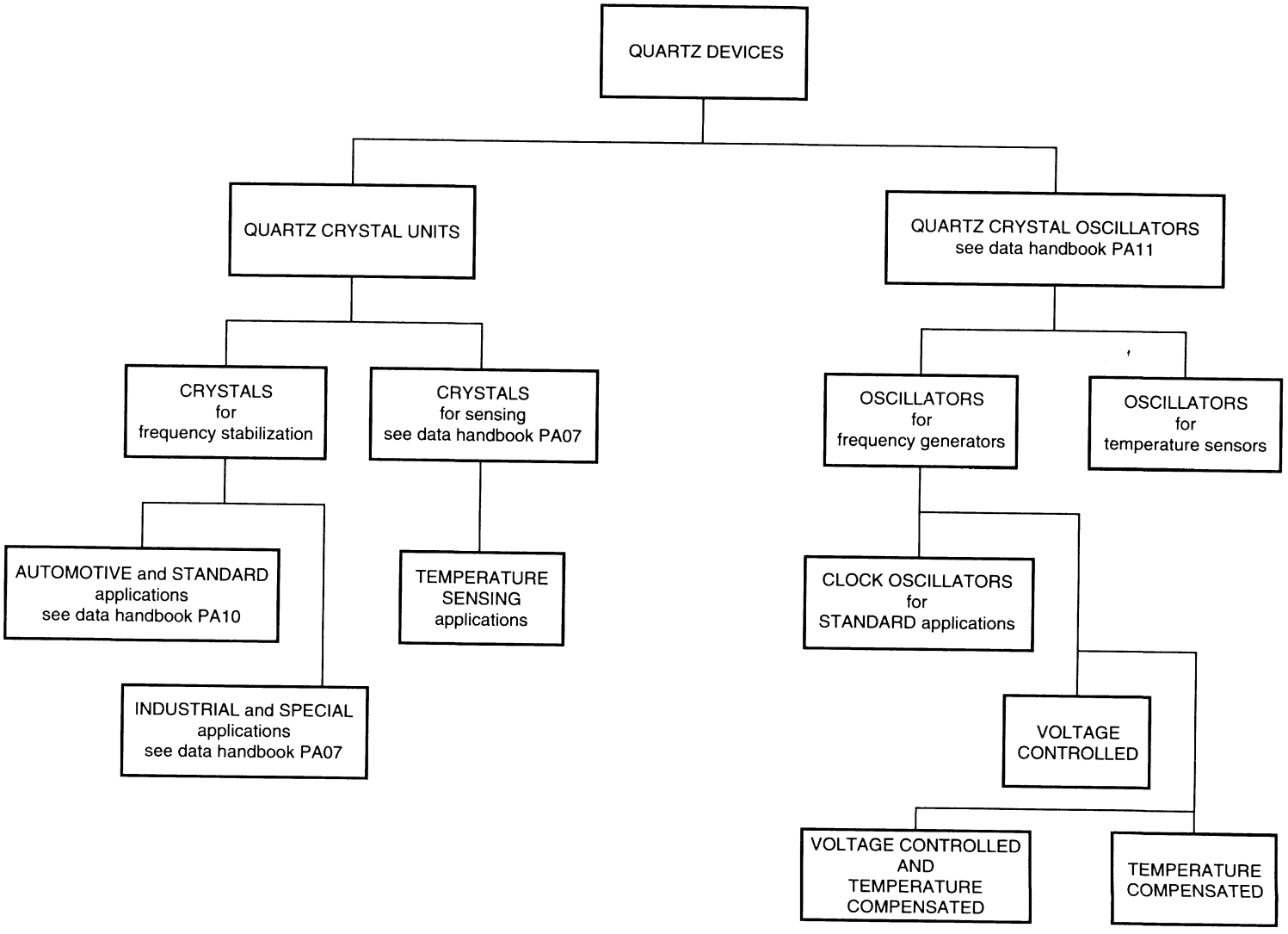
DATA HANDBOOK

Quartz Oscillators

BOOK PA1 1 1993

Philips Components

PHILIPS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Quartz Oscillators

Contents

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

GENERAL INTRODUCTION

SURVEY OF TYPES

TYPE	NOMINAL FREQUENCY (kHz)	TEMPERATURE RANGE (°C)	SUPPLY VOLTAGE (V)
XO	1000 to 70 000	0 to +70	5 ±10%
XOHC	1000 to 50 000	0 to +70	5 ±10%
VCXO	1000 to 40 000	–5 to +70	5 ±5%
TCXO	4000 to 50 000	–40 to +85	5 or 12
VTCXO	8000 to 20 000	–30 to +80	5 ±10%
CTCXO	8000 to 16 000	0 to +55	5 ±5% or 3.2 ±5%
DTCXO	4000 to 15 000	–40 to +85	5 ±5%
TSO	0.250 to 750	–40 to +85	5 ±10%

INTRODUCTION

For practical reasons, technical information on piezo-electric quartz devices is divided into three handbooks which have the following titles:

PA07 - Quartz crystals for special and industrial applications

PA10 - Quartz crystals for automotive and standard applications

PA11 - Quartz oscillators

The quartz crystal controlled oscillators consist in general of a quartz crystal and an oscillator circuit, packaged together in a hermetically sealed encapsulation. When connected to an appropriate supply voltage, the oscillator produces an output signal with a certain waveform and frequency. For applications where a high frequency stability is required, a temperature compensating network is added to the oscillator circuit which reduces the original temperature drift of the quartz crystal unit with a factor of 20 to 60. The range of quartz controlled oscillators comprise the following main groups.

Quartz crystal clock oscillator (XO)

The XO's and XOHC's are small oscillators in a DIL14/4 encapsulation without temperature compensation. The output characteristic is designed for TTL and HCMOS - level applications with symmetric waveform. Microcontroller and logic circuitry are typical applications for XO's and XOHC's.

Voltage controlled quartz crystal oscillators (VCXO)

A VCXO is a crystal oscillator the frequency of which can be changed by means of a control voltage. The relation between frequency and control voltage approaches a straight line. They feature LS-TTL and HCMOS output compatibility. VCXO's are especially suitable for phase-locked-loop applications, as used in ISDN multiplex equipment.

Temperature compensated quartz crystal oscillators (TCXO)

In the TCXO's an analog circuit is incorporated which compensates the temperature influence on the frequency stability of the oscillator. TCXOs are available with stability figures of ±1 to ±3 $x10^{-6}$ (ppm). This type of oscillator is used in measuring and communication equipment.

Voltage controlled and temperature compensated quartz crystal oscillators (VTCXO)

These oscillators can be tuned electrically by means of a DC voltage, or can be modulated by an AC voltage while the circuit is electronically temperature compensated. Extremely suitable in portable telephone applications.

Temperature compensated quartz crystal oscillators for Cordless Telephones (CTCXO)

The CTCXO's are small reference oscillators in DIL14/3 encapsulation. They have been developed especially for cordless telephones and have a stability of ±2.5 x 10^{-6} (ppm).

Digitally temperature compensated quartz crystal oscillators (DTCXO)

The DTCXO is the latest development in temperature compensated crystal oscillator design. Temperature compensation is carried out by means of a digital

SUPPLY CURRENT (mA)	FREQUENCY STABILITY ($x10^{-6}$)	ADJUSTMENT FACILITY	OUTPUT COMPATIBILITY
30 to 50	±100	none	TTL
4 to 25	±100	none	HCMOS
6 to 12.5	±20	control voltage	HCMOS
4 to 15	±1	external variable capacitor or resistor	sinewave semi-TTL or HCMOS
2.5	±1.5	control voltage	clipped sinewave
1.5	±2.5	internal trimmer	clipped sinewave
15	±0.5	external variable resistor	HCMOS
2.5	not applicable	none	HCMOS

circuit and is based upon the following principle.

A memory chip contains a table with temperature correction data for both crystal and oscillator over the quartz crystal temperature range, –40 to +85 °C for example. The memory is adressed by a digital (quartz) thermometer, so that at each temperature within this range, a particular memory cell contains the specific correction factor to keep the output frequency within very close tolerances. Oscillators of this type show a frequency stability of $< \pm 0.5 \times 10^{-6}$ (ppm) in the temperature range of –40 to +85 °C. DTCXO's are used in high-professional equipment especially where high frequency stability combined with low power consumption, small dimensions and no warming-up time is required.

Temperature sensing quartz crystal oscillators (TSO)

In the TSO the frequency is a function of the temperature. For this oscillator a special crystal cut is used with a high sensitivity for temperature changes. The temperature information is available in a digital format and no Analog to Digital Conversion is needed. The TSO's are used as temperature sensing devices in measurement and industrial equipment. For example, the correction of measurement-errors caused by ambient temperature changes.

TERMS AND CONDITIONS

Nominal frequency (f_{nom})

The frequency assigned to the oscillator when operated under specified conditions.

Frequency offset ($\Delta f/f$)

The frequency difference, positive or negative, which should be added to the specified nominal frequency of the oscillator when adjusting the oscillator frequency at +25 °C, in order to minimize it's deviation from nominal frequency over the specified operating temperature.

Frequency tuning range ($\Delta f/f$)

Frequency tuning range is the range over which the oscillator frequency may be varied by means of an external resistor or capacitor for the purpose of:

Setting the frequency to a particular value in order to give a frequency offset.

Correcting the oscillator frequency after deviation due to ageing or other changed conditions.

Operating temperature range (T_{op})

The temperature range over which the oscillator shall function, maintaining frequency and other output signal attributes within specified tolerances.

Operable temperature range (T_o)

The temperature range over which the oscillator shall continue to provide an output signal, though not within the specified tolerances of frequency, level, waveform and other parameters.

Storage temperature range (T_{stg})

The temperature range within the (non-operating) oscillator may be stored for a prolonged time without any damage.

Frequency ageing ($\Delta f/f$)

The relationship between oscillator frequency and time. This long-term frequency drift is caused by secular changes in the quartz crystal and/or other elements of the oscillator circuit, and is expressed as fractional change in mean frequency per specified time interval (e.g. $\pm 1 \times 10^{-6}$ (ppm) per year).

Table 1 Crystal clock oscillators **(XO)** - Type selection

TYPE	NOMINAL FREQUENCY (kHz)	TEMPERATURE RANGE (°C)	SUPPLY VOLTAGE (V)
XO	1000 to 70 000	0 to +70	5
XOHC	1000 to 50 000	0 to +70	5

Table 2 Voltage controlled crystal oscillators **(VCXO)** - Type selection

TYPE	FREQUENCY RANGE (kHz)	TEMPERATURE RANGE (°C)	SUPPLY VOLTAGE (V)
VCO2	7000 to 23 000	–5 to +60	5 ±5
VCO3	1000 to 10 000	–5 to +55	5 ±5
VCO4	7000 to 17 000	0 to +70	5 ±5
VCO5	17 000 to 40 000	0 to +70	5 ±5
VCO6	7000 to 17 000	0 to +60	5 ±5

Table 3 Temperature compensated crystal oscillator **(TCXO)** - Type selection

TYPE	PACKAGE	FREQUENCY RANGE (kHz)	SUPPLY VOLTAGE (V)
TC201	B2	4000 to 20 000	5 to 12
TC202	B2	4000 to 20 000	5
TC301	B3	4500 to 15 000	12
TC302	B3	4500 to 12000	12
TC303	B3	4000 to 20 000	12
TC304	B3	4000 to 20 000	12
TC305	B3	20 000 to 50 000	12
TC501	B5	6000 to 20 000	5
TC502	B5	6000 to 20 000	5
TC601	B6	6000 to 20 000	5
TC602	B6	6000 to 20 000	5

SUPPLY CURRENT (mA)	FREQUENCY STABILITY ($x10^{-6}$)	MAXIMUM HEIGHT OVER PCB (mm)	OUTPUT COMPATIBILITY	PAGE
30 to 50	±100	6.5	TTL	12
4 to 25	±100	6.5	HCMOS	20

SUPPLY CURRENT (mA)	CONTROL VOLTAGE (V)	FREQUENCY STABILITY ($x10^{-6}$)	MAXIMUM HEIGHT OVER PCB (mm)	OUTPUT COMPATIBILITY	PAGE
6	–5 to +5	±20	7.3	HCMOS	28
4	–4 to +4	±20	7.3	HCMOS	35
6	0.5 to 4.5	±25	7.3	HCMOS	42
12.5	0.5 to 4.5	±20	7.3/10.9	HCMOS	49
9	1.0 to 4.0	±10	10.9	HCMOS	56

TEMPERATURE RANGE (°C)	FREQUENCY STABILITY ($x10^{-6}$)	ADJUSTMENT FACILITY	OUTPUT COMPATIBILITY	PAGE
–40 to +85	±1.0	variable R	sinewave	60
–40 to +85	±1.0	variable R	semi TTL	64
–20 to +70	±2.0	variable C	sinewave	68
–20 to +70	±2	variable R	sinewave	73
–40 to +85	±1	variable C	sinewave	78
–40 to +85	±1	variable R	sinewave	82
–20 to +70	±2	variable C	sinewave	86
–40 to +85	±1.0	variable R	sinewave	91
–40 to +85	±1.0	variable R	semi TTL	95
–20 to +70	±1.0	variable R	sinewave	99
–20 to +70	±1.0	variable R	semi TTL	103

Table 4 Voltage controlled temperature compensated crystal oscillator **(VTCXO)** - Type selection

TYPE	PACKAGE	FREQUENCY RANGE (kHz)	SUPPLY VOLTAGE (V)
VTCO1	B8	8000 to 20 000	5
VTCO2	B8	8000 to 20 000	5
VTCO3	B8	8000 to 20 000	5
VTCO4	B8	8000 to 20 000	5

Table 5 Temperature compensated crystal clock oscillator **(CTCXO)** - Type selection

TYPE	FREQUENCY RANGE (kHz)	TEMPERATURE RANGE (°C)	SUPPLY VOLTAGE (V)
CTCXO	8000 to 16 000	0 to +55	3 to 5

SUPPLY CURRENT (mA)	FREQ. DEVIATION x10^{-6} IN THE TEMP. RANGE −30/+80 °C	FREQ. DEVIATION vs V_{CC} CHANGES 5 V ±5% (x10^{-6})	FREQ. MODULATION	PAGE
3 max.	±1.5	±0.2	±4.0	107
3 max.	±2.5	±0.2	±7.0	107
3 max.	±4.0	±0.3	±19.0	107
3 max.	±8.2	±0.3	±38.0	107

SUPPLY CURRENT (mA)	FREQUENCY STABILITY	MAXIMUM HEIGHT OVER PCB (mm)	OUTPUT COMPATIBLITY	PAGE
1.5 max.	±2.5 x 10^{-6}	7.6 max.	clipped sinewave	122

DEVICE DATA

Crystal Clock Oscillator Type XO 9922 515 71... series

DESCRIPTION

The type XO crystal clock oscillator comprises of a quartz crystal and an oscillator circuit assembled together on a printed-circuit board. The assembly is encapsulated in a hermetically sealed metal housing. The package has four connecting pins with pin spacing compatible with 14-pin DIL packages. The output signal conforms to TTL standards.

APPLICATIONS

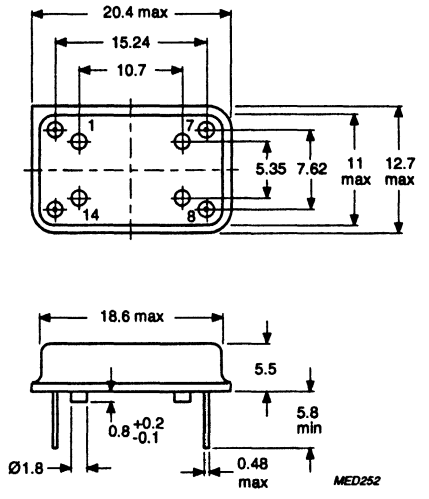
- Microprocessors
- Measuring equipment
- Medical equipment
- Electronic timers.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	1000	70 000	kHz
$\Delta f/f$	frequency stability (all effects and tolerances included)	−100	+100	ppm
T_{op}	operating temperature range	0	+70	°C
V_{CC}	nominal supply voltage	4.5	5.5	V
n	fan-out	–	10	TTL

All references to ppm = 10^{-6}.

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package Outline.

Pinning

SYMBOL	PIN	DESCRIPTION
n.c.	1	n.c. (standard) or control input (3-state) (enable 1)
GND	7	ground (case)
V_{osc}	8	oscillator output
V_{CC}	14	supply voltage, +5 V (DC)

Marking

- Line 1: frequency in kHz
- Line 2: last five digits of catalogue number - XO
- Line 3: code for year and week of manufacture - PHD.

Mass

Typical: 3.9 g

Packing

The oscillators are supplied in sticks in box: 25 pieces per stick; 4, 20 or 40 sticks per box.

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
f_{nom}	nominal frequency	square wave output	1000	–	70 000	kHz
$\Delta f/f$	frequency stability (note 1)	all effects and tolerances included	–100	–	+100	ppm
V_{CC}	nominal supply voltage		4.5	5	5.5	V
I_{CC}	supply current	(T) f = 1.0 to 8.0 MHz (note 2)	–	45	50	mA
		(T) f = 8.0 to 40.0 MHz (note 2)	–	30	40	mA
		(T) f = 40.0 to 70.0 MHz (note 2)	–	40	55	mA
		(C) f = 1.0 to 8.0 MHz (note 3)	–	5	10	mA
		(C) f = 8.0 to 24.0 MHz (note 3)	–	10	15	mA
		(C) f = 24.0 to 40.0 MHz (note 3)	–	20	25	mA
T_{op}	operating temperature range (note 1)		0	–	+70	°C
T_{stg}	storage temperature range		–55	–	+125	°C
	output pulse shape	conform to standard TTL data				
δ	duty cycle (note 1)	1.5 V level	40	–	60	%
n	fan-out	standard TTL load	–	–	10	
t_r, t_f	rise and fall time	(T) 0.4 to 2.4 V (note 2)	4	5	–	ns
		(C) 0.4 to 2.4 V (note 3)	1	2	–	ns
t_{st}	start-up time	up to 40 MHz	–	–	10	ms
		above 40 MHz	–	–	15	ms

All references to ppm = 10^{-6}.

Notes

1. If specifications for a specific product deviate from these standard specifications, refer to Table 1.
2. (T) holds for TTL technology.
3. (C) holds for CMOS technology for TTL output.

The optional 3-state function is only available in (C) up to:

DUTY CYCLE	AT 5 TTL LOAD	AT 10 TTL LOAD
40/60%	40 MHz	34 MHz
45/55%	20 MHz	16 MHz

Note

The optional "enable 1" function is only available in (T) from 8 MHz onwards.

Logic table

CONTROL INPUT (PIN 1)	OUTPUT (PIN 8)		REMARK
	TRISTATE VERSION	ENABLE 1 VERSION	
0 (LOW)	high impedance	logic 1	oscillator stops
1 or open (HIGH)	oscillating (V_{osc})	oscillating (V_{osc})	

SPECIFIC PRODUCT DATA

Table 1

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY (note 5)			T_{op} (°C) (note 2)	T/E (note 3)	δ (%) (min./max.) (note 4)
		TOTAL	INITIAL (25°C)	IN THE TEMP. RANGE			
Standard values (note 6)		±100	±50	±50	0/+70		40/60
9922 515 71806	1 000.000						
9922 515 71802	1 843.200						
9922 515 71807	2 048.000						
9922 515 71803	2 457.600						
9922 515 71804	3 686.400						
9922 515 71805	4 000.000						
9922 515 71602	4 915.200						
9922 515 71607	4 915.200						
9922 515 71605	5 068.800						
9922 515 71608	6 000.000						
9922 515 71601	6 144.000						
9922 515 71001	8 000.000						
9922 515 71047	9 000.000						
9922 515 71014	9 600.000						
9922 515 71002	10 000.000						

Notes

1. f_{nom} = nominal frequency.
2. T_{op} = operating temperature range.
3. T/E: T = 3-state, E = Enable.
4. δ = duty cycle.
5. Values to be multiplied by 10^{-6}.
6. Standard values hold for each product unless otherwise specified.

SPECIFIC PRODUCT DATA

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY (note 5)			T_{op} (°C) (note 2)	T/E (note 3)	δ (%) (min./max.) (note 4)
		TOTAL	INITIAL (25°C)	IN THE TEMP. RANGE			
Standard values (note 6)		±100	±50	±50	0/+70		40/60
9922 515 71003	12 000.000						
9922 515 71038	14 318.180						
9922 515 71039	14 745.600						
9922 515 71035	15 667.200					T	
9922 515 71007	16 000.000						
9922 515 71048	16 384.000						
9922 515 71055	19 660.800						
9922 515 71004	20 000.000						
9922 515 71041	25 000.000						
9922 515 71017	24 000.000						
9922 515 71015	30 000.000						
9922 515 71033	30 240.000					T	
9922 515 71031	31 334.400						
9922 515 71032	31 334.400					T	
9922 515 71042	32 000.000						

Notes

1. f_{nom} = nominal frequency.
2. T_{op} = operating temperature range.
3. T/E: T = 3-state, E = Enable.
4. δ = duty cycle.
5. Values to be multiplied by 10^{-6}.
6. Standard values hold for each product unless otherwise specified.

SPECIFIC PRODUCT DATA

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY (note 5)			T_{op} (°C) (note 2)	T/E (note 3)	δ (%) (min./max.) (note 4)
		TOTAL	INITIAL (25°C)	IN THE TEMP. RANGE			
Standard values (note 6)		±100	±50	±50	0/+70		40/60
9922 515 71052	33 330.000						
9922 515 71049	33 333.300						
9922 515 71008	36 000.000						
9922 515 71009	40 000.000						
9922 515 71034	40 000.000					T	
9922 515 71043	50 000.000						
9922 515 71036	57 283.200						
9922 515 71046	65 536.000	50					
9922 515 71011	66 666.000						

Notes

1. f_{nom} = nominal frequency.
2. T_{op} = operating temperature range.
3. T/E: T = 3-state, E = Enable.
4. δ = duty cycle.
5. Values to be multiplied by 10^{-6}.
6. Standard values hold for each product unless otherwise specified.

