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/Standby)
- 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 Two Pre-Defined Frequencies
- High Stability: ±25 ppm, ±50 ppm
- Wide Temperature Range
  - Industrial: –40°C to 85°C
  - Ext. Commercial: –20° to 70°C
- Excellent Shock and 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

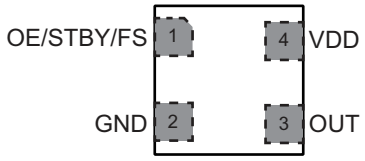
General Description

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
3.2 mm x 2.5 mm DFN
2.5 mm x 2.0 mm LGA
2.0 mm x 1.6 mm LGA
1.6 mm x 1.2 mm LGA
(Top View)



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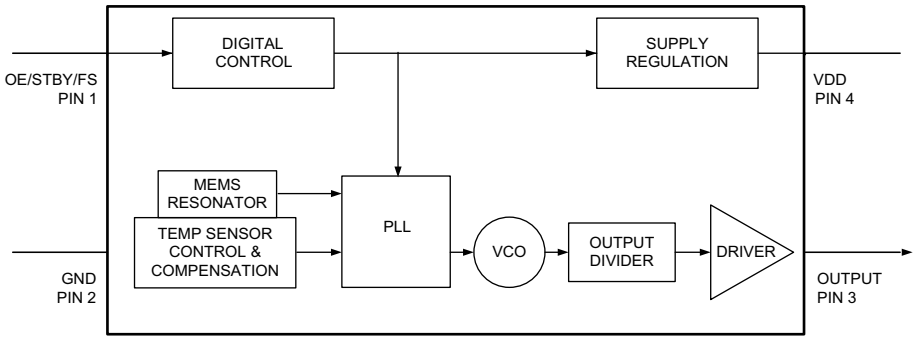
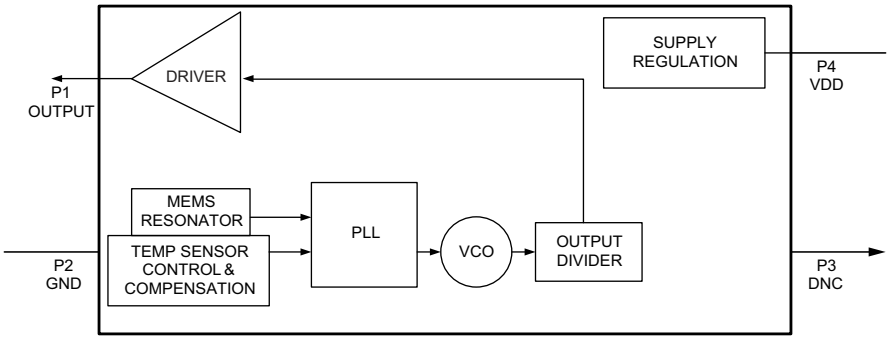
Block Diagrams

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



DSC6083 (kHz Output)



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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 ..... 4 kV HBM, 400V MM, 2 kV 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	Symbol	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
		—	1.19	—		F_{OUT} = 32.768 kHz (DSC6083), V_{DD} = 1.8V, No Load
Power Supply Ramp	t_{PU}	0.1	—	100	ms	Note 9
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	V_{IH}	0.7 x V_{DD}	—	—	V	Input Logic High
	V_{IL}	—	—	0.3 x V_{DD}	V	Input Logic Low
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, Low Drive	V_{OH}	0.8 x V_{DD}	—	—	V	Output Logic High, I = 1 mA
	V_{OL}	—	—	0.2 x V_{DD}	V	Output Logic Low, I = –1 mA

Note 1: Pin 4 V_{DD} should be filtered with 0.1 µF 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 one 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.
9: Time to reach 90% of target V_{DD}. Power ramp rise must be monotonic.

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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	Symbol	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			V_{DD} = 2.5V/3.3V
		—	115	190		DSC60x1, Std. Drive, F_{OUT} = 27 MHz	V_{DD} = 1.8V
		—	90	150			V_{DD} = 2.5V/3.3V

Note 1: Pin 4 V_{DD} should be filtered with 0.1 µF 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 one 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.

