

Switchmode Pulse Width Modulation Control Circuit

The PJ494 incorporates on a single monolithic chip all the functions required in the construction of a pulse-width-modulation control circuit. Designed primarily for power supply control, these devices offer the systems engineer the flexibility to tailor the power supply control circuitry to his application.

The PJ494 contains an error amplifier, an on-chip adjustable oscillator, a dead-time control comparator, pulse-steering control flip-flop, a 5-volt, 5% precision regulator, and output-control circuits. The error amplifier exhibits a common-mode voltage from -0.3 volts to $V_{cc} - 2$ volts. The dead-time control comparator has a fixed offset that provides

approximately 5% dead time when externally altered. The on-chip oscillatory be bypassed by terminating R_T (pin 6) to the reference output and providing a sawtooth input to C_T (PIN 5), or it may be used to drive the common circuits in synchronous multiple-rail power supplies. The uncommitted output transistor provide either common-emitter or emitter-follower output capability. Each device provides for push-pull or single-ended output operation, which may be selected through the output-control function. The architecture of these devices prohibits the possibility of either output being pulsed twice during push-pull operation.

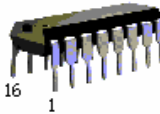
FEATURES

- 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 5-V Reference Supply, 5%
- Circuit Architecture Allows Easy Synchronization

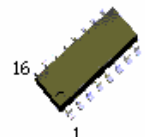
ORDERING INFORMATION

Device	Operating Temperature	Package
PJ494CD	-20°C to +85°C	DIP-16
PJ494CS		SOP-16

DIP-16



SOP-16



Pin 1.Noninv Input	} Error Amp1
2.Inv Input	
3.Feedback	4.Dead-Time Control
5. C_T	6. R_T 7.Gnd
8.C1	9.E1 10.E2
11.C2	12. V_{cc}
13.Output Control	14.RefOut
15.Inv Input	} Error Amp2

ABSOLUTE MAXIMUM RATINGS OVER OPERATING FREE-AIR TEMPERATURE RANGE

(unless otherwise noted)

Rating	Symbol	Value	Unit
Supply voltage	V_{cc}	41	V
Amplifier input voltage	V_i	$V_{cc}+0.3$	
Collector output voltage	V_o	41	
Collector output current		250	mA
Operating free-air temperature range		0 to 70	°C
Storage temperature range	T_{stg}	-65 to 150	
Lead temperature 1,6mm from case for 10 seconds		260	

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RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Max	Unit
Supply voltage	V _{cc}	7	40	V
Amplifier input voltage	V _i	-0.3	V _{cc} -2	
Collector output voltage	V _o		40	
Collector output current(each transistor)			200	mA
Current into feedback terminal			0.3	
Timing capacitor	C _T	0.47	10000	nF
Timing resistor	R _T	1.8	500	KΩ
Oscillator frequency		1	300	KHz
Operating free-air temperature	T _A	0	70	°C

ELECTRICAL CHARACTERISTICS OVER RECOMMENDED OPERATING FREE-AIR TEMPERATURE

V_{cc}=15V, f=10KHz (unless otherwise noted).

Reference section

Parameter	Test Conditions*	Value			Unit
		Min	Typ**	Max	
Output voltage(V _{ref})	I _o =1mA	4.90	5	5.10	V
Input regulation	V _{cc} =7V to 40V		2	25	mV
Output regulation	I _o =1mA to 10mA		1	15	
Output voltage change with temperature	ΔT _A =MIN to MAX		0.2	1	%
Short-circuit output current***	V _{ref} =0		35		mA

Oscillator section(see Figure 1)

Parameter	Test Conditions*	Value			Unit
		Min	Typ**	Max	
Frequency	C _T =0.01μF, R _T =12KΩ		10		KHz
Standard deviation of frequency****	All values of V _{cc} , C _T , R _T , and T _A constant		10		
Frequency change with voltage	V _{cc} =7V to 40V, T _A =25°C		0.1		%
Frequency change with temperature***	C _T =0.01μF, R _T =12KΩ ΔT _A =MIN to MAX			1	

Amplifier section(see Figure 2)

