PULSE-WIDTH-MODULATION CONTROL CIRCUITS AZ494A

General Description

The AZ494A incorporates on a single chip all the functions required in the construction of a pulse-width-modulation (PWM) control circuit. Designed primarily for power supply control, this device offers the flexibility to tailor the power supply control circuitry to a specific application.

The AZ494A contains two error amplifiers, an on-chip adjustable oscillator, a dead-time control (DTC) comparator, a pulse-steering control flip-flop, a 5V regulator, and output control circuits. The error amplifiers exhibit a common-mode voltage range from -0.3V to V_{CC}-2V. The dead-time control comparator has a fixed offset that provides approximately 5% dead time. The on-chip oscillator can be bypassed by terminating the RT pin to the reference output and providing a sawtooth input to the CT pin, or it can drive the common circuits in synchronous multiple-rail power supplies.

The uncommitted output transistors can be configured in either common-emitter or emitter-follower output topology. The AZ494A provides for push-pull or single-ended output operation, which can be selected through the output control function. The architecture of this device prohibits the possibility of either output being pulsed twice during push-pull operation. The AZ494A is characterized for operation from -40^{o}C to 85^{o}C.

Features

- Complete PWM power-control circuitry
- Uncommitted outputs for 200mA sink or source current
- Output control selects single-ended or push-pull operation
- Internal circuitry prohibits double pulse at either output
- Variable dead time provides control over total range
- Internal regulator provides a stable 5V reference supply with ±1.5% tolerance
- Circuit architecture allows easy synchronization

Applications

- SMPS
- Back Light Inverter

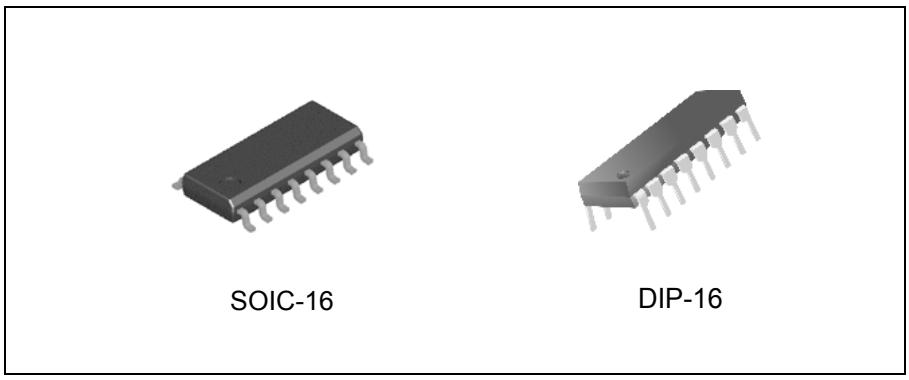
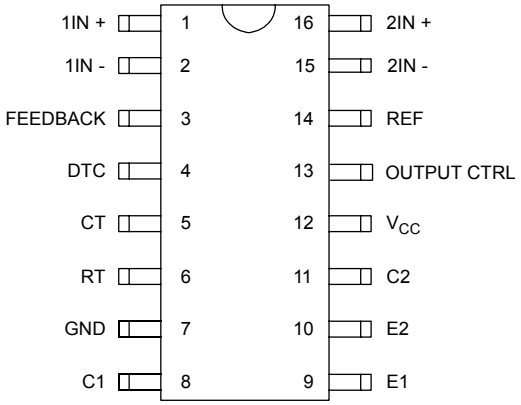


Figure 1. Package Types of AZ494A

Pin Configuration

M Package / P Package
(SOIC-16 / DIP-16)



Top View

Figure 2. Pin Configuration of AZ494A

Function Table

Input To Output Control	Output Function
V_I = GND	Single-ended or parallel output
V_I = V_{ref}	Normal push-pull operation

