AZ494

Lead-free Green

VOLTAGE MODE DUAL OUTPUT PWM CONTROLLER

Description

The DIODES™ AZ494 is a voltage mode pulse width modulation switching regulator control circuit designed primarily for power supply control.

The AZ494 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 ±1% through trimming and this provides a better output voltage regulation. The AZ494 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 AZ494 is available in standard packages of PDIP-16 and SO-16.

Features

- Stable 4.95V/5V Reference Voltage Trimmed to ±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
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Applications

- SMPS
- Back Light Inverter
- Charger

Pin Assignments

(Top View)

1IN+	1		16	2IN+
1IN-	2		15	2IN-
FEEDBACK	3		14	REF
DTC	4		13	OUTPUT CTRL
CT	5		12	V_{CC}
RT	6		11	C2
GND	7		10	E2
C1	8		9	E1

SO-16

(Top View)

| 1IN+ | 1 | | 16 | 2IN+ |
1IN-	2		15	2IN-
FEEDBACK	3		14	REF
DTC	4		13	OUTPUT CTRL
CT	5		12	V_{CC}
RT	6		11	C2
GND	7		10	E2
C1	8		9	E1

PDIP-16

Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
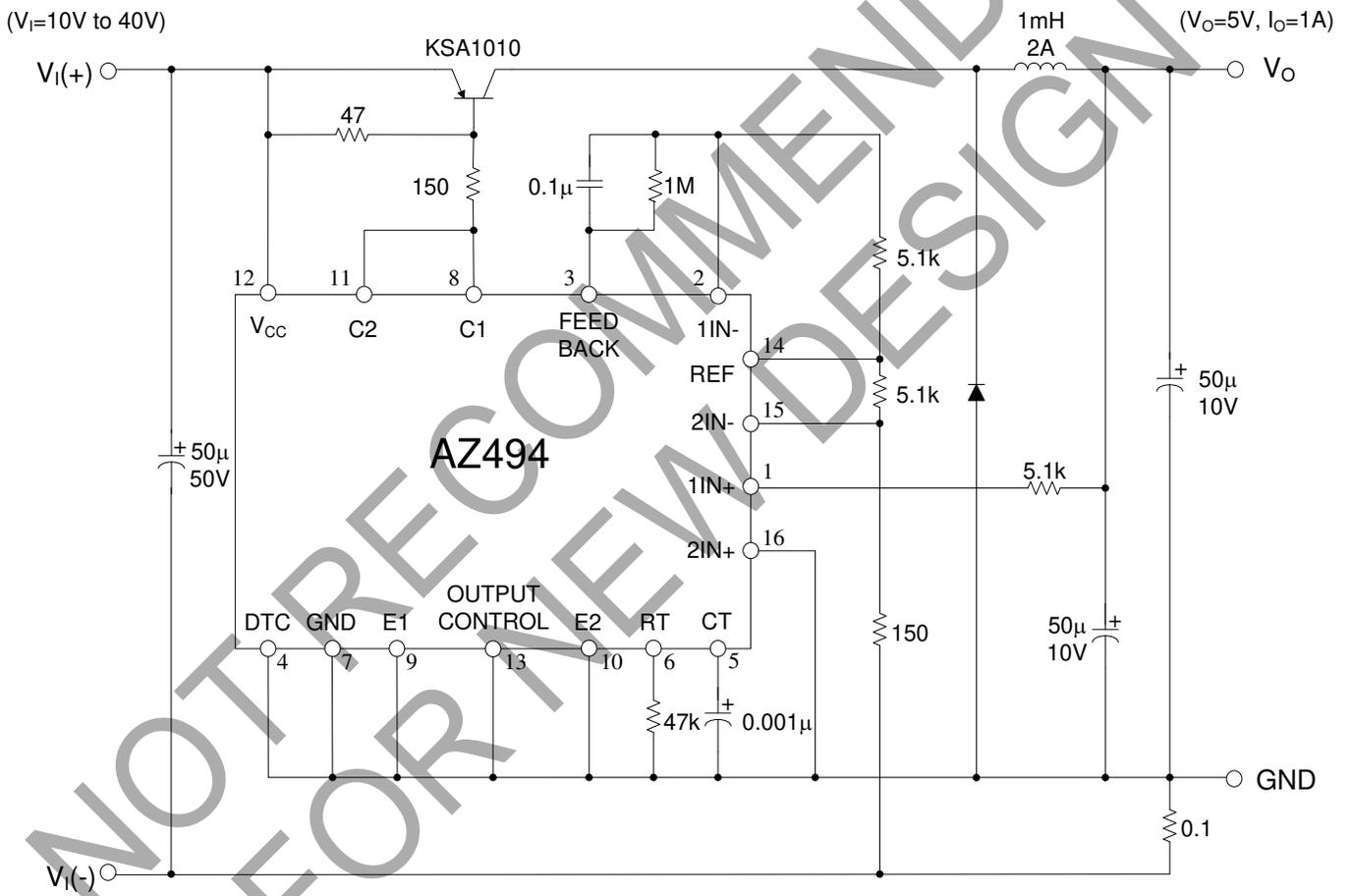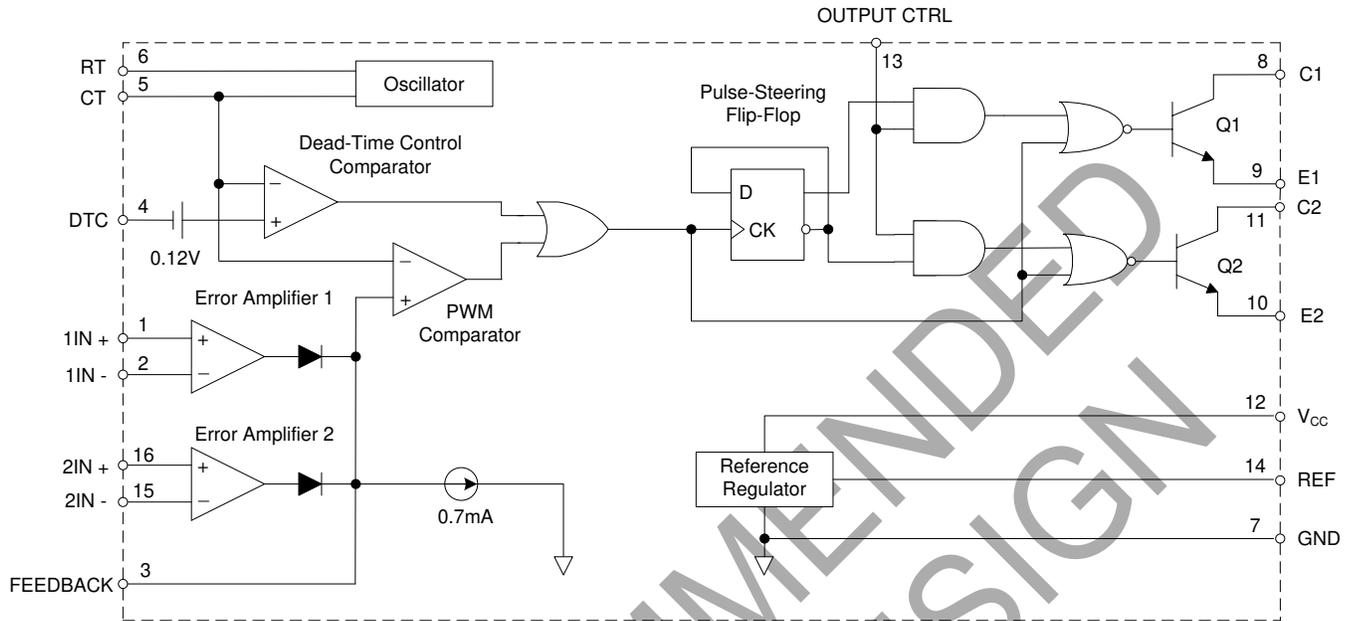
AZ494
Document number: DS37862 Rev. 2 - 3

