

**PULSE-WIDTH-MODULATION CONTROL CIRCUITS****AZ7500B/C****General Description**

The AZ7500B/C is a voltage mode pulse width modulation switching regulator control circuit designed primarily for power supply control.

The AZ7500B/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 AZ7500B/C provides for push-pull or single-ended output operation, which can be selected through the output control.

The difference between AZ7500B and AZ7500C is that they have 4.95V and 5V reference voltage respectively.

The AZ7500B/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

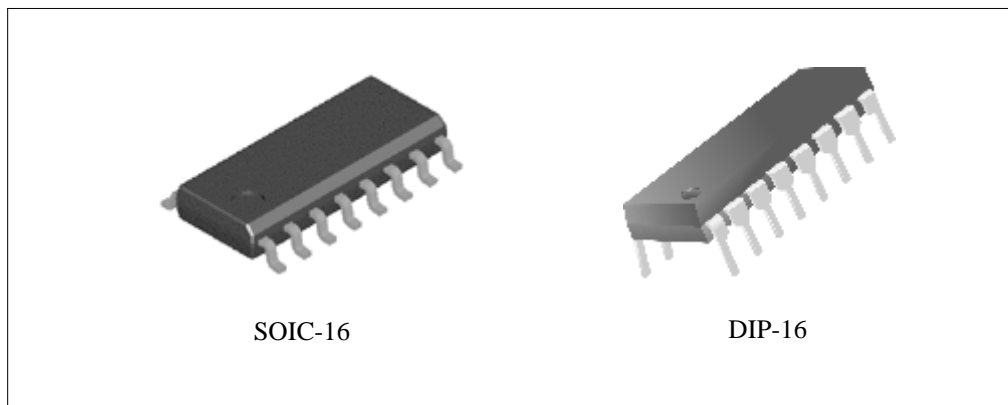


Figure 1. Package Types of AZ7500B/C



**PULSE-WIDTH-MODULATION CONTROL CIRCUITS**

**AZ7500B/C**

**Pin Configuration**

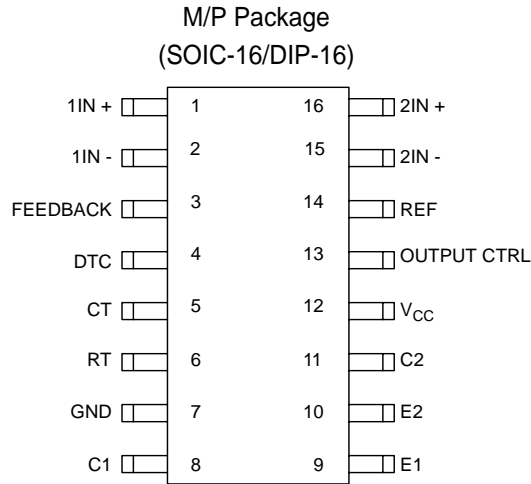


Figure 2. Pin Configuration of AZ7500B/C (Top View)

