

# NTSC color TV signal encoder

## BA7230LS

The BA7230LS comprises an RGB signal matrix circuit, balanced modulator circuit (rectangular 2-phase modulation), oscillator circuit (VCXO) for a 3.58MHz subcarrier synchronized with video input burst signals, luminosity and color difference signal mixing circuit, and a high speed switch for selecting composite signals of video input and RGB input. RGB signals, synch signals, BFP (burst flag pulses), PCP (pedestal clamp pulses) are input, and an NTSC composite signal is output.

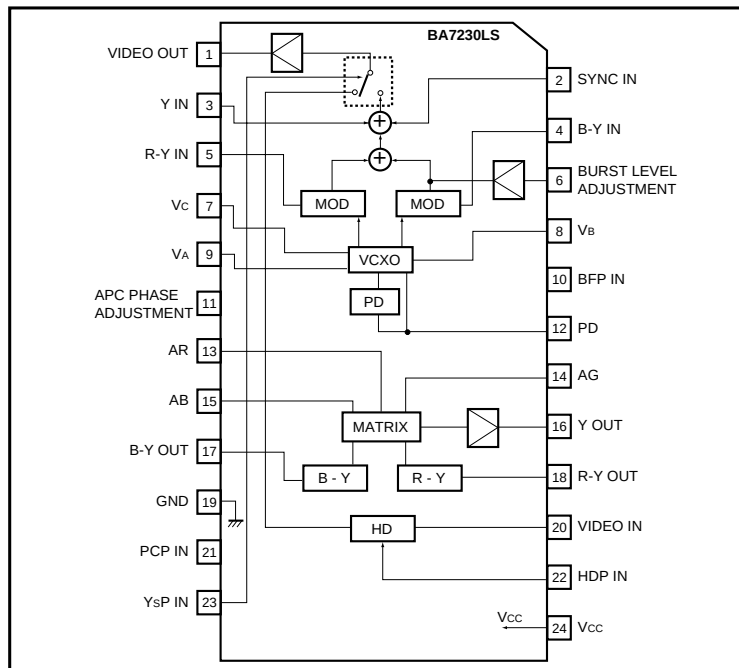
### ●Applications

Televisions (Teletext-capable), caption systems, video cameras, personal computers

### ●Features

- 1) Allows superimposition of video images (VIDEO IN) and computer images (RGB IN).
- 2) During superimposition, the subcarrier locked onto the video input burst signal RGB is modulated with the RGB signals by the APC circuit, preventing unnatural color disturbance due to switching.
- 3) Both the RGB and video input signals are pedestal-clamped, maintaining a natural image even during fluctuation in luminosity.
- 4) Using a half down pulse, the video signal can be reduced by 5dB to darken the background and make the superimposed RGB image easier to see.
- 5) Carrier leak is suppressible to less than 70mV<sub>P-P</sub> ( $V_{OUT} = 2V_{P-P}$ ) without adjustment.
- 6) Can be adapted for analog RGB input.
- 7) Compact 24-pin SZIP package minimizes external components.

### ●Block diagram



●Input / output circuits

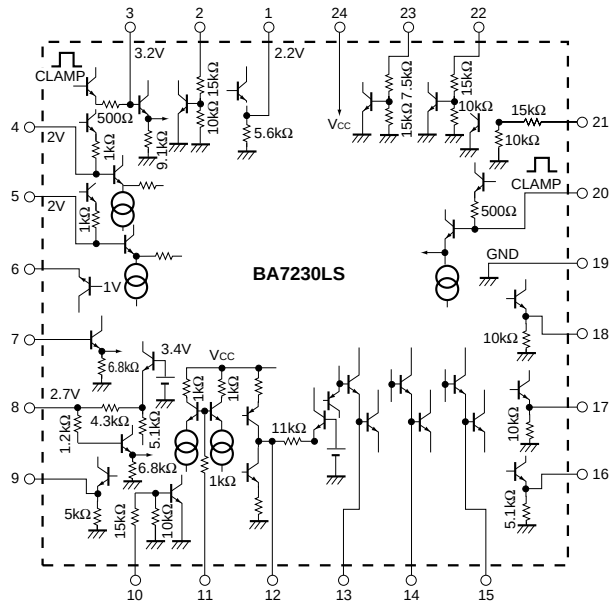


Fig. 1

●Absolute maximum ratings (Ta = 25°C)

