General Description

The 9DMV0441 is a member of IDT's SOC-Friendly 1.8V Very-Low-Power (VLP) PCIe Gen1-2-3 family. It has integrated output terminations providing Zo=100Ω for direct connection to 100Ω transmission lines. Each of the 4 outputs has its own dedicated OE# pin for optimal system control and power management. The part provides asynchronous and glitch-free switching modes.

Recommended Application

2:4 PCIe Gen1-2-3 Clock Multiplexer

Output Features

- 4 -Low-Power (LP) HCSL DIF pairs w/ZO=100Ω

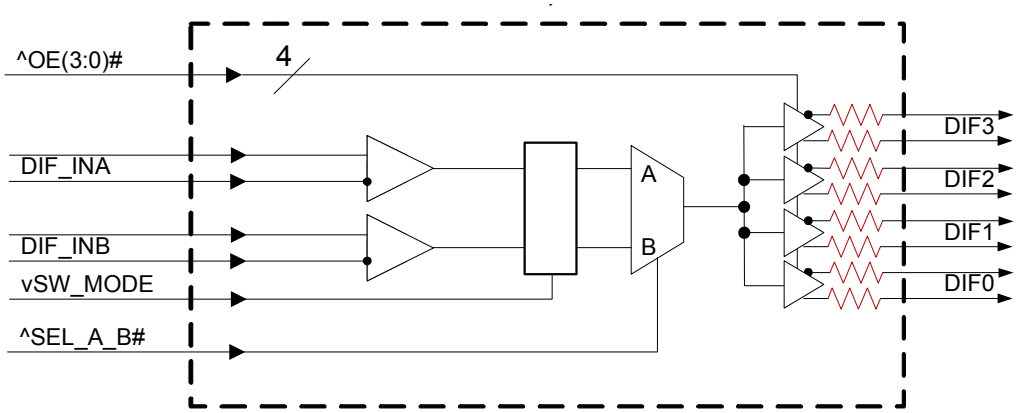
Key Specifications

- DIF *additive* cycle-to-cycle jitter <5ps
- DIF phase jitter is PCIe Gen1-2-3 compliant
- Additive phase jitter @ 125MHz: 420fs rms typical (12kHz to 20MHz)
- DIF output-to-output skew <50ps

Features/Benefits

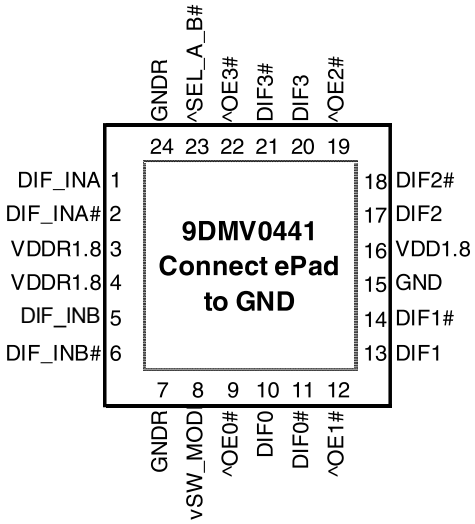
- LP-HCSL outputs w/integrated terminations; saves 16 resistors compared to standard HCSL outputs
- 1.8V operation; 36mW typical power consumption
- Selectable asynchronous or glitch-free switching; allows the mux to be selected at power up even if both inputs are not running, then transition to glitch-free switching mode
- Spread Spectrum Compatible; supports EMI reduction
- OE# pins; support DIF power management
- HCSL differential inputs; can be driven by common clock sources
- 1MHz to 200MHz operating frequency
- Space saving 24-pin 4x4mm VFQFPN; minimal board space

Block Diagram



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Pin Configuration



24 VFQFPN, 4x4 mm, 0.5mm pitch

^ prefix indicates internal 120KOhm pull up resistor

v prefix indicates internal 120KOhm pull down resistor

Power Management Table

OEx# Pin	DIF_IN	DIFx	
		True O/P	Comp. O/P
0	Running	Running	Running
1	Running	Low	Low

Power Connections

Pin Number		Description
VDD	GND	
3	24	Input A receiver analog
4	7	Input B receiver analog
16	15	DIF outputs

