

---

---

## Temperature Compensated Crystal Oscillator

---

---

### Features

- 10.000 MHz - 52.000 MHz Output Frequency
- $\pm 2.5$  ppm Temperature Stability over  $-40$  °C to  $85$  °C
- Frequency Tuning Option
- Fundamental Crystal Design
- Gold over Nickel Contact Pads
- Hermetically Sealed  $3.2$  mm  $\times$   $2.5$  mm Ceramic VDFN Package
- Product is Compliant to RoHS-Compliant and Fully Lead-Free Assembly Compatible (Excluding Solder Dipped, \_SNPB, Option)

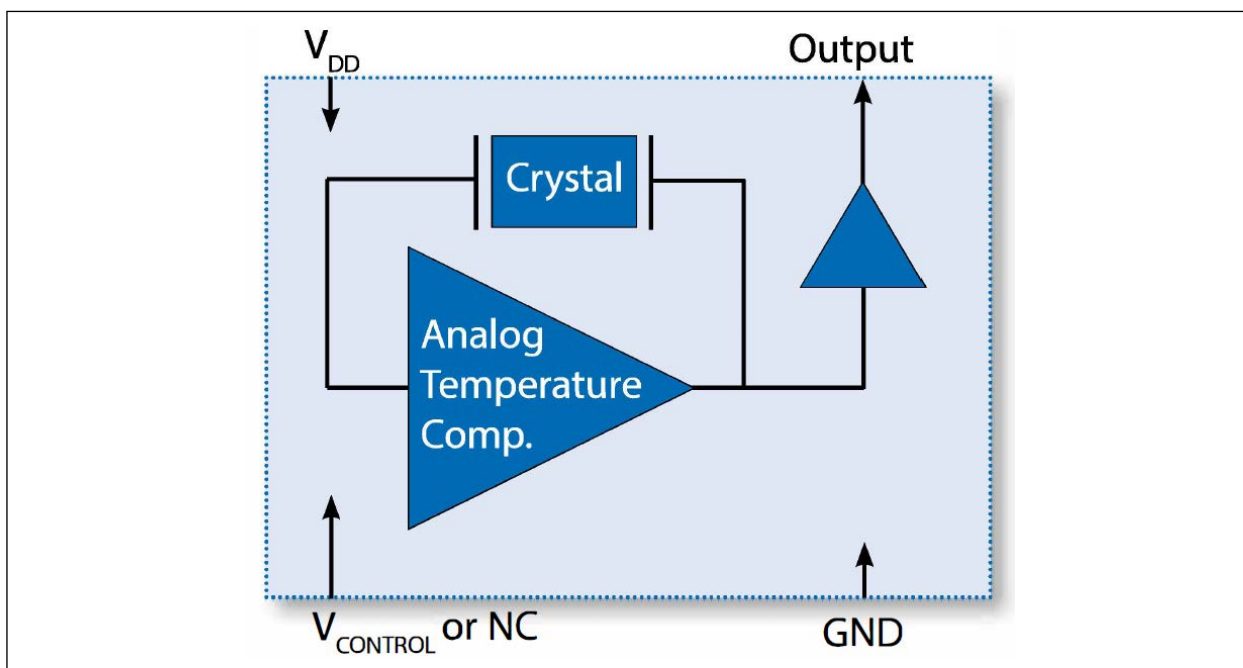
### General Description

Microchip's VT-820B Temperature Compensated Crystal Oscillator (TCXO) is a quartz stabilized, clipped sine wave output, analog temperature compensated oscillator, operating off a 1.8V, 2.8V, 3.0V, or 3.3V supply in a hermetically sealed  $3.2$  mm  $\times$   $2.5$  mm ceramic package.

### Applications

- GPS
- WiLAN, WiMAX
- IoT
- Point-to-Point Radio
- Manpack Radio

### Block Diagram



# VT-820B

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings †

Supply Voltage ( $V_{DD}$ )	.....	-0.3V to +4.6V
Maximum Control Voltage ( $V_C$ , <a href="#">Note 2</a> )	.....	-0.3V to $V_{DD} + 0.3V$
ESD Rating, Human Body Model ( <a href="#">Note 1</a> )	.....	2.0 kV
ESD Rating, Charged Device Model ( <a href="#">Note 1</a> )	.....	750V
Storage Temperature ( $T_S$ )	.....	-40°C to +85°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:** Although ESD protection circuitry has been designed into the VT-820B, 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 k $\Omega$  and capacitance of 100 pF is widely used and therefore can be used for comparison purposes.

