XINLUDA®
WWW.XINLUDA.COM 信路达

XD494 DIP16 / XL494 SOP16

1 Features

- Complete PWM Power-Control Circuitry
- Uncommitted Outputs for 200-mA 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 5-V Reference Supply With 5% Tolerance
- Circuit Architecture Allows Easy Synchronization

2 Applications

- Desktop PCs
- Microwave Ovens
- Power Supplies: AC/DC, Isolated, With PFC, > 90 W
- Server PSUs
- Solar Micro-Inverters
- Washing Machines: Low-End and High-End
- E-Bikes
- Power Supplies: AC/DC, Isolated, No PFC, < 90 W
- Power: Telecom/Server AC/DC Supplies: Dual Controller: Analog
- Smoke Detectors
- Solar Power Inverters

3 Description

The XD494 device incorporates all the functions required in the construction of a pulse-width-modulation (PWM) control circuit on a single chip. Designed primarily for power-supply control, this device offers the flexibility to tailor the power-supply control circuitry to a specific application.

The XD494 device contains two error amplifiers,an on-chip adjustable oscillator, a dead-time control (DTC) comparator, a pulse-steering control flip-flop, a 5-V, 5%-precision regulator, and output-control circuits.

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

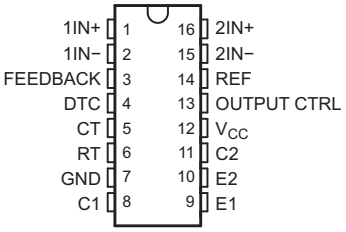
The uncommitted output transistors provide either common-emitter or emitter-follower output capability. The XD494 device provides for push-pull orsingle-ended output operation, which can be selected through the output-control function. The architecture of this device prohibits the possibility of either output being pulsed twice during push-pull operation.The XD494C device is characterized foroperationfrom 0°C to 70°C. The XL494 device ischaracterizedfor operation from –40°C to 85°C.

5 Device Information(1)

PART NUMBER	PACKAGE (PIN)	BODY SIZE
494	SOIC (16)	9.90 mm × 3.91 mm
	PDIP (16)	19.30 mm × 6.35 mm
	SOP (16)	10.30 mm × 5.30 mm
	TSSOP (16)	5.00 mm × 4.40 mm

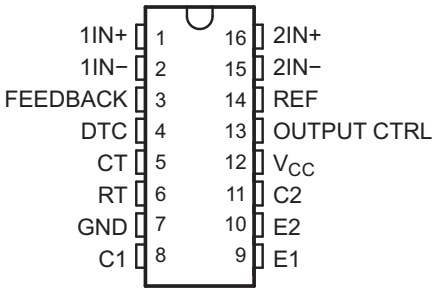
4 Pinout Drawing

D, DB, N, NS, OR PW PACKAGE
(TOP VIEW)



6 Pin Configuration and Functions

D, DB, N, NS, OR PW PACKAGE
(TOP VIEW)



Pin Functions

PIN		TYPE	DESCRIPTION
NAME	NO.		
1IN+	1	I	Noninverting input to error amplifier 1
1IN-	2	I	Inverting input to error amplifier 1
2IN+	16	I	Noninverting input to error amplifier 2
2IN-	15	I	Inverting input to error amplifier 2
C1	8	O	Collector terminal of BJT output 1
C2	11	O	Collector terminal of BJT output 2
CT	5	—	Capacitor terminal used to set oscillator frequency
DTC	4	I	Dead-time control comparator input
E1	9	O	Emitter terminal of BJT output 1
E2	10	O	Emitter terminal of BJT output 2
FEEDBACK	3	I	Input pin for feedback
GND	7	—	Ground
OUTPUT CTRL	13	I	Selects single-ended/parallel output or push-pull operation
REF	14	O	5-V reference regulator output
RT	6	—	Resistor terminal used to set oscillator frequency
V_{CC}	12	—	Positive Supply

7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
V_{CC}	Supply voltage(2)		41	V
V_I	Amplifier input voltage		V_{CC} + 0.3	V
V_O	Collector output voltage		41	V
I_O	Collector output current		250	mA
	Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds		260	°C
T_{stg}	Storage temperature range	–65	150	°C

(1) Stresses beyond 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-rated conditions for extended periods may affect device reliability.
(2) All voltages are with respect to the network ground terminal.

7.2 ESD Ratings

			MAX	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins	500	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins	200	

7.3 Recommended Operating Conditions

			MIN	MAX	UNIT
V_{CC}	Supply voltage		7	40	V
V_I	Amplifier input voltage		–0.3	V_{CC} – 2	V
V_O	Collector output voltage			40	V
	Collector output current (each transistor)			200	mA
	Current into feedback terminal			0.3	mA
f_{OSC}	Oscillator frequency		1	300	kHz
C_T	Timing capacitor		0.47	10000	nF
R_T	Timing resistor		1.8	500	kΩ
T_A	Operating free-air temperature	XD494	0	70	°C
		XL494	–40	85	

7.4 Thermal Information

over operating free-air temperature range (unless otherwise noted)

PARAMETER		XD494					UNIT
		D	DB	N	NS	PW	
$R_{\theta JA}$	Package thermal impedance(1)(2)	73	82	67	64	108	°C/W

(1) 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.
(2) The package thermal impedance is calculated in accordance with JESD 51-7.

7.5 Electrical Characteristics, Reference Section

over recommended operating free-air temperature range, V_{CC} = 15 V, f = 10 kHz (unless otherwise noted)

PARAMETER	TEST CONDITIONS(1)	XD494, XL494			UNIT
		MIN	TYP(2)	MAX	
Output voltage (REF)	I_O = 1 mA	4.75	5	5.25	V
Input regulation	V_{CC} = 7 V to 40 V		2	25	mV
Output regulation	I_O = 1 mA to 10 mA		1	15	mV
Output voltage change with temperature	ΔT_A = MIN to MAX		2	10	mV/V
Short-circuit output current(3)	REF = 0 V		25		mA

(1) For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
(2) All typical values, except for parameter changes with temperature, are at T_A = 25°C.
(3) Duration of short circuit should not exceed one second.

7.6 Electrical Characteristics, Oscillator Section

C_T = 0.01 µF, R_T = 12 kΩ (see Figure 5)

PARAMETER	TEST CONDITIONS(1)	XD494, XL494			UNIT
		MIN	TYP(2)	MAX	
Frequency			10		kHz
Standard deviation of frequency(3)	All values of V_{CC}, C_T, R_T, and T_A constant		100		Hz/kHz
Frequency change with voltage	V_{CC} = 7 V to 40 V, T_A = 25°C		1		Hz/kHz
Frequency change with temperature(4)	ΔT_A = MIN to MAX			10	Hz/kHz

(1) For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
(2) All typical values, except for parameter changes with temperature, are at T_A = 25°C.
(3) Standard deviation is a measure of the statistical distribution about the mean as derived from the formula:

$$\sigma = \sqrt{\frac{\sum_{n=1}^{N} \left(x_n - \overline{X}\right)^2}{N-1}}$$

(4) Temperature coefficient of timing capacitor and timing resistor are not taken into account.

