

## High Performance CMOS MEMS Oscillator for Automotive

### Features

- Automotive AEC-Q100 Qualified
- Wide Frequency Range: 2.5 MHz to 170 MHz
- Very Low RMS Phase Jitter: <650 fs (typ.)
- High Stability:  $\pm 20$  ppm,  $\pm 25$  ppm,  $\pm 50$  ppm
- Wide Temperature Range:
  - Automotive Grade 1:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
  - Automotive Grade 2:  $-40^{\circ}\text{C}$  to  $+105^{\circ}\text{C}$
  - Automotive Grade 3:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Small Industry-Standard Footprints
  - 2.5 mm x 2.0 mm
  - 3.2 mm x 2.5 mm
  - 5.0 mm x 3.2 mm
  - 7.0 mm x 5.0 mm
- Excellent Shock and Vibration Immunity
  - Qualified to MIL-STD-883
- High Reliability
  - 20x Better MTF than Quartz Oscillators
- Supply Range of 2.25V to 3.63V
- Standby, Frequency Select, and Output Enable Functions
- Lead-Free and RoHS-Compliant

### Applications

- Automotive Infotainment
- Automotive ADAS
- In-Vehicle Networking, CAN Bus, Ethernet

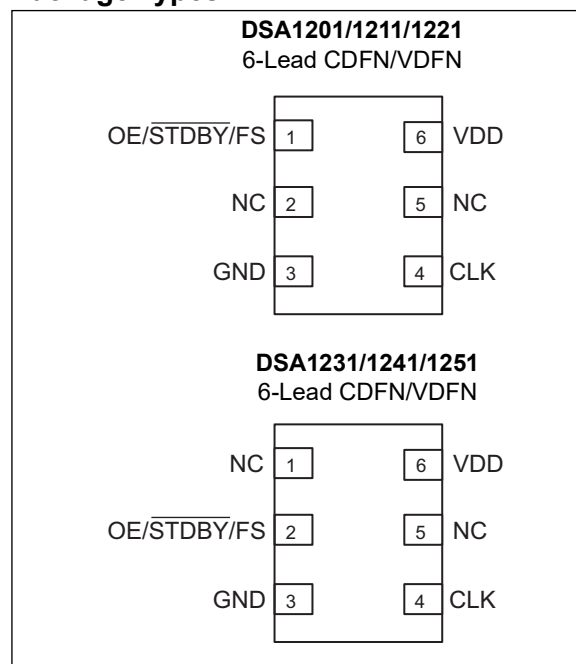
### General Description

The DSA12x1 family of high performance oscillators utilizes the latest generation of silicon MEMS technology that reduces close-in noise and provides excellent jitter and stability over a wide range of supply voltages and temperatures. By eliminating the need for quartz or SAW technology, MEMS oscillators significantly enhance reliability and accelerate product development, while meeting stringent clock performance criteria for automotive applications.

The DSA12x1 family features a control function on pin 1 or pin 2 that permits either a standby feature (complete power down when  $\overline{\text{STDBY}}$  is low), output enable (output is tri-stated with OE low), or a frequency select (choice of two frequencies selected by FS high/low). See the [Product Identification System](#) section for detailed information.

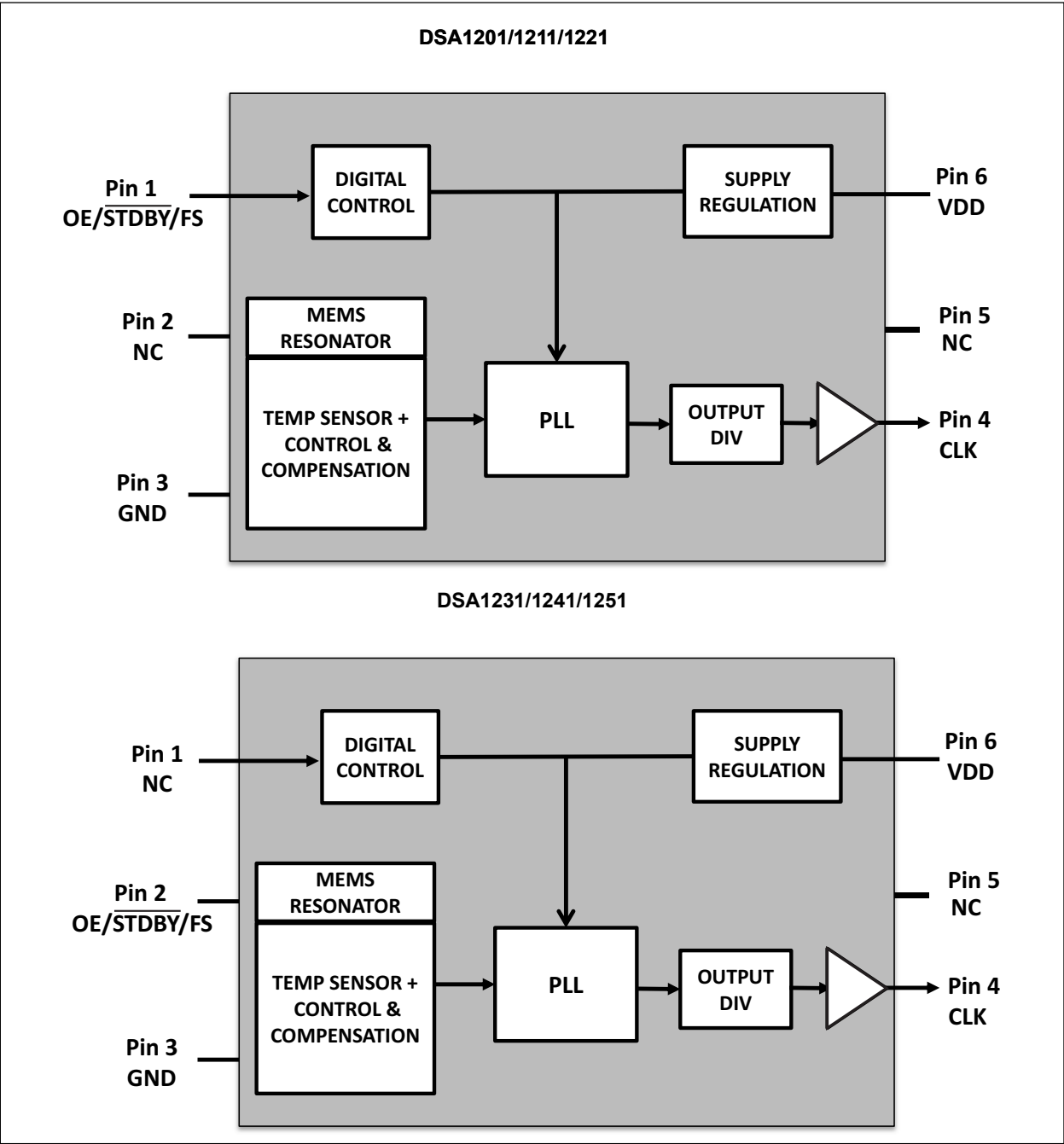
All oscillators are available in industry-standard packages, including the small 2.5 mm x 2.0 mm, and are “drop-in” replacements for standard 4-pin and 6-pin CMOS quartz crystal oscillators.