**Output Function Control Table**

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

**Functional Block Diagram**

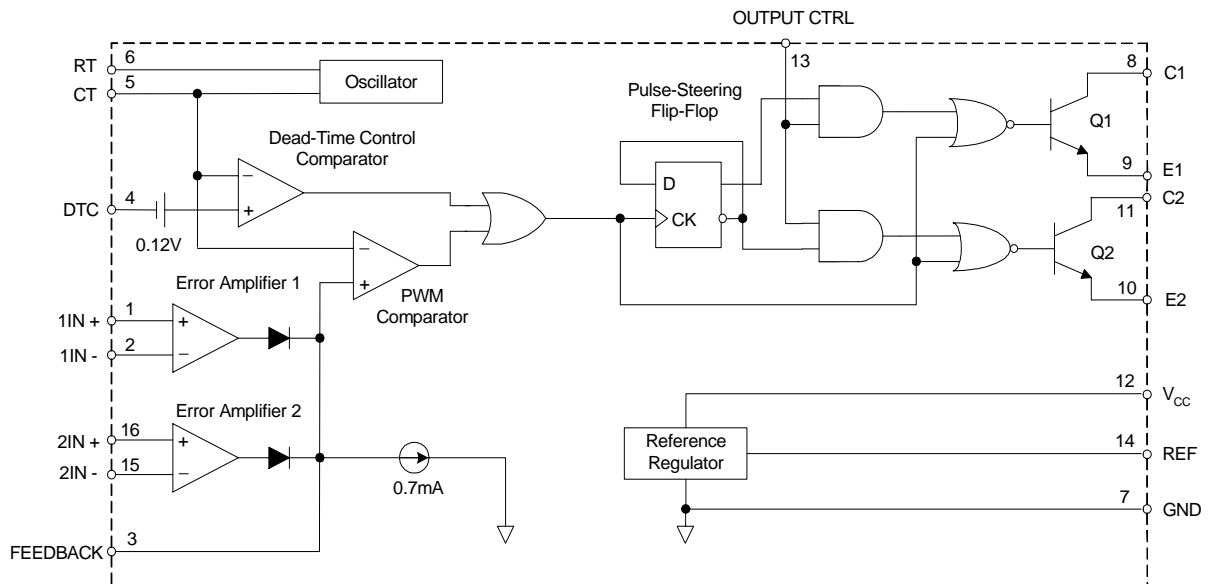


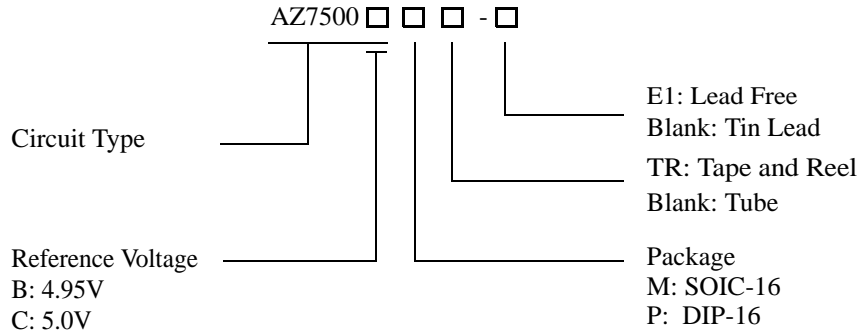
Figure 3. Functional Block Diagram of AZ7500B/C



**PULSE-WIDTH-MODULATION CONTROL CIRCUITS**

**AZ7500B/C**

**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	AZ7500BM	AZ7500BM-E1	AZ7500BM	AZ7500BM-E1	Tube
		AZ7500BMTR	AZ7500BMTR-E1	AZ7500BM	AZ7500BM-E1	Tape & Reel
		AZ7500CM	AZ7500CM-E1	AZ7500CM	AZ7500CM-E1	Tube
		AZ7500CMTR	AZ7500CMTR-E1	AZ7500CM	AZ7500CM-E1	Tape & Reel
DIP-16		AZ7500BP	AZ7500BP-E1	AZ7500BP	AZ7500BP-E1	Tube
		AZ7500CP	AZ7500CP-E1	AZ7500CP	AZ7500CP-E1	Tube

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



**PULSE-WIDTH-MODULATION CONTROL CIRCUITS**

**AZ7500B/C**

**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)	$R\theta_{JA}$	M Package	73
		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  $T_J(\max)$ ,  $R\theta_{JA}$  and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\max) - T_A) / R\theta_{JA}$ . 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