9: Time to reach 90% of target V_{DD}. Power ramp rise must be monotonic.

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TEMPERATURE SPECIFICATIONS (Note 1)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Maximum Junction Temperature	T_J	—	—	+150	°C	—
Ambient Operating Temperature	T_A	–40	—	+85	°C	Industrial
Ambient Operating Temperature	T_A	–20	—	+70	°C	Extended Commercial
Storage Ambient Temperature Range	T_A	–55	—	+150	°C	—
Soldering Temperature	T_S	—	+260	—	°C	40 sec. max.

Note 1: The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction to air (i.e., T_A, T_J, θ_{JA}). Exceeding the maximum allowable power dissipation will cause the device operating junction temperature to exceed the maximum +150°C rating. Sustained junction temperatures above +150°C can impact the device reliability.

2.0 PIN DESCRIPTIONS

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

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 an external pull-up or to be driven by another 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 the V_{DD} 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.

2.1 Output Buffer Options

The DSC60xx family is available in multiple output driver configurations.

The low-drive DSC60x3 is configured with a low-power driver that minimizes 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.

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3.0 DIAGRAMS

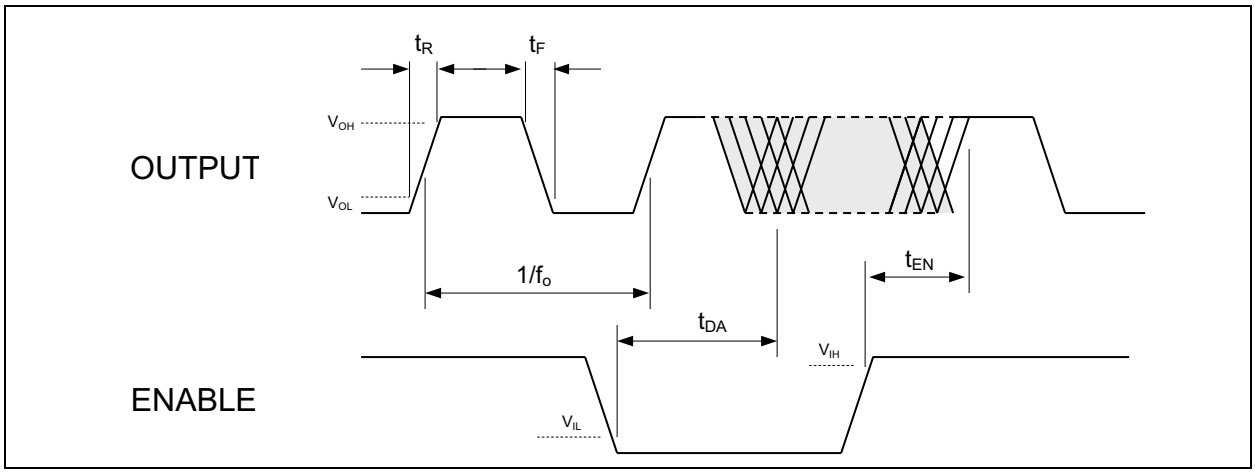

FIGURE 3-1: *Output Waveform.*

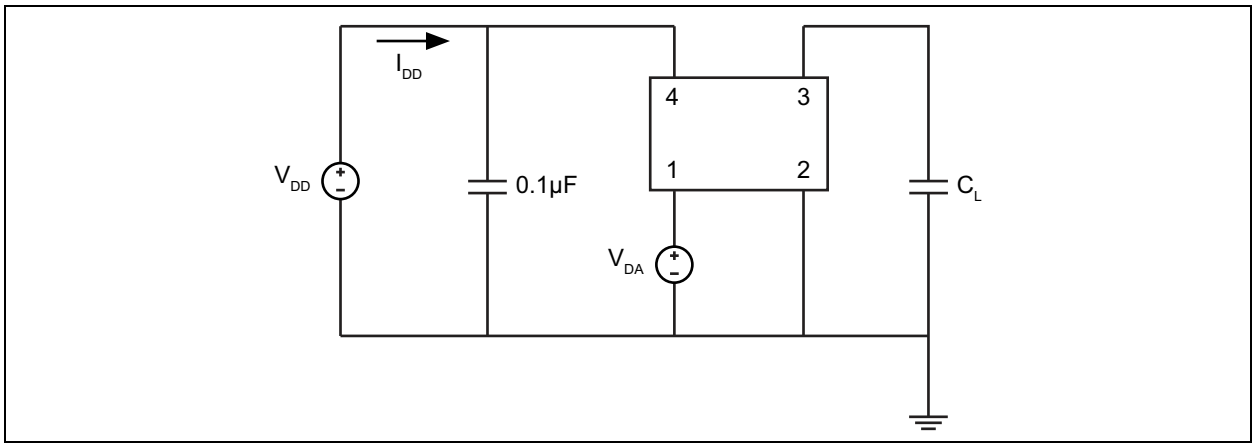

FIGURE 3-2: *Test Circuit.*

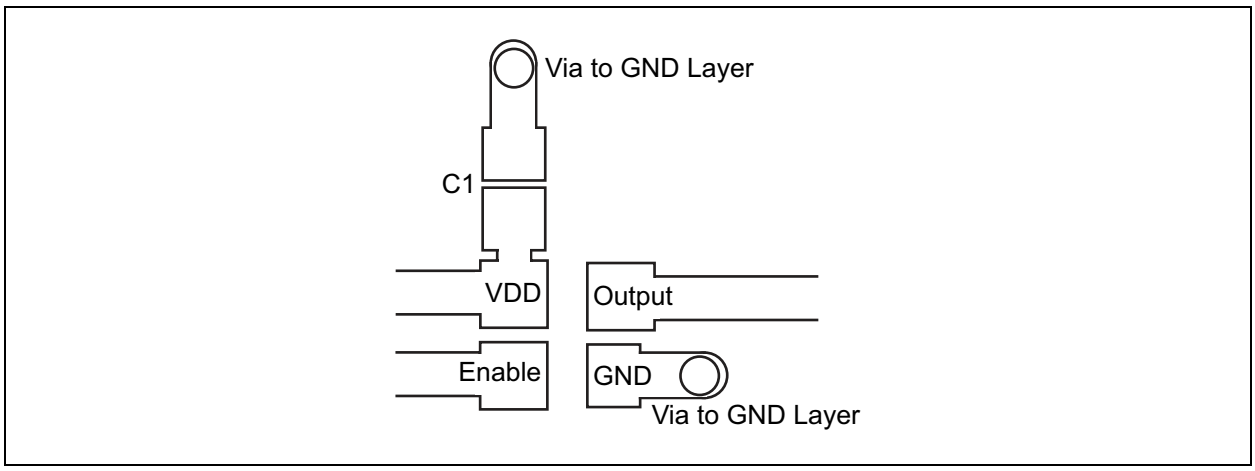

FIGURE 3-3: *Recommended Board Layout.*

4.0 SOLDER REFLOW PROFILE

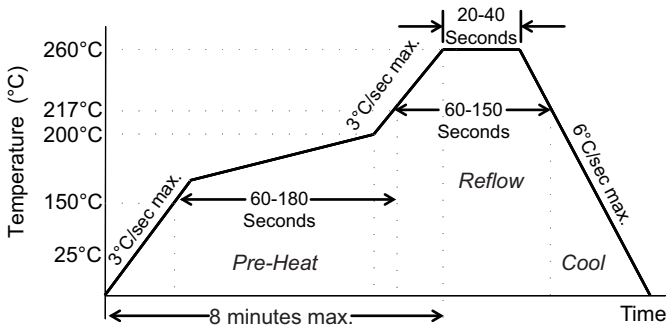

FIGURE 4-1: *Solder Reflow Profile.*

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 to 180 sec.
Time maintained above 217°C	60 to 150 sec.
Peak Temperature	255°C to 260°C
Time within 5°C of actual Peak	20 to 40 sec.
Ramp-Down Rate	6°C/sec. max.
Time 25°C to Peak Temperature	8 minutes max.

