GLF1592T, GLF1593T, GLF1593LT

2 A Low Input Voltage Power Load Switch

Preliminary Specification

DESCRIPTION

The GLF1592T, GLF1593T and GLF1593LT are fully integrated 2 A N-channel load switches. The device is ideal for the mobile computing and data storage markets as a high-performance solution for load switch applications.

The GLF1592T, GLF1593T and GLF1593LT support ultra-low VIN range applications, with an input supply voltage range of 0.6 V to 5.5 V and does not require another additional power supply.

The GLF1592T, GLF1593T and GLF1593LT are available in ultra-thin wafer level chip scale package (WLCSP) measuring 0.67 mm x 1.02 mm x 0.35 mm with a 0.35 mm pitch. This helps user to save board space.

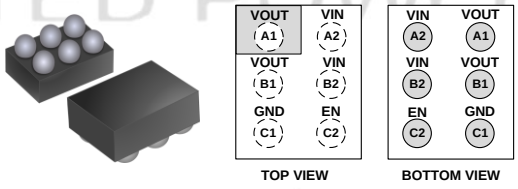
FEATURES

- Wide Input Voltage Range, V_{IN}: 0.6 V to 5.5 V
- Low On-Resistance, R_{ON}: 24 mΩ at 3.3 V_{IN}
- 2.0 A Maximum Continuous Output Current
- Low Quiescent Current, I_Q
  - 2.5 µA at V_{IN} = 0.6 V
  - 16 µA at V_{IN} = 3.3 V
- Low Shutdown Current, I_{SD}
  - 8 nA at V_{IN} = 0.6 V
  - 10 nA at V_{IN} = 3.3 V
- Output Discharge Switch:
  - Only GLF1593T and GLF1593LT
- Reverse Current Blocking When Disabled
- Operating Temperature Range
  - 40 °C to + 85 °C

APPLICATIONS

- Smart doorbell
- Wearables
- Low Power Subsystems
- Portable device

PACKAGE



0.67 mm x 1.02 mm x 0.35 mm Thin WLCSP

APPLICATION DIAGRAM

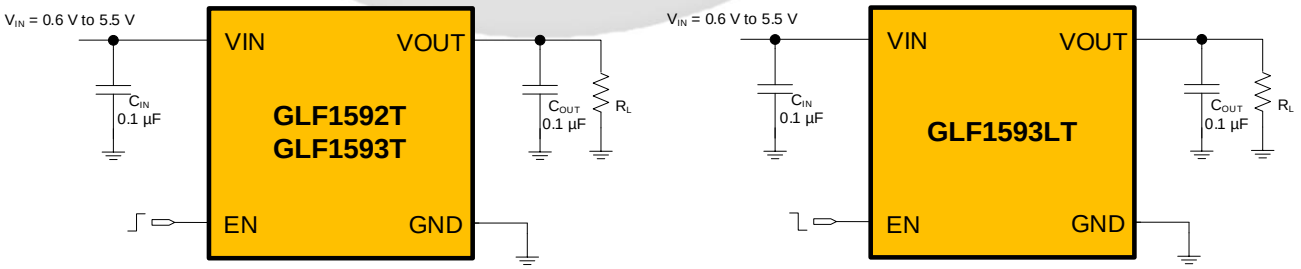


Figure 1. Application diagram

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DEVICE ORDERING INFORMATION

Part Number	Top Mark	R_{ON} (Typ.) at 3.3 V_{IN}	Output Discharge (Typ.)	EN Activity	Package
GLF1592T-S97	GW	24 mΩ	NA	High	0.67 mm x 1.02 mm x 0.35 mm Thin WLCSP
GLF1593T-S97	FY		150 Ω	High	
GLF1593LT-S97	GY			Low	