7.7 Electrical Characteristics, Error-Amplifier Section

See Figure 6

PARAMETER	TEST CONDITIONS	XD494, XL494			UNIT
		MIN	TYP(1)	MAX	
Input offset voltage	V_O (FEEDBACK) = 2.5 V		2	10	mV
Input offset current	V_O (FEEDBACK) = 2.5 V		25	250	nA
Input bias current	V_O (FEEDBACK) = 2.5 V		0.2	1	µA
Common-mode input voltage range	V_{CC} = 7 V to 40 V	–0.3 to V_{CC} – 2			V
Open-loop voltage amplification	ΔV_O = 3 V, V_O = 0.5 V to 3.5 V, R_L = 2 kΩ	70	95		dB
Unity-gain bandwidth	V_O = 0.5 V to 3.5 V, R_L = 2 kΩ		800		kHz
Common-mode rejection ratio	ΔV_O = 40 V, T_A = 25°C	65	80		dB
Output sink current (FEEDBACK)	V_{ID} = –15 mV to –5 V, V (FEEDBACK) = 0.7 V	0.3	0.7		mA
Output source current (FEEDBACK)	V_{ID} = 15 mV to 5 V, V (FEEDBACK) = 3.5 V	–2			mA

(1) All typical values, except for parameter changes with temperature, are at T_A = 25°C.

7.8 Electrical Characteristics, Output Section

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
Collector off-state current		V_{CE} = 40 V, V_{CC} = 40 V		2	100	µA
Emitter off-state current		V_{CC} = V_C = 40 V, V_E = 0			–100	µA
Collector-emitter saturation voltage	Common emitter	V_E = 0, I_C = 200 mA		1.1	1.3	V
	Emitter follower	$V_{O(C1 \text{ or } C2)}$ = 15 V, I_E = –200 mA		1.5	2.5	
Output control input current		V_I = V_{ref}			3.5	mA

(1) All typical values, except for temperature coefficient, are at T_A = 25°C.

7.9 Electrical Characteristics, Dead-Time Control Section

See Figure 5

PARAMETER	TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
Input bias current (DEAD-TIME CTRL)	V_I = 0 to 5.25 V		–2	–10	µA
Maximum duty cycle, each output	V_I (DEAD-TIME CTRL) = 0, C_T = 0.01 µF, R_T = 12 kΩ		45%		—
Input threshold voltage (DEAD-TIME CTRL)	Zero duty cycle		3	3.3	V
	Maximum duty cycle	0			

(1) All typical values, except for temperature coefficient, are at T_A = 25°C.

7.10 Electrical Characteristics, PWM Comparator Section

See Figure 5

PARAMETER	TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
Input threshold voltage (FEEDBACK)	Zero duty cyle		4	4.5	V
Input sink current (FEEDBACK)	V (FEEDBACK) = 0.7 V	0.3	0.7		mA

(1) All typical values, except for temperature coefficient, are at T_A = 25°C.

7.11 Electrical Characteristics, Total Device

PARAMETER	TEST CONDITIONS		MIN	TYP(1)	MAX	UNIT
Standby supply current	R_T = V_{ref}, All other inputs and outputs open	V_{CC} = 15 V		6	10	mA
		V_{CC} = 40 V		9	15	
Average supply current	V_I (DEAD-TIME CTRL) = 2 V, See Figure 5			7.5		mA

(1) All typical values, except for temperature coefficient, are at T_A = 25°C.

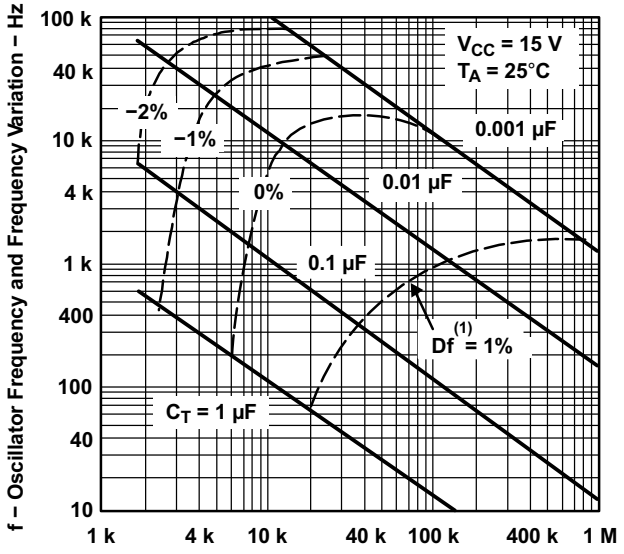
7.12 Switching Characteristics

T_A = 25°C

PARAMETER	TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
Rise time	Common-emitter configuration, See Figure 7		100	200	ns
Fall time			25	100	ns
Rise time	Emitter-follower configuration, See Figure 8		100	200	ns
Fall time			40	100	ns

(1) All typical values, except for temperature coefficient, are at T_A = 25°C.

7.13 Typical Characteristics



Frequency variation (Δf) is the change in oscillator frequency that occurs over the full temperature range.

