

PULSE-WIDTH-MODULATION CONTROL CIRCUITS

AZ494A/C

General Description

The AZ494A/C is a voltage mode pulse width modulation switching regulator control circuit designed primarily for power supply control.

The AZ494A/C consists of a reference voltage circuit, two error amplifiers, an on-chip adjustable oscillator, a dead-time control (DTC) comparator, a pulse-steering control flip-flop, and an output control circuit. The precision of voltage reference (V_{REF}) is improved up to $\pm 1\%$ through trimming and this provides a better output voltage regulation. The AZ494A/C provides for push-pull or single-ended output operation, which can be selected through the output control.

The difference between AZ494A and AZ494C is that they have 4.95V and 5V reference voltage respectively.

The AZ494A/C is available in standard packages of DIP-16 and SOIC-16.

Features

- Stable 4.95V/5V Reference Voltage Trimmed to $\pm 1.0\%$ Accuracy
- Uncommitted Output TR for 200mA Sink or Source Current
- Single-End or Push-Pull Operation Selected by Output Control
- Internal Circuitry Prohibits Double Pulse at Either Output
- Complete PWM Control Circuit with Variable Duty Cycle
- On-Chip Oscillator with Master or Slave Operation

Applications

- SMPS
- Back Light Inverter
- Charger

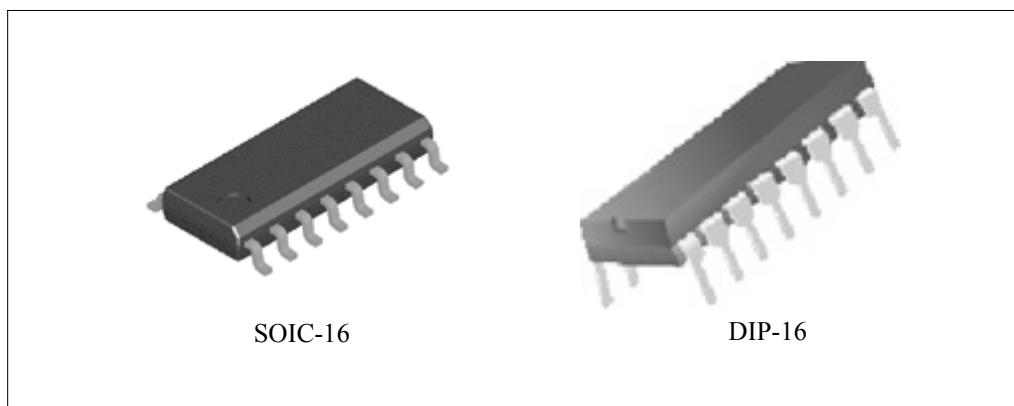


Figure 1. Package Types of AZ494A/C

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Pin Configuration

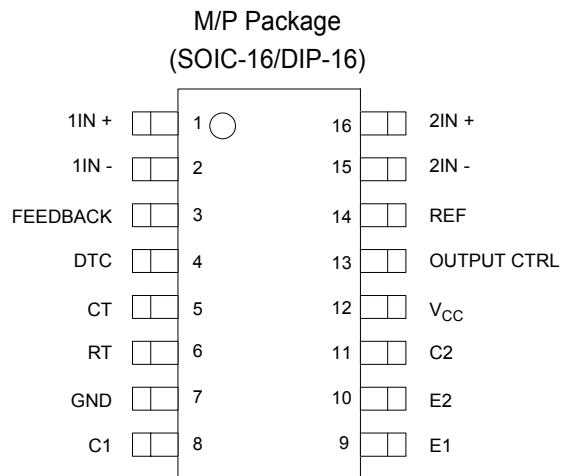


Figure 2. Pin Configuration of AZ494A/C (Top View)

Output Function Control Table

Signal for Output Control	Output Function
$V_I = GND$	Single-ended or parallel output
$V_I = V_{REF}$	Normal push-pull operation

