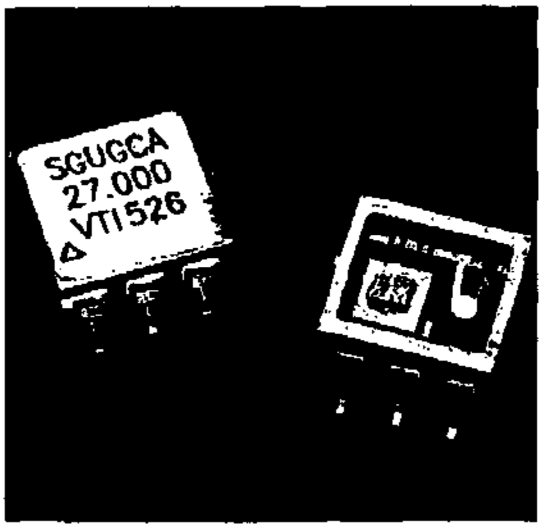
VECTRON TECHNOLOGIES INCORPORATED

Data Sheet
February 1996

S-Type
Fixed and Voltage Controlled Crystal Oscillator



The S-Type Oscillator

Features

- VCXO or fixed frequency
- Surface mountable
- Small, 6-pin DIP, J-Lead Compatible
- Laser stamping
- Choice of lead configurations
- Machine insertable
- Stability to 50 ppm
- Frequencies to 52 MHz
- TTL or CMOS selectable
- 3-state output
- Phase jitter <200 ps
- Choice of temperature ranges
- High reliability
- Tape and reel packaging

Description

The S-Type Crystal Oscillators are quartz-stabilized, TTL or CMOS selectable, square-wave generators. They are packaged in low-profile, hermetic ceramic, 6-pin DIPs. Long-term reliability exceeds 20-million hours mean time between failure (MTBF).

Pin Information

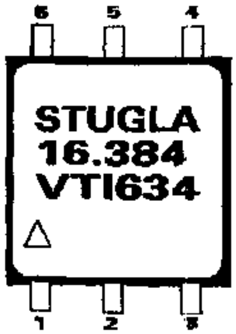


Figure 1. Pin Diagram

Table 1. Pin Descriptions

Pin #	Symbol	Name/Function
1	VC or NC	VCXO: Control Voltage to modulate frequency. Fixed Frequency Oscillator: Do not use Pin 1.
2	Tri-state	TTL logic low disables output. TTL logic high or no connection enables output frequency.
3	GND	Circuit and package ground.
4	Output	Output waveform.
5	TTL/CMOS	*TTL logic low provides waveform symmetry for CMOS. TTL logic high or no connection provides waveform symmetry for TTL.
6	V_{DD}	Supply Voltage, 5 V ±10%.

* This silicon oscillator is fabricated in CMOS technology and its output waveform will swing between ground and VDD for all but the highest frequency applications. To account for the difference in switching thresholds between TTL logic (1.40 V) and CMOS logic (VDD/2), the TTL/CMOS lead modifies the "on time" of the oscillator for maximum symmetry about the TTL or CMOS logic threshold. TTL logic low provides waveform symmetry for CMOS. TTL logic high or no connection provides waveform symmetry for TTL. At output frequencies less than 12 MHz, this option is not provided as the waveform transition times are small compared to the period. Hence, for fo < 12 MHz, this pin should be grounded for electrical isolation.

Handling Precautions

Although protection circuitry has been designed into this device, proper precautions should be taken to avoid exposure to electrostatic discharge (ESD) during handling and mounting. VTI employs a human-body model (HBM) and a charged-device model (CDM) for ESD-susceptibility testing and protection design evaluation. ESD voltage thresholds are dependent on the circuit parameters used to define the mode. Although no industry-wide standard has been adopted for the CDM, a standard HBM (resistance = 1500Ω, capacitance = 100 pF) is widely used and therefore can be used for comparison purposes. The HBM ESD threshold presented here was obtained by using these circuit parameters.

