GLF74139

4.5 A Power Mux IC with Reverse Current Blocking Protection and Low Power Consumption

Product Specification

DESCRIPTION

The GLF74139 is a fully integrated power path switch with the automatic and manual selection function. The GLF74139 offers an industry leading reverse current blocking (RCB) function to protect input sources when the VOUT increase higher than VIN abnormally.

The EN pin can be used along with the SEL pin to control two integrated main FETs of the GLF74139. By the combination of these two pins, one of input source selection modes is set to provide power to downstream system seamlessly.

The automatic selection mode chooses a higher input voltage source between two inputs. In the manual selection mode, one of input sources is connected to downstream system.

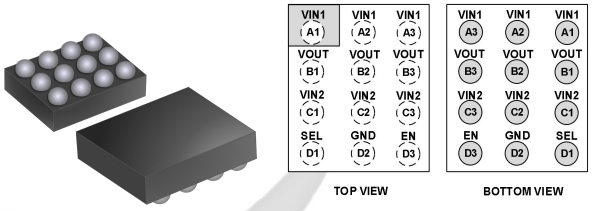
FEATURES

- Two-Input and Single-Output Power Multiplexer Switch
- Automatic and Manual Input Selection Modes
- Reverse Current Blocking on Each Channel
- No Cross Conduction between Two Input Sources
- Supply Voltage Range: 2.0 V to 5.5 V
- R_{ON}: 20 mΩ Typ at 5.5 V_{IN1} or V_{IN2}
- 4.5 A Continuous Output Current Capability Per Channel
- Ultra-Low Supply Current at Operation
  I_Q: 4 μA Typ at 5.5 V_{IN}
- Ultra-Low Stand-by Current
  I_{SD}: 30 nA Typ at 5.5 V_{IN}
- Smart Control Pins
  I_{EN} and I_{SEL}: 10 nA Typ at V_{EN} or V_{SEL} > V_{IH}
  R_{EN} and R_{SEL}: 500 kΩ Typ
- HBM: 6 kV, CDM: 2 kV

APPLICATIONS

- Smart Devices
- Subsystem with Backup Power
- IoT Tracking System

PACKAGE

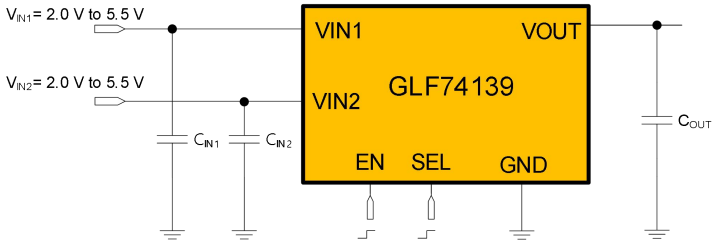


1.27 mm x 1.67 mm x 0.55 mm, WLCSP
0.4 mm pitch

DEVICE INFORMATION

Part Number	Top Mark	R_{ON} at 5.5 V_{IN}	Output Current, I_{OUT} Per Channel	Ultra-low I_Q at 5.5 V_{IN}	Output Discharge	Status
GLF74137	*TBD*	*20 mΩ*	*4.5 A*	*4 μA*	*70 Ω*	*On request*
GLF74139	EN	20 mΩ	4.5 A	4 μA	NA	Released