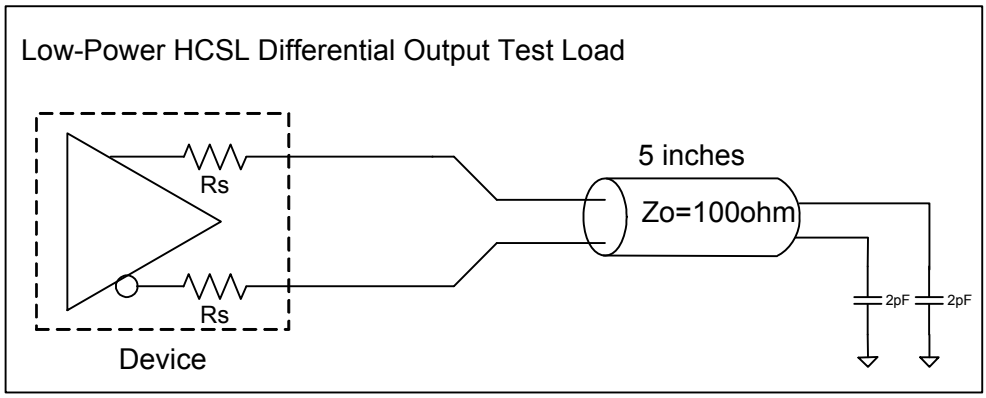
Pin Descriptions

Pin#	Pin Name	Type	Pin Description
1	DIF_INA	IN	HCSL Differential True input
2	DIF_INA#	IN	HCSL Differential Complement Input
3	VDDR1.8	PWR	1.8V power for differential input clock (receiver). This VDD should be treated as an Analog power rail and filtered appropriately.
4	VDDR1.8	PWR	1.8V power for differential input clock (receiver). This VDD should be treated as an Analog power rail and filtered appropriately.
5	DIF_INB	IN	HCSL Differential True input
6	DIF_INB#	IN	HCSL Differential Complement Input
7	GNDR	GND	Analog Ground pin for the differential input (receiver)
8	vSW_MODE	IN	Switch Mode. This pin selects either asynchronous or glitch-free switching of the mux. Use asynchronous mode if 0 or 1 of the input clocks is running. Use glitch-free mode if both input clocks are running. This pin has an internal pull down resistor of ~120kohms. 0 = asynchronous mode 1 = glitch-free mode
9	^OE0#	IN	Active low input for enabling DIF pair 0. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
10	DIF0	OUT	Differential true clock output
11	DIF0#	OUT	Differential Complementary clock output
12	^OE1#	IN	Active low input for enabling DIF pair 1. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
13	DIF1	OUT	Differential true clock output
14	DIF1#	OUT	Differential Complementary clock output
15	GND	GND	Ground pin.

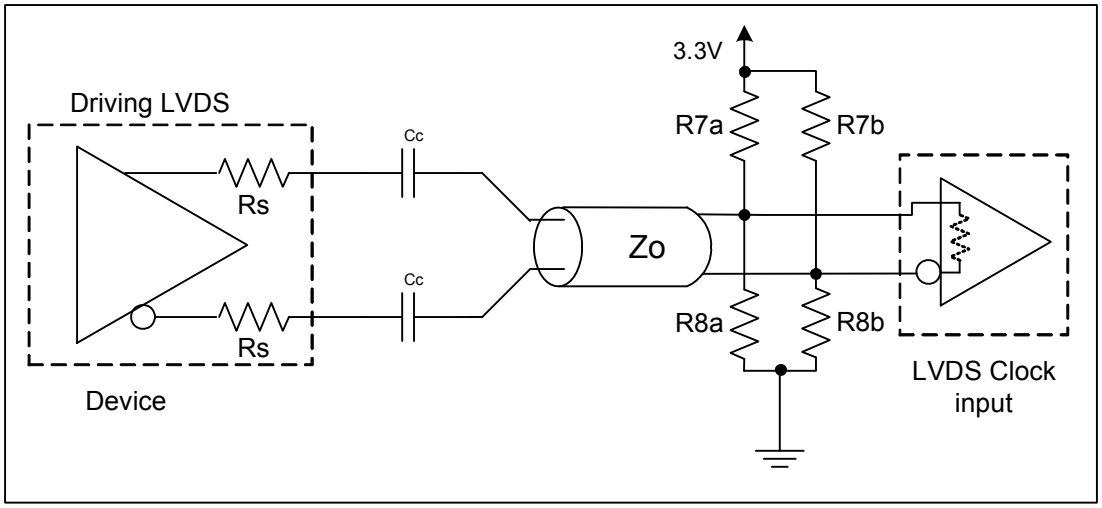
Pin Descriptions (cont.)

