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![Microchip logo] MICROCHIP

DSC60XX

Ultra-Small, Ultra-Low Power MEMS Oscillator

Features

- Wide Frequency Range: 2 kHz to 80 MHz
- Ultra-Low Power Consumption: 1.3 mA/12 µA (Active/Stdby)
- Ultra-Small Footprints
  - 1.6 mm × 1.2 mm
  - 2.0 mm × 1.6 mm
  - 2.5 mm × 2.0 mm
  - 3.2 mm × 2.5 mm
- Frequency Select Input Supports 2 Predefined Frequencies
- High Stability: ±25, ±50 ppm
- Wide Temperature Range
  - Industrial: –40°C to 85°C
  - Ext. Commercial: –20° to 70°C
- Excellent Shock & Vibration Immunity
  - Qualified to MIL-STD-883
- High Reliability
  - 20x Better MTF Than Quartz Oscillators
- Supply Range of 1.71V to 3.63V
- Short Sample Lead Time: <2 weeks
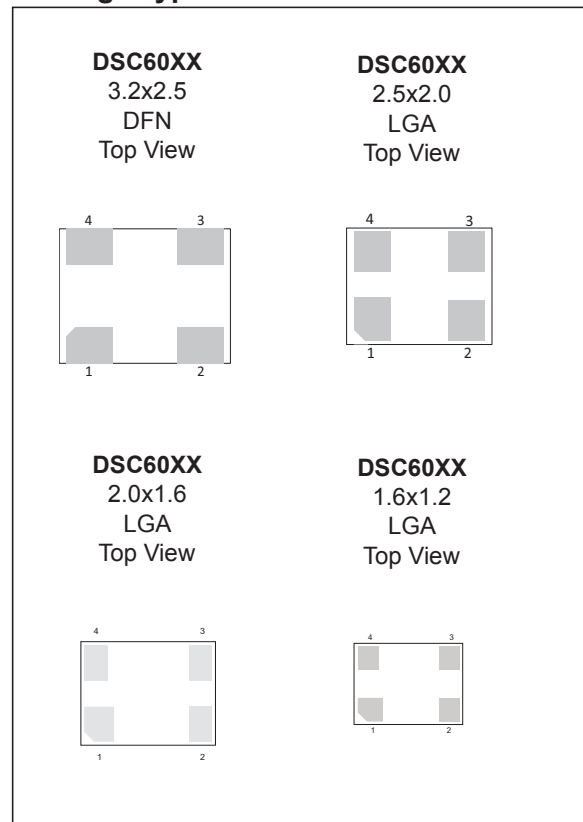- Lead Free & RoHS Compliant

Applications

- Low Power/Portable Applications - IoT, Embedded/Smart Devices
- Consumer - Home Healthcare, Fitness Devices, Home Automation
- Automotive - Rear View/Surround View Cameras, Infotainment System
- Industrial - Building/Factory Automation, Surveillance Camera

General Description

The DSC60xx family of MEMS oscillators combines industry-leading low-power consumption, ultra-small packages with exceptional frequency stability, and jitter performance over temperature. The single-output DSC60xx MEMS oscillators are excellent choices for use as clock references in small, battery-powered devices such as wearable and Internet of Things (IoT) devices in which small size, low power consumption, and long-term reliability are paramount. They also meet the stringent mechanical durability and reliability requirements within Automotive Electronics Council standard Q100 (AEC-Q100), so they are well suited for under-hood applications as well.
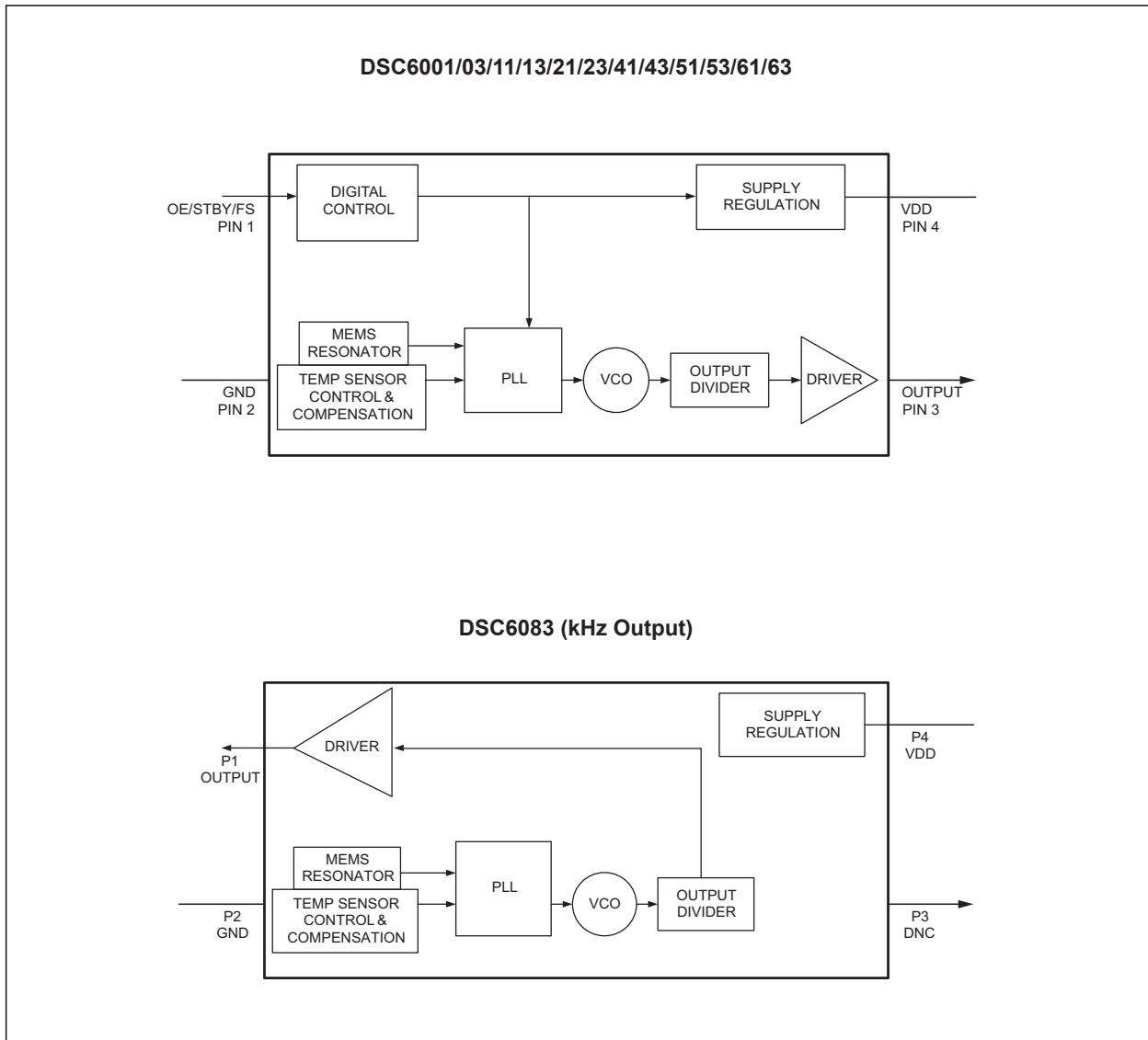
The DSC60xx family is available in ultra-small 1.6 mm x 1.2 mm and 2.0 mm x 1.6 mm packages. Other package sizes include: 2.5 mm x 2.0 mm and 3.2 mm x 2.5 mm. These packages are "drop-in" replacements for standard 4-pin CMOS quartz crystal oscillators.

