DIO7709
300 mA Low I_Q, Wide Input Voltage Low Dropout Regulator

Features

- Operating input voltage range: 2.5 V to 24 V
- Fixed voltage options available: 1.2 V to 5 V (upon request)
- Ultra−low quiescent current: 4 μA (typ.) over temperature
- PSRR: 60 dB at 1 kHz
- Stable with small 1 μF ceramic capacitor
- Soft−start to reduce inrush current and overshoots
- Thermal shutdown and current limit protection
- Available in SOT89-3, SOT23-5, SOT23-3 and DFN2*2-6 packages
- These devices are Pb−free, halogen free/BFR free, and are RoHS Compliant

Descriptions

The DIO7709 is a 300 mA LDO linear voltage regulator. It is a very stable and accurate device with ultra−low quiescent current consumption (typically 4 μA over the full temperature range) and a wide input voltage range (up to 24 V). The regulator incorporates several protection features, such as thermal shutdown and current limiting.

Applications

- Wireless chargers
- Portable equipment
- Communication systems

Typical Applications

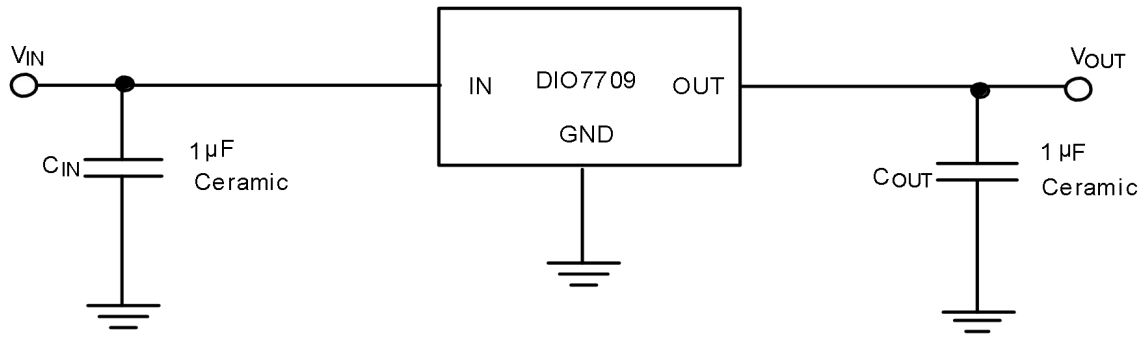
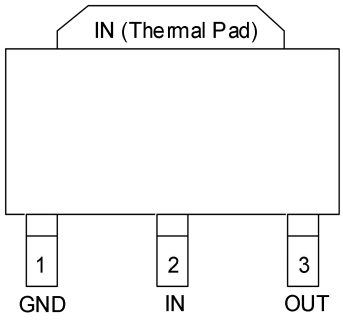


