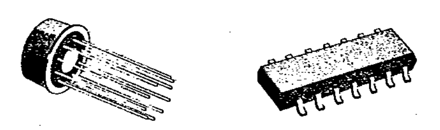
S G S-THOMSON 07E D 7929237 0013127 8
81C 19298 D T-77-09

LS025

BALANCED MODULATOR

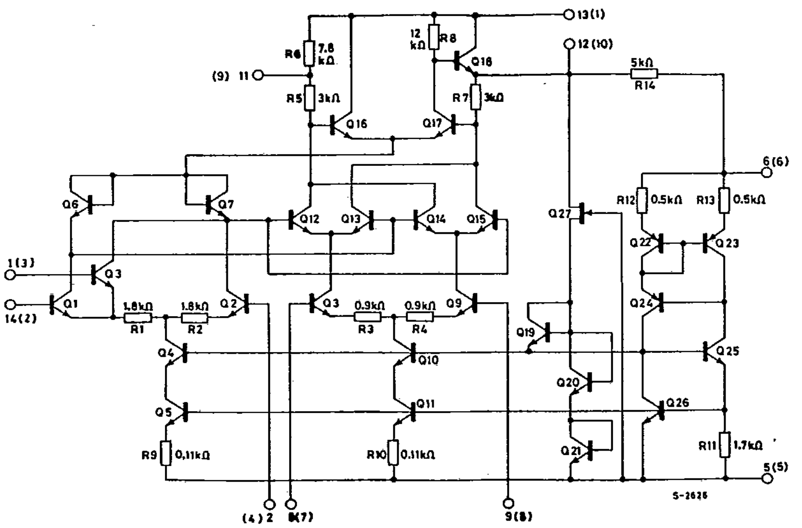
- SINGLE OR DUAL SUPPLY OPERATION
- LOW POWER CONSUMPTION
- LOW CARRIER LEAKAGE
- LOW DISTORTION
- LOW NOISE

The LS025 is a low noise linear integrated circuit, intended for use as a channel modulator and demodulator in FDM telephone equipments and as analogue AC and DC multiplier in industrial and professional applications. It features low quiescent power consumption, low distortion and intermodulation. It shows a typical carrier leakage better than 85dB throughtout the audio bandwidth. The LS025 is available in TO-100 metal case, while the hermetic gold chip (8000 series) is available in SO-14 (14-lead plastic micropackage). This last version is particularly suitable for professional and telecom applications wherever very high MTBF are required.



TO-100 SO-14

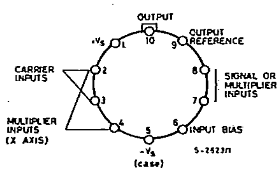
SCHEMATIC DIAGRAM (The pin numbers refer to the μ package version, while the numbers in brackets refer to the TO-100 version)

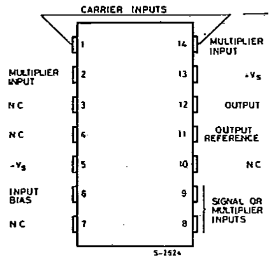


LS025

ABSOLUTE MAXIMUM RATINGS		TO-100	μpackage
V_s	Supply voltage	30 V	
ΔV_i	Differential input voltage	± 5 V	
T_{op}	Operating temperature	-25 to 85 °C	
P_{tot}	Power dissipation at T_{amb} = 70 °C	520 mW	400 mW
T_{stg}	Storage temperature	-65 to 150 °C	-55 to 150 °C

CONNECTION DIAGRAMS AND ORDERING NUMBERS
(top views)





Type	TO-100	SO-14
LS 025	LS 025T	LS025M
LS 8025		LS 8025M

THERMAL DATA			TO-100	SO-14
$R_{th\ j-amb}$	Thermal resistance junction ambient	max	155 °C/W	200* °C/W

* The thermal resistance is measured with the device mounted on a ceramic substrate (25 x 16 x 0.6 mm).

