300mA, Low I_Q, High PSRR LDO Regulators

FEATURES

- 2.5V to 5.5V Input Voltage Range
- 380mV @300mA Dropout Voltage
- Excellent Transient Response
- Stable with 1μF Ceramic Output Capacitor
- 70dB PSRR at 1kHz
- Low 37μA Quiescent Current
- Low Shutdown Current: <1μA
- Output Accuracy: ±2%
- Fixed Output Voltage: 1.2V~3.3V (0.1V per step)
- Current Limit Protection
- Thermal Shutdown
- Output Auto-Discharge in Shutdown
- RoHS Compliant and 100% Lead (Fb)-Free Halogen-Free

DESCRIPTION

The AIC1747A is a 300mA, low-dropout (LDO) linear regulator with fast transient response and high PSRR. It offers high output accuracy, low dropout voltage and low quiescent current as well as fast start-up time. This regulator is based on a CMOS process.

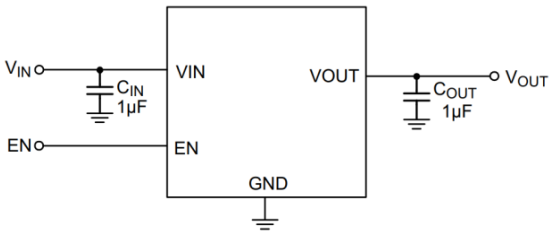
The AIC1747A is designed to work with low-ESR ceramic capacitors, reducing the amount of the PCB area necessary for power applications. Only a 1μF ceramic output capacitor can make the device stable over the whole load range current (0mA to 300mA).

The other key features of AIC1747A include over-current protection and thermal shutdown. The AIC1747A is packaged in DFN 4L 1×1 package.

APPLICATIONS

- Cellular Phones
- Bluetooth portable radios and Accessories
- Battery-Powered Equipment
- Laptop, Palmtops, Notebook Computer
- PDAs
- Digital still Camera and Video Recorders

TYPICAL APPLICATION CIRCUIT



AIC1747A Typical Application Circuit

ORDERING INFORMATION

AIC1747A-XXXXX XX

- PACKING TYPE
  TR: TAPE & REEL
  BG: BAG
- PACKAGE TYPE
  D4A:DFN 4L 1x1
- G: Green Package
- OUTPUT VOLTAGE
  12: 1.2V
  18: 1.8V
  25: 2.5V
  28: 2.8V
  30: 3.0V
  33: 3.3V
  (Of a unit of 0.1V within 1.2~3.3V, additional voltage versions are available on demand)

3 PIN CONFIGURATION

DFN 4L 1x1
TOP VIEW
1: VOUT
2: GND
3: EN
4: VIN

Example: AIC1747A-18GD4ATR
→ 1.8V Version, in DFN 4L 1x1 Green Package and Tape & Reel Packing Type

Part Number	Package	Top Mark
AIC1747A-12GD4A	DFN1x1	TDBxxx
AIC1747A-18GD4A	DFN1x1	TDCxxx
AIC1747A-28GD4A	DFN1x1	TDExxx
AIC1747A-30GD4A	DFN1x1	TDFxxx

Top Mark: (xxx: Inside code)

ABSOLUTE MAXIMUM RATINGS

VIN Pin and EN Pin Voltage..... -0.3~6V

All other pins Voltage ..... -0.3 to (V_{IN}+0.3)

Maximum Junction Temperature..... 160ºC

Storage Temperature Range ..... -65ºC~150ºC

Lead Temperature (Soldering, 10 sec)..... 260ºC

Thermal Resistance - Junction to Ambient DFN 4L 1x1 .....239˚C /W
(Assume no ambient airflow)

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

ELECTRICAL CHARACTERISTICS

(V_{IN}=V_{OUT}+1V, or V_{IN}=2.5V for V_{OUT}<1.5V, T_A=25°C, unless otherwise specified) (Note 1)

PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Input Voltage						
Input Voltage Range		V_{IN}	2.5		5.5	V
Quiescent Current	V_{EN}=2.5V, I_{OUT}=0mA	I_Q	35		70	μA
Shutdown Current	V_{EN}=0V	I_{SHDN}		0.1	1	μA
Power Supply Ripple Rejection	V_{IN}=Vnom+1V_{P-P}, f=1kHz, I_{LOAD}=10mA	PSRR		70		dB
Enable						
Enable High Voltage	All temperature range	V_{ENH}	1.5			V
Enable Low Voltage	All temperature range	V_{ENL}			0.4	V
EN Input Current	V_{IN}=3.5V, V_{EN}=3.5V or 0V	I_{EN}	-1	0.2	1	μA
Start-up Time	V_{IN}=3.5V, V_{OUT}=2.5V	T_{ST}		40		μS
Output Voltage						
Output Voltage Accuracy	V_{IN}=V_{OUT}+1V, I_{OUT}=10mA	V_{OUT}	-2		+2	%
	V_{IN}=V_{OUT}+1V, I_{OUT}=10mA,T_A=-40℃ to +85℃		-3		+3	%
Output Line Regulation	V_{OUT}+0.5V<V_{IN}<5.5V, I_{OUT}=10mA	V_{LNR}		0.01	0.1	%/V
Output Load Regulation	1mA<I_{OUT}<300mA, V_{IN}=V_{NOM}+1.0V	V_{LDR}		3	6	mV
Dropout Voltage (Note 2)	I_{OUT}=300mA (Applied for V_{OUT}≥2.3V)	V_{DROP}		320	350	mV
Maximum Output Current		I_{OUTMAX}	300			mA
Protection						
Current Limit		I_{limit}	350	470		mA
Resistance of Auto-Discharge		R_{AD}		130		Ω
Thermal Shutdown Temperature	No Load, V_{IN}=V_{EN}=5V	T_{SD}		155		°C
Thermal Shutdown Hysteresis	No Load, V_{IN}=V_{EN}=5V	T_{SDHYS}		30		°C

Note 1. Specifications are production tested at T_A=25°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. Dropout is defined as V_{IN}-V_{OUT} when V_{OUT} is 2% below the value of V_{OUT} for V_{IN}=V_{OUT}+0.5V.

TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN}=3.8V, V_{OUT}=2.8V, I_{OUT}=10mA to 300mA

