



LC89975M

PAL-Format Delay Line

Preliminary

Overview

The LC89975M is a lower-cost PAL-Format CCD delay line based on the LC89970M, with the sizes of chip and package miniaturized and the external parts count reduced.

Features

- 5 V single-voltage power supply
- On-chip 3× PLL circuit for 3-fsc operation from an fsc (4.43 MHz) input
- Supports PAL/GBI and 4.43 NTSC systems, selected by a control pin input
- Includes an on-chip comb filter for chrominance signal crosstalk exclusion. This adjustment-free circuit provides high-precision comb characteristics.
- Peripheral circuits included on chip to allow operation with minimal external circuits.
- Positive-phase signal input, positive phase signal output (luminance signal)

Functions

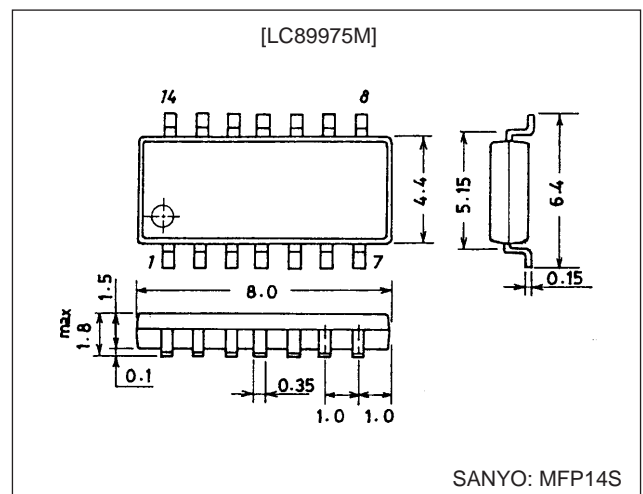
- CCD shift register (for chrominance and luminance signals)
- CCD drive circuit
- Circuit for switching the number of CCD stages
- CCD signal addition circuit

- Auto-bias circuit
- Sync tip clamping circuit (luminance signal)
- Center bias circuit (chrominance signal)
- Sample-and-hold circuit
- PLL 3× circuit
- 3-fsc clock output circuit
- RD voltage generation step-up circuit

Package Dimensions

unit: mm

3111-MFP14S



Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{DD}		-0.3 to +6.0	V
Allowable power dissipation	P_{dmax}		250	mW
Operating temperature	T_{opr}		-10 to +60	°C
Storage temperature	T_{stg}		-55 to +150	°C

Recommended Conditions at Ta = 25°C

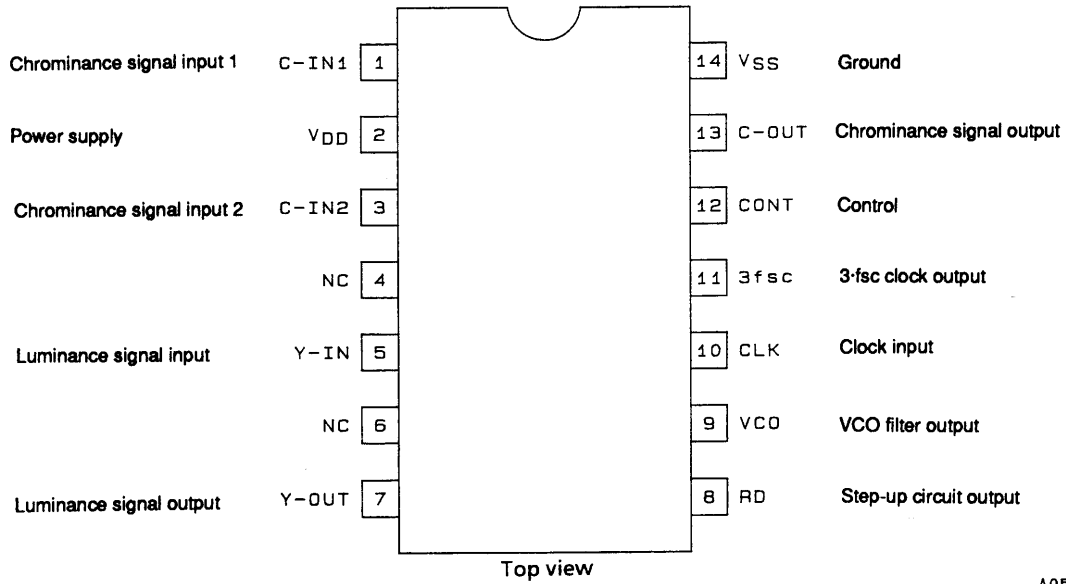
Parameter	Symbol	Conditions	min	typ	max	Unit
Supply voltage	V_{DD}		4.75	5.00	5.25	V
Clock input amplitude	V_{CLK}		300	500	1000	mVp-p
Clock frequency	F_{CLK}	Sine wave	—	4.43361875	—	MHz
Chrominance signal input amplitude	V_{IN-C}		—	350	500	mVp-p
Luminance signal input amplitude	V_{IN-Y}		—	400	572	mVp-p