FUNCTIONAL BLOCK DIAGRAM

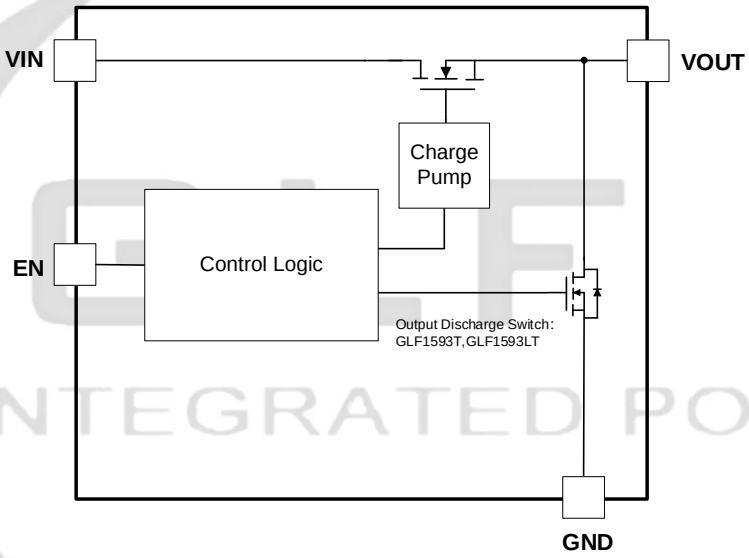

Figure 2. Functional Block Diagram

PIN CONFIGURATION

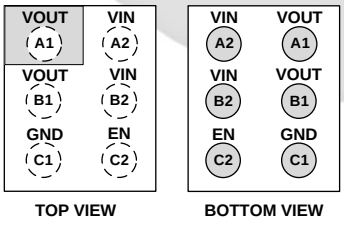

Figure 3. 0.67 mm x 1.02 mm x 0.35 mm Thin WLCSP

PIN DEFINITION

Pin #	Name	Description
A1, B1	VOUT	Switch Output
A2, B2	VIN	Switch Input.
C1	GND	Ground
C2	EN	Enable to control the switch

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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; 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 Output Current			2	A
T_{STG}	Storage Temperature		- 65	150	°C
T_J	Maximum Junction Temperature			150	°C
T_A	Operating Ambient Temperature Range		- 40	+85	°C
θ_{JA}	Thermal Resistance, Junction to Ambient			80	°C/W
ESD	Electrostatic Discharge Capability	Human Body Model, JESD22-A114	± 2		kV
		Charged Device Model, JESD22-C101	± 2		

ELECTRICAL CHARACTERISTICS

V_{IN} = 3.3 V, C_{IN} = 1μF, C_{OUT} = 0.1μF, T_A = 25 °C. Unless otherwise noted

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
Basic Operation							
I_Q	Quiescent Current	EN = Enable, V_{IN} = 0.6 V, I_{OUT} = 0 mA			2.5		μA
		EN = Enable, V_{IN} = 3.3 V, I_{OUT} = 0 mA			16	20	
		EN = Enable, V_{IN} = 5.5 V, I_{OUT} = 0 mA	T_A = 25 °C		39	52	
			T_A = 85 °C (2)		45		
I_{SD}	Shutdown Current	EN = Disable, V_{IN} = 0.6 V, I_{OUT} = 0 mA			8		nA
		EN = Disable, V_{IN} = 3.3 V, I_{OUT} = 0 mA			10		
		EN = Disable, V_{IN} = 5.5 V, I_{OUT} = 0 mA	T_A = 25 °C		15	50	
			T_A = 85 °C (2)		500		
R_{ON}	On-Resistance	V_{IN} = 0.6 V, I_{OUT} = 200 mA	T_A = 25 °C		27	40	mΩ
			T_A = 85 °C (2)		34		
		V_{IN} = 3.3 V, I_{OUT} = 200 mA	T_A = 25 °C		24	32	
			T_A = 85 °C (2)		29		
		V_{IN} = 5.5 V, I_{OUT} = 200 mA	T_A = 25 °C		26	35	
			T_A = 85 °C (2)		30		
R_{DSC}	Output Discharge Resistance	GLF1593T, GLF1593LT	V_{IN} = 0.6 V to 1.5 V, EN = Disable, I_{FORCE} = 10 mA			5k	Ω
			V_{IN} = 1.5 V to 5.5 V, EN = Disable, I_{FORCE} = 10 mA	100	150	200	
I_{EN}	EN Pin Leakage	V_{EN} = 5.5 V			4		nA
V_{IH}	EN Input Logic High Voltage	V_{IN} = 0.6 V to 1.5 V		0.6			V
		V_{IN} = 1.5 V to 5.5 V		1			
V_{IL}	EN Input Logic Low Voltage	V_{IN} = 0.6 V to 1.5 V				0.1	
		V_{IN} = 1.5 V to 5.5 V				0.2	
Switching Characteristics (1), (2)							
t_{dON}	Turn-On Delay	V_{IN} = 0.6 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 μF			299		μs
t_R	V_{OUT} Rise Time				295		
t_{dOFF}	Turn-Off Delay				44		
t_F	V_{OUT} Fall Time	V_{IN} = 0.6 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 μF, GLF1593T and GLF1593LT			20		
t_F	V_{OUT} Fall Time	V_{IN} = 0.6 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 μF, GLF1592T			27		

