

**PULSE-WIDTH-MODULATION CONTROL CIRCUITS****AZ494B/D****General Description**

The AZ494B/D is a voltage mode pulse width modulation switching regulator control circuit designed primarily for power supply control.

The AZ494B/D 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 AZ494B/D is capable for push-pull or single-ended output operation, which can be selected through the output control.

AZ494B has 4.95V and AZ494D has 5V reference voltage respectively. The precision of voltage reference (V_{REF}) is improved up to $\pm 1.5\%$ through trimming and this provides a better output voltage regulation.

The AZ494B/D is available in standard packages of DIP-16 and SOIC-16.

Features

- Stable 4.95V for AZ494B or 5V for AZ494D Reference Voltage Trimmed to $\pm 1.5\%$ 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

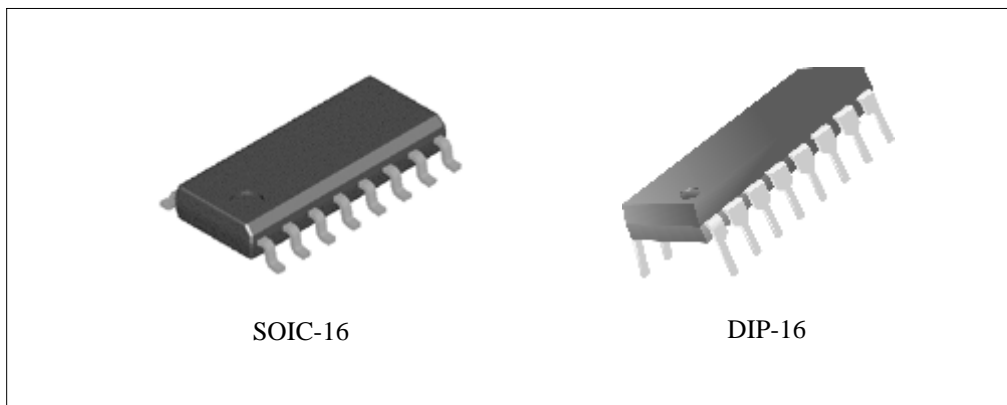


Figure 1. Package Types of AZ494B/D



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Pin Configuration

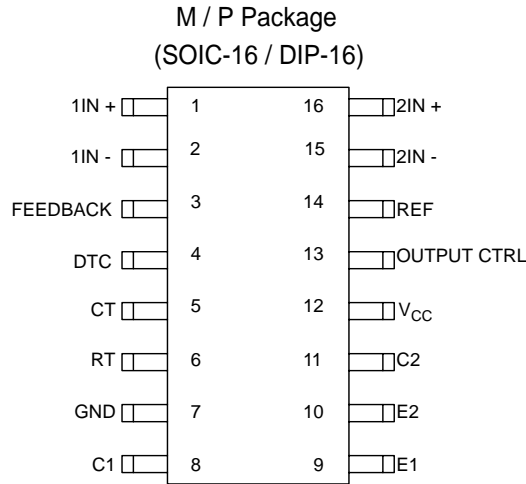


Figure 2. Pin Configuration of AZ494B/D (Top View)

