DSA12X1

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: ±20 ppm, ±25 ppm, ±50 ppm
- Wide Temperature Range:
  - Automotive Grade 1: –40°C to +125°C
  - Automotive Grade 2: –40°C to +105°C
  - Automotive Grade 3: –40°C to +85°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

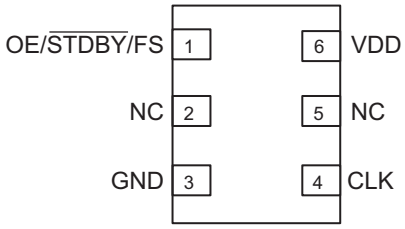
The DSA12x1 family of high performance oscillators utilizes the latest generation of silicon MEMS technology that reduces close-in noise and provides excellent jitter and stability over a wide range of supply voltages and temperatures. By eliminating the need for quartz or SAW technology, MEMS oscillators 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.

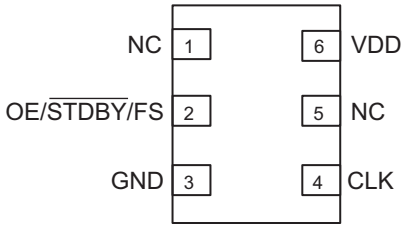
All oscillators are available in industry-standard packages, including the small 2.5 mm x 2.0 mm, and are “drop-in” replacements for standard 4-pin and 6-pin CMOS quartz crystal oscillators.

Package Types

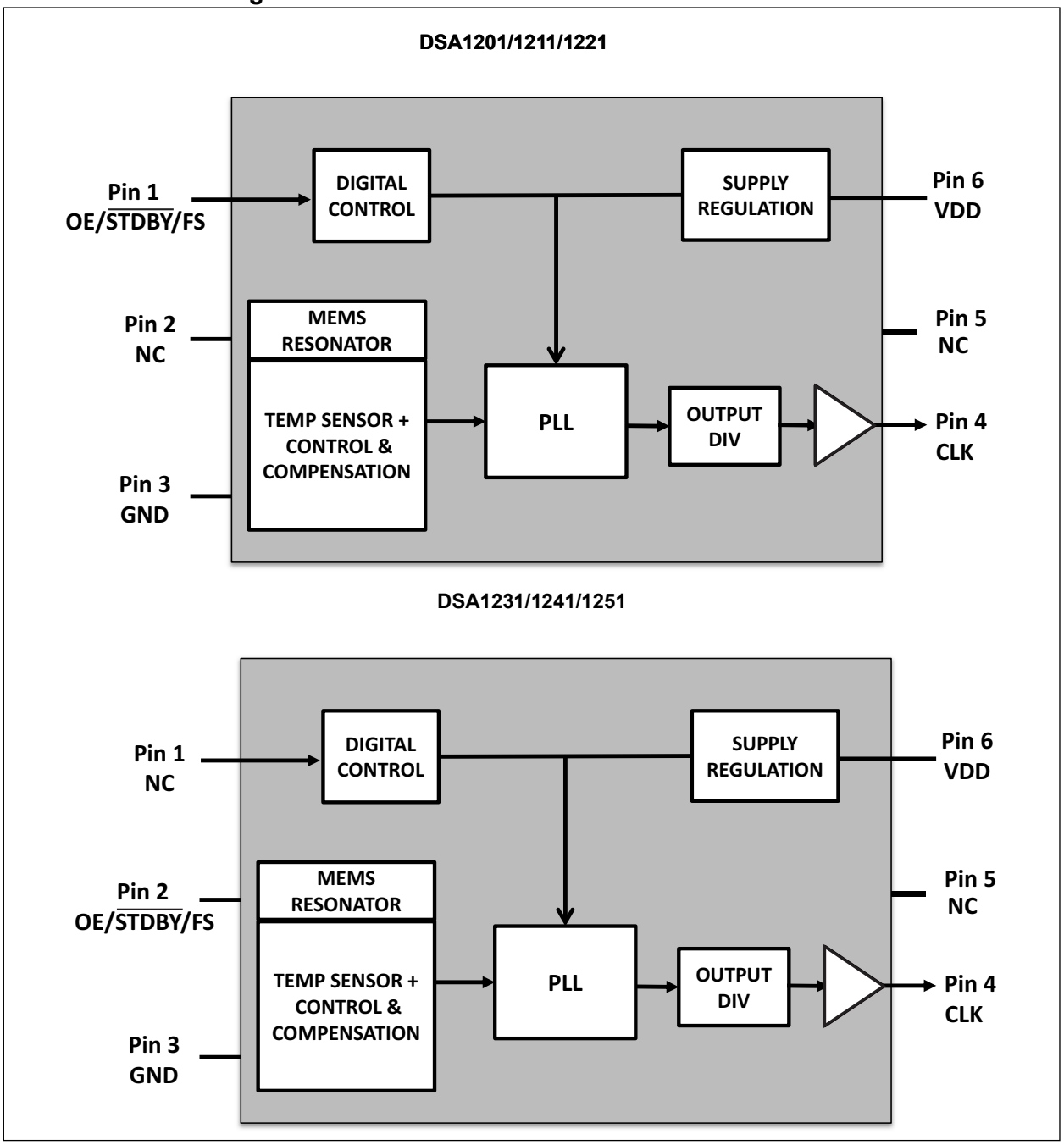
DSA1201/1211/1221
6-Lead CDFN/VDFN



DSA1231/1241/1251
6-Lead CDFN/VDFN



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 ±10% or 3.3V ±10%; T_A = –40°C to +125°C, unless noted.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply Voltage	V_{DD}	2.25	—	3.63	V	Note 1
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	µA	Input pin = $\overline{\text{STDBY}}$ = Asserted (V_{DD} = 3.3V)
Frequency Stability	Δf	—	—	±20	ppm	Includes frequency variations due to initial tolerance, temp., and power supply voltage
		—	—	±25		
		—	—	±50		
Aging	Δf	—	—	±5	ppm	First year @ 25°C
		—	—	±1		Per year after first year
Startup Time	t_{SU}	—	5.5	6	ms	From 90% V_{DD} to valid clock output, T = +25°C, Note 2
Input Logic Levels	V_{IH}	0.75 x V_{DD}	—	—	V	Input logic high
	V_{IL}	—	—	0.25 x V_{DD}		Input logic low
Output Disable Time	t_{DA}	—	—	25	ns	Note 3
Output Enable Time	t_{EN}	—	—	6	ms	$\overline{\text{STDBY}}$
		—	—	350	ns	OE
Enable Pull-Up Resistor	—	—	1.5	—	MΩ	Pull-up resistor on pin 1, Note 4
Frequency	f_0	2.5	—	170	MHz	—
Output Logic Level High	V_{OH}	0.8 x V_{DD}	—	—	V	I = ±12 mA
Output Logic Level Low	V_{OL}	—	—	0.2 x 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	—

ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Characteristics: V_{DD} = 2.5V ±10% or 3.3V ±10%; T_A = –40°C to +125°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°C

Note 1: V_{DD} pin should be filtered with a 0.1 µF 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
Temperature Ranges						
Maximum Junction Temperature	T_J	—	—	+150	°C	—
Storage Temperature Range	T_S	–55	—	+150	°C	—
Lead Temperature	—	—	—	+260	°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, 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: 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

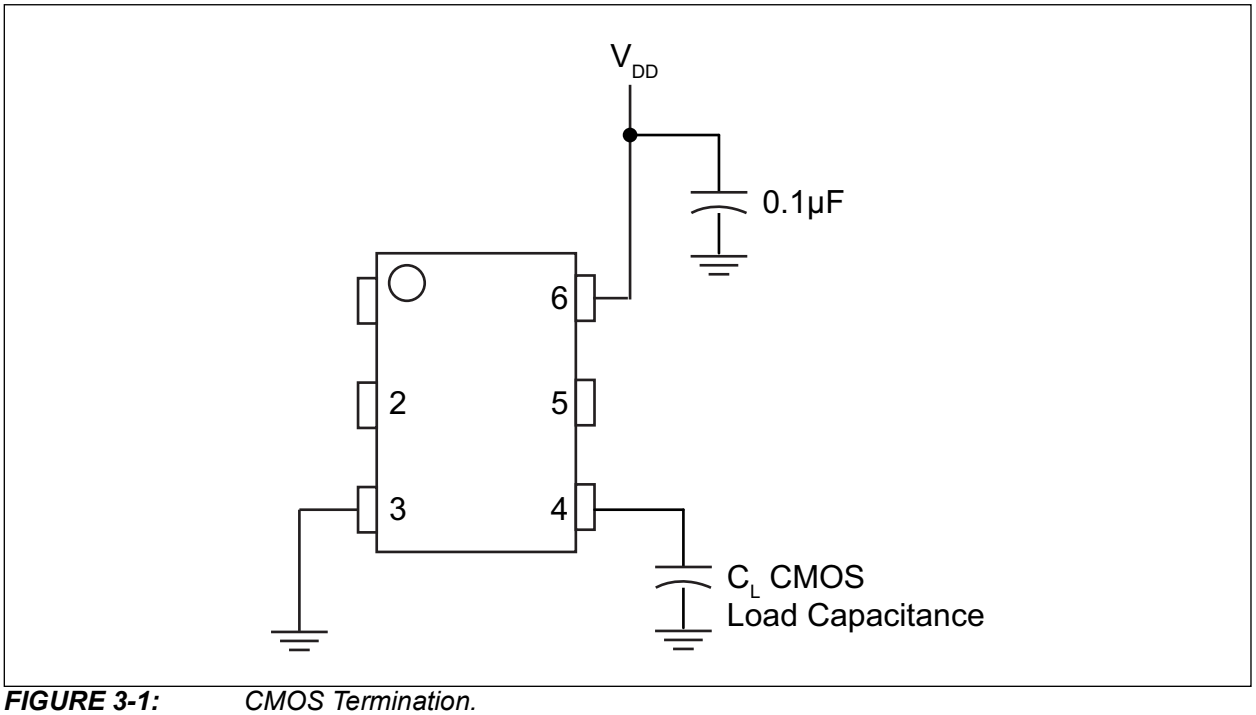


FIGURE 3-1: *CMOS Termination.*

4.0 OUTPUT WAVEFORM

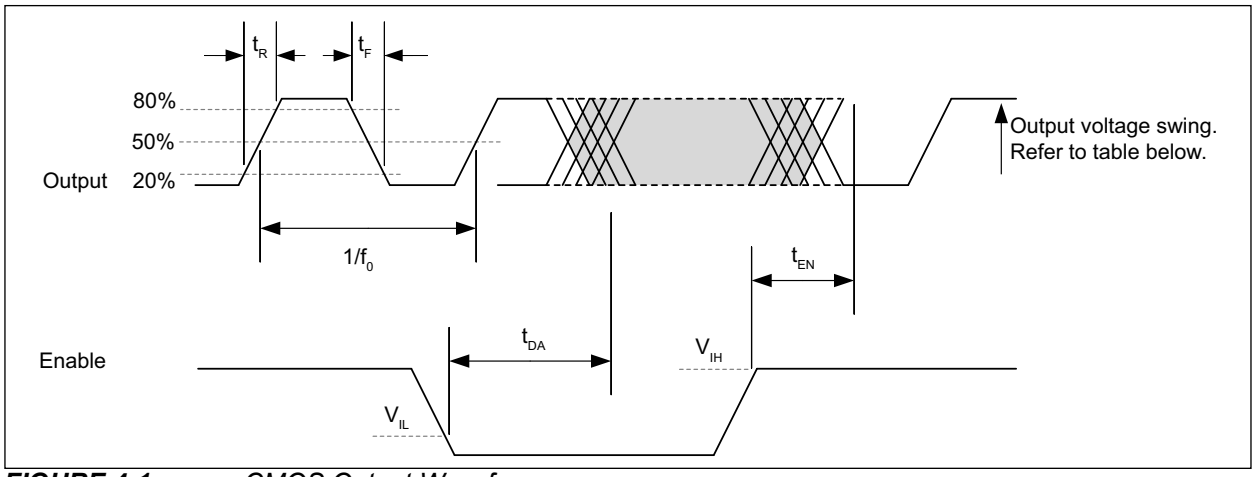


FIGURE 4-1: *CMOS Output Waveform.*

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

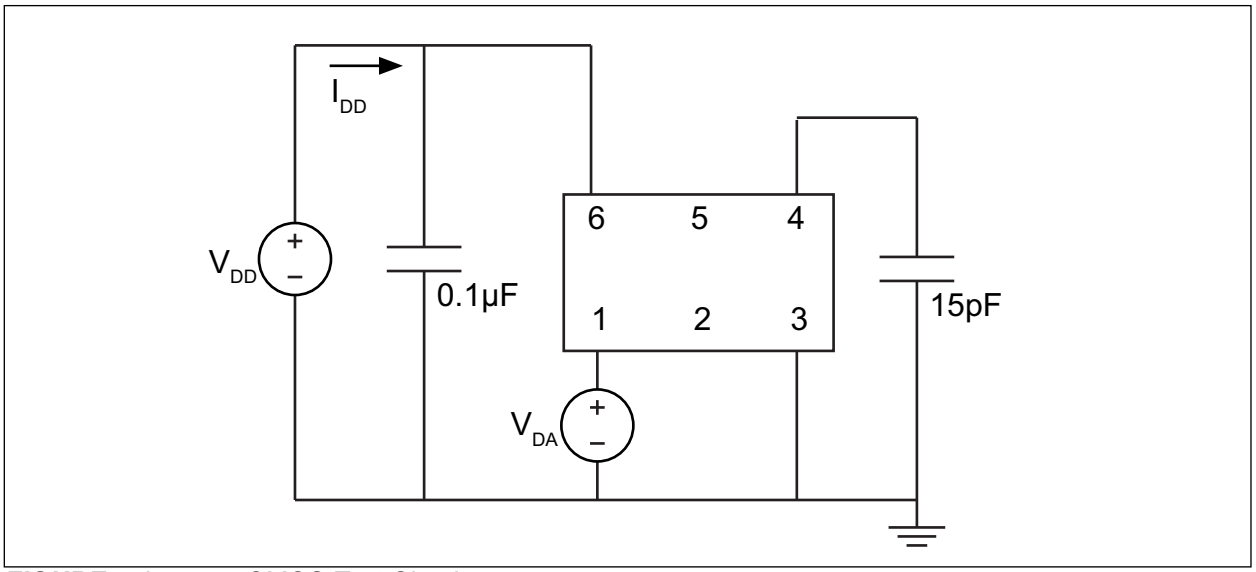


FIGURE 5-1: *CMOS Test Circuit.*

6.0 SOLDER REFLOW PROFILE

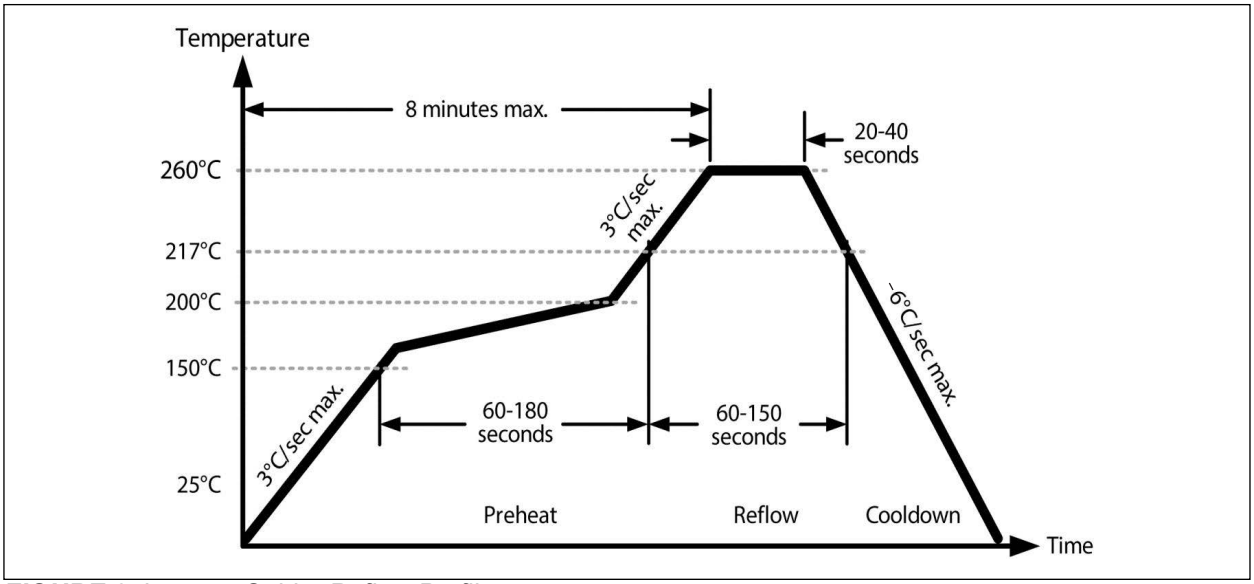


FIGURE 6-1: *Solder Reflow Profile.*

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.