Functional Block Diagram

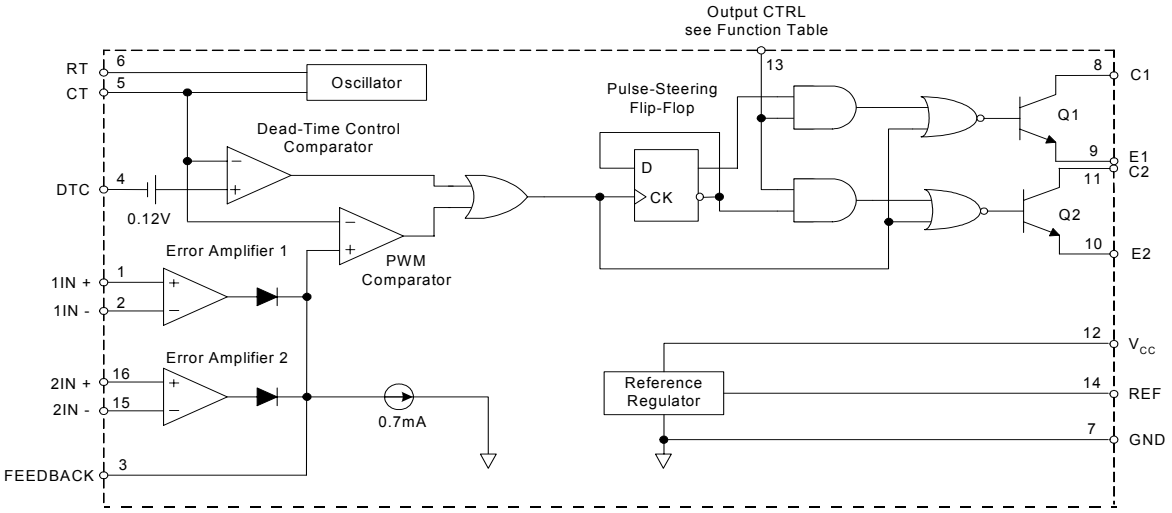


Figure 3. Functional Block Diagram of AZ494A

Ordering Information

Package	Temperature Range	Part Number	Marking ID	Packing Type
SOIC-16	-40°C~85°C	AZ494AM	AZ494AM	Tube
DIP-16		AZ494AP	AZ494AP	Tube

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	°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 $T_J(max)$, 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	KΩ
Operating Free-Air Temperature	T_A	-40	85	^oC

Electrical Characteristics

All typical values, except for parameter changes with temperature, are at $T_A = 25^oC$.

Vcc=15V, f=10KHz unless otherwise noted.

Parameter		Symbol	Conditions (Note 4)	Min	Typ	Max	Unit
Reference Section							
Output Voltage (REF)		Vref	IO=1mA	4.90	5.00	5.05	V
Line Regulation			V_{CC} = 7V to 36V		2	25	mV
Load Regulation			I_O=1mA to 10mA		1	15	mV
Output Voltage Change with Temperature			ΔT_A = MIN to MAX		2	10	mV/V
Short-Circuit Output Current (Note 5)		I_{SC}	REF = 0V		25		mA
Oscillator Section, C_T = 0.01μF, R_T = 12KΩ (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}=7V to 36V, T_A = 25°C		1		Hz/KHz
Frequency Change with Temperature (Note 7)			ΔT_A= MIN to MAX			10	Hz/KHz
Error-Amplifier Section (See Figure 5)							
Input Offset Voltage		V_{OS}	V_O (FEEDBACK) = 2.5V		2	10	mV
Input Offset Current		I_{OS}	V_O (FEEDBACK) = 2.5V		25	250	nA
Input Bias Current		I_{BIAS}	V_O (FEEDBACK) = 2.5V		0.2	1	μA
Common-Mode Input Voltage Range			V_{CC}=7V to 36V	-0.3 to V_{CC}-2			V
Large-Signal Open-Loop Voltage Gain		A_{VO}	ΔV_O = 3V, R_L =2KΩ, V_O =0.5V to 3.5V	70	95		dB
Large-Signal Unity-Gain Bandwidth		GB	V_O =0.5V to 3.5V, R_L =2KΩ		800		KHz
Common-Mode Rejection Ratio		CMRR	ΔV_O = 36V, T_A = 25°C	65	80		dB
Output Sink Current (FEEDBACK)		I_{SINK}	V_{ID} = -15mV to -5V, V(FEEDBACK) = 0.7V	0.3	0.7		mA
Output Source Current (FEEDBACK)		I_{SOURCE}	V_{ID} = 15mV to 5V, V(FEEDBACK) = 3.5V	-2			mA
Output Section							
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
Collector-Emitter Saturation Voltage	Common Emitter		V_E = 0, I_C =200mA		1.1	1.3	V
	Emitter Follower		V_O (C1 or C2) = 15V, I_E = -200mA		1.5	2.5	

