

1.8V-3.3V Low-Power Precision CMOS Oscillators for Automotive

Features

- Automotive AEC-Q100 Qualified
- Frequency Range: 1 MHz to 150 MHz
- Exceptional Stability over Temperature
 - ± 20 ppm, ± 25 ppm, ± 50 ppm
- Operating Voltage
 - 1.7 to 3.6V
- Operating Temperature Range
 - Automotive Grade 2: -40°C to 105°C
 - Automotive Grade 3: -40°C to 85°C
- Low Operating and Standby Current
 - 6 mA Operating (1 MHz)
 - 15 μA Standby (Max.)
- Ultra Miniature Footprint
 - 2.5 mm x 2.0 mm x 0.85 mm
 - 3.2 mm x 2.5 mm x 0.85 mm
 - 5.0 mm x 3.2 mm x 0.85 mm
- MIL-STD 883 Shock and Vibration Resistant
- Pb Free, RoHS, Reach SVHC Compliant

Applications

- Automotive Infotainment
- Automotive ADAS
- Automotive Camera Module

Benefits

- Replace High Temperature Crystals and Quartz Oscillators
- Pin for Pin “Drop-In” Replacement for Industry Standard Oscillators
- Semiconductor Level Reliability, Significantly Higher than Quartz
- Longer Battery Life/Reduced Power Consumption
- Compact Plastic Package
- Cost Effective

General Description

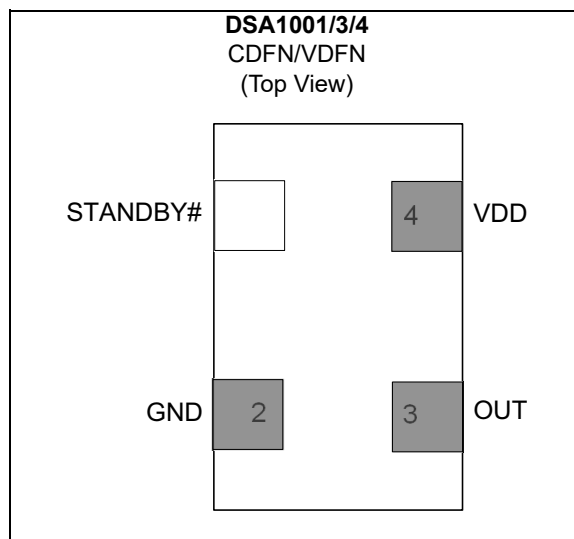
The DSA1001/3/4 is a silicon MEMS based CMOS family of oscillators that offers excellent jitter and stability performance over a wide range of supply voltages and temperatures. The device operates from 1 MHz to 150 MHz with supply voltages between 1.8 to 3.3 volts and temperature ranges up to -40°C to 105°C .

The DSA1001/3/4 incorporate an all silicon resonator that is extremely robust and nearly immune to stress related fractures, common to crystal based oscillators. Without sacrificing the performance and stability required of today's systems, a crystal-less design allows for a higher level of reliability, making the DSA1001/3/4 ideal for rugged, industrial, and portable applications where stress, shock, and vibration can damage quartz crystal based systems.

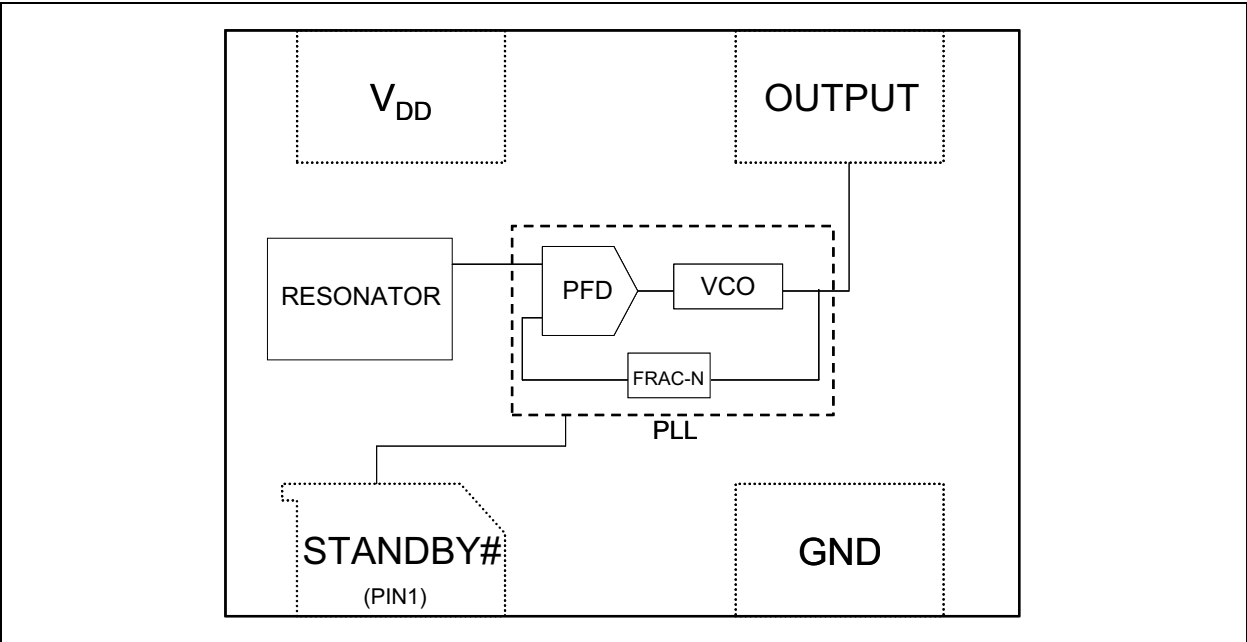
Available in industry standard packages, the DSA1001/3/4 can be “dropped-in” to the same PCB footprint as standard crystal oscillators.

The DSA1003 and DSA1004 have the same functionality and performance as the DSA1001, but feature higher output drives of 25 pF and 40 pF, respectively.