7.0 BOARD LAYOUT (RECOMMENDED)

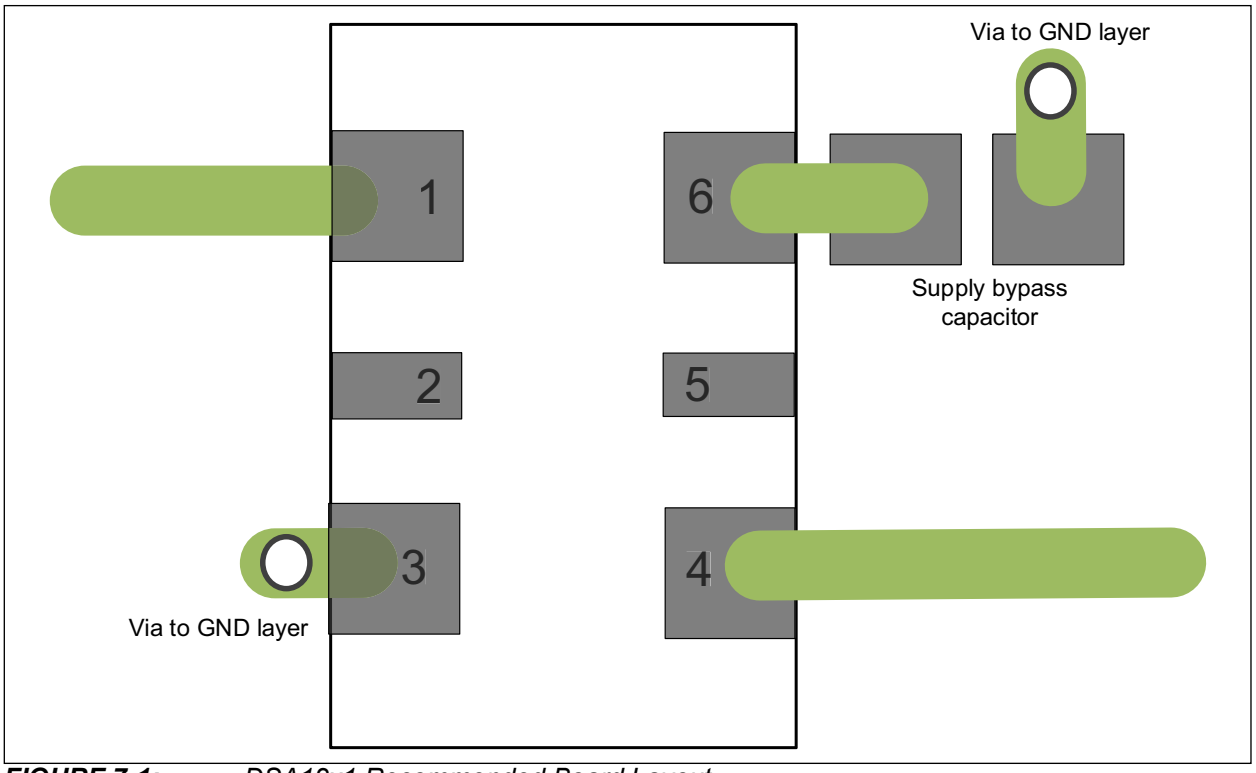


FIGURE 7-1: *DSA12x1 Recommended Board Layout.*

8.0 PHASE NOISE

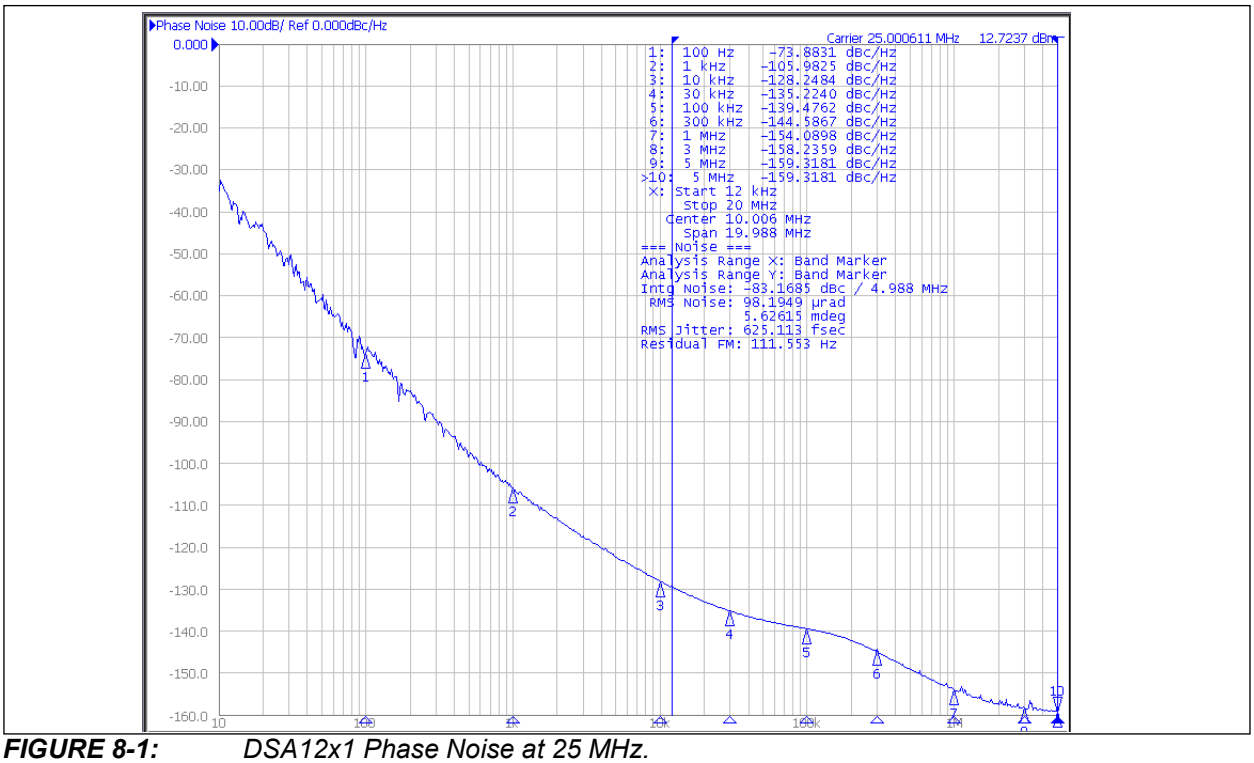


FIGURE 8-1: *DSA12x1 Phase Noise at 25 MHz.*

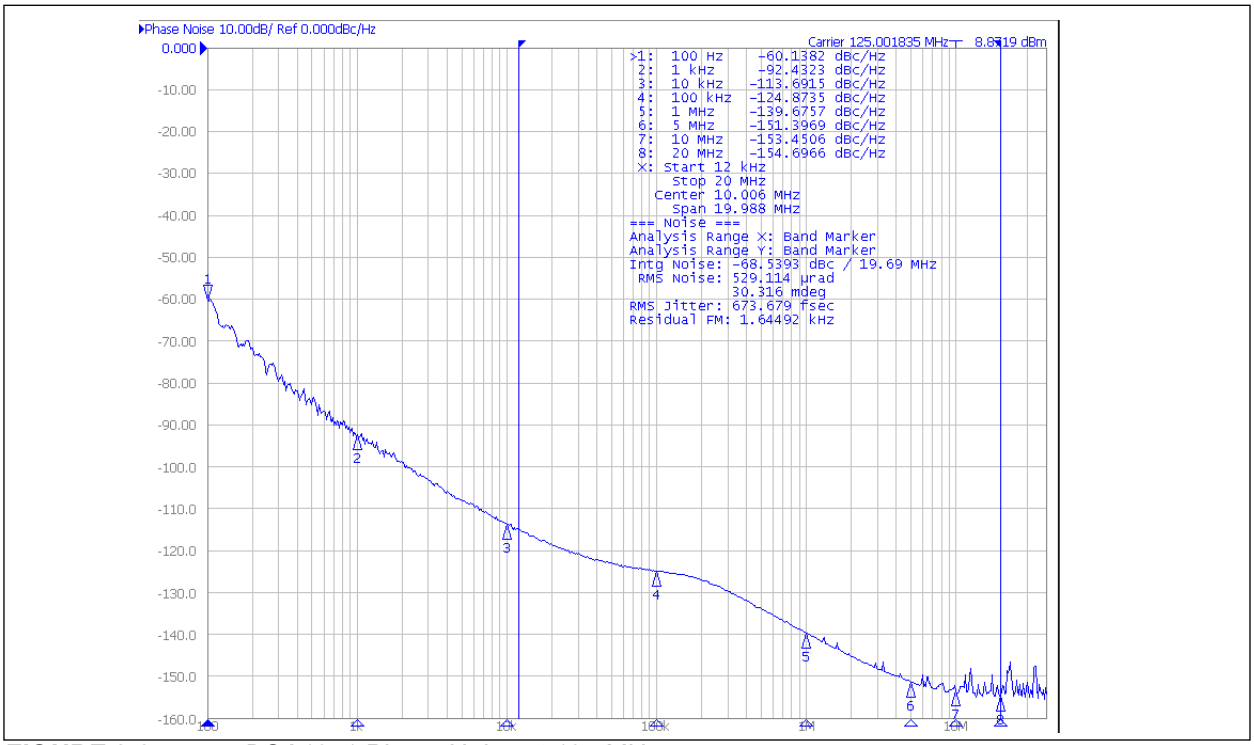
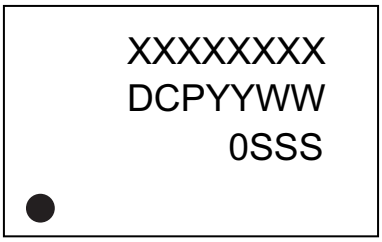


FIGURE 8-2: *DSA12x1 Phase Noise at 125 MHz.*

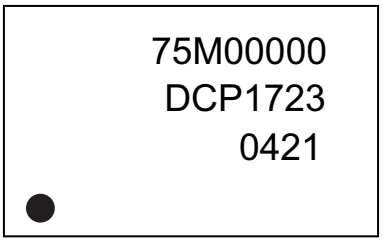
