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}=36mΩ at V_{IN}=5.0V
  - r_{ON}=38mΩ at V_{IN}=4.2V
  - r_{ON}=39mΩ at V_{IN}=3.6V
  - r_{ON}=46mΩ at V_{IN}=2.5V
  - r_{ON}=58mΩ at V_{IN}=1.8V
  - r_{ON}=150mΩ 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)

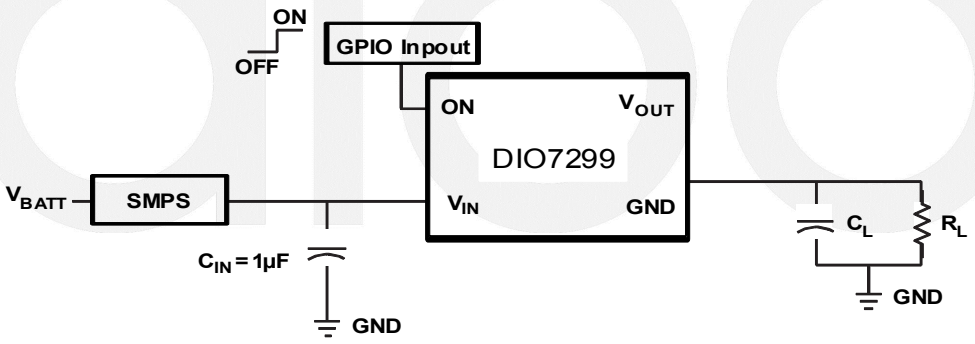
Descriptions

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 120Ω 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

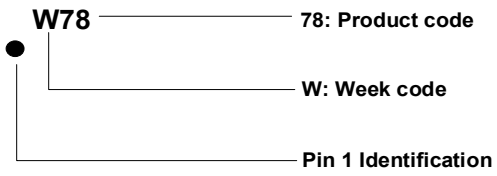
Applications



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

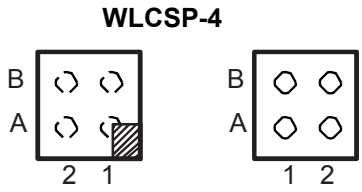


Figure 1. Top View & Bottom View

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

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 maxim 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°C	0.48	W
I_{MAX}	Maximum continuous switch current	2	A
T_A	Operating free air temperature range	-40 to 85	°C
T_{lead}	Maximum lead temperature (10s soldering time)	300	°C
T_{stg}	Storage temperature	-45 to 145	°C
θ_{JA}	Thermal Resistance	189.1	°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

Electrical Characteristics

V_{IN}=1.2V to 5.5V, T_A = -40°C to 85°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		
				Full			85	
			V_{IN}=3.6V	25°C		176		
				Full			212	
			V_{IN}=4.2V	25°C		210		
				Full			255	
			V_{IN}=5.0V	25°C		260		
				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		
				Full			306	
			V_{IN}=3.6V	25°C		92		
				Full			700	
			V_{IN}=4.2V	25°C		110		
				Full			800	
			V_{IN}=5.0V	25°C		145		
				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		
				Full			306	
			V_{IN}=3.6V	25°C		92		
				Full			700	
			V_{IN}=4.2V	25°C		110		
				Full			800	
			V_{IN}=5.0V	25°C		145		
				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		
				Full			51	
			V_{IN}=3.6V	25°C		39		
				Full			55	
			V_{IN}=2.5V	25°C		46		
				Full			65	

			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}=120Ω, T_A = 25°C, unless otherwise specified.

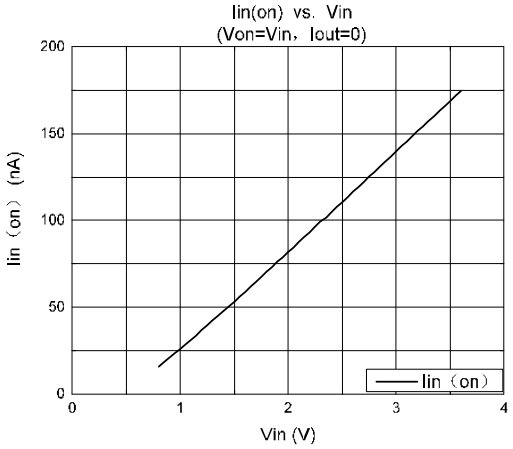
Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
V_{IN}=1.2V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		655		μs
			C_L=1μF		710		
			C_L=3.3μF		782		
t_{OFF}	Turnoff time	R_L=500Ω	C_L=0.1μF		17		μs
			C_L=1μF		93		
			C_L=3.3μF		281		
t_r	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		489		μs
			C_L=1μF	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

