

## DOUBLE BALANCED MODULATION / DEMODULATOR

### ■ GENERAL DESCRIPTION

The **NJM1496** is a double balanced modulator-demodulator which produces an output voltage proportional to the product of an input (signal) voltage and a switching (carrier) signal. Typical applications include suppressed carrier modulation, amplitude modulation, synchronous detection, FM or PM detection, broadband frequency doubling and chopping.

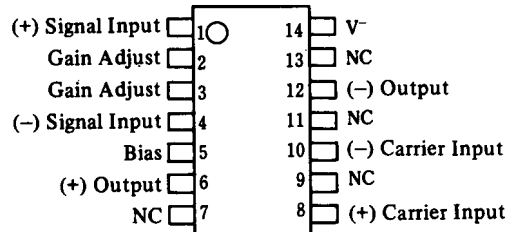
### ■ FEATURES

- Excellent carrier suppression  
65dB typical at 0.5MHz  
50dB typical at 10MHz
- Adjustable gain and signal handling
- Fully balanced inputs and outputs
- High Common Mode Rejection 85dB Typ.
- Package Outline DIP14, DMP14, SSOP14
- Bipolar Technology

### ■ APPLICATION

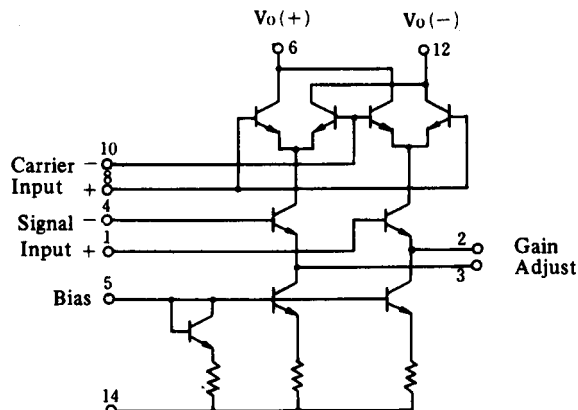
- Balanced Modulation
- Synchronous Detection
- FM Detection
- Phase Detection
- Sampling

### ■ PIN CONFIGURATION



**NJM1496D**  
**NJM1496M**  
**NJM1496V**

### ■ EQUIVALENT CIRCUIT



# NJM1496

## ■ ABSOLUTE MAXIMUM RATINGS

(T<sub>a</sub>=25°C)

PARAMETER	RATINGS	UNIT
Applied Voltage	30 (Applied Pins 6-8, 12-8, 6-10, 12-10, 10-1, 8-1, 10-4, 8-4, 2-5, 3-5)	V
Carrier Input Voltage	±5 (Applied Pins 8-10)	V
Signal Input Voltage	±(5+I <sub>s</sub> , R <sub>e</sub> ) (Applied Pins 1-4)	V
Input Signal	5	V
Bias Current (I <sub>s</sub> )	10	mA
Power Dissipation	(DIP14) 570	mW
	(DMP14) 300	mW
	(SSOP14) 300	mW
Operating Temperature Range	-20 to +75	°C
Storage Temperature Range	-40 to +125	°C

## ■ ELECTRICAL CHARACTERISTICS

DC characteristics (V<sup>+</sup>=12V, V<sup>-</sup>=-8V, I<sub>s</sub>=1.0mA, R<sub>L</sub>=3.9kΩ, R<sub>e</sub>=1.0kΩ, T<sub>a</sub>=25°C)

