DIO7004

5.5 V Low Loss Power Distribution Switch

Features

- Input voltage: 2.7 V to 5.5 V
- Typical 75 mΩ on-resistance
- Six different continuous current versions
- Undervoltage lockout
- Over current protection, short circuit protection and over temperature protection
- Fault time 4 ms typically with blanking
- Reverse blocking (no body diode)
- No reverse current when power ON or power OFF
- Enable polarity: active high or active low
- Quick output discharge
  DIO7004: available
  DIO7004N: not available
- Green SOT23-5, SOIC-8, EP-MSOP8 and MSOP-8 packages
- UL certification file No. E483954
- CB certification file No. DK-122853-UL

Applications

- USB ports/Hubs
- Digital TV
- Set-top boxes
- VOIP phones

Descriptions

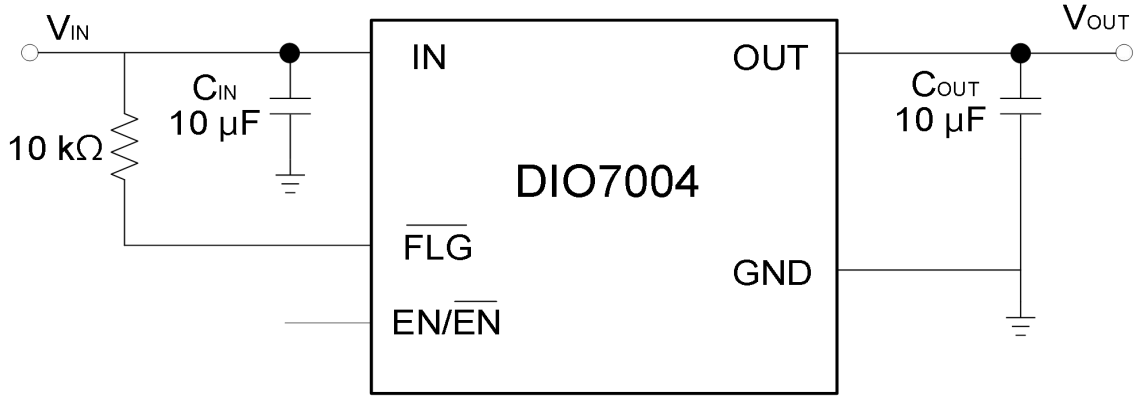
The DIO7004 power distribution switch is intended for applications where precision current limiting is required or heavy capacitive loads and short circuits are encountered. The power switch rising and falling times are controlled to minimize current surges during turning on/off.

The DIO7004A/B/C/D/E/W provide separately 350 mA/700 mA/1 A/1.5 A/2 A/1.3 A six current levels.

The DIO7004 device limits the output current under a safe level by using a constant current mode when the output load exceeds the current limit threshold.

The DIO7004 is available in the SOT23-5, SOIC-8, EP-MSOP8 and MSOP-8 packages. It is rated over the -40°C to 85°C temperature range.

Typical Application



Ordering Information

Order Part Number	Top Marking	Output Discharge Resistance	MSL	RoHS	T_A	Package	
DIO7004abST5	4abW	Yes	3	Green	-40 to + 85°C	SOT23-5	Tape & Reel, 3000
DIO7004NabST5	NabW	No	3	Green	-40 to + 85°C	SOT23-5	Tape & Reel, 3000
DIO7004abSO8	D704ab	Yes	3	Green	-40 to + 85°C	SOIC-8	Tape & Reel, 2500
DIO7004NabSO8	D70Nab	No	3	Green	-40 to + 85°C	SOIC-8	Tape & Reel, 2500
DIO7004abXM8	D704ab	Yes	3	Green	-40 to + 85°C	EP-MSOP8	Tape & Reel, 3000
DIO7004NabXM8	D70Nab	No	3	Green	-40 to + 85°C	EP-MSOP8	Tape & Reel, 3000
DIO7004abMP8	D704ab	Yes	3	Green	-40 to + 85°C	MSOP-8	Tape & Reel, 3000
DIO7004NabMP8	D70Nab	No	3	Green	-40 to + 85°C	MSOP-8	Tape & Reel, 3000

Ordering Information Complimentary Note

Ordering Number = Part No. + a：Enable Active Version + b：Continuous Current Version + Package Code

Part No.:
- DIO7004
- DIO7004N

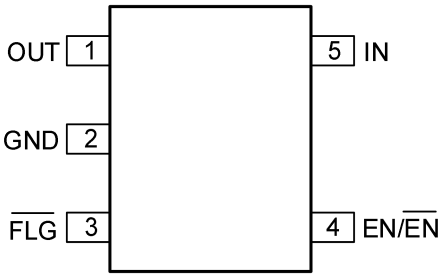
a：Enable Active Version:
- H: Enable Active High
- L: Enable Active Low

b：Continuous Current Version:
- A: 350 mA Continuous current version
- B: 700 mA Continuous current version
- C: 1 A Continuous current version
- D: 1.5 A Continuous current version
- E: 2 A Continuous current version
- W: 1.3 A Continuous current version

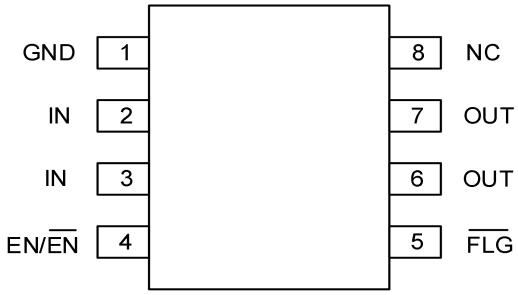
Package Code:
- ST5: Stands for SOT23-5
- SO8: Stands for SOIC-8
- XM8: Stands for EP-MSOP8
- MP8: Stands for MSOP-8