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

### ELECTRICAL CHARACTERISTICS

Parameter	Sym.	Min.	Typ.	Max.	Units	Conditions
Output Frequency, <a href="#">Note 1</a>	$f_O$	10	—	52	MHz	Ordering Option
Supply Voltage, <a href="#">Note 2</a>	$V_{DD}$	—	1.8	—	V	Ordering Option
		—	2.8	—		
		—	3.0	—		
		—	3.3	—		
Supply Current, <a href="#">Note 3</a>	$I_{DD}$	—	—	2.0	mA	$f_O \leq 26$ MHz
		—	—	2.5		$f_O > 26$ MHz
Operating Temperature	$T_{OP}$	-20	—	+70	°C	Ordering Option
		-30	—	+85		
		-40	—	+85		
<b>Frequency Stability</b>						
Stability over Operating Temperature, <a href="#">Note 4</a>	$f_{STAB}$	—	—	$\pm 0.5$	ppm	Ordering Option
		—	—	$\pm 1.0$		
		—	—	$\pm 1.5$		
		—	—	$\pm 2.0$		
		—	—	$\pm 2.5$		

**Note 1:** The output is DC-coupled. Refer to the Standard Frequencies table in the [Product Identification System](#) section.

**2:** The VT-820B power supply pin (Pin 4) should be filtered using a bypass capacitor, such as 0.01  $\mu F$  for optimal performance.

**3:** No load.

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

**5:** Frequency measured at +25°C, two hours after two IR reflows.

**6:** Referenced to Mid Control Voltage and over the operating temperature.

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

## ELECTRICAL CHARACTERISTICS (CONTINUED)

Parameter	Sym.	Min.	Typ.	Max.	Units	Conditions
Frequency Tolerance, <a href="#">Note 5</a>	$f_{TOL}$	—	—	±1.5	ppm	—
Power Supply Stability ±5%	$f_{PWR}$	—	—	±0.2	ppm	—
Load Stability ±10%	$f_{LOAD}$	—	—	±0.2	ppm	—
Aging	$f_{AGE}$	—	—	±1.0	ppm	1st Year at +25°C
<b>Frequency Tuning (EFC), Ordering Option</b>						
Tuning Pull Range, <a href="#">Note 6</a>	TPR	±5	—	—	ppm	Ordering Option
		±10	—	—		
		±15	—	—		
Tuning Slope	—	Positive			—	—
Control Voltage to Reach Pull Range	$V_C$	0.3	0.9	1.5	V	1.8V Supply Voltage
		0.5	1.5	2.5	V	2.5V, 2.8V, 3.0V, and 3.3V Supply Voltage
Linearity	Lin	—	—	10	%	—
Control Voltage Impedance	—	500	—	—	kΩ	—
<b>RF Output, Clipped Sine Wave</b>						
Output Level	$V_{OP-P}$	0.8	—	—	V	—
Output Load	—	—	10k    10pF	—	—	—
Duty Cycle	SYM	40	—	60	%	—
Start-Up Time	$t_{SU}$	—	—	2	ms	—
<b>Phase Noise</b>						
Phase Noise, 10 Hz	$\emptyset_N$	—	-95	—	dBc/Hz	19.200 MHz, <a href="#">Note 7</a>
Phase Noise, 100 Hz		—	-121	—		
Phase Noise, 1 kHz		—	-142	—		
Phase Noise, 10 kHz		—	-154	—		
Phase Noise, 100 kHz		—	-160	—		
Phase Noise, 1 MHz		—	-160	—		
Phase Noise, 5 MHz		—	-160	—		

**Note 1:** The output is DC-coupled. Refer to the Standard Frequencies table in the [Product Identification System](#) section.

**2:** The VT-820B power supply pin (Pin 4) should be filtered using a bypass capacitor, such as 0.01 μF for optimal performance.

