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VMK3/VMK4

32.768 kHz Tuning Fork

Features

- ±20 ppm Initial Accuracy
- –20°C to +70°C or –40°C to +85°C Operating Temperature Range
- Small, Industry Standard Packages
- Products are Compliant to RoHS Directive and Fully Compatible with Lead-Free Assembly

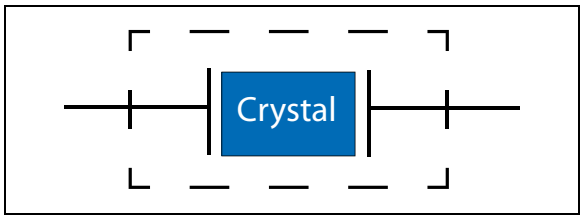
Applications

- Realtime Clocks
- Microprocessors
- Wearables
- IoT
- Bluetooth Low Energy
- Medical, Hearing Aids, Meters and Monitors
- Security

General Description

The VMK series 32.768 kHz tuning fork is used as a building block for 32.768 kHz oscillator clocks, and associated divide-by to generate a 1 Hz/1 second clock signal. The VMK3 is a 3.2 mm x 1.5 mm ceramic hermetically sealed package and the VMK4 is 2.0 mm x 1.2 mm.

Block Diagram



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1.0 ELECTRICAL CHARACTERISTICS

VMK3 ELECTRICAL PERFORMANCE

Parameter	Symbol	Min.	Typ.	Max.	Units
Nominal Frequency	f_{NOM}	—	32.768	—	kHz
Crystal Mode	—		Tuning Fork		—
Operating Temperature Range, *ordering option*	T_{OP}	–20	—	+70	°C
		–40	—	+85	
Frequency Stability					
Stability over T_{OP}	f_{STAB}	—	—	–0.04	ppm/°C[2]
Turnover Temperature	—	20	25	30	°C
Frequency Tolerance, referenced to +25°C	f_{TOL}	—	—	±20	ppm
Load Capacitance, *ordering option*	C_L		6, 7, 9, or 12.5		pF
Equivalent Series Resistance	ESR	—	—	70	kΩ
Shunt Capacitance	C_O	—	1.2	3.0	pF
Motional Capacitance	C_1	—	3.5	—	fF
Drive Level	—	—	—	1.0	µW
Aging, 1st Year	f_{AGE}	—	—	±3	ppm
Storage Temperature	T_{STO}	–55	—	+125	°C
Package	—		3.2 x 1.5		mm
Weight	—	—	13	—	mg

Note 1: Product is compliant with RoHS directive and fully compatible with lead-free assembly.

VMK4 ELECTRICAL PERFORMANCE

Parameter	Symbol	Min.	Typ.	Max.	Units
Nominal Frequency	f_{NOM}	—	32.768	—	kHz
Crystal Mode	—		Tuning Fork		—
Operating Temperature Range, *ordering option*	T_{OP}	–20	—	+70	°C
		–40	—	+85	
Frequency Stability					
Stability over T_{OP}	f_{STAB}	—	—	–0.045	ppm/°C[2]
Turnover Temperature	—	20	25	30	°C
Frequency Tolerance, referenced to +25°C	f_{TOL}	—	—	±20	ppm
Load Capacitance, *ordering option*	C_L		6, 7, 9, or 12.5		pF
Equivalent Series Resistance	ESR	—	—	90	kΩ
Shunt Capacitance	C_O	—	—	1.5	pF
Motional Capacitance	C_1	—	4.7	—	fF
Drive Level	—	—	—	1.0	µW
Aging, 1st Year	f_{AGE}	—	—	±3	ppm
Storage Temperature	T_{STO}	–55	—	+125	°C
Package	—		2.0 x 1.2		mm
Weight	—	—	6	—	mg

Note 1: Product is compliant with RoHS directive and fully compatible with lead-free assembly.

