

**40 – CHANNEL CITIZENS' BAND SYNTHESISER IC SETS**

**SP8922    SP8921    SP8923**



Recognising the different requirements of citizens' band transceiver manufacturers, Plessey Semiconductors have developed a range of integrated circuits for 40-channel CB. This datasheet describes three of these: SP8921, SP8922 and SP8923.

The devices are designed for use in pairs. SP8922 and SP8921 incorporate all the functions for a synthesised local oscillator with binary-coded channel entry; the SP8923/21 pair offering similar facilities but with BCD channel entry.

**FEATURES**

- Low External Component Count
- Binary (SP8922) or BCD (SP8923) Channel Setting
- Internal Pulldowns on Channel I/Ps
- Integral 10.24MHz Crystal Oscillator with Buffered O/P
- 10.695MHz IF Offset for Double Conversion
- 455 kHz IF offset for Single Conversion
- No Mixing or Prescaling Required between VCO and Synthesiser I/P
- Digital Phase/Frequency Comparator has Source and Sink O/Ps
- Lock Detect O/P
- 5V Supply Rail
- Low Power: 225mW Typ. (SP8921)  
225mW Typ. (SP8922)  
325mW Typ. (SP8923)

The synthesisers are partitioned into two parts as shown in Figs. 2 and 3. The SP8922 and SP8923 contain a preamplifier followed by a fixed divide by four prescaler. The amplifier input will accept a signal at a frequency up to 30MHz. The input is a high impedance and requires an AC coupled source which is achieved by a series capacitor. The prescaler is followed by seven bits of programmable division. In the SP8922, these seven bits are programmed from the six binary inputs, as shown in Table 1, plus the 5kHz program input.

The SP8923 is programmed by seven BCD channel inputs (see Table 2), the 40 input codes being converted by a decoding matrix to the appropriate citizens' band frequencies.

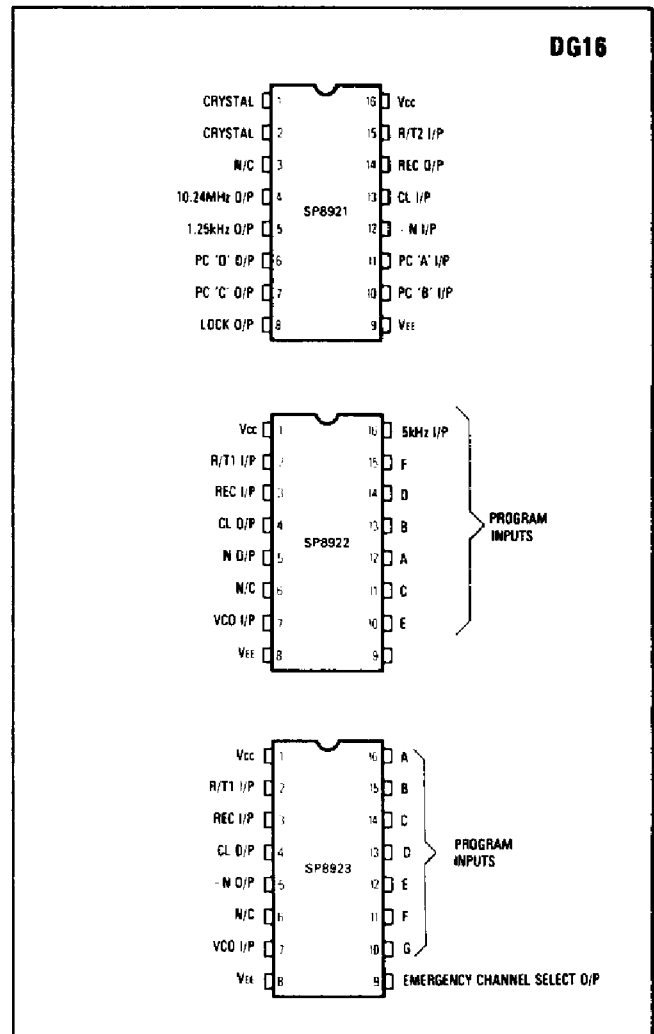


Fig. 1 Pin connections (top view)

A receive/transmit (R/T) input is provided on both SP8922 and SP8923 to give an offset of 91 counts (corresponding to -455kHz) when the receive mode is selected.

Clock and preset outputs to the SP8921 are provided by SP8922 and SP8923, which in turn accept a recognition signal from the SP8921.

Pin 9 on the SP8923 is an Emergency Channel Select output, which gives a low output whenever channel 9.

or a non-permitted channel, is selected. When this output is low, the synthesiser programs to channel 9.