**PULSE-WIDTH-MODULATION CONTROL CIRCUITS**

**AZ7500B/C**

**Electrical Characteristics**

T<sub>A</sub> = 25°C, V<sub>CC</sub>=20V, f=10KHz unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>Reference Section</b>						
Output Reference Voltage for AZ7500B	V <sub>REF</sub>	I <sub>REF</sub> =1mA	4.90	4.95	5.0	V
		I <sub>REF</sub> =1mA, T <sub>A</sub> = -40 to 85°C	4.85	4.95	5.05	V
Output Reference Voltage for AZ7500C	V <sub>REF</sub>	I <sub>REF</sub> =1mA	4.95	5.0	5.05	V
		I <sub>REF</sub> =1mA, T <sub>A</sub> = -40 to 85°C	4.9	5.0	5.1	V
Line Regulation	R <sub>LINE</sub>	V <sub>CC</sub> = 7V to 36V		2	25	mV
Load Regulation	R <sub>LOAD</sub>	I <sub>REF</sub> =1mA to 10mA		1	15	mV
Short-Circuit Output Current	I <sub>SC</sub>	V <sub>REF</sub> = 0V	10	35	50	mA
<b>Oscillator Section</b>						
Oscillator Frequency	f <sub>OSC</sub>	C <sub>T</sub> =0.001μF, R <sub>T</sub> =30KΩ		40		KHz
		C <sub>T</sub> =0.01μF, R <sub>T</sub> =12KΩ	9.2	10	10.8	
		C <sub>T</sub> =0.01μF, R <sub>T</sub> =12KΩ, T <sub>A</sub> = -40 to 85°C	9.0		12	
Frequency Change with Temperature	Δf /ΔT	C <sub>T</sub> =0.01μF, R <sub>T</sub> =12KΩ, T <sub>A</sub> = -40 to 85°C			1	%
<b>Dead-Time Control Section</b>						
Input Bias Current	I <sub>BIAS</sub>	V <sub>CC</sub> =15V, V <sub>4</sub> = 0 to 5.25V		-2	-10	μA
Maximum Duty Cycle,	D(MAX)	V <sub>CC</sub> =15V, V <sub>4</sub> = 0V, Pin 13= V <sub>REF</sub>	45			%
Input Threshold Voltage	V <sub>ITH</sub>	Zero Duty Cycle		3	3.3	V
		Maximum Duty Cycle	0			
<b>Error-Amplifier Section</b>						
Input Offset Voltage	V <sub>IO</sub>	V <sub>3</sub> = 2.5V		2	10	mV
Input Offset Current	I <sub>IO</sub>	V <sub>3</sub> = 2.5V		25	250	nA
Input Bias Current	I <sub>BIAS</sub>	V <sub>3</sub> = 2.5V		0.2	1	μA
Common-Mode Input Voltage Range	V <sub>CM</sub>	V <sub>CC</sub> =7V to 36V	-0.3		V <sub>CC</sub> -2	V
Open-Loop Voltage Gain	G <sub>VO</sub>	V <sub>O</sub> =0.5V 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 <sub>SINK</sub>	V <sub>ID</sub> = -15mV to -5V, V <sub>3</sub> = 0.7V	-0.3	-0.7		mA
Output Source Current (Feedback)	I <sub>SOURCE</sub>	V <sub>ID</sub> =15mV to 5V, V <sub>3</sub> = 3.5V	2			mA



**PULSE-WIDTH-MODULATION CONTROL CIRCUITS**

**AZ7500B/C**

**Electrical Characteristics (Continued)**

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>PWM Comparator Section</b>						
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
<b>Output Section</b>						
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	$\mu A$
Emitter Off-State Current	$I_E$ (OFF)	$V_{CC} = V_C = 36V, V_E = 0$			-100	$\mu A$
<b>Total Device</b>						
Supply Current	$I_{CC}$	Pin 6 = $V_{REF}$ , $V_{CC} = 15V$		6	10	mA
<b>Output Switching Characteristics</b>						
Rise Time	$t_R$	Common Emitter Common Collector		100	200	ns
Fall Time	$t_F$	Common Emitter Common Collector		25	100	ns