Table 2. ESD Threshold Voltage

Model	ESD Threshold, Minimum	Unit
Human Body	1500*	V
Charged Device	1500	V

* MIL-STD-883D, Method 3015, Class 1

Electrical Specifications

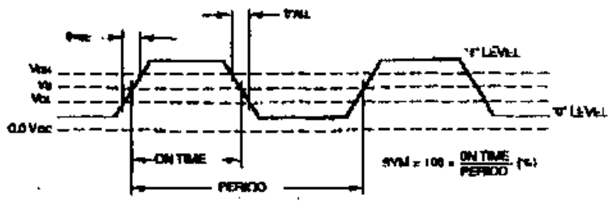
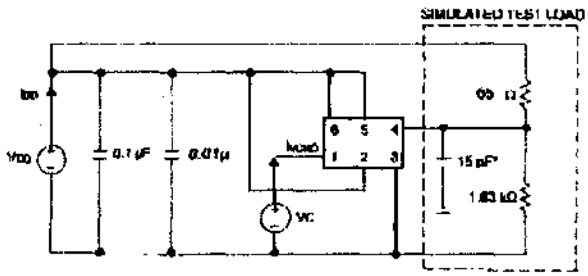


Figure 2. Output Waveform



* Includes probe and test jig capacitance.

Figure 3. Output Test Conditions
(TAmb = 25 ±5 ° C)

Table 2. General Electrical Specifications

WARNING: Unit will be severely damaged if placed in backwards.

Parameter	Symbol	Min	Max	Unit
Supply Voltage[1]	V_{DD}	4.5	5.5	V
Supply Current (Frequency Dependent)	I_{DD}	See Figure 9		mA
Output Voltage Levels (VDD = 4.5 V):				
Output Logic High[2]	V_{OH}	4.00	-	V
Output Logic Low[2]	V_{OL}	-	0.50	V
Transition Times[2]:				
Rise Time	t_R	1.0	5.0	ns
Fall Time	t_F	1.0	5.0	ns
Symmetry or Duty Cycle[3]	SYM	See Figures 14		%
Nominal Output Frequency	f_0	183 Hz	52 MHz	MHz
Frequency Tolerance (Fixed Frequency Only)[4]	FT	See Table 1		ppm

1 A 0.1 µF low frequency tantalum bypass capacitor that is parallel with a 0.01 µF high-frequency ceramic capacitor is recommended.
2 Figure 2 defines these parameters. Figure 3 illustrates the equivalent five-gate MTTL load and operating conditions under which these parameters are specified and tested.
3 Symmetry is the ON TIME/PERIOD with VS = 1.4 V for TTL or VS = 2.5 V for CMOS, per Figure 2.
4 Frequency tolerance is the maximum frequency deviation, in ppm, from the specified output frequency, fo, including variations due to temperature, power supply, load, and aging over 20 years.

Table 3. VCXO Specifications

Parameter	Symbol	Minimum	Maximum	Unit
Control Voltage	V_C	0.0	V_{DD}	V
Center Voltage*	V_O	2.5 ± 0.5 Typical		V
Leakage Current of Control Input	Ivcxo	-1.0	1.0	µA
Control Voltage Bandwidth (-3 dB, Vc=2.50 V)	BW	5	-	kHZ
Sensitivity @ $V_C = V_O$	Δf/ΔVC	See Figures 12, 13		ppm/V

* V_O is the control voltage at which the output frequency, f, is equal to the nominal frequency fo at 25 ±5 ° C ambient temperature. V_O is set during tuning so that the VCXO works in the center of its characteristic curve and is typically near 2.5 V, but may vary depending on temperature, aging, power supply, load, and process variations.