APPLICATION DIAGRAM



FUNCTIONAL BLOCK DIAGRAM

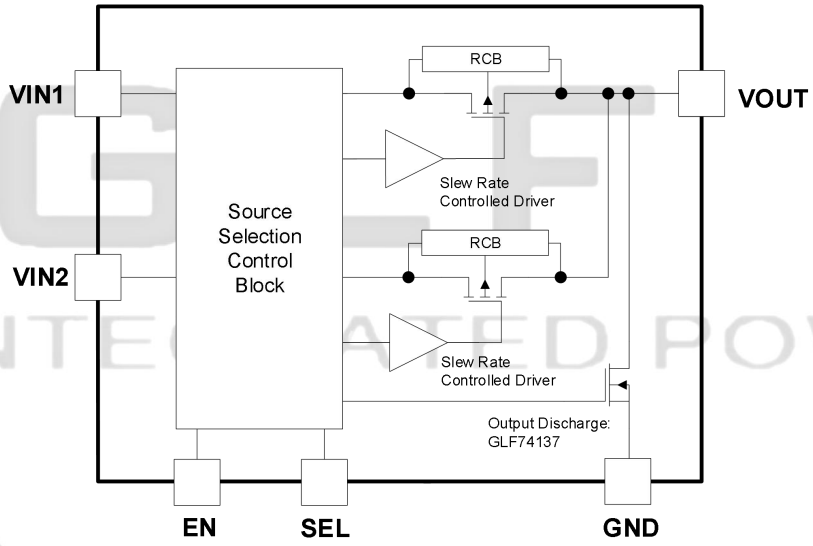


Figure 1. Functional Block Diagram

PIN CONFIGURATION

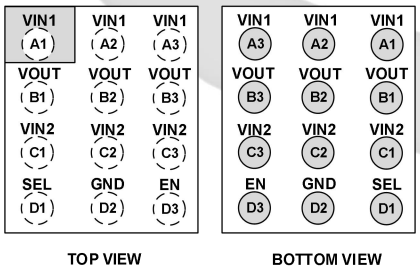


Figure 2. 1.27mm x 1.67mm x 0.55mm WLCSP

PIN DEFINITION

Pin #	Name	Description
A1, A2, A3	VIN1	Switch Input 1 Supply Voltage
B1, B2, B3	VOUT	Switch Output
C1, C2, C3	VIN2	Switch Input 2 Supply Voltage
D1	SEL	Input Source Selection.
D2	GND	Ground
D3	EN	Enable Pin

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_{IN1}, V_{IN2} V_{OUT}, V_{EN}	Each Pin Voltage Range to GND		-0.3	6	V
I_{OUT}	Continuous Current			4.5	A
	Pulse, 100 μs pulse and 2 % duty cycle			6.5	A
P_D	Power Dissipation at T_A = 25 °C			1.2	W
T_J	Maximum Junction Temperature			150	°C
T_{STG}	Storage Junction Temperature		-65	150	°C
T_A	Ambient Operating Temperature Range		-40	85	°C
θ_{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_{IN1}, V_{IN2}	Supply Voltage	2.0	5.5	V
T_A	Ambient Operating Temperature Range	-40	+85	°C

ELECTRICAL CHARACTERISTICS

V_{IN1} = V_{IN2} = 2.0 V to 5.5 V and T_A = 25 °C. Unless otherwise noted

Symbol	Parameter	Conditions		Min	Typ	Max	Units
Basic Operation							
I_{Q1}, I_{Q2}	Quiescent Current	V_{IN1} = 5.5 V, V_{IN2} < V_{IN1}, I_{OUT} = 0 mA, EN = 0 V, SEL = VIN1, VOUT = VIN1 or V_{IN2} = 5.5 V, V_{IN1} < V_{IN2}, I_{OUT} = 0 mA, EN = SEL = VIN2, VOUT=VIN2			4	6	µA
		As above, T_A = 85 °C (1)			4.7		
I_{SD1}, I_{SD2}	Shutdown Current	$V_{IN1,2}$ = 5.5 V, VOUT = GND, EN = SEL = 0 V			30	200	nA
		$V_{IN1,2}$ = 5.5 V, VOUT = GND, EN = SEL = 0 V T_A=85 °C (1)			290		
R_{ON}	On-Resistance	V_{IN1} or V_{IN2} = 5.5 V, I_{OUT} = 500 mA	T_A = 25 °C		20	26	mΩ
			T_A = 85 °C (1)		25		
		V_{IN1} or V_{IN2} = 4.5 V, I_{OUT} = 500 mA	T_A = 25 °C		23		
			T_A = 85 °C (1)		26		
		V_{IN1} or V_{IN2} = 3.3 V, I_{OUT} = 500 mA	T_A = 25 °C		27	33	
			T_A = 85 °C (1)		32		
		V_{IN1} or V_{IN2} = 2.5 V, I_{OUT} = 300 mA	T_A = 25 °C		34		
		V_{IN1} or V_{IN2} = 2.0 V, I_{OUT} = 300 mA	T_A = 25 °C		43		
V_{IH}	EN and SEL Input Logic High Voltage	V_{IN1} or V_{IN2} = 2.0 V to 5.5 V		1.2			V
V_{IL}	EN and SEL Input Logic Low Voltage	V_{IN1} or V_{IN2} = 2.0 V to 5.5 V				0.45	V
I_{EN}, I_{SEL}	EN, SEL Current	EN or SEL Voltage > V_{IH}, Enabled			10		nA
R_{EN}, R_{SEL}	EN and SEL pull down resistance	EN or SEL Voltage < V_{IH}, Disabled			500		kΩ
V_{RCB_TH}	RCB Protection Threshold	V_{OUT} – V_{IN}			35		mV
V_{RCB_RL}	RCB Protection Release	V_{IN} – V_{OUT}			20		
I_{RVS}	Reverse Current (1)	V_{IN1} = V_{IN2} =0 V, V_{OUT}= 5.5 V, EN=SEL= 0 V, Current on the input node from VOUT to VIN			70		nA
R_{DSC}	Quick Output Discharge Resistance	V_{IN1} or V_{IN2} =5.5 V, I_{FORCE} = 10 mA, GLF74137			70		Ω
Switching Characteristics (2)							
V_{TR}	Auto Input Selection Trigger (1)	V_{INX} – V_{INY}, In automatic selection mode			290		
t_{dON}	Turn-On Delay	V_{IN1} = 5.0 V, V_{IN2} = 3.3 V R_L = 150 Ω, C_{OUT} = 10 µF			740		µs
t_R	VOUT Rise Time				1		ms
TdHL	High-low Delay (1)				15		µs
TfHL	High-low Fall Time (1)				240		µs
Vdroop	Voltage Droop (1)				100		mV
TdLH	Low-high Delay (1)				10		µs
TrLH	Low-high Rise Time (1)				9		µs
td_{OFF}	Turn-Off Delay (1)				80		µs
t_F	VOUT Fall Time (1)				3		ms