1 of 13
www.diodes.com

August 2022
© Diodes Incorporated
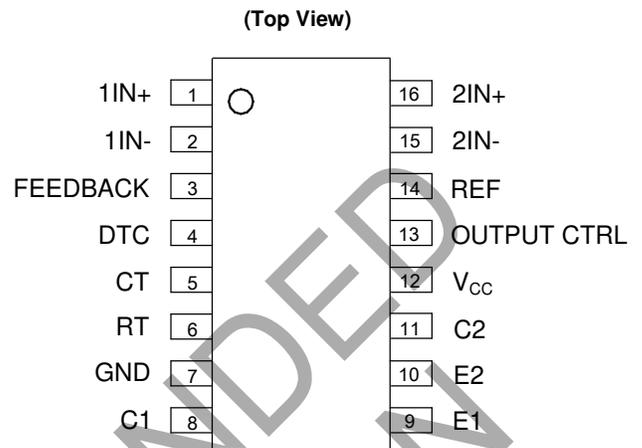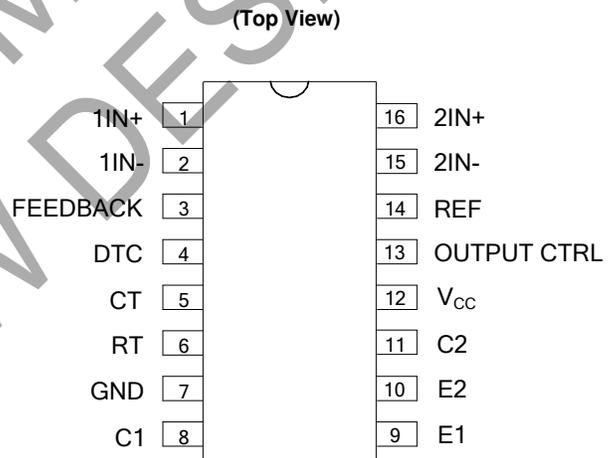
Output Function Control Table

