

DIO7297

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

Features

- Low-Input Voltage: 1.2V to 5.5V
- Ultra-Low ON-State Resistance
 - $r_{ON}=47m\Omega$ at $V_{IN}=5.0V$
 - $r_{ON}=50m\Omega$ at $V_{IN}=4.2V$
 - $r_{ON}=54m\Omega$ at $V_{IN}=3.6V$
 - $r_{ON}=67m\Omega$ at $V_{IN}=2.5V$
 - $r_{ON}=88m\Omega$ at $V_{IN}=1.8V$
 - $r_{ON}=177m\Omega$ at $V_{IN}=1.2V$
- Continuous Switch Current: 500mA (Max.)
- Ultra-Low Quiescent Current: 67nA at 1.8V
- Ultra-Low Shutdown Current: 35nA 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)

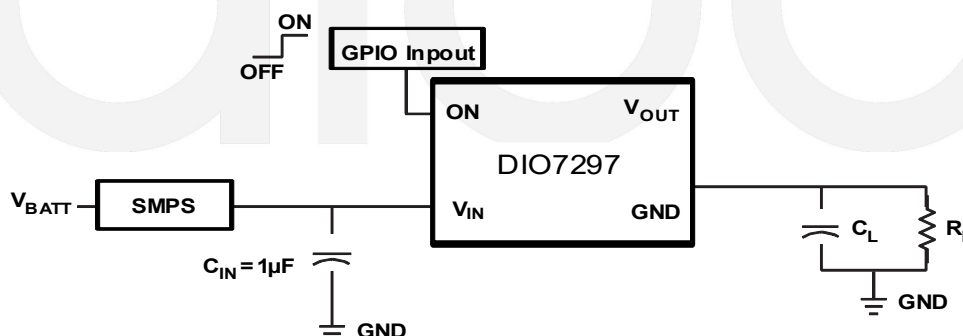
Descriptions

DIO7297 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. DIO7297 is housed in WLCSP-4 with 0.5mm pitch. It operates over the free-air temperature range of -40°C to 85°C.

Applications

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

Applications





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Ordering Information

Order Part Number	Top Marking		T _A	Package	
DIO7297WL4	W76	Green	-40 to 85°C	WLCSP-4	Tape & Reel, 3000

Pin Assignment

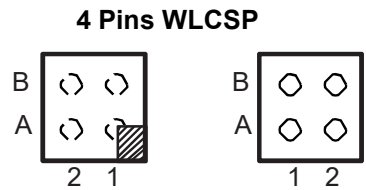


Figure 1 Top View & Bottom View

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 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	500	mA
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
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 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



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Electrical Characteristics

$V_{IN}=1.0V$ 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	30		nA
				Full		44	
			$V_{IN}=1.8V$	25°C	67		nA
				Full		87	
			$V_{IN}=3.6V$	25°C	182		nA
				Full		220	
			$V_{IN}=4.2V$	25°C	221		nA
				Full		262	
			$V_{IN}=5.0V$	25°C	272		nA
				Full		325	
$I_{IN(OFF)}$	OFF-state supply current	$V_{ON}=GND$, $OUT=Open$	$V_{IN}=1.2V$	25°C	16		nA
				Full		180	
			$V_{IN}=1.8V$	25°C	35		nA
				Full		261	
			$V_{IN}=3.6V$	25°C	93		nA
				Full		629	
			$V_{IN}=4.2V$	25°C	115		nA
				Full		898	
			$V_{IN}=5.0V$	25°C	146		nA
				Full		1161	
$I_{IN(LEAKAGE)}$	OFF-state switch current	$V_{ON}=GND$, $V_{OUT}=0$	$V_{IN}=1.2V$	25°C	16		nA
				Full		180	
			$V_{IN}=1.8V$	25°C	35		nA
				Full		261	
			$V_{IN}=3.6V$	25°C	93		nA
				Full		629	
			$V_{IN}=4.2V$	25°C	115		nA
				Full		898	
			$V_{IN}=5.0V$	25°C	146		nA
				Full		1161	
R_{ON}	ON-state resistance	$I_{OUT}=-200mA$	$V_{IN}=5.0V$	25°C	47		mΩ
				Full		62	
			$V_{IN}=4.2V$	25°C	50		mΩ
				Full		66	
			$V_{IN}=3.6V$	25°C	54		mΩ
				Full		70	
			$V_{IN}=2.5V$	25°C	67		mΩ
				Full			



