



February 1995

LM1596/LM1496 Balanced Modulator-Demodulator

General Description

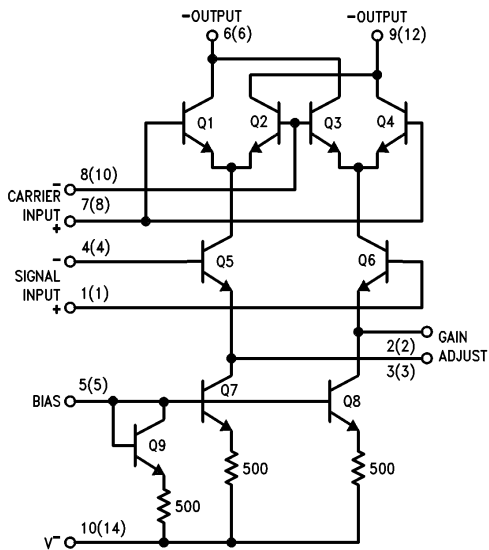
The LM1596/LM1496 are doubled balanced modulator-demodulators which produce an output voltage proportional to the product of an input (signal) voltage and a switching (carrier) signal. Typical applications include suppressed carrier modulation, amplitude modulation, synchronous detection, FM or PM detection, broadband frequency doubling and chopping.

The LM1596 is specified for operation over the -55°C to $+125^{\circ}\text{C}$ military temperature range. The LM1496 is specified for operation over the 0°C to $+70^{\circ}\text{C}$ temperature range.

Features

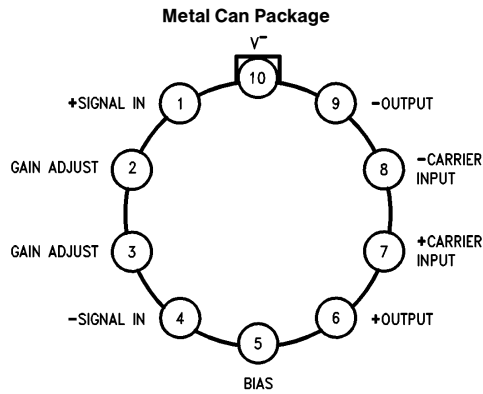
- Excellent carrier suppression
65 dB typical at 0.5 MHz
50 dB typical at 10 MHz
- Adjustable gain and signal handling
- Fully balanced inputs and outputs
- Low offset and drift
- Wide frequency response up to 100 MHz

Schematic and Connection Diagrams



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Numbers in parentheses show DIP connections.



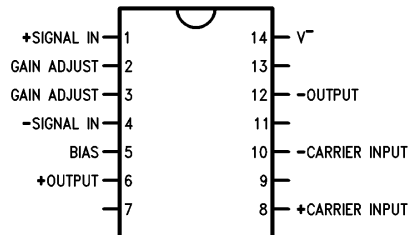
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Top View

Note: Pin 10 is connected electrically to the case through the device substrate.

Order Number **LM1496H** or **LM1596H**
See NS Package Number **H08C**

Dual-In-Line and Small Outline Packages



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Order Number **LM1496M** or **LM1496N**
See NS Package Number **M14A** or **N14A**

LM1596/LM1496 Balanced Modulator-Demodulator

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Internal Power Dissipation (Note 1)	500 mW
Applied Voltage (Note 2)	30V
Differential Input Signal ($V_7 - V_8$)	$\pm 5.0V$
Differential Input Signal ($V_4 - V_1$)	$\pm (5 + I_5 R_0)V$
Input Signal ($V_2 - V_1, V_3 - V_4$)	5.0V
Bias Current (I_5)	12 mA
Operating Temperature Range LM1596	-55°C to +125°C
LM1496	0°C to +70°C
Storage Temperature Range	-65°C to +150°C

Soldering Information

- Dual-In-Line Package

Soldering (10 seconds)	260°C
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- Small Outline Package

Vapor Phase (60 seconds)	215°C
Infrared (15 seconds)	220°C

See AN-450 "Surface Mounting Methods and their effects on Product Reliability" for other methods of soldering surface mount devices.

