DSC12X2/3/4

High Performance Differential MEMS Oscillators

Features

- Very Low RMS Phase Jitter: <650 fs (typ.)
- High Stability: ±20 ppm, ±25 ppm, ±50 ppm
- Wide Temperature Range:
  - Automotive: –40°C to +125°C (DSC12x3 LVDS Only)
  - Extended Industrial: –40°C to +105°C
  - Industrial: –40°C to +85°C
  - Commercial: –20°C to +70°C
- Supports LVPECL, LVDS, or HCSL Differential Outputs
- Wide Frequency Range: 2.5 MHz to 450 MHz
- 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

- Storage Area Networks
- Passive Optical Networks
- 10/100G Ethernet
- HD/SD/SDI Video and Surveillance
- PCI Express Gen 1/2/3/4
- Display Port

General Description

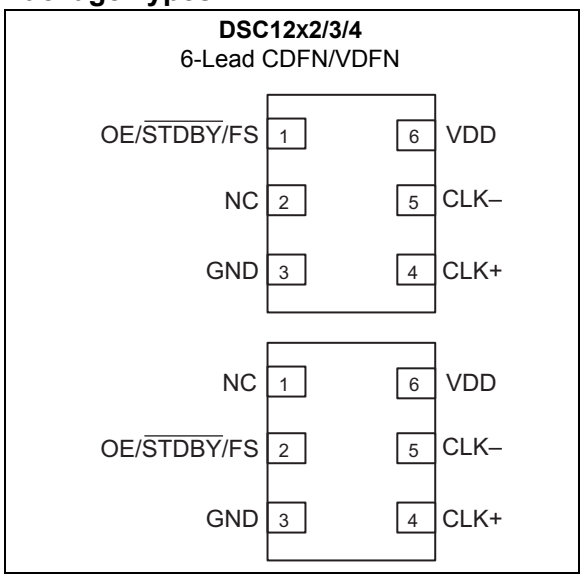
The DSC12x2/3/4 family of high performance oscillators utilizes the latest generation of silicon MEMS technology that reduces close-in noise and provides excellent jitter and stability over a wide range of supply voltages and temperatures. By eliminating the need for quartz or SAW technology, MEMS oscillators significantly enhance reliability and accelerate product development, while meeting stringent clock performance criteria for a variety of communications, storage, and networking applications.

The DSC12x2/3/4 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 6-pin LVPECL/LVDS/HCSL crystal oscillators.

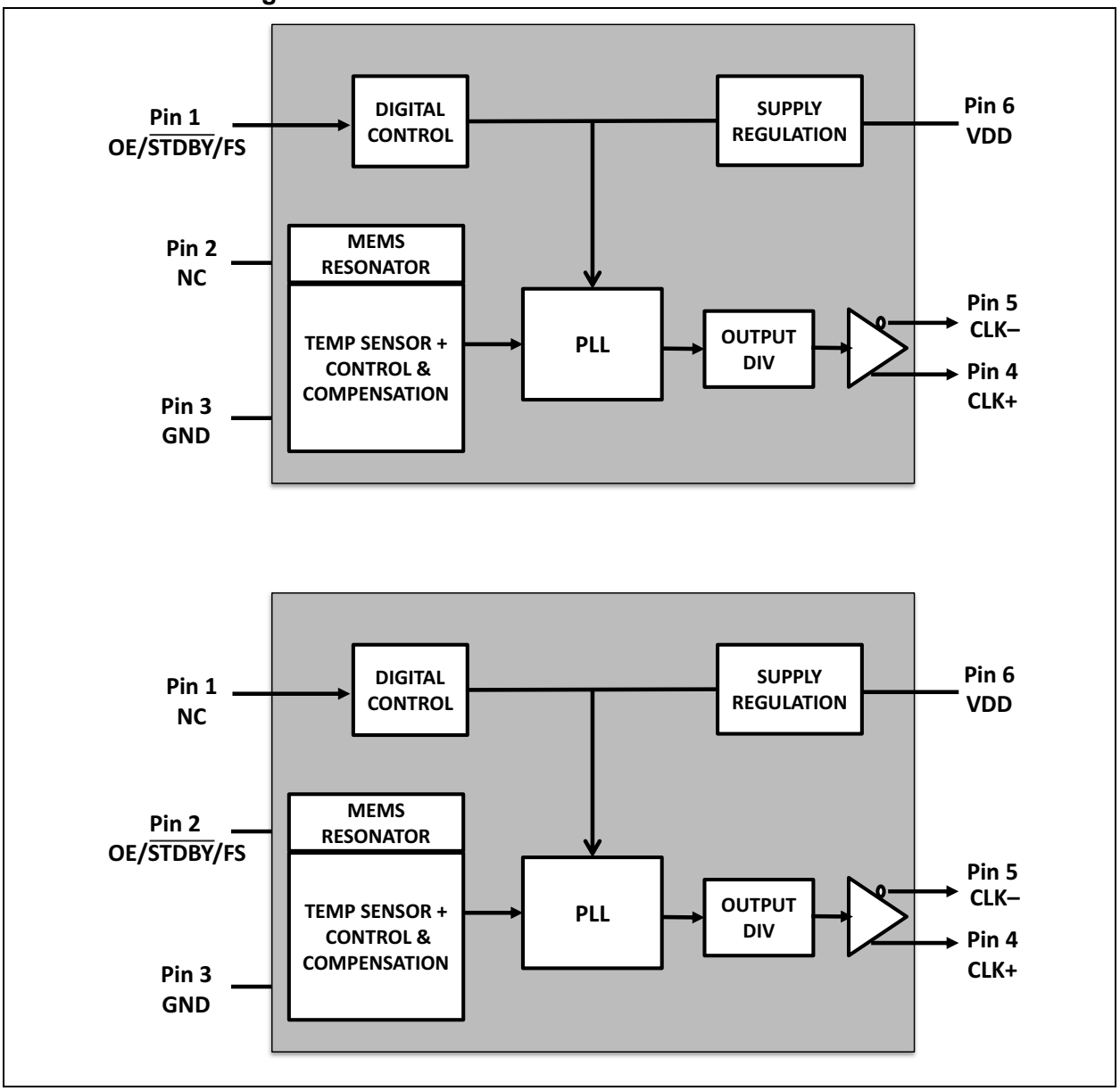
Package Types

DSC12x2/3/4
6-Lead CDFN/VDFN



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Functional Block Diagrams



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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 +105°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}	—	50	—	mA	LVPECL, f_{OUT} = 100 MHz
		—	32	—		LVDS, f_{OUT} = 100 MHz
		—	40	—		HCSL, 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		
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
LVPECL (DSC12x2)						
Frequency	f_0	2.5	—	450	MHz	—
Output Logic Levels	V_{OH}	V_{DD} – 1.145	—	—	V	R_L = 50Ω
	V_{OL}	—	—	V_{DD} – 1.695		
Peak-to-Peak Output Swing	V_{PP}	—	800	—	mV	Single-Ended
Output Transition Time	t_R	—	200	250	ps	20% to 80%, R_L = 50Ω
	t_F	—	250	300		
Output Duty Cycle	SYM	48	—	52	%	Differential
Period Jitter RMS	J_{PER}	—	2.0	—	ps	f_0 = 156.25 MHz, 10k cycles