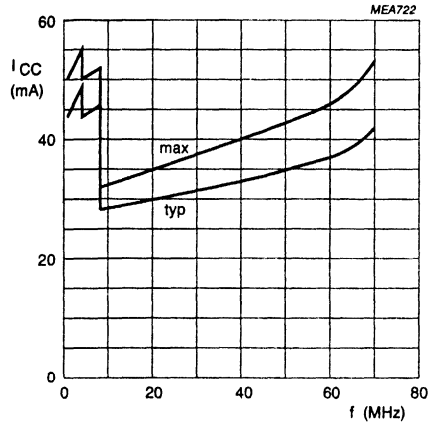


Fig.2 Supply current as a function of frequency.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	$\Delta f/f \leq 5$ ppm
Ea	shock	100 g; half sine 6 directions; 1 blow/direction	$\Delta f/f \leq 5$ ppm
Ed	free fall	250 mm on hard wood	$\Delta f/f \leq 5$ ppm
Fc	vibration	frequency 10 to 500 Hz; acceleration 20 g; 3 directions; 30 minutes	no damage $\Delta f/f \leq 5$ ppm
Nb	rapid change of temperature	1 hour at –40 °C/1 hour at +85 °C; 10 cycles	no damage $\Delta f/f \leq 5$ ppm
Qc	sealing gross leak	method 1	no bubbles
Ta	solderability	235 ±5 °C; 2 ±0.5 s; flux 600 (activated)	good tinning
Tb-1a	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 5$ ppm

IEC679-1	TEST	PROCEDURE	REQUIREMENTS
9.3.1	ageing	1000 hours; 70 °C	$\Delta f/f \leq 10$ ppm

All references to ppm = 10^{-6}.

Solvent resistance tests

Procedure: In accordance with IEC 68-2-45 (XA) and IEC 653: immersion time 5 minutes; at ambient temperature, and ultrasonic (40 kHz); brushing included.

Solvents:
- Neutropon P3 and Saxin P3
- Meta Clean 820
- Lonco 446 and 520
- Isopropanol cleaning solvent.

Crystal Clock Oscillator Type XOHC 9922 515 72... series

DESCRIPTION

The type XOHC crystal clock oscillator comprises of a quartz crystal and an oscillator circuit assembled together on a printed-circuit board. The assembly is encapsulated in a hermetically sealed metal housing. The package has four connecting pins with pin spacing compatible with 14-pin DIL packages. The output signal conforms to HCMOS standards.

APPLICATIONS

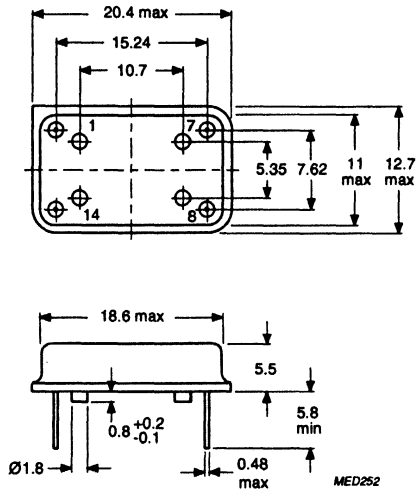
- Microprocessors
- Measuring equipment
- Medical equipment
- Electronic timers.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	1000	50 000	kHz
$\Delta f/f$	frequency stability (all effects and tolerances included)	−100	+100	ppm
T_{op}	operating temperature range	0	+70	°C
V_{CC}	nominal supply voltage	4.5	5.5	V
n	fan-out	– –	10 15	HCMOS LSTTL

All references to ppm = 10^{-6}.

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package Outline.

Pinning

SYMBOL	PIN	DESCRIPTION
n.c.	1	n.c. (standard) or control input (3-state)
GND	7	ground (case)
V_{osc}	8	oscillator output
V_{CC}	14	supply voltage, +5 V (DC)

Marking

- Line 1: frequency in kHz
- Line 2: last five digits of catalogue number - XOHC
- Line 3: code for year and week of manufacture - PHD.

Mass

Typical: 3.9 g

Packing

The oscillators are supplied in sticks in box: 25 pieces per stick; 4, 20 or 40 sticks per box.

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
f_{nom}	nominal frequency	square wave output	1000	–	50 000	kHz
$\Delta f/f$	frequency stability (note 1)	all effects and tolerances included	–100	–	+100	ppm
V_{CC}	nominal supply voltage		4.5	5.0	5.5	V
I_{CC}	supply current at 15 pF load	f = 1.0 to 8.0 MHz f = 8.0 to 24.0 MHz f = 24.0 to 50.0 MHz	– – –	5 10 20	10 15 25	mA mA mA
T_{op}	operating temperature range (note 1)		0	–	+70	°C
T_{stg}	storage temperature range		–55	–	+125	°C
	output pulse shape	conform to standard HCMOS data				
δ	duty cycle	0.5 V level	40	–	60	%
n	fan-out	standard HCMOS load LSTTL load	– –	– –	10 15	
t_r, t_f	rise and fall time	at 15 pF load	3	–	5	ns
t_{st}	start-up time	up to 40 MHz above 40 MHz	– –	– –	10 15	ms ms

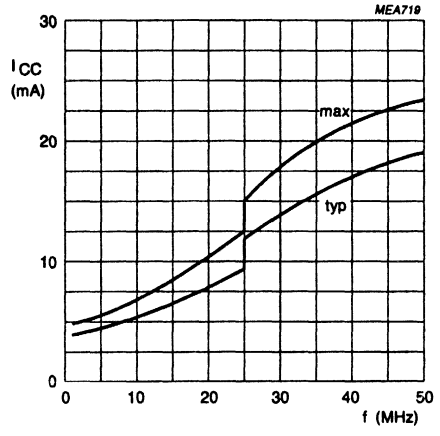
All references to ppm = 10^{-6}.

Note

1. If specifications for a specific product deviate from these standard specifications, refer to Table 1.

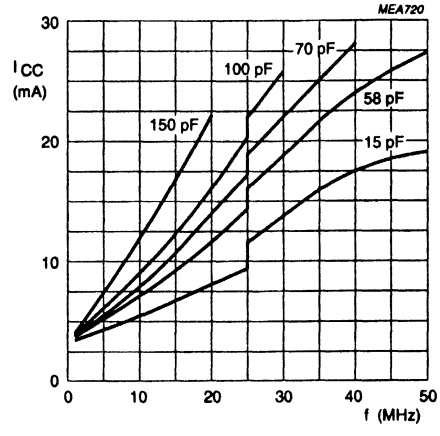
Logic table for 3-state version

CONTROL INPUT (PIN 1)	OUTPUT (PIN 8)	REMARK
0 (LOW) 1 or open (HIGH)	high impedance oscillating (V_{osc})	oscillator stops



Maximum values measured at 5.5 V supply voltage.
Typical values at 5 V supply voltage.

Fig.2 Supply current as a function of frequency for XOHC at standard load of 15 pF.



End of curve also indicates the maximum frequency at that load for 10% to 90% of V_{CC} output levels.

Fig.3 Typical supply current as a function of frequency for XOHC at various load capacitances.

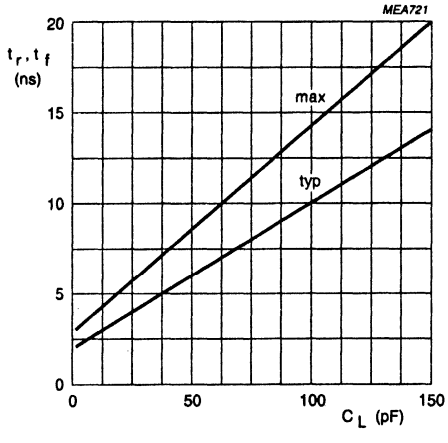


Fig.4 Rise and fall times as a function of load capacitance for XOHC.

SPECIFIC PRODUCT DATA

Table 1

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY (note 5)			T_{op} (°C) (note 2)	T (note 3)	δ (%) (min./max.) (note 4)
		TOTAL	INITIAL (25°C)	IN THE TEMP. RANGE			
Standard values (note 6)		±100	±50	±50	0/+70		40/60
9922 515 72805	1 000.000						
9922 515 72801	1 843.200						
9922 515 72802	2 457.600						
9922 515 72803	3 686.400						
9922 515 72804	4 000.000						
9922 515 72601	4 915.200						
9922 515 72602	5 068.800						
9922 515 72002	8 000.000						
9922 515 72018	9 600.000						
9922 515 72003	10 000.000						
9922 515 72022	11 059.200						
9922 515 72028	11 059.200	50			-20/+70		
9922 515 72004	12 000.000						
9922 515 72005	14 318.180						
9922 515 72006	14 745.600						

Notes

1. f_{nom} = nominal frequency.
2. T_{op} = operating temperature range.
3. T = 3-state.
4. δ = duty cycle.
5. Values to be multiplied by 10^{-6}.
6. Standard values hold for each product unless otherwise specified.

SPECIFIC PRODUCT DATA

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY (note 6)			T_{op} (°C) (note 2)	T (note 3)	δ (%) (min./max.) (note 4)
		TOTAL	INITIAL (25°C)	IN THE TEMP. RANGE			
Standard values (note 7)		±100	±50	±50	0/+70		40/60
9922 515 72007	16 000.000						
9922 515 72031	18 432.000						
9922 515 72026	18 720.000	30					
9922 515 72008	20 000.000						
9922 515 72032	22 118.400						
9922 515 72009	24 000.000						
9922 515 72011	25 000.000						
9922 515 72015	30 000.000	50 (note 5)					
9922 515 72016	30 209.800	50 (note 5)					
9922 515 72001	32 000.000					T	
9922 515 72012	32 000.000						
9922 515 72019	33 333.000						
9922 515 72013	40 000.000						
9922 515 72023	40 000.000					T	
9922 515 72021	45 000.000						

Notes

1. f_{nom} = nominal frequency.
2. T_{op} = operating temperature range.
3. T = 3-state.
4. δ = duty cycle.
5. C_L = 50 pF.
6. Values to be multiplied by 10^{-6}.
7. Standard values hold for each product unless otherwise specified.

SPECIFIC PRODUCT DATA

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY (note 6)			T_{op} (°C) (note 2)	T (note 3)	δ(%) (min./max.) (note 4)
		TOTAL	INITIAL (25°C)	IN THE TEMP. RANGE			
Standard values (note 7)		±100	±50	±50	0/+70		40/60
9922 515 72052	45 158.400	50 (note 5)					
9922 515 72014	50 000.000						
9922 515 72027	51 840.000	50					

Notes

1. f_{nom} = nominal frequency.
2. T_{op} = operating temperature range.
3. T = 3-state.
4. δ = duty cycle.
5. C_L = 50 pF.
6. Values to be multiplied by 10^{-6}.
7. Standard values hold for each product unless otherwise specified.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	$\Delta f/f \leq 5$ ppm
Ea	shock	100 g; half sine 6 directions; 1 shock/direction	$\Delta f/f \leq 5$ ppm
Ed	free fall	250 mm on hard wood	$\Delta f/f \leq 5$ ppm
Fc	vibration	frequency 10 to 500 Hz; acceleration 20 g; 3 directions; 30 minutes	no damage $\Delta f/f \leq 5$ ppm
Nb	rapid change of temperature	1 hour at –40 °C/1 hour at +85 °C; 10 cycles	no damage $\Delta f/f \leq 5$ ppm
Qc	sealing gross leak	method 1	no bubbles
Ta	solderability	235 ±5 °C; 2 ±0.5 s; flux 600 (activated)	good tinning
Tb-1a	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 5$ ppm

IEC679-1	TEST	PROCEDURE	REQUIREMENTS
9.3.1	ageing	1000 hours; 70 °C	$\Delta f/f \leq 10$ ppm

All references to ppm = 10^{-6}.

Solvent resistance tests

Procedure: In accordance with IEC 68-2-45 (XA) and IEC 653: immersion time 5 minutes; at ambient temperature, and ultrasonic (40 kHz); brushing included.

Solvents:
- Neutropon P3 and Saxin P3
- Meta Clean 820
- Lonco 446 and 520
- Isopropanol cleaning solvent.

Voltage Controlled Crystal Oscillator Type VCO2

9922 515 602.. series

DESCRIPTION

The type VC02 voltage controlled crystal oscillator comprises of a quartz crystal and two HCMOS integrated circuits for oscillating and output buffering. These are assembled together on a hybrid circuit in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has four connecting pins with pin spacing compatible with 14-pin DIL packages.

APPLICATIONS

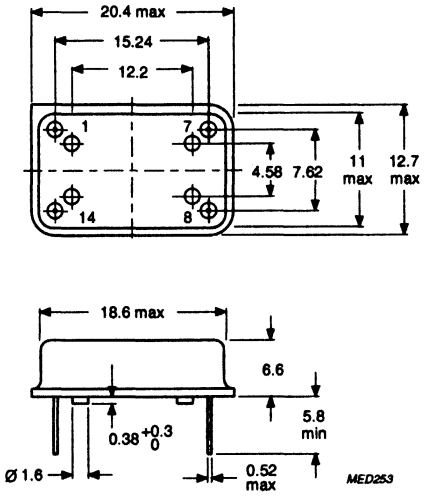
- Clock recovery circuits (phase-locked-loops)
- Multiplexing equipment in digital telephone networks
- Local area networks.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
f_{nom}	nominal frequency range	7000	–	23 000	kHz
$\Delta f/f$	frequency stability (all effects and tolerances included)	–	–	±45	ppm
V_{CC}	supply voltage range	4.75	5.0	5.25	V
V_{contr}	control voltage range (inverse characteristic)	–5	0.0	+5	V
$\Delta f/f\ (V_{contr})$	pullability (reference to f_{nom})	–	±160	–	ppm
n	fan-out	–	–	3	TTL

All references to ppm = 10^{-6}.

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline DIL 14/4.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{contr}	1	control voltage
GND	7	ground (case)
V_{osc}	8	oscillator output
V_{CC}	14	supply voltage

Marking

- Line 1: frequency in kHz
- Line 2: last five digits of catalogue number - PHD
- Line 3: code for month and year of manufacture - VC02.

Mass

Typical: 3.9 g

Packing

The oscillators are supplied in blister package in box: 25 pieces per blister package; 12 blister packages per box.

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage	(note 1)	4.75	5.0	5.25	V
I_{CC}	supply current	7 to 17 MHz 7 to 17 MHz at V_{CC} = 5.25 V 17 to 21 MHz	– – –	6 – 10	10 12 12.5	mA mA mA
V_{contr}	control voltage range		–5	0.0	+5	V
n	output load (fan-out)	TTL load	–	–	3	
t_{st}	start-up time	in T_{op} range	–	–	10	ms
T_{op}	operating temperature range		–5	+25	+60	°C
T_o	operable temperature range		–40	–	+85	°C
T_{stg}	storage temperature range	MIL-0-55310 A	–40	–	+100	°C
Frequency characteristics						
f_{nom}	nominal frequency range		7000	–	23 000	kHz
$\Delta f/f_{nom}$	initial frequency tolerance with respect to the nominal frequency	V_{contr} = 0 V (note 2)	–	–	±30	ppm
$\Delta f/f_{25}(T)$	frequency stability as a function of temperature change	T_{op} = +60 to –5 °C (reference to f initial)	–	–	±20	ppm
$\Delta f/f_{25}(V_{CC})$	frequency tolerance as a function of supply voltage and load variations	V_{CC} = 5 V ±5% C_L = 15 to 50 pF or unloaded to 3 TTL loads (reference to f initial)	–	–	±5	ppm
$\Delta f/f$ (t)	frequency ageing	during 10 years at 60 °C (reference to f initial)	–	–	±20	ppm
$\Delta f/f$ (tot)	total frequency tolerance due to ageing, temperature, supply voltage and load variations	V_{contr} = 0 V (reference to f initial)	–	–	±45	ppm
$\Delta f/f$ (V_{contr})	pullability (reference to f_{nom})	V_{contr} = –5 V to +5 V (see Fig.2)	±130	±160	±200	ppm
$\Delta f/f/\Delta V_{contr}$	pulling sensitivity per volt	inverse monotonic characteristic; f_{max} at V_{contr} = –5 V	–15	–32	–60	ppm/V
t_{stab}	stabilization time after power-on	to ±1 ppm of final frequency	–	–	20	s

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output characteristics						
t_r t_f	rise time fall time	between 10 and 90% between 10 and 90%	– –	– –	15 15	ns ns
	output logic levels	compatible with HCMOS	–	–	–	
δ	duty cycle 7 to 17 MHz	T_{op} = 25 °C V_{contr} = 0 V output level 1.5 V	45	–	55	%
δ	duty cycle 7 to 17 MHz	T_{op} = –5 to +60 °C V_{contr} = –5 to +5 V output level 1.5 V	40	–	60	%
δ	duty cycle 17 to 23 MHz	T_{op} = –5 to +60 °C V_{contr} = –5 to +5 V output level 2.5 V	40	–	60	%

All references to ppm = 10^{-6}.

Notes

1. Supply voltage is decoupled internally.
2. The initial frequency deviation does not degrade the margin between pullability and stability as the pullability is stated relative to the nominal frequency.
3. If specifications for a specific product deviate from these standard specifications, refer to Table 1.
4. The parameters are measured at: T_{amb} = 25 ±2 °C ; V_{CC} = 5 V and 15 pF output-load capacitor to ground (unless otherwise specified).

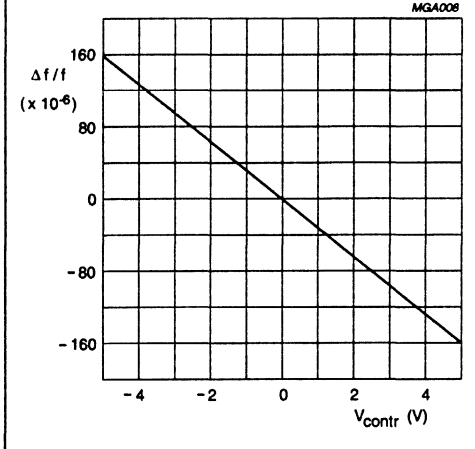


Fig.2 Frequency as a function of control voltage characteristic (typical curve).

Voltage Controlled Crystal Oscillator Type VCO2

9922 515 602.. series

SPECIFIC PRODUCT DATA

Table 1

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY		T_{op} (°C) (note 2)	MAXIMUM AGEING		
		INITIAL (notes 3 and 4)	IN THE TEMP. RANGE		VALUE (note 4)	(°C)	TIME
9922 515 60201	8 192.000	±30	±20	−5/+60	±20	85	2000 hours
9922 515 60202	8 448.000	±30	±20	−5/+60	±20	85	2000 hours
9922 515 60216	10 080.000	±30	±20	−5/+60			
9922 515 60203	11 456.000	±30	±20	−5/+60	±20	85	2000 hours
9922 515 60209	11 520.000	±30	±20	−5/+60			
9922 515 60213	11 605.333	±20	±20	−15/+85	±20	25	20 years
9922 515 60211	12 288.000	±30	±20	−5/+60			
9922 515 60212	12 624.000	±30	±20	−5/+60			
9922 515 60207	15 360.000	±30	±20	−5/+60			
9922 515 60205	16 384.000	±30	±20	−5/+60			
9922 515 60214	16 384.000	±20	±20 ±15	−5/+60 +20/+60	±15	40	10 years
9922 515 60206	20 480.000	±30	±20	−40/+85			
9922 515 60215	22 579.200	±30	±20	−0/+70		25	10 years

Notes

1. f_{nom} = nominal frequency.
2. T_{op} = operating temperature range.
3. INITIAL at nominal V_{contr}.
4. Values to be multiplied by 10^{-6}.

Voltage Controlled Crystal Oscillator Type VCO2

9922 515 602.. series

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	PULLABILITY (notes 2 and 3)			CONTROL VOLTAGE RANGE (V)			PULLING SENSITIVITY PER VOLT (note 3)		
		MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
9922 515 60201	8 192.000	±130	±160	±200	–5	0	+5		–32	
9922 515 60202	8 448.000	±130	±160	±200	–5	0	+5		–32	
9922 515 60216	10 080.000	±130	±160	±200	–5	0	+5		–32	
9922 515 60203	11 456.000	±130	±160	±200	–5	0	+5		–32	
9922 515 60209	11 520.000	±145	–	–	–5	0	+5		–35	
9922 515 60213	11 605.333	±150	–	–	–5	0	+5		–37.5	
9922 515 60211	12 288.000	±130	±160	±200	–5	0	+5		–32	
9922 515 60212	12 624.000	±130	±160	±200	–5	0	+5		–32	
9922 515 60207	15 360.000	±130	–	–	–5	0	+5		–32	
9922 515 60205	16 384.000	±130	–	–	–5	0	+5		–32	
9922 515 60214	16 384.000	±100	–	–	–3.5	0	+3.5		–35	
9922 515 60206	20 480.000	±130	±160	±200	–5	0	+5		–32	
9922 515 60215	22 579.200	±150	–	–	–5	0	+5		–32	

Notes

1. f_{nom} = nominal frequency.
2. Pullability reference to f_{nom}.
3. Values to be multiplied by 10^{-6}.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	$\Delta f/f \leq 5$ ppm
Ea	shock	100 g; half sine 6 directions; 1 shock/direction	$\Delta f/f \leq 5$ ppm
Ed	free fall	250 mm on hard wood	$\Delta f/f \leq 5$ ppm
Fc	vibration	frequency 10 to 500 Hz; acceleration 20 g; 3 directions; 30 minutes	no damage $\Delta f/f \leq 5$ ppm
Nd	rapid change of temperature	1 hour at –40 °C/1 hour at +85 °C; 10 cycles	no damage $\Delta f/f \leq 5$ ppm
Qc	sealing gross leak		no bubbles
Qk	sealing fine leak	16 hours; 700 kPa He	$< 1 \cdot 10^{-8}$ Ncc/s He
Ta-1	solderability	235 ±5 °C; 2 ±0.5 s; flux 600 (activated)	good tinning
Tb-1a	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 5$ ppm
Ub	bending of wire terminations	1 bend of 90°; load 5 N	no leaking leads

IEC679-1	TEST	PROCEDURE	REQUIREMENTS
9.3.1	ageing	2000 hours at 85 °C 1000 hours at 70 °C	$\Delta f/f \leq 20$ ppm $\Delta f/f \leq 5$ ppm

All references to ppm = 10^{-6}.

Note

Expected field failure rate in operating temperature range: $< 350 \cdot 10^{-9}$/hour.

Voltage Controlled Crystal Oscillator Type VCO3

9922 515 603.. series

DESCRIPTION

The type VC03 voltage controlled crystal oscillator comprises of a quartz crystal, an oscillator circuit, a voltage reference and an HCMOS integrated divider circuit. These are assembled together on a hybrid circuit in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has four connecting pins with pin spacing compatible with 14-pin DIL packages.

APPLICATIONS

- Clock recovery circuits (phase-locked-loops)
- Multiplexing equipment in digital telephone networks
- Local area networks.