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

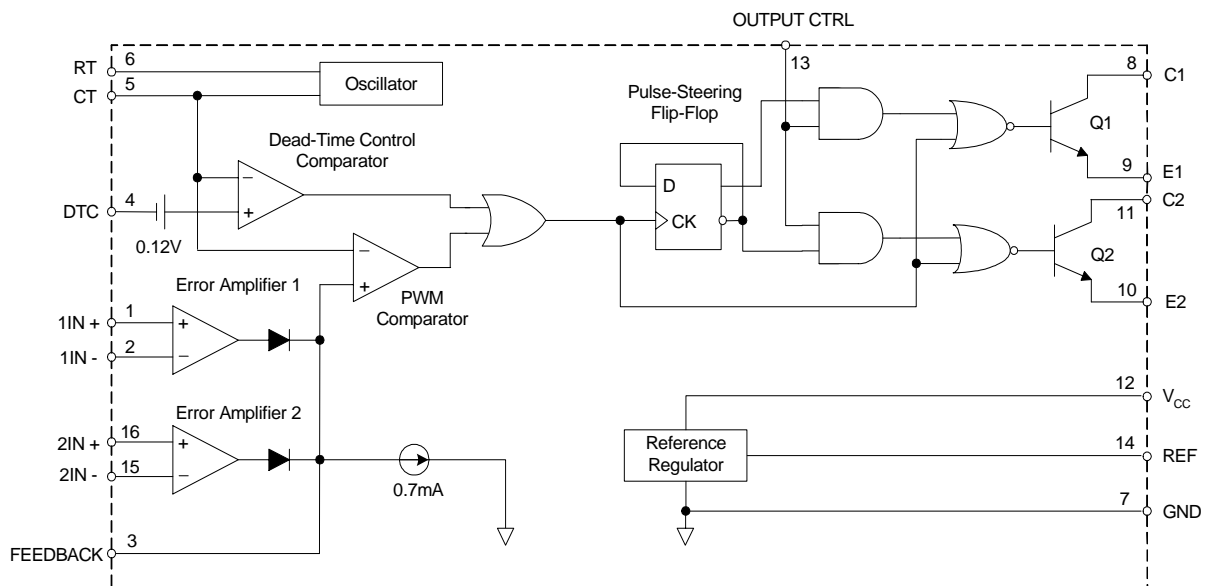


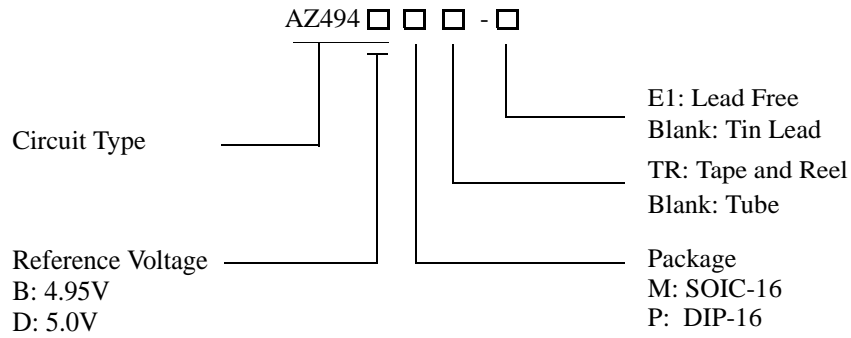
Figure 3. Functional Block Diagram of AZ494B/D



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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	AZ494BM	AZ494BM-E1	AZ494BM	AZ494BM-E1	Tube
		AZ494BMTR	AZ494BMTR-E1	AZ494BM	AZ494BM-E1	Tape & Reel
		AZ494DM	AZ494DM-E1	AZ494DM	AZ494DM-E1	Tube
		AZ494DMTR	AZ494DMTR-E1	AZ494DM	AZ494DM-E1	Tape & Reel
DIP-16		AZ494BP	AZ494BP-E1	AZ494BP	AZ494BP-E1	Tube
		AZ494DP	AZ494DP-E1	AZ494DP	AZ494DP-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****AZ494B/D****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)	θ_{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 $T_J(\max)$, θ_{JA} and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\max) - T_A) / \theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{CC}	7	36	V
Amplifier Input Voltage	V_I	-0.3	$V_{CC} - 2$	V
Collector Output Voltage	V_O		36	V
Collector Output Current (Each Transistor)			200	mA
Current Into Feedback Terminal			0.3	mA
Oscillator Frequency	f_{osc}		300	KHz
Timing Capacitor	C_T	0.47	10000	nF
Timing Resistor	R_T	1.8	500	K Ω
Operating Free-Air Temperature	T_A	-40	85	°C
Reference Output Current	I_{REF}		10	mA



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Electrical Characteristics

$T_A = 25^{\circ}\text{C}$, $V_{CC}=15\text{V}$, $f=10\text{KHz}$ unless otherwise noted.

