

Low Noise, Low Quiescent Current, 150mA Linear Regulator with Noise Bypass

FEATURES

- Very Low Noise, $25 \mu\text{V}_{\text{RMS}} @ f=10\sim 100\text{kHz}$.
- Very Low Quiescent Current, $35 \mu\text{A}$.
- Very Low Dropout Voltage, $90\text{mV} @ 50\text{mA}$.
- Active Low Shutdown Control.
- Short Circuit and Thermal Protection.
- 1.5V, 1.8V, 2.0V, 2.5V, 2.8V, 2.85V, 2.9V, 3.0V, 3.3V Output Voltage.
- Available in $\pm 2\%$ Output Tolerance.
- Low Profile Package: SOT-23-5

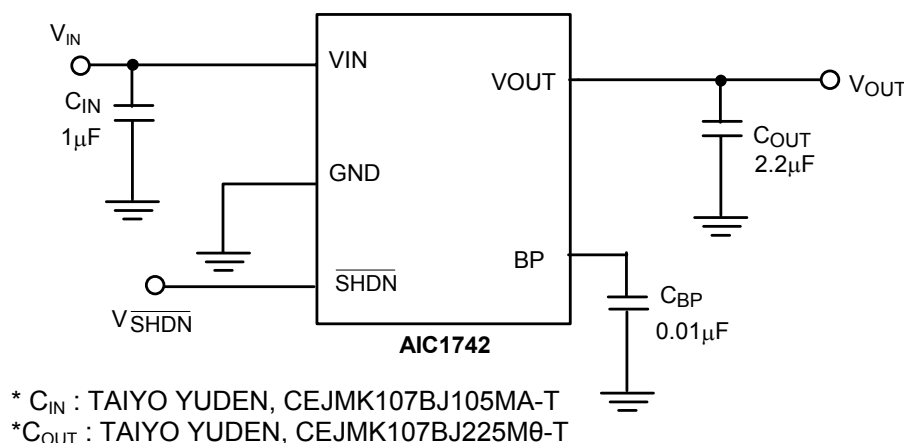
APPLICATIONS

- Cellular Telephones.
- Pagers.
- Personal Communication Equipment.
- Cordless Telephones.
- Portable Instrumentation.
- Portable Consumer Equipment.
- Radio Control Systems.
- Low Voltage Systems.
- Battery Powered Systems

DESCRIPTION

AIC1742 is a low noise, low dropout linear regulator, and is housed in a small SOT-23-5 package. The device is in the "ON" state when the SHDN pin is set to logic high level. A low dropout voltage of 90mV at 50mA load current is performed. It offers high precision output voltage of $\pm 2\%$. The quality of low quiescent current and low dropout voltage makes this device ideal for battery power applications. The internal reverse bias protection eliminates the requirement for a reverse voltage protection diode. The high ripple rejection and low noise of AIC1742 provide enhanced performance for critical applications. The noise bypass pin can be connected an external capacitor to reduce the output noise level.

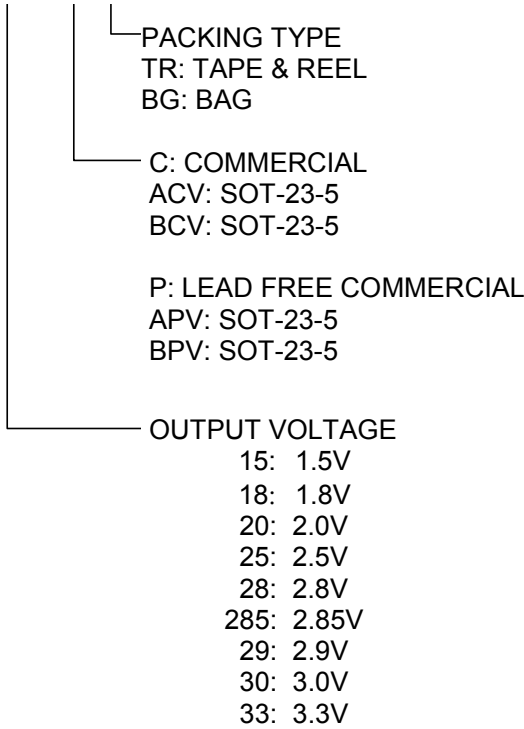
TYPICAL APPLICATION CIRCUIT



Low Noise Low Dropout Linear Regulator

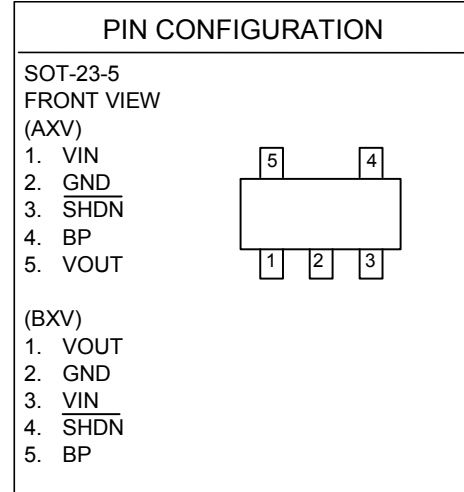
ORDERING INFORMATION

AIC1742-XXX XXX XX



(Of a unit of 0.1V within the voltage range from 1.5V to 3.3V, additional voltage versions for this product line may be available on demand with prior consultation with AIC.)