**3:** No load.

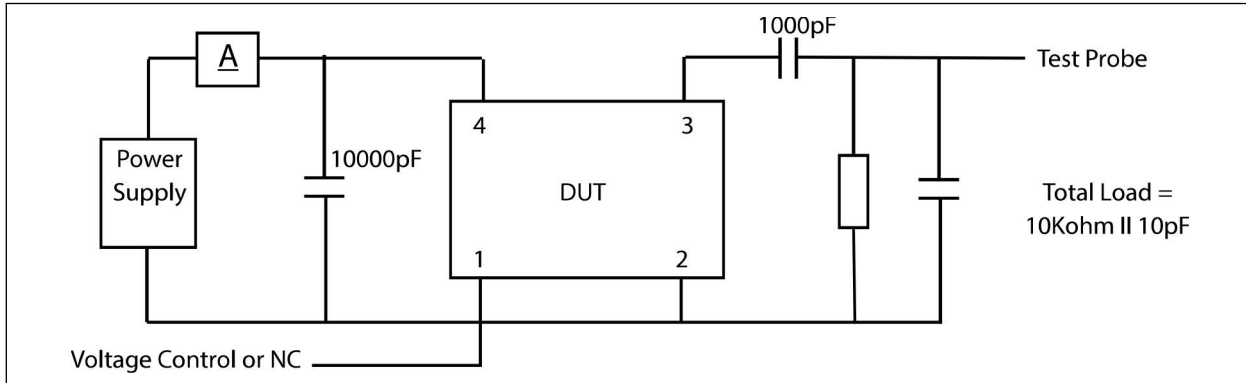
**4:** Referenced to the midpoint between the minimum and maximum frequency value over the operating temperature range.

**5:** Frequency measured at +25°C, two hours after two IR reflows.

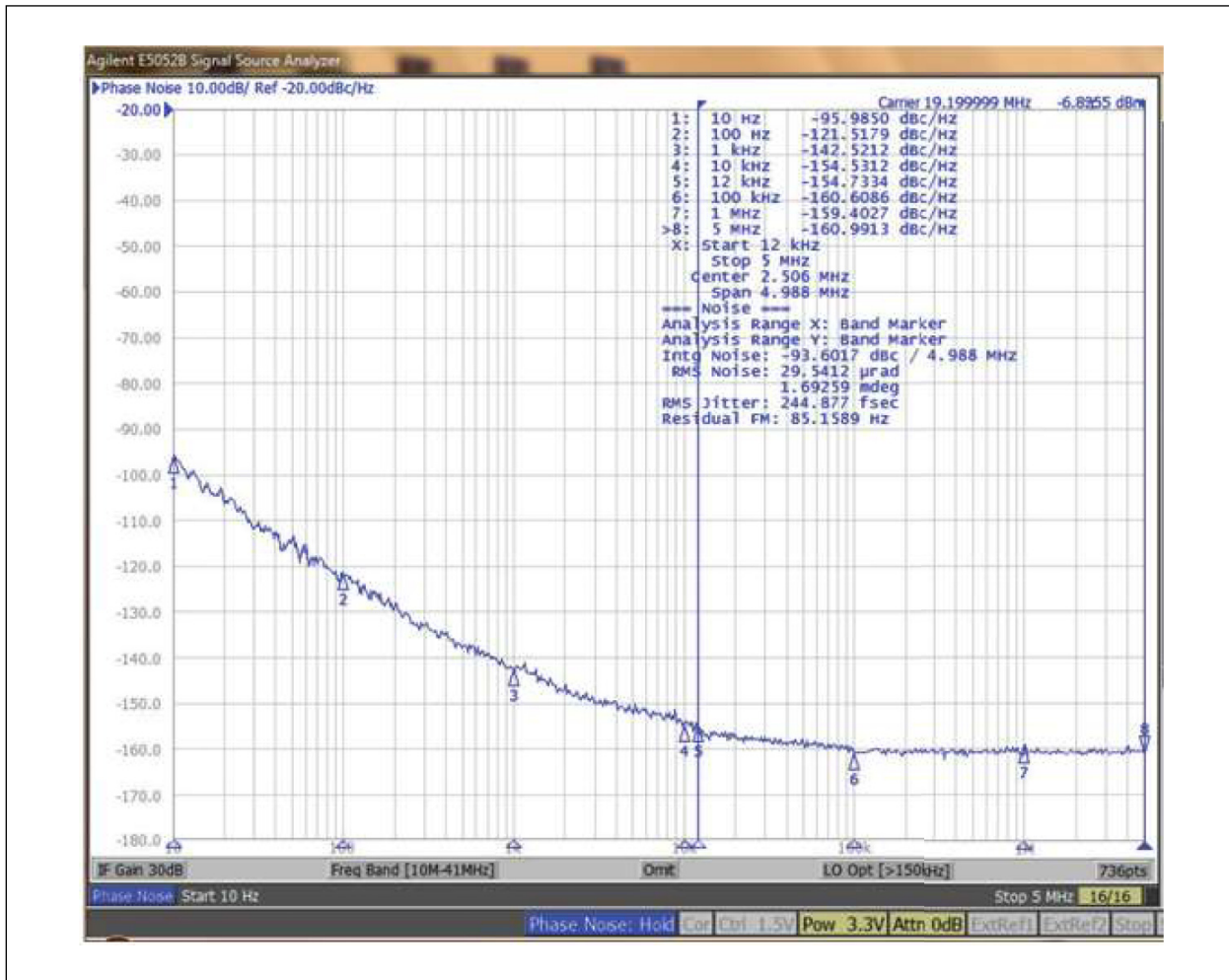
**6:** Referenced to Mid Control Voltage and over the operating temperature.