Package Types

DSC60XX

Block Diagram

DSC6001/03/11/13/21/23/41/43/51/53/61/63

DIGITAL CONTROL

OE/STBY/FS PIN 1

SUPPLY REGULATION

VDD PIN 4

MEMS RESONATOR

TEMP SENSOR CONTROL & COMPENSATION

GND PIN 2

PLL

VCO

OUTPUT DIVIDER

DRIVER

OUTPUT PIN 3

DSC6083 (kHz Output)

DRIVER

P1 OUTPUT

SUPPLY REGULATION

P4 VDD

MEMS RESONATOR

TEMP SENSOR CONTROL & COMPENSATION

P2 GND

PLL

VCO

OUTPUT DIVIDER

P3 DNC

1.0   ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Supply Voltage .... –0.3V to +4.0V
Input Voltage, V_{IN} .... –0.3V to V_{DD}+0.3V
ESD Protection ....4000V HBM, 400V MM, 2000V CDM

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: Unless otherwise indicated, V_{DD}= 1.8V –5% to 3.3V +10%, T_A= –40°C to 85°C.						
Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Supply Voltage Note 1	V_{DD}	1.71	—	3.63	V	—
Active Supply Current	I_{DD}	—	1.3	—	mA	F_{OUT} = 24 MHz, V_{DD} = 1.8V, No Load
Standby Supply Current Note 2	I_{STBY}	—	12	—	μA	V_{DD} = 1.8/2.5V
		—	80	—		V_{DD} = 3.3V
Frequency Stability Note 3	Δf	—	—	±25 ±50	ppm	All temp ranges
Aging	Δf	—	—	±5	ppm	1st year @25°C
		—	—	±1		Per year after first year
Startup Time	t_{SU}	—	—	1.3	ms	From 90% V_{DD} to valid clock output, T = 25°C
Input Logic Levels Note 4 Input Logic High Input Logic Low	V_{IH}	0.7xV_{DD}	—	—	V	—
	V_{IL}	—	—	0.3xV_{DD}	V	
Output Disable Time Note 5	t_{DA}	—	—	200+Period	μs	—
Output Enable Time Note 6	t_{EN}	—	—	1	μs	—
Enable Pull-up Resistor Note 7	—	—	300	—	kΩ	If configured
Output Logic Levels Output Logic High Output Logic Low	V_{OH}	0.8xV_{DD}	—	—	V	I = 1mA
	V_{OL}	—	—	0.2xV_{DD}	V	I = –1mA

Note 1:   Pin 4 V_{DD} should be filtered with 0.1 uf capacitor.

2:   Not including current through pull-up resistor on EN pin (if configured). Higher standby current seen at >3.3V V_{DD}.

3:   Includes frequency variations due to initial tolerance, temp. and power supply voltage.

4:   Input waveform must be monotonic with rise/fall time < 10 ms

5:   Output Disable time takes up to 1 Period of the output waveform + 200 ns.

6:   For parts configured with OE, not Standby.

7:   Output is enabled if pad is floated or not connected.

8:   Output Duty Cycle will be 40% to 60% when output frequency is between 40 MHz to 60 MHz.

DSC60XX

ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Characteristics: Unless otherwise indicated, V_{DD}= 1.8V –5% to 3.3V +10%, T_A= –40°C to 85°C.

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions	
Output Transition Time Rise Time/Fall Time	t_{RX}/t_{FX}	—	2.5	3.5	ns	DSC60x3 Low Drive, 20% to 80% C_L=5 pF	V_{DD} = 1.8V
		—	1.5	2.2			V_{DD} = 2.5V/3.3V
	t_{RY}/t_{FY}	—	1.2	2.0	ns	DSC60x1 Std. Drive, 20% to 80% C_L=10 pF	V_{DD} = 1.8V
		—	0.6	1.2			V_{DD} = 2.5V/3.3V
Frequency	f_0	0.002	—	80	MHz	Output on Pin 1 for < 1 MHz	
Output Duty Cycle, Note 8	SYM	45	—	55	%	—	
Period Jitter, RMS	J_{PER}	—	32	40	ps_{RMS}	DSC60x3 Low Drive, F_{OUT} = 27 MHz	V_{DD} = 1.8V
		—	25	32			V_{DD} = 2.5V/3.3V
		—	23	30		DSC60x1 Std. Drive, F_{OUT} = 27 MHz	V_{DD} = 1.8V
		—	20	28			V_{DD} = 2.5V/3.3V
Cycle-to-Cycle Jitter (peak)	$J_{Cy–Cy}$	—	180	240	ps	DSC60x3 Low Drive, F_{OUT} = 27 MHz	V_{DD} = 1.8V
		—	120	170			
		—	115	190		DSC60x1, Std. Drive, F_{OUT} = 27 MHz	V_{DD} = 2.5V/3.3V
		—	90	150			

Note 1: Pin 4 V_{DD} should be filtered with 0.1 uf capacitor.

2: Not including current through pull-up resistor on EN pin (if configured). Higher standby current seen at >3.3V V_{DD}.

3: Includes frequency variations due to initial tolerance, temp. and power supply voltage.

4: Input waveform must be monotonic with rise/fall time < 10 ms

5: Output Disable time takes up to 1 Period of the output waveform + 200 ns.