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2.0 RELIABILITY AND IR COMPLIANCE

TABLE 2-1: ENVIRONMENTAL COMPLIANCE

Parameter	Conditions
Mechanical Shock	MIL-STD-883, Method 2002, Condition A
Mechanical Vibration	MIL-STD-883, Method 2007, Condition A
Temperature Cycle	MIL-STD-883, Method 1010, Condition B
Solderability	MIL-STD-202-210, Condition B
Gross and Fine Leak	MIL-STD-883, Method 1014
Altitude	MIL-STD-883, Method 1001, Condition B
Moisture Sensitivity Level	MSL 1

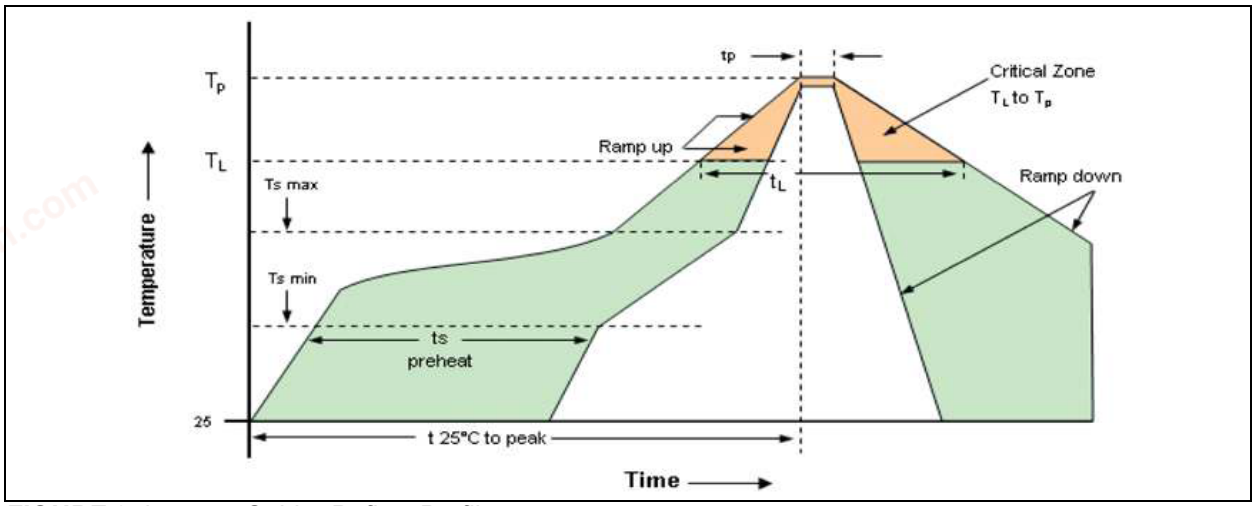


FIGURE 2-1: *Solder Reflow Profile.*

TABLE 2-2: REFLOW PROFILE

Parameter	Symbol	Value
Pre-Heat Time	t_S	60 sec. min.; 260 sec. max.
T_S min.	—	+150°C
T_S max.	—	+200°C
Ramp Up	R_{UP}	3°C/sec. max.
Time Above 217°C	t_L	60 sec. min.; 150 sec. max.
Time to Peak Temperature	t_{AMB-P}	480 sec. max.
Time at 260°C	t_P	10 sec. max.
Ramp Down	R_{DN}	6°C/sec. max.

Tuning fork products oscillate at frequency bands that are close to ultrasonic cleaning processes. This may cause electrical resonance deterioration and even damaging the overall structure of devices. Using ultrasonic cleaning machine to clean tuning fork devices should be avoided. If the use of this method to clean tuning fork devices is required, it's recommended to qualify the process and functionality of devices before and after the cleaning process.

