WR1117AN

1A, High Efficiency, Low Dropout Regulator

1. General Description

The WR1117AN series are high efficiency regulators with high accuracy, low dropout voltage and 1A output current, including fixed output voltage version and adjustable output voltage version. The input voltage range is 3.0V to 15V and the output voltage range is 1.2V to 12V, making the device suitable for electronic products. WR1117AN provides current limiting and thermal shutdown.

WR1117AN regulators are available in Green SOT89-3 packages, SOT223-3 packages and TO252-2 packages.

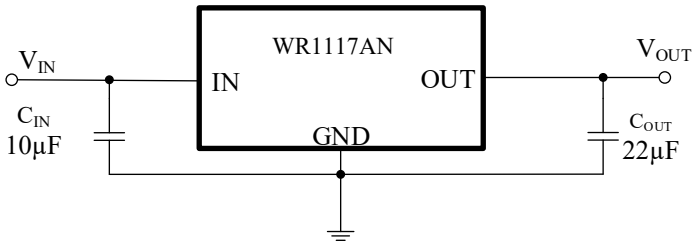
2. Features

- Input Voltage: 3.0V~15V
- Fixed Output Voltage: 1.2V,1.5V,1.8V,2.5V, 3.3V,5.0V
- Adjustable Output Voltage: 1.25V~12V
- Output Voltage Accuracy: 2%
- Output Current: 0.8A/1A
- Low Dropout Voltage: 1.1V @1A
- Ambient Temperature: -40°C to 125°C

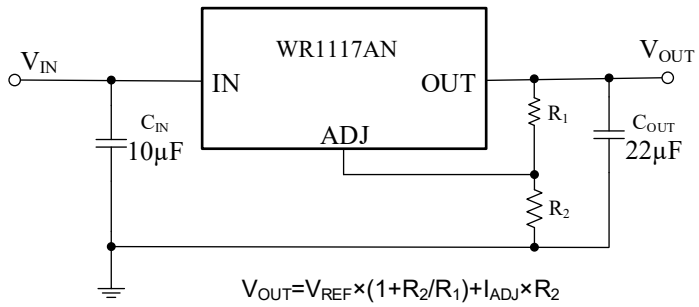
3. Applications

- High efficiency linear regulators
- Post regulators for switching supplies
- Adjustable power supply
- TV, STB, LCD, Monitor, DATACOM

4. Typical Application



Fixed Voltage Regulator



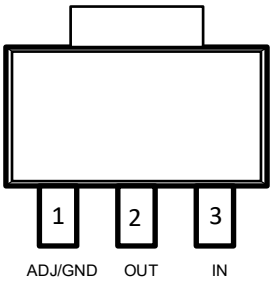
Adjustable Voltage Regulator

Note1: A 10μF tantalum capacitor is recommended as bypass capacitor (CIN) for all application circuit.

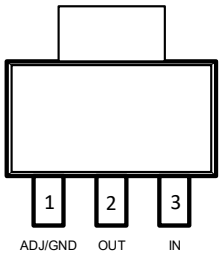
Note2: A 22μF tantalum capacitor (COUT) is recommended to assure circuit stability.

5. Pin Configuration

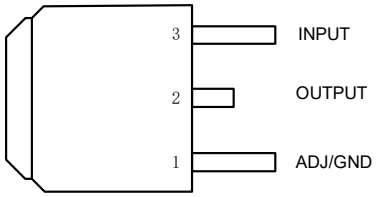
(Top View)



SOT223-3



SOT89-3



TO252-2

6. Pin Description

PIN NUMBER			PIN NAME	TYPE	PIN FUNCTIONS
SOT223-3	SOT89-3	TO252-2			
1	1	1	ADJ/GND	-	Adjust pin for adjustable output option. Ground pin for fixed output option.
2, TAB	2, TAB	2, TAB	V_{OUT}	O	Output voltage.
3	3	3	V_{IN}	I	Input voltage.

7. Absolute Maximum Ratings

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

SYMBOL	PARAMETER		RATING	UNIT
V_{IN}	Input Voltage		18	V
P_D	Power Dissipation P_D @T_A = 25ºC	SOT89-3	0.71	W
		SOT223-3	1.31	W
		TO-252-2	2.84	W
$R_{\theta JA}$[2] [3] [4]	Junction-to-ambient thermal resistance	SOT89-3	175	℃/W
		SOT223-3	95	℃/W
		TO-252-2	44	℃/W
T_J	Junction Temperature		150	℃
T_{SDR}	Lead Temperature Range		260	℃
T_{STG}	Storage Temperature Range		-65 to 150	℃
ESD	HBM		±2000	V

NOTE1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE2: Measured on 2cm x 2cm 2-layer FR4 PCB board, 2 oz copper, no via holes on GND copper.

NOTE3: Measured according to JEDEC board specification. Detailed description of the board can be found in JESD51−7.

