signetics LINEAR FOUR-QUADRANT MULTIPLIER 5595

LINEAR INTEGRATED CIRCUITS

DESCRIPTION

The 5595 is a Monolithic Four-Quadrant Multiplier designed for uses where the output voltage is a linear product of two input voltages. The S5595F is a pin-for-pin replacement for the MC1595L and the N5595A replaces the MC1495L.

FEATURES

- **EXCELLENT LINEARITY – 1% MAX ERROR ON X-INPUT, 2% MAX ERROR ON Y-INPUT – S5595F**
- **EXCELLENT LINEARITY – 2% MAX ERROR ON X-INPUT, 4% MAX ERROR ON Y-INPUT – N5595A**
- **ADJUSTABLE SCALE FACTOR, K**
- **EXCELLENT TEMPERATURE STABILITY**
- **WIDE INPUT VOLTAGE RANGE – ±10 VOLTS**

APPLICATIONS

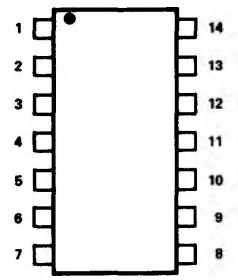
ANALOG MULTIPLICATION AND DIVISION
SQUARE ROOT OPERATION
MEAN SQUARING
PHASE DETECTION
FREQUENCY DOUBLING
BALANCED MODULATION/DEMODULATION
ELECTRONIC GAIN CONTROL

ABSOLUTE MAXIMUM RATINGS

Applied Voltage		30V
(V_2-V_1, V_{14}-V_1, V_1-V_9, V_1-V_{12}, V_1-V_4, V_1-V_8, V_{12}-V_7, V_9-V_7, V_8-V_7, V_4-V_7)		
Differential Input Signal	V_{12}-V_9	$\pm(6 + I_{13}R_X)V$
	V_4-V_8	$\pm(6 + I_3R_Y)V$

PIN CONFIGURATION

A AND F PACKAGE
(Top View)



1. V^+
2. V_{out}^+
3. Y Bias
4. +Y Input
5. Y Gain Adjust
6. Y Gain Adjust
7. V^-
8. −Y Input
9. +X Input
10. X Gain Adjust
11. X Gain Adjust
12. −X Input
13. X Bias
14. V_{out}^-

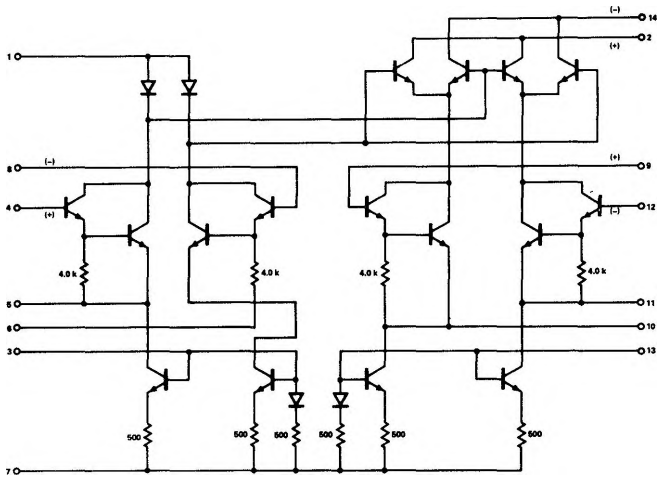
ORDER PART NOS. S5595F/N5595A

ABSOLUTE MAXIMUM RATINGS (Cont'd.)

