Advanced Analog Circuits

1A ULTRA LOW DROPOUT LINEAR REGULATOR AZ2940

General Description

The AZ2940 is a low dropout three-terminal regulator with a typical dropout of 280mV at 1A output current.

The AZ2940 provides current limit and thermal shutdown. On-chip thermal shutdown provides protection against any combination of high current and ambient temperature that would create excessive junction temperatures.

The AZ2940 has 2.5V, 3.3V and 5.0V versions.

The AZ2940 is available in the industry standard TO-220-3, TO-263-3 and TO-252-2 (1) power packages.

Features

- Minimum Guaranteed Output Current: 1A
- Dropout Voltage at I_{OUT}=1A: 280mV
- Output Accuracy: ± 1%
- Low Ground Current
- Internal Current Limit and Thermal Protection
- Reversed-battery and Reversed-lead Insertion Protection
- Fast Transient Response

Applications

- LCD TV
- Set Top Box
- LCD Monitor
- SMPS Post Regulator
- Laptop, Palmtop and Notebook
- Portable Instrumentation
- USB Power Supply

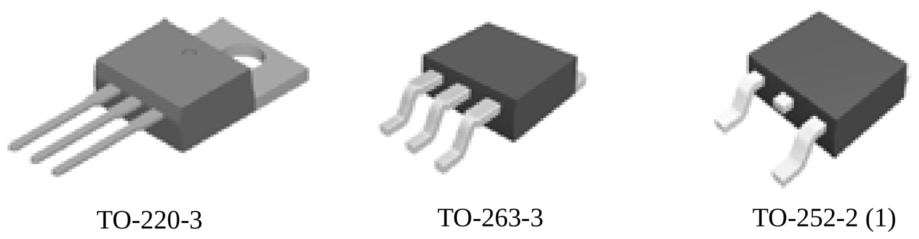


Figure 1. Package Types of AZ2940

Pin Configuration

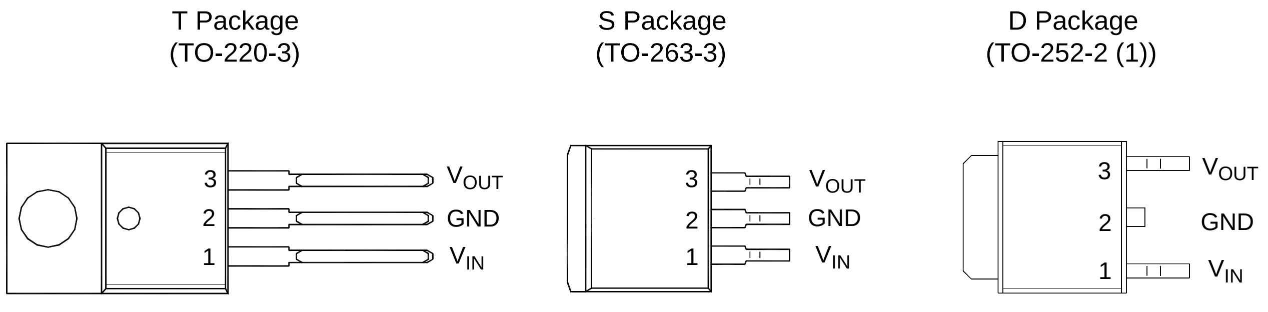


Figure 2. Pin Configuration of AZ2940 (Top View)

Pin Description

Pin Number	Pin Name	Function
1	V_{IN}	Unregulated Input.
2	GND	Ground pin. This pin and TAB are internally connected.
3	V_{OUT}	Regulated Output.

Functional Block Diagram

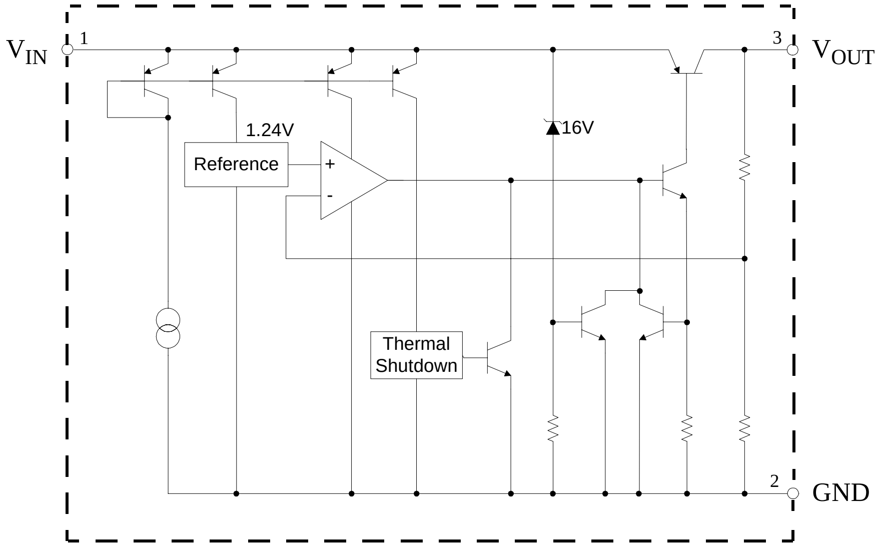
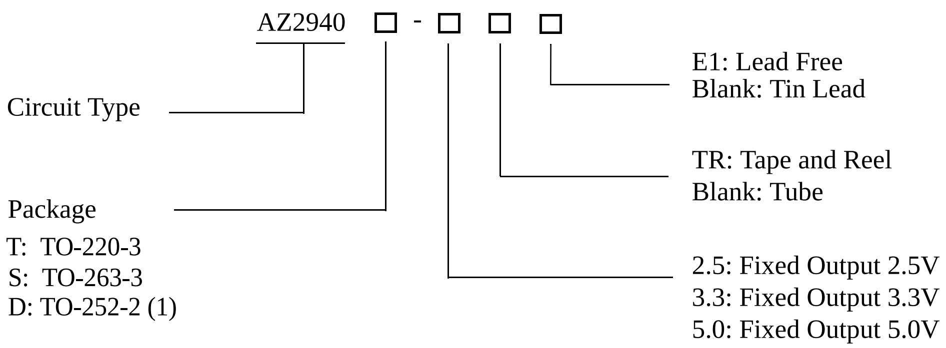