Electrical Characteristics ($T_A = 25^\circ C$, unless otherwise specified, see test circuit)

Parameter	Conditions	LM1596			LM1496			Units
		Min	Typ	Max	Min	Typ	Max	
Carrier Feedthrough	$V_C = 60$ mVrms sine wave $f_C = 1.0$ kHz, offset adjusted		40			40		μ Vrms
	$V_C = 60$ mVrms sine wave $f_C = 10$ kHz, offset adjusted		140			140		μ Vrms
	$V_C = 300$ mV _{pp} square wave $f_C = 1.0$ kHz, offset adjusted		0.04	0.2		0.04	0.2	mVrms
	$V_C = 300$ mV _{pp} square wave $f_C = 1.0$ kHz, not offset adjusted		20	100		20	150	mVrms
Carrier Suppression	$f_S = 10$ kHz, 300 mVrms	50	65		50	65		dB
	$f_C = 500$ kHz, 60 mVrms sine wave offset adjusted $f_S = 10$ kHz, 300 mVrms		50			50		dB
	$f_C = 10$ MHz, 60 mVrms sine wave offset adjusted							
Transadmittance Bandwidth	$R_L = 50\Omega$ Carrier Input Port, $V_C = 60$ mVrms sine wave $f_S = 1.0$ kHz, 300 mVrms sine wave		300			300		MHz
	Signal Input Port, $V_S = 300$ mVrms sine wave $V_7 - V_8 = 0.5V_{dc}$		80			80		MHz
Voltage Gain, Signal Channel	$V_S = 100$ mVrms, $f = 1.0$ kHz $V_7 - V_8 = 0.5 V_{dc}$	2.5	3.5		2.5	3.5		V/V
Input Resistance, Signal Port	$f = 5.0$ MHz $V_7 - V_8 = 0.5 V_{dc}$		200			200		k Ω
Input Capacitance, Signal Port	$f = 5.0$ MHz $V_7 - V_8 = 0.5 V_{dc}$		2.0			2.0		pF
Single Ended Output Resistance	$f = 10$ MHz		40			40		k Ω
Single Ended Output Capacitance	$f = 10$ MHz		5.0			5.0		pF
Input Bias Current	$(I_1 + I_4)/2$		12	25		12	30	μ A
Input Bias Current	$(I_7 + I_8)/2$		12	25		12	30	μ A
Input Offset Current	$(I_1 - I_4)$		0.7	5.0		0.7	5.0	μ A
Input Offset Current	$(I_7 - I_8)$		0.7	5.0		5.0	5.0	μ A
Average Temperature Coefficient of Input Offset Current	$(-55^\circ C < T_A < +125^\circ C)$ $(0^\circ C < T_A < +70^\circ C)$		2.0			2.0		nA/ $^\circ$ C nA/ $^\circ$ C
Output Offset Current	$(I_6 - I_9)$		14	50		14	60	μ A
Average Temperature Coefficient of Output Offset Current	$(-55^\circ C < T_A < +125^\circ C)$ $(0^\circ C < T_A < +70^\circ C)$		90			90		nA/ $^\circ$ C nA/ $^\circ$ C

Electrical Characteristics ($T_A = 25^\circ\text{C}$, unless otherwise specified, see test circuit) (Continued)