### Package Types



# DSA12X1

## Functional Block Diagrams



## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings †

Supply Voltage .....	–0.3V to +4.0V
Input Voltage .....	–0.3V to $V_{DD} + 0.3V$
ESD Protection (HBM) .....	4 kV
ESD Protection (MM) .....	400V
ESD Protection (CDM) .....	1.5 kV

† **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.

## ELECTRICAL CHARACTERISTICS

**Electrical Characteristics:**  $V_{DD} = 2.5V \pm 10\%$  or  $3.3V \pm 10\%$ ;  $T_A = -40^\circ C$  to  $+125^\circ C$ , unless noted.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply Voltage	$V_{DD}$	2.25	—	3.63	V	<a href="#">Note 1</a>
Supply Current	$I_{DD}$	—	27	—	mA	Output enabled, CMOS (no load), $f_{OUT} = 100$ MHz
		—	23	—		Output disabled (tri-state), $f_{OUT} = 100$ MHz
Standby Current	$I_{STDBY}$	—	2.5	5	$\mu A$	Input pin = $\overline{STDBY}$ = Asserted ( $V_{DD} = 3.3V$ )
Frequency Stability	$\Delta f$	—	—	$\pm 20$	ppm	Includes frequency variations due to initial tolerance, temp., and power supply voltage
		—	—	$\pm 25$		
		—	—	$\pm 50$		
Aging	$\Delta f$	—	—	$\pm 5$	ppm	First year @ $25^\circ C$
		—	—	$\pm 1$		Per year after first year
Startup Time	$t_{SU}$	—	5.5	6	ms	From 90% $V_{DD}$ to valid clock output, $T = +25^\circ C$ , <a href="#">Note 2</a>
Input Logic Levels	$V_{IH}$	$0.75 \times V_{DD}$	—	—	V	Input logic high
	$V_{IL}$	—	—	$0.25 \times V_{DD}$		Input logic low
Output Disable Time	$t_{DA}$	—	—	25	ns	<a href="#">Note 3</a>
Output Enable Time	$t_{EN}$	—	—	6	ms	$\overline{STDBY}$
		—	—	350	ns	OE
Enable Pull-Up Resistor	—	—	1.5	—	$M\Omega$	Pull-up resistor on pin 1, <a href="#">Note 4</a>
Frequency	$f_0$	2.5	—	170	MHz	—
Output Logic Level High	$V_{OH}$	$0.8 \times V_{DD}$	—	—	V	$I = \pm 12$ mA
Output Logic Level Low	$V_{OL}$	—	—	$0.2 \times V_{DD}$		
Output Transition Time, Rise 20% to 80%; $C_L = 15$ pF	$t_R$	—	1.2	—	ns	—
Output Transition Time, Fall 20% to 80%; $C_L = 15$ pF	$t_F$	—	1.1	—	ns	—

# DSA12X1

## ELECTRICAL CHARACTERISTICS (CONTINUED)

**Electrical Characteristics:**  $V_{DD} = 2.5V \pm 10\%$  or  $3.3V \pm 10\%$ ;  $T_A = -40^\circ C$  to  $+125^\circ C$ , unless noted.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Duty Cycle	SYM	45	—	55	%	—
Period Jitter, Peak-to-Peak	$J_{PTP}$	—	25	—	ps	$f_{OUT} = 100$ MHz
Cycle-to-Cycle Jitter, Peak	$J_{CC}$	—	22	—	ps	$f_{OUT} = 100$ MHz
Integrated Phase Noise (Random)	$J_{PH}$	—	0.65	—	$ps_{RMS}$	12 kHz to 20 MHz @ 100 MHz, $T_A = +105^\circ C$

- Note 1:**  $V_{DD}$  pin should be filtered with a 0.1  $\mu F$  capacitor.  
**2:**  $t_{SU}$  is the time to 100 ppm stable output frequency after  $V_{DD}$  is applied and outputs are enabled.  
**3:**  $t_{DA}$ : See the [Output Waveform](#) and the [Test Circuit](#) sections for more information.  
**4:** Output is enabled if pad is floated (not connected).

## TEMPERATURE SPECIFICATIONS [Note 1](#)

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
<b>Temperature Ranges</b>						
Maximum Junction Temperature	$T_J$	—	—	+150	$^\circ C$	—
Storage Temperature Range	$T_S$	–55	—	+150	$^\circ C$	—
Lead Temperature	—	—	—	+260	$^\circ C$	Soldering, 40s

- 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.,  $T_A$ ,  $T_J$ ,  $\theta_{JA}$ ). Exceeding the maximum allowable power dissipation will cause the device operating junction temperature to exceed the maximum  $+150^\circ C$  rating. Sustained junction temperatures above  $+150^\circ C$  can impact the device reliability.

## 2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 2-1](#).

**TABLE 2-1: DSA1201/1211/1221 PIN FUNCTION TABLE**

Pin Number	DSA1201		DSA1211		DSA1221	
	Pin Name	Description	Pin Name	Description	Pin Name	Description
1	$\overline{\text{STDBY}}$	Standby.	FS	Frequency select.	OE	Output enable.
2	NC	No connect.	NC	No connect.	NC	No connect.
3	GND	Power supply ground.	GND	Power supply ground.	GND	Power supply ground.
4	CLK	Clock output.	CLK	Clock output.	CLK	Clock output.
5	NC	No connect.	NC	No connect.	NC	No connect.
6	VDD	Power supply.	VDD	Power supply.	VDD	Power supply.

**TABLE 2-2: DSA1231/1241/1251 PIN FUNCTION TABLE**

Pin Number	DSA1231		DSA1241		DSA1251	
	Pin Name	Description	Pin Name	Description	Pin Name	Description
1	NC	No connect.	NC	No connect.	NC	No connect.
2	$\overline{\text{STDBY}}$	Standby.	FS	Frequency select.	OE	Output enable.
3	GND	Power supply ground.	GND	Power supply ground.	GND	Power supply ground.
4	CLK	Clock output.	CLK	Clock output.	CLK	Clock output.
5	NC	No connect.	NC	No connect.	NC	No connect.

### 2.1 Standby

Complete power down when  $\overline{\text{STDBY}}$  is low.