Characteristic Curves

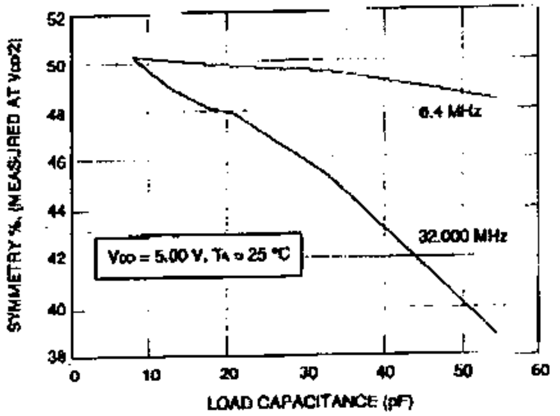


Figure 4. Waveform Symmetry vs. Load Capacitance

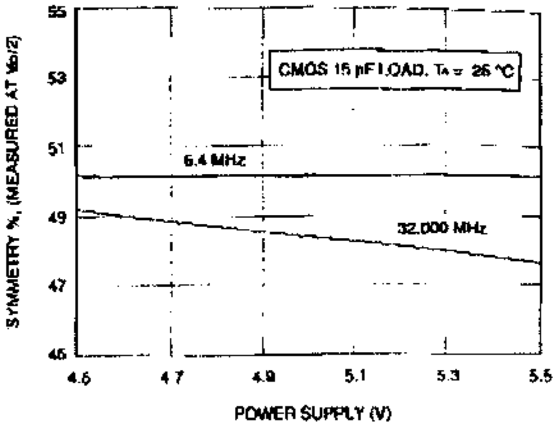


Figure 5. Variation of Duty Cycle with Supply Voltage

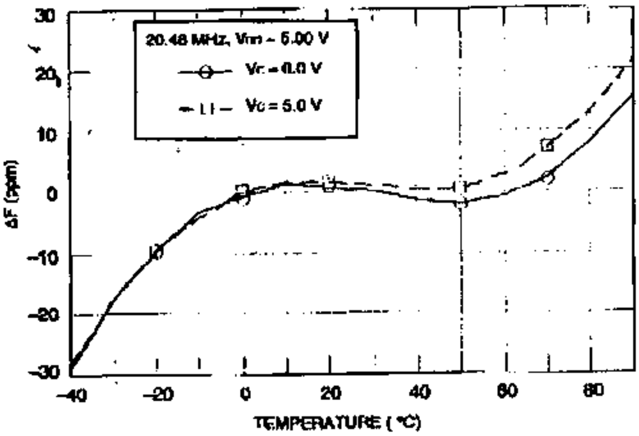


Figure 6. Typical Frequency vs. Temperature

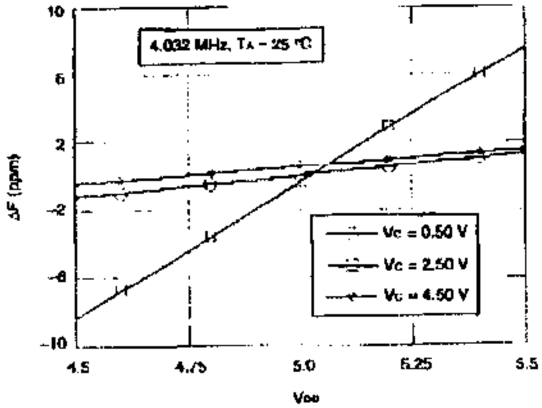


Figure 7. Output Frequency vs. Power Supply Voltage

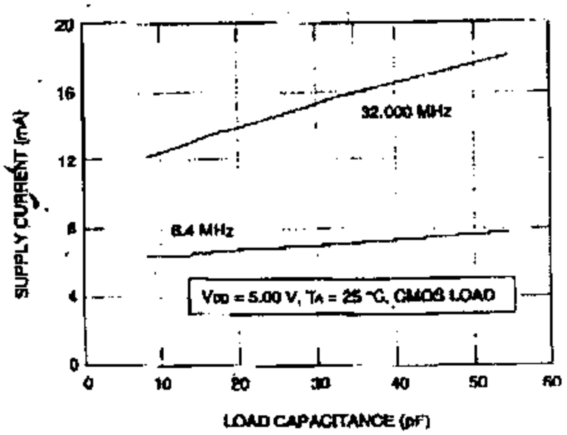


Figure 8. Variation of Supply Current with Capacitive Load

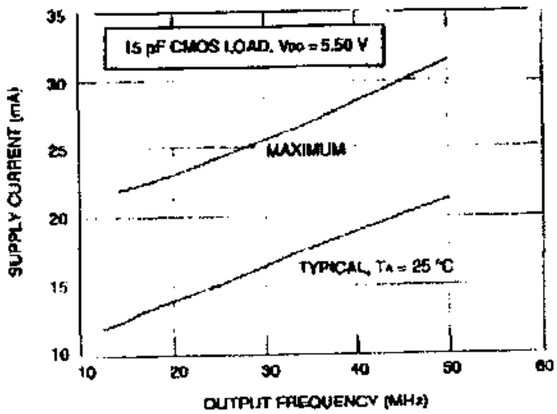


Figure 9. Supply Current vs. Output Frequency

Characteristic Curves (continued)