NOTE4: Power dissipation is calculated by $P_{D(MAX)} = (T_J - T_A) / R_{\theta JA}$.

8. Recommended Operating Conditions

PARAMETER	RATING	UNIT
Input voltage range	3.0 to 15	V
Nominal output voltage range	1.2 to 12	V
Output current	0 to 0.8/1	A
Input capacitor	10	μF
Output capacitor	22	μF
Operating junction temperature	-40 to 125	℃

9. Electrical Characteristics

(V_{IN} =$V_{OUT(NOMINAL)}$+2V, C_{IN}=10μF, C_{OUT}=22μF, T_A=25℃, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
V_{REF}	Reference voltage	WR1117AN-ADJ, 10mA≤I_{OUT}≤1A ,V_{IN}=3.25V	1.225	1.250	1.275	V
V_{OUT}	Output Voltage Range	V_{OUT}＜1.5V, 10mA≤I_{OUT}≤800mA	0.98 V_{OUT}	V_{OUT}	1.02 V_{OUT}	V
		V_{OUT}≥1.5V, 10mA≤I_{OUT}≤1A				
V_{DO} [5]	Dropout Voltage	I_{OUT} =100mA		1.0	1.3	V
		I_{OUT} =500mA		1.0	1.3	
		I_{OUT} =800mA		1.05	1.3	
		I_{OUT} =1A		1.1	1.4	
I_{LIM}	Output current limit	V_{IN}=$V_{OUT(NOMINAL)}$+2V		2.4		A
I_{OUT} [6]	Maximum output current in the accuracy range	V_{IN}=$V_{OUT(NOMINAL)}$+2V,V_{OUT}＜1.5V	0.8			A
		V_{IN}=$V_{OUT(NOMINAL)}$+2V, V_{OUT}≥1.5V	1			
I_Q	Quiescent Current	I_{OUT}=0mA		5	10	mA
I_{ADJ}	Adjust pin current	WR1117AN-ADJ V_{IN}≤15V		70	120	μA
Δ I_{ADJ}	I_{ADJ} change	WR1117AN-ADJ V_{IN}≤15V ,10mA≤I_{OUT}≤0.8/1A		0.2	10	μA
LNR	Line Regulation	WR1117AN-12, I_{OUT}=10mA, 3.0V≤V_{IN}≤15V		4	20	mV
		WR1117AN-15, I_{OUT}=10mA, 3.0V≤V_{IN}≤15V		5	30	
		WR1117AN-18, I_{OUT}=10mA, 3.3V≤V_{IN}≤15V		5	35	
		WR1117AN-33, I_{OUT}=10mA, 4.8V≤V_{IN}≤15V		9	50	
		WR1117AN-50, I_{OUT}=10mA, 6.5V≤V_{IN}≤15V		10	60	
		WR1117AN-ADJ, I_{OUT}=10mA, 3.0V≤V_{IN}≤15V		5	25	

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
LDR [7]	Load Regulation	WR1117AN-12, V_{IN}=3.2V, 10mA≤I_{OUT}≤0.8A		3	10	mV
		WR1117AN-15, V_{IN}=3.5V, 10mA≤I_{OUT}≤1A		3	10	
		WR1117AN-18, V_{IN}=3.8V, 10mA≤I_{OUT}≤1A		4	15	
		WR1117AN-33, V_{IN}=5.3V, 10mA≤I_{OUT}≤1A		7	25	
		WR1117AN-50, V_{IN}=7V, 10mA≤I_{OUT}≤1A		10	40	
		WR1117AN-ADJ, V_{IN}=3.25V, 10mA≤I_{OUT}≤1A		4	10	
PSRR	Power Supply Ripple Rejection	V_{IN}=(V_{OUT}+3V) $_{DC}$+1V_{P-P} f=120Hz, I_{OUT}=200mA		62		dB

NOTE5: The dropout voltage is defined as (V_{IN}-V_{OUT}) when V_{OUT} is $V_{OUT(NOM)}$×98%.

NOTE6: 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_{DO}.

NOTE7: The Load regulation is measured by pulse test.

