5.5 V Low Loss Power Distribution Switch

Features

- Input voltage: 2.7 V to 5.5 V
- Typical 57 mΩ on-resistance
- Five different current limit versions
- Undervoltage lockout
- Overcurrent protection, short circuit protection and over temperature protection
- Fault time 8 ms (typ) 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
  - DIO70040H: available, EN high
  - DIO70040NH: not available, EN high
  - DIO70040L: available, EN low
  - DIO70040NL: not available, EN low

Applications

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

Package Information

Part Number	Package	Body Size
DIO70040	SOT23-5	2.93 mm × 1.63 mm
	SOIC-8	4.90 mm × 3.90 mm
	EP-MSOP8	3.00 mm × 3.00 mm
	MSOP-8	3.00 mm × 3.00 mm

Description

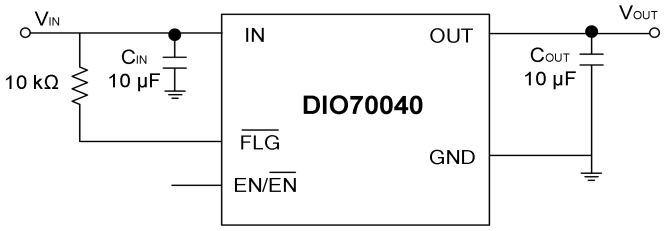
The DIO70040 power distribution switch is intended for applications where precision current limiting is required or heavy capacitive loads and short circuits are encountered. The power switch rising and falling times are controlled to minimize current surges during turning on / off.

The DIO70040 provides separately 500 mA/1 A/1.5 A/2 A/2.5 A five current levels.

The DIO70040 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 DIO70040 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.

Simplified Schematic



Ordering Information

Ordering Part No.	Top Marking	MSL	RoHS	T_A	Package	
DIO70040HXST5	4VHXW	3	Green	-40 to 85°C	SOT23-5	Tape & Reel, 3000
DIO70040NHXST5	4NHXW	3	Green	-40 to 85°C	SOT23-5	Tape & Reel, 3000
DIO70040LXST5	4VLXW	3	Green	-40 to 85°C	SOT23-5	Tape & Reel, 3000
DIO70040NLXST5	4NLXW	3	Green	-40 to 85°C	SOT23-5	Tape & Reel, 3000
DIO70040HXSO8	D740HX	3	Green	-40 to 85°C	SOIC-8	Tape & Reel, 2500
DIO70040NHXSO8	D74NHX	3	Green	-40 to 85°C	SOIC-8	Tape & Reel, 2500
DIO70040LXSO8	D740LX	3	Green	-40 to 85°C	SOIC-8	Tape & Reel, 2500
DIO70040NLXSO8	D74NLX	3	Green	-40 to 85°C	SOIC-8	Tape & Reel, 2500
DIO70040HXXM8	D740HX	3	Green	-40 to 85°C	EP-MSOP8	Tape & Reel, 3000
DIO70040NHXXM8	D74NHX	3	Green	-40 to 85°C	EP-MSOP8	Tape & Reel, 3000
DIO70040LXXM8	D740LX	3	Green	-40 to 85°C	EP-MSOP8	Tape & Reel, 3000
DIO70040NLXXM8	D74NLX	3	Green	-40 to 85°C	EP-MSOP8	Tape & Reel, 3000
DIO70040HXMP8	D740HX	3	Green	-40 to 85°C	MSOP-8	Tape & Reel, 3000
DIO70040NHXMP8	D74NHX	3	Green	-40 to 85°C	MSOP-8	Tape & Reel, 3000
DIO70040LXMP8	D740LX	3	Green	-40 to 85°C	MSOP-8	Tape & Reel, 3000
DIO70040NLXMP8	D74NLX	3	Green	-40 to 85°C	MSOP-8	Tape & Reel, 3000

Ordering Information Complementary Note

Ordering Number = Part No. + H/L：Enable Active Version + X：Current Limit Version + Package Code

DIO70040: quick output discharge available
DIO70040N: quick output discharge not available

H: Enable active high
L: Enable active low

A: 500 mA current limit version (typ)
B: 1 A current limit version (typ)
C: 1.5 A current limit version (typ)
D: 2 A current limit version (typ)
E: 2.5 A current limit version (typ)

ST5: stands for SOT23-5
SO8: stands for SOIC-8
XM8: stands for EP-MSOP8
MP8: stands for MSOP-8

If you encounter any issue in the process of using the device, please contact our customer service at marketing@dioo.com or phone us at (+86)-21-62116882. If you have any improvement suggestions regarding the datasheet, we encourage you to contact our technical writing team at docs@dioo.com. Your feedback is invaluable for us to provide a better user experience.