Parameter	Symbol	Conditions (Note 4)	Min	Typ	Max	Unit	
Reference Section							
Output Reference Voltage	for AZ494B	V_{REF}	$I_{REF}=1\text{mA}$	4.875	4.95	5.025	V
	for AZ494D	V_{REF}	$I_{REF}=1\text{mA}$	4.925	5.0	5.075	V
Line Regulation	R_{LINE}	$V_{CC} = 7\text{V to } 36\text{V}$		2	25	mV	
Load Regulation	R_{LOAD}	$I_{REF}=1\text{mA to } 10\text{mA}$		1	15	mV	
Short-Circuit Output Current(Note 5)	I_{SC}	$V_{REF} = 0\text{V}$		25		mA	
Oscillator Section, $C_T = 0.01\mu\text{F}$, $R_T = 12\text{K}\Omega$ (See Figure 4)							
Frequency	f_{osc}			10		KHz	
Standard Deviation of Frequency (Note 6)		All values of V_{CC} , C_T , R_T and T_A constant		100		Hz/KHz	
Frequency Change with Voltage		$V_{CC}=7\text{V to } 36\text{V}$, $T_A = 25^{\circ}\text{C}$		1		Hz/KHz	
Frequency Change with Temperature (Note 7)		$\Delta T_A = \text{MIN to MAX}$			10	Hz/KHz	
Error-Amplifier Section							
Input Offset Voltage	V_{IO}	$V_O (\text{FEEDBACK}) = 2.5\text{V}$		2	10	mV	
Input Offset Current	I_{IO}	$V_O (\text{FEEDBACK}) = 2.5\text{V}$		25	250	nA	
Input Bias Current	I_{BIAS}	$V_O (\text{FEEDBACK}) = 2.5\text{V}$		0.2	1	μA	
Common-Mode Input Voltage Range	V_{CM}	$V_{CC}=7\text{V to } 36\text{V}$	-0.3		$\frac{V_{CC}-2}{2}$	V	
Large-Signal Open-Loop Voltage Gain	A_{VO}	$\Delta V_O = 3\text{V}$, $R_L = 2\text{K}\Omega$, $V_O = 0.5\text{V to } 3.5\text{V}$	70	95		dB	
Unity-Gain Bandwidth	GB			800		KHz	
Common-Mode Rejection Ratio	CMRR	$V_{CC}=7\text{V to } 36\text{V}$	65	80		dB	
Output Sink Current (FEEDBACK)	I_{SINK}	$V_{ID} = -15\text{mV to } -5\text{V}$, $V(\text{FEEDBACK}) = 0.7\text{V}$	- 0.3	- 0.7		mA	
Output Source Current (FEEDBACK)	I_{SOURCE}	$V_{ID} = 15\text{mV to } 5\text{V}$, $V(\text{FEEDBACK}) = 3.5\text{V}$	2			mA	
Output Section							
Collector Off-State Current	$I_{C, OFF}$	$V_{CE} = 36\text{V}$, $V_{CC}=36\text{V}$		2	100	μA	
Emitter Off-State Current	$I_{E, OFF}$	$V_{CC} = V_C = 36\text{V}$, $V_E = 0$			-100	μA	
Collector-Emitter Saturation Voltage	Common Emitter	$V_E = 0$, $I_C = 200\text{mA}$		1.1	1.3	V	
	Emitter Follower	$V_O (C1 \text{ or } C2) = 15\text{V}$, $I_E = -200\text{mA}$		1.5	2.5		



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Electrical Characteristics (Continued)

Parameter	Symbol	Conditions (Note 4)	Min	Typ	Max	Unit	
Output Control Input Current		$V_1 = V_{REF}$			3.5	mA	
Dead-Time Control Section							
Input Bias Current		$V_1 = 0$ to 5.25V		-2	-10	μ A	
Maximum Duty Cycle, Each Output		V_1 (DEAD-TIME CTRL) = 0, $C_T = 0.01\mu$ F, $R_T = 12K\Omega$		45		%	
Input Threshold Voltage		Zero Duty Cycle		3	3.3	V	
		Maximum Duty Cycle	0				
PWM Comparator Section (See Figure 4)							
Input Threshold Voltage (FEEDBACK)		Zero duty cycle		4	4.5	V	
Input Sink Current (FEEDBACK)		$V(\text{FEEDBACK}) = 0.7V$	-0.3	-0.7		mA	
Total Device							
Standby Supply Current	I_{STDBY}	$V_{RT} = V_{REF}$, All other inputs and outputs open	$V_{CC} = 15V$		6	10	mA
			$V_{CC} = 36V$		9	15	
Average Supply Current		V_1 (DEAD-TIME-CTRL) = 2V See Figure 4.		7.5		mA	
Switching Characteristics							
Rise Time	t_r	Common-emitter Configuration See Figure 6		100	200	ns	
Fall Time	t_f			25	100	ns	
Rise Time	t_r	Emitter-follower Configuration See Figure 7		100	200	ns	
Fall Time	t_f			40	100	ns	

Note 4: For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

Note 5: Duration of the short circuit should not exceed one second.

Note 6: Standard deviation is a measure of the statistical distribution about the mean as derived from the formula:

$$\sigma = \sqrt{\frac{\sum_{n=1}^N (X_n - \bar{X})^2}{N - 1}}$$

Note 7: Temperature coefficient of timing capacitor and timing resistor are not taken into account.



