

**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

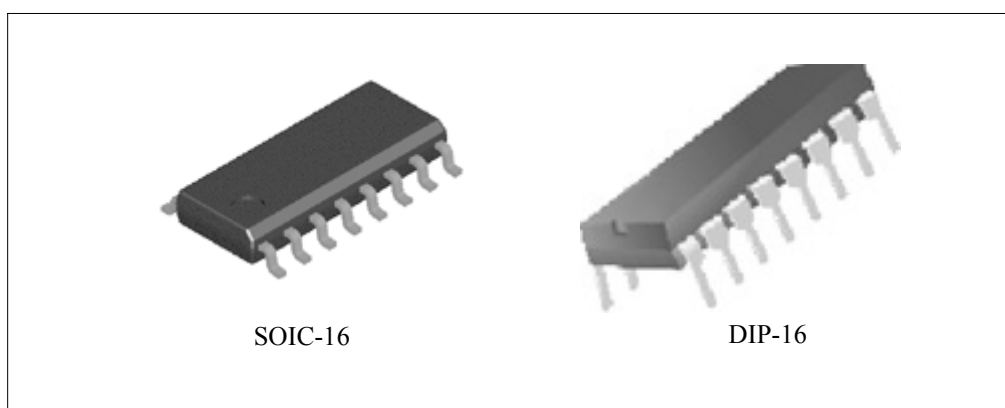


Figure 1. Package Types of AZ7500B/C



PULSE-WIDTH-MODULATION CONTROL CIRCUITS

AZ7500B/C

Pin Configuration

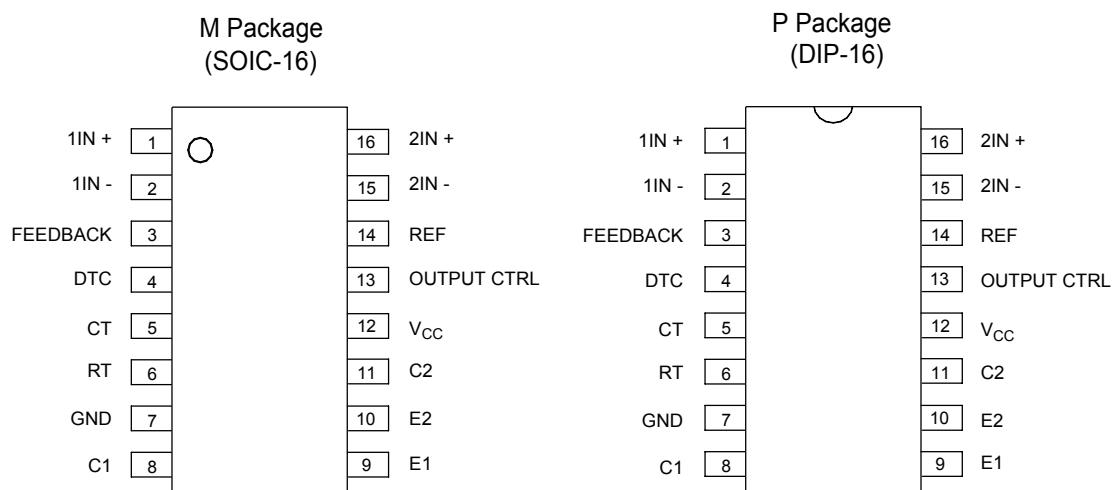


Figure 2. Pin Configuration of AZ7500B/C (Top View)

