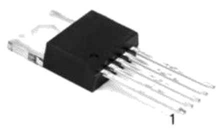
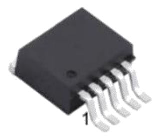
3A Fast Response LDO Regulator

Features

- High-Current Capability
- Operating Input Voltage Range: 3V to 16V
- Low Dropout Voltage
- Low Ground Current
- Accurate 1% Tolerance
- Fast Transient Response
- 1.24V to 15V Adjustable Output Voltage
- Packages: TO-263-5、TO-220-5 and TO-252-4



TO-220-5



TO-263-5

TO-220-5-A2

TO-263-5-A2

TO-252-4

Ordering Information

DEVICE	Package Type	MARKING	Packing	Packing Qty
MIC29302WT	TO-220-5/TO-220-5-A2	MIC29302W	TUBE	1000pcs/box
MIC29302WS/TR	TO-263-5/TO-263-5-A2	MIC29302W	REEL	500pcs/reel
MIC29302WMDT/TR	TO-252-4	MIC29302W	REEL	2500pcs/reel

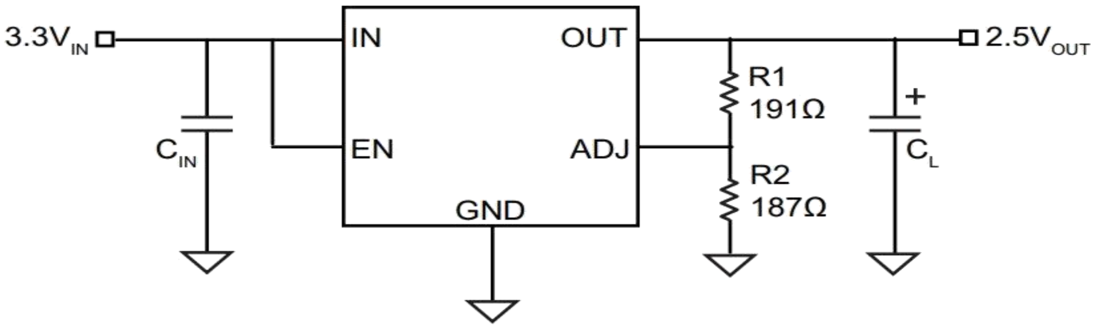
General Description

The MIC29302W is a high-current, low-dropout voltage regulator that uses proprietary Super βeta PNP process with a PNP pass element. The 3A LDO regulator features 300mV to 370mV (full load) dropout voltageand very low ground current. Designed for high-currentloads, these devices also find applications in lowercurrent, low-dropout critical systems, where theirdropout voltages and ground current values ar eimportant attributes.

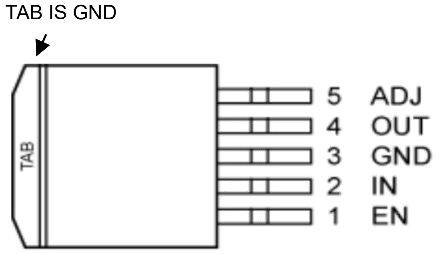
Along with a total accuracy of ±2% (over temperature,line, and load regulation) the regulator features very fast transient recovery from input voltage surges and output load current changes.

The MIC29302W has an adjustable output that can beset by two external resistors to a voltage between1.24V and 15V. In addition, the device is fully protected against overcurrent faults, reversed input polarity,reversed lead insertion, and over temperature operation. A TTL/CMOS logic enable (EN) pin isavailable in the MIC29302W to shutdown the regulator.When not used, the device can be set to continuous operation by connecting EN to the input (IN). The MIC29302W is available in the standard TO263-5L TO220-5L and TO-252 package with an operating junction temperature range of –40°C to +125°C.