Table of Contents

List of Figures

1. Pin Assignment and Functions

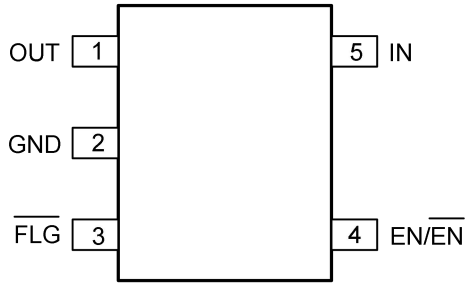


Figure 1. SOT23-5 (Top view)

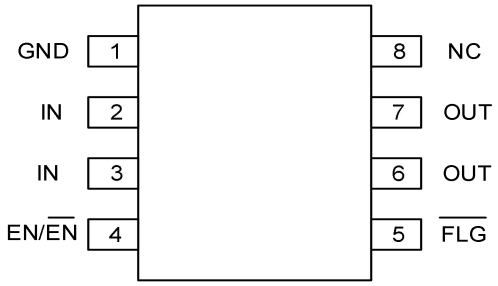


Figure 2. SOIC-8/MSOP-8 (Top view)

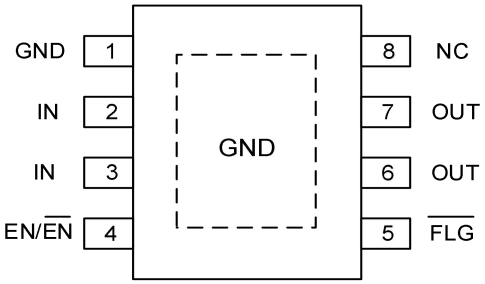


Figure 3. EP-MSOP8 (Top view)

Name	Description
OUT	Output pin, decoupled with a 10 μF capacitor to GND
GND	Ground pin
$\overline{FLG}$	Fault flag output
EN / $\overline{EN}$	Active high or Active low. Do not leave it floating
IN	Input pin, decoupled with a 10 μF capacitor to GND
Thermal pad (GND)	Internally connect to GND. Recommend to connect to a large ground plane for the improved thermal performance.

2. Absolute Maximum Ratings

Exceeding the maximum ratings listed under Absolute Maximum Ratings when designing is likely to damage the device permanently. Do not design to the maximum limits because long-time exposure to them might impact the device's reliability. The ratings are obtained over an operating free-air temperature range unless otherwise specified.

Symbol	Parameter	Rating	Unit
V_{IN}	Operation voltage	-0.3 ~ 6.0	V
T_J	Maximum junction temperature	150	°C
T_{STG}	Storage temperature	-65 ~ 150	°C
T_L	Maximum lead temperature (Soldering, 10 sec)	260	°C

3. Recommended Operating Conditions

Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. The ratings are obtained over an operating free-air temperature range unless otherwise specified.

Symbol	Parameter	Rating	Unit
V_{IN}	Operation voltage	2.7 ~ 5.5	V
	Terminal voltage at all other pins	0 ~ 5.5	V
T_J	Junction temperature range	-40 to 125	°C
T_A	Ambient temperature range	-40 to 85	°C

4. ESD Ratings

When a statically-charged person or object touches an electrostatic discharge sensitive device, the electrostatic charge might be drained through sensitive circuitry in the device. If the electrostatic discharge possesses sufficient energy, damage might occur to the device due to localized overheating.

Model	Condition	Value	Unit
Human-body model	ANSI/ESDA/JEDEC JS-001	±2	kV
Charged-device model	ANSI/ESDA/JEDEC JS-002	±2	kV

5. Thermal Considerations

The thermal resistance determines the heat insulation property of a material. The higher the thermal resistance is, the lower the heat loss. Accumulation of heat energy degrades the performance of semiconductor components.

Symbol	Metric		Value	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance	SOT23-5	250	°C/W
		SOIC-8	130	
		EP-MSOP8	100	
		MSOP-8	166	

6. Electrical Characteristics

Typical value: T_A = 25°C, V_{IN} = 5 V, unless otherwise specified.