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

TIMING DIAGRAM AND TRUTH TABLE

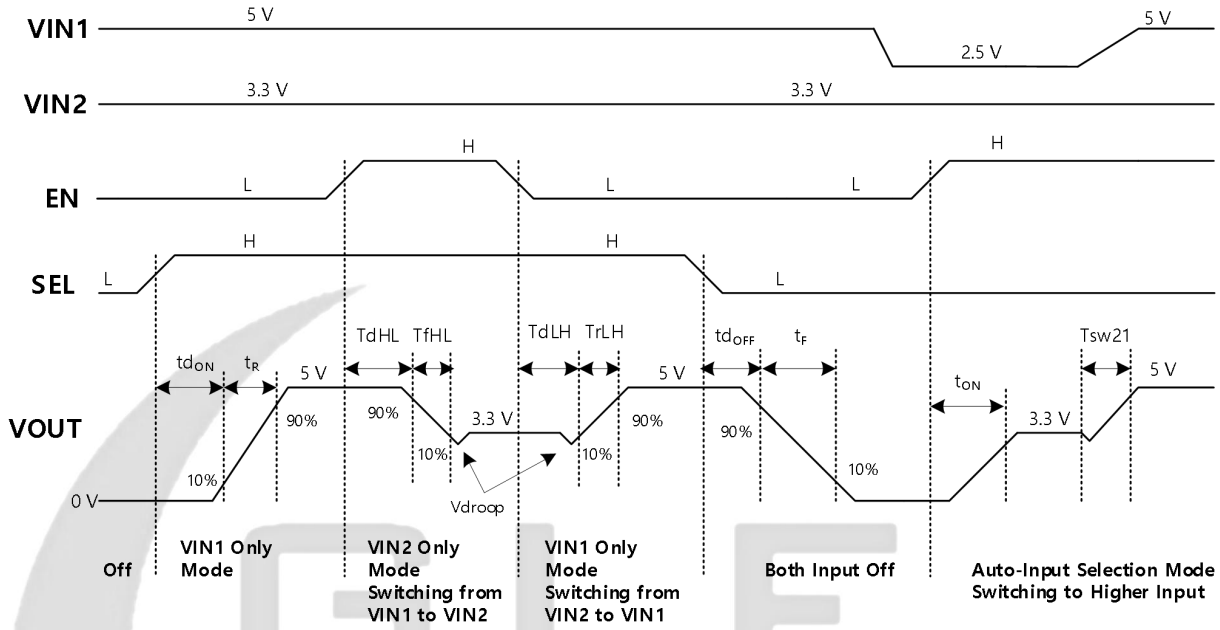


Figure 3. Timing Diagram

SEL	EN	Function	VOUT
0	0	Both switches are off.	High-Z
0	1	Auto-Input selection. VOUT is connected to a higher input source automatically.	Higher Voltage between VIN1 and VIN2
1	0	Only VIN1 is selected.	VIN1
1	1	Only VIN2 is selected.	VIN2

Table 1. Truth Table of Input Source Selection

TYPICAL PERFORMANCE CHARACTERISTICS

Both VIN1 and VIN2 switches are identical.