- Example: AIC1742-15ACVTR
 → 1.5V Version, in SOT-23-5 Package & Tape & Reel Packing Type
- AIC1742-15APVTR
 → 1.5V Version, in SOT-23-5 Lead Free Package & Tape & Reel Packing Type



• SOT-23-5 Marking

Part No.	ACV	APV
AIC1742-15AXV	ER15	ER15P
AIC1742-18AXV	ER18	ER18P
AIC1742-20AXV	ER20	ER20P
AIC1742-25AXV	ER25	ER25P
AIC1742-28AXV	ER28	ER28P
AIC1742-285AXV	ER2J	ER2JP
AIC1742-29AXV	ER29	ER29P
AIC1742-30AXV	ER30	ER30P
AIC1742-33AXV	ER33	ER33P

Part No.	BCV	BPV
AIC1742-15BXV	ES15	ES15P
AIC1742-18BXV	ES18	ES18P
AIC1742-20BXV	ES20	ES20P
AIC1742-25BXV	ES25	ES25P
AIC1742-28BXV	ES28	ES28P
AIC1742-285BXV	ES2J	ES2JP
AIC1742-29BXV	ES29	ES29P
AIC1742-30BXV	ES30	ES30P
AIC1742-33BXV	ES33	ES33P

■ ABSOLUTE MAXIMUM RATINGS

Supply Voltage	9V
Shutdown Terminal Voltage9V
Power Dissipation	500mW
Operating Temperature Range	-40°C~85°C
Maximum Junction Temperature	125°C
Storage Temperature Range	-65°C~150°C
Lead Temperature (Soldering, 10 sec)	260°C
Thermal Resistance Junction to Case	130°C/W
Thermal Resistance Junction to Ambient	220°C/W

(Assume no ambient airflow, no heatsink)

Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

■ TEST CIRCUIT

Refer to TYPICAL APPLICATION CIRCUIT

■ ELECTRICAL CHARACTERISTICS

($T_J=25^{\circ}\text{C}$, unless otherwise specified) (Note1)

PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Quiescent Current	$V_{IN} = V_{OUT} + 1\text{V}$, $V_{\overline{\text{SHDN}}}=1.6\text{V}$, $I_{OUT} = 0\text{mA}$	I_Q		35	45	μA
Standby Current	$V_{IN} = V_{OUT} + 1\text{V to } 8\text{V}$, $V_{\overline{\text{SHDN}}}=0.6\text{V}$, Output OFF	I_{STBY}			0.1	μA
GND Pin Current	$I_{OUT} = 50\text{mA}$	I_{GND}		2.5	3.5	mA
Continuous Output Current	$V_{IN} = V_{OUT} + 1\text{V to } 8\text{V}$	I_{OUT}			150	mA
Output Current Limit	$V_{IN} = V_{OUT} + 1\text{V}$, $V_{OUT} = 0\text{V}$	I_{IL}	150	250		mA
Output Voltage Tolerance	$V_{IN} = V_{OUT} + 1\text{V}$, no load	V_{OUT}	-2		2	%
Temperature Coefficient		T_C		50	150	$\text{ppm}/^{\circ}\text{C}$
Line Regulation	$V_{IN} = V_{OUT(\text{TYP})} + 1\text{V to } 8\text{V}$	ΔV_{LIR}		2	5	mV
Load Regulation	$V_{IN} = 5\text{V}$, $I_{OUT} = 0.1\sim 150\text{mA}$	ΔV_{LOR}		0.005	0.01	$\%/ \text{mA}$
Dropout Voltage	$I_{OUT} = 50\text{mA}$	V_{DROP}				mV
	$I_{OUT} = 100\text{mA}$					
	$I_{OUT} = 150\text{mA}$					
	$I_{OUT} = 150\text{mA}$					
	$V_{\text{out}} \geq 2.5\text{V}$		90	160		
	$V_{\text{out}} < 2.5\text{V}$		140	230		
			200	350		
			500	800		
Noise Bypass Terminal Voltage		V_{REF}		1.25		V
Ripple Rejection	$f=1\text{KHz}$, Ripple= $0.5\text{V}_{\text{P-P}}$, $C_{\text{BP}} = 0.1\mu\text{F}$	RR		65		dB
Output Noise	$C_{\text{BP}} = 0.1\mu\text{F}$, $f = 10\sim 100\text{KHz}$	e_n		25		μV_{rms}
SHUTDOWN TERMINAL SPECIFICATIONS						
Shutdown Pin Current	$V_{\overline{\text{SHDN}}}=1.6\text{V}$	$I_{\overline{\text{SHDN}}}$			2	μA
Shutdown Pin Voltage (ON)	Output ON	$V_{\overline{\text{SHDN}}}(\text{ON})$	1.6			V
Shutdown Pin Voltage (OFF)	Output OFF	$V_{\overline{\text{SHDN}}}(\text{OFF})$			0.6	V
Shutdown Exit Delay Time	$C_{\text{BP}} = 0.1\mu\text{F}$, $C_{\text{OUT}} = 1\mu\text{F}$, $I_{OUT}=30\text{mA}$	Δt		300		μs

Note 1: Specifications are production tested at $T_A=25^{\circ}\text{C}$. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with Statistical Quality Controls (SQC).

