

Temperature Compensated Crystal Oscillator

Features

- Clipped Sine Wave or CMOS Output
- 5.000 MHz to 52.000 MHz Output Frequency
- ± 0.5 ppm Temperature Stability
- Optional Frequency Tuning
- Fundamental Crystal Design
- Gold over Nickel Contact Pads
- Hermetically Sealed Ceramic SMD Package
- Product is Compliant to RoHS Directive and Fully Compatible with Lead-Free Assembly

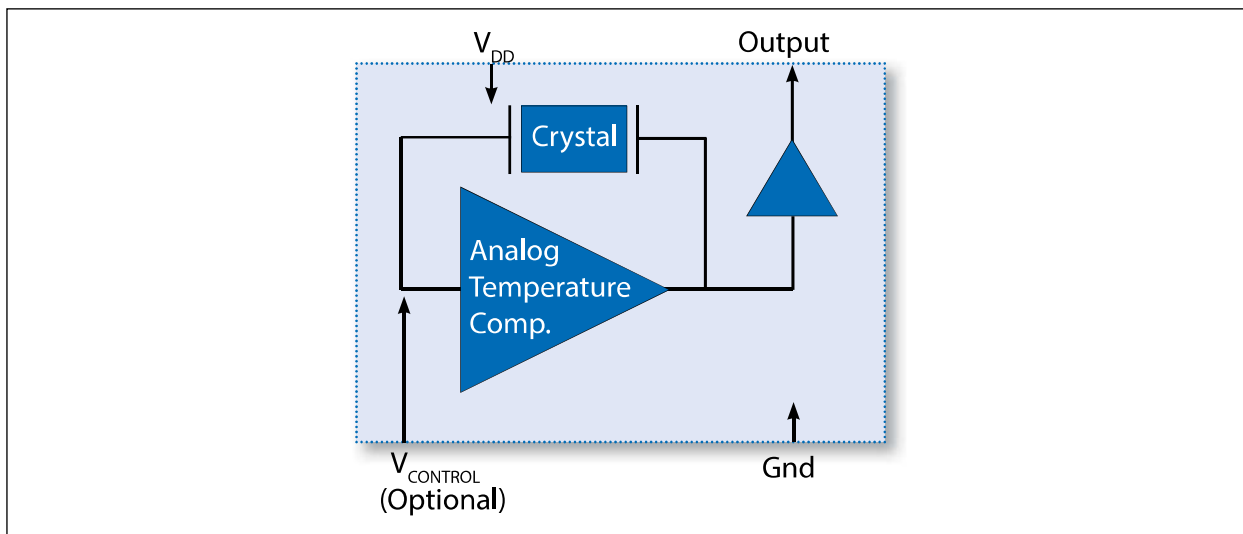
General Description

Microchip's VT-704A temperature compensated crystal oscillator (TCXO) is a quartz stabilized, clipped sine wave or CMOS output, analog temperature compensated oscillator that operates off a 2.5V to 3.3V supply in a hermetically sealed 7.0 mm x 5.0 mm ceramic package.

Applications

- Femto Cells
- Base Stations
- IP Networking
- Global Positioning Systems
- Point-to-Point Radio
- Manpack Radio
- Test and Measurement

Block Diagram



VT-704A

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V_{DD})	.....	-0.3V to +4.6V
Control Voltage (V_C) (Note 1)	.....	-0.3V to $V_{DD} + 0.3V$
ESD Rating, Human Body Model (Note 2)	.....	1.5 kV
ESD Rating, Charged Device Model (Note 2)	.....	750V
Storage Temperature (T_S)	.....	-55°C to +125°C

† **Notice:** Stresses in excess of the Absolute Maximum Ratings can permanently damage the device. Functional operation is not implied at these or any other conditions in excess of conditions represented in the operational sections of this data sheet. Exposure to Absolute Maximum Ratings for extended periods may adversely affect device reliability.

Note 1: The maximum rating is ($V_{DD} + 0.3V$) up to 4.6V.

2: Although ESD protection circuitry has been designed into the VT-704A, proper precautions should be taken when handling and mounting. Microchip employs a Human Body Model (HBM) and a Charged Device Model (CDM) for ESD susceptibility testing and design protection evaluation. ESD thresholds are dependent on the circuit parameters used to define the model. Although no industry standard has been adopted for the CDM, a standard resistance of 1.5 kΩ and capacitance of 100 pF is widely used and therefore can be used for comparison purposes.

