

**AIC1730**

Low Noise Low Dropout, 150mA Linear Regulator

■ FEATURES

- Available in $\pm 2\%$ Output Tolerance.
- 1.8V to 3.3V Output Voltage with 0.1V Increment.
- Active Low Shutdown Control.
- Very Low Quiescent Current.
- Very Low Dropout Voltage.
- Miniature Package (SOT-23-5 & SOT-23-6W)
- Short Circuit and Thermal Protection.
- Very Low Noise.

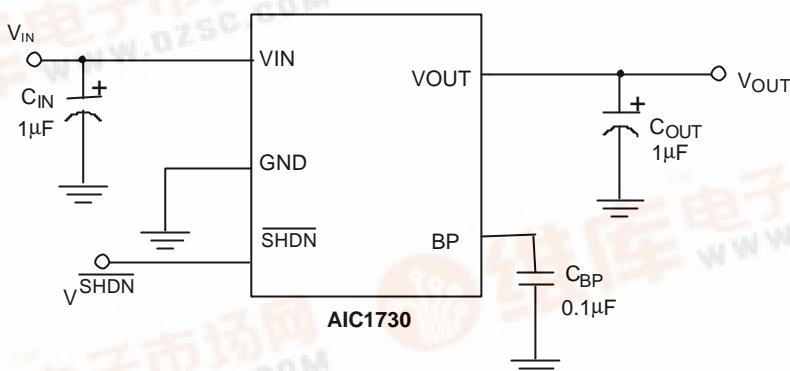
■ APPLICATIONS

- 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, housed in a small SOT-23-5 & SOT-23-6W package. The device is in the "ON" state when the SHDN pin is set to a logic high level. An internal P-MOSFET pass transistor is used to achieve a low dropout voltage of 90mV at 50mA load current. It offers high precision output voltage of $\pm 2\%$. The very low quiescent current and low dropout voltage make this device ideal for battery powered 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. An external capacitor can be connected to the noise bypass pin to reduce the output noise level.

■ TYPICAL APPLICATION CIRCUIT



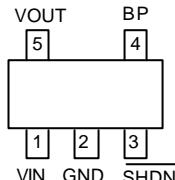
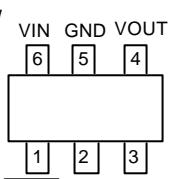
Low Noise Low Dropout Linear Regulator



AIC1730

■ ORDERING INFORMATION

AIC1730-XCX	
PACKAGE TYPE	
V: SOT-23-5	
Q: SOT-23-6W	
OUTPUT VOLTAGE	
18: 1.8V	
.	
285: 2.85V	
.	
.	
33: 3.3V	

ORDER NUMBER	PIN CONFIGURATION
AIC1730-18CV AIC1730-33CV (SOT-23-5)	FRONT VIEW  VOUT BP 5 4 1 2 3 VIN GND SHDN
AIC1730-18CQ AIC1730-33CQ (SOT-23-6W)	FRONT VIEW  VIN GND VOUT 6 5 4 1 2 3 SHDN GND BP

The output voltage is available by 0.1V per step.

■ ABSOLUTE MAXIMUM RATINGS

Supply Voltage	12V
Power Dissipation	500mW
Operating Temperature Range	-40°C~85°C
Storage Temperature Range	-65°C~150°C
Shutdown Terminal Voltage	12V
Noise Bypass Terminal Voltage	5V