Note 2: The dropout voltage is defined as $V_{IN} - V_{OUT}$ when V_{OUT} is 1% below the value of V_{OUT} for $V_{IN} = V_{OUT} + 0.5\text{V}$. (Only applicable for $V_{OUT} = 2.5\text{V} \sim 5\text{V}$)

TYPICAL PERFORMANCE CHARACTERISTICS

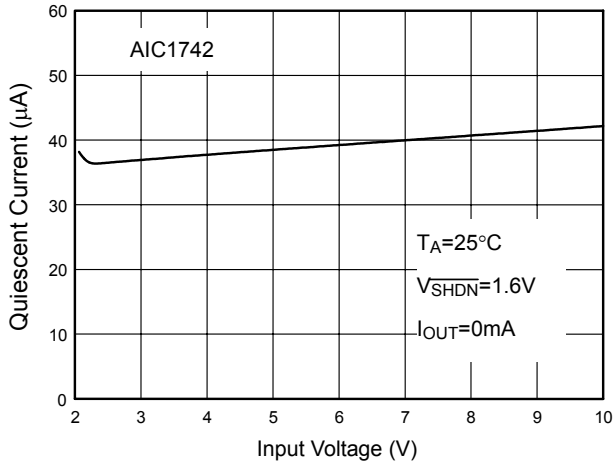


Fig. 1 Quiescent Current

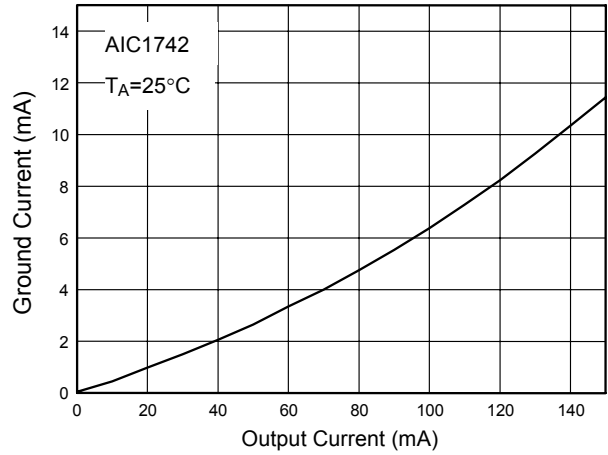


Fig. 2 Ground Current

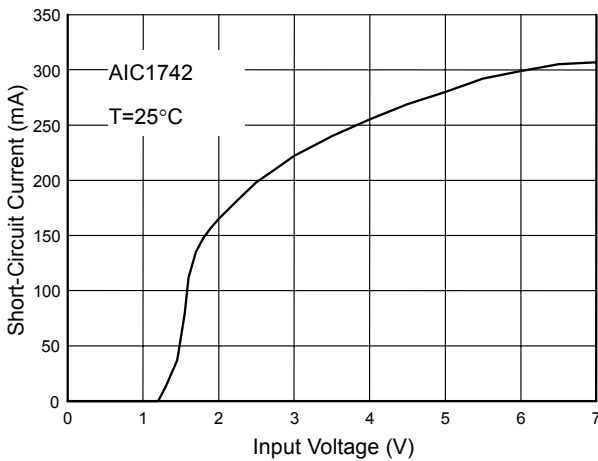


Fig. 3 Short-Circuit Current