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

# VT-820B



**FIGURE 1-1:** Test Circuit.



**FIGURE 1-2:** Typical Phase Noise Performance.

## 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	VC or NC	Voltage controlled frequency tuning or No connection.
2	GND	Ground.
3	OUT	RF output.
4	VDD	Supply voltage.

**Note 1:** 0.01  $\mu$ F capacitor is a bypass power supply filter capacitor placed between VDD (Pin 4) and GND for optimal performance.

**2:** Side pads are Do Not Connect.

# VT-820B

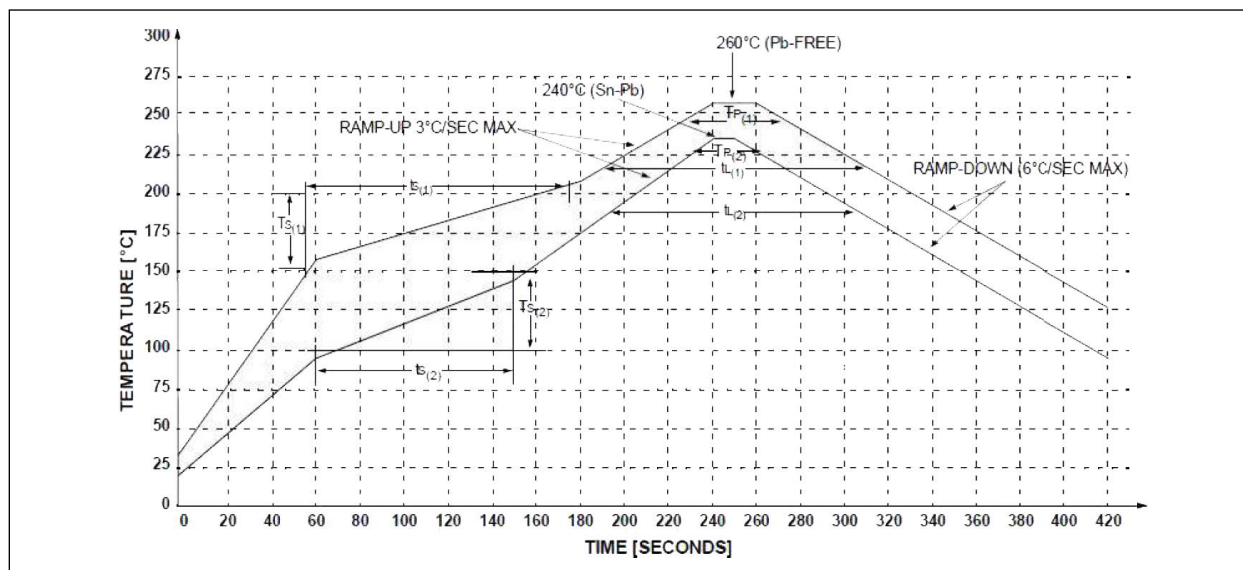
## 3.0 RELIABILITY

**TABLE 3-1: ENVIRONMENTAL COMPLIANCE**

Parameter	Conditions
Mechanical Shock	MIL-STD-883 Method 2002, B
Mechanical Vibration	MIL-STD-883 Method 2007, A
Temperature Cycle	MIL-STD-883 Method 1010, B
IR Reflow	JEDEC-STD 020
Fine and Gross Leak	MIL-STD-883 Method 1014
Damp Heat	JESD22-A101
Moisture Sensitivity Level	MSL1