The device common to both sets, SP8921, contains the six most significant bits of the programmable counter, a 10.24MHz crystal oscillator maintaining circuit, a  $2^{13}$  fixed divider, and a digital phase/frequency comparator. The six bits of the programmable counter have a fixed preset code which, combined with the variable code of the SP8922 or SP8923, give the total count required to select the 40 citizens' band frequencies. The R/T input to the SP8921 gives an offset in the programmable count of minus 2048 (corresponding to  $-10.24$  MHz) when in the receive mode.

The crystal oscillator has a direct emitter follower output which may be used as an input to the second mixer in a double conversion transceiver as shown in Fig. 4. The oscillator is connected internally to the fixed divider, which gives an output reference frequency of 1.25kHz with a 10.24MHz crystal. The phase/frequency comparator has two outputs which may be used to drive a variety of charge pump filter circuits as shown in Figs. 7 through 10. There is also a 'lock detect' output which requires an external filter as shown in Figs. 2 and 3.

The frequencies available from the SP8922/1 and SP8923/1 when connected in a synthesiser loop are shown in Tables 1 and 2 respectively.

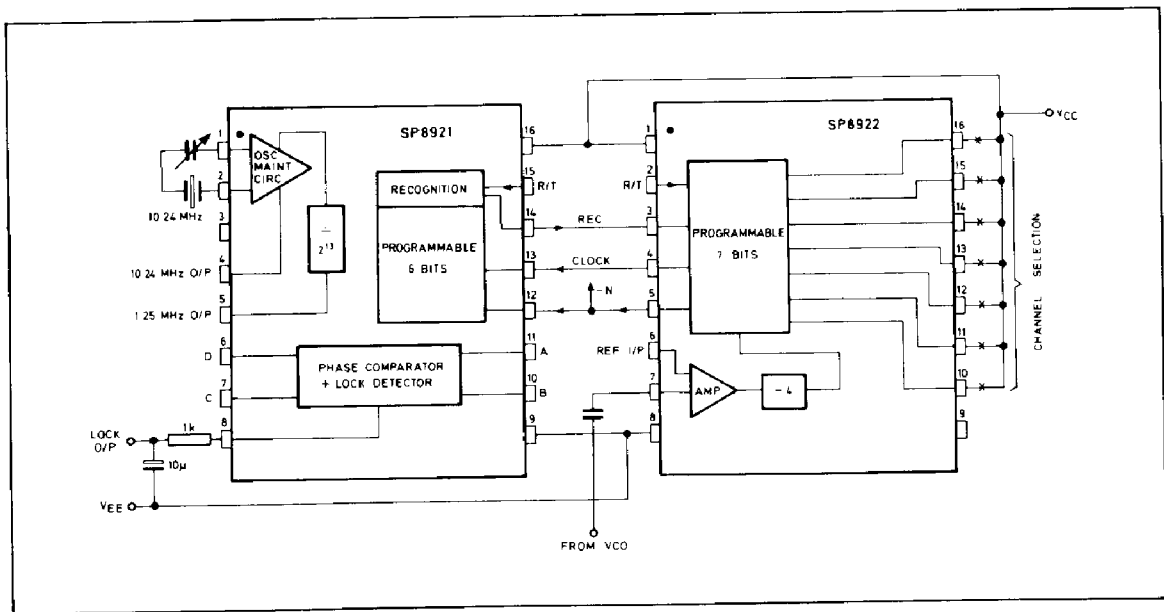


Fig. 2 SP8921/SP8922 interconnections (10.695MHz receive offset)