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ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Characteristics: V_{DD} = 2.5V ±10% or 3.3V±10%; T_A = –40°C to +105°C, unless noted.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Period Jitter Peak-to-Peak	J_{PTP}	—	20	—	ps	f_0 = 156.25 MHz, 10k cycles
Integrated Phase Noise (Random)	J_{PH}	—	0.65	—	ps_{RMS}	12 kHz to 20 MHz @156.25 MHz
LVDS (DSC12x3)						
Frequency	f0	2.3	—	450	MHz	—
Output Offset Voltage	V_{OS}	1.15	1.25	1.35	V	R = 100Ω Differential
Peak-to-Peak Output Swing	V_{PP}	250	350	450	mV	Single-Ended
Output Transition Time	t_R	120	170	220	ps	20% to 80%, R_L = 100Ω
	t_F					
Output Duty Cycle	SYM	48	—	52	%	Differential
Period Jitter RMS	J_{PER}	—	2.5	—	ps	f_0 = 156.25 MHz, 10k cycles
Period Jitter Peak-to-Peak	J_{PTP}	—	20	—	ps	f_0 = 156.25 MHz, 10k cycles
Integrated Phase Noise (Random)	J_{PH}	—	0.65	—	ps_{RMS}	12 kHz to 20 MHz @156.25 MHz
Period Jitter RMS	J_{PER}	—	3	—	ps	f_0 = 156.25 MHz, T_A = –40°C to +125°C
Period Jitter Peak-to-Peak	J_{PTP}	—	25	—	ps	f_0 = 156.25 MHz, T_A = –40°C to +125°C
Integrated Phase Noise (Random)	J_{PH}	—	0.9	—	ps_{RMS}	12 kHz to 20 MHz @156.25 MHz, T_A = –40°C to +125°C
HCSL (DSC12x4)						
Frequency	f_0	2.3	—	450	MHz	—
Output Logic Levels	V_{OH}	0.64	—	—	V	R_L = 50Ω
	V_{OL}	—	—	0.1		
Peak-to-Peak Output Swing	V_{PP}	—	750	—	mV	Single-Ended
Output Transition Time	t_R	200	260	400	ps	20% to 80%, R_L = 50Ω
	t_F	250	370	500		
Output Duty Cycle	SYM	48	—	52	%	Differential
Period Jitter RMS	J_{PER}	—	2	—	ps	f_0 = 100.00 MHz, 10k cycles
Period Jitter Peak-to-Peak	J_{PTP}	—	16	—	ps	f_0 = 100.00 MHz, 10k cycles
Integrated Phase Noise (Random)	J_{PH}	—	0.65	—	ps_{RMS}	12 kHz to 20 MHz @100.00 MHz

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 Waveforms and the Test Circuits sections for more information.

4: Output is enabled if pad is floated (not connected).

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TEMPERATURE SPECIFICATIONS (Note 1)

Parameters	Sym.	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

2.0 PIN DESCRIPTIONS

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

TABLE 2-1: DSC120X/1X/2X PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	OE/$\overline{\text{STDBY}}$/FS	Control pin: Output enable/standby/frequency select.
2	NC	No connect.
3	GND	Power supply ground.
4	CLK+	Clock output +.
5	CLK–	Clock output –.
6	VDD	Power supply.

TABLE 2-2: DSC123X/4X/5X PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	NC	No connect.
2	OE/$\overline{\text{STDBY}}$/FS	Control pin: Output enable/standby/frequency select.
3	GND	Power supply ground.
4	CLK+	Clock output +.
5	CLK–	Clock output –.
6	VDD	Power supply.

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3.0 TERMINATION SCHEME

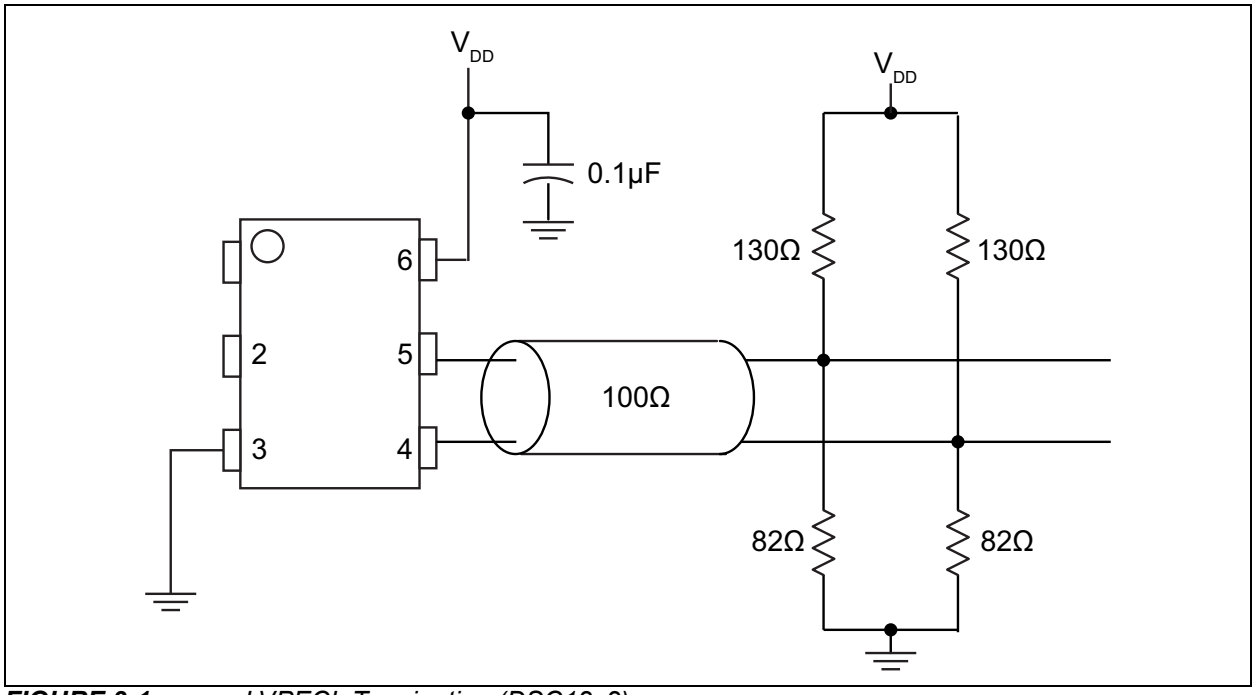


FIGURE 3-1: *LVPECL Termination (DSC12x2).*

In Figure 3-1, Thevenin termination for 3.3V operation. Values will differ for V_{DD} = 2.5V.