Functional Block Diagram

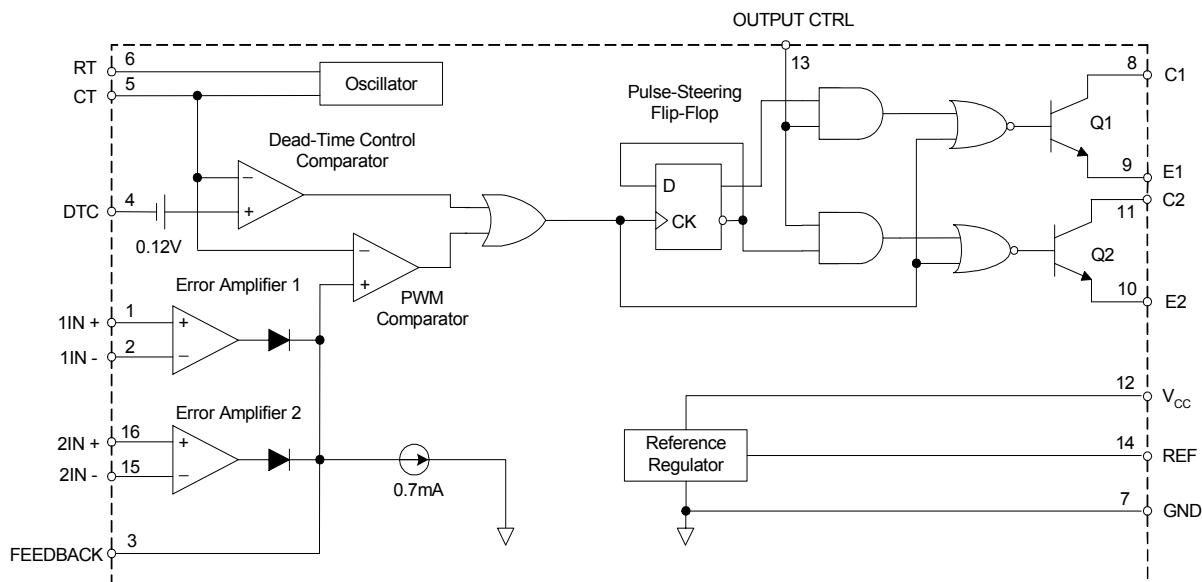


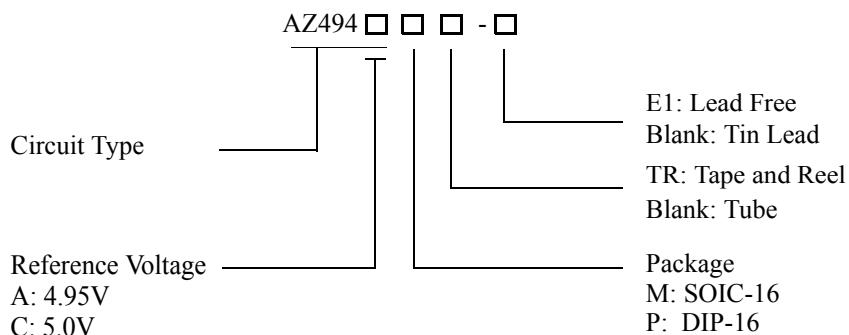
Figure 3. Functional Block Diagram of AZ494A/C



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Ordering Information



Package	Temperature Range	Part Number		Marking ID		Packing Type
		Tin Lead	Lead Free	Tin Lead	Lead Free	
SOIC-16	-40 to 85°C	AZ494AM	AZ494AM-E1	AZ494AM	AZ494AM-E1	Tube
		AZ494AMTR	AZ494AMTR-E1	AZ494AM	AZ494AM-E1	Tape & Reel
		AZ494CM	AZ494CM-E1	AZ494CM	AZ494CM-E1	Tube
		AZ494CMTR	AZ494CMTR-E1	AZ494CM	AZ494CM-E1	Tape & Reel
		AZ494AP	AZ494AP-E1	AZ494AP	AZ494AP-E1	Tube
		AZ494CP	AZ494CP-E1	AZ494CP	AZ494CP-E1	Tube
DIP-16						

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



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Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value		Unit
Supply Voltage (Note 2)	V _{CC}	40		V
Amplifier Input Voltage	V _I	-0.3 to V _{CC} + 0.3		V
Collector Output Voltage	V _O	40		V
Collector Output Current	I _O	250		mA
Package Thermal Impedance (Note 3)	R _{θJA}	M Package	73	°C/W
		P Package	67	
Lead Temperature 1.6mm from case for 10 seconds		260		°C
Storage Temperature Range	T _{STG}	-65 to 150		°C
ESD rating (Machine Model)		200		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.