Package Types



Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Input Voltage (V_{IN}) -0.3V to $V_{DD} + 0.3V$
ESD Protection 4 kV HBM, $\pm 200V$ MM, 1.5 kV CDM

Recommended Operating Conditions

Supply Voltage (V_{DD}) +1.7V to +3.6V
Output Load (Z_L) $R > 10\text{ k}\Omega$, $C \leq 15\text{ pF}$

† **Notice:** Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

TABLE 1-1: ELECTRICAL CHARACTERISTICS

Electrical Characteristics: $V_{DD} = 1.8$ to $3.3V$; $T_A = +85^\circ C$ unless otherwise specified.

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Frequency	F_0	1	—	150	MHz	Single Frequency
Frequency Tolerance	Δf	—	—	± 20	ppm	Includes frequency variations due to initial tolerance, temperature and power supply voltage
		—	—	± 25		
		—	—	± 50		
Aging	Δf	—	—	± 5	ppm	1 year @ $+25^\circ C$
Supply Current, Standby	I_{DD}	—	—	15	μA	$T = +25^\circ C$
Output Startup Time (Note 1)	t_{SU}	—	1.0	1.3	ms	$T = +25^\circ C$
Output Disable Time	t_{DA}	—	20	100	ns	—
Output Duty Cycle	SYM	45	—	55	%	—
Input Logic Level High	V_{IH}	$0.75 \times V_{DD}$	—	—	V	—
Input Logic Level Low	V_{IL}	—	—	$0.25 \times V_{DD}$	V	—
$V_{DD} = 1.8V$						
Supply Current, No Load	I_{DD}	—	6.0	6.3	mA	1 MHz
		—	6.5	7.1		27 MHz
		—	7.2	8.5		70 MHz
		—	8.3	11.9		150 MHz
Output Logic Level High	V_{OH}	$0.8 \times V_{DD}$	—	—	V	-6 mA, DSA1004, $C_L = 40\text{ pF}$
		$0.8 \times V_{DD}$	—	—	V	-6 mA, DSA1003, $C_L = 25\text{ pF}$
		$0.8 \times V_{DD}$	—	—	V	-4 mA, DSA1001, $C_L = 15\text{ pF}$
Output Logic Level Low	V_{OL}	—	—	$0.2 \times V_{DD}$	V	6 mA, DSA1004, $C_L = 40\text{ pF}$
		—	—	$0.2 \times V_{DD}$	V	6 mA, DSA1003, $C_L = 25\text{ pF}$
		—	—	$0.2 \times V_{DD}$	V	6 mA, DSA1001, $C_L = 15\text{ pF}$

Note 1: t_{SU} is time to stable output frequency after V_{DD} is applied. t_{SU} and t_{EN} (after EN is asserted) are identical values.

2: Measured over 50k clock cycles.

DSA1001/3/4

TABLE 1-1: ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Characteristics: $V_{DD} = 1.8$ to $3.3V$; $T_A = +85^\circ C$ unless otherwise specified.

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Output Transition Rise Time	t_R	—	1.4	3.0	ns	DSA1001, $C_L = 15$ pF
		—	1.5	3.0		DSA1003, $C_L = 25$ pF
		—	1.8	3.0		DSA1004, $C_L = 40$ pF
Output Transition Fall Time	t_F	—	1.0	3.0	ns	DSA1001, $C_L = 15$ pF
		—	1.1	3.0		DSA1003, $C_L = 25$ pF
		—	1.2	3.0		DSA1004, $C_L = 40$ pF
Jitter, Max. Cycle-to-Cycle	J_{CC}	—	60	—	ps	$f = 100$ MHz (Note 2)
Period Jitter	J_P	—	10	15	ps _{RMS}	$f = 100$ MHz (Note 2)
$V_{DD} = 2.5V$						
Supply Current, No Load	I_{DD}	—	6.0	6.4	mA	1 MHz
		—	6.7	7.5		27 MHz
		—	7.7	9.4		70 MHz
		—	9.6	13.9		150 MHz
Output Logic Level High	V_{OH}	$0.9 \times V_{DD}$	—	—	V	–6 mA, DSA1004, $C_L = 40$ pF
		$0.8 \times V_{DD}$	—	—	V	–6 mA, DSA1003, $C_L = 25$ pF
		$0.8 \times V_{DD}$	—	—	V	–4 mA, DSA1001, $C_L = 15$ pF
Output Logic Level Low	V_{OL}	—	—	$0.1 \times V_{DD}$	V	6 mA, DSA1004, $C_L = 40$ pF
		—	—	$0.2 \times V_{DD}$	V	6 mA, DSA1003, $C_L = 25$ pF
		—	—	$0.2 \times V_{DD}$	V	4 mA, DSA1001, $C_L = 15$ pF
Output Transition Rise Time	t_R	—	1.0	2.0	ns	DSA1001, $C_L = 15$ pF
		—	1.1	2.0		DSA1003, $C_L = 25$ pF
		—	1.2	2.0		DSA1004, $C_L = 40$ pF
Output Transition Fall Time	t_F	—	0.9	2.0	ns	DSA1001, $C_L = 15$ pF
		—	1.0	2.0		DSA1003, $C_L = 25$ pF
		—	1.1	2.0		DSA1004, $C_L = 40$ pF

Note 1: t_{SU} is time to stable output frequency after V_{DD} is applied. t_{SU} and t_{EN} (after EN is asserted) are identical values.

2: Measured over 50k clock cycles.

TABLE 1-1: ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Characteristics: $V_{DD} = 1.8$ to $3.3V$; $T_A = +85^\circ C$ unless otherwise specified.