9.0 PACKAGING INFORMATION

9.1 Package Marking Information

6-Pin CDFN/VDFN*



Example

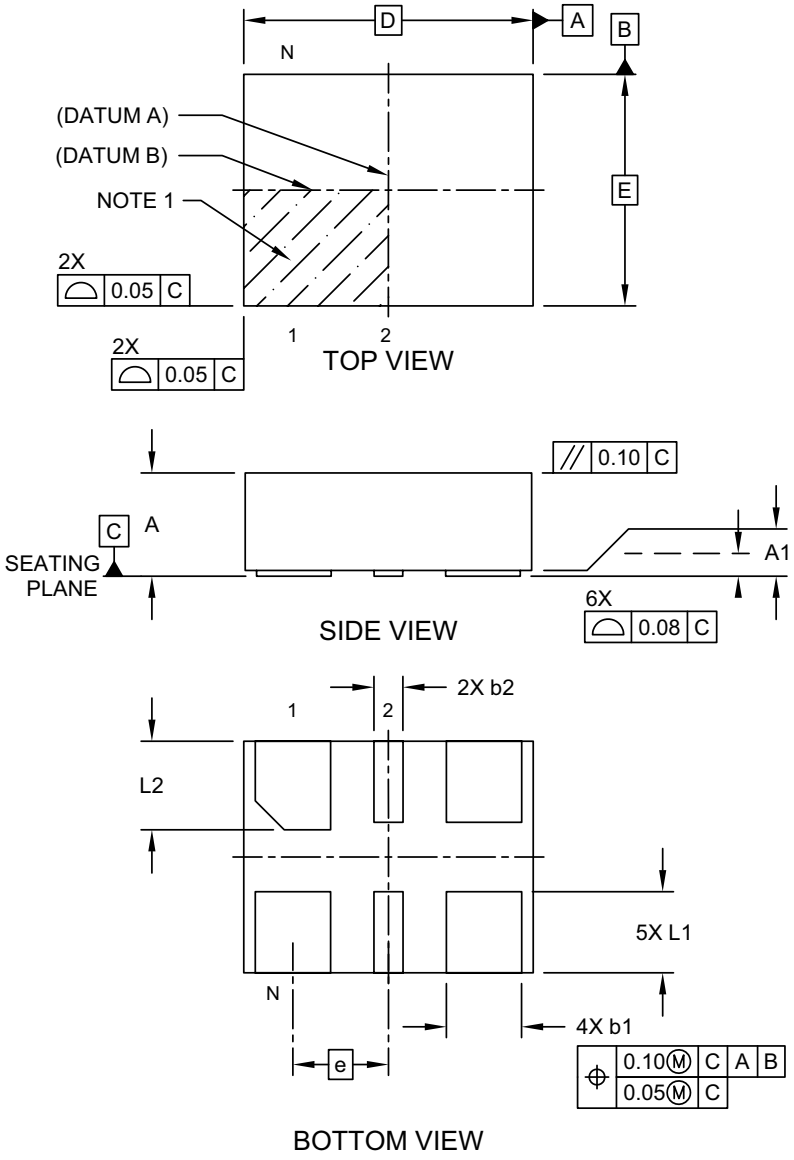


Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	SSS	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package 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).
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.	