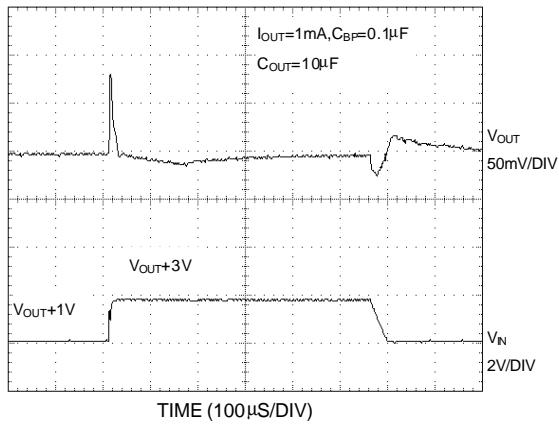
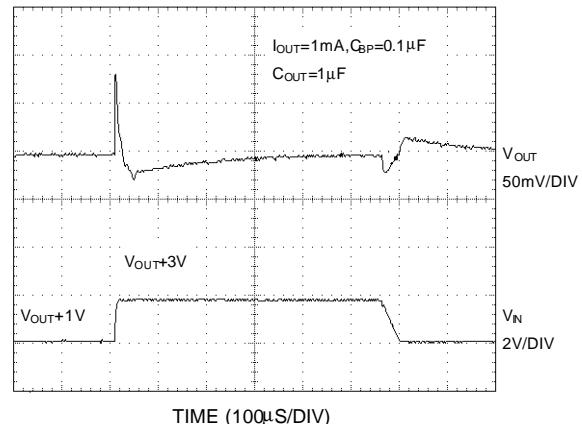
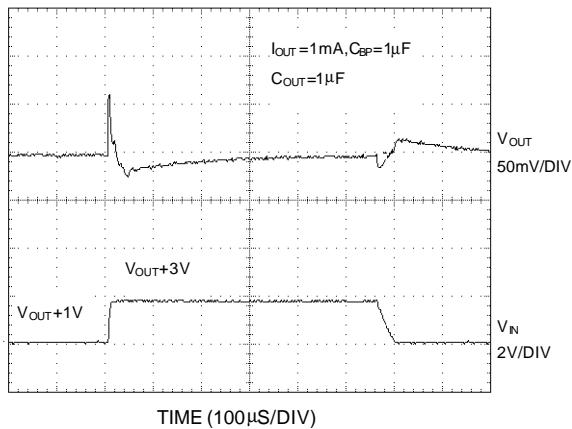
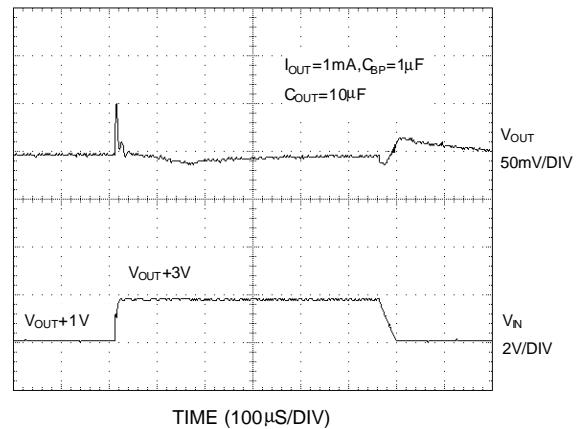
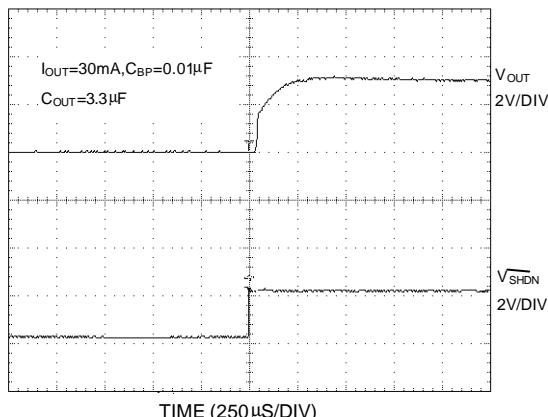
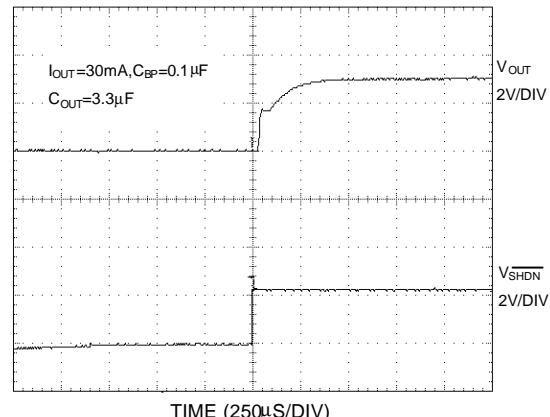


