GLF74138

4.5 A Power Mux IC with Bidirectional Operation and Low Power Consumption

Product Specification

DESCRIPTION

The GLF74138 is a fully integrated power path switches with the automatic and manual selection function.

The EN pin can be used along with the SEL pin to control two integrated main FETs of the GLF74138. By the combination of these two pins, one of input source selection modes is set to provide power to downstream system seamlessly. Each FET of the GLF74138 is conducted bidirectionally when it is turned on and current flows from VOUT to VIN pin and vice versa.

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.

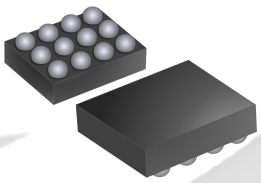
FEATURES

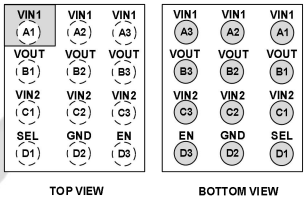
- Two-Input and Single-Output Power Multiplexer Switch
- Automatic and Manual Input Selection Modes
- No Cross Conduction between Two Input Sources
- Bidirectional Current Flow at Conduction State
- Reverse Current Blocking when Disabled
- Supply Voltage Range: 2.0 V to 5.5 V
- R_{ON}: 20 mΩ Typ at 5.5 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



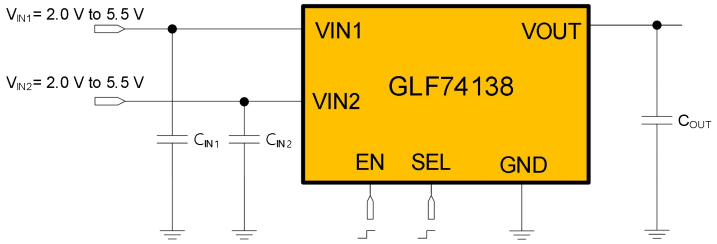


1.27 mm x 1.67 mm x 0.55 mm, WLCSP
0.4 mm pitch

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
GLF74136	*TBD*	*20 mΩ*	*4.5 A*	*4 μA*	*70 Ω*	*On request*
GLF74138	EN	20 mΩ	4.5 A	4 μA	NA	Released