Parameter	Test Conditions*	Value			Unit
		Min	Typ**	Max	
Input offset voltage	V _o =(pin 3)=2.5V		2	10	mA
Input offset current	V _o =(pin 3)=2.5V		25	250	nA
Input bias current	V _o =(pin 3)=2.5V		0.2	1	μA
Common-mode input voltage range	V _{cc} =7V to 40V	-0.3 to V _{cc} -2			V
Open-loop voltage amplification	ΔV _o =3V, R _L =2KΩ, V _o =0.5 to 3.5V	70	95		dB
Unity-gain bandwidth	R _L =2KΩ, V _o =0.5 to 3.5V		800		
Common-mode rejection ratio	ΔV _o =40V, T _A =25°C	65	80		dB
Output sink current (pin 3)	V _{ID} =-15mV to -5V, V _(PIN3) =0.7V	0.3	0.7		mA
Output source current (pin 3)	V _{ID} =15mV to 5V, V _(PIN3) =3.5V	-2			mA

- For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
- All typical values except for parameter changes with temperature are at T_A=25°C
- Duration of the short-circuit should not exceed one second
- Standard deviation is a measure of the statistical distribution about the mean as derived from the formula

$$\sigma = \left[\sum_{n=1}^N \frac{(x_n - \bar{x})^2}{N - 1} \right]^{1/2}$$

- Temperature coefficient of timing capacitor and timing resistor not taken into account

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Output section

Parameter	Test Conditions	Value			Unit
		Min	Typ*	Max	
Collector off-state current	$V_{CE}=40V, V_{CC}=40V$		2	100	μA
Emitter off-state current	$V_{CC}=V_C=40V, V_E=0$			-100	
Collector-emitter saturation voltage	Common-emitter	$V_E=0, I_C=200mA$	1.1	1.3	V
	Emitter-follower	$V_C=15V, I_E=-200mA$	1.5	2.5	
Output control input current	$V_I=V_{ref}$			3.5	mA

Dead-time control-section (See Figure 1)

Parameter	Test Conditions	Value			Unit
		Min	Typ*	Max	
Input bias current (pin 4)	$V_I=0$ to 5.25V		-2	-10	μA
Maximum duty cycle, each output	$V_I(\text{pin } 4)=0, C_T=0.1\mu F, R_T=12K\Omega$		45		%
Input threshold voltage(pin 4)	Zero duty cycle		3	3.3	V
	Maximum duty cycle	0			

PWM comparator section (See Figure 1)

Parameter	Test Conditions	Value			Unit
		Min	Typ*	Max	
Input threshold voltage (pin 3)	Zero duty cycle		4	4.5	V
Input sink current (pin 3)	$V(\text{pin } 3)=0.7V$	0.3	0.7		mA

Total device

Parameter	Test Conditions	Value			Unit
		Min	Typ*	Max	
Standby supply current	Pin 6 at V_{ref} , all other inputs and outputs open	$V_{CC}=15V$	6	10	mA
		$V_{CC}=40V$	9	15	
Average supply current	$V_{I(\text{PIN}4)}=2V$, See Figure 1		7.5		

Switching characteristics, $T_A=25^\circ C$

Parameter	Test Conditions	Value			Unit
		Min	Typ*	Max	
Output voltage rise time	Common-emitter configuration, See Figure 3		100	200	ns
Output voltage fall time			25	100	
Output voltage rise time	Emitter-follower configuration, See Figure 4		100	200	
Output voltage fall time			40	100	