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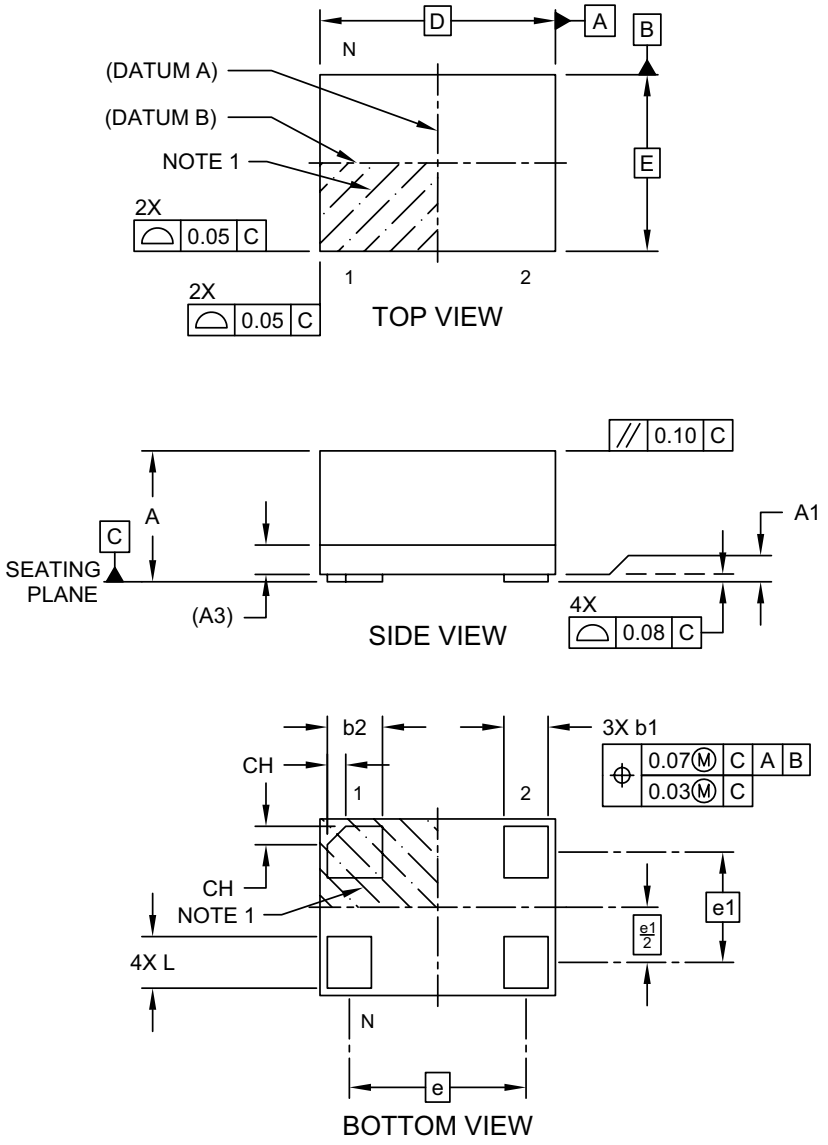
5.0 PACKAGING INFORMATION

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

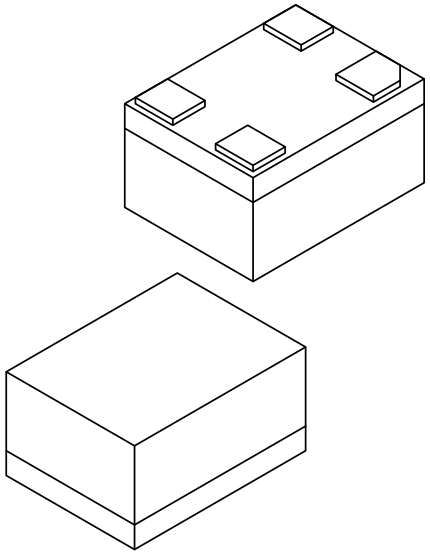


Microchip Technology Drawing C04-1199A Sheet 1 of 2

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.