APPLICATION DIAGRAM



FUNCTIONAL BLOCK DIAGRAM

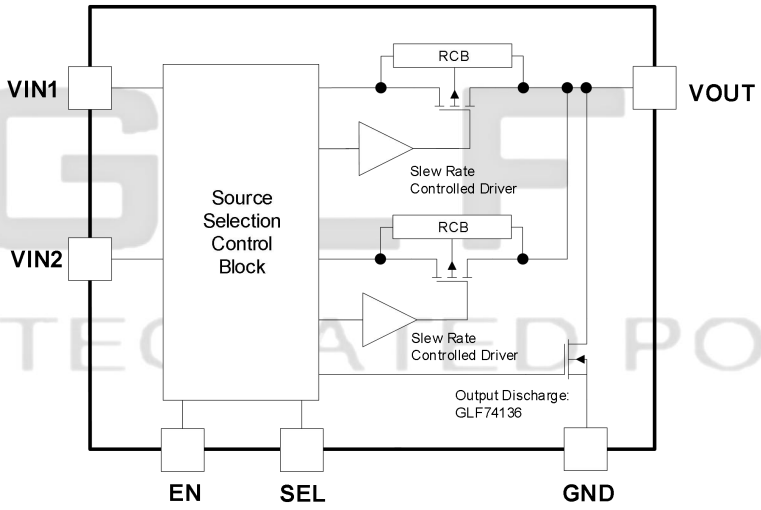


Figure 1. Functional Block Diagram

PIN CONFIGURATION

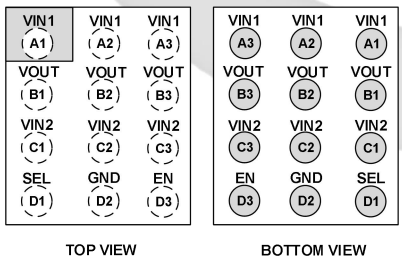


Figure 2. 1.27 mm x 1.67 mm x 0.55 mm WLCSP

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	Unit
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
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			23		nA
R_{DSC}	Quick Output Discharge Resistance	V_{IN1} or V_{IN2} =5.5 V, I_{FORCE} = 10 mA, GLF74136			70		Ω
Switching Characteristics (2)							
V_{TR}	Auto Input Selection Trigger(1)	V_{INX} – V_{INY}, In automatic selection mode			230		mV
t_{dON}	Turn-On Delay	V_{IN1} = 5.0 V, V_{IN2} = 3.3 V R_L = 150 Ω, C_{OUT} = 10 µF			410		µs
t_R	VOUT Rise Time				573		µs
TdHL	High-low Delay (1)				10		µs
TfHL	High-low Fall Time (1)				9.5		µs
Vdrop	Voltage Drop (1)				40		mV
TdLH	Low-high Delay (1)				11		µs
TrLH	Low-high Rise Time (1)				7		µs
td_{OFF}	Turn-Off Delay (1)				70		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

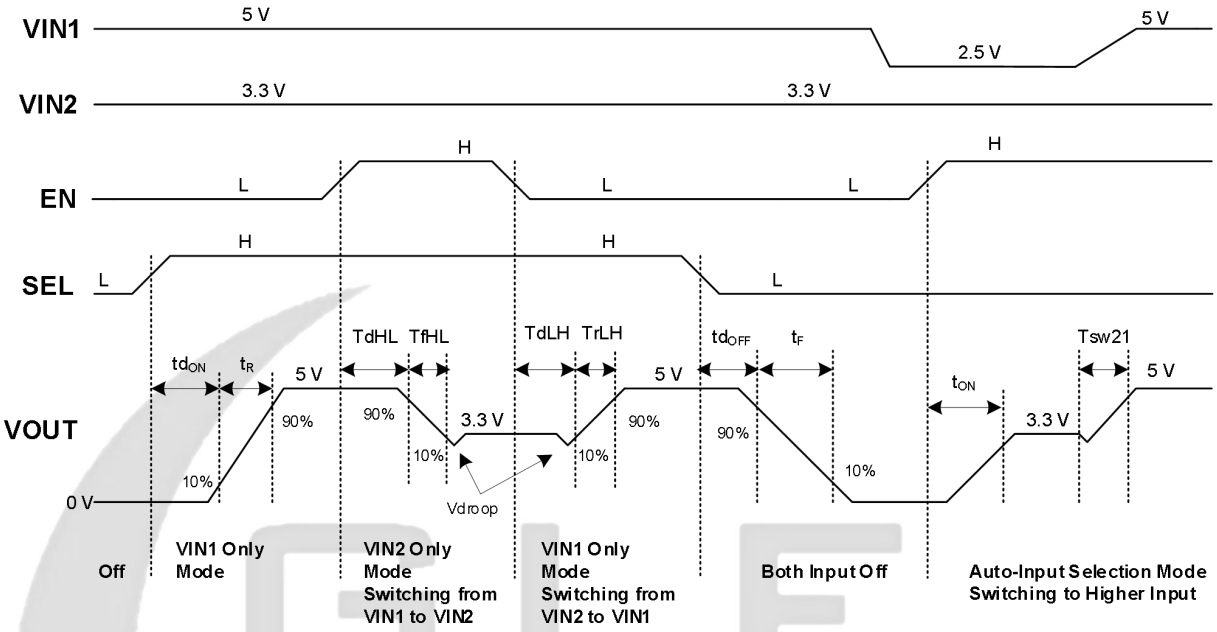


Figure 3. Timing Diagram

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.