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]

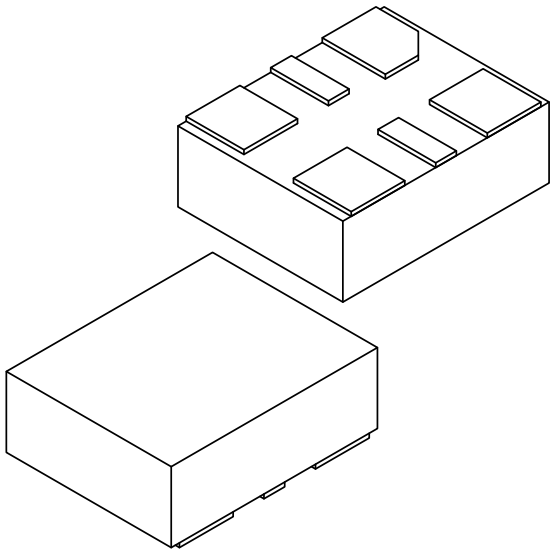
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



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:

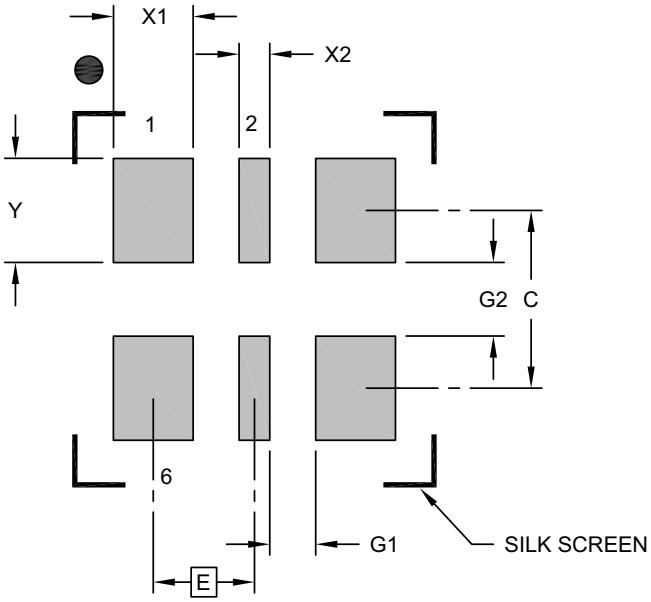
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M

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:

1. Dimensioning and tolerancing per ASME Y14.5M

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

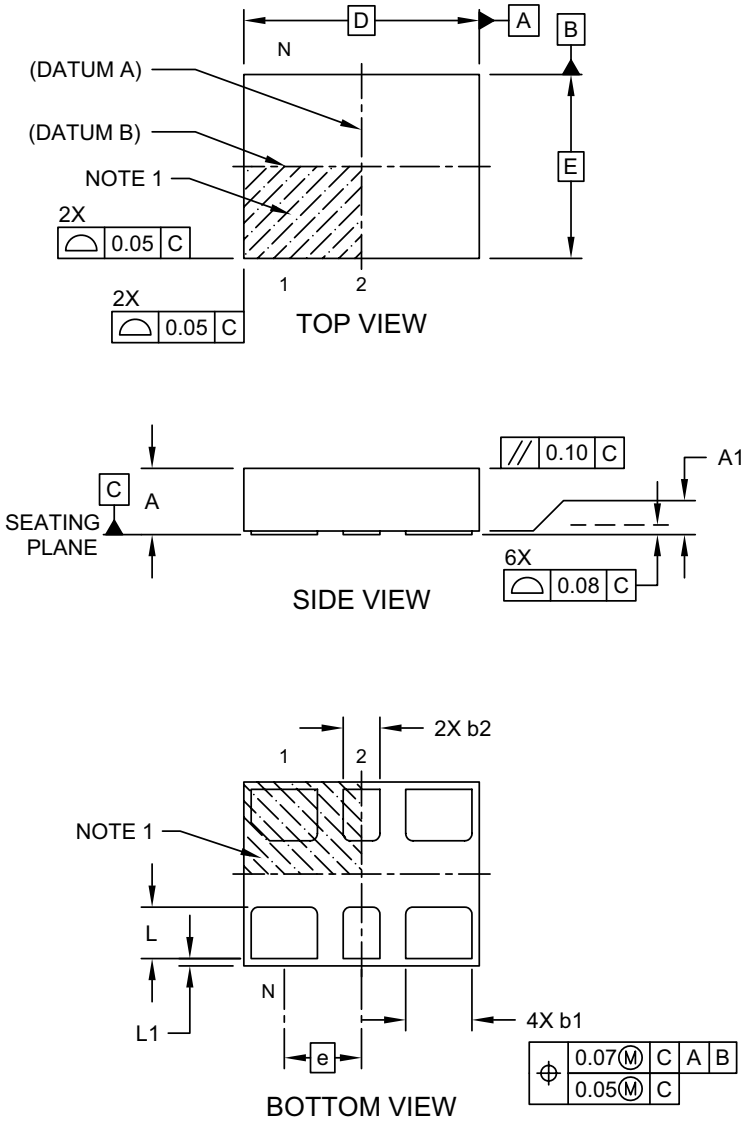
2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-3005A