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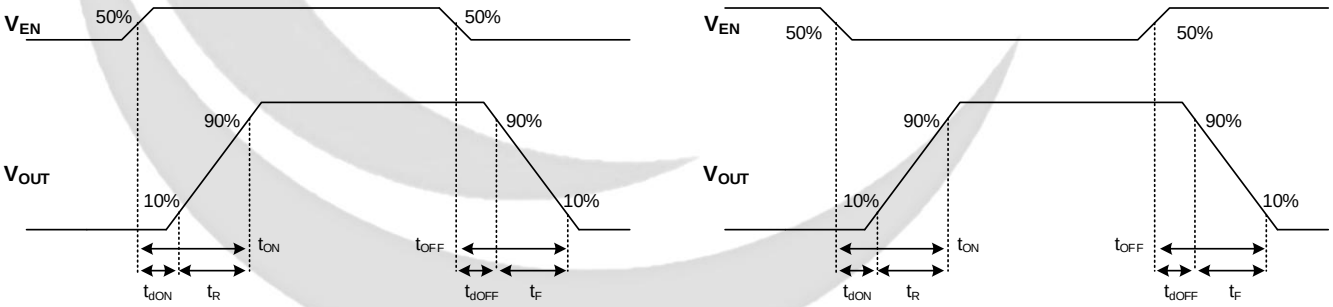
ELECTRICAL CHARACTERISTICS (CONTINUED)

V_{IN} = 3.3 V, C_{IN}=1µF, C_{OUT}=0.1µF, T_A = 25 °C. Unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Switching Characteristics (1), (2)						
t_{dON}	Turn-On Delay	V_{IN} = 2.5 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 µF		110		µs
t_R	V_{OUT} Rise Time			377		
t_{dOFF}	Turn-Off Delay			4.3		
t_F	V_{OUT} Fall Time	V_{IN} = 2.5 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 µF, GLF1593T and GLF1593LT		14		
t_F	V_{OUT} Fall Time	V_{IN} = 2.5 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 µF, GLF1592T		28		
t_{dON}	Turn-On Delay	V_{IN} = 3.3 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 µF		115		µs
t_R	V_{OUT} Rise Time			423		
t_{dOFF}	Turn-Off Delay			3.6		
t_F	V_{OUT} Fall Time	V_{IN} = 3.3 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 µF, GLF1593T and GLF1593LT		14.2		
t_F	V_{OUT} Fall Time	V_{IN} = 3.3 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 µF, GLF1592T		29		
t_{dON}	Turn-On Delay	V_{IN} = 5.5 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 µF		87		µs
t_R	V_{OUT} Rise Time			440		
t_{dOFF}	Turn-Off Delay			2.7		
t_F	V_{OUT} Fall Time	V_{IN} = 5.5 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 µF, GLF1593T and GLF1593LT		14.5		
t_F	V_{OUT} Fall Time	V_{IN} = 5.5 V, R_{OUT} = 150 Ω, C_{OUT} = 0.1 µF, GLF1592T		30		

Notes: 1. $t_{ON} = t_{dON} + t_R$, $t_{OFF} = t_{dOFF} + t_F$
2. By design; characterized, not production tested



GLF1592T and GLF1593T **GLF1593LT**

Figure 4. Timing Diagram

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TYPICAL PERFORMANCE CHARACTERISTICS