Contact Pads	Gold (0.3um min 1.0 um max) over Nickel
Contact Pads, _SNPB Option	Tinned using solder alloy Sn63Pb37 in accordance with J-STD-006
Weight	32 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](#). The contact pads are gold over nickel and lower maximum temperatures can also be used, such as 220°C.



**FIGURE 4-1:** Solder Profile.

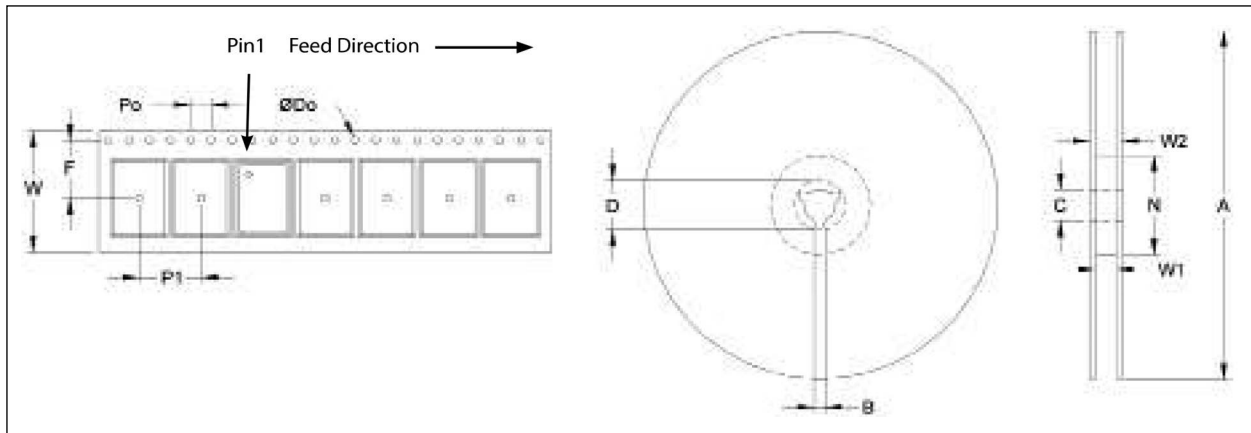
**TABLE 4-1: REFLOW PROFILE**

Symbol	Min.	Max.	Units	Conditions
Ts(1)	150	200	°C	Pb-Free
Ts(2)	100	150	°C	_SNPB Option
ts(1)	60	180	Sec	Pb-Free
ts(2)	60	120	Sec	_SNPB Option
tl(1)	60	150	Sec	Pb-Free
tl(2)	60	150	Sec	_SNPB Option
Tp(1)	245	260	°C	Pb-Free
Tp(2)	225	240	°C	_SNPB Option

## 5.0 TAPE AND REEL

**TABLE 5-1: TAPE AND REEL INFORMATION**

Tape Dimensions (mm)						Reel Dimensions (mm)							
Dimension	W	F	Do	Po	P1	A	B	C	D	N	W1	W2	# per Reel
VT-820B	8	3.5	1.6	4	4	180	2.3	13	20.2	60	10.3	11.4	3000



