



### Overview

The LC89971 and LC89971M are CCD delay lines for multi television systems. They incorporate a comb filter for chrominance signal and a 1H delay line for luminance signal.

### Structure

- NMOS + CCD

### Functions

- Two CCD shift registers (for chrominance and luminance signals)
- CCD drive circuits
- CCD stage count switching circuit
- CCD signal adder
- Auto-bias circuit
- Sync tip clamping circuit (luminance signal)
- Center-bias circuit (chrominance signal)
- Sample-and-hold circuit
- PLL 4 × frequency multiplier
- fsc clock output circuit
- RD voltage generator

### Features

- 5 V single-voltage power supply
- Built-in PLL 4 × frequency multiplier circuit allows 4 fsc operation from an fsc (3.58 MHz) input.
- Control pin switchable to handle NTSC/M, PAL/GBI and PAL/M systems.
- Built-in chrominance signal crosstalk exclusion comb filter features high precision comb characteristics in an adjustment-free circuit.
- Built-in peripheral circuits allow applications to be constructed with a minimum number of external components.
- Positive-phase signal input/positive-phase signal output (luminance signal)

### Specifications

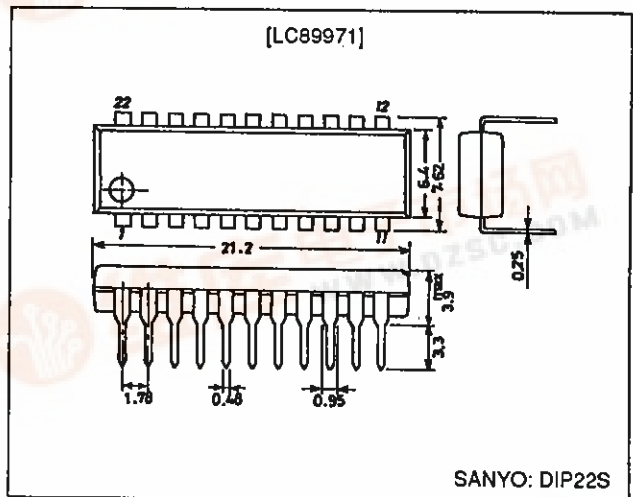
Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>DD</sub> max		-0.3 to +6.0	V
Allowable power dissipation	Pd max	LC89971	1200	mW
		LC89971M	600	mW
Operating temperature	T <sub>opr</sub>		-10 to +70	°C
Storage temperature	T <sub>stg</sub>		-55 to +150	°C

### Package Dimensions

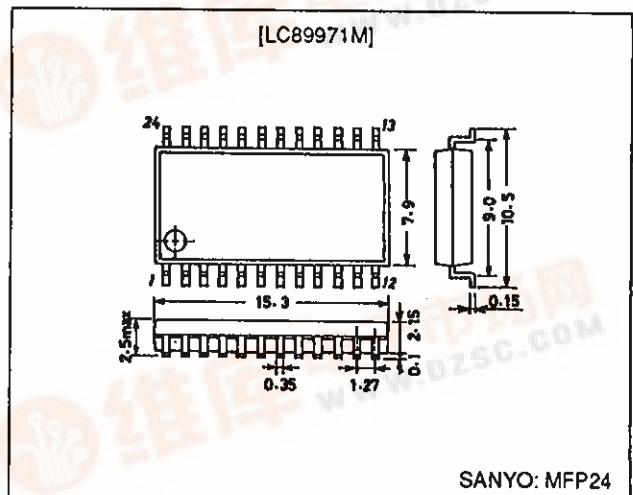
unit: mm

3059-DIP22S



unit: mm

3045B-MFP24



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Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	min	typ	max	Unit
Supply voltage	V <sub>DD</sub>		4.75	5.00	5.25	V
Clock input amplitude	V <sub>CLK</sub>		300	500	1000	mVp-p
Clock frequency	F <sub>CLK</sub>	Sine wave	—	3.579545	—	MHz
Clock signal input amplitude	V <sub>IN-C</sub>		—	350	500	mVp-p
Luminance signal input amplitude	V <sub>IN-Y</sub>		—	400	572	mVp-p

