

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

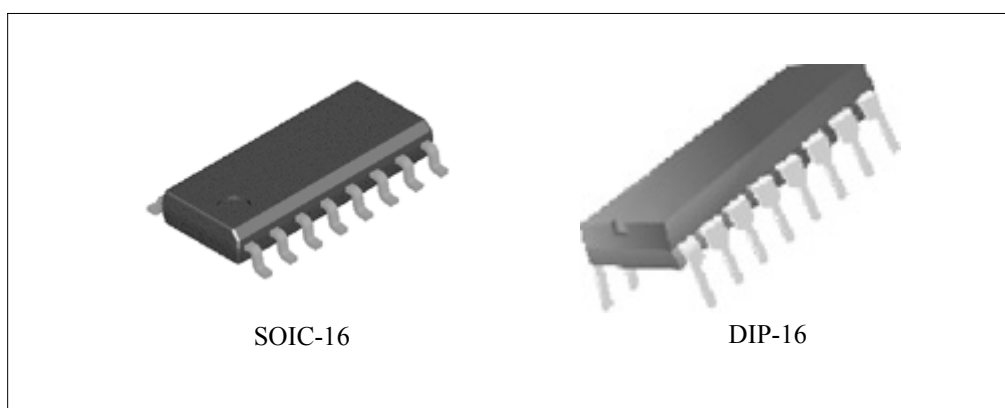


Figure 1. Package Types of AZ494A/C



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Pin Configuration

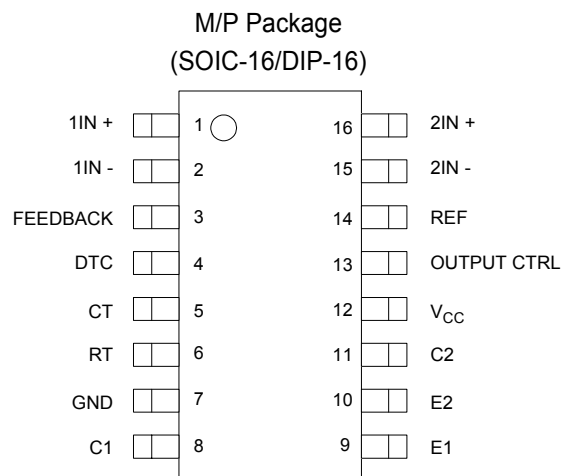


Figure 2. Pin Configuration of AZ494A/C (Top View)