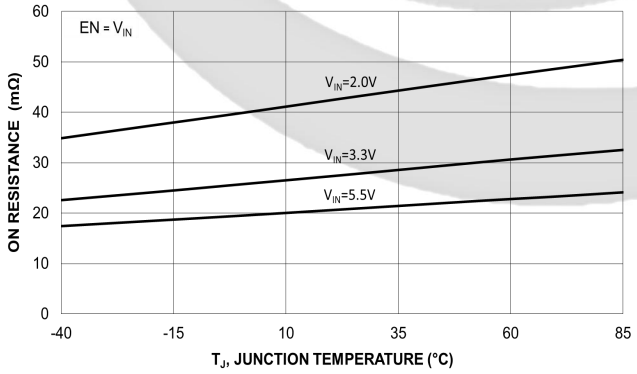


Figure 4. On-Resistance vs. Temperature

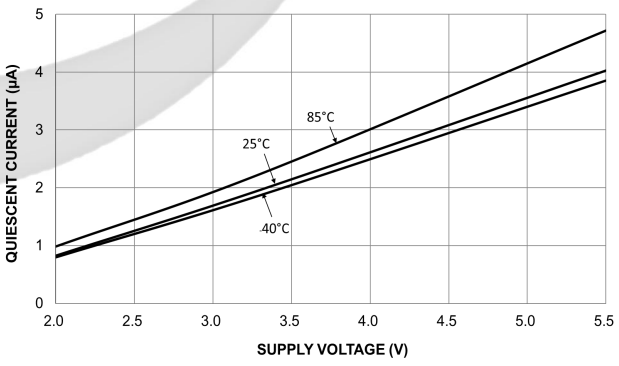


Figure 5. Quiescent Current vs. Supply Voltage

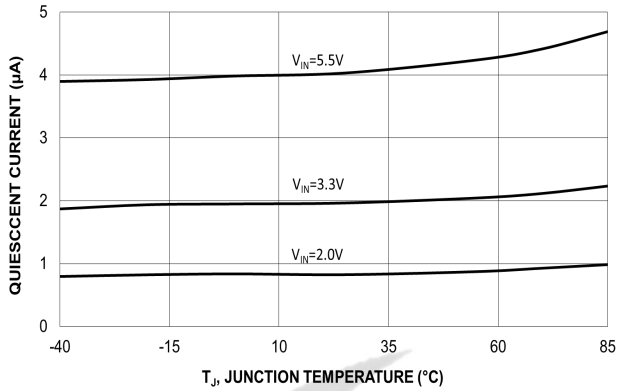


Figure 6. Quiescent Current vs. Temperature

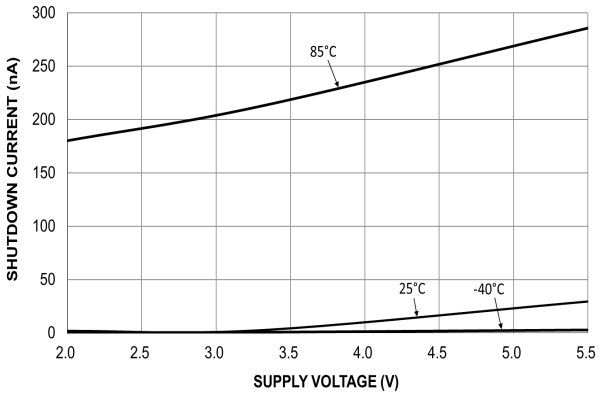


Figure 7. Shutdown Current vs. Supply Voltage

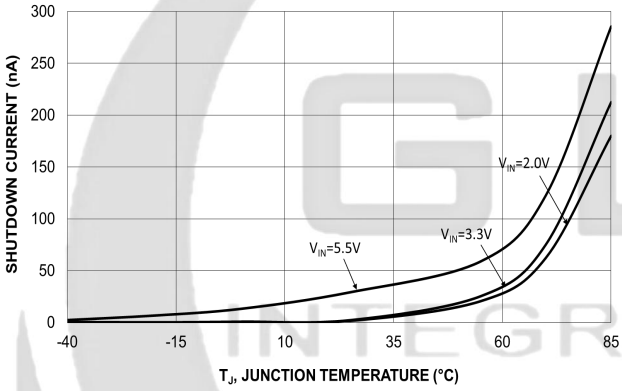


Figure 8. Shutdown Current vs. Temperature

