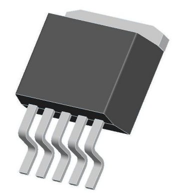
Silicore 芯谷科技

D2631

High-Current Low-Dropout Regulator

General Description



TO263-5

The D2631 is a high current, high accuracy and low-dropout voltage regulator. This regulator features 600mV (over full load) dropout voltage and very low ground current. Designed for high current load, the device also finds applications in lower current, extremely low dropout-critical systems, where its tiny dropout voltage and ground current value are important attributes.

The D2631 is fully protected against over-current fault, reversed input polarity, reversed lead insertion, over-temperature operation, and positive and negative transient voltage spikes.

On the D2631, the ENABLE pin may be tied to V_{IN} if it is not required for ON/OFF control.

The D2631 is available in TO263-5package.

Features

- 3.3V, 5V, 12V output versions
- High Current Capability of 3A
- Low-Dropout Voltage of 600mV at Full Load
- Low Ground Current
- Accurate 1% Guaranteed Tolerance
- Extremely Fast Transient Response
- Reverse-Battery and “Load Dump” Protection
- Zero-Current Shutdown Mode
- Also Characterized For Smaller Loads with Industry-Leading Performance Specifications
- Adjustable Version

Package Information

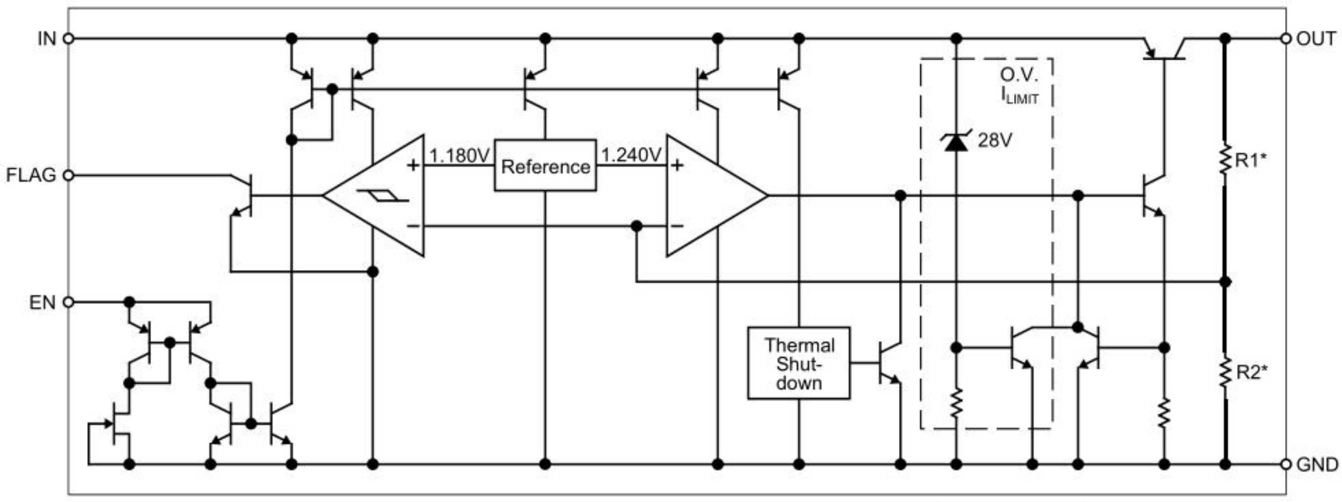
PART NO.	PACKAG DESCRIPTION	PACKAGE MARKING	PACKAGE OPTION
D2631-3.3	TO263-5	CHMC D2631 33 SXXXX	50/Tube 800/Reel
D2631-5.0	TO263-5	CHMC D2631 50 SXXXX	50/Tube 800/Reel
D2631-12	TO263-5	CHMC D2631 12 SXXXX	50/Tube 800/Reel

CHMC:Trademark D2631:Part NO. 33(3.3V)/50(5.0V)/12(12V):Output Voltage SXXXX:Lot NO.