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

Typical Applications Circuit

Pulse Width Modulated Step-Down Converter

AZ494
Document number: DS37862 Rev. 2 - 3

2 of 13
www.diodes.com

August 2022
© Diodes Incorporated

Functional Block Diagram

Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Rating		Unit
V_{CC}	Supply Voltage (Note 5)	40		V
V_I	Amplifier Input Voltage	-0.3 to V_{CC} + 0.3		V
V_O	Collector Output Voltage	40		V
I_O	Collector Output Current	250		mA
θ_{JA}	Package Thermal Impedance (Note 6)	M Package	73	^{o}C/W
		P Package	67	
	Lead Temperature 1.6mm from case for 10 seconds	+260		^{o}C
T_{STG}	Storage Temperature Range	-65 to +150		^{o}C
—	ESD Rating (Machine Model)	200		V

Notes: 4. 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.

5. All voltage values are with respect to the network ground terminal.

6. 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)/ θ_{JA}. Operating at the absolute maximum T_J of +150°C can affect reliability.

AZ494
Document number: DS37862 Rev. 2 - 3

3 of 13
www.diodes.com

August 2022
© Diodes Incorporated

Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Supply Voltage	7	15	36	V
V_{C1}, V_{C2}	Collector Output Voltage	–	30	36	V
I_{C1}, I_{C2}	Collector Output Current(Each Transistor)	–	–	200	mA
V_I	Amplifier Input Voltage	0.3	–	V_{CC} - 2	V
I_{FB}	Current Into Feedback Terminal	–	–	0.3	mA
I_{REF}	Reference Output Current	–	–	10	mA
C_T	Timing Capacitor	0.00047	0.001	10	μF
R_T	Timing Resistor	1.8	30	500	kΩ
f_{osc}	Oscillator Frequency	1.0	40	200	kHz
–	PWM Input Voltage (Pin 3, 4, 14)	0.3	–	5.3	V
T_A	Operating Free-Air Temperature	-40	–	+85	^{o}C

Electrical Characteristics (T_A=+25°C, V_{CC}=20V, f=10kHz, unless otherwise noted.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Reference Section						
V_{REF}	Output Reference Voltage for AZ494A	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
V_{REF}	Output Reference Voltage for AZ494C	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
R_{LINE}	Line Regulation	V_{CC} = 7V to 36V	–	2	25	mV
R_{LOAD}	Load Regulation	I_{REF}=1mA to 10mA	–	1	15	mV
I_{SC}	Short-Circuit Output Current	V_{REF} = 0V	10	35	50	mA
Oscillator Section						
f_{OSC}	Oscillator Frequency	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	
$\Delta f / \Delta T$	Frequency Change with Temperature	C_T=0.01μF, R_T=12kΩ T_A= -40 to +85°C	–	–	1	%

AZ494
Document number: DS37862 Rev. 2 - 3

4 of 13
www.diodes.com

August 2022
© Diodes Incorporated

Electrical Characteristics $(T_A=+25^oC, V_{CC}=20V, f=10kHz$ unless otherwise noted.) (Cont.)