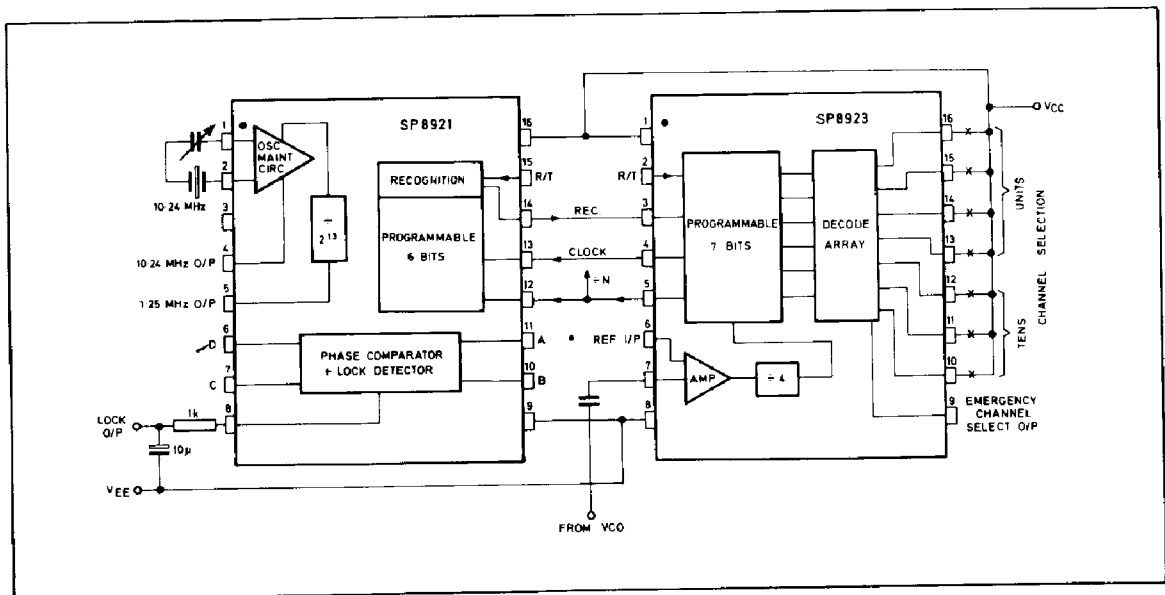


Fig. 3 SP8921/SP8923 interconnections (10.695MHz receive offset)

## ELECTRICAL CHARACTERISTICS

### Test Conditions (unless otherwise stated)

$V_{EE} = 0V$ ,  $V_{CC} = -4.75V$  to  $+5.5V$

$T_A = -30^{\circ}C$  to  $+70^{\circ}C$

| Characteristic   | Value          |      |          | Units             | Conditions                      |
|--|----------------|------|----------|-------------------|---------------------------------|
|  | Min.           | Typ. | Max.     |                   |                                 |
| <b>Inputs (see Note 1)</b>   |                |      |          |                   |                                 |
| Low  | 0              |      | 0.5      | V                 | AC-coupled                      |
| High   | 2.4            |      | $V_{CC}$ | V                 |                                 |
| VCO  | 0.4            |      | 1.0      | V <sub>p-p</sub>  |                                 |
| Max. clock frequency   | 30             | 50   |          | MHz               |                                 |
| <b>Outputs (except 10.24MHz O/P and phase comparator C and D O/Ps)</b> |                |      |          |                   | 6mA sink<br>No load, see Note 2 |
| Low  | $V_{CC} - 0.5$ |      | 0.5      | V                 |                                 |
| High   |                |      |          | V                 |                                 |
| <b>10.24MHz O/P</b>  | 600            | 800  |          | mV <sub>p-p</sub> |                                 |
| <b>Phase comp. C O/P</b>   |                |      |          |                   | 5mA sink                        |
| Leakage O/P high   |                |      | 50       | $\mu A$           |                                 |
| O/P low  |                |      | 0.5      | V                 |                                 |
| <b>Phase comp. D O/P</b>   |                |      |          |                   | 5mA source                      |
| Leakage O/P low  | $V_{CC} - 1.2$ |      | 50       | $\mu A$           |                                 |
| O/P high   |                |      |          | V                 |                                 |
| <b>Power supply</b>  |                |      |          |                   |                                 |
| $V_{CC}$   | +4.75          |      | +5.5     | V                 |                                 |
| $I_{CC}$ SP8921  |                | 45   | 60       | mA                |                                 |
| SP8922   |                | 45   | 60       | mA                |                                 |
| SP8923   |                | 65   | 90       | mA                |                                 |

### NOTES

- Programming inputs may be left open circuit as input low, or connected  $V_{CC}$  as input high. All inputs (except VCO I/P) have internal  $10k\Omega$  pull down resistors to  $V_{EE}$ . SP8922, SP8923 pin 6 is the VCO I/P reference; this pin may be left open circuit, or decoupled to  $V_{EE}$  to improve I/P sensitivity.
- Outputs have an internal  $5k\Omega$  pull up resistor to  $V_{CC}$ . Lock output (SP8921 pin 8) has an internal  $10k\Omega$  pull up resistor to  $V_{CC}$ .