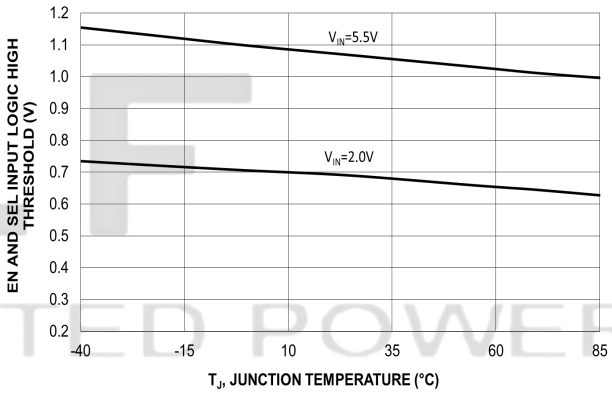


Figure 9. EN and SEL Input Logic High Threshold Vs. Temperature

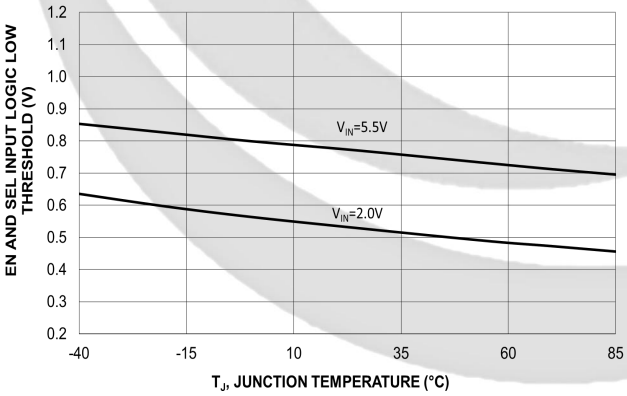


Figure 10. EN and SEL Input Logic Low Threshold vs. Temperature

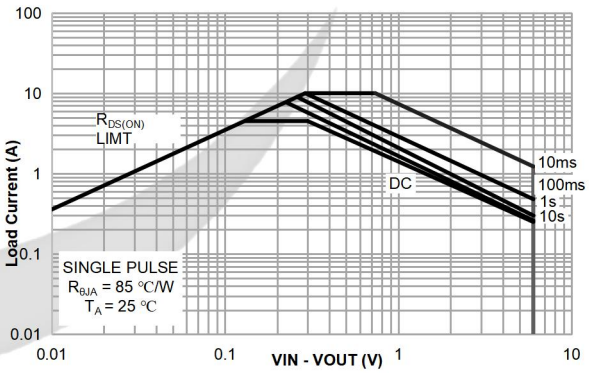


Figure 11. Safe Operating Area.

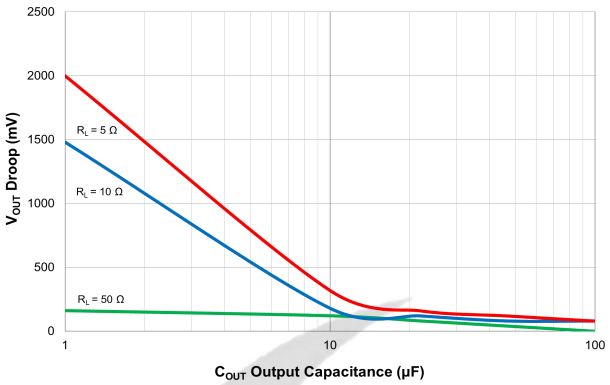


Figure 12. Output Voltage Drop at Switching Over from V_{IN1} (5 V) to V_{IN2} (3.3 V)

