VC-840A

CMOS Crystal Oscillator

Features

- Ultra-Low Jitter, Fundamental or 3rd Overtone Crystal Design
- CMOS Output Crystal Oscillator
- Output Frequencies from 1.024 MHz to 160.000 MHz
- 1.8V, 2.5V, 3.3V, or 5.0V Operation
- Output Disable Feature
- Excellent ±25 ppm Temperature Stability
- –10°C to +70°C, –40°C to +85°C, –40°C to +105°C, –40°C to +125°C, or –55°C to +125°C Operating Temperature Options
- Small, Industry Standard 2.5 mm x 2.0 mm Package
- Product is Compliant with RoHS Directive and Fully Compatible with Lead-Free Assembly (Excluding Solder-Dipped _SNPB Option)

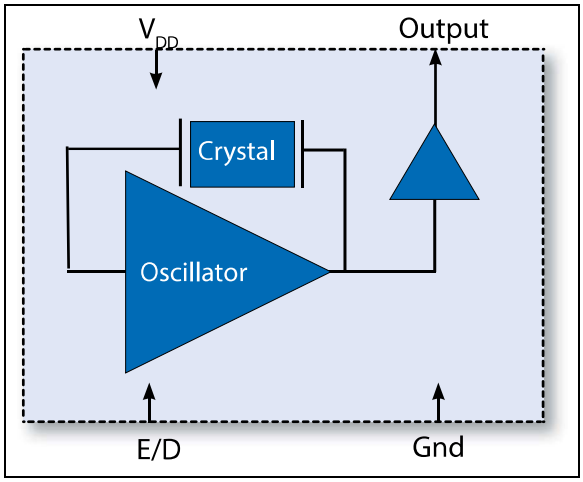
Applications

- SONET/SDH/DWDM
- Ethernet, GE, SyncE
- Storage Area Networking
- Fibre Channel
- Digital Video
- Broadband Access
- Base Stations, Picocells

General Description

Microchip's VC-840A Crystal Oscillator (XO) is a quartz-stabilized square wave generator with a CMOS output. The VC-840A uses a fundamental or a 3rd overtone crystal—oscillating in a fundamental tone that results in very low jitter performance—and a monolithic IC that improves reliability and reduces cost.

Block Diagram



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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 VC-840A, 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	—
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 x V_{DD}	—	—	V	Note 2
Output Logic Level Low	V_{OL}	—	—	0.1 x V_{DD}		
Load	I_{OUT}	—	15	30	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, 100 MHz (Note 5)	ϕ_J	—	2.4	—	ps	RMS
		—	23	—		Peak-to-peak
RMS Jitter (Note 6)	ϕ_J	—	65	100	fs	12 kHz to 20 MHz

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ELECTRICAL CHARACTERISTICS, 5.0V OPTION (CONTINUED)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Enable/Disable						
Output Enable Voltage	V_{IH}	0.7 x 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		
		–40	—	+105		
		–40	—	+125		
		–55	—	+125		

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 [(30 pF – 15 pF) × V_{DD} × f_{OUT}(in MHz) x 0.001] mA for the 30 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	—		

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ELECTRICAL CHARACTERISTICS, 3.3V OPTION (CONTINUED)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Outputs						
Output Logic Level High	V_{OH}	0.9 x V_{DD}	—	—	V	Note 2
Output Logic Level Low	V_{OL}	—	—	0.1 x V_{DD}		
Load	I_{OUT}	—	15	30	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 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
		—	25	—		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 x 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		
		–40	—	+105		
		–40	—	+125		
		–55	—	+125		

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 [(30 pF – 15 pF) × V_{DD} × f_{OUT}(in MHz) x 0.001] mA for the 30 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.

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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
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 x V_{DD}	—	—	V	Note 2
Output Logic Level Low	V_{OL}	—	—	0.1 x V_{DD}		
Load	I_{OUT}	—	15	30	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

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ELECTRICAL CHARACTERISTICS, 2.5V OPTION (CONTINUED)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Enable/Disable						
Output Enable Voltage	V_{IH}	0.7 x 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		
		–40	—	+105		
		–40	—	+125		
		–55	—	+125		

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 [(30 pF – 15 pF) × V_{DD} × f_{OUT}(in MHz) x 0.001] mA for the 30 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	—
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 x V_{DD}	—	—	V	Note 2
Output Logic Level Low	V_{OL}	—	—	0.1 x V_{DD}		
Load	I_{OUT}	—	15	30	pF	—

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ELECTRICAL CHARACTERISTICS, 1.8V 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
		—	—	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 x 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		
		–40	—	+105		
		–40	—	+125		
		–55	—	+125		

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 [(30 pF – 15 pF) × V_{DD} × f_{OUT}(in MHz) x 0.001] mA for the 30 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.

