# GLF2365A

## Programmable High Precision Current Limit Power Switch

**Preliminary Specification**

## DESCRIPTION

The GLF2365A is an advanced technology fully integrated power switch for applications that required precision output current limitation. The GLF2365A also features a variety of protection functions, including under voltage lockout, reverse current blocking (RCB), short circuit protection, and thermal shutdown.

The GLF2365A provides a built-in output voltage slew rate control to eliminate the inrush current and voltage surge. The FLGB output pin can be used to send a fault event signal to the system controller. The integrated thermal shutdown (TSD) insures complete protection for the switch during output current limit and short circuit conditions. The GLF2365A is an ideal switch for any USB power supply.

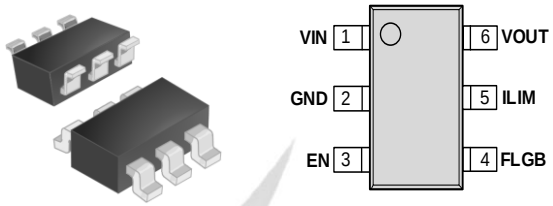
## FEATURES

- Input Range: 2.5 V to 5.5 V
- Programmable Output Constant Current Limit:
  - Range: 100 mA to 3.0 A
- Low $R_{ON}$: 56 mΩ Typ. at 5.0 $V_{IN}$
- Ultra-Low $I_Q$: 16 μA Typ. at 5.0 $V_{IN}$
- Ultra-Low $I_{SD}$: 62 nA Typ. at 5.0 $V_{IN}$
- Under Voltage Lockout Protection
- Output Voltage Slew Rate Controlled
- Reverse Current Blocking Protection
- Constant Current During Over Current
- Short Circuit Protection
- Deglitched Fault Flag Indication
- Integrated Output Discharge Switch
- Thermal Shutdown Protection

## APPLICATIONS

- Notebooks and Tablets
- Wireless LAN and Broadband Access Devices
- Storage and Peripherals
- Smart Mobile Devices

## PACKAGE




**SOT23-6L**

## DEVICE ORDERING INFORMATION

| Part Number | Top Mark | Current Limit $I_{LIM}$ | Output Discharge | Fault Flag FLGB | EN Activity | Package |
|---|---|---|---|---|---|---|
| GLF2365A-T2G7 | JK | Programmable Output Current Limit Up to 3.0 A | 93 Ω | Yes | High | SOT23-6L |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## APPLICATION DIAGRAM