6: For parts configured with OE, not Standby.

7: Output is enabled if pad is floated or not connected.

8: Output Duty Cycle will be 40% to 60% when output frequency is between 40 MHz to 60 MHz.

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Junction Operating Temperature	T_J	—	+150	—	°C	—
Storage Temperature Range	T_A	–55	—	+150	°C	—
Soldering Temperature	T_S	—	+260	—	°C	40 Sec. Max.

DSC60XX

2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

TABLE 2-1: **DSC6001/03/11/13/21/23/41/43/51/53/61/63 PIN FUNCTION TABLE (OUTPUT ≥1 MHZ)**

Pin Number	Pin Name	Pin Type	Description
1	OE	I	Output Enable: H = Specified Frequency Output, Note 1 L = Output is high impedance
	STBY		Standby: H = Specified Frequency Output, Note 1 L = Output is high impedance, Device is in low power mode, Supply current is at I_{STBY}
	FS		Frequency Select: H = Output Frequency 1, Note 2 L = Output Frequency 2
2	GND	Power	Power supply ground
3	Output	O	Oscillator clock output
4	VDD	Power	Power supply, Note 3

Note 1: DSC600x/1x/2x has 300 kΩ internal pull-up resistor on pin1. DSC604x/5x/6x has no internal pull-up resistor on pin1 and needs external pull up or being driven by other chip.

2: Two pre-programmed frequencies can be configured at http://clockworks.microchip.com/timing/.

3: Bypass with 0.1 µF capacitor placed as close to VDD pin as possible.

TABLE 2-2: **DSC6083 PIN FUNCTION TABLE (OUTPUT FREQUENCY < 1 MHZ)**

Pin Number	Pin Name	Pin Type	Description
1	Output	O	Oscillator clock output
2	GND	Power	Power supply ground
3	DNC	DNC	Do Not Connect
4	VDD	Power	Power supply, Note 1

Note 1: Bypass with 0.1 µF capacitor placed as close to V_{DD} pin as possible.

DSC60xx family is available in multiple output driver configurations.

The low-drive DSC60x3 is configured with a low-power driver minimizing current consumption and EMI while delivering greater than 1 mA output current at 20%/80% of the supply voltage. The standard-drive DSC60x1 delivers greater than 3 mA output current at 20%/80% of the supply voltage.

3.0   OUTPUT WAVEFORM

FIGURE 3-1:   **OUTPUT WAVEFORM**
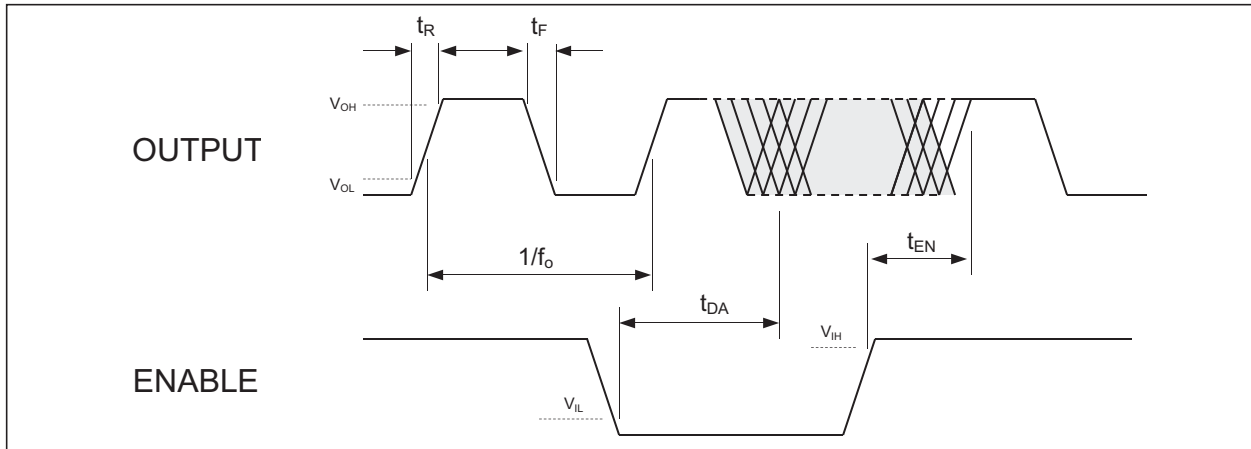
DSC60XX