Note 2: All voltage values are with respect to the network ground terminal.

Note 3: Maximum power dissipation is a function of T_{J(max)}, R_{θJA} and T_A. The maximum allowable power dissipation at any allowable ambient temperature is P_D = (T_{J(max)} - T_A)/R_{θJA}. Operating at the absolute maximum T_J of 150°C can affect reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V _{CC}	7	15	36	V
Collector Output Voltage	V _{C1} , V _{C2}		30	36	V
Collector Output Current (Each Transistor)	I _{C1} , I _{C2}			200	mA
Amplifier Input Voltage	V _I	0.3		V _{CC} - 2	V
Current Into Feedback Terminal	I _{FB}			0.3	mA
Reference Output Current	I _{REF}			10	mA
Timing Capacitor	C _T	0.00047	0.001	10	μF
Timing Resistor	R _T	1.8	30	500	KΩ
Oscillator Frequency	f _{osc}	1.0	40	200	KHz
PWM Input Voltage (Pin 3, 4, 14)		0.3		5.3	V
Operating Free-Air Temperature	T _A	-40		85	°C



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Electrical Characteristics

 $T_A = 25^\circ\text{C}$, $V_{CC} = 20\text{V}$, $f = 10\text{KHz}$ unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Reference Section						
Output Reference Voltage for AZ494A	V_{REF}	$I_{REF}=1\text{mA}$	4.90	4.95	5.0	V
		$I_{REF}=1\text{mA}$, $T_A = -40$ to 85°C	4.85	4.95	5.05	V
Output Reference Voltage for AZ494C	V_{REF}	$I_{REF}=1\text{mA}$	4.95	5.0	5.05	V
		$I_{REF}=1\text{mA}$, $T_A = -40$ to 85°C	4.9	5.0	5.1	V
Line Regulation	R_{LINE}	$V_{CC} = 7\text{V}$ to 36V		2	25	mV
Load Regulation	R_{LOAD}	$I_{REF}=1\text{mA}$ to 10mA		1	15	mV
Short-Circuit Output Current	I_{SC}	$V_{REF} = 0\text{V}$	10	35	50	mA
Oscillator Section						
Oscillator Frequency	f_{OSC}	$C_T=0.001\mu\text{F}$, $R_T=30\text{K}\Omega$		40		KHz
		$C_T=0.01\mu\text{F}$, $R_T=12\text{K}\Omega$	9.2	10	10.8	
		$C_T=0.01\mu\text{F}$, $R_T=12\text{K}\Omega$, $T_A = -40$ to 85°C	9.0		12	
Frequency Change with Temperature	$\Delta f/\Delta T$	$C_T=0.01\mu\text{F}$, $R_T=12\text{K}\Omega$, $T_A = -40$ to 85°C			1	%
Dead-Time Control Section						
Input Bias Current	I_{BIAS}	$V_{CC}=15\text{V}$, $V4= 0$ to 5.25V		-2	-10	μA
Maximum Duty Cycle	D(MAX)	$V_{CC}=15\text{V}$, $V4= 0\text{V}$, Pin 13= V_{REF}	45			%
Input Threshold Voltage	V_{ITH}	Zero Duty Cycle		3	3.3	V
		Maximum Duty Cycle	0			
Error-Amplifier Section						
Input Offset Voltage	V_{IO}	$V3 = 2.5\text{V}$		2	10	mV
Input Offset Current	I_{IO}	$V3 = 2.5\text{V}$		25	250	nA
Input Bias Current	I_{BIAS}	$V3 = 2.5\text{V}$		0.2	1	μA
Common-Mode Input Voltage Range	V_{CM}	$V_{CC}=7\text{V}$ to 36V	-0.3		$V_{CC}-2$	V
Open-Loop Voltage Gain	G_VO	$V_O = 0.5\text{V}$ to 3.5V	70	95		dB
Unity-Gain Bandwidth	BW			650		KHz
Common-Mode Rejection Ratio	CMRR		65	80		dB
Output Sink Current (Feedback)	I_{SINK}	$V_{ID} = -15\text{mV}$ to -5V , $V3 = 0.7\text{V}$	-0.3	-0.7		mA
Output Source Current (Feedback)	I_{SOURCE}	$V_{ID}=15\text{mV}$ to 5V $V3 = 3.5\text{V}$	2			mA