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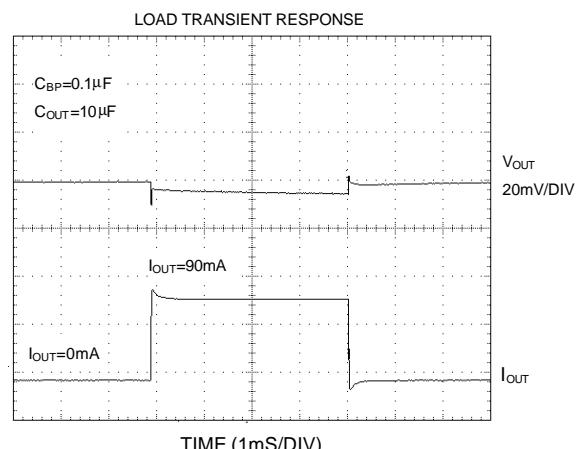
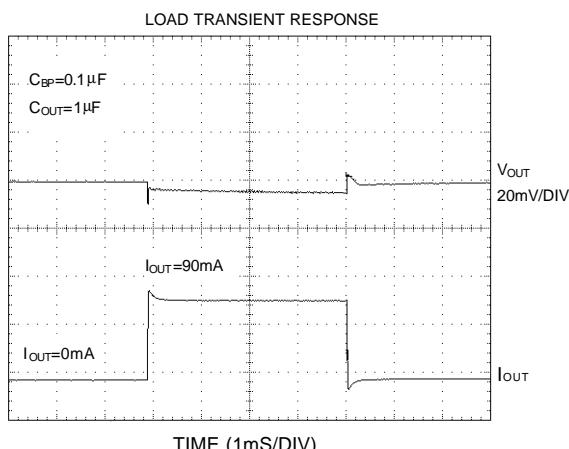
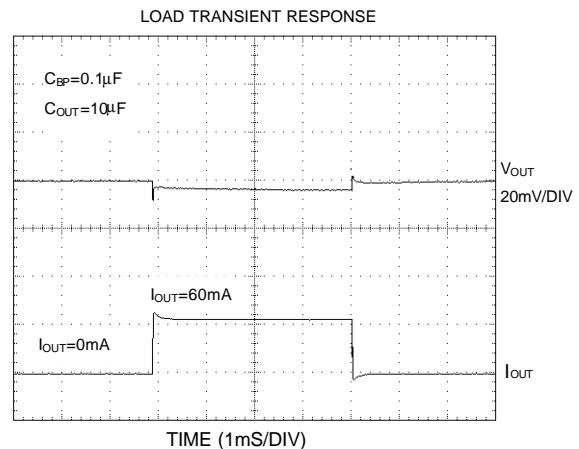
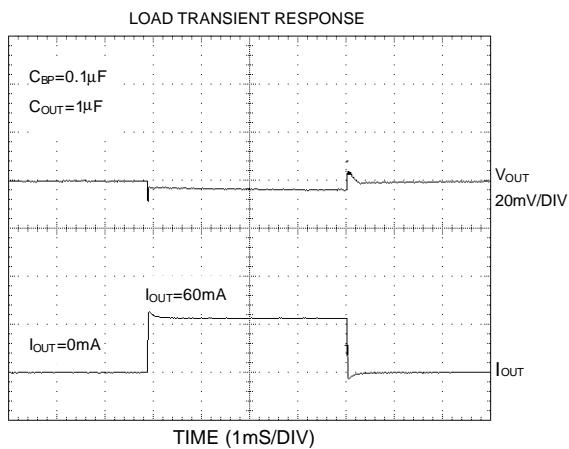
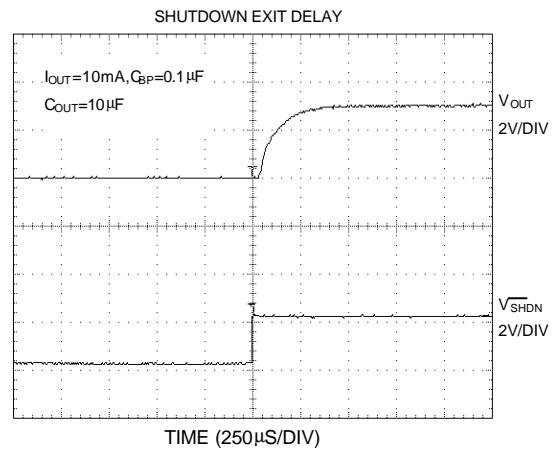
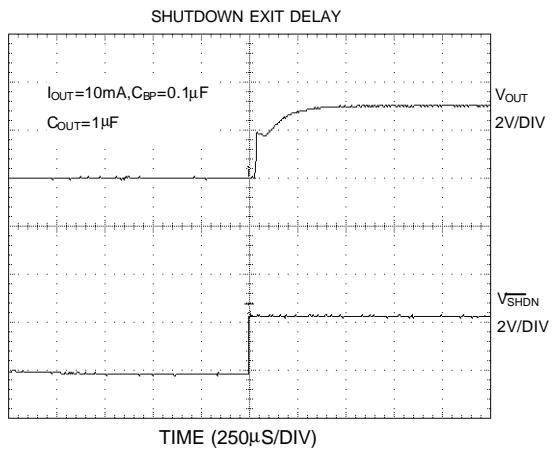
■ ELECTRICAL CHARACTERISTICS (C_{IN}=1mF, C_{OUT}=10mF, T_J=25°C, unless otherwise specified)

PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Quiescent Current	I _{OUT} = 0mA, V _{IN} = 3.6~12V	I _Q	55	80	80	µA
Standby Current	V _{IN} = 3.6~8V, output OFF	I _{STBY}		0.1	0.1	µA
GND Pin Current	I _{OUT} = 0.1~150mA	I _{GND}	55	80	80	µA
Continuous Output Current	V _{IN} = V _{OUT} + 1V	I _{OUT}		150	150	mA
Output Current Limit	V _{IN} = V _{OUT} + 1V, V _{OUT} = 0V	I _{IL}	150	220	220	mA
Output Voltage Tolerance	V _{IN} = V _{OUT} + 1V, no load	V _{OUT}	-2	2	2	%
Temperature Coefficient		TC	50	150	150	ppm/°C
Line Regulation	V _{IN} = V _{OUT(TYP)} + 1V to V _{OUT(TYP)} + 6V	ΔV _{LIR}	2	7	7	mV
Load Regulation	V _{IN} = 5V, I _{OUT} = 0.1~150mA	ΔV _{LOR}	7	25	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	1.23	1.23	V
Output Noise	C _{BP} = 0.1µF, f = 1KHz V _{IN} = 5V	?n	0.46	0.46	0.46	$\frac{mV}{\sqrt{Hz}}$
SHUTDOWN TERMINAL SPECIFICATIONS						
Shutdown Pin Current		I _{SHDN}		0.1	0.1	µA
Shutdown Pin Voltage (ON)	Output ON	V _{SHDN} (ON)	1.6	1.6	1.6	V
Shutdown Pin Voltage (OFF)	Output OFF	V _{SHDN} (OFF)		0.6	0.6	V
Shutdown Exit Delay Time	C _{BP} = 0.1µF, C _{OUT} = 1µF, I _{OUT} = 30mA	t	300	300	300	µS
THERMAL PROTECTION						
Thermal Shutdown Temperature		T _{SD}	155	155	155	°C