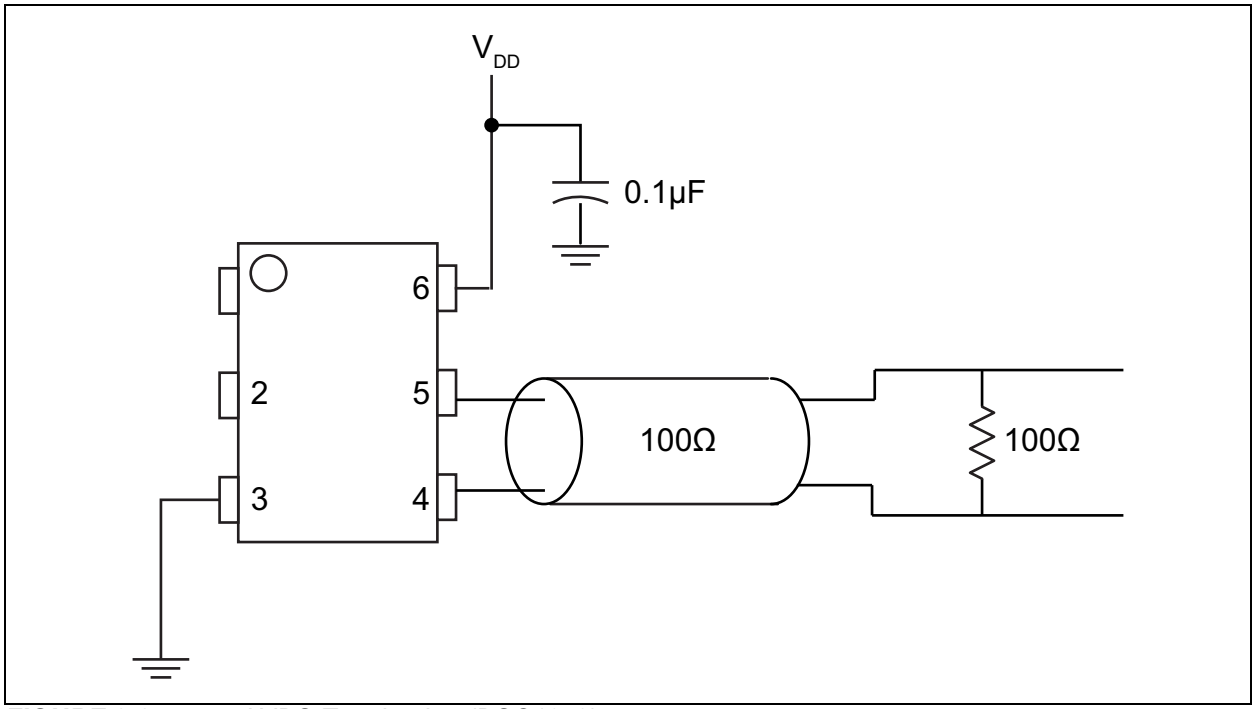


FIGURE 3-2: *LVDS Termination (DSC12x3).*

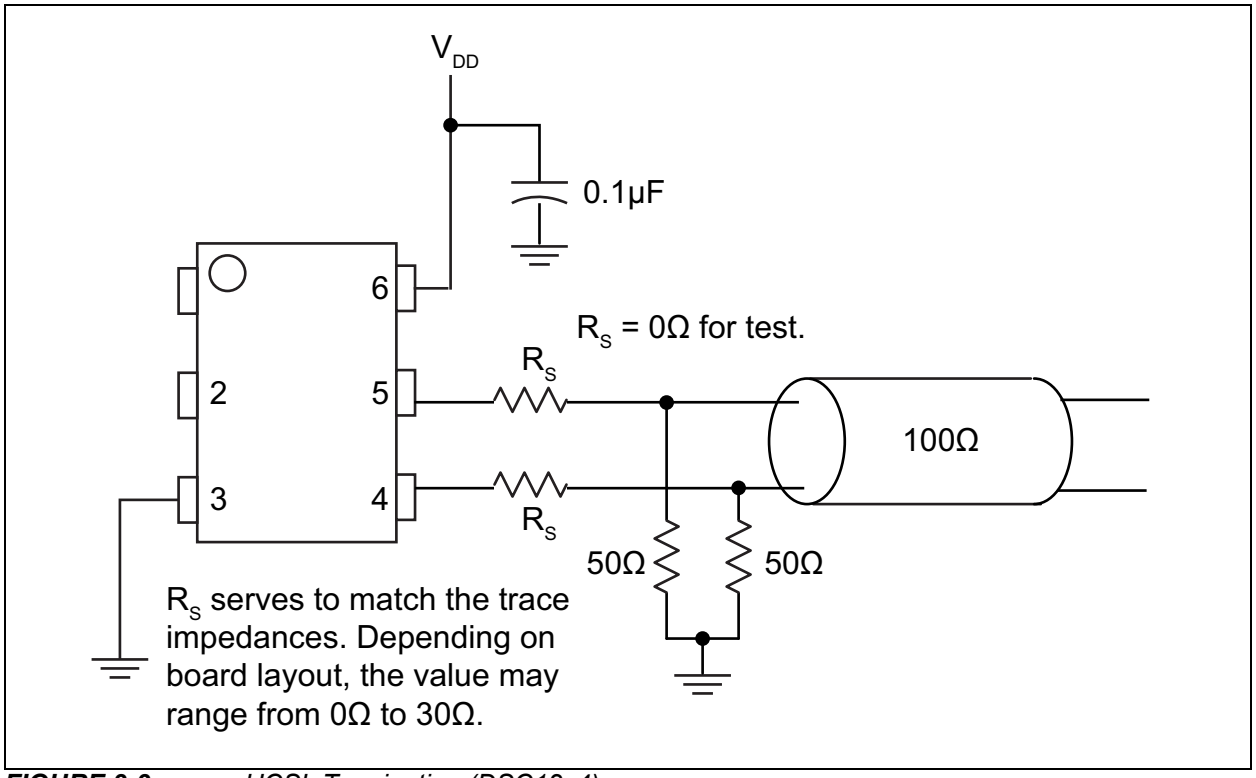


FIGURE 3-3: *HCSL Termination (DSC12x4).*

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4.0 OUTPUT WAVEFORM

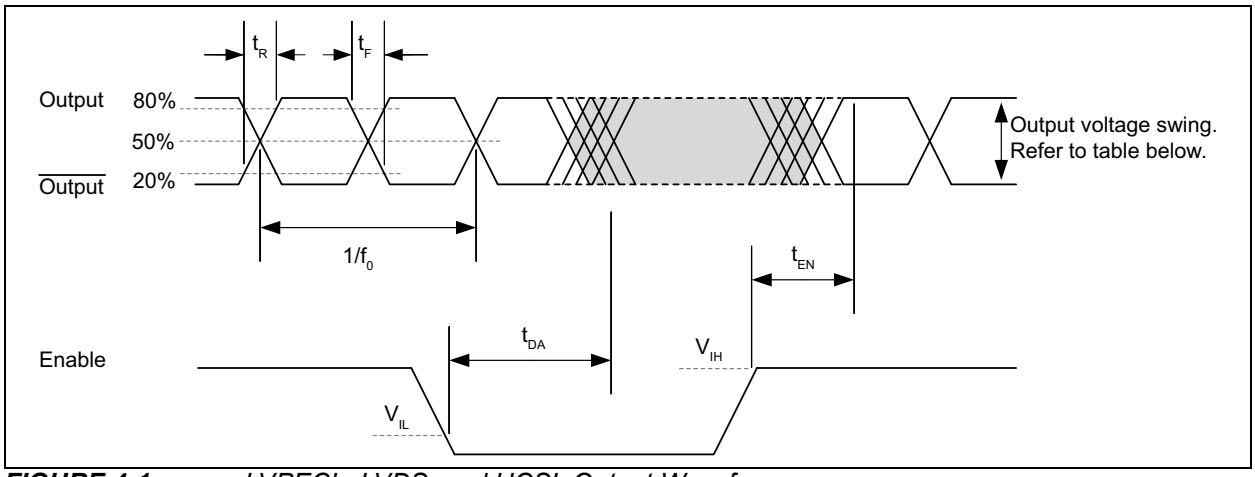


FIGURE 4-1: *LVPECL, LVDS, and HCSL Output Waveform.*

TABLE 4-1: OUTPUT VOLTAGE SWING BY LOGIC TYPE

Output Logic Protocol	Typical Peak-to-Peak Output Swing
LVPECL	830 mV
LVDS	350 mV
HCSL	675 mV