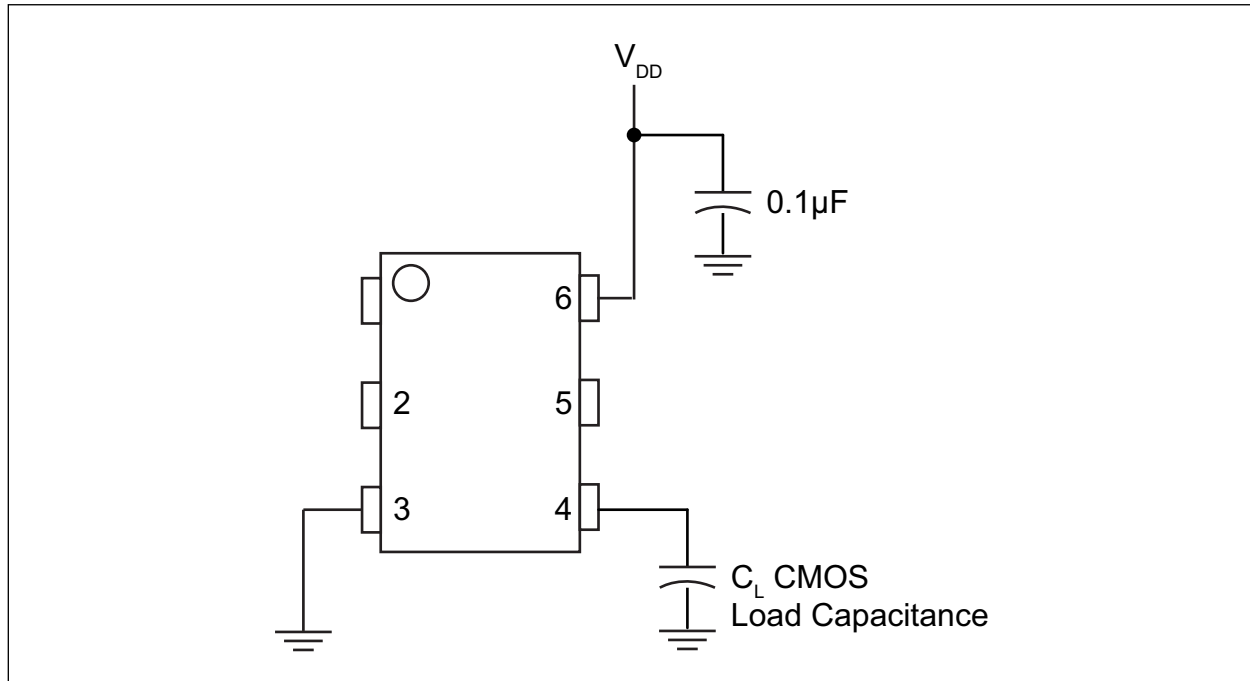
### 2.2 Frequency Select

Two frequencies may be chosen, selected by FS = High or Low. Please use the [ClockWorks](#) tool to customize frequencies.

### 2.3 Output Enable

Output buffers (only) are tri-stated when OE is low.

## 3.0 TERMINATION SCHEME



**FIGURE 3-1:** CMOS Termination.

4.0 OUTPUT WAVEFORM

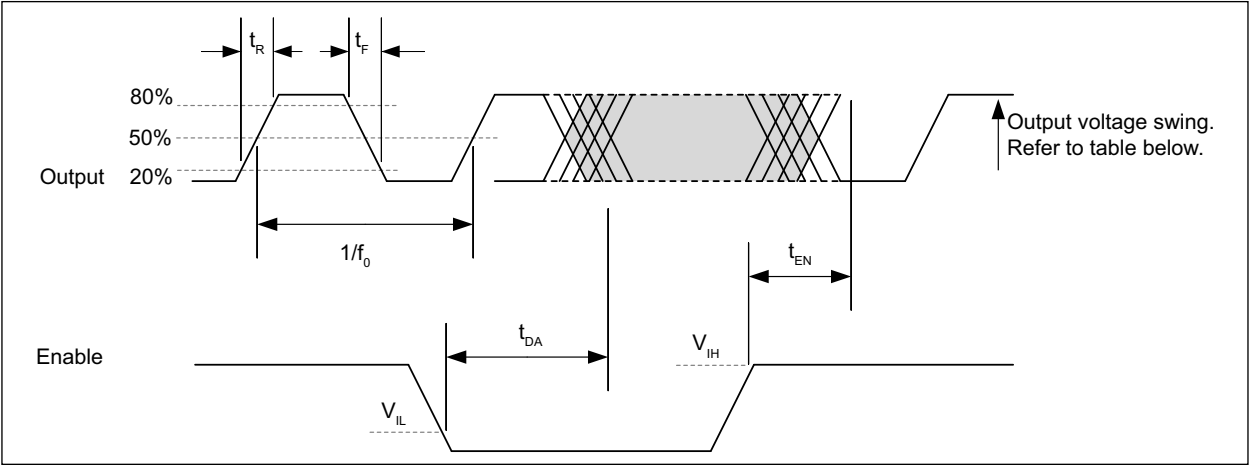
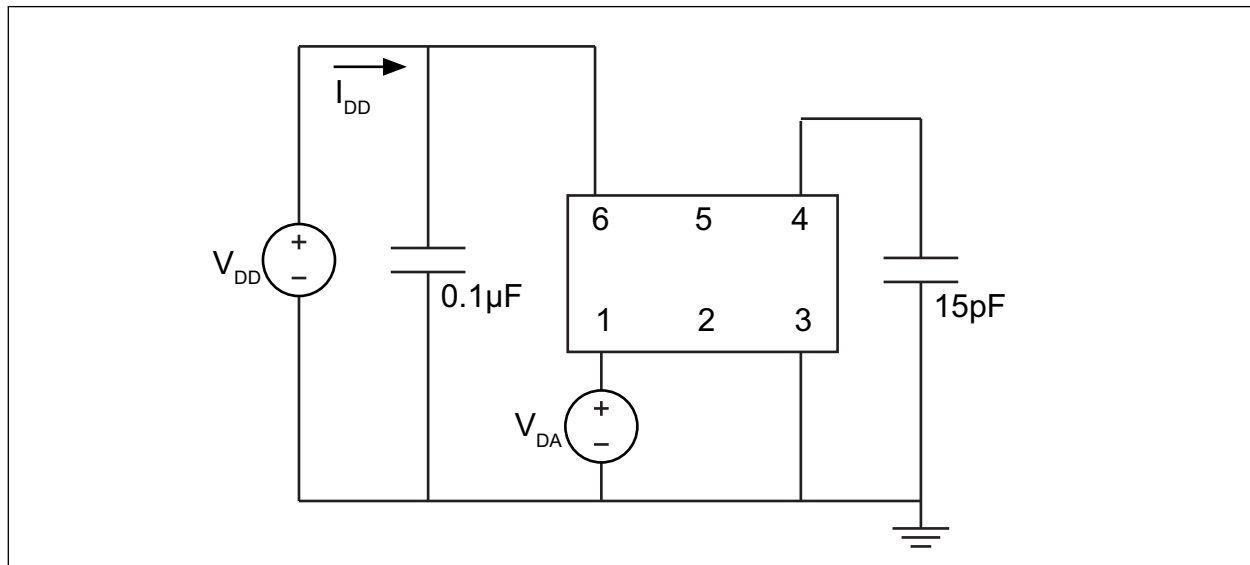


FIGURE 4-1: CMOS Output Waveform.