Electrical Characteristics at V<sub>DD</sub> = 5.0 V, Ta = 25°C, F<sub>CLK</sub> = 3.579545 MHz, V<sub>CLK</sub> = 500 mVp-p

Parameter	Symbol	Switch states				Conditions	min	typ	max	Unit				
		SW1	SW2	SW3	SW4									
Supply current	I <sub>DD-1</sub>	a	a	a	b	1	45	55	65	mA				
	I <sub>DD-2</sub>	a	b	a	b									
	I <sub>DD-3</sub>	b	b	a	b									
Chrominance System Characteristics (with no Y-IN input)														
Pin voltage (input)	V <sub>INC-1</sub>	a	a	a	b	2	2.0	2.4	2.8	V				
	V <sub>INC-2</sub>	a	b	a	b									
	V <sub>INC-3</sub>	b	b	a	b									
Pin voltage (output)	V <sub>OUYC-1</sub>	a	a	a	b						1.2	1.6	2.0	V
	V <sub>OUTC-2</sub>	a	b	a	b									
	V <sub>OUTC-3</sub>	b	b	a	b									
Voltage gain	G <sub>VC-1</sub>	a	a	a	b	3	-2	0	+2	dB				
	G <sub>VC-2</sub>	a	b	a	b									
	G <sub>VC-3</sub>	b	b	a	b									
Comb depth	C <sub>D-1</sub>	a	a	a	b	4	—	-40	-35	dB				
	C <sub>D-2</sub>	a	b	a	b									
	C <sub>D-3</sub>	b	b	a	b									
Linearity	L <sub>NC-1</sub>	a	a	a	b	5	-0.3	0.0	+0.3	dB				
	L <sub>NC-2</sub>	a	b	a	b									
	L <sub>NC-3</sub>	b	b	a	b									
Clock leakage (4 fsc)	L <sub>CK4C-1</sub>	a	a	a	b	6	—	10	50	mVrms				
	L <sub>CK4C-2</sub>	a	b	a	b									
	L <sub>CK4C-3</sub>	b	b	a	b									
Clock leakage (fsc)	L <sub>CK1C-1</sub>	a	a	a	b						—	0.8	1.5	mVrms
	L <sub>CK1C-2</sub>	a	b	a	b									
	L <sub>CK1C-3</sub>	b	b	a	b									
Noise	N <sub>C-1</sub>	a	a	a	b	7	—	0.5	2.0	mVrms				
	N <sub>C-2</sub>	a	b	a	b									
	N <sub>C-3</sub>	b	b	a	b									
Output impedance	Z <sub>OC-1</sub>	a	a	a	a, b	8	200	350	500	Ω				
	Z <sub>OC-2</sub>	a	b	a	a, b									
	Z <sub>OC-3</sub>	b	b	a	a, b									
OH delay time	T <sub>DC-1</sub>	a	a	a	b	9	—	230	—	ns				
	T <sub>DC-2</sub>	a	b	a	b									
	T <sub>DC-3</sub>	b	b	a	b									