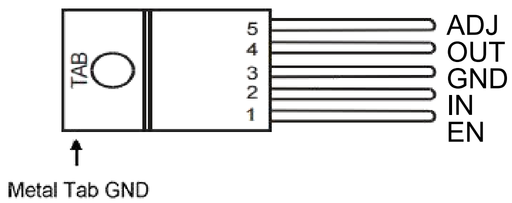
Typical Application Circuit



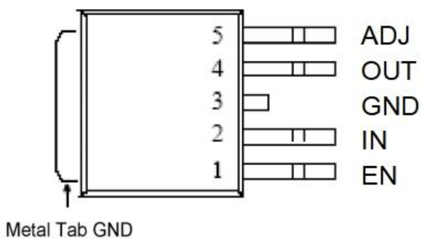
Pin Configuration



TO-263-5

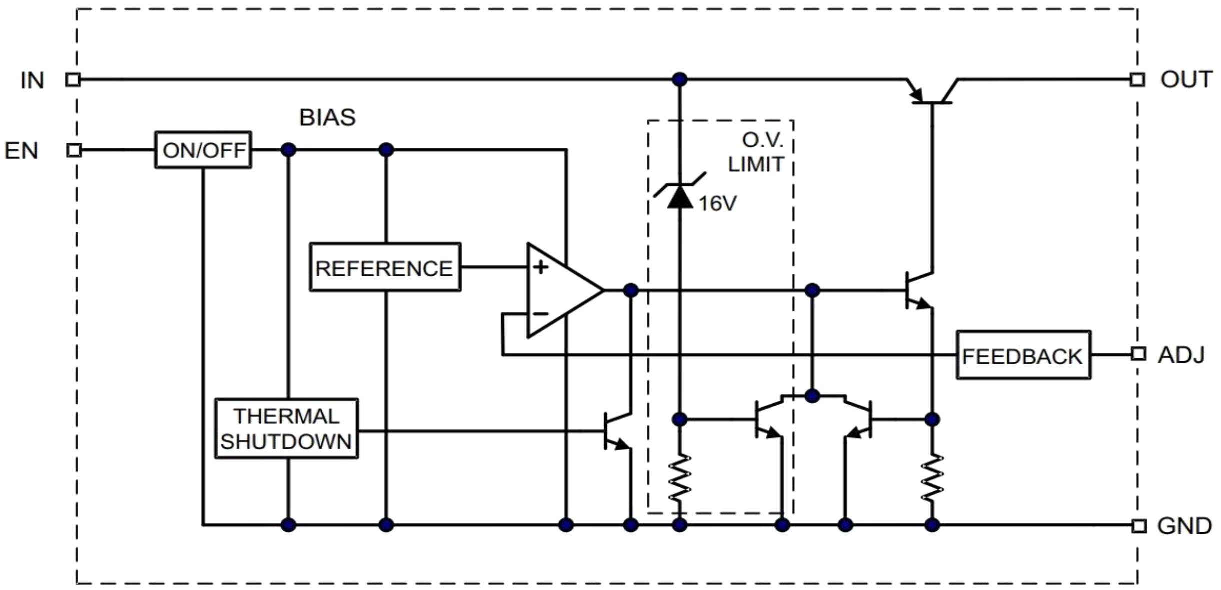


TO-220-5



TO-252-4

Functional Block Diagram



Absolute Maximum Ratings(Ta=25°C)

Rating		Symbol	Value	Unit
Input Supply Voltage		V_{IN}	26	V
Enable Input Voltage		V_{EN}	VIN	V
Operating Junction Temperature Range		T_J	− 40 to +125	°C
Storage Temperature Range		T_{stg}	− 65 to +150	°C
Operating Input Voltage		V_{OP}	3~18	V
Package Thermal Resistances	TO-263	θ_{JC}	3	°C/W
	TO-252		3	°C/W
Package Thermal Resistances	TO-263	θ_{JA}	28	°C/W
	TO-252		56	°C/W
Lead Temperature (soldering 10sec.)	TO-263/TO-220	T_L	245	°C
	TO-252		260	°C

Note: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured.

Electrical Characteristics

V_{IN} = 4.184V; I_{OUT} = 100 mA; T_A = +25°C, **bold** values indicate –40°C ≤ T_J ≤ +125°C,unless noted. Note 1

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Voltage						
Output Voltage Accuracy	ΔV_{OUT}	**–2**	—	**2**	%	100 mA ≤ I_{OUT} ≤ 3A, (V_{OUT} + 1V) ≤V_{IN} ≤ 16V
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	—	0.1	0.5	%	I_{OUT} = 100 mA, (V_{OUT} + 1V) ≤ V_{IN} ≤16V
Load Regulation	$\Delta V_{OUT}/\Delta I_{OUT}$	—	0.2	1	%	V_{IN} = V_{OUT} + 1V, 100 mA ≤ I_{OUT} ≤3A
Dropout Voltage (Note 2)	V_{DO}	—	100	**200**	mV	I_{OUT} = 100 mA, V_{IN} ≥ 3.184V
		—	300	—		I_{OUT} = 1.5A, V_{IN} ≥ 3.184V
		—	500	—		I_{OUT} = 2.75A, V_{IN} ≥ 3.184V
		—	560	**800**		I_{OUT} = 3A, V_{IN} ≥ 3.4V
Ground Current						
Ground Current	I_{GND}	—	5	**20**	mA	I_{OUT} = 750 mA, V_{IN} = V_{OUT} + 1V
		—	15	—		I_{OUT} = 1.5A
		—	60	**150**		I_{OUT} = 3A
Ground Pin Current at Dropout	I_{GNDDO}	—	2	—	mA	V_{IN} = 0.5V less than specified V_{OUT}; I_{OUT} = 10 mA
Current Limit	I_{LIMIT}	3	4	—	A	V_{OUT} = 0V, Note 3
Output Noise Voltage (10 Hz to 100 kHz)	e_N	—	400	—	μVRMS	C_L = 10 μF
		—	260	—		C_L = 33 μF
Ground Pin Current in Shutdown	I_{SHDN}	—	32	—	μA	Input Voltage VIN = 16V
Reference						
Reference Voltage	V_{REF}	**1.215**	—	**1.267**	V	Note 4
Adjust Pin Bias Current	I_{ADJ}	—	40	—	nA	—
		—	—	120		
ENABLE Input						
Input Logic Voltage	V_{ENABLE}	—	—	**0.8**	V	Low (OFF)
		2.4	—	—		High (ON)
Enable Pin Input Current	I_{ENABLE}	—	15	30	μA	V_{EN} = 4.2V
		—	—	**75**		
		—	—	2		V_{EN} = 0.8V
		—	—	**4**		
Regulator Output Current in Shutdown	$I_{OUT-SHDN}$	—	10	—	μA	Note 5
		—	—	20		

Note: 1、Specification for packaged product only

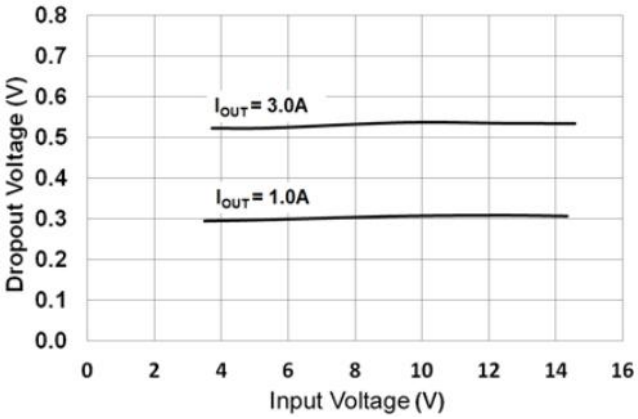
2、Dropout voltage is defined as the input-to-output differential when output voltage drops to 99% of its nor mal value with V_{OUT} + 1V applied to VIN.