Pin Assignments

SOT23-5(Top view)



SOIC-8/MSOP-8 (Top view)



EP-MSOP8 (Top view)

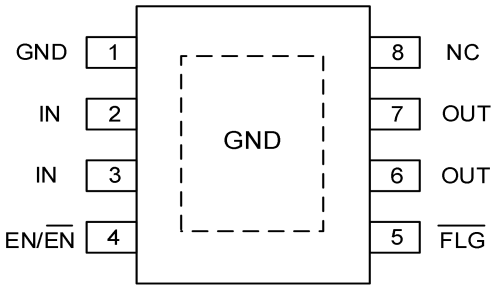


Figure 1 Pin assignment

Pin Description

Pin Name	Pin Description
OUT	Output pin, decoupled with a 10 μF capacitor to GND
GND	Ground pin
/FLG	Fault flag output
EN, /EN	Active high or Active low. Do not leave it floating
IN	Input pin, decoupled with a 10 μF capacitor to GND

Absolute Maximum Ratings

Stresses beyond those listed under the Absolute Maximum Rating table 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
	All Pins		-0.3 to 6	V
θ_{JA}	Package Thermal Resistance	θ_{JA} ,SOT23-5	250	°C/W
		θ_{JA} ,SOIC-8	130	
		θ_{JA} , EP-MSOP8	100	
		θ_{JA} , MSOP-8	166	
T_J	Junction Temperature Range		150	°C
T_L	Lead Temperature (Soldering, 10 sec)		260	°C
T_{STG}	Storage Temperature Range (T_{STG})		-65 to 150	°C
ESD	HBM (Human Body Mode)		±6	kV
	CDM (Charged Device Mode)		±2	

Note:

(1) Input and output negative ratings may be exceeded if input and output diode current ratings are observed.

Recommended 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
	IN	2.7 to 5.5	V
	All Other Pins	0 to 5.5	V
T_J	Junction Temperature Range	-40 to 125	°C
T_A	Ambient Temperature Range	-40 to 85	°C

Electrical Characteristics

T_A = 25°C, V_{IN} = 5 V, unless otherwise noted.

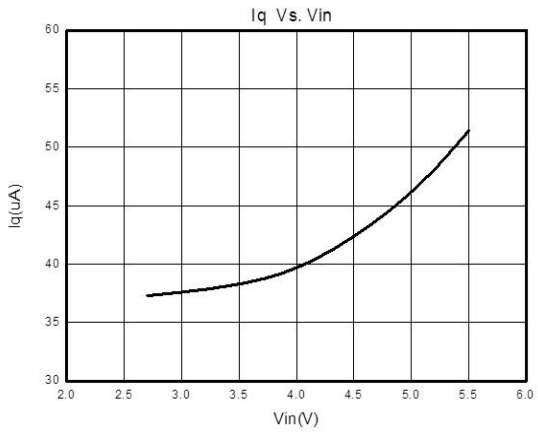
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage Range		2.7		5.5	V
I_{SHDN}	Shut Down Input Current	Open Load, IC Disabled		0.2	1	μA
I_Q	Quiescent Supply Current	Open Load, IC Enabled		50	88	μA
$R_{DS(ON)}$	FET R_{ON}	I_{OUT} = 100 mA		75	99	mΩ
$V_{EN(H)}$	EN Rising Threshold	V_{IN} = 2.7 V to 5.5 V	1.4			V
$V_{EN(L)}$	EN Falling Threshold	V_{IN} = 4.5 V to 5.5 V			0.6	V
		V_{IN} = 2.7 V to 4.5 V			0.5	
I_{EN}	EN Leakage Current	V_{EN} = 5.0 V			1	μA
V_{IN_UVLO}	IN UVLO Threshold				2.5	V
V_{IN_HYS}	IN UVLO Hysteresis			240	400	mV
I_{LIM}	Current Limit	DIO7004 - A	0.375	0.5	0.625	A
		DIO7004 - B	0.75	1	1.25	
		DIO7004 - C	1.1	1.5	1.9	
		DIO7004 - D	1.5	2	2.5	
		DIO7004 - E	2.1	2.5	3.1	
		DIO7004 - W	1.05	1.275	1.5	
I_{SHORT}	Short-Circuit Current Limit	Enabled, Output Short to Ground		30%		I_{LIM}
T_{ON}	Turn-on Time	R_L = 10 Ω, C_{OUT} = 1 μF		400		μs
T_{OFF}	Turn-off Time	R_L = 10 Ω, C_{OUT} = 1 μF		20		μs
T_{SD}	Thermal Shut Down Temperature			140		°C
	Thermal Shut Down Hysteresis			20		°C
R_{DIS}	Discharge Resistance			600		Ω

Note:

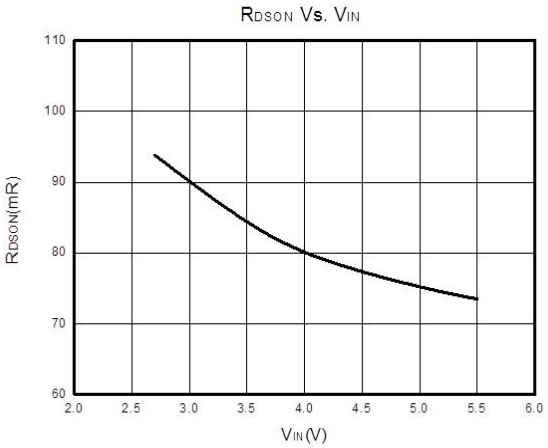
(1) Specifications subject to change without notice.