QUICK REFERENCE DATA

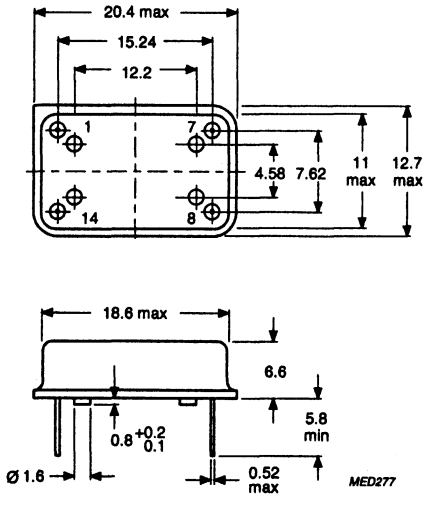
SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
f_{nom}	nominal frequency range	1000	–	10 000	kHz
$\Delta f/f$	frequency stability (all effects and tolerances included)	–	–	±45	ppm
V_{CC}	supply voltage range	4.75	5.0	5.25	V
V_{contr}	control voltage range (inverse characteristic)	–4	0.0	+4	V
$\Delta f/f$ (V_{contr})	pullability (reference to f_{nom})	–	±220	–	ppm
n	fan-out	–	–	3	TTL

All references to ppm = 10^{-6}.

Voltage Controlled Crystal Oscillator Type VCO3

9922 515 603.. series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline DIL14/4.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{contr}	1	control voltage
GND	7	ground (case)
V_{osc}	8	oscillator output
V_{CC}	14	supply voltage

Marking

- Line 1: frequency in kHz
- Line 2: last five digits of catalogue number - PHD
- Line 3: code for month and year of manufacture - VC03.

Mass

Typical: 3.9 g

Packing

The oscillators are supplied in blister package in box: 25 pieces per blister package; 12 blister packages per box.

Voltage Controlled Crystal Oscillator Type VCO3

9922 515 603.. series

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage	(note 1)	4.75	5.0	5.25	V
I_{CC}	supply current		–	4	8	mA
V_{contr}	control voltage range		–4	0.0	+4	V
n	output load (fan-out)	TTL load	–	–	3	
t_{st}	start-up time		–	–	10	ms
T_{op}	operating temperature range		–5	+25	+55	°C
T_o	operable temperature range		–20	–	+70	°C
T_{stg}	storage temperature range	MIL-0-55310 A	–40	–	+100	°C
Frequency characteristics						
f_{nom}	nominal frequency range		1000	–	10 000	kHz
$\Delta f/f_{nom}$	initial frequency tolerance with respect to the nominal frequency	V_{contr} = 0 V (note 2)	–	–	±15	ppm
$\Delta f/f_{25}(T)$	frequency stability as a function of temperature change	T_{op} = +55 to –5 °C (reference to f initial)	–	–	±20	ppm
$\Delta f/f_{25}$ (V_{CC})	frequency tolerance as a function of supply voltage and load variations	V_{CC} = 5 V ±5% C_L = 15 to 50 pF or unloaded to 3 TTL loads (reference to f initial)	–	±1.5	±3	ppm
$\Delta f/f_{25}$ (t)	frequency ageing	during 10 years at 55 °C (reference to f initial)	–	–	±20	ppm
$\Delta f/f_{25}$ (tot)	total frequency tolerance due to ageing, temperature, supply voltage and load variations	V_{contr} = 0 V (reference to f initial)	–	–	±45	ppm
$\Delta f/f_{nom}(V_{contr})$	pullability (reference to f_{nom})	V_{contr} = –4 V to +4 V (see Fig.2)	–	±220	±350	ppm
$\Delta f/f/\Delta V_{contr}$	pulling sensitivity per volt	inverse monotonic characteristic; f_{max} at V_{contr} = –4 V	–	–55	–	ppm/V
t_{stab}	stabilization time after power-on	to ±1 ppm of final frequency	–	–	20	s

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output characteristics						
t_r	rise time	between 10 and 90%	–	–	10	ns
t_f	fall time	between 10 and 90%	–	–	10	ns
	output logic levels	compatible with HCMOS	–	–	–	
δ	duty cycle	T_{op} = –5 to +55 °C V_{contr} = –4 to +4 V output level 2.5 V	48	–	52	%

All references to ppm = 10^{-6}.

Notes

1. Supply voltage is decoupled internally.
2. The initial frequency deviation does not degrade the margin between pullability and stability as the pullability is stated relative to the nominal frequency.
3. If specifications for a specific product deviate from these standard specifications, refer to Table 1.
4. The parameters are measured at: T_{amb} = 25 ±2 °C; V_{CC} = 5 V and 15 pF output-load capacitor to ground (unless otherwise specified).

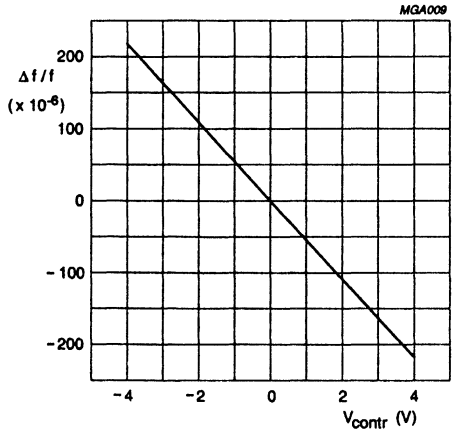


Fig.2 Frequency as a function of control voltage characteristic (typical curve).

SPECIFIC PRODUCT DATA

Table 1

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY		T_{op} (°C) (note 2)	MAXIMUM AGEING		
		INITIAL (notes 3 and 4)	IN THE TEMP. RANGE		VALUE (note 4)	(°C)	TIME
9922 515 60301	2 048.000	±15	±20	–5/+70	±10	50	10 years
9922 515 60303	2 304.000	±15	±35	–0/+70	±35	50	15 years
9922 515 60307	4 681.143	±15	±20	–5/+55	–	–	–

Notes

1. f_{nom} = nominal frequency.
2. T_{op} = operating temperature range.
3. INITIAL at nominal V_{contr}.
4. Values to be multiplied by 10^{-6}.

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	PULLABILITY (notes 2 and 3)			CONTROL VOLTAGE RANGE (V)			PULLING SENSITIVITY PER VOLT (note 3)		
		MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
9922 515 60301	2 048.000	±190	±220	–	–4	0	+4	–	–55	–
9922 515 60303	2 304.000	±190	±220	–	–4	0	+4	–	–55	–
9922 515 60307	4 681.143	±190	±220	–	–4	0	+4	–	–55	–

Notes

1. f_{nom} = nominal frequency.
2. Pullability reference to f_{nom}.
3. Values to be multiplied by 10^{-6}.

TESTS AND REQUIREMENTS

Essentially all tests are carried out along in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	$\Delta f/f \leq 5$ ppm
Ea	shock	100 g; half sine 6 directions; 1 shock/direction	$\Delta f/f \leq 5$ ppm
Ed	free fall	250 mm on hard wood	$\Delta f/f \leq 5$ ppm
Fc	vibration	frequency 10 to 500 Hz; acceleration 20 g; 3 directions; 30 minutes	$\Delta f/f \leq 5$ ppm
Nd	rapid change of temperature	1 hour at –40 °C/1 hour at +85 °C; 10 cycles	$\Delta f/f \leq 5$ ppm
Qc	sealing gross leak		no bubbles
Qk	sealing fine leak	16 hours; 700 kPa He	$< 1 \cdot 10^{-8}$ Ncc/s He
Ta-1	solderability	235 ±5 °C; 2 ±0.5 s; flux 600 (activated)	good tinning
Tb-1a	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 5$ ppm
Ub	bending of wire terminations	1 bend of 90°; load 5 N	no leaking leads

IEC679-1	TEST	PROCEDURE	REQUIREMENTS
9.3.1	ageing	2000 hours at 85 °C 1000 hours at 70 °C	$\Delta f/f \leq 20$ ppm $\Delta f/f \leq 5$ ppm

All references to ppm = 10^{-6}.

Note

Expected field failure rate in operating temperature range: $< 350 \cdot 10^{-9}$/hour.

Voltage Controlled Crystal Oscillator Type VCO4

9922 515 604.. series

DESCRIPTION

The type VC04 voltage controlled crystal oscillator comprises of a quartz crystal, an oscillator circuit and an HCMOS integrated buffer circuit. These are assembled together on a hybrid circuit in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has four connecting pins with pin spacing compatible with 14-pin DIL packages.

APPLICATIONS

- Clock recovery circuits (phase-locked-loops)
- Multiplexing equipment in digital telephone networks
- Local area networks.

QUICK REFERENCE DATA

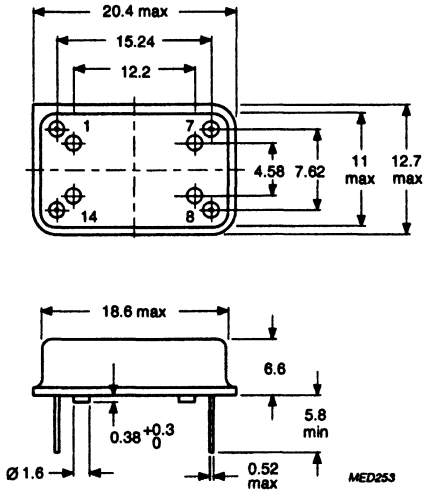
SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
f_{nom}	nominal frequency range	7000	–	17 000	kHz
$\Delta f/f$	frequency stability (all effects and tolerances included)	–	–	±50	ppm
V_{CC}	supply voltage range	4.75	5.0	5.25	V
V_{contr}	control voltage range (positive characteristic)	+0.5	+2.5	+4.5	V
$\Delta f/f_{nom}$ (V_{contr})	pullability (reference to f_{nom})	±100	±125	±150	ppm
n	fan-out	–	–	3	TTL

All references to ppm = 10^{-6}.

Voltage Controlled Crystal Oscillator Type VCO4

9922 515 604.. series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline DIL14/4.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{contr}	1	control voltage
GND	7	ground (case)
V_{osc}	8	oscillator output
V_{CC}	14	supply voltage

Marking

- Line 1: frequency in kHz
- Line 2: last five digits of catalogue number - PHD
- Line 3: code for month and year of manufacture - VC04.

Mass

Typical: 3.9 g

Packing

The oscillators are supplied in blister package in box: 25 pieces per blister package; 12 blister packages per box.

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage	(note 1)	4.75	5.0	5.25	V
I_{CC}	supply current		–	6	10	mA
V_{contr}	control voltage range		+0.5	+2.5	+4.5	V
n	output load (fan-out)	TTL load	–	–	3	
C_L	load capacitance		–	–	50	pF
t_{st}	start-up time		–	2	10	ms
T_{op}	operating temperature range		0	+25	+70	°C
T_o	operable temperature range		–20	–	+70	°C
T_{stg}	storage temperature range	MIL-0-55310 A	–40	–	+100	°C
Frequency characteristics						
f_{nom}	nominal frequency range		7000	–	17 000	kHz
$\Delta f/f_{nom}$	initial frequency tolerance with respect to the nominal frequency	V_{contr} = 2.5 V (note 2)	–	–	±20	ppm
$\Delta f/f_{25}(T)$	frequency stability as a function of temperature change	T_{op} = +70 to 0 °C (reference to f initial)	–	–	±25	ppm
$\Delta f/f_{25}(V_{CC})$	frequency tolerance as a function of supply voltage and load variations	V_{CC} = 5 V ±5% C_L = 15 to 50 pF or unloaded to 3 TTL loads (reference to f initial)	–	±2.5	±5	ppm
$\Delta f/f_{25}(t)$	frequency ageing	during 10 years at 70 °C (reference to f initial)	–	–	±20	ppm
$\Delta f/f_{25}(tot)$	total frequency tolerance due to ageing, temperature, supply voltage and load variations	V_{contr} = 2.5 V (reference to f initial)	–	–	±50	ppm
$\Delta f/f_{nom}(V_{contr})$	pullability (reference to f_{nom})	V_{contr} = +0.5 to +4.5 V (see Fig.2)	±100	±125	±150	ppm
$\Delta f/f/\Delta V_{contr}$	pulling sensitivity per volt	positive monotonic characteristic; f_{max} at V_{contr} = +4.5 V	–	+62.5	–	ppm/V
t_{stab}	stabilization time after power-on	to ±1 ppm of final frequency	–	–	20	s

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output characteristics						
t_r	rise time	between 10 and 90%	–	–	10	ns
t_f	fall time	between 10 and 90%	–	–	10	ns
	output logic levels	compatible with HCMOS	–	–	–	
δ	duty cycle	T_{op} = –5 to +70 °C V_{contr} = +0.5 to +4.5 V output level 2.5 V	40	–	60	%

All references to ppm = 10^{-6}.

Notes

1. Supply voltage is decoupled internally.
2. The initial frequency deviation does not degrade the margin between pullability and stability as the pullability is stated relative to the nominal frequency.
3. If specifications for a specific product deviate from these standard specifications, refer to Table 1.
4. The parameters are measured at: T_{amb} = 25 ±2 °C ; V_{CC} = 5 V and 15 pF output-load capacitor to ground (unless otherwise specified).

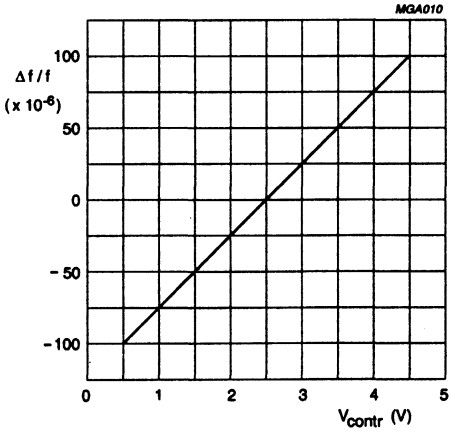


Fig.2 Frequency as a function of control voltage characteristic (typical curve).

SPECIFIC PRODUCT DATA

Table 1

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY		T_{op} (°C) (note 2)	MAXIMUM AGEING		
		INITIAL (notes 3 and 4)	IN THE TEMP. RANGE		VALUE (note 4)	(°C)	TIME
9922 515 60401	8 192.000	±20	±25	−0/+70	–	–	–
9922 515 60416	11 605.330	±20	±20	−15/+85	±20	25	20 years
9922 515 60417	12 960.000	±20	±25	−0/+70	–	–	–
9922 515 60415	16 000.000	±20	±25	−0/+70	±5 ±2	25 25	year1 + year2-20
9922 515 60404	16 384.000	±10	±25	−0/+70	±5 ±2	25 25	year1 + year2-20
9922 515 60411	16 384.000	±10	±25	−0/+70	±5 ±2	25 25	year1 + year2-20
9922 515 60413	16 384.000	±20	±25	−0/+70	±5 ±2	25 25	year1 + year2-20

Notes

1. f_{nom} = nominal frequency.
2. T_{op} = operating temperature range.
3. INITIAL at nominal V_{contr}.
4. Values to be multiplied by 10^{-6}.

Voltage Controlled Crystal Oscillator Type VCO4

9922 515 604.. series

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	PULLABILITY (notes 2 and 3)			CONTROL VOLTAGE RANGE (V)			PULLING SENSITIVITY PER VOLT (note 3)		
		MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
9922 515 60401	8 192.000	±80	±100	±120	0.5	2.5	4.5	–	50	–
9922 515 60416	11 605.330	±75	–	–	0.5	2.0	3.5	–	–	–
9922 515 60417	12 960.000	±80	±100	±120	0.5	2.5	4.5	–	50	–
9922 515 60415	16 000.000	±100	±125	±150	0.5	2.5	4.5	–	62.5	–
9922 515 60404	16 384.000	±80	±100	±120	0.5	2.5	4.5	–	50	–
9922 515 60411	16 384.000	±100	–	–	0.5	2.5	4.5	–	50	–
9922 515 60413	16 384.000	±100	±125	150	0.5	2.5	4.5	–	62.5	–

Notes

1. f_{nom} = nominal frequency.
2. Pullability reference to f_{nom}.
3. Values to be multiplied by 10^{-6}.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	$\Delta f/f \leq 5$ ppm
Ea	shock	100 g; half sine 6 directions; 1 shock/direction	$\Delta f/f \leq 5$ ppm
Ed	free fall	250 mm on hard wood	$\Delta f/f \leq 5$ ppm
Fc	vibration	frequency 10 to 500 Hz; acceleration 20 g; 3 directions; 30 minutes	$\Delta f/f \leq 5$ ppm
Nd	rapid change of temperature	1 hour at –40 °C/1 hour at +100 °C; 10 cycles	$\Delta f/f \leq 5$ ppm
Qc	sealing gross leak		no bubbles
Qk	sealing fine leak	16 hours; 700 kPa He	$< 1 \cdot 10^{-8}$ Ncc/s He
Ta-1	solderability	235 ±5 °C; 2 ±0.5 s; flux 600 (activated)	good tinning
Tb-1a	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 5$ ppm
Ub	bending of wire terminations	1 bend of 90°; load 5 N	no leaking leads

IEC679-1	TEST	PROCEDURE	REQUIREMENTS
9.3.1	ageing	2000 hours at 85 °C 1000 hours at 70 °C	$\Delta f/f \leq 20$ ppm $\Delta f/f \leq 5$ ppm

All references to ppm = 10^{-6}.

Note

Expected field failure rate in operating temperature range: $< 350 \cdot 10^{-9}$/hour.

Voltage Controlled Crystal Oscillator Type VCO5

9922 514/515 605.. series

DESCRIPTION

The type VC05 voltage controlled crystal oscillator comprises of a quartz crystal, a trimmer and two HCMOS integrated circuits for oscillating and output buffering. The assembly is available in two different envelopes, a package with pin spacing compatible with 14-pin DIL packages and in a B6 housing.

APPLICATIONS

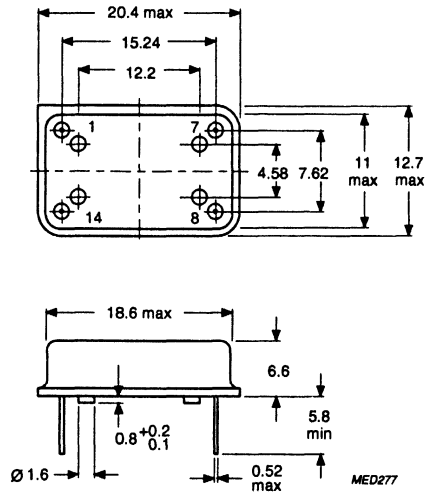
- Clock recovery circuits (phase-locked-loops)
- Multiplexing equipment in digital telephone networks
- Local area networks.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
f_{nom}	nominal frequency range	17 000	–	40 000	kHz
$\Delta f/f$	frequency stability (all effects and tolerances included)	–	–	±40	ppm
V_{CC}	supply voltage range	4.75	5.0	5.25	V
V_{contr}	control voltage range (positive characteristic)	+0.5	+2.5	+4.5	V
$\Delta f/f_{nom}$ (V_{contr})	pullability (reference to f_{nom})	–	±60	–	ppm
n	fan-out	–	–	3	TTL

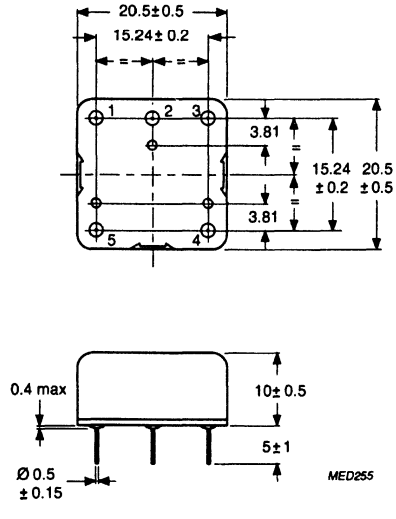
All references to ppm = 10^{-6}.

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline DIL14/4.



Dimensions in mm.

Fig.2 Package outline B6.

Voltage Controlled Crystal Oscillator Type VCO5

9922 514/515 605.. series

Pinning to DIL14/4

SYMBOL	PIN	DESCRIPTION
V_{contr}	1	control voltage
GND	7	ground (case)
V_{osc}	8	oscillator output
V_{CC}	14	supply voltage

Pinning to B6

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
V_{osc}	2	oscillator output
GND	3	ground (case)
n.c.	4	not connected
V_{contr}	5	control voltage

Marking

- Line 1: PHILIPS
- Line 2: frequency in MHz
- Line 3: last five digits of catalogue number
- Line 4: serial number/year and week of manufacture.

Mass

Typical: 3.9 g

Packing

The oscillators are supplied in blister package in box: 25 pieces per blister package; 12 blister packages per box.

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage	(note 1)	4.75	5.0	5.25	V
I_{CC}	supply current		–	12.5	20	mA
V_{contr}	control voltage range		+0.5	+2.5	+4.5	V
n	output load (fan out)	TTL load	–	–	3	
t_{st}	start-up time	in T_{op} range	–	–	10	ms
T_{op}	operating temperature range		0	+25	+70	°C
T_o	operable temperature range		–20	–	+85	°C
T_{stg}	storage temperature range	MIL-0-55310 A	–40	–	+85	°C
Frequency characteristics						
f_{nom}	nominal frequency range		17 000	–	40 000	kHz
$\Delta f/f_{nom}$	initial frequency tolerance with respect to the nominal frequency	V_{contr} = 2.5 V (note 2)	–	–	±20	ppm
$\Delta f/f_{25}(T)$	frequency stability as a function of temperature change	T_{op} = +70 to 0 °C (reference to f initial)	–	–	±20	ppm
$\Delta f/f_{25}(V_{CC})$	frequency tolerance as a function of supply voltage and load variations	V_{CC} = 5 V ±5% C_L = 15 to 50 pF or unloaded to 3 TTL loads (reference to f initial)	–	–	±5	ppm
$\Delta f/f_{25}(t)$	frequency ageing	during 1000 hours at 85 °C (reference to f initial)	–	±10	–	ppm
$\Delta f/f(tot)$	total frequency tolerance due to ageing, temperature, supply voltage and load variations	V_{contr} = 2.5 V (reference to f initial)	–	–	±40	ppm
$\Delta f/f_{nom}(V_{contr})$	pullability (reference to f_{nom})	V_{contr} = +0.5 to +4.5 V (see Fig.2)	±45	±60	±100	ppm
$\Delta f/f/\Delta V_{contr}$	pulling sensitivity per volt	positive monotonic characteristic; f_{max} at V_{contr} = +4.5 V	–	+30	–	ppm/V
t_{stab}	stabilisation time after power-on	to ±1 ppm of final frequency	–	–	20	s

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output characteristics						
t_r	rise time	between 10 and 90%	–	–	10	ns
t_f	fall time	between 10 and 90%	–	–	10	ns
	output logic levels	compatible with HCMOS	–	–	–	
δ	duty cycle	T_{op} = 0 to +70 °C V_{contr} = +0.5 to +4.5 V output level 2.5 V	40	–	60	%

All references to ppm = 10^{-6}.