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Parametr Measurement information

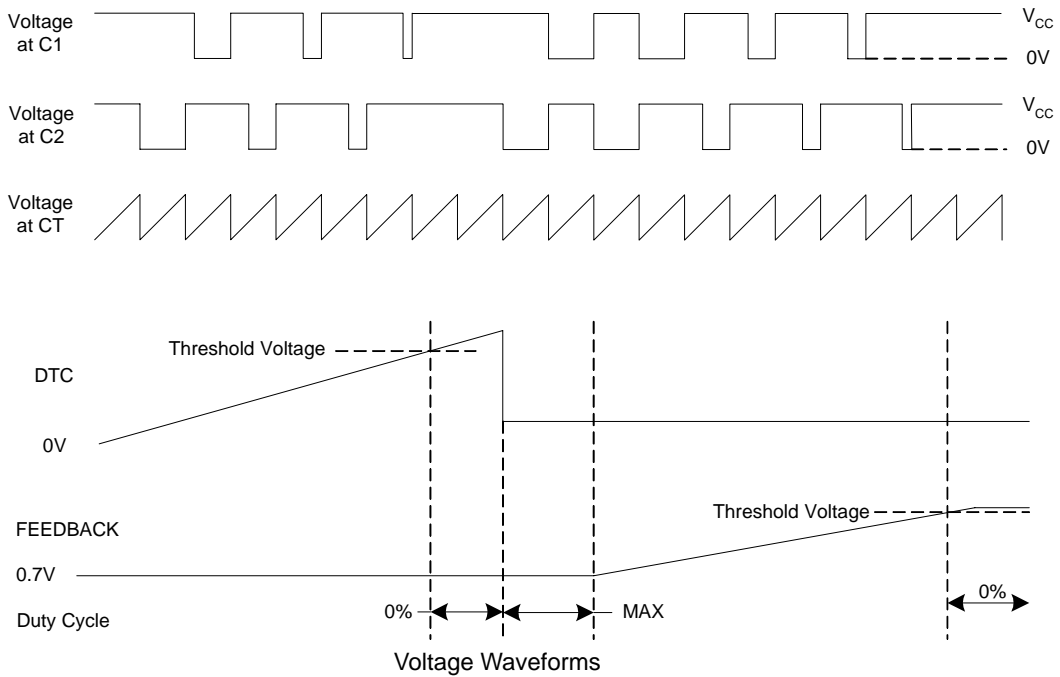
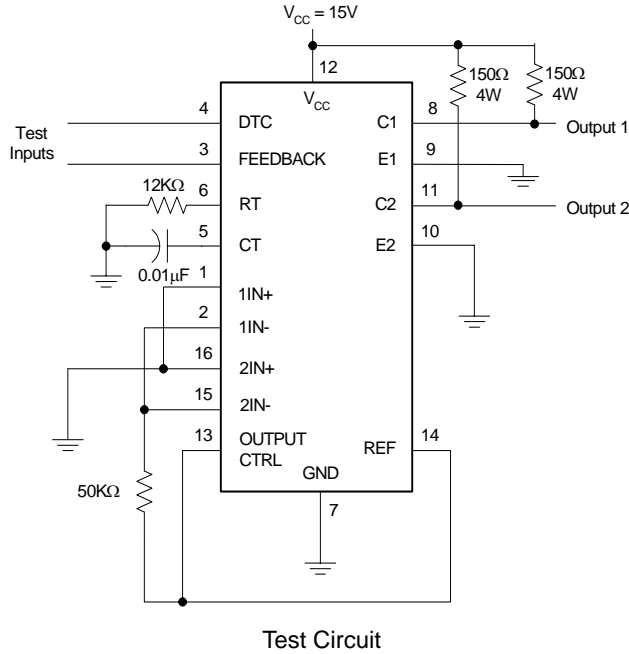


Figure 4. Operational Test Circuit and Waveforms



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Parametr Measurement information (Continued)