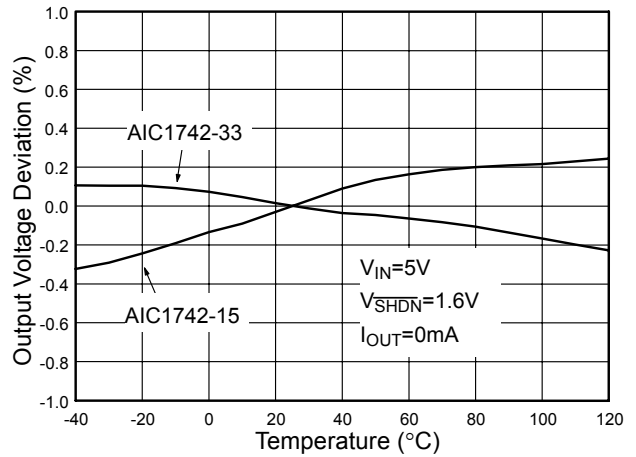


Fig. 4 Output Voltage

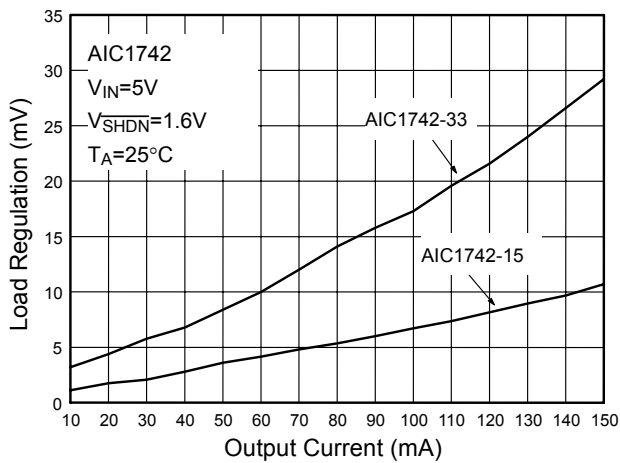


Fig. 5 Load Regulation

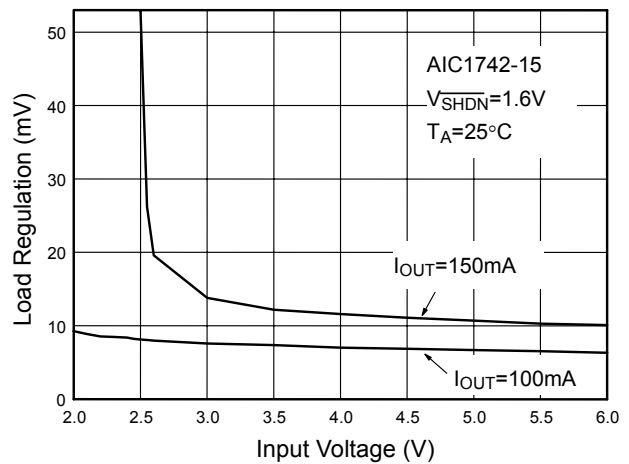


Fig. 6 Load Regulation

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

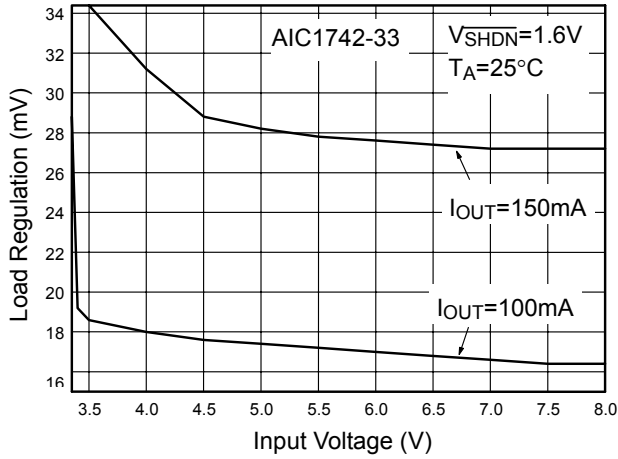


Fig. 7 Load Regulation

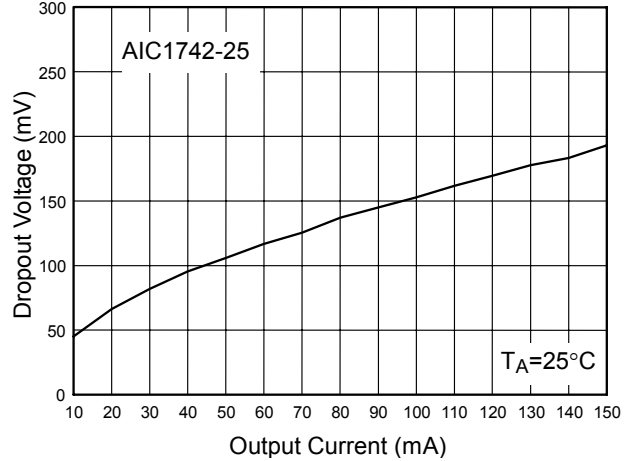


Fig. 8 Dropout Voltage

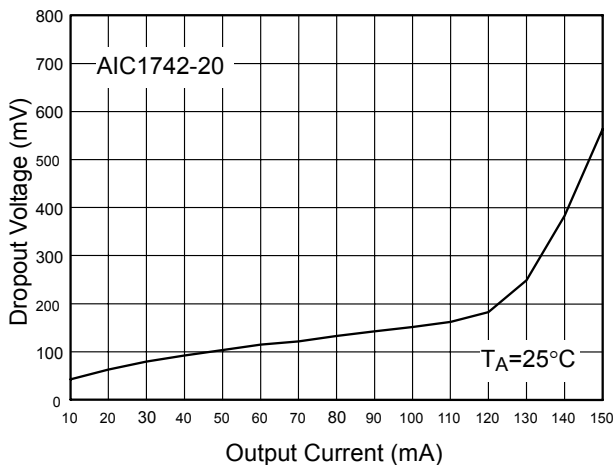