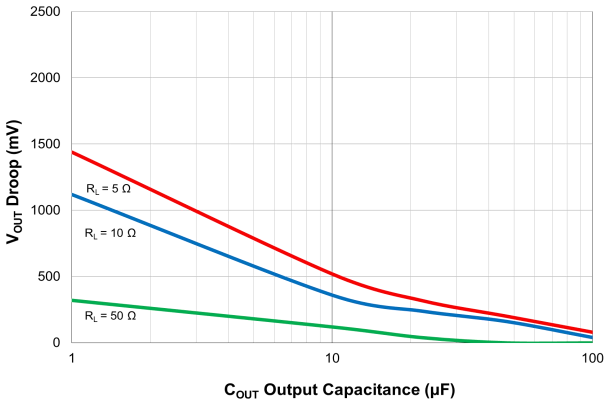


Figure 13. Output Voltage Drop at Switching Over from V_{IN2} (3.3 V) to V_{IN1} (5 V)

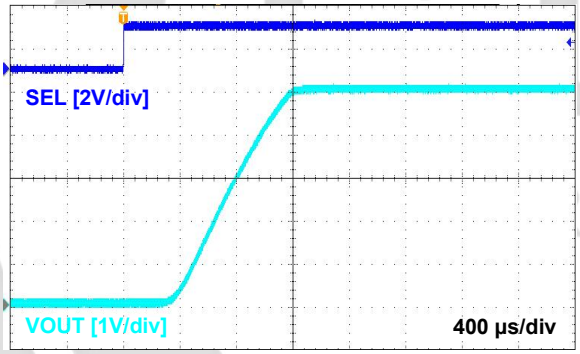


Figure 14. Turn-On Response
V_{IN1}=5.0 V, C_{IN}=C_{OUT}=10 µF, R_L=150 Ω, EN=Low

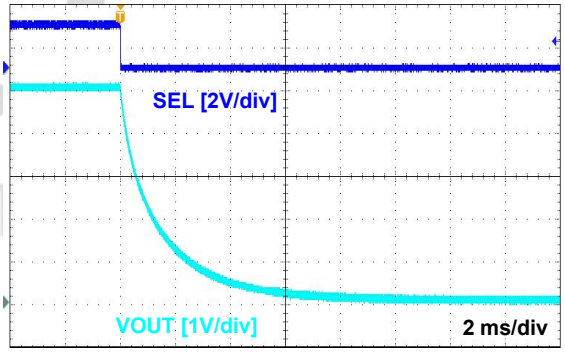


Figure 15. Turn-Off Response
V_{IN1}=5.0 V, C_{IN}=C_{OUT}=10 µF, R_L=150 Ω. EN=Low

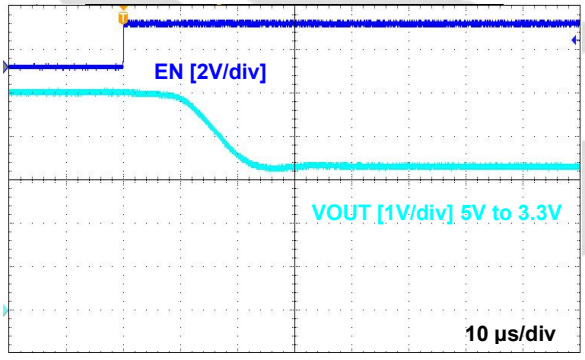


Figure 16. V_{OUT} Switchover from 5 V_{IN} to 3.3 V_{IN}
V_{IN1}=5.0 V, V_{IN2}=3.3 V, C_{IN}=C_{OUT}=10 µF, R_L=150 Ω