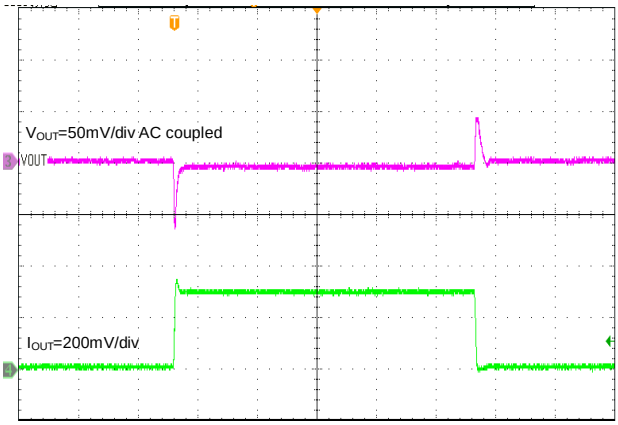


Fig. 1 Load Transient

V_{OUT}=2.8V, I_{OUT}=10mA, V_{IN}=3.3V to 4.3V

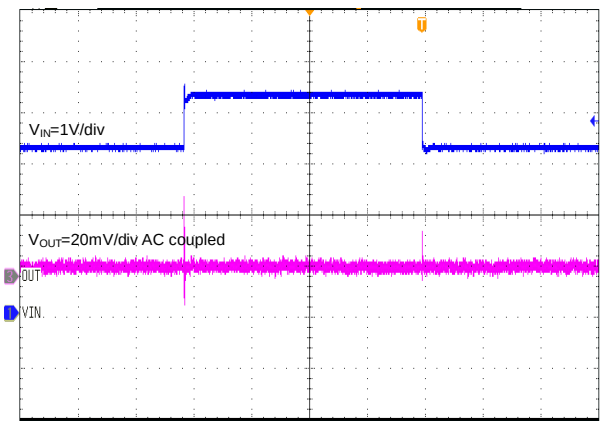


Fig. 2 Line Transient

V_{IN}=3.8V, V_{OUT}=2.8V, Ro=5.1Ω

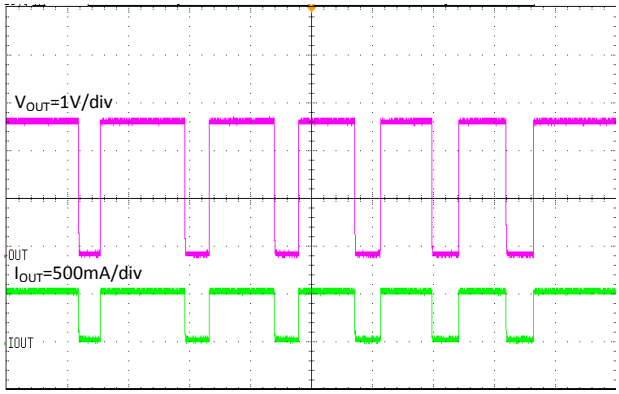


Fig. 3 Over Temperature Protection

V_{IN}=3.8V, T_A=25°C

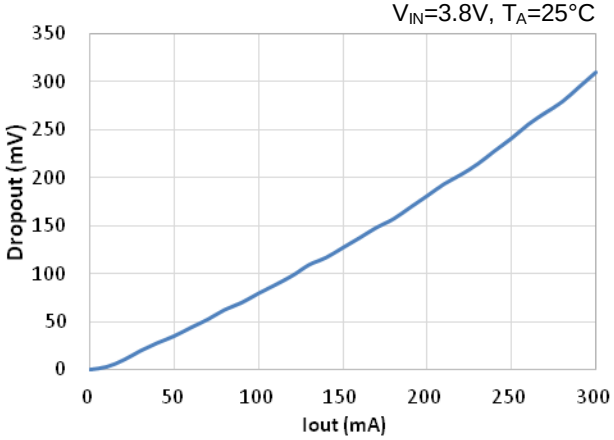


Fig. 4 Dropout vs. I_{out}

V_{IN}=3.8V, V_{OUT}=2.8V, T_A=25°C

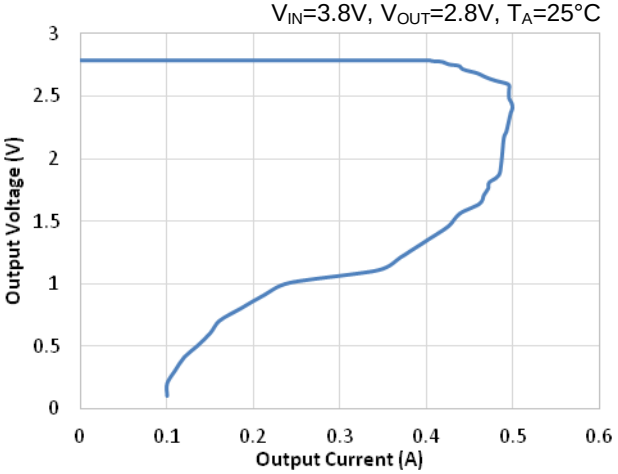


Fig. 5 Over Current Protection

V_{IN}=3.8V, V_{OUT}=2.8V, I_{OUT}=10mA, T_A=25°C

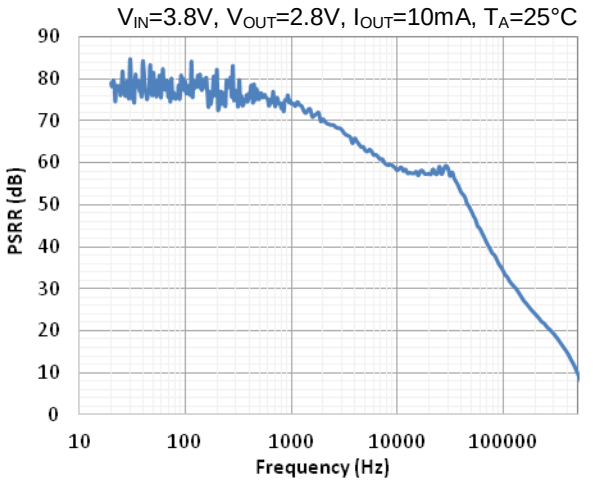
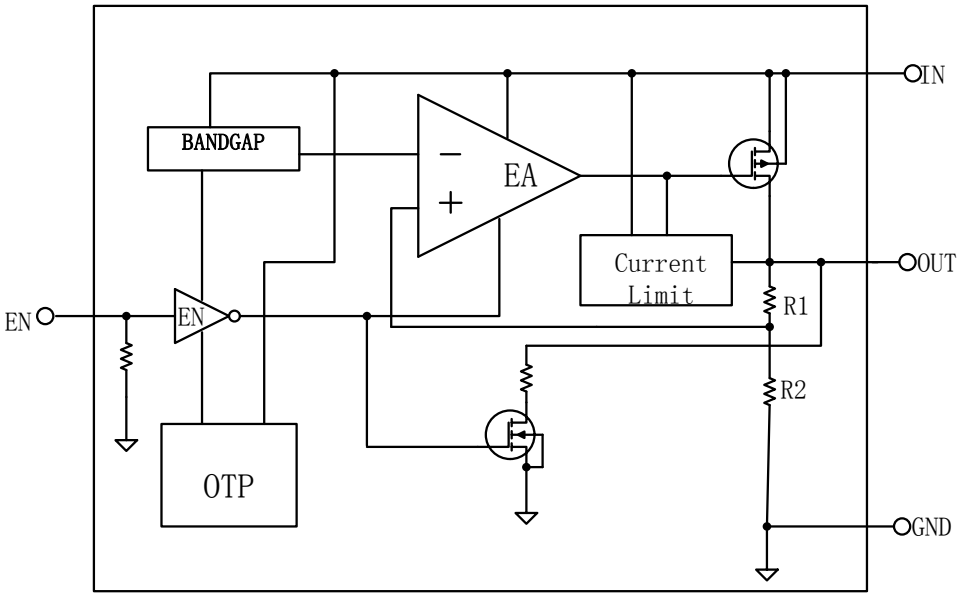


Fig. 6 PSRR vs. Frequency

BLOCK DIAGRAM



Functional Block Diagram of AIC1747A

PIN DESCRIPTION

VIN - Input Supply of the LDO.
GND - Signal Ground.
EN - Enable Pin. Connect this pin to ground or less than 0.4V to disable the device, connect EN to 1.5V or above to enable the device. This pin should not be floated.
VOUT - Output of the LDO.