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

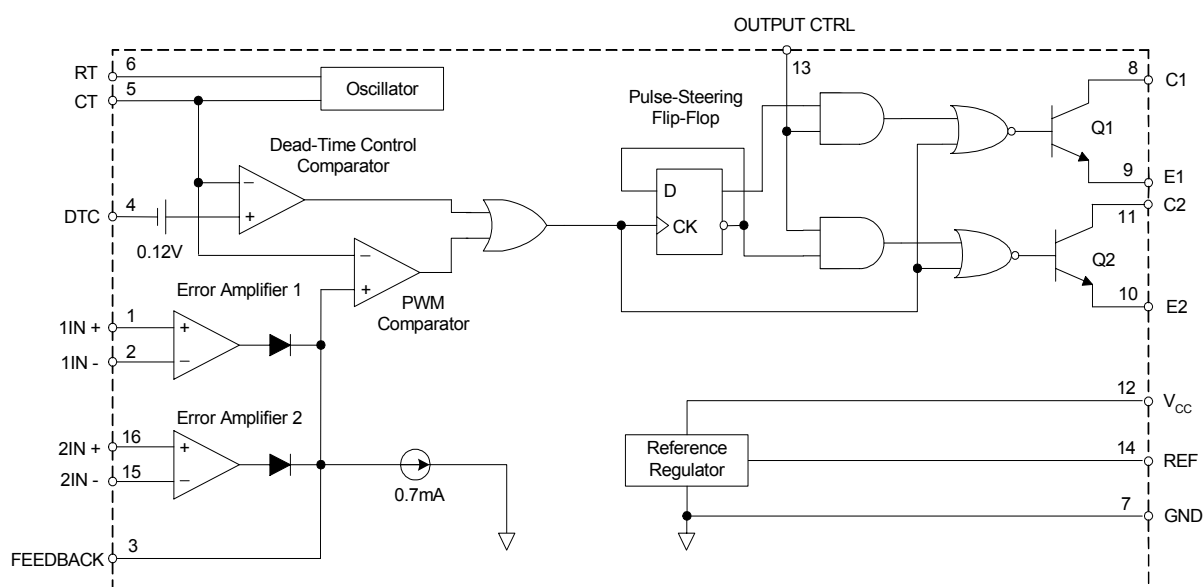
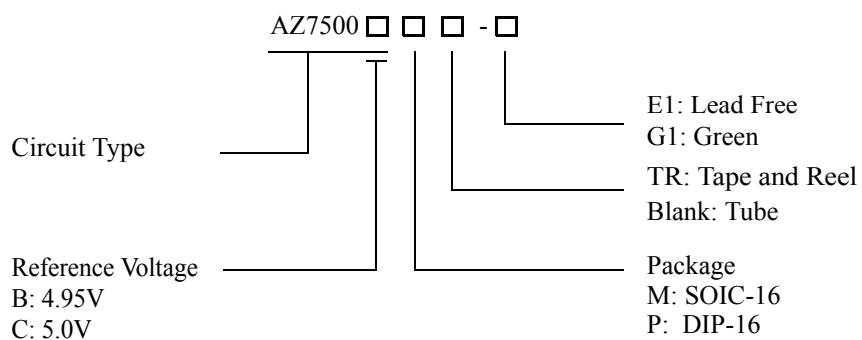


Figure 3. Functional Block Diagram of AZ7500B/C

**PULSE-WIDTH-MODULATION CONTROL CIRCUITS****AZ7500B/C****Ordering Information**

Package	Temperature Range	Part Number		Marking ID		Packing Type
		Lead Free	Green	Lead Free	Green	
SOIC-16	-40 to 85°C	AZ7500BM-E1	AZ7500BM-G1	AZ7500BM-E1	AZ7500BM-G1	Tube
		AZ7500BMTR-E1	AZ7500BMTR-G1	AZ7500BM-E1	AZ7500BM-G1	Tape & Reel
		AZ7500CM-E1	AZ7500CM-G1	AZ7500CM-E1	AZ7500CM-G1	Tube
		AZ7500CMTR-E1	AZ7500CMTR-G1	AZ7500CM-E1	AZ7500CM-G1	Tape & Reel
DIP-16	-40 to 85°C	AZ7500BP-E1	AZ7500BP-G1	AZ7500BP-E1	AZ7500BP-G1	Tube
		AZ7500CP-E1	AZ7500CP-G1	AZ7500CP-E1	AZ7500CP-G1	Tube

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant. Products with "G1" suffix are available in green packages.