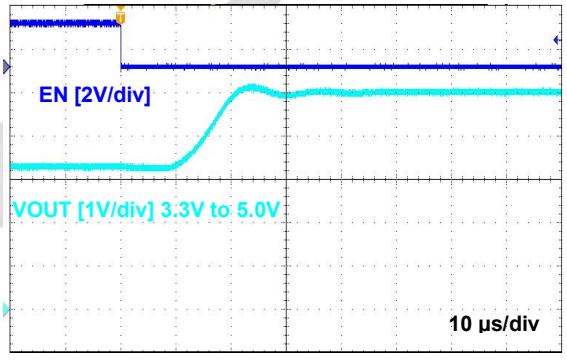


Figure 17. V_{OUT} Switchover 3.3 V_{IN} to 5 V_{IN}
V_{IN1}=5.0 V, V_{IN2}=3.3 V, C_{IN}=C_{OUT}=10 µF, R_L=150 Ω

APPLICATION INFORMATION

The GLF74138 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 GLF74138 is conducted bidirectionally when it is turned on and current flows from VOUT to VIN pin and vice versa. The device 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 GLF74138 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 When Disabled

The GLF74138 prevents the reverse current from the output voltage when both switches are turned off at EN = SEL = 0 V.

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 to save unnecessary power consumption.

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.

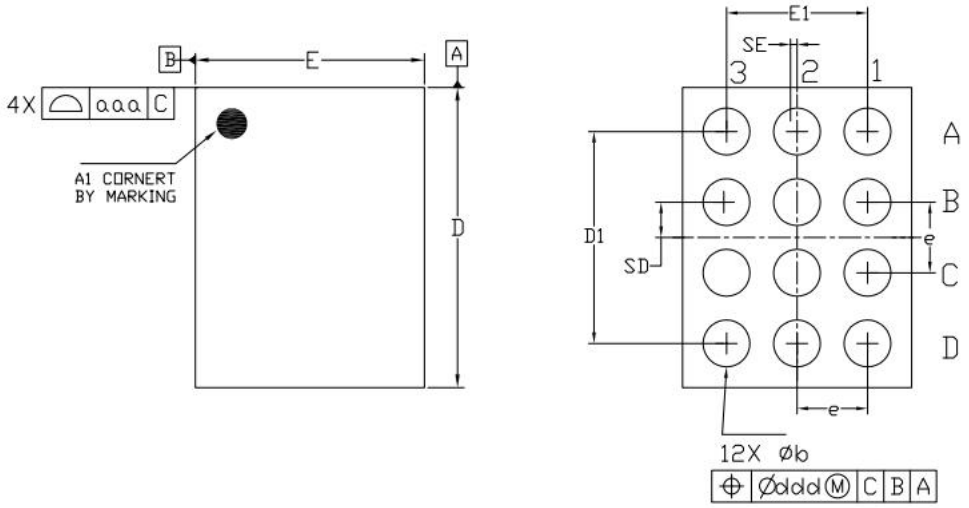
Output Capacitor

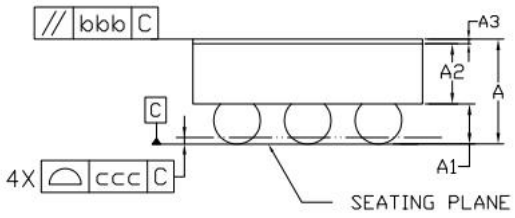
MLCC 10 µF capacitor is recommended to mitigate voltage undershoot on the output pin the moment when the switch is turned off. Undershoot can be caused by parasitic inductance from board traces or intentional load inductances. If load inductances do exist, use of an output capacitor can improve output 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.