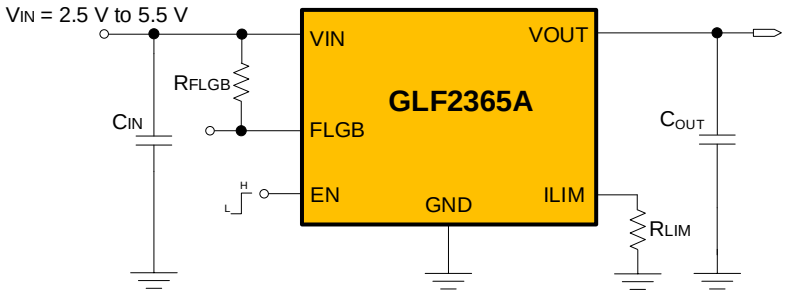


**Figure 1. Typical Application**

## FUNCTIONAL BLOCK DIAGRAM

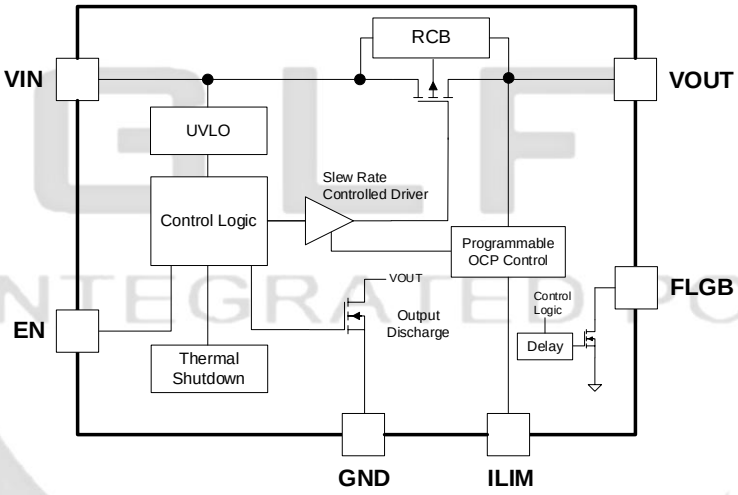


**Figure 2. Functional Block Diagram**

## PIN CONFIGURATION

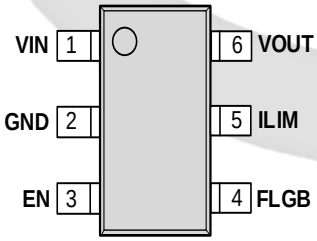


**Figure 3. Package and Pin configuration**

## PIN DEFINITION

| Pin # | Name | Description |
|---|---|---|
| 1 | VIN | Switch Input. Supply voltage for IC |
| 2 | GND | Ground |
| 3 | EN | Active high switch output enables to control the switch |
| 4 | FLGB | FLGB pin goes low to indicate OCP, SC, RCB and TSD fault conditions |
| 5 | ILIM | Programmable current limit,<br>Do not leave this pin floating |
| 6 | VOUT | Switch output |


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## 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 and 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 |
|---|---|---|---|---|---|
| $V_{IN}$, $V_{OUT}$, $V_{EN}$ | VIN, VOUT, EN to GND | | - 0.3 | 6 | V |
| $I_{OUT}$ | DC Continuous Current at $T_A$= 25 °C | | | 3.0 | A |
| $T_{STG}$ | Storage Temperature | | - 65 | 150 | °C |
| $T_J$ | Maximum Junction Temperature | | | 150 | °C |
| $T_A$ | Operating Ambient Temperature | | - 40 | 85 | °C |
| $\theta_{JA}$ | Thermal Resistance, Junction to Ambient | | | 100 | °C/W |
| ESD | Electrostatic Discharge Capability | Human Body Model, JESD22-A114 | ± 8 | | kV |
| | | Charged Device Model, JESD22-C101 | ± 0.5 | | |

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min. | Max. | Unit |
|---|---|---|---|---|
| $V_{IN}$ | Supply Voltage | 2.5 | 5.5 | V |
| $T_A$ | Operating Ambient Temperature | - 40 | + 85 | °C |

## ELECTRICAL CHARACTERISTICS

Values are at $V_{IN}$ = 5.0 V and $T_A$ = 25 °C. Unless otherwise noted

| Symbol | Parameter | Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| **Basic Operation** | | | | | | | |
| $I_Q$ | Quiescent Current | EN = Enable, $I_{OUT}$ = 0 mA | | | 16 | 25 | μA |
| $I_{SD}$ | Shutdown Current | EN = Disable, $I_{OUT}$ = 0 mA | | | 62 | 100 | nA |
| $R_{ON}$ | On-Resistance | $V_{IN}$ = 5.0 V, $I_{OUT}$ = 500 mA | $T_A$ = 25 °C | | 56 | 60 | mΩ |
| | | | $T_A$ = 85 °C (1) | | 61 | | |
| | | $V_{IN}$ = 3.3 V, $I_{OUT}$ = 500 mA | $T_A$ = 25 °C | | 62 | 65 | |
| | | | $T_A$ = 85 °C (1) | | 67 | | |
| $R_{DSC}$ | Output Discharge Resistance | EN = Disable , $I_{FORCE}$ = 10 mA | | | 93 | | Ω |
| $V_{IH}$ | EN Input Logic High Voltage | $V_{IN}$ = 2.5 V to 5.5 V | | 1.2 | | | V |
| $V_{IL}$ | EN Input Logic Low Voltage | $V_{IN}$ = 2.5 V to 5.5 V | | | | 0.6 | V |
| $V_{FLGB}$ | FLGB Output Low Voltage | $I_{FLGB}$ = 0.5 mA | | | | 50 | mV |
| $I_{FLGB}$ | FLGB Output High Leakage | $V_{FLGB}$ = 5.5 V | | | 6 | | nA |
| $t_{FLGB}$ | FLGB Output Delay Time (1) | Delay Time for Assertion at Over - Current | | | 8.5 | | ms |
| | | Delay Time for Assertion at Short Circuit and Thermal Shutdown Conditions | | | 255 | | μs |


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## ELECTRICAL CHARACTERISTICS (CONTINUED)

