

DIO7299

Ultra-Small, Low-Input Voltage, Low r_{ON} Load Switch

Features

- Low-Input Voltage: 1.2V to 5.5V
- Ultra-Low ON-State Resistance
 - $r_{ON}=36m\Omega$ at $V_{IN}=5.0V$
 - $r_{ON}=38m\Omega$ at $V_{IN}=4.2V$
 - $r_{ON}=39m\Omega$ at $V_{IN}=3.6V$
 - $r_{ON}=46m\Omega$ at $V_{IN}=2.5V$
 - $r_{ON}=58m\Omega$ at $V_{IN}=1.8V$
 - $r_{ON}=150m\Omega$ at $V_{IN}=1.2V$
- DC Current Up to 2A
- Ultra-Low Quiescent Current: 67nA at 1.8V
- Ultra-Low Shutdown Current: 36nA at 1.8V
- Low Control Input Thresholds Enable Use of 1.2V/1.8V/3.6V/4.2V/5.0V Logic
- Controlled Slew Rate to Avoid Inrush Current
- Package: WLCSP-4 (0.9mm x 0.9mm, 0.5mm Pitch, 0.5mm Height)

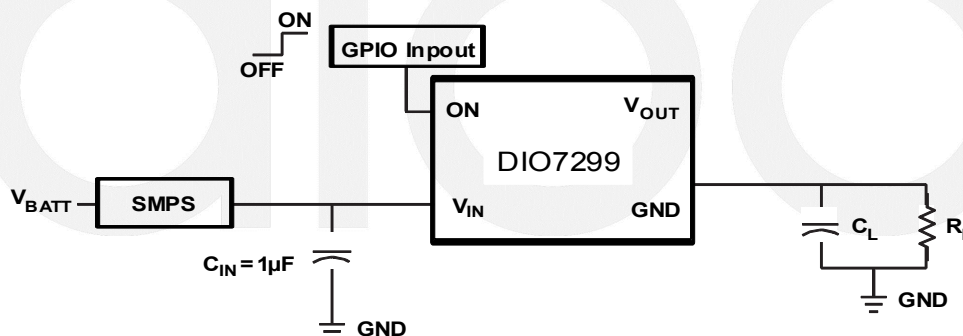
Descriptions

DIO7299 device is low R_{ON} MOSEFT controlled by external logic pin, allowing optimization of battery life, and portable device autonomy. It includes a P-channel MOSFET that operates over an input voltage range of 1.2V to 5.5V. An on/off input (ON) controls the switch that can interface with low voltage control signals. A 120 Ω on chip load resistor is added for output quick discharge when the switch is turned off. DIO7299 is packaged in WLCSP-4 with 0.5mm pitch. It is characterized for operation over the free-air temperature range of -40°C to 85°C.

Applications

- Cellular Phones
- GPS Devices
- Digital Cameras
- Peripheral Ports
- Portable Instrumentation
- RF Modules
- Personal Digital Assistants (PDAs)
- MP3 Players

Applications





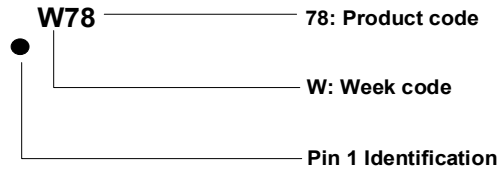
DIO7299

Ultra-Small, Low-Input Voltage, Low r_{ON} Load Switch

Ordering Information

Order Part Number	Top Marking		T_A	Package	
DIO7299WL4	W78	Green	-40 to 85°C	WLCSP-4	Tape & Reel, 3000

Marking Definition



Pin Assignment

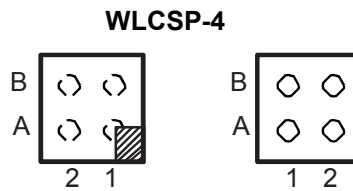


Figure 1. Top View & Bottom View

Pin Descriptions

Name	NO.	Description
V_{OUT}	A1	Switch output
V_{IN}	A2	Switch input, bypass this input with a ceramic capacitor to ground
GND	B1	Ground
ON	B2	Switch control input, active high