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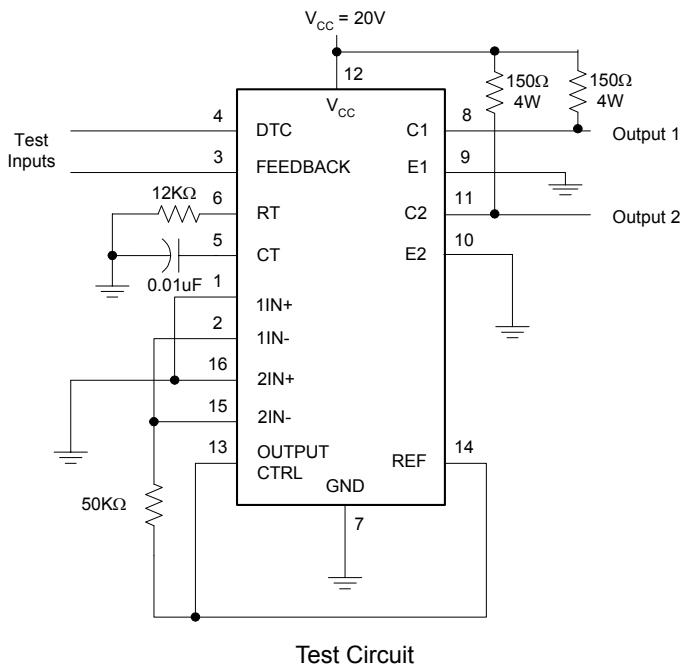
Electrical Characteristics (Continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit	
PWM Comparator Section							
Input Threshold Voltage	V _{ITH}	Zero duty cycle		4	4.5	V	
Input Sink Current	I _{SINK}	V ₃ = 0.7V	-0.3	-0.7		mA	
Output Section							
Output Saturation Voltage	Common Emitter	V _{CE} (SAT)	V _E = 0V, I _C = 200mA		1.1	1.3	V
	Emitter Follower	V _{CC} (SAT)	V _{CC} = 15V, I _E = -200mA		1.5	2.5	
Collector Off-State Current	I _C (OFF)	V _{CE} = 36V, V _{CC} = 36V		2	100	μA	
Emitter Off-State Current	I _E (OFF)	V _{CC} = V _C = 36V, V _E = 0			-100	μA	
Total Device							
Supply Current	I _{CC}	Pin 6 = V _{REF} , V _{CC} = 15V		6	10	mA	
Output Switching Characteristics							
Rise Time	t _R	Common Emitter Common Collector		100	200	ns	
Fall Time	t _F	Common Emitter Common Collector		25	100	ns	

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Parametr Measurement information