Output Function Control Table

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

Functional Block Diagram

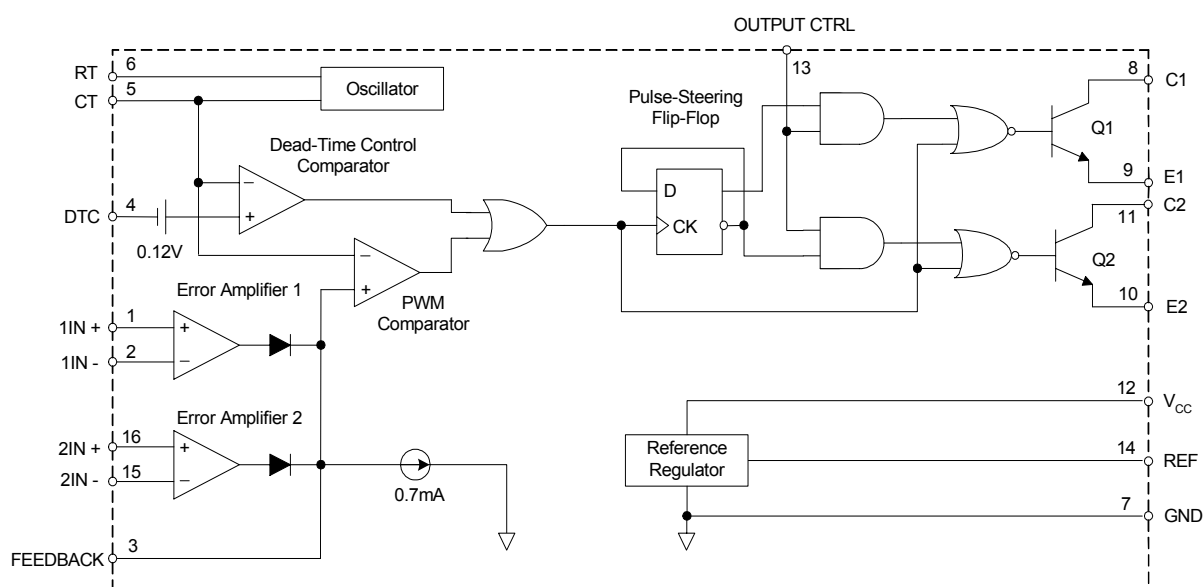
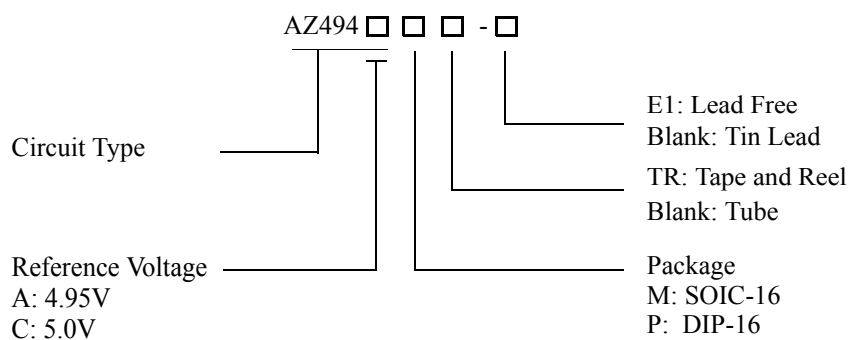


Figure 3. Functional Block Diagram of AZ494A/C

**PULSE-WIDTH-MODULATION CONTROL CIRCUITS****AZ494A/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	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
DIP-16	-40 to 85°C	AZ494AP	AZ494AP-E1	AZ494AP	AZ494AP-E1	Tube
		AZ494CP	AZ494CP-E1	AZ494CP	AZ494CP-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****AZ494A/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

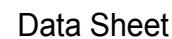
Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{CC}	7	15	36	V
Collector Output Voltage	V_{C1}, V_{C2}		30	36	V
Collector Output Current (Each Transistor)	I_{C1}, I_{C2}			200	mA
Amplifier Input Voltage	V_I	0.3		$V_{CC} - 2$	V
Current Into Feedback Terminal	I_{FB}			0.3	mA
Reference Output Current	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	$^{\circ}\text{C}$


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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} =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 AZ494C	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, V4= 0 to 5.25V		-2	-10	μA
Maximum Duty Cycle	D(MAX)	V _{CC} =15V, V4= 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}	V3 = 2.5V		2	10	mV
Input Offset Current	I _{IO}	V3 = 2.5V		25	250	nA
Input Bias Current	I _{BIAS}	V3 = 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, V3 = 0.7V	-0.3	-0.7		mA
Output Source Current (Feedback)	I _{SOURCE}	V _{ID} =15mV to 5V V3 = 3.5V	2			mA


PULSE-WIDTH-MODULATION CONTROL CIRCUITS
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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

**AZ494A/C**

The diagram shows a DTC (Digital-to-Thermistor Converter) IC with the following connections:

- V_{CC} = 20V** connected to pin 12.
- GND** connected to pin 7.
- REF** connected to pin 14.
- OUTPUT CTRL** connected to pin 13.
- 1IN+** connected to pin 16.
- 2IN+** connected to pin 15.
- 2IN-** connected to pin 13.
- CT** connected to pin 1.
- RT** connected to pin 5.
- FEEDBACK** connected to pin 6.
- Test Inputs** connected to pins 3 and 4.
- C1** connected to pin 8.
- E1** connected to pin 9.
- C2** connected to pin 11.
- E2** connected to pin 10.