**PULSE-WIDTH-MODULATION CONTROL CIRCUITS**

**AZ7500B/C**

**Parametr Measurement information**

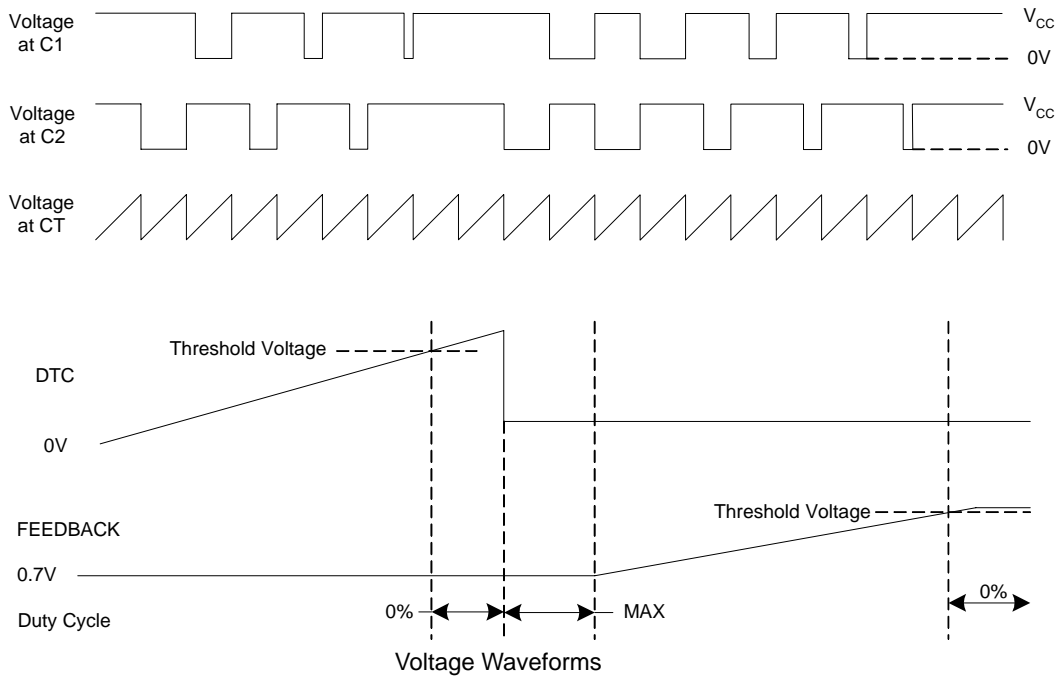
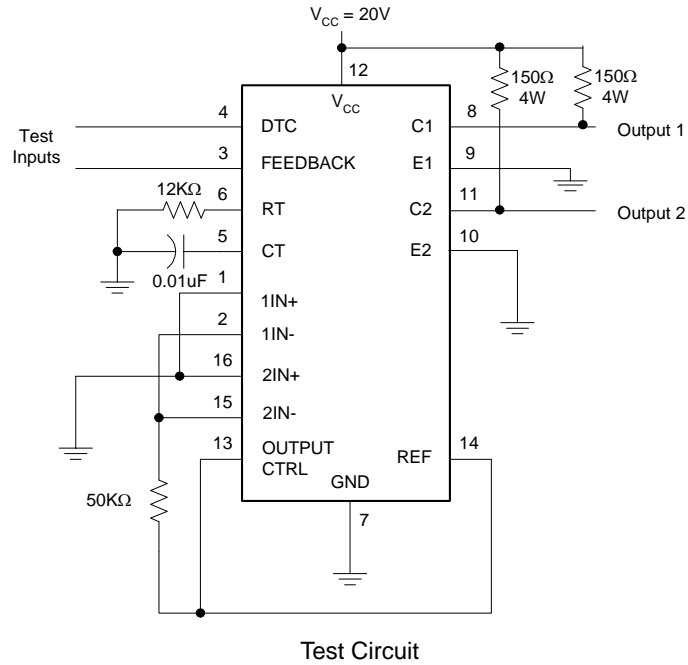


Figure 4. Operational Test Circuit and Waveforms



**PULSE-WIDTH-MODULATION CONTROL CIRCUITS**

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**Parametr Measurement information (Continued)**