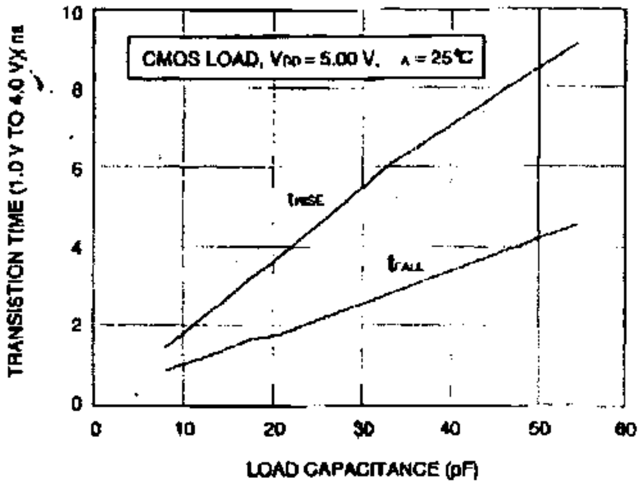


Figure 10. Waveform Transition Times vs. Load Capacitance

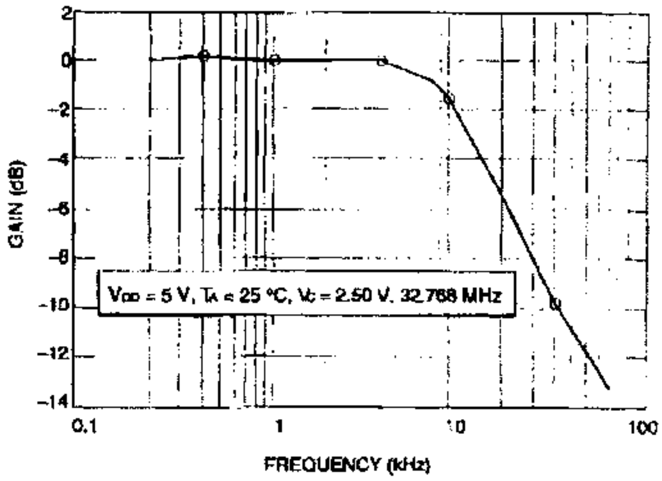


Figure 11. VCXO Input Frequency Response

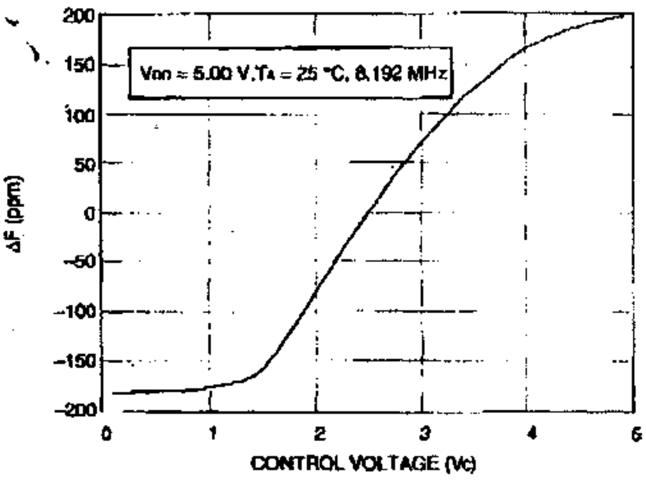


Figure 12. Output Frequency vs. Control Voltage

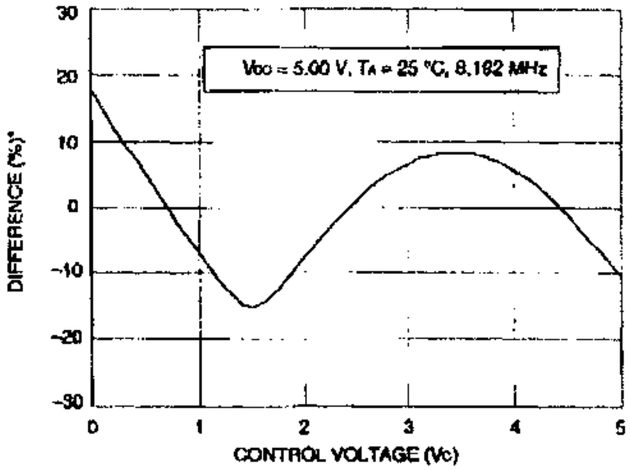


Figure 13. VCXO Linearity (Deviation From Best Linear Fit)

Absolute Pull Range (APR)

Parameter	Symbol	Min	Max	Unit
Absolute Frequency Pull Range:	APR			ppm from fo
Control Voltage, VC = 0.50 V	-	-APR	-	ppm from fo
Control Voltage, VC= 4.50 V	-	+APR	-	ppm from fo

Absolute pull range (APR) is specified by the fourth character of the product code (see Figure 14). The APR is the minimum guaranteed frequency shift from fo over variations in temperature, aging, power supply, and load. Both frequency and environment limit the specified APR.

With VC between 0.5 V and 4.5 V, total pull range for the S-Type VCXO is typically between 200 ppm and 400 ppm. A 50 ppm APR VCXO fully tracks a 50 ppm source oscillator or any other 50 ppm reference over all specified environmental conditions.

Mechanical Characteristics

Mechanical and Environmental

Mechanical Shock: .... MIL-STD-883C 2002.3 Test B
Mechanical Vibration: .... MIL-STD-883C 2007.1 Test C
Solderability: MIL-STD-883C 2003.5
Gross Leak Test: MIL-STD-883C 1014.7
Fine Leak Test: MIL-STD-883C 1014.7
Storage Temperature: .... -55 ° C to 125 ° C

Oscillator Aging

Quartz-based oscillators exhibit a change in output frequency with time. Two dominant mechanisms for this phenomena are: changes in the stresses on the quartz resonator and mass-loading of the quartz resonator.

Changes in output frequency due to stress are a result of relaxation in the mounting stresses of the quartz resonator or transmittal of environmental stresses through the mounting arrangement. The S-Type oscillator contains a state-of-the-art miniature rectangular AT-Cut resonator, rather than the traditional round resonator which allows for a mounting arrangement that has very little stress relaxation and isolates the quartz resonator from external stresses.