Figure 1. Oscillator Frequency and Frequency Variation vs Timing Resistance

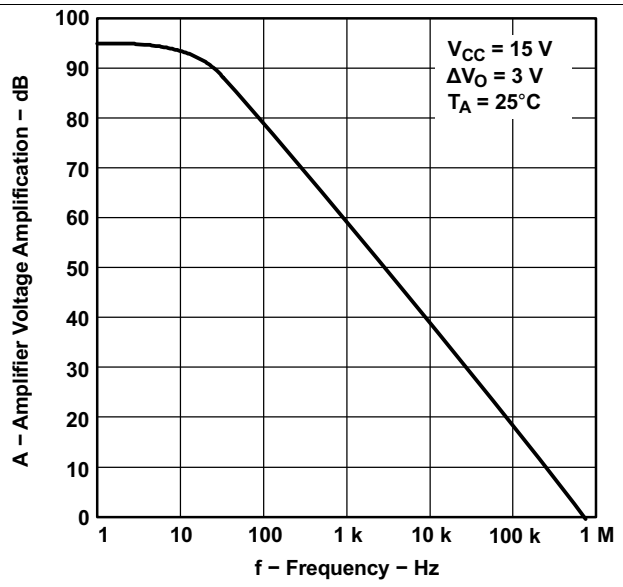


Figure 2. Amplifier Voltage Amplification vs Frequency

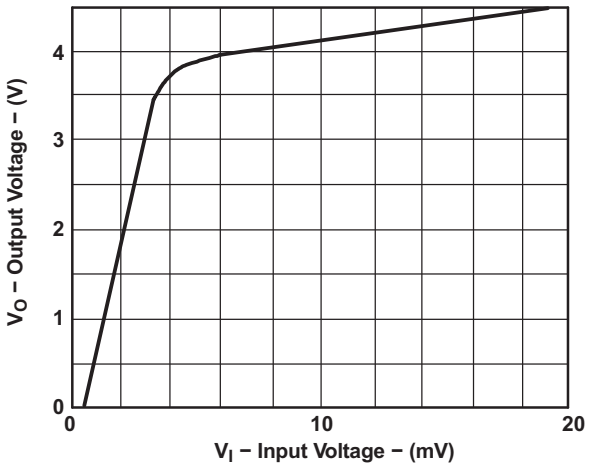


Figure 3. Error Amplifier Transfer Characteristics

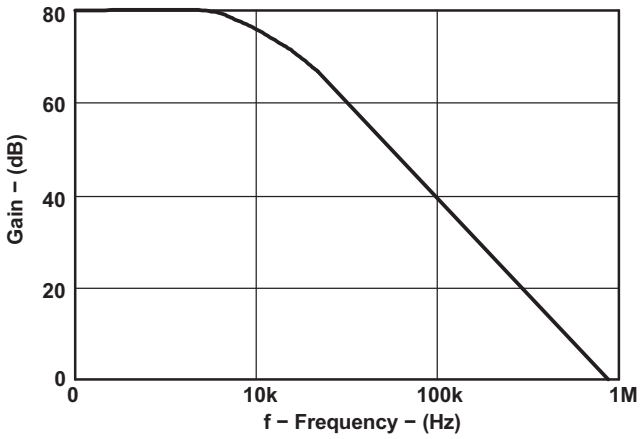
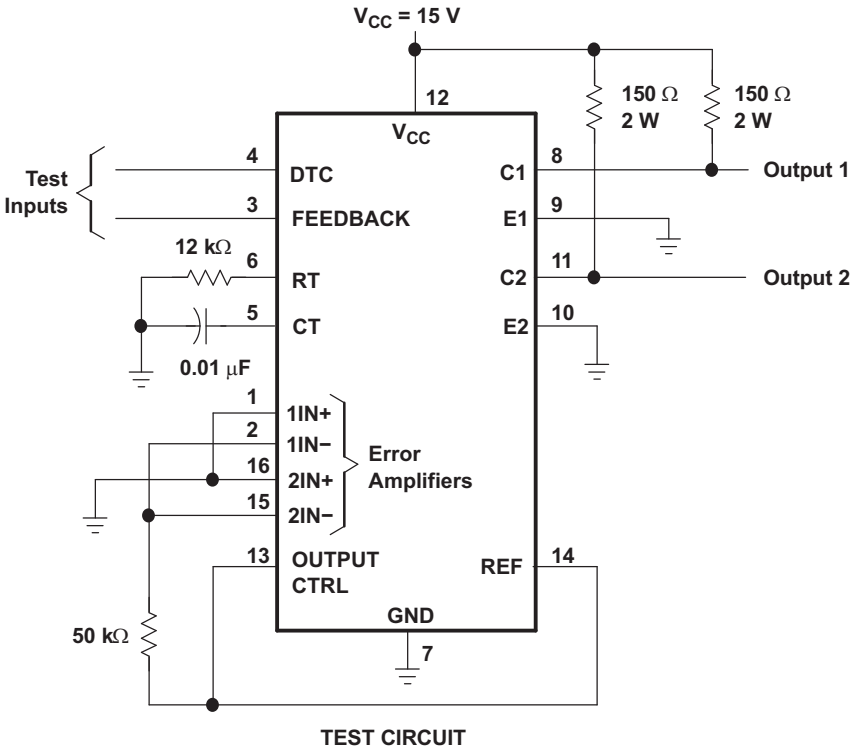


Figure 4. Error Amplifier Bode Plot

8 Parameter Measurement Information



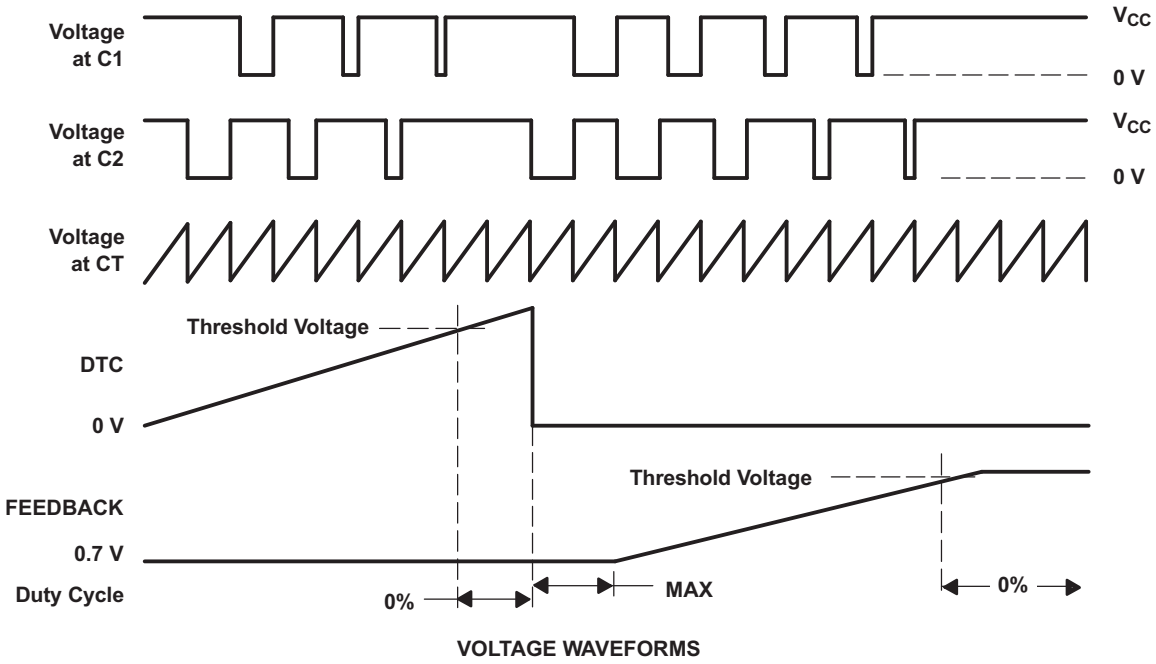


Figure 5. Operational Test Circuit and Waveforms

Parameter Measurement Information (continued)

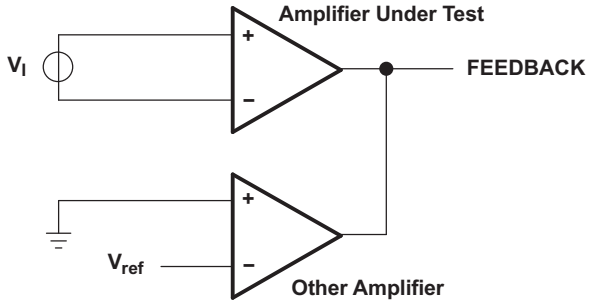
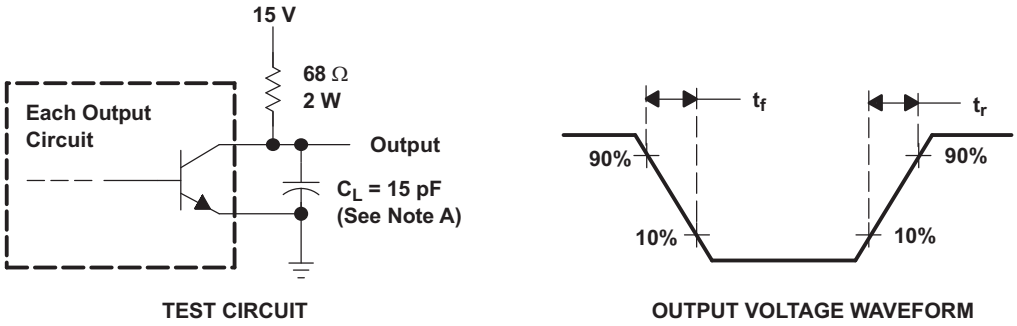
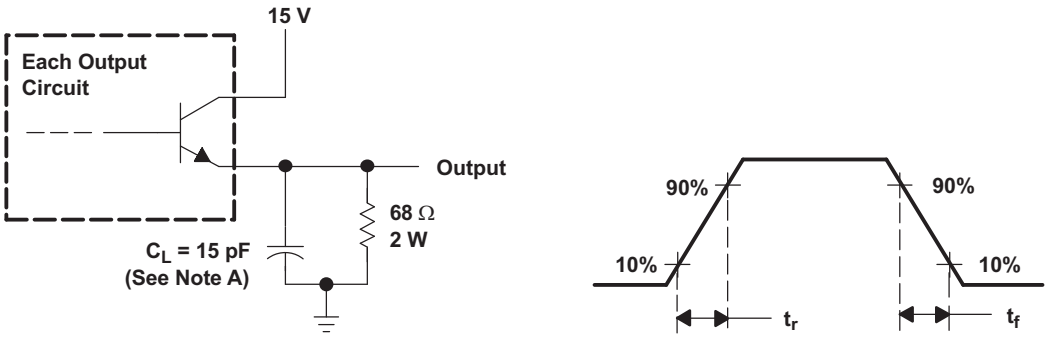


Figure 6. Amplifier Characteristics



NOTE A: C_L includes probe and jig capacitance.