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			Full			86	
			25°C		88		
			Full			111	
			25°C		177		
			Full			195	
R_{PD}	Output pulldown resistance	$V_{IN}=3.3V, V_{ON}=0, I_{OUT}=30mA$	25°C		92	120	Ω
I_{ON}	ON input leakage current	$V_{ON}=1.1V$ 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}	Turnon time	$R_L=500\Omega$	$C_L=0.1\mu F$		827	μs
			$C_L=1\mu F$		908	
			$C_L=3.3\mu F$		993	
t_{OFF}	Turnoff time	$R_L=500\Omega$	$C_L=0.1\mu F$		16	μs
			$C_L=1\mu F$		103	
			$C_L=3.3\mu F$		271	
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$		371	μs
			$C_L=1\mu F$		359	
			$C_L=3.3\mu F$		389	
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$		28	μs
			$C_L=1\mu F$		276	
			$C_L=3.3\mu F$		875	
$V_{IN}=1.8V$						
t_{ON}	Turnon time	$R_L=500\Omega$	$C_L=0.1\mu F$		524	μs
			$C_L=1\mu F$		577	
			$C_L=3.3\mu F$		633	
t_{OFF}	Turnoff time	$R_L=500\Omega$	$C_L=0.1\mu F$		10	μs
			$C_L=1\mu F$		72	
			$C_L=3.3\mu F$		164	
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$		241	μs
			$C_L=1\mu F$		234	
			$C_L=3.3\mu F$		247	



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t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$		23		μs
			$C_L=1\mu F$		240		
			$C_L=3.3\mu F$		696		
$V_{IN}=2.5V$							
t_{ON}	Turnon time	$R_L=500\Omega$	$C_L=0.1\mu F$		376		μs
			$C_L=1\mu F$		417		
			$C_L=3.3\mu F$		453		
t_{OFF}	Turnoff time	$R_L=500\Omega$	$C_L=0.1\mu F$		9		μs
			$C_L=1\mu F$		65		
			$C_L=3.3\mu F$		143		
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$		189		μs
			$C_L=1\mu F$		182		
			$C_L=3.3\mu F$		185		
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$		22		μs
			$C_L=1\mu F$		238		
			$C_L=3.3\mu F$		640		
$V_{IN}=3.0V$							
t_{ON}	Turnon time	$R_L=500\Omega$	$C_L=0.1\mu F$		314		μs
			$C_L=1\mu F$		350		
			$C_L=3.3\mu F$		384		
t_{OFF}	Turnoff time	$R_L=500\Omega$	$C_L=0.1\mu F$		9		μs
			$C_L=1\mu F$		62		
			$C_L=3.3\mu F$		126		
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$		169		μs
			$C_L=1\mu F$		167		
			$C_L=3.3\mu F$		161		
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$		22		μs
			$C_L=1\mu F$		239		
			$C_L=3.3\mu F$		613		
$V_{IN}=3.6V$							
t_{ON}	Turnon time	$R_L=500\Omega$	$C_L=0.1\mu F$		268		μs
			$C_L=1\mu F$		297		
			$C_L=3.3\mu F$		319		
t_{OFF}	Turnoff time	$R_L=500\Omega$	$C_L=0.1\mu F$		8		μs
			$C_L=1\mu F$		61		
			$C_L=3.3\mu F$		107		