Electrical Characteristics (Continued)

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Output Control Input Current		$V_I = V_{ref}$				3.5	mA
Dead-Time Control Section							
Input Bias Current		V_I = 0 to 5.25V			-2	-10	μA
Maximum Duty Cycle, Each Output		V_I (DEAD-TIME CTRL) = 0, C_T =0.01μF, R_T =12KΩ			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(FEEDBACK) = 0.7V		0.3	0.7		mA
Total Device							
Standby Supply Current	I_{STDBY}	RT=V_{ref}, All other inputs and outputs open	V_{CC} = 15V		6	10	mA
			V_{CC} = 36V		9	15	
Average Supply Current		V_I (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.

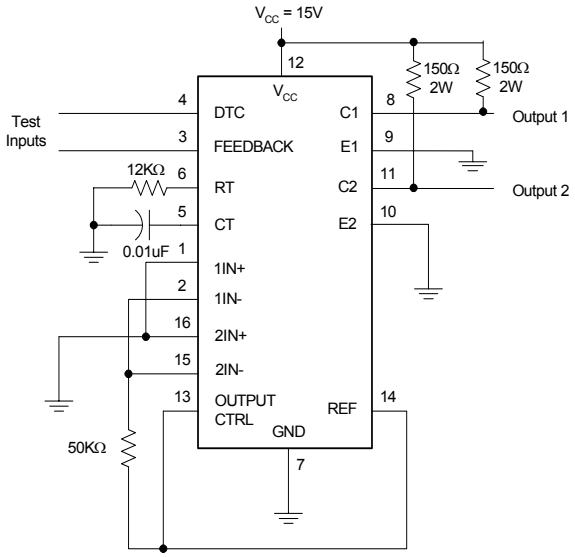
Note 5: Duration of the short circuit should not exceed one second.

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

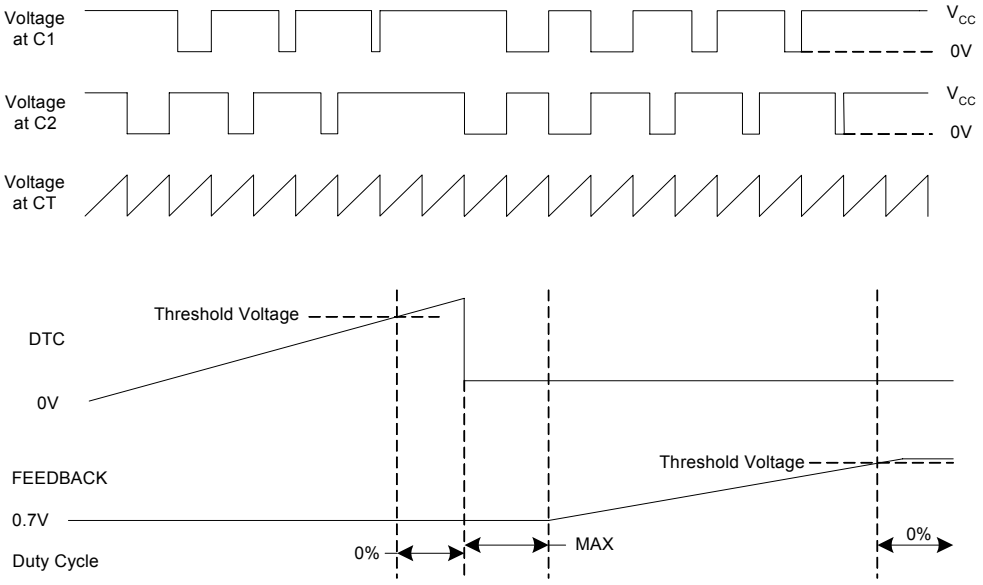
$$\sigma = \sqrt{\frac{\sum_{n=1}^{N} (X_n - \bar{X})^2}{N-1}}$$