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Dead-Time Control Section							
I_{BIAS}	Input Bias Current	$V_{CC}=15V, V_{PIN4}= 0$ to 5.25V		–	-2	-10	µA
D(MAX)	Maximum Duty Cycle	$V_{CC}=15V, V_{PIN4}= 0V, V_{PIN13}= V_{REF}$		45	–	–	%
V_{ITH}	Input Threshold Voltage	Zero Duty Cycle		–	3	3.3	V
		Maximum Duty Cycle		0	–	–	
Error-Amplifier Section							
V_{IO}	Input Offset Voltage	$V_{PIN3} = 2.5V$		–	2	10	mV
I_{IO}	Input Offset Current	$V_{PIN3} = 2.5V$		–	25	250	nA
I_{BIAS}	Input Bias Current	$V_{PIN3} = 2.5V$		–	0.2	1	µA
V_{CM}	Common-Mode Input Voltage Range	$V_{CC}=7V$ to 36V		-0.3	–	$V_{CC}-2$	V
G_{VO}	Open-Loop Voltage Gain	$V_O =0.5V$ to 3.5V		70	95	–	dB
BW	Unity-Gain Bandwidth	–		–	650	–	kHz
CMRR	Common-Mode Rejection Ratio	–		65	80	–	dB
I_{SINK}	Output Sink Current (Feedback)	$V_{ID} = -15mV$ to -5V, V3 = 0.7V		-0.3	-0.7	–	mA
I_{SOURCE}	Output Source Current (Feedback)	$V_{ID}=15mV$ to 5V, V3 = 3.5V		2	–	–	mA
PWM Comparator Section							
V_{ITH}	Input Threshold Voltage	Zero duty cycle		–	4	4.5	V
I_{SINK}	Input Sink Current	V3 = 0.7V		-0.3	-0.7	–	mA
Output Section							
V_{CE} (SAT)	Output Saturation Voltage	Common Emitter	$V_E = 0V, I_C =200mA$	–	1.1	1.3	V
V_{CC} (SAT)		Emitter Follower	$V_{CC} = 15V, I_E = -200mA$	–	1.5	2.5	
I_C (OFF)	Collector Off-State Current	$V_{CE} = 36V, V_{CC}=36V$		–	2	100	µA
I_E(OFF)	Emitter Off-State Current	$V_{CC} = V_C = 36V, V_E = 0$		–	–	-100	µA
Total Device							
I_{CC}	Supply Current	$V_{PIN6} = V_{REF}, V_{CC}=15V$		–	6	10	mA
Output Switching Characteristics							
t_R	Rise Time	Common Emitter Common Collector		–	100	200	ns
t_F	Fall Time	Common Emitter Common Collector		–	25	100	ns

AZ494
Document number: DS37862 Rev. 2 - 3

5 of 13
www.diodes.com

August 2022
© Diodes Incorporated

Parameter Measurement Information

Figure 1. Operational Test Circuit and Waveforms

AZ494
Document number: DS37862 Rev. 2 - 3

6 of 13
www.diodes.com

August 2022
© Diodes Incorporated

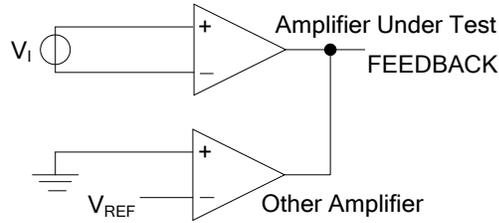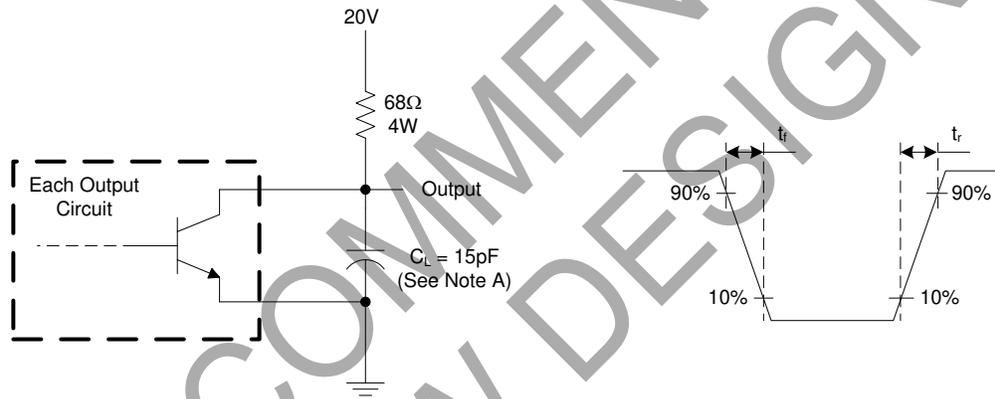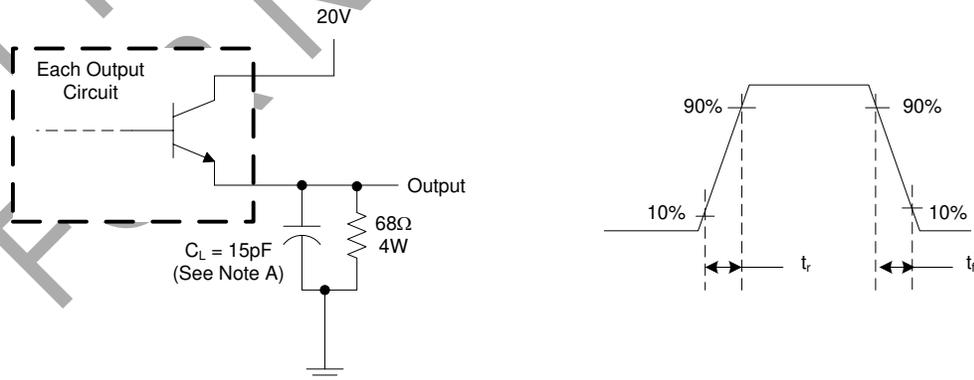## Parameter Measurement Information (Cont.)

