

■ FEATURES

- Very Low Quiescent Current, 55 μ A
- Very Low Dropout Voltage, 90mV @ 50mA.
- Short Circuit and Thermal Protection.
- Available in $\pm 2\%$ Output Tolerance.
- 1.8V to 3.3V Output Voltage with 0.1V Increment.
- Active Low Shutdown Control.
- Low Noise.
- Low Profile Package: SOT-23-5

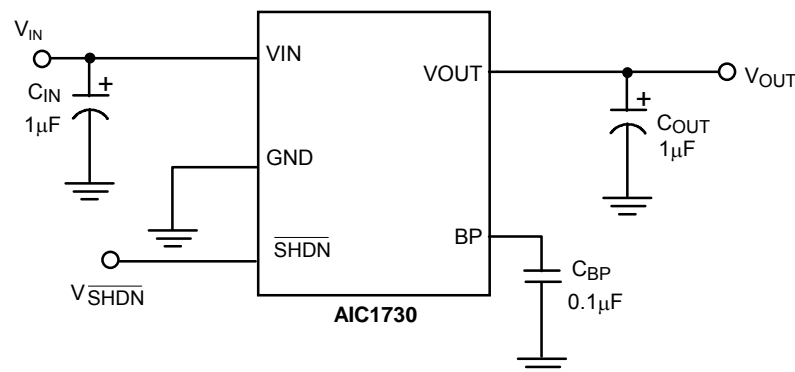
■ APPLICATIONS

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

■ DESCRIPTION

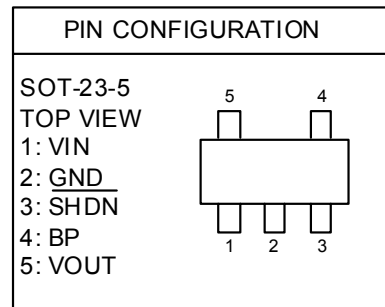
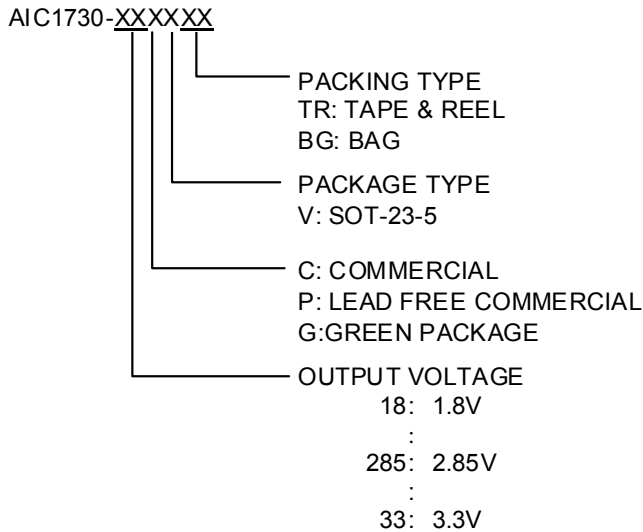
The AIC1730 is a low noise, low dropout linear regulator, and is housed in a small SOT-23-5 package. The device is in the "ON" state when the $\overline{\text{SHDN}}$ pin is set to logic high level. A low dropout voltage of 90mV at 50mA load current is performed. It offers high precision output voltage 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 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



Example: AIC1730-18CVTR

→ 1.8V version in SOT-23-5 Package & Taping & Reel Packing Type

AIC1730-18PVTR

→ 1.8V version in SOT-23-5 Lead Free Package & Taping & Reel Packing Type

AIC1730-18GVTR

→ 1.8V version in SOT-23-5 Green Package & Taping & Reel Packing Type

SOT-23-5 Marking

Part No.	CV	PV	GV
AIC1730-18	EC18	EC18P	EC18G
AIC1730-19	EC19	EC19P	EC19G
AIC1730-20	EC20	EC20P	EC20G
AIC1730-21	EC21	EC21P	EC21G
AIC1730-22	EC22	EC22P	EC22G
AIC1730-23	EC23	EC23P	EC23G
AIC1730-24	EC24	EC24P	EC24G
AIC1730-25	EC25	EC25P	EC25G
AIC1730-26	EC26	EC26P	EC26G