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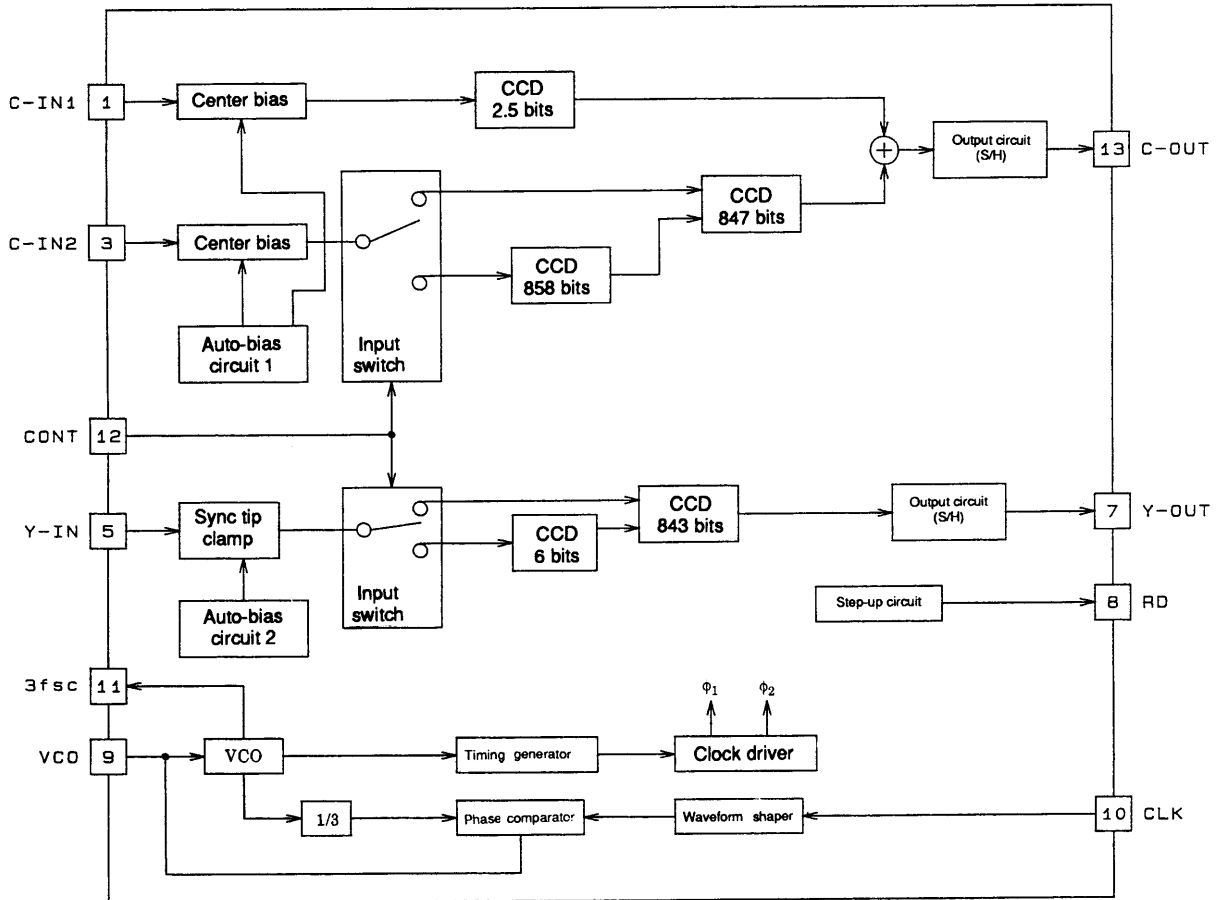
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Pin Assignment