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

Parameter Measurement Information



Test Circuit



Voltage Waveforms

Figure 4. Operational Test Circuit and Waveforms

Parameter Measurement Information

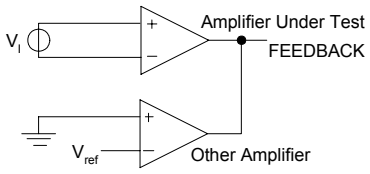
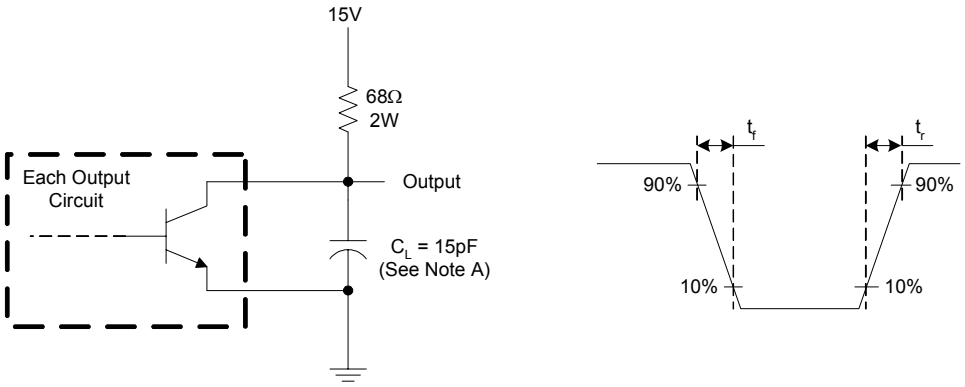
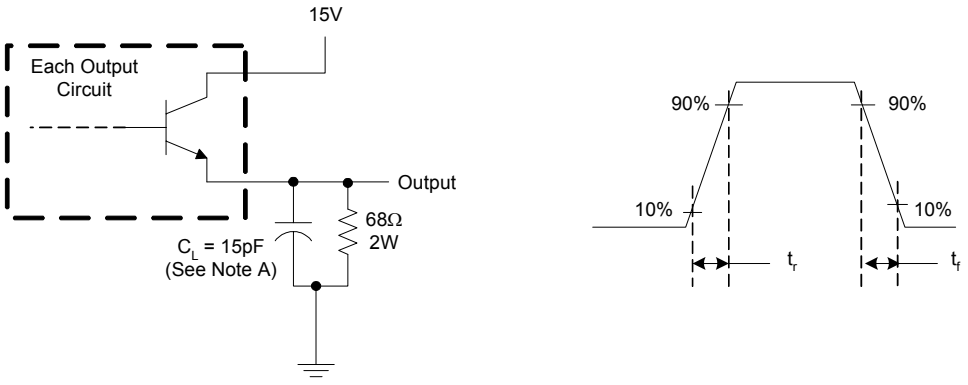