| Parameter             | Symbol           | Limits       | Unit |
|-----------------------|------------------|--------------|------|
| Power supply voltage  | V <sub>CC</sub>  | 7.0          | V    |
| Power dissipation     | P <sub>d</sub>   | 500*         | mW   |
| Operating temperature | T <sub>opr</sub> | − 20 ~ + 70  | °C   |
| Storage temperature   | T <sub>stg</sub> | − 55 ~ + 125 | °C   |

\* Reduced by 5.0mW for each increase in Ta of 1°C over 25°C.

●Recommended operating conditions

| Parameter            | Symbol          | Limits    | Unit             |
|----------------------|-----------------|-----------|------------------|
| Power supply voltage | V <sub>CC</sub> | 4.5 ~ 5.5 | V                |
| R input level        | V <sub>R</sub>  | 0 ~ 0.7   | V <sub>P-P</sub> |
| G input level        | V <sub>G</sub>  | 0 ~ 0.7   | V <sub>P-P</sub> |
| B input level        | V <sub>B</sub>  | 0 ~ 0.7   | V <sub>P-P</sub> |
| Video input level    | V <sub>IN</sub> | 0 ~ 1.0   | V <sub>P-P</sub> |

●Electrical characteristics (unless otherwise noted, Ta = 25°C, V<sub>CC</sub> = 5.0V)