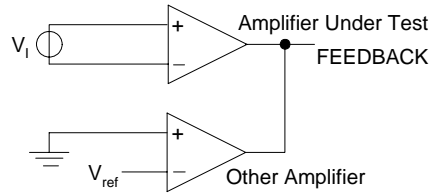
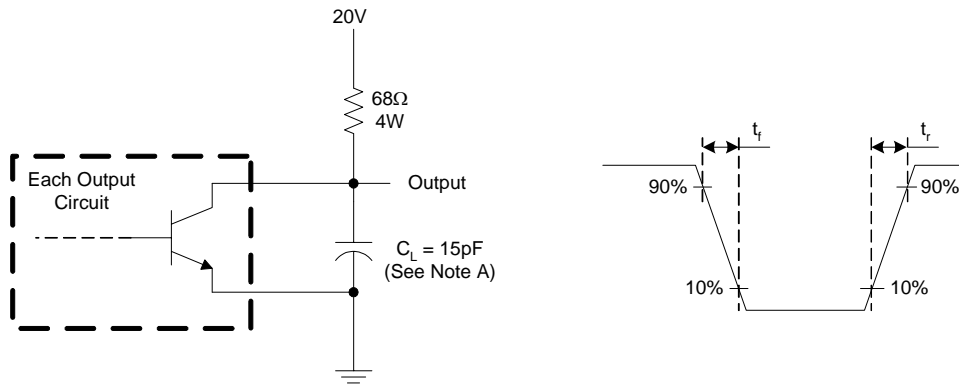
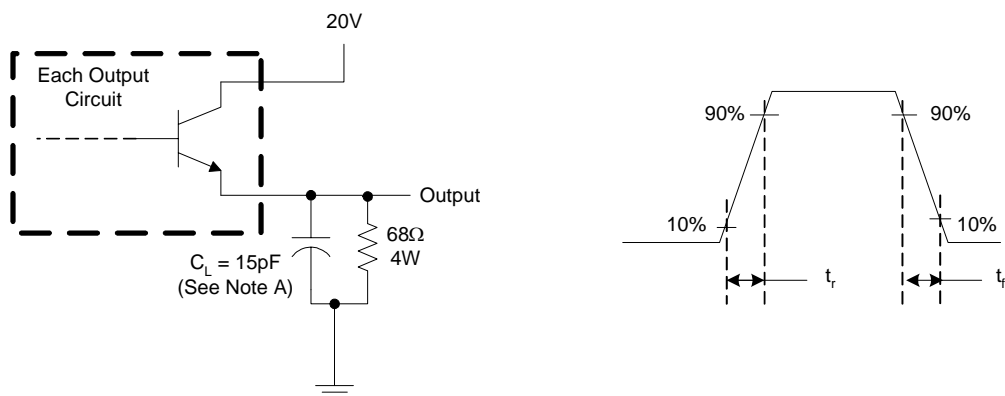


