For applications where a compact, low-power, stable frequency source is required, Hy-Q offers a comprehensive range of quartz crystal oscillators. Here, the quartz crystal and the whole resonant circuit are packaged in a single can. In addition to many customized 'specials' we manufacture four types of oscillator:

- the SPXO (simple packaged crystal oscillator)
- the TCXO (temperature-compensated crystal oscillator)
- the VCXO (voltage-controlled crystal oscillator)
- the TCVCXO (temperature-compensated VCXO).

A variety of package sizes, voltage ratings and output stage configurations are available, together with a wide range of frequency stability and operating temperature. Current consumption ranges from 1.5 to 15 mA depending on frequency and output stage configuration.
Where particular requirements can't be met from within the product range, Hy-Q's development engineers can tailor a design to the customer's exact specification. By using sophisticated computer-aided design techniques, such customized designs can be produced within weeks of the initial enquiry.

The SPXO

The SPXO provides a low-cost, compact frequency source whose frequency stability is essentially determined by the quartz crystal itself. It comes in a standard 8- or 14-pin DIL package (only 4 pins are fitted) or in other packages on customer request. SPXOs are mainly used as clock generators in digital circuits, particularly for cordless telephones.

The TCXO

In the SPXO the frequency stability with respect to temperature is essentially determined by the quality of the crystal. Therefore, for a given range, there is a limit to the stability that can be achieved. In fact, over a temperature range of 0 to 60 °C, it's difficult to achieve tolerances tighter than ±5 ppm. In the past, this problem was overcome by putting the oscillator in a small oven. The TCXO, however, offers a compact solution to the problem of stability. In a TCXO the load capacitance of the oscillator crystal is varied with temperature in such a way that the resultant oscillator frequency remains almost constant. As Fig. 7 shows, stabilities of ±1 ppm over the temperature range −20 to +70 °C are relatively easy to maintain. What's more, unlike the oven-controlled oscillator, the TCXO offers instant start-up and consumes very low power.

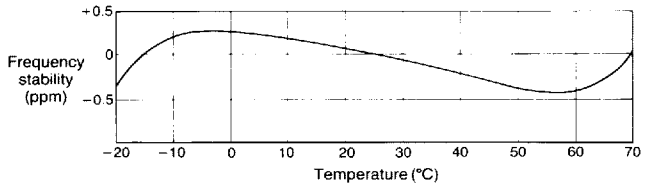


Fig. 7 Typical frequency stability versus temperature characteristic for a TXCO

TCXOs are available with the following output stage configurations: sine-wave, open-collector TTL, TTL-compatible, CMOS-compatible and HCMOS-compatible. They're mainly used in portable measuring and communications equipment such as timer/counters, mobile radios and carphones.

The VCXO

The VCXO includes a varactor diode as part of the oscillator crystal's load capacitance. An external control voltage is used to vary the bias on the diode and thus the load capacitance of the crystal. By careful design of the oscillator circuit, an essentially linear frequency/voltage characteristic (Fig. 8) can be obtained. Typically, for a control voltage range of 0 to 5 V, the frequency excursion may be up to 200 ppm with a standard linearity of better than 10% (3% available). VCXOs are available with TTL, CMOS and HCMOS-compatible output stage configurations. They're mainly used in sweep-generators, FM modulators and for noise-free recovery of PCM signals in phase-locked loop (PLL) systems for digital telephone switching networks.

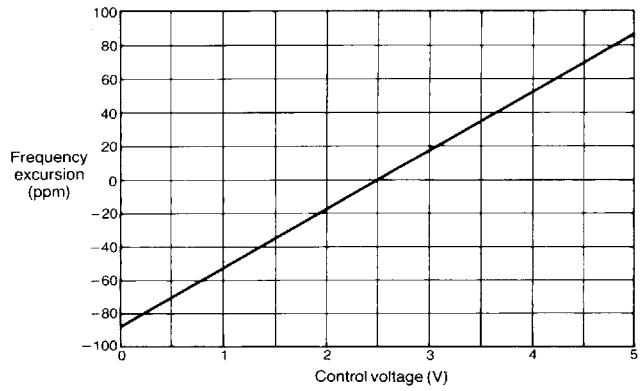


Fig. 8 Typical frequency excursion versus control voltage characteristic for a VCXO