External components and connections include:

- A **12KΩ** resistor between pins 6 and 5.
- A **0.01μF** capacitor between pins 5 and 1.
- A **50KΩ** resistor between pins 16 and 13.
- Two **150Ω 4W** resistors between pins 12 and 8, and pins 12 and 11.
- The output of the IC is connected to **Output 1** and **Output 2**.

Test Circuit

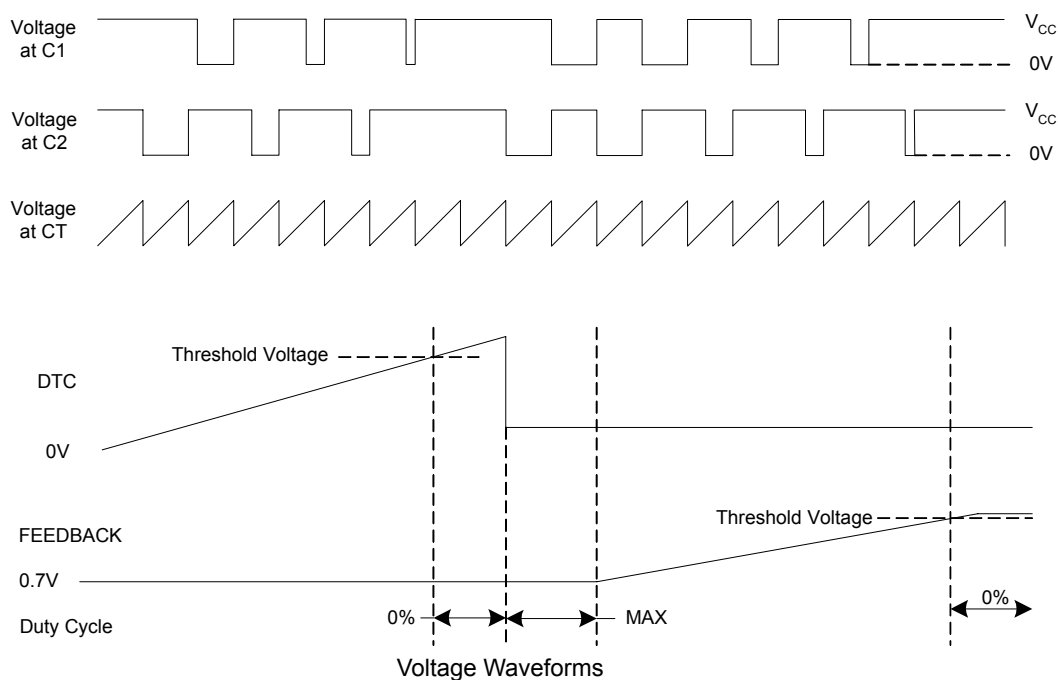


Figure 4. Operational Test Circuit and Waveforms

PULSE-WIDTH-MODULATION CONTROL CIRCUITS

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Parametr Measurement information (Continued)