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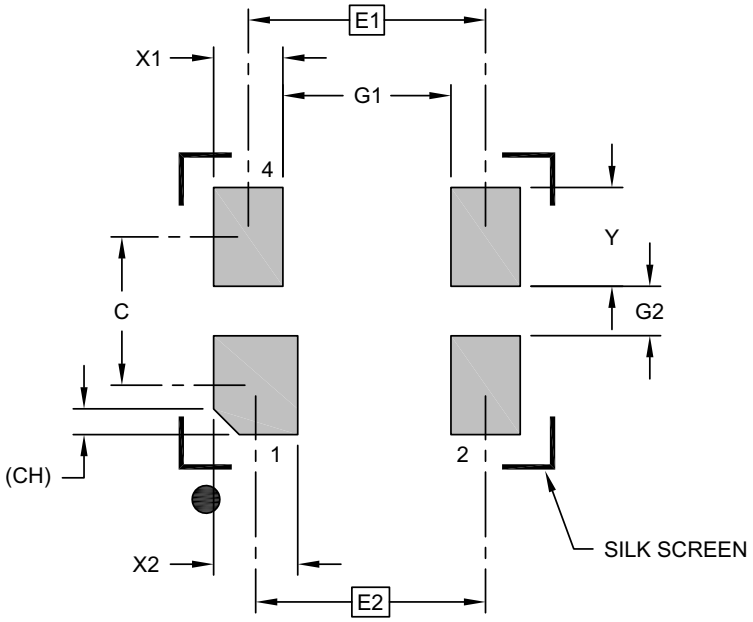
4-Lead VFLGA 1.6 mm x 1.2 mm Recommended Land Pattern

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

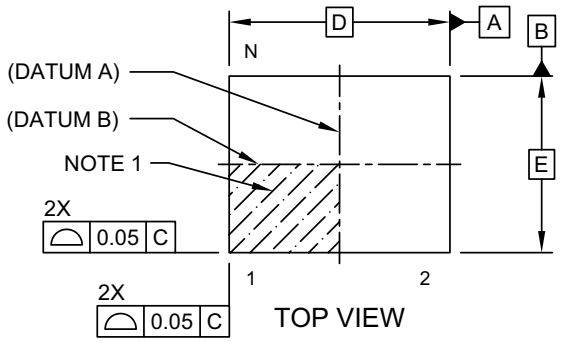
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