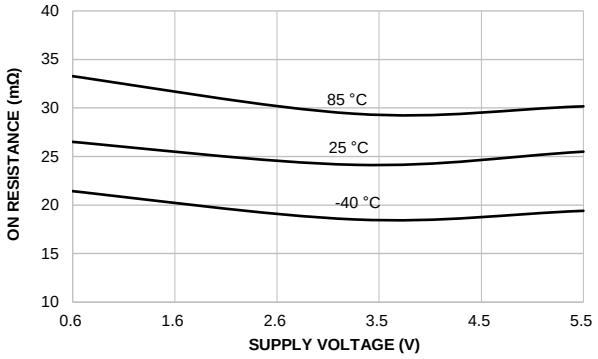

Figure 5. On-Resistance vs. Supply Voltage

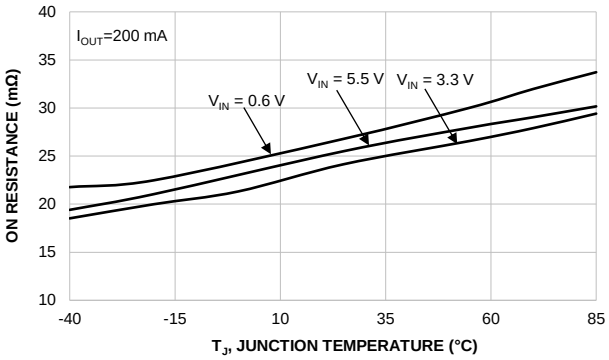

Figure 6. On-Resistance vs. Temperature

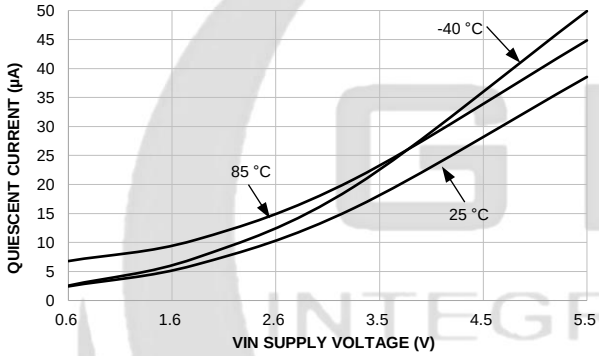

Figure 7. Quiescent Current vs. Supply Voltage

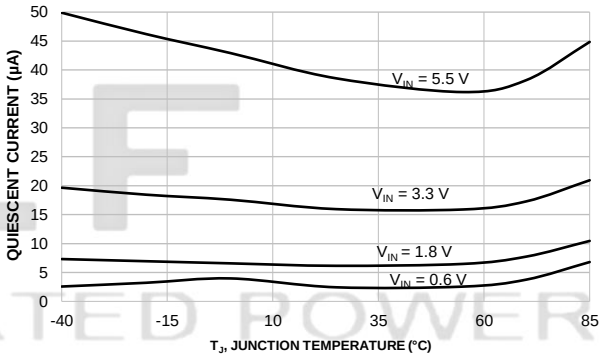

Figure 8. Quiescent Current vs. Temperature

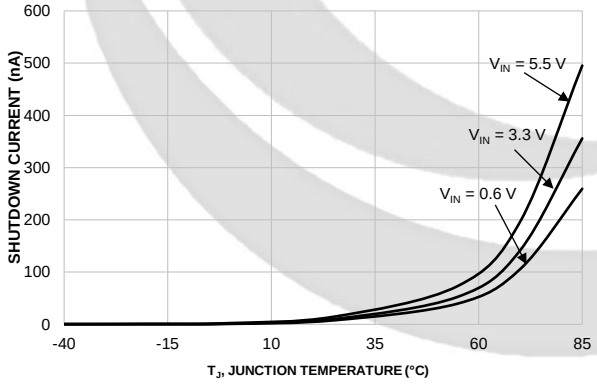

Figure 9. V_{IN} Shutdown Current vs. vs. Temperature

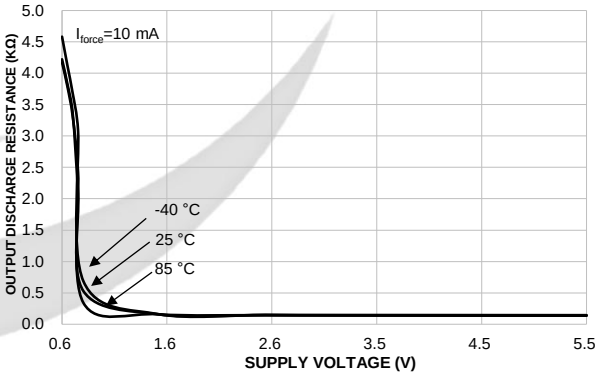

Figure 10. Output Discharge Resistance vs. Supply Voltage

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TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

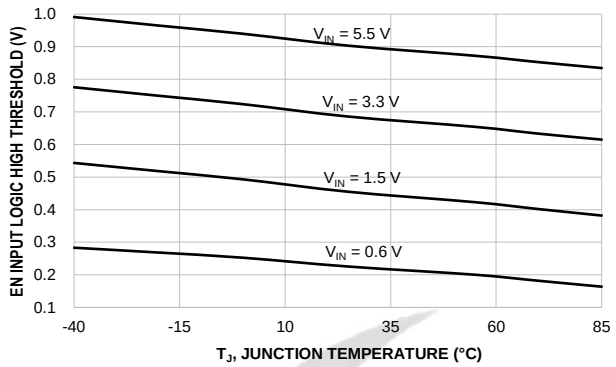

Figure 11. EN Input Logic High Threshold vs. Temperature

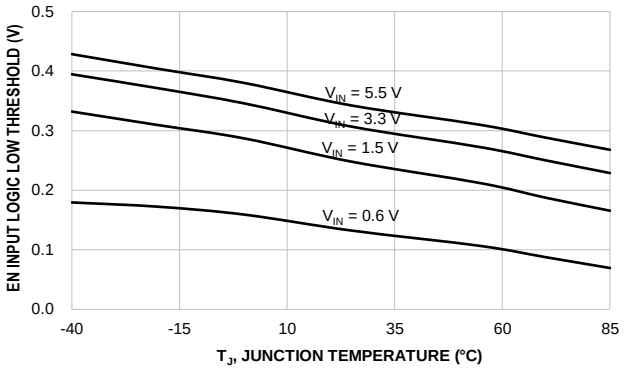

Figure12. EN Input Logic Low Threshold vs. Temperature

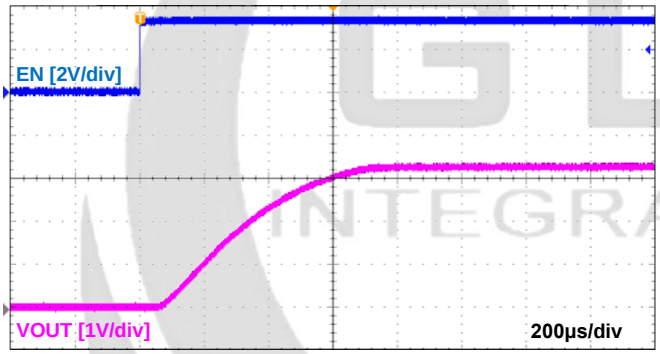

Figure 13. Turn-On Response
V_{IN}=V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1593T