Fig. 9 Dropout Voltage

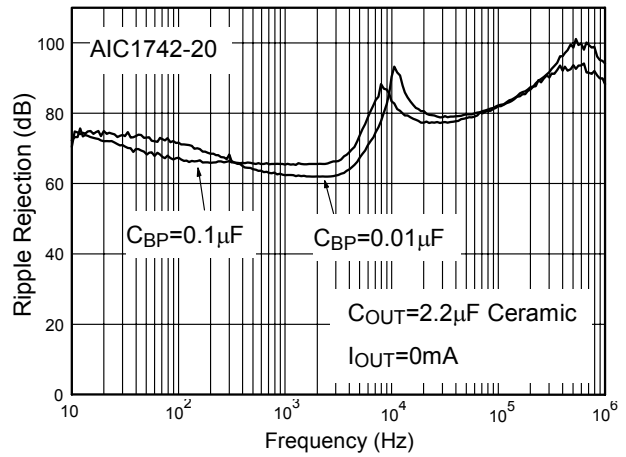


Fig. 10 Input Ripple Rejection

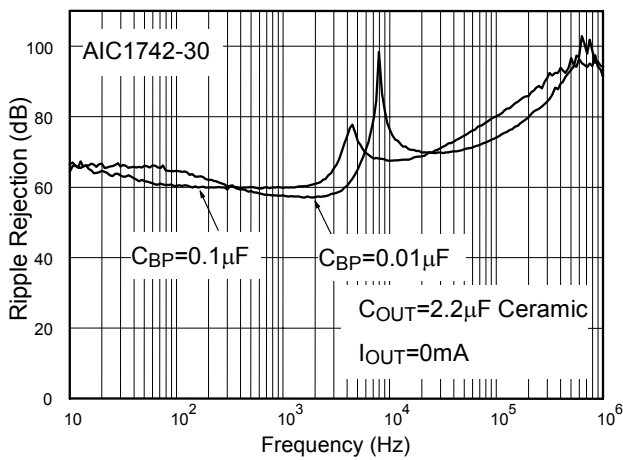


Fig. 11 Input Ripple Rejection

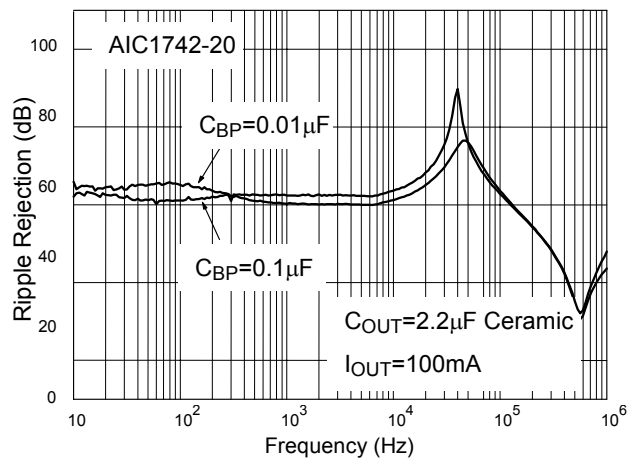


Fig. 12 Input Ripple Rejection

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

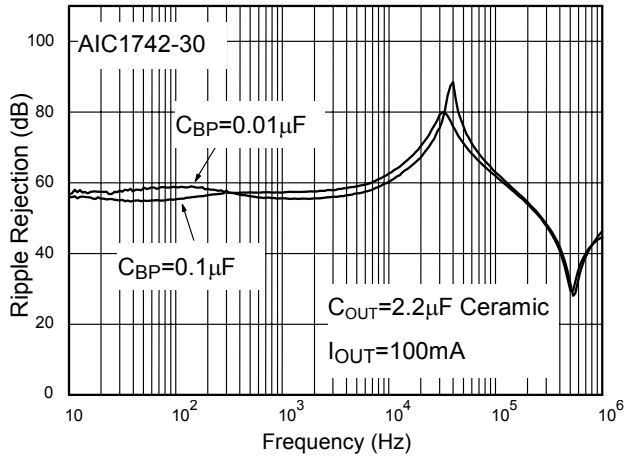


Fig. 13 Input Ripple Rejection

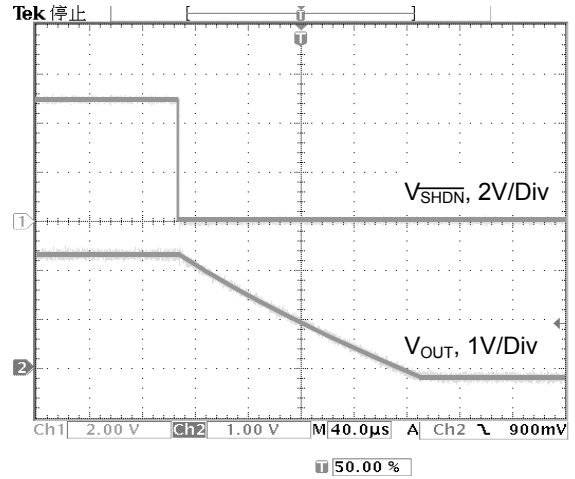


Fig. 14 Shutdown Delay