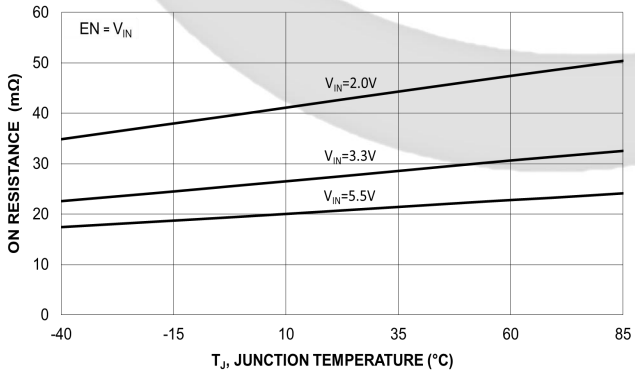


Figure 4. On-Resistance vs. Temperature

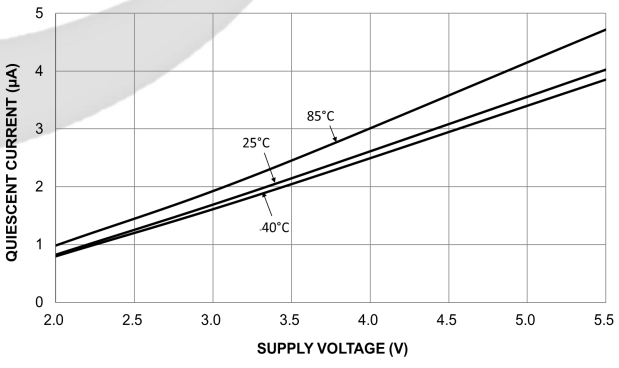


Figure 5. Quiescent Current vs. Supply Voltage

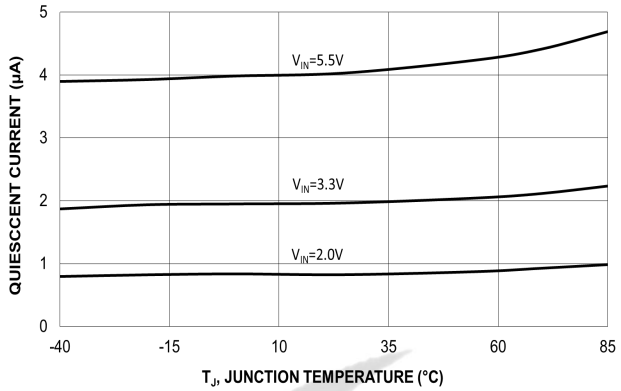


Figure 6. Quiescent Current vs. Temperature

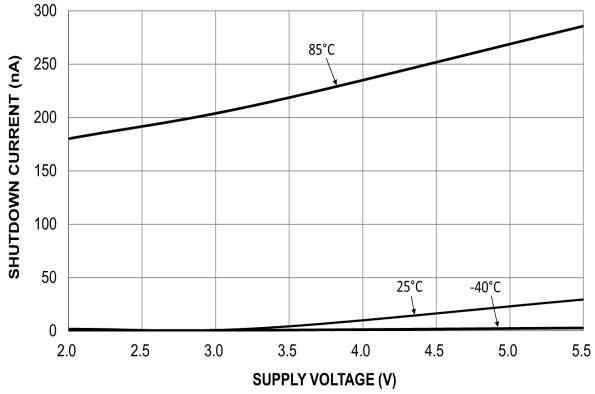


Figure 7. Shutdown Current vs. Supply Voltage

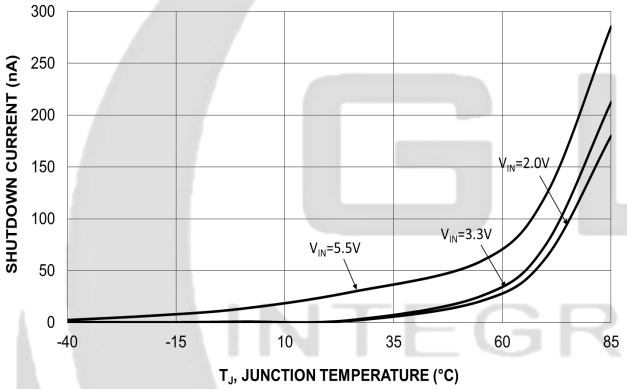


Figure 8. Shutdown Current vs. Temperature

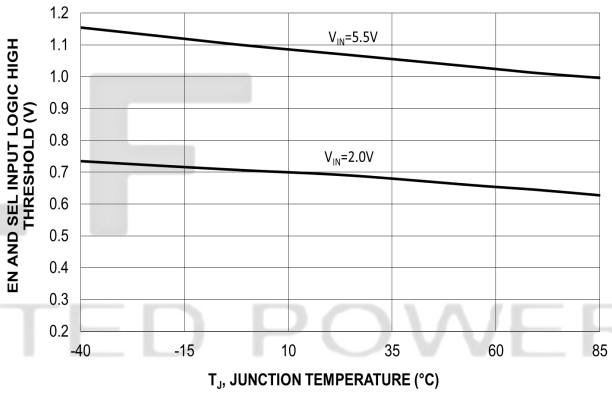


Figure 9. EN and SEL Input Logic High Threshold Vs. Temperature

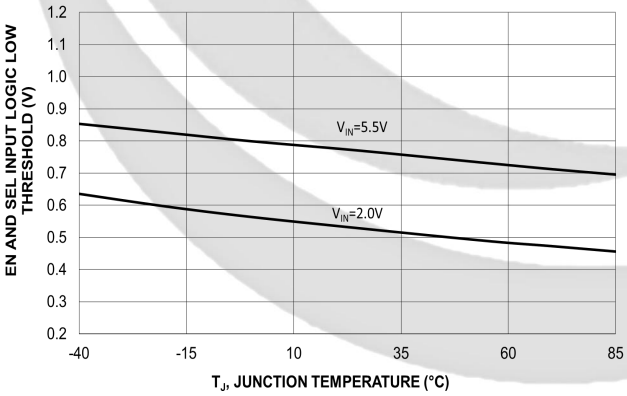


Figure 10. EN and SEL Input Logic Low Threshold vs. Temperature