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		36	60	μA
$R_{DS(ON)}$	FET R_{ON}	I_{OUT} = 100 mA, T_A = 25°C		57	70	mΩ
		I_{OUT} = 100 mA T_A = -40 ~ 85°C		57	80(1)	
$V_{EN(H)}$	EN rising threshold	V_{IN} = 2.7 V to 5.5 V	0.85			V
$V_{EN(L)}$	EN falling threshold	V_{IN} = 2.7 V to 5.5 V			0.4	V
I_{EN}	EN leakage current	V_{EN} = 5.0 V			1	μA
V_{IN_UVLO}	IN UVLO threshold				2.5	V
V_{IN_HYS}(1)	IN UVLO hysteresis			150	400	mV
I_{LIM}	Current limit	DIO70040 - A	0.45	0.5	0.55	A
		DIO70040 - B	0.9	1	1.1	
		DIO70040 - C	1.35	1.5	1.65	
		DIO70040 - D	1.8	2	2.2	
		DIO70040 - E	2.25	2.5	2.75	
	Output reverse voltage fault deglitch time		2.5	4	7	ms
I_{SHORT}(1)	Short-circuit current limit	Enabled, output short to ground		10%		I_{LIM}
t_{ON}	EN turn-on time	R_L = 10 Ω, C_{OUT} = 1 μF		400		μs
t_{OFF}	EN turn-off time	R_L = 10 Ω, C_{OUT} = 1 μF		7		μs
t_R	Output turn-on rise time	R_L = 100 Ω, 90% settling		0.6		ms
t_F	Output turn-off time	R_L = 100 Ω, 10% settling		0.3		ms
T_{SD}	Thermal shutdown temperature			140		°C
	Thermal shutdown hysteresis			20		°C
R_{DIS}	Discharge resistance			500		Ω
$V_{reverse}$	Reverse voltage comparator trip point			175		mV

Note:

(1) Guaranteed by design.

(2) Specifications subject to change without notice.