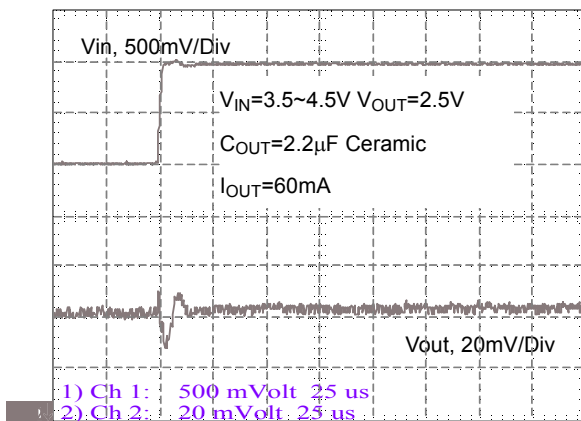


Fig. 15 Line Transient Response

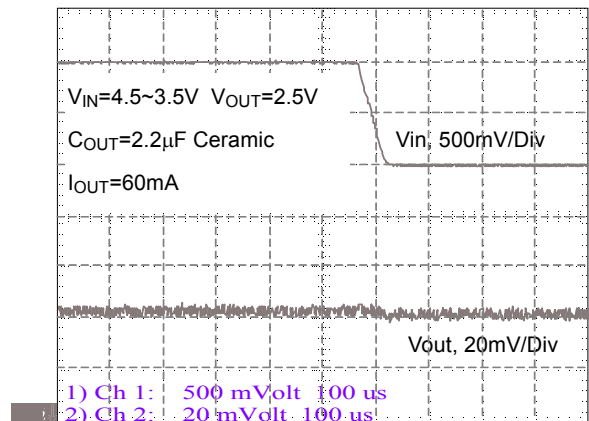


Fig. 16 Line Transient Response

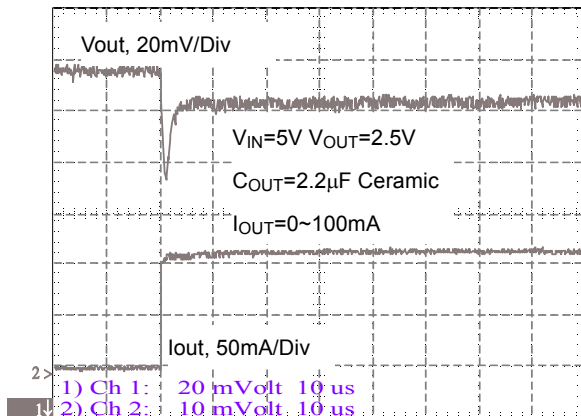


Fig. 17 Transient Response 2

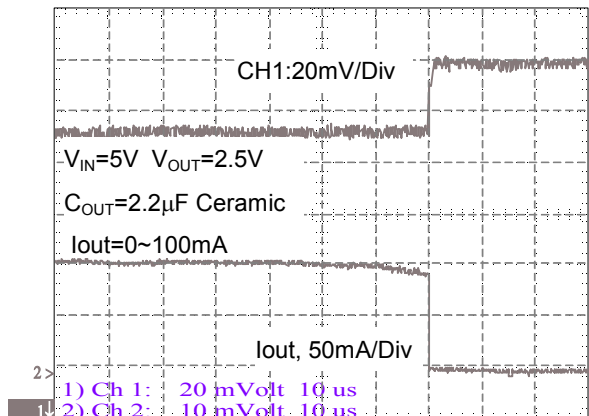


Fig. 18 Load Transient Response

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

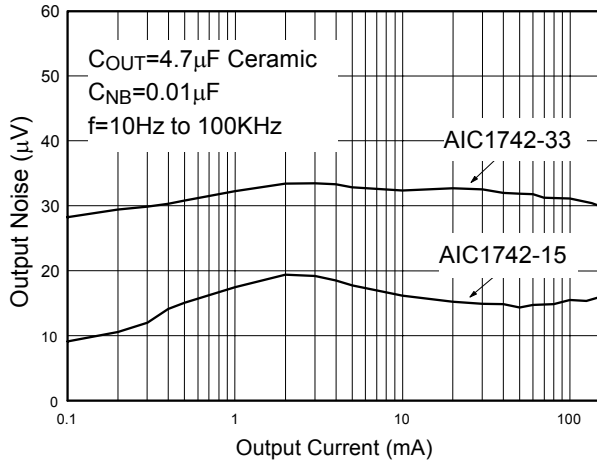
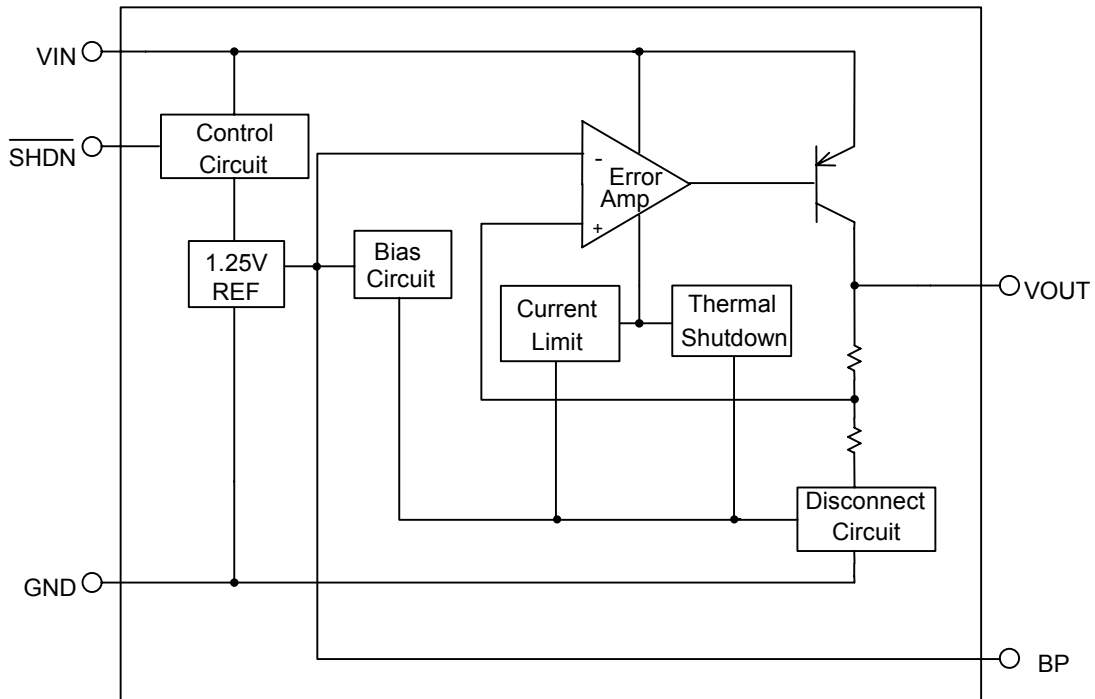


