1. General Description

The WR0310 series low-power, low-dropout, CMOS linear voltage regulators operate from a 1.6V to 5.5V input voltage and deliver up to 300mA output current. A low ground current and a 10nA logic-controlled shutdown mode make this part attractive for battery power systems. The WR0310 series feature low dropout voltage to prolong battery life in portable electronics. Systems requiring a quiet voltage source, such as RF applications, will benefit from low output noise and high PSRR of the WR0310 series.

The WR0310 has the fold-back maximum output current limit with respect to the output voltage and thermal shutdown protection.

The WR0310 has auto-discharge function to quickly discharge V_{OUT} when the device is disabled.

The WR0310 is available in Green DFN1×1-4 , SOT23-5 and SOT353 packages. It operates over an ambient temperature range of -40℃ to +85℃.

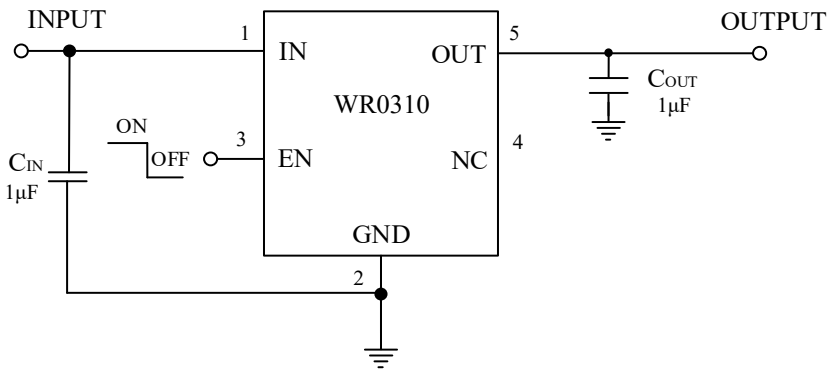
2. Features

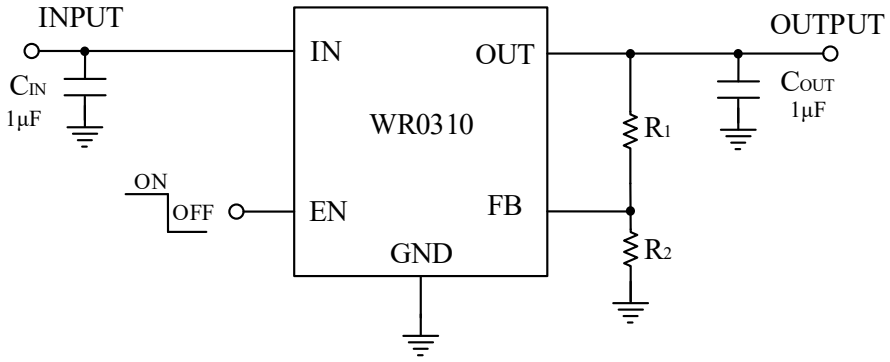
- Low Dropout Voltage
- 20μA Low Ground Current
- 10nA Logic-Controlled Shutdown
- 1.6V to 5.5V Input Voltage Range
- Fixed Outputs of 0.8V, 0.9V, 1.0V, 1.05V, 1.1V，1.2V, 1.3V, 1.8V, 1.85V, 2.1V, 2.2V, 2.5V, 2.8V, 3.0V, 3.3V
- Adjustable Output from 0.8V to 5.0V
- Feedback Voltage：0.8V(TYP.)
- 300mA Output Current
- Quick Start-Up Time
- High Output Voltage Accuracy
- Short Auto-Discharge Function
- Thermal Overload Protection
- Built-In Fold Back Protection Circuit

3. Applications

- Cellular Telephones
- Cordless Telephones
- PCMCIA Cards
- Modems
- MP3 Player
- Hand-Held Instruments
- Palmtop Computers
- Electronic Planners
- Portable/Battery-Powered Equipment

4. Typical Application Circuits



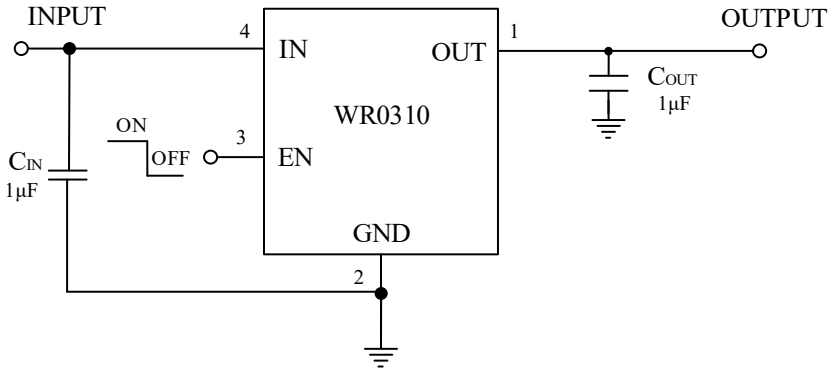


SOT23-5/SOT353

NOTE: Select R_2=160kΩ to maintain a 5μA minimum load.

Calculate the value of R_1 using the following equation:

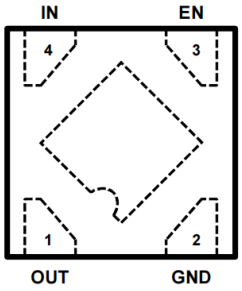
$$R_1 = R_2 \times \left(\frac{V_{OUT}}{0.8V} - 1\right)$$



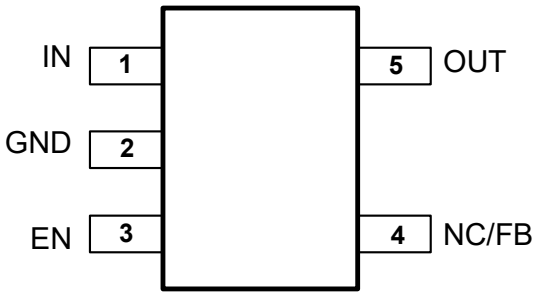
DFN 1×1-4

5. Pin Configuration

(Top View)



DFN 1×1- 4



SOT 23-5/SOT353

6. Pin Description

NUMBER		NAME	FUNCTION
DFN1×1-4	SOT23-5/SOT353		
1	5	OUT	Regulator Output.
2	2	GND	Ground.
3	3	EN	Enable Pin, Active High. This pin has an internal pull-down resistor. When EN pin is floating, it will be shutdown.
4	1	IN	Regulator Input. Supply voltage can range from 1.6V to 5.5V. Bypass with a 1μF capacitor to GND.
—	4	NC/FB	NC

7. Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)[1]

SYMBOL	PARAMETER		RATING	UNIT
V_{IN}	IN to GND		-0.3 to 6	V
V_{EN}, V_{FB}	EN, FB Input Voltage Range		-0.3 to V_{IN}	V
V_{OUT}	OUT to GND		-0.3V to (V_{IN} + 0.3V)	V
P_D	Power Dissipation $P_{D(MAX)}$@T_A = 25℃	DFN1×1-4	664	mW
		SOT353	700	mW
		SOT23-5	1046	mW
$R_{\theta JA}$	Thermal resistance	DFN1×1-4	188.1	°C/W
		SOT353	160	°C/W
		SOT23-5	119.4	°C/W
T_J	Junction Temperature		150	°C
T_{SDR}	Storage Temperature Range		-65 to +150	°C
T_{STG}	Lead Temperature (Soldering, 10 sec)		260	°C
ESD	HBM		4000	V
	MM		400	V

NOTE: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions 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.

8. Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{IN}	Input Voltage	1.6	5.5	V
T_A	Operating Ambient Temperature	-40	85	°C

9. Electrical Characteristics

($V_{OUT\ (NOMINAL)}$ + 1V < Vin <5.5V, T_A=25℃, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP.	MAX	UNIT
V_{IN}	Input Voltage			1.6		5.5	V
V_{OUT}	Output Voltage Accuracy	I_{OUT} = 0.1mA		-2		+2	%
V_{FB}	Feedback Voltage	I_{OUT}=1mA		0.784	0.8	0.816	V
I_{OUT}	Maximum Output Current [1]			300			mA
I_{LIM}	Current Limit			360	560		mA
I_Q	Supply Pin Current	No Load, V_{EN} = V_{IN}			20	26	μA
V_{DROP}	Dropout Voltage [2]	I_{OUT} = 300mA	V_{OUT}=0.8V		700	850	mV
			0.8V <V_{OUT} ≤1.2V		510	600	
			1.2V <V_{OUT} ≤1.8V		360	430	
			1.8V <V_{OUT} ≤2.1V		240	320	
			2.1V <V_{OUT} ≤2.8V		180	230	
			2.8V <V_{OUT} ≤3.6V		130	180	
$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	Line Regulation	V_{IN} = 1.6V or (V_{OUT} + 0.5V) to 5.5V, I_{OUT} = 1mA	1.8V ≤ V_{OUT} ≤ 3.3V		0.01	0.06	%/V
			V_{OUT}<1.8V , V_{OUT} > 3.3V		0.01	0.1	
ΔV_{OUT}	Load Regulation	I_{OUT} = 0.1mA to 300mA			12	40	mV
I_{SHORT}	Short Current Limit	V_{OUT} = 0V			200		mA

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP.	MAX	UNIT
PSRR	Power Supply Rejection Ratio	I_{OUT} = 30mA, C_{OUT} = 1μF, V_{IN} = V_{OUT} + 1V, ΔV_{RIPPLE} = 0.2V_{P-P}	f = 217Hz		80		dB
			f = 1KHz		75		
e_n	Output Voltage Noise	f = 10Hz to 100kHz, C_{OUT} = 1μF, V_{OUT} = 1.8V	I_{OUT} = 0mA		100		μV_{RMS}
			I_{OUT} = 30mA		200		
V_{ENH}	EN Input Threshold	V_{IN} = 5.5V		0.9			V
V_{ENL}						0.4	
I_{ENH}	EN Input Bias Current	V_{EN} = 5.5V			0.8	2	μA
I_{ENL}		V_{EN} = 0V			0.01	1	
I_{SHDN}	Shutdown Supply Current	V_{EN} = 0V			0.01	1	μA
t_{STR}	Start-Up Time [3]	C_{OUT} = 1μF, No Load			30		μs
R_{DIS}	RON of Discharge MOSFET	V_{IN} = 4.0V, V_{EN} = 0V			50		Ω
T_{SD}	Thermal Shutdown Temperature				165		°C
ΔT_{SD}	Thermal Shutdown Hysteresis				15		°C

NOTE1. Maximum output current is affected by the PCB layout, size of metal trace, the thermal conduction path between metal layers, ambient temperature and the other environment factors of system. Attention should be paid to the dropout voltage when V_{IN} < V_{OUT} + V_{DROP}.

NOTE2. The dropout voltage is defined as (V_{IN}-V_{OUT}) when V_{OUT} is $V_{OUT(NOM)}$*98% at T_A=25℃ and maybe various with respect to load and temperature.

NOTE3. Time needed for V_{OUT} to reach 90% of final value.

10. Typical Performance Characteristics

($V_{OUT\ (NOMINAL)}$ + 1V < Vin <5.5V, V_{EN} = 2V, C_{IN}=1μF, C_{OUT}=1μF, T_A=25°C, unless otherwise noted)