TABLE 4-1: OUTPUT VOLTAGE SWING BY LOGIC TYPE

Output Logic Protocol	Typical Peak-to-Peak Output Swing
CMOS	$V_{OH}, V_{OL}$

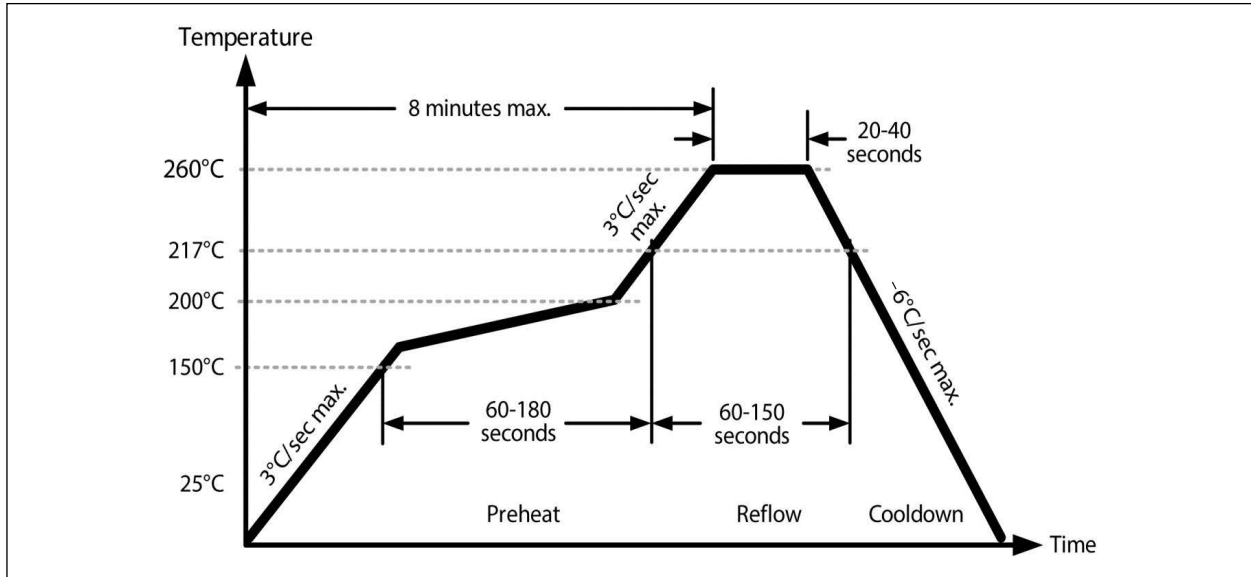
## 5.0 TEST CIRCUIT



**FIGURE 5-1:** CMOS Test Circuit.



## 6.0 SOLDER REFLOW PROFILE



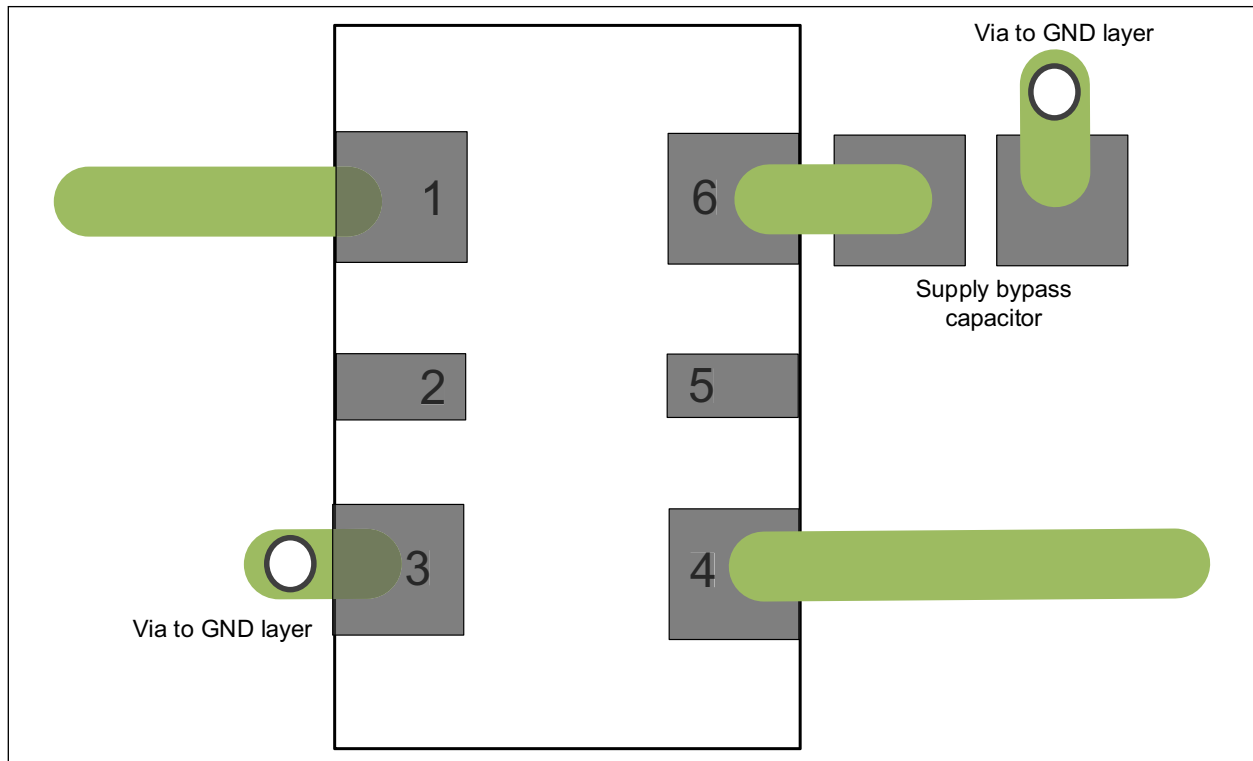
**FIGURE 6-1:** Solder Reflow Profile.