Fig. 19 Output Noise RMS

BLOCK DIAGRAM



PIN DESCRIPTIONS

- VIN PIN - Power supply input pin. Bypass with a 1µF capacitor to GND.
- GND PIN - Ground pin.
- SHDN PIN- Active-Low shutdown input pin.

- BP PIN - Noise bypass pin. An external bypass capacitor connecting to BP pin to reduce noises at the output.
- VOUT PIN - Output pin. Sources up to 150 mA.

■ DETAILED DESCRIPTION OF TECHNICAL TERMS

DROPOUT VOLTAGE (V_{DROP})

The dropout voltage is defined as the difference between the input voltage and output voltage at which the output voltage drops 100mV. Below this value, the output voltage will fall as the input voltage reduces. It depends on the load current and junction temperature.

LINE REGULATION

Line regulation is the ability of the regulator to maintain a constant output voltage as the input voltage changes. The line regulation is specified as the input voltage changes from $V_{IN} = V_{OUT} + 1V$ to $V_{IN} = 8V$ and $I_{OUT} = 1mA$.

LOAD REGULATION

Load regulation is the ability of the regulator to maintain a constant output voltage as the load current changes. A pulsed measurement with an input voltage set to $V_{IN} = V_{OUT} + V_{DROP}$ can minimize temperature effects. The load regulation is specified by the output current ranging from 0.1mA to 150mA.

QUIESCENT CURRENT (I_Q)

Quiescent current is the current flowing through ground pin with no output load.

GROUND CURRENT (I_{GND})

Ground current is the current flowing through the ground pin with output load.

STANDBY CURRENT (I_{STBY})

Standby current is the current flowing into the regulator when the output is shutdown by setting V_{SHDN} at 0V and V_{IN} at 8 V.

CURRENT LIMIT (I_{IL})

Current limiting of AIC1742 monitors and controls the maximum output current, in case of a shorted output. It protects device from the damage resulting from any unexpected current.

RIPPLE REJECTION (RR)

Ripple rejection is the ability of the regulator to reduce voltage ripple, which comes from input, at output terminal. It is specified with a signal of $0.5V_{P-P}$ at 1KHz frequency applying to input, output capacitor at $2.2\mu F$ as well as a noise bypass of $0.1\mu F$. Ripple rejection, expressed in dB, is the ratio of output ripple to input.

THERMAL PROTECTION

Thermal sensor protects device when the junction temperature exceeds $T_J = +155^\circ C$. It signals shutdown logic, turning off pass transistor and allowing IC to cool down. After the IC's junction temperature cools by $15^\circ C$, the thermal sensor will turn the pass transistor back on. Thermal protection is designed to protect the device in the event of fault conditions. For a continuous operation, do not exceed the absolute maximum junction-temperature rating of $T_J = 150^\circ C$, or damage may occur to the device.

■ APPLICATION INFORMATION

INPUT-OUTPUT CAPACITORS

Linear regulators require input and output capacitors to maintain stability. Input capacitor at $1\mu\text{F}$ with $1\mu\text{F}$ aluminum electrolytic or $2.2\mu\text{F}$ ceramic output capacitor is recommended. And it should be selected within the Equivalent Series Resistance (ESR) range as shown in the figure 20,21. ESR of ceramic capacitor is lower and its electrical characteristics (capacitance and ESR) vary widely over temperature. In general, tantalum or electric output capacitor is suggested for heavy load. Normally, the output capacitor should be $1\mu\text{F}$ (aluminum electrolytic) at least and rates for operating temperature range. Note that it's important to check selected manufactures electrical characteristics (capacitance and ESR) over temperature.

NOISE BYPASS CAPACITOR

$0.01\mu\text{F}$ bypass capacitor at BP pin reduces output voltage noise. And the BP pin has to connect a capacitor to GND.