ELECTRICAL CHARACTERISTICS, CLIPPED SINE WAVE OPTION

Parameter	Sym.	Min.	Typ.	Max.	Units	Conditions
Output Frequency (Note 1)	f_O	5	—	52	MHz	Ordering Option
Supply Voltage (Note 2)	V_{DD}	—	2.5	—	V	Ordering Option
		—	2.8	—		
		—	3.0	—		
		—	3.3	—		
Supply Current	I_{DD}	—	—	3.5	mA	—
Operating Temperature	T_{OP}	-20	—	+70	°C	Ordering Option
		-30	—	+85		
		-40	—	+85		
Frequency Stability						
Stability over Operating Temperature (Note 3)	f_{STAB}	±5.0			ppm	Ordering Option
Frequency Tolerance (Note 4)	f_{TOL}	—	—	±2.0	ppm	—
Power Supply Stability, ±5%	f_{PWR}	—	—	±0.1	ppm	—
Load Stability, ±10%	f_{LOAD}	—	—	±0.2	ppm	—
Aging	f_{AGE}	—	—	±1.0	ppm	First year

Note 1: Refer to Table 1 for Clipped Sine Wave Standard Frequencies.

2: The VT-704A power supply pin (Pin 4) should be filtered using a bypass capacitor of 0.1 μF for optimal performance.

3: Referenced to the midpoint between minimum and maximum frequency value over the operating temperature range.

4: Frequency measured at 25°C, one hour after two IR reflows.

5: Referenced to Mid Control Voltage.

6: Measured at ambient temperature using an E5052B Signal Source Analyzer or equivalent.

ELECTRICAL CHARACTERISTICS, CLIPPED SINE WAVE OPTION (CONTINUED)

Parameter	Sym.	Min.	Typ.	Max.	Units	Conditions
Frequency Tuning (EFC), Ordering Option						
Tuning Range (Note 5)	PR	±5.0	—	—	ppm	—
		±8.0	—	—		
Tuning Slope	—	Positive			—	—
Control Voltage to Reach Pull Range	V _C	0.5	1.5	2.5	V	—
Control Voltage Impedance	—	100	—	—	kΩ	—
RF Output (Clipped Sine Wave), Ordering Option						
Output Amplitude	V _{OPP}	0.8	—	—	V	—
Output Load	C _L	—	10k || 10 pF	—	—	—
Start Up Time	t _{SU}	—	—	10	ms	—
Phase Noise (Note 6)						
Phase Noise, 100 Hz	∅ _N	—	-115	—	dBc/Hz	10.000 MHz
Phase Noise, 1 kHz		—	-135	—		
Phase Noise, 10 kHz		—	-148	—		

- Note 1:** Refer to [Table 1](#) for Clipped Sine Wave Standard Frequencies.
- Note 2:** The VT-704A power supply pin (Pin 4) should be filtered using a bypass capacitor of 0.1 μF for optimal performance.
- Note 3:** Referenced to the midpoint between minimum and maximum frequency value over the operating temperature range.
- Note 4:** Frequency measured at 25°C, one hour after two IR reflows.
- Note 5:** Referenced to Mid Control Voltage.
- Note 6:** Measured at ambient temperature using an E5052B Signal Source Analyzer or equivalent.

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ELECTRICAL CHARACTERISTICS, CMOS OPTION

Parameter	Sym.	Min.	Typ.	Max.	Units	Conditions
Output Frequency (Note 1)	f_O	5	—	52	MHz	Ordering Option
Supply Voltage (Note 2)	V_{DD}	—	2.5	—	V	Ordering Option
		—	2.8	—		
		—	3.0	—		
		—	3.3	—		
Supply Current	I_{DD}	—	—	8	mA	—
Operating Temperature	T_{OP}	-20	—	+70	°C	Ordering Option
		-30	—	+85		
		-40	—	+85		
Frequency Stability						
Stability over Operating Temperature (Note 3)	f_{STAB}	±5.0			ppm	Ordering Option
Frequency Tolerance (Note 4)	f_{TOL}	—	—	±2.0	ppm	—
Power Supply Stability, ±5%	f_{PWR}	—	—	±0.1	ppm	—
Load Stability, ±10%	f_{LOAD}	—	—	±0.2	ppm	—
Aging	f_{AGE}	—	—	±1.0	ppm	First year
Frequency Tuning (EFC), Ordering Option						
Tuning Range (Note 5)	PR	±5	—	—	ppm	—
		±8	—	—		
Tuning Slope	—	Positive			—	—
Control Voltage to Reach Pull Range	V_C	0.5	1.5	2.5	V	—
Control Voltage Impedance	—	100	—	—	kΩ	—
RF Output, Ordering Option						
Output Level High	V_{OH}	$0.9 \times V_{DD}$	—	—	V	—
Output Level Low	V_{OL}	—	—	$0.1 \times V_{DD}$		
Output Load	C_L	—	—	15	pF	—
Duty Cycle	—	45	—	55	%	—
Start-Up Time	t_{SU}	—	—	10	ms	—
Rise and Fall Times (Note 6)	—	—	—	8	ns	—