7. Typical Performance Characteristics

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

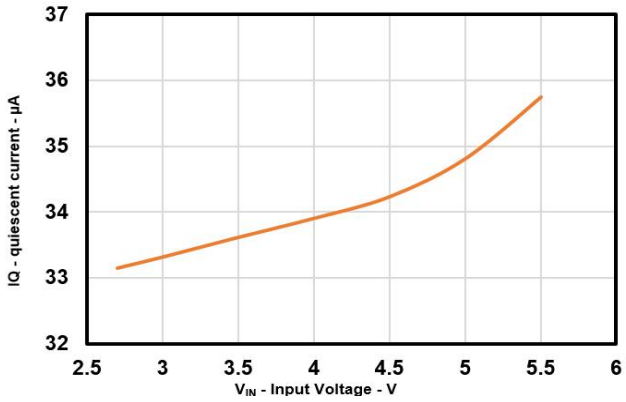


Figure 4. Quiescent current vs. Input voltage

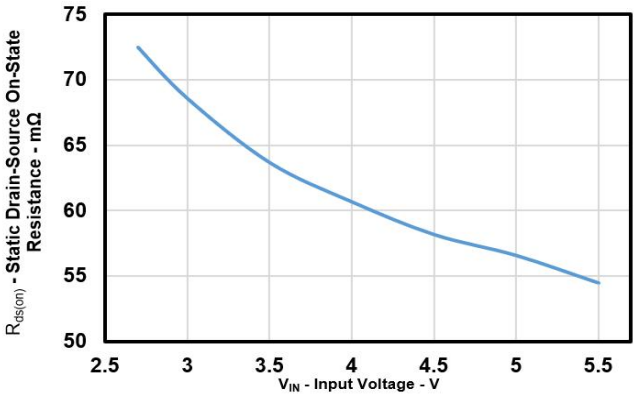


Figure 5. Static $R_{DS(ON)}$ vs. Input voltage

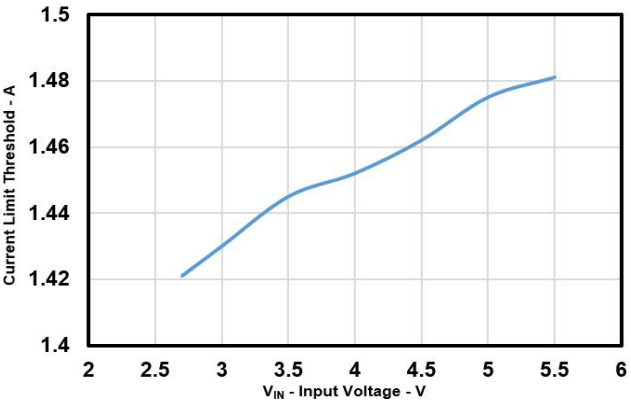


Figure 6. Current limit threshold vs. Input voltage

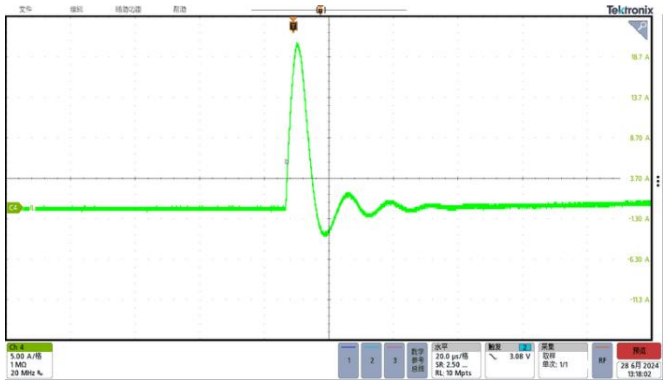


Figure 7. No-load to short-circuit response

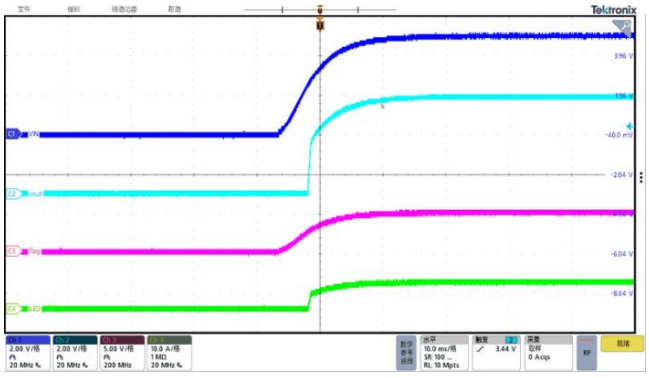


Figure 8. Input voltage turn on rise time

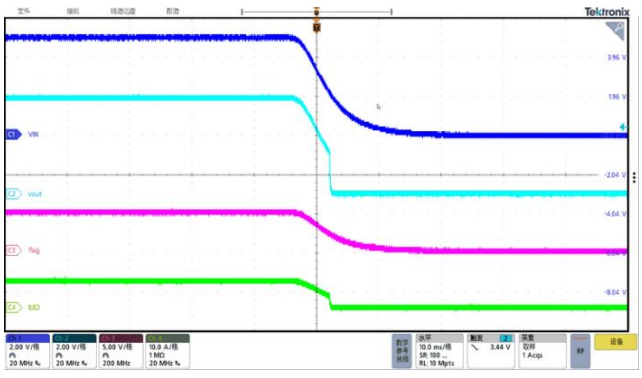


Figure 9. Input voltage turn off fall time

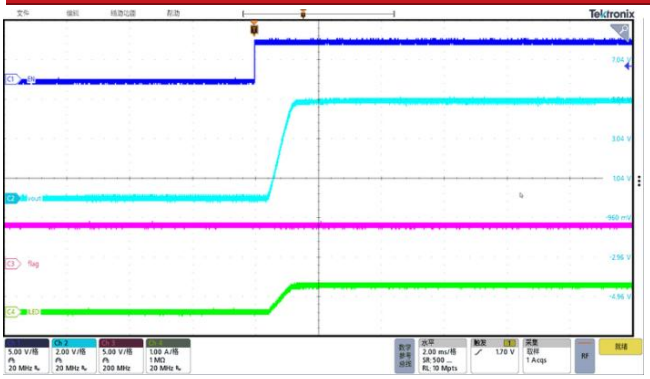


Figure 10. Enable voltage turn on rise time