Part No.	CV	PV	GV
AIC1730-27	EC27	EC27P	EC27G
AIC1730-28	EC28	EC28P	EC28G
AIC1730-285	EC2J	EC2JP	EC2JG
AIC1730-29	EC29	EC29P	EC29G
AIC1730-30	EC30	EC30P	EC30G
AIC1730-31	EC31	EC31P	EC31G
AIC1730-32	EC32	EC32P	EC32G
AIC1730-33	EC33	EC33P	EC33G

■ **ABSOLUTE MAXIMUM RATINGS**

Supply Voltage.....	12V
Shutdown Terminal Voltage.....	12V
Noise Bypass Terminal Voltage.....	5V
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 SOT-23-5.....	130°C /W
Thermal Resistance Junction to Ambient SOT-23-5.....	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
(C_{IN}=1μF, C_{OUT}=10μF, T_J=25°C, unless otherwise specified) (Note1)

PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT	
Quiescent Current	I _{OUT} = 0mA, V _{IN} = 3.6~12V	I _Q		55	80	μA	
Standby Current	V _{IN} = 3.6~8V, output OFF	I _{STBY}			0.1	μA	
GND Pin Current	I _{OUT} = 0.1~150mA	I _{GND}		55	80	μA	
Continuous Output Current	V _{IN} = V _{OUT} + 1V	I _{OUT}			150	mA	
Output Current Limit	V _{IN} = V _{OUT} + 1V, V _{OUT} = 0V	I _{IL}	150	220		mA	
Output Voltage Tolerance	V _{IN} = V _{OUT} + 1V, no load	V _{OUT}	-2		2	%	
Temperature Coefficient		TC		50	150	ppm/°C	
Line Regulation	V _{IN} = V _{OUT(TYP)} + 1V to V _{OUT(TYP)} + 6V	ΔV _{LIR}		2	7	mV	
Load Regulation	V _{IN} = 5V, I _{OUT} = 0.1~150mA	ΔV _{LOR}		7	25	mV	
Dropout Voltage (1)	I _{OUT} = 50 mA	V _{OUT} ≥ 2.5V	V _{DROP1}		90	160	mV
	I _{OUT} = 100 mA				140	230	mV
	I _{OUT} = 150 mA				200	350	mV
Dropout Voltage (2)	I _{OUT} = 150 mA	V _{OUT} < 2.5V	V _{DROP2}			700	mV
Noise Bypass Terminal Voltage		V _{REF}		1.23		V	
Output Noise	C _{BP} = 0.1μF, f = 1KHz V _{IN} = 5V	Δn		0.46		$\frac{\mu V}{\sqrt{Hz}}$	
SHUTDOWN TERMINAL SPECIFICATIONS							
Shutdown Pin Current		I _{SHDN}			0.1	μA	
Shutdown Pin Voltage (ON)	Output ON	V _{SHDN (ON)}	1.6			V	
Shutdown Pin Voltage (OFF)	Output OFF	V _{SHDN (OFF)}			0.6	V	
Shutdown Exit Delay Time	C _{BP} = 0.1μF, C _{OUT} = 1μF, I _{OUT} = 30mA	Δt		300		μS	
THERMAL PROTECTION							
Thermal Shutdown Temperature		T _{SD}		155		°C	
Thermal Shutdown Hysteresis	Guaranteed by design	T _{HYST}		20		°C	

Note 1: Specifications are production tested at TA=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).