Figure 7. Common-Emitter Configuration



NOTE A: C_L includes probe and jig capacitance.

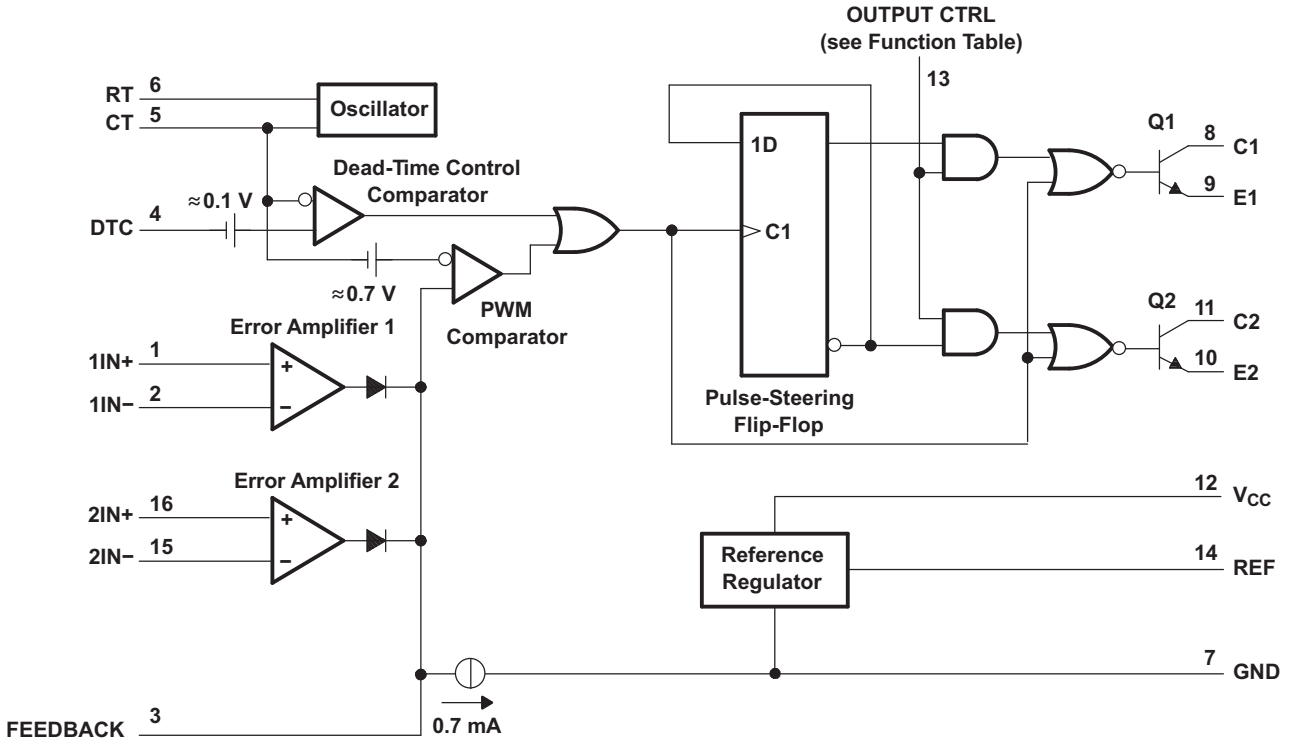
Figure 8. Emitter-Follower Configuration

9 Detailed Description

9.1 Overview

The design of the XD494 not only incorporates the primary building blocks required to control a switchingpower supply, but also addresses many basic problems and reduces the amount of additional circuitry required in the total design. The XD494 is a fixed-frequency pulse-width-modulation (PWM) control circuit. Modulation of output
pulses is accomplished by comparing the sawtooth waveform created by the internal oscillator on the timing capacitor (CT) to either of two control signals. The output stage is enabled during the time when the sawtooth voltage is greater than the voltage control signals. As the control signal increases, the time during which the sawtooth input is greater decreases; therefore, the output pulse duration decreases. A pulse-steering flip-flop alternately directs the modulated pulse to each of the two output transistors.

9.2 Functional Block Diagram



9.3 Feature Description

9.3.1 5-V Reference Regulator

The XD494 internal 5-V reference regulator output is the REF pin. In addition to providing a stable reference,it acts as a preregulator and establishes a stable supply from which the output-control logic, pulse-steering flip-flop, oscillator, dead-time control comparator, and PWM comparator are powered. The regulator employs a band-gap circuit as its primary reference to maintain thermal stability of less than 100-mV variation over the operating free-air temperature range of 0°C to 70°C. Short-circuit protection is provided to protect the internal reference and preregulator; 10 mA of load current is available for additional bias circuits. The reference is internally programmed to an initial accuracy of ±5% and maintains a stability of less than 25-mV variation over an input voltage range of 7 V to 40 V. For input voltages less than 7 V, the regulator saturates within 1 V of the input and tracks it.

Feature Description (continued)

9.3.2 Oscillator

The oscillator provides a positive sawtooth waveform to the dead-time and PWM comparators for comparison to the various control signals.

The frequency of the oscillator is programmed by selecting timing components R_T and C_T. The oscillator charges the external timing capacitor, C_T, with a constant current, the value of which is determined by the external timing resistor, R_T. This produces a linear-ramp voltage waveform. When the voltage across C_T reaches 3 V, the oscillator circuit discharges it, and the charging cycle is reinitiated. The charging current is determined by the formula:

$$I_{CHARGE} = \frac{3\,V}{R_T} \quad (1)$$

The period of the sawtooth waveform is:

$$T = \frac{3\,V \times C_T}{I_{CHARGE}} \quad (2)$$

The frequency of the oscillator becomes:

$$f_{OSC} = \frac{1}{R_T \times C_T} \quad (3)$$

However, the oscillator frequency is equal to the output frequency only for single-ended applications. For push-pull applications, the output frequency is one-half the oscillator frequency.

Single-ended applications:

$$f = \frac{1}{R_T \times C_T} \quad (4)$$

Push-pull applications:

$$f = \frac{1}{2R_T \times C_T} \quad (5)$$

9.3.3 Dead-time Control

The dead-time control input provides control of the minimum dead time (off time). The output of the comparator inhibits switching transistors Q1 and Q2 when the voltage at the input is greater than the ramp voltage of the oscillator. An internal offset of 110 mV ensures a minimum dead time of ~3% with the dead-time control input grounded. Applying a voltage to the dead-time control input can impose additional dead time. This provides a linear control of the dead time from its minimum of 3% to 100% as the input voltage is varied from 0 V to 3.3 V, respectively. With full-range control, the output can be controlled from external sources without disrupting the error amplifiers. The dead-time control input is a relatively high-impedance input (I_I < 10 μA) and should be used where additional control of the output duty cycle is required. However, for proper control, the input must be terminated. An open circuit is an undefined condition.