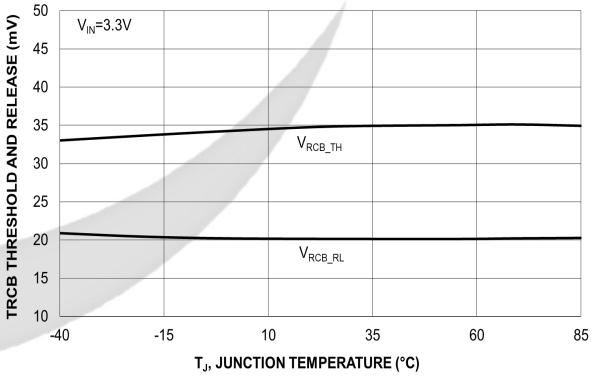


Figure 11. Reverse Current vs. Temperature

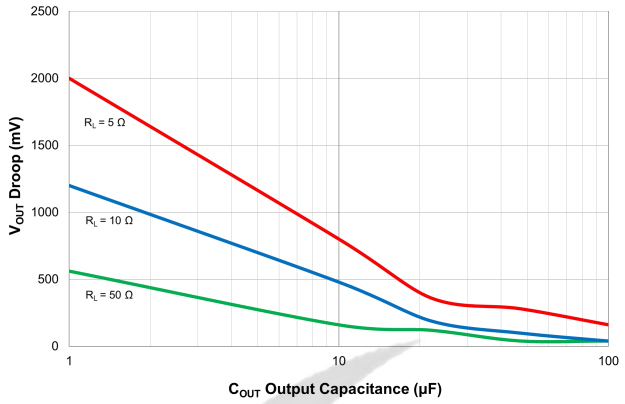


Figure 12. Output Voltage Droop at Switching Over from V_{IN1} (5 V) to V_{IN2} (3.3 V)

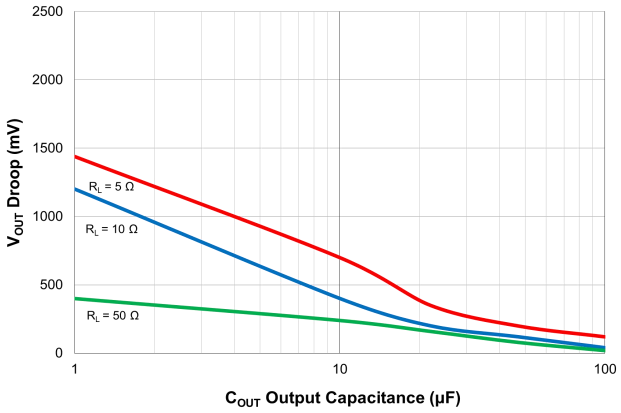


Figure 13. Output Voltage Droop at Switching Over from V_{IN2} (3.3 V) to V_{IN1} (5 V)

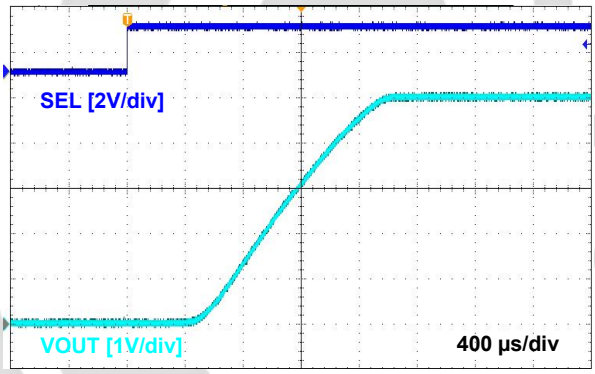


Figure 14. Turn-On Response
V_{IN1}=5.0 V, C_{IN}=C_{OUT}=10 µF, R_L=150 Ω, EN=Low

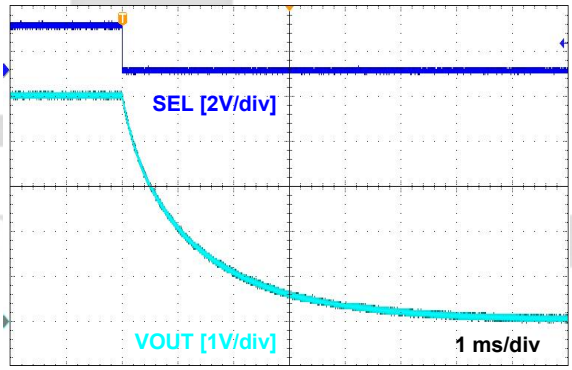


Figure 15. Turn-Off Response
V_{IN1}=5.0 V, C_{IN}=C_{OUT}=10 µF, R_L=150 Ω. EN=Low