| Parameter                                  | Symbol           | Min.  | Typ.  | Max. | Unit              | Conditions                                                             |
|--------------------------------------------|------------------|-------|-------|------|-------------------|------------------------------------------------------------------------|
| Quiescent current                          | I <sub>Q</sub>   | —     | 38    | 54   | mA                | —                                                                      |
| Video output level                         | V <sub>OV</sub>  | 1.7   | 2.2   | 2.6  | V <sub>P-P</sub>  | VIDEO IN = 1V <sub>P-P</sub>                                           |
| Half down level change                     | G <sub>VH</sub>  | − 3   | − 5   | − 7  | dB                | —                                                                      |
| DC offset                                  | V <sub>OF</sub>  | —     | 50    | 160  | mV <sub>P-P</sub> | VIDEO IN = 1V <sub>P-P</sub>                                           |
| Crosstalk                                  | CT               | —     | − 46  | − 40 | dB                | VIDEO IN = 1V <sub>P-P</sub>                                           |
| ER-EY output level                         | V <sub>R-Y</sub> | 0.3   | 0.42  | 0.55 | V <sub>P-P</sub>  | V <sub>R</sub> = 0.7V <sub>P-P</sub>                                   |
| EB-EY output level                         | V <sub>B-Y</sub> | 0.2   | 0.31  | 0.42 | V <sub>P-P</sub>  | V <sub>B</sub> = 0.7V <sub>P-P</sub>                                   |
| YOUT output level                          | V <sub>Y</sub>   | 1.0   | 1.4   | 1.8  | V <sub>P-P</sub>  | V <sub>R</sub> = V <sub>G</sub> = V <sub>B</sub> = 0.7V <sub>P-P</sub> |
| Ys switching delay time                    | T <sub>D</sub>   | —     | 60    | —    | ns                | —                                                                      |
| SYNC output level                          | V <sub>OS</sub>  | 0.4   | 0.65  | 0.9  | V <sub>P-P</sub>  | —                                                                      |
| Burst output level                         | V <sub>OB</sub>  | 0.25  | 0.46  | 0.8  | V <sub>P-P</sub>  | R <sub>E</sub> = 1.8kΩ                                                 |
| Composite output level                     | V <sub>OY</sub>  | 1.7   | 2.2   | 2.6  | V <sub>P-P</sub>  | Y <sub>IN</sub> = 0.7V <sub>P-P</sub>                                  |
| R-Y modulation gain                        | G <sub>R-Y</sub> | 9     | 11    | 13   | dB                | R - Y <sub>IN</sub> = 0.3V <sub>P-P</sub>                              |
| B-Y modulation gain                        | G <sub>B-Y</sub> | 9     | 11    | 13   | dB                | B - Y <sub>IN</sub> = 0.2V <sub>P-P</sub>                              |
| (R-Y) / (B-Y) modulation gain differential | G <sub>R-B</sub> | —     | —     | 2    | dB                | Difference between above gains                                         |
| (R-Y) / (B-Y) orthogonal phase shift       | ΔR               | − 6   | —     | 6    | deg               | —                                                                      |
| (R - Y) ·Burst orthogonal phase shift      | ΔB               | − 6   | —     | 6    | deg               | —                                                                      |
| Carrier leak                               | L <sub>SC</sub>  | —     | 30    | 70   | mV <sub>P-P</sub> | V <sub>OUT</sub> = 2V <sub>P-P</sub>                                   |
| APC capture range                          | f <sub>CAP</sub> | ± 100 | —     | —    | Hz                | Burst = 0.1V <sub>P-P</sub> , 2.8μS                                    |
| Carrier phase range                        | φ <sub>SC</sub>  | ± 30  | ± 45  | —    | deg               | Superimposition                                                        |
| Video frequency characteristic             | f <sub>V</sub>   | 4.5   | 6     | —    | MHz               | − 3dB when f = 100kHz                                                  |
| Video output DG                            | DG               | —     | ± 3.5 | —    | %                 | VIDEO IN = 1V <sub>P-P</sub>                                           |
| Video output DP                            | DP               | —     | ± 2.5 | —    | deg               | VIDEO IN = 1V <sub>P-P</sub>                                           |
| Input impedance (SY, BF, PC, HD)           | Z <sub>T</sub>   | 8     | 15    | —    | kΩ                | —                                                                      |
| Input impedance (Ys)                       | Z <sub>TY</sub>  | 3     | 7.5   | —    | kΩ                | —                                                                      |
| Threshold level (SY, BF, PC, HD)           | V <sub>T</sub>   | 0.9   | 2.0   | 2.8  | V                 | —                                                                      |
| Threshold level (Ys)                       | V <sub>TY</sub>  | 0.5   | 1.1   | 1.8  | V                 | —                                                                      |