Test Circuit

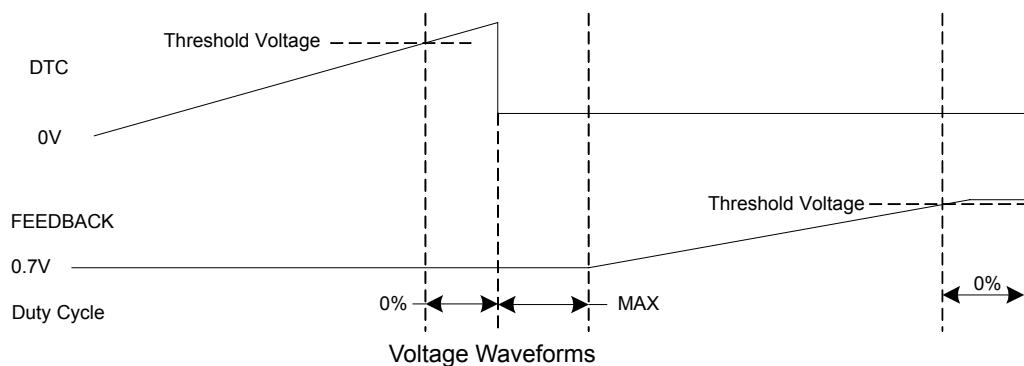
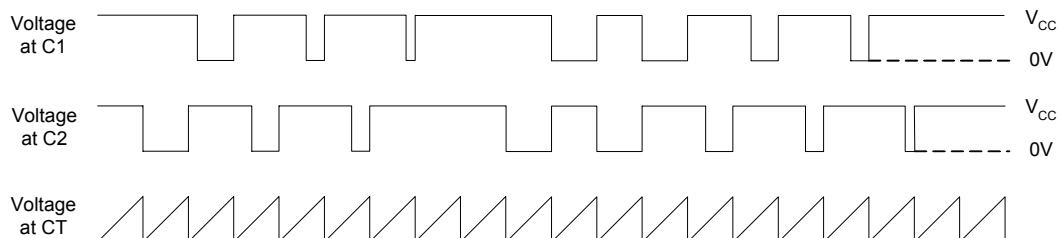


Figure 4. Operational Test Circuit and Waveforms

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Parametr Measurement information (Continued)

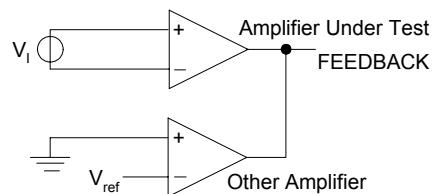
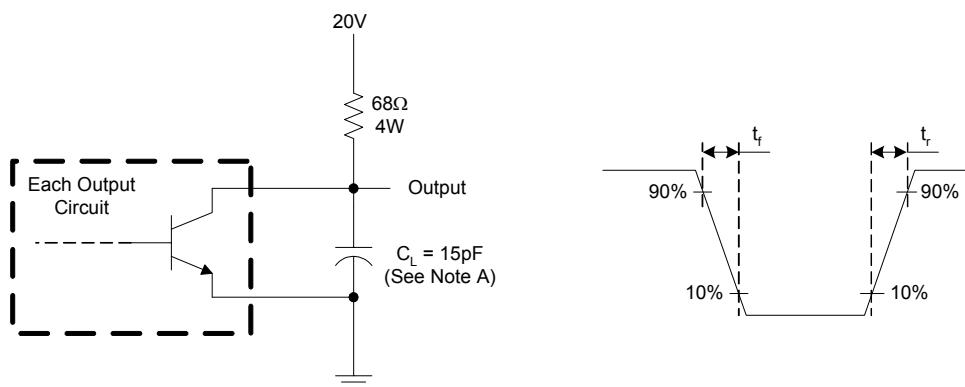
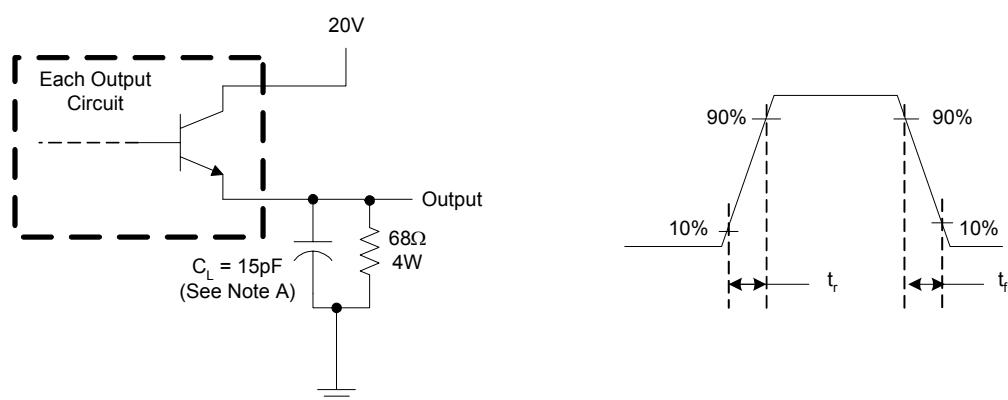


Figure 5. Error Amplifier Characteristics



Note A: C_L includes probe and jig capacitance.