6-Lead VDFN 3.2 mm x 2.5 mm Package Outline and Recommended Land Pattern

6-Lead Very Thin Plastic Dual Flatpack No-Lead (H5A) - 3.2x2.5 mm Body [VDFN]

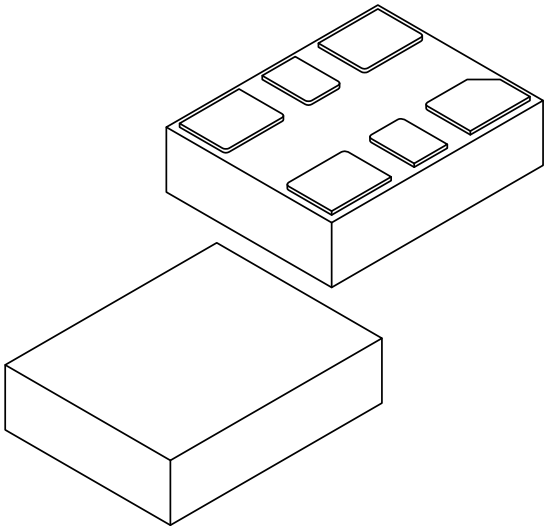
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-1007A Sheet 1 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



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:

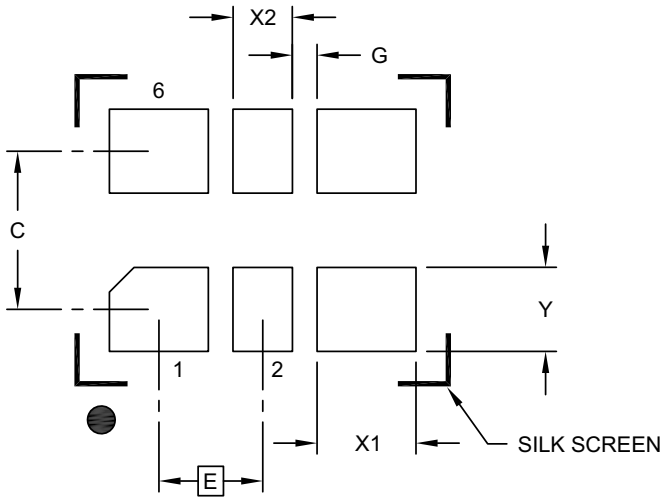
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing C04-1007A 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

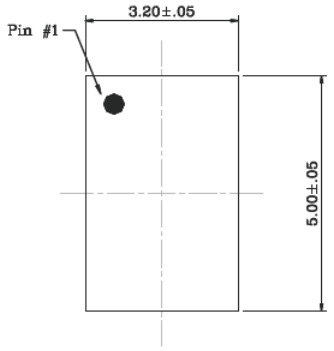
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-3007A

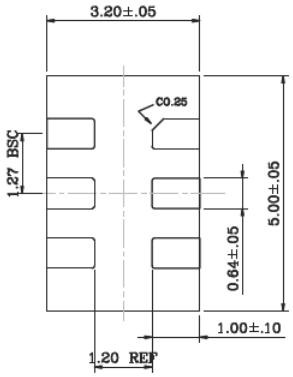
6-Lead CDFN 5.0 mm x 3.2 mm Package Outline and Recommended Land Pattern

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

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

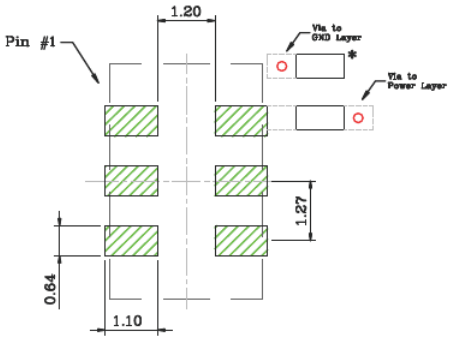


Top View



Bottom View

Side View



Recommended Land Pattern

NOTE:

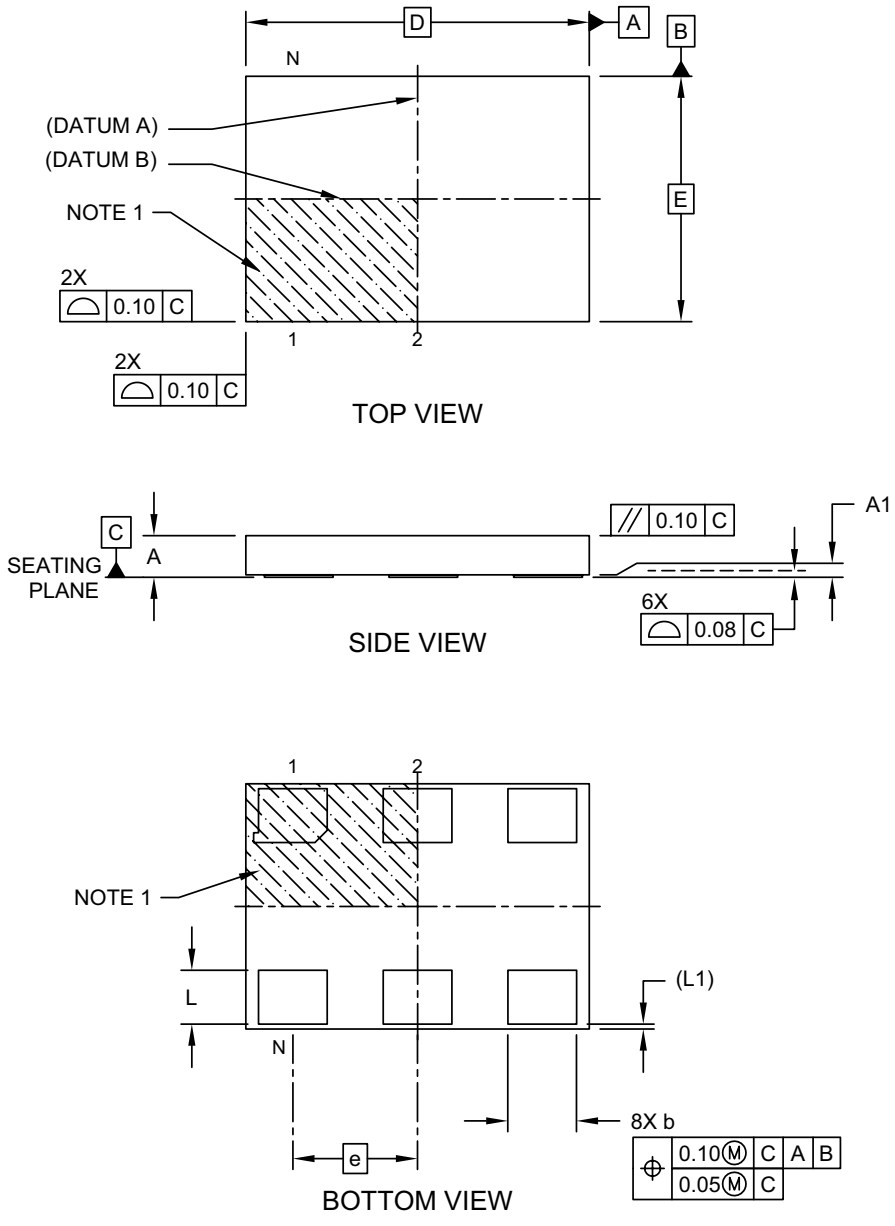
1. * Power Supply Decoupling Capacitor is required in Recommended Land Pattern.
2. Green shaded rectangles in Recommended Land Pattern are solder stencil opening.
3. Red circles in Recommended Land Pattern are thermal VIA.