Figure 5. Error Amplifier Characteristics



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

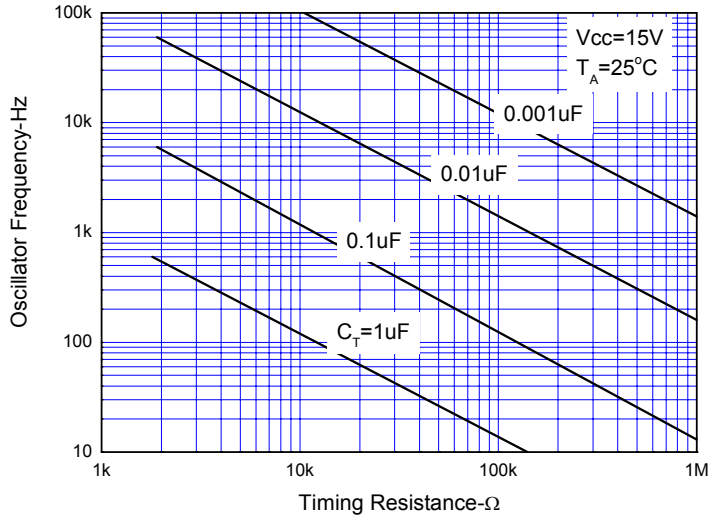


Figure 8. Oscillator Frequency vs. Timing Resistance

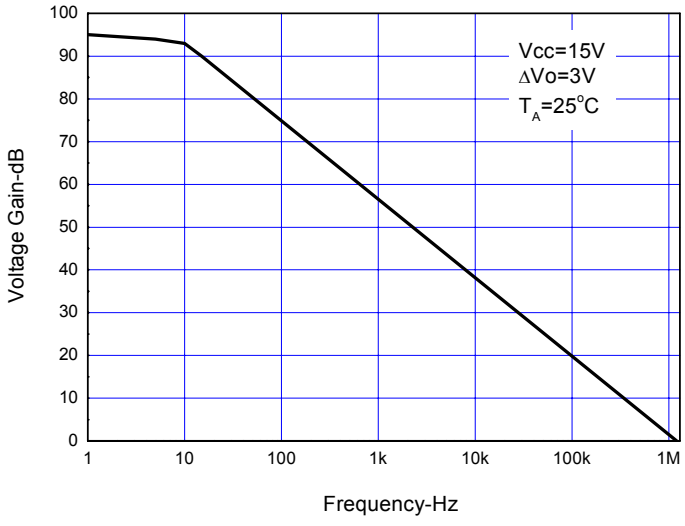
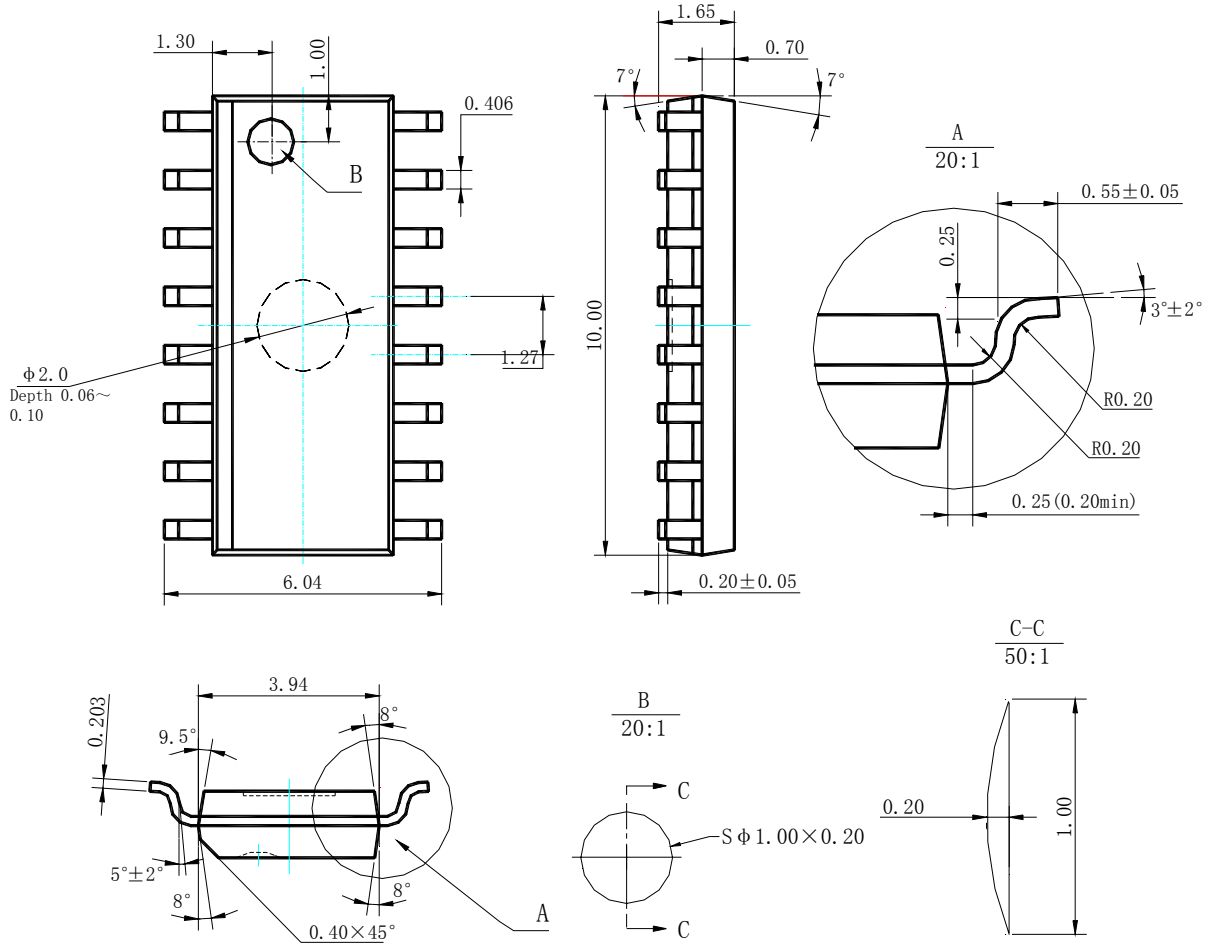