Typical Performance Characteristics

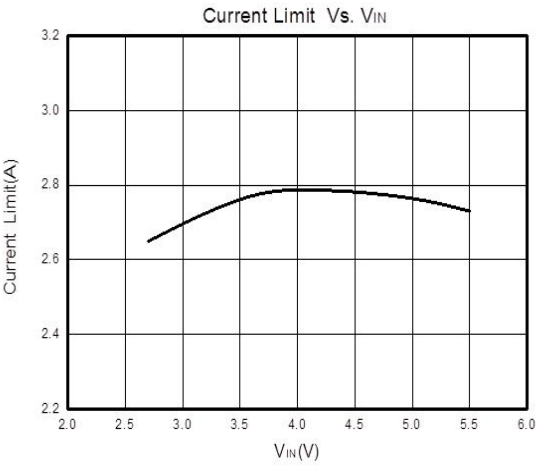
T_A = 25°C, V_{IN} = 5 V, unless otherwise noted.



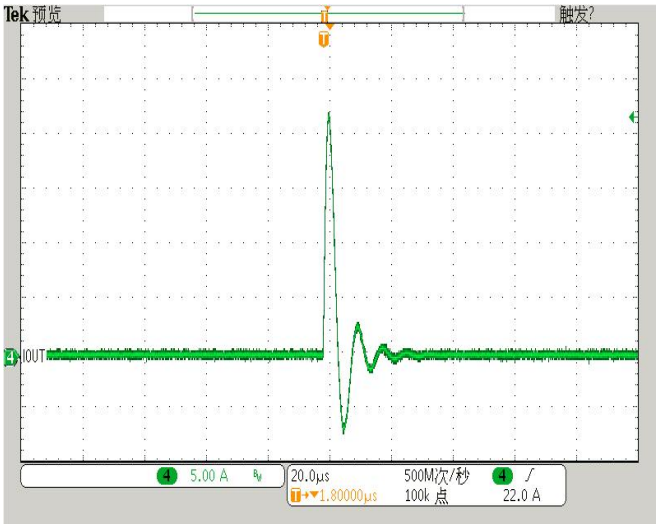
I_Q



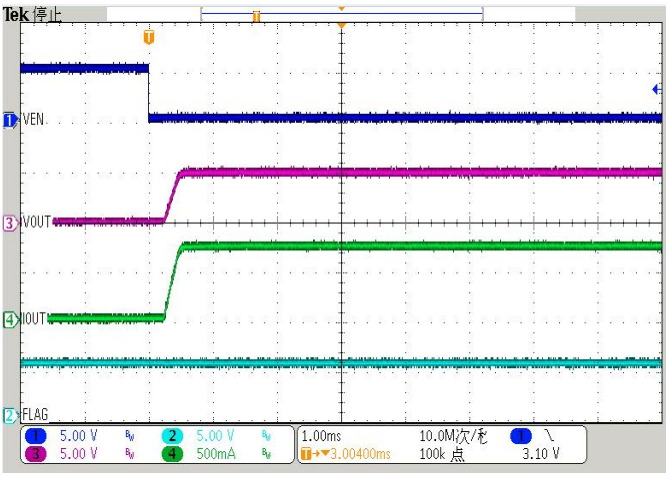
R_{DSON}



Current limit

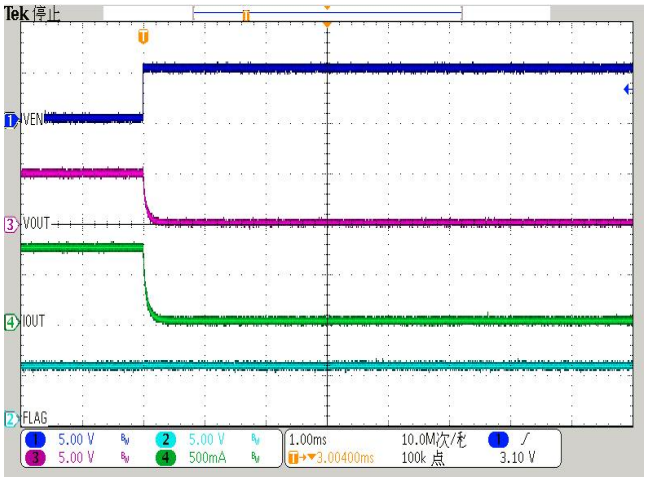


Output short response



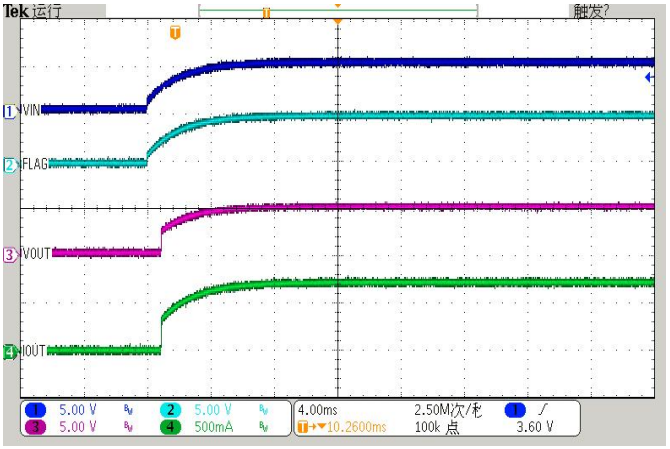
(I_{Load} = 0.7 A, V_{IN} = 5 V, R = 7 Ω)