Applications

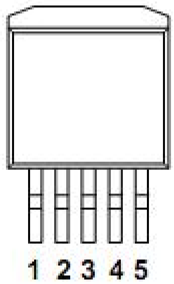
- Battery Powered Equipment
- High-Efficiency "Green" Computer Systems
- Automotive Electronics
- High-Efficiency Linear Power Supplies
- High-Efficiency Post-Regulator for Switching Supply

Functional Block Diagram



* Feedback network in fixed versions only
† Adjustable version only

Pin Configuration



Pin Description

Pin Number	Pin Name	Function Description
1	EN	Enable pin
2	V_{IN}	Power supply
3	GND	Ground
4	V_{OUT}	Output
5	Flag	Flag signal output

Absolute Maximum Ratings

Parameter Name	Symbol	Value	Unit
Power Dissipation	P_D	Internally Limited	
Input Supply Voltage （*1）	V_{IN}	-20～+60	V
Lead Temperature (soldering, 5 seconds)	T_{LEAD}	260	℃
Operating Junction Temperature	T_{OPR}	-40～+125	℃
Storage Temperature Range	T_{STG}	-55～+150	℃
Thermal Resistance(JC)	θ_{JC}	2	℃/W

*** 1:** Maximum positive supply voltage of 60V must be of limited duration (<100msec) and duty cycle (≤1%).

The maximum continuous supply voltage is 26V.

Recommended Operating Conditions

Parameter Name	Symbol	Value	Unit
Maximum Operating Input Voltage	V_{IN}	+2.3 ~ +26	V

Electrical Characteristics

Unless otherwise noted Vin=Vout+1V, T_J = 25°C. Bold values indicate 0℃≤T_J≤+125℃.

Parameter Name	Test Conditions		Min.	Typ.	Max.	Units
Output Voltage	10mA≤I_O≤I_{FL}, (V_{OUT}+1V) ≤V_{IN}≤26V (*2)		-2	0	2	%
Line Regulation	I_O=10mA, (V_{OUT}+1V) ≤V_{IN}≤16V			0.1	0.5	%
Load Regulation	V_{IN}=V_{OUT}+5V, 10mA≤I_{OUT}≤$I_{FULLLOAD}$ (*2,3)			0.2	1.0	%
$\frac{\Delta V_O}{\Delta T}$	Output Voltage (*3) Temperature Coefficient			20	100	ppm/°C
Dropout Voltage	I_O=100mA I_O=1.5A I_O=3A	Δ V_{OUT} = -1% (*4)		100 300 600	200 1000	mV
Ground Current	I_O= 1.5A, I_O=3A	V_{IN}=V_{OUT}+1V (*5)		10 37	35	mA
Ground Pin Current at Dropout	V_{IN}=0.5V less than specified V_{OUT} I_{OUT}=10mA			2.0		mA
Current Limit	V_{OUT} =0V (*6)		3.2	4.5		A
Minimum Load Current				7	10	mA
Output Noise Voltage(10Hz to 100kHz) I_L=100mA	C_L=10μF C_L=33μF			400 260		μV(rms)
Flag Output						
Output Leakage Current	V_{OH}=26V			0.01	2.00	μA
Output Low Voltage	Device set for 5V,V_{IN}=4.5V,I_{OL}=250μA			220	300	mV
Upper Threshold Voltage	Device set for 5V		40	60		mV
Low Threshold Voltage	Device set for 5V			75	95	mV
Hysteresis	Device set for 5V			15		mV

Parameter Name	Test Conditions	Min.	Typ.	Max.	Units
Enable Input					
Input Logic Voltage Low (OFF) High (ON)		 2.4		 0.8 	V
Enable Pin Input Current	V_{EN}=4.2V		15	30 75	µA
	V_{EN}=0.8V			2 4	µA
Regulator Output Current in Shutdown	(*7)		10	20	µA

*** 1:** Full Load current (I_{FL}) is defined as 3A.

*** 2:** Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

*** 3:** Dropout voltage is defined as the input-to-output differential when the output voltage drops to 99% of its nominal value with V_{OUT} + 1V applied to V_{IN}.

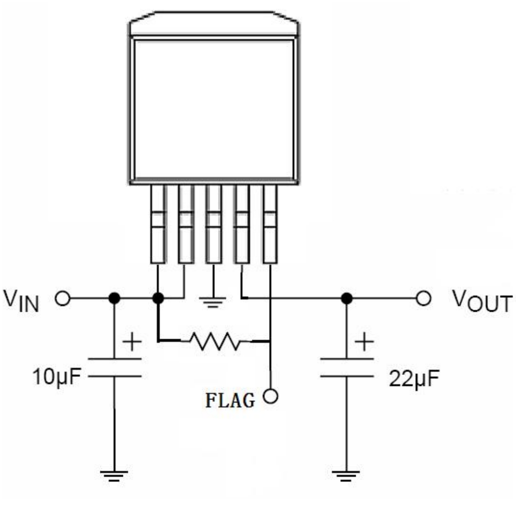
*** 4:** Ground pin current is the regulator quiescent current. The total current drawn from the source is the sum of the load current plus the ground pin current.