4.0   TEST CIRCUIT

FIGURE 4-1:   TEST CIRCUIT

© 2016 Microchip Technology Inc.
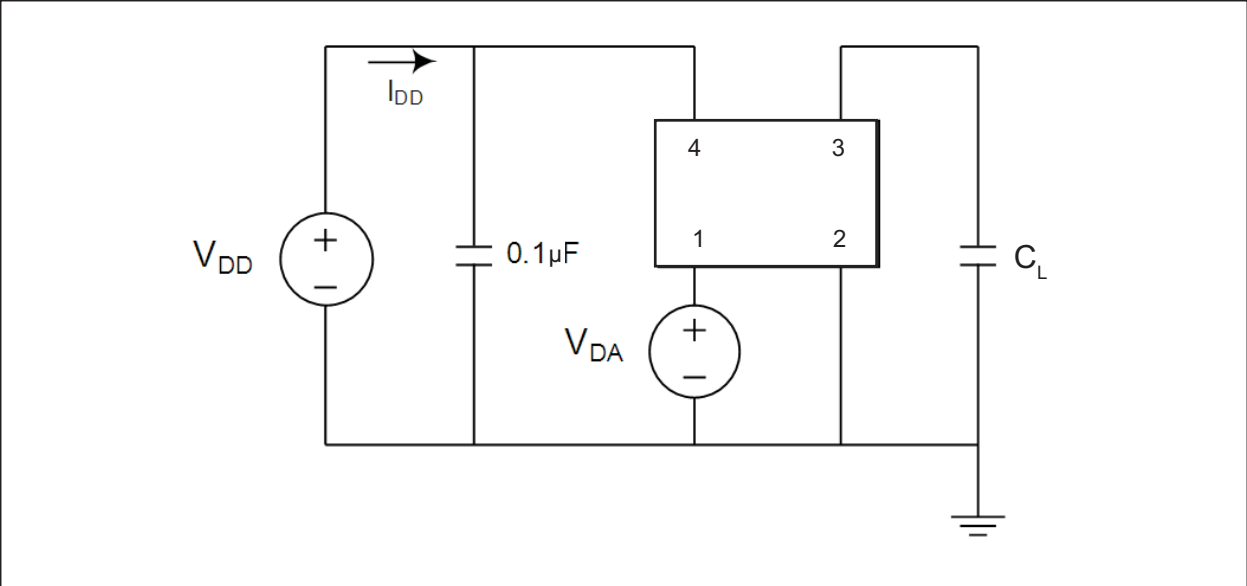
5.0   BOARD LAYOUT (RECOMMENDED)
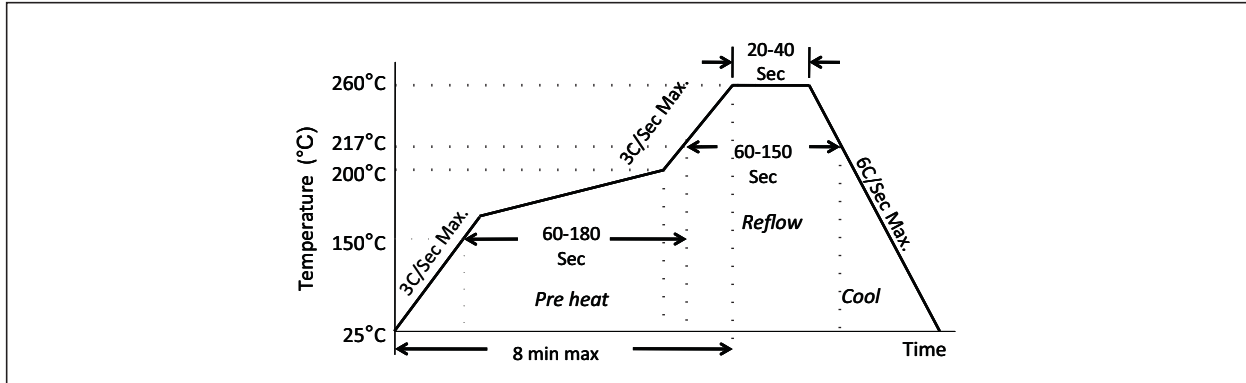
FIGURE 5-1:   BOARD LAYOUT (RECOMMENDED)
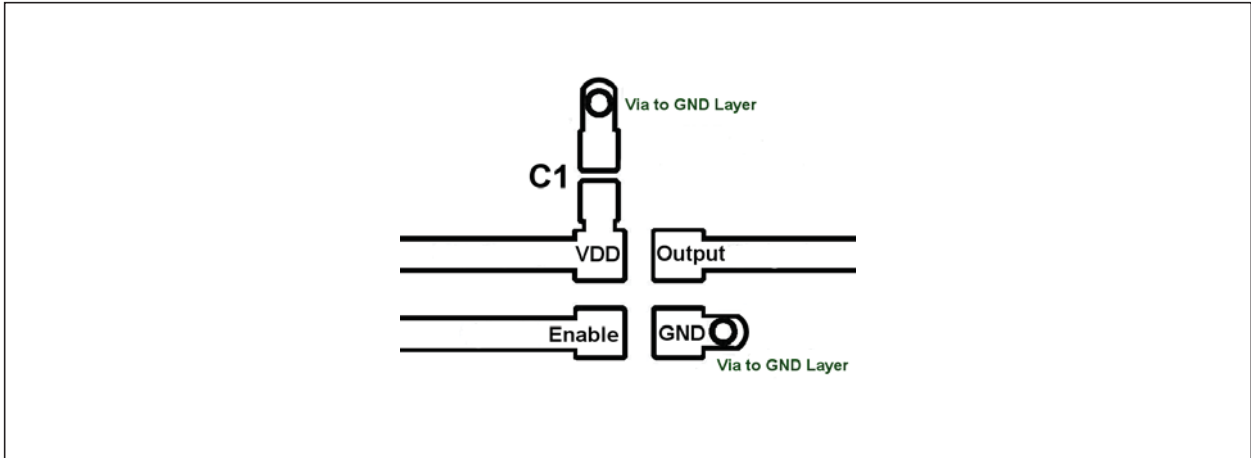
## 6.0   SOLDER REFLOW PROFILE

FIGURE 6-1:   SOLDER REFLOW

MSL 1 @ 260°C refer to JSTD-020C	
Ramp-Up Rate (200°C to Peak Temp)	3°C/Sec Max.
Preheat Time 150°C to 200°C	60-180 Sec
Time maintained above 217°C	60-150 Sec
Peak Temperature	255-260°C
Time within 5°C of actual Peak	20-40 Sec
Ramp-Down Rate	6°C/Sec Max.
Time 25°C to Peak Temperature	8 min. Max.

7.0 PACKAGING INFORMATION

4-Lead VFLGA 1.6 mm x 1.2 mm Package Outline

4-Lead Very Thin Fine Pitch Land Grid Array (ARA) - 1.6x1.2 mm Body [VFLGA]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging
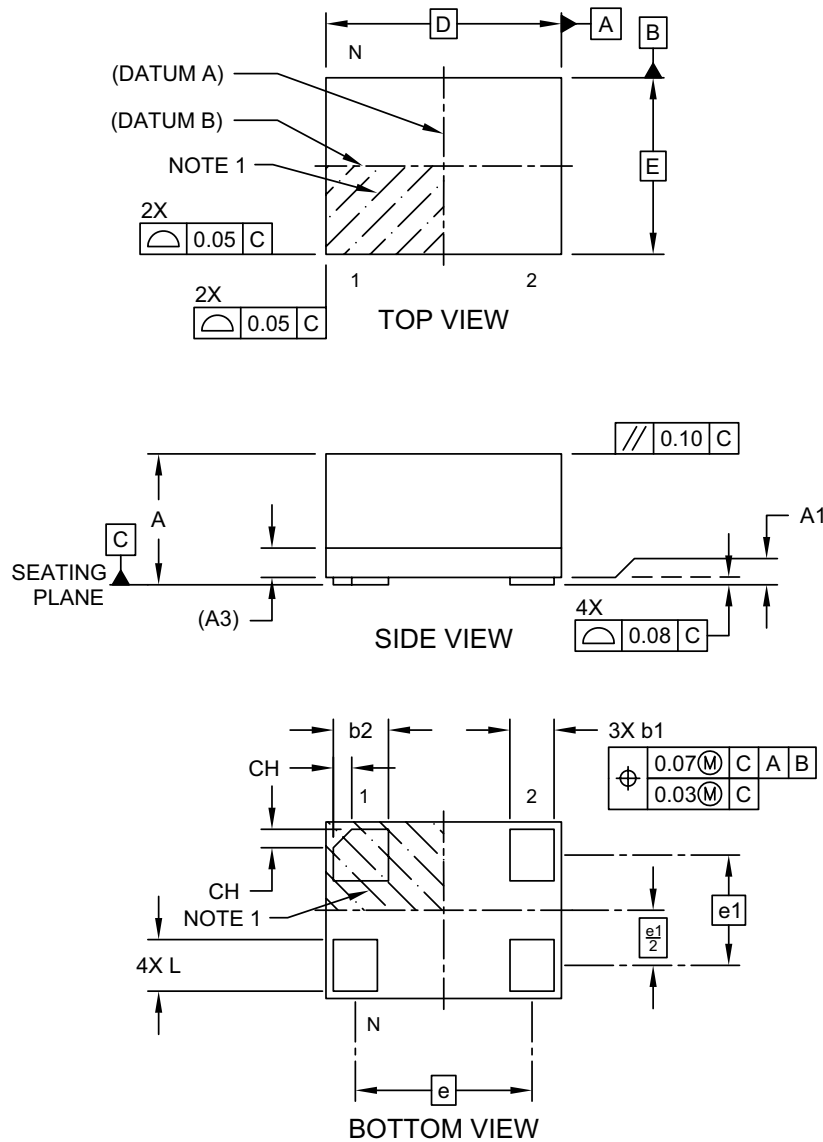
Microchip Technology Drawing C04-1199A Sheet 1 of 2

