VCC4A

CMOS Crystal Oscillator

Features

- Ultra Low Jitter, Fundamental or 3rd OT Crystal Design
- CMOS Output Crystal Oscillator
- Output Frequencies from 1.024 MHz to 160.000 MHz
- +1.8, +2.5, +3.3 or +5.0V Operation
- Output Disable Feature
- Excellent ±25 ppm temperature stability
- -10/70°C or -40/85°C operating temperature
- Small Industry Standard Package, 5 x 3.2 mm
- Product is Compliant to RoHS Directive and Fully Compatible with Lead-Free Assembly (Excluding Solder Dipped, _SNPB, Option)

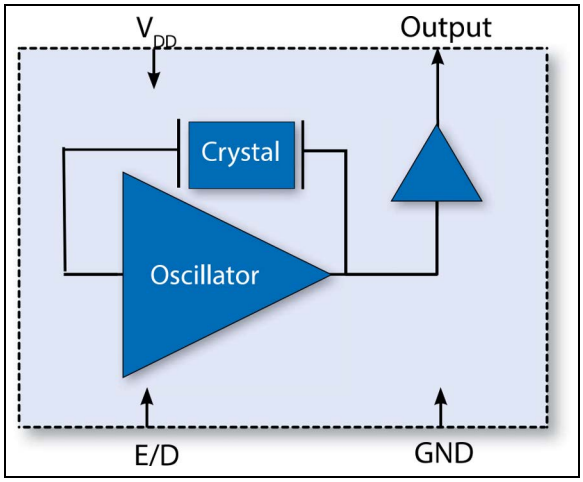
Applications

- SONET/SDH/DWDM
- Ethernet, GE, SynchE
- Storage Area Networking
- Fiber Channel
- Digital Video
- Broadband Access
- Base Stations, Picocells
- Driving A/D's, D/A's, FPGA's
- Test and Measurement
- COTS

General Description

Microchip's VCC4A Crystal Oscillator (XO) is a quartz stabilized square wave generator with a CMOS output. The VCC4A uses a fundamental or third overtone crystal, resulting in very low jitter performance, and a monolithic IC, which improves reliability and reduces cost.

Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Storage Temperature (T_S) ..... –55°C to +125°C
Soldering Temperature, 30 seconds (T_{LS}) ..... +260°C
ESD Rating (Human Body Model, JES22-A115 Conditions, Note 1) 400V
ESD Rating (Charged Device Model, JESD22-C101E Conditions, Note 1) ..... 2 kV

† 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. Permanent damage is also possible if Enable/Disable is applied before V_{DD}.

Note 1: Although ESD protection circuitry has been designed into the VCC4A, 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.

ELECTRICAL CHARACTERISTICS, 5.0V OPTION

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply						
Voltage (Note 1)	V_{DD}	4.5	5.0	5.5	V	—
Max. Supply Voltage	—	–0.5	—	7.0	V	— $\Delta V_{OUT}/(\Delta V_{OUT} \times \Delta V_{IN})$
Max. Voltage E/D	—	–0.5	—	V_{DD} + 0.5	V	—
Current (Note 2)	I_{DD}	—	—	5	mA	≤12 MHz
		—	—	13		12.001 MHz to 20 MHz
		—	—	18		20.001 MHz to 40 MHz
		—	—	21		40.001 MHz to 65 MHz
		—	—	30		65.001 MHz to 100 MHz
Current	I_{DD}	—	—	10	µA	Output Disabled
Frequency						
Nominal Frequency	f_{NOM}	1.024	—	100.000	MHz	—
Frequency Stability (Note 3)	f_{STAB}	—	±25	—	ppm	Ordering option.
		—	±50	—		
		—	±100	—		
Outputs						
Output Logic Level High	V_{OH}	0.9 × V_{DD}	—	—	V	Note 2
Output Logic Level Low	V_{OL}	—	—	0.1 × V_{DD}		
Load	I_{OUT}	—	15	50	pF	—
Output Rise/Fall Time (Note 2)	t_r/t_f	—	—	8	ns	≤20 MHz
		—	—	5		20.001 MHz to 50 MHz
		—	—	3		50.001 MHz to 100 MHz
Output Leakage	I_Z	—	—	±10	µA	Output disabled
Duty Cycle	DC	45	50	55	%	Note 2, Note 4
Period Jitter (Note 5)	ϕ_J	—	2.4	—	ps	100 MHz, RMS
		—	23	—		100 MHz, peak-to-peak
RMS Jitter (Note 6)	ϕ_J	—	65	100	fs	12 kHz to 20 MHz