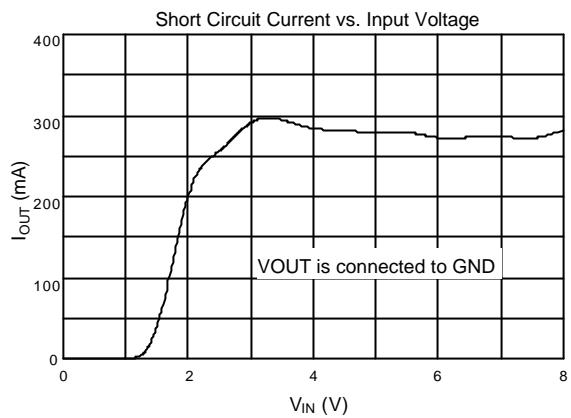
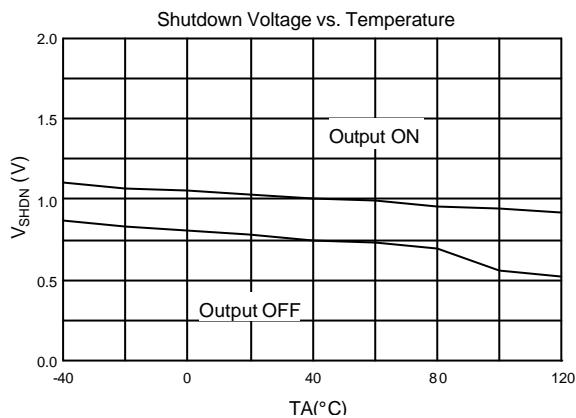
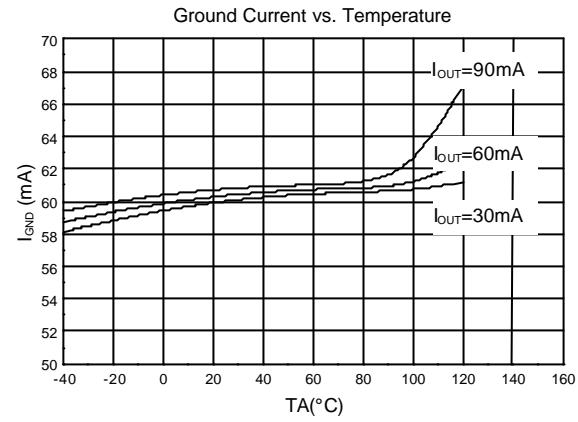
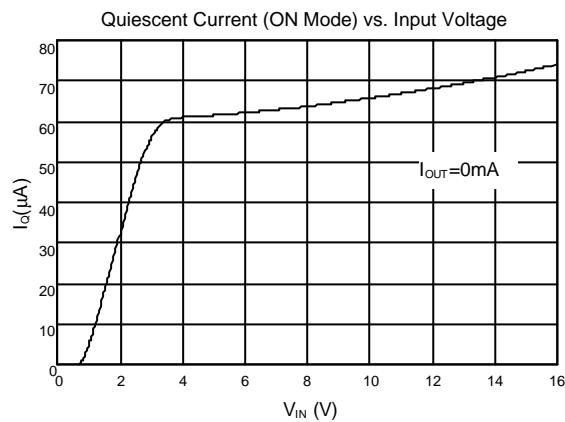
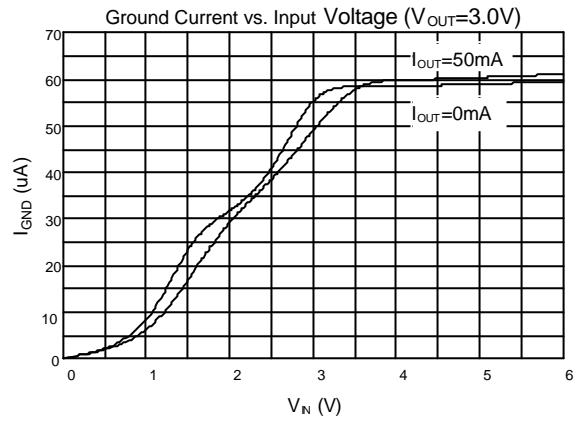
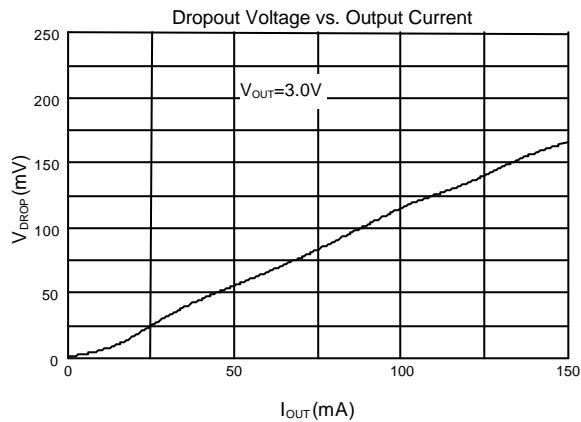
■ TYPICAL PERFORMANCE CHARACTERISTICS

LINE TRANSIENT RESPONSE

LINE TRANSIENT RESPONSE

LINE TRANSIENT RESPONSE

LINE TRANSIENT RESPONSE

SHUTDOWN EXIT DELAY

SHUTDOWN EXIT DELAY


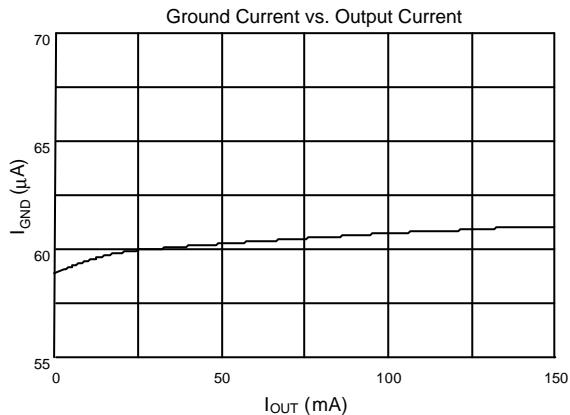
■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)