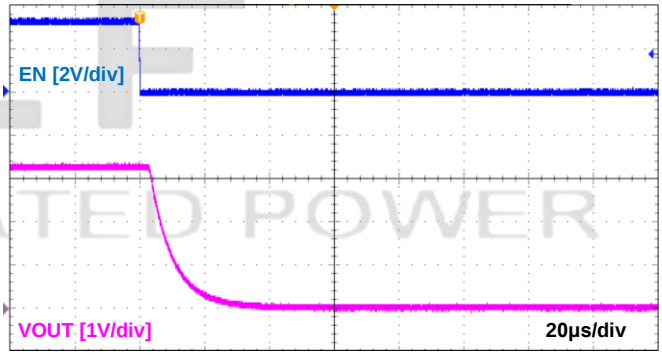

Figure 14. Turn-Off Response
V_{IN}=V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1593T

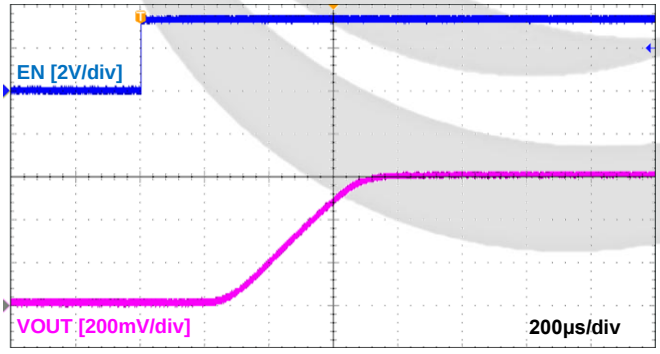

Figure 15. Turn-On Response
V_{IN}=0.6 V, V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1593T

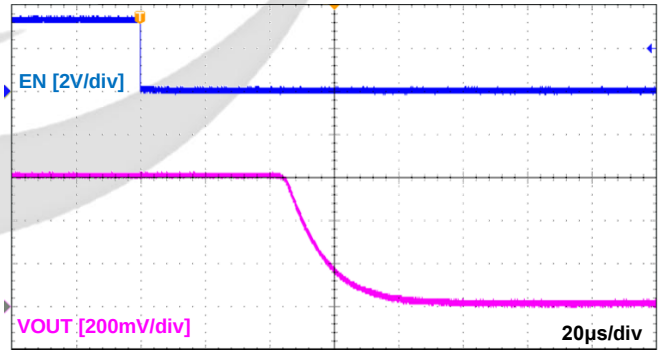

Figure 16. Turn-Off Response
V_{IN}=0.6 V, V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1593T

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TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

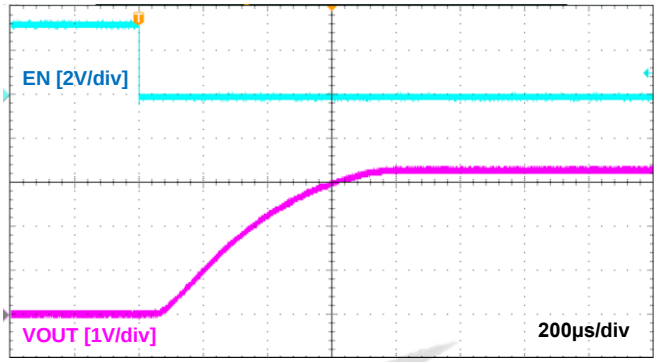

Figure 17. Turn-On Response
V_{IN}=V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1593LT

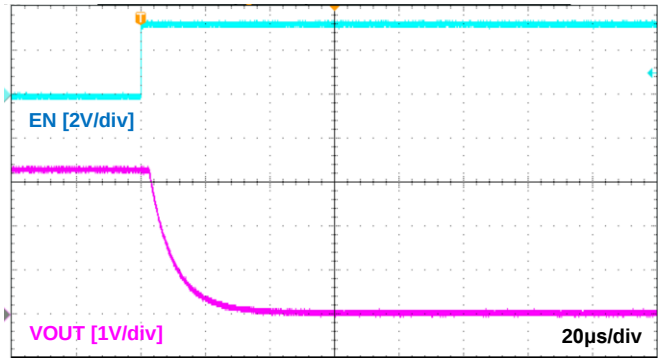

Figure 18. Turn-Off Response
V_{IN}=V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1593LT