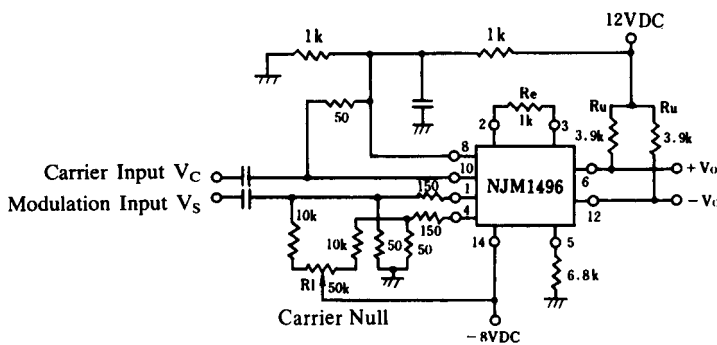
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Single-Ended Input Impedance						
Parallel Input Resistance	R <sub>ip</sub>	Signal Port, f =5.0MHz	-	200	-	kΩ
Parallel Input Capacitance	C <sub>ip</sub>	Signal Port, f =5.0MHz	-	2.0	-	pF
Single-Ended Output Impedance						
Parallel Output Resistance	R <sub>op</sub>	f =10MHz	-	40	-	kΩ
Parallel Output Capacitance	C <sub>op</sub>	f =10MHz	-	5.0	-	pF
Input Bias Current						
I <sub>bs</sub> =I <sub>1</sub> +I <sub>4</sub> / 2	I <sub>bs</sub>		-	12	30	μA
I <sub>bs</sub> =I <sub>8</sub> +I <sub>10</sub> / 2	I <sub>bc</sub>		-	12	30	μA
Input Offset Current						
I <sub>ios</sub> =I <sub>1</sub> - I <sub>4</sub>	I <sub>ios</sub>		-	0.7	7	μA
I <sub>ios</sub> =I <sub>8</sub> - I <sub>10</sub>	I <sub>ioc</sub>		-	0.7	7	μA
Average Temperature Coefficient of Input Offset Current	ΔI <sub>io</sub>		-	2.0	-	nA / °C
Output Offset Current						
(I <sub>6</sub> - I <sub>12</sub> )	I <sub>oc</sub>		-	15	80	μA
Average Temperature Coefficient of Output Offset Current	ΔI <sub>oc</sub>		-	90	-	nA / °C
Output Voltage	V <sub>O</sub>		-	8.0	-	V
Operating Current						
(I <sub>6</sub> + I <sub>12</sub> )	I <sub>D+</sub>		-	2.0	4.0	mA
I <sub>14</sub>	I <sub>D-</sub>		-	3.0	5.0	mA
DC Power Dissipation	P <sub>D</sub>		-	33	-	mW

■ **ELECTRICAL CHARACTERISTICS** AC characteristics ( $V^+=12V$ ,  $V^-=-8V$ ,  $I_S=1.0mA$ ,  $R_L=2.9k\Omega$ ,  $R_e=1.0k\Omega$ ,  $T_a=25^\circ C$ )

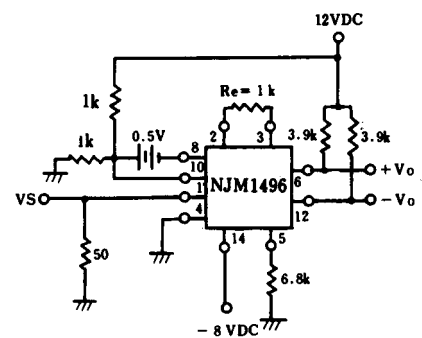
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Carrier Feedthrough	$V_{CFT}$	$V_C=60mV_{rms}$ sine wave offset adjusted	-	40	-	$\mu V_{rms}$	
		$f_C=1.0kHz$	-	140	-	$\mu V_{rms}$	
	$V_{CFT}$	$V_C=300mV_{P-P}$ square wave $f_C=1.0kHz$ offset adjusted	-	0.04	0.4	$mV_{rms}$	
		offset not adjusted	-	20	200	$mV_{rms}$	
	Carrier Suppression	$V_{CS}$	$f_S=10kHz$ , $300mV_{rms}$ sine wave offset adjusted	40	65	-	dB
		$V_{CS}$	$f_C=500kHz$ , $60mV_{rms}$ sine wave $f_C=10MHz$ , $60mV_{rms}$ sine wave	-	50	-	dB
Transadmittance Bandwidth ( $R_L=50\Omega$ )	BW 3dB	$V_C=60mV_{rms}$ sine wave $f_S=1.0kHz$ , $300mV_{rms}$ sine wave	-	300	-	MHz	
Carrier Input Port	BW 3dB	$V_S=300mV_{rms}$ sine wave $ V_C =0.5V_{dc}$	-	80	-	MHz	
Signal Input Port	BW 3dB	$V_S=100mV_{rms}$ , $f_S=1.0kHz$ $ V_C =0.5V_{dc}$	2.5	3.5	-	V/V	
Voltage Gain, Signal Channel	$AV_S$	$V_S=100mV_{rms}$ , $f_S=1.0kHz$ $ V_C =0.5V_{dc}$	2.5	3.5	-	V/V	
Signal Port Common Mode Input Voltage Range	$CM_V$	$f_S=1.0kHz$	-	5.0	-	$V_{P-P}$	
Signal Port Common Mode Rejection Ratio	ACM	$f_S=1.0kHz$ , $ V_C =0.5V_{dc}$	-	-85	-	dB	
Differential Output Swing Capability	$DV_{out}$		-	8.0	-	$V_{P-P}$	

