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## 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.

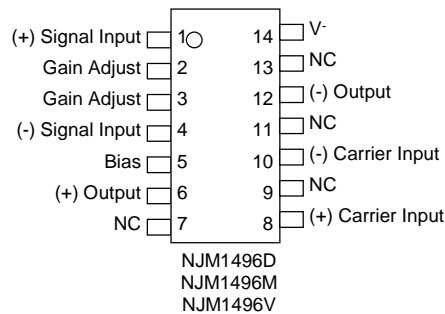
### ■ FEATURES

- 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

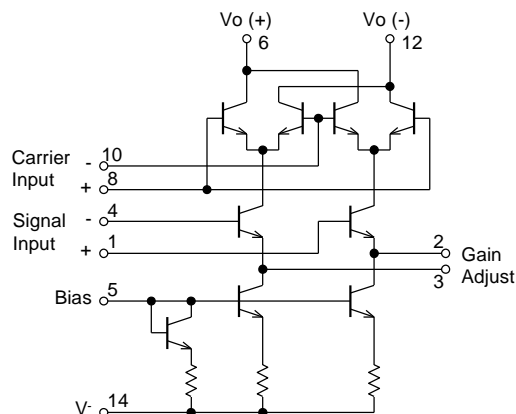
### ■ APPLICATION

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

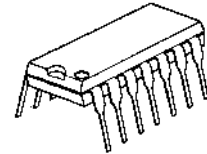
### ■ PIN CONFIGURATION



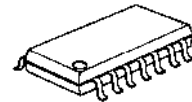
### ■ EQUIVALENT CIRCUIT



### ■ PACKAGE OUTLINE



NJM1496D



NJM1496M



NJM1496V

# NJM1496

## ■ ABSOLUTE MAXIMUM RATINGS

( $T_a=25^\circ\text{C}$ )

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	$\pm 5$ (Applied Pins 8-10)	V
Signal Input Voltage	$\pm(5+I_5 \cdot R_e)$ (Applied Pins 1-4)	V
Input Signal	5	V
Bias Current ( $I_5$ )	10	mA
Power Dissipation	(DIP14) 570	mW
	(DMP14) 300	mW
	(SSOP14) 300	mW
Operating Temperature Range	-40 to +85	$^\circ\text{C}$
Storage Temperature Range	-40 to +125	$^\circ\text{C}$

## ■ ELECTRICAL CHARACTERISTICS

DC characteristics ( $V^+=12\text{V}$ ,  $V^-=-8\text{V}$ ,  $I_5=1.0\text{mA}$ ,  $R_L=3.9\text{k}\Omega$ ,  $R_e=1.0\text{k}\Omega$ ,  $T_a=25^\circ\text{C}$ )

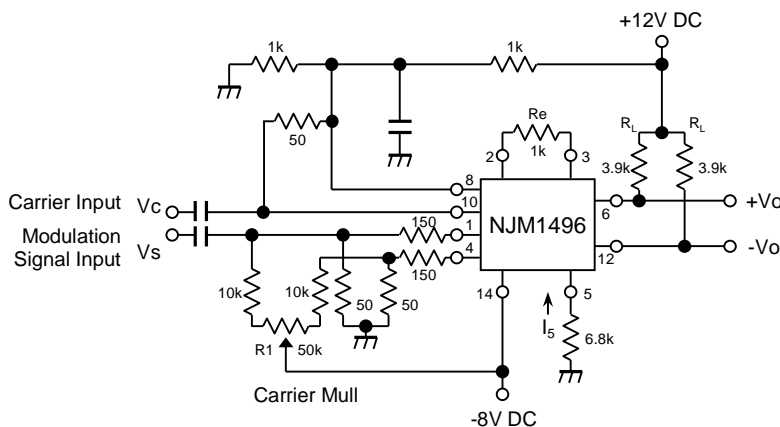
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Single-Ended Input Impedance						
Parallel Input Resistance	$R_{ip}$	Signal Port, $f=5.0\text{MHz}$	-	200	-	$\text{k}\Omega$
Parallel Input Capacitance	$C_{ip}$	Signal Port, $f=5.0\text{MHz}$	-	2.0	-	pF
Single-Ended Output Impedance						
Parallel Output Resistance	$R_{op}$	$f=10\text{MHz}$	-	40	-	$\text{k}\Omega$
Parallel Output Capacitance	$C_{op}$	$f=10\text{MHz}$	-	5.0	-	pF
Input Bias Current						
$I_{b5}=I_1+I_4/2$	$I_{b5}$		-	12	30	$\mu\text{A}$
$I_{b5}=I_8+I_{10}/2$	$I_{b5}$		-	12	30	$\mu\text{A}$
Input Offset Current						
$I_{ios}=I_1-I_4$	$I_{ios}$		-	0.7	7	$\mu\text{A}$
$I_{ios}=I_8-I_{10}$	$I_{ios}$		-	0.7	7	$\mu\text{A}$
Average Temperature Coefficient of Input Offset Current	$\Delta I_{io}$		-	2.0	-	$\text{nA}/^\circ\text{C}$
Output Offset Current						
$(I_6-I_{12})$	$I_{oc}$		-	15	80	$\mu\text{A}$
Average Temperature Coefficient of Output Offset Current	$\Delta I_{oc}$		-	90	-	$\text{nA}/^\circ\text{C}$
Output Voltage	$V_o$		-	8.0	-	V
Operating Current						
$(I_6+I_{12})$	$I_{D+}$		-	2.0	4.0	mA
$I_{14}$	$I_{D-}$		-	3.0	5.0	mA
DC Power Dissipation	$P_D$		-	33	-	mW