Maximum Bias Current	I_3	10mA
	I_{13}	10mA
Power Dissipation (Note 1)		
Ceramic Package		750mW
Operating Temperature Range		
S5595F		−55°C to +125°C
N5595A		0°C to +70°C
Storage Temperature Range		−65°C to +150°C

Note 1: Derate linearly at 5mW/°C for ambient temperatures above +25°C

EQUIVALENT CIRCUIT



ELECTRICAL CHARACTERISTICS ($V^+ = +32V$, $V^- = -15V$, $T_A = 25°C$, $I_3 = I_{13} = 1$ mA, $R_X = R_Y = 15$ kΩ, $R_L = 11$ kΩ unless otherwise noted)

CHARACTERISTICS	SYMBOL	LIMITS						UNITS	TEMPERATURE	FIGURE
		MIN		TYP		MAX				
		S5595	N5595	S5595	N5595	S5595	N5595			
Linearity:										
Output Error in Percent of Full Scale:								%		1
$-10 < V_X < +10 (V_Y = \pm 10V)$	E_{RX}			0.5	1.0	1.0	2.0		+25°C	
					1.5				0°C to +70°C	
				0.75					−55°C to +125°C	
$-10 < V_Y < +10 (V_X = \pm 10V)$	E_{RY}			1.0	2.0	2.0	4.0		+25°C	
					3.0				0°C to +70°C	
				1.5					−55°C to +125°C	
Squaring Mode Error:										
Accuracy in Percent of Full Scale After Offset and Scale Factor Adjustment	E_{SQ}			0.5	0.75			%	+25°C	1
					1.0				0°C to +70°C	
				0.75					−55°C to +125°C	
Scale Factor (Adjustable)										
$K = \frac{2R_L}{I_3 R_X R_Y}$	K			0.1	0.1				+25°C	1
Input Resistance										
(f = 20 Hz)	R_{inx}			35	20			MΩ	+25°C	2
	R_{iny}			35	20					
Differential Output Resistance (f = 20 Hz)	R_o			300	300			kΩ	+25°C	3
Input Bias Current										
$I_{bx} = \frac{(I_9 + I_{12})}{2}$, $I_{by} = \frac{(I_4 + I_8)}{2}$	I_{bx}			2.0	2.0	8.0	12	μA	+25°	4
	I_{by}			2.0	2.0	8.0	12	μA		
Input Offset Current										
$\lvert I_9 - I_{12} \rvert$	$\lvert I_{iox} \rvert$			0.2	0.4	1.0	2.0	μA	+25	4
$\lvert I_4 - I_8 \rvert$	$\lvert I_{ioy} \rvert$			0.2	0.4	1.0	2.0			
Average Temperature Coefficient of Input Offset Current	$\lvert TC_{Iio} \rvert$					2.0		nA/°C	0°C to +70°C	4
					2.0				−55 to +70°C	
Output Offset Current										
$\lvert I_{14} - I_2 \rvert$	$\lvert I_{oo} \rvert$			10	20	50	100	μA	+25°C	4
Average Temperature Coefficient of Output Offset Current	$\lvert TC_{Ioo} \rvert$				20			nA/°C	0°C to +70°C	4
				20					−55°C to +125°C	
Frequency Response										
3.0 dB Bandwidth	BW_{3dB}			3.0	3.0			MHz	+25°C	5
3° Relative Phase Shift between V_X and V_Y	f_ϕ			750	750			kHz		
1% Absolute Error Due to Input-Output Phase Shift	f_θ			30	30			kHz		
Common Mode Input Swing (Either Input)	CMV	±11.5	±10.5	±13	±12			V	+25°C	6
Common Mode Gain (Either Input)	A_{CM}	−50	−40	−60	−50			dB	+25°C	6
Common Mode Quiescent Output Voltage	V_{o1}			21	21			V	+25°C	1
	V_{o2}			21	21					
Differential Output Voltage Swing Capability	V_{out}			±14	±14			V	+25°C	1
Power Supply Sensitivity	S^+			5.0	5.0			mV/V	+25°C	7
	S^-			10	10					
Power Supply Current	I_7			6.0	6.0	7.0	7.0	mA	+25°C	1
DC Power Dissipation	P_D			135	135	170	170	mW	+25°C	1