- All typical value except for temperature coefficient are at $T_A=25^\circ C$

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FUNCTION BLOCK DIAGRAM

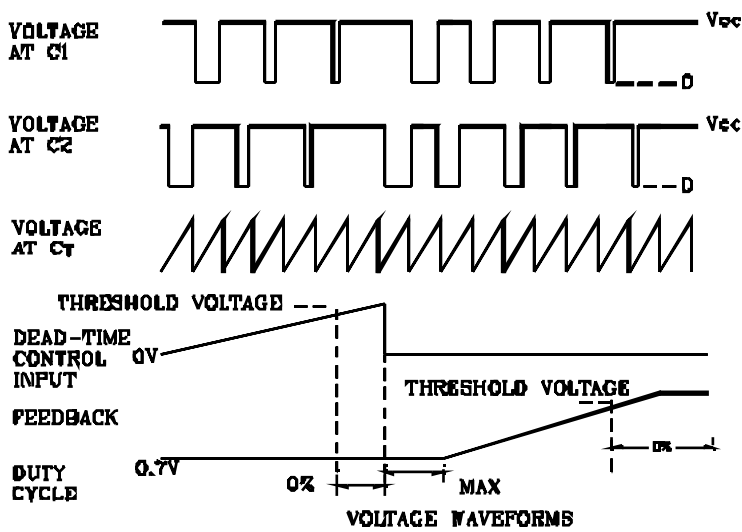
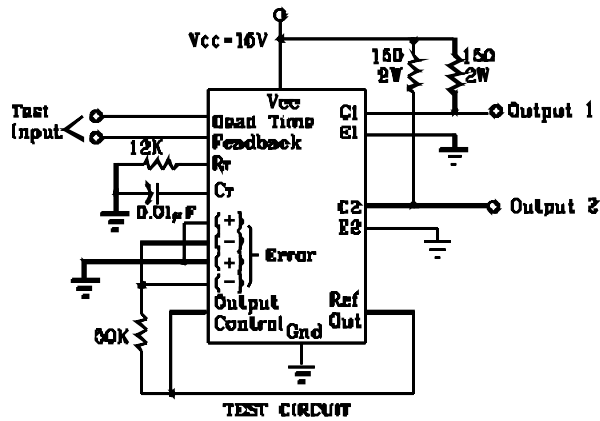
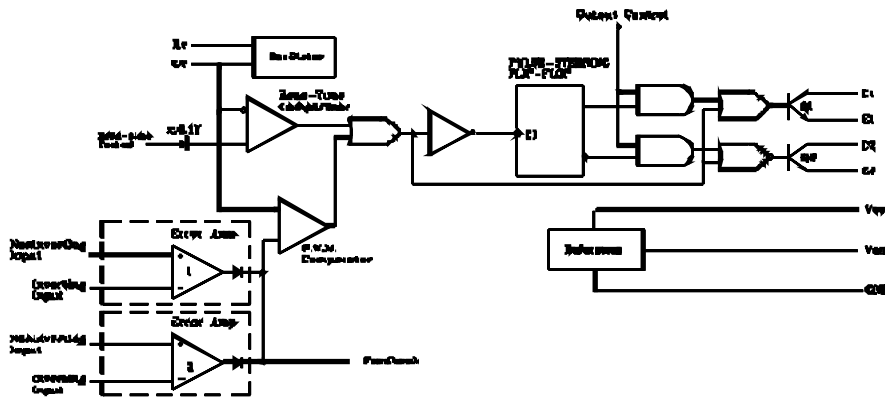