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Jitter, Max. Cycle-to-Cycle	J_{CC}	—	50	—	ps	$f = 100$ MHz (Note 2)
Period Jitter	J_P	—	5	10	ps _{RMS}	$f = 100$ MHz (Note 2)
$V_{DD} = 3.3V$						
Supply Current, No Load	I_{DD}	—	6.0	6.5	mA	1 MHz
		—	6.8	8.0		27 MHz
		—	8.2	10.5		70 MHz
		—	10.8	16.6		150 MHz
Output Logic Level High	V_{OH}	$0.9 \times V_{DD}$	—	—	V	–8 mA, DSA1004, $C_L = 40$ pF
		$0.9 \times V_{DD}$	—	—	V	–6 mA, DSA1003, $C_L = 25$ pF
		$0.8 \times V_{DD}$	—	—	V	–4 mA, DSA1001, $C_L = 15$ pF
Output Logic Level Low	V_{OL}	—	—	$0.1 \times V_{DD}$	V	8 mA, DSA1004, $C_L = 40$ pF
		—	—	$0.1 \times V_{DD}$	V	6 mA, DSA1003, $C_L = 25$ pF
		—	—	$0.2 \times V_{DD}$	V	4 mA, DSA1001, $C_L = 15$ pF
Output Transition Rise Time	t_R	—	1.0	2.0	ns	DSA1001, $C_L = 15$ pF
		—	1.1	2.0		DSA1003, $C_L = 25$ pF
		—	1.2	2.0		DSA1004, $C_L = 40$ pF
Output Transition Fall Time	t_F	—	0.9	2.0	ns	DSA1001, $C_L = 15$ pF
		—	1.0	2.0		DSA1003, $C_L = 25$ pF
		—	1.1	2.0		DSA1004, $C_L = 40$ pF
Jitter, Max. Cycle-to-Cycle	J_{CC}	—	50	—	ps	$f = 100$ MHz (Note 2)
Period Jitter	J_P	—	5	10	ps _{RMS}	$f = 100$ MHz (Note 2)

Note 1: t_{SU} is time to stable output frequency after V_{DD} is applied. t_{SU} and t_{EN} (after EN is asserted) are identical values.

2: Measured over 50k clock cycles.

TEMPERATURE SPECIFICATIONS (Note 1)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Operating Temperature Range (T)	T_A	-40	—	+105	°C	Ordering Option L
		-40	—	+85	°C	Ordering Option I
Junction Operating Temperature	T_J	—	—	+150	°C	—
Storage Temperature Range	T_A	-55	—	+150	°C	—
Soldering Temperature Range	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](#).

TABLE 2-1: PIN FUNCTION TABLE

Pin Number	Symbol	Description
1	STANDBY#	Standby input (Section 4.1 “Standby Function”)
2	GND	Power supply ground
3	OUT	Oscillator output
4	VDD	Positive power supply

3.0 NOMINAL PERFORMANCE CHARACTERISTICS

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

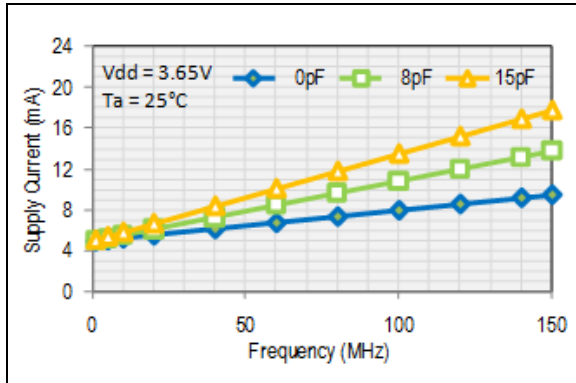


FIGURE 3-1: Supply Current.

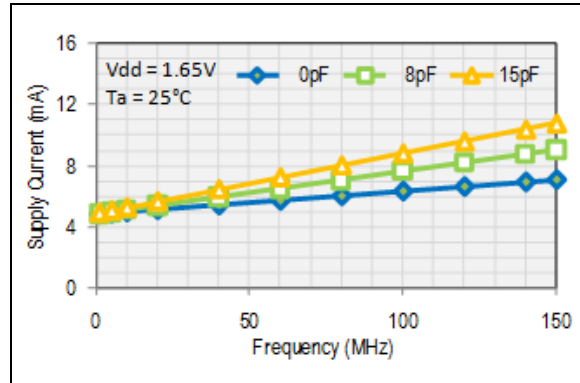


FIGURE 3-4: Supply Current.

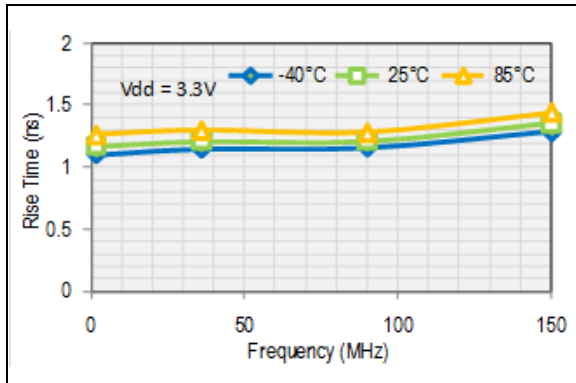


FIGURE 3-2: Rise Time.

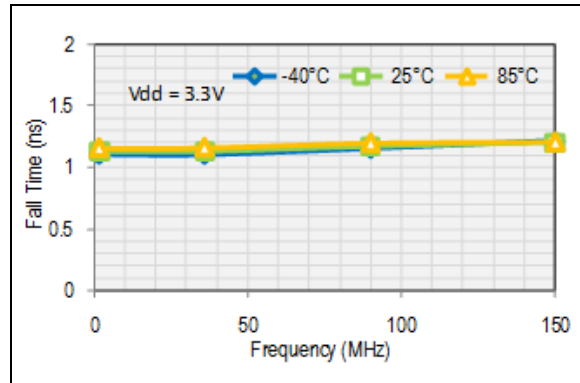


FIGURE 3-5: Fall Time.

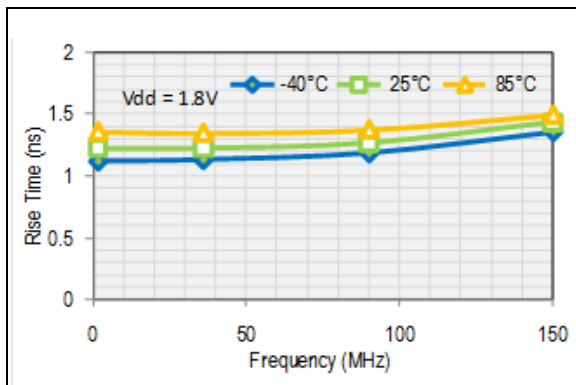


FIGURE 3-3: Rise Time.