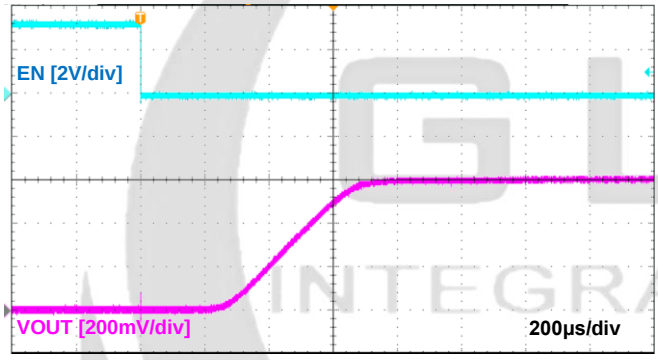

Figure 19. Turn-On Response
V_{IN}=0.6 V, V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1593LT

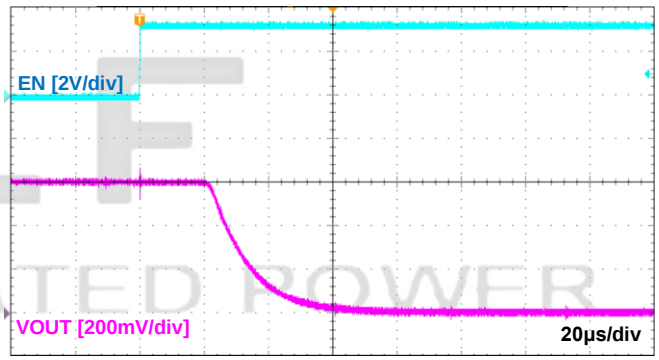

Figure 20. Turn-Off Response
V_{IN}=0.6 V, V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1593LT

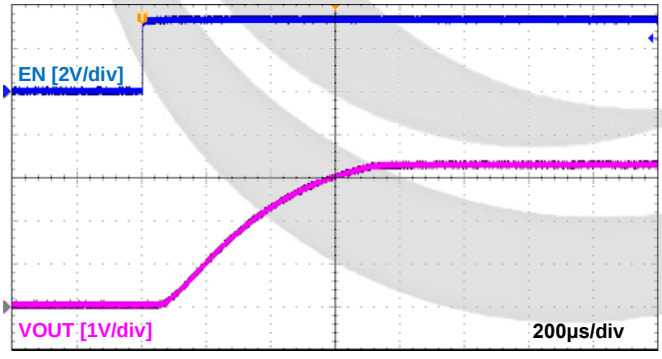

Figure 21. Turn-On Response
V_{IN}=V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1592T

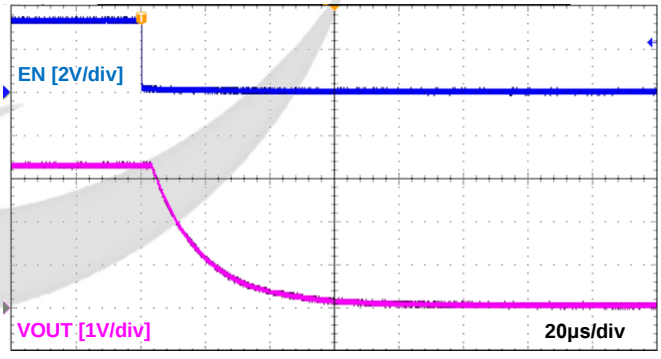

Figure 22. Turn-Off Response
V_{IN}=V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1592T

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TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)

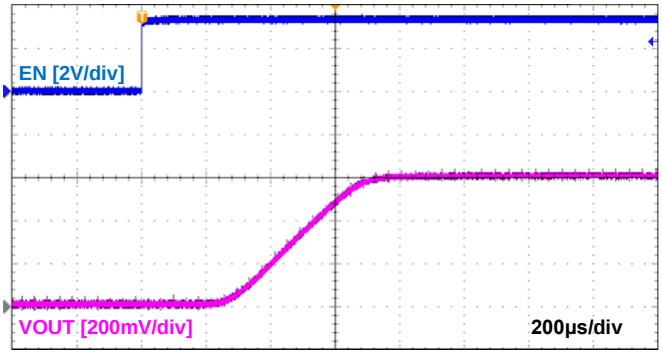

Figure 23. Turn-On Response
V_{IN}=0.6 V, V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1592T