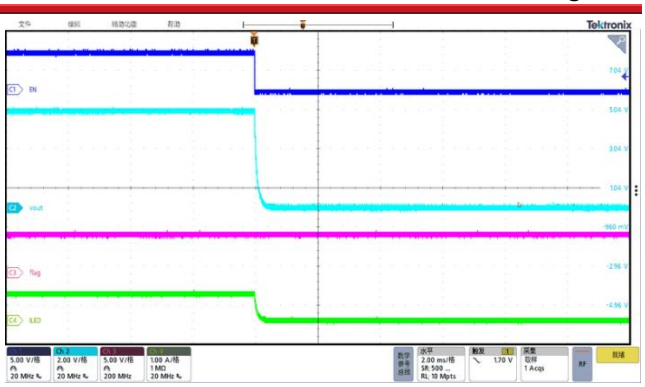


Figure 11. Enable voltage turn off fall time

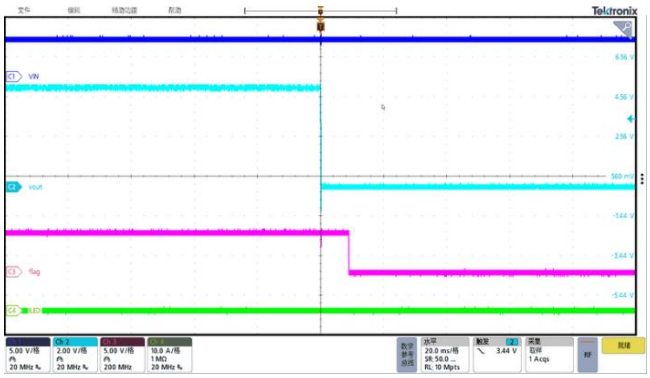


Figure 12. No load to short transient response

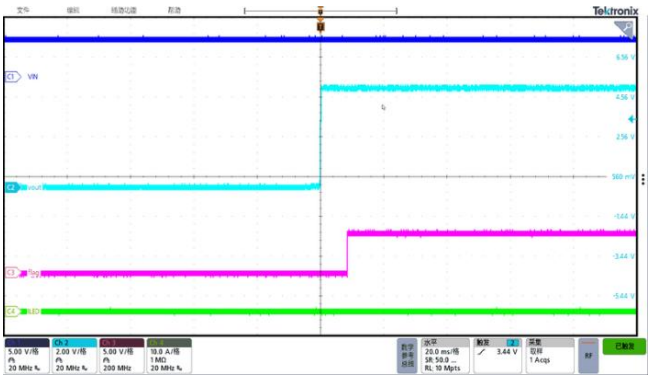


Figure 13. Short to no load transient response

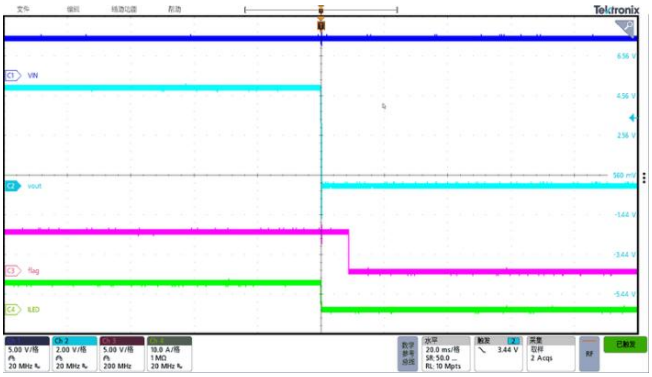


Figure 14. Heavy load to short transient response

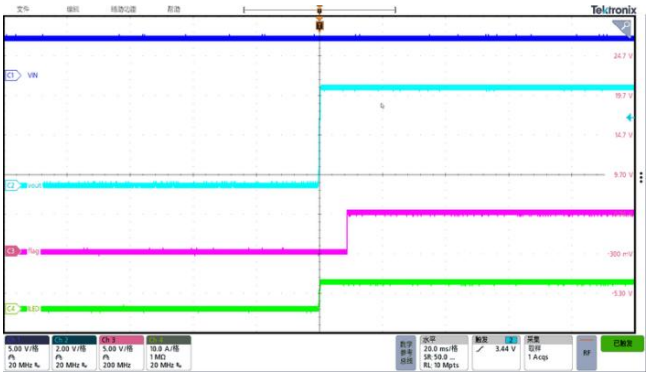
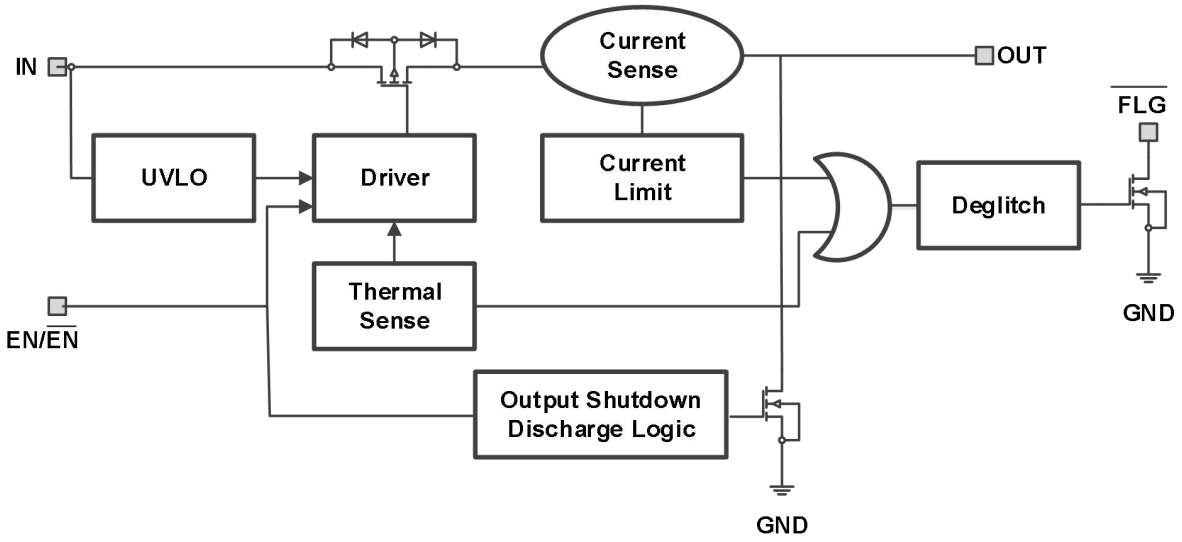


Figure 15. Short to heavy load transient response

8. Block Diagram



9. Application Information

Important notice: Validation and testing are the most reliable ways to confirm system functionality. The application information is not part of the specification and is for reference purposes only.