Figure 6. Common-Emitter Configuration



Note A: C_L includes probe and jig capacitance.

Figure 7. Emitter-Follower Configuration

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Typical Performance Characteristics

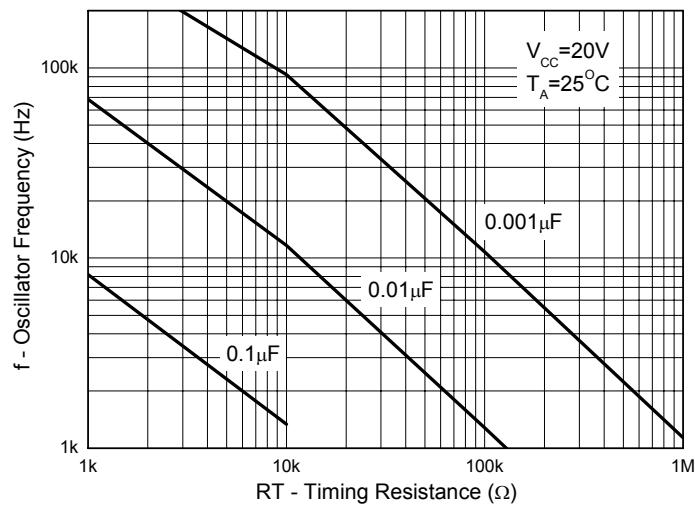


Figure 8. Oscillator Frequency vs. RT and CT

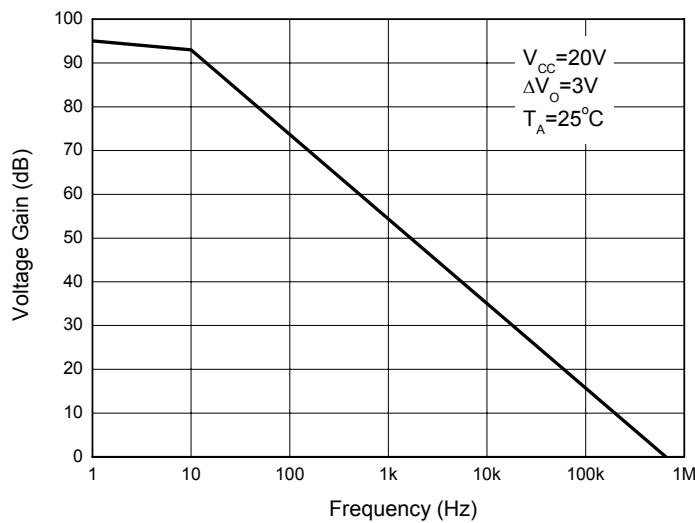


