sub> = 1.1 V   |                                       | 2    |      | nA   |
|  |   | EN = Disable, I <sub>OUT</sub> = 0 mA, V <sub>IN</sub> = 1.8 V   |                                       | 3    |      |      |
|  |   | EN = Disable, I <sub>OUT</sub> = 0 mA, V <sub>IN</sub> = 3.3 V   |                                       | 4    |      |      |
|  |   | EN = Disable, I <sub>OUT</sub> = 0 mA, V <sub>IN</sub> = 4.5 V   |                                       | 5    |      |      |
|  |   | EN = Disable, I <sub>OUT</sub> = 0 mA, V <sub>IN</sub> = 5.5 V   |                                       | 10   | 50   |      |
|  |   | EN = Disable, I <sub>OUT</sub> = 0 mA, V <sub>IN</sub> = 5.5 V, T <sub>A</sub> = 55 °C <sup>(4)</sup>                                    |                                       | 45   |      |      |
|  |   | EN = Disable, I <sub>OUT</sub> = 0 mA, V <sub>IN</sub> = 5.5 V, T <sub>A</sub> = 85 °C <sup>(4)</sup>                                    |                                       | 250  |      |      |
| R <sub>ON</sub>                                | On-Resistance   | V <sub>IN</sub> = 5.5 V, I <sub>OUT</sub> = 500 mA   | T <sub>A</sub> = 25 °C                | 52   | 60   | mΩ   |
|  |   |  | T <sub>A</sub> = 85 °C <sup>(4)</sup> | 62   |      |      |
|  |   | V <sub>IN</sub> = 4.5 V, I <sub>OUT</sub> = 500 mA   | T <sub>A</sub> = 25 °C                | 57   | 65   |      |
|  |   |  | T <sub>A</sub> = 85 °C <sup>(4)</sup> | 67   |      |      |
|  |   | V <sub>IN</sub> = 3.3 V, I <sub>OUT</sub> = 500 mA   | T <sub>A</sub> = 25 °C                | 67   | 77   |      |
|  |   |  | T <sub>A</sub> = 85 °C <sup>(4)</sup> | 80   |      |      |
|  |   | V <sub>IN</sub> = 2.5 V, I <sub>OUT</sub> = 300 mA   | T <sub>A</sub> = 25 °C                | 82   | 92   |      |
|  |   | V <sub>IN</sub> = 1.8 V, I <sub>OUT</sub> = 300 mA   | T <sub>A</sub> = 25 °C                | 112  | 125  |      |
|  |   | V <sub>IN</sub> = 1.5 V, I <sub>OUT</sub> = 100 mA   | T <sub>A</sub> = 25 °C                | 142  |      |      |
|  |   | V <sub>IN</sub> = 1.1 V, I <sub>OUT</sub> = 100 mA   | T <sub>A</sub> = 25 °C                | 270  |      |      |
| R <sub>DSC</sub>                               | Output Discharge Resistance                                     | V <sub>EN</sub> = Low, I <sub>FORCE</sub> = 10 mA, excluding GLF1120H<br>V <sub>EN</sub> = High, I <sub>FORCE</sub> = 10 mA for GLF1121L |                                       | 85   |      | Ω    |
| V <sub>IH</sub>                                | EN Input Logic High Voltage                                     | V <sub>IN</sub> = 1.1 V to 1.8 V   | 0.9                                   |      |      | V    |
| V <sub>IL</sub>                                | EN Input Logic Low Voltage                                      | V <sub>IN</sub> = 1.8 V to 5.5 V   | 1.2                                   |      |      |      |
| R <sub>EN</sub>                                | EN Internal resistance  | Internal Pull-down Resistance: GLF112xH<br>Internal Pull-up Resistance: GLF1121L   |                                       | 10   |      | MΩ   |
| I <sub>EN</sub>                                | EN Current  | V <sub>EN</sub> = 5.5 V GLF112xH Only  |                                       | 0.55 | 0.8  | μA   |
| <b>Switching Characteristics<sup>(2)</sup></b> |   |  |                                       |      |      |      |
| t <sub>dON</sub>                               | Turn-On Delay   | R <sub>L</sub> = 150 Ω, C <sub>OUT</sub> = 0.1 μF<br>GLF1121H, GLF1121HN<br>GLF1121L   |                                       | 290  |      | μs   |
| t <sub>R</sub>                                 | V <sub>OUT</sub> Rise Time                                      |  |                                       | 380  |      |      |
| t <sub>dOFF</sub>                              | Turn-Off Delay <sup>(3), (4)</sup>                              |  |                                       | 16   |      |      |
| t <sub>F</sub>                                 | V <sub>OUT</sub> Fall Time <sup>(3), (4)</sup>                  |  |                                       | 11   |      |      |
| t <sub>dON</sub>                               | Turn-On Delay   | R <sub>L</sub> = 150 Ω, C <sub>OUT</sub> = 0.1 μF<br>GLF1120H  |                                       | 290  |      |      |
| t <sub>R</sub>                                 | V <sub>OUT</sub> Rise Time                                      |  |                                       | 380  |      |      |
| t <sub>dOFF</sub>                              | Turn-Off Delay <sup>(3), (4)</sup>                              |  |                                       | 16   |      |      |
| t <sub>F</sub>                                 | V <sub>OUT</sub> Fall Time <sup>(3), (4)</sup>                  |  |                                       | 28   |      |      |