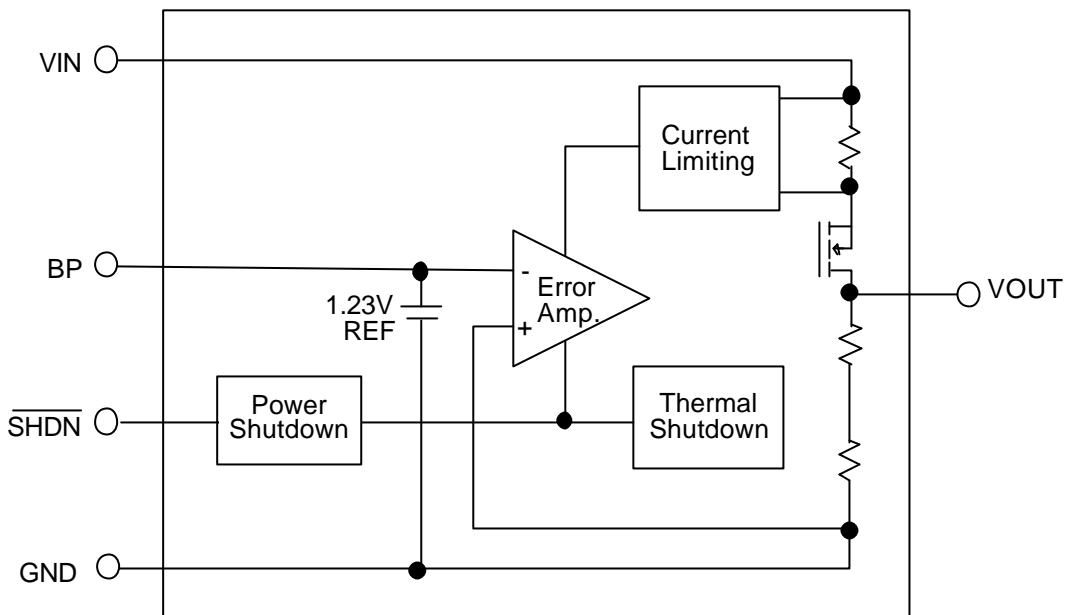
■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)



■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)



■ BLOCK DIAGRAM



■ PIN DESCRIPTIONS

SOT-23-5

PIN 1 : VIN - Power supply input pin. Bypass with a $1\mu\text{F}$ capacitor to GND

PIN 2 : GND - Ground pin. This pin also functions as a heatsink. To maximize power dissipation, use of a large pad or the circuit-board ground plane is recommended.

PIN 3 : SHDN - Active-Low shutdown input pin.

PIN 4 : BP - Noise bypass pin. An external bypass capacitor connected to the BP pin reduces noises at the output.

PIN 5 : VOUT - Output pin. Sources up to 150 mA.

SOT-23-6W

PIN 1 : SHDN - Active-Low shutdown input pin.

PIN 2 : GND - Ground pin. This pin also functions as a heatsink. To maximize power dissipation, use of a large pad or the circuit-board ground plane is recommended.

PIN 3 : BP - Noise bypass pin. An external bypass capacitor connected to the BP pin reduces noises at the output.

PIN 4 : VOUT - Output pin. Sources up to 150 mA.

PIN 5 : GND - Ground pin. This pin also functions as a heatsink. To maximize power dissipation, use of a large pad or the circuit-board ground plane is recommended.

PIN 6 : VIN - Power supply input pin. Bypass with a $1\mu\text{F}$ capacitor to GND

■ DETAILED DESCRIPTION OF TECHNICAL TERMS

OUTPUT VOLTAGE (V_{OUT})

The AIC1730 provides factory-set output voltages from 1.8V to 3.3V, in 100mV increments. The output voltage is specified with $V_{\text{IN}} = V_{\text{OUT}} \text{ (TYP)} + 1\text{V}$ and $I_{\text{OUT}} = 0\text{mA}$

DROPOUT VOLTAGE (V_{DROP})

The dropout voltage is defined as the difference between the input voltage and output voltage at which point the regulator starts to fall out of regulation. Below this value, the output voltage will

fall as the input voltage is reduced. It depends on the load current and junction temperature. The dropout voltage is specified at which the output voltage drops 100mV below the value measured with a 1V difference.

CONTINUOUS OUTPUT CURRENT (I_{OUT})

Normal rated output current. This is limited by package power dissipation.

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 is changed from $V_{IN} = V_{OUT} + 1$ V to $V_{IN} = V_{OUT} + 6$ V and $I_{OUT} = 1$ mA.

LOAD REGULATION

Load regulation is the ability of the regulator to maintain a constant output voltage as the load current changes. To minimize temperature effects, it is a pulsed measurement with the input voltage set to $V_{IN} = V_{OUT} + 1$ V. The load regulation is specified under the output current step of 0.1mA to 150mA.

QUIESCENT CURRENT (I_Q)

The quiescent current is the current flowing through the ground pin under no load.

GROUND CURRENT (I_{GND})

Ground current is the current flowing through the ground pin under loading.

STANDBY CURRENT (I_{STBY})

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

CURRENT LIMIT (I_{IL})

The AIC1730 include a current limiter, which monitors and controls the maximum output current to be 300mA typically if the output is shorted to ground. This can protect the device from being damaged.