5.0 TEST CIRCUITS

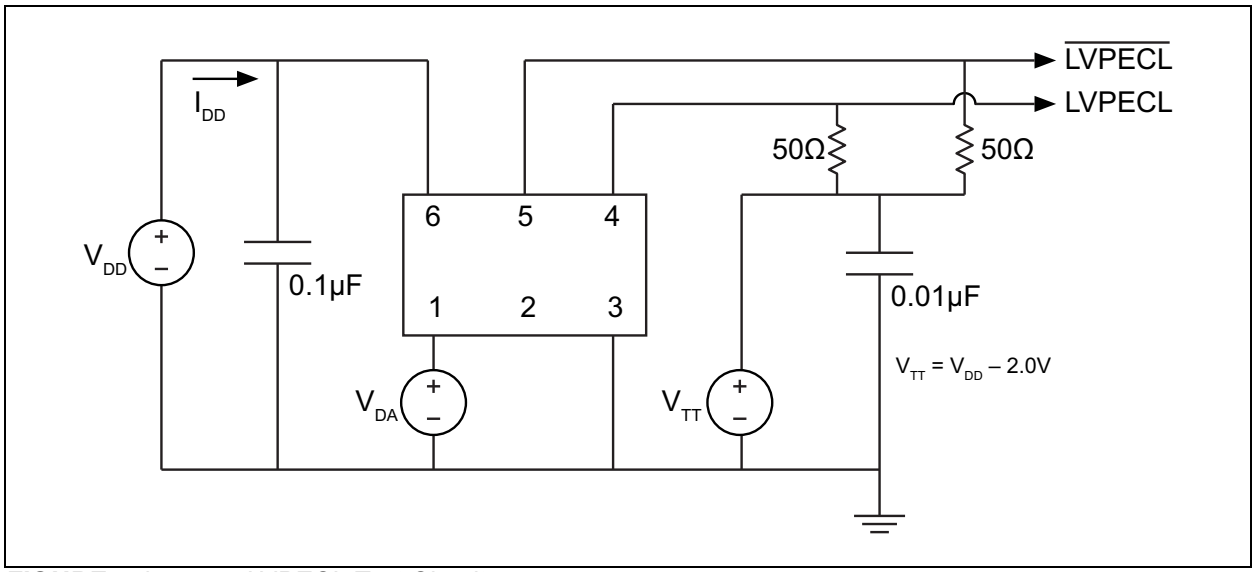


FIGURE 5-1: *LVPECL Test Circuit.*

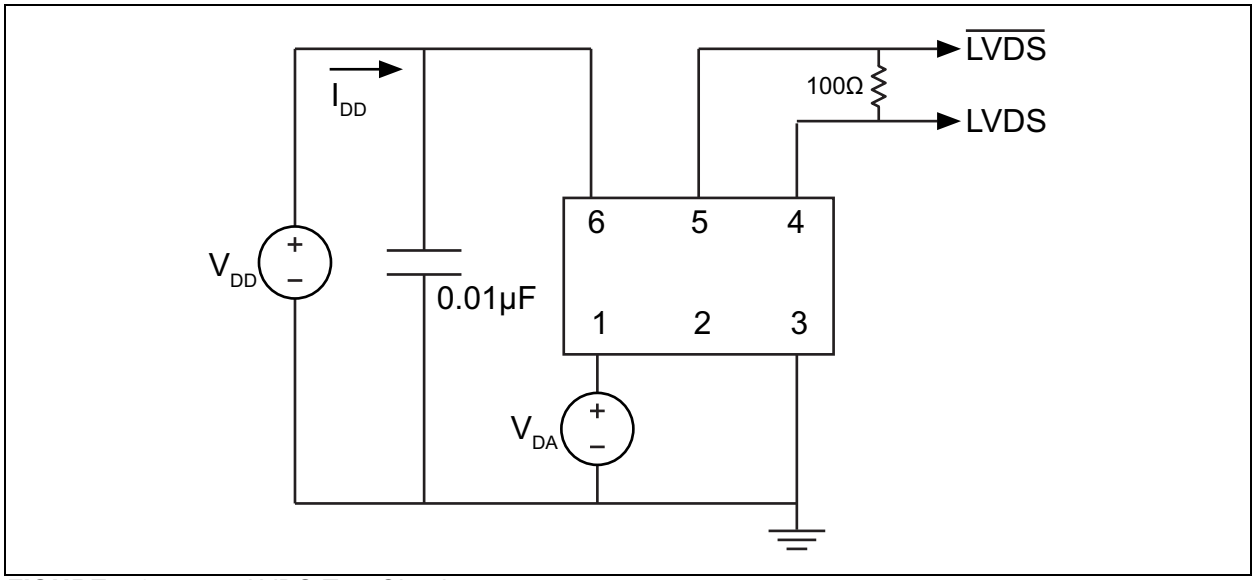


FIGURE 5-2: *LVDS Test Circuit.*

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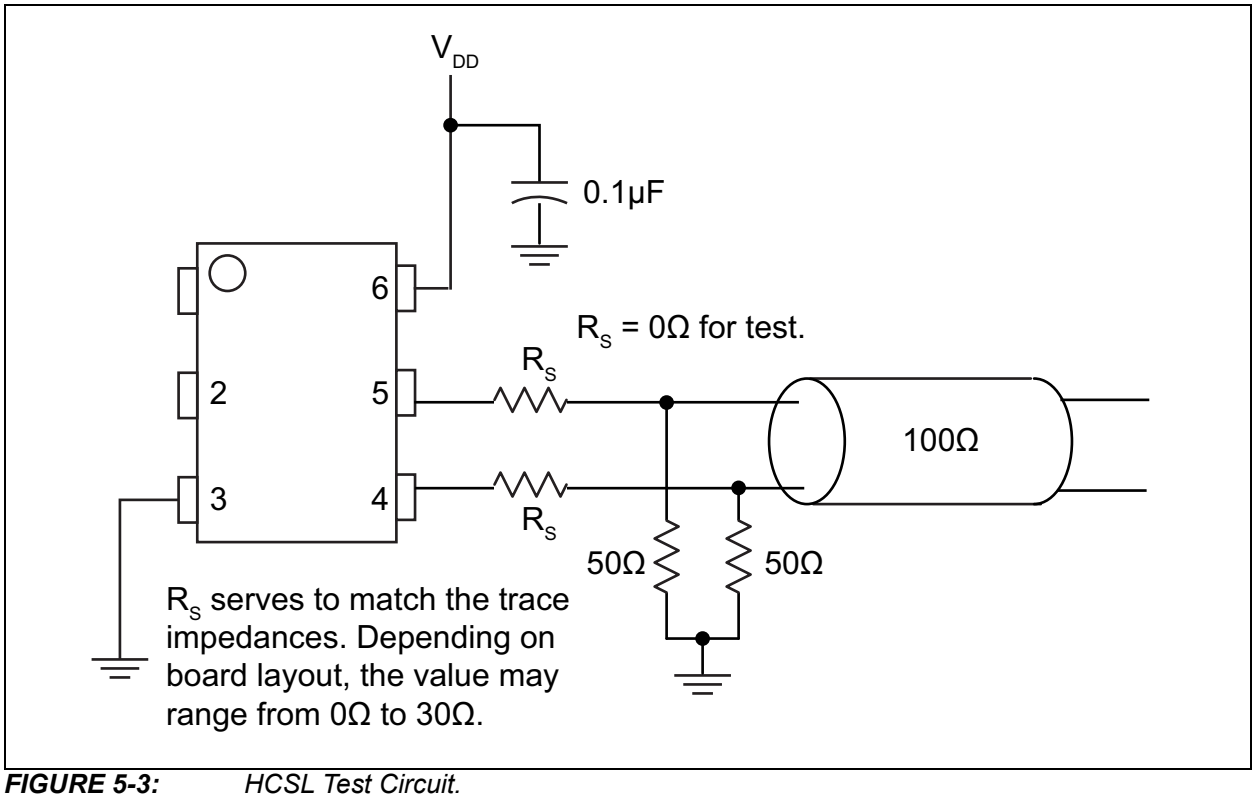


FIGURE 5-3: *HCSL Test Circuit.*

6.0 SOLDER REFLOW PROFILE

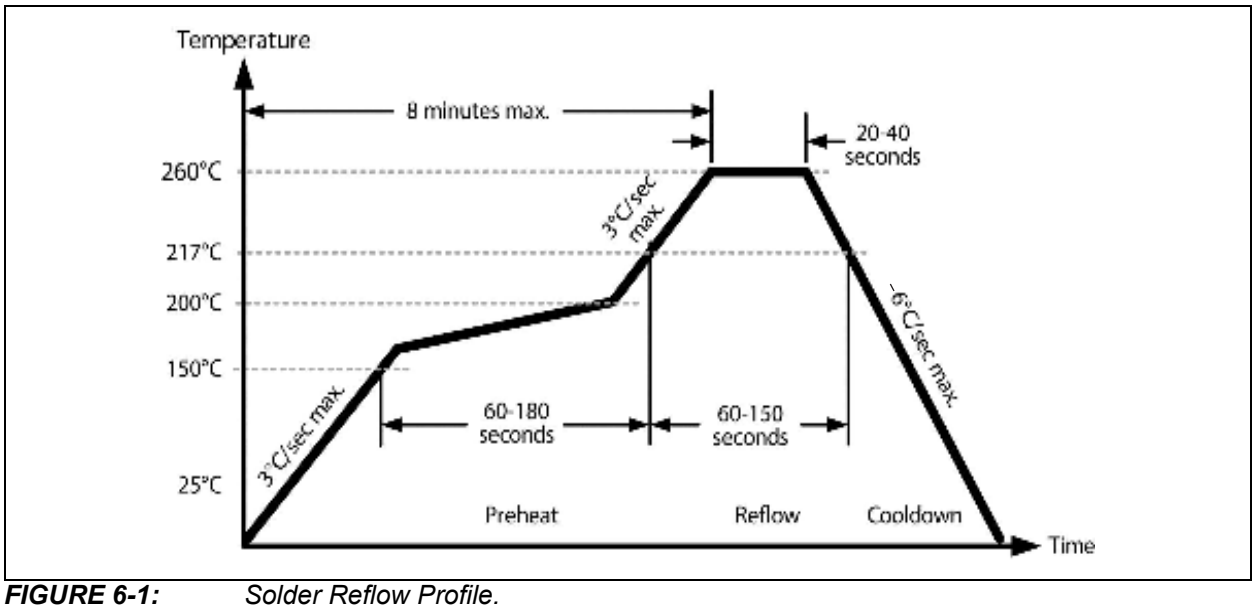


FIGURE 6-1: *Solder Reflow Profile.*

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.