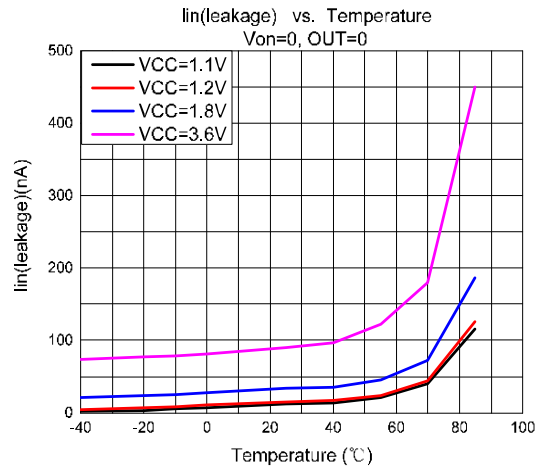
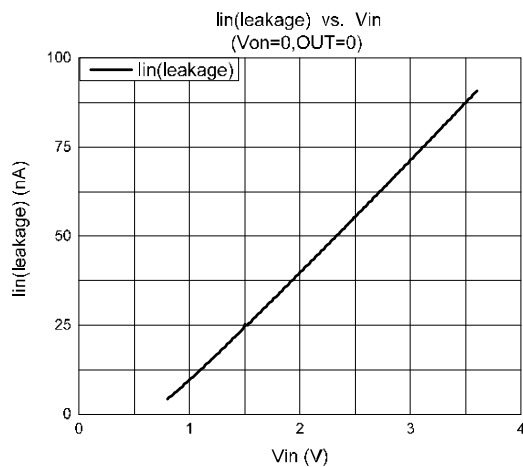
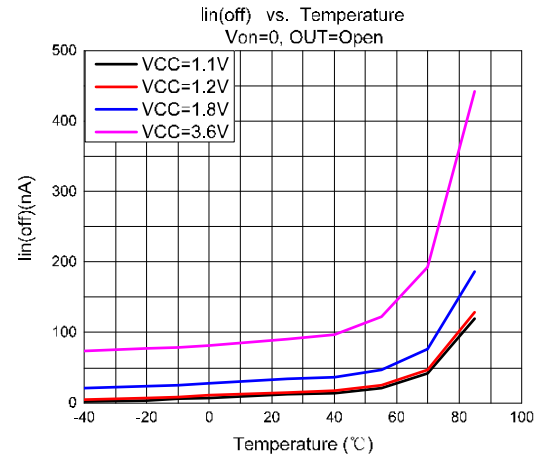
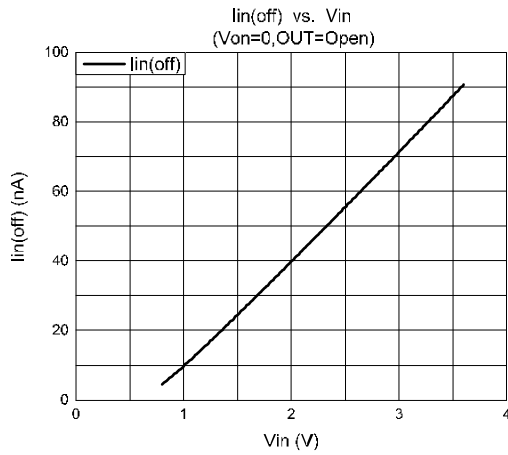
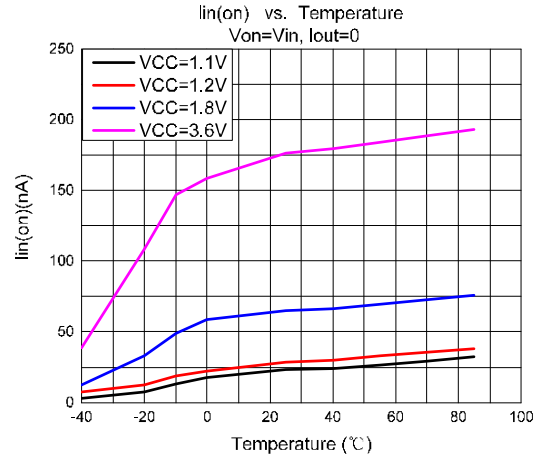
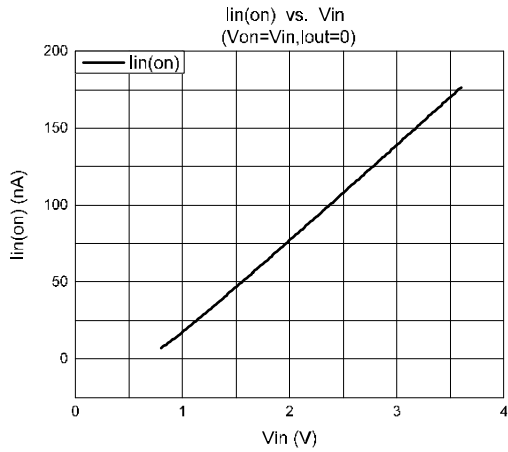
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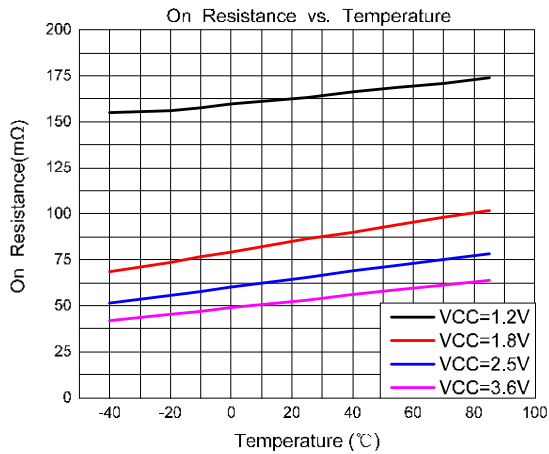
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t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$	157	μs
			$C_L=1\mu F$	149	
			$C_L=3.3\mu F$	145	
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$	22	μs
			$C_L=1\mu F$	228	
			$C_L=3.3\mu F$	571	
$V_{IN}=4.2V$					
t_{ON}	Turnon time	$R_L=500\Omega$	$C_L=0.1\mu F$	236	μs
			$C_L=1\mu F$	263	
			$C_L=3.3\mu F$	282	
t_{OFF}	Turnoff time	$R_L=500\Omega$	$C_L=0.1\mu F$	8	μs
			$C_L=1\mu F$	56	
			$C_L=3.3\mu F$	87	
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$	145	μs
			$C_L=1\mu F$	141	
			$C_L=3.3\mu F$	130	
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$	21	μs
			$C_L=1\mu F$	225	
			$C_L=3.3\mu F$	528	
$V_{IN}=5.0V$					
t_{ON}	Turnon time	$R_L=500\Omega$	$C_L=0.1\mu F$	202	μs
			$C_L=1\mu F$	226	
			$C_L=3.3\mu F$	240	
t_{OFF}	Turnoff time	$R_L=500\Omega$	$C_L=0.1\mu F$	8	μs
			$C_L=1\mu F$	55	
			$C_L=3.3\mu F$	81	
t_r	V_{OUT} rise time	$R_L=500\Omega$	$C_L=0.1\mu F$	136	μs
			$C_L=1\mu F$	130	
			$C_L=3.3\mu F$	123	
t_f	V_{OUT} fall time	$R_L=500\Omega$	$C_L=0.1\mu F$	21	μs
			$C_L=1\mu F$	222	
			$C_L=3.3\mu F$	484	