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3.0 TAPE AND REEL

TABLE 3-1: TAPE AND REEL DIMENSIONS

Tape Dimensions (mm)						Reel Dimensions (mm)							
Part #	**W**	**F**	**Do**	**Po**	**P1**	**A**	**B**	**C**	**D**	**N**	**W1**	**W2**	**# per Reel**
VMK3	12	5.5	1.5	4.0	4.0	180	2	13	21	60	13.0	15.4	3000
VMK4	8	3.5	1.5	4.0	4.0	178	2.5	13	21	60	9	11.4	3000

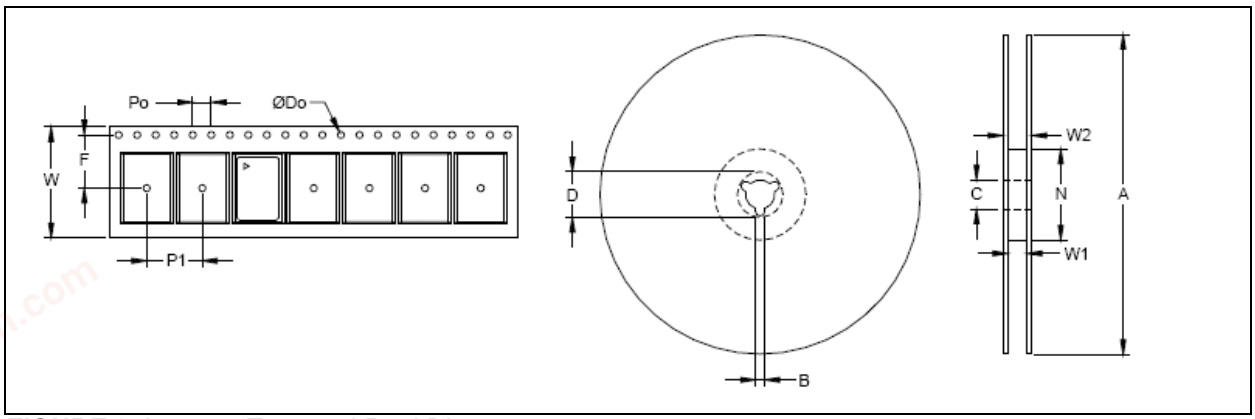


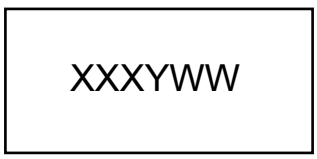
FIGURE 3-1: *Tape and Reel Diagram.*

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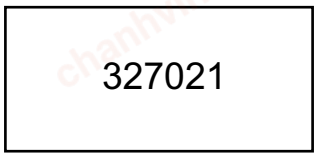
4.0 PACKAGING INFORMATION

4.1 Package Marking Information

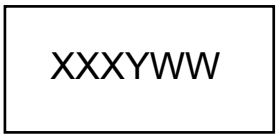
2-Lead VDFN*



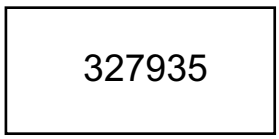
Example



2-Lead CDFP*



Example



Legend:	327	32.768 kHz
	Y	Year code (last digit of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.
	●, ▲, ▼	Pin one index is identified by a dot, delta up, or delta down (triangle mark).

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

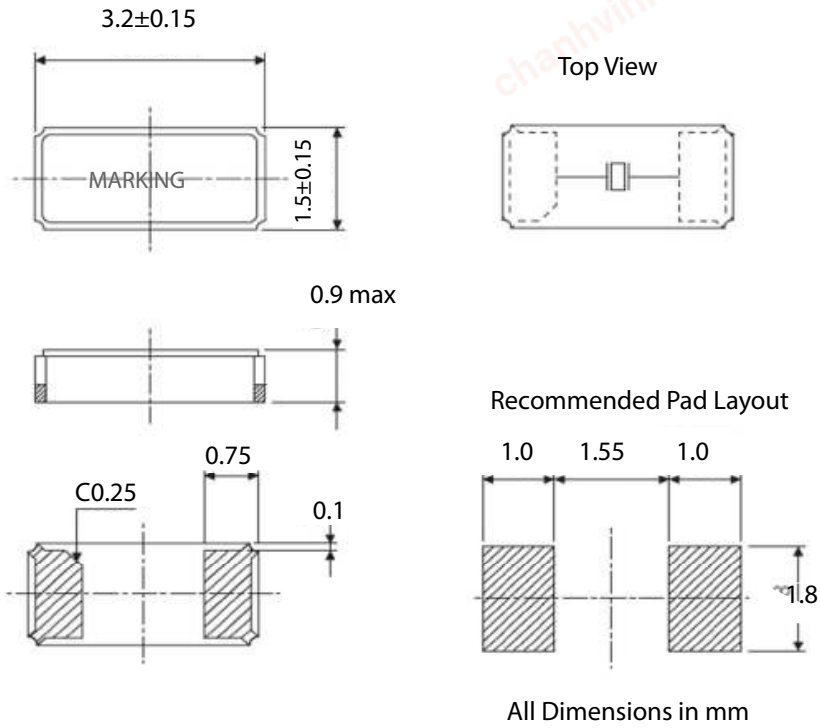
Underbar (_) and/or Overbar (¯) symbol may not be to scale.