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

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]

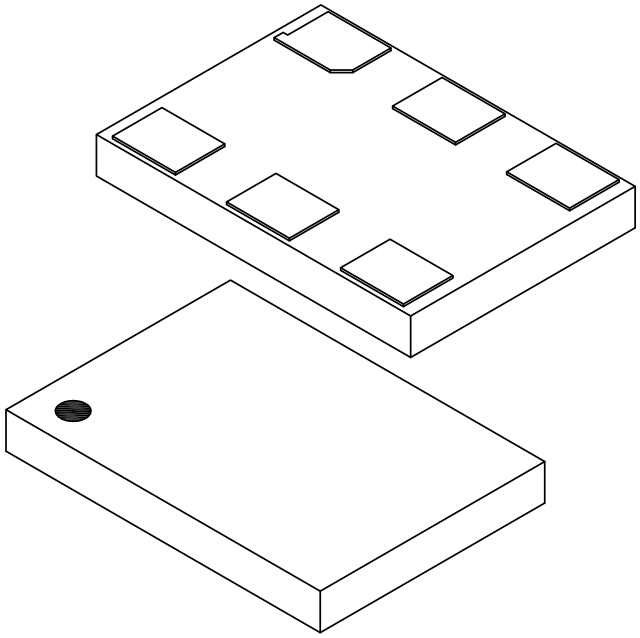
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



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:

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

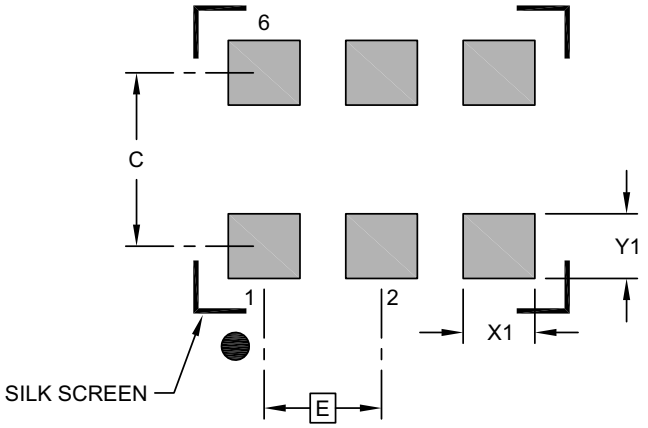
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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

Microchip Technology Drawing C04-1227 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

Units		MILLIMETERS		
Dimension Limits		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:

1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
2. 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.

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	-XXXXXXXX	X	XXX
Device	Control Pin	Output Format	Package	Temperature	Freq. Stability	Output Frequency	Media Type	Automotive Suffix

Device:	DSA12:		High Performance CMOS MEMS Oscillator for Automotive
Control Pin:	0	=	Pin 1 $\overline{\text{STDBY}}$ with Pull-up
	1	=	Pin 1 Frequency Select with Pull-up
	2	=	Pin 1 $\overline{\text{OE}}$ with Pull-up
	3	=	Pin 2 $\overline{\text{STDBY}}$ with Pull-up
	4	=	Pin 2 Frequency Select with Pull-up
	5	=	Pin 2 OE with Pull-up
Output Format:	1	=	CMOS
Package:	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
Temperature:	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)
Frequency Stability:	1	=	±50 ppm
	2	=	±25 ppm
	3	=	±20 ppm
Output Frequency:	xMxxxxxx	=	<10 MHz
	xxMxxxxx	=	<100 MHz
	xxxMxxxx	=	>100 MHz
	CCCCC	=	with Frequency Select
	PROG	=	TimeFlash
Media Type:	<blank>	=	Bulk
	T	=	1,000/Reel
	B	=	3,000/Reel
Automotive Suffix:	VXX	=	Automotive suffix in which “XX” is assigned by Microchip. Default value is “AO” for standard automotive part

Please visit the Microchip ClockWorks Configurator® website to configure the part number for customized frequency select settings.

http://clockworks.microchip.com/timing

Examples:

a) DSA1201NI1-25M00000TVAO: Pin 1 $\overline{\text{STDBY}}$ with Pull-up, CMOS Output, 7x5 VDFN, –20°C to +85°C, ±50 ppm, 25 MHz Output Frequency, 1,000/Reel, Standard Automotive

b) 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

c) 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

d) 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

e) DSA1231NI1-C0014BVAO: Pin 2 $\overline{\text{STDBY}}$ 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.

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