Notes

1. Supply voltage is decoupled internally.
2. The initial frequency deviation does not degrade the margin between pullability and stability as the pullability is stated relative to the nominal frequency.
3. If specifications for a specific product deviate from these standard specifications, refer to Table 1.
4. The parameters are measured at: T_{amb} = 25 ±2 °C; V_{CC} = 5 V and 15 pF output-load capacitor to ground (unless otherwise specified).

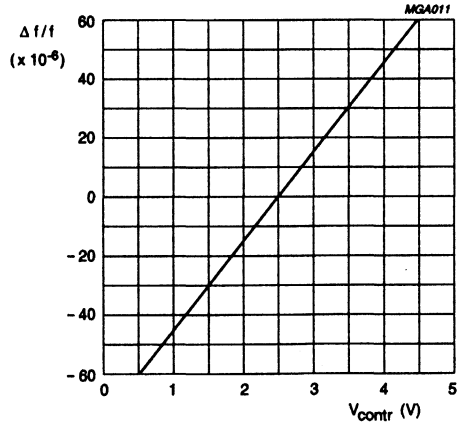


Fig.3 Frequency as a function of control voltage characteristic (typical curve).

SPECIFIC PRODUCT DATA

Table 1

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY		T_{op} (°C) (note 2)	MAXIMUM AGEING			HOUSE
		INITIAL (notes 3 and 4)	IN THE TEMP. RANGE		VALUE (note 4)	(°C)	TIME	
9922 514 60501	30 720.000	±10	±20	0/+70	±10 ±10	85 25	1000 hours 20 years	B6
9922 514 60502	31 104.000	–	–	–20/+85	±15	70	10 years	B6
9922 515 60501	34 368.000	±4	±8	0/+70	±6	25	15 years	DIL14/4

Notes

1. f_{nom} = nominal frequency.
2. T_{op} = operating temperature range.
3. INITIAL at nominal V_{contr}.
4. Values to be multiplied by 10^{-6}.

Voltage Controlled Crystal Oscillator Type VCO5

9922 514/515 605.. series

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	PULLABILITY (notes 2 and 3)			CONTROL VOLTAGE RANGE (V)			PULLING SENSITIVITY PER VOLT (note 3)		
		MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
9922 514 60501	30 720.000	±55	–	100	0.5	2.5	4.5	20	–	50
9922 514 60502	31 104.000	–	–	–	0.5	2.5	4.5	20	30	40
9922 515 60501	34 368.000	±63	–	–	0.25	2.5	4.75	–	–	–

Notes

1. f_{nom} = nominal frequency.
2. Pullability reference to f_{nom}.
3. Values to be multiplied by 10^{-6}.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	Δf/f ≤5 ppm
Ea	shock	100 g; half sine 6 directions; 1 shock/direction	Δf/f ≤5 ppm
Ed	free fall	250 mm on hard wood	Δf/f ≤5 ppm
Fc	vibration	frequency 10 to 500 Hz; acceleration 20 g; 3 directions; 30 minutes	Δf/f ≤5 ppm
Nd	rapid change of temperature	1 hour at –40 °C/1 hour at +85 °C; 10 cycles	Δf/f ≤5 ppm
Ta-1	solderability	235 ±5 °C; 2 ±0.5 s; flux 600 (activated)	good tinning
Tb-1a	resistance to soldering heat	260 ±5 °C; 10 ±1 s	Δf/f ≤5 ppm
Ub	bending of wire terminations	1 bend of 90°; load 5 N	no leaking leads

IEC679-1	TEST	PROCEDURE	REQUIREMENTS
9.3.1	ageing	2000 hours at 85 °C 1000 hours at 70 °C	t.b.f.

All references to ppm = 10^{-6}.

Note

Expected field failure rate in operating temperature range: <350 • 10^{-9}/hour.

Voltage Controlled Crystal Oscillator Type VCO6

9922 514 606.. series

DESCRIPTION

The type VCO6 voltage controlled crystal oscillator has a high pulling sensitivity plus a linear and stable frequency control characteristic. It comprises of a quartz crystal and an oscillator circuit using surface mount techniques. The assembly is encapsulated in a metal housing.

APPLICATIONS

- Clock recovery circuits (phase-locked-loops)
- Multiplexing equipment in digital telephone networks
- Local area networks.

QUICK REFERENCE DATA

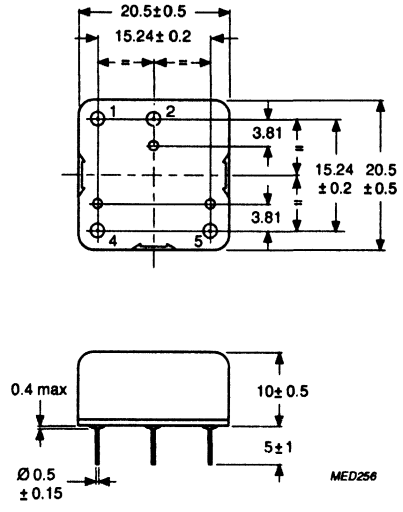
SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
f_{nom}	nominal frequency range	7000	–	17 000	kHz
$\Delta f/f$	frequency stability (all effects and tolerances included)	–	–	±40	ppm
V_{CC}	supply voltage range	4.75	5.0	5.25	V
V_{contr}	control voltage range	1	–	4	V
$\Delta f/f_{nom}$ (V_{contr})	pullability (reference to f_{nom})	–	±150	–	ppm
n	fan-out	–	–	3	TTL

All references to ppm = 10^{-6}.

Voltage Controlled Crystal Oscillator Type VCO6

9922 514 606.. series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
V_{osc}	2	oscillator output
V_{contr}	4	control voltage
GND	5	ground (case)

Marking

- Line 1: frequency in MHz
- Line 2: last five digits of catalogue number
- Line 3: code for month and year of manufacture.

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage		4.75	5.0	5.25	V
I_{CC}	supply current		–	9	15	mA
V_{contr}	control voltage range		1	–	4	V
n	output load (fan-out)	TTL load	–	–	3	
T_{op}	operating temperature range		0	–	+60	°C
Frequency characteristics						
f_{nom}	nominal frequency range		7000	–	17 000	kHz
$\Delta f/f_{nom}$	initial frequency tolerance with respect to the nominal frequency	V_{contr} = +1 to +4 V	–	150	–	ppm
$\Delta f/f(tot)$	total frequency tolerance due to ageing, temperature, supply voltage and load variations		–	–	±40	ppm
$\Delta f/f/\Delta V_{contr}$	pulling sensitivity per volt		–	+100	–	ppm/V
Output characteristics						
	output logic levels	compatible with HCMOS	–	–	–	
δ	duty cycle		40	–	60	%

All references to ppm = 10^{-6}.

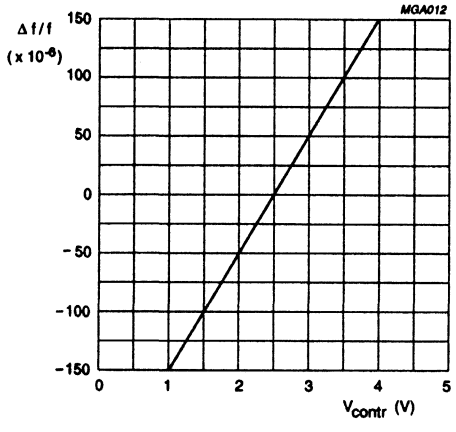


Fig.2 Frequency as a function of control voltage characteristic (typical curve).

Temperature Compensated Crystal Oscillator Type TC201

9922 511 3.... series

DESCRIPTION

The type TC201 temperature compensated crystal oscillator comprises of a quartz crystal oscillator and a temperature controlled circuit that compensates for frequency changes over the whole temperature range. The assembly is encapsulated in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has five connecting pins. The unit is provided with two connecting studs and can be mounted on a printed-circuit board and/or secured by 2 bolts (M2).

APPLICATIONS

- Mobile telephony (base stations)
- Electronic timers
- Electronic measuring equipment
- Frequency synthesizers.

QUICK REFERENCE DATA

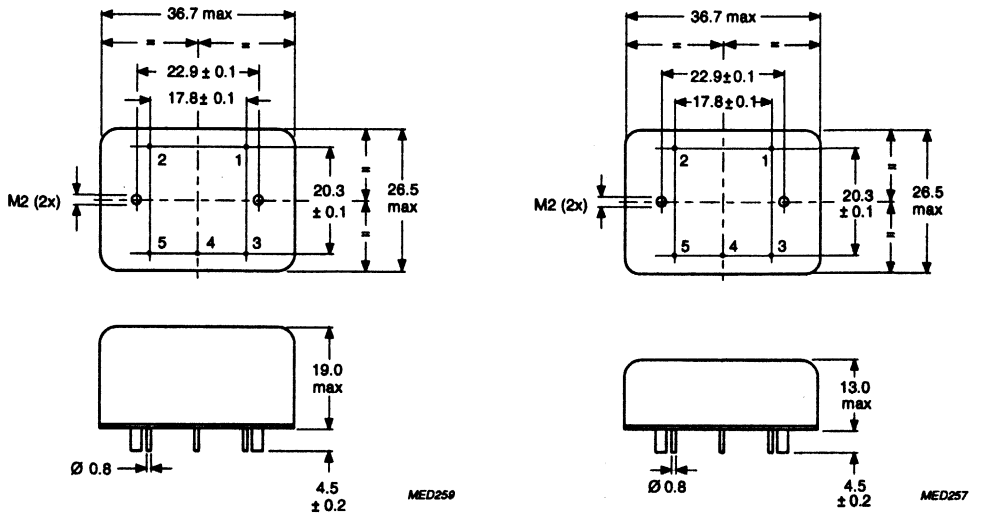
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	4000	20 000	kHz
$\Delta f/f$	frequency stability in the temperature range: –40 to +85 °C	–	±1	ppm
T_{op}	operating temperature range	–40	+85	°C
V_{CC}	supply voltage range (fixed value)	5	12	V
Z_L	load impedance (fixed value)	50	1000	Ω
m	mass	–	35	g

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC201

9922 511 3.... series

MECHANICAL DATA



B2 (4-20 MHz) B'2 (8-20 MHz)

Dimensions in mm.

Fig.1 Package outline B2.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
GND	2	ground
R_{ext}	3	external trimming resistor connected between pins 3 and 4
R_{ext}	4	external trimming resistor connected between pins 3 and 4
V_{osc}	5	oscillator output

Marking

Type	catalogue code
Freq ...MHz	nominal frequency
Δf25°C ..Hz	value for frequency adjustment
Range ...°C	temperature range
No .../...	serial number/code for week and year of manufacture

Mass

Typical: 35 g

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage (fixed value)		5	–	12	V
I_{CC}	supply current		–	6	10	mA
T_{op}	operating temperature range		–40	–	+85	°C
T_{stg}	storage temperature range		–55	–	+125	°C
Frequency characteristics						
f_{nom}	nominal frequency range		4000	–	20 000	kHz
Δf/f	frequency tuning range		±3	±5	–	ppm
Δf/f	frequency tolerance over operating temperature range referenced to the nominal frequency (note)	V_{CC} = 5 to 12 V –20 to +70 °C –40 to +85 °C V_{CC} = 12 V only –40 to +85 °C –55 to –40 °C +85 to +105 °C	 – – – – –	 – – – – –	 ±1 ±1 ±2 ±5 ±5	 ppm ppm ppm ppm ppm
Δf/f	frequency stability versus supply voltage variations	per % V_{CC}	–	–	±0.04	ppm
Δf/f	frequency stability versus load variations	Z_L = 1 kΩ ±5%	–	–	±0.1	ppm
Δf/f	frequency ageing	per year	–	–	±1.0	ppm
Output characteristics						
	phase noise	at 1 kHz	–	–	–130	dB_c/Hz
Z_L	load impedance	fixed value	50	–	1000	Ω
V_{OSC}	output voltage (RMS value)	Z_L = 50 Ω Z_L =1000 Ω	200 350	– –	– –	mV mV

All references to ppm = 10^{-6}.

Note

It is not guaranteed that the nominal frequency occurs at room temperature. The frequency can be shifted by an external variable resistor (0 to 10 kΩ) between pins 3 and 4.

For optimum stability over the whole temperature range the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf. A trimming range of minimum ±3 ppm is still available to correct ageing influences.

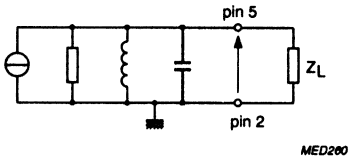


Fig.2 Equivalent output circuit.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+40 °C; at RH >95%	$\Delta f/f \leq 0.3$ ppm
N	thermal shock	−55 to +105 °C; t_t = 30 minutes; 5 cycles; relaxation 24 hours	$\Delta f/f \leq 0.5$ ppm
Fc	vibration	frequency 10 to 2000 Hz; acceleration 15 g; total time 4 hours/axis one octave/minute	$\Delta f/f \leq 1$ ppm
Ea	shock	50 g; half sine; 6 directions; 1 blow/direction	$\Delta f/f \leq 1$ ppm
Ta	solderability	235 ±5 °C; 5 s	good tinning
Tb	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 1$ ppm
	storage	16 hours at +105 °C 2 hours at −55 °C	$\Delta f/f \leq 0.5$ ppm

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC202

9922 511 1.... series

DESCRIPTION

The type TC202 temperature compensated crystal oscillator comprises of a quartz crystal oscillator and a temperature controlled circuit that compensates for frequency changes over the whole temperature range. The assembly is encapsulated in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has five connecting pins. The unit is provided with two connecting studs and can be mounted on a printed-circuit board and/or secured by 2 bolts (M2).

APPLICATIONS

- Mobile telephony (base stations)
- Electronic timers
- Electronic measuring equipment
- Frequency synthesizers.

QUICK REFERENCE DATA

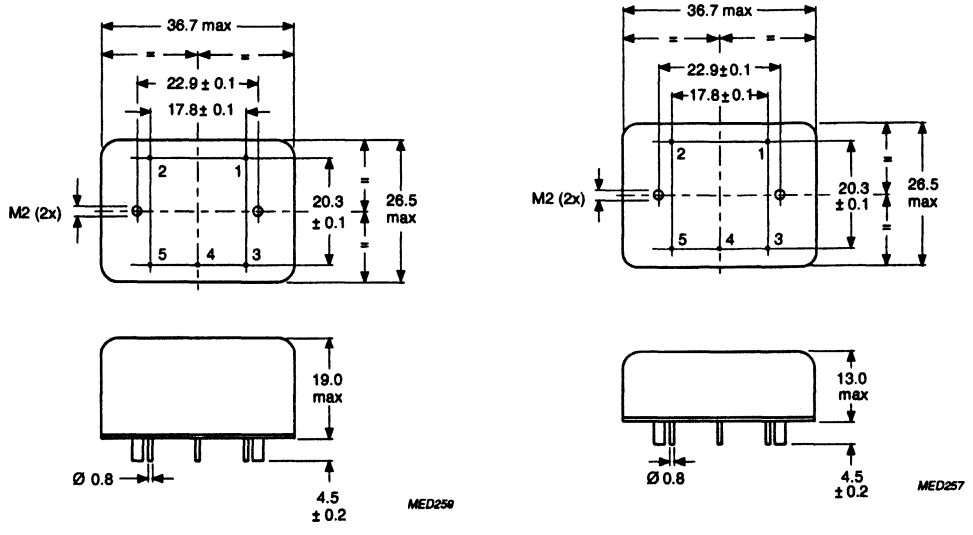
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	4000	20 000	kHz
$\Delta f/f$	frequency stability in the temperature range: –40 to +85 °C	–	±1	ppm
T_{op}	operating temperature range	–40	+85	°C
V_{CC}	supply voltage range	4.75	5.25	V
n	fan-out	–	3	LSTTL
m	mass	–	35	g

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC202

9922 511 1.... series

MECHANICAL DATA



B2 (4-20 MHz) B'2 (8-20 MHz)

Dimensions in mm.

Fig.1 Package outline B2.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
GND	2	ground
R_{ext}	3	external trimming resistor connected between pins 3 and 4
R_{ext}	4	external trimming resistor connected between pins 3 and 4
V_{osc}	5	oscillator output

Marking

Type	catalogue code
Freq ...MHz	nominal frequency
Δf25°C ..Hz	value for frequency adjustment
Range ...°C	temperature range
No .../...	serial number/code for week and year of manufacture

Mass

Typical: 35 g

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage		4.75	5	5.25	V
I_{CC}	supply current		–	6	10	mA
T_{op}	operating temperature range		-20	–	+70	°C
T_{stg}	storage temperature range		-55	–	+105	°C
Frequency characteristics						
f_{nom}	nominal frequency range		4000	–	20 000	kHz
Δf/f	frequency tuning range		±3	±5	–	ppm
Δf/f	frequency tolerance over operating temperature range referenced to the nominal frequency (note)	V_{CC} = 5 V -20 to +70 °C -40 to +85 °C	 – –	 – –	 ±1 ±1	 ppm ppm
Δf/f	frequency stability versus supply voltage variations	per %V_{CC}	–	–	±0.04	ppm
Δf/f	frequency ageing	per year	–	–	±1	ppm
	phase noise	at 1 kHz	–	–	-130	dB_c/Hz
Output characteristics						
n	fan-out		–	–	3	LSTTL
δ	duty cycle		40	–	60	%

All references to ppm = 10^{-6}.

Note

It is not guaranteed that the nominal frequency occurs at room temperature. The frequency can be shifted by an external variable resistor (0 to 10 kΩ) between pins 3 and 4.

For optimum stability over the whole temperature range the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf. A trimming range of minimum ±3 ppm is still available to correct ageing influences.

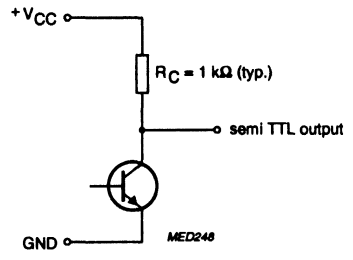


Fig.2 Equivalent output circuit.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+40 °C; at RH >95%	$\Delta f/f \leq 0.3$ ppm
N	thermal shock	−55 to +105 °C; t_t = 30 minutes; 5 cycles; relaxation 24 hours	$\Delta f/f \leq 0.5$ ppm
Fc	vibration	frequency 10 to 2000 Hz; acceleration 15 g; total time 4 hours/axis one octave/minute	$\Delta f/f \leq 1$ ppm
Ea	shock	50 g; half sine; 6 directions; 1 blow/direction	$\Delta f/f \leq 1$ ppm
Ta	solderability	235 ±5 °C; 5 s	good tinning
Tb	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 1$ ppm
	storage	16 hours at +105 °C; 2 hours at −55 °C	$\Delta f/f \leq 0.5$ ppm

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC301

9922 510 3.... series

DESCRIPTION

The type TC301 temperature compensated crystal oscillator comprises of a quartz crystal oscillator and a temperature controlled circuit that compensates for frequency changes over the whole temperature range. The assembly is encapsulated in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has five connecting pins which can be mounted on a printed-circuit board with a grid pitch of 2.54 mm.

APPLICATIONS

- Mobile telephony (base stations)
- Electronic timers
- Electronic measuring equipment
- Frequency synthesizers.

QUICK REFERENCE DATA

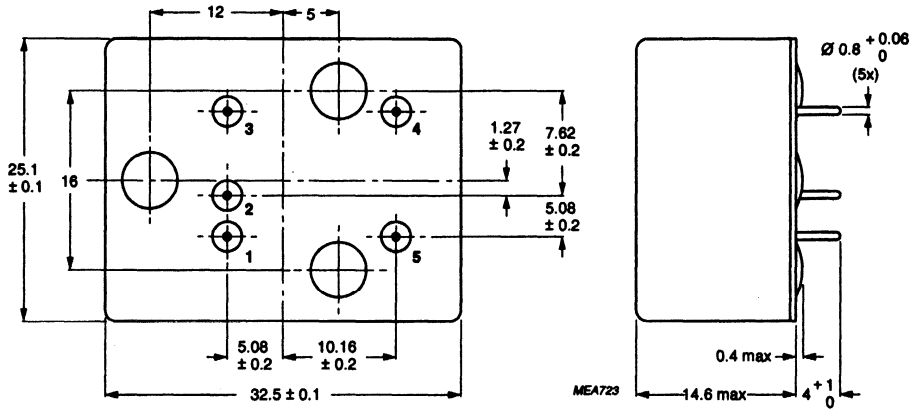
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	4500	15 000	kHz
$\Delta f/f$	frequency stability in the temperature range:			
	class 'A': –20 to +70 °C	–	±2	ppm
	class 'B': –10 to +60 °C	–	±1.5	ppm
	class 'C': 0 to +50 °C	–	±1	ppm
T_{op}	operating temperature range			
	class 'A'	–20	+70	°C
	class 'B'	–10	+60	°C
	class 'C'	0	+50	°C
V_{CC}	supply voltage range (fixed value)	8	24	V
Z_L	load impedance	500	–	Ω
m	mass	–	25	g

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC301

9922 510 3.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
GND	2	ground (case)
C_{ext}	3	external trimming capacitor connected between pins 3 and 2
i.c.	4	internally connected
V_{osc}	5	oscillator output

Marking

Type	catalogue code
Freq ...MHz	nominal frequency
Δf25°C ..Hz	value for frequency adjustment
Range ...°C	temperature range
No .../...	serial number/code for week and year of manufacture

Mass

Maximum: 25 g

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage (fixed value)	see connection diagram; R1 = 470 Ω	8	–	24	V
I_{CC}	supply current		–	4	6	mA
Frequency characteristics						
f_{nom}	nominal frequency range		4500	–	15 000	kHz
Δf/f	frequency stability with respect to the nominal frequency (f_{nom}) after adjustment	ΔT_{amb} <1 K/minute Z_L = 500 Ω	–	–	–	
Δf/f	frequency deviation due to temperature variation					
	class 'A'	–20 to +70 °C	–	–	±2	ppm
	class 'B'	–10 to +60 °C	–	–	±1.5	ppm
	class 'C'	0 to +50 °C	–	–	±1	ppm
Δf/f	frequency ageing	per year	–	–	±1	ppm
Δf/f	ageing correction	(note)	±2	–	–	ppm
Additional characteristics						
R_i	internal resistance	(see Fig.2)	2660	2800	2940	Ω
C_i	internal capacitance	(see Fig.2)	–	5.5	–	pF
V_i	internal voltage source	(see Fig.2)	360	600	840	mV
Z_L	load impedance		500	–	–	Ω
V_{osc}	output voltage (RMS value)	(see Figs 2 and 4)	–	–	–	V
T_{stg}	storage temperature		–25	–	+85	°C

All references to ppm = 10^{-6}.