DIO7299

Ultra-Small, Low-Input Voltage, Low r_{ON} Load Switch

Absolute Maximum Ratings

Stresses beyond those listed under "Absolute Maximum Rating" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Symbol	Parameter	Rating	Unit
V_{IN}	Input voltage	-0.3 to 6	V
V_{OUT}	Output voltage	$V_{IN}+0.3$	V
V_{ON}	Input voltage	-0.3 to 6	V
P_D	Power dissipation at $T_A=25^{\circ}C$	0.48	W
I_{MAX}	Maximum continuous switch current	2	A
T_A	Operating free air temperature range	-40 to 85	$^{\circ}C$
T_{lead}	Maximum lead temperature (10s soldering time)	300	$^{\circ}C$
T_{stg}	Storage temperature	-45 to 145	$^{\circ}C$
θ_{JA}	Thermal Resistance	189.1	$^{\circ}C/W$
ESD	HBM: All Pins	± 4000	V
	CDM	± 2000	
	MM	± 200	
Latch up		± 400	mA

Recommend Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended Operating conditions are specified to ensure optimal performance to the datasheet specifications. DIOO does not Recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Rating	Unit
V_{IN}	Input voltage range	1.2 to 5.5	V
V_{OUT}	Output voltage range	V_{IN}	V
V_{IH}	High level input voltage, ON	0.95 to 5.5	V
V_{IL}	Low level input voltage, ON	0.4	V
C_{IN}	Input capacitor	1	μF



DIO7299

Ultra-Small, Low-Input Voltage, Low r_{ON} Load Switch

Electrical Characteristics

$V_{IN}=1.2V$ to $5.5V$, $T_A = -40^{\circ}C$ to $85^{\circ}C$, unless otherwise specified.

Symbol	Parameter	Conditions	T_A	Min.	Typ.	Max.	Unit			
I_{IN}	Quiescent current	$I_{OUT}=0$, $V_{IN}=V_{ON}$	$V_{IN}=1.2V$	25°C	31		nA			
				Full		43				
			$V_{IN}=1.8V$	25°C	67		nA			
				Full		85				
			$V_{IN}=3.6V$	25°C	176		nA			
				Full		212				
			$V_{IN}=4.2V$	25°C	210		nA			
				Full		255				
			$V_{IN}=5.0V$	25°C	260		nA			
				Full		314				
			$I_{IN(OFF)}$	OFF-state supply current	$V_{ON}=GND$, $OUT=Open$	$V_{IN}=1.2V$	25°C	18		nA
							Full		216	
$V_{IN}=1.8V$	25°C	36					nA			
	Full					306				
$V_{IN}=3.6V$	25°C	92					nA			
	Full					700				
$V_{IN}=4.2V$	25°C	110					nA			
	Full					800				
$V_{IN}=5.0V$	25°C	145					nA			
	Full					1000				
$I_{IN(LEAKAGE)}$	OFF-state switch current	$V_{ON}=GND$, $V_{OUT}=0$				$V_{IN}=1.2V$	25°C	18		nA
							Full		211	
			$V_{IN}=1.8V$	25°C	35		nA			
				Full		306				
			$V_{IN}=3.6V$	25°C	92		nA			
				Full		700				
			$V_{IN}=4.2V$	25°C	110		nA			
				Full		800				
			$V_{IN}=5.0V$	25°C	145		nA			
				Full		1000				
			R_{ON}	ON-state resistance	$I_{OUT}=-200mA$	$V_{IN}=5.0V$	25°C	36		mΩ
							Full		48	
$V_{IN}=4.2V$	25°C	38					mΩ			
	Full					51				
$V_{IN}=3.6V$	25°C	39					mΩ			
	Full					55				
$V_{IN}=2.5V$	25°C	46					mΩ			
	Full					65				



DIO7299

Ultra-Small, Low-Input Voltage, Low r_{ON} Load Switch

			$V_{IN}=1.8V$	25°C		58		
				Full			78	
			$V_{IN}=1.2V$	25°C		150		
				Full			220	
R_{PD}	Output pull down resistance	$V_{IN}=3.3V, V_{ON}=0, I_{OUT}=30mA$		25°C		95	120	Ω
I_{ON}	ON input leakage current	$V_{ON}=1.2V$ to 5.5V or GND		Full			48	nA

Specifications subject to change without notice.