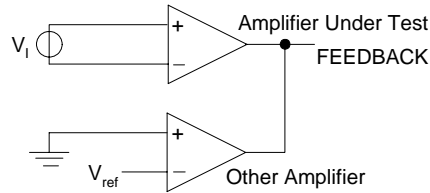
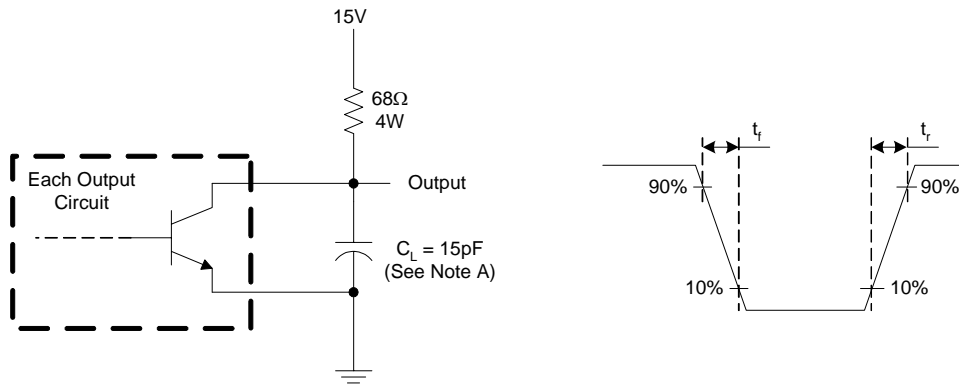
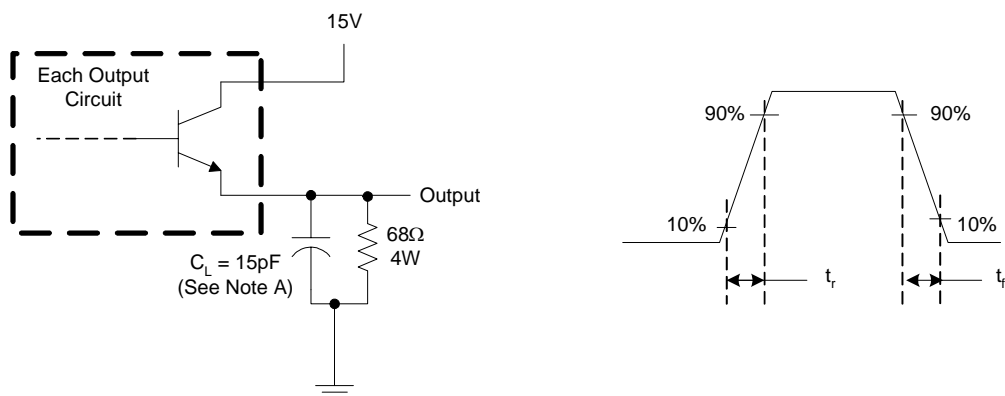


Figure 5. Error Amplifier Characteristics



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

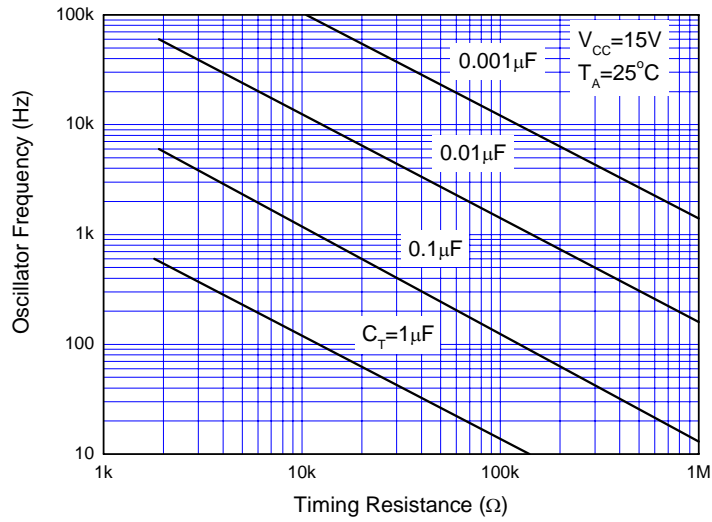


Figure 8. Oscillator Frequency vs. R_T and C_T

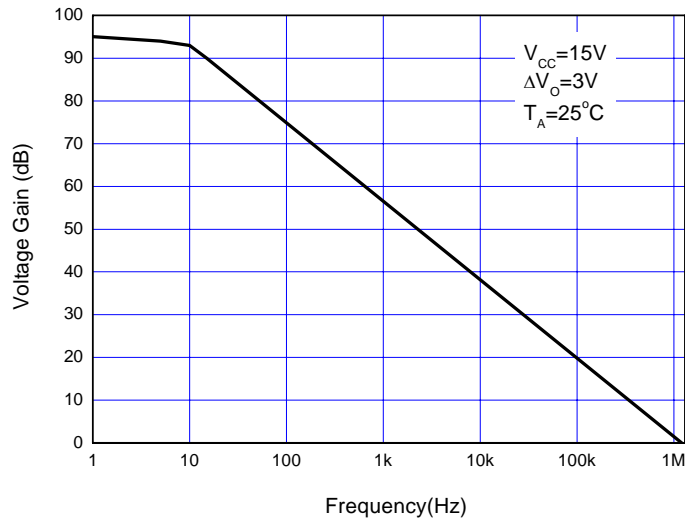


Figure 9. Error Amplifier Small-Signal Voltage Gain vs. Frequency



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