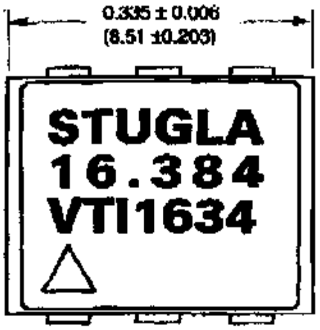
Mass-loading of the quartz resonator, which generally drives the frequency lower, is a result of outgassing of materials within a package or a lack of package hermeticity. Higher frequency resonators are more susceptible to this aging mechanism. The S-Type oscillator contains a minimum number of parts internal to the package, a monolithic IC and a quartz resonator, resulting in an internal environment that is well controlled and characterized.

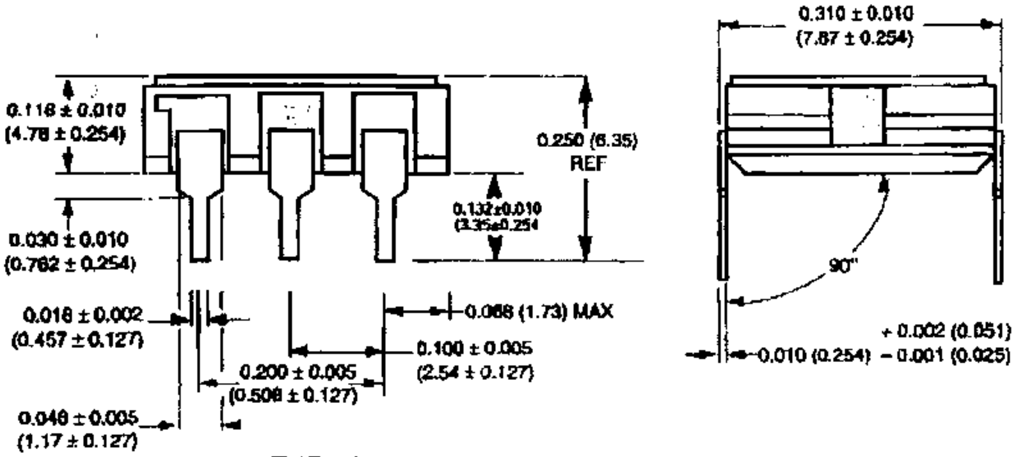
With an application of 40°C and under normal conditions, the oscillator aging is typically 2ppm the first year, 1 ppm the second year, and continues to logarithmicaly decline every year thereafter.

Outline Diagrams

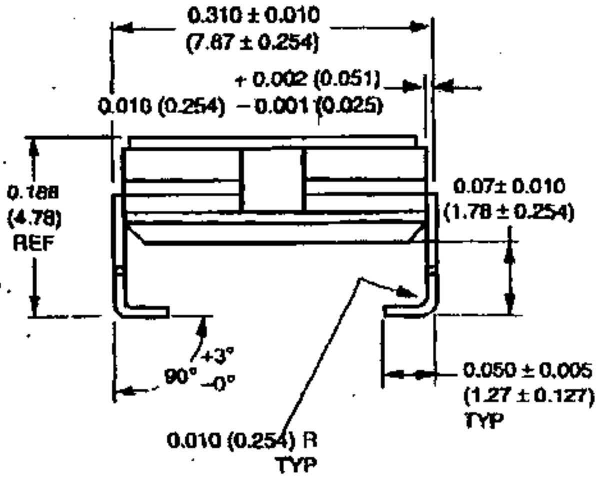
6-Pin, Ceramic DIP

Dimensions are in inches and (millimeters).