Values are at $V_{IN}$ = 5.0 V and $T_A$ = 25 °C. Unless otherwise noted

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Protection | | | | | | |
| $V_{UVLO}$ | Under Voltage Lockout Voltage | Input Rising | | 2.3 | | V |
| | | Input Falling | | 2.1 | | V |
| $I_{LIM}$ | Over Current Limit Threshold | $R_{LIM}$ = 5.1 kΩ | | 2.3 | | A |
| $V_{RCB_TH}$ | Reverse Current Blocking Protection Trip Voltage | $V_{OUT}$ - $V_{IN}$ | | 23 | | mV |
| $V_{RCB_RL}$ | Reverse Current Blocking Protection Release Voltage | $V_{IN}$ - $V_{OUT}$ | | 50 | | |
| $I_{RCB}$ | Reverse Current Blocking Protection Leakage | $V_{OUT}$ - $V_{IN}$ > $V_{RCB}$ | | | 1 | µA |
| TSD | Thermal Shutdown (1) | | | 140 | | °C |
| | Thermal Shutdown Hysteresis (1) | | | 20 | | |
| **Switching Characteristics** (1) (2) | | | | | | |
| $t_{dON}$ | Turn-On Delay | $R_{OUT}$ = 150 Ω, $C_{OUT}$ = 1.0 µF | | 160 | | µs |
| $t_R$ | $V_{OUT}$ Rise Time | | | 580 | | |
| $t_{dOFF}$ | Turn-Off Delay | | | 13 | | |
| $t_F$ | $V_{OUT}$ Fall Time | | | 130 | | |

**Notes:** 1. By design; characterized; not production tested.
2. Switching Timing Diagram.

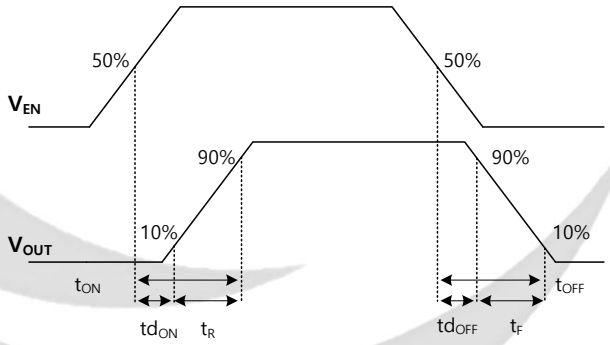


**Figure 4. Switching Timing Diagram**


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## TYPICAL PERFORMANCE CHARACTERISTICS