9.1. 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.

9.2. Undervoltage lockout

The undervoltage lockout (UVLO) circuit disables the power switch until the input voltage reaches the UVLO turn-on threshold. Built-in hysteresis prevents unwanted on / off cycling due to input voltage drop from large current surges.

9.3. Enable

The logic enable controls the power switch, driver, and other circuitry to reduce the supply current. The EN / $\overline{EN}$ 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.

9.4. Overcurrent protection

The DIO70040 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 DIO70040 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 current limit threshold (I_{LIM}) is reached or until the thermal limit of the device is exceeded. The DIO70040 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.

9.5. 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 DIO70040 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.

9.6. Reverse-voltage protection

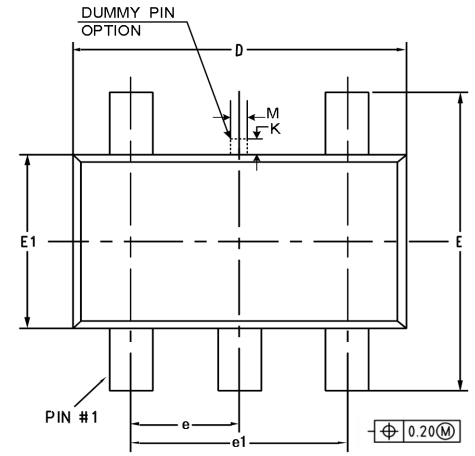
The reverse-voltage protection feature turns off the P-channel MOSFET whenever the output voltage exceeds the input voltage by 175 mV (typ). A reverse current of (V_{OUT} - V_{IN}) / $R_{DS(ON)}$ will be present when this occurs. This prevents damage to devices on the input side of the DIO70040 by preventing significant current from sinking into the input capacitance. The DIO70040 devices allow the P-channel MOSFET to turn on once the output voltage goes bellow the input voltage.

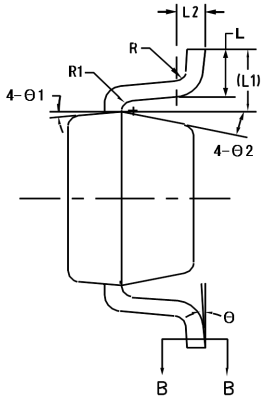
9.7. $\overline{\text{FLG}}$ output

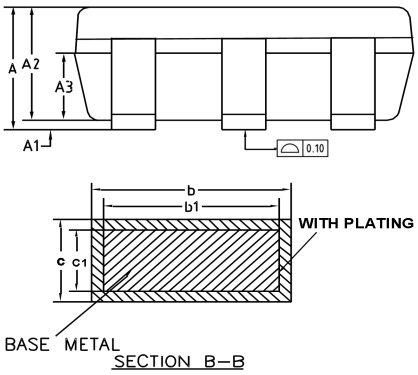
Error flag is an open-drain output of a N-channel MOSFET. If current limiting or short circuit occurs, $\overline{\text{FLG}}$ is pulled low after a delay of 8 ms (typ), and if no current limiting or short circuit occurs, $\overline{\text{FLG}}$ is pulled high after a delay of 8 ms (typ). If reverse-voltage protection occurs, $\overline{\text{FLG}}$ is pulled low after a delay of 4 ms (typ), and if no reverse-voltage protection occurs, $\overline{\text{FLG}}$ is pulled high after a delay of 4 ms (typ). If overtemperature protection occurs, $\overline{\text{FLG}}$ is pulled low immediately, and if no overtemperature protection occurs, $\overline{\text{FLG}}$ is pulled high after a delay of 8 ms (typ).