|            |                              |  |    |         |
|------------|------------------------------|--|----|---------|
| $t_{dON}$  | Turn-On Delay                | $R_L=150\ \Omega$ , $C_{OUT}=0.1\ \mu F$<br>GLF1123H | 15 | $\mu s$ |
| $t_R$      | $V_{OUT}$ Rise Time          |  | 4  |         |
| $t_{dOFF}$ | Turn-Off Delay (3), (4)      |  | 15 |         |
| $t_F$      | $V_{OUT}$ Fall Time (3), (4) |  | 11 |         |

- Notes:
1.  $I_Q$  does not include the EN pin current 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

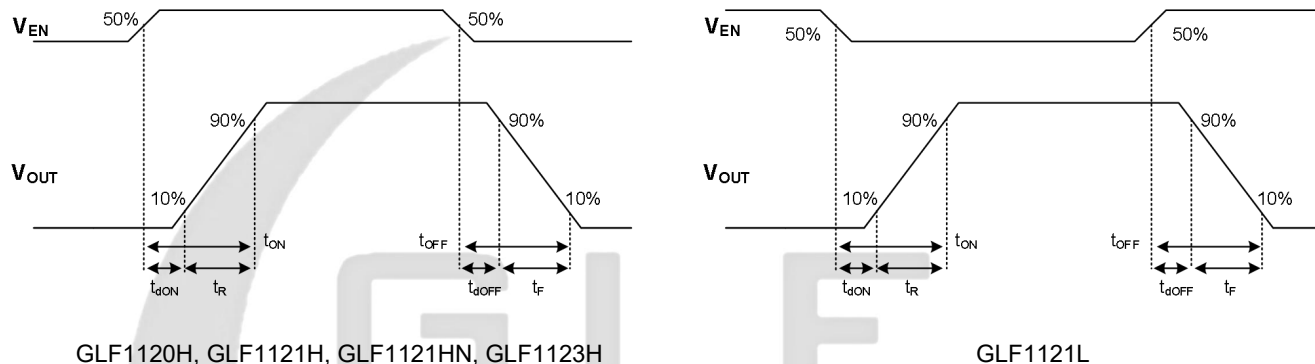


Figure 3. Timing Diagram