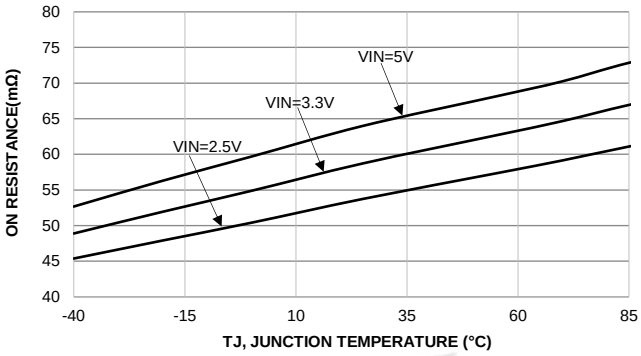


**Figure 5. On-Resistance vs. Temperature**

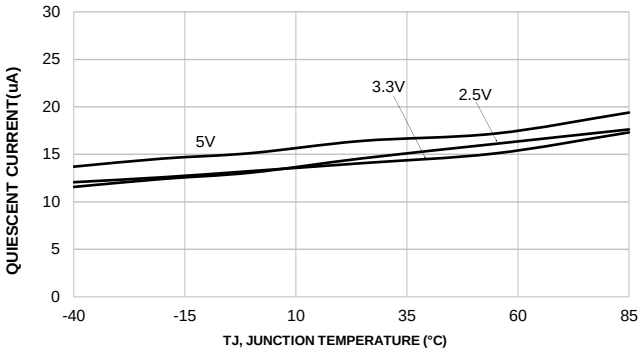


**Figure 6. Quiescent Current vs. Temperature**

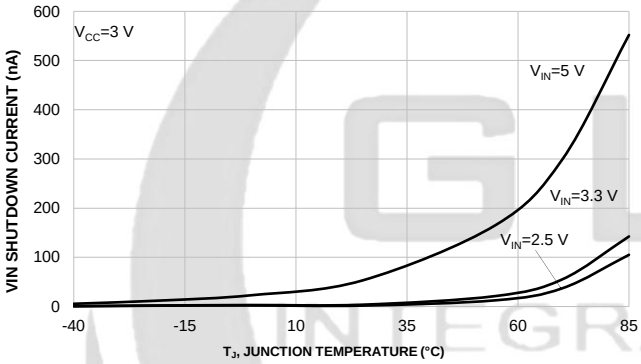


**Figure 7. Shutdown Current vs. Temperature**

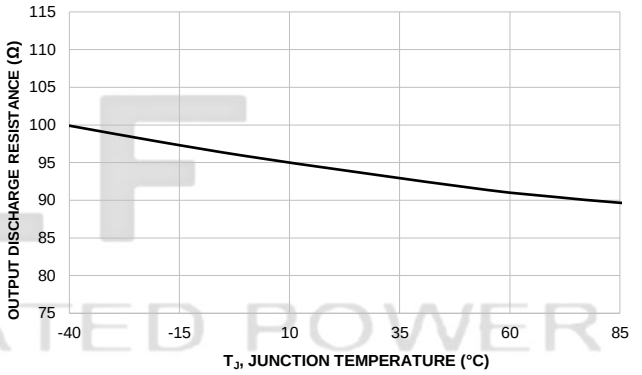


**Figure 8. Output Discharge Resistance vs. Temperature**

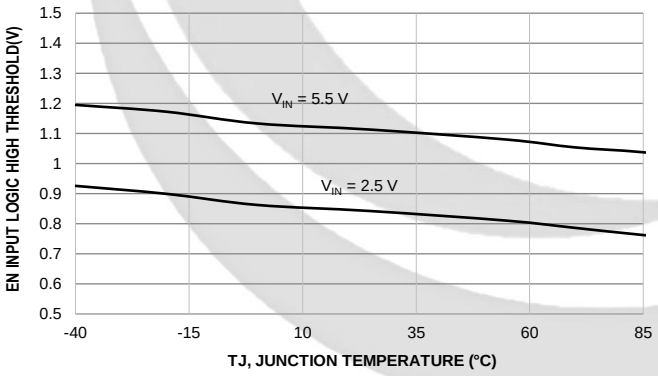


**Figure 9. EN Input Logic High Threshold**

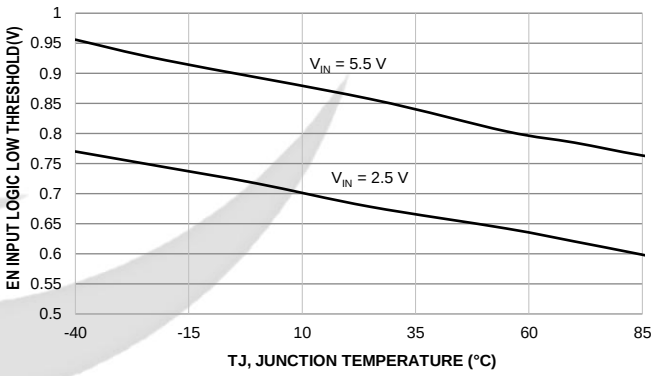


**Figure 10. EN Input Logic Low Threshold**


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## TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

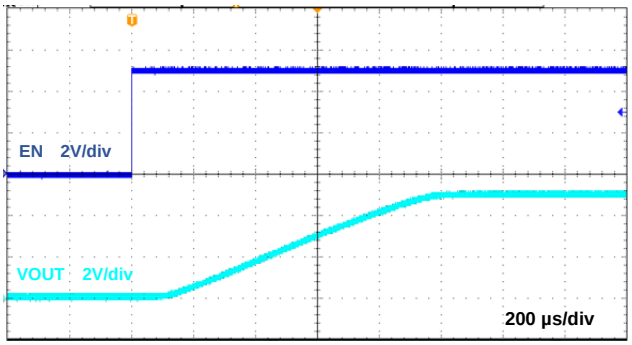


Figure 11. Turn-On Response
$V_{IN}$=5.0 V, $C_{IN}$=1.0 µF, $C_{OUT}$=1.0 µF, $R_L$=150 Ω

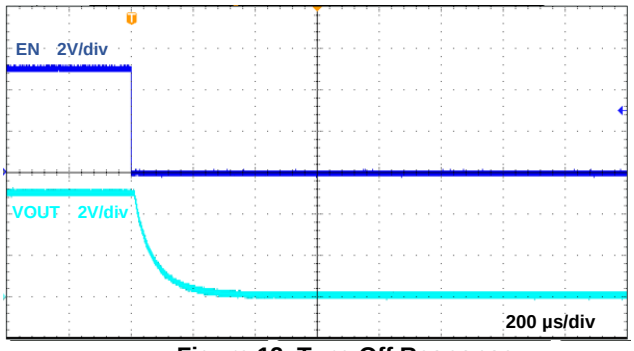


Figure 12. Turn-Off Response
$V_{IN}$=5.0 V, $C_{IN}$=1.0 µF, $C_{OUT}$=1.0 µF, $R_L$=150 Ω