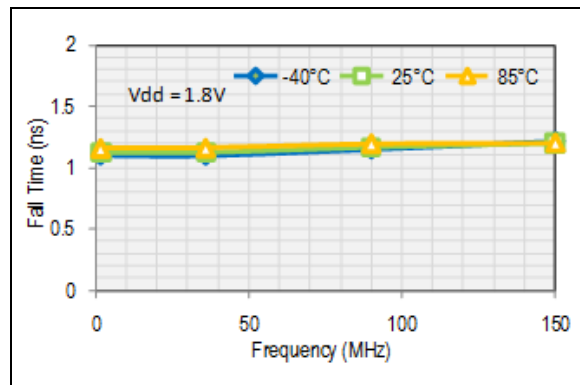


FIGURE 3-6: Fall Time.

4.0 OUTPUT WAVEFORM

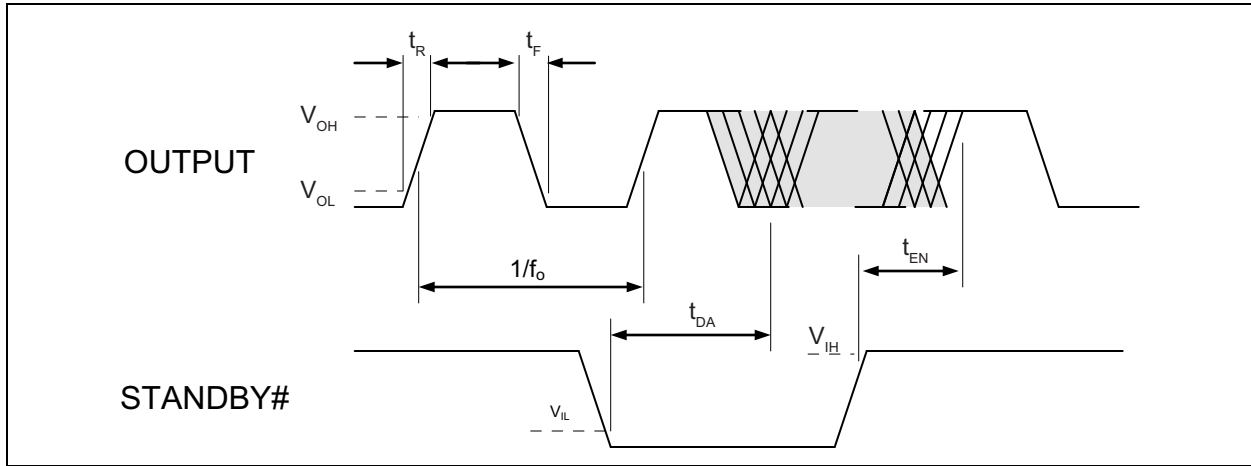


FIGURE 4-1: Output Waveform.

4.1 Standby Function

Standby# (Pin 1)	Output (Pin 3)
High Level	Output ON
Open (no connect)	Output ON
Low Level	High Impedance

5.0 TEST CIRCUIT

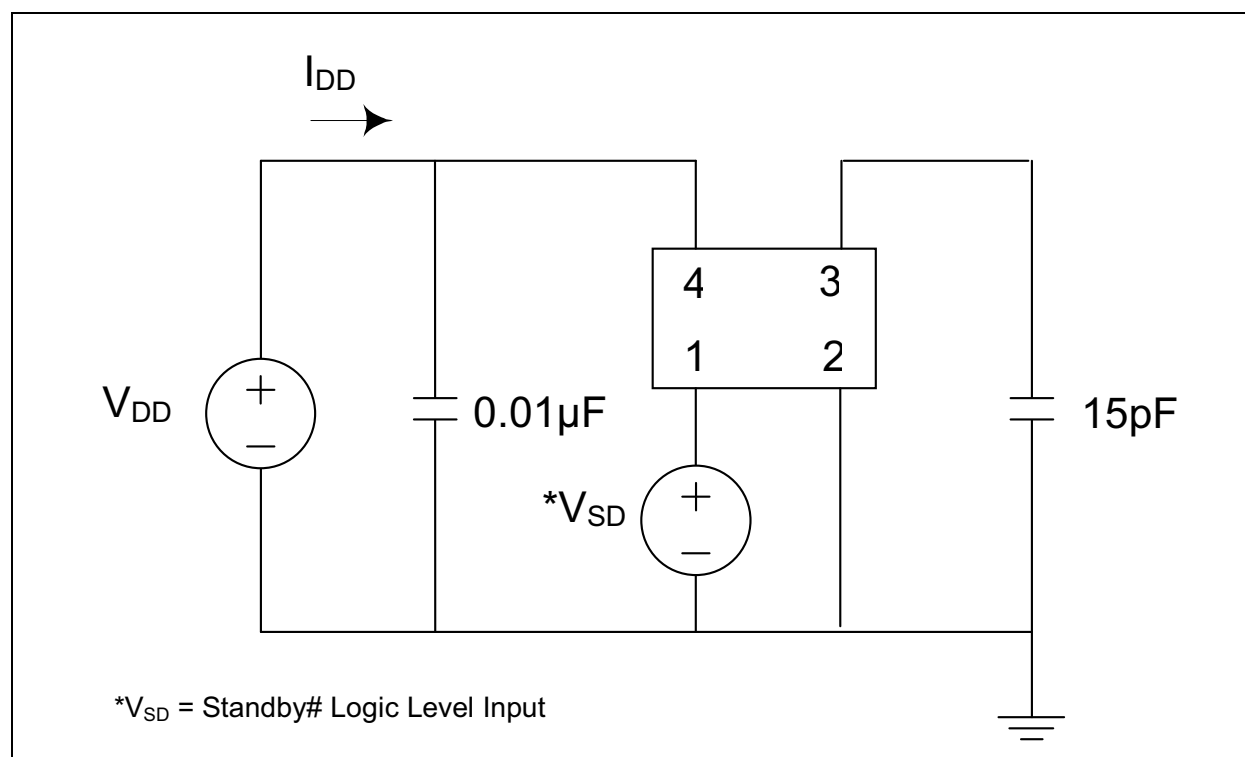


FIGURE 5-1: DSA1001/3/4 Test Circuit.

