Balanced modulator/demodulator

MC1496/MC1596

DESCRIPTION

The MC1496 is a monolithic double-balanced modulator/demodulator designed for use where the output voltage is a product of an input voltage (signal) and a switched function (carrier). The MC1596 will operate over the full military temperature range of -55 to +125°C. The MC1496 is intended for applications within the range of 0 to +70°C.
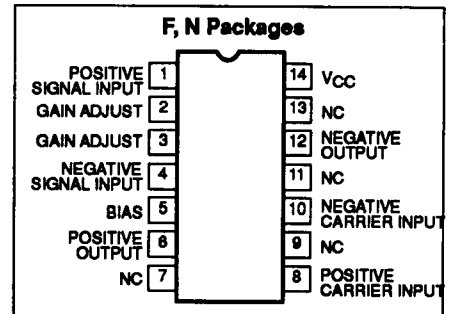
FEATURES

- Excellent carrier suppression
  65dB typ @ 0.5MHz
  50dB typ @ 10MHz

- Adjustable gain and signal handling

- Balanced inputs and outputs

- High common-mode rejection—85dB typ

APPLICATIONS

- Suppressed carrier and amplitude modulation

- Synchronous detection

- FM detection

- Phase detection

- Sampling

- Single sideband

- Frequency doubling

PIN CONFIGURATION

F, N Packages

Pin	Name	Pin	Name
1	POSITIVE SIGNAL INPUT	14	V_{CC}
2	GAIN ADJUST	13	NC
3	GAIN ADJUST	12	NEGATIVE OUTPUT
4	NEGATIVE SIGNAL INPUT	11	NC
5	BIAS	10	NEGATIVE CARRIER INPUT
6	POSITIVE OUTPUT	9	NC
7	NC	8	POSITIVE CARRIER INPUT

ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE	DWG #
14-Pin Cerdip	0 to +70°C	MC1496F	0581
14-Pin Plastic	0 to +70°C	MC1496N	0405
14-Pin Cerdip	-55 to +125°C	MC1596F	0581
14-Pin Plastic	-55 to +125°C	MC1596N	0405

ABSOLUTE MAXIMUM RATINGS

| SYMBOL	PARAMETER	RATING	UNIT
	Applied voltage	30	V
V_8-V_{10}	Differential input signal	±5.0	V
V_4-V_1	Differential input signal	$(5 \pm I_5 R_e)$	V
V_2-V_1, V_3-V_4	Input signal	5.0	V
I_5	Bias current	10	mA
P_D	Maximum power dissipation, T_A=25°C (still-air)[1] F package N package	1190 1420	mW mW
T_A	Operating temperature range MC1496 MC1596	0 to +70 -55 to +125	°C °C
T_{STG}	Storage temperature range	-65 to +150	°C

NOTES:
1. Derate above 25°C, at the following rates:
     F package at 9.5mW/°C
     N package at 11.4mW/°C

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EQUIVALENT SCHEMATIC
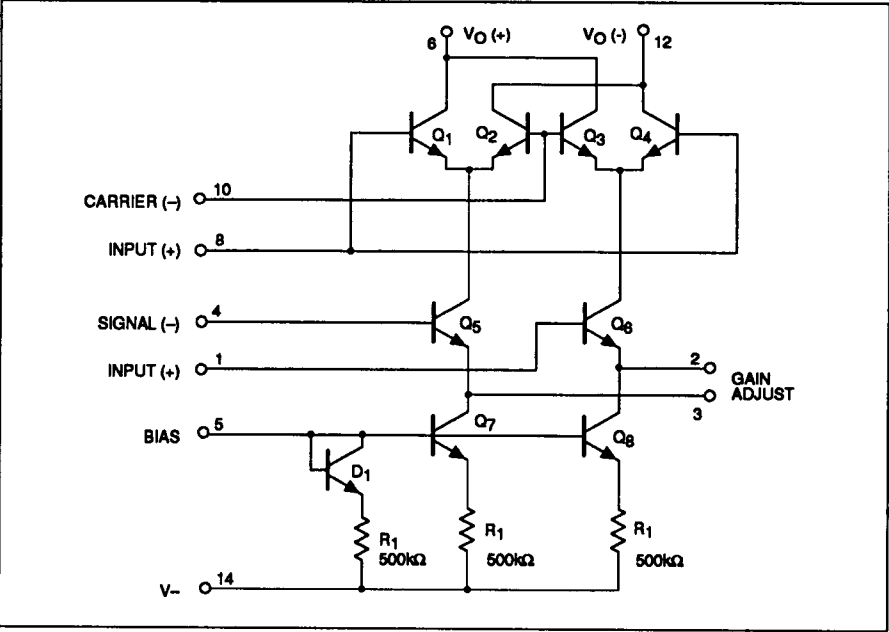
DC ELECTRICAL CHARACTERISTICS