Note

It is not guaranteed that the nominal frequency occurs at room temperature. The frequency can be shifted by an external variable capacitor of max. 60 pF between pins 2 and 3.

For optimum stability over the whole temperature range the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf. A trimming range of minimum ±2 ppm is still available to correct ageing influences.

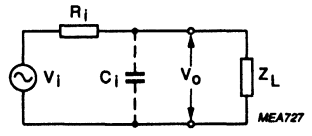


Fig.2 Equivalent output circuit.

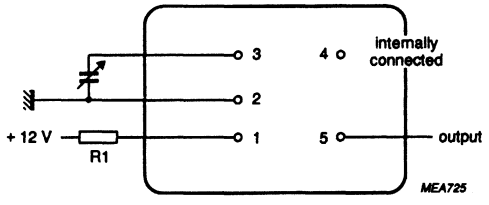


Fig.3 Connection diagram.

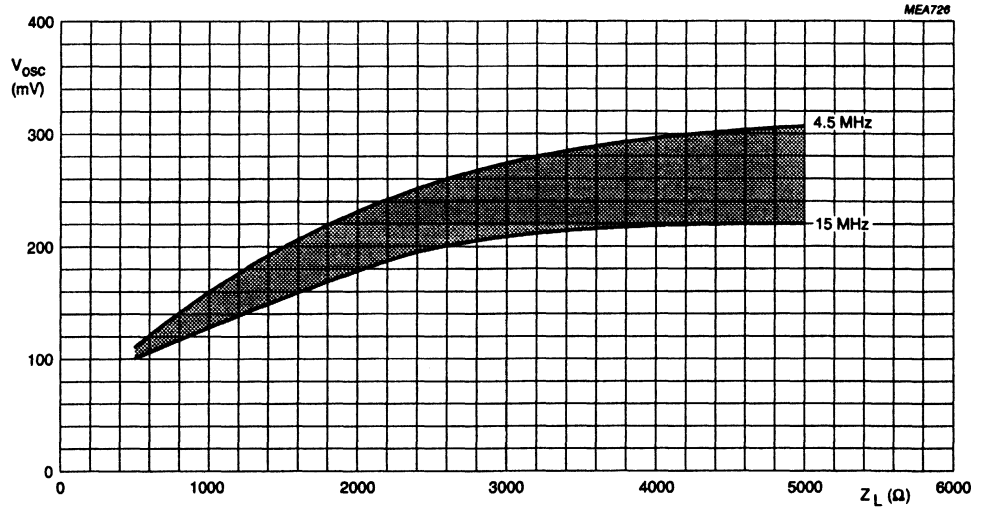


Fig.4 Output voltage as a function of load impedance; typical values.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	$\Delta f/f \leq 0.5$ ppm
Ea	shock	50 g; 6 directions; 1 blow/direction	$\Delta f/f \leq 0.5$ ppm
Fc	vibration	frequency 10 to 500 to 10 Hz; acceleration 10 g; 3 directions; 30 minutes/direction	$\Delta f/f \leq 0.5$ ppm
Tb	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 0.5$ ppm

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC302

9922 510 3.... series

DESCRIPTION

The type TC302 temperature compensated crystal oscillator comprises of a quartz crystal oscillator and a temperature controlled circuit that compensates for frequency changes over the whole temperature range. The assembly is encapsulated in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has five connecting pins which can be mounted on a printed-circuit board with a grid pitch of 2.54 mm.

APPLICATIONS

- Mobile telephony (base stations)
- Electronic timers
- Electronic measuring equipment
- Frequency synthesizers.

QUICK REFERENCE DATA

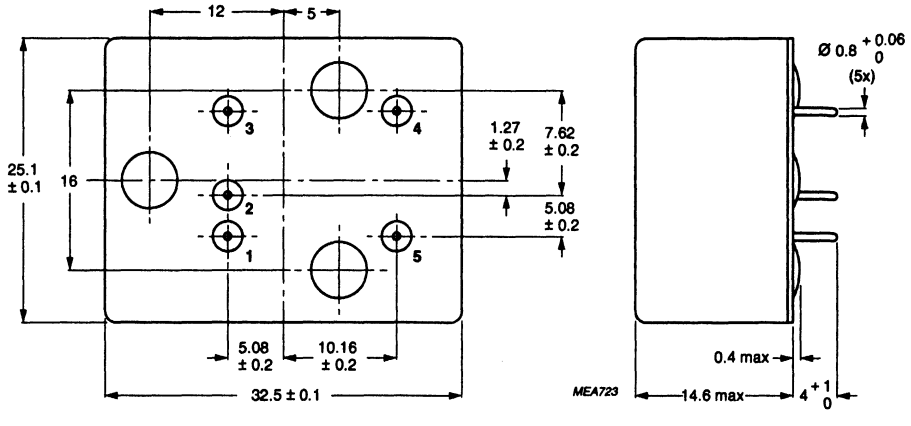
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	4500	12 000	kHz
$\Delta f/f$	frequency stability in the temperature range:			
	class 'A': −20 to +70 °C	−	±2	ppm
	class 'B': −10 to +60 °C	−	±1.5	ppm
	class 'C': 0 to +50 °C	−	±1	ppm
T_{op}	operating temperature range			
	class 'A'	−20	+70	°C
	class 'B'	−10	+60	°C
	class 'C'	0	+50	°C
V_{CC}	supply voltage range (fixed value)	8	24	V
Z_L	load impedance	500	−	Ω
m	mass	−	25	g

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC302

9922 510 3.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
GND	2	ground (case)
R_{ext}	3	external trimming resistor connected between pins 3 and 2
i.c.	4	internally connected
V_{osc}	5	oscillator output

Marking

Type	catalogue code
Freq ...MHz	nominal frequency
Δf25°C ..Hz	value for frequency adjustment
Range ...°C	temperature range
No ../..	serial number/code for week and year of manufacture

Mass

Maximum: 25 g

Temperature Compensated Crystal Oscillator Type TC302

9922 510 3.... series

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage (fixed value)	see connection diagram; R1 = 0 to 470 Ω	8	–	24	V
I_{CC}	supply current		–	4	6	mA
Frequency characteristics						
f_{nom}	nominal frequency range		4500	–	12 000	kHz
Δf/f	frequency stability with respect to the nominal frequency (f_{nom}) after adjustment	(note) ΔT_{amb} <1 K/minute Z_L = 500 Ω	–	–	–	
Δf/f	frequency deviation due to temperature variation					
	class 'A'	−20 to +70 °C	–	–	±2	ppm
	class 'B'	−10 to +60 °C	–	–	±1.5	ppm
	class 'C'	0 to +50 °C	–	–	±1	ppm
Δf/f	frequency ageing	per year	–	–	±1	ppm
Δf/f	ageing correction	(see note)	±2	–	–	ppm
Additional characteristics						
R_i	internal resistance	(see Fig.2)	2660	2800	2940	Ω
C_i	internal capacitance	(see Fig.2)	–	5.5	–	pF
V_i	internal voltage source	(see Fig.2)	360	600	840	mV
Z_L	load impedance		500	–	–	Ω
V_{osc}	output voltage (RMS value)	(see Figs 2 and 4)	–	–	–	V
T_{stg}	storage temperature range		−25	–	+85	°C

All references to ppm = 10^{-6}.

Note

1. It is not guaranteed that the nominal frequency occurs at room temperature. The frequency can be shifted by an external variable resistor (max. 2 kΩ) between pins 2 and 3.

For optimum stability over the whole temperature range the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf. A trimming range of minimum ±2 ppm is still available to correct ageing influences.

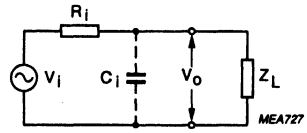


Fig.2 Equivalent output circuit.

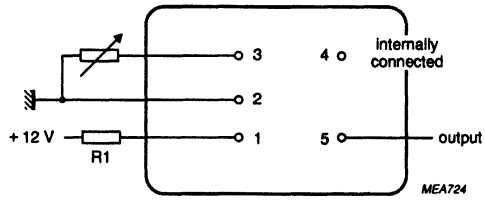


Fig.3 Connection diagram.

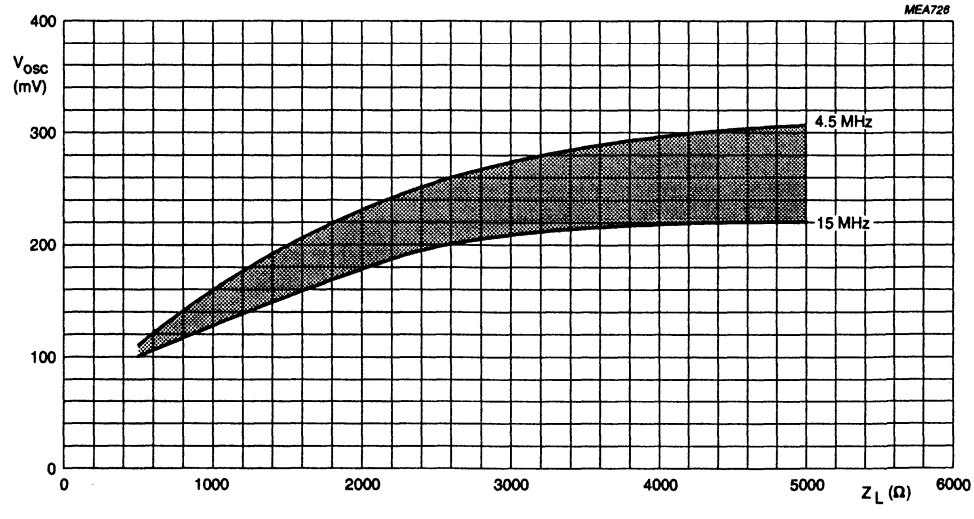


Fig.4 Output voltage as a function of load impedance; typical values.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	$\Delta f/f \leq 0.5$ ppm
Ea	shock	50 g; 6 directions; 1 blow/direction	$\Delta f/f \leq 0.5$ ppm
Fc	vibration	frequency 10 to 500 to 10 Hz; acceleration 10 g; 3 directions; 30 minutes/direction	$\Delta f/f \leq 0.5$ ppm
Tb	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 0.5$ ppm

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC303

9922 510 3.... series

DESCRIPTION

The type TC303 temperature compensated crystal oscillator comprises of a quartz crystal oscillator and a temperature controlled circuit that compensates for frequency changes over the whole temperature range. The assembly is encapsulated in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has five connecting pins which can be mounted on a printed-circuit board with a grid pitch of 2.54 mm.

APPLICATIONS

- Mobile telephony (base stations)
- Electronic timers
- Electronic measuring equipment
- Frequency synthesizers.

QUICK REFERENCE DATA

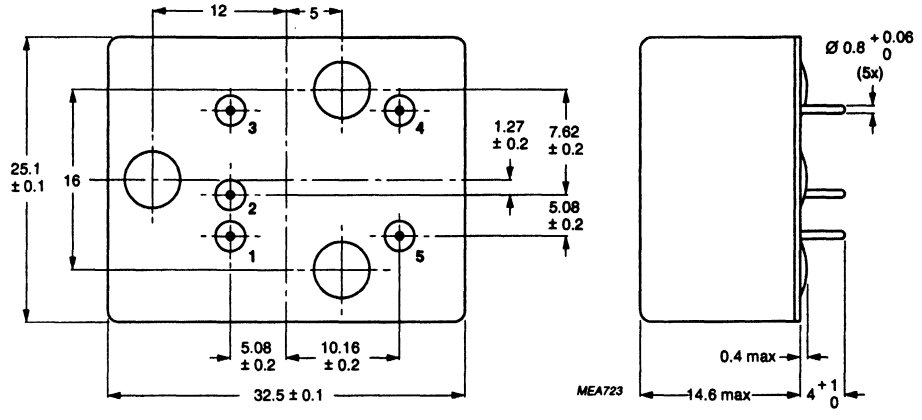
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	4000	20 000	kHz
$\Delta f/f$	frequency stability in the temperature range:			
	−20 to +70 °C	−	±1	ppm
	−40 to +85 °C	−	±1	ppm
	−40 to +85 °C	−	±2	ppm
	−55 to −40 °C	−	±5	ppm
	+85 to +105 °C	−	±5	ppm
T_{stg}	storage temperature range	−55	+125	°C
V_{CC}	supply voltage range	11.4	12.6	V
Z_L	load impedance (fixed value)	50	1000	Ω
m	mass	−	25	g

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC303

9922 510 3.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
GND	2	ground (case)
C_{ext}	3	external trimming capacitor connected between pins 3 and 2
i.c.	4	internally connected
V_{osc}	5	oscillator output

Marking

Type	catalogue code
Freq ...MHz	nominal frequency
Δf25°C ..Hz	value for frequency adjustment
Range ...°C	temperature range
No .../...	serial number/code for week and year of manufacture

Mass

Maximum : 25 g

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage		11.4	12	12.6	V
I_{CC}	supply current		–	5	8	mA
Frequency characteristics						
f_{nom}	nominal frequency range		4000	–	20 000	kHz
$\Delta f/f$	frequency tuning range		±2	±3	–	ppm
$\Delta f/f$	frequency stability with respect to the nominal frequency (f_{nom}) after adjustment	(note) –20 to +70 °C –40 to +85 °C –40 to +85 °C –55 to –40 °C +85 to +105 °C	 – – – – –	 – – – – –	 ±1 ±1 ±2 ±5 ±5	 ppm ppm ppm ppm ppm
$\Delta f/f$	frequency ageing	per year	–	–	±1	ppm
$\Delta f/f$	frequency deviation due to load impedance variation	ΔZ_L = ±5%	–	–	±0.1	ppm
$\Delta f/f$	frequency deviation due to supply voltage variation	per % V_{CC}	–	–	±0.04	ppm
Additional characteristics						
Z_L	load impedance	fixed value	50	–	1000	Ω
V_{osc}	oscillator output voltage (RMS value)	Z_L = 50 Ω Z_L = 1000 Ω	200 350	– –	– –	mV mV
T_{stg}	storage temperature range		–55	–	+125	°C

All references to ppm = 10^{-6}.

Note

It is not guaranteed that the nominal frequency occurs at room temperature. The frequency can be shifted by an external variable capacitor (max. 60 pF) between pins 2 and 3.

For optimum stability over the whole temperature range the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf. A trimming range of minimum ±2 ppm is still available to correct ageing influences.

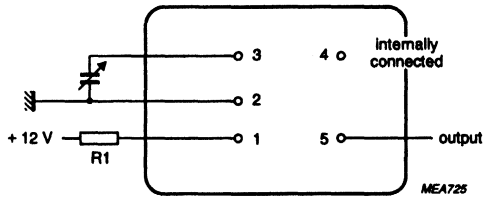


Fig.2 Connection diagram.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+40 at RH >95%	$\Delta f/f \leq 0.3$ ppm
N	thermal shock	−55 to +105 °C; t_t = 30 minutes; 5 cycles; relaxation 24 hours	$\Delta f/f \leq 0.5$ ppm
Fc	vibration	frequency 10 to 2000 Hz; 15 minutes or 15 g; (f_c=57 Hz) cycle time: 20 minutes total time: 12 hours	$\Delta f/f \leq 1$ ppm
Ea	shock		$\Delta f/f \leq 1$ ppm
Ta	solderability	235 ±5 °C; 5 s	good tinning $\Delta f/f \leq 0.5$ ppm
Tb	resistance to solvents		no damage
	storage	16 hours at +105°C 2 hours at −55°C	$\Delta f/f \leq 0.5$ ppm

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC304

9922 510 3.... series

DESCRIPTION

The type TC304 temperature compensated crystal oscillator comprises of a quartz crystal oscillator and a temperature controlled circuit that compensates for frequency changes over the whole temperature range. The assembly is encapsulated in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has five connecting pins which can be mounted on a printed-circuit board with a grid pitch of 2.54 mm.

APPLICATIONS

- Mobile telephony (base stations)
- Electronic timers
- Electronic measuring equipment
- Frequency synthesizers.

QUICK REFERENCE DATA

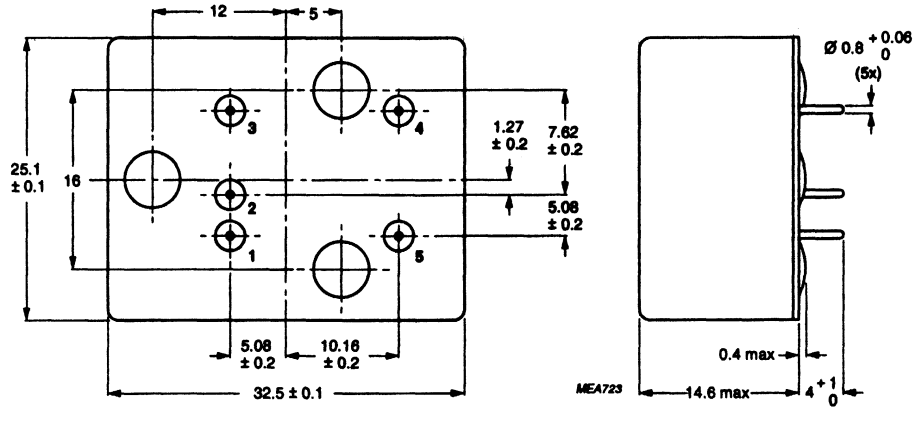
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	4000	20 000	kHz
$\Delta f/f$	frequency stability in the temperature range:			
	–20 to +70 °C	–	±1	ppm
	–40 to +85 °C	–	±1	ppm
	–40 to +85 °C	–	±2	ppm
	–55 to –40 °C	–	±5	ppm
	+85 to +105 °C	–	±5	ppm
T_{stg}	storage temperature range	–55	+125	°C
V_{CC}	supply voltage range	11.4	12.6	V
Z_L	load impedance (fixed value)	50	1000	Ω
m	mass	–	25	g

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC304

9922 510 3.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
GND	2	ground (case)
R_{ext}	3	external trimming resistor connected between pins 3 and 2
i.c.	4	internally connected
V_{osc}	5	oscillator output

Marking

Type	catalogue code
Freq ...MHz	nominal frequency
Δf25°C ..Hz	value for frequency adjustment
Range ...°C	temperature range
No .../...	serial number/code for week and year of manufacture

Mass

Maximum: 25 g

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage		11.4	12	12.6	V
I_{CC}	supply currrent		–	5	8	mA
Frequency characteristics						
f_{nom}	nominal frequency range		4000	–	20 000	kHz
$\Delta f/f$	frequency tuning range		±2	±3	–	ppm
$\Delta f/f$	frequency stability with respect to the nominal frequency (f_{nom}) after adjustment	(note) –20 to +70 °C –40 to +85 °C –40 to +85 °C –55 to –40 °C +85 to +105 °C	 – – – – –	 – – – – –	 ±1 ±1 ±2 ±5 ±5	 ppm ppm ppm ppm ppm
$\Delta f/f$	frequency ageing	per year	–	–	±1	ppm
$\Delta f/f$	frequency deviation due to load impedance variation	ΔZ_L = ±5%	–	–	±0.1	ppm
$\Delta f/f$	frequency deviation due to supply voltage variation	per % V_{CC}	–	–	±0.04	ppm
Additional characteristics						
Z_L	load impedance	fixed value	50	–	1000	Ω
V_{osc}	oscillator output voltage (RMS value)	Z_L = 50 Ω Z_L = 1000 Ω	200 350	– –	– –	mV mV
T_{stg}	storage temperature range		–55	–	+125	°C

All references to ppm = 10^{-6}.

Note

It is not guaranteed that the nominal frequency occurs at room temperature. The frequency can be shifted by an external variable resistor (max. 1 kΩ) between pins 2 and 3.

For optimum stability over the whole temperature range the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf. A trimming range of minimum ±2 ppm is still available to correct ageing influences.

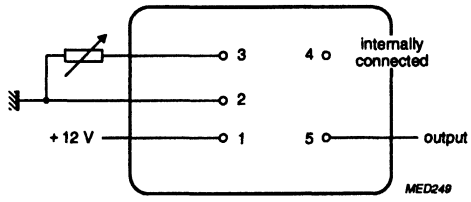


Fig.2 Connection diagram.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+40 at RH >95%	$\Delta f/f \leq 0.3$ ppm
N	thermal shock	−55 to +105 °C; t_t = 30 minutes; 5 cycles; relaxation 24 hours	$\Delta f/f \leq 0.5$ ppm
Fc	vibration	frequency 10 to 2000 Hz; 15 minutes or 15 g; (f_c=57 Hz) cycle time: 20 minutes total time: 12 hours	$\Delta f/f \leq 1$ ppm
Ea	shock		$\Delta f/f \leq 1$ ppm
Ta	solderability	235 ±5 °C; 5 s	good tinning $\Delta f/f \leq 1$ ppm
Tb	resistance to solvents		no damage
	storage	16 hours at +105°C; 2 hours at −55°C	$\Delta f/f \leq 1$ ppm

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC305

9922 510 1.... series

DESCRIPTION

The type TC305 temperature compensated crystal oscillator comprises of a quartz crystal oscillator and a temperature controlled circuit that compensates for frequency changes over the whole temperature range. The assembly is encapsulated in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has five connecting pins which can be mounted on a printed-circuit board with a grid pitch of 2.54 mm.

APPLICATIONS

- Mobile telephony (base stations)
- Electronic timers
- Electronic measuring equipment
- Frequency synthesizers.