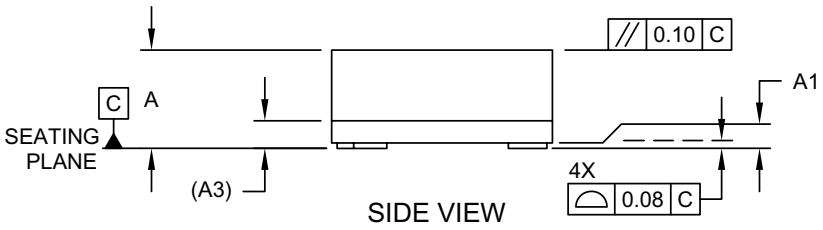
Microchip Technology Drawing C04-3199A

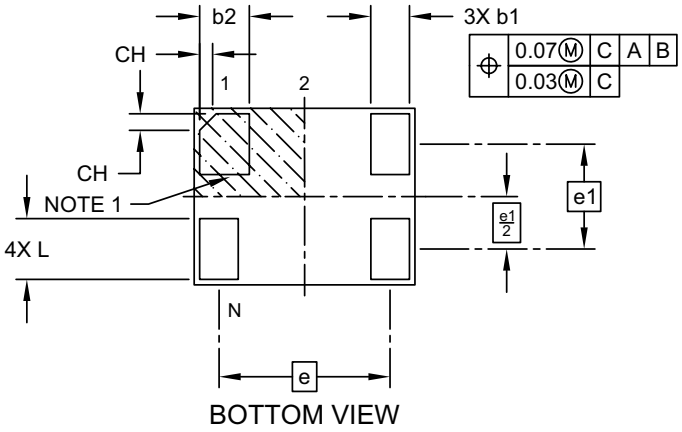
4-Lead VFLGA 2.0 mm x 1.6 mm Package Outline

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







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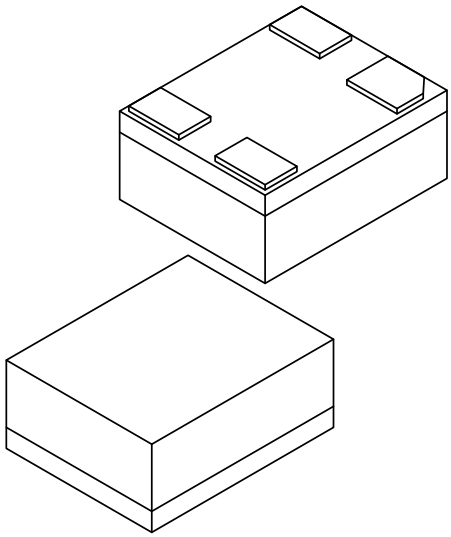
4-Lead VFLGA 2.0 mm x 1.6 mm Package Outline (Continued)

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

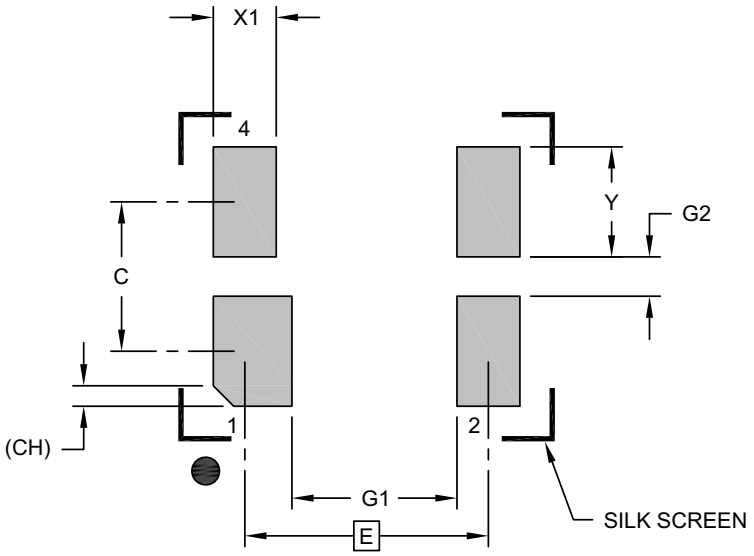
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-1200A Sheet 2 of 2

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.