$V_{CC}=+12V_{DC}$; $V_{CC}=-8.0V_{DC}$; $I5=1.0mADC$; $R_L=3.9k\Omega$; $R_E=1.0k\Omega$; $T_A=25°C$, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MC1596			MC1496			UNIT
			Min	Typ	Max	Min	Typ	Max	
R_{IP} C_{IP}	Single-ended input impedance Parallel input resistance Parallel input capacitance	Signal port, f=5.0MHz		200 2.0			200 2.0		$k\Omega$ pF
R_{OP} C_{OP}	Single-ended output impedance Parallel output resistance Parallel output capacitance	f=10MHz		40 5.0			40 5.0		$k\Omega$ pF
I_{BS} I_{BC}	Input bias current $I_{BS}=$ $I_{BC}=$			12 12	25 25		12 12	30 30	μA μA
I_{IOS} I_{IOC}	Input offset current $I_{IOS}=I_1-I_4$ $I_{IOC}=I_8-I_{10}$			0.7 0.7	5.0 5.0		0.7 0.7	7.0 7.0	μA μA
$Tc I_{IO}$ I_{OO}	Average temperature coefficient of input offset current Output offset current I_6-I_{12}			2.0 14	 50		2.0 15	 80	nA/°C μA
$Tc I_{OO}$ V_O	Average temperature coefficient of output offset current Common-mode quiescent output voltage (Pin 6 or Pin 12)			90 8.0			90 8.0		nA/°C V_{DC}
I_{D+} I_{D-}	Power supply current I_6+I_{12} I_{14}			2.0 3.0	3.0 4.0		2.0 3.0	4.0 5.0	mA_{DC}
P_D	DC power dissipation			33			33		mW

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AC ELECTRICAL CHARACTERISTICS

V_{CC}=+12$_{DC}$; V_{CC}=-9.0V_{DC}; I_5=1.0mA$_{DC}$; R_L=3.9kΩ; R_E=1.0kΩ; T_A=+25°C unless otherwise specified.

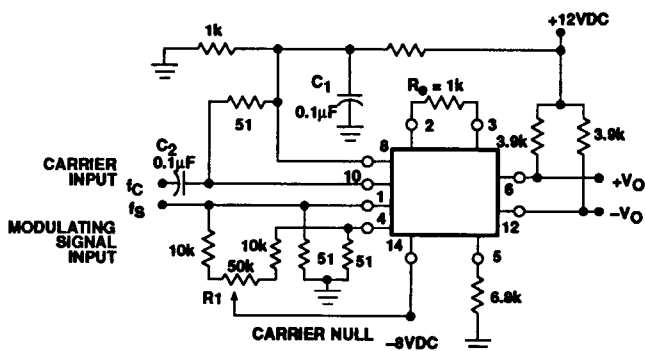| SYMBOL	PARAMETER	TEST CONDITIONS	MC1596			MC1496			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{CFT}	Carrier feedthrough	V_C=60mV_{RMS} sinewave and offset adjusted to zero							
		f_C=1.0kHz		40			40		μV_{RMS}
		f_C=10MHz		140			140		
		V_C=300mV_{P-P} squarewave:							
		Offset adjusted to zero f_C=1.0kHz		0.04	0.2		0.04	0.4	mV_{RMS}
		Offset not adjusted f_C=1.0kHz		20	100		20	200	
V_{CS}	Carrier suppressions	f_S=10kHz, 300mV_{RMS} sinewave							
		f_C=500kHz, 60mV_{RMS} sinewave	50	65		40	65		dB
		f_C=10MHz, 60mV_{RMS} sinewave		50			50		
BW_{3dB}	Transadmittance bandwidth (Magnitude) (R_L=50Ω)	Carrier input port, V_C=60mV_{RMS} sinewave f_S=1.0kHz, 300mV_{RMS} sinewave		300			300		MHz
		Signal input port, V_S=300mV_{RMS} sinewave $|V_C|$ = 0.5V_{DC}		80			80		MHz
A_{VS}	Signal gain	V_S=100mV_{RMS}; f=1.0kHz $|V_C|$ = 0.5V_{DC}	2.5	3.5		2.5	3.5		V/V
CMV	Common-mode input swing	Signal port, f_S=1.0kHz		5.0			5.0		V_{P-P}
A_{CM}	Common-mode gain	Signal port, f_S=1.0kHz $|V_C|$ = 0.5V_{DC}		-85			-85		dB
DV_{OUT}	Differential output voltage swing capability			8.0			8.0		V_{P-P}

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TEST CIRCUITS
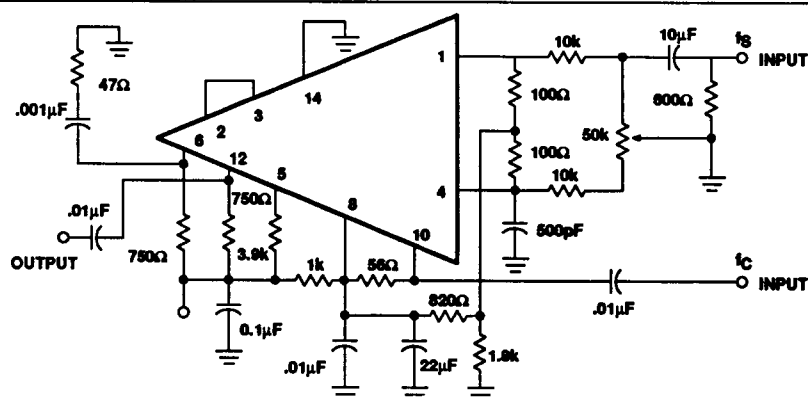
Carrier Rejection and Suppression

Carrier Rejection and Suppression

Signal Gain and Output Swing