**TABLE 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 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.

# DSA12X1

## 7.0 BOARD LAYOUT (RECOMMENDED)



**FIGURE 7-1:** *DSA12x1 Recommended Board Layout.*

## 8.0 PHASE NOISE

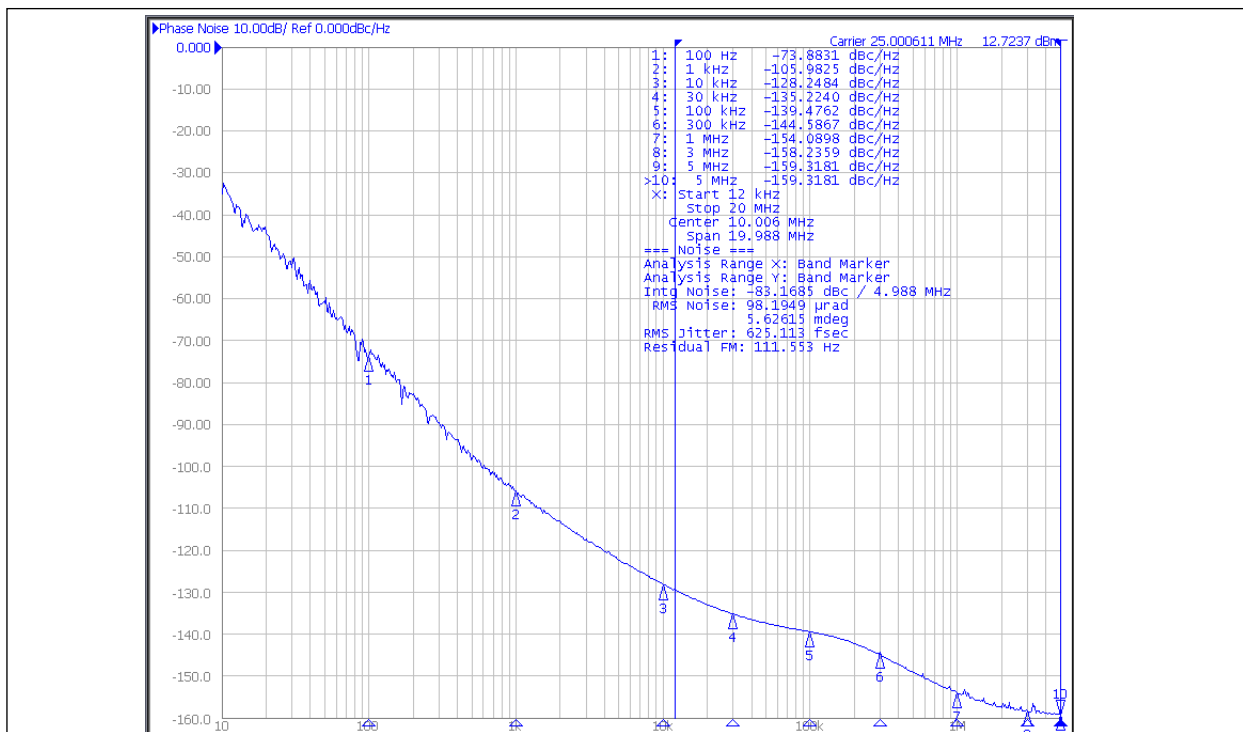


FIGURE 8-1: DSA12x1 Phase Noise at 25 MHz.

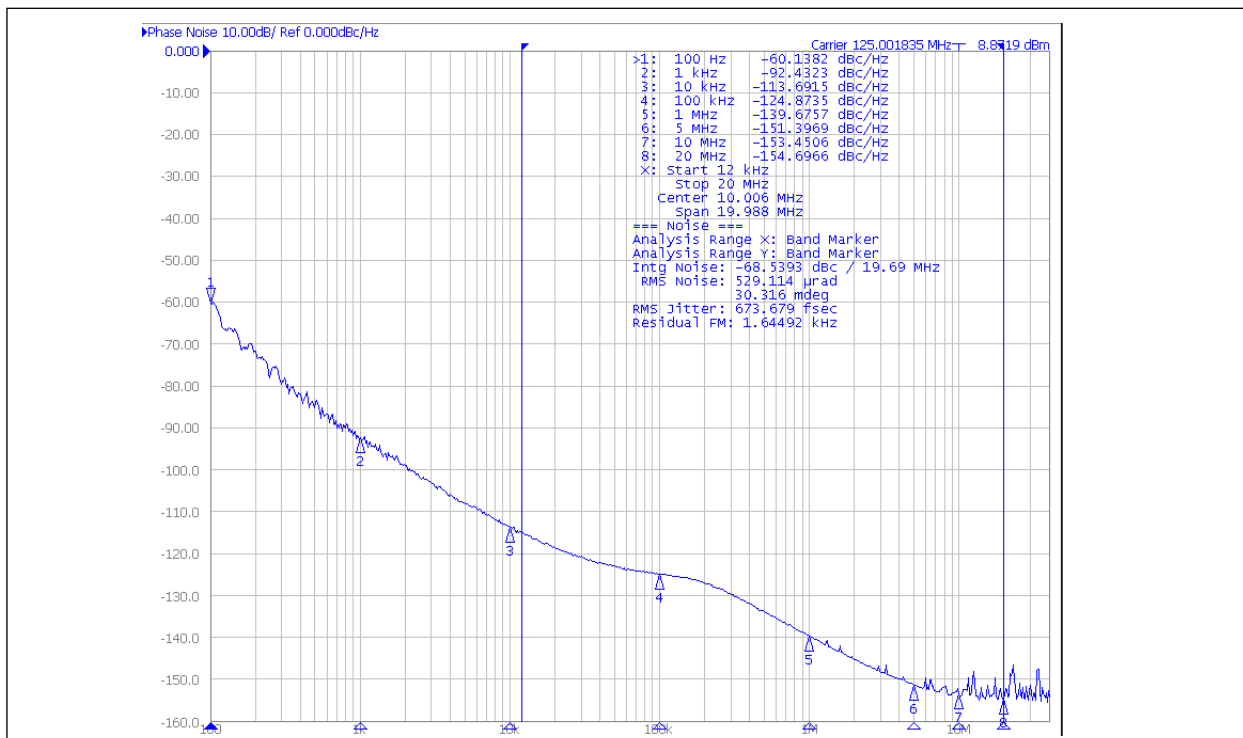


FIGURE 8-2: DSA12x1 Phase Noise at 125 MHz.

## 9.0 PACKAGING INFORMATION

### 9.1 Package Marking Information

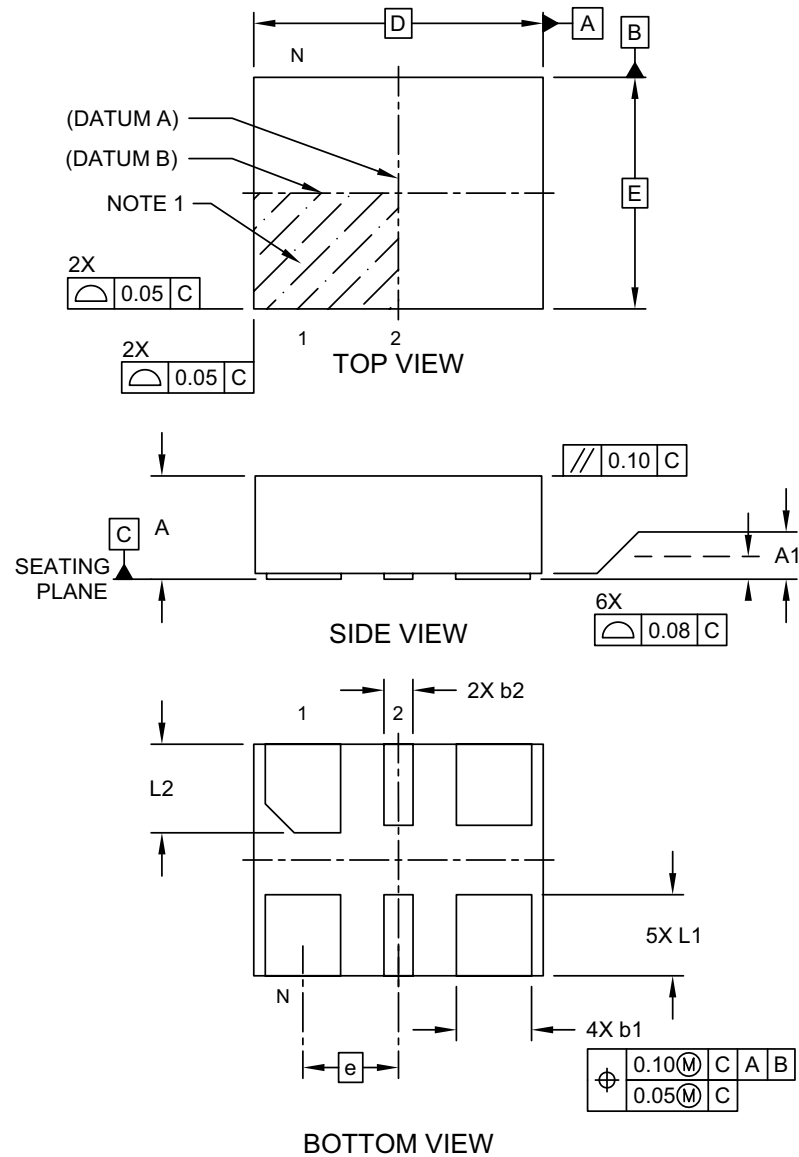
6-Pin CDFN/VDFN*	Example
<div>XXXXXXXXX DCPYYWW 0SSS</div>	<div>75M00000 DCP1723 0421</div>