Pin#	Pin Name	Type	Pin Description
16	VDD1.8	PWR	Power supply, nominal 1.8V
17	DIF2	OUT	Differential true clock output
18	DIF2#	OUT	Differential Complementary clock output
19	^OE2#	IN	Active low input for enabling DIF pair 2. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
20	DIF3	OUT	Differential true clock output
21	DIF3#	OUT	Differential Complementary clock output
22	^OE3#	IN	Active low input for enabling DIF pair 3. This pin has an internal pull-up resistor. 1 =disable outputs, 0 = enable outputs
23	^SEL_A_B#	IN	Input to select differential input clock A or differential input clock B. This input has an internal pull-up resistor. 0 = Input B selected, 1 = Input A selected.
24	GNDR	GND	Analog Ground pin for the differential input (receiver)
25	EPAD	GND	Connect to Ground.

Test Loads



Driving LVDS



Driving LVDS inputs

Component	Value		Note
	Receiver has termination	Receiver does not have termination	
R7a, R7b	10K ohm	140 ohm	
R8a, R8b	5.6K ohm	75 ohm	
Cc	0.1 uF	0.1 uF	
Vcm	1.2 volts	1.2 volts	

Electrical Characteristics–Absolute Maximum Ratings

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Supply Voltage	VDDxx	Applies to all VDD	-0.5		2.5	V	1,2
Input Voltage	V_{IN}		-0.5		V_{DD}+0.5V	V	1, 3
Input High Voltage, SMBus	V_{IHSMB}	SMBus clock and data pins			3.6V	V	1
Storage Temperature	Ts		-65		150	°C	1
Junction Temperature	Tj				125	°C	1
Input ESD protection	ESD prot	Human Body Model	2000			V	1

[1]Guaranteed by design and characterization, not 100% tested in production.

[2] Operation under these conditions is neither implied nor guaranteed.

[3] Not to exceed 2.5V.

Electrical Characteristics–Input/Supply/Common Parameters–Normal Operating Conditions

TA = T_{AMB}, Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Supply Voltage	VDDxx	Applies to all VDD	1.7	1.8	1.9	V	1
Ambient Operating Temperature	T_{AMB}	Industrial range	-40	25	85	°C	1
Input High Voltage	V_{IH}	Single-ended inputs, except SMBus	0.75 V_{DD}		V_{DD} + 0.3	V	1
Input Low Voltage	V_{IL}	Single-ended inputs, except SMBus	-0.3		0.25 V_{DD}	V	1
Input Current	I_{IN}	Single-ended inputs, V_{IN} = GND, V_{IN} = VDD	-5		5	uA	1
	I_{INP}	Single-ended inputs V_{IN} = 0 V; Inputs with internal pull-up resistors V_{IN} = VDD; Inputs with internal pull-down resistors	-200		200	uA	1
Input Frequency	F_{ibyp}		1		200	MHz	1
Pin Inductance	L_{pin}				7	nH	1
Capacitance	C_{IN}	Logic Inputs, except DIF_IN	1.5		5	pF	1
	C_{INDIF_IN}	DIF_IN differential clock inputs	1.5		2.7	pF	1,4
	C_{OUT}	Output pin capacitance			6	pF	1
Input SS Modulation Frequency	f_{MODIN}	Allowable Frequency (Triangular Modulation)	0	31.5	66	kHz	1
OE# Latency	$t_{LATOE\#}$	DIF start after OE# assertion DIF stop after OE# deassertion	1		3	clocks	1,3
Tfall	t_F	Fall time of single-ended control inputs			5	ns	1,2
Trise	t_R	Rise time of single-ended control inputs			5	ns	1,2

[1]Guaranteed by design and characterization, not 100% tested in production.

[2]Control input must be monotonic from 20% to 80% of input swing.