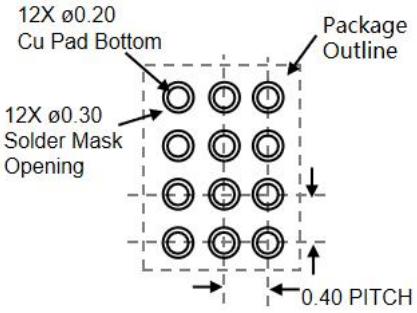
PACKAGE OUTLINE





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

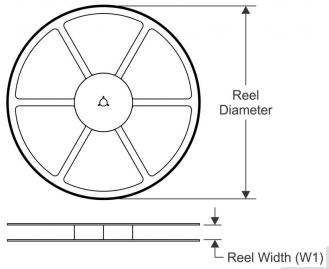


Notes

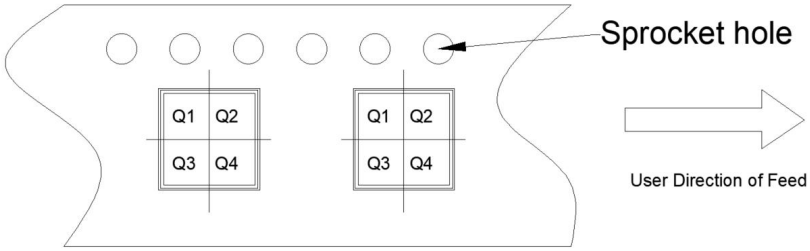
1. ALL DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGRESS)
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
3. A3: BACKSIDE LAMINATION

TAPE AND REEL INFORMATION

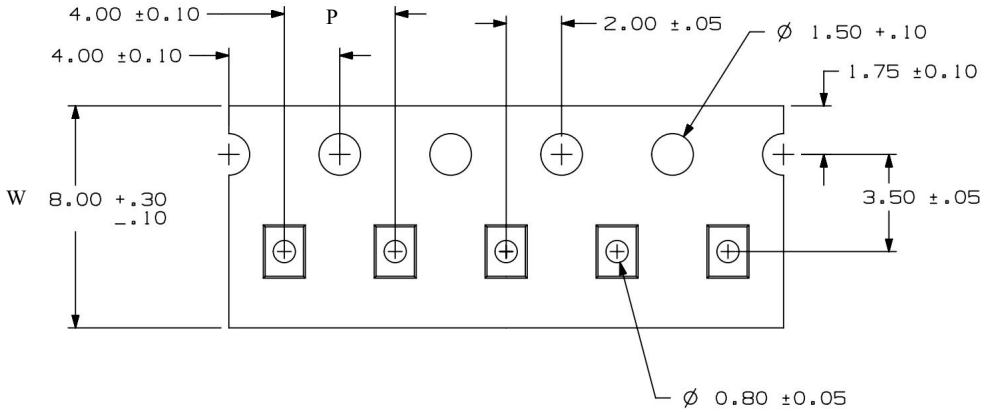
REEL DIMENSIONS

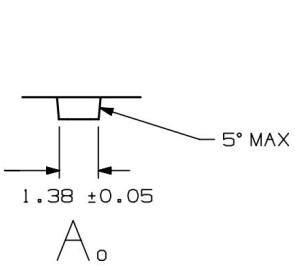


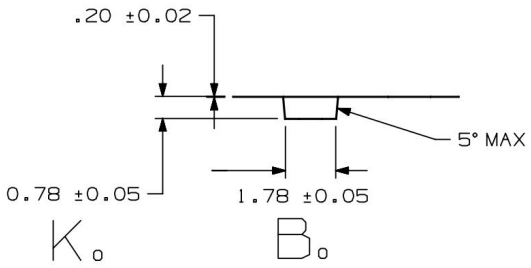
QUADRANT ASSIGNMENTS PIN 1 ORIENTATION TAPE



TAPE DIMENSIONS







Device	Package	Pins	SPQ	Reel Diameter (mm)	Reel Width W1	A0	B0	K0	P	W	Pin1
GLF74136	WLCSP	12	3000	180	9	1.38	1.78	0.78	4	8	Q1
GLF74138	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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