3、V_{IN} = V_{OUT} (nominal) + 1V. For example, use V_{IN} = 4.3V for a 3.3V regulator or use 6V for a 5V regulator. Employ pulse testing procedure for current-limit.

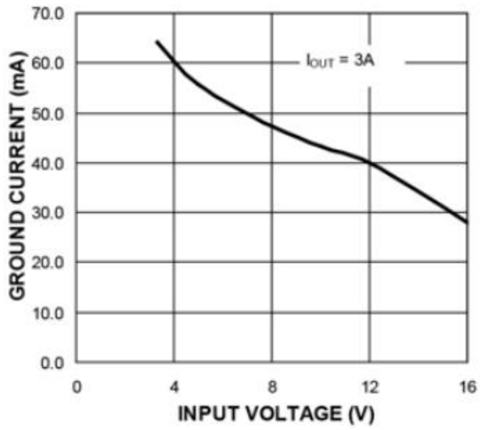
4、V_{REF} ≤ V_{OUT} ≤ V_{IN} – 1, 3V ≤ V_{OUT} ≤ 16V, 10 mA ≤ I_L ≤ I_{FL}, T_J ≤ T_J(MAX).

5、V_{EN} ≤ 0.8V, V_{IN} ≤ 16V and V_{OUT} = 0V.

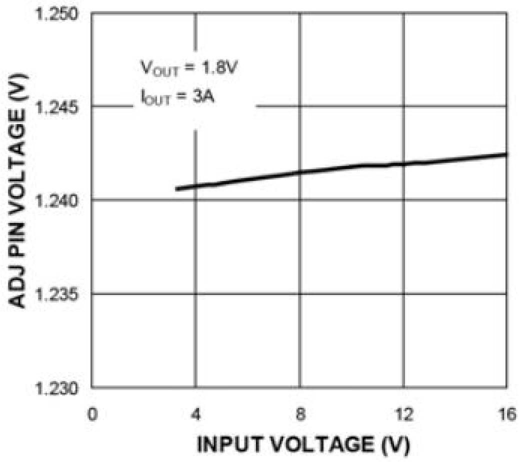
Typical Characteristics



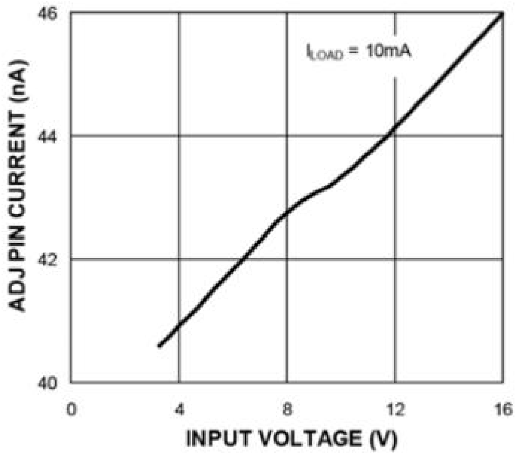
Dropout Voltage vs. Input Voltage.



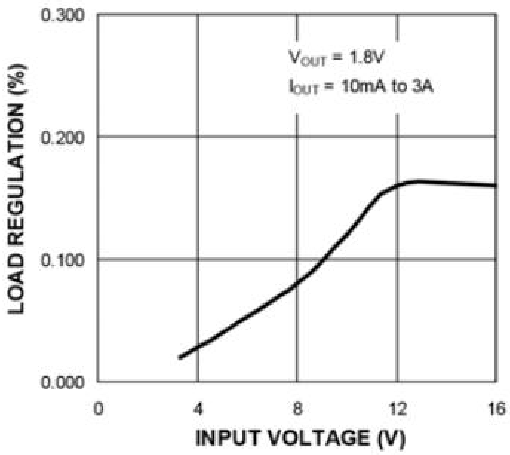
GND Pin Current vs. Input Voltage.



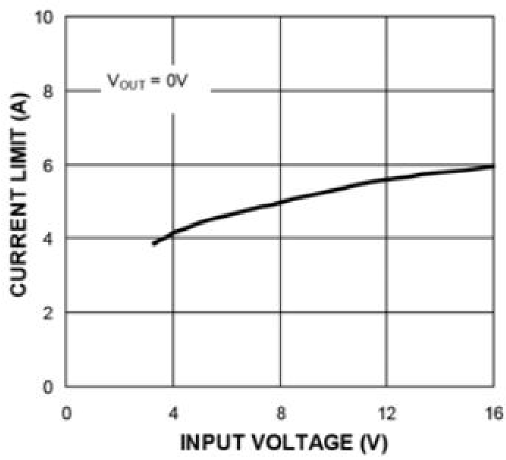
Adjust Pin Voltage vs. Input Voltage.