ELECTRICAL CHARACTERISTICS, 5.0V OPTION (CONTINUED)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Enable/Disable						
Output Enable Voltage	V_{IH}	0.7 × V_{DD}	—	—	V	Note 7
Output Disable Voltage	V_{IL}	—	—	0.4		
Disable Time	t_D	—	—	100	ns	—
Start-Up Time	t_{SU}	—	—	10	ms	—
Operating Temperature Range	T_{OP}	–10	—	+70	°C	Ordering option
		–40	—	+85		

Note 1: The power supply should have bypass capacitors as close to the supply and to ground as possible. For example, 0.1 µF and 0.01 µF.

2: Parameters are tested with the test circuit shown in Figure 1-1. Add [(50 pF – 15 pF) × V_{DD} × f_{OUT}(in MHz) x 0.001] mA for the 50 pF option.

3: Includes initial accuracy, operating temperature, supply voltage, shock and vibration (not under operation), and 10 years' aging for ±50 ppm and ±100 ppm options.

4: Duty cycle is measured as On-Time/Period. See Figure 1-2.

5: Broadband period jitter measured using a LeCroy Waverunner 610Zi, 100k samples.

6: Measured using an Agilent E5052 or equivalent at 100 MHz and +25°C.

7: The output is enabled if Enable/Disable is left open. A 10 kΩ pull-up to V_{DD} is recommended.

ELECTRICAL CHARACTERISTICS, 3.3V OPTION

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply						
Voltage (Note 1)	V_{DD}	2.97	3.3	3.63	V	—
Max. Supply Voltage	—	–0.5	—	7.0	V	—
Max. Voltage E/D	—	–0.5	—	V_{DD} + 0.5	V	—
Current (Note 2)	I_{DD}	—	—	3	mA	≤12 MHz
		—	—	4		12.001 MHz to 20 MHz
		—	—	8		20.001 MHz to 40 MHz
		—	—	18		40.001 MHz to 65 MHz
		—	—	25		65.001 MHz to 100 MHz
		—	—	30		100.001 MHz to 133 MHz
		—	—	40		133.001 MHz to 160 MHz
Current	I_{DD}	—	—	10	µA	Output Disabled
Frequency						
Nominal Frequency	f_{NOM}	1.024	—	160.000	MHz	—
Frequency Stability (Note 3)	f_{STAB}	—	±25	—	ppm	Ordering option.
		—	±50	—		
		—	±100	—		
Outputs						
Output Logic Level High	V_{OH}	0.9 × V_{DD}	—	—	V	Note 2
Output Logic Level Low	V_{OL}	—	—	0.1 × V_{DD}		
Load	I_{OUT}	—	15	50	pF	—

ELECTRICAL CHARACTERISTICS, 3.3V OPTION (CONTINUED)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Rise/Fall Time (Note 2)	t_r/t_f	—	—	8	ns	≤20 MHz
		—	—	5		20.001 MHz to 50 MHz
		—	—	3		50.001 MHz to 160 MHz
Output Leakage	I_Z	—	—	±10	µA	Output disabled
Duty Cycle	DC	45	50	55	%	Note 2, Note 4
Period Jitter (Note 5)	ϕ_J	—	2.8	—	ps	100 MHz, RMS
		—	25	—		100 MHz, peak-to-peak
RMS Jitter (Note 6)	ϕ_J	—	76	115	fs	12 kHz to 20 MHz
Enable/Disable						
Output Enable Voltage	V_{IH}	0.7 × V_{DD}	—	—	V	Note 7
Output Disable Voltage	V_{IL}	—	—	0.4		
Disable Time	t_D	—	—	100	ns	—
Start-Up Time	t_{SU}	—	—	10	ms	—
Operating Temperature Range	T_{OP}	–10	—	+70	°C	Ordering option
		–40	—	+85		

Note 1: The power supply should have bypass capacitors as close to the supply and to ground as possible. For example, 0.1 µF and 0.01 µF.