■ **ELECTRICAL CHARACTERISTICS** AC characteristics ( $V^+=12V$ ,  $V^-=-8V$ ,  $I_S=1.0mA$ ,  $R_L=3.9k\Omega$ ,  $R_e=1.0k\Omega$ ,  $T_a=25^\circ C$ )

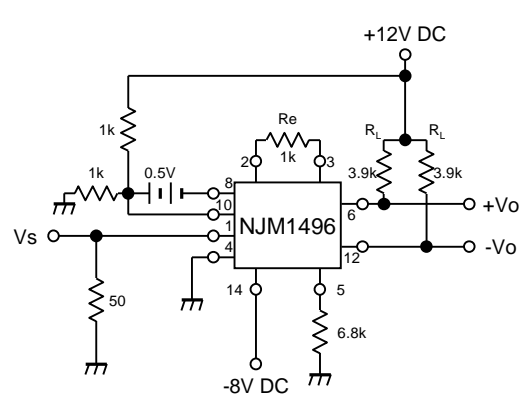
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Carrier Feedthrough	$V_{CFT}$	$V_C=60mV_{rms}$ sine wave offset adjusted	-	40	-	$\mu V_{rms}$
		$f_C=1.0kHz$	-	140	-	$\mu V_{rms}$
	$V_{CFT}$	$V_C=300mV_{P-P}$ square wave $f_C=1.0kHz$ offset adjusted	-	0.04	0.4	$mV_{rms}$
		offset not adjusted	-	20	200	$mV_{rms}$
		$f_S=10kHz$ , $300mV_{rms}$ sine wave offset adjusted	-	-	-	-
Carrier Suppression	$V_{CS}$	$f_C=500kHz$ , $60mV_{rms}$ sine wave	40	65	-	dB
	$V_{CS}$	$f_C=10MHz$ , $60mV_{rms}$ sine wave	-	50	-	dB
Transadmittance Bandwidth ( $R_L=50\Omega$ )		$V_C=60mV_{rms}$ sine wave				
Carrier Input Port	BW 3dB	$f_S=1.0kHz$ , $300mV_{rms}$ sine wave	-	300	-	MHz
Signal Input Port	BW 3dB	$V_S=300mV_{rms}$ sine wave $ V_C =0.5V_{dc}$		80		MHz
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



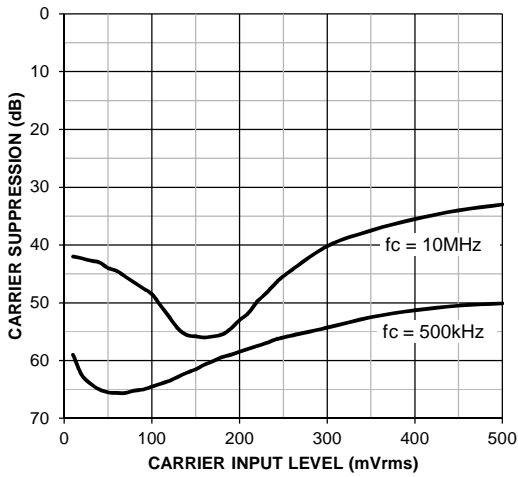
- Differential Output Swing Capability
- Signal Port Common Mode Rejection Ratio