Switching Characteristics

$R_{L_CHIP}=120\Omega, T_A = 25^\circ C$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_{IN}=1.2V$						
t_{ON}	Turn on time	$R_L=500\Omega$	$C_L=0.1\mu F$		655	μs
			$C_L=1\mu F$		710	
			$C_L=3.3\mu F$		782	
t_{OFF}	Turnoff time	$R_L=500\Omega$	$C_L=0.1\mu F$		17	μs
			$C_L=1\mu F$		93	
			$C_L=3.3\mu F$		281	
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$		489	μs
			$C_L=1\mu F$		473	
			$C_L=3.3\mu F$		519	
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$		28	μs
			$C_L=1\mu F$		261	
			$C_L=3.3\mu F$		992	
$V_{IN}=1.8V$						
t_{ON}	Turn on time	$R_L=500\Omega$	$C_L=0.1\mu F$		420	μs
			$C_L=1\mu F$		454	
			$C_L=3.3\mu F$		495	
t_{OFF}	Turnoff time	$R_L=500\Omega$	$C_L=0.1\mu F$		11	μs
			$C_L=1\mu F$		67	
			$C_L=3.3\mu F$		175	
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$		339	μs
			$C_L=1\mu F$		331	
			$C_L=3.3\mu F$		347	
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$		23	μs



DIO7299

Ultra-Small, Low-Input Voltage, Low r_{ON} Load Switch

			$C_L=1\mu F$		225		
			$C_L=3.3\mu F$		757		
$V_{IN}=2.5V$							
t_{ON}	Turn on time	$R_L=500\Omega$	$C_L=0.1\mu F$		317		μs
			$C_L=1\mu F$		341		
			$C_L=3.3\mu F$		366		
t_{OFF}	Turnoff time	$R_L=500\Omega$	$C_L=0.1\mu F$		10		μs
			$C_L=1\mu F$		61		
			$C_L=3.3\mu F$		141		
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$		279		μs
			$C_L=1\mu F$		269		
			$C_L=3.3\mu F$		274		
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$		23		μs
			$C_L=1\mu F$		228		
			$C_L=3.3\mu F$		649		
$V_{IN}=3.0V$							
t_{ON}	Turn on time	$R_L=500\Omega$	$C_L=0.1\mu F$		275		μs
			$C_L=1\mu F$		293		
			$C_L=3.3\mu F$		314		
t_{OFF}	Turnoff time	$R_L=500\Omega$	$C_L=0.1\mu F$		9		μs
			$C_L=1\mu F$		61		
			$C_L=3.3\mu F$		120		
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$		258		μs
			$C_L=1\mu F$		254		
			$C_L=3.3\mu F$		252		
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$		22		μs
			$C_L=1\mu F$		224		
			$C_L=3.3\mu F$		636		
$V_{IN}=3.6V$							
t_{ON}	Turn on time	$R_L=500\Omega$	$C_L=0.1\mu F$		245		μs
			$C_L=1\mu F$		257		
			$C_L=3.3\mu F$		276		
t_{OFF}	Turn off time	$R_L=500\Omega$	$C_L=0.1\mu F$		9		μs
			$C_L=1\mu F$		58		
			$C_L=3.3\mu F$		104		
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$		241		μs