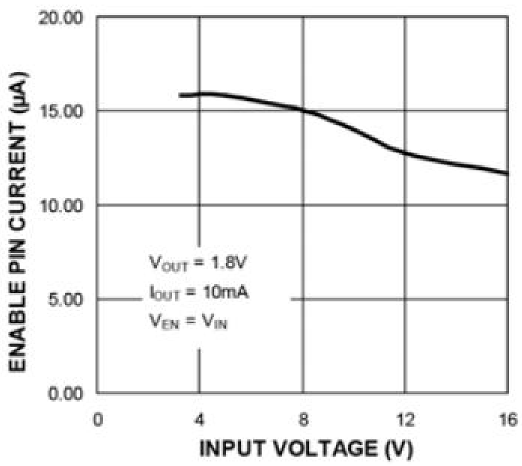
Adjust Pin Current vs. Input Voltage.



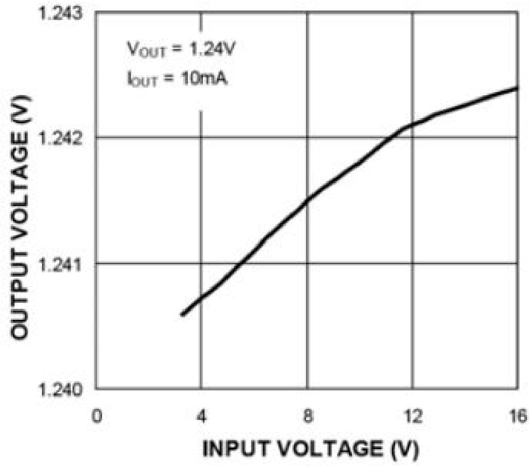
Load Regulation vs. Input Voltage.



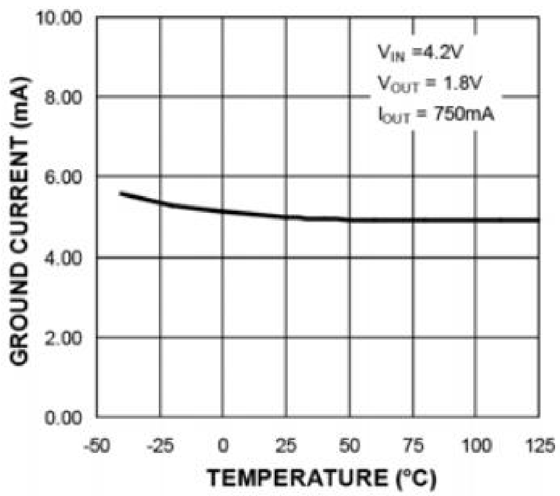
Short-Circuit Current vs.Input Voltage.



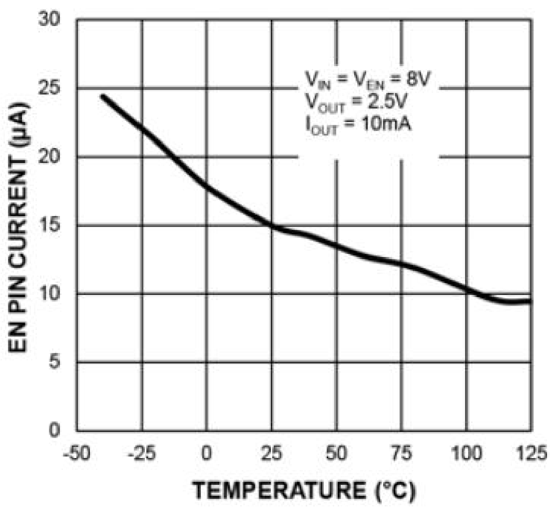
Enable Pin Current vs. Input Voltage.



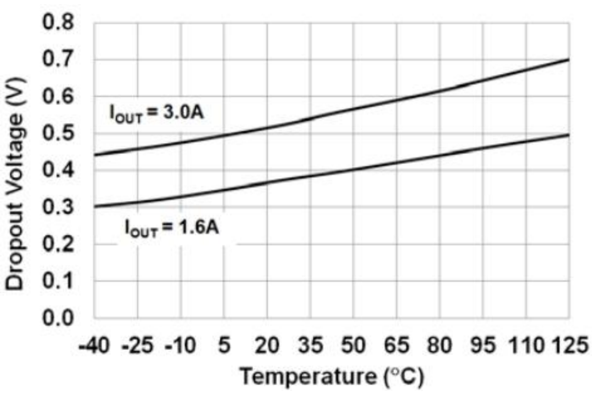
Output Voltage vs. Input Voltage.



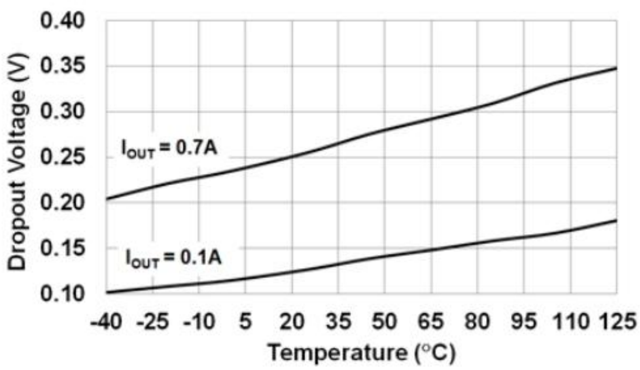
GND Pin Current vs.Temperature.