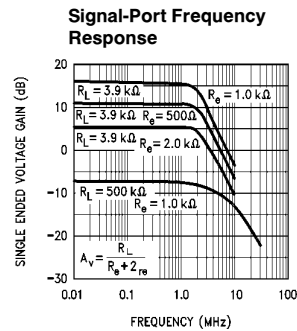
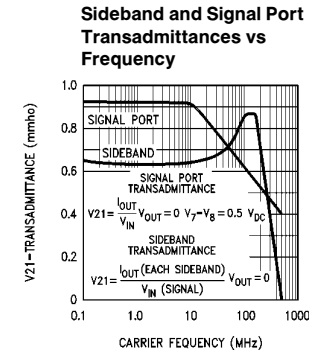
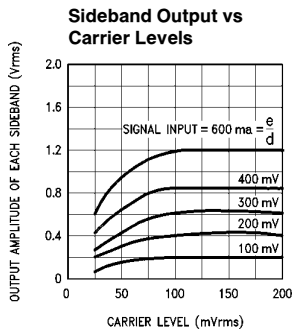
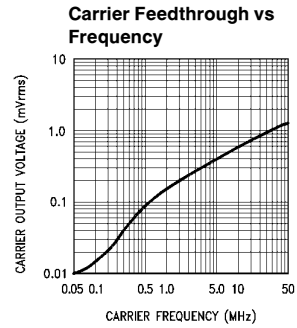
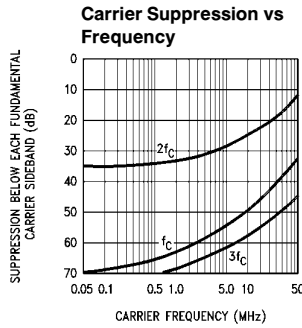
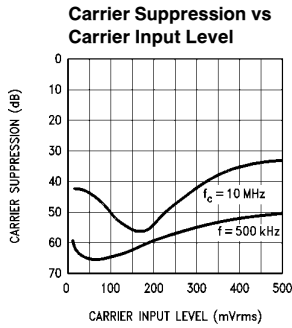
Parameter	Conditions	LM1596			LM1496			Units
		Min	Typ	Max	Min	Typ	Max	
Signal Port Common Mode Input Voltage Range	$f_S = 1.0 \text{ kHz}$		5.0			5.0		V_{p-p}
Signal Port Common Mode Rejection Ratio	$V_7 - V_8 = 0.5 \text{ Vdc}$		-85			-85		dB
Common Mode Quiescent Output Voltage			8.0			8.0		Vdc
Differential Output Swing Capability			8.0			8.0		V_{p-p}
Positive Supply Current	$(I_6 + I_9)$		2.0	3.0		2.0	3.0	mA
Negative Supply Current	(I_{10})		3.0	4.0		3.0	4.0	mA
Power Dissipation			33			33		mW

Note 1: LM1596 rating applies to case temperatures to $+125^\circ\text{C}$; derate linearly at $6.5 \text{ mW}/^\circ\text{C}$ for ambient temperature above 75°C . LM1496 rating applies to case temperatures to $+70^\circ\text{C}$.

Note 2: Voltage applied between pins 6-7, 8-1, 9-7, 9-8, 7-4, 7-1, 8-4, 6-8, 2-5, 3-5.

Note 3: Refer to rets1596x drawing for specifications of military LM1596H versions.

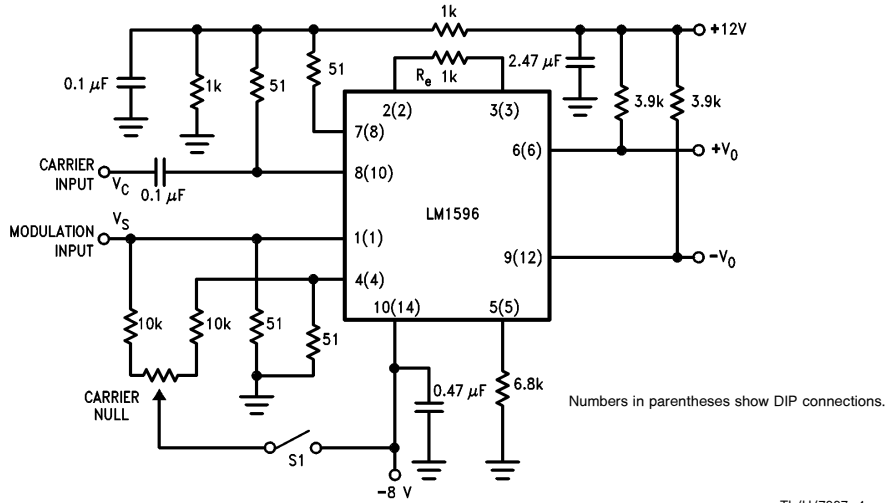
Typical Performance Characteristics



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Typical Application and Test Circuit