[3]Time from deassertion until outputs are >200 mV

[4]DIF_IN input

Electrical Characteristics–Clock Input Parameters

TA = $T_{AMB,}$ Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Input High Voltage - DIF_IN	V_{IHDIF}	Differential inputs (single-ended measurement)	300	750	1150	mV	1
Input Low Voltage - DIF_IN	V_{ILDIF}	Differential inputs (single-ended measurement)	V_{SS} - 300	0	300	mV	1
Input Common Mode Voltage - DIF_IN	V_{COM}	Common Mode Input Voltage	200		725	mV	1
Input Amplitude - DIF_IN	V_{SWING}	Peak to Peak value (V_{IHDIF} - V_{ILDIF})	300		1450	mV	1
Input Slew Rate - DIF_IN	dv/dt	Measured differentially	0.35		8	V/ns	1,2
Input Leakage Current	I_{IN}	V_{IN} = V_{DD} , V_{IN} = GND	-5		5	uA	
Input Duty Cycle	d_{tin}	Measurement from differential wavefrom	45	50	55	%	1
Input Jitter - Cycle to Cycle	J_{DIFIn}	Differential Measurement	0		150	ps	1

[1] Guaranteed by design and characterization, not 100% tested in production.

[2] Slew rate measured through +/-75mV window centered around differential zero

Electrical Characteristics–DIF Low-Power HCSL Outputs

TA = $T_{AMB,}$ Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Slew rate	Trf	Scope averaging on	2.0	3.0	4.4	V/ns	1,2,3
Slew rate matching	ΔTrf	Slew rate matching,Scope averaging on		3	20	%	1,2,4
Voltage High	V_{HIGH}	Statistical measurement on single-ended signal using oscilloscope math function. (Scope averaging on)	660	783	850	mV	
Voltage Low	V_{LOW}		-150	26	150		
Max Voltage	Vmax	Measurement on single ended signal using absolute value. (Scope averaging off)		790	1150	mV	
Min Voltage	Vmin		-300	9			
Vswing	Vswing	Scope averaging off	300	1514		mV	1,2
Crossing Voltage (abs)	Vcross_abs	Scope averaging off	250	393	550	mV	1,5
Crossing Voltage (var)	Δ-Vcross	Scope averaging off		12	140	mV	1,6

[1]Guaranteed by design and characterization, not 100% tested in production.

[2] Measured from differential waveform

[3] Slew rate is measured through the Vswing voltage range centered around differential 0V. This results in a +/-150mV window around differential 0V.

[4] Matching applies to rising edge rate for Clock and falling edge rate for Clock#. It is measured using a +/-75mV window centered on the average cross point where Clock rising meets Clock# falling. The median cross point is used to calculate the voltage thresholds the oscilloscope is to use for the edge rate calculations.

[5] Vcross is defined as voltage where Clock = Clock# measured on a component test board and only applies to the differential rising edge (i.e. Clock rising and Clock# falling).

[6] The total variation of all Vcross measurements in any particular system. Note that this is a subset of Vcross_min/max (Vcross absolute) allowed. The intent is to limit Vcross induced modulation by setting Δ-Vcross to be smaller than Vcross absolute.

Electrical Characteristics–Current Consumption

TA = $T_{AMB,}$ Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Operating Supply Current	I_{DDOP}	VDD rails, All outputs active @100MHz		20	28	mA	
Disable Current	I_{DDDIS}	VDD rails, All outputs disabled Low/Low		1.5	2.5	mA	2

[1] Guaranteed by design and characterization, not 100% tested in production.

[2] Input clock stopped after outputs have parked Low/Low.

Electrical Characteristics–Output Duty Cycle, Jitter, Skew and PLL Characteristics

TA = $T_{AMB,}$ Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
Duty Cycle Distortion	t_{DCD}	Measured differentially, Bypass Mode @100MHz	-1	-0.12	1	%	1,3
Skew, Input to Output	t_{pdBYP}	V_T = 50%	1850	2409	3150	ps	1
Skew, Output to Output	t_{sk3}	V_T = 50%		12	50	ps	1
Jitter, Cycle to cycle	$t_{jcyc-cyc}$	*Additive* Jitter		0.1	5	ps	1,2

[1] Guaranteed by design and characterization, not 100% tested in production.

[2] Measured from differential waveform

[3] Duty cycle distortion is the difference in duty cycle between the output and the input clock .