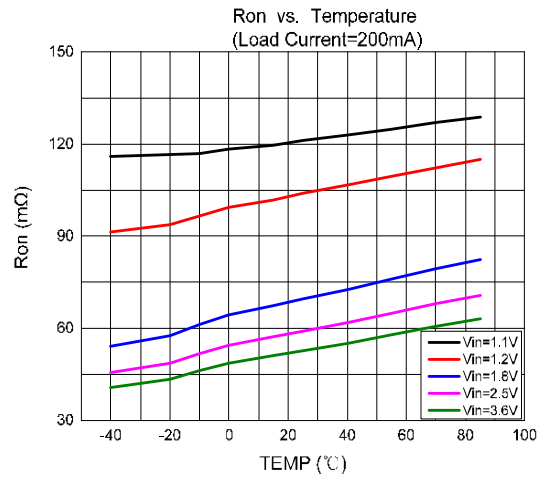
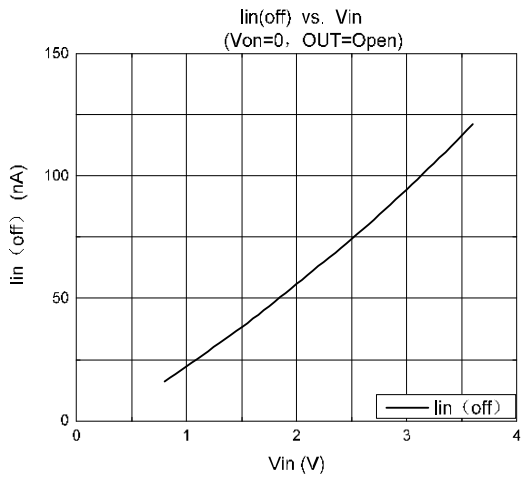
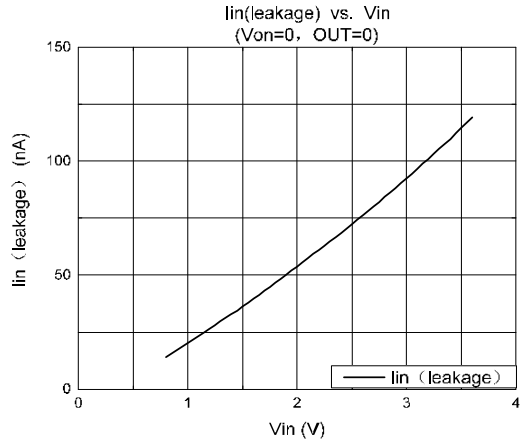
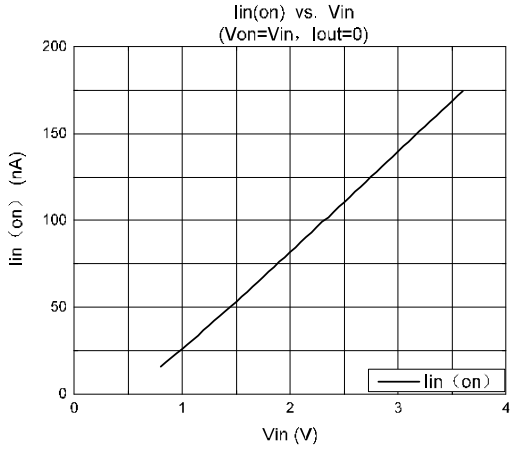
DIO7299

Ultra-Small, Low-Input Voltage, Low r_{ON} Load Switch

			$C_L=1\mu F$		238		
			$C_L=3.3\mu F$		233		
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$		22		μs
			$C_L=1\mu F$		221		
			$C_L=3.3\mu F$		593		
$V_{IN}=4.2V$							
t_{ON}	Turn on time	$R_L=500\Omega$	$C_L=0.1\mu F$		230		μs
			$C_L=1\mu F$		242		
			$C_L=3.3\mu F$		250		
t_{OFF}	Turn off time	$R_L=500\Omega$	$C_L=0.1\mu F$		9		μs
			$C_L=1\mu F$		59		
			$C_L=3.3\mu F$		89		
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$		230		μs
			$C_L=1\mu F$		222		
			$C_L=3.3\mu F$		218		
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$		22		μs
			$C_L=1\mu F$		221		
			$C_L=3.3\mu F$		525		
$V_{IN}=5.0V$							
t_{ON}	Turn on time	$R_L=500\Omega$	$C_L=0.1\mu F$		203		μs
			$C_L=1\mu F$		213		
			$C_L=3.3\mu F$		220		
t_{OFF}	Turn off time	$R_L=500\Omega$	$C_L=0.1\mu F$		8		μs
			$C_L=1\mu F$		50		
			$C_L=3.3\mu F$		73		
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$		220		μs
			$C_L=1\mu F$		216		
			$C_L=3.3\mu F$		207		
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$		21		μs
			$C_L=1\mu F$		213		
			$C_L=3.3\mu F$		489		