Figure 1. Typical application schematic

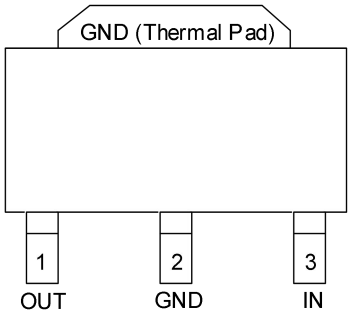
Ordering Information

Ordering Part No.	Voltage Option	Top Marking	MSL	RoHS	T_A	Package	
DIO7709120TC3	1.2 V	D7709B	3	Green	-40 to 105°C	SOT89-3	Tape & Reel, 2500
DIO7709150TC3	1.5 V	D7709C	3	Green	-40 to 105°C	SOT89-3	Tape & Reel, 2500
DIO7709180TC3	1.8 V	D7709D	3	Green	-40 to 105°C	SOT89-3	Tape & Reel, 2500
DIO7709250TC3	2.5 V	D7709E	3	Green	-40 to 105°C	SOT89-3	Tape & Reel, 2500
DIO7709300TC3	3.0 V	D7709F	3	Green	-40 to 105°C	SOT89-3	Tape & Reel, 2500
DIO7709330TC3	3.3 V	D7709G	3	Green	-40 to 105°C	SOT89-3	Tape & Reel, 2500
DIO7709R330TC3	3.3 V	252X	3	Green	-40 to 105°C	SOT89-3	Tape & Reel, 2500
DIO7709120ST5	1.2 V	YW9B	3	Green	-40 to 105°C	SOT23-5	Tape & Reel, 3000
DIO7709150ST5	1.5 V	YW9C	3	Green	-40 to 105°C	SOT23-5	Tape & Reel, 3000
DIO7709180ST5	1.8 V	YW9D	3	Green	-40 to 105°C	SOT23-5	Tape & Reel, 3000
DIO7709250ST5	2.5 V	YW9E	3	Green	-40 to 105°C	SOT23-5	Tape & Reel, 3000
DIO7709300ST5	3.0 V	YW9F	3	Green	-40 to 105°C	SOT23-5	Tape & Reel, 3000
DIO7709330ST5	3.3 V	YW9G	3	Green	-40 to 105°C	SOT23-5	Tape & Reel, 3000
DIO7709330BST5	3.3 V	YW9GA	3	Green	-40 to 105°C	SOT23-5	Tape & Reel, 3000
DIO7709120ST3	1.2 V	YW9B	3	Green	-40 to 105°C	SOT23-3	Tape & Reel, 3000
DIO7709150ST3	1.5 V	YW9C	3	Green	-40 to 105°C	SOT23-3	Tape & Reel, 3000
DIO7709180ST3	1.8 V	YW9D	3	Green	-40 to 105°C	SOT23-3	Tape & Reel, 3000
DIO7709250ST3	2.5 V	YW9E	3	Green	-40 to 105°C	SOT23-3	Tape & Reel, 3000
DIO7709300ST3	3.0 V	YW9F	3	Green	-40 to 105°C	SOT23-3	Tape & Reel, 3000
DIO7709330ST3	3.3 V	YW9G	3	Green	-40 to 105°C	SOT23-3	Tape & Reel, 3000
DIO7709330CD6	3.3 V	GV9G	3	Green	-40 to 105°C	DFN2*2-6	Tape & Reel, 3000

Pin Assignment



SOT89-3
DIO7709XXXTC3



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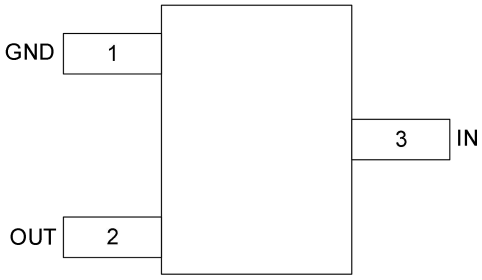
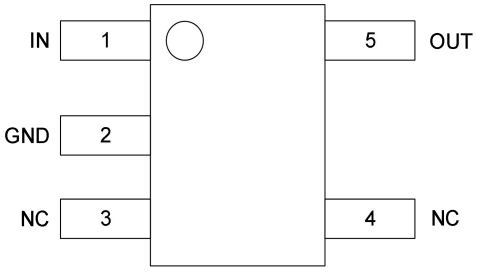
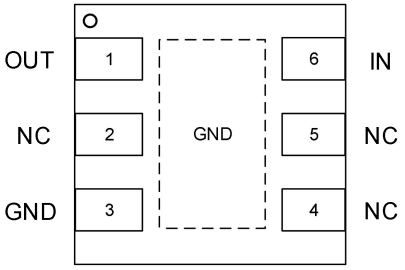
DIO7709R330TC3



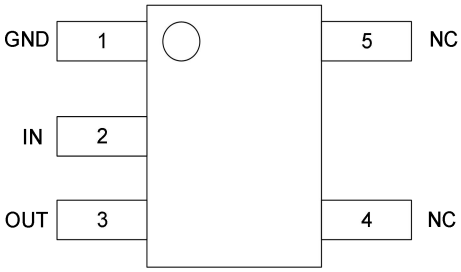
SOT23-3
DIO7709XXXST3



SOT23-5
DIO7709XXXST5



DFN2*2-6
DIO7709330CD6



SOT23-5
DIO7709XXXBST5

Figure 2. Top view

Pin Descriptions

Name	Description
IN	Input pin. A small capacitor is needed from this pin to ground to assure stability.
GND	Power supply ground.
OUT	Regulated output voltage pin. A small 1 μF ceramic capacitor is needed from this pin to ground to assure stability.
NC	No connection.