THRU HOLE MOUNTING



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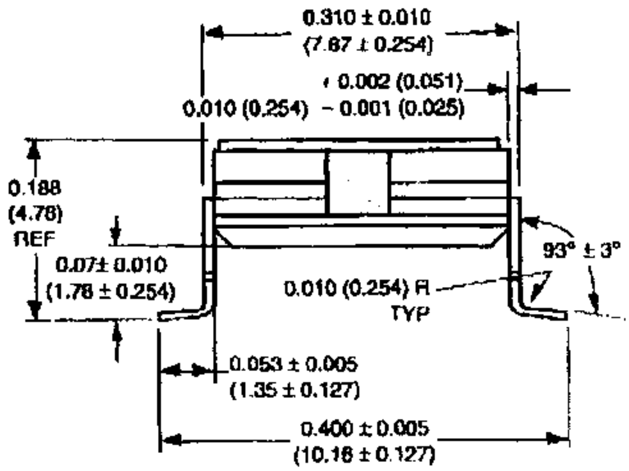

GULL LEAD

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Standard Frequencies* (MHz)

1.024	1.544	2.048	3.088	3.580	3.6864
4.000	4.032	4.096	4.4336	5.000	5.760
6.144	6.176	6.312	6.400	7.3728	8.000
8.064	8.192	8.448	9.216	10.000	10.066
10.700	11.000	11.059	11.360	12.000	12.288
12.352	12.500	12.620	12.960	13.000	13.500
14.318	14.745	15.000	15.360	15.552	16.000
16.384	16.500	16.670	17.734	18.432	19.440
20.000	20.480	21.477	24.000	24.064	24.576
24.704	24.883	25.000	25.175	25.226	25.600
25.920	26.666	27.000	27.120	28.000	28.322
30.000	30.072	30.880	32.000	32.768	33.000
33.333	34.368	34.695	35.250	35.280	35.468
35.760	36.000	36.684	37.632	38.880	40.000
44.400	44.736	46.320	47.852	48.000	50.000
51.840	52.000				

* Other frequencies available upon request.

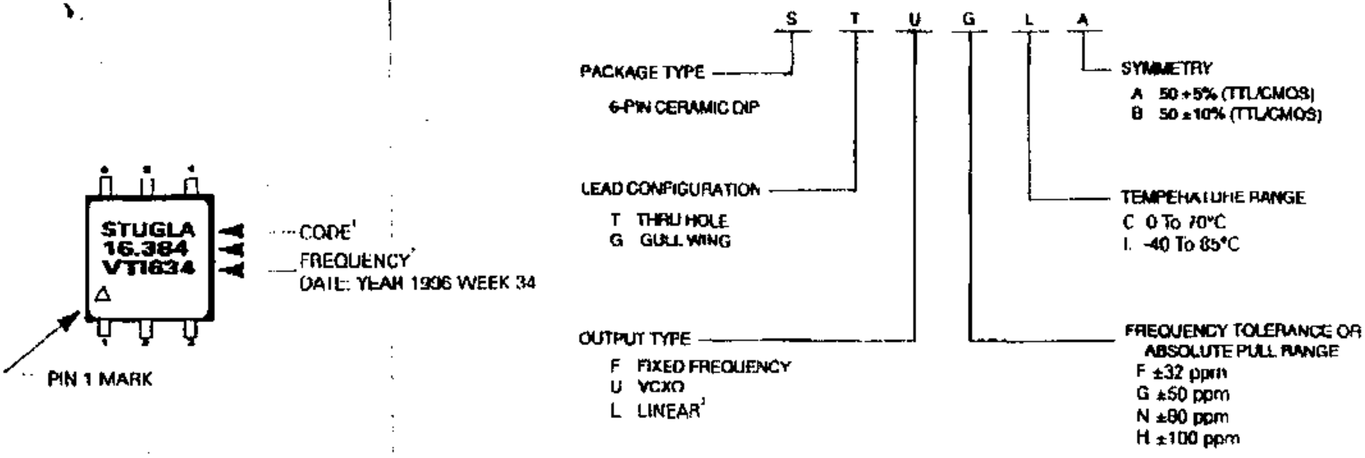

Figure 4. Part Numbering Information

1 Not all combinations are possible. Other specifications may be available upon request.
2 Frequency: in MHZ with decimal point, in HZ if no decimal is present.
3 10% linearity, ±25PPM stability at Vc=2.5V, available in limited frequencies.

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