Figure 3. Functional Block Diagram of AZ2940

Ordering Information



Package	Temperature Range	Part Number		Marking ID		Packing Type
		Tin Lead	Lead Free	Tin Lead	Lead Free	
TO-220-3	-40 to 125°C	AZ2940T-2.5	AZ2940T-2.5E1	AZ2940T-2.5	AZ2940T-2.5E1	Tube
		AZ2940T-3.3	AZ2940T-3.3E1	AZ2940T-3.3	AZ2940T-3.3E1	Tube
		AZ2940T-5.0	AZ2940T-5.0E1	AZ2940T-5.0	AZ2940T-5.0E1	Tube
TO-263-3	-40 to 125°C	AZ2940S-2.5	AZ2940S-2.5E1	AZ2940S-2.5	AZ2940S-2.5E1	Tube
		AZ2940S-2.5TR	AZ2940S-2.5TRE1	AZ2940S-2.5	AZ2940S-2.5E1	Tape & Reel
		AZ2940S-3.3	AZ2940S-3.3E1	AZ2940S-3.3	AZ2940S-3.3E1	Tube
		AZ2940S-3.3TR	AZ2940S-3.3TRE1	AZ2940S-3.3	AZ2940S-3.3E1	Tape & Reel
		AZ2940S-5.0	AZ2940S-5.0E1	AZ2940S-5.0	AZ2940S-5.0E1	Tube
		AZ2940S-5.0TR	AZ2940S-5.0TRE1	AZ2940S-5.0	AZ2940S-5.0E1	Tape & Reel
TO-252-2 (1)	-40 to 125°C	AZ2940D-2.5	AZ2940D-2.5E1	AZ2940D-2.5	AZ2940D-2.5E1	Tube
		AZ2940D-2.5TR	AZ2940D-2.5TRE1	AZ2940D-2.5	AZ2940D-2.5E1	Tape & Reel
		AZ2940D-3.3	AZ2940D-3.3E1	AZ2940D-3.3	AZ2940D-3.3E1	Tube
		AZ2940D-3.3TR	AZ2940D-3.3TRE1	AZ2940D-3.3	AZ2940D-3.3E1	Tape & Reel
		AZ2940D-5.0	AZ2940D-5.0E1	AZ2940D-5.0	AZ2940D-5.0E1	Tube
		AZ2940D-5.0TR	AZ2940D-5.0TRE1	AZ2940D-5.0	AZ2940D-5.0E1	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant.

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value		Unit
Input Voltage	V_{IN}	16		V
Operating Junction Temperature	T_J	150		^oC
Storage Temperature Range	T_{STG}	-65 to 150		^oC
Lead Temperature (Soldering, 10sec)	T_{LEAD}	260		^oC
Thermal Resistance	θ_{JA}	TO-220-3	60	$^oC/W$
		TO-263-3	60	
		TO-252-2 (1)	100	
ESD (Human Body Model)	ESD	5000		V
ESD (Machine Model)	ESD	300		V

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Input Voltage	V_{IN}		13.2	V
Operating Junction Temperature	T_J	-40	125	^oC

Electrical Characteristics

AZ2940-2.5 Electrical Characteristics

Operating Conditions: V_{IN}=3.5V, I_{OUT}=10mA, C_{IN}=10μF, C_{OUT}=10μF, T_J=25^oC, unless otherwise specified. The **Boldface** applies over -40^{o}C≤T_J≤125^{o}C.

Parameter	Symbol	Condition		Min	Typ	Max	Unit
Output Voltage	V_{OUT}	I_{OUT}=10mA		2.475	2.5	2.525	V
		10mA≤I_{OUT}≤1A, 3.5V≤V_{IN}≤13.2V		**2.45**	**2.5**	**2.55**	V
Line Regulation	V_{RLINE}	I_{OUT}=10mA, 3.5V≤V_{IN}≤13.2V			5.0	25	mV
Load Regulation	V_{RLOAD}	V_{IN}=3.5V, 10mA≤I_{OUT}≤1A			7.5	37.5	mV
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	I_{OUT}=10mA			**50**	**250**	μV/^{o}C
Dropout Voltage (Note 2)	V_{DROP}	ΔV_{OUT}=1%	I_{OUT}=100mA		70	**200**	mV
			I_{OUT}=1A		280	**550**	mV
Ground Current	I_{GND}	V_{IN}=3.5V	I_{OUT}=750mA		12	**25**	mA
			I_{OUT}=1A		18		mA
Short Circuit Current	I_{SC}	V_{OUT}=0V (Note 3)		1.5	2.2		A
Minimum Load Current	$I_{LOAD\ (MIN)}$				1	5	mA
Output Noise Voltage (rms)		10Hz to 100KHz, I_{OUT}=100mA, C_{OUT}=10μF			400		μV

Note 2: Dropout voltage is defined as the input-to-output differential when the output voltage drops to 99% of its nominal value which is measured at V_{OUT}+1V applied to V_{IN}.