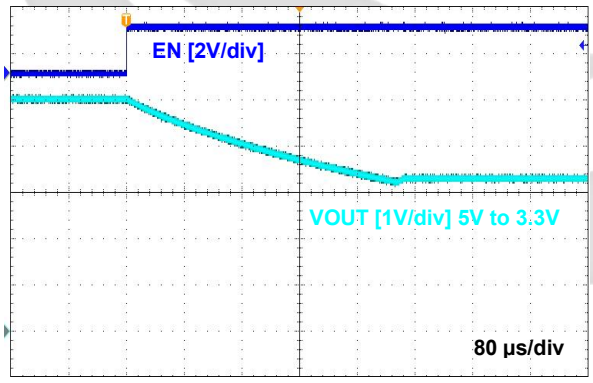


Figure 16. V_{OUT} Switchover from 5 V_{IN} to 3.3 V_{IN}
V_{IN1}=5.0 V, V_{IN2}=3.3 V, C_{IN}=C_{OUT}=10 µF, R_L=150 Ω

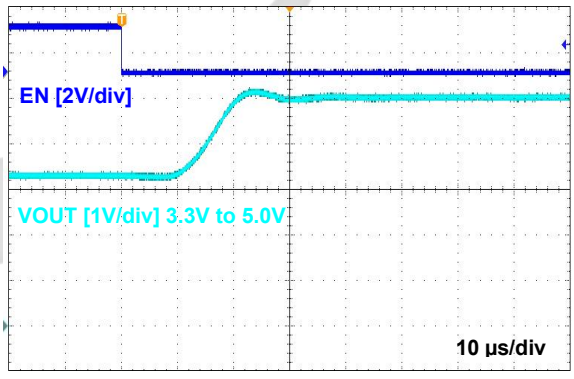


Figure 17. V_{OUT} Switchover 3.3 V_{IN} to 5 V_{IN}
V_{IN1}=5.0 V, V_{IN2}=3.3 V, C_{IN}=C_{OUT}=10 µF, R_L=150 Ω

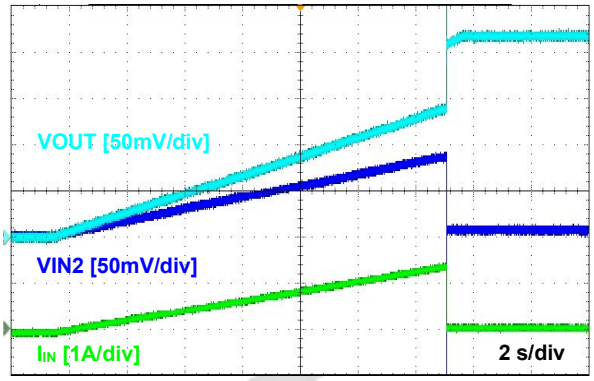


Figure 18. Reverse Current Blocking on Each VIN
V_{IN1} or V_{IN2}=3.3 V, V_{OUT}= From 3 V to 3.4 V, C_{IN}=C_{OUT}=10 µF

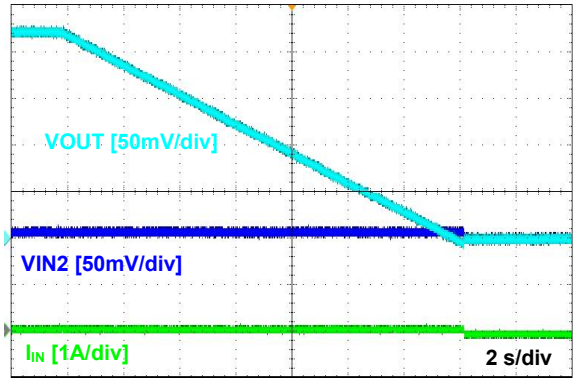


Figure 19. Reverse Current Blocking Release
V_{IN1} or V_{IN2}=3.3 V, V_{OUT}= From 3 V to 3.4 V, C_{IN}=C_{OUT}=10 µF