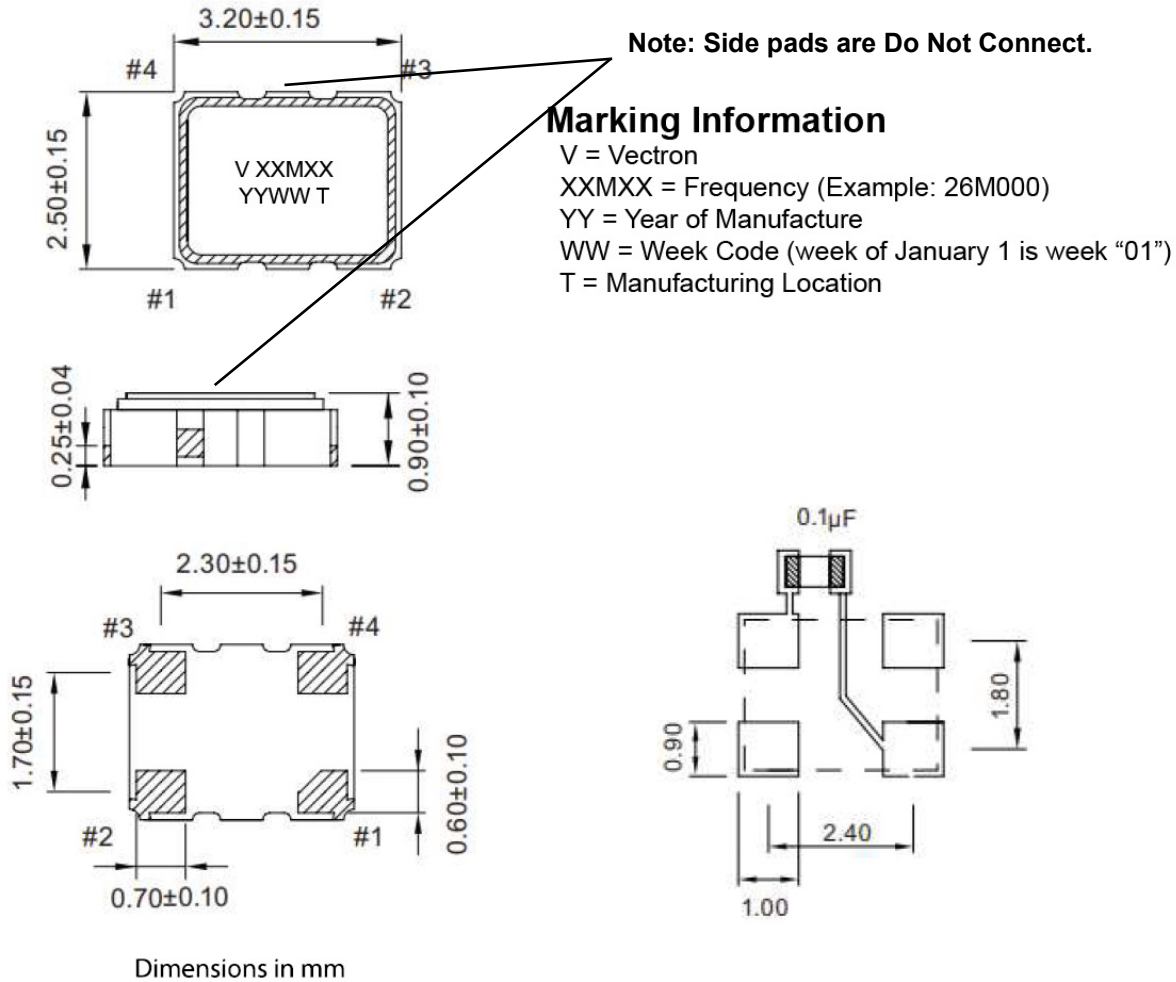
**FIGURE 5-1:** *Tape and Reel Diagram.*

# VT-820B

## 6.0 PACKAGING INFORMATION

### 4-Lead 3.2 mm x 2.5 mm VDFN 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>



## APPENDIX A: REVISION HISTORY

### Revision A (November 2024)

- Converted Micrel data sheet for VT-820B to Microchip format as DS20006945A.
- Minor text changes throughout.