## TYPICAL PERFORMANCE CHARACTERISTICS

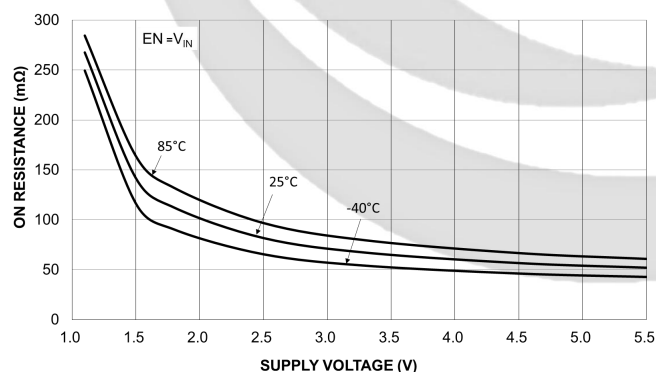


Figure 4. On-Resistance vs. Supply Voltage  
GLF112xH and GLF112xHN

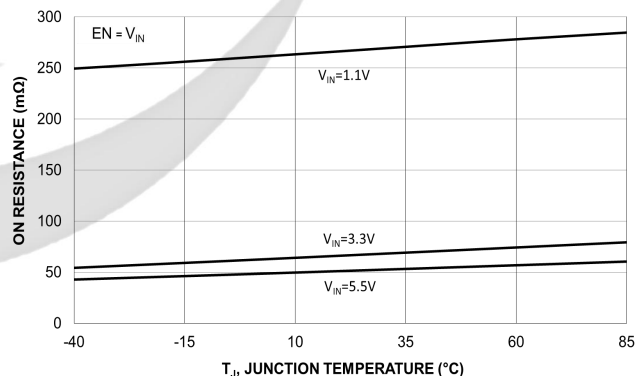
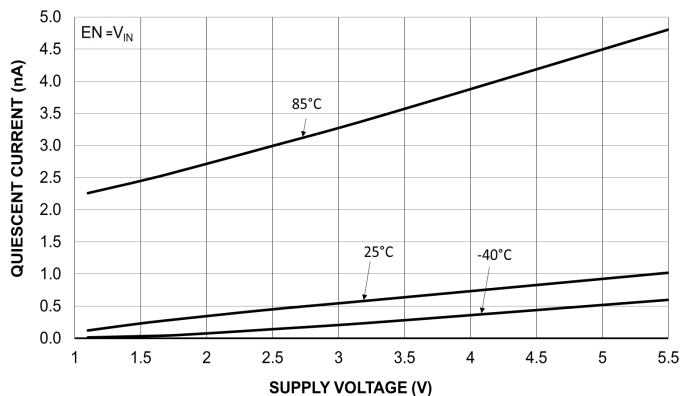
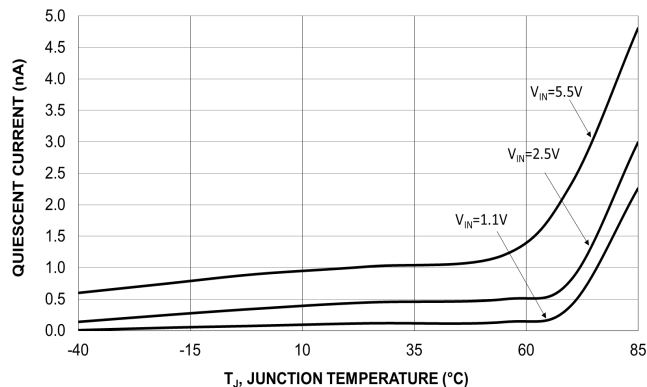


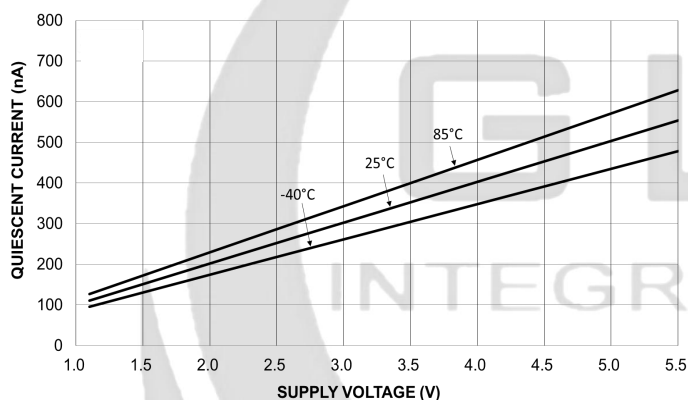
Figure 5. On-Resistance vs. Temperature  
GLF112xH and GLF112xHN



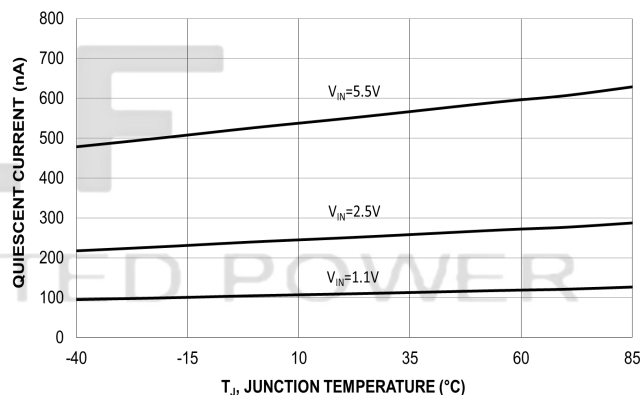
**Figure 6. Quiescent Current vs. Supply Voltage  
GLF112xH and GLF112xHN**



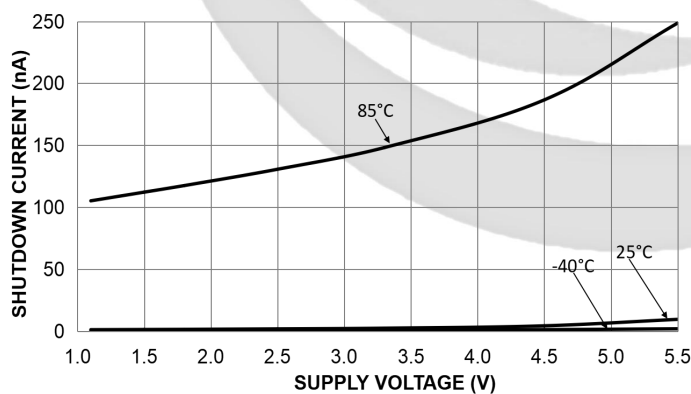
**Figure 7. Quiescent Current vs. Temperature  
GLF112xH and GLF112xHN**