2: Parameters are tested with the test circuit shown in Figure 1-1. Add [(50 pF – 15 pF) × V_{DD} × f_{OUT} (in MHz) x 0.001] mA for the 50 pF option.

3: Includes initial accuracy, operating temperature, supply voltage, shock and vibration (not under operation), and 10 years' aging for ±50 ppm and ±100 ppm options.

4: Duty cycle is measured as On-Time/Period. See Figure 1-2.

5: Broadband period jitter measured using a LeCroy Waverunner 610Zi, 100k samples.

6: Measured using an Agilent E5052 or equivalent at 100 MHz and +25°C.

7: The output is enabled if Enable/Disable is left open. A 10 kΩ pull-up to V_{DD} is recommended.

ELECTRICAL CHARACTERISTICS, 2.5V OPTION

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply						
Voltage (Note 1)	V_{DD}	2.25	2.5	2.75	V	—
Max. Supply Voltage	—	–0.5	—	7.0	V	—
Max. Voltage E/D	—	–0.5	—	V_{DD} + 0.5	V	—
Current (Note 2)	I_{DD}	—	—	2	mA	≤12 MHz
		—	—	3		12.001 MHz to 20 MHz
		—	—	7		20.001 MHz to 40 MHz
		—	—	12		40.001 MHz to 65 MHz
		—	—	18		65.001 MHz to 100 MHz
		—	—	21		100.001 MHz to 133 MHz
		—	—	30		133.001 MHz to 160 MHz
Current	I_{DD}	—	—	10	µA	Output Disabled

ELECTRICAL CHARACTERISTICS, 2.5V OPTION (CONTINUED)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Frequency						
Nominal Frequency	f_{NOM}	1.024	—	160.000	MHz	—
Frequency Stability (Note 3)	f_{STAB}	—	±25	—	ppm	Ordering option.
		—	±50	—		
		—	±100	—		
Outputs						
Output Logic Level High	V_{OH}	0.9 × V_{DD}	—	—	V	Note 2
Output Logic Level Low	V_{OL}	—	—	0.1 × V_{DD}		
Load	I_{OUT}	—	15	50	pF	—
Output Rise/Fall Time (Note 2)	t_r/t_f	—	—	8	ns	≤20 MHz
		—	—	5		20.001 MHz to 50 MHz
		—	—	4		50.001 MHz to 160 MHz
Output Leakage	I_Z	—	—	±10	µA	Output disabled
Duty Cycle	DC	45	50	55	%	Note 2, Note 4
Period Jitter, 100 MHz (Note 5)	ϕ_J	—	2.8	—	ps	RMS
		—	26	—		Peak-to-peak
RMS Jitter (Note 6)	ϕ_J	—	97	145	fs	12 kHz to 20 MHz
Enable/Disable						
Output Enable Voltage	V_{IH}	0.7 × V_{DD}	—	—	V	Note 7
Output Disable Voltage	V_{IL}	—	—	0.4		
Disable Time	t_D	—	—	100	ns	—
Start-Up Time	t_{SU}	—	—	10	ms	—
Operating Temperature Range	T_{OP}	–10	—	+70	°C	Ordering option
		–40	—	+85		

Note 1: The power supply should have bypass capacitors as close to the supply and to ground as possible. For example, 0.1 µF and 0.01 µF.

2: Parameters are tested with the test circuit shown in Figure 1-1. Add [(50 pF – 15 pF) × V_{DD} × f_{OUT}(in MHz) x 0.001] mA for the 50 pF option.