Figure 9. Error Amplifier Small-Signal Voltage Gain vs. Frequency

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Typical Applications

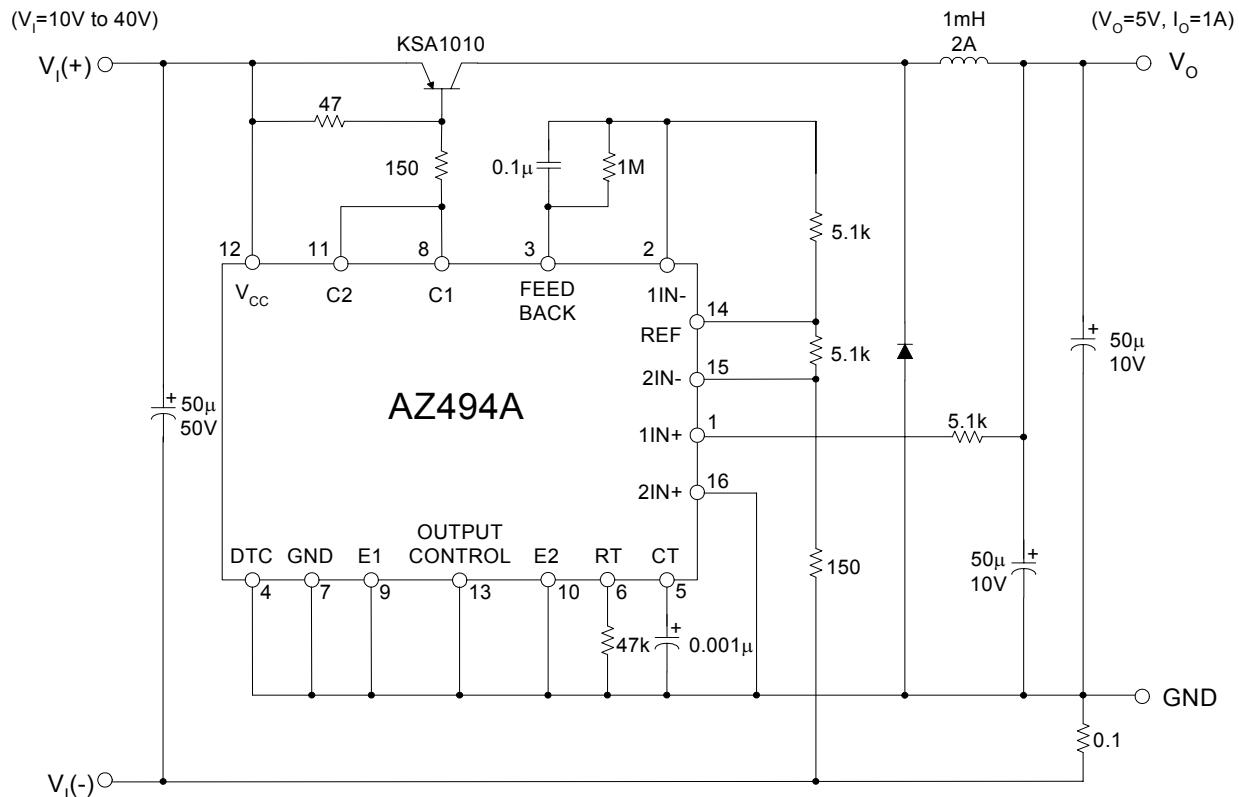


Figure 10. Pulse Width Modulated Step-Down Converter

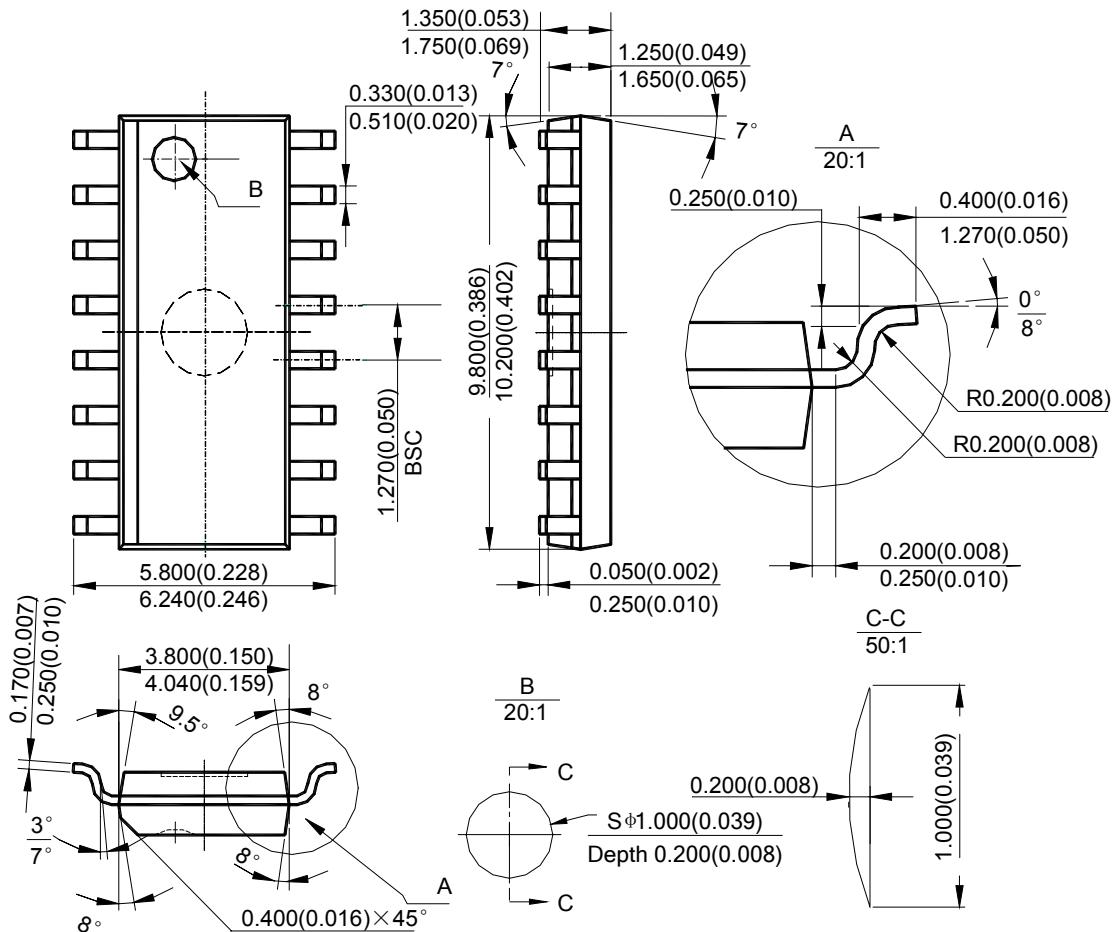
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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Mechanical Dimensions