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Parameter	Symbol	Switch states				Conditions	min	typ	max	Unit	
		SW1	SW2	SW3	SW4						
Luminance System Characteristics (with no C-IN1 or C-IN2 input)											
Pin voltage (input)	V <sub>INY-1</sub>	a	a	a	b	10	1.7	2.1	2.5	V	
	V <sub>INY-2</sub>	a	b	a	b						
	V <sub>INY-3</sub>	b	b	a	b						
Pin voltage (output)	V <sub>OUTY-1</sub>	a	a	a	b		0.8	1.2	1.6		V
	V <sub>OUTY-2</sub>	a	b	a	b						
	V <sub>OUTY-3</sub>	b	b	a	b						
Voltage gain	G <sub>VY-1</sub>	a	a	a	b	11	-2	0	+2	dB	
	G <sub>VY-2</sub>	a	b	a	b						
	G <sub>VY-3</sub>	b	b	a	b						
Frequency response	G <sub>FY-1</sub>	a	a	b	b	12	-2	0	+2		dB
	G <sub>FY-2</sub>	a	b	b	b						
	G <sub>FY-3</sub>	b	b	b	b						
Differential gain	D <sub>GY-1</sub>	a	a	a	b	13	0	5	7	%	
	D <sub>GY-2</sub>	a	b	a	b						
	D <sub>GY-3</sub>	b	b	a	b						
Differential phase	D <sub>PY-1</sub>	a	a	a	b		0	5	7		deg
	D <sub>PY-2</sub>	a	b	a	b						
	D <sub>PY-3</sub>	b	b	a	b						
Linearity	L <sub>SY-1</sub>	a	a	a	b	14	37	40	43	%	
	L <sub>SY-2</sub>	a	b	a	b						
	L <sub>SY-3</sub>	b	b	a	b						
Clock leakage (4 fsc)	L <sub>CK4Y-1</sub>	a	a	a	b	15	—	10	50		mVrms
	L <sub>CK4Y-2</sub>	a	b	a	b						
	L <sub>CK4Y-3</sub>	b	b	a	b						
Clock leakage (fsc)	L <sub>CK1Y-1</sub>	a	a	a	b		—	0.8	1.5	mVrms	
	L <sub>CK1Y-2</sub>	a	b	a	b						
	L <sub>CK1Y-3</sub>	b	b	a	b						
Noise	N <sub>Y-1</sub>	a	a	a	b	16	—	0.5	2.0		mVrms
	N <sub>Y-2</sub>	a	b	a	b						
	N <sub>Y-3</sub>	b	b	a	b						
Output impedance	Z <sub>OY-1</sub>	a	a	a	c, b	17	250	400	550	Ω	
	Z <sub>OY-2</sub>	a	b	a	c, b						
	Z <sub>OY-3</sub>	b	b	a	c, b						
Delay time	T <sub>DY-1</sub>	a	a	a	b	18	—	63.88	—		μs
	T <sub>DY-2</sub>	a	b	a	b						
	T <sub>DY-3</sub>	b	b	a	b						

**Test Conditions**

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

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

Test frequencies

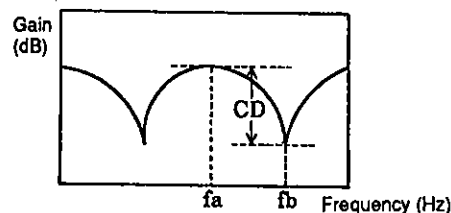
- GVC-1 4.431395 MHz (PAL/GBI)
- GVC-2 3.571628 MHz (PAL/M)
- GVC-3 3.571628 MHz (NTSC/M)

4. Measure the comb depth from the C-OUT output with a 350 mVp-p sine wave signal of frequency  $f_a$  input to C-IN1 and C-IN2 and with a frequency of  $f_b$  input.

$$CD = 20 \log \frac{\text{C-OUT output with } f_b \text{ input [mVp-p]}}{\text{C-OUT output with } f_a \text{ input [mVp-p]}} \text{ [dB]}$$

Test frequencies

	$f_a$	$f_b$
CD-1	4.431395 MHz	4.435303 MHz (PAL/GBI)
CD-2	3.571628 MHz	3.575561 MHz (PAL/M)
CD-3	3.571628 MHz	3.575561 MHz (NTSC/M)



5. Measure the C-OUT output with a 200 mVp-p sine wave signal input to C-IN1 and C-IN2 and with 500 mVp-p sine wave signal input and calculate the difference in the gains.