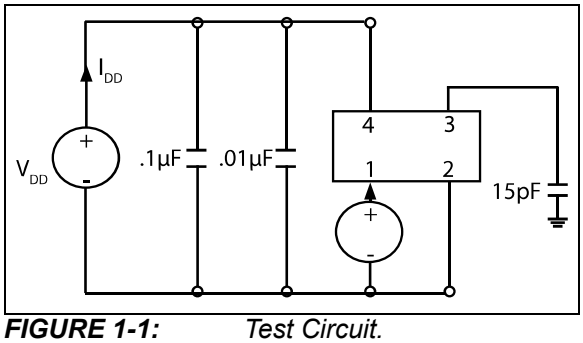

FIGURE 1-1: *Test Circuit.*

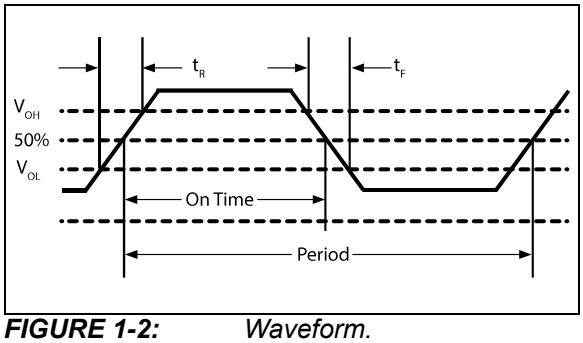

FIGURE 1-2: *Waveform.*

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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

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3.0 RELIABILITY

Microchip qualification includes aging at various extreme temperatures, shock and vibration, temperature cycling, and IR reflow simulation. The VC-840A 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
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

4.0 IR REFLOW

The VC-840A 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 VC-840A 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.

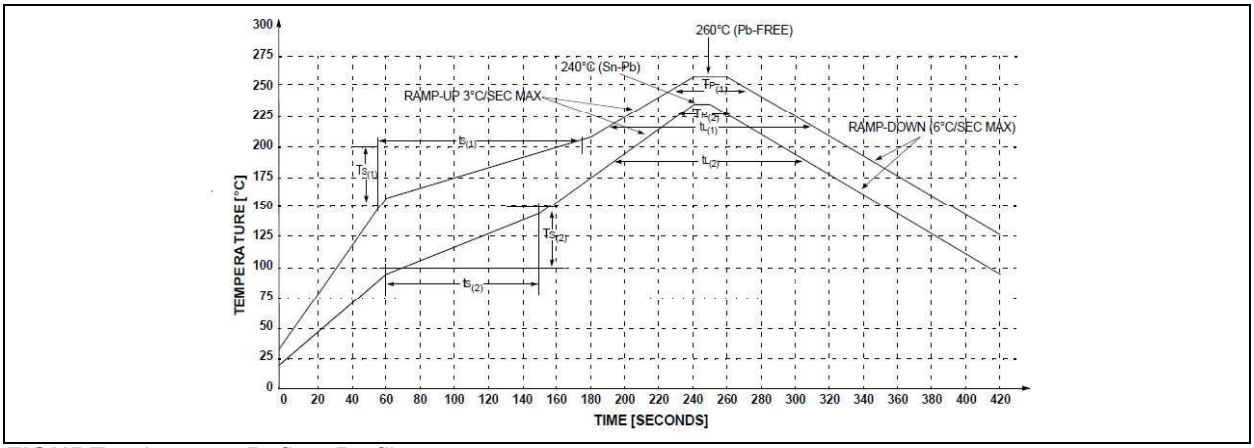

FIGURE 4-1: *Reflow Profile.*

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

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5.0 TAPE AND REEL

TABLE 5-1: TAPE AND REEL DIMENSIONS

Tape Dimensions (mm)						Reel Dimensions (mm)							Qty.
Dimension	W	F	D_O	P_O	P1	A	B	C	D	N	W1	W2	per Reel
Tolerance	Typ.	Typ.	Typ.	Typ.	Typ.	Typ.	Min.	Typ.	Min.	Min.	Typ.	Max.	
VC-840A	8.0	3.5	1.5	4.0	4.0	180	2.0	13.0	21.0	60.0	9	11.4	3000