EN turn on for DIO7004HC



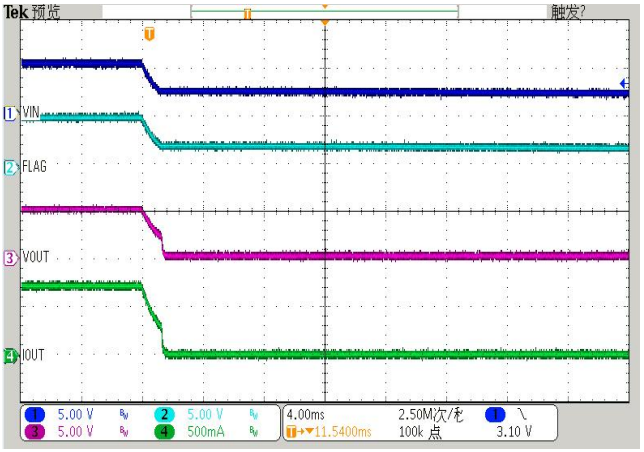
(I_{Load} = 0.7 A, V_{IN} = 5 V, R = 7 Ω)

EN turn off for DIO7004HC



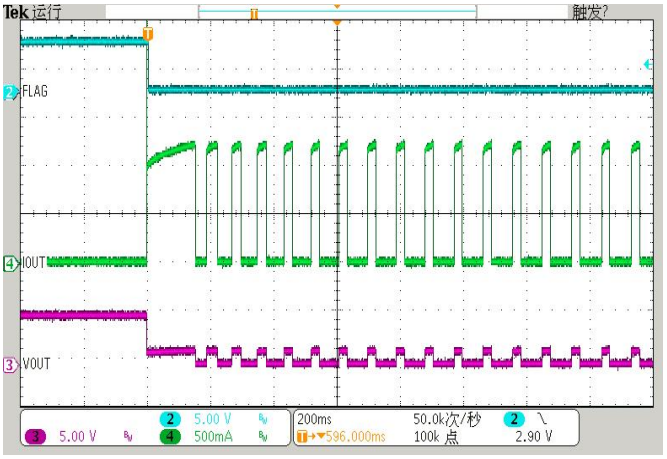
(I_{Load} = 0.7 A, V_{IN} = 5 V, R = 7 Ω)

UVLO turn on for DIO7004HC



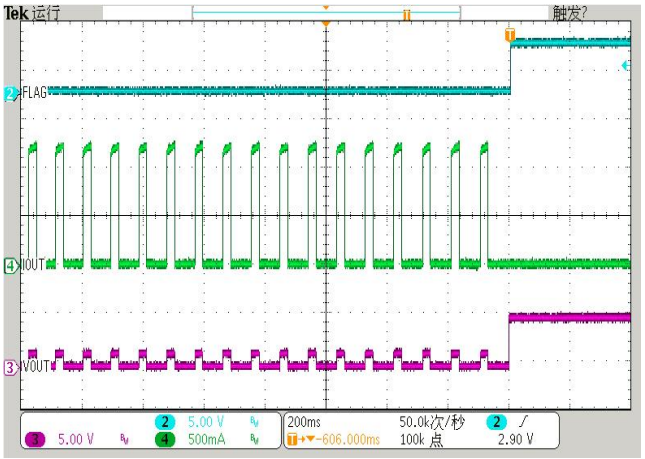
(I_{Load} = 0.7 A, V_{IN} = 5 V, R = 7 Ω)

UVLO turn off for DIO7004HC



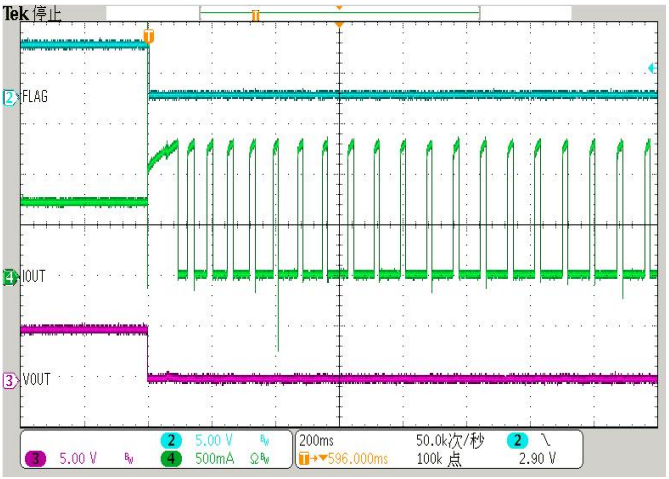
(V_{IN} = 5 V, R = 1 Ω)

No-load to over-load transient response for DIO7004HC



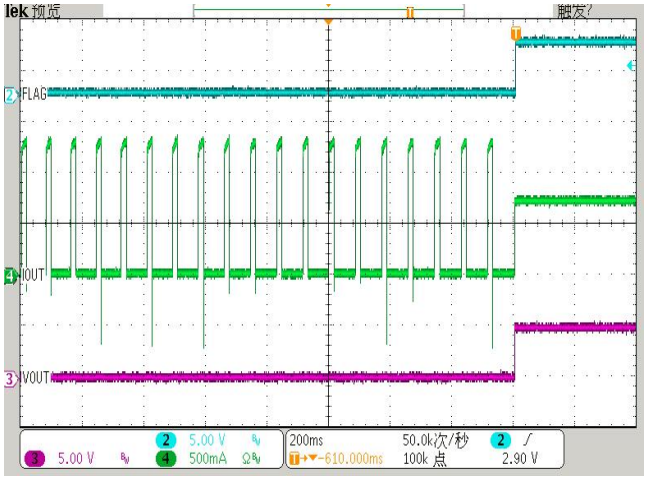
(V_{IN} = 5 V, R = 1 Ω)