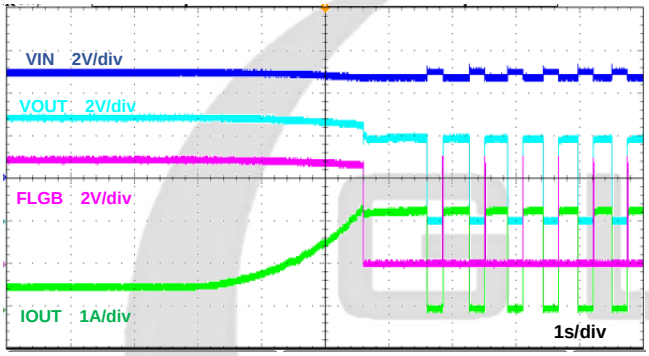


Figure 13. Current Limit Response
$V_{IN}$=5.0 V, $C_{IN}$=1.0 µF, $C_{OUT}$=1.0 µF

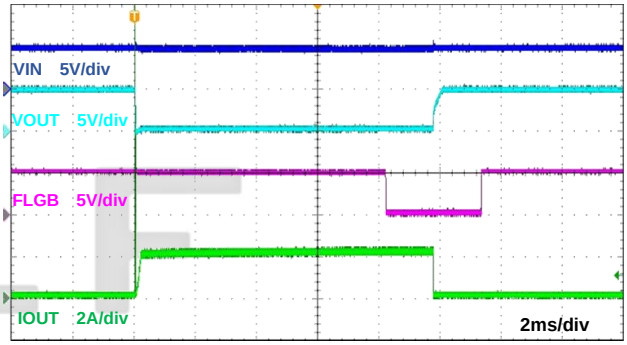


Figure 14. Short Circuit Response
$V_{IN}$=5.0 V, $C_{IN}$=1.0 µF, $C_{OUT}$=1.0 µF, $R_L$=0 Ω

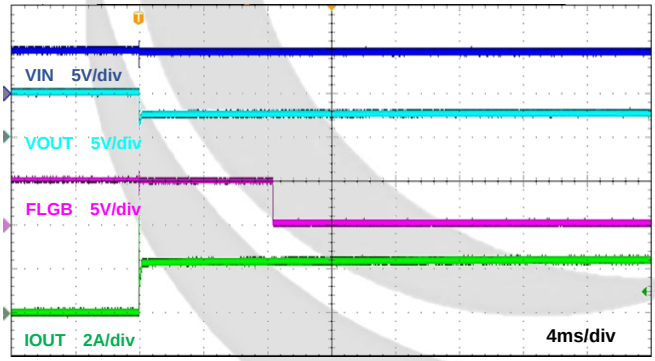


Figure 15. FLGB Response
$V_{IN}$=5.0 V, $C_{IN}$=1.0 µF, $C_{OUT}$=1.0 µF

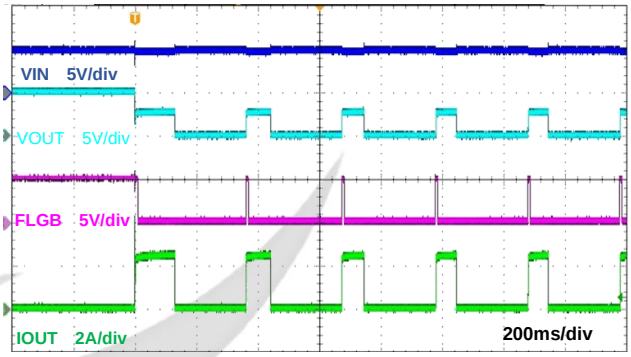


Figure 16. OTP Response
$V_{IN}$=5.0 V, $C_{IN}$=1.0 µF, $C_{OUT}$=1.0 µF

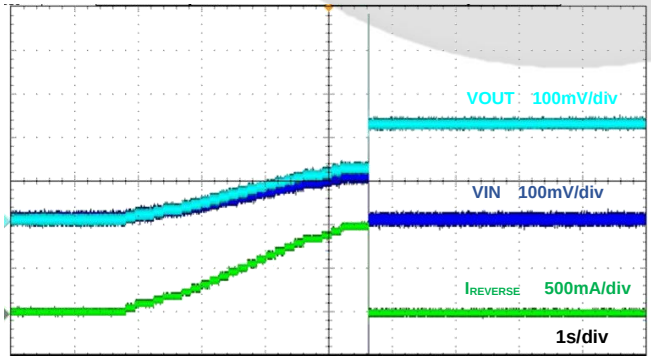


Figure 17. Reverse Current Blocking Threshold
$V_{IN}$=5 V, $V_{OUT}$=Up to 5.1 V, $C_{IN}$=1.0 µF, $C_{OUT}$=1.0 µF