Note 1: Refer to Table 2 for CMOS Standard Frequencies.

2: The VT-704A power supply pin (Pin 4) should be filtered using a bypass capacitor of 0.1 μF for optimal performance.

3: Referenced to the midpoint between minimum and maximum frequency value over the operating temperature range.

4: Frequency measured at 25°C, one hour after two IR reflows.

5: Referenced to Mid Control Voltage.

6: Measured at (10%/90% and 90%/10%) x V_{DD} .

7: Measured at ambient temperature using an E5052B Signal Source Analyzer or equivalent.

ELECTRICAL CHARACTERISTICS, CMOS OPTION (CONTINUED)

Parameter	Sym.	Min.	Typ.	Max.	Units	Conditions
Phase Noise (Note 7)						
Phase Noise, 100 Hz	\emptyset_N	—	-115	—	dBc/Hz	10.000 MHz
Phase Noise, 1 kHz		—	-138	—		
Phase Noise, 10 kHz		—	-148	—		

- Note 1:** Refer to [Table 2](#) for CMOS Standard Frequencies.
- 2:** The VT-704A power supply pin (Pin 4) should be filtered using a bypass capacitor of 0.1 μ F for optimal performance.
- 3:** Referenced to the midpoint between minimum and maximum frequency value over the operating temperature range.
- 4:** Frequency measured at 25°C, one hour after two IR reflows.
- 5:** Referenced to Mid Control Voltage.
- 6:** Measured at (10%/90% and 90%/10%) $\times V_{DD}$.
- 7:** Measured at ambient temperature using an E5052B Signal Source Analyzer or equivalent.

2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 2-1](#).

TABLE 2-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	V_C or NC	TCXO control voltage or No connect.
2	GND	Ground.
3	OUT	RF Output.
4	V_{DD}	Supply voltage.

- Note 1:** 0.1 μ F capacitor is a bypass power supply filter capacitor placed between Pin 4 (V_{DD}) and Ground for optimal performance.

2.1 VCXO Function

The VT-704A is supplied with a VCXO function for applications where it will be used in a PLL or if the output frequency needs fine tune calibration adjustments. This is a high impedance input, 100 k Ω , and can be driven with an op-amp or terminated with adjustable resistors, etc. Pin 1 should not be left floating on the VCXO-optional device.

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3.0 RELIABILITY

Microchip qualification will include aging at various extreme temperatures, shock and vibration, temperature cycling, and IR reflow simulation. The VT-704A is capable of meeting the following qualification tests.

TABLE 3-1: ENVIRONMENTAL COMPLIANCE

Parameter	Conditions
Mechanical Shock	MIL-STD-883 Method 2002
Mechanical Vibration	MIL-STD-883 Method 2007
Temperature Cycle	MIL-STD-883 Method 1010
Solderability	MIL-STD-883 Method 2003
Fine and Gross Leak	MIL-STD-883 Method 1014
Resistance to Solvents	MIL-STD-883 Method 2015
Moisture Sensitivity Level	MSL 1
Contact Pads	Gold over Nickel
Weight	184 mg

4.0 IR REFLOW

Devices are built using lead-free epoxy and can be subjected to standard lead-free IR reflow conditions shown in [Table 4-1](#). Contact pads are gold over nickel and lower maximum temperatures can also be used, such as 220°C.