QUICK REFERENCE DATA

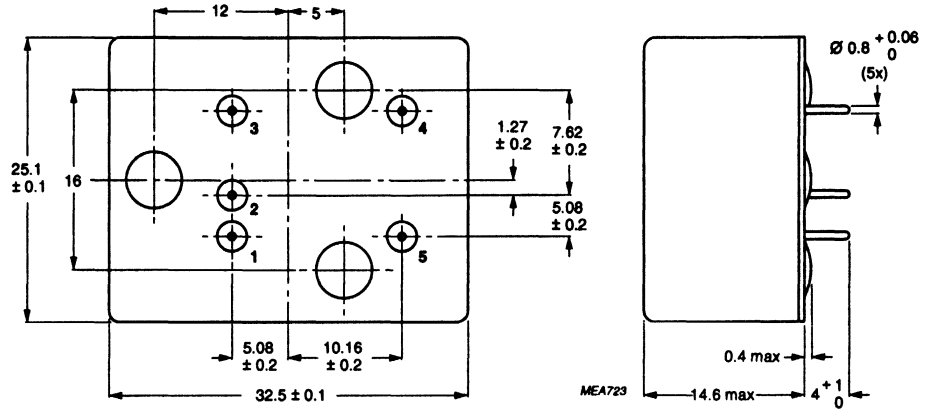
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	20 000	50 000	kHz
$\Delta f/f$	frequency stability in the temperature range:			
	class 'A': 0 to +50 °C	–	±1	ppm
	class 'B': –20 to +70 °C	–	±2	ppm
	class 'C': 0 to +50 °C	–	±2	ppm
	class 'D': –20 to +70 °C	–	±3	ppm
T_{op}	operating temperature range			
	class 'A'	0	+50	°C
	class 'B'	–20	+70	°C
	class 'C'	0	+50	°C
	class 'D'	–20	+70	°C
V_{CC}	supply voltage range			
	class 'A' and 'B'	11.76	12.24	V
	class 'C' and 'D'	10.8	13.2	V
Z_L	load impedance	500	–	Ω
m	mass	–	25	g

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC305

9922 510 1.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
GND	2	ground (case)
C_{ext}	3	external trimming capacitor connected between pins 3 and 2
i.c.	4	internally connected
V_{osc}	5	oscillator output

Marking

Type	catalogue code
Freq ...MHz	nominal frequency
Δf25°C ..Hz	value for frequency adjustment
Range ...°C	temperature range
No .../...	serial number/code for week and year of manufacture

Mass

Maximum: 25 g

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage class 'A' and 'B' class 'C' and 'D'		 11.76 10.8	 12 12	 12.24 13.2	 V V
I_{CC}	supply current		–	13	15	mA
Frequency characteristics						
f_{nom}	nominal frequency range		20 000	–	50 000	kHz
$\Delta f/f$	frequency stability with respect to the nominal frequency (f_{nom}) after adjustment	(see Figs 2 and 4) ΔT_{amb}<1 K/minute V_{CC} = 12 V; Z_L = 500 Ω				
	class 'A'	0 to +50 °C	–	–	±1	ppm
	class 'B'	–20 to +70 °C	–	–	±2	ppm
	class 'C'	0 to +50 °C	–	–	±2	ppm
	class 'D'	–20 to +70 °C	–	–	±3	ppm
$\Delta f/f$	frequency ageing	per year	–	–	±1	ppm
$\Delta f/f$	ageing correction	(note)	±2	–	–	ppm
Additional characteristics						
R_i	internal resistance		2660	2800	2940	Ω
C_i	internal capacitance		–	5.5	–	pF
V_i	internal voltage source		–	600	–	mV
Z_L	load impedance		500	–	–	Ω
V_o	output voltage	(see Fig.5)	–	–	–	V
T_{stg}	storage temperature range		–25	–	+85	°C

All references to ppm = 10^{-6}.

Note

It is not guaranteed that the nominal frequency occurs at room temperature. The frequency can be shifted by an external variable capacitor (max. 20 pF) between pins 2 and 3.

For optimum stability over the whole temperature range the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf. A trimming range of minimum ±2 ppm is still available to correct ageing influences.

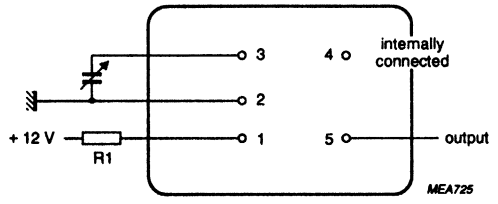


Fig.2 Connection diagram. R1 = 390Ω.

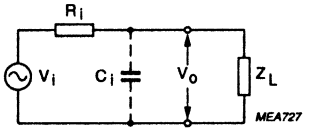


Fig.3 Equivalent circuit.

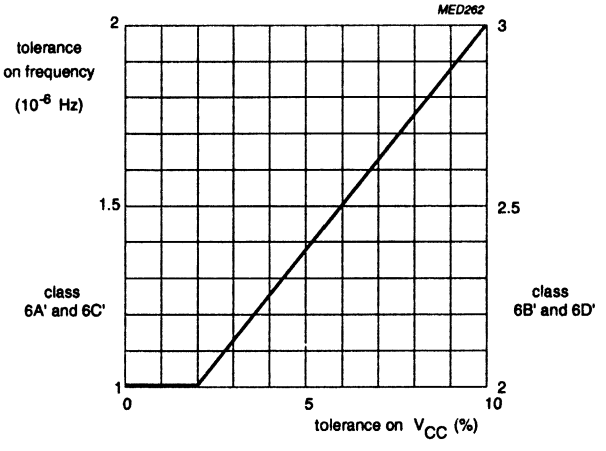


Fig.4 Frequency stability (Δf_{nom}) as a function of the tolerance on supply voltage (V_{CC}) over the whole temperature range.

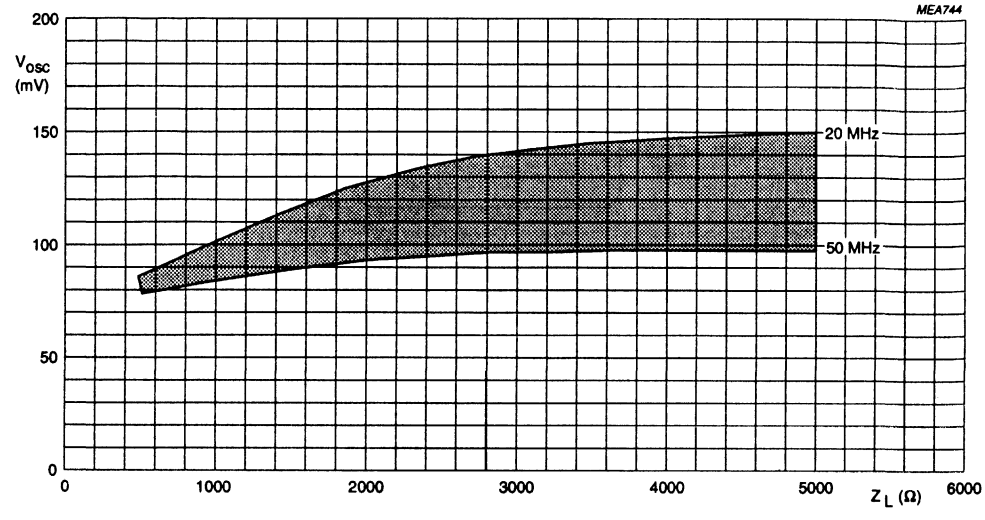


Fig.5 Output voltage (V_o) as a function of load impedance (Z_L); typical values.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	$\Delta f/f \leq 0.5$ ppm
Ea	shock	50 g; 6 directions; 1 blow/direction	$\Delta f/f \leq 0.5$ ppm
Fc	vibration	frequency 10 to 500 to 10 Hz; acceleration 10 g; 3 directions; 30 minutes/direction	$\Delta f/f \leq 0.5$ ppm
Tb	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 0.5$ ppm

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC501

9922 513 3.... series

DESCRIPTION

The type TC501 temperature compensated crystal oscillator comprises of a quartz crystal oscillator and a temperature controlled circuit that compensates for frequency changes over the whole temperature range. The assembly is encapsulated in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has five connecting pins which can be mounted on a printed-circuit board with a grid pitch of 2.54 mm.

APPLICATIONS

- Mobile telephony (base stations)
- Electronic timers
- Electronic measuring equipment
- Frequency synthesizers.

QUICK REFERENCE DATA

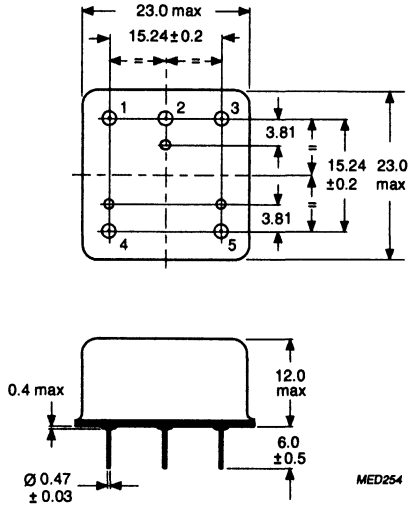
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	6000	20 000	kHz
$\Delta f/f$	frequency stability in the temperature range: –40 to +85 °C	–	±1	ppm
T_{op}	operating temperature range	–40	+85	°C
V_{CC}	supply voltage range (fixed value)	5	12	V
Z_L	load impedance (fixed value)	50	1000	Ω
m	mass	–	10	g

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC501

9922 513 3.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline. 85

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
V_{osc}	2	oscillator output
GND	3	ground (case)
R_{ext}	4	external trimming resistor connected between pins 4 and GND
GND	5	ground (case)

Marking

Type	catalogue code
Freq ...MHz	nominal frequency
Δf25°C ..Hz	value for frequency adjustment
Range ...°C	temperature range
No .../...	serial number/code for week and year of manufacture

Mass

Maximum: 10 g

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage range	fixed value	5	–	12	V
I_{CC}	supply current		–	4	5	mA
Frequency characteristics						
f_{nom}	nominal frequency range		6000	–	20 000	kHz
$\Delta f/f$	frequency tuning range		±5	–	–	ppm
$\Delta f/f$	frequency stability with respect to the nominal frequency (f_{nom}) in the temperature range	(note)				
$\Delta f/f$	frequency deviation due to temperature variation	V_{CC} = +5V to 12 V T_{op} = –20 to +70 °C T_{op} = –40 to +85 °C V_{CC} = 12 V only T_{op} = –40 to +85 °C T_{op} = –55 to –40 °C T_{op} = +85 to +105 °C	 – – – – –	 – – – – –	 ±1 ±1 ±2 ±5 ±5	 ppm ppm ppm ppm ppm
$\Delta f/f$	frequency ageing	per year	–	–	±1	ppm
$\Delta f/f$	frequency deviation due to load impedance variation	ΔZ_L = ±10%	–	–	±0.2	ppm
$\Delta f/f$	frequency deviation due to supply voltage variation	V_{CC} ±5%	–	–	±0.1	ppm
Additional characteristics						
Z_L	load impedance	fixed value	50	–	1000	Ω
	phase noise	at 1 kHz	–	–	–130	dB_c/Hz
V_{osc}	output voltage (RMS value)	Z_L = 50 Ω Z_L = 1000 Ω	80 350	– –	– –	mV mV
T_{stg}	storage temperature range		–55	–	+125	°C

All references to ppm = 10^{-6}.

Note

It is not guaranteed that the nominal frequency occurs at room temperature. The frequency can be shifted by an external variable resistor (max. 10 kΩ) between pins 4 and 5.

For optimum stability over the whole temperature range the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf. A trimming range of minimum ±5 ppm is still available to correct ageing influences.

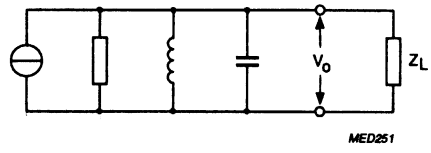


Fig.2 Equivalent circuit.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+40 °C at RH >95%	$\Delta f/f \leq 0.3$ ppm
N	thermal shock	−55 to +105 °C; t_t = 30 minutes; 5 cycles; relaxation 24 hours	$\Delta f/f \leq 0.5$ ppm
Fc	vibration	frequency 10 to 2000 Hz; 15 g; total time 4 hours/axis; one octave/minute	$\Delta f/f \leq 1$ ppm
Ea	shock	50 g half sine; 6 directions; 1 blow/direction	$\Delta f/f \leq 1$ ppm
T	solderability	235 ±5 °C; 5 s	good tinning
Tb	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 0.5$ ppm

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC502

9922 513 1.... series

DESCRIPTION

The type TC502 temperature compensated crystal oscillator comprises of a quartz crystal oscillator and a temperature controlled circuit that compensates for frequency changes over the whole temperature range. The assembly is encapsulated in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has five connecting pins which can be mounted on a printed-circuit board with a grid pitch of 2.54 mm.

APPLICATIONS

- Mobile telephony (base stations)
- Electronic timers
- Electronic measuring equipment
- Frequency synthesizers.

QUICK REFERENCE DATA

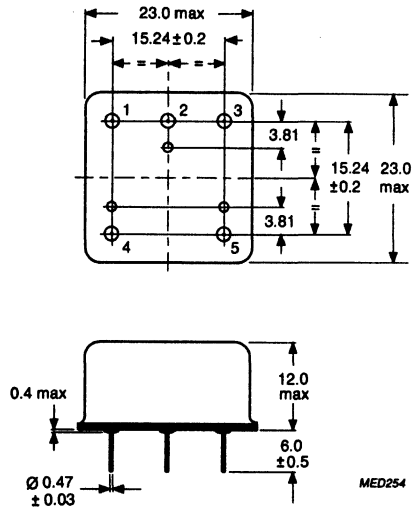
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	6000	20 000	kHz
$\Delta f/f$	frequency stability in the temperature range: –40 to +85 °C	–	±1	ppm
T_{op}	operating temperature range	–40	+85	°C
V_{CC}	supply voltage range	4.75	5.25	V
n	fan-out	–	3	LSTTL
m	mass	–	10	g

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC502

9922 513 1.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
V_{osc}	2	oscillator output
GND	3	ground (case)
R_{ext}	4	external trimming resistor connected between pins 4 and GND
GND	5	ground (case)

Marking

Δf25°C ...Hz	value for frequency adjustment
Freq ....MHz	nominal frequency
Type	catalogue code
No .../...	serial number/code for week and year of manufacture

Mass

Maximum: 10 g

Temperature Compensated Crystal Oscillator Type TC502

9922 513 1.... series

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage range		4.75	–	5.25	V
I_{CC}	supply current		–	4	6	mA
Frequency characteristics						
f_{nom}	nominal frequency range		6000	–	20 000	kHz
$\Delta f/f$	frequency tuning range		±5	–	–	ppm
$\Delta f/f$	frequency stability with respect to the nominal frequency (f_{nom}) in the temperature range	(note) V_{CC} = +5V to 12 V T_{op} = –20 to +70 °C T_{op} = –40 to +85 °C	 – –	 – –	 ±1 ±1	 ppm ppm
$\Delta f/f$	frequency ageing	per year	–	–	±1	ppm
$\Delta f/f$	frequency deviation due to supply voltage variation	V_{CC} ±5%	–	–	±0.1	ppm
Additional characteristics						
	phase noise	at 1 kHz	–	–	–130	dB_c/Hz
n	output load (fan-out)	LSTTL load	–	–	3	
T_{stg}	storage temperature range		–55	–	+125	°C

All references to ppm = 10^{-6}.

Note

It is not guaranteed that the nominal frequency occurs at room temperature. The frequency can be shifted by an external variable resistor (max. 10 kΩ) between pins 4 and 5.

For optimum stability over the whole temperature range the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf. A trimming range of minimum ±5 ppm is still available to correct ageing influences.

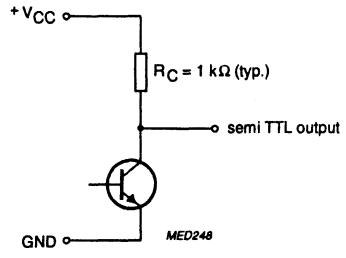


Fig.2 Equivalent circuit.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+40 °C at RH >95%	$\Delta f/f \leq 0.3$ ppm
N	thermal shock	−55 to +105 °C; t_1 = 30 minutes; 5 cycles; relaxation 24 hours	$\Delta f/f \leq 0.5$ ppm
Fc	vibration	frequency 10 to 2000 Hz; total time 4 hours/axis; one octave/minute	$\Delta f/f \leq 1$ ppm
Ea	shock	50 g half sine; 6 directions; 1 blow/direction	$\Delta f/f \leq 1$ ppm
Ta	solderability	235 ±5 °C; 5 s	good tinning
Tb	resistance to soldering heat	260 ±5 °C; maximum 10 ±1 s	$\Delta f/f \leq 1$ ppm

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC601

9922 514 3.... series

DESCRIPTION

The type TC601 temperature compensated crystal oscillator comprises of a quartz crystal oscillator and a temperature controlled circuit that compensates for frequency changes over the whole temperature range. The assembly is encapsulated in a metal housing. The package has four connecting pins which can be mounted on a printed-circuit board with a grid pitch of 2.54 mm.

APPLICATIONS

- Mobile telephony (base stations)
- Electronic timers
- Electronic measuring equipment
- Frequency synthesizers.

QUICK REFERENCE DATA

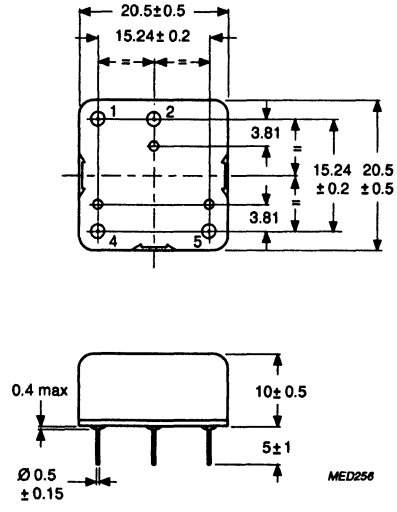
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	6000	20 000	kHz
$\Delta f/f$	frequency stability in the temperature range: –20 to +70 °C	–	±1	ppm
T_{op}	operating temperature range	–20	+70	°C
V_{CC}	supply voltage range (fixed value)	5	12	V
Z_L	load impedance (fixed value)	50	1000	Ω
m	mass	–	10	g

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC601

9922 514 3.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline. B6

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
V_{osc}	2	oscillator output
R_{ext}	4	external trimming resistor connected between pins 4 and 5
GND	5	ground (case)

Marking

Δf25°C ..Hz	value for frequency adjustment
Freq ...MHz	nominal frequency
Type	catalogue code
No .../...	serial number/code for week and year of manufacture

Mass

Maximum: 10 g

Temperature Compensated Crystal Oscillator Type TC601

9922 514 3.... series

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage range	fixed value	5	–	12	V
I_{CC}	supply current		–	4	5	mA
Frequency characteristics						
f_{nom}	nominal frequency range		6000	–	20 000	kHz
$\Delta f/f$	frequency tuning range		±5	–	–	ppm
$\Delta f/f$	frequency stability with respect to the nominal frequency (f_{nom}) in the temperature range	(note) T_{op} = –20 to +70 °C	–	–	±1	ppm
$\Delta f/f$	frequency ageing	per year	–	–	±1	ppm
$\Delta f/f$	frequency deviation due to load impedance variation	ΔZ_L = ±10%	–	–	±0.2	ppm
$\Delta f/f$	frequency deviation due to supply voltage variation	V_{CC} ±5%	–	–	±0.1	ppm
Additional characteristics						
	phase noise	at 1 kHz	–		–130	dB_c/Hz
Z_L	load impedance	fixed value	50	–	1000	Ω
V_{osc}	output voltage (RMS value)	Z_L = 50 Ω Z_L = 1000 Ω	80 350	– –	– –	mV mV
T_{stg}	storage temperature range		–40	–	+85	°C

All references to ppm = 10^{-6}.

Note

It is not guaranteed that the nominal frequency occurs at room temperature. The frequency can be shifted by an external variable resistor (max. 10 kΩ) between pins 4 and 5.

For optimum stability over the whole temperature range the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf. A trimming range of minimum ±5 ppm is still available to correct ageing influences.

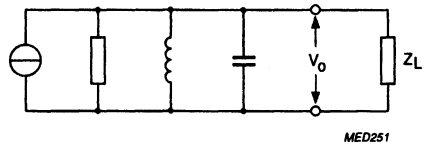


Fig.2 Equivalent circuit.

Temperature Compensated Crystal Oscillator Type TC602

9922 514 1.... series

DESCRIPTION

The type TC602 temperature compensated crystal oscillator comprises of a quartz crystal oscillator and a temperature controlled circuit that compensates for frequency changes over the whole temperature range. The assembly is encapsulated in a metal housing. The package has four connecting pins which can be mounted on a printed-circuit board with a grid pitch of 2.54 mm.

APPLICATIONS

- Mobile telephony (base stations)
- Electronic timers
- Electronic measuring equipment
- Frequency synthesizers.

QUICK REFERENCE DATA

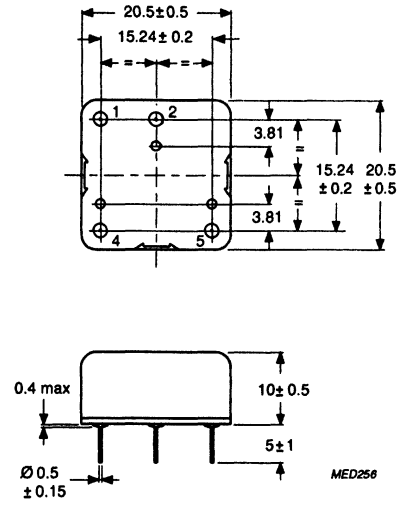
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	6000	20 000	kHz
$\Delta f/f$	frequency stability in the temperature range: –20 to +70 °C	–	±1	ppm
T_{op}	operating temperature range	–20	+70	°C
V_{CC}	supply voltage range	4.75	5.25	V
n	fan-out	–	3	LSTTL
m	mass	–	10	g

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Oscillator Type TC602

9922 514 1.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline.

Pinning

SYMBOL	PIN	DESCRIPTION
V_{CC}	1	supply voltage
V_{osc}	2	oscillator output
R_{ext}	4	external trimming resistor connected between pins 4 and 5
GND	5	ground (case)

Marking

Δf25°C ...Hz	value for frequency adjustment
Freq ....MHz	nominal frequency
Type	catalogue code
No .../...	serial number/code for week and year of manufacture

Mass

Maximum: 10 g

Temperature Compensated Crystal Oscillator Type TC602

9922 514 1.... series

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage range		4.75	5	5.25	V
I_{CC}	supply current		–	4	6	mA
Frequency characteristics						
f_{nom}	nominal frequency range		6000	–	20 000	kHz
$\Delta f/f$	frequency tuning range		±5	–	–	ppm
$\Delta f/f$	frequency stability with respect to the nominal frequency (f_{nom}) in the temperature range	(note) V_{CC} = 5 V T_{op} = –20 to +70 °C	–	–	±1	ppm
$\Delta f/f$	frequency ageing	per year	–	–	±1	ppm
$\Delta f/f$	frequency deviation due to supply voltage variation	V_{CC} ±5%	–	–	±0.1	ppm
Additional characteristics						
	phase noise	at 1 kHz	–	–	–130	dB_c/Hz
n	fan-out	LSTTL load	–	–	3	
T_{stg}	storage temperature range		–40	–	+85	°C

All references to ppm = 10^{-6}.

Note

It is not guaranteed that the nominal frequency occurs at room temperature. The frequency can be shifted by an external variable resistor (max. 10 kΩ) between pins 4 and 5.

For optimum stability over the whole temperature range the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf. A trimming range of minimum ±5 ppm is still available to correct ageing influences.