3: Includes initial accuracy, operating temperature, supply voltage, shock and vibration (not under operation), and 10 years' aging for ±50 ppm and ±100 ppm options.

4: Duty cycle is measured as On-Time/Period. See Figure 1-2.

5: Broadband period jitter measured using a LeCroy Waverunner 610Zi, 100k samples.

6: Measured using an Agilent E5052 or equivalent at 100 MHz and +25°C.

7: The output is enabled if Enable/Disable is left open. A 10 kΩ pull-up to V_{DD} is recommended.

ELECTRICAL CHARACTERISTICS, 1.8V OPTION

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply						
Voltage (Note 1)	V_{DD}	1.71	1.8	1.89	V	—
Max. Supply Voltage	—	–0.5	—	7.0	V	—
Max. Voltage E/D	—	–0.5	—	V_{DD} + 0.5	V	—

ELECTRICAL CHARACTERISTICS, 1.8V OPTION (CONTINUED)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Current (Note 2)	I_{DD}	—	—	2	mA	≤12 MHz
		—	—	3		12.001 MHz to 20 MHz
		—	—	11		20.001 MHz to 65 MHz
		—	—	18		65.001 MHz to 133 MHz
		—	—	25		133.001 MHz to 160 MHz
Current	I_{DD}	—	—	10	µA	Output Disabled
Frequency						
Nominal Frequency	f_{NOM}	1.024	—	160.000	MHz	—
Frequency Stability (Note 3)	f_{STAB}	—	±25	—	ppm	Ordering option.
		—	±50	—		
		—	±100	—		
Outputs						
Output Logic Level High	V_{OH}	0.9 × V_{DD}	—	—	V	Note 2
Output Logic Level Low	V_{OL}	—	—	0.1 × V_{DD}		
Load	I_{OUT}	—	15	50	pF	—
Output Rise/Fall Time (Note 2)	t_r/t_f	—	—	8	ns	≤20 MHz
		—	—	5		20.001 MHz to 50 MHz
		—	—	5		50.001 MHz to 160 MHz
Output Leakage	I_Z	—	—	±10	µA	Output disabled
Duty Cycle	DC	45	50	55	%	Note 2, Note 4
Period Jitter, 100 MHz (Note 5)	ϕ_J	—	3.4	—	ps	RMS
		—	33	—		Peak-to-peak
RMS Jitter (Note 6)	ϕ_J	—	212	320	fs	12 kHz to 20 MHz
Enable/Disable						
Output Enable Voltage	V_{IH}	0.7 × V_{DD}	—	—	V	Note 7
Output Disable Voltage	V_{IL}	—	—	0.4		
Disable Time	t_D	—	—	100	ns	—
Start-Up Time	t_{SU}	—	—	10	ms	—
Operating Temperature Range	T_{OP}	–10	—	+70	°C	Ordering option
		–40	—	+85		

Note 1: The power supply should have bypass capacitors as close to the supply and to ground as possible. For example, 0.1 µF and 0.01 µF.

2: Parameters are tested with the test circuit shown in Figure 1-1. Add [(50 pF – 15 pF) × V_{DD} × f_{OUT}(in MHz) x 0.001] mA for the 50 pF option.

3: Includes initial accuracy, operating temperature, supply voltage, shock and vibration (not under operation), and 10 years' aging for ±50 ppm and ±100 ppm options.

4: Duty cycle is measured as On-Time/Period. See Figure 1-2.

5: Broadband period jitter measured using a LeCroy Waverunner 610Zi, 100k samples.

6: Measured using an Agilent E5052 or equivalent at 100 MHz and +25°C.

7: The output is enabled if Enable/Disable is left open. A 10 kΩ pull-up to V_{DD} is recommended.