Fig 1. OPERATIONAL TEST CIRCUIT AND WAVEFORMS

Switchmode Pulse Width Modulation Control Circuit

Fig 2. AMPLIFIER CHARACTERISTICS

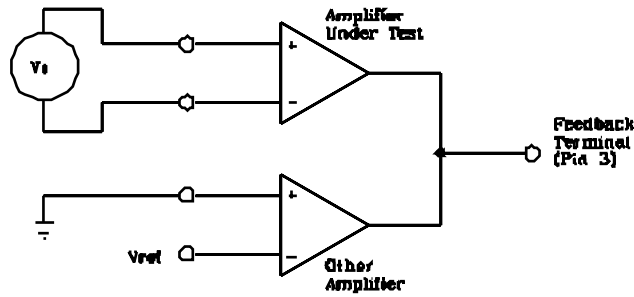
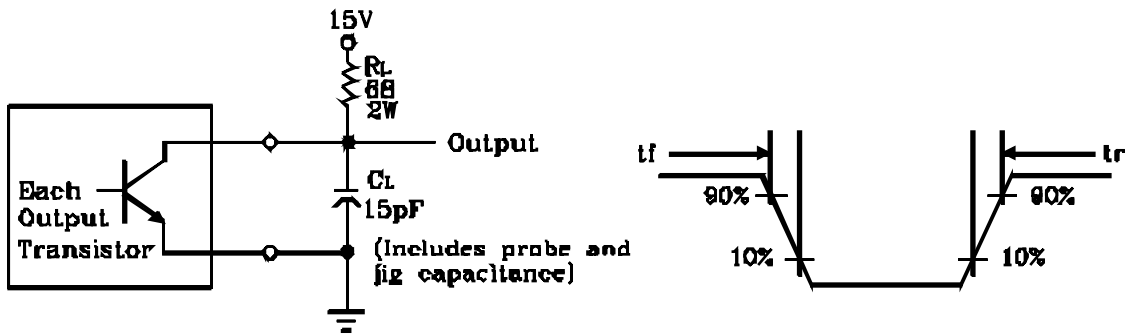
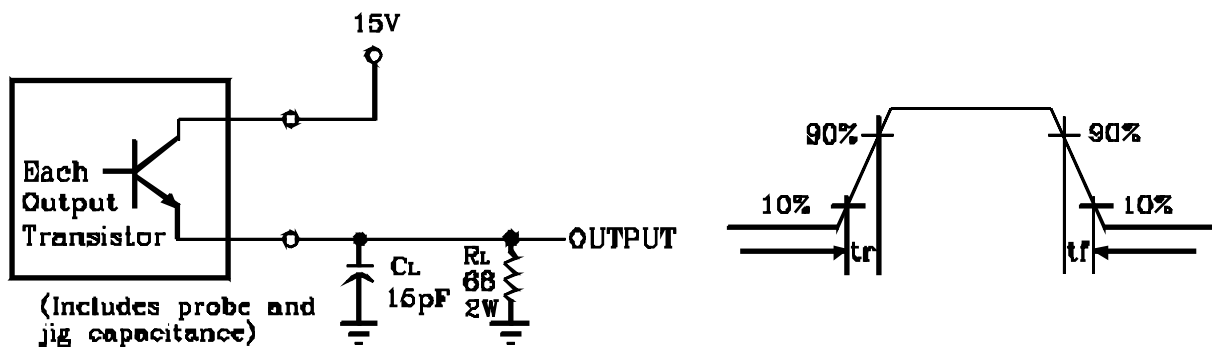


Fig 3. COMMON-EMITTER CONFIGURATION



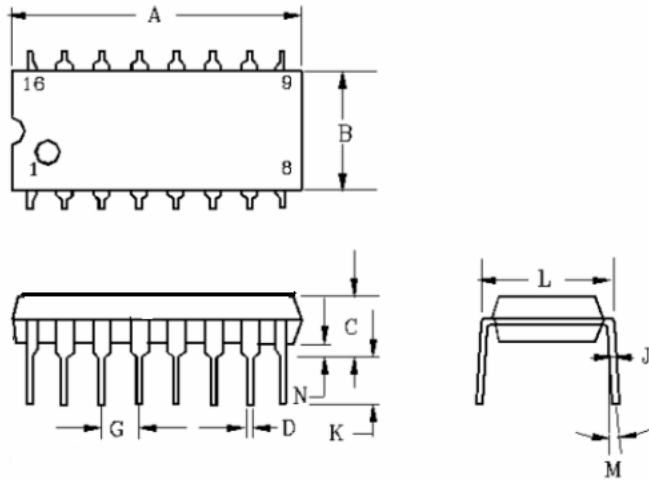
PARAMETER MEASUREMENT INFORMATION

Fig 4. EMITTER-FOLLOWER CONFIGURATION



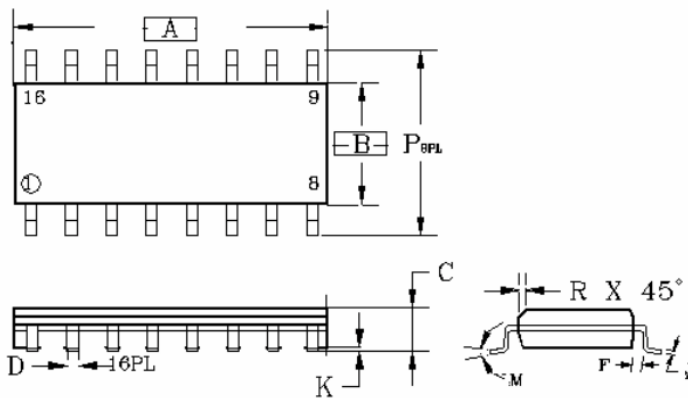
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DIP-16



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	17.80	18.05	0.701	0.710
B	6.25	6.45	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
G	1.27BSC		0.05BSC	
J	0.25	0.32	0.010	0.012
K	0.10	0.25	0.004	0.009
L	0°	7°	0°	7°
M	-	10°	0.395	0.415

SOP-16



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.50	0.90	0.020	0.035
G	1.27BSC		0.05BSC	
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029