Figure 2. Error Amplifier Characteristics

Note A: C_L includes probe and jig capacitance.

Figure 3. Common-Emitter Configuration

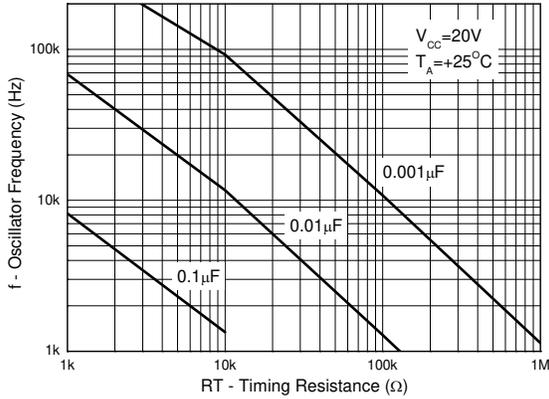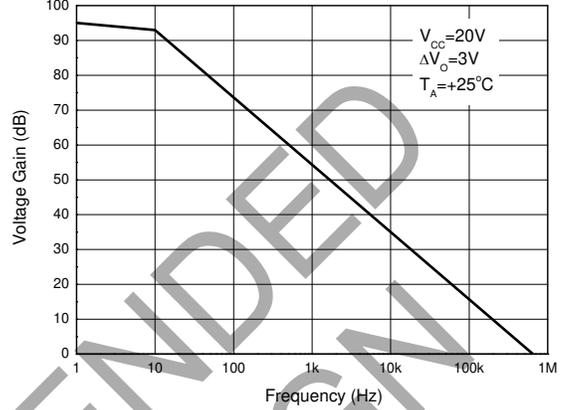Note A: C_L includes probe and jig capacitance.
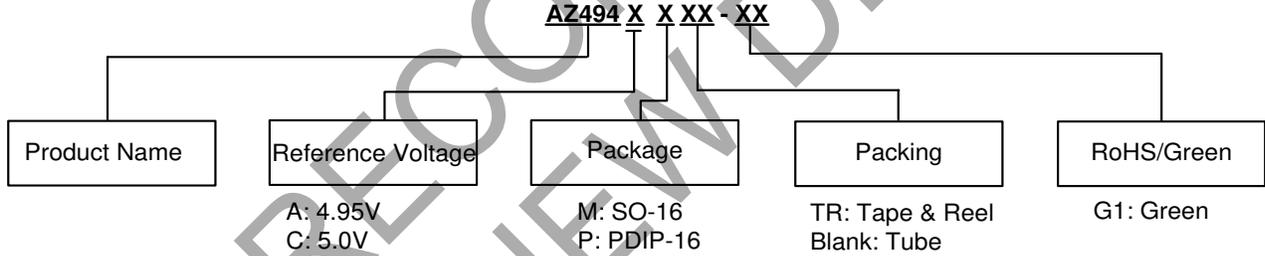
Figure 4. Emitter-Follower Configuration

AZ494
Document number: DS37862 Rev. 2 - 3

7 of 13
www.diodes.com

August 2022
© Diodes Incorporated

Performance Characteristics

Oscillator Frequency vs. RT and CT

Error Amplifier Small-Signal Voltage Gain vs. Frequency

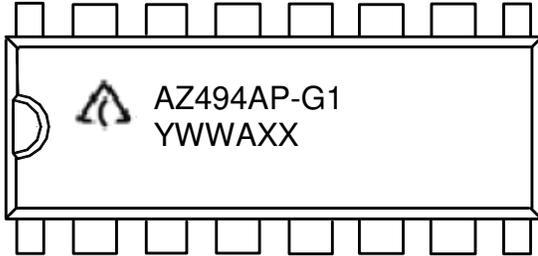## Ordering Information

AZ494 **X** **X** **XX** - **XX**

Product Name	Reference Voltage	Package	Packing	RoHS/Green
	A: 4.95V C: 5.0V	M: SO-16 P: PDIP-16	TR: Tape & Reel Blank: Tube	G1: Green

Package	Temperature Range	Part Number	Marking ID	Packing
SO-16	-40 to +85°C	AZ494CMTR-G1	AZ494CM-G1	4000/Tape & Reel
PDIP-16		AZ494AP-G1	AZ494AP-G1	25/Tube