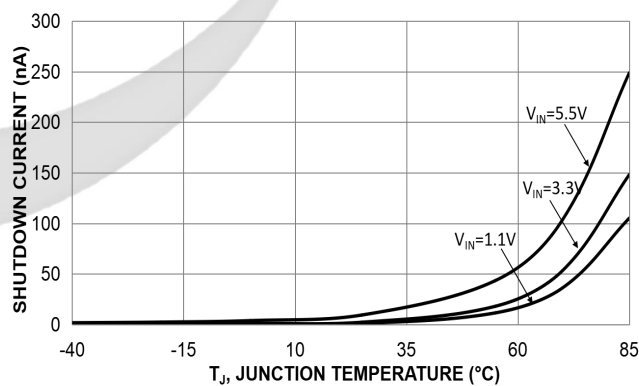
**Figure 8. Quiescent Current vs. Supply Voltage  
GLF1121L**



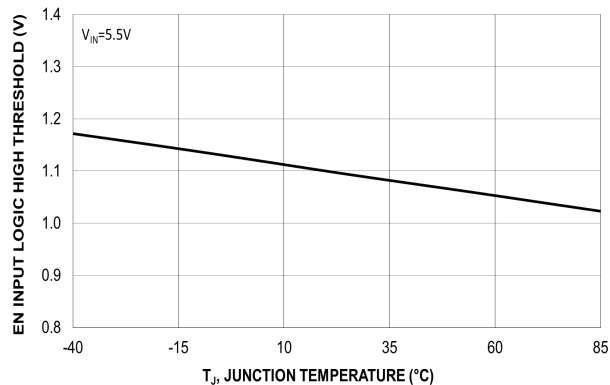
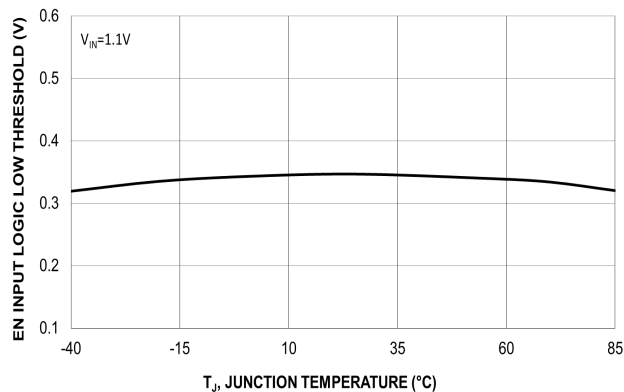
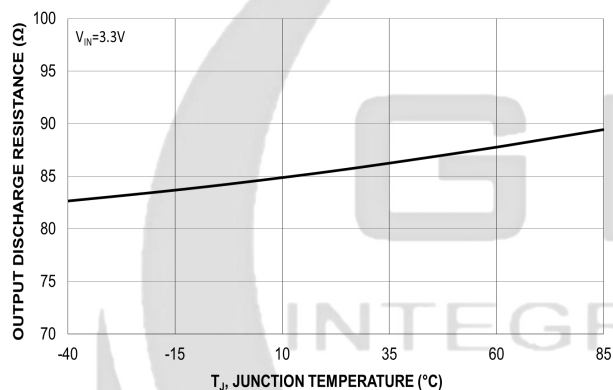
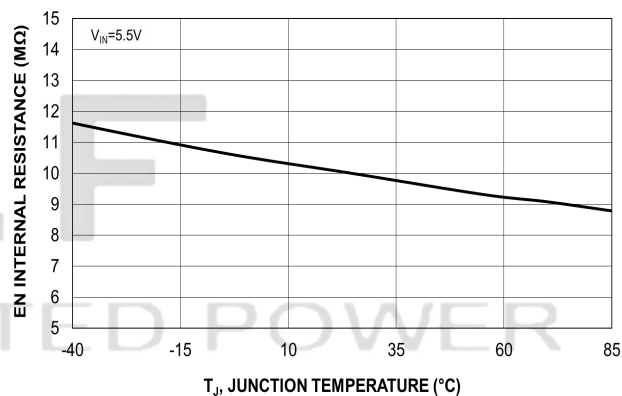
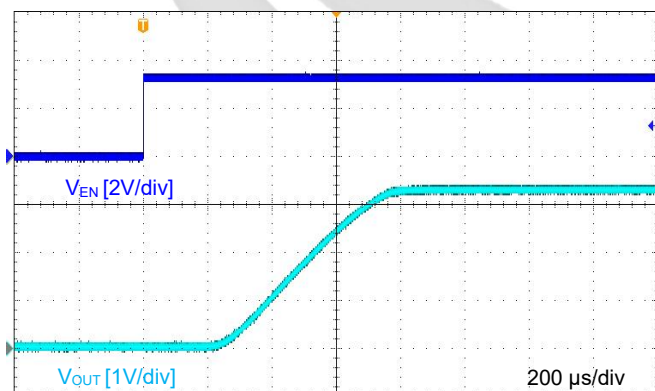
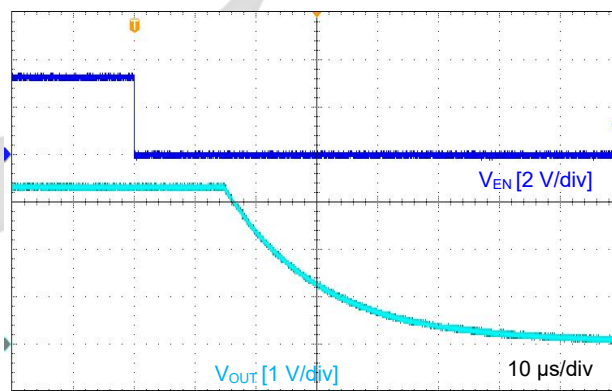
**Figure 9. Quiescent Current vs. Temperature  
GLF1121L**