Note 3: V_{IN}=$V_{OUT(NOMINAL)}$+1V.

Electrical Characteristics (Continued)

AZ2940-3.3 Electrical Characteristics

Operating Conditions: V_{IN}=4.3V, I_{OUT}=10mA, C_{IN}=10μF, C_{OUT}=10μF, T_J=25^{o}C, unless otherwise specified. The **Boldface** applies over -40^{o}C≤T_J≤125^{o}C.

Parameter	Symbol	Condition		Min	Typ	Max	Unit
Output Voltage	V_{OUT}	I_{OUT}=10mA		3.27	3.3	3.33	V
		10mA≤I_{OUT}≤1A, 4.3V≤V_{IN}≤13.2V		**3.23**	**3.3**	**3.37**	V
Line Regulation	V_{RLINE}	I_{OUT}=10mA, 4.3V≤V_{IN}≤13.2V			6.6	33	mV
Load Regulation	V_{RLOAD}	V_{IN}=4.3V, 10mA≤I_{OUT}≤1A			9.9	50	mV
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	I_{OUT}=10mA			**66**	**330**	μV/^{o}C
Dropout Voltage (Note 2)	V_{DROP}	ΔV_{OUT}=1%	I_{OUT}=100mA		70	**200**	mV
			I_{OUT}=1A		280	**550**	mV
Ground Current	I_{GND}	V_{IN}=4.3V	I_{OUT}=750mA		12	**25**	mA
			I_{OUT}=1A		18		mA
Short Circuit Current	I_{SC}	V_{OUT}=0V (Note 3)		1.5	2.2		A
Minimum Load Current	$I_{LOAD\ (MIN)}$				1	5	mA
Output Noise Voltage (rms)		10Hz to 100KHz, I_{OUT}=100mA, C_{OUT}=10μF			400		μV

Note 2: Dropout voltage is defined as the input-to-output differential when the output voltage drops to 99% of its nominal value which is measured at V_{OUT}+1V applied to V_{IN}.

Note 3: V_{IN}=$V_{OUT(NOMINAL)}$+1V.

Electrical Characteristics (Continued)

AZ2940-5.0 Electrical Characteristics

Operating Conditions: V_{IN}=6V, I_{OUT}=10mA, C_{IN}=10μF, C_{OUT}=10μF, T_J=25^{o}C, unless otherwise specified. The **Boldface** applies over -40^{o}C≤T_J≤125^{o}C.

Parameter	Symbol	Condition		Min	Typ	Max	Unit
Output Voltage	V_{OUT}	I_{OUT}=10mA		4.95	5.0	5.05	V
		10mA≤I_{OUT}≤1A, 6V≤V_{IN}≤13.2V		**4.90**	**5.0**	**5.10**	V
Line Regulation	V_{RLINE}	I_{OUT}=10mA, 6V≤V_{IN}≤13.2V			10	50	mV
Load Regulation	V_{RLOAD}	V_{IN}=6V, 10mA≤I_{OUT}≤1A			15	75	mV
Output Voltage Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	I_{OUT}=10mA			**100**	**500**	μV/^{o}C
Dropout Voltage (Note 2)	V_{DROP}	ΔV_{OUT}=1%	I_{OUT}=100mA		70	**200**	mV
			I_{OUT}=1A		280	**550**	mV
Ground Current	I_{GND}	V_{IN}=6V	I_{OUT}=750mA		12	**25**	mA
			I_{OUT}=1A		18		mA
Short Circuit Current	I_{SC}	V_{OUT}=0V (Note 3)		1.5	2.2		A
Minimum Load Current	$I_{LOAD\ (MIN)}$				1	5	mA
Output Noise Voltage (rms)		10Hz to 100KHz, I_{OUT}=100mA, C_{OUT}=10μF			400		μV

Note 2: Dropout voltage is defined as the input-to-output differential when the output voltage drops to 99% of its nominal value which is measured at V_{OUT}+1V applied to V_{IN}.

Note 3: V_{IN}=$V_{OUT(NOMINAL)}$+1V.