Figure 9. Error Amplifier Small-Signal Voltage Gain vs. Frequency

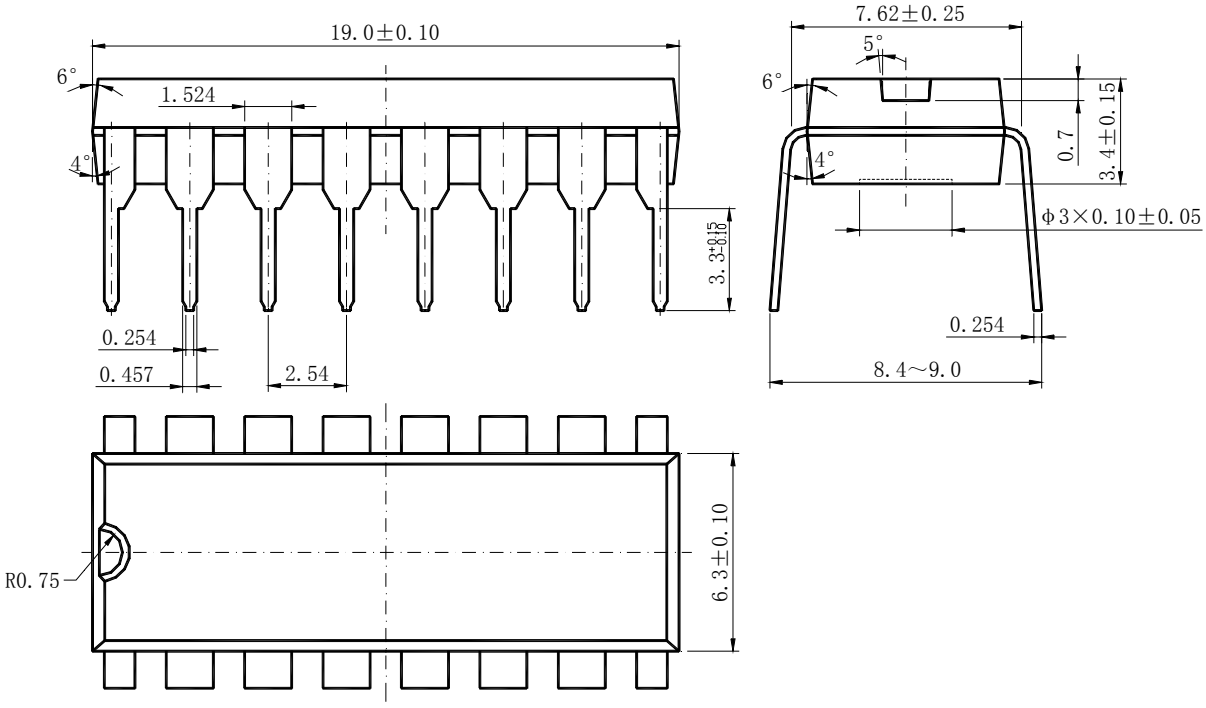
Mechanical Dimensions

SOIC-16 **Unit: mm**



Mechanical Dimensions (Continued)

DIP-16 **Unit: mm**



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