POWER DISSIPATION

The maximum power dissipation of AIC1742 depends on the thermal resistance of its case and circuit board, the temperature difference between the die junction and ambient air, and the rate of airflow. The rate of temperature rise is greatly affected by the mounting pad configuration on the PCB, the board material, and the ambient temperature. When the IC mounting with good thermal conductivity is used, the junction temperature will be low even when large power dissipation applies.

The power dissipation across the device is

$$P = I_{\text{OUT}} (V_{\text{IN}} - V_{\text{OUT}}).$$

The maximum power dissipation is:

$$P_{\text{MAX}} = \frac{(T_{\text{J}} - T_{\text{A}})}{(R_{\theta\text{JB}} + R_{\theta\text{BA}})}$$

Where $T_{\text{J}} - T_{\text{A}}$ is the temperature difference between the die junction and the surrounding air, $R_{\theta\text{JB}}$ is the thermal resistance of the package, and $R_{\theta\text{BA}}$ is the thermal resistance through the PCB, copper traces, and other materials to the surrounding air.

As a general rule, the lower temperature is, the better reliability of the device is. So the PCB mounting pad should provide maximum thermal conductivity to maintain low device temperature.

GND pin performs a dual function of providing an electrical connection to ground and channeling heat away. Therefore, connecting the GND pin to ground with a large pad or ground plane would increase the power dissipation and reduce the device temperature.

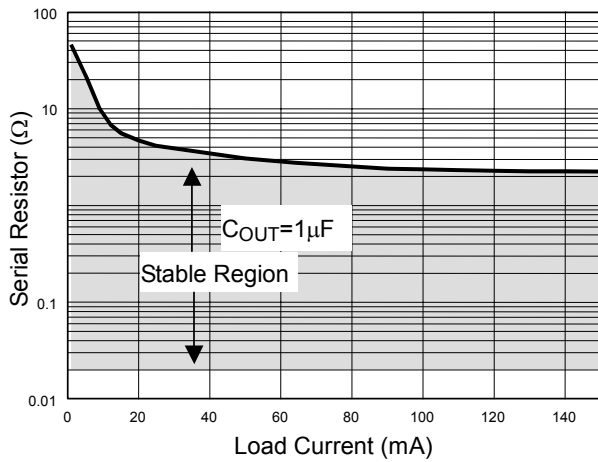


Fig. 20 Stable Region with extra Serial Resistor vs. Load Current

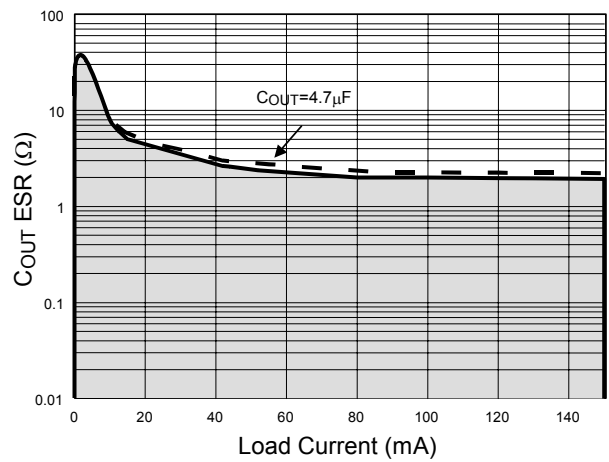
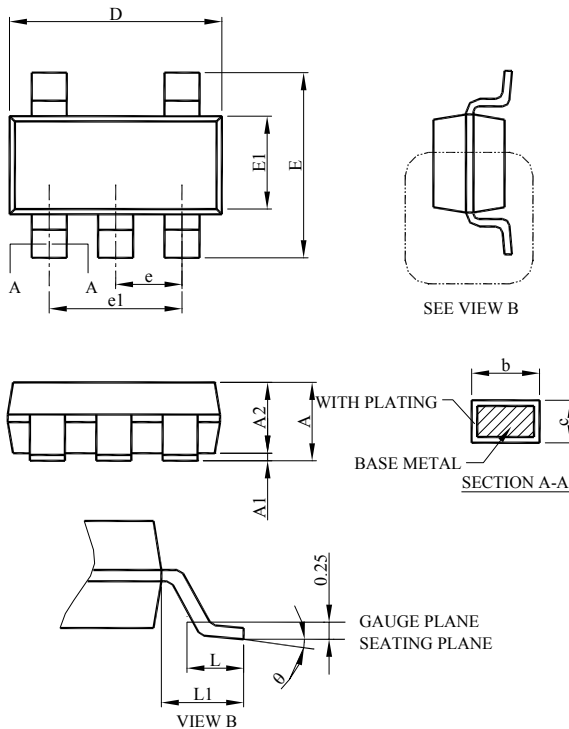


Fig. 21 Region of Stable C_{OUT} ESR vs. Load Current

PHYSICAL DIMENSIONS

- SOT-23-5 (unit: mm)



SYMBOL	SOT-25	
	MILLIMETERS	
	MIN.	MAX.
A	0.95	1.45
A1	0.05	0.15
A2	0.90	1.30
b	0.30	0.50
c	0.08	0.22
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.95 BSC	
e1	1.90 BSC	
L	0.30	0.60
L1	0.60 REF	
θ	0°	8°

Note:

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