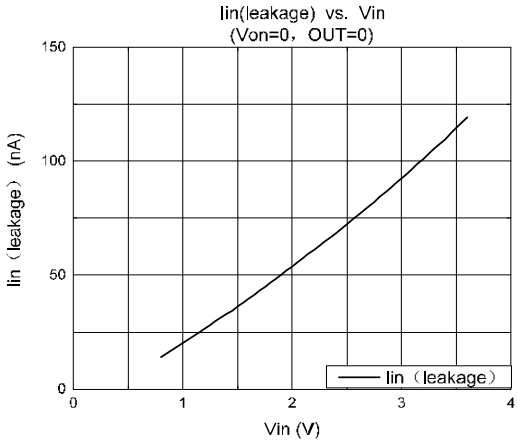
			C_L=1μF		225		
			C_L=3.3μF		757		
V_{IN}=2.5V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		317		μs
			C_L=1μF		341		
			C_L=3.3μF		366		
t_{OFF}	Turnoff time	R_L=500Ω	C_L=0.1μF		10		μs
			C_L=1μF		61		
			C_L=3.3μF		141		
t_r	V_{OUT} rise time	R_L=500Ω	C_L=0.1μF		279		μs
			C_L=1μF		269		
			C_L=3.3μF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

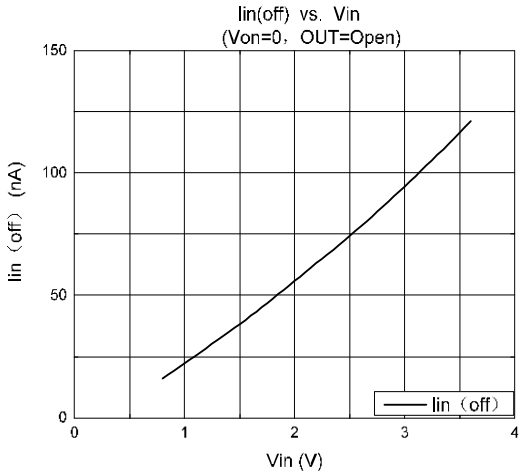
			C_L=1μF		238		
			C_L=3.3μF		233		
t_f	V_{OUT} fall time	R_L=500Ω	C_L=0.1μF		22		μs
			C_L=1μF		221		
			C_L=3.3μF		593		
V_{IN}=4.2V							
t_{ON}	Turn on time	R_L=500Ω	C_L=0.1μF		230		μs
			C_L=1μF		242		
			C_L=3.3μF		250		
t_{OFF}	Turn off time	R_L=500Ω	C_L=0.1μF		9		μs
			C_L=1μF		59		
			C_L=3.3μF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

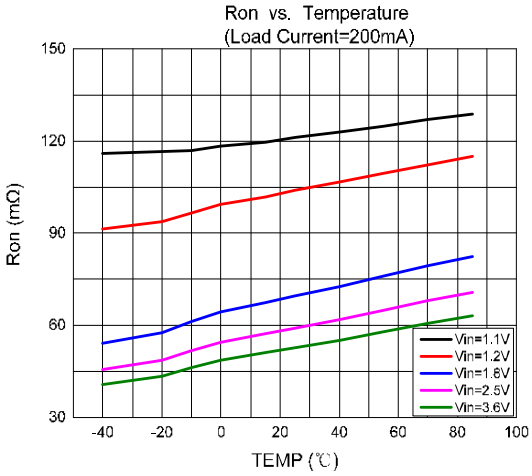
Specifications subject to change without notice.