DSC60XX

4-Lead VFLGA 1.6 mm x 1.2 mm Package Outline

4-Lead Very Thin Fine Pitch Land Grid Array (ARA) - 1.6x1.2 mm Body [VFLGA]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging
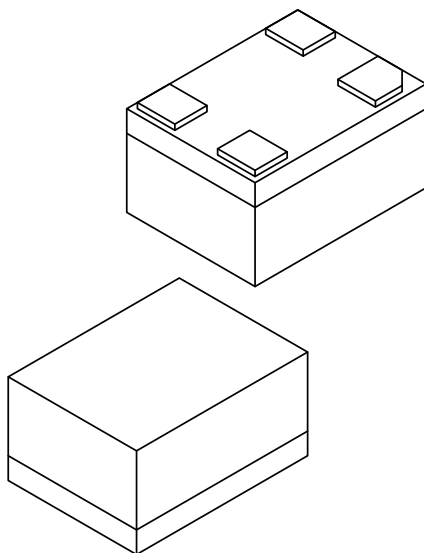
	Units	MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Terminals	N		4	
Terminal Pitch	e		1.20 BSC	
Terminal Pitch	e1		0.75 BSC	
Overall Height	A	0.79	0.84	0.89
Standoff	A1	0.00	0.02	0.05
Substrate Thickness (with Terminals)	A3		0.20 REF	
Overall Length	D		1.60 BSC	
Overall Width	E		1.20 BSC	
Terminal Width	b1	0.25	0.30	0.35
Terminal Width	b2	0.325	0.375	0.425
Terminal Length	L	0.30	0.35	0.40
Terminal 1 Index Chamfer	CH	-	0.125	-

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
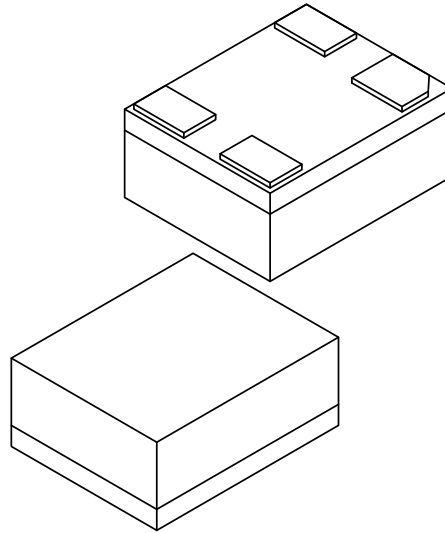2. Package is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M

    BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-1199A Sheet 2 of 2

4-Lead VFLGA 1.6 mm x 1.2 mm Recommended Land Pattern

4-Lead Very Thin Fine Pitch Land Grid Array (ARA) - 1.6x1.2 mm Body [VFLGA]

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

RECOMMENDED LAND PATTERN
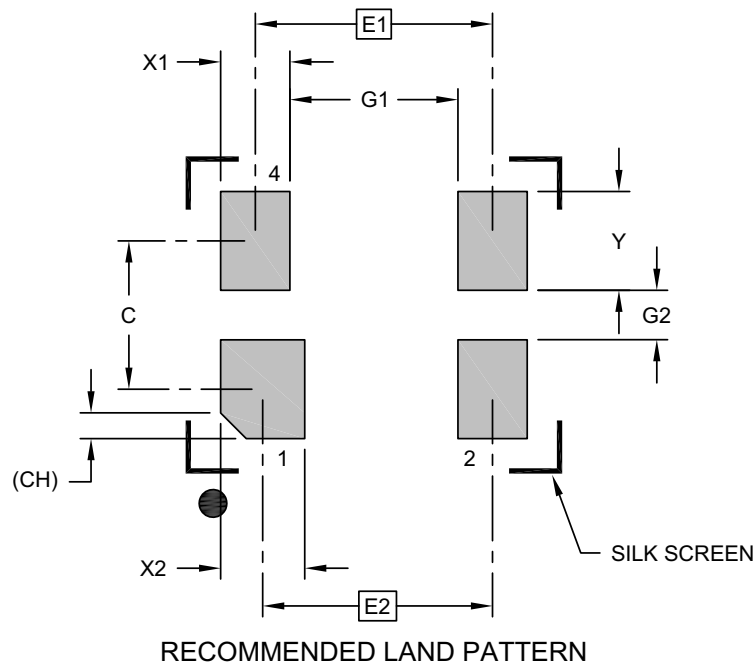
	Units	MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E1		1.20 BSC	
Contact Pitch	E2		1.16 BSC	
Contact Spacing	C		0.75	
Contact Width (X3)	X1			0.35
Contact Width	X2			0.43
Contact Pad Length (X6)	Y			0.50
Space Between Contacts (X4)	G1	0.85		
Space Between Contacts (X3)	G2	0.25		
Contact 1 Index Chamfer	CH		0.13 X 45° REF	