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

Test frequencies

LNC-1	4.431395 MHz (PAL/GBI)
LNC-2	3.571628 MHz (PAL/M)
LNC-3	3.571628 MHz (NTSC/M)

6. Measure the 4 fsc (14.3 MHz) and fsc (3.58 MHz) components in the C-OUT output with no input.
7. Measure the noise in the C-OUT output with no input.  
Measure the noise with a noise meter set up with a 200 kHz high-pass filter and a 5 MHz low-pass filter.
8. Let V1 be the C-OUT output with a 350 mVp-p sine wave input to C-IN1 and C-IN2 and SW3 set to a, and let V2 be the C-OUT output with SW3 set to b.

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

Test frequencies

ZOC-1	4.431395 MHz (PAL/GBI)
ZOC-2	3.571628 MHz (PAL/M)
ZOC-3	3.571628 MHz (NTSC/M)

9. The C-OUT output delay time with respect to inputs to C-IN1. (the CCD 2.5 bit delay)

10. Y-OUT voltage (clamp voltage) with no signal input.

11. Measure the Y-OUT output with a 200 kHz 400 mVp-p sine wave input to Y-IN.

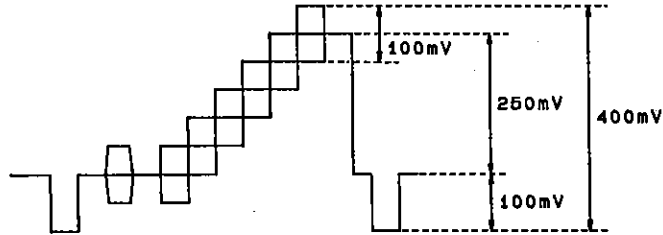
$$GVY = 20 \log \frac{\text{Y-OUT output [mVp-p]}}{400 \text{ [mVp-p]}} \text{ [dB]}$$

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

$$GFY = 20 \log \frac{\text{Y-OUT output with a 3.5 MHz input [mVp-p]}}{\text{Y-OUT output with a 200 kHz input [mVp-p]}} \text{ [dB]}$$

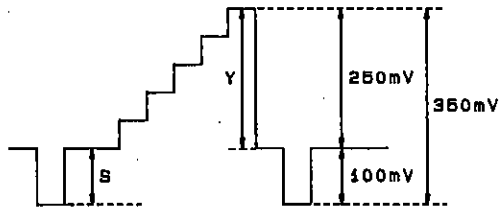
Note that  $V_{bias}$  should be adjusted so that the circuit is biased to the clamp level plus 250 mV.

13. Input a five-level step waveform (see the figure below) to Y-IN and measure the differential gain and differential phase in the Y-OUT output with a vector scope.



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14. Input a five-level step waveform (see the figure below) to Y-IN and measure the luminance level (Y) and the sync level (S) in the Y-OUT output.



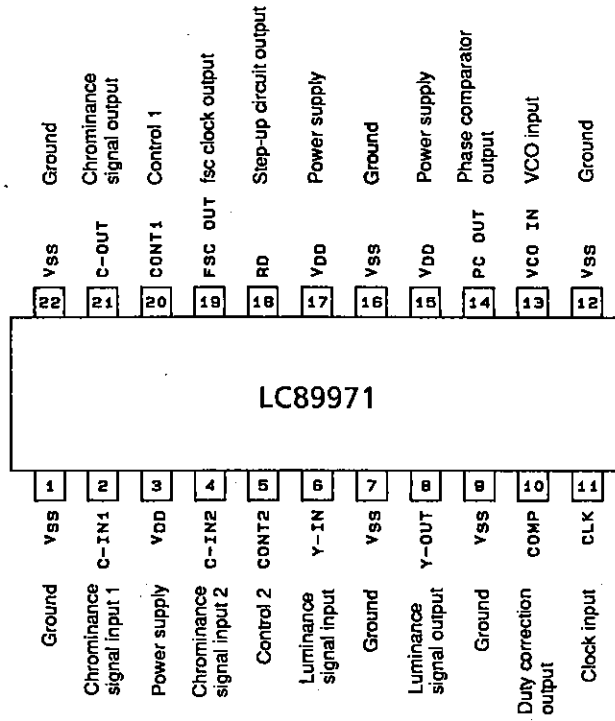
$$LS = \frac{S \text{ [mV]}}{Y \text{ [mV]}} \times 100 \text{ [%]}$$