10. Typical Performance Characteristics

(C_{IN}=10μF, C_{OUT}=22μF, unless otherwise noted)

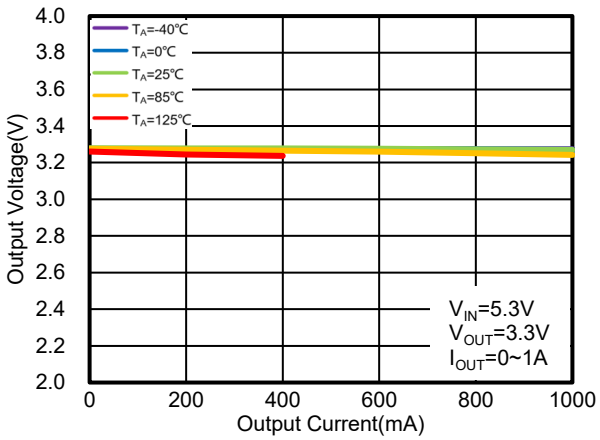


Figure 1. WR1117AN-33A70R
Load Regulation vs. I_{OUT}

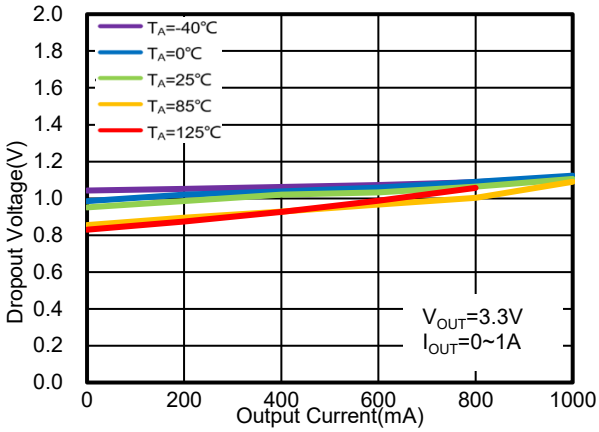


Figure 2. WR1117AN-33A70R
Dropout Voltage vs. I_{OUT}

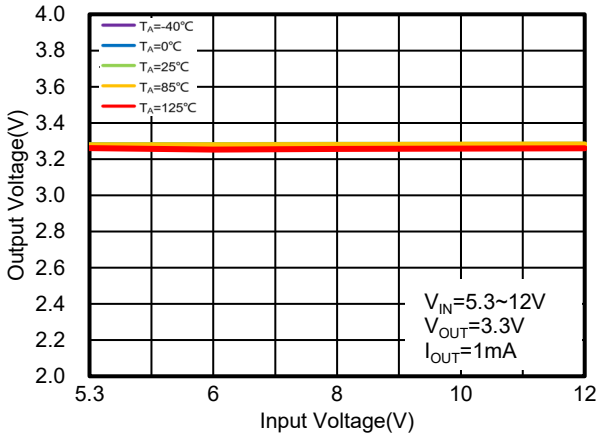


Figure 3. WR1117AN-33A70R
Line Regulation vs. V_{IN}

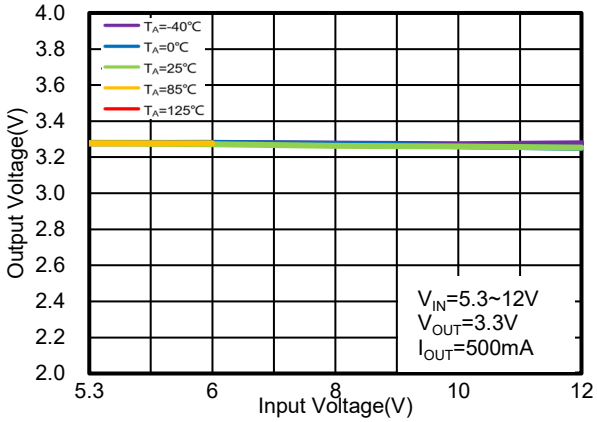


Figure 4. WR1117AN-33A70R
Line Regulation vs. V_{IN}

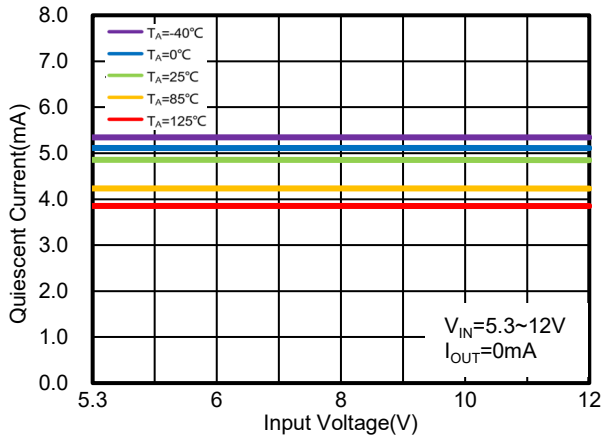


Figure 5. WR1117AN-33A70R
Quiescent Current vs. V_{IN}

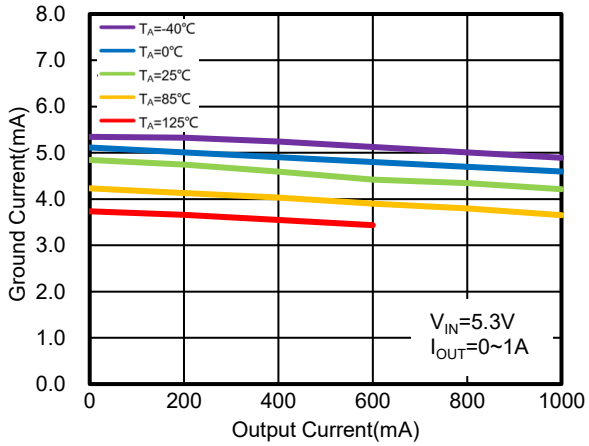


Figure 6. WR1117AN-33A70R
Ground Current vs. I_{OUT}

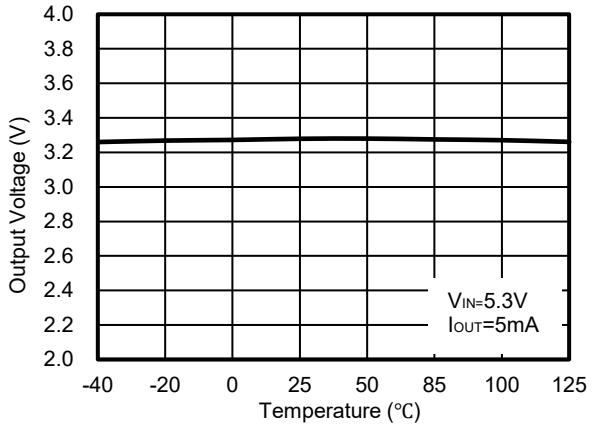


Figure 7. WR1117AN-33A70R
Output Voltage vs. Ambient Temperature

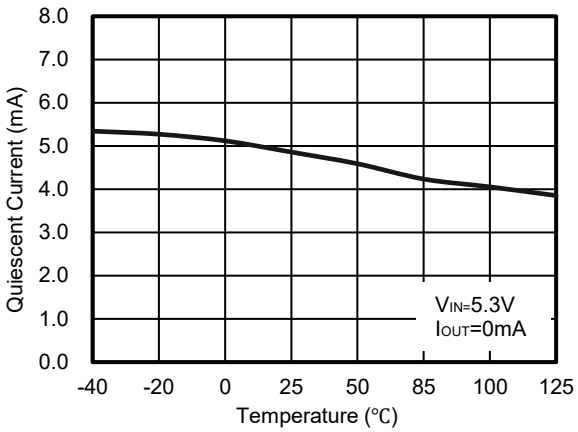


Figure 8. WR1117AN-33A70R
Quiescent Current vs. Ambient Temperature

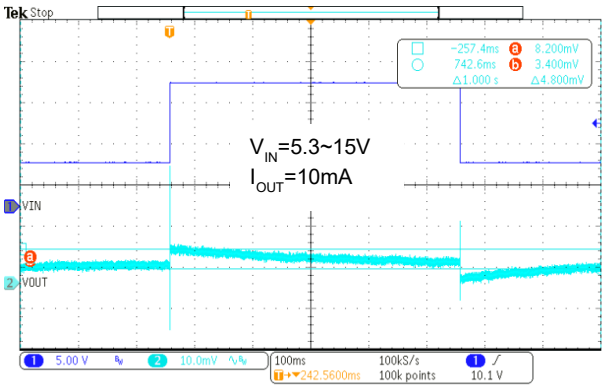


Figure 9. WR1117AN-33A70R
Line Transient

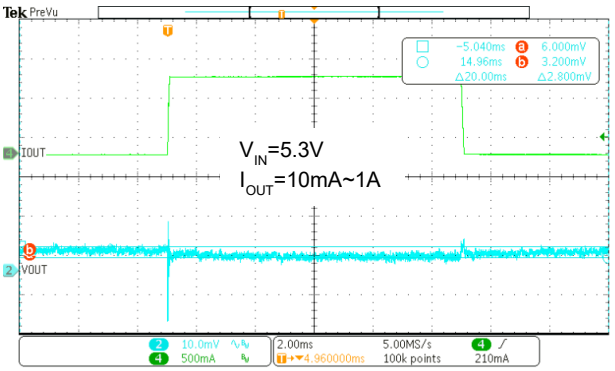


Figure 10. WR1117AN-33A70R
Load Transient