6.0 BOARD LAYOUT (RECOMMENDED)

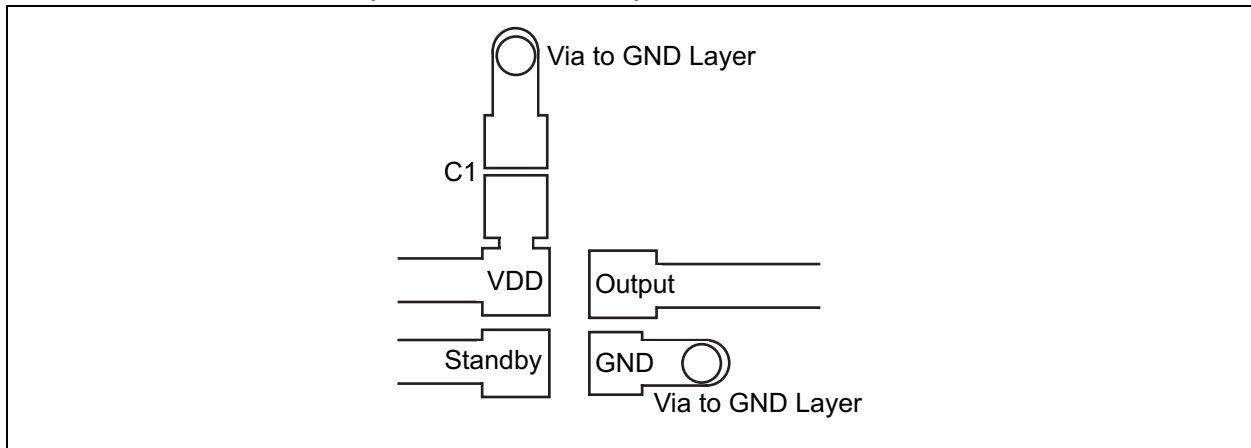


FIGURE 6-1: Recommended Board Layout for DSA1001/3/4.

7.0 SOLDER REFLOW PROFILE

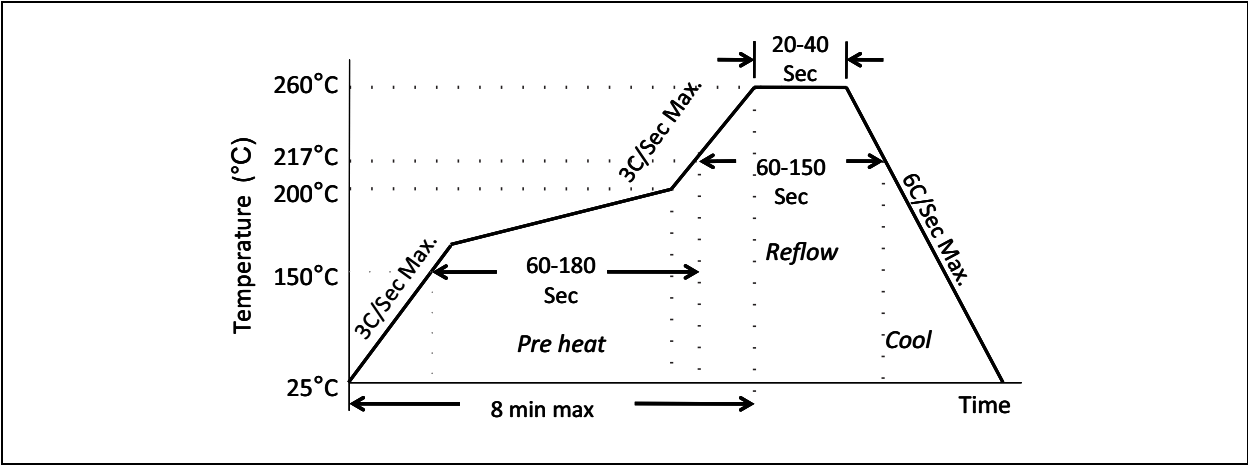
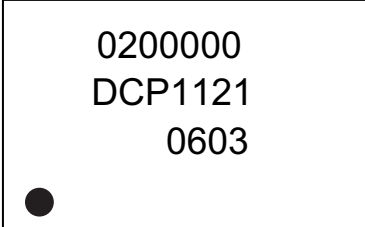


FIGURE 7-1: Solder Reflow Profile.

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.