LS025

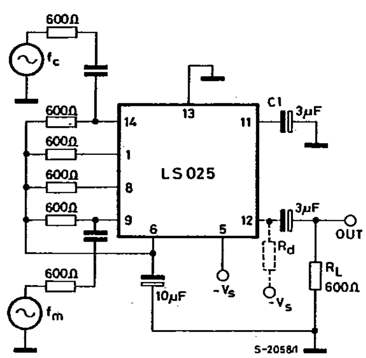
ELECTRICAL CHARACTERISTICS (Referred to the circuit of fig. 1; T_{amb}= 25°C unless otherwise specified. The pins correspond to the μpackage version)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_s	Supply voltage range		-12		-30	V
I_s	Supply current			2	2.5	mA
I_b	Input bias current	Pins 14-1 Pins 14-2 Pins 8-9		0.7 0.7 1.4	2 2 4	μA μA μA
ΔI	Input offset current	Pins 14-1 Pins 14-2 Pins 8-9		50 70 100		nA nA nA
	Positive input common mode voltage			4.5		V
	Negative input common mode voltage			-8		V
V_o	DC output voltage (pin 12)		-3.2	-3.8	-4.6	V
ΔV_o	Differential output voltage (pins 11-12)			25	100	mV
V_{ref}	Input biasing reference voltage (pin 6)			-7.5		V
R_I	Input resistance	Pins 14-1 Pins 14-2 Pins 8-9		30 300 150		kΩ kΩ kΩ
R_o	Output resistance	f = 1 kHz		3	10	Ω
V_o	Output voltage swing		1	1.3		Vpp
CMR	Common mode rejection	CM signal (pins 14-1) V = 700 mVrms f_1= 10 kHz Diff. signal (pins 8-9) V = 350 mVrms f_2= 40 kHz		98		dB
		CM signal (pins 14-2) V = 700 mVrms f_1= 10 kHz Diff. signal (pins 8-9) V = 350 mVrms f_2= 40 kHz		86		dB
		CM signal (pins 8-9) V = 350 mVrms f_1= 10 kHz Diff. signal (pins 14-1) V = 175 mVrms f_2= 40 kHz		80		dB
SVR	Positive supply voltage rejection	f = 1 kHz		33		dB
SVR	Negative supply voltage rejection	f = 1 kHz		80		dB

ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
K	Scale factor			3.2		V^{-1}
G_c	Conversion gain		4.5	5	5.5	dB
ΔG_c	Conversion gain change	T_{amb} = 10 to 50°C		± 0.1		dB
	Carrier leakage	V_m = 0	-35	-50		dBv
$\frac{V_{fm}}{V_{(f_c \pm f_m)}}$	Modulating signal leakage		-35	-50		dBmo
$\frac{V_{(2f_m)}}{V_{(f_c \pm f_m)}}$	2nd harmonic modulating signal leakage			-75		dBmo
$\frac{V_{(f_c \pm 2f_m)}}{V_{(f_c \pm f_m)}}$	2nd harmonic distortion		-60	-75		dBmo
$\frac{V_{2(f_c \pm f_m)}}{V_{(f_c \pm f_m)}}$	2nd harmonic distortion		-55	-80		dBmo
$\frac{V_{(f_c \pm 3f_m)}}{V_{(f_c \pm f_m)}}$	3rd harmonic distortion		-60	-79		dBmo
	Low frequency thermal noise	V_m = 0 f = 1 kHz B = 100 Hz	-115	-125		dBv
	High frequency thermal noise	V_m = 0 f = 30 kHz B = 100 Hz		-127		dBv

Fig. 1 – Test and application circuit of modulator with single supply voltage



Working conditions

V_s = -20V
f_c = 130 kHz
f_m = 25 kHz
V_o = -15 dBv ($f_c \pm f_m$)
V_c = -13 dBv
R_L ≡ 600 Ω