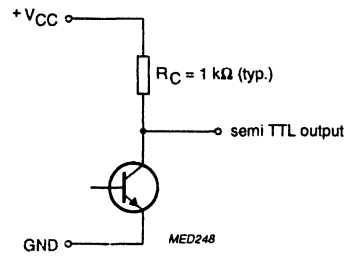


Fig.2 Equivalent circuit.

Voltage controlled Temperature Compensated Crystal Oscillator Type VTCXO

9922 515 0.... series

DESCRIPTION

The type VTCXO voltage controlled temperature compensated crystal oscillator comprises of a quartz crystal and an integrated circuit (IC). The IC contains the oscillator, the temperature compensation and the modulation function. The components are assembled on a hybrid circuit. A metal cover is placed on top of the hybrid for shielding. An external voltage is applied for calibration, adjustment and modulation. The VTCXO is available in types with different stability and pullability or modulation values.

APPLICATIONS

- Cellular telephone (e.g. GSM, ADC)
- Mobile and portable radio/telephone
- Communications transceivers
- Cordless telephone.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	8000	20 000	kHz
V_{CC}	supply voltage range	4.75	5.25	V
V_{contr}	control voltage range	0.5	4.5	V
$V_{osc(p-p)}$	output voltage (peak-to-peak value)			
	8 to 13 MHz	1.0	–	V
	13 to 16 MHz	0.8	–	V
	16 to 20 MHz	0.7	–	V
T_{op}	operating temperature range	–30	+80	°C

Frequency stability over the temperature range and pullability

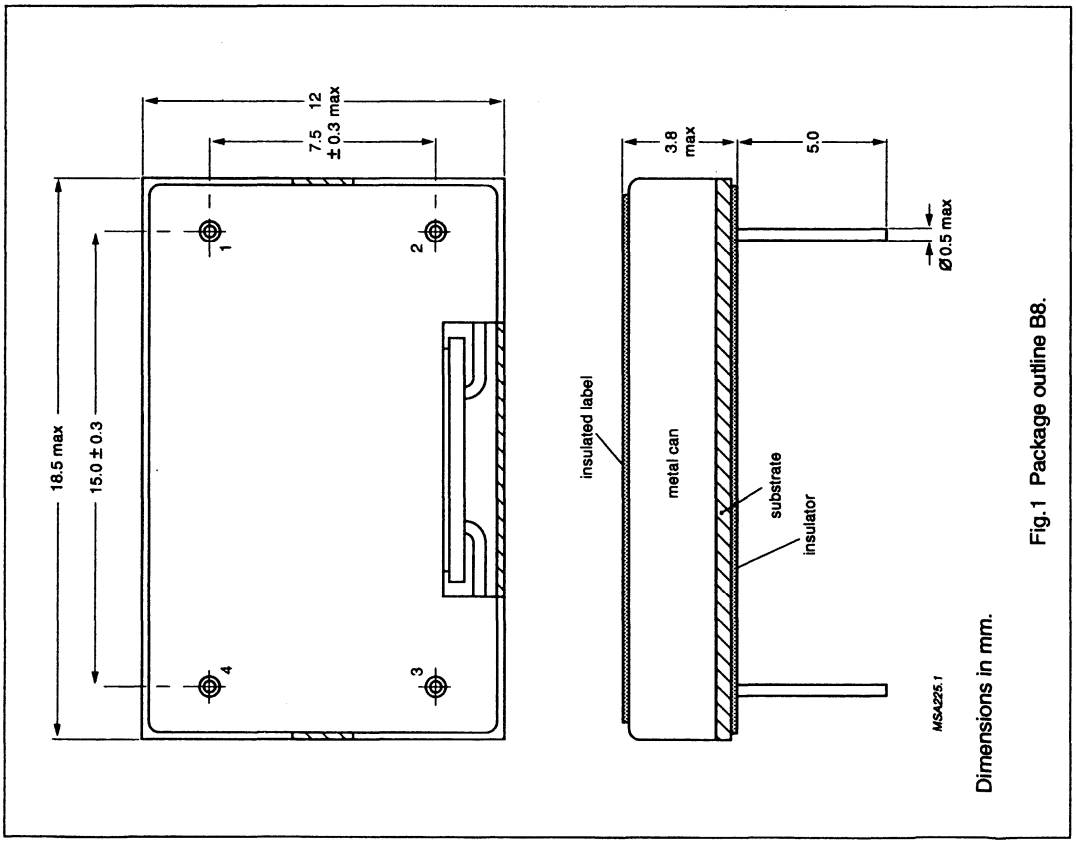
TYPE NUMBER	MAXIMUM STABILITY		PULLABILITY	UNIT
	OPTIONAL	STANDARD	TYPICAL	
VTC01	±1.0	±1.5	±8.5	ppm
VTC02	±1.5	±2.5	±15.0	ppm
VTC03	±2.0	±4.0	±40.0	ppm
VTC04	±2.5	±8.0	>40.0	ppm

All references to ppm = 10^{-6}.

Voltage controlled Temperature Compensated Crystal Oscillator Type VTCXO

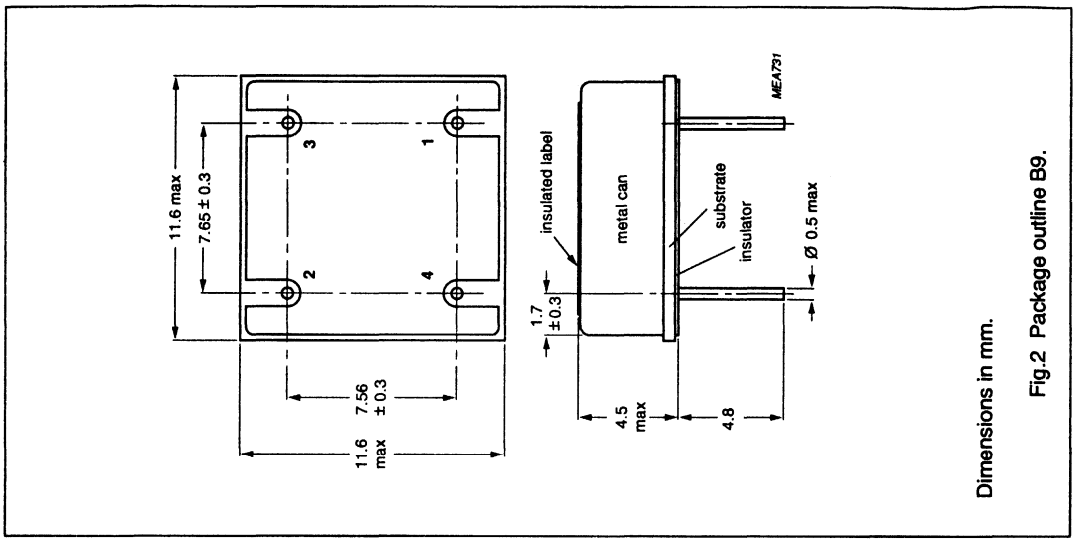
9922 515 0.... series

MECHANICAL DATA



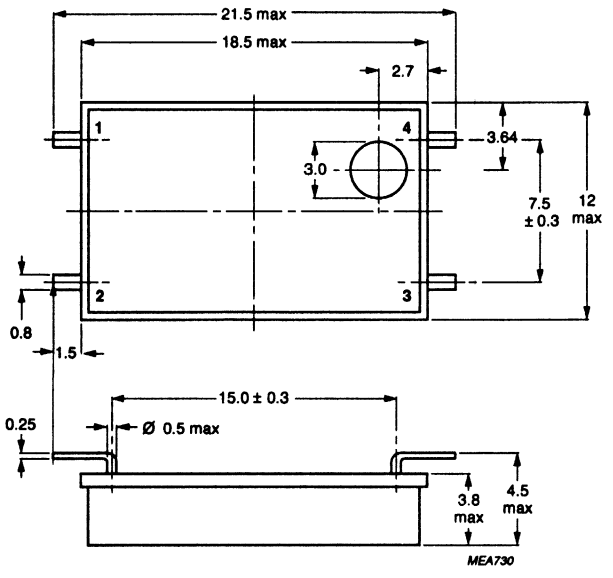
Dimensions in mm.

Fig.1 Package outline B8.



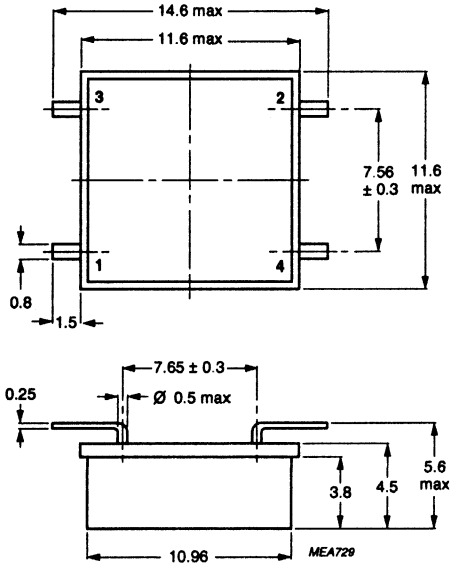
Dimensions in mm.

Fig.2 Package outline B9.



Dimensions in mm.

Fig.3 Package outline B8 SMD.



Dimensions in mm.

Fig.4 Package outline B9 SMD.

Pinning to B8, B9, B8 SMD and B9 SMD

SYMBOL	PIN	DESCRIPTION
GND	1	ground (case)
V_{osc}	2	oscillator output
V_{CC}	3	supply voltage
V_{contr}	4	control voltage

Note to B9 and B9 SMD pinning

* on top of case indicates pin number one.

Marking: holder type B8 and B8 SMD

- Line 1: PHILIPS
- Line 2: frequency in MHz
- Line 3: code for year and week of manufacture followed by last five digits of catalogue number.

Mass

Typical: 1.4 g

Marking: holder type B9 and B9 SMD

- Line 1: PH *
- Line 2: frequency in MHz
- Line 3: code for year and week of manufacture.

Mass

Typical: 1.15 g

Packing for B8 and B9 standard types

The oscillators are supplied in trays or blister package: 50 pieces per tray or 25 pieces per blister.

SMD types t.b.f.

Voltage controlled Temperature Compensated Crystal Oscillator Type VTCXO

9922 515 0.... series

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	supply voltage	internally decoupled with:	4.75	5.0	5.25	V
I_{CC}	supply current	100 nF (type B9) 22 nF (type B8)	–	2.65	3.0	mA
$V_{osc(p-p)}$	output voltage (peak-to-peak value) (load 10 kΩ I I 10 pF)	(see Fig.3) 8 - 13 MHz 13 - 16 MHz 16 - 20 MHz	 1.0 0.8 0.7	 1.2 1.1 1.0	 – – –	 V V V
R_L	load resistor	R_L I I C_L	10	–	–	kΩ
C_L	load capacitor		–	–	10	pF
T_{op}	operating temperature range		–30	+25	+80	°C
T_o	operable temperature range		–40	–	+90	°C
T_{stg}	storage temperature range		–45	–	+100	°C
t_{st}	start-up time	0 to 90% output level; 1.5 x rated frequency stability rated frequency stability	– – –	2 – –	5 0.2 1	ms s s

Voltage controlled Temperature Compensated Crystal Oscillator Type VTCXO

9922 515 0.... series

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Frequency characteristics at nominal V_{contr}						
f_{nom}	nominal frequency range		8000	–	20 000	kHz
$\Delta f/f_{nom}$	initial frequency tolerance, (reference to f_{nom})	(note 1)	–	–	–	
$\Delta f/f_{25}(T)$	frequency stability as a function of temperature change, (reference to initial frequency)	VTC01 optional	–	–	±1.0	ppm
		VTC02 optional	–	–	±1.5	ppm
		VTC03 optional	–	–	±2.0	ppm
		VTC04 optional	–	–	±2.5	ppm
		VTC01 standard	–	–	±1.5	ppm
		VTC02 standard	–	–	±2.5	ppm
		VTC03 standard	–	–	±4.0	ppm
		VTC04 standard	–	–	±8.0	ppm
$\Delta f/\Delta T$	frequency change rate versus temperature change	VTC01	–	±0.2	±0.4	ppm/K
		VTC02	–	±0.35	±0.7	ppm/K
		VTC03	–	±0.55	±1.1	ppm/K
		VTC04	–	±1.0	±2.0	ppm/K
$\Delta f/f_{25}(V_{CC})$	frequency tolerance as a function of supply voltage change, (reference to initial frequency)	V_{CC} = 5 V ±5%				
		VTC01	–	–	±0.2	ppm
		VTC02	–	–	±0.2	ppm
		VTC03	–	–	±0.3	ppm
		VTC04	–	–	±0.3	ppm
$\Delta f/f_{25}(Z)$	frequency tolerance as a function of load change, (reference to initial frequency)	10 kΩ/10 pF ±10%				
		VTC01	–	–	±0.2	ppm
		VTC02	–	–	±0.3	ppm
		VTC03	–	–	±0.5	ppm
		VTC04	–	–	±1.0	ppm
$\Delta f/f_{25}(t)$	frequency ageing, (reference to initial frequency)	per year				
		T_{op} = 35°C				
		VTC01	–	–	±1.0	ppm
		VTC02	–	–	±1.0	ppm
		VTC03	–	–	±1.3	ppm
		VTC04	–	–	±2.5	ppm
Control characteristics						
$\Delta f/f_{nom}$ (V_{contr})	pullability in control voltage range, (reference to f_{nom})	VTC01	–	±8.5	–	ppm
		VTC02	–	±15.0	–	ppm
		VTC03	–	±40.0	–	ppm
		VTC04	–	t.b.f.	–	ppm
V_{contr}	control voltage		0.5	2.5	4.5	V

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Modulation tuning characteristics						
$\Delta f/f_{nom}$ (V_{mod})	frequency modulation range, (reference to f_{nom})	(note 2) VTC01 VTC02 VTC03 VTC04	 – – – –	 ±4.0 ±7.0 ±19.0 ±38.0	 – – – –	 ppm ppm ppm ppm
V_{bias}	bias voltage	(note 3)	1.75	2.5	3.25	V
$V_{mod(p-p)}$	modulation voltage range (peak-to-peak value)	(note 4)	±0.6	±0.9	±1.2	V
	phase noise	offset = 1 kHz	–	–	–120	dB_c/Hz
	modulation non-linearity	over maximum modulation range	– –	– –	±5 ±0.4	% dB
	modulation distortion	rated maximum modulation 0.2 x maximum modulation 10 to 150 Hz	– – –	10 1 3	– – –	% % %
R_{mod}	modulation input resistance to ground	R_{mod} I I C_{mod}	100	–	150	kΩ
C_{mod}	modulation input capacitance to ground		–	3	5	pF
ΔZ_{mod}	stability over temperature range	T_{op} = –30 to +80 °C	–	–	10	%
	modulation frequency response versus tuning bandwidth	DC to 150 Hz DC to 2 kHz DC to 3 kHz DC to 6 kHz	– – – –	±0.17 ±0.25 ±1.0 ±3.0	– – – –	dB dB dB dB

All references to ppm = 10^{-6}.

Notes

1. The initial frequency tolerance does not degrade the margin between pullability and stability as the pullability is stated relative to the nominal frequency.
2. The frequency modulation figure indicates the nominal modulation obtained when the modulation voltage has a certain value within the specified range.
3. The DC bias voltage may be used for calibration at 25 °C and for ageing adjustment.
4. The modulation voltage range is relative to a DC bias voltage of 2.5 V ±0.75 V.

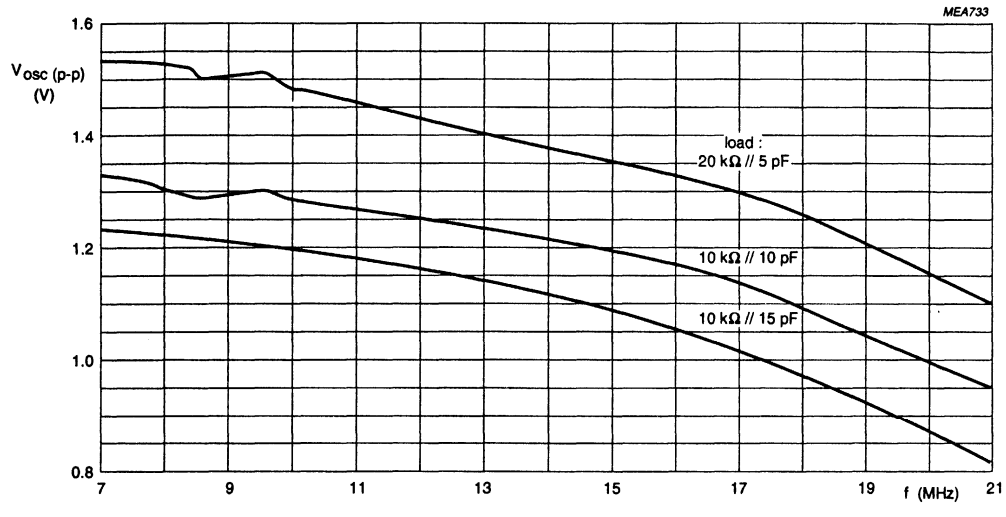


Fig.5 Output voltage (peak-to-peak value) versus frequency; typical values.

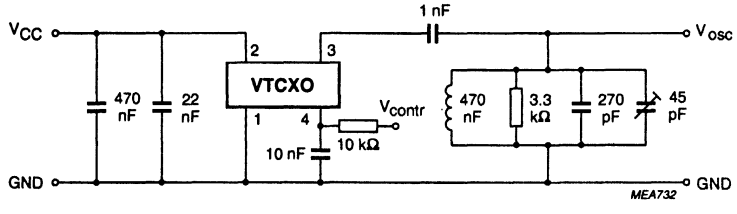


Fig.6 Application specific measurement circuit.

Figure 6 shows a tuned measurement circuit, representing a specific application load to obtain maximum output voltage.

Frequency and component values table:

f (MHz)	L (nH)	R (kΩ)	C1 (pF)	C2 (pF)
13	470	3.3	270	45

Voltage controlled Temperature Compensated Crystal Oscillator Type VTCXO

9922 515 0.... series

SPECIFIC PRODUCT DATA

Table 1

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	VTC.. (note 2)	Δf_i (notes 3 and 6)	$\Delta f/f_{nom}(V_{contr})$ (notes 4 and 6)			V_{contr} (V) (note 5)		
				MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
9922 515 00022	8 192.000	01	–	–	10	–	0.5	2.5	4.5
9922 515 00025	8 400.000	01	–	–	8.5	–	0.5	2.5	4.5
9922 515 00026	8 400.000	03	–	–	40	–	0.5	2.5	4.5
9922 515 00028	8 400.000	02	–	–	15	–	0.5	2.5	4.5
9922 515 00047	8 828.125	01	–	–	8.5	–	0.5	2.5	4.5
9922 515 00046	9 000.000	01	–	–	8.5	–	0.5	2.5	4.5
9922 515 00001	9 600.000	01	–	–	8.5	–	0.5	2.5	4.5
9922 515 00007	9 600.000	02	–	–	15	–	0.5	2.5	4.5
9922 515 00015	9 600.000	03	–	–	40	–	0.5	2.5	4.5
9922 515 00018	9 900.000	02	–	–	15	–	0.5	2.5	4.5
9922 515 00019	9 900.000	03	–	–	40	–	0.5	2.5	4.5
9922 515 00037	10 000.000	01	–	–	8.5	–	0.5	2.5	4.5
9922 515 00038	10 000.000	02	–	–	15	–	0.5	2.5	4.5
9922 515 00039	10 000.000	03	–	–	40	–	0.5	2.5	4.5
9922 515 00008	11 087.500	02	–	–	15	–	0.5	2.5	4.5
9922 515 00031	11 087.500	–	–	–	6.0	–	0.5	2.5	4.5

Notes

1. f_{nom} = nominal frequency.
2. VTC.. = type code of VTCXO.
3. Δf_i = initial frequency tolerance.
4. $\Delta f/f_{nom}(V_{contr})$ = pullability, referenced to the nominal frequency.
5. V_{contr} = control voltage range.
6. Values to be multiplied by 10^{-6}.

SPECIFIC PRODUCT DATA

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY MODULATION RANGE (note 3)	V_{bias} (V)			MODULATION VOLTAGE RANGE (V)			MODULATION SENSITIVITY (note 4)
			MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	TYP.
9922 515 00022	8 192.000	–	1.75	2.5	3.25	±0.6	±0.9	±1.2	5.0
9922 515 00025	8 400.000	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00026	8 400.000	±19	1.75	2.5	3.25	±0.6	±0.9	±1.2	21.0
9922 515 00028	8 400.000	±7	1.75	2.5	3.25	±0.6	±0.9	±1.2	8.0
9922 515 00047	8 828.125	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00046	9 000.000	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00001	9 600.000	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00007	9 600.000	±7	1.75	2.5	3.25	±0.6	±0.9	±1.2	8.0
9922 515 00015	9 600.000	±19	1.75	2.5	3.25	±0.6	±0.9	±1.2	21.0
9922 515 00018	9 900.000	±7	1.75	2.5	3.25	±0.6	±0.9	±1.2	8.0
9922 515 00019	9 900.000	±19	1.75	2.5	3.25	±0.6	±0.9	±1.2	21.0
9922 515 00037	10 000.000	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00038	10 000.000	±7	1.75	2.5	3.25	±0.6	±0.9	±1.2	8
9922 515 00039	10 000.000	±19	1.75	2.5	3.25	±0.6	±0.9	±1.2	21
9922 515 00008	11 087.500	±7	1.75	2.5	3.25	±0.6	±0.9	±1.2	8.0
9922 515 00031	11 087.500	–	1.75	2.5	3.25	±0.6	±0.9	±1.2	3±1

Notes

1. f_{nom} = nominal frequency.
2. V_{bias} = bias voltage range.
3. Values to be multiplied by 10^{-6}.
4. Values to be multiplied by 10^{-6}/V.