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15. Measure the 4 fsc (14.3 MHz) and fsc (3.58 MHz) components in the Y-OUT output with no input.
16. Measure the noise in the Y-OUT output with no input.  
Measure the noise with a noise meter set up with a 200 kHz high-pass filter, a 4.2 MHz low-pass filter, and a 3.58 MHz trap filter.
17. Let V1 be the Y-OUT output with a 200 kHz 400 mVp-p sine wave input and SW4 set to c, and let V2 be the C-OUT output with SW4 set to b.
- $$ZOY = \frac{V2 \text{ [mVp-p]} - V1 \text{ [mVp-p]}}{V1 \text{ [mVp-p]}} \times 500 \text{ [\Omega]}$$
18. The Y-OUT delay time with respect to Y-IN

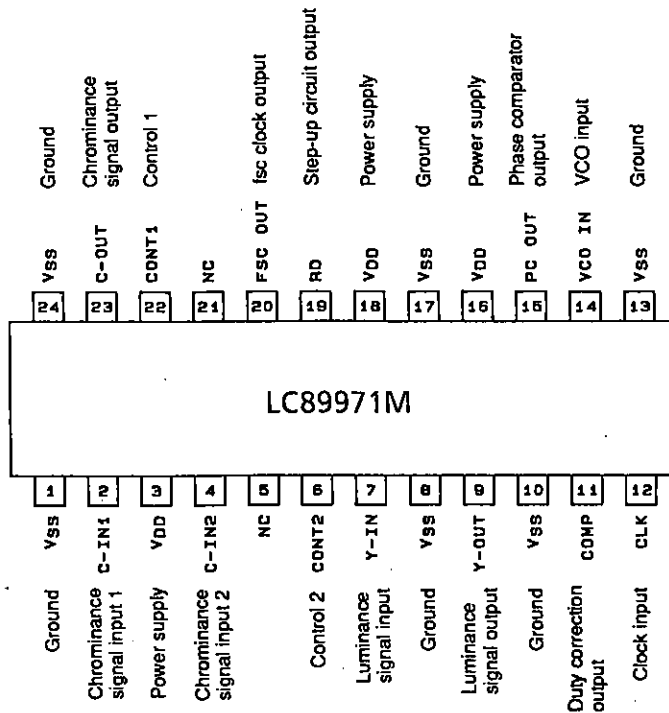
# LC89971, 89971M

## Pin Assignment [LC89971]



A03630 Top view