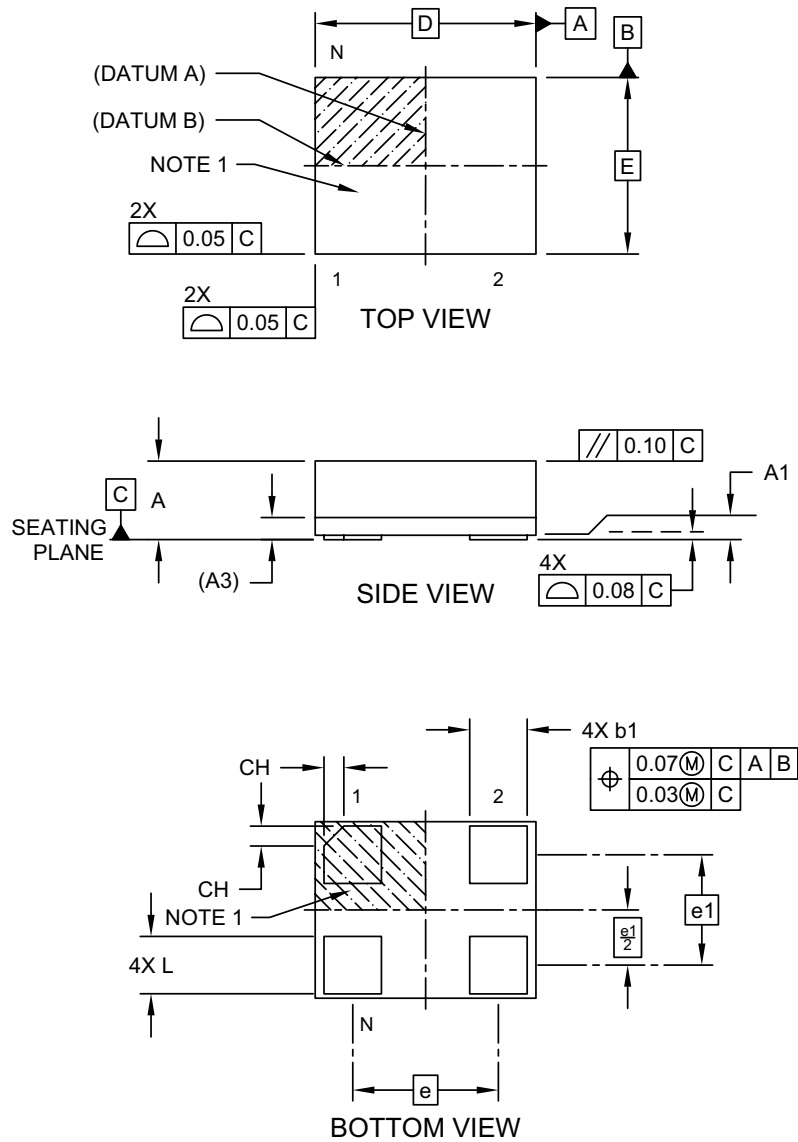Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-3199A

DSC60XX

4-Lead VLGA 2.0 mm x 1.6 mm Package Outline

4-Lead Very Thin Fine Pitch Land Grid Array (ASA) - 2.0x1.6 mm Body [VFLGA]

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

TOP VIEW

SIDE VIEW

BOTTOM VIEW

Microchip Technology Drawing C04-1200A Sheet 1 of 2
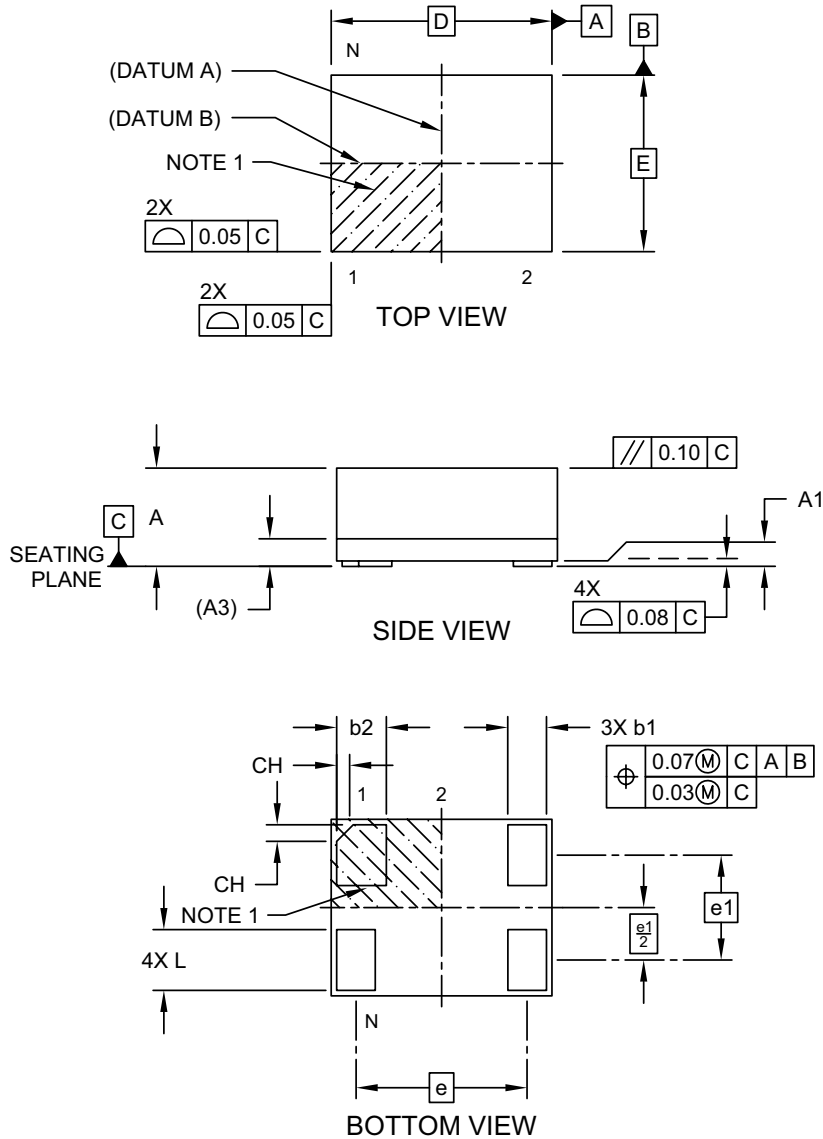
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4-Lead VLGA 2.0 mm x 1.6 mm Package Outline (Continued)