Electrical Characteristics–Phase Jitter Parameters

TA = $T_{AMB,}$ Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	INDUSTRY LIMIT	UNITS	Notes
Additive Phase Jitter, Bypass Mode	$t_{jphPCIeG1}$	PCIe Gen 1		1.3	5	N/A	ps (p-p)	1,2,3,5
	$t_{jphPCIeG2}$	PCIe Gen 2 Lo Band 10kHz < f < 1.5MHz		0.1	0.3	N/A	ps (rms)	1,2,3,4,5
		PCIe Gen 2 High Band 1.5MHz < f < Nyquist (50MHz)		0.1	0.2	N/A	ps (rms)	1,2,3,4
	$t_{jphPCIeG3}$	PCIe Gen 3 (PLL BW of 2-4 or 2-5MHz, CDR = 10MHz)		0.065	0.1	N/A	ps (rms)	1,2,3,4
	$t_{jph125M0}$	125MHz, 1.5MHz to 10MHz, -20dB/decade rollover < 1.5MHz, -40db/decade rolloff > 10MHz		285	300	N/A	fs (rms)	1,6
	$t_{jph125M1}$	125MHz, 12KHz to 20MHz, -20dB/decade rollover < 12kHz, -40db/decade rolloff > 20MHz		420	450	N/A	fs (rms)	1,6

[1]Guaranteed by design and characterization, not 100% tested in production.

[2] See http://www.pcisig.com for complete specs

[3] Sample size of at least 100K cycles. This figures extrapolates to 108ps pk-pk @ 1M cycles for a BER of 1-12.

[4] For RMS figures, additive jitter is calculated by solving the following equation: Additive jitter = SQRT[(total jitter)^2 - (input jitter)^2]

[5] Driven by 9FGV0831 or equivalent

[6] Driven by Rohde& Schartz SMA100

Marking Diagram



Notes:

1. “LOT” denotes the lot number.
2. “YYWW” is the last two digits of the year and week that the part was assembled.
3. Line 2: truncated part number
4. “L” denotes RoHS compliant package.
5. “I” denotes industrial temperature grade.

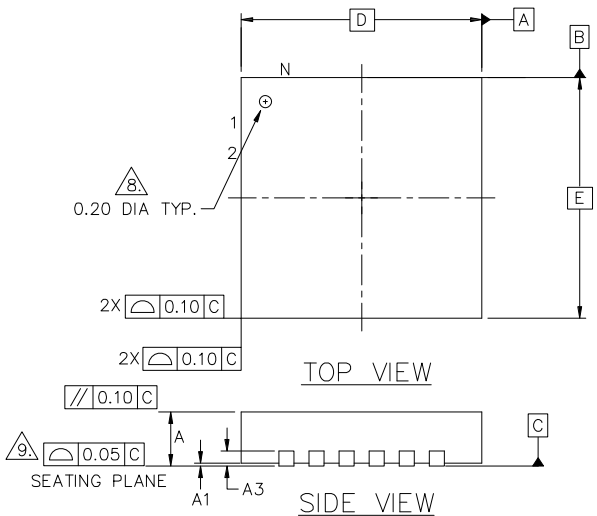
Thermal Characteristics

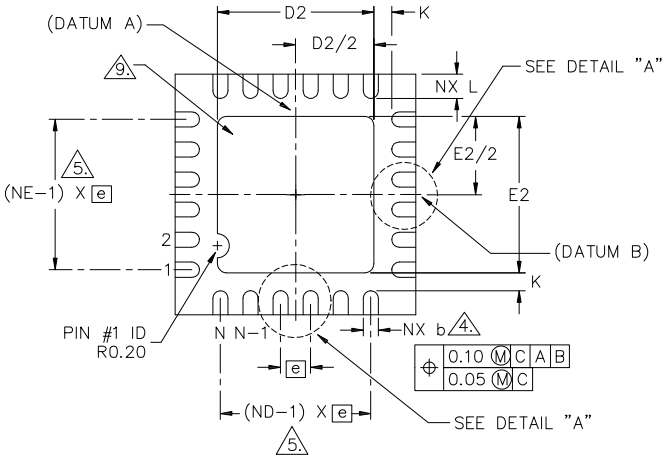
PARAMETER	SYMBOL	CONDITIONS	PKG	TYP VALUE	UNITS	NOTES
Thermal Resistance	θ_{JC}	Junction to Case	NLG24	42	°C/W	1
	θ_{Jb}	Junction to Base		2.4	°C/W	1
	θ_{JA0}	Junction to Air, still air		39	°C/W	1
	θ_{JA1}	Junction to Air, 1 m/s air flow		33	°C/W	1
	θ_{JA3}	Junction to Air, 3 m/s air flow		28	°C/W	1
	θ_{JA5}	Junction to Air, 5 m/s air flow		27	°C/W	1