THERMAL PROTECTION

The thermal sensor protects the device when the junction temperature exceeds $T_J = +155^\circ$ C. It signals the shutdown logic, turning off the pass transistor and allowing the IC to cool. After the IC's junction temperature cools by 15° C, the thermal sensor will turn on the pass transistor again. Thermal protection is designed to protect the device in the event of fault conditions. For 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. The recommended minimum value of input capacitor is 0.22μ F. The output capacitor should be selected within the Equivalent Series Resistance (ESR) range shown in the graphs below for stability. Because the ceramic capacitor's ESR is lower and its electrical characteristics (capacitance and ESR) vary widely over temperature, a tantalum output capacitor is recommended, especially for heavier load. In general, the capacitor should be at least 1μ F(tantalum) and be rated for the actual ambient operating temperature range.

Note: It is very important to check the selected manufacturers' electrical characteristics (capacitance and ESR) over temperature.

NOISE BYPASS CAPACITOR

Use a $0.1\mu\text{F}$ bypass capacitor at BP for low output voltage noise. Increasing the capacitance such as $1\mu\text{F}$ will decrease the output noise, however, values above $1\mu\text{F}$ provide no performance advantage and are not recommended.

POWER DISSIPATION

The maximum power dissipation of AIC1730 depends on the thermal resistance of the case and circuit board, the temperature difference between the die junction and ambient air, and the rate of air flow. 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 will be low even if the power dissipation is great.

The power dissipation across the device is $P = I_{\text{OUT}}(V_{\text{IN}} - V_{\text{OUT}})$.

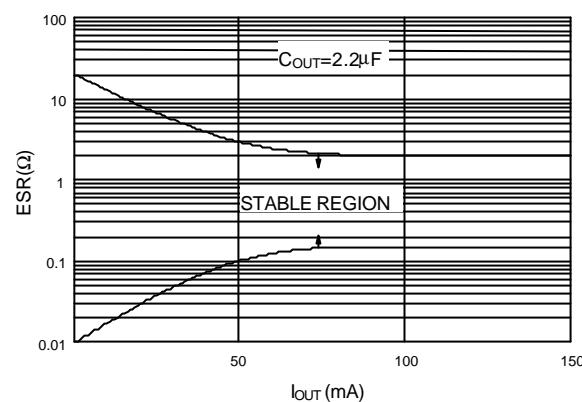
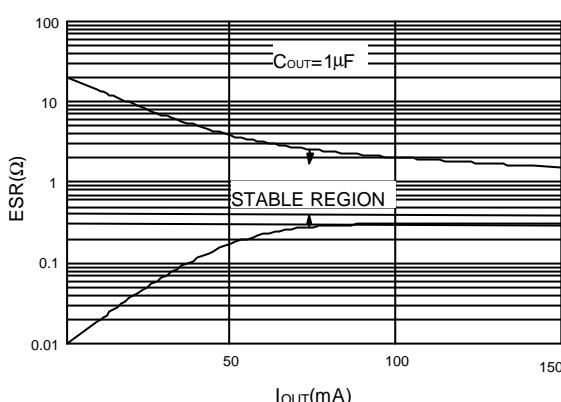
The maximum power dissipation is:

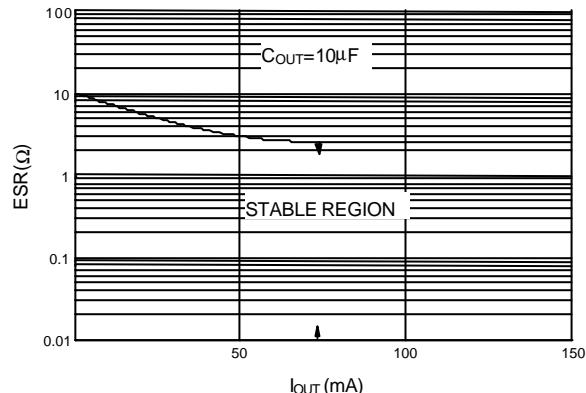
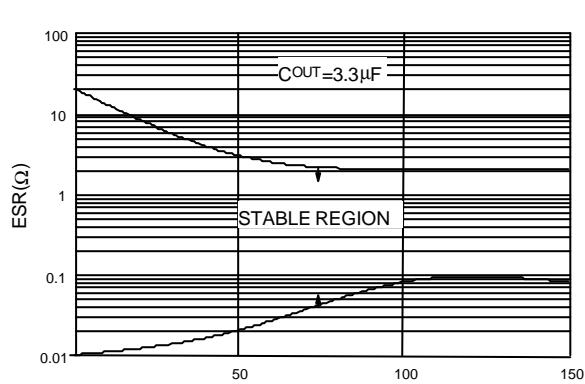
$$P_{\text{MAX}} = (T_J - T_A) / (\theta_{\text{JB}} + \theta_{\text{BA}})$$

where $T_J - T_A$ is the temperature difference between the die junction and the surrounding air, θ_{JB} is the thermal resistance of the package, and θ_{BA} is the thermal resistance through the PCB, copper traces, and other materials to the surrounding air.