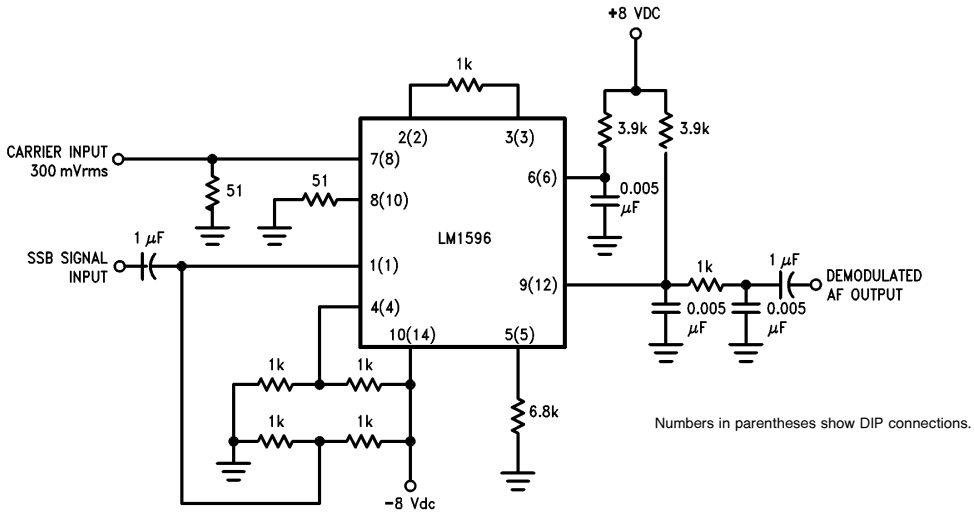
Suppressed Carrier Modulator



Note: S₁ is closed for "adjusted" measurements.

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SSB Product Detector



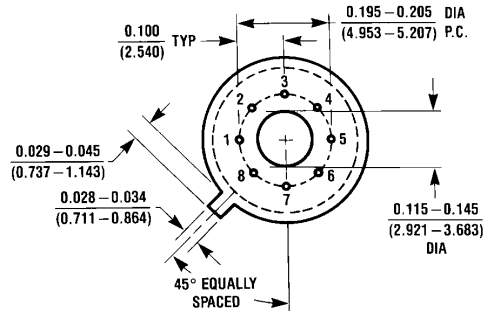
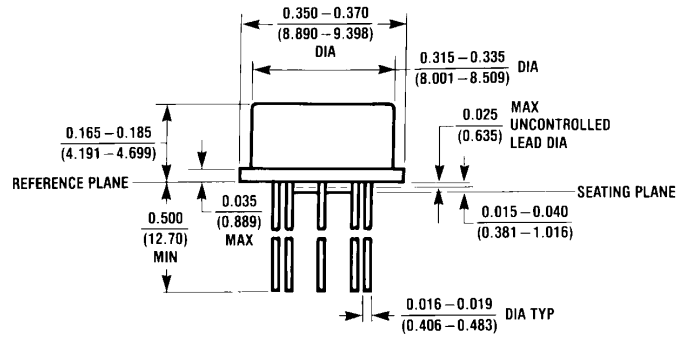
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This figure shows the LM1596 used as a single sideband (SSB) suppressed carrier demodulator (product detector). The carrier signal is applied to the carrier input port with sufficient amplitude for switching operation. A carrier input level of 300 mVrms is optimum. The composite SSB signal is applied to the signal input port with an amplitude of 5.0 to 500 mVrms. All output signal components except the desired demodulated audio are filtered out, so that an offset adjustment is not required. This circuit may also be used as an AM detector by applying composite and carrier signals in the same manner as described for product detector operation.