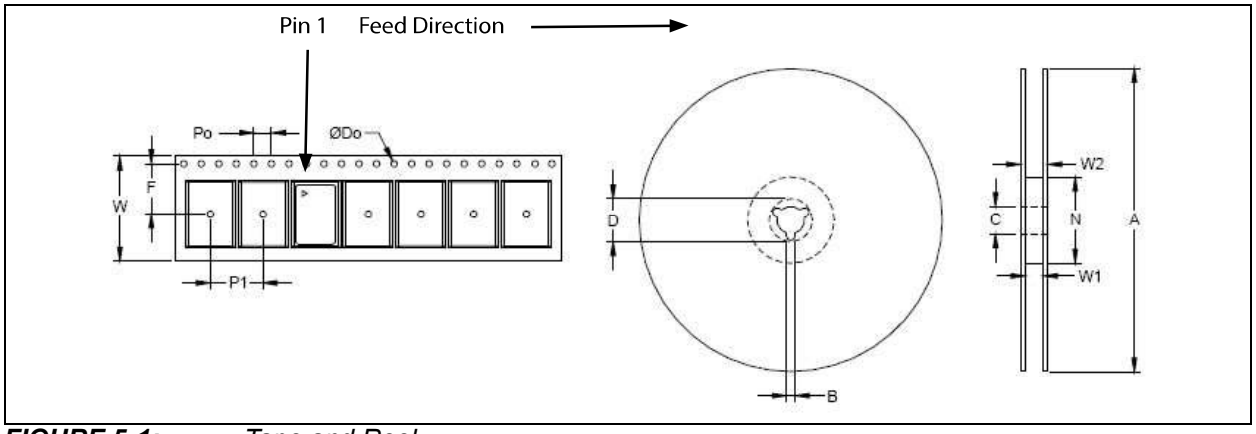

FIGURE 5-1: *Tape and Reel.*

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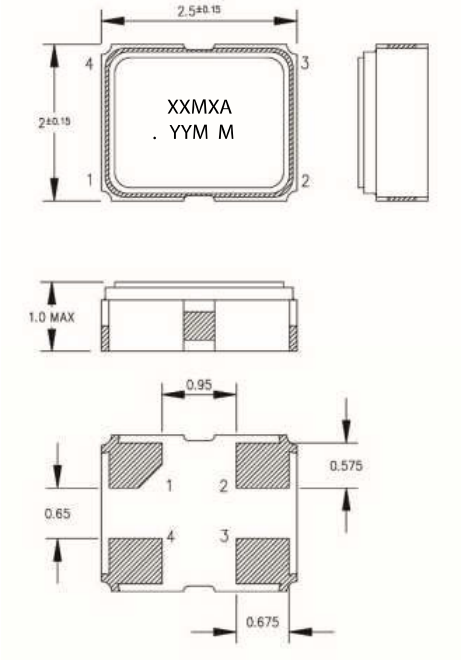
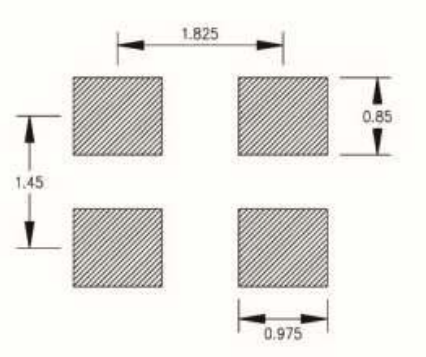
6.0 PACKAGING INFORMATION

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





Marking Information
XXMX =Frequency, eg 25M0 = 25.000MHz
A = Revision Level
YY = Year
M = Month
M = Manufacturing Location, examples, C, C3, J1

Dimensions in mm

NOTES:

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APPENDIX A: REVISION HISTORY

Revision A (January 2023)

- Initial release of VC-840A as Microchip data sheet DS20006760A.

NOTES:

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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	-X	X	X	X	xxMxxxxxxx	XX
Device	Power Supply	Output	Temp. Range	Stability	Enable/ Disable	Load	Custom Options	Frequency	Media Type

Device:	VC-840A:		CMOS Crystal Oscillator in 2.5 mm x 2.0 mm Ceramic Package
Power Supply:	A	=	5.0VDC
	E	=	3.3VDC
	H	=	2.5VDC
	J	=	1.8VDC
Output:	A	=	CMOS
Temperature Range:	W	=	–10°C to +70°C
	E	=	–40°C to +85°C
	F	=	–40°C to +105°C (±50 ppm & ±100 ppm)
	7	=	–40°C to +125°C (±50 ppm & ±100 ppm)
	C	=	–55°C to +125°C (±50 ppm & ±100 ppm)
Stability:	F	=	±25 ppm
	K	=	±50 ppm
	S	=	±100 ppm
Enable/Disable:	A	=	Enable/Diable, Enable High
Load:	A	=	15 pF
	B	=	30 pF
Custom Options:	N	=	Standard option
Frequency:	xxMxxxxxxx	=	Frequency in MHz (3rd character is K, if kHz)
Media Type:	<blank>	=	Cut Tape/non-TR quantities
	TR	=	Tape and Reel
	_SNPB	=	Tin Lead solder dipped

Examples:

a) VC-840A-EAW-KAAN-25M0000000TR: VC-840A, 3.3VDC Power Supply, CMOS Output, –10°C to +70°C Temp. Range, ±50 ppm Stability, Enable/Disable Enable High, 15 pF Load, Standard Option, 25.000 MHz, Tape and Reel

b) VC-840A-AA7-SABN-63M5000000_SNPB: VC-840A, 5.0VDC Power Supply, CMOS Output, –40°C to +125°C Temp. Range, ±100 ppm Stability, Enable/Disable Enable High, 30 pF Load, Standard Option, 63.500 MHz, Tin Lead Solder Dipped

c) VC-840A-JAE-FAAN-130M000000: VC-840A, 1.8VDC Power Supply, CMOS Output, –40°C to +85°C Temp. Range, ±25 ppm Stability, Enable/Disable Enable High, 15 pF Load, Standard Option, 130.000 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.

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NOTES:

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