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2-Lead VDFN 3.2 mm x 1.5 mm 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

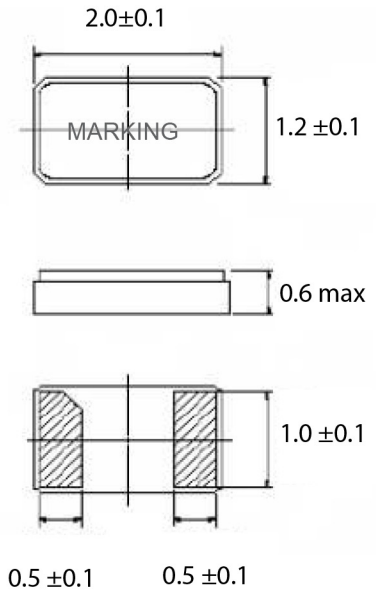


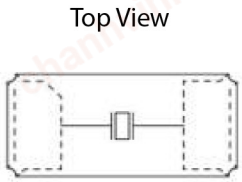
All Dimensions in mm

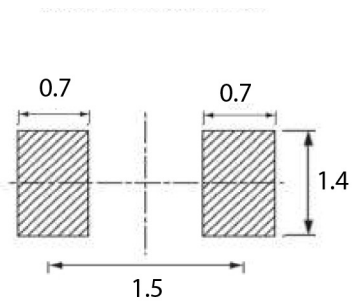
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2-Lead CDFP Package Outline and Recommended Land Pattern

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







All Dimensions in mm

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APPENDIX A: REVISION HISTORY

Revision A (January 2021)

- Initial release of VMK3/VMK4 as Microchip data sheet DS20006440A.

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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 No.	X	-X	X	X	-XX	XXXXXXXXXX	XX
Device	Package	Mode	Frequency Tolerance	Operating Temperature	Load Capacitance	Frequency (in kHz)	Media Type

Device:	VMK:		32.768 kHz Tuning Fork
Package:	3	=	2-Lead 3.2 mm x 1.5 mm VDFN
	4	=	2-Lead 2.0 mm x 1.2 mm CDFP
Mode:	1	=	Fundamental Tuning Fork
Frequency Tolerance:	E	=	±20 ppm
Operating Temperature:	E	=	–40°C to +85°C
	J	=	–20°C to +70°C
Load Capacitance:	06	=	6 pF
	07	=	7 pF
	09	=	9 pF
	12	=	12.5 pF
Frequency:	32K7680000	=	Frequency in kHz
Packing Option:	<blank>	=	Cut Tape/non-TR Quantities
	TR	=	3,000/Reel

Examples:

a) VMK3-1EE-06-32K7680000TR:	32.768 kHz Tuning Fork, 3.2 mm x 1.5 mm VDFN, Fundamental Tuning Fork, ±20 ppm Frequency Tolerance, –40°C to +85°C Temp. Range, 6 pF Load Capacitance, 3,000/ Reel
b) VMK4-1EJ-12-32K7680000TR:	32.768 kHz Tuning Fork, 2.0 mm x 1.2 mm CDFP, Fundamental Tuning Fork, ±20 ppm Frequency Tolerance, –20°C to +70°C Temp. Range, 12.5 pF Load Capacitance, 3,000/ 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.

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