## ● Measurement circuit

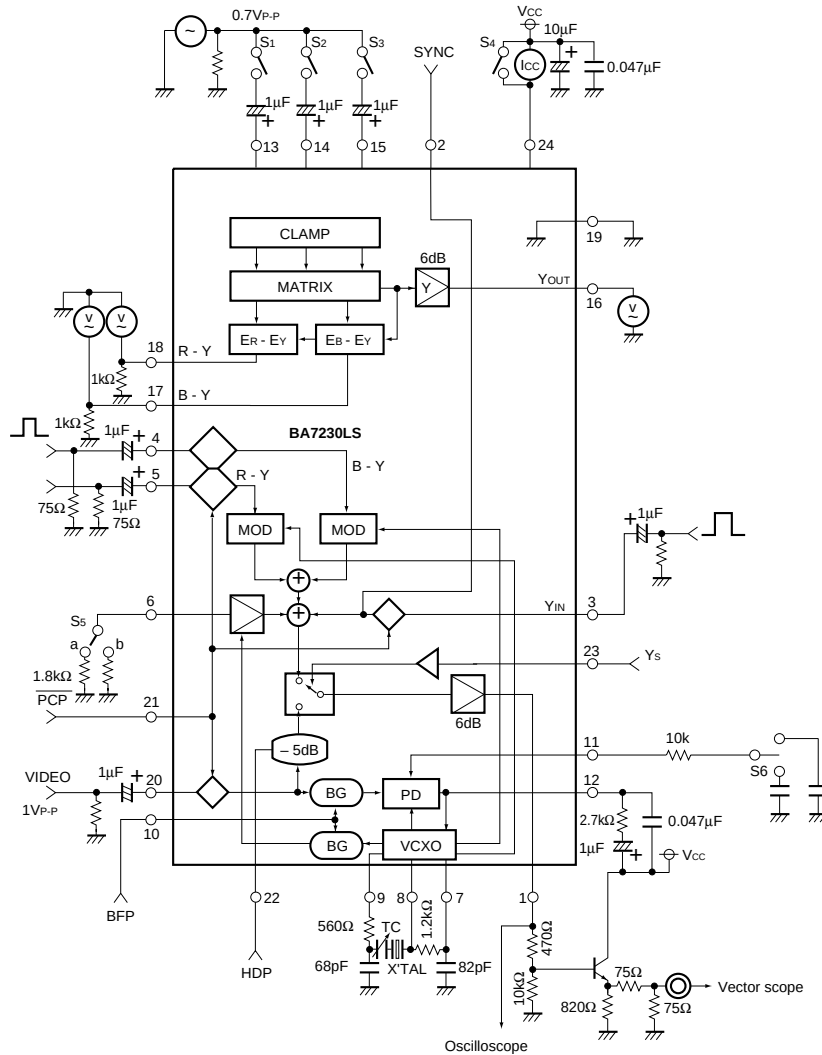
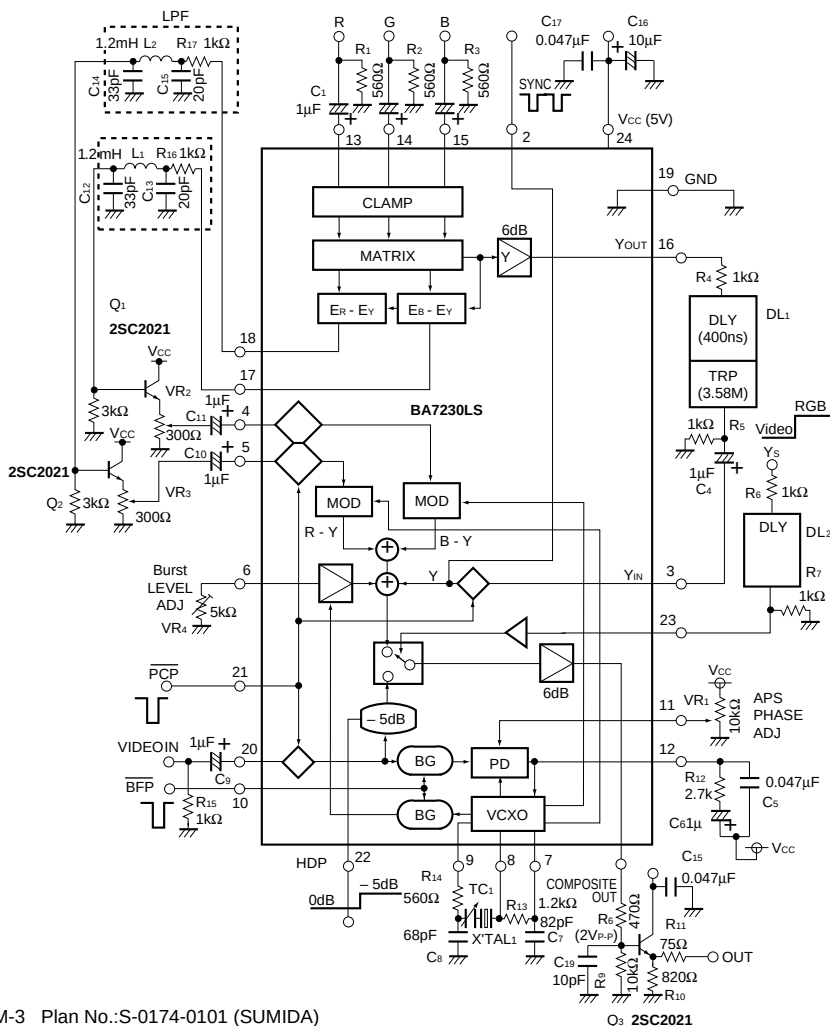