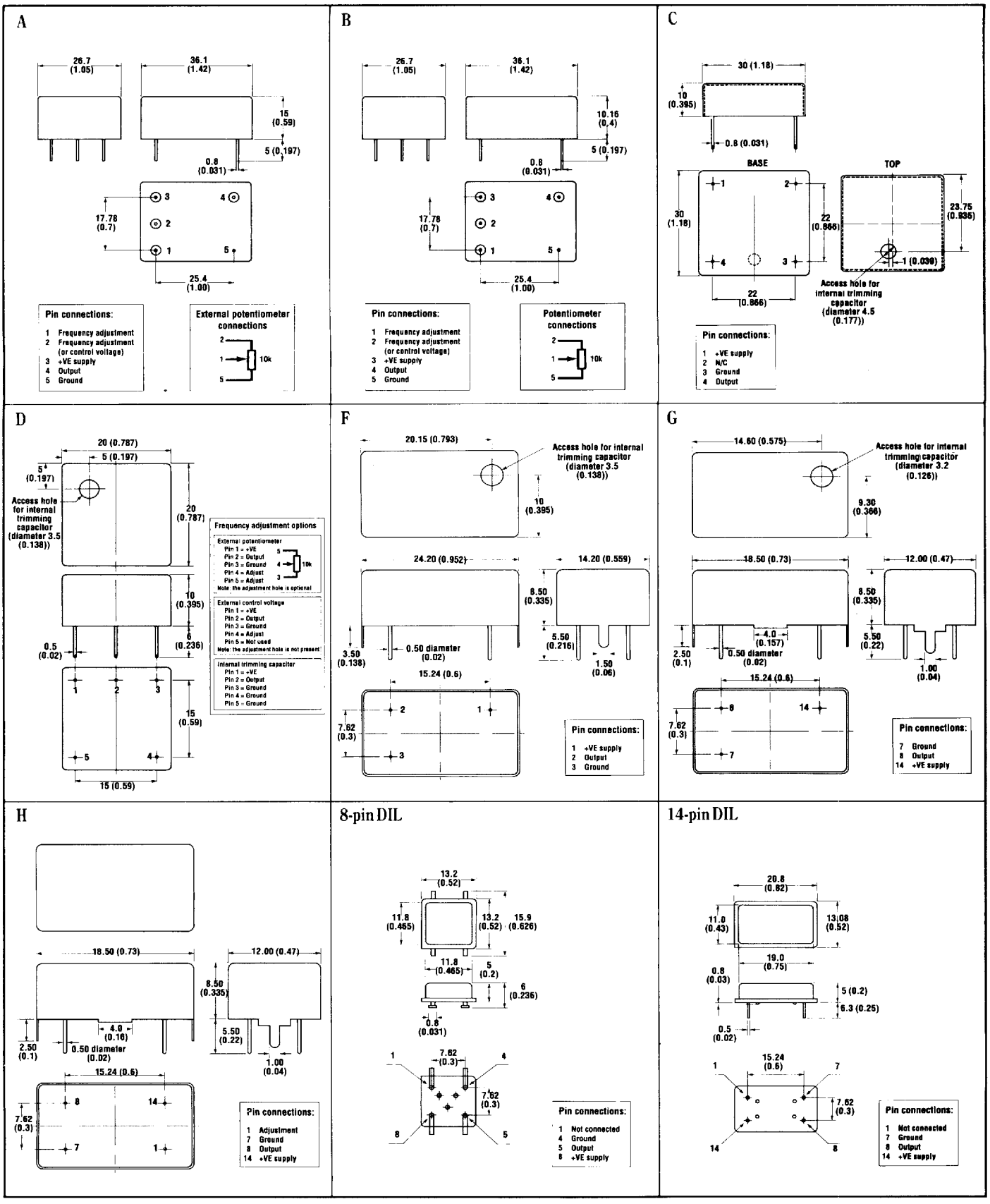
The TCVCXO

For VCXO applications where high stability is required over a range of temperature, the TCVCXO is the ideal solution. It's available with sine-wave, open-collector TTL, TTL-compatible, CMOS-compatible and HCMOS-compatible output configurations.

Package styles

Nine standard package styles (Fig. 9) are available, in addition to numerous custom configurations.

Fig. 9 Oscillator standard package styles. Nominal dimensions are in mm (with inches in brackets).



Data

Table 4 gives the standard range of oscillators available.

Table 4 The range of oscillators

oscillator type	package style[1]	frequency range (MHz)	operating temperature range (°C)
SPXO	8- or 14-pin DIL[2]	0.25 to 70	−20 to +70
TCXO	A,B	4 to 40	−40 to +85[3]
	C	0.0025 to 40	−40 to +85[4]
	D	4 to 40	−30 to +75[3]
			−40 to +85[4]
	F	4 to 40	−30 to +75[4]
	G	8 to 20	−30 to +75[4]
VCXO	H[2]	4 to 25	−40 to +85
	DIL	8 to 25	−40 to +85
TCVCXO	A,B	4 to 40	−40 to +85[5]
	D	4 to 40	−30 to +75[5]
	H	10 to 20	−40 to +85[5]

1) package styles C, H and DIL are only available with TTL, CMOS and HCMOS-compatible outputs
2) other package styles available on request
3) with control voltage or external potentiometer adjustment
4) with internal trimming capacitor adjustment
5) depends on required adjustment sensitivity.