AZ494
Document number: DS37862 Rev. 2 - 3

8 of 13
www.diodes.com

August 2022
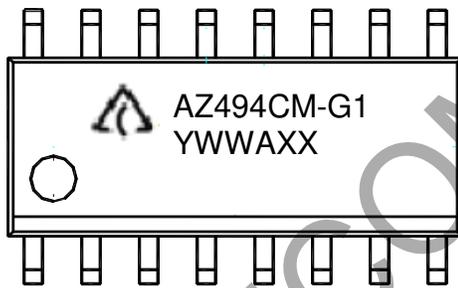© Diodes Incorporated

Marking Information

PDIP-16 (Top View)

AZ494AP-G1
YWWAXX

First Line: Logo and Marking ID
(See Ordering Information)
Second Line: Date Code
Y: Year
WW: Work Week of Molding
A: Assembly House Code
XX: 7th and 8th Digits of Batch No.
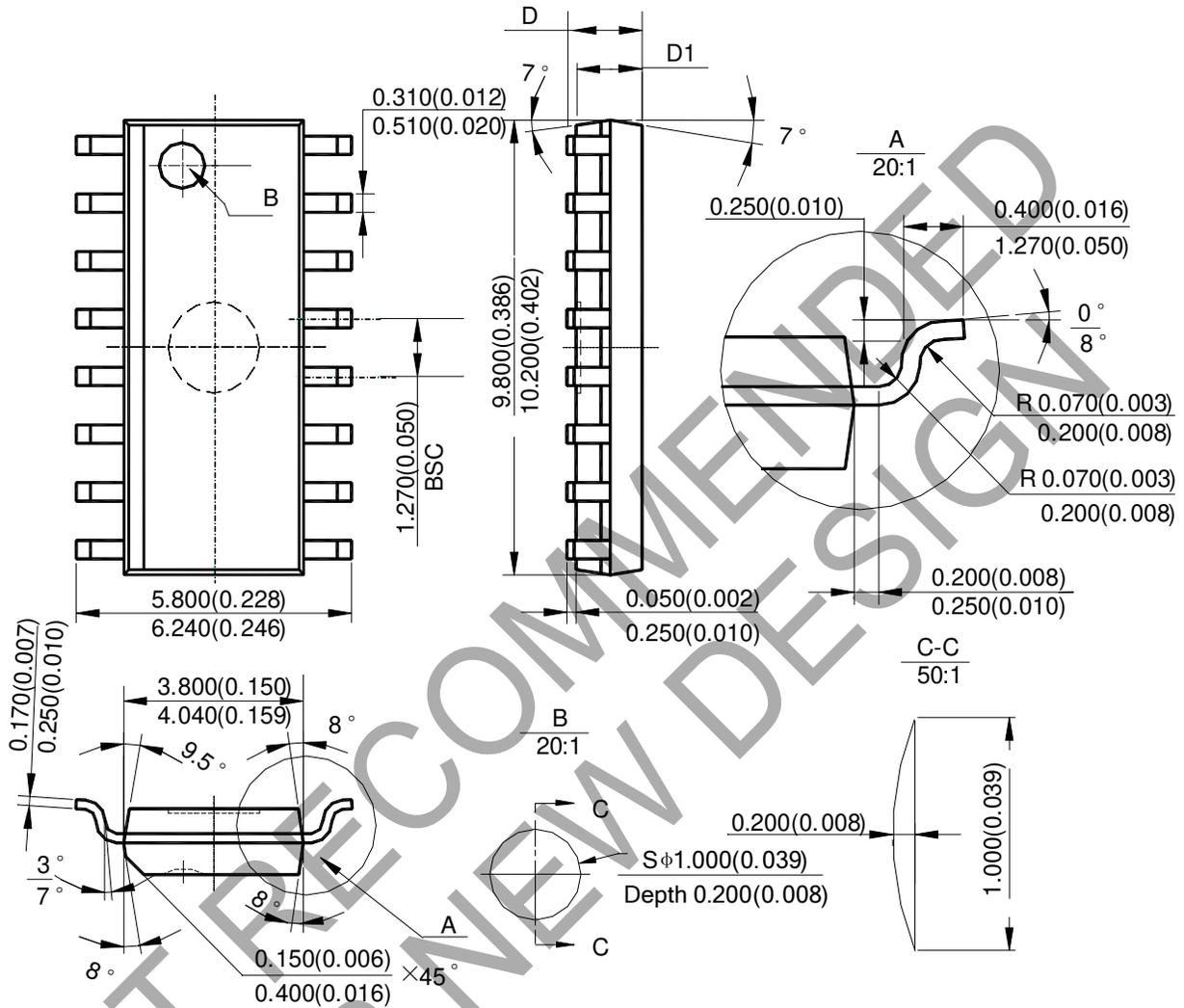
SO-16 (Top View)

AZ494CM-G1
YWWAXX

First Line: Logo and Marking ID
(See Ordering Information)
Second Line: Date Code
Y: Year
WW: Work Week of Molding
A: Assembly House Code
XX: 7th and 8th Digits of Batch No.