<b>Legend:</b>	XX...X	Product code or customer-specific information
	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')
	SSS	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).
<b>Note:</b>	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.	

## 6-Lead VDFN 2.5 mm x 2.0 mm Package Outline and Recommended Land Pattern

### 6-Lead Very Thin Dual Flatpack No-Leads (J7A) - 2.5x2.0 mm Body [VDFN]

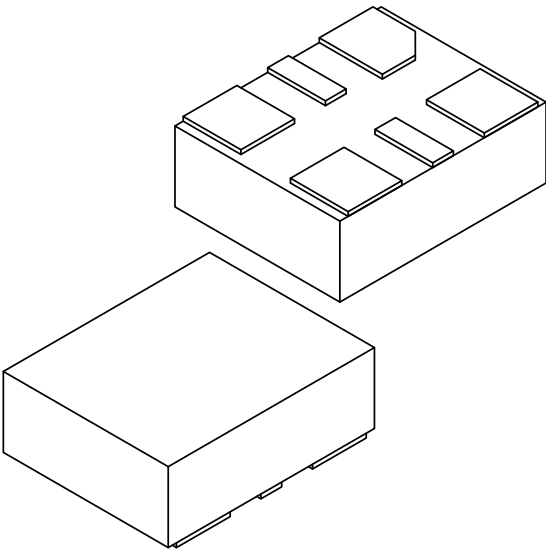
**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-1005A Sheet 1 of 2

6-Lead Very Thin Dual Flatpack No-Leads (J7A) - 2.5x2.0 mm Body [VDFN]

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



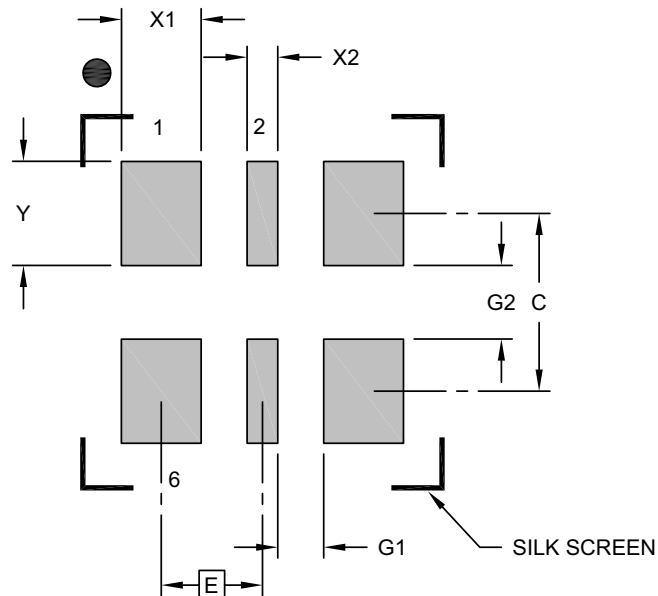
Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Terminals	N	6		
Pitch	e	0.825 BSC		
Overall Height	A	0.80	0.85	0.90
Standoff	A1	0.00	0.02	0.05
Overall Length	D	2.50 BSC		
Overall Width	E	2.00 BSC		
Terminal Width	b1	0.60	0.65	0.70
Terminal Width	b2	0.20	0.25	0.30
Terminal Length	L1	0.60	0.70	0.80
Terminal Length	L2	0.665	0.765	0.865

- 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 C04-1005A Sheet 2 of 2

## 6-Lead Very Thin Dual Flatpack No-Leads (J7A) - 2.5x2.0 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

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	0.825 BSC		
Contact Pad Width (X4)	X1			0.65
Contact Pad Width (X2)	X2			0.25
Contact Pad Length (X6)	Y			0.85
Contact Pad Spacing	C		1.45	
Space Between Contacts (X4)	G1	0.38		
Space Between Contacts (X3)	G2	0.60		

**Notes:**

- Dimensioning and tolerancing per ASME Y14.5M  
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
- For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

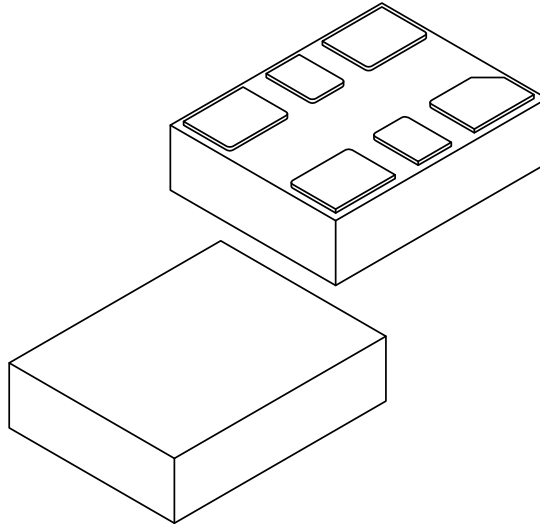
Microchip Technology Drawing C04-3005A





## 6-Lead Very Thin Plastic Dual Flatpack No-Lead (H5A) - 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	6		
Pitch	e	1.05 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	b1	0.85	0.90	0.95
Terminal Width	b2	0.45	0.50	0.55
Terminal Length	L	0.65	0.70	0.75
Terminal Pullback	L1	0.10 REF		