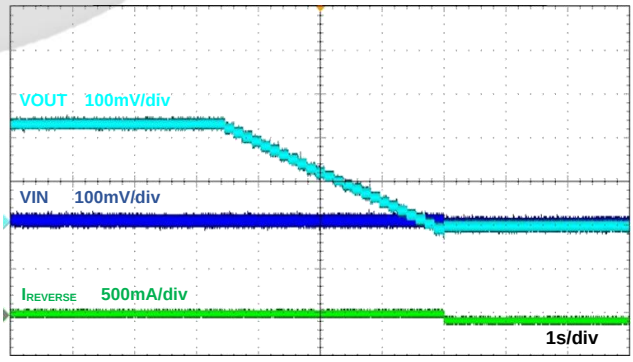


Figure 18. Reverse Current Blocking Release
$V_{IN}$=5 V, $V_{OUT}$=Up to 5.1 V, $C_{IN}$=1.0 µF, $C_{OUT}$=1.0 µF


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## APPLICATION INFORMATION

The GLF2365A is an advanced fully integrated power switch for applications that required precision output current limitation. It also features various protection functions, such as under voltage lockout, reverse current blocking (RCB), short circuit protection, and thermal shutdown.

### Over Current and Short Circuit Protection

When the GLF2365A is enabled by applying a high-level $V_{EN}$ voltage, the current limiting circuit begins to monitor the output current. When the load current reaches the over current limit threshold (set by the external $R_{LIM}$ resistor) and the duration exceeds 100μs, the device will enter over current protection, at which point the output current will be clamped to a constant current state close to the preset current limit threshold level. It is recommended to use a resistor with 1% accuracy. The trace of the $R_{LIM}$ resistor should be kept as short as possible to minimize the impact of parasitic effects on the current limit accuracy. When the device operates under over current protection, the device power consumption will increase, and the junction temperature will rise. If the device's junction temperature exceeds the OTP (over-temperature protection) threshold of 140°C, the GLF2365A will immediately shutdown and resume normal output when the junction temperature falls below the OTP hysteresis value. The short circuit protection will take action immediately to shut down the device when a short circuit on the output node is detected and the $V_{OUT}$ falls lower than [ 0.45 x $V_{IN}$ ]. After the short circuit protection is triggered, the device will turn off and check if the short condition remains. The output current is limited to a preset current limit value if the VOUT short condition still exists. Figure 19 and table 1 below show the over current limit threshold and clamp level of GLF2365A. In addition, the over current limit threshold can also be roughly calculated using this formula: **$I_{LIM}$ (A)=12500 / $R_{LIM}$ (Ω).**

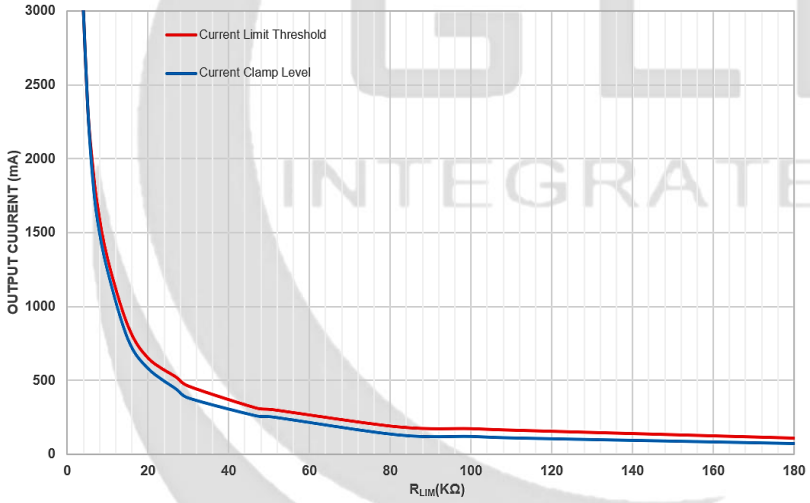


**Figure 19. Current Limit Threshold and Current Clamp vs. $R_{LIM}$**

| $R_{LIM}$ (kΩ) | Current Limit Threshold (mA) | Current Clamp Level (mA) |
|---|---|---|
| | Typ. | Typ. |
| 3.9 | 3060 | 3060 |
| 5.1 | 2340 | 2340 |
| 6.2 | 1980 | 1900 |
| 7.5 | 1680 | 1580 |
| 10 | 1320 | 1240 |
| 15 | 870 | 780 |
| 20 | 650 | 580 |
| 27 | 520 | 440 |
| 30 | 460 | 380 |
| 47 | 310 | 258 |
| 51 | 300 | 251 |
| 82 | 184 | 130 |
| 100 | 172 | 120 |
| 110 | 162 | 110 |
| 180 | 108 | 72 |