AZ494
Document number: DS37862 Rev. 2 - 3

9 of 13
www.diodes.com

August 2022
© Diodes Incorporated

Package Outline Dimensions (All dimensions in mm(inch).)

(1) Package Type: SO-16

Note: Eject hole, oriented hole and mold mark is optional.

Symbol	D				D1			
	min(mm)	max(mm)	min(inch)	max(inch)	min(mm)	max(mm)	min(inch)	max(inch)
Option1	1.350	1.750	0.053	0.069	1.250	1.650	0.049	0.065
Option2	-	1.260	-	0.050	1.020	-	0.040	-

AZ494
Document number: DS37862 Rev. 2 - 3

10 of 13
www.diodes.com

August 2022
© Diodes Incorporated

Package Outline Dimensions (All dimensions in mm(inch).) (Cont.)

(2)   Package Type: PDIP-16

1.524(0.060) TYP

3.710(0.146)
4.310(0.170)

7.320(0.288)
7.920(0.312)

0.700(0.028)

6°

4°

5°

6°

4°

3.200(0.126)
3.600(0.142)

Φ3.000(0.118)
Depth

0.050(0.002)
0.150(0.006)

0.360(0.014)
0.560(0.022)

2.540(0.100)
TYP

0.510(0.020)MIN

3.000(0.118)
3.600(0.142)

0.204(0.008)
0.360(0.014)

8.200(0.323)
9.400(0.370)

6.200(0.244)
6.600(0.260)

18.800(0.740)
19.200(0.756)

R0.750(0.030)

Note: Eject hole, oriented hole and mold mark is optional.

AZ494
Document number: DS37862 Rev. 2 - 3

11 of 13
www.diodes.com

August 2022
© Diodes Incorporated
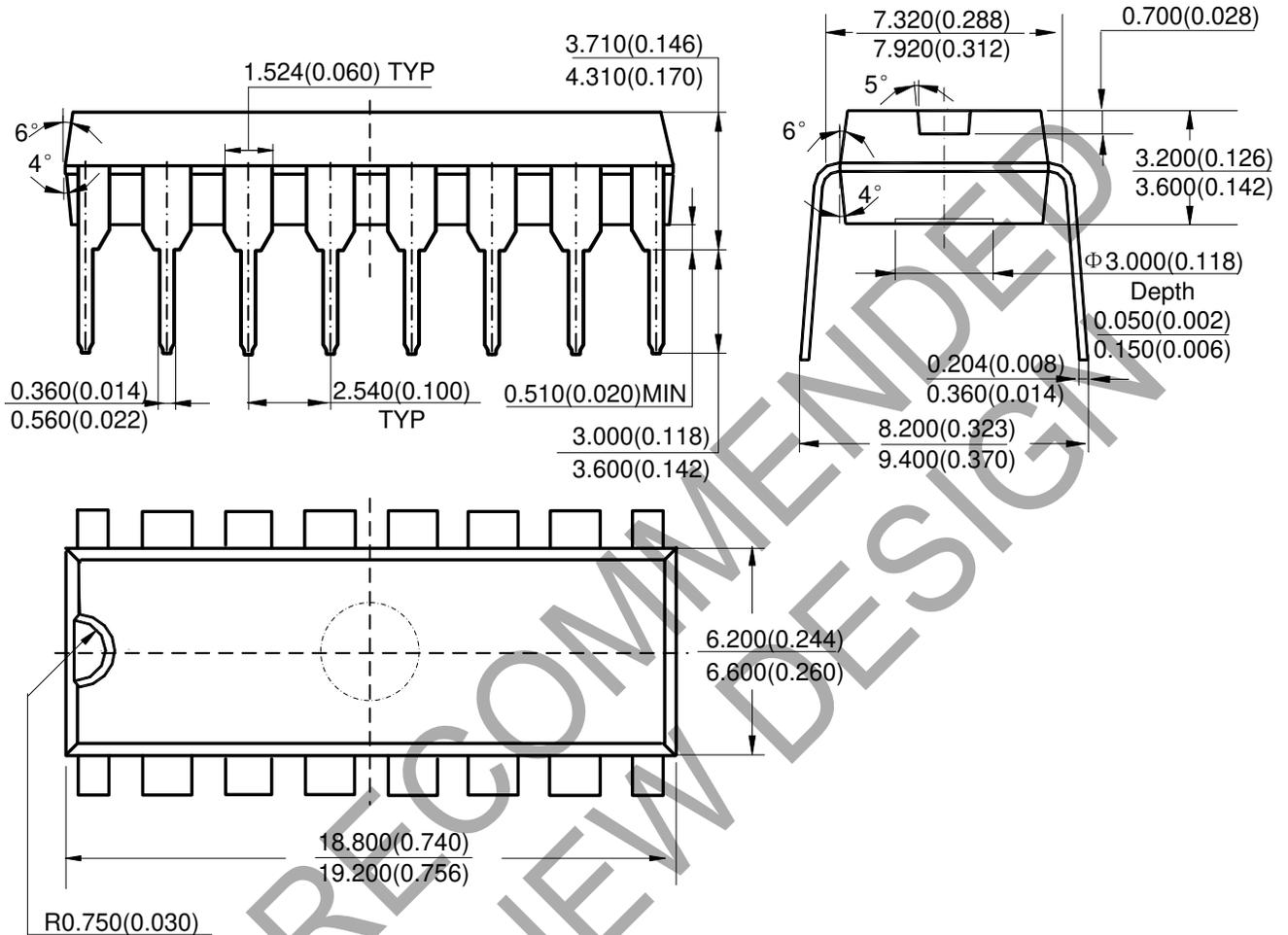
Suggested Pad Layout