Typical Performance Characteristics

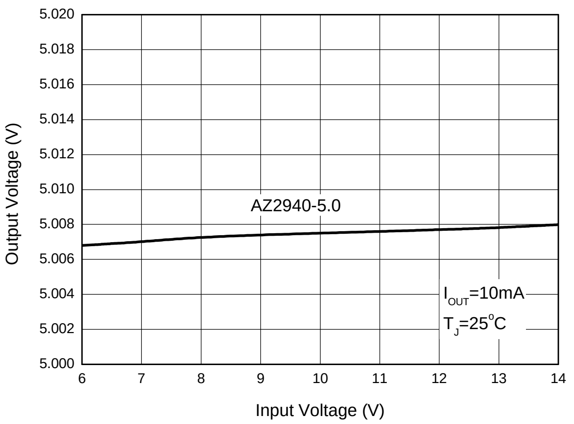


Figure 4. Line Regulation

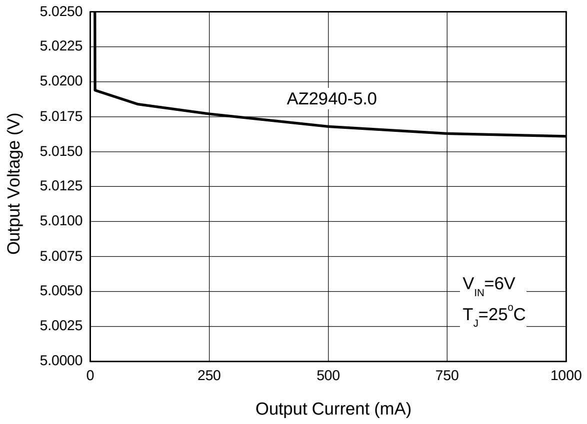


Figure 5. Load Regulation

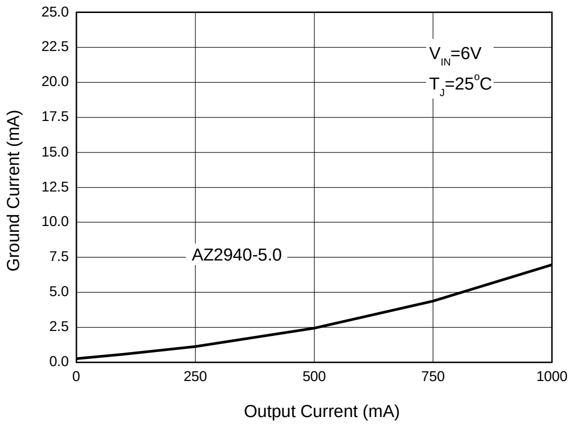


Figure 6. Ground Current vs. Output Current

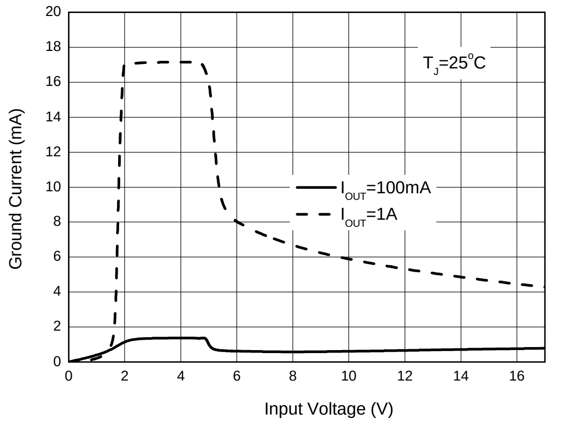


Figure 7. Ground Current vs. Input Voltage

Typical Performance Characteristics (Continued)

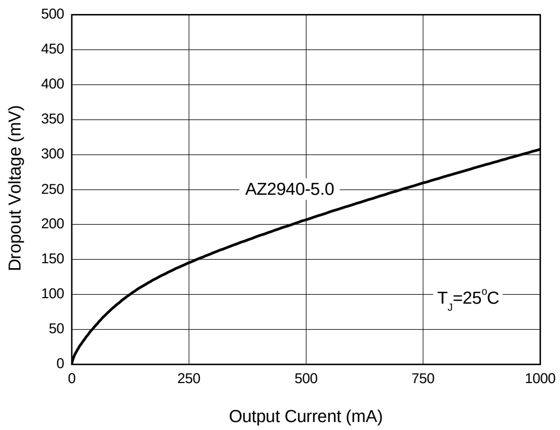


Figure 8. Dropout Voltage vs. Output Current

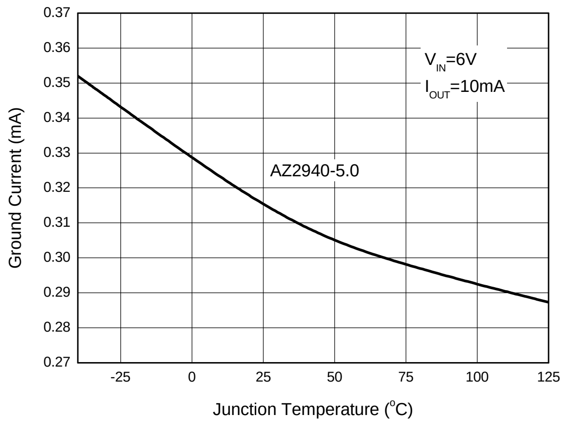


Figure 9. Ground Current vs. Junction Temperature

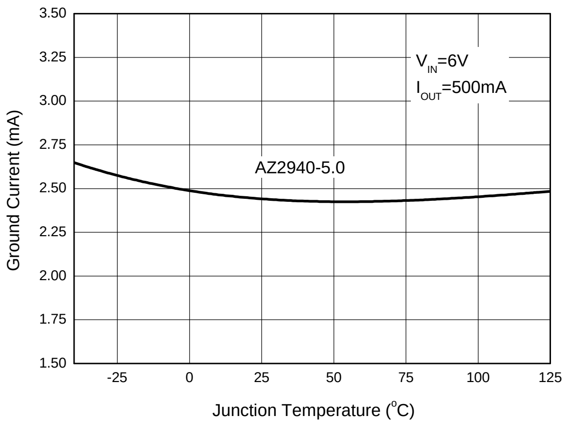


Figure 10. Ground Current vs. Junction Temperature

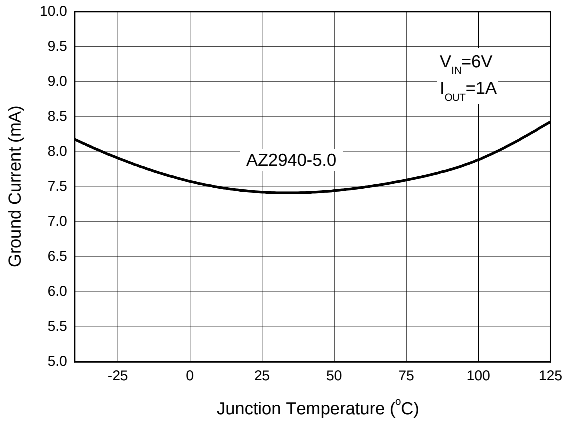


Figure 11. Ground Current vs. Junction Temperature

Typical Performance Characteristics (Continued)