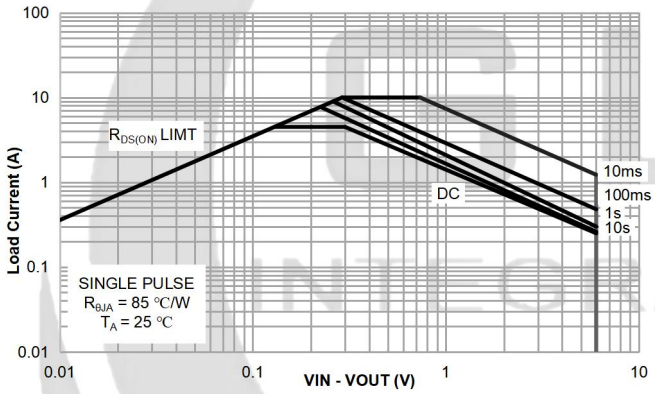


Figure 20. Safe Operating Area

APPLICATION INFORMATION

The GLF74139 is a fully integrated 4.5 A power mux with a fixed slew rate control to limit the inrush current during turn on in the input voltage range from 2.0 V to 5.5 V. Each switch of the GLF74139 has 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. The package is 1.27 mm x 1.67 mm x 0.55 mm wafer level chip scale package saving space in compact applications and it has 12 bumps, 0.4 mm pitch for manufacturing availability.

Input Source Selection

According to the state of SEL and EN pins, the GLF74139 offers the automatic as well as the manual selection mode. In each mode, the VOUT connects to one input source. Do not leave both SEL and EN pins floating.

SEL	EN	Function	VOUT
0	0	Both switches are off.	High-Z
0	1	Auto-Input selection. Vout is connected to a higher input source automatically.	Higher Voltage between VIN1 and VIN2
1	0	Only VIN1 is selected.	VIN1
1	1	Only VIN2 is selected.	VIN2

Reverse Current Blocking

The GLF74139 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} that is the reverse current blocking protection trip voltage, the reverse current blocking function block turns off the switch immediately. Note that some reverse current can occur until the V_{RCB_TH} is triggered. The main switch will get back to normal operation when the output voltage drops below the input source by the reverse current blocking protection release voltage.

Smart EN and SEL Control Pin

With a control voltage less than the V_{IH} for EN or SEL pin, the internal pull-down resistance (R_{EN} or R_{SEL} = 500 kΩ Typ.) is used to keep control pins from floating and ensure a reliable off state. When a voltage higher than the V_{IH} is applied to EN and SEL pin, the 500 kΩ pull-down resistor will be completely disconnected save unnecessary power consumption and enable the pin function.

Input Capacitor

MLCC 10 µF 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. The low ESR capacitor is preferred to avoid output oscillation during the switching-over period in the auto-input selection mode when the output current is high. A higher input capacitor value can be used to further attenuate the input voltage drop.

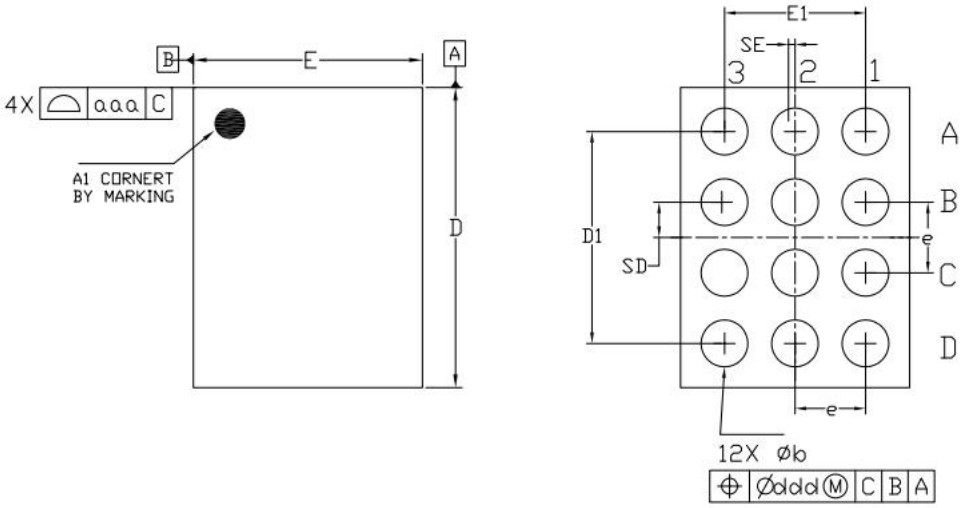
Output Capacitor

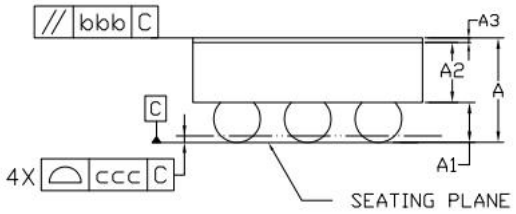
MLCC 10 µF capacitor is recommended to mitigate voltage undershoot on the output pin the moment when the switch is turned off. Undershoot can be caused by parasitic inductance from board traces or intentional load inductances. If load inductances do exist, use of an output capacitor can improve output voltage stability and system reliability. The C_{OUT} capacitor should be placed close to the VOUT and GND pins.