(1)   Package Type: SO-16
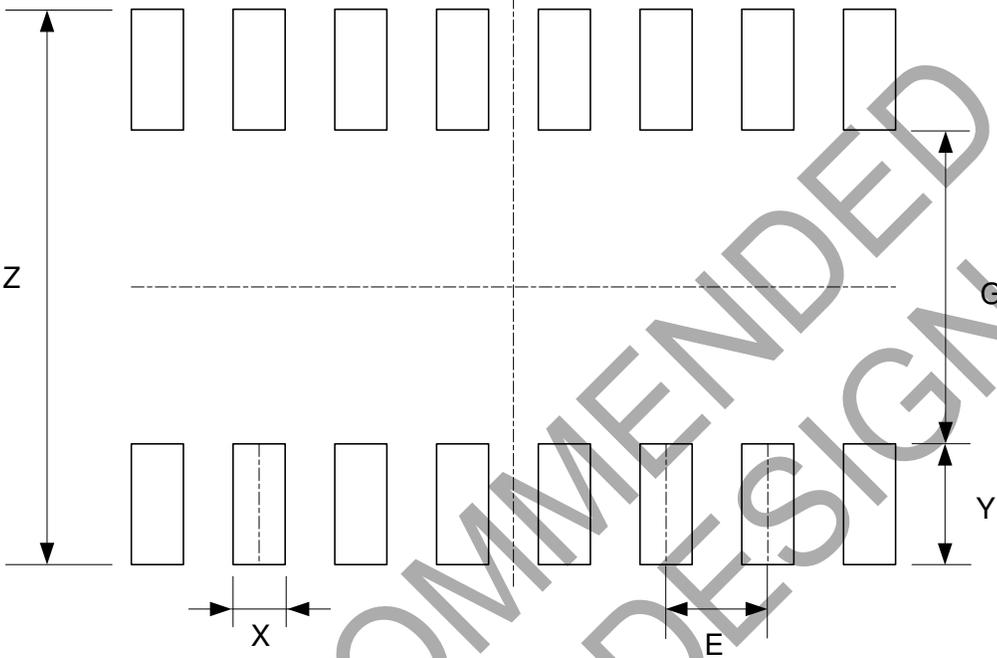
Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	6.900/0.272	3.900/0.154	0.650/0.026	1.500/0.059	1.270/0.050

AZ494
Document number: DS37862 Rev. 2 - 3

12 of 13
www.diodes.com

August 2022
© Diodes Incorporated

IMPORTANT NOTICE

1.   DIODES INCORPORATED (Diodes) AND ITS SUBSIDIARIES MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

2.   The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes' products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes' products. Diodes' products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of Diodes' products for their intended applications, (c) ensuring their applications, which incorporate Diodes' products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.

3.   Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.

4.   Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.

5.   Diodes' products are provided subject to Diodes' Standard Terms and Conditions of Sale (https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.

6.   Diodes' products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes' products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.

7.   While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes.

8.   Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.

9. This Notice may be periodically updated with the most recent version available at https://www.diodes.com/about/company/terms-and-conditions/important-notice

www.diodes.com

AZ494
Document number: DS37862 Rev. 2 - 3

13 of 13
www.diodes.com

August 2022
© Diodes Incorporated