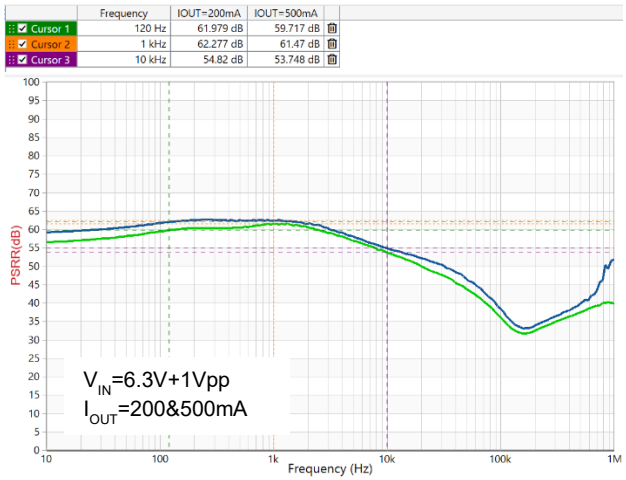


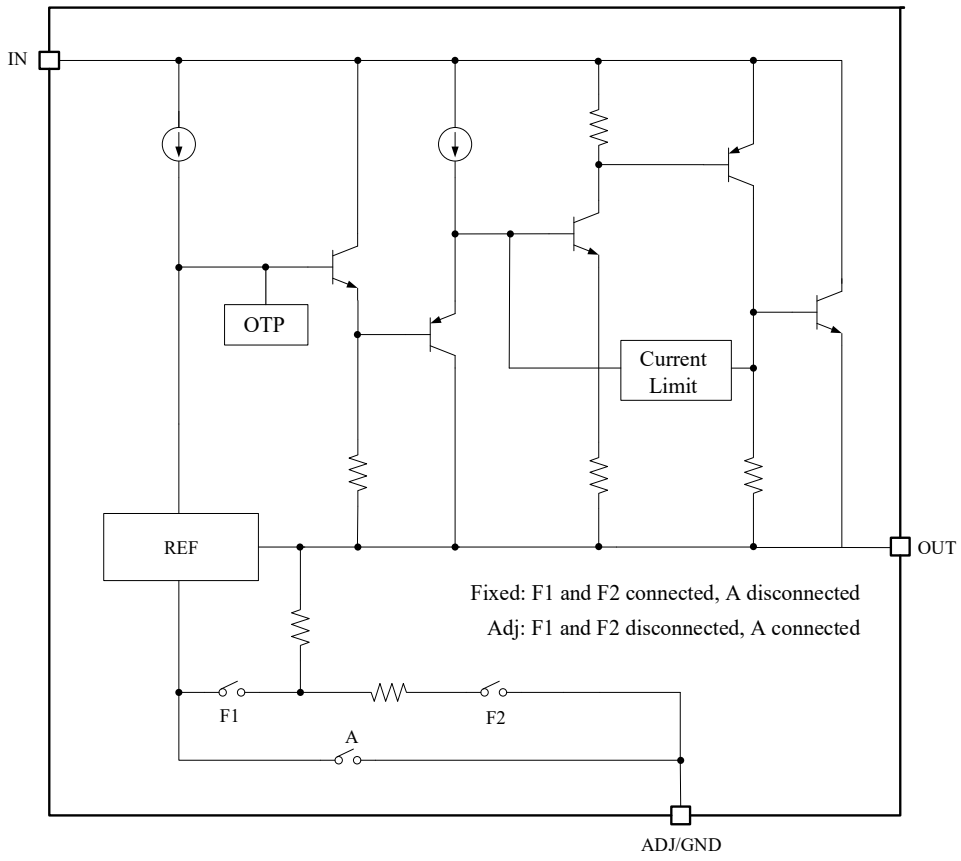
Figure 11. WR1117AN-33A70R
Power Supply Rejection Ratio vs. Frequency

11. Function Description

11.1 Overview

The WR1117AN series are high efficiency regulators with high accuracy, low dropout voltage and 1A output current, including fixed output voltage version and adjustable output voltage version. The input voltage range is 3.0V to 15V and the output voltage range is 1.2V to 12V, making the device suitable for a variety of electronic devices.

11.2 Block Diagram



11.3 Feature Description

11.3.1 Output Voltage Accuracy

Output voltage accuracy is defined as the maximum and minimum error in output voltage. The errors are introduced by internal reference, load regulation and line regulation differences over the full range of rated load and line operating conditions, considering differences between manufacturing lots. The output voltage accuracy of WR1117AN is about 2% at TA = 25℃ and maybe drift in full operating temperature.

11.3.2 Dropout Voltage (V_{DO})

WR1117AN is a low dropout voltage 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.

11.3.3 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:

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.

12. Application and Implementation

12.1 Application Information

The WR1117AN is a linear voltage regulator with an input voltage of 3.0V to 15V and an output voltage of 1.2V to 12V. The accuracy is 2% for output voltages up to 1.2V to 12V. The maximum output current is 1A. 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 voltage difference (V_{IN} - V_{OUT}) must be as small as possible. This section discusses how best to use this device in practical applications.

12.2 Capacitor Recommendation

The WR1117AN uses tantalum capacitors at the V_{IN} and V_{OUT} pins to increase its stability. A 10μF tantalum capacitor is recommended as bypass capacitor (C_{IN}) and a 22μF tantalum capacitor (C_{OUT}) is recommended to assure circuit stability. 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.

12.3 Power Dissipation (P_D)

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.