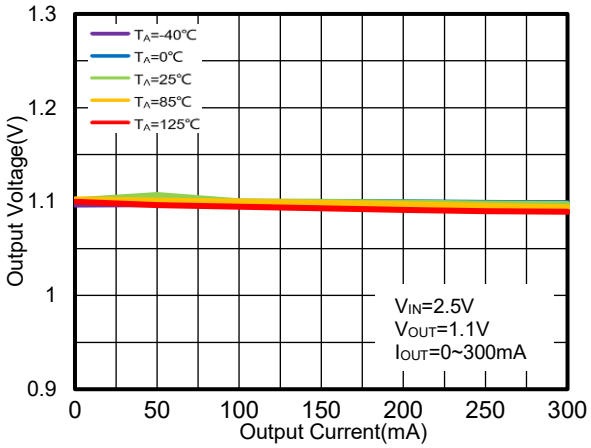


Figure 1.WR0310-11FF4R
Output Voltage vs. Output Current

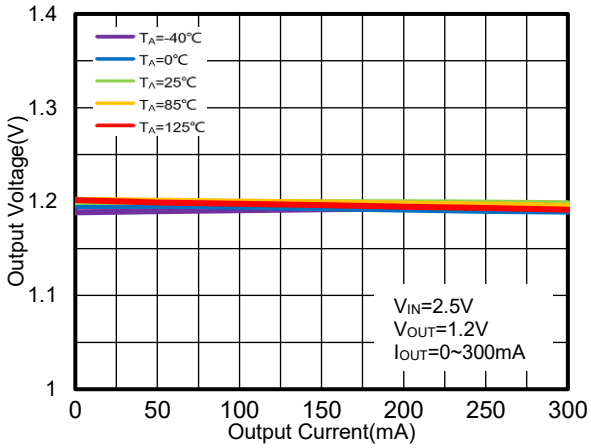


Figure 2.WR0310-12FF4R
Output Voltage vs. Output Current

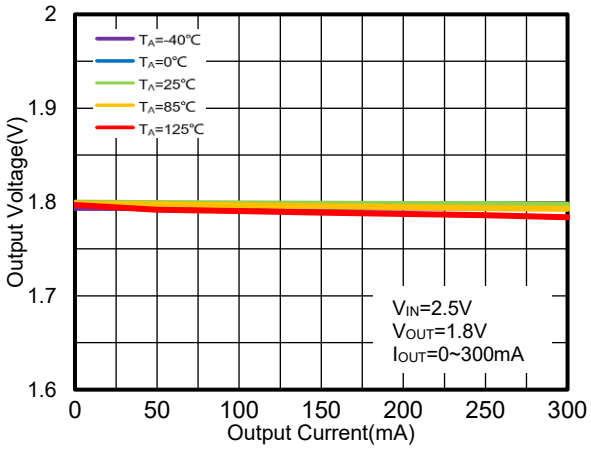


Figure 3.WR0310-18FF4R
Output Voltage vs. Output Current

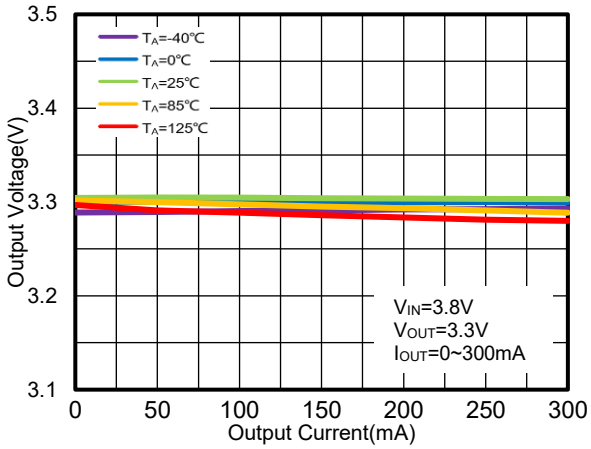


Figure 4.WR0310-33FF4R
Output Voltage vs. Output Current

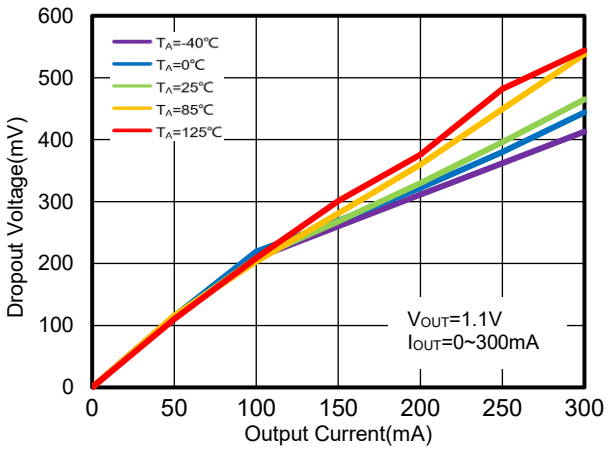


Figure 5.WR0310-11FF4R
Dropout Voltage vs. I_{OUT}

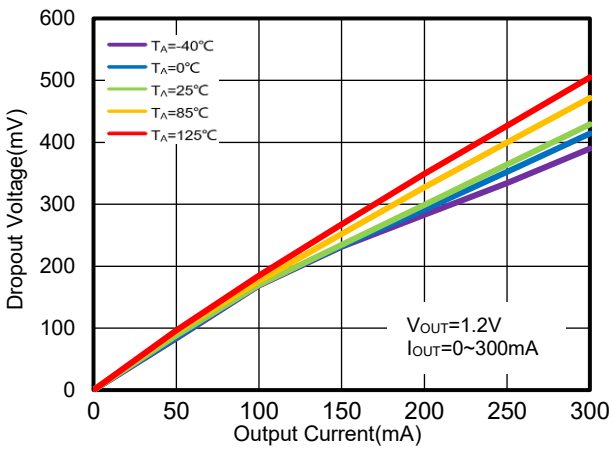


Figure 6.WR0310-12FF4R
Dropout Voltage vs. I_{OUT}

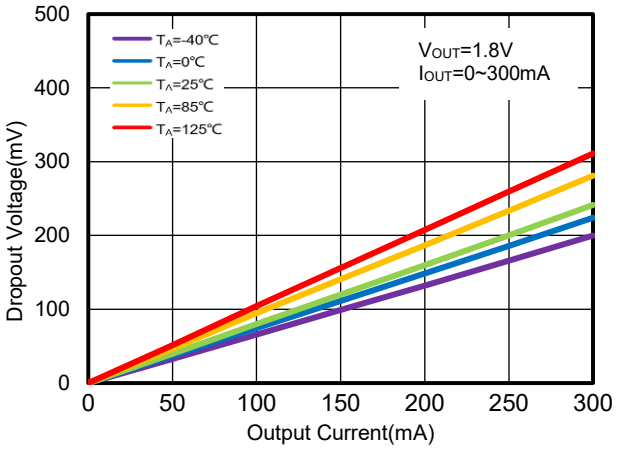


Figure 7.WR0310-18FF4R
Dropout Voltage vs. I_{OUT}

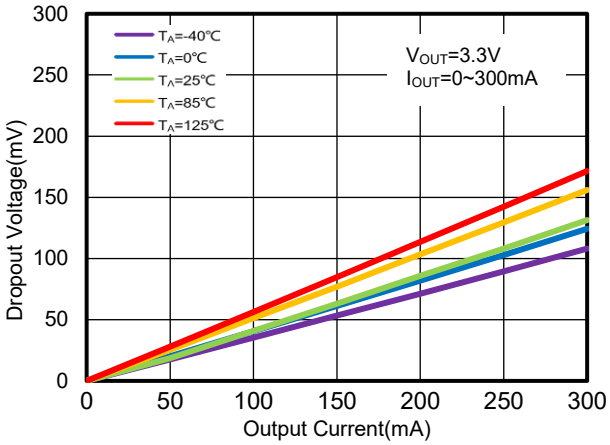


Figure 8.WR0310-33FF4R
Dropout Voltage vs. I_{OUT}

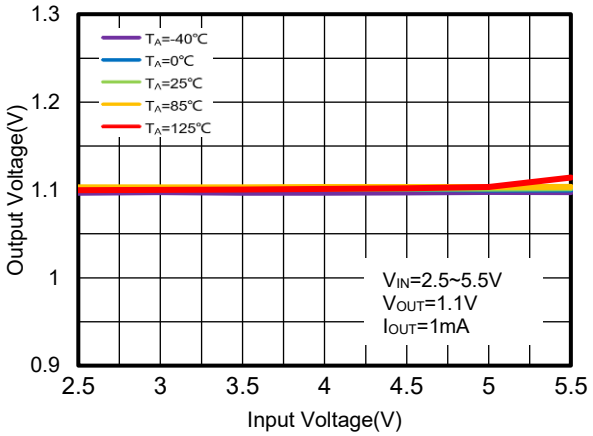


Figure 9.WR0310-11FF4R
Regulation vs. V_{IN} (Line Regulation)

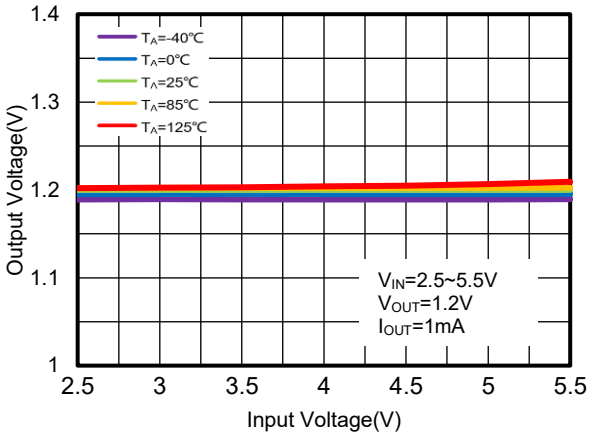


Figure 10.WR0310-12FF4R
Regulation vs. V_{IN} (Line Regulation)

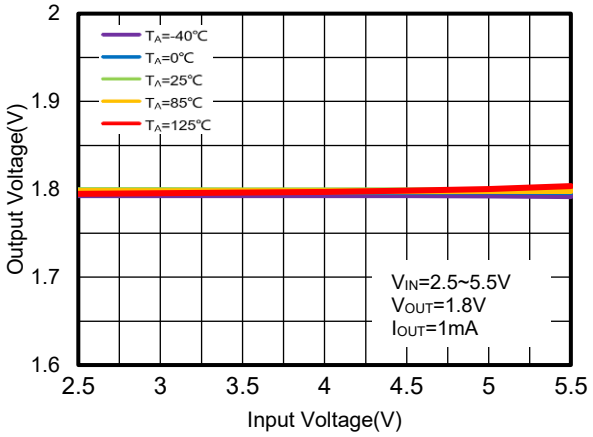


Figure 11.WR0310-18FF4R
Regulation vs. V_{IN} (Line Regulation)

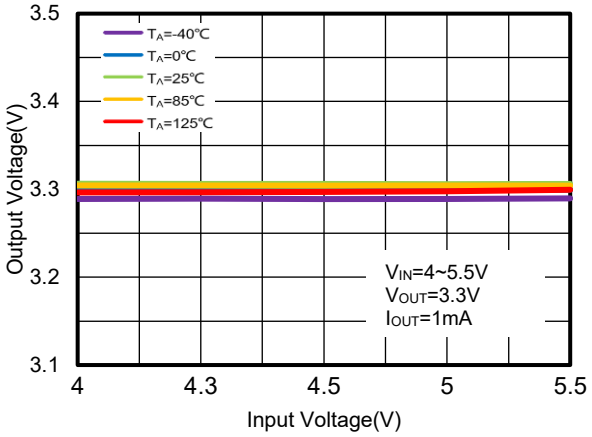


Figure 12.WR0310-33FF4R
Regulation vs. V_{IN} (Line Regulation)

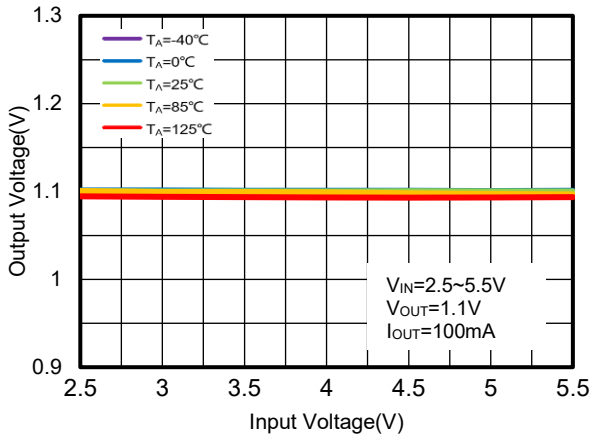


Figure 13.WR0310-11FF4R
Regulation vs. V_{IN} (Line Regulation)

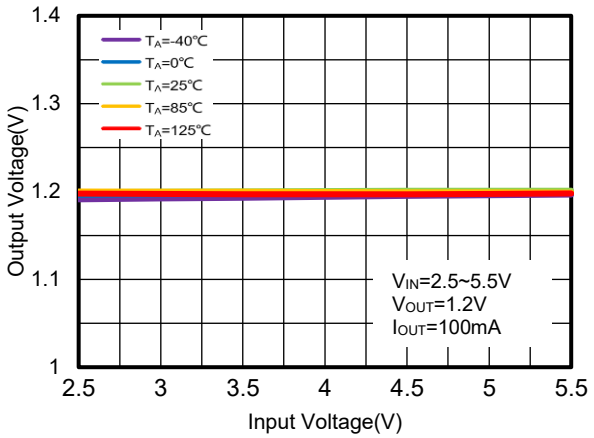


Figure 14.WR0310-12FF4R
Regulation vs. V_{IN} (Line Regulation)

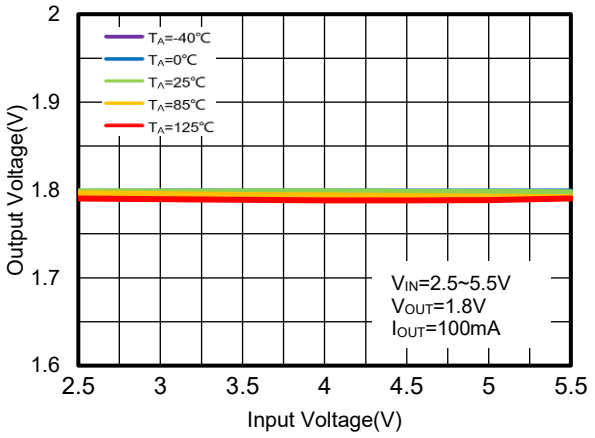


Figure 15.WR0310-18FF4R
Regulation vs. V_{IN} (Line Regulation)

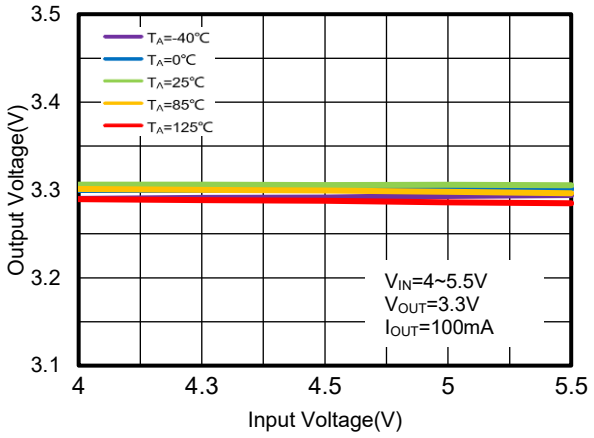


Figure 16.WR0310-33FF4R
Regulation vs. V_{IN} (Line Regulation)

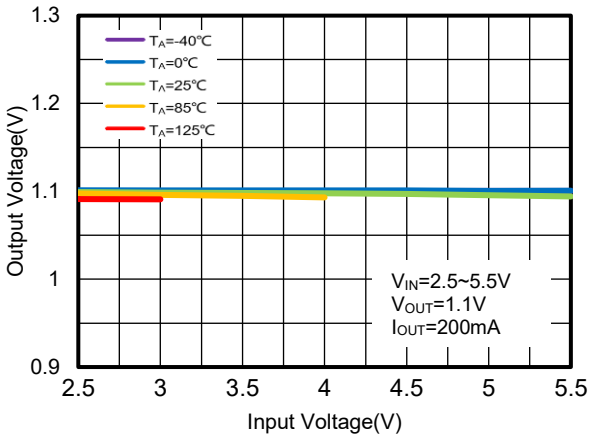


Figure 17.WR0310-11FF4R
Regulation vs. V_{IN} (Line Regulation)

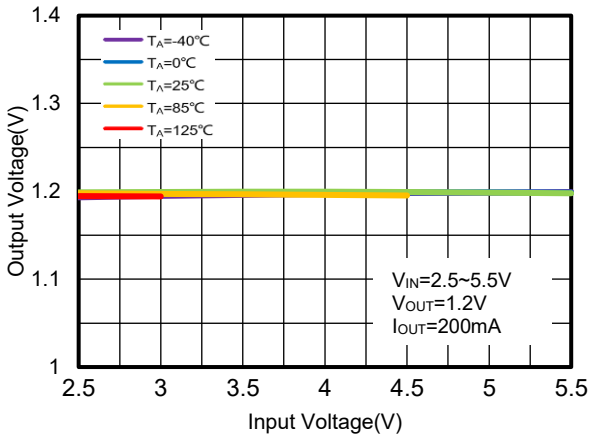


Figure 18.WR0310-12FF4R
Regulation vs. V_{IN} (Line Regulation)