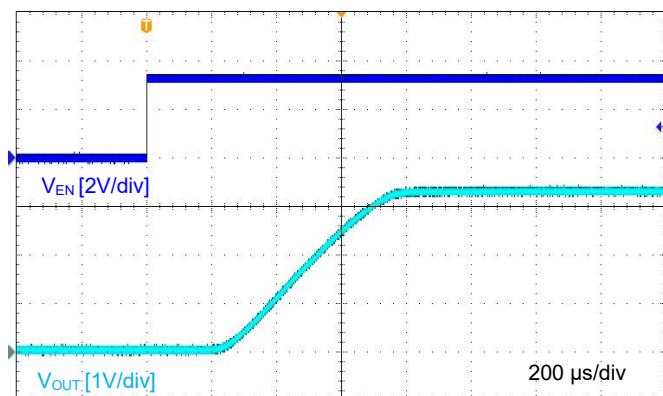
**Figure 10. Shutdown Current vs. Supply Voltage**



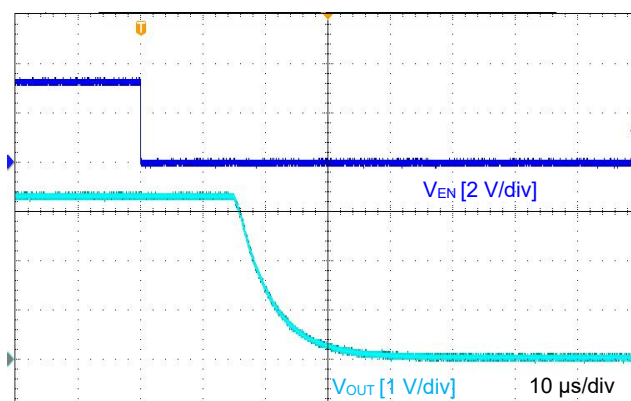
**Figure 11. Shutdown Current vs. Temperature**


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

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

**Figure 14. Output Discharge Resistance Vs. Temperature**

**Figure 15. EN Internal Resistance Vs. Temperature**

**Figure 16. Turn-On Response GLF1120H**  
 $V_{IN}=3.3\text{ V}$ ,  $C_{IN}=1.0\text{ }\mu\text{F}$ ,  $C_{OUT}=0.1\text{ }\mu\text{F}$ ,  $R_L=150\text{ }\Omega$ 

**Figure 17. Turn-Off Response, GLF1120H**  
 $V_{IN}=3.3\text{ V}$ ,  $C_{IN}=1.0\text{ }\mu\text{F}$ ,  $C_{OUT}=0.1\text{ }\mu\text{F}$ ,  $R_L=150\text{ }\Omega$