Voltage controlled Temperature Compensated Crystal Oscillator Type VTCXO

9922 515 0.... series

SPECIFIC PRODUCT DATA

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	VTC.. (note 2)	Δf_l (notes 3 and 6)	$\Delta f/f_{nom}(V_{contr})$ (notes 4 and 6)			V_{contr} (V) (note 5)		
				MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
9922 515 00048	11 456.000	01s	–	–	±8.5	–	0.5	2.5	4.5
9922 515 00042	11 605.330	01s	–	–	±8.5	–	0.5	2.5	4.5
9922 515 00023	11 947.333	01	–	–	±8.5	–	0.5	2.5	4.5
9922 515 00009	12 000.000	02	–	–	±15	–	0.5	2.5	4.5
9922 515 00011	12 800.000	02	–	–	±15	–	0.5	2.5	4.5
9922 515 00005	13 000.000	01	–	–	±8.5	–	0.5	2.5	4.5
9922 515 00012	13 000.000	02	–	–	±15	–	0.5	2.5	4.5
9922 515 00024	13 000.000	–	±1.5	±5	±6.5	±8	0.5	2.5	4.5
9922 515 01001	13 000.000	–	±1.5	±5	±6.5	±8	0.5	2.5	4.5
9922 515 00045	13 000.000	02s	–	±5	±6.5	±8	0.5	2.5	4.5
9922 515 00043	13 133.333	01	–	–	±8.5	–	0.5	2.5	4.5
9922 515 00035	13 926.400	01	–	–	±8.5	–	0.5	2.5	4.5
9922 515 00029	14 400.000	02s	±1.5	–	–	–	–0.15	2.5	5.15
9922 515 00036	14 400.000	01s	±2.5	–	–	–	–0.15	2.5	5.15
9922 515 00034	14 850.000	–	±1.0	±7	±9	±11	0.5	2.5	4.5
9922 515 00041	14 958.200	02	–	–	±15	–	0.5	2.5	4.5

Notes

1. f_{nom} = nominal frequency.
2. VTC.. = type code of VTCXO.
3. Δf_l = initial frequency tolerance.
4. $\Delta f/f_{nom}(V_{contr})$ = pullability, referenced to the nominal frequency.
5. V_{contr} = control voltage range.
   Values to be multiplied by 10^{-6}.

SPECIFIC PRODUCT DATA

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY MODULATION RANGE (note 3)	V_{bias} (V)			MODULATION VOLTAGE RANGE (V)			MODULATION SENSITIVITY (note 4)
			MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	TYP.
9922 515 00048	11 456.000	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00042	11 605.330	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00023	11 947.333	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00009	12 000.000	±7	1.75	2.5	3.25	±0.6	±0.9	±1.2	8.0
9922 515 00011	12 800.000	±7	1.75	2.5	3.25	±0.6	±0.9	±1.2	8.0
9922 515 00005	13 000.000	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00012	13 000.000	±7	1.75	2.5	3.25	±0.6	±0.9	±1.2	8.0
9922 515 00024	13 000.000	–	–	2.5	–	–	–	–	<5.0
9922 515 01001	13 000.000	–	–	2.5	–	–	–	–	<5.0
9922 515 00045	13 000.000	–	–	2.5	–	–	–	–	<5.0
9922 515 00043	13 133.333	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00035	13 926.400	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00029	14 400.000	±>13.2 ±<24.7	1.5	2.5	3.5	–	–	±1.65	>8.0 <15.0
9922 515 00036	14 400.000	±>9.9 ±<16.5	1.5	2.5	3.5	–	–	±1.65	>6.0 <10.0
9922 515 00034	14 850.000	–	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00041	14 958.200	±7	1.75	2.5	3.25	±0.6	±0.9	±1.2	8.0

Notes

1. f_{nom} = nominal frequency.
2. V_{bias} = bias voltage range.
3. Values to be multiplied by 10^{-6}.
4. Values to be multiplied by 10^{-6}/V.

Voltage controlled Temperature Compensated Crystal Oscillator Type VTCXO

9922 515 0.... series

SPECIFIC PRODUCT DATA

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	VTC.. (note 2)	Δf_i (notes 3 and 6)	$\Delta f/f_{nom}(V_{contr})$ (notes 4 and 6)			V_{contr} (V) (note 5)		
				MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
9922 515 00049	14 985.800	01	–	–	8.5	–	0.5	2.5	4.5
9922 515 00006	15 360.000	01	–	–	8.5	–	0.5	2.5	4.5
9922 515 00032	16 384.000	–	–	–	–	–	0	2.5	5.0
9922 515 00033	19 440.000	–	±1.5	8	10	12	0.5	2.5	4.5

Notes

1. f_{nom} = nominal frequency.
2. VTC.. = type code of VTCXO.
3. Δf_i = initial frequency tolerance.
4. $\Delta f/f_{nom}(V_{contr})$ = pullability, referenced to the nominal frequency.
5. V_{contr} = control voltage range.
6. Values to be multiplied by 10^{-6}.

Voltage controlled Temperature Compensated Crystal Oscillator Type VTCXO

9922 515 0.... series

SPECIFIC PRODUCT DATA

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY MODULATION RANGE (note 3)	V_{bias} (V)			MODULATION VOLTAGE RANGE (V)			MODULATION SENSITIVITY (note 4)
			MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	TYP.
9922 515 00049	14 985.800	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00006	15 360.000	±4	1.75	2.5	3.25	±0.6	±0.9	±1.2	4.5
9922 515 00032	16 384.000	–	–	2.5	–	–	–	–	–
9922 515 00033	19 440.000	–	–	2.5	–	–	–	–	<6.0

Notes

1. f_{nom} = nominal frequency.
2. V_{bias} = bias voltage range.
3. Values to be multiplied by 10^{-6}.
4. Values to be multiplied by 10^{-6}/V.

TEST AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC 68-2	TEST	PROCEDURE	REQUIREMENTS
Ea	shock	100 g; half sine 6 directions; 1 blow/direction	$\Delta f/f$ ±0.5 ppm
Ed	free fall	500 mm on hard wood, 3 random drops	$\Delta f/f$ ±0.5 ppm
Fc	vibration	frequency 10 to 500 Hz; acceleration 20g; 3 directions; 30 minutes	no damage $\Delta f/f$ ±0.5 ppm
Ta-1	solderability	235 ±5 °C; 2 ±0.5 s; flux 600 (activated)	≥90%, except for 1 mm from body no visible damage
Tb-1a	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f$ ±0.5 ppm

IEC 679-1	TEST	PROCEDURE	REQUIREMENTS
9.3.1	ageing	1000 hours at 125 °C 10 years at 35 °C first year at 35 °C for all types	$\Delta f/f$ ±3.0 ppm $\Delta f/f$ ±3.0 ppm $\Delta f/f$ ±1.0 ppm

All references to ppm = 10^{-6}.

Solvent resistance tests

Procedure: In accordance with IEC 68-2-45 (XA) and IEC 653: immersion time 5 minutes; at ambient temperature, and ultrasonic (40 kHz); brushing included.

Solvents:
- Neutropon P3 and Saxin P3
- Meta Clean 820
- Lonco 446 and 520
- Isopropanol cleaning solvent.

Temperature Compensated Crystal Clock Oscillator Type CTCXO

9922 515 1.... series

DESCRIPTION

The type CTCXO temperature compensated crystal clock oscillator comprises of a very accurate quartz crystal and an oscillator circuit assembled together with a trimmer on a printed-circuit board. The assembly is encapsulated in a metal housing. The package has three connecting pins with pin spacing compatible with 14-pin DIL packages. The output signal is a clipped sinewave.

APPLICATIONS

- Cordless telephone terminals.

QUICK REFERENCE DATA

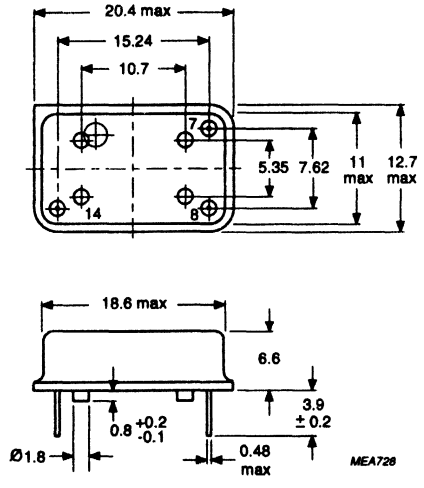
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	8000	16 000	kHz
$\Delta f/f$	frequency stability over the temperature range	−2.5	+2.5	ppm
T_{op}	operating temperature range	0	+55	°C
V_{CC}	nominal supply voltage	3	5	V
I_{CC}	supply current	–	1.5	mA

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Clock Oscillator Type CTCXO

9922 515 1.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package outline DIL14/3.

Pinning

SYMBOL	PIN	CONNECTION
GND	7	ground (case)
V_{osc}	8	oscillator output
V_{CC}	14	supply voltage

Marking

- Line 1: frequency in kHz
- Line 2: last five digits of catalogue number - PHD
- Line 3: code for month and year of manufacture - CTCXO.

Mass

Typical: 4.2 g

Packing

The oscillators are supplied in sticks in box: 25 pieces per stick; 20 sticks per box.

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	nominal supply voltage	±6% tolerance on nominal value	3.0	–	5.0	V
I_{CC}	supply current		–	1.0	1.5	mA
V_{osc}	output voltage (peak-to-peak value)	at V_{cc} = 5.0 V at V_{cc} = 3.0 V	1.0 0.7	– –	– –	V V
	output shape	clipped sinewave				
Z_L	load impedance		– –	10 10	– –	kΩ pF
T_{op}	operating temperature range		0	+22	+55	°C
T_{stg}	storage temperature range		–55	–	+125	°C
t_{st}	start-up time		–	–	–	ms
Frequency characteristics						
f_{nom}	nominal frequency		–	12 800	–	kHz
$\Delta f/f_{nom}$	initial frequency tolerance (reference to f_{nom})	optional tuning T_{op} = 22 °C ±2 °C	–	±0.5	–	ppm
$\Delta f/f_{nom}(T)$	frequency stability as a function of temperature change (reference to f_{nom})	T_{op} = +55 to 0 °C	–	–	±2.5	ppm
$\Delta f/f_{nom}(V_{CC})$	frequency tolerance as a function of supply voltage (reference to f_{nom})	at V_{CC} ±6%	–	–	±0.2	ppm
Δf_{min} Δf_{max}	lowest tunable frequency highest tunable frequency		–3 –	– –	– +3	ppm ppm
$\Delta f/f_{nom}(Z)$	frequency tolerance as a function of load change	C_L = 5 to 30 pF	–	–	0.5	ppm
$\Delta f/f_{nom}(t)$	frequency ageing (yearly) (reference to f_{nom})	T_{op} = 25 °C	–	–	±0.5	ppm

All references to ppm = 10^{-6}.

Temperature Compensated Crystal Clock Oscillator Type CTCXO

9922 515 1.... series

SPECIFIC PRODUCT DATA

Table 1

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY (note 4)			T_{op} (°C) (note 2)	V_{CC} (V) (note 3)
		TOTAL	INITIAL (25°C)	IN THE TEMP. RANGE		
9922 515 10001	12 800			2.5	0/+55	3.2
9922 515 10001	12 800			2.5	0/+55	5.0
9922 515 10001	12 800.176			2.5	0/+55	3.2

Notes

1. f_{nom} = nominal frequency
2. T_{op} = operating temperature range
3. V_{CC} = nominal supply voltage
4. Values to be multiplied by 10^{-6}.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	$\Delta f/f \leq 5$ ppm
Ea	shock	1000 g; half sine 6 directions; 1 blow/direction	$\Delta f/f \leq 5$ ppm
Ed	free fall	250 mm on hard wood	
Fc	vibration	frequency 10 to 500 Hz; acceleration 40 g; 3 directions; 30 minutes	no damage $\Delta f/f \leq 5$ ppm
Nb	rapid change of temperature	1 hour at –40 °C/1 hour at +85 °C; 10 cycles	no damage $\Delta f/f \leq 5$ ppm
Ta	solderability	235 ±5 °C; 2 ±0.5 s; flux 600 (activated)	≥90%, except for 1 mm from body no visible damage no leaks
Tb-1a	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 5$ ppm

IEC679-1	TEST	PROCEDURE	REQUIREMENTS
9.3.1	ageing	1000 hours, 70 °C	$\Delta f/f \leq 5$ ppm

All references to ppm = 10^{-6}.

Solvent resistance tests

Procedure:In accordance with IEC 68-2-45 (XA) and IEC 653: immersion time 5 minutes; at ambient temperature, and ultrasonic (40 kHz); brushing included.

Solvents:
- Neutropon P3 and Saxin P3
- Meta Clean 820
- Lonco 446 and 520
- Isopropanol cleaning solvent.

Digital Temperature Compensated Crystal Oscillator Type DTCXO

9922 519 3.... series

DESCRIPTION

The type DTCXO digital temperature compensated crystal oscillator comprises of a quartz crystal oscillator, a quartz crystal temperature measuring device together with an electronic compensation network which is digitally controlled. The assembly is encapsulated in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has four connecting studs and can be mounted on a printed-circuit board and/or secured by 4 bolts (M3 x 0.5 mm).

APPLICATIONS

- Communication and measuring equipment which require high stability and low power consumption.

QUICK REFERENCE DATA

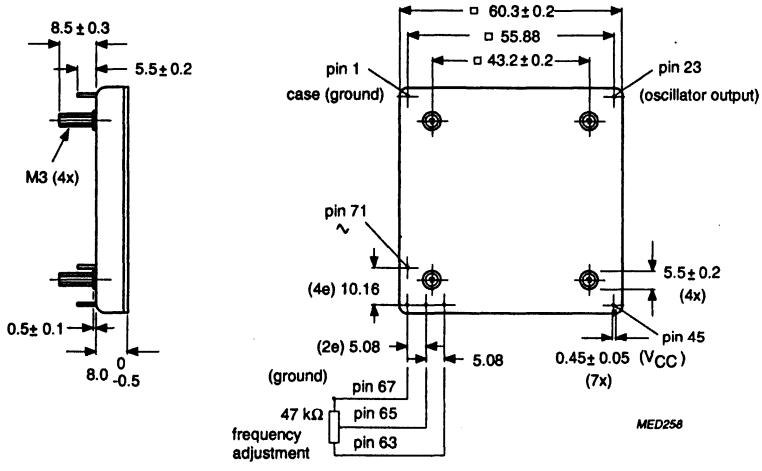
SYMBOL	PARAMETER	MIN.	MAX.	UNIT
f_{nom}	nominal frequency range	4000	15 000	kHz
$\Delta f/f$	frequency stability in the temperature range: –40 to +85 °C	–	+0.5	ppm
T_{op}	operating temperature range	–40	+85	°C
V_{CC}	supply voltage	4.75	5.25	V
n	fan-out	– – –	10 2 10	LSTTL TTL HCMOS
m	mass	–	70	g

All references to ppm = 10^{-6}

Digital Temperature Compensated Crystal Oscillator Type DTCXO

9922 519 3.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package Outline.

Pinning

SYMBOL	PIN	DESCRIPTION
GND	1	ground (case)
V_{osc}	23	oscillator output voltage
V_{CC}	45	supply voltage
V_{ref}	63	frequency adjustment reference voltage
V_I	65	frequency adjustment input voltage
GND	67	ground (frequency adjustment only)
n.c.	71	not connected

Marking

Type	catalogue code
Freq ...MHz	nominal frequency
Δf25°C ..Hz	value for frequency adjustment
Range ...°C	temperature range
No .../...	serial number/code for week and year of manufacture

Mass

Maximum: 70 g

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	nominal supply voltage		4.75	5	5.25	V
I_{CC}	supply current		–	15	20	mA
n	fan out	LSTTL load TTL load HCMOS load	– – –	– – –	10 2 10	
T_{op}	operating temperature range		–40	–	+85	°C
T_{stg}	storage temperature range		–55	–	+125	°C
Frequency characteristics						
f_{nom}	nominal frequency range		4000	–	15 000	kHz
$\Delta f/f$	frequency stability with respect to the nominal frequency (f_{nom}) in the temperature range	(note)	–	–	±0.5	ppm
$\Delta f/f$	frequency deviation due to supply voltage variations	V_{CC} = 4.75 to 5.25 V	–	–	±0.1	ppm
$\Delta f/f$	frequency ageing	during 10 years at 85 °C	–	–	±1.5	ppm
	stabilization time to reach a stability within $5 \cdot 10^{-7}$ of f_{nom}		–	–	1	s
$\Delta f/f_{nom}$	frequency trimming range		±2	–	–	ppm
Output characteristics						
δ	duty cycle	output level = 1.4 V	40	–	60	%

All references to ppm = 10^{-6}.

Note

For optimum stability over the whole temperature range, the oscillator should be adjusted at room temperature to a frequency which deviates from the nominal one by an amount of Δf, labelled on the oscillator.

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with IEC publication 68-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components". Ageing test is in accordance with IEC publication 679-1, "Quartz crystal controlled oscillators".

IEC68-2	TEST	PROCEDURE	REQUIREMENTS
Db	accelerated damp heat	+25 to +55 °C; 6 cycles at RH >95%	$\Delta f/f \leq 0.2$ ppm
Ea	shock	50 g; 6 directions; 1 blow/direction	$\Delta f/f \leq 0.2$ ppm
Fc	vibration	frequency 10 to 500 to 10 Hz; acceleration 10 g; 3 directions; 30 minutes/direction	$\Delta f/f \leq 0.2$ ppm
Tb	resistance to soldering heat	260 ±5 °C; 10 ±1 s	$\Delta f/f \leq 0.2$ ppm

All references to ppm = 10^{-6}.

Temperature Sensing Oscillator Type TSO

9922 515 8.... series

DESCRIPTION

The type TSO temperature sensing oscillator comprises of a quartz crystal which is cut under a special angle. The frequency varies as a linear function of temperature. The temperature information is available as a number of pulses which change with temperature, no analog-to-digital conversion is needed. The crystal and the oscillator are built in hybrid technology. The assembly is encapsulated in a metal housing that is dry-nitrogen-filled and hermetically sealed. The package has four connecting pins with pin spacing compatible with 14-pin DIL packages.

On request the TSO can be supplied with a Master Reset input, in order to minimize standby power consumption.

APPLICATIONS

- Temperature sensing devices in very accurate thermometers
- Temperature monitors in electronic systems.

QUICK REFERENCE DATA

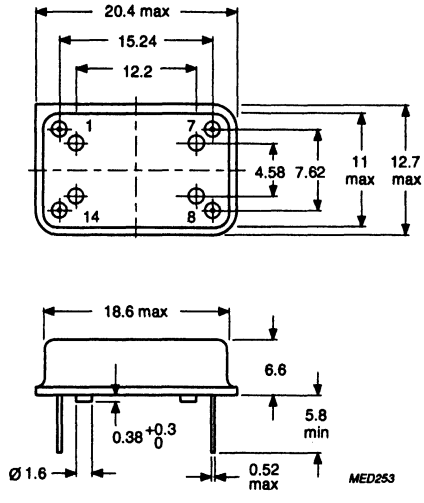
SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
f_{nom}	nominal frequency range	0.25	–	750	kHz
T_{op}	operating temperature range	–40	–	+85	°C
TC	temperature coefficient range	–50	–	+85	ppm/K
n	fan-out	–	–	3	TTL
V_{CC}	supply voltage range	4.5	5.0	5.5	V
I_{CC}	supply current	–	2.5	–	mA

All references to ppm = 10^{-6}.

Temperature Sensing Oscillator Type TSO

9922 515 8.... series

MECHANICAL DATA



Dimensions in mm.

Fig.1 Package Outline.

Pinning

SYMBOL	PIN	DESCRIPTION
n.c. or MR	1	not connected or master reset (optional)
GND	7	ground (case)
V_{osc}	8	oscillator output
V_{CC}	14	supply voltage

Marking

- Line 1: frequency in kHz
- Line 2: last five digits of catalogue number - TSO
- Line 3: code for year and week of manufacture - PHD.

Temperature Sensing Oscillator Type TSO

9922 515 8.... series

ELECTRICAL DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating conditions						
V_{CC}	nominal supply voltage		4.5	5.0	5.5	V
I_{CC}	supply current	(note 1)	–	2.5	–	mA
T_{op}	operating temperature range		–40	25	+85	°C
t_s	start-up time		–	2	–	ms
Frequency characteristics						
f_{nom}	nominal frequency range		0.25	–	750	kHz
TC	temperature coefficient range	(note 2)	–50	–	+85	ppm/K
	linearity	(note 3)	–	1	–	%
t_{th}	thermal time constant		–	10	–	s
Output characteristics						
V_{OH}	output voltage HIGH	V_{CC} = 4.5 V I_O = –4.0 mA	3.7	–	–	V
V_{OL}	output voltage LOW	V_{CC} = 4.5 V I_O = 4.0 mA	–	–	0.4	V
δ	duty cycle	$V_{CC}/2$	45	–	55	
C_L	load capacitance		–	–	50	pF
n	fan-out		–	–	3	TTL
Master Reset (optional)						
a logic 1 on the MR input stops the oscillator and sets the output to the LOW state, current decreases to 0.1 mA						
V_{IH}	input voltage HIGH		2.0	–	–	V
V_{IL}	input voltage LOW		–	–	0.8	V
T_{stg}	storage temperature range		–55	–	+100	°C

All references to ppm = 10^{-6}.

Notes

1. Maximum value dependent on frequency and load.
2. Choose value within range.
3. Dependent on TC and T_{op} range.

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PHILIPS COMPONENTS

DATA HANDBOOK SYSTEM

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Our data handbook titles are listed here.

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DC03	Television Tuners, Coaxial Aerial Input Assemblies
DC05	Flyback Transformers, Mains Transformers and General-purpose FXC Assemblies

Liquid crystal displays

LCD01	Liquid Crystal Displays and Driver ICs for LCDs

Magnetic products

MA01	Soft Ferrites
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Passive components

Book	*Title*
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PA02	Varistors, Thermistors and Sensors
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PHILIPS SEMICONDUCTORS

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SC07	Small-signal Field-effect Transistors
SC08a	RF Power Bipolar Transistors
SC08b	RF Power MOS Transistors
SC09	RF Power Modules
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SC13	PowerMOS Transistors
SC14	Wideband Transistors and Wideband Hybrid IC Modules
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IC14	8048-based 8-bit Microcontrollers
IC15	FAST TTL Logic Series
IC16	ICs for Clocks and Watches
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IC19	Semiconductors for Datacom: LANs, UARTs, Multi-Protocol Controllers and Fibre Optics
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Integrated circuits (continued)

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Errata to handbook PA11

Please incorporate the following ammendments to the 1993 edition of Handbook PA11.

Temperature Compensated Crystal Clock Oscillator Type CTCXO **9922 515 1.... series**

Marking

Line 3: PHD code for year and week of manufacture.

SPECIFIC PRODUCT DATA

Table 1

CATALOGUE NUMBER	f_{nom} (kHz) (note 1)	FREQUENCY STABILITY (note 4)			T_{op} (°C) (note 2)	V_{CC} (V) (note 3)
		TOTAL	INITIAL (22°C)	IN THE TEMP. RANGE		
9922 515 10001	12 800			2.5	0/+55	3.2
9922 515 10002	12 800			2.5	0/+55	5.0
9922 515 10003	12 800.176			2.5	0/+55	3.2

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