Over-load to no-load recovery response for DIO7004HC



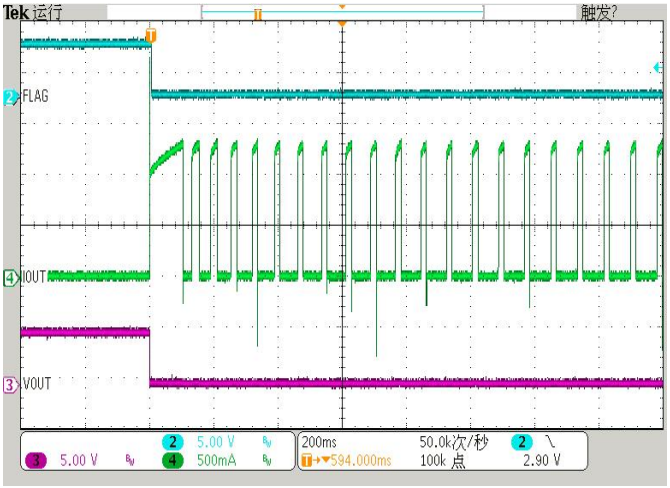
(I_{Load} = 0.7 A, V_{IN} = 5 V)

Full-load to short-circuit transient response for DIO7004HC



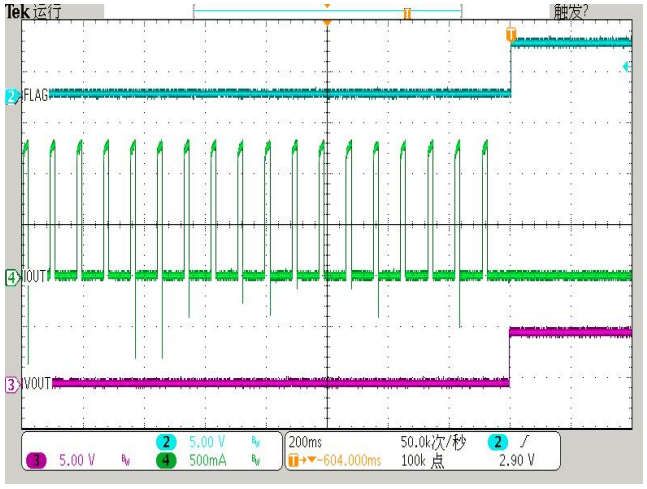
(I_{Load} = 0.7 A, V_{IN} = 5 V)

Short-circuit to full-load recovery response for DIO7004HC



(V_{IN} = 5 V)

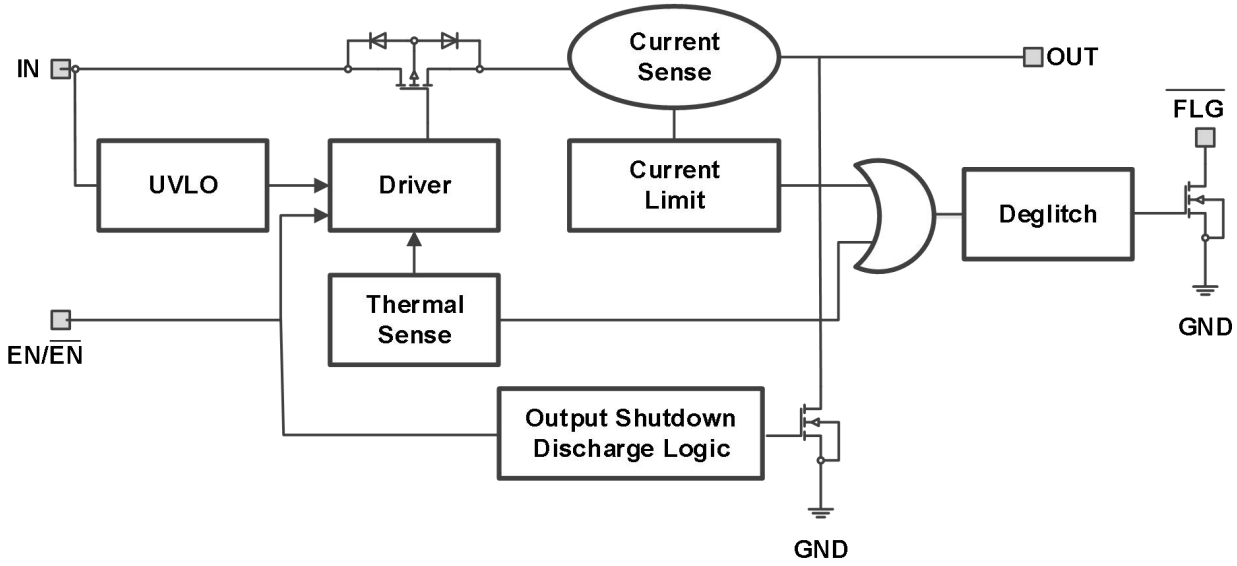
No-load to short-circuit transient response for DIO7004HC



(V_{IN} = 5 V)

Short-circuit to no-load recovery response for DIO7004HC

Block Diagram



Application Information

Power supply considerations

A 10 μF ceramic capacitor from V_{IN} to GND to prevent the input voltage from dropping during the hot-plug condition is strongly recommended. However higher capacitance could help reduce the voltage drop. Further more, bypassing the output with a 10 μF ceramic capacitor improves the immunity of the device to short-circuit transients, because an output short will cause ringing on the input without the input capacitor. It could destroy the internal circuitry when the input transient voltage exceeds the absolute maximum supply voltage even for a short duration.