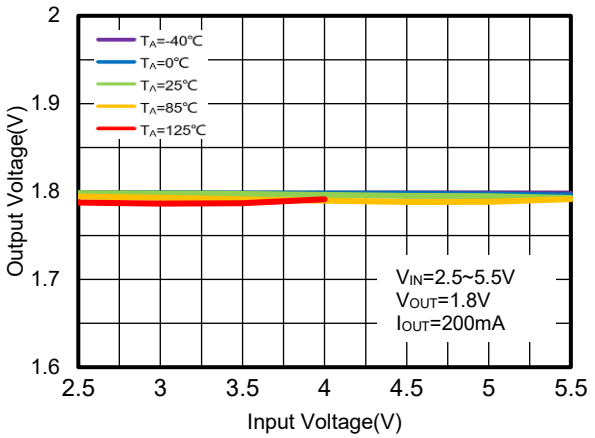


Figure 19.WR0310-18FF4R
Regulation vs. V_{IN} (Line Regulation)

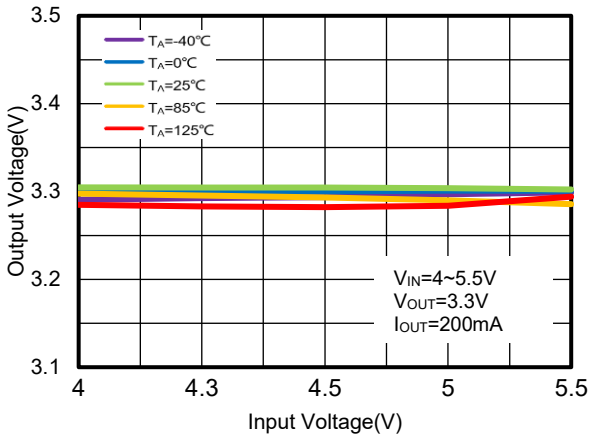


Figure 20.WR0310-33FF4R
Regulation vs. V_{IN} (Line Regulation)

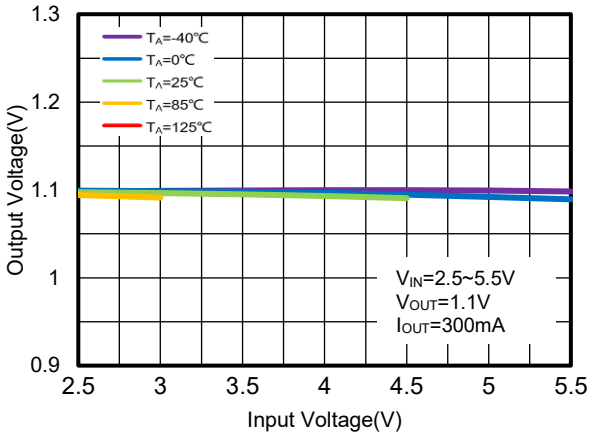


Figure 21.WR0310-11FF4R
Regulation vs. V_{IN} (Line Regulation)

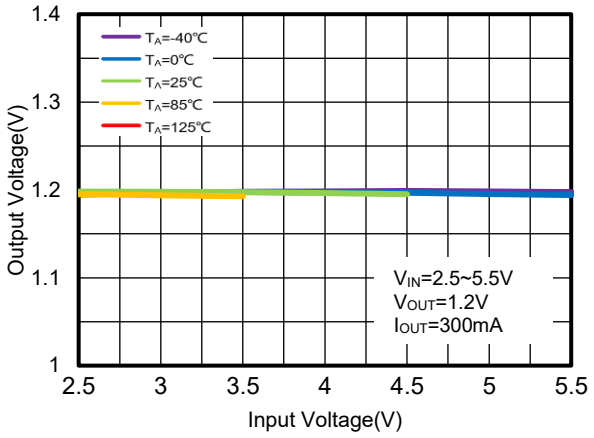


Figure 22.WR0310-12FF4R
Regulation vs. V_{IN} (Line Regulation)

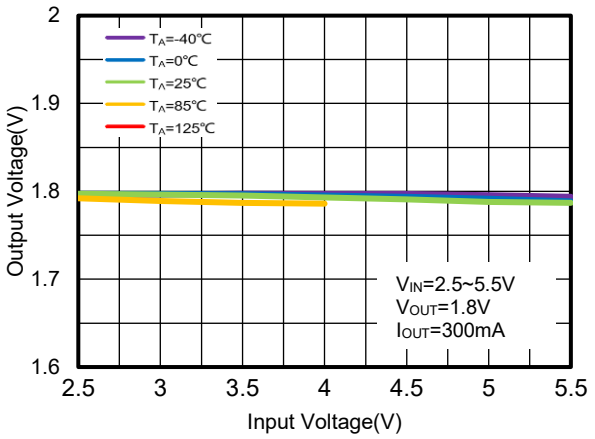


Figure 23.WR0310-18FF4R
Regulation vs. V_{IN} (Line Regulation)

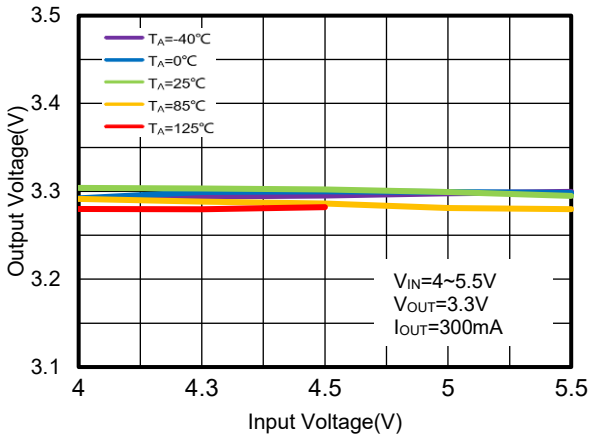


Figure 24.WR0310-33FF4R
Regulation vs. V_{IN} (Line Regulation)