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

*** 6:** $V_{EN} \leq 0.8V$ and $V_{IN} \leq 8V$, $V_{OUT} = 0$.

Typical Application

Below is fix output voltage configuration. For best results, the total series resistance should be small enough to pass the minimum regulator load current.



Application Information

The D2631 is a high performance low-dropout voltage adjustable regulator suitable for all moderate to high-current voltage regulator application. This 600mV of dropout voltage at full load make them 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 of this device is limited merely by the low V_{CE} saturation voltage.

A trade-off for the low dropout voltage is a varying base drive requirement. The D2631 is a fully protected from damage due to fault condition. Current limiting is provided. This limiting is linear; output current under over-load conditions is constant. Thermal shutdown disables the device when the die temperature exceeds the 125°C maximum safe operating temperature. The output structure of this regulator allows voltages in excess of the desired output voltage to be applied without reverse current flow. D2631 offers a logic level ON/OFF control: when disabled, the devices draw nearly zero current.

Thermal Design

Linear regulators are simple to use. The most complicated design parameters to consider are thermal characteristics. Thermal design requires the following application-specific parameters:

- Maximum ambient temperature, T_A
- Output Current, I_{OUT}
- Output Voltage, V_{OUT}
- Input Voltage, V_{IN}

First, we calculate the power dissipation of the regulator from these numbers and the device parameters from this datasheet.

$$P_D = I_{OUT}(1.02V_{IN} - V_{OUT})$$

Where the ground current is approximated by 2% of I_{OUT}. Then the heat sink thermal resistance is determined with this formula:

$$\theta_{SA} = \frac{T_{JMAX} - T_A}{P_D} - (\theta_{JC} + \theta_{CS})$$

Where $T_{J\,MAX} \le 125°C$ and θ_{CS} is between 0 and 2°C/W.

The heat sink may be significantly reduced in applications where the minimum input voltage is known and is large compared with the dropout voltage. Use a series input resistor to drop excessive voltage and distribute the heat between this resistor and the regulator. The low dropout properties of regulators allow very significant reductions in regulator power dissipation and the associated heat sink without compromising performance. When this technique is employed, a capacitor of at least 0.1μF is needed directly between the input and regulator ground.

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. D2631 regulator is stable with the following minimum capacitor values at full load: 10μF. 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.

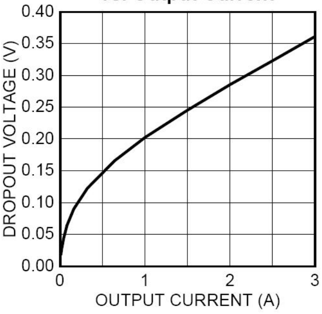
Where the regulator is powered from a source with a high AC impedance, a 0.1μF capacitor connected between Input and GND is recommended.

Enable Input

D2631 feature an enable (EN) input that allows ON/OFF control of the device. Special design allows “zero” current drain when the device is disabled—only microamperes of leakage current flows. The EN input has TTL/CMOS compatible thresholds for simple interfacing with logic, or may be directly tied to Vin. Enabling the regulator requires approximately 20μA of current into the EN pin.