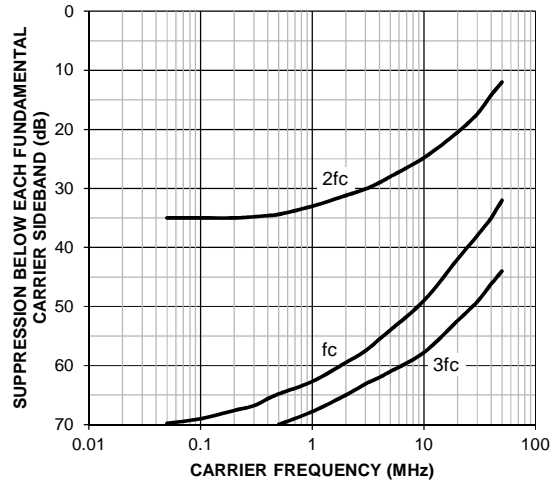
Connect a 100uF capacitor and a 3000pF capacitor in parallel to each other, if the capacitance is not specified.

## ■ TYPICAL CHARACTERISTICS

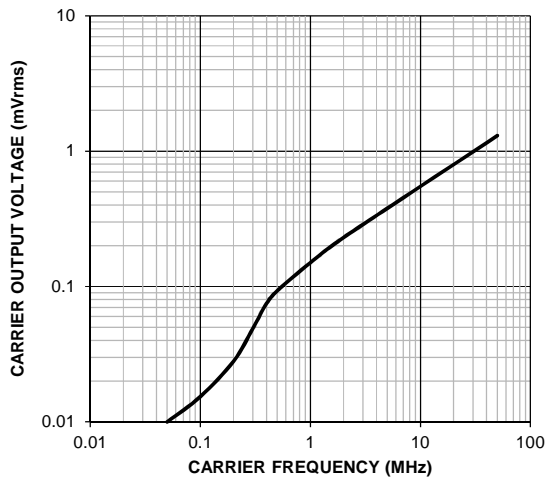
**Carrier Suppression versus Carrier Input Level**



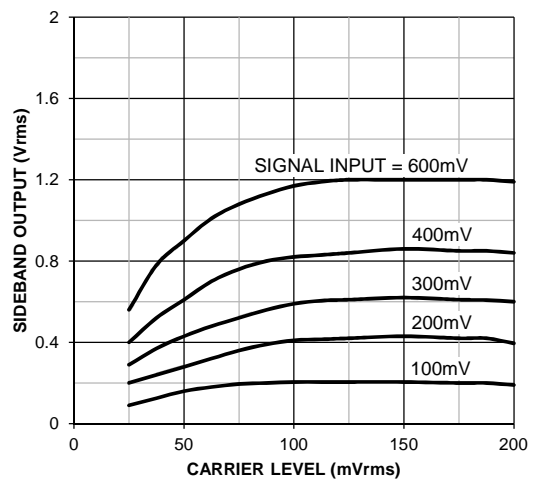
**Carrier Feedthrough versus Frequency**



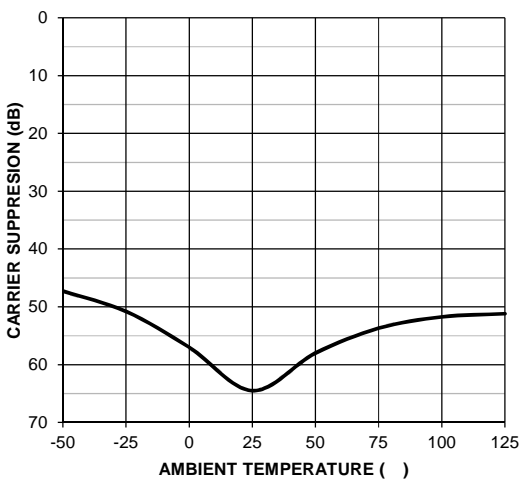
**Carrier Feedthrough versus Frequency**