12.4 Detailed Design Procedure

The adjustable version of the WR1117AN has a thermally stable reference voltage of (1.25 ± 0.025) V between the OUT and ADJ pins. The I_{ADJ} is approximately 55μA and a maximum of 120μA. The ΔI_{ADJ} at 10mA and 1A load is 0.2μA and a maximum of 10μA. According to the formula:

$$V_{OUT} = V_{REF}\left(1 + \frac{R_2}{R_1}\right) + (I_{ADJ} \times R_2)$$

Because of the minimum 5mA load current requirement, 240Ω of R_1 is recommended. The R_2 causes an error in the output voltage, the larger the R_2 value, the greater the error. Because I_{ADJ} is very small, so the product of R_2 x I_{ADJ} has a negligible effect on V_{OUT}.

The above expression then becomes:

$$V_{OUT} = V_{REF}\left(1 + \frac{R_2}{R_1}\right)$$

For low load regulation, R_1 must be connected very close to the OUT and ADJ pins, while the ground side of R_2 must be as close as possible to the load pin.

Recommended Component Values

V_{OUT}(V)	R_1(Ω)	R_2(Ω)
1.5	240	48
1.8	240	110
3.3	240	400
5.0	240	720

13. Power Supply Recommendations

The WR1117AN has a V_{IN} range of between 3.0V and 15V and an input capacitance of 10μF. The input voltage should have some redundancy to ensure a stable output voltage when the load fluctuates. If the input supply is noisy, additional input capacitors can be used to improve the noise performance of the output.

14. 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 module or schematic.

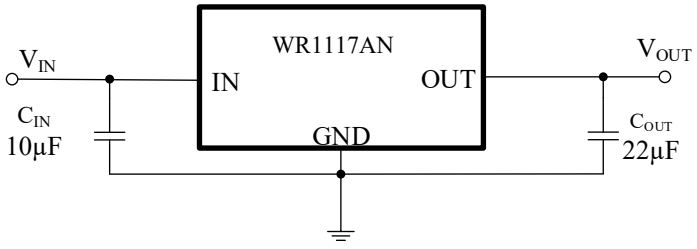
The module names are listed in the following table.

NAME	PACKAGE	EVALUATION MODULE
WR1117AN	SOT223-3	WAYON LDO EVM V1.1 –SOT223-3
	SOT89-3	WAYON LDO EVM V1.0 –SOT89-3
	TO252-2	WAYON LDO EVM_TO-252-2(WR1117)-V1.0

14.1 Typical Application Circuits

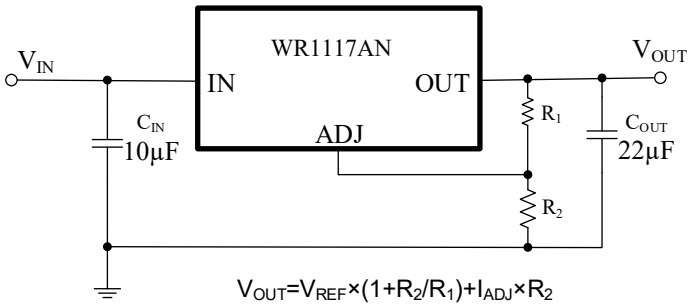
This section discusses the application of the WR1117AN in the circuit. The following figure shows the schematics of the application circuits.

1. Fixed voltage version



Fixed Voltage Regulator

2. Adjustable voltage version



Adjustable Voltage Regulator

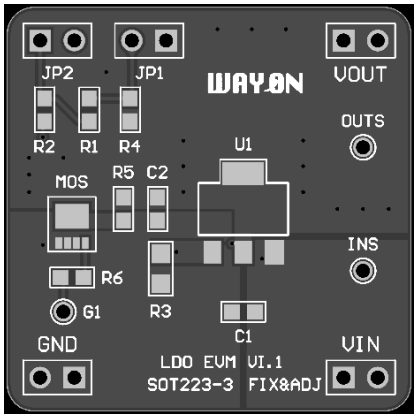
14.2 Layout of Typical Application Circuits

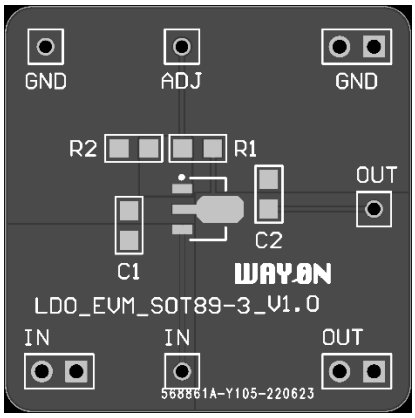
Layout Guidelines

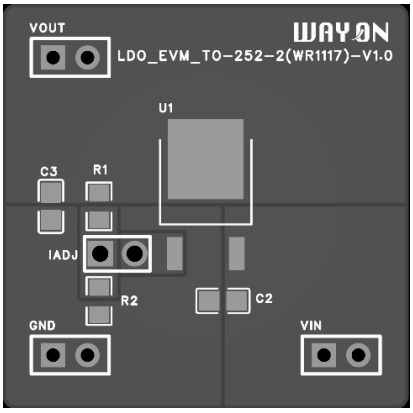
The principle of LDO design is to place all components on the same side of the board and connect them as close as possible to their respective LDO pins. A minimum 10μF input capacitor (C_{IN}) is recommended to IN to minimize the effect of resistance and inductance between the source and the LDO input. A minimum 22μF 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.