[查询"LM1596"供应商](#)

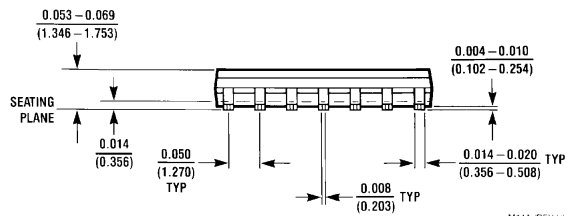
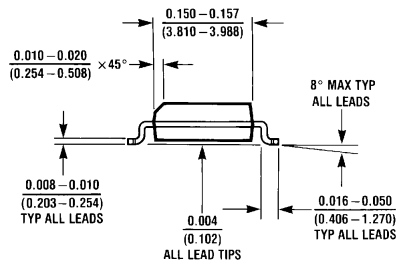
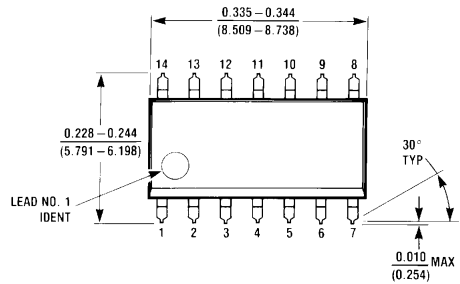


Physical Dimensions inches (millimeters)



H08C (REV E)

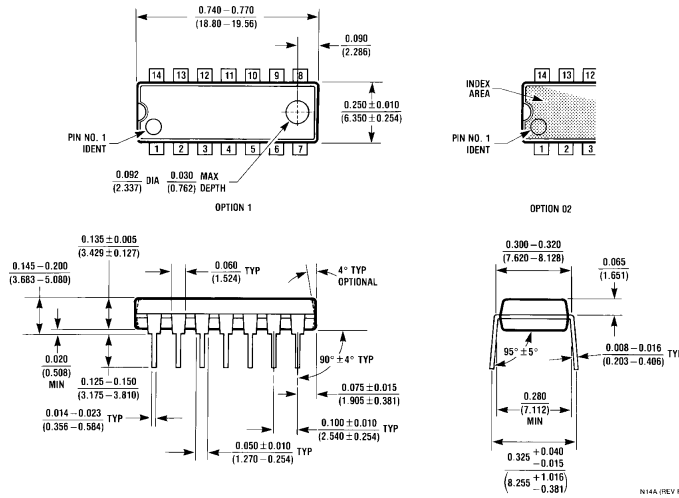
Metal Can Package (H)
Order Number LM1496H or LM1596H
NS Package Number H08C



M14A (REV H)

Molded Small Outline Package (M)
Order Number LM1496M
NS Package Number M14A

Physical Dimensions inches (millimeters) (Continued)



Molded Dual-In-Line Package (N)
Order Number LM1496N
NS Package Number N14A

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National Semiconductor Corporation
 1111 West Bardin Road
 Arlington, TX 76017
 Tel: 1(800) 272-9959
 Fax: 1(800) 737-7018

National Semiconductor Europe
 Fax: (+49) 0-180-530 85 86
 Email: cnjwge@tevm2.nsc.com
 Deutsch Tel: (+49) 0-180-530 85 85
 English Tel: (+49) 0-180-532 78 32
 Français Tel: (+49) 0-180-532 93 58
 Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
 19th Floor, Straight Block,
 Ocean Centre, 5 Canton Rd.
 Tsimshatsui, Kowloon
 Hong Kong
 Tel: (852) 2737-1600
 Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
 Tel: 81-043-299-2309
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