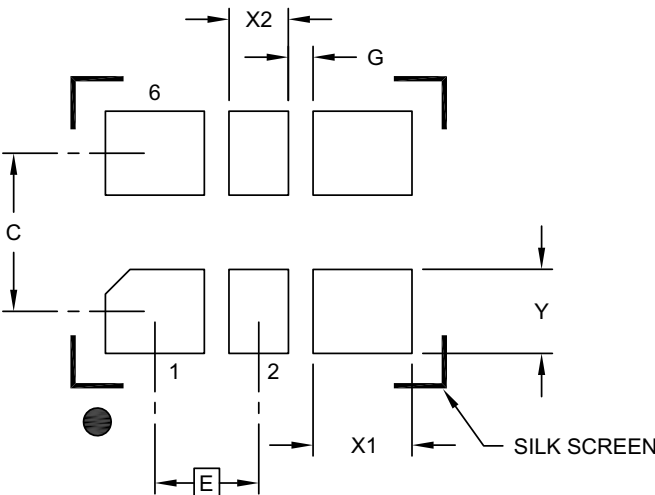
**Notes:**

- 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 C04-1007A Sheet 2 of 2

6-Lead Very Thin Plastic Dual Flatpack No-Lead (H5A) - 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

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	1.05 BSC		
Contact Pad Spacing	C		1.60	
Contact Pad Width (X4)	X1			1.00
Contact Pad Width (X2)	X2			0.60
Contact Pad Length (X6)	Y			0.85
Space Between Contacts (X4)	G1	0.25		

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

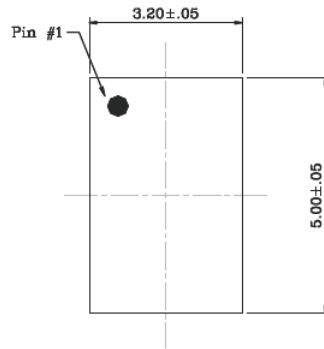
Microchip Technology Drawing C04-3007A

## 6-Lead CDFN 5.0 mm x 3.2 mm Package Outline and Recommended Land Pattern

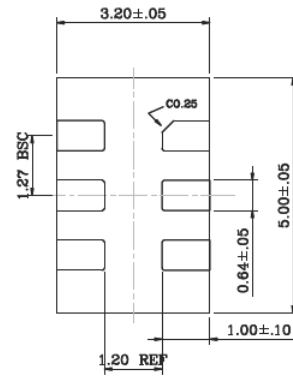
### TITLE

6 LEAD CDFN 5.0x3.2mm COL PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	CDFN5032-6LD-PL-1	UNIT	MM
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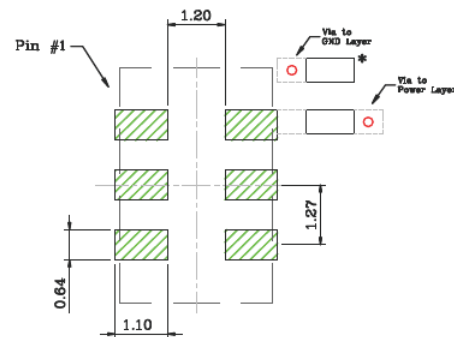
Top View



Bottom View



Side View



Recommended Land Pattern

### NOTE:

- \* Power Supply Decoupling Capacitor is required in Recommended Land Pattern.
- Green shaded rectangles in Recommended Land Pattern are solder stencil opening.
- Red circles in Recommended Land Pattern are thermal VIA.

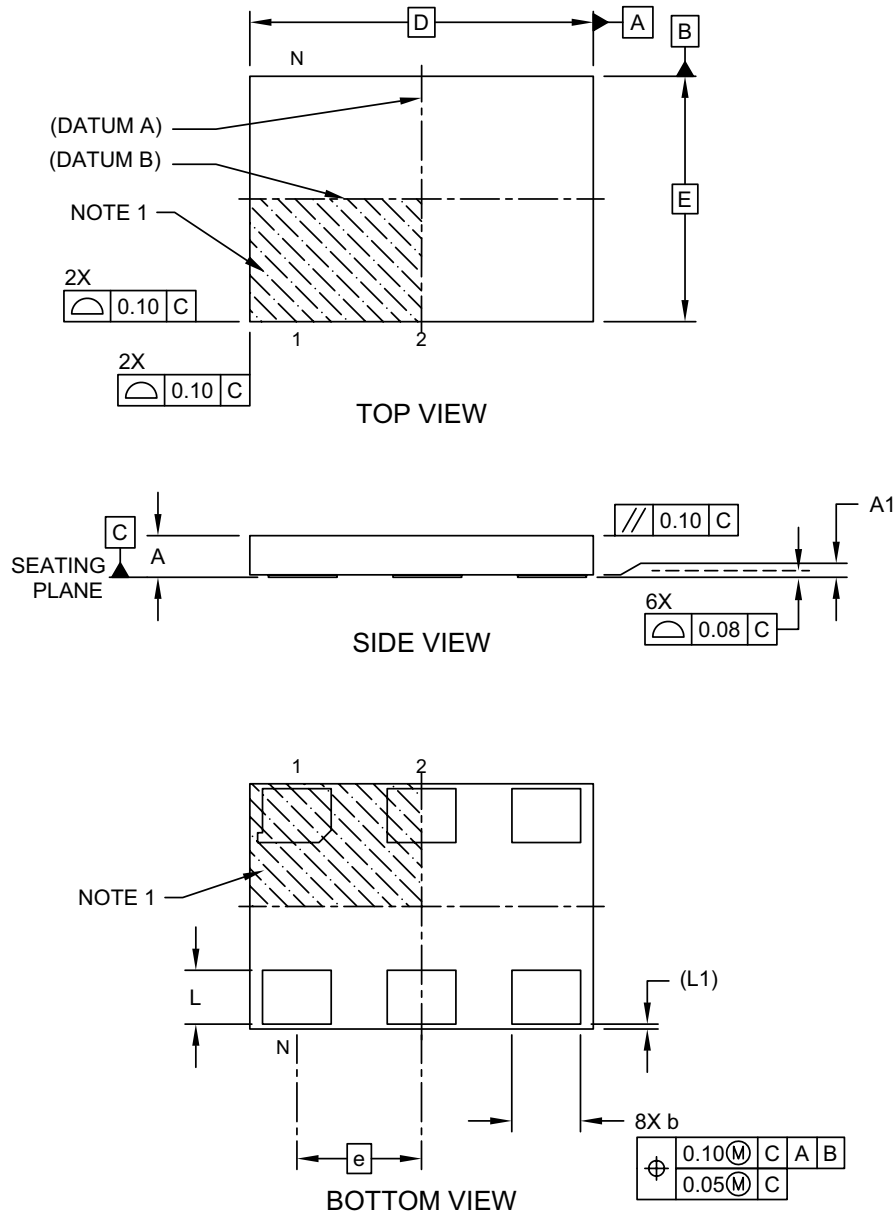
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