Fig. 2

## ● Application example



DL<sub>1</sub>, DL<sub>2</sub>: Part No.:YM-3 Plan No.:S-0174-0101 (SUMIDA)

L<sub>1</sub>, L<sub>2</sub>: RC-875 1.2mH (SUMIDA)

TC<sub>1</sub>: TZ03R200E (MURATA)

Q<sub>1</sub>, Q<sub>2</sub>, Q<sub>3</sub>: 2SC2021 (ROHM)

XTAL<sub>1</sub>: HC - 43U 3579.545kHz (NIKKO DENSHI)

Fig. 3

## ●Circuit operation

### (1) Matrix circuit

The R, G and B inputs are clamped to 3.2V by the clamp circuit and combined into signals  $E_Y$ ,  $E_R - E_Y$  and  $E_B - E_Y$  by the resistance-adding matrix circuit.

$$E_Y = 0.30E_R + 0.59E_G + 0.11E_B$$

$$E_R - E_Y = 0.70E_R - 0.59E_G - 0.11E_B$$

$$E_B - E_Y = -0.30E_R - 0.59E_G + 0.89E_B$$

Signal  $E_Y$  is then amplified by the 6dB amplifier (pin 16) to compensate for the signal's 6dB attenuation in the delay line. To prevent overmodulation, signal  $E_R - E_Y$  is output at  $1/1.14$  and signal  $E_B - E_Y$  at  $1/2.03$  (pins 17 and 18).

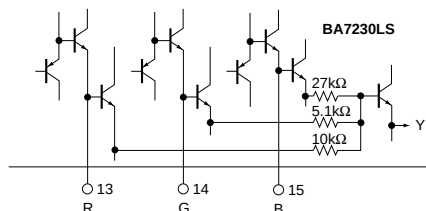


Fig. 4

### (2) Balanced modulator circuit

Color difference signals are modulated (rectangular 2-phase balanced modulation) with color subcarriers (3.58MHz) having a  $90^\circ$  phase difference. This is called the carrier color signal.

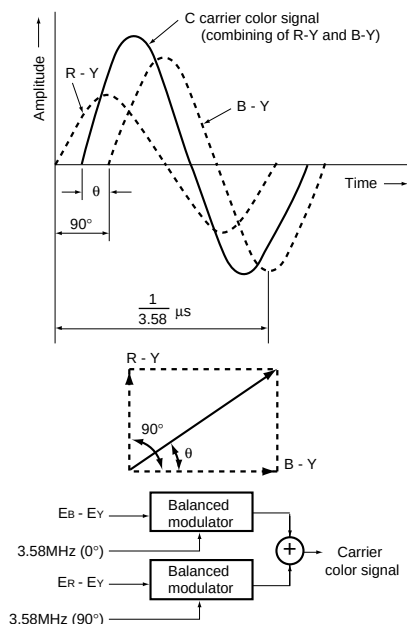


Fig. 5

The carrier color signal is mixed with color burst signals and luminosity signals  $E_Y$  (to which a horizontal synchronization signal is added) to create the NTSC composite signal ( $E_N$ ).

$$E_N = E_Y + \frac{E_R - E_Y}{1.14} \cos 2\pi f_{st} + \frac{E_B - E_Y}{2.03} \sin 2\pi f_{st}$$

### (3) Switch circuit

Signal  $Y_s$  (pin 23) switches between video input and RGB composite signals. Performing this switching at high speeds results in superimposition.