**Table 1. Current Limit Level by $R_{LIM}$**

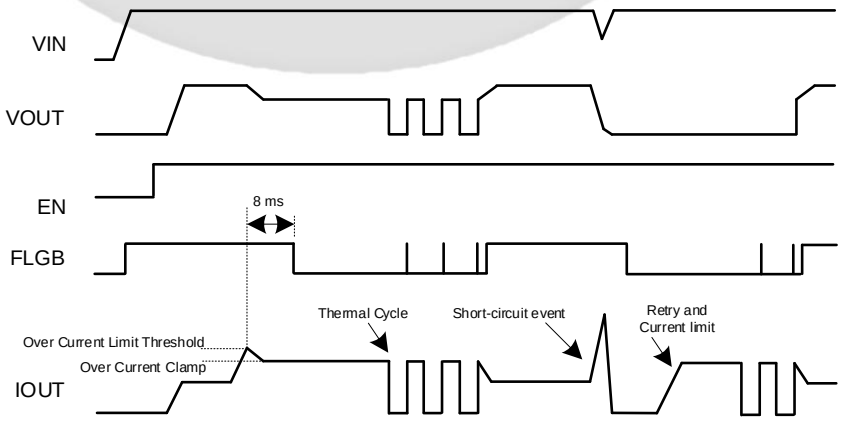


**Figure 20. Over Current and Short Circuit Protection**


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## Fault Flag Response

The output of the open drain FLGB pin will pull down to GND during any of the following fault conditions: output current limit, output short circuit, reverse current blocking, or thermal shutdown. The GLF2365A uses an internal 8 millisecond fading delay for current limit conditions and a 120 microsecond delay for short circuit and thermal conditions to avoid false FLGB reporting. The FLGB output remains low until the overcurrent or overtemperature condition is removed.

## Reverse Current Blocking

The GLF2365A has 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 the reverse current blocking protection threshold voltage ($V_{RCB_TH}$), the reverse current blocking function block turns off the switch. Note that some reverse current can occur until the $V_{RCB_TH}$ is triggered. The main switch will resume normal operation when the output voltage drops below the input source by the reverse current blocking protection release voltage ($V_{RCB_RL}$).

## Input and Output Capacitor

A capacitor is recommended to be placed close to the VIN 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. An output capacitor is recommended to minimize voltage undershoot on the output pin during the transition 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 COUT capacitor should be placed close to the VOUT and GND pins.


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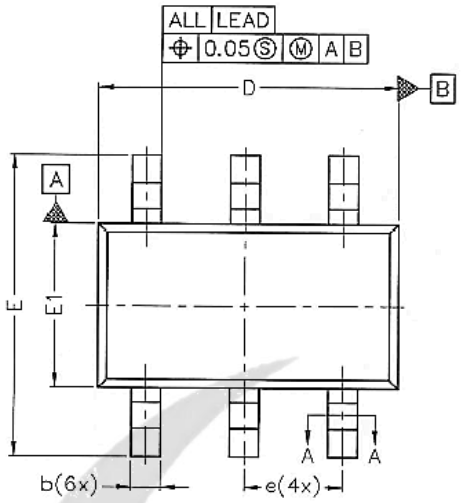
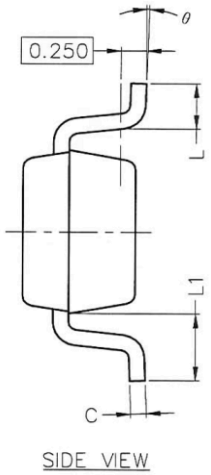
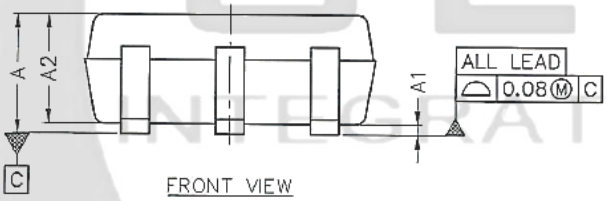
## PACKAGE OUTLINE

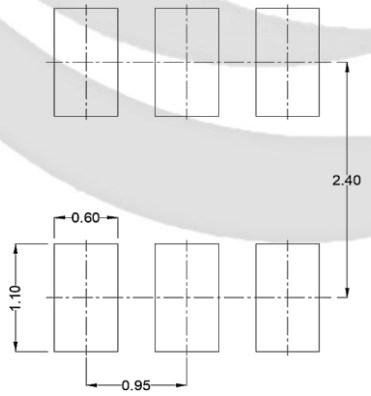



| REF. | Dimensions Ref. | | |
|---|---|---|---|
| | Min. | Nom. | Max. |
| A | - | - | 1.25 |
| A1 | 0.03 | 0.08 | 0.15 |
| A2 | 1.05 | 1.10 | 1.15 |
| b | 0.27 | - | 0.35 |
| b1 | 0.26 | 0.285 | 0.31 |
| c | 0.135 | - | 0.23 |
| c1 | 0.127 | 0.152 | 0.178 |
| D | 2.82 | 2.92 | 3.02 |
| E | 2.60 | 2.90 | 3.00 |
| E1 | 1.50 | 1.62 | 1.70 |
| e | 0.95 BSC | | |
| e1 | 1.90 BSC | | |
| L | 0.35 | 0.45 | 0.55 |
| L1 | 0.49 | 0.64 | 0.79 |
| θ | 0° | - | 8° |