# VT-820B

---

---

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
<b>Device:</b> VT-820B: Temperature Compensated Crystal Oscillator in a 3.2 mm x 2.5 mm VDFN  <b>Power Supply:</b> E = 3.3VDC ±10% F = 3.0VDC ±10% G = 2.8VDC ±10% J = 1.8VDC ±10%  <b>Output:</b> F = Clipped Sine Wave  <b>Temperature Range:</b> E = -40°C to +85°C H = -30°C to +85°C J = -20°C to +70°C  <b>Stability:</b> 507 = ±0.5 ppm 106 = ±1.0 ppm 156 = ±1.5 ppm 206 = ±2.0 ppm 256 = ±2.5 ppm  <b>Tuning:</b> 0 = Fixed, No Tuning A = ±5 ppm B = ±8 ppm C = ±10 ppm E = ±15 ppm  <b>Frequency:</b> xxMxxxxxx=Frequency in MHz  <b>Packaging:</b> TR = 3,000/Reel <blank>= Cut Tape/ non-TR quantities _SNPB = Tin Lead Solder Dip	<b>Examples:</b> a) VT-820B-EFE-1060-19M2000000TR: VT-820B, 3.3VDC ±10%, Clipped Sine Wave Output, -40°C to +85°C Temperature Range, ±1.0 ppm Stability, Fixed, No Tuning, 19.200 MHz, 3,000/Reel  b) VT-820B-EFE-1060-19M2000000: VT-820B, 3.3VDC ±10%, Clipped Sine Wave Output, -40°C to +85°C Temperature Range, ±1.0 ppm Stability, Fixed, No Tuning, 19.200 MHz, Cut Tape/ non-TR  b) VT-820B-EFE-1060-19M2000000_SNPB: VT-820B, 3.3VDC ±10%, Clipped Sine Wave Output, -40°C to +85°C Temperature Range, ±1.0 ppm Stability, Fixed, No Tuning, 19.200 MHz, Tin Lead Solder Dip  <b>Note 1:</b> 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 LIST**

10.000 MHz	12.000 MHz	12.800 MHz	13.000 MHz	14.000 MHz	16.000 MHz
16.368 MHz	16.384 MHz	16.800 MHz	19.200 MHz	19.680 MHz	20.000 MHz
24.000 MHz	25.000 MHz	26.000 MHz	27.000 MHz	30.000 MHz	32.000 MHz
38.400 MHz	38.880 MHz	40.000 MHz	40.960 MHz	48.000 MHz	50.000 MHz

# VT-820B

---

---

NOTES:

---

---

**Note the following details of the code protection feature on Microchip products:**

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable" Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.

---

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at <https://www.microchip.com/en-us/support/design-help/client-support-services>.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

For information regarding Microchip's Quality Management Systems, please visit [www.microchip.com/quality](http://www.microchip.com/quality).

**Trademarks**

The Microchip name and logo, the Microchip logo, Adaptec, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Kleer, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzor, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, TimeCesium, TimeHub, TimePictra, TimeProvider, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, Clockstudio, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, EyeOpen, GridTime, IdealBridge, IGaT, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, IntelliMOS, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, MarginLink, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, mSiC, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, Power MOS IV, Power MOS 7, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQL, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, Trusted Time, TSHARC, Turing, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2024, Microchip Technology Incorporated and its subsidiaries.

All Rights Reserved.

ISBN: 978-1-6683-0506-5



# MICROCHIP

## Worldwide Sales and Service

### AMERICAS

**Corporate Office**  
2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7200  
Fax: 480-792-7277  
Technical Support:  
<http://www.microchip.com/support>  
Web Address:  
[www.microchip.com](http://www.microchip.com)