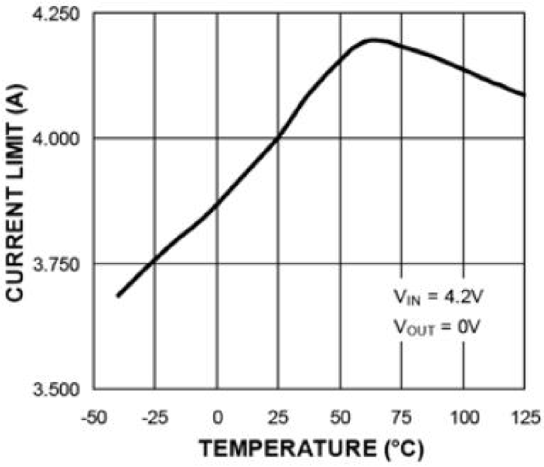
Enable Bias Current vs. Temperature.



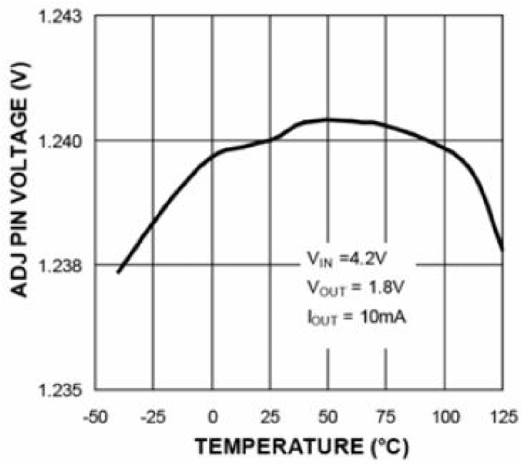
Dropout Voltage vs.Temperature.



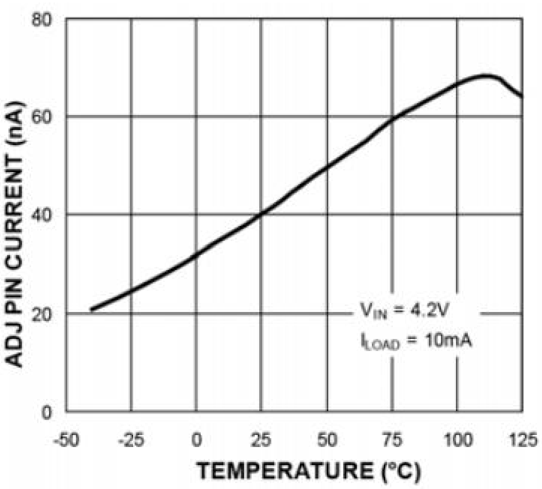
Dropout Voltage vs.Temperature.



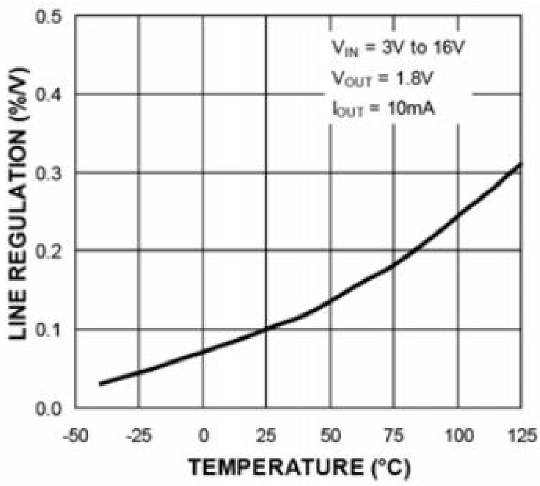
Short-Circuit Current vs. Temperature.



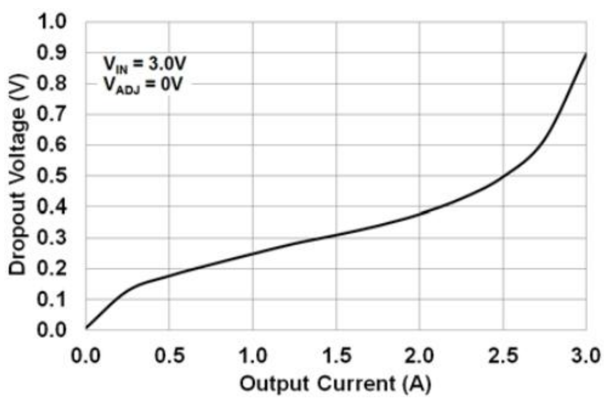
Adjust Pin Voltage vs.Temperature.



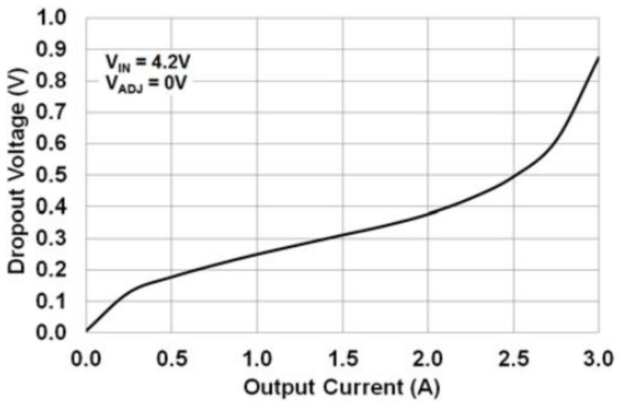
Adjust Pin Current vs.Temperature.