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Block Diagram



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Control Pin

CONT	Mode (typical example)	Chrominance signal delay (number of CCD stages)	Luminance signal delay (number of CCD stages)
Low	PAL/GBI	2H (1705) + 0H (2.5)	1H (849)
High	4.43 NTSC	1H (847) + 0H (2.5)	1H (843)

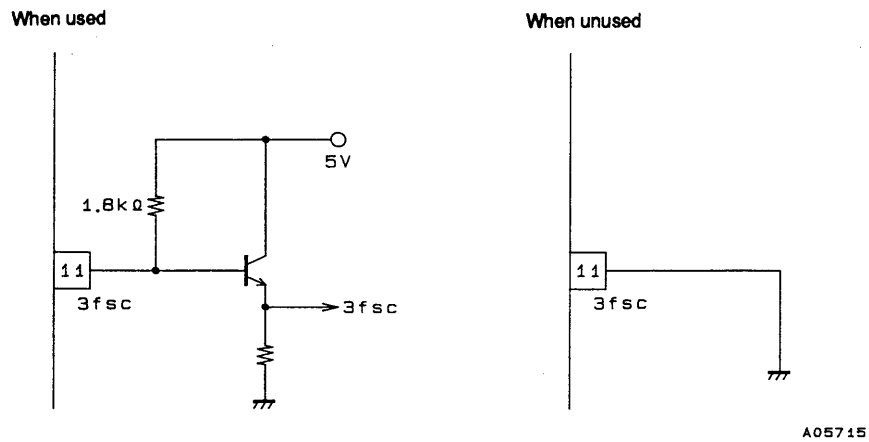
Switching levels

Low/High	Symbol	min	typ	max	Unit
Low	V_L	-0.3	0.0	+0.5	V
High	V_H	2.0	5.0	6.0	V

Note: Since a pull-down resistor of about 70 k Ω is built in the control pin circuit, it will remain fixed at the low level if left open.

3fsc Pin

This pin outputs the 3-fsc clock signal generated by the PLL 3 \times circuit.



Electrical Characteristics at $V_{DD} = 5.0$ V, $T_a = 25^\circ\text{C}$, $F_{CLK} = 4.43361875$ MHz, $V_{CLK} = 500$ mVp-p

Parameter	Symbol	Test conditions	Switch states			min	typ	max	Unit
			SW1	SW2	SW3				
Power-supply current	I_{DD-1}	1	a	a	b	27	32	37	mA
	I_{DD-2}		b	a	b				

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Chrominance System Characteristics (with no signal applied to the Y-IN pin)

Parameter	Symbol	Test conditions	Switch states			min	typ	max	Unit
			SW1	SW2	SW3				
Pin voltage (input)	V _{INC-1}	2	a	a	b	2.2	2.7	3.2	V
	V _{INC-2}		b	a	b				
Pin voltage (output)	V _{OUTC-1}	2	a	a	b	1.5	2.0	2.5	V
	V _{OUTC-2}		b	a	b				
Voltage gain	G _{VC-1}	3	a	a	b	0	2	4	dB
	G _{VC-2}		b	a	b				
Comb depth	C _{D-1}	4	a	a	b	—	-40	-35	dB
	C _{D-2}		b	a	b				
Linearity	L _{NC-1}	5	a	a	b	-0.3	0.0	+0.3	dB
	L _{NC-2}		b	a	b				
Clock leakage (3-fsc)	L _{CK3C-1}	6	a	a	b	—	10	50	mVrms
	L _{CK3C-2}		b	a	b				
Clock leakage fsc)	L _{CK1C-1}	6	a	a	b	—	0.5	1.5	mVrms
	L _{CK1C-2}		b	a	b				
Noise	N _{C-1}	7	a	a	b	—	0.5	2.0	mVrms
	N _{C-2}		b	a	b				
Output impedance	Z _{OC-1}	8	a	a	a, b	200	350	500	Ω
	Z _{OC-2}		b	a	a, b				
OH delay time	T _{DC-1}	9	a	a	b	—	245	—	ns
	T _{DC-2}		b	a	b				