Board Layout

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

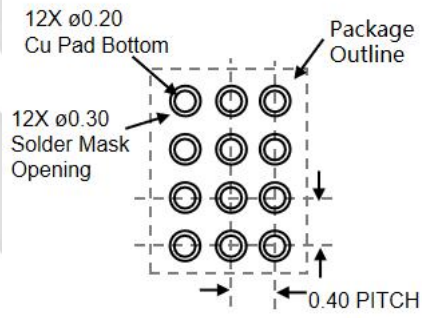
PACKAGE OUTLINE





Dimensional Ref.			
REF.	Min.	Nom.	Max.
A	0.500	0.550	0.600
A1	0.175	0.200	0.225
A2	0.300	0.325	0.350
A3	0.020	0.025	0.030
D	1.655	1.670	1.685
E	1.255	1.270	1.285
D1	1.150	1.200	1.250
E1	0.750	0.800	0.850
b	0.215	0.265	0.315
e	0.400 BSC		
SD	0.200 BSC		
SE	0.000 BSC		
Tol. of Form&Position			
aaa	0.10		
bbb	0.10		
ccc	0.05		
ddd	0.05		

Recommended Footprint

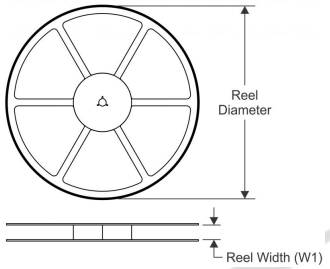


Notes

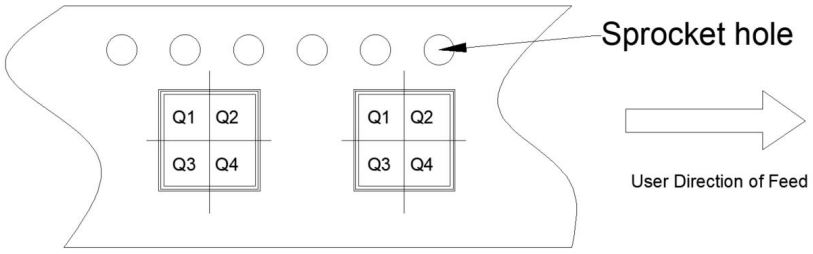
1. ALL DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGRESS)
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
3. A3: BACKSIDE LAMINATION

TAPE AND REEL INFORMATION

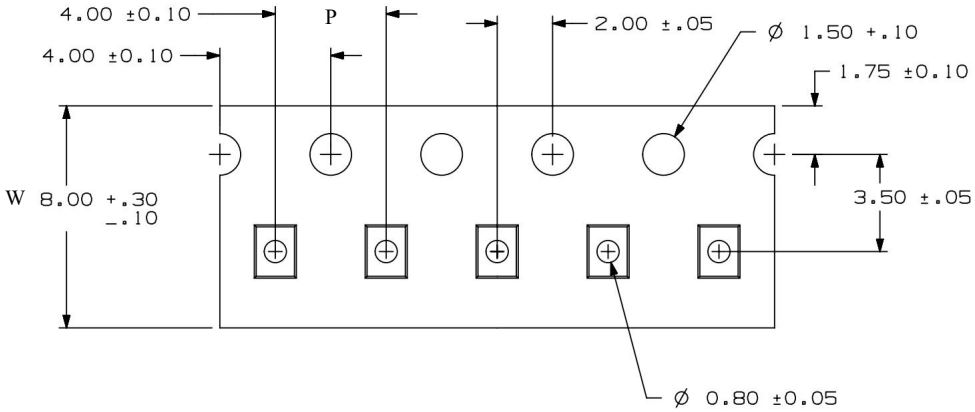
REEL DIMENSIONS

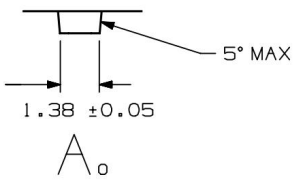


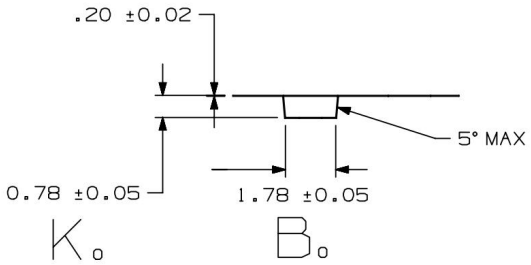
QUADRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE



TAPE DIMENSIONS







Device	Package	Pins	SPQ	Reel Diameter (mm)	Reel Width W1	A0	B0	K0	P	W	Pin1
GLF74137	WLCSP	12	3000	180	9	1.38	1.78	0.78	4	8	Q1
GLF74139	WLCSP	12	3000	180	9	1.38	1.78	0.78	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. 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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