Balanced modulator

STANDARD TEMPERATURE RANGE -20° C TO 85° C

- SINGLE OR DUAL SUPPLY OPERATION
- LOW POWER CONSUMPTION
- LOW CARRIER LEAKAGE
- LOW DISTORTION
- LOW NOISE

ORDERING NUMBER
L 025 T9

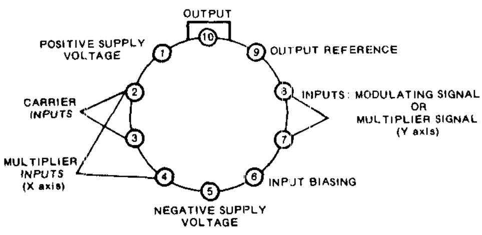
The L 025 T9 is a linear integrated circuit intended for use as channel modulator and demodulator in FDM telephone equipment and as analogue AC multiplier in industrial and professional applications.
It features low quiescent power consumption, low distortion and intermodulation. The circuit requires a minimum number of external components.

ABSOLUTE MAXIMUM RATINGS

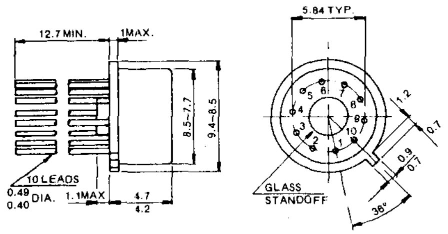
Supply Voltage	30 V
Differential Input Voltage	± 5 V
Power Dissipation (T_A = 70°C) (1)	300 mW
Storage Temperature	-55°C to 150°C
Operating Temperature	-20°C to 85°C

(1) Derate linearly at 3.75 mW/°C for ambient temperature above 70° C

CONNECTION DIAGRAM
(top view)



PHYSICAL DIMENSIONS
in accordance with
JEDEC TO-100 outline



Note: all dimensions in mm.

ELECTRICAL CHARACTERISTICS:

WORKING CONDITIONS FOR THE CIRCUIT SHOWN IN FIG. 2
(unless otherwise specified)

Supply Voltage	V_{CC}	= -20V
Carrier Frequency	f_c	= 130 KHz
Modulating Signal Frequency	f_m	= 25 KHz
Output Signal Level $[f_c \pm f_m = (130 \pm 25)$ KHz$]$	V_o	= -15dBv
Input Carrier Signal Level	V_c	= -13dBv
Load Resistance	R_L	= 600Ω
Ambient Temperature	T_A	= 25°C

PARAMETER	CONDITIONS	Min.	Typ.	Max.	UNIT
Operating Supply Voltage Range		12		30	V
Supply Current	$V_{CC} = \pm 10V$		2	2.5	mA
Input Bias Current: $\frac{I_2 + I_3}{2}$	$V_{CC} = \pm 10V$		0.7	2	μA
$\frac{I_2 + I_4}{2}$	$V_{CC} = \pm 10V$		0.7	2	μA
$\frac{I_7 + I_8}{2}$	$V_{CC} = \pm 10V$		1.4	4	μA
Input Offset Current: $I_2 - I_3$	$V_{CC} = \pm 10V$		50		nA
$I_2 - I_4$	$V_{CC} = \pm 10V$		70		nA
$I_7 - I_8$	$V_{CC} = \pm 10V$		100		nA
Input Common Mode Voltage:	$V_{CC} = \pm 10V$				
Pos.			4.5		V
Neg.			-8		V
DC Output Voltage (pin 10)		-3.2	-3.8	-4.6	V
Differential Output Voltage (pins 9; 10)			25	100	mV
Input Biasing Reference Voltage (pin 6)			-7.5		V
Input Resistance: pins 2 and 3			30		KΩ
pins 2 and 4			300		KΩ
pins 7 and 8			150		KΩ
Output Resistance	f = 1 KHz		3	10	Ω
Output Voltage Swing		1	1.3		Vpp
Common Mode Rejection Ratio:					
CM Signal: pins 2 and 3	CM signal (2-3) (V=700mV rms; f_1 = 10KHz) Diff. signal (7-8) (V=350mV rms; f_2 = 40KHz)		98		dB
CM Signal: pins 2 and 4	CM signal (2-4) (V=700mV rms; f_1 = 10 KHz) Diff. signal (7-8) (V=350mV rms; f_2 = 40KHz)		86		dB
CM Signal: pins 7 and 8	CM signal (7-8) (V=350mV rms; f_1 = 10KHz) Diff. signal (2-3) (V=175mV rms; f_2 = 40KHz)		80		dB
Supply Voltage Rejection Ratio:	$V_{CC} = \pm 10V$ f = 1 KHz				
Pos.			33		dB
Neg.			80		dB
Scale Factor K	$V_{CC} = \pm 10V$		3.2		V^{-1}
Conversion Gain G_c		4.5	5	5.5	dB
Carrier Leakage	$V_{modulating} = 0$	-35	-50		dBv
Modulating Signal Leakage $\frac{V_{fm}}{V_{(fc \pm fm)}}$		-35	-50		dBmo
2nd Harmonic Modulating Signal Leakage $\frac{V_{(2fm)}}{V_{(fc \pm fm)}}$			-75		dBmo
2nd Harmonic Distortion $\frac{V_{(fc \pm 2fm)}}{V_{(fc \pm fm)}}$		-60	-75		dBmo
2nd Harmonic Distortion $\frac{V_{2(fc \pm fm)}}{V_{(fc \pm fm)}}$		-55	-80		dBmo
3rd Harmonic Distortion $\frac{V_{(fc \pm 3fm)}}{V_{(fc \pm fm)}}$		-60	-79		dBmo
Low Frequency Thermal Noise	$V_{modulating} = 0$ f = 1KHz BW = 100 Hz	-115	-125		dBv
High Frequency Thermal Noise	$V_{modulating} = 0$ f = 30KHz BW = 100 Hz		-127		dBv
Conversion Gain Change	T_A = 10°C to 50°C		±0.1		dB