8.0 PACKAGING INFORMATION

8.1 Package Marking Information

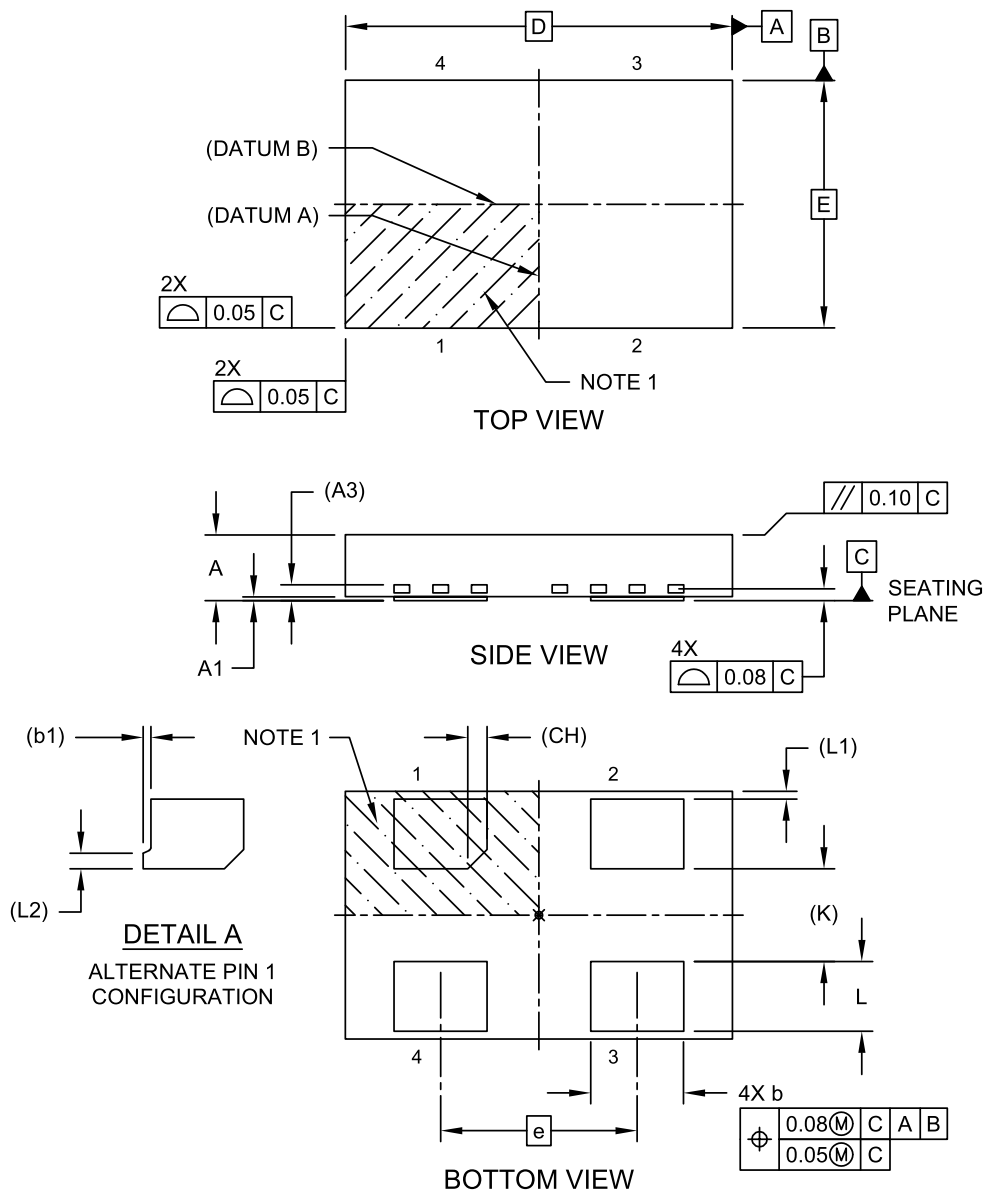
4-Lead CDFN/VDFN*	Example
 <p>XXXXXXX DCPYYWW 0SSS</p>	 <p>0200000 DCP1121 0603</p>

Legend:	XX...X	Product code, customer-specific information, or frequency in MHz without printed decimal point
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(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.	

4-Lead VDFN 5.0 mm x 3.2 mm Package Outline & Recommended Land Pattern

4-Lead Very Thin Plastic Dual Flat, No Lead Package (H6A) - 5x3.2 mm Body [VDFN]

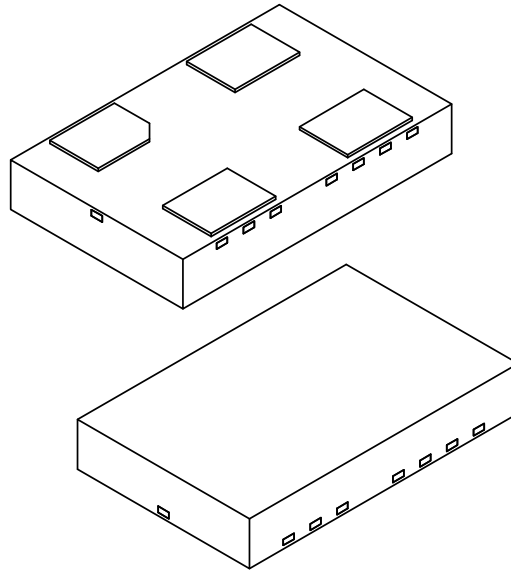
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-1008 Rev A Sheet 1 of 2

4-Lead Very Thin Plastic Dual Flat, No Lead Package (H6A) - 5x3.2 mm Body [VDFN]

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



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Terminals	N	4		
Pitch	e	2.54 BSC		
Overall Height	A	0.80	0.85	0.90
Standoff	A1	0.00	0.02	0.05
Terminal Thickness	A3	0.20 REF		
Overall Length	D	5.00 BSC		
Overall Width	E	3.20 BSC		
Terminal Width	b	1.15	1.20	1.25
Terminal 1 Tab	b1	0.10 REF		
Terminal Length	L	0.80	0.90	1.00
Terminal Pull Back	L1	0.10 REF		
Terminal 1 Tab	L2	0.20 REF		
Terminal 1 Chamfer	CH	0.25 REF		
Terminal Spacing	K	1.20 REF		

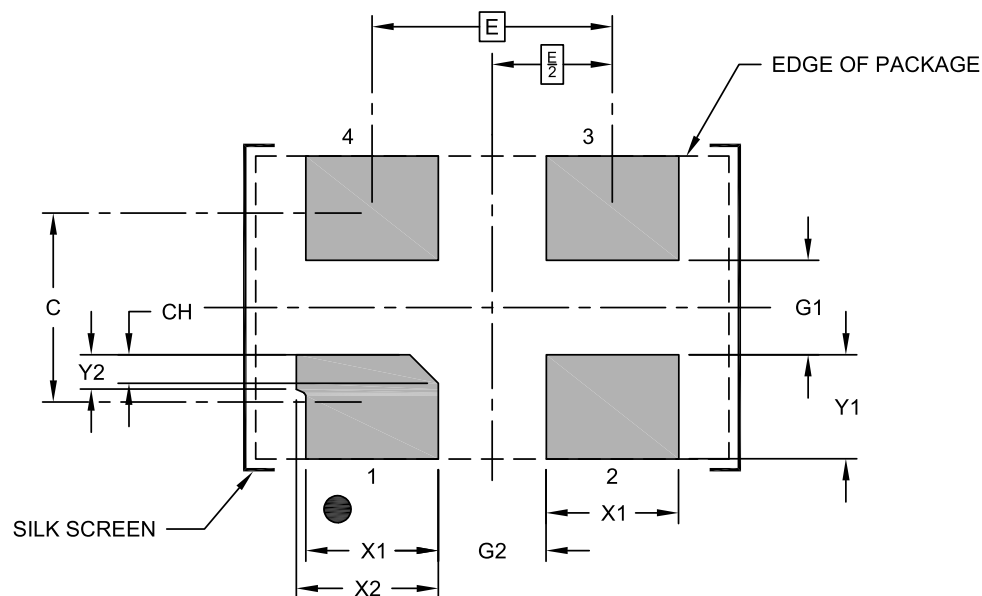
Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- Package is saw singulated
- 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 C04-1008 Rev A Sheet 2 of 2