4-Lead Very Thin Fine Pitch Land Grid Array (ASA) - 2.0x1.6 mm Body [VFLGA]

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

	Units	MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Terminals	N		6	
Terminal Pitch	e		1.55 BSC	
Terminal Pitch	e1		0.95 BSC	
Overall Height	A	0.79	0.84	0.89
Standoff	A1	0.00	0.02	0.05
Substrate Thickness (with Terminals)	A3		0.20 REF	
Overall Length	D		2.00 BSC	
Overall Width	E		1.60 BSC	
Terminal Width	b1	0.30	0.35	0.40
Terminal Width	b2	0.40	0.45	0.50
Terminal Length	L	0.50	0.55	0.60
Terminal 1 Index Chamfer	CH	-	0.15	-

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-1200A Sheet 2 of 2

DSC60XX

4-Lead VFLGA 2.0 mm x 1.6 mm Package Outline

4-Lead Very Thin Fine Pitch Land Grid Array (ASA) - 2.0x1.6 mm Body [VFLGA]

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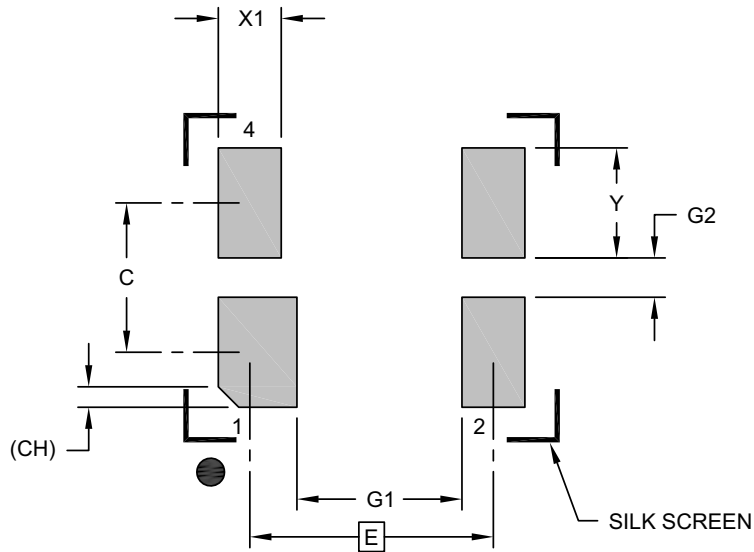
RECOMMENDED LAND PATTERN

	Units	MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	1.55 BSC		
Contact Spacing	C		0.95	
Contact Width (X4)	X1			0.50
Contact Width (X2)	X2			0.40
Contact Pad Length (X6)	Y			0.70
Space Between Contacts (X4)	G1	1.05		
Space Between Contacts (X3)	G2	0.25		
Contact 1 Index Chamfer	CH	0.13 X 45° REF		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-3200A

4-Lead VLGA 2.5 mm x 2.0 mm Package Outline

4-Lead Very Thin Land Grid Array (AUA) - 2.5x2.0 mm Body [VLGA]

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

(DATUM A)

(DATUM B)

NOTE 1

2X ⌓ 0.05 C

2X ⌓ 0.05 C

TOP VIEW

// 0.10 C

C A

SEATING PLANE

A1

(A3)

SIDE VIEW

4X ⌓ 0.08 C

CH

4X b1

⊕ 0.07Ⓜ C A B
0.03Ⓜ C

CH

NOTE 1

e1/2

e1

4X L

N

e

BOTTOM VIEW

Microchip Technology Drawing C04-1202A Sheet 1 of 2

DSC60XX

4-Lead VLGA 2.5 mm x 2.0 mm Package Outline (Continued)

4-Lead Very Thin Land Grid Array (AUA) - 2.5x2.0 mm Body [VLGA]

> **Note:** For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging
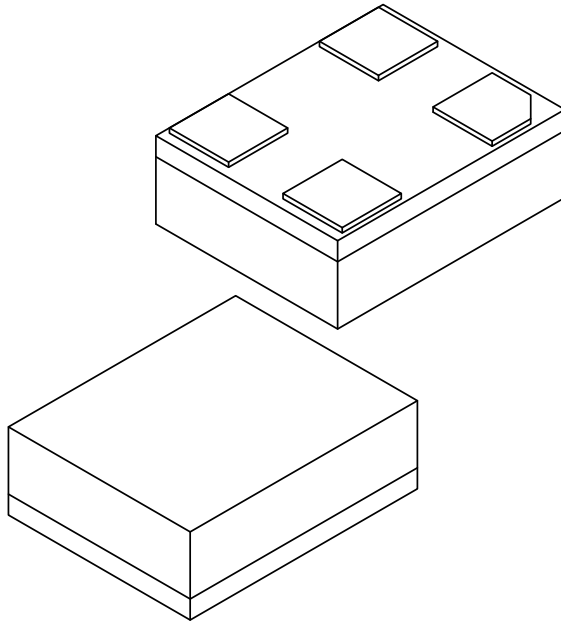
Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Terminals	N		4	
Terminal Pitch	e		1.65 BSC	
Terminal Pitch	e1		1.25 BSC	
Overall Height	A	0.79	0.84	0.89
Standoff	A1	0.00	0.02	0.05
Substrate Thickness (with Terminals)	A3		0.20 REF	
Overall Length	D		2.50 BSC	
Overall Width	E		2.00 BSC	
Terminal Width	b1	0.60	0.65	0.70
Terminal Length	L	0.60	0.65	0.70
Terminal 1 Index Chamfer	CH	-	0.225	-

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M

    BSC: Basic Dimension. Theoretically exact value shown without tolerances.

    REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-1202A Sheet 2 of 2

4-Lead VLGA 2.5 mm x 2.0 mm Recommended Land Pattern

4-Lead Very Thin Land Grid Array (AUA) - 2.5x2.0 mm Body [VLGA]

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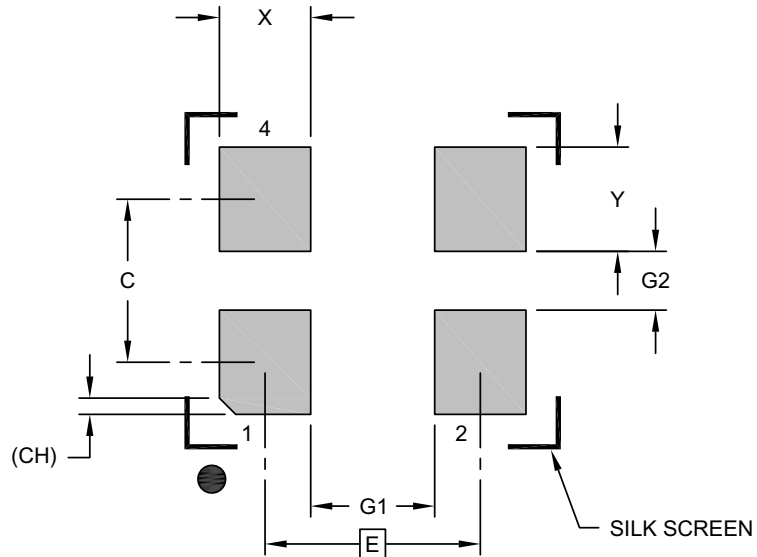
RECOMMENDED LAND PATTERN

	Units	MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		1.65 BSC	
Contact Spacing	C		1.25	
Contact Width (X4)	X			0.70
Contact Pad Length (X6)	Y			0.80
Space Between Contacts (X4)	G1	0.95		
Space Between Contacts (X3)	G2	0.45		
Contact 1 Index Chamfer	CH		0.13 X 45° REF	

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

    BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-3202A

DSC60XX

4-Lead CDFN 3.2 mm x 2.5 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

TITLE
4 LEAD CDFN 3.2x2.5mm COL PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	CDFN3225-4LD-PL-1	**UNIT**	MM
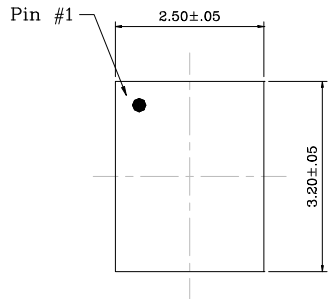
Top View
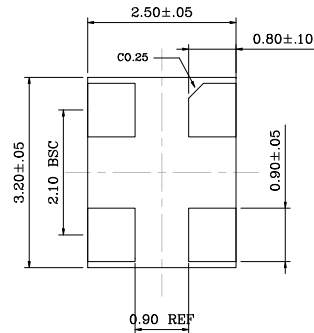
Bottom View
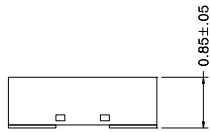
Side View
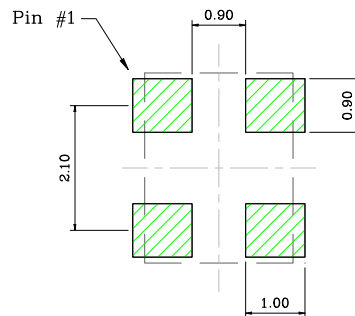
Recommended Land Pattern

NOTE:
1. Green shaded rectangles in Recommended Land Pattern are solder stencil opening.

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APPENDIX A: REVISION HISTORY

Revision A (September 2016)

- Initial creation of DSC60XX Microchip data sheet DS20005625A.

NOTES:

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 | X | X – XXX.XXXX | X

Device | Pin 1 Definition | Output Drive Strength | Package | Temperature Range | Frequency Stability | Revision | Frequency | Tape and Reel

Device:	DSC60XX:	Ultra-Low Power MEMS Oscillator	

Pin Definition:	Selection	Pin 1	Internal Pull Register
	0	OE	Pull-up
	1	STDBY	Pull-up
	2	FS	Pull-up
	4	OE	None
	5	STDBY	None
	6	FS	None
	8	KHz Output	None

Output Drive Strength:	1	Standard
	3	Low

Packages:	C	=	4-Lead 3.2 mm x 2.5 mm DFN
	J	=	4-Lead 2.5 mm x 2.0 mm VFLGA
	M	=	4-Lead 2.0 mm x 1.6 mm VFLGA
	H	=	4-Lead 1.6 mm x 1.2 mm VFLGA

Temperature Range:	E	=	-20°C to +70°C (Extended Commercial)
	I	=	-40°C to +85°C (Industrial)

Frequency Stability:	1	=	± 50 ppm
	2	=	± 25 ppm

Revision:	A	=	Revision A

Frequency:	xxx.xxxx =	User-Defined Frequency between 001.0000 MHz and 80.0000 MHz
	xxxkxxxx =	User-Defined Frequency between 002.000 kHz and 999.999 kHz
	xxxx =	Frequency configuration code when pin 1 = FS. Configure the part online through ClockWorks configurator.

Tape and Reel:	Blank	=	Bulk
	T	=	Tape and Reel

Examples:

a) DSC6013JI2A-024.0000: Ultra–Low Power MEMS Oscillator, Pin1= Standby with internal Pull–Up, Low Output Drive Strength, 4-Lead 2.5 mm x2.0 mm VFLGA, Industrial Temperature (–40°C to 85°C), ±25 ppm, Revision A, 24 MHz Frequency, Bulk

b) DSC6001HE1A-016.0000T: Ultra–Low Power MEMS Oscillator, Pin1= OE with internal Pull–Up, Standard Output Drive Strength, 4-Lead 1.6 mm x1.2 mm VFLGA, Extended Commercial Temperature (–20°C to 70°C), ±50 ppm, Revision A, 16 MHz Frequency, Tape and Reel

c) DSC6083ME1A-032k768: Ultra–Low Power MEMS Oscillator, Pin1= 32.768KHz Clock Output , Low Output Drive Strength, 4-Lead 2.0 mm x1.6 mm VFLGA, Extended Commercial Temperature (–20°C to 70°C), ±50 ppm, Revision A, Bulk

d) DSC6023CI2A-001B: Ultra–Low Power MEMS Oscillator, Pin1= FS with internal Pull-up, Low Output Drive Strength, 4-Lead 3.2 mm x2.5 mm CDFN, Industrial Temperature (–40°C to 85°C), ±25 ppm, Revision A, Frequency code = 001B (configured through ClockWorks), Bulk

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.

Note 1: Please visit Microchip ClockWorks® Configurator Website to configure the part number for customized frequency. http://clockworks.microchip.com/timing/.

NOTES:

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.

- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.

- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.

- Microchip is willing to work with the customer who is concerned about the integrity of their code.

- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

QUALITY MANAGEMENT SYSTEM
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