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7.0 BOARD LAYOUT (RECOMMENDED)

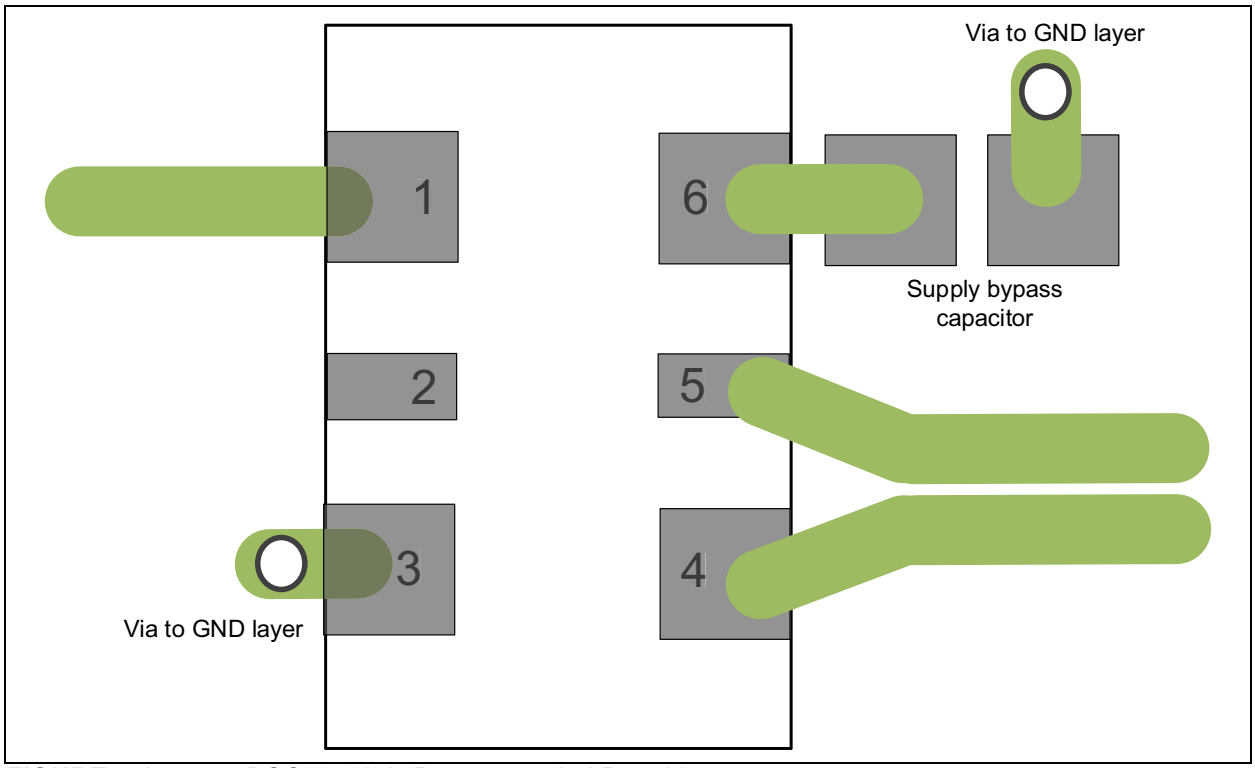


FIGURE 7-1: *DSC12x2/3/4 Recommended Board Layout.*

8.0 PHASE NOISE

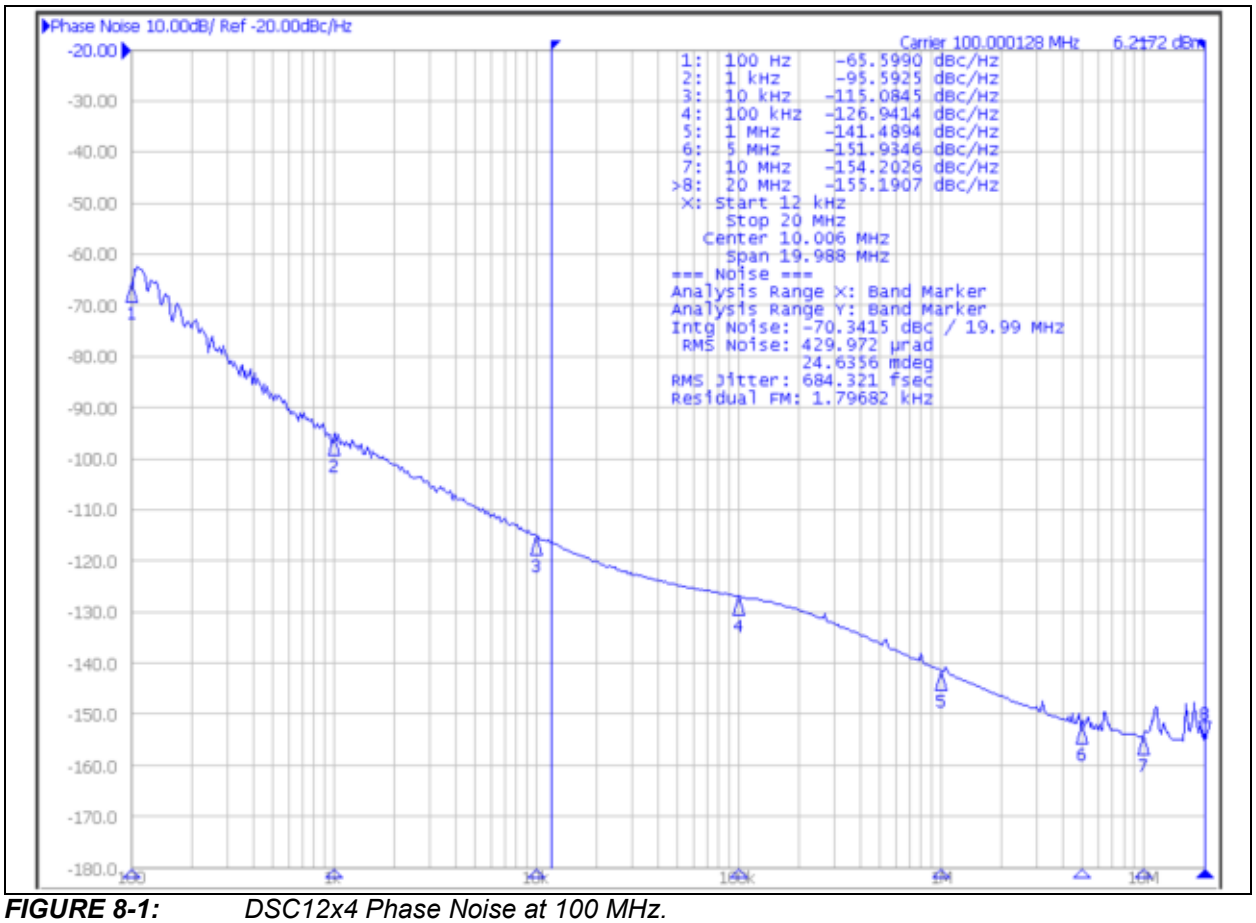


FIGURE 8-1: *DSC12x4 Phase Noise at 100 MHz.*

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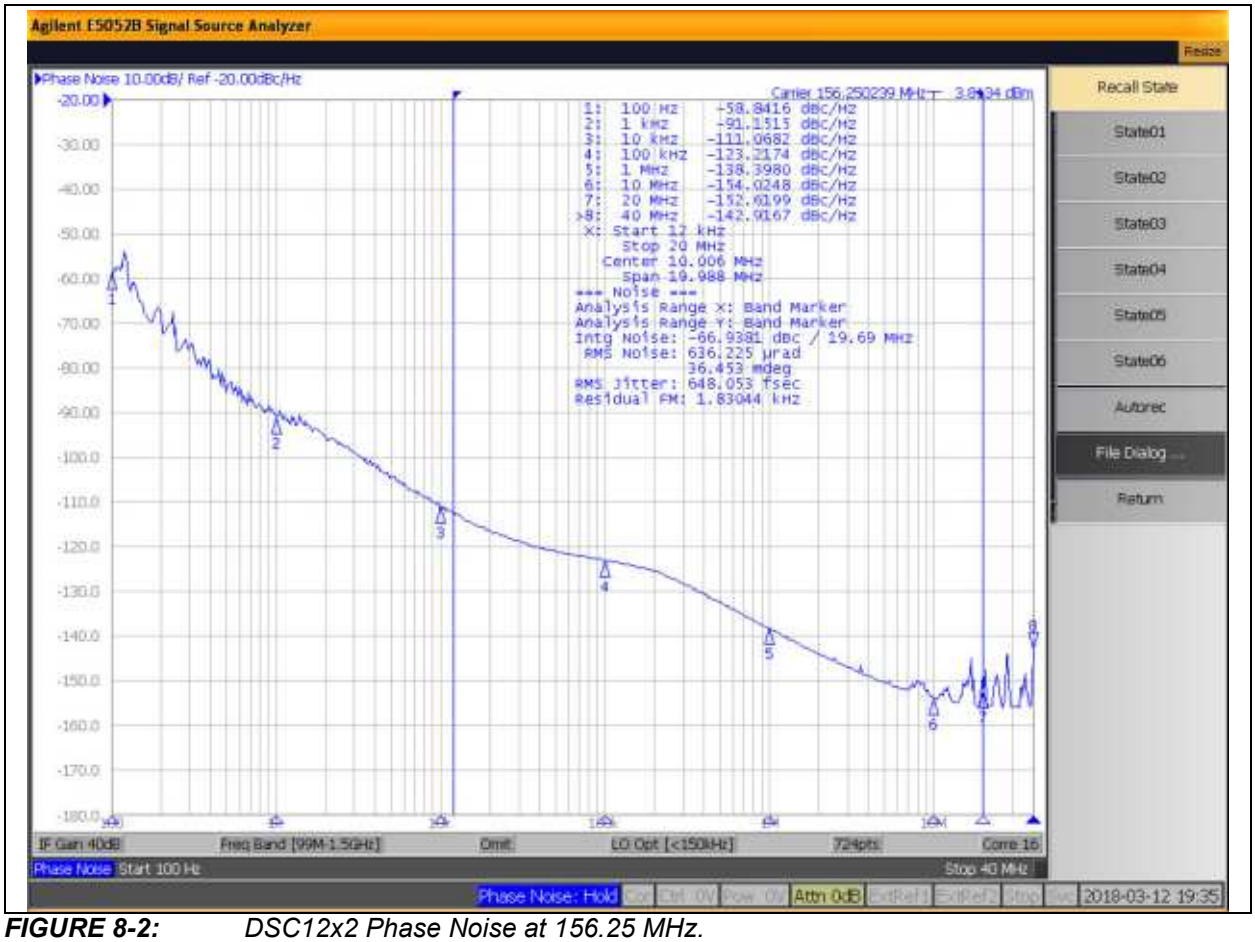
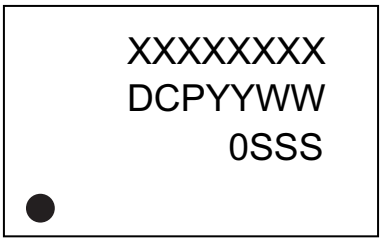


FIGURE 8-2: *DSC12x2 Phase Noise at 156.25 MHz.*

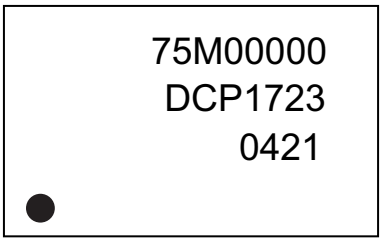