TYPICAL PERFORMANCE CHARACTERISTICS

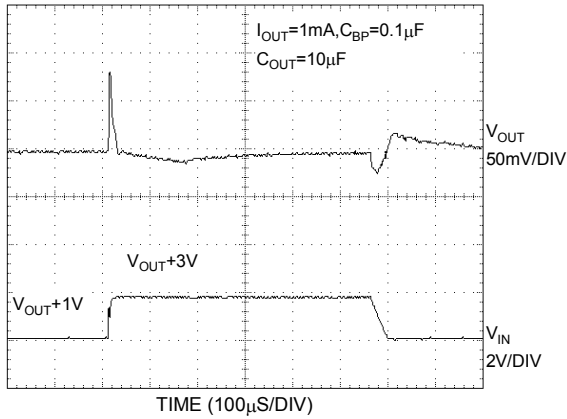


Fig. 1 Line Transient Response

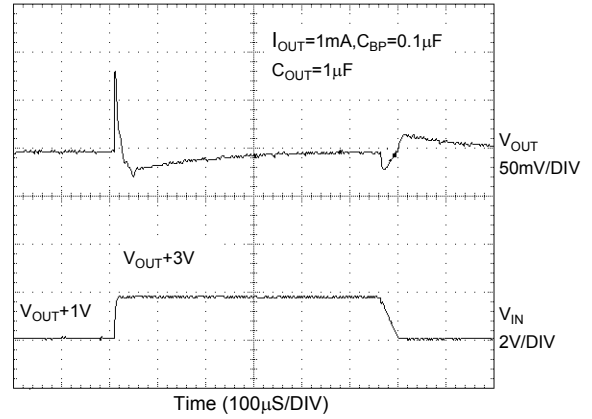


Fig. 2 Line Transient Response

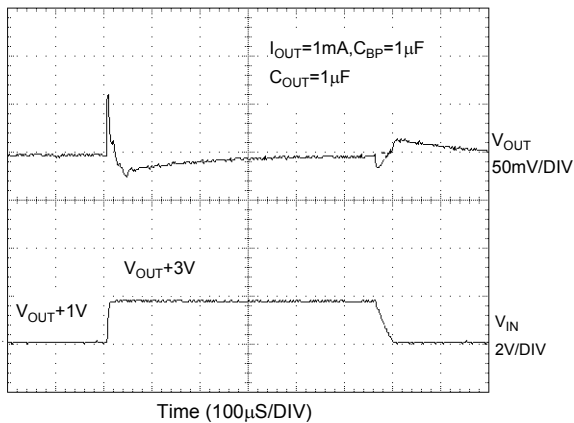


Fig. 3 Line Transient Response

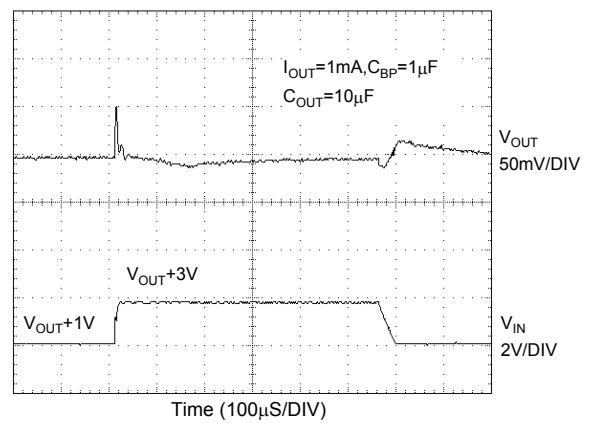


Fig. 4 Line Transient Response

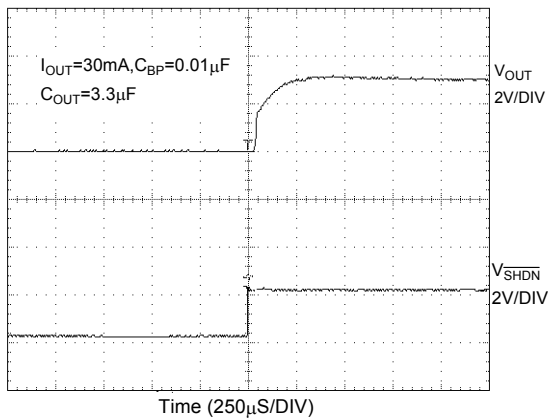


Fig. 5 Shutdown Exit Delay

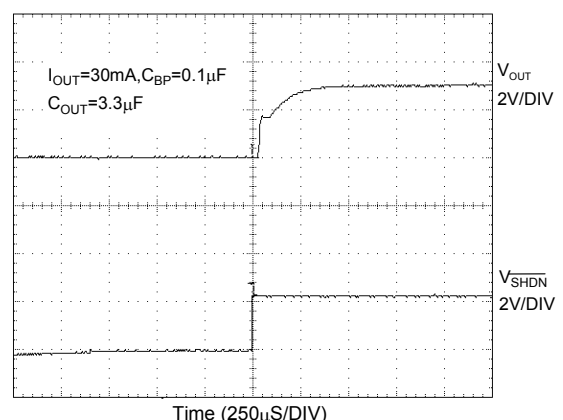