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

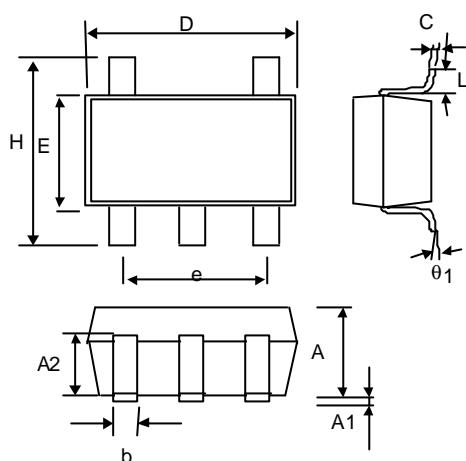
The GND pin performs the dual function of providing an electrical connection to ground and channeling heat away. Therefore, connecting the GND pin to ground with a large pad or ground plane would increase the power dissipation and reduce the device temperature.





■ PACKAGE DIMENSIONS

- SOT-23-5 (unit: mm)



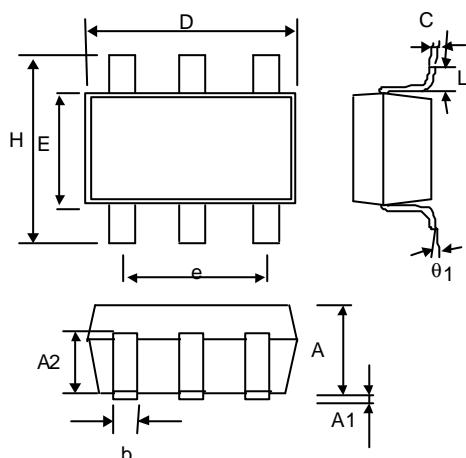
SYMBOL	MIN	MAX
A	1.00	1.30
A1	—	0.10
A2	0.70	0.90
b	0.35	0.50
C	0.10	0.25
D	2.70	3.10
E	1.40	1.80
e	1.90 (TYP)	—
H	2.60	3.00
L	0.37	—
θ1	1°	9°

- SOT-23-5 Marking

Part No.	Marking
AIC1730-18CV	EC18
AIC1730-19CV	EC19
AIC1730-20CV	EC20
AIC1730-21CV	EC21
AIC1730-22CV	EC22
AIC1730-23CV	EC23
AIC1730-24CV	EC24
AIC1730-25CV	EC25
AIC1730-26CV	EC26

Part No.	Marking
AIC1730-27CV	EC27
AIC1730-28CV	EC28
AIC1730-285CV	EC2J
AIC1730-29CV	EC29
AIC1730-30CV	EC30
AIC1730-31CV	EC31
AIC1730-32CV	EC32
AIC1730-33CV	EC33

- **SOT-23-6W (unit: mm)**



SYMBOL	MIN	MAX
A	1.00	1.30
A1	—	0.10
A2	0.70	0.90
b	0.35	0.50
C	0.10	0.25
D	2.70	3.10
E	1.60	2.00
e	1.90 (TYP)	—
H	2.60	3.00
L	0.37	—
θ ₁	1°	9°

- **SOT-23-6W Marking**

Part No.	Marking
AIC1730-18CQ	EB18
AIC1730-19CQ	EB19
AIC1730-20CQ	EB20
AIC1730-21CQ	EB21
AIC1730-22CQ	EB22
AIC1730-23CQ	EB23
AIC1730-24CQ	EB24
AIC1730-25CQ	EB25
AIC1730-26CQ	EB26

Part No.	Marking
AIC1730-27CQ	EB27
AIC1730-28CQ	EB28
AIC1730-285CQ	EB2J
AIC1730-29CQ	EB29
AIC1730-30CQ	EB30
AIC1730-31CQ	EB31
AIC1730-32CQ	EB32
AIC1730-33CQ	EB33