9.0 PACKAGING INFORMATION

9.1 Package Marking Information

6-Pin CDFN/VDFN*



Example



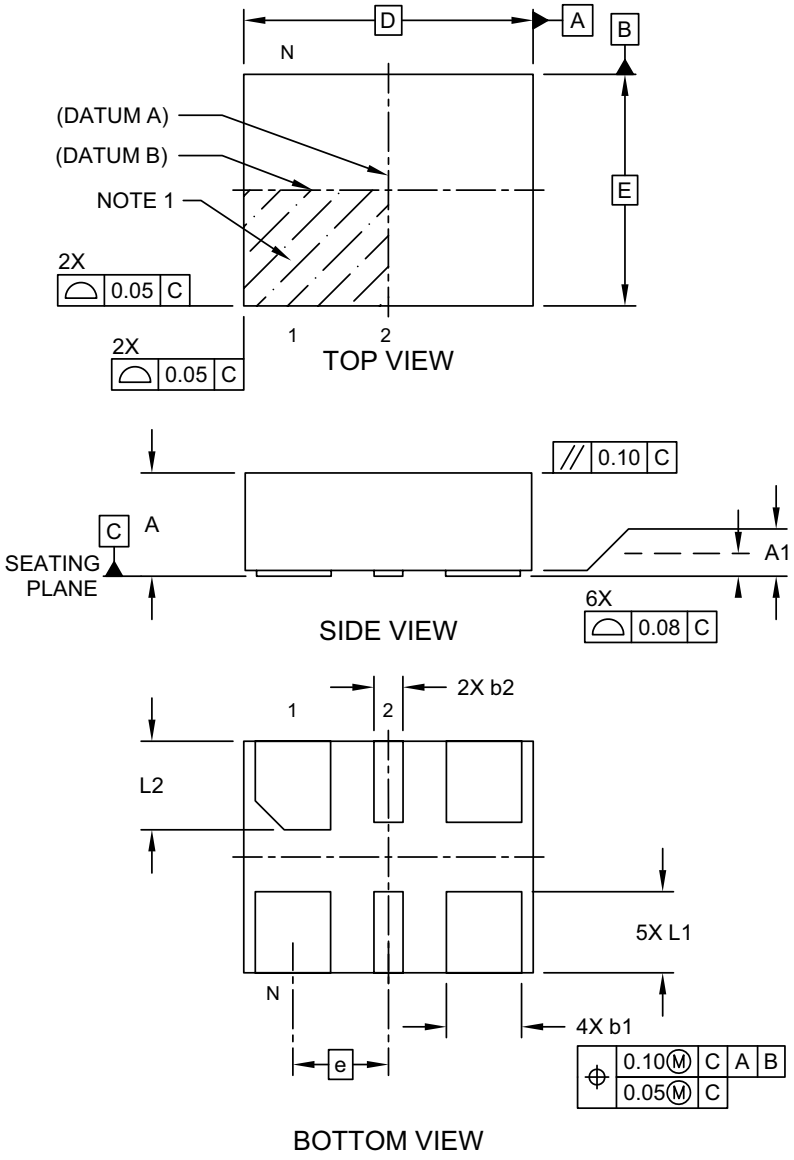
Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	SSS	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package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

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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]

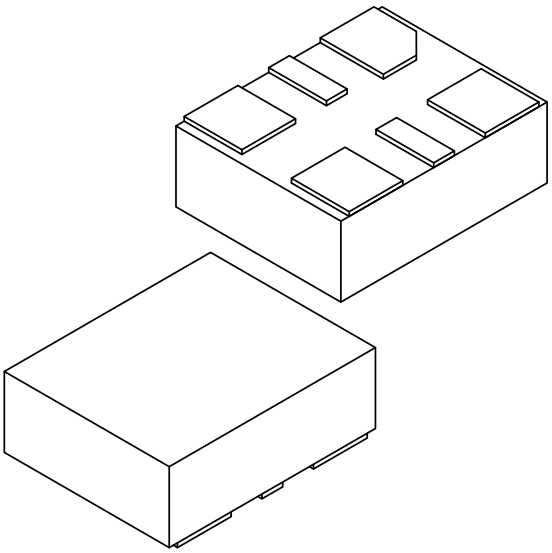
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