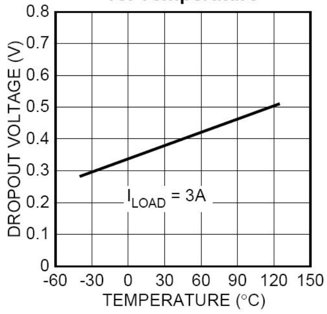
Characteristic Curves

D2631Dropout Voltage
vs. Output Current

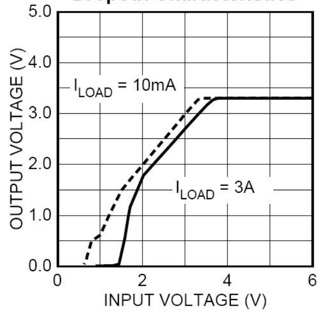


D2631

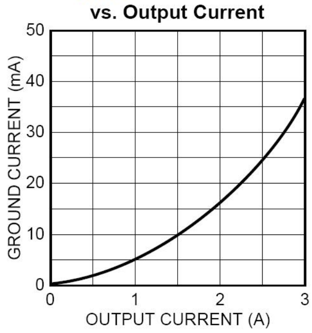
D2631Dropout Voltage
vs. Temperature



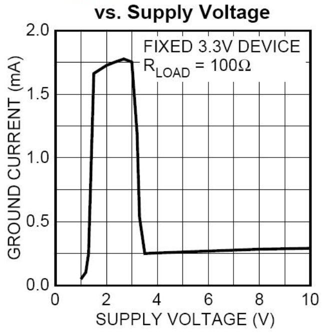
D2631 -3.3V
Dropout Characteristics



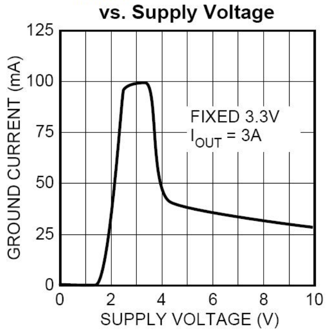
D2631Ground Current
vs. Output Current



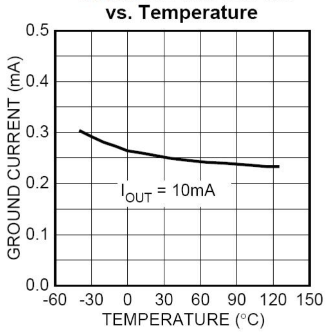
D2631 Ground Current
vs. Supply Voltage



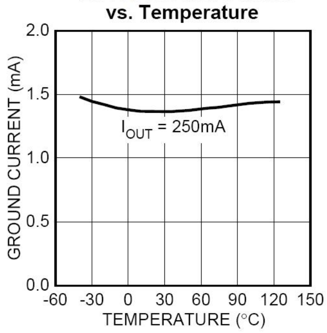
D2631 Ground Current
vs. Supply Voltage



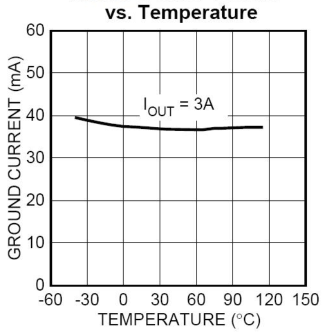
D2631 Ground Current
vs. Temperature



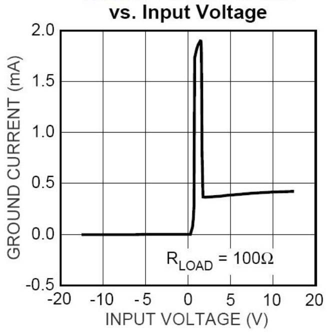
D2631 Ground Current
vs. Temperature

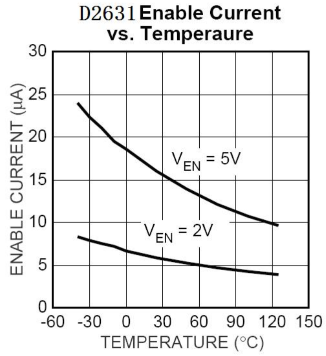


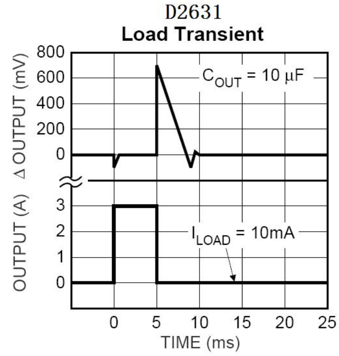
D2631Ground Current
vs. Temperature

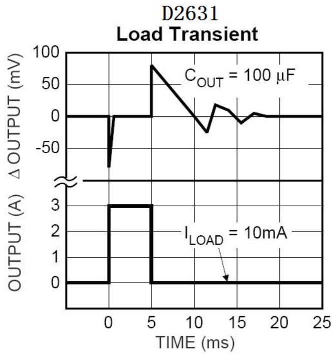


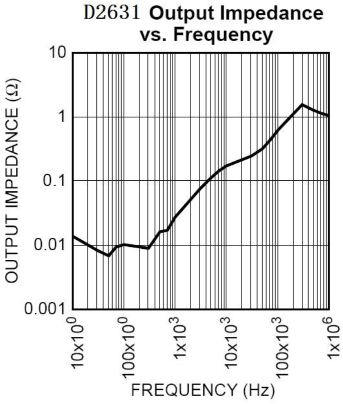
D2631 Ground Current
vs. Input Voltage

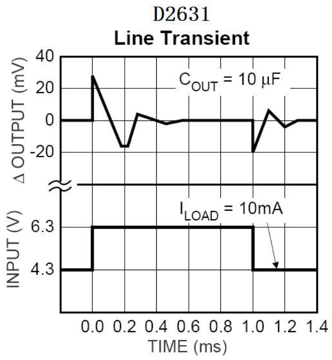


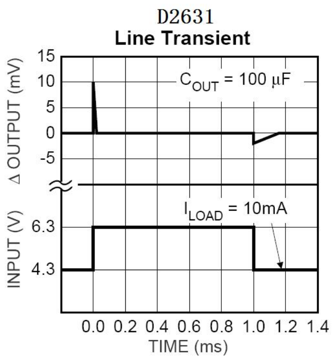

D2631 Enable Current
vs. Temperaure
ENABLE CURRENT (μA)
TEMPERATURE (°C)
V_{EN} = 5V
V_{EN} = 2V
30
25
20
15
10
5
0
-60
-30
0
30
60
90
120
150