How to order Hy-Q oscillators

The *minimum* information required when ordering an oscillator is:

- nominal frequency (MHz)
- maximum allowable current consumption
- 4-column ordering code (see below) or other specification
- for VCXOs and TCVCXOs:
  - minimum frequency adjustment (pulling) over the control voltage (0 to 5 V) range
  - required linearity (if < 10%).

The 4-column ordering code for oscillators

To enable Hy-Q customers to specify oscillators in a concise format, we've developed a 4-column ordering code (Table 5):

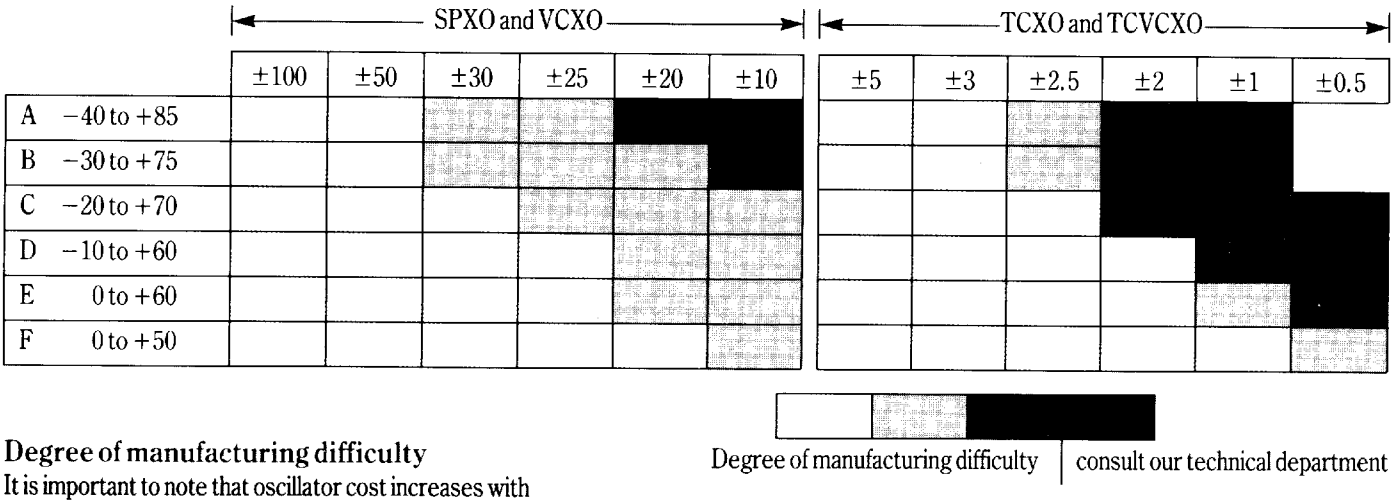
The first column is a single letter specifying the package style (see Fig. 9).

The second column is a 2-digit code specifying the supply voltage.

The third column consists of three letters, specifying the method of adjustment, the output stage configuration, and the operating temperature range respectively.

The fourth column consists of up to 3 digits, specifying the frequency stability (in ppm) numerically (e.g. 0.5 = ±0.5ppm, 100 = ±100ppm).

Fig. 10 Available temperature/frequency stability combinations for oscillators



Degree of manufacturing difficulty

It is important to note that oscillator cost increases with manufacturing difficulty. As Fig. 10 shows, the degree of manufacturing difficulty increases rapidly as requirements on operating temperature range (third letter of third column) and frequency stability (fourth column) are tightened.

Table 5 Explanation of the 4-column ordering code for oscillators

first column (package style) see Fig. 9	second column (supply voltage in V)	third column			fourth column (frequency stability in ± ppm)
		first letter[1] (method of adjustment)	second letter (output stage configuration)	third letter (operating temperature range in °C)	
A	05	P external potentiometer	S sinewave[2] (1 V p-p into 1 kΩ//12pF)	A −40 to +85	0.5
B	09	V external control voltage	O open-collector TTL[2]	B −30 to +75	1
C	10	I internal trimmer	T TTL-compatible	C −20 to +70	2
D	12	N none	C CMOS-compatible	D −10 to +60	2.5
F	15		H HCMOS-compatible	E 0 to +60	3
G				F 0 to +50	5
H					10
*					20
					25
					30
					50
					100

1) standard adjustment range is ±5 ppm
2) TCXO and TCVCXO only.
* 8-pin and 14-pin DIL-packaged oscillators can be supplied with operating temperature range −10 to +70°C and frequency stability 25, 50 or 100 ppm.

Example:
An oscillator ordered as A-05-PSC-2.5 means:

- package style A (see Fig. 9)
- supply voltage 5 V
- external potentiometer adjustment
- sinewave output stage
- operating temperature range −20 to +70 °C
- frequency stability ±2.5 ppm over the operating temperature range.