SOIC-16

Unit: mm(inch)

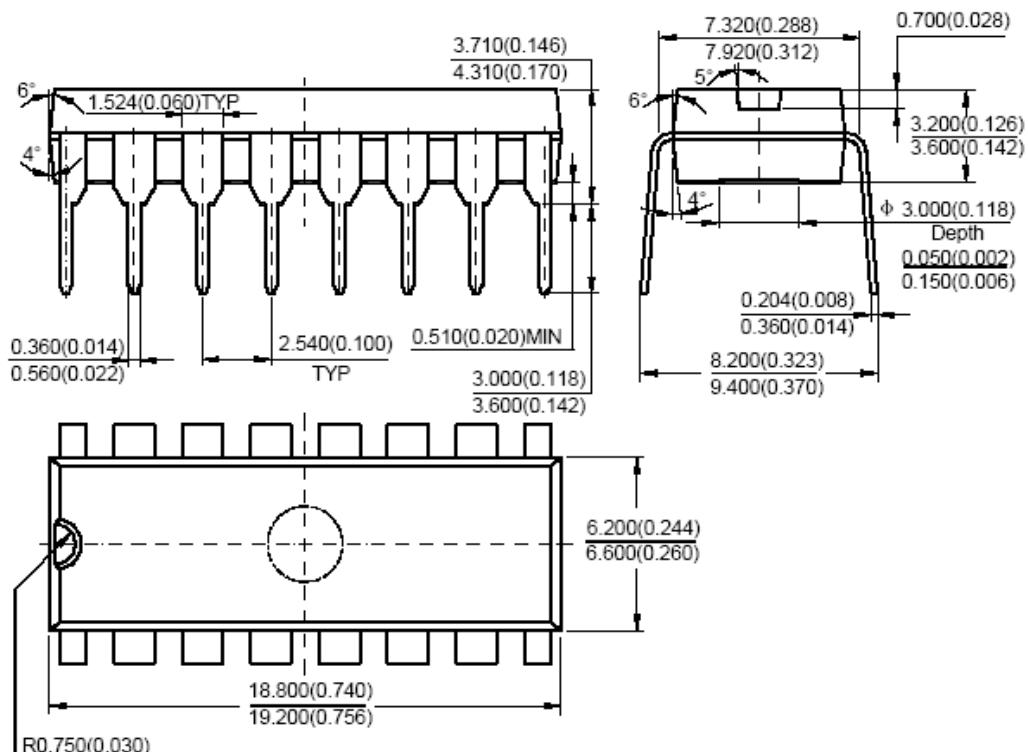


Note: Eject hole, oriented hole and mold mark is optional.

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Mechanical Dimensions (Continued)

DIP-16**Unit: mm(inch)**

Note: Eject hole, oriented hole and mold mark is optional.



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