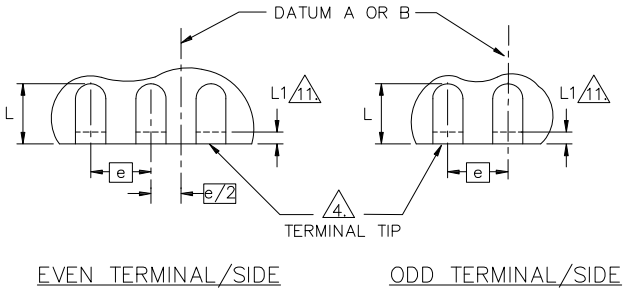
[1]ePad soldered to board

Package Outline and Package Dimensions (NLG24)

REVISIONS			
REV	DESCRIPTION	DATE	APPR
00	INITIAL RELEASE	10/15/08	R.
01	ADD LAND PATTERN	11/19/10	J







NOTES :

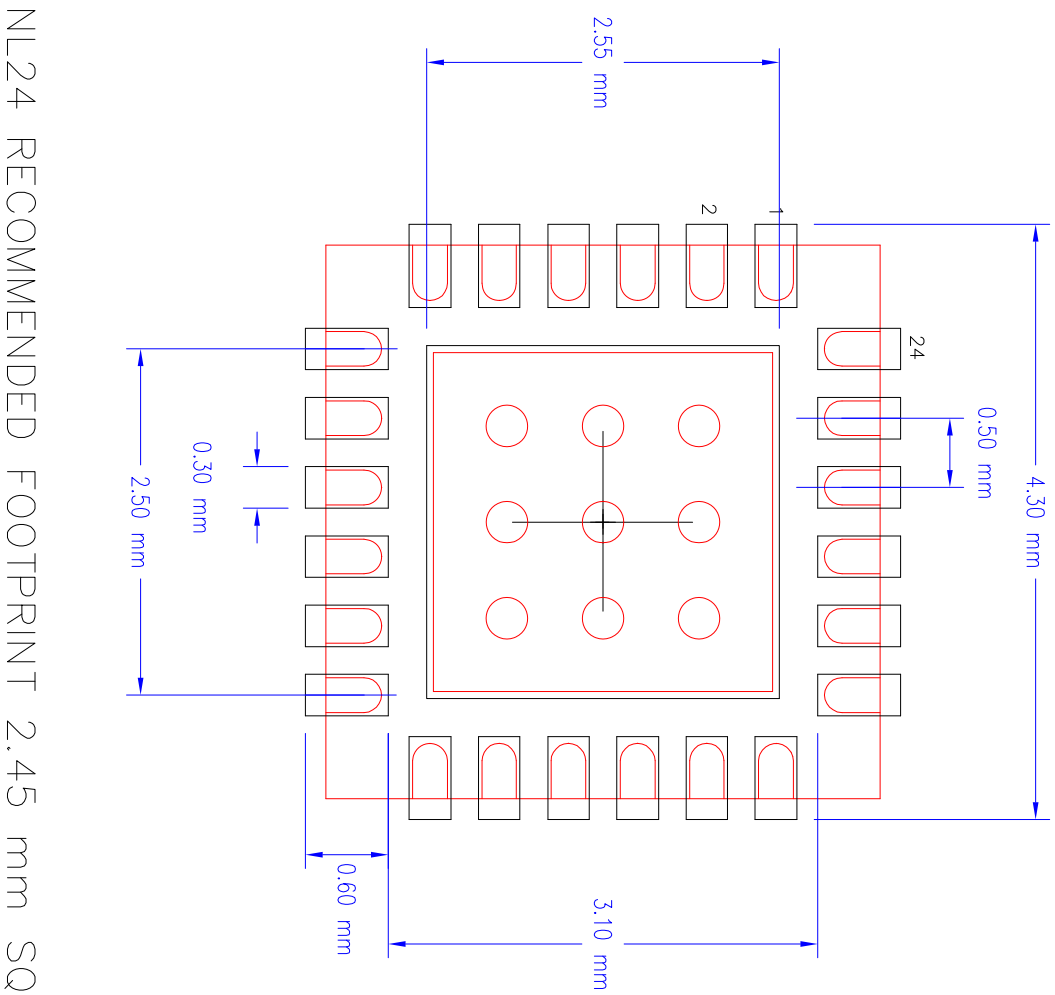
1. DIMENSIONING AND TOLERANCING CONFORME TO ASME Y14.5M – 1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS, θ IS IN DEGREES.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION b SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
5. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.
6. MAX. PACKAGE WARPAGE IS 0.05 mm.
7. MAXIMUM ALLOWABLE BURRS IS 0.076 mm IN ALL DIRECTIONS.
8. PIN #1 ID ON TOP WILL BE LASER MARKED.
9. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
10. THIS DRAWING CONFORMES TO JEDEC REGISTERED OUTLINE MO-220
11. DEPENDING ON THE METHOD OF LEAD TERMINATION AT THE EDGE OF THE PACKAGE, PULLBACK (L1) MAYBE PRESENT
12. PULLBACK DESIGN OPTION IS FOR 0.50mm NOMINAL LANDLENGTH ONLY.