Figure 5. Error Amplifier Characteristics



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





**PULSE-WIDTH-MODULATION CONTROL CIRCUITS**

**AZ7500B/C**

**Typical Performance Characteristics**

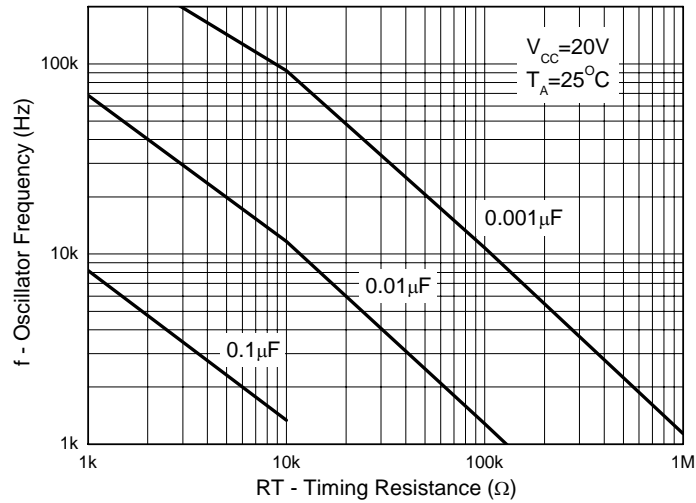


Figure 8. Oscillator Frequency vs. RT and CT

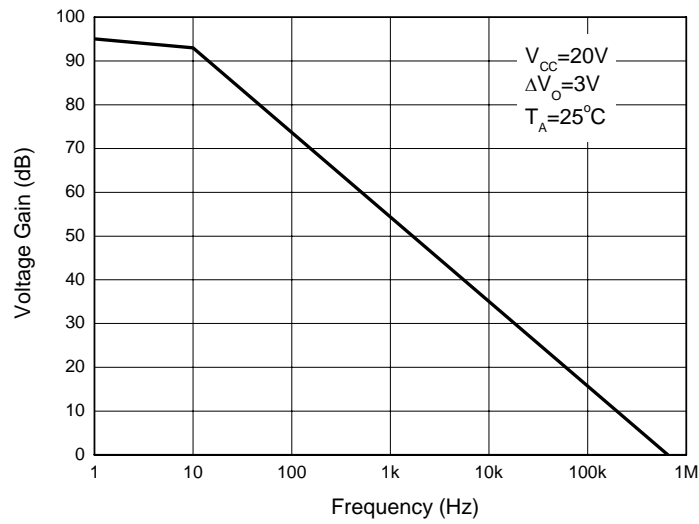


Figure 9. Error Amplifier Small-Signal Voltage Gain vs. Frequency



**PULSE-WIDTH-MODULATION CONTROL CIRCUITS**

**AZ7500B/C**

**Typical Applications**

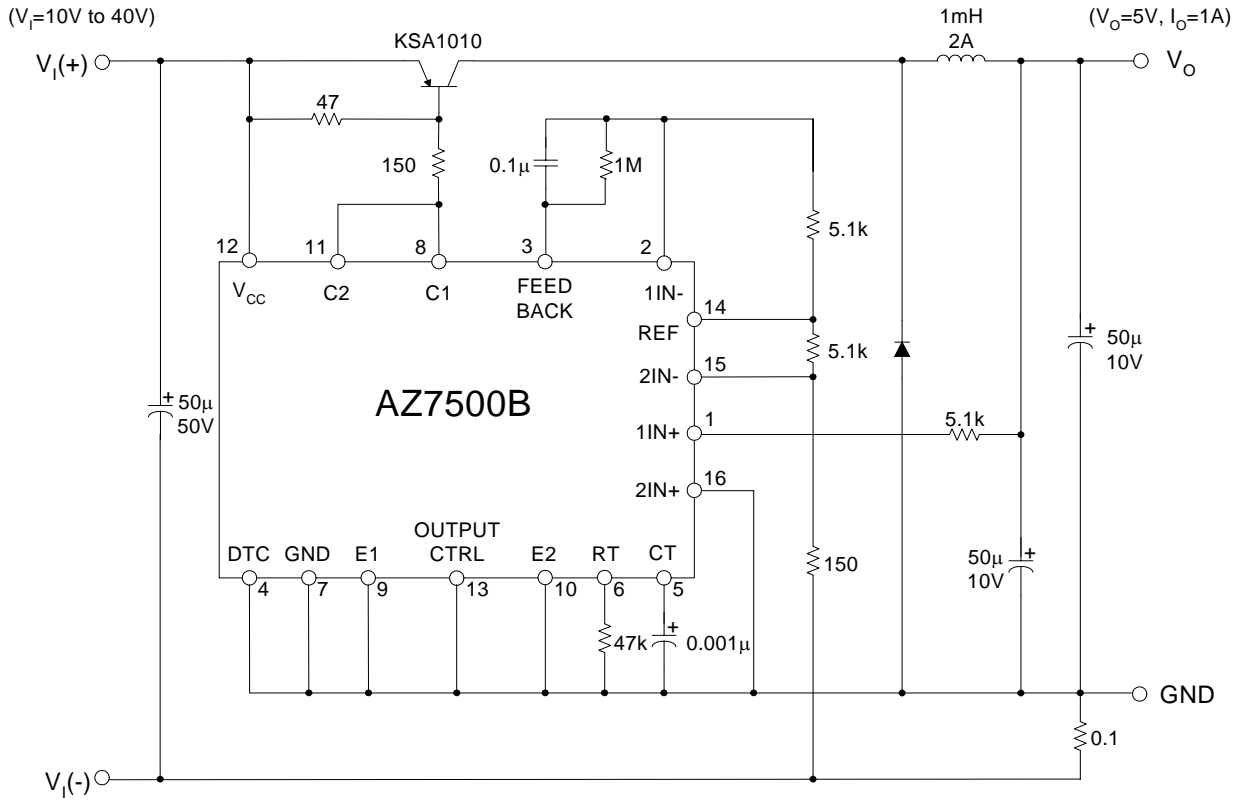


Figure 10. Pulse Width Modulated Step-Down Converter



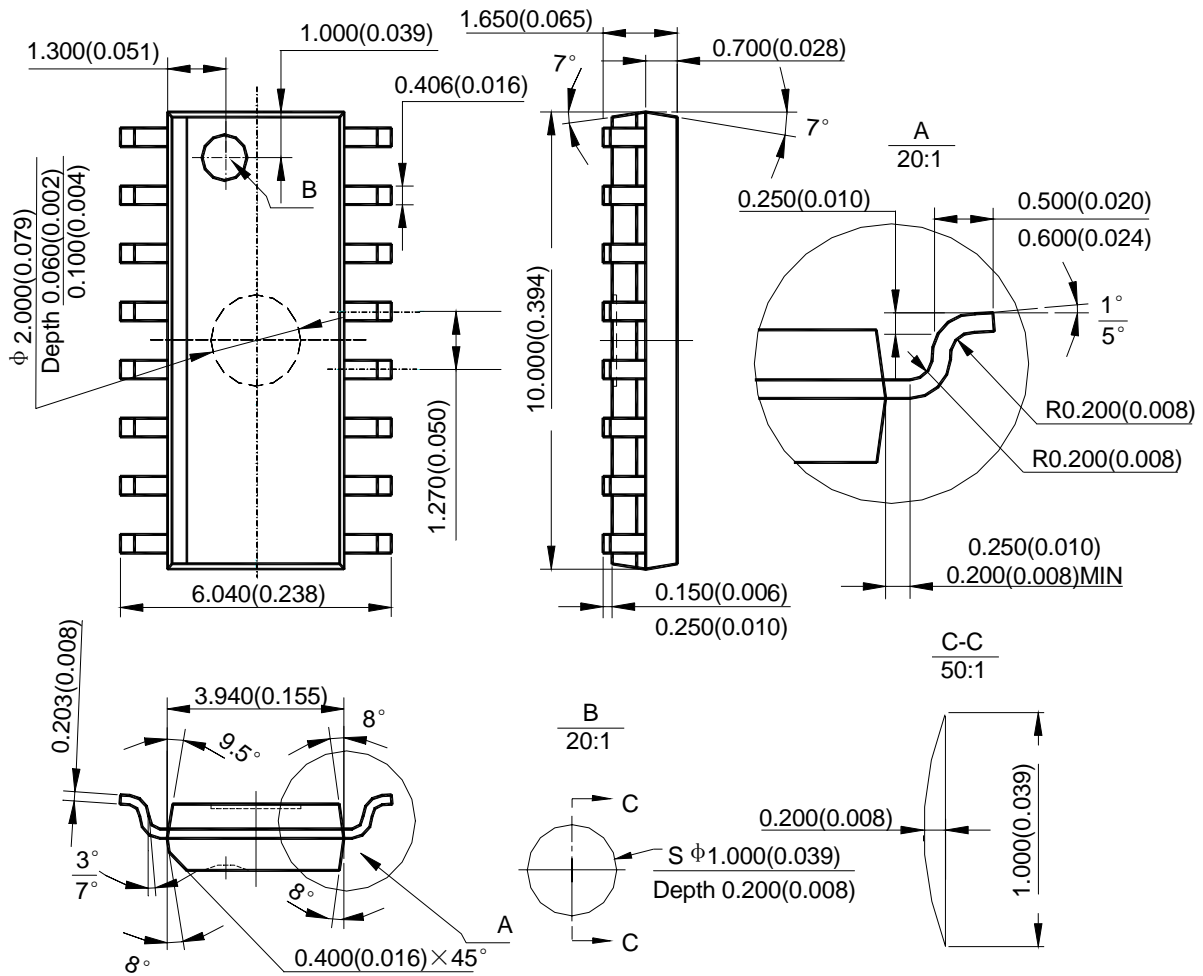