Fig. 6 Shutdown Exit Delay

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

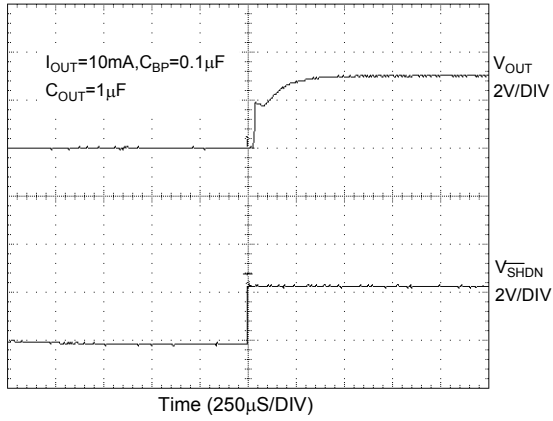


Fig. 7 Shutdown Exit Delay

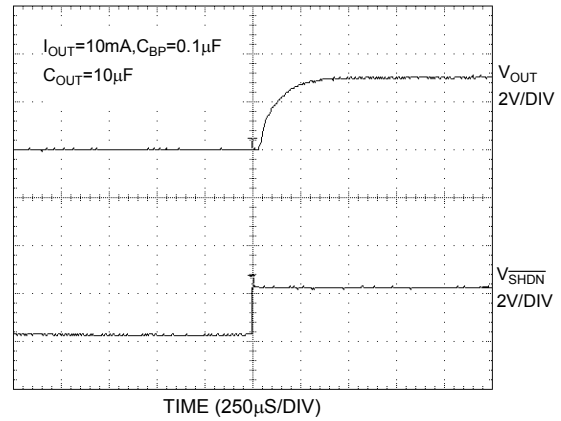


Fig. 8 Shutdown Exit Delay

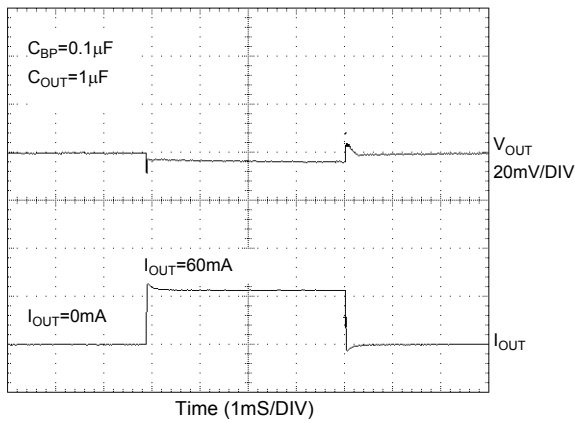


Fig. 9 Load Transient Response

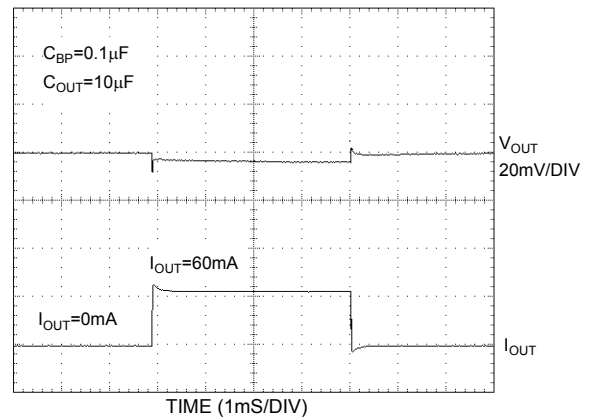


Fig. 10 Load Transient Response

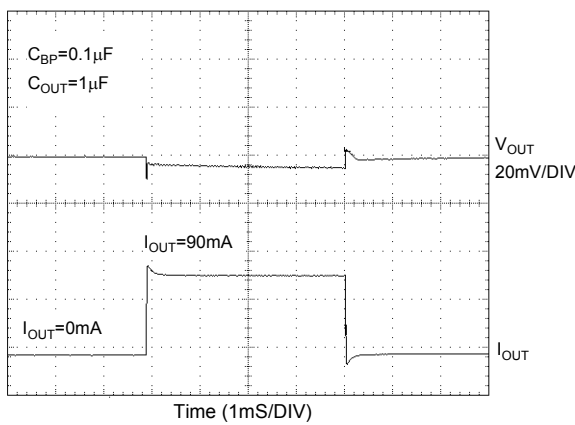