4-Lead Very Thin Plastic Dual Flat, No Lead Package (H6A) - 5x3.2 mm Body [VDFN]

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



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E			
Contact Pad Spacing	C		2.00	
Contact Pad Width (X4)	X1			1.40
Contact Pad Width	X2			1.50
Contact Pad Length (X4)	Y1			1.10
Contact Pad Tab Length	Y2			0.36
Contact Pad to Center Pad (X2)	G1	1.00		
Contact Pad to Contact Pad (X2)	G2	1.14		
Terminal 1 Contact Pad Chamfer	CH		0.30	

Notes:

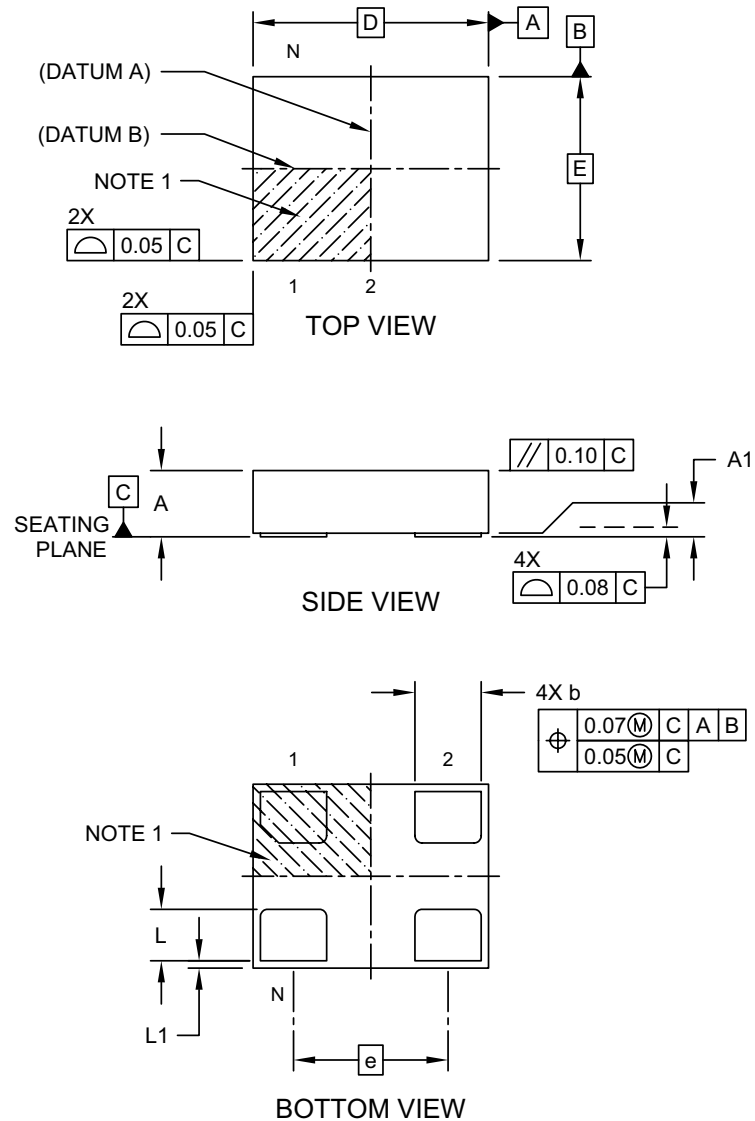
1. Dimensioning and tolerancing per ASME Y14.5M
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-3008 Rev A

4-Lead VDFN 3.2 mm x 2.5 mm Package Outline & Recommended Land Pattern

4-Lead Very Thin Plastic Dual Flatpack No-Lead (H4A) - 3.2x2.5 mm Body [VDFN]

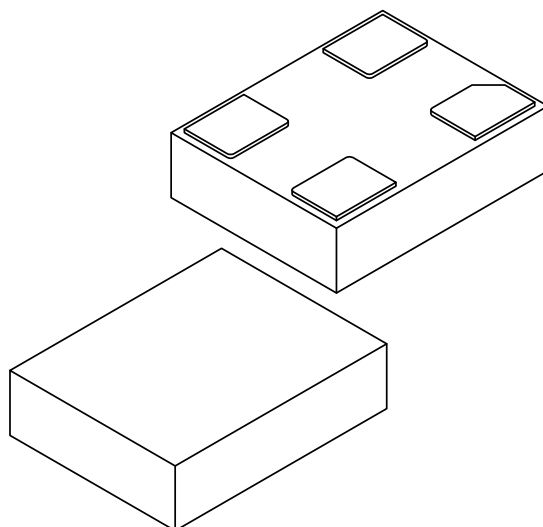
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-1006A Sheet 1 of 2

4-Lead Very Thin Plastic Dual Flatpack No-Lead (H4A) - 3.2x2.5 mm Body [VDFN]

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		
Pitch	e	2.10 BSC		
Overall Height	A	0.80	0.85	0.90
Standoff	A1	0.00	0.02	0.05
Overall Length	D	3.20 BSC		
Overall Width	E	2.50 BSC		
Terminal Width	b	0.85	0.90	0.95
Terminal Length	L	0.65	0.70	0.75
Terminal Pullback	L1	0.10 REF		