Undervoltage lockout

A voltage sense circuit monitors the input voltage. When the input voltage is below approximately 2.4 V, a control signal turns off the power switch.

Enable

The logic enable controls the power switch, the bias for the charge pump, driver, and other circuitry to reduce the supply current. The EN control pin must be driven to a logic high or logic low for a clearly defined signal input. Floating these control lines may cause unpredictable operation.

Over-current protection

The DIO7004 responds to over current conditions by limiting output current to the I_{LIM} levels. When an over current condition is detected, the device maintains a constant output current and reduces the output voltage accordingly. Complete shut down occurs only if the fault is present long enough to activate thermal limit.

Three possible overload conditions can occur. In the first condition, the output has been shorted to GND before

the device is enabled or before VIN has been applied. The DIO7004 senses the short circuit and immediately clamps output current to a certain safe level.

In the second condition, an excessive load occurs while the device is enabled. When the excessive load occurs, very high currents may flow for a short time before the current limit circuit can react. After the current limit circuit has tripped (reached the overcurrent trip threshold) the device switches into constant current mode to limit the current close to $I_{LIM.}$

In the third condition the load is gradually increasing beyond the recommended operating current. The current is permitted to rise until the currentlimit threshold (I_{LIM}) is reached or until the thermal limit of the device is exceeded. The DIO7004 is capable of delivering current up to the current limit threshold (I_{LIM}) without damaging the device. Once the threshold has been reached, the device switches into its constant current mode.

Thermal protection

Thermal protection prevents damage to the IC when heavy overload or short circuit conditions are present for extended periods of time. The conditions force the DIO7004 into constant current mode, and under short circuit conditions, the voltage across the switch is equal to the input voltage. The increased dissipation causes the junction temperature to rise to high levels. The protection circuit senses the junction temperature of the switch and shuts it off. Hysteresis is built into the thermal sense circuit, and after the device has cooled approximately 20 degrees, the switch turns back on. The switch continues to cycle in this way until the overload or input power is removed.

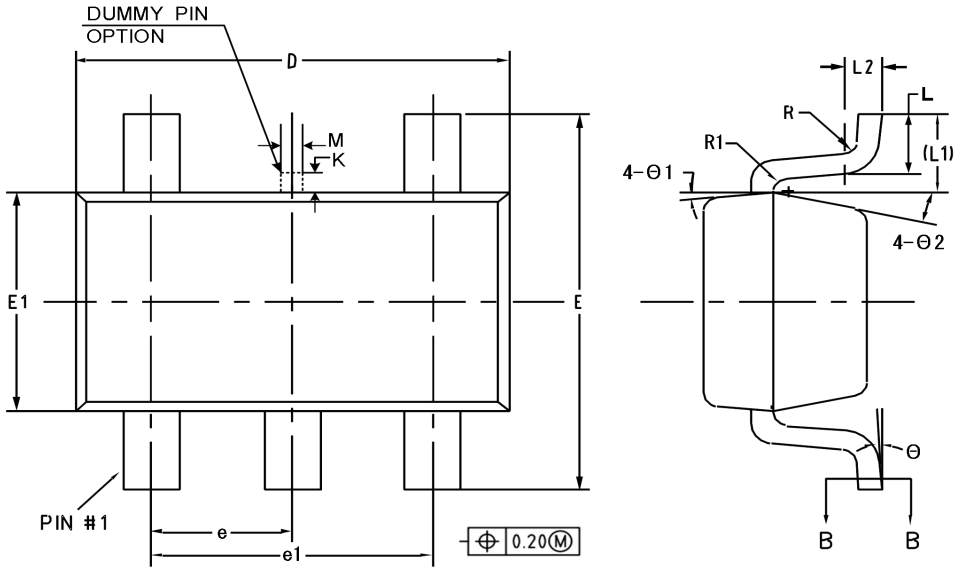
Reverse-voltage protection

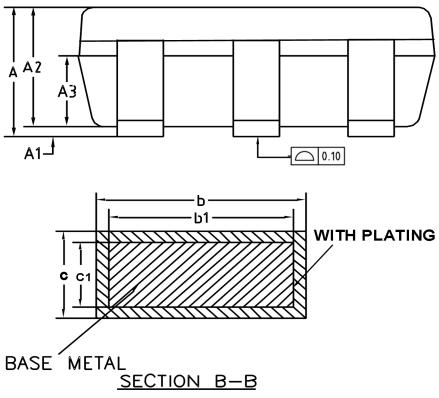
The reverse-voltage protection feature turns off the P-channel MOSFET whenever the output voltage exceeds the input voltage by 175 mV (typ) for 4 ms (typ). A reverse current of $(V_{OUT}-V_{IN})/R_{DS(on)}$ will be present when this occurs. This prevents damage to devices on the input side of the DIO7004 by preventing significant current from sinking into the input capacitance. The DIO7004 devices allow the P-channel MOSFET to turn on once the output voltage goes bellow the input voltage for the same 4 ms deglitch time.

FLG output

An error flag is an open-drained output of an N-channel MOSFET. Flag output is pulled low when the below conditions happen: input under voltage lockout, output current limit, output short circuit and over temperature shut down. The flag response delay time is 4 ms typically.