9.3.4 Comparator

The comparator is biased from the 5-V reference regulator. This provides isolation from the input supply for improved stability. The input of the comparator does not exhibit hysteresis, so protection against false triggering near the threshold must be provided. The comparator has a response time of 400 ns from either of the control-signal inputs to the output transistors, with only 100 mV of overdrive. This ensures positive control of the output within one-half cycle for operation within the recommended 300-kHz range.

10 Application and Implementation

10.1 Application Information

The following design example uses the XD494 to create a 5-V/10-A power supply. This application was takenfrom application note SLVA001.

10.2 Typical Application

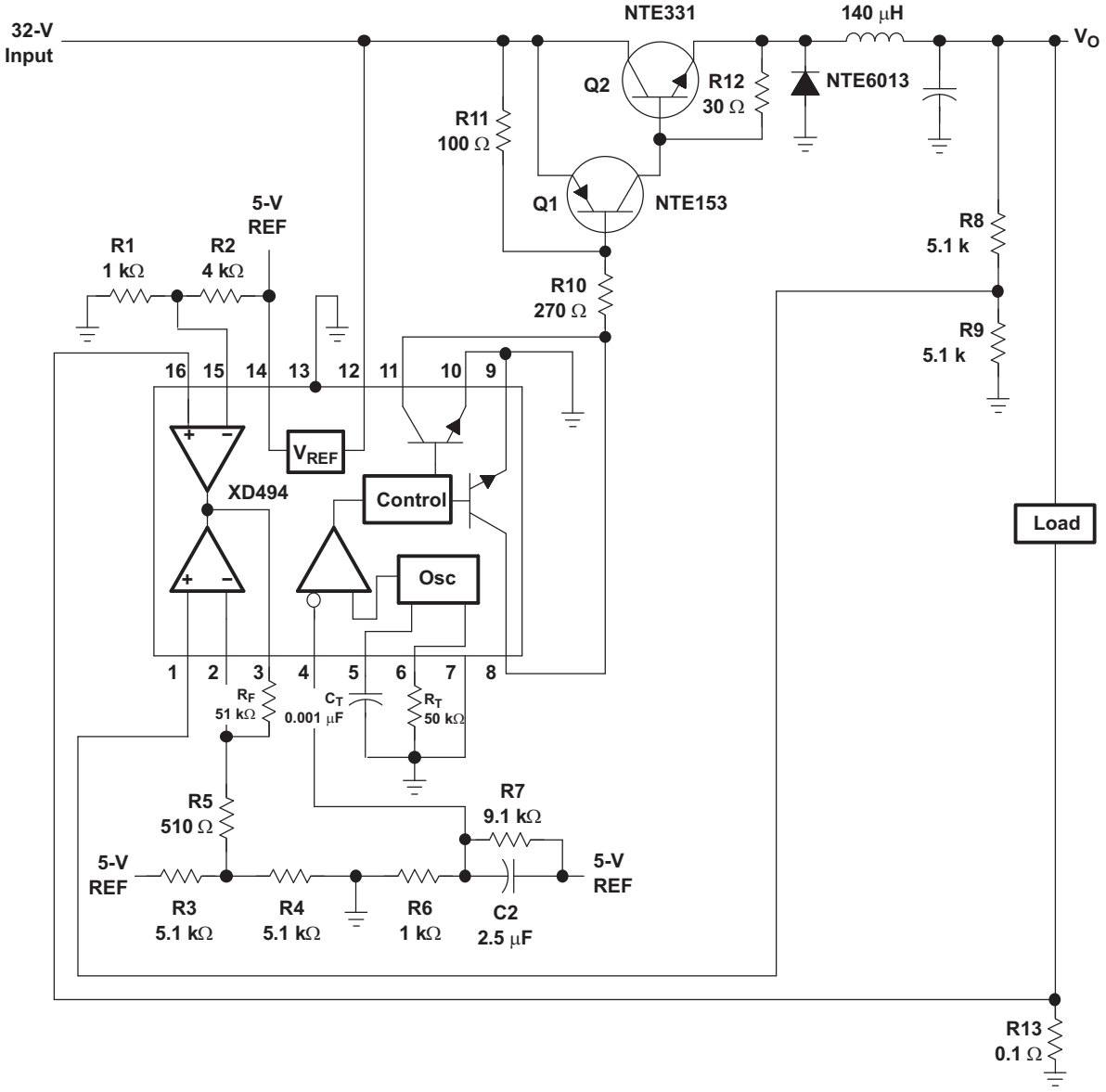


Figure 9. Switching and Control Sections

Typical Application (continued)

10.2.1 Design Requirements

- V_I = 32 V
- V_O = 5 V
- I_O = 10 A
- f_{OSC} = 20-kHz switching frequency
- V_R = 20-mV peak-to-peak (V_{RIPPLE})
- ΔI_L = 1.5-A inductor current change

10.2.2 Detailed Design Procedure

10.2.2.1 Input Power Source

The 32-V dc power source for this supply uses a 120-V input, 24-V output transformer rated at 75 VA. The 24-V secondary winding feeds a full-wave bridge rectifier, followed by a current-limiting resistor (0.3 Ω) and two filter capacitors (see Figure 10).

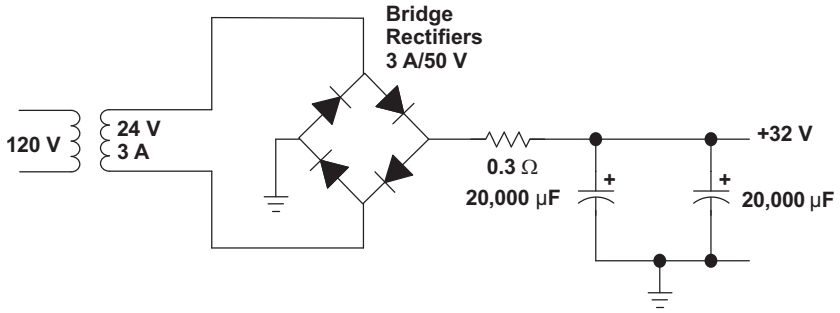


Figure 10. Input Power Source

The output current and voltage are determined by Equation 6 and Equation 7:

$$V_{RECTIFIER} = V_{SECONDARY} \times \sqrt{2} = 24\,V \times \sqrt{2} = 34\,V \quad (6)$$

$$I_{RECTIFIER(AVG)} \approx \frac{V_O}{V_I} \times I_O \approx \frac{5\,V}{32\,V} \times 10\,A = 1.6\,A \quad (7)$$

The 3-A/50-V full-wave bridge rectifier meets these calculated conditions. Figure 9 shows the switching and control sections.

10.2.2.2 Control Circuits

10.2.2.2.1 Oscillator

Connecting an external capacitor and resistor to pins 5 and 6 controls the XD494 oscillator frequency. Theoscillator is set to operate at 20 kHz, using the component values calculated by Equation 8 and Equation 9:

$$f_{OSC} = \frac{1}{R_T \times C_T} \quad (8)$$

Choose C_T = 0.001 µF and calculate R_T:

$$R_T = \frac{1}{f_{OSC} \times C_T} = \frac{1}{(20 \times 10^3) \times (0.001 \times 10^{-6})} = 50\ k\Omega \quad (9)$$

10.2.2.2.2 Error Amplifier

The error amplifier compares a sample of the 5-V output to the reference and adjusts the PWM to maintain a constant output current (see Figure 11).