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

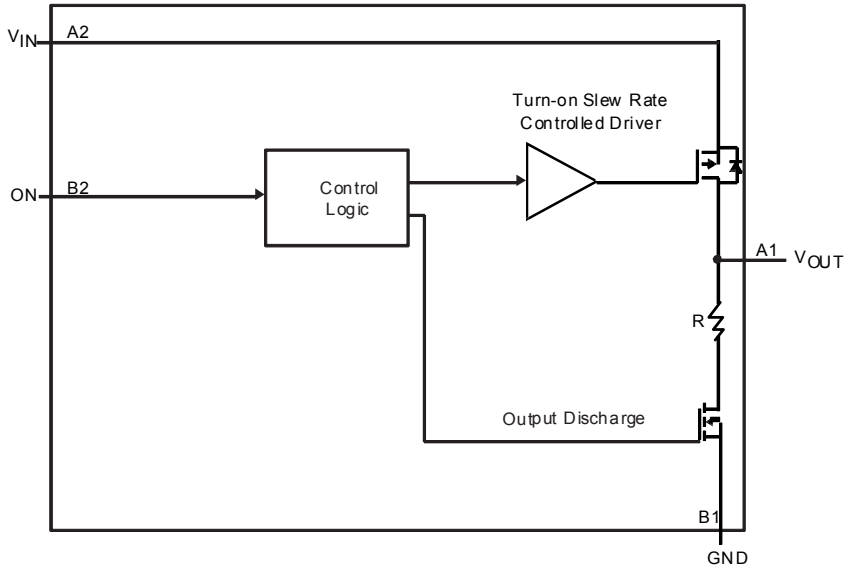


Figure 2. Block Diagram

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

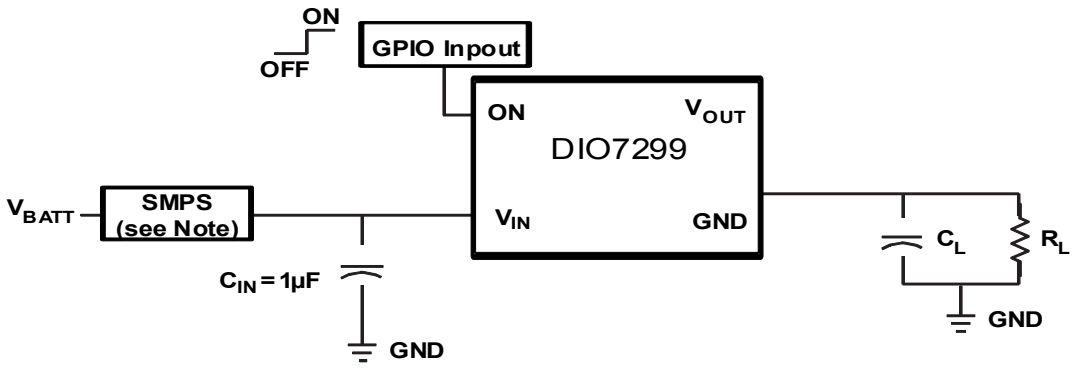
Input Capacitor

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 1μF ceramic capacitor, C_{IN}, place 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

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

- △V= 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 58mΩ. 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,

△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 1μF 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 10μF 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

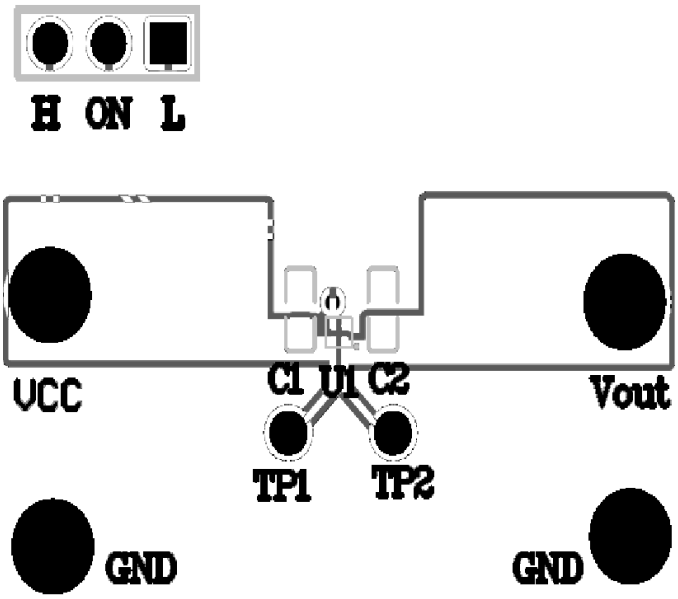


Figure 4. Recommended Board Layout

CONTACT US

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