**Sideband Output versus Carrier Levels**

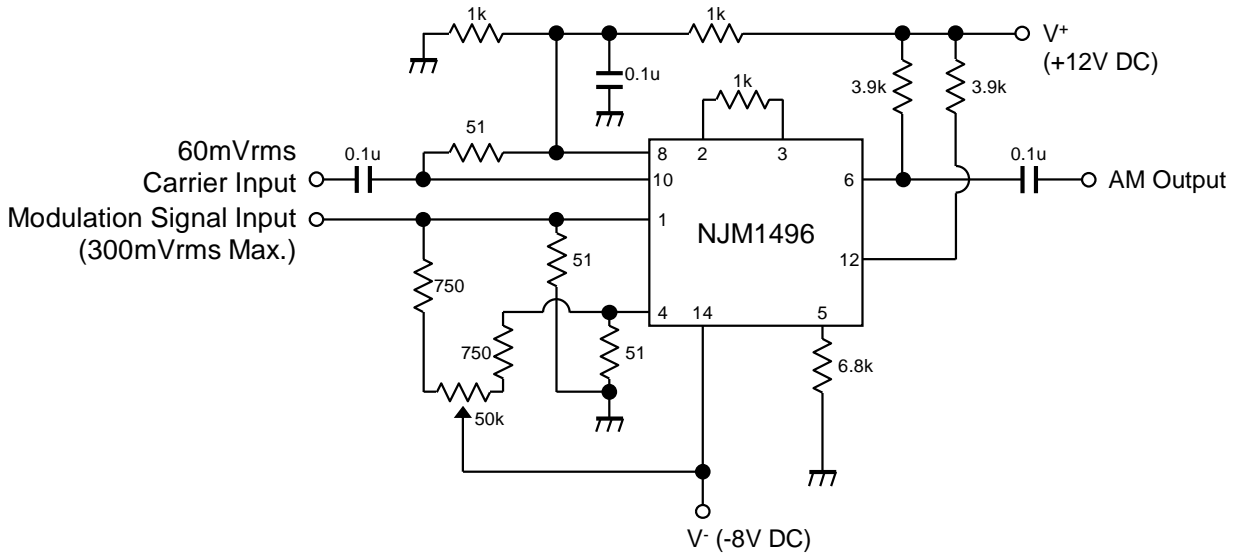


**Carrier Suppression versus Temperature**

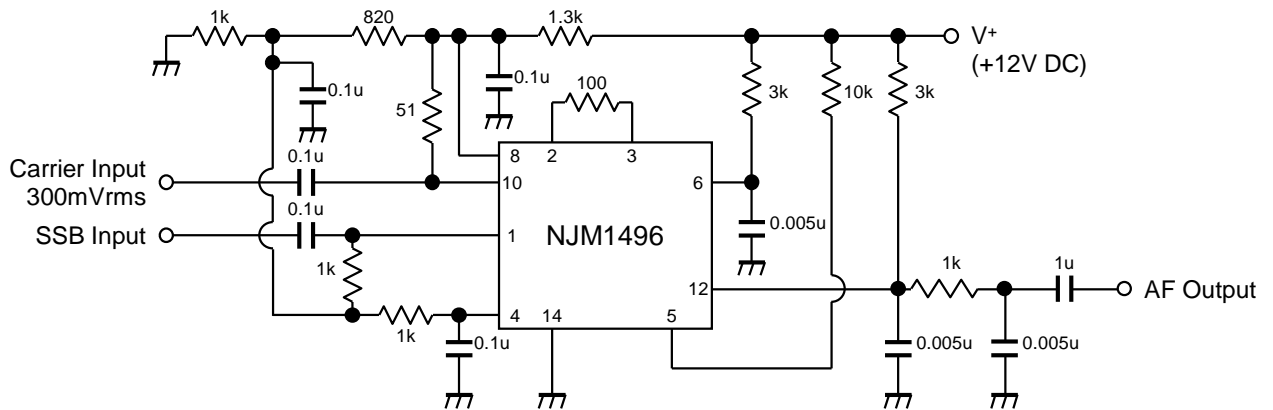


## ■ TYPICAL APPLICATIONS

### AM Modulator Circuit



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



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