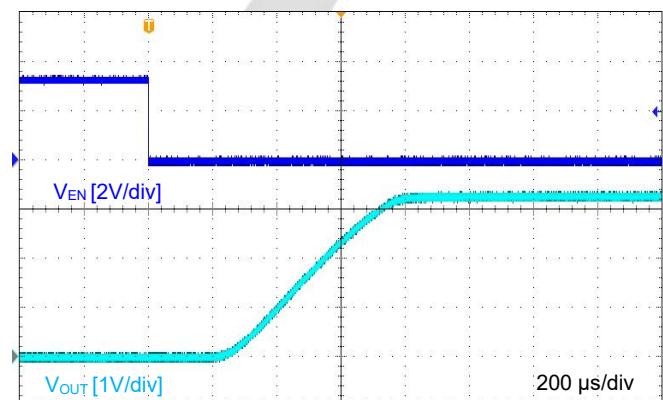




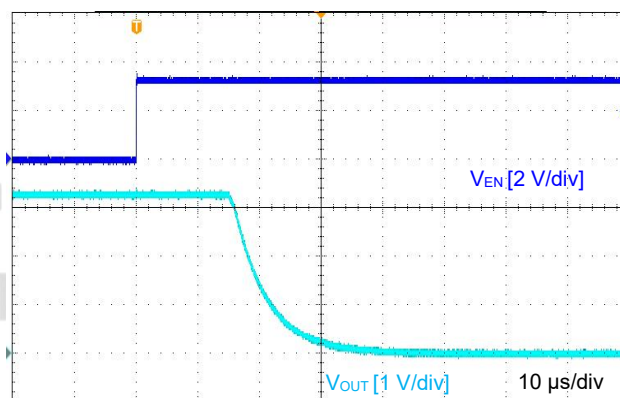
**Figure 18. Turn-On Response, GLF1121H/HH**  
 $V_{IN}=3.3\text{ V}$ ,  $C_{IN}=1.0\text{ }\mu\text{F}$ ,  $C_{OUT}=0.1\text{ }\mu\text{F}$ ,  $R_L=150\text{ }\Omega$



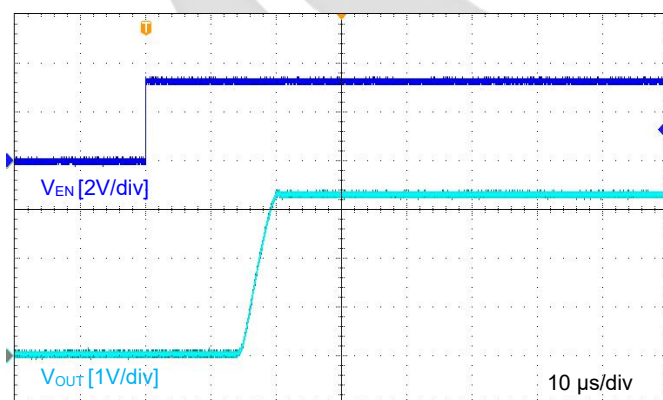
**Figure 19. Turn-Off Response, GLF1121H/HH**  
 $V_{IN}=3.3\text{ V}$ ,  $C_{IN}=1.0\text{ }\mu\text{F}$ ,  $C_{OUT}=0.1\text{ }\mu\text{F}$ ,  $R_L=150\text{ }\Omega$



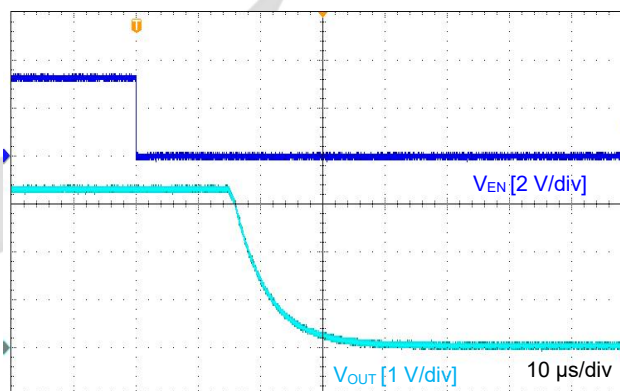
**Figure 20. Turn-On Response, GLF1121L**  
 $V_{IN}=3.3\text{ V}$ ,  $C_{IN}=1.0\text{ }\mu\text{F}$ ,  $C_{OUT}=0.1\text{ }\mu\text{F}$ ,  $R_L=150\text{ }\Omega$



**Figure 21. Turn-Off Response, GLF1121L**  
 $V_{IN}=3.3\text{ V}$ ,  $C_{IN}=1.0\text{ }\mu\text{F}$ ,  $C_{OUT}=0.1\text{ }\mu\text{F}$ ,  $R_L=150\text{ }\Omega$



**Figure 22. Turn-On Response, GLF1123H**  
 $V_{IN}=3.3\text{ V}$ ,  $C_{IN}=1.0\text{ }\mu\text{F}$ ,  $C_{OUT}=0.1\text{ }\mu\text{F}$ ,  $R_L=150\text{ }\Omega$



**Figure 23. Turn-Off Response, GLF1123H**  
 $V_{IN}=3.3\text{ V}$ ,  $C_{IN}=1.0\text{ }\mu\text{F}$ ,  $C_{OUT}=0.1\text{ }\mu\text{F}$ ,  $R_L=150\text{ }\Omega$



## APPLICATION INFORMATION

The GLF112x product family are an integrated 1 A, ultra-efficient I<sub>Q</sub>Smart™ 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 0.67 mm x 0.67 mm x 0.425 mm wafer level chip scale package, saving space in compact applications. It is constructed using 4 bumps, with 0.35 mm pitch for manufacturability.