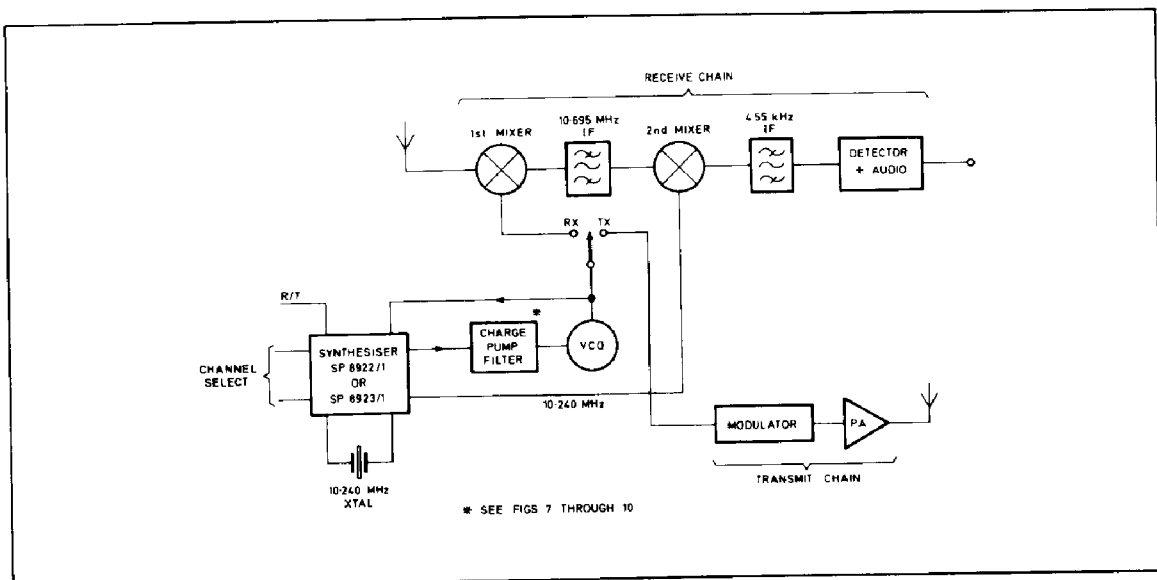


Fig. 4 Double conversion transceiver

| Channel No. | Input Code<br>F E D C B A | Output frequency<br>with R/T = 0 (MHz) |
|-------------|---------------------------|--|
| 1           | 0 0 0 1 1 1               | 26.965                                 |
| 2           | 0 0 1 0 0 0               | 26.975                                 |
| 3           | 0 0 1 0 0 1               | 26.985                                 |
| 4           | 0 0 1 0 1 1               | 27.005                                 |
| 5           | 0 0 1 1 0 0               | 27.015                                 |
| 6           | 0 0 1 1 0 1               | 27.025                                 |
| 7           | 0 0 1 1 1 0               | 27.035                                 |
| 8           | 0 1 0 0 0 0               | 27.055                                 |
| 9           | 0 1 0 0 0 1               | 27.065                                 |
| 10          | 0 1 0 0 1 0               | 27.075                                 |
| 11          | 0 1 0 0 1 1               | 27.085                                 |
| 12          | 0 1 0 1 0 1               | 27.105                                 |
| 13          | 0 1 0 1 1 0               | 27.115                                 |
| 14          | 0 1 0 1 1 1               | 27.125                                 |
| 15          | 0 1 1 0 0 0               | 27.135                                 |
| 16          | 0 1 1 0 1 0               | 27.155                                 |
| 17          | 0 1 1 0 1 1               | 27.165                                 |
| 18          | 0 1 1 1 0 0               | 27.175                                 |
| 19          | 0 1 1 1 0 1               | 27.185                                 |
| 20          | 0 1 1 1 1 1               | 27.205                                 |
| 21          | 1 0 0 0 0 0               | 27.215                                 |
| 22          | 1 0 0 0 0 1               | 27.225                                 |
| 23          | 1 0 0 1 0 0               | 27.255                                 |
| 24          | 1 0 0 0 1 0               | 27.235                                 |
| 25          | 1 0 0 0 1 1               | 27.245                                 |
| 26          | 1 0 0 1 0 1               | 27.265                                 |
| 27          | 1 0 0 1 1 0               | 27.275                                 |
| 28          | 1 0 0 1 1 1               | 27.285                                 |
| 29          | 1 0 1 0 0 0               | 27.295                                 |
| 30          | 1 0 1 0 0 1               | 27.305                                 |
| 31          | 1 0 1 0 1 0               | 27.315                                 |
| 32          | 1 0 1 0 1 1               | 27.325                                 |
| 33          | 1 0 1 1 0 0               | 27.335                                 |
| 34          | 1 0 1 1 0 1               | 27.345                                 |
| 35          | 1 0 1 1 1 0               | 27.355                                 |
| 36          | 1 0 1 1 1 1               | 27.365                                 |
| 37          | 1 1 0 0 0 0               | 27.375                                 |
| 38          | 1 1 0 0 0 1               | 27.385                                 |
| 39          | 1 1 0 0 1 0               | 27.395                                 |
| 40          | 1 1 0 0 1 1               | 27.405                                 |