**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	$^{\circ}\text{C/W}$
		P Package	67	
Lead Temperature 1.6mm from case for 10 seconds		260		$^{\circ}\text{C}$
Storage Temperature Range	T_{STG}	-65 to 150		$^{\circ}\text{C}$
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 $T_J(\text{max})$, $R_{\theta JA}$ and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\text{max}) - T_A) / R_{\theta JA}$. 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	$\text{K}\Omega$
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	$^{\circ}\text{C}$

**PULSE-WIDTH-MODULATION CONTROL CIRCUITS****AZ7500B/C****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 AZ7500B	V _{REF}	I _{REF} =1mA	4.90	4.95	5.0	V
		I _{REF} =1mA, T _A = -40 to 85°C	4.85	4.95	5.05	V
Output Reference Voltage for AZ7500C	V _{REF}	I _{REF} =1mA	4.95	5.0	5.05	V
		I _{REF} =1mA, T _A = -40 to 85°C	4.9	5.0	5.1	V
Line Regulation	R _{LINE}	V _{CC} = 7V to 36V		2	25	mV
Load Regulation	R _{LOAD}	I _{REF} =1mA to 10mA		1	15	mV
Short-Circuit Output Current	I _{SC}	V _{REF} = 0V	10	35	50	mA
Oscillator Section						
Oscillator Frequency	f _{OSC}	C _T =0.001μF, R _T =30KΩ		40		KHz
		C _T =0.01μF, R _T =12KΩ	9.2	10	10.8	
		C _T =0.01μF, R _T =12KΩ, T _A = -40 to 85°C	9.0		12	
Frequency Change with Temperature	Δf /ΔT	C _T =0.01μF, R _T =12KΩ, T _A = -40 to 85°C			1	%
Dead-Time Control Section						
Input Bias Current	I _{BIAS}	V _{CC} =15V, V ₄ = 0 to 5.25V		-2	-10	μA
Maximum Duty Cycle	D(MAX)	V _{CC} =15V, V ₄ = 0V, 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}	V ₃ = 2.5V		2	10	mV
Input Offset Current	I _{IO}	V ₃ = 2.5V		25	250	nA
Input Bias Current	I _{BIAS}	V ₃ = 2.5V		0.2	1	μA
Common-Mode Input Voltage Range	V _{CM}	V _{CC} =7V to 36V	-0.3		V _{CC} -2	V
Open-Loop Voltage Gain	G _{VO}	V _O =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 _{SINK}	V _{ID} = -15mV to -5V, V ₃ = 0.7V	-0.3	-0.7		mA
Output Source Current (Feedback)	I _{SOURCE}	V _{ID} =15mV to 5V V ₃ = 3.5V	2			mA