10. Physical Dimension

10.1. SOT23-5

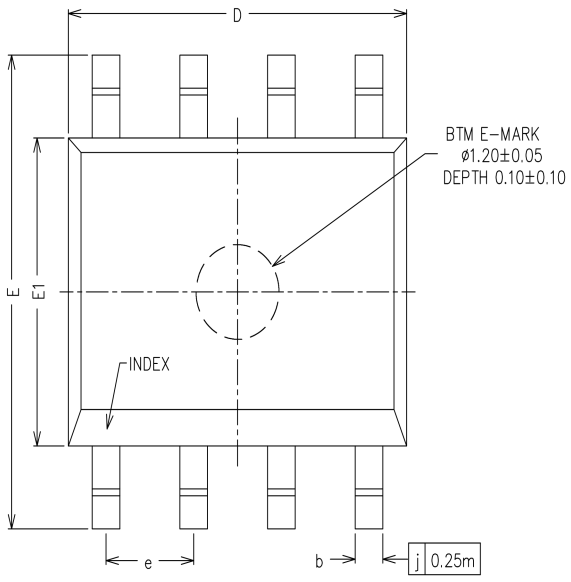


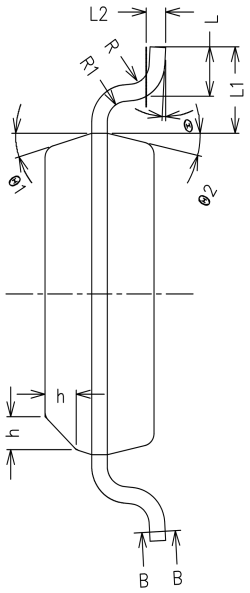


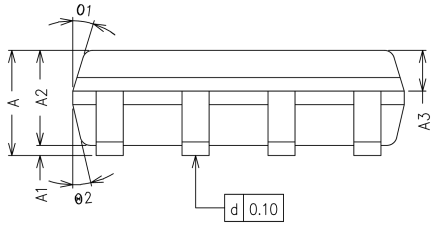


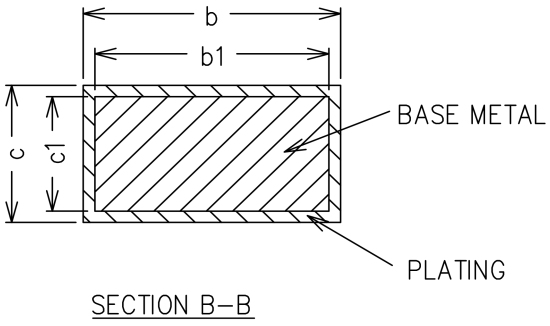
Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.25
A1	0	-	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	-	0.45
b1	0.35	0.38	0.41
c	0.14	-	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
K	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°

10.2. SOIC-8





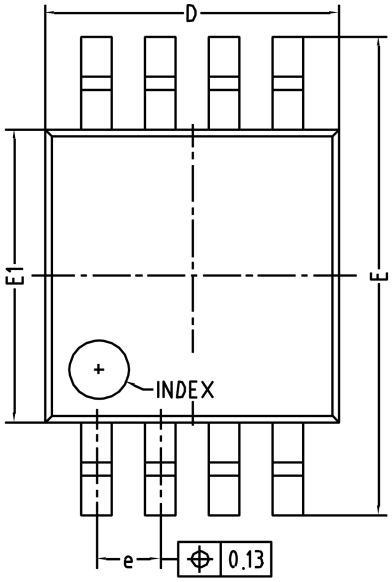


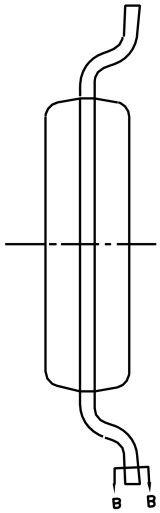


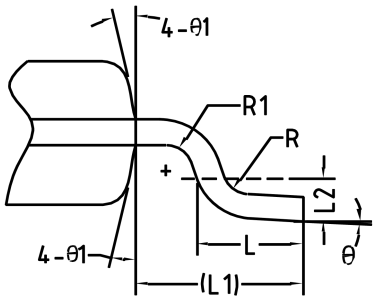
SECTION B–B

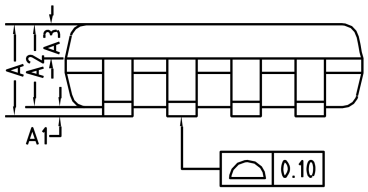
Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	1.35	1.55	1.75
A1	0.10	-	0.25
A2	1.30	1.40	1.50
A3	0.50	0.60	0.70
b	0.38	-	0.47
b1	0.37	0.40	0.43
c	0.17	-	0.25
c1	0.17	0.20	0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.17	1.27	1.37
L	0.45	0.60	0.80
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°