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
V_{IN}	Input voltage	−0.3 to 24	V
V_{OUT}	Output voltage	−0.3 to V_{IN} + 0.3 (max. 6)	V
$T_{J(MAX)}$	Maximum junction temperature	150	°C
T_{STG}	Storage temperature	−55 to 150	°C
HBM	ESD capability, human body model	±2000	V

Thermal Information

Symbol	Thermal Metric		Rating	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance	SOT89-3	100	°C/W
		DFN2*2-6	72	
		SOT23-3	250	

Electrical Characteristics

-40°C ≤ T_J ≤ 125°C; V_{IN} = 2.5 V or (V_{OUT} + 1.0 V), whichever is greater; I_{OUT} = 1 mA, C_{IN} = C_{OUT} = 1 µF, unless otherwise noted. Typical values are at T_J = 25°C. (1)

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{IN}	Operating input voltage			2.5		24	V
V_{OUT}	Output voltage accuracy (fixed versions)	−40°C ≤ T_J ≤ 125°C, V_{OUT} + 1 V < V_{IN} < 24 V, 0.1 mA < I_{OUT} < 300 mA (3)	V_{OUT} < 1.8 V	−3%		3%	V
			V_{OUT} ≥ 1.8 V	−2%		2%	
Reg_{LINE}	Line regulation	V_{OUT} + 1 V ≤ V_{IN} ≤ 24 V, I_{OUT} = 1 mA			10		mV
Reg_{LOAD}	Load regulation	I_{OUT} = 0.1 mA to 300 mA			10		mV
V_{DO}	Dropout voltage	V_{DO} = V_{IN}–($V_{OUT(NOM)}$– 3%), I_{OUT} = 150 mA (2)	2.1 V ~ 2.4 V		480		mV
			2.5 V ~ 2.7 V		300		
			2.8 V ~ 3.2 V		280		
			3.3 V ~ 4.9 V		260		
			5 V		240		
I_{LIM}	Maximum output current	V_{IN} = V_{OUT} + 1 V		300		800	mA
I_Q	Quiescent current	I_{OUT} = 0 mA			4.0	8.0	µA
I_{GND}	Ground current	I_{OUT} = 10 mA			50		µA
		I_{OUT} = 300 mA			300		
PSRR	Power supply rejection ratio	V_{IN} = 3.5 V + 100 mV_{pp} V_{OUT} = 2.5 V, I_{OUT} = 1 mA, C_{OUT} = 1 µF	f = 1 kHz		60		dB
T_{SD}	Thermal shutdown temperature (3)	Temperature increasing from T_J = 25°C			150		°C
T_{SDH}	Thermal shutdown hysteresis (3)	Temperature falling from T_{SD}			25		°C

Note:

(1) Performance guaranteed over the indicated operating temperature range by design and/or characterization production tested at T_J = T_A = 25°C. Low duty cycle pulse techniques are used during testing to maintain the junction temperature as close to ambient as possible.

(2) Voltage dropout for voltage variants below 2.1 V is given by minimum input voltage 2.5 V.

(3) Guaranteed by design and characterization.

(4) Specifications subject to change without notice.