Detailed Function Description

The AIC1747A is a high output current, low dropout linear regulator with fast transient response and high PSRR. It offers high output accuracy, low quiescent current and fast start-up time. It is designed to work with low-ESR ceramic capacitor, reducing the amount of the PCB area. Only a 1μF ceramic output capacitor can make the device stable over the whole load range.

As shown in the function block diagram, the AIC1747A is composed of the bandgap reference voltage, the error amplifier, P-channel MOSFET pass transistor, internal resistor divider and some additional protection circuits. The reference voltage, connected to the cathode terminal of the error amplifier, compares with the feedback voltage to regulate the output voltage to make it constant over the whole load current range. If the feedback voltage is lower than the reference voltage, the pass transistor gate is pulled lower to increase its conductivity. This allows more current to flow to the output and increase the output voltage. If the feedback voltage is higher than the reference voltage, the pass transistor gate is pulled higher to decrease its conductivity. This allows less current to flow to the output and decrease the output voltage. The feedback point is the output of the internal resistor divider connected to the VOUT pin.

ENABLE/SHUTDOWN

The AIC1747A is disabled when the EN pin is connected to ground or the voltage less than 0.4V, and the quiescent current is less than 1μA. Connect EN pin to 1.5V or higher voltage to enable the device. This pin cannot be floated.

OUTPUT AUTO DISCHARGE

When the regulator is disabled, an internal 130Ω resister is connected between VOUT and GND to discharge output capacitor C_{OUT}.

CURRENT LIMIT

The AIC1747A includes a current limit circuit to monitor the gate voltage of the pass transistor to limit the output current. When the output current is higher than the over-current limit, the circuit will clamp the gate voltage of the pass transistor to limit the output current. The typical output current limit is 450mA.

SHORT CIRCUIT PROTECTION

When VOUT pin is short-circuit to GND, short circuit protection will be triggered and clamp the output current to approximately 90mA. This feature protects the regulator from over current condition and damage due to overheating.

THERMAL SHUTDOWN

The AIC1747A monitors internal temperature. When the junction temperature exceeds 155°C, the over temperature protection (OTP) circuit turn off the pass transistor until the device is cooled down by 30°C. Then the pass transistor resumes. For continue operation, do not exceed absolute maximum junction temperature.

APPLICATION INFORMATION

EXTERNAL CAPACITOR

The AIC1747A requires external capacitor for stability. It is specifically designed to work with low-ESR capacitors requiring minimum PCB area. Place the external capacitors as close as possible to the device.

INPUT CAPACITOR

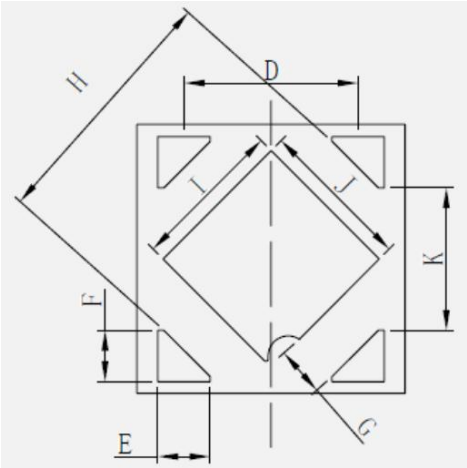
A 1μF or higher capacitance value ceramic capacitor is required between the VIN pin and the GND pin. Place it as close as possible to the device. There are no requirements for the ESR on the input capacitor, but the tolerance and temperature coefficient must be capacitance is 1μF over the whole operating temperature range.

OUTPUT CAPACITOR

An output capacitor (C_{OUT}) is needed to improve transient response and maintain stability. The AIC1747A is stable with very small ceramic output capacitors. A 1μF to 10μF capacitor is suitable for the most AIC1747A applications.

PHYSICAL DIMENSIONS

- **DFN 4L 1x1**



Dimensions In Millimeterer			
Symbol	MIN	TYP	MAX
A	0.950	1.000	1.050
B	0.320	0.370	0.420
C	0.950	1.000	1.050
D	0.600	0.650	0.700
E	0.145	0.195	0.245
F	0.140	0.190	0.240
G	0.134	0.184	0.234
H	0.890	0.940	0.990
I	0.520	0.570	0.620
J	0.520	0.570	0.620
K	0.480	0.530	0.580