Luminance System Characteristics (with no signals applied to the C-IN1 and C-IN2 pins)

Parameter	Symbol	Test conditions	Switch states			min	typ	max	Unit
			SW1	SW2	SW3				
Pin voltage (input)	V _{INY-1}	10	a	a	b	1.7	2.2	2.7	V
	V _{INY-2}		b	a	b				
Pin voltage (output)	V _{OUTY-1}	10	a	a	b	0.8	1.3	1.8	V
	V _{OUTY-2}		b	a	b				
Voltage gain	G _{VY-1}	11	a	a	b	0	2	4	dB
	G _{VY-2}		b	a	b				
Frequency response	G _{FY-1}	12	a	b	b	-2	0	2	dB
	G _{FY-2}		b	b	b				
Differential gain	D _{GY-1}	13	a	a	b	0	5	7	%
	D _{GY-2}		b	a	b				
Differential phase	D _{PY-1}	13	a	a	b	0	5	7	deg
	D _{PY-2}		b	a	b				
Linearity	L _{SY-1}	14	a	a	b	37	40	43	%
	L _{SY-2}		b	a	b				
Clock leakage (3-fsc)	L _{CK3Y-1}	15	a	a	b	—	10	50	mVrms
	L _{CK3Y-2}		b	a	b				
Clock leakage (fsc)	L _{CK1Y-1}	15	a	a	b	—	0.5	1.5	mVrms
	L _{CK1Y-2}		b	a	b				
Noise	N _{Y-1}	16	a	a	b	—	0.5	2.0	mVrms
	N _{Y-2}		b	a	b				
Output impedance	Z _{OY-1}	17	a	a	c, b	250	400	550	Ω
	Z _{OY-2}		b	a	c, b				
Delay time	T _{DY-1}	18	a	a	b	—	63.88	—	μs
	T _{DY-2}		b	a	b				

Test Conditions

1. Power-supply current with no input signal applied
2. Pin output voltage with no input signal applied (center bias voltage)
3. Measure the C-OUT output when 350-mVp-p sine wave signals are input to C-IN1 and C-IN2.

$$G_{VC} = 20 \log \frac{\text{C-OUT output [mVp-p]}}{350 \text{ [mVp-p]}} \text{ [dB]}$$

Measured frequencies

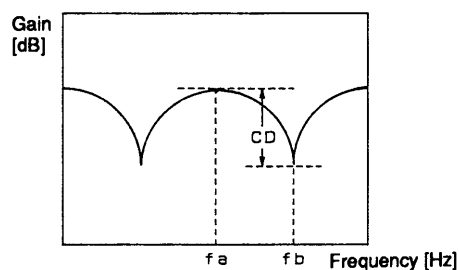
G_{VC-1}	4.429662 MHz	(PAL/GBI)
G_{VC-2}	4.425694 MHz	(4.43 NTSC)

4. Measure the comb depth from the C-OUT output when 350-mVp-p sine wave signals of frequency f_a are input to C-IN1 and C-IN2 and when signals of frequency f_b are input.

$$C_D = 20 \log \frac{\text{The C-OUT output for an } f_b \text{ input [mVp-p]}}{\text{The C-OUT output for an } f_a \text{ input [mVp-p]}} \text{ [dB]}$$

Measured frequencies

	f_a	f_b	
C_{D-1}	4.429662 MHz	4.425756 MHz	(PAL/GBI)
C_{D-2}	4.425694 MHz	4.417819 MHz	(4.43 NTSC)



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5. Measure the C-OUT output when 200-mVp-p sine wave signals are input to C-IN1 and C-IN2 and when 500-mVp-p sine wave signals are input and calculate the gain difference.

$$L_{NC} = 20 \log \left(\frac{\text{Output for a 500-mVp-p input [mVp-p]}}{500 \text{ [mVp-p]}} / \frac{\text{Output for a 200-mVp-p input [mVp-p]}}{200 \text{ [mVp-p]}} \right) \text{ [dB]}$$

Measured frequencies

L_{NC-1}	4.429662 MHz	(PAL/GBI)
L_{NC-2}	4.425694 MHz	(4.43 NTSC)