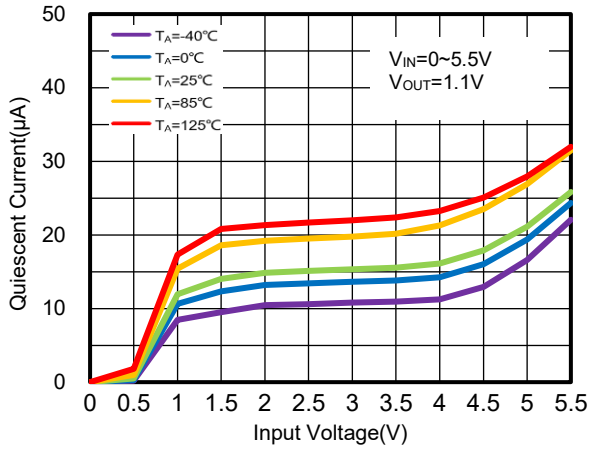


Figure 21.WR0310-11FF4R
Quiescent Current vs. V_{IN}

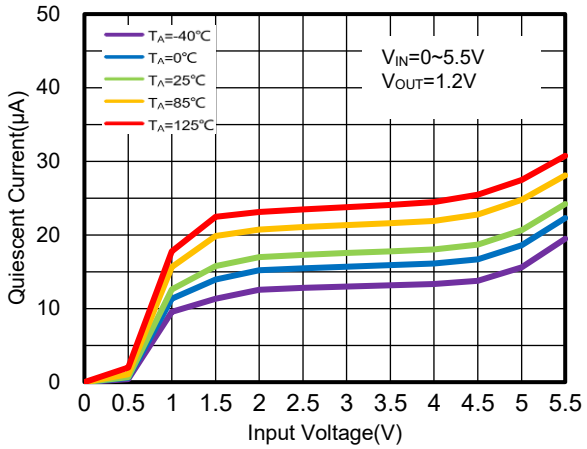


Figure 22.WR0310-12FF4R
Quiescent Current vs. V_{IN}

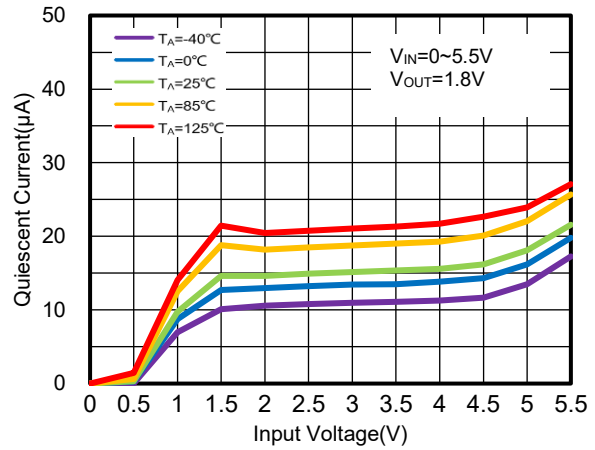


Figure 23.WR0310-18FF4R
Quiescent Current vs. V_{IN}

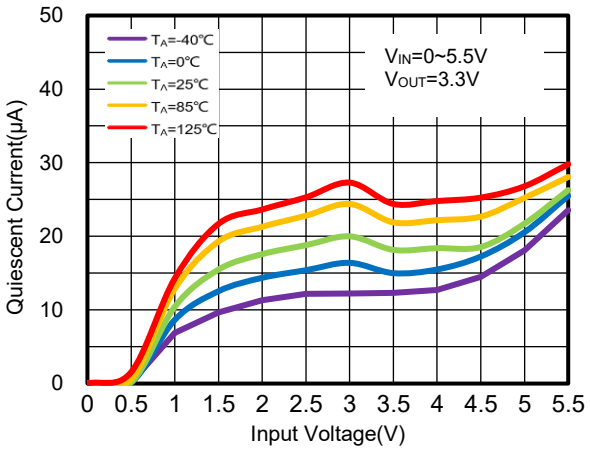


Figure 24.WR0310-33FF4R
Quiescent Current vs. V_{IN}

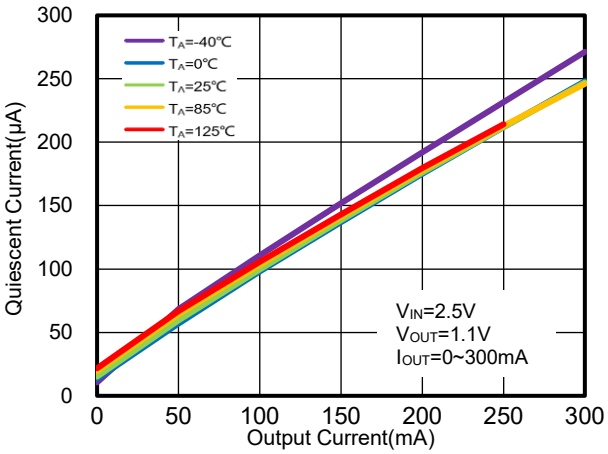


Figure 25.WR0310-11FF4R
Ground Current vs. I_{OUT}

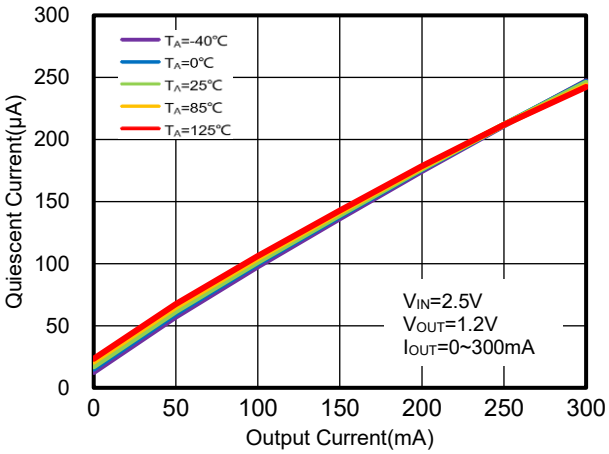


Figure 26.WR0310-12FF4R
Ground Current vs. I_{OUT}

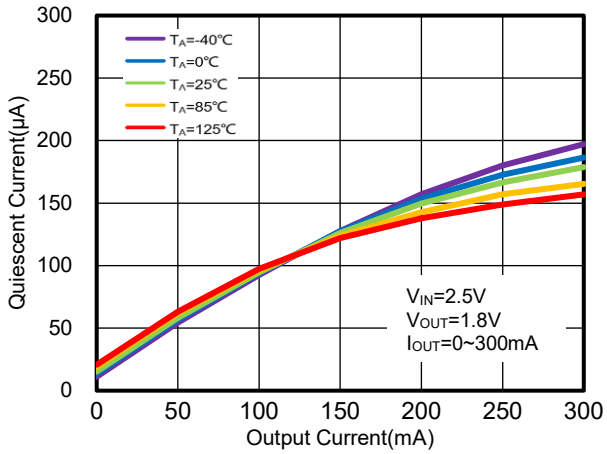


Figure 27.WR0310-18FF4R
Ground Current vs. I_{OUT}

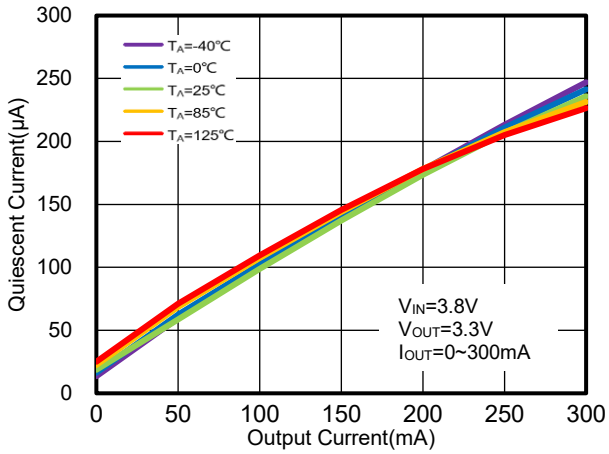


Figure 28.WR0310-33FF4R
Ground Current vs. I_{OUT}

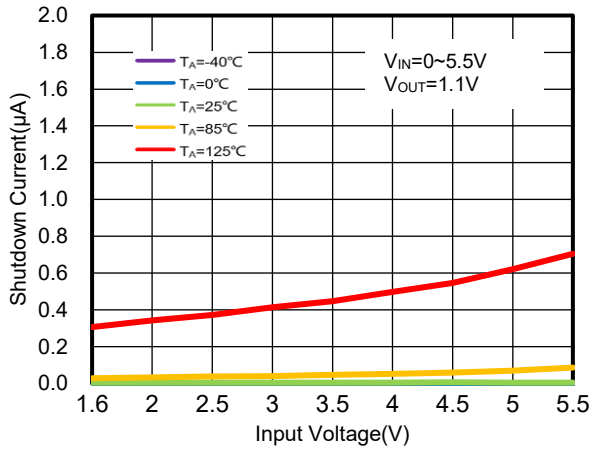


Figure 29.WR0310-11FF4R
Shutdown Current vs. V_{IN}

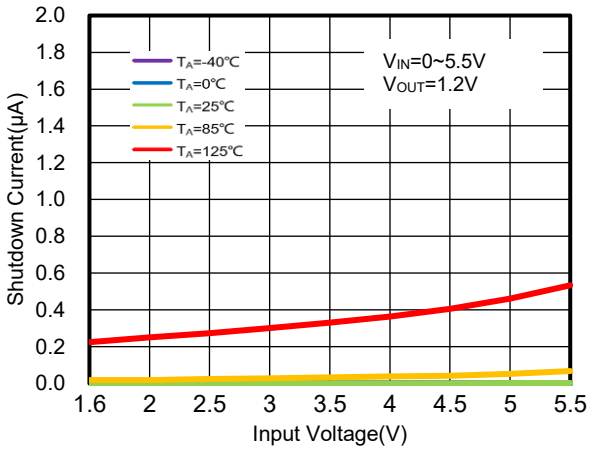


Figure 30.WR0310-12FF4R
Shutdown Current vs. V_{IN}

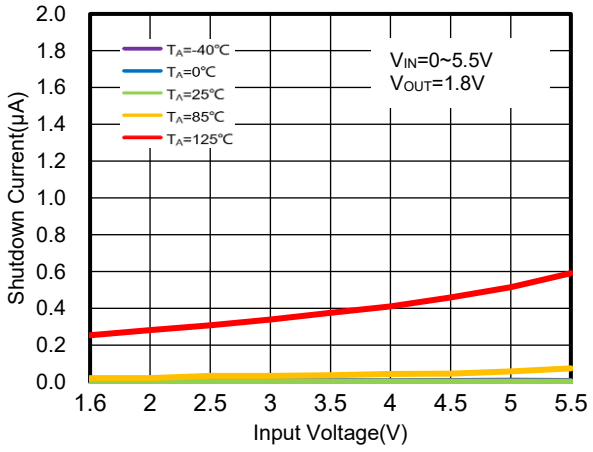


Figure 31.WR0310-18FF4R
Shutdown Current vs. V_{IN}

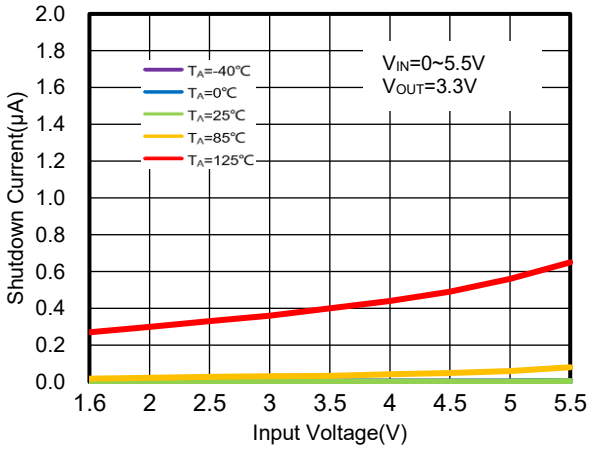


Figure 32.WR0310-33FF4R
Shutdown Current vs. V_{IN}

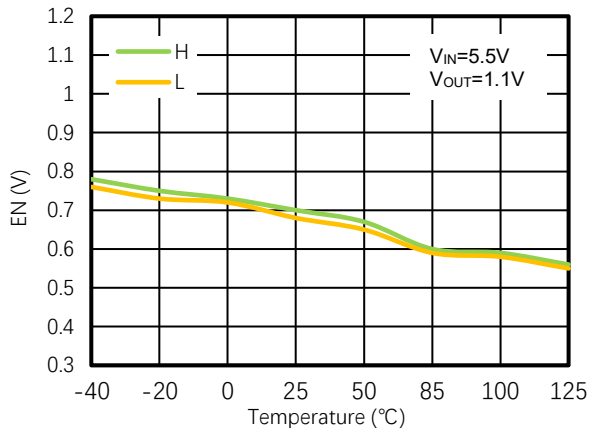


Figure 33.WR0310-11FF4R
Enable Threshold vs. Ambient Temperature

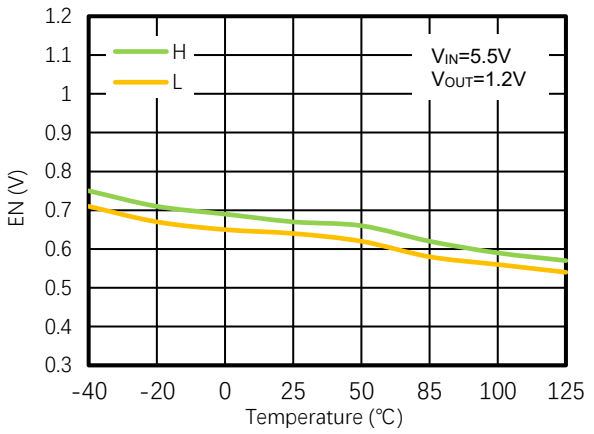


Figure 34.WR0310-12FF4R
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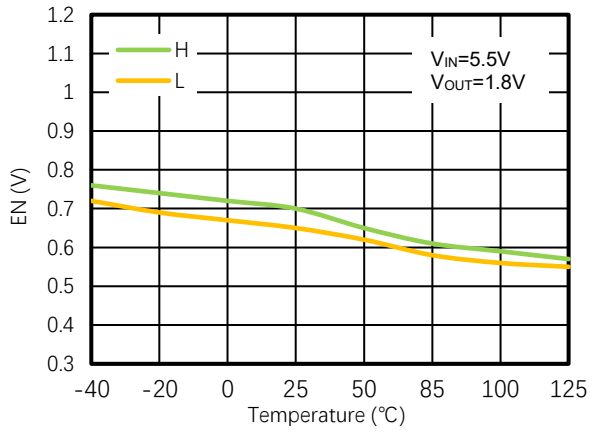