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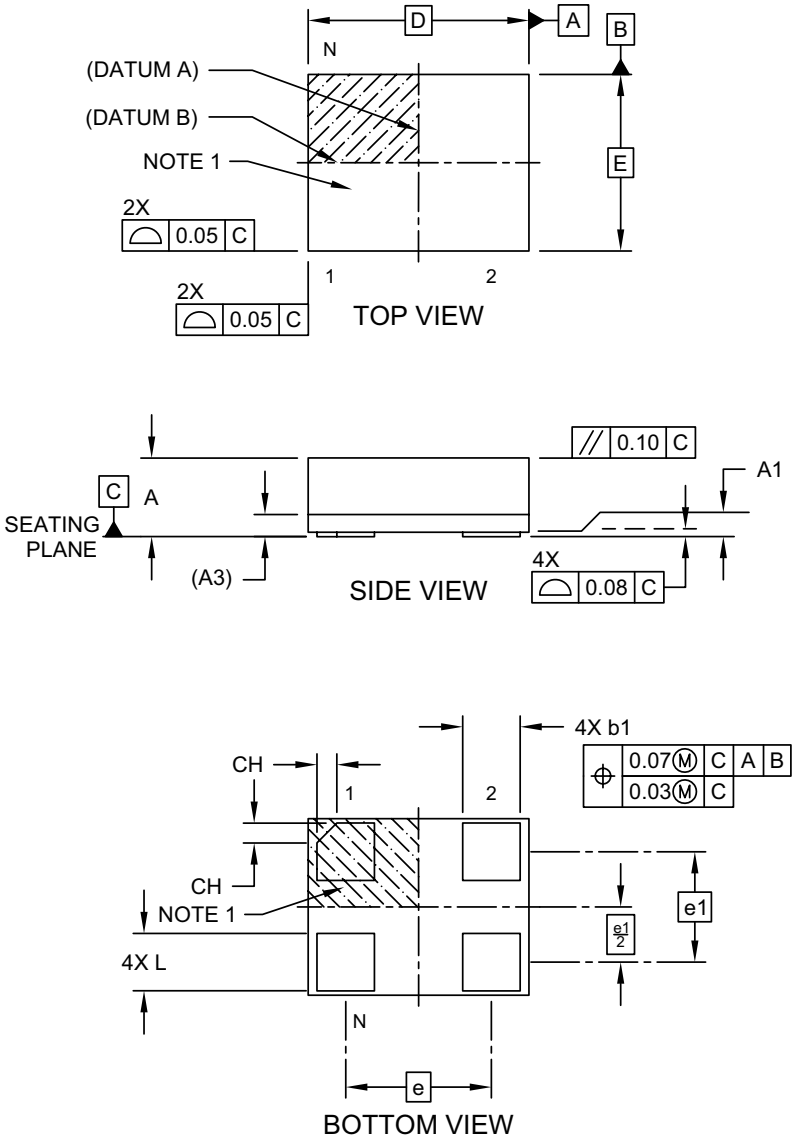
4-Lead VLGA 2.5 mm x 2.0 mm Package Outline

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

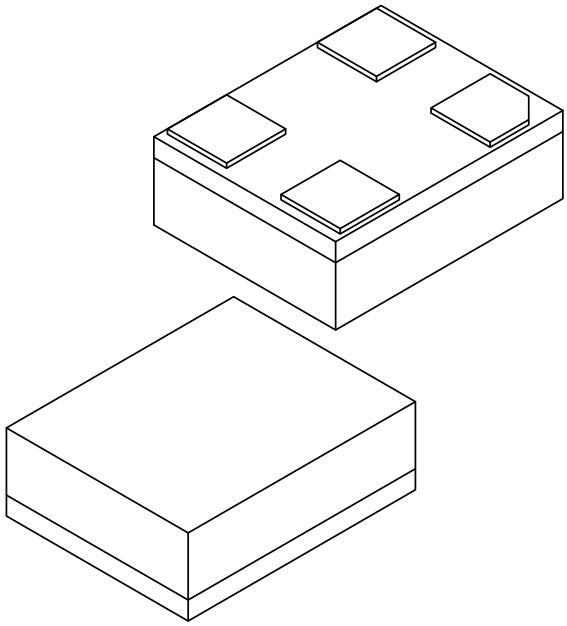


Microchip Technology Drawing C04-1202A Sheet 1 of 2

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.