Specifications subject to change without notice.

Typical Performance Characteristics



Detailed Description

Overview

DIO7299 is a low ON-state resistance (r_{ON}) load switch with controlled turn on. It contains a P-channel MOSFET and can be turned on with a range of battery from 1.2V to 5.5V. An on/off input (ON) controls the switch, which can interface with low-voltage control signals. A 120Ω on-chip load resistor is added for output quick discharge when the switch is turned off.

Functional Block Diagram

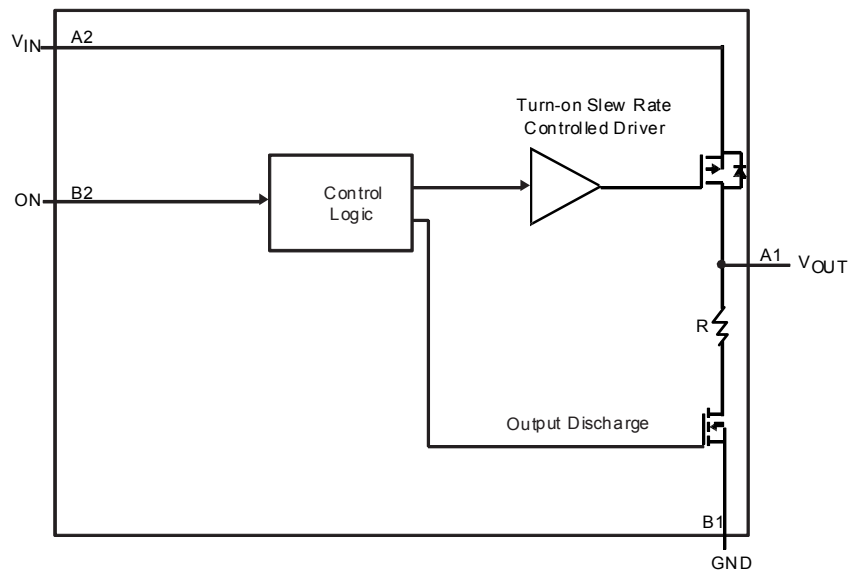


Figure 2. Block Diagram

Feature Description

ON/OFF Control

The state of the switch is controlled by the ON pin. When there is no fault, activating ON can let the switch to be in the on state. ON is active HI and has a low threshold making it capable of interfacing with low-voltage signals. The ON pin is compatible with standard GPIO logic threshold. It can be used with any microcontroller with 1.2V, 1.8V, 2.5V, 3.3V GPIOs.

Device Functional Modes

Table 1 lists the functional modes of the DIO7299.