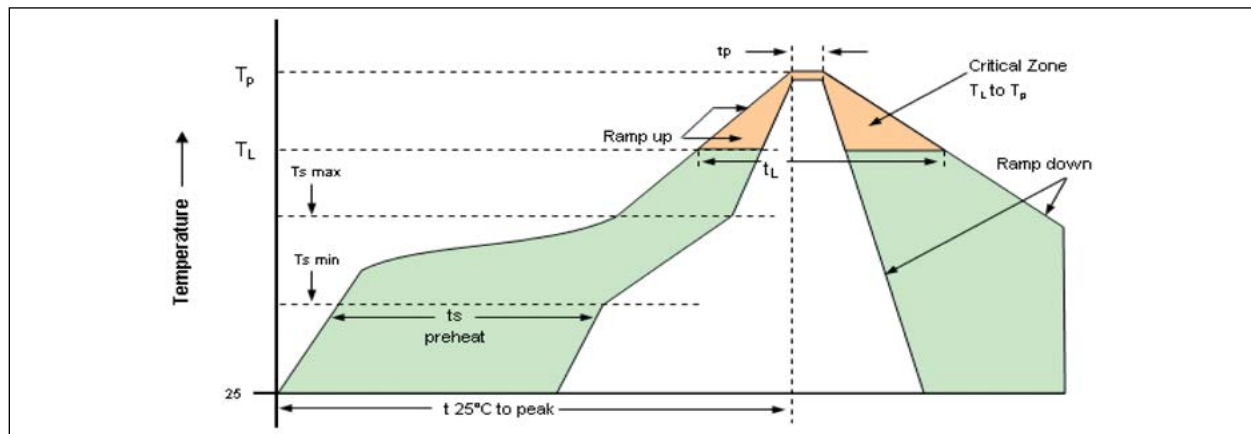


FIGURE 4-1: Solder Profile.

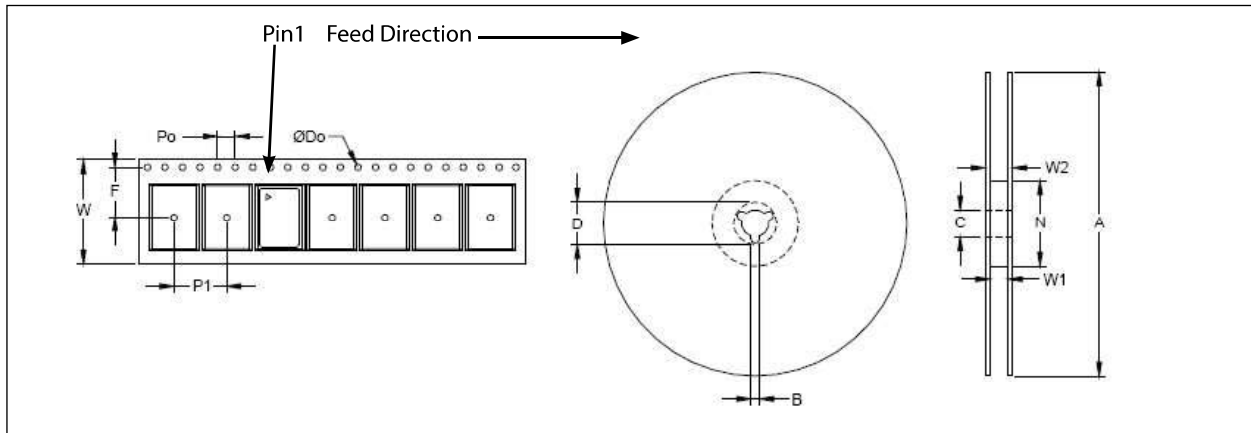
TABLE 4-1: REFLOW PROFILE

Parameter	Symbol	Value
Pre-Heat Time	t_s	200 seconds maximum
—	$T_{S(MIN)}$	150°C
—	$T_{S(MAX)}$	200°C
Ramp Up	R_{UP}	3°C/sec. maximum
Time above 217°C	t_L	150 seconds maximum
Time to Peak Temperature	T_{AMB-P}	480 seconds maximum
Time at 260°C	t_p	30 seconds maximum
Time at 240°C	t_{p2}	60 seconds maximum
Ramp Down	R_{DN}	6°C/sec. maximum

5.0 TAPE AND REEL

TABLE 5-1: TAPE AND REEL DIMENSIONS

Tape Dimensions (mm)						Reel Dimensions (mm)							
Dimension	W	F	Do	Po	P1	A	B	C	D	N	W1	W2	# per Reel
Tolerance	Typ	Typ	Typ	Typ	Typ	Typ	Typ	Typ	Typ	Typ	Typ	Max	
VT-704A	16	7.5	1.5	4	8	180	1.5	13	20.2	60	16.4	20.4	1000