Figure 35.WR0310-18FF4R
Enable Threshold vs. Ambient Temperature

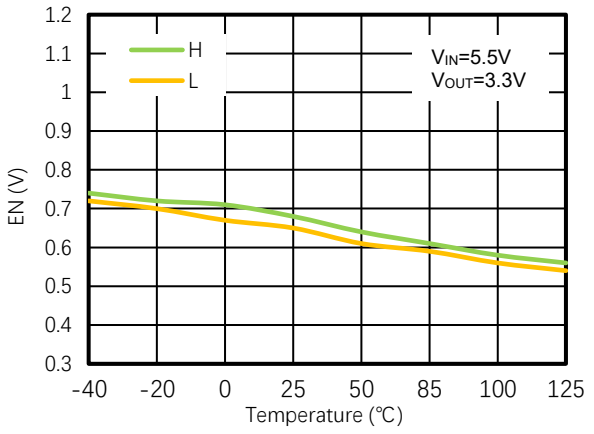


Figure 36.WR0310-33FF4R
Enable Threshold vs. Ambient Temperature

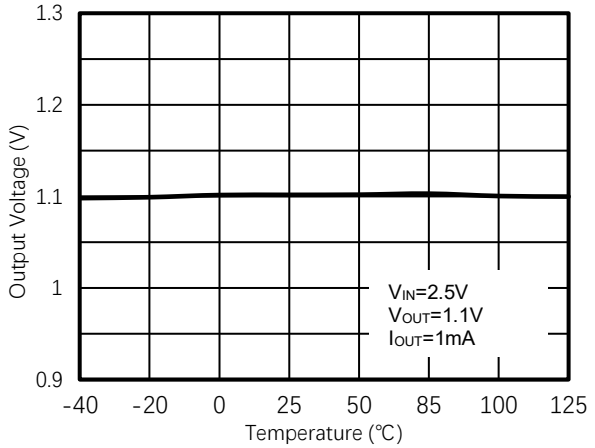


Figure 37.WR0310-11FF4R
Output Voltage vs. Ambient Temperature

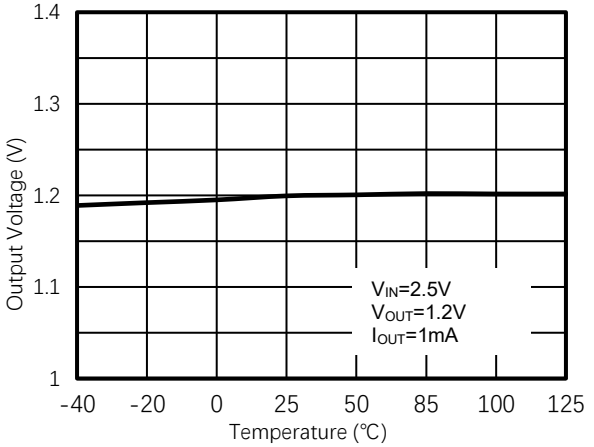


Figure 38.WR0310-12FF4R
Output Voltage vs. Ambient Temperature

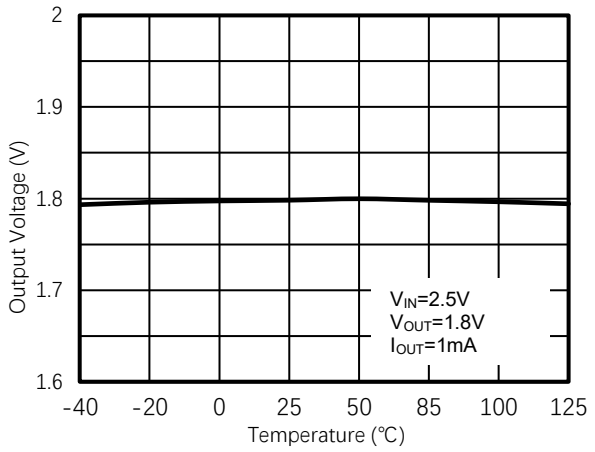


Figure 39.WR0310-18FF4R
Output Voltage vs. Ambient Temperature

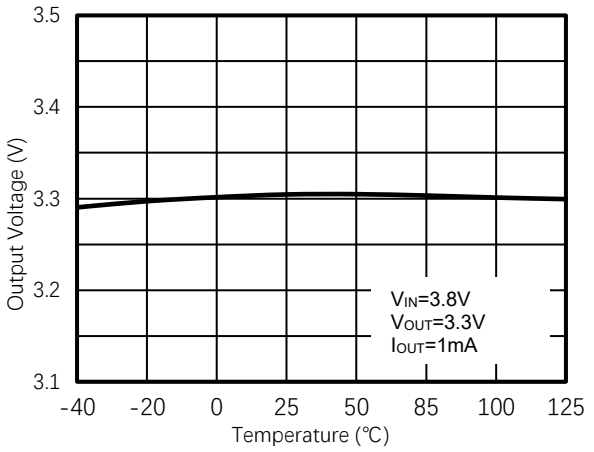


Figure 40.WR0310-33FF4R
Output Voltage vs. Ambient Temperature

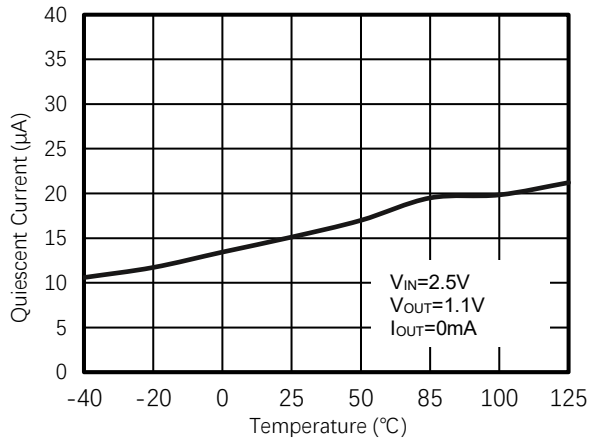


Figure 41.WR0310-11FF4R
Quiescent Current vs. Ambient Temperature

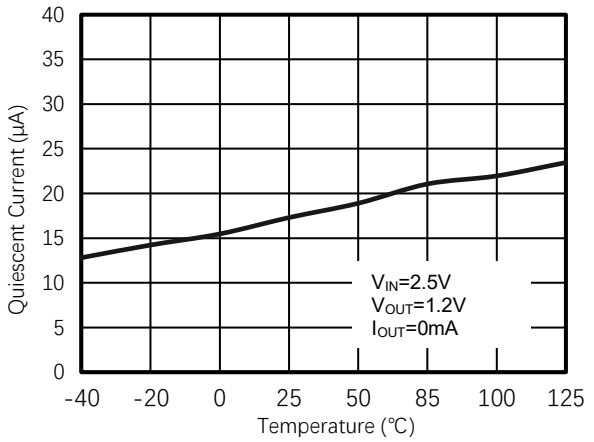


Figure 42.WR0310-12FF4R
Quiescent Current vs. Ambient Temperature

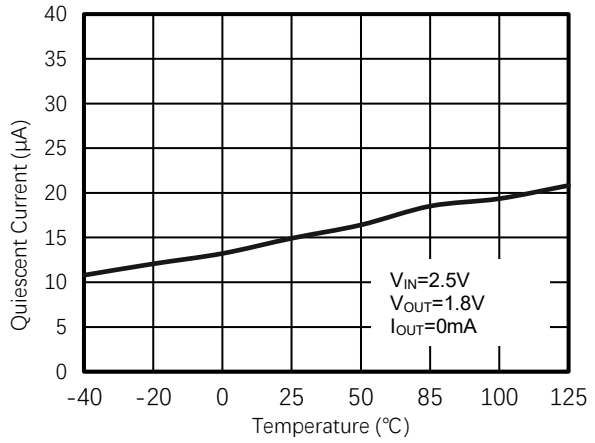


Figure 43.WR0310-18FF4R
Quiescent Current vs. Ambient Temperature

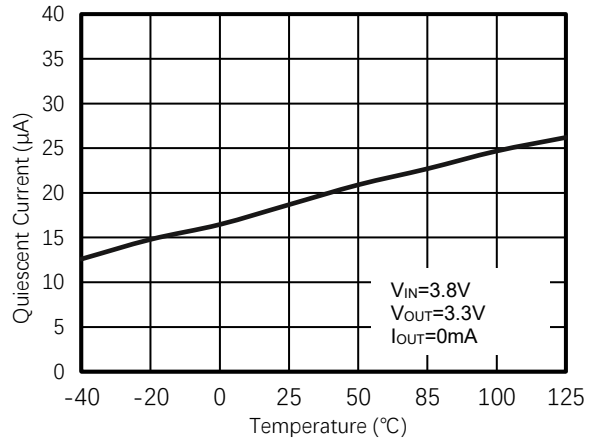


Figure 44.WR0310-33FF4R
Quiescent Current vs. Ambient Temperature

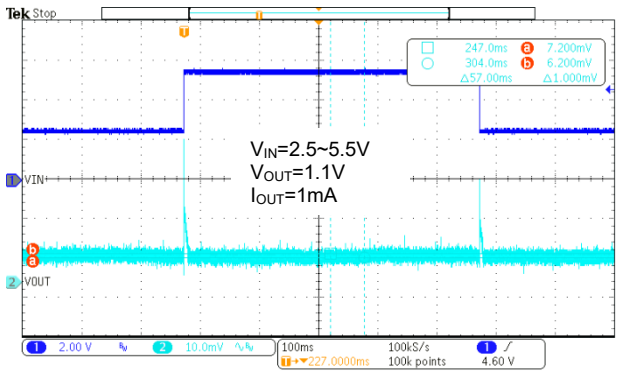


Figure 45.WR0310-11FF4R
Line Transient

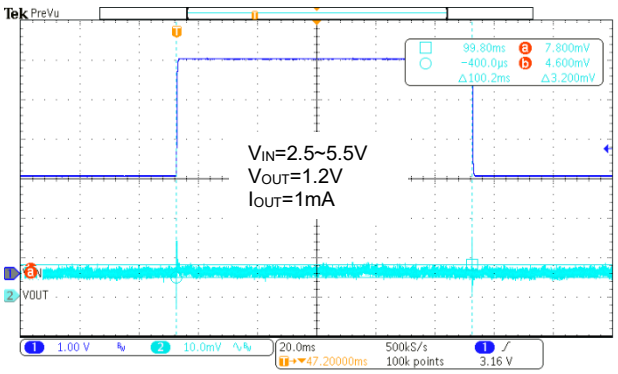


Figure 46.WR0310-12FF4R
Line Transient

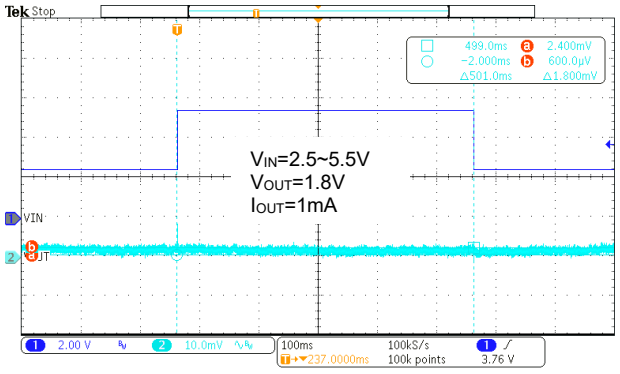


Figure 47.WR0310-18FF4R
Line Transient

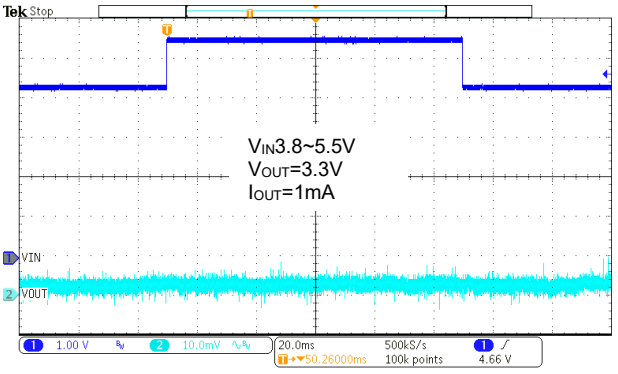


Figure 48.WR0310-33FF4R
Line Transient

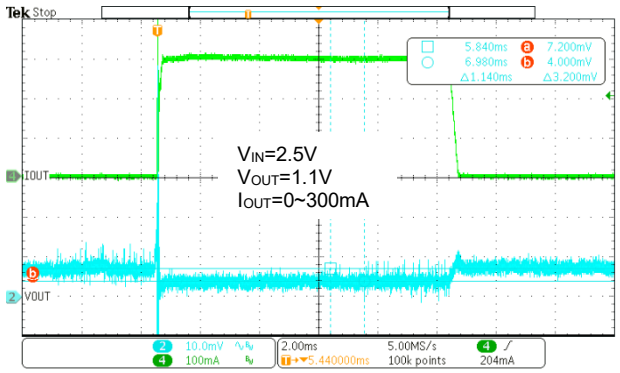


Figure 49.WR0310-11FF4R
Load Transient

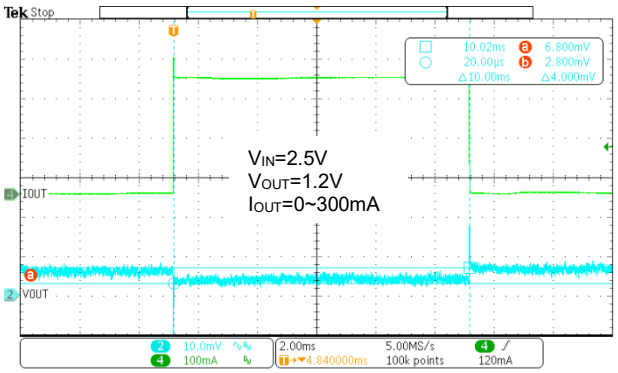


Figure 50.WR0310-12FF4R
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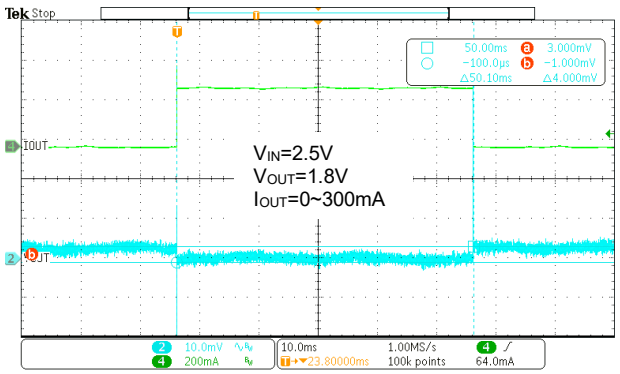


Figure 51.WR0310-18FF4R
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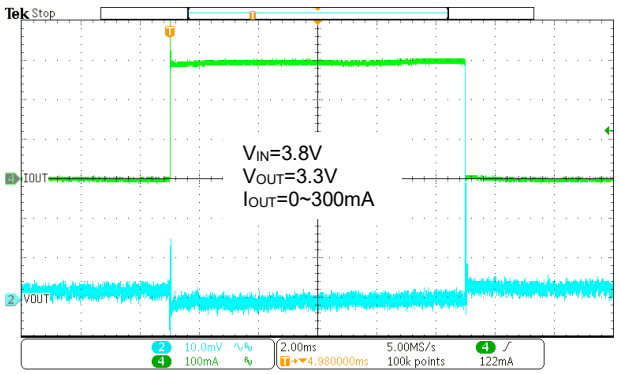