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

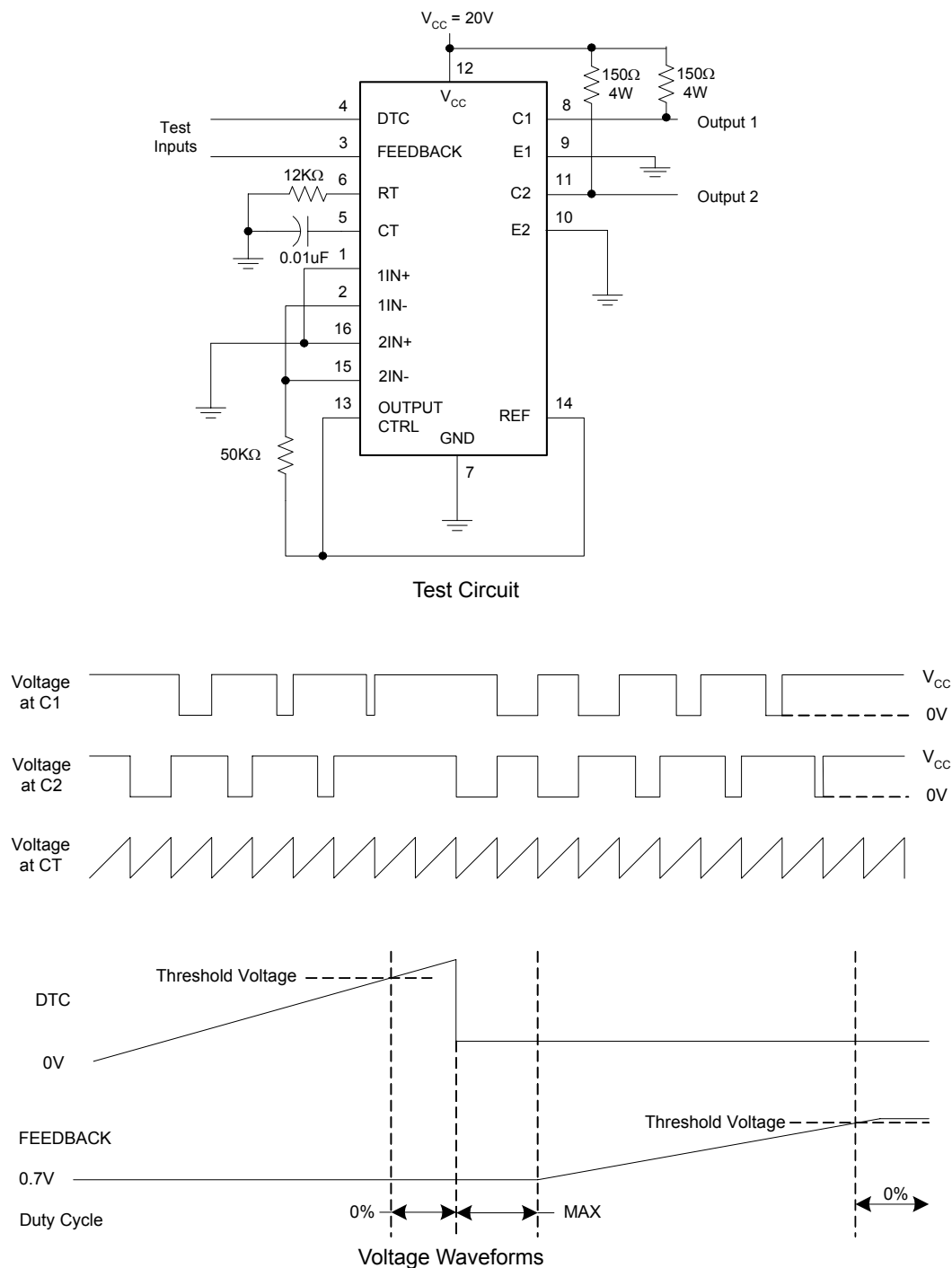
Parametr Measurement information


Figure 4. Operational Test Circuit and Waveforms

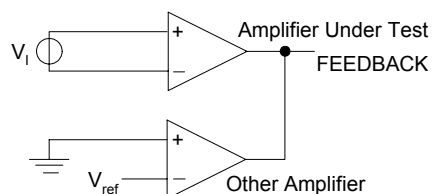
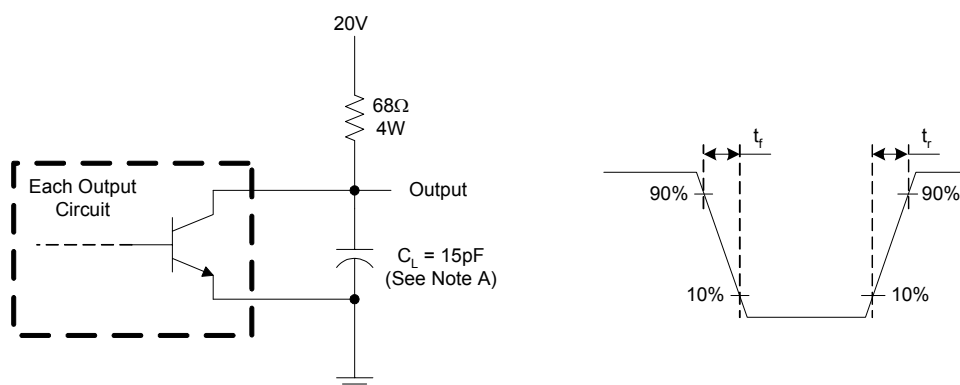
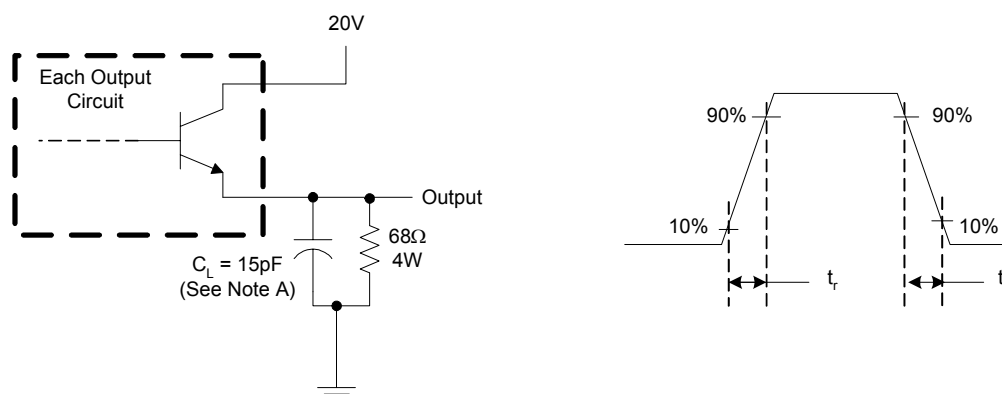
Parametr Measurement information (Continued)