## Pin Assignment [LC89971M]

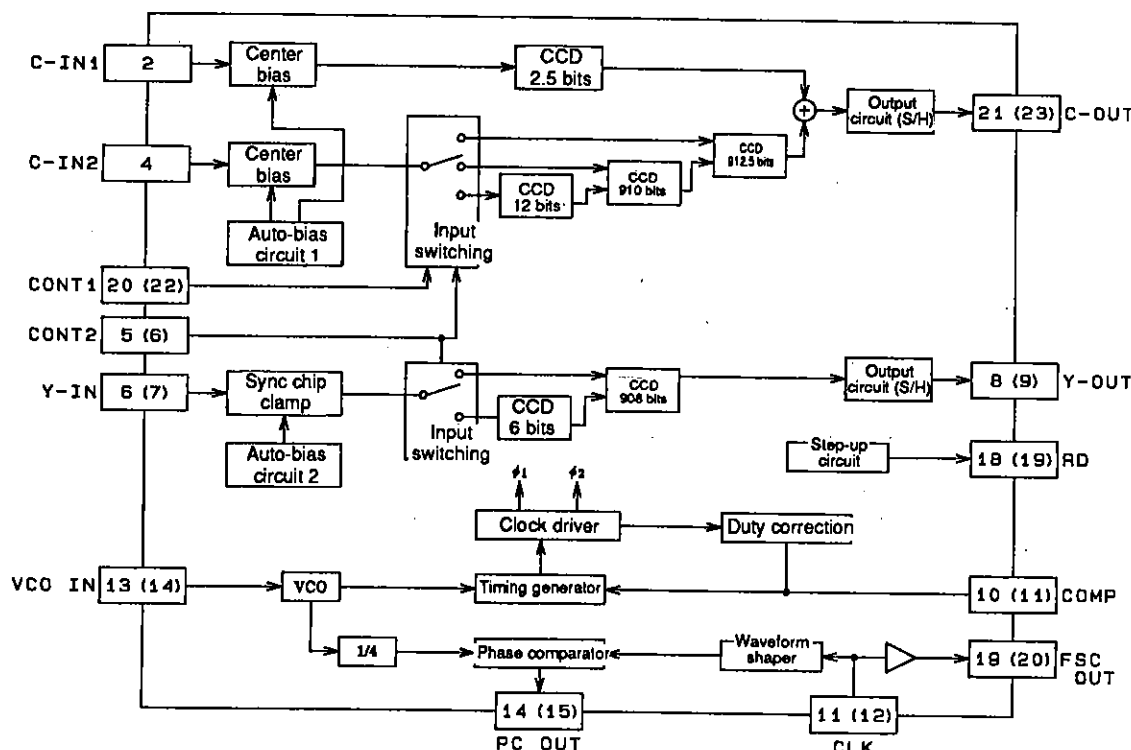


A03660 Top view

# LC89971, 89971M

## Block Diagram

Note \* Pin numbers in parentheses are for the LC89971M.



A03831

## Control Pin Function

CONT1	CONT2	Mode (representative example)	Chrominance signal delay (CCD bits)	Luminance signal delay (CCD bits)
Low	Low	PAL/GBI	2 H (1834.5) + 0 H (2.5)	1 H (914)
Low	High	PAL/M	2 H (1822.5) + 0 H (2.5)	1 H (908)
High	Low	—	—	—
High	High	NTSC/M	1 H (912.5) + 0 H (2.5)	1 H (908)

## Switching Voltage 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 the control pin has a built-in pull-down resistor (= 70 kΩ), the pin will be set to the low state if left open.

## FSC OUT Pin Function

This pin provides a buffer output for the clock signal input to the CLK pin.