#### Atlanta

Duluth, GA  
Tel: 678-957-9614  
Fax: 678-957-1455

#### Austin, TX

Tel: 512-257-3370

#### Boston

Westborough, MA  
Tel: 774-760-0087  
Fax: 774-760-0088

#### Chicago

Itasca, IL  
Tel: 630-285-0071  
Fax: 630-285-0075

#### Dallas

Addison, TX  
Tel: 972-818-7423  
Fax: 972-818-2924

#### Detroit

Novi, MI  
Tel: 248-848-4000

#### Houston, TX

Tel: 281-894-5983

#### Indianapolis

Noblesville, IN  
Tel: 317-773-8323  
Fax: 317-773-5453  
Tel: 317-536-2380

#### Los Angeles

Mission Viejo, CA  
Tel: 949-462-9523  
Fax: 949-462-9608  
Tel: 951-273-7800

#### Raleigh, NC

Tel: 919-844-7510

#### New York, NY

Tel: 631-435-6000

#### San Jose, CA

Tel: 408-735-9110  
Tel: 408-436-4270

#### Canada - Toronto

Tel: 905-695-1980  
Fax: 905-695-2078

### ASIA/PACIFIC

**Australia - Sydney**  
Tel: 61-2-9868-6733

**China - Beijing**  
Tel: 86-10-8569-7000

**China - Chengdu**  
Tel: 86-28-8665-5511

**China - Chongqing**  
Tel: 86-23-8980-9588

**China - Dongguan**  
Tel: 86-769-8702-9880

**China - Guangzhou**  
Tel: 86-20-8755-8029

**China - Hangzhou**  
Tel: 86-571-8792-8115

**China - Hong Kong SAR**  
Tel: 852-2943-5100

**China - Nanjing**  
Tel: 86-25-8473-2460

**China - Qingdao**  
Tel: 86-532-8502-7355

**China - Shanghai**  
Tel: 86-21-3326-8000

**China - Shenyang**  
Tel: 86-24-2334-2829

**China - Shenzhen**  
Tel: 86-755-8864-2200

**China - Suzhou**  
Tel: 86-186-6233-1526

**China - Wuhan**  
Tel: 86-27-5980-5300

**China - Xian**  
Tel: 86-29-8833-7252

**China - Xiamen**  
Tel: 86-592-2388138

**China - Zhuhai**  
Tel: 86-756-3210040

### ASIA/PACIFIC

**India - Bangalore**  
Tel: 91-80-3090-4444

**India - New Delhi**  
Tel: 91-11-4160-8631

**India - Pune**  
Tel: 91-20-4121-0141

**Japan - Osaka**  
Tel: 81-6-6152-7160

**Japan - Tokyo**  
Tel: 81-3-6880-3770

**Korea - Daegu**  
Tel: 82-53-744-4301

**Korea - Seoul**  
Tel: 82-2-554-7200

**Malaysia - Kuala Lumpur**  
Tel: 60-3-7651-7906

**Malaysia - Penang**  
Tel: 60-4-227-8870

**Philippines - Manila**  
Tel: 63-2-634-9065

**Singapore**  
Tel: 65-6334-8870

**Taiwan - Hsin Chu**  
Tel: 886-3-577-8366

**Taiwan - Kaohsiung**  
Tel: 886-7-213-7830

**Taiwan - Taipei**  
Tel: 886-2-2508-8600

**Thailand - Bangkok**  
Tel: 66-2-694-1351

**Vietnam - Ho Chi Minh**  
Tel: 84-28-5448-2100

### EUROPE

**Austria - Wels**  
Tel: 43-7242-2244-39  
Fax: 43-7242-2244-393

**Denmark - Copenhagen**  
Tel: 45-4485-5910  
Fax: 45-4485-2829

**Finland - Espoo**  
Tel: 358-9-4520-820

**France - Paris**  
Tel: 33-1-69-53-63-20  
Fax: 33-1-69-30-90-79

**Germany - Garching**  
Tel: 49-8931-9700

**Germany - Haan**  
Tel: 49-2129-3766400

**Germany - Heilbronn**  
Tel: 49-7131-72400

**Germany - Karlsruhe**  
Tel: 49-721-625370

**Germany - Munich**  
Tel: 49-89-627-144-0  
Fax: 49-89-627-144-44

**Germany - Rosenheim**  
Tel: 49-8031-354-560

**Israel - Hod Hasharon**  
Tel: 972-9-775-5100

**Italy - Milan**  
Tel: 39-0331-742611  
Fax: 39-0331-466781

**Italy - Padova**  
Tel: 39-049-7625286

**Netherlands - Drunen**  
Tel: 31-416-690399  
Fax: 31-416-690340

**Norway - Trondheim**  
Tel: 47-7288-4388

**Poland - Warsaw**  
Tel: 48-22-3325737

**Romania - Bucharest**  
Tel: 40-21-407-87-50

**Spain - Madrid**  
Tel: 34-91-708-08-90  
Fax: 34-91-708-08-91

**Sweden - Gothenberg**  
Tel: 46-31-704-60-40

**Sweden - Stockholm**  
Tel: 46-8-5090-4654

**UK - Wokingham**  
Tel: 44-118-921-5800  
Fax: 44-118-921-5820