Typical Performance Characteristic

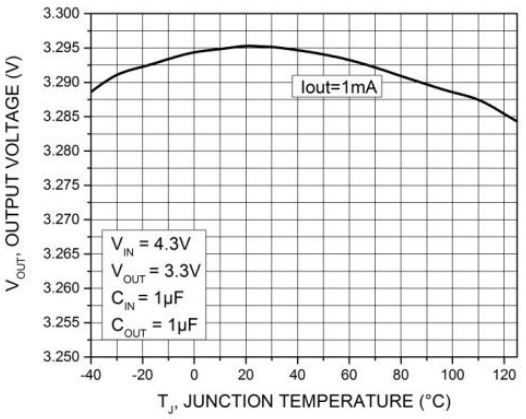


Figure 3. Output voltage vs. Temperature
V_{OUT} = 3.3 V

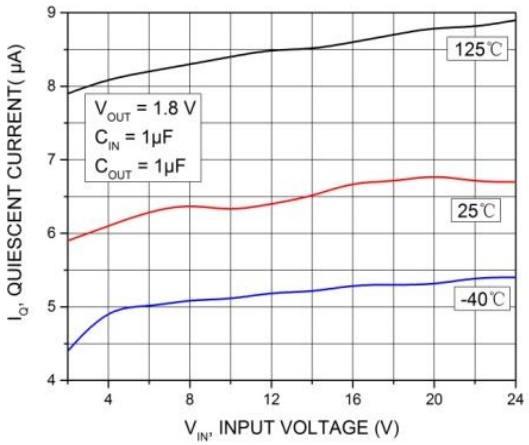


Figure 4. Quiescent current vs. Input voltage
V_{OUT} = 1.8 V

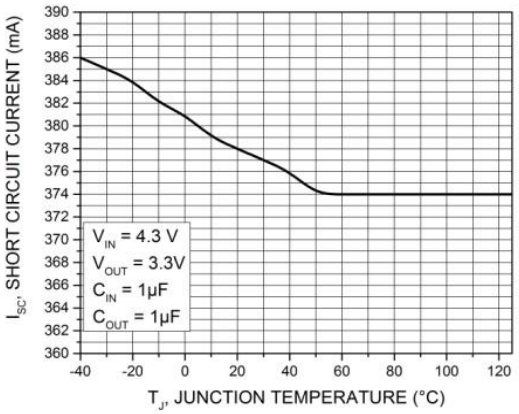


Figure 5. Short circuit current vs. Temperature
V_{OUT} = 3.3 V

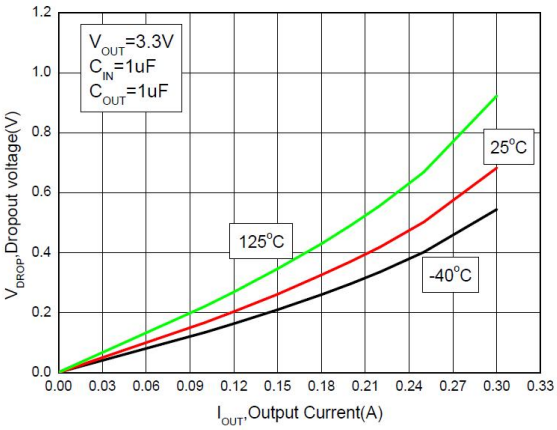


Figure 6. Dropout voltage vs. Output current
V_{OUT} = 3.3 V

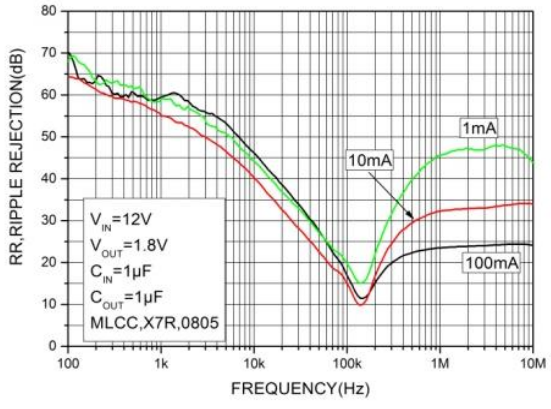


Figure 7. Power supply rejection ratio vs. Current
V_{IN} = 12 V, C_{OUT} = 1 μF

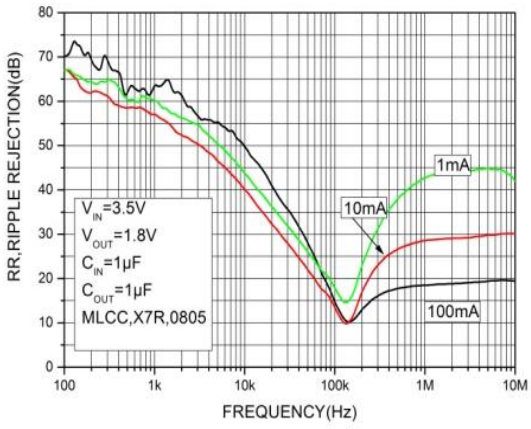


Figure 8. Power supply rejection ratio vs. Current
V_{IN} = 3.5 V, C_{OUT} = 1 μF