Typical Application (continued)

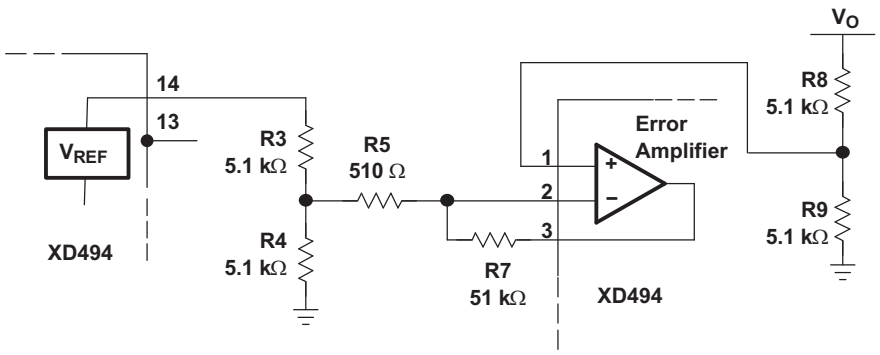


Figure 11. Error-Amplifier Section

The XD494 internal 5-V reference is divided to 2.5 V by R3 and R4. The output-voltage error signal also is divided to 2.5 V by R8 and R9. If the output must be regulated to exactly 5.0 V, a 10-kΩ potentiometer can be used in place of R8 to provide an adjustment.

To increase the stability of the error-amplifier circuit, the output of the error amplifier is fed back to the inverting input through R_T, reducing the gain to 101.

10.2.2.2.3 Current-Limiting Amplifier

The power supply was designed for a 10-A load current and an I_L swing of 1.5 A, therefore, the short-circuit current should be:

$$I_{SC} = I_O + \frac{I_L}{2} = 10.75\,A \tag{10}$$

The current-limiting circuit is shown in Figure 12.

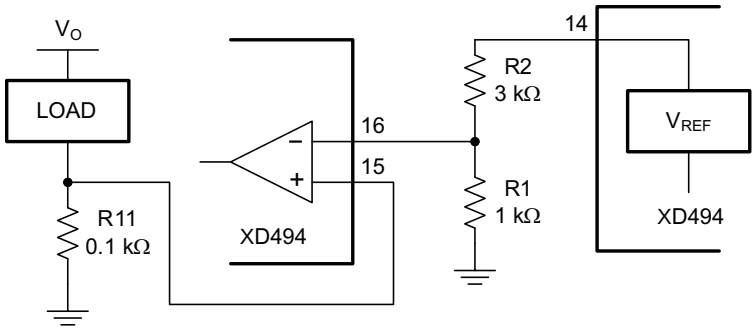


Figure 12. Current-Limiting Circuit

Resistors R1 and R2 set the reference of about 1 V on the inverting input of the current-limiting amplifier. Resistor R13, in series with the load, applies 1 V to the noninverting terminal of the current-limiting amplifier when the load current reaches 10 A. The output-pulse width is reduced accordingly. The value of R13 is:

$$R13 = \frac{1V}{10\,A} = 0.1\Omega \tag{11}$$

10.2.2.2.4 Soft Start and Dead Time

To reduce stress on the switching transistors at start-up, the start-up surge that occurs as the output filter capacitor charges must be reduced. The availability of the dead-time control makes implementation of a soft-start circuit relatively simple (see Figure 13).

Typical Application (continued)

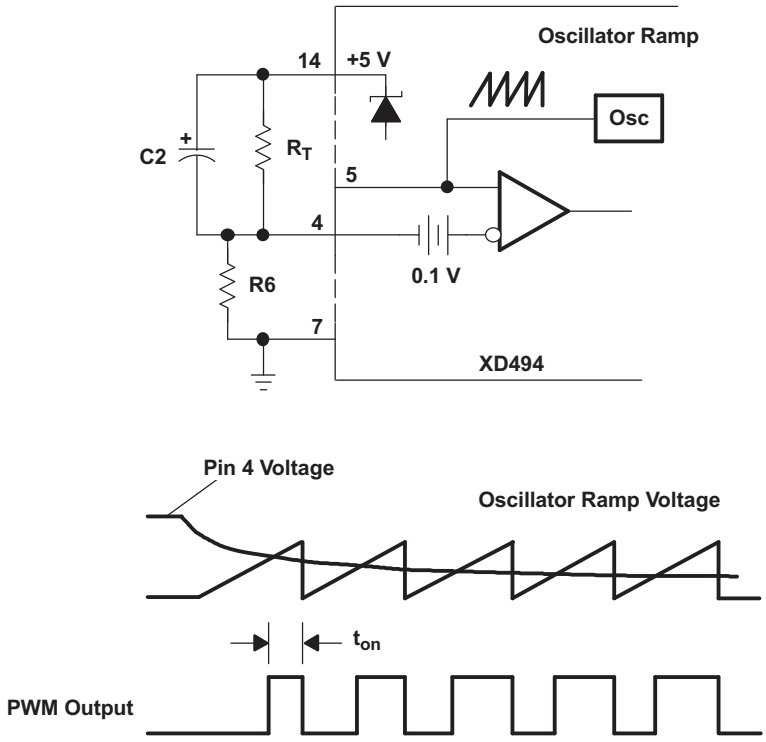


Figure 13. Soft-Start Circuit

The soft-start circuit allows the pulse width at the output to increase slowly (see Figure 13) by applying a negative slope waveform to the dead-time control input (pin 4).

Initially, capacitor C2 forces the dead-time control input to follow the 5-V regulator, which disables the outputs (100% dead time). As the capacitor charges through R6, the output pulse width slowly increases until the control loop takes command. With a resistor ratio of 1:10 for R6 and R7, the voltage at pin 4 after start-up is 0.1 × 5 V, or 0.5 V.

The soft-start time generally is in the range of 25 to 100 clock cycles. If 50 clock cycles at a 20-kHz switching rate is selected, the soft-start time is:

$$t = \frac{1}{f} = \frac{1}{20\,kHz} = 50\,\mu s\,per\,clock\,cycle \quad (12)$$

The value of the capacitor then is determined by:

$$C2 = \frac{soft-start\,time}{R6} = \frac{50\,\mu s \times 50\,cycles}{1\,k\Omega} = 2.5\,\mu F \quad (13)$$

This helps eliminate any false signals that might be created by the control circuit as power is applied.

Typical Application (continued)

10.2.2.3 Inductor Calculations

The switching circuit used is shown in Figure 39.