Figure 52.WR0310-33FF4R
Load Transient

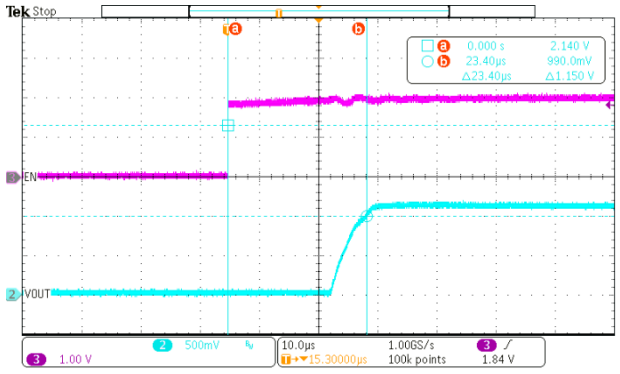


Figure 55.WR0310-11FF4R
Soft Start from EN

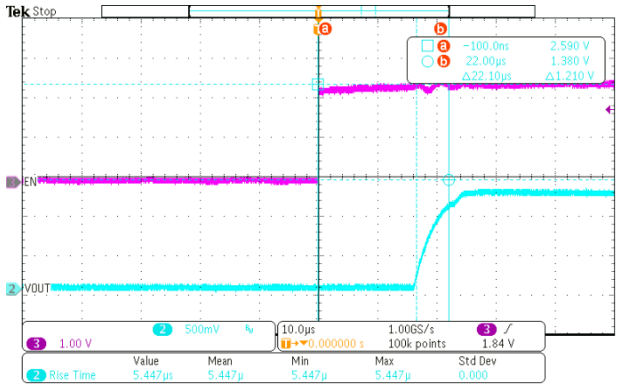


Figure 56.WR0310-12FF4R
Soft Start from EN

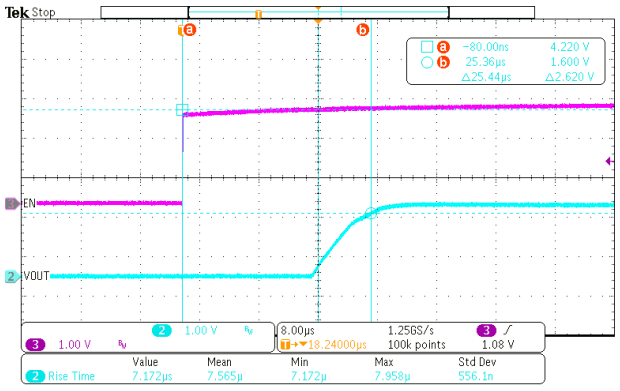


Figure 57.WR0310-18FF4R
Soft Start from EN

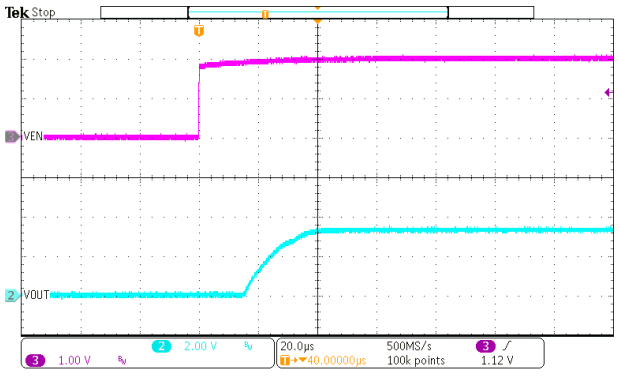


Figure 58.WR0310-33FF4R
Soft Start from EN

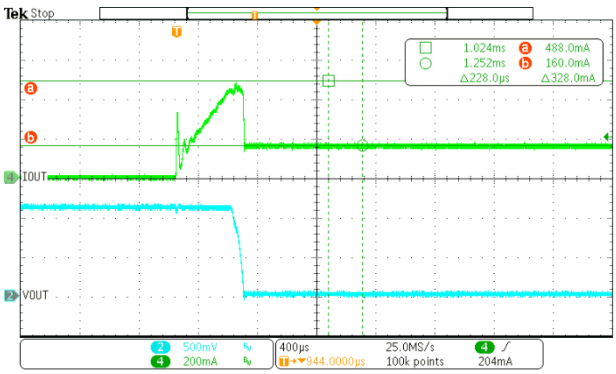


Figure 59.WR0310-11FF4R
Current Limit

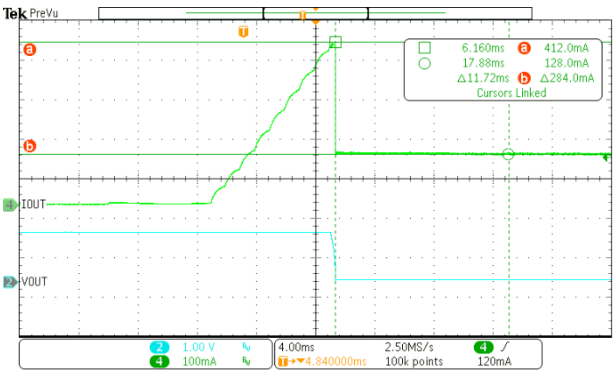


Figure 60.WR0310-12FF4R
Current Limit

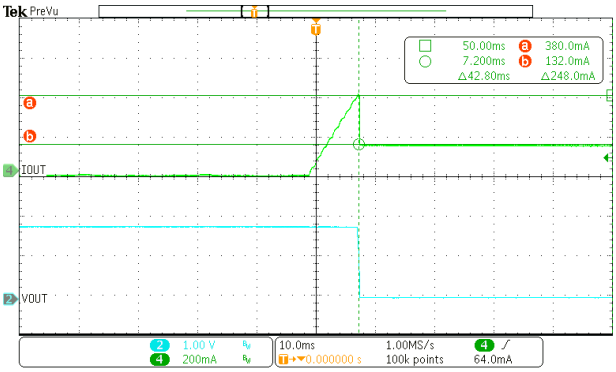


Figure 61.WR0310-18FF4R
Current Limit

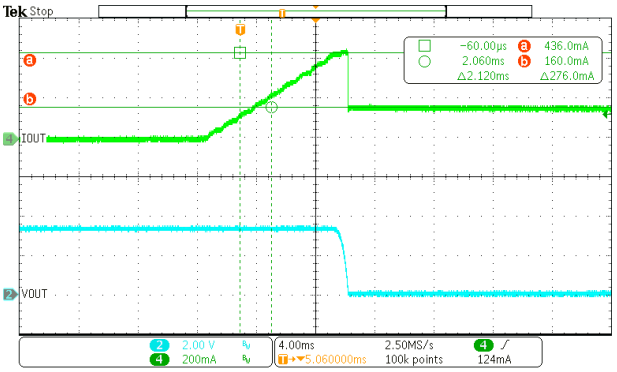


Figure 62.WR0310-33FF4R
Current Limit

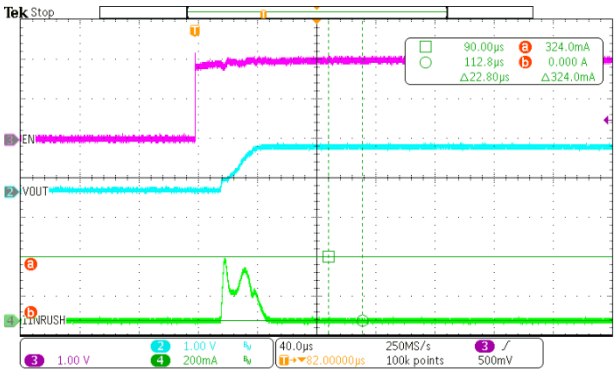


Figure 63.WR0310-11FF4R
Inrush Current

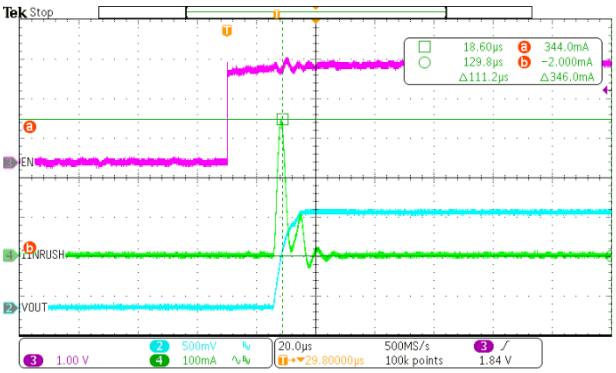


Figure 64.WR0310-12FF4R
Inrush Current

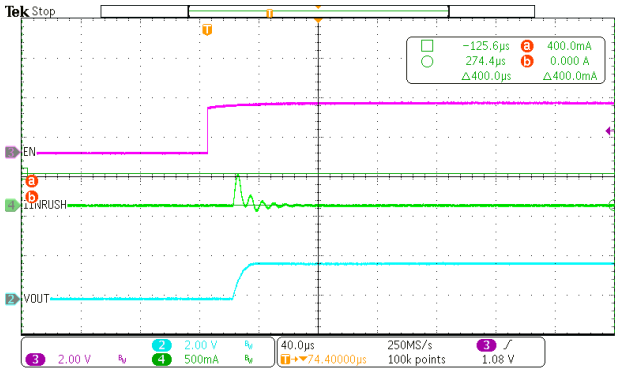


Figure 65.WR0310-18FF4R
Inrush Current

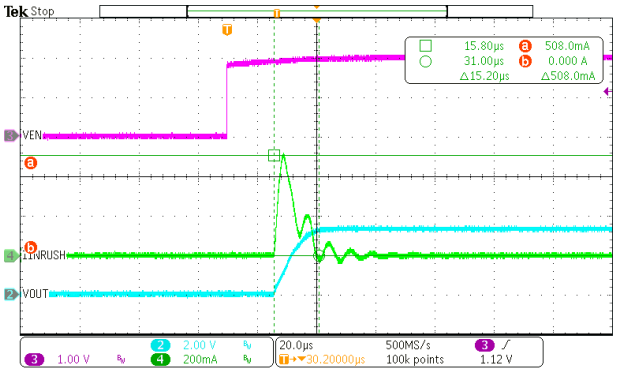


Figure 66.WR0310-33FF4R
Inrush Current

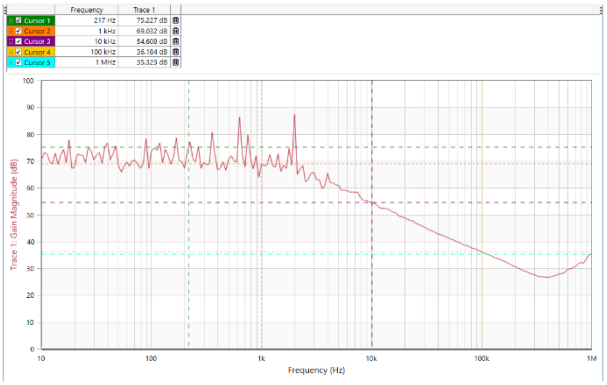


Figure 67.WR0310-11FF4R
PSRR

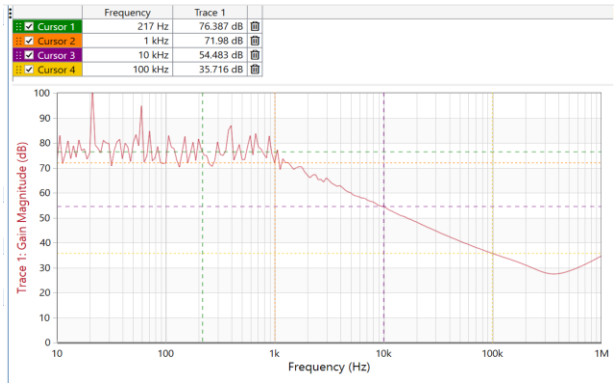


Figure 68.WR0310-12FF4R
PSRR

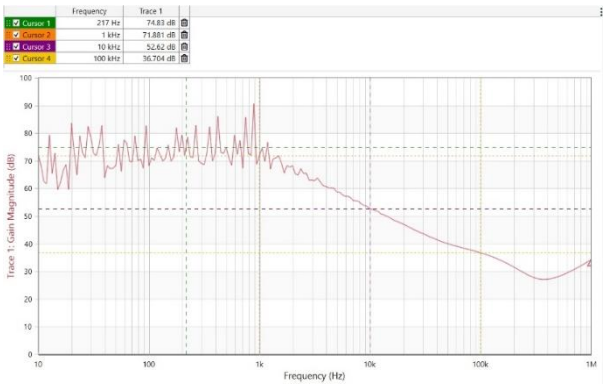


Figure 69.WR0310-18FF4R
PSRR

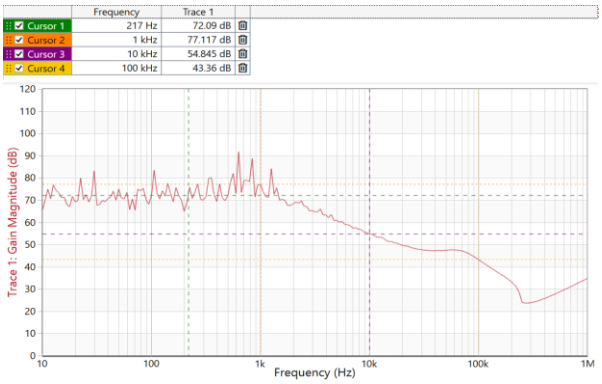


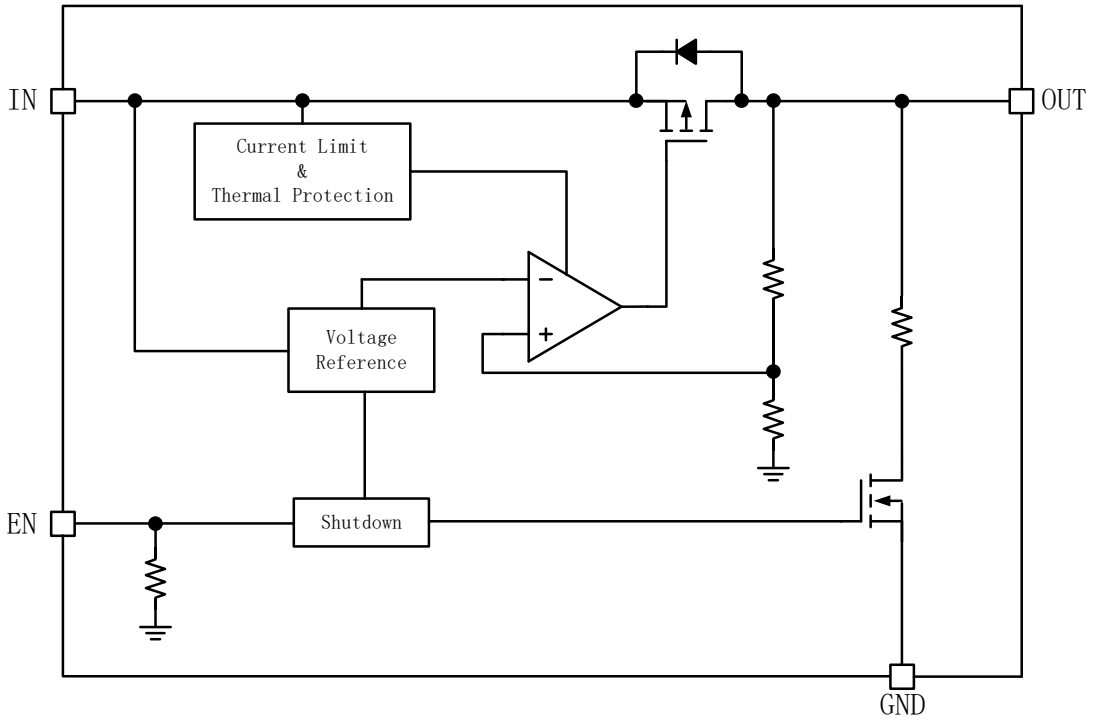
Figure 70.WR0310-33FF4R
PSRR

11. Function Description

11.1 Overview

The WR0310 is high performance high PSRR regulator capable of supplying 300mA and providing wide output voltage range. The device also offers low quiescent current, low-dropout voltage and very small packages suitable for space constrains application. The WR0310 is designed to be used in a variety of applications.

11.2 Block Diagram



11.3 Feature Description

11.3.1 Output Voltage Accuracy

The WR0310 has an output voltage accuracy of 2%. Output voltage accuracy is defined as the maximum and minimum error in output voltage. This includes the errors introduced by internal reference, load regulation and line regulation differences over the full range of rated load and line operating conditions, taking into account differences between manufacturing lots.

11.3.2 Enable (EN)

The WR0310 uses the EN pin to enable /disable its device and to activate /deactivate the active discharge function at devices with this feature. If the EN pin voltage is pulled below 0.4V the device is guaranteed to be disable. When EN is disabled, the active discharge transistor is activated and the output voltage V_{OUT} is pulled to GND through an internal circuitry with effective resistance about 50Ω.

If the voltage of EN pin is higher than 0.9V, the device is guaranteed to be enabled. In case the Enable function is not required, the EN pin should be connected directly to V_{IN}.

When EN pin floats, the device is disabled due to internal pull-down resistance of 6.8MΩ.

11.3.3 Dropout Voltage (V_{DO})

The WR0310 is an ultra-low dropout voltage LDO that can achieve nominal output voltage at lower input voltages. Dropout voltage is defined as the minimum of (V_{IN}-V_{OUT}) at the rated maximum output current where V_{OUT} is the minimum of $V_{OUT(NOM)}$. When the input voltage is below $V_{OUT(NOM)}$ plus V_{DO}, the output voltage varies with the input voltage.

For a CMOS regulator, the dropout voltage is determined by the drain-source on-state resistance ($R_{DS\ (ON)}$) of the pass transistor. Therefore, if the linear regulator operates at less than the rated current, the dropout voltage for that current scales accordingly. The $R_{DS\ (ON)}$ is calculated by following equation.

$$\mathbf{R_{DS(ON)}=V_{DO}/I_{OUT}}$$

11.3.4 Power Supply Rejection Ratio (PSRR)

PSRR, which stands for Power Supply Rejection Ratio, represents the ratio of the two voltage gains obtained when the input and output power supplies are considered as two independent sources.

The basic calculation formula is

$$\mathbf{PSRR = 20lg(Ripple(in) / Ripple(out))}$$

The units are in decibels (dB) and the logarithmic ratio is used.

The above equation shows that the output signal is influenced by the power supply in general, in addition to the circuit itself. PSRR is a quantity used to describe how the output signal is affected by the power supply; the larger the PSRR, the less the output signal is affected by the power supply.

As the level of integration continues to increase, the magnitude of supply current required is also increasing. End users want to extend battery life, i.e. they need very efficient DC/DC conversion processes, using more efficient switching regulators. However, switching regulators generate more ripple in the power line than linear regulators.

The PSRR shows the ability of the LDO to suppress input voltage noise. For a clean, noise-free DC output voltage, use an LDO with a high PSRR.

Noise coupling from the input voltage to the internal reference voltage is the main cause of PSRR performance degradation. Using noise reduction capacitors at the input can effectively filter out noise and improve PSRR performance at low frequencies. The LDO can be used not only to regulate the voltage but also to provide an exceptionally clean DC supply for noise sensitive components.

The WR0310 is a high PSRR LDO that can be used not only for voltage regulation but also for noise cancellation in the power supply.

11.3.5 Noise

LDO noise can be divided into two main categories: internal noise and external noise. Internal noise is the noise generated inside the electronics; external noise is the noise transmitted from outside the circuit to the circuit. The error amplifier determines the PSRR of the LDO and therefore its ability to suppress external noise at the input; internal noise is always present at the output of the LDO.

In practice, minimizing noise from the power supply is critical to system performance. In test and measurement systems, small fluctuations in power supply noise can alter the instantaneous measurement accuracy.

The WR0310 has a low noise reference, high PSRR to ensure that output noise is reduced during normal operation.

11.3.6 Fold-back Current Limit (I_{LIM})

In LDO circuits, if an output short circuit or excessive load current occurs, the device may be burned out. Especially in the case of a short circuit, not only is there too much current flowing through the regulator, but the voltage across the source drain of the regulator is also at its maximum, which is likely to burn out the regulator and make the device inoperable. The current limiting circuit used in LDO is a constant current limiting circuit, where the maximum load current that the LDO can supply is limited to a set constant I_{LIM}, and when an overload or short circuit occurs, the output current will be maintained at I_{LIM}, and the output voltage will be reduced to $I_{LIM}R_{LOAD}$.

However, if the external overload or short circuit condition lasts for a long time, the continuous high current will increase the device temperature and increase the power consumption of the whole system. To improve this situation, a fold-back current limiting circuit can be used. In a fold-back current limiting circuit, both the output current and the output voltage are gradually reduced when the output current reaches the set maximum current I_{LIM}. The output current is reduced to the set current threshold I_{SHORT} and the output voltage is reduced to $I_{SHORT}R_{LOAD}$. The output current is clamped to a smaller value in the event of an overload or short circuit and the system power consumption is reduced and the device temperature does not rise significantly.

The fold-back current limiting circuit is essentially a constant current limiting circuit with an output voltage feedback loop, so that in the event of an overload or short circuit, the output current is gradually reduced due to the reduction in output voltage and eventually clamped at a smaller value.

The WR0310 uses a fold-back current limiting mode where the final current is clamped to around 200mA, thus providing good protection to the device.

11.3.7 Thermal Protection

The WR0310 contains a thermal shutdown protection circuit that implements the required switching gate circuit function through a thermal switch integrated inside the chip. The output current is turned off when the heat in the LDO is too high. Thermal shutdown occurs when the thermal junction temperature (T_J) of the energized crystal exceeds 165°C (typical). The thermal shutdown hysteresis ensures that the LDO resets (turns on) again when the temperature drops to 150°C (typical). The thermal time constant of the semiconductor chip is quite short, so when thermal shutdown is reached, the output turns on and off at a higher rate until the power dissipation is reduced.