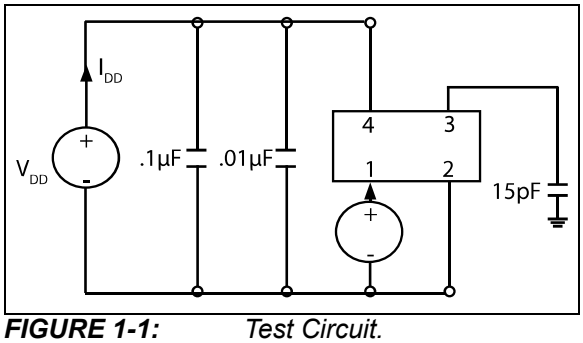


FIGURE 1-1: *Test Circuit.*

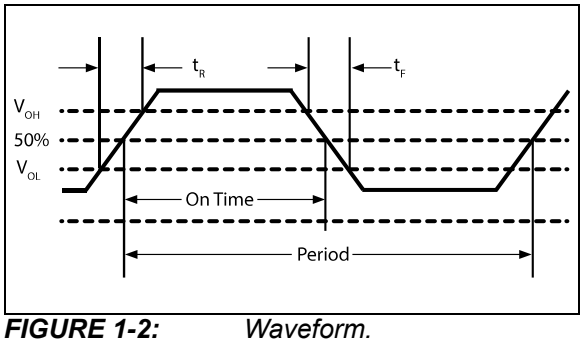


FIGURE 1-2: *Waveform.*

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	E/D	Enable/Disable.
2	GND	Case and electrical ground.
3	Output	Output.
4	V_{DD}	Power supply voltage.

TABLE 2-2: ENABLE/DISABLE FUNCTION

E/D Pin	Output
High	Clock Output
Open	Clock Output
Low	High Impedance

3.0 RELIABILITY

Microchip qualification includes aging at various extreme temperatures, shock and vibration, temperature cycling, and IR reflow simulation. The VCC4A family 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
Gross and Fine Leak	MIL-STD-883, Method 1014
Resistance to Solvents	MIL-STD-883, Method 2015
Moisture Sensitivity Level	MSL 1
Contact Pads	Gold (0.3 µm min. to 1 µm max.) over Nickel
Contact Pads, _SNPB Option	Tinned using solder alloy Sn63Pb37 in accordance with J-STD-006
Weight	62 mg

Although ESD protection circuitry has been designed into the VCC4A, 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.

TABLE 3-2: ESD RATINGS

Model	Minimum	Conditions
Human Body Model	400V	JES22-A115
Charged Device Model	2000V	JESD22-C101

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. Permanent damage is also possible if E/D is applied before V_{DD}.

TABLE 3-3: ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit
Storage Temperature	T_S	–55 to 125	°C
Soldering Temperature / Time	T_{LS}	260 / 30	°C / seconds

4.0 IR REFLOW

The VCC4A is qualified to meet the JEDEC standard for Pb-Free assembly. The temperatures and time intervals listed are based on the Pb-Free small body requirements. The VCC4A device is hermetically sealed so an aqueous wash is not an issue. **Note:** Devices that have been solder dipped (_SNPB option) will not be Pb-Free.