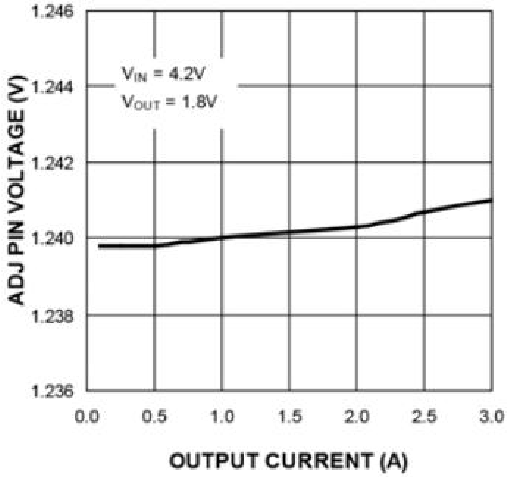
Line Regulation vs.Temperature.



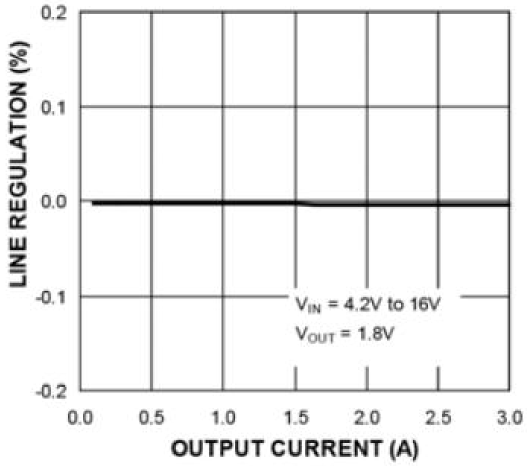
Dropout Voltage vs. Output Current.



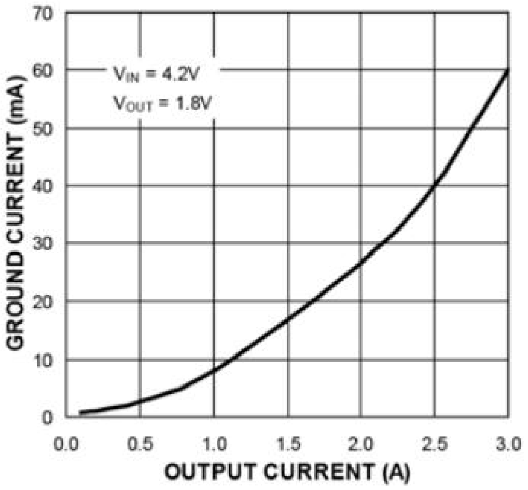
Dropout Voltage vs. Output Current.



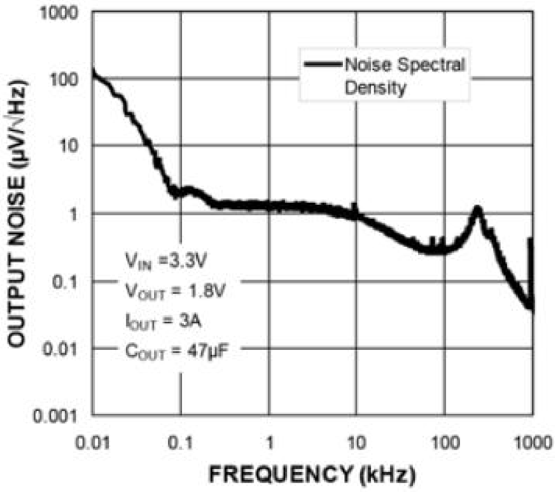
Adjust Pin Voltage vs.Output Current.



Line Regulation vs. Output Current



GND Pin Current vs. Output Current.



Output Noise vs. Frequency

Application Information

The MIC29302W is a high-performance, low-dropout voltage regulator suitable for all moderate to high-current voltage regulation applications. Its 560 mV typical dropout voltage at full load makes it especially valuable in battery-powered systems and as high efficiency noise filters in post-regulator applications. Unlike older NPN-pass transistor designs, where the minimum dropout voltage is limited by the base-emitter voltage drop and collector-emitter saturation voltage, dropout performance of the PNP output is limited merely by the low V_{CE} saturation voltage.

A trade-off for the low dropout voltage is a varying base driver requirement. But the Super ßeta PNP process reduces this drive requirement to merely 1% of the load current.

The MIC29302W regulator is fully protected from damage due to fault conditions. Current limiting is linear; output current under overload conditions is constant. Thermal shutdown disables the device when the die temperature exceeds the +125°C maximum safe operating temperature. The output structure of the regulators allows voltages in excess of the desired output voltage to be applied without reverse current flow. The MIC29302W offers a logic-level ON/OFF control. When disabled, the device draws 32 µA at maximum 16V input.

1 Capacitor Requirements

For stability and minimum output noise, a capacitor on the regulator output is necessary. The value of this capacitor is dependent upon the output current; lower currents allow smaller capacitors. The MIC29302W is stable with a 10 µF capacitor at full load.

This capacitor need not be an expensive low-ESR type; aluminum electrolytics are adequate. In fact, extremely low-ESR capacitors may contribute to instability. Tantalum capacitors are recommended for systems where fast load transient response is important.

When the regulator is powered from a source with high AC impedance, a 0.1 µF capacitor connected between input and GND is recommended.

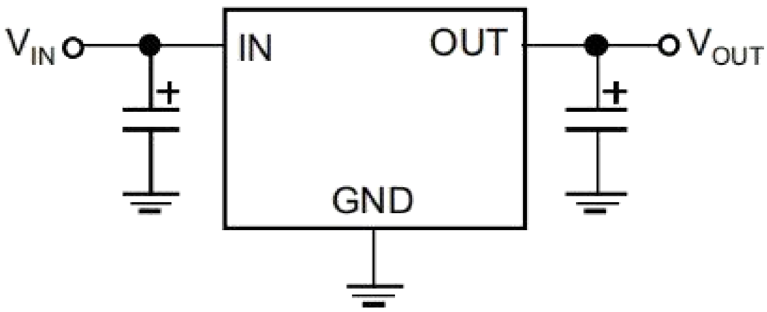


FIGURE 1: Linear Regulators Require O nly Two Capacitors for Operation.