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

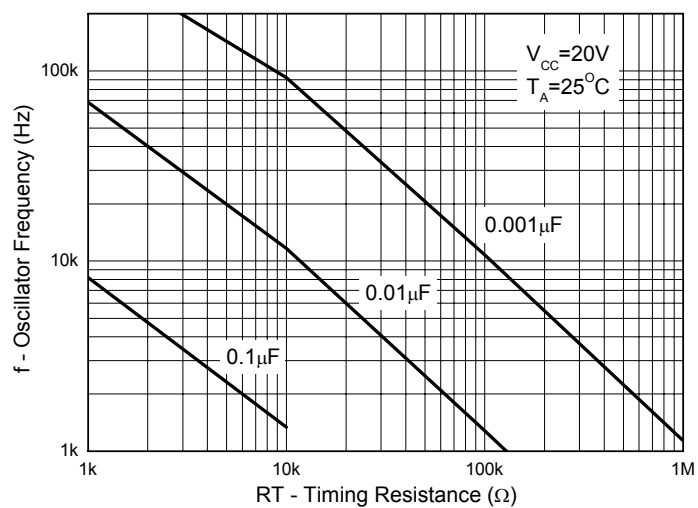
**Typical Performance Characteristics**

Figure 8. Oscillator Frequency vs. RT and CT

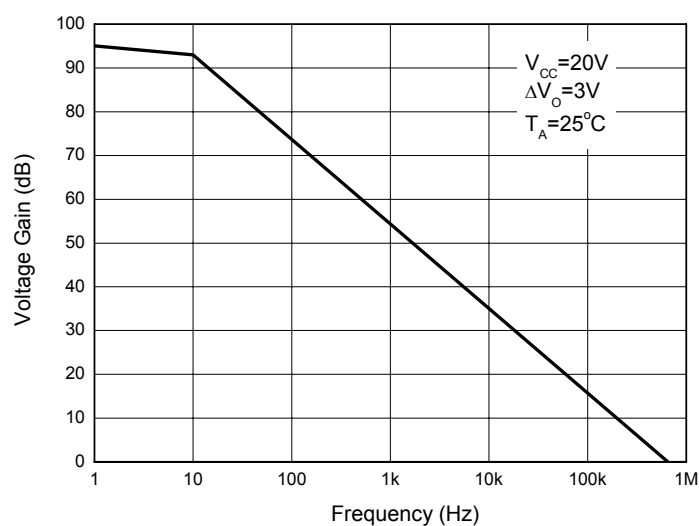


Figure 9. Error Amplifier Small-Signal Voltage Gain vs. Frequency



Typical Applications

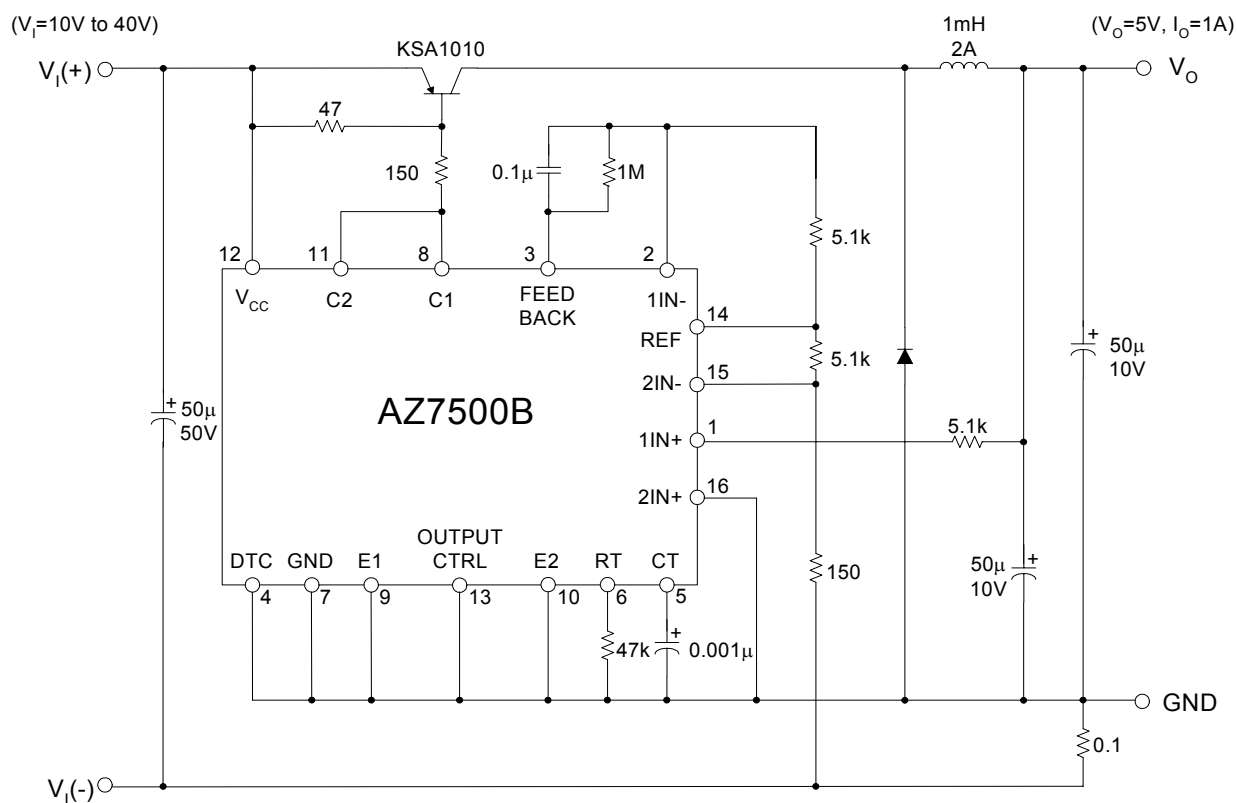
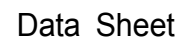


Figure 10. Pulse Width Modulated Step-Down Converter

**AZ7500B/C****SOIC-16**

Unit: mm(inch)

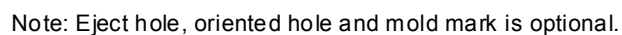


**AZ7500B/C**

Mechanical Dimensions (Continued)

DIP-16

Unit: mm(inch)





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MAIN SITE

- Headquarters

BCD Semiconductor Manufacturing Limited

No. 1600, Zi Xing Road, Shanghai ZiZhu Science-based Industrial Park, 200241, China
Tel: +86-21-24162266, Fax: +86-21-24162277

- Wafer Fab

Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd.

800 Yi Shan Road, Shanghai 200233, China
Tel: +86-21-6485 1491, Fax: +86-21-5450 0008

REGIONAL SALES OFFICE

Shenzhen Office

Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd., Shenzhen Office

Unit A Room 1203, Skyworth Bldg., Gaoxin Ave. I.S., Nanshan District, Shenzhen, China
Tel: +86-755-8826 7951
Fax: +86-755-8826 7865

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 Corp.

30920 Huntwood Ave. Hayward, CA 94544, USA
Tel : +1-510-324-2988
Fax: +1-510-324-2788