**PULSE-WIDTH-MODULATION CONTROL CIRCUITS**

**AZ7500B/C**

**Mechanical Dimensions**

**SOIC-16**

**Unit: mm(inch)**





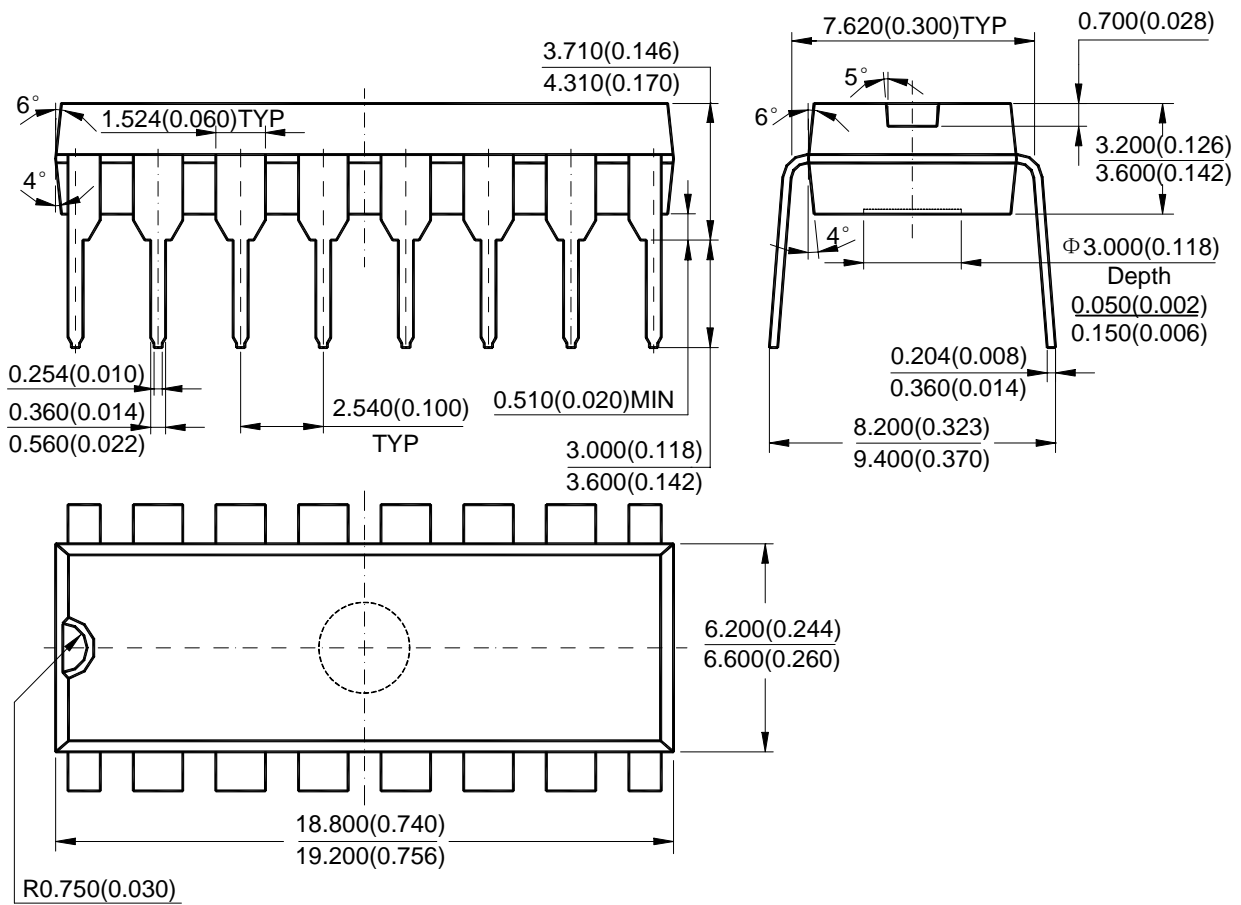
**PULSE-WIDTH-MODULATION CONTROL CIRCUITS**

**AZ7500B/C**

**Mechanical Dimensions (Continued)**

**DIP-16**

**Unit: mm(inch)**





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#### MAIN SITE

**BCD Semiconductor Manufacturing Limited**  
- Wafer Fab  
Shanghai SIM-BCD Semiconductor Manufacturing Limited  
800, Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6485 1491, Fax: +86-21-5450 0008

**BCD Semiconductor Manufacturing Limited**  
- IC Design Group  
Advanced Analog Circuits (Shanghai) Corporation  
8F, Zone B, 900, Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6495 9539, Fax: +86-21-6485 9673

#### REGIONAL SALES OFFICE

**Shenzhen Office**  
Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd. Shenzhen Office  
Advanced Analog Circuits (Shanghai) Corporation Shenzhen Office  
27B, Tower C, 2070, Middle Shen Nan Road, Shenzhen 518031, China  
Tel: +86-755-8368 3987, Fax: +86-755-8368 3166

**Taiwan Office**  
BCD Semiconductor (Taiwan) Company Limited  
4F, 298-1, Rui Guang Road, Nei-Hu District, Taipei,  
Taiwan  
Tel: +886-2-2656 2808, Fax: +886-2-2656 2806

**USA Office**  
BCD Semiconductor Corporation  
3170 De La Cruz Blvd., Suite 105, Santa Clara,  
CA 95054-2411, U.S.A  
Tel: +1-408-988 6388, Fax: +1-408-988 6386