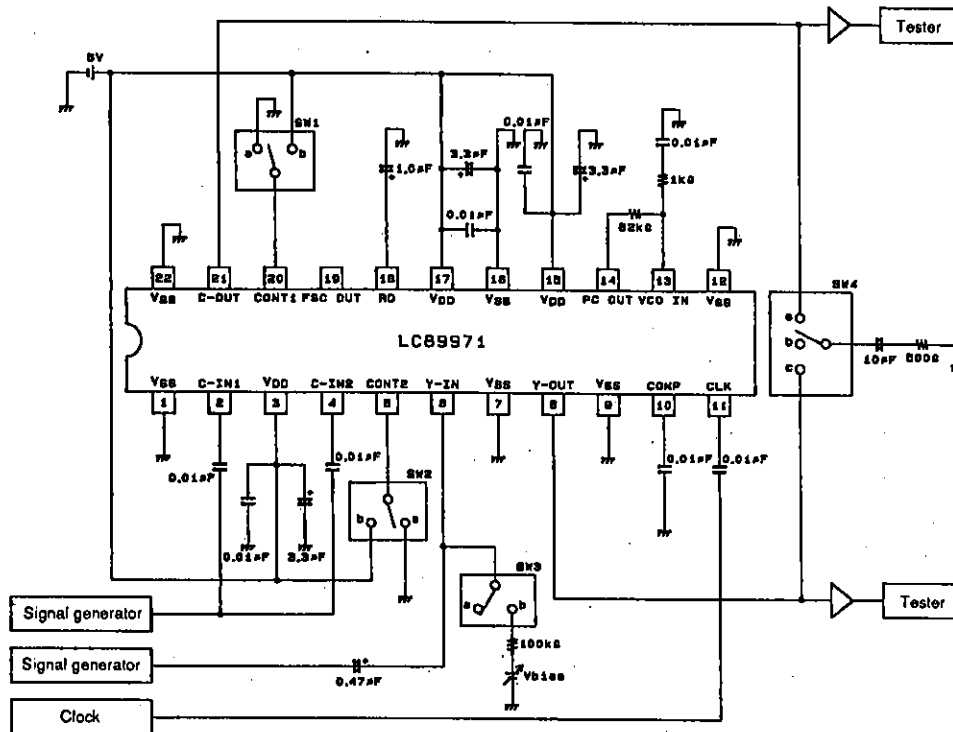


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Note: Since this pin has a built-in pull-up resistor, the pin voltage will go to the supply voltage and output will cease if left open.

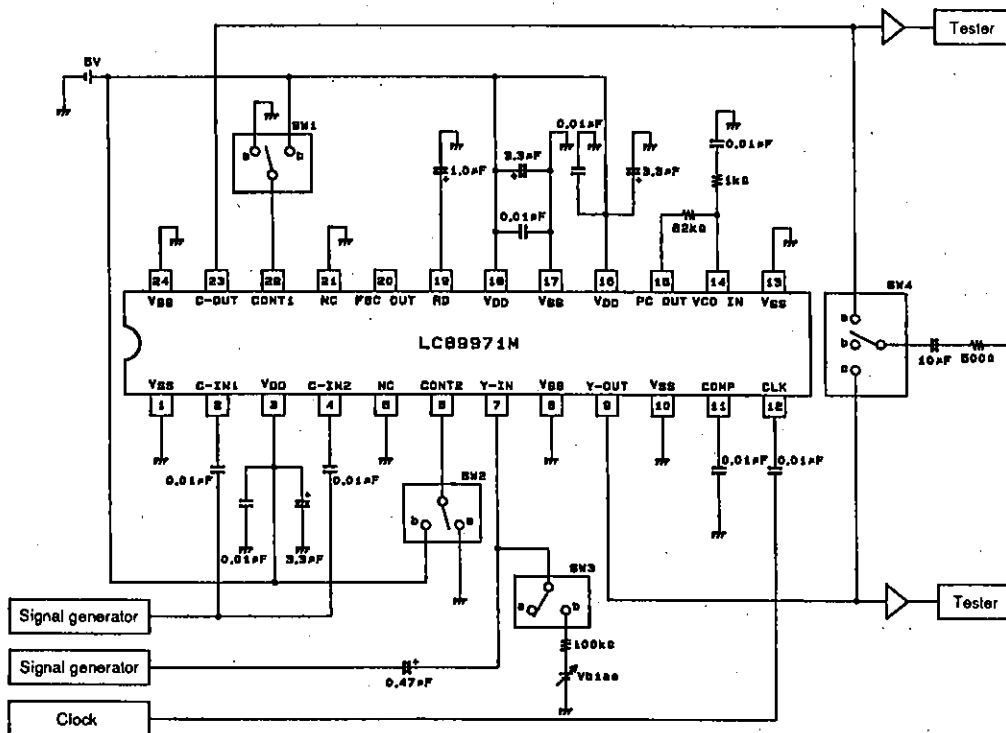
# LC89971, 89971M

## Test Circuit [LC89971]



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## Test Circuit [LC89971M]



A3386



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