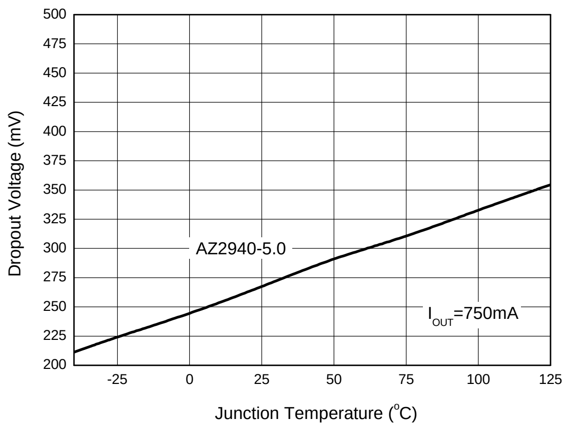


Figure 12. Dropout Voltage vs. Junction Temperature

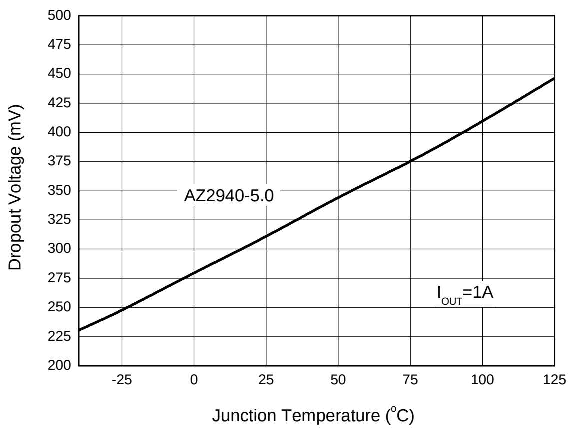


Figure 13. Dropout Voltage vs. Junction Temperature

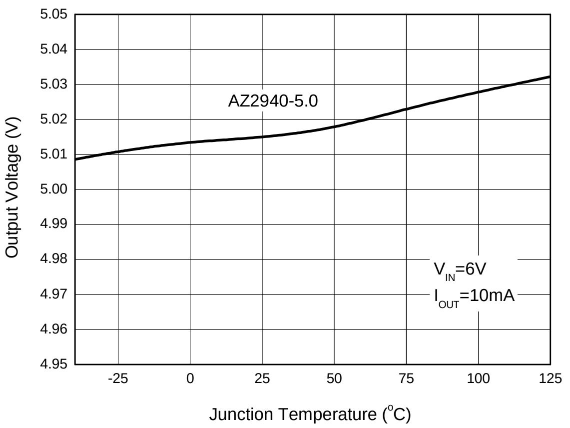


Figure 14. Output Voltage vs. Junction Temperature

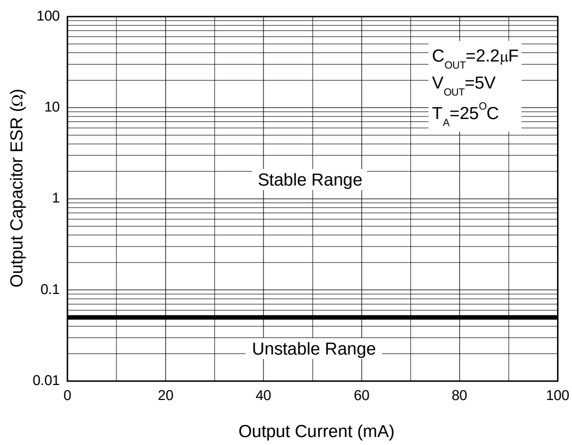


Figure 15. Output Capacitor ESR vs. Output Current

Typical Performance Characteristics (Continued)