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

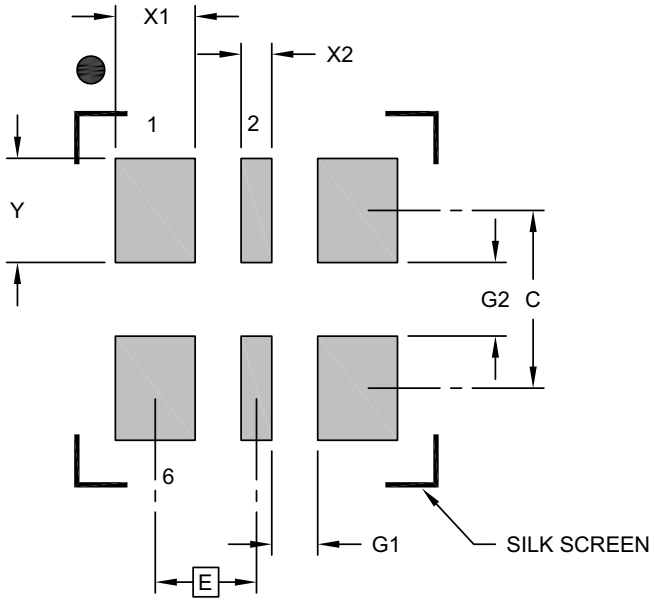
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-1005A Sheet 2 of 2

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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:

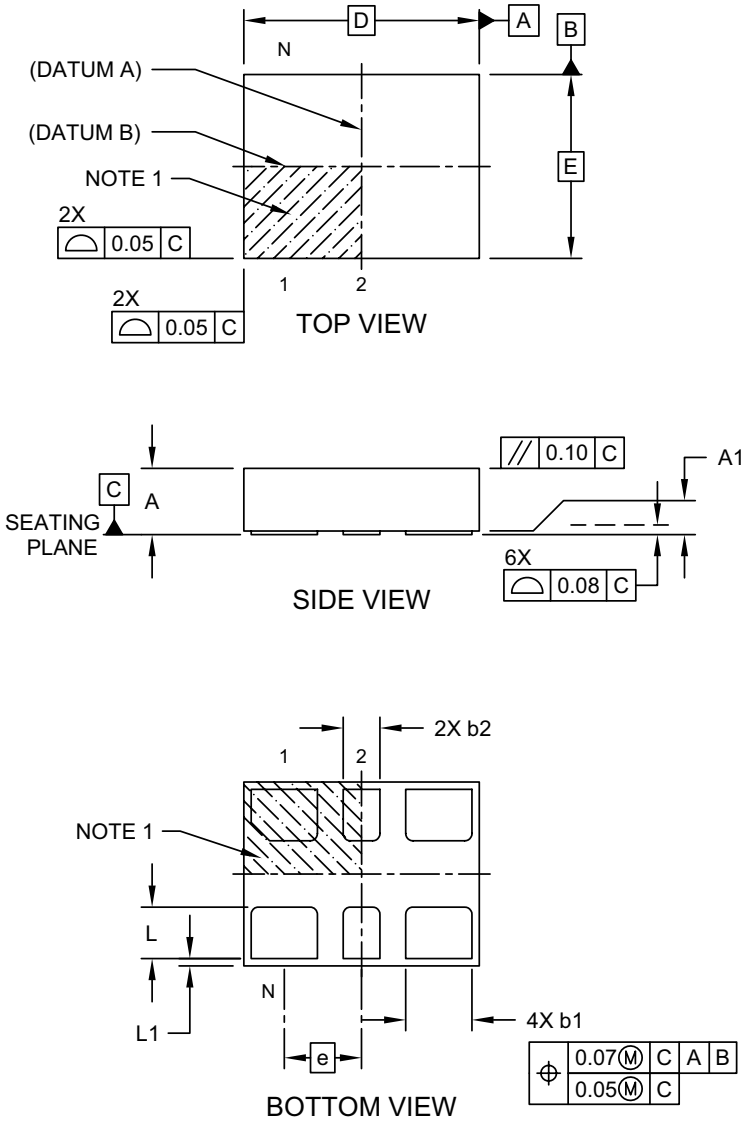
1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

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

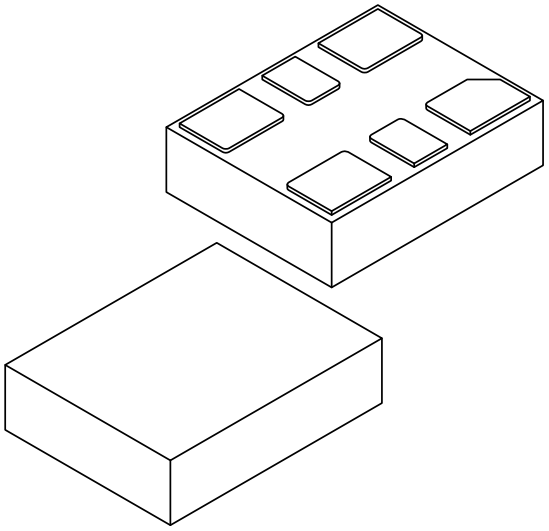


Microchip Technology Drawing C04-1007A Sheet 1 of 2

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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

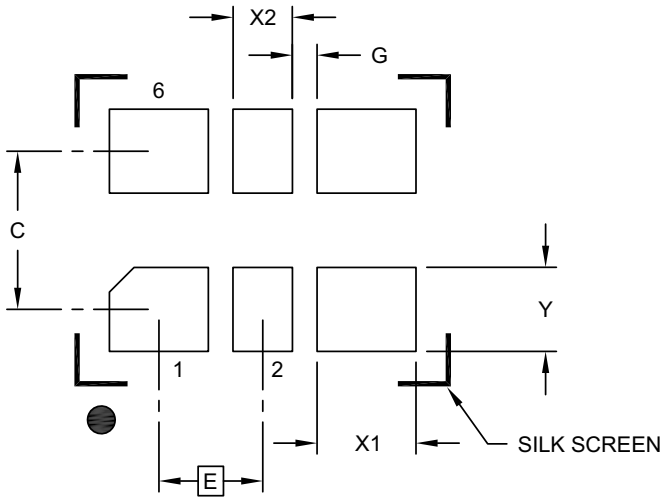
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   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

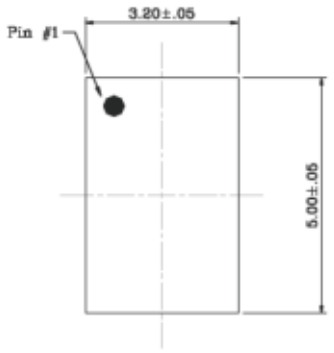
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6-Lead CDFN 5.0 mm x 3.2 mm Package Outline and Recommended Land Pattern

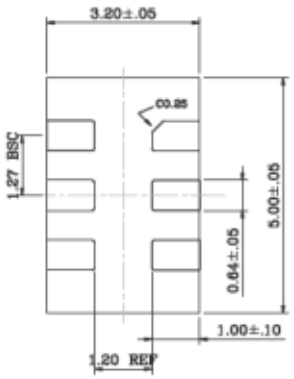
TITLE

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

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



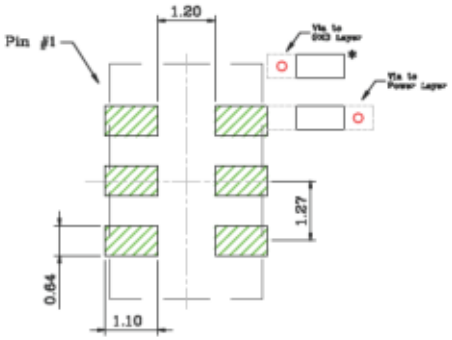
Top View



Bottom View



Side View



Recommended Land Pattern

NOTE:

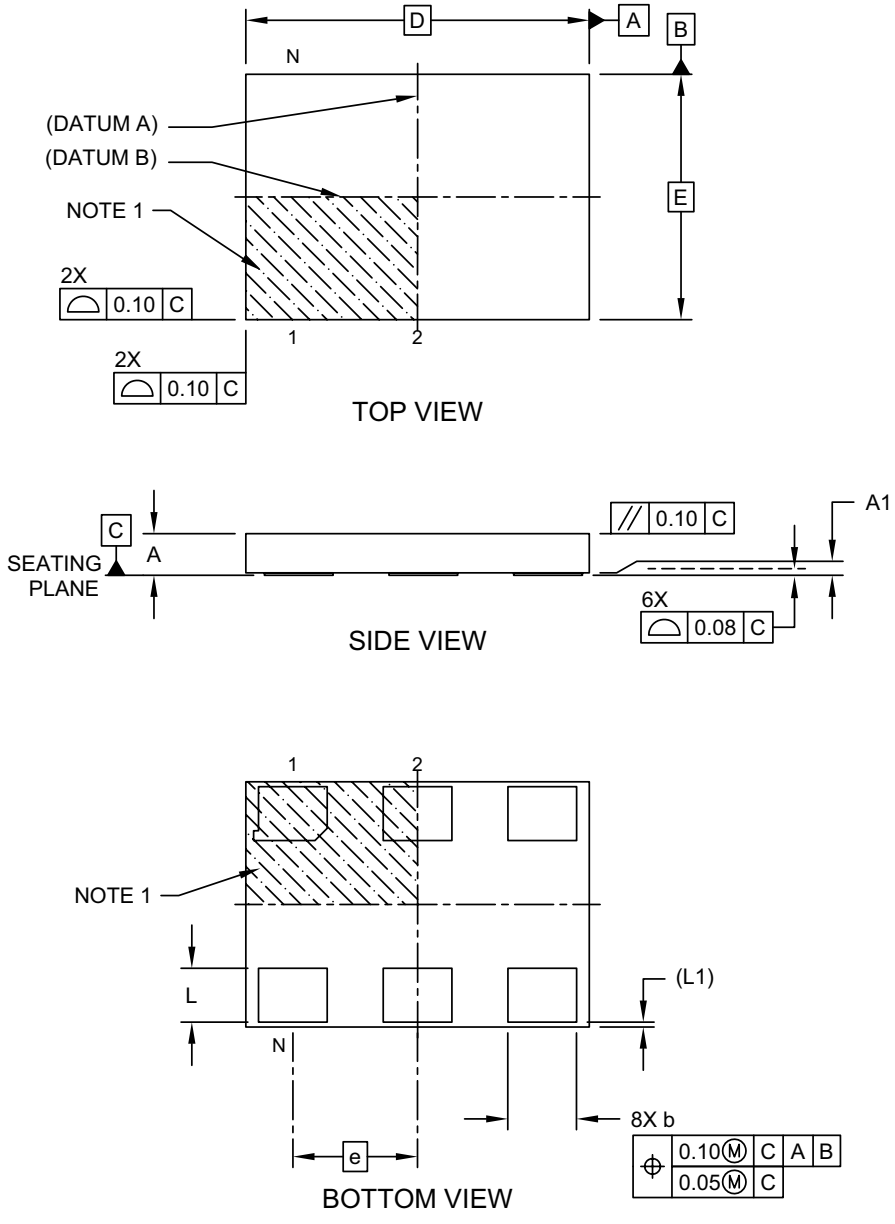
1. * Power Supply Decoupling Capacitor is required in Recommended Land Pattern.
2. Green shaded rectangles in Recommended Land Pattern are solder stencil opening.
3. Red circles in Recommended Land Pattern are thermal VIA.

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

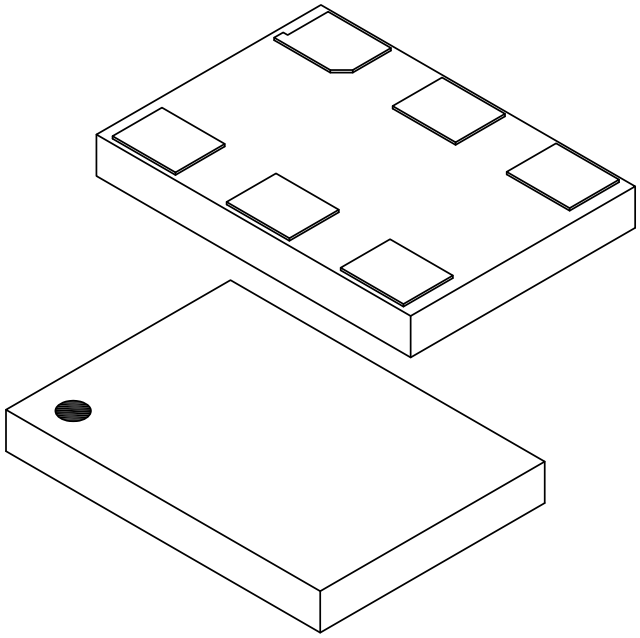


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6-Lead Very Thin Dual Flatpack, No Lead Package (HPA) - 7x5 mm Body [VDFN]

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

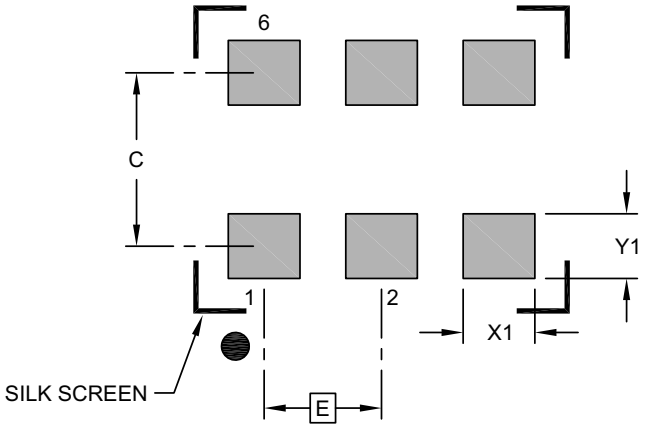
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   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

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APPENDIX A: REVISION HISTORY

Revision A (April 2019)

- Initial release of DSC12x2/3/4 as Microchip data sheet DS20006011A.

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

Device:	DSC12:		High Performance Differential MEMS Oscillators
Control Pin:	0	=	Pin 1 $\overline{\text{STDBY}}$ with Pull-up
	1	=	Pin 1 Frequency Select with Pull-up
	2	=	Pin 1 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:	2	=	LVPECL
	3	=	LVDS
	4	=	HCSL
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(Available on certain options)
	L	=	–40°C to +105°C
	I	=	–40°C to +85°C
	E	=	–20°C to +70°C
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

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

http://clockworks.microchip.com/timing

Examples:

a) DSC1202NE1-25M00000T: Pin 1 $\overline{\text{STDBY}}$ with Pull-up, LVPECL Output, 7x5 VDFN, –20°C to +70°C, ±50 ppm, 25 MHz Output Frequency, 1,000/Reel

b) DSC1243CL3-C0013: Pin 2 Frequency Select with Pull-up, LVDS Output, 3.2x2.5 VDFN, –40°C to +105°C, ±20 ppm, Multiple Output Frequency, Bulk

c) DSC1224BI2-19M50000B: Pin 1 OE with Pull-up, HCSL Output, 5x3.2 CDFN, –40°C to +85°C, ±25 ppm, 19.5 MHz Output Frequency, 3,000/Reel

d) DSC1232DL3-55M82000T: Pin 2 $\overline{\text{STDBY}}$ with Pull-up, LVPECL Output, 2.5x2 VDFN, –40°C to +105°C, ±20 ppm, 55.82 MHz Output Frequency, 1,000/Reel

e) DSC1213NI1-C0014B: Pin 1 Frequency Select with Pull-up, LVDS Output, 7x5 VDFN, –40°C to +85°C, ±50 ppm, Multiple Output Frequency, 3,000/Reel

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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NOTES:

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