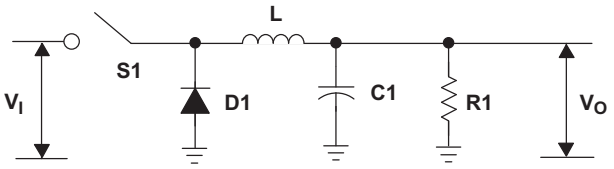


Figure 14. Switching Circuit

The size of the inductor (L) required is:

d	=	duty cycle = V_O/V_I = 5 V/32 V = 0.156
f	=	20 kHz (design objective)
t_{on}	=	time on (S1 closed) = (1/f) × d = 7.8 µs
t_{off}	=	time off (S1 open) = (1/f) – ton = 42.2 µs
L	≠	$(V_I – V_O) \times t_{on}/\Delta I_L$
	≠	[(32 V – 5 V) × 7.8 µs]/1.5 A
	≠	140.4 µH

10.2.2.4 Output Capacitance Calculations

Once the filter inductor has been calculated, the value of the output filter capacitor is calculated to meet the output ripple requirements. An electrolytic capacitor can be modeled as a series connection of an inductance, a resistance, and a capacitance. To provide good filtering, the ripple frequency must be far below the frequencies at which the series inductance becomes important. So, the two components of interest are the capacitance and the effective series resistance (ESR). The maximum ESR is calculated according to the relation between the specified peak-to-peak ripple voltage and the peak-to-peak ripple current.

$$\text{ESR(max)} = \frac{\Delta V_{O(\text{ripple})}}{\Delta I_L} = \frac{V}{1.5\,A} \approx 0.067\,\Omega \tag{14}$$

The minimum capacitance of C3 necessary to maintain the V_O ripple voltage at less than the 100-mV design objective is calculated according to Equation 15:

$$C3 = \frac{\Delta I_L}{8f\,\Delta V_O} = \frac{1.5\,A}{8 \times 20 \times 10^3 \times 0.1\,V} = 94\,\mu F \tag{15}$$

A 220-mF, 60-V capacitor is selected because it has a maximum ESR of 0.074 Ω and a maximum ripple current of 2.8 A.

10.2.2.5 Transistor Power-Switch Calculations

The transistor power switch was constructed with an NTE153 pnp drive transistor and an NTE331 npn output transistor. These two power devices were connected in a pnp hybrid Darlington circuit configuration (see Figure 15).

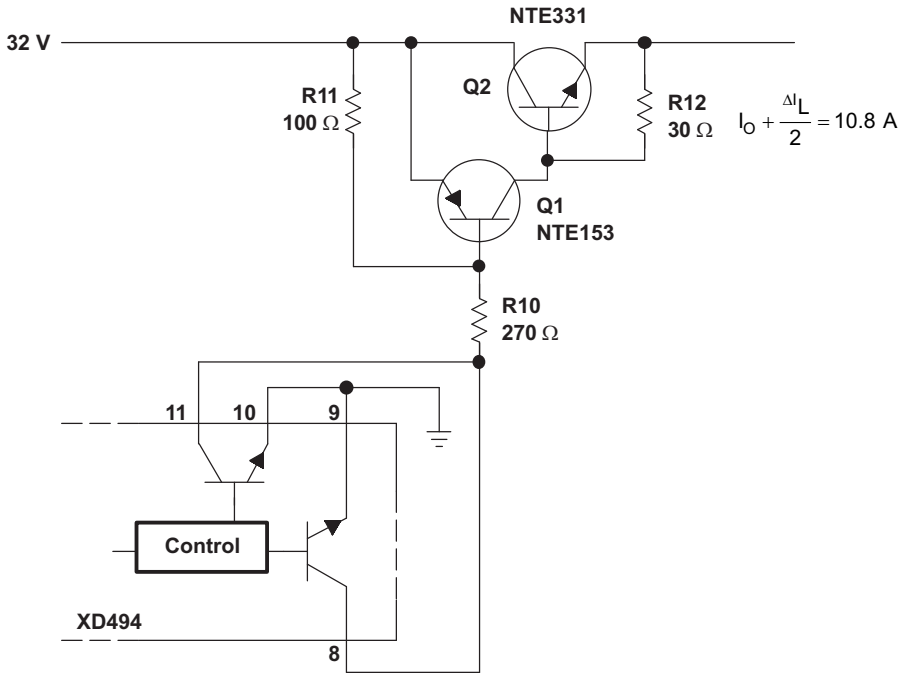


Figure 15. Power-Switch Section

The hybrid Darlington circuit must be saturated at a maximum output current of I_O + $\Delta I_L/2$ or 10.8 A. The Darlington h_{FE} at 10.8 A must be high enough not to exceed the 250-mA maximum output collector current of the XD494. Based on published NTE153 and NTE331 specifications, the required power-switch minimum drive was calculated by Equation 16 through Equation 18 to be 144 mA:

$$h_{FE}(Q1) \text{ at } I_C \text{ of } 3\,A = 15 \tag{16}$$

$$h_{FE}(Q2) \text{ at } I_C \text{ of } 10.0\,A = 5 \tag{17}$$

$$i_B \geq \frac{I_O + \frac{I_L}{2}}{h_{FE}(Q2) \times h_{FE}(Q1)} \geq 144\,mA \tag{18}$$

The value of R10 was calculated by:

$$R10 \leq \frac{V_I - \left[V_{BE}(XD) + V_{CE}(XD494)\right]}{i_B} = \frac{32 - (1.5 + 0.7)}{0.144}$$

$$R10 \leq 207\,\Omega \tag{19}$$

Based on these calculations, the nearest standard resistor value of 220 Ω was selected for R10. Resistors R11 and R12 permit the discharge of carriers in switching transistors when they are turned off.

The power supply described demonstrates the flexibility of the XD494 PWM control circuit. Thispower-supply design demonstrates many of the power-supply control methods provided by the XD494, as well as theversatility of the control circuit.