Specifications subject to change without notice.

Typical Performance Characteristics





Detailed Description

Overview

DIO7297 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 1.0V 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

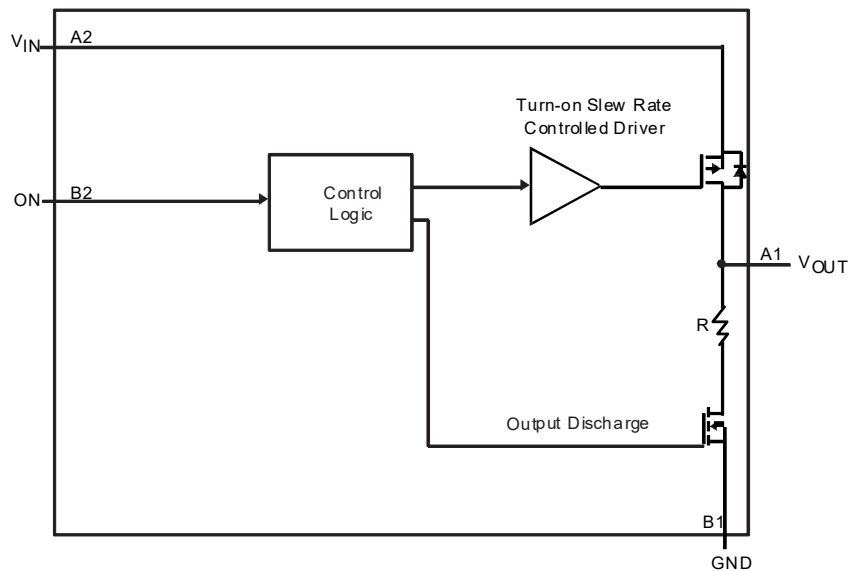


Figure 2. Block Diagram

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 or 5.0V GPIOs.

Device Functional Modes

Table 1 lists the functional modes of the DIO7297.

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

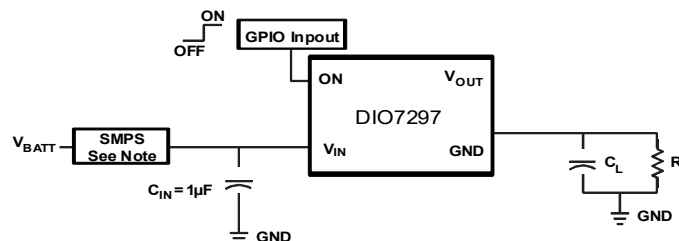
Input Capacitor

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 DIO7297 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

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

At $V_{IN}=1.8V$, the DIO7297 has a r_{ON} value of $88m\Omega$. Using this value and the defined load current, the above equation can be evaluated:

$$\Delta V = 0.30A \times 88m\Omega \quad (2)$$

Where

- $\Delta V = 26.4mV$

Therefore, the voltage drop across the device will be 24.9mV.

Power Supply Recommendations

The DIO7297 is designed to operate with a V_{IN} range of 1V 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 DIO7297 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

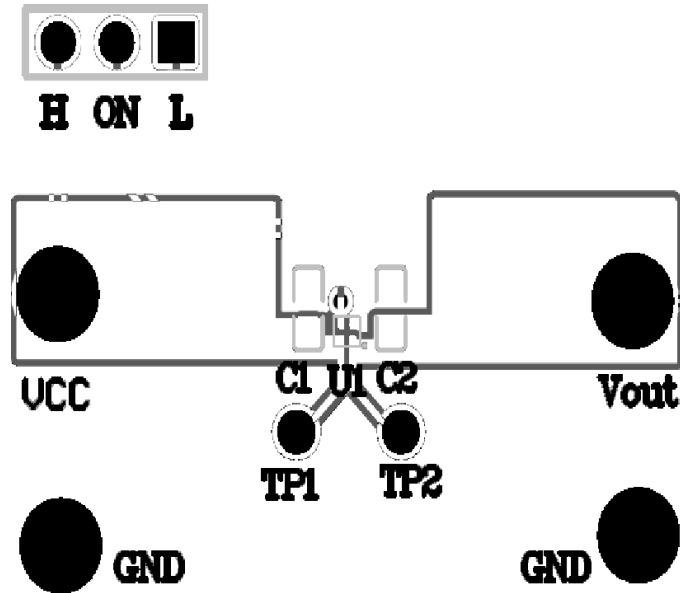


Figure 4. Recommended Board Layout



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CONTACT US

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