Fig. 2 - Carrier leakage vs. modulation signal input offset

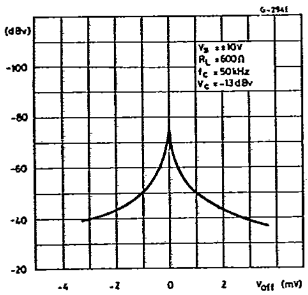


Fig. 3 - Conversion gain vs. frequency

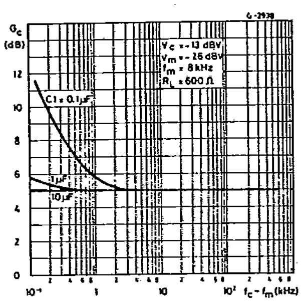


Fig. 4 - Distortion vs. output level

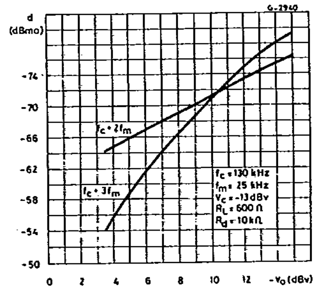


Fig. 5 - Carrier leakage adjustment circuit for system with two supply voltages

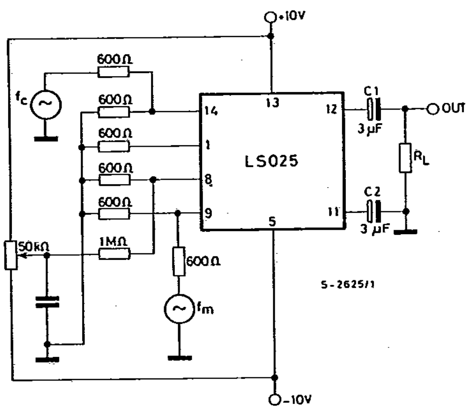
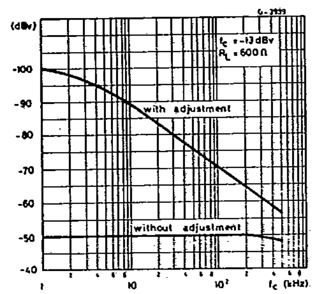
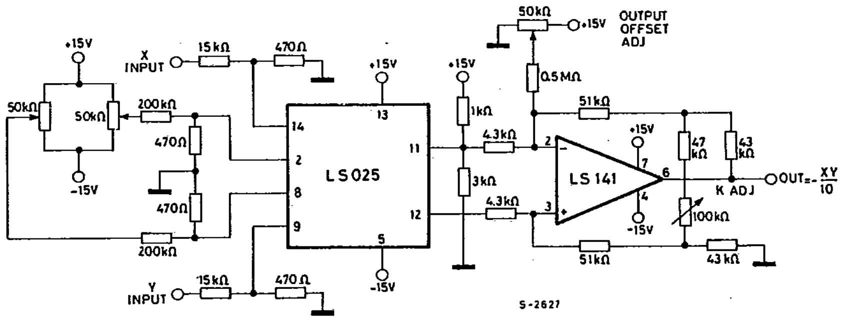


Fig. 6 - Carrier leakage vs. frequency



APPLICATION INFORMATION

Fig. 7 - DC multiplier



Application diagram of DC multiplier, have a scale factor K = 0.1. Typical linearity and leakage errors are less than 1%.
The input voltage range is ± 10V.

Definition of units

dBm : power level $(10 \lg \frac{P_2}{P_1})$ is expressed in dBm when P_1 is 1 mW, therefore 0 dBm= 1 mW.

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 0 dBmo = -15 dBm; if another signal, i.e. the distortion measured at the same point of the circuit, is -90 dBm, then the distortion is -75 dBmo.

dBv : $20 \lg \frac{V_2}{V_1}$ when V_1= 775 mVrms.

Definition of terms

Common mode rejection ratio : $CMR = 20 \lg \frac{V_{CM}\, G}{V_o}$

with G = Conversion gain with specified circuit conditions
V_{CM} = Common mode signal level
V_o = Output signal level at frequency = $f_2 \pm f_1$

Scale factor : $K = \frac{V_o}{V_x \cdot V_y}$

with V_x = voltage input (pins 14 - 2)
V_y = voltage input (pins 8 - 9)

APPLICATION INFORMATION (continued)

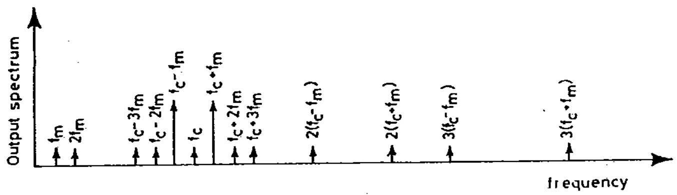
Conversion gain : $G_c = 20 \lg \frac{V_o (f_c \pm f_m)}{V_i (f_m)}$

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

$$M.S.L. = 20 \lg \frac{V_o (f_m)}{V_o (f_c \pm f_m)}$$

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