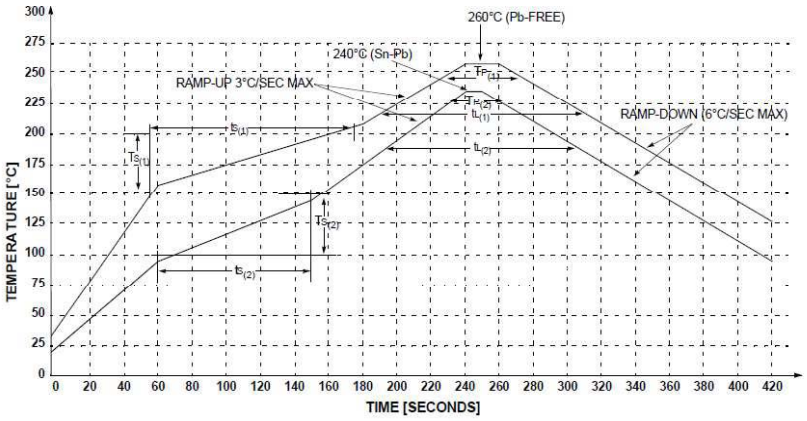


FIGURE 4-1: *Reflow Profile.*

TABLE 4-1: REFLOW PROFILE

Symbol	Minimum	Maximum	Conditions
$T_{S(1)}$	150°C	200°C	Pb-Free
$T_{S(2)}$	100°C	150°C	_SNPB Option
$t_{s(1)}$	60 sec.	180 sec.	Pb-Free
$t_{s(2)}$	60 sec.	120 sec.	_SNPB Option
$t_{l(1)}$	60 sec.	150 sec.	Pb-Free
$t_{l(2)}$	60 sec.	150 sec.	_SNPB Option
$T_{p(1)}$	245°C	260°C	Pb-Free
$T_{p(2)}$	225°C	240°C	_SNPB Option

5.0 TAPE AND REEL

TABLE 5-1: TAPE AND REEL DIMENSIONS

Tape Dimensions (mm)						Reel Dimensions (mm)						
Dimension	**W**	**F**	**D_O**	**P_O**	**P1**	**A**	**B**	**C**	**D**	**N**	**W1**	**W2**
Tolerance	**Typ.**	**Typ.**	**Typ.**	**Typ.**	**Typ.**	**Typ.**	**Min.**	**Typ.**	**Min.**	**Min.**	**Typ.**	**Max.**
VCC4A	12	5.5	1.5	4	8	178	1.78	13	20.6	55	12.4	22.4

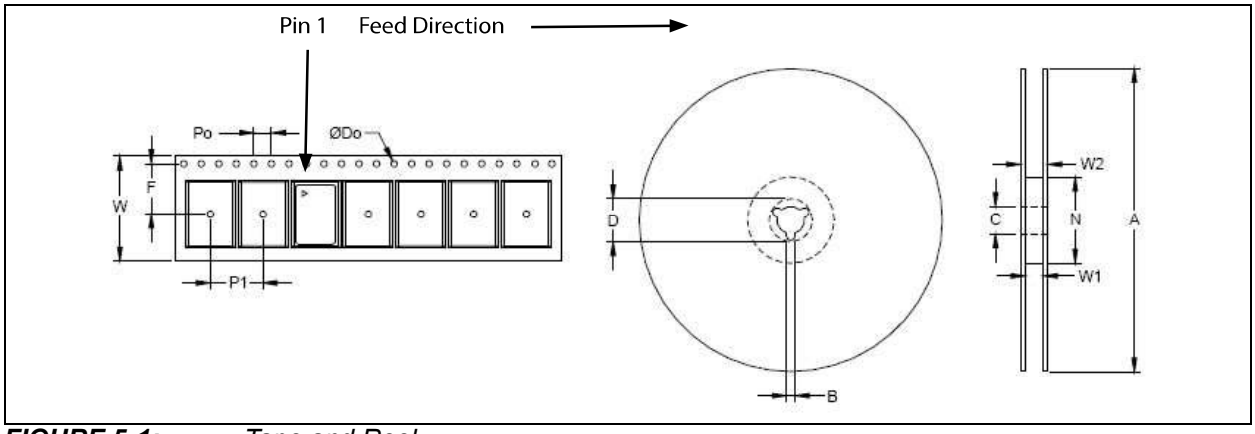
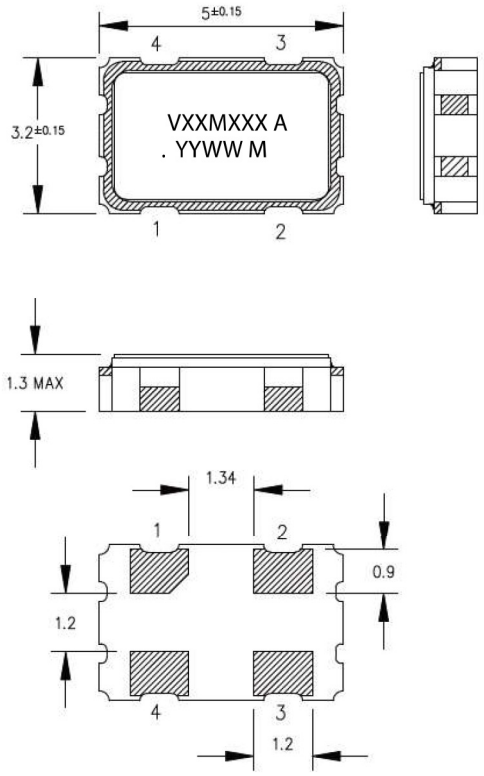