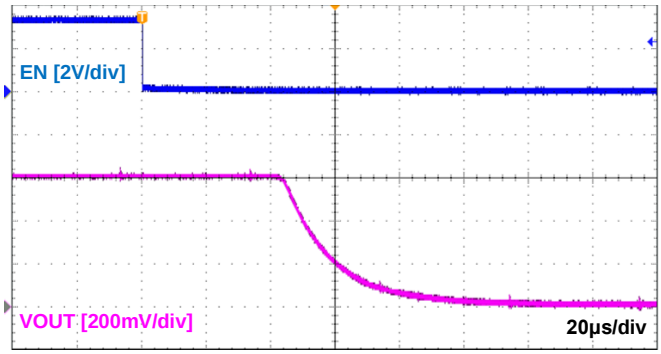

Figure 24. Turn-Off Response
V_{IN}=0.6 V, V_{EN}=3.3 V, C_{OUT}=0.1 µF, R_L=150 Ω, GLF1592T

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APPLICATION INFORMATION

The GLF1592T, GLF1593T and GLF1593LT are ultra-efficient integrated 2 A load switches with Low input voltage. The device is capable of operating over a wide input range from 0.6 V_{IN} to 5.5 V_{IN} 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 supply.

Input and Output Capacitor

A minimum 0.1 µF input 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. Also, a minimum 0.1 µF 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 C_{OUT} capacitor should be placed close to the VOUT and GND pin.

EN pin

The GLF1592T and GLF1593T can be activated by EN pin high and the GLF1593LT can be activated by EN pin low. Note: The EN pin does not have an internal pull-up or pull-down resistor, so do not leave the EN pin floating.

Output Discharge Function

The GLF1593T and GLF1593LT 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 effect. Wide traces for VIN, VOUT, and GND will be better to reduce parasitic effects at dynamic operations and improve thermal performance at high load current.

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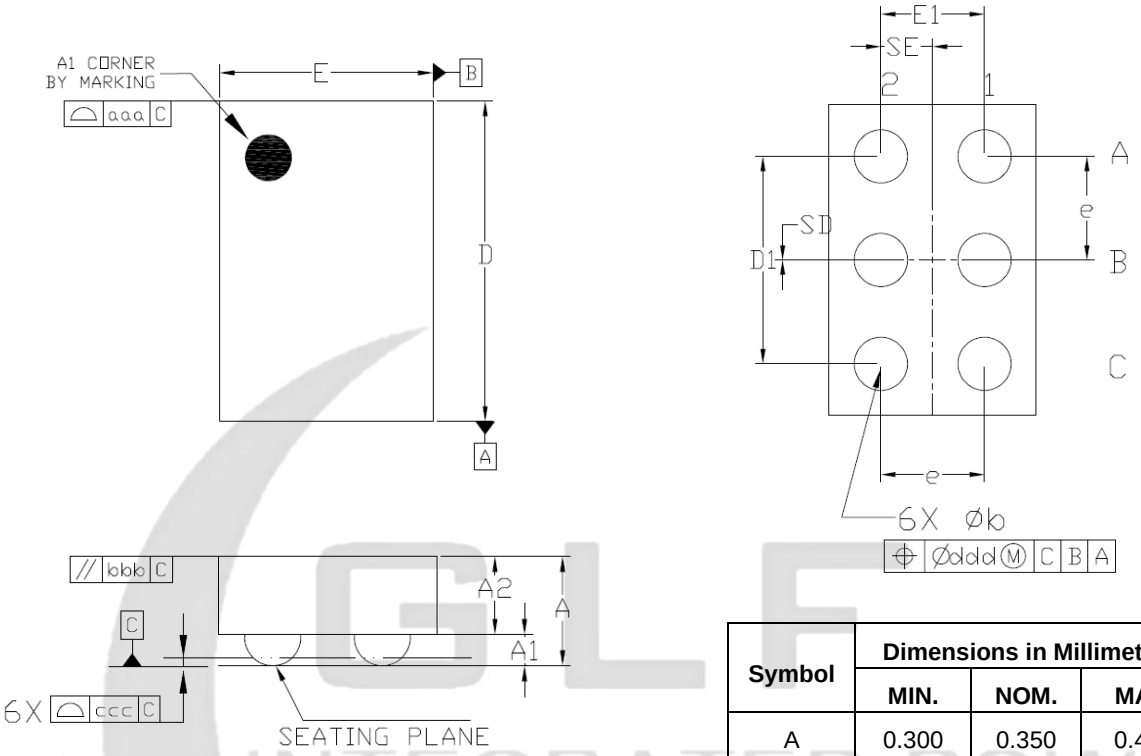
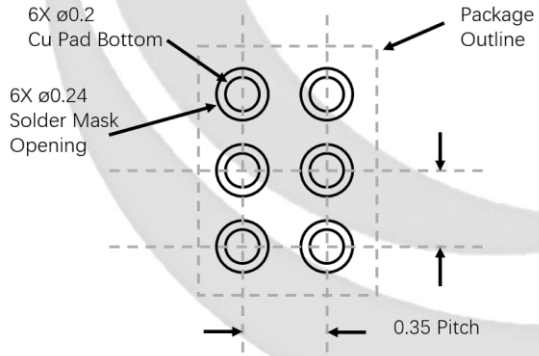
PACKAGE OUTLINE