6. Measure the 3-fsc (13.3 MHz) and fsc (4.43 MHz) components in the C-OUT output with no input signal applied.
7. Measure the noise in the C-OUT output with no input signal applied.
Set up the noise meter with a 200-kHz high-pass filter and a 5-MHz low-pass filter.
8. Let V_1 be the C-OUT output when 350-mVp-p sine wave signals are input to C-IN1 and C-IN2 with SW3 in the a position, and V_2 be the C-OUT output with SW3 in the b position.

$$Z_{OC} = \frac{V_2 \text{ [mVp-p]} - V_1 \text{ [mVp-p]}}{V_1 \text{ [mVp-p]}} \times 500 \text{ [\Omega]}$$

Measured frequencies

Z_{OC-1}	4.429662 MHz	(PAL/GBI)
Z_{OC-2}	4.425694 MHz	(4.43 NTSC)

9. The C-OUT output delay time with respect to a C-IN1 input (the 2.5-bit CCD delay)
10. The pin output voltage when no input signal is applied (the clamp voltage)
11. Measure the Y-OUT output when a 200-kHz 400-mVp-p sine wave is input to Y-IN.

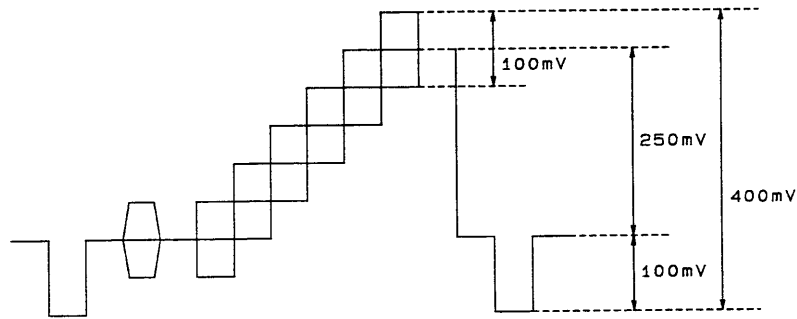
$$G_{VY} = 20 \log \frac{\text{Y-OUT output [mVp-p]}}{400 \text{ [mVp-p]}} \text{ [dB]}$$

12. Measure the Y-OUT output when a 200-kHz 200-mVp-p sine wave is input to Y-IN and when 3.3-MHz 200-mVp-p sine wave is input.

$$G_{FY} = 20 \log \frac{\text{The Y-OUT output for a 3.3-MHz input [mVp-p]}}{\text{The Y-OUT output for a 200-kHz input [mVp-p]}} \text{ [dB]}$$

Adjust Vbias to set the bias to the clamp level plus 250 mV.

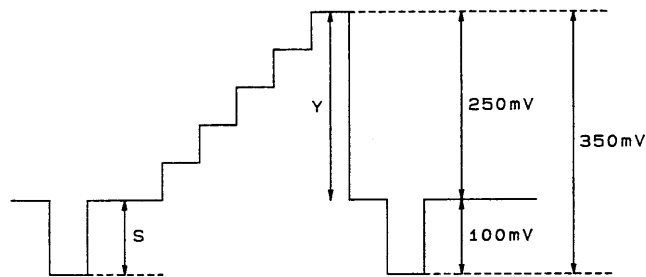
13. Apply a 5-step waveform (see the figure) to Y-IN and measure the Y-OUT output differential gain and differential phase with a vectorscope.



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14. Apply a 5-step waveform (see the figure) to Y-IN and measure the Y-OUT output luminance signal level (Y) and sync level (S).