The WR0310's internal protection circuitry is designed to prevent thermal overload conditions. This circuitry is not a substitute for a proper heat sink. Continuously putting the WR0310 into a thermal shutdown state will reduce the reliability of the device.

11.4 Functional Modes of The Device

The device has three modes: normal, dropout, and disabled modes of operation.

The operating conditions of each mode are listed in the table below.

Operating conditions of each mode

FUNCTIONAL MODE	CONDITIONS			
	V_{IN}	V_{EN}	I_{OUT}	T_J
Normal	$5.5V>V_{IN} > V_{OUT(NOM)} + 1$	$V_{EN} > V_{ENH}$	$I_{OUT} < I_{LIM}$	$T_J < T_{SD}$
Dropout	$V_{IN} < V_{OUT(NOM)} + V_{DO}$	$V_{EN} > V_{ENH}$	$I_{OUT} < I_{LIM}$	$T_J < T_{SD}$
Disabled	—	$V_{EN} < V_{ENL}$	—	$T_J > T_{SD}$

11.4.1 Normal Mode

Normal operating mode requires that both of the following conditions are met.

1. The input voltage is greater than the rated output voltage plus the differential voltage ($V_{OUT(NOM)}$ + 1) and is less than 5.5V.
2. The enable voltage has previously exceeded the enable rise threshold voltage and has not fallen below the enable fall threshold.
3. The output current is less than the current limit ($I_{OUT} < I_{LIM}$).
4. The device junction temperature is less than the thermal shutdown temperature ($T_J < T_{SD}$).

11.4.2 Dropout Mode

If the input voltage is below the rated output voltage plus a specified dropout voltage, the device operates in the dropout state and the output voltage tracks the input voltage.

11.4.3 Disabled

The WR0310 can be turned off by forcing the enable pin low, typically with an enable voltage below 0.4V, at which point the pass device is turned off, internal circuits are shutdown, and the output voltage is actively discharged to ground through an internal resistor from output to ground.

12. Application Guide

Note: The information in the Applications section below is not part of WAY-ON's product specifications and WAY-ON does not guarantee its accuracy or completeness. The customer is responsible for determining the suitability of the component for its intended use and should verify and test its design implementation to confirm system functionality.

12.1 Application Information

The WR0310 is a linear voltage regulator with an input voltage of 1.6V to 5.5V and an output voltage of 0.8V to 5.0V. The accuracy is 2% for output voltage. The maximum output current is 300 mA. The efficiency of a linear voltage regulator is determined by the ratio of the output voltage to the input voltage, so in order to achieve high efficiency, the differential voltage (V_{IN} - V_{OUT}) must be as small as possible. This section discusses how best to use this device in practical applications.

12.1.1 Capacitor Recommendation

The WR0310 uses ceramic capacitors with low equivalent series resistance (ESR) at the V_{IN} and V_{OUT} pins to increase its stability. Multilayer ceramic capacitors are recommended. These capacitors also have limitations, and ceramic capacitors with X7R-, X5R-, and COG-rated dielectric materials have relatively good capacitance stability at different temperatures. WR0310 is designed to use ceramic capacitors of 1μF at the input and output. Place C_{IN} and C_{OUT} as close to the IN and OUT pins as possible to minimize trace inductance from the capacitor to the device.

12.1.2 Power Dissipation (PD)

The reliability of the circuit requires reasonable consideration of the power dissipation of the device, the location of the circuit on the PCB, and the proper sizing of the thermal plane. The regulator should be surrounded by no other heat generating devices as much as possible. The power dissipation of the regulator depends on the input and output voltage difference and the load conditions.

P_D can be calculated using the following equation:

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

Using the proper input voltage minimizes the power dissipation, resulting in greater efficiency. To obtain the lowest power dissipation, use the minimum input voltage required for normal output voltage.

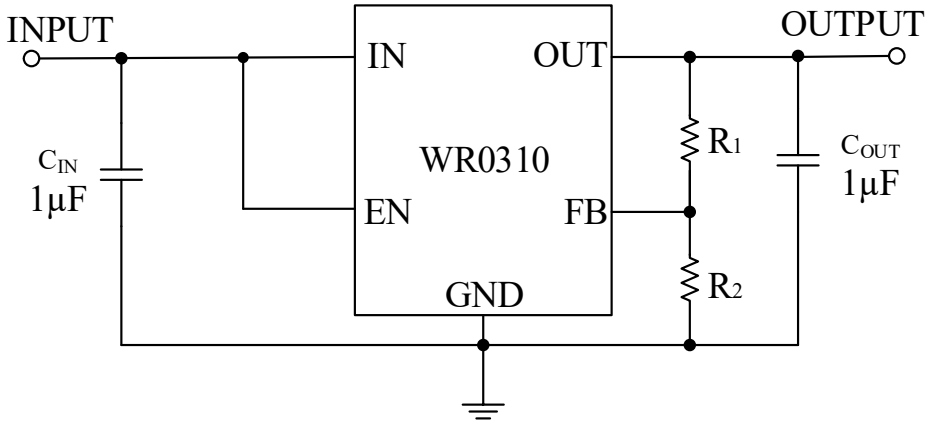
The maximum power dissipation determines the maximum allowable ambient temperature (T_A) of the device. Power dissipation and junction temperature are typically related to the junction-ambient thermal resistance ($R_{\theta JA}$) and ambient air temperature (T_A) of the PCB and package and are calculated as follows.

$$T_J = T_A + (R_{\theta JA} \times P_D)$$

The thermal resistance ($R_{\theta JA}$) depends primarily on the thermal dispersion capability of the PCB design. The total copper area, copper weight, and the location of the plane all affect the thermal dispersion capability, and the PCB and copper laydown area can only be used as a relative measure of the package's thermal performance.

12.1.2 Feedback Resistors For Adjustable Output Voltage

The device requires external feedback divider resistors to set the output voltage. The following figure shows how the output voltage of an adjustable device can be configured from 0.8 V to 5.0 V by using a resistor divider network.



Calculates the values of the R_1 and R_2 resistors to set the output voltage:

$$V_{OUT} = V_{FB} \times (1 + R_1 / R_2)$$

13. Evaluation Modules

Evaluation Modules (EVMs) are available to help evaluate initial circuit performance. We have evaluation modules for different packages, you can contact us to get the evaluation modules or schematics, PCB layout and BOM.

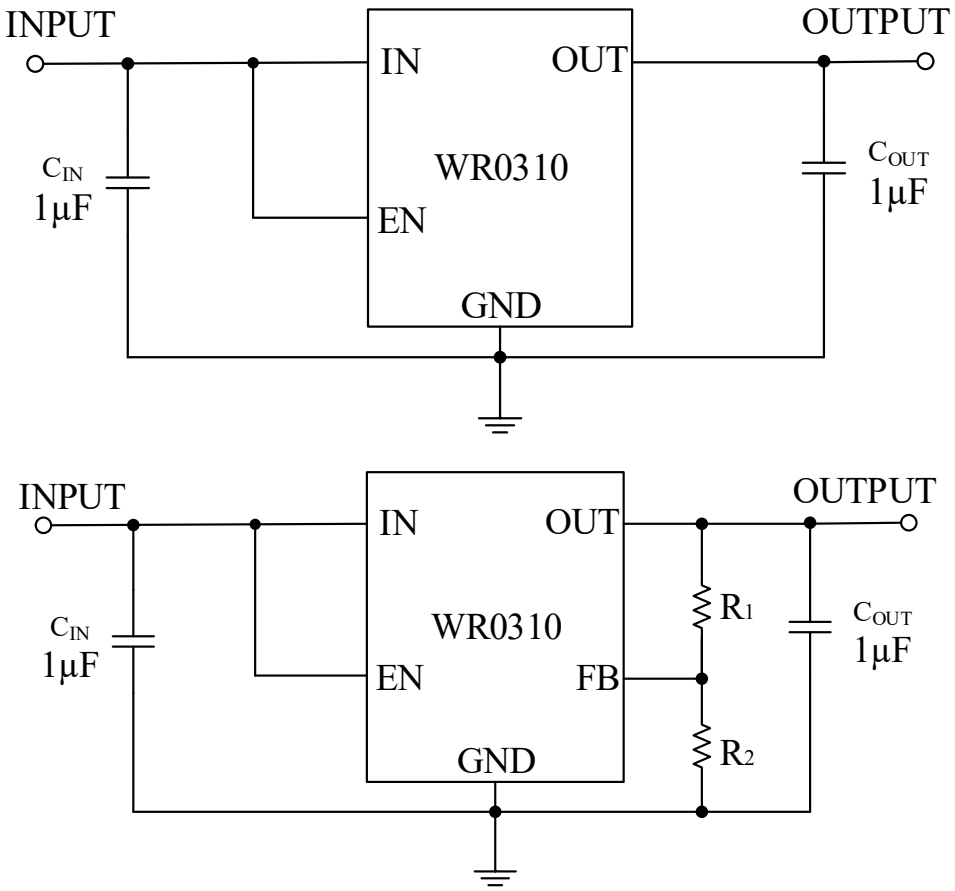
The module names are listed in the following table.

NAME	PACKAGE	EVALUATION MODULE
WR0310	DFN1×1-4	WAYON LDO EVM V1.1 - DFN1×1-4
WR0310	SOT23-5	WAYON LDO EVM V1.1 - SOT23-5
WR0310	SOT353	WAYON LDO EVM V1.0 – SOT353

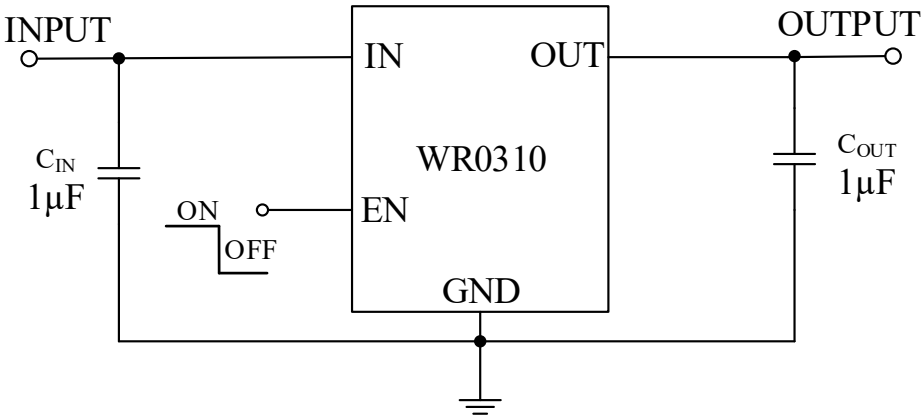
13.1 Schematic

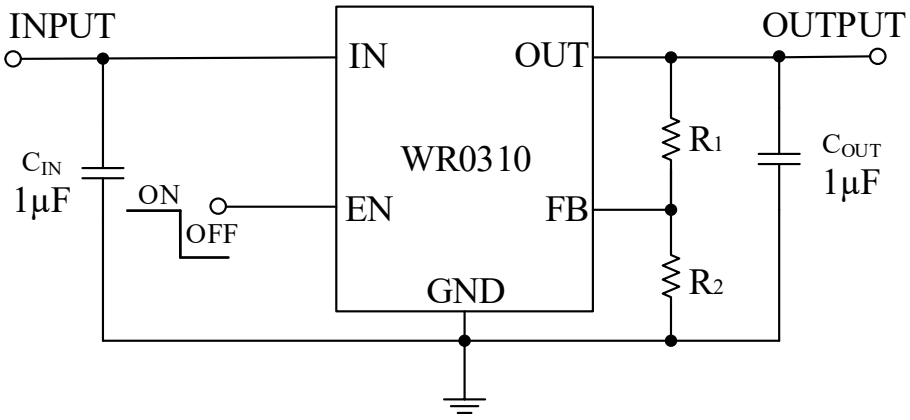
This section discusses the application of the WR0310 in the circuit. The following figure shows the schematic of the application circuit.

Circuit schematic 1: EN is connected to IN.



Circuit schematic 2: EN is controlled by external voltage.





13.2 Layout

Layout Guidelines

The principle of LDO design is to place all components on the same side of the board and connect them as close as possible to their respective LDO pins. A 1.0μF input capacitor (C_{IN}) is recommended to IN to minimize the effect of resistance and inductance between the source and the LDO input. A 1.0μF or smaller output capacitor (C_{OUT}) is recommended to OUT. Connect the ground sides of C_{IN} and C_{OUT} with LDO ground pins as close as possible through a wide copper surface. Through-holes and long wires may seriously affect system performance and is not recommended.

To improve thermal performance, an array of thermal vias is used to connect the thermal pad to the ground plane. A larger ground plane improves the thermal performance of the device and reduces the operating temperature of the device.

Figure 71 to Figure 72 illustrate the PCB layout of DFN1×1-4.