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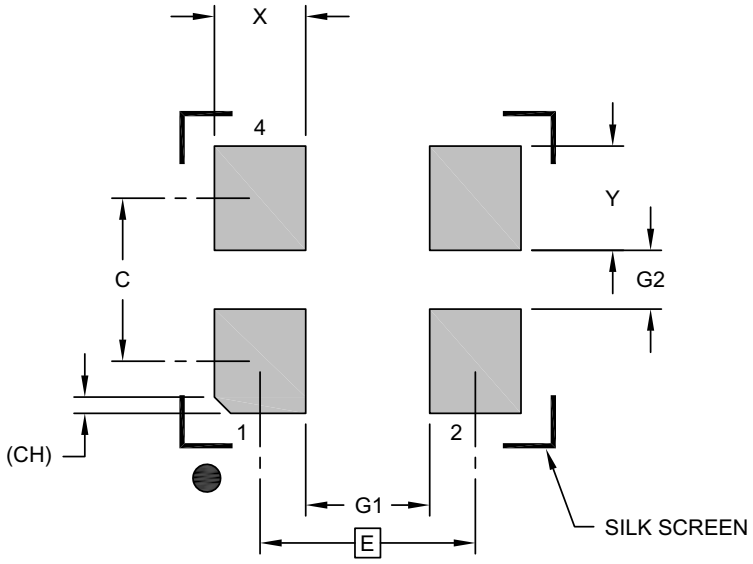
4-Lead VLGA 2.5 mm x 2.0 mm Recommended Land Pattern

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.

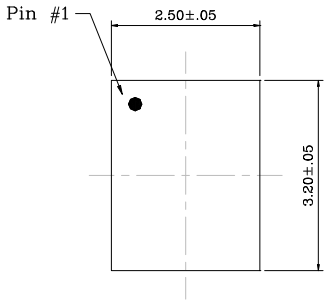
Microchip Technology Drawing C04-3202A

4-Lead CDFN 3.2 mm x 2.5 mm Package Outline and Recommended Land Pattern

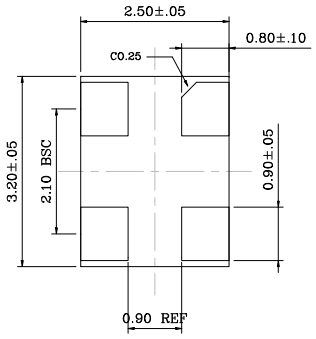
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

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

DRAWING #	CDFN3225-4LD-PL-1	**UNIT**	MM

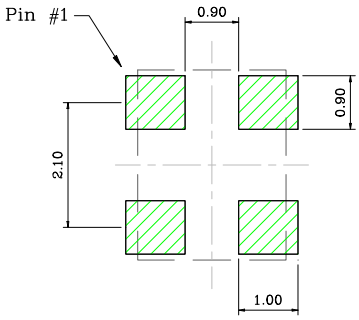


Top View



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.

Revision B (September 2017)

- Added Power Supply Ramp value in Electrical Characteristics table.
- Redrew diagrams for clarity. No technical content affected.

Revision C (November 2018)

- Added a new condition to the Active Supply Current parameter with a new typical value in the Electrical Characteristics table.

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 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-Up 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 VLGA	
	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	
	xxxkxxx =	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>=	100/Bag	
	T =	1,000/Reel	

Examples:

a) DSC6013JI2A-100.0000:
Ultra–Low Power MEMS Oscillator, Pin1 = Standby with Internal Pull-Up, Low Drive Strength, 4-Lead 2.5 mm x 2.0 mm VLGA, Industrial Temperature, ±25 ppm Stability, Revision A, 100 MHz Frequency, 100/Bag

b) DSC6001HE1A-016.0000T:
Ultra–Low Power MEMS Oscillator, Pin1 = OE with Internal Pull–Up, Standard Drive Strength, 4-Lead 1.6 mm x 1.2 mm VFLGA, Extended Commercial Temp., ±50 ppm Stability, Revision A, 16 MHz Frequency, 1,000/Reel

c) DSC6021MI2A-005Q:
Ultra–Low Power MEMS Oscillator, Pin1 = Freq. Select with Internal Pull-Up, Standard Drive Strength, 4-Lead 2.0 mm x 1.6 mm VFLGA, Industrial Temperature, ±25 ppm Stability, Revision A, Two Frequencies Configured through ClockWorks, 100/Bag

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:

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