# DSA12X1

## 6-Lead VDFN 7.0 mm x 5.0 mm Package Outline and Recommended Land Pattern

### 6-Lead Very Thin Dual Flatpack, No Lead Package (HPA) - 7x5 mm Body [VDFN]

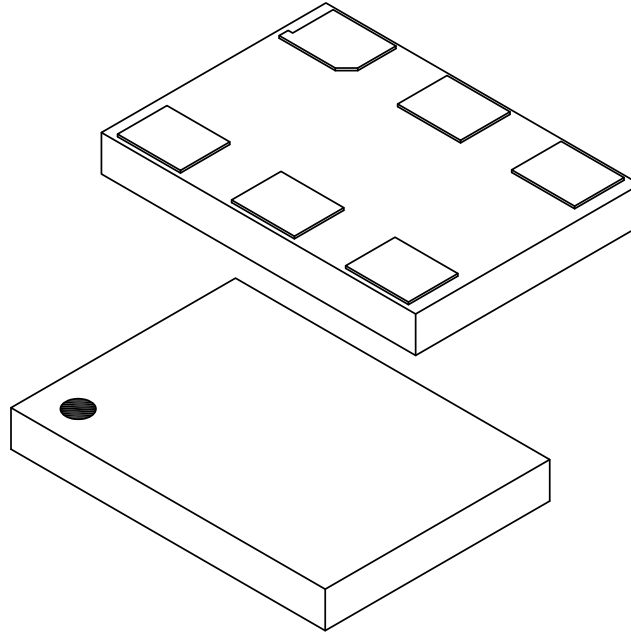
**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-1227 Rev A Sheet 1 of 2

## 6-Lead Very Thin Dual Flatpack, No Lead Package (HPA) - 7x5 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		6		
Pitch	e		2.54 BSC		
Overall Height	A		0.80	0.85	0.90
Standoff	A1		0.00	0.02	0.05
Overall Length	D		7.00 BSC		
Overall Width	E		5.00 BSC		
Terminal Width	b		1.30	1.40	1.50
Terminal Length	L		1.00	1.10	1.20
Pullback	L1		0.10 REF		

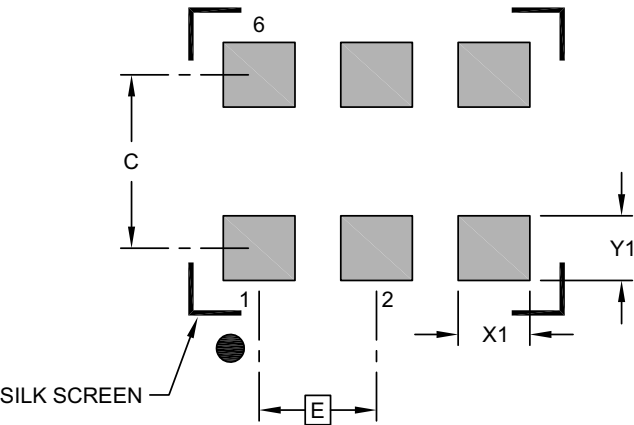
### Notes:

- 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 C04-1227 Rev A Sheet 2 of 2

6-Lead Very Thin Dual Flatpack, No Lead Package (HPA) - 7x5 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	2.54 BSC		
Contact Pad Spacing	C		3.90	
Contact Pad Width (X6)	X1			1.55
Contact Pad Length (X6)	Y1			1.40

- Notes:
- Dimensioning and tolerancing per ASME Y14.5M  
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
  - For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-3227 Rev A

## APPENDIX A: REVISION HISTORY

### Revision A (July 2020)

- Initial release of DSA12x1 as Microchip data sheet DS20006385A.

### Revision B (August 2024)

- Updated values and conditions for Output Logic Levels, Output Transition Times, Period Jitter, and Cycle-to-Cycle Jitter in the [Electrical Characteristics](#) table.

# DSA12X1

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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>X</u>	<u>X</u>	<u>-XXXXXXXX</u>	<u>X</u>	<u>XXX</u>
Device	Control Pin	Output Format	Package	Temperature	Freq. Stability	Output Frequency	Media Type	Automotive Suffix
<b>Device:</b>	DSA12:	High Performance CMOS MEMS Oscillator for Automotive						
<b>Control Pin:</b>	0	=	Pin 1 <u>STDBY</u> with Pull-up					
	1	=	Pin 1 Frequency Select with Pull-up					
	2	=	Pin 1 <u>OE</u> with Pull-up					
	3	=	Pin 2 <u>STDBY</u> with Pull-up					
	4	=	Pin 2 Frequency Select with Pull-up					
	5	=	Pin 2 OE with Pull-up					
<b>Output Format:</b>	1	=	CMOS					
<b>Package:</b>	N	=	7 mm x 5 mm 6-Lead VDFN					
	B	=	5 mm x 3.2 mm 6-Lead CDFN					
	C	=	3.2 mm x 2.5 mm 6-Lead VDFN					
	D	=	2.5 mm x 2 mm 6-Lead VDFN					
<b>Temperature:</b>	A	=	-40°C to +125°C (Automotive Grade 1)					
	L	=	-40°C to +105°C (Automotive Grade 2)					
	I	=	-40°C to +85°C (Automotive Grade 3)					
<b>Frequency Stability:</b>	1	=	±50 ppm					
	2	=	±25 ppm					
	3	=	±20 ppm					
<b>Output Frequency:</b>	xMxxxxxx	=	<10 MHz					
	xxMxxxxx	=	<100 MHz					
	xxxMxxxx	=	>100 MHz					
	CCCCC	=	with Frequency Select					
	PROG	=	TimeFlash					
<b>Media Type:</b>	<blank>	=	Bulk					
	T	=	1,000/Reel					
	B	=	3,000/Reel					
<b>Automotive Suffix:</b>	VXX	=	Automotive suffix in which "XX" is assigned by Microchip. Default value is "AO" for standard automotive part					

### Examples:

- DSA1201NI1-25M00000TVAO: Pin 1 STDBY with Pull-up, CMOS Output, 7x5 VDFN, -20°C to +85°C, ±50 ppm, 25 MHz Output Frequency, 1,000/Reel, Standard Automotive
- DSA1211CL3-C0013VAO: Pin 1 Frequency Select with Pull-up, CMOS Output, 3.2x2.5 VDFN, -40°C to +105°C, ±20 ppm, Frequency Select, 24 MHz & 25 MHz, Bulk, Standard Automotive
- DSA1221BI2-19M50000BVAO: Pin 1 OE with Pull-up, CMOS Output, 5x3.2, -40°C to +85°C, ±25 ppm, 19.5 MHz Output Frequency, 3,000/Reel, Standard Automotive
- DSA1251DL3-55M82000TVAO: Pin 2 OE with Pull-up, CMOS Output, 2.5x2 VDFN, -40°C to +105°C, ±20 ppm, 55.82 MHz Output Frequency, 1,000/Reel, Standard Automotive
- DSA1231NI1-C0014BVAO: Pin 2 STDBY with Pull-up, CMOS Output, 7x5 VDFN, -40°C to +85°C, ±50 ppm, Frequency Select 100 MHz & 156.25 MHz, 3,000/Reel, Standard Automotive

**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.

Please visit the [Microchip ClockWorks Configurator®](http://clockworks.microchip.com/timing) website to configure the part number for customized frequency select settings.

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# DSA12X1

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NOTES:

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