Table 1. Function Table

ON (Control Input)	V_{IN} to V_{OUT}	V_{OUT} to GND
L	OFF	ON
H	ON	OFF

Application and Implementation

Application Information

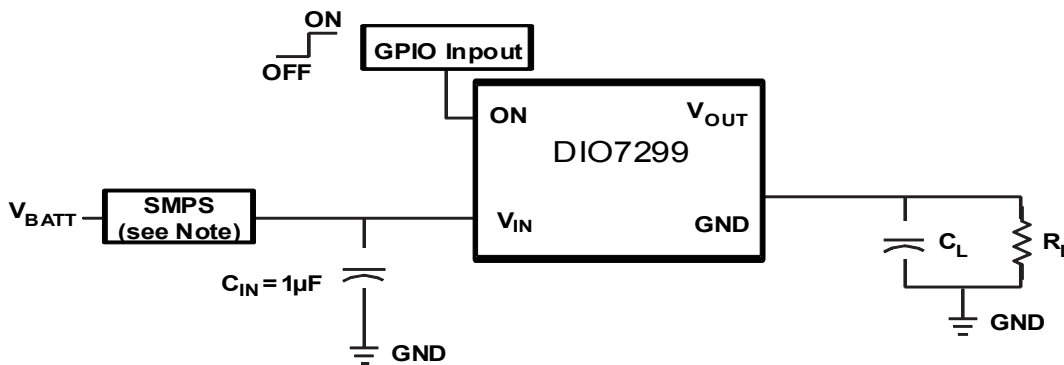
Input Capacitor

When the switch turns on into a discharged load capacitor or short-circuit, a capacitor needs to be placed between V_{IN} and GND to limit the voltage drop on the input supply caused by transient in-rush currents. A $1\mu\text{F}$ ceramic capacitor, C_{IN} , placed close to the pins is usually sufficient. C_{IN} 's higher values can be used to further reduce the voltage drop during high current application. It is recommended to have an input capacitor approximately 10 times higher than the output capacitor to avoid excessive voltage drop when switching heavy loads.

Output Capacitor

A C_{IN} greater than C_L is highly recommended when the integral body diode in the PMOS switch. When the system supply is removed, a C_L greater than C_{IN} can cause V_{OUT} to exceed V_{IN} . This could result in current flow through the body diode from V_{OUT} to V_{IN} .

Typical Application



Note: Switched mode power supply

Figure 3. Powering a Downstream Module

Design Requirements

Table 2 lists the design parameters for the DIO7299 device.

Table 2. Design Parameters

Design Parameter	Example Value
V_{IN}	1.8V
Load Current	0.3A
Ambient Temperature	25°C



DIO7299

Detailed Design Procedure

V_{IN} to V_{OUT} Voltage Drop

The voltage drop from V_{IN} to V_{OUT} is determined by the ON-resistance of the device and the load current. The r_{ON} can be found in Electrical Characteristics and is dependent on temperature. When the value of r_{ON} is found, Equation 1 can be used to calculate the voltage drop across the device:

$$\Delta V = I_{LOAD} \times r_{ON} \quad (1)$$

Where

- ΔV = Voltage drop across the device
- I_{LOAD} = Load current
- r_{ON} = ON-resistance of the device

At $V_{IN}=1.8V$, the DIO7299 has a r_{ON} value of $58m\Omega$. Using this value and the defined load current, the above equation can be evaluated:

$$\Delta V = 0.30 A \times 58 m\Omega \quad (2)$$

Where,

$$\Delta V = 17.4mV$$

Therefore, the voltage drop across the device will be 17.4mV.

Power Supply Recommendations

The DIO7299 is designed to operate with a V_{IN} range of 1.2V to 5.5V. This supply must be well regulated and placed as close to the device terminals as possible. It must also be able to withstand all transient and load currents, using a recommended input capacitance of $1\mu F$ if necessary. If the supply is more than a few inches from the device terminals, additional bulk capacitance may be required in addition to the ceramic bypass capacitors. If additional bulk capacitance is required, an electrolytic, tantalum, or ceramic capacitor of $10\mu F$ may be sufficient.

Layout

Layout Guidelines

All traces should be as short as possible for best performance. To be most effective, the input and output capacitors should be placed close to the DIO7299 to minimize the effects that parasitic trace inductances may have on normal and short circuit operation. Using wide traces for V_{IN} , V_{OUT} , and GND helps minimize the parasitic electrical effects along with minimizing the case to ambient thermal impedance.