Table 1 SP8922/1 O/P frequencies with 10.240 crystal (0 contact open, 1 contact closed to Vcc)

| Channel No. | Input Code<br>G F E D C B A | Output Frequency<br>with R/T = 0 (MHz) |
|-------------|-----------------------------|--|
| 1           | 0 0 0 0 0 0 1               | 26.965                                 |
| 2           | 0 0 0 0 0 1 0               | 26.975                                 |
| 3           | 0 0 0 0 0 1 1               | 26.985                                 |
| 4           | 0 0 0 0 1 0 0               | 27.005                                 |
| 5           | 0 0 0 0 1 0 1               | 27.015                                 |
| 6           | 0 0 0 0 1 1 0               | 27.025                                 |
| 7           | 0 0 0 0 1 1 1               | 27.035                                 |
| 8           | 0 0 0 1 0 0 0               | 27.055                                 |
| 9           | 0 0 0 1 0 0 1               | 27.065                                 |
| 10          | 0 0 1 0 0 0 0               | 27.075                                 |
| 11          | 0 0 1 0 0 0 1               | 27.085                                 |
| 12          | 0 0 1 0 0 1 0               | 27.105                                 |
| 13          | 0 0 1 0 0 1 1               | 27.115                                 |
| 14          | 0 0 1 0 1 0 0               | 27.125                                 |
| 15          | 0 0 1 0 1 0 1               | 27.135                                 |
| 16          | 0 0 1 0 1 1 0               | 27.155                                 |
| 17          | 0 0 1 0 1 1 1               | 27.165                                 |
| 18          | 0 0 1 1 0 0 0               | 27.175                                 |
| 19          | 0 0 1 1 0 0 1               | 27.185                                 |
| 20          | 0 1 0 0 0 0 0               | 27.205                                 |
| 21          | 0 1 0 0 0 0 1               | 27.215                                 |
| 22          | 0 1 0 0 0 1 0               | 27.225                                 |
| 23          | 0 1 0 0 0 1 1               | 27.255                                 |
| 24          | 0 1 0 0 1 0 0               | 27.235                                 |
| 25          | 0 1 0 0 1 0 1               | 27.245                                 |
| 26          | 0 1 0 0 1 1 0               | 27.265                                 |
| 27          | 0 1 0 0 1 1 1               | 27.275                                 |
| 28          | 0 1 0 1 0 0 0               | 27.285                                 |
| 29          | 0 1 0 1 0 0 1               | 27.295                                 |
| 30          | 0 1 1 0 0 0 0               | 27.305                                 |
| 31          | 0 1 1 0 0 0 1               | 27.315                                 |
| 32          | 0 1 1 0 0 1 0               | 27.325                                 |
| 33          | 0 1 1 0 0 1 1               | 27.335                                 |
| 34          | 0 1 1 0 1 0 0               | 27.345                                 |
| 35          | 0 1 1 0 1 0 1               | 27.355                                 |
| 36          | 0 1 1 0 1 1 0               | 27.365                                 |
| 37          | 0 1 1 0 1 1 1               | 27.375                                 |
| 38          | 0 1 1 1 0 0 0               | 27.385                                 |
| 39          | 0 1 1 1 0 0 1               | 27.395                                 |
| 40          | 1 0 0 0 0 0 0               | 27.405                                 |

Table 2 SP8923/1 O/P frequencies with 10.240 crystal (0 contact open, 1 contact closed to Vcc)

| R/T 1 | R/T 2 | Offset     |
|-------|-------|------------|
| 0     | 0     | 0          |
| 1     | 0     | -455kHz    |
| 0     | 1     | -10.240MHz |
| 1     | 1     | -10.695MHz |