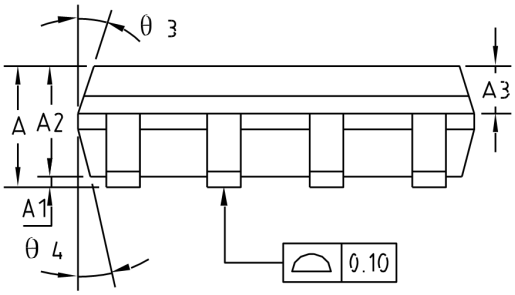
Physical Dimensions: SOT23-5

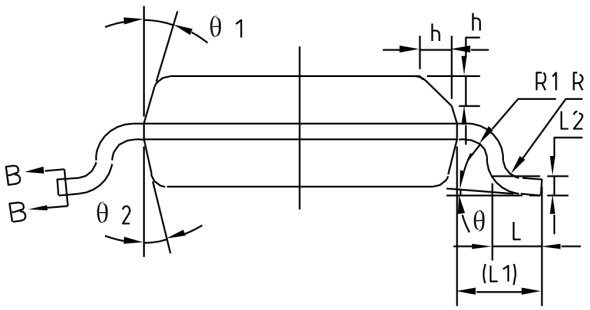


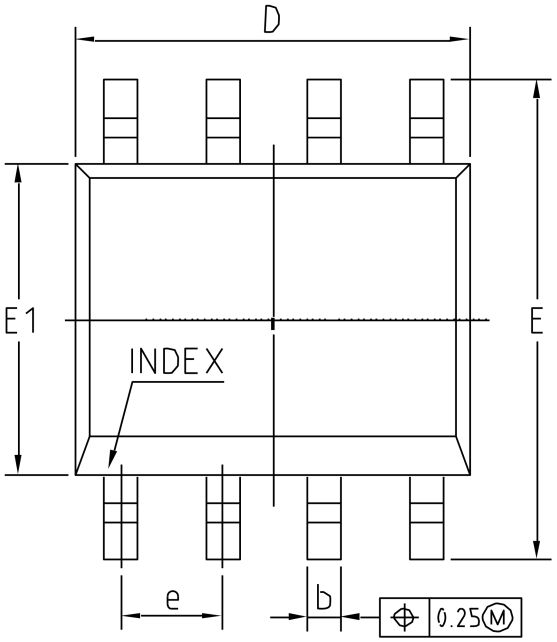


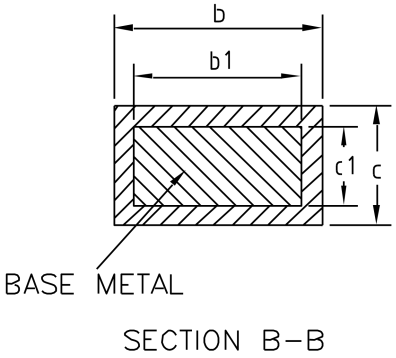
Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.25
A1	0	-	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	-	0.45
b1	0.35	0.38	0.41
c	0.14	-	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
K	0	-	0.25
L	0.30	0.40	0.60
L1	0.59 REF		
L2	0.25 BSC		
M	0.10	0.15	0.25
R	0.05	-	0.20
R1	0.05	-	0.20
Θ	0°	-	8°
Θ1	8°	10°	12°
Θ2	10°	12°	14°