Layout Example







15. Naming Conventions

WR AAAAAA-BB CCC D

WR: WAYON Regulator;

AAAAAA: Product Name;

BB: Output Voltage/AD-Output Voltage, Adjustable Voltage;

CCC: Package – A70: SOT223-3 / A20: SOT89-3 / T20: TO252-2 ;

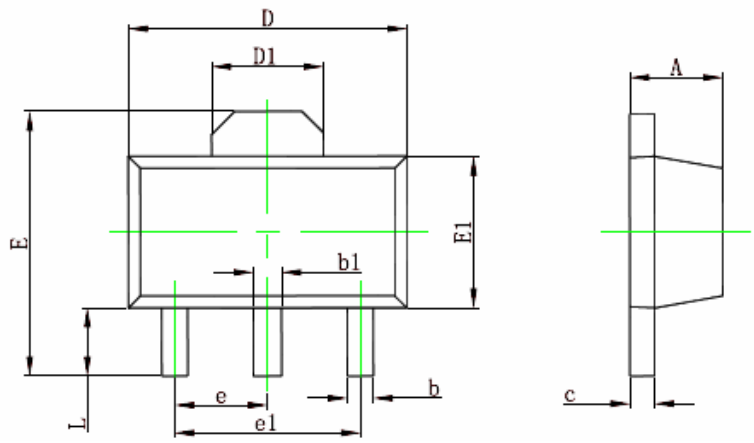
D: R-Reel;

16. Electrostatic discharge warning

ESD can cause irreversible damage to integrated circuits, ranging from minor performance degradation to device failure. Precision ICs are more susceptible to damage because very minor parameter changes can cause the device to be out of compliance with its published specifications. WAY-ON recommends that all ICs be handled with proper precautions. Failure to follow proper handling practices and installation procedures may damage the IC.

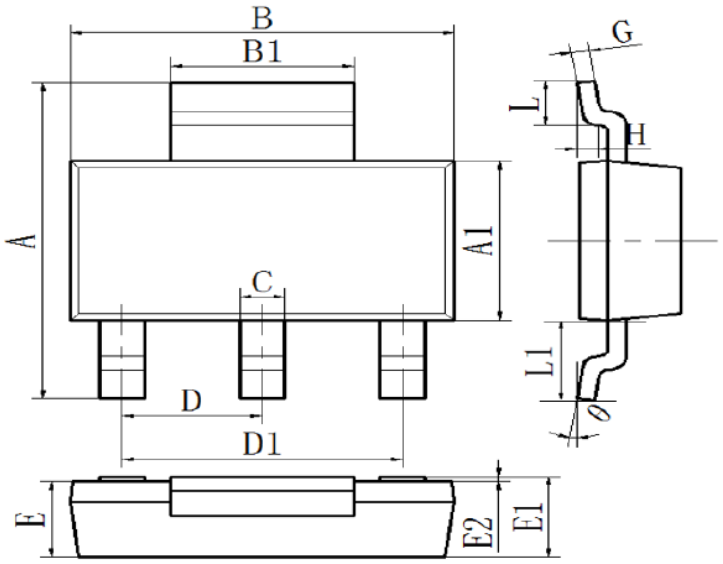
17. Package Information

SOT 89-3



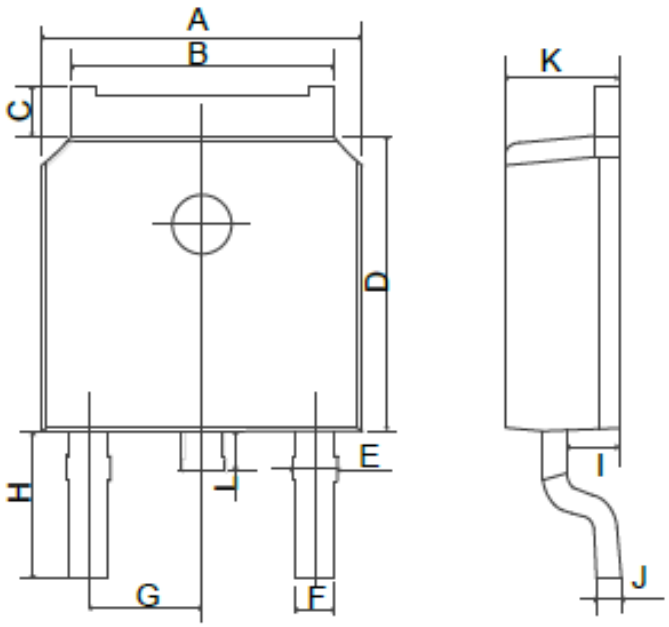
SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	1.4	1.5	1.6
b	0.32	0.42	0.52
b1	0.38	0.48	0.58
c	0.35	0.405	0.46
D	4.40	4.50	4.60
D1	1.5	1.65	1.8
E	3.94	4.12	4.30
E1	2.30	2.45	2.60
e	1.50BSC		
e1	3.00BSC		
L	0.80	1.00	1.20