ELECTRICAL DIAGRAM

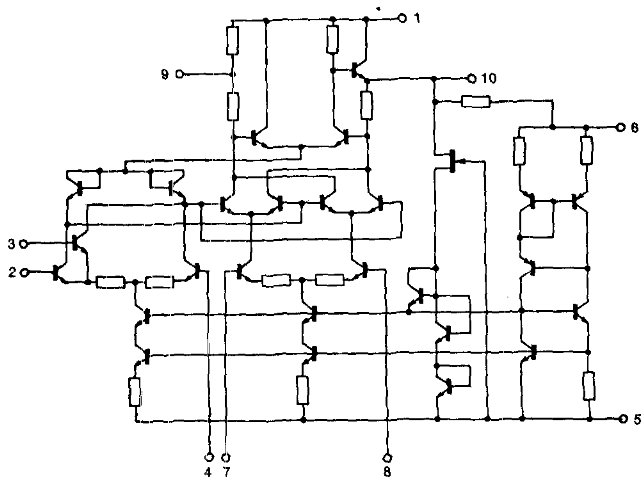


FIG. 1

TYPICAL APPLICATION OF MODULATOR WITH ONE SUPPLY VOLTAGE

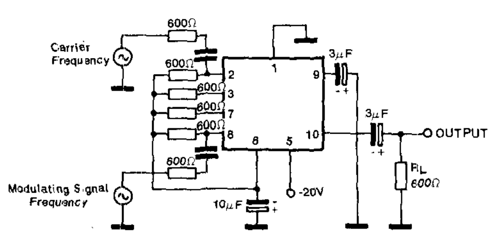


FIG. 2

DEFINITION OF UNITS:

dBm: power gain ($10 \lg \frac{P2}{P1}$) is expressed in dBm when P_1 is 1mW, therefore 0 dBm = 1mW.

dBmo: the power is expressed in dBmo when referred to an established power level in the circuit, generally the output signal level.

e.g. if the output level is -15 dBm and this level is chosen as reference, then we say 0 dBmo = -15 dBm; if another signal, i.e. the distortion measured at the same point of the circuit is -90 dBm, we can say that the distortion is -75 dBmo.

dBv: $20 \text{ Log} \frac{V_2}{V_1}$ when V_1 = 775 mVrms

DEFINITION OF TERMS:

Common mode rejection ratio: $CMRR = 20 \lg \frac{V_{CM} G}{V_{out}}$

with G = Conversion gain with specified circuit conditions

V_{CM} = Common mode signal level

V_{out} = Output signal level at frequency = $f_2 \pm f_1$

Scale factor: $K = \frac{V_{out}}{V_x V_y}$

with V_x = voltage input 2 - 4

V_y = voltage input 7 - 8

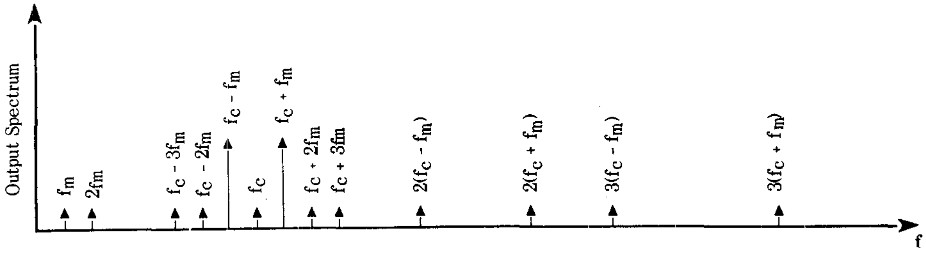
Conversion gain: $G_c = 20 \log \frac{V_{out} (f_c \pm f_m)}{V_{in} (f_m)}$

Carrier leakage: is defined as the output voltage at carrier frequency with only the carrier applied to the input (modulating voltage = 0)

Modulating signal leakage: is defined as the output voltage, at modulating frequency, referred to fundamental carrier sidebands

$M.S.L. = 20 \log \frac{V_{out} (f_m)}{V_{out} (f_c \pm f_m)}$

OUTPUT SPECTRUM VS. FREQUENCY



f_c = carrier fundamental (leakage)

f_m = mod. sig. (leakage)

nf_m = harmonic modulating signal (leakage)

$f_c \pm f_m$ = fundamental carrier sidebands

$f_c \pm nf_m$ = fundamental carrier sideband harmonics

$n(f_c \pm f_m)$ = carrier harmonic sidebands