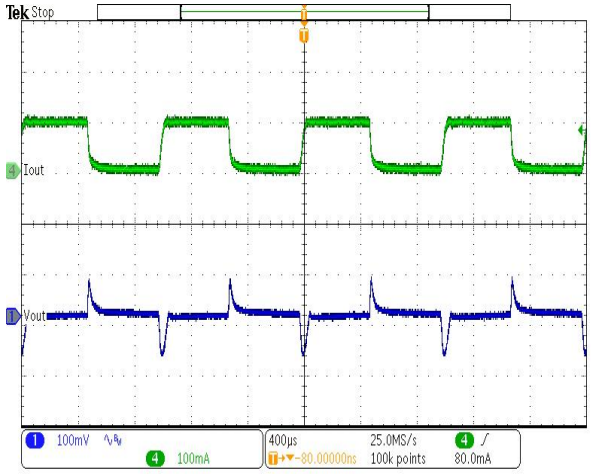


Figure 9. Load transient response

V_{IN} = 2.8 V, V_{OUT} = 1.8 V, I_{LOAD} = 5 mA ~ 100 mA

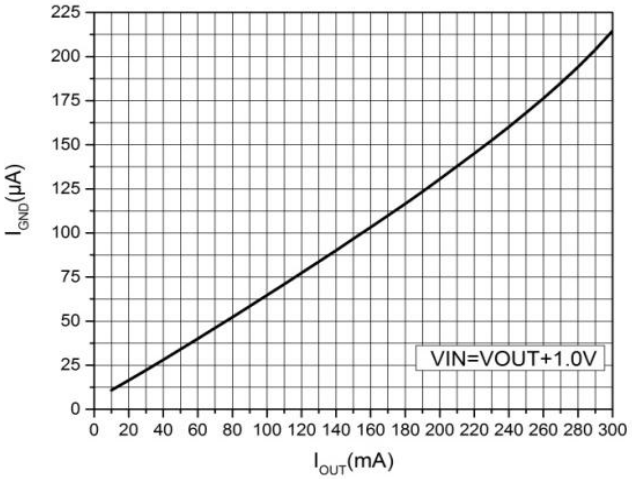
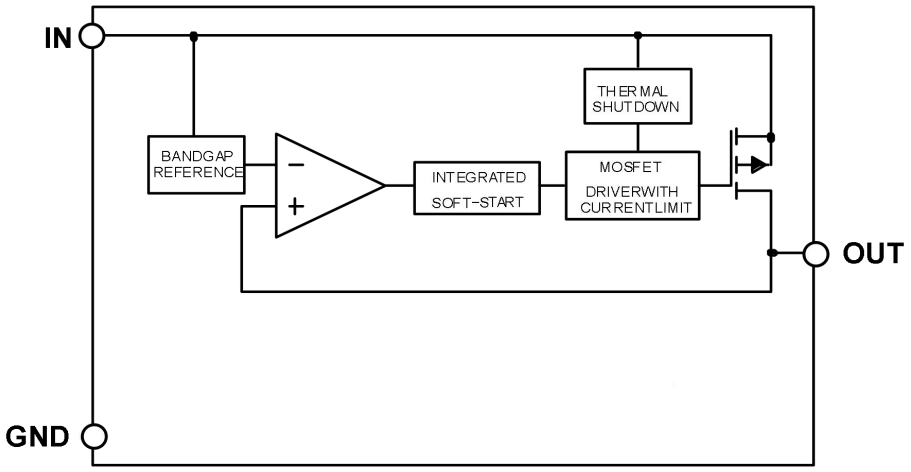


Figure 10. I_{GND} vs. I_{OUT}

Functional Block Diagram



Fixed Version

Figure 11. Functional block diagram

Application Information

The DIO7709 is a member of the new family of wide input voltage range low dropout regulators that delivers ultra low ground current consumption, good noise, and power supply rejection ratio performance.

Input Decoupling (C_{IN})

It is recommended to connect at least a 1 μF ceramic X5R or X7R capacitor between IN and GND pin of the device. This capacitor will provide a low impedance path for any unwanted AC signals or noise superimposed onto constant input voltage. The good input capacitor will limit the influence of input trace inductances and source resistance during sudden load current changes.

Higher capacitance and lower ESR capacitors will improve the overall line transient response.

Output Decoupling (C_{OUT})

The DIO7709 does not require a minimum Equivalent Series Resistance (ESR) for the output capacitor. The device is designed to be stable with standard ceramic capacitors with values of 1 μF or greater. The X5R and X7R types have the lowest capacitance variations over temperature. Thus they are recommendable.