Fig. 11 Load Transient Response

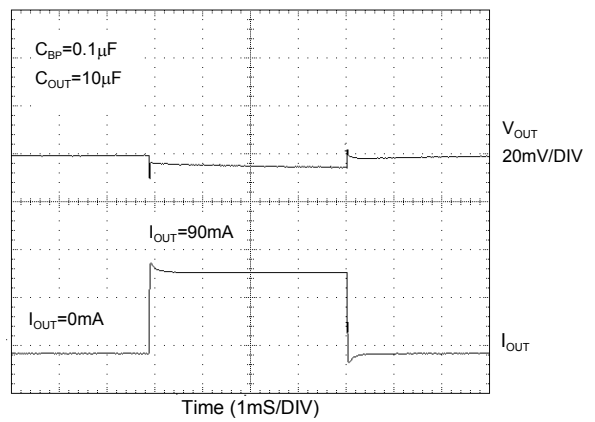


Fig. 12 Load Transient Response

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

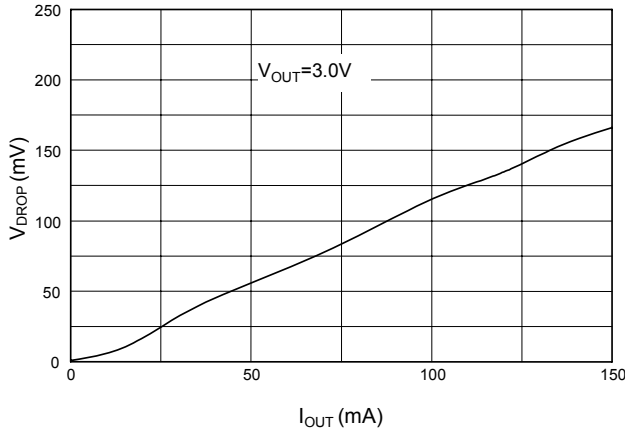


Fig. 13 Dropout Voltage vs. Output Current

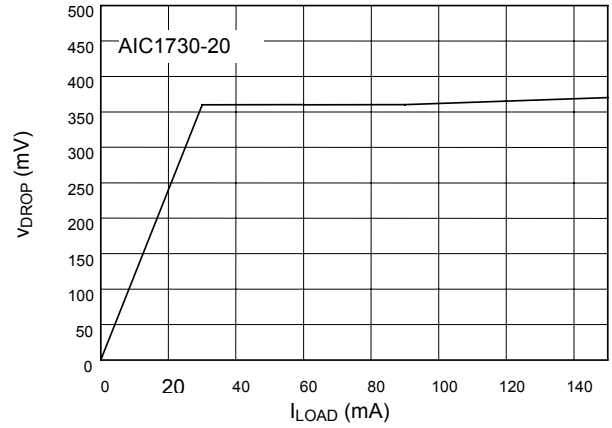


Fig. 14 Dropout Voltage vs. Output Current

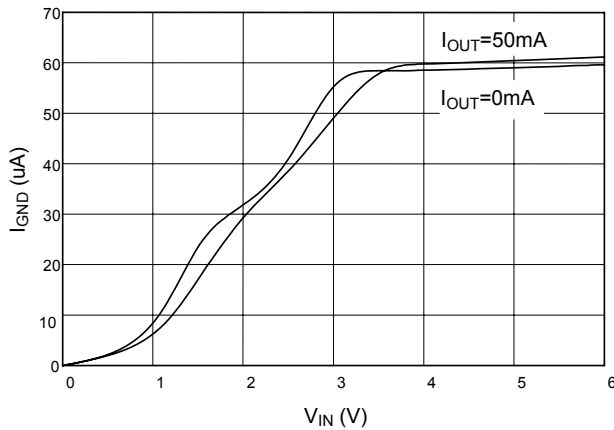


Fig. 15 Ground Current vs. Input Voltage ($V_{OUT}=3.0V$)