Physical Dimensions: SOIC-8





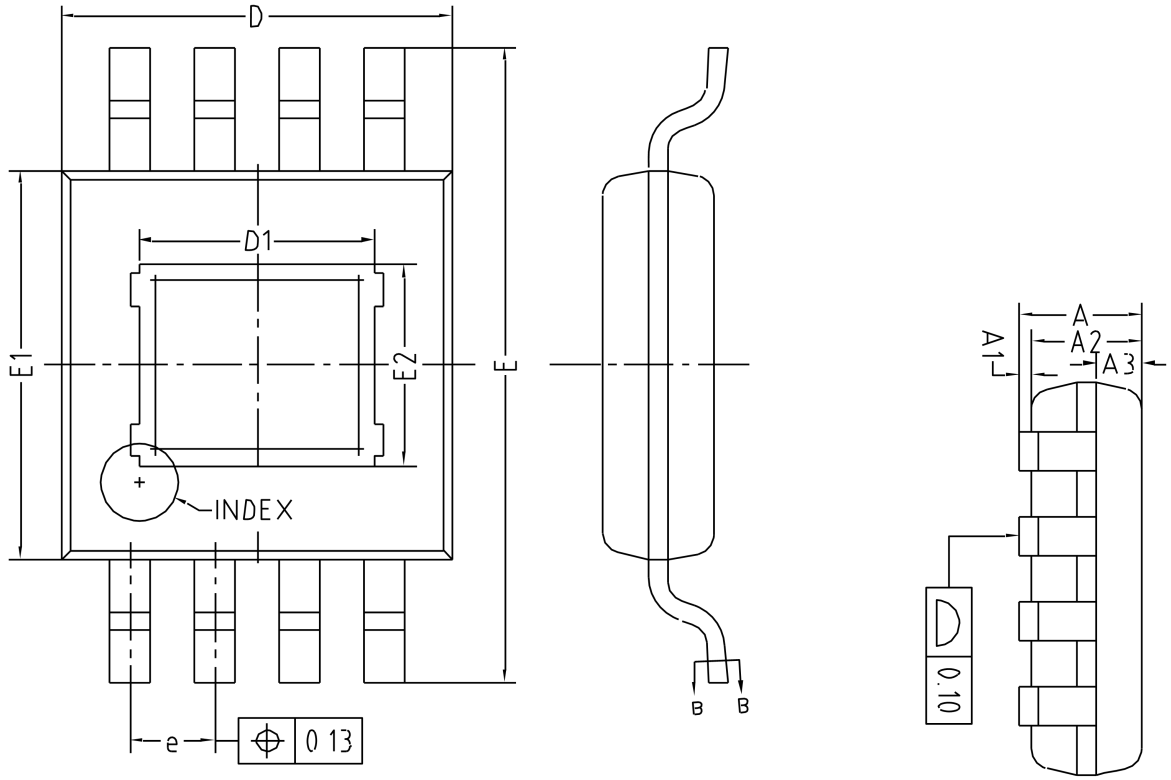


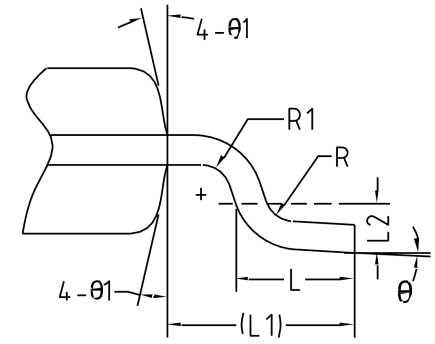


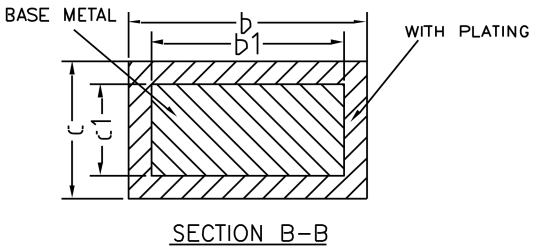
SECTION B–B

Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	1.35	1.55	1.75
A1	0.10	0.15	0.25
A2	1.25	1.40	1.65
A3	0.50	0.60	0.70
b	0.38	-	0.51
b1	0.37	0.42	0.47
c	0.17	-	0.25
c1	0.17	0.20	0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
h	0.30	0.40	0.50
Θ	0°	-	8°
Θ1	15°	17°	19°
Θ2	11°	13°	15°
Θ3	15°	17°	19°
Θ4	11°	13°	15°

Physical Dimensions: EP-MSOP8



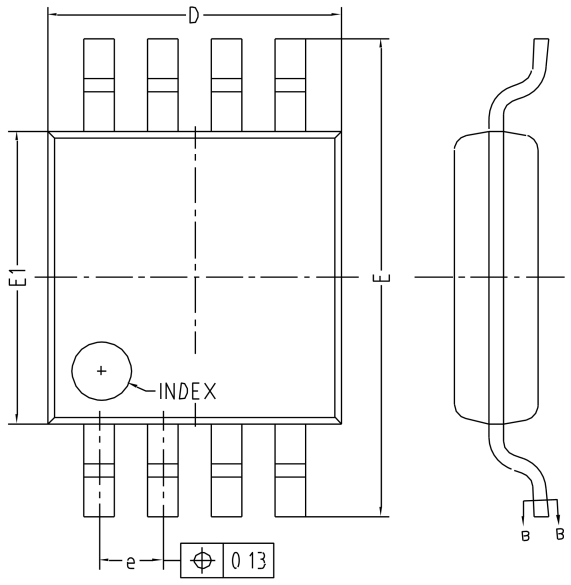


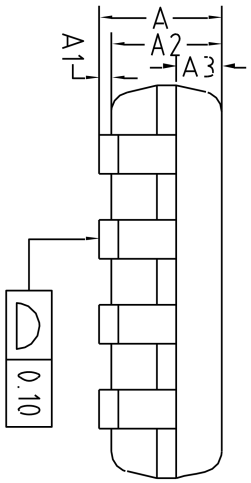


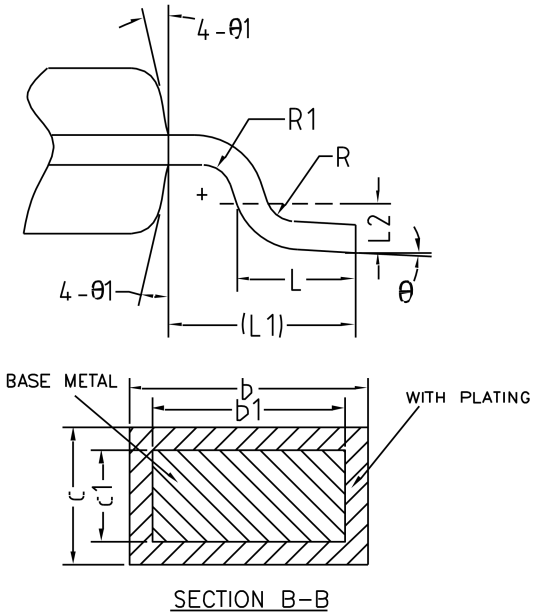
SECTION B–B

Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.10
A1	0	-	0.15
A2	0.75	0.85	0.95
A3	0.25	0.35	0.39
b	0.28	-	0.37
b1	0.27	0.30	0.33
c	0.15	-	0.20
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
D1	0.75	-	2.50
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
E2	0.75	-	2.50
e	0.55	0.65	0.75
L	0.40	0.60	0.80
L1	0.95 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
Θ	0°	-	8°
Θ1	9°	12°	15°

Physical Dimensions: MSOP-8







Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.10
A1	0	-	0.15
A2	0.75	0.85	0.95
A3	0.25	0.35	0.39
b	0.28	-	0.37
b1	0.27	0.30	0.33
c	0.15	-	0.20
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.55	0.65	0.75
L	0.40	0.60	0.80
L1	0.95 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
Θ	0°	-	8°
Θ1	9°	12°	15°

CONTACT US

Dioo is a professional design and sales corporation for high-quality performance analog semiconductors. The company focuses on industry markets, such as cell phones, handheld products, laptops, medical equipment, and so on. Dioo's product families include analog signal processing and amplifying, LED drivers, and charger ICs. Go to http://www.dioo.com for a complete list of Dioo product families.

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