Symbol	Dimensions in Millimeters		
	MIN.	NOM.	MAX.
A	0.300	0.350	0.400
A1	0.075	0.100	0.125
A2	0.225	0.250	0.275
D	1.005	1.020	1.035
E	0.655	0.670	0.685
D1	0.650	0.700	0.750
E1	0.300	0.350	0.400
b	0.175	0.210	0.245
e	0.350 BSC		
SD	0.000 BSC		
SE	0.175 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 DEGREES),
2, DIMENSIONING AND TOLERANCING PER ANSI Y14,5M-1994,

PACKAGING INFORMATION

Part Number	Package	Pins	Top Mark	Moisture Sensitivity Level	Environmental Information
GLF1592T-S97	WLCSP	6	GW	MSL1	ROHS+HF
GLF1593T-S97			FY		
GLF1593LT-S97			GY		

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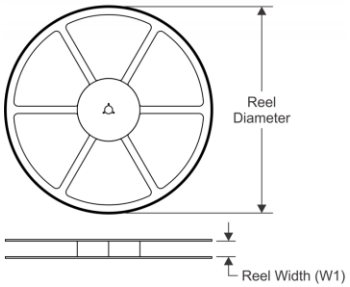
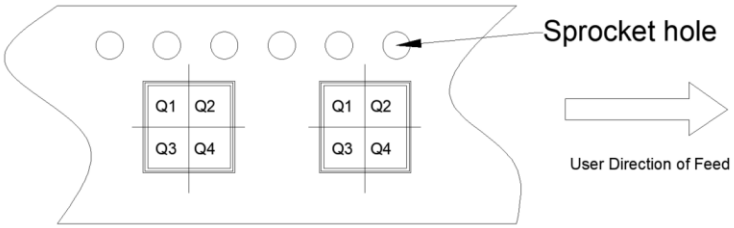
TAPE AND REEL INFORMATION

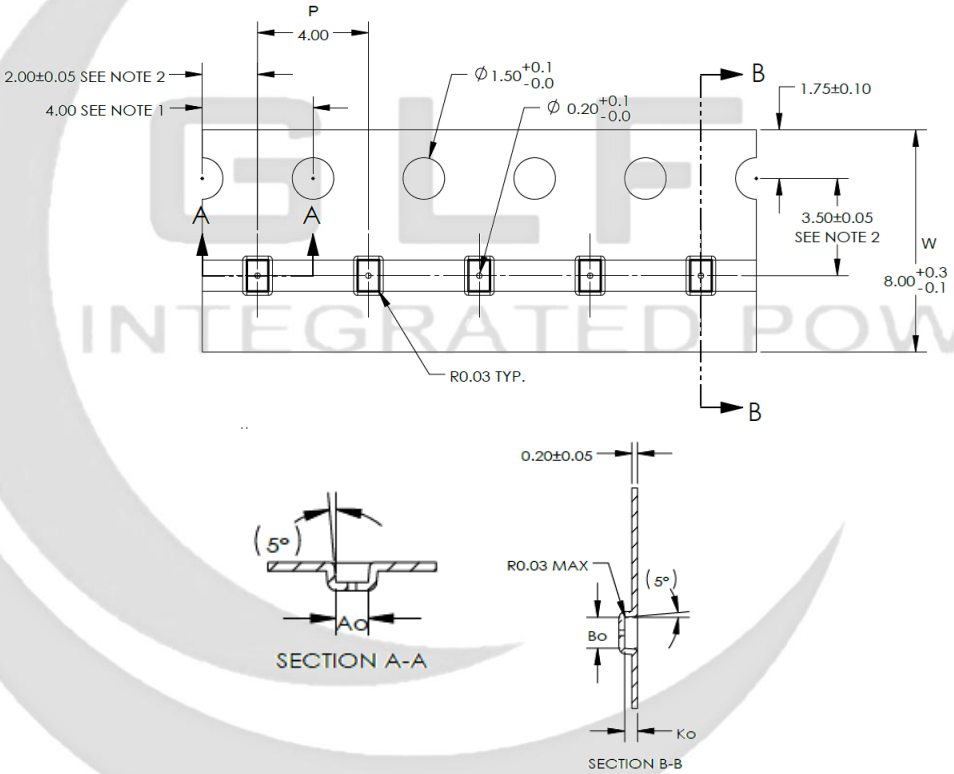
REEL DIMENSIONS



QUADRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE



TAPE DIMENSIONS



Device	Package	Pins	SPQ	Reel Diameter (mm)	Reel Width W1	A0	B0	K0	P	W	Pin1
GLF1592T-S97	WLCSP	6	4000	180	9	0.77	1.12	0.47	4	8	Q1
GLF1593T-S97											
GLF1593LT-S97											

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

P: 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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