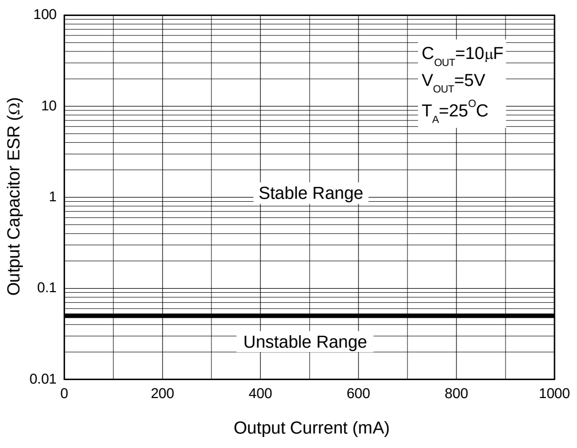


Figure 16. Output Capacitor ESR vs. Output Current

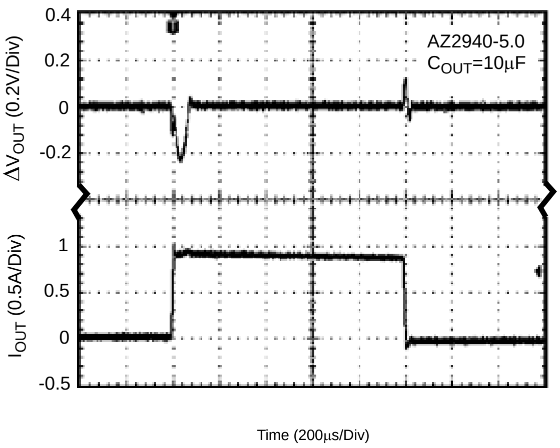


Figure 17. Load Transient

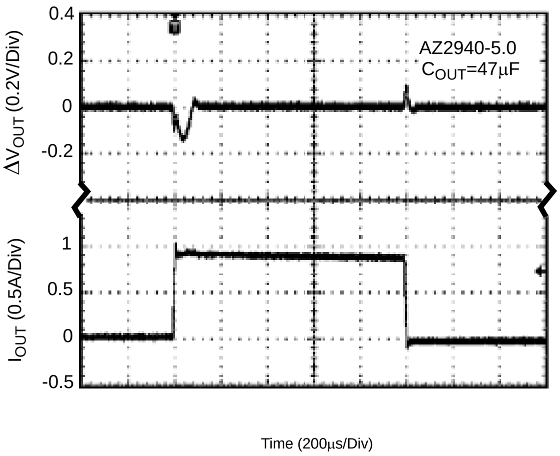


Figure 18. Load Transient

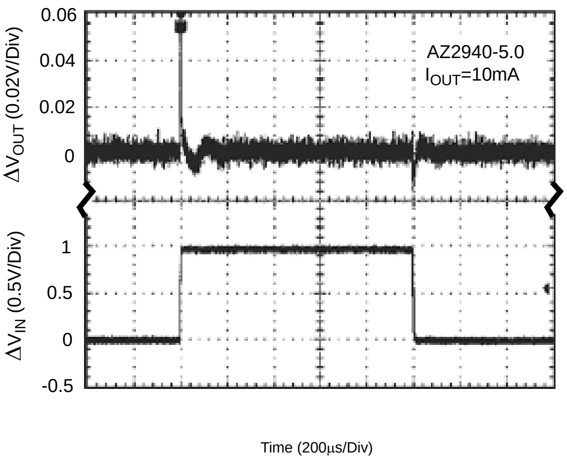


Figure 19. Line Transient

Typical Performance Characteristics (Continued)