$$L_{SY} = \frac{S \text{ [mV]}}{Y \text{ [mV]}} \times 100 \text{ [%]}$$



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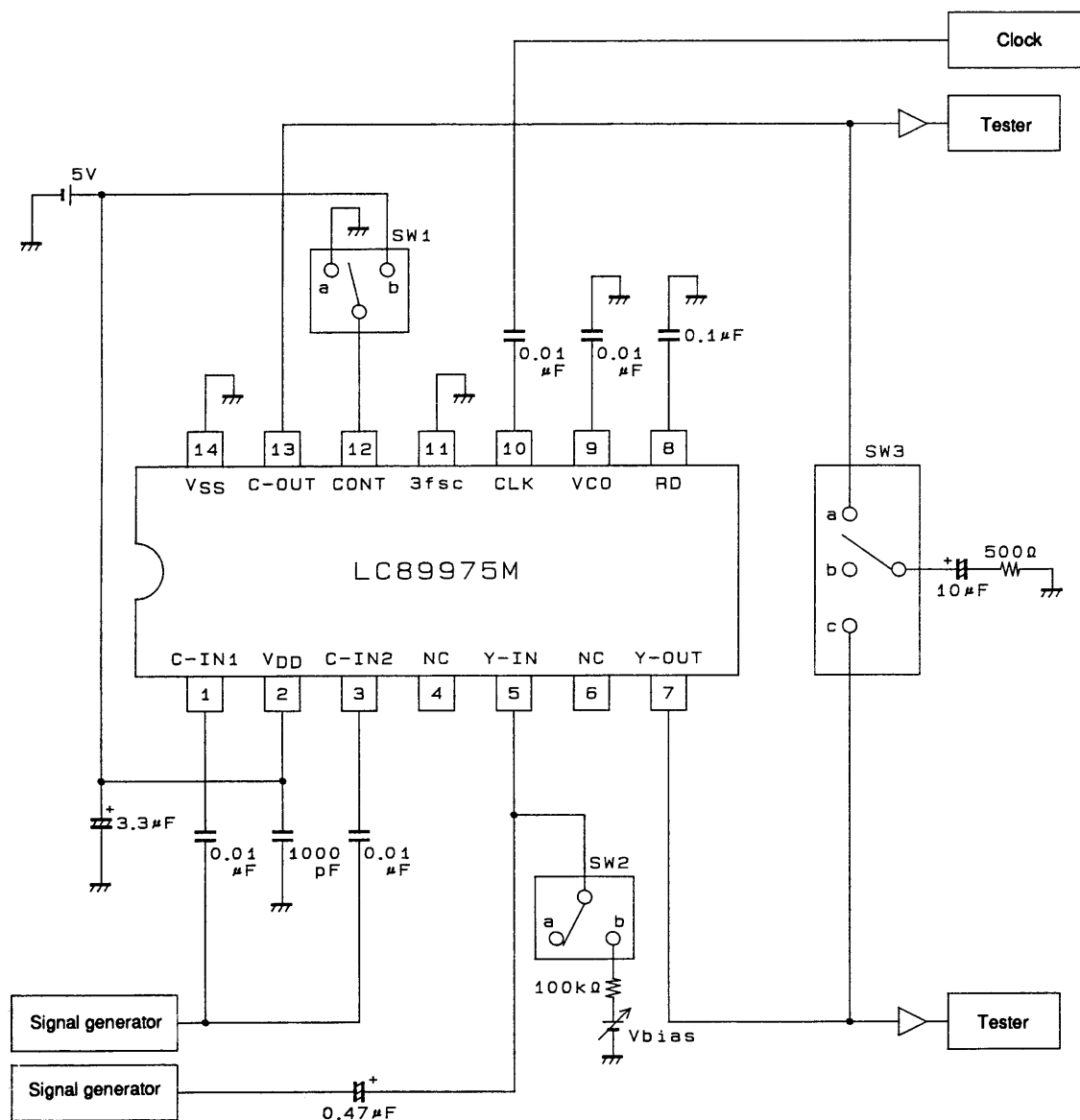
15. Measure the 3-fsc (13.3 MHz) and fsc (4.43 MHz) components in the Y-OUT output with no input signal applied.
16. Measure the noise in the Y-OUT output with no input signal applied.
Set up the noise meter with a 200-kHz high-pass filter, a 5-MHz low-pass filter, and a 4.43-MHz trap filter.
17. Let V1 be the Y-OUT output when a 200-kHz 400-mVp-p sine wave signal is input to Y-IN and with SW3 in the c position, and V2 be the Y-OUT output with SW3 in the b position.

$$Z_{OY} = \frac{V2 \text{ [mVp-p]} - V1 \text{ [mVp-p]}}{V1 \text{ [mVp-p]}} \times 500 \text{ [\Omega]}$$

18. The Y-OUT output delay time with respect to inputs to Y-IN.

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Test Circuit



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