Table 3 Receive/Transmit truth table

## SP8921 CRYSTAL OSCILLATOR PERFORMANCE

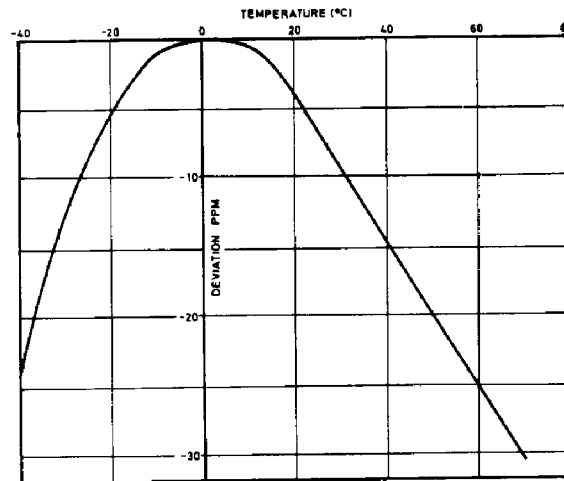


Fig. 5 Frequency/temperature characteristics of CB 10.24 MHz crystal oscillator

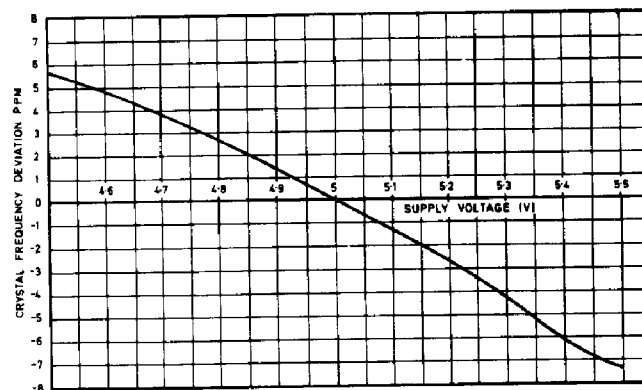


Fig. 6 Crystal frequency v. supply voltage

## CHARGE PUMP FILTER ARRANGEMENTS (FIGS. 7 THROUGH 10)

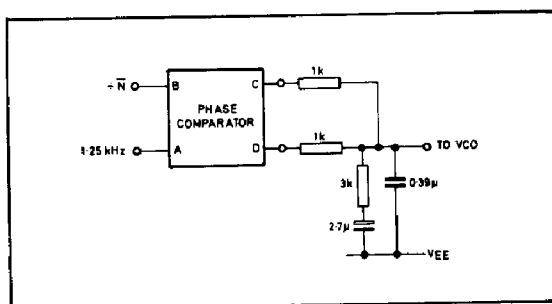


Fig. 7 Filter A. Simple voltage pump, output range 2.5V

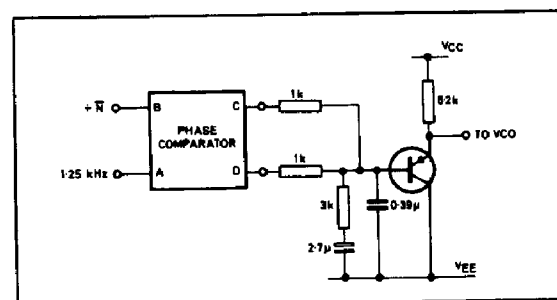


Fig. 8 Filter B. Simple voltage pump with buffered output

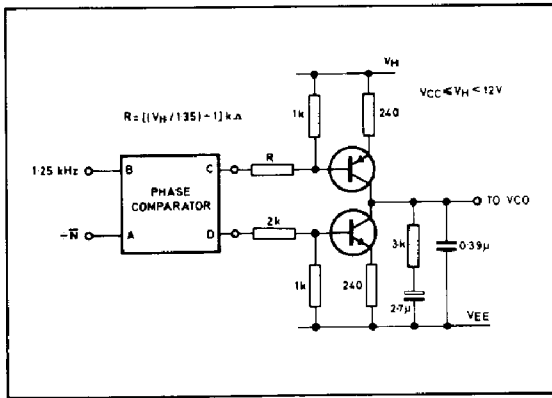


Fig. 9 Filter C. Current pump, output voltage range  $V_H - 1.5V$  for  $V_H$  less than 12V

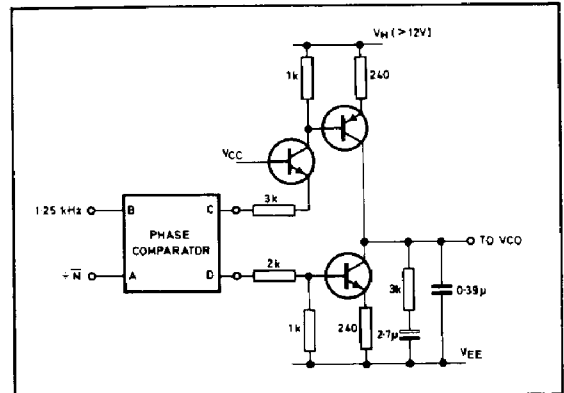


Fig. 10 Filter D. Current pump output voltage range  $V_H - 1.5V$  for  $V_H$  greater than 12V

### INPUT/OUTPUT CIRCUITS (FIGS. 11 THROUGH 16)

The following diagrams show input and output circuit configurations used on the SP8921, 2 and 3.