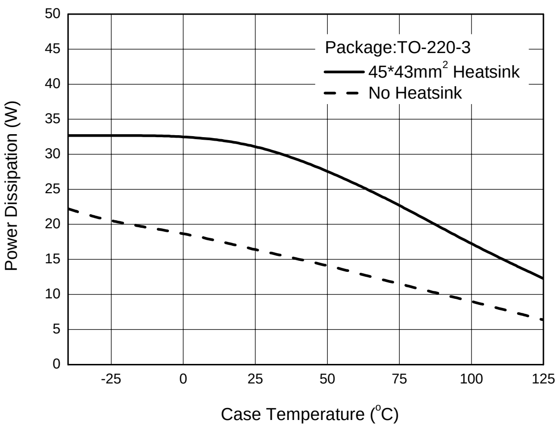


Figure 20. Power Dissipation vs. Case Temperature

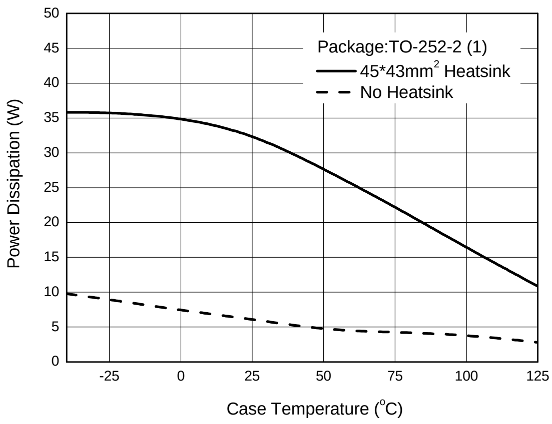


Figure 21. Power Dissipation vs. Case Temperature

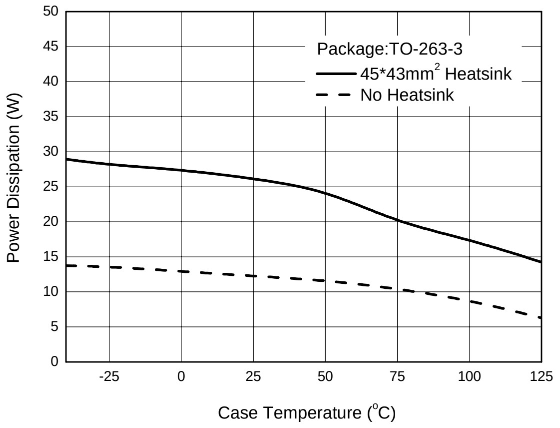


Figure 22. Power Dissipation vs. Case Temperature

Typical Application

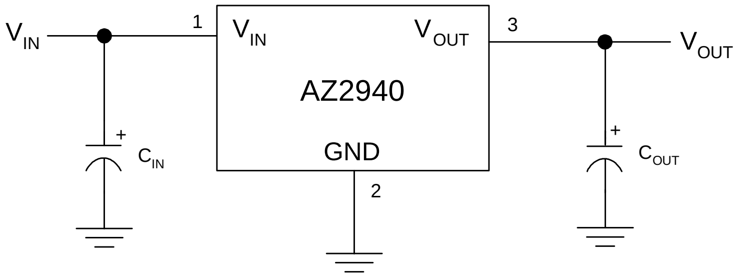
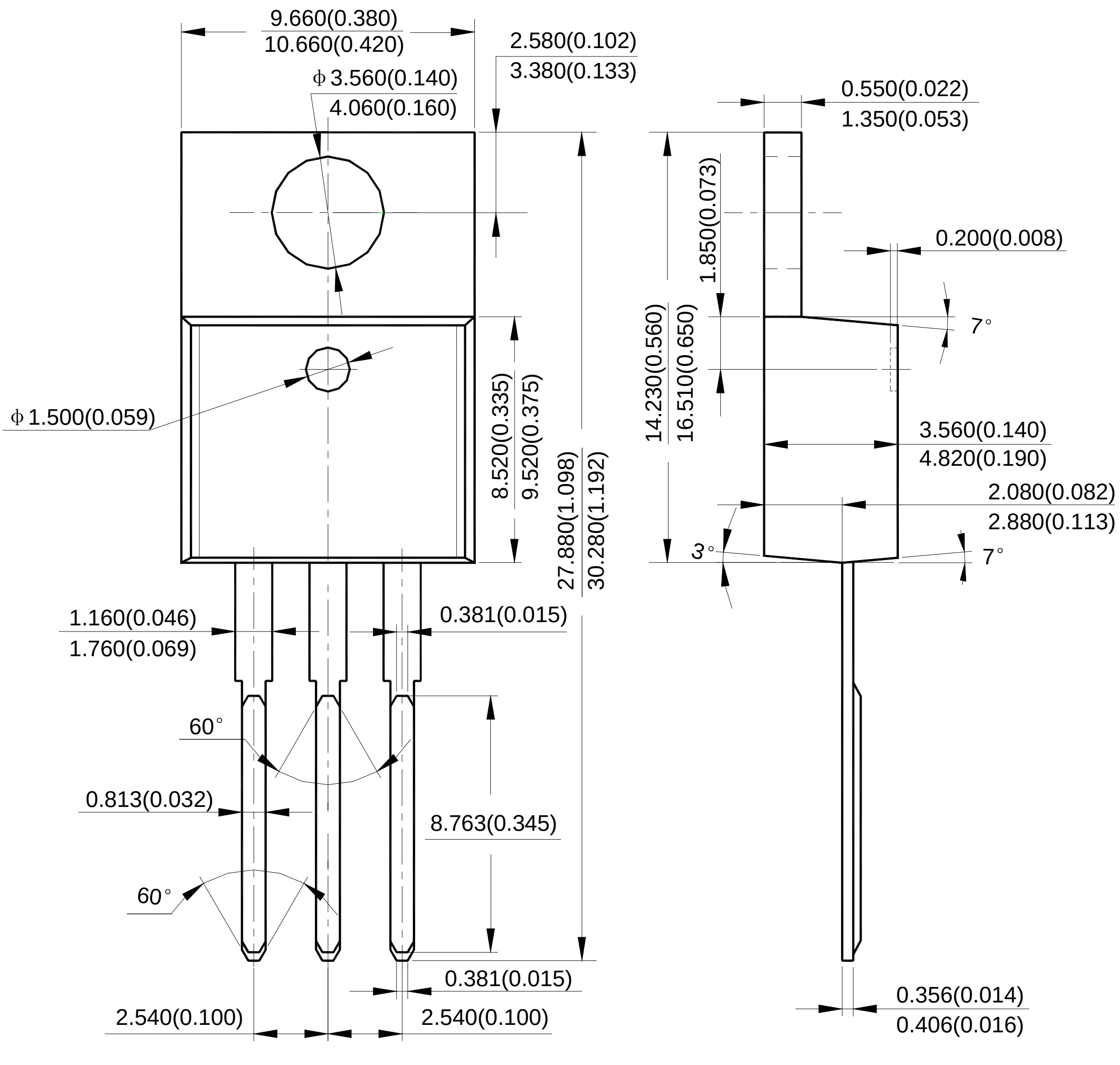


Figure 23. Typical Application of AZ2940

Note: C_{IN} is required if regulator is located far from power supply filter and is recommended to be 0.47μF or greater. To maintain stability, C_{OUT} is recommended to be 2.2μF or greater. The ESR of this capacitor is critical, please see curve.