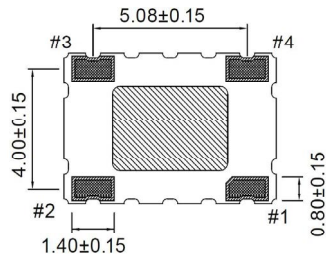
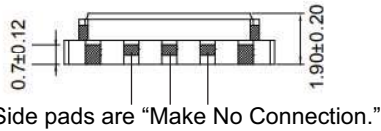
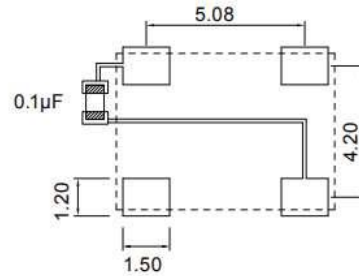
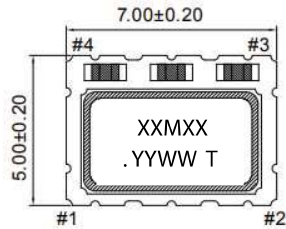


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6.0 PACKAGING INFORMATION

4-Lead 7.0 mm x 5.0 mm DFN Package Outline and Recommended Land Pattern

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimensions in mm

APPENDIX A: REVISION HISTORY

Revision B (April 2024)

- Updated Supply Voltage and Frequency Stability values in the [Electrical Characteristics, Clipped Sine Wave Option](#) table.
- Updated Supply Voltage, Supply Current, and Frequency Stability values in the [Electrical Characteristics, CMOS Option](#) table.
- Updated the [Product Identification System](#) section.

Revision A (July 2022)

- Converted Vectron document VT-704A to Microchip data sheet template DS20006697A.
- Minor grammatical text changes throughout.

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NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

<u>Device</u>	<u>-X</u>	<u>X</u>	<u>X</u>	<u>-XXX</u>	<u>X</u>	<u>-XXXXXXXXXX</u>	<u>XX</u>
Part No.	Power Supply	Output	Temp. Range	Stability	Tuning	Frequency	Packaging
Device: VT-704A: Temperature Compensated Crystal Oscillator in a 7.0 mm x 5.0 mm DFN Power Supply: E = 3.3VDC ±5% F = 3.0VDC ±5% G = 2.8VDC ±5% H = 2.5VDC ±5% Output: A = CMOS F = Clipped Sine Wave Temperature Range: E = -40°C to +85°C G = -30°C to +80°C H = -30°C to +85°C (Standard) J = -20°C to +70°C R = 0°C to +55°C W = -10°C to +70°C Stability: 507 = ±0.5 ppm 106 = ±1.0 ppm 156 = ±1.5 ppm 206 = ±2.0 ppm 256 = ±2.5 ppm 306 = ±3.0 ppm 406 = ±4.0 ppm 506 = ±5.0 ppm Tuning: 0 = Fixed, No Tuning A = ±5 ppm B = ±8 ppm Frequency: xxMxxxxxxx=Frequency in MHz Packaging: TR = 1,000/Reel <blank>= Cut Tape/ non-TR quantities	Examples: a) VT-704A-EAE-507B-16M000000TR: VT-704A, 3.3VDC, CMOS Output, -40°C to +85°C Temp Range, ±0.5 ppm Stability, ±8 ppm Tuning, 16.000 MHz, 1000/Reel b) VT-704A-HFJ-106A-25M0000000: VT-704A, 2.5VDC, Clipped Sine Wave Output, -20°C to +70°C Temp Range, ±1.0 ppm Stability, ±5 ppm Tuning, 25.000 MHz, Cut Tape Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.						

TABLE 1: STANDARD FREQUENCIES, CLIPPED SINE WAVE

8.000 MHz	8.192 MHz	10.000 MHz	12.500 MHz	12.800 MHz	16.000 MHz	16.384 MHz
19.440 MHz	25.000 MHz	26.000 MHz	—	—	—	—

TABLE 2: STANDARD FREQUENCIES, CMOS

5.000 MHz	6.400 MHz	8.000 MHz	8.192 MHz	10.000 MHz	12.500 MHz	12.800 MHz
16.000 MHz	16.384 MHz	19.440 MHz	25.000 MHz	26.000 MHz	—	—

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