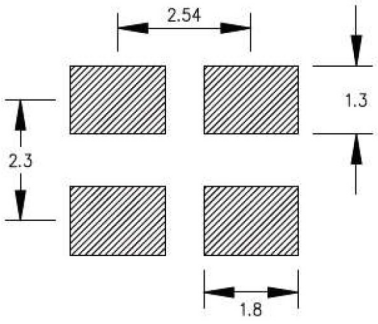
FIGURE 5-1: *Tape and Reel.*

6.0 PACKAGING INFORMATION



Dimensions in mm

Recommended Soldering Pad Layout



Marking
V = Vectron
XXMXXX = Frequency, eg 50M000 = 50.000 MHz
A = Product family
. = Pin 1
YY = Year
WW = Week
M = Manufacturing Location, examples C, C3, J1

APPENDIX A: REVISION HISTORY

Revision A (December 2022)

- Initial release of VCC4A as Microchip data sheet DS20006749A.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

Part Number	-X	X	X	xxMxxxxxxx	XX
Device	Power Supply	Electrical Options	Stability	Frequency	Media Type

Device:	VCC4A:		CMOS Crystal Oscillator in 5 mm x 3.2 mm
Power Supply:	A	=	+5.0 VDC, 15 pF
	B	=	+3.3 VDC, 15 pF
	C	=	+3.0 VDC, 15 pF
	E	=	±5.0 VDC, 50 pF
	F	=	±3.3 VDC, 50 pF
	G	=	±2.5 VDC, 15 pF
	H	=	±1.8 VDC, 15 pF
Electrical Options:	3	=	Tristate, 45/55% Duty Cycle
	0	=	No Tristate, 40/60% Duty Cycle
Option 3 recommended. All other options not recommended for new designs.	1	=	Tristate, 40/60% Duty Cycle
	2	=	No Tristate, 45/55% Duty Cycle
	5	=	Enable, 40/60% Duty Cycle
	6	=	Enable, 45/55% Duty Cycle
Stability:	A	=	±100 ppm, –10 to 70°C
	C	=	±100 ppm, –40 to 85°C
	B	=	±50 ppm, –10 to 70°C
	D	=	±50 ppm, –40 to 85°C
	E	=	±25 ppm, –10 to 70°C
	F	=	±25 ppm, –40 to 85°C
Frequency:	xxMxxxxxxx	=	Frequency in MHz (3rd character is K if kHz)
Media Type:	<blank>	=	Cut tape or non-standard TR quantities
	TR	=	Tape and Reel
	_SNPB	=	Tin Lead solder dipped

Examples:

a) VCC4A-B3B-49M1520000TR:	VCC4A, +3.3VDC Power Supply, Tristate Electrical Option, 45/55% Duty Cycle, –10°C to +70°C Temp. Range, ±50 ppm Stability, 49.152 MHz Frequency, Tape and Reel (1000/Reel).
b) VCC4A-F3F-20M0000000:	VCC4A, ±3.3 VDC Power Supply, Tristate Electrical Option, 45/55% Duty Cycle, ±25 ppm, –40 to 85°C Temp. Range, 20 MHz Frequency, Cut Tape /Non-standard TR Quantities
c) VCC4A-B3D-24M5760000TR:	VCC4A, +3.3 VDC Power Supply, Tristate Electrical Option, 45/55% Duty Cycle, ±50 ppm, –40 to 85°C Temp. Range, 24.576 MHz Frequency, Tape and Reel (1000/Reel)

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.

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.

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