10.2.3 Application Curves for Output Characteristics

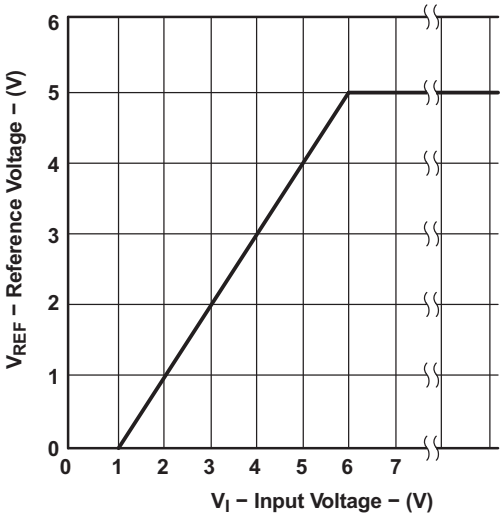
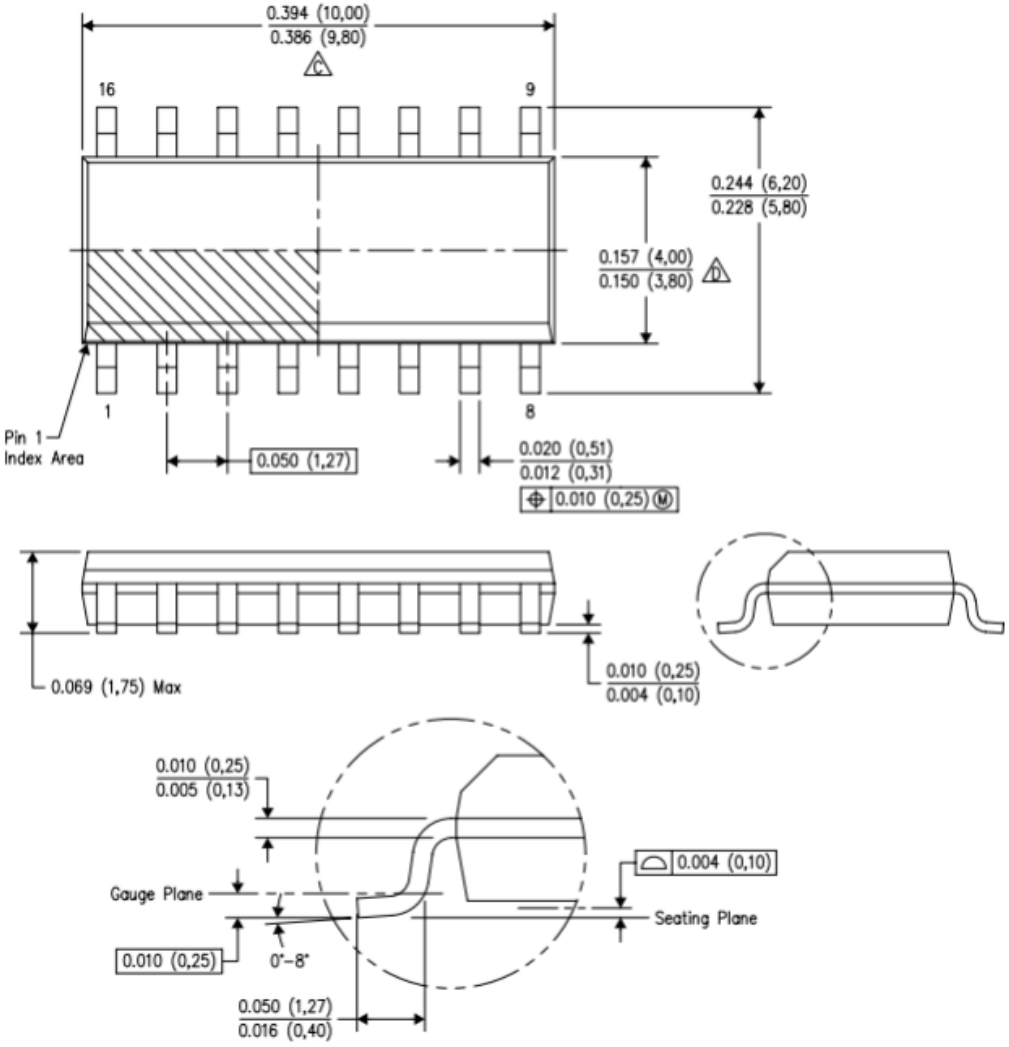
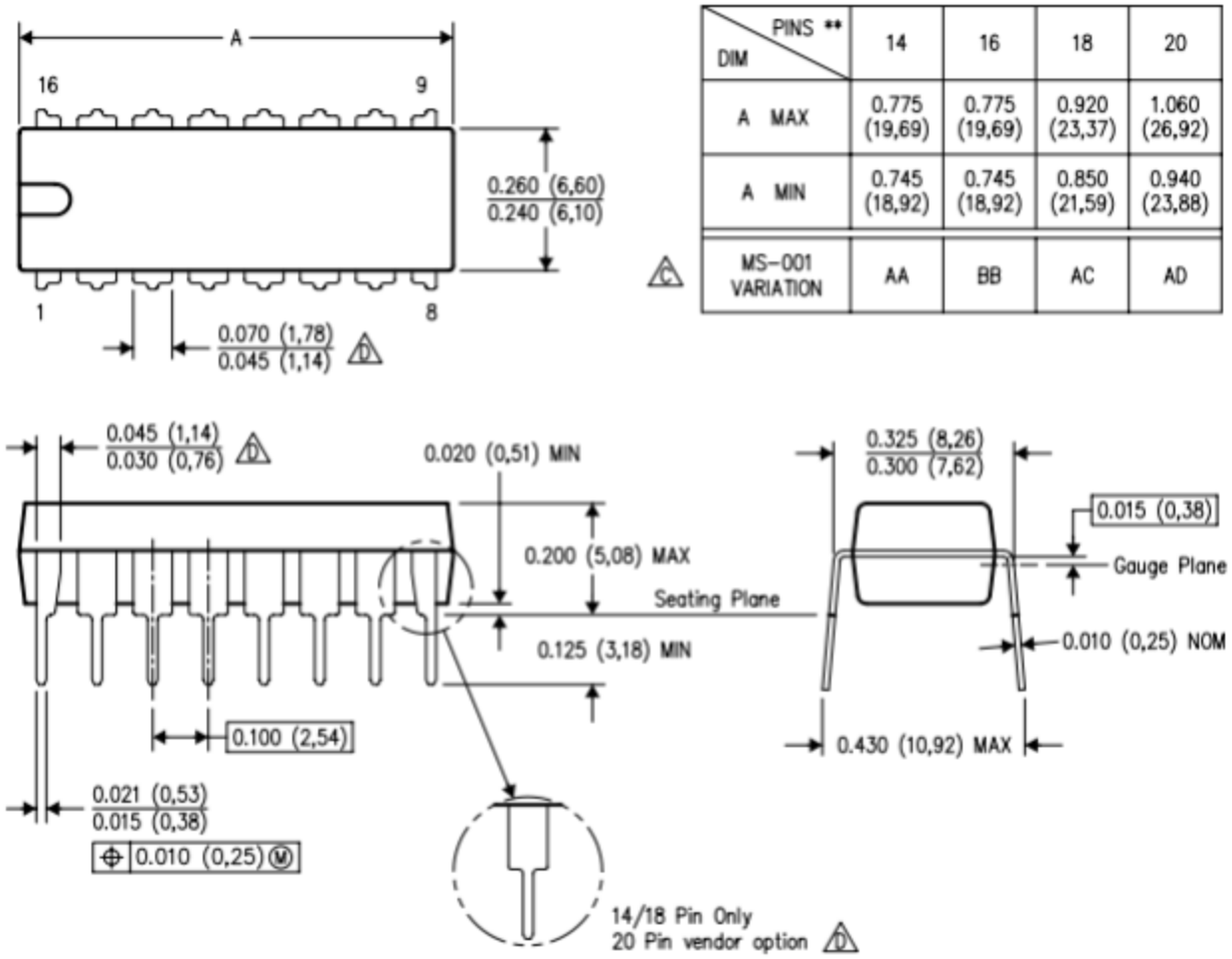


Figure 16. Reference Voltage vs Input Voltage



DIP16



DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD

以上信息仅供参考.如需帮助联系客服人员。谢谢 XINLUDA

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for Switching Controllers ***category:***

Click to view products by XINLUDA ***manufacturer:***

Other Similar products are found below :

LV5065VB-TLM-H LV5066V-TLM-H LV5725JAZ-AH 633888R MP2908AGF AZ7500EP-E1 NCP1012AP133G NCP1217P133G NCP1218AD65R2G NCP1234AD100R2G NCP1244BD065R2G NCP1336ADR2G NCP1587GDR2G NCP6153MNTWG NCP81005MNTWG NCP81101BMNTXG NCP81205MNTXG HV9123NG-G-M934 IR35207MTRPBF ISL6367HIRZ CAT874-80ULGT3 SJ6522AG SJE6600 TLE63893GV50XUMA1 IR35215MTRPBF SG3845DM NCP1216P133G NCP1236DD65R2G NCP1247BD100R2G NCP1250BP65G NCP4202MNR2G NCP4204MNTXG NCP6132AMNR2G NCP81141MNTXG NCP81142MNTXG NCP81172MNTXG NCP81203MNTXG NCP81206MNTXG NX2155HCUPTR UC3845ADM UBA2051C IR35201MTRPBF MAX8778ETJ+ MAX17500AAUB+T MAX17411GTM+T MAX16933ATIR/V+ NCP1010AP130G NCP1063AD100R2G NCP1216AP133G NCP1217AP100G