Power Dissipation and Heat Sinking

The maximum power dissipation supported by the device is dependent upon board design and layout. Mounting pad configuration on the PCB, the board material, and the ambient temperature affect the rate of junction temperature rise for the part. For reliable operational junction temperature should be limited to 150°C. The maximum power dissipation the DIO7709 can handle is given by:

$$P_{D(MAX)} = \frac{[T_{J(MAX)} - T_A]}{R_{\theta JA}} \quad (1)$$

The power dissipated by the DIO7709 for given application conditions can be calculated from the following equations:

$$P_D \approx V_{IN} \times I_{GND} + I_{OUT}(V_{IN} - V_{OUT}) \quad (2)$$

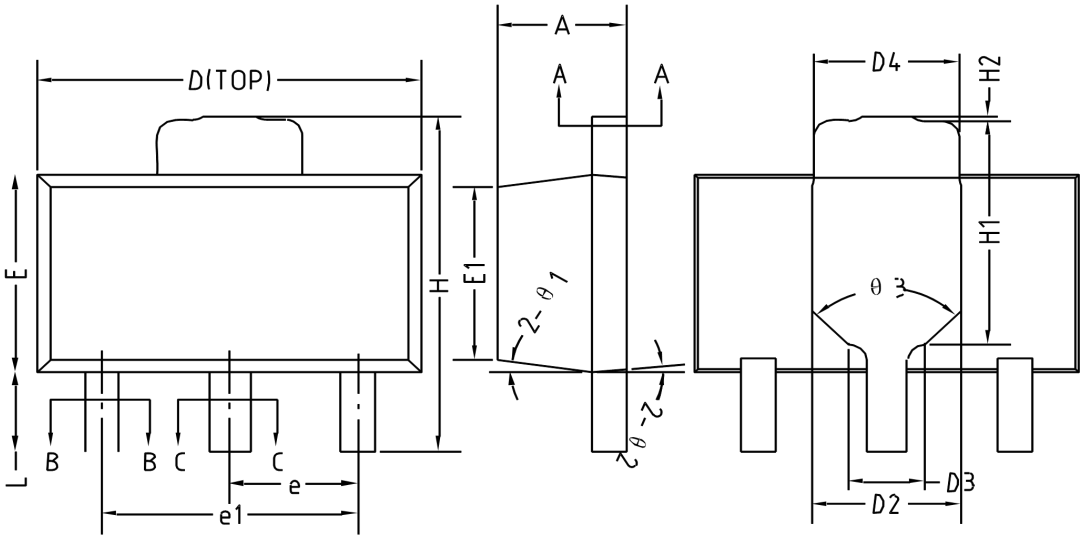
or

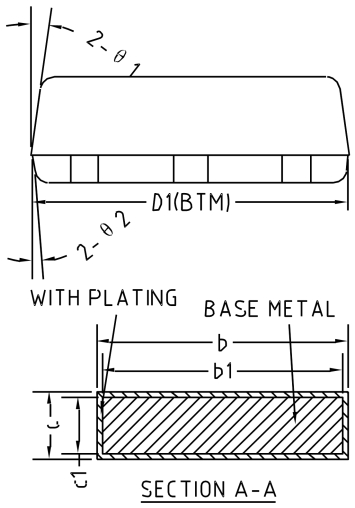
$$V_{IN(MAX)} \approx \frac{P_{D(MAX)} + (V_{OUT} \times I_{OUT})}{I_{OUT} + I_{GND}} \quad (3)$$

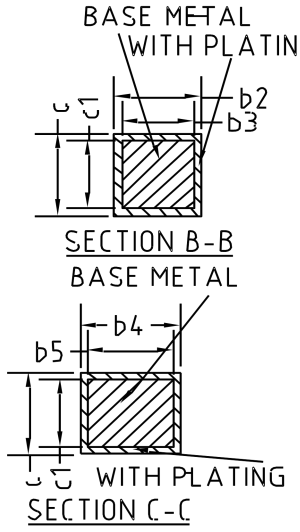
Hints

V_{IN} and GND printed circuit board traces should be as wide as possible. When the impedance of these traces is high, there is a chance to pick up noise or cause the regulator to malfunction. Place external components, especially the output capacitor, as close as possible to the DIO7709, and make traces as short as possible.