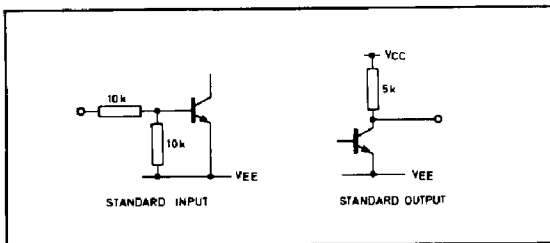


Fig. 11 Standard input and output

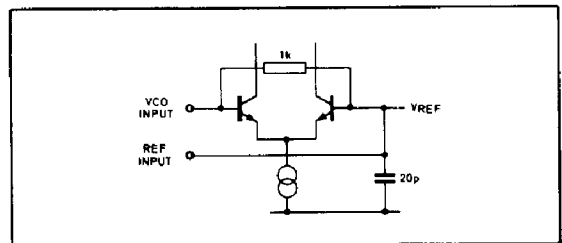


Fig. 12 VCO input

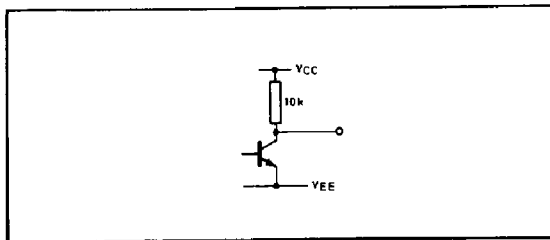


Fig. 13 Lock detect output

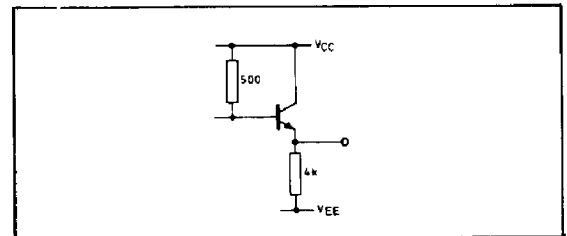


Fig. 14 10.24 MHz output

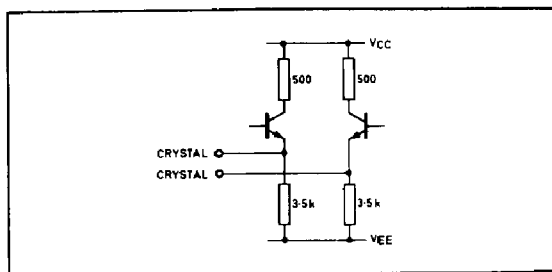


Fig. 15 Crystal oscillator inputs

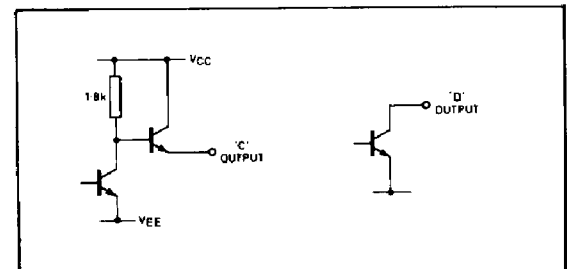