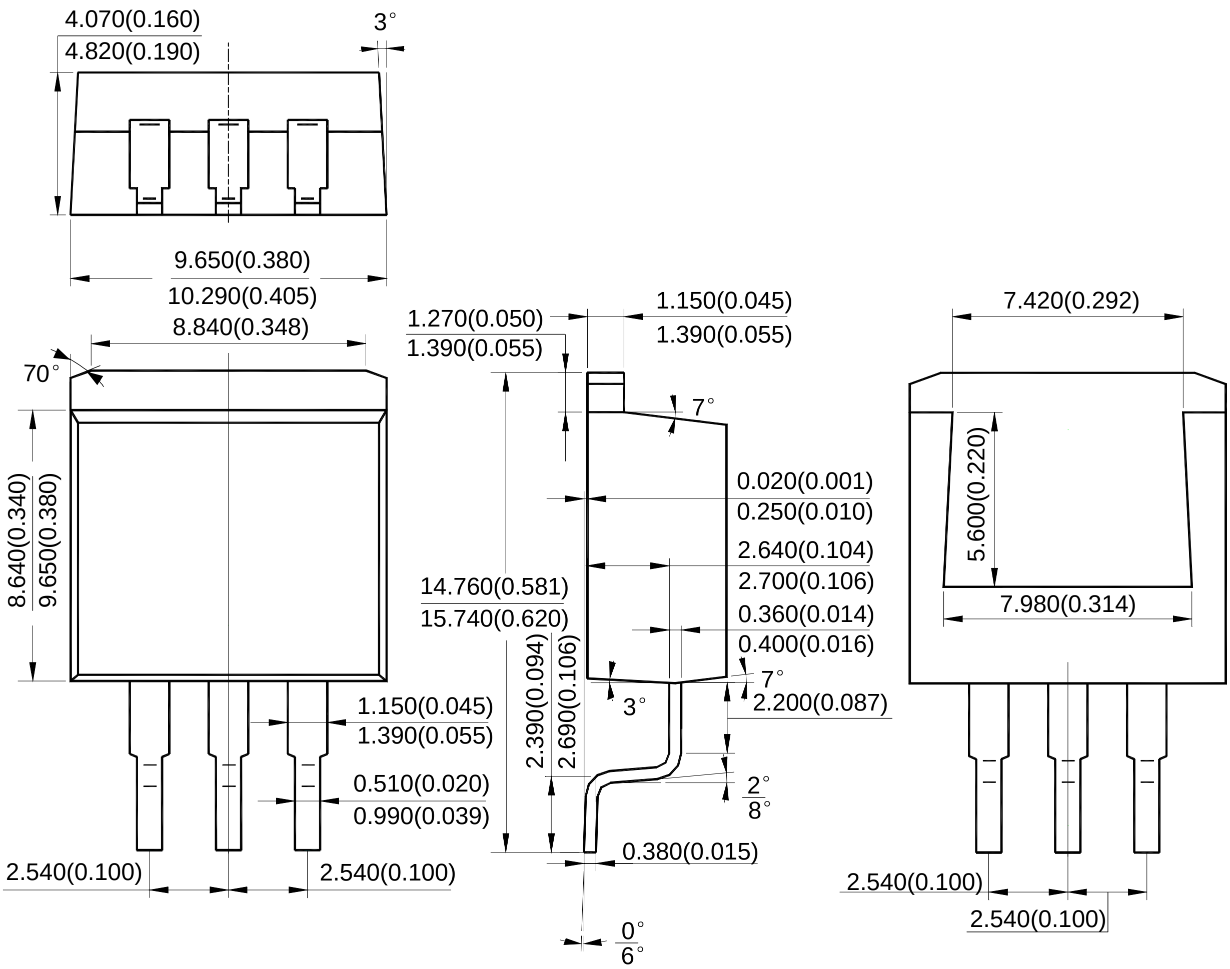
Mechanical Dimensions

TO-220-3 **Unit: mm(inch)**



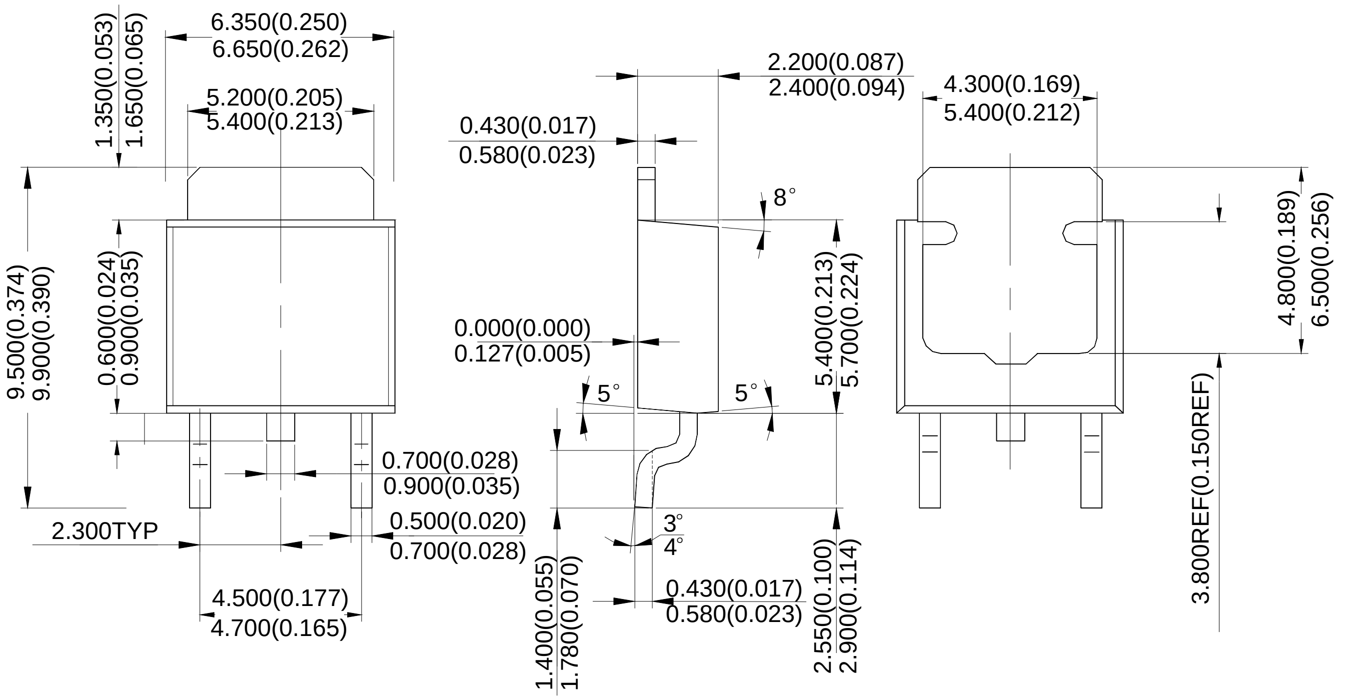
Mechanical Dimensions (Continued)

TO-263-3 **Unit: mm(inch)**



Mechanical Dimensions (Continued)

TO-252-2(1) **Unit: mm(inch)**



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