■ **TEST CIRCUIT**

- Carrier feedthrough
- Carrier Suppression



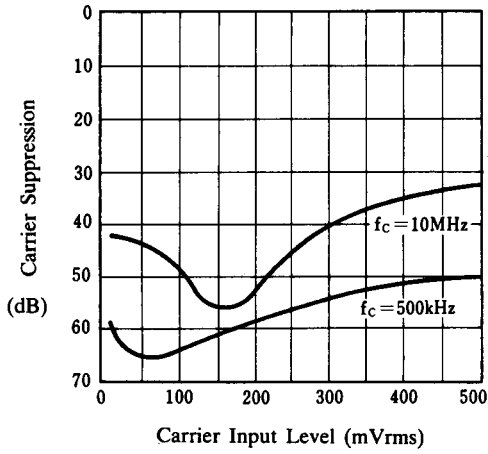
- Differential Output Swing Capability
- Signal Port Common Mode Rejection Ratio



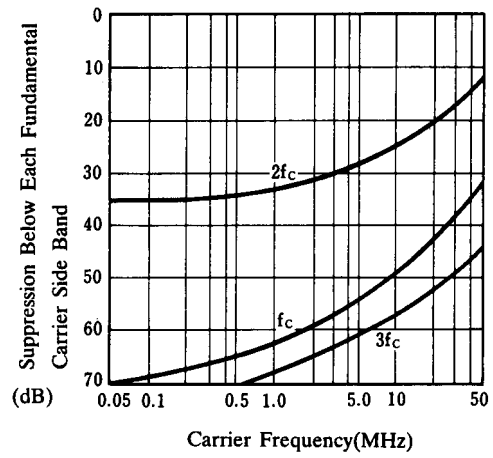
Connect a  $100\mu F$  capacitor and a  $3000pF$  capacitor in parallel to each other, if the capacitance is not specified.