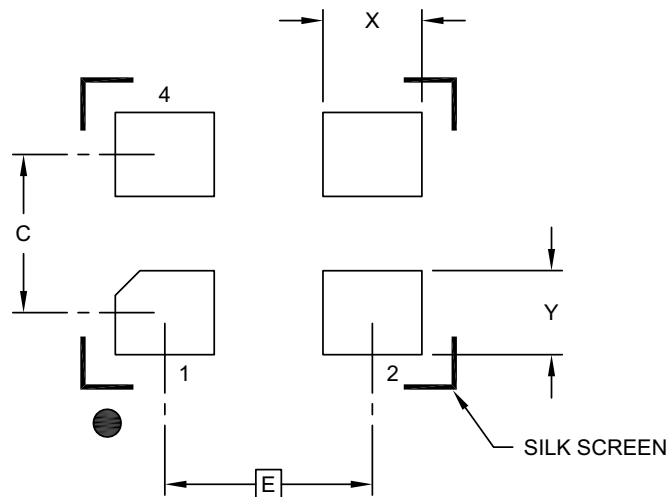
Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- Package is saw singulated
- 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 C04-1006A Sheet 2 of 2

4-Lead Very Thin Plastic Dual Flatpack No-Lead (H4A) - 3.2x2.5 mm Body [VDFN]

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



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	2.10 BSC		
Contact Pad Spacing	C		1.60	
Contact Pad Width (X4)	X			1.00
Contact Pad Length (X4)	Y			0.85

Notes:

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

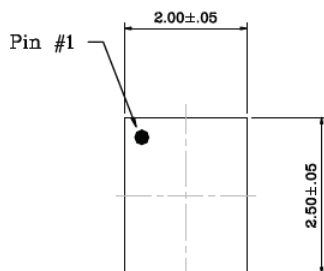
Microchip Technology Drawing C04-3006A

4-Lead CDFN 2.5 mm x 2.0 mm Package Outline & Recommended Land Pattern

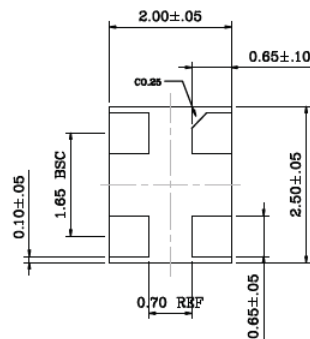
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4 LEAD CDFN 2.5x2.0mm COL PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

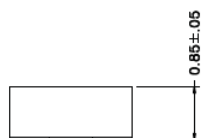
DRAWING #	CDFN2520-4LD-PL-1	UNIT	MM
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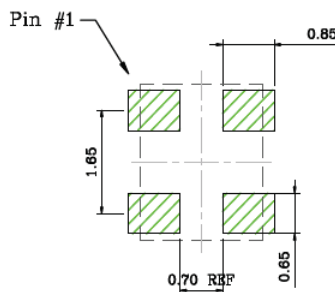
Top View



Bottom View



Side View



Recommended Land Pattern

NOTE:

- Green shaded rectangles in Recommended Land Pattern are solder stencil opening.

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

APPENDIX A: REVISION HISTORY

Revision A (March 2018)

- Initial release of data sheet DSA1001/3/4 to Microchip format data sheet DS20005889A.

Revision B (November 2021)

- Updated the [Product Identification System](#) section to reflect the Automotive Suffix on the part numbers.
- Updated two package options to VDFN and their drawings to the current MCHP-spec drawings.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

<u>Part No.</u>	<u>X</u>	<u>X</u>	<u>X</u>	<u>-XXX.XXXX</u>	<u>X</u>	<u>VXX</u>	Examples:						
Device	Package	Temp. Range	Stability	Frequency	Media Type	Automotive Suffix							
<div><div><div><div><div>Device:</div><div>DSA1001/3/4: 1.8V - 3.3V Low-Power Precision CMOS Oscillator for Automotive</div></div><div><div>Package:</div><div><div><div>B</div><div>=</div><div>4-Lead 5.0 mm x 3.2 mm VDFN</div></div><div><div>C</div><div>=</div><div>4-Lead 3.2 mm x 2.5 mm VDFN</div></div><div><div>D</div><div>=</div><div>4-Lead 2.5 mm x 2.0 mm CDFN</div></div></div></div><div><div>Temperature Range:</div><div><div><div>I</div><div>=</div><div>-40°C to +85°C (Automotive Grade 3)</div></div><div><div>L</div><div>=</div><div>-40°C to +105°C (Automotive Grade 2)</div></div></div></div><div><div>Stability:</div><div><div><div>1</div><div>=</div><div>±50 ppm</div></div><div><div>2</div><div>=</div><div>±25 ppm</div></div><div><div>3</div><div>=</div><div>±20 ppm</div></div></div></div><div><div>Frequency:</div><div>xxx.xxxx = 1 MHz to 150 MHz (user-defined)</div></div><div><div>Media Type:</div><div><div><div><blank></div><div>=</div><div>110/Tube</div></div><div><div>T</div><div>=</div><div>1,000/Reel</div></div></div></div><div><div>Automotive Suffix:</div><div>Vxx = Automotive suffix in which "xx" is assigned by Microchip. Default value is "AO" for the standard automotive part.</div></div></div></div></div> <div><div>a) DSA1003BL3-030.0000VAO:</div><div>DSA1003, 4-Lead 5.0 mm x 3.2 mm VDFN, -40°C to +105°C Automotive Grade 2 Temp. Range, ±20 ppm stability, 30 MHz Output Frequency, 110/Tube, Standard Automotive</div></div> <div><div>b) DSA1004DI1-075.0000TVAO:</div><div>DSA1004, 4-Lead 2.5 mm x 2.0 mm CDFN, -40°C to +85°C Automotive Grade 3 Temp. Range, ±50 ppm stability, 75 MHz Output Frequency, 1,000/Reel, Standard Automotive</div></div> <div><div>Note 1:</div><div>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.</div></div> <tr><td colspan="7">Please use the Microchip Clockworks to check AEC-Q100 compliance status and build the exact part number.</td></tr>							Please use the Microchip Clockworks to check AEC-Q100 compliance status and build the exact part number.						
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