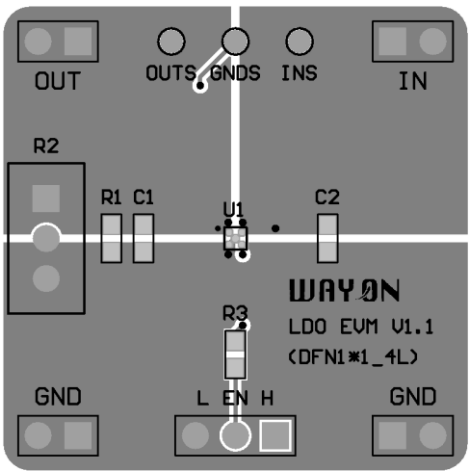


Figure 71. Top Layer Routing of DFN1×1-4

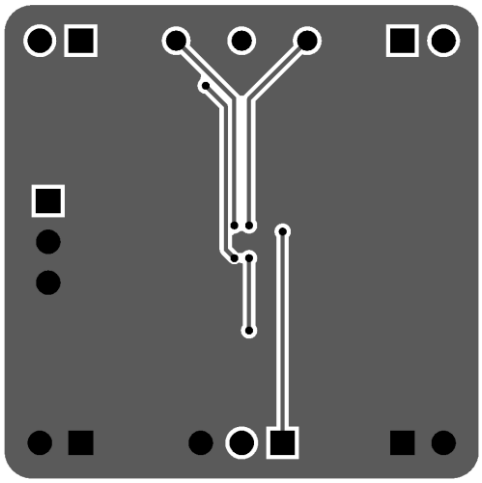


Figure 72. Bottom Layer Routing of DFN1×1-4

14. Naming Conventions

WR AA BB-CC DDD E

WR: WAYON Regulator

AA: 03 - Output Current, 300mA

BB: Product Name

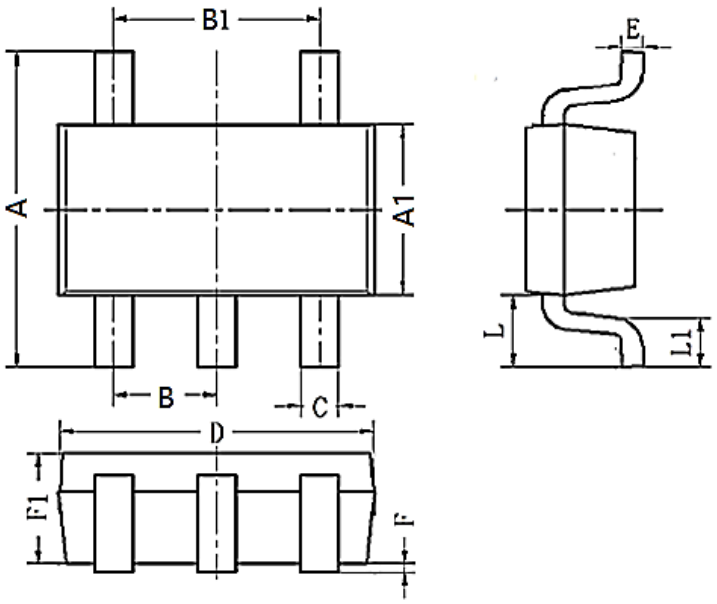
CC: Output Voltage

DDD: Package - FF4: DFN1×1-4；A50-Package, SOT23-5；C50- Package, SOT353

E: R-Reel

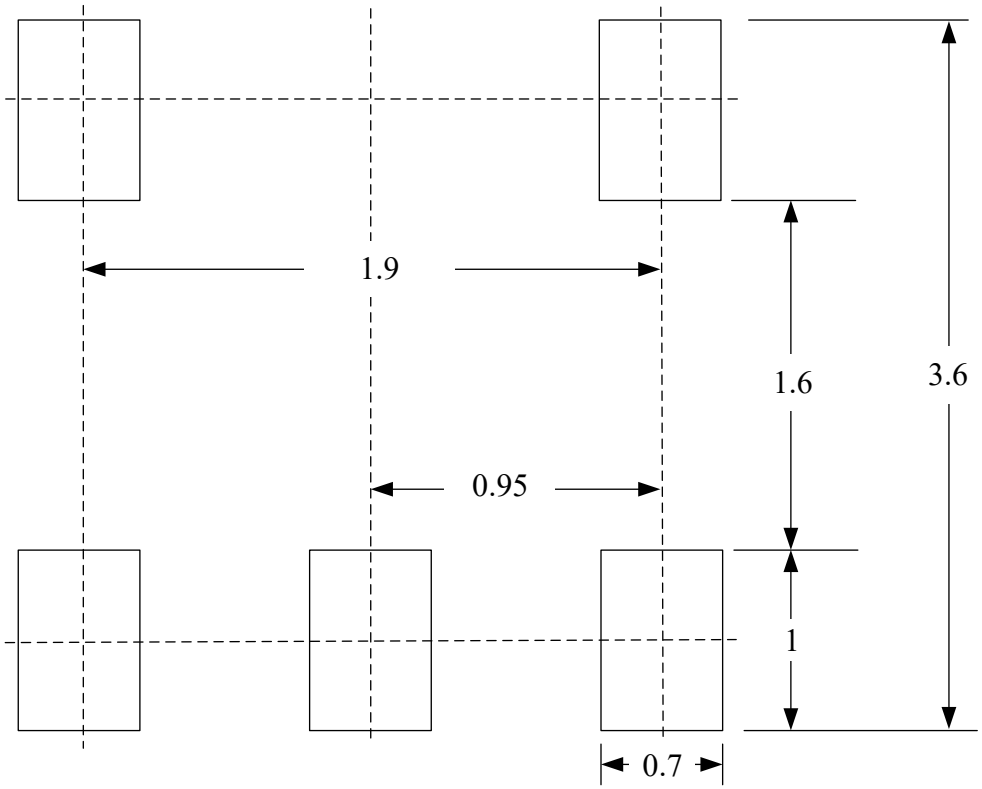
15. Package Information

SOT 23-5



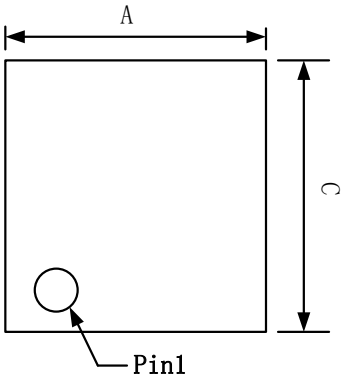
SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	2.60	2.80	3.00
A1	1.50	1.60	1.70
B	0.85	0.95	1.05
B1	1.80	1.90	2.00
C	0.25	0.37	0.50
D	2.79	2.90	3.02
E	0.10	0.15	0.20
F	0.00	0.10	0.20
L	0.60REF		
L1	0.30	0.45	0.60
F1	0.85	1.10	1.30

Suggested Pad Layout: SOT 23-5

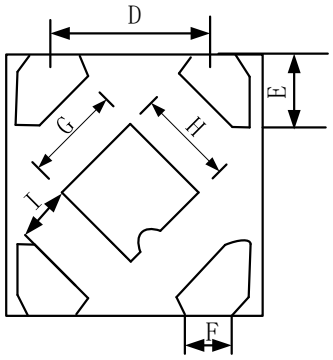


NOTE: Dimensions in Millimeters

DFN1*1-4



Top View



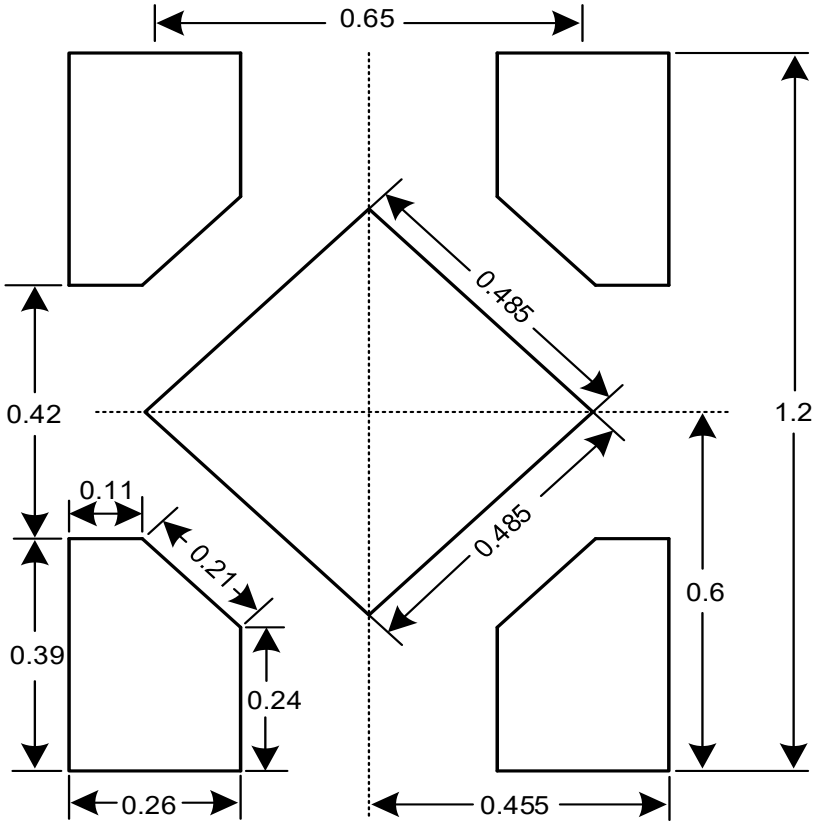
Bottom View



Side View

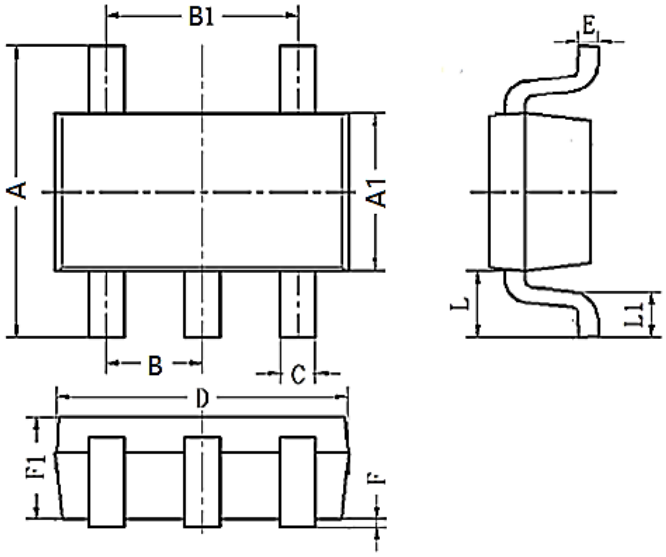
SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.950	1.000	1.050
B	0.320	0.370	0.420
C	0.950	1.000	1.050
D		0.650BSC	
E	0.170	0.270	0.370
F	0.130	0.235	0.300
G	0.430	0.485	0.540
H	0.430	0.485	0.540
I		0.200REF	

Suggested Pad Layout: DFN-4



NOTE: Dimensions in Millimeters

SOT-353



SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	2.15	2.275	2.40
A1	1.15	1.25	1.35
B		0.65TYP	
B1	1.20	1.30	1.40
C	0.15	0.25	0.35
D	2.00	2.10	2.20
E	0.10	0.125	0.15
F	0.00	0.05	0.10
L		0.525REF	
F1	0.90	0.95	1.0
L1	0.26	0.36	0.46

16. Ordering Information

PART NUMBER	OUTPUT VOLTAGE	PACKAGE	PACKING QUANTITY	MARKING*
WR0310-08FF4R	0.8V	DFN1×1-4	10k/Reel	310 08
WR0310-09FF4R	0.9V	DFN1×1-4	10k/Reel	310 09
WR0310-10FF4R	1.0V	DFN1×1-4	10k/Reel	310 10
WR0310-105FF4R	1.05V	DFN1×1-4	10k/Reel	310 105
WR0310-11FF4R	1.1V	DFN1×1-4	10k/Reel	310 11
WR0310-12FF4R	1.2V	DFN1×1-4	10k/Reel	310 12
WR0310-13FF4R	1.3V	DFN1×1-4	10k/Reel	310 13
WR0310-18FF4R	1.8V	DFN1×1-4	10k/Reel	310 18
WR0310-185FF4R	1.85V	DFN1×1-4	10k/Reel	310 185
WR0310-21FF4R	2.1V	DFN1×1-4	10k/Reel	310 21
WR0310-22FF4R	2.2V	DFN1×1-4	10k/Reel	310 22
WR0310-25FF4R	2.5V	DFN1×1-4	10k/Reel	310 25
WR0310-28FF4R	2.8V	DFN1×1-4	10k/Reel	310 28
WR0310-30FF4R	3.0V	DFN1×1-4	10k/Reel	310 30
WR0310-33FF4R	3.3V	DFN1×1-4	10k/Reel	310 33
WR0310-08A50R	0.8V	SOT23-5	3k/Reel	WR0310 08 XXXX
WR0310-09A50R	0.9V	SOT23-5	3k/Reel	WR0310 09 XXXX
WR0310-10A50R	1.0V	SOT23-5	3k/Reel	WR0310 10 XXXX
WR0310-105A50R	1.05V	SOT23-5	3k/Reel	WR0310 105 XXXX
WR0310-11A50R	1.1V	SOT23-5	3k/Reel	WR0310 11 XXXX
WR0310-12A50R	1.2V	SOT23-5	3k/Reel	WR0310 12 XXXX
WR0310-13A50R	1.3V	SOT23-5	3k/Reel	WR0310 13XXXX

PART NUMBER	OUTPUT VOLTAGE	PACKAGE	PACKING QUANTITY	MARKING*
WR0310-18A50R	1.8V	SOT23-5	3k/Reel	WR0310 18 XXXX
WR0310-185A50R	1.85V	SOT23-5	3k/Reel	WR0310 185 XXXX
WR0310-21A50R	2.1V	SOT23-5	3k/Reel	WR0310 21 XXXX
WR0310-22A50R	2.2V	SOT23-5	3k/Reel	WR0310 22 XXXX
WR0310-25A50R	2.5V	SOT23-5	3k/Reel	WR0310 25 XXXX
WR0310-28A50R	2.8V	SOT23-5	3k/Reel	WR0310 28 XXXX
WR0310-30A50R	3.0V	SOT23-5	3k/Reel	WR0310 30 XXXX
WR0310-33A50R	3.3V	SOT23-5	3k/Reel	WR0310 33 XXXX
WR0310-ADA50R	ADJ	SOT23-5	3k/Reel	WR0310 AD XXXX
WR0310-ADC50R	ADJ	SOT353	3k/Reel	310 AD XXXX

* XXXX is variable.

Contact Information

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For additional information, please contact your local Sales Representative.
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Specifications are subject to change without notice.
The device characteristics and parameters in this data sheet can and do vary in different applications and actual device performance may vary over time.
Users should verify actual device performance in their specific applications

Product Specification Statement

- The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.
- The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. WAYON shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and WAYON assumes no responsibility for the application of the product.
- WAYON strives to provide accurate and up-to-date information to the best of our ability. However, due to technical, human, or other reasons, WAYON cannot guarantee that the information provided in the product specification is entirely accurate and error-free. WAYON shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications. WAYON reserves the right to revise or update the product specification and the products at any time without prior notice, and the user's continued use of the product specification is considered an acceptance of these revisions and updates. Prior to purchasing and using the product, users should verify the above information with WAYON to ensure that the product specification is the most current, effective, and complete. If users are particularly concerned about product parameters, please consult WAYON in detail or request relevant product test reports. Any data not explicitly mentioned in the product specification shall be subject to separate agreement.
- Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.
- The design of the product is intended to meet civilian needs and is not guaranteed for use in harsh environments or precision equipment. It is not recommended for use in systems or equipment such as medical devices, aircraft, nuclear power, and similar systems, where failures in these systems or equipment could reasonably be expected to result in personal injury. WAYON shall assume no responsibility for any consequences resulting from such usage.
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