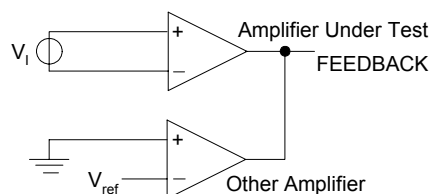
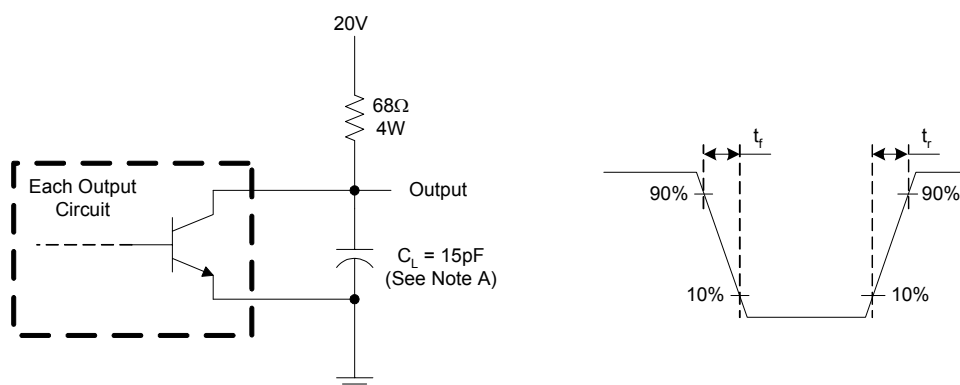
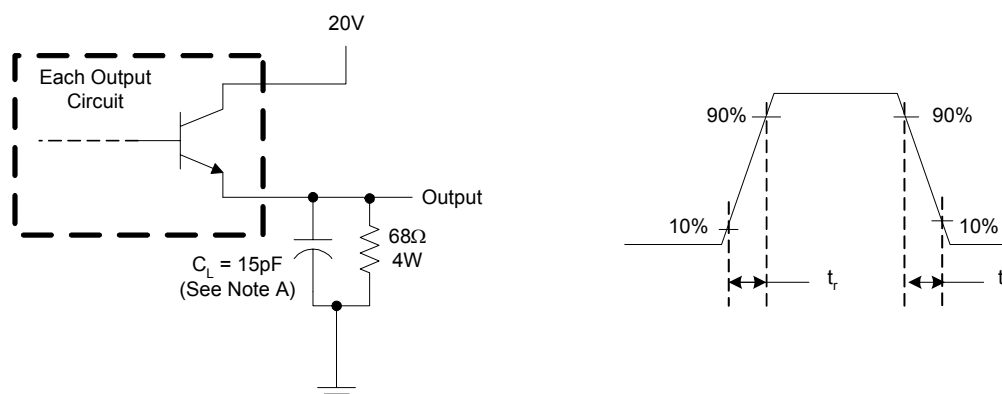