D2631
Load Transient
Δ OUTPUT (mV)
OUTPUT (A)
TIME (ms)
C_{OUT} = 10 μF
I_{LOAD} = 10mA
800
600
400
200
0
3
2
1
0
0
5
10
15
20
25


D2631
Load Transient
Δ OUTPUT (mV)
OUTPUT (A)
TIME (ms)
C_{OUT} = 100 μF
I_{LOAD} = 10mA
100
50
0
-50
3
2
1
0
0
5
10
15
20
25

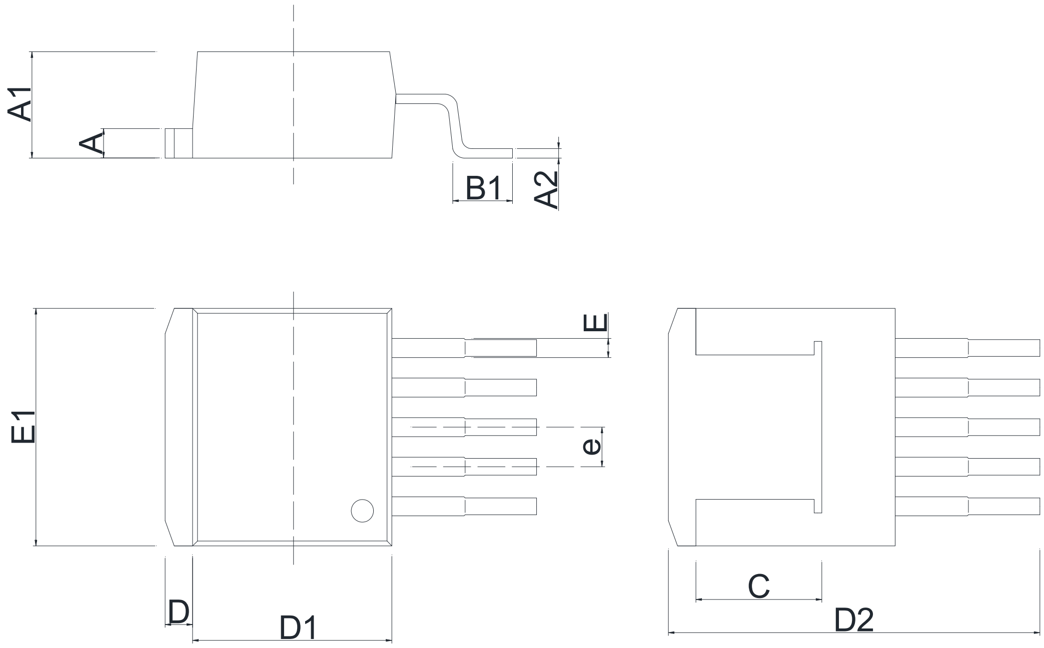

D2631 Output Impedance
vs. Frequency
OUTPUT IMPEDANCE (Ω)
FREQUENCY (Hz)
10
1
0.1
0.01
0.001
10x10^0
100x10^0
1x10^3
10x10^3
100x10^3
1x10^6


D2631
Line Transient
Δ OUTPUT (mV)
INPUT (V)
TIME (ms)
C_{OUT} = 10 μF
I_{LOAD} = 10mA
40
20
0
-20
6.3
4.3
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4


D2631
Line Transient
Δ OUTPUT (mV)
INPUT (V)
TIME (ms)
C_{OUT} = 100 μF
I_{LOAD} = 10mA
15
10
5
0
-5
6.3
4.3
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4

Outline Dimensions

TO263-5 Unit: mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.170	1.370	0.046	0.054
A1	4.350	4.750	0.171	0.187
A2	0.310	0.530	0.012	0.021
B1	1.600	2.740	0.062	0.108
C	5.080 REF		0.200 REF	
D	1.170	1.370	0.046	0.054
D1	8.100	8.900	0.318	0.350
D2	14.550	15.550	0.572	0.612
E	0.660	0.860	0.025	0.034
E1	9.800	10.310	0.385	0.406
e	1.700（BSC）		0.067（BSC）	

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