2 Transient Response and 5V to 3.3V Conversion

The MIC29302Whas excellent response to variations in input voltage and load current. By virtue of its low dropout voltage, the device does not saturate into dropout as readily as similar NPN-based designs. A 3.3V output Microchip LDO will maintain full speed and performance with an input supply as low as 4.2V, and will still provide some regulation with supplies down to 3.8V, unlike NPN devices that require 5.1V or more for good performance and become nothing more than a resistor under 4.6V of input. Microchip's PNP regulators provide superior performance in "5V to 3.3V" conversion applications than NPN regulators, especially when all tolerances are considered.

3 Minimum Load Current

The MIC29302W regulator operates within a specified load range. If the output current is too small, leakage currents dominate and the output voltage rises.

A minimum load current of 10 mA is necessary for proper regulation and to swamp any expected leakage current across the operating temperature range.

For best performance the total resistance (R1+R2) should be small enough to pass the minimum regulator load current of 10 mA.

4 Adjustable Regulator Design

The output voltage can be programmed anywhere between 1.25V and the 15V. Two resistors are used. The resistor values are calculated by:

EQUATION 4-1:

$$R1 = R2 \times \left(\frac{V_{OUT}}{1.240} - 1\right)$$

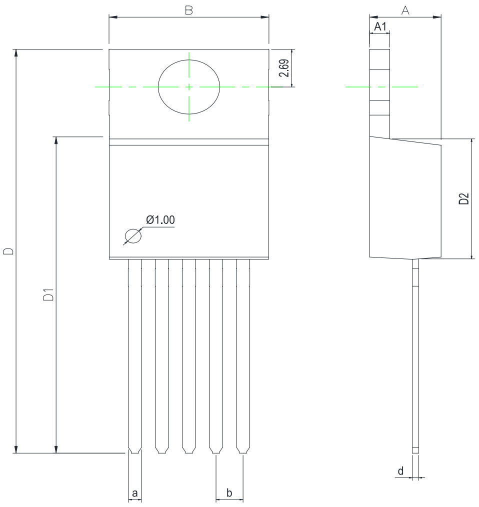
Where:

V_{OUT} = Desired output voltage.

shows component definition. Applicationswith widely varying load currents may scale theresistors to draw the minimum load current required forproper operation (see the Minimum Load Currentsection).

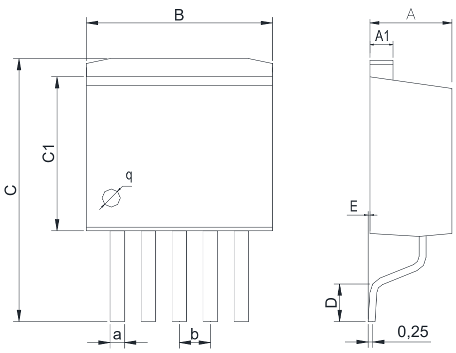
Physical Dimensions

TO-220-5



Dimensions In Millimeters(TO-220-5)									
Symbol:	A	A1	B	D	D1	D2	a	d	b
Min:	4.52	1.25	10	28.2	22.4	8.69	0.71	0.33	1.70BSC
Max:	4.62	1.29	10.3	28.9	22.6	8.79	0.97	0.42	

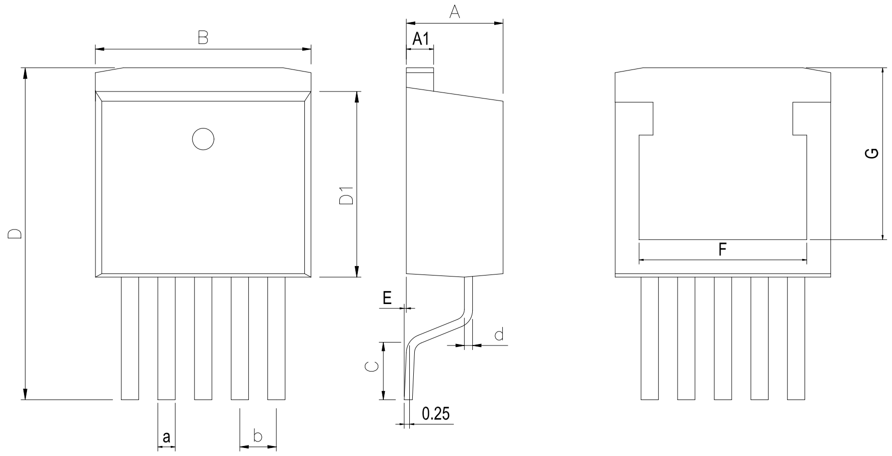
TO-263-5



Dimensions In Millimeters(TO-263-5)									
Symbol:	A	A1	B	C	C1	D	E	a	b
Min:	4.45	1.22	10	13.7	8.40	1.90	0	0.71	1.70BSC
Max:	4.62	1.32	10.4	14.6	8.90	2.10	0.20	0.97	