SOT 223-3



SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	6.70	7.00	7.30
A1	3.30	3.50	3.70
B	6.20	6.45	6.70
B1	2.90	3.00	3.10
C	0.60	0.72	0.84
D	2.25	2.30	2.35
D1	4.50	4.60	4.70
E	1.45	1.60	1.75
E1	1.51	1.66	1.81
E2	0.02	0.08	0.14
G	0.20	0.29	0.35
H	0.20	0.25	0.30
L	0.75	0.95	1.15
L1	1.65	1.75	1.85
θ	0	4°	10°

TO252-2



SYMBOL	DIMENSIONS IN MILLIMETERS	
	MIN	MAX
A	6.40	6.80
B	5.13	5.50
C	0.88	1.28
D	5.90	6.22
E	0.68	1.10
F	0.68	0.91
G	2.29REF	
H	2.90REF	
I	0.85	1.17
J	0.51REF	
K	2.10	2.50
L	0.40	1.00

18. Ordering Information

PART NUMBER	OUTPUT VOLTAGE	PACKAGE	PACKING QUANTITY	MARKING*
WR1117AN-ADA70R	ADJ	SOT223-3	2.5k/Reel	WR1117AN AD XXXX
WR1117AN-12A70R	1.2V	SOT223-3	2.5k/Reel	WR1117AN 12 XXXX
WR1117AN-15A70R	1.5V	SOT223-3	2.5k/Reel	WR1117AN 15 XXXX
WR1117AN-18A70R	1.8V	SOT223-3	2.5k/Reel	WR1117AN 18 XXXX
WR1117AN-25A70R	2.5V	SOT223-3	2.5k/Reel	WR1117AN 25 XXXX
WR1117AN-33A70R	3.3V	SOT223-3	2.5k/Reel	WR1117AN 33 XXXX
WR1117AN-50A70R	5.0V	SOT223-3	2.5k/Reel	WR1117AN 50 XXXX
WR1117AN-ADA20R	ADJ	SOT89-3	1k/Reel	WR1117AN AD XXXX
WR1117AN-12A20R	1.2V	SOT89-3	1k/Reel	WR1117AN 12 XXXX
WR1117AN-15A20R	1.5V	SOT89-3	1k/Reel	WR1117AN 15 XXXX
WR1117AN-18A20R	1.8V	SOT89-3	1k/Reel	WR1117AN 18 XXXX
WR1117AN-25A20R	2.5V	SOT89-3	1k/Reel	WR1117AN 25 XXXX
WR1117AN-33A20R	3.3V	SOT89-3	1k/Reel	WR1117AN 33 XXXX
WR1117AN-50A20R	5.0V	SOT89-3	1k/Reel	WR1117AN 50 XXXX
WR1117AN-ADT20R	ADJ	TO252-2	2.5k/Reel	WR1117AN AD XXXX
WR1117AN-12T20R	1.2V	TO252-2	2.5k/Reel	WR1117AN 12 XXXX
WR1117AN-15T20R	1.5V	TO252-2	2.5k/Reel	WR1117AN 15 XXXX
WR1117AN-18T20R	1.8V	TO252-2	2.5k/Reel	WR1117AN 18 XXXX
WR1117AN-25T20R	2.5V	TO252-2	2.5k/Reel	WR1117AN 25 XXXX
WR1117AN-33T20R	3.3V	TO252-2	2.5k/Reel	WR1117AN 33 XXXX
WR1117AN-50T20R	5.0V	TO252-2	2.5k/Reel	WR1117AN 50 XXXX

* XXXX is variable.

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Product Specification Statement

1.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.

2.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.

3.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.

4.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.

5.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.

6.Users should also comply with relevant laws, regulations, policies, and standards when using the product specification. Users are responsible for the risks and liabilities arising from the use of the product specification and must ensure that it is not used for illegal purposes. Additionally, users should respect the intellectual property rights related to the product specification and refrain from infringing upon any third-party legal rights. WAYON shall assume no responsibility for any disputes or controversies arising from the above-mentioned issues in any form.