Layout Example

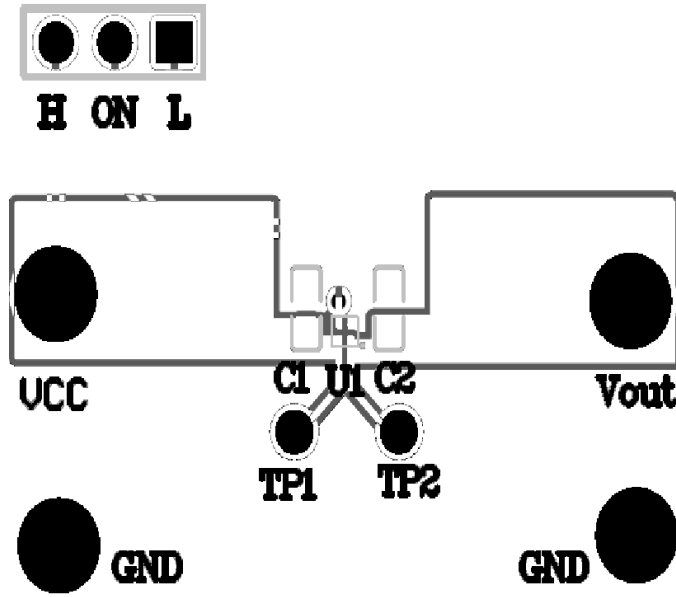
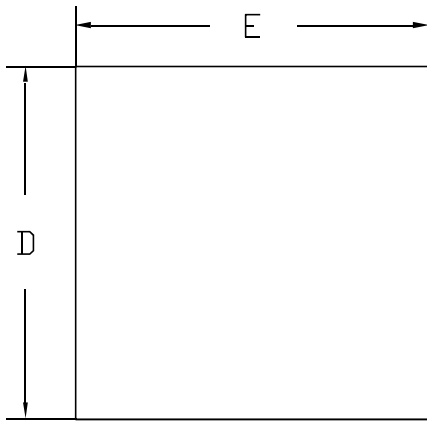
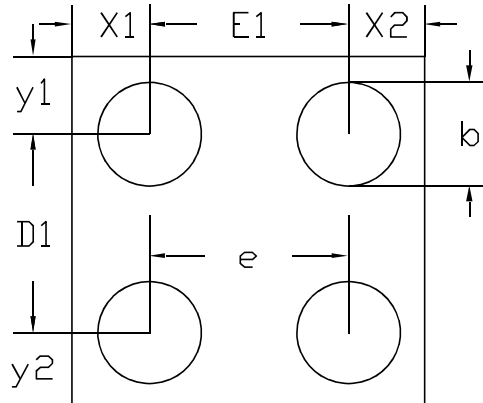


Figure 4. Recommended Board Layout

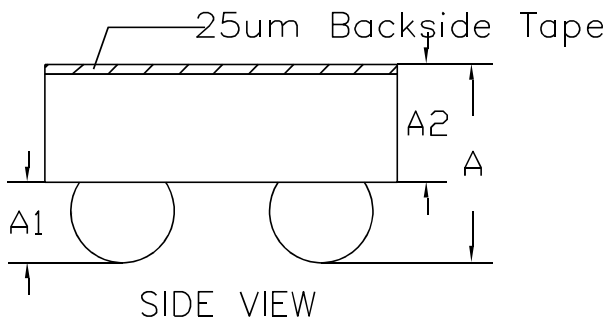
Physical Dimensions: WLCSP-4



TOP VIEW
(MARK SIDE)



BOTTOM VIEW
(BALL SIDE)



SIDE VIEW

COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER)			
Symbol	MIN	NOM	MAX
A	0.460	0.500	0.540
A1	0.182	0.202	0.222
A2	0.278	0.298	0.318
D	0.868	0.888	0.908
D1	0.500 BSC		
E	0.868	0.888	0.908
E1	0.500 BSC		
b	0.230	0.260	0.290
e	0.500 BSC		
x1	0.194 REF		
x2	0.194 REF		
y1	0.194 REF		
y2	0.194 REF		



DIO7299

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CONTACT US

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