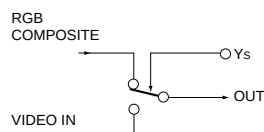


Fig. 6

### (4) Color subcarrier oscillator circuit

The subcarrier oscillator circuit for RGB input. This circuit is synchronized with the video input color burst signal extracted by BFP (burst flag pulses) during superimposition, preventing any unnatural color disturbance due to switching between RGB and video input.

This oscillator circuit generates the RGB color burst signal. An attached variable resistor can be used to change the amplitude of the color burst signal and to adjust its phase relative to the video color burst signal. This oscillator circuit remains in the free-running state when there is no video input.

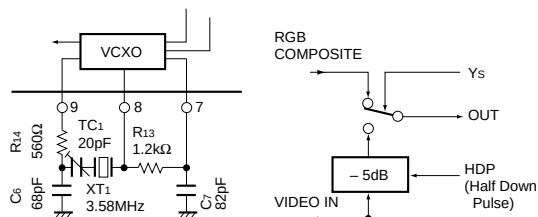


Fig. 7

Fig. 8

(5) During superimposition, video input can be lowered by about 5dB using an HDP (half-down pulse), darkening the background and making RGB input easier to see.

## ● Input waveform and timing chart

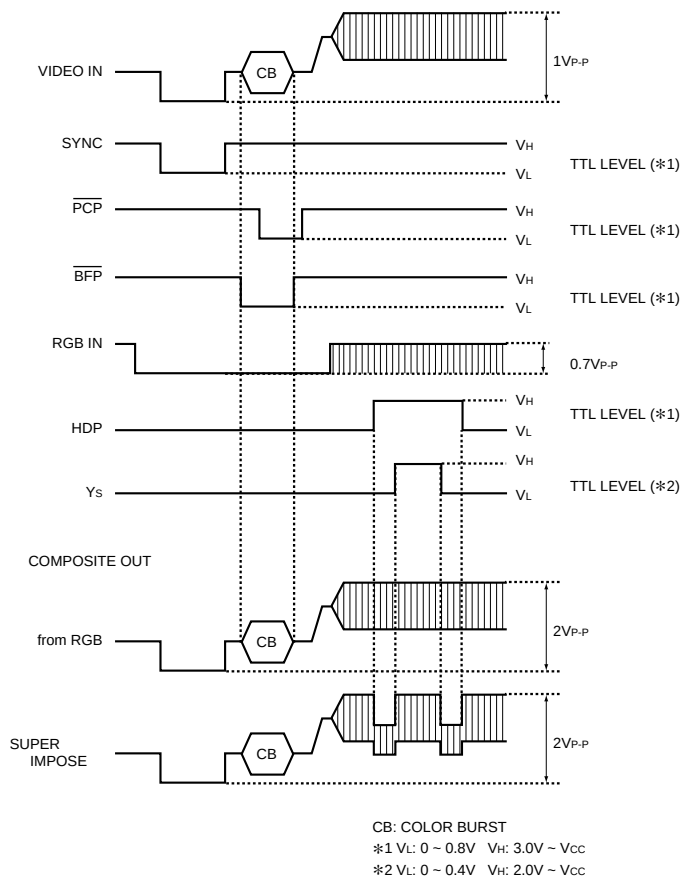


Fig. 9

## ● Electrical characteristic curves

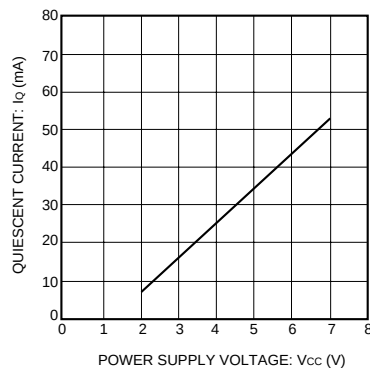


Fig. 10 Quiescent current vs. power supply voltage

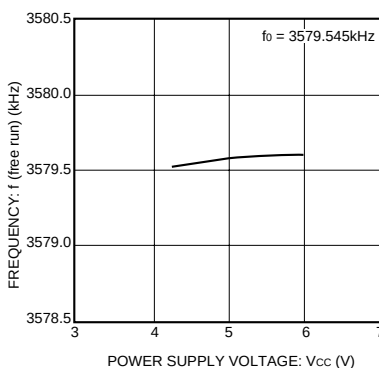
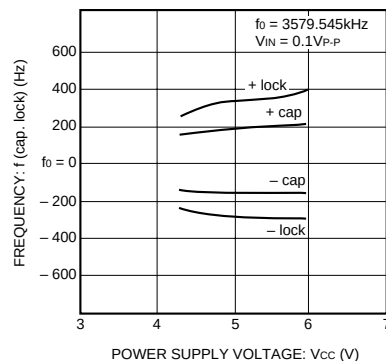


Fig. 11 VCXO free-run frequency vs. power supply voltage