SYMBOL	MIN.	NOM.	MAX.
e		0.50 BSC.	
N		24	
ND		6	
NE		6	
L	0.30	0.40	0.50
b	0.18	0.25	0.30
D2	2.30	2.45	2.60
E2	2.30	2.45	2.60

SYMBOL	DIMENSIONS			NOTE
	MIN.	NOM.	MAX.	
A	0.80	0.90	1.0	
A1	0.00	0.02	0.05	
A3		0.20 REF.		
θ	0	——	12	2
K		0.20 MIN.		
D		4.0 BSC		
E		4.0 BSC		
L1		0.15 mm MAX		11.

TOLERANCES UNLESS SPECIFIED DECIMAL ANGULAR XX± ± XXX± XXXX±		IDT® www.IDT.com	6024 Silver Creek Vall San Jose, CA 95138 PHONE: (408) 284-8 FAX: (408) 284-8591
APPROVALS	DATE	TITLE	NL/NLG24 PACKAGE OUTLINE 4.0 x 4.0 mm BODY 0.5 mm PITCH QFN
DRAWN RAC	10/15/08		
CHECKED		SIZE C	DRAWING No. PSC-4192
		DO NOT SCALE DRAWING	SHEET 1

Package Outline and Package Dimensions, cont. (NLG24)



NL24 RECOMMENDED FOOTPRINT 2.45 mm SQ EPAD

REVISIONS

REV	DESCRIPTION	DATE	APPROVE
00	INITIAL RELEASE	11/19/10	JG
01	ADD LAND PATTERN	11/19/10	JG

TOLERANCES
UNLESS SPECIFIED
DECIMAL ANGULAR
XX± ±
XXX±
XXXX±

APPROVALS DATE
DRAWN 11/19/10
CHECKED

IDT® 6024 Silver Creek Valley R
San Jose, CA 95138
PHONE: (408) 284-8200
FAX: (408) 284-8591
www.IDT.com

TITLE NL/NLG24 PACKAGE OUTLINE
4.0 x 4.0 mm BODY
0.5 mm PITCH VFQFPN

Ordering Information

Part / Order Number	Shipping Packaging	Package	Temperature
9DMV0441AKILF	Tubes	24-pin VFQFPN	-40 to +85° C
9DMV0441AKILFT	Tape and Reel	24-pin VFQFPN	-40 to +85° C

"LF" to the suffix denotes Pb-Free configuration, RoHS compliant.

“A” is the device revision designator (will not correlate with the datasheet revision).

Revision History

Rev.	Initiator	Issue Date	Description	Page #
A	RDW	9/24/2014	1. Updated Electrical Tables with Char data 2. Updated General Description 3. Move to final	Various
B	RDW	1/26/2015	Updated package drawing and dimensions	9

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(Rev.1.0 Mar 2020)

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