## ■ TYPICAL CHARACTERISTICS

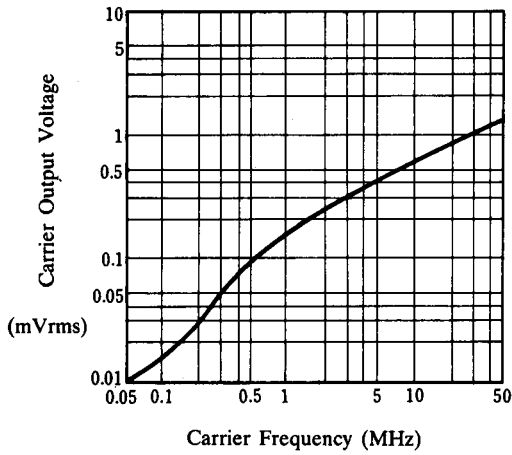
### Carrier Suppression



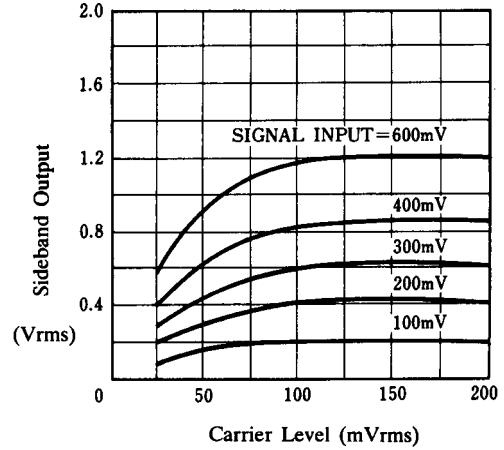
### Carrier Suppression



### Carrier Feedthrough

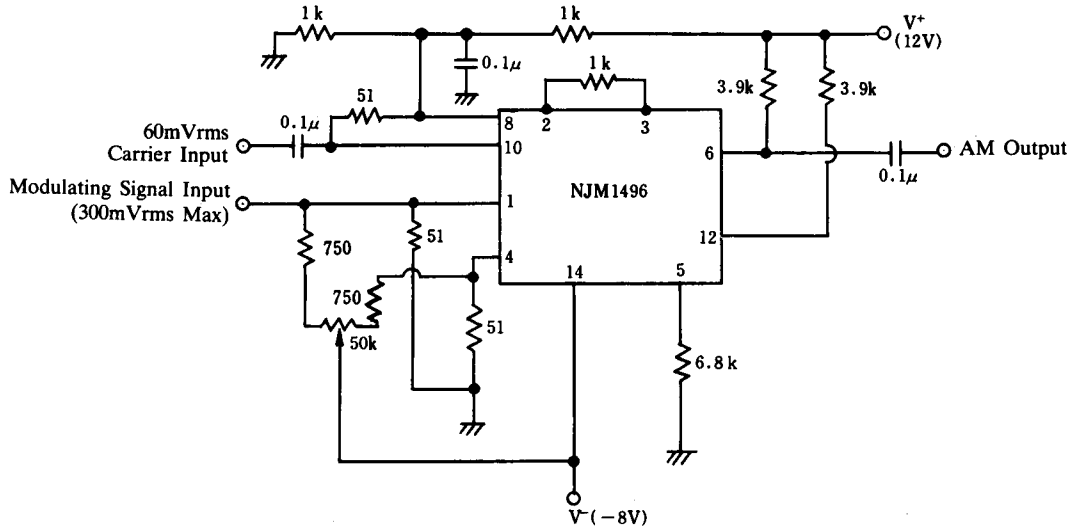


### Sideband Output

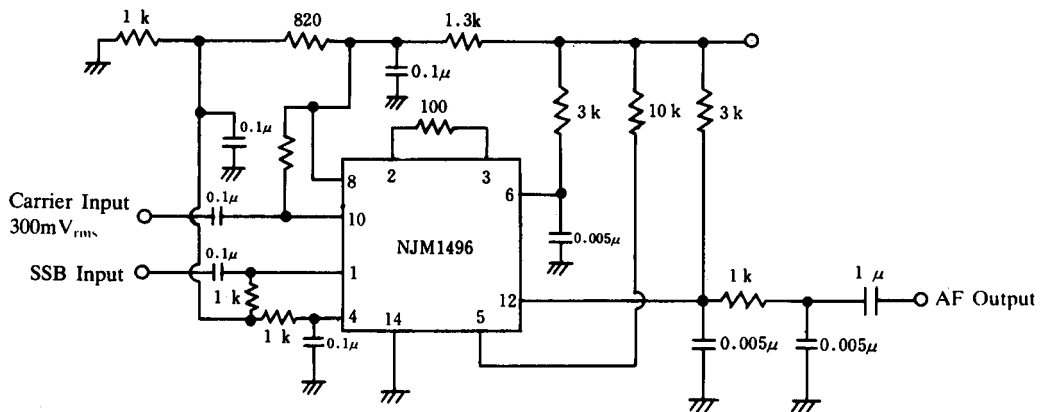


## ■ TYPICAL APPLICATIONS

### AM Modulator Circuit



### Product Detector (+12V DC Single Supply)



**[CAUTION]**

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