Physical Dimensions: SOT89-3

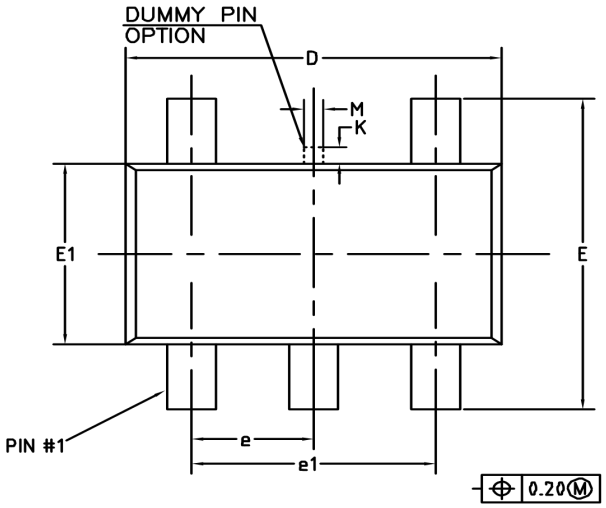


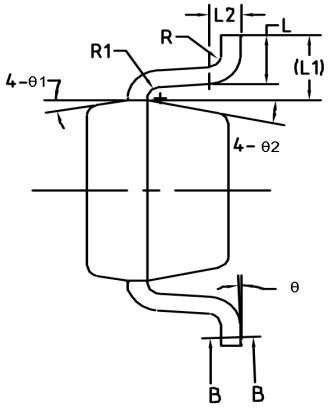


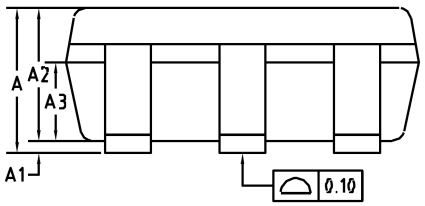


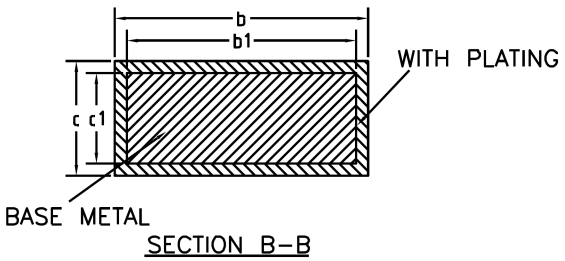
Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	1.40	1.50	1.60
b	1.68	-	1.77
b1	1.67	1.70	1.73
b2	0.38	-	0.47
b3	0.37	0.40	0.43
b4	0.46	-	0.55
b5	0.45	0.48	0.51
c	0.40	-	0.44
c1	0.39	0.40	0.41
D	4.40	4.50	4.60
D1	4.35	4.45	4.55
D2	1.60	1.75	1.90
D3	0.75	0.90	1.05
D4	1.60	1.70	1.80
E	2.40	2.50	2.60
E1	2.13	-	2.19
e	1.50 BSC		
e1	3.00 BSC		
H	4.05	-	4.25
H1	2.70	-	3.00
H2	0	-	0.10
L	0.89	-	1.20
θ1	6°	8°	10°
θ2	3°	5°	7°
θ3	85°	90°	95°