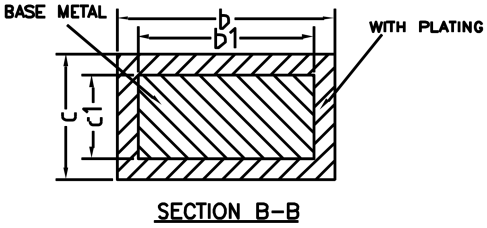
10.3. MSOP-8





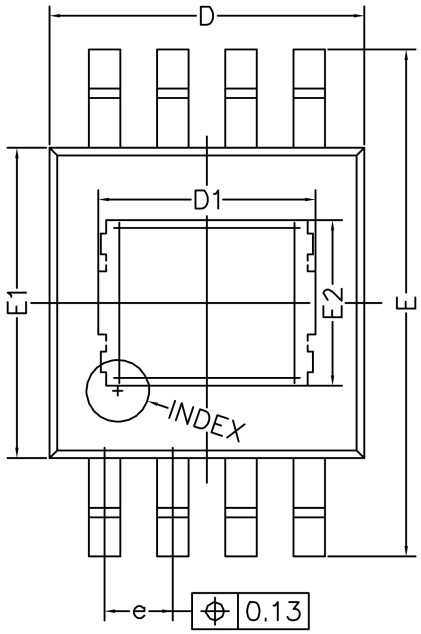


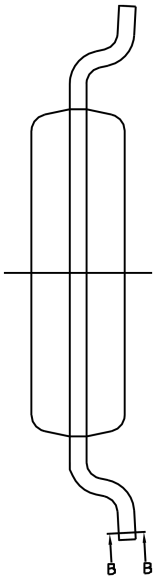


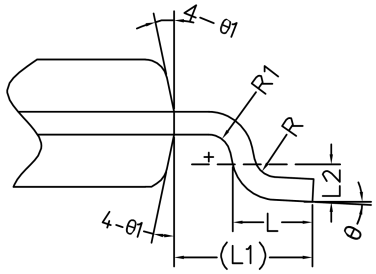


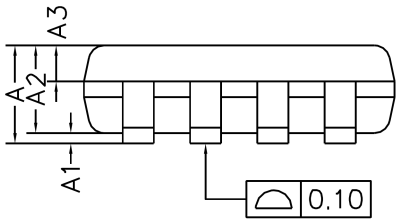
Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.10
A1	0.05	0.10	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.25	-	0.38
b1	0.24	0.30	0.33
c	0.15	-	0.20
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.75	4.90	5.05
E1	2.90	3.00	3.10
e	0.55	0.65	0.75
L	0.40	0.55	0.70
L1	0.95 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
θ	0°	-	8°
θ1	9°	12°	15°

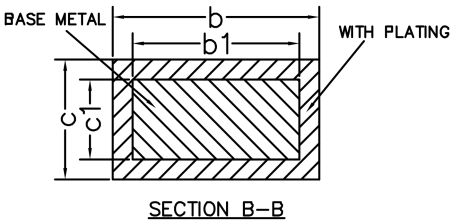
10.4. EP-MSOP8











Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.10
A1	0.05	0.10	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.25	-	0.38
b1	0.24	0.30	0.33
c	0.13	-	0.20
c1	0.13	0.15	0.16
D	2.90	3.00	3.10
D1	1.92	2.07	2.22
E	4.75	4.90	5.05
E1	2.90	3.00	3.10
E2	1.45	1.60	1.75
e	0.55	0.65	0.75
L	0.40	0.55	0.70
L1	0.95 REF		
L2	0.25 BSC		
R	0.07	-	-
R1	0.07	-	-
θ	0°	-	8°
θ1	9°	12°	15°

Disclaimer

This specification and information contained herein are provided on an “AS IS” basis and WITH ALL FAULTS. All product specifications, statements, information, and data (collectively, the “Information”) in this datasheet or made available on the website of www.dioo.com are subject to change without notice. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to his/her application. All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, express or implied.

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for Power Switch ICs - Power Distribution ***category:***

Click to view products by Dioo ***manufacturer:***

Other Similar products are found below :

TLE6232GP VND5E004ATR-E FPF1018 DS1222 NCV380HMUAJAATBG SZNCP3712ASNT3G NCP45520IMNTWG-H VND5004ATR-E AP22811BW5-7 SZNCP3712ASNT1G DML1008LDS-7 VND7012AYTR NCV459MNWTBG NCP4545IMNTWG-L NCV8412ASTT1G NCV8412ASTT3G FPF2260ATMX NCP45780IMN24RTWG AP2151AMP-13 NCP45540IMNTWG-L NCP45650IMNTWG DK5V100R20S BTS7020-2EPA BTT6100-2ERA BTS71220-4ESA DK5V100R15M WS3220C9-9/TR AW32405CSR BTT6030-2ERA TLE75602-ESH BTS5200-4EKA DK5V150R25M DK5V45R25 DK5V100R25S AW35206FOR BTS7120-2EPA TLE75008-ESD DK5V60R10S DK5V45R25S DK5V60R10 DK5V45R15S DK5V100R15S DK5V85R15 WS3241C-12/TR TPS22998RYZR SY7076QMC SY7215ARDC BTT6200-4ESA BTS7080-2EPA AW35122FDR