### Input Capacitor

The GLF112x product family 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 0.1  $\mu$ F capacitor is recommended to be placed close to the VIN pin. A higher input capacitor value can be used to further attenuate the input voltage drop.

### Output Capacitor

The GLF112x product family 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<sub>OUT</sub> capacitor should be spaced close to the VOUT and GND pins.

### EN pin

The GLF112xH can be activated by forcing EN pin high level and the GLF112xL is activated by EN pin low level. Note that the EN pin of GLF112xH/L products has an internal pull-down/pull-up resistor to help pull the main switch to a known “off state” when no EN signal is applied from an external controller. The GLF1121HN does not have the internal pull-down resistor.

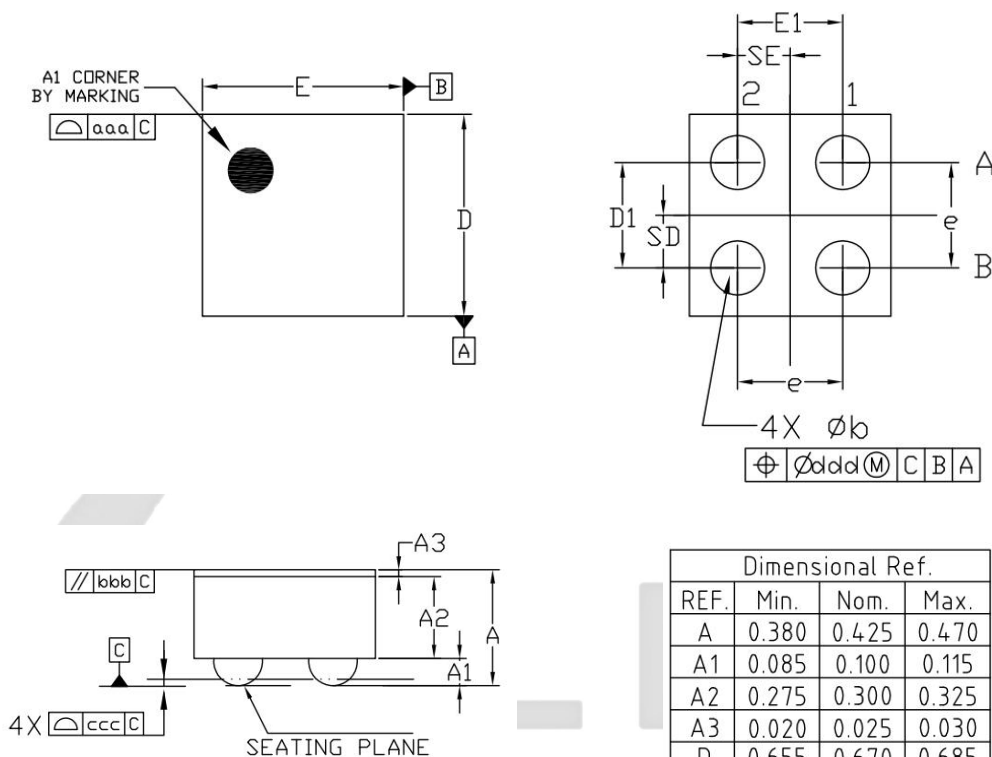
### Output Discharge Function

The GLF1121H, GLF1121HN, GLF1123H and GLF1121L 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.

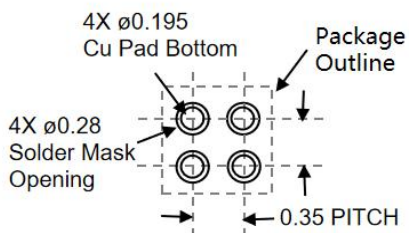
### Board Layout

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



### Recommended Footprint



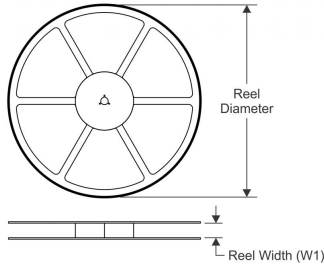
| Dimensional Ref.      |           |       |       |
|-----------------------|-----------|-------|-------|
| REF.                  | Min.      | Nom.  | Max.  |
| A                     | 0.380     | 0.425 | 0.470 |
| A1                    | 0.085     | 0.100 | 0.115 |
| A2                    | 0.275     | 0.300 | 0.325 |
| A3                    | 0.020     | 0.025 | 0.030 |
| D                     | 0.655     | 0.670 | 0.685 |
| E                     | 0.655     | 0.670 | 0.685 |
| D1                    | 0.300     | 0.350 | 0.400 |
| E1                    | 0.300     | 0.350 | 0.400 |
| b                     | 0.145     | 0.180 | 0.215 |
| e                     | 0.350 BSC |       |       |
| SD                    | 0.175 BSC |       |       |
| SE                    | 0.175 BSC |       |       |
| Tol. of Form&Position |           |       |       |
| aaa                   | 0.10      |       |       |
| bbb                   | 0.10      |       |       |
| ccc                   | 0.05      |       |       |
| ddd                   | 0.05      |       |       |