Fig. 12 Capture range and lock range ( $I$ ) vs. power supply voltage

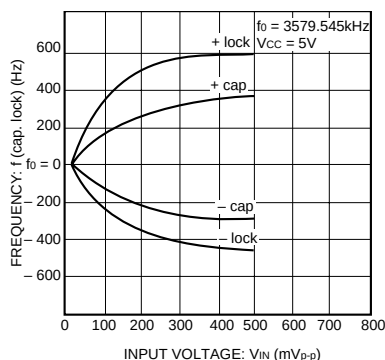


Fig. 13 Capture range and lock range (II) vs. input voltage

#### ● Operation notes

(1) RGB and video inputs should be synchronized. When only RGB is input, connect VIDEO IN (pin 20) to GND with a  $1\mu F$  capacitor, and synchronize  $\overline{PCP}$  and  $\overline{BFP}$  to RGB.

(3) Input pins with pedestal clamps cannot be left open and must be grounded with a low impedance. When not used, ground with a  $1\mu F$  capacitor.

\*Input pins with pedestal clamps:

$Y_{IN}$  (pin 3),  $B-Y_{IN}$  (pin 4),  $R-Y_{IN}$  (pin 5), VIDEO IN (pin 20)

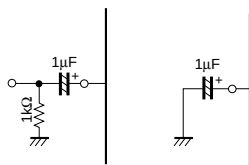
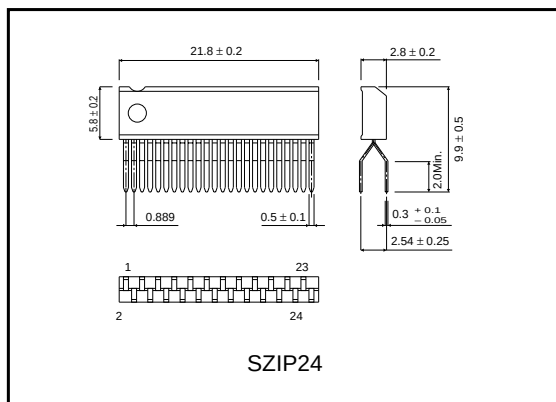


Fig. 14

#### ● External dimensions (Units: mm)



(2) The VCXO remains in a free-running state except during superimposition.

(4) Pin 4 ( $B-Y_{IN}$ ) and pin 5 ( $R-Y_{IN}$ ) have high impedance and are susceptible to the effects of noise and other external factors during pattern generation. For this reason, we recommend adding the circuit in Fig. 15 to lower the input impedance. Adding this circuit can also reduce carrier leakage.

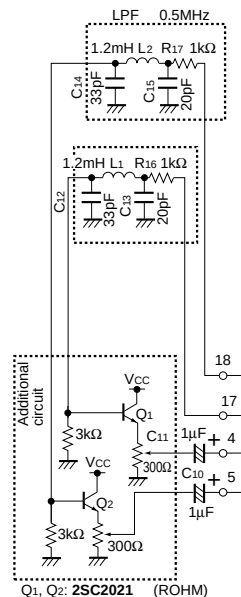


Fig. 15