### Recommended Footprint




## PACKAGING INFORMATION

| Part Number | Package | Pins | Pitch | Top Mark | Moisture Sensitivity Level | Environmental Information |
|---|---|---|---|---|---|---|
| GLF2365A-T2G7 | SOT23-6L | 6 | 0.95mm | JK | MSL3 | ROHS+HF |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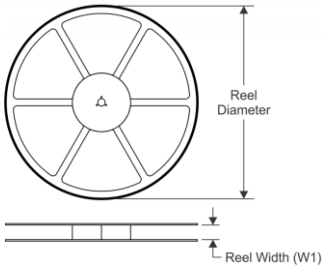
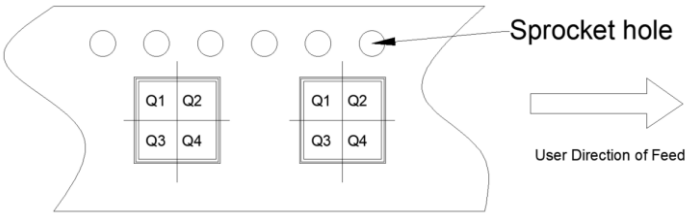
# TAPE AND REEL INFORMATION

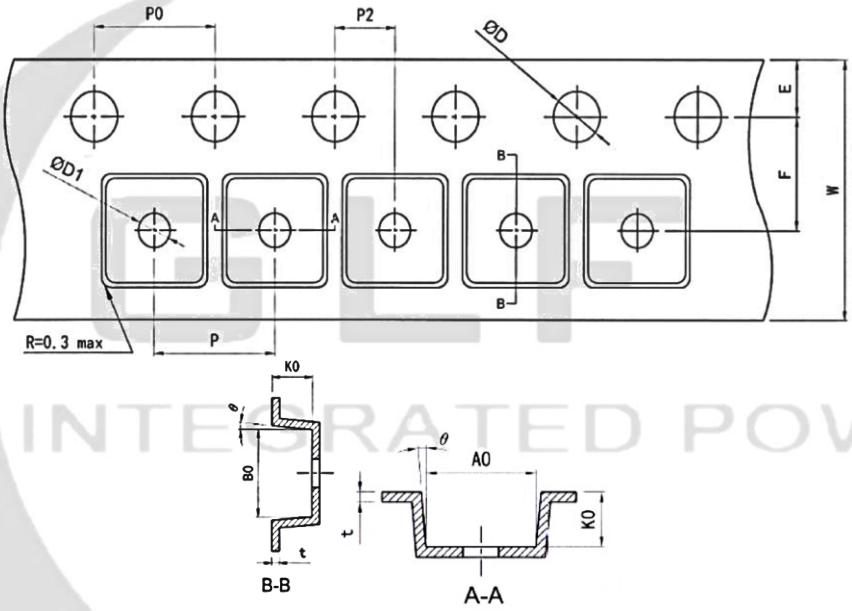
## REEL DIMENSIONS




## QUADRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE




## TAPE DIMENSIONS




| Device | Package | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 | A0 | B0 | K0 | P | W | Pin1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GLF2365A-T2G7 | SOT23-6L | 6 | 3000 | 178 | 9 | 3.26 | 3.23 | 1.05 | 4 | 8 | Q3 |

Remark:

A0: Dimension designed to accommodate the component width

B0: Dimension designed to accommodate the component length

K0: Dimension designed to accommodate the component thickness

W: Overall width of the carrier tape

P1: Pitch between successive cavity centers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## SPECIFICATION DEFINITIONS

| Document Type | Meaning | Product Status |
|---|---|---|
| Target Specification | This is a target specification intended to support exploration and discussion of critical needs for a proposed or target device. Parameters including the typical, minimum, and maximum values are desired, or target. GLF reserves the right to change contents at any time without warning or notification. A target specification will not guarantee the future production of the device. | Design / Development |
| Preliminary Specification | This is a draft version of a product specification which is under internal review and subject to change. GLF reserves the right to change the specification at any time without warning or notification. A preliminary specification will not guarantee the future production of the device. | Qualification |
| Product Specification | This document represents the characteristics of the device. | Production |

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