### Notes

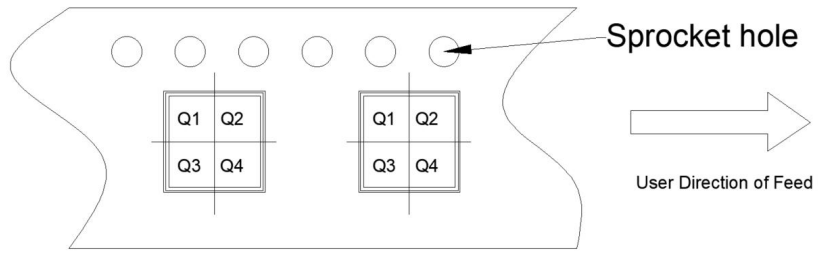
1. ALL DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES)
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
3. A3: BACKSIDE LAMINATION

## TAPE AND REEL INFORMATION

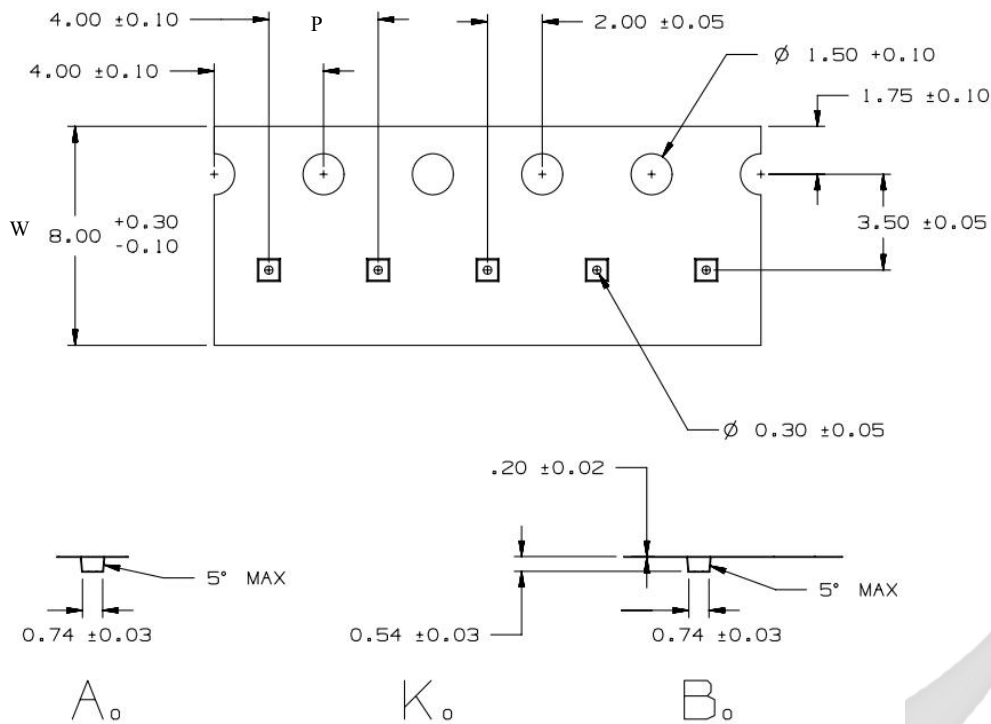
### REEL DIMENSIONS



### QUADRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE



### TAPE DIMENSIONS



| Device    | Package | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 | A0   | B0   | K0   | P | W | Pin1 |
|-----------|---------|------|------|--------------------|---------------|------|------|------|---|---|------|
| GLF1120H  | WLCSP   | 4    | 4000 | 180                | 9             | 0.74 | 0.74 | 0.54 | 4 | 8 | Q1   |
| GLF1121H  | WLCSP   | 4    | 4000 | 180                | 9             | 0.74 | 0.74 | 0.54 | 4 | 8 | Q1   |
| GLF1121HN | WLCSP   | 4    | 4000 | 180                | 9             | 0.74 | 0.74 | 0.54 | 4 | 8 | Q1   |
| GLF1121L  | WLCSP   | 4    | 4000 | 180                | 9             | 0.74 | 0.74 | 0.54 | 4 | 8 | Q1   |
| GLF1123H  | WLCSP   | 4    | 4000 | 180                | 9             | 0.74 | 0.74 | 0.54 | 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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