Fig. 16 Phase/frequency comparator outputs

## FURTHER APPLICATIONS

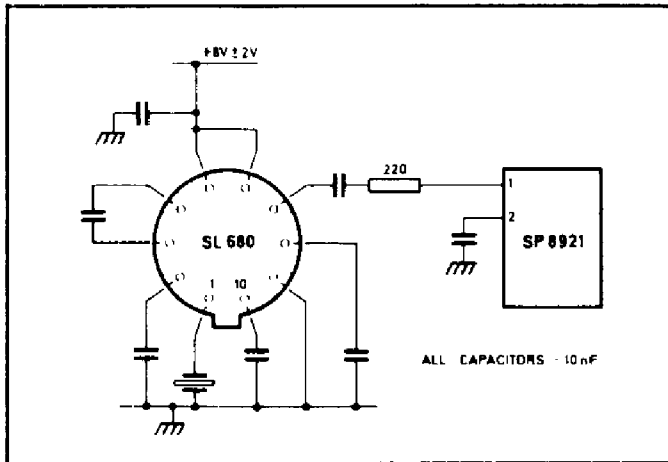


Fig. 17 High stability crystal reference oscillator using SL680

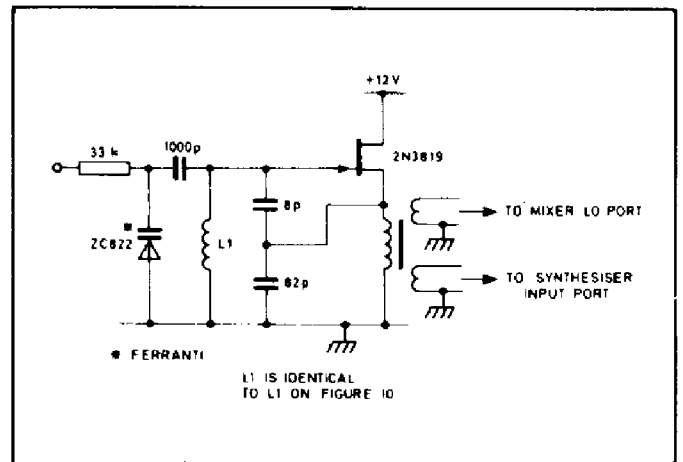


Fig. 18 Voltage controlled oscillator for 27MHz CB synthesiser

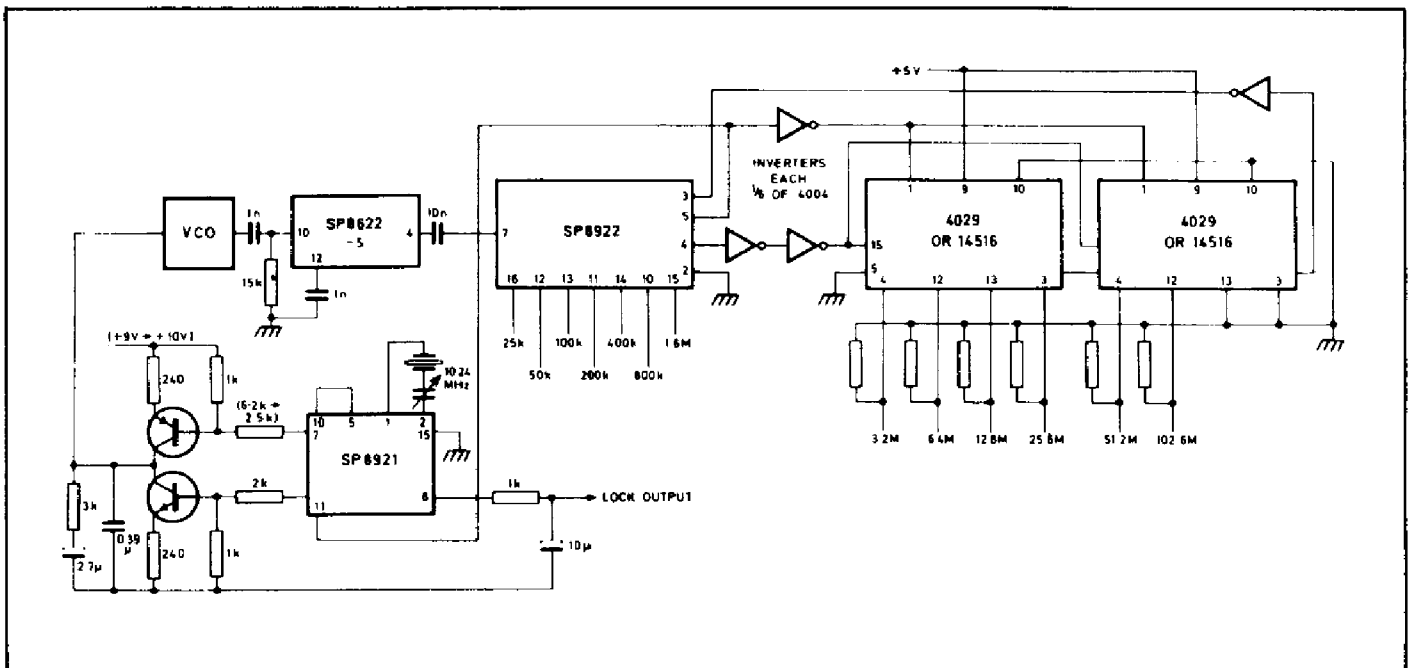


Fig. 19 200 MHz general purpose binary programmed synthesiser with 25KHz resolution using SP8921/22