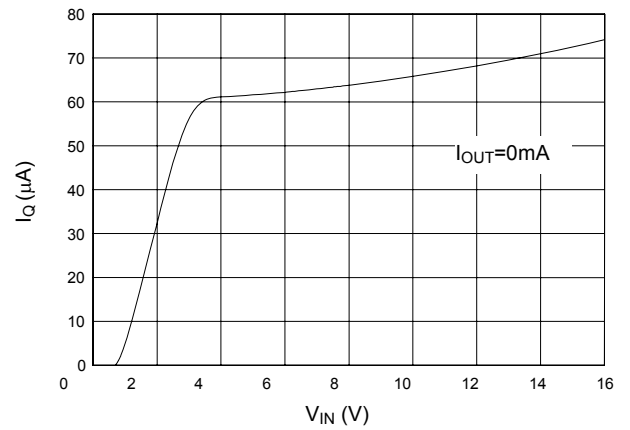


Fig. 16 Quiescent Current (ON Mode) vs. Input Voltage

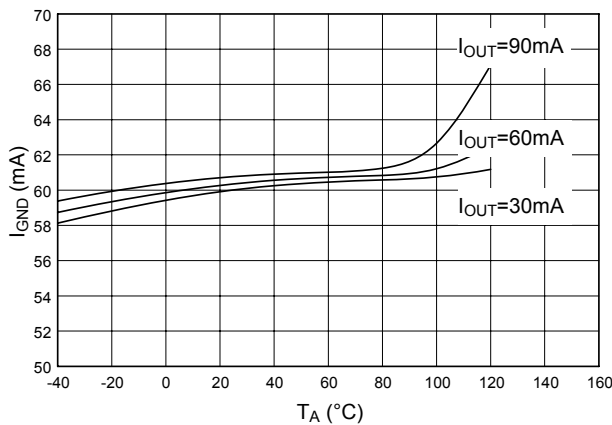


Fig. 17 Ground Current vs. Temperature

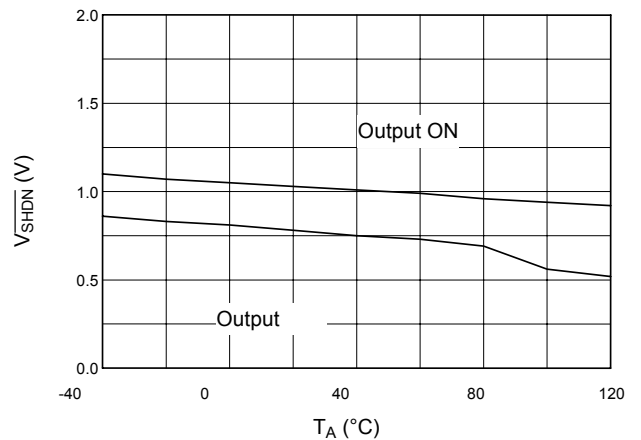


Fig. 18 Shutdown Voltage vs. Temperature

■ **TYPICAL PERFORMANCE CHARACTERISTICS (Continued)**

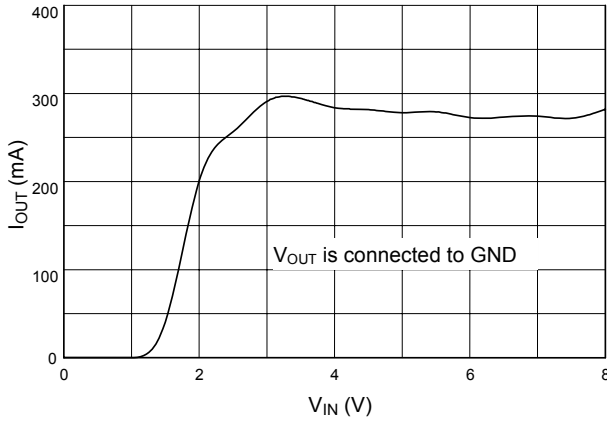


Fig. 19 Short Circuit Current vs. Input Voltage

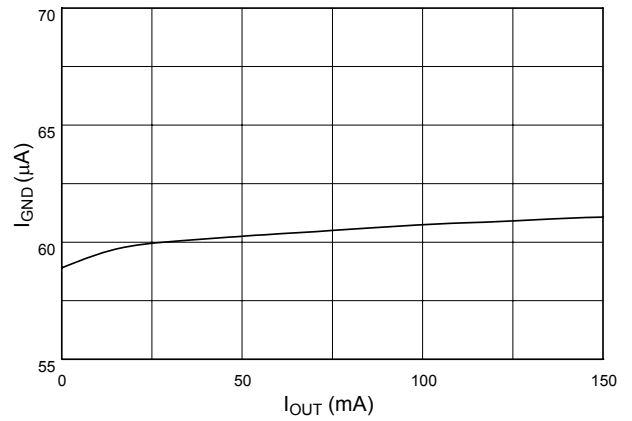
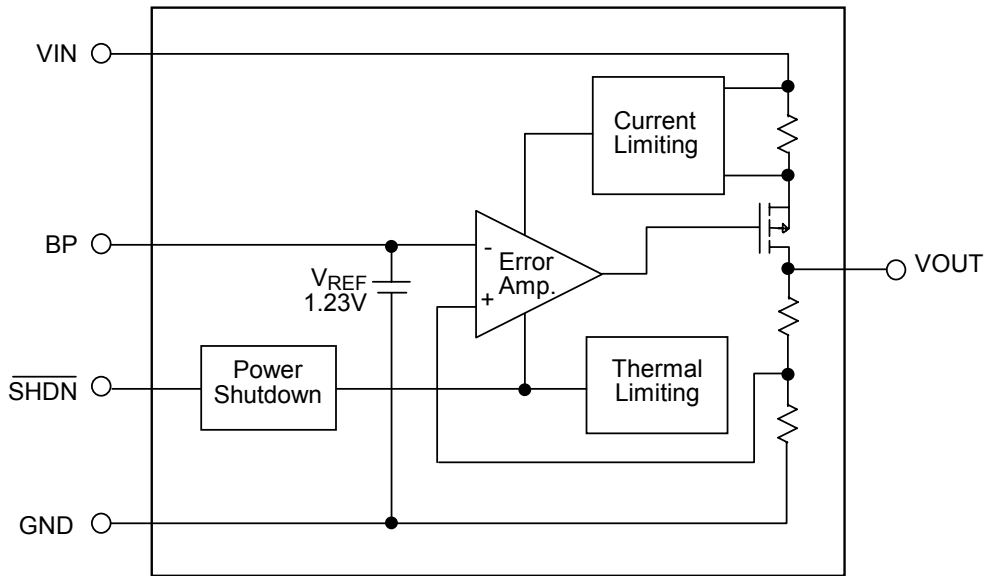


Fig. 20 Ground Current vs. Output Current

■ **BLOCK DIAGRAM**



■ PIN DESCRIPTIONS

PIN 1 : VIN - Power supply input pin. Bypass with a 1 μ F capacitor to GND

PIN 2 : GND - Ground pin.

PIN 3 : $\overline{\text{SHDN}}$ - Active-Low shutdown input pin.

PIN 4 : BP - Noise bypass pin. An external bypass capacitor connecting to

BP pin to reduce noises at the output.

PIN 5 : VOUT - 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 $V_{\text{IN}} = V_{\text{OUT}} + 1\text{V}$ to $V_{\text{IN}} = 8\text{V}$ and $I_{\text{OUT}} = 1\text{mA}$.

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 $V_{\text{IN}} = V_{\text{OUT}} + V_{\text{DROP}}$ 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 $\overline{\text{SHDN}}$ at 0V and V_{IN} at 8 V.

CURRENT LIMIT (I_{IL})

Current limiting of AIC1730 monitors and controls the maximum output current, in case of a shorted output. It protects device from the damage resulting from any unexpected current.

THERMAL PROTECTION

Thermal sensor protects device when the junction temperature exceeds $T_{\text{J}} = +155^{\circ}\text{C}$. It signals shutdown logic, turning off pass transistor and allowing IC to cool down. After the IC's junction temperature cools by 20°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 $T_{\text{J}} = 150^{\circ}\text{C}$, 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 output capacitor is recommended. And it should be selected within the Equivalent Series Resistance (ESR) range as shown in the figure 21, 22, 23, and 24. 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

$0.1\mu\text{F}$ 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.