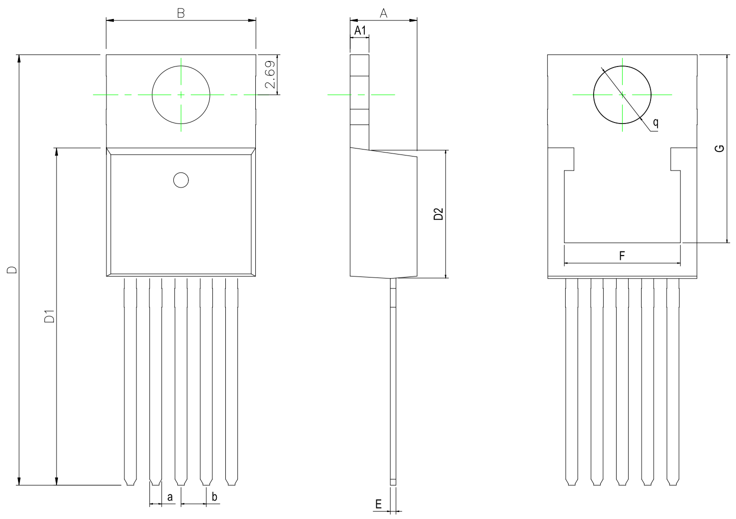
Physical Dimensions

TO-263-5(A2)



Dimensions In Millimeters(TO-263-5)										
Symbol:	A	A1	B	C	D	D1	E	F	G	a	b
Min:	4.40	1.22	9.8	2.10	14.7	8.50	0	7.70	7.87	0.71	1.70
Max:	4.60	1.32	10.4	2.60	15.6	9.10	0.305	7.90	8.07	0.97	BSC

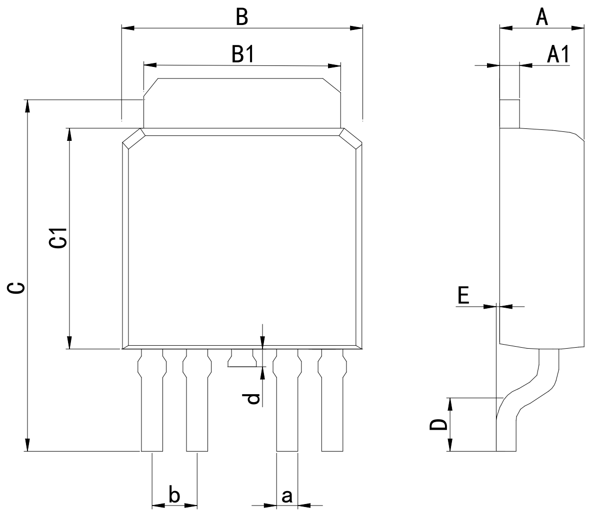
TO-220-5(A2)



Dimensions In Millimeters(TO-220-5)											
Symbol:	A	A1	B	D	D1	D2	E	F	G	a	b	q
Min:	4.40	1.22	9.8	28.5	22.4	8.50	0.33	7.70	12.55	0.71	1.70	3.80
Max:	4.60	1.32	10.4	28.9	22.7	9.10	0.43	7.90	12.65	0.97	BSC	TYP

Physical Dimensions

TO-252-4



Dimensions In Millimeters(TO-252-4)											
Symbol:	A	A1	B	B1	C	C1	D	E	a	d	b
Min:	2.10	0.45	6.40	5.10	9.20	5.30	0.90	0	0.50	0.60	1.27
Max:	2.50	0.70	6.80	5.50	10.6	6.30	1.75	0.23	0.80	1.20	BSC

Revision History

REVISION NUMBER	DATE	REVISION	PAGE
V1.0	2017-11	New	1-15
V1.1	2025-3	Document Reformatting	1-15

IMPORTANT STATEMENT:

Huaguan Semiconductor reserves the right to change its products and services without notice. Before ordering, the customer shall obtain the latest relevant information and verify whether the information is up to date and complete. Huaguan Semiconductor does not assume any responsibility or obligation for the altered documents.

Customers are responsible for complying with safety standards and taking safety measures when using Huaguan Semiconductor products for system design and machine manufacturing. You will bear all the following responsibilities: Select the appropriate Huaguan Semiconductor products for your application; Design, validate and test your application; Ensure that your application meets the appropriate standards and any other safety,security or other requirements. To avoid the occurrence of potential risks that may lead to personal injury or property loss.

Huaguan Semiconductor products have not been approved for applications in life support, military, aerospace and other fields, and Huaguan Semiconductor will not bear the consequences caused by the application of products in these fields. All problems, responsibilities and losses arising from the user's use beyond the applicable area of the product shall be borne by the user and have nothing to do with Huaguan Semiconductor, and the user shall not claim any compensation liability against Huaguan Semiconductor by the terms of this Agreement.

The technical and reliability data (including data sheets), design resources (including reference designs), application or other design suggestions, network tools, safety information and other resources provided for the performance of semiconductor products produced by Huaguan Semiconductor are not guaranteed to be free from defects and no warranty, express or implied, is made. The use of testing and other quality control technologies is limited to the quality assurance scope of Huaguan Semiconductor. Not all parameters of each device need to be tested.

The documentation of Huaguan Semiconductor authorizes you to use these resources only for developing the application of the product described in this document. You have no right to use any other Huaguan Semiconductor intellectual property rights or any third party intellectual property rights. It is strictly forbidden to make other copies or displays of these resources. You should fully compensate Huaguan Semiconductor and its agents for any claims, damages, costs, losses and debts caused by the use of these resources. Huaguan Semiconductor accepts no liability for any loss or damage caused by infringement.