Physical Dimensions: SOT23-5





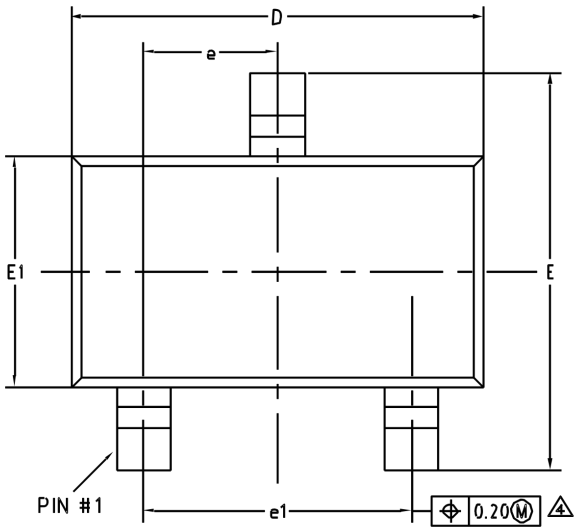


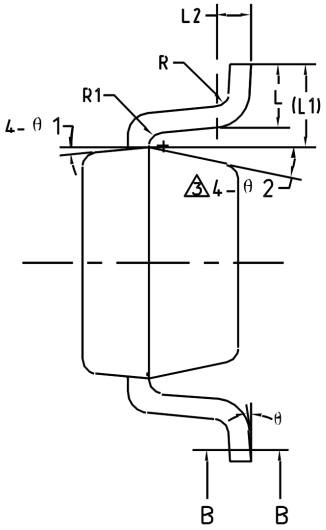


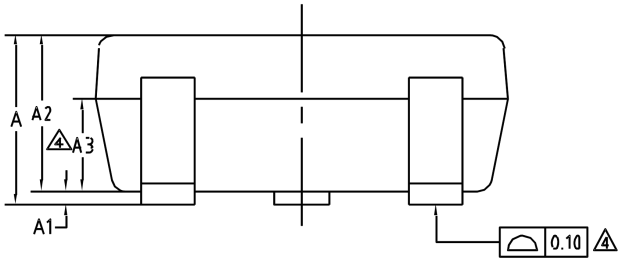
SECTION B–B

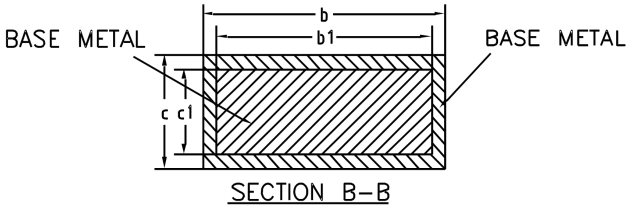
Common Dimensions (Units of of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.25
A1	0	-	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	-	0.45
b1	0.35	0.38	0.41
c	0.14	-	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
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: SOT23-3



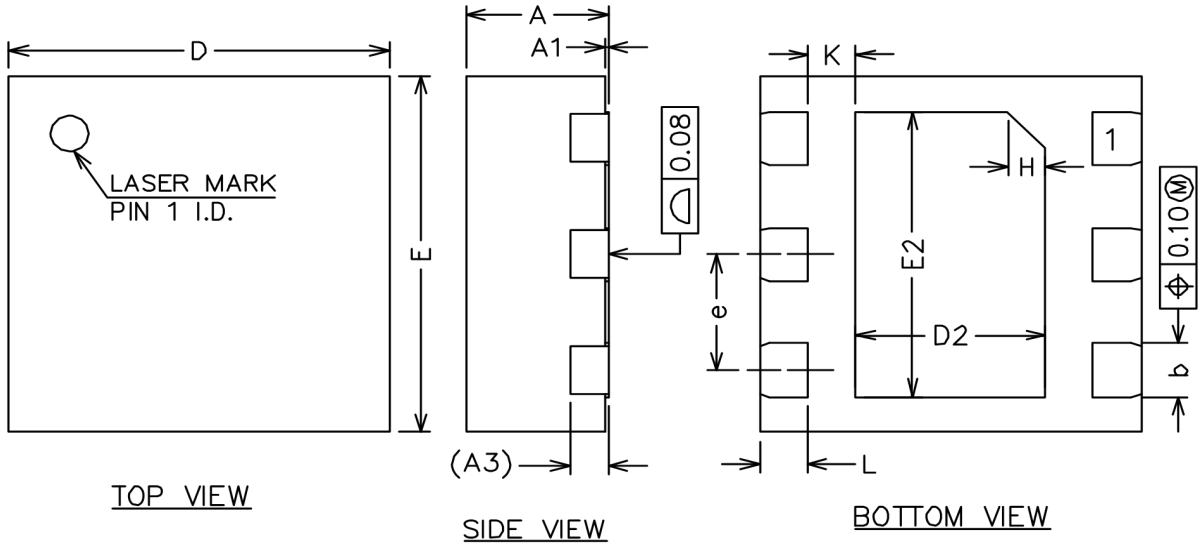


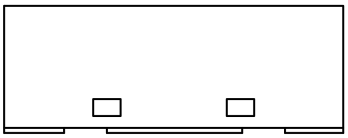




Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.25
A1	0	-	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	-	0.50
b1	0.36	0.38	0.45
c	0.14	-	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.35	0.45	0.60
L1	0.59 REF		
L2	0.25 BSC		
R	0.05	-	-
R1	0.05	-	0.20
Θ	0°	-	8°
Θ1	3°	5°	7°
Θ2	6°	-	14°

Physical Dimensions: DFN2*2-6





SIDE VIEW

Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	0.70	0.75	0.80
A1	0	0.02	0.05
A3		0.20 REF	
b	0.25	0.30	0.35
D	1.90	2.00	2.10
E	1.90	2.00	2.10
D2	0.90	1.00	1.10
E2	1.50	1.60	1.70
e	0.55	0.65	0.75
K	0.15	0.25	0.35
L	0.20	0.25	0.30
H		0.20 REF	

CONTACT US

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

For additional product information, or full datasheet, please contact with our Sales Department or Representatives.