Figure 5. Error Amplifier Characteristics



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

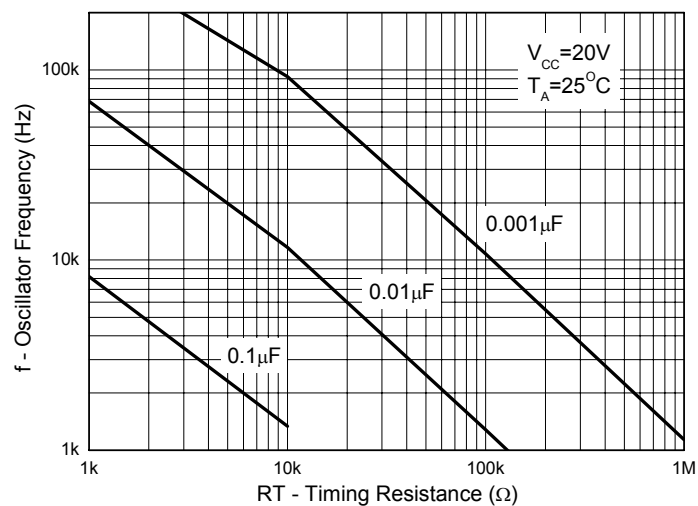
**Typical Performance Characteristics**

Figure 8. Oscillator Frequency vs. RT and CT

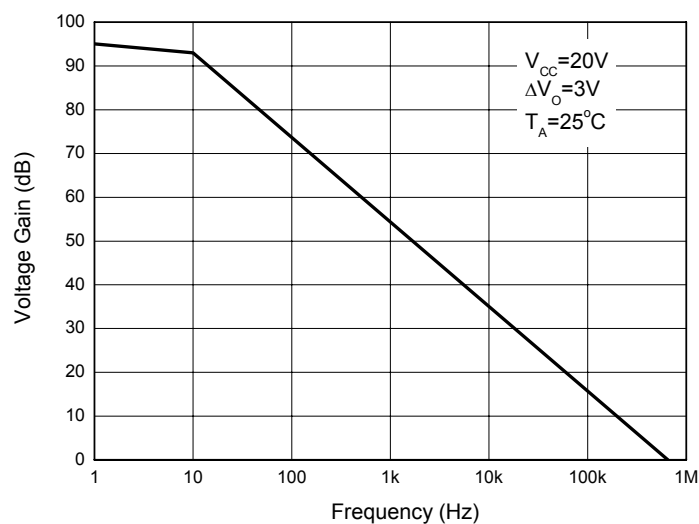
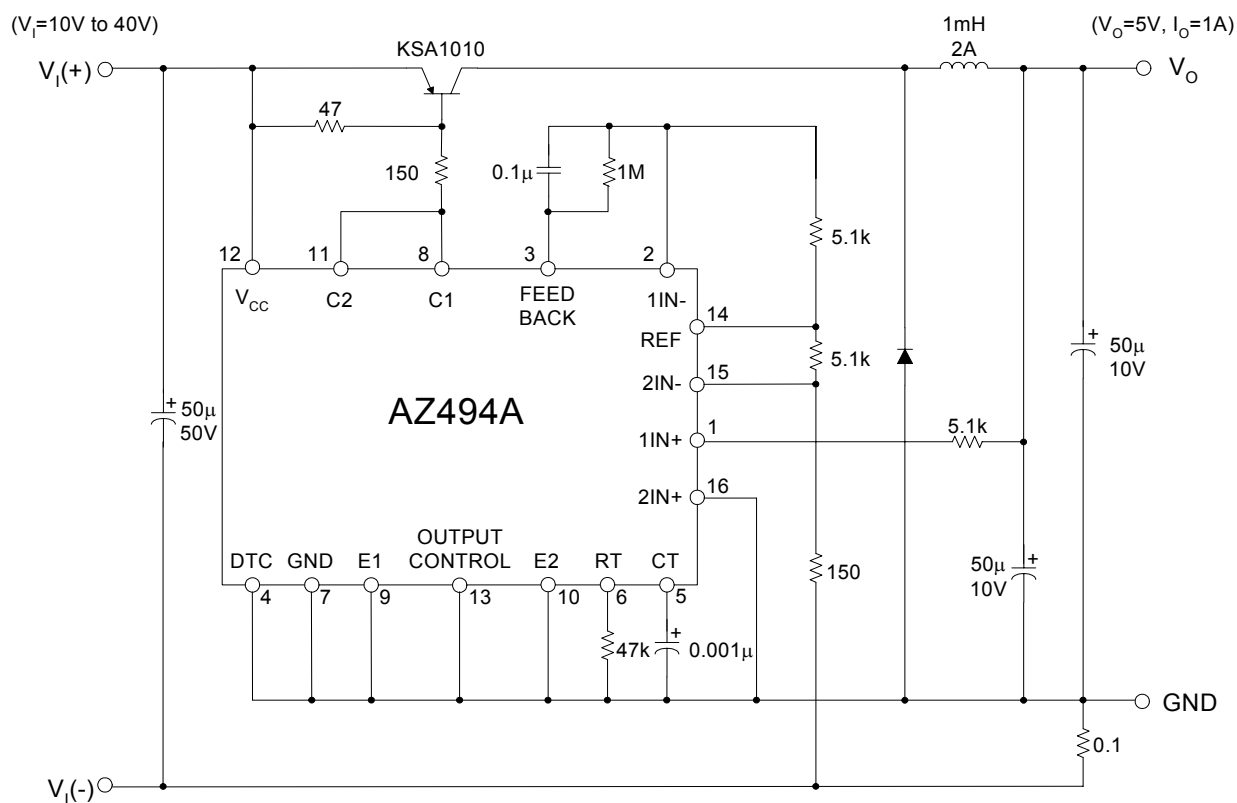


Figure 9. Error Amplifier Small-Signal Voltage Gain vs. Frequency

Typical Applications



**AZ494A/C****SOIC-16**

Unit: mm(inch)

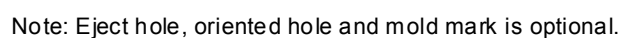


**AZ494A/C**

Mechanical Dimensions (Continued)

DIP-16

Unit: mm(inch)





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