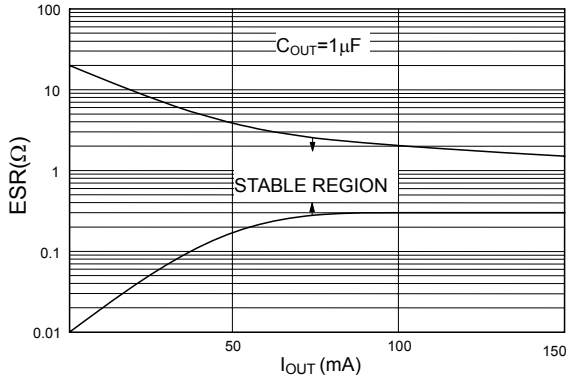


Fig. 21 Max Power Dissipation, $C_{OUT}=1\mu F$

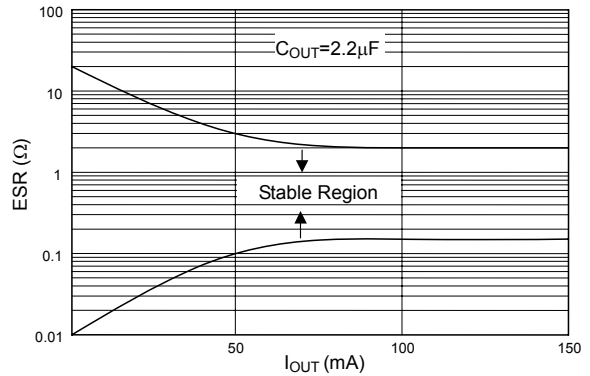


Fig. 22 Max Power Dissipation, $C_{OUT}=2.2\mu F$

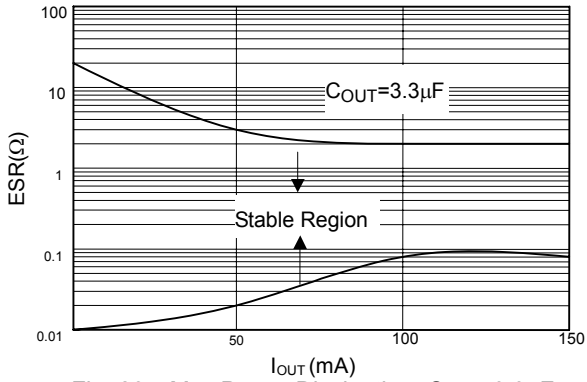


Fig. 23 Max Power Dissipation, $C_{OUT}=3.3\mu F$

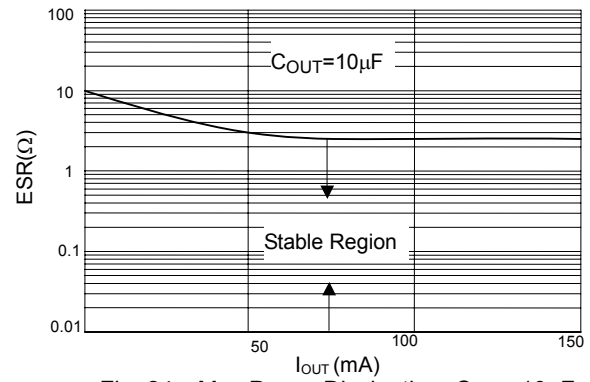
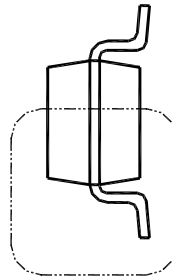
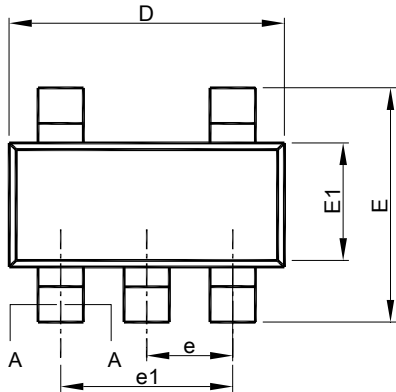


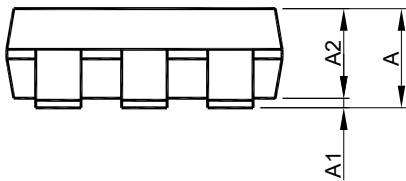
Fig. 24 Max Power Dissipation, $C_{OUT}=10\mu F$

■ PHYSICAL DIMENSIONS

● SOT-23-5 (unit: mm)



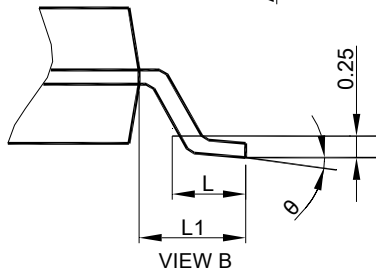
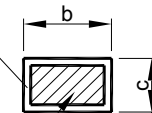
SEE VIEW B



WITH PLATING

BASE METAL

SECTION A-A



VIEW B

GAUGE PLANE
SEATING PLANE

SYMBOL	SOT-23-5	
	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	
q	0°	8°

- Note : 1. Refer to JEDEC MO-178AA.
 2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.
 3. Dimension "E1" does not include inter-lead flash or protrusions.
 4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

Note:

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